Data products from the ESA CCI Sea Level Budget Closure project

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The SLBC_cci project

ESA's Climate Change Initiative (CCI)

includes several Essential Climate Variables (ECVs) addressing sea level

sea level cci

sea surface temperature cci

glaciers cci

ice sheets greenland cci

antarctic ice sheet cci

Sea Level Budget Closure (SLBC_cci)

is a cross-ECV project that
- utilizes the framework and quality of CCI products
- develops additional products in this framework
- investigates the sea level budget and ocean mass budget.

SLBC_cci
- concentrates on products by CCI and by consortium members
- exploits insights into their genesis and uncertainty characteristics
- facilitates a consistent framework of uncertainty characterization and sea level budget analysis.

SLBC_cci
- addresses the global mean sea level budget over
  - 1993-2016 (altimetry era)
  - 2003-2016 (GRACE/Argo era)
- includes a regional study for the Arctic.

Budget elements at monthly resolution

sea level budget closure cci
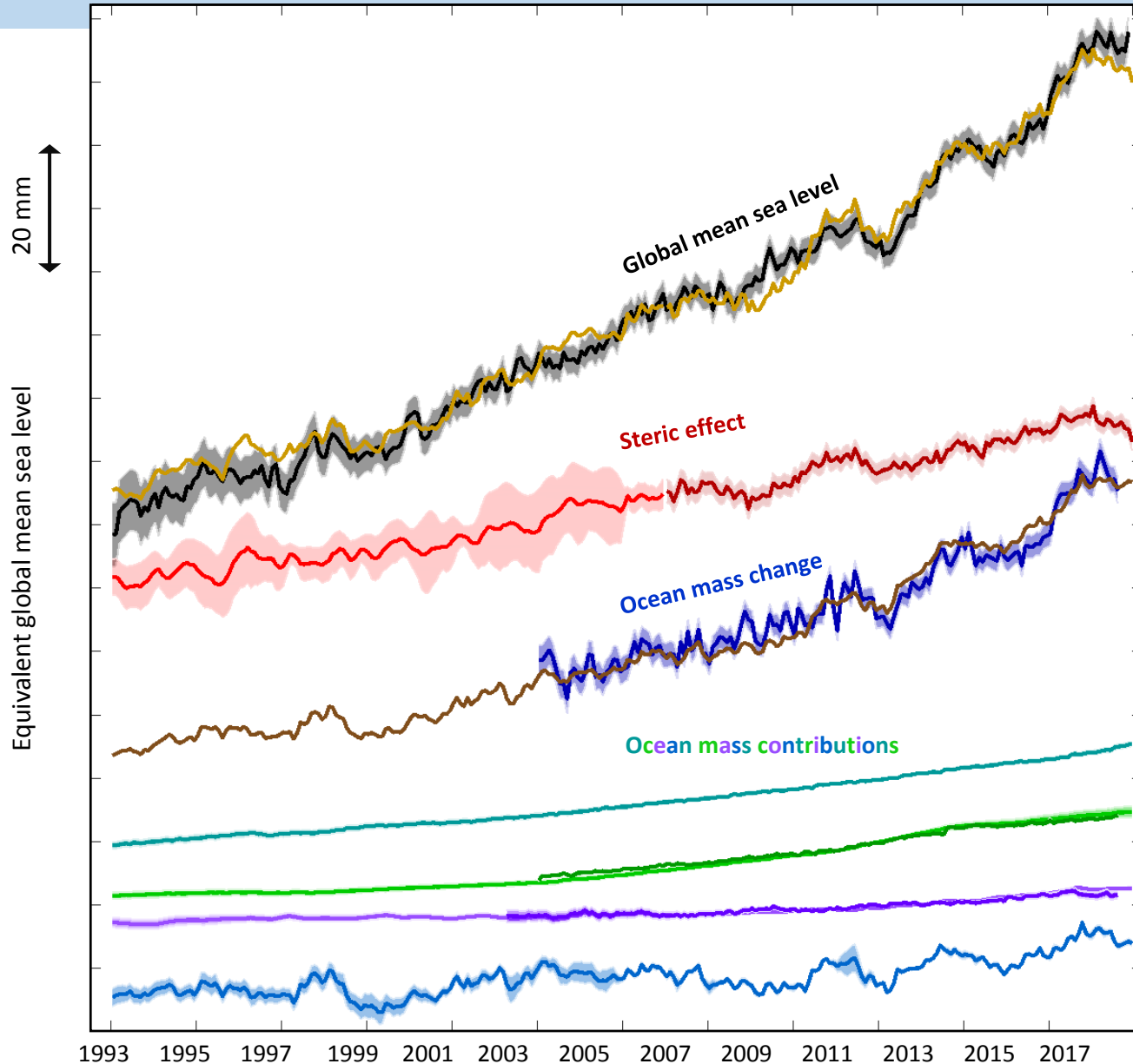
Global mean sea level change
from satellite altimetry (Sea_Level_cci) with comprehensive uncertainty characterisation

Sum of steric effect and ocean mass change

Steric sea level change
from Argo profiles with additional constraints by sea surface temperature (SST_cci)

Ensemble mean of existing steric sea level datasets

Ocean mass change
from GRACE satellite gravimetry (SLBC_cci)

Sum of ocean mass contributions

Glaciers
Global Glacier Model, using Glaciers_cci results for initialisation and validation

Greenland
from improved satellite radar altimetry processing (Greenland_Ice_Sheet_cci), calibrated against satellite laser altimetry,

from GRACE sat. gravimetry (Greenland_Ice_Sheet_cci)

Antarctica
from improved satellite radar altimetry processing (Antarctic_Ice_Sheet_cci) involving a time-evolving ice and snow density mask

from GRACE sat. gravimetry (Antarctic_Ice_Sheet_cci)

Land water storage
WaterGAP global hydrology model with improved representation of reservoir operation

Data products

Data products (if not yet available) will be made available soon.

Check cci.esa.int/ and tu-dresden.de/bu/umwelt/geo/ipg/gef/forschung/projekte/slbc_cci.

By now, please send individual requests.

- A compiled set of time series and uncertainties at a consistent monthly sampling (similar to what slide 3 shows) will be delivered together with a related manuscript.

- The underlying data products on the individual components are, or will be, also available. They are different in their temporal coverage and sampling and many are more comprehensive than the compiled time series, involving gridded representations and various variants of data analysis.

- The following appendix slides give more details on the individual budget component datasets.

Appendix: some details on data products

Global Mean Sea Level from altimetry

- Sea Level CCI product until 2015

- AVISO/CMEMS for 2016

- TOPEX A drift correction from Ablain et al.

- New uncertainty characterisation based on Ablain et al. (2017)

- ✓ GMSL data and underlying global grids of sea level changes are available from the CCI Sea Level project (www.esa-sealevel-cci.org).
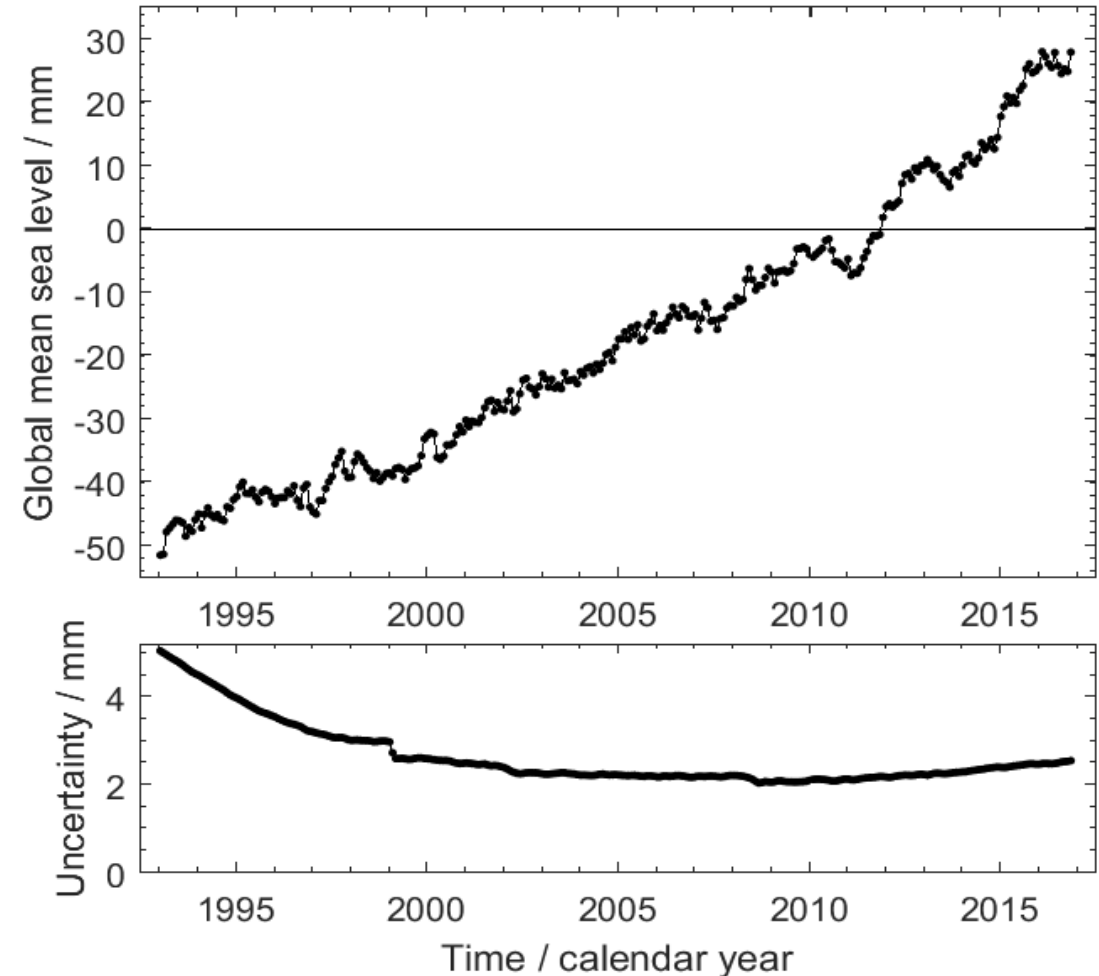
Steric component

Development within SLBC project
- Based on Argo profiles
- Incorporate Sea Surface Temperature (via conditional climatology method)
- Advanced uncertainty characterisation

✓ Gridded SLBC_cci steric sea level height anomaly product at 5°x5° spatial resolution and monthly temporal resolution, from January 2002 to December 2017, as well as the spatial average over the latitude range from 65°N to 65°S.
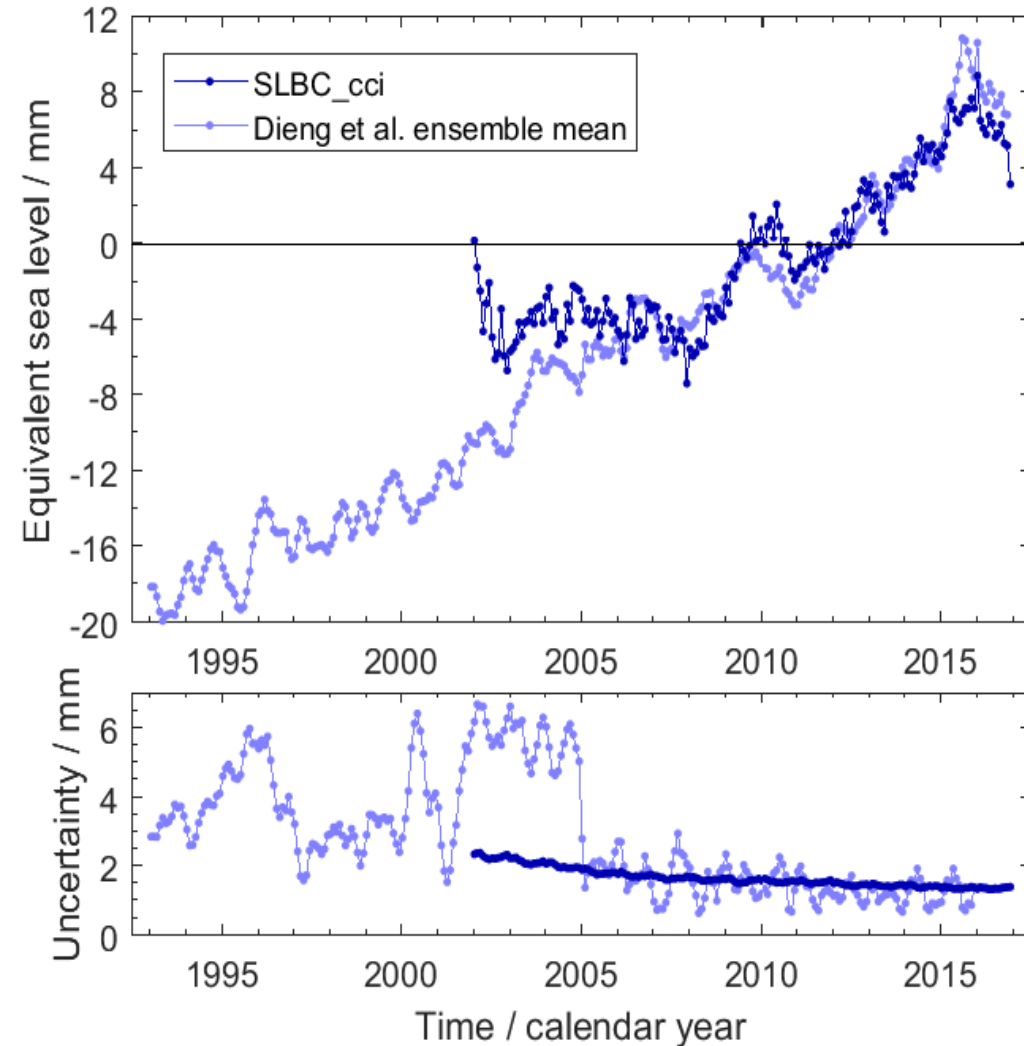
Global Ocean mass change from GRACE

- GRACE monthly spherical harmonic solutions: ITSG-Grace2018.

- Integration over buffered ocean kernel

- Handling of "AOD" background models based on recent methodological insights (cf. Uebbing et al. 2019)

- ✓ Time series from GRACE for 4 series of SH GRACE solutions, 3 GIA corrections (and the option of no GIA correction), and 3 different integration domains.
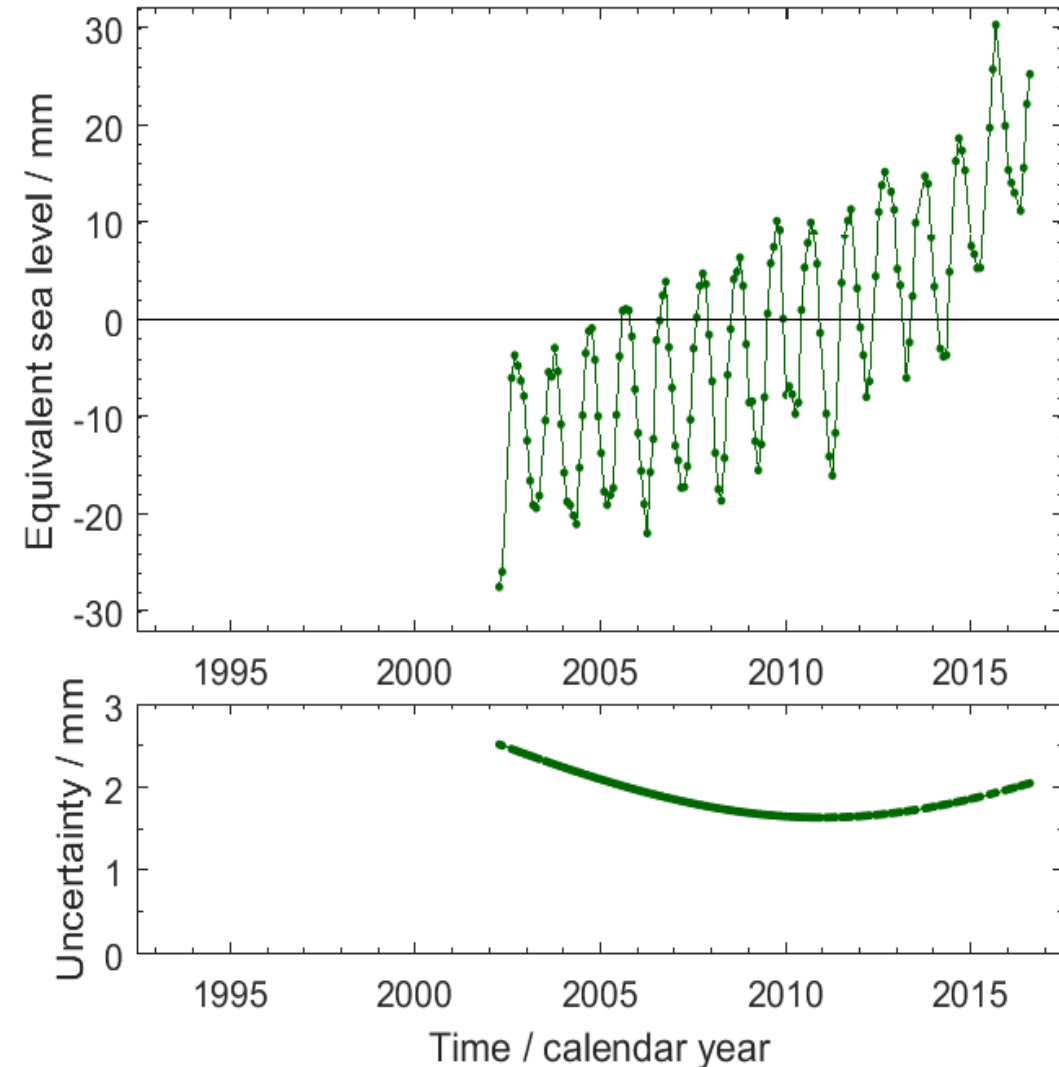
Global glaciers mass change

Global Glacier Model uses:

- global glacier outlines (RGI 6.0)

- atmospheric boundary conditions: 7 different global reanalysis products and observational data sets

- measured mass balances for calibration and validation

✓ Global grids of glacier mass change as well as glacier mass change rates at annual resolution and monthly resolution
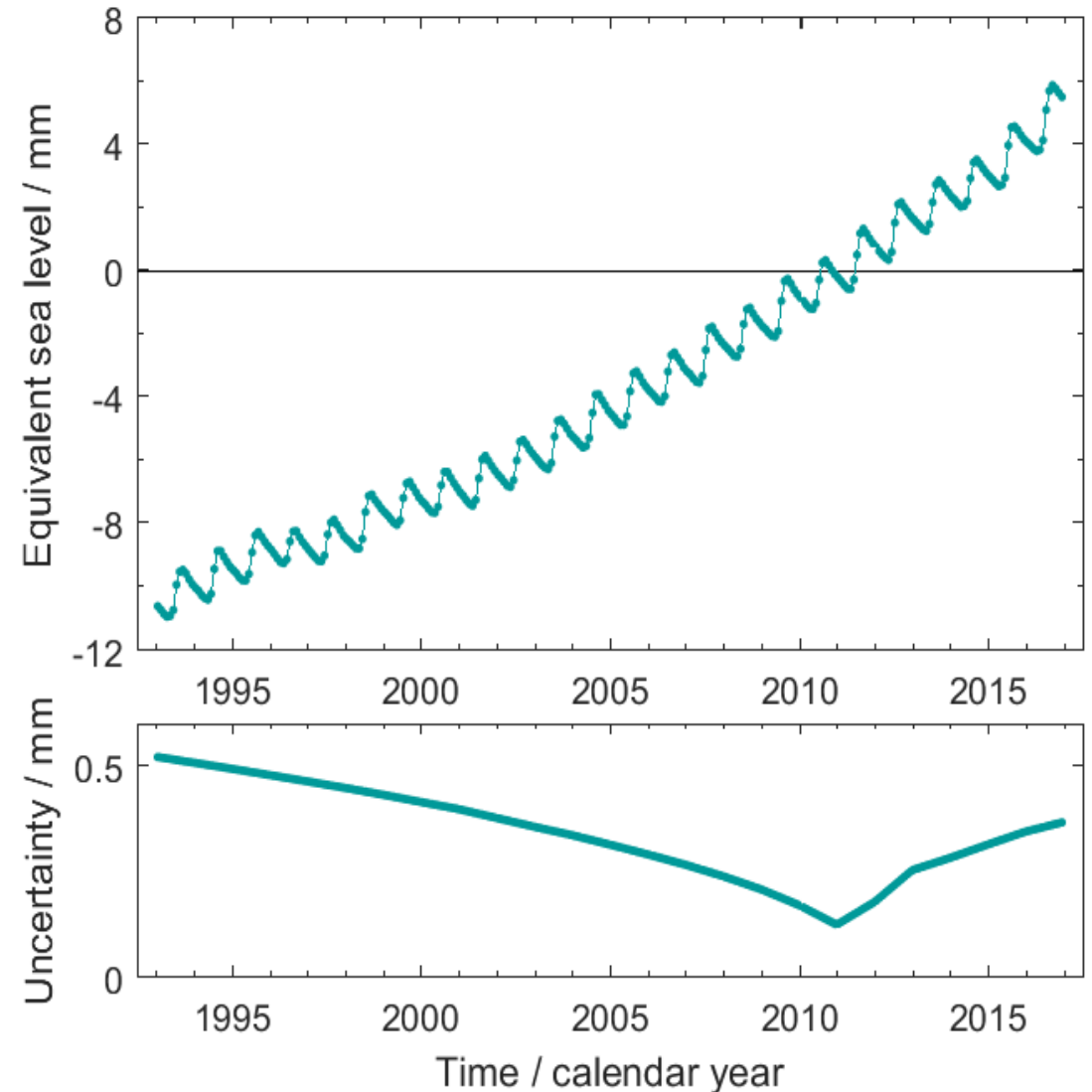
Greenland

- GRACE mass balance based on CSR-RL06, including peripheral glaciers and ice caps

- **Sum of:** Radar altimetry, calibrated to ICESat laser altimetry 2003-2009, over ice sheet, and Peripheral glacier mass change

- ✓ Monthly GRACE-based mass change estimates (grids and basin time series) from CCI Greenland Ice Sheet (http://esa-icesheets-greenland-cci.org/).

- ✓ Altimetry-based rates of change as monthly grids in a 100x100km² resolution from 1992-2017
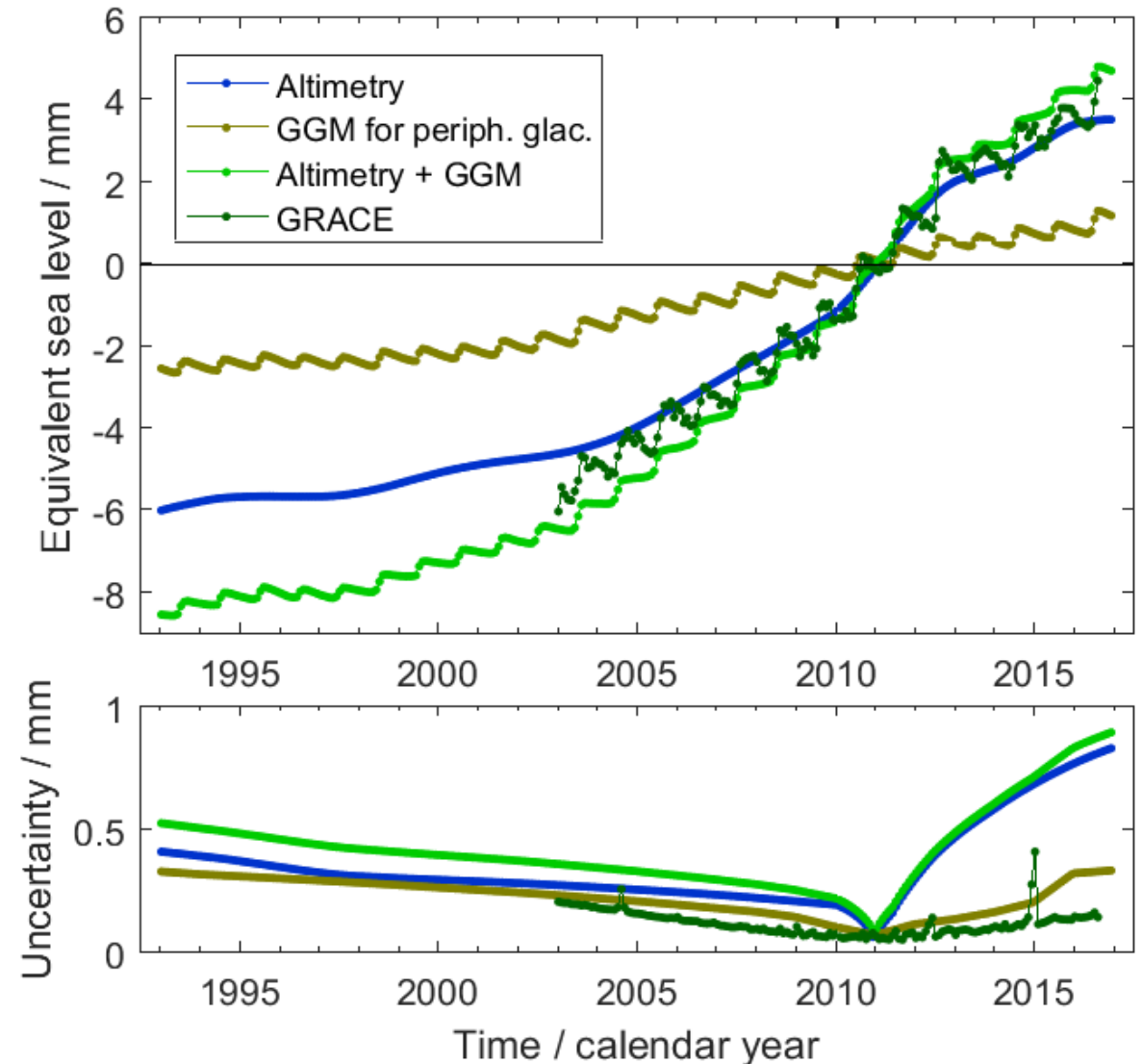
Antarctica

- GRACE mass balance using ITSG-Grace2016

- Radar altimetry using a time-evolving ice density mask

✓ Monthly GRACE-based mass change estimates (grids and basin time series) from CCI Antarctic Ice Sheet (http://esa-icesheets-antarctica-cci.org/).

✓ Altimetry-based mass changes for the West Antarctic Ice Sheet, the East Antarctic Ice Sheet and the Antarctic Peninsula at a 140-day resolution from 1992 to 2016
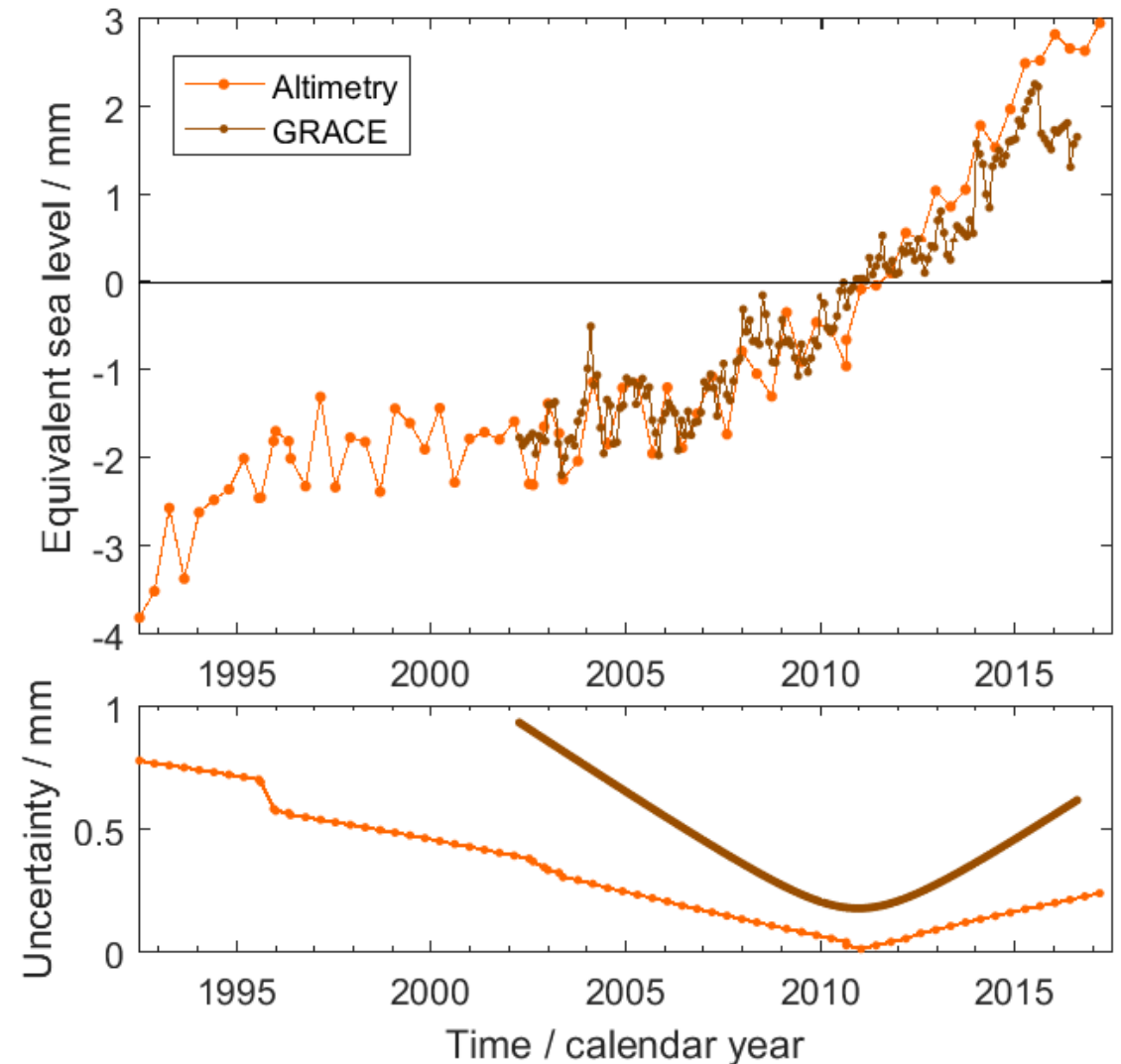
- Global hydrological model WaterGAP2.2d
- Two irrigation scenarios:
    - 70% deficit irrigation
    - optimal irrigation
- Two climate forcings
- Use ensemble mean and spread

✓ Results from 8 runs of the WaterGAP2.2d global hydrology model as monthly grids from 1992 to 2016. Two versions (wg22d_std and wg22d_gl) were run with two irrigation variants (70% deficit irrigation and optimal irrigation) and two state-of-the-art climate forcings.
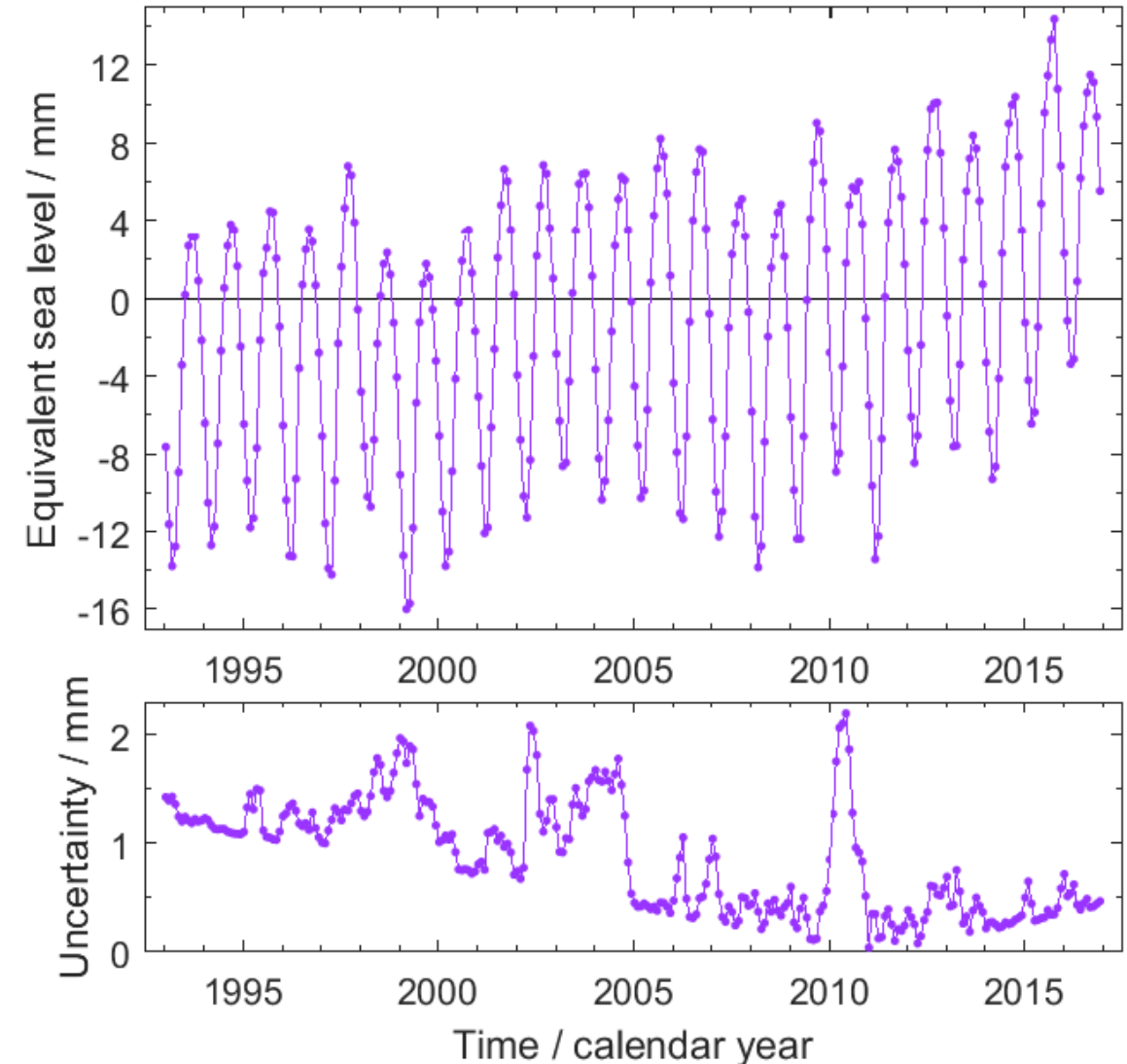
Arctic Ocean (ocean north of 65°N)

- ✓ *DTU Arctic Altimetric Sea Level Record:* The SLA data cover the region from 65°N-81.5°N and 180°W-180°E with a resolution of 0.25° in latitudinal and 0.5° in longitude, respectively. Data are given in monthly intervals between January 1996 and October 2018.

- ✓ *NERSC TOPAZ4:*The TOPAZ4 ("Towards an Operational Prediction system for the North Atlantic European coastal Zones") covers the Nordic Seas and entire Arctic Oceans bounded by 65°N-90°N and 180°W to 180°E with a spatial resolution of 0.25°. The temporal coverage is from 2003-2017 at a monthly resolution.