

Session 6 – Evolving Requirements II (IPCC): Ocean breakout

How To Address Knowledge Gaps In Preparation For AR7

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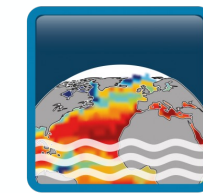
sea level
cci



sea state
cci



ocean colour
cci



**sea surface
salinity**
cci



sst
cci

12th CMUG-CCI Colocation Meeting
ESRIN, Frascati, Italy, October 26th, 2022

1. What are the **major knowledge gaps that we have over the ocean?**
2. How could you address these gaps in future projects and/or **CLIMATE-SPACE?**
3. How to optimize impact of CCI+ and CLIMATE-SPACE on AR7?

Importance of high-quality scientific publications based on CCI products that are geared towards addressing IPCC gaps

Cross-ECV activities could be an important avenue for enhancing uptake at the level of IPCC. Cross ECV could and should transcend partitions into domains as needed (go beyond oceans)

Synthesis is important

Trends are important: but equally important are confidence in trends (relevance of uncertainties). Data could contribute to reanalyses and assimilation.

Note: We discussed everything in relation to Climate-Space.

Knowledge Gaps



Anna Pirani: High Resolution turbulence scale fluxes are still one of the areas of low confidence

Sabrina Speich: Also related to message yesterday (see next slide)

Richard Jones: Needs further links to modelling world



Knowledge Gaps: Southern Ocean

Anna Pirani: the southern ocean role (including in ocean ventilation) needs to be better quantified

More observations (for instance: need sustained improved salinity, see next slide from Sabrina Speich)

New studies? Integration of existing studies?

Needs interdisciplinary approach

Gaps: polynya, ice edge, ocean ventilation, SST not validated in Southern Ocean

notes

Anna Pirani: need coastal and regional enhanced observations

High resolution and full physics/biology coupling

Sea level: Differences in trends at coasts. These differences need explanation. Need independent data and models to understand observations. Regional sea level budget.

Ocean colour: Needs specific work to improve quality of ocean products in coastal waters. Importance of influence of suspended sediment load and coloured dissolved organic matter. Need for higher resolution products in the coasts. Importance of pigments other than chl-a (GCOS IP with respect to phytoplankton and biodiversity).

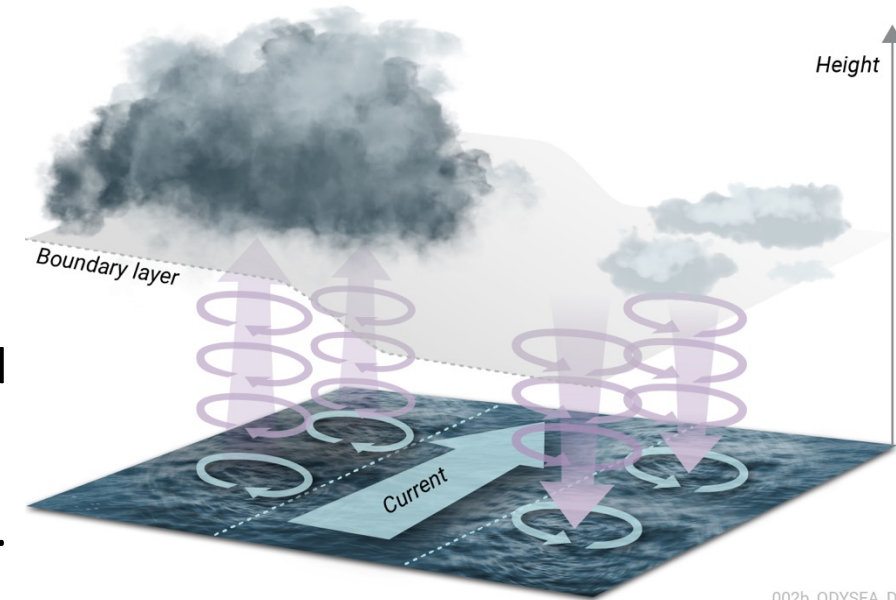
Primary production

New satellite missions to measure ocean surface currents

- Fundamental to understanding how momentum & kinetic energy are transferred between two major components of Earth's system, the ocean and atmosphere.
- Ocean surface currents important in redistributing heat, salt, passive tracers, and ocean pollutants in the surface layer of the ocean.
- Space-based estimates of near-surface currents produced by combining surface geostrophic currents derived from altimetry and Ekman Current derived from ocean-surface wind stress.
- More representative of mixed-layer currents than surface currents. Not suitable near the equator.

➡ **Direct measurements of surface currents from space are thus needed.**

ODYSEA (Ocean DYNamics and Surface Exchange with the Atmosphere)



Gille et al., 2022

002b_ODYSEA_D

Credits: S. Speich

Ocean currents? Geostrophic + Ekman. More work needed. Preliminary study on climatology of Ekman currents. Issues at the equator. Need in situ observations, especially in the equatorial region. Need for new mission. Process-oriented missions on the horizon. A few years away from a CDR.

Freshwater influx into the ocean (cross-ECV project?): potential new ECV? We can do a much better job than before. River discharge project. Fate of freshwater influx. Impact on circulation, ocean ecosystem. Role of salinity in water cycle. Particular challenges of salinity retrieval in cold waters. CDOM and salinity as indicators of freshwater influx. Potential to identify different water sources. Many of the impacts of climate change and human activities are felt at the coastal zone.

Opportunity for integrating with high-resolution models for testing consistency and for modelling processes involved.

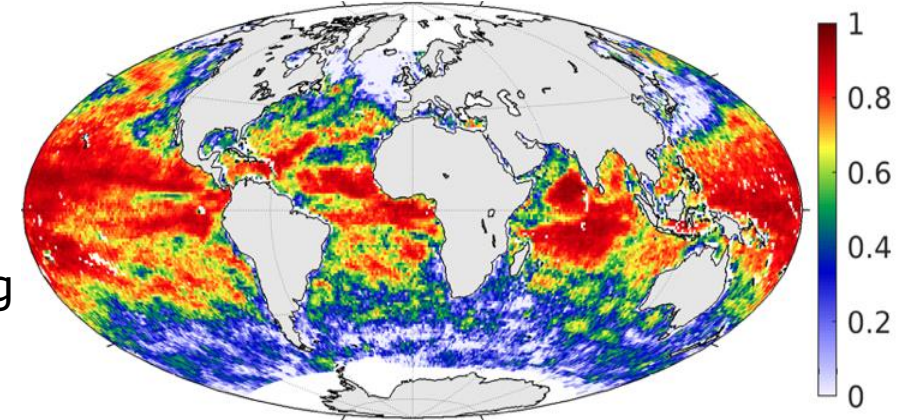
Integrate the needs of the coastal communities.

Upcoming critical gaps in satellite observations – (A2)

Sea Surface Salinity

- **Ocean: a major component of water cycle**
- Salinity is a **footprint of Freshwater input** (run off, precipitation, ice melting)
- Salinity plays a **key role in setting the water density*** (high latitude, surface ocean) :
 - ➡ high-latitude → **thermohaline circulation**
 - ➡ in ocean surface layer → **air-sea, land-sea and ice-sea exchanges**
- **SSS and SST vary at different time scales**, SST responds

Correlation of CCI SSS with an ensemble of in situ observations



Stammer et al., 2021

Currently there **is only one mission concept**, the Copernicus Microwave Imaging Radiometer (CIMR) by ESA, that aims to provide satellite SSS. But the mission timeline is 2028 or beyond even if it will move into the operation phase. Given the ages of the current SSS-measuring satellites (SMOS since 2009 and SMAP since 2015), a gap before CIMR is extremely likely.

Credits: S. Speich

3- how to maximise impact on AR7

Integration - integration – Integration!

..and it is a **community** work

SIXTH ASSESSMENT REPORT
Working Group I – The Physical Science Basis

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Lessons learned for AR7

- Ease of **integration** of multiple lines of evidence e.g. with **community** data standards and documentation, analysis tools, facilitated data access
- Documentation and curation of data assessed in the report for transparency and FAIR principles for open science
- Cataloguing datasets and literature assessed in the report
- Greater **integration** of data products, including links to other WGs by means of interactive tools to support user access and exploration
- Coordinated **community** support of the assessment and small author teams

Credits: A. Pirani

notes

Importance high-quality scientific publications based on CCI products that are geared towards addressing IPCC gaps

Cross-ECV activities could be an important avenue for enhancing uptake at the level of IPCC. Cross ECV could and should transcend partitions into domains as needed (go beyond oceans)

Synthesis is important

Trends are important: but equally important are confidence in trends (relevance of uncertainties).

Data could contribute to reanalyses and assimilation.

We recognized that some ECVs from CCI are not as well taken up at the level of IPCC as they might be. We need to consider how to improve that.

Example: Importance of cross-ECV + model

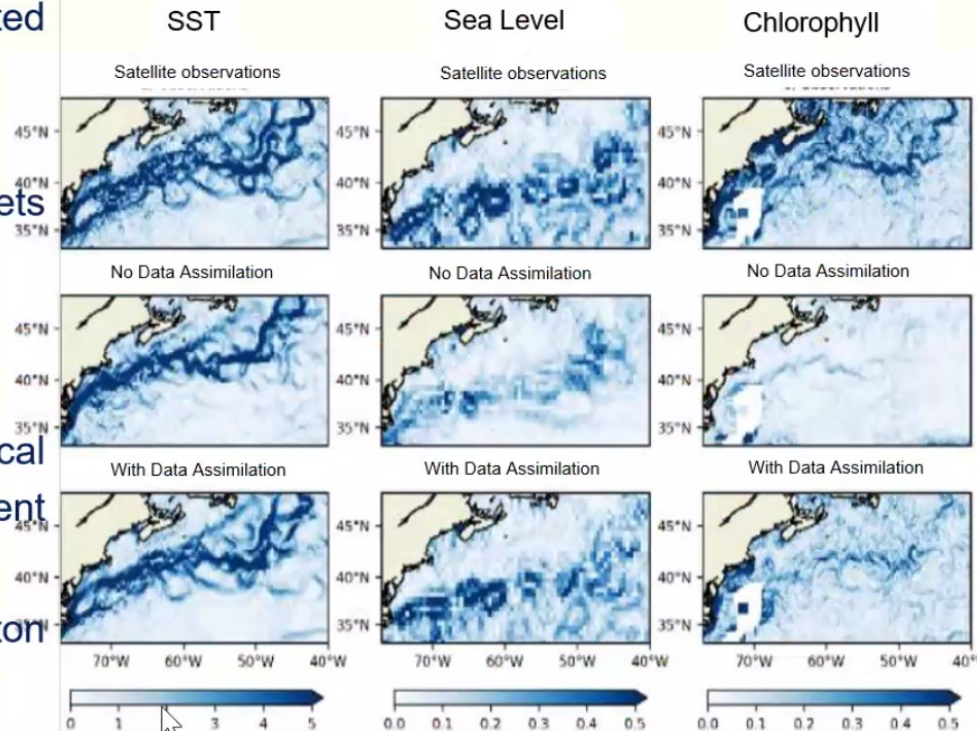
Using SST, Sea Level, Sea Ice, Ocean Colour in reanalysis with *in situ* measurements of temperature and salinity



Physical–biogeochemical ocean model assimilated different combinations of the ESA CCI ECVs

The aims of the study were to assess:

- The impact of assimilating the ESA CCI datasets on the marine carbon cycle and showed
- ESA CCI dataset consistency
- Consistency of physical–biogeochemical relationships in reanalyses assimilating different combinations of data
- strong positive correlation between phytoplankton and net air–sea heat flux
- seasonal variations in carbon-to-chlorophyll ratio



Temperature, sea level and chlorophyll in the Gulf Stream region during December 2010

Important:
Biology +
Physics

High-resolution

Credits:
R. Jones



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Should we specifically address oceanic tipping points?



Tipping points in the oceans: In addition to coral reefs and AMOC. Coastal erosion, fisheries collapse(?), regional tipping points (?) could be as final or irreversible as global tipping points. Climate refugees: social and cultural tipping points? Ecological niches. Tipping elements in high Arctic associated with disappearing sea ice.

2- what work needs to be done in CLIMATE-SPACE

Refer to 'pillars of CLIMATE SPACE'

Investigate reasons why uptake of CCI products in climate research could be improved.
Need for community-based approaches

Focus on what can be achieved through Earth Observation, aiming towards AR7.

High-resolution turbulence (Pirani)

Further links to modelling world (Jones)

Additional information could from CCI Sea State work (currently underexploited)

Southern Ocean (role in ventilation needs to be better quantified)

Upcoming critical gap in satellite observations (SSS)

Coastal and regional enhanced observations (Pirani)

High resolution and full physics/biology gaps

Link to the main pillars