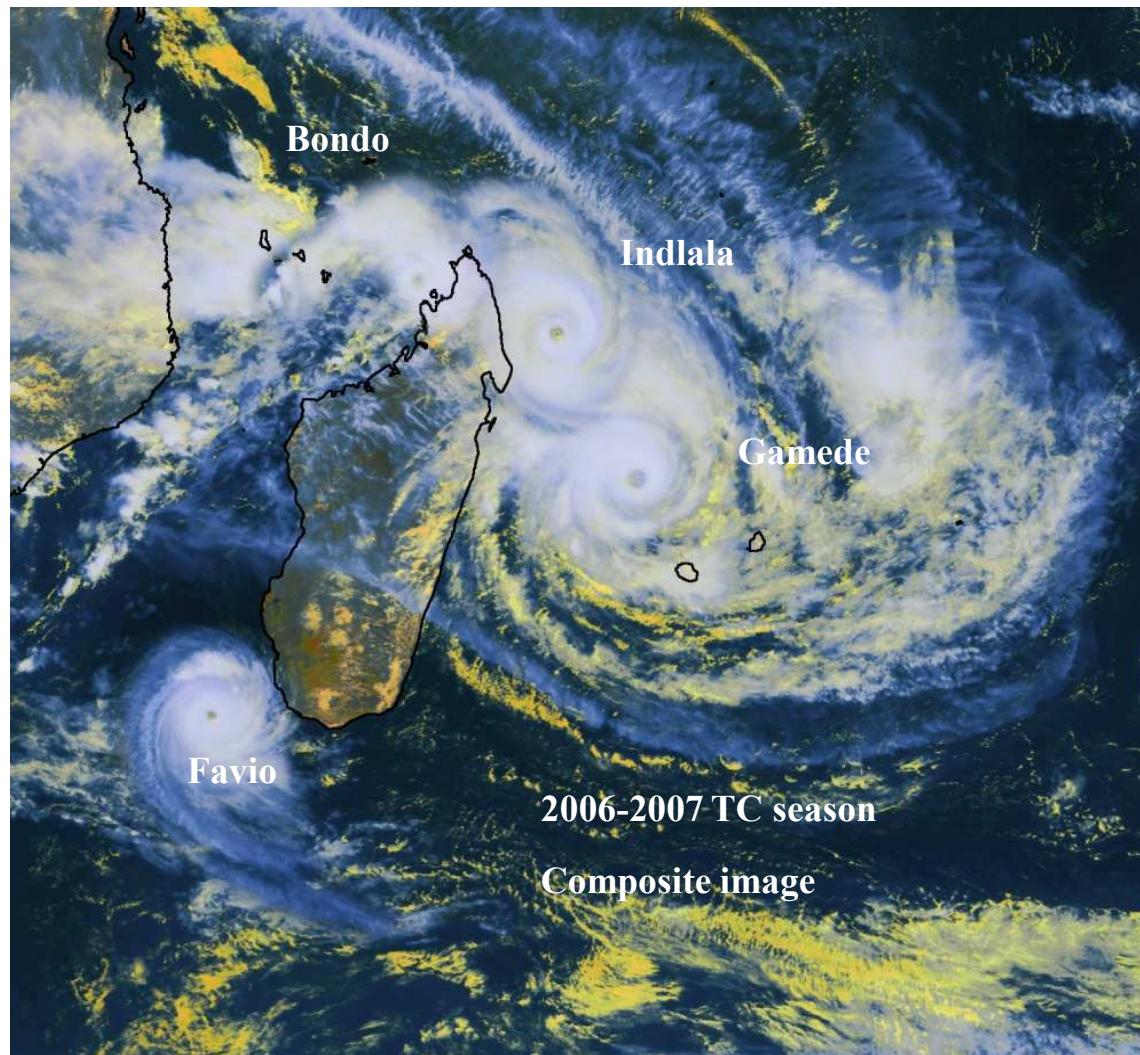


The SouthWest Indian Ocean cyclone basin



Sébastien Langlade

Tropical cyclone forecaster – RSMC La Reunion



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OUTLINE

1. Introduction- Global cyclonic activity
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Basic definitions

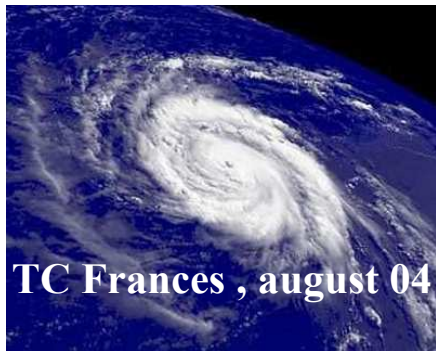
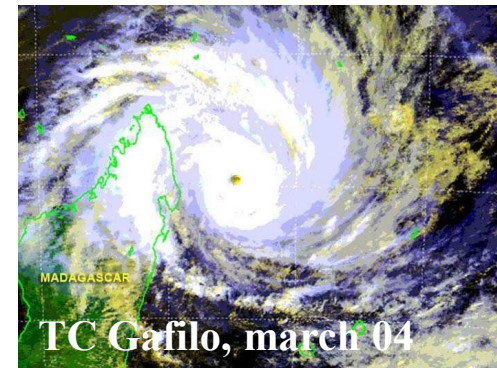
DEFINITIONS:

A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection (i.e. thunderstorm activity) and definite cyclonic surface wind circulation (Holland 1993)

Max wind < 34 kt → Tropical depression

33 kt < max wind < 64 kt → Tropical storm

Max wind > 63 kt → "**hurricane**" (north ATL, NEPAC)



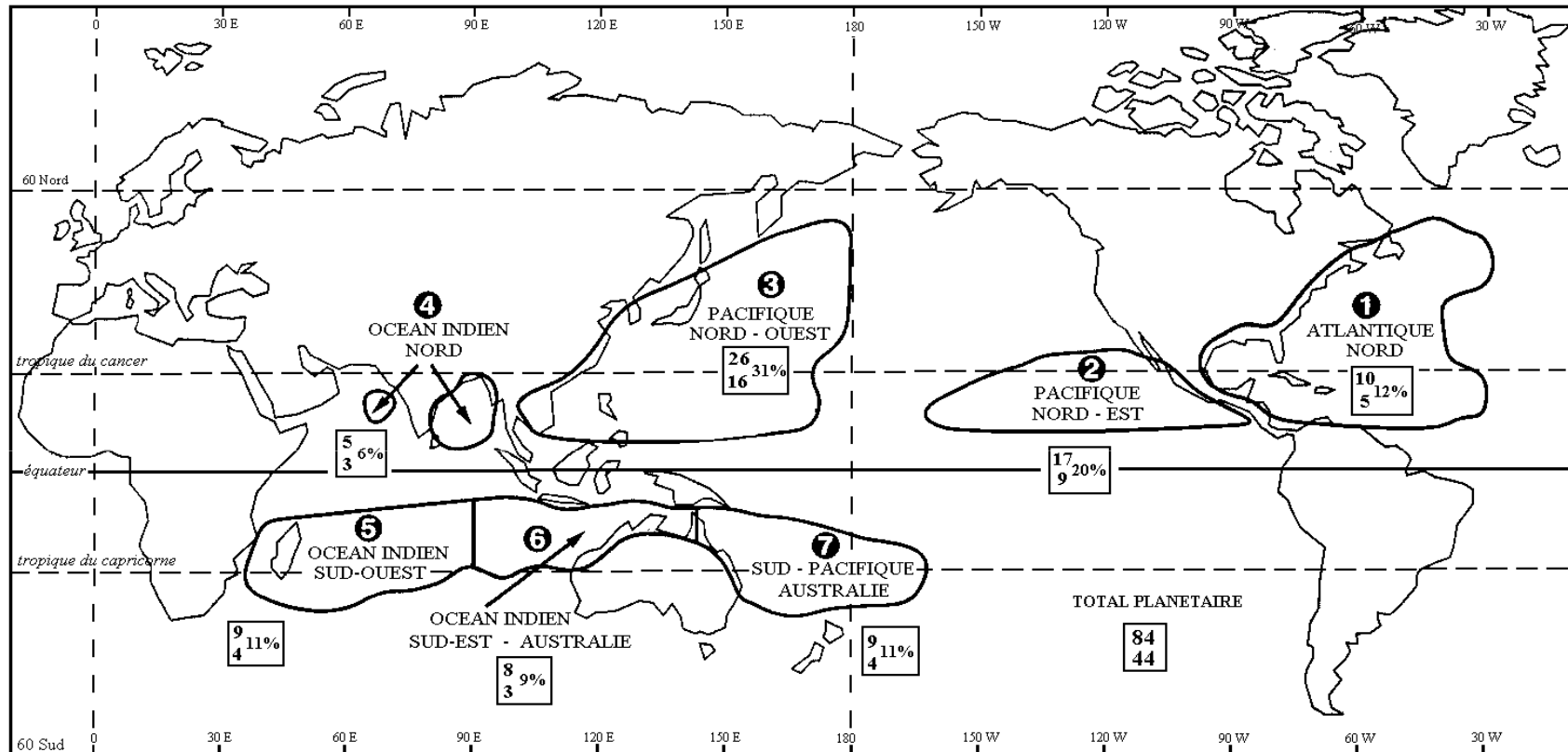
"**typhoon**" (the NWPAC west of the dateline)

"**severe tropical cyclone**" (the SWPAC and SEI east of 90E)

"**severe cyclonic storm**" (the North IND)

"**tropical cyclone**" (the SWIO)

Cyclone basins

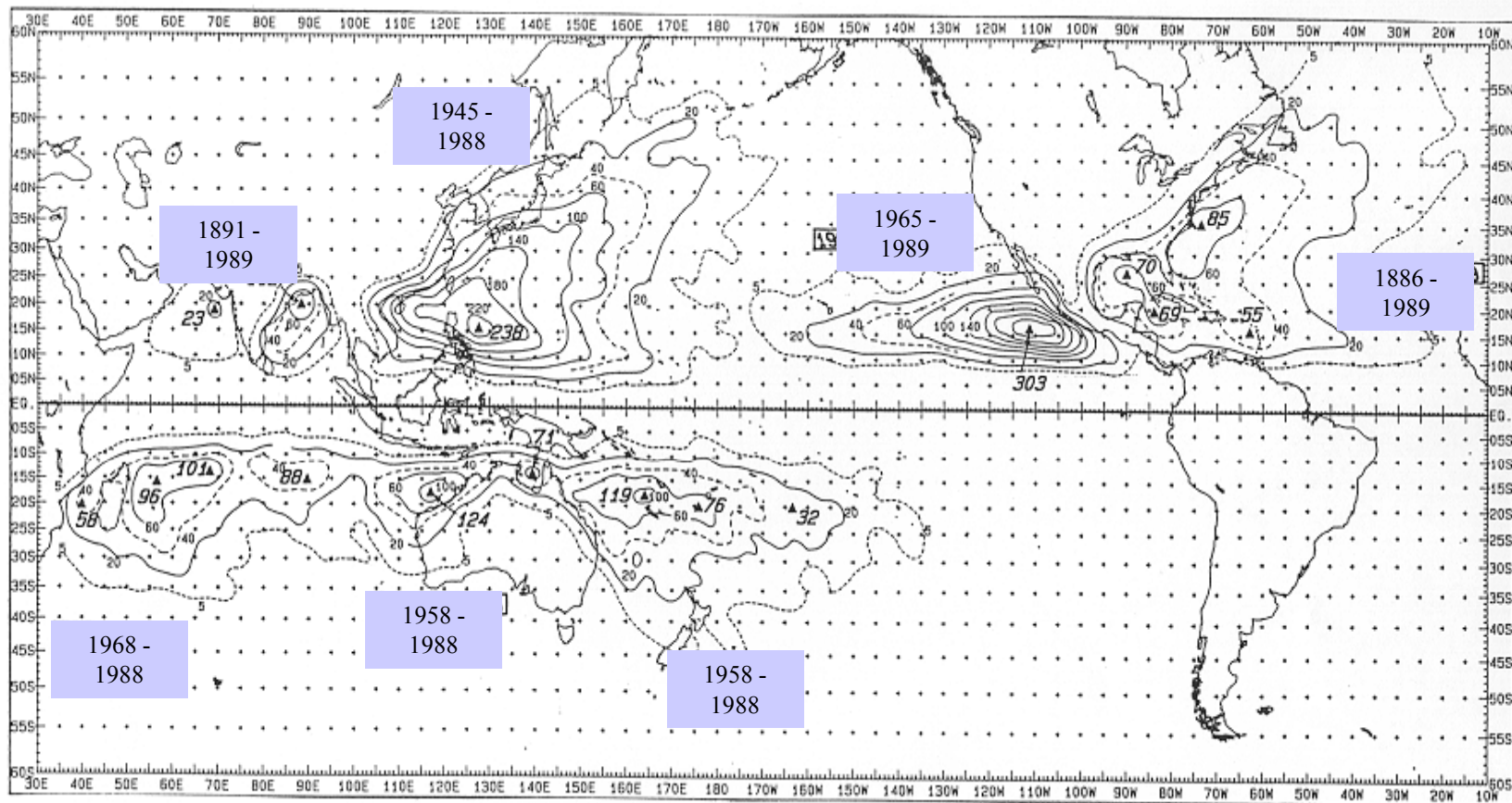


Statistiques sur la période 1968-1990

- A C%
B
- A : Nombre annuel moyen de tempêtes et cyclones tropicaux
 - B : Nombre annuel moyen de cyclones tropicaux
 - C : Pourcentage de la population mondiale (tempêtes et cyclones)

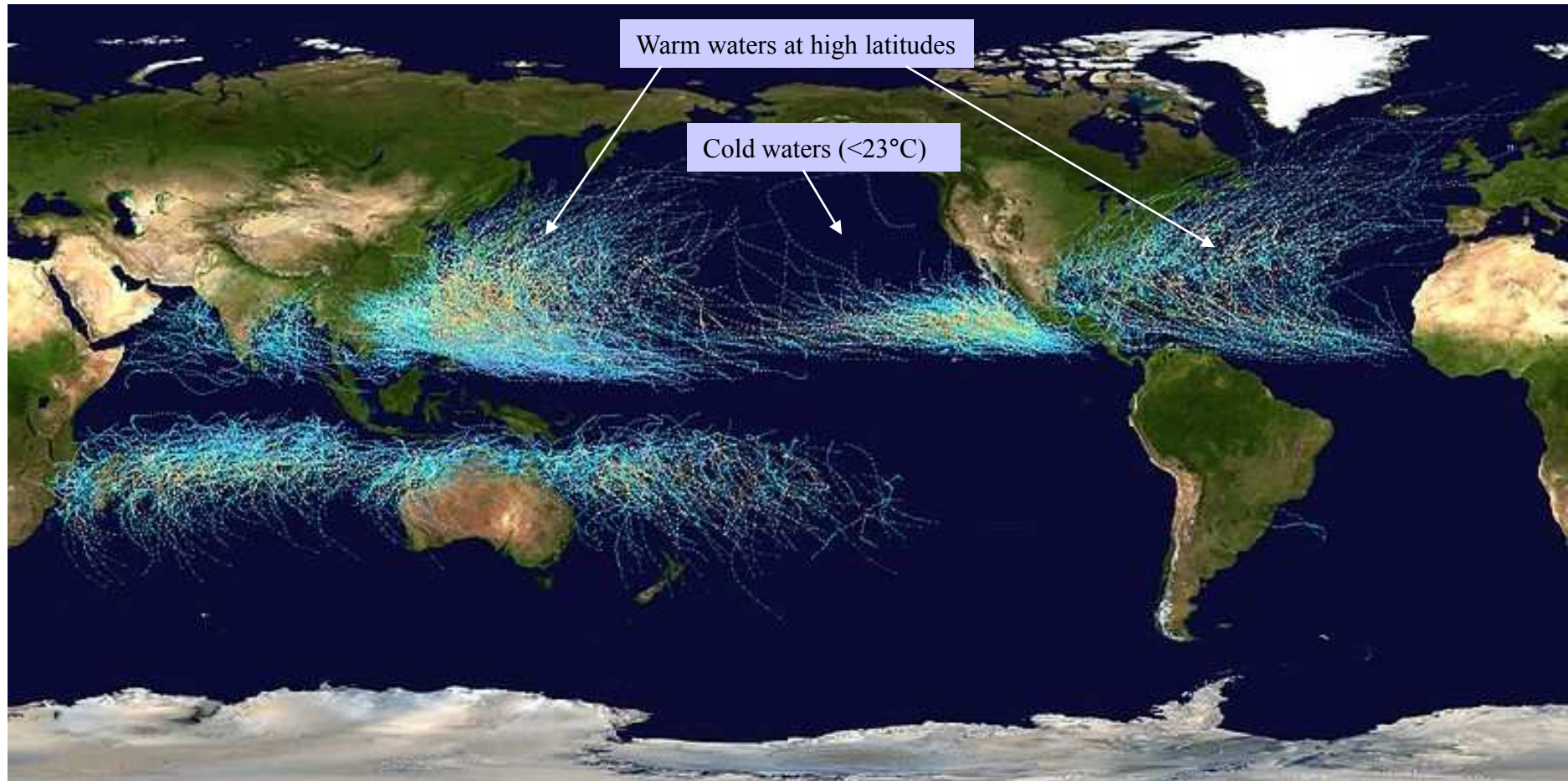
D'après Charles J. Neumann, in *Global Guide of Tropical Cyclone Forecasting*, WMO/TD N°560, 1993.

Frequency of tropical cyclones



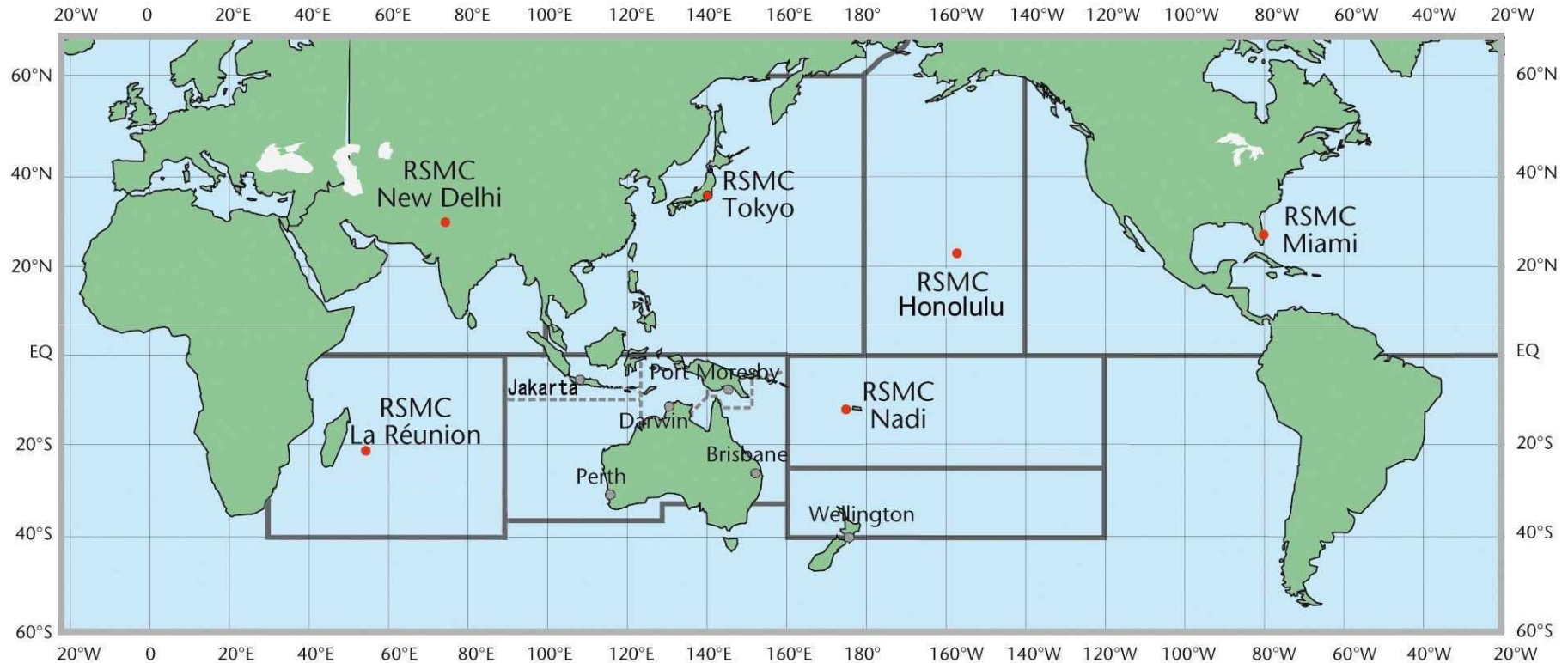
Frequency of tropical cyclones per 100 years within 140 km of any point. Solid triangles indicate maxima, with values shown. Period of record is shown in boxes for each basin. (Neumann 1993)

*Tracks of tropical cyclones (with maximum winds greater than 63km/h, 34kt)
for the period 1985-2005. Best-track from JTWC*



World cyclone watch

TCP, tropical cyclones programme, programme of the World Weather Watch created in 1972 by WMO

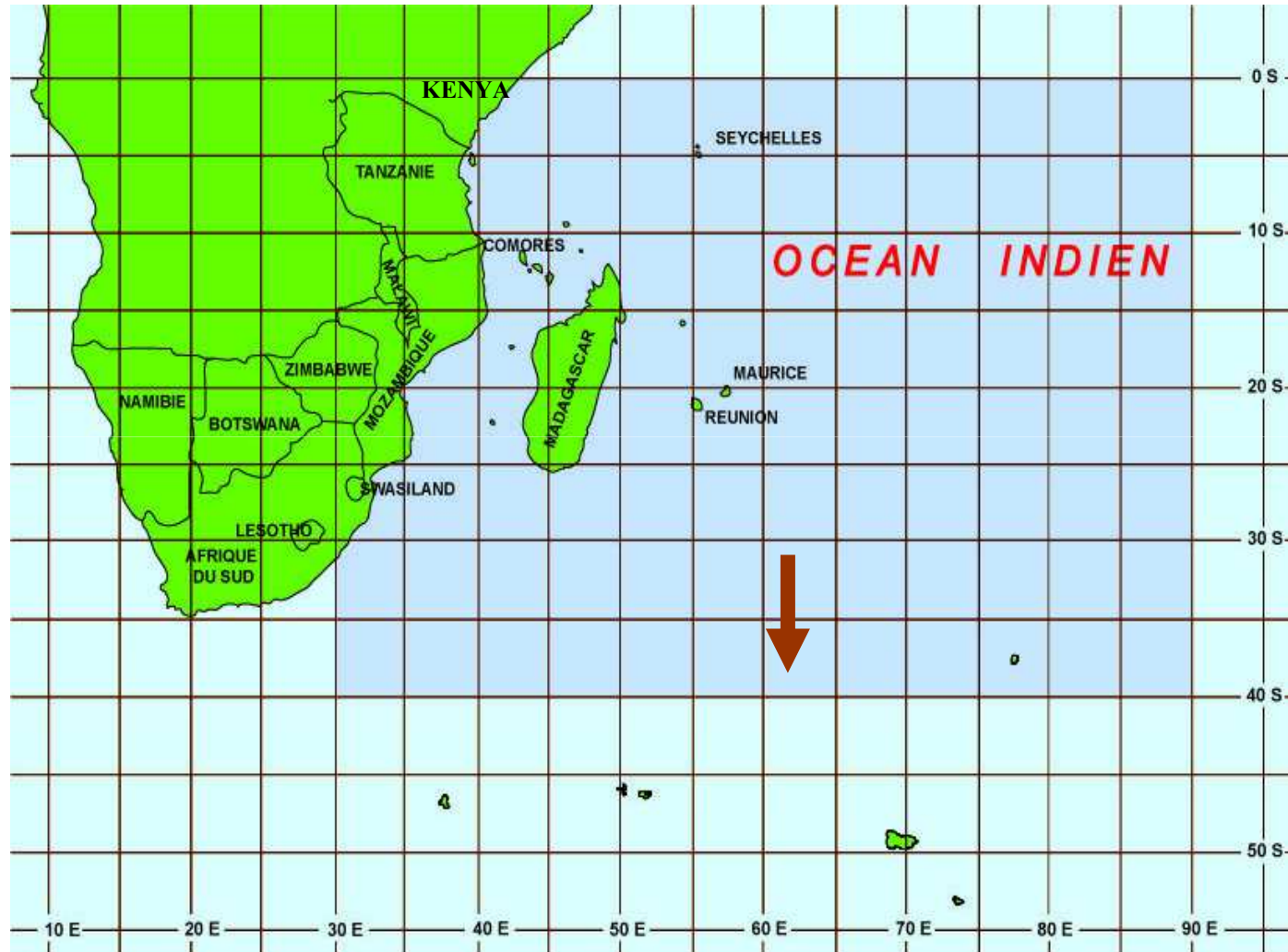


A specific organisation led by WMO : 6 RSMCs (Regional Specialized Meteorological Centres) and 6 TCWCs (Tropical Cyclone Warning Centres)

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Area of Responsibility extended southwards (30S →40S) since september 2003, to monitor singular warm core systems.



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Dvorak scale used in the South West Indian Ocean

Practices in the SWIO :

- *Dvorak scale used since 1982*
- *Wind-Pressure relationship: newly used of Courtney&Knaff (2009) – Atkinson & Holliday (1977) used before*
- *Criteria: average wind (10mn)*

Modifications in September 1999 :

- Conversion factor between 1 min and 10 min winds changes from 0,80 to **0,88**
- Gust factor changes from 1,5 to **1,41**.

Recommandations from Harper et.al (2010):

Conversion factor from 1min to 10 min is **0.93** (open sea)

Gust factor for a 3 sec gust associated with a 10 min average wind is **1.23** (open sea)



Naming in the South West Indian Ocean

TC names 2013/2014

Names	Provided by
AMARA	Tanzania
BEJISA	Swaziland
COLIN	Seychelles
DELIWE	Zimbabwe
EDILSON	Mozambique
FOBANE	Lesotho
GUI TO	France
HELLEN	South Africa
IVANOE	Mauritius
JIRANI	Comores
KATUNDU	Malawi
LET SO	Botswana
MIRANA	Madagascar
NASERIAN	Kenya
OPANG	Lesotho
PAYA	Comores
QUERIDA	Tanzania
ROMANE	France
SINGANO	Malawi
TARUS	Kenya
UNAMI	Botswana
VUMA	Mozambique
WAMIL	Mauritius
XOLILE	South Africa
YASMINE	Seychelles
ZAMILE	Swaziland

List changing on 1st july

List of names defined during the Tropical Cyclone Comitee (TCC, every 2 years), among the propositions of the 15 members

Naming criteria:

•10 min average winds reaching 34 kt over half of the clockwise circulation and near the centre .

Naming :

- Mauritius east of 55E**
- Madagascar west of 55E**



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Classification of tropical disturbances in the South West Indian Ocean basin

WIND FORCE

No clear circulation center

< 28 kt (< 51 km/h)

28-33 kt (51-63 km/h)

34-47kt (63-88 km/h) ←

48-63 kt (89-117 km/h)

64-89 kt (118-165 km/h)

90-115kt (166-212 km/h)

> 115 kt (> 212 km/h)

NAMING

STAGE

Disturbance area

Tropical disturbance

Tropical depression

→ ***Moderate tropical storm***

Severe tropical storm

Tropical cyclone

Intense tropical cyclone

Very intense tropical cyclone

The wind force is averaged over 10 mn.

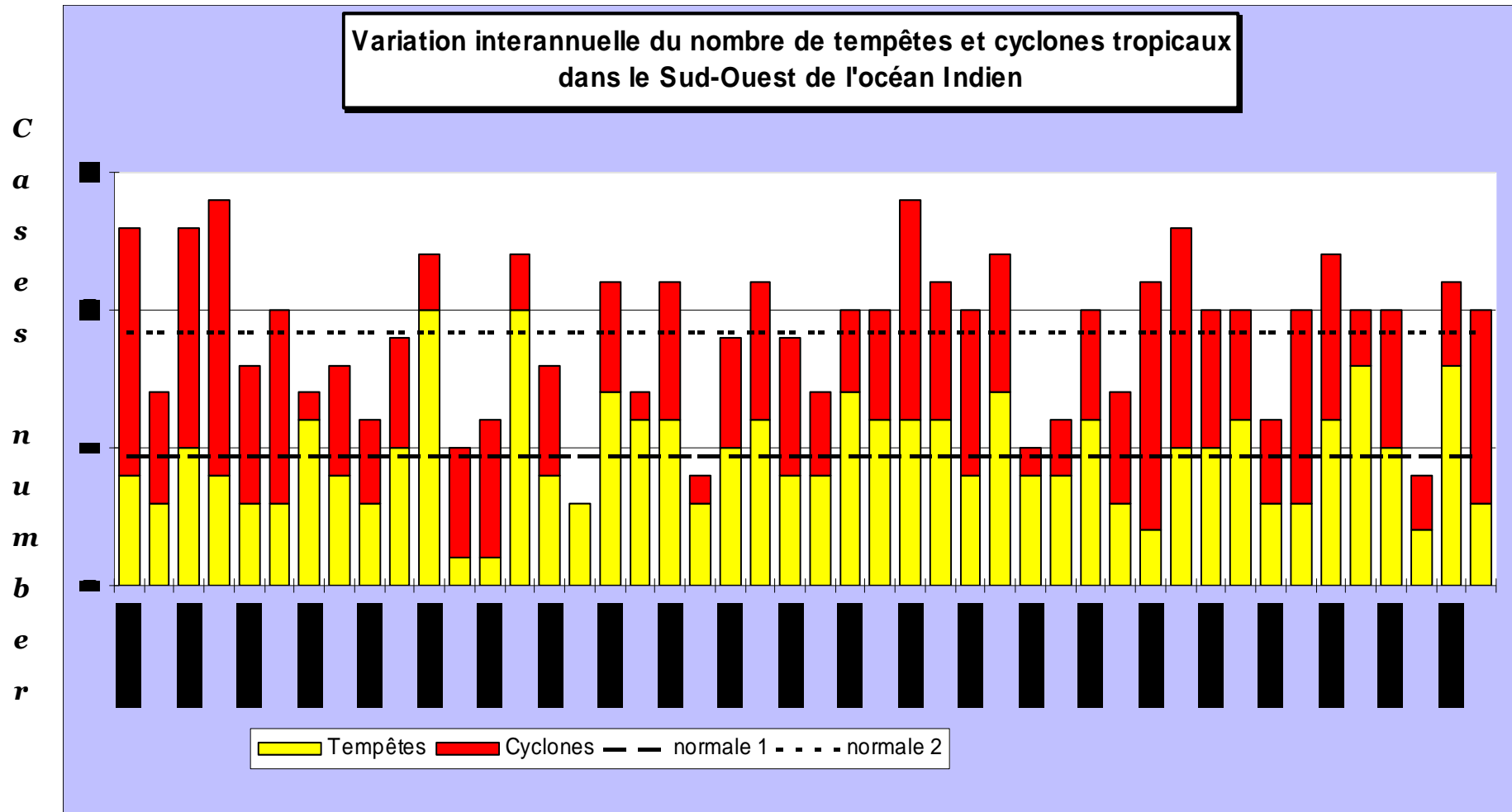


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Annual distribution of number of tropical storms and cyclones



Average values since 1967 : 9 named systems with 4-5 TC

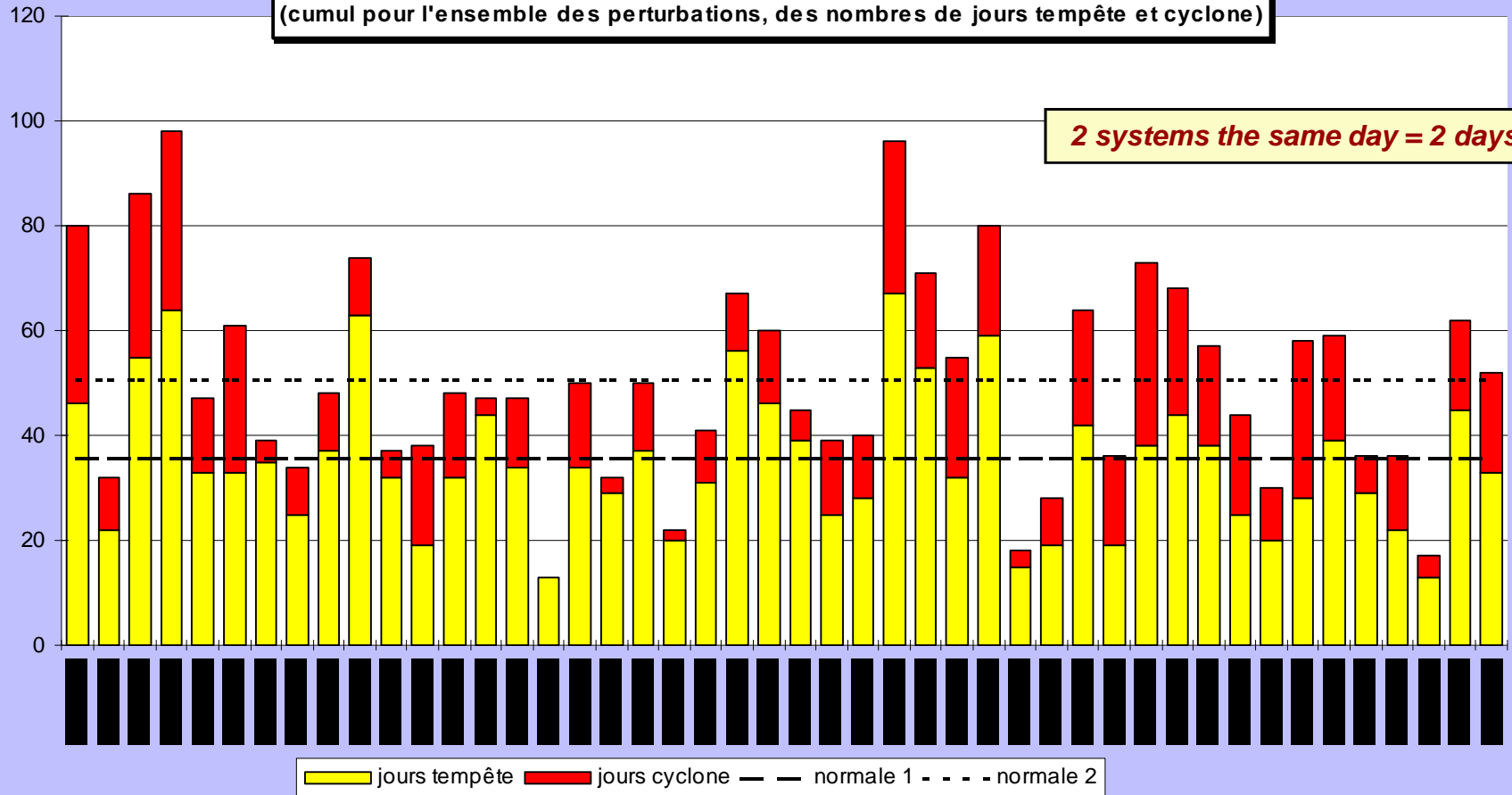
Annual variation in cyclone activity

Cyclone activity is defined as the total number of days on which disturbances were storm or cyclone.

D
a
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Variation interannuelle de l'activité cyclonique dans le Sud-Ouest de l'Océan Indien
(cumul pour l'ensemble des perturbations, des nombres de jours tempête et cyclone)

2 systems the same day = 2 days



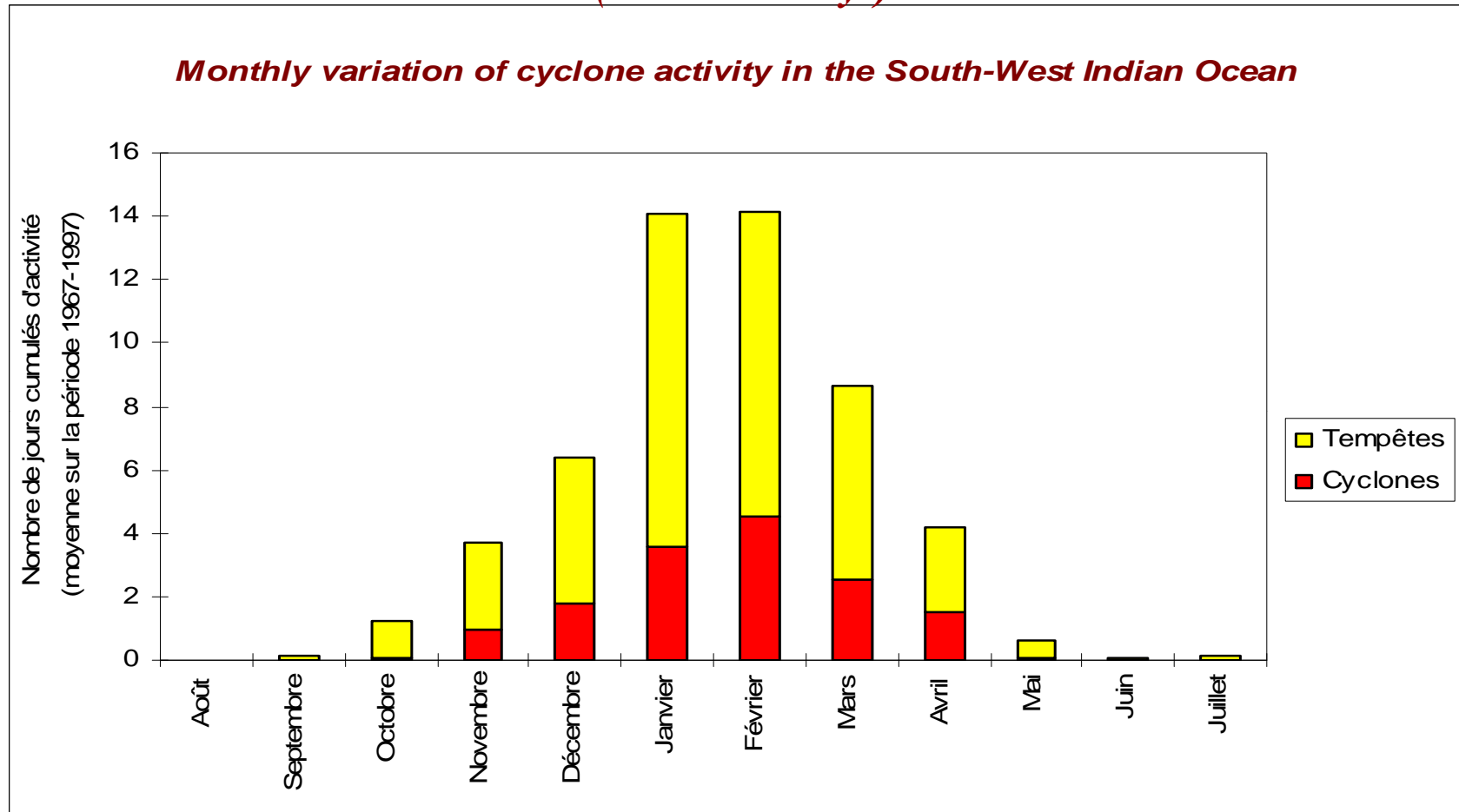
Average values since 1967 : 51 days for cumulated activity
36 TS days / 15 TC days

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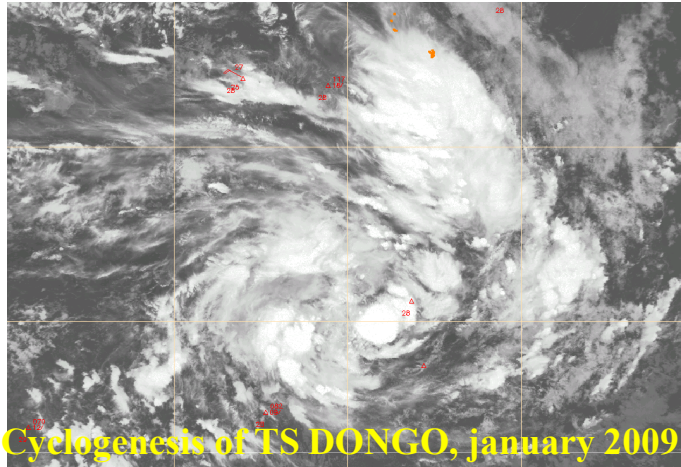
Monthly variation in cyclone activity

(cumulated days)

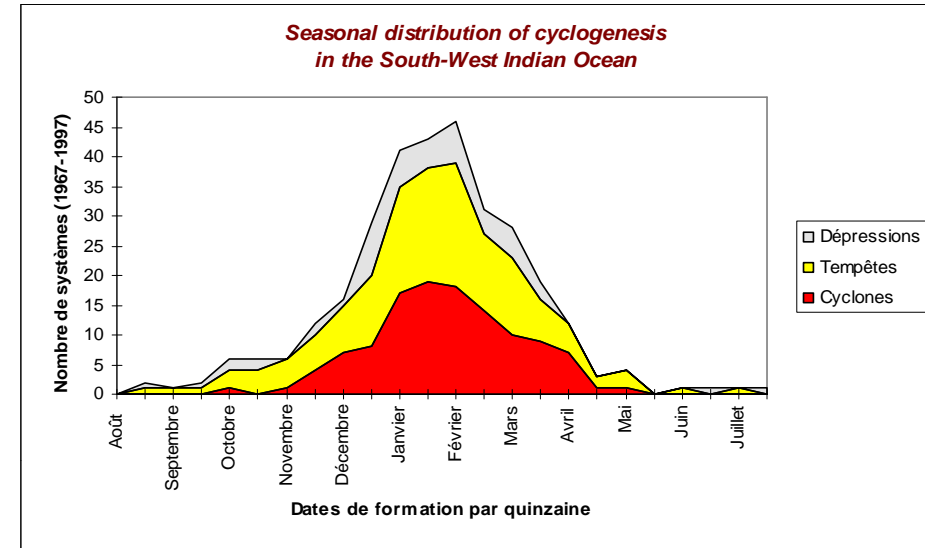


Each saison : 1 july to 30 june, since july 2002 (before :1 august to 31 july). 90% of tropical activity between the 15th of november and the 30th of april, period usually called « official cyclonic season »

Monthly variation of cyclogenesis



Operational definition of cyclogenesis:
When a system is classified as a Tropical Depression

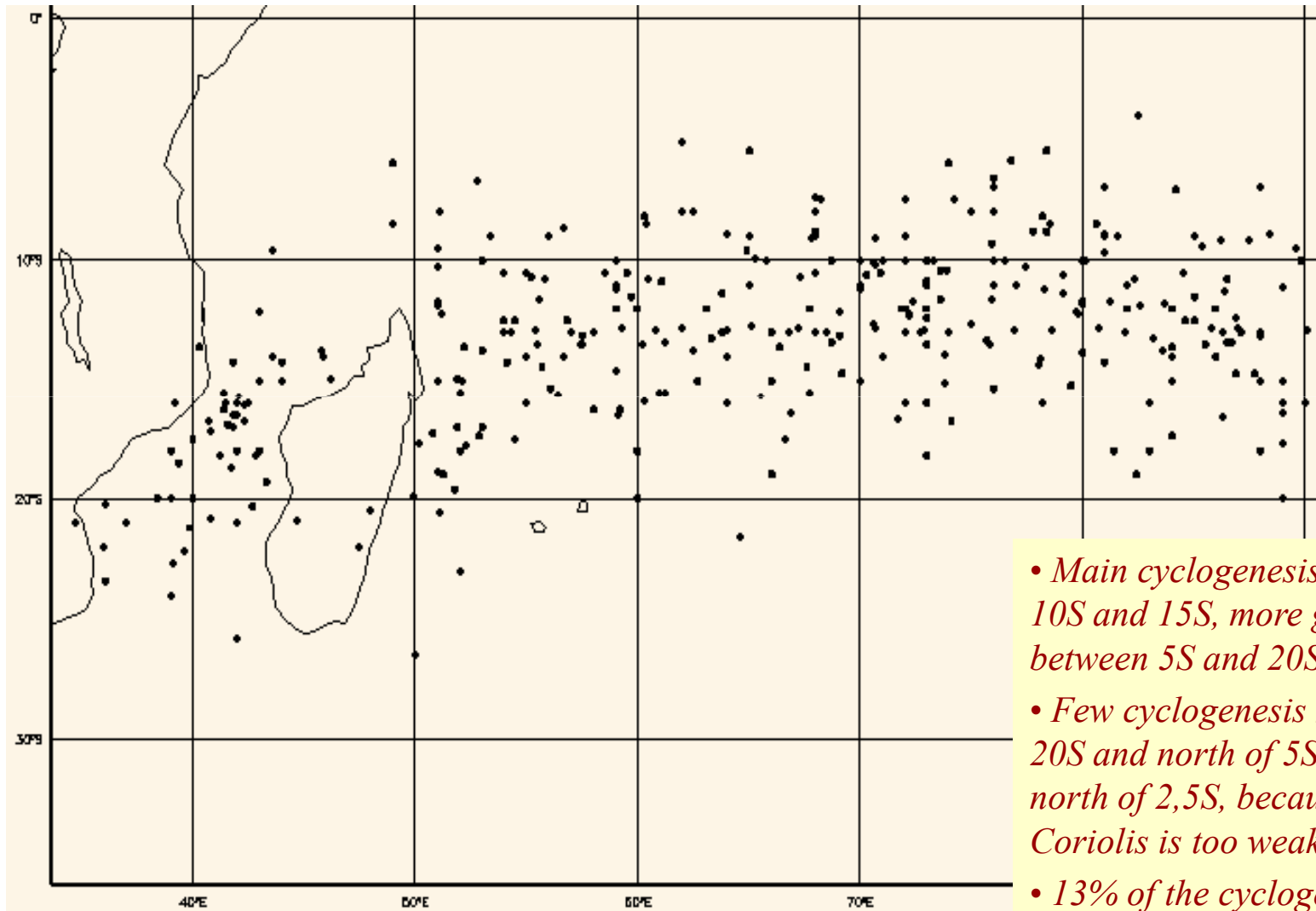


- Earliest TC in oct (Blanche, 7 oct 69), latest in may (Lila in 86, Konita in 93, Kesiny in 2002 and Manou in 2003)
- No TC from june to september
- Storm possible all over the year even during austral winter.
- Since 62, in may: 14 TS (4 TC), in june: Gritelle in 91, Kuena in 2012, in july: Odette in 71, in september: 4 TS (Alice, Aviona) and more recently TS 01-20022003 (landfall in Seychelles) and Abaimba in 2003.

First and last cyclogenesis over the basin

Over the 67-10 period	Date of season's start	Date of season's end
Most early	15 august 1996	16 january 1983
First quantille	End september-early october	End march
Mediane	15 november	18 april
Last quintille	10 december	11 may
Most lately	16 janvier 1987	25 july 1997

Cyclogenesis over the basin from 1966 to 2000

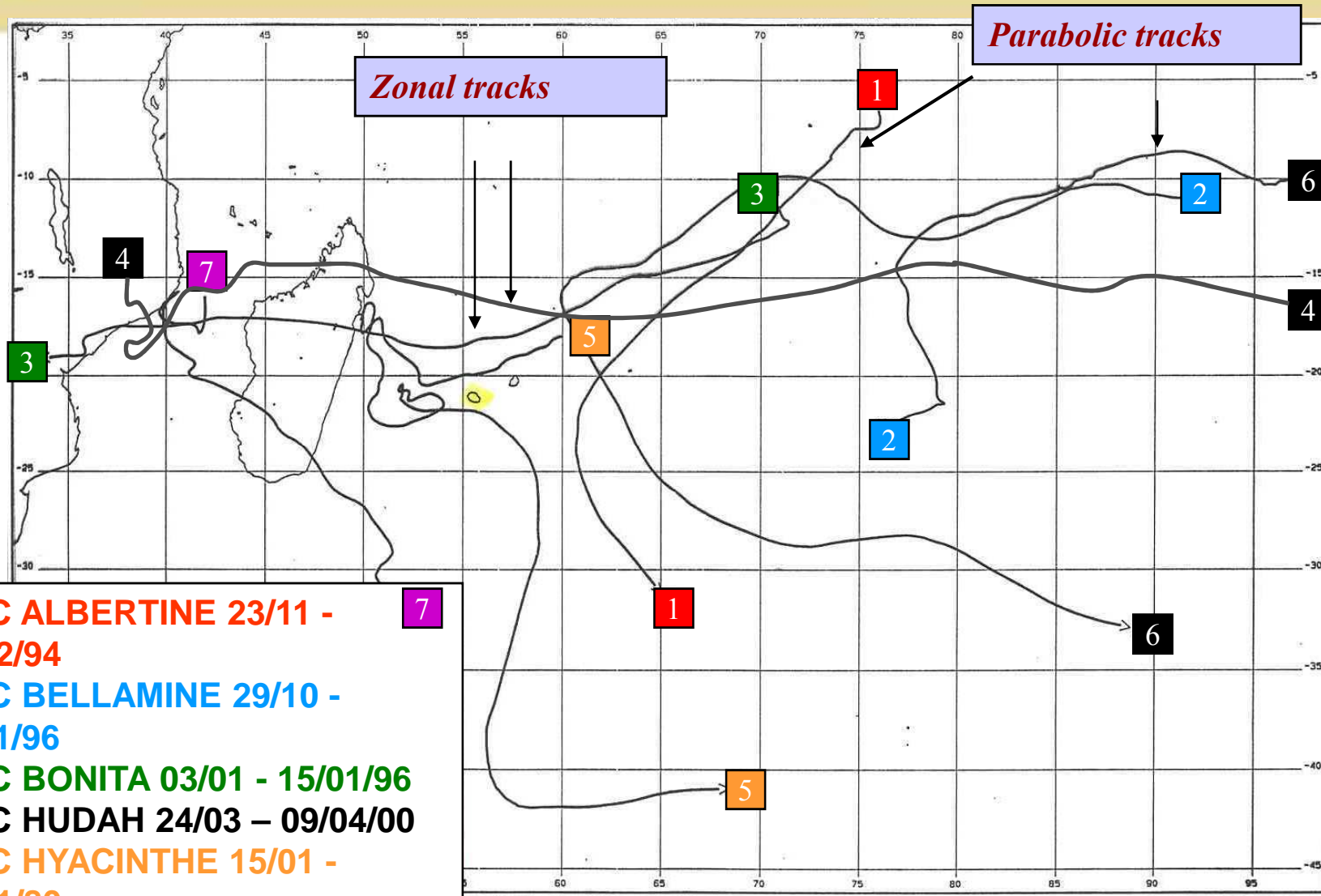


- *Main cyclogenesis between 10S and 15S, more generally between 5S and 20S.*
- *Few cyclogenesis south of 20S and north of 5S (never north of 2,5S, because Coriolis is too weak)*
- *13% of the cyclogenesis over the Mozambique Channel.*

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Some typical tracks

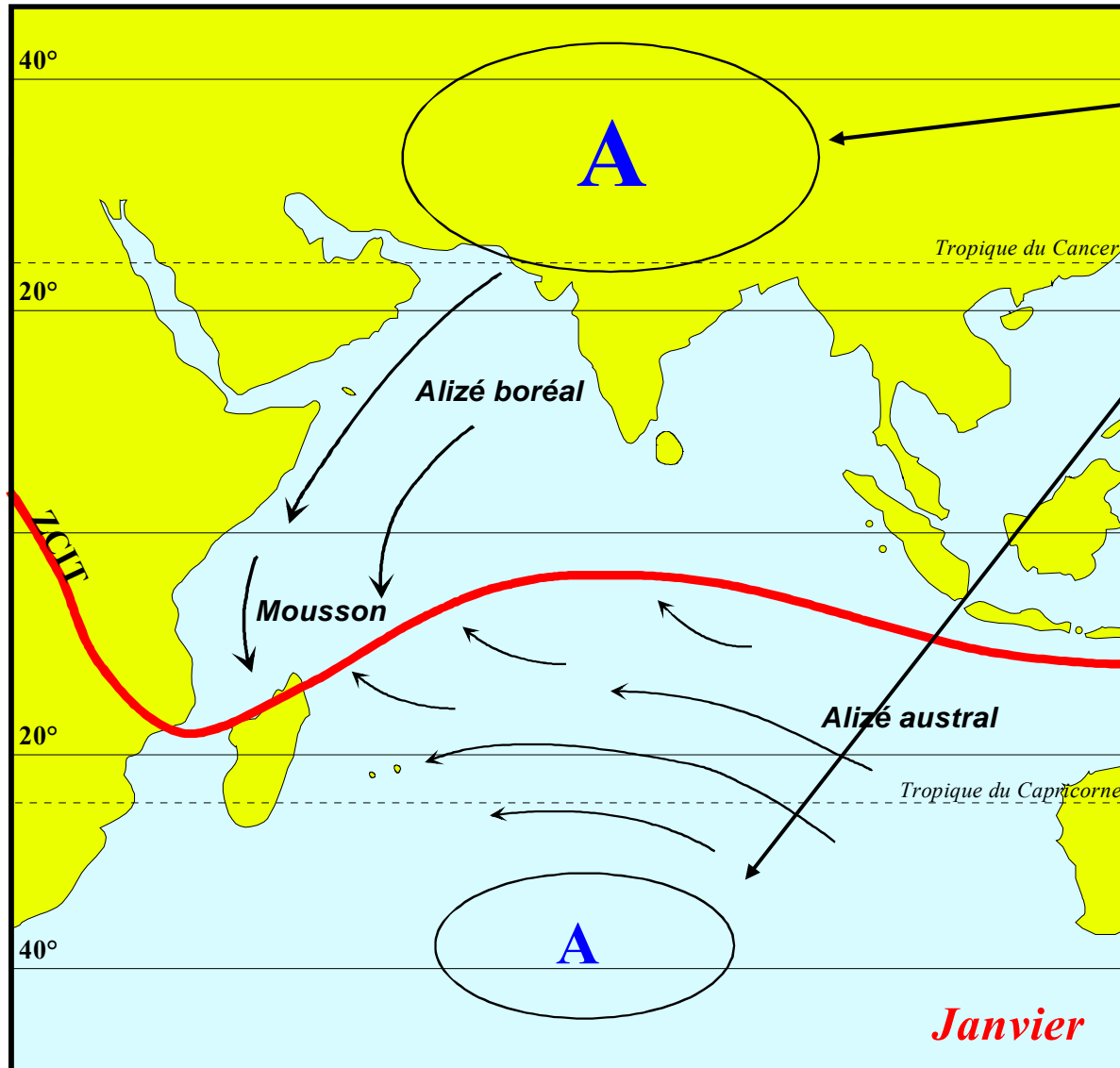


- 1. TC ALBERTINE 23/11 - 03/12/94
- 2. TC BELLAMINE 29/10 - 12/11/96
- 3. TC BONITA 03/01 - 15/01/96
- 4. TC HUDAH 24/03 - 09/04/00
- 5. TC HYACINTHE 15/01 - 31/01/80
- 6. TC ODILLE 29/03 - 17/04/94
- 7. TS DESSILIA 16/01 - 24/01/93

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Mean atmospheric circulation during the southern summer



Northern high

+

Subtropical high



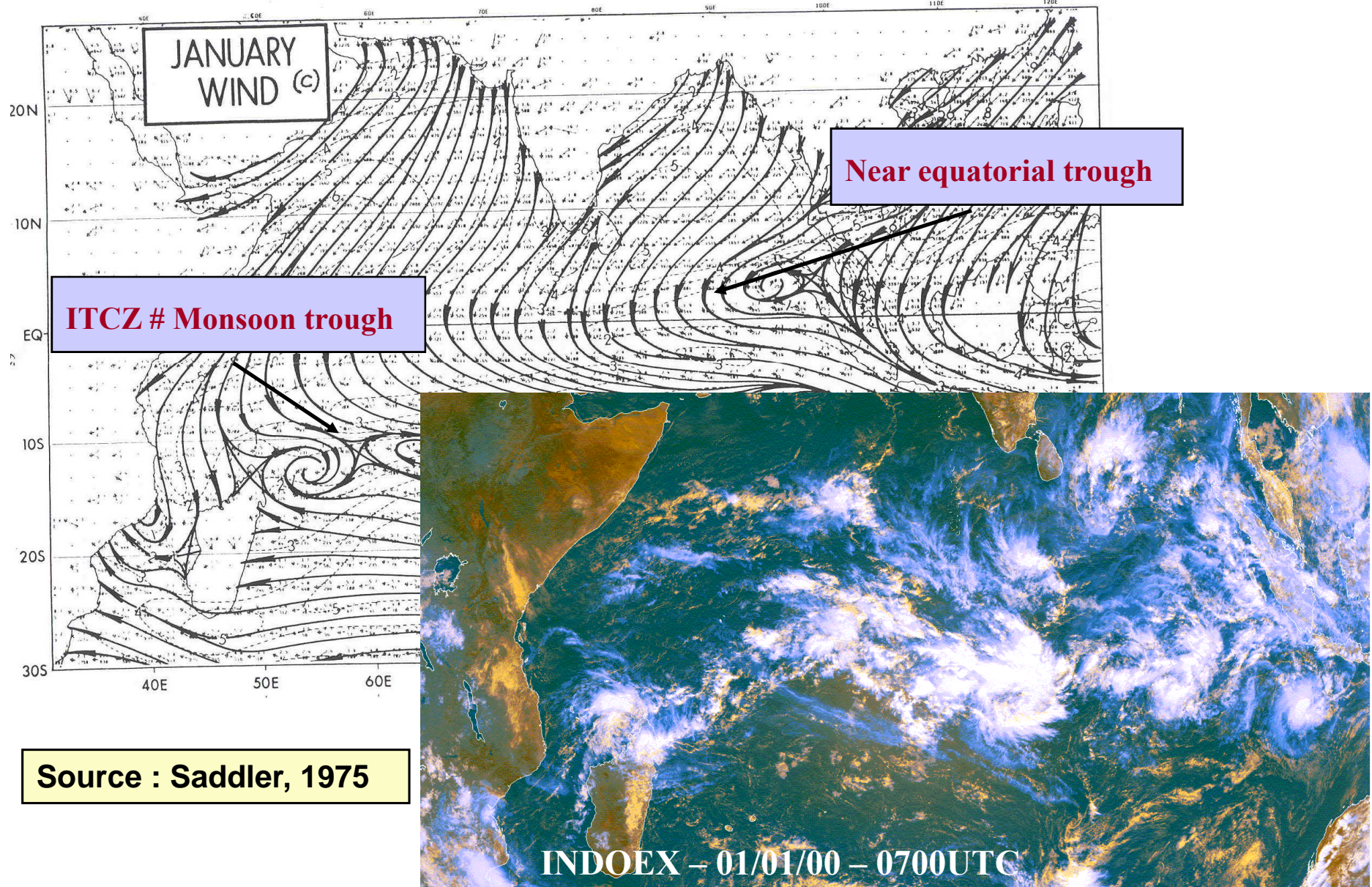
Convergence of the trade winds flow and the monsoon flow

ITCZ # The monsoon trough

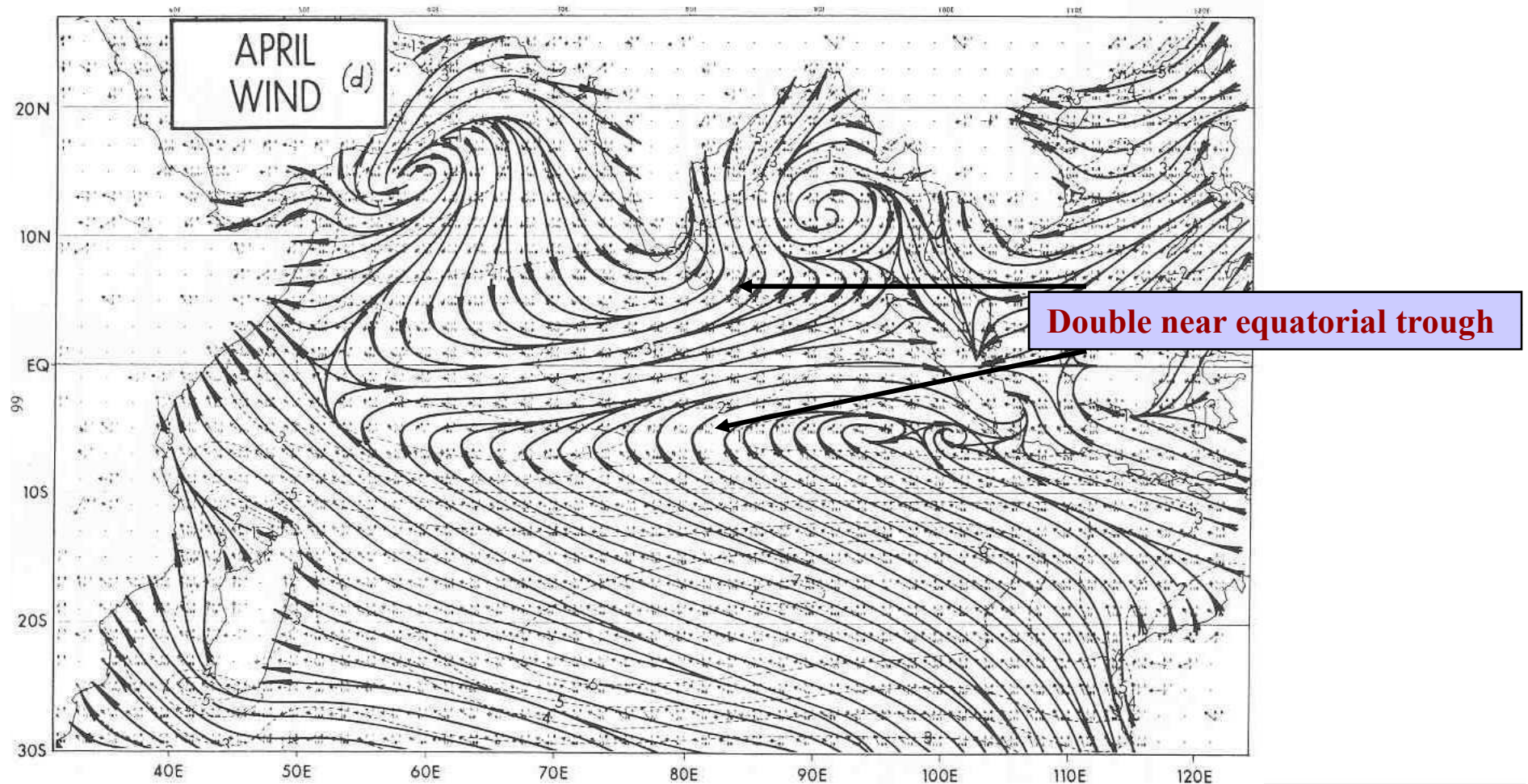


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Mean surface streamlines during southern summer

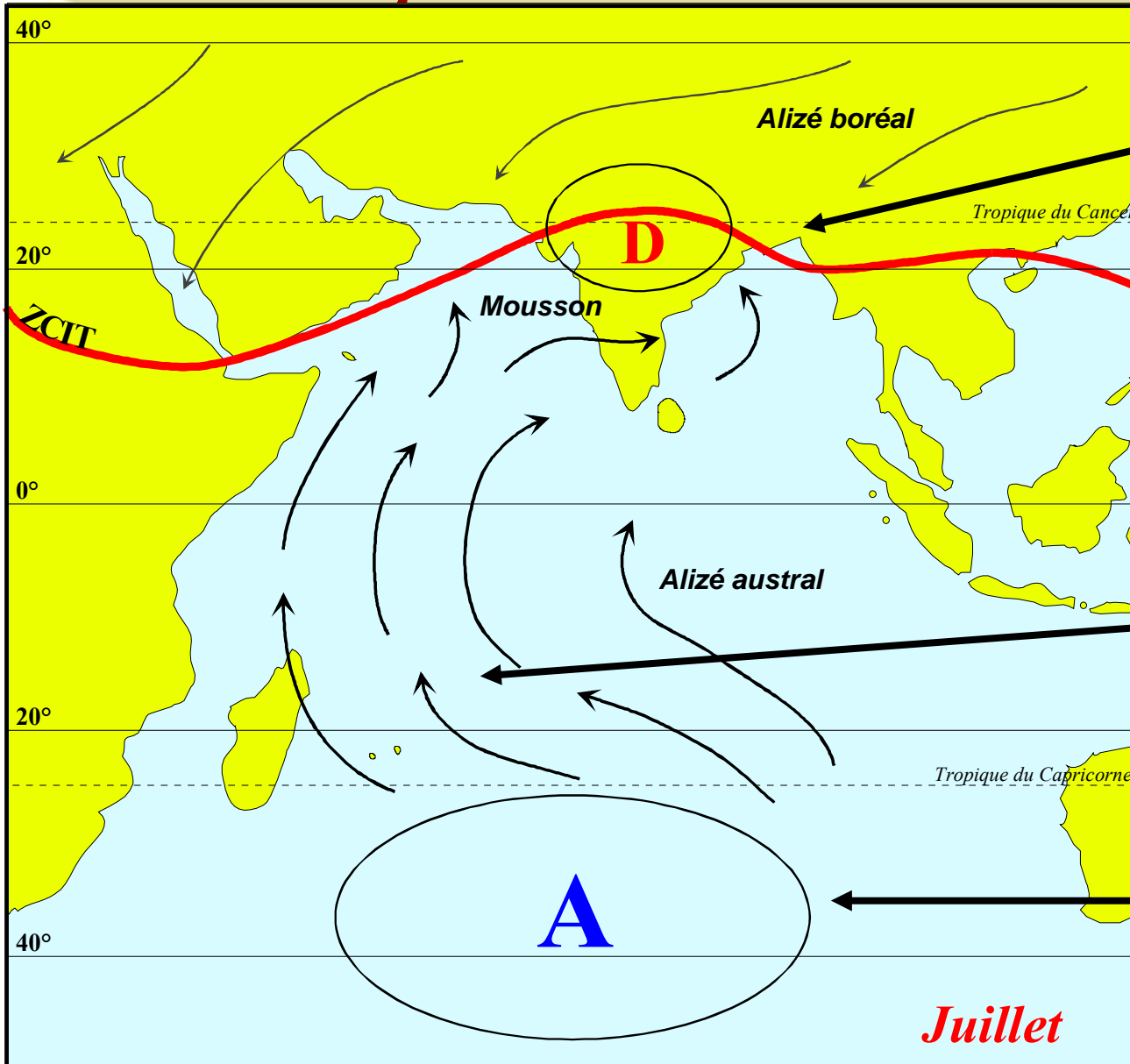


Mean surface streamlines during austral fall



Source : Saddler, 1975

Mean atmospheric circulation during southern winter

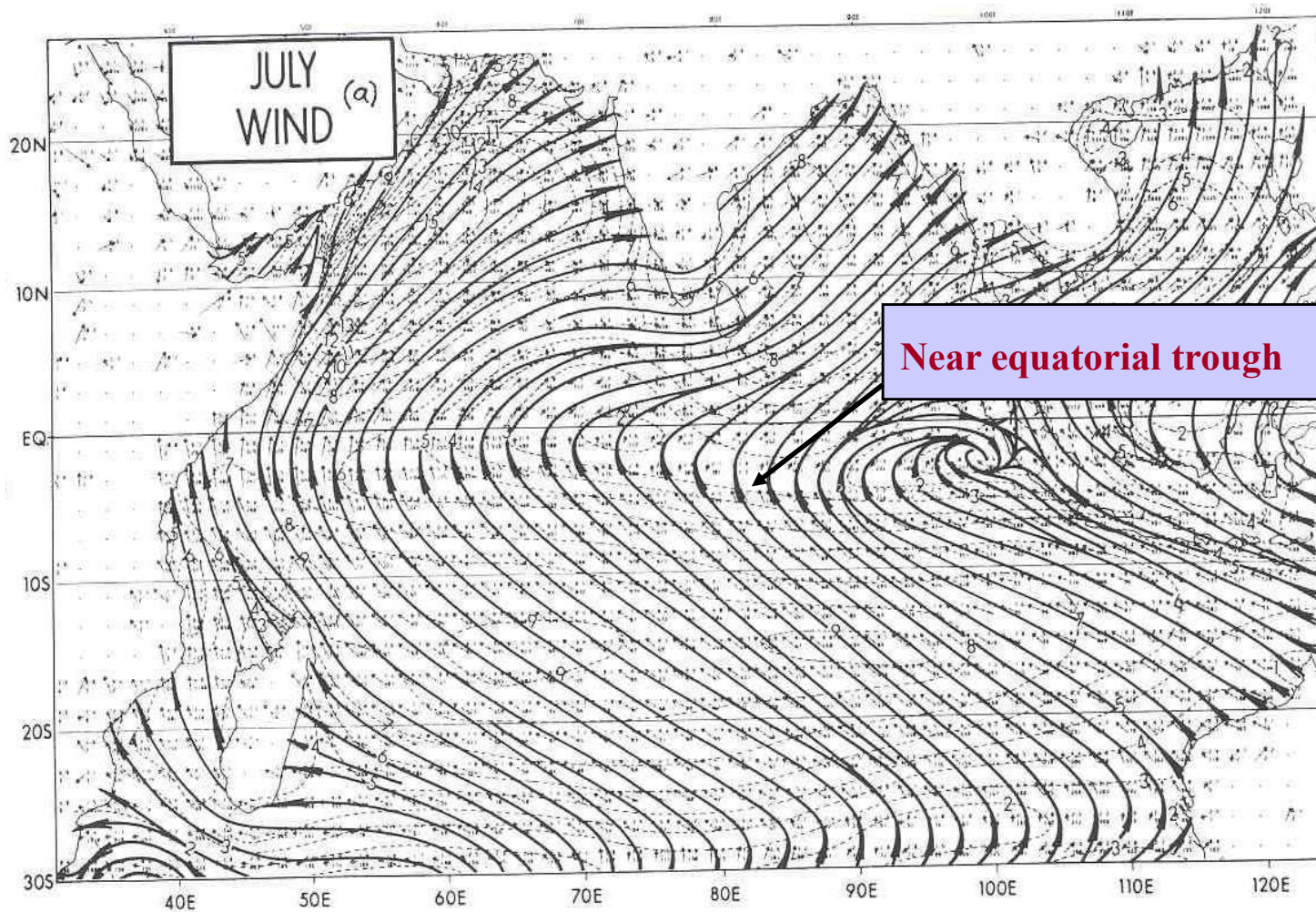


Heat low over India

Stronger trade winds flows

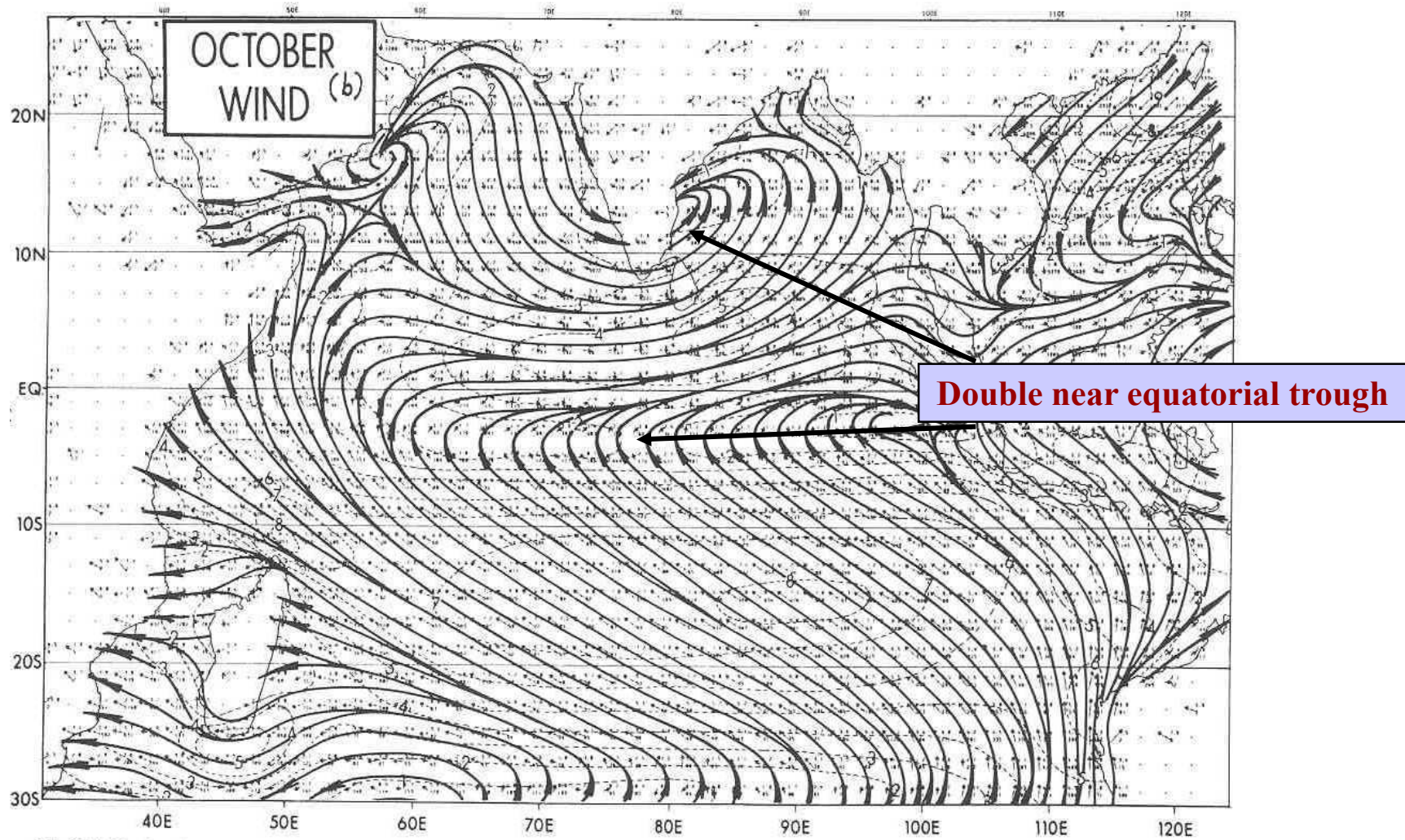
Stronger and more northwards high pressures

Mean surface stream lines during southern winter



Source : Saddler,
1975

Mean surface streamlines during austral spring



Source : Sadler, 1975

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Some remarkable values in the SW Indian Ocean

Minimum pressure recorded:

- **932 hPa** at Tromelin with *Lydie* in 1973
- **933 hPa** at Rodrigues with *Monique* in 1968

Max wind gusts recorded:

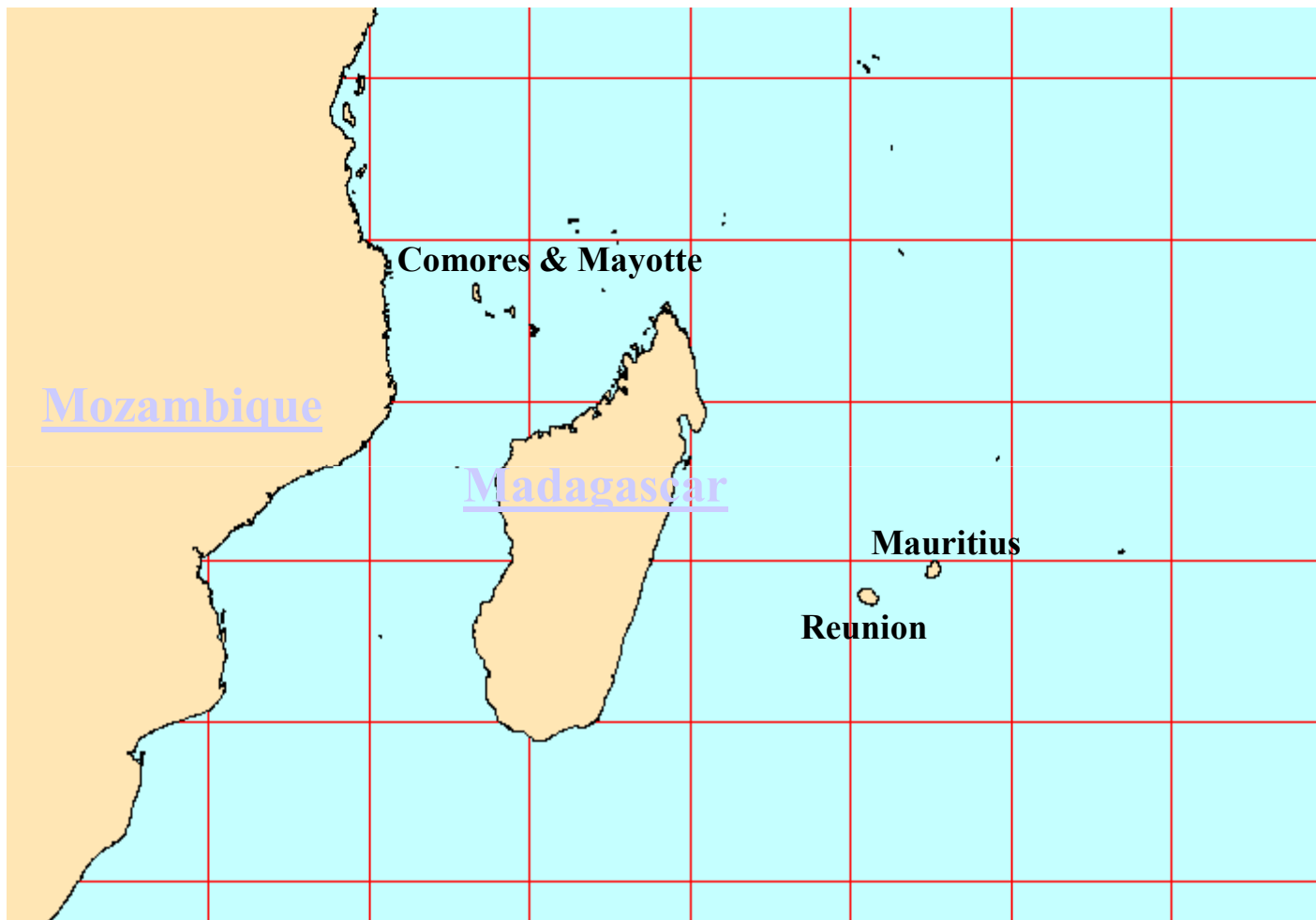
- **280 km/h** at Mauritius with *Gervaise* in 1975
- **278 km/h** at Rodrigues with *Monique* in 1968
- **277 km/h** at La Reunion with *Dina* in 2002 (mountainous area)
- **223 km/h** at La Reunion with *Jenny* in 1962

Maximum amount of rainfall recorded:

- **1825 mm in 24 h** at La Reunion with *Denise* in 1966 (world record)
- **4869 mm in 4 days** at La Reunion with *Gamede* in 2007 (world record)
- **6083 mm in 15 days** at La Reunion with *Hyacinthe* in 1980 (world record)

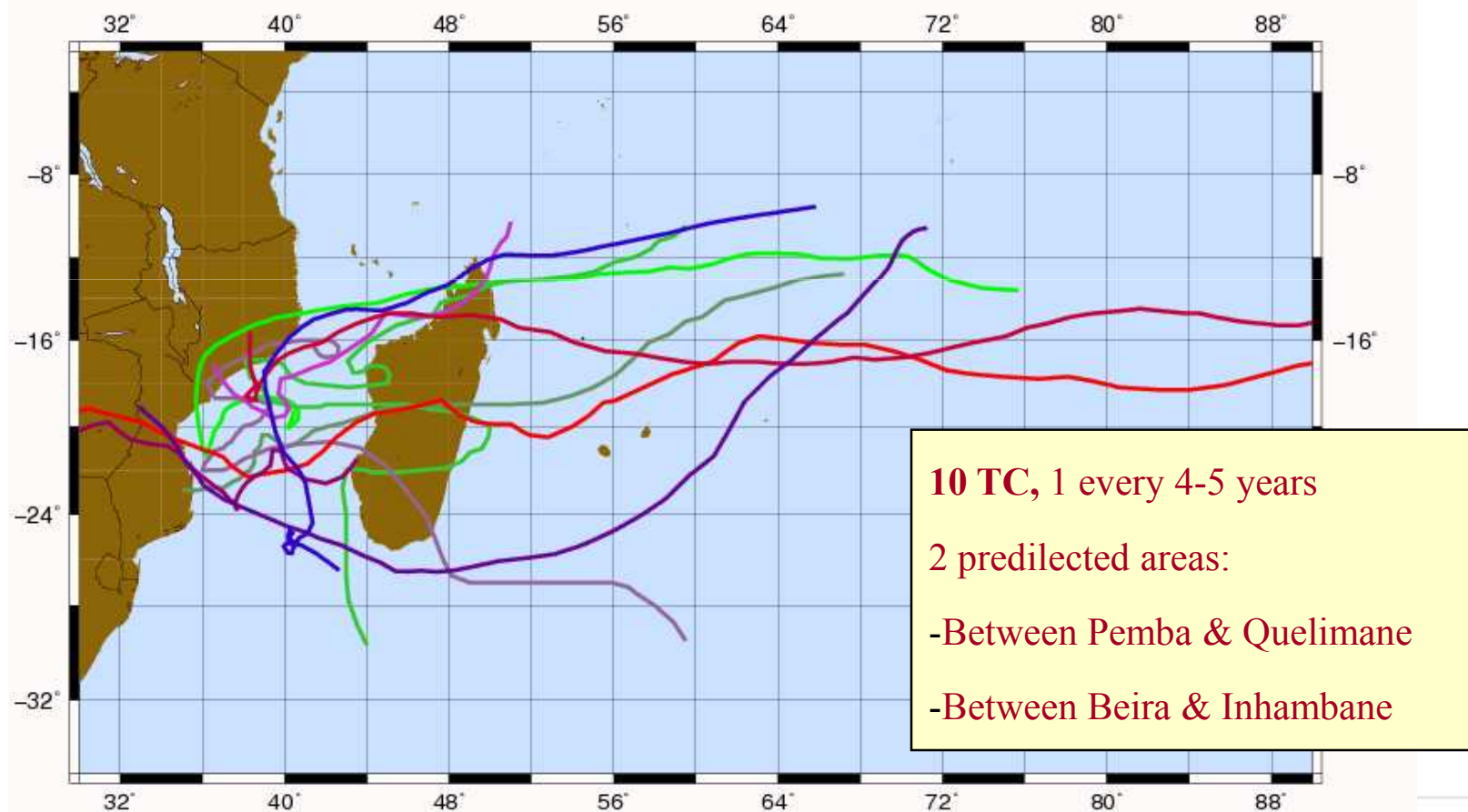


Some statistics about landfalling TC in SWIO



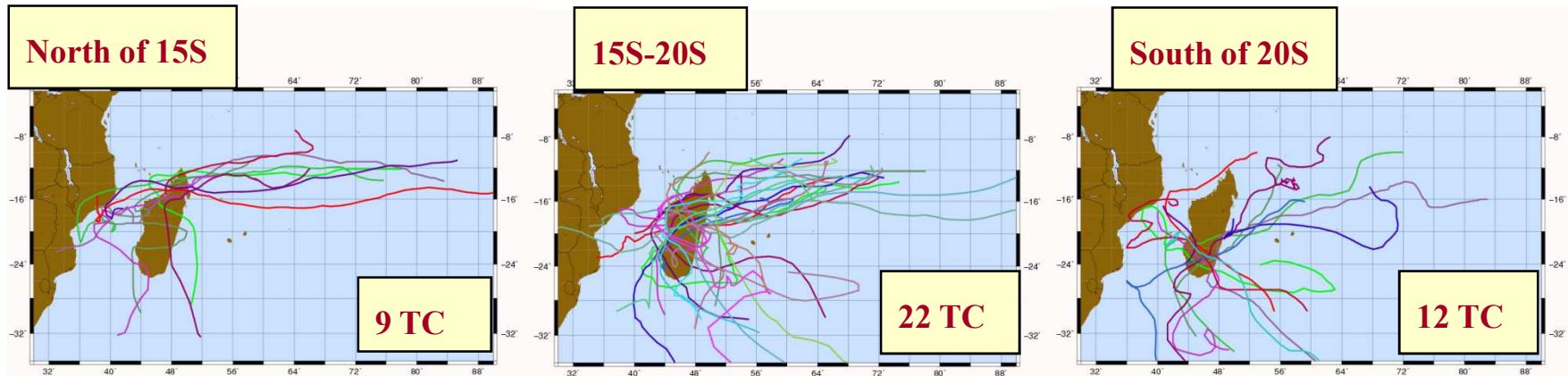
67/68 → 12/13 – 45 years

Mozambique TC landfalls

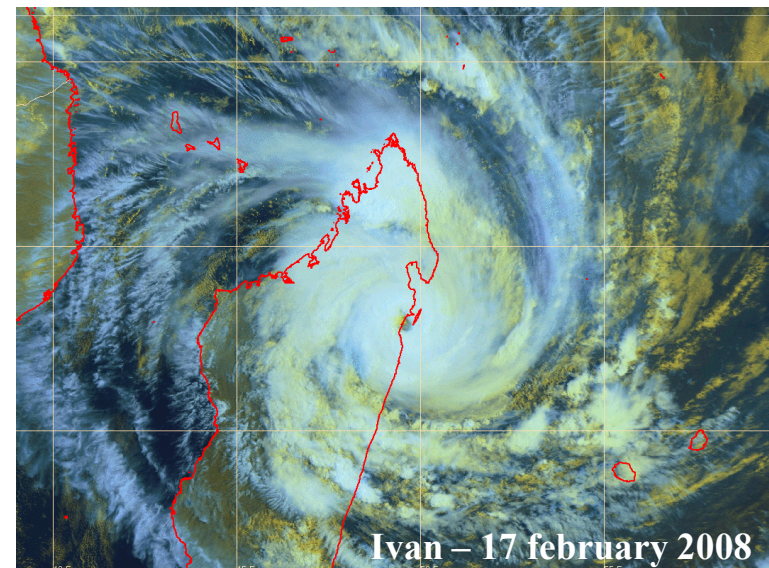


67/68 → 12/13 – 45 years

Madagascar TC landfalls

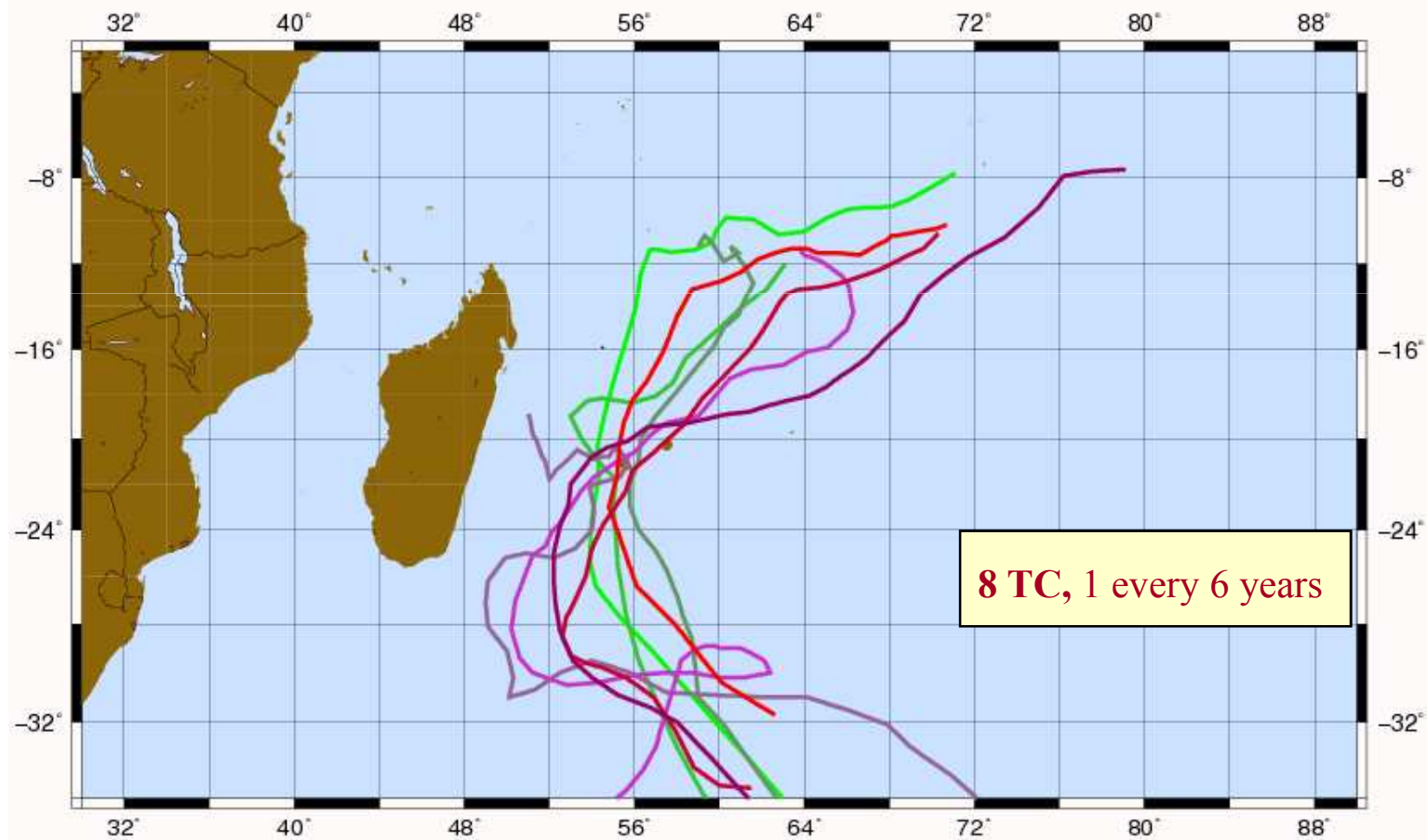


- 43 landfalls !! (nearly 1 every year ...)
- Mainly between 15S-20S
- 15% of landfalls along western coast



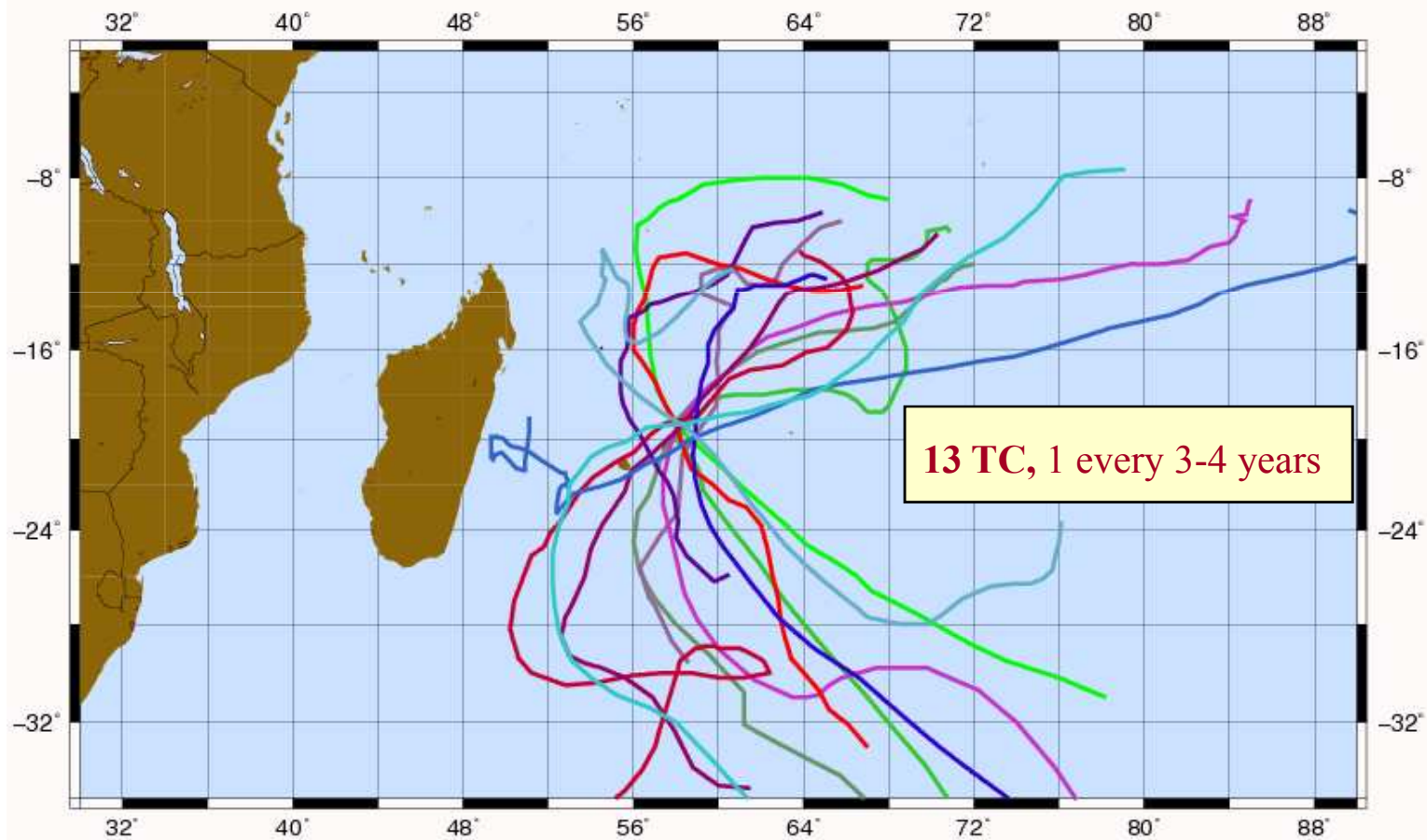
67/68 → 12/13 – 45 years

La Reunion TC less than 1°



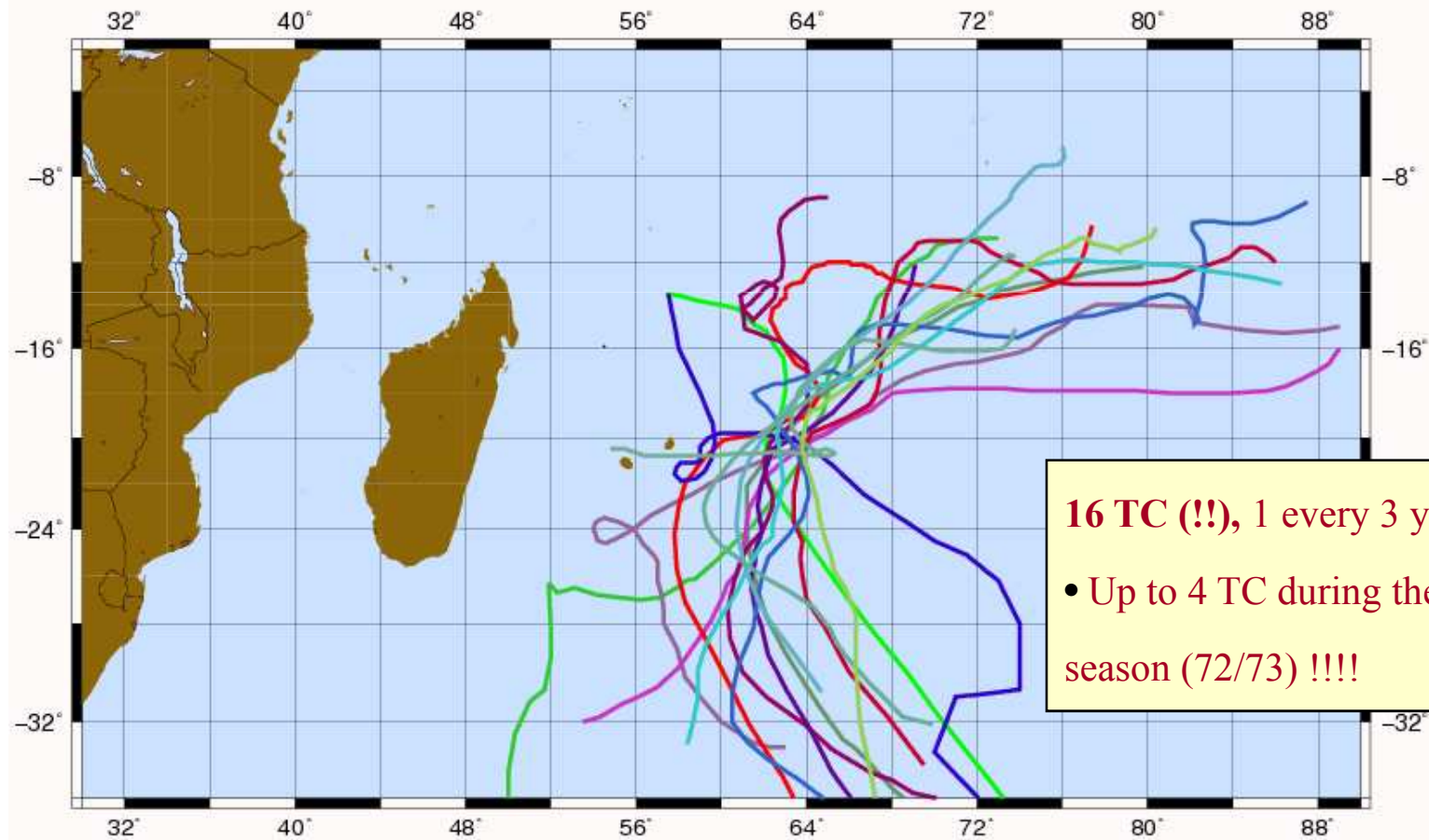
67/68 → 12/13 – 45 years

Mauritius TC less than 1°



67/68 → 12/13 – 45 years

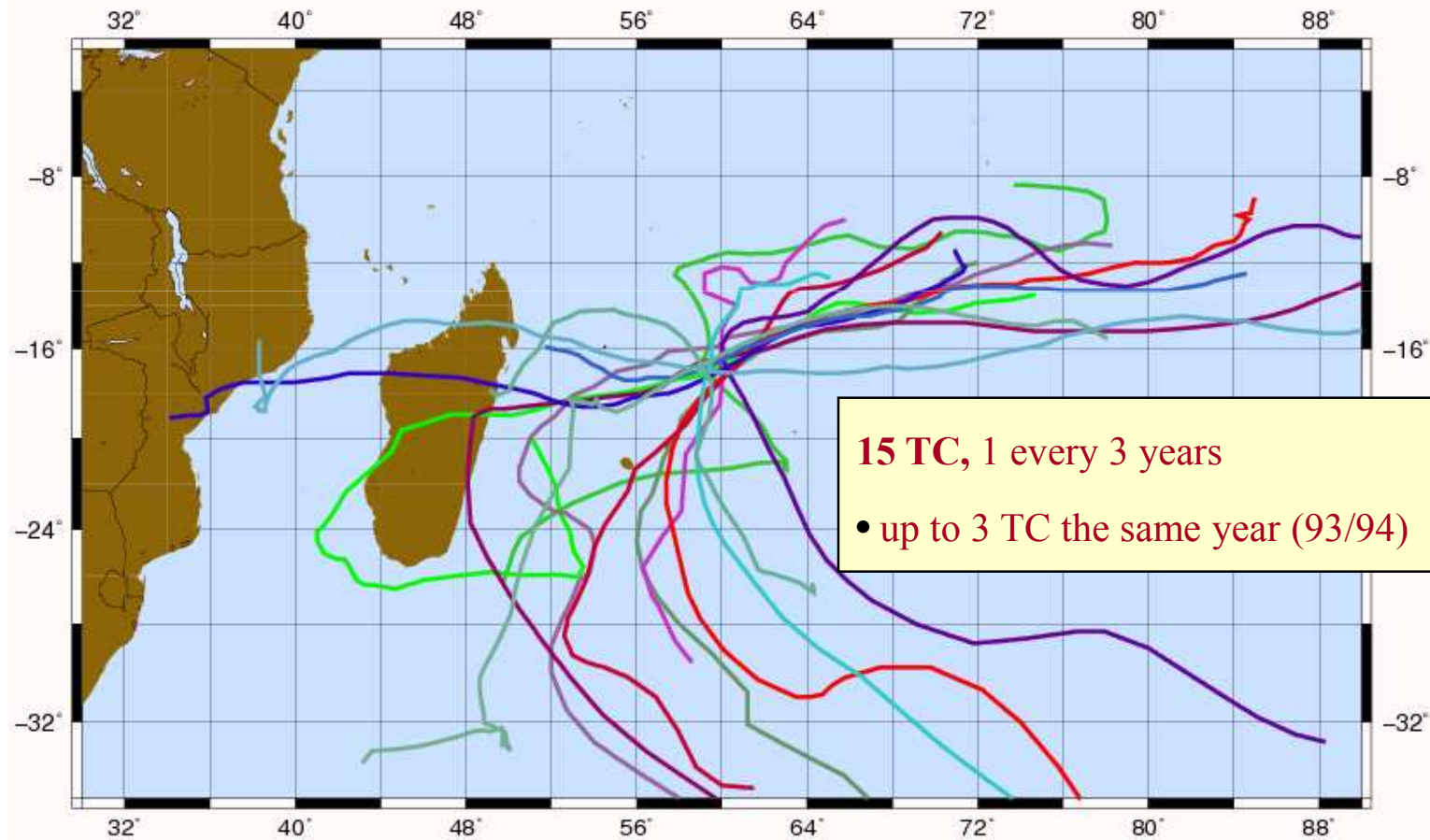
Rodrigues TC less than 1°



16 TC (!!), 1 every 3 years
• Up to 4 TC during the same season (72/73) !!!!

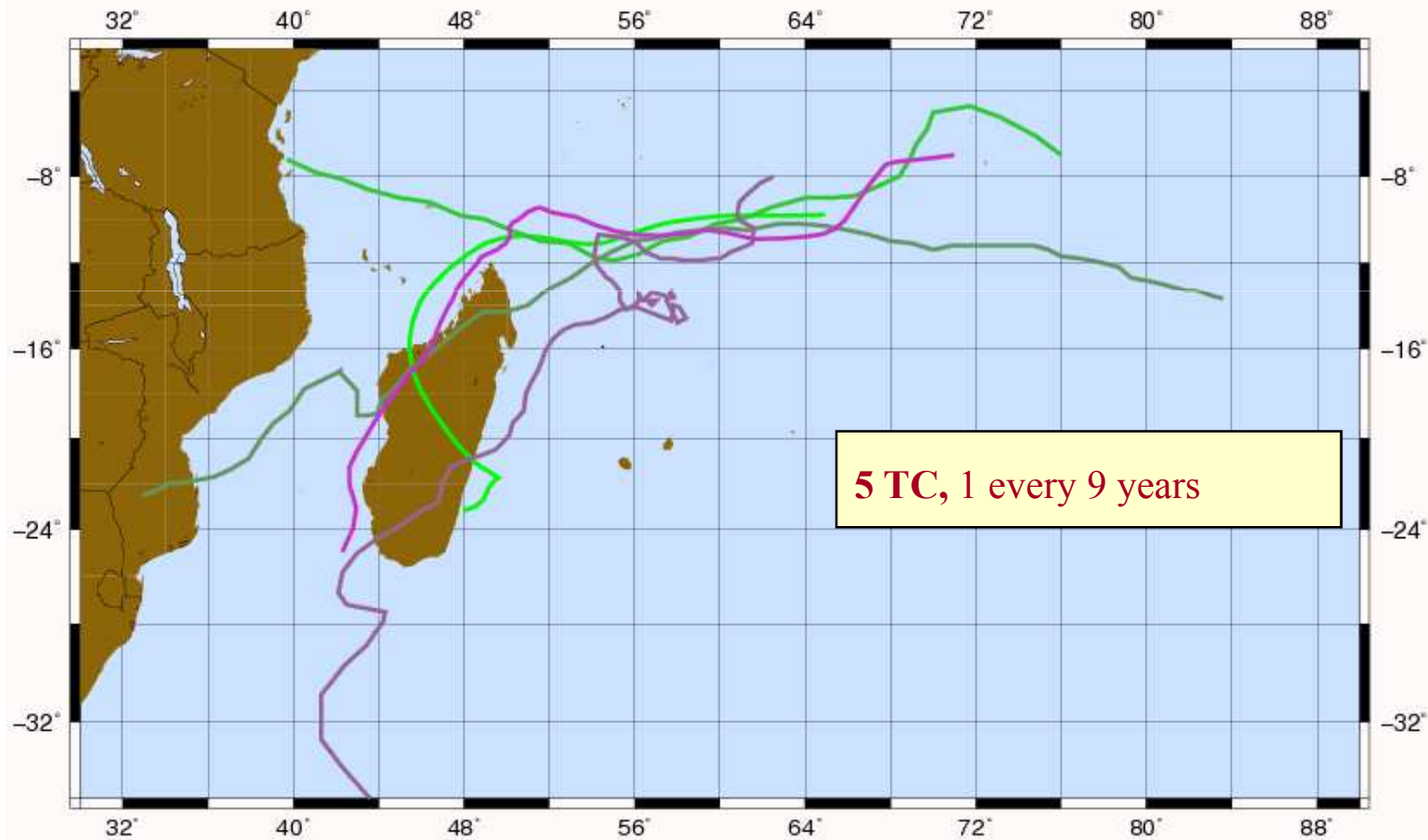
67/68 → 12/13 – 45 years

St-Brandon TC less than 1°



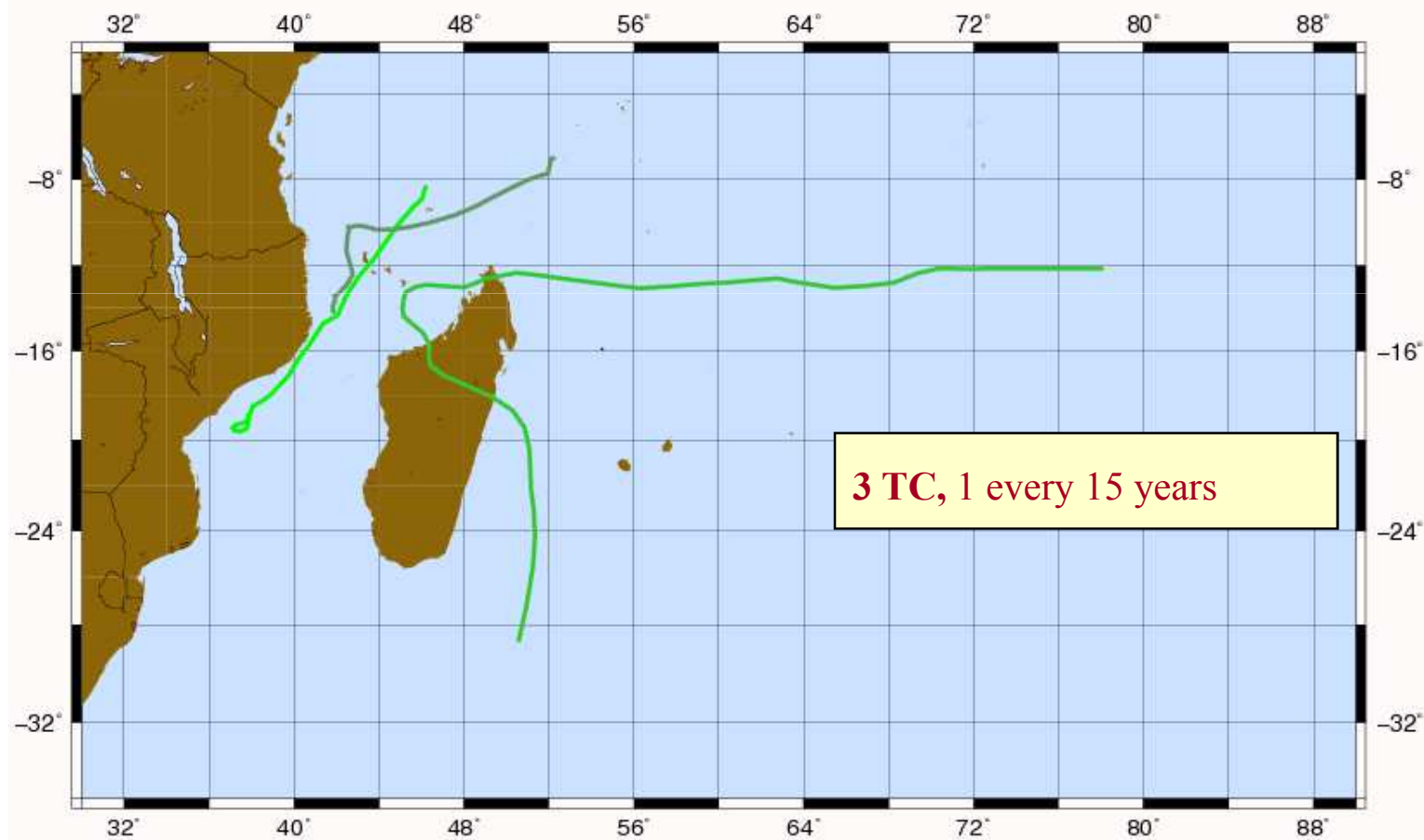
67/68 → 12/13 – 45 years

Agalega TC less than 1°



67/68 → 12/13 – 45 years

Comoros arch. & Mayotte TC less than 1°



67/68 → 12/13 – 45 years