SEA LEVEL BUDGET CLOSURE

CLIMATE CHANGE INITIATIVE

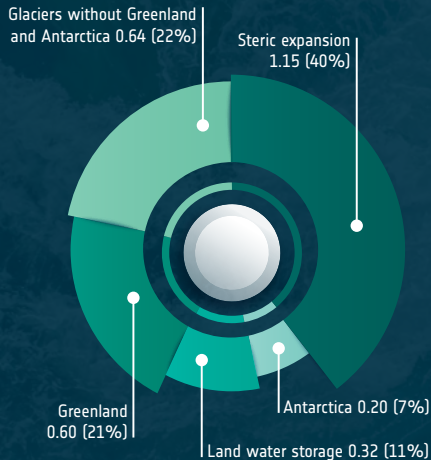## Sea Level

$$\Delta \, SeaLevel =$$
+ Steric effect (thermal expansion)
+ Ocean mass effect
- Glaciers
- Greenland Ice Sheet
- Antarctic Ice Sheet
- Land water storage ...

Sea level reflects changes in several climate system components.

Through sea level budget studies we assess the reliability of our knowledge on sea level change and its contributions.

Glaciers without Greenland and Antarctica 0.64 (22%)

Steric expansion 1.15 (40%)

Greenland 0.60 (21%)

Antarctica 0.20 (7%)

Land water storage 0.32 (11%)

Sea level trend budget 1993-2016 in mm/yr

ESA's Climate Change Initiative (CCI)

includes several Essential Climate Variables (ECVs) addressing sea level

sea level cci

antarctic ice sheet cci

greenland ice sheet cci

sea surface temperature cci

glaciers cci
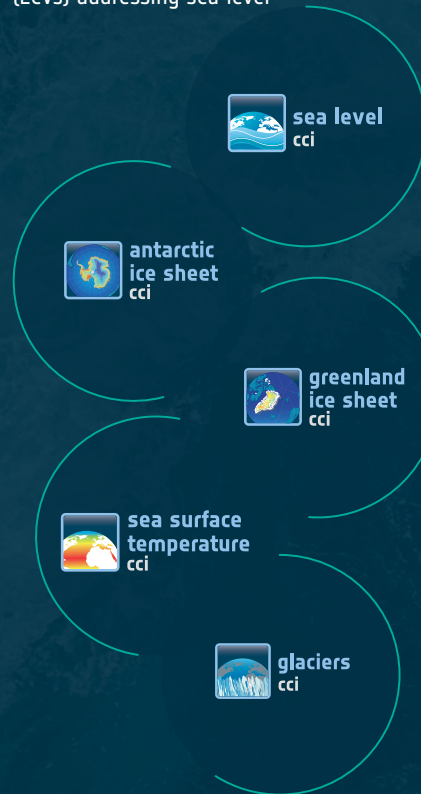
Sea Level Budget Closure (SLBC_cci)

is a cross-ECV project that

- utilizes the framework and quality of CCI products
- develops additional products in this framework
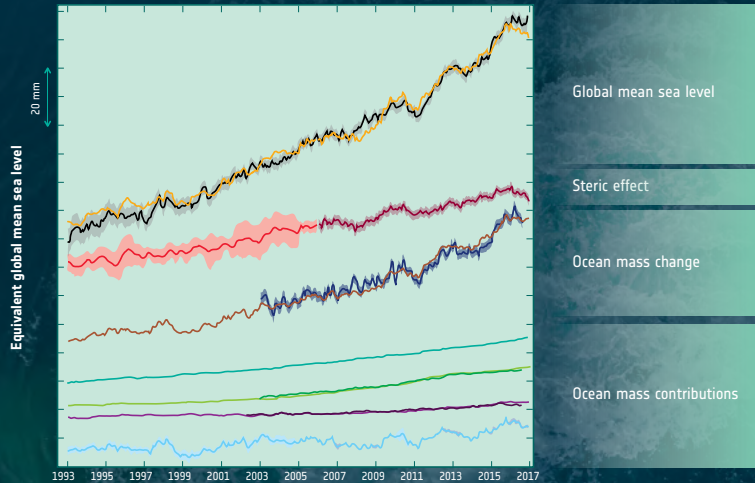- investigates the sea level budget and ocean mass budget.

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 characterisation 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.

Sea level budget and ocean mass budget elements at monthly resolution

Equivalent global mean sea level

20 mm

1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017

Global mean sea level

Steric effect

Ocean mass change

Ocean mass contributions

Results

- For the long-term trend, global mean sea level budget and ocean mass budget are closed within uncertainties.

- Uncertainties (1-sigma) are on the order of 0.3 mm/yr for several elements of the budget.

- For monthly times series, budgets are also closed within uncertainties.

Products

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

Greenland 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

Antarctica from GRACE sat. gravimetry (Antarctic_Ice_Sheet_cci)

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

CONSORTIUM

TU Dresden, Germany

LEGOS Toulouse, France
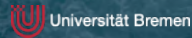
University of Reading, UK

Mercator Ocean, France

UNIVERSITY OF LEEDS

University of Leeds, UK

DTU Space
Technical University of Denmark

Universität Bremen

University of Bremen, Germany

Universität Zürich

University of Zurich, Switzerland

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

Goethe University Frankfurt, Germany

NERSC

Nansen Environmental and
Remote Sensing Center, Norway

Information | Documents | Products

http://cci.esa.int

http://cci.esa.int/sea-level-budget-closure

Contact

Martin Horwath
Technische Universität Dresden,
Germany
martin.horwath@tu-dresden.de

Jérôme Benveniste
ESA-ESRIN Frascati, Italy
jerome.benveniste@esa.int