



Jet Propulsion Laboratory
California Institute of Technology

20th Century sea-level changes in the South Atlantic Ocean

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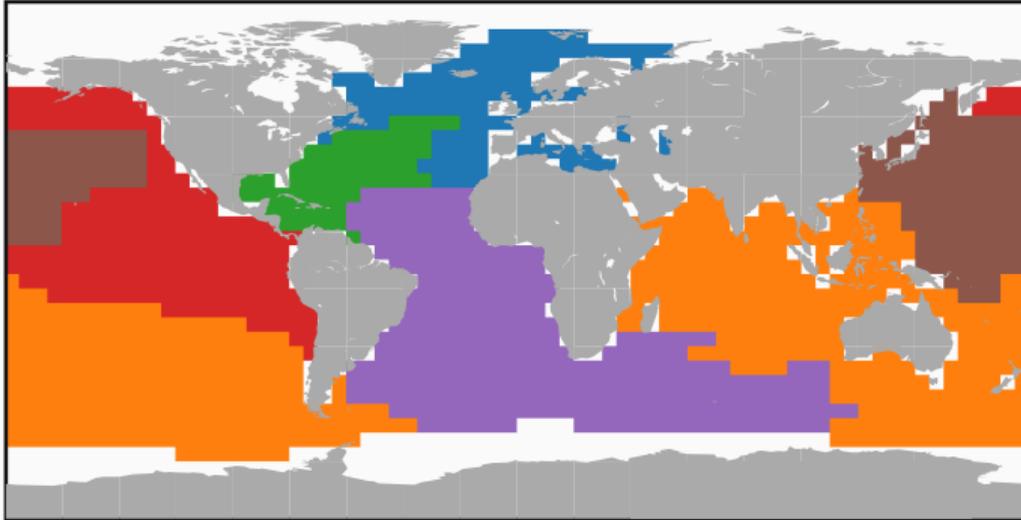
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Why do we want to constrain South Atlantic sea-level rise?

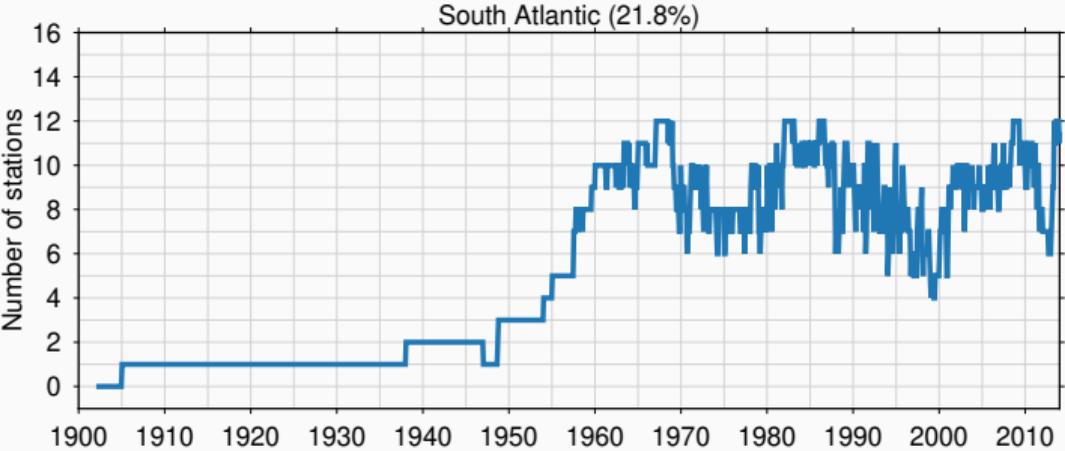
- In current reconstructions, only very limited number of observations
- Only one long record (Buenos Aires) routinely included
- Large source of uncertainty

Which region?



- Regions have common variability signal
- South Atlantic region covers 22 percent of global ocean

Low number of observations in South Atlantic



In D2017,F2018:
Number of observations goes to 1 when going back in time

Two approaches

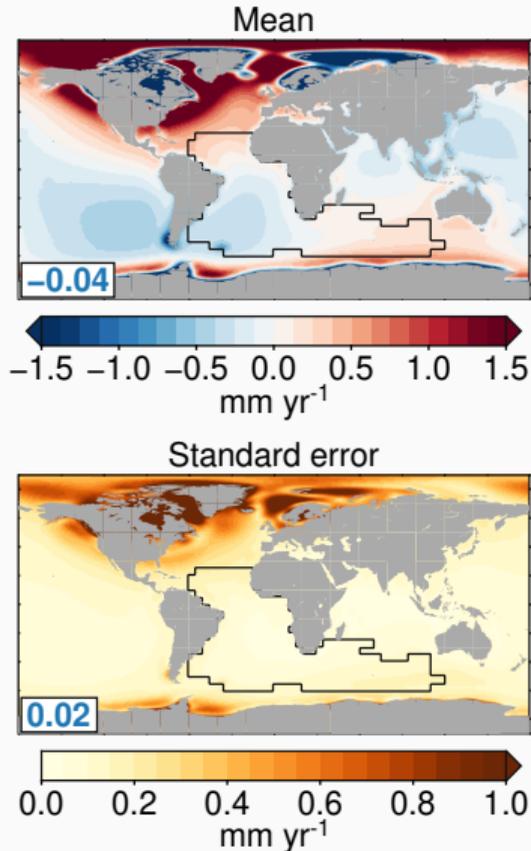
Do we expect a difference between SA and global?

- Do GIA, fingerprints, steric observations, or climate models point at a substantial difference between South Atlantic and the global ocean?

Can we find extra observations?

- Do we have new tide-gauge records or paleo proxies that could help us out?

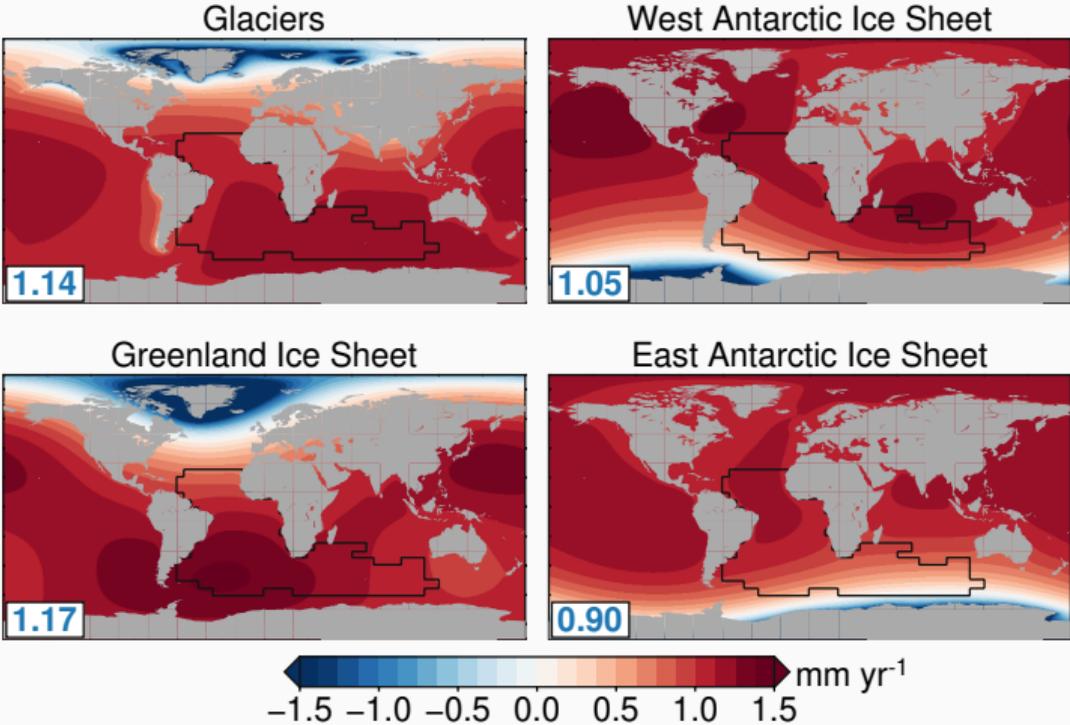
Glacial Isostatic Adjustment



Large GIA model ensemble from Caron et al (2018)

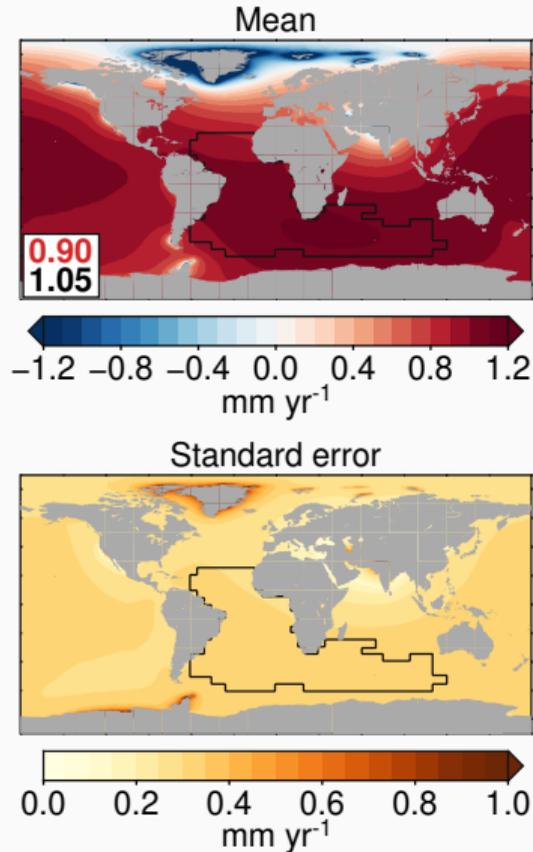
- GIA in South Atlantic generally small
- Uncertainty is limited
- Individual stations on location with larger signal: possible sampling bias

Present-day mass redistribution



All fingerprints (except EAIS) show above-average sea-level rise in the South Atlantic

Present-day mass redistribution

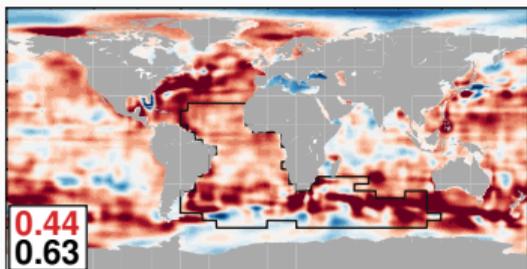


Estimates of 20th-century mass redistribution from Adhikari et al (2019)

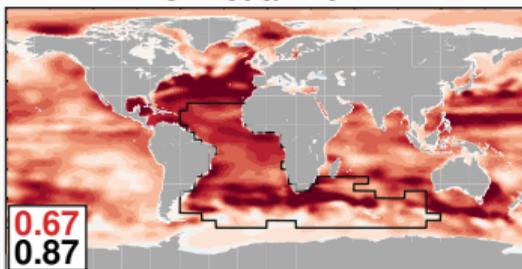
- Difference of 0.15 mm/yr between SA and global
- Uncertain contributions over this era

Steric sea-level changes

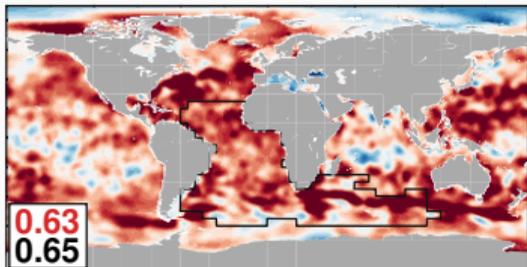
EN4



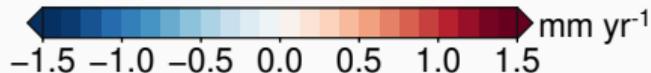
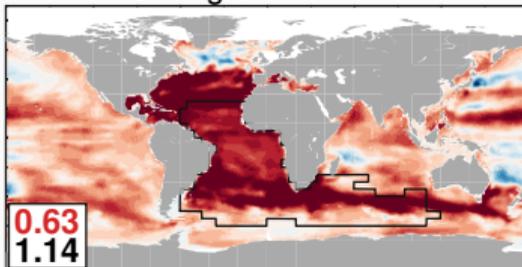
Ishii et al. 2017



Levitus et al. 2012

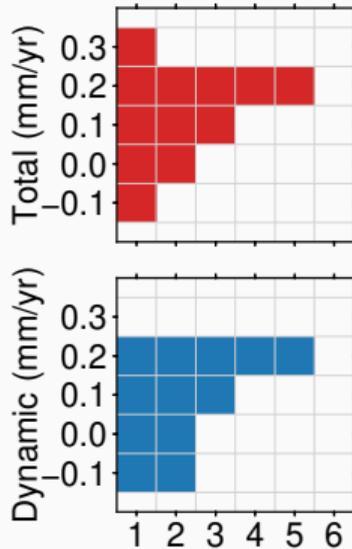
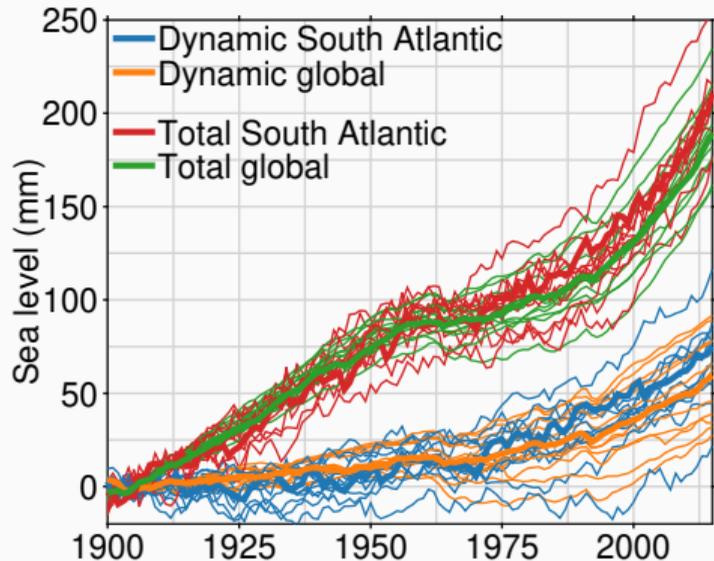


Cheng & Zhu 2017



- All products show above-average steric trends in basin
- Representative for the 20th century?
- Role of salinity and sparse observations

CMIP5 models



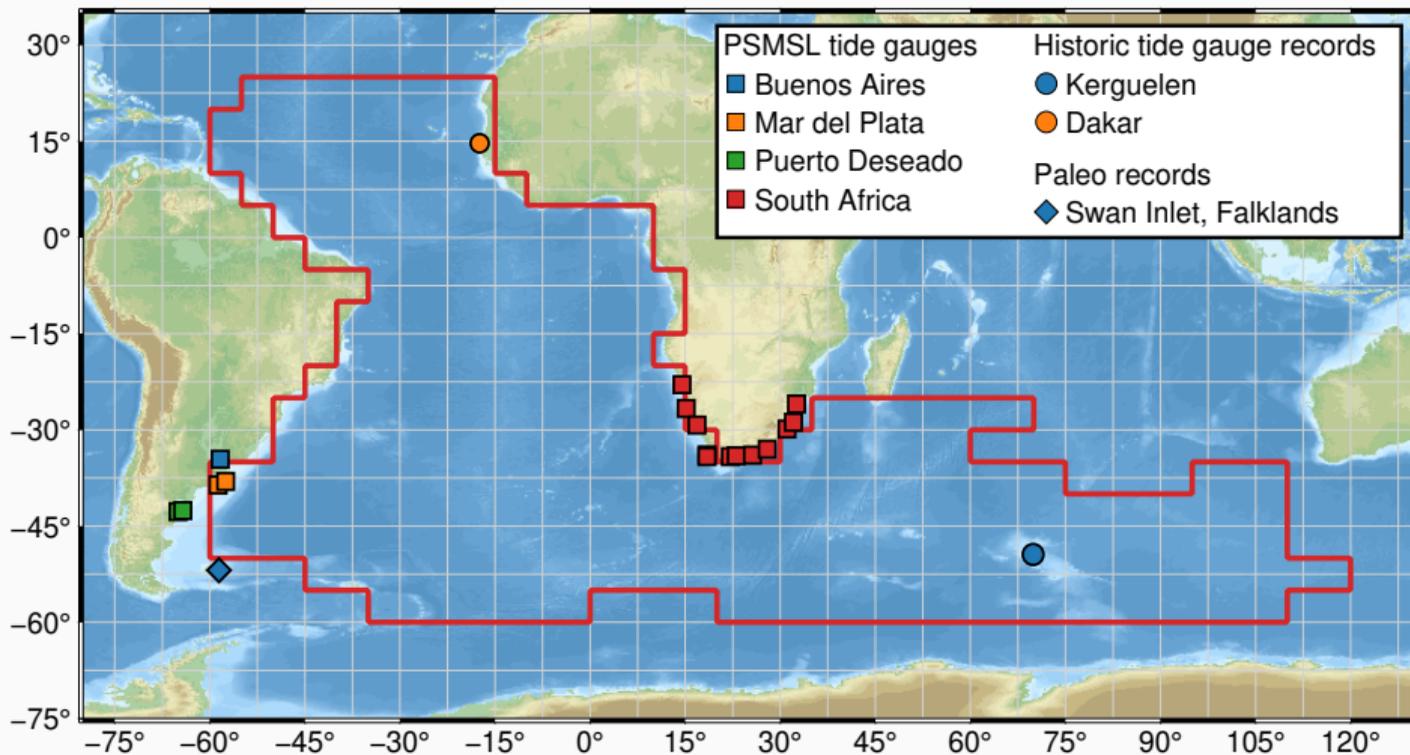
- South Atlantic versus global mean (From Meyssignac et al, 2018)
- Both dynamic and total sea level show above-average South Atlantic MSL rise
- Difference remains small

Processes cause an above-average SA sea-level rise Back-of-the-envelope:

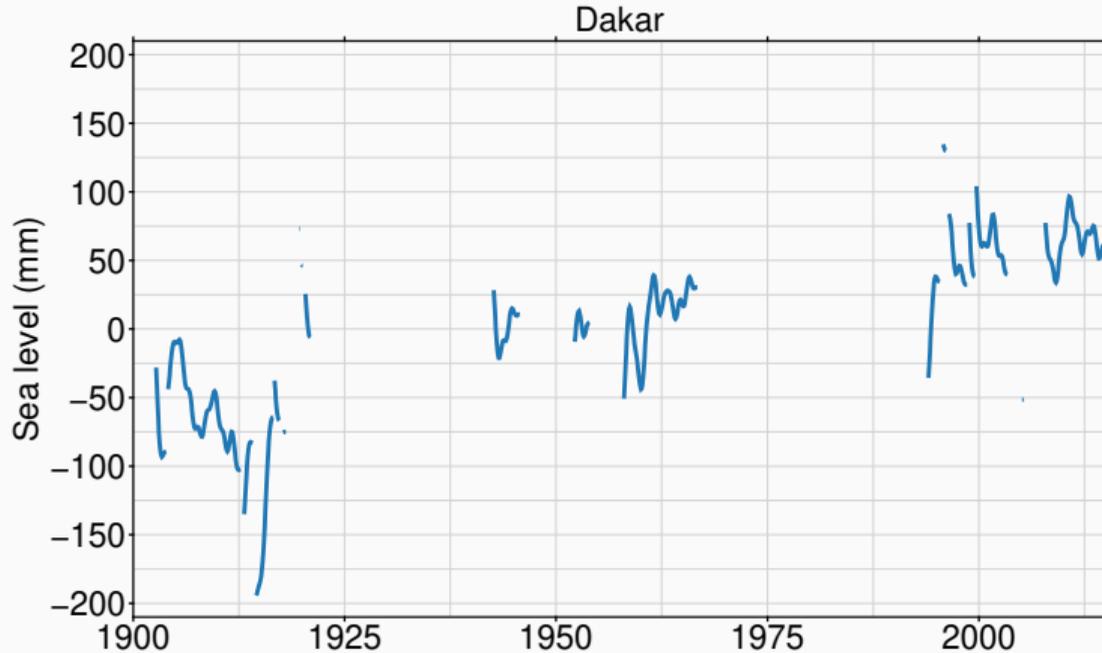
- GIA: -0.04 mm/yr
- Present-day mass: $+0.15$ mm/yr
- Steric: about $+0.2$ mm/yr

We could expect a SA sea-level trend of about 0.3 mm/yr above global-mean
CMIP5 models also point at above-average contribution

Increasing the number of observation



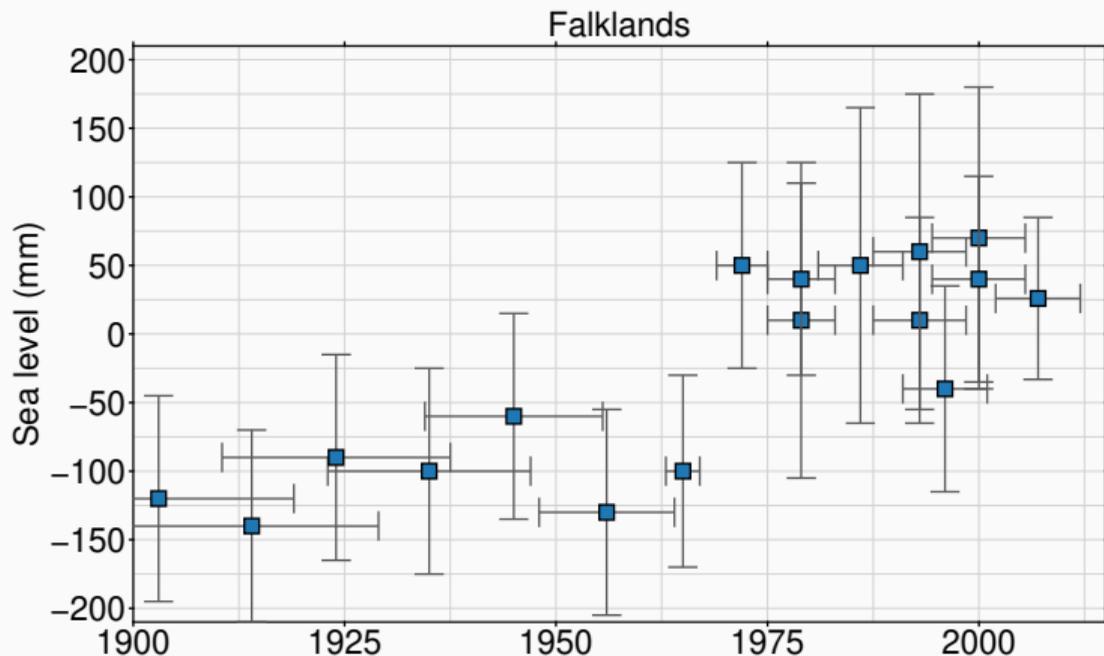
New observations: Dakar



Data rescue by Guy and Marta

- Longest record from Africa
- Trend of 1.4 mm/yr over 1900-2016

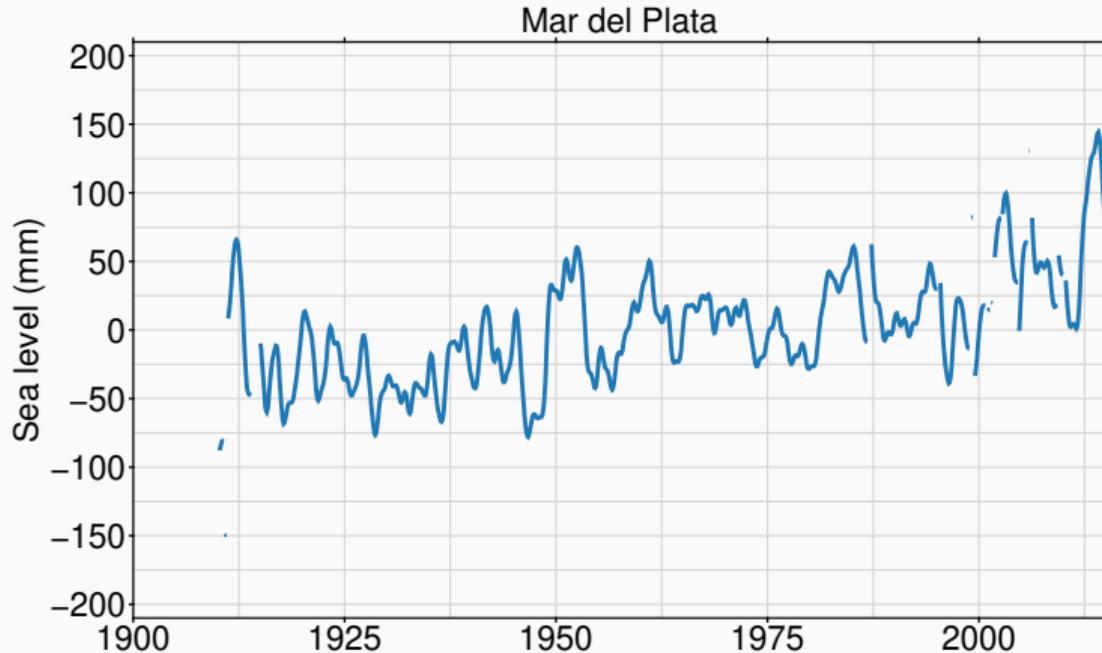
New observations: Falklands



Salt-marsh reconstruction by
PhD student of Roland

- Trend of 1.8 mm/yr over
1900-2010

New observations: Mar del Plata



Combination of nearby PSMSL records

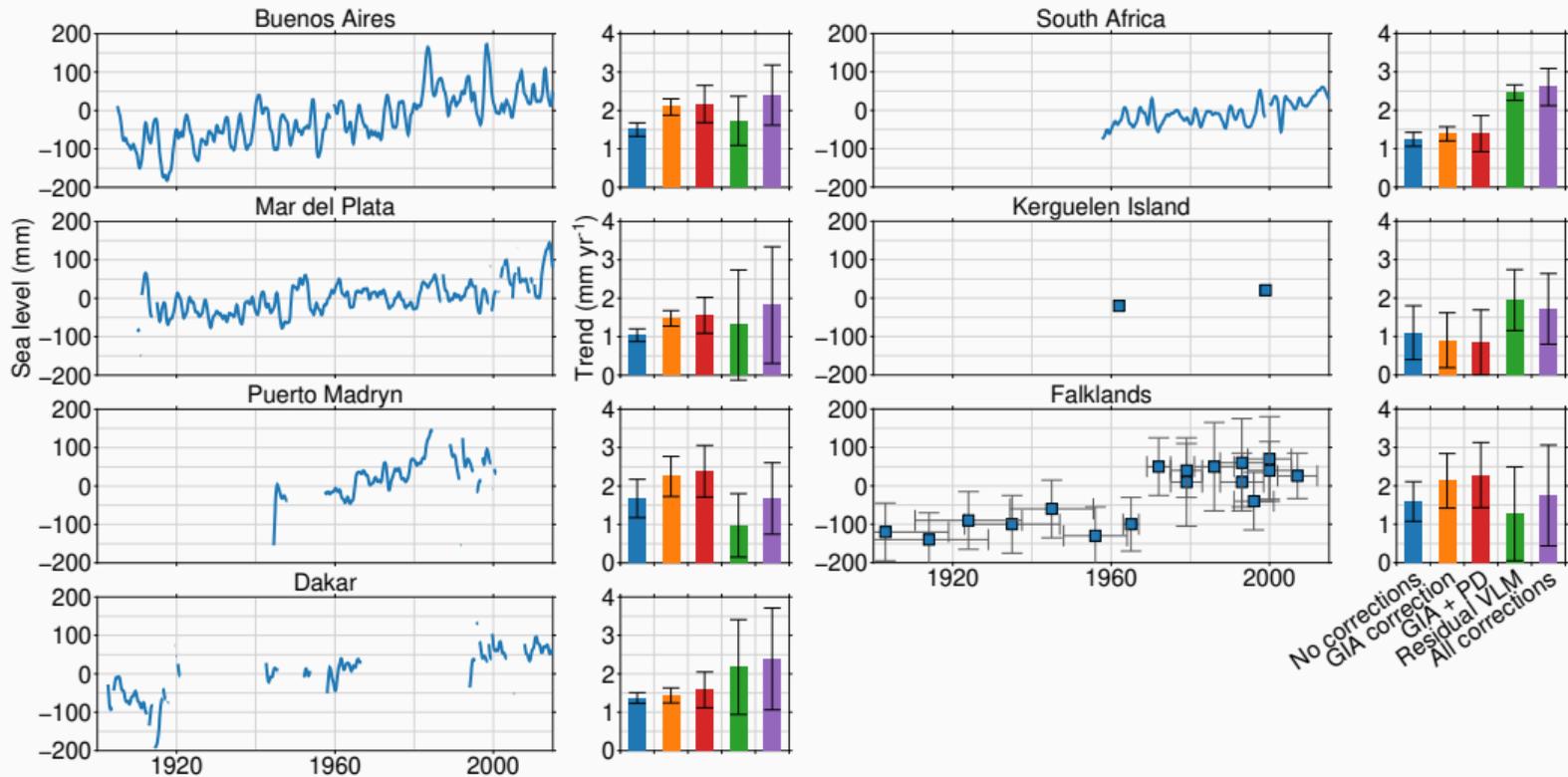
- Some parts are not RLR but don't look suspect
- Trend of 1.0 mm/yr over 1900-2016

Merging the the observation into a basin estimate

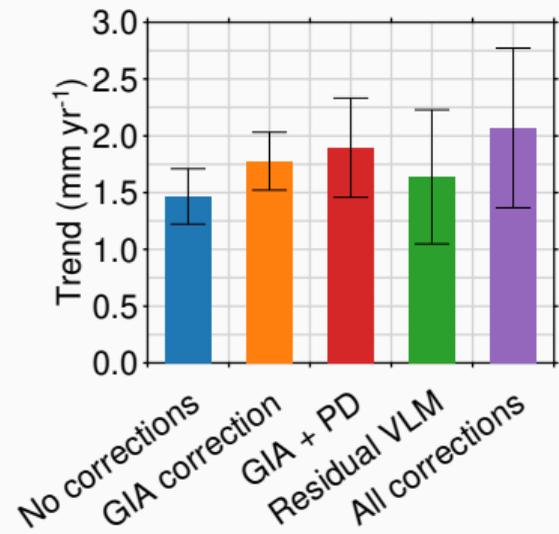
We now have individual observations: how to get best basin-estimate?

- Correct for residual VLM (previous presentation)
- Correct for GIA bias
- correct for Present-day mass bias
- Combine using virtual station method
- Monte-Carlo simulation to propagate uncertainties

Merging: Individual stations



Merging: Basin estimate



All corrections lead to higher basin estimate:

- Each correction: about 0.2 mm/yr
- Best estimate: 2 mm/yr
- Large spread

- High SA trend expected from processes (about 0.3 mm/yr above GMSL) and CMIP5
- Some new observations (Falklands, Dakar, Mar del Plata)
- Best estimate larger than GMSL + expected bias
- Uncertainties still large