CNES POD Activities

Timothée BRAZ[2], Alexandre COUHERT[1], Vincent DEBOUT[2], Katsigianni GEORGIA[3], Sabine HOURY[1], Flavien MERCIER[1], John MOYARD[1], Eléonore SAQUET[3]
[1]Centre National d'Etudes Spatiales
[2]CS-SI, Toulouse, France
[3]Collecte Localisation Satellites, Toulouse, France

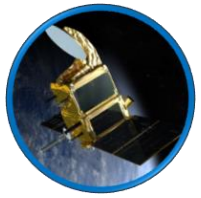
A proven expertise

Precise Orbit Determination (POD) aims at deriving satellite trajectories with highest accuracy

- Last achievement: **5 mm in the radial direction** / 9 mm 3D (DORIS+GNSS orbits)

A team of 7 people from the CNES Orbit Determination Department defines and computes precise and homogeneous orbit solutions for the following satellite altimetry missions:


CryoSat-2
ESA

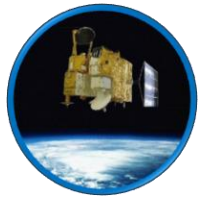

Saral/AltiKa
ISRO/CNES

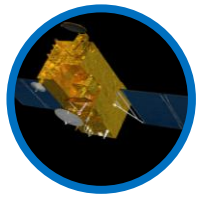

Jason-3
CNES/NASA
EUMETSAT/NOAA


Sentinel-3A
ESA


Sentinel-3B
ESA


CFOSAT
CNSA/CNES


HY-2B
NSOAS


HY-2C
NSOAS


Sentinel-6A
ESA/NASA
EUMETSAT/NOAA

Experience gained with the past altimeter missions initiated by TOPEX/Poseidon (1992) and continued through Jason-1, Envisat, OSTM/Jason-2, HY-2A, and with the currently flying satellites

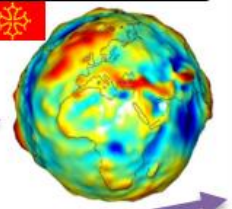
- State of the art force and geometric models implemented in CNES **ZOOM orbit estimation software**
- **Expertise on DORIS/GNSS/SLR measurements** (member of the IDS/IGS/ILRS Working Groups)
- Periodically define and produce an **updated set of orbits and geophysical standards** to address short-term and long-term orbit errors impacting **mean sea level change estimates**

POE-F Orbital Standards

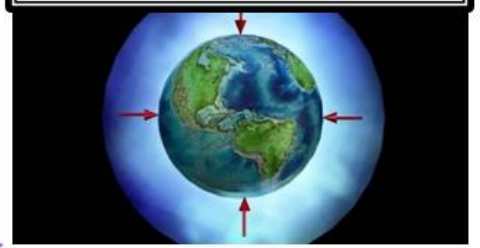
Main updates for DORIS-only orbits

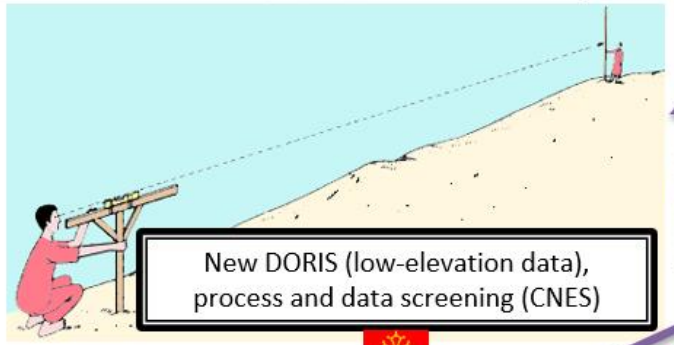
Tropospheric horizontal gradients and GPT2/VMF1 correction model (TU Wien)

RL04 mean gravity field model (CNES)

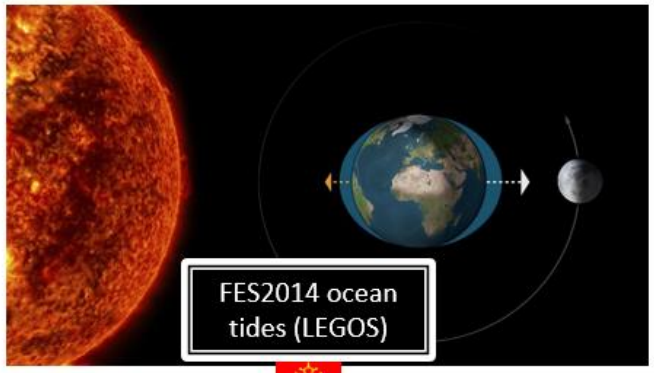


AOD1B RL06 time-variable atmospheric/oceanic gravity (GFZ)

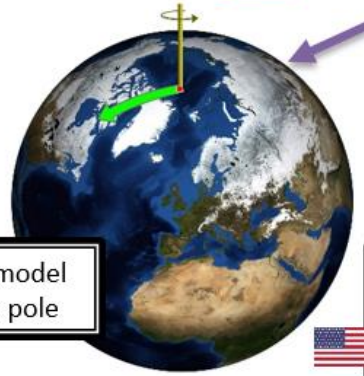




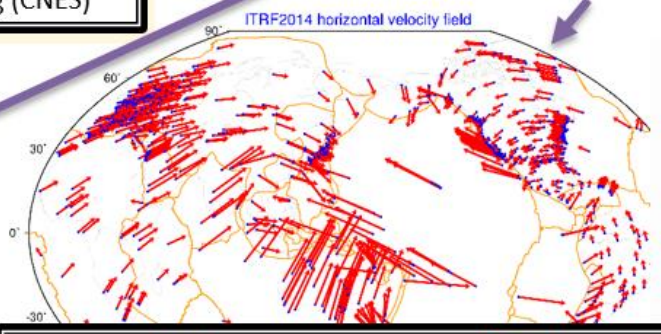
New DORIS (low-elevation data), process and data screening (CNES)



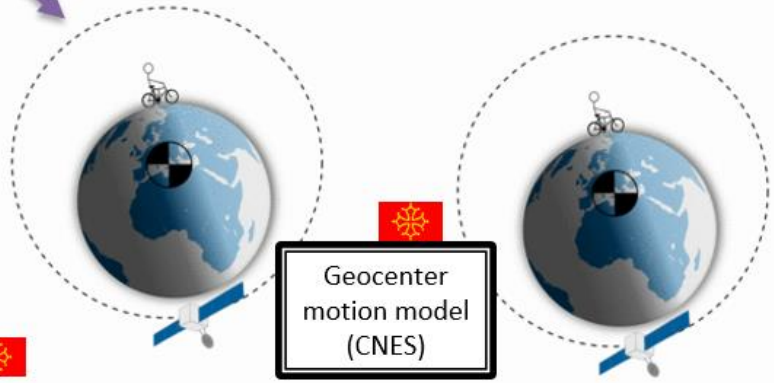
FES2014 ocean tides (LEGOS)



Linear model for the pole

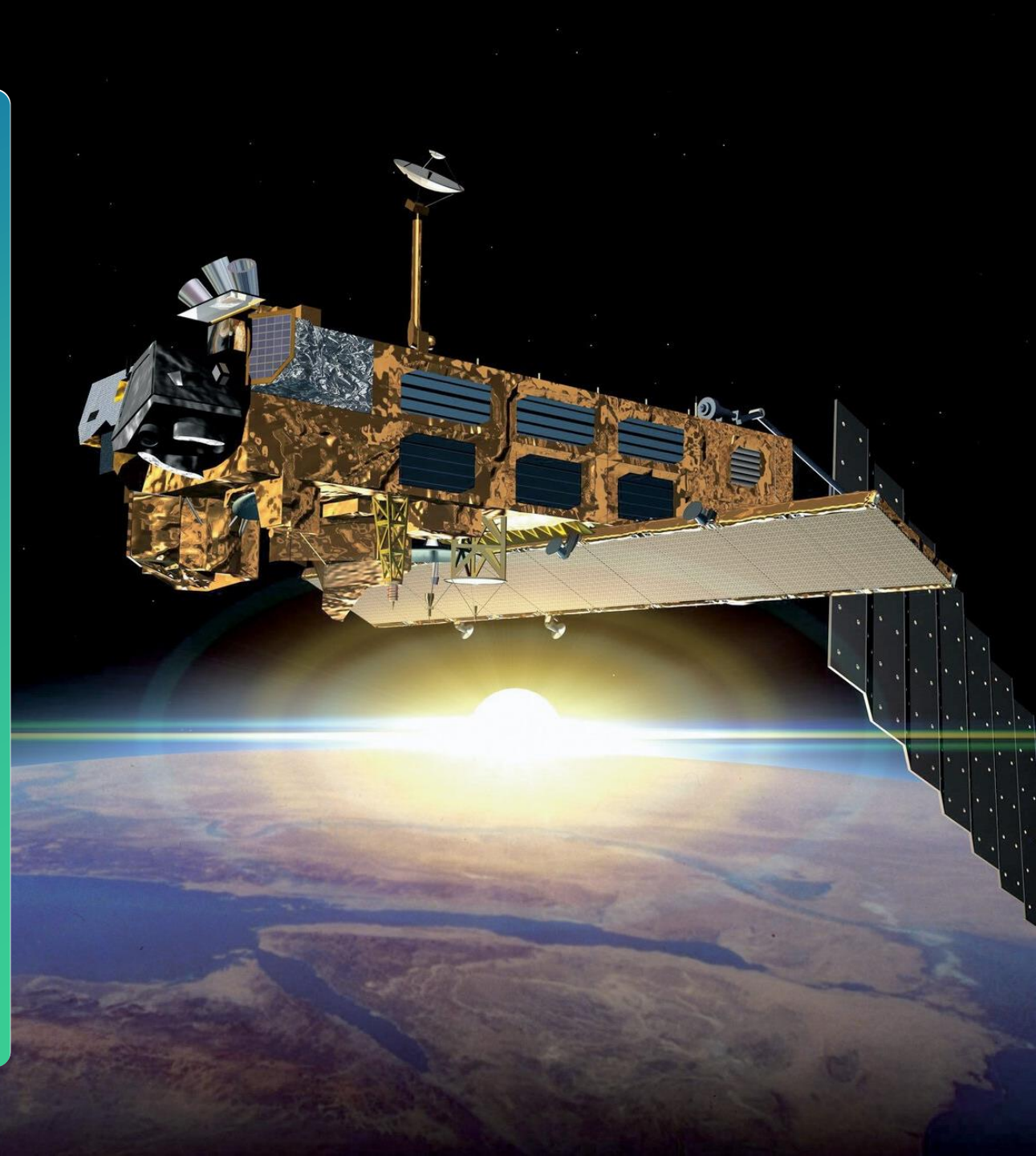


Reference frame
ITRF2014 (IGN) / DPOD2014 (CLS) /
SLRF2014 (ILRS) / IGS14 (JPL and GRG CNES/CLS)



Geocenter motion model (CNES)

Comparison for ENVISAT CNES POE-F versus CNES POE-E



Used dataset

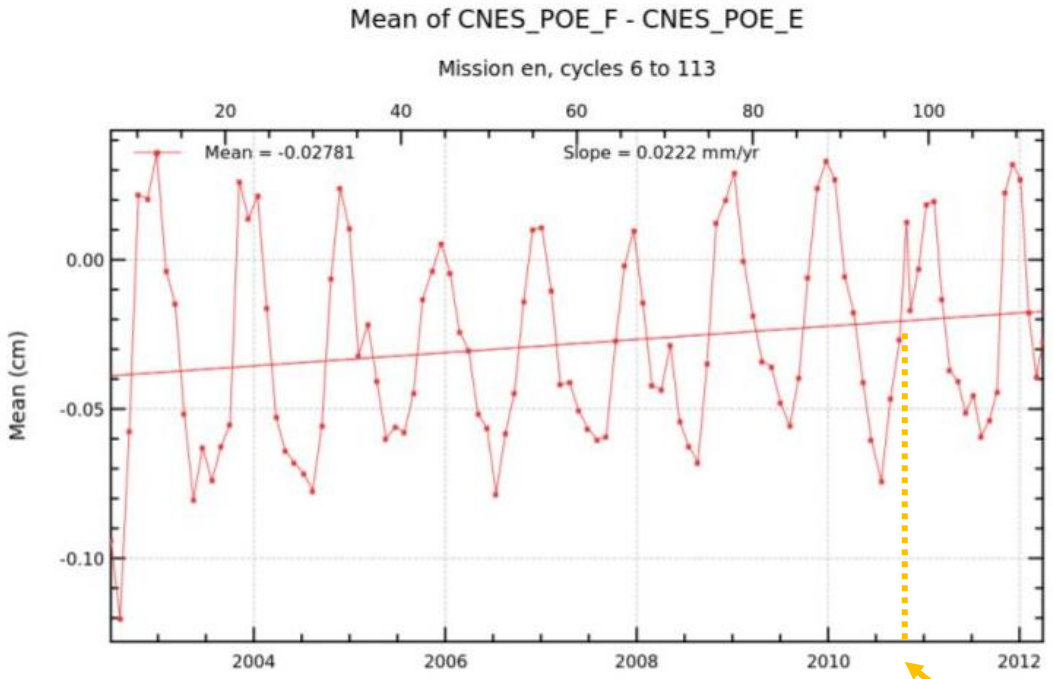
Reference data : all cycles from 6 to 113 (May 2002 to April 2012) reprocessed into a homogeneous standard (so called V3.0 version)

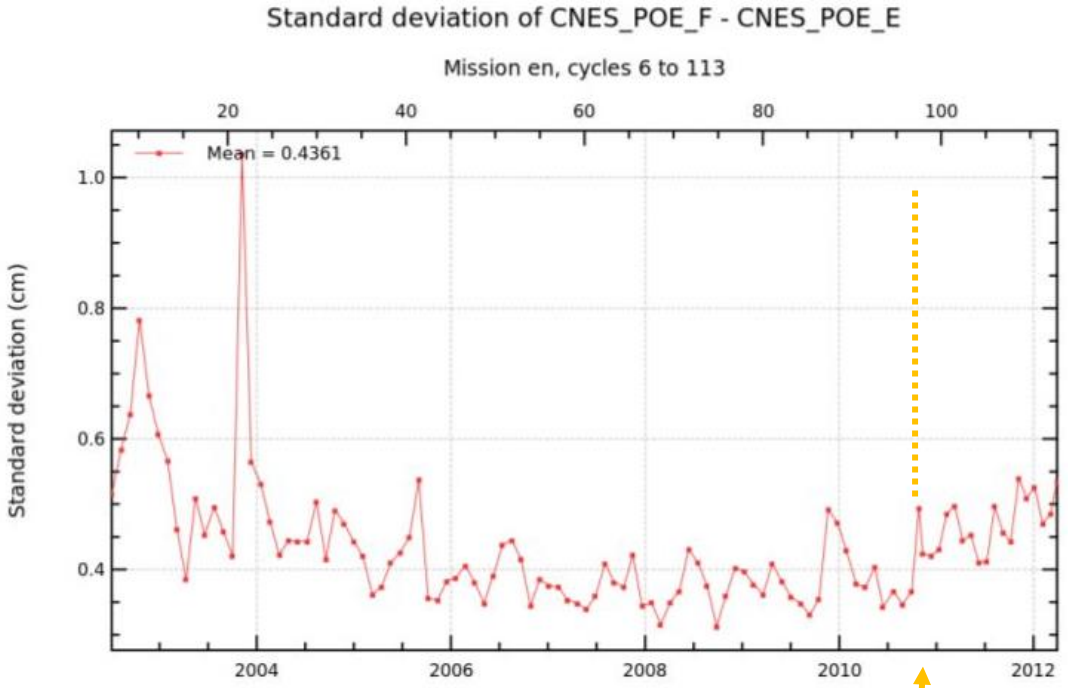
Analysis span over cycle 007 (**17/06/2002**) to cycle 113 (**08/04/2012**)

Reference orbit : **CNES POE-E**
Studied orbit : **CNES POE-F**

Direct comparison between CNES POE-F and CNES POE-E with FLAG_VAL

Difference between orbits throughout time

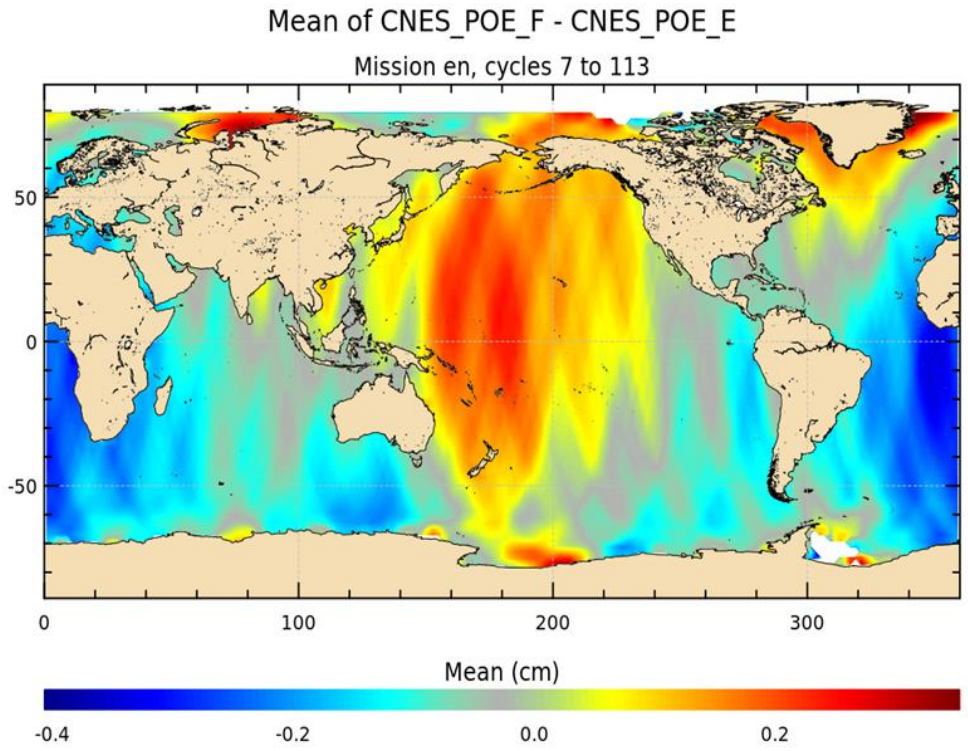


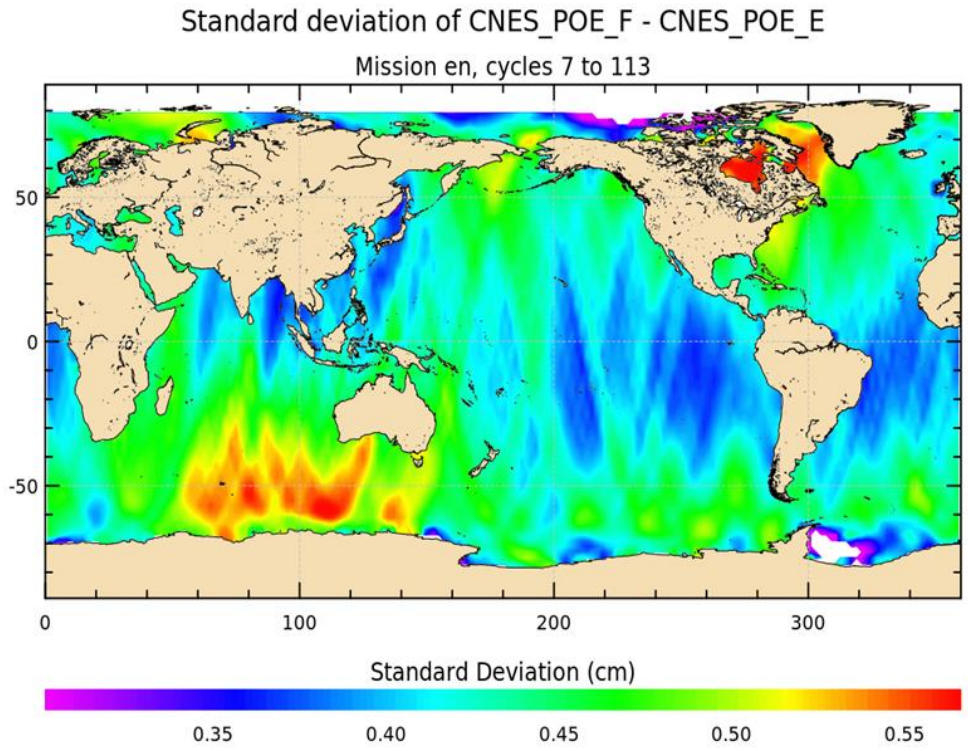


Global bias : ~-0,03cm
No significant trend (~0.02mm/yr.)

22/10/2010 : Envisat moved to a new lower orbit

Maps of differences of orbit

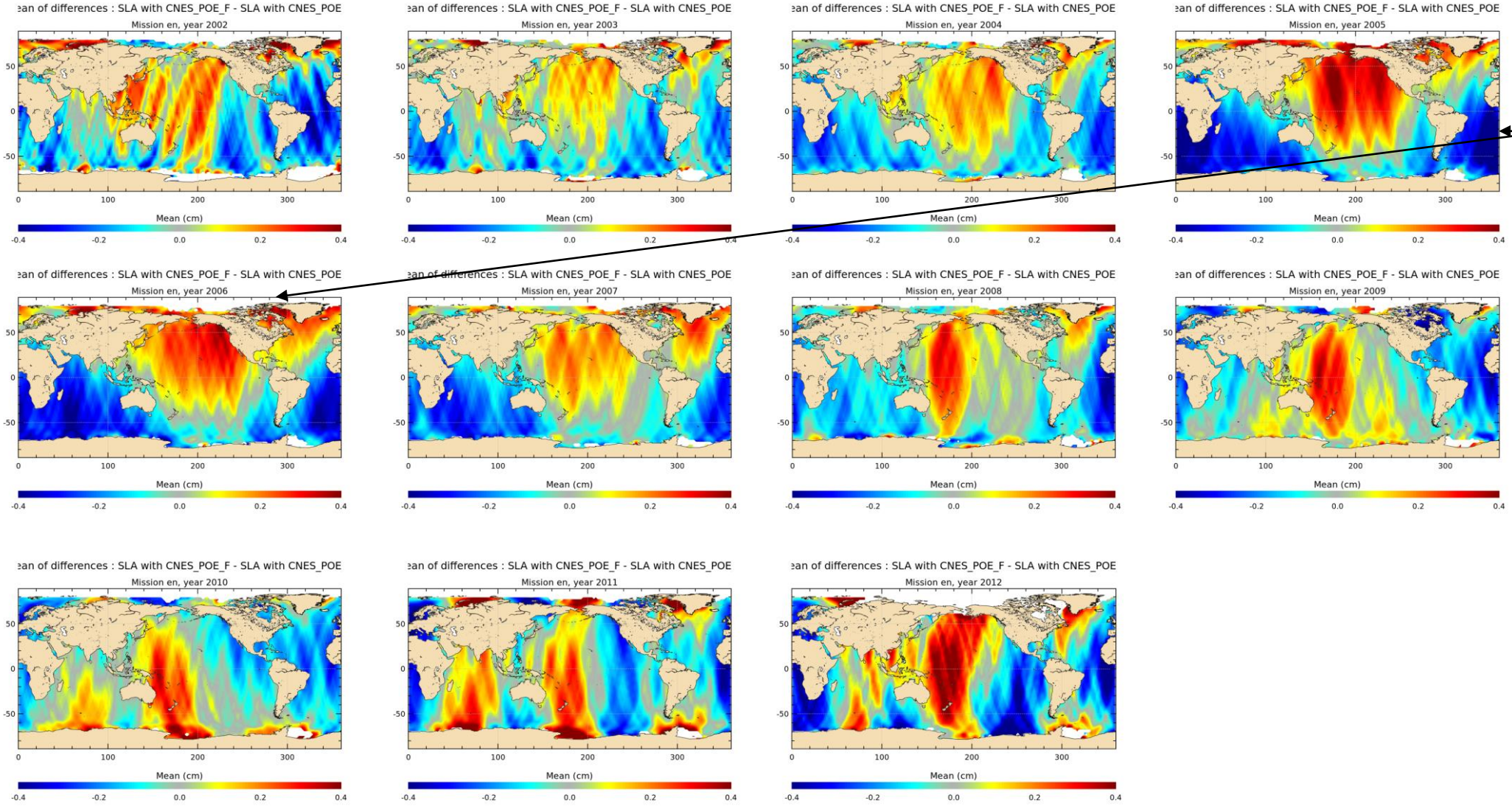




Geographically correlated difference with a maximum of ~**0.2 cm**

Differences of orbits per year

6 months available for 2002

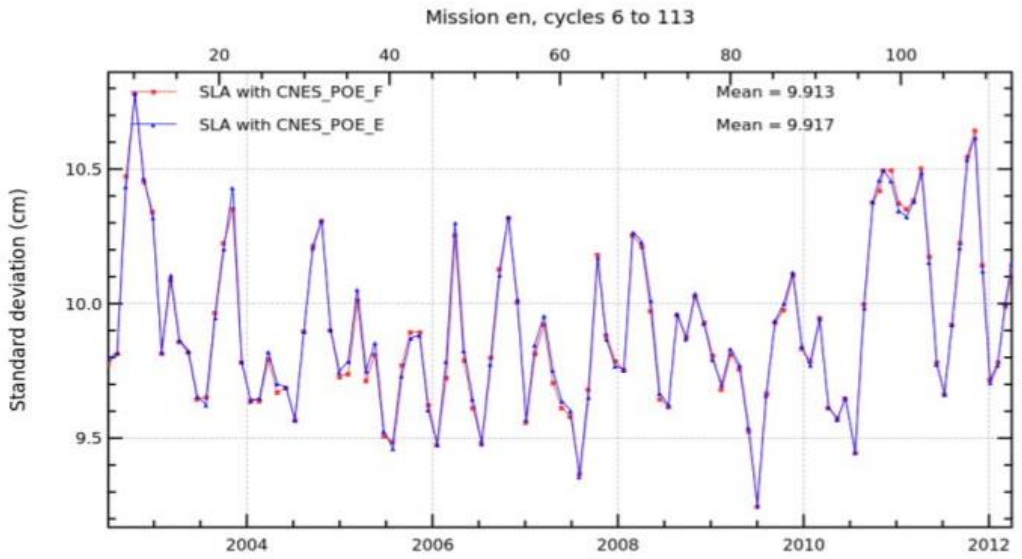


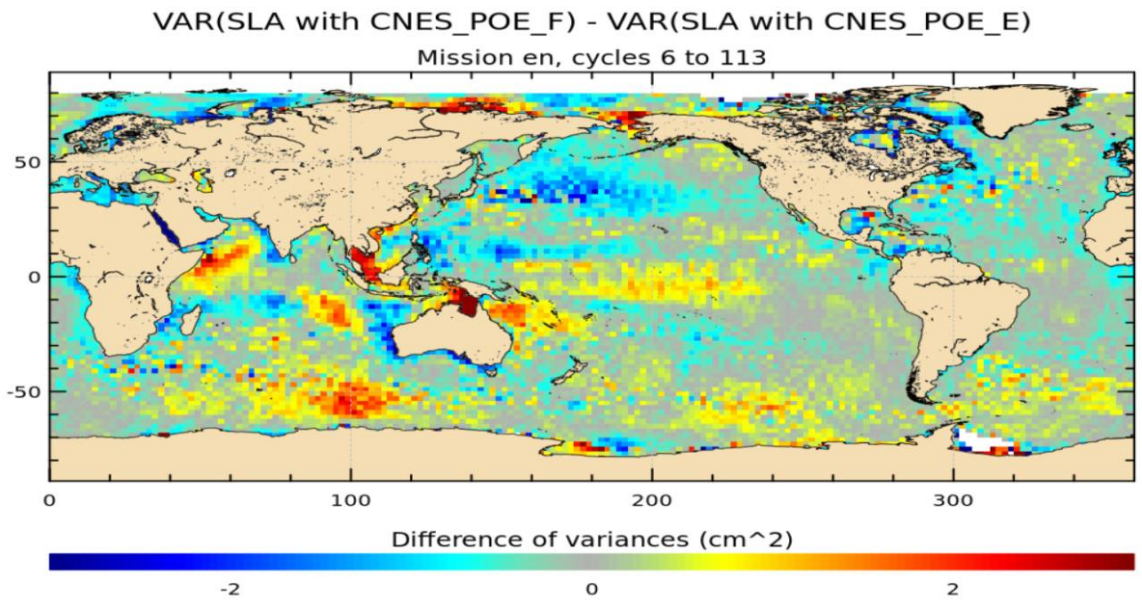
Geographical patterns are higher for 2005-2006 compared to other years

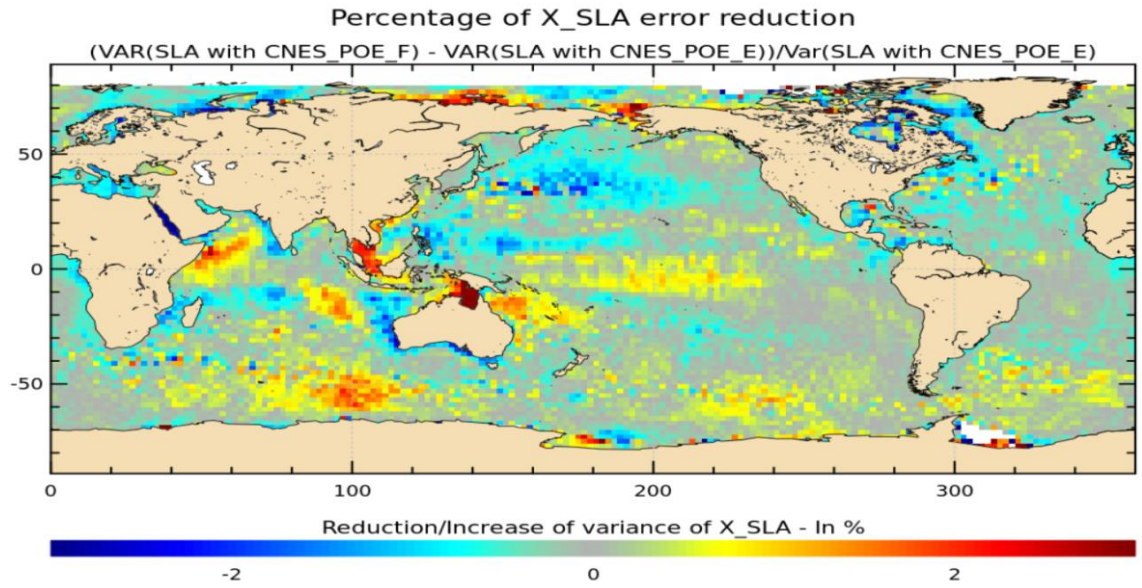
4 months available for 2012

Impact on along-track SLA performances

Difference of SLA variance



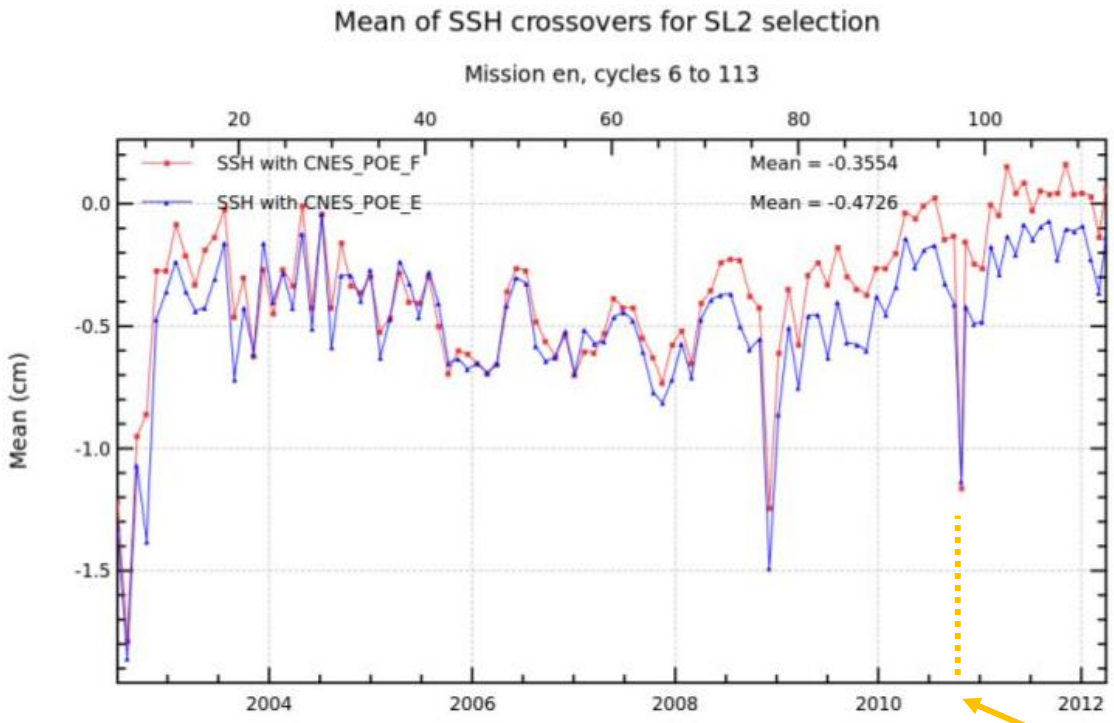


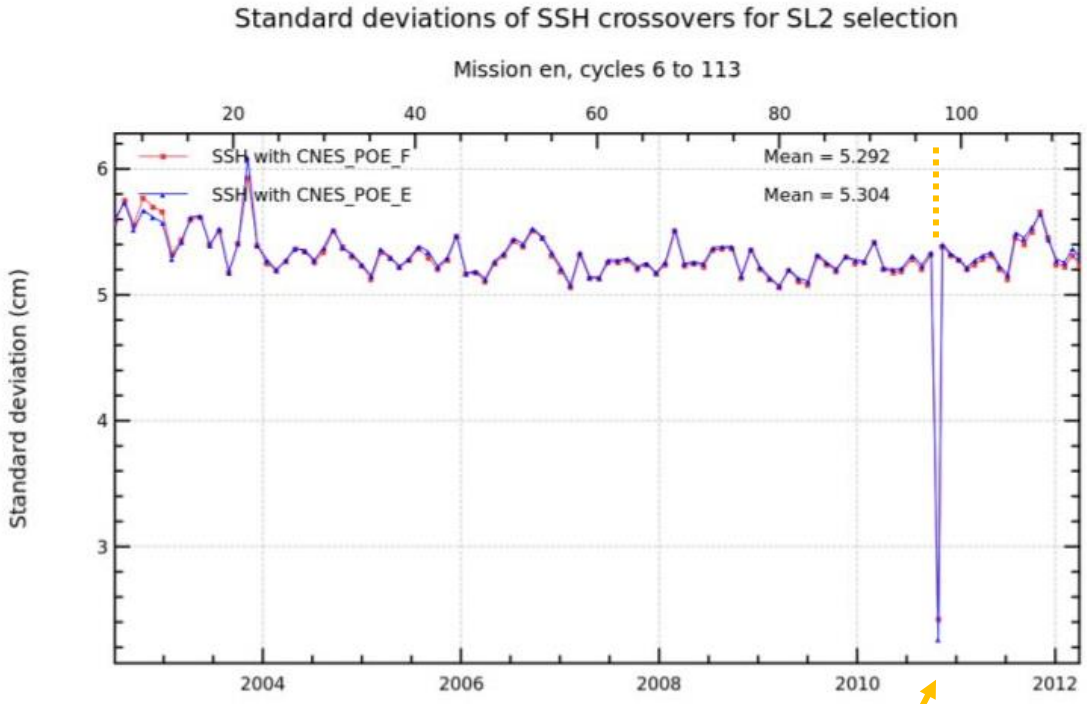


➔ No significant impact on global SLA std,
But geographically correlated patterns

Impact of CNES POE-F on performances at crossovers

Temporal evolution at crossover





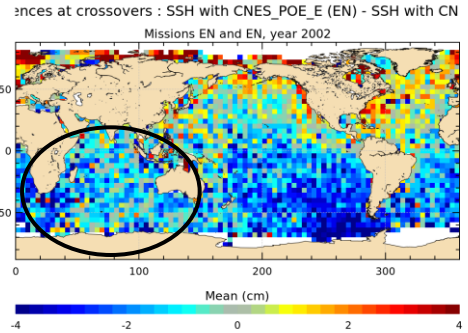
22/10/2010 : Envisat moved to a new lower orbit

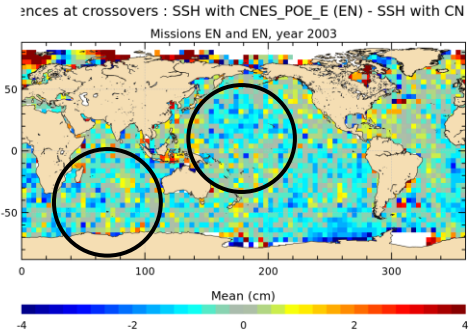
Means at crossovers
(selection on |latitude|<50°,
bathy<-1000m, oceanic variability < 0,2) :

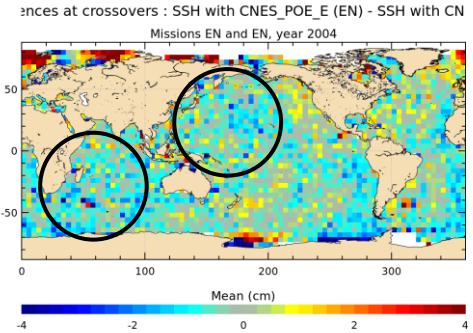
CNES POE-F	-0,36 cm
CNES POE-E	-0,47 cm

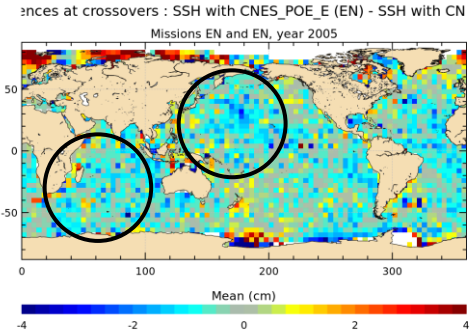
Mean of SSH difference at Crossover per year (CNES POE-E)

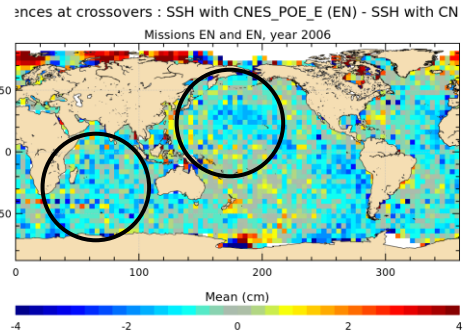
6 months available for 2002

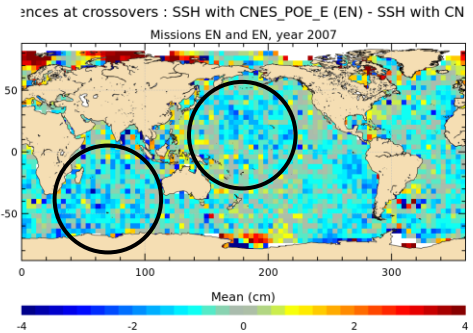


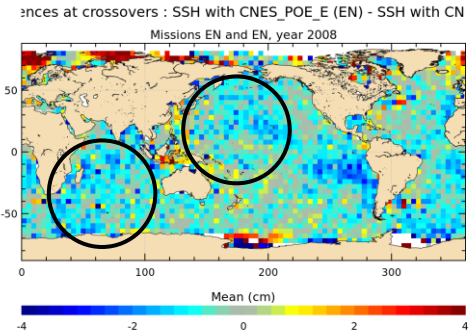


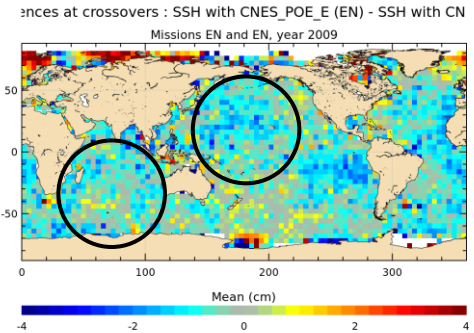


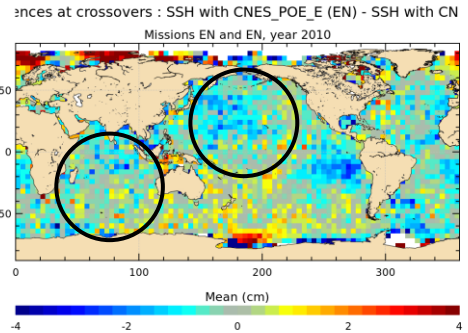


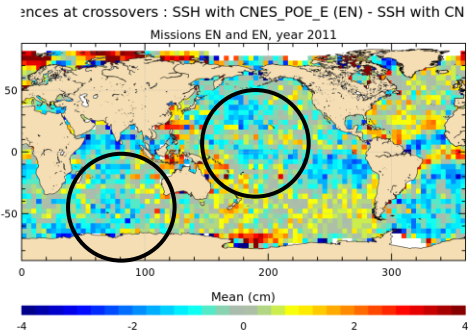


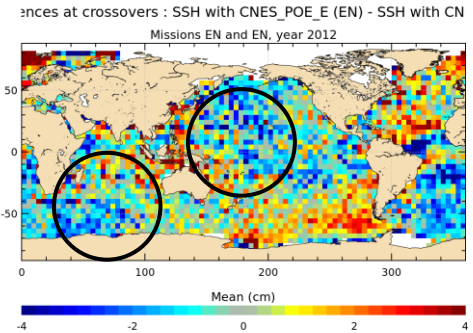










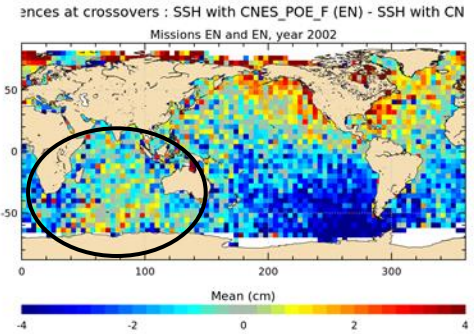


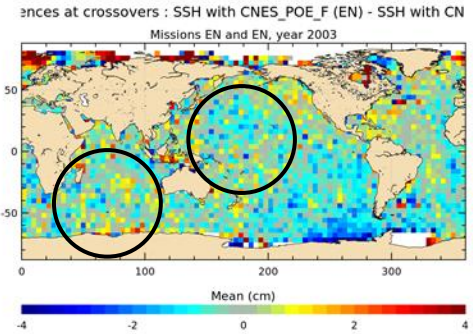
4 months available for 2012

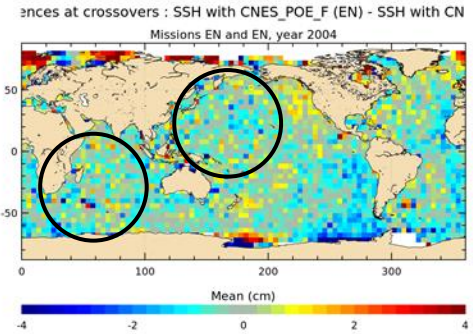
22/10/2010 : Envisat moved to a new lower orbit

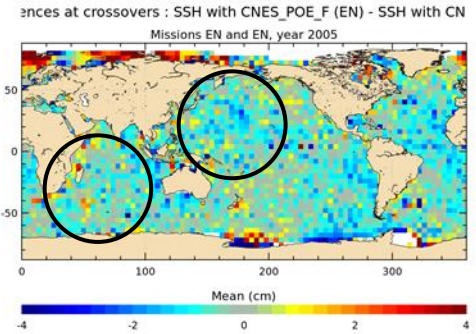
Mean of SSH difference at Crossover per year (CNES POE-F)

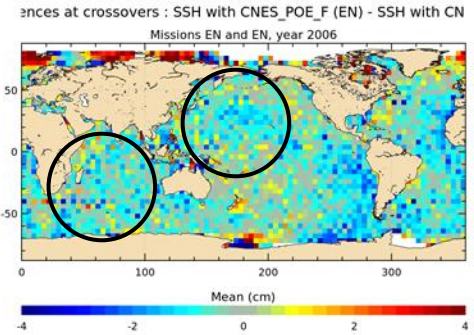
6 months available for 2002

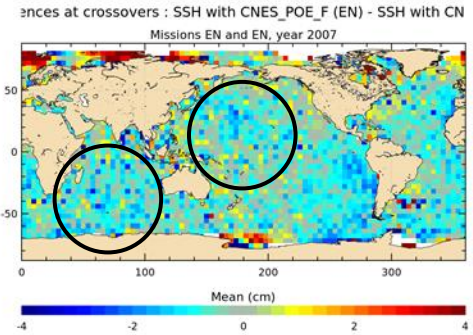


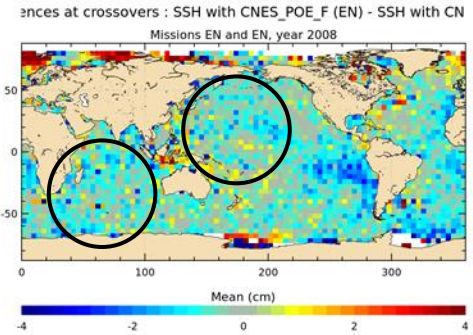


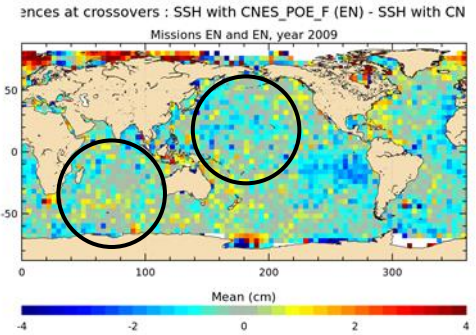


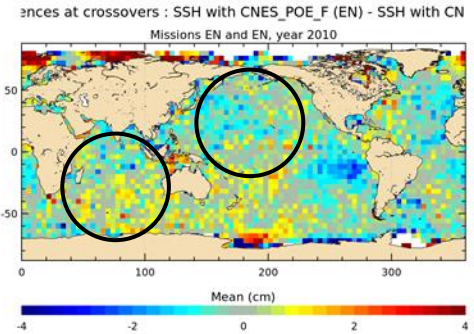


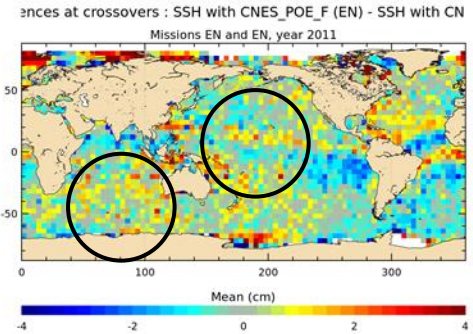


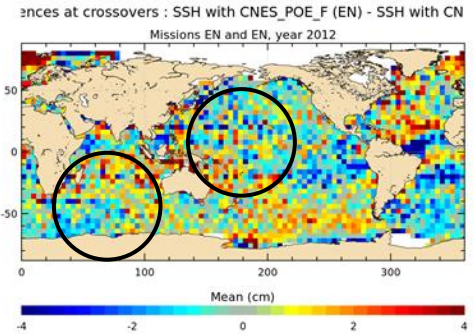










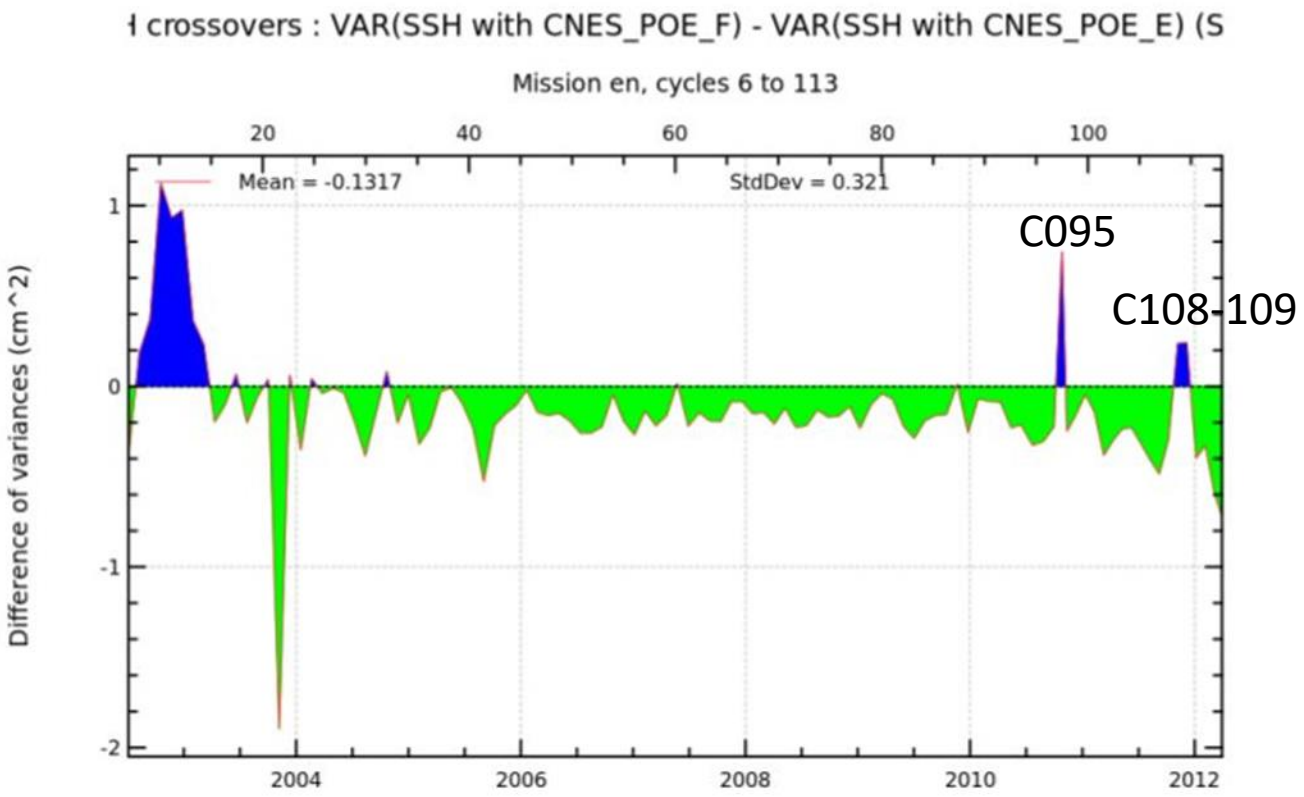


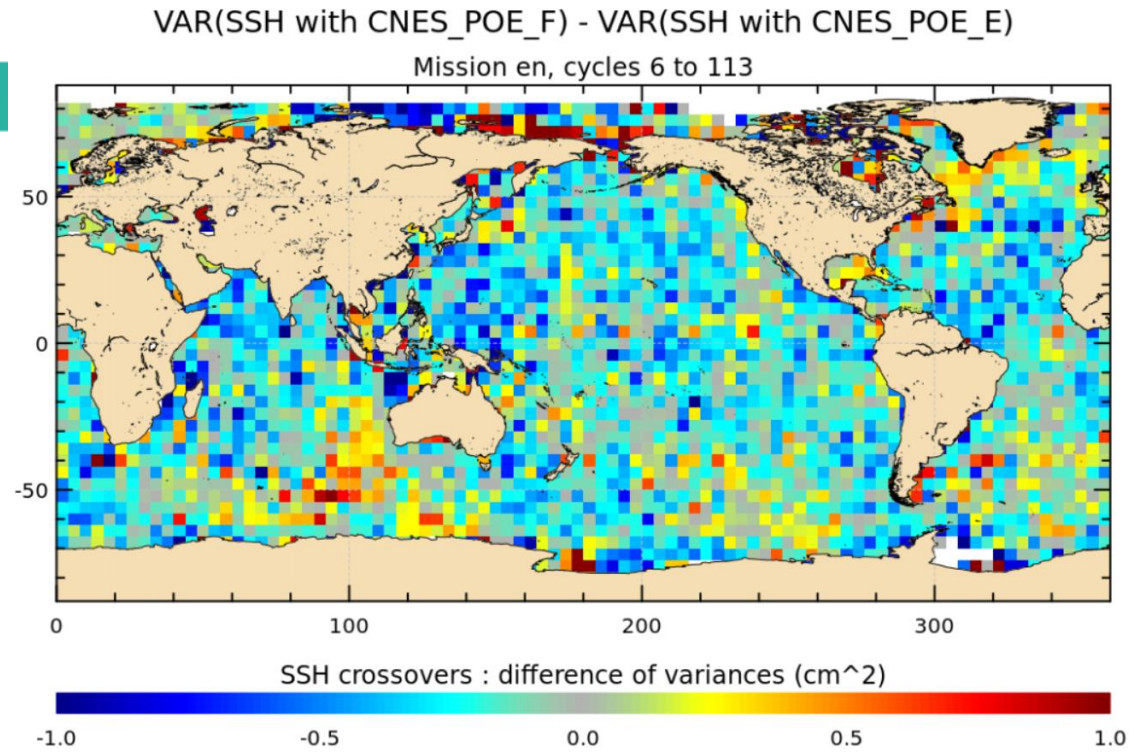
22/10/2010 : Envisat moved to a new lower orbit

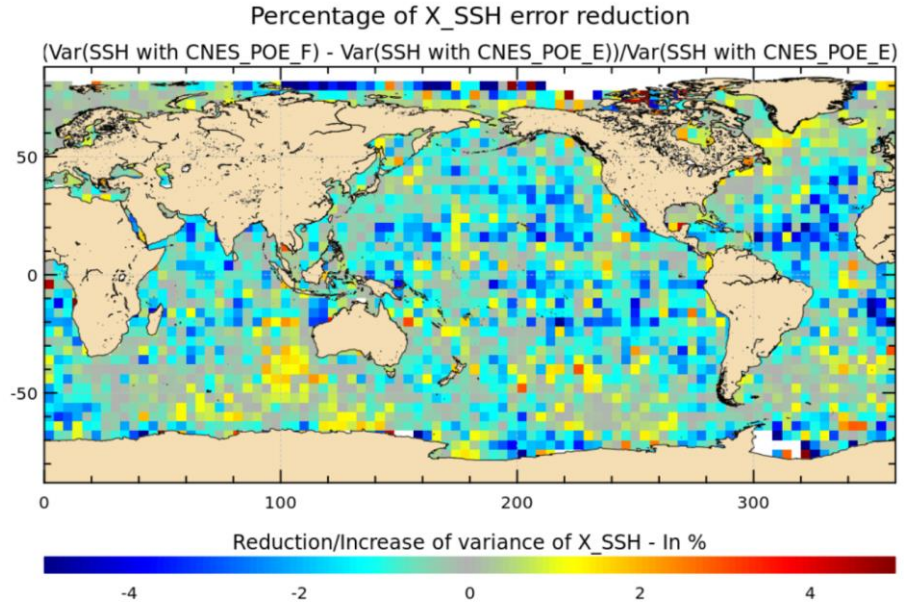
4 months available for 2012

Small reduction of geographical patches of mean difference at crossovers from POE-E (previous slide) to POE-F in pacific ocean and indian ocean

Difference of variance at crossover







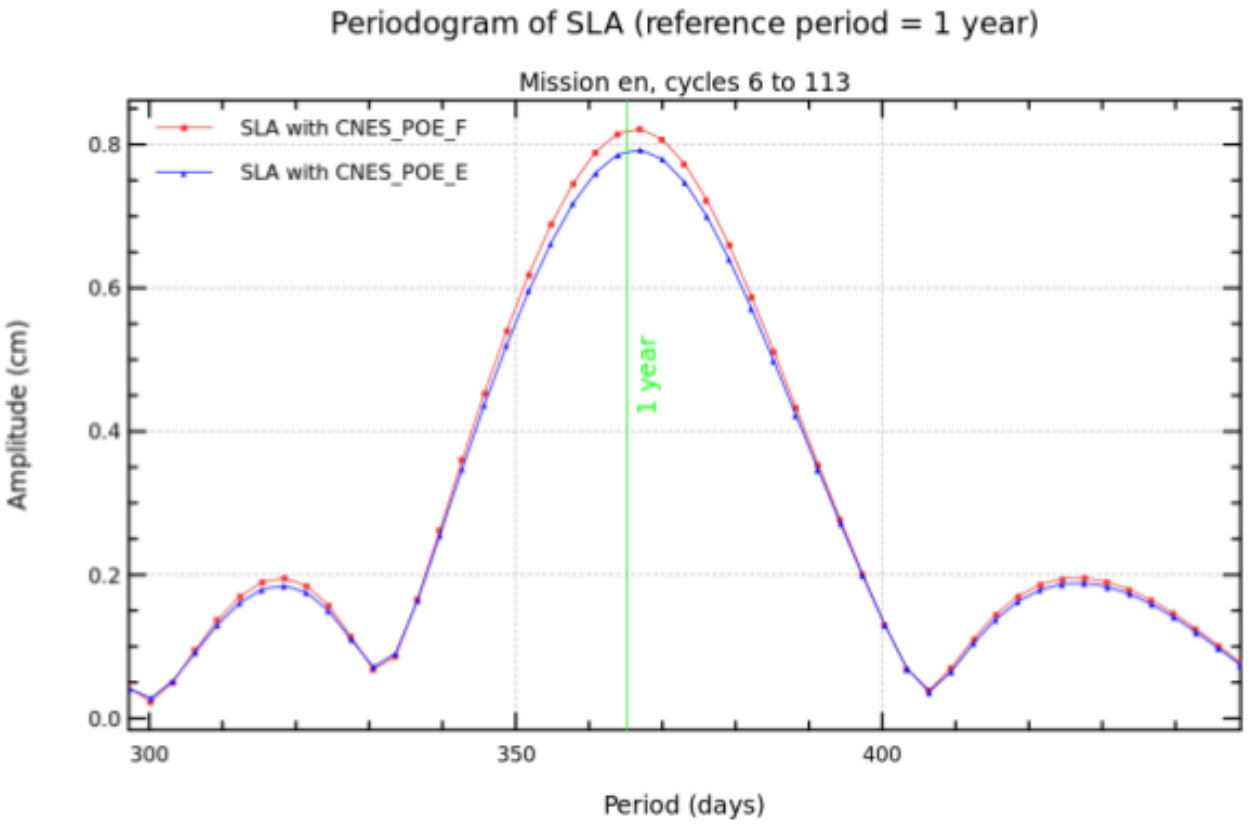
Slight decrease (-0,13cm²) of the variance of SSH at crossovers for CNES POE-F wrt CNES POE-E :

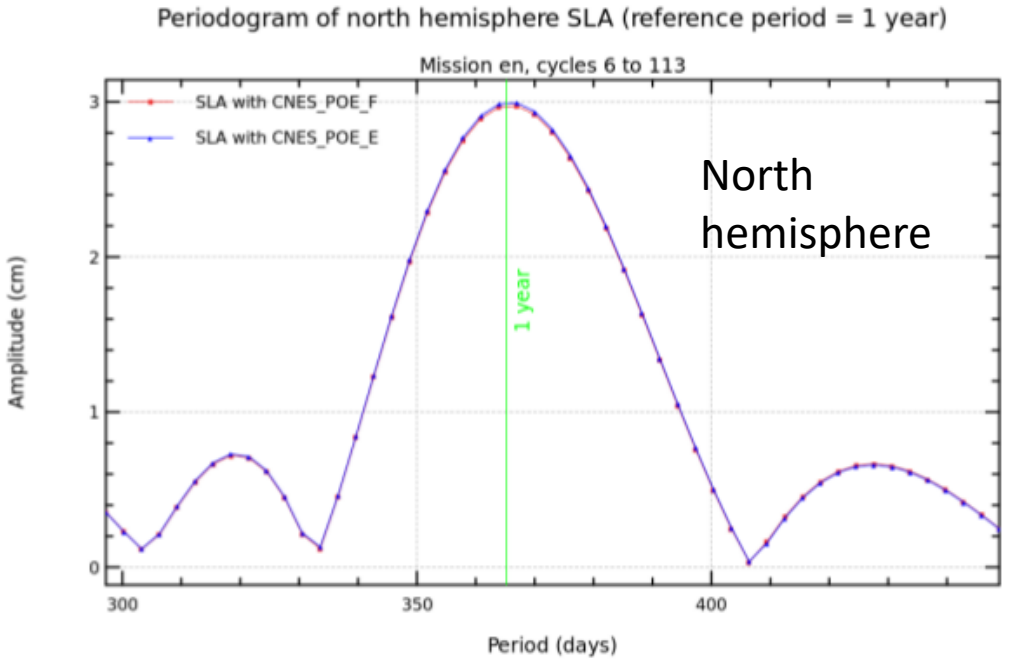
cycle 95 (drifting orbit) : not significant wrt coverage

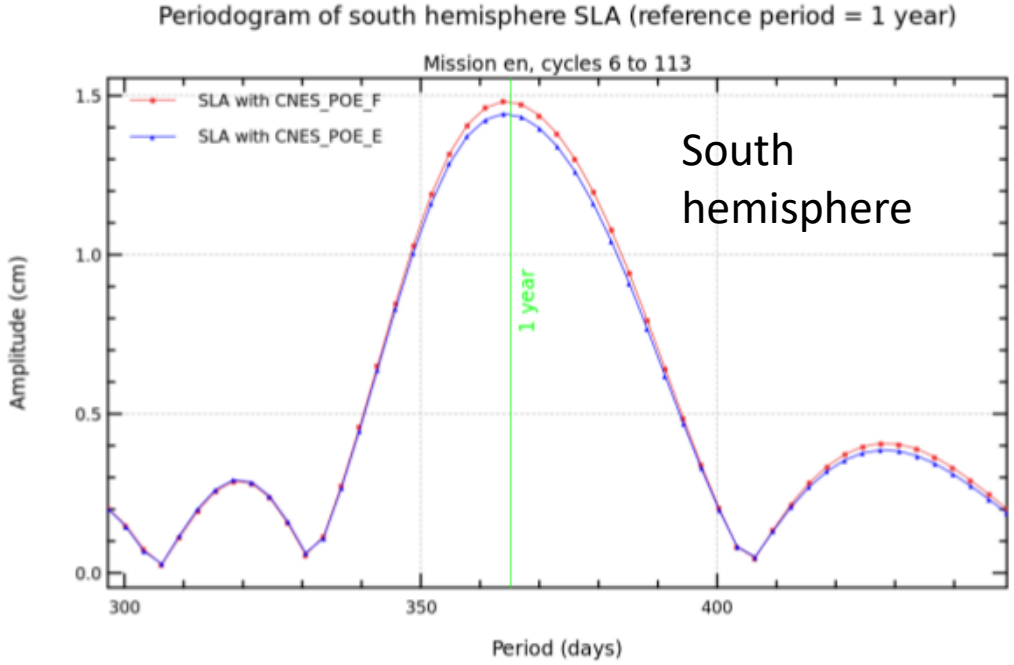
cycles 108 & 109 (end of 2011)

Impact of CNES POE-F on long term drift of SLA (MSL)

Periodogram

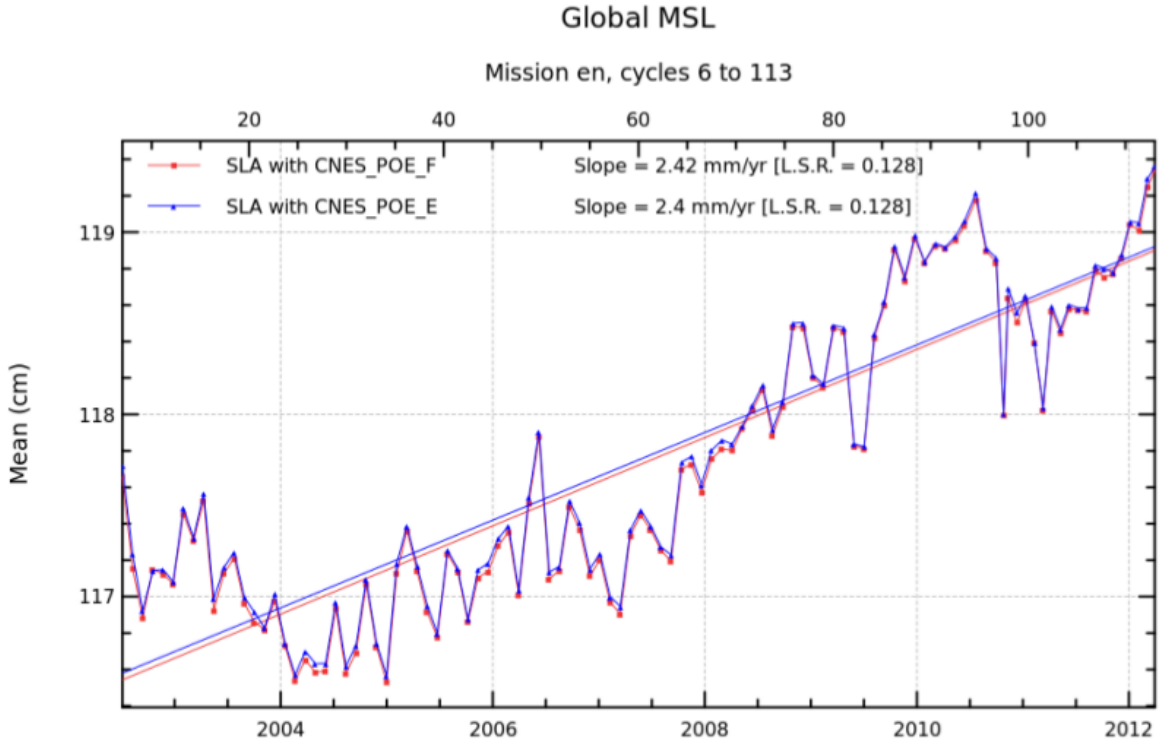




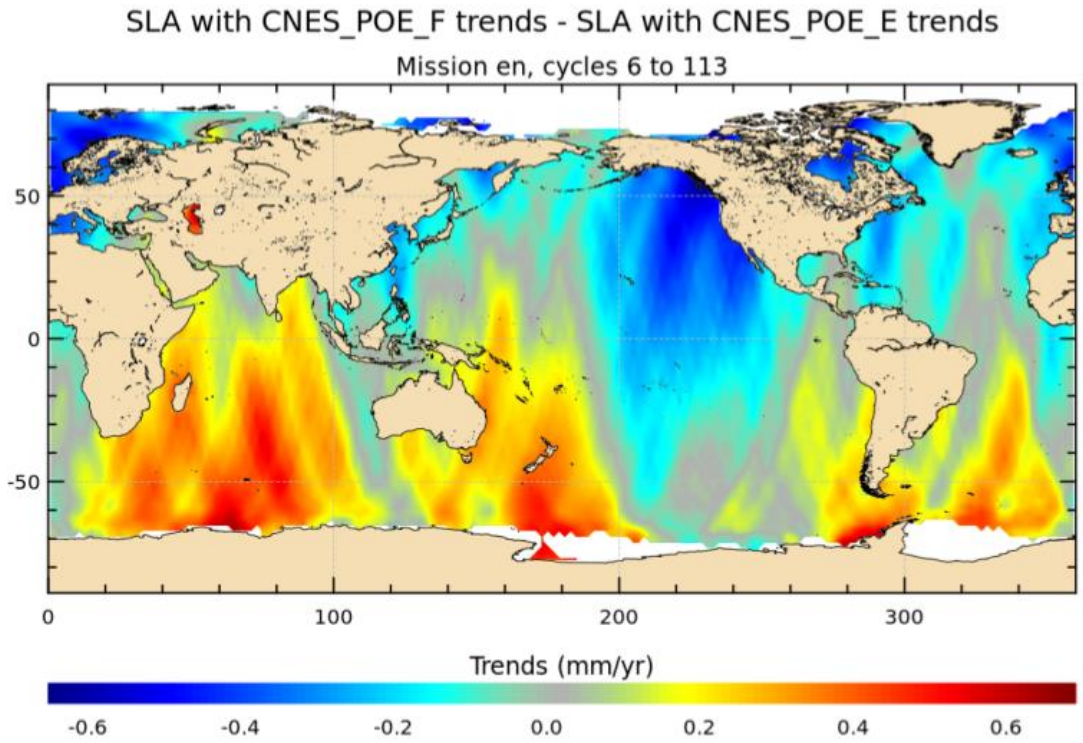


Small impact on annual signal,
Higher in southern hemisphere than in northern

Global and regional MSL trends



No significant impact
on global MSL trend



North/South patterns (~0,5mm/yr)

EnviSat POE-F vs POE-E

Conclusions

No significant impact on GMSL trend and regional trends differences up to +/-0.5mm/yr

Mean of the difference of SSH at crossover is slightly reduced (from 0.47cm to 0.36cm in average)

Variance at crossovers is slightly reduced using POE-F instead of POE-E for cycle 016 onwards