

ESA's role in providing evidence of a changing climate, including CCI's achievements

10th ESA Climate Change Initiative (CCI) colocation meeting
9 September 2020

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Director of Earth Observation Programmes

ESA EO Vision:



Taking the Pulse of our Planet

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European Space Agency

ESA Climate Change Initiative



climate modelling
user group
cci



climate change initiative

Oceanic



sea level
budget closure

Terrestrial



reccap-2

Atmospheric

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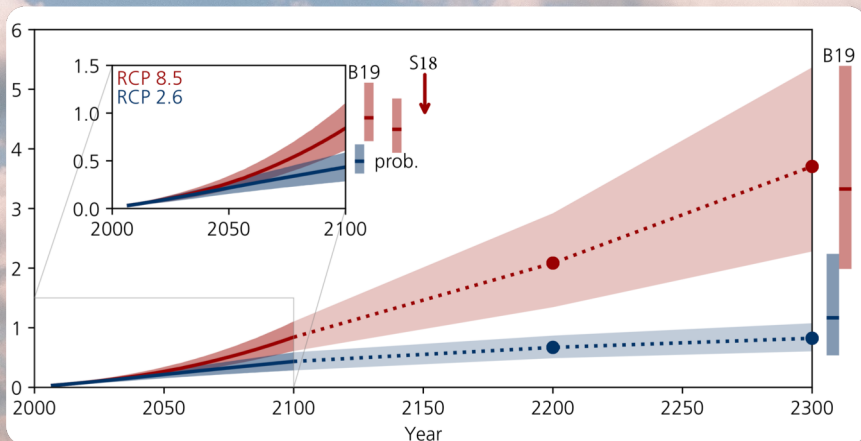


European Space Agency

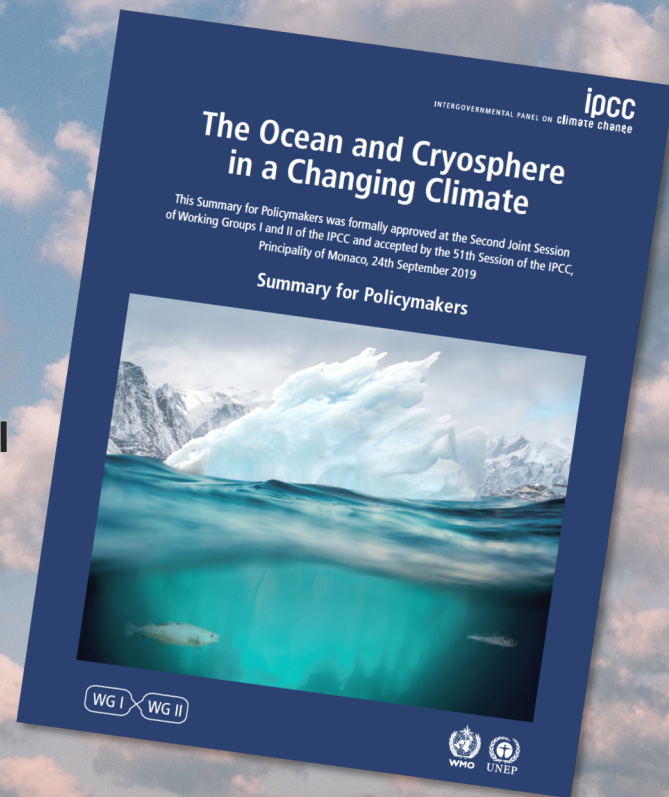
IPCC Special Report: Oceans & Cryosphere

“The best available scientific knowledge to empower governments and communities”

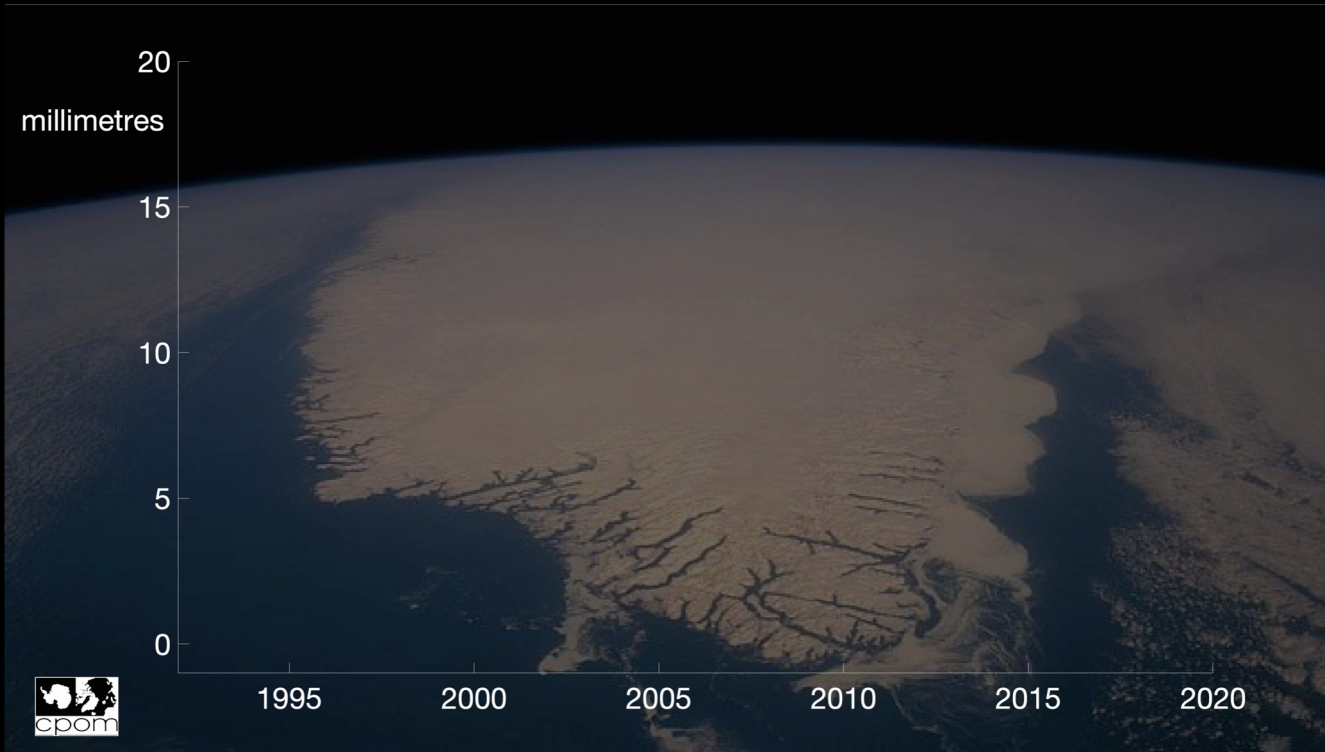
- ca. 50 ESA CCI papers cited
- 5 CCI scientists contributing directly to the report
- Results from Sea Level, Sea Level Budget Closure, Ocean Colour, Glaciers & Ice Sheet projects



Projected Sea Level Rise until 2300



Ice Sheets: ice loss six times faster than expected



Greenland and Antarctica are losing ice six times faster than in the 1990s.

Polar ice sheets are now responsible for a third of all sea level rise.

Losses are currently on track with the IPCC's worst-case climate warming scenario.

Mass balance of the Greenland Ice Sheet from 1992 to 2018 (2019) Nature doi:10.1038/s41586-019-1855-2
Mass balance of the Antarctic Ice Sheet from 1992 to 2017 (2020) Nature doi:10.1038/s41586-018-0179-y

Utilising data from 11 satellites including ESA's ERS-1, ERS-2, Envisat and CryoSat, Sentinel-1 and Sentinel-2

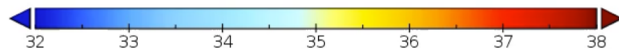
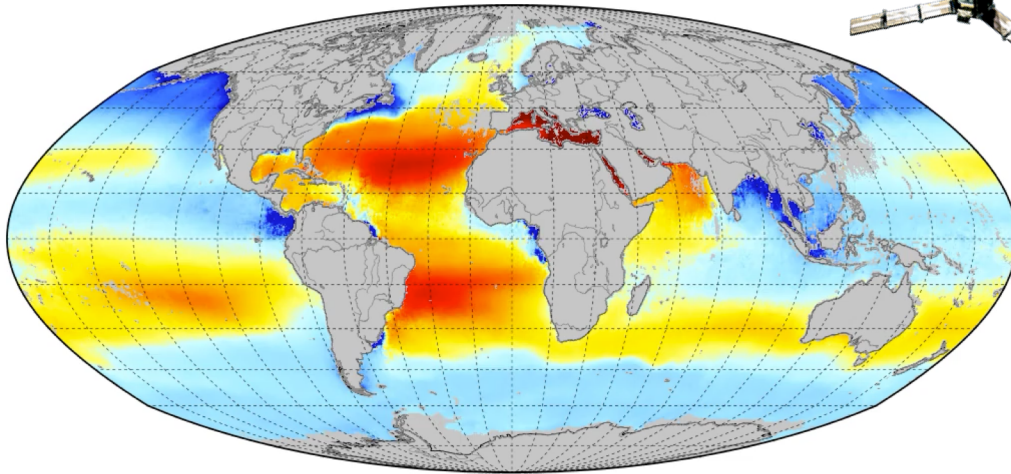
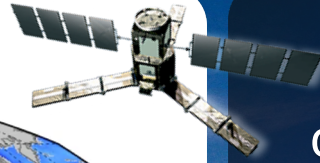
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Sea Surface Salinity: essential for ocean modeling

ESA's Soil Moisture & Salinity SMOS satellite

Merged Sea Surface Salinity - 2010-01-01
CCI+ Monthly SSS ECV Year 1



A key driver of ocean circulation, the water cycle and climate.

ESA/NASA collaboration

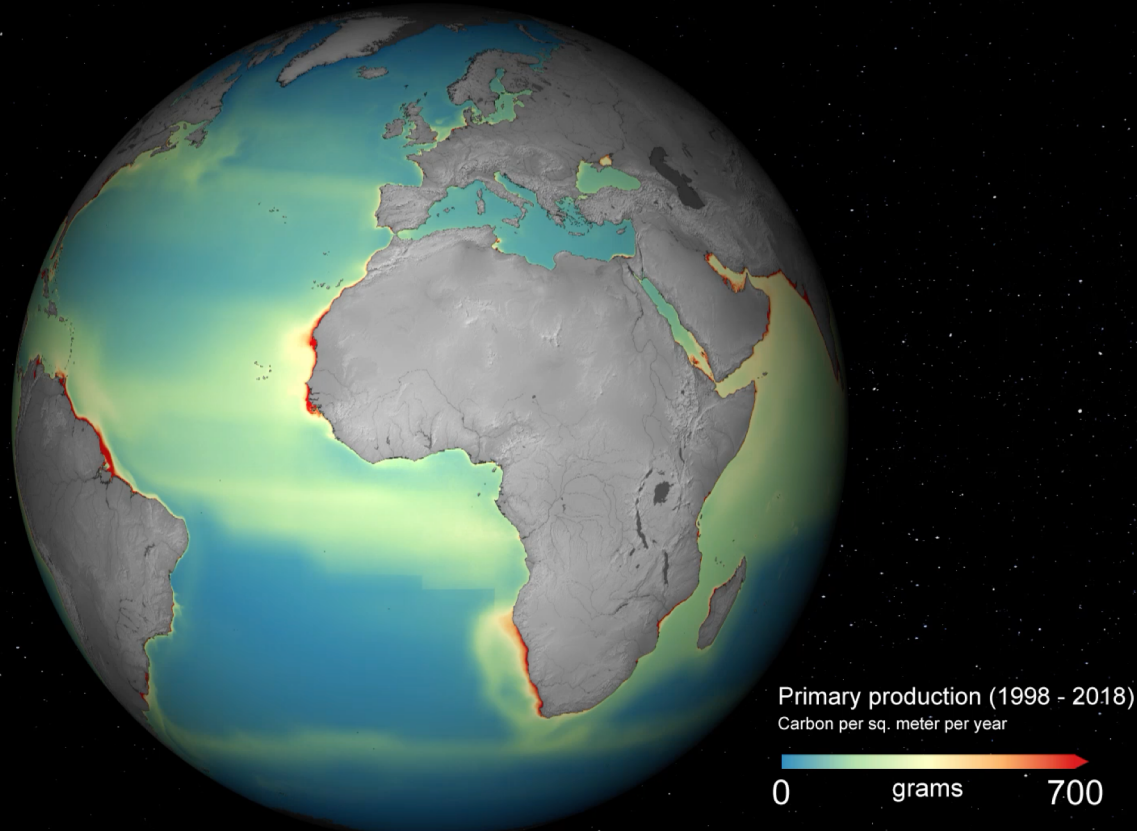
Merging SMOS, Aquarius & SMAP satellites has led to the first global view of salinity

ESA's Soil Moisture & Salinity (SMOS) satellite 2010 to the The first satellite Sea Surface Salinity (SSS) maps produced by the ESA climate Change Initiative combines SMOS, AQUARIUS & SMAP SSS - Boutin, J. et al. (2019)
<http://dx.doi.org/10.5285/9ef0ebf847564c2eabe62cac4899ec41>

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Tracking the ocean's living carbon pump



A biological climate indicator for the oceans.

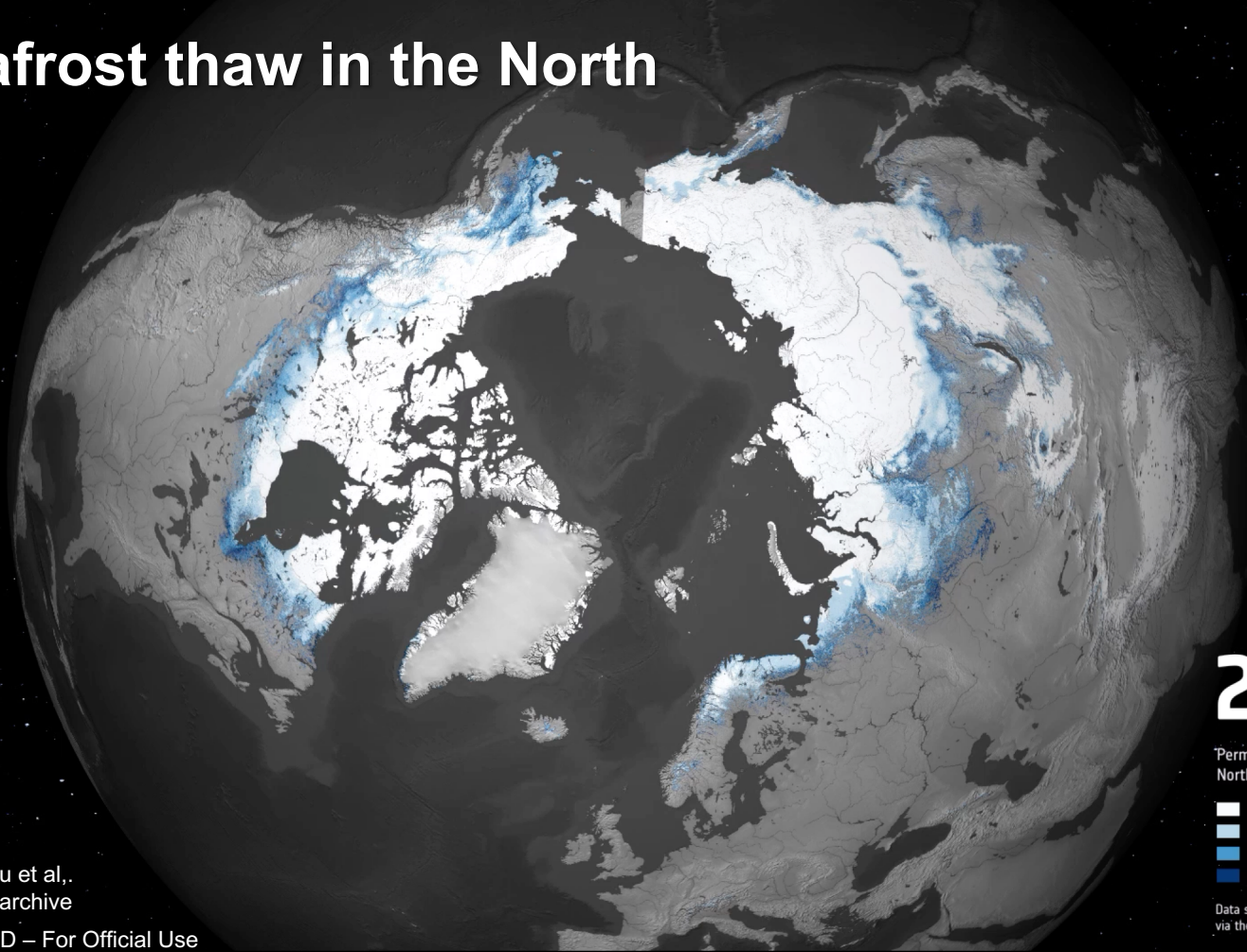
Global primary production varied between 38 and 42 gigatonnes C per year between 1998-2018.

Productivity is influenced by El Nino, Indian Ocean Dipole & the North Atlantic Oscillation

Kulk, G et al. (2020). Primary Production, an Index of Climate Change in the Ocean: Satellite-Based Estimates over Two Decades. Remote Sensing. 12. 826. 10.3390/rs12050826.
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Permafrost thaw in the North



2003

Permafrost extent for the Northern Hemisphere

- Continuous
- Discontinuous
- Sporadic
- Isolated

Data source: Permafrost CCI, Obu et al., 2019 via the CEDA archive

Permafrost CCI, Obu et al., 2019 via the CEDA archive

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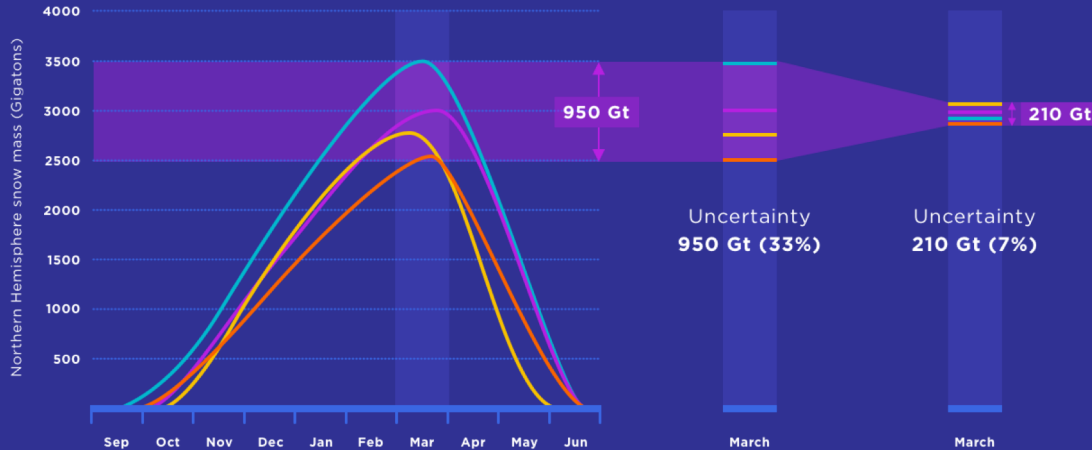
European Space Agency

Reliable NH snow mass estimate



REDUCTION OF UNCERTAINTY IN NH SEASONAL SNOW MASS

Observation data: Merra2 Crocusv7 GlobSnow Brown



A first reliable estimate of NH snow mass change using 1980-2018 snow mass record.

Uncertainty reduced from 33% to 7.4%

Enabled continental trends to investigate with N. America snow mass decreasing by 46Gt per decade

Pulliainen, J., Luojus, K., Derksen, C. *et al.* Patterns and trends of Northern Hemisphere snow mass from 1980 to 2018. *Nature* **581**, 294–298 (2020). <https://doi.org/10.1038/s41586-020-2258-0>

Space19+ Outcomes for Earth Observation

Programme	Proposed (M€)	Subscribed (M€)	Subscription Rate
FutureEO	650	553	85%
CSC-4	1402	1811	129%
EW-ALTIUS phE	55	55	99%
EW-InCubed+	150	61	41%
EW-GDA	50	30	60%
EW-TRUTHS	32	32	101%
EW-AW	42	42	100%
Proba-V Exploitation	13	13	97%
<i>Seosat</i>	-	11.4	-
<i>CCI+</i>	-	0.7	-
TOTAL	2394	2610	109%

Earth Explorer FORUM is key for Climate Science



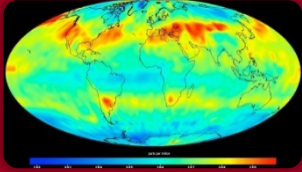
By measuring radiation emitted by Earth into space, FORUM will provide new insight into the planet's radiation budget and how it is controlled

Launch planned for 2025



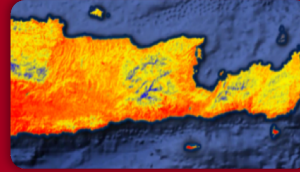
New Copernicus missions

CO2M - Anthropogenic CO₂ Monitoring



Identify sources of greenhouse gases

LST – Land Surface Temperature Mission



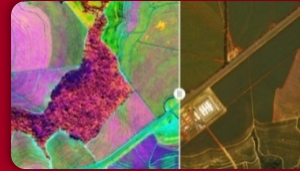
Agriculture & Water Productivity

CRISTAL – Polar Ice & Snow Topography



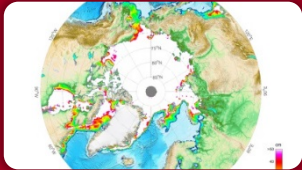
Effects of Climate Change

CHIME – Hyperspectral Imaging Mission



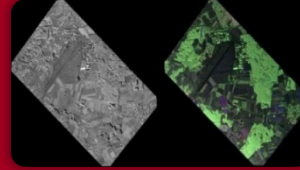
Food Security, Soil, Minerals, Biodiversity

CIMR – Passive Microwave Radiometer



Sea: Surface Temp. & Ice Concentration

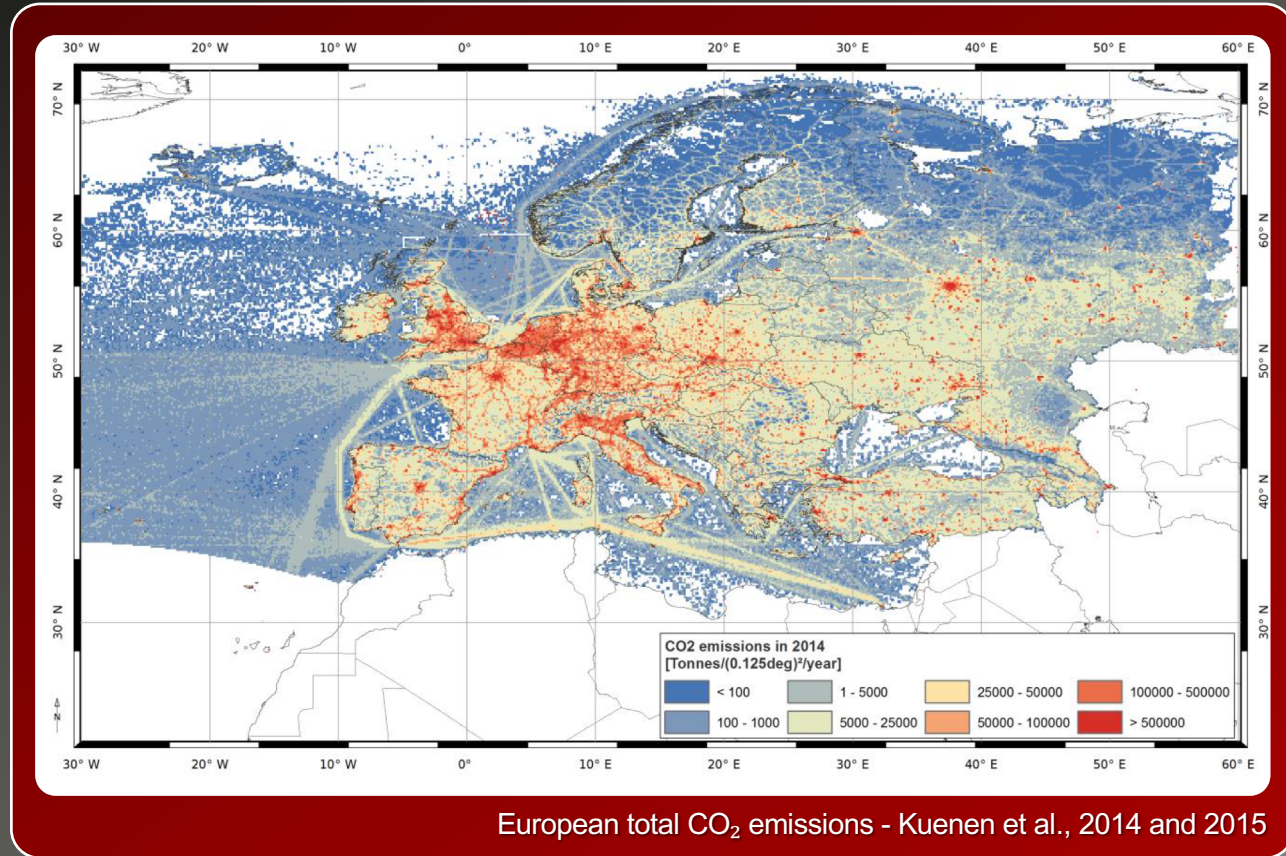
ROSE-L – L-band SAR Mission



Vegetation & Ground Motion & Moisture

Anthropogenic CO₂ Monitoring Mission (CO2M)

- Analyse man-made CO₂ emissions and overall CO₂ budget
- Assess the effectiveness of the relevant COP21 decisions
- Through the use of CO₂ satellite imagers
- At country and regional/megacity scales



Digital Twin Earth

Observations

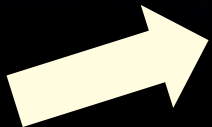
- Public
- Commercial
- NewSpace



AI



Earth System
Science



Scientific knowledge

Predictions

Simulations

Intelligent solutions

Thanks for your attention!

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