



Estimating and modeling the sea ice cover impact on high frequency ocean bottom pressure anomalies

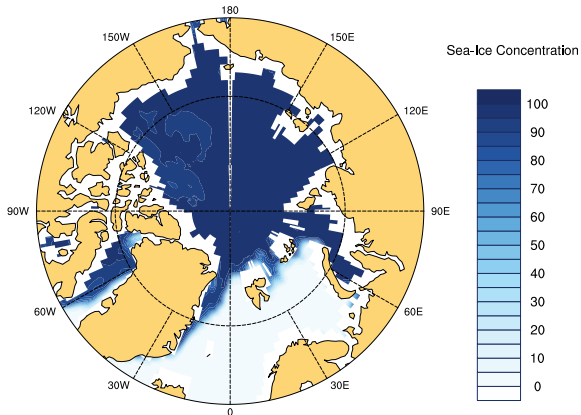
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OVERVIEW

- ▶ Sea surface anomalies are closely linked to high frequency ocean bottom pressure (OBP) anomalies
- ▶ Comparing OBP observations from areas with and without sea ice cover



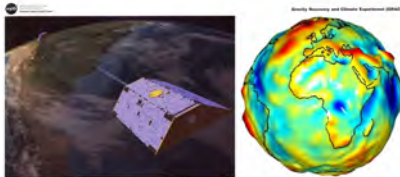
ESA-CCI SEA-ICE-ECV PROJECT

- ▶ National Energy Research Scientific Computing Center (NERSC) is leader of the project
- ▶ **Phase 1: SSM/I and AMSR-E Radiometry Measurements**
- ▶ **Sea-ice concentrations derived with:**
 - ▶ Bootstrap algorithm for few-year ice
 - ▶ NASA Team2 algorithm for multi-year ice



GRAVITY RECOVERY AND CLIMATE EXPERIMENT

- ▶ Measuring the Earth's gravity field and its temporal variations
- ▶ GRACE solutions from the Institute of Theoretical Geodesy Bonn (ITG)
- ▶ Daily solutions using Kalman smoothing
- ▶ The Stokes coefficients of ITG-GRACE are provided up to degree $N=40$
- ▶ The degree 1 term is included as a mean annual sinusoid determined from Satellite Laser Ranging and DORIS observations



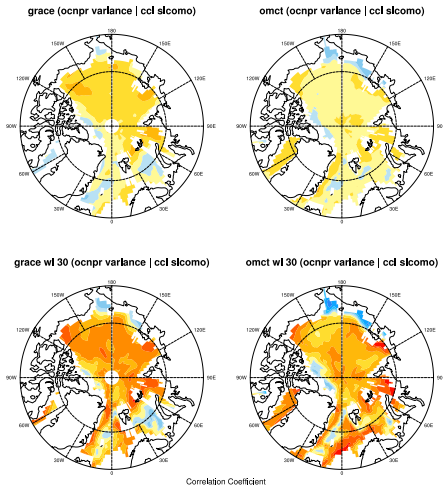
OCEAN MODEL FOR CIRCULATION AND TIDES

- ▶ Sea-ice is modeled as a non-linear viscous plastic
- ▶ Atmospheric forcing comes from the ECMWF Era-Interim product and includes wind stress, surface pressure as well as heat and freshwater fluxes
- ▶ The OMCT uses a constant horizontal resolution of 1° in longitude and latitude, and 20 vertical layers



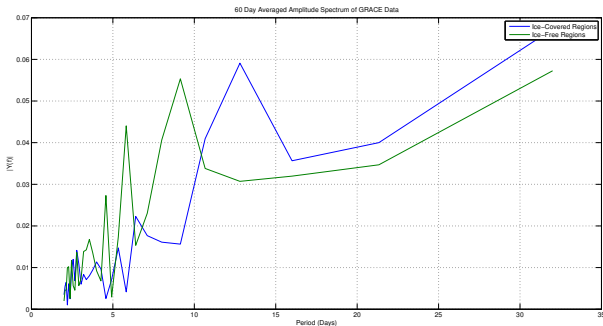
CORRELATION OF OBP WITH SEA-ICE

- ▶ Correlation between OBP variance and mean sea-ice concentration data
- ▶ Almost linear increase of correlation with increasing moving window length
- ▶ Possibly only changes within a seasonal cycle



OBP WITH AND WITHOUT ICE COVER

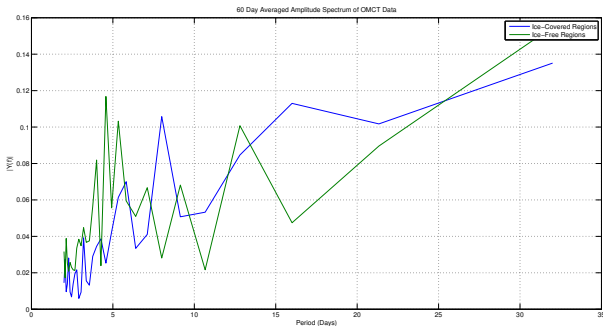
- ▶ FFT over regions which had 60 days with and without ice
- ▶ Characteristic low frequency peaks with sea-ice cover



GRACE OBP: Ice & Ice-Free Times

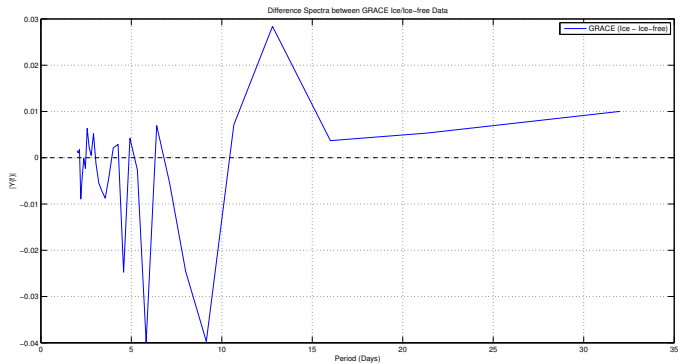
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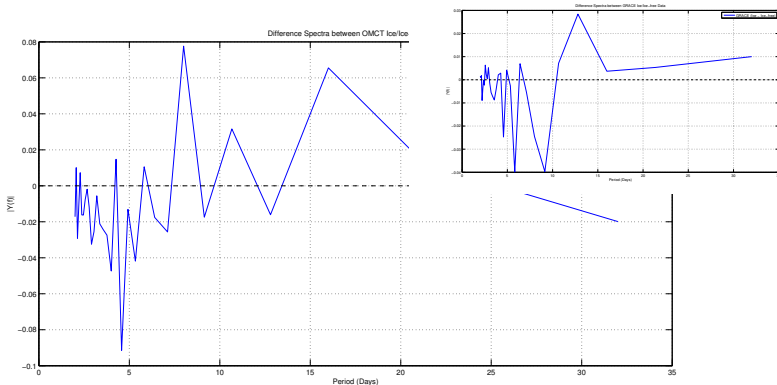
OMCT OBP: Ice & Ice-Free Times

DIFFERENCES BETWEEN ICE AND ICE-FREE TIMES



- GRACE shows high frequency dampening when sea-ice is present

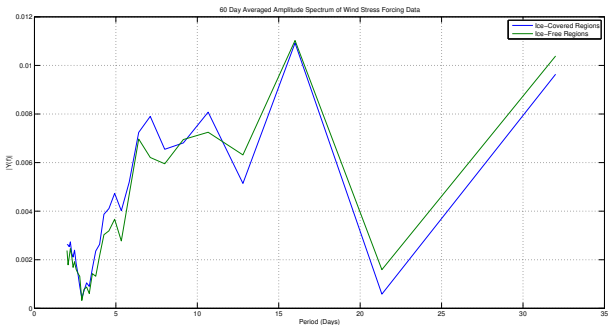
DIFFERENCES BETWEEN ICE AND ICE-FREE REGIONS



- **OMCT shows over accentuation of OBP with a Period Time of $5d < T < 10d$**

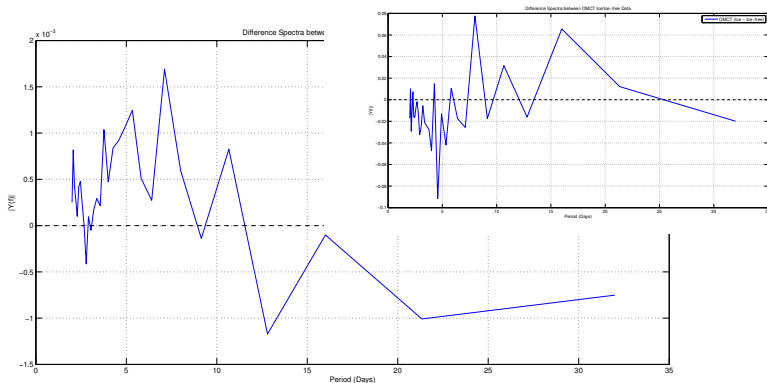
EXPLANATION ATTEMPT

- ▶ **Wind stress** is probably main reason
- ▶ The Sea-Ice Model and Ocean Model within the OMCT are only coupled through Temperature



Wind Stress: Ice & Ice-Free Times

EXPLANATION ATTEMPT



- Difference spectra shows accentuation of high frequency's ($T < 10d$)

SUMMARY

- ▶ Still work in progress
- ▶ There is a correlation between OBP variance and mean sea-ice concentration data which increases linearly with the window length
- ▶ There is an dampening of high frequency OBP anomalies in sea-ice covered areas
- ▶ This is probably related to wind stress forcing

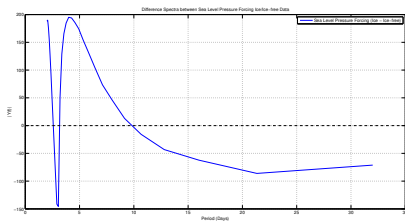
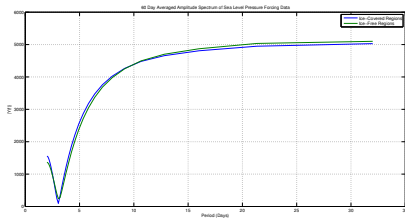
OUTLOOK

- ▶ Influence of other factors (Temperature, Salinity, Stratification)
- ▶ Implementing a frequency dependent forcing parameterization into the OMCT

Thank you for listening

SEA LEVEL PRESSURE

- ▶ OBP ice/no-ice differences should be visible for high frequency's ($T < 5d$)
- ▶ Sea level pressure not the dominant mechanism within the OMCT for OBP anomalies



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