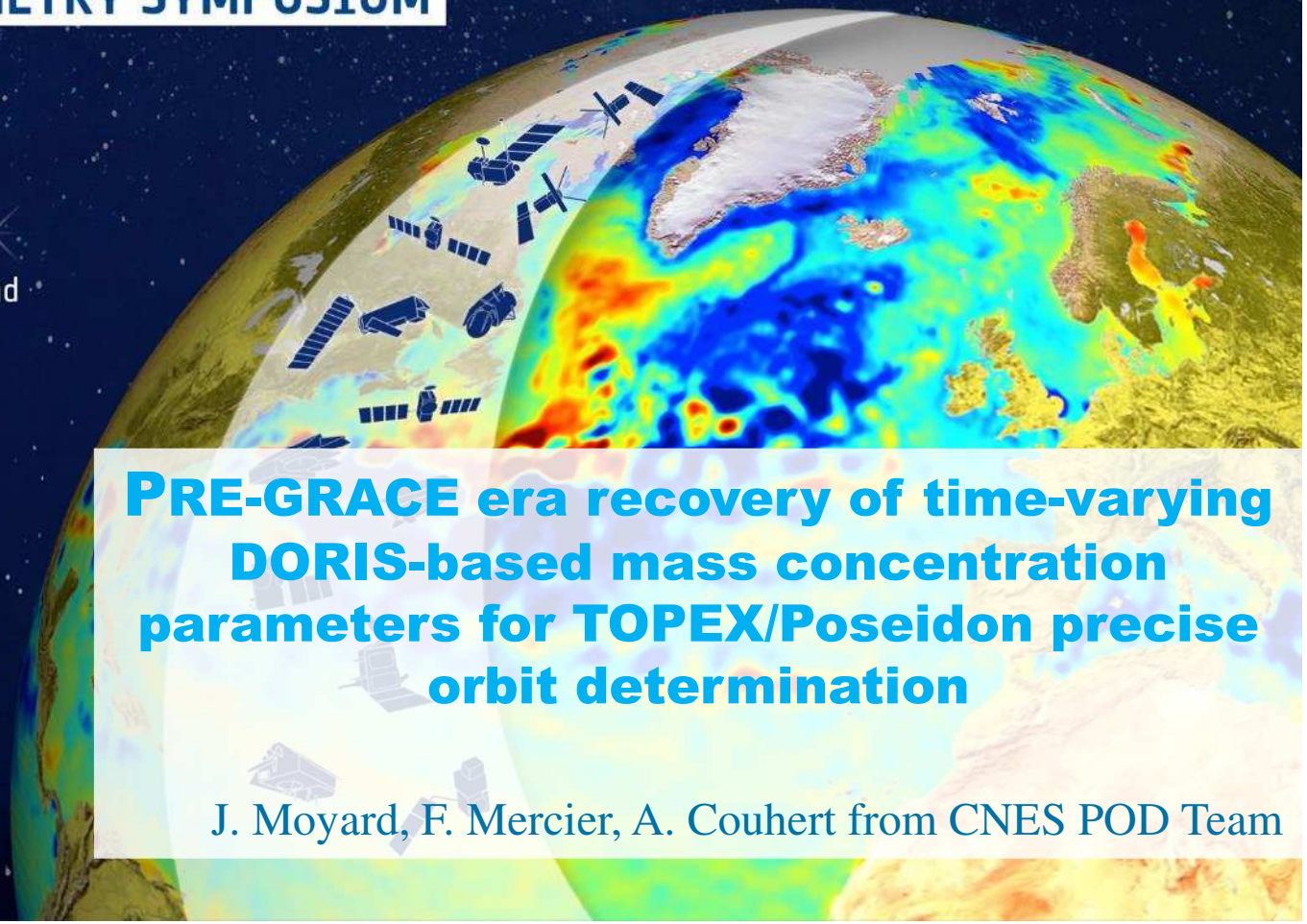
cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

esa
European Space Agency

→ 25 YEARS OF PROGRESS
IN RADAR ALTIMETRY SYMPOSIUM

IDS WORKSHOP

24–29 September 2018
Ponta Delgada, São Miguel Island
Azores Archipelago, Portugal



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

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IDS

SUMMARY

CONFIGURATION

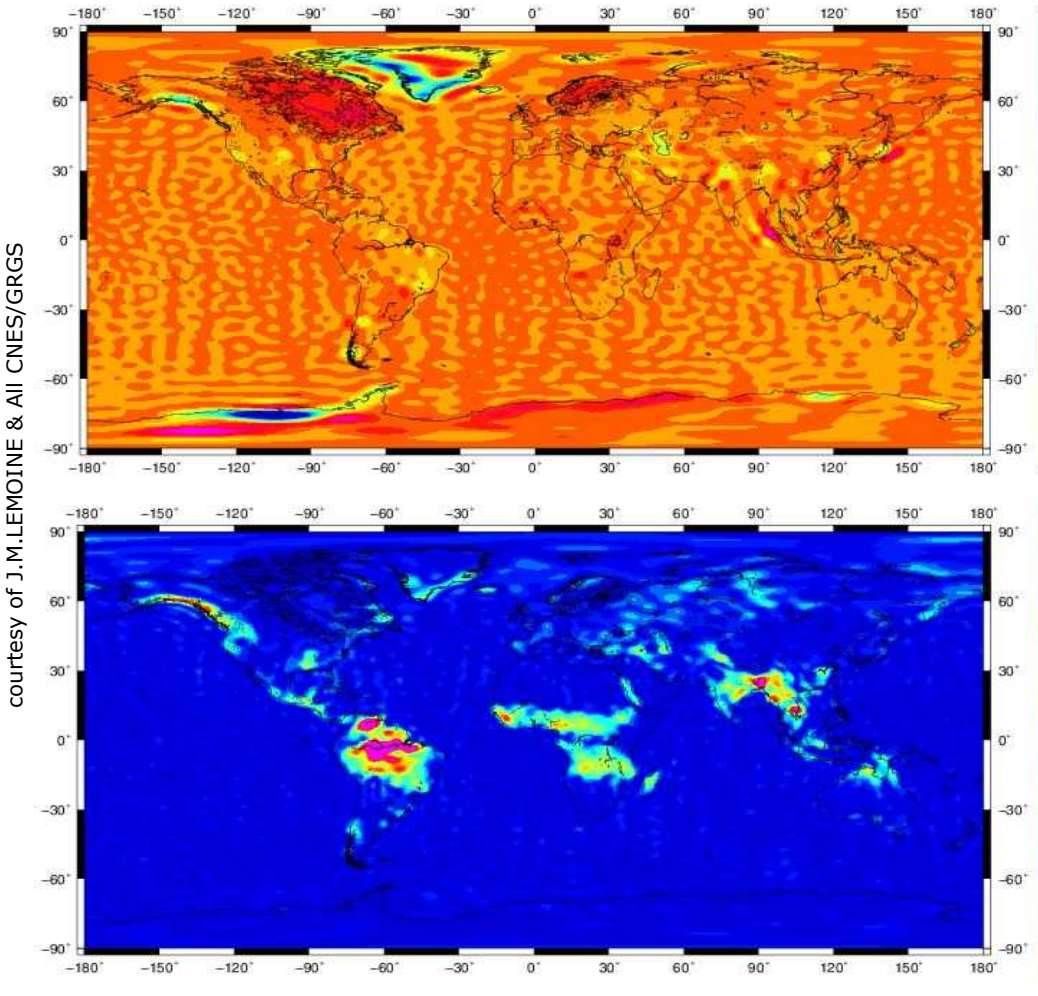
PRELIMINARY VALIDATION

TOPEX/Poseidon orbits performance

CONCLUSION

Localization of mascons need some information on variable masses location, i.e. long term or periodic signals

GRACE times series CNES/GRGS, 2002 → 2016

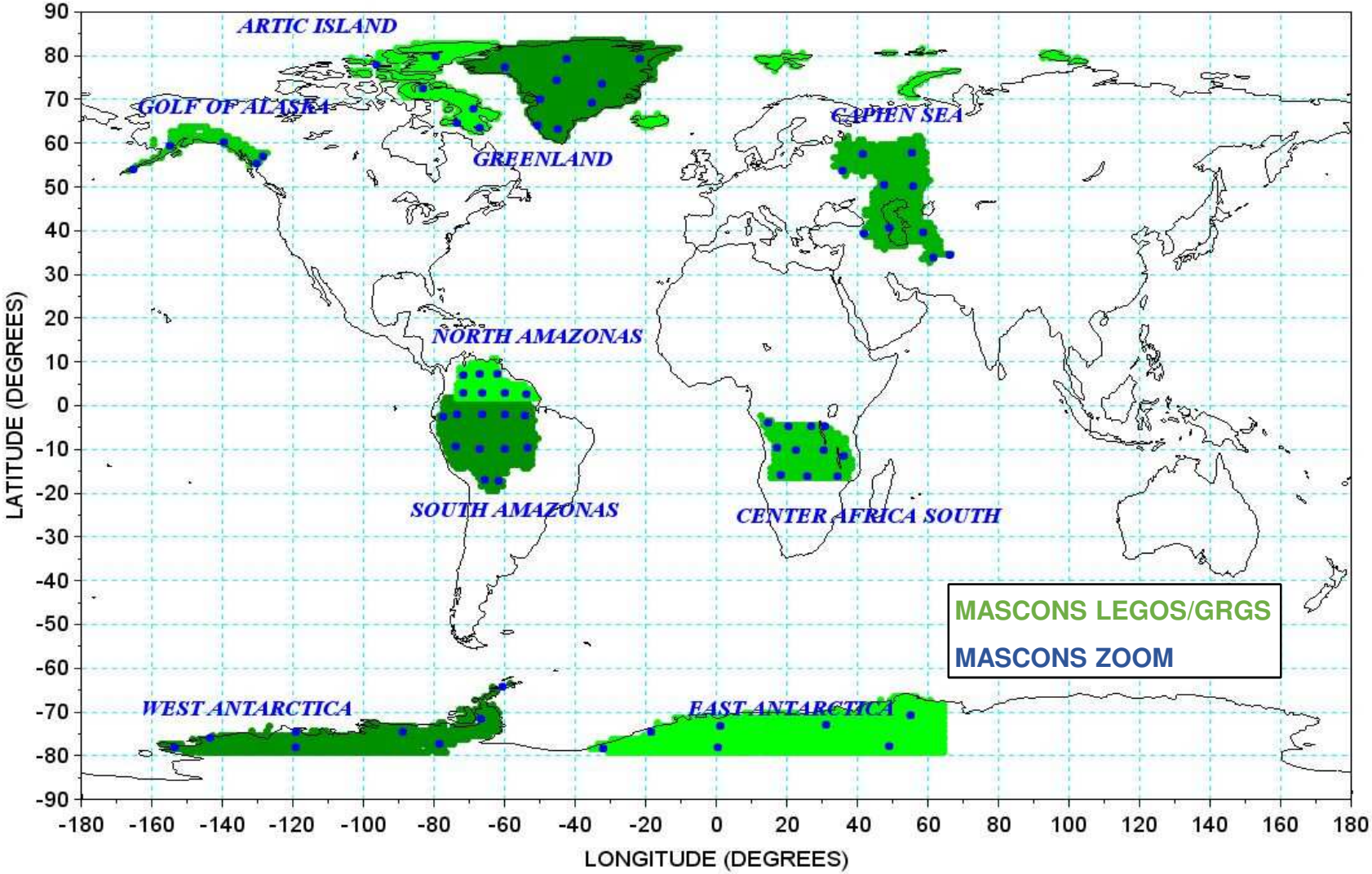


courtesy of J.M.LEMOINE & All CNES/GRGS

Average Trend (EWH in m/year)

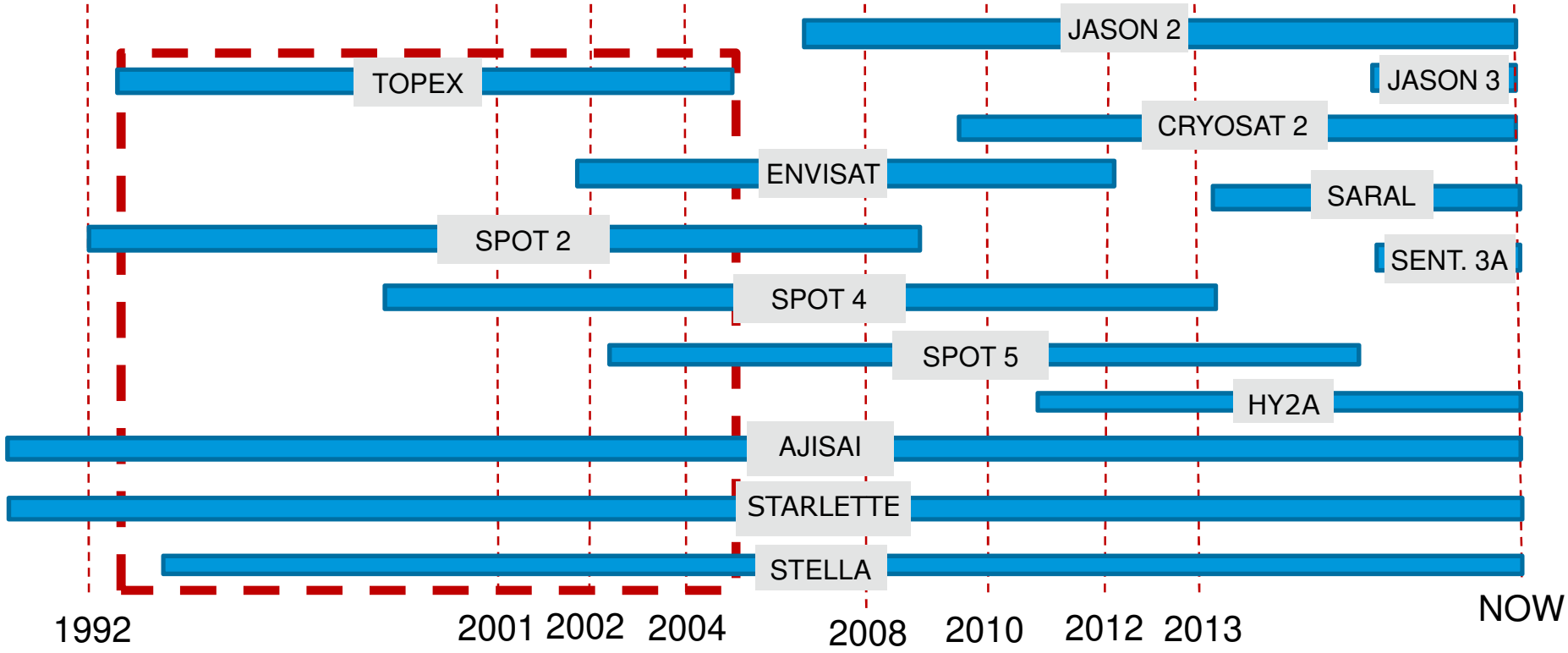
Mean Amplitude of the Annual signal (EWH in m)

MASCONS TOPOLOGY, 9 regions



DEFINITION

14 MISSIONS, 11 DORIS and 3 SLR



Orbit determination process uses only DORIS measurements (σ=0.5cm) or SLR measurements (σ=2.0cm)

Normal equations stacking process includes noise model correlated to mascons latitude

TOPEX period, stacking process :

- **starts with 2 missions "DORIS" and 3 missions "SLR"**
- **ends with 5 missions "DORIS" and 3 missions "SLR"**

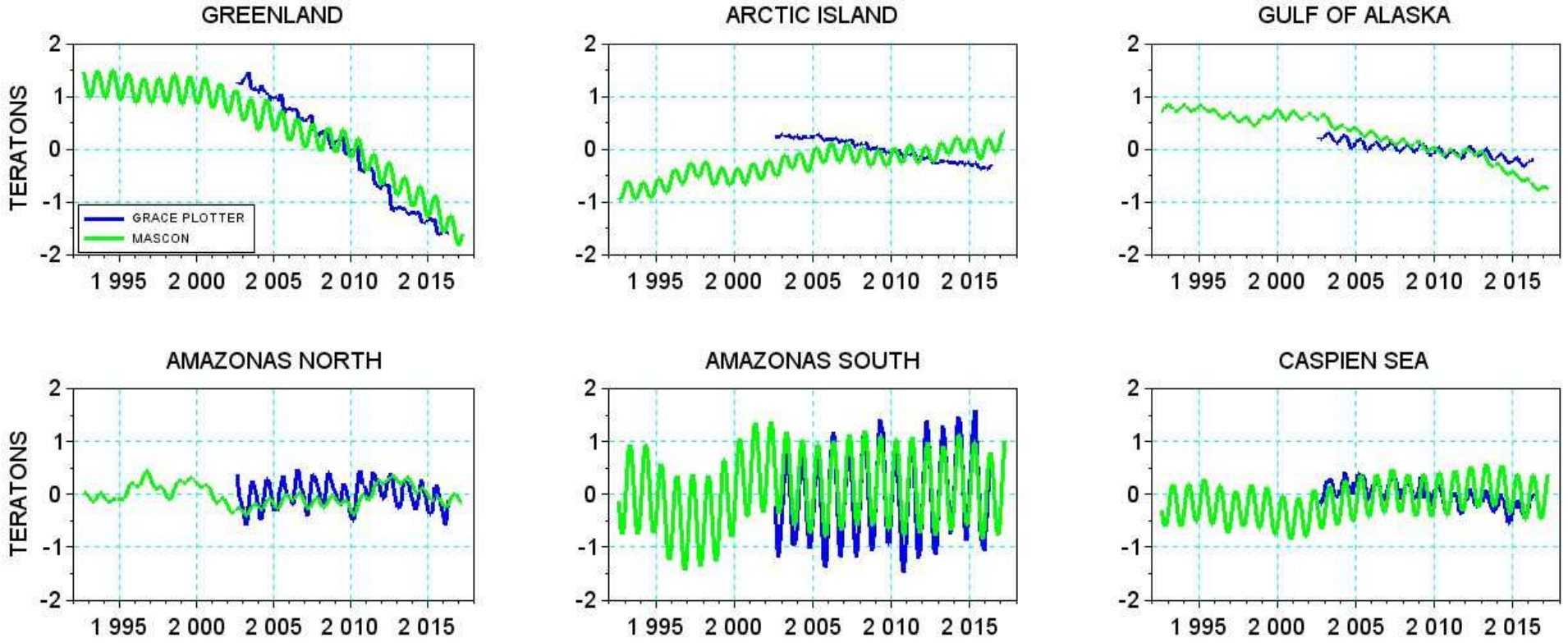
PRELIMINARY VALIDATION

Comparison with GRACE PLOTTER tool → *www.thegraceplotter.com*

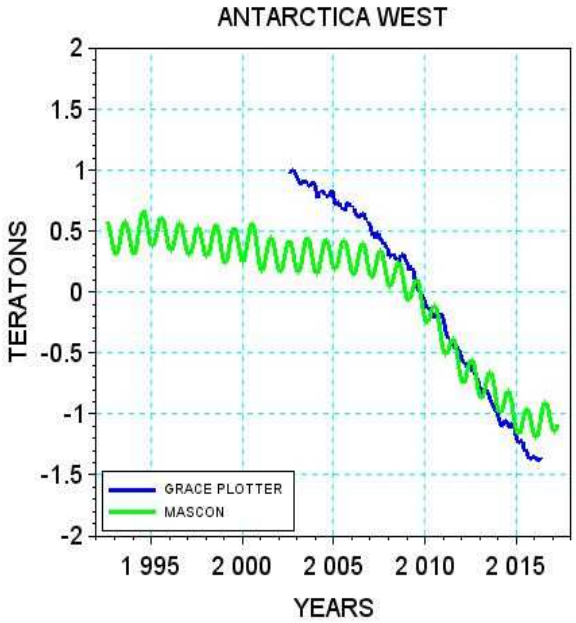
CNES/GRGS static field used in orbit determination process to estimate mascons

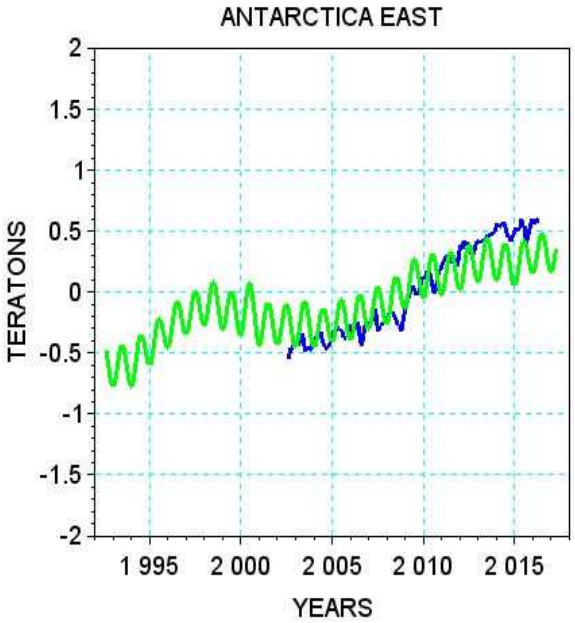
+ GDR-E POE CNES standard

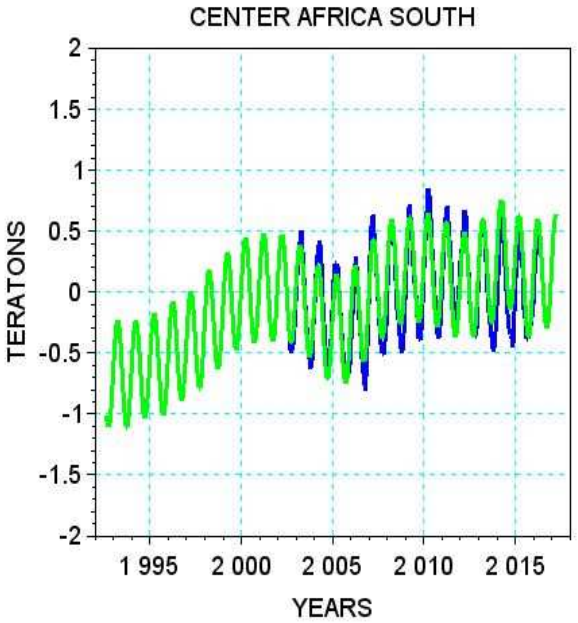
+ stacking process on 3 months



PRELIMINARY VALIDATION



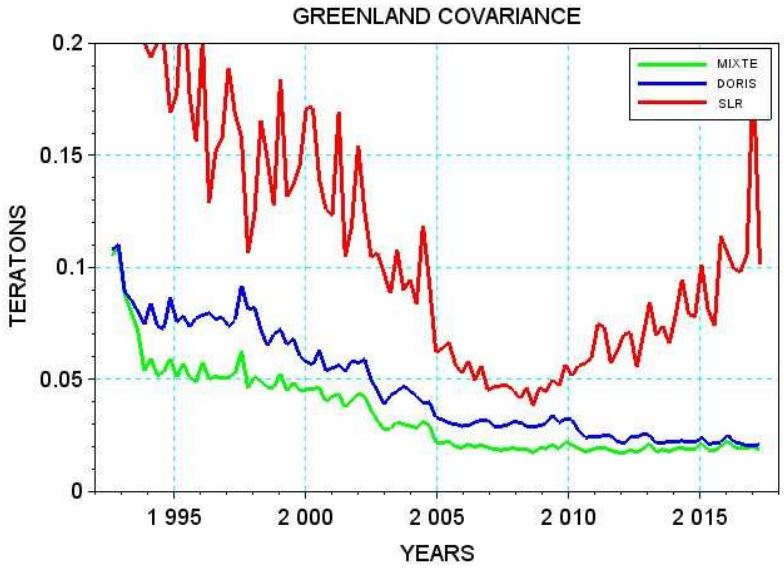




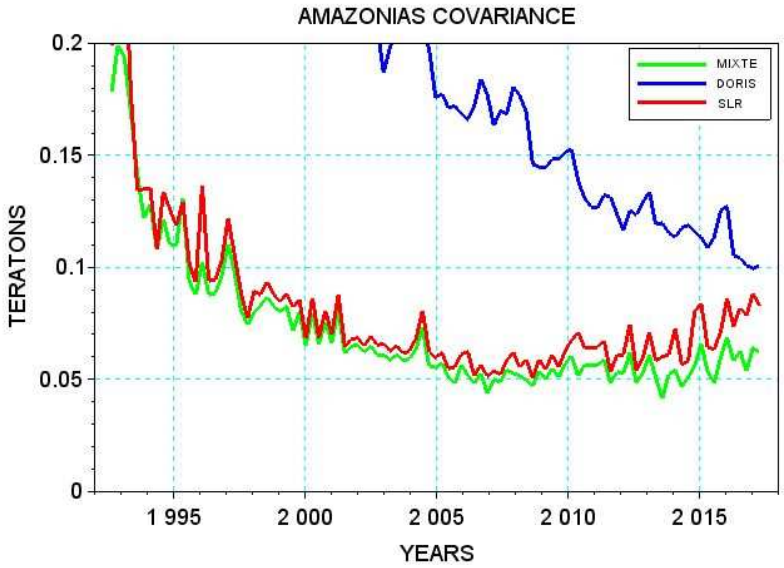
Except for Artic Island, behaviour of other 8 mascons seems quite good in regards of GRACE PLOTTER data

PRELIMINARY VALIDATION

Equivalent covariance for all

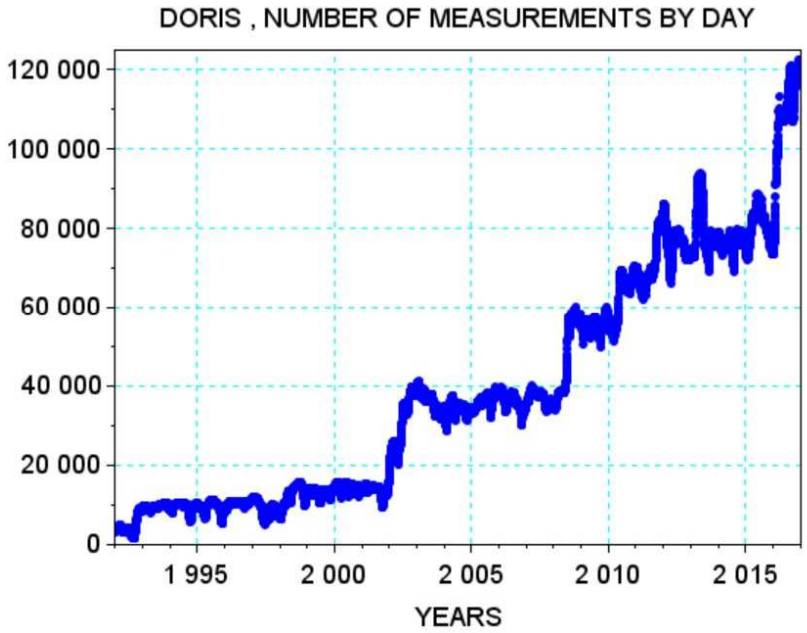


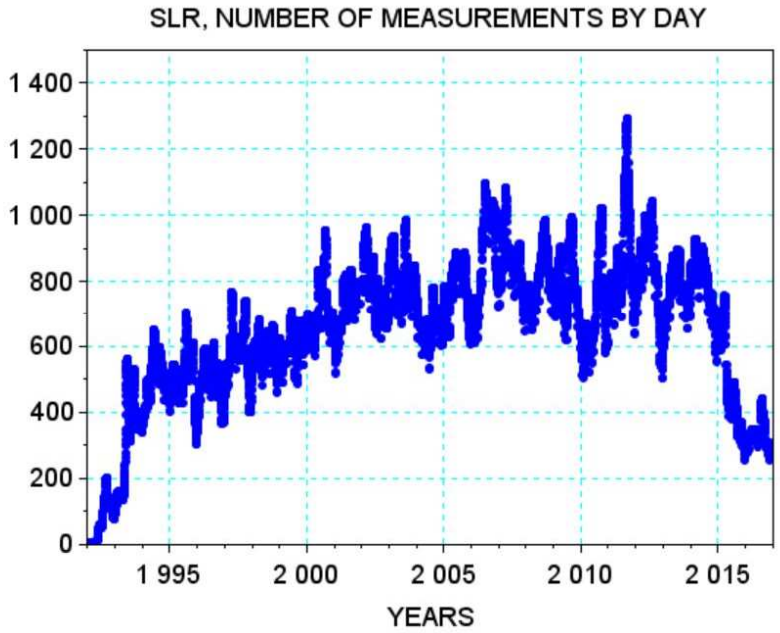
except for Amazonias regions



Covariance « mixte solution » for Amazonias has an amplitude x 2 in comparison to others mascons covariance

A comparison of the covariance DORIS/SLR plots could be done with number of measurements for each solution

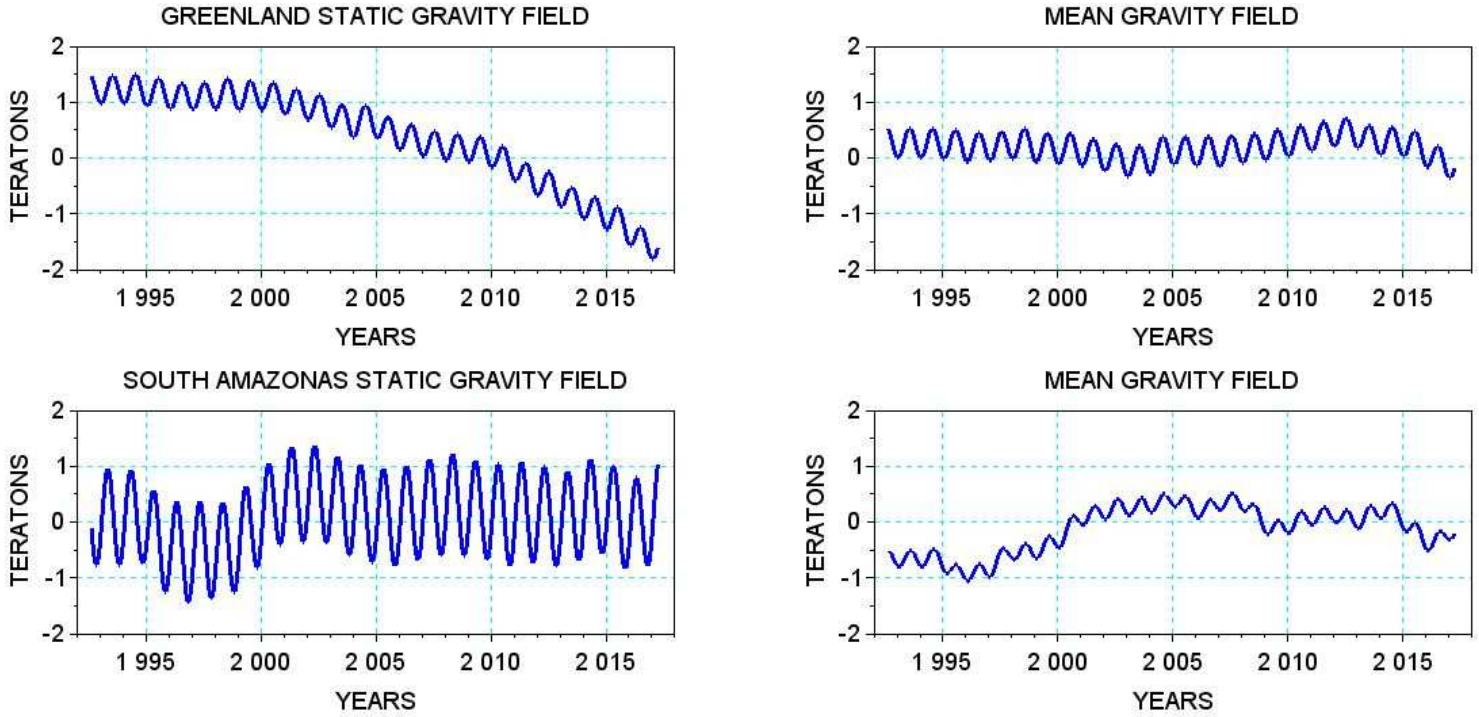




PRELIMINARY VALIDATION

Comparisons between mascons estimated with static field vs mascons estimated with mean field.

https://grace.obs-mip.fr/ : *mean field contains a series of periodic and secular gravity variations for the lowest degrees of gravity field. Those variations include annual, semi annual and drift terms*



→ if a mascon(mean field) values are around 0. on GRACE period, a good observation to validate this mascon on pre-GRACE period

TOPEX POSEIDON Orbits performance

CNES/GRGS mean field used in orbit determination process.

(for degree 2 of mean field, TVG are extended to 1985-2012 using LAGEOS/LAGEOS2 SLR mission)

GDR-E POE CNES standard

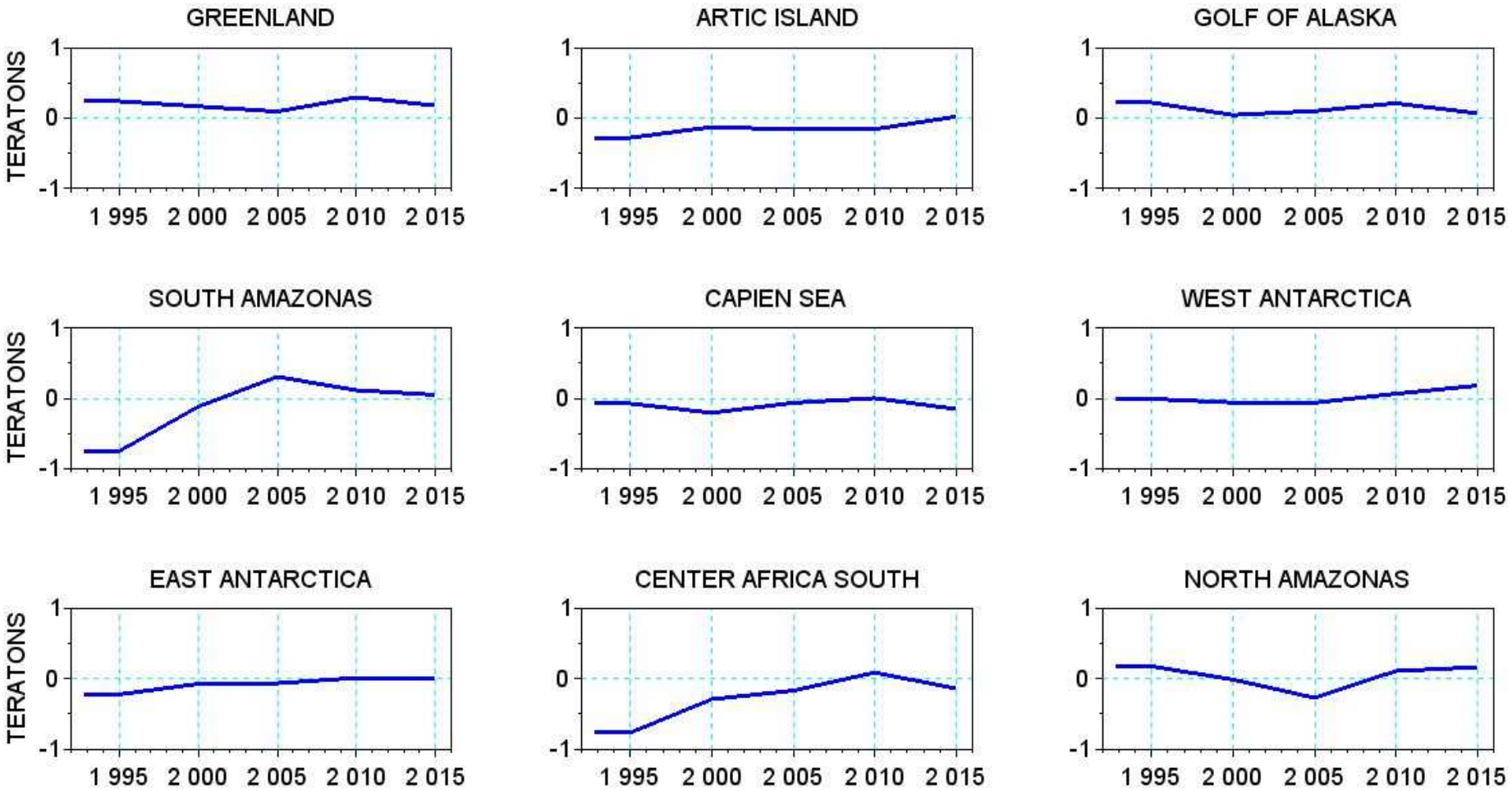
Confident in annual and semi-annual periodic terms of mean field, focus on drift/bias

Normal equations stacking process on five years, focus on long term

Impact on Orbits performance criteria (RMS SLR + Crossover Variance) on period pre-GRACE ?

TOPEX POSEIDON Orbits performance

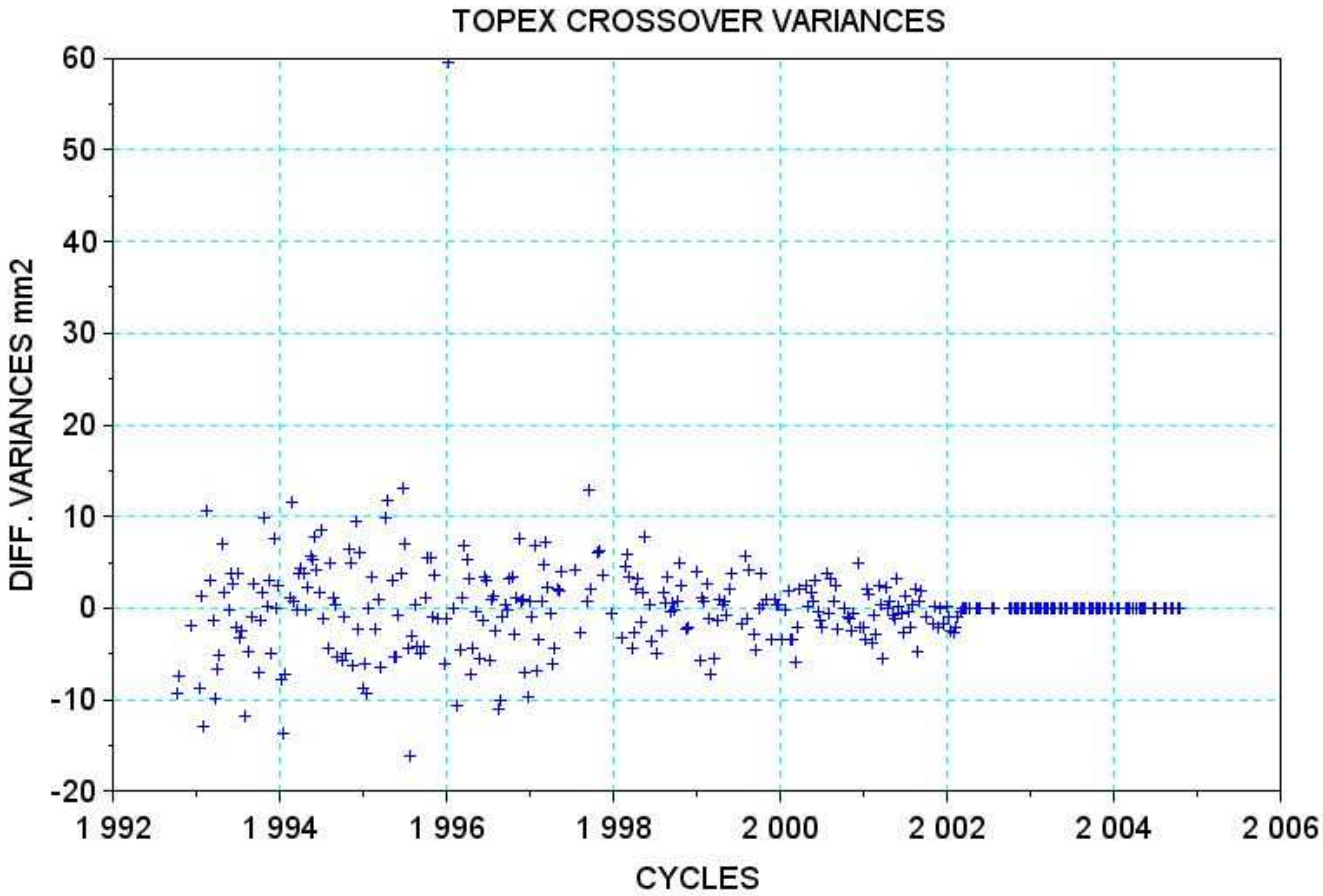
Adjusted mascons



TOPEX POSEIDON Orbits performance

CROSSOVER VARIANCE between GDR-E vs GDR-E+mascons

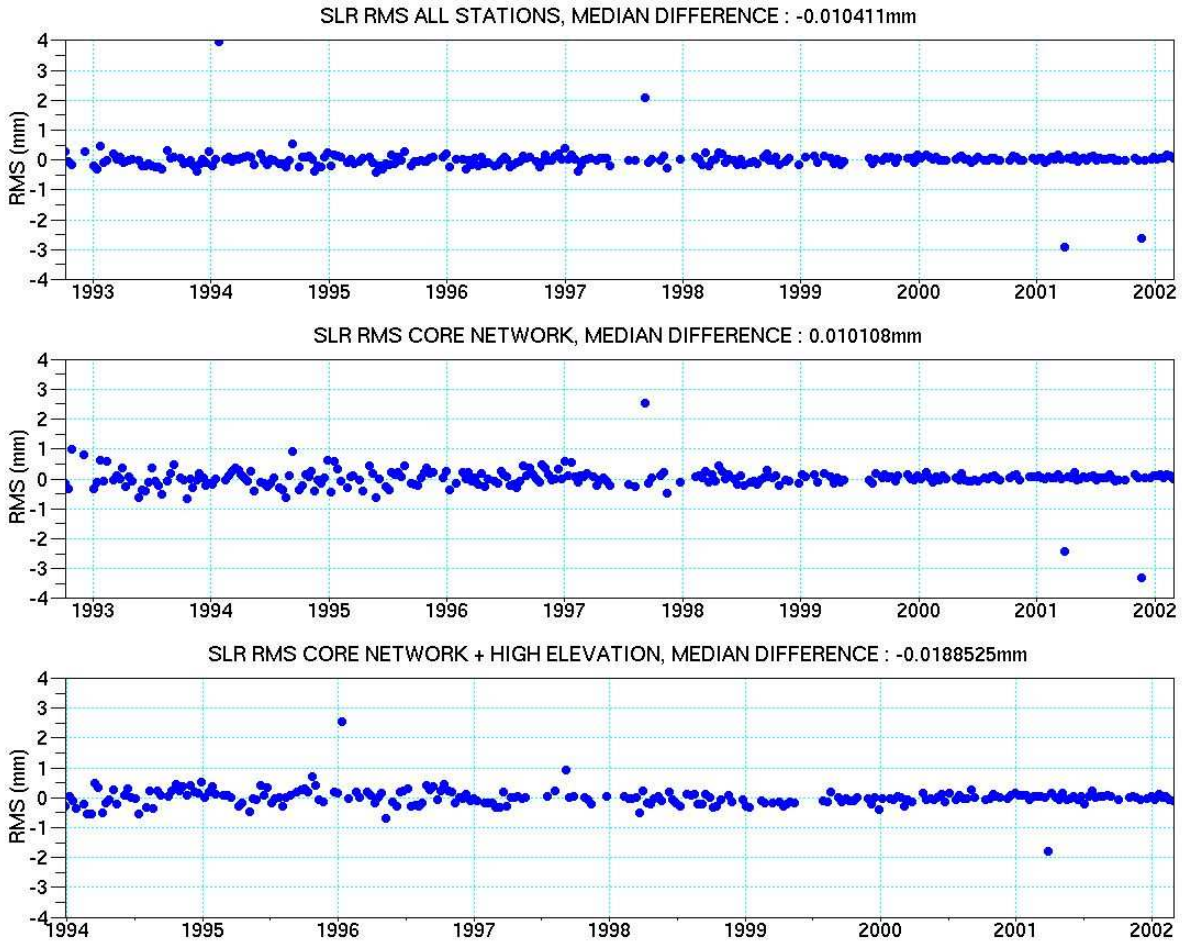
mean 0.026mm² / median 0.002mm²



no improvement for this criteria…

TOPEX POSEIDON Orbits performance

SLR RMS between GDR-E vs GDR-E+mascons



no improvement for this criteria too…

For CNES/GRGS mean field, extension of TVG to 1985-2012 using LAGEOS/LAGEOS2

SLR mission is efficient for orbits TOPEX performance

CONCLUSION

MASCONS approach give good results in comparison with GRACE PLOTTER tools (physical point of view) : give an insight on the mass evolution of Greenland before the GRACE era

Some tested regions need to be improved in our approach like Artic Islands

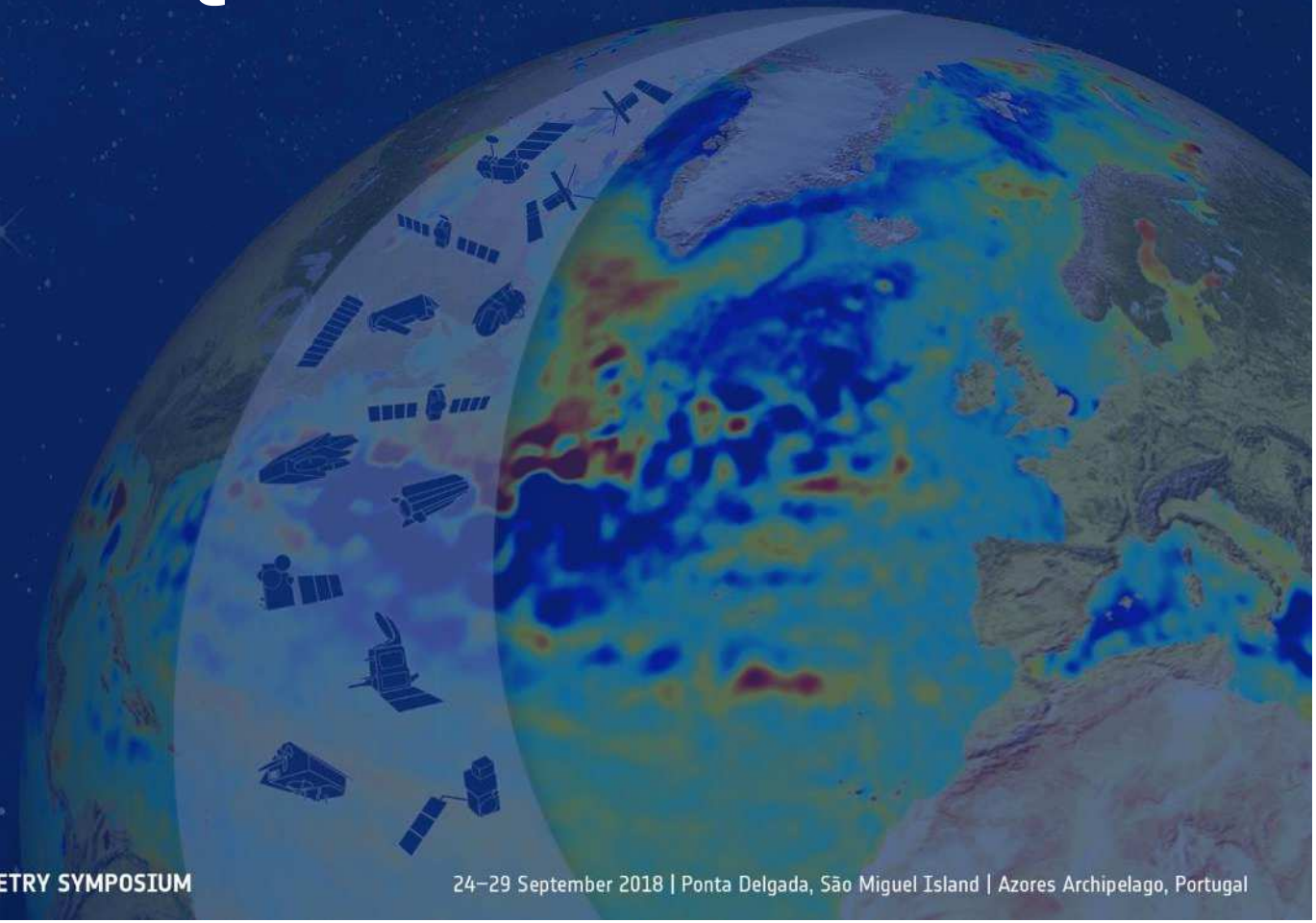
For CNES/GRGS mean field, extension of TVG to 1985-2012 using LAGEOS/LAGEOS2 SLR mission could be enough for orbits TOPEX performance, mascons approach doesn't give real improvement yet.

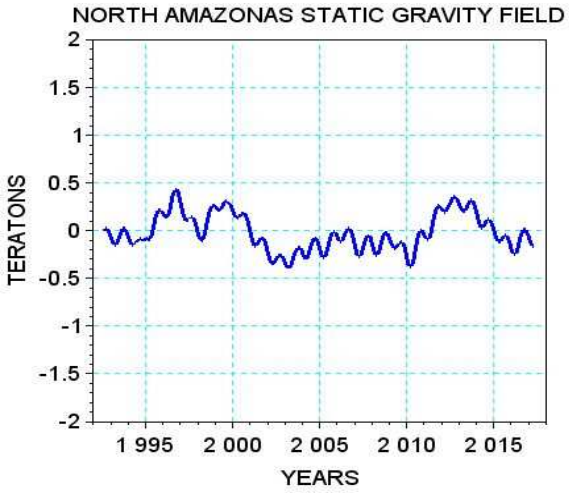
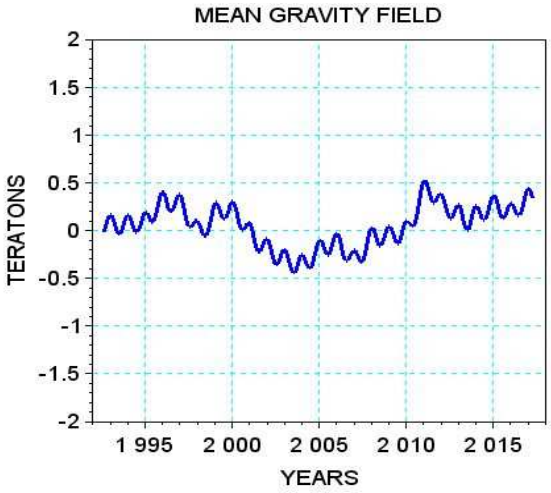
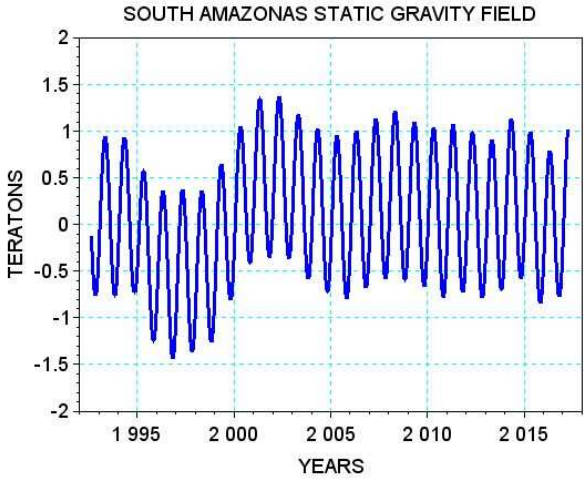
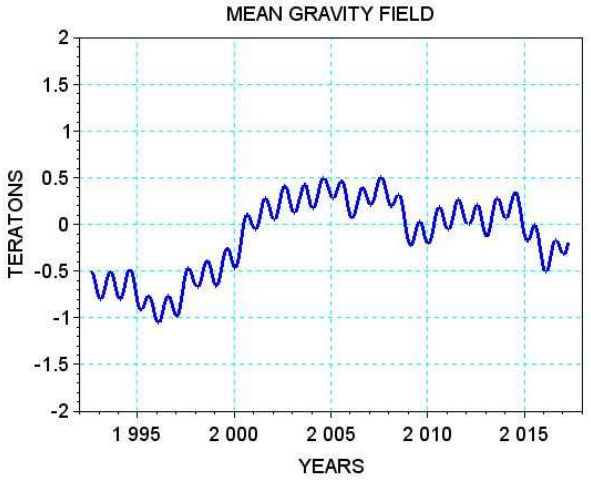
Mascons approach could be improved :

- 9 mascons are not enougth to cover all regions with long term or periodic signals, could add more mascons but observability issue to be solved ?

- Improved models like troposphere (test GPT GMF1 instead of GPT GMF) in DORIS orbit dermination or cut off à 20° (annual period amplitude)

THANK YOU FOR YOUR ATTENTION
QUESTIONS ?



PRELIMINARY VALIDATION

Comparisons between mascons estimated with static field vs mascons estimated with mean field, not very clean on Amazonia mascons