Proceedings of the 14th EGOWS meeting
16-19 June 2003 in Tromsø, Norway

Contents

Hans-Joachim Koppert, Deutscher Wetterdienst	NinJo - The current status of the project
Magnus Ovhed , Norwegian Meteorological Institute	Successfull software - not only codewriting
Roar Skålin, Norwegian Meteorological Institute	Experiences with the use of open source and Linux at the Norwegian Meteorological Institute
Bruno Zürcher, MeteoSwiss	Server Scalability with WildcardMaps

Reports from the Workgroups

Workgroup 1. Moderator: Peter Trevellyan	Strategies in system design and development
Workgroup 2. Moderator: Juha Kilpinen	Role of workstation systems in the forecasting process
Workgroup 3. Moderator: Jens Daabeck	Objectives of the EGOWS meeting

Appendix: Recent documents from the working group on Meteorological Objects

Meteorological Objects in operational use: Steps towards a standard format for exchange
(Letter to WMO (Expert Team on Datarepresentation and Codes) submitted by Dick Blaauboer (KNMI), Eric Brun (Météo-France), Chris Little (MetOffice))

Preliminary list of meteorological objects

EGOWS 2003 - List of Participants

#	Last name	First name	Institute / Organisation
1	Bergholt	Lisbeth	Norwegian Meteorological Institute
2	Berthou	Claude	Meteo-France
3	Brock	Jacob	Danish Meteorological Institute
4	Brunet	Jean	Meteorological Service of Canada
5	Christoffersen	Audun	Norwegian Meteorological Institute
6	Conny	Claus	Deutscher Wetterdienst
7	Csekits	Christian	ZAMG (Austrian Meteorological Service)
8	Daabeck	Jens	ECMWF
9	Edhag	Thomas	SMHI
10	Elliott	Simon	EUMETSAT
11	Falla	Marie	Meteorological Service of Canada
12	Flibotte	Michel	Meteorological Service of Canada
13	Gaillard	Olivier	Meteo-France
14	Gelin	Lisa	FMV
15	Hamilton	James	Met Eireann -- Irish Met Service
16	Haucke	Sibylle	Deutscher Wetterdienst
17	Heizenreder	Dirk	Deutscher Wetterdienst
18	Jacobsson	Caje	SMHI
19	Jung	Volker	sd&m AG / DWD
20	Kadic	Nevenka	Meteorological and hydrological service of Croatia
21	Kangasniemi	Viljo	Finnish Meteorological Institute
22	Kerhervé	Pierre	WMO
23	Kilpinen	Juha	Finnish Meteorological Institute
24	Koppert	Hans-Joachim	Deutscher Wetterdienst
25	Korsmo	Helen	Norwegian Meteorological Institute
26	Krausser	Frank	MeteoSwiss
27	Kræmer	Grete	Norwegian Meteorological Institute
28	Lagerweij	Peter	KNMI
29	Larsson	Anders	SMHI
30	Laursen	Bjarne Riis	Danish Meteorological Institute
31	Leitass	Andris	Latvian HydroMeteorological Agency
32	Lemcke	Kees	KNMI

33	Marjan	Sandev	Czech Hydrometeorological Institute
34	Martinsen	Eivind	Norwegian Meteorological Institute
35	Ovhed	Magnus	Norwegian Meteorological Institute
36	Pesata	Karel	CHMI
37	Piontek	Michael R.	Deutscher Wetterdienst
38	Razinger	Miha	Environmental Agency of the Republic of Slovenia
39	Schulze	Jürgen	Norwegian Meteorological Institute
40	Skålin	Roar	Norwegian Meteorological Institute
41	Tangen	Helge	Norwegian Meteorological Institute
42	Trevelyan	Peter	The Met Office
43	Zürcher	Bruno	MeteoSwiss

EGOWS 2003 Conference Program

Monday 16. June		
Time	**Title / Event**	**Speaker**
Session 1: Opening of the meeting		
09:00 - 10:00	Registration	
10:00 - 10:15	Welcome address	Eivind Martinsen Director of Research & Development
10:15 - 10:30	General Information	Audun Christoffersen
Session 2: Visualisation and Production		Chairman: Peter Trevellyan
10:30 - 11:00	The Canadian Radar Decision Support Software	Marie Falla *Meteorological Service of Canada*
11:00 - 11:30	Integration of AUTOTAF system to TAF-workstation	Juha Kilpinen *Finnish Meteorological Institute*
11:30 - 12:00	Computer Graphics at Met Eireann	James Hamilton *Met Eireann -- Irish Met Service*
12:00 - 13:00	Welcome Lunch	
13:00 - 13:30	Recent Metview and Magics developments	Jens Daabeck *ECMWF*
13:30 - 14:00	NinJo - The current status of the project	Hans-Joachim Koppert *Deutscher Wetterdienst*
14:00 - 14:30	Coffee break	
Session 3: Status and Demonstration Announcements		Chairman: Jens Daabeck
14:30 - 15:00	Trajectories and diagrams in Ninjo	Bjarne Riis Laursen *Danish Meteorological Institute*
15:00 - 15:30	Recent Developments in Terms of Nowcasting and Visualisation at ZAMG	Christian Csekits *ZAMG (Austrian Meteorological Service)*

15:30 -	Preparations for the Demonstration Session
18:00 -	Social Event hosted by Kongsberg Spacetec at Tromsø Polar Museum

Tuesday 17. June		
Time	**Title / Event**	**Speaker**
09:00 - 09:30	Recent Developments at FMI	Juha Kilpinen *Finnish Meteorological Institute*
09:30 - 10:00	The operational workstation at met.no	Lisbeth Bergholt *Norwegian Meteorological Institute*
10:00 - 10:30	Coffee break	
10:30 - 12:00	Demonstration announcements • Claude Berthou, *MeteoFrance* : **Synergie** • Audun Christoffersen, *met.no* : **met.no operational workstation** • Marie Falla, *Meteorological Service of Canada* : **CARDS** • Viljo Kangasniemi, *FMI* : **TAF workstation** • Juha Kilpinen, *FMI* : **Grid Editor** • Hans-Joachim Koppert, *DWD* : **NinJo** • Peter Trevellyan, *The Met Office* : **Horace**	
12:00 - 12:45	Lunch	
12:45	Departure for met.no, Tromsø	
13:00 - 17:00	Demonstration Session and visit at the Forecasting Centre	

Wednesday 18. June		
Time	**Title / Event**	**Speaker**
Session 4: System strategies / Software design		Chairman: Hans-Joachim Koppert
09:00 - 09:30	NinJo- Development of Frameworks for Meteorological Applications	Sibylle Haucke *Deutscher Wetterdienst*
09:30 - 10:00	CORBA and NinJo - System Design and Experiences	Volker Jung *sd&m AG / DWD*
10:00 -	Coffee break	

10:30		
10:30 - 11:00	Server Scalability with WildcardMaps	Bruno Zürcher *MeteoSwiss*
11:00 - 11:30	Experiences with the use of open source and Linux at the Norwegian Meteorological Institute	Roar Skålin *Norwegian Meteorological Institute*
11:30 - 12:00	Experiences with Linux	Jacob Brock *Danish Meteorological Institute*
12:00 - 13:00	Lunch	
13:00 - 13:30	Successfull software - not only codewriting	Magnus Ovhed *Norwegian Meteorological Institute*
13:30 – 14:00	Severe weather warnings at DWD – Recent developments	Dirk Heizenreder *Deutscher Wetterdienst*
14:00 - 16:00	Working Group Session • Workgroup 1: **Strategies in system design and development**. Moderator: Peter Trevellyan • Workgroup 2: **Role of workstation systems in the forecasting process**. Moderator: Juha Kilpinen • Workgroup 3: **Objectives of the EGOWS meeting**. Moderator: Jens Daabeck	
17:00 -	Social Event / Conference Dinner	

Thursday 19. June		
Time	**Title / Event**	**Speaker**
09:00 - 09:30	Synergie move to linux	Claude Berthou *MeteoFrance*
09:30 - 10:00	Meteorological Product Quality Monitoring in EUMETSAT's MSG Ground Segment	Simon Elliott *EUMETSAT*
10:00 - 10:30	Coffee break	
Session 5: Discussion and Recommendations		Chairman: Eivind Martinsen
10:30 -	Presentation of results/recommendations from groups	

11:30		
11:30 - 12:00	Final discussions	
12:00	Closure of the meeting (Lunch)	

Norwegian
Meteorological Institute
met.no

The Operational Workstation at met.no

By Lisbeth Bergholt

EGOWS 2003

The Operational Workstation at met.no

Status

- Diana
- Modfly
- Tseries
- Quba

Future plans

- Quba
- Verification
- Monitoring
- Forecast Editor

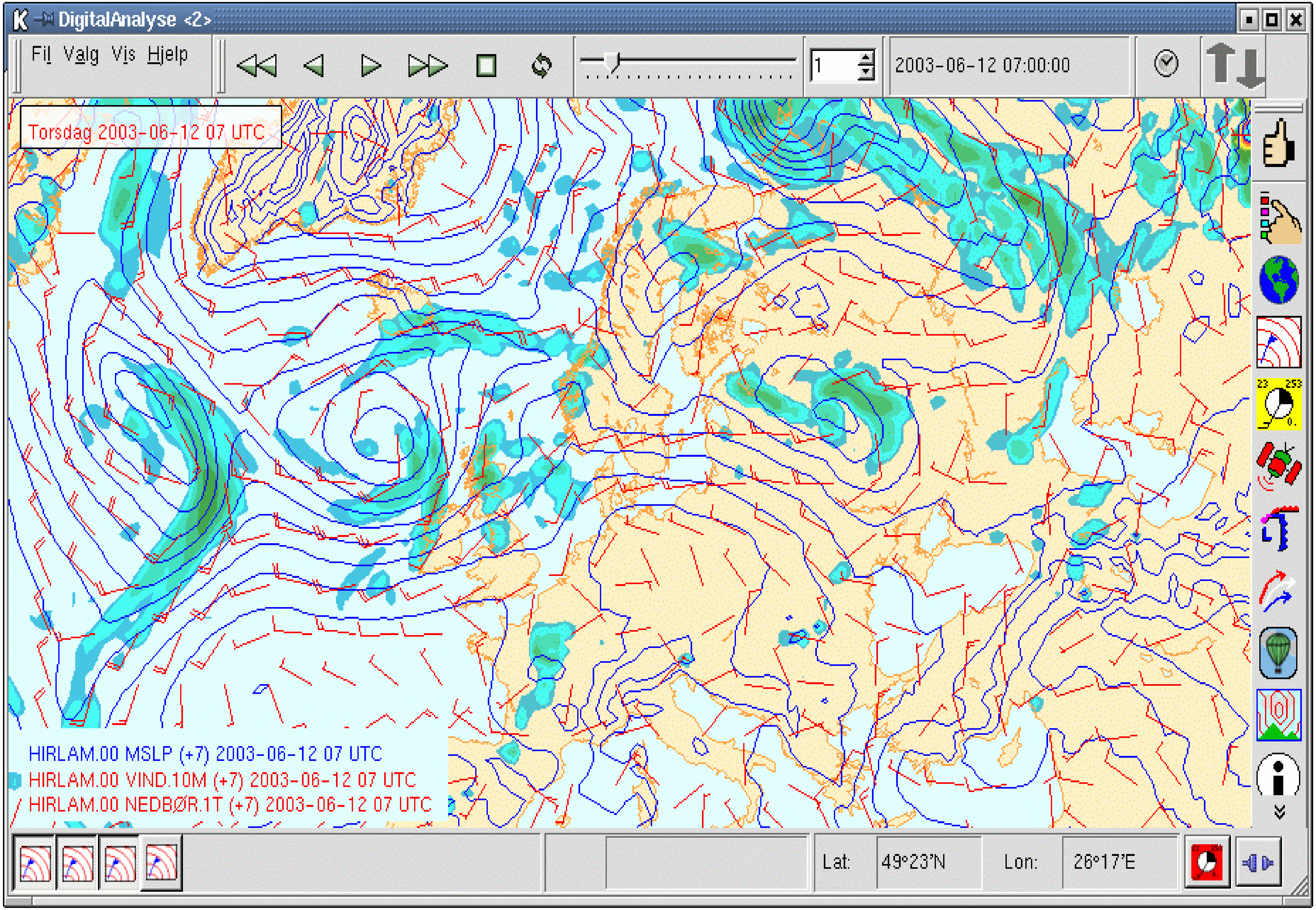
Technical Standards

- Linux (Irix)
- C++
- Mesa (Open GL)
- Qt

DIANA (DIgital ANAlysis)

Visualisation

- Fields
- Satellite and radar images
- Surface observations
- Soundings
- Cross Sections
- Forecast products



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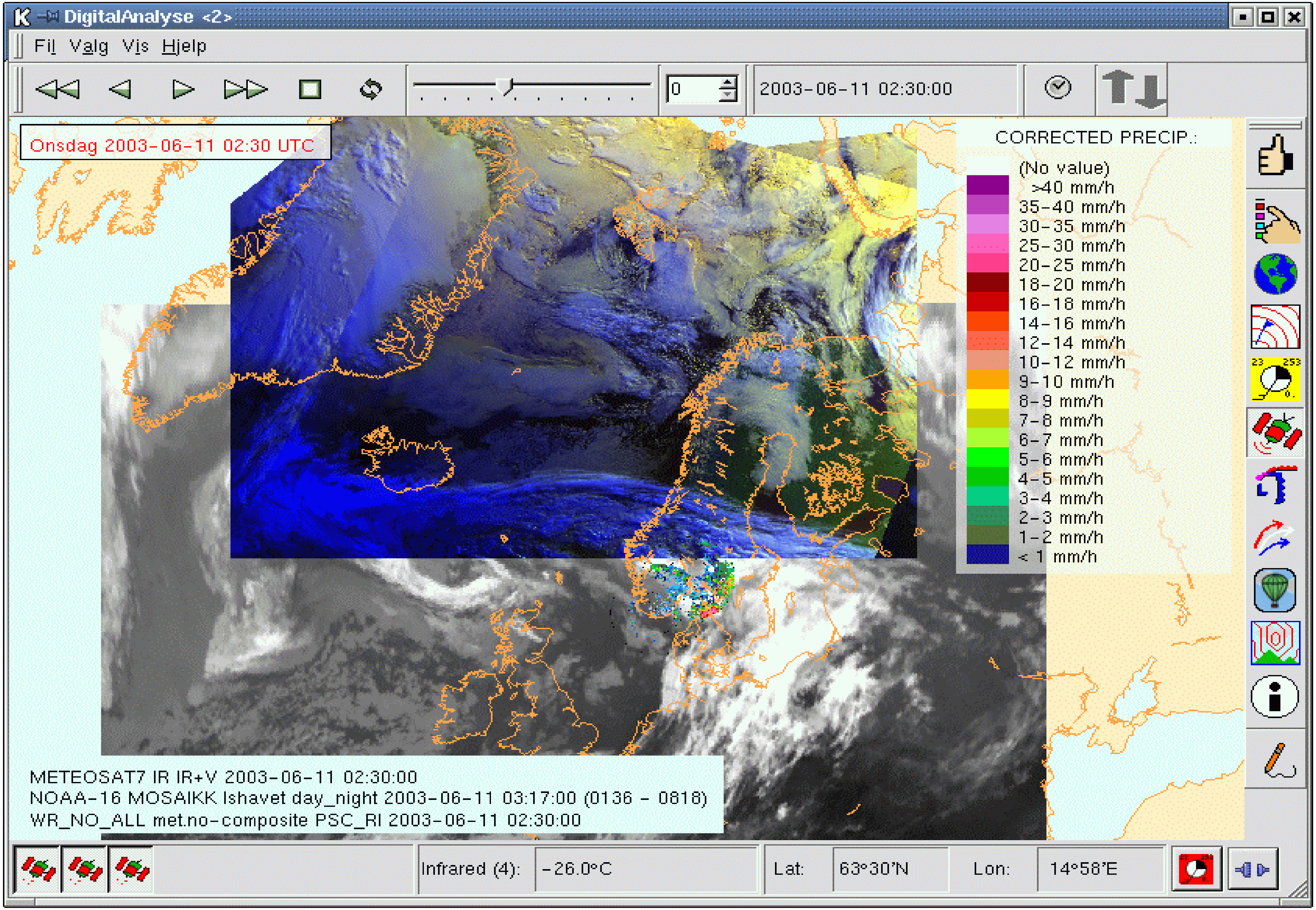
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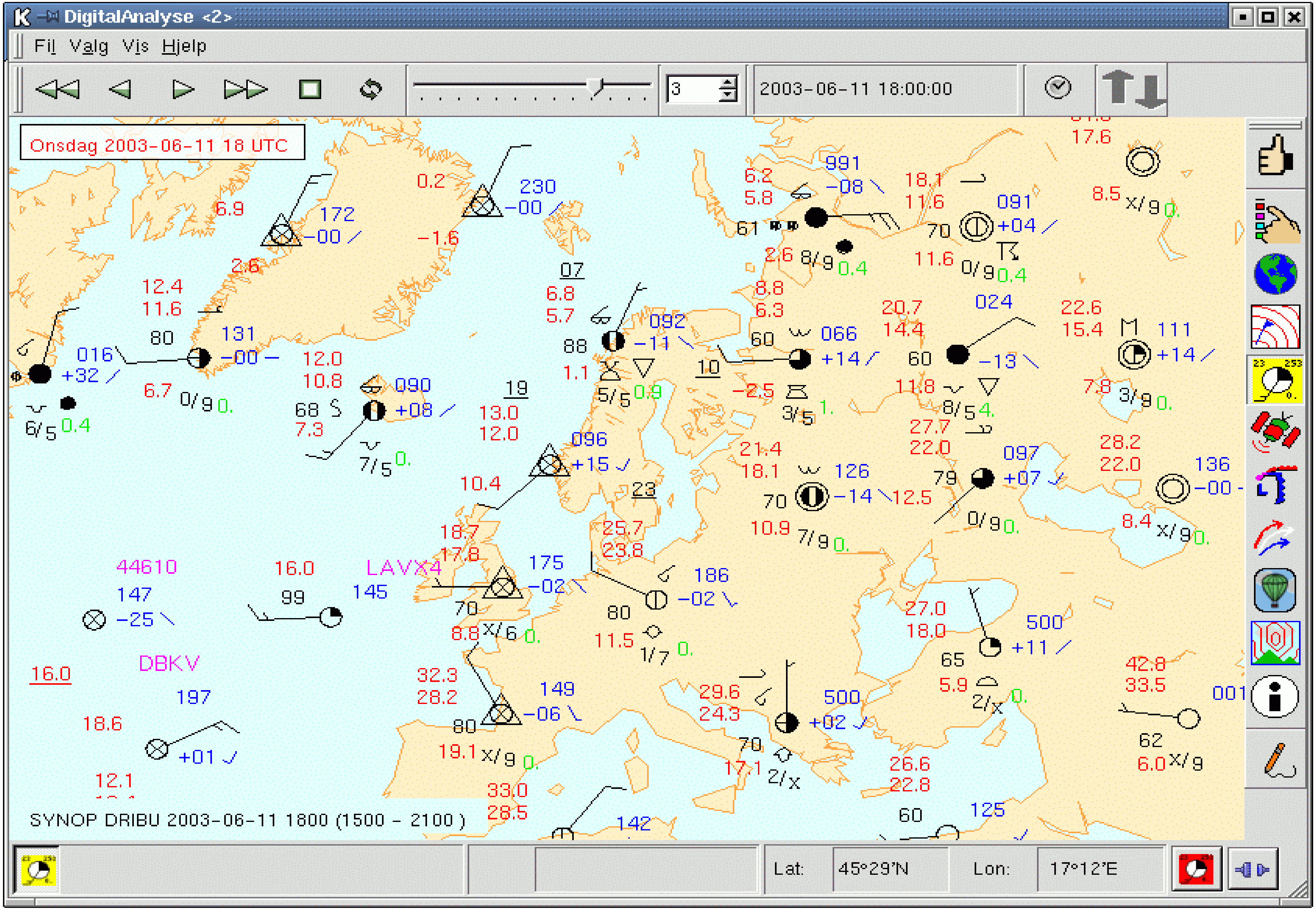
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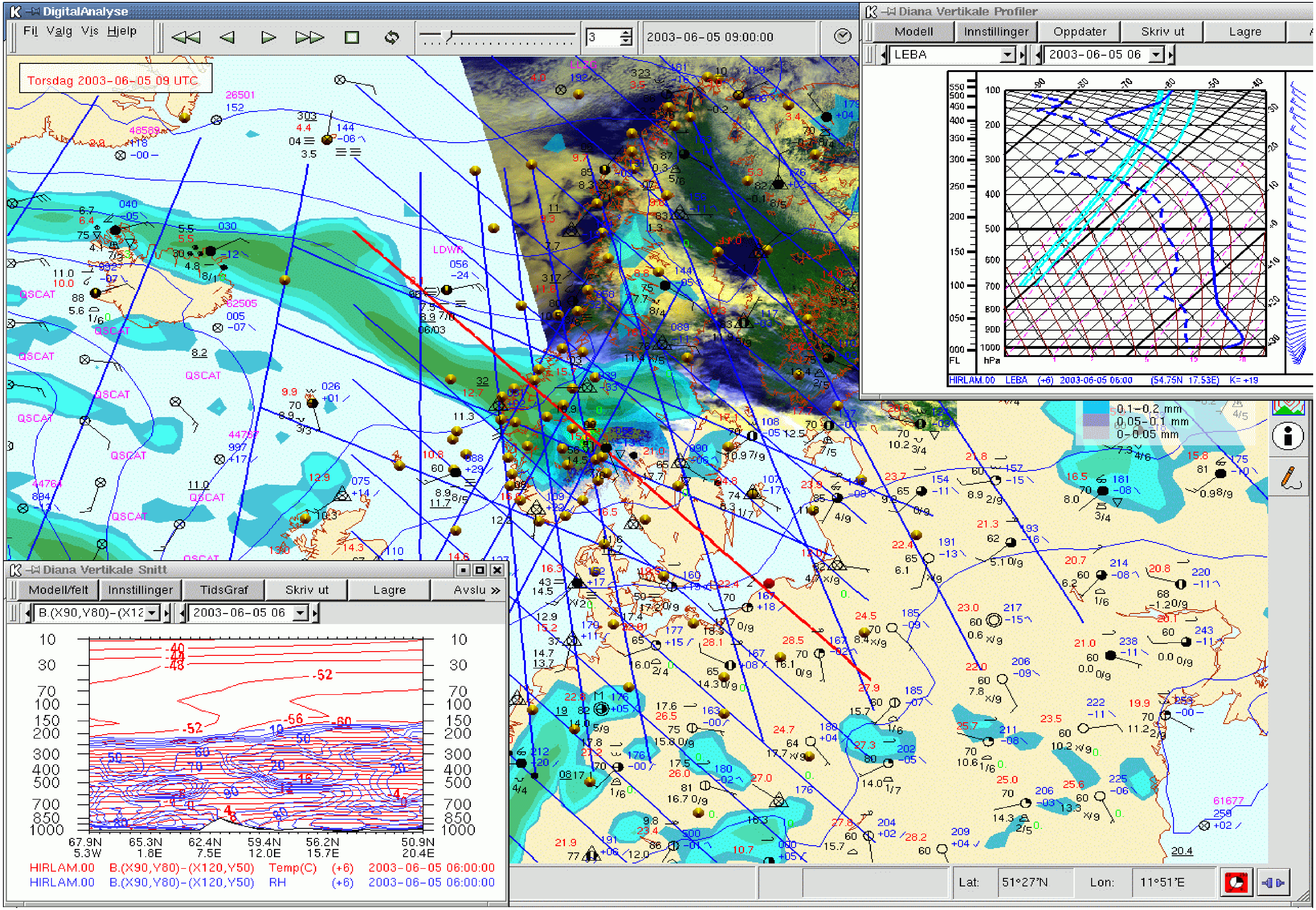
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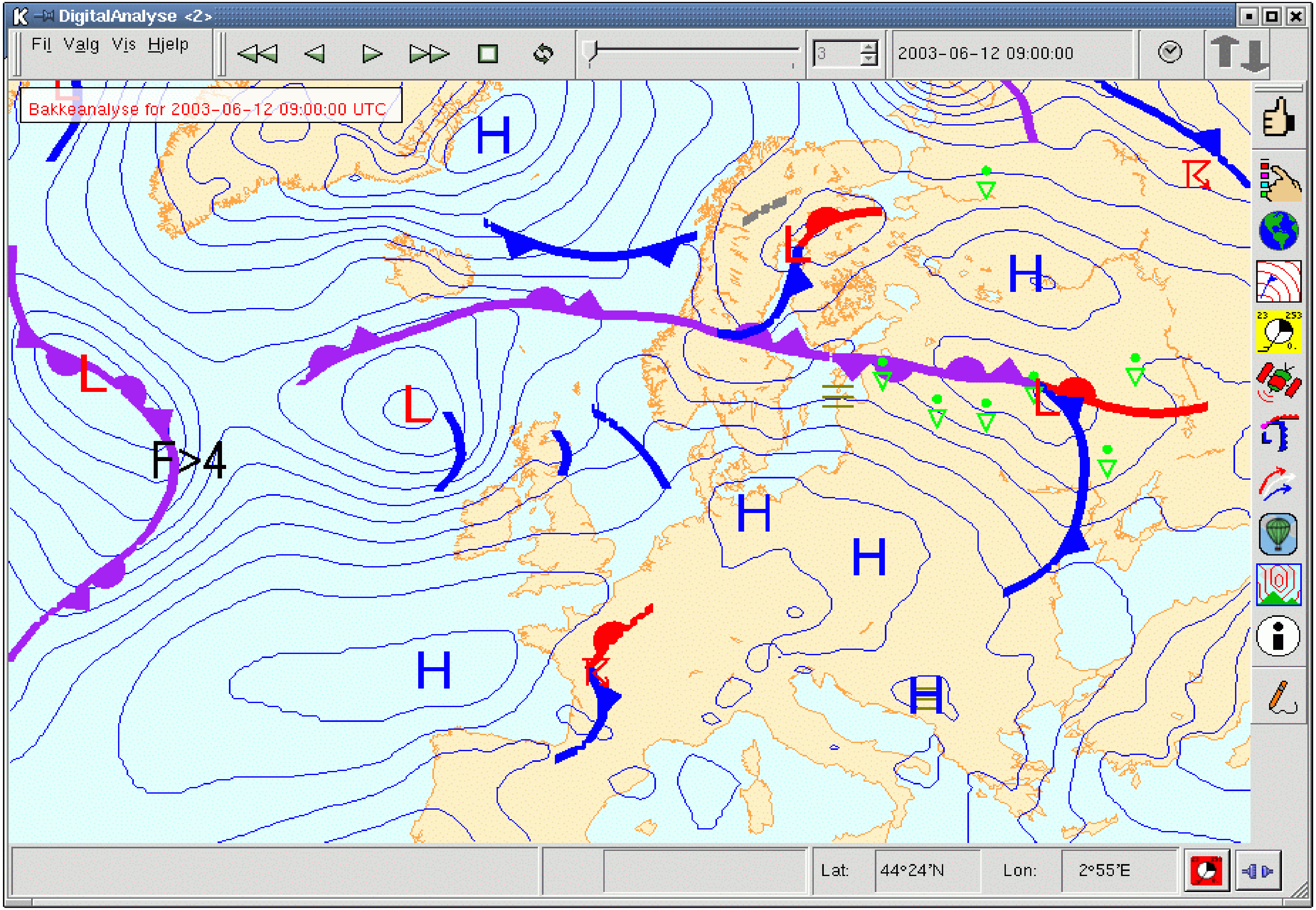
DIANA

Interactive tools

- Scalar field modification
- Drawing of fronts, significant weather symbols, etc.
- Writing text
- Combination of analyses from regional centers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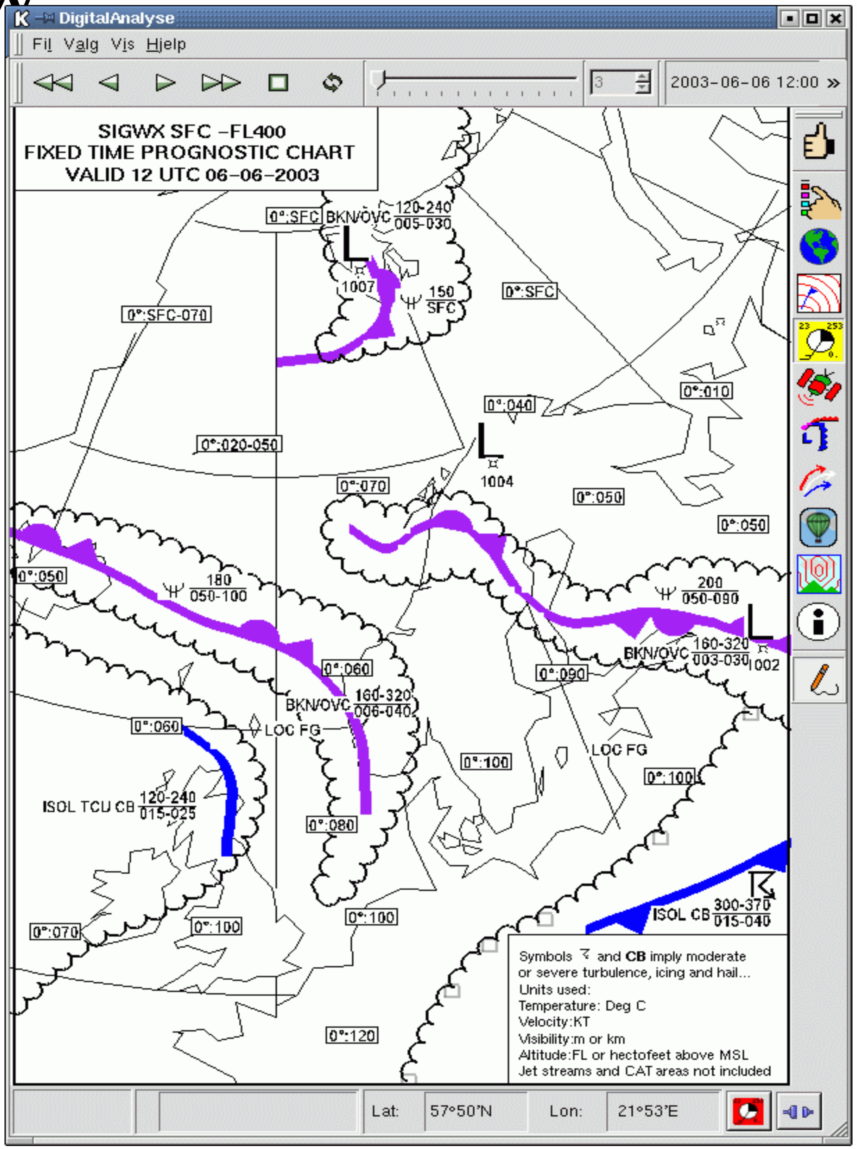
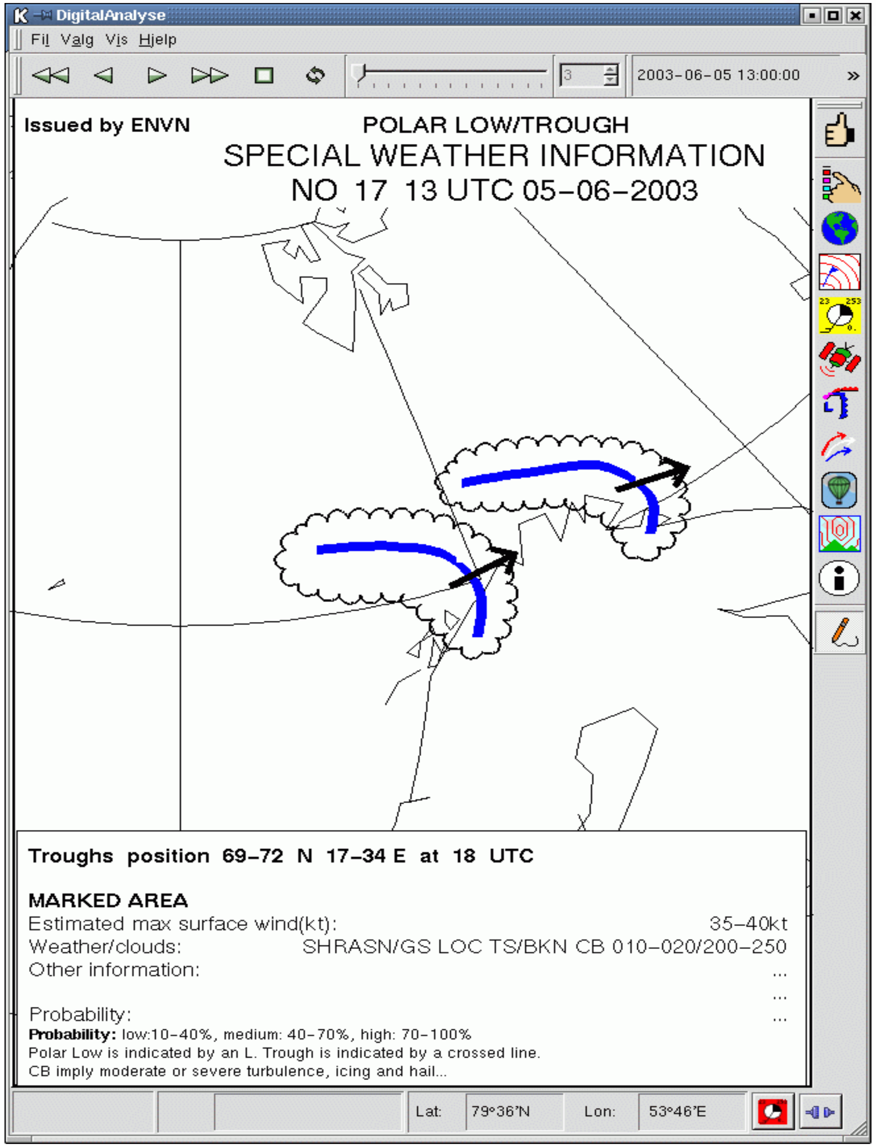
DIANA

Products

- Surface analysis
- Prognostic chart
- Significant weather chart
- Polar low chart

Significant weather Polar low



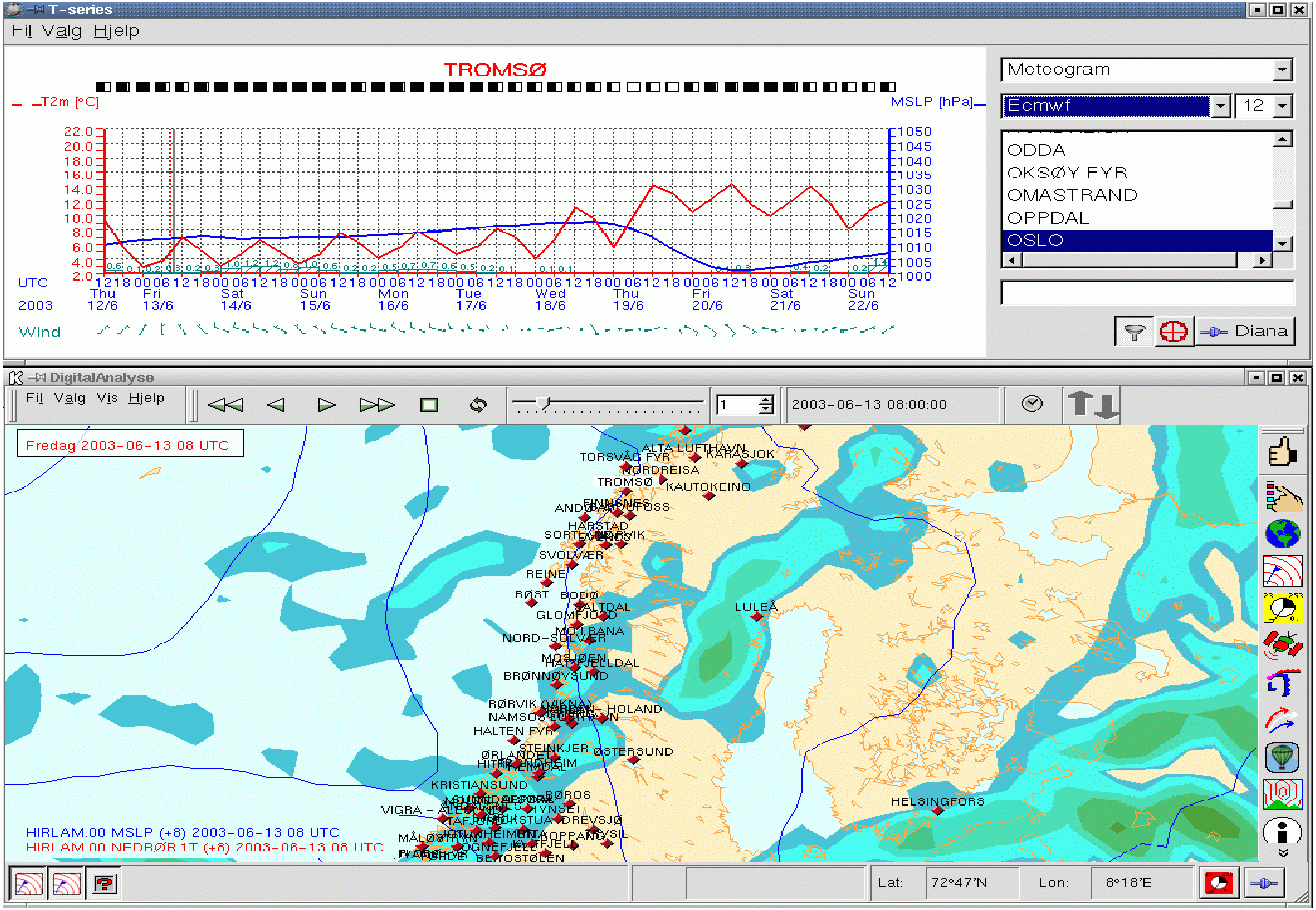


DIANA

- Text based command interface
- Dialog
- Quick menus
- Batch

Middleware

- Sockets (QSockets from the Qt toolkit)
- Server
- Communication is based on text
- Diana, Modfly, Tseries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Lon: 8°18'E

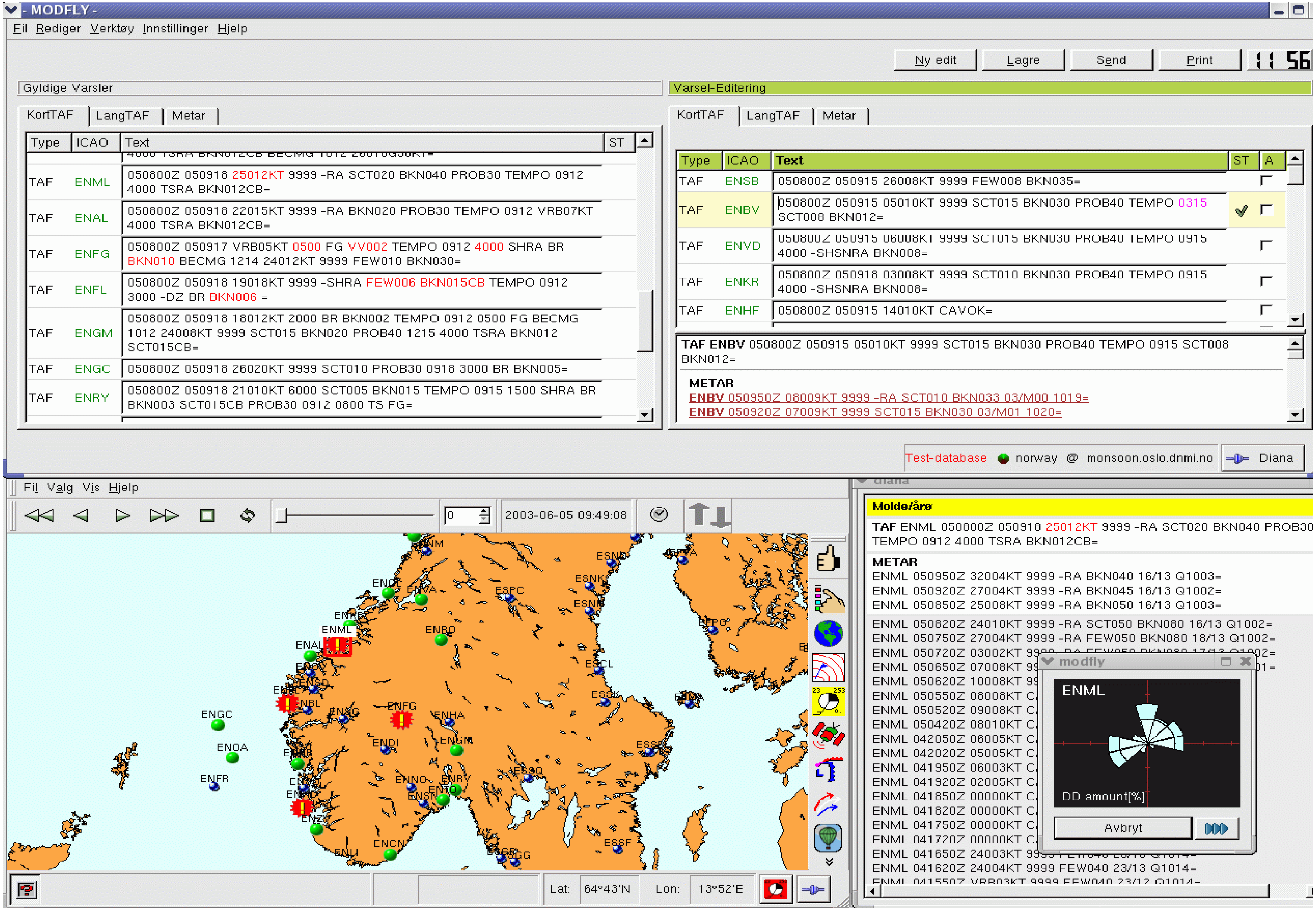
MODFLY

- Aviation forecast tool
- Operational since November 2002
- TAF/METAR processing based on the TIPS library

MODFLY

Features

- Central TAF/METAR- database
- Syntax check of TAF/METAR while editing
- Automatic monitoring of all valid TAFs against the newest METAR
- Connected to DIANA, the monitoring results in certain symbols on the map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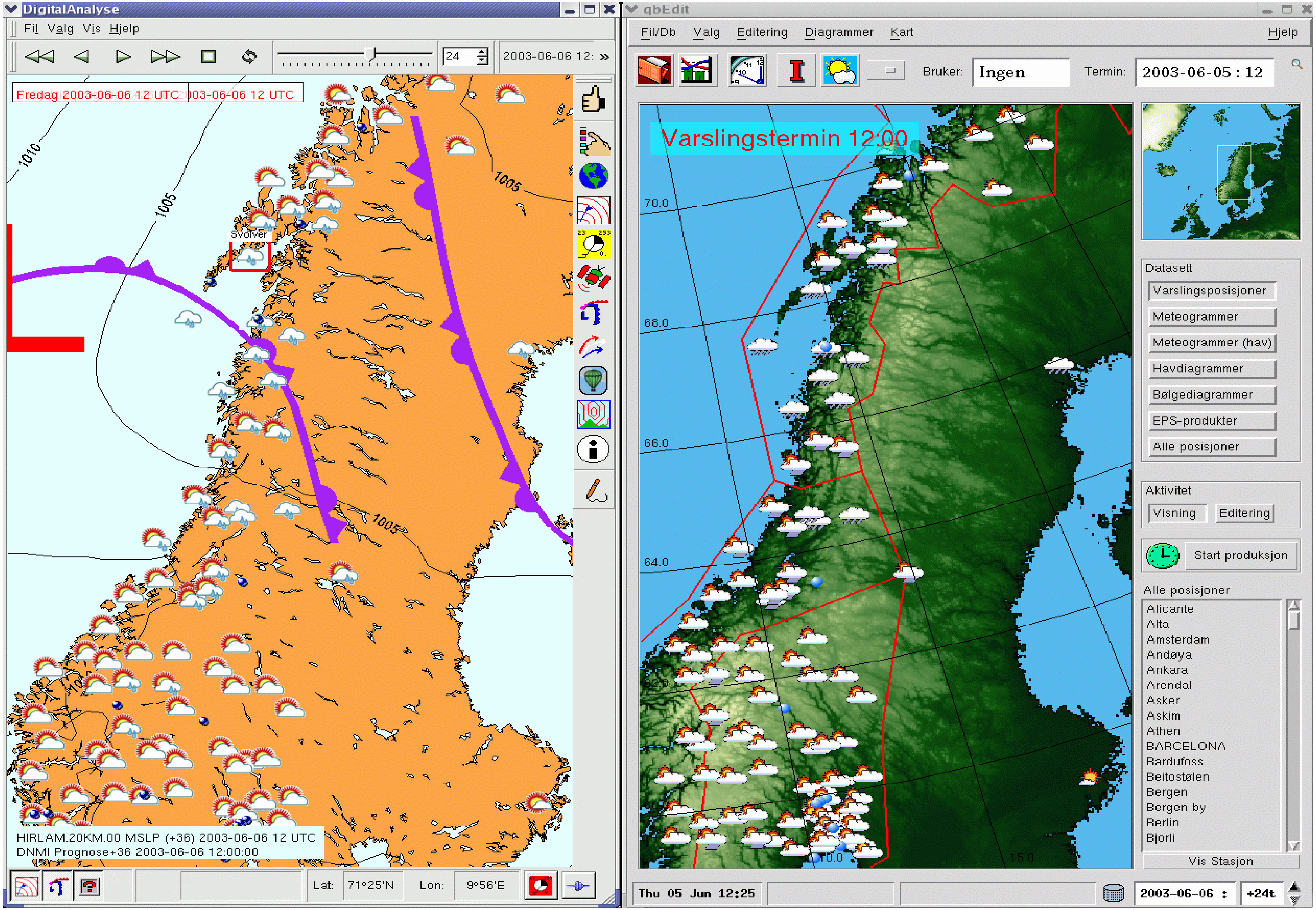
QUBA

Production of point forecasts

- One central database
- An interactive system for graphical editing of time series
- Personal verification results possible
- Bidirectional communication to the production database
- Operational since July 2001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Bølgediagrammer
EPS-produkter
Alle posisjoner
Aktivitet
Visning
Editering
Start produksjon
Alle posisjoner
Alicante
Alta
Amsterdam
Andøya
Ankara
Arendal
Asker
Askim
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Bardufoss
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Berlin
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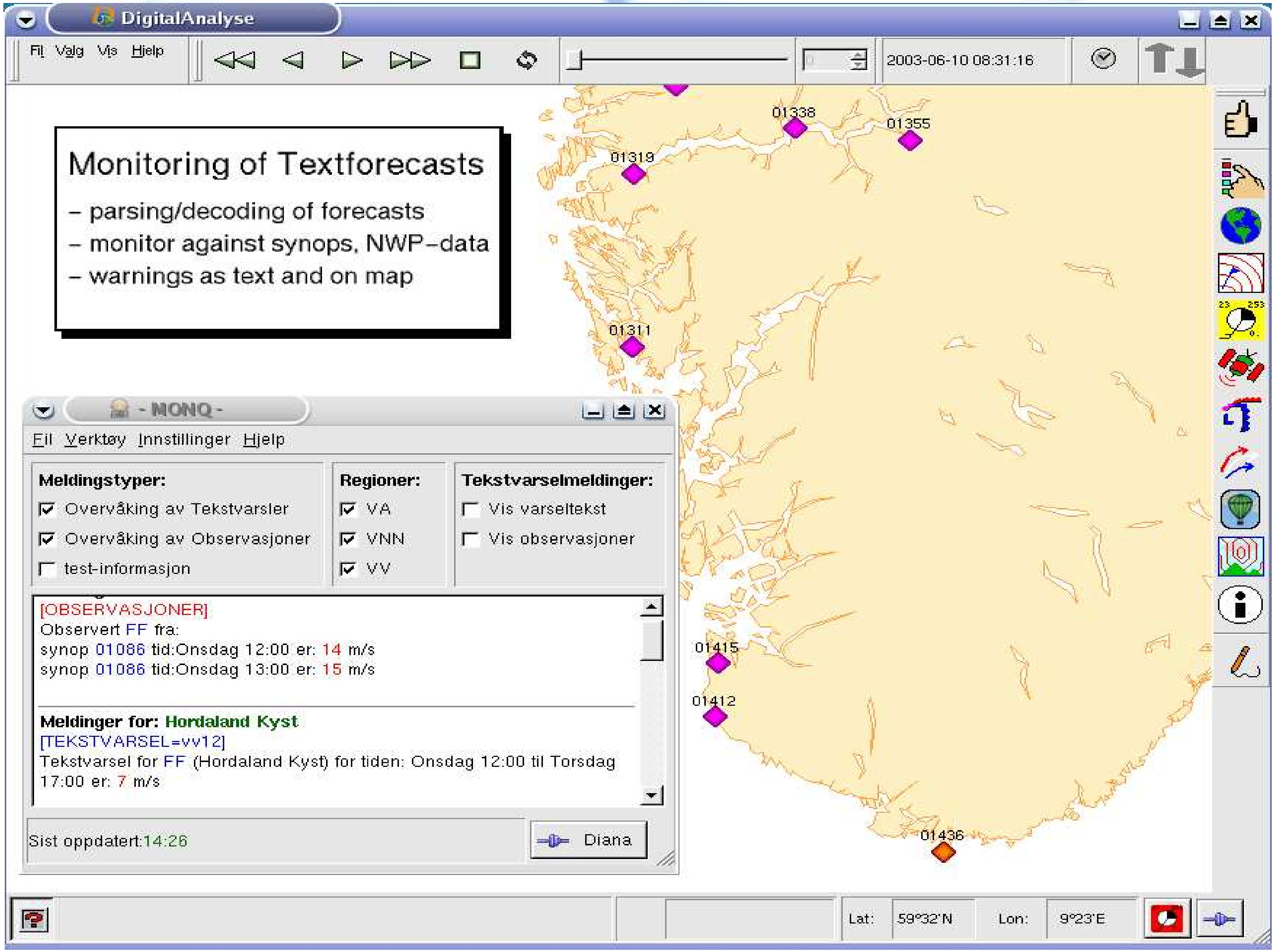
Thu 05 Jun 12:25
2003-06-06 :
+24t

VEPS - VErification Presentation System

- Produces verification results on demand
- Forecasts and observations read from database in real time
- Time series and contingency tables produced according to the user specification
- Forecasters log in to check their own verification results
- Connected to Diana, verification results can be shown on the map

Monitoring of Textforecasts

- parsing/decoding of forecasts
- monitor against synops, NWP-data
- warnings as text and on map



Forecast Editor

Today

- Word + macro

In the Future

- Integrated in the met.no workstation
- Tagging of parameters, timescale, area
- Online monitoring

Summary

- Diana - visualisation, editing
- Tseries - time series
- Modfly - aviation forecasts
- Quba - point forecasts
- Veps - verification
- Monq - monitoring
- Forecast Editor

Plan

1 Objectives

1-1 Short range

- h Cost reduction
- h Plateform independance
- h Constructor independance
- h new Synergie users (ex: Army)

1-2 Medium range

- **new impulse for the current decade**
- **Opened to new technologies**
- **Free RDBMS**
- **new generation of window manager**
- **new Synergie using (Hydrology, nowcasting, cylconic tools)**

2 History

2-1 History

h

1989 Project structure creation

h

1993 Synergie 1.0 first operationnal release

h

1994 Commercial action starts

h

1995 First operational production

h

1996 Permanent structure

h

1998 Synergie 3.2 Y2K compliance

2-2 2000 : very first step

- h redhat 6.2
- h subset of client
- h demo at Egows (Helsinki)

Synergie 3.3 avaible on Solaris

Synergie move to Linux

2-3 2001 : consolidation

h

redhat 7.1, Open Motif, Oracle 8i

h

code management : both Solaris & Linux

h

client and server subset

Synergie 3.4 avaible on Solaris

2-4 2002 : first release

h

redhat 7.3

h

Synergie3.5i

h

MFI acceptance

Synergie 3.5 avaible on Solaris

2-5 2003 : first operational users

- Laos (MFI)
- Satellite dissemination - Retim 2000
- Africa covered by "Retim Afrique"
- Synergie3.6i
- Army

Synergie 3.6 avaible on Solaris

3 Technical steps

3-1 Technical choices

- Redhat 7.3 at least
- Oracle 8i standard edition
- XFree86 Release 4, 16 bits TrueColor
- gcc, g++, g77
- portland fortran if need
- Applix 4.4

3-2 Code management

- **Code is unique**
- **home made tools**
- **some *#ifdef* if needed**
- **rather improvement than adaption**
- **Little Endian adaptation (reference is big)**

3-3 Tests done

h

ref : Big Endian

h

heterogeneous platforms

client intel - server sparc

client sparc - server intel

client intel - display sparc

client sparc - display intel

3-4 Pending points

h

full validation including en users production

h

colormap is ReadOnly

3-5 Regrets

h

- libintl (more flexible on Solaris)

h

- 8 bits, PseudoColor

4 New platforms

4-1 General Calendar

	2003			2004			2005			2006	
3.5	OM + export										
3.6		op + patches		OM + export							
3.7		developpements		valid.	op + patches + OM						
4.0				validation		op / patches	patches + OM + export				
4.1			analyse / priorites		developpements		valid.	op + patches		OM + export	
4.2						analyse / priorites		developpements		valid.	op + patches
4.3									analyse / priorites		developpements

4-2 Calendar may-03 may-05

2003																																				
	May					June				July					August				Septembre				October					November				December				
weeks	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
V3.6	Installation					**OnSite-3.6.0.b**																														
V3.6 *i*	**3.6*i* b.1**					Radar + Expertise Validation											**F.Accept -3.6*i*.0**																			
V3.7	content definition									coding																										
Tender									1- Start										2-				3-							4-						

2004																																				
	January					Février				Mars					April				May				June				July					August				
weeks	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
V3.7	coding			Validation								Trainin g3.7			**F.Accept-3.7.0**				Operationnal Installation							**OnSite-3.7.0.b**										
Tender	4-				5-														6-				7- first delivery													
V4.0												(Utilisateur. 4.0)			non regression Validation										**F.Accept -4.0.0**				Met School Installation							
V4.1																			content definition								développements									

2004																	2005																			
	Septembre			Octobre			Novembre				December							January					Février				Mars					April				
weeks	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
Tender	Operationnal Delivery																	Non OP Delivery and Over Seas Delivery																		

4-3 Hardware evaluation

h

benchmarks with subset of synergie code

h

simulation of forecaster activity by automatic sequences

h

analyse of response time whene activity increase (load)

4-4 Benchmark results

http://athenes/html/synergie/home_linux/egows2003/images/Benchmark_results.jpg

4-5 Questions

h
new platforms life ?

h
hardware stability

h
hotline and assistance

Experiences with Linux

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For a number of reasons we want to keep our workstations running Unix. And if we have to be able to afford the hardware, is has to be Intel based PC's. These two requirements put together points strongly towards using Linux. This presentation will point out a number of the pro's and con's, which we have experienced, and how we use a centralized database for configuring the Linux based workstations for different purposes.

The task of maintaining a hundred+ Unix workstations

As long as there were only a few brands of workstations at the DMI (SUN, HP, SGI, IBM), of which only SUN and SGI were operational, and each had their own dedicated operating system, the task of supporting the systems was manageable. Not simple, but somehow there was a finite number of different installations; all machines of one brand could be kept at a certain OS version with a known patch-level.

The performance of PCs or Intel based machines in general rose, and at some stage they outperformed the conventional workstations as goes for price/performance. At that stage, it became interesting to find a Unix, which could run on Intel. As most of our operational machines were SUNs, and the SUN operating system Solaris was released for the Intel platform, the transition to Intel based machines was not very hard. The biggest problem was to handle byte-swapping correctly inside programs using binary storage formats for data in files.

But problems started to turn up. At some stage Sun Microsystems announced, that they would not support Solaris on Intel in upcoming versions of Solaris. After some time, they recalled that announcement, but for how long?

Hardware developed so rapidly that it was hard to get drivers for peripherals, particularly CD-ROM and DVD readers and burners, and graphics cards. Solaris has always been a bit conservative in the way, that drivers were not released until believed stable. This has made - and still makes - Solaris a very stable operating system, that hardly ever falls over. But in the turbulent market of Intel based machines the effect was that by the time you could get a driver for device X, device X was not available on the market anymore, because it had been outperformed by a faster product. And if a device in an "old" machine ("old" often meaning just one year old) broke, you could not get an exact replacement, had to buy a newer version, and patch Solaris (if at all possible) to cater for this new device.

As a result, every workstation seemed to grow in its own direction, contain undocumented installations of programs and drivers, and the number of patch levels seemed to be just as numerous as the number of workstations. All in all, it required more and more work for the IT department to offer reasonable support to Unix workstations. And as operational machines has top priority for support, non-operational users like developers started to feel that it became very hard to get support for their workstations.

A new beginning

How could you try to solve these problem? It was an economic demand that a new solution should be able to run on Intel based machines. And nearly all the programs written are for Unix.

One solution was to go for Solaris, hope it would be supported further on on Intel platforms, and then buy new hardware in large batches. For each batch, a Solaris configuration could be put together and used on that batch of workstations. But, a solution like that requires investments in big lumps, the surplus of a batch might be on store for so long, that the workstation is old fashioned and too slow for the newest applications when it is taken out of store, and it would be necessary to buy extra spare parts of devices known to break after some time.

Another solution would be to go for Linux as operating system, as it seems more likely that Linux will be supported in the future than Solaris for Intel. A uniform configuration of the workstations could still be done by the "batch-buy" method. But this method does not work all that well at DMI. New projects are launched, they require a couple of state-of-the-art workstation, or some special devices, and who is going to invest the money to buy machines to put into storage?

It was necessary to accept the dynamic environment, and instead find a way to establish a centralized record of the configurations of the workstations.

This was the start of the DMITUX project.

Which distribution of Linux to choose?

So Linux was chosen to be the new Unix operating system for our workstations in the future. But a decision had to be made on, which distribution to use. We had a closer look at at least debian, Mandrake, SuSE and RedHat. The following considerations were done during the summer of 2002, and were considered correct at that time. Things change very fast in this area, so some of them are probably not correct anymore.

Mandrake, SuSe and RedHat are all backed by a commercial company. This can be an advantage, the company has an interest in supporting their distribution, removing errors and adding updates. It can be a disadvantage too. In order to configure for instance RedHat, you had to have a quite old version of Python. That's OK, you get it for free, BUT, it could not coexist with the newest version of Python, which some of our programmers wanted to use.

Other problems seen with RedHat was:

- you could not upgrade your way through major releases, you had to do a complete reinstall.
- older releases were only supported for a short time, maybe only 6 months. So if you needed to patch a program, perhaps because of a security hole, you would probably have to upgrade to a newer version.
- if you decided upon a fixed release of RedHat as your baseline, it could soon be impossible to buy a new machine and install that version on it, and, further down the track, if you choose to upgrade to a newer release, it would probably not be possible to install it on your old machines, as older drivers are not included in new releases.
- standard dynamic libraries are not always compatible across an upgrade. So an upgrade could very well imply a complete recompilation and relinking of all the programs, you have developed! Software baselines will multiply.

debian is not backed by a commercial company, but maintained by a group of volunteers, and you can only get into this group (be a contributor) by invitation from one of the existing members of the group. In that way there is no commercial incentive to push forward the development of new programs, but as most programmers want to use the newest software available, programs seem to get written/ported anyway.

debian can be installed once and then upgraded from then on, a feature which is unique to debian (at least back then). Upgrades are available at servers on the web, but you can fetch them and put them on your own, local server, if you want.

A problem with debian is to get commercial packages for it, like compilers. These are promoted on the commercially backed systems (but usually only in fixed versions, suitable only for one specific version), but can be hard to get to systems like debian. At the moment we are using Intel-compilers (for c, C++ and FORTRAN, used as reference for our NEC supercomputer compilers, which are modified Intel-compilers) and Portland compilers (mainly for FORTRAN, but c and C++ are available too). Getting them up and running took just a little time for local configuration.

One of the big advantages if choosing debian, is the possibility to use FAI; Fully Automatic Installation of debian GNU/Linux. FAI is mainly a proof of concept, but does contain sample scripts and configuration files. It is developed by Thomas Lange of the University of Cologne, Germany, and it is able to do everything a system administrator has to do, before a user can log in on a brand new computer. It will install and configure debian, and it is also capable of installing all the applications, which are needed on the new computer. And all configurations and scripts, needed by FAI, can be stored on a central server. Other distributions come with tools like FAI (KickStart for RedHat, yast and alice for SuSE), but FAI seemed to be the most flexible solution.

One further matter to take into consideration was, that a number of the special boxes used at our place, such as routers and firewalls, are based on the LRP distribution of Linux, which has its roots in debian too.

So in the end, we ended up choosing debian.

How is the configuration stored?

A fully installed debian host can easily contain several hundred individual software packages. A lot of these belongs together in program groups. Getting X11 to work on the host for instance requires about 20 different packages.

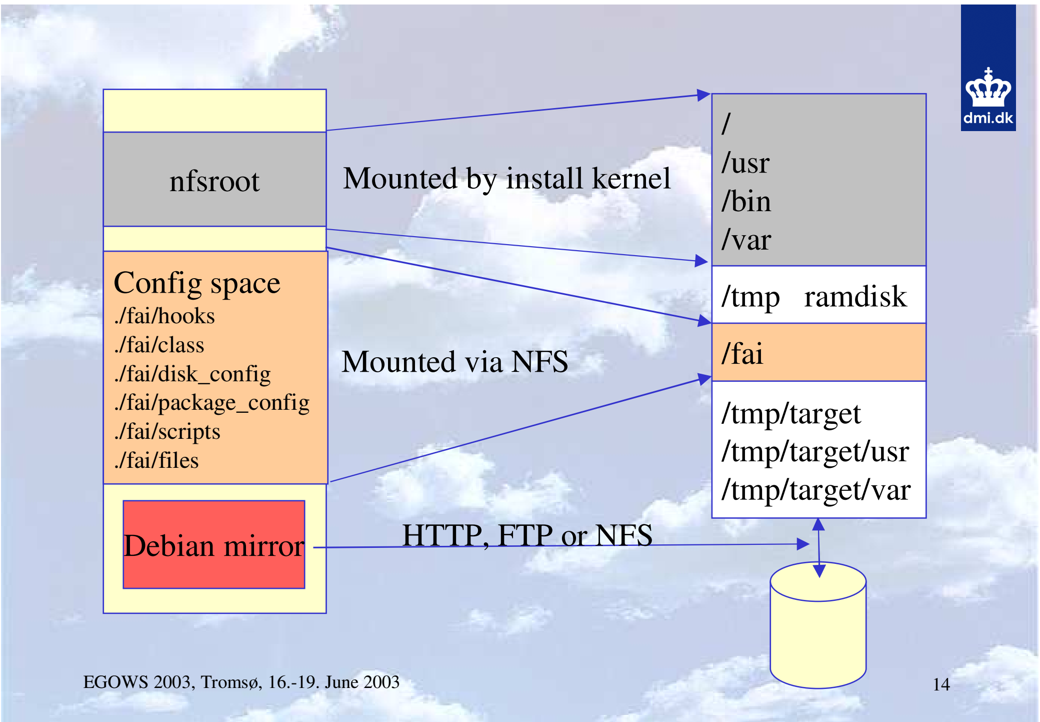
In FAI, the description of a host is done by a number of configuration and scripts files in a directory structure. Some of the configuration files are general ones, like describing what it takes to get X11 running. Others are specific to each host, listing the contents, which should be installed on that particular host. There is a dynamic part, which during the installation will probe the machine for hardware and install necessary drivers and related software, for instance an audio driver and various players if a sound card is detected. A script part makes it possible to execute scripts during the installation of a host, enabling you to do whatever is necessary.

One use of the scripting part during development is to get a tar-ball of some software from the server and unfold it on the client.

In the spring, we had to test an evaluation version of NinJo on a Linux platform. 3 Intel computers were bought. One had a basic debian installed, and then the Java Virtual Machine reference platform for NinJo and NinJo itself were installed by hand. It took several hours to get everything in place, partly because the NinJo image came from Windows.

Once that was running, it took about 3 hours to put the configuration into FAI and test it a couple of times. But from then on, creating a new machine with the evaluation version of NinJo just requires to put in the special boot diskette, booting the machine and appr. 15 minutes later you can log on to the new machine and start up NinJo.

Moreover, modifying an installation is as easy as modifying a few text files, pertaining to this particular host (or group of hosts).



Experiences with the DMITUX machines

When the concept of DMITUX was first introduced to a broader audience, it was met with mixed feelings.

On one hand were users, for which the workstation was mainly a gateway to other systems. In the past, they had often experienced that the IT department had troubles, fixing problems with their machines, because the exact configuration of the machine was not obvious. Getting a workstation, for which the IT department would do guaranteed support, would be very nice.

At the other end of the scale were hardcore developers, who have the need to test and change settings and configurations, who are using specialized tools, and supporting old programs. They really objected to the prospect of what they saw as losing the control of THEIR machine, as a machine by default is not supplied with a root password for security reasons. If a root password was to be installed, it would be rather easy to get into the configuration files and find the root password for every machine installed. But you can get root access to your own machine through ssh-keys.

As the project has matured, it has been possible to cater for many of the requests that have come around. It is even possible to have the root password, if you insist. You might not be able to get support, if you run into problems, but if you are a bit careful, maintaining the profile for your workstation, you can always have it reinstalled, if it crashes, or cloned if someone else is going to test the new setup.

By the start of June 2003, 74 workstations are catered for by the DMITUX system. 16 of these hosts are server installation. (For instance, the FAI server is itself a FAI-installation, and can easily be cloned!)

Java - the platform independent language?

The main reason for the development group at DMI to get into Linux, was to get NinJo up and running on this platform, as the strategic decision had been made, that Linux is to be used on workstations in the future.

NinJo has so far been developed on Windows based workstations. At some stage, Java was - and still is - marketed as "The platform independent language". It is true, that you can move your "binaries" or byte-code class files to any platform - provided you can get a Java Runtime Environment for that platform. But for most non-trivial applications that is not enough. There are add-ons and plug-ins, which are needed to obtain the full potential of Java programming. So instead of putting bits and pieces of hardware into a machine, you now have to put bits and pieces of software from several sources into a reference platform for the specific operating system, you want to run.

But once you have been able to establish a runtime environment, things gets easier. But still, when moving from Windows to Linux, a few pitfalls turned up, rather trivial, but annoying anyway:

The direction of a slash. The directory-delimiter when programming under Windows is backslash, `\', but it is forward slash, `/', on Unix. When programming Java on Windows, you are free use either `\' or `/', or you might even mix them in a path. But taking such code to Unix makes the path unusable, as `\' is interpreted as an escape character indicator, and the path is garbled. Keep to `/' for portable code.

Disk drives and partitions. On Windows different disk drives are often used to store different types of information, one drive for programming, another for data, as they could easily be mounted from the network. But path-prefixes like "C:" or "M:" is not quite the way Unix handles disk partitions. But there is a quick fix, make a symbolic link:

```
ln -s /data/NinJoData `M:'
```

Looks a bit funny in the directory listing, but it works.

A case to consider. Windows could not care less about how you mix upper and lower case letters in file names, whereas Unix is pedantic about it. So a number of directory and files names had to be tracked down and changed (or soft-linked). To make things worse, some older file-browsers on Windows had their own opinion on, how to display case of a filename, regardless of the way it had been defined.

These matters have now been standardized, and as long as there are no changes to the Java reference platform, the marketing slogan of platform independency is true.

Recent developments at DMI

- NinJo
- CMS
  - Content Management System for new web, ObTree with Oracle database, XML/Soap interface
- Text forecast editing
  - XML tagged
- Ship routing
  - Web and onboard systems

Recent developments at DMI

- Verification
- WEB-ification
  - Aeronautical information
  - Lightning
  - Road condition system

EGOWS, Tromsö, 16 - 19 June 2003

RECENT DEVELOPMENTS IN TERMS OF NOWCASTING AND VISUALISATION AT ZAMG

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EGOWS, Tromsö, 16 - 19 June 2003

OVERVIEW

- Introduction
- Recent developments
    - * Nowcasting
    - * MAVIS
- Further investigations and plans for the future
    - * Nowcasting
    - * MAVIS
- Design of the new tools

NOWCASTING

- Recent developments
  * modifications in convective cell tool
  * generation of radar motion vectors
  * modifications in manually generated SATREP
  * new design for automatic SATREP

NOWCASTING/ CC TOOL

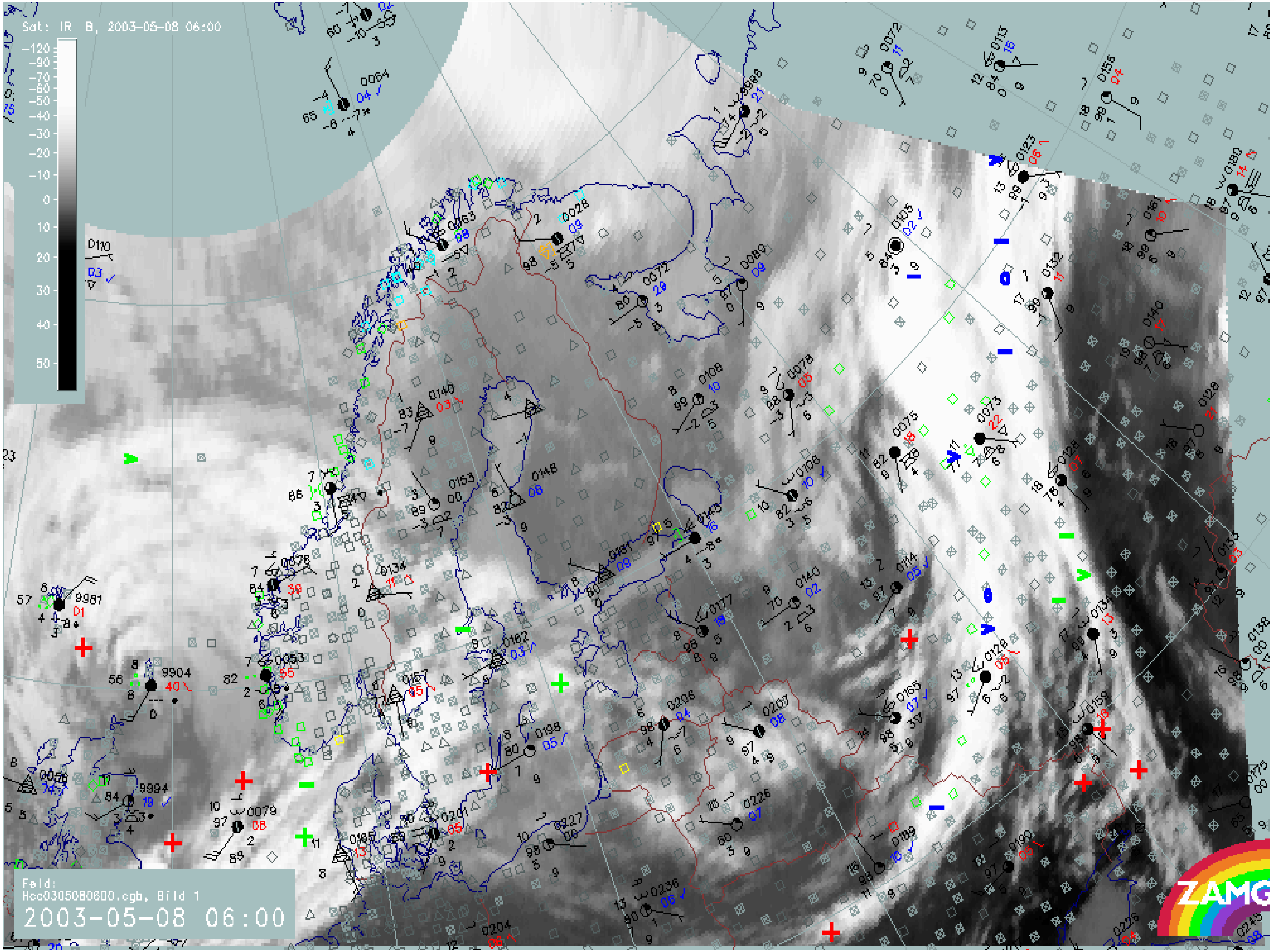
- CC Tool:
  * detection of cells based on IR image:
    + brightness maxima
    + pixel difference to surrounding area

- NEW:
  * inclusion of VIS image
    + IR criterion must be fulfiled
    + if VIS pixel too dark $\Rightarrow$ not convective

NOWCASTING/ CC TOOL

- Advantage of new CC Tool:
  * High, thin clouds separated from thick clouds
  * frontal clouds separated from convective cells

- Problem:
  * VIS images only available during daytime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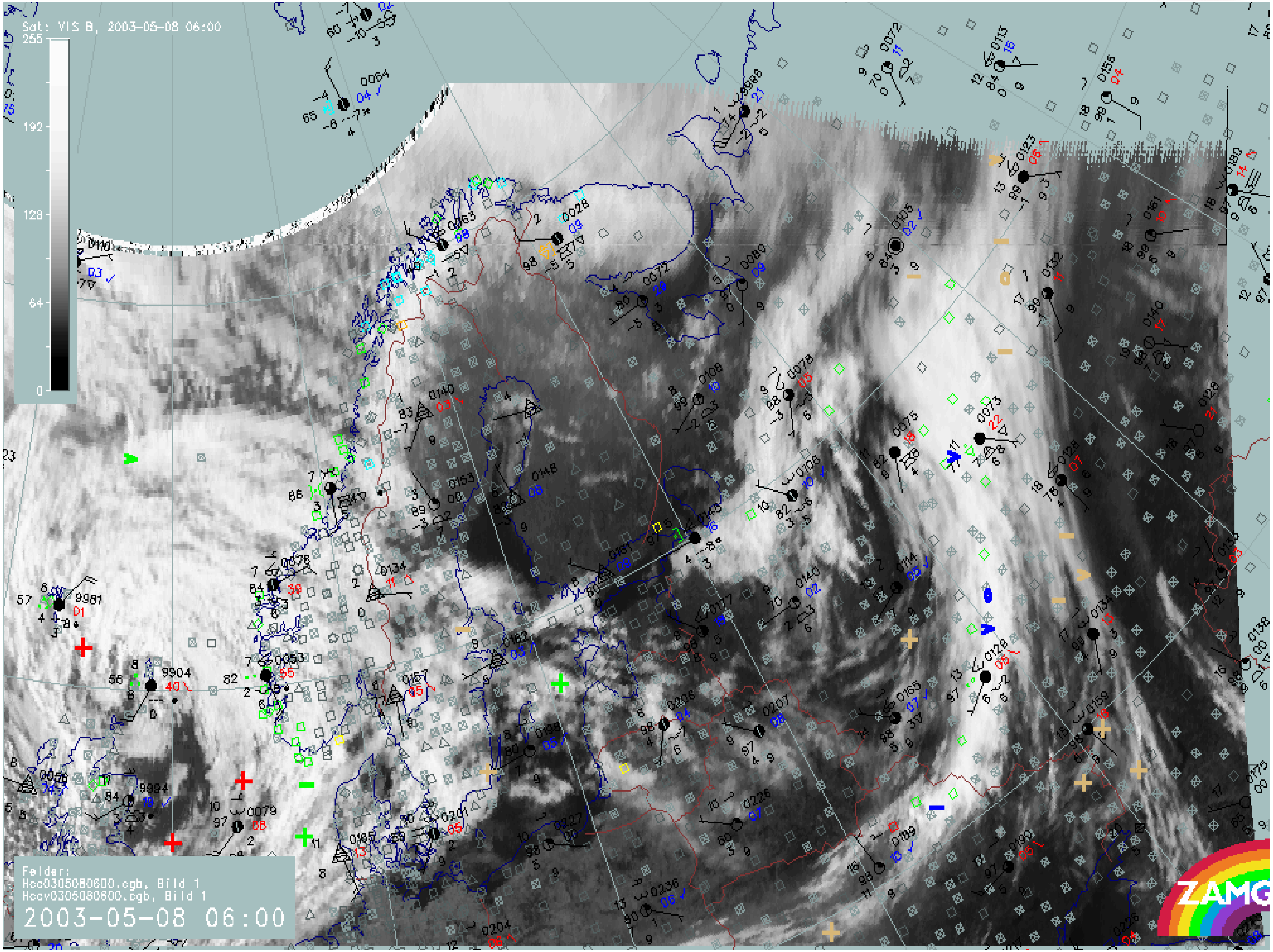
2003-05-08 06:00
ZAMG



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192
128
64
0
Felder:
Hcc0305080600.cgb, Bild 1
Hccv0305080600.cgb, Bild 1
2003-05-08 06:00
ZAMG

NOWCASTING/ RADAR

- Generation of RADAR motion vectors (RMV)
  * for correcting satellite winds (AMV)
    + if precipitation from low clouds

- Problem:
  * calculation of RMV difficult in mountainous regions

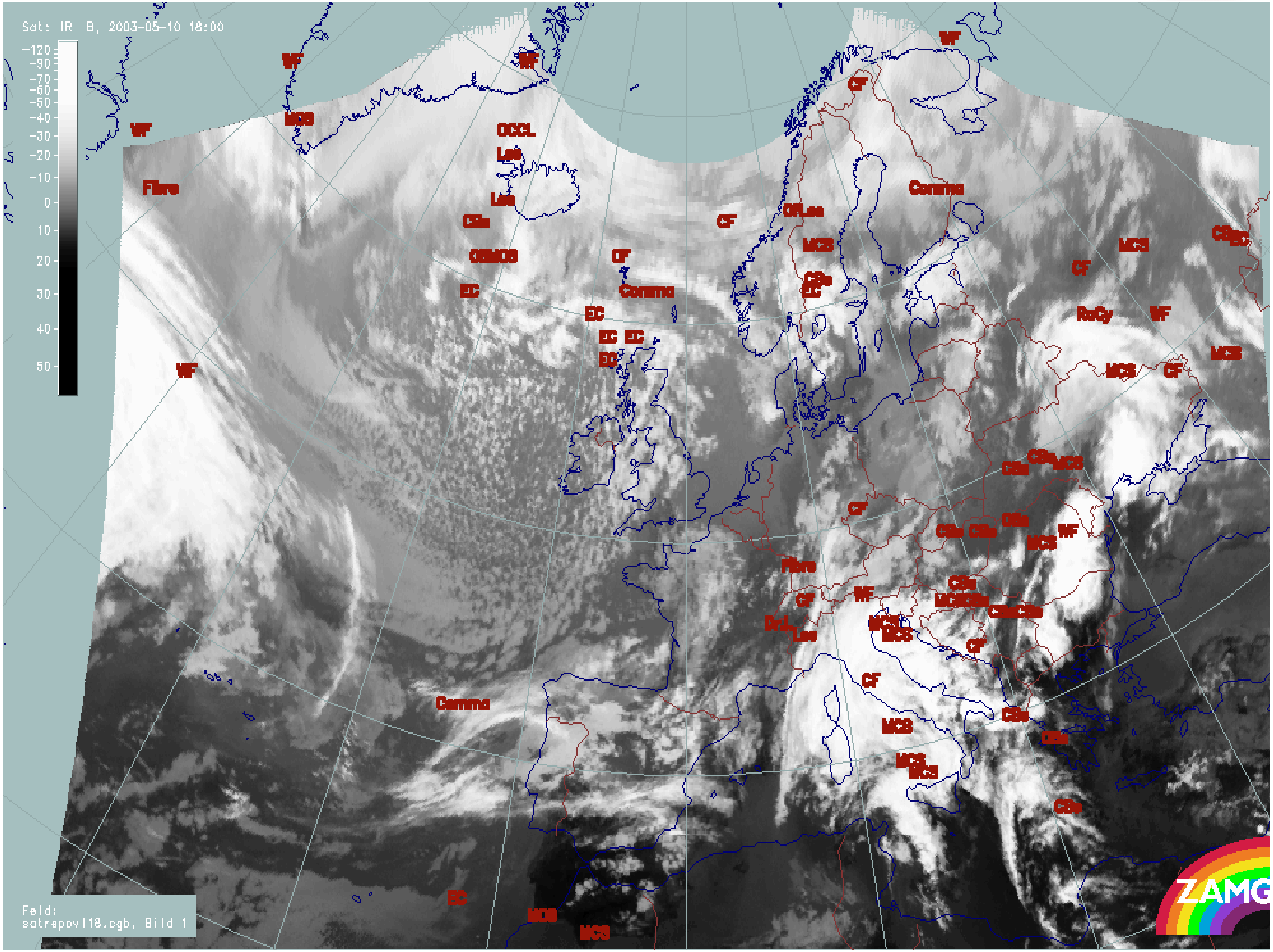
NOWCASTING/ SATREP

- Manually generated SATREP (*Sat*ellite *Rep*ort)
  * NEW: DWD, ALADIN available (before: only ECMWF) ⇒ comparison between the models

- Automatically generated SATREP
  * new design
    - now only available at ZAMG

NOWCASTING/ SATREP

- Automatically generated SATREP
  * designation of CMs same as in manually generated SATREP
  * functionality of key parameters (NWP) same as in manually generated SATREP
  * physical conditions for automatical classification written in Info
- Automatically generated 00 UTC SATREP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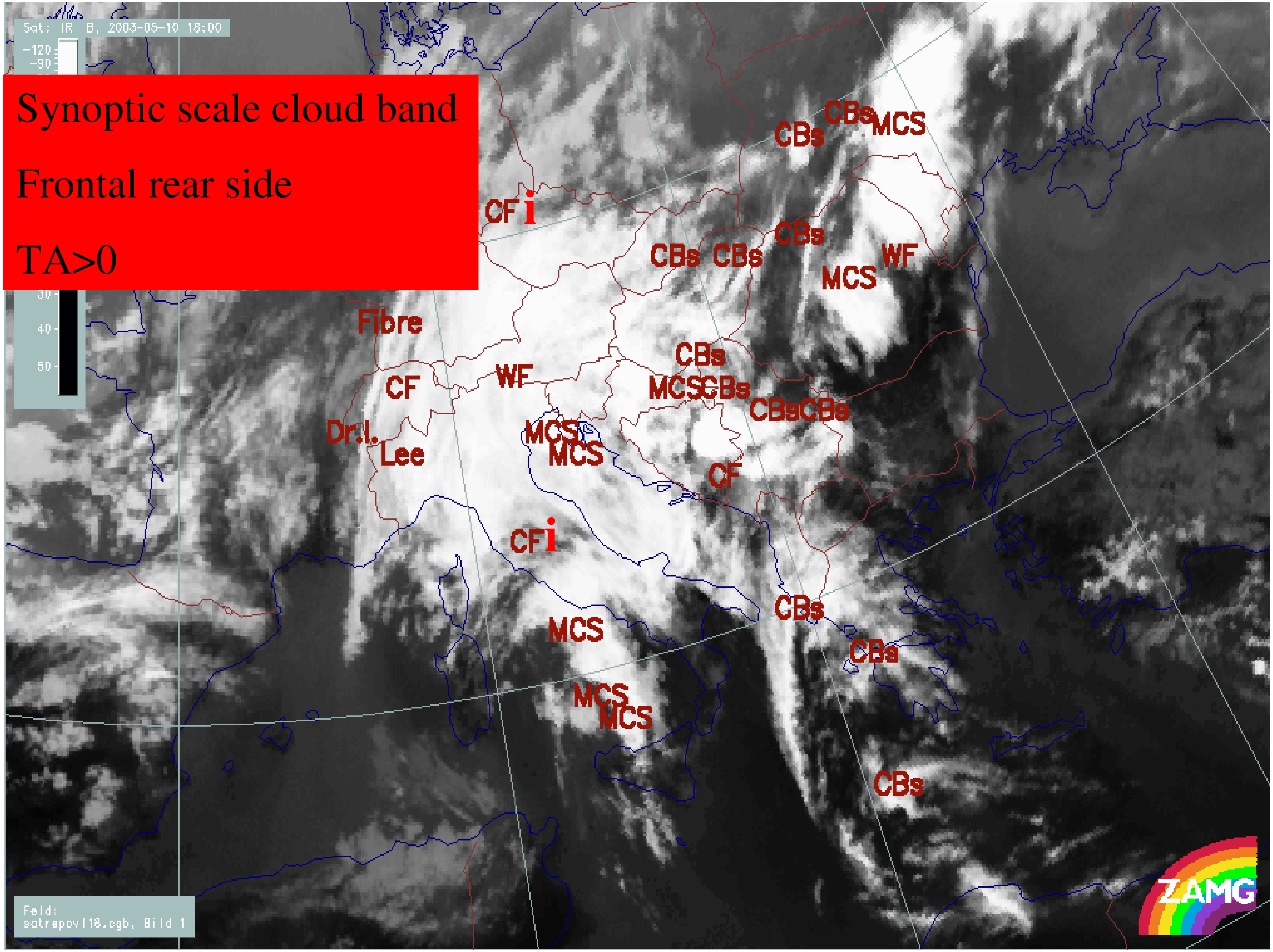
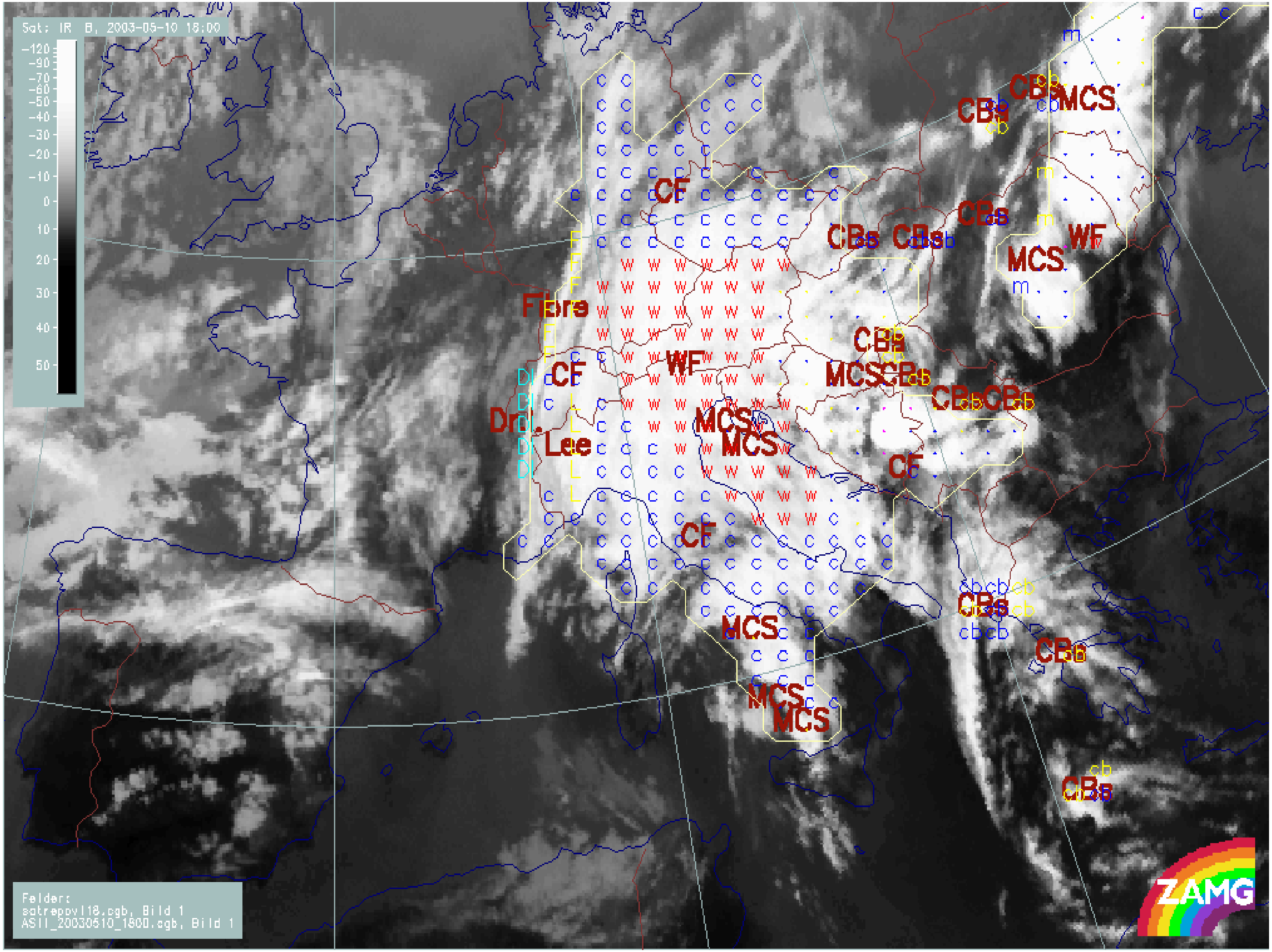
-120 -90 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50
Feld:
satrepovl18.cgb, Bild 1
ZAMG

Synoptic scale cloud band

Frontal rear side

TA>0





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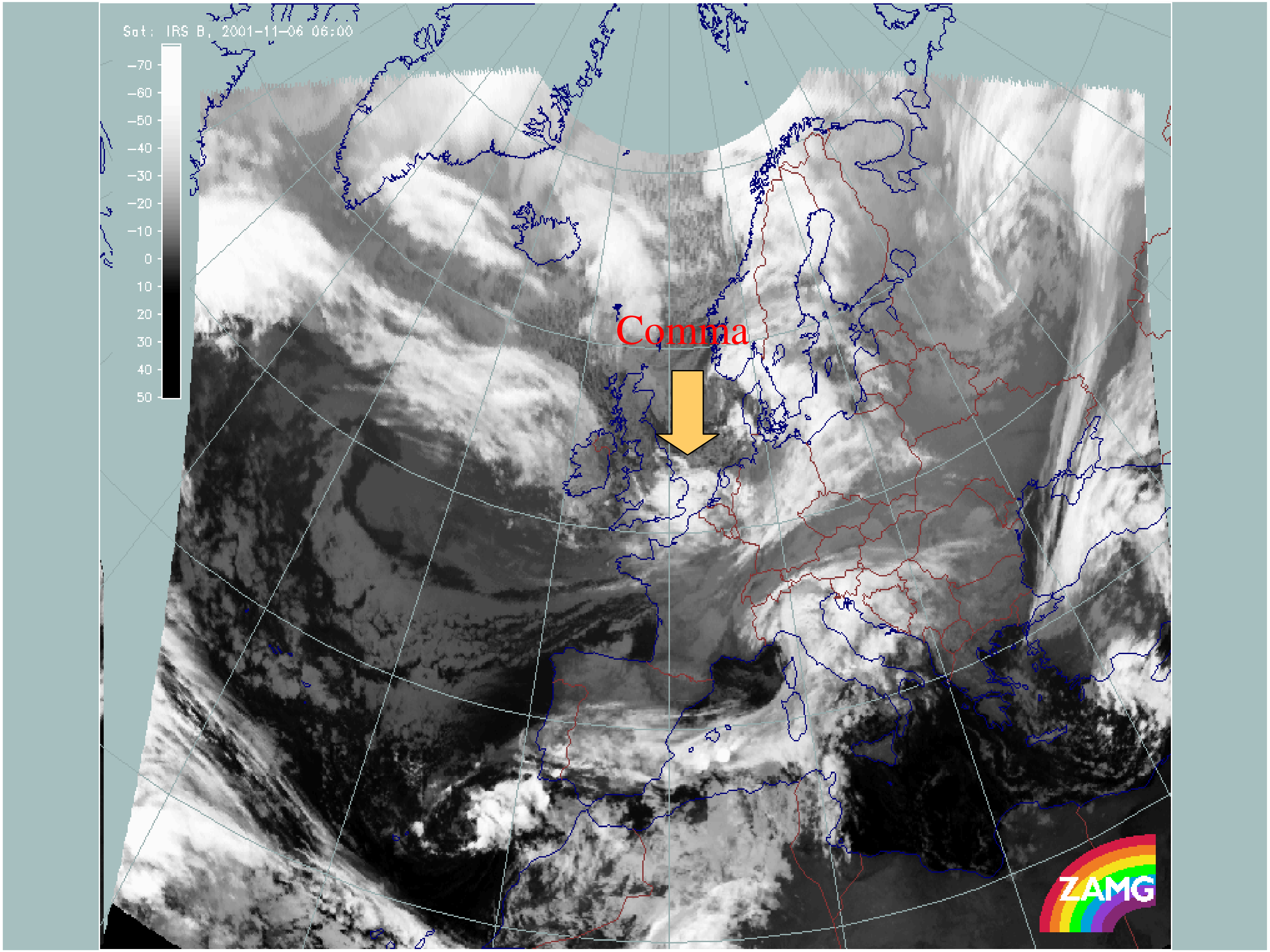
Felder:
satrepovl18.cgb, Bild 1
ASII_200305101800.cgb, Bild 1
ZAMG
CF
WF
MCS
CBs
Fibre
Lee

NOWCASTING

- Plans for the near future:
  * Radar images included in the CC Tool
  * Nowcasting system based on RMV
  * Nowcasting tools based on MSG
  * New Nowc. tools based on MSG, e.g.. fog
  * SATREP: ECMWF, DWD, Aladin: 00 UTC
  * Automatically generated SATREP every 3 hours
  * simulated satellite images for detection of model errors



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-70
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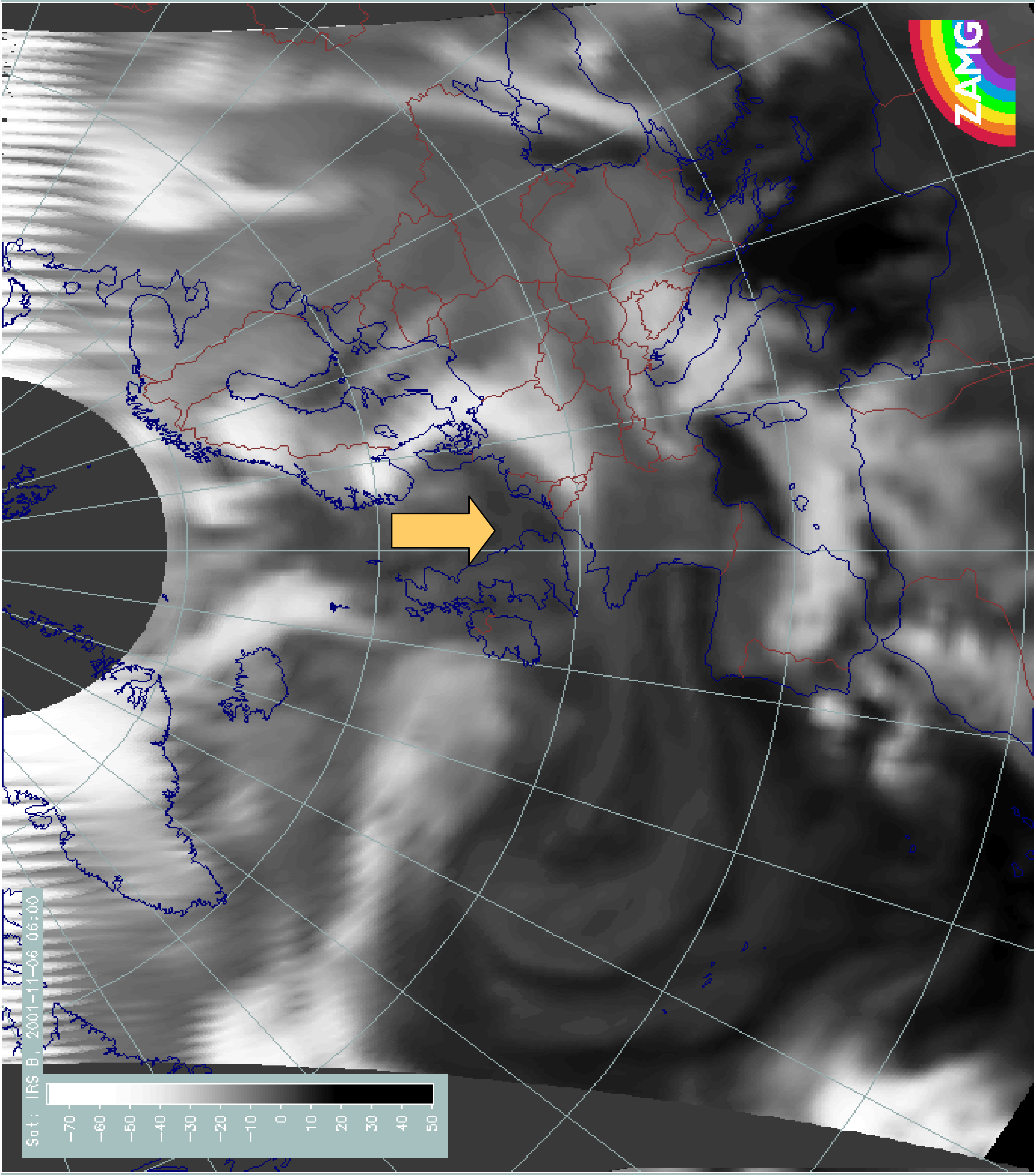
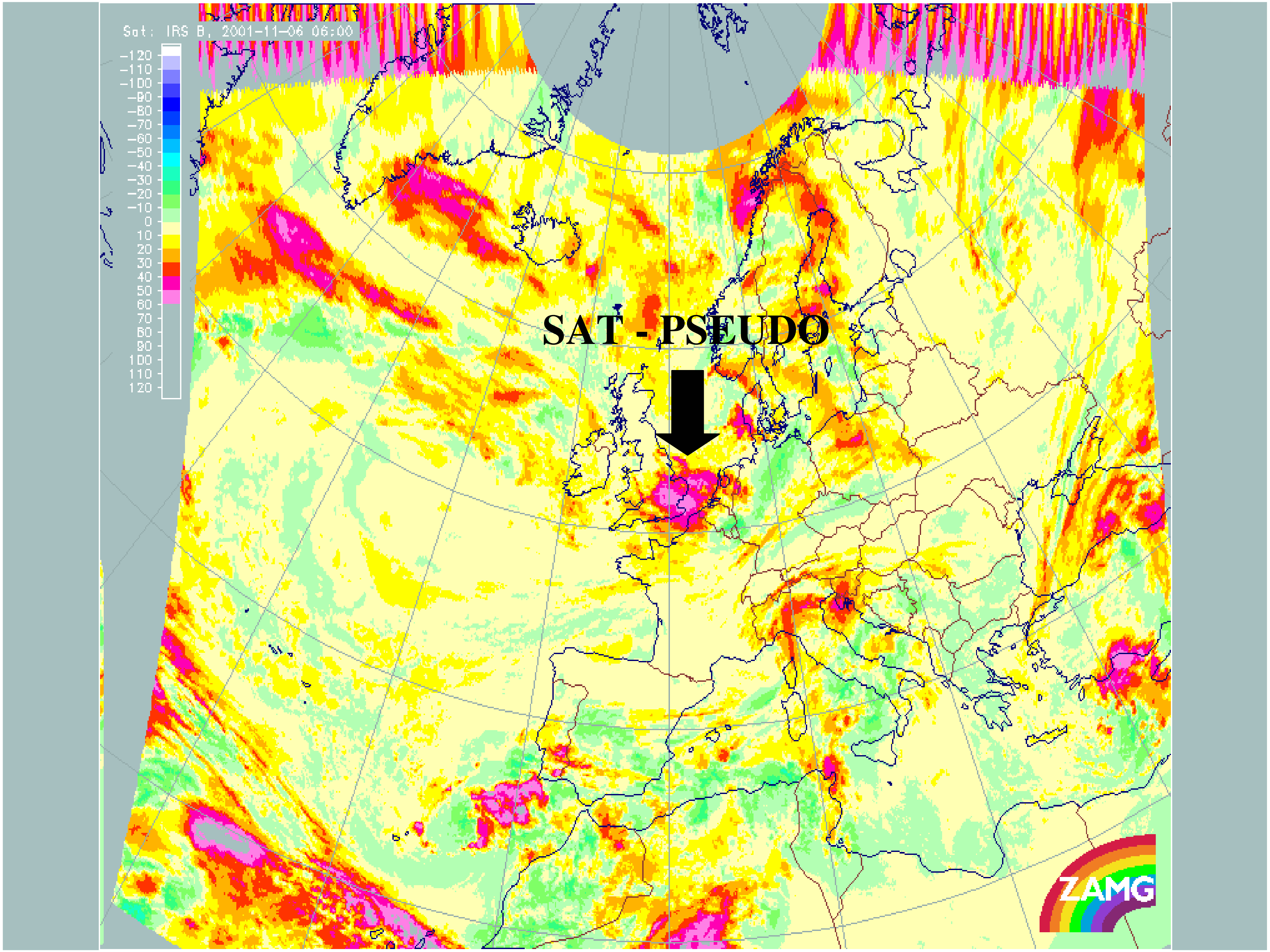

ZAMG
Sat: IRS B, 2001-11-06 06:00
-70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50



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-70
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-40
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-20
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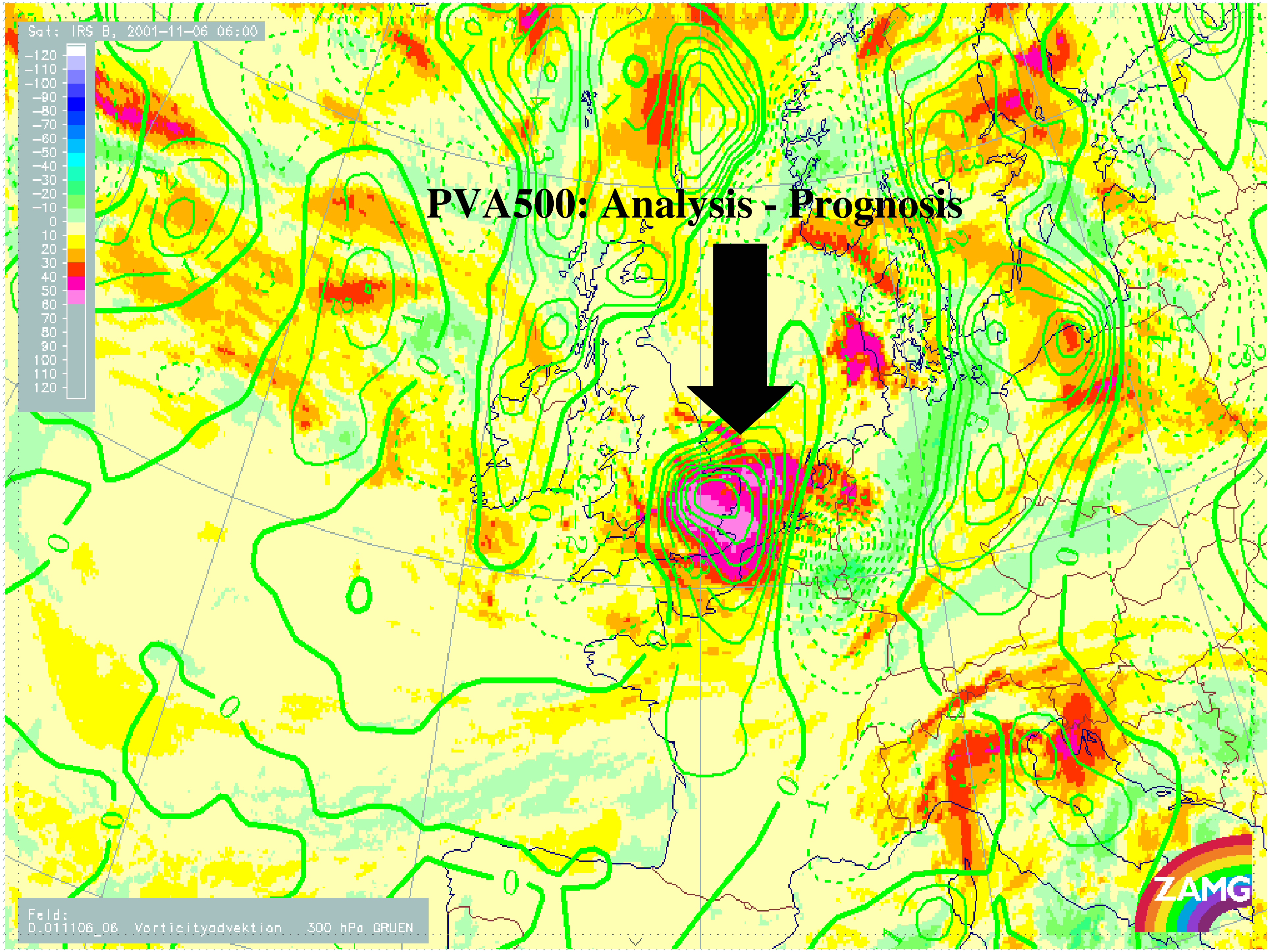
110
120
SAT - PSEUDO
ZAMG

PVA500: Analysis - Prognosis



MAVIS (Met Austria Visualisation System)

- Recent developments:
  * Radar images included (Austrian radar, 2km)
  * map of the world with world-wide SYNOPS
  * topography world-wide
  * geographical information world-wide (rivers, cities, borders, etc.)

MAVIS

- Plans for the near future:
  * CERAD included
  * MSG data and applications in MAVIS (preparations and tests successfully)
  * Graphical Interaction

Graphics Update

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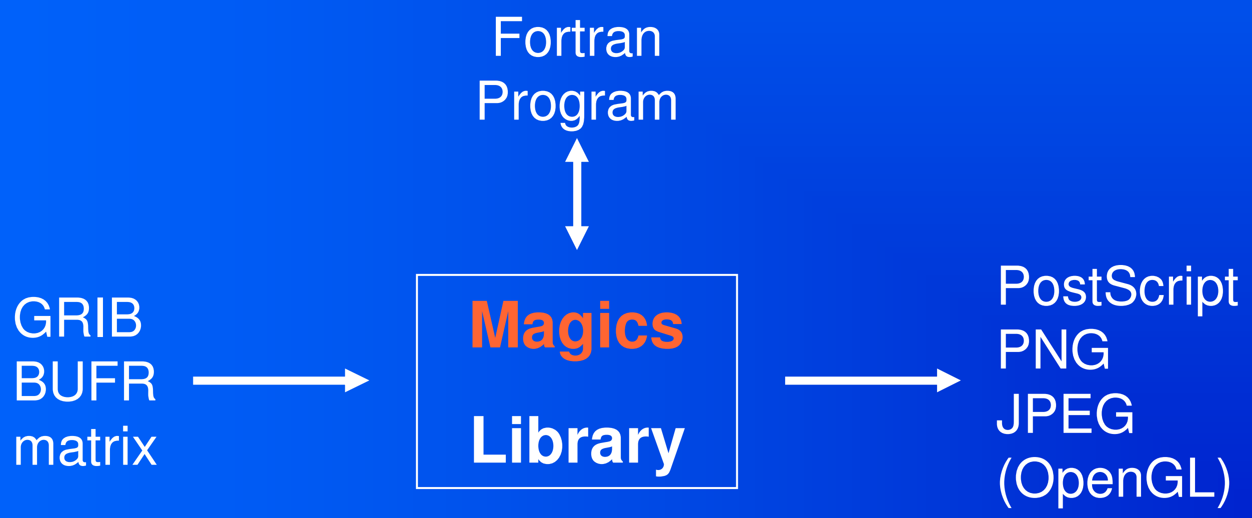
14th EGOWS
Tromsø, 16-19 June 2003

Overview

- Magics
  - New-Magics Project
- Metview
  - New Mars access scheme
- Meteograms
- Summary

Magics

- Magics is a software system for plotting contours, satellite images, wind fields, observations, symbols, streamlines, isotachs, axes, graphs, text and legends



Magics
New features

- The implementation of new coastlines based on the NOAA GSHHS database was completed and it has now become the default for both Magics and Metview
- Support for data in Polar Stereographic Grib (NESDIS) has been added
- The Magics test and installation procedures have been improved
- Use of shared Magics libraries under the IBM AIX operating system was considered

Magics
Plans

- Limited netCDF support (for Metview)
- ODB support (to be developed for selected applications)
- **Magics 6.8 - export**
- **New-Magics Project**

Magics 6.8 - export

- Available to the Member States
  - July 2003
- UNIX platforms

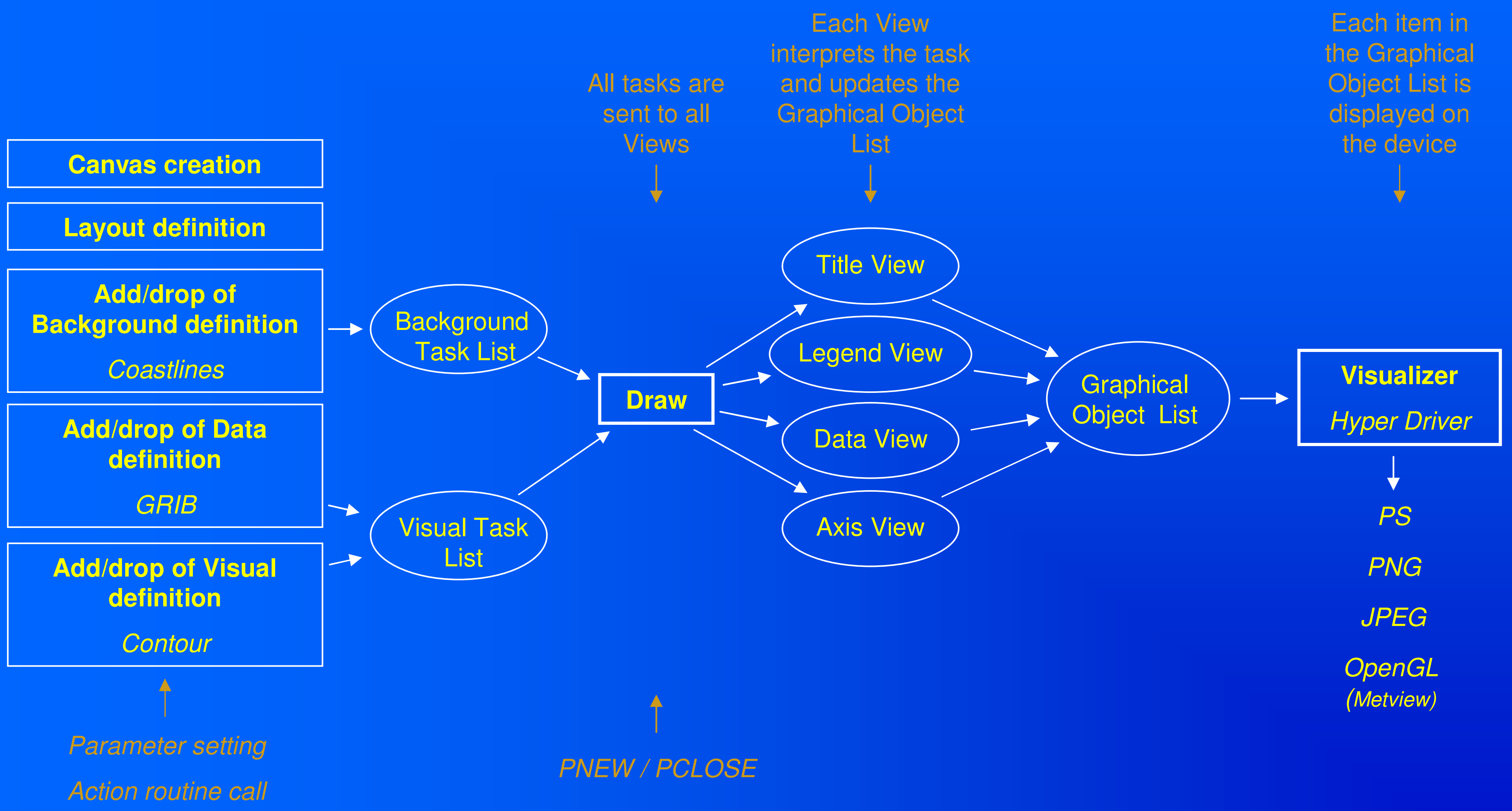
Linux	SuSE 7.3 & 8.0 - GNU version 3 - Portland Fortran compiler
IBM	AIX 4.3
SGI	IRIX 6.5
HP	HP-UX B.11
HP/Alpha	OSF1 V5.1
Sun	SunOS 5.9

- User Guide in HTML, PDF and PostScript format

New-Magics Project
Migration to C++

- Work on the phased migration of the Magics library from Fortran to C++ continued
- Analysis of the internal structure of new-Magics has been performed and tested by a prototype to ensure its efficiency
- Externally, the aim is that existing Magics user programs will need minimal changes to use new-Magics
- Phased implementation
- A hyper driver for new-Magics has been developed
  - The hyper driver generates lists of Magics-independent graphical objects containing window/viewport transformation definitions, graphical primitives and graphical attributes to be rendered outside Magics
  - Each list can be directly rendered to any of the available device drivers suitable for a multi-threaded Metview environment

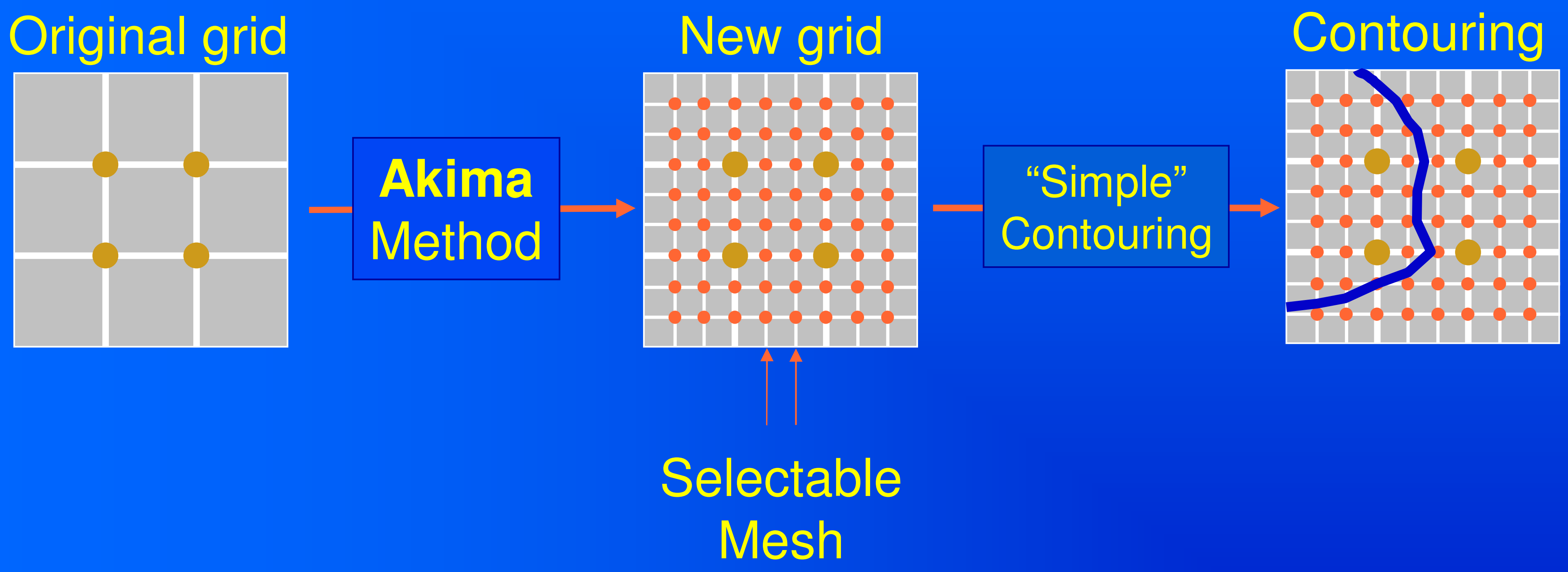
New-Magics Project Design



New-Magics Project
The Akima method

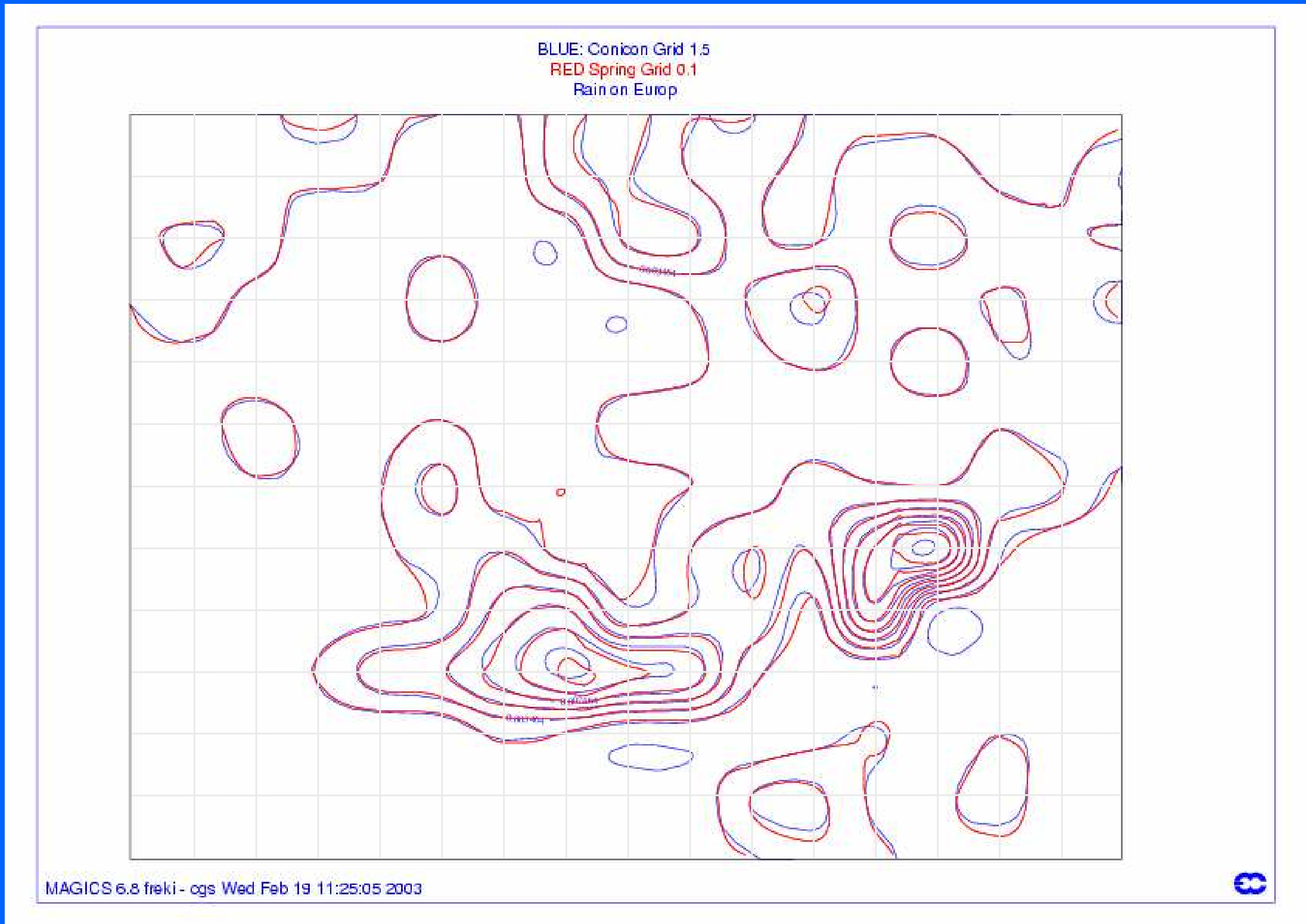
- The Akima method has been selected as the contouring method for new-Magics
- Algorithm 760: **Rectangular-grid-data surface fitting that has the Accuracy of a bicubic polynomial**, ACM Transactions on Mathematical Software, Vol. 22, No. 3, September 1996, Pages 357-361
- INPE/CPTEC, Brazil, is making a C++ implementation of the latest version of the Akima method available for inclusion in new-Magics

New-Magics Project
The Akima method

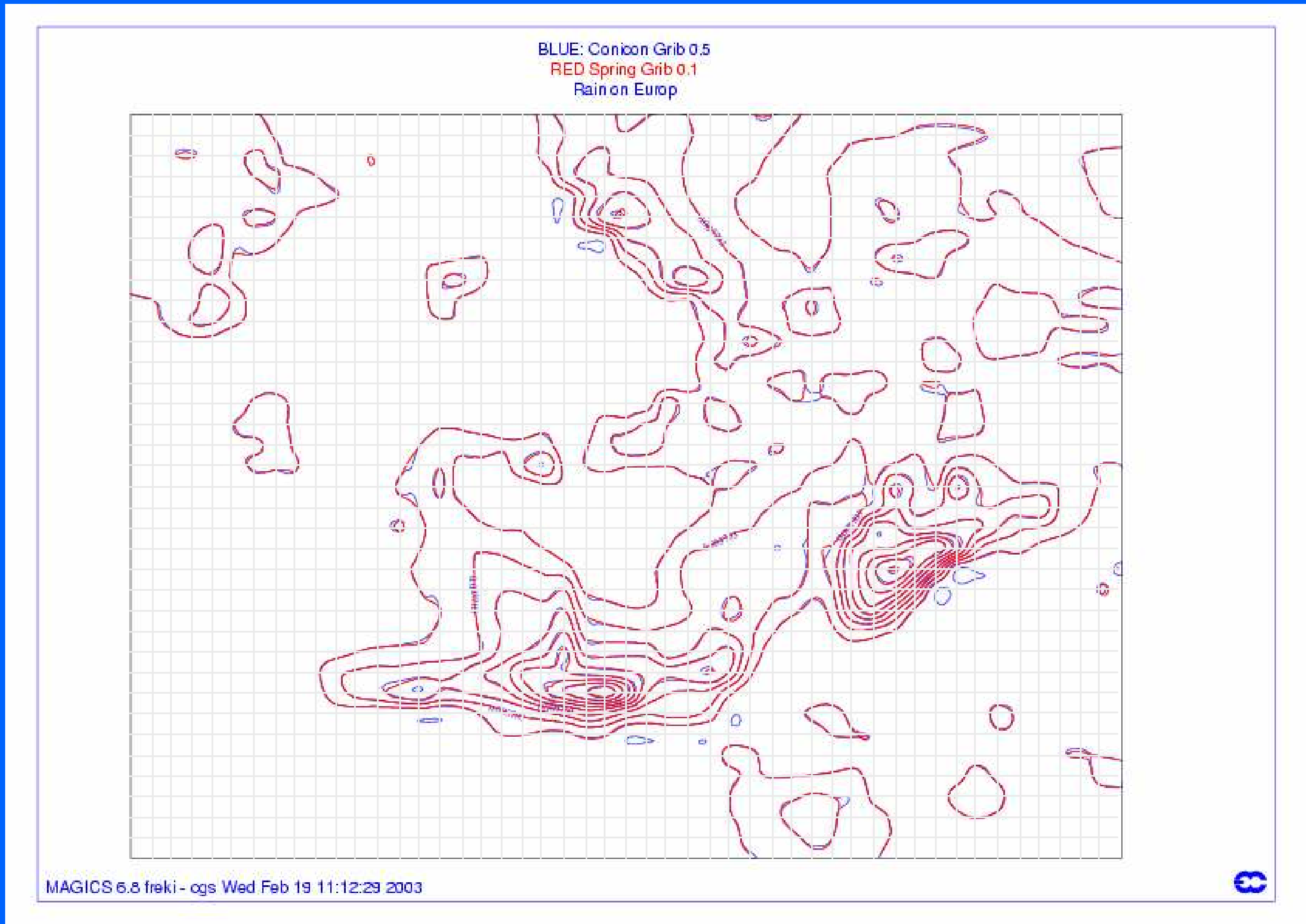


Also an algorithm for scattered data

New-Magics Project
The Akima method



New-Magics Project
The Akima method

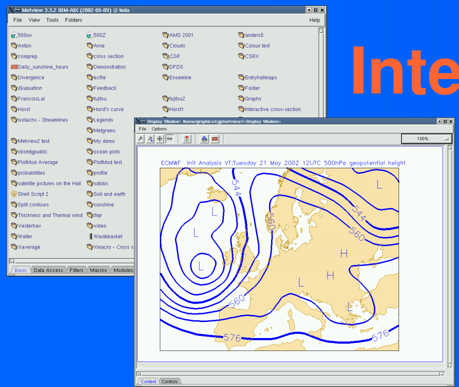


New-Magics Project
Project plan

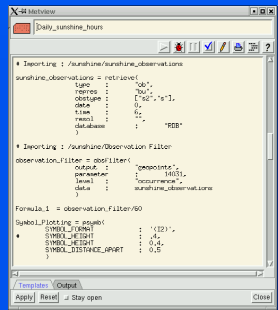
- Demonstration version of New-Magics to be presented at the *9th Meteorological Operational Systems Workshop, 10-14 November, 2003*
- Prototype 1Q2004
- Pre-operational release 2Q2004

Metview

- ECMWF's meteorological data visualisation and processing tool
- Complete working environment for the operational and research meteorologist



Interactive



Macro

Batch script

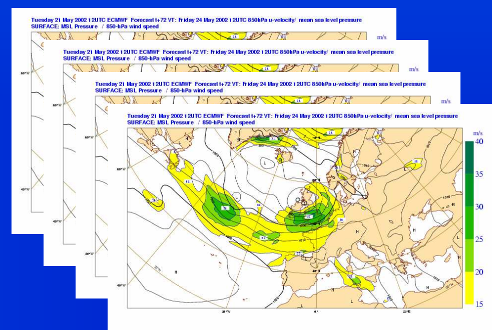
routine production

PostScript
PNG, JPEG

Mars

GRIB
BUFR
Matrix
other

Metview
Visualisation
Processing



Metview
New Mars access scheme

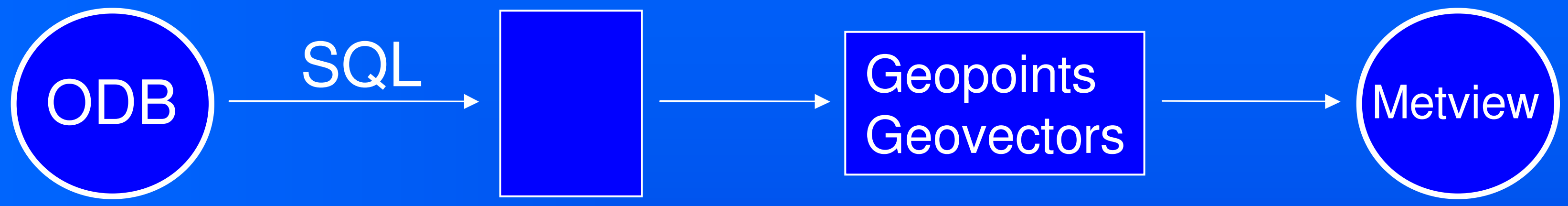
- *ECaccess* replacing *ECbatch*
- Update of the Metview Mars module not needed if Metview is built with MARS_none
- If Metview is built with MARS_remote access to ECMWF MARS archives
  - You need to update the Metview Mars module and the Mars configuration file that *etc/MARS_remote* is pointing to
  - A distribution package containing the updated Metview Mars module is available from Data Services
  - The distribution package will let you build and replace the Metview Mars module in Metview 2 or 3
- If an external Mars Client is used as a common cache holder for all Metview sessions
  - You need to update the Mars Client Software
- New full Metview 3.5 - export distribution package planned for 3Q2003

Metview
New features

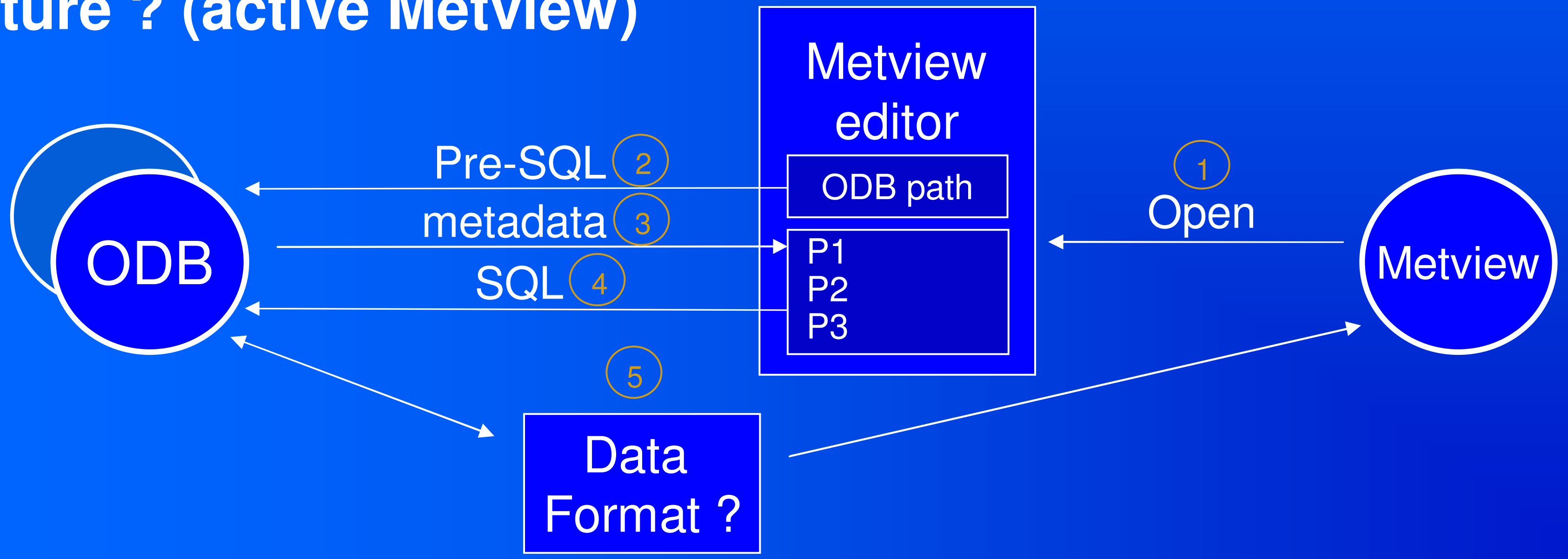
- High volume satellite data
- Support for handling vector type point data format (GeoVectors)
  - ODB support
- Examine geopoints values and satellite pixel values
- Running several Metview sessions simultaneously
- Support for *missing data values* in Grib fields have been added in macros
- Support for missing data values in BUFR messages added to geopoints and the ObsFilter editor
- Control over plotting grid point values has been improved
- A Metview fix log file has been introduced for better feedback to users reporting problems
- A trajectory model has been integrated as part of Metview, providing Metview users with a fast and easy facility to compute and visualise trajectory data

ODB and Metview

Current (passive Metview)

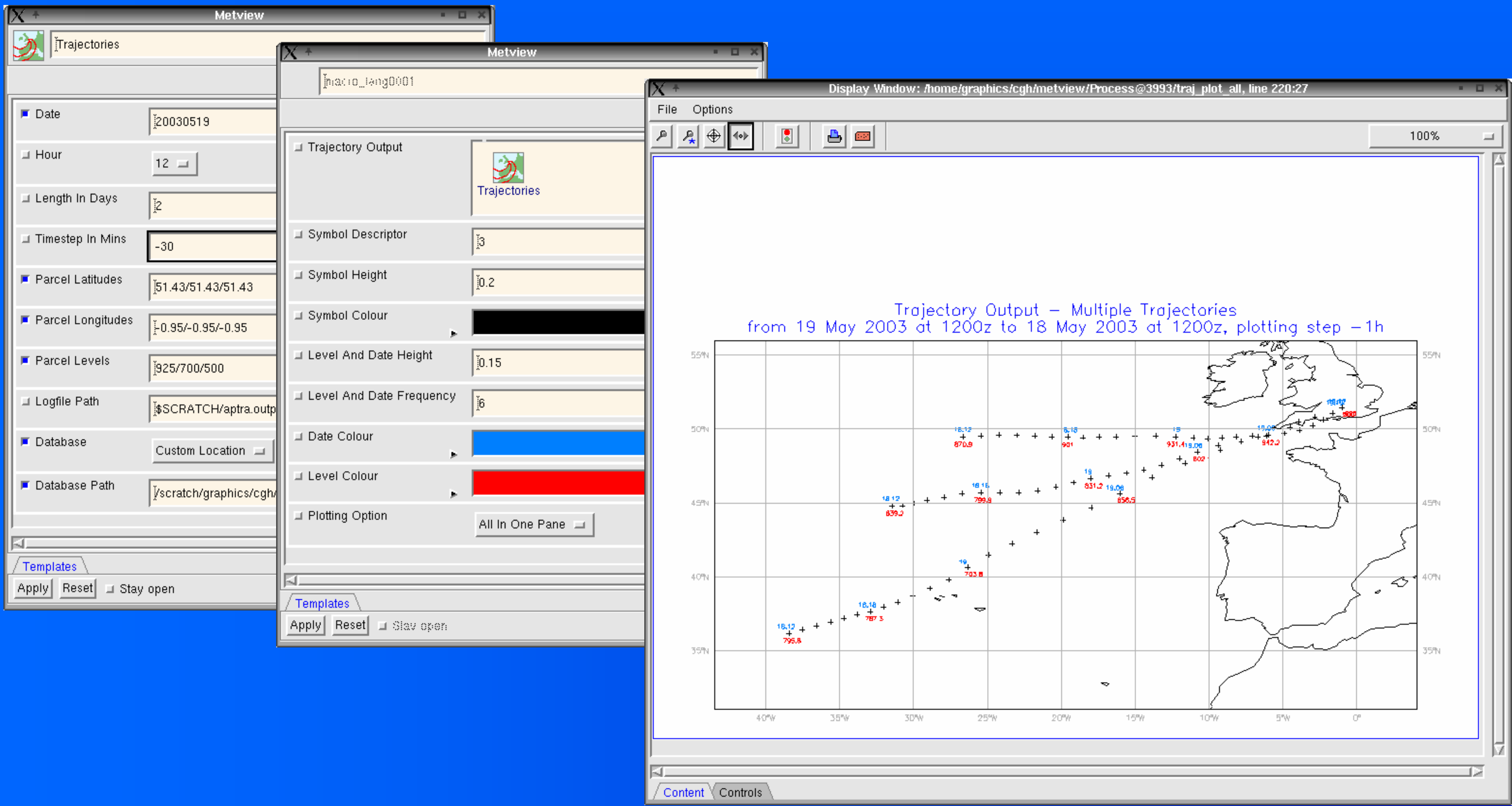


Future ? (active Metview)



Metview

Trajectory model

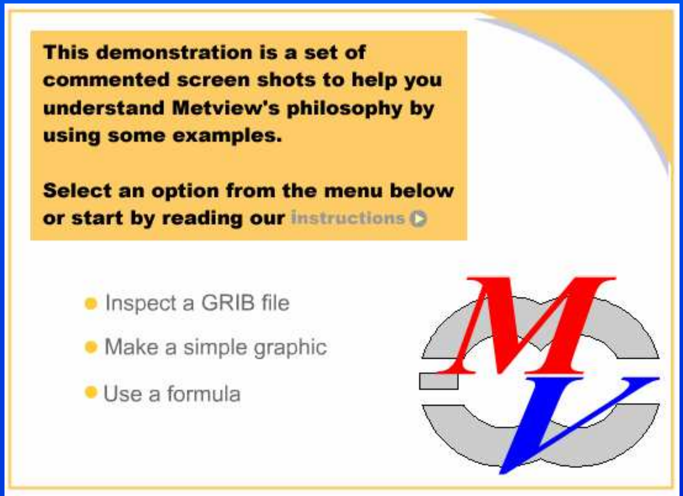


Metview
Plans

- ODB support (to be developed for selected applications)
- New-Magics support
- New Mars access scheme
- **Metview 3.5 - export**

Metview 3.5 - export

- Available to the Member States
  - 3Q2003
- UNIX platforms
  - Linux SuSE 7.3 & 8.0 (Portland Fortran compiler)
  - IBM AIX 4.3
  - SGI IRIX 6.5
  - HP HP-UX B.11
  - HP/Alpha OSF1 V5.1
  - Sun SunOS 5.9
- User Guide online
  - PDF and HTML format
- *Metview demonstration*
  - *http://www.ecmwf.int/products/data/software/flash/metview_demo.html*
  - *Data Services*



EPS Meteograms

- EPS Meteogram charts available via ECMWF Web pages
  - Shows EPS members forecast distribution for a model run
- Metview user interface
- BUFR data interface
  - Same format as dissemination files
- EPS Meteograms also available as standalone system

- Classic Meteograms available at ECMWF via Metview

Summary

- **Magics 6.6 available**
  - Version 6.8 July 2003
- **Update of Metview Mars module available**
- **Metview 3.4 available**
  - Version 3.5 3Q2003
- **EPS & Classic Meteograms**

Meteorological Product Quality Monitoring in EUMETSAT's MSG Ground Segment

Simon Elliott
EUMETSAT

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Background

- EUMETSAT operates meteorological satellites for its member states
- In addition to image data, level 2 geophysical products are produced
- Products are derived from image data and forecast data
- Products are validated by comparison with observations from balloons, ships, aircraft
- Graphics workstation is used to display all these data, allowing the analysis of the images and products by meteorologists
- MWS - Original system in MTP ground segment, fixed set of products, fixed layout for each product
- PQM - Part of MSG ground segment, uses (j) data dictionary, and (ij) visualization templates to enable analysis of many products in different ways, without software changes
- PQM can handle data in internal format and in BUFR

Catalogues

- Catalogues are used to display available data, display templates, colour tables
- Local catalogue shows what is on the local machine
- Remote catalogue shows what is available from central RAID storage
- Offline catalogue shows templates and lookup tables are available from configuration control
- Items can be dragged an dropped between catalogues or data into templates

Local catalogue of data, templates, et c.

Image data with control panel and coast

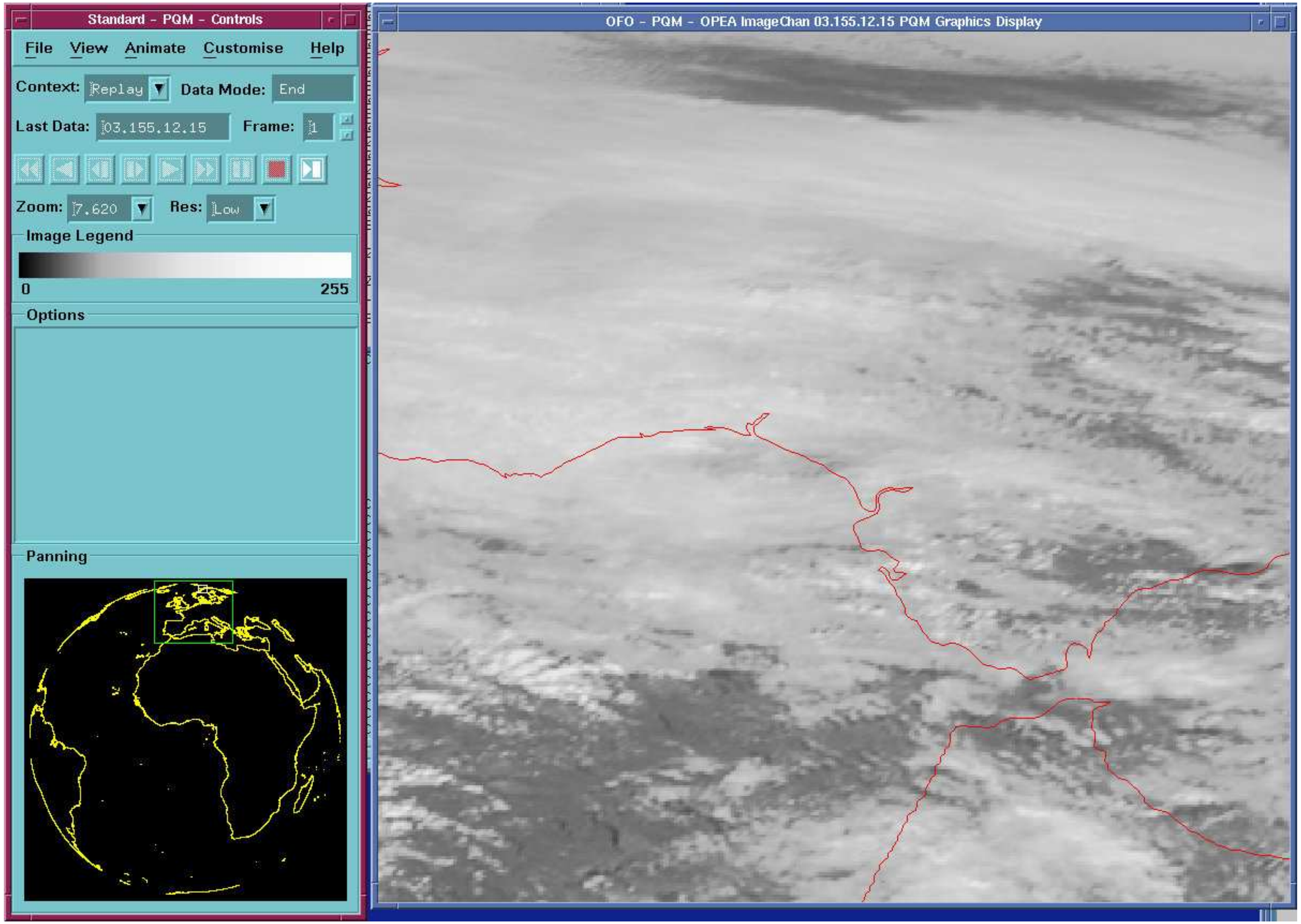
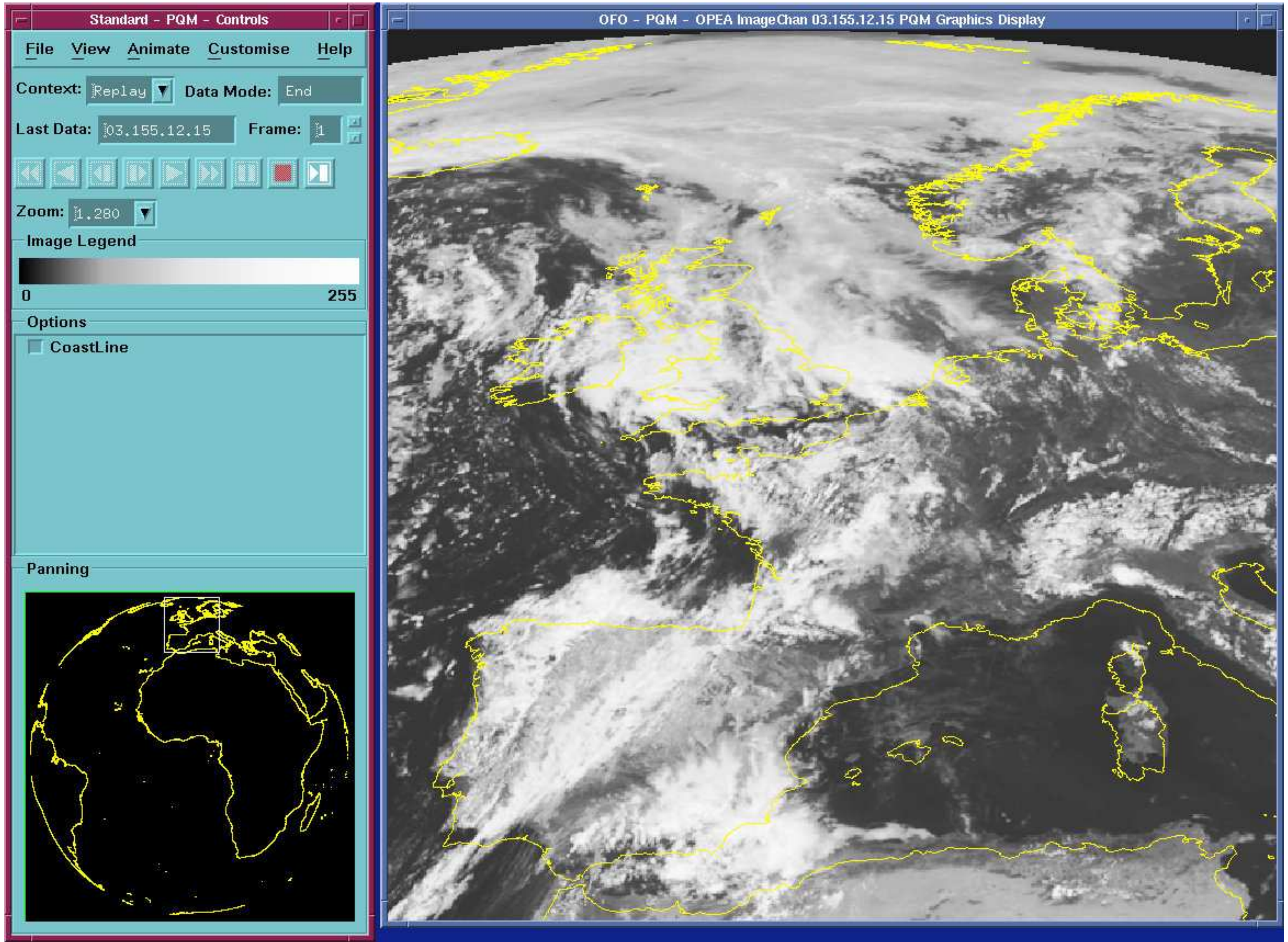


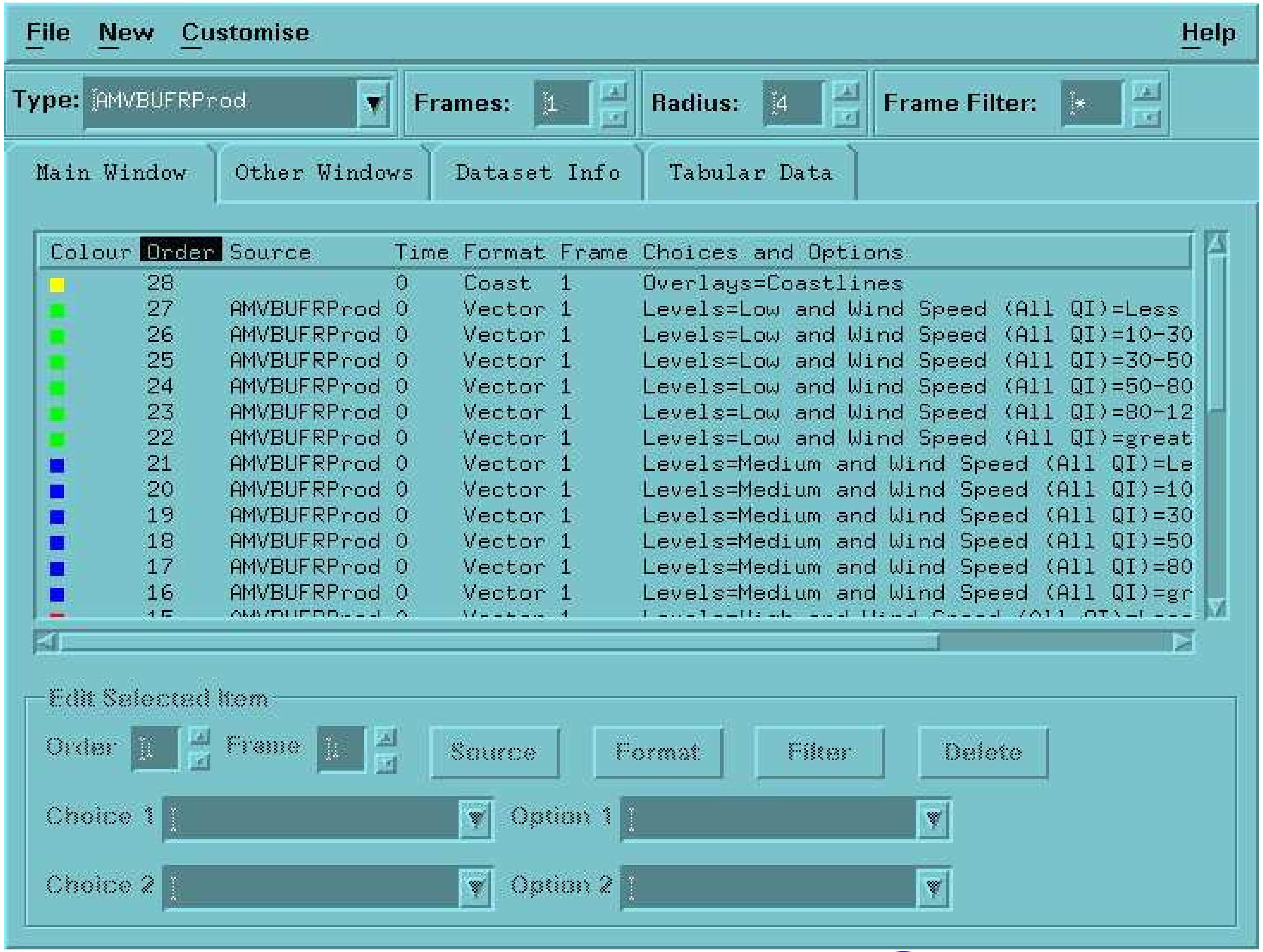
Image data with control panel and coast toggle



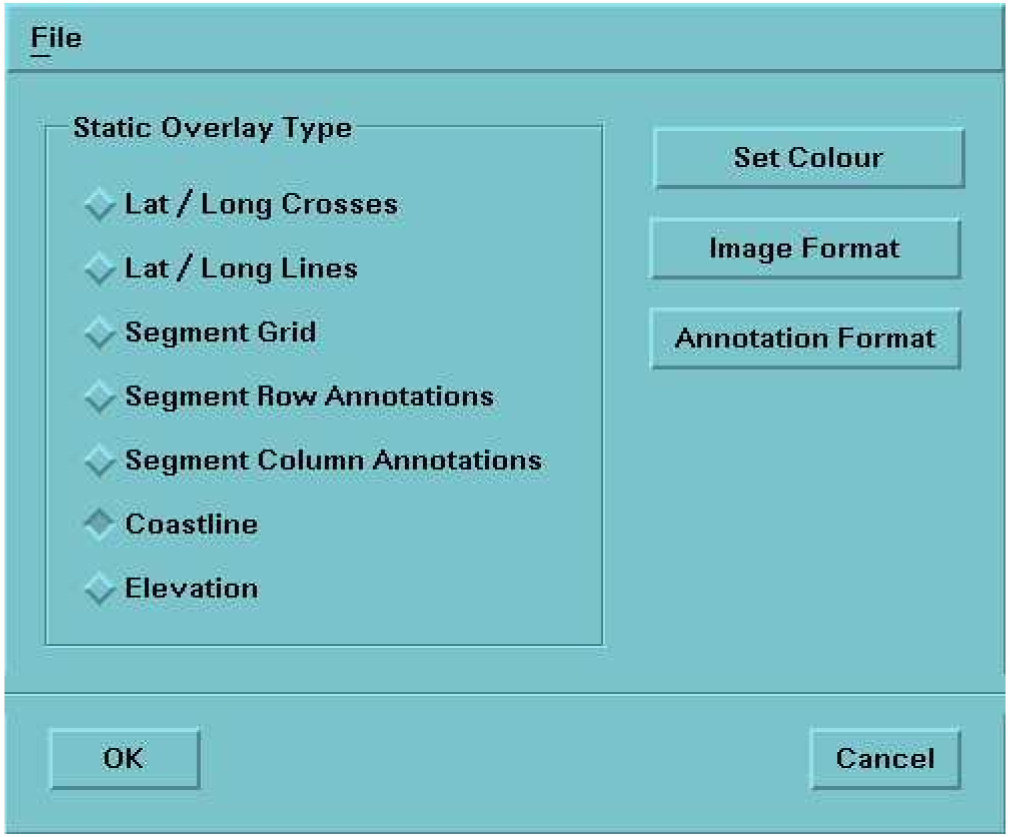
Templates and the template editor

- Data display is controlled by a template
- Template determines what controls are available during visualisation
- User can define multiple templates for different tasks
- Templates are editable via MMI; no software change needed
- Template editing is involved but simpler than rewriting software
- Template controls
  - image and/or pseudo image
  - overlays
  - data set information display
  - tabular data display
  - animation sequences
  - vector displays
  - annotations
  - contour plots, radiosonde profiles

Template editor - main tab



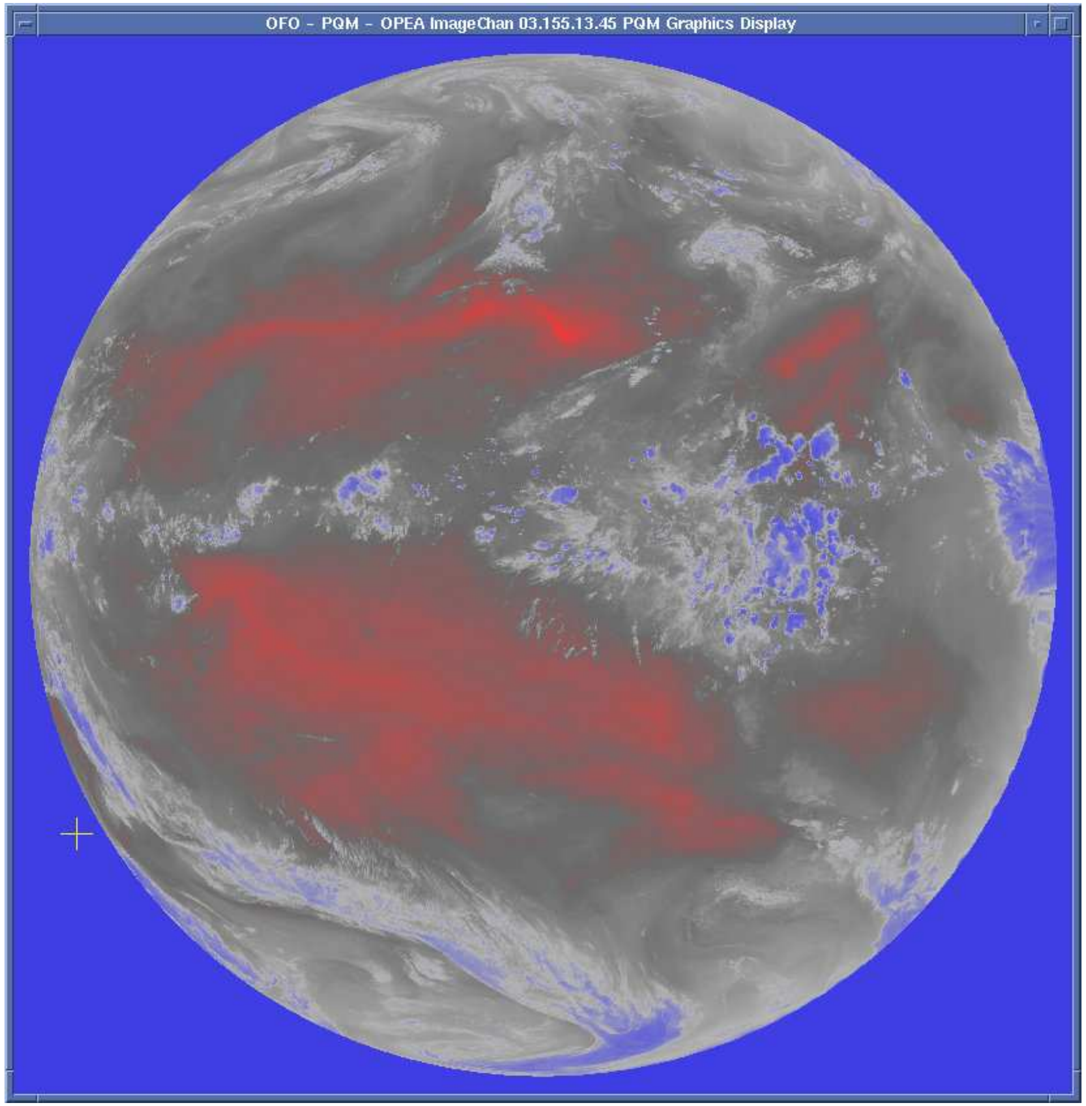
Static data specification dialogue



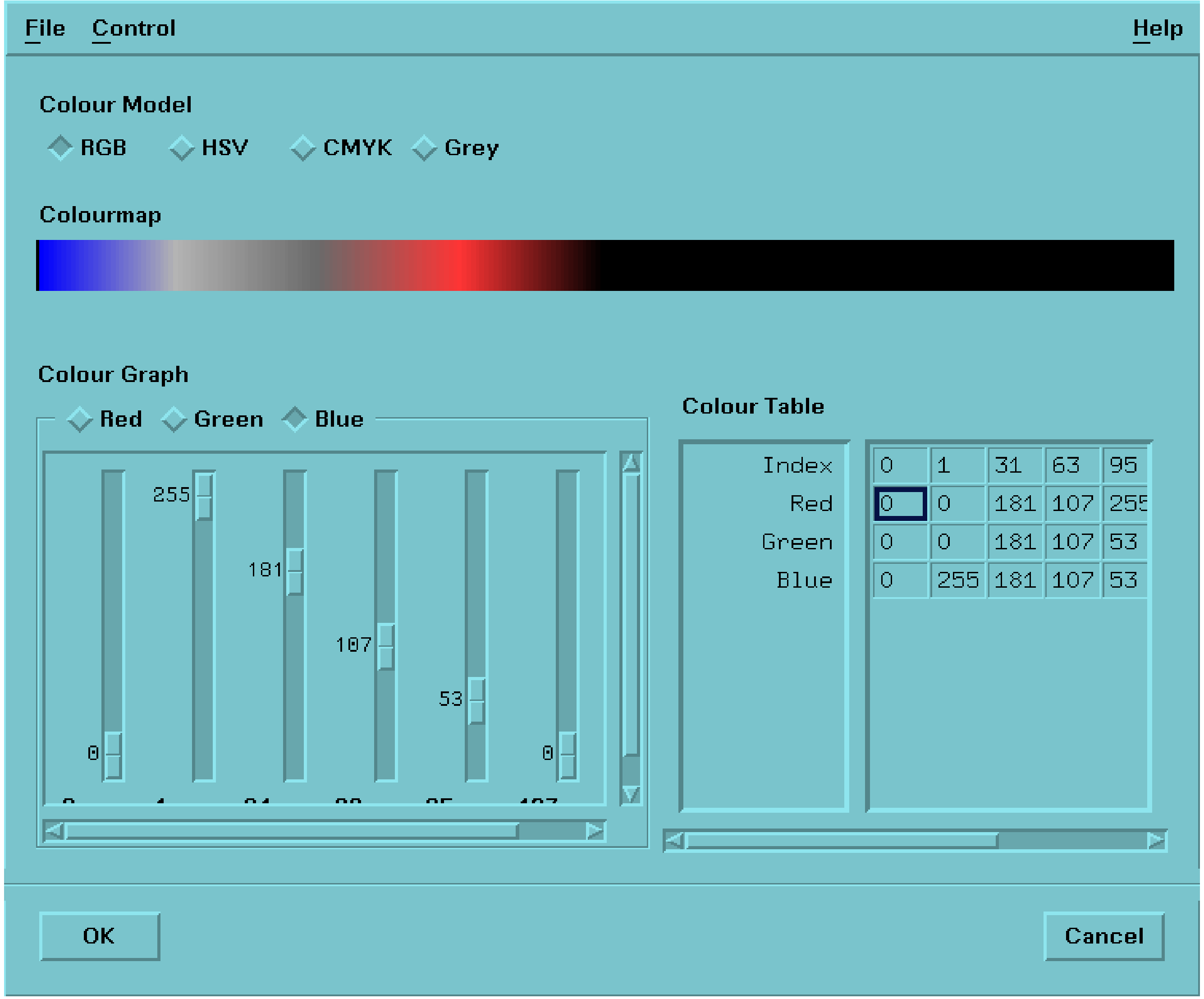
Colour table definition

- Colour tables can be defined images and pseudo images
- Colours can be specified in RBG, HSV, CMYK or as a grey scale
- Colour tables can be edited ad hoc
- Different colour tables can be associated with different frames in an animation

Coloured water vapour image data



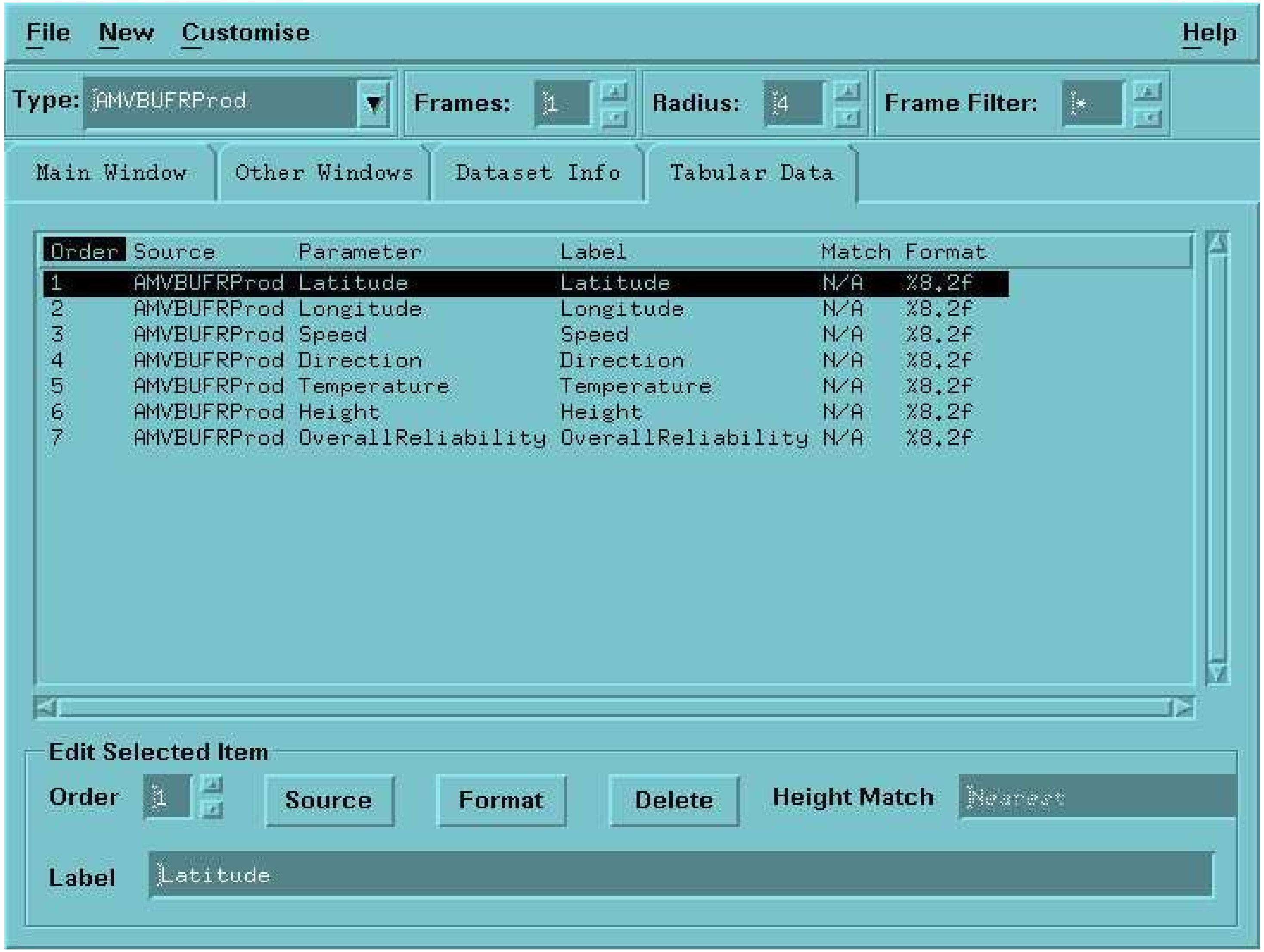
Colour editor for image data



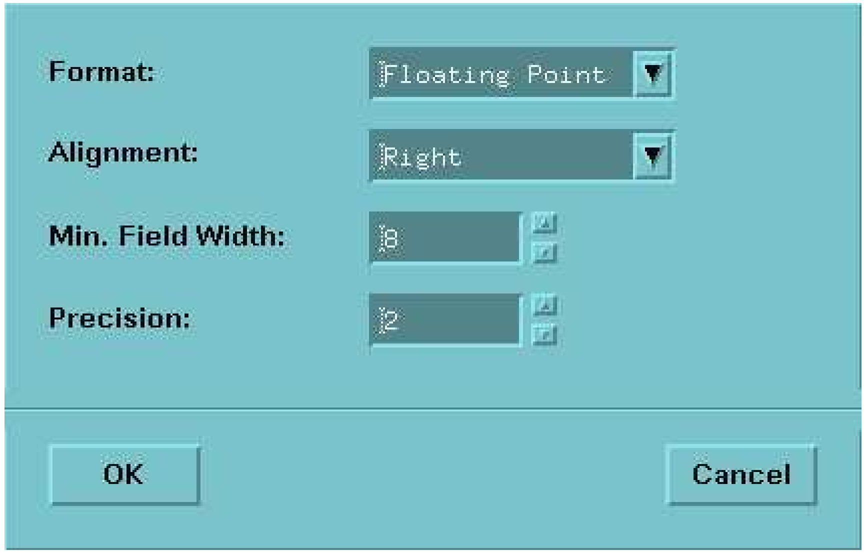
Tabular data display and data set info

- Tabular data are available by clicking on a part of the graphics display
- Information is given for data within a given radius of that point
- Format and content is controlled by the template
- Data set information describes the overall data set
- Content (typically time, number of results) is controlled by the template

Template editor - tabular data tab



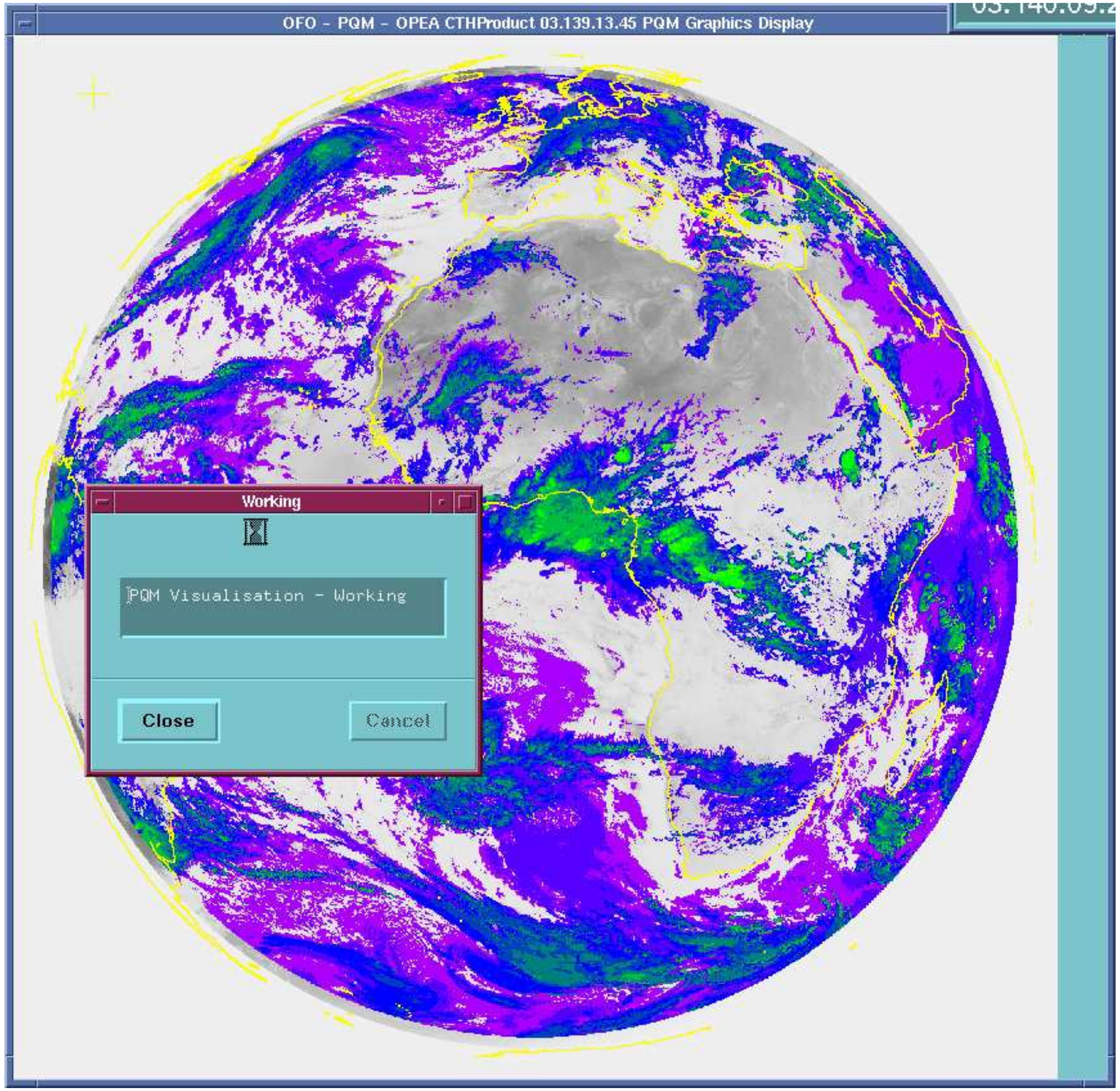
Format editor for tabular data display



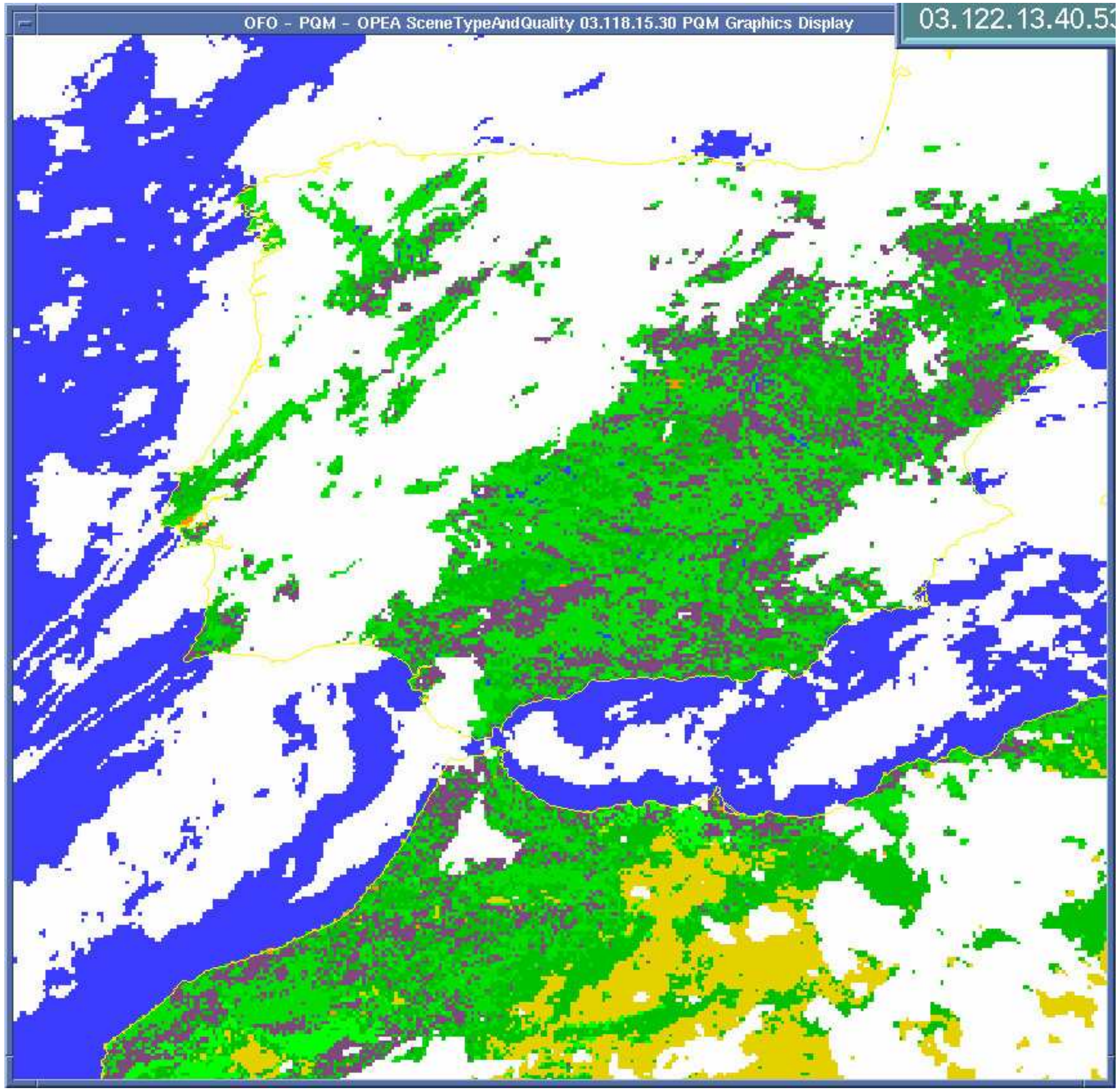
Other image like products

- Some products which are not images are displayed as images
- Cloud top height band
  - 0 - 63 in steps of 300 m
- Scenes type and quality
  - Scene code per pixel defining pixel type (desert, sea, cloud, …)

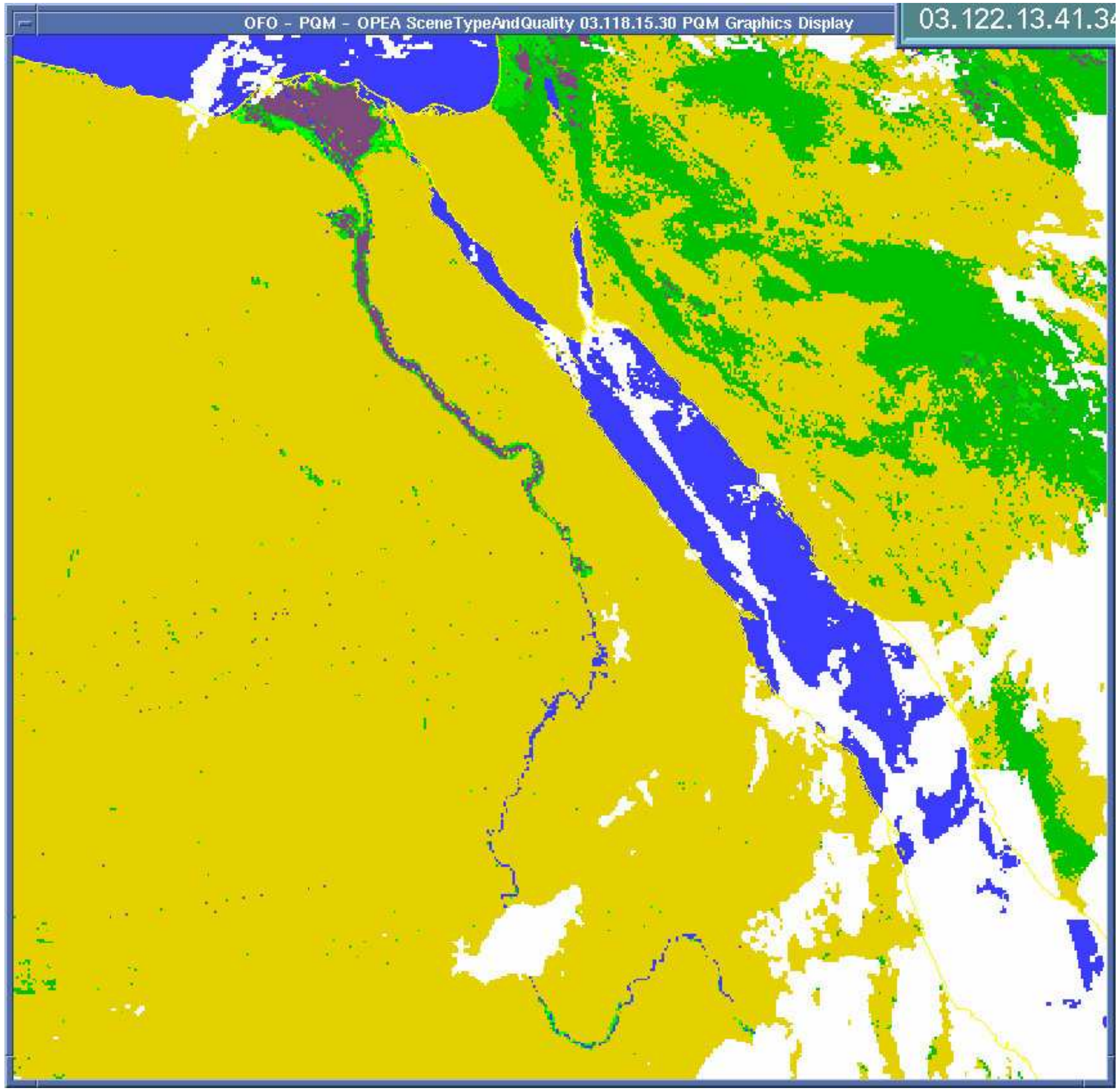
Cloud top height image display



Classified image data (Iberia)



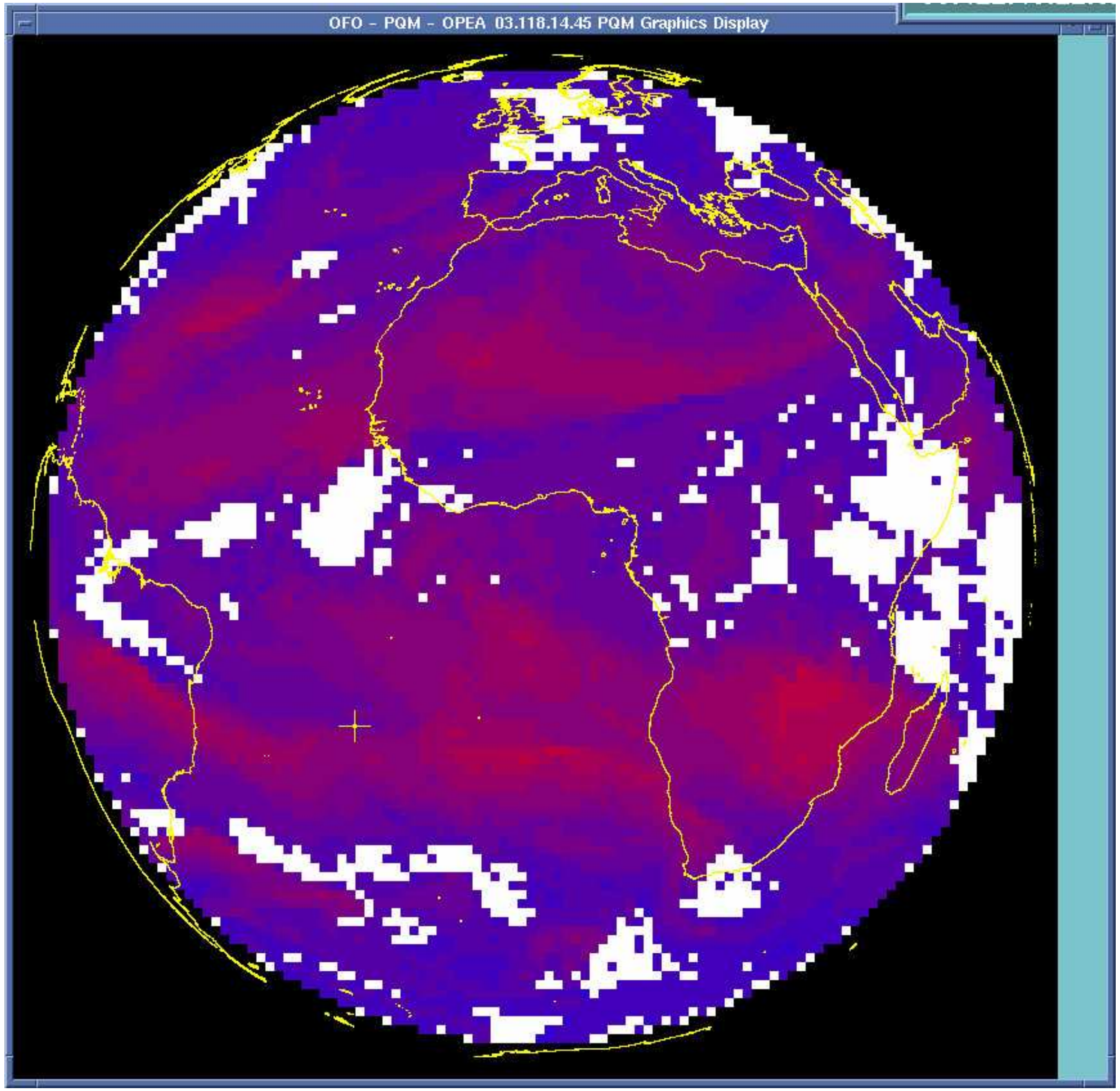
Classified image data (Nile)



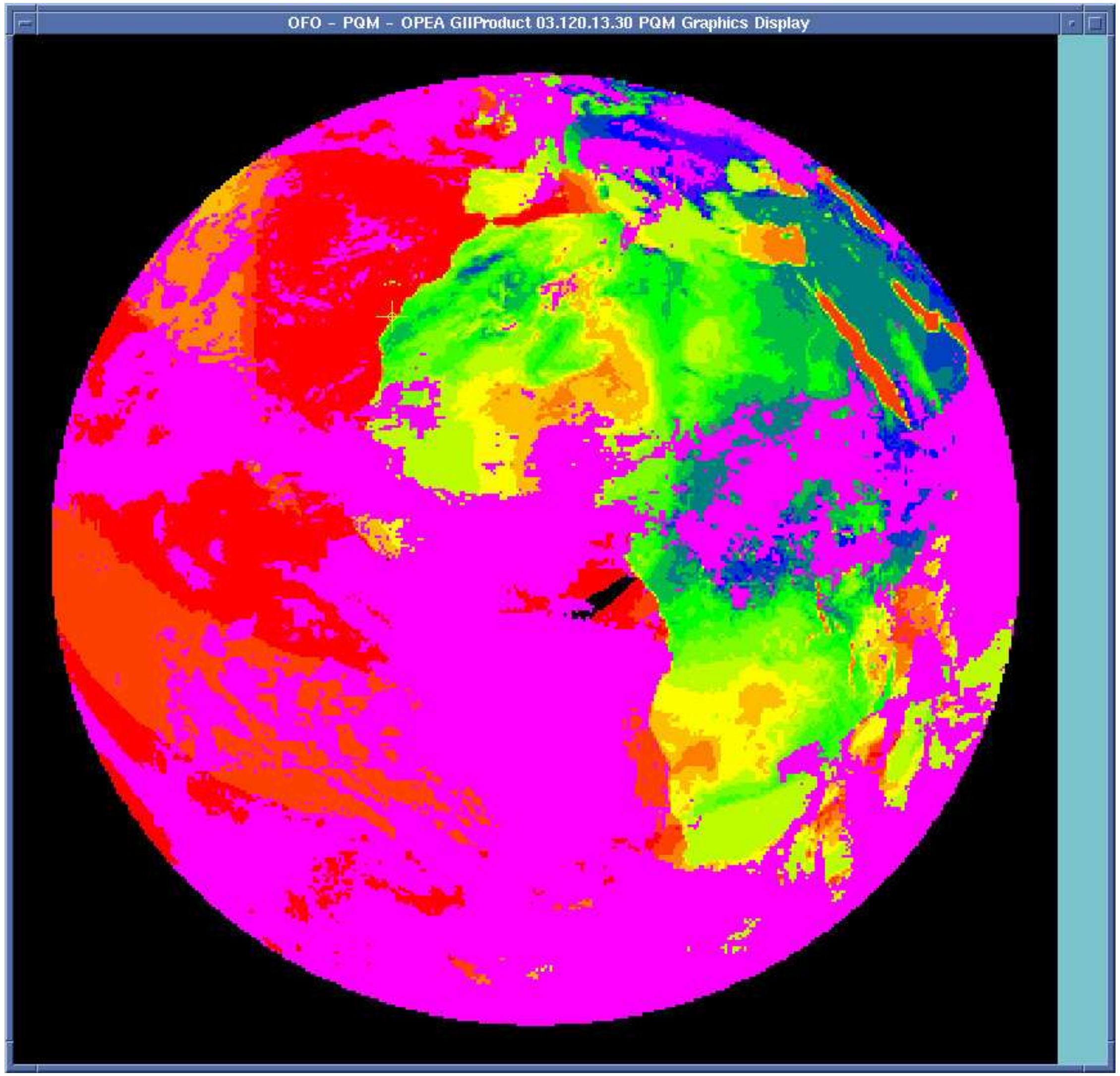
Pseudo image data

- Many products are generated on a segment basis
- Segment size is configurable and varies between products
- Variable transparancy can be used to display image and pseudo image together
- Annotations can be added to each segment
- Segment grid can be overlaid

Clear sky radiance pseudo image display



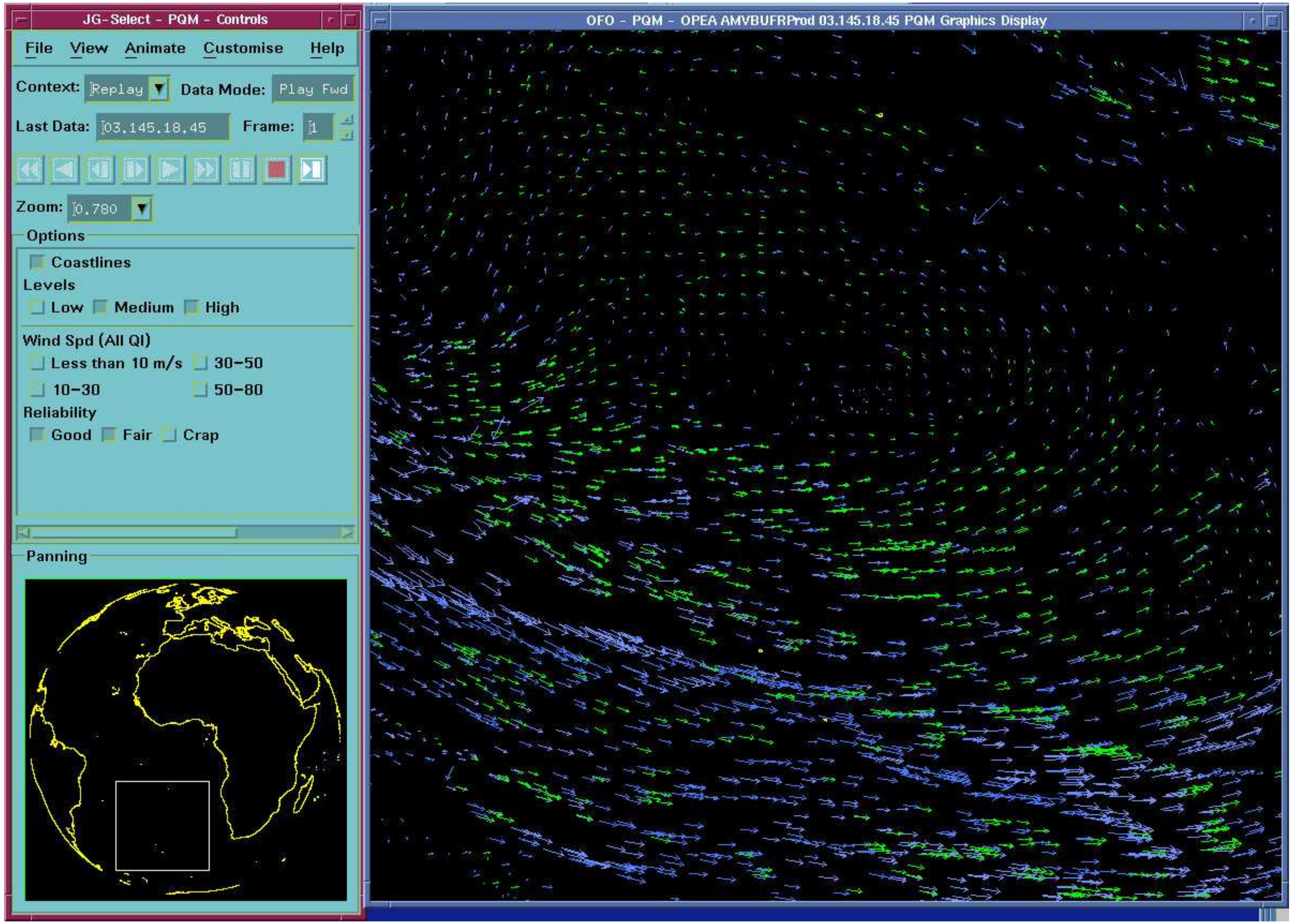
High resolution pseudo image display (MB)



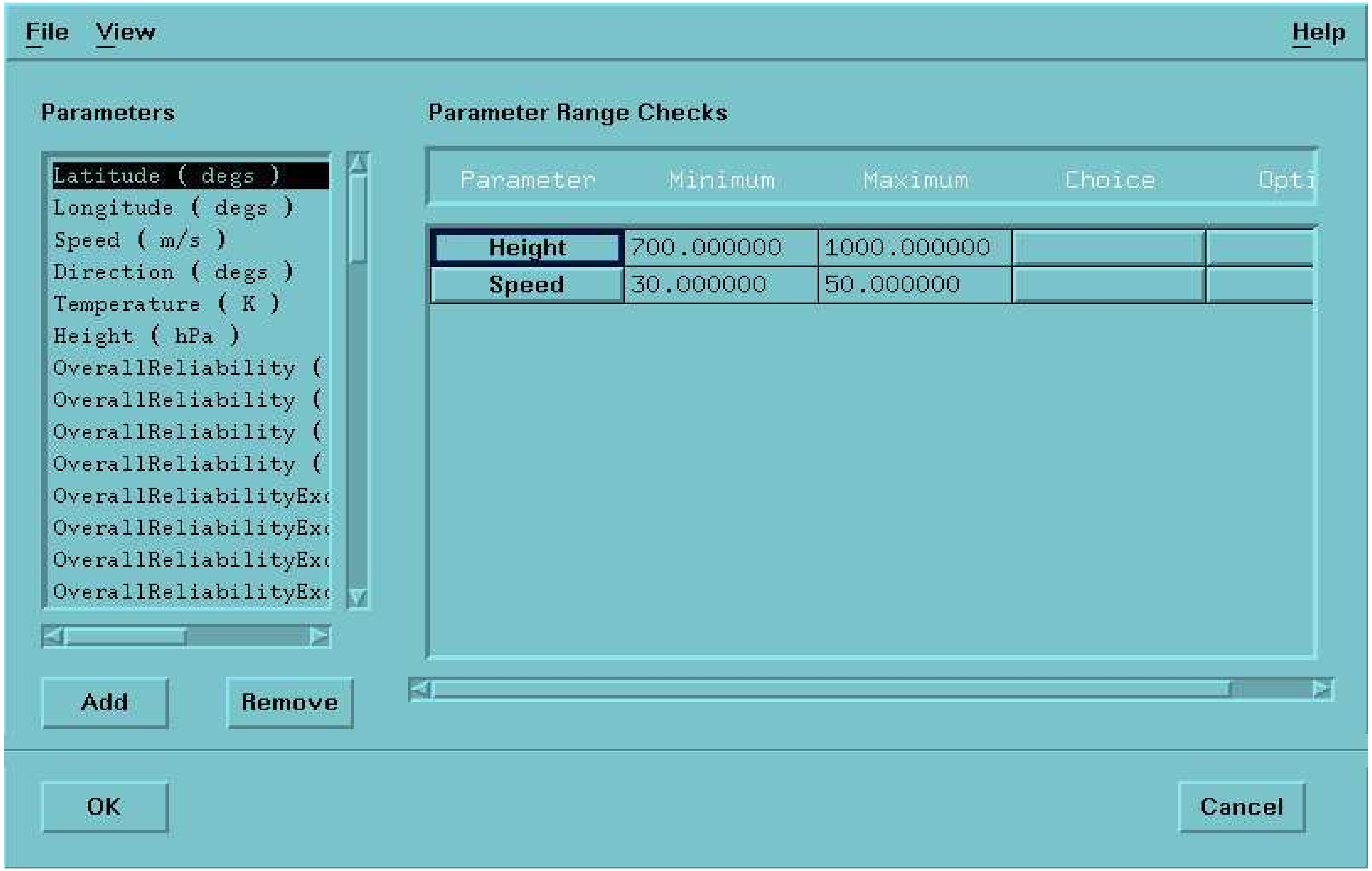
Vector data, animations and filters

- Wind products can be displayed as vectors
  - Vectors can be arrows, lines or feathers
- Animations can be created of images and pseudo images for the same or different times
  - Animations can update automatically as new data arrives
  - Animation rate is configurable
- Filters can be defined
  - Filters can be applied manually to data
  - Filters can apply to all data via the template
  - Filters can be associated with toggles or combo boxes

Wind vectors with control panel



Parameter filter management dialogue



Conclusion

- \+ System is robust and flexible
- \+ All requirements to date have been met, including new products
- ± "Perfect" templates are a tempting target but use up human effort
- – Underlying software (mainly C, some PV-Wave) is very complex
- – Templates are stored in binary format … adding a new control to the template editor means all existing templates must be re-created from scratch.

Canadian Radar Decision Support System

Marie Falla
Meteorological Service of Canada

EGOWS: Outline

- Introduction to the National Radar Project
- Radar Network (Hardware Installs)
- Radar Software Project
  - Software Development Process
  - Technology Transfer - radar science
  - Software Design

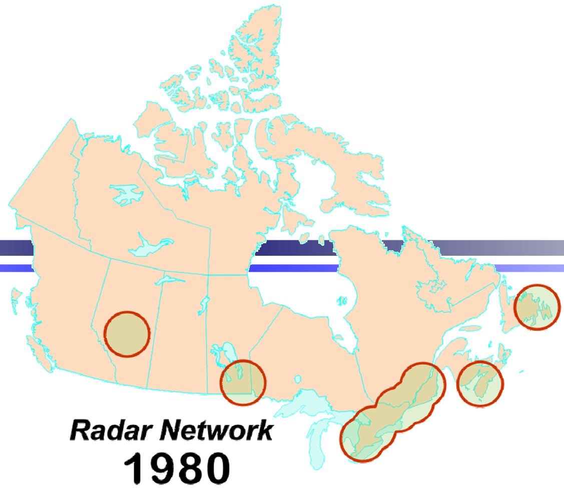
The National Radar Project

- Expanding and upgrading Canadian Weather Radar Network (1997 - 2003)
- Three main components:
  - Total network from 20 to 31 radars: Doppler
  - radar processing software development
  - establish the logistical support to the network

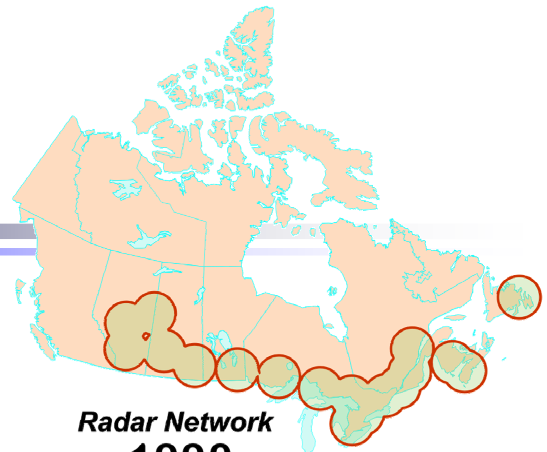
NRP Approach

- In-house design and build of the radar hardware
- In-house design and build of the radar processing software
- Phased approach to both hardware installs and software development releases
- Combine Expertise in MSC National, Regional, and Research Offices and University Researchers

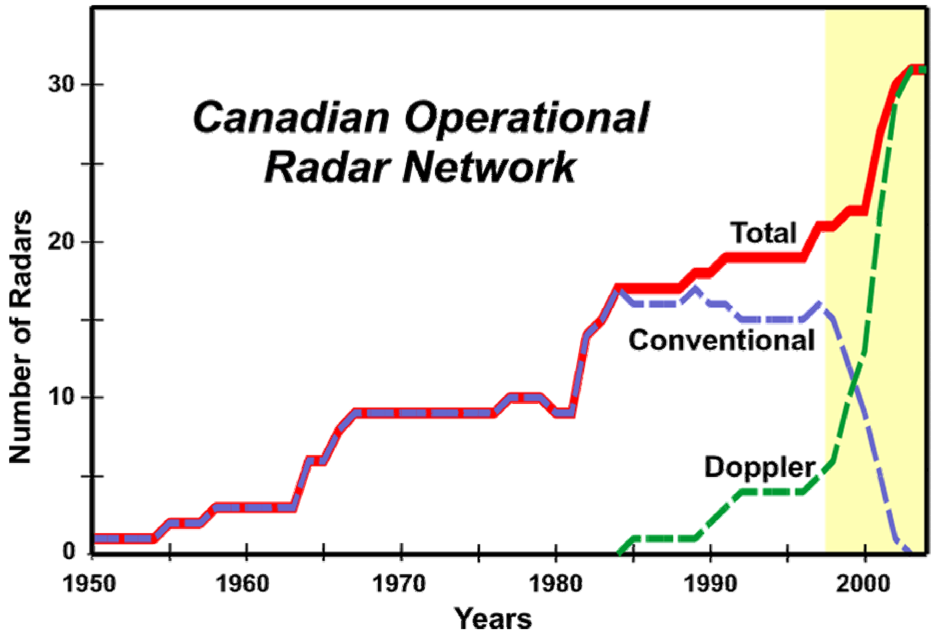
MSC Radar Network Evolution

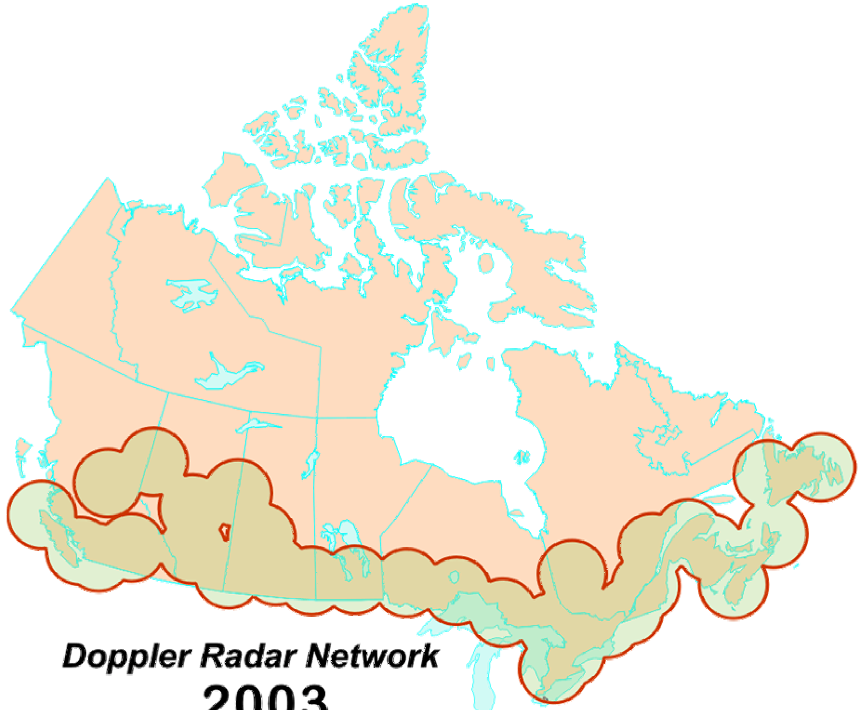


Radar Network
1980



Radar Network
1990





Doppler Radar Network
2003

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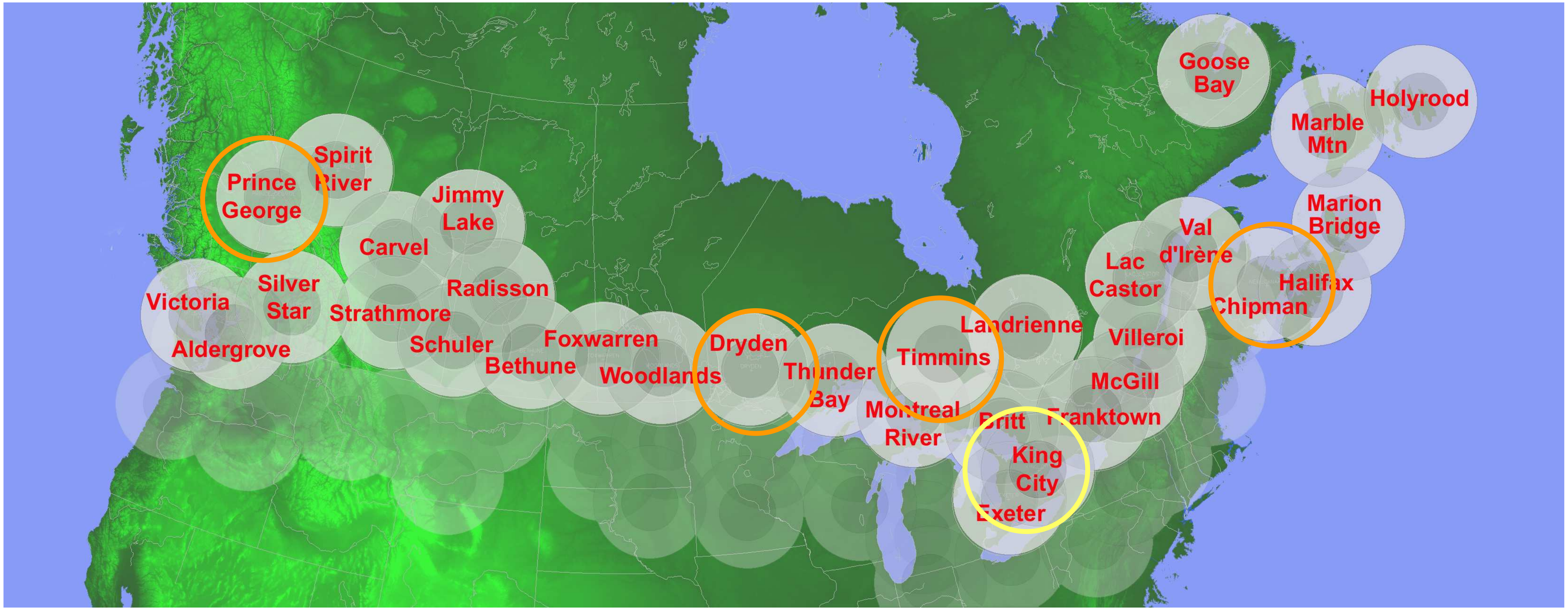
Radar Network



NRP Approach: Hardware

- In-house design and build hardware
  - In-house design based on commercial off the shelf components
  - Integration of components done in-house
  - Multi-year upgrade/install schedule
  - Regional, Research, National expertise utilized

NRP Approach: Software

- In-house design and build software
  - Based on functionality of several existing systems
  - Unify all systems to process radar data both for forecasters and research
  - Iterative multi-year development schedule
  - Regional, Research, National and University expertise utilized
  - Use US data in border areas for upstream info

Software Team

- 1998-current: total of 23 developers
- Largest team size: 7-8
- Regional, Research, National and University expertise utilized

Software Process

- Software Process: Iterative approach with continuous improvement through the release cycle
- Adapt through iteration: Use what works, Improve what works, remove what doesn't work at all
- Software Process started with CMM in mind
- Adapted to include some best practices from other process models

Current Software Process

- Requirements management: User Committee
- Project Planning: Project Plans, Schedules, Tracked and updated regularly
- Configuration Management Plan: Source code, documents under CM. Release Management Versioning through CM tool.
- QA Plan: Defect Tracking, Reviews: Technical and User, Unit, Integration and System Testing.

Key Process Areas

- User Committee: Users define the requirements
- Technical Reviews: Peer Reviews
- User Reviews: Users comment on software **before** release
- Iterative development

Technology Transfer

- Designed so that researchers, forecasters, developers use the same system (not "reinvent the wheel")
- Modular Design: batch mode (Production)/series mode (standalone)
- Encapsulate Software Infrastructure: allow for addition of science without fundamental changes to software as a whole (Module Template/Module Algorithm)

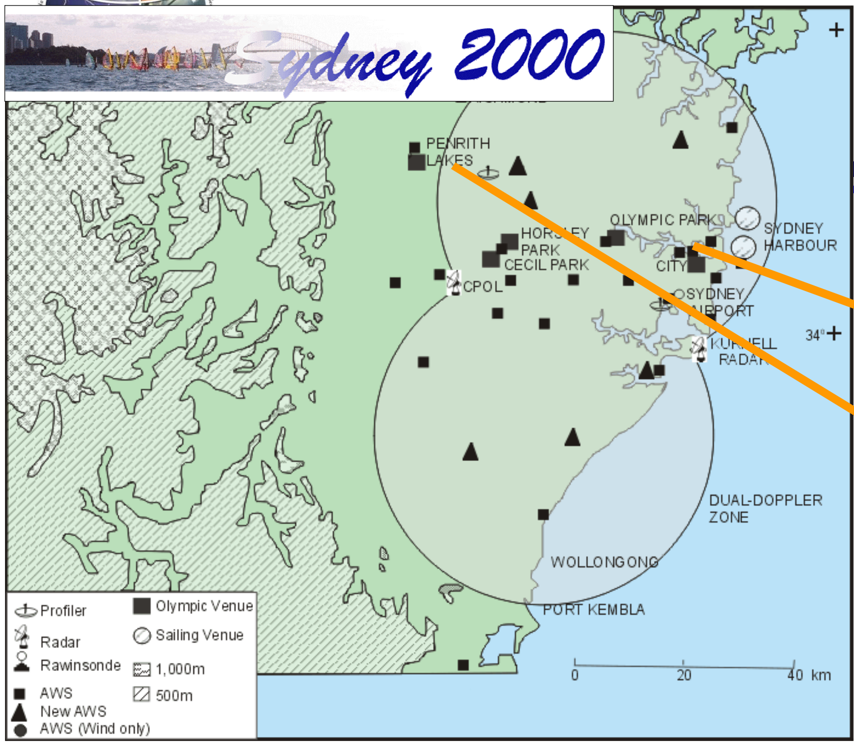
Technology Transfer

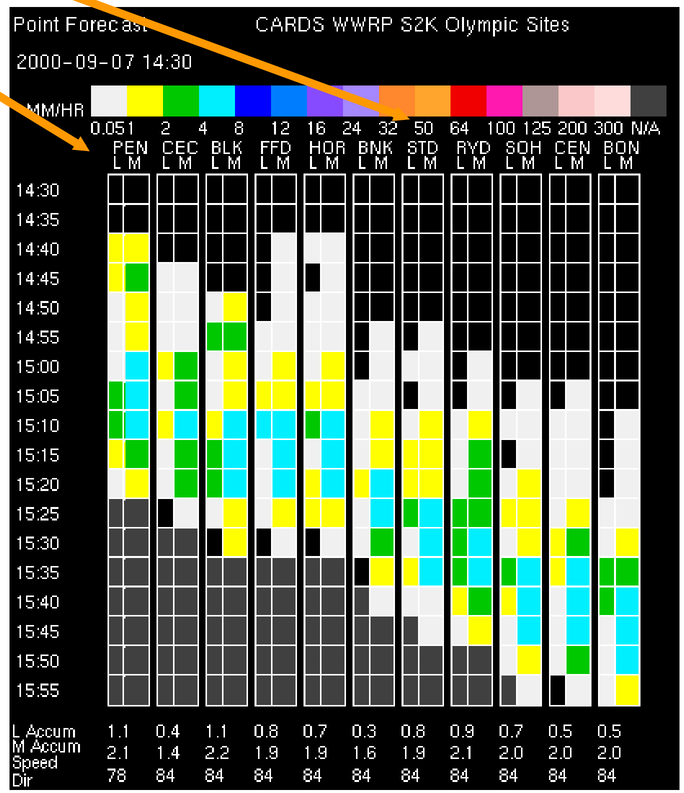
- HPUX/Linux portability from the beginning: Code and Data
- Linux Systems/Product Developers Kit: opens up development
- Affordable development systems lead to more development/research within the same framework

Benefits

- Faster time to "market": from conception to prototyping to real world use
- Adaptability of software: flexibility of software allowed for mitigation of shifting requirements and undefined requirements fulfillment
- Extended use: field projects, research verification, additions of components while retaining previous modules

CARDS and Field Projects





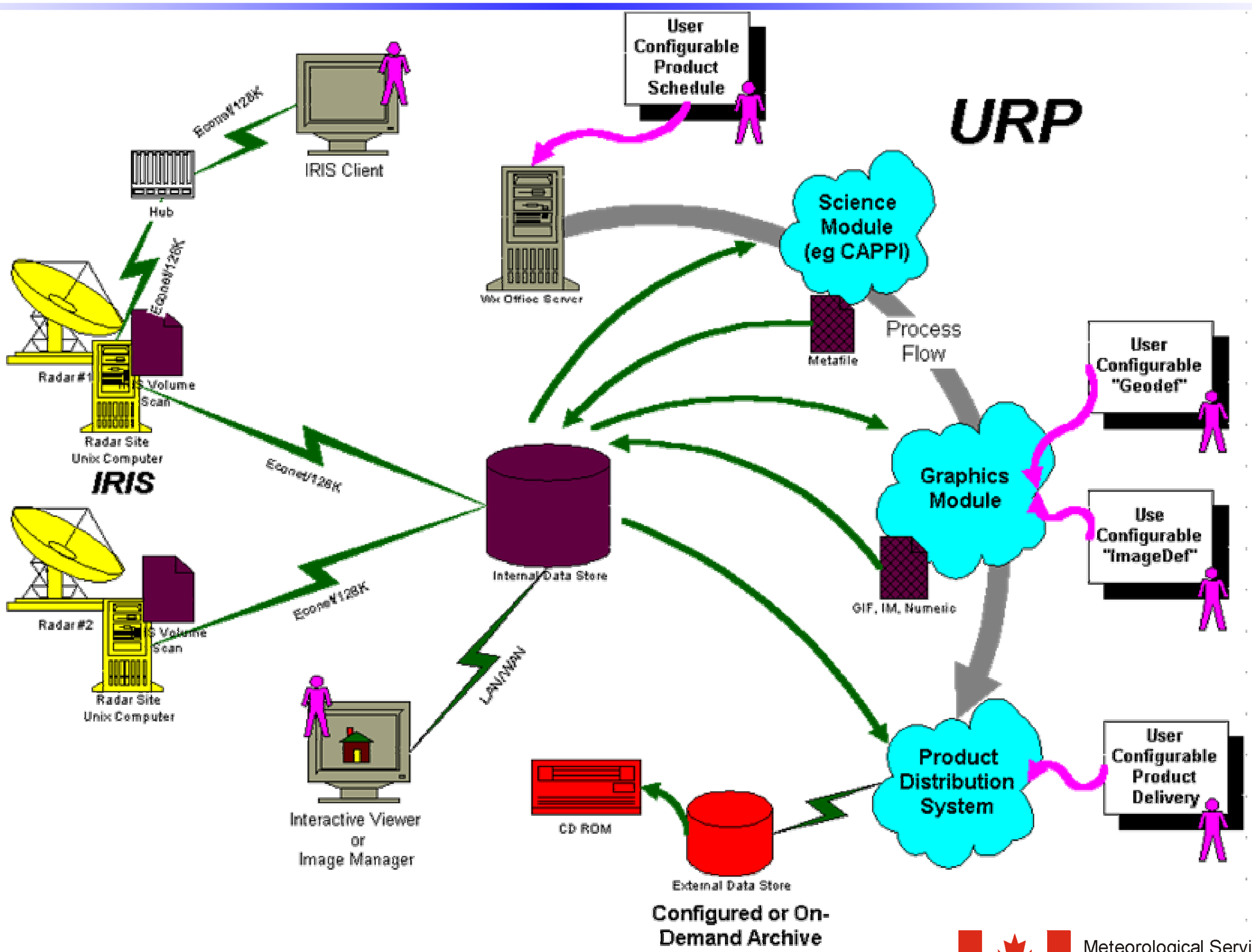
Radar Software: CARDS

- An in-house evolving software development
- Based on several existing radar processing systems: King City radar (various flavours), RDP, McGill
- Design Team started Jan. 1998
- First Release 0.9 for Bethune Radar install, Sept. 1998
- Current Version “CARDS” (aka URP/IV)

The Technology

- Radar Processing Server
  - Written in C
  - Linux "clusters" in operational use
    - Front end Dual CPU
    - 2 - 3 Backend Dual CPU
    - scripting jobs utilizes the backend nodes
- Client Viewer
  - Written in Java
  - Dual Headed Linux Workstation in operational use

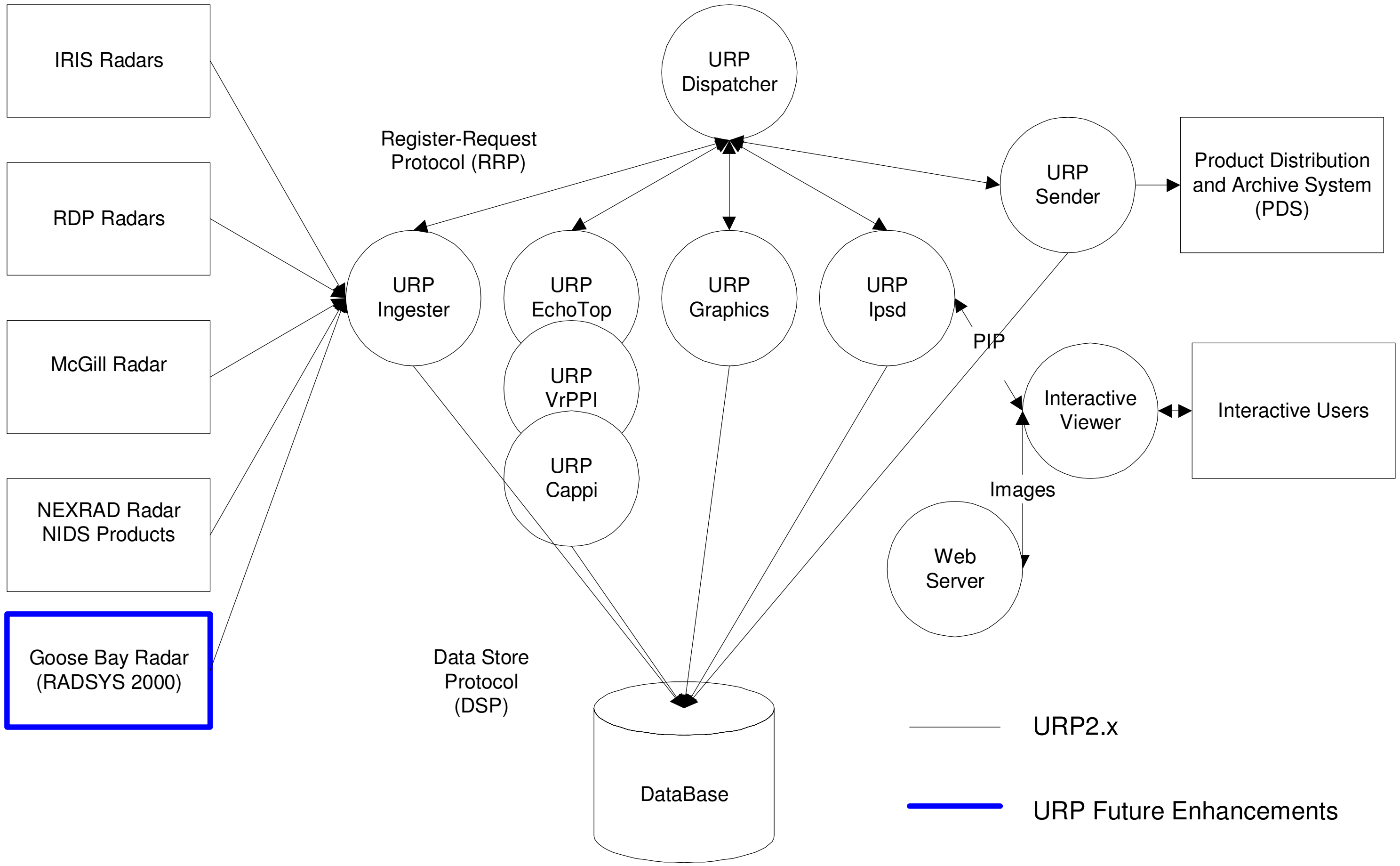
Processing Software



Radar Processing Server

- All products created on the server
- Production Schedule
  - Products scheduled for creation
- Geographic Definition
  - Geographic Area of a product defined
- Image/Numeric Definition
  - Layout of an image or numeric data file defined

Design



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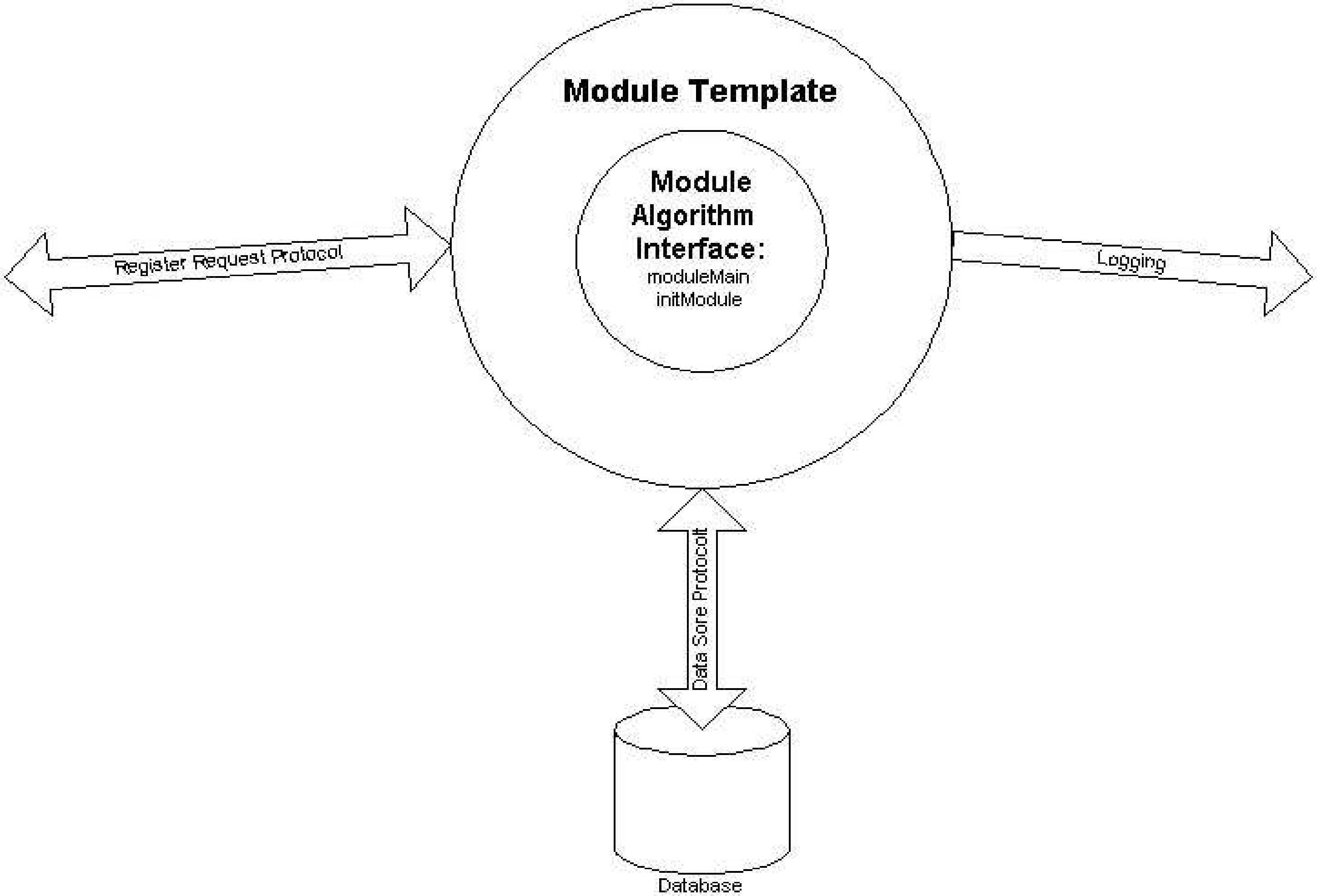
Module Template/Module Algorithm

- Module Template
  - Access to Infrastructure
  - Changes to the infrastructure do not affect the algorithms
- Module Algorithm
  - Processing of data and production of products
- Supporting APIs:
  - Radar Data Decode
  - Projection libraries
  - “Metafile” Decode

Modular Design



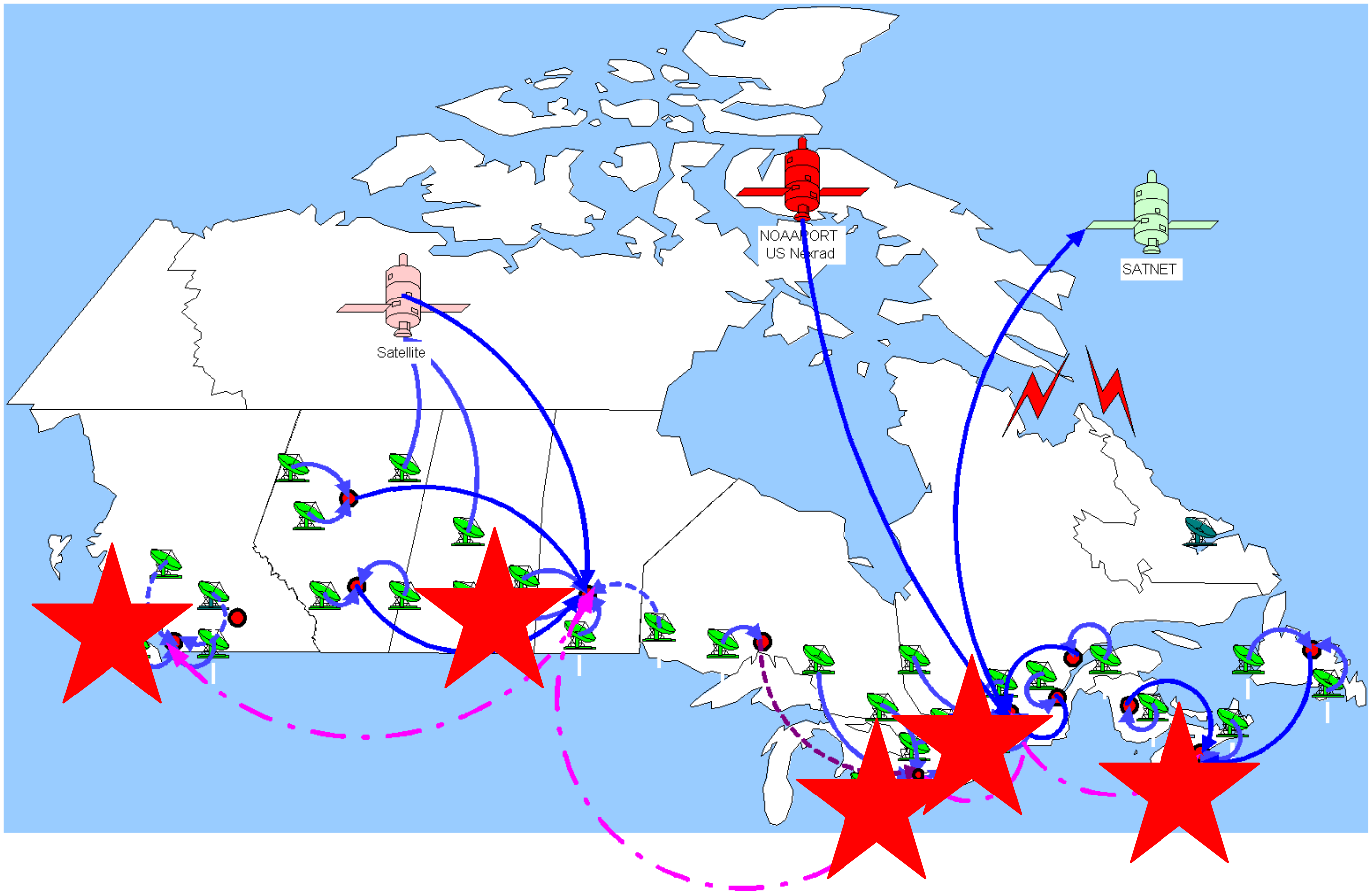
Client Viewer

- All products created on server
- Client displays “multi-layer” products (GIF images or XML based“cell” data)
  - “Cell” data displayed/linked on image or in text table
- Client tools include:
  - Zoom/Pan
  - Drawing tools
  - Extrapolator
  - Interactive Cross Section request to server
  - “Drill Down” requests to server

Current Version: Severe Weather Requirement

- Large Forecast Areas
- One forecaster monitors 5 to 10 Radars
- Area example: 3 x 10^6 km sq.
- Assess severity of local storms on the order of a few kms wide

The Canadian Warning Offices



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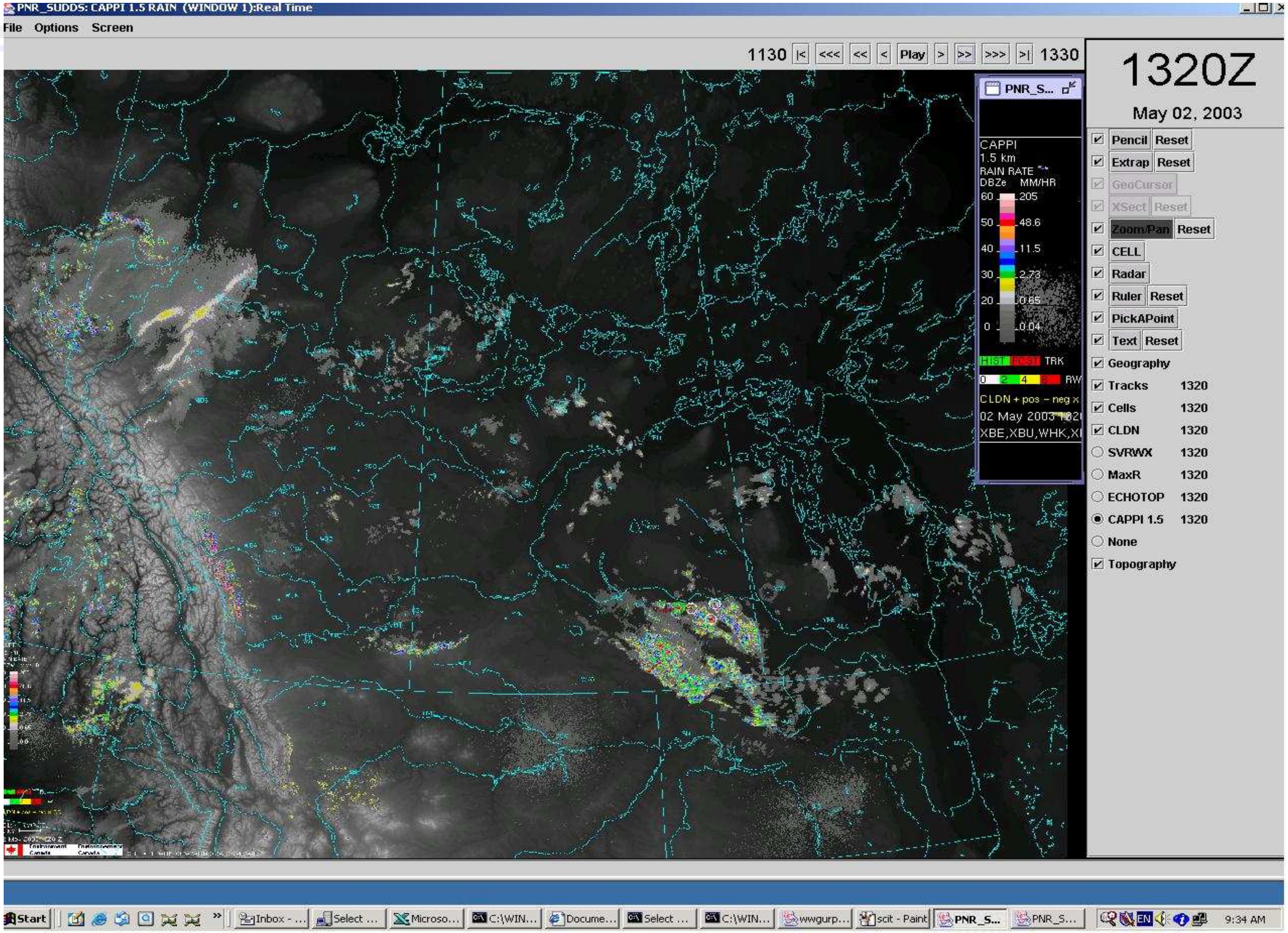
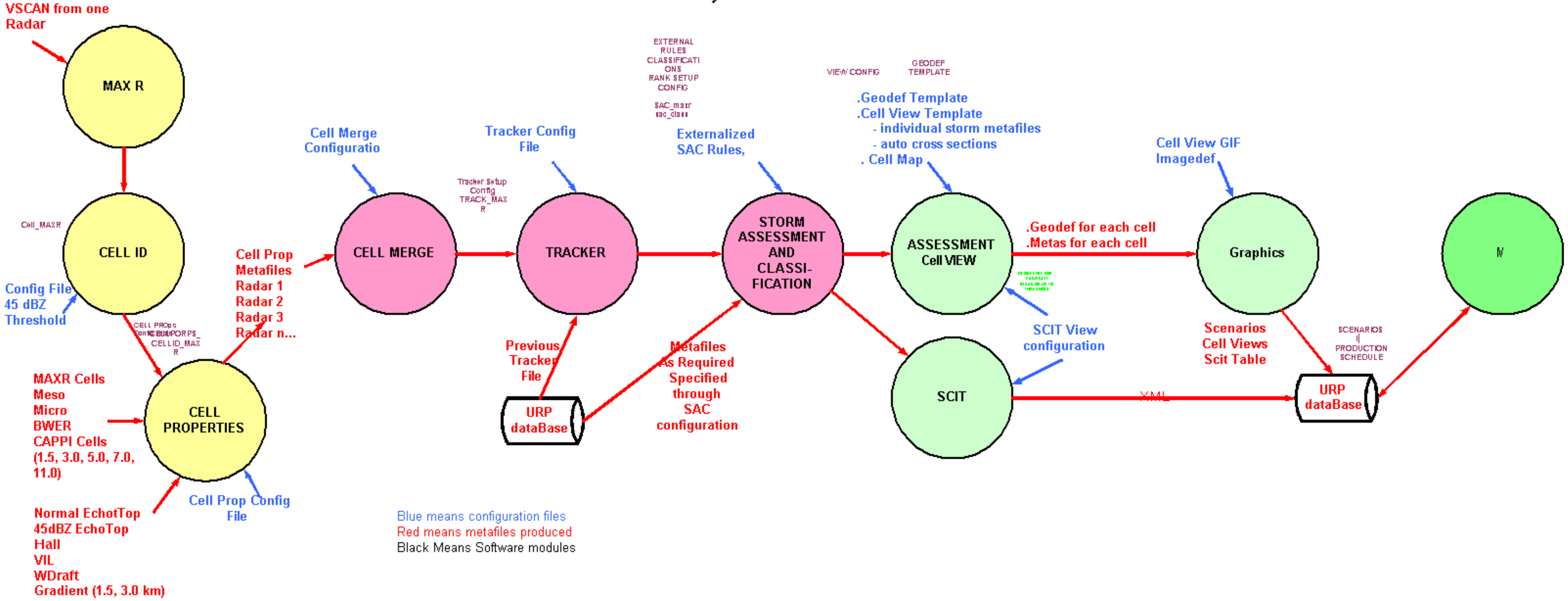
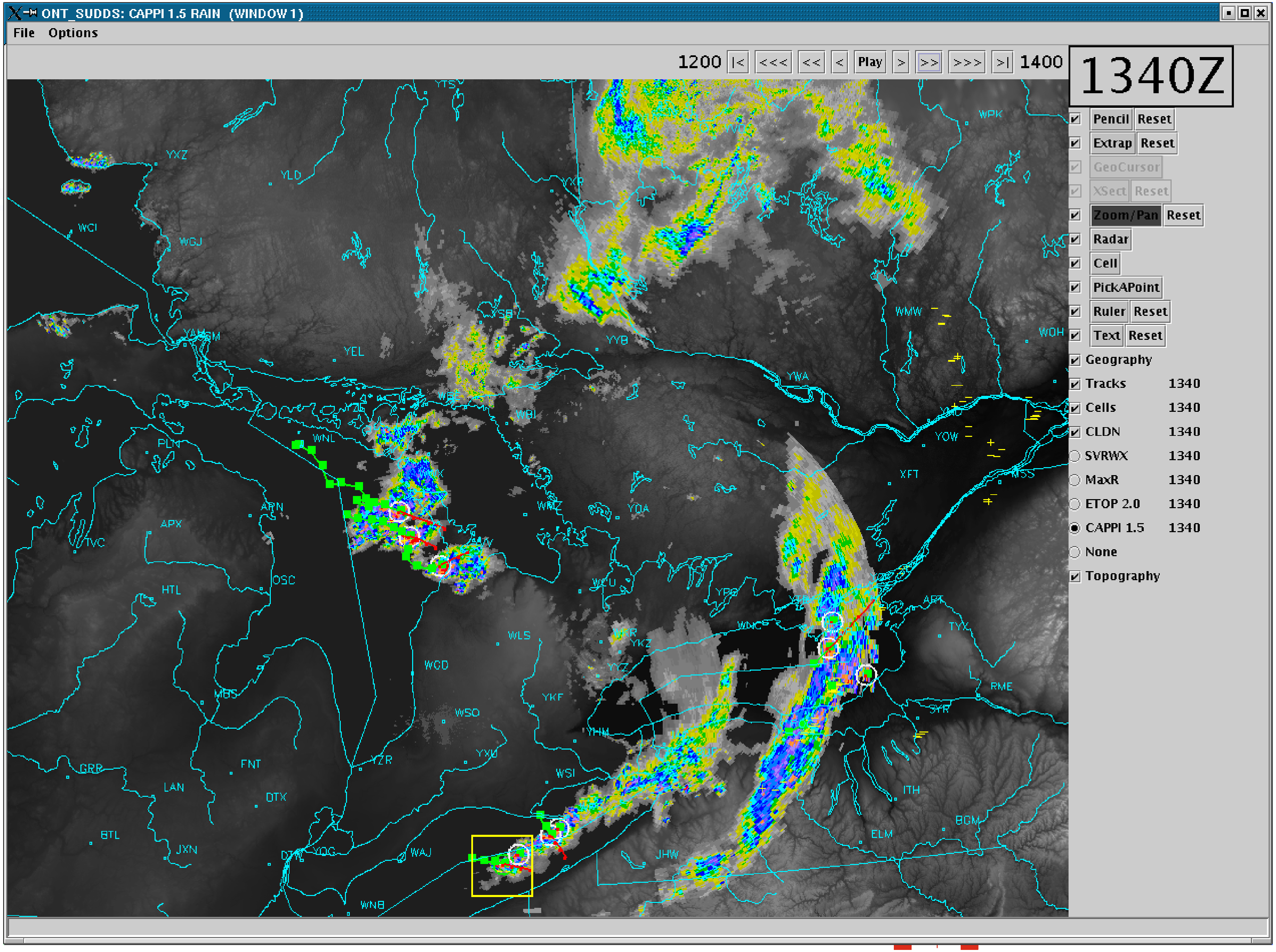
Large Scale Composite



Cell Processing

URP Cell Identification, Classification Production

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File
Options
1200
Play
1400
1340Z
Pencil
Reset
Extrap
Reset
GeoCursor
XSect
Reset
Zoom/Pan
Reset
Radar
Cell
PickAPoint
Ruler
Reset
Text
Reset
Geography
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Cells 1340
CLDN 1340
SVRWX 1340
MaxR 1340
ETOP 2.0 1340
CAPPI 1.5 1340
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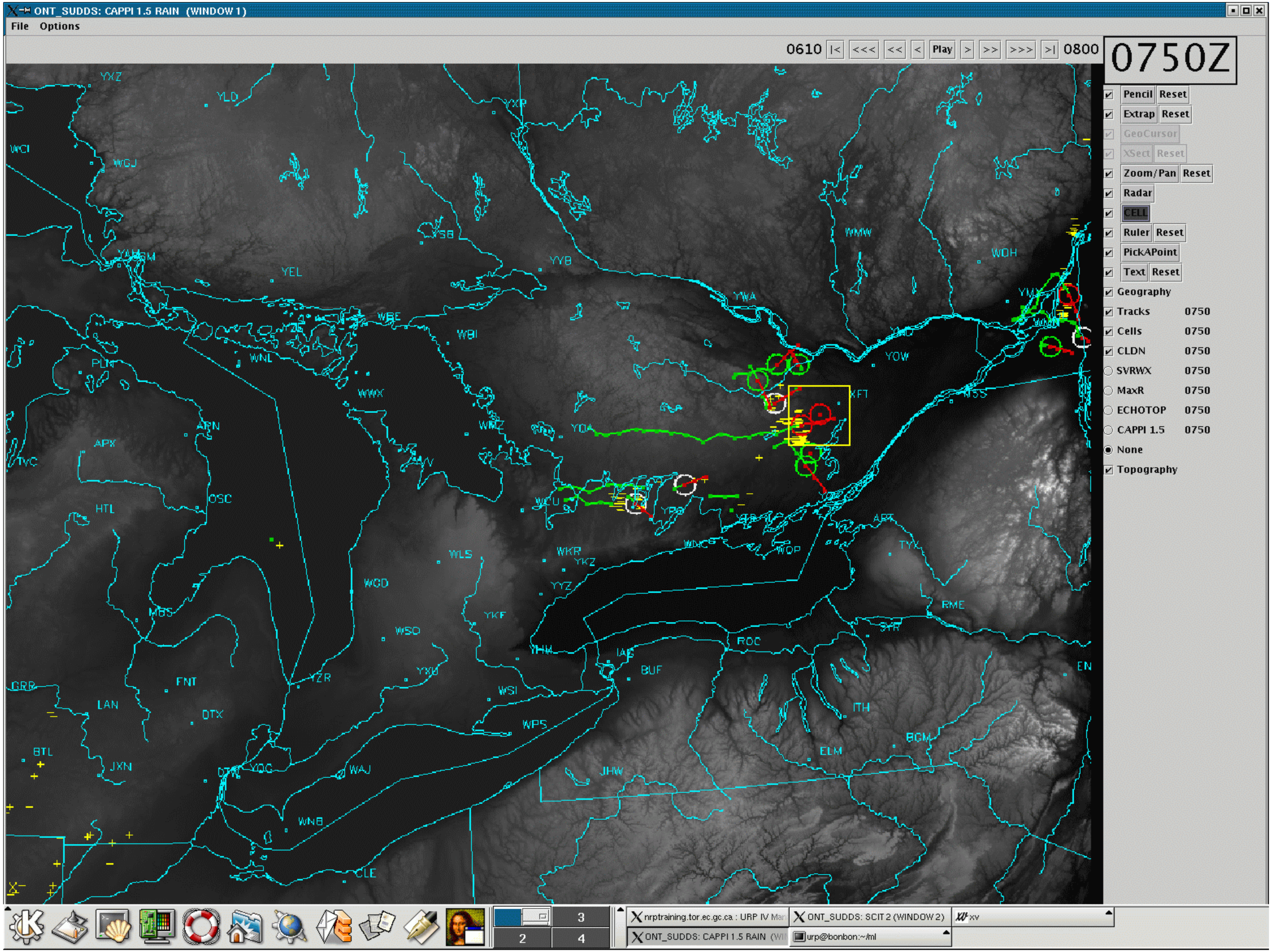
Topography


ONT_SUDDS: CAPPI 1.5 RAIN (WINDOW 1)
File Options
0610 |< <<< << < Play > >> >>> >| 0800
0750Z
Pencil Reset
Extrap Reset
GeoCursor
XSect Reset
Zoom/Pan Reset
Radar
CELL
Ruler Reset
PickAPoint
Text Reset
Geography
Tracks 0750
Cells 0750
CLDN 0750
SVRWX 0750
MaxR 0750
ECHOTOP 0750
CAPPI 1.5 0750
None
Topography
nrptraining.tor.ec.gc.ca : URP IV Mar
ONT_SUDDS: SCIT 2 (WINDOW 2)
ONT_SUDDS: CAPPI 1.5 RAIN
urp@bonbon:~/ml

SCIT

PNR_SUDDS: SCIT 2 (WINDOW 2)

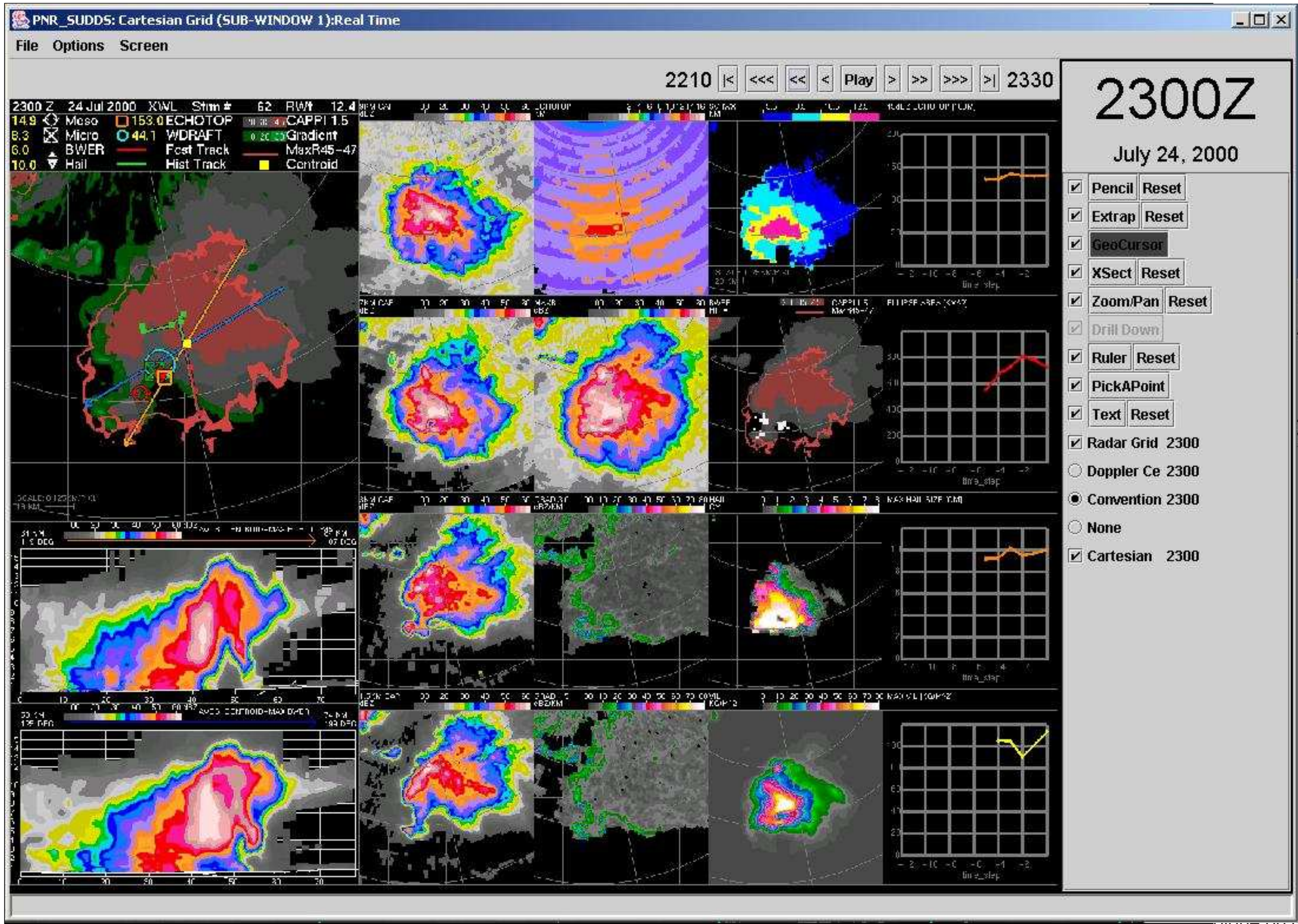
Screen

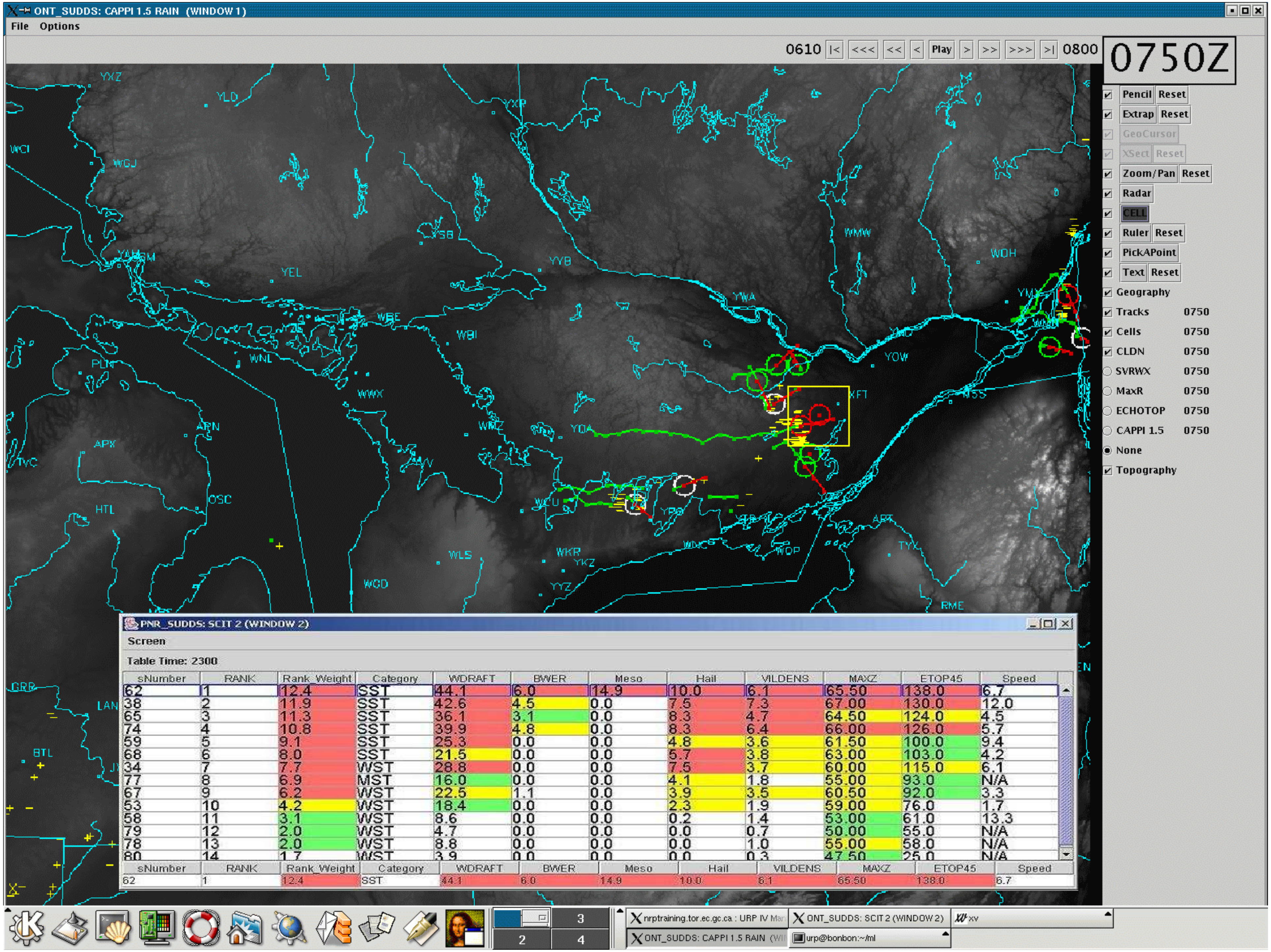
Table Time: 2300

sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7
38	2	11.9	SST	42.6	4.5	0.0	7.5	7.3	67.00	130.0	12.0
65	3	11.3	SST	36.1	3.1	0.0	8.3	4.7	64.50	124.0	4.5
74	4	10.8	SST	39.9	4.8	0.0	8.3	6.4	66.00	126.0	5.7
59	5	9.1	SST	25.3	0.0	0.0	4.8	3.6	61.50	100.0	9.4
68	6	8.0	SST	21.5	0.0	0.0	5.7	3.8	63.00	103.0	4.2
34	7	7.7	WST	28.8	0.0	0.0	7.5	3.7	60.00	115.0	6.1
77	8	6.9	MST	16.0	0.0	0.0	4.1	1.8	55.00	93.0	N/A
67	9	6.2	WST	22.5	1.1	0.0	3.9	3.5	60.50	92.0	3.3
53	10	4.2	WST	18.4	0.0	0.0	2.3	1.9	59.00	76.0	1.7
58	11	3.1	WST	8.6	0.0	0.0	0.2	1.4	53.00	61.0	13.3
79	12	2.0	WST	4.7	0.0	0.0	0.0	0.7	50.00	55.0	N/A
78	13	2.0	WST	8.8	0.0	0.0	0.0	1.0	55.00	58.0	N/A
80	14	1.7	WST	3.9	0.0	0.0	0.0	0.3	47.50	25.0	N/A

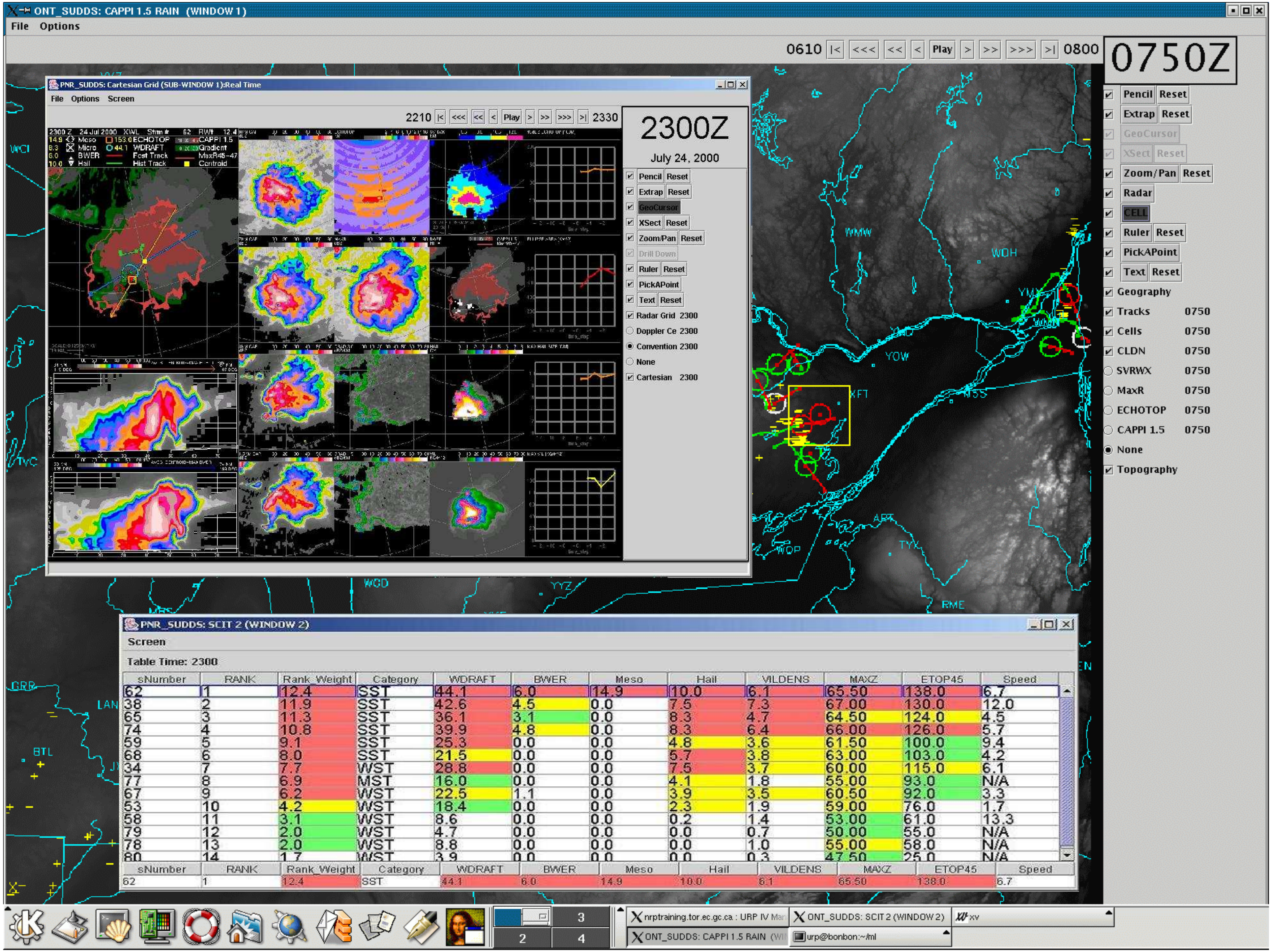
sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7

Single Cell Products





sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7
38	2	11.9	SST	42.6	4.5	0.0	7.5	7.3	67.00	130.0	12.0
65	3	11.3	SST	36.1	3.1	0.0	8.3	4.7	64.50	124.0	4.5
74	4	10.8	SST	39.9	4.8	0.0	8.3	6.4	66.00	126.0	5.7
59	5	9.1	SST	25.3	0.0	0.0	4.8	3.6	61.50	100.0	9.4
68	6	8.0	SST	21.5	0.0	0.0	5.7	3.8	63.00	103.0	4.2
34	7	7.7	WST	28.8	0.0	0.0	7.5	3.7	60.00	115.0	6.1
77	8	6.9	MST	16.0	0.0	0.0	4.1	1.8	55.00	93.0	N/A
67	9	6.2	WST	22.5	1.1	0.0	3.9	3.5	60.50	92.0	3.3
53	10	4.2	WST	18.4	0.0	0.0	2.3	1.9	59.00	76.0	1.7
58	11	3.1	WST	8.6	0.0	0.0	0.2	1.4	53.00	61.0	13.3
79	12	2.0	WST	4.7	0.0	0.0	0.0	0.7	50.00	55.0	N/A
78	13	2.0	WST	8.8	0.0	0.0	0.0	1.0	55.00	58.0	N/A
80	14	1.7	WST	3.9	0.0	0.0	0.0	0.3	47.50	25.0	N/A
sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7


ONT_SUDDS: CAPPI 1.5 RAIN (WINDOW 1)
File Options
0610 Play 0800
0750Z
Pencil Reset
Extrap Reset
GeoCursor
XSect Reset
Zoom/Pan Reset
Radar
CELL
Ruler Reset
PickAPoint
Text Reset
Geography
Tracks 0750
Cells 0750
CLDN 0750
SVRWX 0750
MaxR 0750
ECHOTOP 0750
CAPPI 1.5 0750
None
Topography
PNR_SUDDS: Cartesian Grid (SUB-WINDOW 1):Real Time
File Options Screen
2210 Play 2330
2300Z
July 24, 2000
Pencil Reset
Extrap Reset
GeoCursor
XSect Reset
Zoom/Pan Reset
Drill Down
Ruler Reset
PickAPoint
Text Reset
Radar Grid 2300
Doppler Ce 2300
Convention 2300
None
Cartesian 2300
WMW
WOH
YOW
XFT
NSS
ARX
TYX
WOP
RME
WGD
YYZ
WCI
TVC
GRR
LAN
BTL
PNR_SUDDS: SCIT 2 (WINDOW 2)
Screen
Table Time: 2300
sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7
38	2	11.9	SST	42.6	4.5	0.0	7.5	7.3	67.00	130.0	12.0
65	3	11.3	SST	36.1	3.1	0.0	8.3	4.7	64.50	124.0	4.5
74	4	10.8	SST	39.9	4.8	0.0	8.3	6.4	66.00	126.0	5.7
59	5	9.1	SST	25.3	0.0	0.0	4.8	3.6	61.50	100.0	9.4
68	6	8.0	SST	21.5	0.0	0.0	5.7	3.8	63.00	103.0	4.2
34	7	7.7	WST	28.8	0.0	0.0	7.5	3.7	60.00	115.0	6.1
77	8	6.9	MST	16.0	0.0	0.0	4.1	1.8	55.00	93.0	N/A
67	9	6.2	WST	22.5	1.1	0.0	3.9	3.5	60.50	92.0	3.3
53	10	4.2	WST	18.4	0.0	0.0	2.3	1.9	59.00	76.0	1.7
58	11	3.1	WST	8.6	0.0	0.0	0.2	1.4	53.00	61.0	13.3
79	12	2.0	WST	4.7	0.0	0.0	0.0	0.7	50.00	55.0	N/A
78	13	2.0	WST	8.8	0.0	0.0	0.0	1.0	55.00	58.0	N/A
80	14	1.7	WST	3.9	0.0	0.0	0.0	0.3	47.50	25.0	N/A
sNumber	RANK	Rank_Weight	Category	WDRAFT	BWER	Meso	Hail	VILDENS	MAXZ	ETOP45	Speed
62	1	12.4	SST	44.1	6.0	14.9	10.0	6.1	65.50	138.0	6.7
nrptraining.tor.ec.gc.ca : URP IV Mar
ONT_SUDDS: SCIT 2 (WINDOW 2)
xv
ONT_SUDDS: CAPPI 1.5 RAIN (WI
urp@bonbon:~/ml

CARDS Demonstration

- Demo of the “Canadian Radar Decision Support” System
  - Tuesday

Papers

- Joe, Paul, and Steve Lapczak, 2002: “Evolution of the Canadian Operational Radar Network”
- Lapczak, Steve, et al, 1999: “The Canadian National Radar Project”
- Joe Paul, et al, 2002: “Radar Data Processing for Severe Weather in the National Radar Project of Canada”

The Irish Meteorological Service

XCHARTS

An X-Application for the Display of NWP Products at Met Éireann (Irish Meteorological Service)

(James Hamilton -- Met Éireann)

MET éireann

NEED FOR AN INTERACTIVE DISPLAY SYSTEM

Many Sources of Data Available to Forecaster

- NWP Products : Hirlam, ECMWF, UKMO, DWD
- Raw NWP data and derived products
- [Ocean] Wave Models : Met-Éireann, ECMWF, UKMO
- Satellite Data [PDUS for Meteosat]
- Weather Radar [Dublin and Shannon]

NEED FOR AN INTERACTIVE DISPLAY SYSTEM

Forecaster has Many Option to Display Data

- Selection of products depending on weather situation
- Overlay of charts
- Overlay of charts and satellite data
- Animation
- Vertical Cross Sections
- Observations
- Derived products [Difference charts /Thickness charts]

OVERVIEW OF XCHARTS

Hardware and Software Systems

- Runs on SGI Workstation or Linux PC [RedHat]
- Can display on X-terminal [e.g. PC]
- Written in C / Fortran-77 / X / Motif

Evolved from earlier system called CHARTS [1982]

- Display of NWP Products
- Command Driven Interface
- Charts generated as needed
- All possible charts allowed

The Irish Meteorological Service

CHARTS : Command driven interactive system [1982]

Application

- Used by forecasters to display NWP products

Hardware

- DEC-2050 Mainframe, Graphics VDU [VT-340]
- Hardcopy Unit [Canon laser printer]

Software

- Command processor / Interactive Interrogation system
- User friendly command recognition / Abbreviation

Example

- COMMAND : Plot 3day ecmwf surface pressure

MET éireann

Migration of CHARTS to XCHARTS [X-Windows]

Hardware and Software

- SGI-workstation of Linux-PC
- System uses X-Windows / Motif
- Fortran-77 / C
- Code is written directly [no 4GL]

Use of Windows / Icons / Menus

- Command Processor is retained
- Button clicks generate CHARTS commands
- Command line option still available [seldom used]
- Script files use CHARTS command language

Design of USER INTERFACE for XCHARTS

Workstation for Forecasters

- Display : NWP Output / Observations / Satellites
- Command line and menu buttons
- Compatible with CHARTS
- Use of script files

Design of user Interface

- Multiple Mouse Clicks for selection …

  … e.g. Parm=geo, Level=500mb, Model=Hirlam, PLOT

- Button clicks generate CHARTS commands
- Uses defaults for all parameters / remembers previous selections

Other Features of the USER INTERFACE

Short-Cut Buttons

- Reduce number of Button clicks
- Just two clicks to change : Model / Forecast / Level

Specifying a Chart for Plotting

- System remembers previous settings
- Only need to specify parameters which have changed
- User can request illegal / non-existent charts [e.g. 5-day Hirlam]

MAIN FEATURES of XCHARTS

Types of Data

- NWP Output from Hirlam, ECMWF, UKMO, DWD
- Observations [Surface / Upper-Air] : de-cluttering
- PDUS Satellite data from METEOSAT [PolarStereographic Plot]

Basic design Features

- All possible charts allows : generated as needed
- Derived products [e.g. Vorticity, Stability indices]
- Latitude/longitude zoom ; Solid shading ; Animation
- Vertical cross sections [generated as needed]
- Overlay of satellite data [including ZAMG SATREP options]

OTHER FEATURES OF XCHARTS - I

Difference Charts / Thickness Charts

- All possible difference / thickness charts supported
- Charts are generated as needed [via subtraction]

Tephigram Plot

- User can select station via WMO-number or from map

SATREP products

- Vorticity. Divergence. Advection, Frontal parameters etc.
- SATREP report from ZAMG

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MET éireann

OTHER FEATURES OF XCHARTS - II

Thresholding of Data

- Allows user to set upper / lower thresholds
- e.g. Plot of NWP output when temperatures are Negative
- e.g. Plot of NWP output when winds are above 100kts

Hardcopy Option

- Hardcopy is done by generating PostScript files
- PostScript format can be vector or bitmap
- Files can be saved as PostScript or as EPS

OPERATIONAL USE of XCHARTS

Used at Three Sites

- Met Éireann HQ in Dublin
- Shannon Airport [200Km from Dublin]
- HQ of RTE [Irish TV station] in Dublin

Data Formats

- GRIB for NWP ; BUFR for Observations

Data Sources

- Data is shared via nfs in Dublin HQ
- Data is broadcast to Shannon / RTE and stored locally

OVERVIEW of XCHARTS

- Based on earlier command driven system [CHARTS]
- GUI Interface generates commands
- Command-language used for ‘scripts’
- Display NWP / Observations / METEOSAT
- Fields contoured ‘on-the-fly’
- Derived fields calculated ‘on-the-fly’
- Cross-sections
- Animation
- etc..

Met Éireann XCHARTS Display System -- Summary

STRENGTHS

- User Friendly
- Very fast
- Access to many models
- Large amount of information on single display [up to 9 charts possible]

LIMITATIONS

- Multiple overlays can be confusing
- Unable to toggle on/off overlays
- No on-screen analysis
- No production capability

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OTHER GRAPHICS SYSTEMS at MET-ÉIREANN

GIS System used by Climatology

- ArcView vs 3.2 on Windows NT-2000

TV-graphics system

- Weather-ONE Metacast System on SGI-IRIX

External Website

- External Website [www.met.ie] contains selection of charts

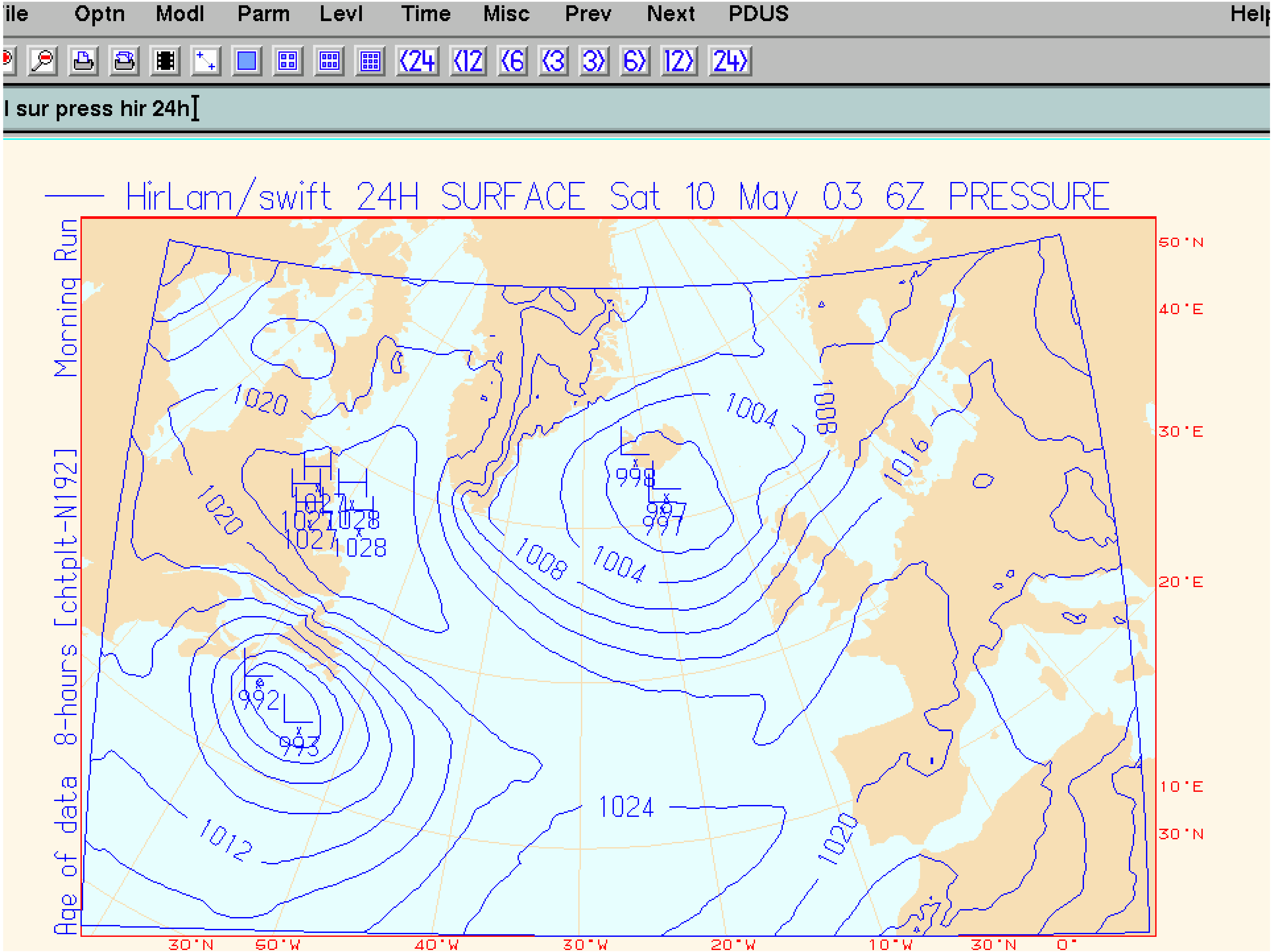
Internal Website [Intranet]

- Internal Website has many pre-calculated NWP products
- Satellite and Radar animations ; Observation plots etc.

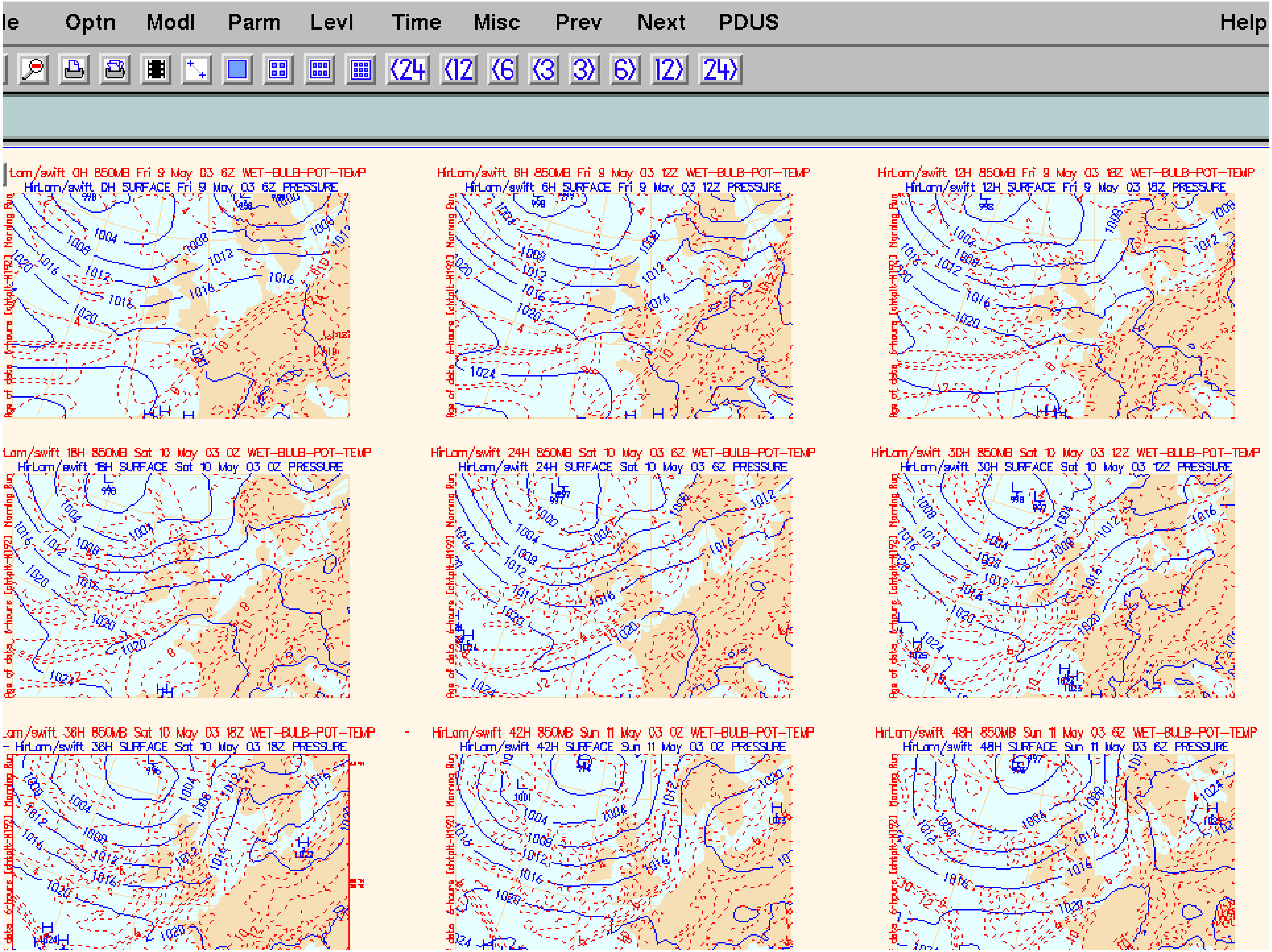
MET éireann

SAMPLE PLOTS PRODUCED via XCHARTS

The following slides show some examples of the type of chart which can be produced via XCHARTS ...



File Optn Modl Parm Levl Time Misc Prev Next PDUS Help
‹24 ‹12 ‹6 ‹3 3› 6› 12› 24›
l sur press hir 24h
HirLam/swift 24H SURFACE Sat 10 May 03 6Z PRESSURE
Morning Run
[chtplt-N192]
8-hours
Age of data
1020
1020
1027
1028
998
997
1004
1004
1008
1008
1016
992
993
1012
1024
1020
50°N
40°E
30°E
20°E
10°E
30°N
0°
10°W
20°W
30°W
40°W
50°W


le
Optn
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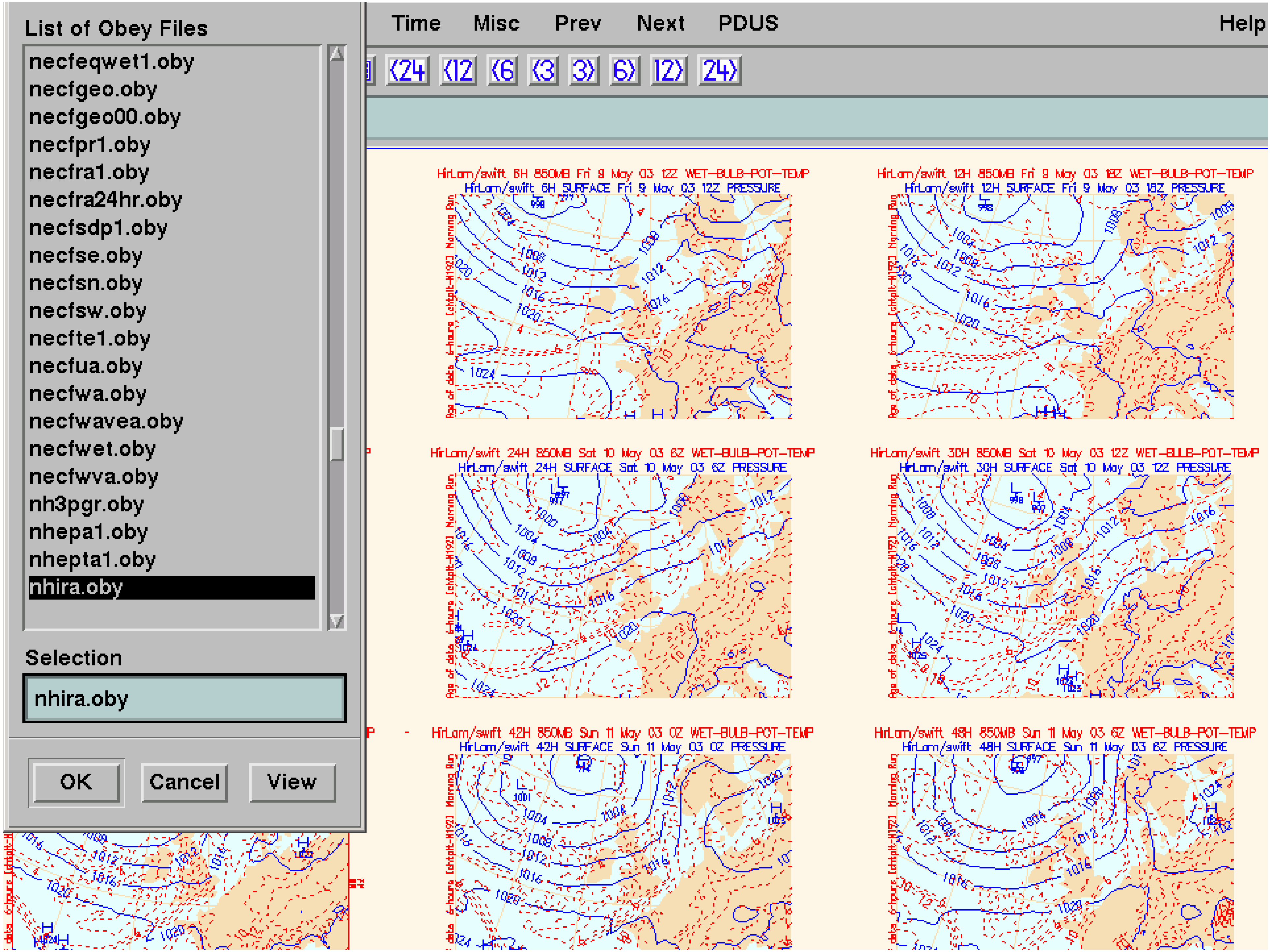
Prev
Next
PDUS
Help
⟨24 ⟨12 ⟨6 ⟨3 3⟩ 6⟩ 12⟩ 24⟩
Lam/swift 0H 850MB Fri 9 May 03 6Z WET-BULB-POT-TEMP
HirLam/swift 0H SURFACE Fri 9 May 03 6Z PRESSURE
HirLam/swift 6H 850MB Fri 9 May 03 12Z WET-BULB-POT-TEMP
HirLam/swift 6H SURFACE Fri 9 May 03 12Z PRESSURE
HirLam/swift 12H 850MB Fri 9 May 03 18Z WET-BULB-POT-TEMP
HirLam/swift 12H SURFACE Fri 9 May 03 18Z PRESSURE
Lam/swift 18H 850MB Sat 10 May 03 0Z WET-BULB-POT-TEMP
HirLam/swift 18H SURFACE Sat 10 May 03 0Z PRESSURE
HirLam/swift 24H 850MB Sat 10 May 03 6Z WET-BULB-POT-TEMP
HirLam/swift 24H SURFACE Sat 10 May 03 6Z PRESSURE
HirLam/swift 30H 850MB Sat 10 May 03 12Z WET-BULB-POT-TEMP
HirLam/swift 30H SURFACE Sat 10 May 03 12Z PRESSURE
Lam/swift 36H 850MB Sat 10 May 03 18Z WET-BULB-POT-TEMP
HirLam/swift 36H SURFACE Sat 10 May 03 18Z PRESSURE
HirLam/swift 42H 850MB Sun 11 May 03 0Z WET-BULB-POT-TEMP
HirLam/swift 42H SURFACE Sun 11 May 03 0Z PRESSURE
HirLam/swift 48H 850MB Sun 11 May 03 6Z WET-BULB-POT-TEMP
HirLam/swift 48H SURFACE Sun 11 May 03 6Z PRESSURE



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necfeqwet1.oby
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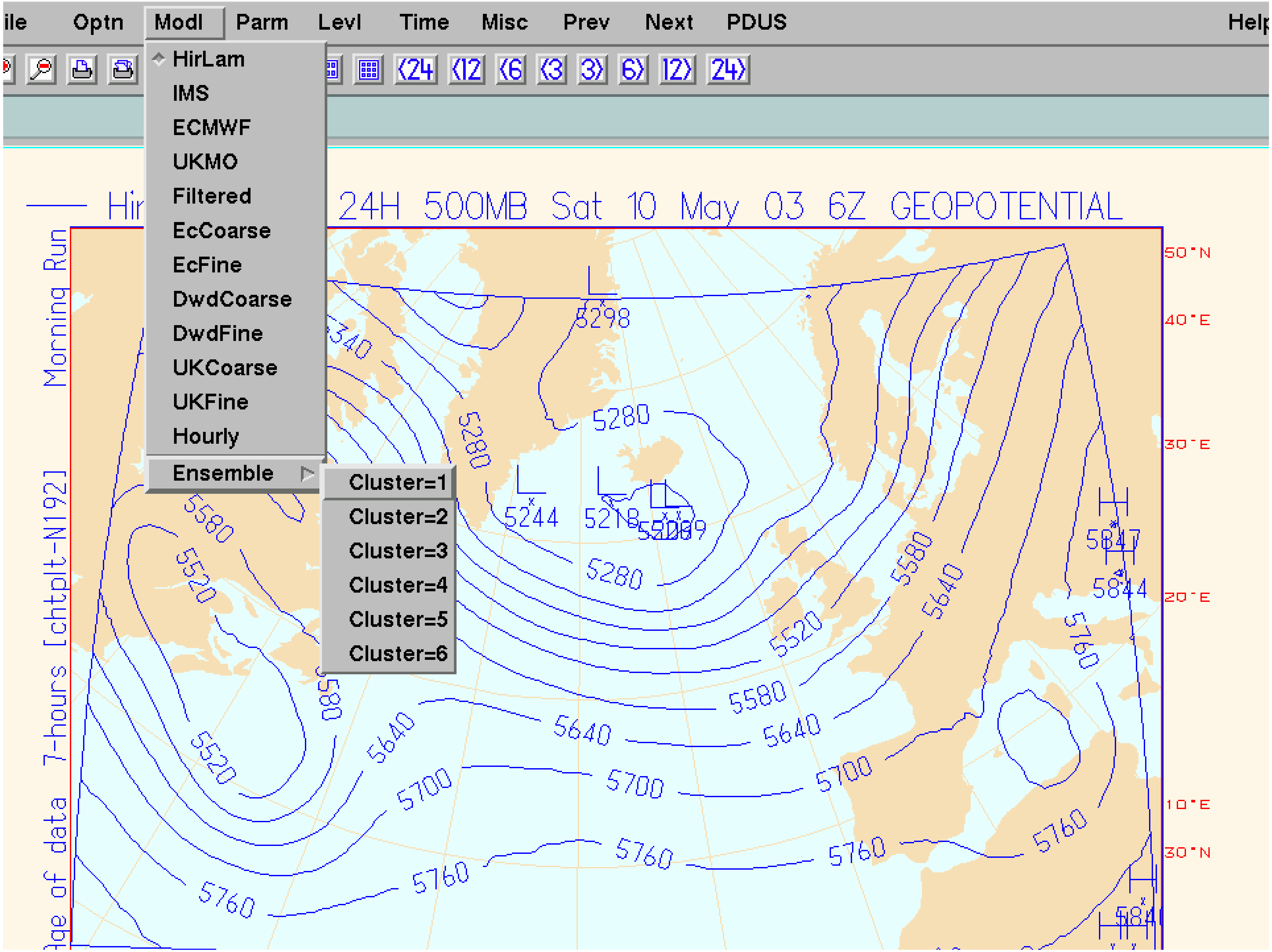
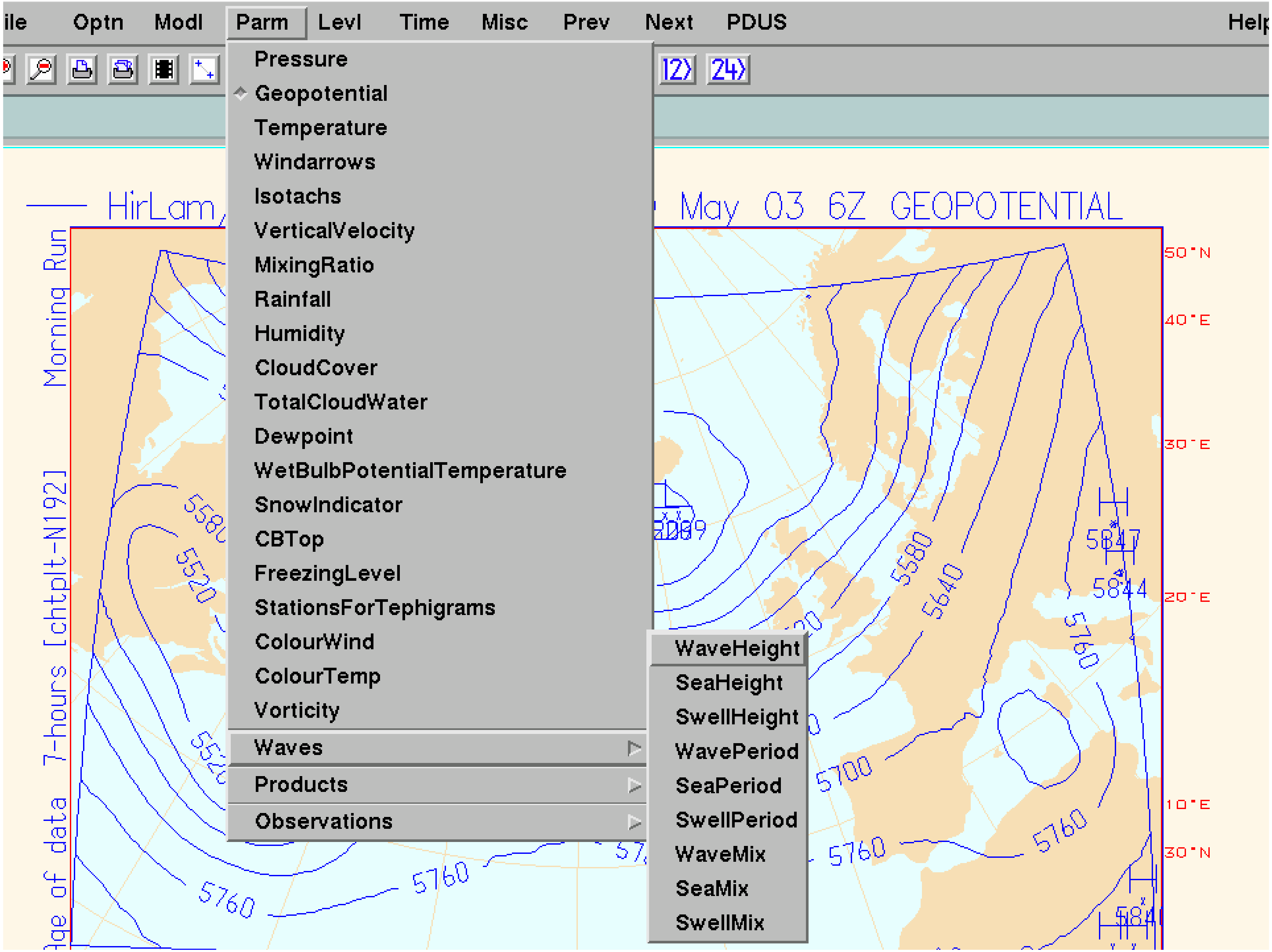
necfgeo00.oby
necfpr1.oby
necfra1.oby
necfra24hr.oby
necfsdp1.oby
necfse.oby
necfsn.oby
necfsw.oby
necfte1.oby
necfua.oby
necfwa.oby
necfwavea.oby
necfwet.oby
necfwva.oby
nh3pgr.oby
nhepa1.oby
nhepta1.oby
nhira.oby
Selection
nhira.oby
OK
Cancel
View
Time
Misc
Prev
Next
PDUS
Help
⟨24 ⟨12 ⟨6 ⟨3 3⟩ 6⟩ 12⟩ 24⟩
HirLam/swift 6H 850MB Fri 9 May 03 12Z WET-BULB-POT-TEMP
HirLam/swift 6H SURFACE Fri 9 May 03 12Z PRESSURE
HirLam/swift 12H 850MB Fri 9 May 03 18Z WET-BULB-POT-TEMP
HirLam/swift 12H SURFACE Fri 9 May 03 18Z PRESSURE
HirLam/swift 24H 850MB Sat 10 May 03 6Z WET-BULB-POT-TEMP
HirLam/swift 24H SURFACE Sat 10 May 03 6Z PRESSURE
HirLam/swift 30H 850MB Sat 10 May 03 12Z WET-BULB-POT-TEMP
HirLam/swift 30H SURFACE Sat 10 May 03 12Z PRESSURE
HirLam/swift 42H 850MB Sun 11 May 03 0Z WET-BULB-POT-TEMP
HirLam/swift 42H SURFACE Sun 11 May 03 0Z PRESSURE
HirLam/swift 48H 850MB Sun 11 May 03 6Z WET-BULB-POT-TEMP
HirLam/swift 48H SURFACE Sun 11 May 03 6Z PRESSURE



ile Optn Modl Parm Levl Time Misc Prev Next PDUS Help
HirLam
IMS
ECMWF
UKMO
Filtered
EcCoarse
EcFine
DwdCoarse
DwdFine
UKCoarse
UKFine
Hourly
Ensemble
Cluster=1
Cluster=2
Cluster=3
Cluster=4
Cluster=5
Cluster=6
24H 500MB Sat 10 May 03 6Z GEOPOTENTIAL
Morning Run
7-hours [chtplt-N192]
50°N
40°E
30°E
20°E
10°E
30°N


ile
Optn
Modl
Parm
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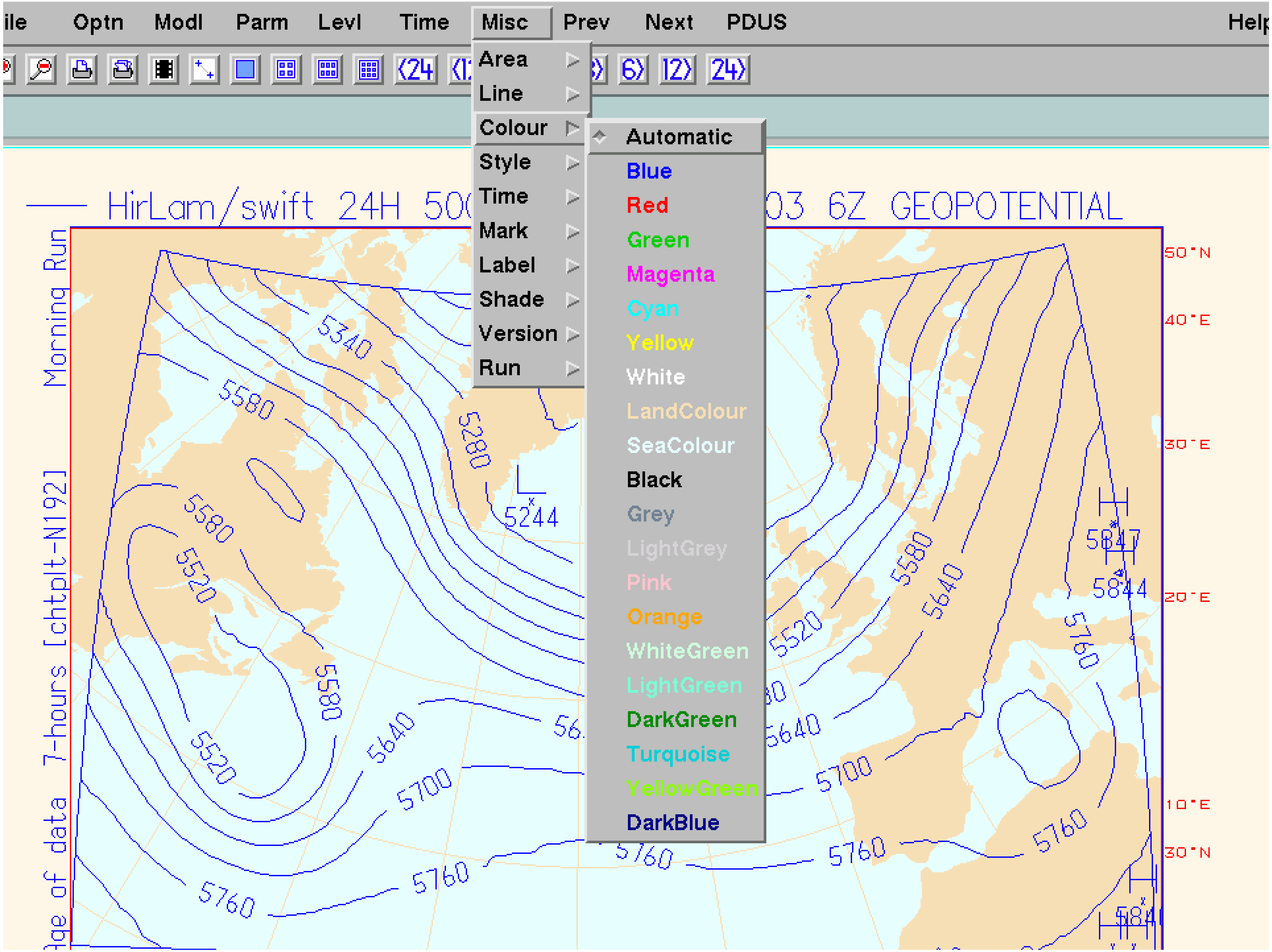
Time
Misc
Prev
Next
PDUS
Help
12›
24›
Pressure
Geopotential
Temperature
Windarrows
Isotachs
VerticalVelocity
MixingRatio
Rainfall
Humidity
CloudCover
TotalCloudWater
Dewpoint
WetBulbPotentialTemperature
SnowIndicator
CBTop
FreezingLevel
StationsForTephigrams
ColourWind
ColourTemp
Vorticity
Waves
Products
Observations
WaveHeight
SeaHeight
SwellHeight
WavePeriod
SeaPeriod
SwellPeriod
WaveMix
SeaMix
SwellMix
HirLam
May 03 6Z GEOPOTENTIAL
Morning Run
7-hours [chtplt-N192]
50°N
40°E
30°E
20°E
10°E
30°N
5580
5520
5760
5640
5700
5847
5844


ile Optn Modl Parm Levl Time Misc Prev Next PDUS Help
Area
Line
Colour
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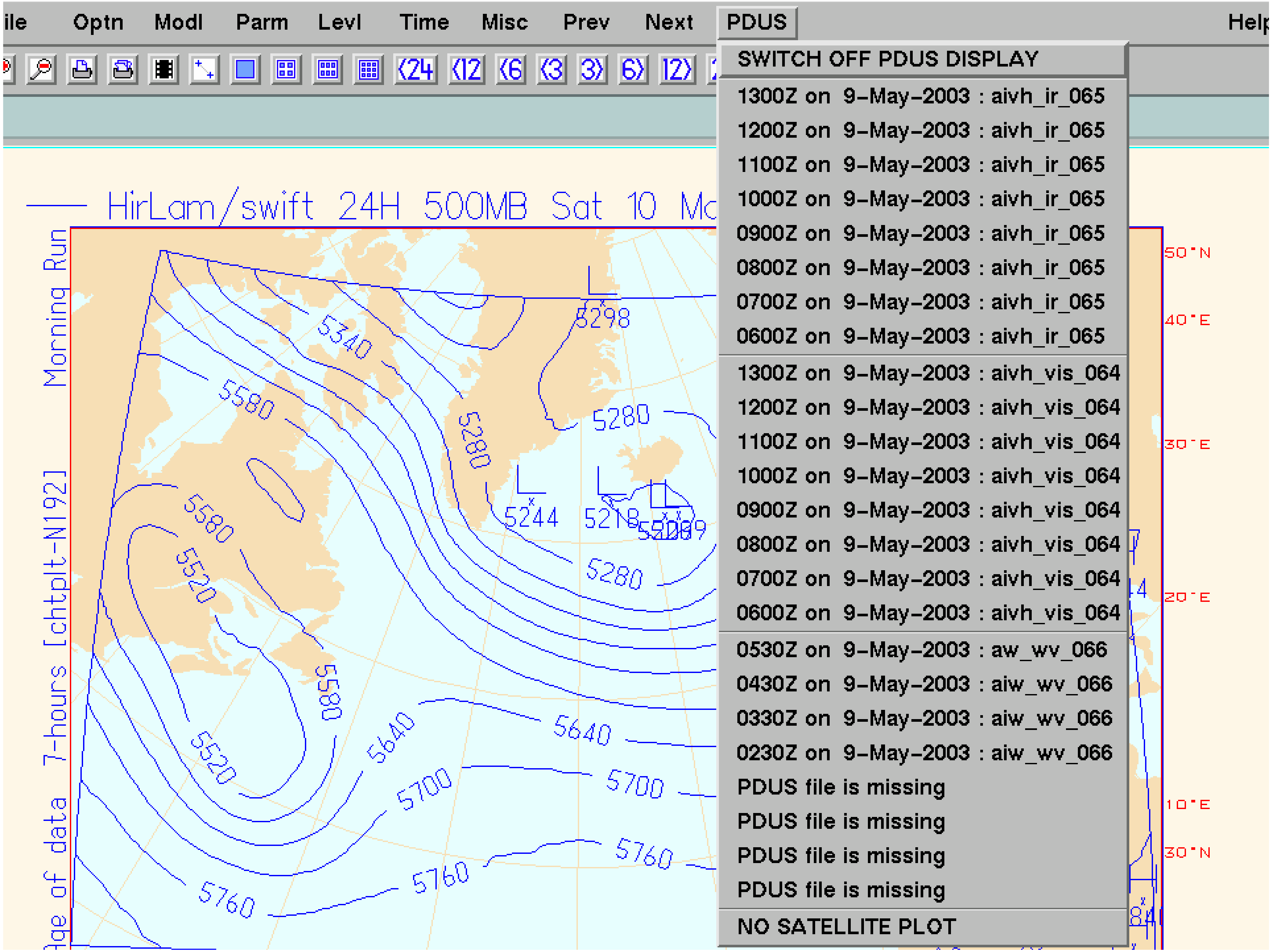
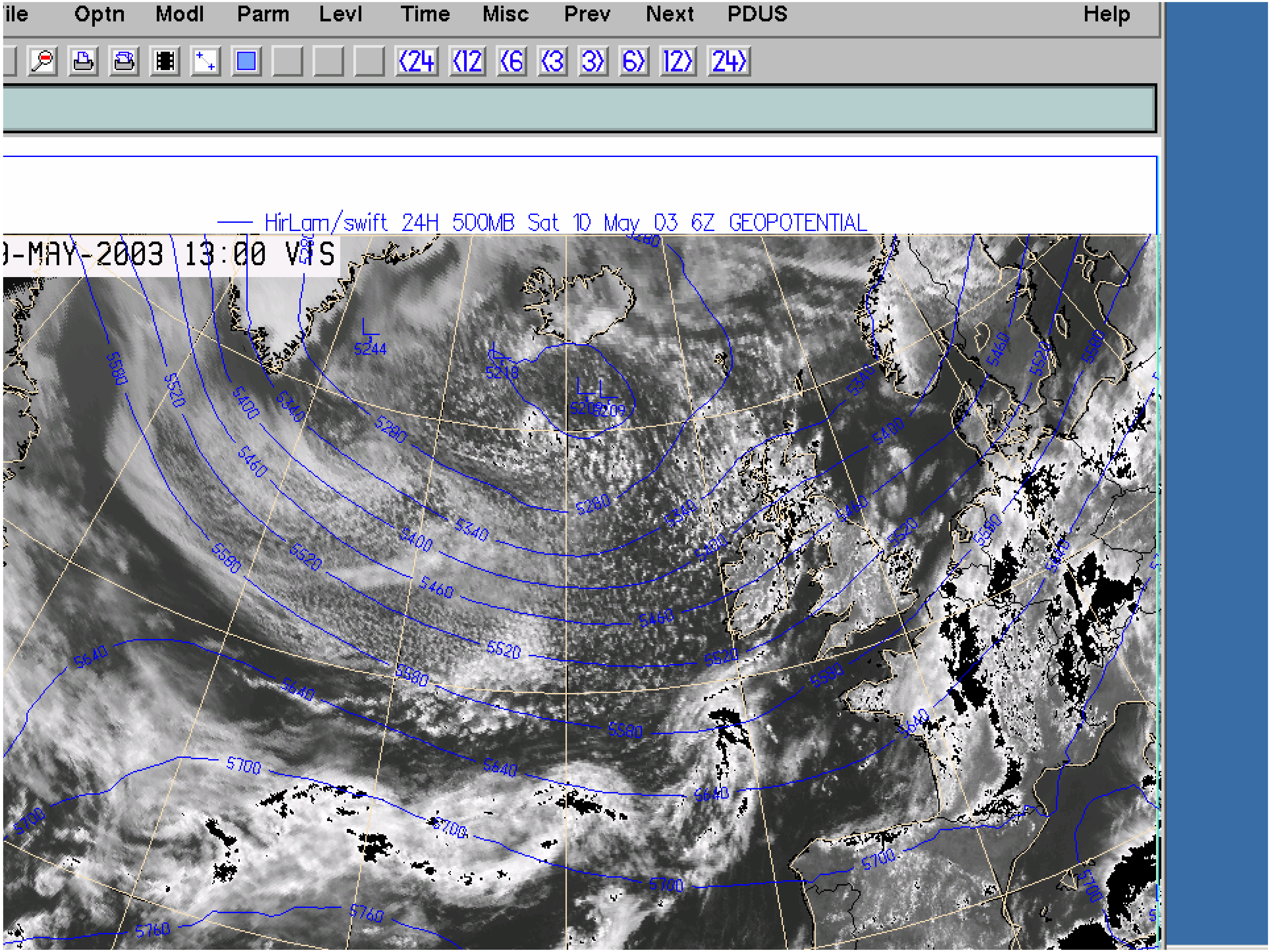
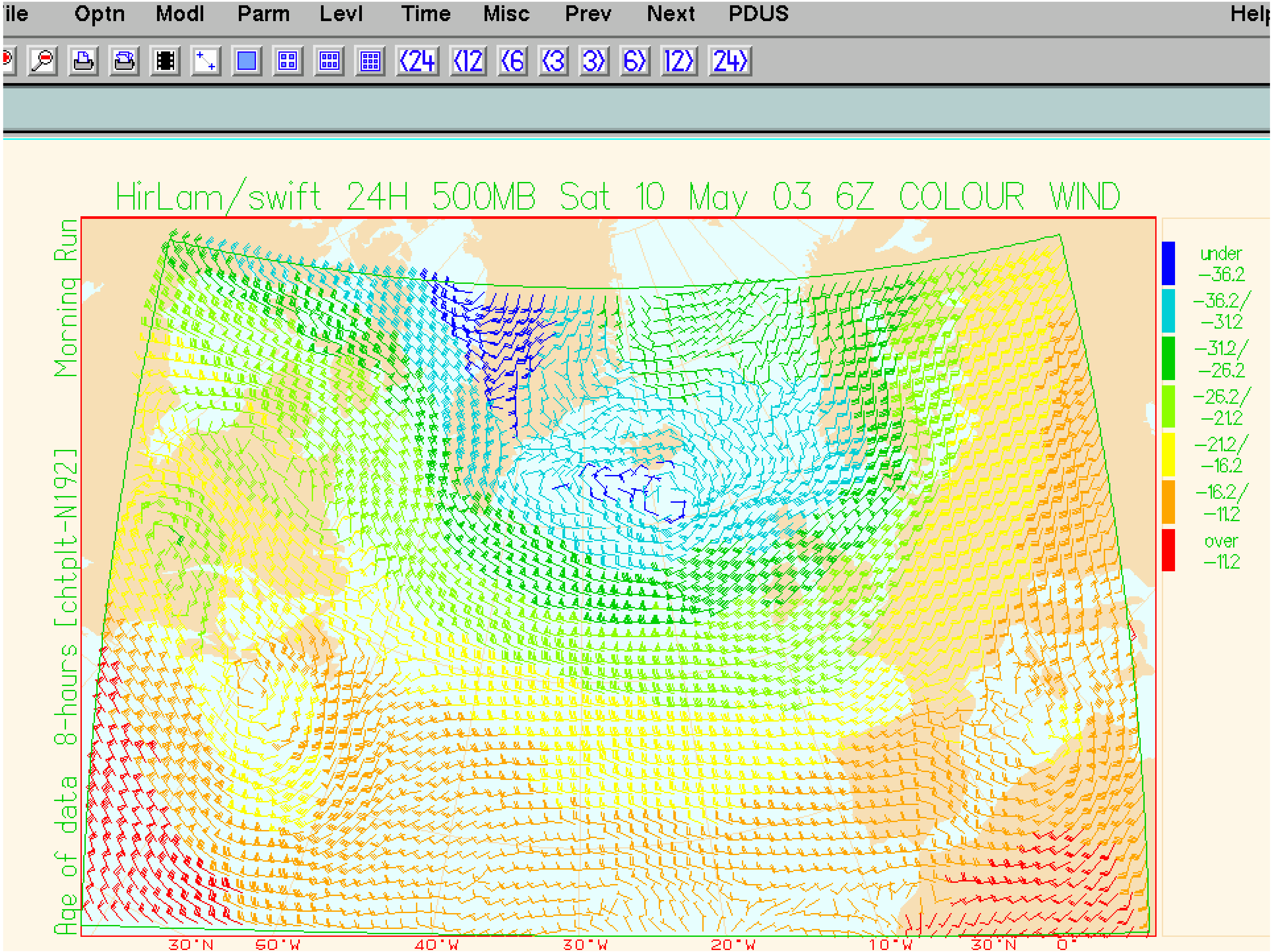
Time
Mark
Label
Shade
Version
Run
Automatic
Blue
Red
Green
Magenta
Cyan
Yellow
White
LandColour
SeaColour
Black
Grey
LightGrey
Pink
Orange
WhiteGreen
LightGreen
DarkGreen
Turquoise
YellowGreen
DarkBlue
HirLam/swift 24H 500
03 6Z GEOPOTENTIAL
Morning Run
7-hours [chtplt-N192]
50°N
40°E
30°E
20°E
10°E
30°N
5340
5580
5280
5244
5520
5640
5700
5760
5847
5844

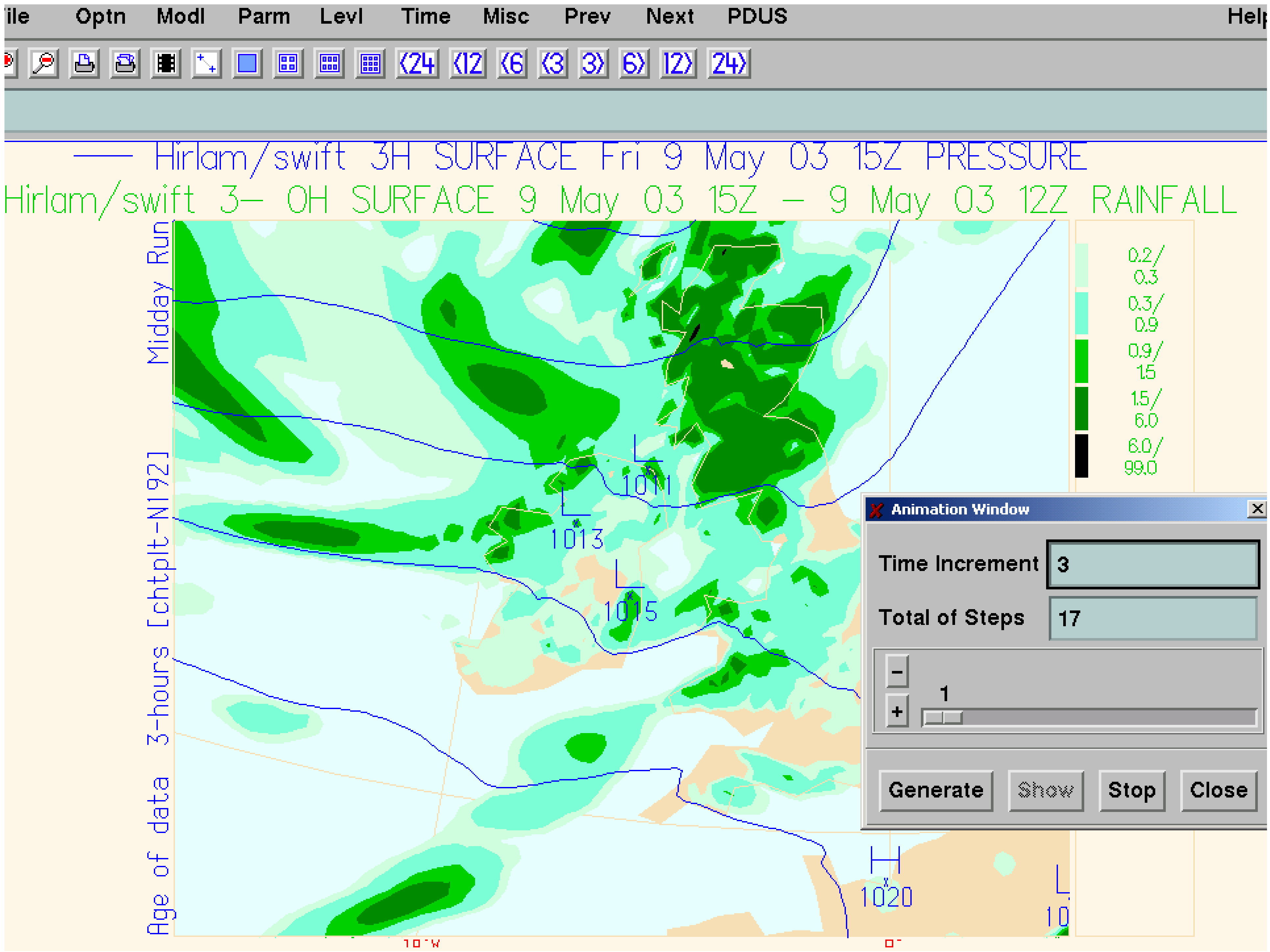

ile Optn Modl Parm Levl Time Misc Prev Next PDUS Help
HirLam/swift 24H 500MB Sat 10 Mo
Morning Run
7-hours [chtplt-N192]
age of data
SWITCH OFF PDUS DISPLAY
1300Z on 9-May-2003 : aivh_ir_065
1200Z on 9-May-2003 : aivh_ir_065
1100Z on 9-May-2003 : aivh_ir_065
1000Z on 9-May-2003 : aivh_ir_065
0900Z on 9-May-2003 : aivh_ir_065
0800Z on 9-May-2003 : aivh_ir_065
0700Z on 9-May-2003 : aivh_ir_065
0600Z on 9-May-2003 : aivh_ir_065
1300Z on 9-May-2003 : aivh_vis_064
1200Z on 9-May-2003 : aivh_vis_064
1100Z on 9-May-2003 : aivh_vis_064
1000Z on 9-May-2003 : aivh_vis_064
0900Z on 9-May-2003 : aivh_vis_064
0800Z on 9-May-2003 : aivh_vis_064
0700Z on 9-May-2003 : aivh_vis_064
0600Z on 9-May-2003 : aivh_vis_064
0530Z on 9-May-2003 : aw_wv_066
0430Z on 9-May-2003 : aiw_wv_066
0330Z on 9-May-2003 : aiw_wv_066
0230Z on 9-May-2003 : aiw_wv_066
PDUS file is missing
PDUS file is missing
PDUS file is missing
PDUS file is missing
NO SATELLITE PLOT
50°N
40°E
30°E
20°E
10°E
30°N
5298
5340
5580
5280
5244
5218
5580
5520
5640
5700
5760



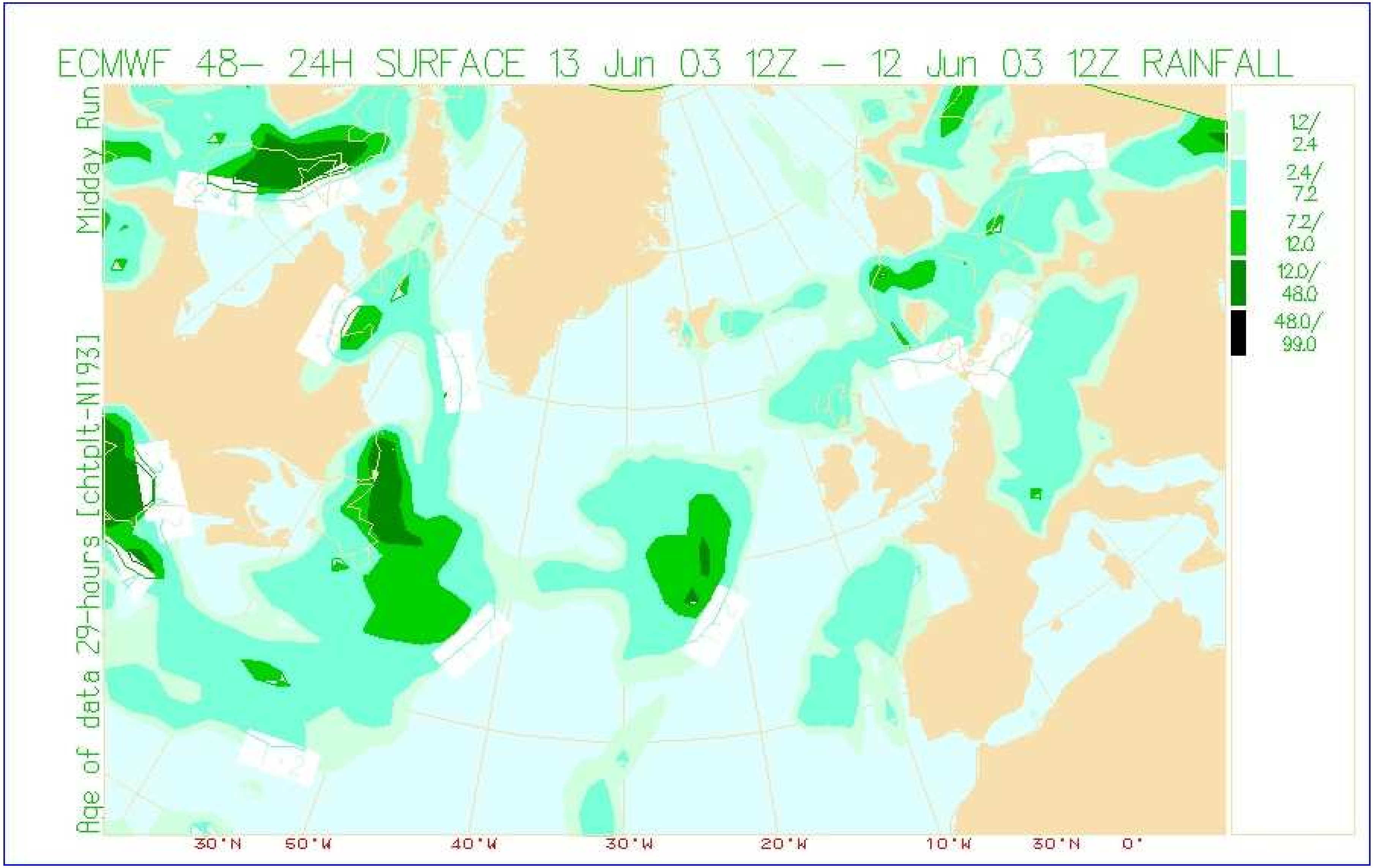
ile Optn Modl Parm Levl Time Misc Prev Next PDUS Help
(24 (12 (6 (3 3) 6) 12) 24)
HirLam/swift 24H 500MB Sat 10 May 03 6Z GEOPOTENTIAL
-MAY-2003 13:00 VIS

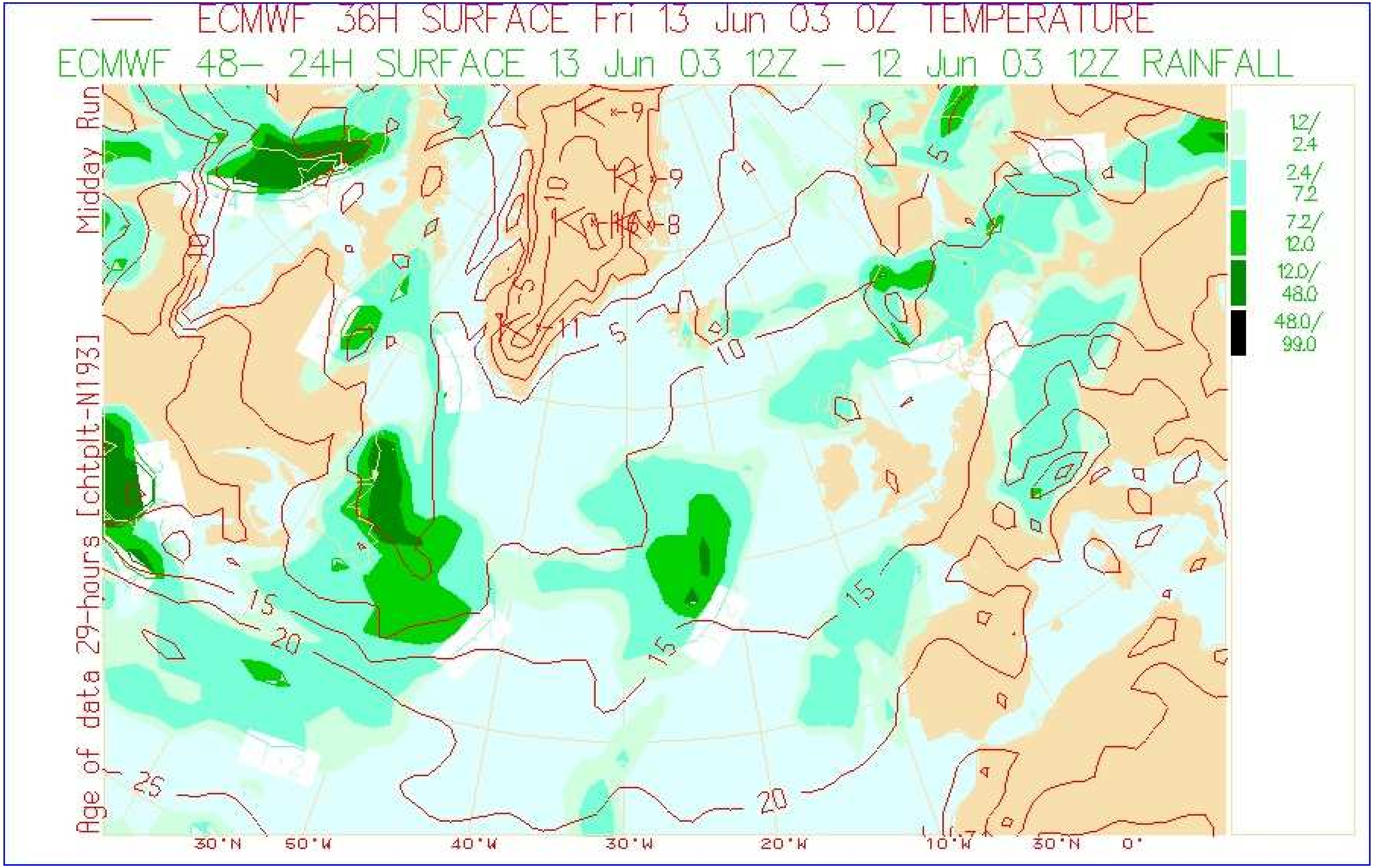


File Optn Modl Parm Levl Time Misc Prev Next PDUS Help
⟨24 ⟨12 ⟨6 ⟨3 3⟩ 6⟩ 12⟩ 24⟩
HirLam/swift 24H 500MB Sat 10 May 03 6Z COLOUR WIND
Age of data 8-hours [chtplt-N192] Morning Run
under −36.2
−36.2/ −31.2
−31.2/ −26.2
−26.2/ −21.2
−21.2/ −16.2
−16.2/ −11.2
over −11.2
30°N
50°W
40°W
30°W
20°W
10°W
30°N
0°



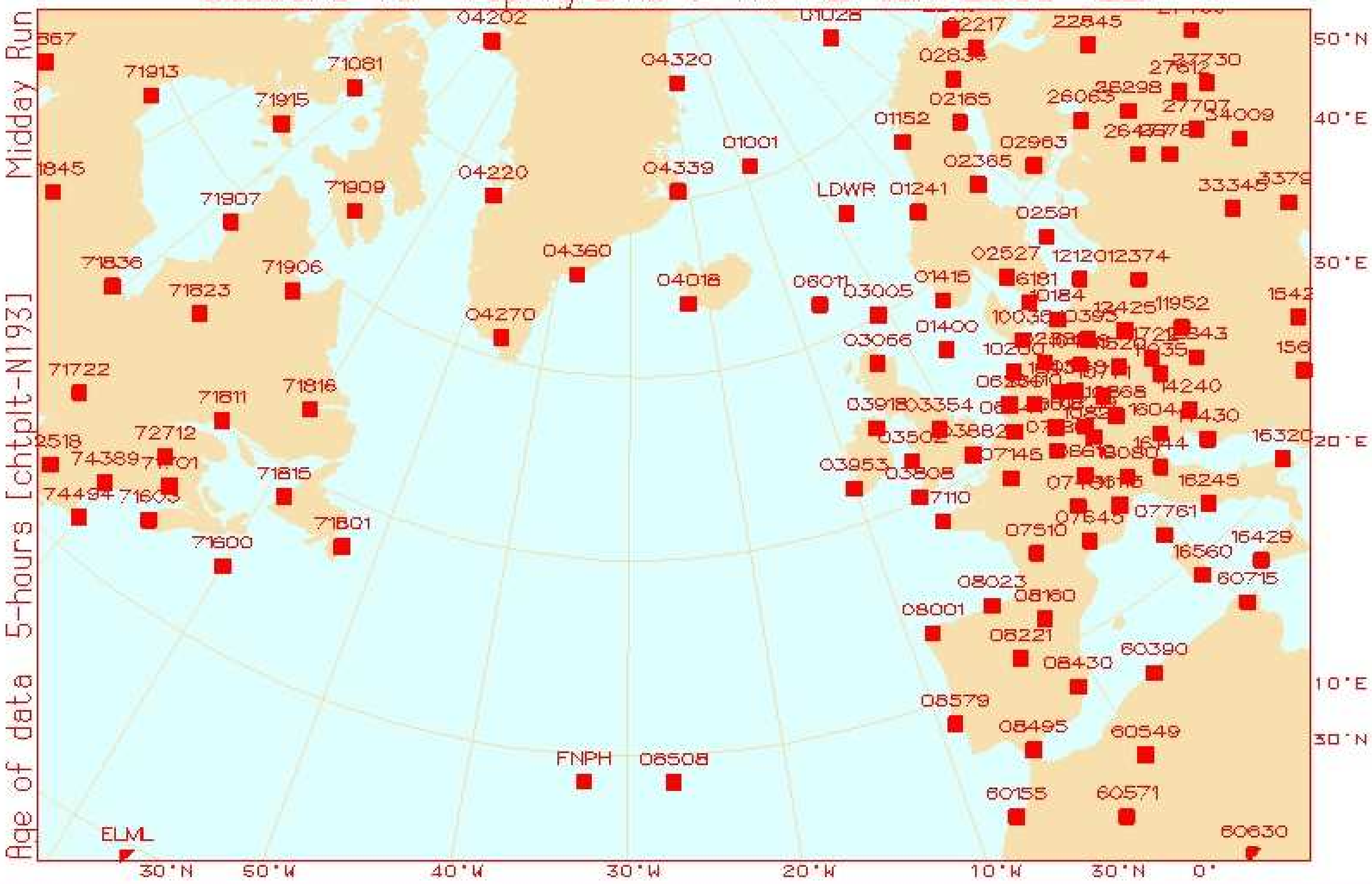
ile Optn Modl Parm Levl Time Misc Prev Next PDUS Help
⟨24 ⟨12 ⟨6 ⟨3 3⟩ 6⟩ 12⟩ 24⟩
Hirlam/swift 3H SURFACE Fri 9 May 03 15Z PRESSURE
Hirlam/swift 3- 0H SURFACE 9 May 03 15Z - 9 May 03 12Z RAINFALL
Midday Run
[chtplt-N192]
Age of data 3-hours
0.2/ 0.3
0.3/ 0.9
0.9/ 1.5
1.5/ 6.0
6.0/ 99.0
1011
1013
1015
1020
10°W
0°
Animation Window
Time Increment 3
Total of Steps 17
1
Generate
Show
Stop
Close


ECMWF 48- 24H SURFACE 13 Jun 03 12Z - 12 Jun 03 12Z RAINFALL
Midday Run
Age of data 29-hours [chtplt-N193]
1.2/ 2.4
2.4/ 7.2
7.2/ 12.0
12.0/ 48.0
48.0/ 99.0
30°N
50°W
40°W
30°W
20°W
10°W
30°N
0°



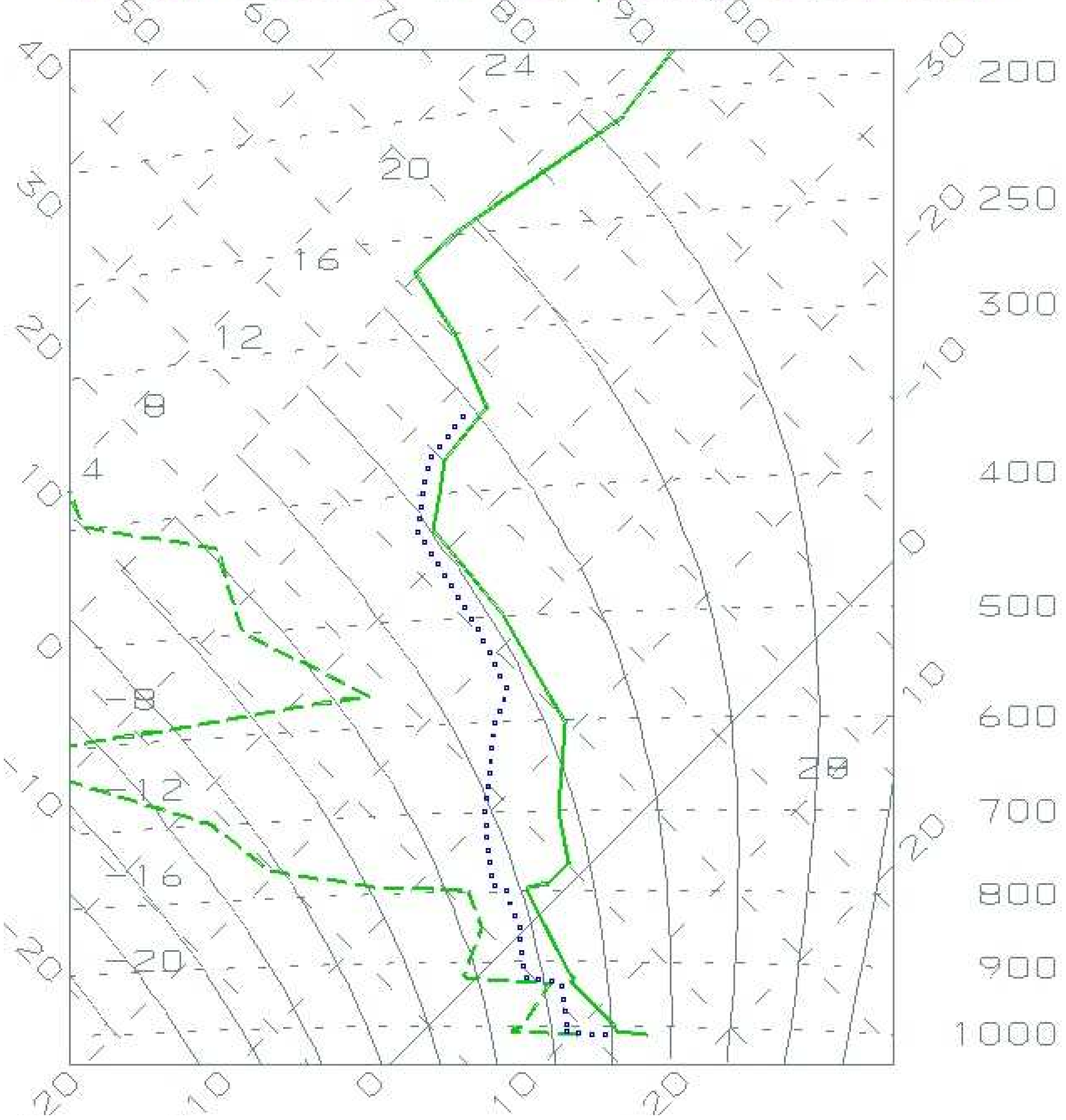
ECMWF 36H SURFACE Fri 13 Jun 03 0Z TEMPERATURE
ECMWF 48- 24H SURFACE 13 Jun 03 12Z - 12 Jun 03 12Z RAINFALL
Midday Run
Age of data 29-hours [chtplt-N193]
1.2/ 2.4
2.4/ 7.2
7.2/ 12.0
12.0/ 48.0
48.0/ 99.0
30°N
50°W
40°W
30°W
20°W
10°W
0°

Stations for Tephigrams : Thr 12 Jun 2003 12Z

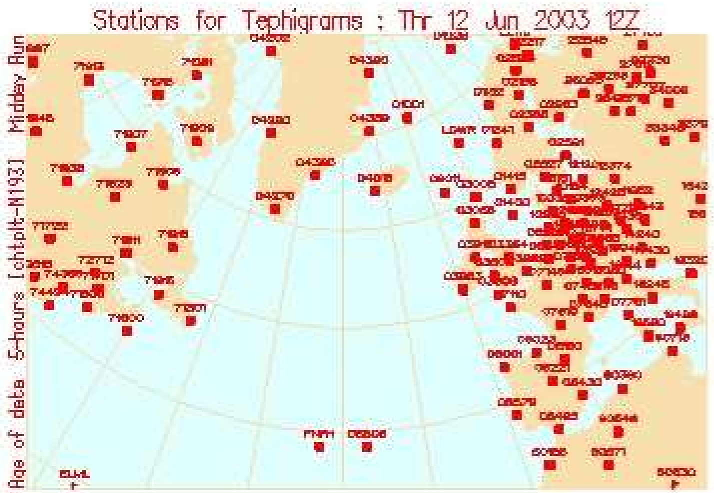


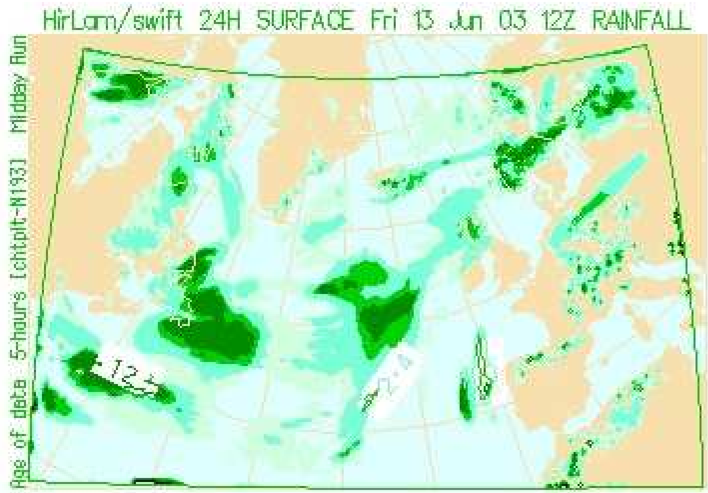
Station: 03953 :

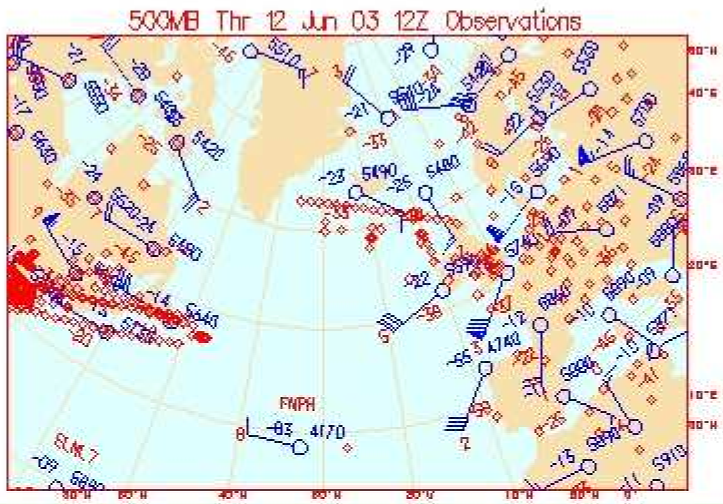
12 Jun 2003 at 12 utc, position 51.9N 10.2W

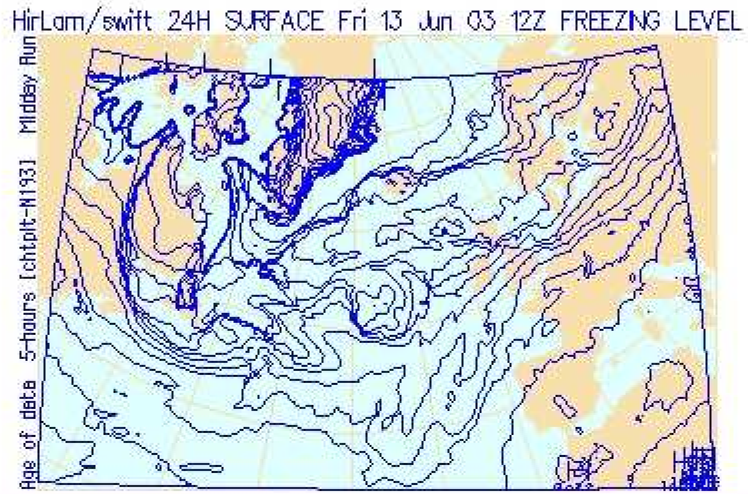


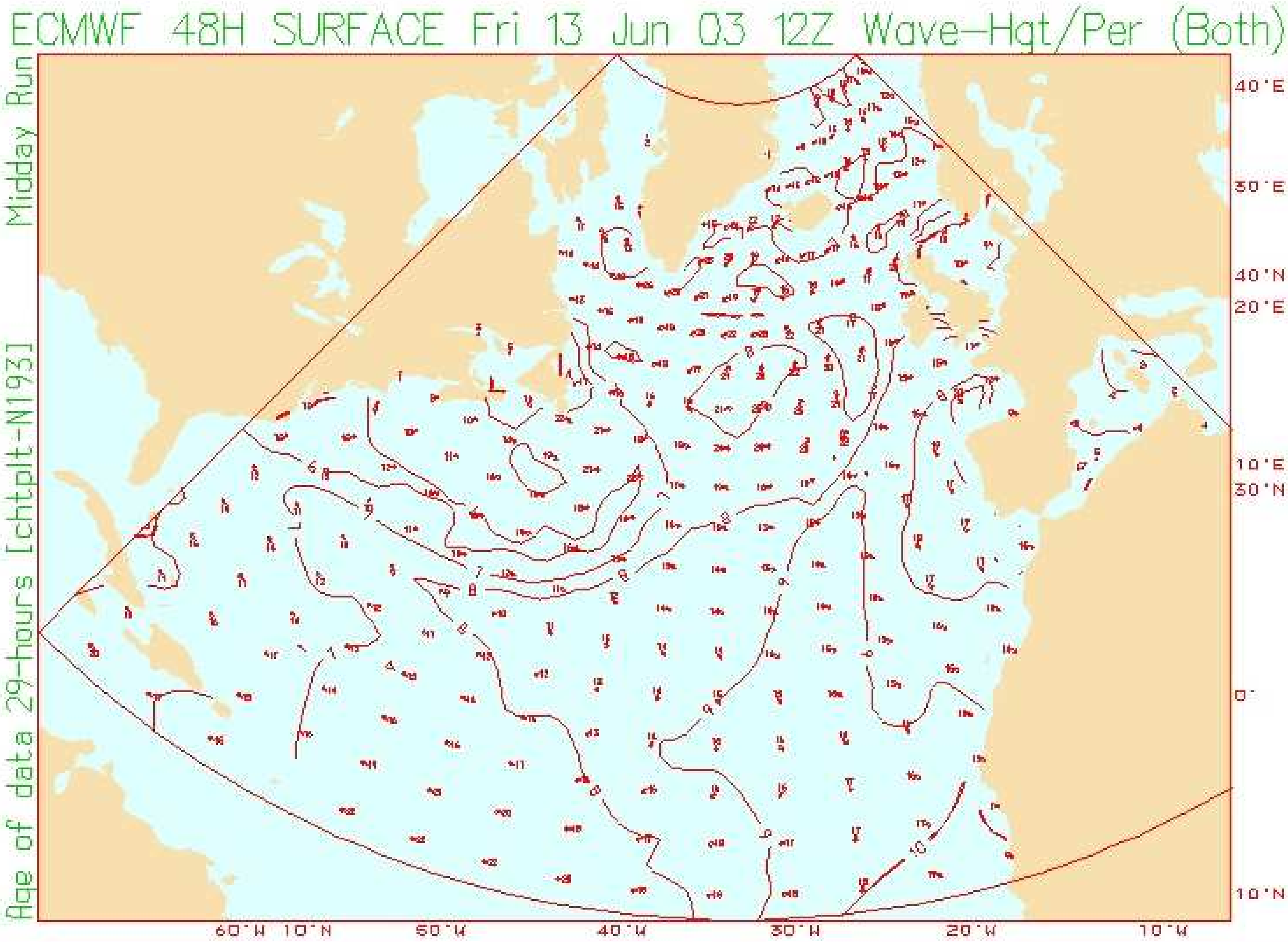
MAX-WIND-LEVL		FREEZ
298	265 102	5355
11839	250	56
10369	260	94
9170	270	102
7190	260	50
5590	250	40
3029	250	34
1488	240	26
801	240	22
156	240	24


Stations for Tephigrams : Thr 12 Jun 2003 12Z
Midday Run
Age of data 5-hours [chtplt-N193]

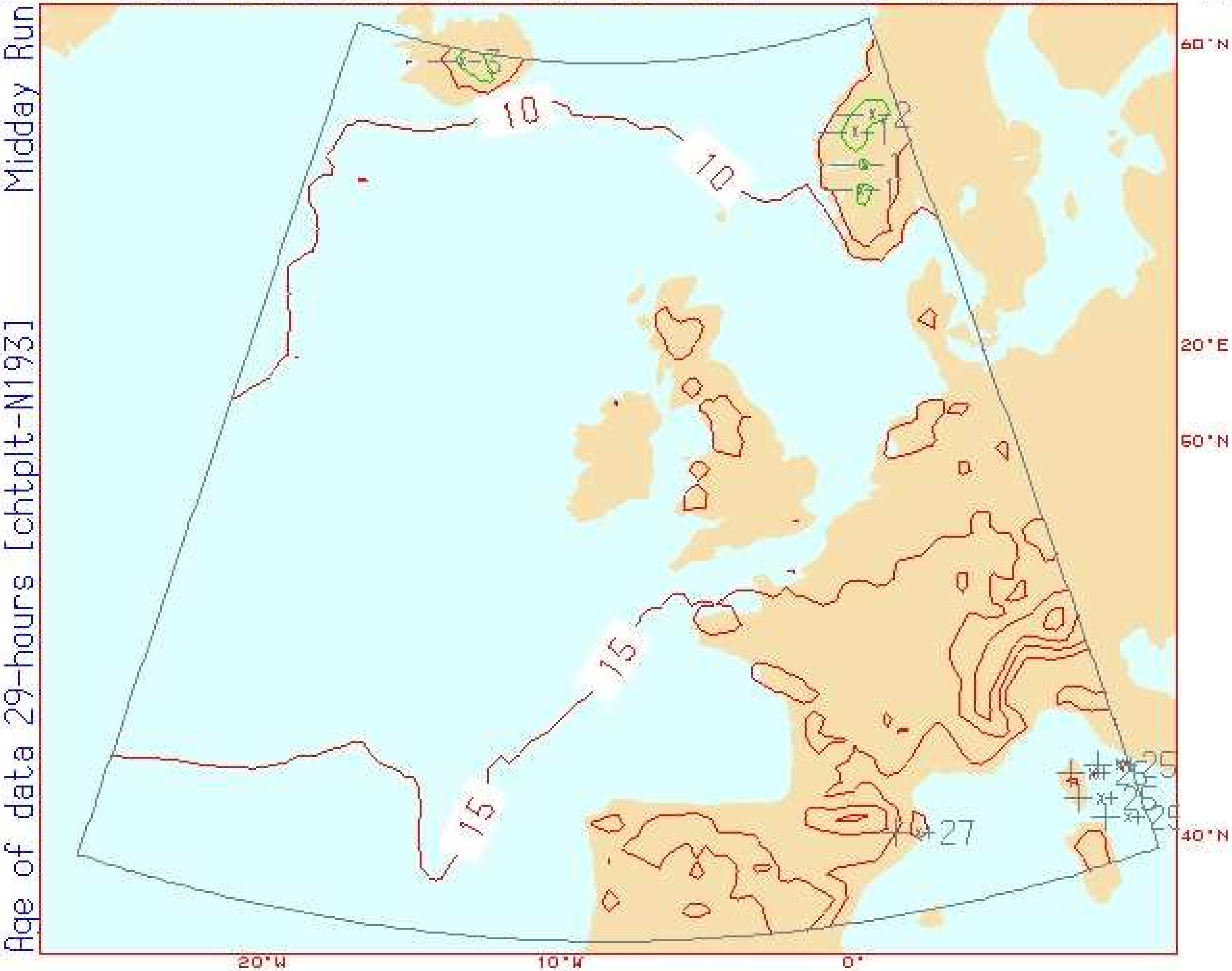

HirLam/swift 24H SURFACE Fri 13 Jun 03 12Z RAINFALL
Midday Run
Age of data 5-hours [chtplt-N193]

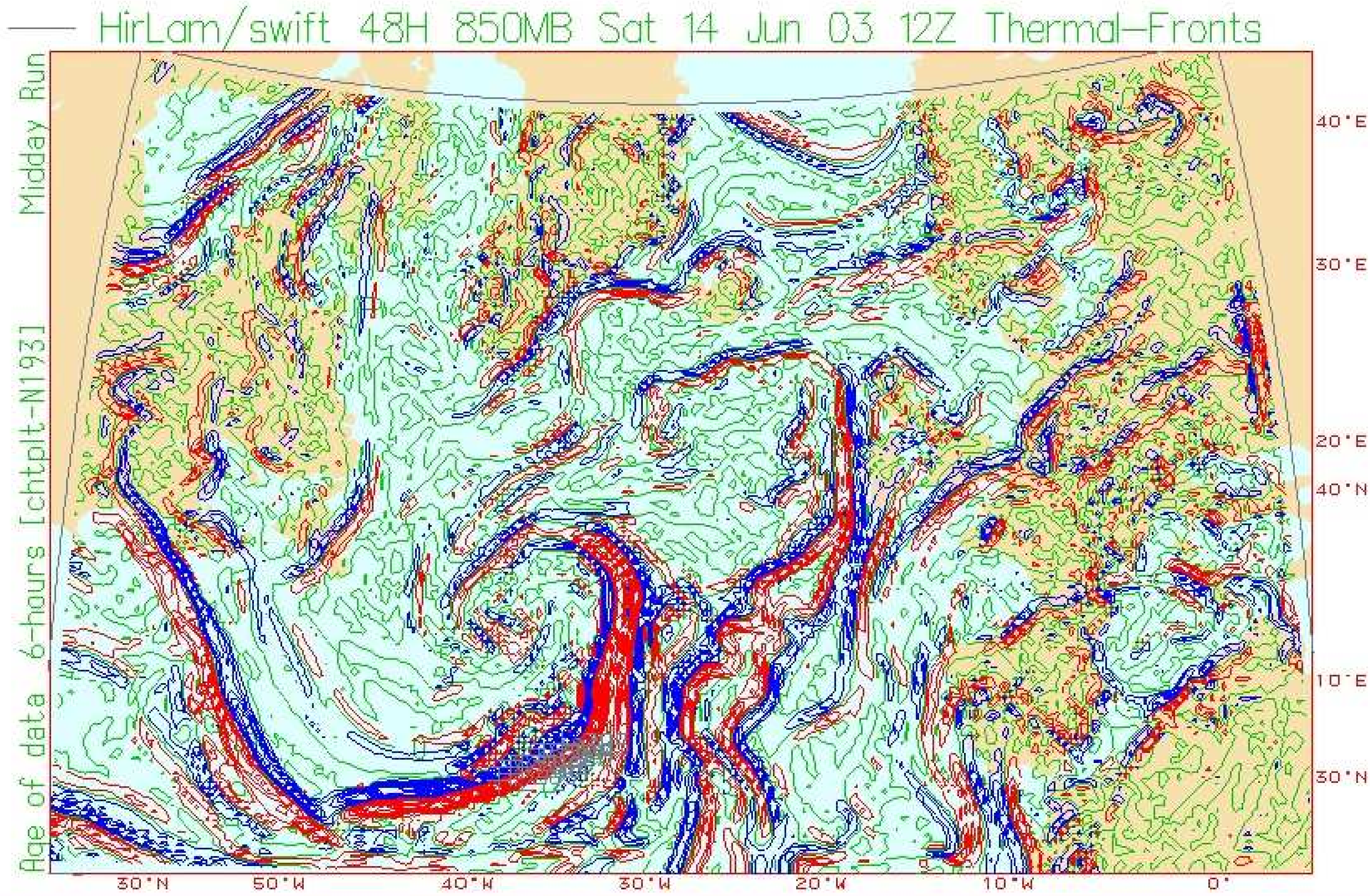

500MB Thr 12 Jun 03 12Z Observations

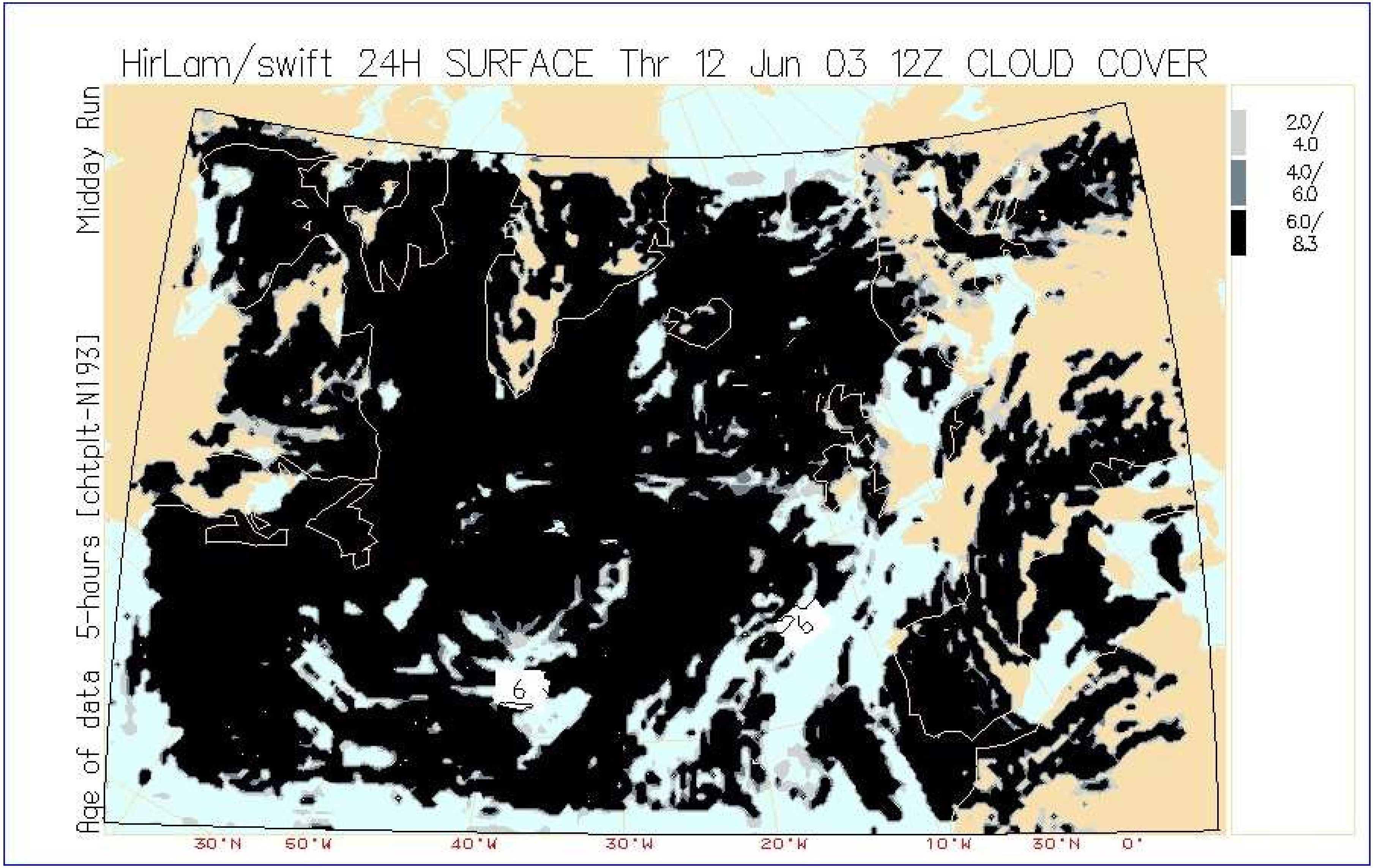

HirLam/swift 24H SURFACE Fri 13 Jun 03 12Z FREEZING LEVEL
Midday Run
Age of data 5-hours [chtplt-N193]


ECMWF 48H SURFACE Fri 13 Jun 03 12Z Wave-Hgt/Per (Both)
Midday Run
Age of data 29-hours [chtplt-N193]
40°E
30°E
40°N
20°E
10°E
30°N
0°
10°N
60°W 10°N
50°W
40°W
30°W
20°W
10°W

ECMWF120- 96H SURFACE 16 Jun 03 12Z - 15 Jun 03 12Z Min Temp




HirLam/swift 48H 850MB Sat 14 Jun 03 12Z Thermal-Fronts
Midday Run
Age of data 6-hours [chtplt-N193]
40°E
30°E
20°E
40°N
10°E
30°N
30°N
50°W
40°W
30°W
20°W
10°W
0°

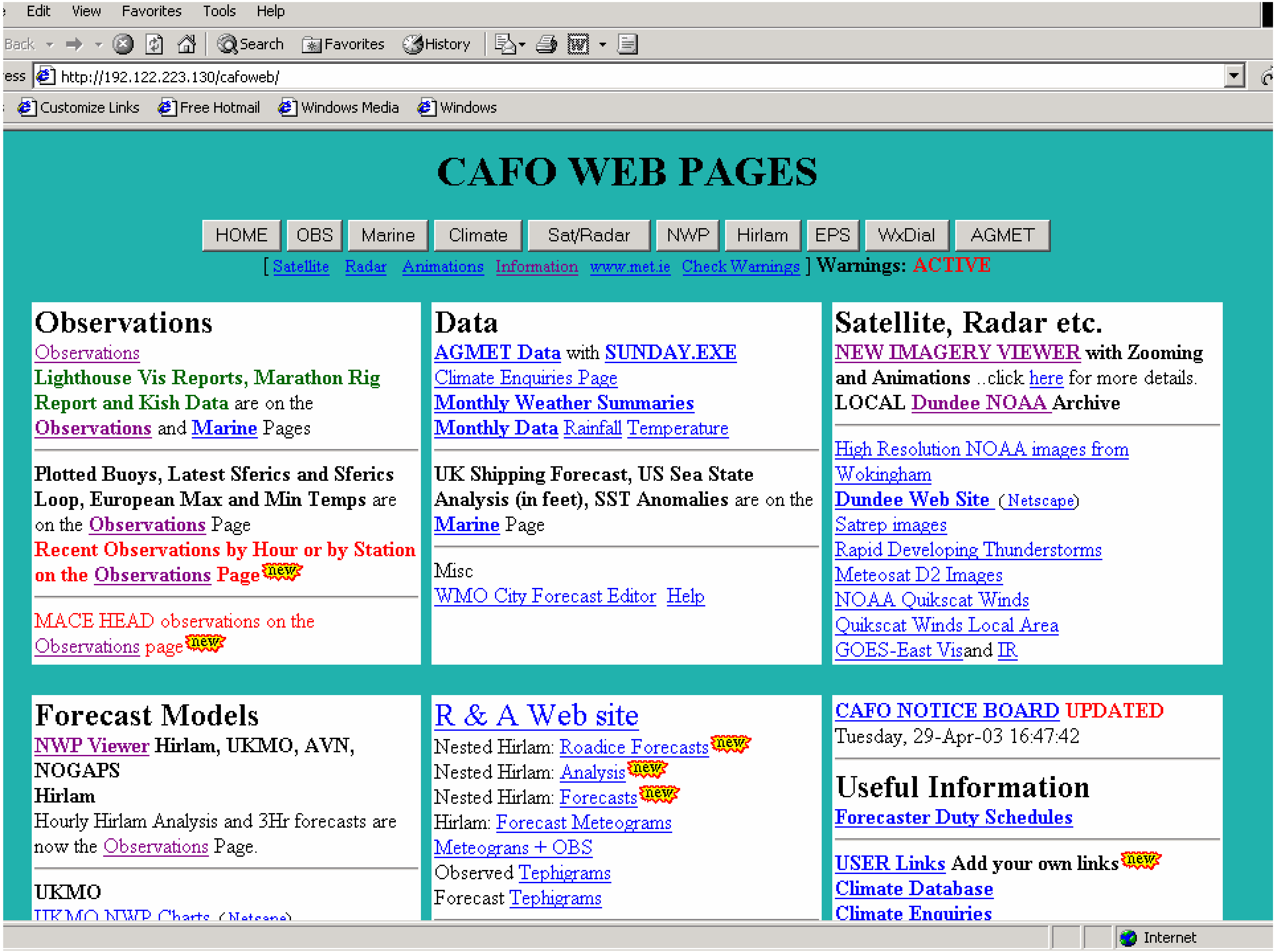

HirLam/swift 24H SURFACE Thr 12 Jun 03 12Z CLOUD COVER
Midday Run
Age of data 5-hours [chtplt-N193]
2.0/ 4.0
4.0/ 6.0
6.0/ 8.3
30°N
50°W
40°W
30°W
20°W
10°W
30°N
0°

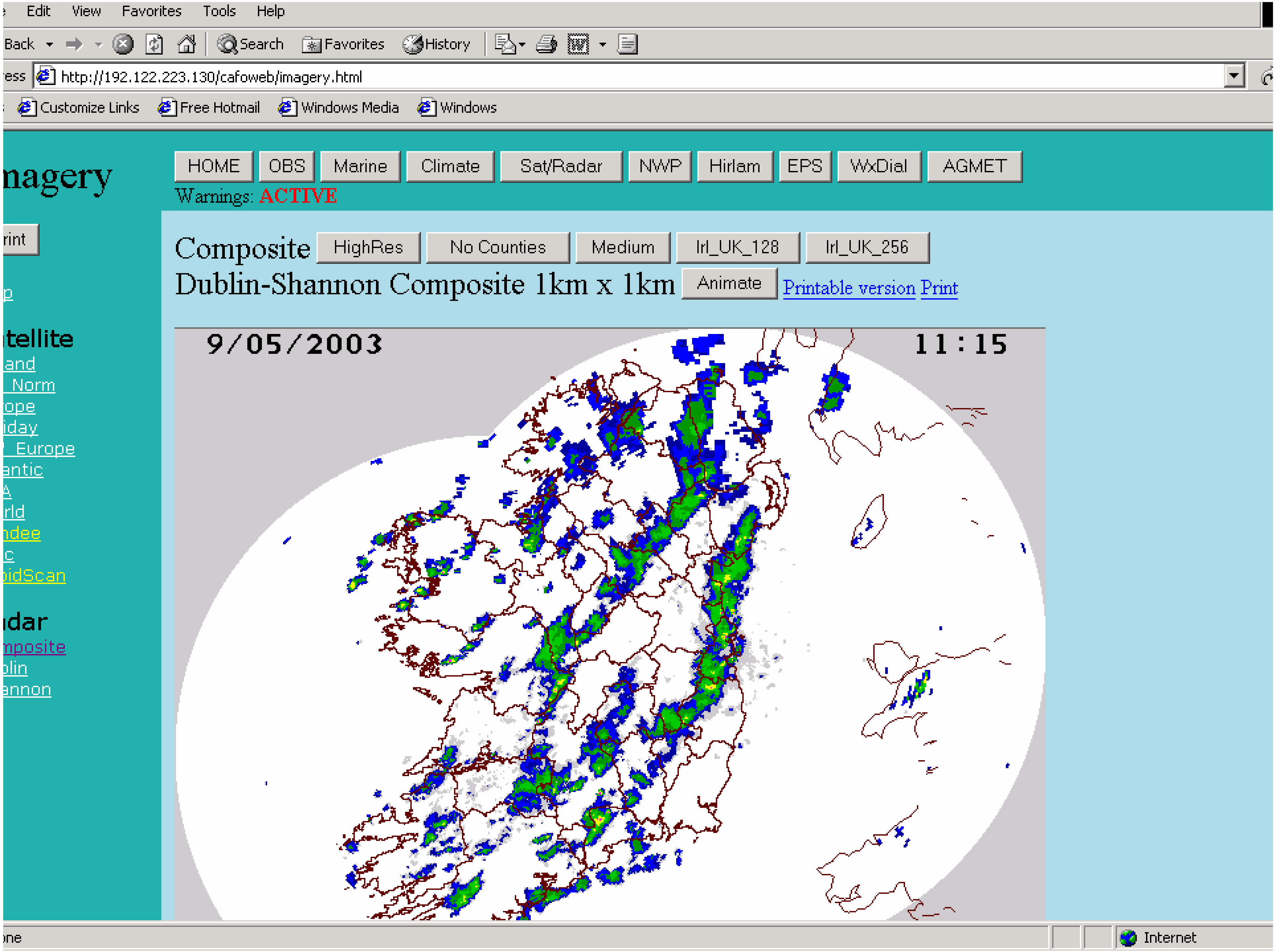
The Irish Meteorological Service

SAMPLE MET ÉIREANN WEB PAGES

The following slides show some examples of the type of web pages available internally at Met Éireann ...

MET éireann


Edit View Favorites Tools Help
Back Search Favorites History
http://192.122.223.130/cafoweb/
Customize Links Free Hotmail Windows Media Windows
CAFO WEB PAGES
HOME OBS Marine Climate Sat/Radar NWP Hirlam EPS WxDial AGMET
[Satellite Radar Animations Information www.met.ie Check Warnings] Warnings: ACTIVE
Observations
Observations
Lighthouse Vis Reports, Marathon Rig Report and Kish Data are on the Observations and Marine Pages
Plotted Buoys, Latest Sferics and Sferics Loop, European Max and Min Temps are on the Observations Page
Recent Observations by Hour or by Station on the Observations Page new
MACE HEAD observations on the Observations page new
Data
AGMET Data with SUNDAY.EXE
Climate Enquiries Page
Monthly Weather Summaries
Monthly Data Rainfall Temperature
UK Shipping Forecast, US Sea State Analysis (in feet), SST Anomalies are on the Marine Page
Misc
WMO City Forecast Editor Help
Satellite, Radar etc.
NEW IMAGERY VIEWER with Zooming and Animations ..click here for more details.
LOCAL Dundee NOAA Archive
High Resolution NOAA images from Wokingham
Dundee Web Site (Netscape)
Satrep images
Rapid Developing Thunderstorms
Meteosat D2 Images
NOAA Quikscat Winds
Quikscat Winds Local Area
GOES-East Visand IR
Forecast Models
NWP Viewer Hirlam, UKMO, AVN, NOGAPS
Hirlam
Hourly Hirlam Analysis and 3Hr forecasts are now the Observations Page.
UKMO
R & A Web site
Nested Hirlam: Roadice Forecasts new
Nested Hirlam: Analysis new
Nested Hirlam: Forecasts new
Hirlam: Forecast Meteograms
Meteograns + OBS
Observed Tephigrams
Forecast Tephigrams
CAFO NOTICE BOARD UPDATED
Tuesday, 29-Apr-03 16:47:42
Useful Information
Forecaster Duty Schedules
USER Links Add your own links new
Climate Database
Climate Enquiries
Internet



Edit View Favorites Tools Help
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Customize Links Free Hotmail Windows Media Windows
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HOME OBS Marine Climate Sat/Radar NWP Hirlam EPS WxDial AGMET
Warnings: ACTIVE
Composite HighRes No Counties Medium Irl_UK_128 Irl_UK_256
Dublin-Shannon Composite 1km x 1km Animate Printable version Print
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Links Customize Links Free Hotmail Windows Media Windows

Imagery

HOME | OBS | Marine | Climate | Sat/Radar | NWP | Hirlam | EPS | WxDial | AGMET

Warnings: ACTIVE

Print

Help

Satellite

Ireland
Vis_Norm
Europe
Midday
NWP_Europe
Atlantic
USA
World
Dundee
Arctic
RapidScan

Radar

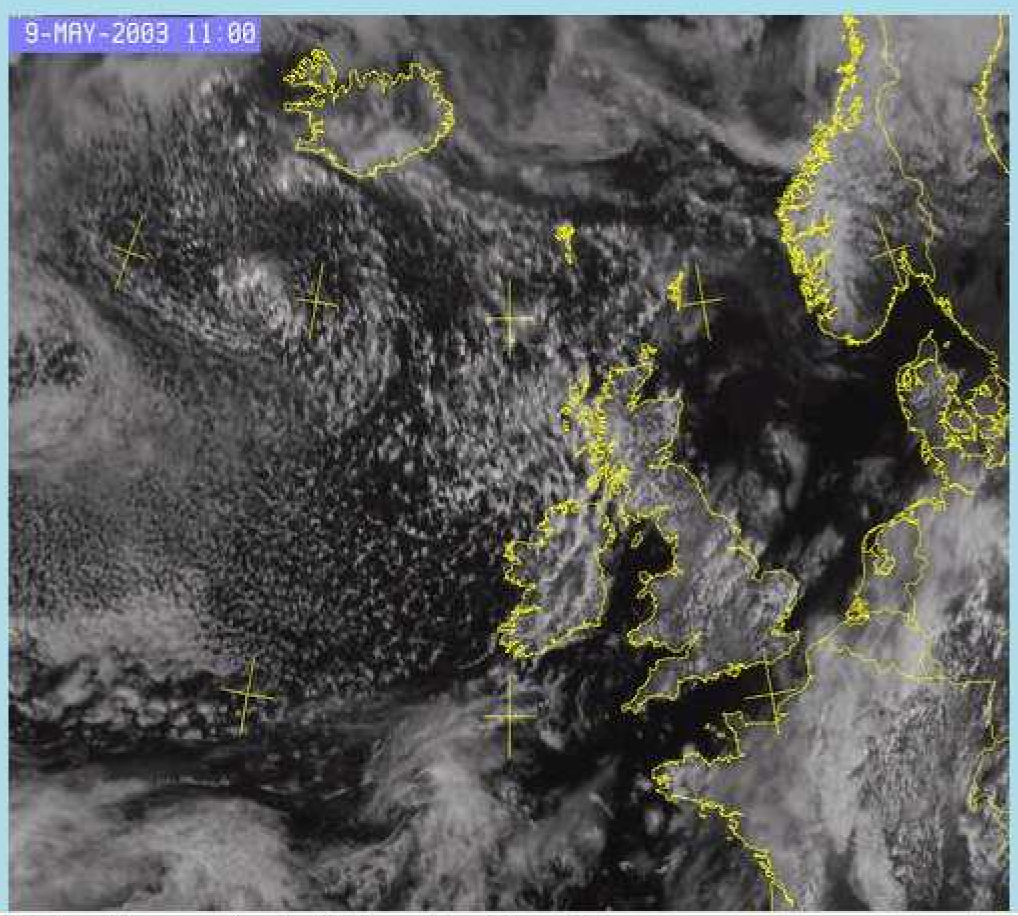
Composite
Dublin
Shannon

Vis_Norm

Vis Norm | Vis Norm 100% | Vis Norm Zoomed

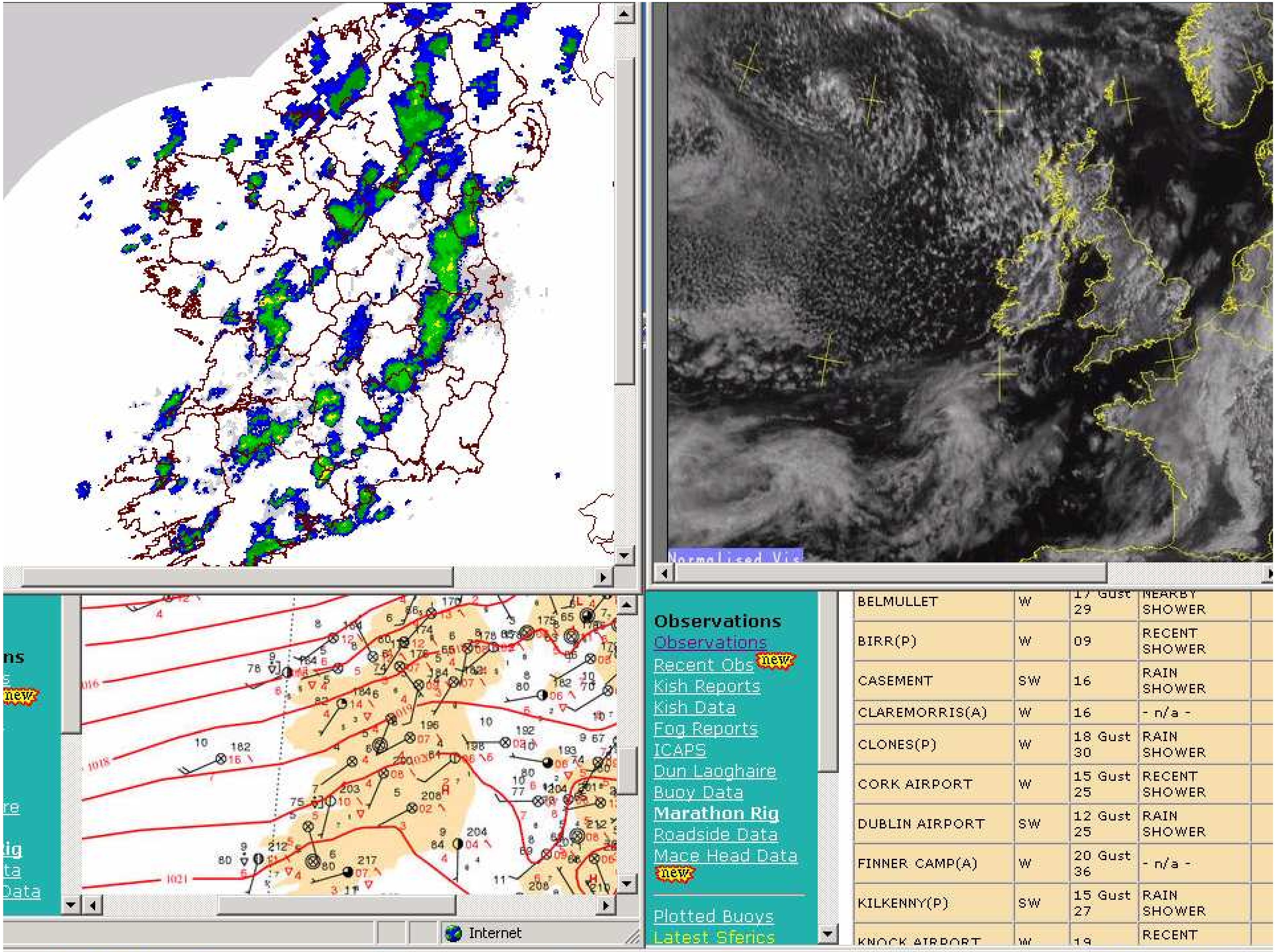
Ireland Normalised Visible

Animate | Printable version Print



http://192.122.223.130/cgi-bin/cafoweb/imagery.cgi?mode=IMG&area=Europe&type=def

Internet



Normalised Vis
Observations
Observations
Recent Obs
new
Kish Reports
Kish Data
Fog Reports
ICAPS
Dun Laoghaire
Buoy Data
Marathon Rig
Roadside Data
Mace Head Data
new
Plotted Buoys
Latest Sferics
BELMULLET W 17 Gust 29 NEARBY SHOWER
BIRR(P) W 09 RECENT SHOWER
CASEMENT SW 16 RAIN SHOWER
CLAREMORRIS(A) W 16 - n/a -
CLONES(P) W 18 Gust 30 RAIN SHOWER
CORK AIRPORT W 15 Gust 25 RECENT SHOWER
DUBLIN AIRPORT SW 12 Gust 25 RAIN SHOWER
FINNER CAMP(A) W 20 Gust 36 - n/a -
KILKENNY(P) SW 15 Gust 27 RAIN SHOWER
KNOCK AIRPORT W 19 RECENT
Internet

PLANS for the FUTURE

CHALLENGES

• Display	YES
• Modification	NO
• Automatic Production	NO [Some but not integrated]

NEED

- Grid-Point Field Database / Time-Series Point Database
- Field Editor / Time-Series Editor
- Improved Automatic Production facilities

TWO SEPARATE COMPONENTS

- Editing of Data / Automatic production of products

POSSIBILITIES

DEVELOP SYSTEM

- Needs lots of resources
- Looking at possibility of developing newspaper system [in Java]

PURCHASE SYSTEM

- Cost considerations
- May not have full flexibility needed for our applications

CO-OPERATION

- Co-operate with another Met service to develop / extend system

The Irish Meteorological Service

MET éireann

The End

NinJo : Development of Frameworks for Meteorological Applications

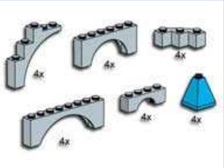
Sibylle Haucke, DWD

EGOWS 2003 Tromsö

Overview

- NinJo: application or building kit?
- Examples of NinJo frameworks : more details
- NinJo frameworks: definition and main design concepts
- Changing of frameworks being used : How do the frameworks and the configuration management support the migration ?
- Advantages and disadvantages of current NinJo development strategy
- Conclusions

NinJo- Application Or Building Kit ?



- NinJo (client) consists of:
  - Frameworks on the one hand
  - Applications (normally called Layers) on the other hand
  - Applications use the frameworks and must follow unique design rules
  - Applications provide Gui components and concrete graphical representations of data
  - Frameworks itself use NinJo frameworks
  - NinJo client is configured in a way that applications (Layers) are put together
  - Layers handle different kinds of data and are displayed as overlays inside a map
  - Other applications are diagrams (Meteograms) and tables
- NinJo server use frameworks too

NinJo- Application Or Building Kit ?
NinJo frameworks - definition

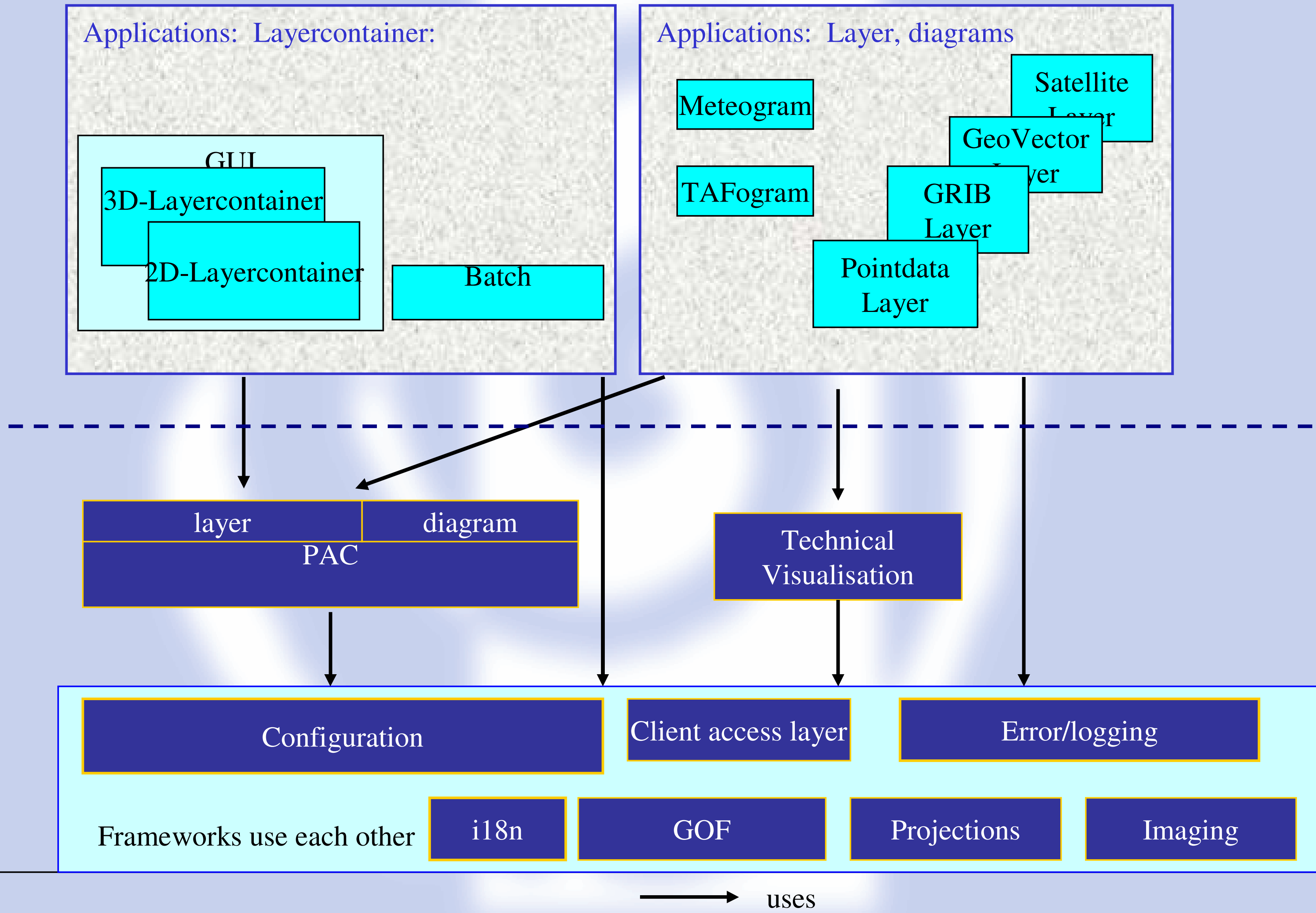
- What do we call a framework in NinJo context?
  - A separate software module (or sub tier) inside the NinJo client
  - Similar to a software library
  - Consists of interfaces and base classes
  - Based on other NinJo frameworks and existing JAVA classes
  - Is used by several applications inside NinJo
  - Implementation of the frameworks is most generic
  - Most are configurable themselves

NinJo- Application Or Building Kit ?

NinJo frameworks - overview

- Configuration Framework
  - makes all NinJo components configurable with XML files
- PAC
  - the building kit for layers and diagrams
- GOF
  - graphic objects factory
- Client AccessLayer
  - interface to the server base data
- I18n
  - Provides capabilities of internationalisation
- Error/Logging
  - provides a unique error handling and logging of informations
- Imaging
  - NinJo Imaging Core
- Projections
  - geographical projections and maps

NinJo- Application Or Building Kit ?
NinJo client frameworks and applications

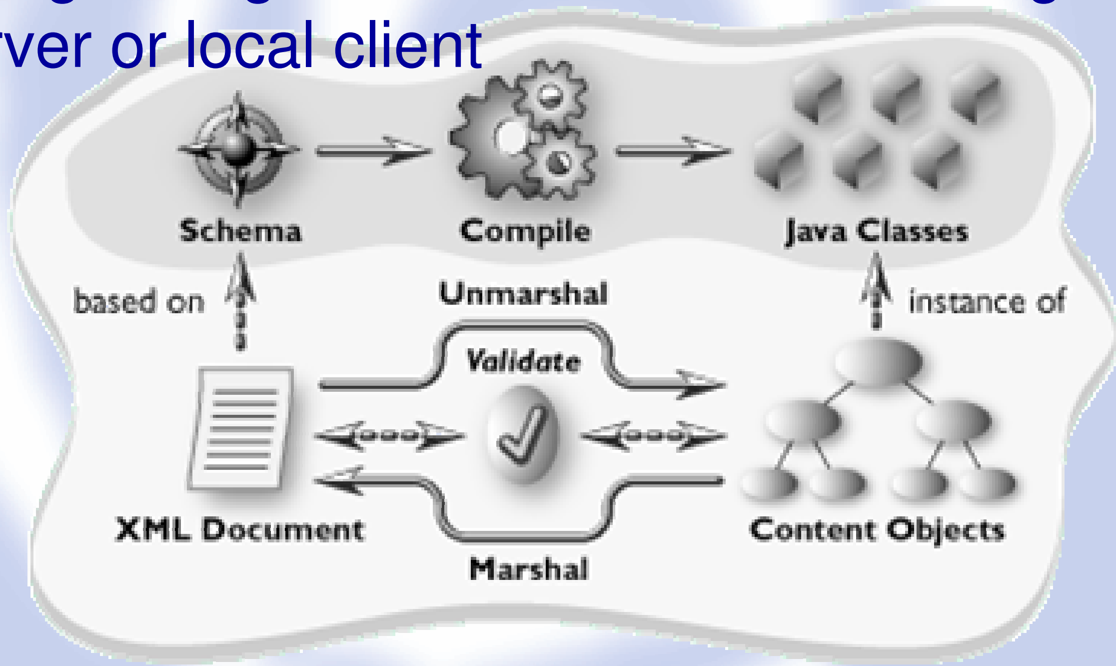


NinJo Framework Examples
Configuration framework

- NinJo is high configurable
  - Based on XML and uses a data binding mechanism
  - Takes care of loading and saving single configurations as well as whole favourites (Scene configurations, workplace configurations,..)
  - Contains class generator for generation of Configuration classes
  - The Client is mainly determined by its configuration
  - Each client can have its own GUI look & feel, number of Layers, Scenes, diagrams ,...
  - Configuration objects control the information and control flow inside NinJo, are even used to perform Undo/Redo capabilities
  - Configuration objects are also used on the server side

NinJo Framework Examples
Configuration framework

- Data binding
  - Maps the content of XML documents to Java objects that expose the data in way similar to JavaBeans™.
- Has a hierarchy of ConfigContexts
- The ConfigManager is used to retrieve configuration data from server or local client



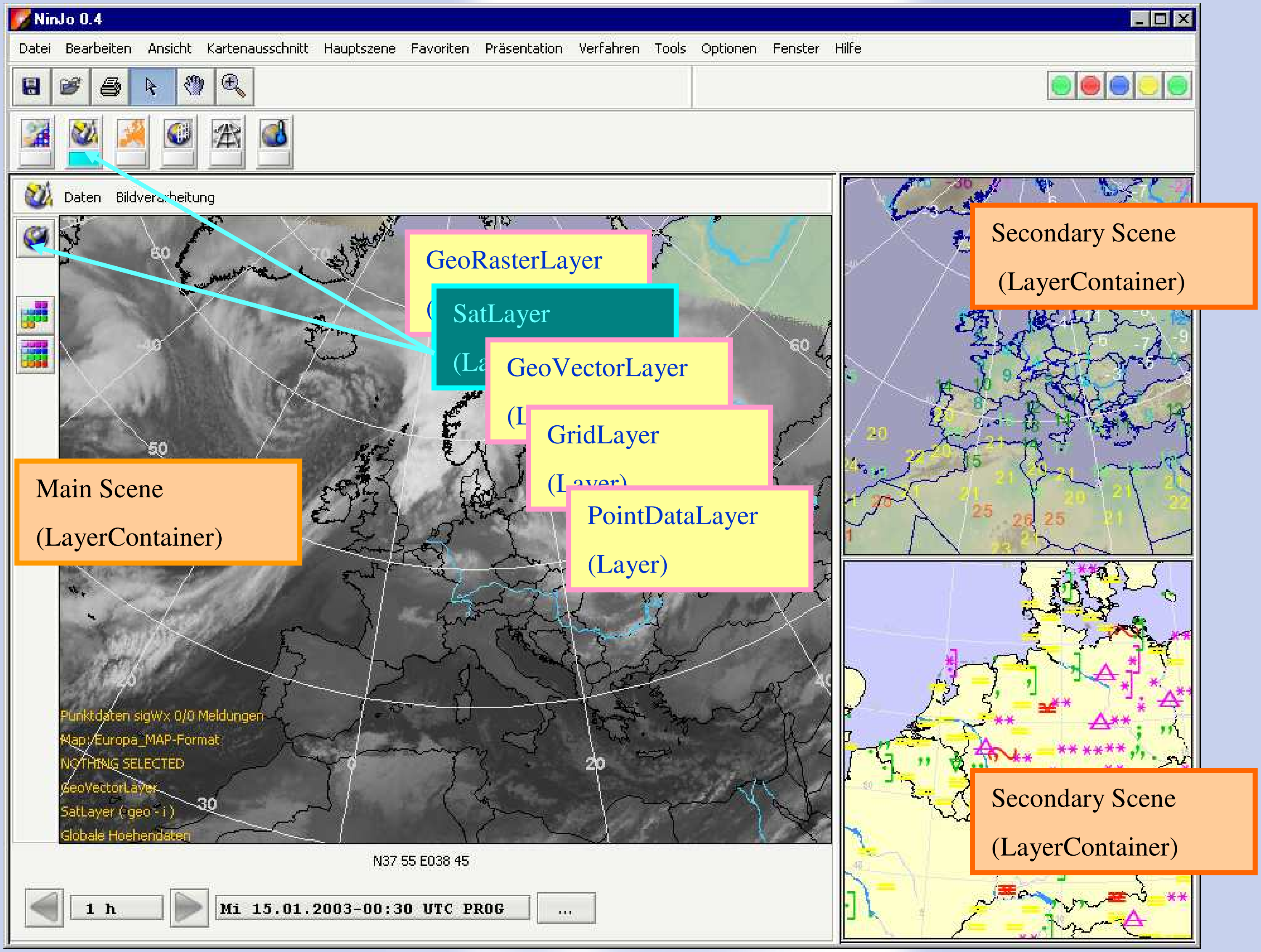
NinJo Framework Examples

PAC - the Layer Framework

- The Presentation-Abstraction-Control architectural pattern (PAC) defines a structure for interactive software systems in the form of a hierarchy of co-operating agents.
- The PAC-Framework provides interfaces, that can be used to compose subject oriented GUI components to a “whole” client GUI, to manipulate and change them.
- The technical dependencies between agents (for example the tree like agent hierarchy) are covered by the PAC framework.
- The configuration of the NinJo client is loaded and interpreted inside the PAC framework, the agent objects of configured agents are automatically created.

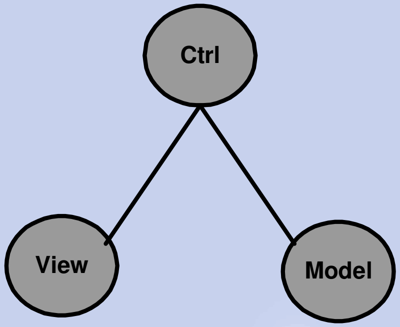
NinJo Framework Examples

Layers in NinJo GUI



NinJo Framework Examples

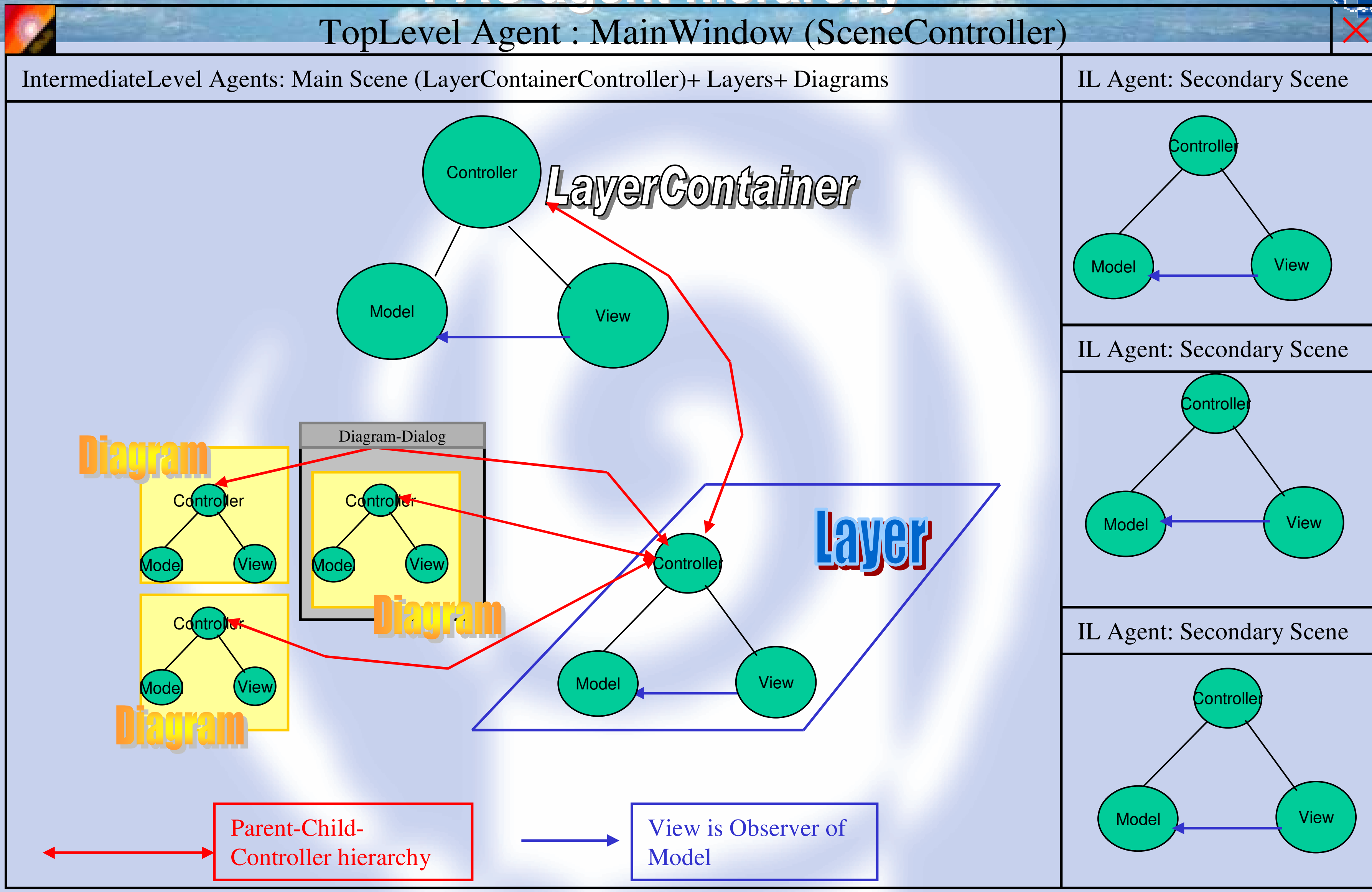
PAC Agents - MVC triples in NinJo



- NinJo Client consists of a tree of MVC triples, each of them called „PAC Agent“
- These agents are used like GUI components
- Hierarchy of agents as „aggregation“ represents the GUI
- Build different NinJo (DWD, MeteoSWISS, GeoPhys, DMI, MSC) clients with a „building kit“
- Objectives of design of the PAC framework:
  - configurability of agent-hierarchy (XML)
  - configurability of representation of an agent
  - strict decoupling of agents

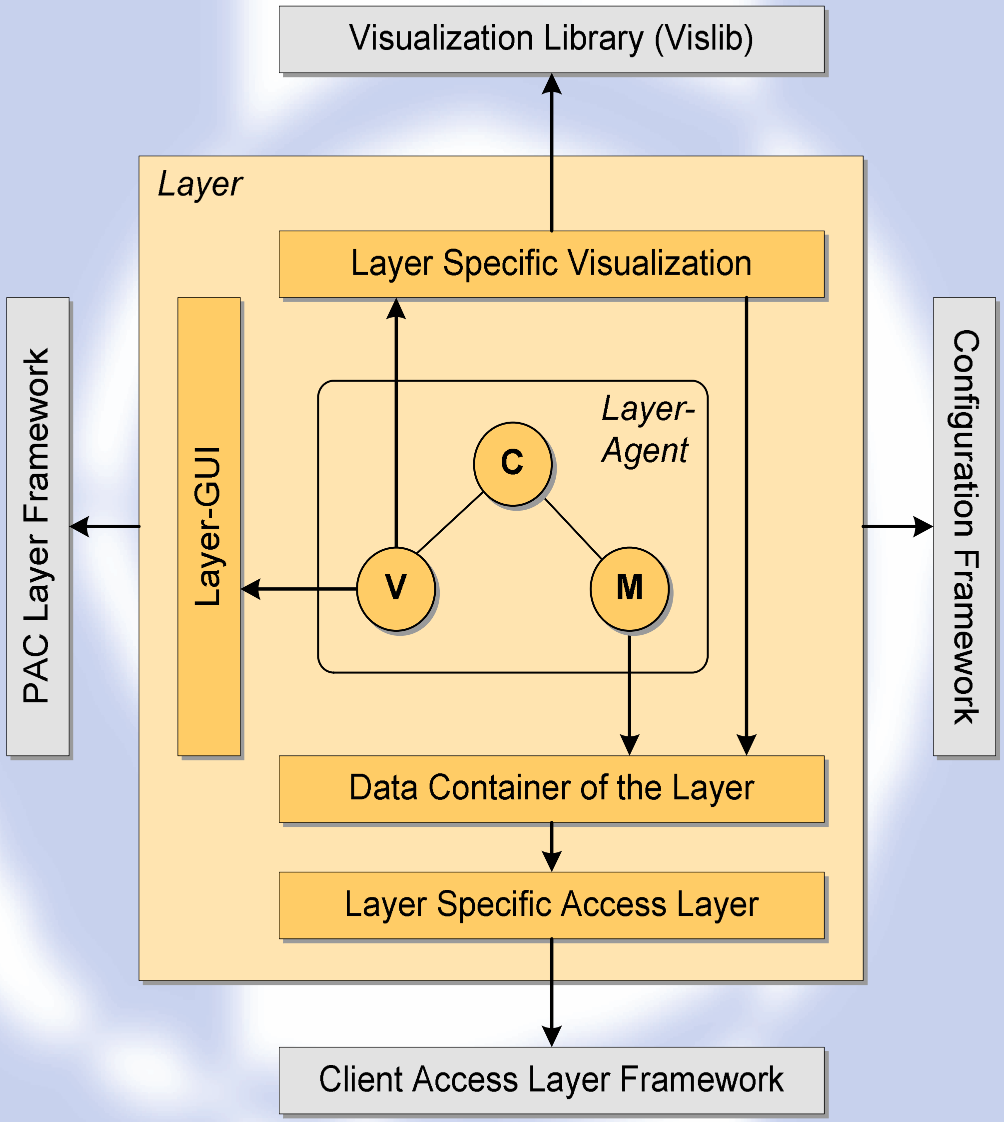
NinJo Framework Examples

PAC agent hierarchy



NinJo Framework Examples

NinJo Client - Layer pattern

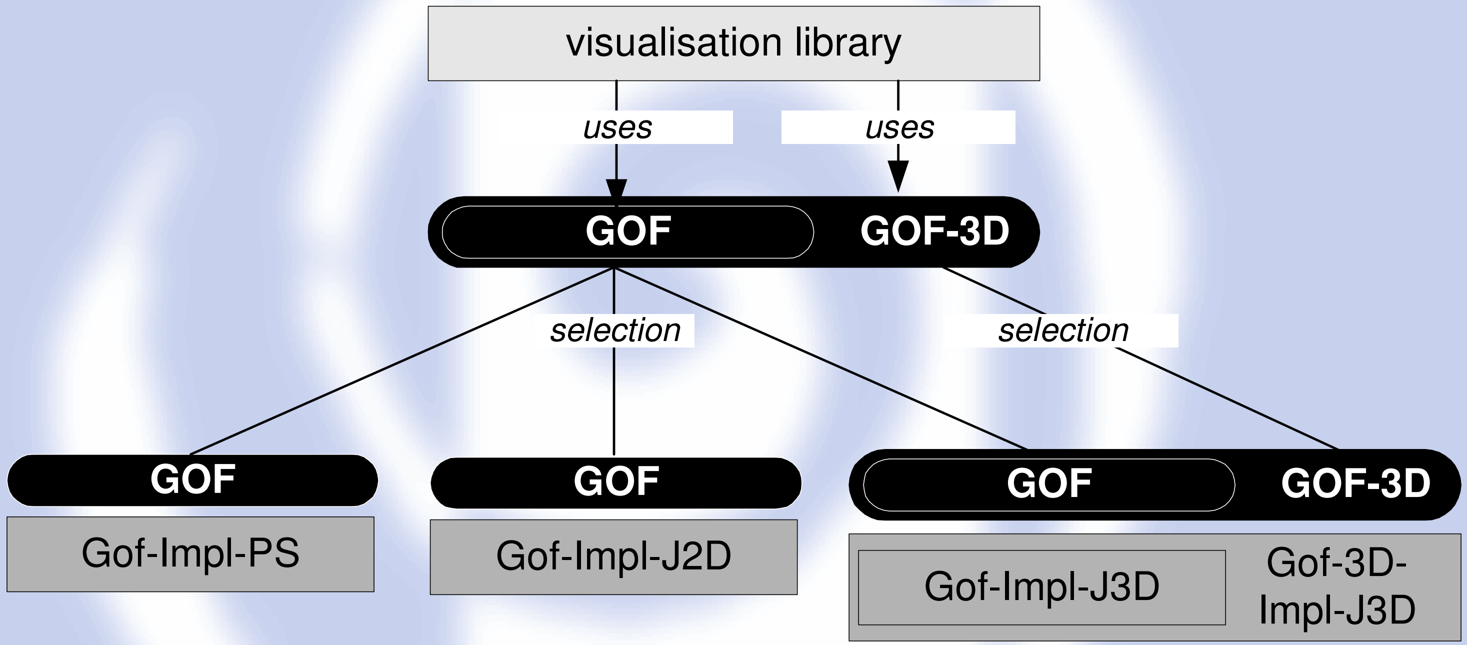


NinJo Framework Examples

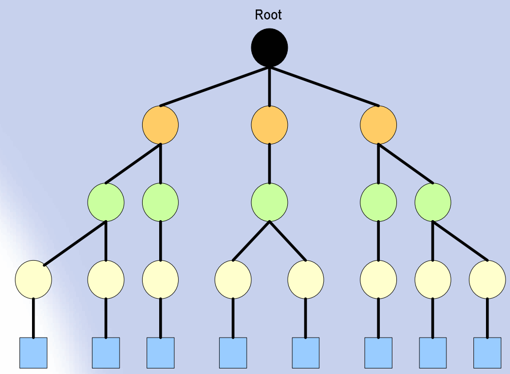
GOF - the graphics object factory

- Provides graphical objects and methods
- 2D-Vector graphics
  - lines
  - polygons
  - texts
- Raster graphics
  - image visualisation and transformation
- 3D-Graphics
  - free shape surfaces
  - lighting and transparency
  - navigation in 3D scenes

NinJo Framework Examples
GOF - the graphics object factory

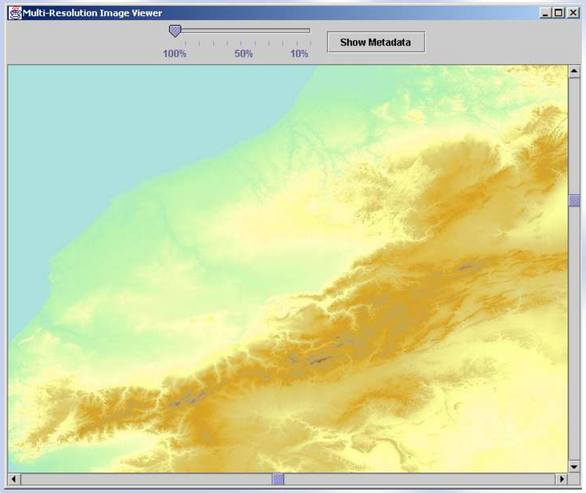


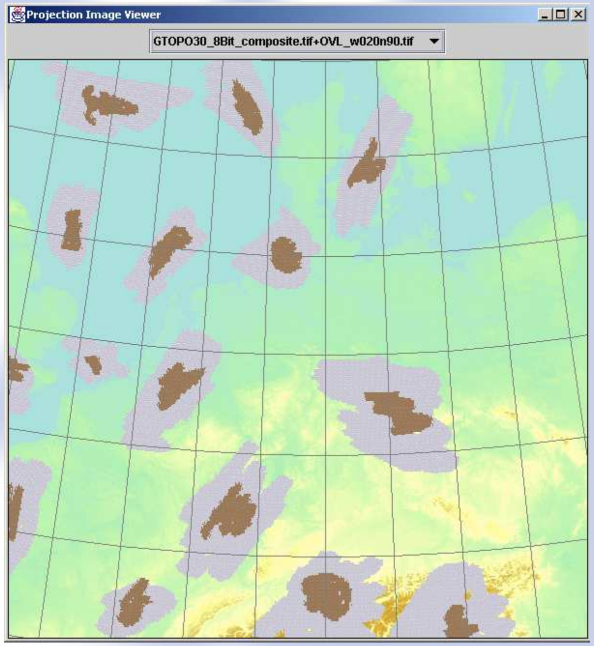
NinJo Framework Examples
Client Access Layer



- Task: Data Management
  - The Client Access Layer ...
    - ... knows, which kind of data is available.
    - ... knows, where the data is available.
- Task: Providing Information
  - The Client Access Layer ...
    - ... provides this knowledge to any client module interested in the information.
- Task: Accessing Data Source
  - The Client Access Layer ...
  - ... provides mechanisms to access the data
    including error handling, automatic fail over and load balancing.
  - ... hides technical details about accessing the data source.
- The data management in the Client AL is based on meta data.
- For every kind of data type a *meta data tree* is built up.

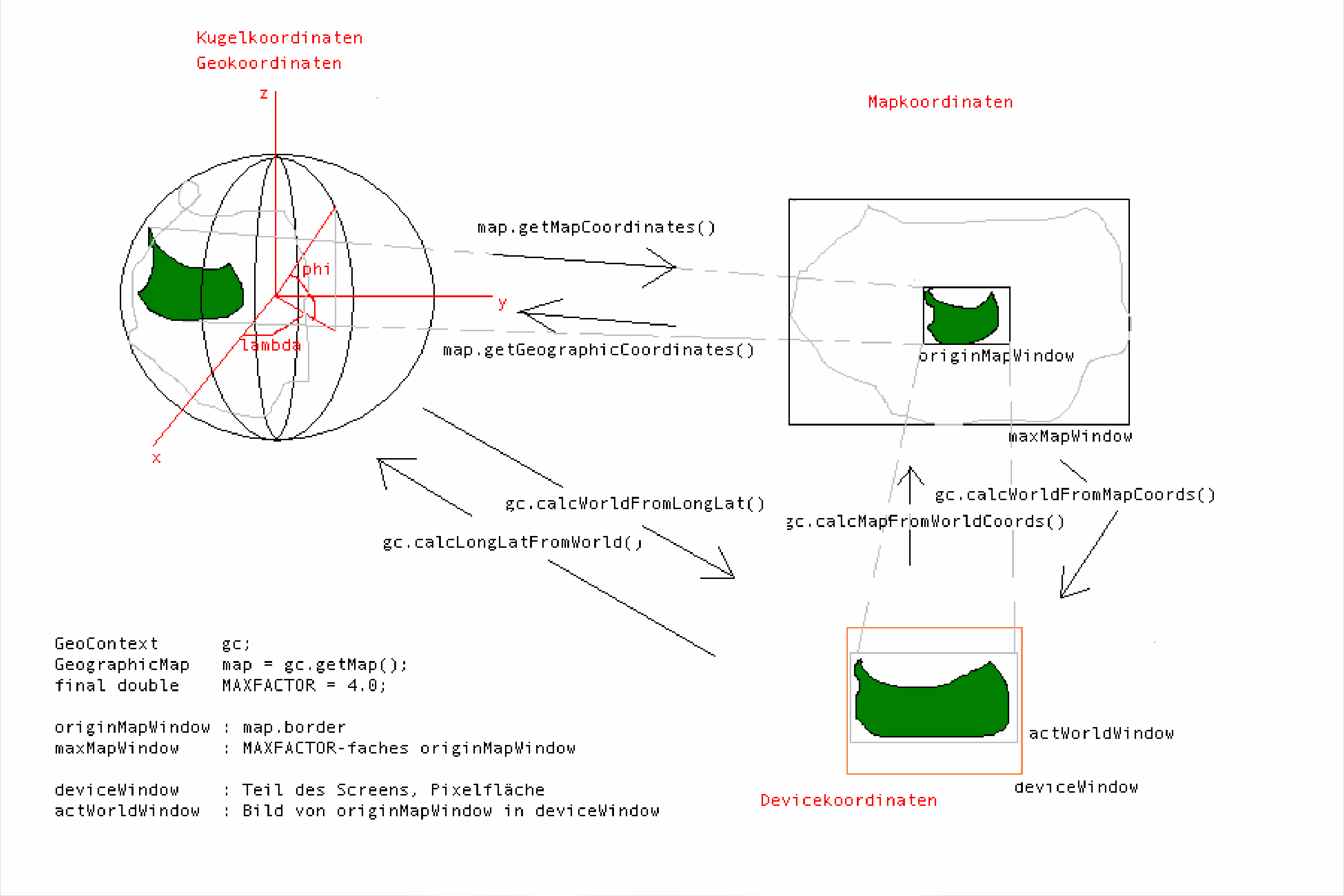
- NIC (NinJo Imaging Core)
  - Based on Tiled-TIFF and JAI (JAVA Advanced Imaging)
  - Loading,
  - Projecting,
  - Overlaying,
  - Visualising images





NinJo Framework Examples
Projections and Maps

- Projections and maps: takes care of geographical projections, maps and some tools for graphical applications



Changing Of Frameworks Being Used
Motivation

- Changing of frameworks being used - is this necessary?
- Situation after version NinJo0.41- beginning of 2003:
  - We could not fulfil a number of important use cases with the old frameworks and current Layer implementations
  - Examples:
    - Favourites (extensions to: Config +PAC)
    - Batch production (extensions to : Config +PAC)
    - Internationalisation (introduction i18n)
    - Server access (introduction client-AL)
    - Diagrams (extensions to PAC)
    - UNDO (extensions to Config + PAC)
  - We planned a consolidation phase for Layers : a chance to improve the quality of the Layers and bring them up to a more unique design, May/June 2003
  - We organised a training week to teach the new features of the frameworks (in March 2003)

Changing Of Frameworks Being Used

How do the frameworks support the migration?

- Rules for NinJo frameworks
  - Well defined responsibilities
  - Backward compatibility as far as possible
  - Well documented
  - Framework usage and architectural patterns are trained
  - Developed by high qualified framework developers with the best technical skills in the NinJo teams
  - High software quality standards (Code reviews)
  - Well defined version management and frozen (in Perforce) versions

Changing Of Frameworks Being Used

How do the frameworks support the migration?

- Most important aspect: the software architecture
  - Usage of object oriented design patterns
  - Use interfaces for defining the communication between objects
  - Construct base classes with the basic functionality
  - Define NinJo specific design patterns (e.g. the Layer pattern)
  - Teach these patterns as rules and “HowTo ..”- tutorials
  - Multi tier architecture - functionality can be added inside the framework without affecting the Layer programmer
  - The advantages of object orientation (inheriting, overloading of methods) can be used for that
- Well defined development and migration steps
  - Backward compatible as far as possible
- Framework developers themselves prepare training courses and documents

Changing Of Frameworks Being Used

How do the frameworks support the migration ?

- Example Favourite and Batch
  - very important and with some effort
  - Support by Configuration Framework and PAC :
    - The most features are implemented inside the frameworks, Layers don't have to care, how to load/save configurations or favourites
    - Basic implementations (some final, some can be overwritten) deliver most of the desired functionality
    - For easier integration some effort was made by framework developers:
      - Integration steps were defined (and frozen with Perforce labels)
      - These integration steps were practised during the training week on a Layer example
      - Personally Support (framework designers) at some locations (Traben-Trarbach, Offenbach)

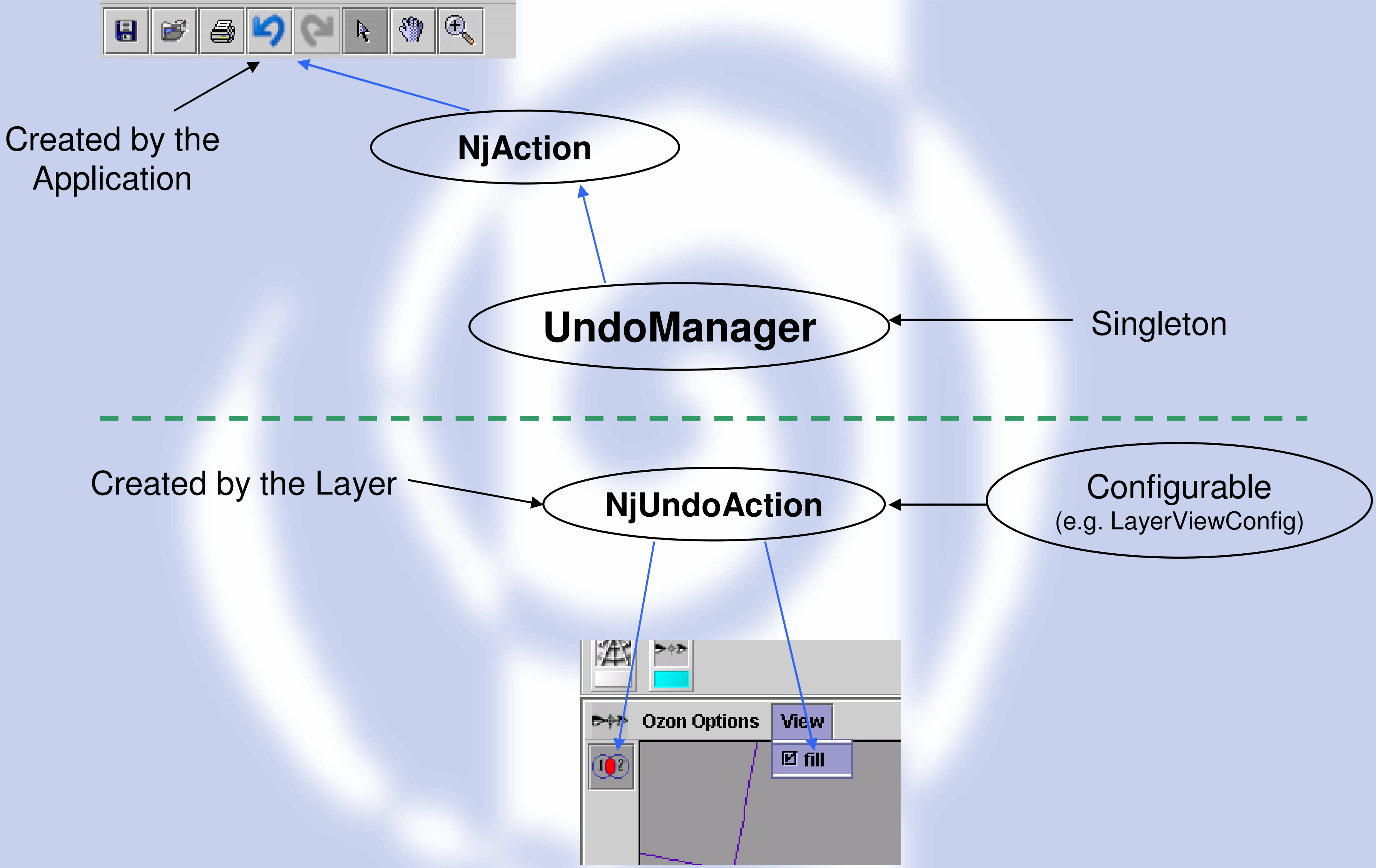
Changing Of Frameworks Being Used

Motivation for the Layer teams

- New functionality inside the layers without much work
  - Example: UNDO and Favourites
  - With a integrated UNDO mechanism (via PAC and Configuration) only few new classes and methods must be known by the Layer teams -see next slide

Changing Of Frameworks Being Used

Motivation for the Layer teams



Changing Of Frameworks Being Used
Organisation of work

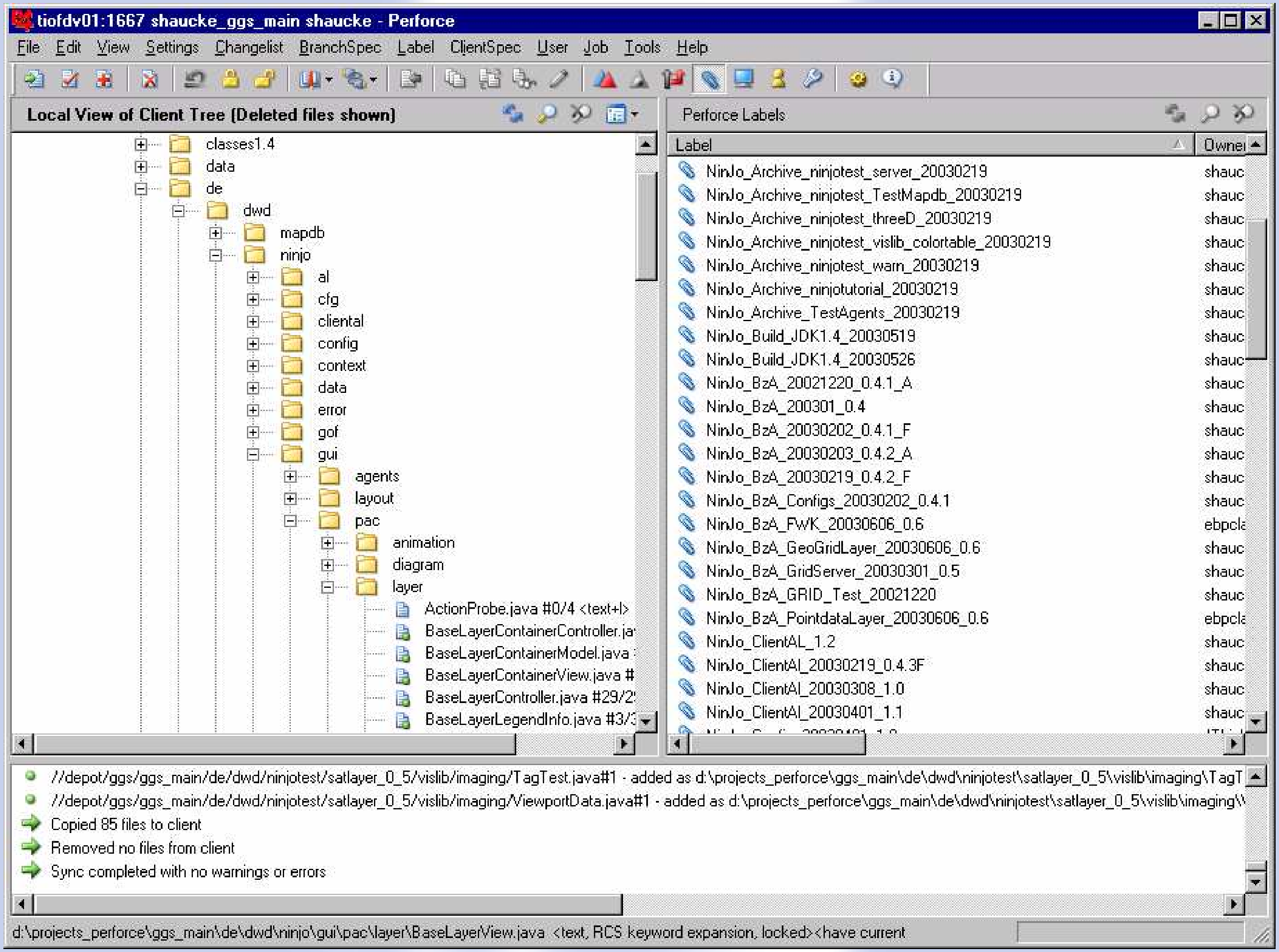
- The work is distributed among several teams
- Architectural team: provides frameworks, patterns
  - consists of all local chief designers from Offenbach, Hamburg, Potsdam, Traben.Trarbach, Zürich, Kopenhagen, (Toronto) , Consultants and the "Chief Designer"
- Client application (Layer) teams:
  - Offenbach, Traben-Trarbach, Potsdam, Kopenhagen, Zürich, Toronto, Montreal
- Server application teams:
  - Zürich, Offenbach
- This way all locations take part in the development of frameworks <u>and</u> applications
  - good communication between the teams is very important -> regular design meetings of architectural team

Changing Of Frameworks Being Used
Source Code and Configuration Management

- Perforce as Source Code Management Tool
  - Very fast
  - Solve the firewall problems
  - P4Win for Windows platform, p4tk for Linux
  - Used for the project documents too
- Use Perforce Labels as Configurations
  - A configuration is a collection of source files with certain versions
- Extensive usage of labels for versioning purposes
  - Unique naming conventions of labels
  - Framework labels with frozen framework versions
  - Layer labels with frozen Layer versions
  - Build up whole prototypes from a number of labels

Changing Of Frameworks Being Used

Source Code and Configuration Management



Changing Of Frameworks Being Used

Are these the last changes in frameworks?

- Unfortunately not:
- Why ?
  - Some planned extensions could not be realised yet (to less time)
  - Example: PAC:
    - planned releases :
      - 1.4 (diagram framework ,Visualizer concept and event handling)
      - 1.5 (editor functionality)
- When will these framework updates come to an end?
  - Hopefully end of 2003 : here the most use cases should be defined inside requirement specifications and be known to the framework developers
  - But no guarantee for it- if we get new requirements during the project development

Advantages And Disadvantages

Did or do we have any other choice ?

- In NinJo we started to build first client versions on rudimentary frameworks in a very early stage to have quick success
  - We needed these evaluation versions to integrate our users into the development process
  - An alternative would have been : first develop all frameworks to the end, then start Layer development
    - These was impossible, because nobody could imagine all necessary use cases in the beginning of development
    - A framework design must be created step by step and then tested by applications (Layers)
    - If we would have created dummy test Layers: I´m sure, we had not found all design or implementation errors of the frameworks

Advantages And Disadvantages

What are the disadvantages of this strategy?

- More work for the application developers
- Very high load on framework designers and developers
- The development time increases somehow
- The Layer developers often have to learn new framework usage
- We must plan consolidation time phases for the applications (Layers)
- We must plan training weeks

Advantages And Disadvantages

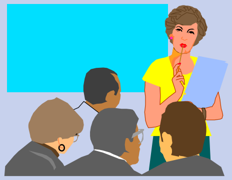
What are the benefits of this strategy?

- Hopefully to achieve a good user acceptance, because of evaluation process
- The organisations see results of our work on a regular time schedule
- We have the chance to recognise design flaws in frameworks early
- Our frameworks got a better design to avoid most of migration effort for the application (Layer) developers, framework designers learned to create backward compatible changes
- Documentation of the frameworks got high priority since it was necessary to prepare the training week- now we have well documented frameworks
- At the end the frameworks are very flexible, can be extended without any (or few) coding effort at the application side (Layers,..)

Conclusions

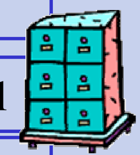
- Our strategy is adapted to the special NinJo environment - another way is not feasible
- We must plan further consolidation phase(s)
- Training of team members and quality management inclusive Code reviews is important
- We must adjust the project mile stones to the real situation
  - Layers that seem to be nearly ready, are not really finished
  - If all main use cases of NinJo (e.g.: Batch, UNDO , or such “little” problems like editing graphics and data) are realised and all Layers then are consolidated (or migrated) again: this might be the right time to assume a Layer as “finished”
  - See next (the very last) slides: what does it mean for developing a Layer ?

Remember:
7 steps to create a NinJo Layer



NinJo - PAC (Layer) -Framework course, incl.
Configuration Framework training, Layer Pattern

- Create new Layer Agent implementation classes by extending the base classes (and creating a new gui.agents.layer-package)



- Design new data implementation classes (data container), use them in Model
- Design new client al implementation classes for data access

- Create a new Layer Agent Configuration with Config Framework
- Create new Visualisation (Visualizer) classes, configure them
- Develop specific GUI-elements like Toolbar, Dialog boxes , menu and actions for the Layer Agent
- Extend the LayerContainer configuration file to integrate the new Layer Agent into NinJo client by inserting a line for the new Layer

---

Now the Layer should work, but is not finished yet (missing some quality standards).

Creating A Layer - Part 2:
Consolidation and Correctness (the next 7 steps)

- ✓ A working NinJo Layer with correct Configuration.
- Implement i18n , create the properties files
- Insert logging instead of „System.out.println“
- Error handling with NinJo-Error FWK
- Create UNDO-able Actions
- Optional: Event handling on GOF objects (Pick/Touch on Visualizer)
- Code profiling (Performance, Safety Programming), Code Reviews
- Documentation: Update the Design Document + Create User Manual

---

Now the Layer should fulfil the high quality standards of NinJo and is „Ready for acceptance“

CORBA and NinJo: Software Design and Experiences

Dr. Volker Jung
sd&m AG, Offenbach, Germany
volker.jung@sdm.de

Why should you be interested in CORBA?

- It is the standard middleware for building distributed, object-oriented applications
- It easily operates across platforms, operating systems and programming languages
- CORBA-related products are very stable and reliable
- It can reduce the cost of developing client-server applications
- It can help make your (server-side) software last longer
- It is well-suited to data-rich applications such as meteorological data processing

Some facts about CORBA

CORBA

- the Common Object Request Broker Architecture
- mechanism for object-oriented Remote Procedure Calls (RPCs)
- object services
- mappings for numerous programming languages
- communication protocol (IIOP)

OMG

- founded in 1989
- Hardware and Software Vendors, Universities, Organisations
- approx. 800 members
- specifications for CORBA , UML, CWM, MOF

IDL

- language-neutral interface definition
- compiles into language-specific APIs
- purely declarative
- comparable to Java Interfaces

Agenda

þ Introduction

¤ **Architecture / Middleware Evaluation for NinJo**

¤ **CORBA in NinJo's Software Architecture**

¤ **Optimization and Performance**

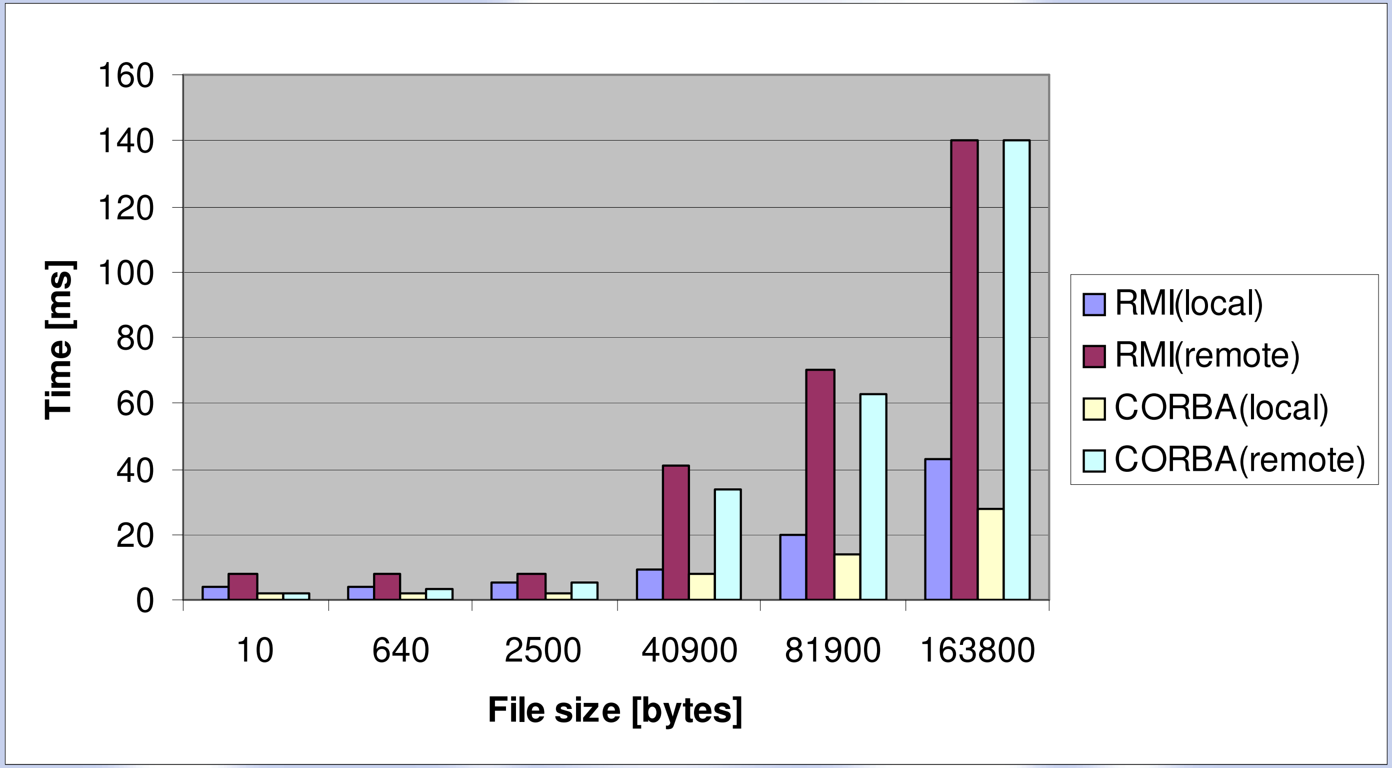
¤ **Conclusions and Recommendations**

Evaluation of Middleware Options

Sockets	RMI	Corba	XML
+ performance + know-how available	+ easy to use + maintainability + Java integration	+ (relatively) easy to use + larger standard + platfrom independent	+ extremely flexible + gaining importance
− need to write own commu-nication layer − concurrency − maintainability	− Java only − know-how scarce	− product SW − know-how scarce	− overhead − complexity of usage

Platform independance and ease of use are crucial factors indicating the use of CORBA. Performance needed to be evaluated

Performance Evaluation for RPCs



- early tests where made with JacORB
- no significant differences between RMI and CORBA
- no significant overhead for middleware, limiting factor is the network (or the server disk drive speed)

Agenda

þ Introduction

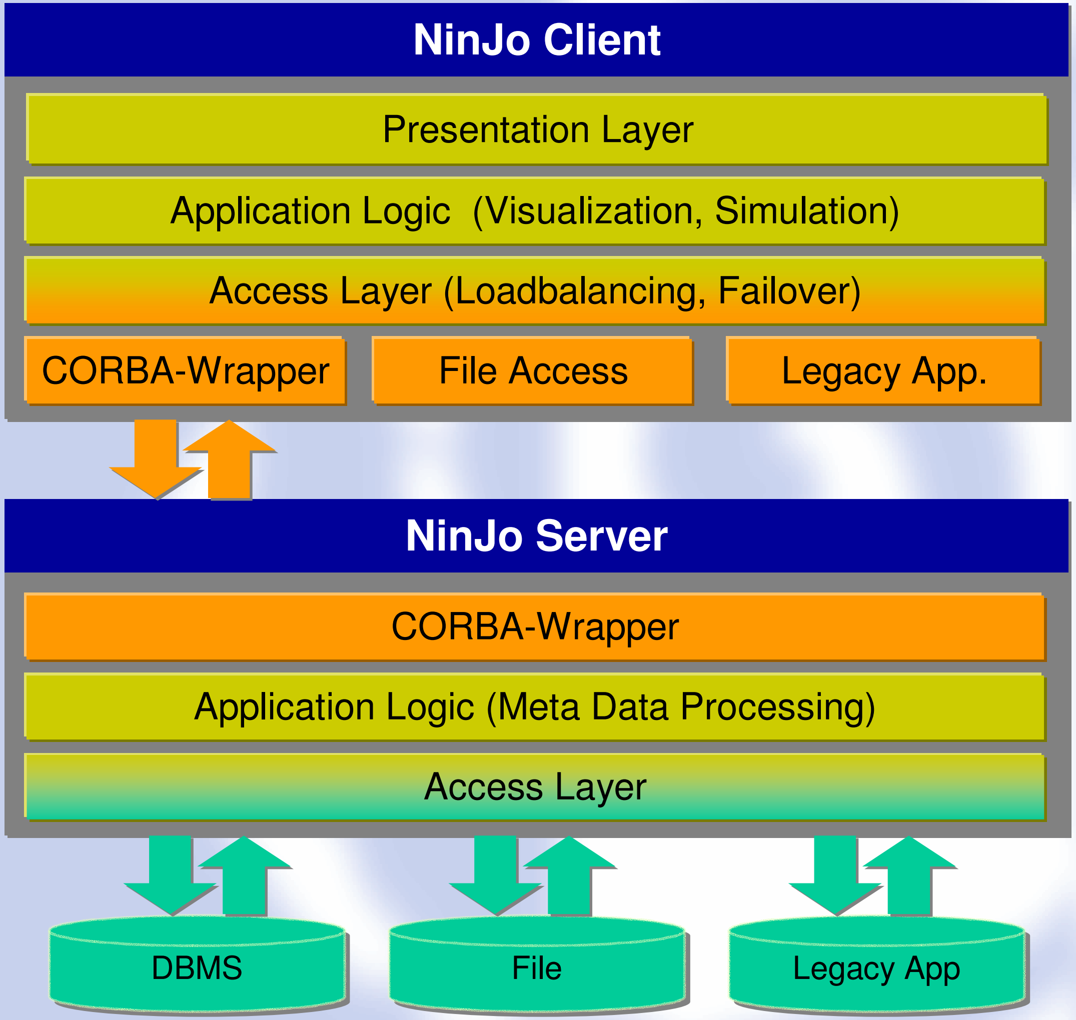
þ Architecture / Middleware Evaluation for NinJo

¤ **CORBA in NinJo's Software Architecture**

¤ **Optimization and Performance**

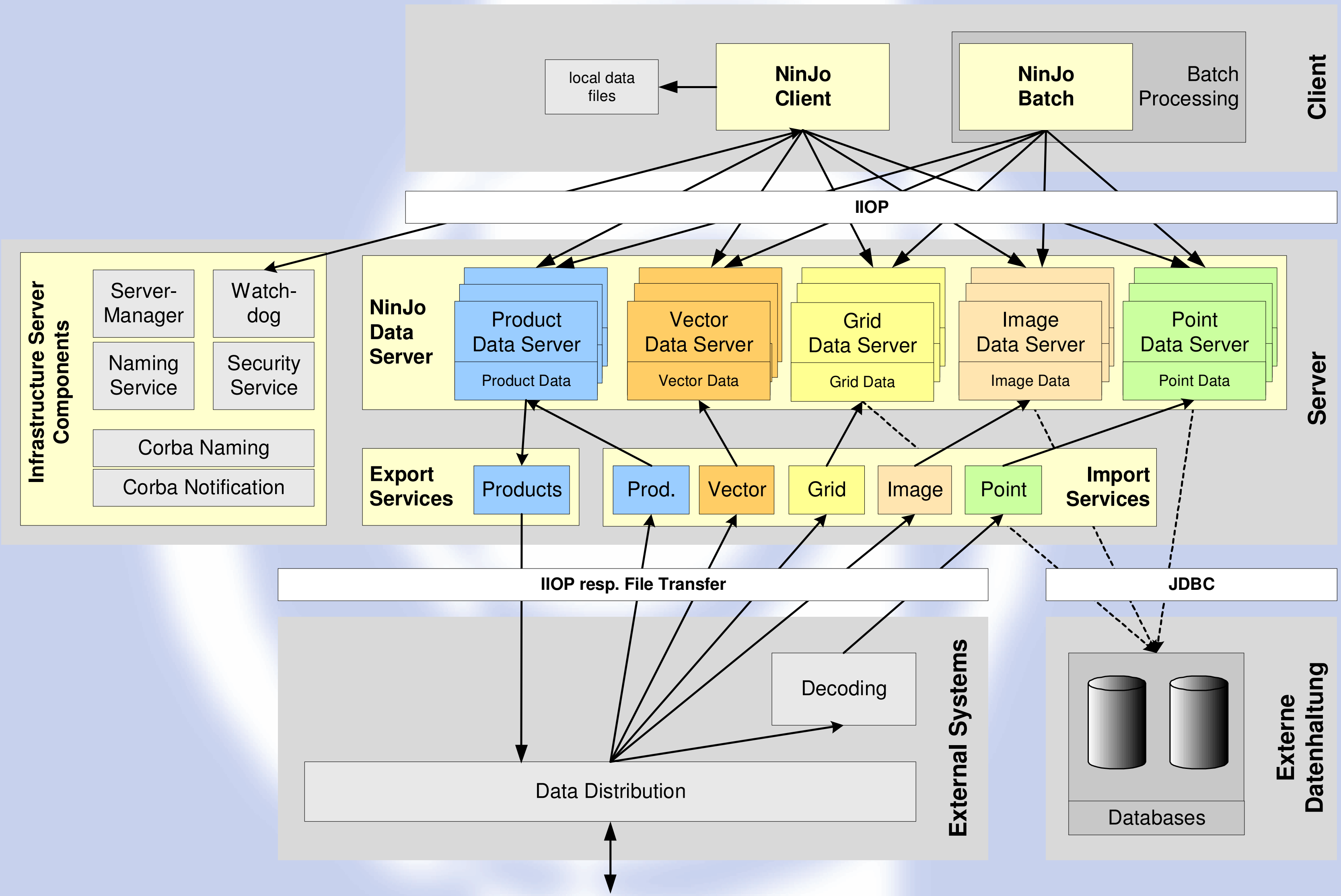
¤ **Conclusions and Recommendations**

NinJo Architecture: Application Tiers

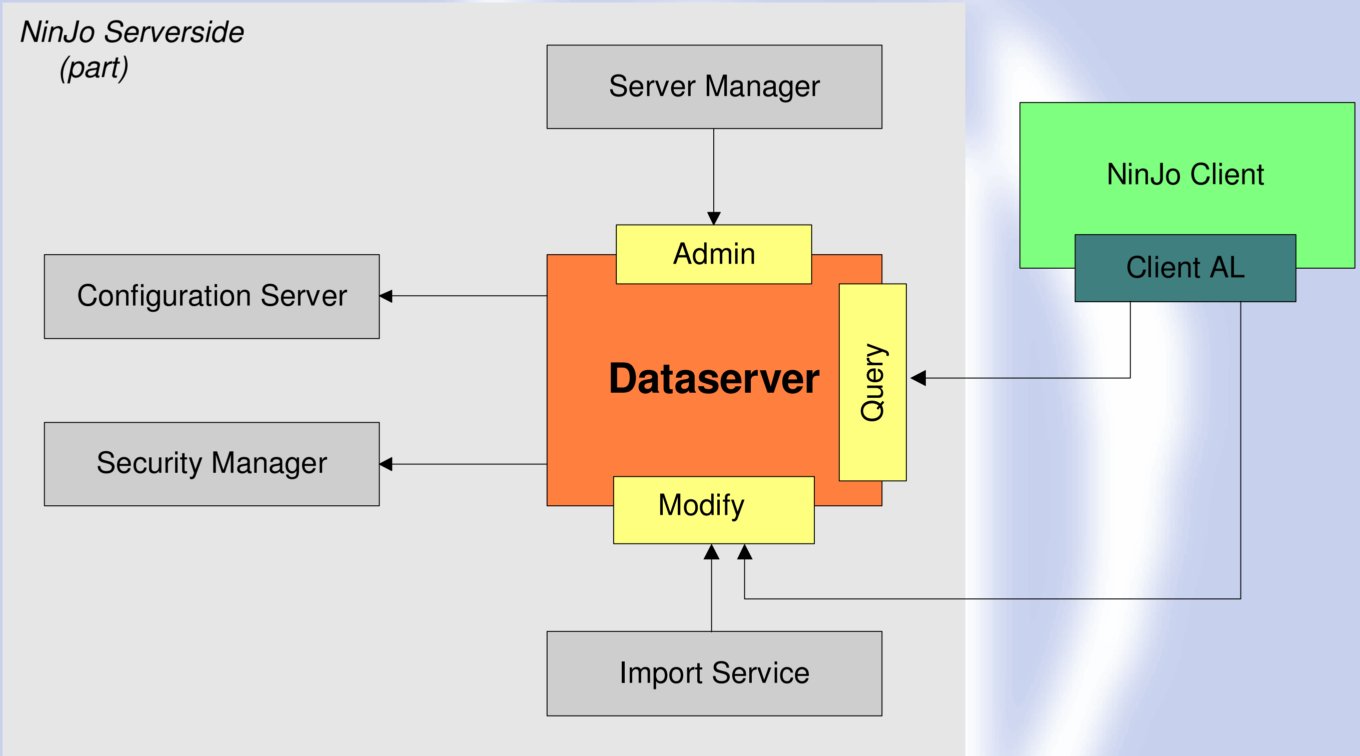


- presentation uses custom framework
- fat client with complex numerical calculations
- access layer with adapters for various data storage options
- servers are pure data servers
- data storage and caching possible on several levels

NinJo Architecture: Communication

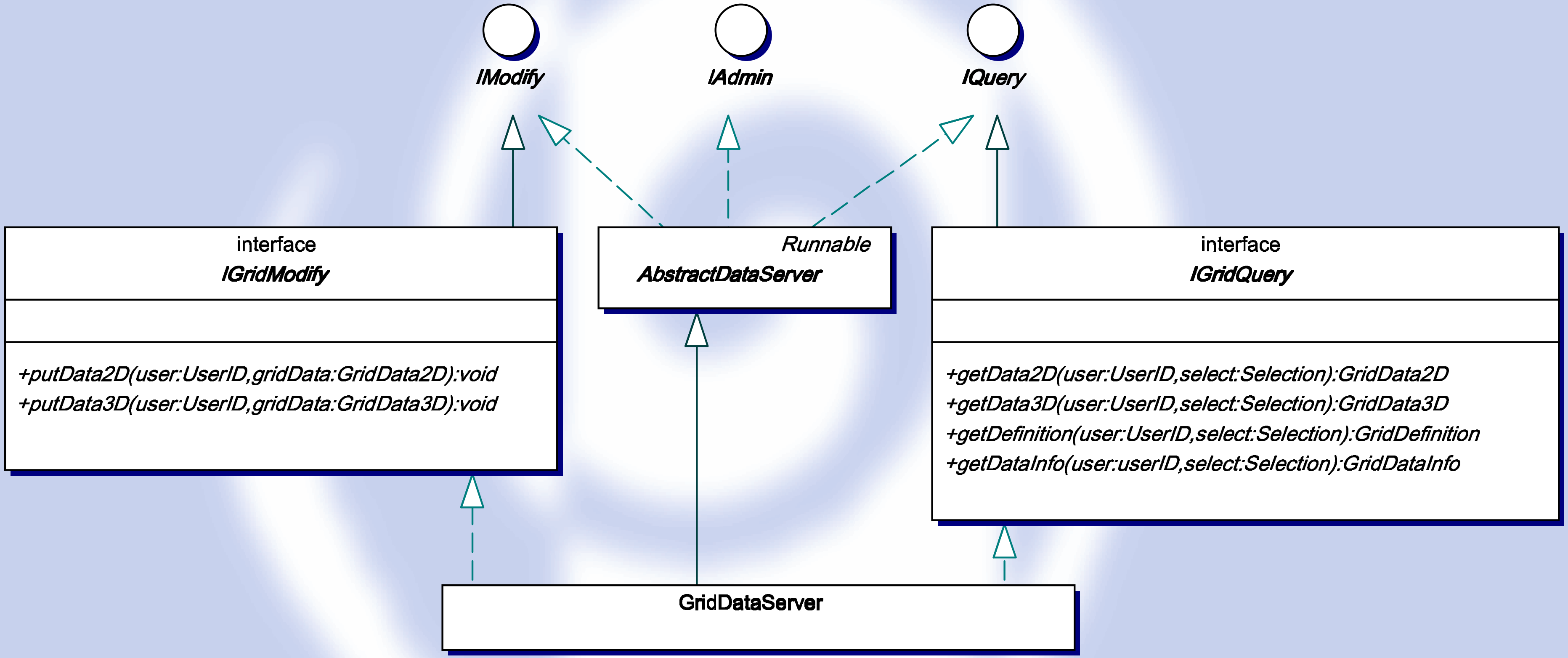


Data Server Architecture

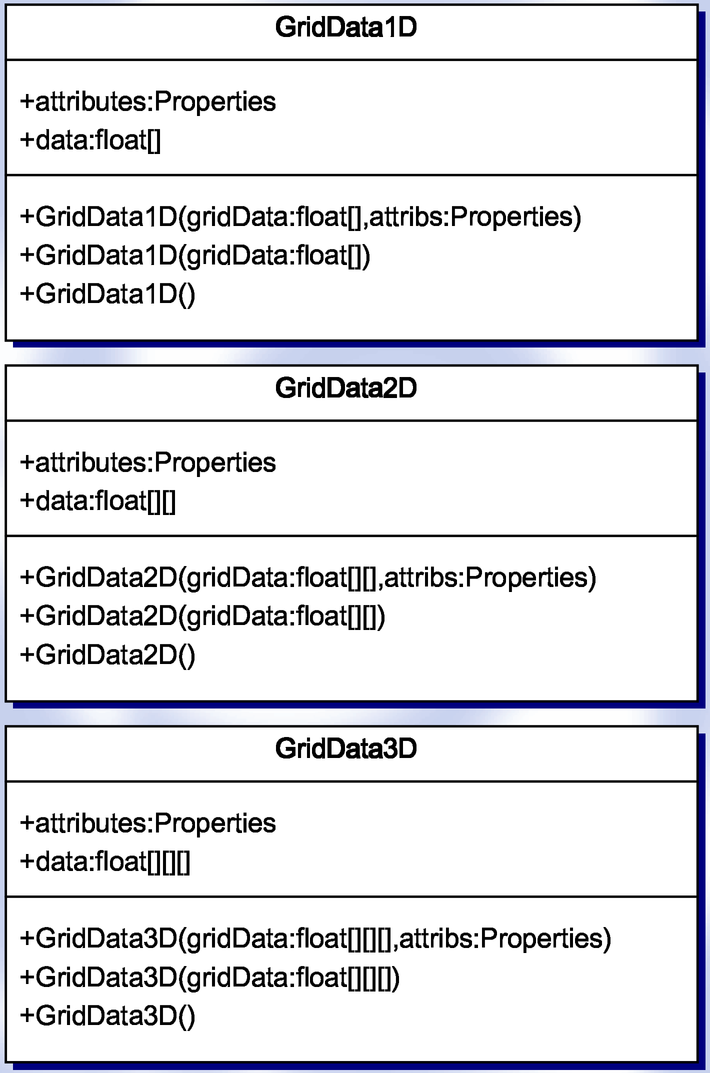


Legend		
Server components	Dataserver Interfaces	← uses

Design Example: Grid Data Server Interface



Design Example: Grid Data Transport Model



Design Example: Grid Data Server IDL (Extract)

IDLGridData[123]D

```
typedef    sequence<float>        IDLData1D;
typedef    sequence<IDLData1D>    IDLData2D;
typedef    sequence<IDLData2D>    IDLData3D;
struct IDLGridData1D {
    IDLProperties          attributes;
    IDLData1D              data;
};
struct IDLGridData2D {
    IDLProperties          attributes;
    IDLData2D              data;
};

struct IDLGridData3D {
    IDLProperties          attributes;
    IDLData3D              data;
};
```

IDLGridQuery

```
interface IDLGridQuery : IDLQuery {
    IDLGridData2D getData2D(in IDLUserID user, in IDLSelection
        select)
      raises(IDLAccessException,
           IDLIllegalParameterException,
           IDLDataNotFoundException,
           IDLInternalServerException,
           IDLWaitTimeOutException);
    IDLGridData3D getData3D(in IDLUserID user, in IDLSelection
        select)
      raises(IDLAccessException,
           IDLIllegalParameterException,
           IDLDataNotFoundException,
           IDLInternalServerException,
           IDLWaitTimeOutException);
    IDLGridDefinition getDefinition(in IDLUserID user, in IDLSelection
        select)
      raises(IDLAccessException,
           IDLIllegalParameterException,
           IDLDataNotFoundException,
           IDLInternalServerException,
           IDLWaitTimeOutException);
};
```

CORBA Products

Popular CORBA Products

- Commercial
  - Borland Visigenic
  - IONA Orbix
  - **IONA ORBacus** (free for non-commercial use)
- Free
  - Java IDL
  - **JacORB** (also recommended)
  - OpenORB
  - MICO
  - TAO

ORBacus (currently NinJo's ORB)

- IONAs low-end CORBA Product of IONA
- CORBA 2.4 compliant
- Language Bindings for Java and C++
- Naming, Event, Time und Property Service are standard
- Notification, Trading and Transaction Service are optional
- distributed as source code

CORBA Features used in NinJo

CORBA Features used

- IDL
- RPC
- Naming Service
- *soon:* Event Service, probably Notification Service (*$$*)

CORBA features not used

- load-balancing, fail-over
- Trading Service (*$$*)
- Transaction Service (*not required*)
- other services ...

- very straightforward way of using CORBA (fits application logic)
- abstraction from technical / non-standard features of CORBA

Agenda

þ Introduction

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þ CORBA in NinJo's Software Architecture

¤ **Optimization and Performance**

¤ **Conclusions and Recommendations**

Optimizations in NinJo

NinJo uses various optimization techniques for data server performance and stability:

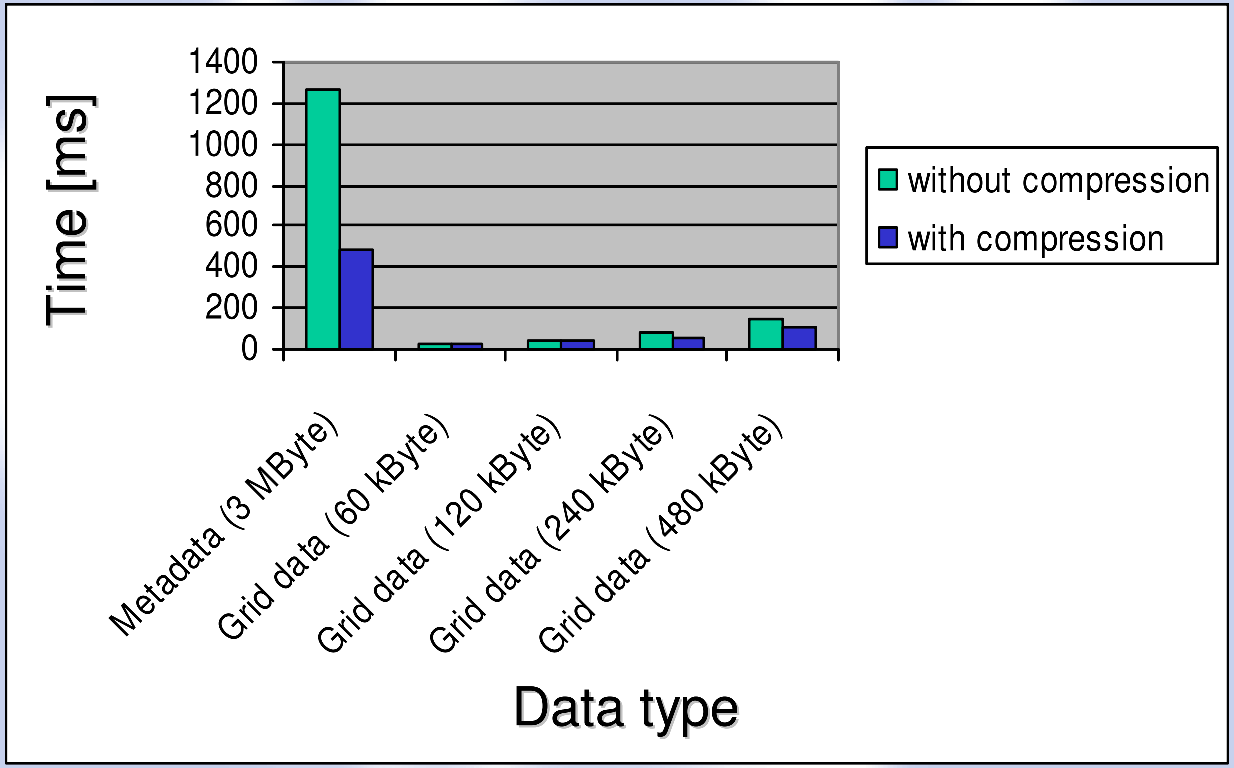
- **Parallelization**
  - data partitioning on small disk drives (utilization of drive caches)
  - independent data import agents
  - server machines with multi-processor CPUs
- **Reduction of network traffic**
  - minimization of remote calls
  - use of compression techniques
  - (nearly) stateless servers
  - client-side validation of request parameters
- **Redundancy**
  - caches, failover
- **Functional optimization**
  - transport of differences

Optimization by caching

- **caches at client-side and server-side**
  synchronisation by notification mechanisms, straightforward implementation with Maps (keys are requests, values are transport objects)
- **new data frequently requested by many users**
  high hit rate in caches because of many similar requests, reduces load on server CPU and I/O, especially when importing large data volumes
- **data change rarely or never**
  little effort for cache synchronization
- **implementation of failover machanisms**
  use of client-side access layer, configurable list of data servers

Optimization by compression

- compressing the transport objects is straightforward (directly supported by Java)
- compression is computationally expensive, decompression is not
- usefulness depends on data tape



Agenda

þ Introduction

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þ CORBA in NinJo's Software Architecture

þ Optimization and Performance

¤ **Conclusions and Recommendations**

Conclusions and Recommendations

- CORBA is a mature standard and CORBA products are very reliable
- for maintainability and variability, use advanced CORBA features only sparingly and encapsulate purely technical aspects of CORBA
- for performance, minimize remote calls and object distribution

- there is no universally valid software architecture
- a well-balanced, individual software architecture is the most important precondition for system performance
- early prototypes and measurements greatly reduce the risk of new technologies and architectures

- Java is fit for high performance and computationally expensive applications on client-side and server-side
- nevertheless, be generous with your hardware budget ...

BACKUP

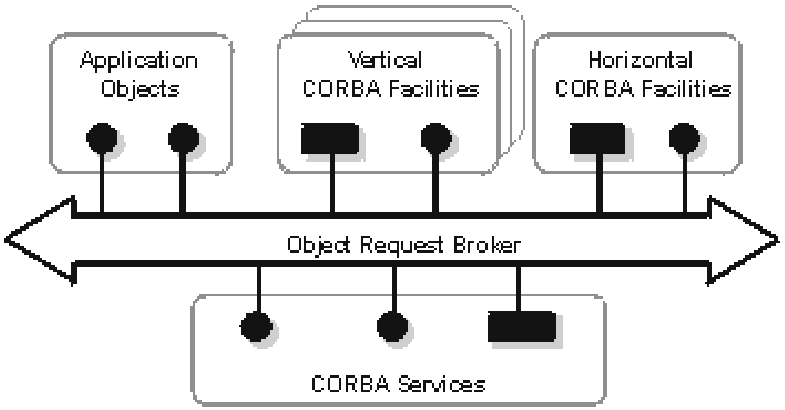
Agenda

- Introduction
- Architecture / Middleware Evaluation for NinJo
- CORBA in NinJo's Software Architecture
- Optimization and Performance
- Conclusions and Recommendations

OMA and Corba Call

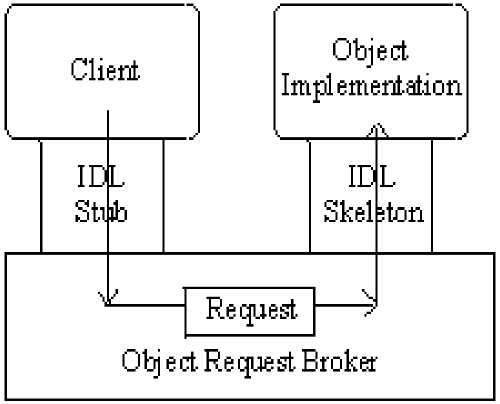
Object Management Architecture

- CORBAservices (Naming, Object Trader, Persistent State)
- Horizontal CORBAfacilities (Printing, Secure Time, Internationalization, Mobile Agent)
- Domain (Vertical) CORBAfacilities
- Application Objects (no Standards)



Remote Call

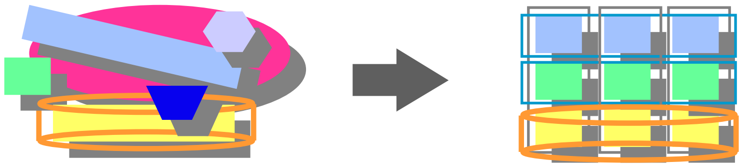
- create IDL
- generate Stubs/Skeletons
- implement Object
- implement Client
- remote calls by ORB-to-ORB communication



What's Software *Architecture* ?

Software Architecture

- Software Architecture (SA) is the separation of a system into components and the interfaces between the components
- "Divide and conquer"
- Quality SA reduces complexity
- Quality SA improves variability and maintainability



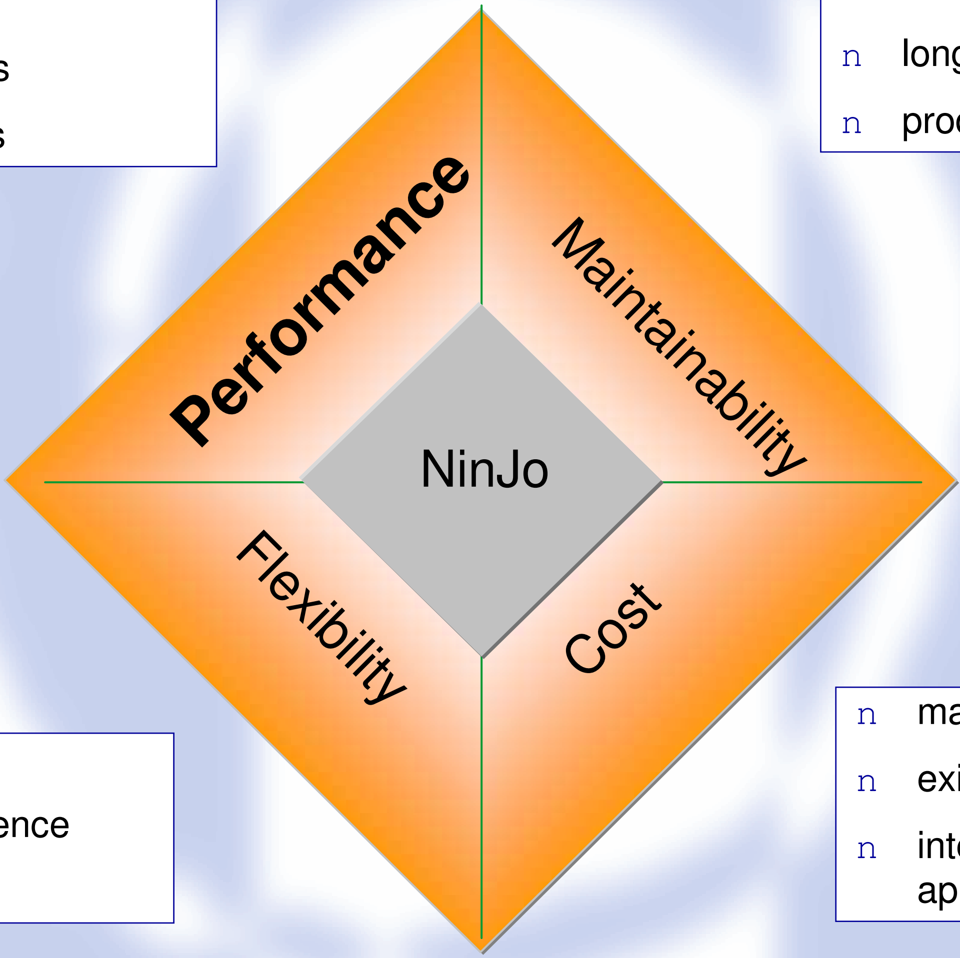
Separation of Responsibilities

- keep different resposibilities in different components
- separate technical responsibilities from application logic
- minimize use-relationships (interfaces) between components
- interfaces should be abstract and minimal
- principles apply at all levels
  - system
  - layer / tier
  - package
  - class

NinJo: Major Goals and Requirements

- sophisticated data visualization
- low response times
- large data volumes

- distributed development
- long-lived system
- product character



- application profiles
- platform independence
- scalability

- make vs. buy
- existing know-how
- integration of legacy applications

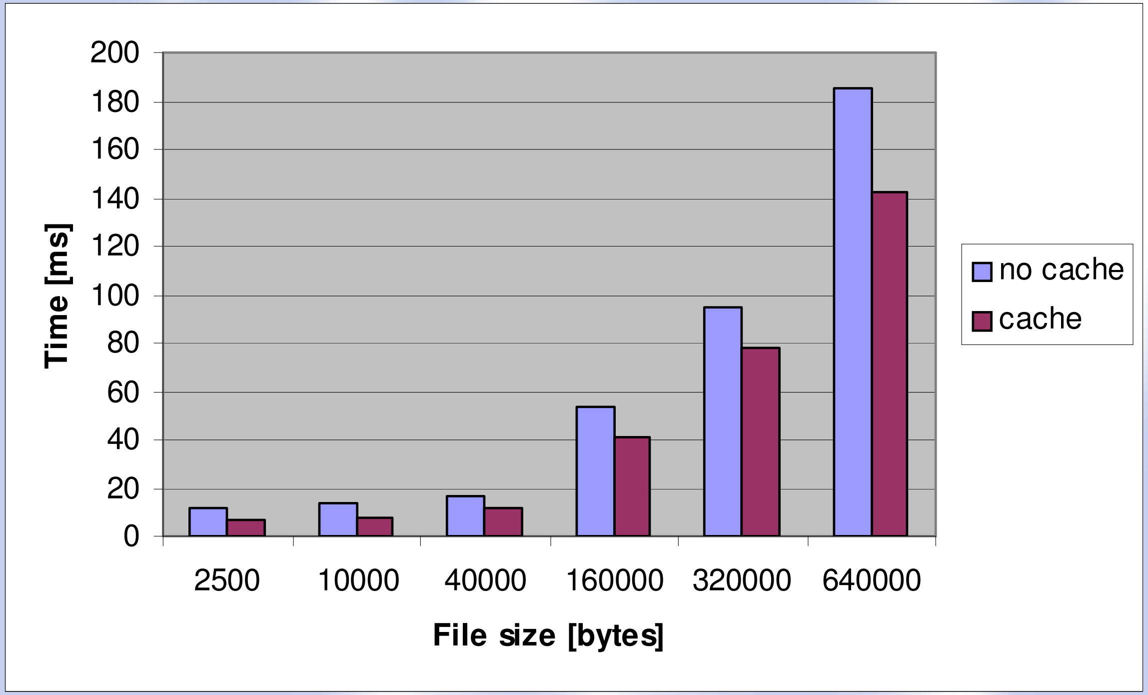
Evaluation of Data Storage Options

DBMS	Application Server	Custom Data Server
standardization	standard architecture „modern“	customized to application performance-optimized scalable
requires product SW mobile use ? not customizable	usually requires database much overhead for little funtionailty requires product SW	not standardized development cost

Application Servers are overweight. DBMS used only for archive data (functional and performance requirements less demanding)

Types of caches

- **server-side caching**
  configurable, does not produce load, limited by main memory size
- **client-side caching**
  best results, synchronisation issues, encapsulated by access layer



RECENT DEVELOPMENTS AT FMI

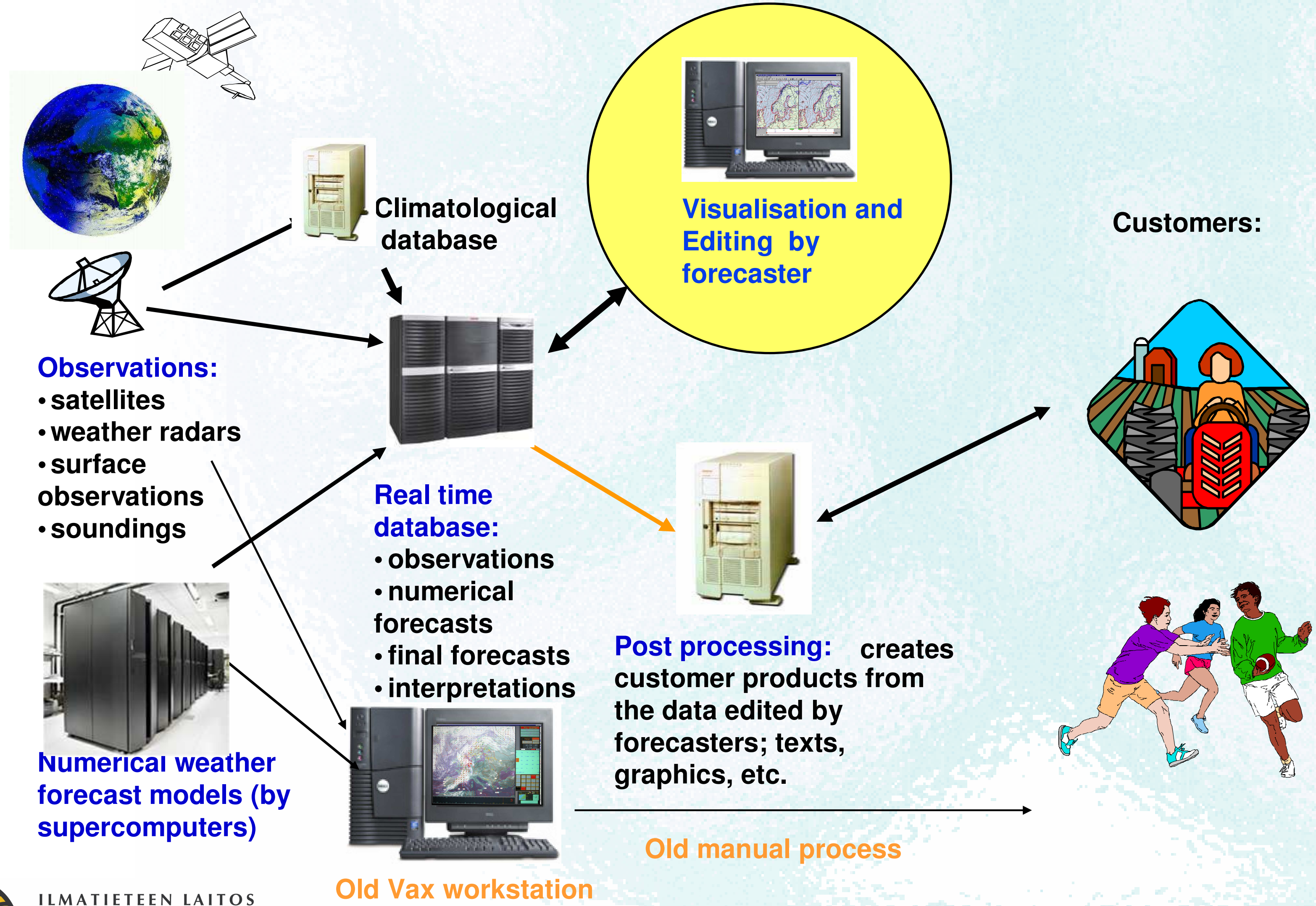
Juha Kilpinen and Marko Pietarinen
Finnish Meteorological Institute (FMI)
http://www.fmi.fi/

- **Development of present forecasting process**
- **New features of grid editor and some verification results**
- **Future editing of aviation weather parameters (and the integration to TAF production)**
- **Development of future workstation (network programming, web services, Java)**
- **Some other new applications**

Recent developments at FMI cont.

- To apply latest technology the forecasting and production process has to be changed (re-ingenering, typically the most difficult part)
- The migration to new automated production process began at mid 1990's, the work is still continuing;
- The core of the new system is the real time database (grid data, observations etc)
- The forecasters duty is to keep the quality of data in database in best possible level: the grid editor is used to interact with the data
- Most commercial products for customers are made automatically from this data (the number of products is thousands); still the old manual process also in use

Forecasting process at FMI (technical aspect)



Forecasting process at FMI

Old VAX workstation

Old manual forecast process and production still exits: Hand drawing of maps, human Made text bulletins etc.....

TAF editor system with partly manual process

The new forecast process expanding: integration of TAF-production to edited grid data

New Grid editor system with automated production process

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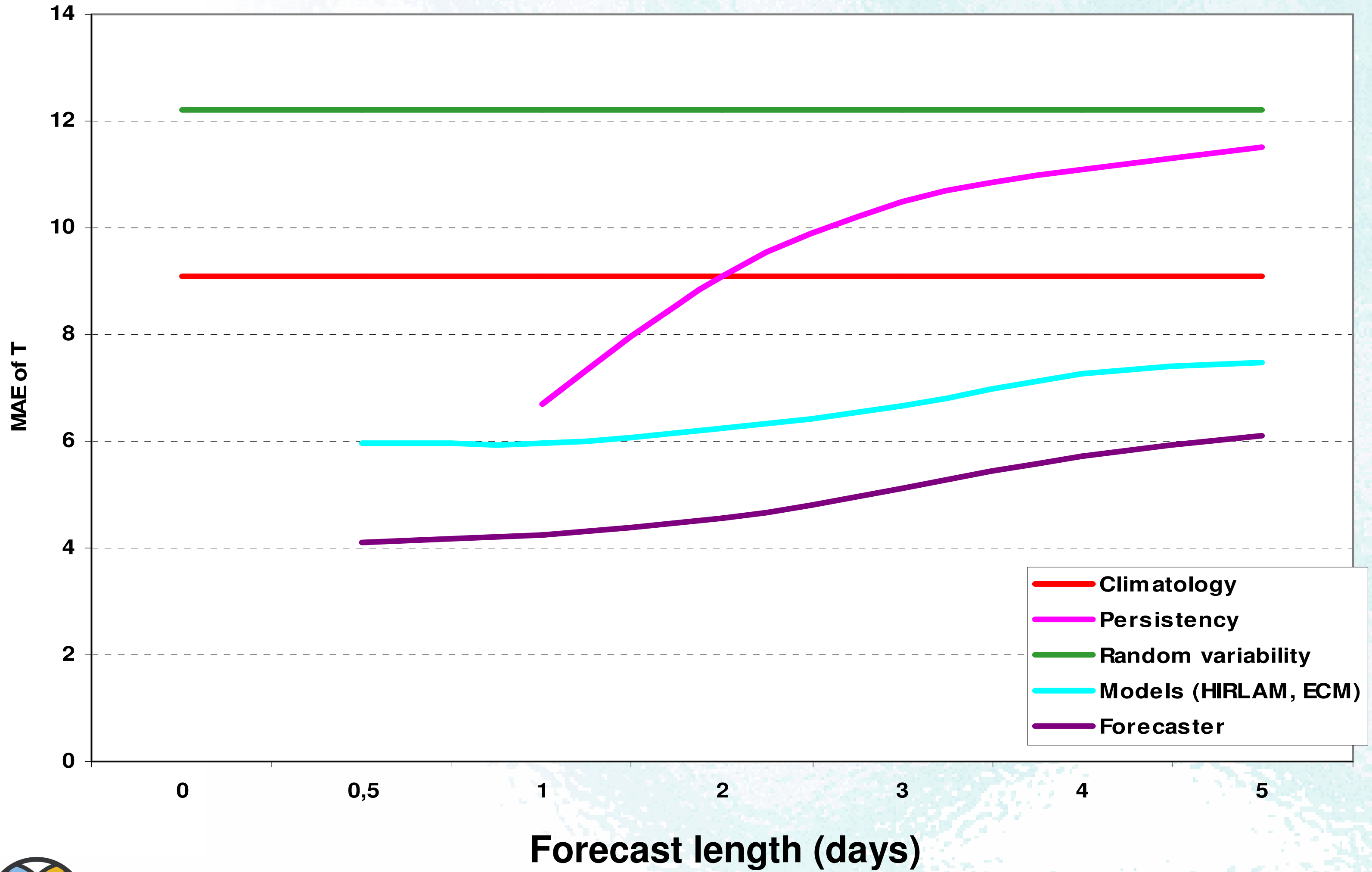
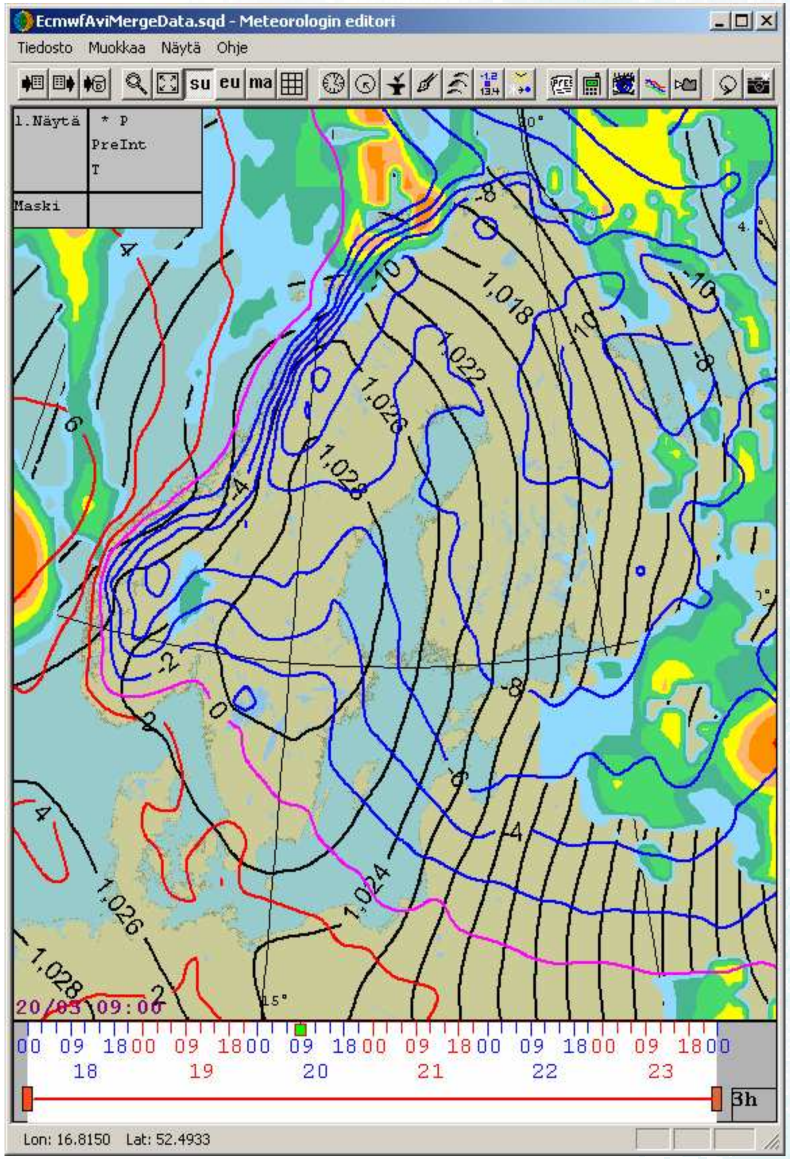
Predictability of temperature (T2m) (Sodankylä winter/night)





The Grid Editor

- Time series editing using masks
- Paint brush
- Time-shifting and Smoothing
- Control point editing
- Combination of data from different sources
- Integrated visualisation and product generation
- SmartTools

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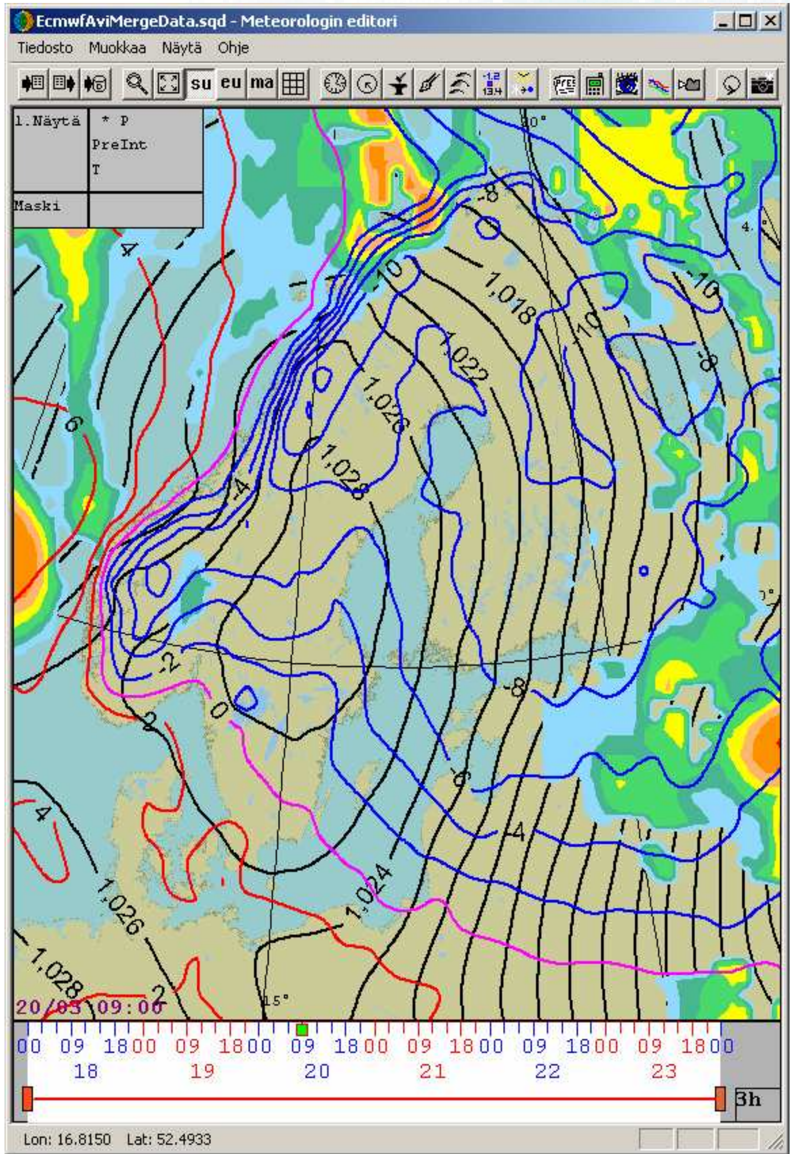
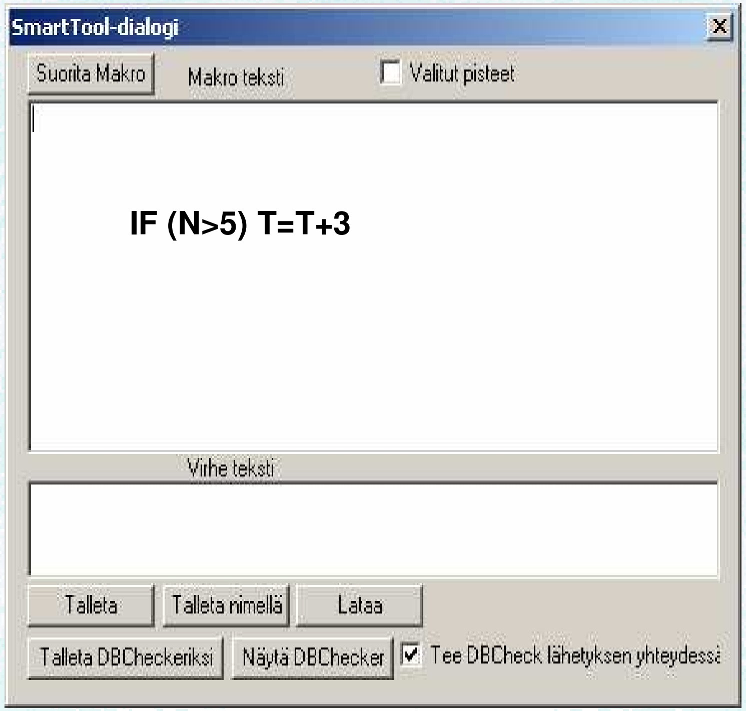


The Grid Editor

Smart Tools: ability to make scripts to perform more complicated and often repeated editing actions in a more easy manner



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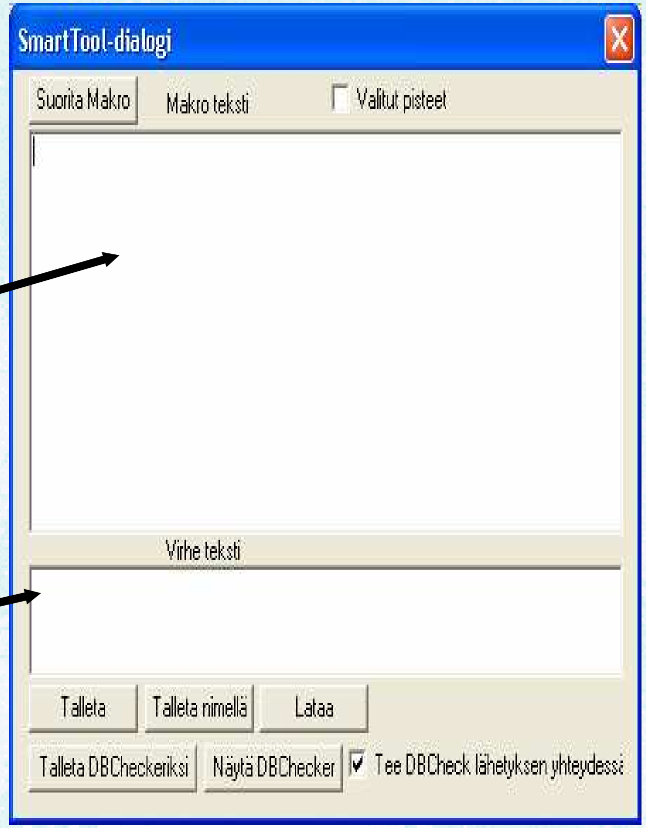
Grid Editor - SmartTools

- Own scripting language:
- Editing window
- An error log window



Grid Editor - SmartTools

- **Operators;**

  T = T + P * 0.123 – RH/100 * WS + (T - DP) ^ 2
- **Blocks:**

  {

  T = T + 1

  P = P + 1

  RH = RH + 1

  }
- **Conditionals:**

  IF(T – DP > 2)

  T = T + 1

  P = P + 1 // both are executed if condition fulfills.

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Grid Editor - SmartTools

- **More complicated conditionals:**

  IF(T – DP > 4)

  T = T + 1

  P = P + 1

  ELSEIF(T – DP > 2) // means actually that (T-DP) is betweenn 2 and 4.

  T = T + 2

  P = P + 2

  ELSE // in all other cases, if T – DP <= 2, then ELSE is executed

  T = T + 3

  P = P + 3

Grid Editor - SmartTools

• **T**	**TEMPERATURE**
• **P**	**SURFACE PRESSURE**
• **RH**	**RELATIVE HUMIDITY**
• **KIND**	**K-INDEX**
• **DP**	**DEW POINT**
• **LRAD**	**LONG WAVE RADIATION**
• **SRAD**	**SHORT WAVE RADIATION**
• **WD**	**WIND DIRECTION**
• **WS**	**WIND SPEED**
• **N**	**TOTAL CLOUD COVER**
• **CL**	**AMOUNT OF LOW CLOUDS**
• **CM**	**AMOUNT OF MEDIUM CLOUDS**
• **CH**	**AMOUNT OF HIGH CLOUDS**
• **RR**	**INTENSITY OF PRECIPITATION**
• **PREF**	**PRECIPITATION TYPE (RAIN, SLEET, SNOW)**
• **PRET**	**PRECIPITATION TYPE (CONTINOUS, SHOWER,..)**
• **THUND**	**PROPABILITY OF THUNDER**
• **FOG**	**INTENSITY OF FOG**
• **HSADE**	**PRECIPITATION SYMBOL (NOT EDITABLE; SYNOP)**
• **HESSAA**	**WEATHER SYMBOL (NOT EDITABLE)**

Grid Editor - SmartTools

• FL1BASE	Flight Level 1 cloud Base
• FL1TOP	Flight Level 1 cloud Top
• FL1COVER	Flight Level 1 cloud COVER
• FL1CLOUDTYPE	Flight Level 1 cloud TYPE
• FL2BASE	Flight Level 2 cloud Base
• FL2TOP	Flight Level 2 cloud Top
• FL2COVER	Flight Level 2 cloud COVER
• FL2CLOUDTYPE	Flight Level 2 cloud TYPE
• FL3BASE	Flight Level 3 cloud Base
• FL3TOP	Flight Level 3 cloud Top
• FL3COVER	Flight Level 3 cloud COVER
• FL3CLOUDTYPE	Flight Level 3 cloud TYPE
• ……	
• FL8BASE	Flight Level 8 cloud Base
• FL8TOP	Flight Level 8 cloud Top
• FL8COVER	Flight Level 8 cloud COVER
• FL8CLOUDTYPE	Flight Level 8 cloud TYPE
• FLCBBASE	Flight Level CB BASE
• FLCBCOVER	Flight Level CB COVER
• FLMINBASE	Flight Level cloud minimum BASE
• FLMAXBASE	Flight Level cloud maximum BASE
• AVIVIS	Aviation Visibility
• VERVIS	Vertical Visibility

Grid Editor - SmartTools

STATIC AND NON STATIC FUNCTIONS

• TOPO	TOPOGRAPHY (static)
• SLOPE	SLOPE OF SURFACE
• SLOPEDIR	DIRECTION OF DEEPIST SLOPE
• DISTSEA	SHORTEST DISTANCE TO SEA
• DIRSEA	DIRECTION TO SEA
• DISTLAND	SHORTES DISTANCE TO LAND
• DIRLAND	DIRECTION TO LAND
• LANDSEAMASK	LAND SEA MASK
• RELTOPO	RELATIVE TOPOGRAPHY
• LAT	*LATITUDE (non static)*
• LON	*LONGITUDE (non static)*
• EANGLE	*ELEVATION ANGLE (non static)*

Grid Editor - SmartTools

Integrating functions

- AVG calculates the arithmetic average
- MIN seeks the minimum value
- MAX seeks the maximim value
- SUM calculates the sum
- WAVG calculates the weighted average (?)

Mathematical functions

- SIN, COS, LN, SQRT, LOG, ATAN, EXP, ….

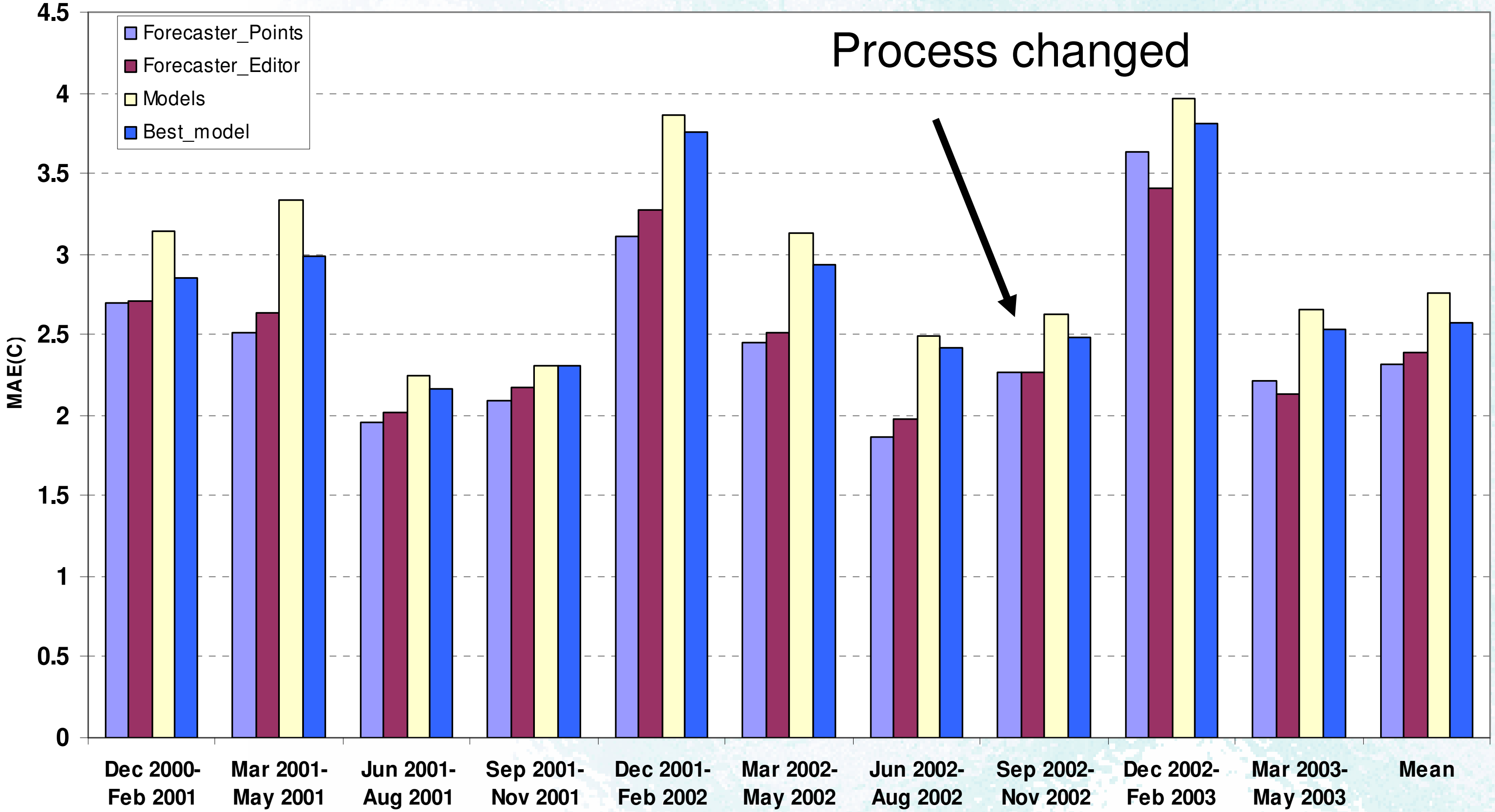
Ramp functions

- RU (ramp up)
- RD (ramp down)
- DD (douple ramp)

Grid Editor - SmartTools

```
// Säteilykorjaus  (Radiation correction)
// SN 2002.09.30
// pilvisyys korjataan => säteilyt korjataan
// ECMWF-lyhytaaltosäteily liian pieni selkeissä tilanteissa => 20% lisäys,
// Viitteet: Lauros Johanna, 2001, Tienpinnan talviset liukkausolosuhteet ja niiden mallintaminen,
//         pro gradu, Helsingin yliopiston meteorologian laitos
//         Katso myös gradun kirjallisuusviitteet: Niemelä Sami, Räisänen Petri, Savijärvi Hannu
// SRAD = (1 - 0.67 * (N/100) ^ 3.32) / (1 - 0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
// LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100) ^ 2.75) * LRAD_ORIG
// SRAD_SELKEA = 1000 * (1 - EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 - EXP(-0.05 * EANGLE))
// missä EANGLE >= 0
IF (SRAD == SRAD_EC  AND (N_ORIG <= 30 OR N <= 30))
{
  SRAD = 1.2 * (1 - 0.67 * (N/100) ^ 3.32) / (1 - 0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
  LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100) ^ 2.75) * LRAD_ORIG
}
ELSE
{
  SRAD = (1 - 0.67 * (N/100) ^ 3.32) / (1 - 0.67 * (N_ORIG/100) ^ 3.32) * SRAD_ORIG
  LRAD = (1 + 0.22 * (N/100) ^ 2.75) / (1 + 0.22 * (N_ORIG/100) ^ 2.75) * LRAD_ORIG
}
// IF ( SRAD > SRAD_SELKEA)
//      SRAD = SRAD_SELKEA
// missä EANGLE >= 0
IF ( ( SRAD ) - ( 1000 * (1 - EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 - EXP(-0.05 * EANGLE)) ) > 0 AND EANGLE >= 0 )
      SRAD = 1000 * (1 - EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 - EXP(-0.05 * EANGLE))
ELSEIF ( ( SRAD ) - ( 1000 * (1 - EXP(-0.06 * EANGLE)) * SIN(EANGLE) + 5 + 96 * (1 - EXP(-0.05 * EANGLE)) ) > 0 AND EANGLE < 0 )
            SRAD = 1000 * (1 - EXP(-0.06 * 0)) * SIN(0) + 5 + 96 * (1 - EXP(-0.05 * 0))
IF ( SRAD < 0 )
 SRAD = 0
```

MAE of temperature forecasts (3 stations, 10 seasons, 0.5-5 days)



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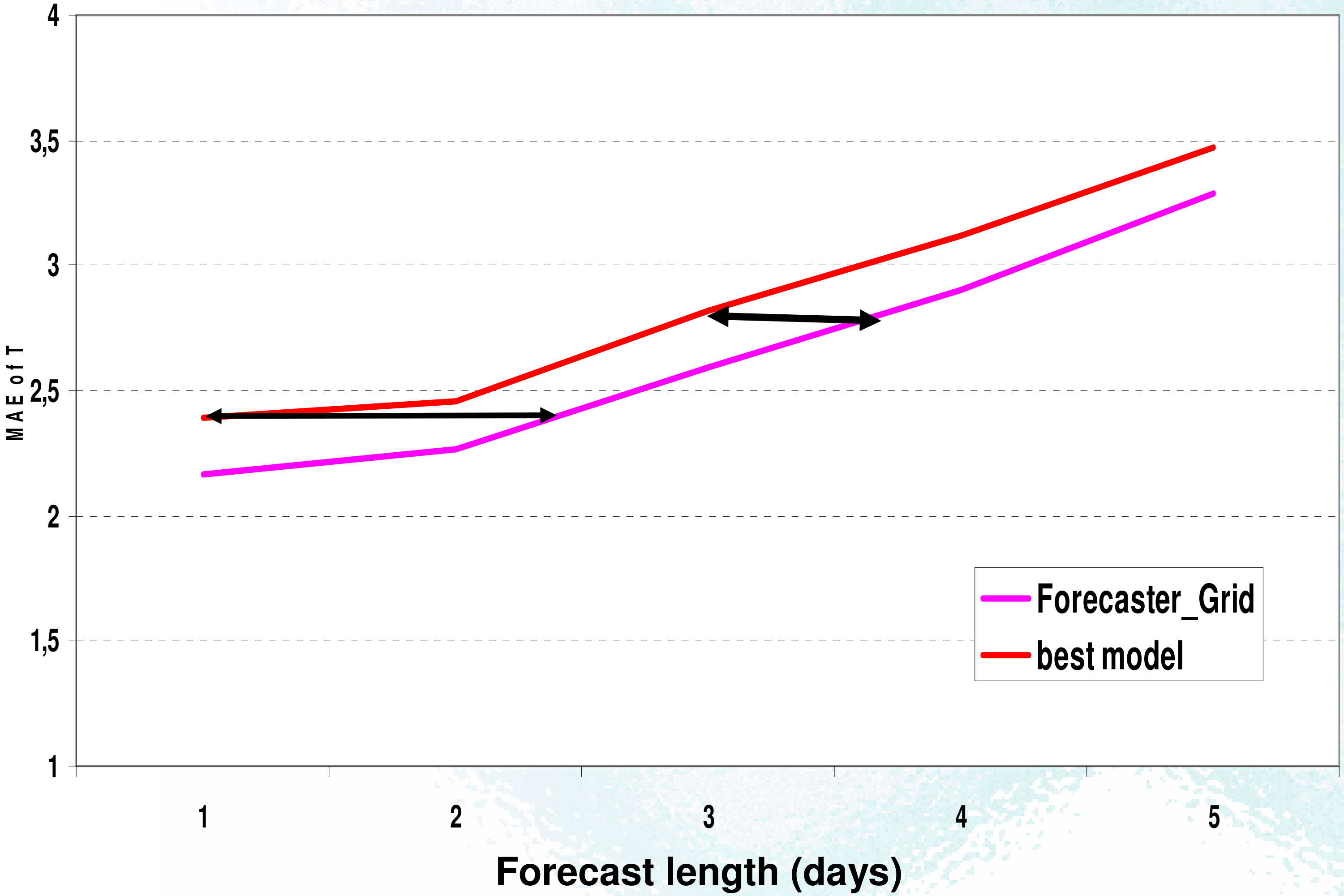
MAE of temperature forecasts (3 stations, 2 years)



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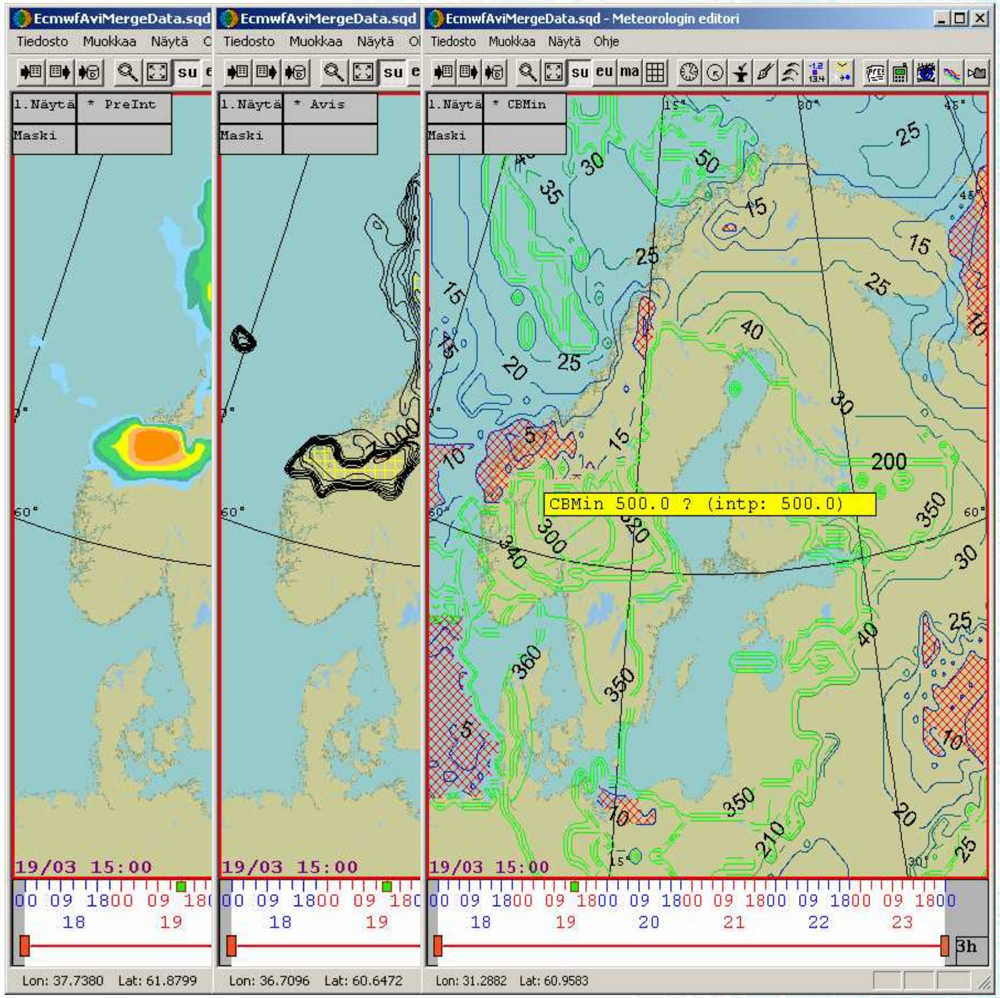
New aviation variables for editing



Variables:
Wind direction
Wind speed KT
Wind gusts KT
1 layer Cloud Amount
2 layer Cloud Amount
3 layer Cloud Amount
..
Aviation visibility
Vertical visibility

Derived variables..
..

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Derivation of cloud amounts from model data

All model (both ECMWF and HIRLAM) levels are used:

- RH_{min}=75%
- RH_{max}=98%
- N=0/8 when $RH \le RH_{min}$ (printed as RH<=RH)
- N=8*max(c,1) when $RH_{min} < RH \le RH_{max}$
- N=8/8 when $RH > RH_{max}$
- $c=((RH-RH_{min})/(RH-RH_{max}))^2$

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Derived cloud amount for ICAO cloud layers:

Cloud layer 1: 0-200 ft →

Cloud layer 2 : 200-500 ft

Cloud layer 3 : 500-1000 ft

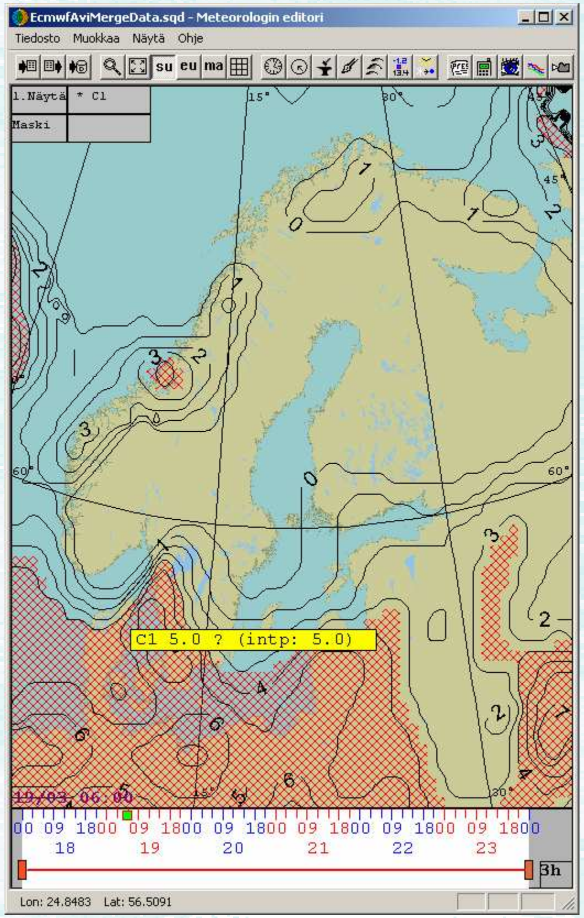
Cloud layer 4 : 1000-1500 ft

Cloud layer 5 : 1500-5000 ft

Cloud layer 6 : 5000-10000 ft

Cloud layer 7 : 10000-20000 ft

Cloud layer 8 : 20000-30000 ft



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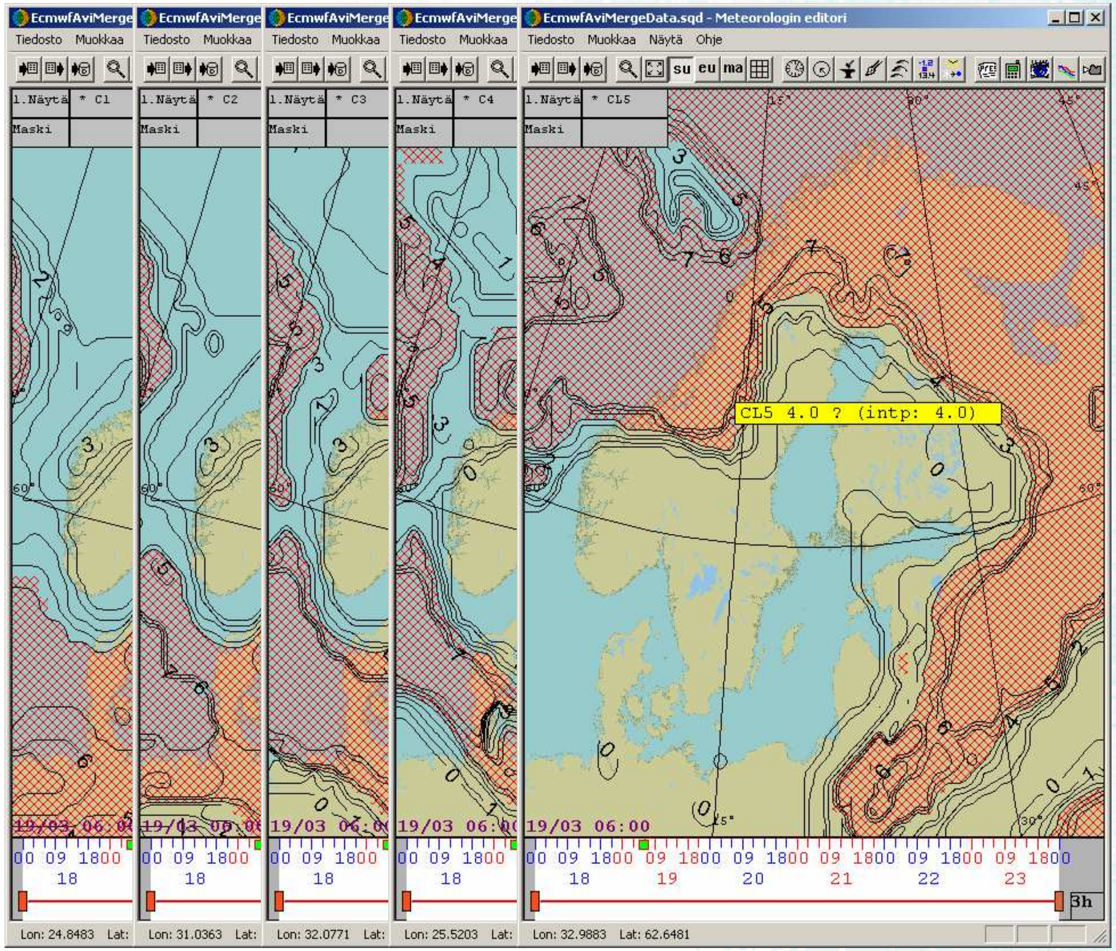
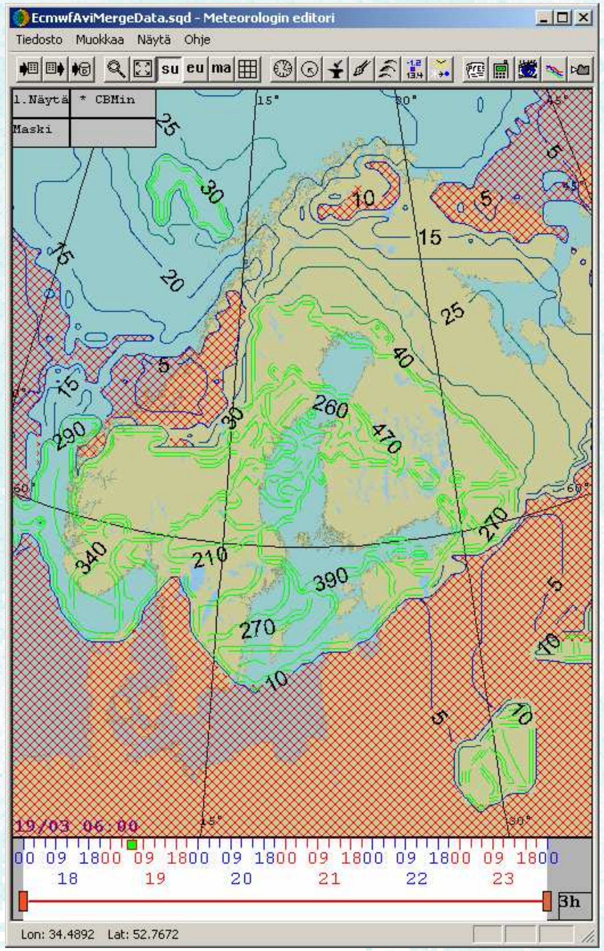
The cloud amount in ICAO layers and ceiling height





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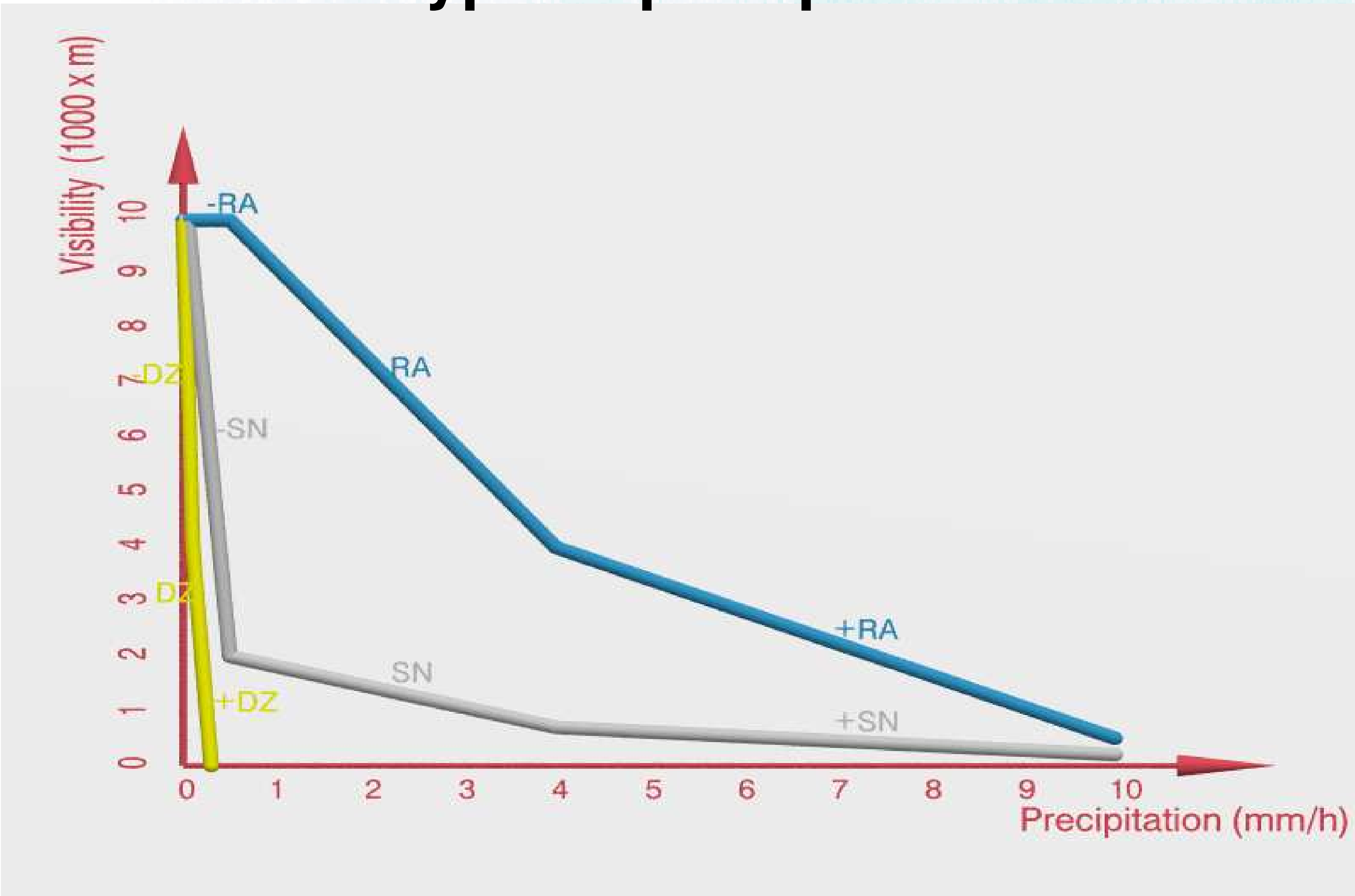
Interpretation of visibility from intensity and type of precipitation



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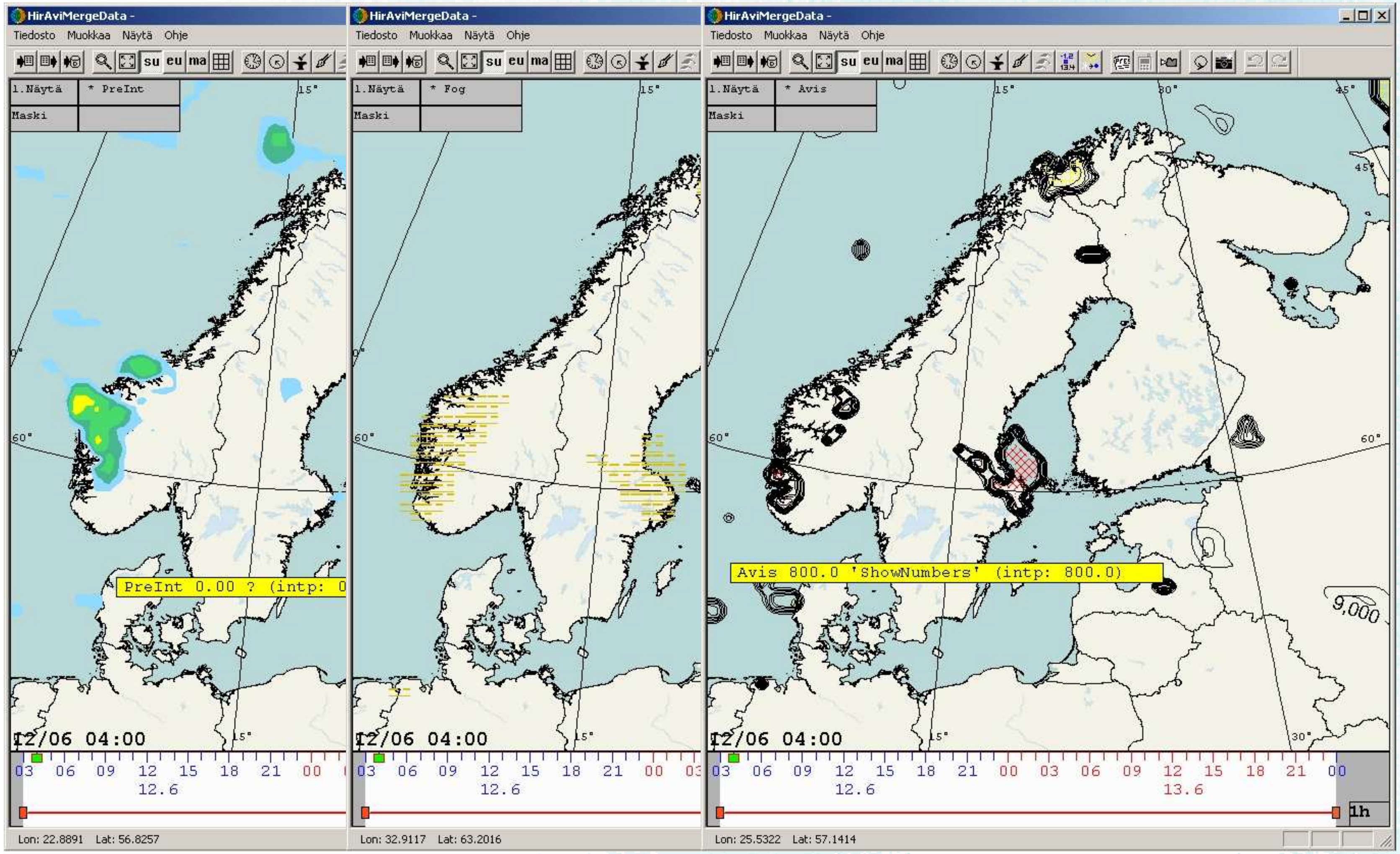
Aviation visibility derived from precipitation and fog



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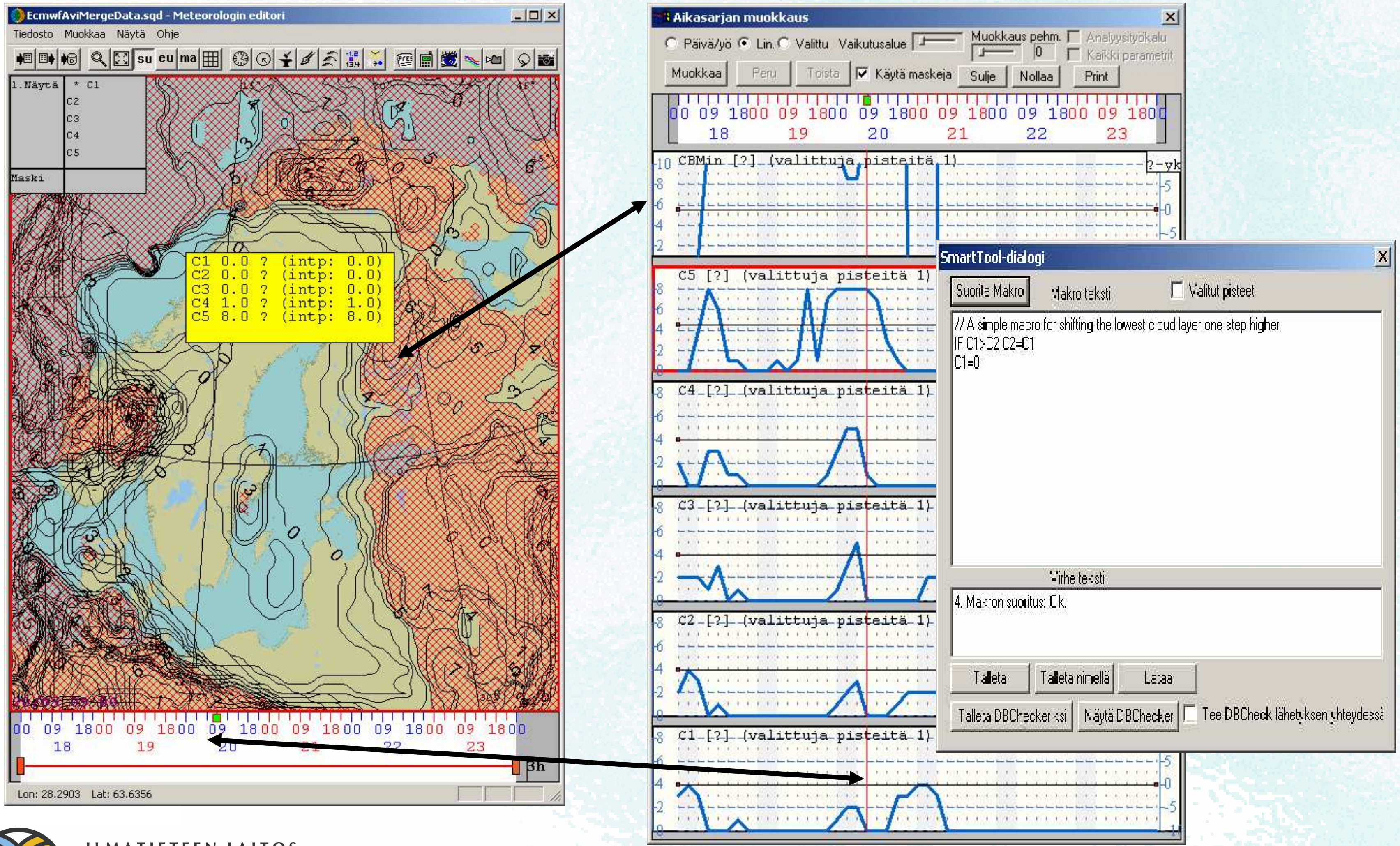
The cloud amount in ICAO layers and ceiling height



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Editing of aviation parameters (near future)

Edited parameters:
cloud amount in ICAO layers
intensity of fog (0,1,2)
intensity of precipitation (mm/h)
(edited already elsewhere)

SmartTools scripts are used mainly

Visibility and ceiling height are derived from edited and interpreted parameters

(next integration to Auto-TAF production)

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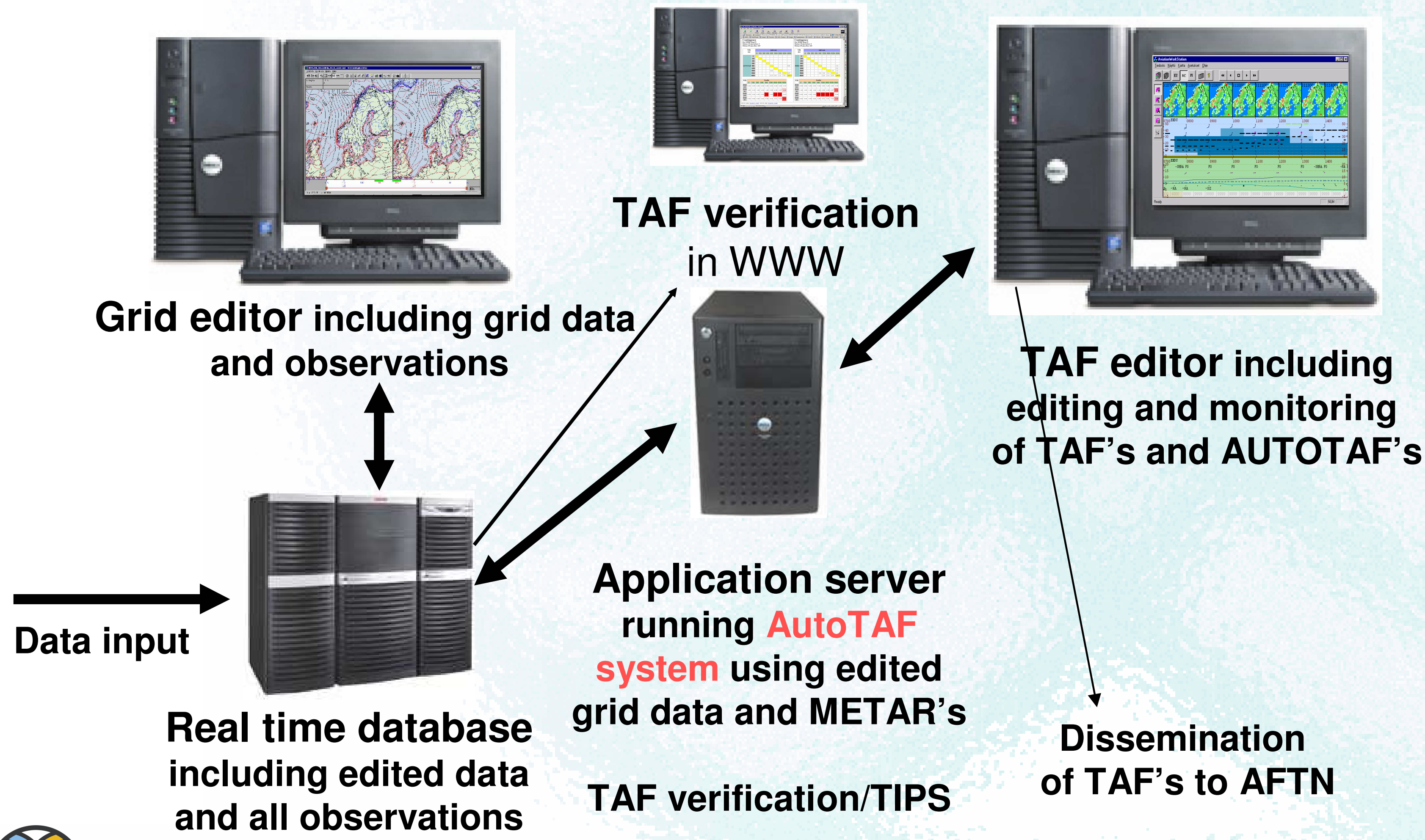
Integration of Auto-TAF system at FMI



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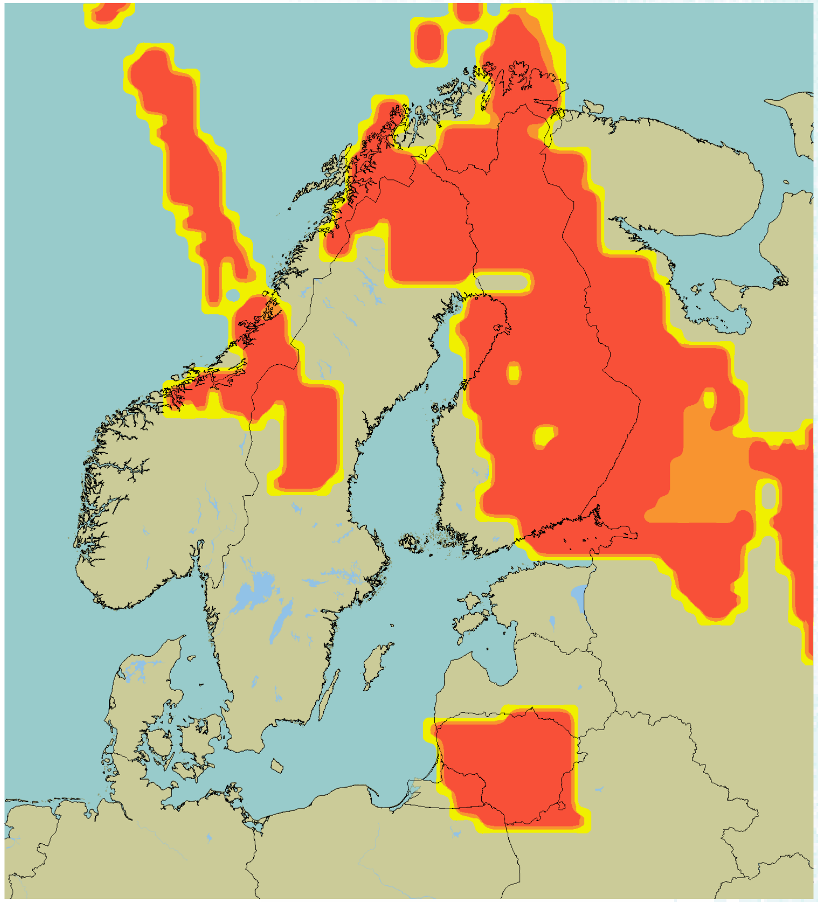
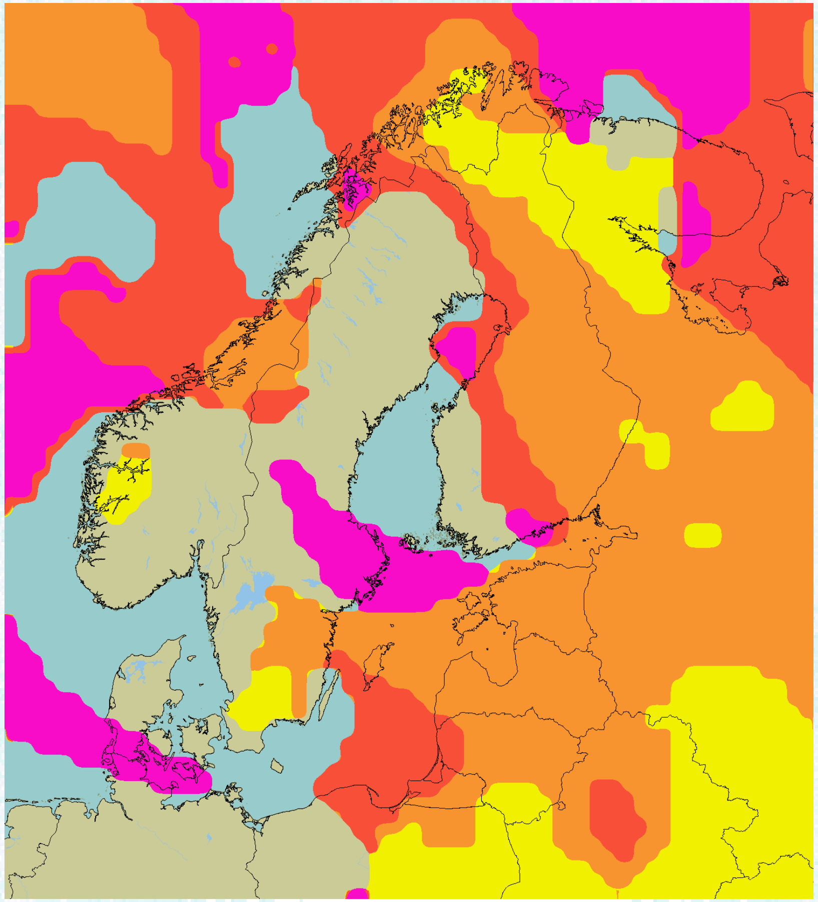
An example of customer product for military aviation (combination of ceiling heigth and visibility)





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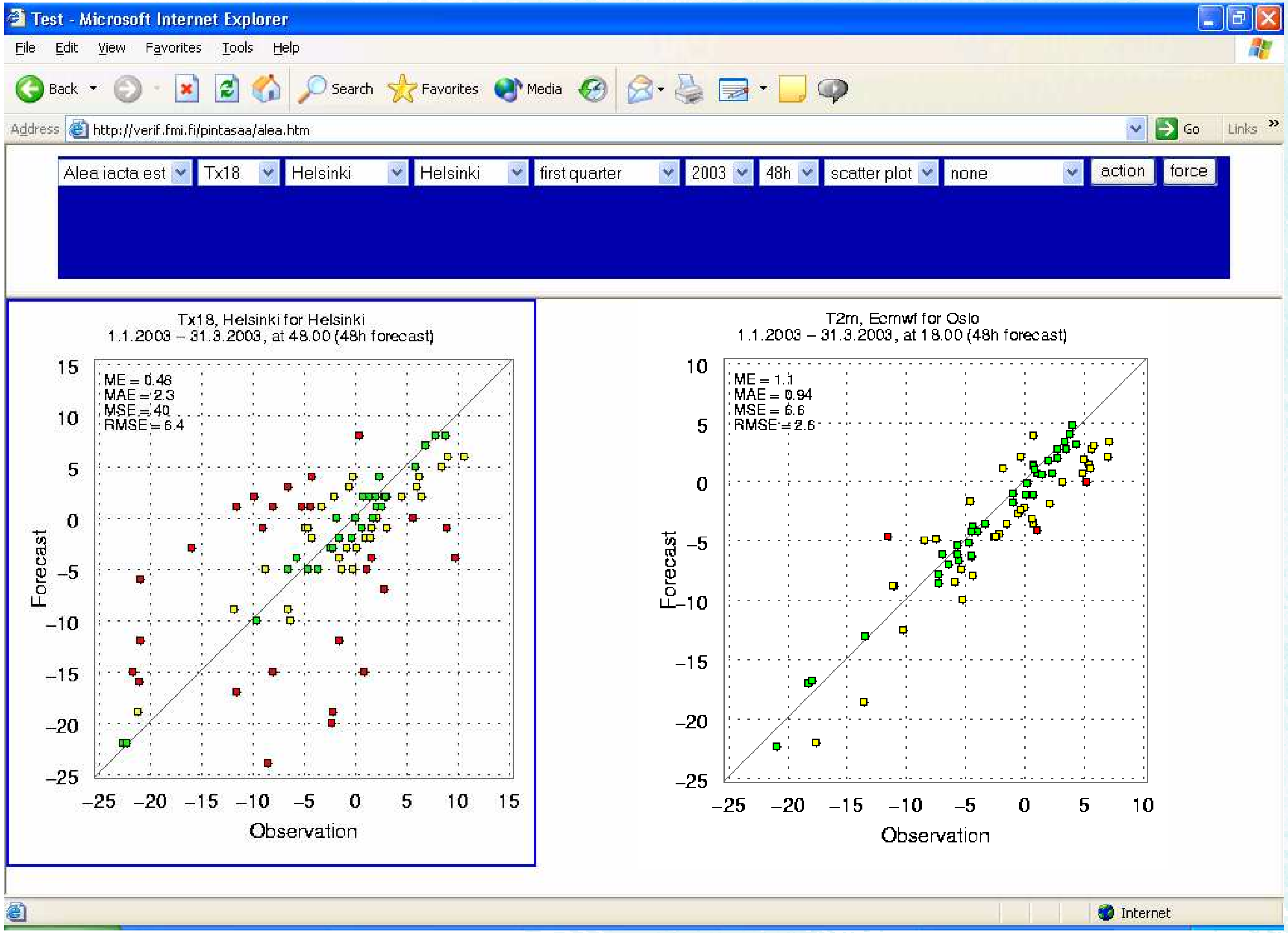
Other new applications



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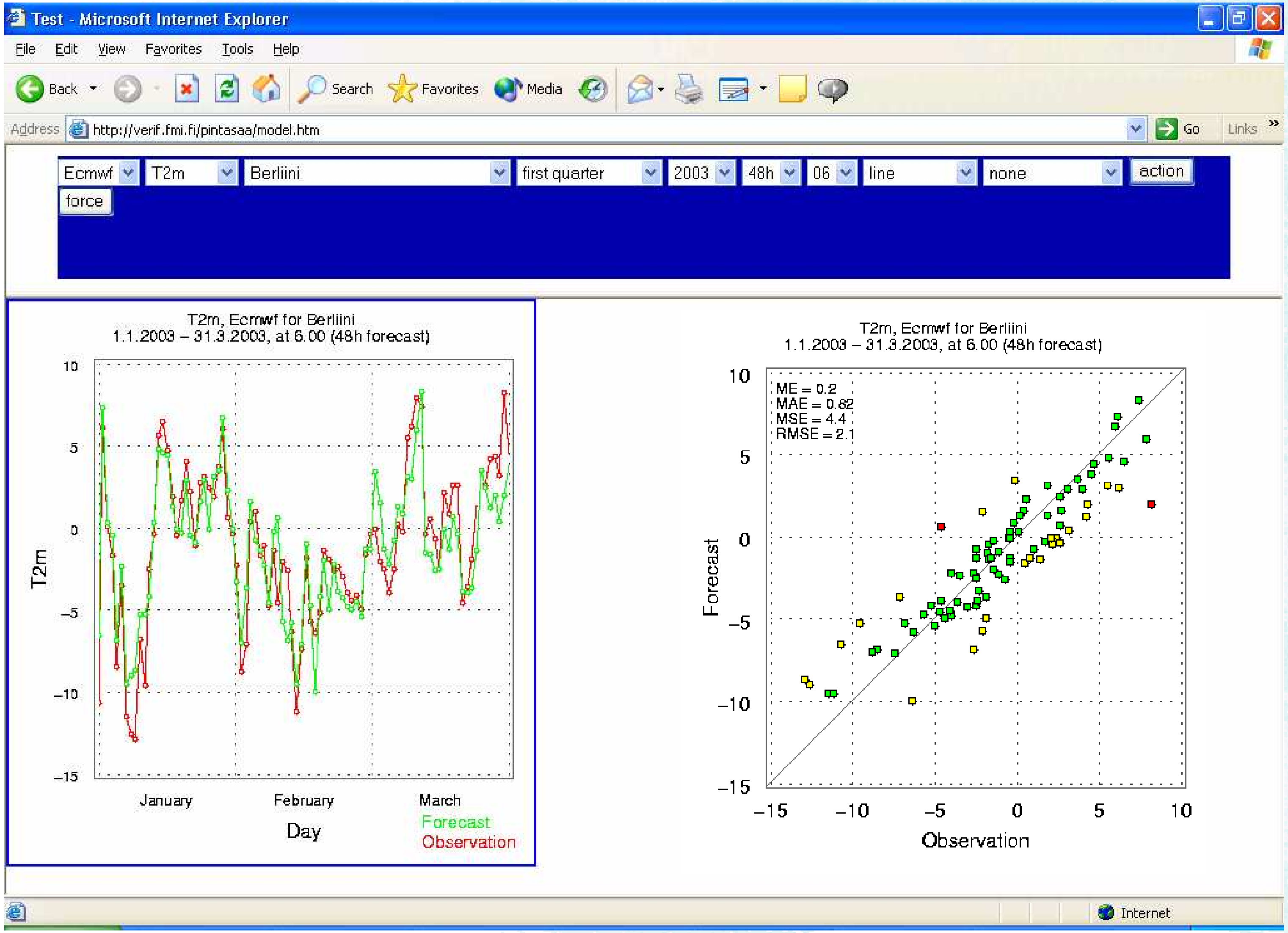
Other new applications



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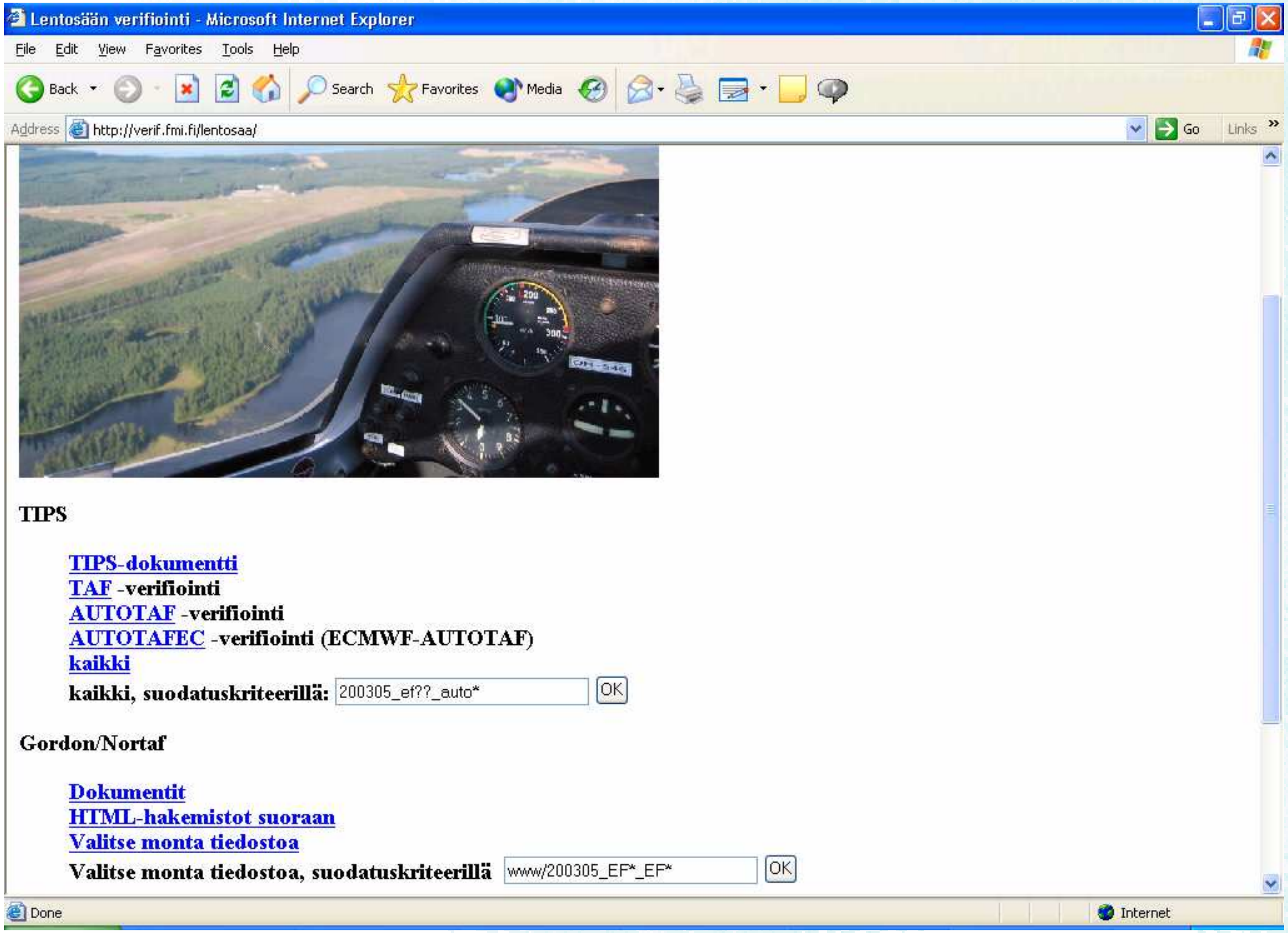
Other new applications



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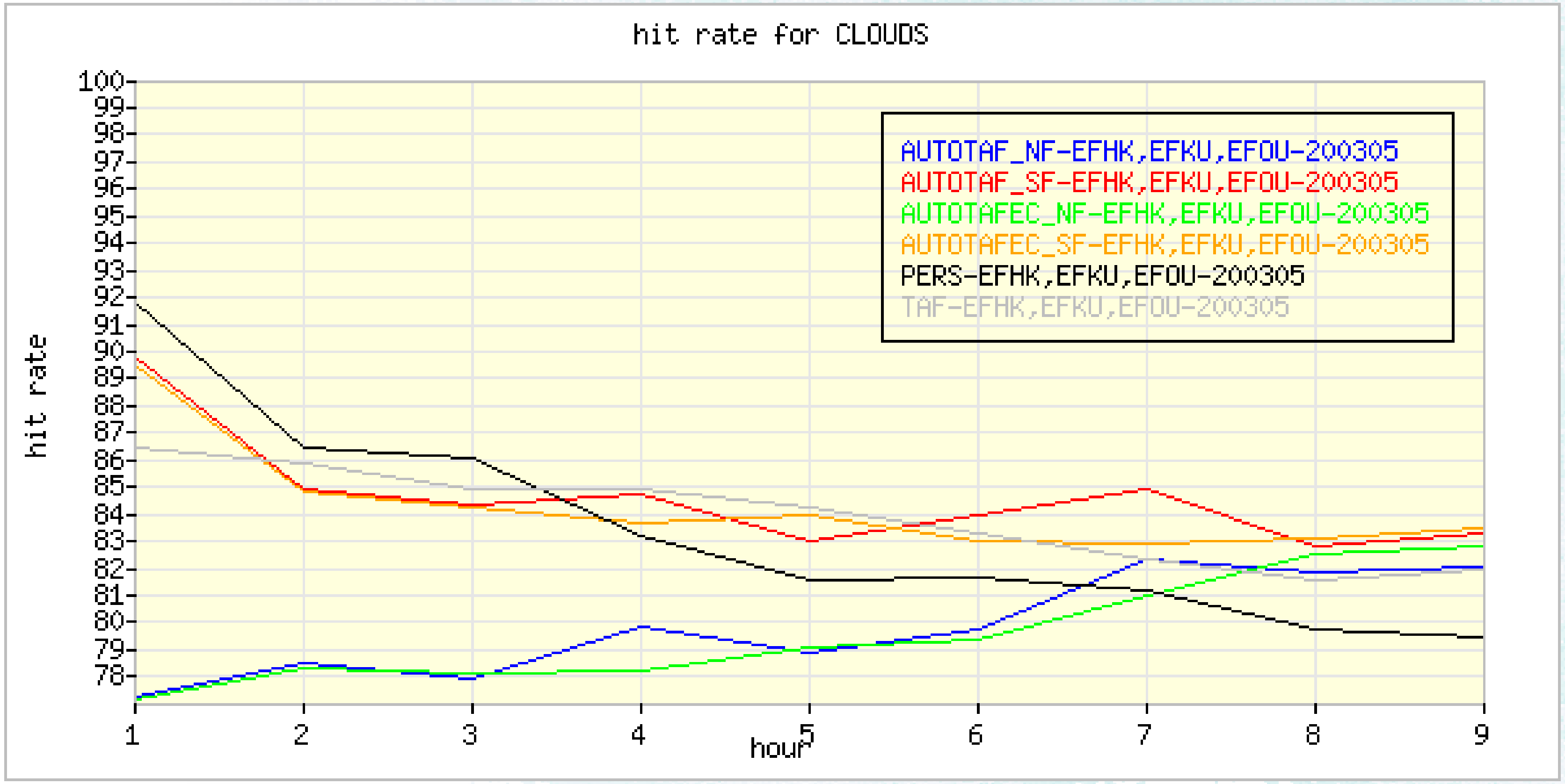
Other new applications



Other new applications

Contingency
For=EDDF Hour=1
Metars 20 min after: 2825
Metars 50 min after: 15

CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0						
	1	0.50	1.75	2.50	0.68		2.58
	2	1.50	1.50	21.32	9.25	1.50	5.25
	5		0.25	22.43	20.50	8.50	70.95
	10		0.75	16.25	18.75	16.82	53.08
	15	3.00	3.75	13.50	26.82	39.17	2378.15

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.22	0.28	0.27	0.25	0.95
POD no	1.00	1.00	0.99	0.96	0.97	0.63
FAR yes	0.00	0.78	0.47	0.83	0.84	0.03
FAR no	0.00	0.00	0.02	0.02	0.02	0.48

HIT RATE: **88.97**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.33
POD no	0.99
FAR yes	0.40
FAR no	0.02

Contingency
For=EFHK Hour=1
Metars 20 min after: 2843
Metars 50 min after: 85

CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0						
	1		2.50	8.68			0.50
	2		22.57	102.60	13.55	1.58	8.38
	5		3.75	61.73	108.85	32.52	80.35
	10			10.50	50.27	69.55	62.65
	15		4.17	25.50	66.33	102.35	1977.13

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.08	0.49	0.46	0.34	0.93
POD no	1.00	1.00	0.98	0.93	0.95	0.71
FAR yes	0.00	0.79	0.31	0.62	0.64	0.09
FAR no	0.00	0.01	0.04	0.05	0.05	0.24

HIT RATE: **80.28**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.56
POD no	0.99
FAR yes	0.15
FAR no	0.04

Contingency
For=EGLL Hour=1
Metars 20 min after: 3002
Metars 50 min after: 65

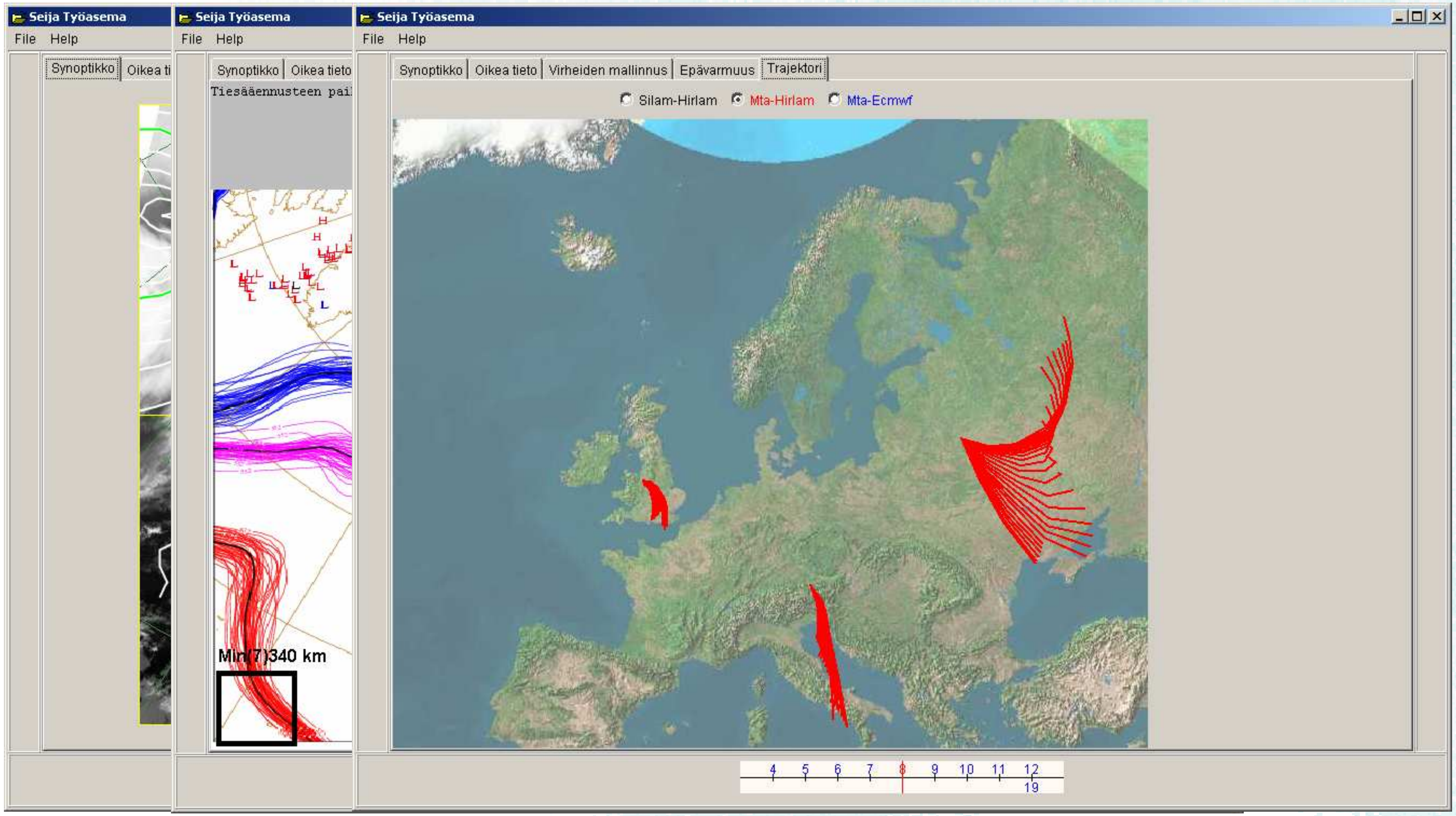
CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0		1.85				
	1	1.00	2.33	2.92			3.77
	2	1.75	2.33	6.55	4.25	0.60	5.13
	5	0.25	0.50	11.93	29.90	28.88	195.80
	10			5.15	31.43	53.88	57.95
	15	3.00		5.45	44.42	76.65	2217.36

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.33	0.20	0.27	0.34	0.89
POD no	1.00	1.00	0.99	0.91	0.96	0.59
FAR yes	1.00	0.77	0.68	0.89	0.64	0.06
FAR no	0.00	0.00	0.01	0.03	0.04	0.59

HIT RATE: **82.65**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.42
POD no	1.00
FAR yes	0.42
FAR no	0.01

The development of next generation workstation & production system



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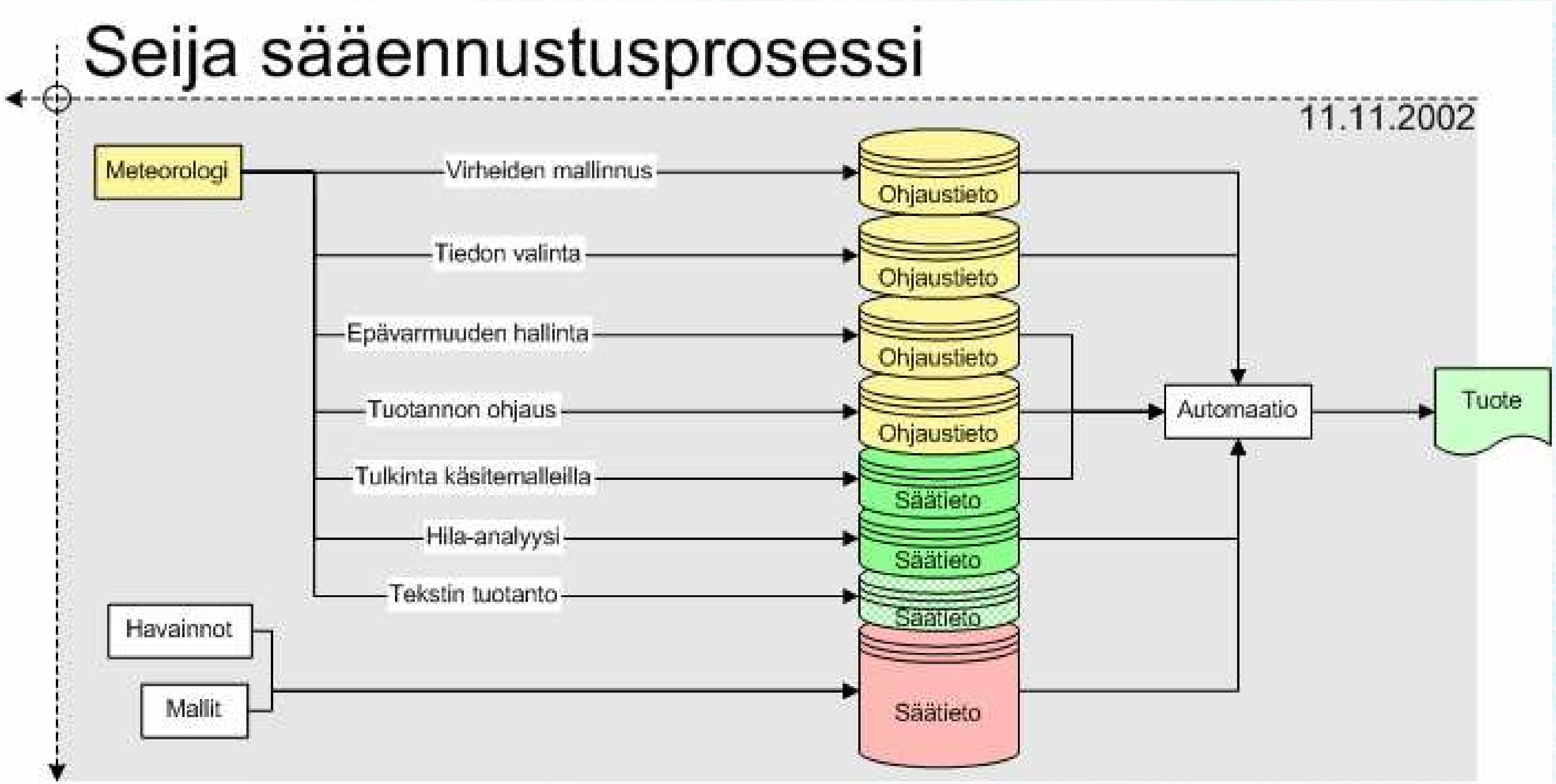
The future production process



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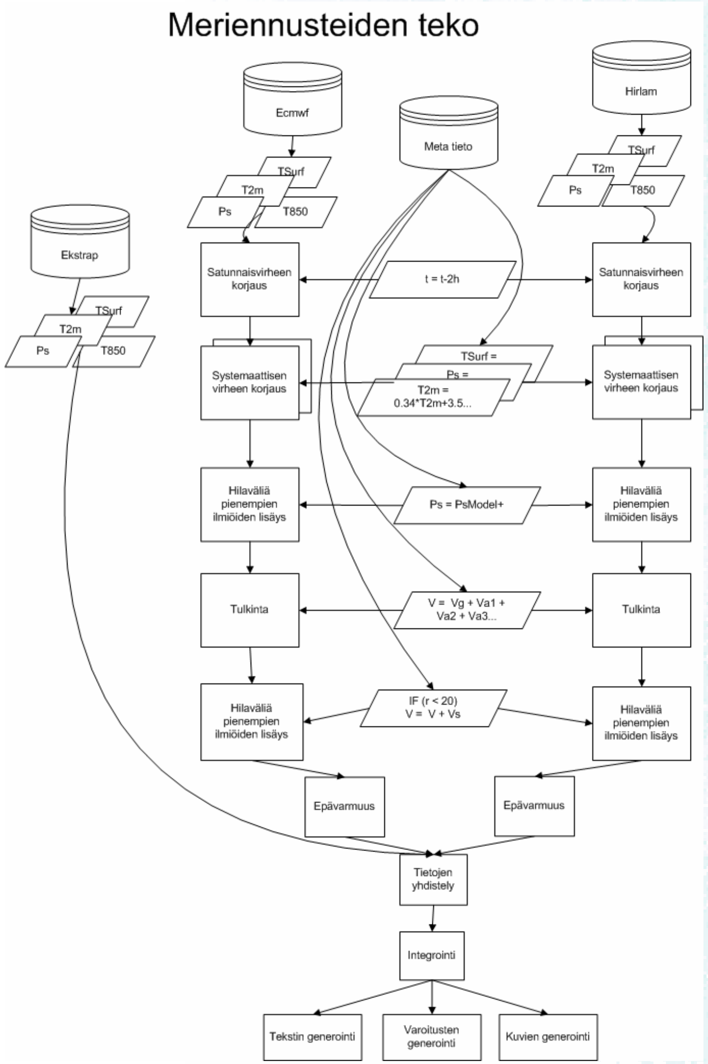

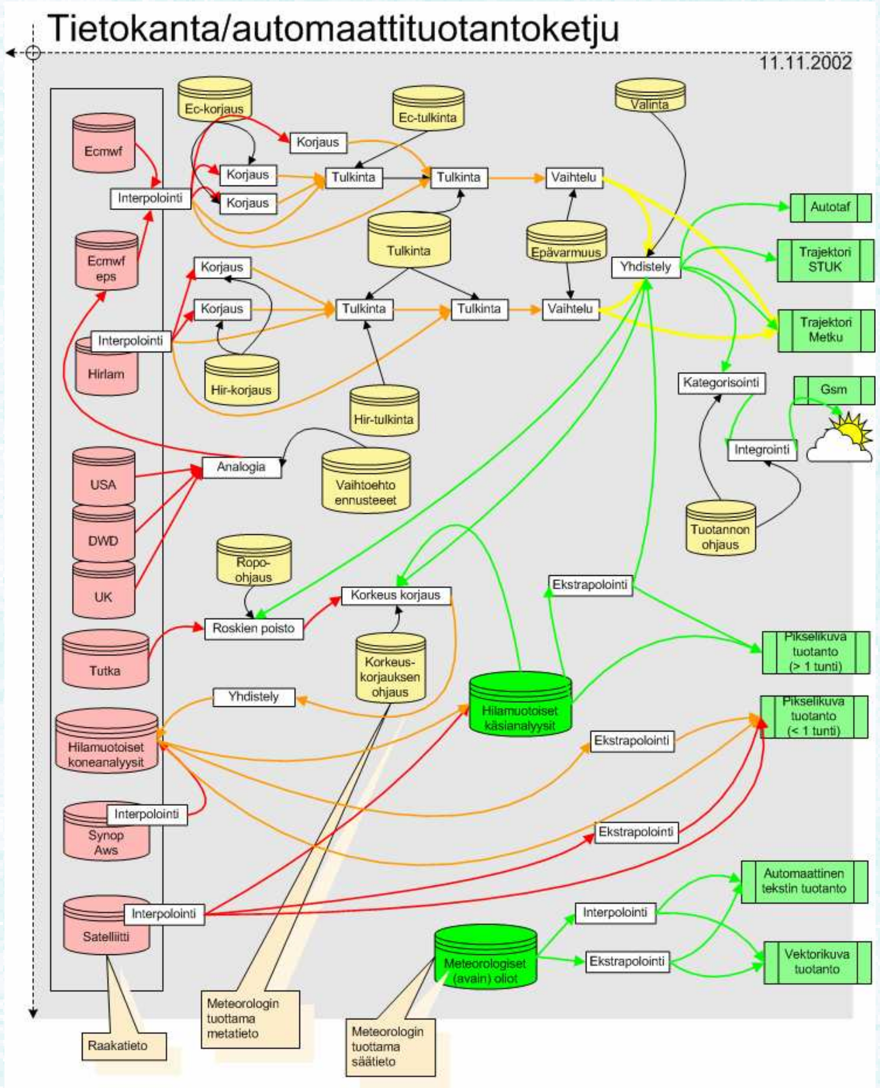

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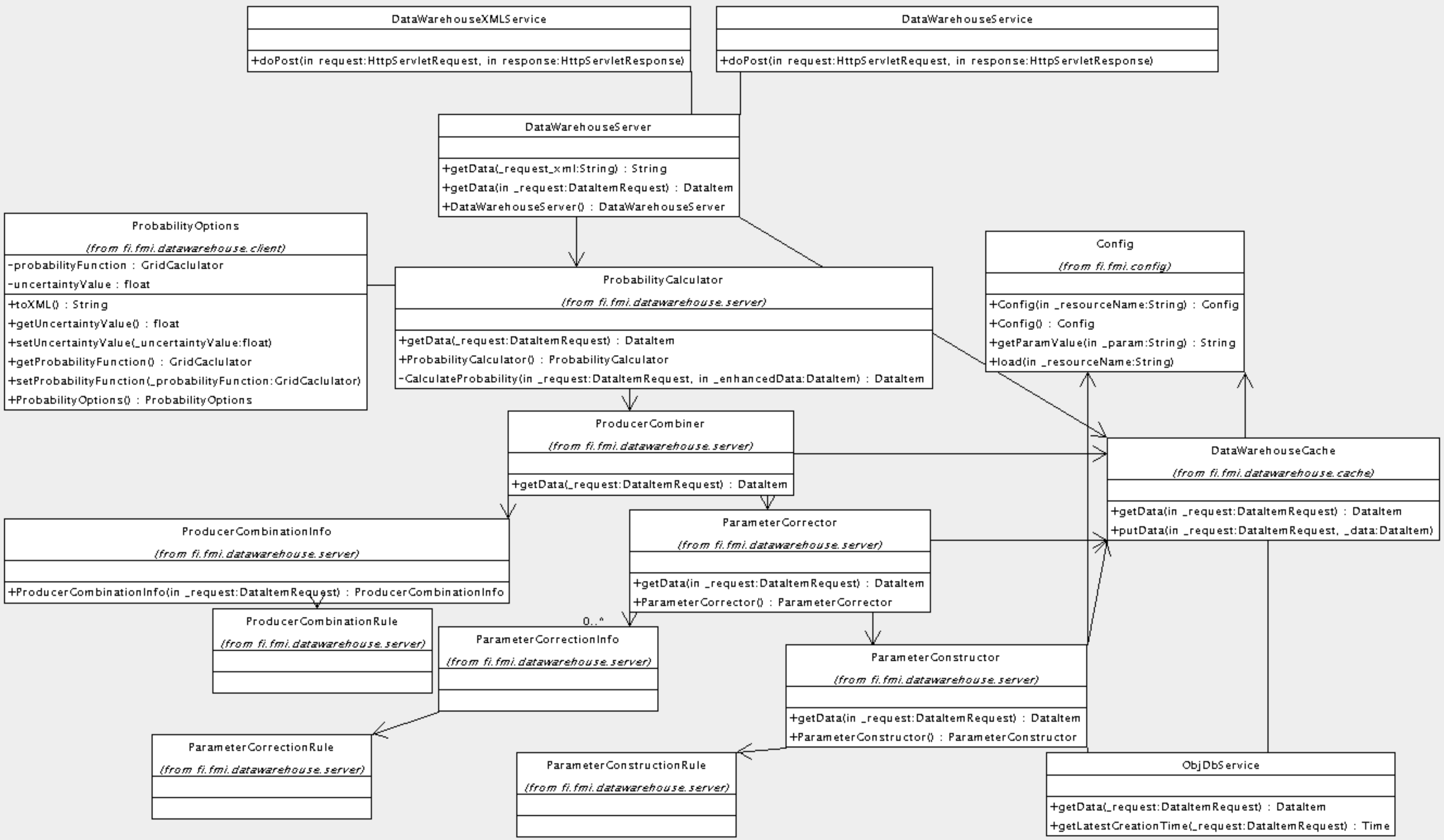

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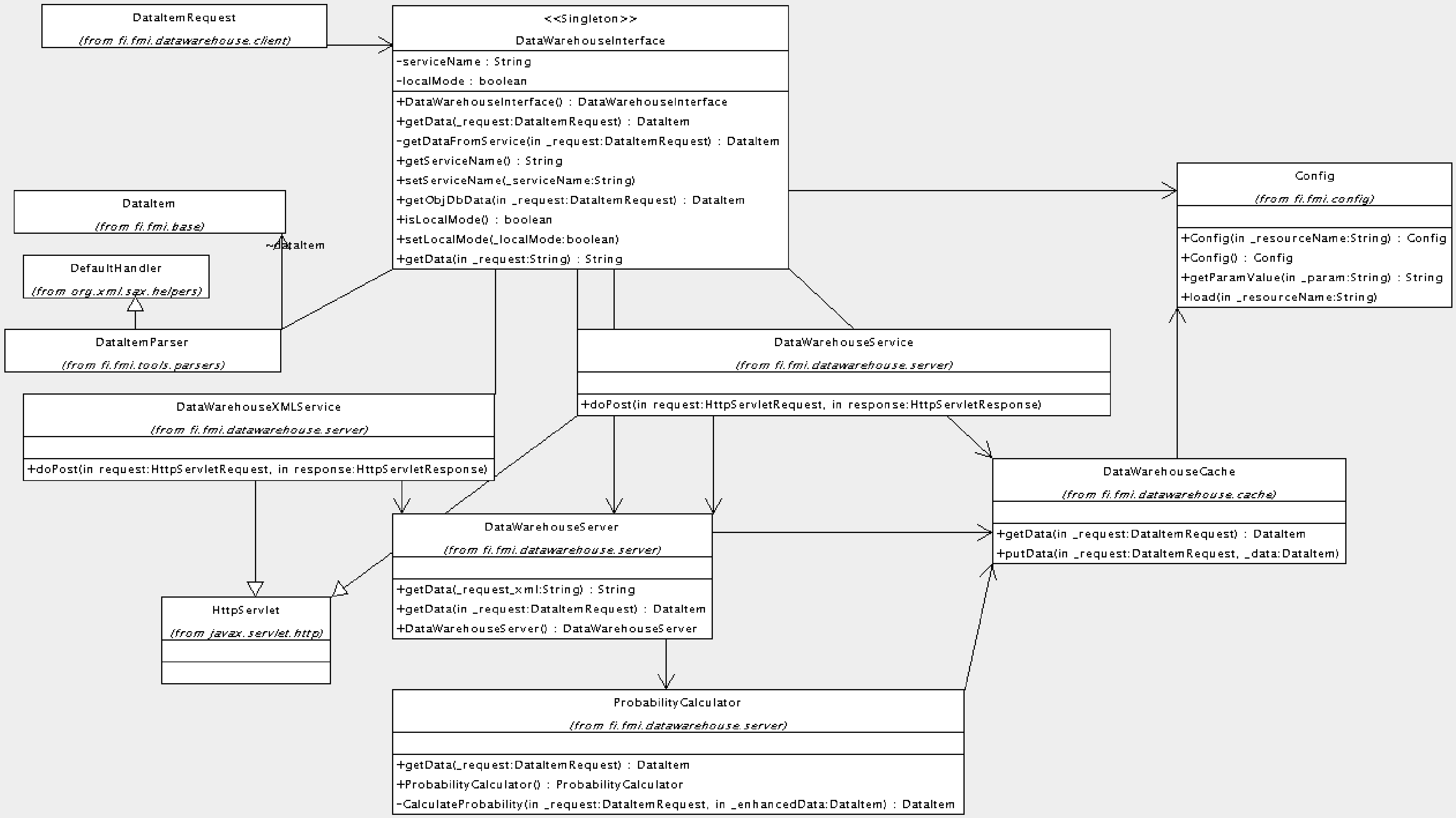
DataItemRequest
(from fi.fmi.datawarehouse.client)
<<Singleton>>
DataWarehouseInterface
-serviceName : String
-localMode : boolean
+DataWarehouseInterface() : DataWarehouseInterface
+getData(_request:DataItemRequest) : DataItem
-getDataFromService(in _request:DataItemRequest) : DataItem
+getServiceName() : String
+setServiceName(_serviceName:String)
+getObjDbData(in _request:DataItemRequest) : DataItem
+isLocalMode() : boolean
+setLocalMode(_localMode:boolean)
+getData(in _request:String) : String
DataItem
(from fi.fmi.base)
~dataItem
DefaultHandler
(from org.xml.sax.helpers)
DataItemParser
(from fi.fmi.tools.parsers)
Config
(from fi.fmi.config)
+Config(in _resourceName:String) : Config
+Config() : Config
+getParamValue(in _param:String) : String
+load(in _resourceName:String)
DataWarehouseService
(from fi.fmi.datawarehouse.server)
+doPost(in request:HttpServletRequest, in response:HttpServletResponse)
DataWarehouseXMLService
(from fi.fmi.datawarehouse.server)
+doPost(in request:HttpServletRequest, in response:HttpServletResponse)
DataWarehouseCache
(from fi.fmi.datawarehouse.cache)
+getData(in _request:DataItemRequest) : DataItem
+putData(in _request:DataItemRequest, _data:DataItem)
DataWarehouseServer
(from fi.fmi.datawarehouse.server)
+getData(_request_xml:String) : String
+getData(in _request:DataItemRequest) : DataItem
+DataWarehouseServer() : DataWarehouseServer
HttpServlet
(from javax.servlet.http)
ProbabilityCalculator
(from fi.fmi.datawarehouse.server)
+getData(_request:DataItemRequest) : DataItem
+ProbabilityCalculator() : ProbabilityCalculator
-CalculateProbability(in _request:DataItemRequest, in _enhancedData:DataItem) : DataItem

Thank you

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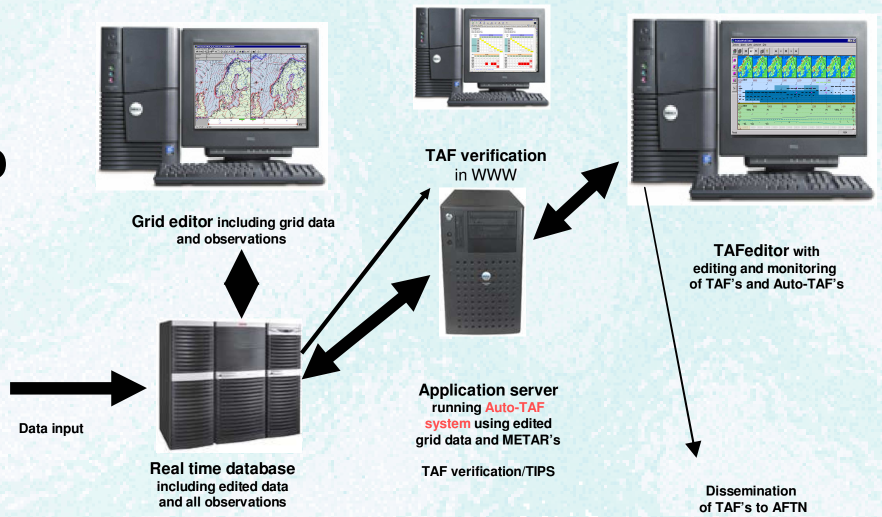
The integration of Auto-TAF system to TAFeditor environment at FMI

Viljo Kangasniemi and Juha Kilpinen
Finnish Meteorological Institute (FMI)

- **TAFeditor:**
  - **Visualisation of TAF/METAR**
  - **Editing and dissemination of TAFs to AFTN/ICAO**
  - **Monitoring of TAF's**
  - **Visualisation of HIRLAM/ECMWF level data**
- **Auto-TAF:**
  - **Encoding of TAF's**



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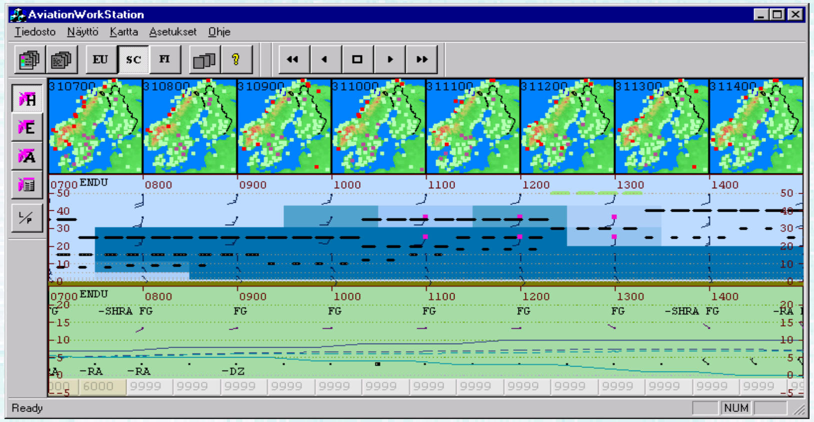
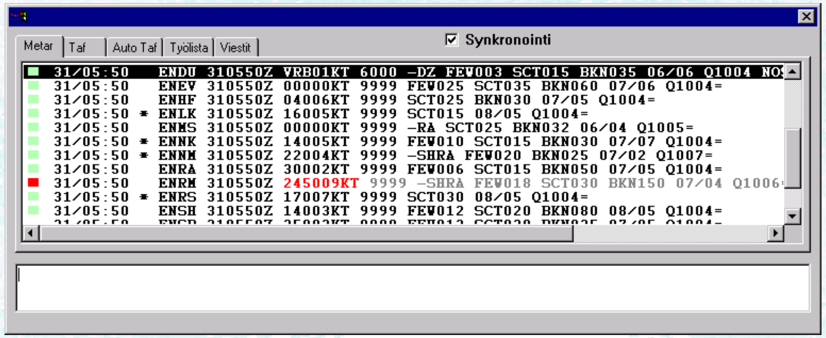
  - **Encoding of TAF's**





Forecasting process at FMI

Old VAX workstation

Old manual forecast process and production still exits: Hand drawing of maps, human Made text bulletins etc.....

TAF editor system with partly manual process

New Grid editor system with automated production process

The new forecast process expanding: integration of TAF-production to edited grid data

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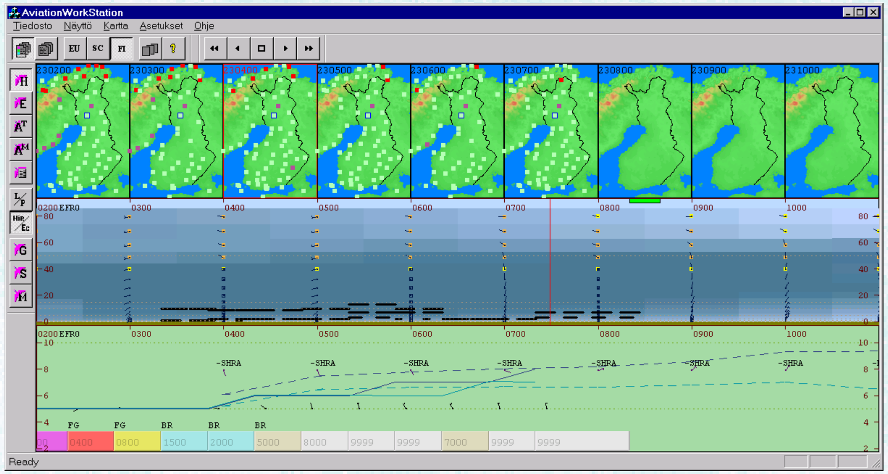
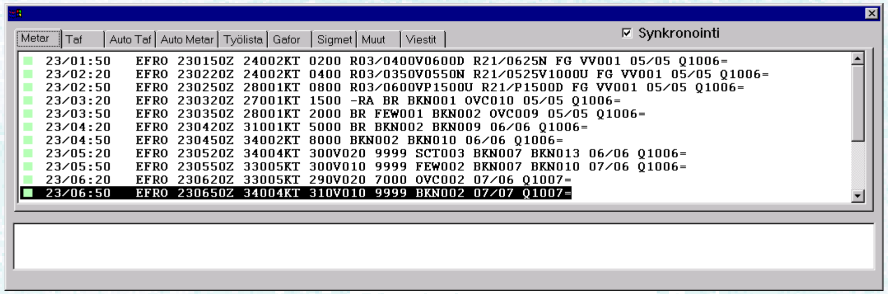
Visualisation

- **receives aviation messages (METAR, TAF, …) from AFTN/ICAO**
- **visualises METAR- and TAF-messages**
- **visualises Auto-TAF and forecasted "METAR" messages**
- **visualises HIRLAM/ECMWF model level data and edited surface model data**





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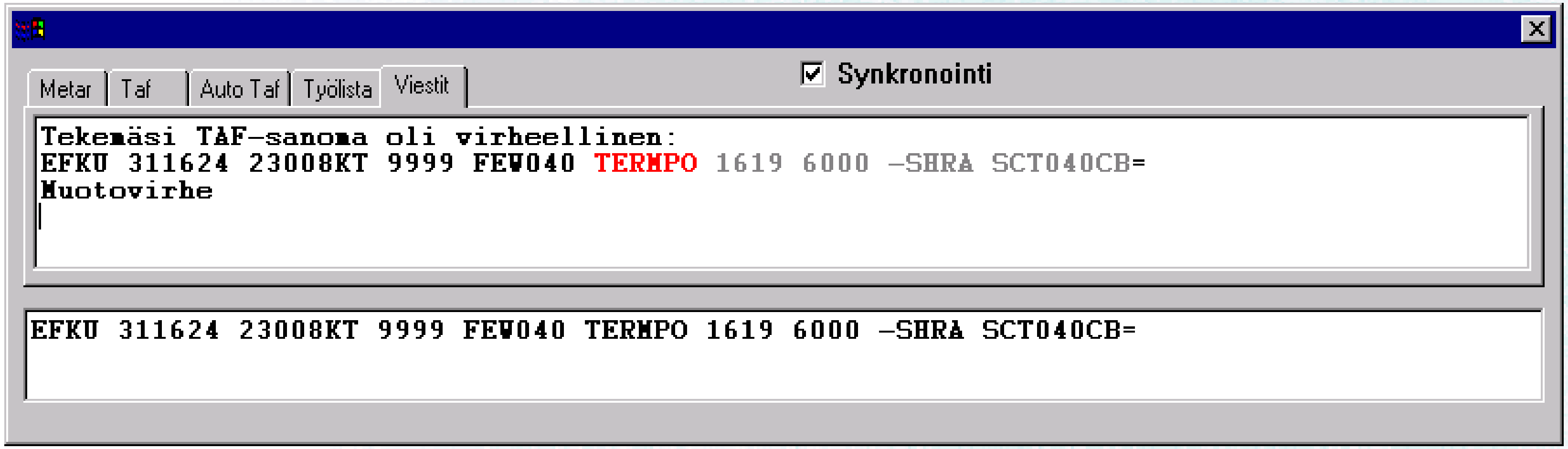
Editing and sending of TAFs to AFTN/ICAO

- Checks spelling and ICAO-standards when editing TAFs
- Checks correspondence between TAF:s forecast section and TAF-section specified in ICAO-standards



- Checks sending time in regard to the send window and TAF-section specified in ICAO-standards
- Automatic TAF-type checking (normal, RRA, AAA, CCA) when writing TAFs
- Creates and sends proper bulletins to AFTN/ICAO

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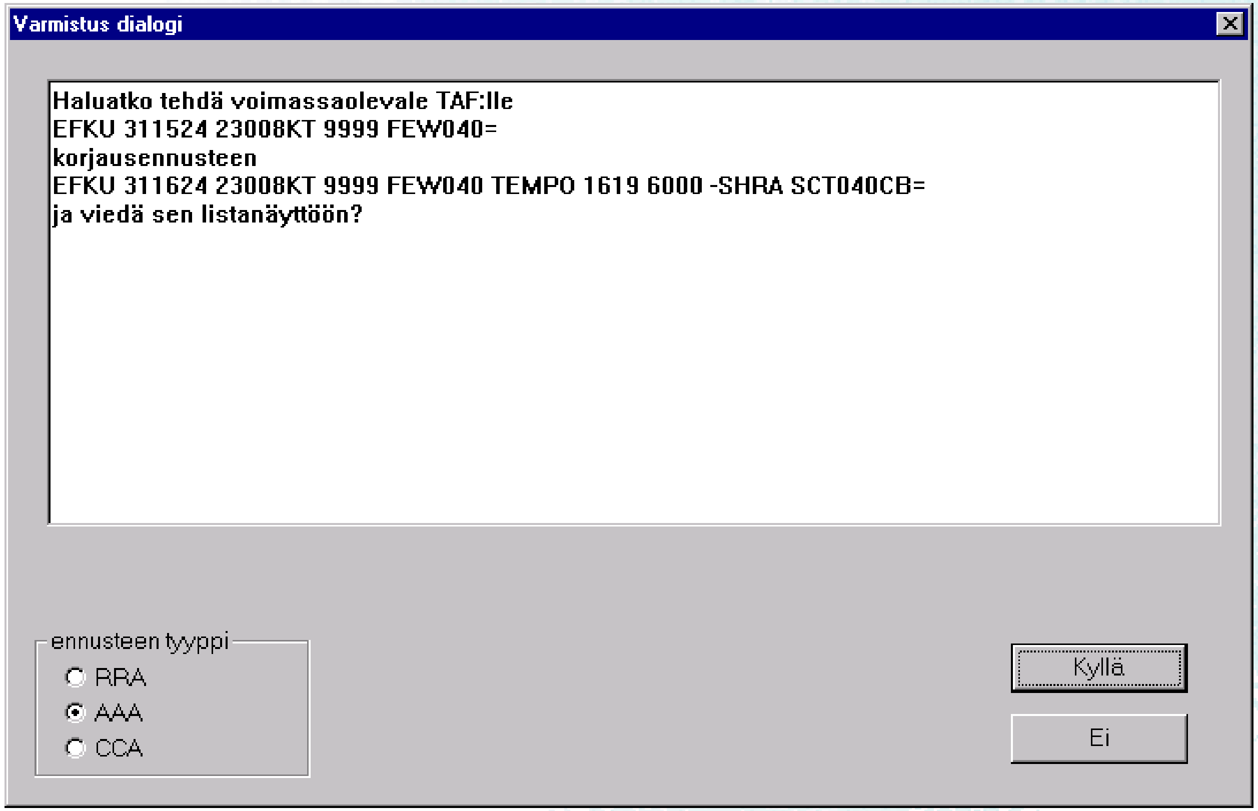
Editing and sending of TAFs to AFTN/ICAO

- **A confirmation dialog before an edited AAA-TAF will be moved to its task list.**



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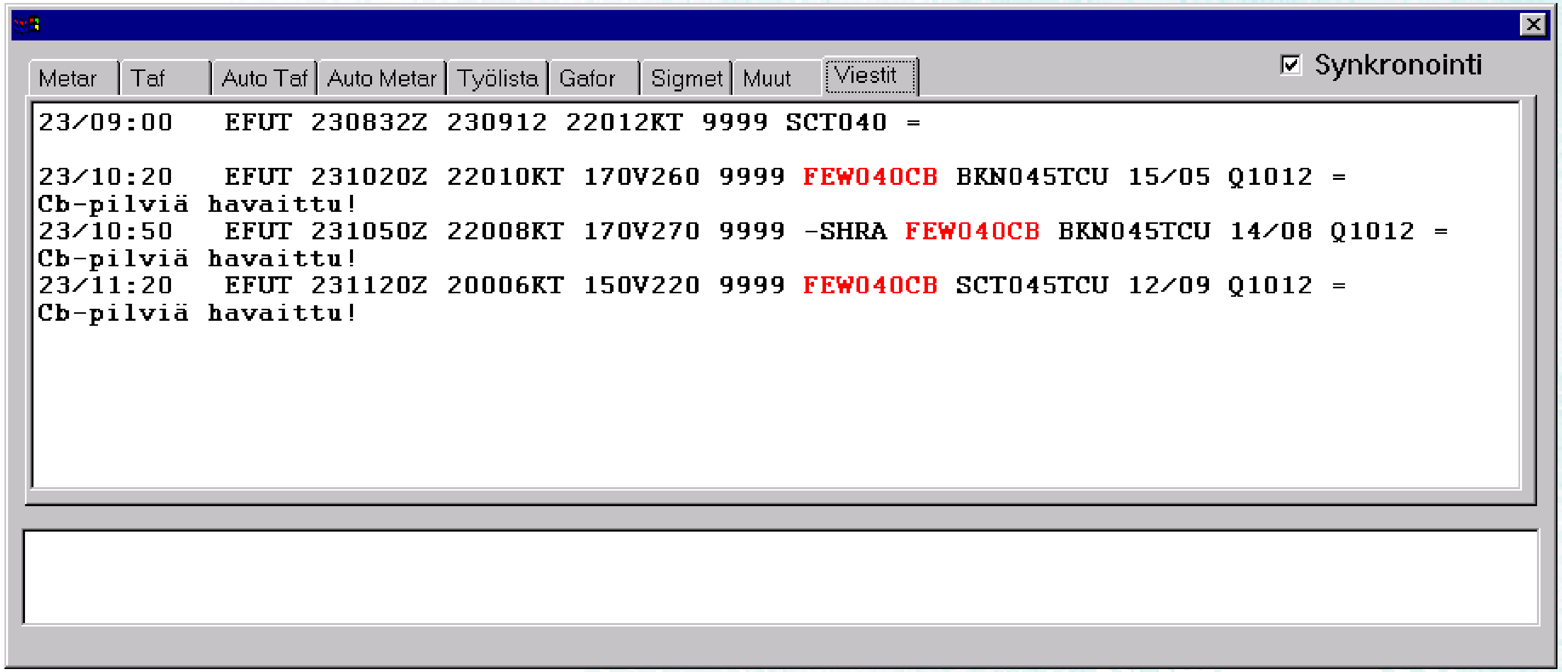
Monitoring

- TAF's are monitored against METAR's
- TAF-task scheduler
- TAF type and its forecast section checked in regard to current time when bulletin is sent to AFTN



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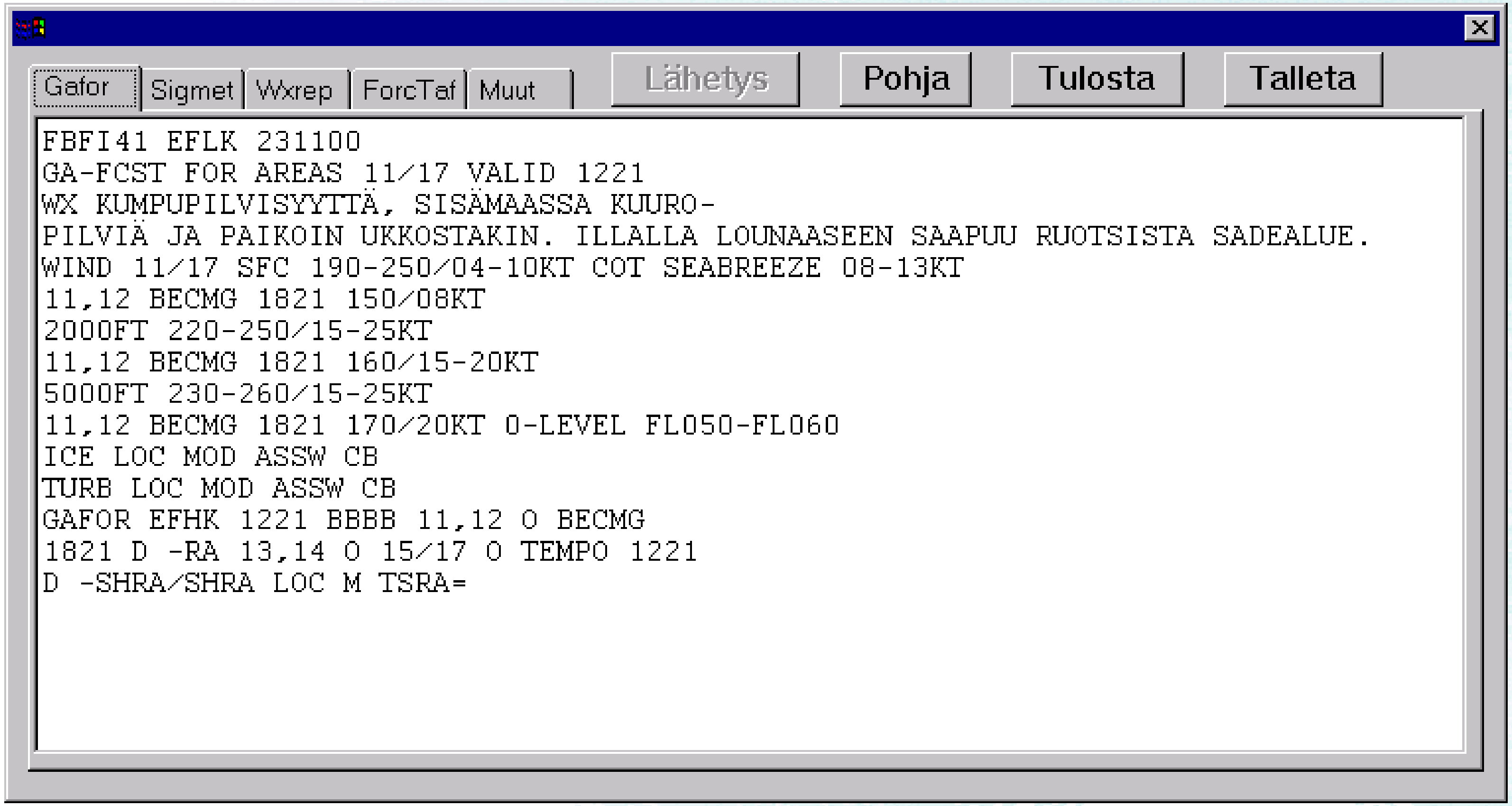
Other properties

- **Editing and sending of informal aviation messages (GAFOR, SIGMET, ICING…)**



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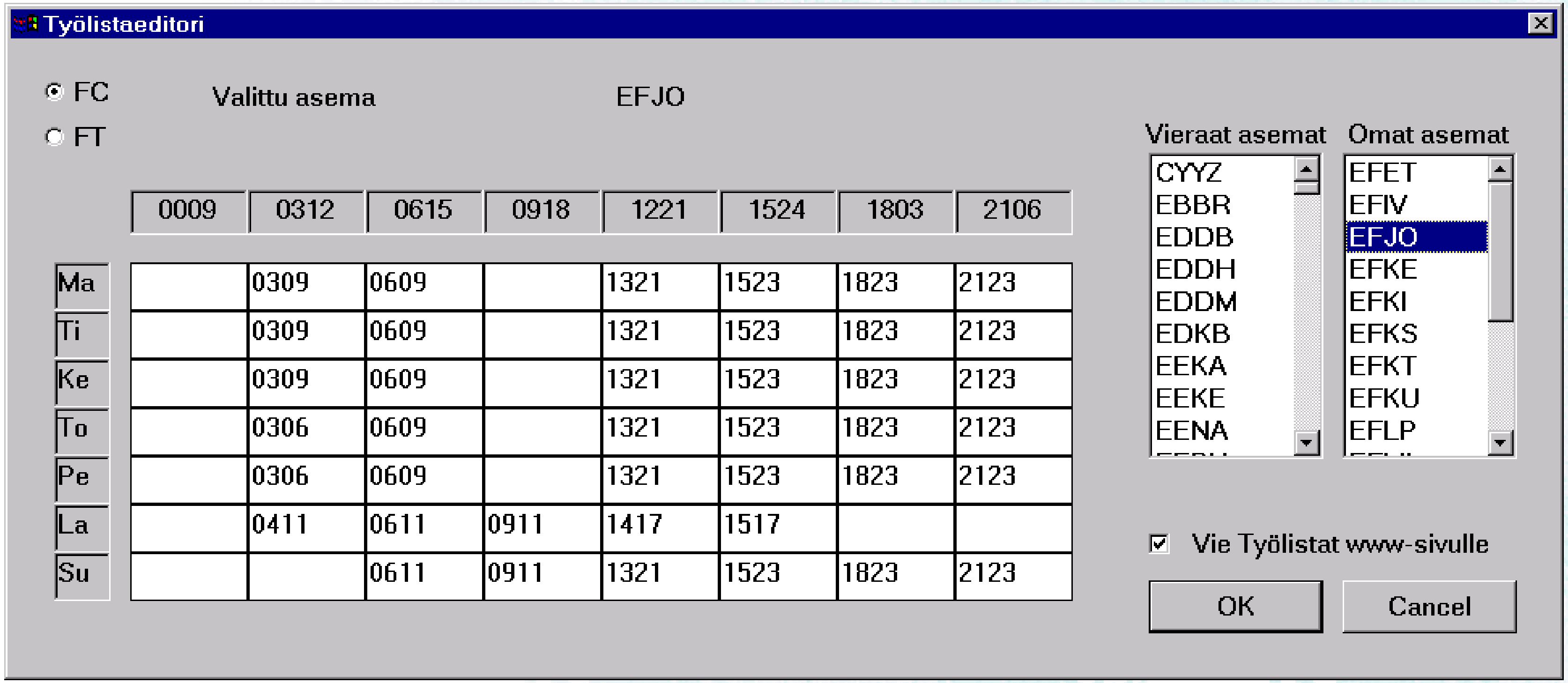
Other properties

- **Task list editor**
- **Some statistical support**



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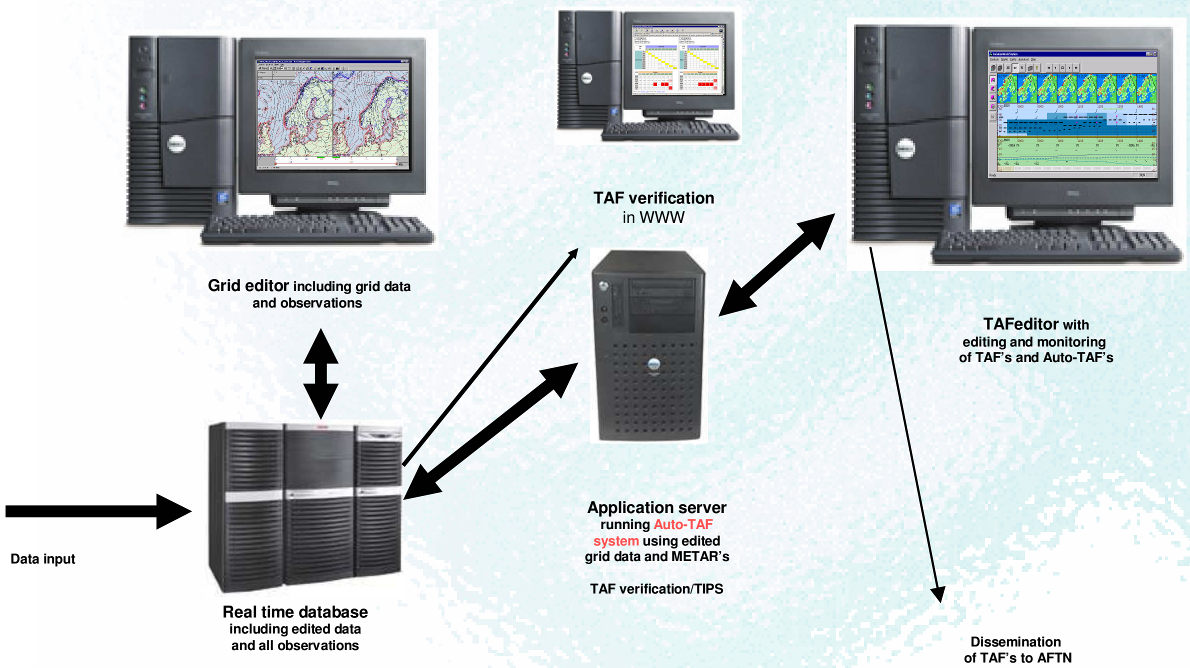
The Auto-TAF -system at FMI

- **Auto-TAF's are made from:**
  - **model data (levels of ECMWF & HIRLAM)**
  - **METAR's**
  - **edited (by forecaster) data**



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The Auto-TAF -system at FMI

- Auto-TAF's are made from:
    - model data (levels of ECMWF & HIRLAM)
    - METAR's
    - edited (by forecaster) data
- Cloud layers are derived from model level humidity data
- Surface variables are taken from data edited by forecasters: dddff (wind), VVVV (visibility), ww (significant weather)
- Different techniques for merging (fitting) of METAR's to model/edited data has been tested (no fit/simple fit/smart fit)
- Encoding of TAF applies the TAF-object of TAFeditor
- Verification is made using TIPS/NORTAF/Gordon methods

Derivation of clouds from model data

All model levels are used

The alghorithm used in deriving cloud from humidity:

- RH_{min}=75%
- RH_{max}=98%
- N=0/8 when $RH<=RH_{min}$
- N=8*max(c,1) when $RH_{min}<RH<=RH_{max}$
- N=8/8 when $RH>RH_{max}$
- $c=((RH-RH_{min})/(RH-RH_{max}))^2$

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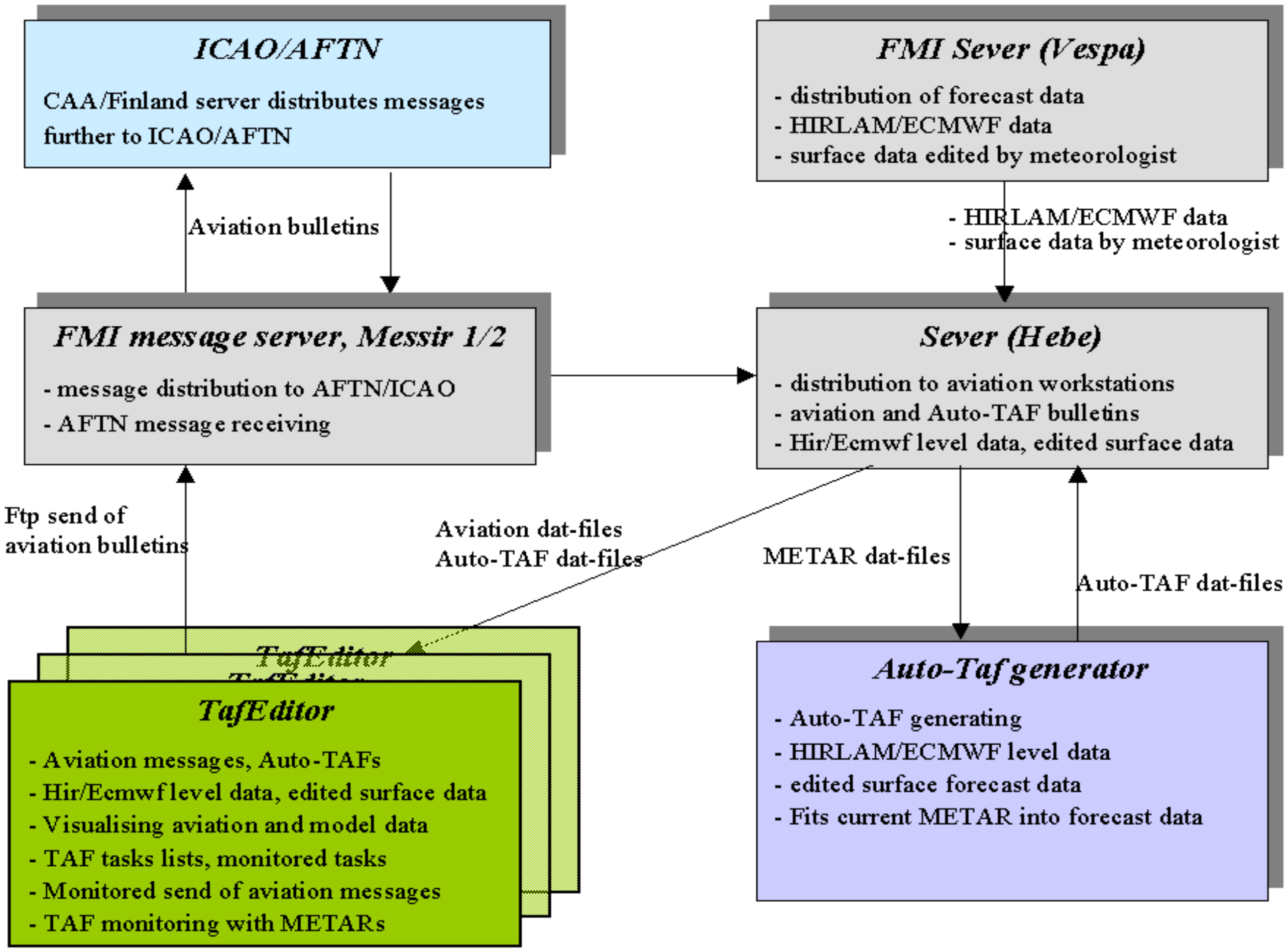
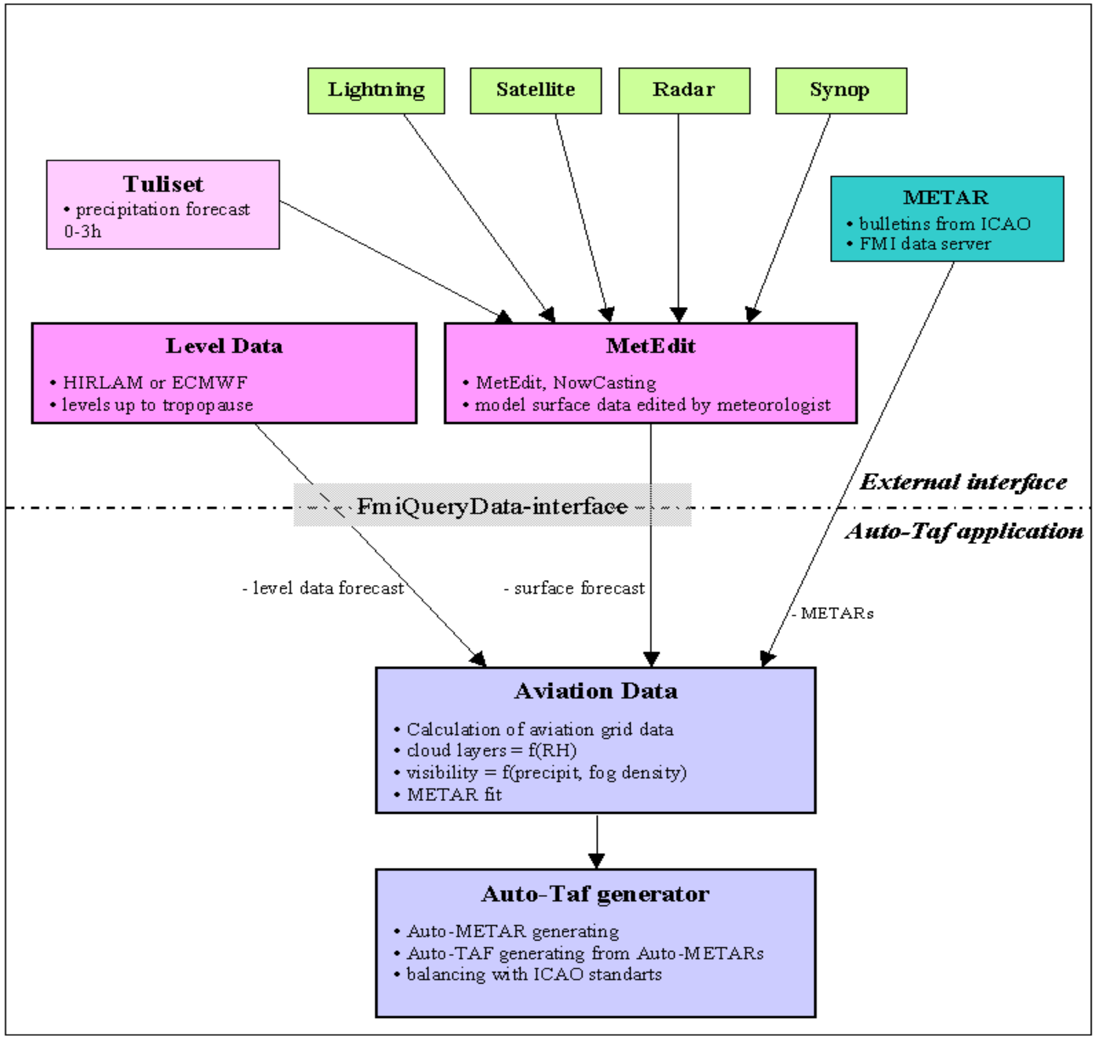
The Auto-TAF -system at FMI



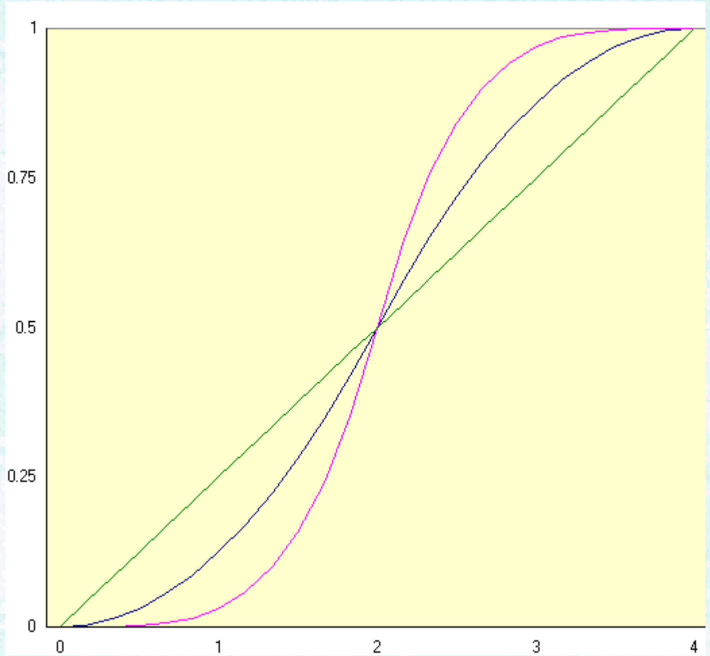

Lightning
Satellite
Radar
Synop
Tuliset
• precipitation forecast 0-3h
METAR
• bulletins from ICAO
• FMI data server
Level Data
• HIRLAM or ECMWF
• levels up to tropopause
MetEdit
• MetEdit, NowCasting
• model surface data edited by meteorologist
External interface
FmiQueryData-interface
Auto-Taf application
- level data forecast
- surface forecast
- METARs
Aviation Data
• Calculation of aviation grid data
• cloud layers = f(RH)
• visibility = f(precipit, fog density)
• METAR fit
Auto-Taf generator
• Auto-METAR generating
• Auto-TAF generating from Auto-METARs
• balancing with ICAO standarts

Fitting of METAR's and aviation data in time

Fit order:

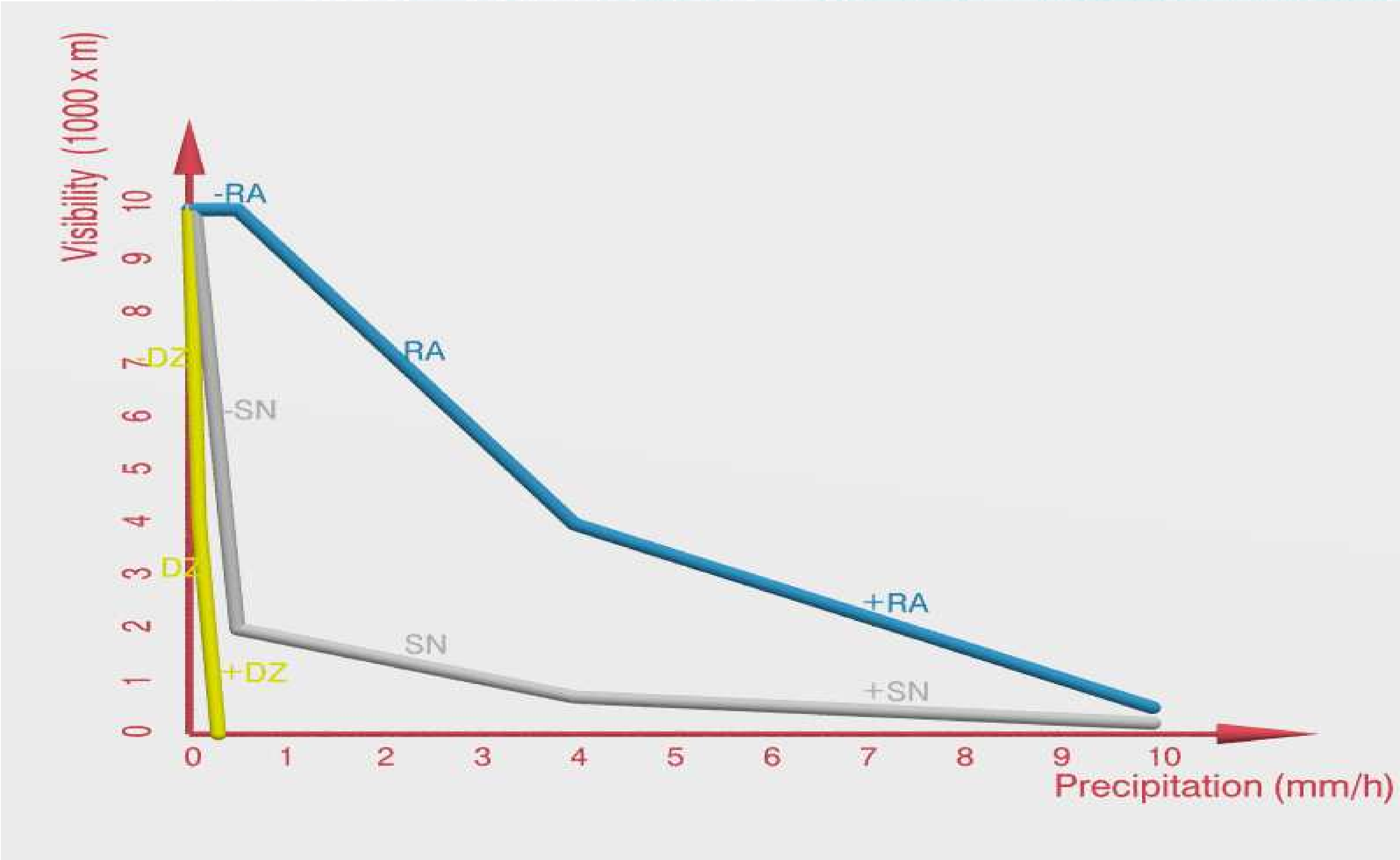
wind
probability of precipitation and thunder
temperature and dew-point
visibility
vertical visibility
cloud layers

Smart Fit **takes into account the persistency of weather parameters**



Weight curves inside fit section

Interpretation of visibility from intensity and type of precipitation



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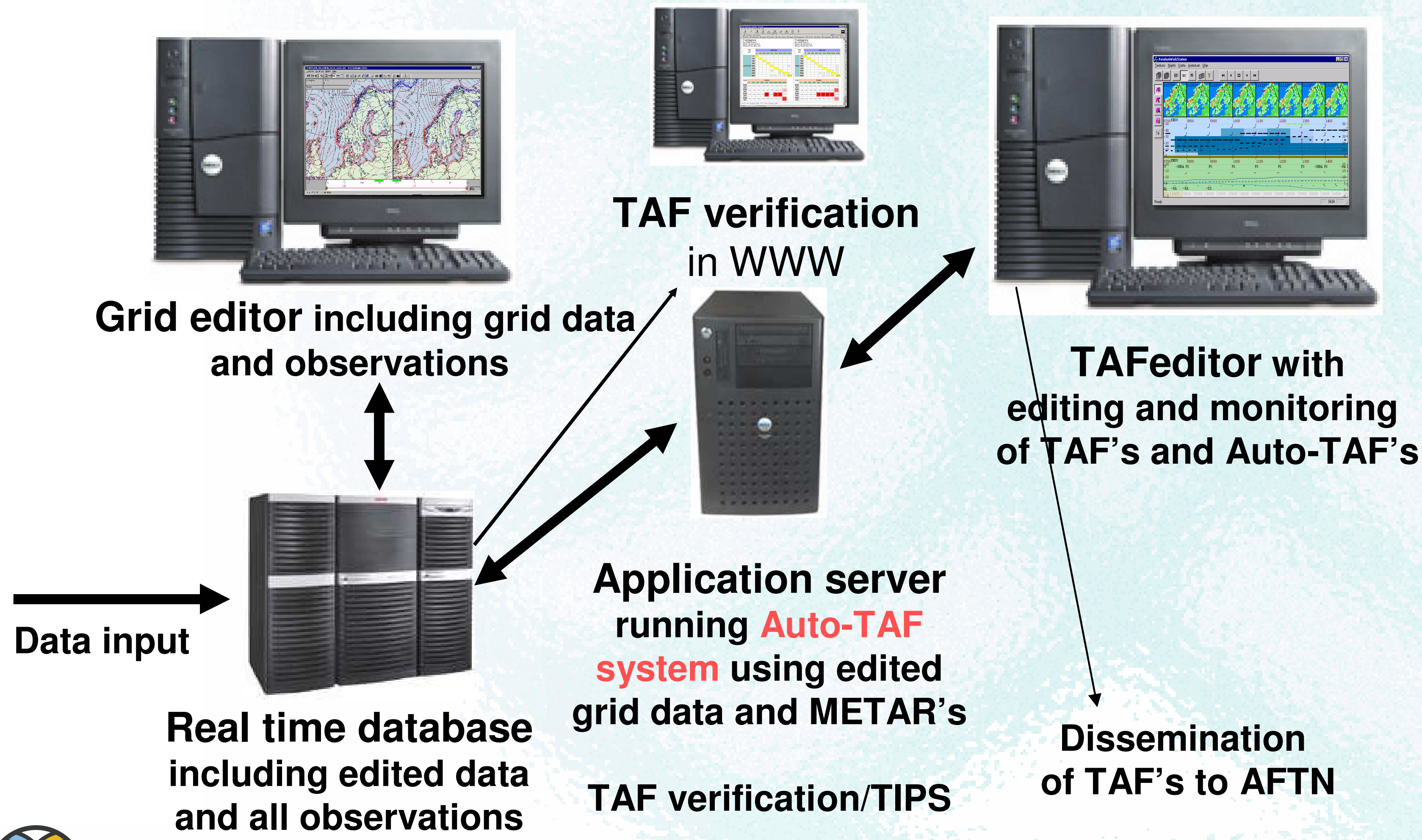
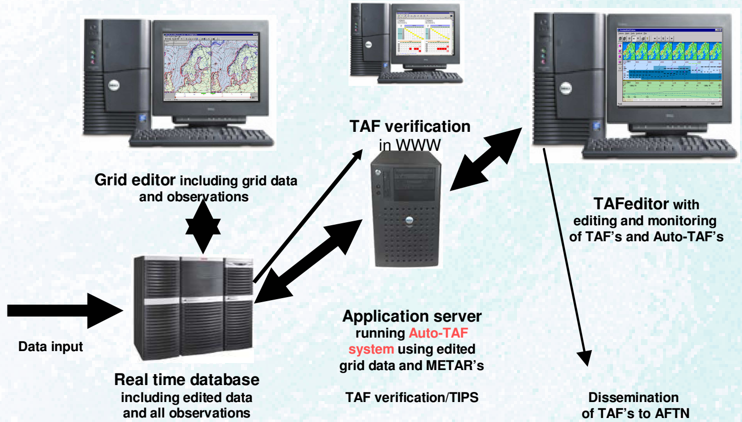
Integration of AUTOTAF system at FMI





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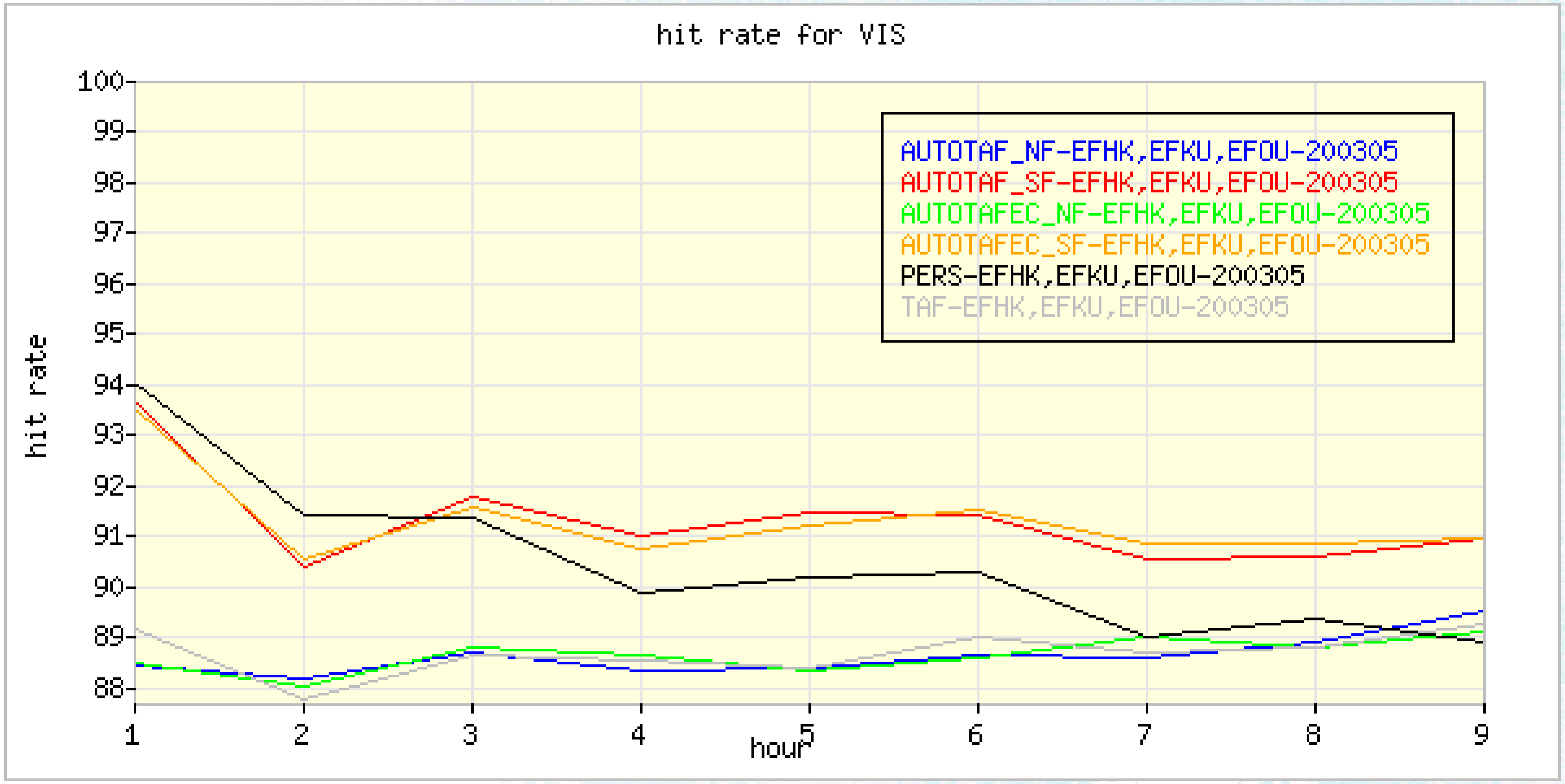
TIPS verification method

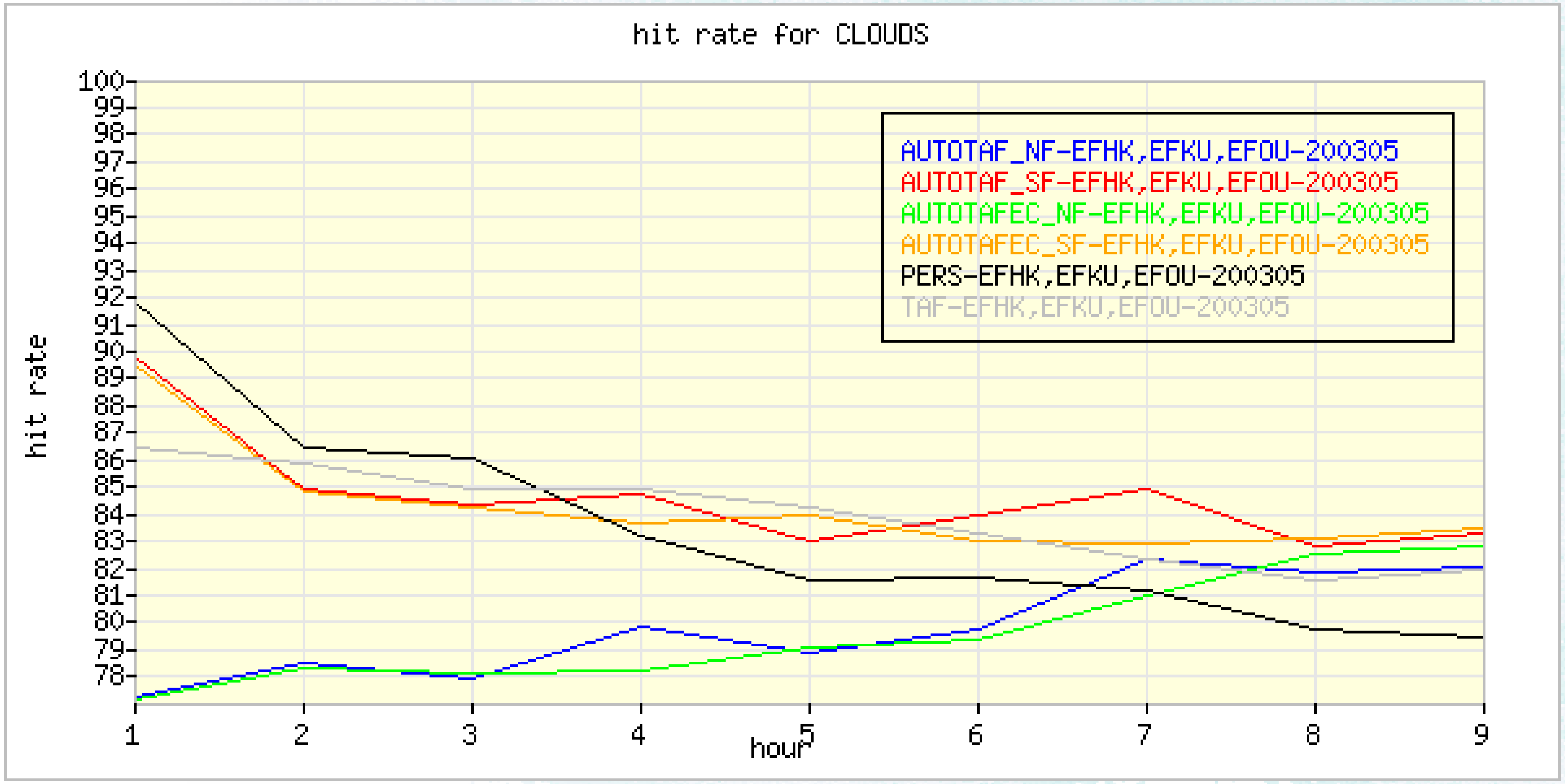
- TIPS considers TAF as a probabilistic forecast (TEMPO group is also handeled in the same way as PROB
- Every TAF gets weight 1 in contingency table
- If TAF/AUTOTAF consists only from basic weather the basic weather gets weight 1
- If TAF/AUTOTAF has a TEMPO-group, this TEMPO-group gets weight 0.25 and the basic weather weight 0.75
- PROB30 TEMPO gets weight 0.3*0.25 and the rest of weight i.e. 0.925 is left to basic weather
- within a BECMG group the weight is interpolated in a linear way
- FM is regarded as a new forecast from the beginning and it get weight 1

- FMI provides TAF verification also using GORDON and NORTAF methods

TIPS verification



TIPS verification



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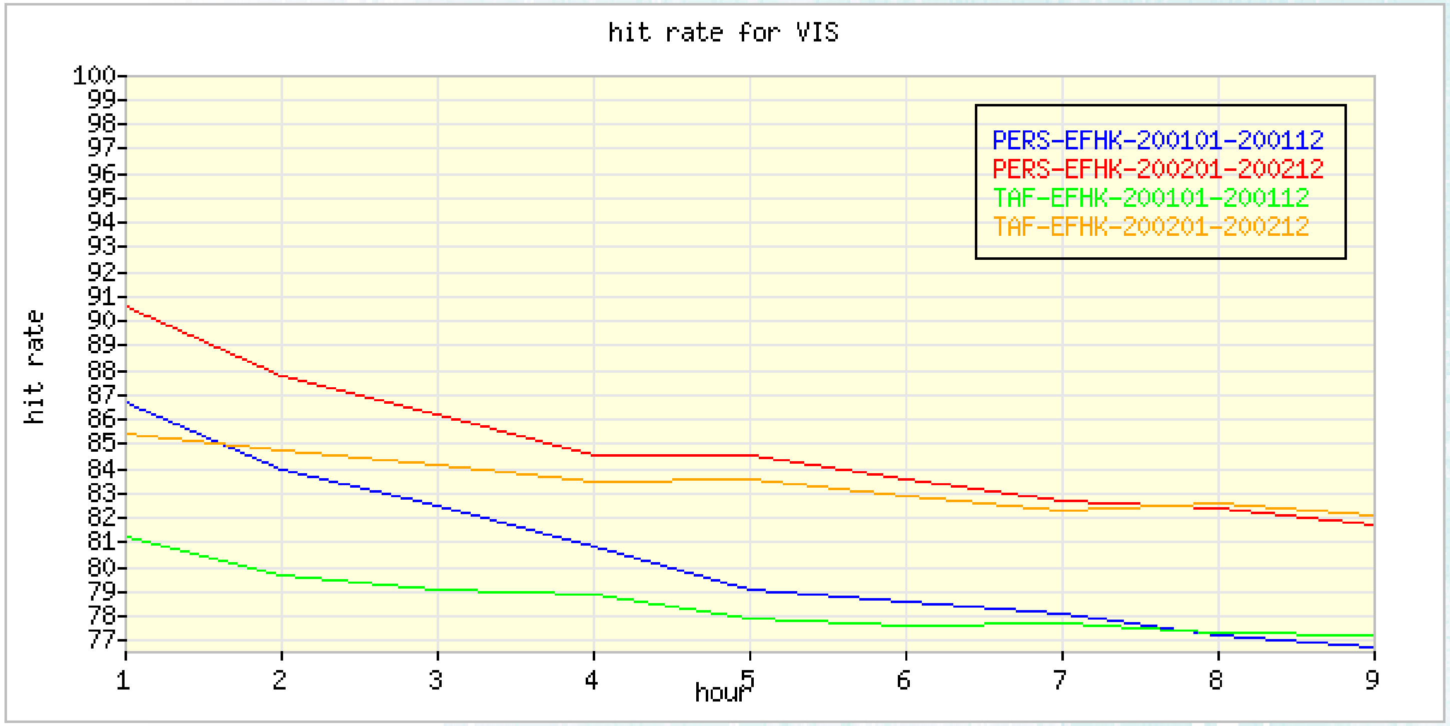
TIPS verification



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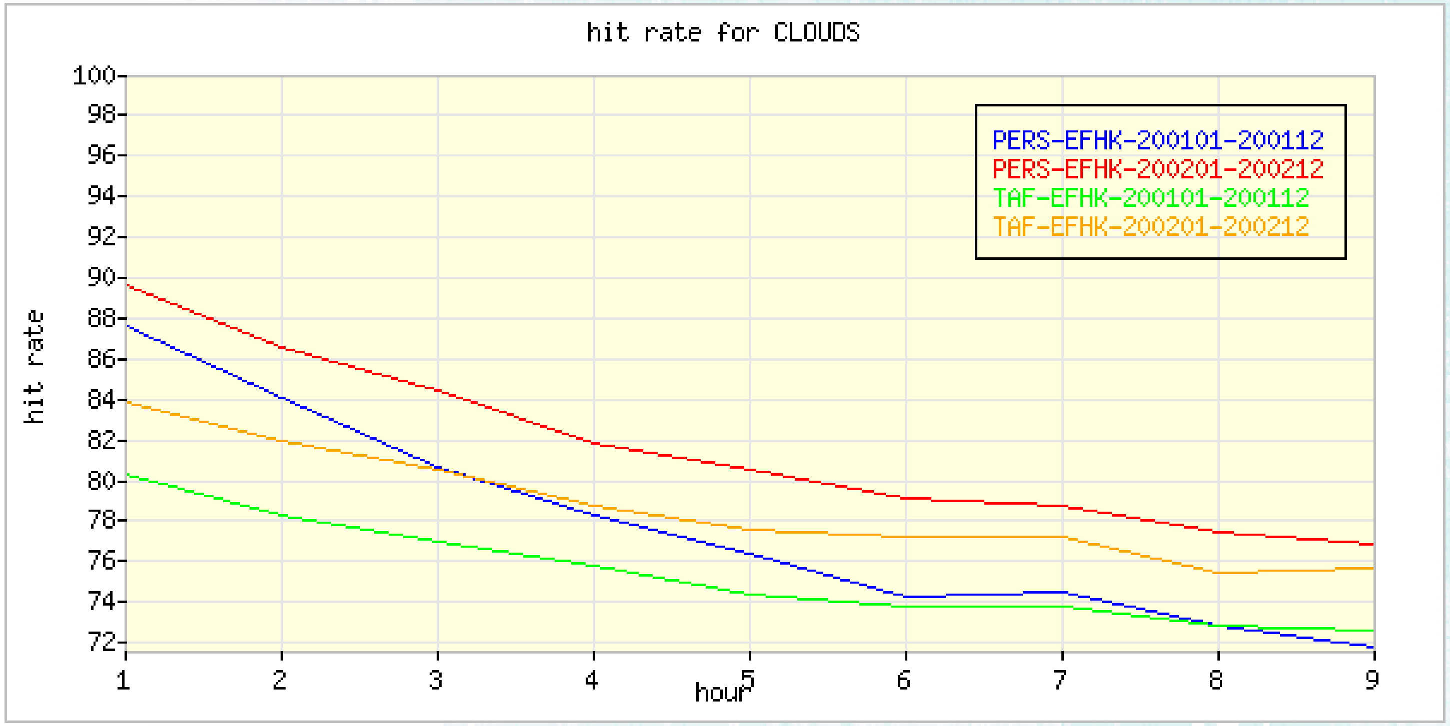
TIPS verification



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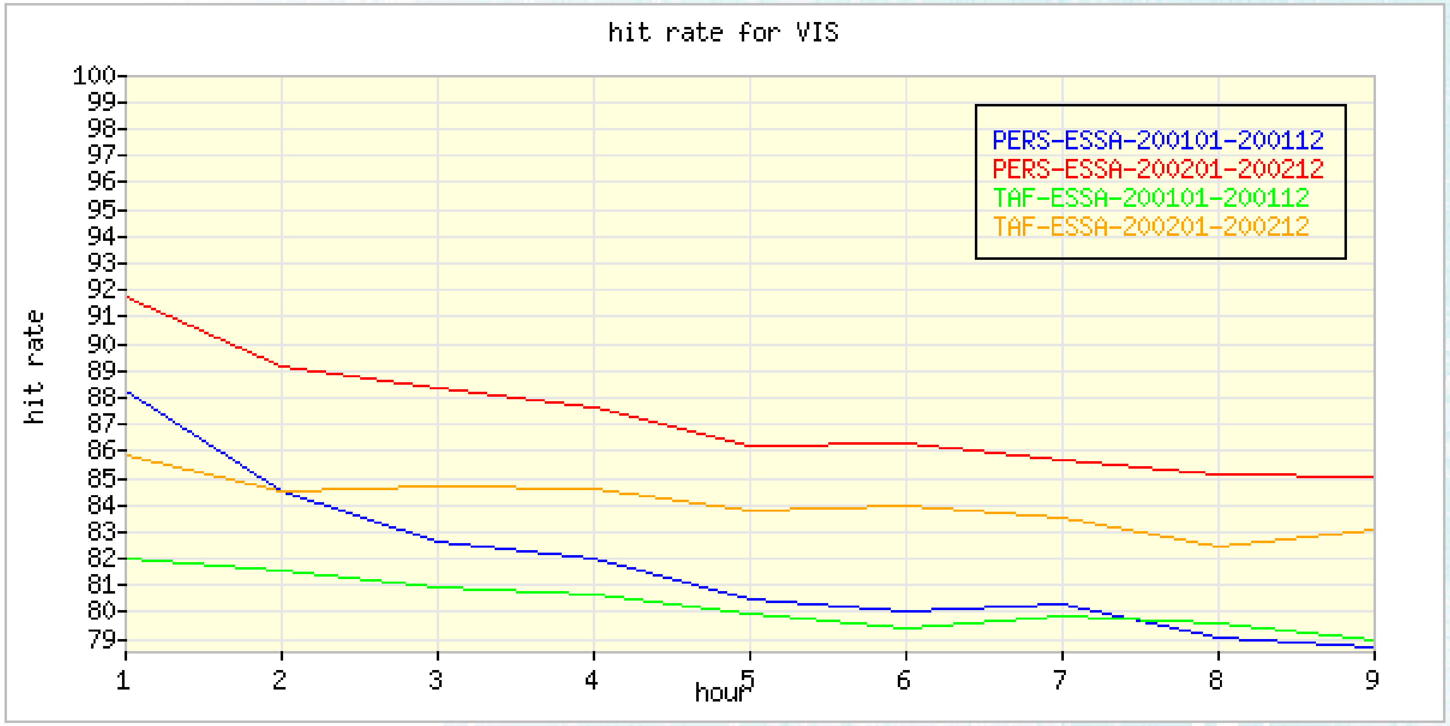
TIPS verification



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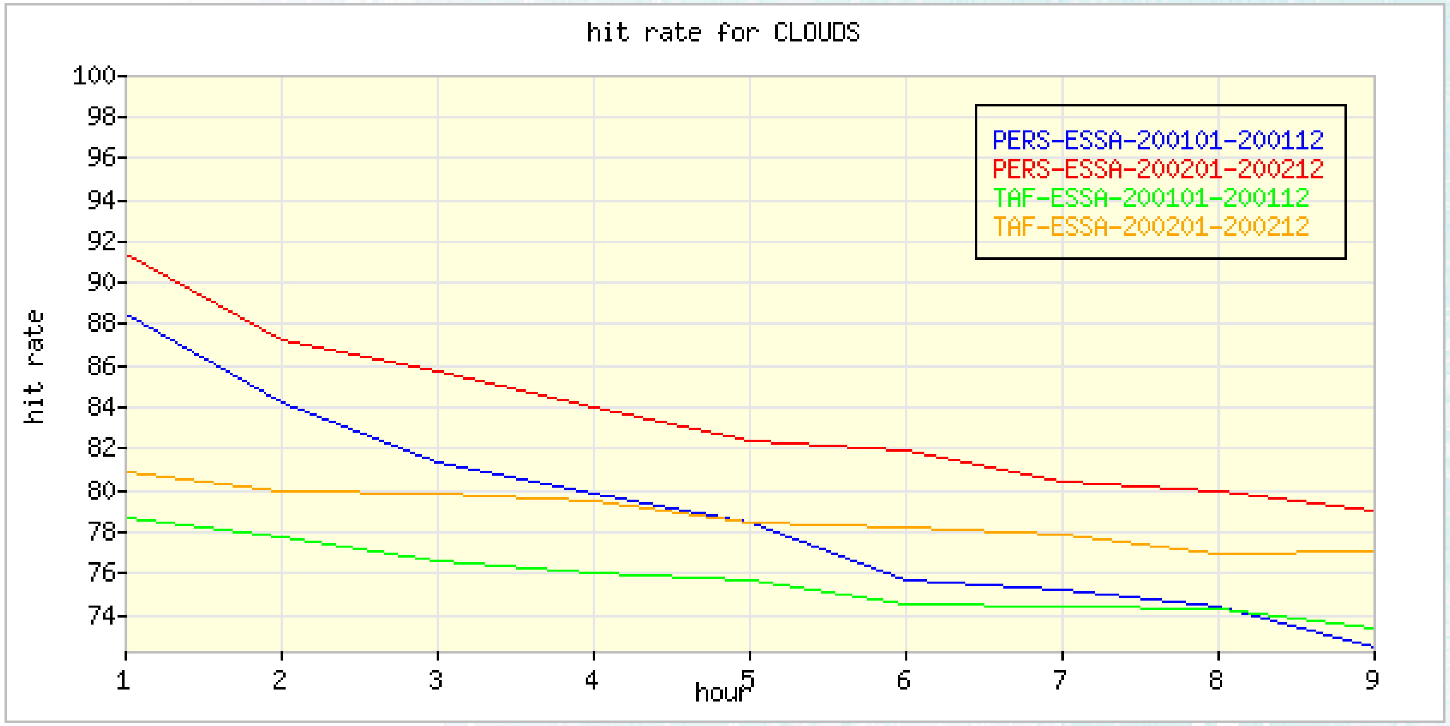
TIPS verification



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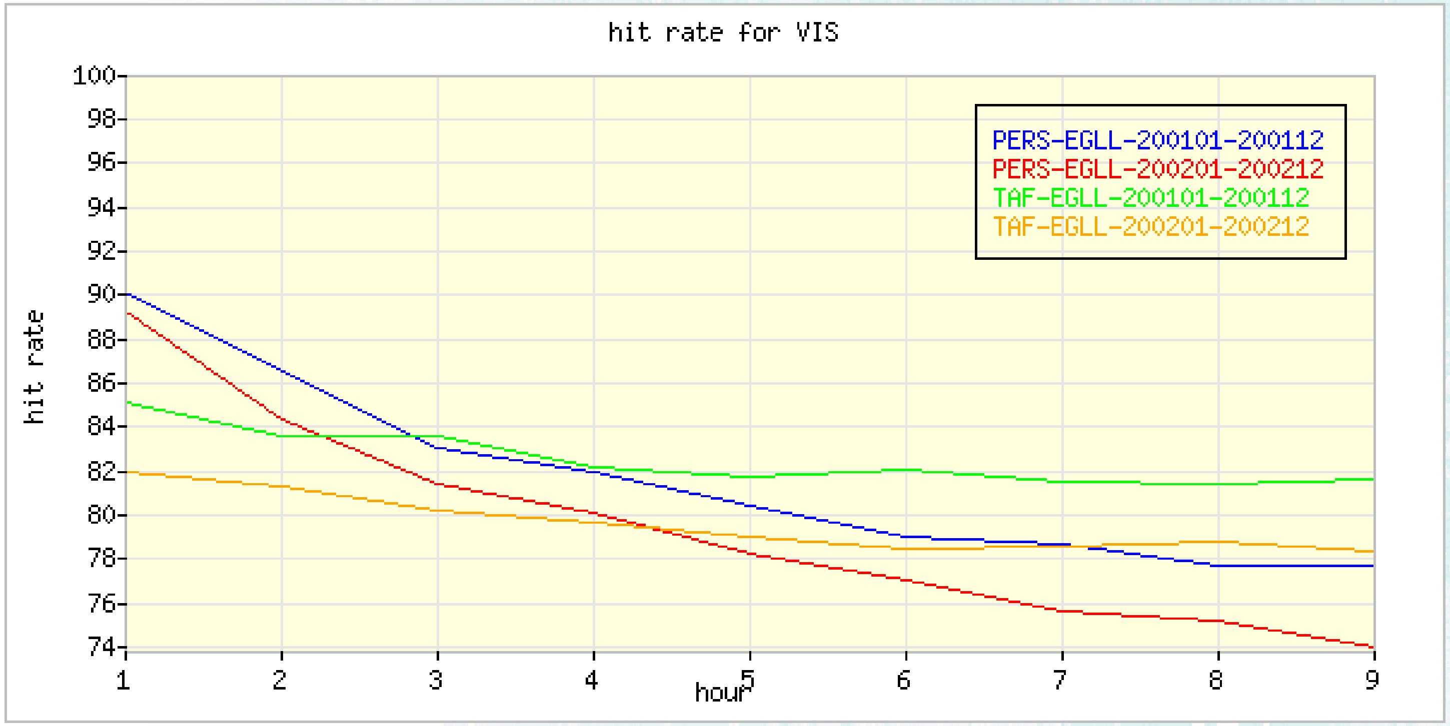
TIPS verification



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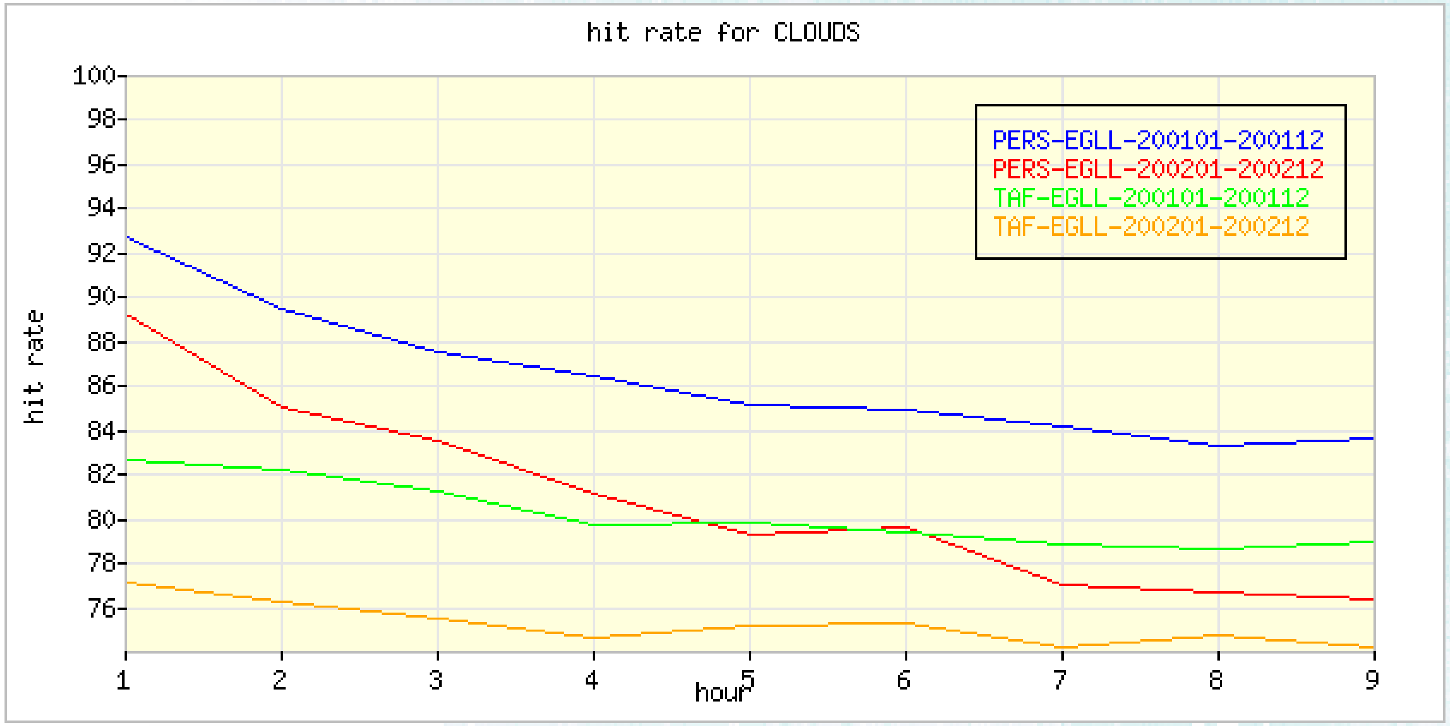
TIPS verification



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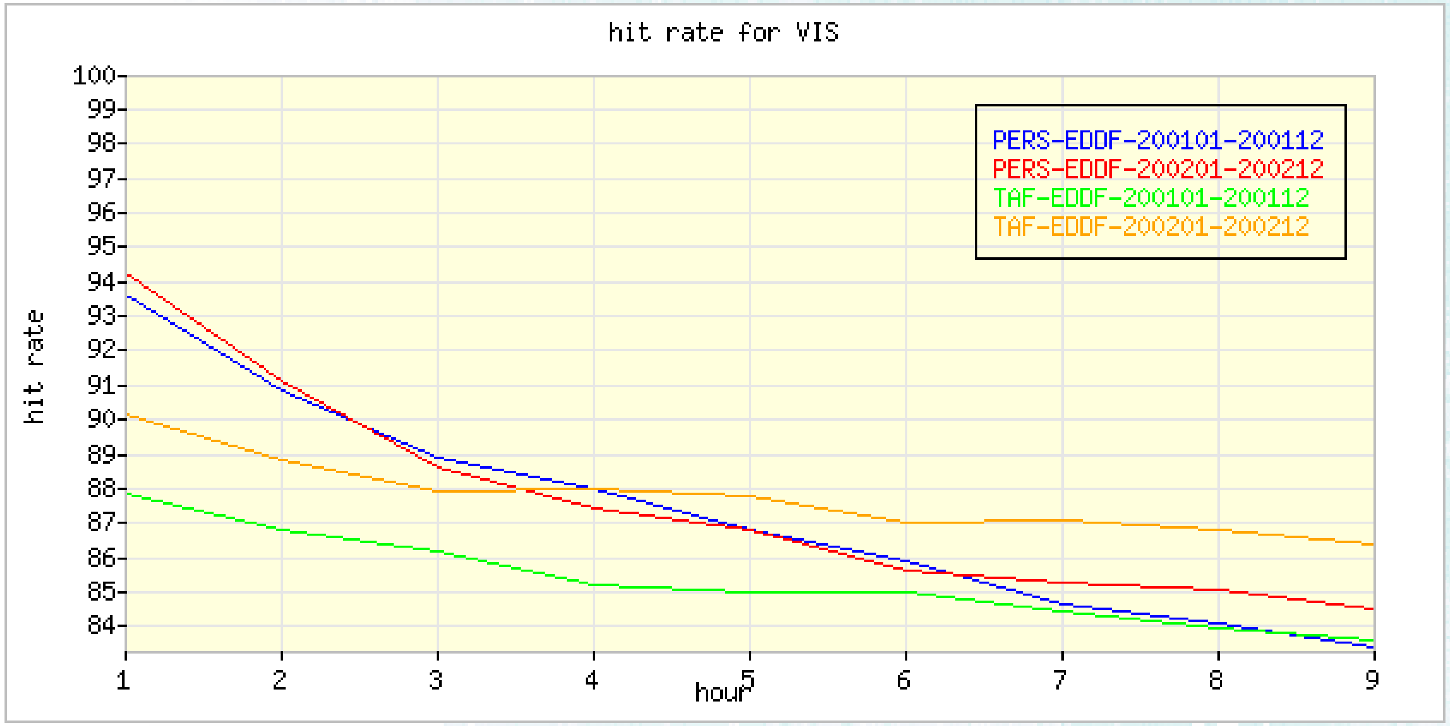
TIPS verification



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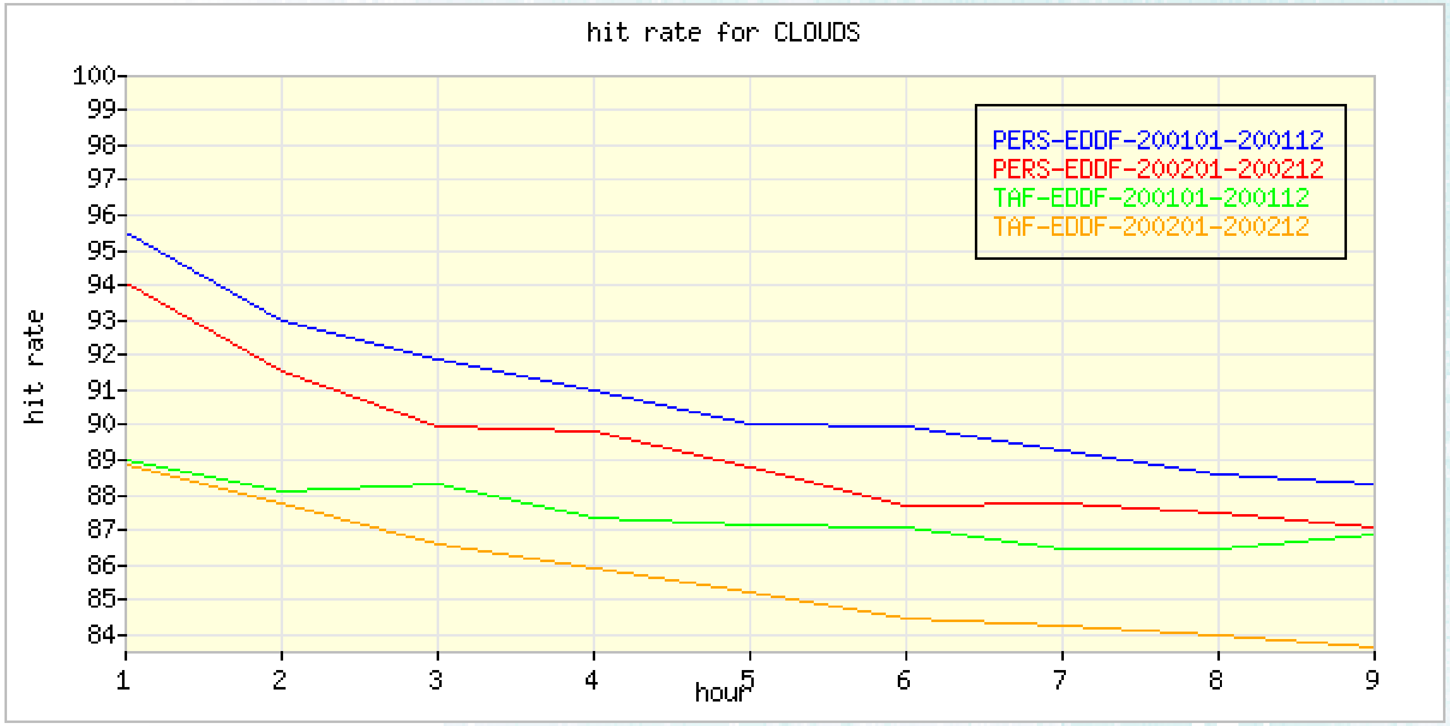
TIPS verification



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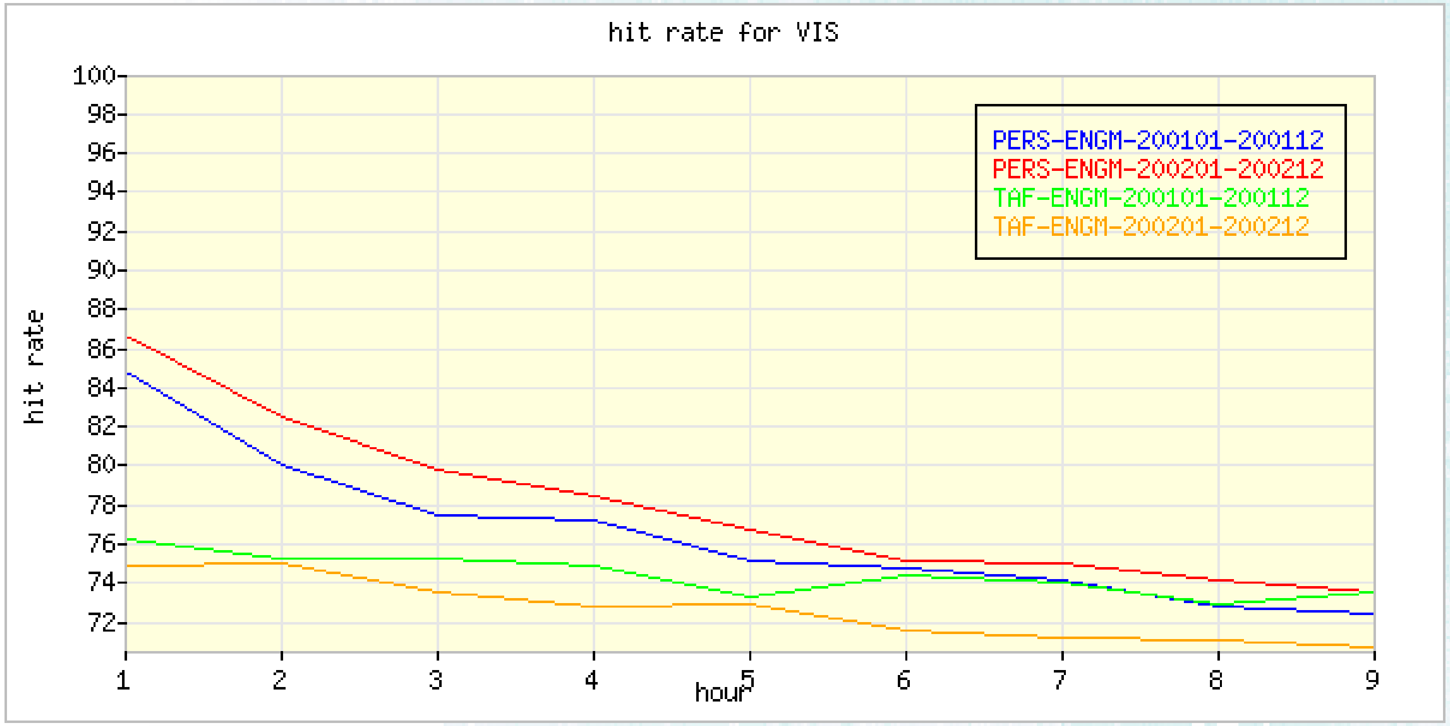
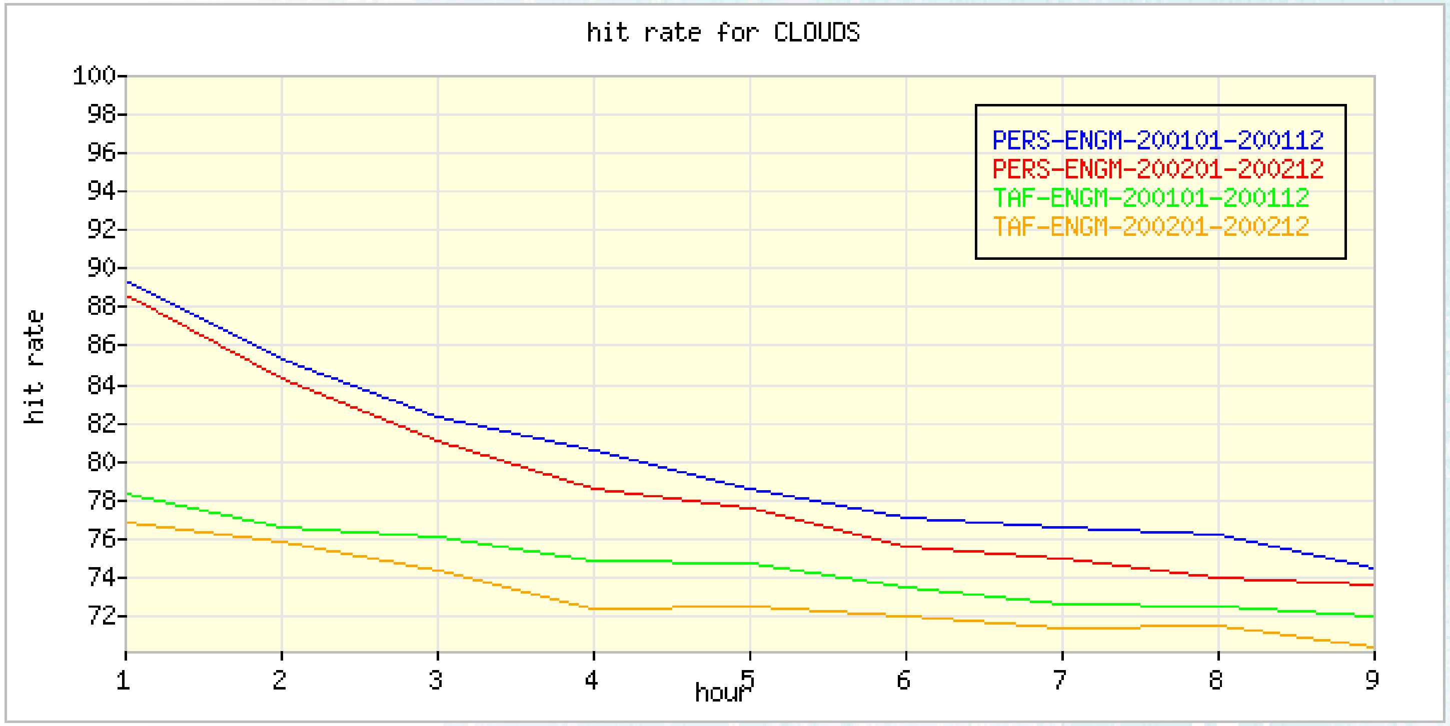
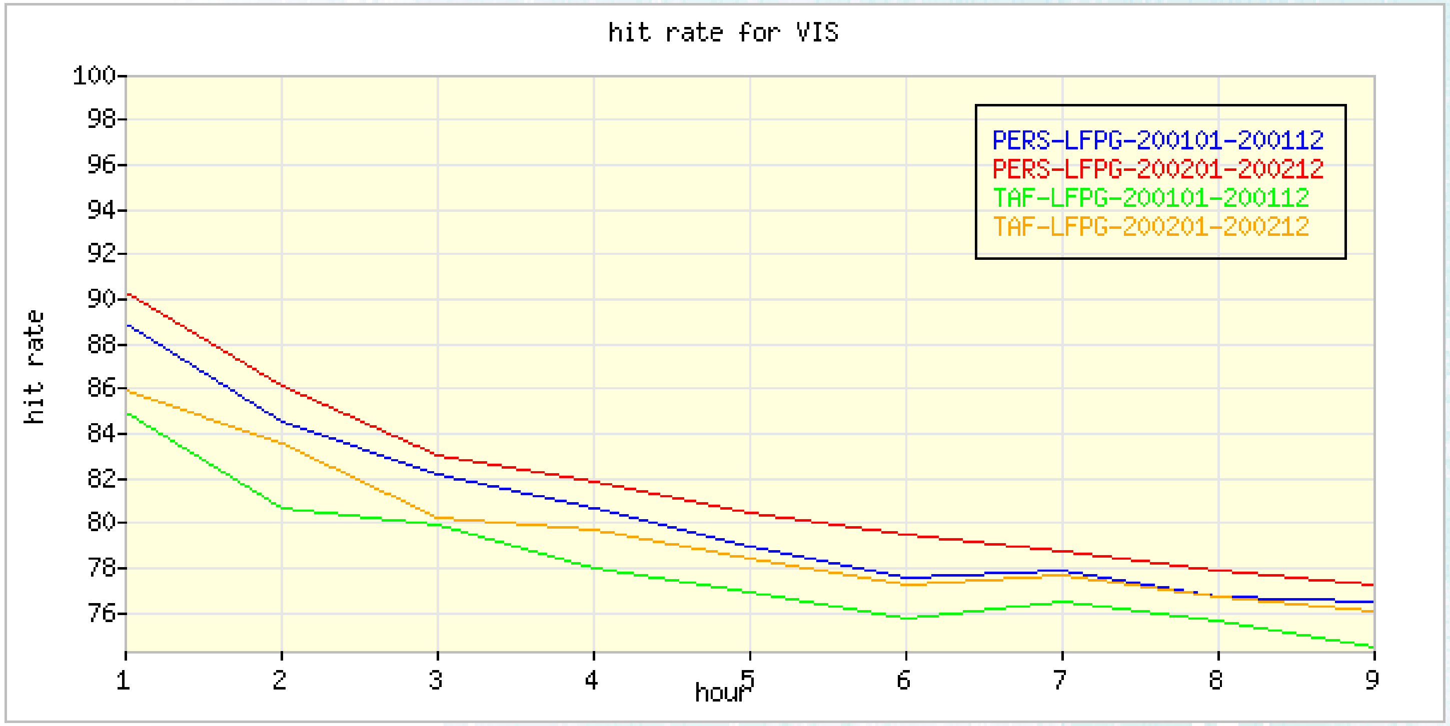


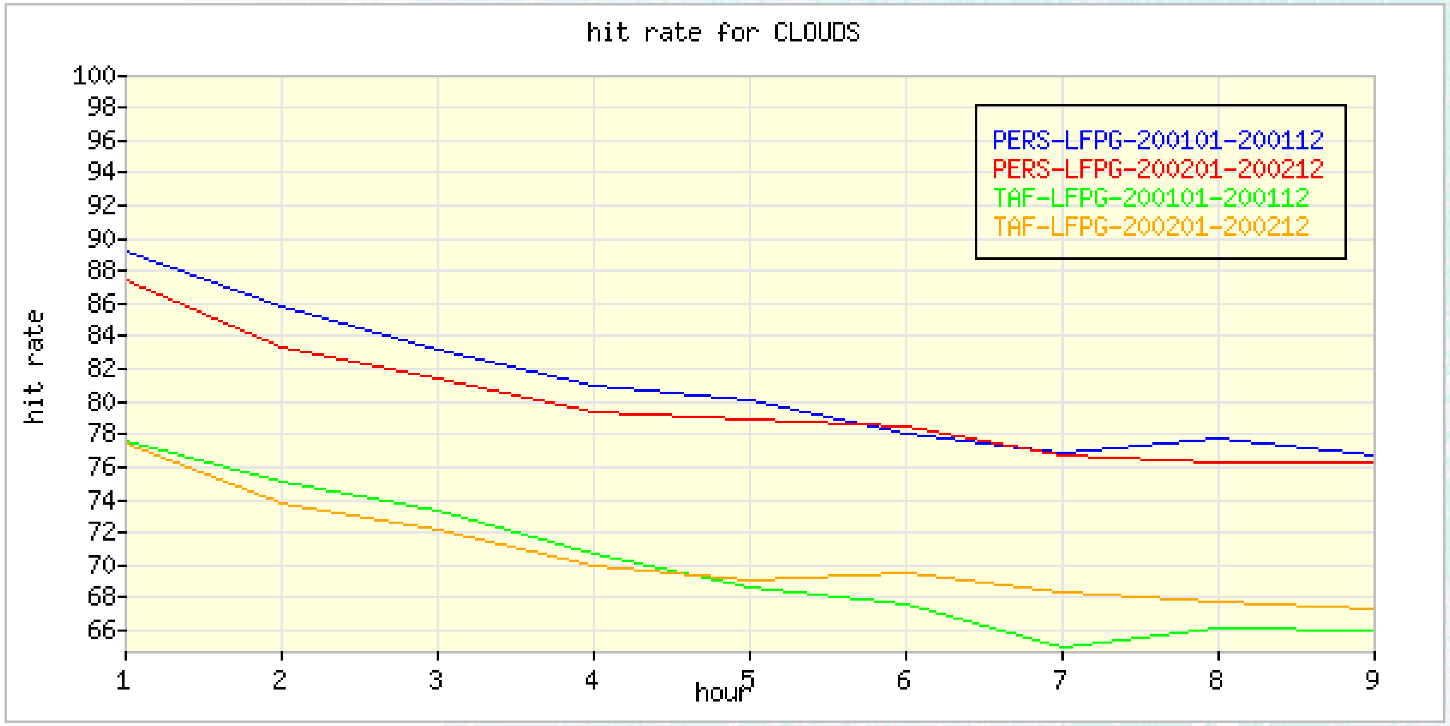
TIPS verification



TIPS verification



TIPS verification



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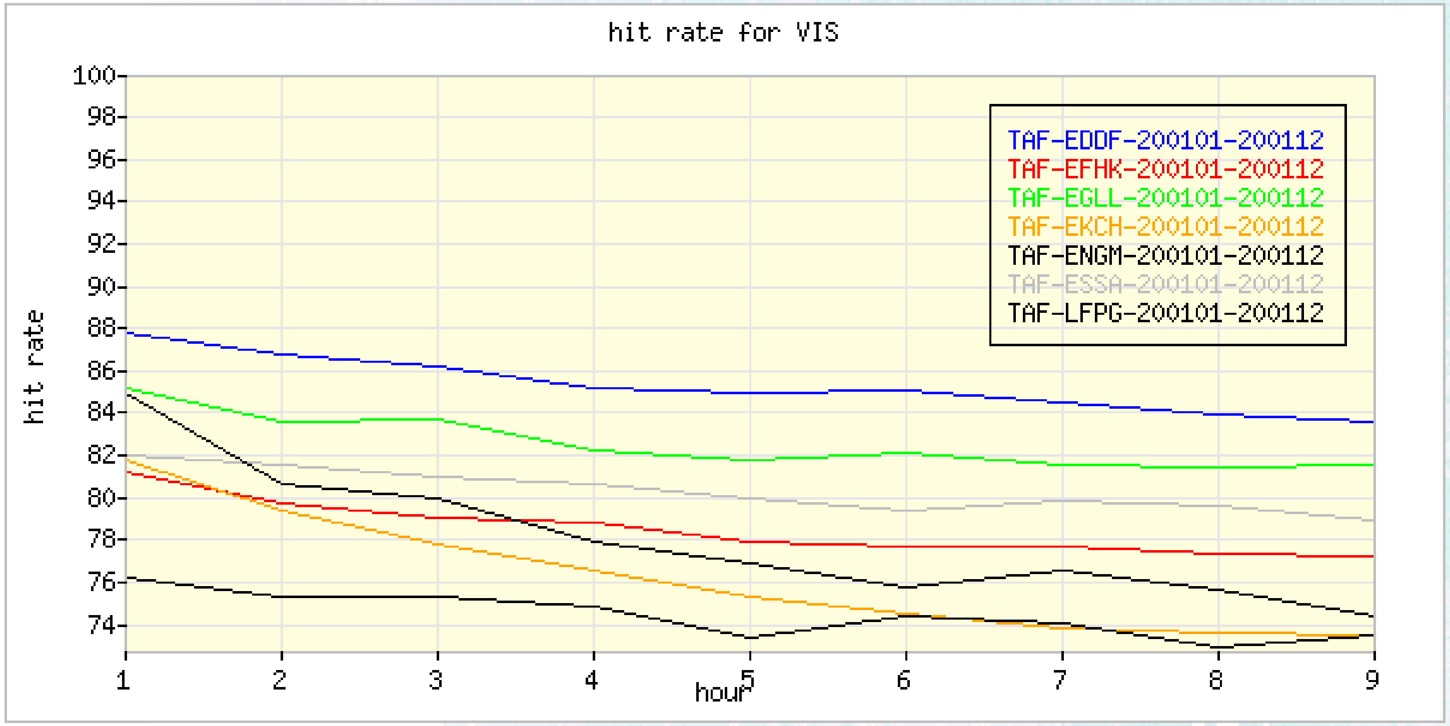
TIPS verification



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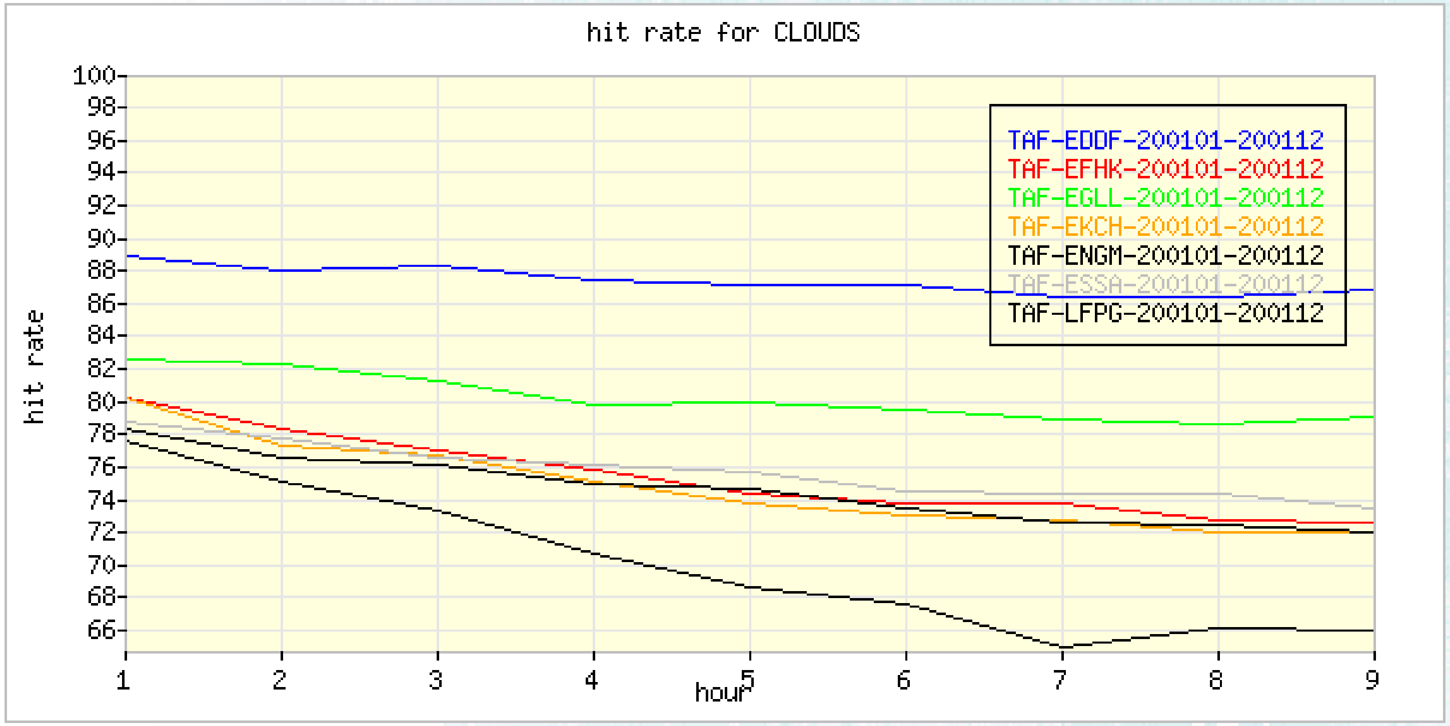
TIPS verification



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TIPS verification

Contingency
For=EDDF Hour=1
Metars 20 min after: 2825
Metars 50 min after: 15

CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0						
	1	0.50	1.75	2.50	0.68		2.58
	2	1.50	1.50	21.32	9.25	1.50	5.25
	5		0.25	22.43	20.50	8.50	70.95
	10		0.75	16.25	18.75	16.82	53.08
	15	3.00	3.75	13.50	26.82	39.17	2378.15

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.22	0.28	0.27	0.25	0.95
POD no	1.00	1.00	0.99	0.96	0.97	0.63
FAR yes	0.00	0.78	0.47	0.83	0.84	0.03
FAR no	0.00	0.00	0.02	0.02	0.02	0.48

HIT RATE: **88.97**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.33
POD no	0.99
FAR yes	0.40
FAR no	0.02

Contingency
For=EFHK Hour=1
Metars 20 min after: 2843
Metars 50 min after: 85

CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0						
	1		2.50	8.68			0.50
	2		22.57	102.60	13.55	1.58	8.38
	5		3.75	61.73	108.85	32.52	80.35
	10			10.50	50.27	69.55	62.65
	15		4.17	25.50	66.33	102.35	1977.13

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.08	0.49	0.46	0.34	0.93
POD no	1.00	1.00	0.98	0.93	0.95	0.71
FAR yes	0.00	0.79	0.31	0.62	0.64	0.09
FAR no	0.00	0.01	0.04	0.05	0.05	0.24

HIT RATE: **80.28**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.56
POD no	0.99
FAR yes	0.15
FAR no	0.04

Contingency
For=EGLL Hour=1
Metars 20 min after: 3002
Metars 50 min after: 65

CLOUDS [FT*100]		METAR					
		0	1	2	5	10	15
TAF	0		1.85				
	1	1.00	2.33	2.92			3.77
	2	1.75	2.33	6.55	4.25	0.60	5.13
	5	0.25	0.50	11.93	29.90	28.88	195.80
	10			5.15	31.43	53.88	57.95
	15	3.00		5.45	44.42	76.65	2217.36

CLOUDS	Quality					
	0	1	2	5	10	15
POD yes	0.00	0.33	0.20	0.27	0.34	0.89
POD no	1.00	1.00	0.99	0.91	0.96	0.59
FAR yes	1.00	0.77	0.68	0.89	0.64	0.06
FAR no	0.00	0.00	0.01	0.03	0.04	0.59

HIT RATE: **82.65**

Special statistics CLOUDS	Quality
	< 500 ft
POD yes	0.42
POD no	1.00
FAR yes	0.42
FAR no	0.01

TIPS verification

Contingency
For=EKCH Hour=1
Metars 20 min after: 2816
Metars 50 min after: 52

CLOUDS [FT*100]		METAR 0	1	2	5	10	15
TAF	0						
	1		16.00	10.25	2.25	0.50	7.50
	2		5.75	39.75	28.25	7.75	25.88
	5		0.25	36.75	60.75	20.57	151.32
	10			5.75	29.00	43.50	57.50
	15		4.00	21.50	56.75	67.67	2020.80

CLOUDS	Quality 0	1	2	5	10	15
POD yes	0.00	0.62	0.35	0.34	0.31	0.89
POD no	1.00	0.99	0.97	0.92	0.96	0.67
FAR yes	0.00	0.56	0.63	0.77	0.68	0.07
FAR no	0.00	0.00	0.03	0.05	0.04	0.44

HIT RATE: **80.18**

Special statistics CLOUDS	Quality < 500 ft
POD yes	0.51
POD no	0.97
FAR yes	0.50
FAR no	0.03

Contingency
For=ENGM Hour=1
Metars 20 min after: 1389
Metars 50 min after: 36

CLOUDS [FT*100]		METAR 0	1	2	5	10	15
TAF	0						
	1	0.75	15.43	17.63	3.50	1.15	13.40
	2		7.85	32.38	16.30	4.30	14.20
	5		2.75	33.73	39.00	8.75	45.40
	10			3.25	16.10	15.30	21.23
	15	0.25	8.97	15.03	34.10	31.50	980.77

CLOUDS	Quality 0	1	2	5	10	15
POD yes	0.00	0.44	0.32	0.36	0.25	0.91
POD no	1.00	0.97	0.97	0.93	0.97	0.71
FAR yes	0.00	0.70	0.57	0.70	0.73	0.08
FAR no	0.00	0.01	0.05	0.06	0.03	0.30

HIT RATE: **78.30**

Special statistics CLOUDS	Quality < 500 ft
POD yes	0.54
POD no	0.96
FAR yes	0.42
FAR no	0.05

Contingency
For=ESSA Hour=1
Metars 20 min after: 2855
Metars 50 min after: 61

CLOUDS [FT*100]		METAR 0	1	2	5	10	15
TAF	0						
	1		13.60	17.05	1.80		6.90
	2		7.25	72.78	31.52	5.10	30.13
	5		5.58	59.77	80.35	25.93	100.65
	10			11.20	38.00	28.15	63.80
	15		5.58	36.20	87.33	73.83	2056.52

CLOUDS	Quality 0	1	2	5	10	15
POD yes	0.00	0.42	0.37	0.34	0.21	0.91
POD no	1.00	0.99	0.97	0.93	0.96	0.66
FAR yes	0.00	0.65	0.50	0.70	0.80	0.09
FAR no	0.00	0.01	0.05	0.06	0.04	0.34

HIT RATE: **78.75**

Special statistics CLOUDS	Quality < 500 ft
POD yes	0.48
POD no	0.97
FAR yes	0.41
FAR no	0.04

Concluding remarks

- Auto-TAF system is able to produce equal quality if the data is of good quality (the encoding woks)
- Cloud base forecasts are reasonable good
- Visibility forecasts associated with precipitation (intensity, type) are rather good
- Visibility forecasts associated with fog are not yet good enough

NinJo

The Current Status of the Project

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NinJo at EGOWS 2003

- NinJo - talks
  - This talk, Overview and Status
  - Trajectories and Diagrams
  - Development of Frameworks for Meteorological Applications
  - Corba and NinJo - System Design and Experiences
  - Server Scalability with WildcardMaps

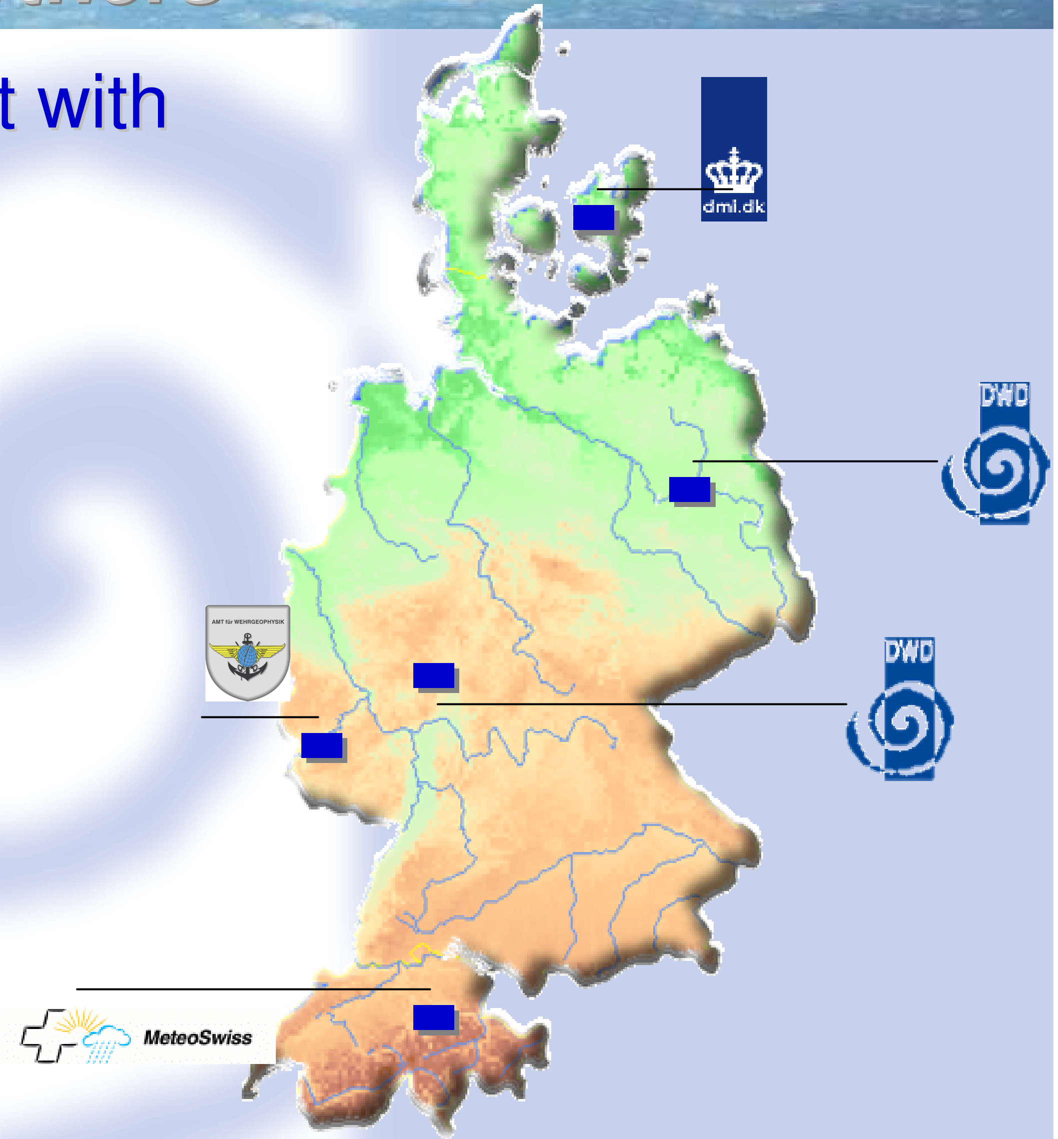
- NinJo - Demo

NinJo
Outline

- The Project
  - Partners
  - Collaboration
  - Meteorological and Technical Goals
- Architecture
  - Technical Prerequisites of a Generic Meteorological Workstation System
  - Overview Client/Server
- Status
  - Components
  - Milestones

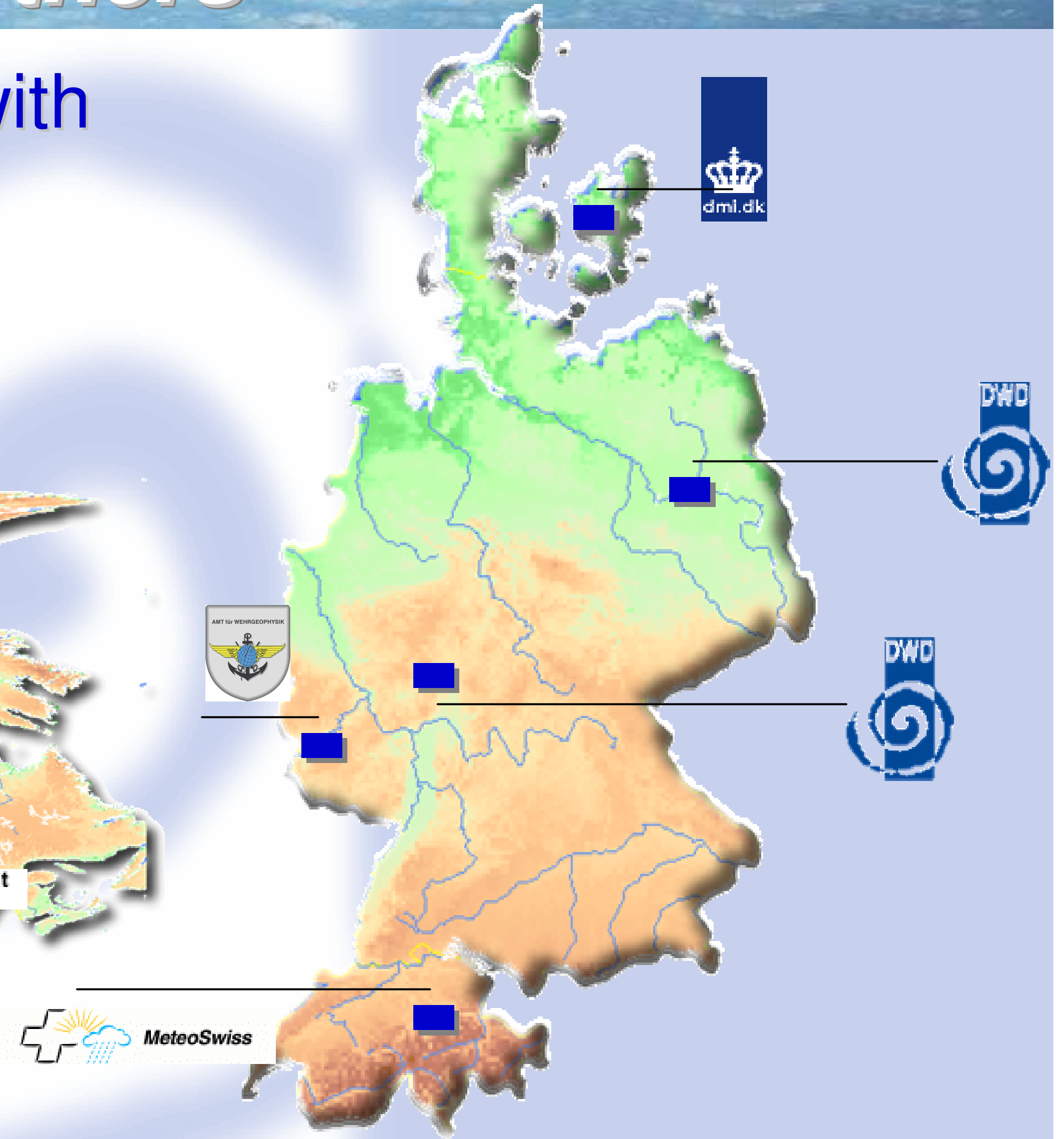
NinJo - The Project
Partners

NinJo was a Joint project with
4 organisations involved



NinJo - The Project
Partners

NinJo is a Joint project with
5 organisations involved



Maps not drawn to scale ;-)

NinJo - The Project
Collaboration

- Distributed Teams
  - 3 locations in Germany
  - 1 location in Switzerland
  - 1 location in Denmark
  - 2 locations in Canada

- Project Bodies
  - Project office in Offenbach
  - Steering Committee
    - Project Managers of all Partners
    - Topics: Planning, Budget, Risk Management
    - Every 2 months
  - Project User Group
    - accompanies the project from the users standpoint
    - appoints members of the evaluation group
    - reports to the steering committee

NinJo - The Project
Collaboration 2

- The Development Team
  - Work packages
    - are handled completely at one location
      - E.g. geography, point data layer, point data server ..
      - Makes sure that no additional overhead is introduced
  - One exception to the rule
    - Architecture team consists of members from all locations
      - Decides technical issues
      - meets every 6-8 weeks
- Software
  - Standardized software products
    - IDE, Performance analysis tool, UML-modeling tool
    - common code and document repository in Offenbach
      - product perforce
      - accessible through firewall :-)

NinJo - The Project
Meteorological Goals

- Support the whole forecast process
- Support the workflow of other departments as well (Research..)
- Interactive display of all meteorological data
- Access to standard infrastructure (archives)
- Product generation including warning operations
- Batch production
- Replacement of most legacy software

Where to we place NinJo in the forecast process?

Stat. FCst.
Mos, Kalman ..
Wx-Parameters

Auto text
Grafics
Animations
Guidance
misc...

Reports
Monitoring
Warning Oper.
Nowcasting
IGS
MMO

NWV → **NWV-Post-Processing** → **Automated PP** → **Manuel PP** → **User customer**

Supporting development
•Vis Tool
•Archiv
•3D (Future)

Batch production of
•Vectorgraphics
•Images

•Wx Monitoring
•Map production
•MMO
•Warning Operations
•Science Modules

•Application Server
•E.g. Flash-Flugwetter

Meteorological Goals
Client

- Global functionality
  - 2D display of data in different layers
  - Geographical display with pan and zoom
  - Integrated 3D Visualization
  - Animation, automatic update
  - Context menus
  - Multiple scenes/windows

- New or integrated meteorological functionality
  - Product editor
  - On Screen Analysis
  - Modified Model Output
  - Editor to support warning operations
  - Interactive product generation

Technical Prerequisites of a Generic Meteorological Workstation System

- IT-Goals
  - Clear, open and expandable software architecture
  - Scalability and fault-tolerance
  - Portability across hardware / OS platform
- Portability
  - Independence from the operating system
  - Independence from the underlying hardware
  - Java as a computing platform fulfills the requirement
    - Pure JAVA, no platform specific code
    - no JNI calls
- Benefits of Portability
  - Development can be carried out on any operating system
    - DMI: Debian Linux
    - DWD: Windows, SuSe Linux
    - MeteoSwiss: Windows, Sun Solaris
  - Operational implementation on local infrastructure
    - Eg. IBM AIX (DWD, Server Apps)

Technical Prerequisites of a Generic Meteorological Workstation System 2

- Flexible Application and Programming Model
  - Basis of application development in NinJo is a set of frameworks
    - Frameworks range from Visualization Libraries, Configuration Frameworks, to PAC
    - More on Frameworks in Sibylles talk !
  - Frameworks should offer all functions to build the required meteorological applications
    - A NinJo application is made up of several (1-many) layers, 1 to 3 secondary scenes and secondary window applications
    - Every partner can use all the basic layers and applications
    - Every partner is placed in a position to develop layers independently to implement specific applications

Managing Data Sources

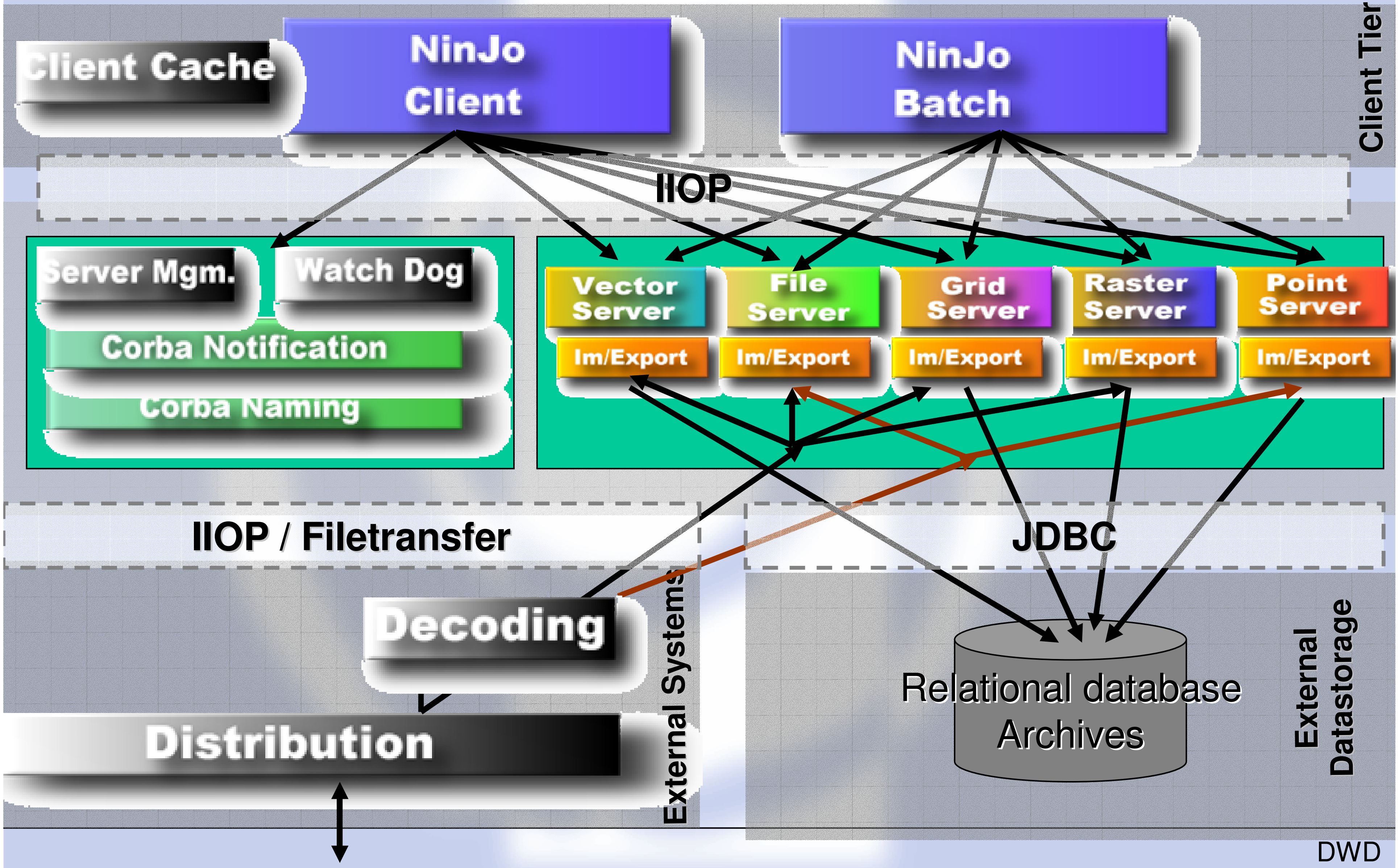
- Every partner has his data distributed over several servers
  - Local file systems
  - Corba data servers
  - Archive servers (CORBA, RDBMS)
- Access Layer Frameworks manages data sources through a centralized metadata tree
  - Cares for the transparency when accessing any of these data sources
  - Helps partners to hook up their data infrastructure
  - Additional benefits
    - filters to concentrate on special types of data sources,
    - automatic failover when data access fails,
    - load-balancing to gain performance

Technical Prerequisites of a Generic Meteorological Workstation System 4

- Documentation
  - Requirement Specs
  - Design
    - no framework based development without proper design documentation
  - API Documentation
    - JavaDoc
  - User Manuals
    - targeted towards the end user

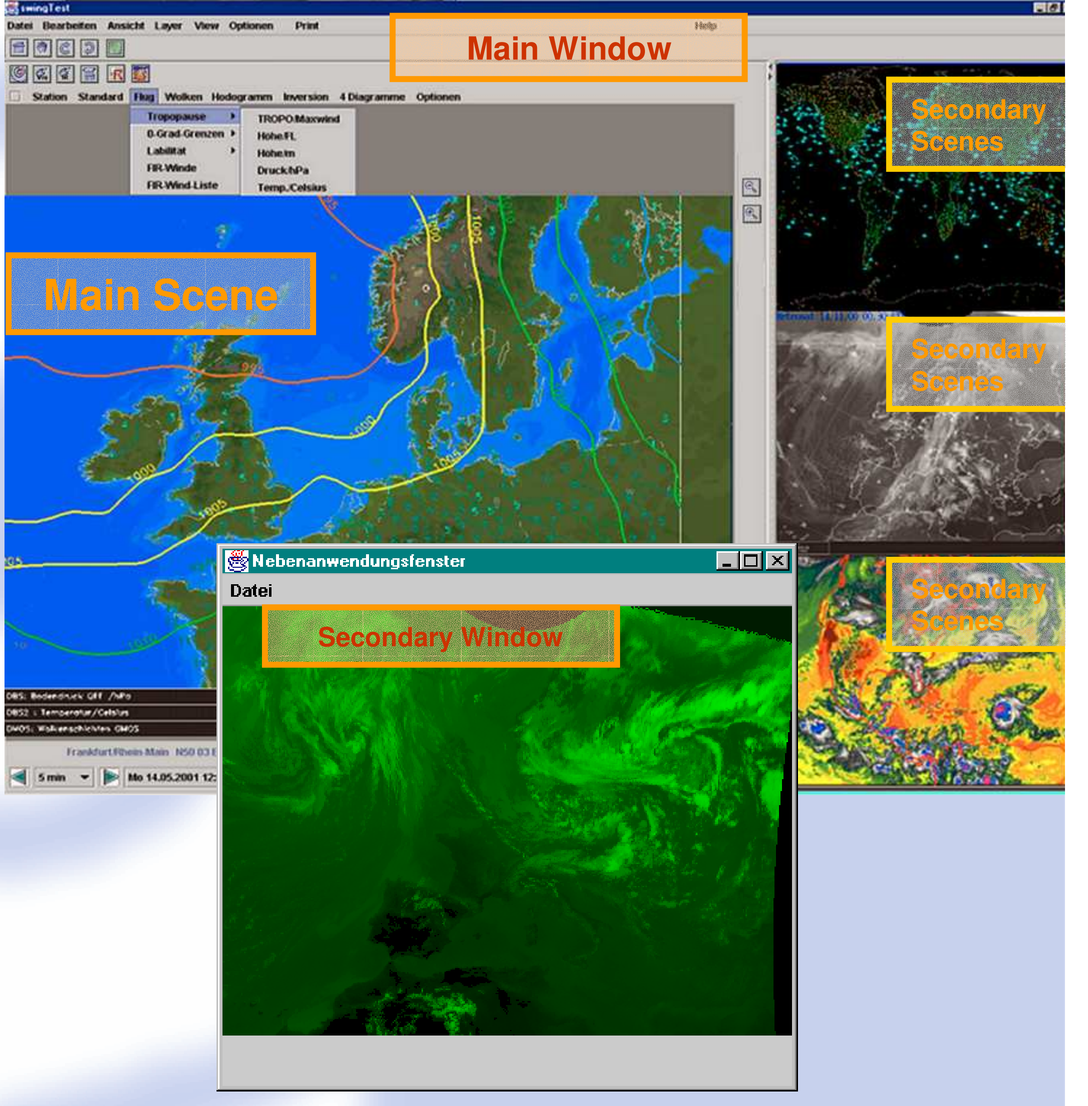
Architecture revisited

The NinJo Tiers

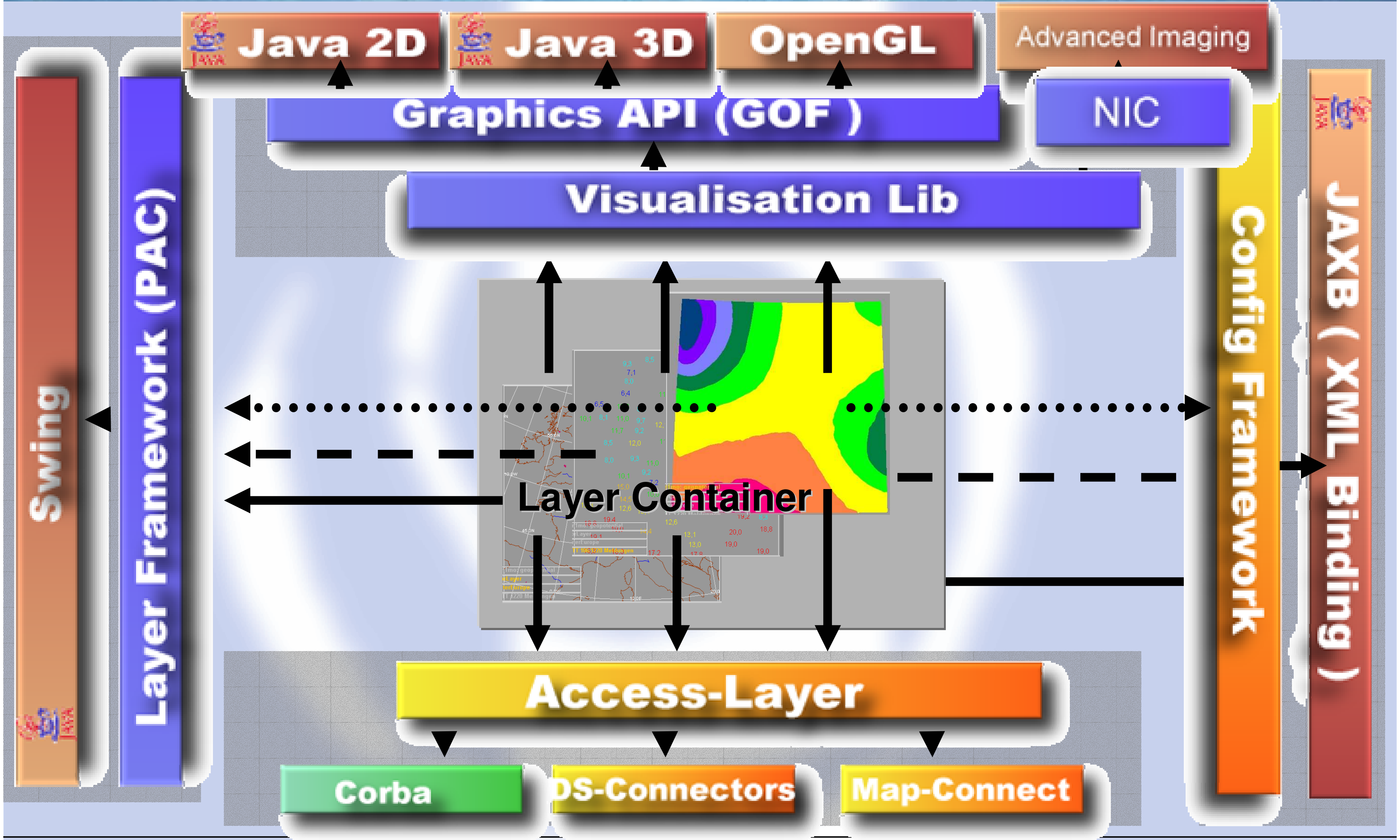


Architecture revisited
GUI and Client-Framework

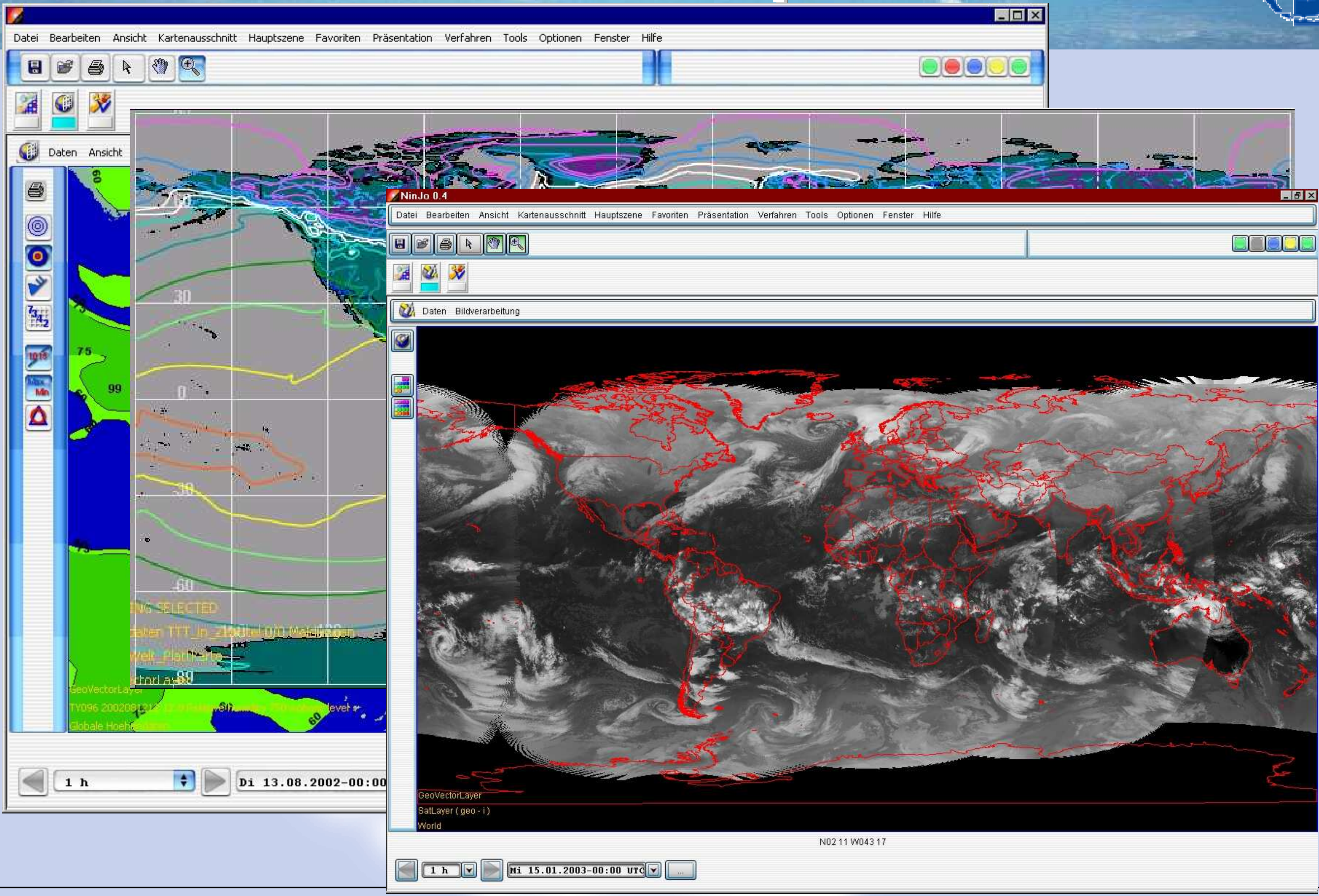
- Windows
  - One main Window with up to 4 scenes (layout configurable)
  - several secondary windows
- Layer Framework (2D)
  - A window is made up of several layers
  - Each layer is responsible for one kind of data
  - Each layer uses MVC
  - Client is a hierarchy of MVC triplets
  - Client is composed of configurable (XML) building blocks



Architecture revisited
GUI and Client-Framework



Some examples



Architecture Summary

- The architecture of NinJo (CGS) is open and portable
- It can be adopted easily to the needs of organizations involved
  - different hardware and OS-infrastructure
  - different configuration of clients
  - different primary data storage mechanisms: files or database
  - different data supply and backend systems
  - different communication and middleware infrastructures
- It can be easily extended
  - new data types
  - new storage types (data sources)
- Till now our experiences with Java are mostly good, but not in every respect ...

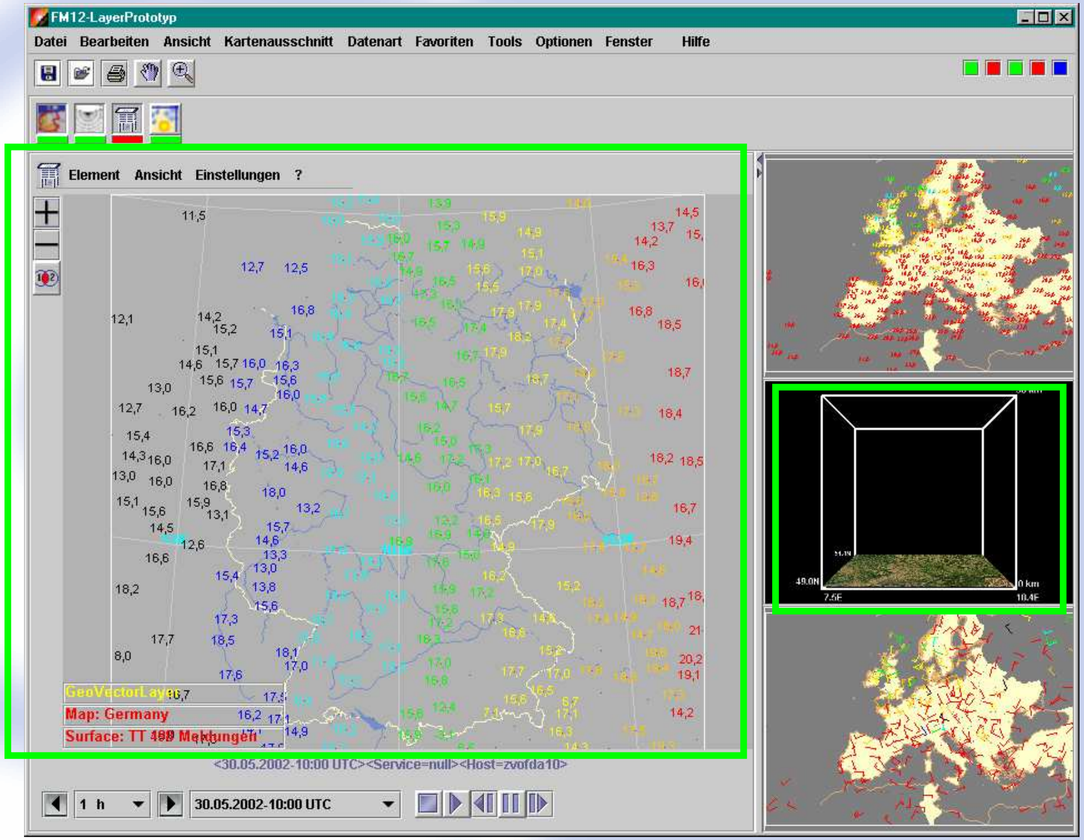
Architecture Summary (cont.)

- How can we make sure that NinJo is really generic?
  - Several institutions involved
  - each with their applications
  - each with their own data infrastructure
  - it has to work!

Architecture Summary (cont.)

Where is the Client's Flexibilty ?

Layer supplied by a project partner



Trajectory layer
developed exclusively in Denmark

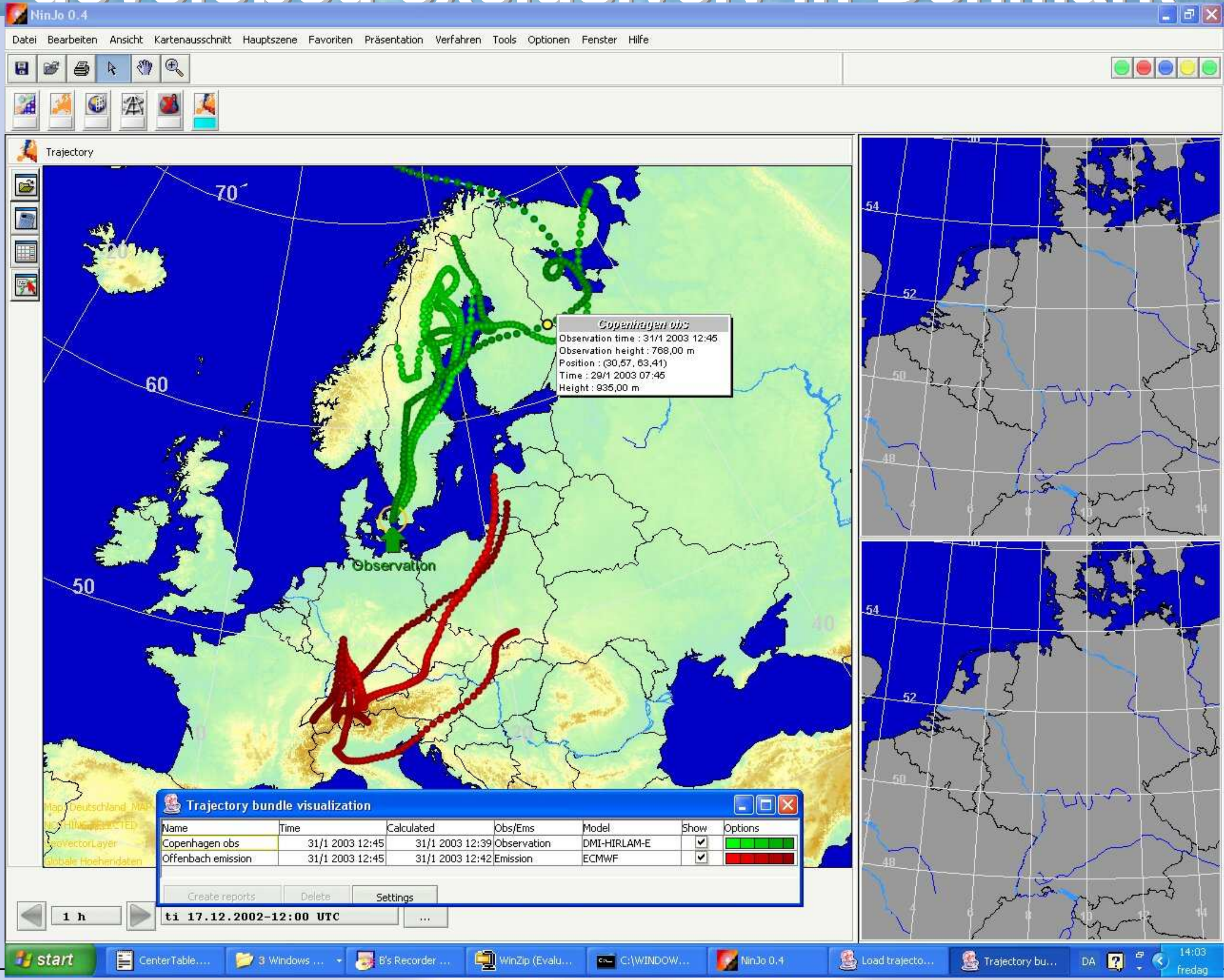
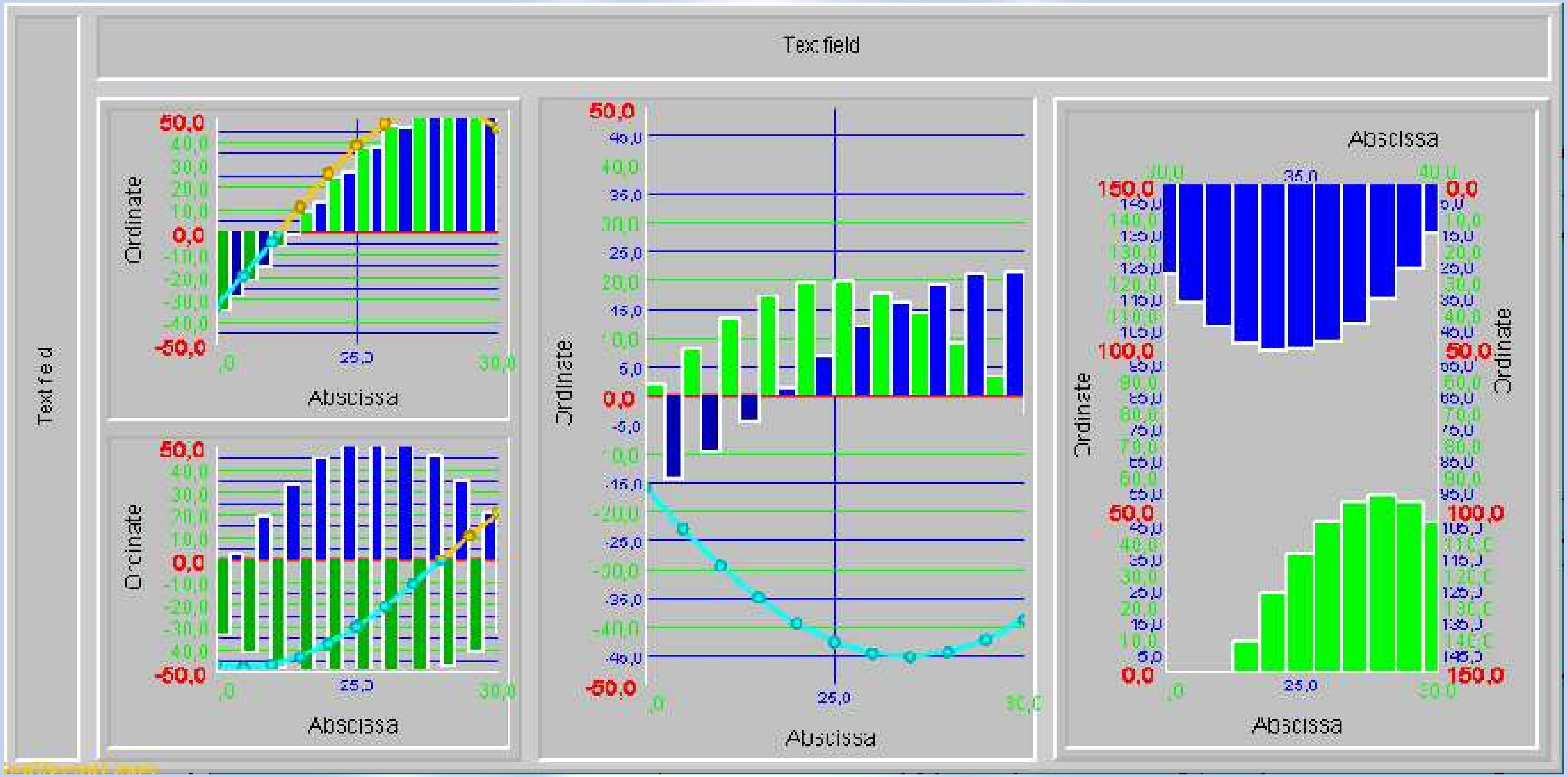
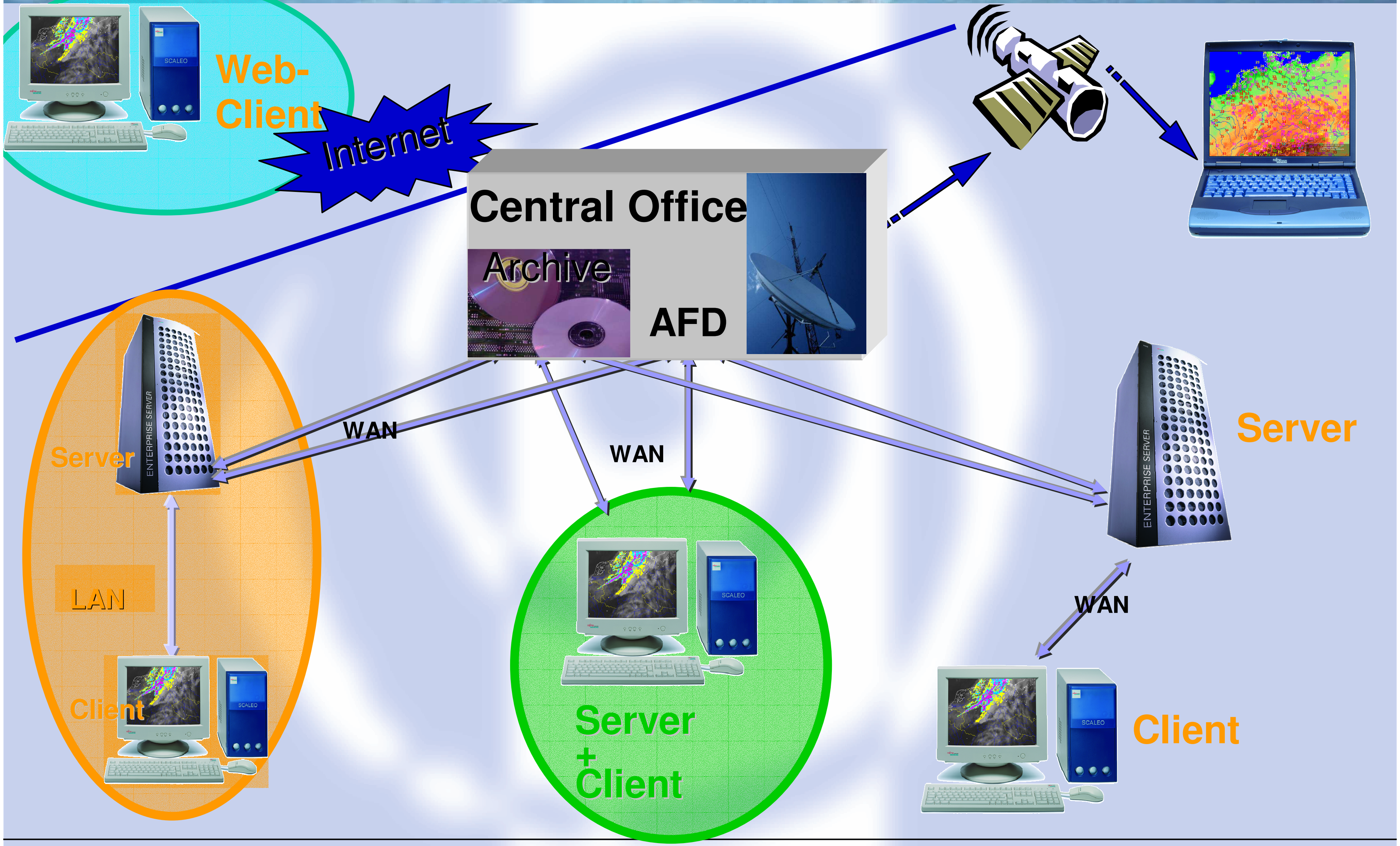


Diagram-development in Denmark



NinJo Communication



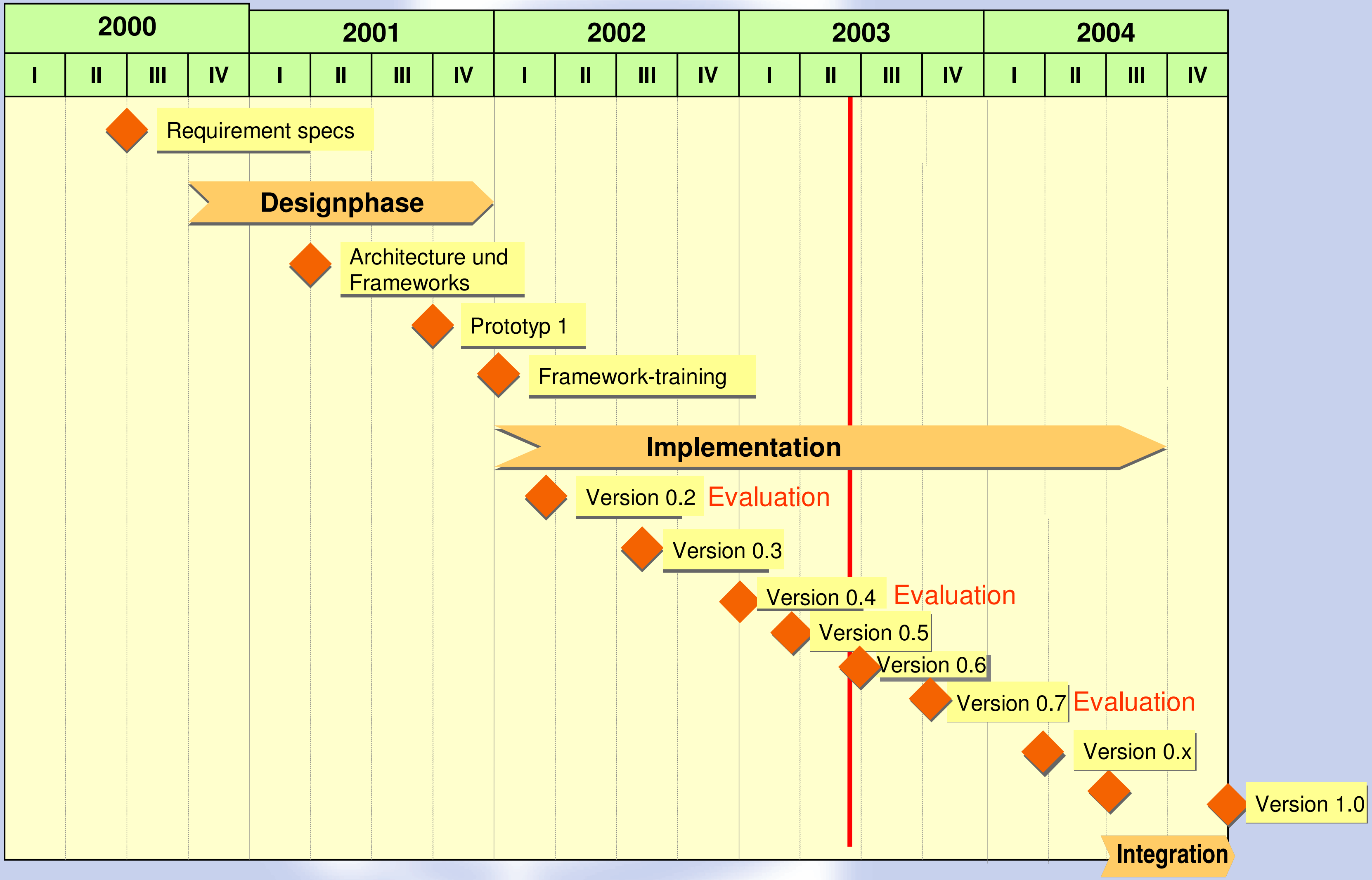
Project Status

- Essential client framework components nearly finished
  - PAC, Config, GUI, Vis, GOF
  - But, some new functionality and consolidation necessary
- Six application layers close to final version(Grid, Point Data, GeoVector, GeoRaster, Satellite, Trajectories)
- Minor system framework modules essentially finished
  - error handling, logging, i18n
- some application layers under development
  - Graphical/Product Editor, Streamline layer
  - requirement specs nearly done
- Requirement specs available
  - Radar, but it will be heavily revised (usage of high res datasets)
  - Streamline layer

Project Status 2

- Batch component implementation started, incl. Layout Manager
- Servers
  - Grid server almost finished, running pre operationally
  - Point data server running pre operationaly, retrieve only
    - Interfacing with java decoding component GLOBUS will start shortly
  - Product data server specs and design available, first tests
  - Satellite data server, work starts after EGOWS, prototypes necessary
- Several requirement specs in progress
  - Temps, cross sections, radar to be revised...
- operational end of 2004 (still the valid milestone)

The Project
Milestones



Project Status
Evaluation

- Important NinJo version are reviewed by the NinJo Evaluation group
- Forecasters and researches can evaluate the software on locally available desktops
- Very valuable input received
- The latest results (NinJo 0.41):
  - Visualization should just be one click away
    - Currently it's somehow cumbersome - under certain circumstances
  - Shortcuts and convenience functions
  - Navigator panel
  - User manuals less technical

The Project

Version Feature List 1

Version/ Release Date	Features
0.1, Oct. 2001	Graphic API 3D-Visualisation of isosurfaces 3D-textured DEM data
0.2, Feb. 2002	Client frame work 1.0 Surface observation layer (FM12 only) with limited functionality Geovector layer based on VMAP0 and german high res. Data First Version of Access layer
0.3, Sep. 2002	grid layer Geo vector layer Configuration framework Logging and error handling Start QM
0.41; January 15th	Raster image framework New FM 12 layer Geo raster data Gridded data server Redesign Access Layer

The Project

Version Feature List 2

Version/ Release Date	Features
Feb, 18th, 2003, NinJo 0.5	■ Satellite Layer, no Server Functionality
June, 2003, NinJo 0.60	■ Consolidated layers and frameworks ■ Point data server export ■ Favourites and undo ■ New features in existing layers ■ Trajectory layer ■ Optimized geography
November, 2003, NinJo 0.70	■ Evaluation Group input ■ Diagrams ■ Graphical Editor ■ Batch ■ More point data ■ Radar ■ Formula editor (IDs) ■ Streamlines ■ More Servers pre operational

Norwegian
Meteorological Institute
met.no

Successful software - not only codewriting

by Magnus Ovhed

From a forecasters point of view

- What makes software successful?
- Know your user!
- Case study: Diana and Modfly

based on the experience at met.no

What makes software successful?

- Good optimalised code?
- Userfriendly GUI?
- Intense marketing?
- Low cost?
- Good support?

All of above, but mainly:

Satisfied users!

Obvious, but many times neglected.

Knowing the user, the forecaster

Who is it?

What does he/she like?

What does he/she dislike?

How is the software used?

The users are mainly meteorologists.

But it is otherwise a very diverse group.

- Range from almost computerfobic to advanced code hackers. From cynics to curious optimists.

- Have a strong tradition for individualism.

- Takes pride in their work.

Forecasters Nightmares

Bosses	- wants to replace you
Developers	- makes your work harder
Models	- will soon replace you
Meteorologists	- your competitors
Customers	- do not buy quality
People	- blame you for bad forecasts

Forecasters Dreams

Bosses	- see you as important
Developers	- make your work easier
Models	- your great helpers
Meteorologists	- your team mates
Customers	- understands quality
People	- likes you

How is the software used (diana)?

Used almost all the time at work.

Many times in very stressful situations.

User skills vary a lot.

A crash is many times very disruptive.

Longer malfunctions (hours) is often critical.

What do the forecasters want?

1) Something fast and reliable, with at least the basic functions

2) Good and intuitive GUI, with large flexibility

3) As many functions as possible

Case:

The making of a new program (Diana, Modfly).

This large development, aimed at “distant” users was a new concept for met.no.

How to involve users?

Diana

Specifications (with communication problems)

Dev: What do you want?

Met: I don't know, what can you make?

Dev: Anything is possible!

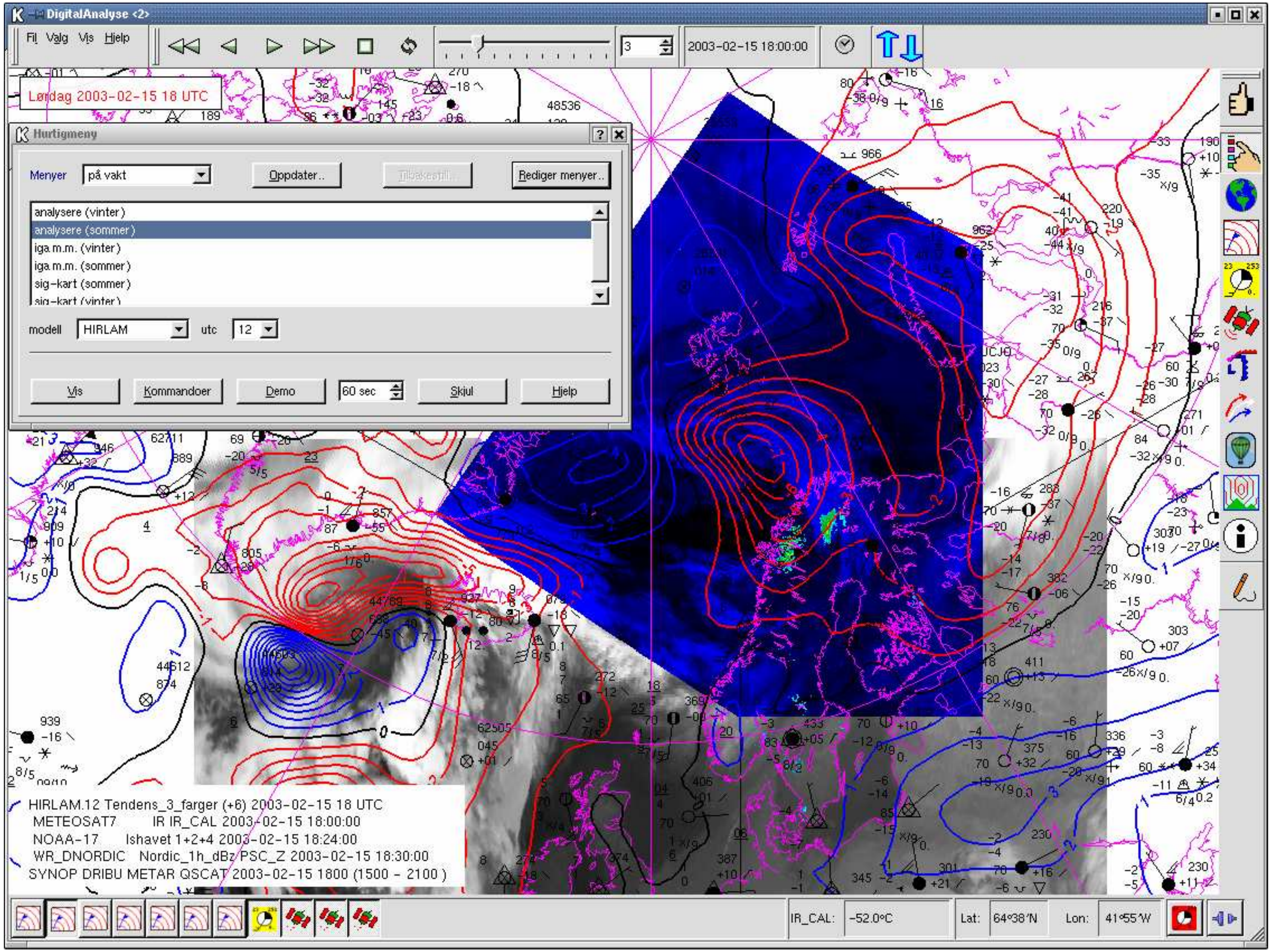
Met: ?????

The result was a somewhat vague specification.

The first Diana looked on the surface like the current version, but many interface details where wrong in some way or the other.

It was judged “unoperational” by many users.

It has then taken several iterations to get to the latest version.


DigitalAnalyse <2>
Fil Valg Vis Hjelp
2003-02-15 18:00:00
Lørdag 2003-02-15 18 UTC
Hurtigmeny
Menyer
på vakt
Oppdater..
Rediger menyer..
analysere (vinter)
analysere (sommer)
iga m.m. (vinter)
iga m.m. (sommer)
sig-kart (sommer)
sig-kart (vinter)
modell
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Demo
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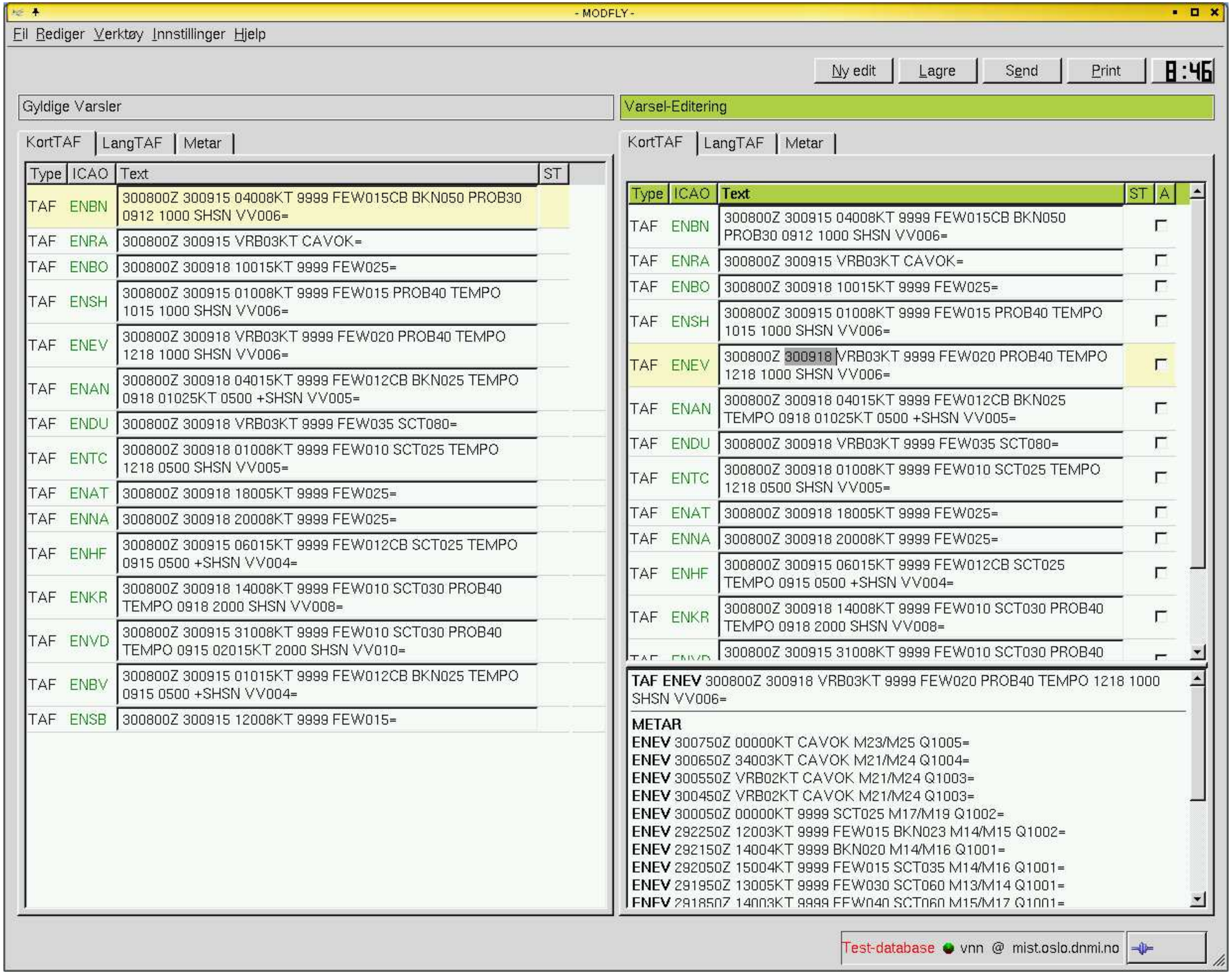
Hjelp
HIRLAM.12 Tendens_3_farger (+6) 2003-02-15 18 UTC
METEOSAT7 IR IR_CAL 2003-02-15 18:00:00
NOAA-17 Ishavet 1+2+4 2003-02-15 18:24:00
WR_DNORDIC Nordic_1h_dBz PSC_Z 2003-02-15 18:30:00
SYNOP DRIBU METAR QSCAT 2003-02-15 1800 (1500 - 2100)
IR_CAL:
-52.0°C
Lat:
64°38'N
Lon:
41°55'W

Modfly

Here the users had learned their lesson and made a 30 pages long interface specification.

The program was quick accepted by the users


- MODFLY -
Fil Rediger Verktøy Innstillinger Hjelp
Ny edit
Lagre
Send
Print
8:46
Gyldige Varsler
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KortTAF
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Type ICAO Text ST
TAF ENBN 300800Z 300915 04008KT 9999 FEW015CB BKN050 PROB30 0912 1000 SHSN VV006=
TAF ENRA 300800Z 300915 VRB03KT CAVOK=
TAF ENBO 300800Z 300918 10015KT 9999 FEW025=
TAF ENSH 300800Z 300915 01008KT 9999 FEW015 PROB40 TEMPO 1015 1000 SHSN VV006=
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TAF ENVD 300800Z 300915 31008KT 9999 FEW010 SCT030 PROB40 TEMPO 0915 02015KT 2000 SHSN VV010=
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TAF ENBN 300800Z 300915 04008KT 9999 FEW015CB BKN050 PROB30 0912 1000 SHSN VV006=
TAF ENRA 300800Z 300915 VRB03KT CAVOK=
TAF ENBO 300800Z 300918 10015KT 9999 FEW025=
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TAF ENAN 300800Z 300918 04015KT 9999 FEW012CB BKN025 TEMPO 0918 01025KT 0500 +SHSN VV005=
TAF ENDU 300800Z 300918 VRB03KT 9999 FEW035 SCT080=
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TAF ENKR 300800Z 300918 14008KT 9999 FEW010 SCT030 PROB40 TEMPO 0918 2000 SHSN VV008=
300800Z 300915 31008KT 9999 FEW010 SCT030 PROB40
TAF ENEV 300800Z 300918 VRB03KT 9999 FEW020 PROB40 TEMPO 1218 1000 SHSN VV006=
METAR
ENEV 300750Z 00000KT CAVOK M23/M25 Q1005=
ENEV 300650Z 34003KT CAVOK M21/M24 Q1004=
ENEV 300550Z VRB02KT CAVOK M21/M24 Q1003=
ENEV 300450Z VRB02KT CAVOK M21/M24 Q1003=
ENEV 300050Z 00000KT 9999 SCT025 M17/M19 Q1002=
ENEV 292250Z 12003KT 9999 FEW015 BKN023 M14/M15 Q1002=
ENEV 292150Z 14004KT 9999 BKN020 M14/M16 Q1001=
ENEV 292050Z 15004KT 9999 FEW015 SCT035 M14/M16 Q1001=
ENEV 291950Z 13005KT 9999 FEW030 SCT060 M13/M14 Q1001=
Test-database vnn @ mist.oslo.dnmi.no

The programs are developed and introduced.

What now?

A user group has been formed to gather user suggestions and to make priority lists.

Twice a year, 1/5 of the forecasters are sent to course to meet developers and other forecasters.

So far, so good:

Good relations between developers and users.

The programs are now accepted and liked by almost all users.

The forecasters now know each other better.

So far, not so good:

The skill differ to much between forecasters.

A test project in Tromsø will this autumn and winter address the problem, by pushing handpicked users together using Diana to solve different types of problems.

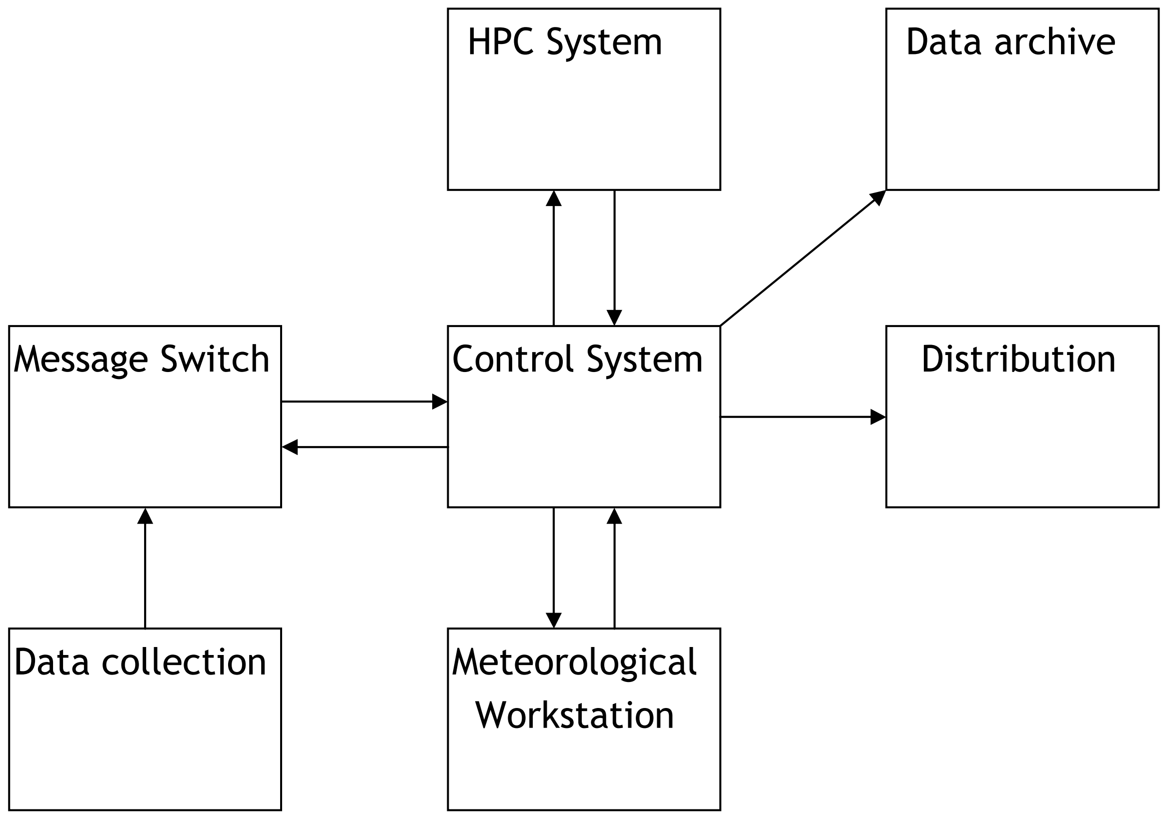
Norwegian Meteorological Institute met.no

Experiences with the use of open source and Linux at the Norwegian Meteorological Institute

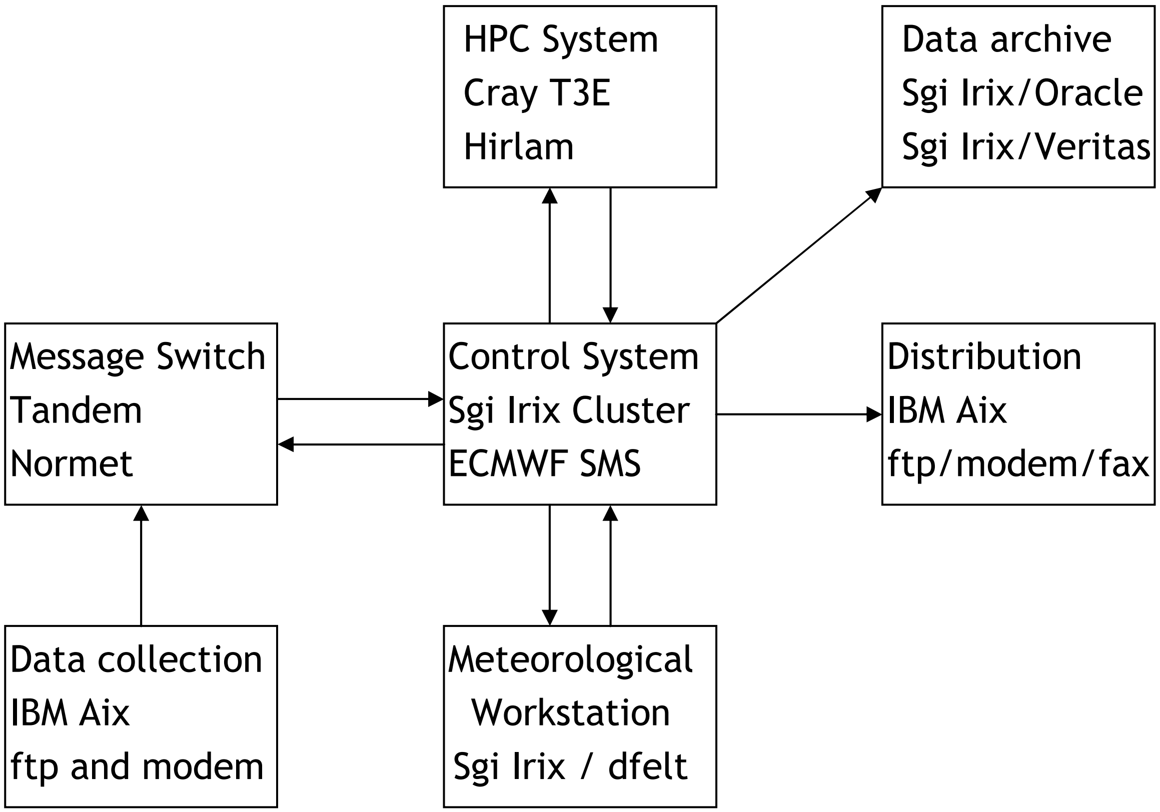
Tromsø 18.06.2003 – EGOWS 2003

Roar Skålin
Director of information technology, met.no

met.no Production Chain



met.no Production Chain 1998



~20 operational servers

~10 meteorological workstations (+ 40 for the scientists)

Why Open Source?

- Shorter ”mean-time-to-repair”: We have a problem and know how to solve it, but have to wait for a patch from the US…
- Reduced investment and operating cost:
  - Message switch maintenance 1998: € 80000
  - Cost of a new Sgi O2 in 1998: € 8000
- Attractive employer for IT-personnel: Only an interesting job could attract qualified personnel in the .com era
- Lot of in-house competence and eager employees

Why **NOT** Open Source?

- Dependent on high competence in-house: In most cases, you cannot buy help from external companies
- Migration costs: Moving existing systems to an open source platform or developing new systems based on open source take valuable time:
  - Moving 700 SMS jobs from Irix to Linux
  - Moving a base of serial line modems from IBM to commodity hardware
- Enormous freedom: An Irix distribution is one system, a Linux distribution is as many systems as there are users

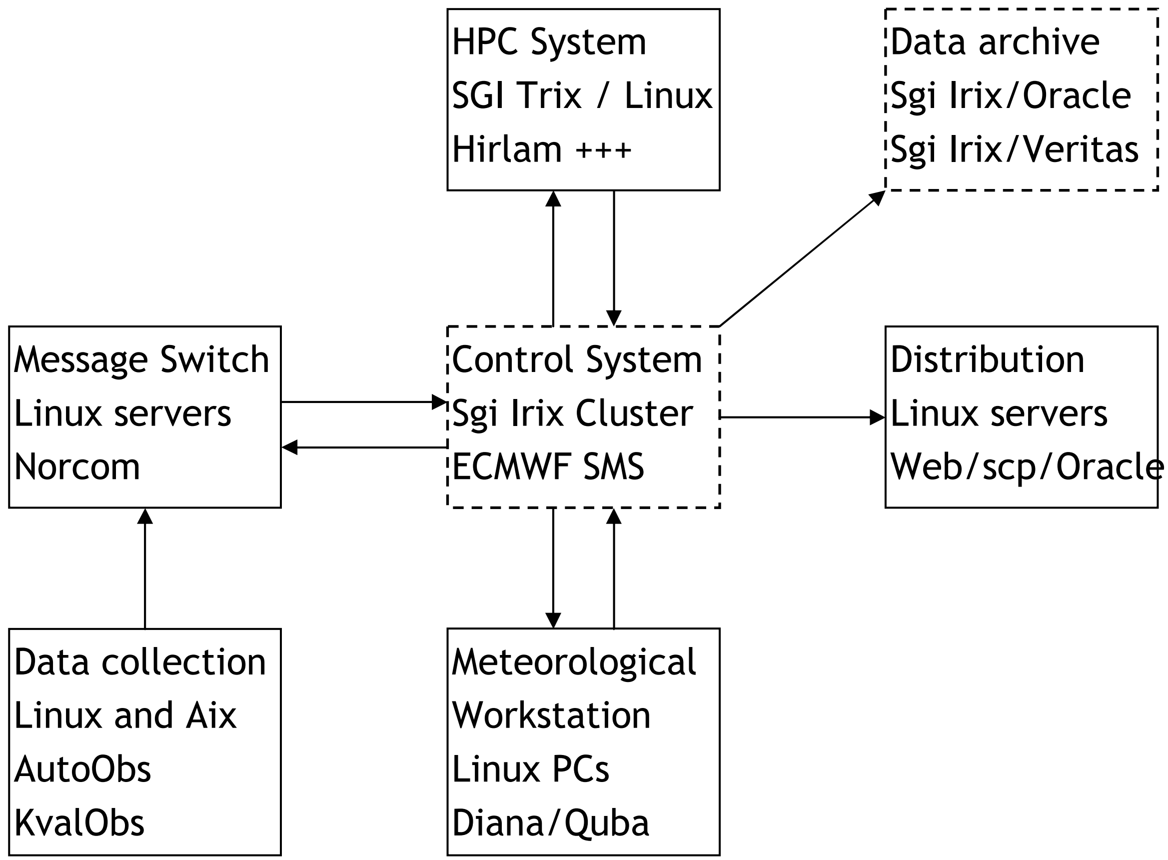
Some arguments are used both ways

- Quality of software: Which is best – open source or commercial?
- Support of software: Which is best – news lists or dedicated support personnel?

How did we implement the OS strategy?

- Anarchy: Find solutions and allow people to test them, improve if required (some analogy with the XP method?)
- Incremental: Start with the systems that have a high operating cost or are easy to migrate
- Duplication: All critical systems should be able to run on two different servers
- Recruitment: Interest in and experience from Open Source is used actively when recruiting new personnel

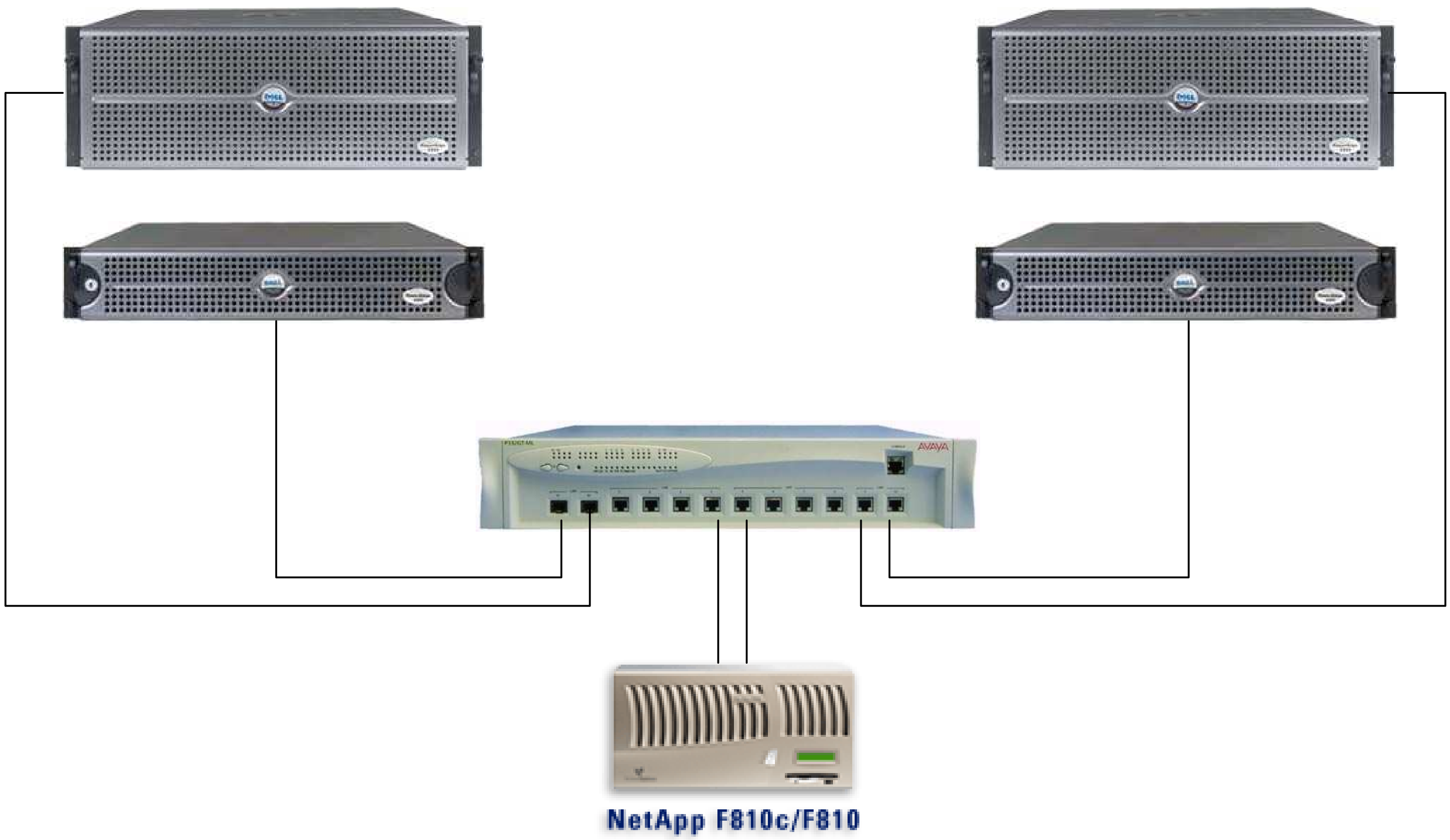
met.no Production Chain 2003



~40 operational servers (including support systems)

~15 meteorological workstations (+ 60 for the scientists)

New control system 2003



Examples of Open Source at met.no

- OS: Linux, User Mode Linux (UML)
- Languages: gcc, Perl, Pyton, PHP
- Applications: Apache, Bind, Exim, Autofax, OpenLDAP, CUPS
- Databases: MySQL, PostgreSQL
- Tools: OpenSSH, OpenSSL, SAMBA, FreeRADIUS
- Formats: NetCDF, HDF, XML
- Middelware: Corba
- Configuration: cfengine

Open Source software developed at met.no

- Web-based helpdesk
- Web publishing system: wgen
- Message switch: Norcom

Experiences with Open Source

- Stability: Excellent
- Economy: Significant netto gain
  - Operating cost reduced by 30% so far
  - Significantly more hardware for a constant amount of money
  - Recruited one extra system engineer
- User satisfaction: Positive, but want more software, more individualism, more support…
- Anarchy: Led to many different workstation configurations and a high cost of operations
- In-fighting: RedHat vs. Debian, Perl vs. Pyton etc. (Good news for the Windows supporters)

www.CFENGINE.org

- Designed for testing and configuring software
- Configuration files describe all hosts
- Deviations from the configuration file are fixed
- Some of the primitives which can be automated:
  - Edit textfiles
  - Make and maintain symbolic links, including multiple links from a single command
  - Check and set the permissions and ownership of files
  - Tidy (delete) junk files which clutter the system
  - Systematic, automated mounting of filesystems (Unix)
  - Checking for the presence of important files and filesystems
  - Controlled execution of user scripts and shell commands

Cfengine at met.no

- Installation of new machines
  - Minimal base system with cfengine on CD
  - Kernel, filesystems, software from cfengine
  - Host and service specific changes from cfengine configuration files
- Reinstallation
- Configuration updates and changes
- Distribution and update of software

MeteoSwiss

Server Scalability with WildcardMaps

Bruno Zürcher

MeteoSwiss, Zürich

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presented at 14th EGOWS meeting
Tromsø, 16 – 19 June 2003

EGOWS 03

MeteoSwiss

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1. Introduction to Server Scalability
2. Introduction to Maps
3. WildcardMap
4. Application in NinJo Project

Introduction to Server Scalability

Server Scalability

Scalability is the ability of a server to grow to support

- an increasing number of concurrent users
- an increasing complexity of offered services (i.e. increasing amount of stored data)

Scalability is achieved by

- server cloning
- server partitioning

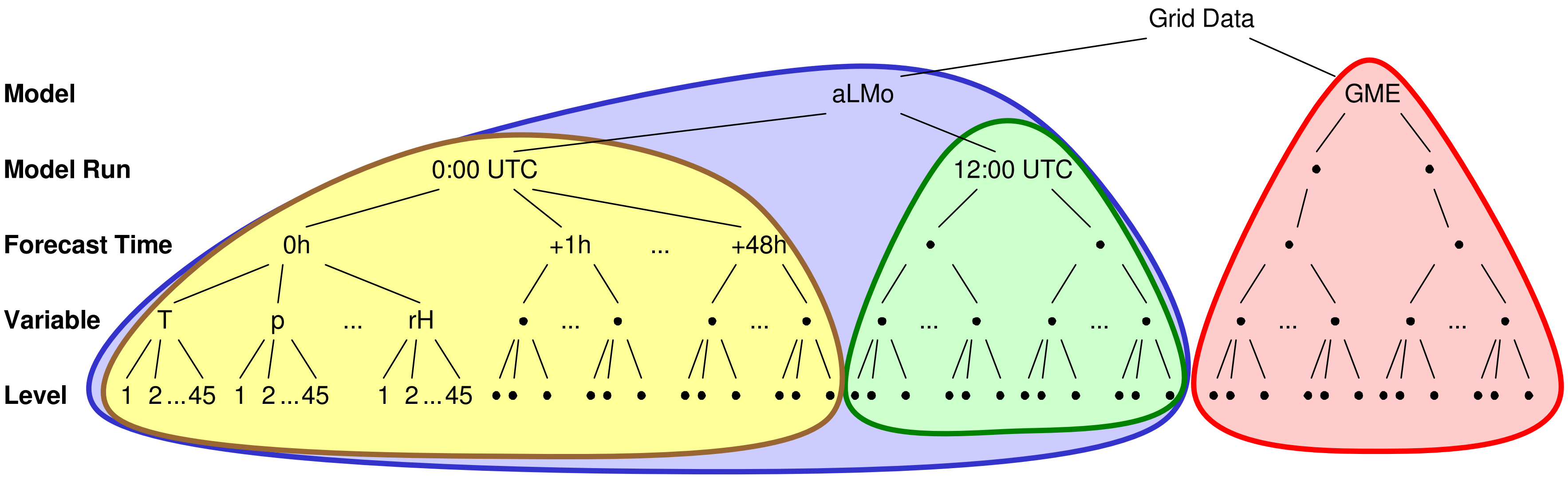
focus of this presentation

Example: Grid Data Server

Alpine Model (aLMo)	**currently**	**planned**
• grid size:	385 x 325	770 x 650
• number of levels:	45	60
• number of variables:	~10	~12
• forecast times:	49	73
• model runs per day:	2	3
• resulting data size:	20 GB / day	300 GB / day

⇒ server partitioning strongly required

Hierarchical Approach to Partitioning



server partitioning steps:

Grid Data ⇒ Grid Data – aLMo / Grid Data – GME ⇒ Grid Data – aLMo – 0:00 UTC / Grid Data – aLMo – 12:00 UTC / Grid Data – GME

Routing of Client Requests

- task: find the correct server for a specific grid data request
- a request has to specify the model, model run, forecast time, variable and level (put together in the *qualifier*)
- the correct server is now determined by pruning the qualifier's tail until a matching server name is found

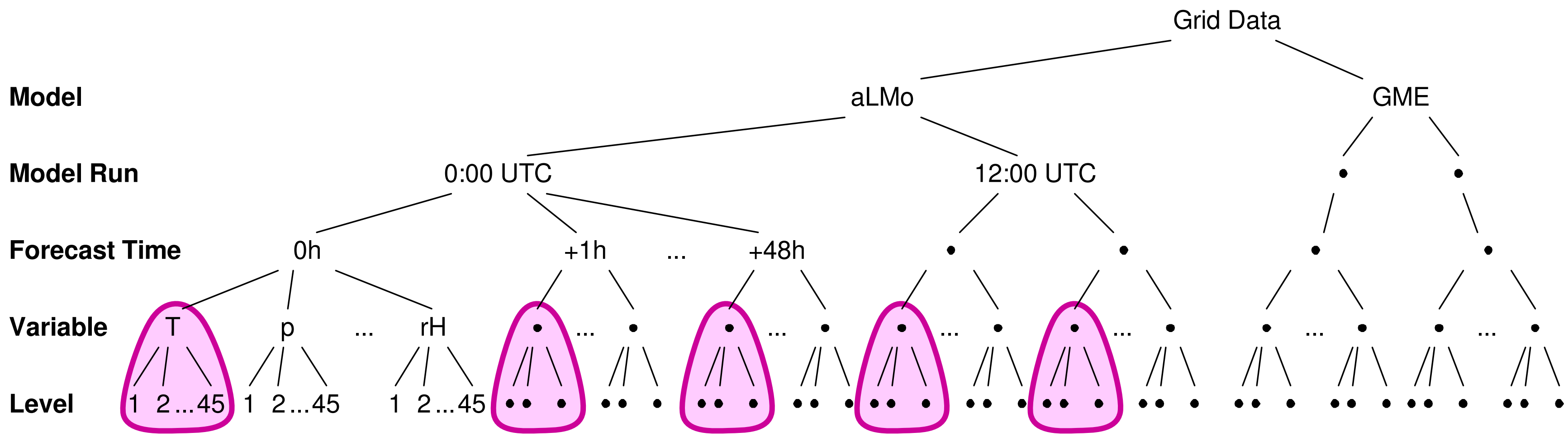
request qualifier: Grid Data – aLMo – 12:00 UTC – +3h – T – 23

⇓

matching server: Grid Data – aLMo – 12:00 UTC

Drawbacks of Hierarchical Partitioning

- next partitioning step of aLMo server would be applied to the forecast time and a large number (2 x 49) of new servers would be created…
- or worse: what if an aLMo-temperature server (the union of the marked subtrees!) should be created…



Conclusion

- hierarchical server partitioning is inflexible
- we need a partitioning-mechanism which allows us to create servers in a *wildcard* manner like

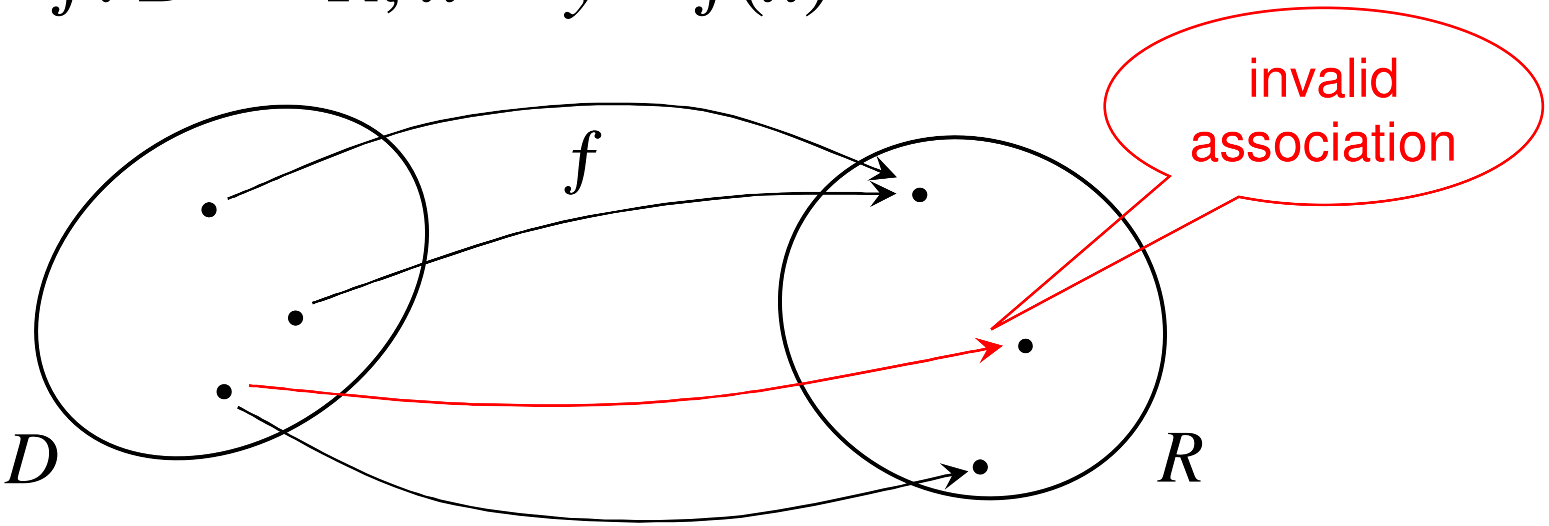
Grid Data – aLMo – * – * – T – *

Introduction to Maps

Concept of a Map

Definition: a *map* is an instruction f which associates an element x of the domain D with an element y of the range R.

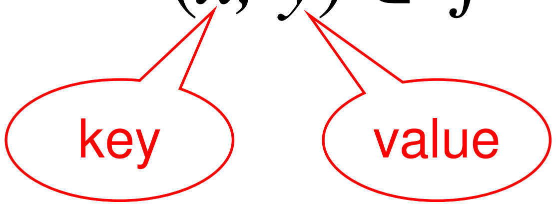
$$f: D \longrightarrow R,\ x \mapsto y = f(x)$$



Remarks on Maps

- one can consider a map as a relation
- instead of writing $f\colon x \mapsto y = f(x)$ one writes

$$(x, y) \in f$$



- long known data structure: *Associative Arrays* (Snobol 4, 1967)

Realization of Maps in Java (1)

- Java defines common map-functionality in an interface Map
- most important methods are
  - `void put(Object key, Object value)`
    ⇒ to populate the map
  - `Object get(Object key)`
    ⇒ to look up a value associated with a key

key: element of the domain *D*
value: element of the range *R*

Realization of Maps in Java (2)

- other useful methods
  - `Set keySet()`

    ⇒ the set of all keys contained in the map
  - `Collection values()`

    ⇒ the collection of all values contained in the map
  - `Set entrySet()`

    ⇒ the set of all key-value pairs contained in the map
- returned Set and Collection objects allow iteration over all keys and all values contained in a Map instance

Realization of Maps in Java (3)

- Java knows several standard classes implementing the Map interface
  - HashMap / Hashtable
    $\Rightarrow$ efficient lookup in $O(1)$, unordered iteration
  - TreeMap
    $\Rightarrow$ lookup in $O(ln\ n)$, ordered iteration
- and a rather exotic implementation
  - WeakHashMap
    $\Rightarrow$ intelligent cooperation with garbage collector

WildcardMap

Properties of WildcardMap Class (1)

- implements the Map interface
- the keys of a WildcardMap are restricted to String objects, more precise to qualifiers like

  Grid Data – aLMo – 12:00 UTC – +3h – T – 23
- we distinguish two kinds of keys:
  - *map-keys* used with put() method
    may be composed of wildcard Strings "*"
  - *access-keys* used with get() method
    must be composed of concrete Strings

Properties of WildcardMap Class (2)

- get() does not perform exact matching, rather wildcard matching is performed
- by means of a backtracking algorithm the best matching map-key is determined and subsequently its associated value is returned

Matching Metric

- given an access-key $a = (a_{N\text{-}1}, \ldots, a_0)$ and a map-key $m = (m_{N\text{-}1}, \ldots, m_0)$
- component metric ρ

$$\rho(a_i, m_i) := \begin{cases} 0, & \text{if } a_i = m_i \text{ (exact match)} \\ 1, & \text{if } m_i = * \text{ (wildcard match)} \\ \infty, & \text{else (no match)} \end{cases}$$

- overall metric δ

$$\delta(a, m) := \sum_{i=0}^{N-1} 2^i \cdot \rho(a_i, m_i)$$

similar to a binary number

Matching Metric Properties

- for a fixed access-key a and two matching map-keys m_1 and m_2 with $m_1 \neq m_2$ the following inequality holds

  $$\delta(a, m_1) \neq \delta(a, m_2)$$

  proof left to the reader…

- implications
  - we can order the matching map-keys

    $$\delta(a, m_1) < \delta(a, m_2) < \ldots < \delta(a, m_K)$$

  - if there are matching map-keys, there is exactly one least map-key – the best matching map-key
- WildcardMap's get() method is well defined (unambiguous)

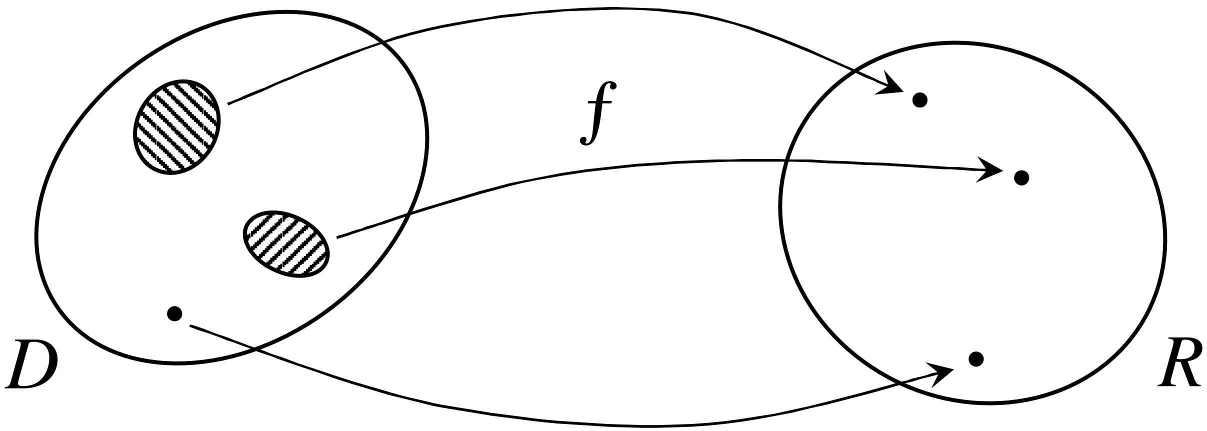
Example

```
// create and populate map
map = new WildcardMap();
map.put("*-*-*",              "Hello");
map.put("Swiss-*-*",          "Grüezi");
map.put("*-Peter-Müller", "Hallo Peter Müller");

// returns "Hello"
map.get("Italian-Sofia-Loren");
// returns "Grüezi"
map.get("Swiss-Anna-Meier");
// returns "Hallo Peter Müller"
map.get("German-Peter-Müller");
// returns "Grüezi"
map.get("Swiss-Peter-Müller");
```

WildcardMap Generalizes Map

- a wildcarded map-key maps whole subdomains of *D* to a certain value of the range *R*



- the concrete elements of *D* may not be known a priori

Lookup Complexity in WildcardMaps

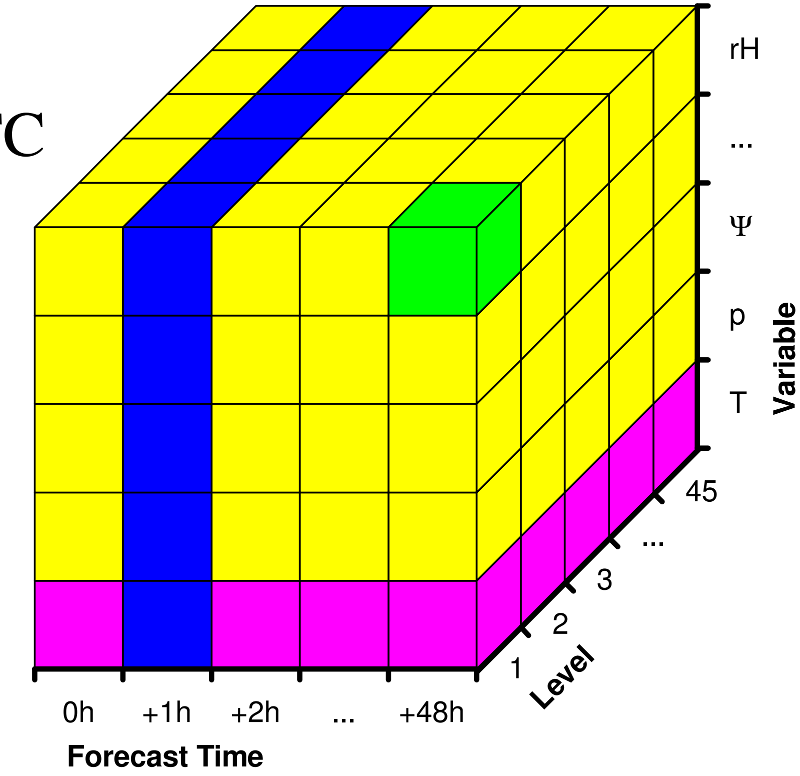
- a general statement is difficult to make as the complexity depends heavily on the actual used map-keys
- best-case for lookup: $O(N)$
- worst-case for lookup: $O(2^N)$
  where N is the number of qualifier components

not exponential in n (number of map-keys)

Application in NinJo Project

Wildcard Approach to Partitioning

considering only the
Grid Data – aLMo – 0:00 UTC
part



server partitioning:

Grid Data – aLMo – 0:00 UTC – * – * – *
Grid Data – aLMo – 0:00 UTC – * – T – *
Grid Data – aLMo – 0:00 UTC – +1h – * –
Grid Data – aLMo – 0:00 UTC – +48h – rH – 1

A WildcardMap for Grid Data Servers

- qualifiers are used as keys
- GridDataServer instances are corresponding values

provided by middleware

```
// create server map
serverMap = new WildcardMap();
serverMap.put("GridData-aLMo-0:00-*-*-*", server1);
serverMap.put("GridData-aLMo-0:00-*-T-*", server2);
serverMap.put("GridData-aLMo-0:00-+1h-*-*", server3);
serverMap.put("GridData-aLMo-0:00-+48h-rH-1",server4);
```

defined in configuration

Client Request Routing

- routing is a simple access to the server WildcardMap

```
// Convert client request to qualifier
String qualifier = getQualifier(request);

// determine correct server
GridDataServer server;
server = (GridDataServer) serverMap.get(qualifier);

if (server != null) {
  // return grid data hold by this server
  return server.getData(request);
} else {
  // no appropriate server found
  throw new DataNotFoundException();
}
```

similar code for data import!

Unit Conversions During Import

- extend qualifier by additional component for unit
- Converter instances are used as values

defined in configuration

```
// create converter map
converterMap = new WildcardMap();
converterMap.put("*-*-*-*-*-K-*", KToCConverter);
converterMap.put("*-*-*-*-*-Pa-*", PaTohPaConverter);

// during data import
String qualifier = getQualifier(importData);

// get optional converter and convert data
Converter converter;
converter = (Converter) converterMap.get(qualifier);
if (converter != null)
  converter.convertData(importData);
```

Summary

- WildcardMap is a new and specialized implementation of the Java Map interface
- WildcardMap restricts the keys to be (qualifier-) Strings
- WildcardMap relaxes the map concept by allowing wildcards
- WildcardMap is used successfully in NinJo's server side software

Reports from the Workgroups

Workgroup 1: **Strategies in system design and development**
Moderator: Peter Trevellyan

Workgroup 2: **Role of workstation systems in the forecasting process**
Moderator: Juha Kilpinen

Workgroup 3: **Objectives of the EGOWS meeting**
Moderator: Jens Daabeck

EGOWS 2003
Working Group 1 Report
Strategies in System Design

Moderation: Peter Trevelyan, peter.trevelyan@metoffice.com
Report: Volker Jung, volker.jung@sdm.de

This working group session took place during EGOWS 2003 on June 18, 2003 in Tromsø, Norway. 17 participants, mostly system designers of various European Weather Services, took part in the discussion. The topic was design strategies for Meteorological Workstation systems, with a special focus on Object-Orientation and on the Linux operating System.

1. Object-Oriented (OO) Languages

1.1 How are they used at the different Met Services today?

- NinJo (DWD and others) strictly use Java only for new Workstation System development
- MSC (Canada) has very little experience with OO languages today, but is joining the NinJo consortium and will base future development on Java
- Norwegian Met Service uses C++
- UK Met. Office uses Pascal and Delphi
- SMHI (Sweden) uses Java

1.2 What are the benefits of OO?

- Benefits are not so obvious for small projects with small solutions, they can be done effectively also using classic programming techniques
- OO is very useful for the development of larger systems, though. The benefit is increased maintainability.
- Java is very useful also because of the advanced APIs and freeware code that come with it, e.g. Java's Advanced Imaging.

1.3 Process to create a good OO system design

- Experience with developing meteorological workstations in general is important for developing these systems using OO.
- Also, experience in software engineering and OO programming is important for creating good software architectures.
- Some fundamental principles for good software architectures apply universally and are independent of OO:
    - Separation of Responsibilities
    - Abstraction and Interfaces

1.4 Learning OO

- In the experience of the participants, OO is hard to learn for some, some will never learn it very well.
- For learning OO, peer reviews of code and of designs can help. External reviews can also be helpful

1.5 Recommendations for books

- OO-Programming and Design: *Developing Software with UML, Bernd Oestereich*

- Java programming: *Thinking in Java, Bruce Eckel*
- Patterns (Advanced Design Topic): *Design Patterns. Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson*
- Software Architecture:
    - *Documenting Software Architectures, Clements, Felix Bachmann, Len Bass*
    - *Software Architecture in Practice, Len Bass, Paul Clements, Rick Kazman*
- Architecture Patterns (Advanced Topic): *A System of Patterns. Pattern- Oriented Software Architecture, Frank Buschmann, Regine Meunier, Hans Rohnert*

2. J2EE vs .NET

2.1 Usage at the Met. Services

- UK Met Service uses J2EE architecture for web services
- Sweden uses J2EE for community products. These are small applications, larger use will come soon.
- Not used very much at the Met. Services.

2.2 C# / .NET

- Not used yet at the Met. Services
- Some reports are promising (mature technology), others say they have heard criticism.
- One of the major downsides is, that it is a proprietary technology
- Because it is proprietary, C# may not be embraced by science community and good freeware code may not be written as much as it is available today for Java.

3. Middleware / N-tier Architectures

- CORBA is used by:
    - DWD
    - Meteofrance in a very limited way
- One advantage of CORBA is, that data servers may be used by other systems within the organization, not only by the workstation system (though some feel, this may encourage misuse)
- UK Met Office aims at viable ways of providing access to data:
    - One data portal
    - One database architecture
- The recommendation of the working group is to use N-tier architectures and abstraction from database technology

4. Usage of Database Management Systems (DBMS)

- MSC (Canada)
    - Uses a "homegrown" database, though Postgres may be used in future
    - They are interested in RDBMS. Benefits are SQL and Standardization.
- MeteoFrance
    - Synergie is based on Oracle, they may use Postgres in the future
- Norwegian Met Service
    - Currently uses mySql (TAF, Diana) but are not satisfied with it (some things in mySql are not reliable, there is no rollback)
    - Postgres will be used in next project
- Netherlands
    - Uses commercial system based on flat files
- UK Met Office
    - Is prototyping the use of RDBMS (Oracle 9i) for GRIB data with spatial extension
- DWD/NinJo

- Uses dedicated file servers for the workstation system. Databases are used in neighbouring systems (Climate data archive, GIS)

5. Linux

5.1 Usage at Met. Services

- Linux is used a lot at Met. Services today.

5.2 Reasons for not using Linux

- What is lacking in Linux?
  - Some Office applications, e.g. MS Project
  - Driver support is still not as good as for Windows
- Microsoft office file formats are the Standard and there are still compatibility issues with OpenOffice
- Some think that Linux may never succeed on the desktop, because
  - There are several companies that can’t agree on a standard
  - It is hard to configure

5.3 Crossover Office

- These are tools that can make Windows Apps run natively under Linux
  - VMware (UK Met Service is very happy with it)
  - VNC (Vnc.com) is used by MeteoFrance. It is freeware

5.5 Linux clusters

- Met.no uses Linux clusters as a backup for their HPC system and they are very happy with it
- MSC did not use a real cluster but a network of Linux machines for CARDS. They might look at "real" clusters for their next projects.

Workgroup 2:

Role of workstation systems
in the forecasting process

Forecast/production process

- Observations
- Models
- Postprocessing
- Forecaster (modeller/developer)
- End production/product generation (also batch)

Use of workstations in nowcasting, short time – and medium range forecasting

- Workstation is used by forecaster in all forecast lengths to visualise observations and forecast data, to analyse situations and to evaluate models and their weaknesses
- Workstations should have more intelligence to work as a watchdog and alert of significant weather etc.

The forecasters role in the process

- Forecaster has an important role in forecasting process
- In most weather services some totally automatic products are generated
- In future forecasters role is seen more as an weather expert and less as end product generator
- Expert system features should also be included in workstations

Automation/product generation

- Automation and automatic product generation is there and it will even increase in future
- Automation will give forecaster more time to concentrate to actual weather and in keeping the quality of databases high -> leads to increased quality and effectivity in process

Objectives of the EGOWS meeting

What should be the key objectives for EGOWS

- The presentations and working groups are to remain technical, focusing on the IT aspects of workstations. Forecasters are welcome, and it is very interesting to have a local forecastergive a presentation on the work process at the local site. But generally, topics are to be kept technical.
- Demos are very valuable, and work well, whether structured or not. They are most effective with a general introduction part. Might do approx. 15-20 minutes of demo on a big screen for everyone, interactively showing the newest developments, then answer specific questions at the demo site. The beginning of the repetition of a demo needs to be clearly indicated. Demos are rather easy nowadays due to laptops.
- EGOWS has no formal framework, no reporting structure, but is popular with the participants as a form to exchange views and experience.
- Should there be a list of recommendations? If so, there should be one or several bodies to present them to (Directors' meeting?, ECAM, TAC at ECMWF, EUMETNET, WMO expert teams), otherwise they will never be recognised.
- An initiative for getting some consensus on XML schemas throughout Europe was suggested. It might be initiated at the biennual workshop at ECMWF November 2003.

Benefits from 14th EGOWS meeting

- As from other meetings: Exchange of information.
- Newcomers find the technical workgroups useful to get an idea of what is going on.
- The usual visit to the local operational service is appreciated, both by delegates and the service.
- One of the best things of EGOWS is the informality and the possibility to talk to others in small groups. It is easier to get information at EGOWS than at ECAM or the biennual ECMWF workshops. Also the technical contributions are getting less prominent at places like AMS, because they are concentrating on refinements of their system.

How important has EGOWS been for meteorological workstation development in Europe

- Important, many organisations are represented.
- A lot has been learned by the experiences of others; should we do this or that, should we avoid certain things?
- Learn of the existence of specific tools, compilers, profilers…

Cooperation, common software components (middleware)

- Some minor efforts, but it is hard now, as nearly everyone has quite mature software.
- Seeing EGOWS as the source of cooperation is probably not valid anymore. Contacts may be initiated, but not formal projects.
- As services are being commercialized, they are probably not so much prepared to give away developed software for reasons of competition.

- As for exchange of information between meetings, KNMI will look at the possibility of hosting a small webpage on EGOWS with mailing lists and a document on experiences from organizing the meeting.

Recommendations for future meetings

- A "How to organize EGOWS"-document could be nice, listing the experiences of previous organizers.
- There is a consensus that it would be good to have a lecture of a technical character on a specific subject as part of the EGOWS meeting. One such topic could be XML.
- It is necessary to find a venue for the next meeting, otherwise, no more meetings.
- Commercial companies are not wanted for presentations as part of the meeting, but it is acceptable to have a presentation from a commercial company as part of a social event, which is funded by the company.
- We do not see many eastern countries, but everyone is welcome if they are interested. It might be possible to get some funding from WMO; some invitations could be extended through the WMO.
- There should be an EGOWS contact person at all potential sites, who can at least propagate information locally, making it easier for the organiser to contact someone for questions and requests.
- A written report should be issued after the meeting, as a web-site tends to be too volatile. To minimize the overhead of collecting, printing and distributing the report, it was decided that the report is to be prepared as one big PDF-file, containing
    - Agenda
    - Reports from working groups
    - Presentations
    - List of participants, including e-mail addresses

  The PDF-file is to be sent to the participants, who can individually print it as needed. Deadline for contributions to this year's report is set to 1st July 2003.

Appendix

Recent documents from the working group on Meteorological Objects

Meteorological Objects in operational use: Steps towards a standard format for exchange (Letter to WMO (Expert Team on Datarepresentation and Codes) submitted by Dick Blaauboer (KNMI), Eric Brun (Météo-France), Chris Little (MetOffice))

Preliminary list of meteorological objects

WORLD METEOROLOGICAL ORGANIZATION

30.XI.2002

ITEM x.x

to OPAG/ISS ET-IDM, ET-DRC

Original: ENGLISH

DRAFT

METEOROLOGICAL OBJECTS IN OPERATIONAL USE: STEPS TOWARDS A STANDARD FORMAT FOR EXCHANGE

Submitted by Dick Blaauboer (KNMI), Eric Brun (Météo-France), Chris Little (MetOffice)

Summary and Purpose of Document

This document gives an overview of the work of the working group on Meteorological Objects in Interaction with Gridded Fields, more specifically a common list of Meteorological Objects and their attributes to be used as a standard by WMO members

ACTION PROPOSED

The ET-DRC and ET-IDM are invited to take note of the activities of the Working Group presented in this document and to consider adoption of the model of the current list of common Meteorological Objects as the basis for a WMO standard for exchange.

References:

[1] COST-78 Proceedings of the International Workshop on Graphical Interaction with Gridded Fields, Helsinki, Finnish Meteor. Institute, 80 pp., 1999

DISCUSSION

0. Introduction

The Working Group on Meteorological Objects in Interaction with Gridded Fields was established after the Workshop on Graphical Interaction in December 1998 at Helsinki, organized within the framework of COST-78 on Improvement of Nowcasting Techniques [1]. It had its first meeting during ECAM, the European Conference on Applied Meteorology, 1999 in Norrköping.

The working group acts as an informal group. It convenes normally once a year as a subgroup of EGOWS, the European Group on Operational Worskstation Systems, a forum for exchange of information on meteorological workstation development in Europe. In June 2000 the group agreed its Terms of Reference (ToR).

1. Terms of Reference

- The goal of the Working Group is to define a common list of Met Objects with their attributes and to propose it as a standard to WMO. To that purpose the WG will have links with National Hydro-Meteorological Services outside Europe.
- This goal should be reached within a relatively short time period because some user applications are already using Met Objects with their own definitions.
- The Working Group on Met Objects will be a permanent subgroup of EGOWS and have annual meetings in parallel with EGOWS.
- Between meetings information exchange will take place using email and a website that will be set up shortly.

2. Inventory of Current Practice

An initial inventory of objects was constructed from the initial working group meetings and correspondance, including a questionnaire for assessing the present use of Meteorological Objects at European National Weather Services. General definitions were derived from the initial working group meetings and the results of the inventory and then further analysed and refined to produce agreed definitions (both physical and abstract) through local workshops and more correspondance.

Working definition of a Met Object: A meteorological object is a feature limited in space and time (point, line, area, volume) with certain attributes representing a meteorological phenomenon or concept. Examples: cloud system, precipitation area, front, pressure centre.

Met Objects are complementary to gridded fields used to represent weather forecast and analysis. Also, entities like satellite imagery, synoptic surface observations and soudings are not considered as Met Objects, especially as exchange formats already exist for these. However, the MetObjects have been defined in a way that is consistent with these other entities.

The working group focused much more on the concepts and methods behind the objects rather than on computational or presentation aspects. At least two technologies could be used to exchange Met Objects in practice:

a) BUFR, considered as a generalisation of the exchange of aviation Significant Weather information;
b) XML, the eXtensible Mark-up Language, with a proposal like OMF (Weather Observation Definition Format) also appears to be a format very suitable to represent Met Objects.

3. Requirements for Met Objects

Met Objects are considered as powerful tools to help forecasters in formalising their expertise. In an environment where outputs from Numerical Weather Prediction models will continuously increase, meteorological objects will provide a unique way for forecasters to interact through graphical interfaces with gridded fields, especially if they are associated with conceptual models. As such they may prove to be a useful vehicle for the exchange of SatRep reports.

In an overview the areas where Met Objects are already being used or considered include:

- Aviation charts (SIGWX) (UK, France, Germany)
- SatRep (Finland, Netherlands, Austria)
- Frontal charts (France, UK)
- Graphical user products (UK, France)

Standardised Met Objects could also facilitate the exchange of severe weather information on both regional dn global scales

4. Common list of Meteorological Objects

Currently the most important goal of the Working Group is to define a common list of Met Objects with their attributes and to propose it as a standard to WMO. Based on current practice in various countries, the working group derived a first version of this common list of Met Objects and their attributes. Though changes in the description of attributes will occur and the number of Met Objects will increase, it is believed that the model established by the Working group to create the current draft list may serve as a “standard” for exchange of existing Met Objects.

The various attributes have been subdivided in classes: top level, second level and third level. The top level attributes include:

- abstract attributes: defining the object (sub)class and annotation;
- location attribute: describing horizontal, vertical and time position of the object;
- meteorological attribute: describing the parameters involved;
- purpose attribute: describing for what the object is meant;
- generator attribute: describing how the object has been generated.

The full draft list of objects with all attributes is included in Annex 1. This list will be consolidated by the Working Group during the next 3 months and validated by another questionnaire to assess which objects and attributes are actually implemented in existing systems, or planned to be implemented soon.

Annex 1: common list of Meteorological Objects and their attributes

Example Object Name																								
Top level attributes	**Abstract Attributes(1)**										**Location(1)**						**Meteorological(?)**						**Purpose(1)**	
Second level attributes	**Type(1)**		**Affiliation(1)**				**Extent(1)**				**Coordinates(+)**				**Movement (speed&direction)(*)**	**Path(?)**	**Parameter (*)**				**Other Defining Attributes(*)**	**MetID(?)**	**Status(1)**	**Validity window(?)**
Third level attributes	**Abstract type(1)**	**Subtype(?)**	**Annotation(*)**	**InstanceID(1)**	**ParentID(?)**	**ChildID(*)**	**Spatial Dimensions**	**Areal extent**	**Vertical extent**	**Past-ParentID**	**(x, y)(+)**	**z(+)**	**Level type(1)**	**t**			**Type (*)**	**Intensity or value(*)**	**Probability(?)**	**Tendency(*)**				
Possible attribute values											**Lat, Lon**		**MSL, Surface, Z, hPa**	**yyyy-mm-dd hh:mm:ss**		**Normal, Recurving**	**PMSL, Z, T, PV, WV, etc**			**Frontolysing, Frontogenesis (Decreasing, Increasing)**		**seq.letter, seq.number, name**	**Warning, Advisory, Test**	**+/-h1:m1:s1 +/-h2:m2:s2**
ACTION CENTRES																								
High	High/Maximum						0D				(x, y)	z	yes	t	(u,v)		yes			yes		yes	yes	
Anticyclone	High/Maximum						0D				(x, y)	z	yes	t	(u,v)								yes	
High geopotential	High/Maximum						0D				(x, y)	z	yes	t	(u,v)								yes	
Low	Low/Minimum						0D		?		(x, y)	z	yes	t	(u,v)		yes			yes		yes	yes	
Upper level low	Low/Minimum						0D				(x, y)	z	yes	t	(u,v)								yes	
Depression	Low/Minimum						0D				(x, y)	z	yes	t	(u,v)								yes	
Low geopotential	Low/Minimum						0D				(x, y)	z	yes	t	(u,v)								yes	
Polar low	Low/Minimum	polar					0D				(x, y)	z	yes	t	(u,v)								yes	
Tropical low	Low/Minimum	tropical					0D				(x, y)	z	yes	t	(u,v)								yes	
Orographic low	Low/Minimum	orographic					0D				(x, y)	z	yes	t	(u,v)								yes	
Thermal low	Low/Minimum	thermal					0D		?		(x, y)	z	yes	t	(u,v)								yes	
Low from old tropical storm	Low/Minimum	old tropical					0D				(x, y)	z	yes	t	(u,v)								yes	
Secondary low with occlusion	Low/Minimum	secondary					0D				(x, y)	z	yes	t	(u,v)								yes	
Cold core	Low/Minimum	cold core					0D				(x, y)	z	yes	t	(u,v)								yes	
Water vapour eye	Low/Minimum	water vapour					0D				(x, y)	z	yes	t	(u,v)								yes	
Water vapour eddy	Low/Minimum	water vapour					0D				(x, y)	z	yes	t	(u,v)								yes	
Tropical storm/cyclone	Tropical						0D				(x, y)	z	yes	t	(u,v)	(lat,lon)*m	yes	yes		yes	Max wind,	yes	yes	yes
Hurricane	Tropical	Hurricane					0D				(x, y)	z	yes	t	(u,v)	(lat,lon)*m						yes	yes	yes
Typhoon	Tropical	Typhoon					0D				(x, y)	z	yes	t	(u,v)	(lat,lon)*m						yes	yes	yes
SYNOPTIC TYPICAL FEATURES																								
Cold front	Discontinuity/fron	Cold					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Cold front at the surface	Discontinuity/fron	Cold					1D				(lat,lon)*n	z	yes	t	(u,v)*n			yes					yes	yes
Frontolysing cold front	Discontinuity/fron	Cold					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Cold pseudo-front	Discontinuity/fron	Cold	pseudo				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Arctic cold front	Discontinuity/fron	Cold	arctic				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Surface trace of a split cold front	Discontinuity/fron	Cold	trace of a split cold				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Upper trace of a split cold front	Discontinuity/fron	Cold	trace of a split cold				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Cold front in cold advection	Discontinuity/fron	Cold	in cold advection				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Cold front in warm advection	Discontinuity/fron	Cold	in warm advection				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Warm front	Discontinuity/fron	Warm					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Warm front at the surface	Discontinuity/fron	Warm					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	yes
Frontolysing warm front	Discontinuity/fron	Warm					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Warm pseudo-front	Discontinuity/fron	Warm	pseudo				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Warm front detached	Discontinuity/fron	Warm	detached				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Occluded front at the surface	Discontinuity/fron	Occluded					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	yes
Frontolysing occluded front	Discontinuity/fron	Occluded					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Occluded front warm conveyor belt	Discontinuity/fron	Occluded	warm conveyor belt				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Occluded front cold conveyor belt	Discontinuity/fron	Occluded	cold conveyer belt				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Occluded front bent back	Discontinuity/fron	Occluded	bent back				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Quasi-stationary front at the surface	Discontinuity/fron	Quasi-stationary					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Frontolysing quasi-stationary front	Discontinuity/fron	Quasi-stationary					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Quasi-stationary pseudo-front	Discontinuity/fron	Quasi-stationa	pseudo				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Low tropopause limit	Line	Low tropopause limit					1D				(lat,lon)*n	z	yes	t	(u,v)*n									
Inter-tropical front	Discontinuity/fron	Inter-tropical					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Convergence line	Line	Convergence					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Convergence line coastal	Line	Convergence	coastal				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Convergence line non-orographic	Line	Convergence	non-orographic				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Convergence line orographically ind	Line	Convergence	orographic				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Convergence line over seas and lak	Line	Convergence	over seas and lakes				1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Squall line	Line	Squall					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Ridge	Line	Ridge					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Trough	Line	Trough					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Surface trough	Line	Trough					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Instability line	Line	Instability					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Easterly wave	Line	Easterly wave					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Upper wave	Line	Upper wave					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Wave	Line	Wave					1D				(lat,lon)*n	z	yes	t	(u,v)*n								yes	
Jet-stream (aviation)	Jet	Aviation					1D		yes		(lat,lon)*n	z*n	yes	t	(u,v)*n		Speed*n						yes	yes
Jet-stream (forecasting)	Jet	Forecasting					1D		yes		(lat,lon)*n	z*n	yes	t	(u,v)*n		Speed*n				Entrance & exit		yes	
Jet-stream 2D core	Area	2D Core					2D	yes			(lat,lon)*n	z	yes	t	(u,v)*n		Speed*n						yes	
Low-level jet	Jet	Low level					1D	yes			(lat,lon)*n	z*n	yes	t	(u,v)*n								yes	
Inter-tropical convergence zone	Area	Inter-tropical convergence zone					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Air advection zone	Area	Air advection zone					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n						Characteristics		yes	
Absolute vorticity advection zone	Area	Absolute vorticity advection zone					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Convective instability zone	Area	Convective instability zone					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Wind shear 2D zone	Area	Wind shear zone					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n						Characteristics (direct …)		yes	
Wind shear cross-section zone	Area	Wind shear zone					2D		yes		(lat,lon)*(n-1)	z	yes	t	(u,v)*n						Characteristics (direct …)		yes	
Warm front band	Area	Warm front band					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Warm front shield	Area	Warm front shield					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Warm conveyor belt	Area	Warm conveyor belt					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	

	Generator						
	Generating Centre ID(?)	Version(?)	Generating Process(1)				Process type(?)
Abstract type(1)			Process	Data time or forecast length(?)	Data cut-off wrt Data Time(?)	Algorithm & fields used for generation(?)	
	Manual on Codes Vol. C?	Original, Correction N	Sensing, Analysis, Forecast				Automatic, Manual
High/Maximum	yes	yes	yes			Mean sea level pressure, surface winds	yes
High/Maximum	yes	yes	yes				yes
High/Maximum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes			Mean sea level pressure, surface winds	yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Low/Minimum	yes	yes	yes				yes
Tropical	yes	yes	yes			Mean sea level pressure, surface winds	yes
Tropical	yes	yes	yes				yes
Tropical	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes			Obs & model fields	yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Line	yes	yes	yes				yes
Discontinuity/front	yes	yes	yes				yes
Line	yes	yes	yes			T gradient, q, uv fields	yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Line	yes	yes	yes				yes
Jet	yes	yes	yes			Altitude & FF of max winds, wind at upper	yes
Jet	yes	yes	yes			Altitude & FF of max winds, wind at upper	yes
Area	yes	yes	yes			Altitude & FF of max winds, wind at upper	yes
Jet	yes	yes	yes			Wind at low levels	yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes

Top level attributes	**Abstract Attributes(1)**										**Location(1)**						**Meteorological(?)**						**Purpose(1)**	
Second level attributes	**Type(1)**				**Affiliation(1)**		**Extent(1)**				**Coordinates(+)**				**Movement (speed&direction)(*)**	**Path(?)**	**Parameter (*)**				**Other Defining Attributes(*)**	**MetID(?)**	**Status(1)**	**Validity window(?)**
Third level attributes	**Abstract type(1)**	**Subtype(?)**	**Annotation(*)**	**InstanceID(1)**	**ParentID(?)**	**ChildID(*)**	**Spatial Dimensions**	**Areal extent**	**Vertical extent**	**Past-ParentID**	**(x, y)(+)**	**z(+)**	**Level type(1)**	**t**			**Type (*)**	**Intensity or value(*)**	**Probability(?)**	**Tendency(*)**				
Possible attribute values											**Lat, Lon**		**MSL, Surface, Z, hPa**	**yyyy-mm-dd hh:mm:ss**		**Normal, Recurving**	**PMSL, Z, T, PV, WV, etc**			**Frontolysing, Frontogenesis (Decreasing, Increasing)**		**seq.letter, seq.number, name**	**Warning, Advisory, Test**	**+/-h1:m1:s1 +/-h2:m2:s2**
Deformation band	Area	Deformation band					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Rapid cyclogenesis	Area	Rapid cyclogenesis					2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)*n								yes	
Cold air development	Area	Cold air development					2D	yes			(lat,lon)*(n-1)	z	yes	t									yes	
SENSIBLE WEATHER																								
Areas of significant postfrontal weatl	Area	postfrontal					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		Zone index?						yes	
Areas of significant convective weatl	Area	convective					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		Zone index?						yes	
Areas of significant cluster of weathe	Area	cluster					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Cloud	Area	list of different cloud types				precipitation	2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		yes		yes				yes	
Comma	Area						2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)		yes		yes				yes	
Precipitation	Area	list of different precipitation types			cloud		2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		yes	yes	yes				yes	
Aircraft icing	Area				cloud		2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		yes	yes	yes				yes	yes
Squalls	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		yes	yes	yes				yes	yes
Thunderstorms	Area				meso-scale convective cell		2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)			yes	yes				yes	yes
Dry meteors	Area	list of different dry meteor types					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)			yes	yes				yes	yes
Visibility reduction by meteors	Area				precipitation, dry meteor,		2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)		yes	yes	yes				yes	yes
Moderate/severe turbulence (CAT)	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)			yes	yes				yes	yes
Meso-scale convective cell/system	Area					thunderstorn	2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)						Age, movement speed and directio		yes	yes
Rapid Developing Thunderstorms	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)						shape (size at various temperat		yes	yes
Radar convective cell	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)	(lat,lon)*m					Echotop, VIL-grid or cell, HMAX		yes	yes
Cumulonimbus cluster	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	yes
Enhanced cumulus	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	yes
Fog and stratus	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Stratocumulus sheets	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Lee cloudiness	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t									yes	
Jet cloudiness (fiber)	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Convergence cloudiness	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Stau cloudiness (English?)	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Thickness ridge cloudiness	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t	(u,v)								yes	
Dark stripes	Area						2D	yes	yes		(lat,lon)*(n-1)	z	yes	t									yes	
OTHERS																								
Mountain waves	Area	Mountain waves					2D	yes	yes		(lat,lon)*(n-1)	z	yes	t									yes	yes
Volcano	Location	Volcano				volcanic plu	0D				(lat,lon)	z	yes									yes	yes	
Volcanic plume 2D	Plume 2D	Volcanic			volcano		2D	yes			(lat,lon)*(n-1)	z	yes	t	(u,v)		pollutant					yes	yes	yes
Sea ice line	Edge?	Sea ice					1D	yes			(lat,lon)*n	z	yes	t	(u,v)								yes	
Baroclinic boundary	Edge?	Baroclinic					1D	yes			(lat,lon)*n	z	yes	t	(u,v)								yes	
Ocean fronts	?						2/3D	yes	yes		?	z	yes	t	(u,v)								yes	

	Generator						
	Generating Centre ID(?)	Version(?)	Generating Process(1)				Process type(?)
Abstract type(1)			Process	Data time or forecast length(?)	Data cut-off wrt Data Time(?)	Algorithm & fields used for generation(?)	
	Manual on Codes Vol. C?	Original, Correction N	Sensing, Analysis, Forecast				Automatic, Manual
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes			Surface or altitude fields (q,..),T gradient,	yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes			CAT index, wind shears *M5	yes
Area	yes	yes	yes			Satellite image derivation *M1	yes
Area	yes	yes	yes			Derivation from satellite IR	yes
Area	yes	yes	yes			Radar image or volume derivation	yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Area	yes	yes	yes				yes
Location	?	?	yes				
Plume 2D	yes	yes	yes				yes
Edge?	yes	yes	yes				yes
Edge?	yes	yes	yes				yes
?	yes	yes	yes				yes