Agenda Item D-2

40th Argos Operations Committee meeting
Prepared by CNES
May 24th, 2006

Status of Argos instruments

1- Argos 1 instruments :

After the deactivation of the NOAA-H satellite in June 2004, there are still two Argos-1 instruments in service.

The first Argos-1 instrument is on-board NOAA-J and continues to function properly . It has no redundant receiver.

The other Argos-1 instrument is on-board NOAA-D and has spent 15 years in orbit. It is part of the initial series TN (NOAA-A to G) and was manufactured a long time ago.

Both payloads are operational in regional (real-time in L-band) and in global mode.

NOAA-K to NOAA-N satellites record data onboard and then download them to NOAA's receiving stations at Fairbanks and Wallops Island. Data from NOAA-D and NOAA-J are also recorded onboard, but only retrieved by NOAA when station availability allows.

It can be noted that the HRPT signal of NOAA-L is transmitted in LHCP polarization (instead of RHCP for all other satellites), meaning that some of the HRPT stations cannot receive the real-time signal of this satellite.

2- Argos 2 instruments:

Argos instruments onboard NOAA-K, L, M and N are second generation instruments. They have an increased receiving bandwidth (80 kHz instead of 24 kHz) and an increased telemetry bit rate of 2560 b/s.

The Argos-2 system capacity is considered to be reached when the probability to receive a single message is 50% . That corresponds to a system occupancy from the satellite = 11 Erlang (computed with 8 processing units over the 80 kHz bandwidth).

Currently, a mean capacity = 2.2 Erlang is used by the Argos system with peaks = 6 to 7 Erlang above the most crowded areas (South America, West-Europe and mainly South-East Asia).

The last Argos-2 instrument has been launched with NOAA-N in May 2005. It functions properly with the exception of the processing unit DRU#8 which has failed immediately after the instrument switch-on.

The impact of having 7 DRUs instead of 8 is not critical, only a few percent of messages are lost over the most crowded areas (as Perou or Indonesia).

There are now six operational payloads on orbit. Four of them are Argos 2. With the failure of Argos-Next on ADEOS II in October 2003, the downlink service is not operational. It must be waited still several weeks to recover this downlink service with the new Argos-3 instrument and the next METOP-A Launch (expected date is July 17th, 2006).

3- System availability

The system has reached a very high level of availability: as supposed that individual satellites IFOV (Instantaneous Filed Of View) are not overlapping, the instantaneous constellation coverage is approximately 30% of the earth surface.

Satellite	Launch date	Stop	Duration (days)	Total (year)	Comment
Tiros-N	13/10/1978	27/02/1981	868	2,4	prototype
NOAA-A	27/06/1979	31/03/1987	2834	7,8	
NOAA-B	29/05/1980	29/05/1980	0	0,0	launch failed
NOAA-C	23/06/1981	01/06/1986	1804	4,9	
NOAA-D	14/05/1991	06/06/2006	5502	15,1	3 orbits/day
NOAA-E	28/03/1983	29/12/1985	1007	2,8	proto Advanced Tiros-N
NOAA-F	12/12/1984	13/02/1998	4811	13,2	
NOAA-G	17/09/1986	30/08/2001	5461	15,0	
NOAA-H	24/09/1988	16/06/2004	5744	15,7	stopped on 16/6/04
NOAA-I	09/08/1993	21/08/1993	12	0,0	short-circuit on board
NOAA-J	30/12/1994	06/06/2006	4176	11,4	operational
NOAA-K	13/05/1998	06/06/2006	2946	8,1	operational
NOAA-L	21/09/2000	06/06/2006	2084	5,7	operational
NOAA-M	24/06/2002	06/06/2006	1443	4,0	operational
NOAA-N	20/05/2005	06/06/2006	382	1,0	operational
		Total	39074	107,1	

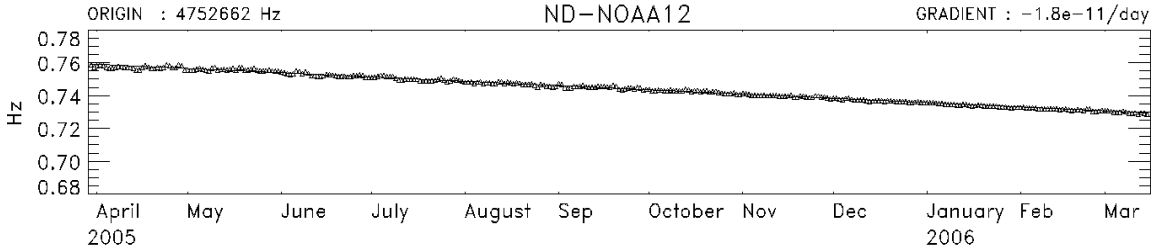
We are currently in the 105th year of cumulated lifetime with Argos onboard payloads without any Argos failure.

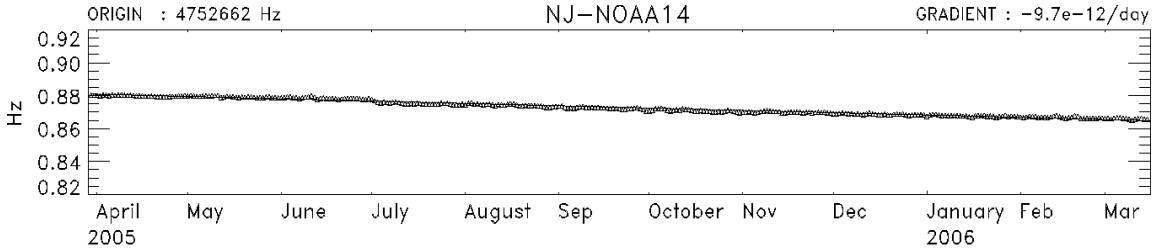
4- USO monitoring

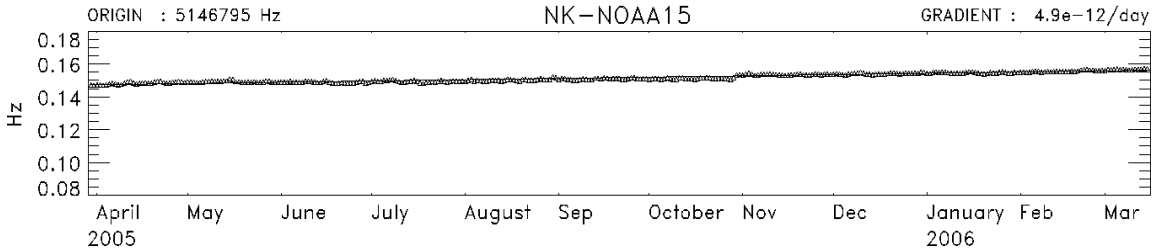
One of the major components of the instrument is the Ultra-Stable Oscillator and it is particularly monitored by CNES and by CLS since most of the instruments functions are referenced to this clock. More particularly, all time-tagging and frequency measurements depend highly on the oscillator stability.

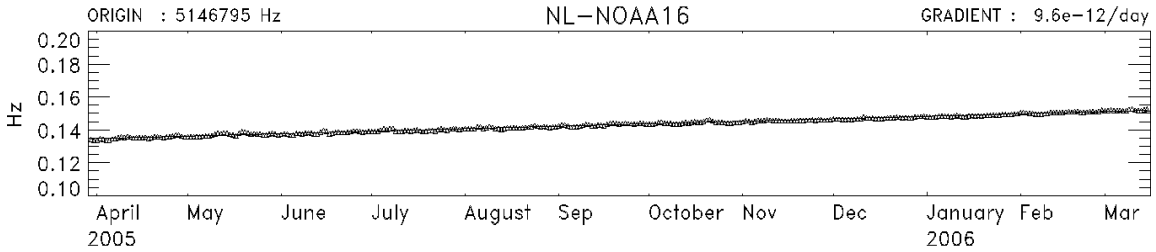
The following table provided by CLS presents the evolution of the frequency over 12 months for all the instruments. It shows that all the oscillators stay within their nominal range in term of stability (gradient around 1.10^{-11} per day).

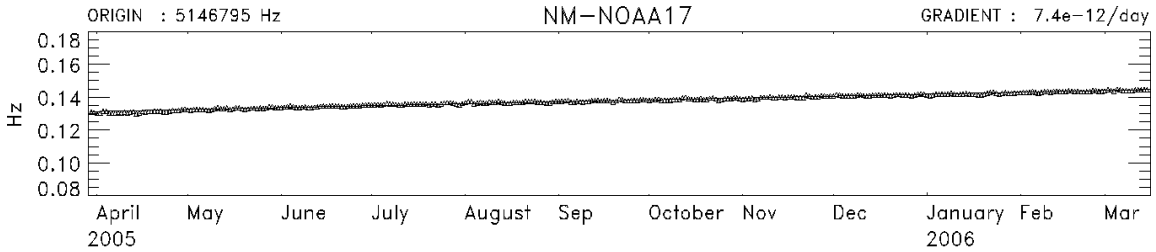
Evolution of onboard USO frequency over 12 months

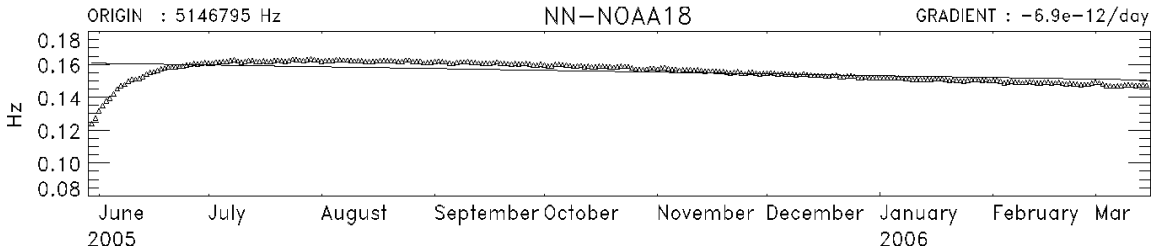












5- Orbital planes

The figure below shows the repartition of the orbital planes of the six satellites as of May 2006 (see figure in the next page).

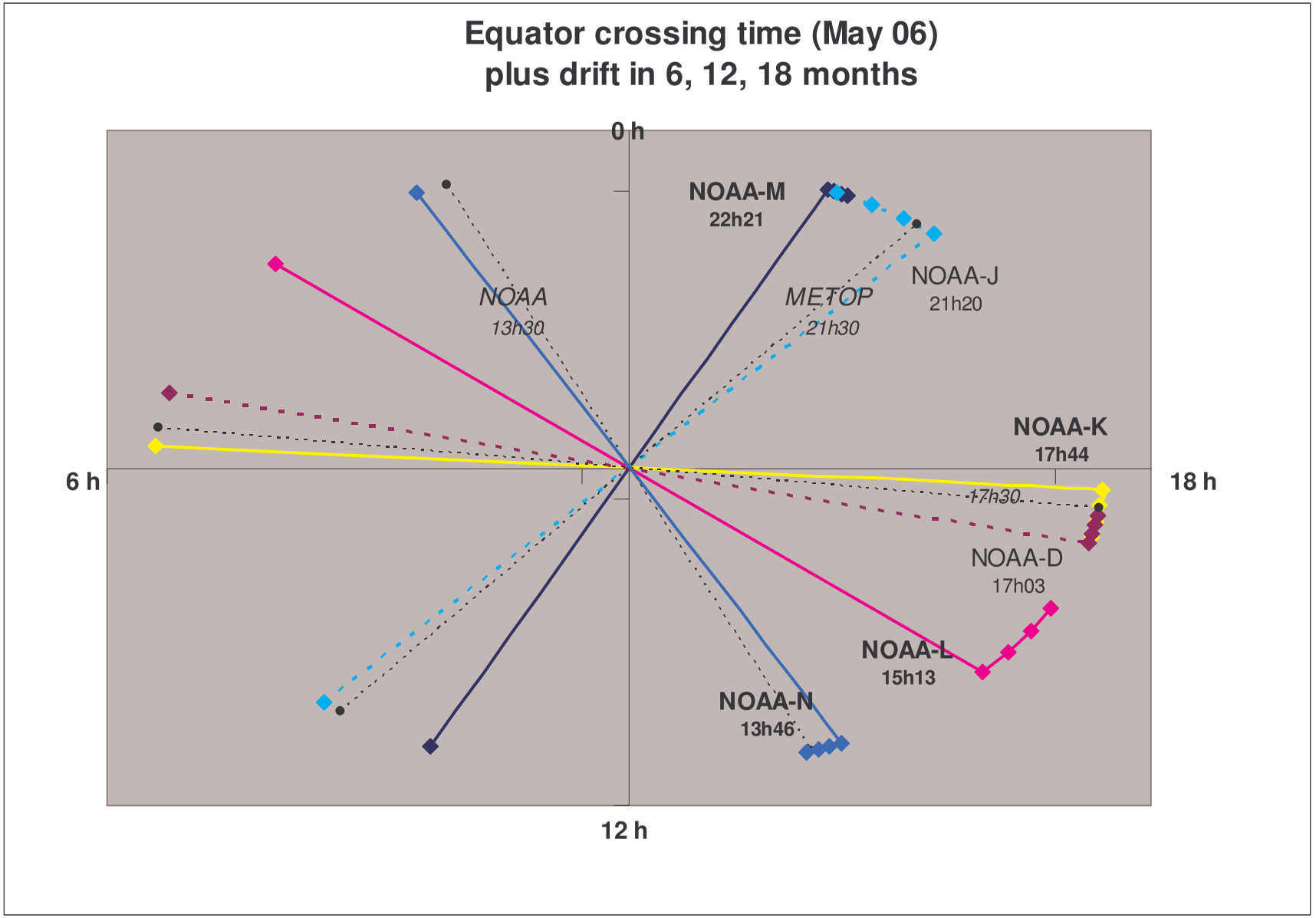
Currently, with the 6 satellites, the repartition is optimal with a good repartition of the plans and the waiting time for any beacon on the surface of the earth is minimised.

Within 18 months, the orbital planes of NOAA-D and NOAA-J will have drifted and the NOAA-D plane should be close of the NOAA-K one. There is the same situation with the NOAA-J plan that should be close of the NOAA-M one.
The Argos Service should be a bit degraded but should stay performing as far as the four NOAA satellites embarking the Argos-2 instruments are still operational (see figure 2) and cover the three “Argos planes” at 13h30, 17h30 and 21h30 are covered.

On the 13h30 plane, there is the most recent satellite (NOAA-N launched in 2005) and the next one is NOAA-N’ (2009 ?) with an Argos-3 instrument.

On the 21h30 plane, the situation is always very good with the NOAA-M satellite (launched in 2002) and the next METOP-A embarking also an Argos-3 instrument.

The situation can be very soon critical on the 17h30 plane covered today by NOAA-K which was launched in 1998 (NOAA-D, launched in 1991 is very old and covers only a limited 24 kHz bandwidth).
In 2009, in case of problem on NOAA-K, NOAA-L could replace it due to the very important drift (3.2 minute/month) on the orbit and it should reach an orbit close to 17h00 in 2009. But NOAA-L will be also old in 2009 (launched in 2000).
There are today NO substitute decided on the 17h30 plan, there are also no planned Argos-3 instrument with the downlink on this orbit.


Equator crossing time (May 06)
plus drift in 6, 12, 18 months
0 h
6 h
18 h
12 h
NOAA-M
22h21
NOAA-J
21h20
NOAA
13h30
METOP
21h30
NOAA-K
17h44
17h30
NOAA-D
17h03
NOAA-L
15h13
NOAA-N
13h46