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?



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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)



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





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"Earth rotation and global dynamic processes" FOR584

Land ocean distribution





Hydrological excitations

















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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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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 (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!





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