Constraint of GIA in Northern Europe with Geological RSL and VLM Data
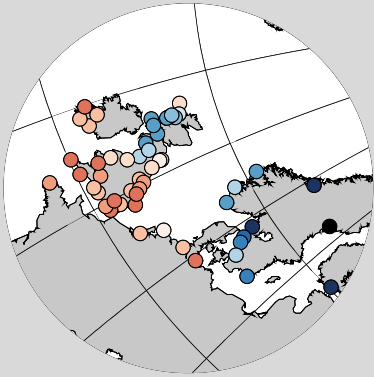
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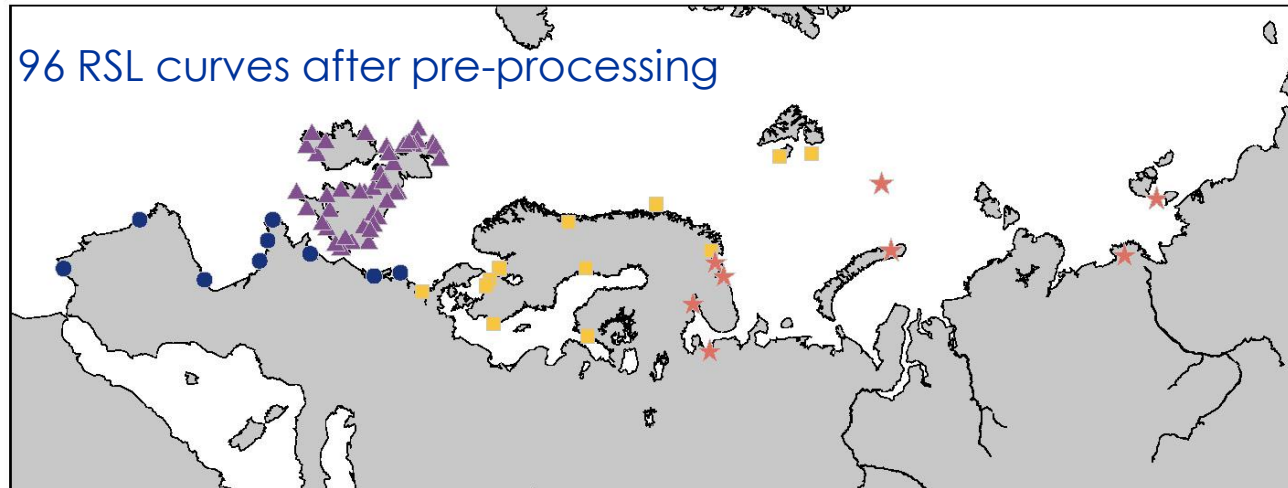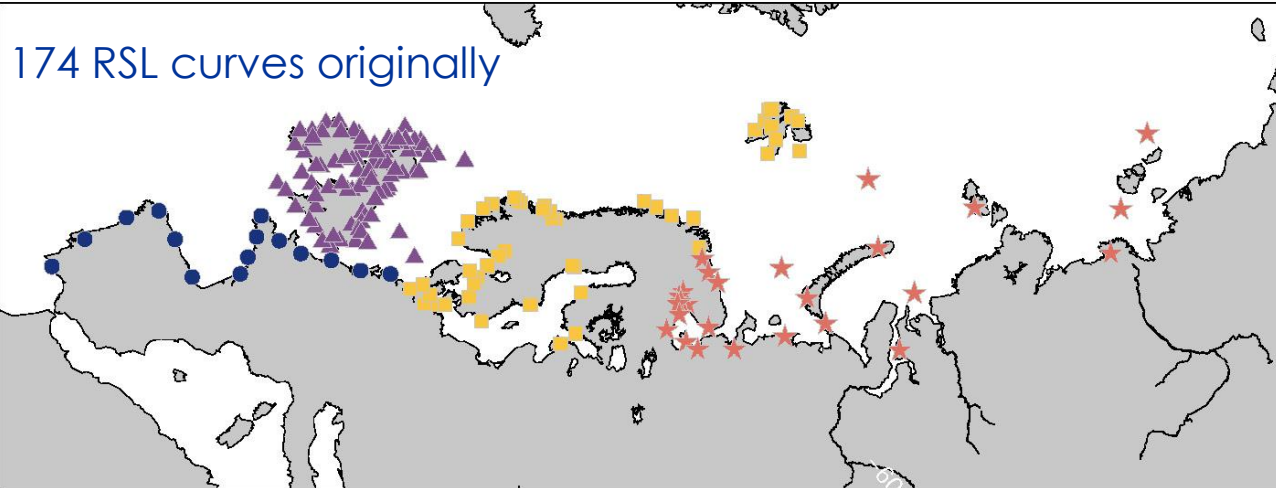## Holocene Relative Sea Level Data

Question:

Using updated regional databases, can geological RSL data be used to derive proxy rates of present-day GIA?

Original Selection Criteria - RSL Curves Must:

- Have ≥3 data points in the last 4 kyr

- Have adequate RSL points classified as sea-level index points (SLIPs)

174 RSL curves originally

96 RSL curves after pre-processing

● European Coastline (García−Artola et al. 2018, Meijles et al. 2018, Hijma and Cohen 2019)

▲ British Isles (Shennan et al. 2018)

■ Scandinavia (Tushingham and Peltier 1993) (Nordman et al. 2015)

★ Russian Arctic (Baranskaya et al. 2018)

Inferred Rates of Geological RSL Change + VLM Rates

Geological RSL Rates:

- Computed using iteratively reweighted least squares over last ≤4 kyr
- To be included in inversion, rates must be within 2σ or have associated σ ≤ 0.5 mm/yr
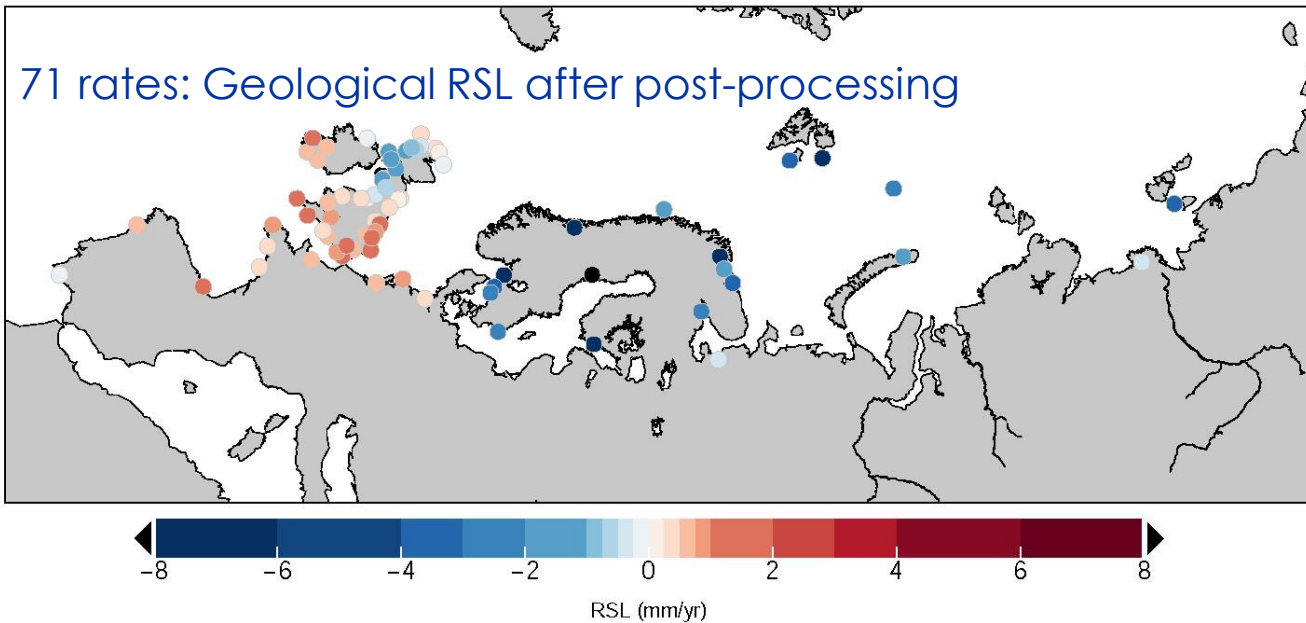
VLM Rates:

- from Nevada Geodetic Laboratory (Blewitt et al. 2016) and Kierulf et al. (2014) (Scandinavia only)
- Rates span 1996-2016
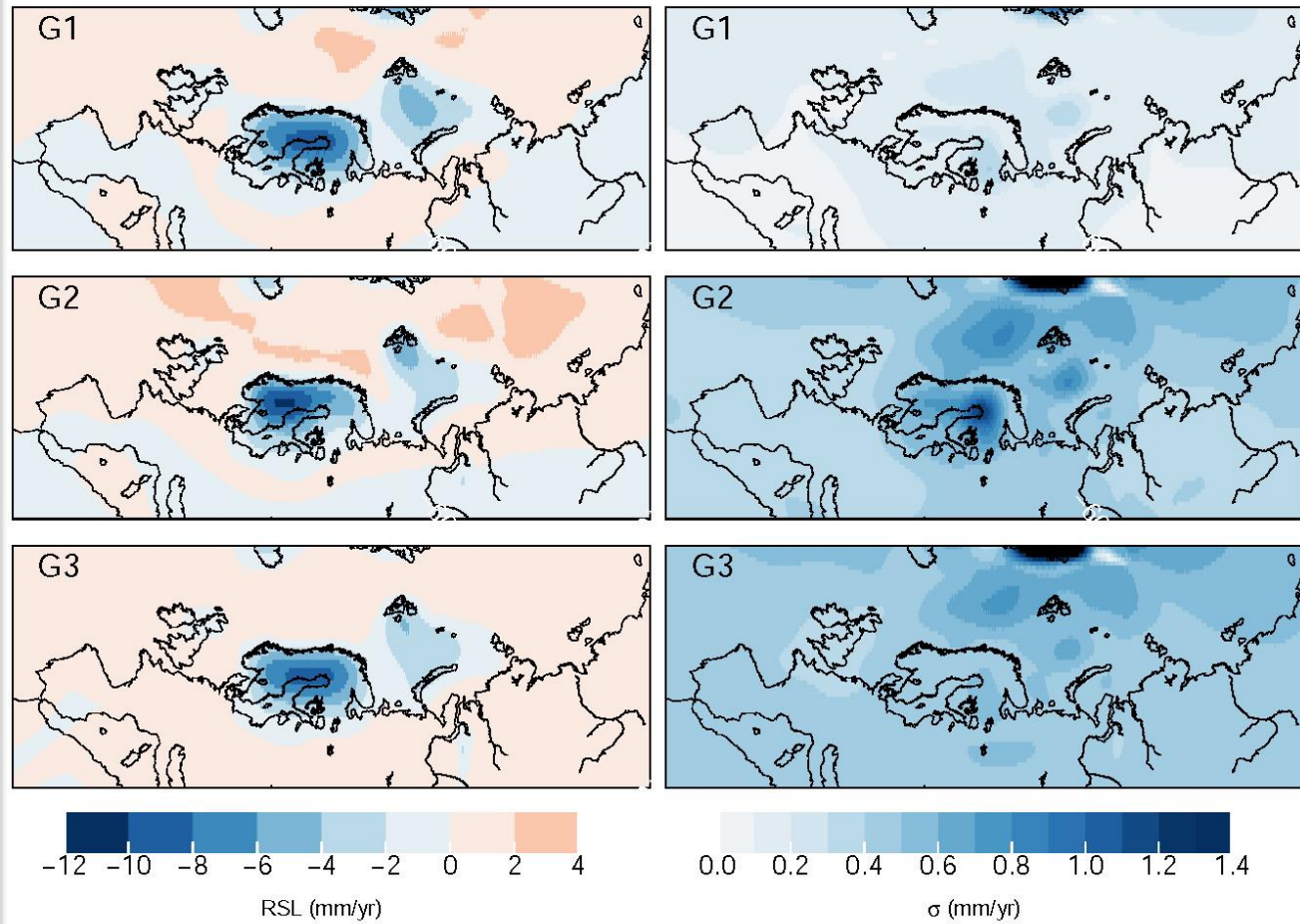- Corrected for present-day mass effects

71 rates: Geological RSL after post-processing

RSL (mm/yr)

108 rates: VLM

VLM (mm/yr)
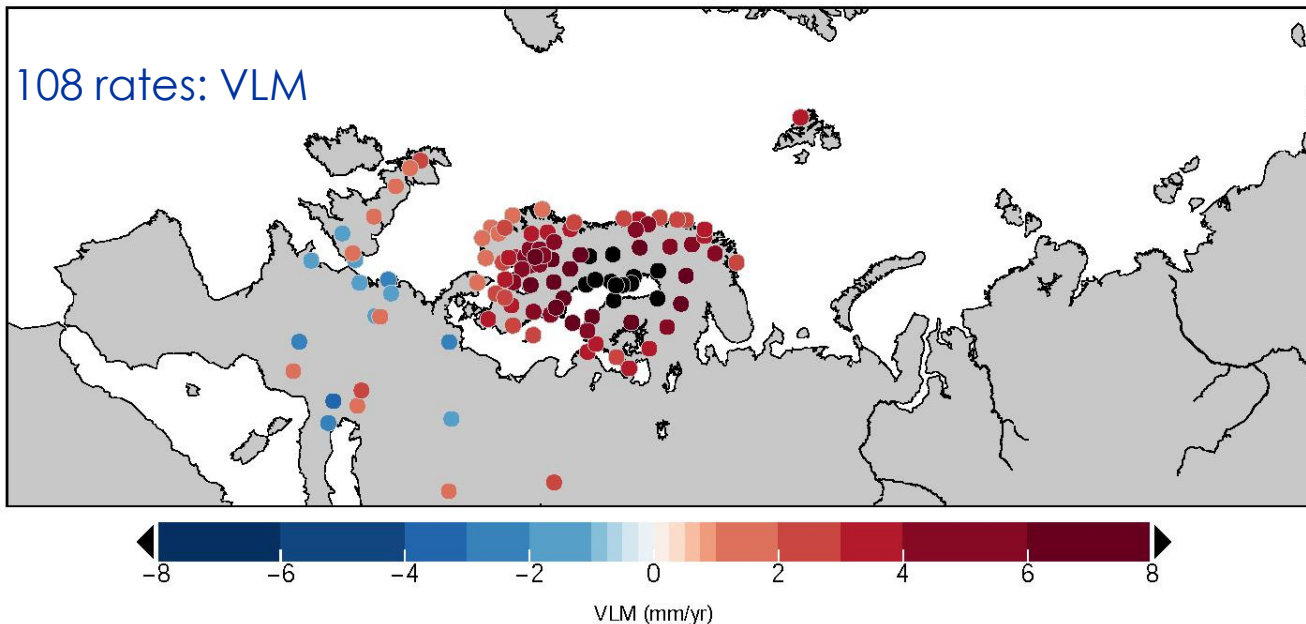
Present-day RSL Change from GIA: Model Predictions

Model Methodology:

Semi-empirical modelling approach in which the misfit is simultaneously minimized between set of prior GIA model estimates and observational constraints (Hill et al. 2010, Simon et al. 2017)

Prior GIA model information inverted with observations:

- **G1:** Vertical GNSS rates
- **G2:** Geological RSL rates
- **G3:** GNSS and Geological RSL rates

RSL (mm/yr)

σ (mm/yr)

Validation with Independent Tide Gauge Data

- Following Frederikse et al. (2016), RSL rates at 13 PSMSL TGs in the North Sea corrected for present-day mass effects and ocean dynamics → TG derived estimate of the GIA component of RSL change

- Models G1-G3 give independent predictions of GIA RSL change

- The geological RSL data are needed to fit the TG derived rates, with the G3 model providing the best fit ($\chi 2 < 1$)

North Sea

1. Aberdeen
2. North Shields
3. Lowestoft
4. Vlissingen
5. Maassluis
6. IJmuiden
7. W. Terschelling
8. Cuxhaven
9. Esbjerg
10. Hirtshals
11. Tregde
12. Stavanger
13. Lerwick