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

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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*

- 0.3 m/y
- 0.0 m/y
- 0.1 m/y

Average Trend (EWH in m/year)

- 0.3 m
- 0.0 m
+ 0.3 m

Mean Amplitude of the Annual signal (EWH in m)
MASCONS TOPOLOGY, 9 regions

- ARTIC ISLAND
- GOLF OF ALASKA
- GREENLAND
- NORTH AMAZONAS
- SOUTH AMAZONAS
- CENTER AFRICA SOUTH
- WEST ANTARCTICA
- EAST ANTARCTICA

MASCONS LEGOS/GRGS
MASCONS ZOOM
Orbit determination process uses only DORIS measurements ($\sigma=0.5\text{cm}$) or SLR measurements ($\sigma=2.0\text{cm}$)

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

- Greenland
- Arctic Island
- Gulf of Alaska
- South Amazonas
- Capien Sea
- West Antarctica
- East Antarctica
- Center Africa South
- North Amazonas
CROSSOVER VARIANCE between GDR-E vs GDR-E+mascons
mean 0.026mm² / median 0.002mm²

no improvement for this criteria...
For CNES/GRGS mean field, extension of TVG to 1985-2012 using LAGEOS/LAGEOS2
SLR mission is efficient for orbits TOPEX performance
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 enough 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 determination or cut off à 20° (annual period amplitude)
THANK YOU FOR YOUR ATTENTION QUESTIONS?
Comparisons between mascons estimated with static field vs mascons estimated with mean field, not very clean on Amazonia mascons.