Ocean Colour Climate Change Initiative
of the European Space Agency

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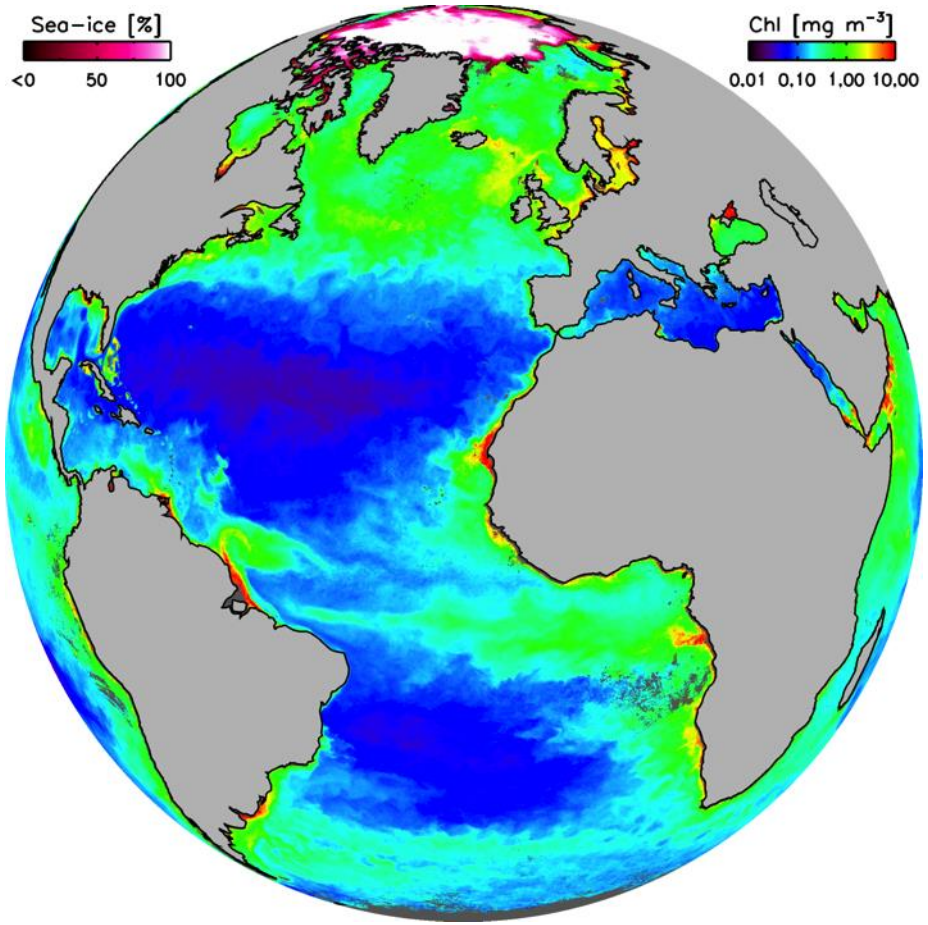
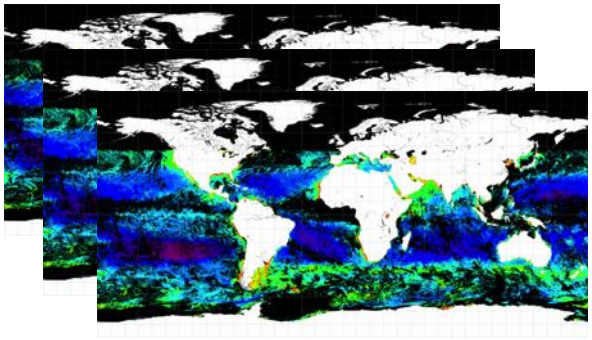
Ocean Colour and Climate



- Colour of the ocean contains latent information on the abundance of the marine microflora (phytoplankton).
- Invisible to the naked eye, phytoplankton have huge collective impact visible from space.
- Chlorophyll-a, a ubiquitous pigment contained in phytoplankton, is a major product.
- Algorithm based on light absorption by pigments: feedback to heat budget.
- The Green component of the Blue Planet.
- Phytoplankton are highly vulnerable to changes in environmental conditions.
- Marine equivalent of the canary in the coal mine.

OC-CCI System Prototype

SeaWiFS
MERIS
MODIS, VIIRS
OLCI



Atmospheric Correction using best algorithms from round-robin comparison

Merging, Bias Correction

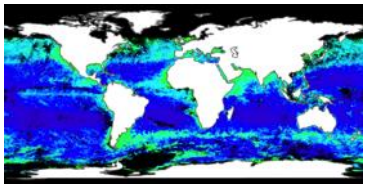
Global In-situ database

Ocean products using best algorithms from round-robin comparisons

Quality Control and Scientific Analysis

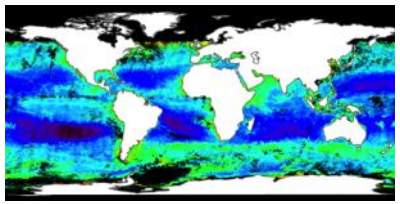
Unified multi-sensor Products

Uncertainty characterisation



User Community

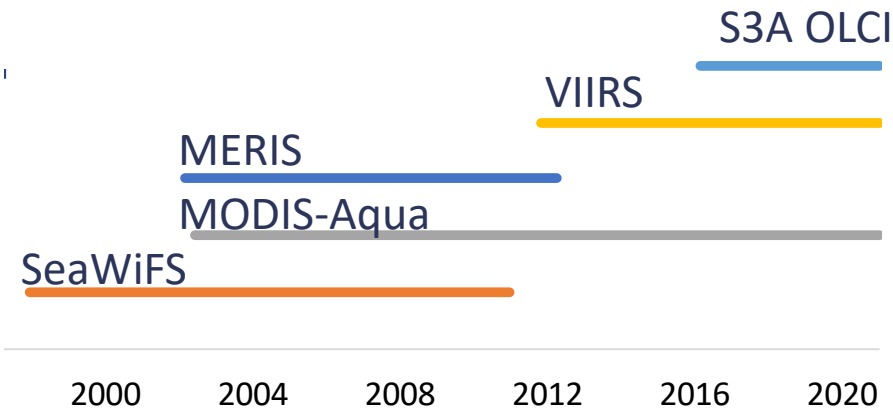
Modellers
Oceanographic Scientists
Earth Observation Scientists



For data, please visit:
http://www.esa-oceancolour-cci.org/
http://www.oceancolour.org/

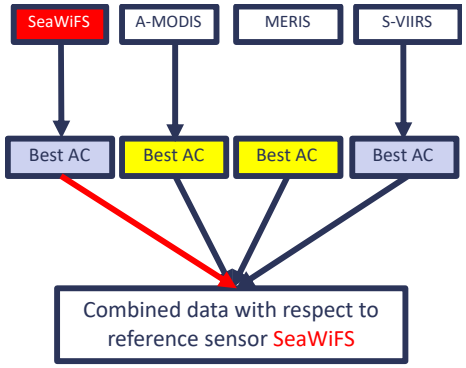
OC CCI 2020: Inter-sensor biases

- Sensors have finite lives
- Sensors launched as “one-offs” (but a step change with Sentinel 3 and VIIRS)
- Each sensor has part coverage daily
- Clouds mask the signal
- Need inter-sensor bias correction with respect to “reference” sensor
- Some sensors don’t overlap with primary reference!



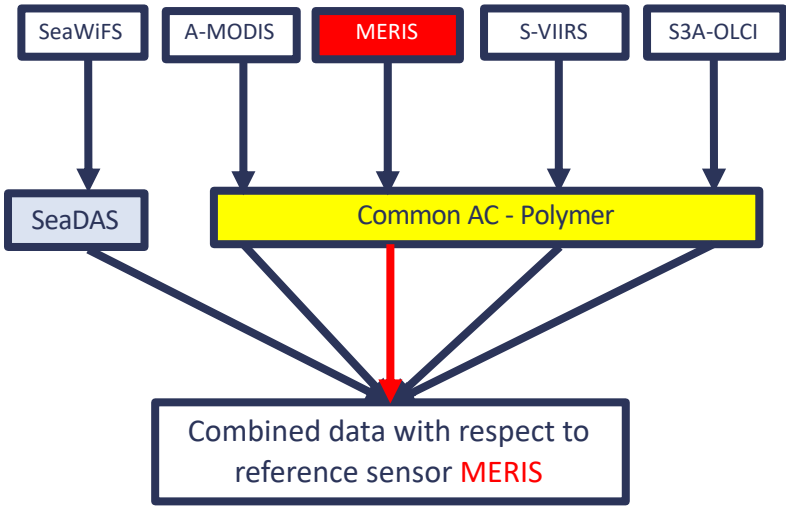
Version 2, 3 and 4

- SeaWiFS, A-MODIS, MERIS, S-VIIRS
- SeaWiFS as reference



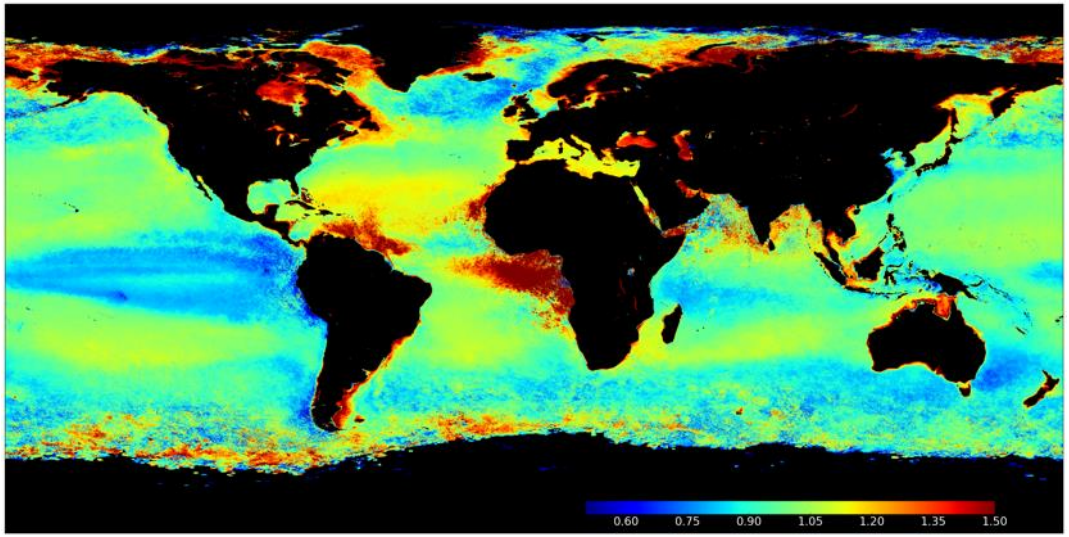
Version 5

- SeaWiFS, A-MODIS, MERIS, S-VIIRS, S3A-OLCI
- MERIS as reference



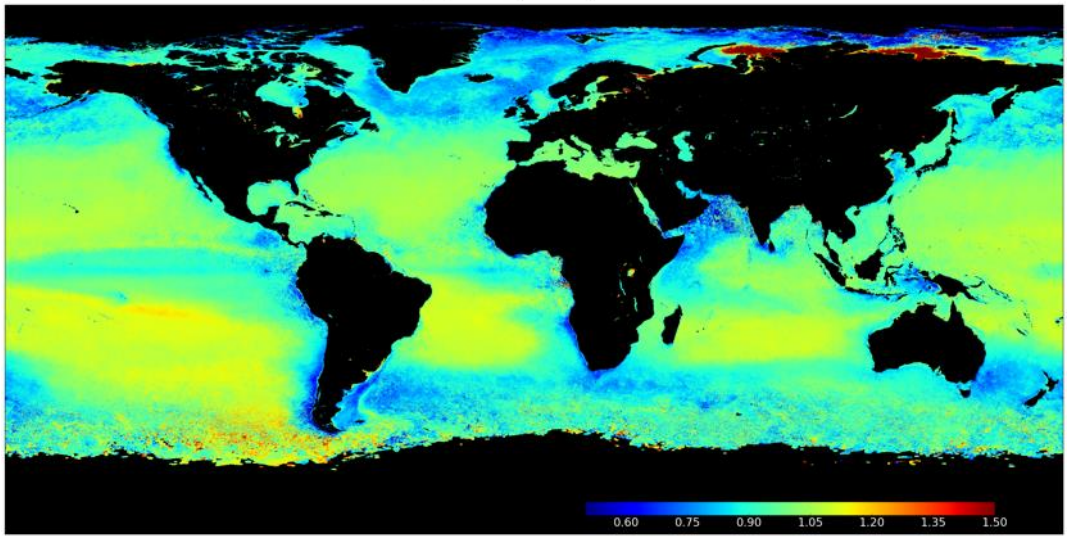
Inter-sensor bias maps: A-MODIS

Rrs_443, AS, 220



Version 3.1
A-MODIS/SeaWiFS
Different atmospheric corrections

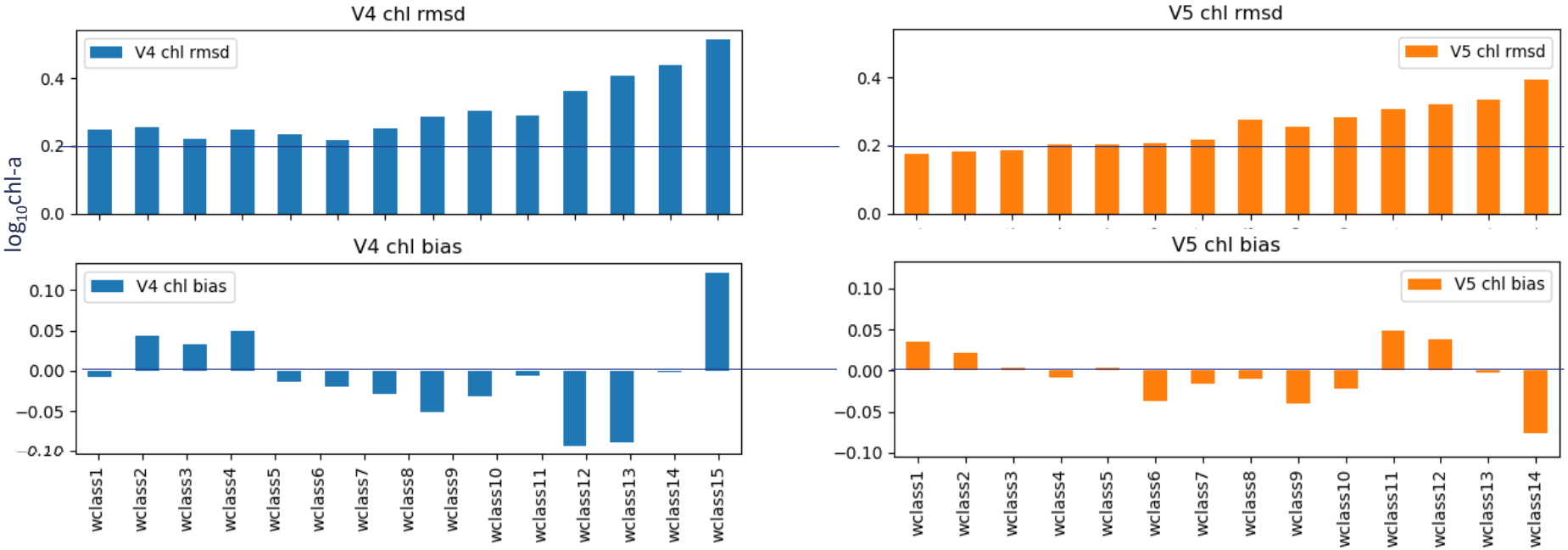
Rrs_443, AM, 220



Version 5
A-MODIS/MERIS
common atmospheric corrections

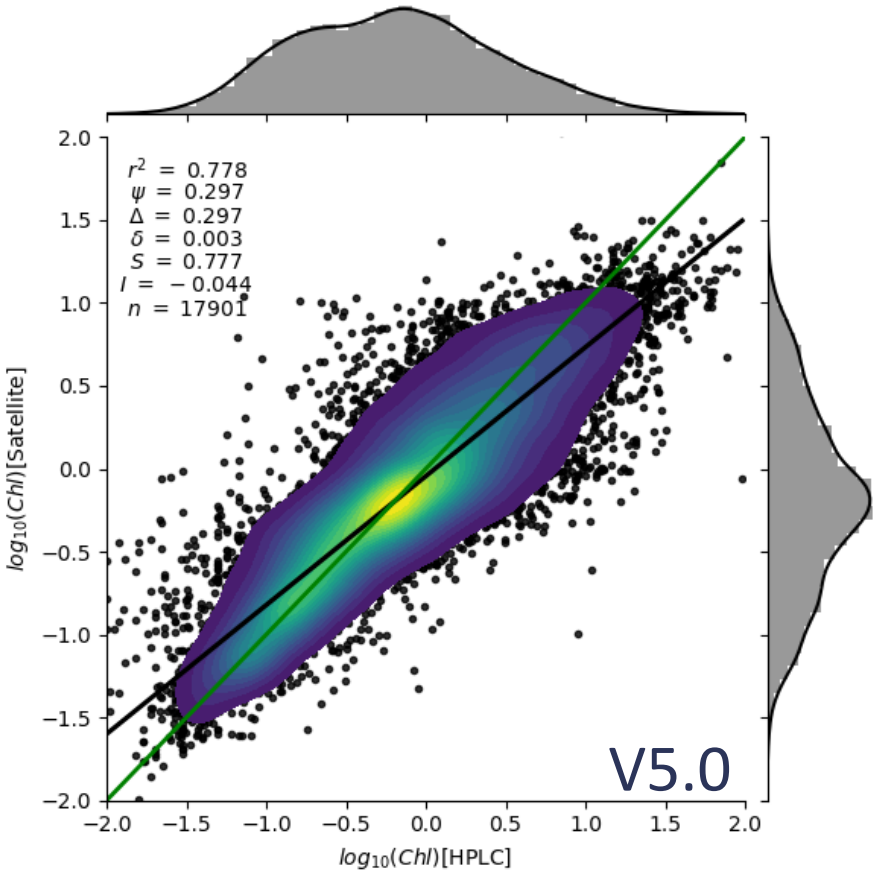
Results: Uncertainty characteristics of v5

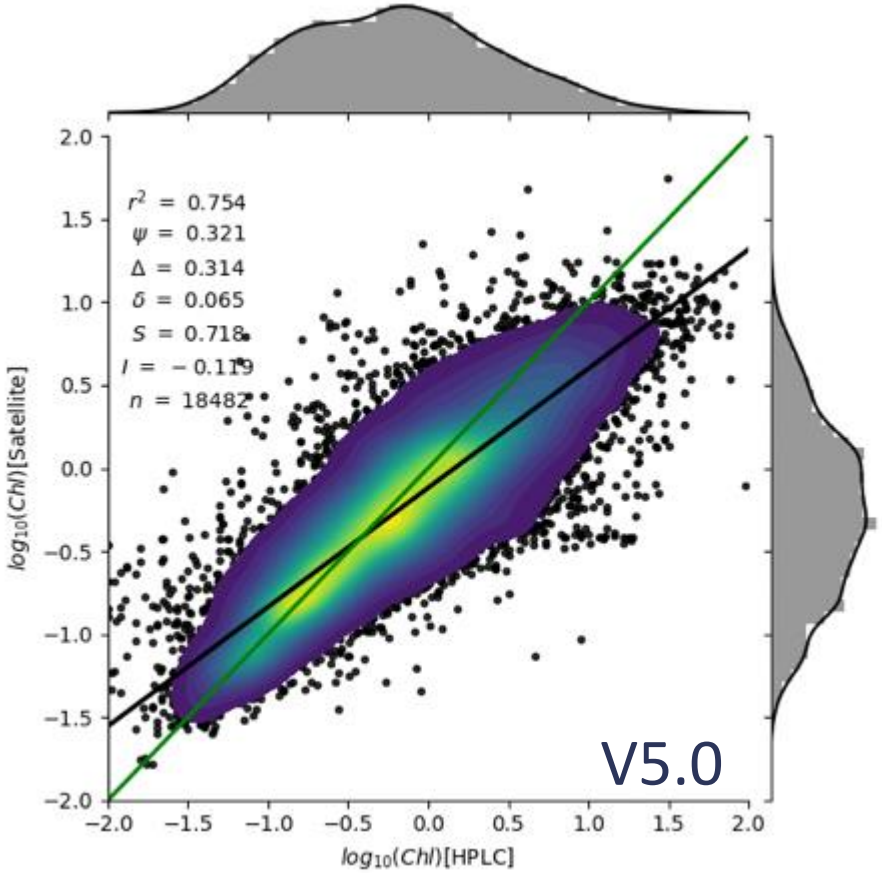
- Uncertainties computed per water class
- V5 generally has lower chl-a rmsd
- V5 generally has lower chl-a bias



Uncertainty characteristics of v5

- Plot of V5 and V4.2 chl-a vs in situ chl-a -Stats better in V5



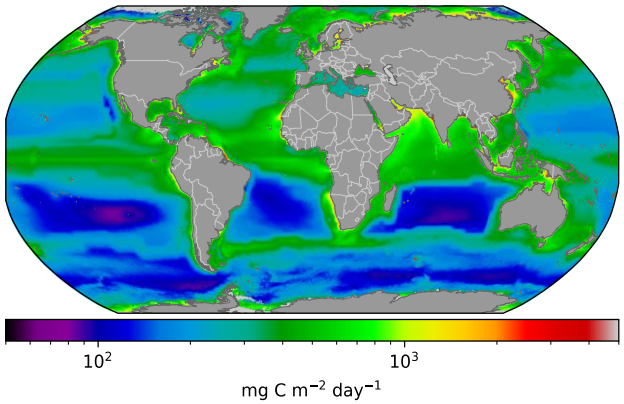


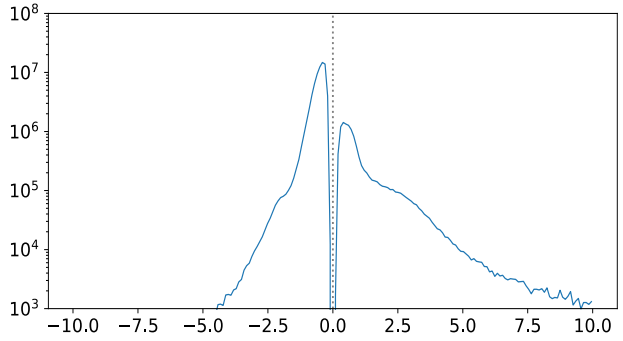
Results: global uncertainty characteristics of v5

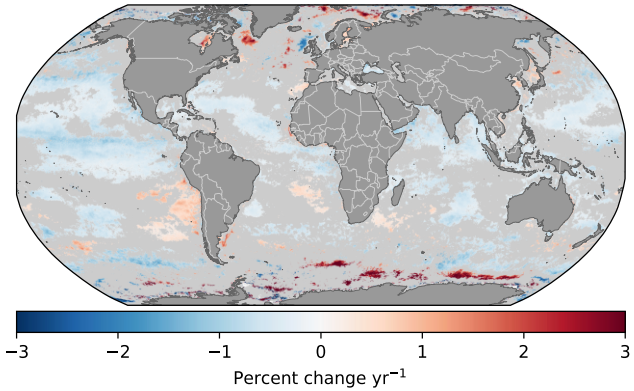
- 15 June 2016

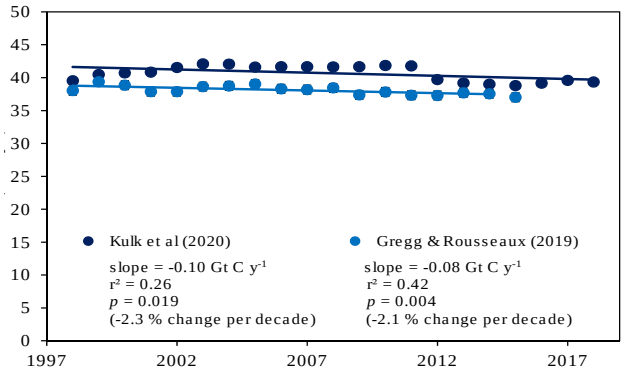
Version	Metric	N pixels	mean	median	Std dev
V4	$\log_{10}$RMSD	2,409,323	0.26	0.25	0.04
V5	$\log_{10}$RMSD	3,273,359	0.23	0.21	0.05
V4	$\log_{10}$BIAS	2,409,323	-0.0014	-0.0029	0.04
V5	$\log_{10}$BIAS	3,273,359	-0.012	-0.017	0.02

Some Applications: Marine Primary Production from OC-CCI





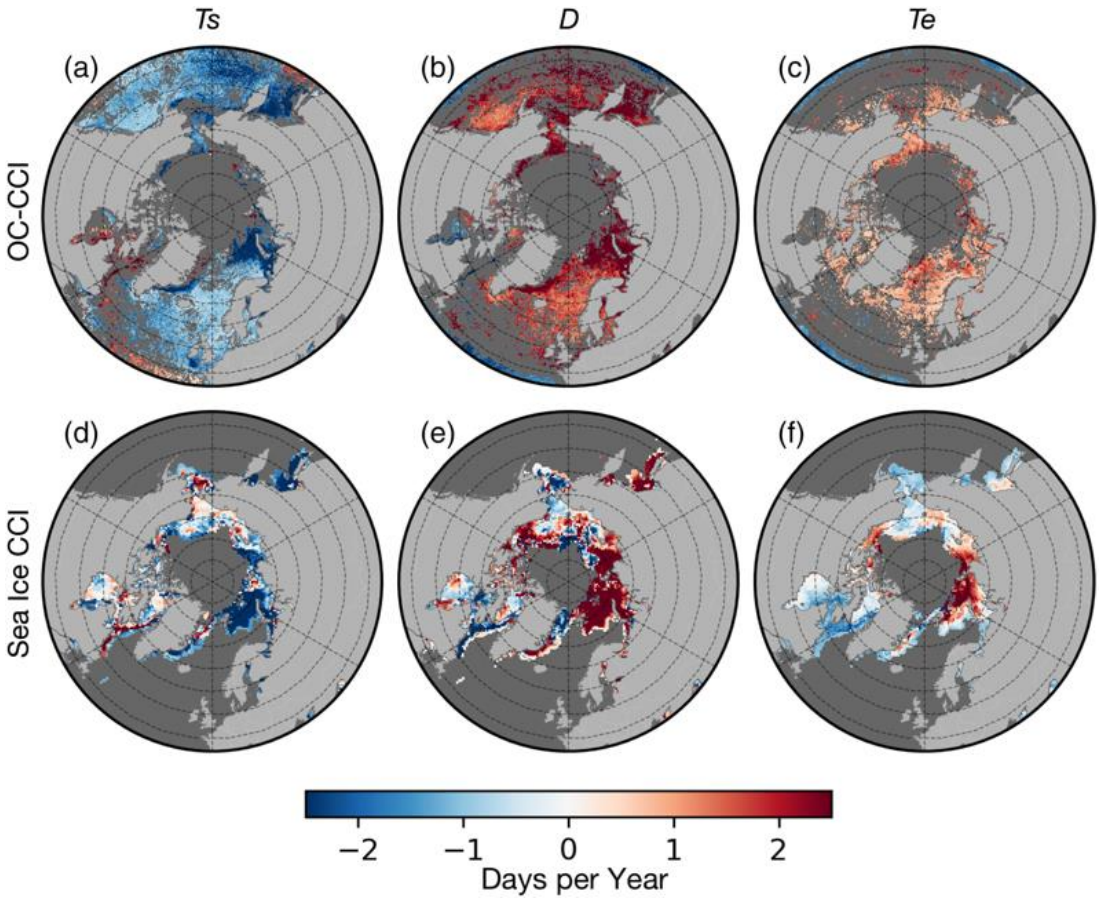




Interannual variations appear to be linked to inter-annual climate variability. Length of time series too short to discern trends associated with climate change, at the global scale.

Kulk et al. 2020
https://doi.org/10.3390/rs12050826

Some Applications:
Trends in Winter Light Environment Over the Arctic Ocean



OC-CCI data show that winter conditions in high latitudes (seasonal ice cover + persistent cloud cover) are changing.

Cloud-free and ice-free conditions are starting earlier in the year (T_s) and and ending (T_e) later in the year.

The difference (T_e-T_s), a measure of duration of light conditions favourable for phytoplankton growth, is increasing.

Results compared with Sea Ice cover (Sea Ice CCI).

Jönsson et al. 2020 (ESA BICEP Project, Simons Project)

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020GL089037

Future

- Ocean Colour record is now 23 years contiguous
  - Maybe possible to differentiate climate change signals within 5-10 years?

- OC CCI data are researched in ESA CCI but produced in the Copernicus Climate Change Service (CCCS)

- OC-CCI also contributes to Copernicus Marine Environmental Monitoring Service (CMEMS)