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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DATA BUOY COOPERATION PANEL

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FREMANTLE, AUSTRALIA
2-6 OCTOBER 2012

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ARGOS OPERATIONS AND DEVELOPMENTS

(Submitted by CLS)

Summary and purpose of the document

As for past DBCP meetings, this document contains, in consolidated form, the summary report from CLS/Service Argos, covering report on 2011 – 2012 Operations and System Improvements.

ACTION PROPOSED

The Panel will review the information contained in this report and comment and make decisions or recommendations as appropriate. See part A for the details of recommended actions.

Appendix: **A**. Report on 2011 – 2012 Operations and System Improvements

-A- DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

10.3.1 The CLS Representative presented a report on Argos operations and system improvements during 2011-2012. The Panel recalled that Argos is a global satellite-based location and data collection system dedicated to studying and protecting our planet's environment. CLS, as a unique operator of the Argos system on behalf of NOAA, CNES and EUMETSAT, continues to maintain and improve a high operational service for all Argos users, especially for the meteorology and ocean community.

[to be completed according to the discussion during the Session]

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Appendix: 1

APPENDIX A

Report on Argos 2011 – 2012 Operations and System Improvements

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1 2011-2012 Argos Highlights

1.1 Operations

- Kalman Filter Localization Processing On since 15 March 2011
- Two new NOAA Global Antennas: McMurdo (since 08/06/2011) and Svalbard (since 28/09/2011). Svalbard for NOAA satellites blind orbits and McMurdo for METOP-A only
- CLS America Processing Center move from Landover to Lanham on June 23rd 2011
- A86 Peru Regional Processing center stopped the 1st June 2011
- METOP-A platform restart performed by EUMETSAT on 22/10/2011
- METOP-A / A-DCS software error on 24/10/2011

1.2 System improvements

- The 3 global receiving stations (Fairbanks, Wallops and Svalbard) are working nominally.
- McMurdo station (Antarctica) is delivering METOP-A orbits and has improved the data availability time.
- The regional ground stations network is composed of 60 antennas. Three have been added in 2011 (Lajes, Ramonville, Ali El Salem).
- The architecture of the global processing centers is stable and no major improvements in 2011.
- New functionalities have been integrated to the Argos application software in 2011:
- KALMAN Location processing improvements
- Preparation of METOP-B and SARAL Launches
- Switch from BUFRV3 to BUFRV4
- PMT Commands through Email (Web commands already available)
- Internal Developments to improve Argos Ground Segment Operation monitoring

1.3 Outlook

- METOP-B launch: 19/09/2012. Argos-3 instrument, Polar orbit, launched from Baikonur
- SARAL launch: October 2012. Argos-3 instrument, Polar orbit, launched from Satish Dhawan.
- CLS processing centre move in the new building in October 2012
- Development of the new Argos orbitography to not use OpenVMS anymore
- Development of new tools to monitor station network and delays
- Migration of Argos operating system (OS) which are obsolete
- Study for migration from Oracle 10g to Oracle 11g
- Study to migration screens developed with Forms to java screens
- Continue to setup the new HRPT optimized network
- Development of an Argos-3/Argos-4 receiver chipset with CNES and the Belgium space agency
- Observations available via the Argos WebService
- Study to extend the Argos data extraction period online
- Archiving Argos data from 1994 to 2007 (Argos 86) available for requesting

2 Argos space segments

2.1 Operational status

During 2011, Argos instruments were onboard 6 POES's spacecrafts. The status information on each spacecraft and its Argos various subsystems describes as follow:

Satellites	Launch date	NOAA status	Real time data (HRPT)	Stored data (STIP)	Data AVHRR
METOP-A (MA)	19-Oct-06	AM Primary	Ok/Nok*	Svalbard	Ok
NOAA-19 (NP)	06-Feb-09	PM Primary	Ok	Gilmore, Wallops, Svalbard	Ok
NOAA-18 (NN)	20-May-05	PM Secondary	Ok	Gilmore, Wallops	Ok
NOAA-17 (NM)	24-Jun-02	AM Backup	Ok	Gilmore, Wallops	Ok
NOAA-16 (NL)	21-Sep-00	PM Secondary	Ok	Gilmore, Wallops	Ok
NOAA-15 (NK)	13-May-98	AM Secondary	Ok	Gilmore, Wallops	Ok

Figure 1: Argos Constellation

* Scheduled activities define on Orbit Switch ON and Switch OFF (see below for more details).

2.2 METOP-A HRPT Switch Zone

To minimize the risk of failure to the AHRPT-B unit whilst still offering the user community a service, EUMETSAT has implemented a "partial" AHRPT service in those areas where the risk of damage from heavy ion radiation is reduced.

For southbound passes, AHRPT side B was activated for all orbits over the North Atlantic and European area, starting at around 60°N. The AHRPT will then be switched off before the spacecraft reaches the Southern Atlantic Anomaly region at around 10°N.

In January 2011, EUMETSAT announced the extension of this activation zone while maintaining the same operational restrictions over the polar caps and South Atlantic anomaly. Furthermore, AHRPT operations will also be made in ascending orbits, but with more stringent risk reduction measures than applied for the descending passes given the availability of data via the Fast Dump Extract System (FDES) to cover the North Hemisphere.

Figure 2 shows the extended activation zone of the AHRPT for both descending and ascending parts of the orbit. The extended AHRPT coverage is effective since 18 January 2011 as a pre-operational service.

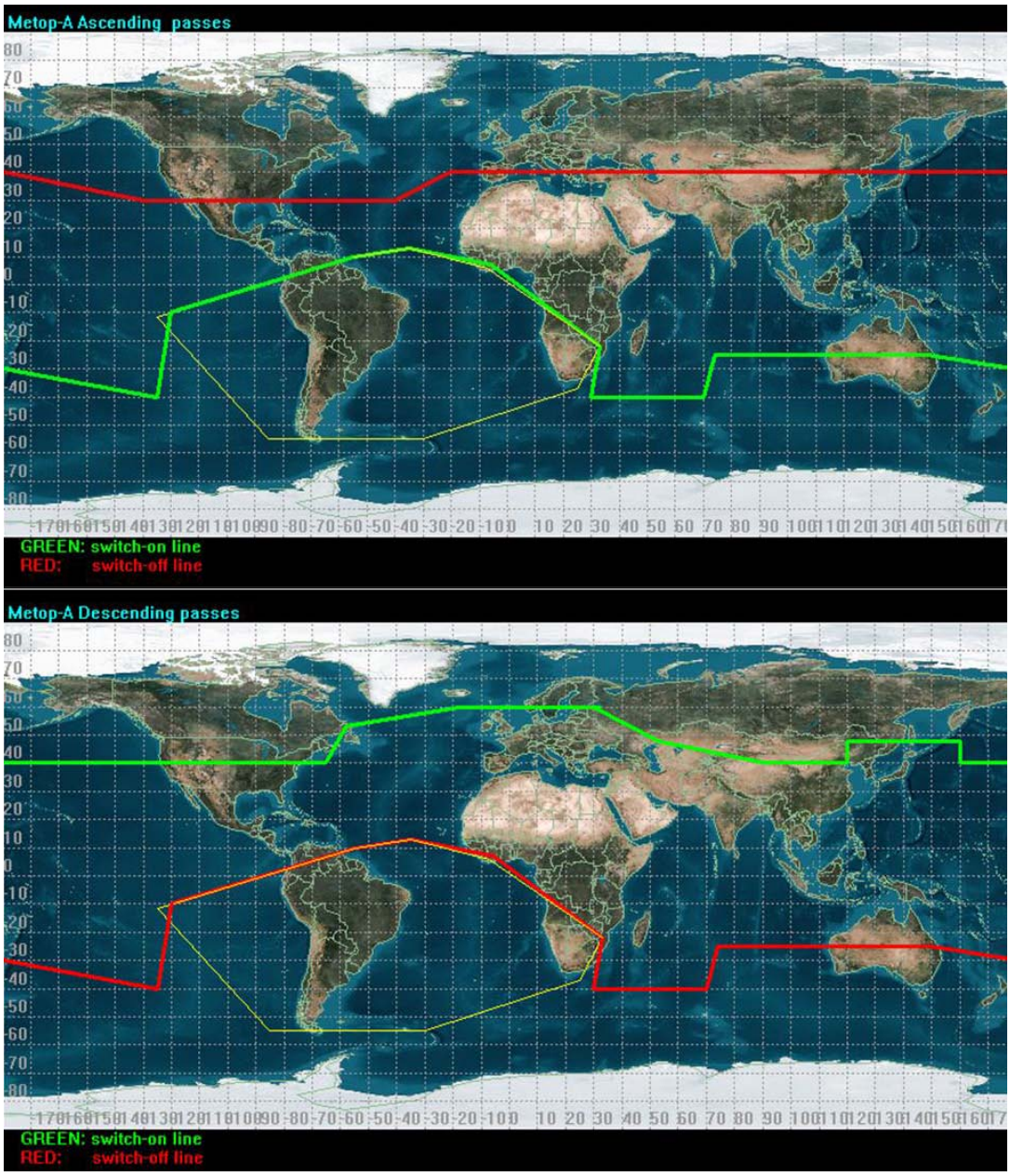


Figure 2 : A-HRPT Extended Switch Zone (Descending and Ascending orbits)

2.3 Ascending Nodes Local hour

The diagram here below presents the local time of ascending notes in February 2012

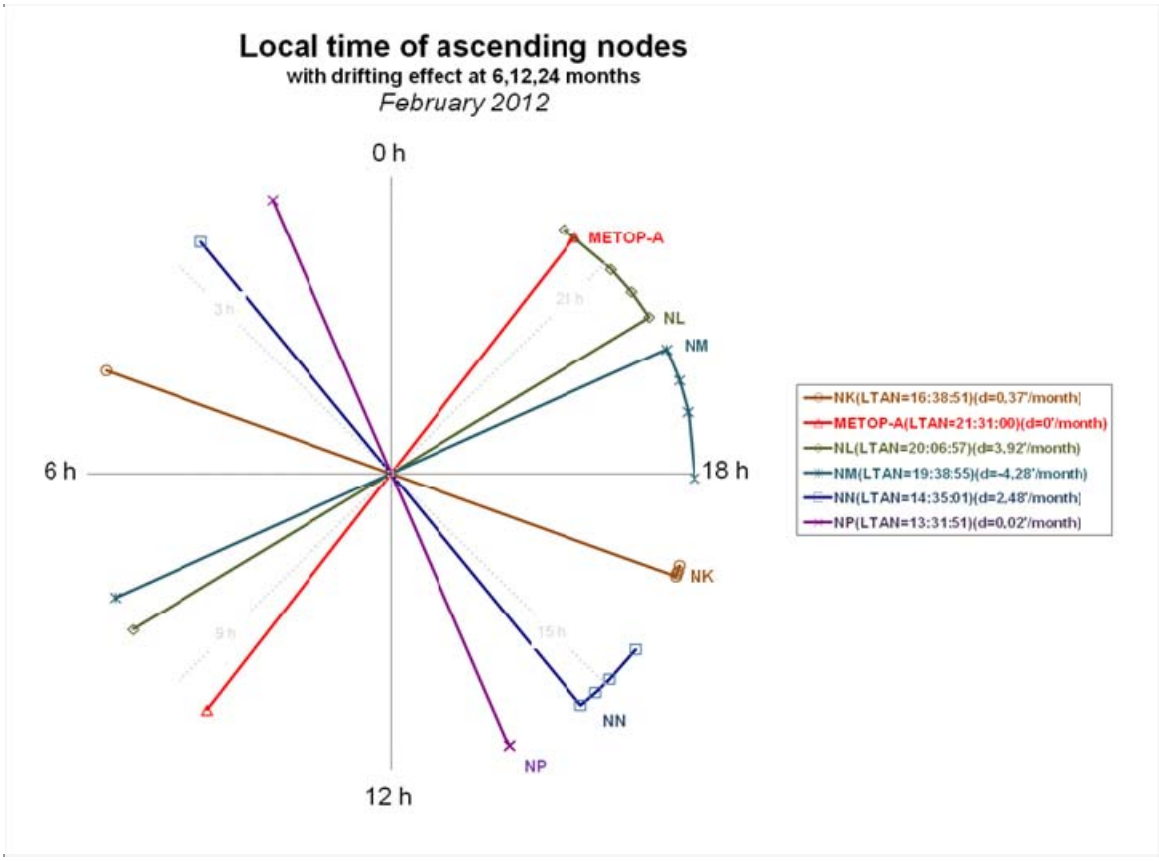


Figure 3: Local Equator crossing time in February 2012

2.4 Anomalies

METOP-A:

22/10/11: Platform Stop/Start by EUMETSAT. No HK data for 16 hours, no Downlink Way for 18 hours, no diffusion on Downlink Way for 45 hours, no ARGOS collection for 59 hours, no Argos location for 131 hours.

24/10/11: Watchdog and Major Software Error. Second Restart of the onboard software.

NOAA-19: NA

NOAA-18: NA
NOAA-17: NA

NOAA-16: NA

NOAA-15:

29/11/11: NOAA-15 was placed into the Gyroless Mode for a baseline on-orbit test. No dataset from NOAA during this period (loss of data is around 32%).

2.5 Maneuvers

METOP-A:

31/03/11: In Plane Manoeuvre.1 burst of 5 seconds. Degradation of the ARGOS locations quality for 24 hours.

01/05/11: Emergency In-Plane Manoeuvre. 1 burst of 1.5s. ARGOS Location service closed for 60 hours.

09/06/11: In Plane Manoeuvre. 1 burst of 4 seconds. Degradation of the ARGOS location quality for 24 hours.

28/09/11: Out of Plane Manoeuvre. 2 bursts of ten minutes. No ARGOS location for 48 hours.

14/12/11: In Plane Manoeuvre. 1 burst of 11 seconds. Degradation of the ARGOS locations quality for 15 hours.

2.6 Next launches of satellites with Argos instrument

- METOP-B (EUMETSAT) with an Argos-3 instrument on 19/09/2012
- SARAL (ISRO) with an Argos-3 instrument in the second half of October 2012
- JPSS-1 (NOAA) with an Argos-4 instrument in 2015
- METOP-C (EUMETSAT) with an Argos-4 instrument in 2017
- JPSS-2 (NOAA) with an Argos-4 instrument in 2020

3 Argos ground segment

3.1 Global antennas (store and forward mode)

The Argos global antennas network is composed by five stations:

- The two NOAA global stations of Fairbanks and Wallops acquire the global recorded telemetry transmitted by N15, N16, N17, N18 and N19.

- The EUMETSAT global receiving station of Svalbard acquires the global recorded telemetry transmitted by Metop-A as well as the two daily blind orbits of N18 and N19 for NOAA stations.

- A new Svalbard antenna operated by NOAA that delivers NOAA 15/16/17/18 blind orbits when not in conflict with NOAA-19. Please note that these blind orbits were previously received from the EUMETSAT Svalbard antenna (via NOAA). This improves data delays because these orbits are now received directly after the pass.

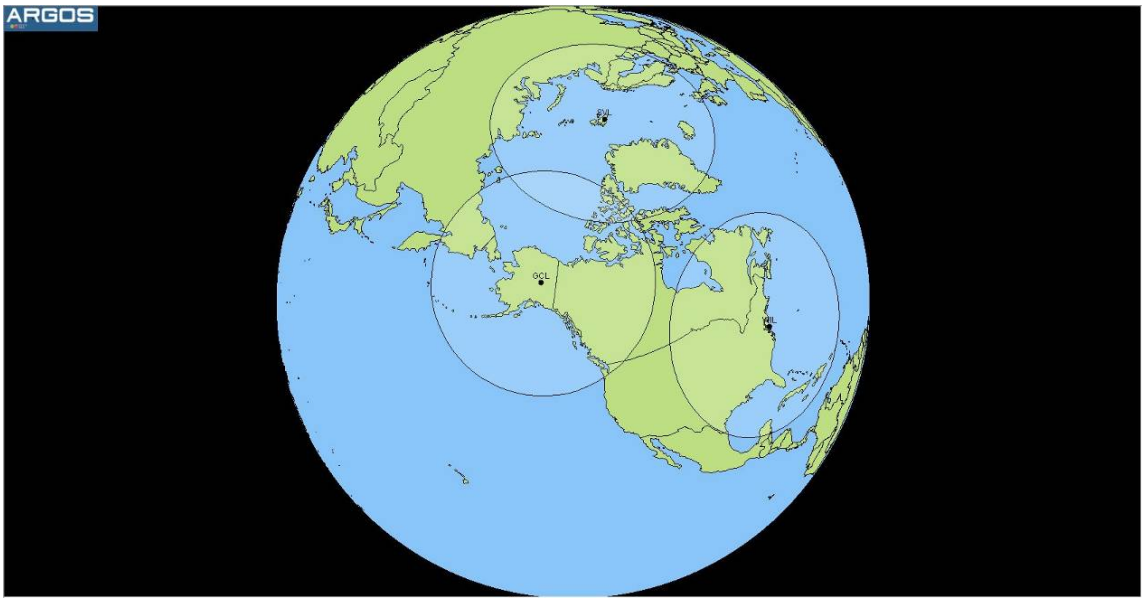


Figure 4 : The Argos Global antenna network (without McMurdo)

- The NOAA McMurdo antenna in Antarctica that only received Metop-A half orbits. This antenna is operational since 08/06/2011. Timeliness for the provision of METOP-A data collected out of HRPT coverage to users has improved from 115 to 65 minutes.

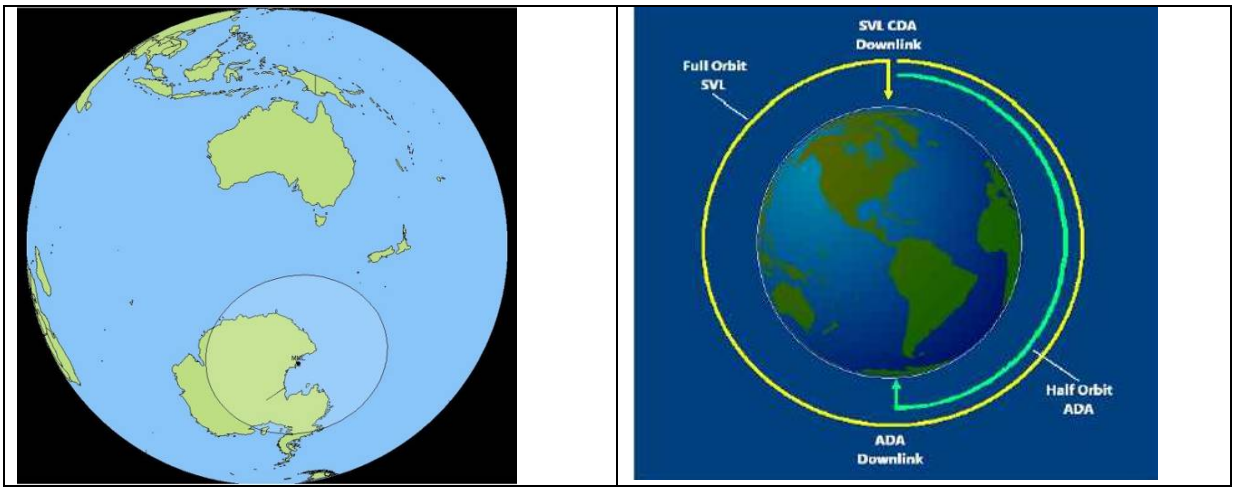


Figure 5 : METOP-A Mc Murdo Global antennas coverage and principle

Comparison of METOP-A data delivery time with and without Mc Murdo station:

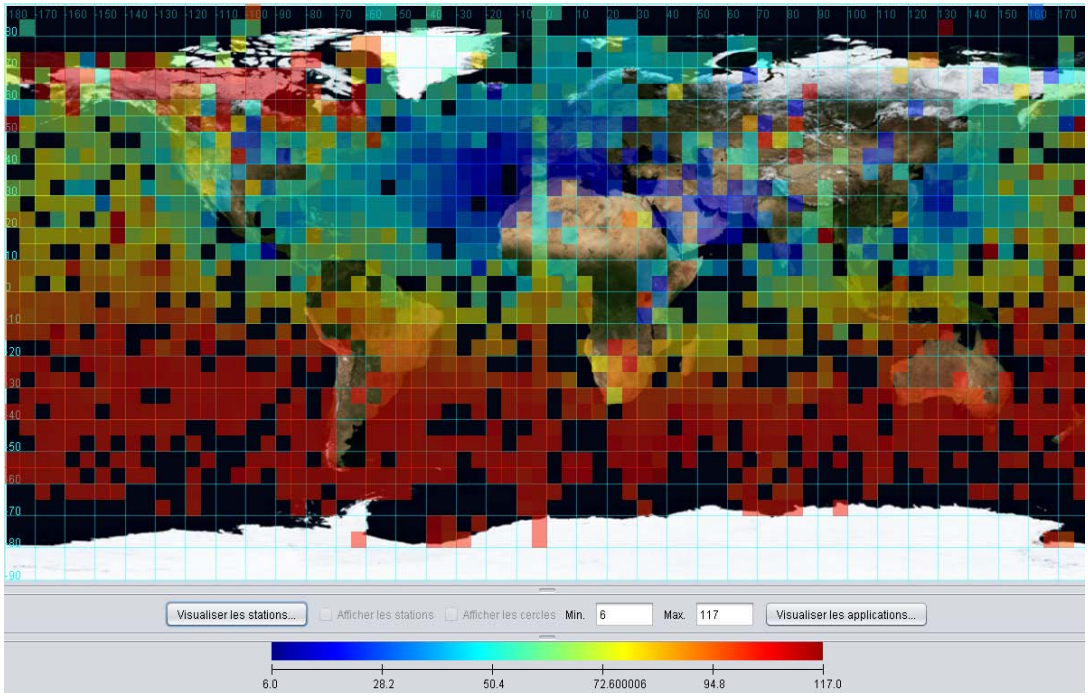


Figure 6 : METOP-A Data Mean Disposal Time in June 7, 2011 (in minutes)

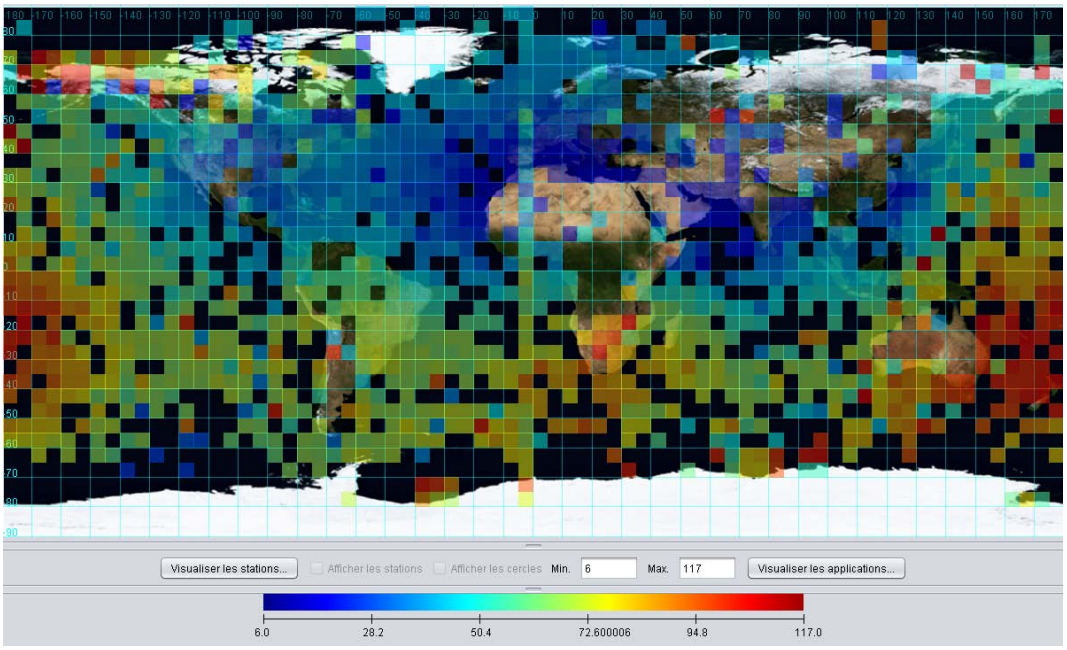


Figure 7 : METOP-A Data Mean Disposal Time in June 9, 2011 (in minutes)

3.2 Regional antennas (real-time mode)

3.2.1. *Operation and improvements*

In 2011, the real-time network is still growing, 3 HRPT antennas were added. Improvements are still focused on redundancy locations and coverage extension.

Operating date	Name	Code	Country	Operator	Possible satellites					
20/02/2012	Lajes	LA	PT	US AIR FORCE		NL		NN	NP	
04/01/2012	Ali Al Salem	AS	KW	US AIR FORCE	NK	NL		NN	NP	
11/05/2011	Ramonville	RV	FR	CLS	NK	NL	NM	NN	NP	MA

Figure 8 : List of new HRPT antennas added in 2011

In 2011, CLS was still focused on the HRPTA4 project that consists of upgrading selected antennas in order to be compatible with METOP and SARAL satellites. This project also aims to optimize in terms of performances the real-time receiving stations network (see paragraph 3.2.3 for further details).

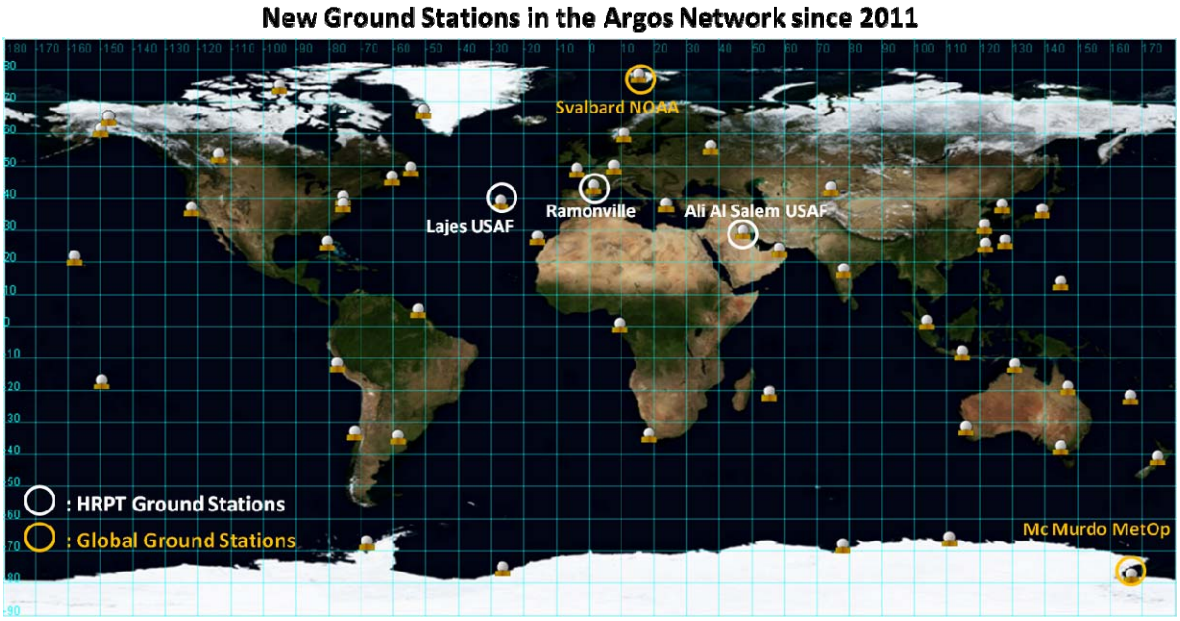


Figure 9 : New stations in 2011

Today, both Toulouse and Lanham processing centers receive Argos real-time data from 65 stations located all over the world.

Please note that the Aludeid antenna was decommissioned and removed from the network on February 2012.

Here below are displayed the Argos HRPT coverage world map and the list of the 65 operational stations part of the Argos real-time antennas network.

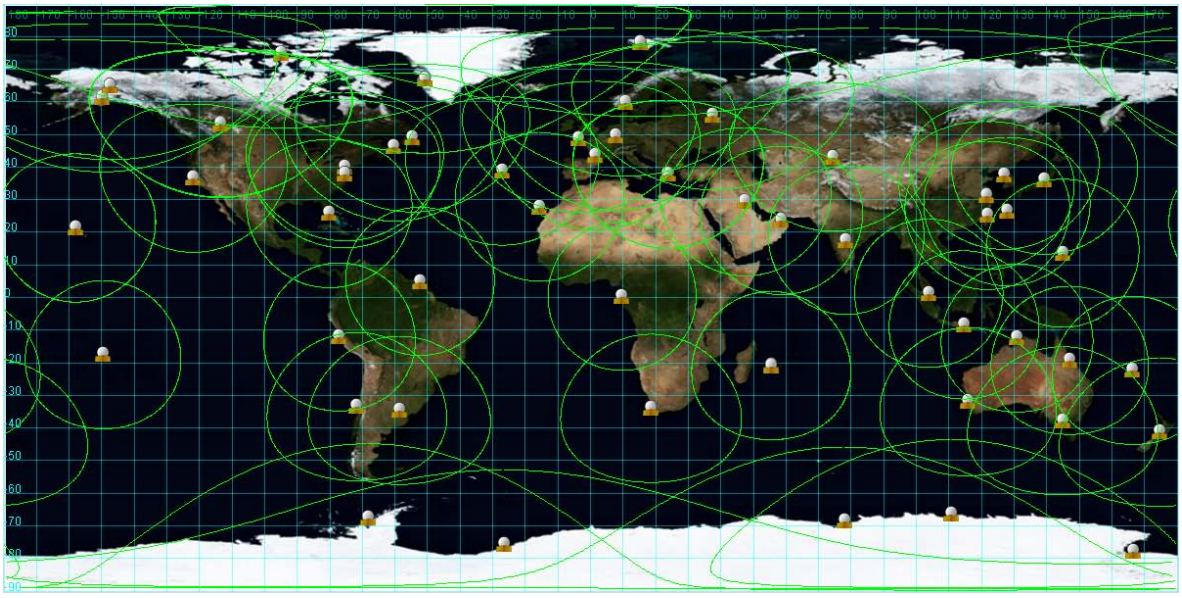


Figure 10 : April 2012 Real-time coverage map

Name	Code	Country	Operator	Possible satellites					
Ali Al Salem	AS	KW	US AIR FORCE	NK	NL		NN	NP	
Andersen	AN	GU	US AIR FORCE	NK	NL	NM	NN	NP	
Athens	AT	GR	CLS	NK	NL	NM	NN	NP	
Athens EARS	XA	GR	EUMETSAT		NL	NM	NN	NP	MA
Bali	BL	ID	PT CLS INDONESIA	NK	NL	NM	NN	NP	
Buenos Aires	BA	AR	INTA	NK	NL	NM	NN		
Cape Ferguson	CF	AU	NOAA NESDIS	NK	NL	NM	NN	NP	
Cape Town	SA	ZA	SAWB	NK	NL	NM	NN	NP	
Casey	CA	AU	BOM	NK	NL	NM	NN	NP	
Cayenne	CY	FR	IRD	NK	NL	NM	NN	NP	
Darwin	DA	AU	BOM	NK	NL	NM	NN	NP	
Davis	DV	AU	BOM	NK	NL	NM	NN	NP	
Edmonton	ED	CA	ENVIRONNEMENT CANADA	NK	NL	NM	NN	NP	
Edmonton EARS	XE	CA	EUMETSAT	NK	NL		NN	NP	
Elmendorf - Anchorage	EL	US	US AIR FORCE	NK	NL		NN	NP	
France Lannion	FL	FR	METEO-FRANCE			NM	NN	NP	MA
Gander EARS	XG	CA	EUMETSAT	NK	NL		NN	NP	
Gilmore Creek	GC	US	NOAA NESDIS	NK	NL	NM	NN	NP	
Halifax	HF	CA	CANADIAN COAST GUARD	NK	NL	NM	NN		
Halley	HR	GB	British Antarctic Survey		NL		NN	NP	
Hatoyama	HT	JP	Jaxa	NK	NL	NM	NN	NP	MA
Hawaïi	HW	US	NOAA NWS	NK		NM	NN	NP	MA
Hickam - Honolulu	HI	US	US AIR FORCE	NK	NL		NN	NP	
Hyderabad	HY	IN	INCOIS	NK	NL	NM	NN	NP	
Jamstec - Tokyo	JM	JP	CUBIC-I	NK	NL	NM	NN		
Kandena-Okinawa	KA	JP	US AIR FORCE	NK	NL		NN	NP	
Kangerlussuaq EARS	XK	GL	EUMETSAT	NK	NL	NM	NN	NP	
Lajes	LA	PT	US AIR FORCE		NL		NN	NP	
Las Palmas	LP	ES	IRD	NK	NL	NM	NN	NP	
Libreville - N Koltang	GB	GA	CLS	NK	NL	NM	NN	NP	
Lima	LM	PE	CLS PERU	NK	NL	NM	NN	NP	MA
Lima	PR	PE	CLS PERU	NK	NL	NM	NN	NP	
Manas	MN	KG	US AIR FORCE	NK	NL	NM	NN	NP	
Maspalomas EARS	XM	ES	EUMETSAT	NK	NL	NM	NN	NP	MA
Mc Murdo	MM	AQ	NOAA						MA

Melbourne	ME	AU	BOM	NK	NL	NM	NN	NP	
Miami	MA	US	NOAA AOML	NK	NL	NM	NN	NP	MA
Montererey	MO	US	NOAA NESDIS	NK	NL	NM	NN	NP	MA
Moscou EARS	XR	RU	EUMETSAT	NK	NL	NM	NN	NP	MA
Muscat EARS	XO	OM	EUMETSAT EARS	NK	NL	NM	NN	NP	MA
Nouméa	NC	NC	METEO FRANCE	NK		NM	NN		
Nouméa	NO	NC	IRD	NK		NM	NN	NP	
Oslo	OS	NO	NMI	NK	NL	NM	NN		
Papeete	TA	FR	IRD	NK		NM	NN	NP	
Perth	PE	AU	BOM	NK	NL	NM	NN	NP	
Ramonville	RV	FR	CLS	NK	NL	NM	NN	NP	MA
Resolute Bay	RB	CA	Environment Canada	NK	NL	NM	NN	NP	
Reunion Island	RE	FR	IRD	NK	NL	NM	NN	NP	
Reunion Island	RN	FR	METEO FRANCE			NM	NN	NP	
Reunion Island HRPT4	FR	FR	METEO FRANCE				NN	NP	MA
Rothera	RO	GB	British Antarctic Survey	NK	NL	NM	NN		
Santiago	CH	CL	METEO CHILE	NK	NL		NN	NP	
Sembach	SM	DE	US AIR FORCE	NK	NL		NN	NP	
Séoul	SE	KR	KMA	NK	NL	NM	NN	NP	
Shanghai	SH	CN	EAST CHINA SEA FISHERIES	NK	NL	NM		NP	
Singapore	SG	SG	SMM	NK	NL	NM	NN	NP	
Sondre	GR	GL	DMI	NK	NL	NM	NN	NP	
Svalbard	SN	NO	NOAA	NK				NP	MA
Svalbard	SV	NO	EUMETSAT	NK			NN	NP	MA
Svalbard EARS	XS	NO	EUMETSAT		NL	NM	NN	NP	MA
Svalbard NOAA	SW	US	NOAA	NK	NL	NM	NN		
Taïwan	TW	TW	NTOU	NK	NL	NM	NN	NP	
Valley Forge (Test)	UA	US	US AIR FORCE	NK	NL		NN	NP	
Wallops Island	WI	US	NOAA NESDIS	NK	NL	NM	NN	NP	
Wellington	NZ	NZ	NIWA	NK	NL	NM	NN	NP	

Figure 11 : List for Operational Antennas on April 2012 and tracked satellites

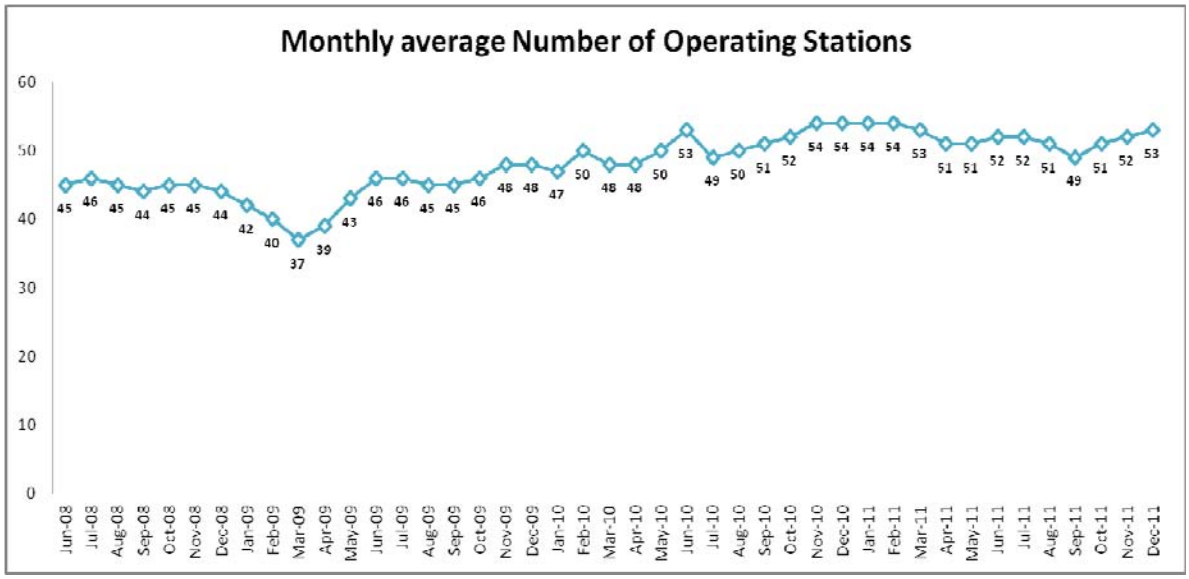


Figure 12 : Operational real-time antennas since January 2008

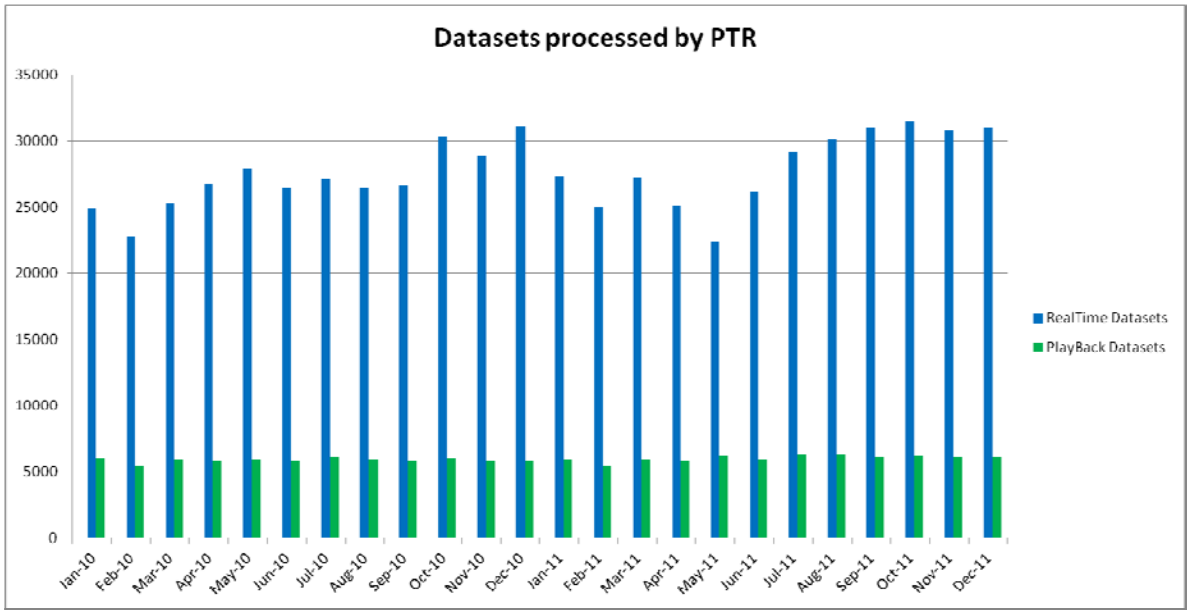


Figure 13 : NOAA and METOP Playback and Real-time datasets processed per Month

3.2.2. *METOP real-time coverage*

The regional antennas network dedicated to METOP satellites is still growing with 16 compatible stations in July 2012:

Name	Code	Country	Operator
Athens EARS	XA	GR	EUMETSAT

France Lannion	FL	FR	METEO-FRANCE
Hatoyama	HT	JP	Jaxa
Hawaïi	HW	US	NOAA NWS
Lima	LM	PE	CLS PERU
Maspalomas EARS	XM	ES	EUMETSAT
Mc Murdo	MM	AQ	NOAA
Miami	MA	US	NOAA AOML
Montererey	MO	US	NOAA NESDIS
Moscou EARS	XR	RU	EUMETSAT
Muscat EARS	XO	OM	EUMETSAT EARS
Ramonville	RV	FR	CLS
Reunion Island	FR	FR	METEO FRANCE
Svalbard	SN	NO	NOAA
Svalbard	SV	NO	EUMETSAT
Svalbard EARS	XS	NO	EUMETSAT

Figure 14 : List for METOP satellites compatible antennas on July 2011

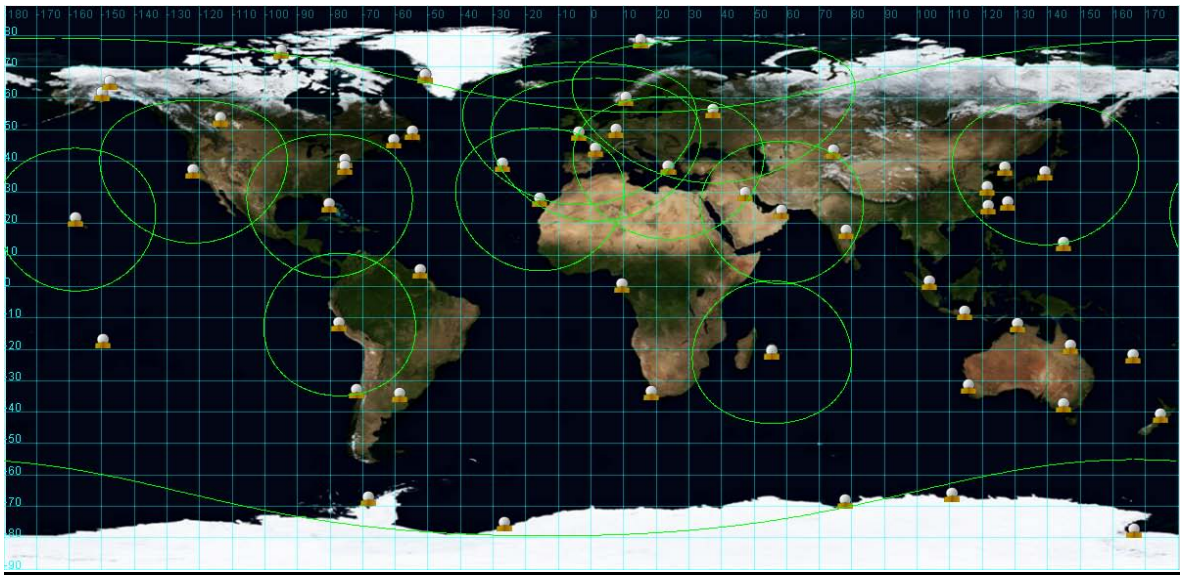


Figure 15 : Current METOP-A real-time coverage

3.2.3. ***HRPT-A4 project***

This project had been initiated in 2010 and was presented for the first time during the 43th Argos

Operation Committee. It consists in upgrading a significant part of the network so that it is capable of acquiring data from NOAA, METOP and SARAL satellites. Since the receiver developed in the frame of the upgrade is "agile" and multi missions, it should be possible to perform a light update to receive data issued from the future satellites which will carry the Argos-4 instruments. This project is led by CLS with the strong help and support of CNES.

On the base of the network defined during the system study, year 2011 was normally devoted to the deployment phase. Unfortunately, for technical reasons, it has not been possible to deploy our upgrade equipment in EARS network stations leading to a complete redefinition of the network. On that new basis, the network on which the upgrade will be applicable will be composed of 17 stations as shown on the map below. Among these 17 stations (see figure 15):

- 12 stations will be upgraded using our upgrade equipment (white circles)
- 2 new stations will be deployed (red circles)
- 3 stations will be upgraded in partnership with Australia (orange circles)

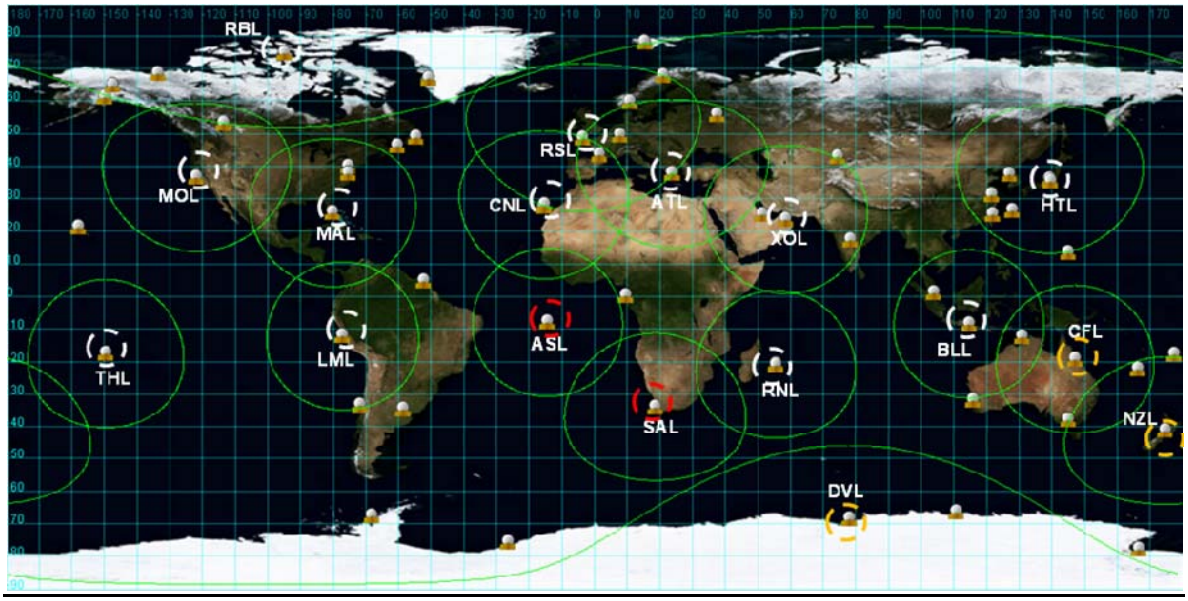


Figure 16 : Planned HRPT-A4 antenna network (upgrade in progress)

From an engineering point of view, all the equipment is tested and ready to be deployed (new station and upgrades).

From a deployment point of view, it has to be noticed that the negotiation with the host organizations take much more time than expected at the beginning of the project.

Over the 17 stations of the network, in July 2012 the status of the deployment is as follow:

Six antennas are already upgraded and currently received in production by both Argos processing centers (Toulouse & Lanham) in the HRPT-A4 network:

- Lima in Peru operated by CLS-PERU,
- Lannion in France operated by Meteo-France,
- Ramonville in France operated by CLS,
- Reunion Island operated by Meteo-France,

- Cape Town in South Africa operated by the South Africa Weather Bureau,
- Hatoyama in Japan operated by JAXA.

The next stations to upgrade in 2012 are:

- Athens, Greece in September 2012
- Bali, Indonesia in October 2012
- Davis, Australia in November 2012
- Las Palmas, Gran Canarias in December 2012.

3.2.4. ***Blind Orbits***

"Blind orbits" from Svalbard have been implemented operationally! However, all secondary spacecraft do conflict with NPOESS Preparatory Program for 6-10 days at a time. Schedulers determine which spacecraft to schedule at NOAA Svalbard for a given period, selecting up to 10-20 double Global Area Coverage dumps (5-10 passes) for a given week. Due to conflicts, some weeks will have less than 10 passes, and only one spacecraft is selected for any given week.

In addition, it should be noted that NOAA Svalbard is a Global Area Coverage data retrieval site only. Still, this is progress – and is hopefully resulting in some improvements to data latency.

3.3 Processing centers

The two global processing centers in Toulouse and Largo were nominal over 2011 and first semester of 2012. Redundancy is used at least once a month (Up to two times on one month). Redundancy means all Argos users rerouted to CLS or CLSA during an anomaly on the nominal global processing center.

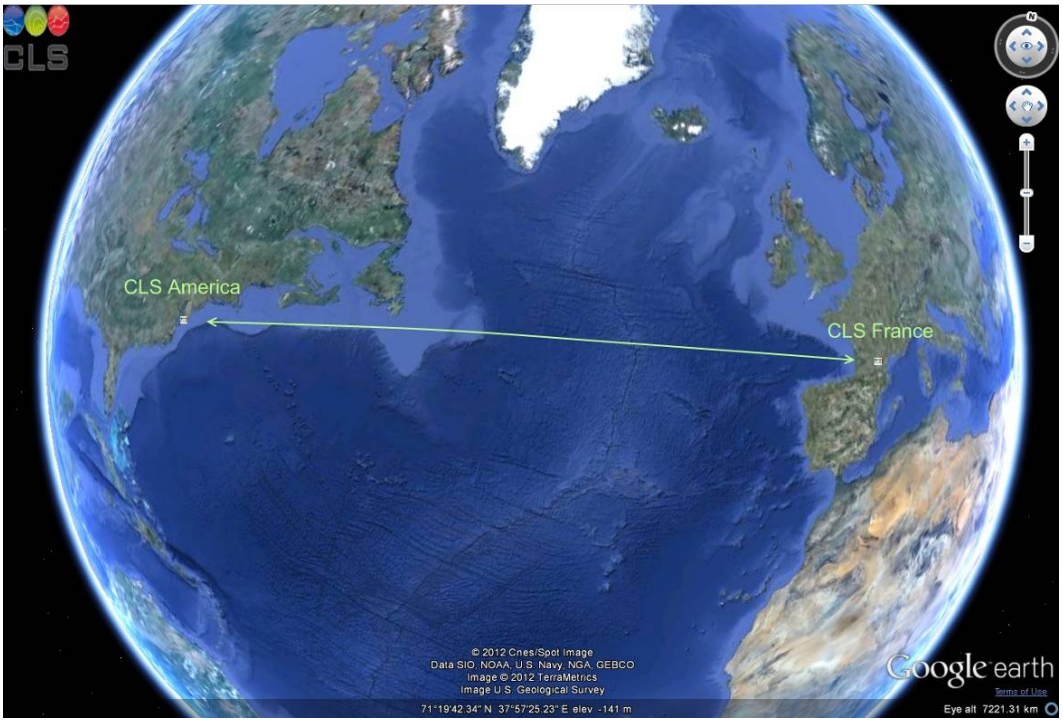


Figure 17 : Global and Regional Processing Centers

Figure 18 : CLS Toulouse Global Processing Center

Figure 19 : CLS America Global Processing Center

In June 2011, CLS America processing center moved to a new building in Lanham, Maryland. A double power outage occurred in July 2011 due to a generator issue.

The new building that will hosts the new CLS processing centre is still under construction in front of current CLS building. The project of moving Personnel, IT infrastructure and all operations staff into the new CLS building facilities will start in October 2012. This moving has to be transparent for our Argos customers and need to be prepared. A moving testing day is scheduled in September in order to be sure that all operations will be secured.

All Operations Staff is mobilized on this project in order to satisfy all Customer services and minimized the operations' impacts.

Figure 20 : New CLS control and monitoring room

3.3.1. ***Argos global processing centers architecture***

Each global processing center is autonomous and can work alone. In normal mode, both processing centers receive process and distribute Argos data to:

- North American users for CLS America,
- Users of the rest of the world for CLS France.

In case of a problem with one of the two centers, the other one stays alive and is capable of receiving, processing and distributing Argos data to ALL users. The switch to the remaining alive center is completely transparent for the users. It means that the users continue to receive or to access their data, without changing anything on their side. CLS has a 99.64% system availability (see details in chapter 3.3.4 Data processing statistics) with three processing centers in back-up (two nominal and one disaster recovery).

In 2011, https architecture in CLS France was updated and CLS America firewalls were replaced to get the same hardware and software version as CLS France.

In 2011, we initiate a rebuilt of ARGOS application servers, in order to prepare the next decade. This process was started on the development configuration in CLS France. The application server is now based on CentOS Linux release 6.0, 64 bits (rather than RedHat, 32bits).

In 2012, progressively these changes on operating systems will be propagated up to the production environment, both in CLS America and CLS France datacenters.

In 2012, in order to address the increase of quantity of data to be processed (due to the launch of METOP-B and SARAL spacecraft), space disk will be increased. Moreover, the databases backup mechanism will be optimized and updated.

The architectures of CLS France and CLS America processing centers are quite similar and based on the same principle. Each has the same three main subsets:

- the processing chain
- the Oracle database service
- the Web distribution

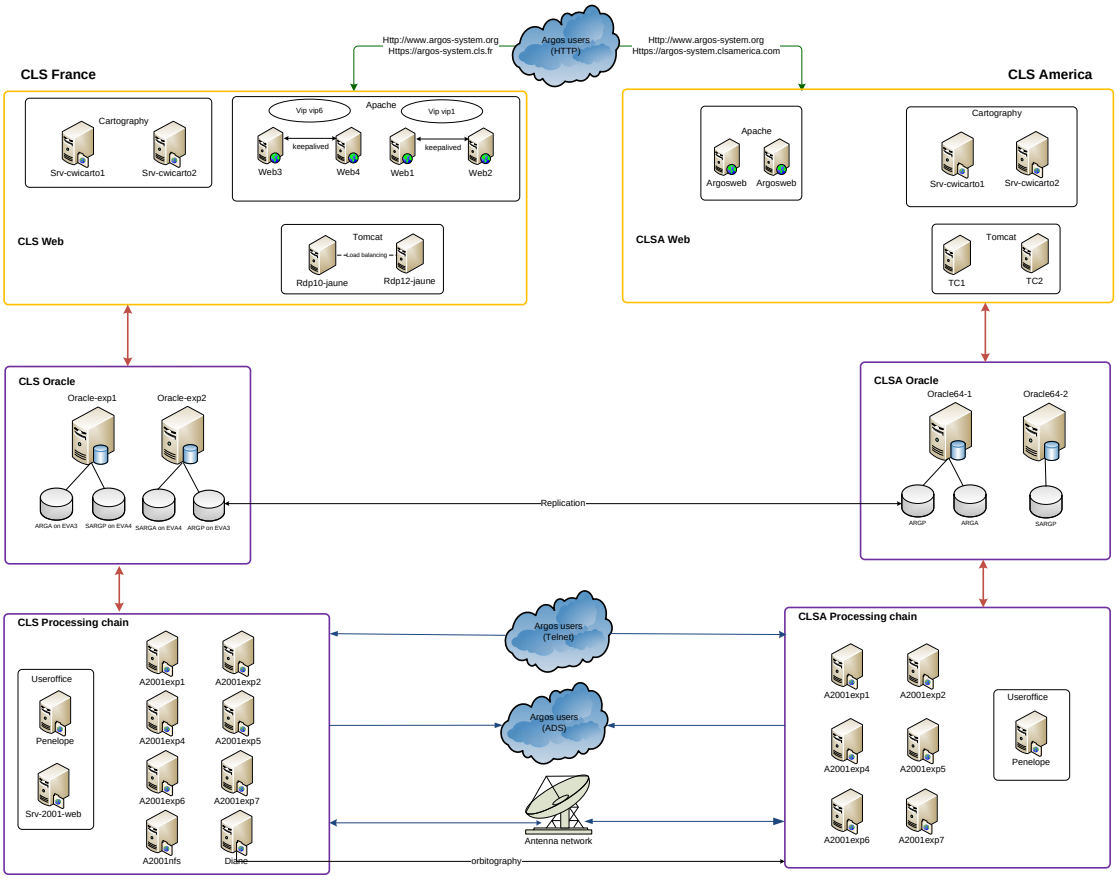


Figure 21: Architecture of the CLS France and the CLS America global processing centers

3.3.1.1. **The CLS Argos processing chain**

Composed of different software modules, the processing chain is in charge of receiving and processing the Argos data issued from the satellites and acquired by the global and real-time ground stations networks.

Argos data are processed in terms of collect and location, and stored into a database.

The processing chain is also in charge of distributing the data by ADS (Automatic Distribution System) or allowing users to access to their data using Telnet, ArgosWeb or the web services.

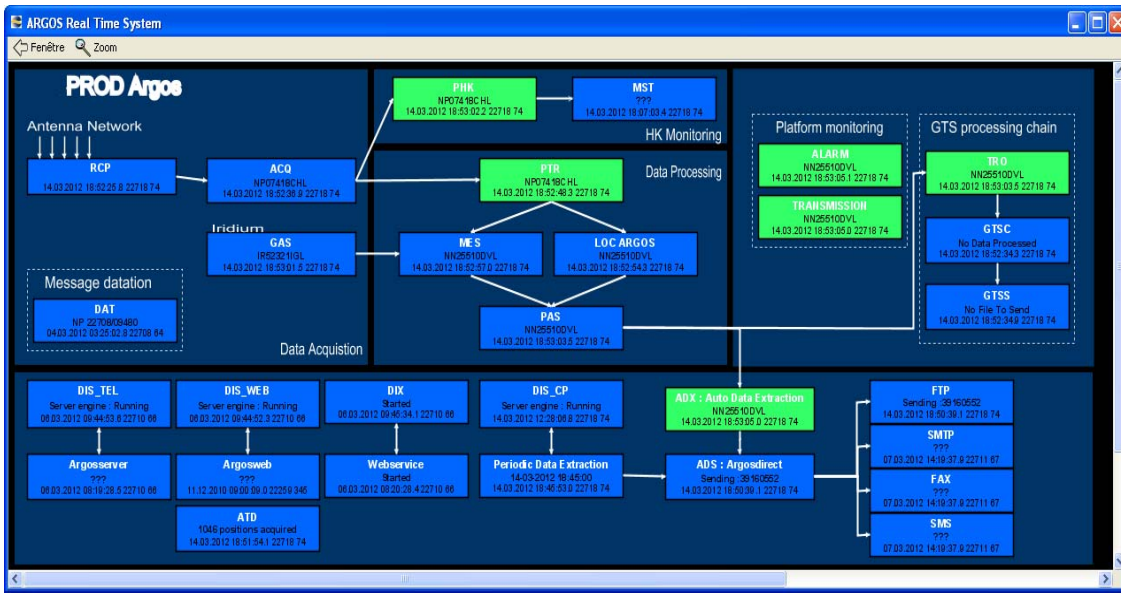


Figure 22: Synoptic of the CLS Argos processing chain

3.3.1.2. **The Oracle database**

At the heart of the computing architecture, the Oracle database is used to store the Argos declarative data as well as the processed data.

In order to keep a perfect coherency between CLS France and CLS America centers (mandatory to guarantee the redundancy between both centers), an automatic mechanism of replication is implemented between CLS France and CLS America databases.

3.3.1.3. **The web distribution**

Based on a farm of Apache Web servers, the Web distribution allows the users to access their data using a Web cartographic interface. The service of maps is supported by two cartographic servers on which are running the mapping engines C-Map for the marine cartography and MapInfo for the terrestrial one. The application server is supported by Tomcat.

3.3.2. ***Disaster recovery architecture***

Disaster recovery architecture implementation is completed. The computer room is located into CNES Toulouse. Some of the Argos architecture components are DR compliant in order to improve services availability. However, the main backup is based on the 2 global processing centers (Toulouse & Lanham).

Figure 23 : Disaster Recovery Room located in CNES

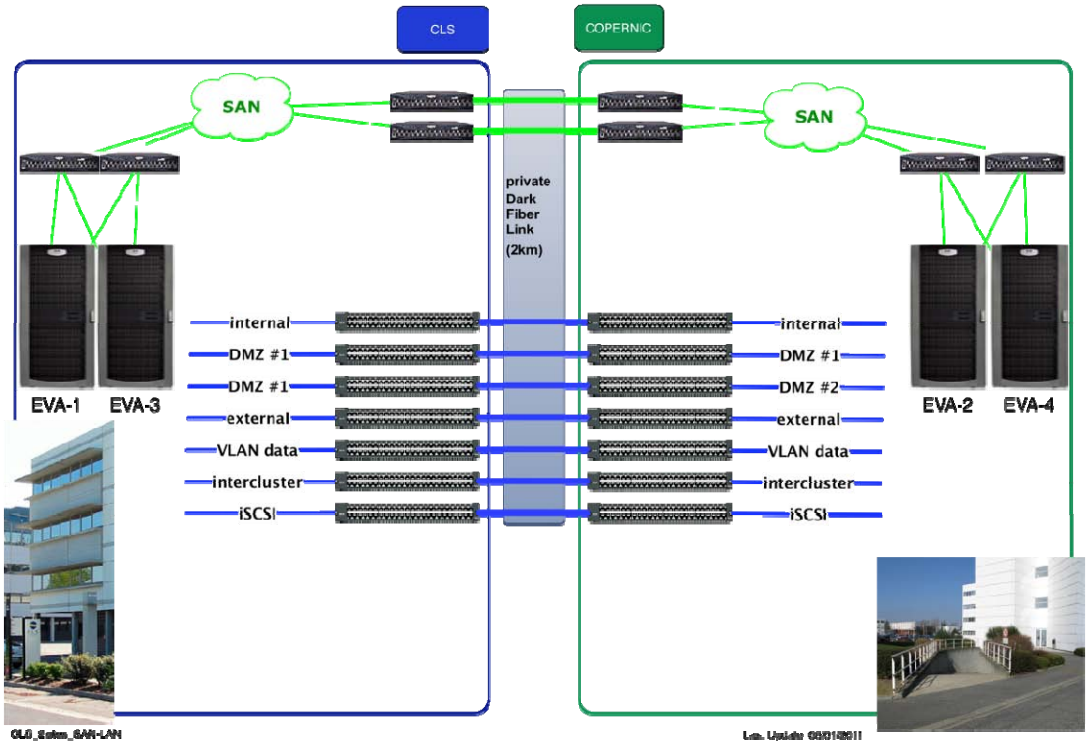


Figure 24 : Disaster recovery architecture diagram

3.3.3. ***Data processing statistics***

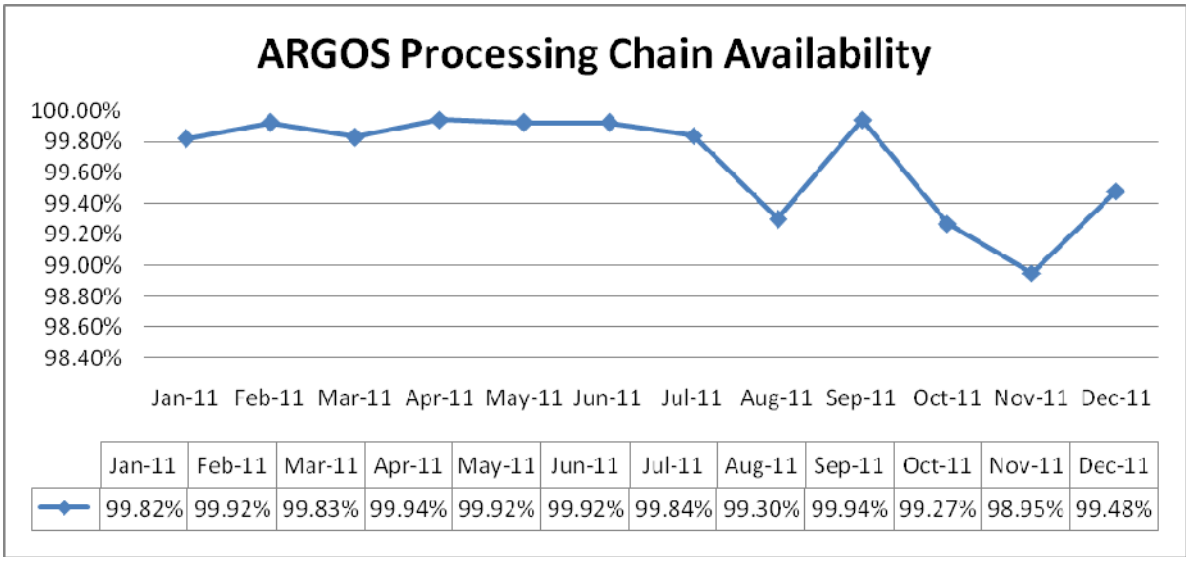
The Argos Operations missions at CLS are:

- Availability and reliability of Argos Products and Services in accordance with the SLAs,
- Support internal or external Argos projects, or proposals,
- Control and reduce operational risks and costs in order to ensure 24h/24, 7 days per week operational services.

In order to monitor the Argos processing centers, statistics are produced in real-time:

- on the availability of Argos data distribution tools,
- on the data delivery time for sample platforms,
- on Argos location delivery time for sample platforms,
- and on the percentage of data available in less than one hour.

In 2011, the average availability is **99,68%**. This indicator corresponds to the percentage of real time datasets processed in less than 10 minutes (Between Pre-Processing component PTR and PAS component in charge of inserting data in database for user requesting). This number does not include periods when French site was in backup mode on the US site.
In this context, decreasing availability could be observed in case of a module crashes and the time it takes to restart it. During these periods, other datasets are queued and are waiting to be processed increasing the time they passed between PTR and PAS modules.



	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
	99.82%	99.92%	99.83%	99.94%	99.92%	99.92%	99.84%	99.30%	99.94%	99.27%	98.95%	99.48%

Figure 25 : Argos Processing SLA follow up in 2011

3.3.3.1. **Number of Argos messages processed**

The average number of messages received every day by the Lanham or Toulouse Centers in 2011

has been multiplied by 1.5 in 4 years.

Per day	2008	2009	2010	2011
Messages received	1 969 658	2 273 233	2 871 885	2 904 476

Figure 26 : Number of Argos messages received since 2008

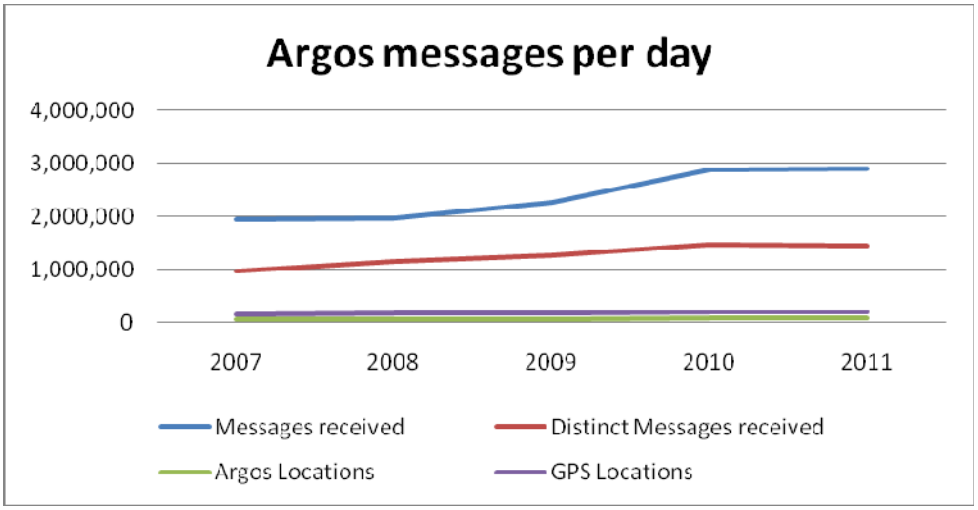


Figure 27 : Argos messages per day (Chart view)

3.3.3.2. Argos location and data collection latencies

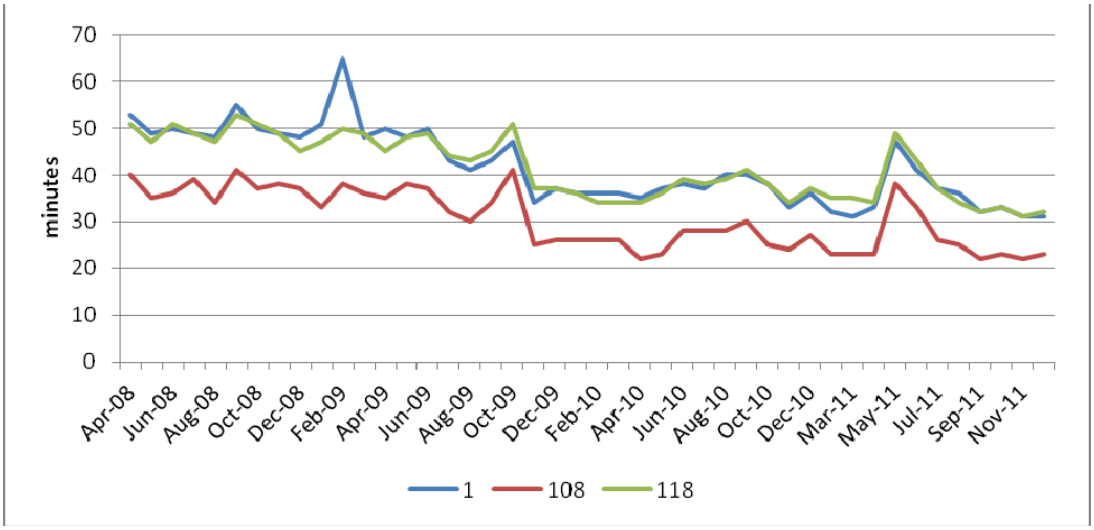


Figure 28 : Average latency on Argos data collection for sample platforms *

Figure 29 : Average latency on Argos locations for sample platforms*

* Sample platforms are timing and orbit determination platforms. Every hour, the last data collection and location times for these three platforms are controlled. Collection and location latency on ID 108 (Fairbanks) is under latency of Ids 1(Toulouse) and 118 (Wallops Island) due to the transmitter location and the higher number of passes over this transmitter.

We can see major improvement on data and Argos location delivery time since 2008 due to a better real-time antennas network, a sixth operational Argos satellite in 2009 (NOAA-19) and enhancements of the Argos data processing performance. Increase during May 2011 is due to processing issue on 07 May (Database insertion driver issue).

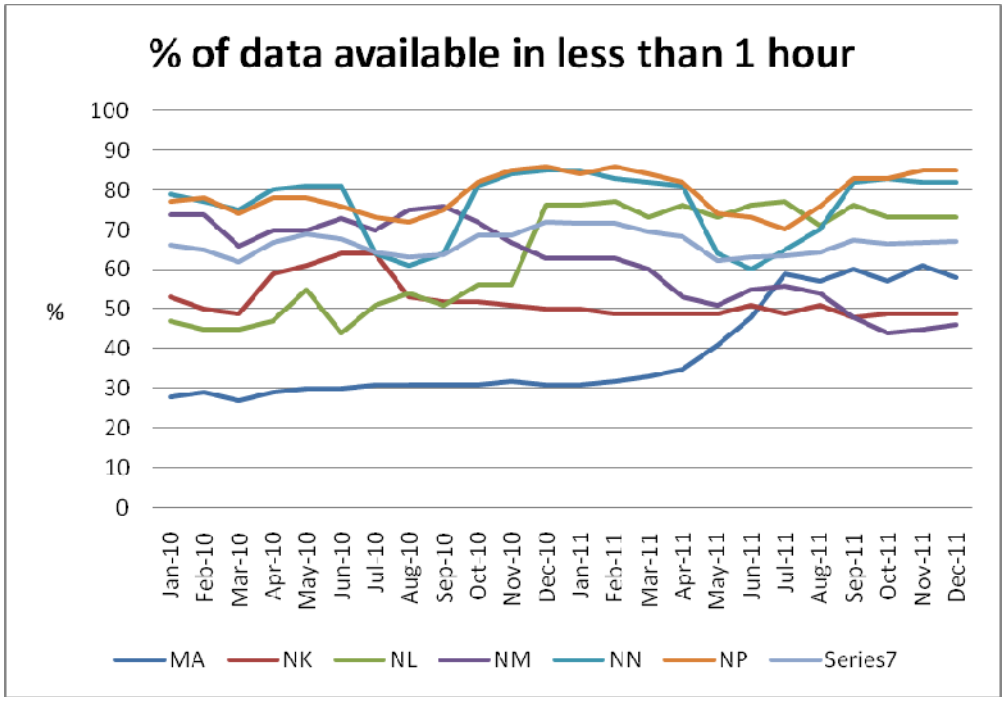


Figure 30 : Data available in 1 hour

Percentage of data available in less than one hour means which percentage of raw data has been processed one hour after its recording on board of the Argos Instrument.

The MA increase corresponds to the addition of the McMurdo antenna in the network. We remind that this Antarctic antenna receives METOP-A half orbits.

NOAA N (Secondary) and P (Primary) as well as NOAA L (Secondary) get better coverage than NOAA K (Secondary) and NOAA M (Backup)

3.3.3.3. **Daily and Monthly active Argos platforms**

The number of Argos platforms operating continues to increase. There is still more activity in Spring/Summer due to the higher number of deployments.

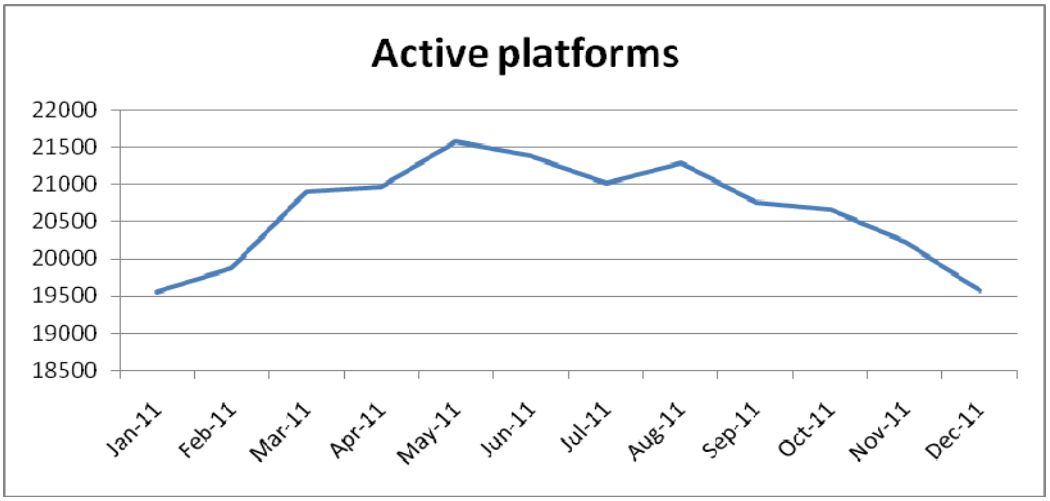


Figure 31: Active Argos platforms in 2011

3.3.4. *Data distribution statistics*

3.3.4.1. **ArgosWeb site**

ArgosWeb is a free web site for Argos users. They can access their data via the Internet, by logging on to a secure website (http://www.argos-system.org) with their username and password (assigned to them by User Services).

ArgosWeb gives users secure and easy access to Argos data via an attractive and user-friendly website. With ArgosWeb, users can view platform trajectories on land and marine maps. Users can also personalize data download formats (table or map format). Users have immediate access to information on their Argos account, as well as platform and program settings.

The annual availability of the French ArgosWeb site (FR) in 2011 is 99.79%
The annual availability of the U.S. ArgosWeb site (US) in 2011 is 99.74%

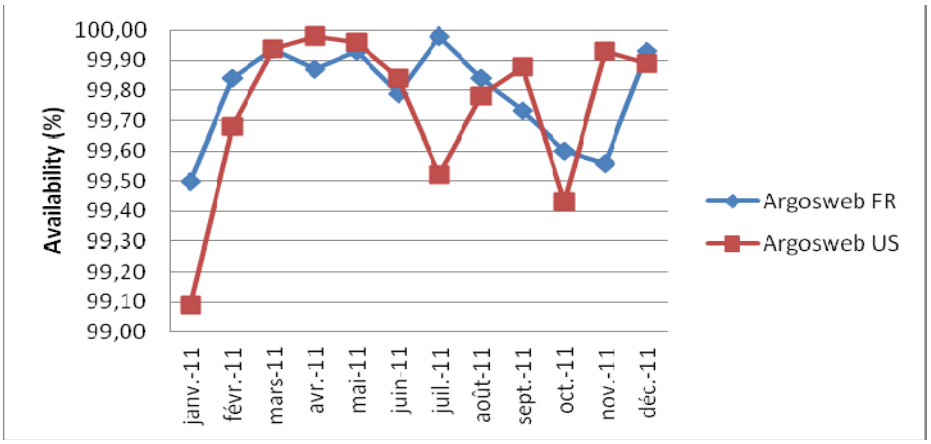


Figure 32 : ArgosWeb site monthly availability in 2011

3.3.4.2. **ArgosServer**

With ArgosServer, the Argos users can logon to Argos Processing Centers and access their data via TELNET. TELecommunication NETwork is a network protocol used by all TCP/IP compatible networks. A Telnet session with CLS's servers can be opened by typing the "Telnet" command on most operating systems (Windows, Unix...). Addresses of the both ArgosServers are:

- ArgosServer.cls.fr
- ArgosServer.clsamerica.com

The annual availability of the French ArgosServer site (FR) in 2011 is 99.83%
The annual availability of the U.S. ArgosServer site (US) in 2011 is 99.48%

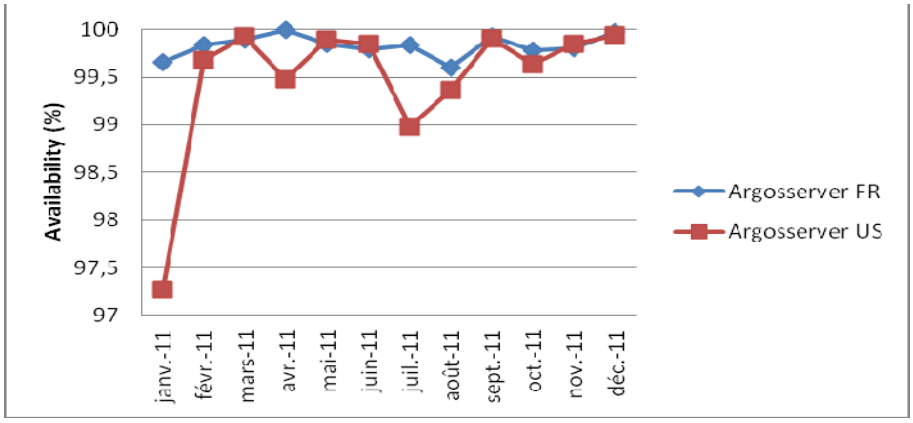
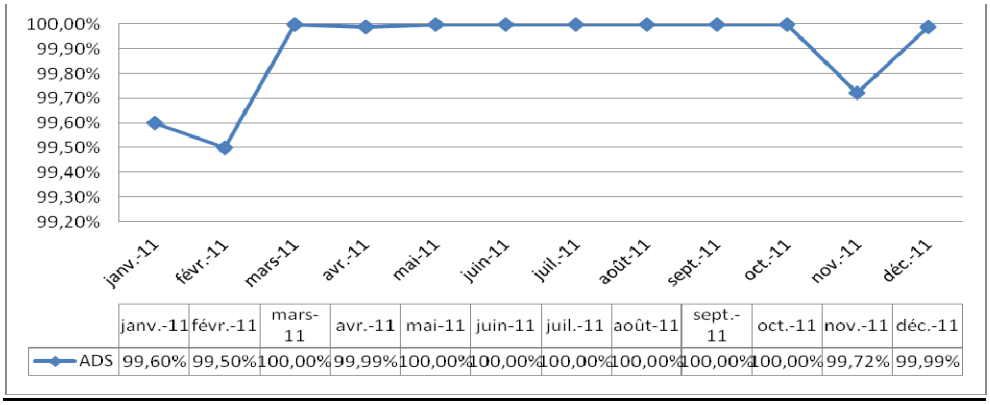


Figure 33 : ArgosServer monthly availability in 2011

3.3.4.3. **ArgosDirect**

ArgosDirect automatically sends data to users by e-mail, FTP or CD-ROM. ArgosDirect allows users to receive their data in several available format (tabular, DS, DIAG…).

The annual availability of the ArgosDirect service in 2011 is 99.90%



	janv.-11	févr.-11	mars-11	avr.-11	mai-11	juin-11	juil.-11	août-11	sept.-11	oct.-11	nov.-11	déc.-11
ADS	99,60%	99,50%	100,00%	99,99%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	99,72%	99,99%

Figure 34 : ArgosDirect monthly availability in 2011

3.3.4.4. **Argos WebService**

CLS has developed a new machine-to-machine/automatic interface called WebService in order to

distribute Argos data. This modern alternative to ArgosServer (Telnet) is free of charge and makes it possible for Argos users to contact CLS's data base directly, via internet, and receive their data in **CSV, XML and KML (GoogleEarth) format**. The Argos WebService delivers useful information such as positions, error estimates,diagnostic data, raw messages, sensor data, etc. The user can choose the different types of data to download via filters.

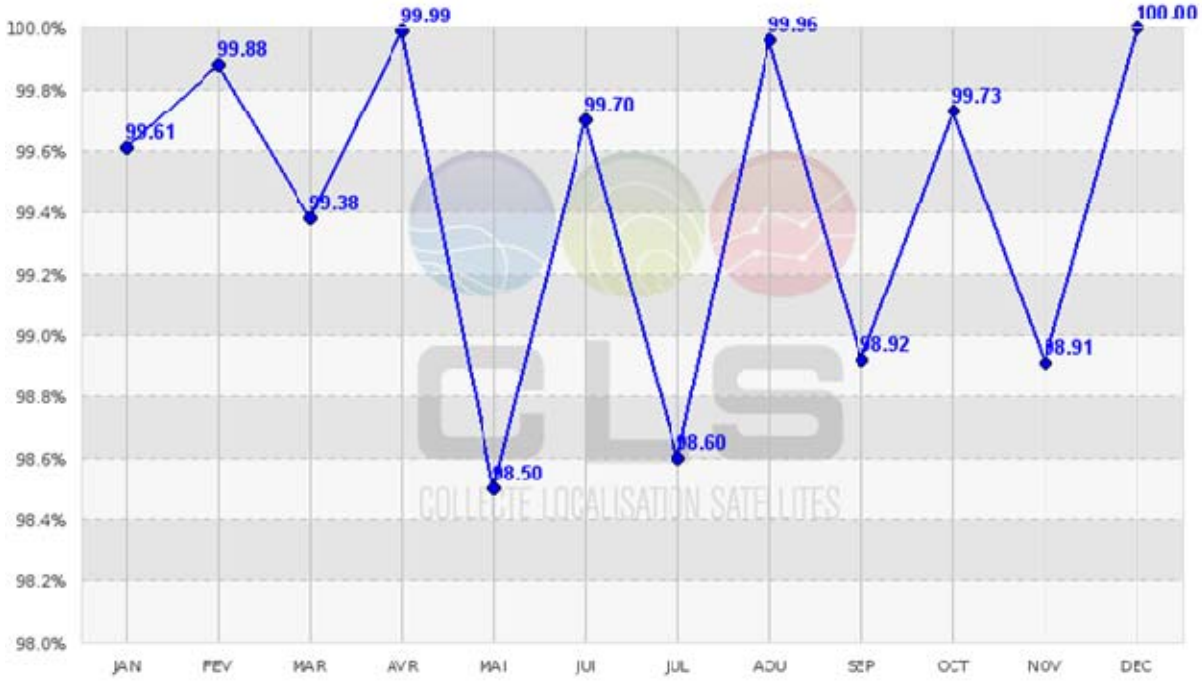


Figure 35 : Argos WebService monthly availability in 2011

3.3.5. ***GTS processing statistics***

CLS is monitoring 24/7 a) the GTS processing system with real-time operational surveillance on the processing modules, b) the quality of the data and c) the system performance (time to process the data, number and size of bulletins)

In 2009 developed a GTS monitoring tool, with following statistics computed each day:
- Number of GTS platforms (with a WMO id) processed,
- Number of observations processed,
- Average disposition time (observation time –time inserted onto the GTS)

These 3 statistics are provided for:
- All types of bulletins
- Each type of text bulletins (BUOY, SHIP, TESAC, and SYNOP)
- Each type of buoy (ATLAS, DRIFTERS, ICE, TRITON and OTHERS)

In 2010, CLS has developed improvements on this GTS monitoring tool with same statistics provided now by ocean basin. CLS is closely working with the DBCP TC to find a solution to publish these statistics on the JCOMMOPS website (see details on chapter 4.1.2. of this document).

According to the last DBCP meeting (XXVII) decisions on GTS bulletins, CLS and CLS America as operational GTS data processing centers:

(i) Displays bulletins for 7-digit WMO buoy numbers in FM-94 BUFR format only. For 5-digits WMO numbers, FM-18 BUOY and FM-94 BUFR reports are displayed on the GTS. For 7-digits WMO numbers, only FM-94 BUFR reports are displayed on the GTS.

(ii) Setup for all buoy observations BUFR reports a subcategory value equal to 25 under category 1. This new subcategory value replaces the previous one (255 “missing value”) since the September 11, 2012 at 12:00 UTC for all surface buoy observation BUFR reports displayed by CLS and CLS America GTS processing centers.

GTS statistics by WMO areas are available at CLS since August 15, 2011. CLS is working with JCOMMOPS to publish these statistics on the JCOMMOPS website.

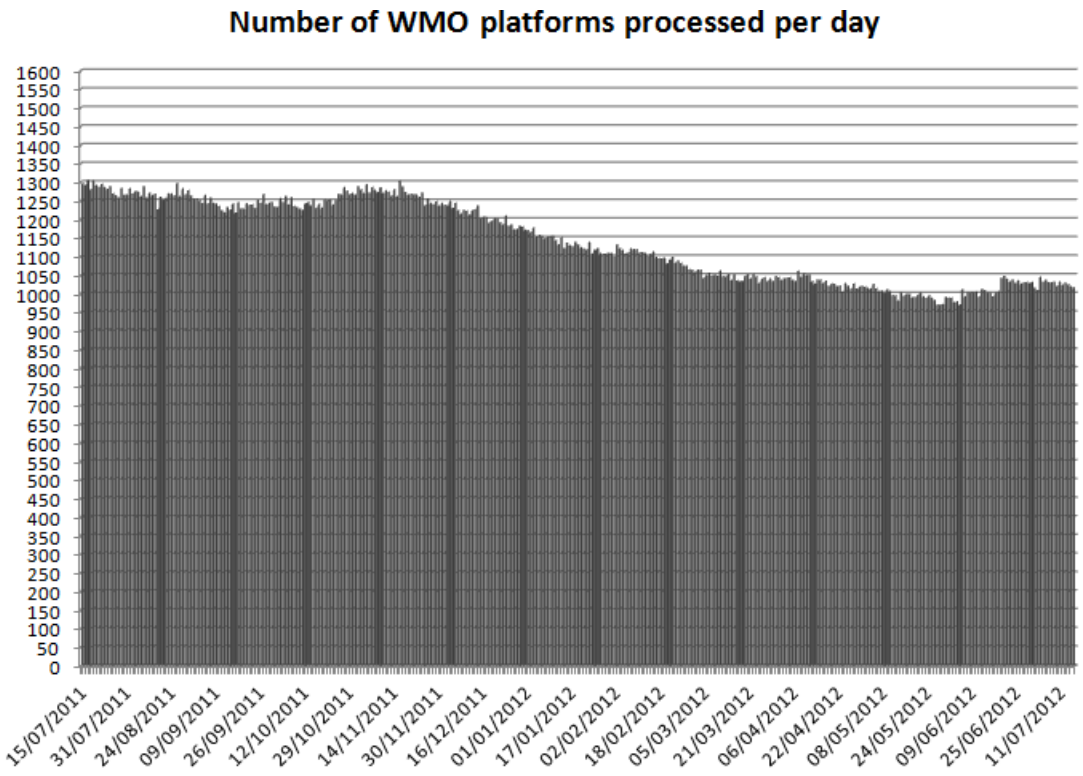


Figure 36: Argos platforms GTS processed per day since July 2011

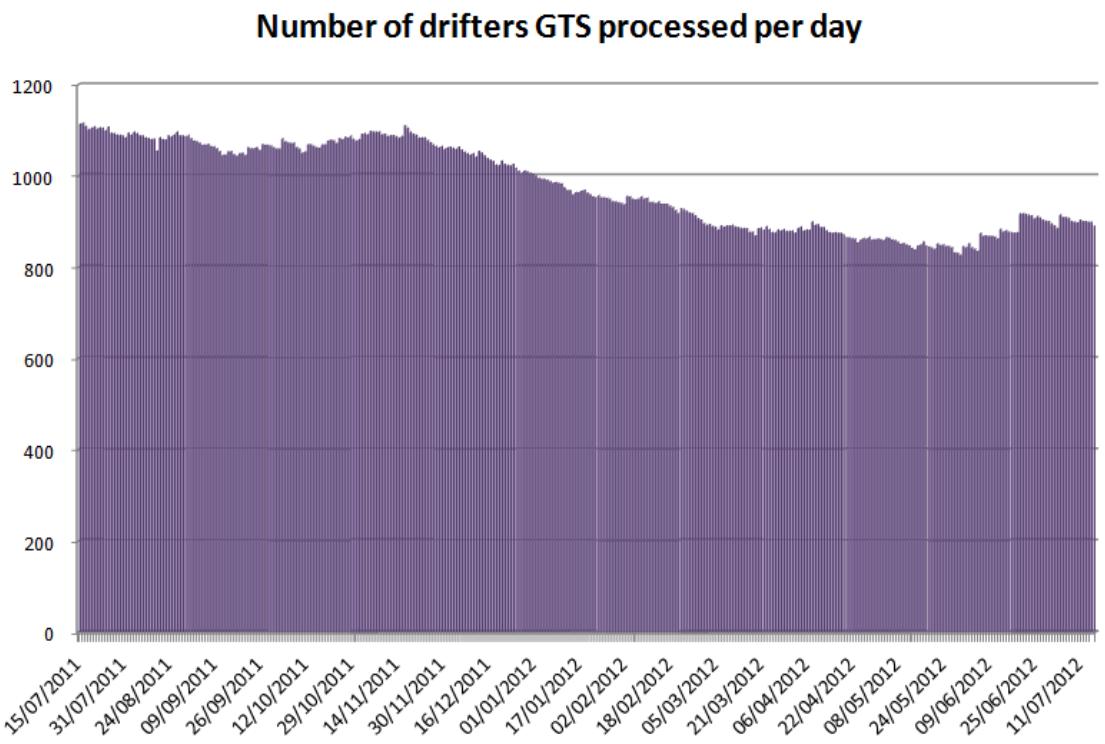


Figure 37: Argos drifters GTS processed per day since July 2011

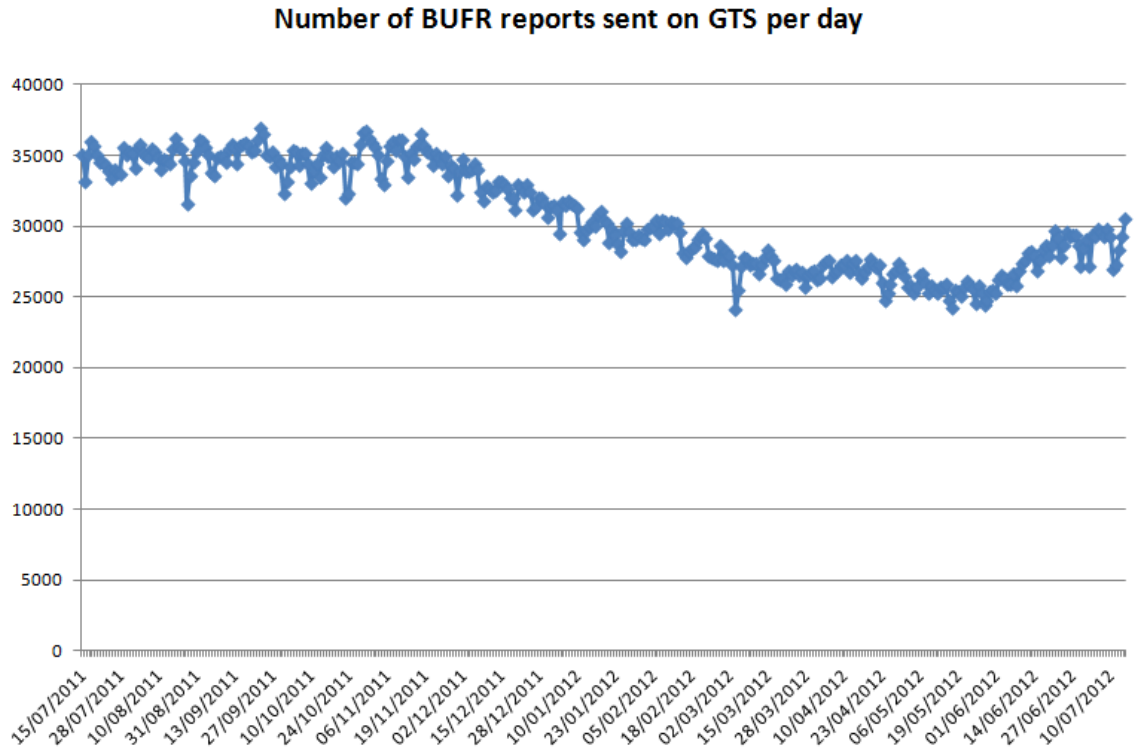


Figure 38: Number of GTS BUFR bulletins produced by CLS per day since July 2011

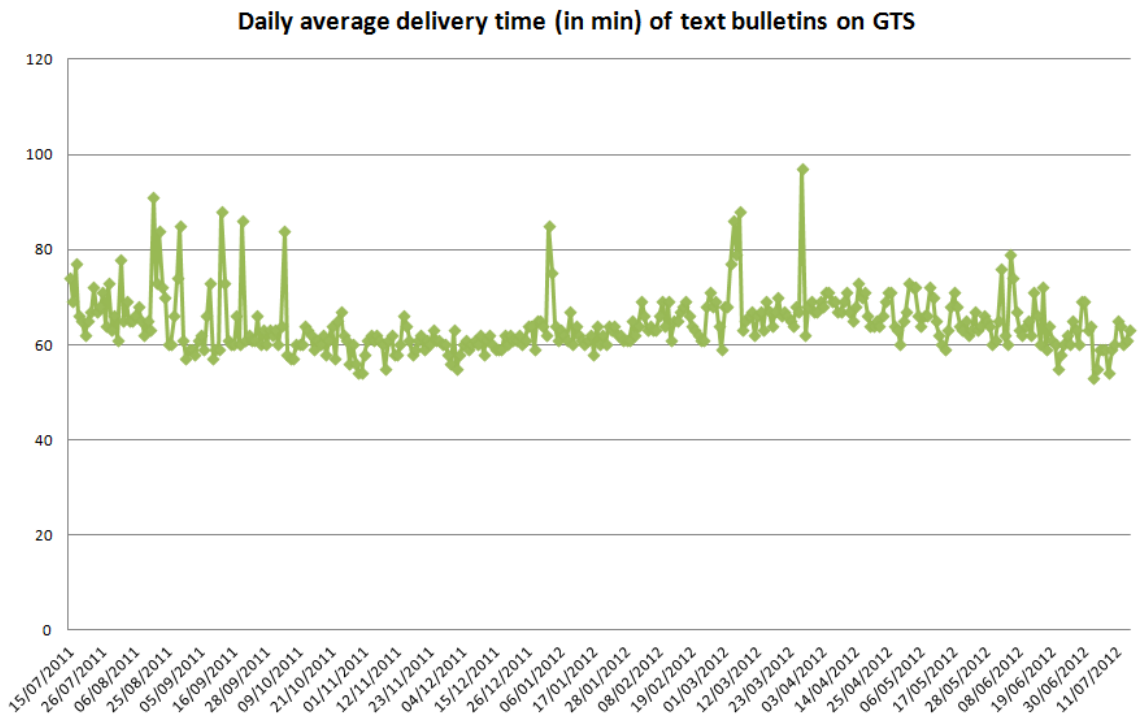


Figure 39: Daily average delivery time for all Argos GTS platforms processed by CLS

3.3.6. *System improvements*

As every year, several software improvements were implemented in 2011 in order to fit with the user requirements. During this year 161 anomaly forms have been treated as 162 system change proposals.

3.3.6.1. **Location processing improvements**

Some improvements have been made on location processing. These improvements have concerned:

- Improvement of controls on locations with 1 message
- Possibility (or not) to compute and / or to distribute locations with 1 message
- Addition of controls on declared mean speeds used in location quality controls
- Opening of a new service for reprocessing Argos locations

3.3.6.2. **Preparation of METOP-B and SARAL launches**

Some corrections and improvements has been mode on the following modules for preparing METOP-B and SARAL launches:

- Acquisition (ACQ) and preprocessing (PTR) to be able to process the new telemetry formats

- Preprocessing of housekeeping telemetry (PHK) to able to decode housekeeping of these 2 new satellites
- Monitoring of satellite housekeeping telemetry (MST) to be able to monitor housekeeping of these 2 new satellites
- Downlink Message Management Center (DMMC) to integrate these 2 new satellites
- System monitoring tools (SST) to adapt these tools for the 2 new satellites
- Orbitography (ORB) to be able to process the orbitography of theses 2 new satellites
- Datation (DAT) to integrate these 2 new satellites

3.3.6.3. **Preparation of the BUFR migration V3 to V4**

In September 2012, the CLS GTS BUFR version will be upgraded to the version 4. We have improved our BUFR coding module to be compliant with this new format.

Acceptance tests for these upgrades have been made successfully by Météo-France and the National Weather Service.

The GTS BUFR version will be upgraded to V4 on September 18, 2012.

3.3.6.4. **Downlink message management system**

The creation of a command to send to a PMT was only possible through Argosweb interface. Now it is possible to create and / or to monitor these commands by emails via the Downlink Message Management System (DMMS).

3.3.6.5. **Various improvements**

Many other improvements have been during this year to improve the Argos service. For example, we have:

- Modify CTA processing to integrate the decoding of Ifremer Arvor Argos-3 Argo float
- Improve operation tools to improve CTA reliability
- Improve CTA processing to improve processing delays and redundancy
- BUFR : switch to tables version 15
- Integration of error ellipse display in kml files generated through ArgosWeb and Argos web services.

3.3.6.6. **2012 planned improvements**

In the second half of the year 2012 will see new improvements. Among the ones which are already

planned, we can list:

- Development of the new Argos orbitography to not use OpenVMS anymore
- Development of new tools to monitor station network and delays
- Migration of Argos operating system (OS) which are obsolete
- Study for migration from Oracle 10g to Oracle 11g
- Study to migration screens developed with Forms to java screens

4 Argos user's applications

4.1. Monitoring Argos platforms

The number of science Argos platforms (except animals) operating is slightly decreasing due primarily to the decrease in the GDP. In June 2012, 5957 platforms were active in the month (6339 in June 2011).

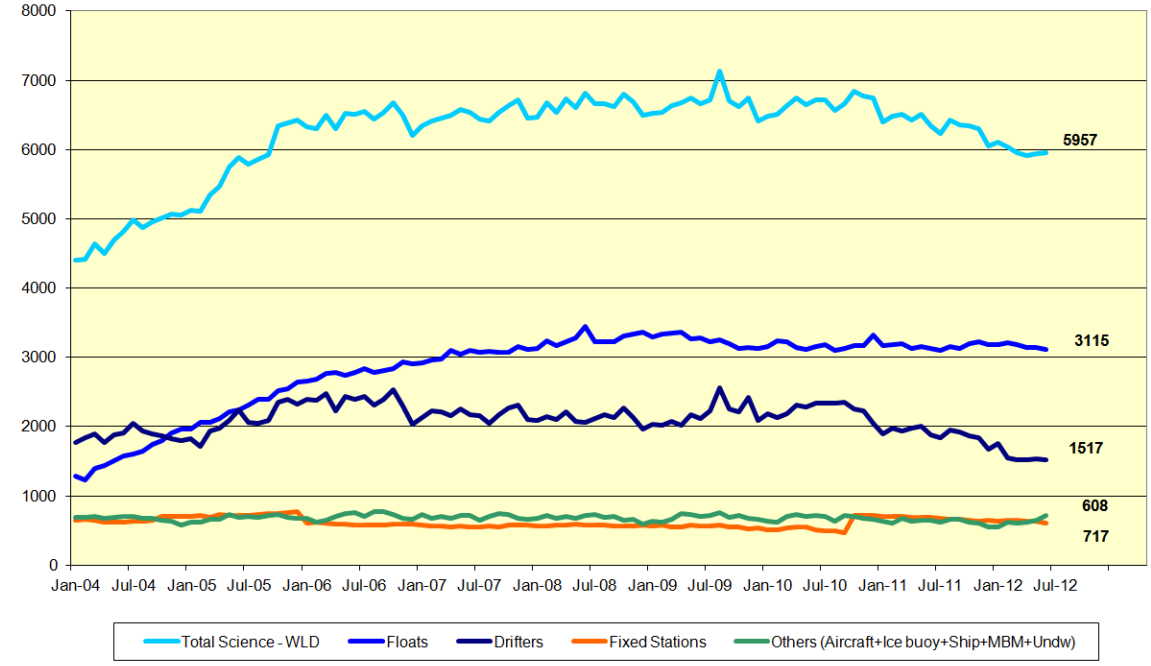


Figure 40: Monthly active ocean Argos platforms statistics

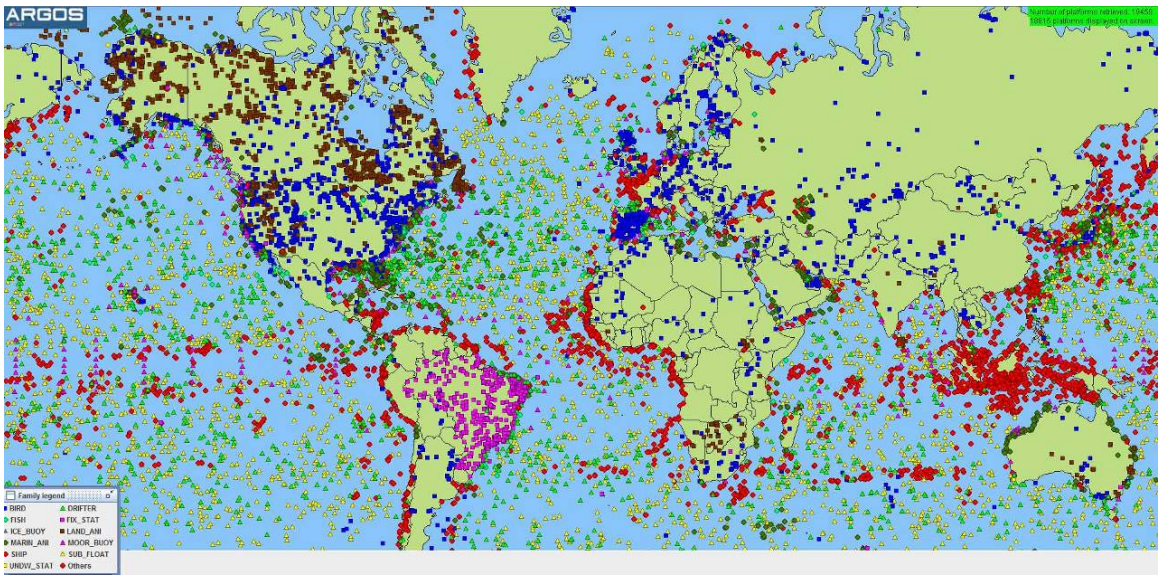


Figure 41 : Active ocean Argos platforms repartition over the world

4.1.1. *CLS Argos report for JCOMMOPS*

In order to answer to the following DBCP action (reference D23/3.3.8): *To identify sources of buoy data not currently reported on the GTS and determine reason for non-availability, particularly for the Arctic Buoys IABP…*

CLS in close collaboration with JCOMMOPS has decided to provide a report on quarterly basis including following information:

- All new ocean and meteorological Argos programs created
- All new ocean and meteorological Argos ID numbers created
- Active Argos platforms without WMO ID number allocated
- All Iridium platforms processed at CLS

4.1.2. *GTS processing statistics report*

In order to answer to the following DBCP action (reference D26/10.3.6):*To make the information from CLS on the new monitoring tools available via its website.*

CLS has collaborated with JCOMMOPS in 2012 on the integration of the GTS monitoring statistics for their distribution on the JCOMMOPS website.

4.2. Argos data timeless

The Argos Data disposal time is defined as the elapsed time between when an observation is collected by an Argos platform and is available to the user.
The Argos Data Mean Disposal Time is composed of four typical delays:

- T1 = the revisit time (time for a platform to be seen by one of the Argos satellite),
- T2 = the time for the data to be downloaded to a ground station (it's nearly instantaneous for an HRPT station or it's the time for the satellite to reach a global station),
- T3 = the data retrieval time (average time for the data to be transmitted to the Argos Data Processing Centers),
- T4 = the processing time (requisite time for the data to be processed in the Argos Data Processing Center and to be available for the users).

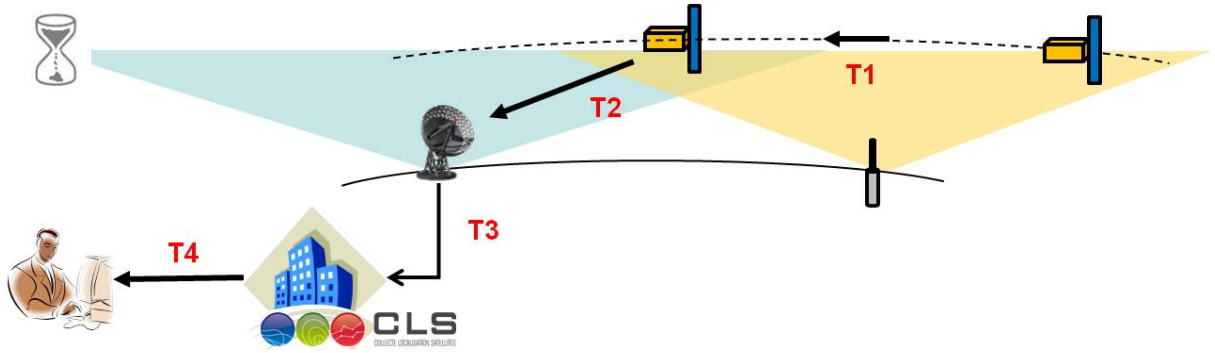


Figure 42 : Argos data mean disposal time diagram

The next figures represent the simulated Argos Data Mean Disposal Time taking into account the Argos satellites constellation, the Argos ground stations and data processing centers' performances in May 2011 and May 2012.

Data disposal time is defined as the elapsed time between when an observation is collected by an Argos platform and is available to the user.

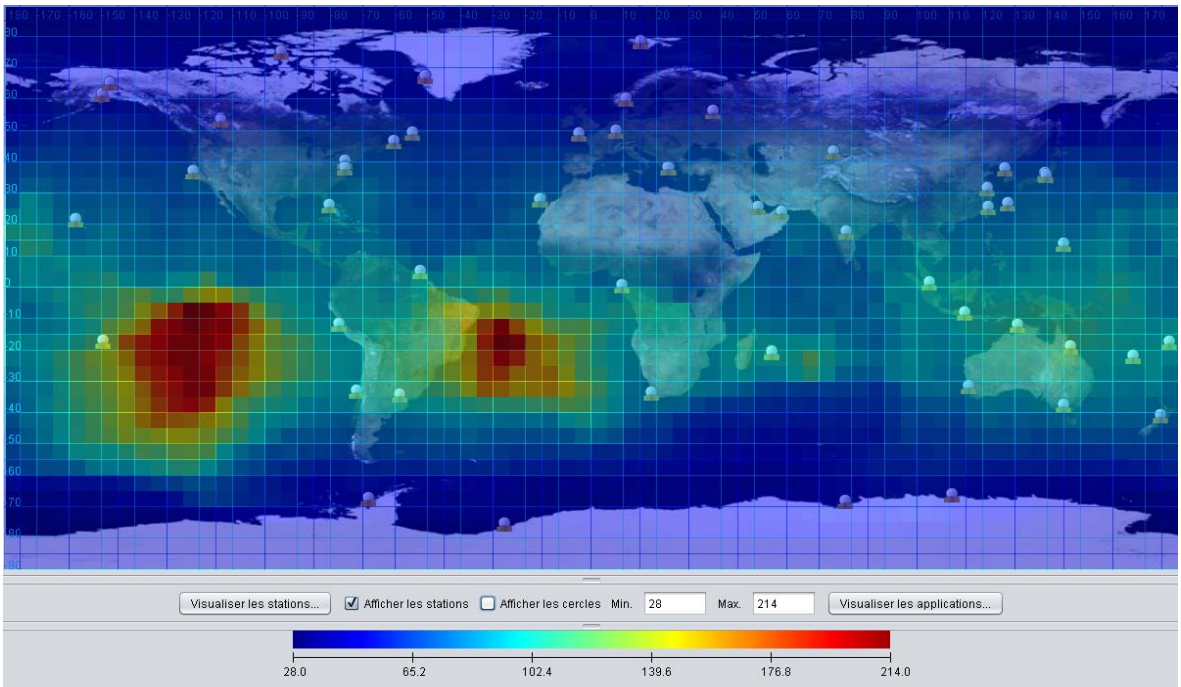


Figure 43 : Argos Data Mean Disposal Time in May 2011 (in minutes)

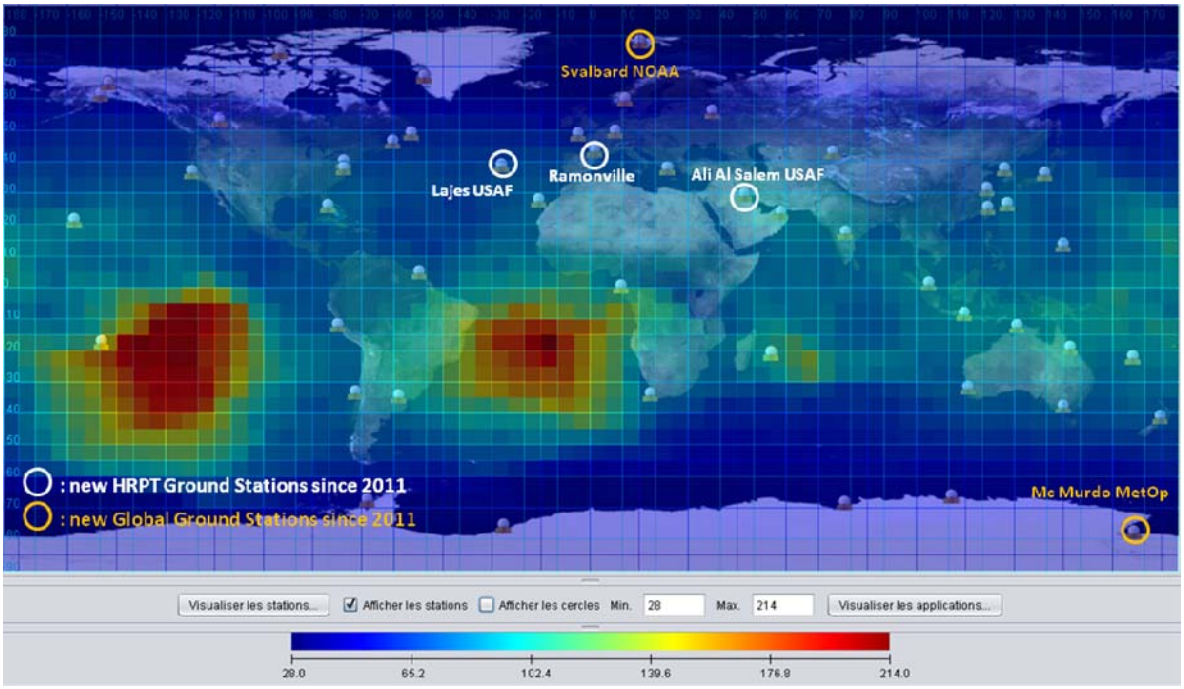


Figure 44 : Argos Data Mean Disposal Time in May 2012 (in minutes)

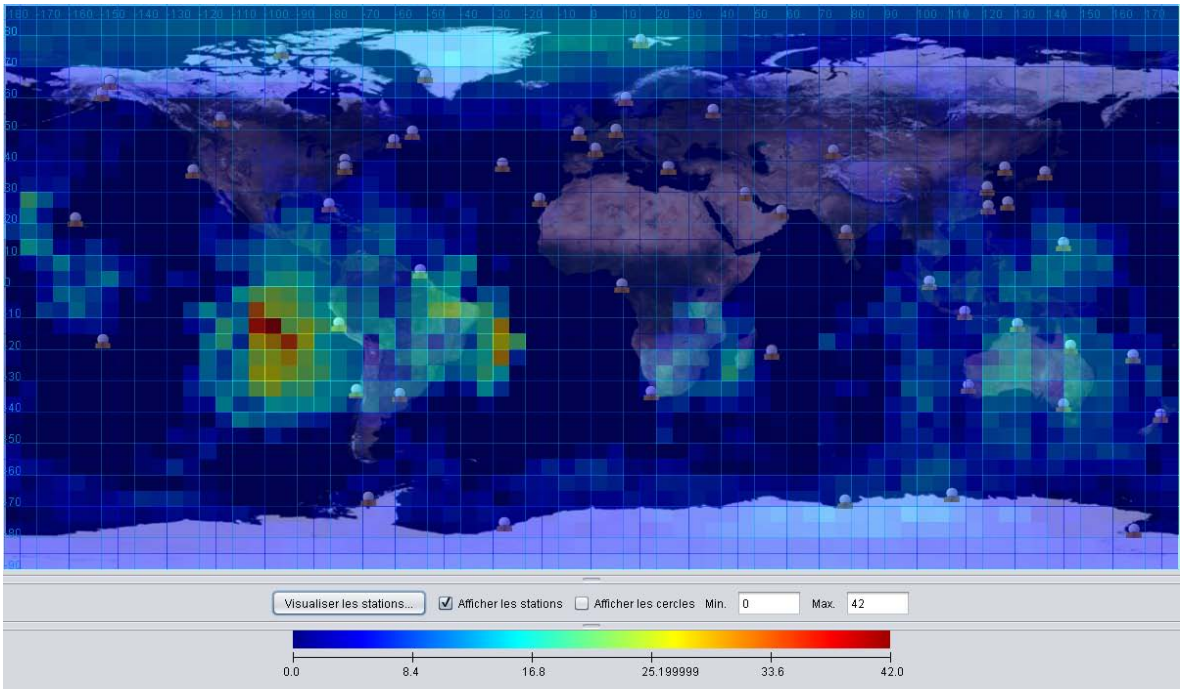


Figure 45 : Average time saved between May 2011 & May 2012 (in minutes)

The improved performances in terms of data mean disposal time observed during the last year are

mainly due to:

- More HRPT Stations track METOP-A (Miami, Monterey, Hawaï, Lima, Cape Town, La Réunion…),
- Mc Murdo Global Station for METOP-A (improvements over the SAA and Australia areas),
- Improved performances for retrieving data from stations (for example: Cape Ferguson, North Australia).

4.3. Argos-3

The third generation Argos system, Argos-3, is functioning 100%. It has been and continues to be operationally available on the METOP-A satellite since early 2007. Although the Argos-3 downlink signal on NOAA-19 is currently turned off, more Argos-3 systems are scheduled to be launched:

- METOP-B (EUMETSAT) on 19/09/2012,
- And SARAL (ISRO) in the second half of October 2012.

Many manufacturers have already integrated the Argos-3 PMT transceivers into their products and others are encouraged to do the same. Users are strongly encouraged to evaluate the Argos-3 capabilities for their data collection needs.

To date, over 3 000 Argos-3 Kenwood PMTs have been sold to Argos manufacturers, mainly in the US.

4.3.1. ***Argos-3 in drifters***

The DBCP setup a dedicated project to assess the Argos-3 system. Drifters were developed:

Figure 46 : Argos-3 Kenwood PMT integrated in a SVP drifter

Bi-frequency antennas were designed with a low-cost approach:

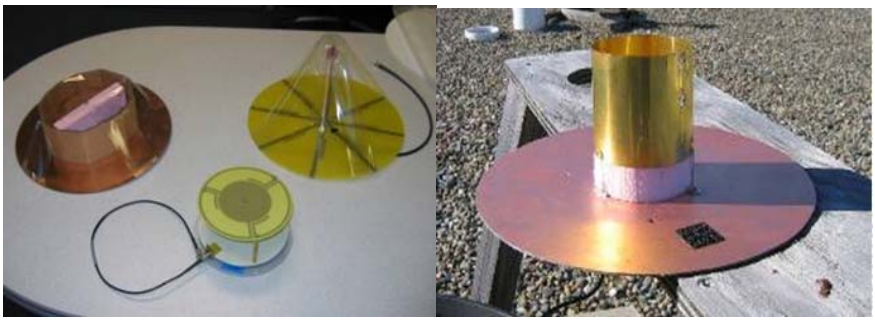


Figure 47 : Bi-frequency antennas for SVP drifter

All main drifters manufacturers have integrated the Argos-3 Kenwood PMT:

- Pacific-Gyre,
- Metocean,
- Clearwater,
- Data Buoy Instrumentation,
- Marlin-Yug.

Here below, the list of all Argos-3 drifters deployed in the Argos-3 DBCP Pilot Project, except the failures at deployment. The lifetime of drifters is computed with the first date of the Argos transmission after deployment and the last date of transmission until August 10, 2012.

PMT ID	Deployment	Last location	Lifetime in days	Drifter type	Manufacturer	Comments
42964	02/11/2010	03/11/2010	2	SVP_B	MARLIN_YUG	
82583	30/03/2011	02/04/2011	3	SVP_B	CLEARWATER	
82545	07/03/2011	16/03/2011	9	SVP_B	CLEARWATER	
41885	22/08/2010	05/09/2010	15	SVP_B	MARLIN_YUG	
82546	07/03/2011	28/03/2011	22	SVP_B	CLEARWATER	
82223	10/09/2009	18/12/2009	99	SVP_B	CLEARWATER	
82537	25/11/2009	06/03/2010	101	SVP_B	MARLIN_YUG	
82236	15/09/2009	28/12/2009	104	SVP	PACIFIC_GYRE	
82227	16/10/2009	30/01/2010	106	SVP_B	CLEARWATER	
42652	07/09/2011	22/01/2012	137	SVP_B	PACIFIC_GYRE	
82244	22/09/2009	10/02/2010	141	SVP	PACIFIC_GYRE	
82245	22/09/2009	16/02/2010	148	SVP	PACIFIC_GYRE	
82234	04/11/2009	01/04/2010	148	SVP	PACIFIC_GYRE	
82240	22/09/2009	02/03/2010	161	SVP	PACIFIC_GYRE	
42758	15/01/2011	31/07/2011	197	SVP_B	PACIFIC_GYRE	
42708	12/09/2011	16/04/2012	217	SVP_B	PACIFIC_GYRE	
82226	25/09/2009	03/05/2010	220	SVP_B	CLEARWATER	
42965	20/08/2010	11/04/2011	234	SVP_B	MARLIN_YUG	
42750	02/03/2011	22/10/2011	235	SVP_B	PACIFIC_GYRE	

82242	13/09/2009	06/05/2010	235	SVP	PACIFIC_GYRE	
82274	14/09/2009	09/05/2010	237	SVP_B	METOCEAN	No data due to a software issue
82544	12/01/2011	13/09/2011	245	SVP_B	CLEARWATER	
82276	15/09/2009	24/05/2010	251	SVP_B	METOCEAN	No data due to a software issue
42759	02/03/2011	08/11/2011	251	SVP_B	PACIFIC_GYRE	
82233	21/09/2009	03/06/2010	255	SVP_B	CLEARWATER	Beached
42757	03/03/2011	21/11/2011	264	SVP_B	PACIFIC_GYRE	
82549	05/04/2011	05/01/2012	275	SVP_B	CLEARWATER	
82282	21/09/2009	01/07/2010	283	SVP_B	METOCEAN	No data due to a software issue
82542	02/12/2010	19/09/2011	291	SVP_B	CLEARWATER	
42755	02/03/2011	30/12/2011	304	SVP_B	PACIFIC_GYRE	
82280	23/09/2009	28/07/2010	308	SVP_B	METOCEAN	No data due to a software issue
82534	24/11/2009	06/10/2010	315	SVP_B	MARLIN_YUG	
82585	05/04/2011	29/02/2012	331	SVP_B	CLEARWATER	
42716	03/03/2011	31/01/2012	334	SVP_B	PACIFIC_GYRE	
42658	09/09/2011	10/08/2012	336	SVP_B	PACIFIC_GYRE	Still in operation
82273	19/09/2009	12/10/2010	388	SVP	METOCEAN	No data due to a software issue
82235	05/11/2009	17/12/2010	407	SVP	PACIFIC_GYRE	
82237	05/11/2009	18/01/2011	439	SVP	PACIFIC_GYRE	
42973	02/09/2010	13/12/2011	467	SVP_B	MARLIN_YUG	Beached and recovered
82258	20/09/2009	02/02/2011	499	SVP	METOCEAN	No data due to a software issue
42737	02/03/2011	21/07/2012	507	SVP_B	PACIFIC_GYRE	
82279	15/09/2009	05/03/2011	536	SVP_B	METOCEAN	No data due to a software issue
42957	02/09/2010	14/04/2012	591	SVP_B	MARLIN_YUG	
42961	19/08/2010	10/08/2012	665	SVP_B	MARLIN_YUG	Still in operation - beached and redeployed
41882	01/10/2010	10/08/2012	679	SVP_B	MARLIN_YUG	Still in operation
41803	30/09/2010	10/08/2012	680	SVP_B	MARLIN_YUG	Still in operation

Figure 48 : List of drifters deployed in the Argos-3 DBCP Pilot Project

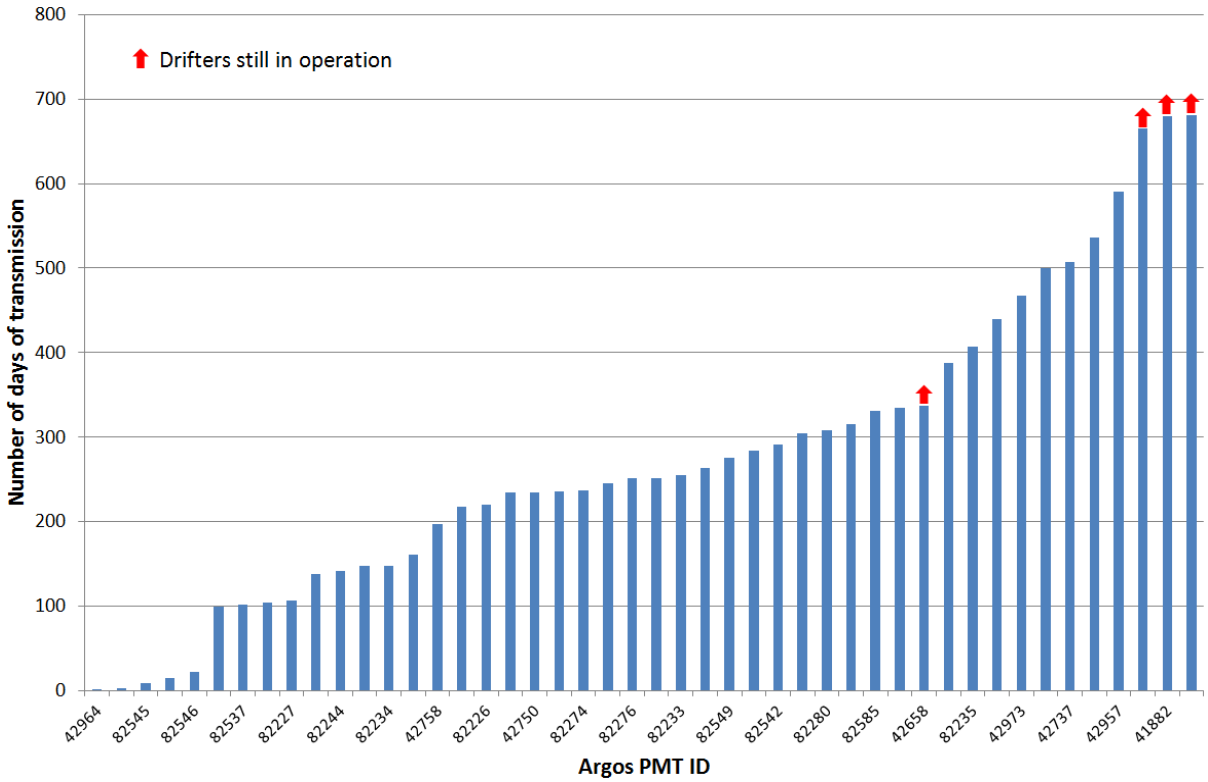


Figure 49 : Argos-3 drifters lifetime in number of days of transmission

Four drifters are still in operation and the lifetime record in term of satellite transmission is held by an Argos-3 Marlin-Yug drifter, still in operation after 680 days ON.

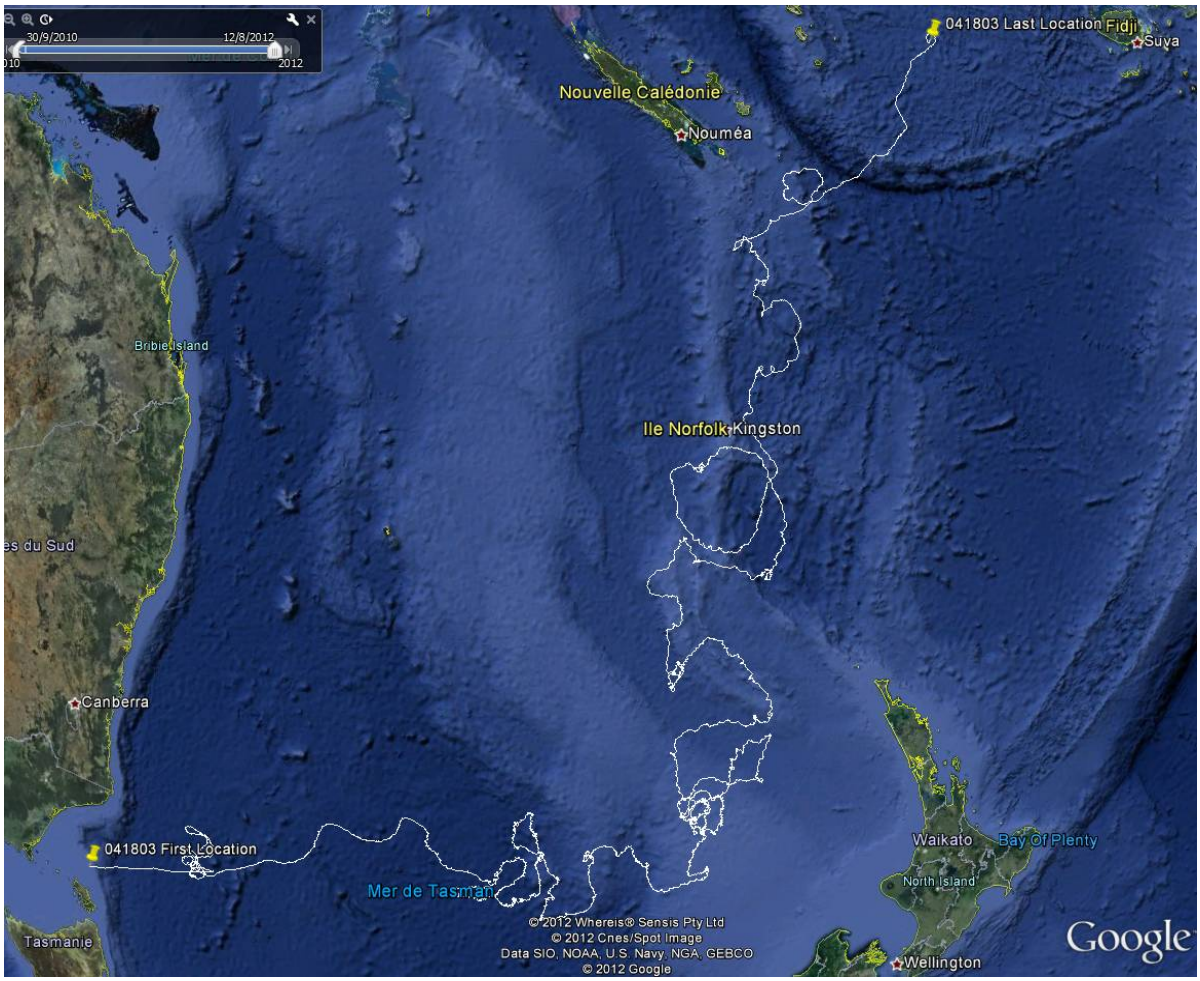


Figure 50 : Argos-3 Marlin-Yug drifter ID 41803 track

The Argos-3 benefits for drifters are:

- A high performance for collecting hourly sensor acquisitions (>95%) for those buoys that are operating
- A large reduction (~75%) of the power consumption used for the data transmission, allowing a reduction in the size of the battery pack and/or increasing the drifter lifetime,
- Improved synoptic measurements (on average, more than 22 hourly observations collected per day),
- Optimization of the transmission leading to a better use of the satellite network and then better performance for users,
- Secure uplink transmission with an automatic checksum control,
- Remote commands via the Argos-3 downlink to change the mission parameters.

4.3.2. ***Argos-3 in moored buoys***

The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is using high-speed data transmission by the ARGOS-3 system into the m-TRITON buoy. Four m-TRITON buoys are already deployed.

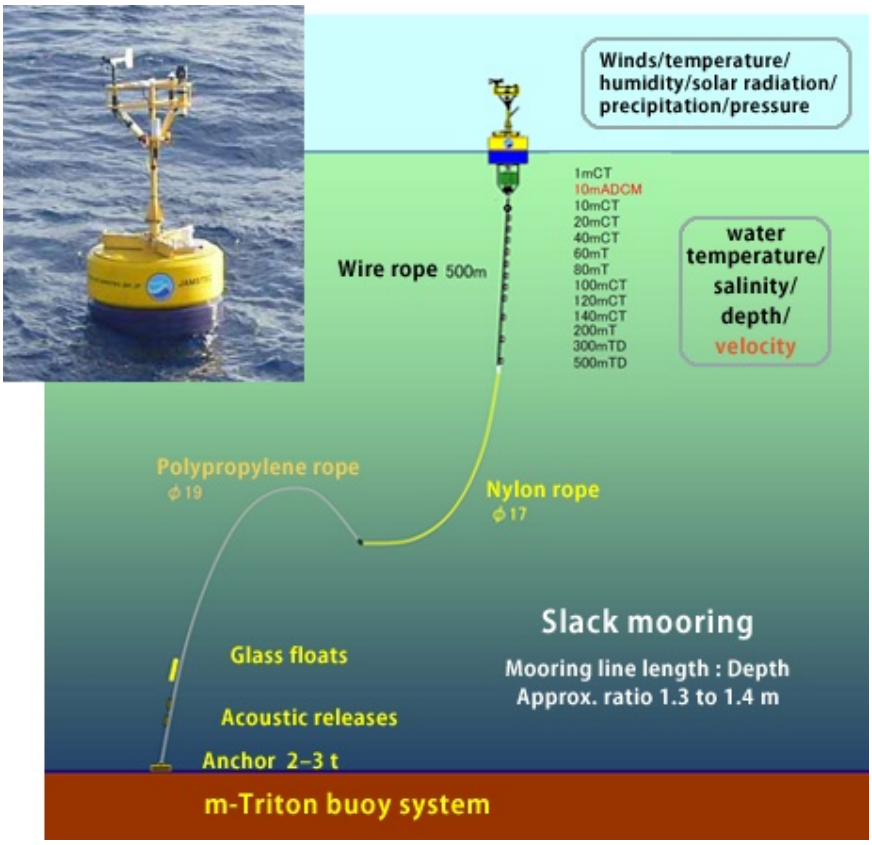


Figure 51 : m-Triton buoy using Argos-3 high data rate

The transmission system with the PMT-HD, which can provide a two-way communication and high data-rate uplink, has enabled a large transfer of data, allowing greater efficiency in data acquisition.

The Argos-3 m-TRITON buoy collects 15.3 times more than a TRITON buoy equipped with an Argos-2 transmitter (27.6 kbytes per day) and energy consumption due to transmission is divided by 6 as the PMT is synchronized with the satellite and transmits only during satellite passes.

The high-speed data transmission achieved by the PMT-HD can provide real-time and continuous observational data that has no missing values.

The Oceanography Department of the Canaries Institute of Marine Sciences (ICCM) is using the bidirectional data link Argos-3 system of into its own custom observing system (moored buoy) for real-time met-ocean monitoring at the ESTOC site (European Station for Time-series in the Ocean Canaries, 60 Nm North of the archipelago at 29°10'N – 015° 30'W and over 3670 meters depth).

Figure 52 : ESTOC moored buoy using Argos-3 interactive mode

The ESTOC moored buoy is using an Argos-3 Kenwood PMT in interactive low data rate mode to transmit ocean and meteorological data in real-time.

Argos-3 system provides the stable and powerful satellite link telemetry required.

4.3.3. *Argos-3/Argos-4 chipset*

Thanks to the Argos-3 implementation plan, we learned about the need to have low power consumption PMTs as well as an Argos-3/Argos-4 receiver for the Argos community. In the frame of the European Artes-5 Program, the Belgium Space Agency together with CNES are supporting a 2M€ contract for developing such solutions. CLS and ANSEM (http://www.ansem.com) will be involved in this 3-year development.
The Project will design a new low-cost generation tag dedicated to track marine animals equipped with Argos-3/4 features for improving the volume of data collected by satellites. The tag will be manufactured then tested on a sample of marine animals in real conditions.

Prototypes will implement a new miniaturized Argos-3/4 RF module enabling 2-way communication and providing improved battery lifetime.

Successful development of the Monolithic Microwave Integrated Circuit (MMIC) would allow deployments of such technology in other environmental fields eligible by the Argos systems such as ocean surface drifters, profiling floats, moored buoys....

Main objectives of the Argos-3/Argos-4 chipset project are:

- Technical development of a tiny Argos-3/4 transceiver module compliant with the required size and technical specifications,
- Technical development of a tiny Argos-3/-4 PMT transceiver compliant with application field constrains,
- A very low power consumption,
- Low cost production unit.

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