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Pre-GRACE era recovery of time-varying DORIS-based mass concentration parameters for TOPEX/Poseidon precise orbit determination

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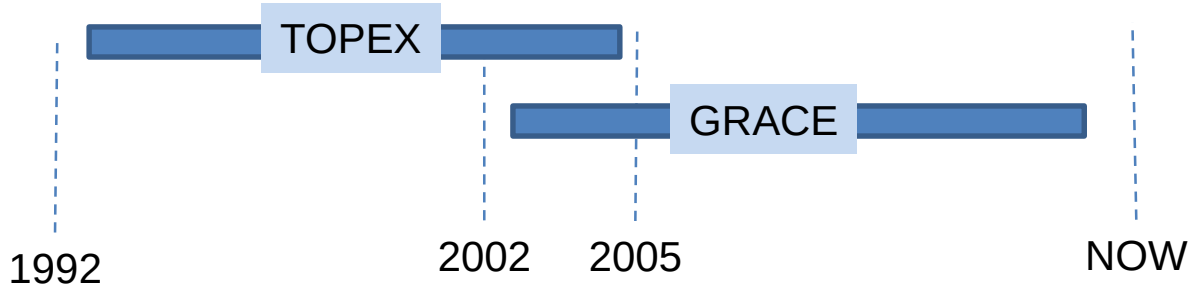
CENTRE NATIONAL D'ÉTUDES SPATIALES

CONTEXT OF THE STUDY

CNES will reprocess TOPEX/Poseidon (T/P) orbits in the POE-F standards this summer
The POE-F standards include the last RL04 version of CNES/GRGS mean TVG model, based on GRACE data:

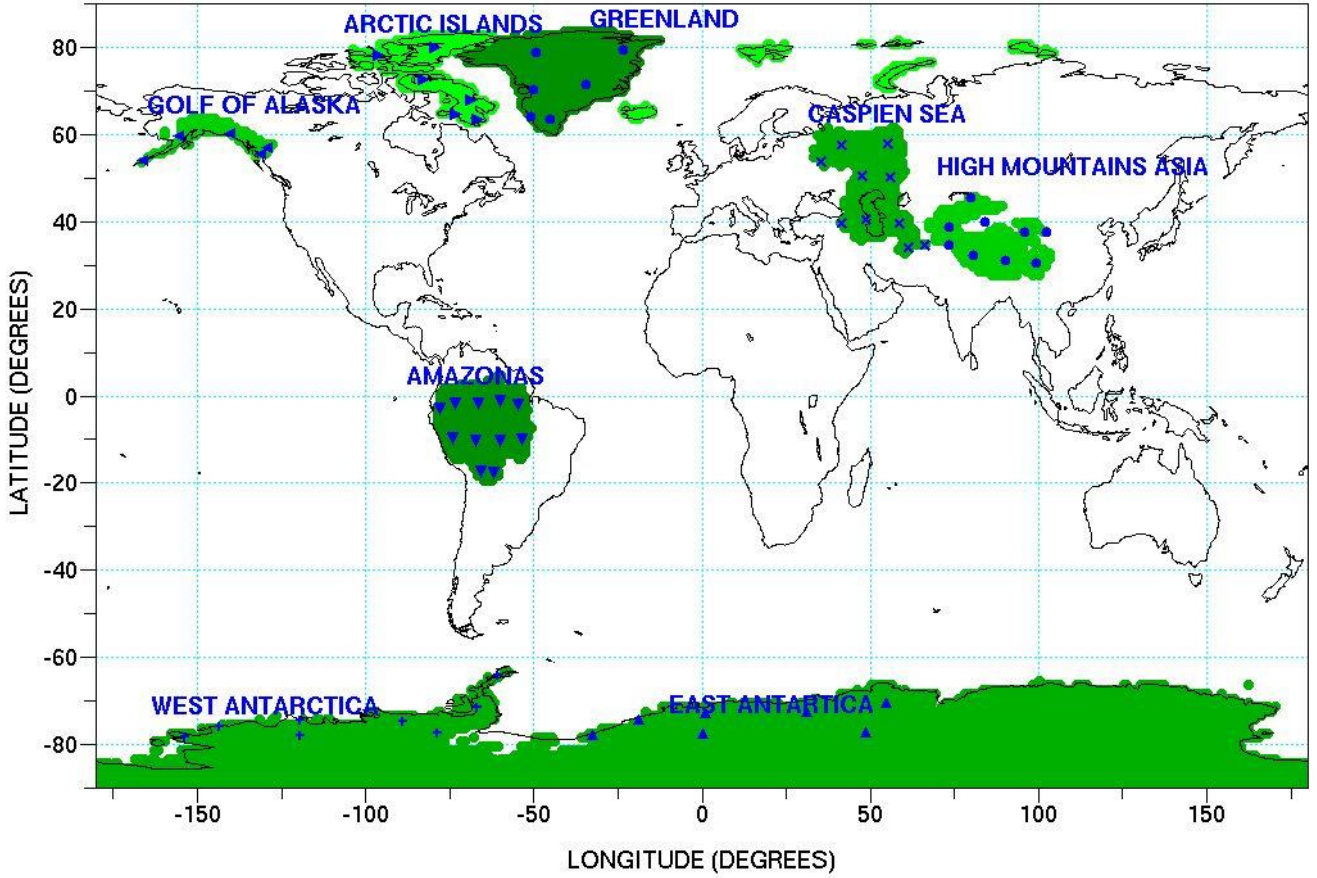


Could the use of concentrated mass (mascons) improve T/P orbits POE-F DORIS-only performance?
Improvements are assesed on the radial orbit component, not a 'geodetic' approach

MASCONS TOPOLOGY

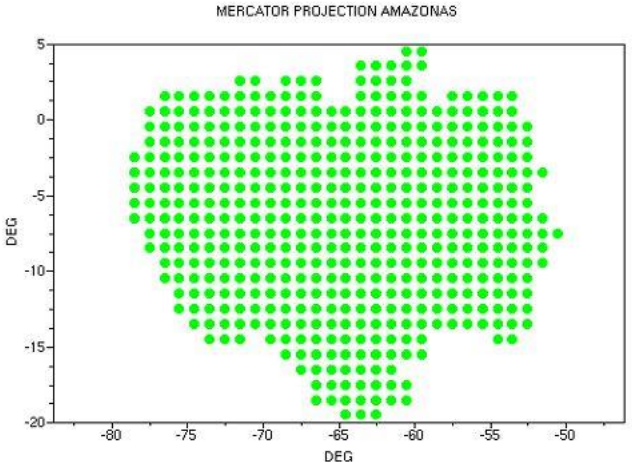
MASCONS LEGOS/GRGS

MASCONS ZOOM

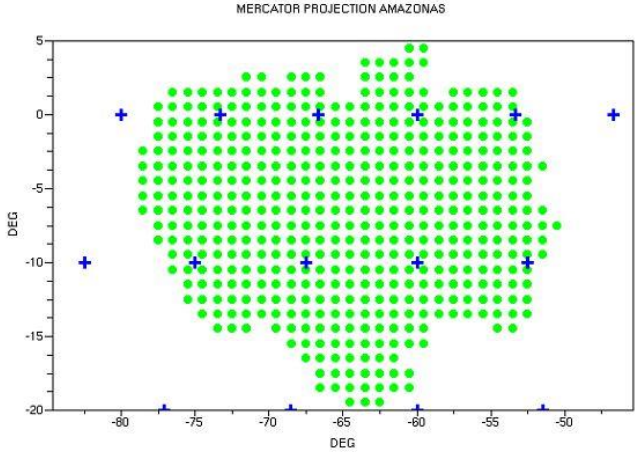


7 regions with strong annual signals and/or linear trends

MASCONS CONSTRUCTION

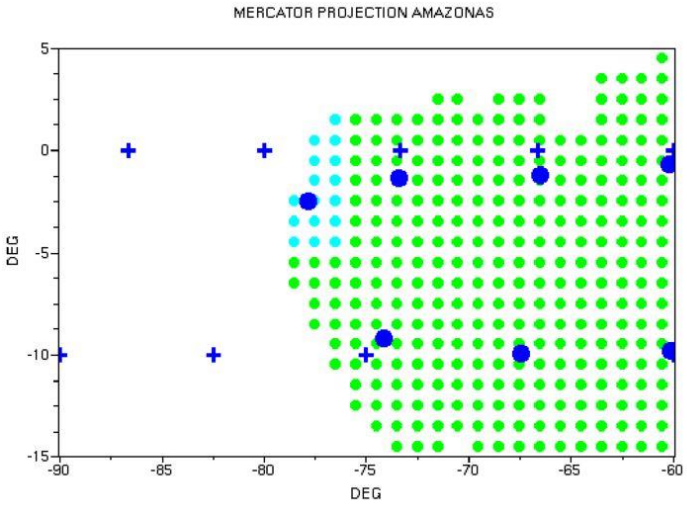


MASCONS LEGOS/GRGS
points p_i

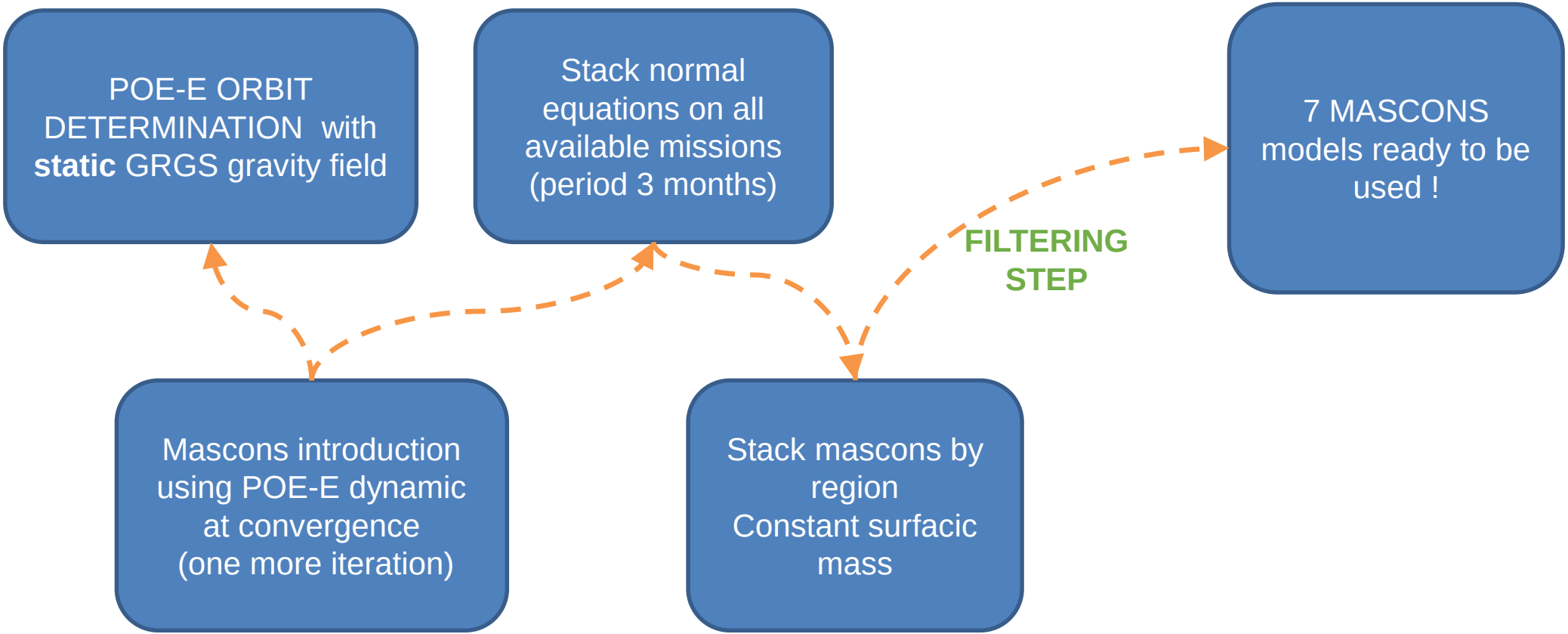


MESH with latitude step 10°
points m_j

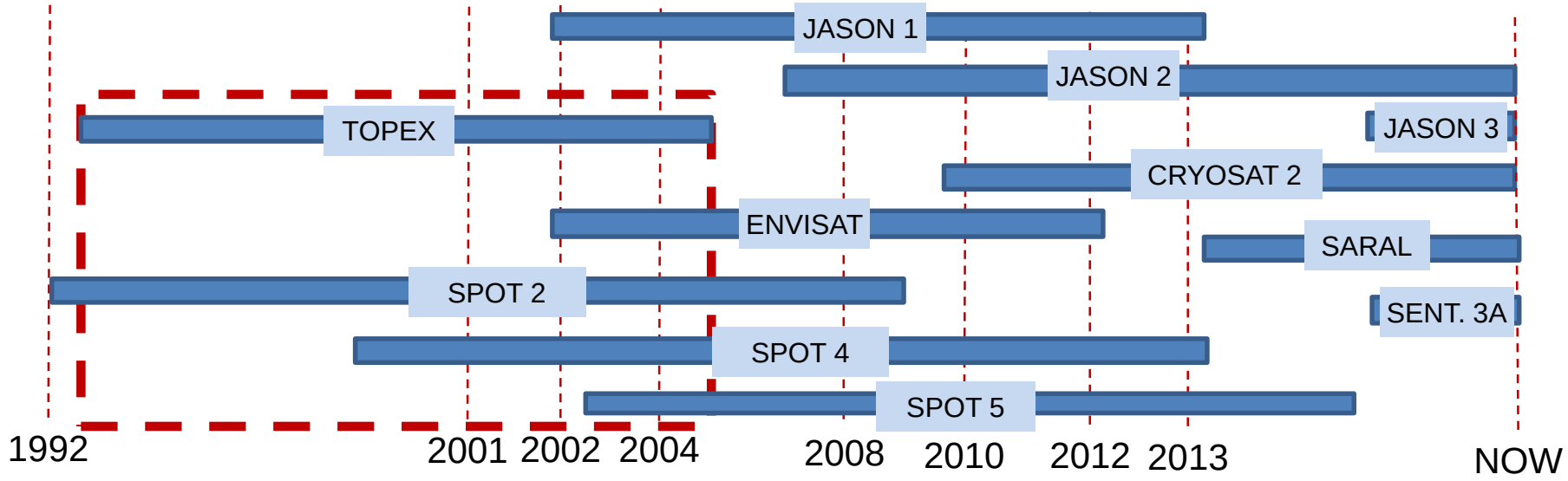
min(distance(pi, mj))
defines set of d_k points
→ barycenters with
associated surfaces



METHODOLOGY

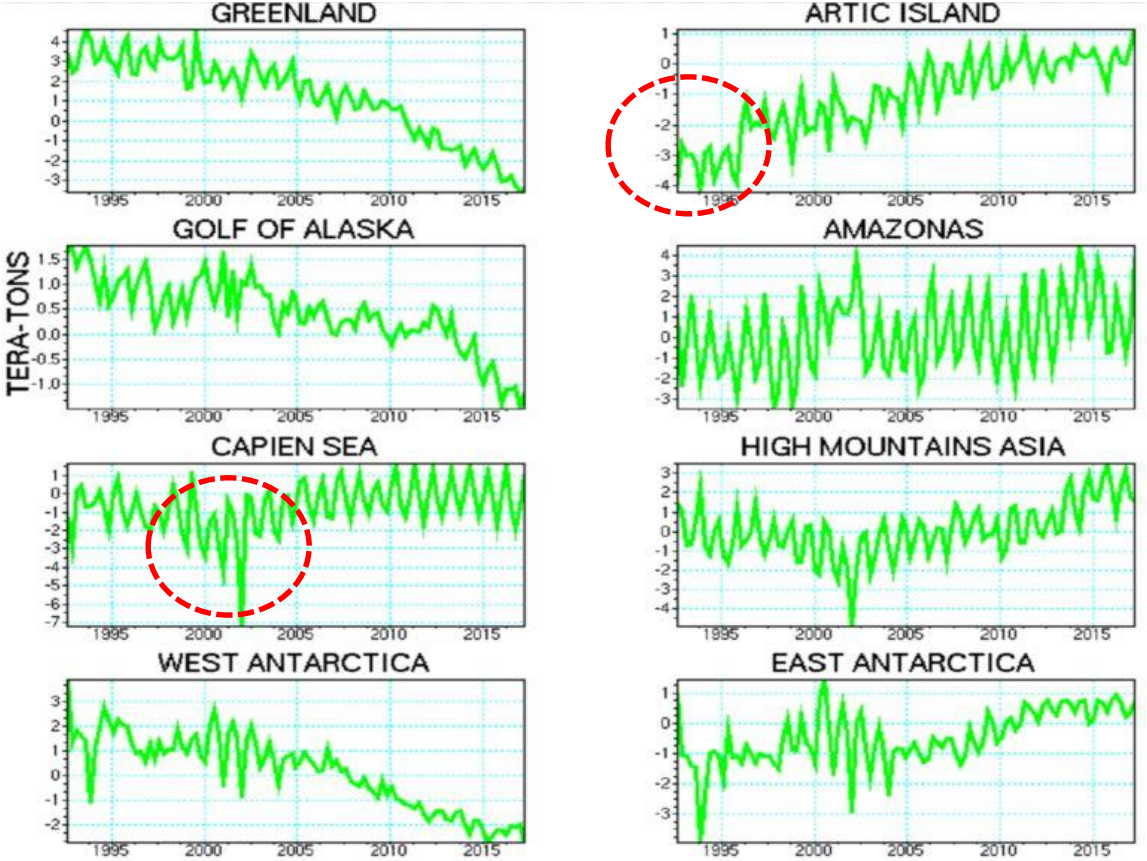


11 MISSIONS

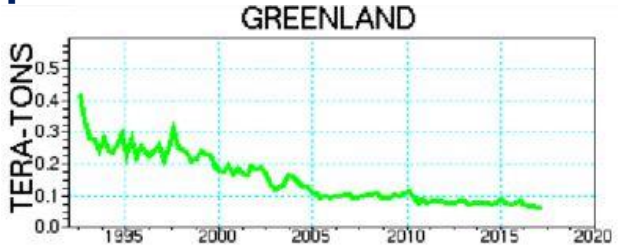


The orbit determination process uses only DORIS measurements
Several missions → different altitudes, repeat periods, number of revolutions within a cycle, …
TOPEX period : stacking process starts with only 2 missions and uses 5 missions at the end

ADJUSTED MASCONS



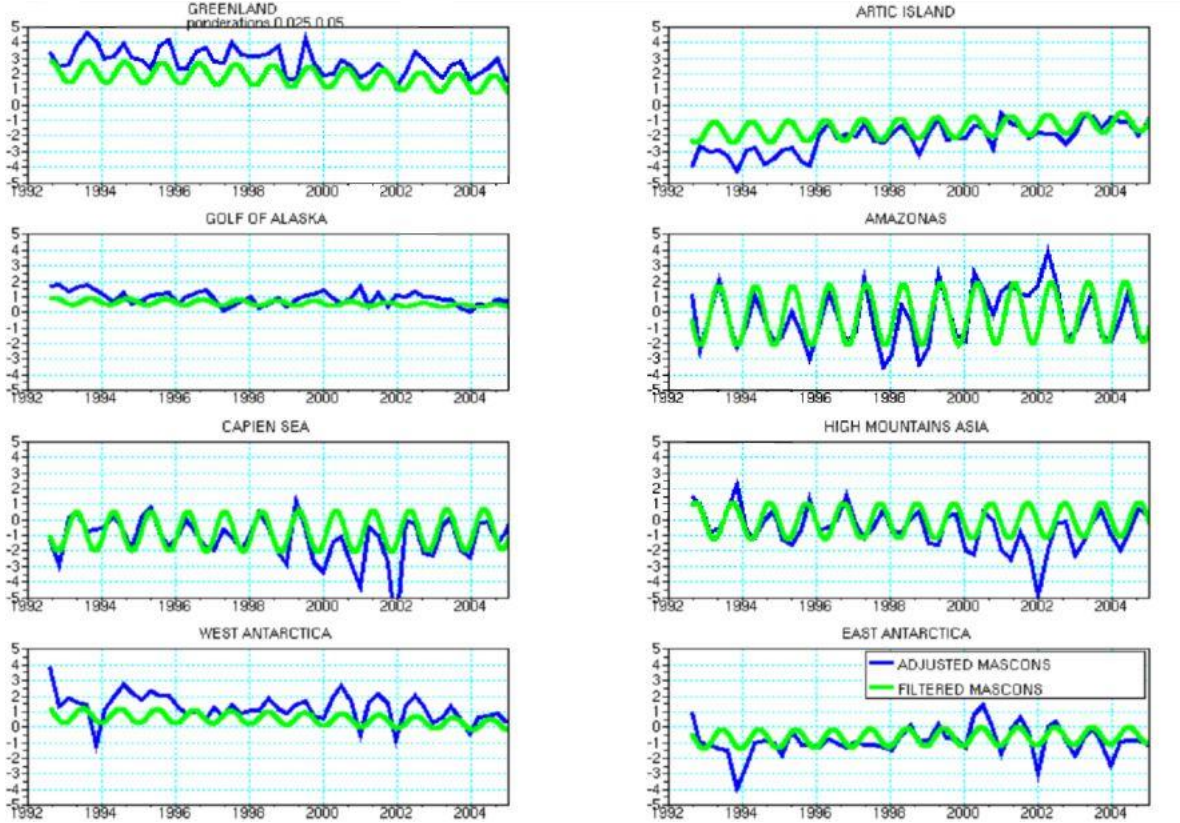
Equivalent covariance for all :



Greenland, Golf of Alaska, West Antarctica tend to 'loose mass'
East Antarctica tend to 'gain mass'
Amazonas has a significant annual amplitude

Some periods with strange observations, need to be improved

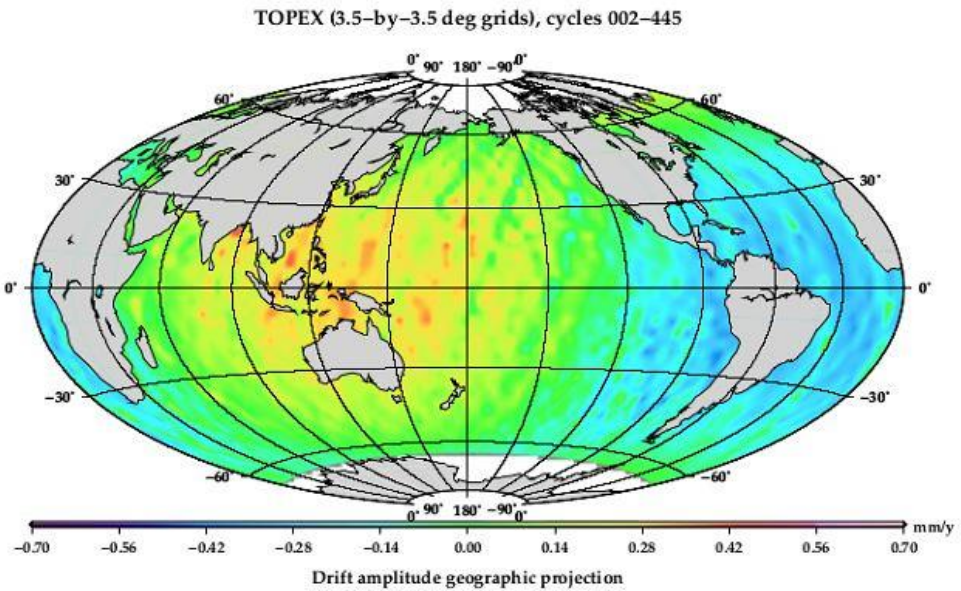
ADJUSTED MASCONS, FILTERING STEP

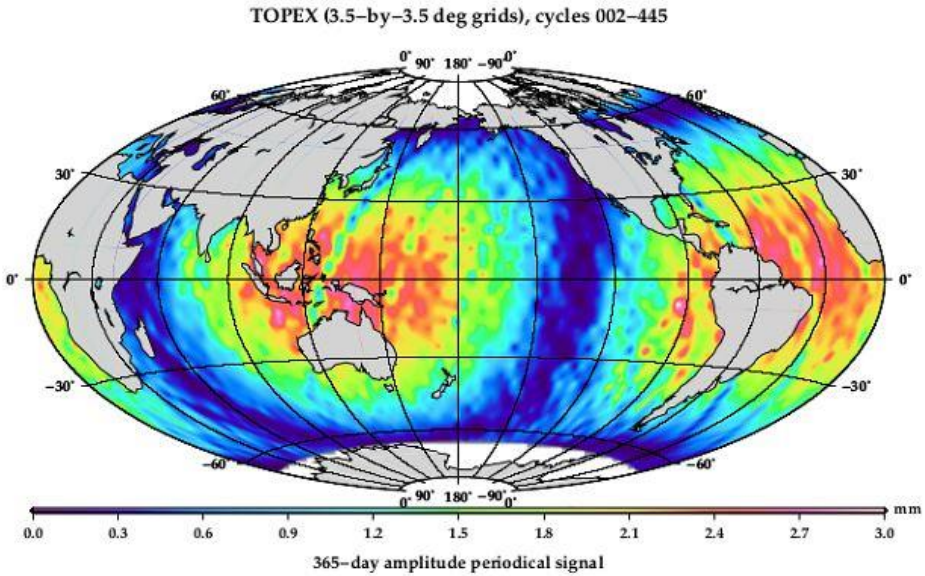


Filtering step, possible to :
- **constrain drift/amplitude signal**
- **remove outliers**

Need to constraint the drift for Greenland and Arctic Islands ?

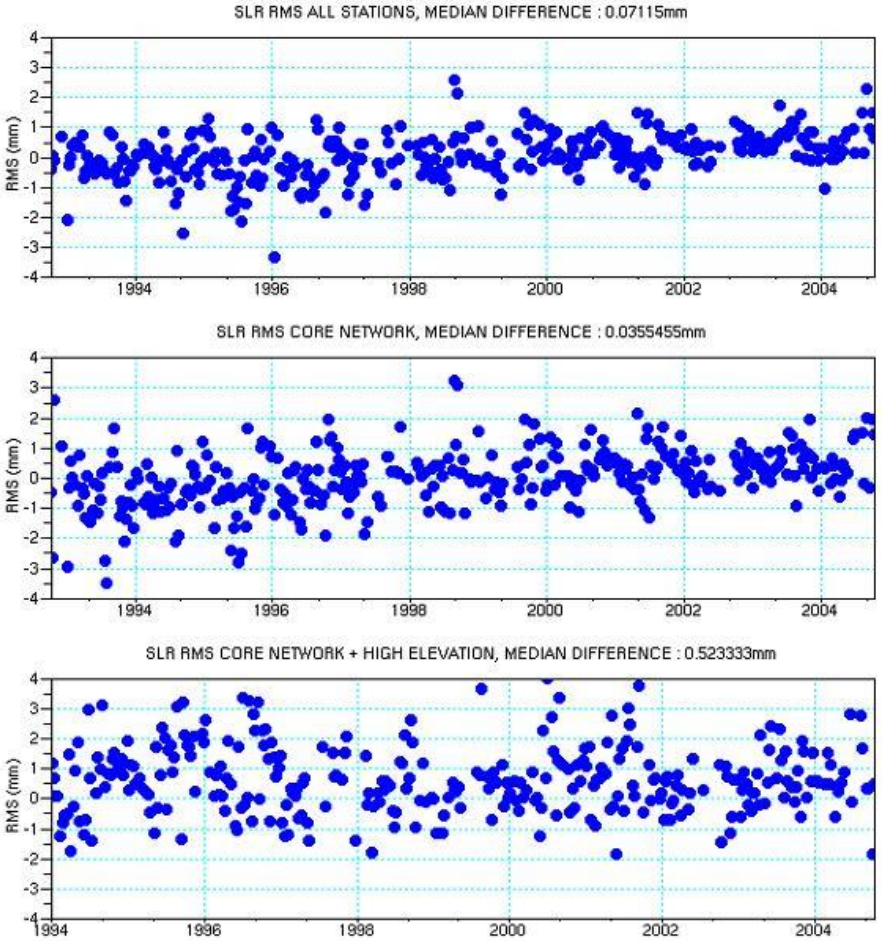
ORBITS PERFORMANCE
GEOGRAPHICALLY CORRELATED ERRORS





Patchs East – West
drift 0.5mm/year **annual amplitude 2.5mm**

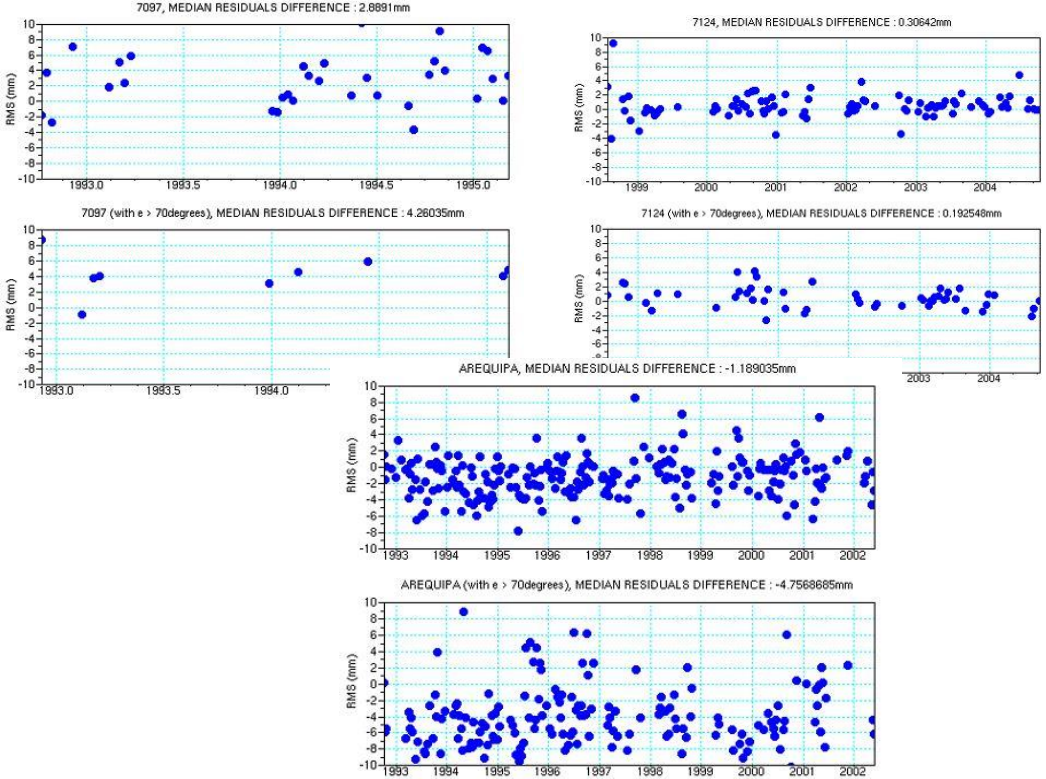
ORBITS PERFORMANCE, SLR RMS

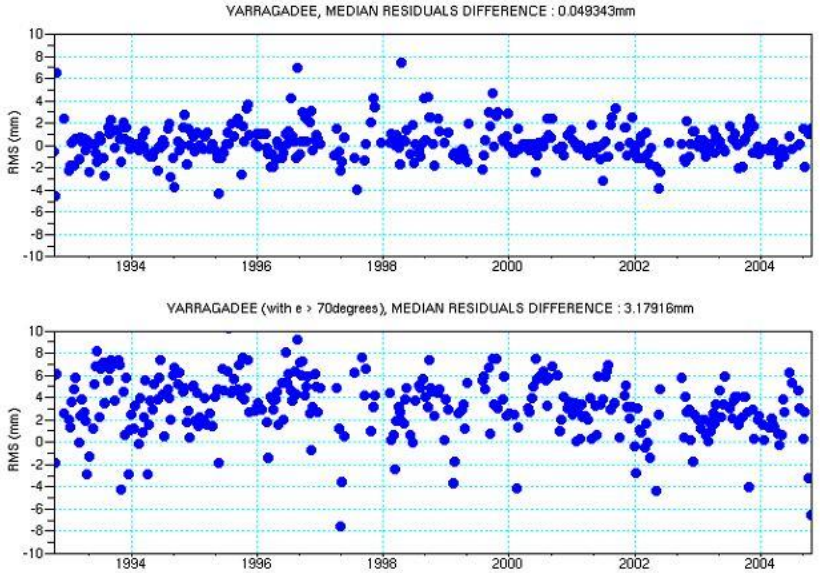


Sub-millimetric improvement for SLR RMS all stations / Core network
A bit more significative improvement for Core Network + high elevation (e>70°)

Core Network specific for T/P and period 1992 → 2002:
7090 7105 7110 7124 7210 7836 7838 7839 7849 7918

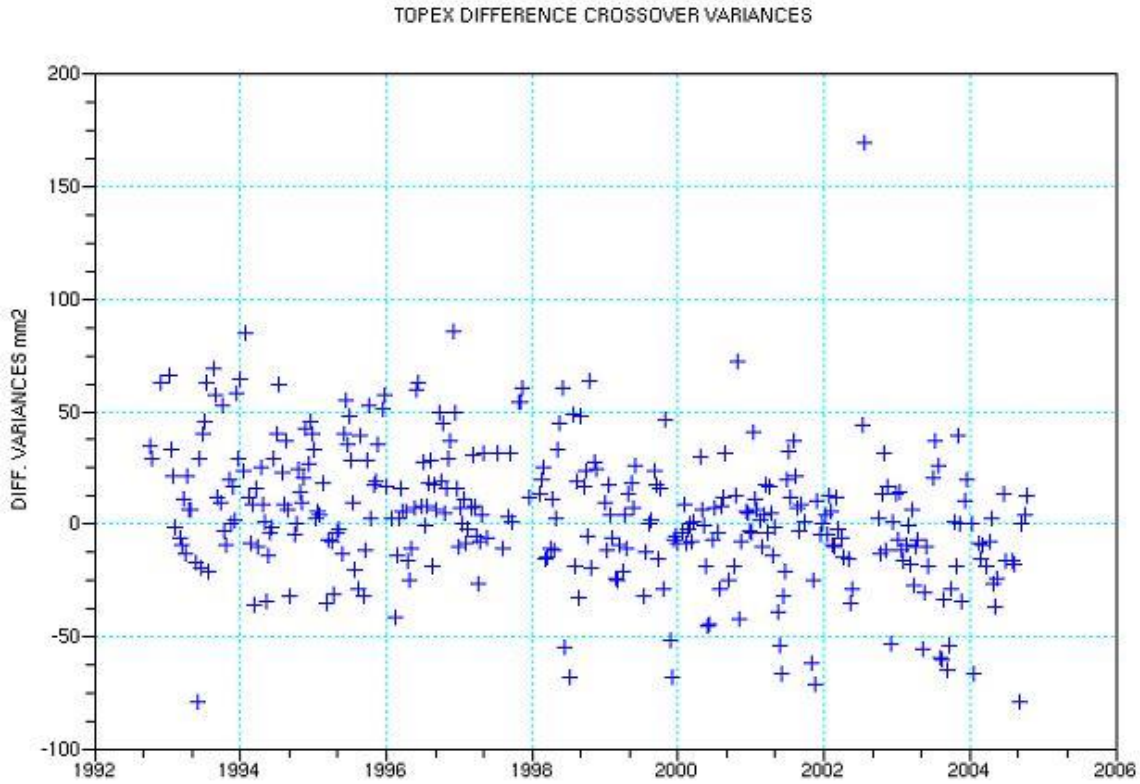
ORBITS PERFORMANCE, SLR RMS





Patch East, improvement 3mm for 7090 (core network)
Patch West, improvement for 7124 (core network) and 7097 but degradation for 7403

ORBITS PERFORMANCE, CROSSOVER VARIANCES



Mean difference of crossover variances, improvement of 4.75mm²
And for period before march 2002, improvement of 7.9mm²

CONCLUSION

The adjusted mascons improve slighlty the orbit performance. Submillimetric improvements in global SLR RMS and mean improvement of 4.75mm² on crossover variances.

The adjusted mascons still shows some ‘too noisy’ periods. Need to improve SPOT orbits performance or to introduce complementary SLR missions like LAGEOS. The filtering process helps to workaround

The orbit determination process was based here on the GDR-E standards with a static gravity field : effects should be less important when using a mean gravity field model including TVG?

Next evaluation with up to date GRGS mean gravity field arriving soon for the POE-F reprocessing