



Contribution of non-tidal oceanic mass variations to Earth rotation determined from space geodesy and ocean data

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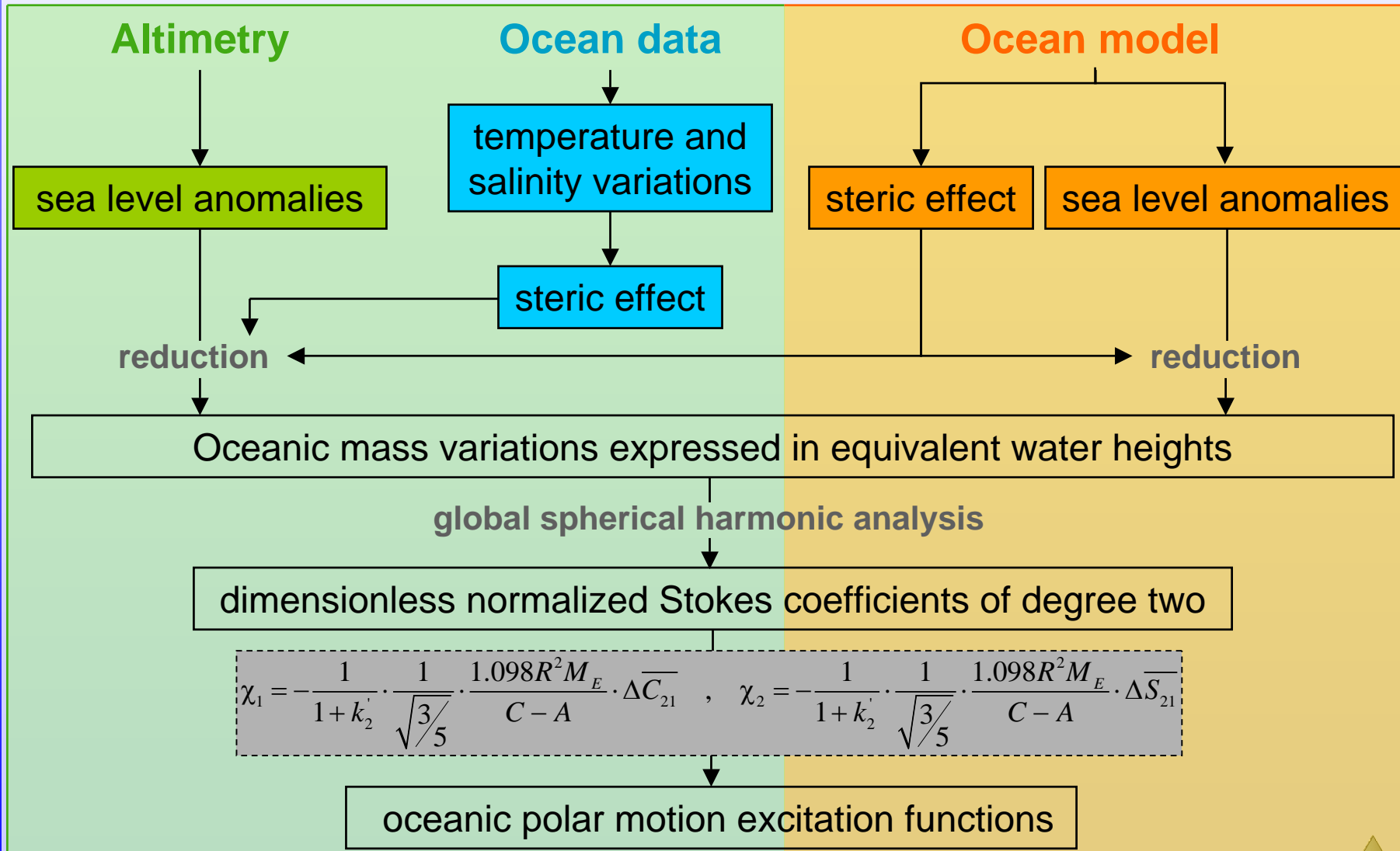


Motivation

- The **motion of the rotation axis** with respect to the Earth's surface can be **observed precisely** from space geodetic techniques
- **Underlying geophysical processes** within and between the subsystems of the Earth that perturb the Earth rotation **have to be separated** for a better understanding of our planet
- Global **mass displacements and movements** can be **estimated** from terrestrial and space observations and from assimilated models

Can satellite altimetry estimate oceanic mass variations better than ocean models?

Calculation method





Data sources (1)

Altimetry

Sea level anomalies (SLA) from TOPEX/Poseidon extended mission

- Altimeter data: MGDR, Version C
- Consideration of environmental and geophysical corrections, including inverse barometer correction
- Mean sea surface of 2003 - 2005
- Monthly mean (time series)
- Roman Savcenko, Wolfgang Bosch (DGFI)

Ocean data

Temperature and salinity climatologies of the WOA05

- 24 depth level (0 - 1500m)
- long-period monthly mean (averages)
- <http://www.nodc.nova.gov/OC5/WOA05>

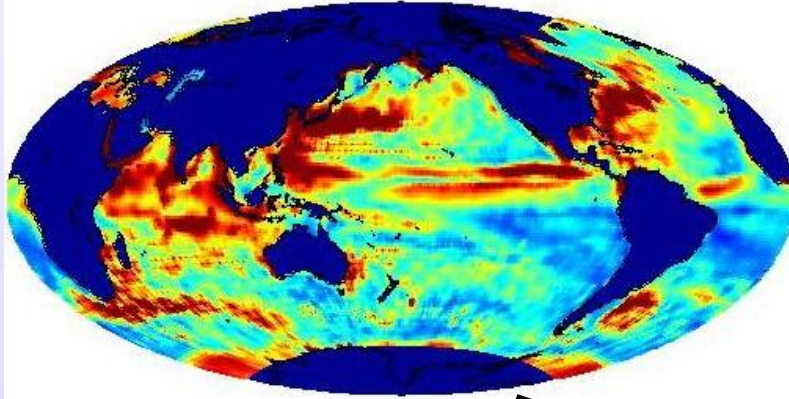
Temperature and salinity fields from Masayoshi Ishii

- 16 depth level (0 - 700m)
- monthly mean (time series)
- Masayoshi Ishii (Frontier Research Center for Global Change)

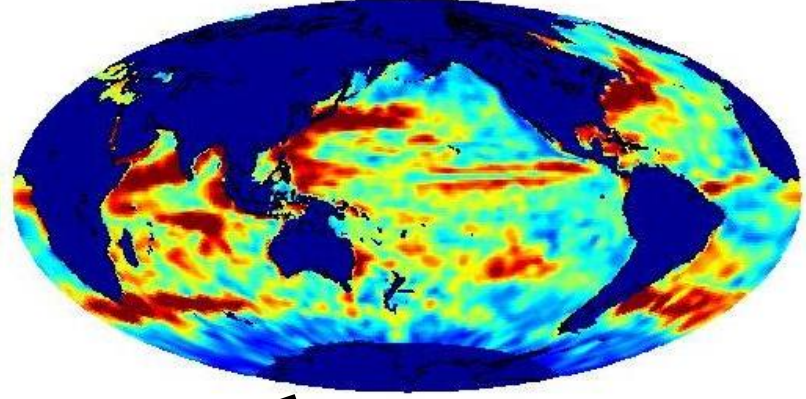


Data sources (2)

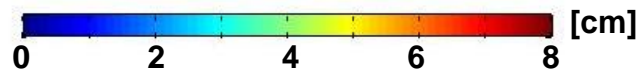
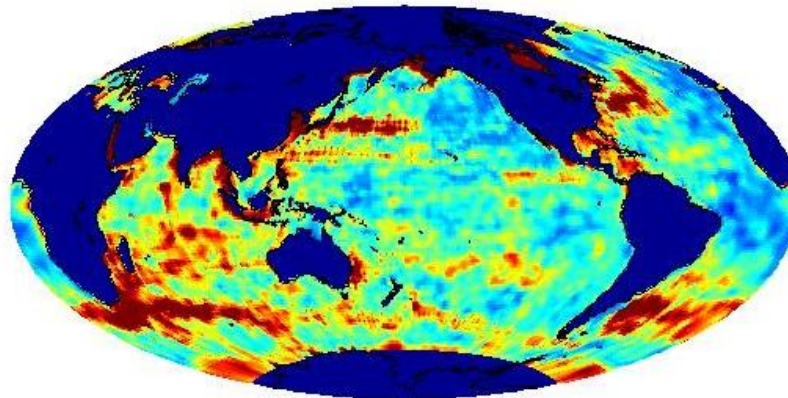
RMS of monthly mean SLA (TOPEX/Poseidon)
[2003 - 2005]



RMS of monthly mean steric effect (M. Ishii)
[2003 - 2005]



RMS of monthly mean residuals (SLA - steric effect)
[2003 - 2005]





Data sources (3)

Ocean model

Oceanic excitation functions from baroclinic ocean model OMCT

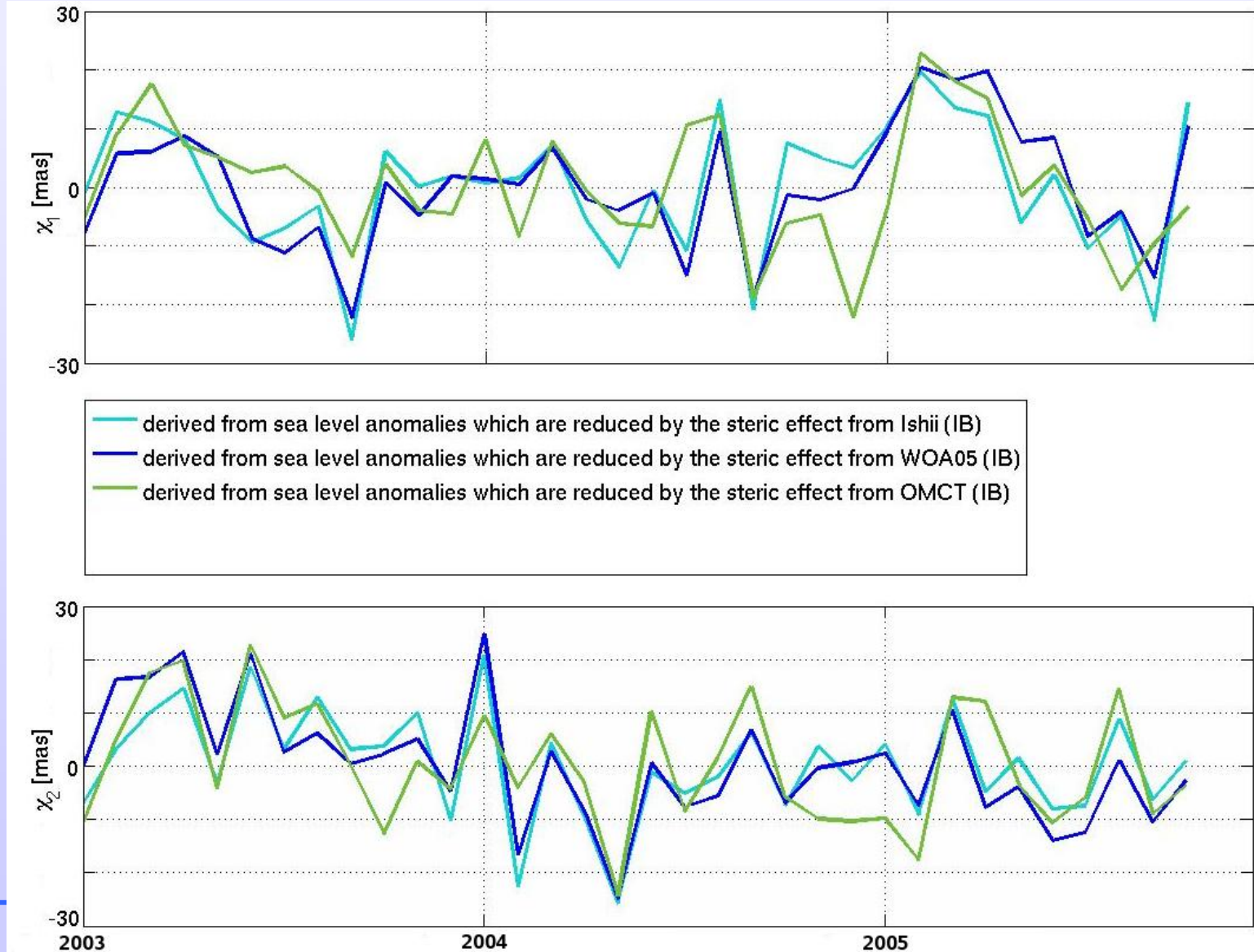
- Forcing with ECMWF
 - wind stress
 - 2m-temp.
 - freshwater fluxes
- IB adoption
- Assimilation: no
- Mass conservation
- Monthly mean (time series)
- Maik Thomas (GFZ-Potsdam)

Oceanic excitation functions from baroclinic ocean model ECCO (kf049f)

- Forcing with NCEP reanalysis
 - wind stress
 - heat flux
 - freshwater fluxes
- IB adoption
- Assimilation: altimetry & XBT
- Mass conservation
- Monthly mean (time series)
- http://euler.jpl.nasa.gov/sbo/sbo_data.html



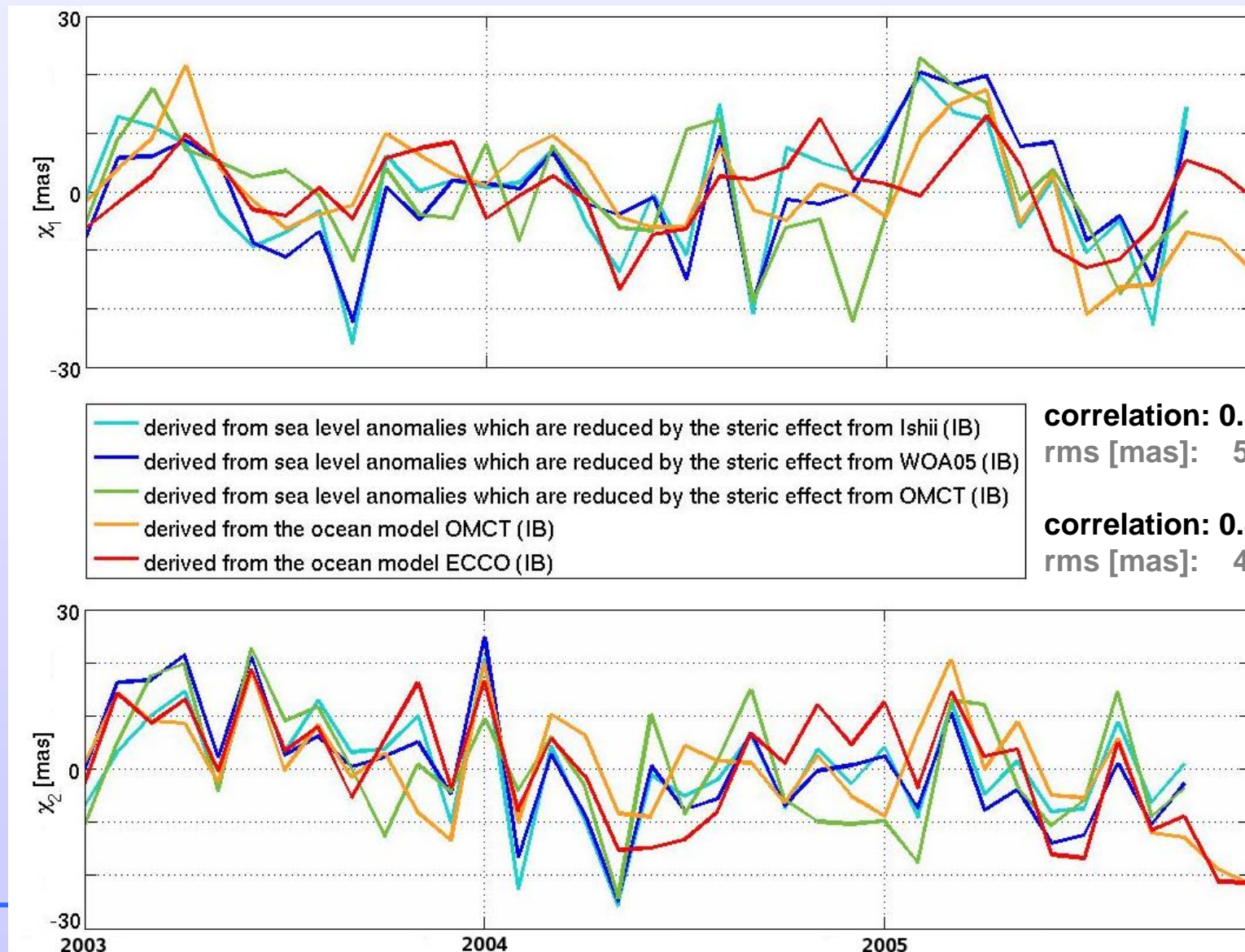
Oceanic excitations





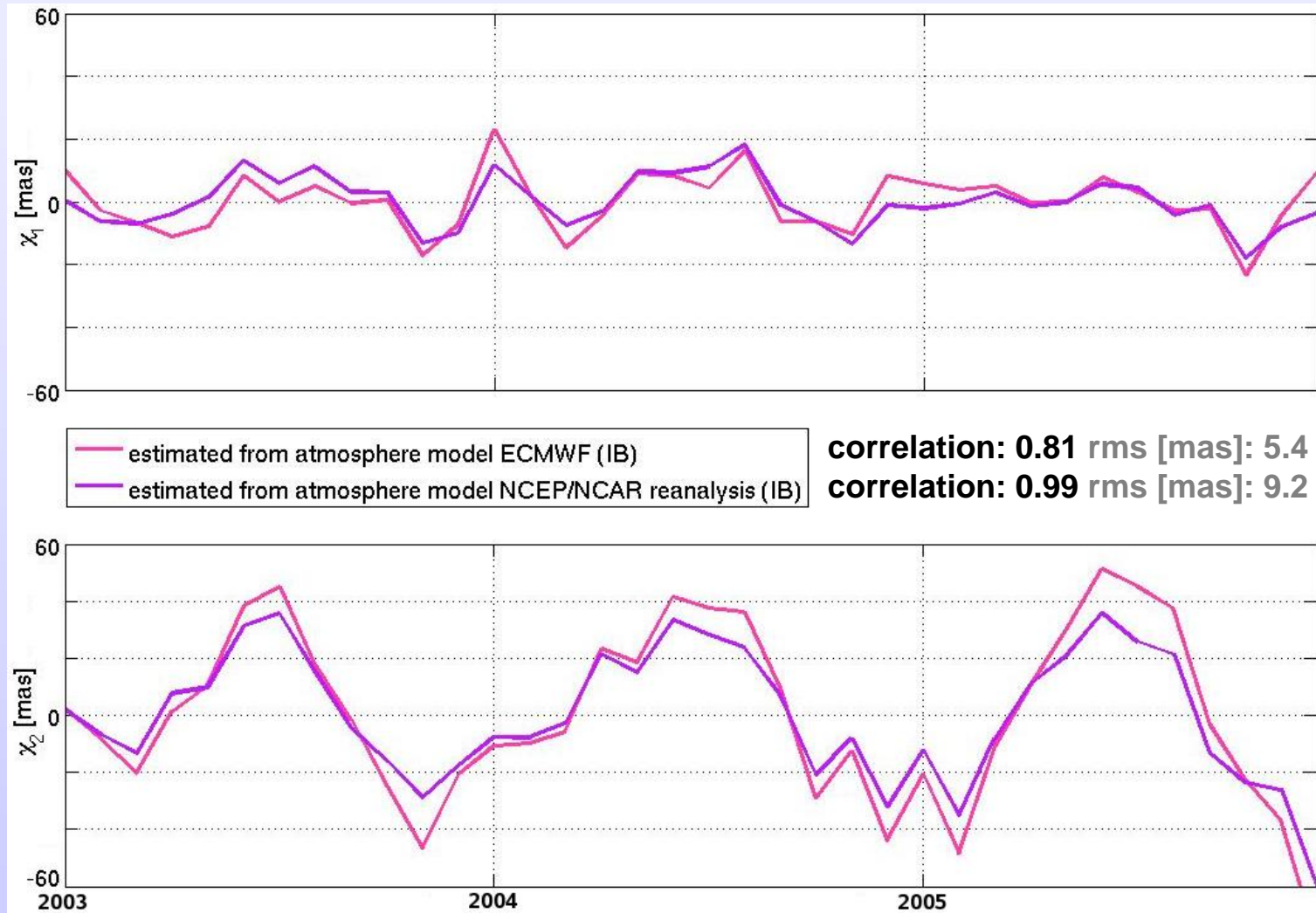
Oceanic excitations

- compare



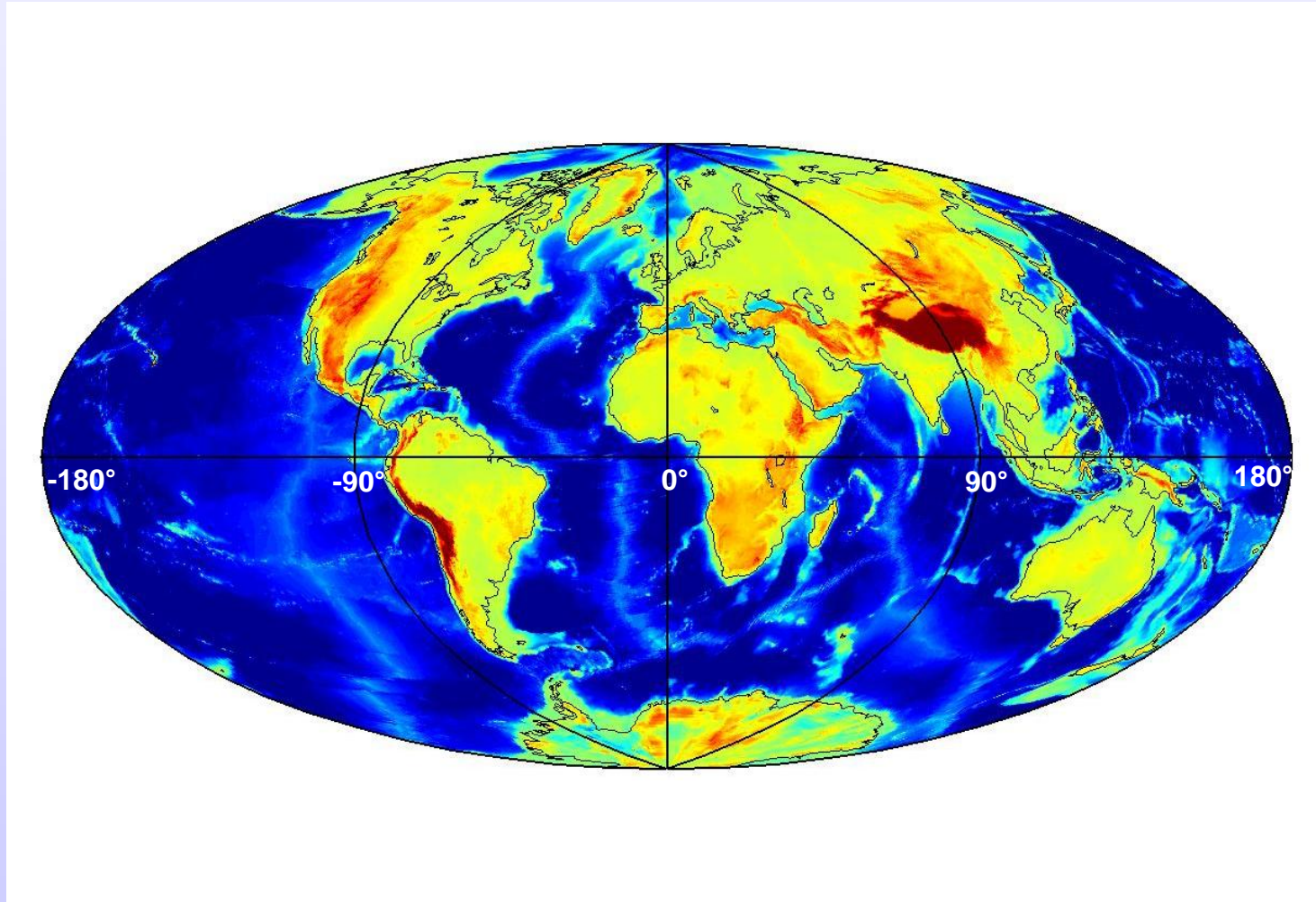


Atmospheric excitations



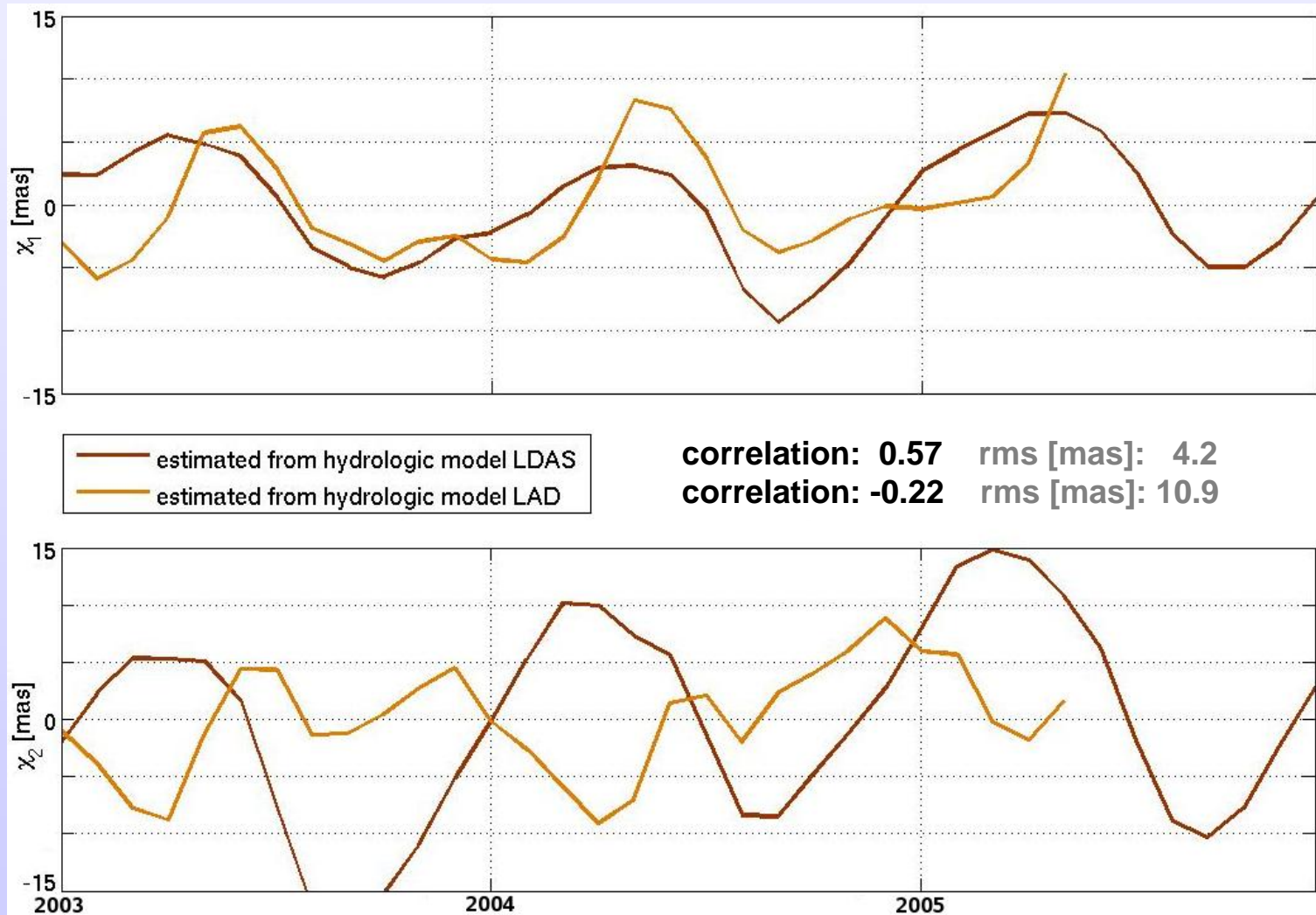


Land ocean distribution



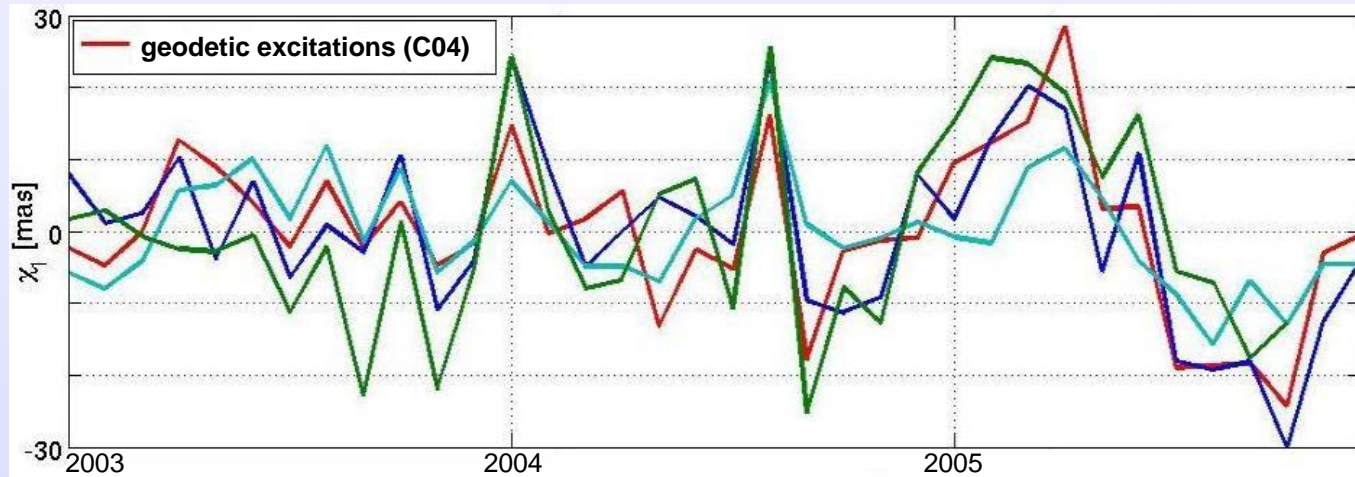


Hydrological excitations

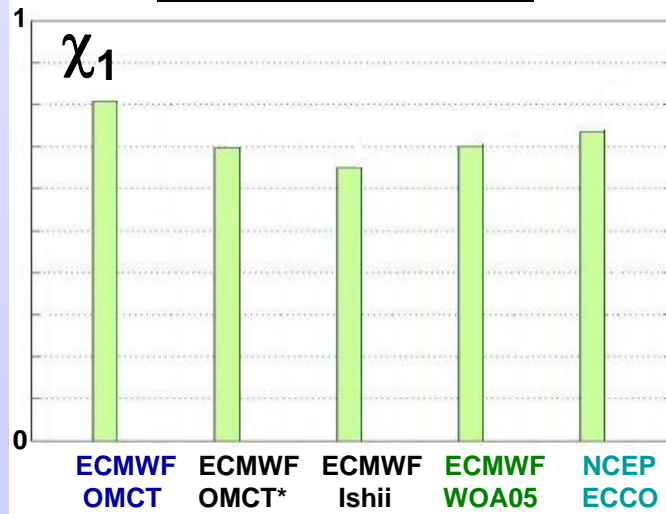




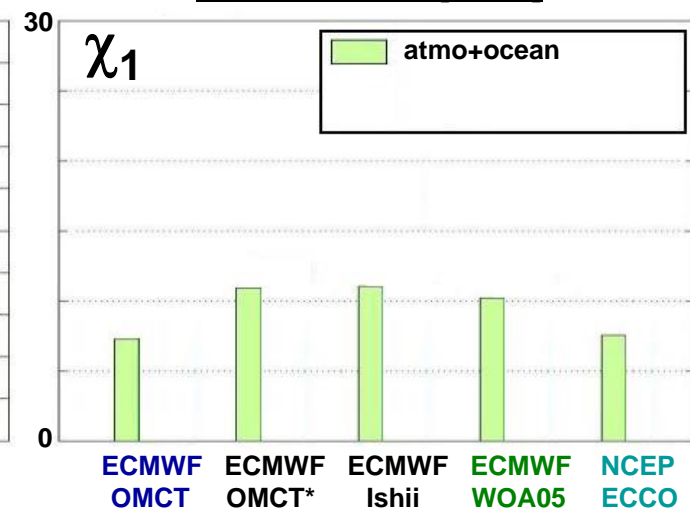
Agreement w. geodetic excitations (C04)



correlation with C04

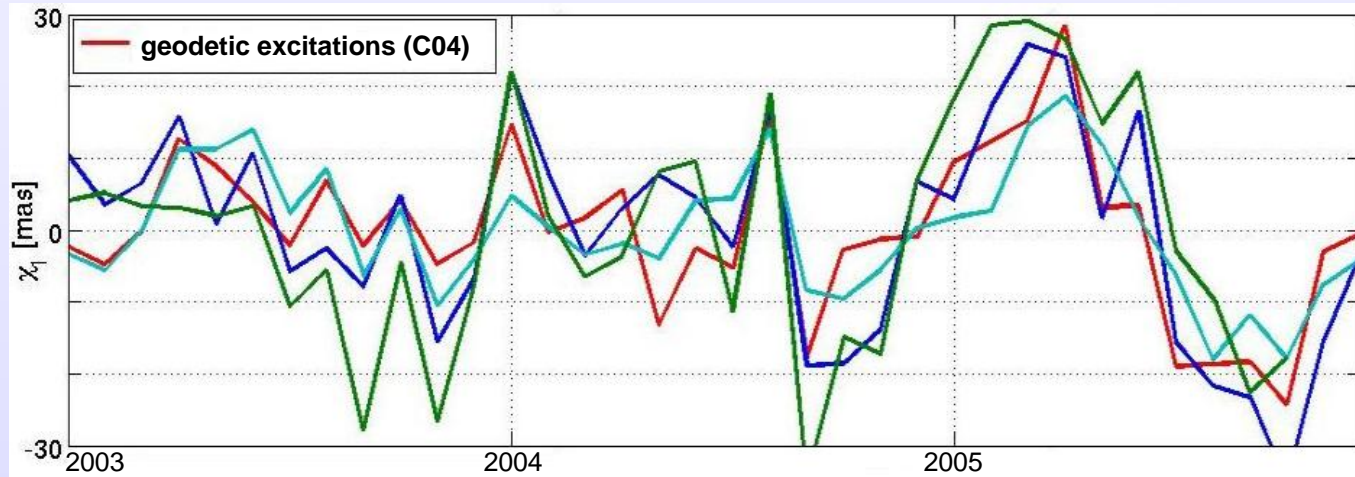


rms wrt C04 [mas]

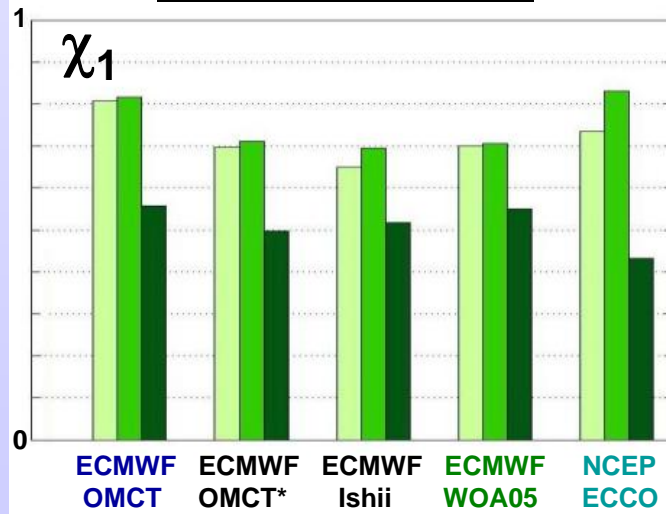




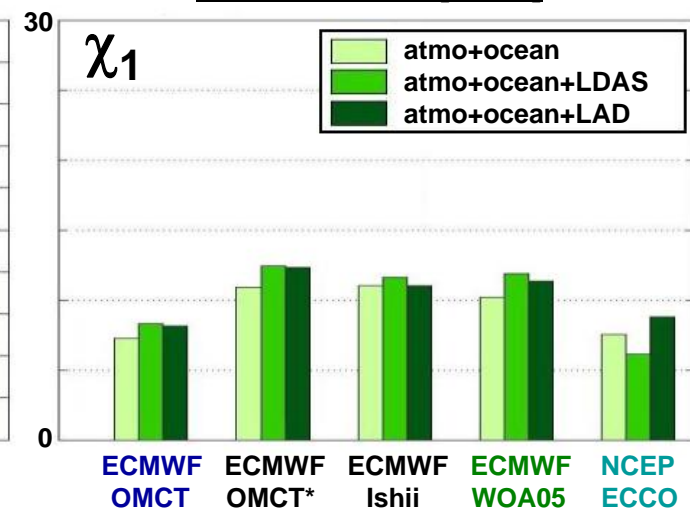
Agreement w. geodetic excitations (C04)



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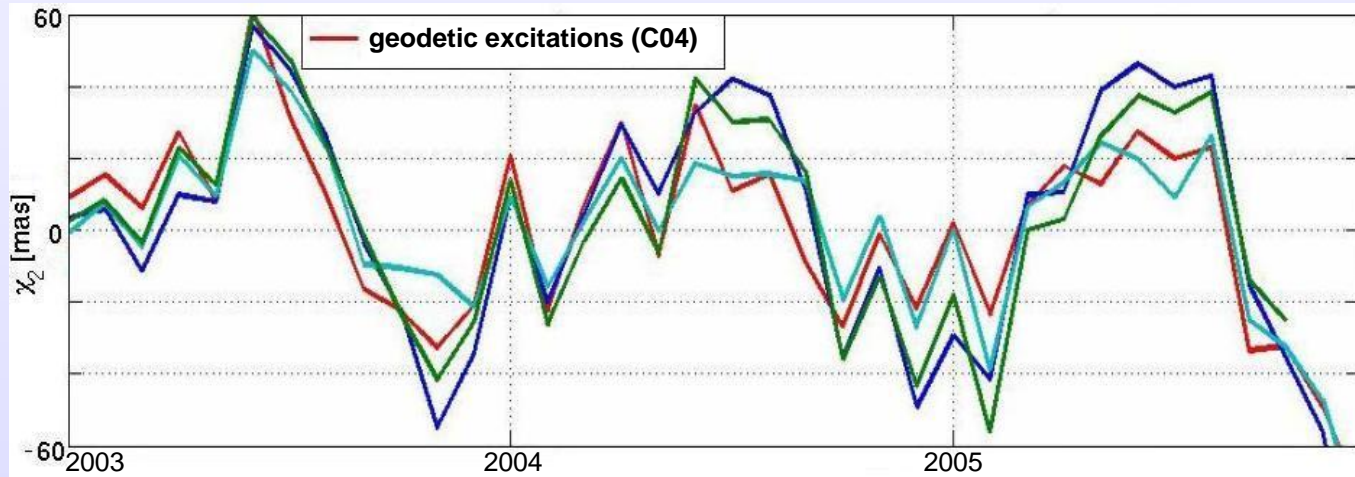


rms wrt C04 [mas]

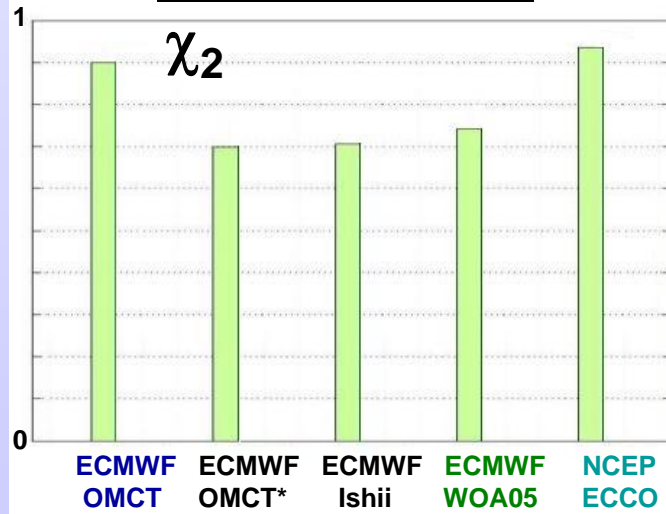




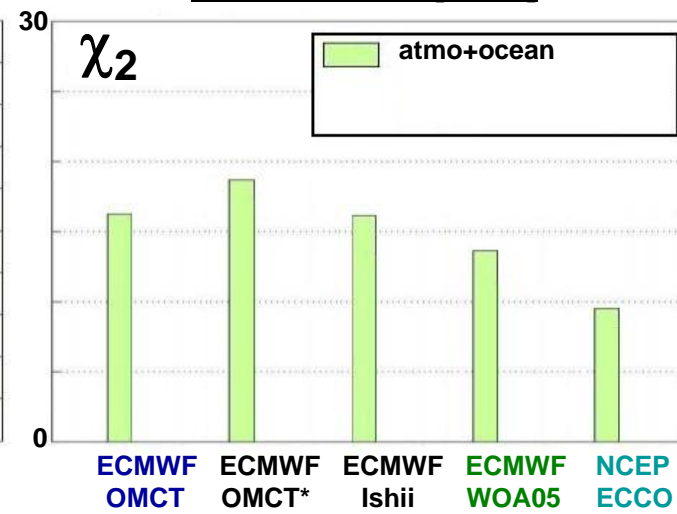
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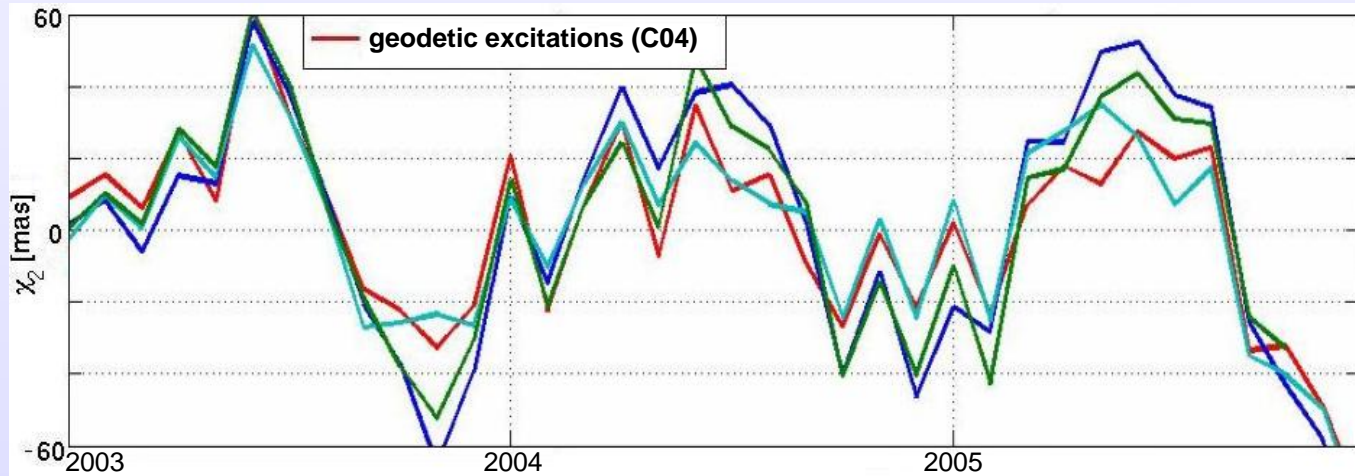


rms wrt C04 [mas]

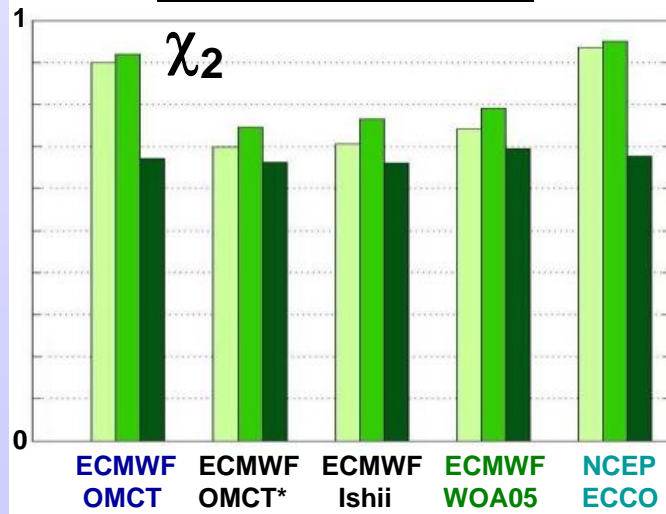




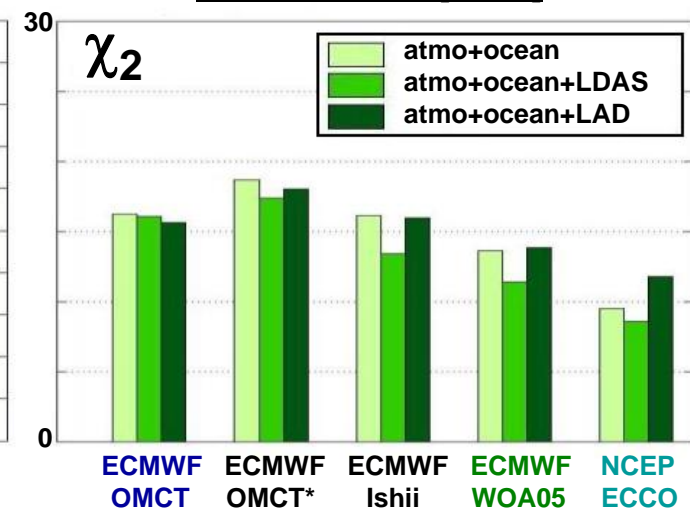
Agreement w. geodetic excitations (C04)



correlation with C04



rms wrt C04 [mas]





Conclusions and Outlook

Adding hydrological excitations from LDAS do mostly raise the agreement with geodetic excitations.

Assimilated-model-only polar motion excitations seem to be better than combined polar motion excitations.

- Assimilated-model-only solutions are consistent
 - Errors of atmospheric model are compensated by ocean model
- Combined solutions may be inconsistent
 - Classical IB adoption
 - Uncertainties of steric effect
 - Uncertainties of atmosphere model
 - Uncertainties of oceanic mass movements from ocean model



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Assimilated-model-only polar motion excitations seem to be better than combined polar motion excitations.

- Assimilated-model-only solutions are consistent
 - Errors of atmospheric model are compensated by ocean model
- Combined solutions may be inconsistent
 - Classical IB adoption (**dynamic atmosphere correction**)
 - Uncertainties of steric effect (**new satellite mission SMOS**)
 - Uncertainties of atmosphere model
 - Uncertainties of oceanic mass movements from ocean model



**Thank you for your
attention!**



Agreement w. geodetic excitations (C04)

