

ARGOS FORUM

70

06/2010

ARGOS GUINNESS BOOK



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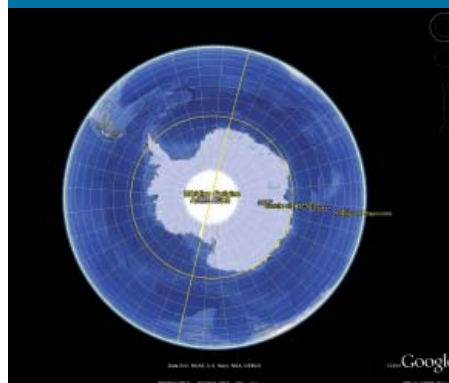
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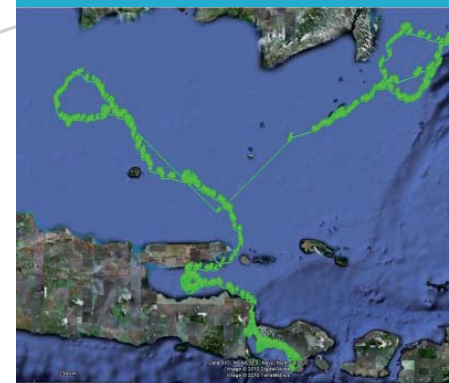
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CEO of CLS, global operator of the Argos system
President and CEO of CLS America



The ability to observe our planet from space has revolutionized our capacity to understand and protect our environment. At the heart of the system are the scientists who watch over planet Earth. These scientists observe the Earth from space through the use of Argos beacons.

This 70th issue of the ARGOS Forum is an appropriate opportunity not only to celebrate the achievements of the Argos satellite system but also to review the records discovered and measured by scientists.

By using ARGOS every day, the scientific community is able to provide us with incredible information about life on Earth. By closely examining its oceans, its inhabitants and its biodiversity, science unlocks the planet's mysteries and tells us when things are going wrong.

The mission for scientists is to study the climate and the ocean and help protect wildlife. Little by little, the countless data collected by Argos have changed the way we look at our world. Without this system and the scientists who use it, what would we know about the great migrations, species living in extreme conditions or the ocean itself?

In the two previous issues, we celebrated 30 years of the system and especially 30 years of discoveries. Today, more than 21,000 Argos beacons (drifting buoys, subsurface floats, fixed stations and beacons attached to animals) are used by the main scientific programs for oceanography and environmental protection.

This issue of the magazine is for anyone fascinated by records and discoveries.

Our thanks to all those dedicated enthusiasts in every part of the system whose observations help protect the planet and its biodiversity. ■



Max, the bird tracked for the longest period

By **ADRIAN AEBISCHER**,
Ornithologist, Fribourg Natural History Museum



The science teams from the Fribourg Natural History Museum have been monitoring Max the stork for 11 years thanks to the ARGOS system. What have we learned over this record period? What mysteries about the species have been resolved?

Storks are migratory wading birds that travel thousands of miles. Scientists at the Fribourg Natural History Museum wishing to learn more about this fascinating species fitted Max, a female White Stork, with an ARGOS beacon on 5 July 1999. This splendid specimen was nicknamed Max in homage to Max Bloesch (1908-1997) who, from 1948 onwards, reintroduced young storks from Alsace and Algeria to Altreu, in Switzerland.

THE STORY OF A MIGRATION

From her birthplace in Switzerland, Max's every wing-beat was tracked by satellite thanks to the ARGOS beacon. In August 1999, she started her first migration. She was barely two months old but already had the wings of an athlete and crossed the Strait of Gibraltar to take up her winter quarters in Morocco. She spent eight months there and, in the spring of 2000, returned to Europe. She left every August and returned every April, following the same pattern until 2006.



CHANGE OF DIRECTION

Thanks to ARGOS the scientists discovered that in her first year, after wintering in Morocco, Max did not in fact return to Switzerland but spent the summer in the centre of Spain, until August. They noticed that from year to year Max spent less and less time in Morocco: she left Europe later and later and returned earlier and earlier. In 2007, there was a major change: Max didn't even bother to cross the Strait of Gibraltar and winter in Africa. She remained in Andalusia.

In 2008 and 2009, our stork did not even fly as far as the south of Spain, settling in the centre of the country for the winter. Like millions of migrating birds, Max has become increasingly experienced and is changing her migratory behavior with age.

A FASHIONABLE ACCESSORY

The beacon worn by Max is an ARGOS beacon powered by a solar panel. Like all the beacons carried by animals, it does not exceed 3% of the animal's weight. This satellite monitoring operation revealed that Max has already had 23 offspring since 2002, her first year of reproduction.



RATHER INDISCREET MONITORING

The beacon has also allowed scientists to uncover some of the stork's most intimate secrets. After spending the winter of 2009 in the sunny south of Spain, Max returned on 21 February to her nest in Tüfingen (near Lake Constance in Germany) to find it already occupied by a male stork. They found it difficult to get on at first and there were a few quarrels, but things soon calmed down. Surprisingly, Max then mated with a male that was not the one with whom she had produced all her offspring since 2005. But on the Sunday, her regular mate returned and drove off the interloper. In Max's defence, such a thing could only happen because male storks generally return before the females, as they have to defend their nests. But Max's mate is well known for always arriving late!

COMMUNITY

On the subject of stork-monitoring, and as an example of extraordinary behavior, the ARGOS satellite observation system also tracked a stork that flew from the South of France to lay her eggs in Sardinia. By using ARGOS to follow the female and her chicks, scientists noticed that the young storks followed exactly the same route, returning to the very nest where they were hatched!



Sparkey, the largest land mammal tracked by ARGOS

By **W. B. KARESH**,
Director of the Global Health program of the American Wildlife Conservation Society



The elephant is the largest land mammal and is an endangered species. To better protect them, scientists monitor elephants with the Argos system to learn more about the impact of illegal hunting and changes to the animal's ecology.

Poaching is a serious threat to elephants, which play a key role in the ecology of the habitats wherever they live. In the last hundred years, the number of African elephants has dropped from 10 million individuals in 1900, to 2 million in 1970 and less than 400,000 in the 1990s. A better understanding of the elephant's ecology is essential for defining a conservation strategy.

NOT AN EASY JOB

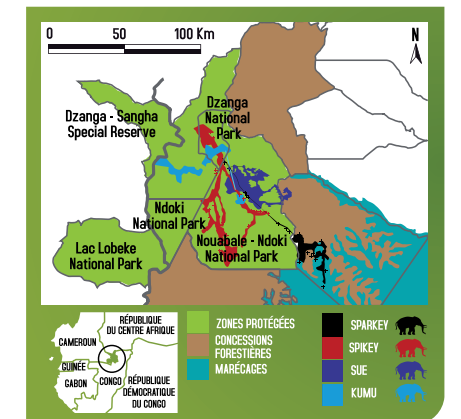
This elephant fitted with an ARGOS Beacon is a young adult male about 25 years old. He weighs several tons and is a fine specimen. He was captured by WCS veterinarians. The anaesthetic given by drug dart needed 11 minutes to take effect. Fitting the collar took another 47 minutes. Two minutes after the reversal drug was injected, the elephant recovered all his faculties, got up and walk away.



OVERLAYING DATASETS

The ARGOS data allowed the scientists to match the elephant's positions with different types of vegetation. ARGOS showed park managers that this elephant spends half of his time in the forest. By plotting the movements of this young elephant they clearly saw that it:

- mostly stays in a relatively limited area ($\pm 73 \text{ km}^2$).
- also visits marshy areas during the dry season.



Furthermore, the data confirmed the on-ground observations showing that elephants occupy the Savannah and clearings at night and forested areas in the daytime. This behavior is probably related to years of persecution by poachers. As an example it is worth remembering that in 2008, sales of ivory hit an exceptional level. Although this trade is legal, being approved by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and supported by the United Nations, it nonetheless involved 102 tons of ivory taken from stocks in South Africa, Botswana, Namibia and Zimbabwe. It was worth more than €12 million. Illegal hunting far exceeds this sanctioned hunting. So the species is still severely threatened. Although these scientific studies, made possible by the ARGOS system, provided some fascinating information, on this occasion ARGOS monitoring raised more questions than it answered.

UNANSWERED QUESTIONS

Why did this young male not cross the Lekoli and Mambili Rivers? Does pressure from poaching south of the park's borders explain the southern limit of his living space? Many unanswered questions remain that scientists are trying to resolve using ARGOS data.



© Naoto Honda

The giant jellyfish is an amazing creature which is unfortunately harmful to coastal fisheries. In the search for solutions for peaceful coexistence between fishermen and the jellyfish, Naoto Honda has been conducting a scientific study of this gelatinous species with the help of ARGOS.

The giant Nomura's Jellyfish, *Nemopilema nomurai*, is one of the largest jellyfish in the world. It can attain a diameter of 2m and weigh in excess of 200kg. This amazing species used to be restricted mostly to the coast of China until the end of the 20th century when it started to arrive in vast numbers along the Japanese coast, causing serious damage to coastal fisheries.



Naoto has already been able to exploit data from all of the ten jellyfish. The jellyfish frequently showed vertical movement, with the swimming depth ranging from 0 to 176 m. The mean swimming depths of most individuals were less than 40 m. And the swimming depths of the jellyfish in the northern Japan Sea in the winter were mostly deeper than those of this species in the southern Japan Sea in the autumn. Swimming depths during the nighttime were significantly deeper than those during the daytime. More specifically, during the daytime, the depths in the afternoon tended to be shallower than those in the morning, while during the nighttime, the depths after midnight were deeper than those before midnight. In order to elucidate the mysterious life of giant jellyfish in detail, it will be necessary to fit tags to more specimens.

In order to avoid the damage these giant jellyfish cause to fishing nets, scientists such as Naoto Honda are trying to understand the ecology of these gelatinous creatures, their lifecycle, growth mechanisms and also their distribution at depth.

It seems that this last parameter is the most important. If they were sure of the distribution of giant jellyfish at different ocean depths, fishermen could avoid catching them during fishing campaigns.

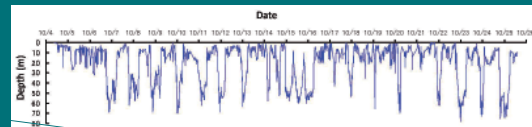
A knowledge of this parameter could also help scientists determine the speed and trajectory of their migration as a function of ocean currents. For this purpose, Naoto fitted giant jellyfish with PTT-100 standard and Mk10-PAT Pop-Up ARGOS satellite tags.

These beacons send back information about the jellyfish's diving and swimming depths. Naoto fitted ten specimens with the tags. Almost all the jellyfish had a diameter of over 1 metre as can be seen from the photos. The tags were fitted far out in the Sea of Japan from 2004 to 2006. They were attached to the creatures' necks using a plastic strap, so as not to damage the body of the jellyfish or hamper its movements.



The most unlikely creature tracked by ARGOS: a giant jellyfish in the Sea of Japan

By **NAOTO HONDA**,
Japan's Fisheries Agency



© Stearn

Antarctic Mission: record for the lowest temperature ever measured!

By **CHARLES R. STEARNS**,
Polar scientist, University of Wisconsin.
MATTHEW A. LAZZARA,
Meteorologist, University of Wisconsin



Antarctica is the coldest, driest and windiest continent in the world. Technically speaking, it is also the largest desert. Among the records held by this region, we can also add another: the record for the lowest temperature ever observed by ARGOS.

The record for the lowest temperature ever recorded by an ARGOS weather station dates from 1982, when -84.6°C was observed in Antarctica.

An AWS (Automatic Weather Station) registered the record temperature. This high-performance station is in Antarctica, of course, at Dome C, on the 7th Continent's highest plateau, which is also the coldest, the whitest and the most desertlike.

This measurement was possible because of the work of scientists from the University of Wisconsin. The AWS that took the measurement is one of 63 ARGOS weather stations in Antarctica.



The Wisconsin AWS group has deployed, contributed to the development, or inspired the development of most weather stations in the Antarctic. The data collected have been used in numerous studies such as:

- a study of Katabatic winds (Reeves Glacier, coast of Adélie Land);
- long-term ecological research on the Antarctic Peninsula;
- climatology;
- a study of key areas such as Dome C, in Eastern Antarctica.

The network of automatic weather stations fulfils several roles in support of research activities.

In such extreme regions, keeping such a network of automatic stations operational can be a real challenge. It is a full-time job! The network operates because of the contribution of international partners and the dedication of members of the team that builds and repairs the stations.

Considering the local weather conditions, just getting from station to station around Antarctica is a constant struggle! The network could not be so successful without the commitment and dedication of the teams in the field and their support workers.

The ARGOS system is therefore indispensable to any study of these hostile regions. The weather data thus collected (temperature, wind, humidity, air pressure, etc.) are extremely precious for configuring weather forecasting computer models.

Among the heroes of this icy saga we should mention Kenn Borek Air, the 109th New York Air National Guard, PHI Helicopters, Raytheon Polar services, the various French, Australian, British, Japanese and Chinese partners, and the Office of Polar Programs of America's National Science Foundation.



We are saddened to inform you that Dr Stearns passed away on June 22, 2010. The ARGOS team and Community send their thoughts and sincere condolences to his family. The death of Dr Stearns is a huge loss for the scientific community.

Ten years, 4 months and 16 days is the absolute record for the lifetime of a drifting buoy. Throughout its long career, this buoy has been measuring the surface temperatures of the oceans it crossed.

Since the 1970s, many drifting buoys have been deployed in all the world's seas and oceans as part of a wide range of scientific studies.



The SVP drifting buoys (Surface Velocity Program)

'Surface Velocity Program' (SVP) drifting buoys each consist of a surface float and a subsurface drogue (a sea-anchor attached by a long narrow tether) that remains 15m below the surface of the water. This keeps the floats stable on the surface by protecting them from the effects of the wind and obliging them to follow the ocean currents.

Each drifting buoy can be fitted with a range of sensors to measure the surface temperature of the sea, barometric pressure, salinity, wind speed and direction, etc. The buoy also carries sensors testing for submersion and tension on the tether, to prove that the drogue is still attached. It also has a transmitter that sends all the data collected to the constellation of ARGOS satellites. The Drifter Data Assembly Center run by NOAA/AOML (National Oceanic and Atmospheric Administration/ Atlantic Oceanographic and Meteorological Laboratory) is based in Miami, Florida. The centre's mission is to collect the data, verify their quality, interpolate them at six hours intervals and keep them in the database which can then be consulted online at the following address:

<http://www.aoml.noaa.gov/phod/dac/dacdata.html>

The database currently contains the data from 13,876 SVP drifting buoys deployed since 1979. The data collected from this array of buoys comes from many countries participating in the Global Drifter program. Countries participating in the program purchase drifting buoys and also pay to have them upgraded with more sensors, or help in deploying them.

The nominal lifetime of a satellite transmitter is 450 days. A drogue generally remains attached to a buoy for 300 days.

In this whole ocean-wide adventure, one particular 'drifter' stands out. The ID number of the buoy in question is 26028. This drifting buoy holds the absolute record for longevity and data collection. It remained operational and transmitted data for 10 years, 4 months and 16 days.

It was built by Technocean (Cape Coral, Florida, USA) and was fitted with sensors to measure sea surface temperature, submergence sensor to confirm the presence of the drogue as well as a voltmeter.

This 'record-buoy' was deployed on 25 January 1996 and finally ended its long and distinguished career on 13 June 2006. It lost its drogue on 9 December 1997, 1 year, 10 months and 24 days after being deployed, but still managed to send back good quality Sea Surface Temperature (SST) readings for the full duration of its voyage.

Five other drifting buoys have also followed the oceans' currents for eight and even nine years.

Five other drifting buoys have also followed the oceans' currents for eight and even nine years.

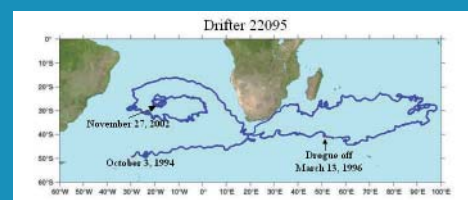
One of these, number 22095, had a particularly remarkable career. It was originally deployed by the South Africa Weather Service on 25 September 1994. It transmitted good-quality data from 3 October 1994 until it ceased operating on 27 November 2002 after 8 years, 1 month and 24 days of successful drifting.

It lost its drogue 527 days after being deployed. On its travels, it followed the circumpolar Antarctic current, headed north with an Ekman current, got caught up in the subtropical gyre of the Indian Ocean, was carried along by the Agulhas and Benguela currents before ending up in the southern Atlantic Ocean. This buoy was fitted with a sea surface temperature (SST) sensor, a voltmeter, and a barometric pressure sensor.

The design of SVP drifting buoys is constantly improving. Scientists are trying to extend the lifetime of the satellite transmitter and the drogue while preserving the quality of data measurement and the buoys' capacity for following ocean currents.

Absolute record for the lifetime of a drifting buoy

By **MAYRA PAZOS**,
America's National Oceanic and Atmospheric Administration (NOAA)



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Where the wind blows! Distance record for boundary layer pressurized balloons

By **NICOLAS VERDIER**,
French Space Agency (CNES)
CLAUDE BASDEVANT,
National Scientific Research Centre (CNRS)



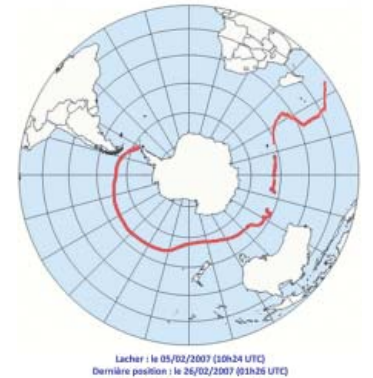
How can we measure weather conditions out in the desert or in mid-ocean? An engineer from CNES and a scientist from CNRS, Nicolas Verdier and Claude Basdevant, have teamed up to design and deploy atmospheric balloons that are real gems of cutting-edge technology. One of them holds the record for the longest flight ever made by a boundary layer pressurized balloon.

GENESIS

Nicolas Verdier, Director of the tropospheric tracker balloon series at CNES (Centre National d'Etudes Spatiales), has now been developing and constructing ARGOS atmospheric balloons for almost 10 years, and specializing in boundary layer pressurized balloons for almost five.

These balloons are designed to carry out measurement campaigns in what are known as the lower levels of the atmosphere (below 2000m). The measurements they take (temperature, pressure, humidity, wind speed and direction) provide key information for weather and climate specialists and are brought to these scientists and engineers by the ARGOS system.

BPCL Vol 08 (Vasco 2007)



The balloon that provided the most impressive data was called DOLLFUS V08/D33. It was launched with 15 others like it, from Mahé airport in the Seychelles, on 5 February 2007 at 10.27am.

The scientists exploiting the data collected, including Claude Basdevant, a Professor at Paris's Ecole Polytechnique and director of research at the Dynamic Meteorology Laboratory (LMD) at CNRS (Centre National de la Recherche Scientifique) had not foreseen this record performance and were particularly surprised by the impressive flight of 24,870 km covered in 21 days.

The average lifetime of these balloons is 10 days. They usually cover a few thousand kilometres and very rarely 20,000!

This is the longest known flight since the introduction of these balloons in the 1970s. But the other balloons in this campaign also had fascinating flights! They were almost all caught up in the cyclones of the Indian Ocean and also provided key information for improving our understanding of these devastating meteorological phenomena.

These BLPBs (Boundary Layer pressurized Balloons) therefore once again provided researchers with valuable information.

Every day, these scientists improve their models for medium-term weather forecasting and also the energy processes that influence our climate. The next campaign is planned for the end of 2010 – so keep your eyes open!



ADVANTAGES

The main advantage of these balloons compared with fixed weather stations, is that they follow the air masses whereas fixed stations can only watch them pass by.

The Technological Research and Development Department of the French Research Institute for Exploitation of the Sea (IFREMER) is currently working on the integration of ARGOS PMTs* into their ARVOR float. They plan to deploy these new, improved floats by the end of the year.

In Brest, in Western France, Serge LE RESTE, director of the profiler development project, Xavier ANDRE, an electronics expert, and Bertrand Moreau, a computer specialist, are developing the latest generation of ARVOR floats.

As part of IFREMER's operational oceanography program, the three engineers are using cutting-edge technology to help oceanographers collect more and more in-situ data on our seas and oceans. The first Argos-3 ARVOR floats will be added to the EURO-ARGO network as a European contribution to the international ARGO program.

These subsurface floats collect data (temperature, salinity, pressure) from all the world's oceans. Here is a look into some avant-garde development.

Why did you decide to integrate ARGOS-3 into your latest ARVOR float?

The floats that we develop at IFREMER are designed to be of use to physical oceanographers. They are at their most vulnerable when they come to the surface in order to transmit the data to the ARGOS satellites:

- surface drifting can lead to a float running aground,
- danger from trawling or collisions,
- risk of biofouling (accumulation of biological matter on the sensors, reducing measurement quality).

In order to mitigate these hazards, it is absolutely necessary to reduce the time the float spends on the surface.

Our latest ARVOR float, a descendant of the PROVOR model, includes several technological advances. Firstly, it has been miniaturized. Its weight has been reduced from 35kg to 20kg, its length from 2m40 to 2m and its diameter by 6cm to only 11cm.

We are currently working on ways to reduce the time spent on the surface for the reasons given above. The PROVOR float spent an average of six to eight hours on the surface. With the introduction of the ARGOS-3 interactive transmission mode, ARVOR floats will only need to spend 40 minutes,

15 minutes of which will be actual transmission time! This performance is made possible by their ability to foresee satellite passes, thanks to information communicated by the ARGOS-3 downlink.

This allows us to set a rendezvous between the ARVOR and an Argos-3 satellite for the float's next rise to the surface. It no longer has to spend hours transmitting to an empty sky. This means we are more efficient, as we now only transmit when a satellite is in range. In addition, the bi-directionality offered by the third generation of ARGOS instruments guarantees that transmissions succeed, thanks to the acknowledgements sent back by the satellite.

This ARVOR ARGOS-3 mode of transmission will therefore accommodate the transfer of a greater volume of data (a profile from 0 to 2000m with increased resolution), at a lower cost (less energy spent on transmission) and more efficiently (less time spent on the surface).



When will they be deployed?

We have been developing the software for this float for nearly 10 months. Test bench qualification for nominal operations, simulating the float's environment, is almost complete. However, we still need to be sure it can manage cases of error, which is vital for such an autonomous instrument.

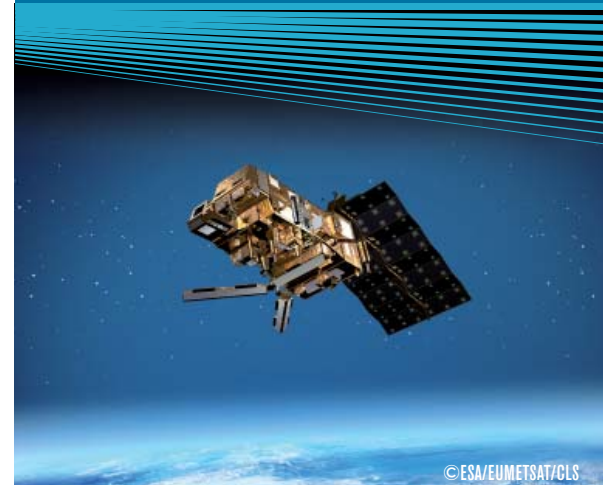
We therefore hope to deploy our first 'ARGOS-3 generation' ARVOR by the end of this year. The first stage will be integration of ARGOS-3 in IFREMER's ARGO floats!

Over the next few years, we hope that this technology will allow us to transmit data from other sensors and therefore to measure such physical parameters as oxygen, chlorophyll or sea turbidity.

* PMT: Platform Messaging Transceiver - Emetteur-récepteur Argos-3.

IFREMER A new generation of ARVOR floats with ARGOS-3 capability

By
SERGE LE RESTE,
XAVIER ANDRÉ and BERTRAND MOREAU
French Research Institute
for Exploitation of the Sea (IFREMER)



New ARGOS location algorithm: better accuracy

By
JEAN-PIERRE MALARDE
PHILIPPE GASPAR
FRANÇOIS ROYER
et RÉMY LOPEZ
CLS



ARGOS Positioning: greater precision

A new processing system for ARGOS positioning will be available at the end of 2010. It will reduce positioning errors, eliminate mirror locations and provide systematic information about the precision obtained.

THE CONTEXT

In response to many user requests, CLS, the operator of the ARGOS system and responsible for data processing, is developing a new positioning system.

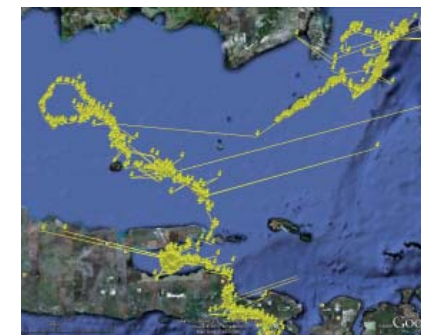
Thanks to this new processing system, the positions found will be more accurate and there will be no more mirror locations. Furthermore, all positions will be provided with an estimation of error (in the form of an error ellipse). Previously, the position error was only estimated in the case of passes with at least 4 messages.

METHOD

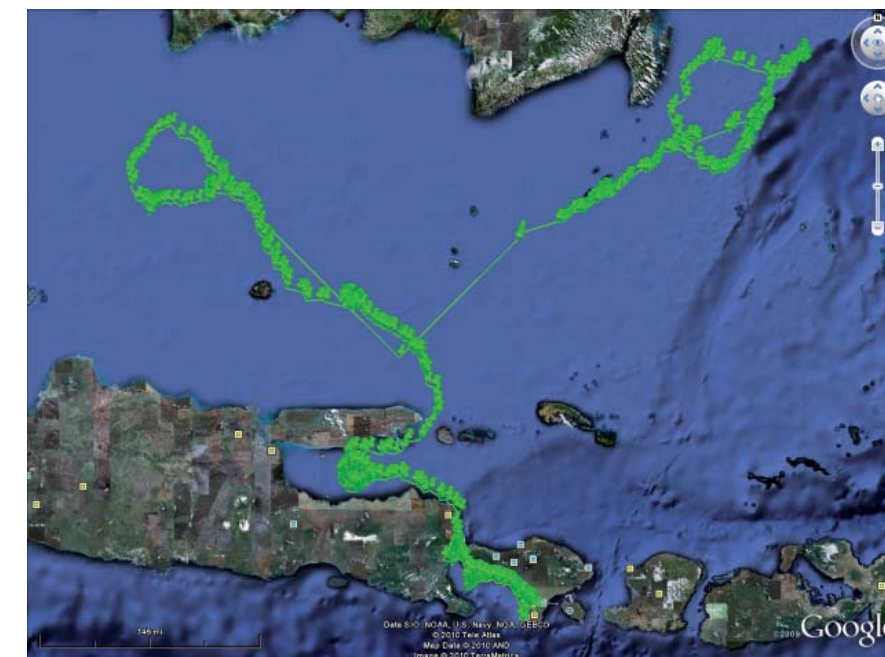
With the current processing system, positions are calculated by a traditional 'least squares' estimation method. In the new system, positions are estimated by applying Kalman filtering to the Doppler measurements. Using this filter requires choosing a movement model for the beacon being tracked. A simple random walk is sufficient to obtain significantly improved positioning.

VALIDATION

Validating this new algorithm depends, among other things, on an analysis of the data from a number of beacons located simultaneously by ARGOS and by GPS. The purpose of this validation is to verify that the new ARGOS positioning is closer to the GPS positioning than the old ARGOS system. The results obtained so far are very encouraging. If, as we believe, all the tests underway have been positive, users of the system will benefit from the results of this improved processing system by the end of 2010.



ARGOS trajectory before switching to the new processing system.



ARGOS positions calculated using the new ARGOS processing system. The mirror locations have disappeared.

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