Response of the sea level to multiple drivers in the Baltic Sea

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Drivers of Baltic sea level

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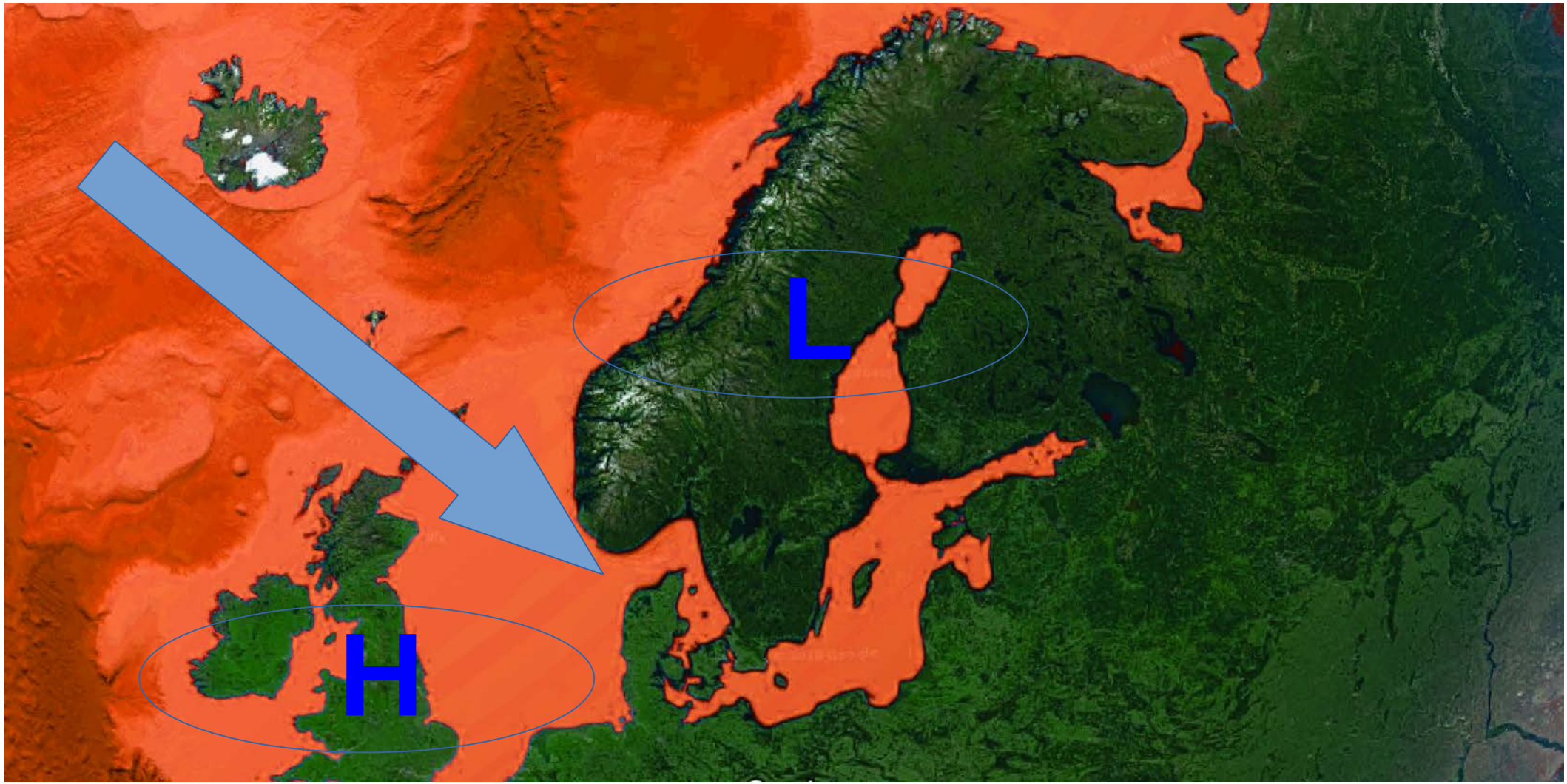
Thermal expansion, winds



Drivers of Baltic sea level: salinity and runoff

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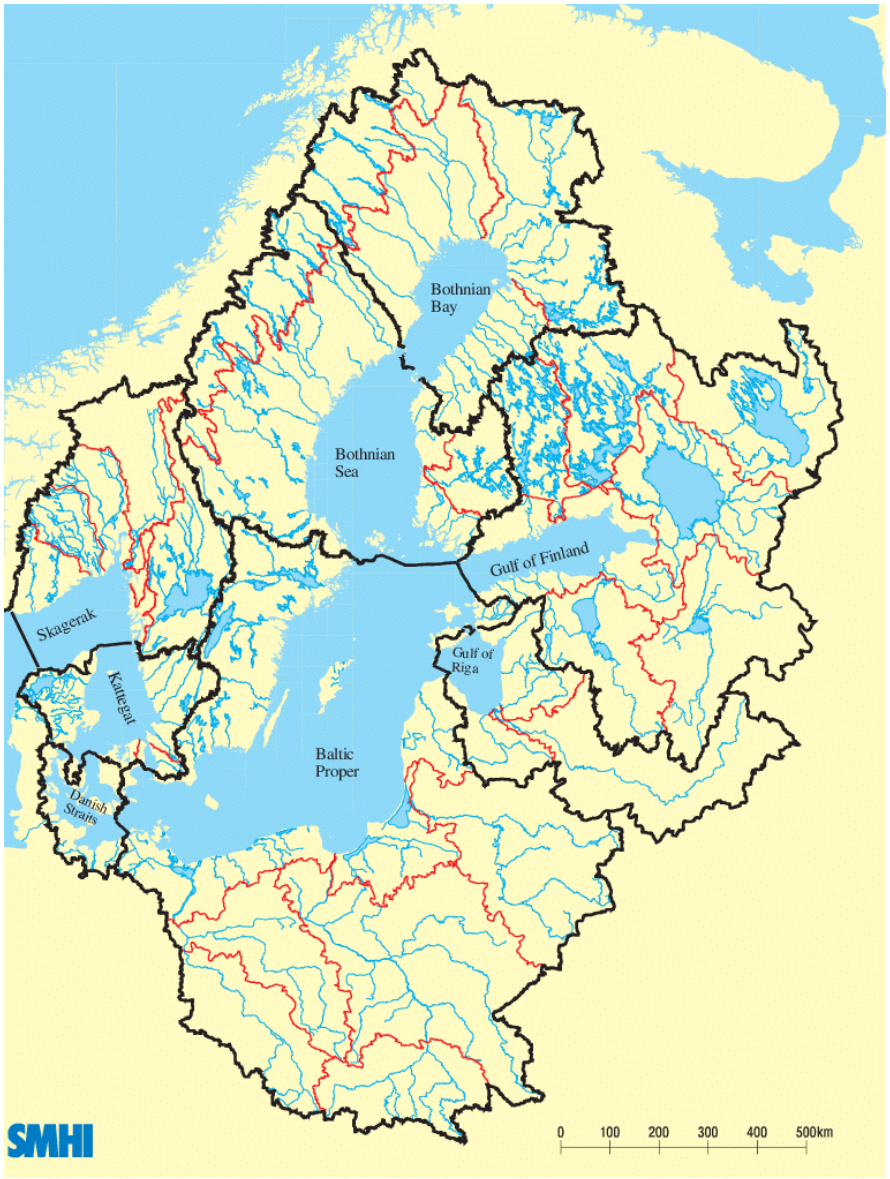
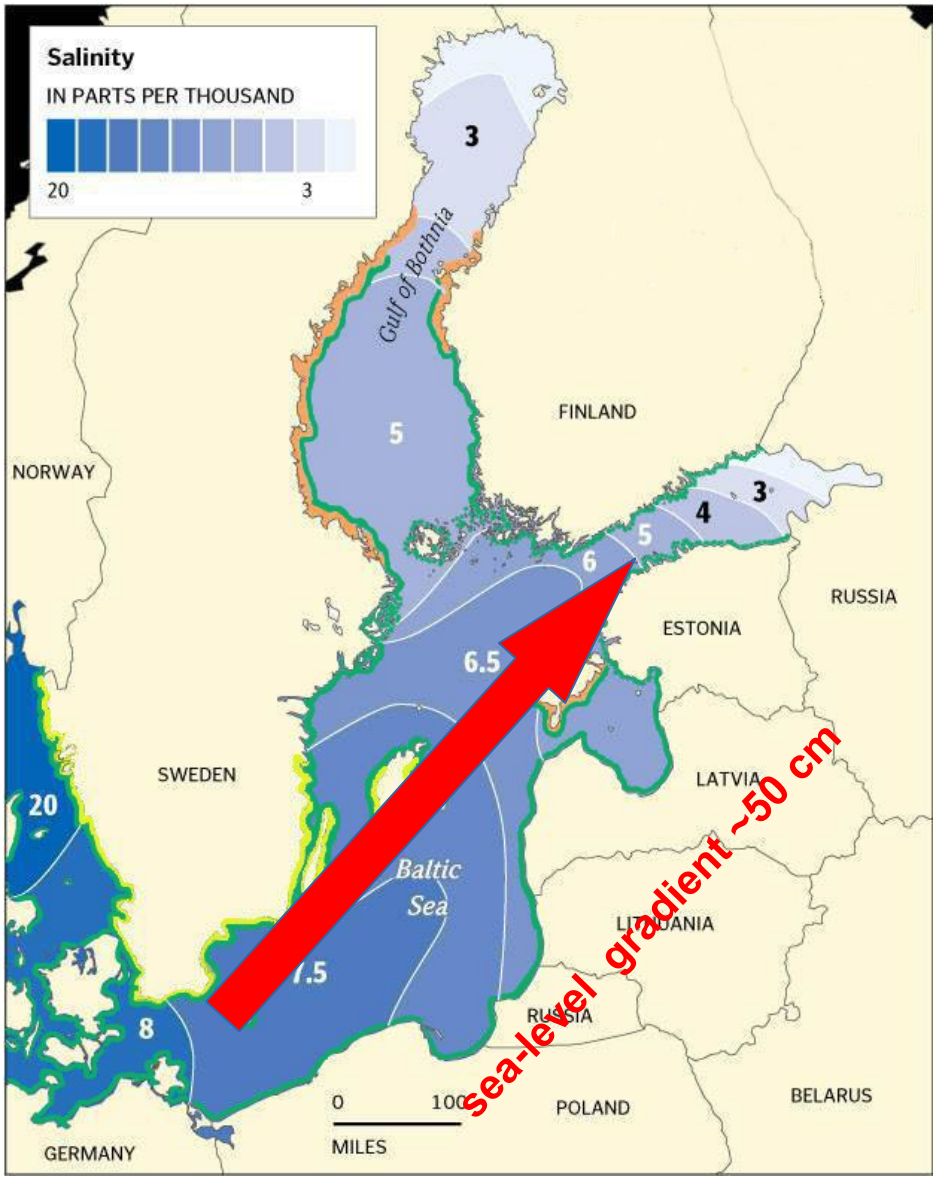
Baltic Sea Catchment basin



Salinity gradient



Drivers of Baltic sea level: Land Movement (Glacial Isostatic Adjustment)

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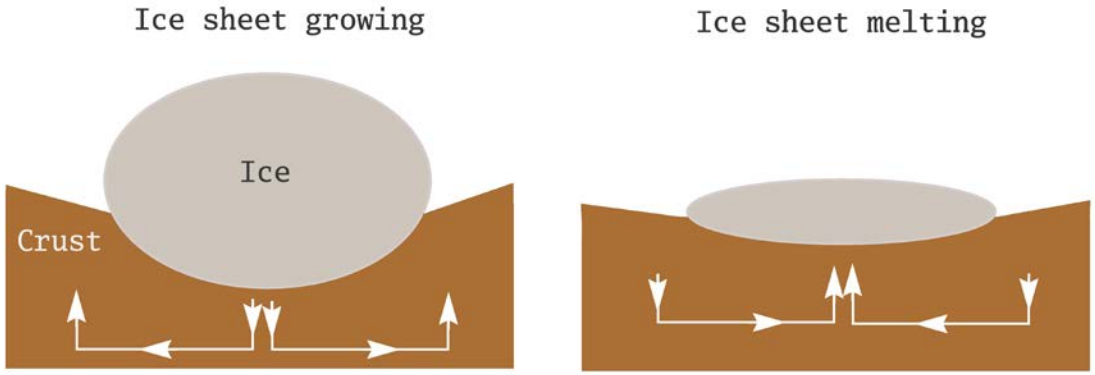
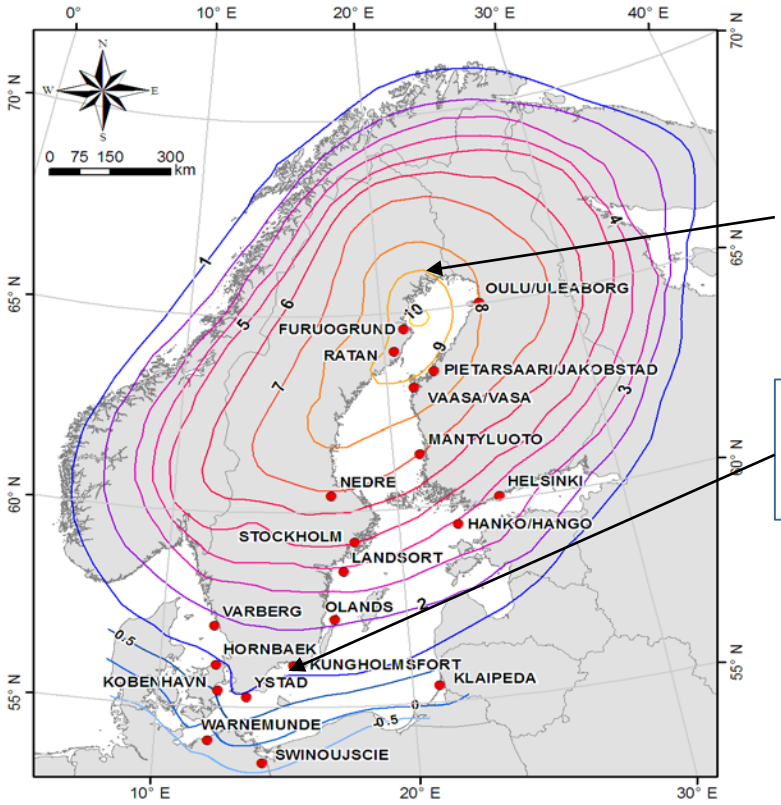


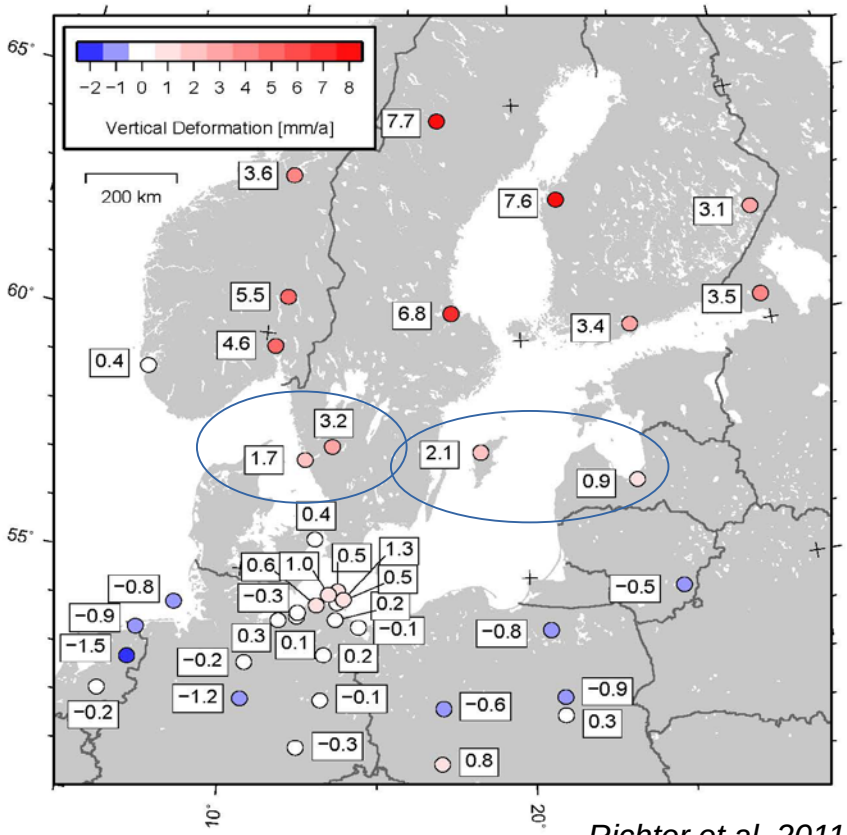
Adjustment time scale ~10 000 years



+ 10mm /year uplift

-1 mm/year sinking

Ekman (1996) and Rosentau et al.(2007)



Richter et al. 2011).

Estimation of vertical velocities (crustal deformation rates) in the Baltic Sea Region derived by network of 44 GPS stations, 2001-2008

Self-gravitation between ice and ocean masses

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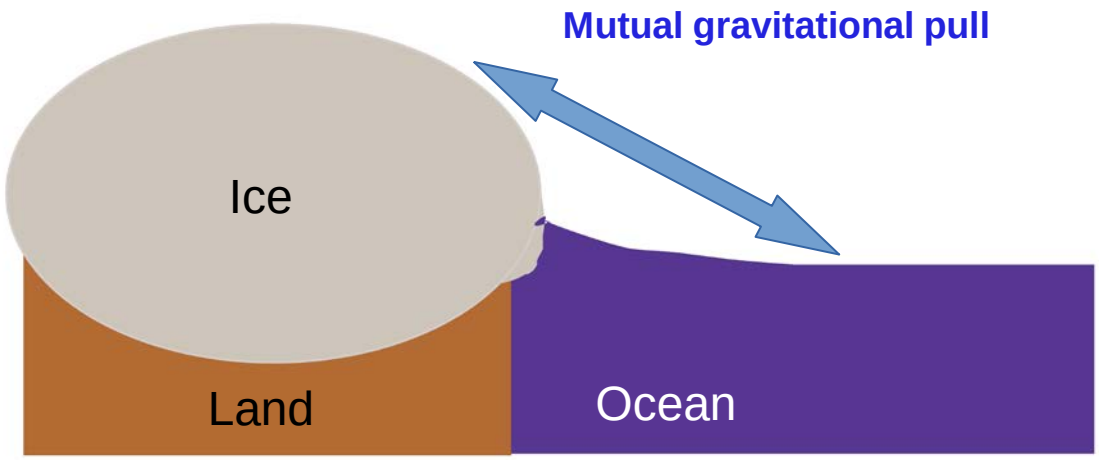

Sea level 'gain factor'
due to modified gravitational field
(Mitrovica, 2001)

Absolute Sea level Change (ASL)

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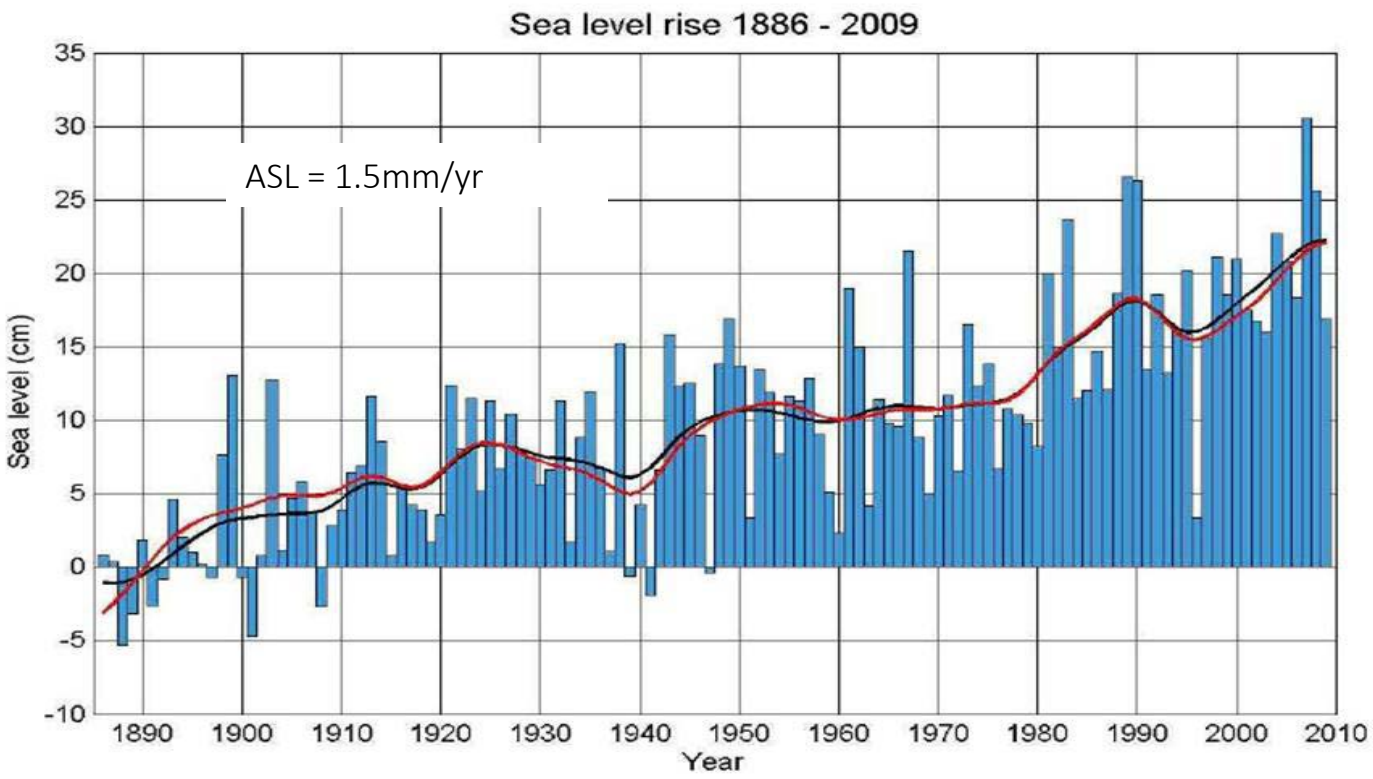
Example Sweden



Hammarklint 2009)

Annual sea level means averaged for 14 Swedish sea level records, corrected for land uplift and compared to the 1886 level. Black line: time-filtered version together with the filtered Stockholm sea level time series (red line)

- Mean 20th- century trends for Sweden lie in the range of 1.5 mm/year
- estimates for different locations in the Baltic Sea lie in the range of 1.3 to 1.8 mm/yr, dependent on the spatial and temporal coverage of the observational datasets (1800-2000).

→ values lie within the range of recent global estimates

Probabilistic projections of Relative sea level for Northern European Seas , RCP 8.5

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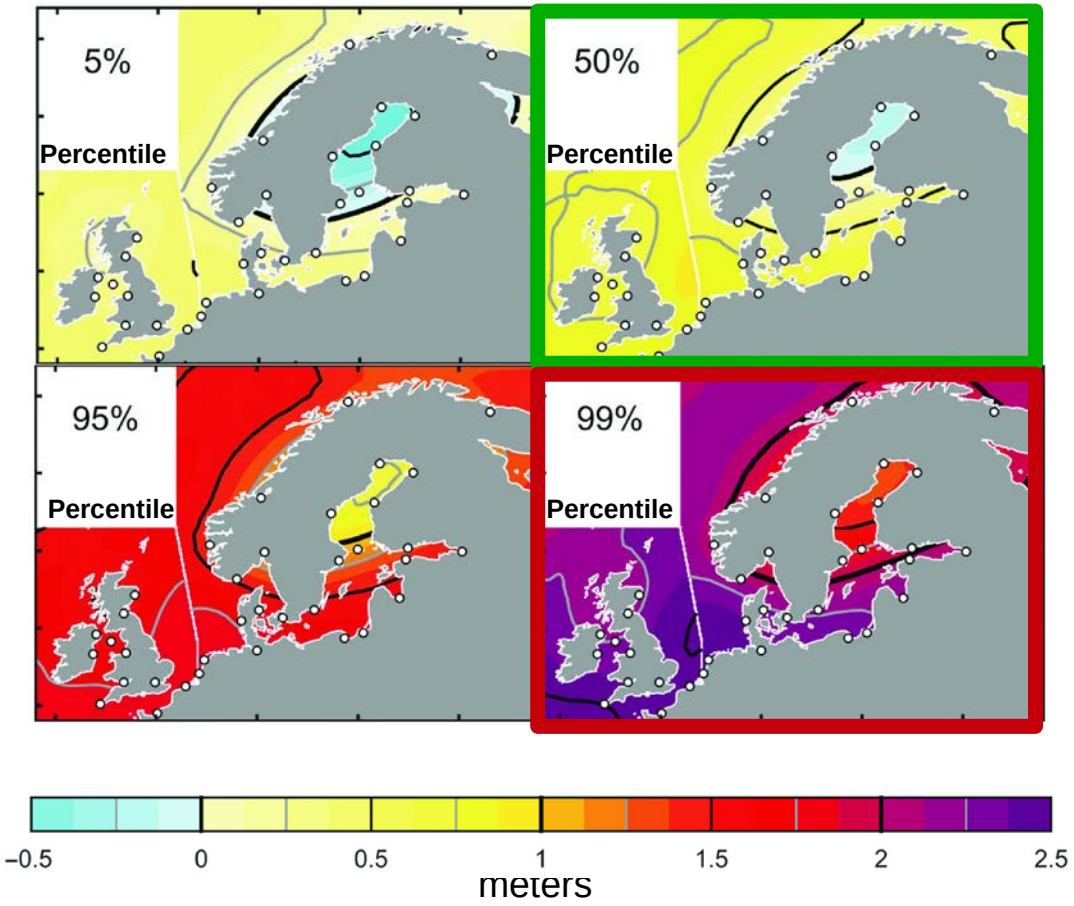
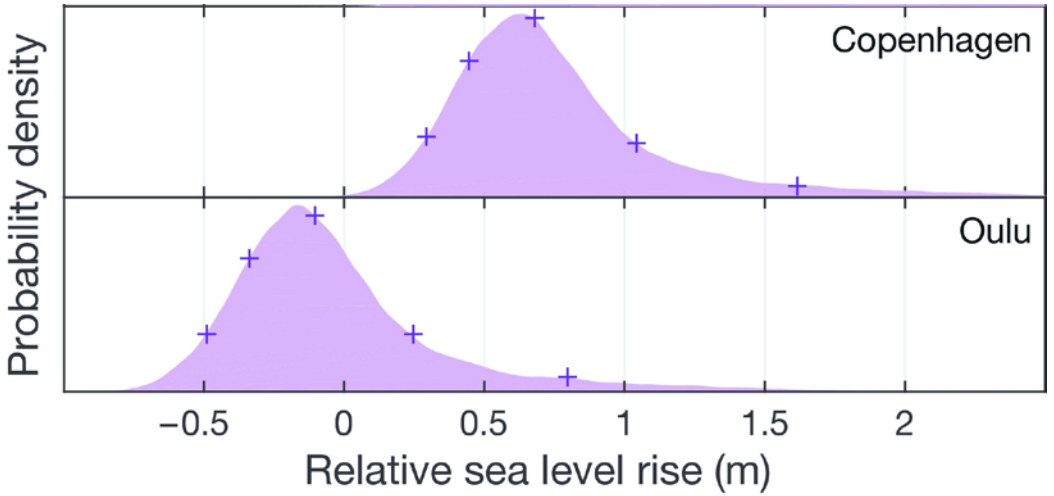


Grinsted et al, 2017

Includes the effect of:

- **ocean thermal expansion**
- **mass transfer to ocean shelf**
- **Land ice melting (with regional fingerprints)**
- **Land movement (Glacial isostatic Adjustment)**



Atmospheric driver: is it the North Atlantic Oscillation ?

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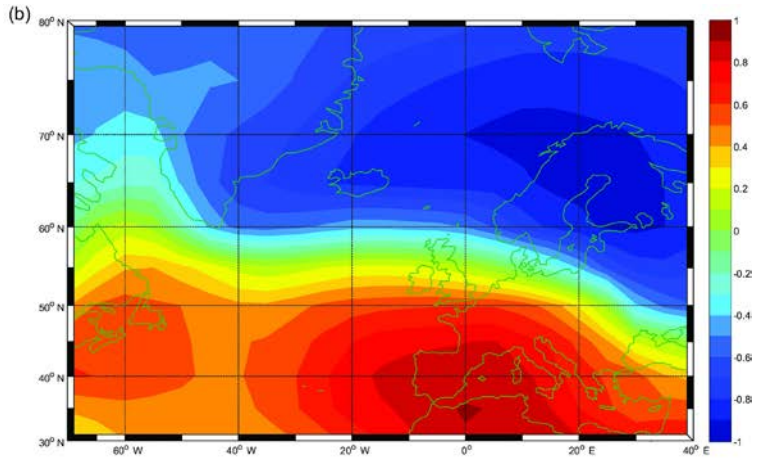
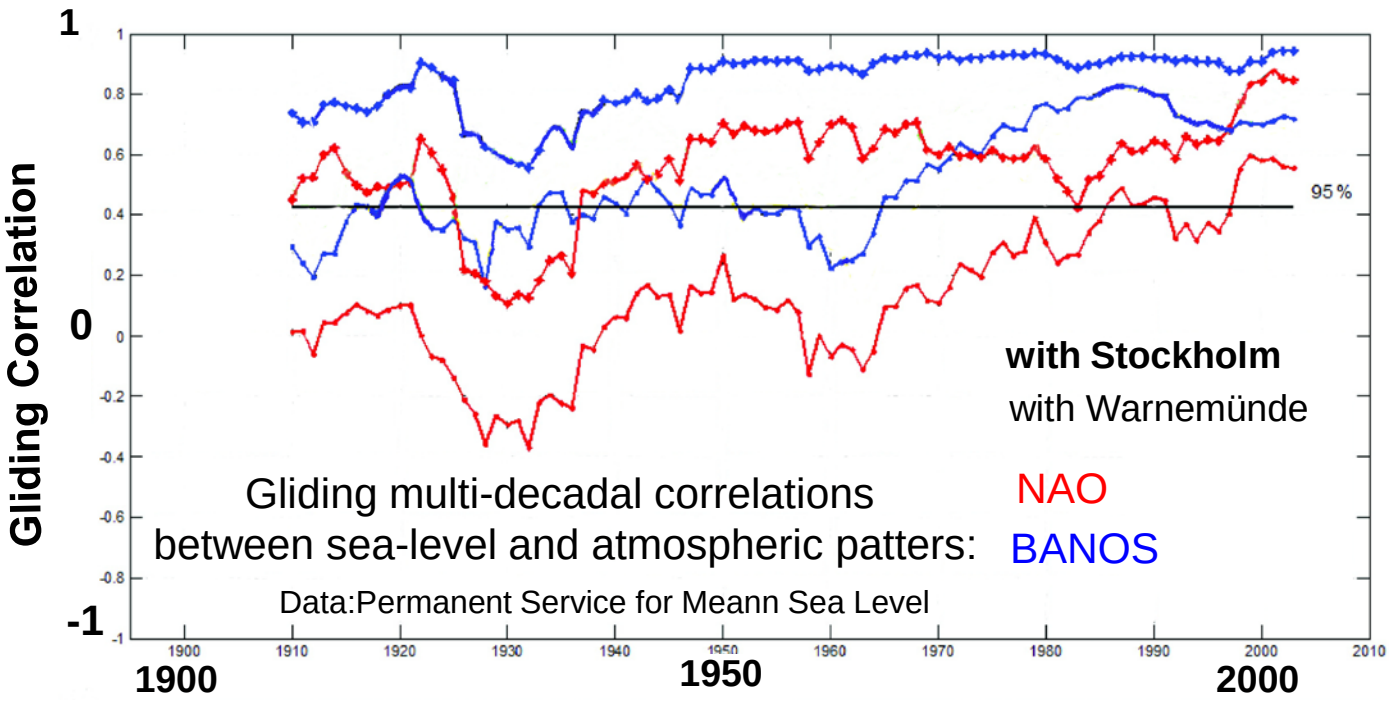
North Atlantic Oscillation
sea-level-pressure pattern





Mechanisms linked to BANOS
(seasonal means)

(1) Inverse barometer effect
V
(2) Heat flux at the surface
V
(3) Fresh water flux

For the Baltic Sea, little effect
of direct wind forcing

Small contribution to
future long-term trends: a few cm

Karabil et al., 2018

Is Baltic sea-level rise accelerating ?

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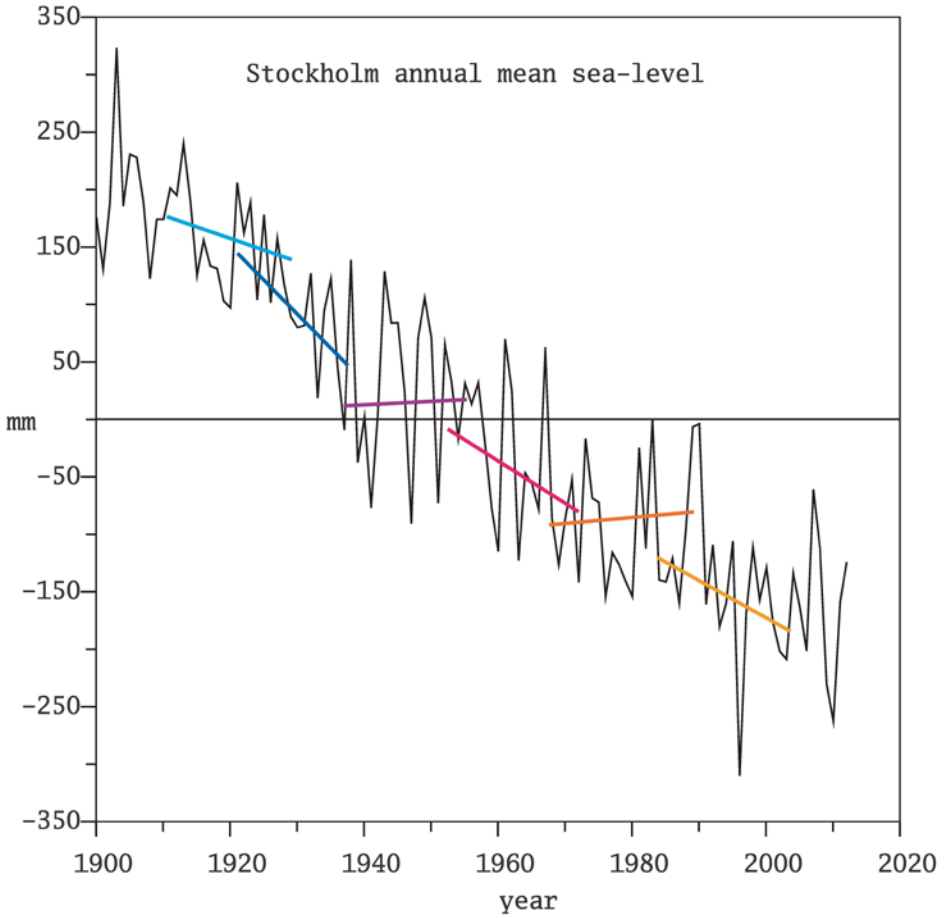
Several methods to estimate (define) sea-level acceleration

decadal gliding trends becoming more positive



Zorita and Hünicke, 2017

(Relative) Sea-level rise is slightly accelerating

More strongly in the northeast, with possible contribution of Glacial Adjustment

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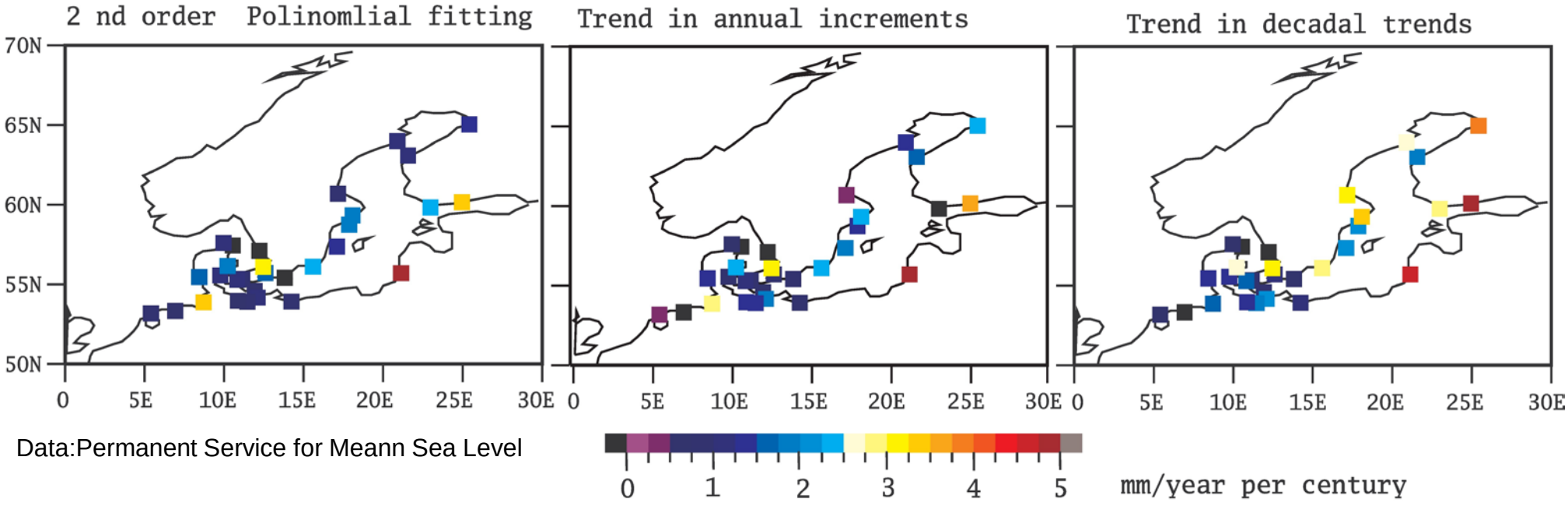
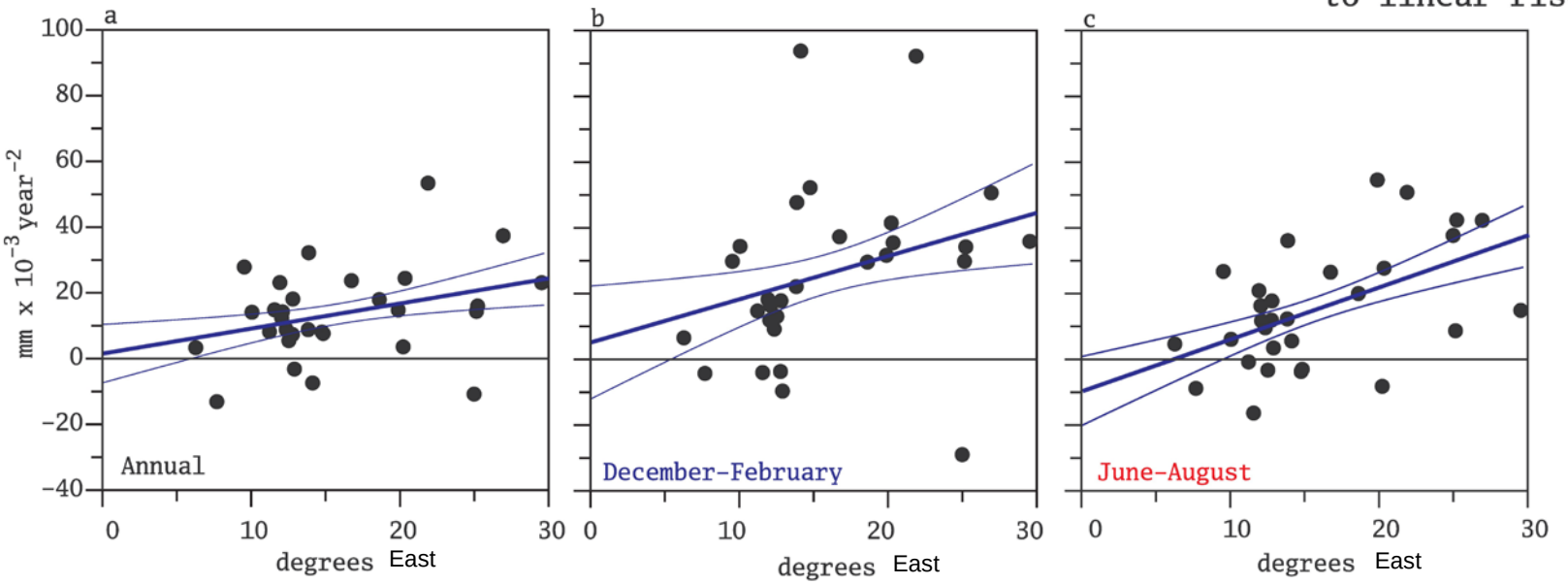


Data:Permanent Service for Meann Sea Level

~25 cm of additional rise wrt to linear rise



Hünicke and Zorita, 2016

The Glacial Adjustment has also effects on the (relative) acceleration

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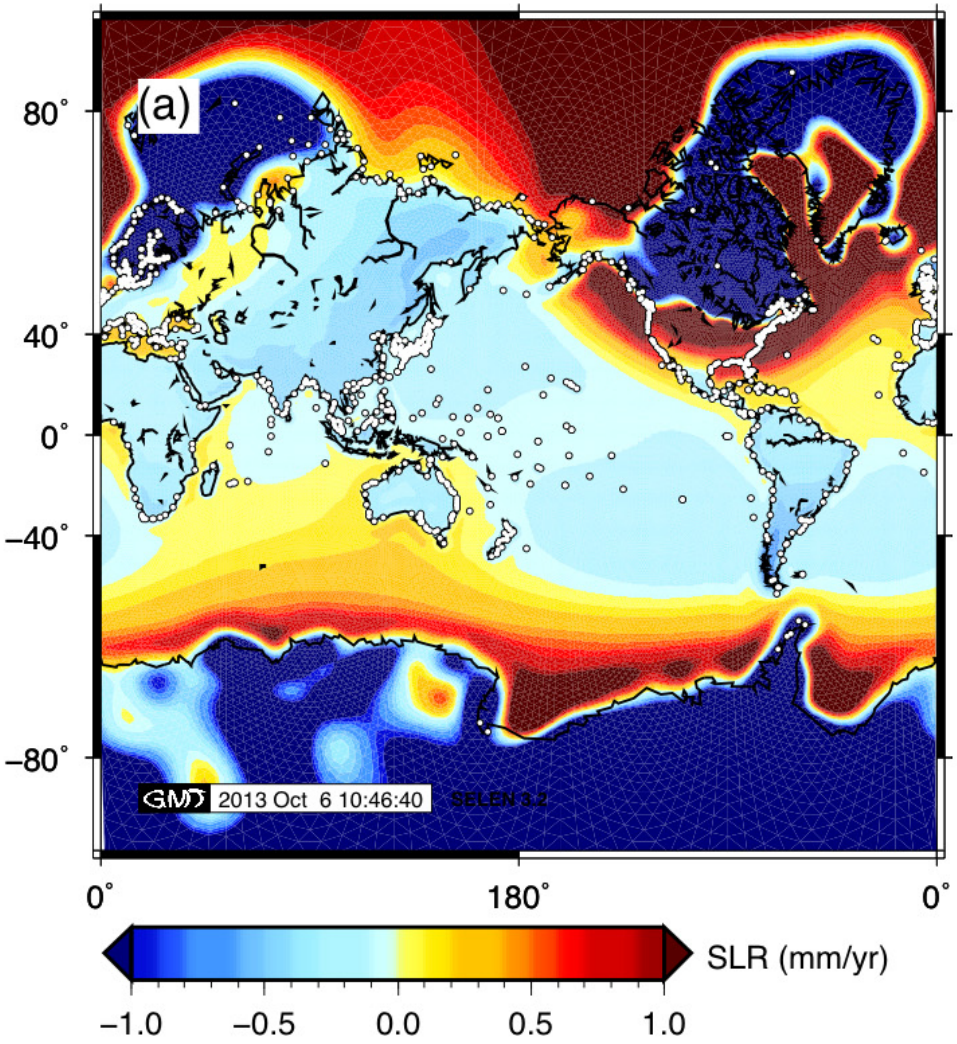
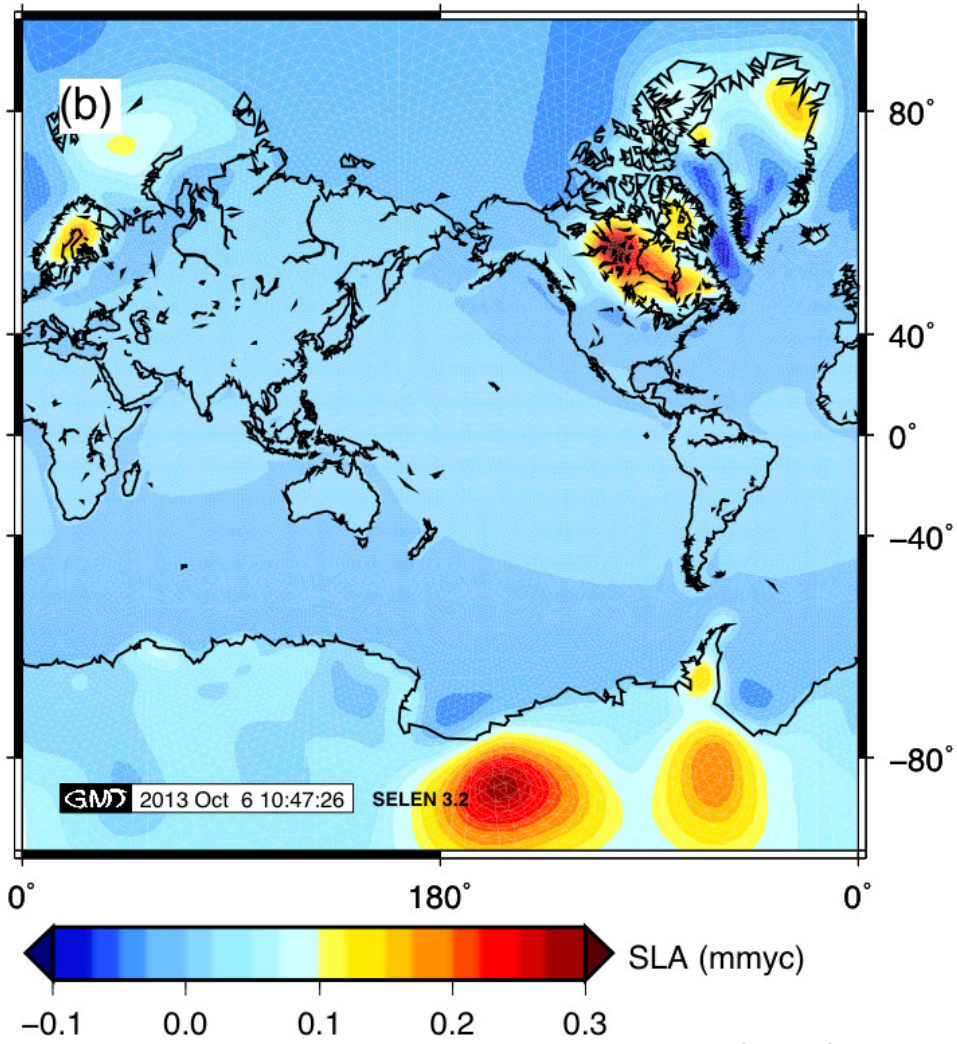
Simulated effect of GIA on present...

...Relative sea-level rate



...Relative sea-level acceleration



Spada et al., 2014