Task 5000 “Assessment of output products by Climate users”

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WP 5000 Reporting

WP5000 : Assessment of Output products by Climate Users (resp LEGOS)

WP5100 : Assessment by Climate research group (resp UoH)

WP5200 : Error Characterization (resp LEGOS)

WP5300 : International comparison exercise (Resp LEGOS)
Task 5130: Assessment in Arctic using a multi-ECV approach

- Assess simulations from the Norwegian Earth System Model (NorESM) that has been delivered to CMIP5.
- Assess TOPAZ re-analyses.
- Assess an assimilation experiment using the NorESM reanalyses and prediction (NorCMP).
CMIP5 versus ESA CCI

1993-2012
CMIP5 versus ESA CCI

1993-2005

NorESM1-M
TOPAZ
ESA-CCI
DTU

1993-2012

NorESM1-M
TOPAZ
ESA-CCI
DTU

CLS, Toulouse

ESA CCI Annual Review 29-30 January 2015
1993-2012
NORESM versus ESA CCI

Time series for the Lofoten and SPG

CLS, Tc

0 January 2015
TOPAZ versus ESA CCI

Time series for the Lofoten and SPG

![Graphs showing time series data for the Lofoten and SPG regions, comparing different datasets: DTU, ESA, AVISO, and TOPAZ.](image)
NORESM and TOPAZ versus ESA CCI

1993-2012

NorESM1-M

TOPAZ

ESA-CCI

(mm/yr)
Thermo- and halosteric contributions

1993-2011

CLSC, Toulouse
Thermo- and halosteric contributions

Altimeter sea level

In-situ thermosteric (IK09)

1993 - 2009

from Henry et al. (2012)

Halosteric (IK09)
Thermo- and halosteric contributions

Hamburg ATL 1/12 degree model fields 2003-2009

From Koldunov et al. (2015)
SPG index is box-averaged SSH [60W-15W, 48N-65N]

Weak SPG

Strong SPG

Courtesy F. Counillon

29-30 January 2015
Thermo- and halosteric contributions

SPG index is box-averaged SSH [60W-15W, 48N-65N]

Strong SPG

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Thermo- and halosteric contributions

SPG index is box-averaged SSH [60W-15W, 48N-65N]

Weak SPG

Strong SPG

Courtesy F. Counillon
GREENLAND ICE SHEET MELTING (from GRACE)

Tedesco et al 2014
SUMMARY

• assessment of sea level changes at high northern latitudes seas and in the Arctic Ocean by comparison of SL CCI products and NorESM fields;
• assessment using re-analyses from TOPAZ;
• inter-comparison of thermosteric and halosteric anomalies in the in-situ observations and in the NorESM simulation;

• test the impact of using the SL CCI product in a 20-years reanalysis using the coupled global climate model (NORCPM – NorESM with assimilation) using monthly assimilation of the SLA; ongoing

• assess fluxes and heat content of re-analyses against independent in-situ data set as well as to the NorESM CMIP5 results; not started
• interact with other CCI groups wrt the high latitude/Arctic Sea; not started
• estimate the impact of freshwater cycle on SSH changes. not started
Summary

The GCOS observation requirements wrt sea level change for regional seas (Arctic Ocean) is not yet met (accuracy: 1 cm for a 50-100 km cell, stability < 1mm/y).

We lack in-situ observations and process understanding and thus ability to fully validate models as well as satellite observations with satisfactory uncertainty estimates. Sustainable improvement of the in-situ obs system should include:

• expansion of the tide gauge monitoring system
• implementation of multi-platform observations (e.g. Argo and gliders under ice)
• implementation of a bottom pressure gauge system
Satellite Observations of these contributors to Sea Level Change in the high latitude seas and the Arctic Ocean

- Ocean Heat and Salinity Change
- Mass transfer from land to ocean (e.g. melting ice sheet and glaciers, river discharges, groundwater)
- Mean Sea Level Pressure
- Near surface wind
- Gravitational change due to land movement, ice sheet melting, tectonic changes, etc.

Presence of sea ice limits SST and SSS observations, cold water sensitivity limits reliable SSS retrievals, sea ice freeboard must be removed to recover SSH from altimetry with adequate accuracy.

Surface elevation change from SAR altimetry, motion from interferometry, river discharges not adequately determined from satellites. Not possible over sea ice covered regions. Not possible, IB very uncertain in the high latitude and Arctic regions.

The GCOS observation requirements with sea level change for regional seas (Arctic Ocean) is not yet met (accuracy: 1 cm for a 50-100 km cell, stability < 1 mm/y).

Continuity of GRACE type mission is highly needed.
Operating period of 62 available tide gauges from Henry et al., 2012
ESA Climate Change Initiative

ESA CCI Annual Review 29

CLS, Toulouse

1999

2003

2005

CLCS, Tc

12

10

8

6

4

2

0

-2

-4

-6

-8

(mm/yr)

BCC_CSM1

CCSM4

CESM1_CAM

CMCC_CMS

CNRM_CM5

CanCM4

CanESM2

GFDL_ESM2

IPSL_CM5A_LR

MPI_ESM_LR

IPSL_CM5A_LR

MPI_ESM_LR

IPSL_CM5A_LR

MPI_ESM_LR

IPSL_CM5A_LR

MPI_ESM_LR

NorESM1

TOPAZ

ESA_CCI

DTU

2015
Time series for the Sub-polar gyre

ESA-CCI: 4.44 mm/yr
NorESM: 1.80 mm/yr
Time series for the Lofoten Basin

ESA-CCI: 5.16 mm/yr
NorESM: 4.56 mm/yr