



Climate
Change

Actionable data for climate change communication: beyond temperature

Carlo Buontempo & Julien Nicolas

**International Weather Forum: media workshop on climate
21/06/2022**



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C3S in numbers



C3S is presented as an **exemplar of climate service in IPCC AR6 WG1** report where **ERA5 is mentioned over 240 times**.

119 Datasets | **22** public applications
~140.000 data users

92.3 TB /day **500k** Daily requests

Paper by Hans Hersbach et al. about ERA5 published in 2020 and as of March 1st had **2445 citations** (3230 according to Google Scholar)

Quarterly Journal of the Royal Meteorological Society



RESEARCH ARTICLE [Open Access](#)

The ERA5 global reanalysis

Hans Hersbach , Bill Bell, Paul Bernhofer, Shoji Hirahara, András Horányi, Joaquín Muñoz-Sabater, Julien Nicolas, Carole Peubey, Raluca Radu, Dinand Schepers, Adrian Simmons ... [See all authors](#) →

First published: 17 May 2020 | <https://doi.org/10.1002/qj.3803> | Citations: 2,445

Funding Information: European Union through the Copernicus Climate Change Service



Broadcast in 9 languages, in year, C3S content - was seen 157 million times in Europe via the Euronews Climate Now show.

And C3S maps and data have been seen by 225m people around the world via CNN's climate updates.



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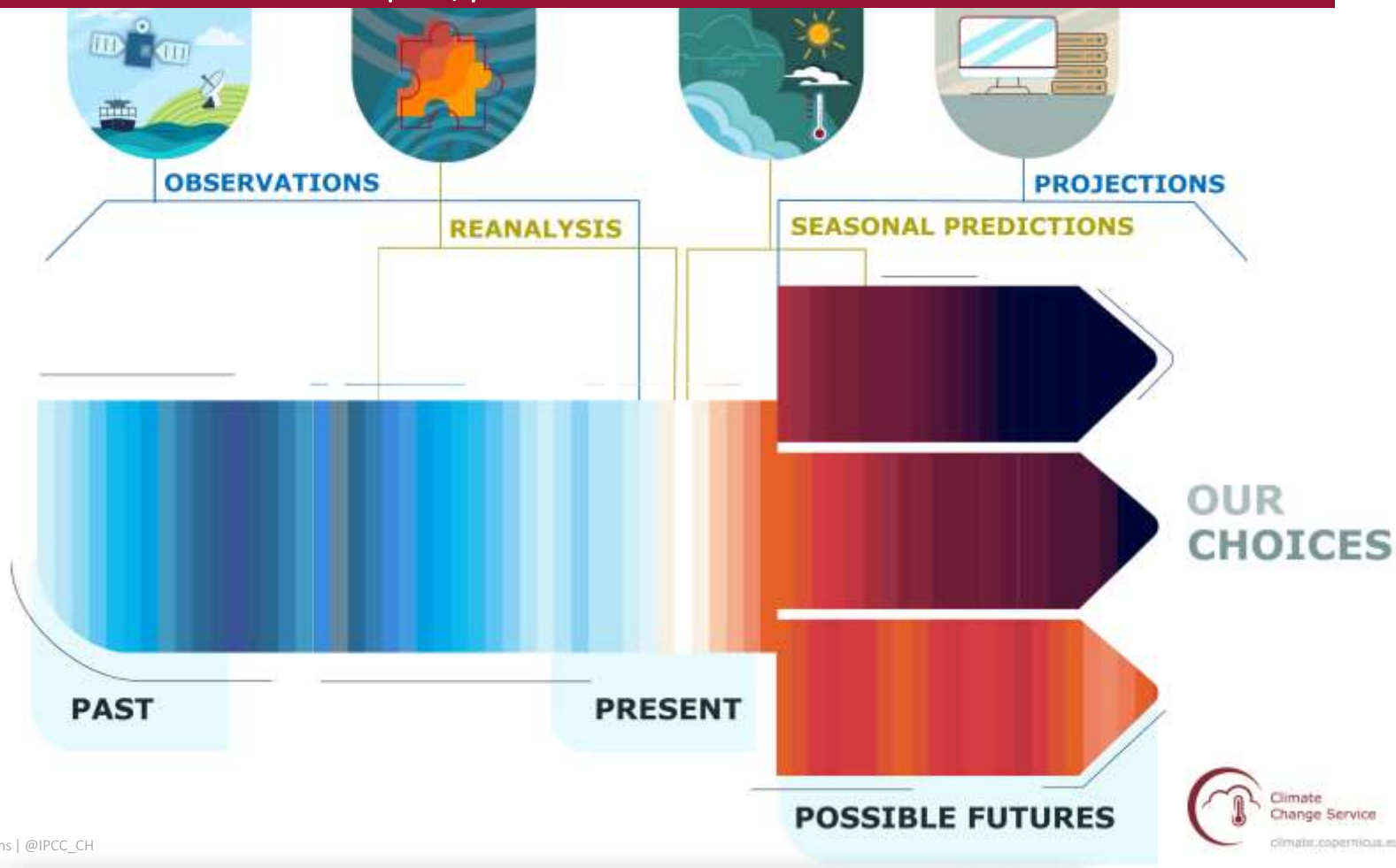


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Smart data for smart decisions: past, present and future.





Essential Climate Variables

CRYOSPHERE



Snow



Ice Sheets
and Ice Shelves



Glaciers



Permafrost

SURFACE OCEAN PHYSICS



Surface
Currents



Surface
Stress



Sea Surface
Temperature



Sea Ice



Ocean Surface
Heat Flux



Sea Level



Sea Surface
Salinity



Sea State

SUBSURFACE OCEAN PHYSICS



Subsurface
Temperature



Subsurface
Currents



Subsurface
Salinity

OCEAN BIOLOGY / ECOSYSTEMS



Plankton



Marine
Habitats

OCEAN BIOGEOCHEMISTRY



Ocean Colour



Transient
Tracers



Inorganic
Carbon



Oxygen



Nitrous Oxide



Nutrients

COP1

□ = satellite ECVs

□ = ECVs from reanalysis

SURFACE ATMOSPHERE



Surface
Radiation
Budget



Surface
Pressure



Surface
Temperature



Surface
Water
Vapour



Surface Wind
Speed and
Direction



Precipitation

UPPER-AIR ATMOSPHERE



Upper-air
Temperature



Upper-air
Water
Vapour



Upper-air
Wind Speed
and Direction



Lightning



Earth Radiation
Budget



Clouds

ATMOSPHERIC COMPOSITION



Precursors
for Aerosols
and Ozone



Aerosols



CO₂, CH₄,
and other
GHGs



Ozone

HYDROSPHERE



Soil Moisture



Lakes



Groundwater



River
Discharge



Evaporation
from Land

ANTHROPOSPHERE



Anthropogenic
Water Use



Anthropogenic
Greenhouse Gas Fluxes

BIOSPHERE



Soil Carbon



Albedo



Fire



FAPAR¹



Leaf Area
Index (LAI)



Land Surface
Temperature



Above-ground
Biomass



Land
Cover



Climate
Change Service

climate.copernicus.eu

¹ Fraction of Absorbed Photosynthetically Active Radiation



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Applications

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Tropospheric humidity profiles averaged monthly and zonally from 2006 to present derived from satellite observations

[Overview](#)
[Download data](#)
[Quality assessment](#)
[Documentation](#)
[View](#)

This application depicts the latitude-height distribution of humidity and its variability in the lowest 12 kilometers of Earth's atmosphere. The variability is quantified by the standard deviation of the humidity within 5° latitude bands. All data is taken from the [Tropospheric humidity profiles averaged monthly and zonally from 2006 to present derived from satellite observations](#) dataset.

Users can select the time period to display data from and are given the option to download the displayed data.

Year
2021

Month
January

Tropospheric humidity
January 2021
Zonal monthly mean

Tropospheric humidity
January 2021
Zonal monthly standard deviation

Zonal monthly mean latitude-height distribution of specific humidity (left panel) and the corresponding variability (right panel).

Data Description

Zonal tropospheric humidity profiles from 2006 to present derived from satellite observations

Property	Description
Data type	Dataset
Accession number	Climate Change Service

Contact

[ECMWF Support Portal](#)

Licence

[EUROPEAN COMMISSION](#)

Publication date

2021-01-01

Resource updated

2022-04-01

References

[Citation](#)

DOI: [10.34886/ea/612130](#)

Related data

[Cloud properties, global gridded monthly and daily data from 1982 to present derived from satellite observations](#)

[Monthly and 6-hourly total column water vapour over ocean from 1988 to 2020 derived from satellite observations](#)

[Monthly total column water vapour over land and ocean from 2002 to 2012 derived from satellite observations](#)

[Temperature and precipitation gridded data for global and regional domains derived from re-obs and satellite observations](#)

[Upper tropospheric humidity gridded data from 1999 to present derived from satellite observations](#)

Related applications



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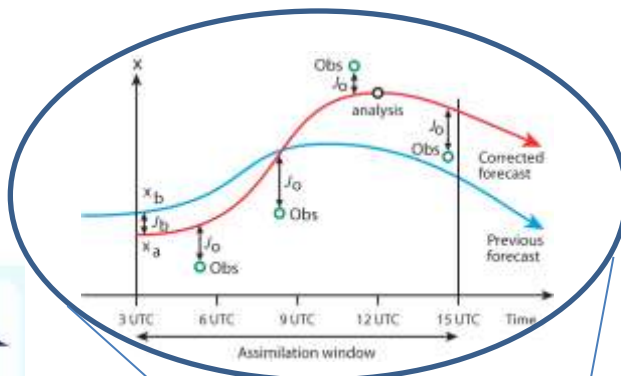


Reanalysis: a key tool and a popular product

MODELING

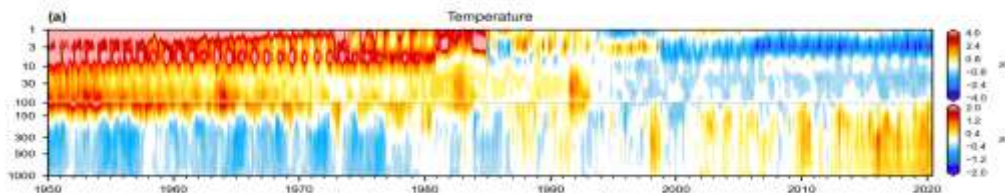
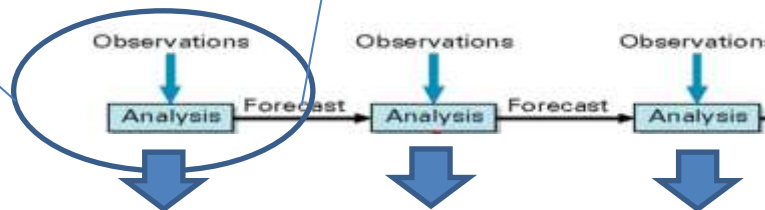


OBSERVATIONS



Data assimilation & reanalysis

Combining information from observations and models to provide an estimate of weather and climate over multi-decadal timescales



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Reconstructing the weather of the past



Image @NASA | Apollo



Image ECMWF @Philippe Lopez

<https://www.ecmwf.int/en/about/media-centre/science-blog/2019/ecmwf-over-moon>

NASA Apollo 17 image of the Earth taken on 7 December 1972 at 10h39 UTC (left) and the corresponding pseudo-image generated from an 11-hour 9-km resolution ECMWF forecast initialised from ERA5 reanalysis (right).

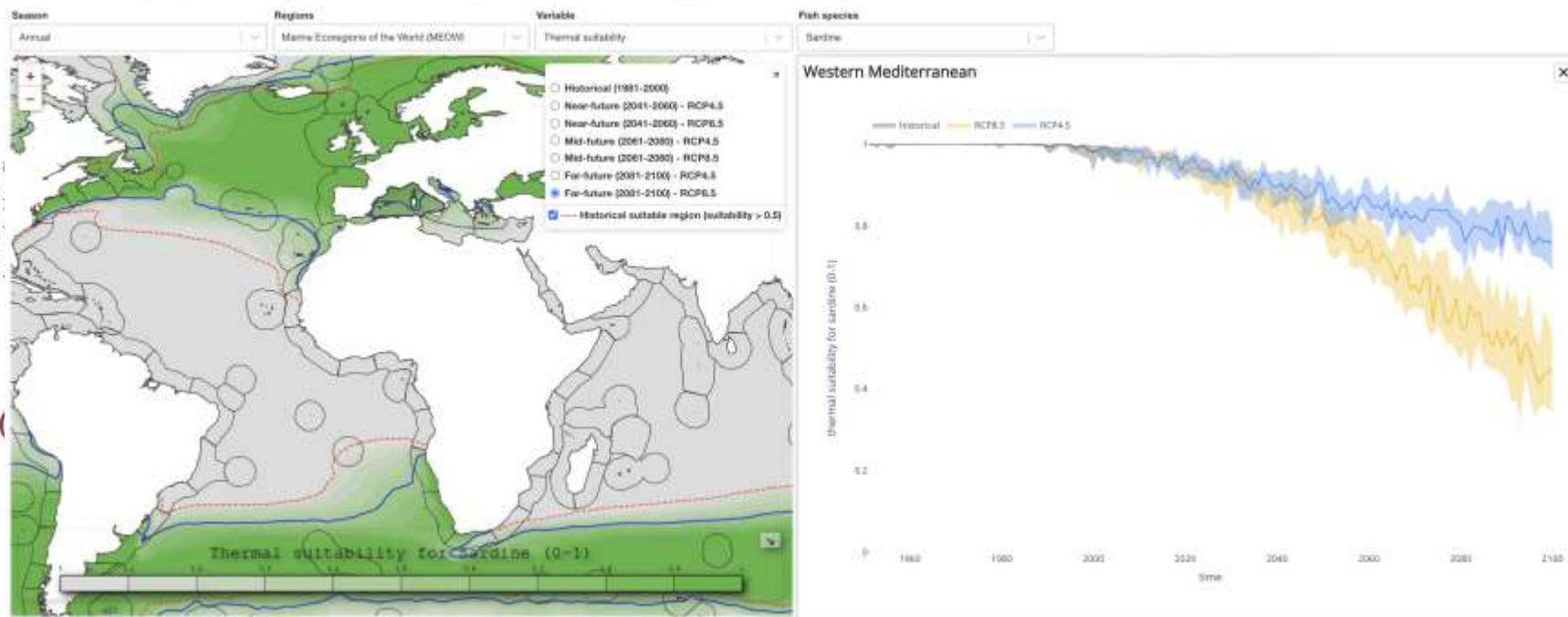




What lies ahead

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You can use the interactive map to explore **thermal suitability for sardine** under various climate change scenarios and time horizons, then select a region to discover more detailed projections.



Note: The blue line in the map is drawn at the threshold where the thermal suitability equals 0.5 to create a representative cut-off point between suitable and unsuitable regions. You can compare this blue line with the equivalent region for the historical period (not dotted line).



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European State of the Climate 2021 – 5th edition of annual report



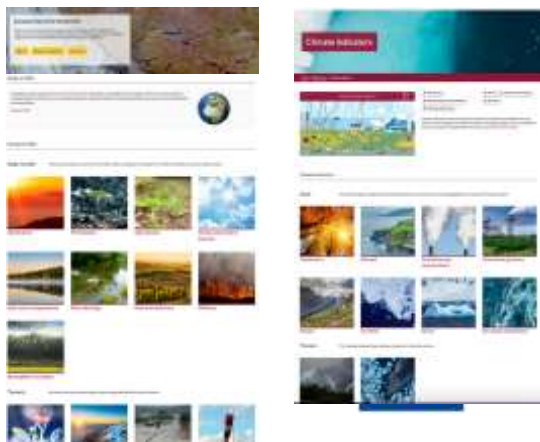
Editorial Team

Francesca Guglielmo, David Lavers, Julien Nicolas, Freja Vamborg (ECMWF)

Contributing authors across C3S and beyond

Science writers

Communications team + agencies



- <https://climate.copernicus.eu/esotc/2021>
- <https://climate.copernicus.eu/climate-indicators>

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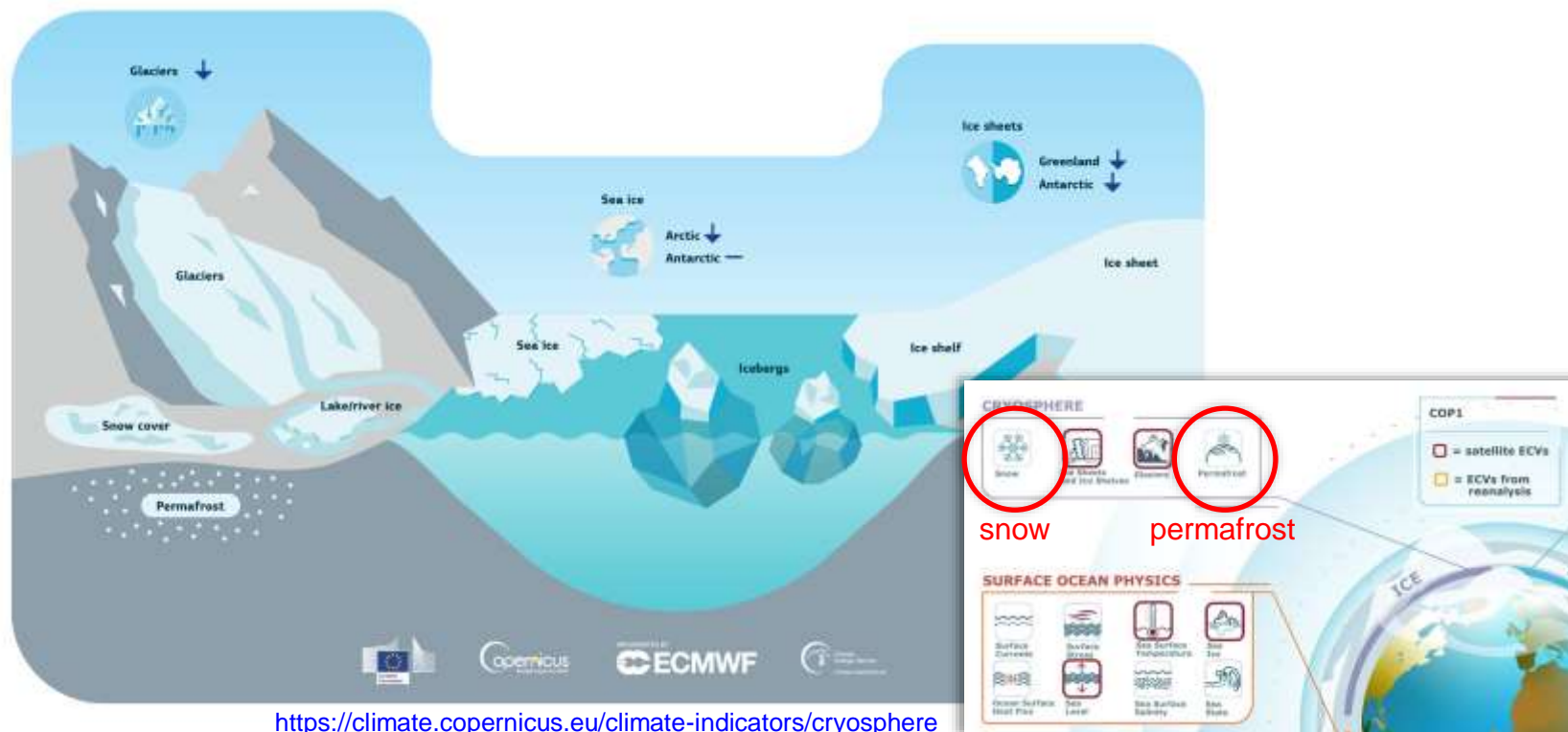
Climate monitoring





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Climate stories: Example of the Cryosphere



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C3S monitoring of the Cryosphere



Arctic in 2021



Temperature



Wildfires



Sea ice



Low sea ice extent
in the Greenland

Climate indicators



Glaciers



Ice sheets



Sea ice



Cryosphere

Monthly summaries



Surface air
temperature

This series of monthly maps and charts, generated from ERA5 data, covers global and European surface air temperatures.



Sea ice

We produce sea ice maps every month, based on ERA5 reanalysis data, these provide near real time monitoring of the polar ice caps.



Hydrological variables

This series of monthly maps and charts, based on ERA5 data, covers several variables: precipitation, humidity, and soil moisture for Europe and the extra-tropical regions.

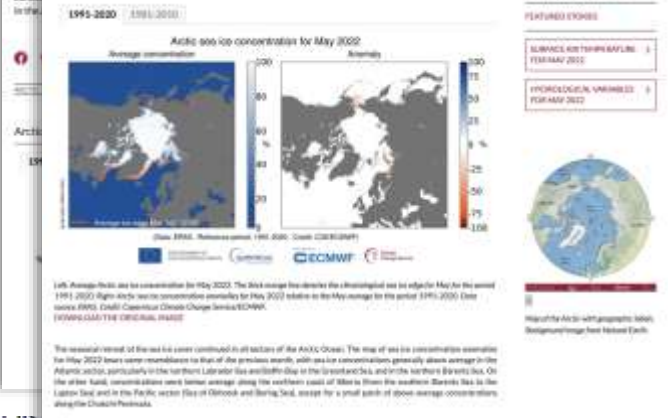


Surface in-situ
monitoring for Europe

Monthly and yearly State-of-the-Europe climate reports provided by C3S partners

Sea ice cover for May 2022

Antarctic sea ice extent for May was 8% below the 1991-2020 average, marking 6th lowest in the 44-year satellite record. Annual Antarctic sea ice concentration anomalies were most below average in the Bellingshausen and Amundsen Seas, in contrast to above average in the Ross Sea.



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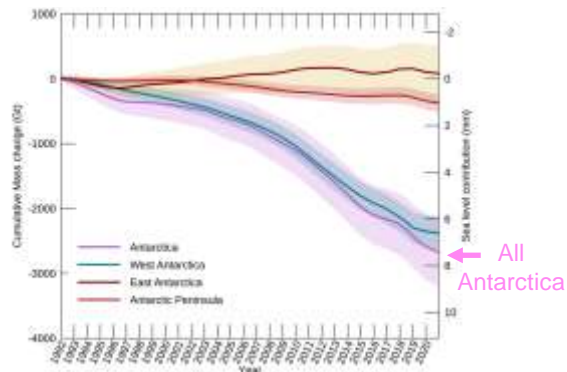
European
eyes on Earth



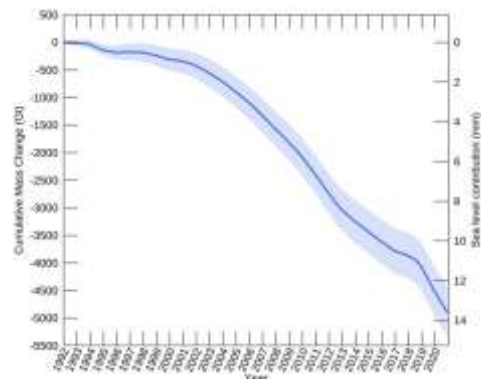
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Land ice changes and their contribution to sea level rise

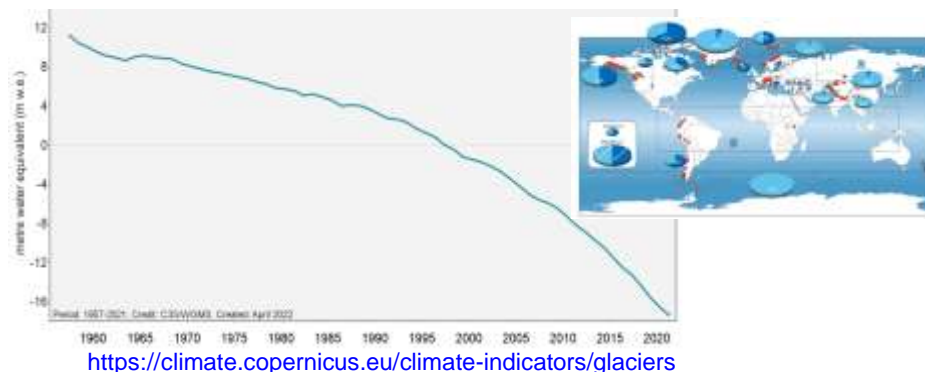
Mass balance of the **Antarctic** Ice Sheet



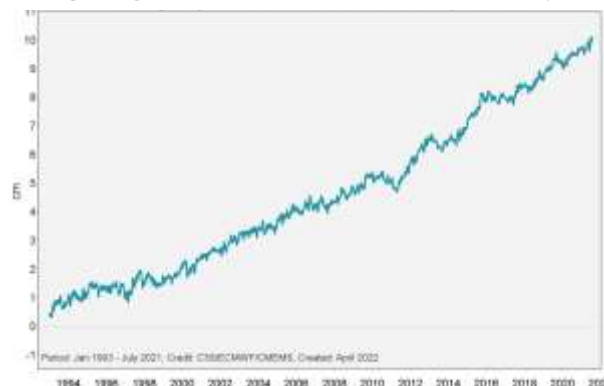
Mass balance of the **Greenland** Ice Sheet



Cumulative **glacier** mass balance relative to 1957



Change in **global mean sea level** relative to the year 1993



Data: IMBIE. Credit: IMBIE/ESA/NASA

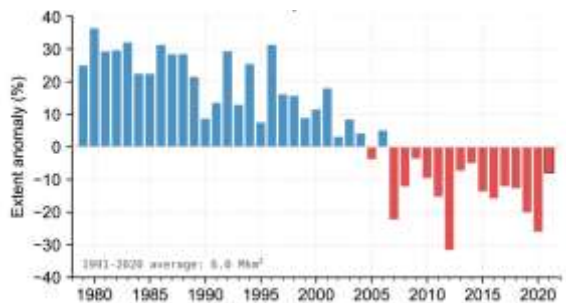
<https://climate.copernicus.eu/climate-indicators/ice-sheets>

<https://climate.copernicus.eu/climate-indicators/sea-level>



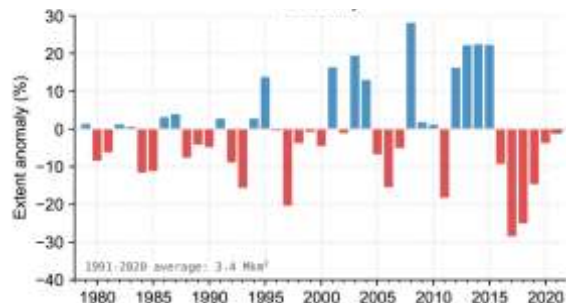
Sea ice changes: Arctic vs Antarctic

Arctic sea ice extent anomalies in September



Data: OSI SAF Sea Ice Index v2.1 • Reference period: 1991-2020 • Credit: C3S/ECMWF

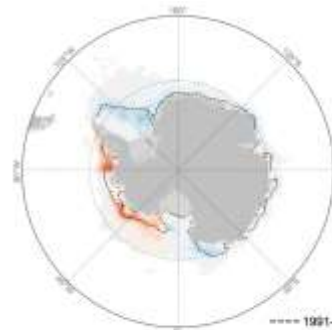
Antarctic sea ice extent anomalies in February



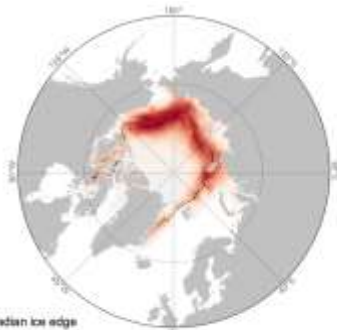
Data: OSI SAF Sea Ice Index v2.1 • Reference period: 1991-2020 • Credit: C3S/ECMWF

Sea ice concentration trends 1979-2021

Antarctic – February



Arctic – September



Data: OSI SAF Global Sea Ice Concentration CDR/CDR v2, C3S Sea Ice Edge CDR v2 • Credit: C3S/ECMWF

Covered both in our monthly sea ice summaries
and our Sea Ice Climate Indicator

<https://climate.copernicus.eu/climate-indicators/sea-ice>
<https://climate.copernicus.eu/sea-ice>

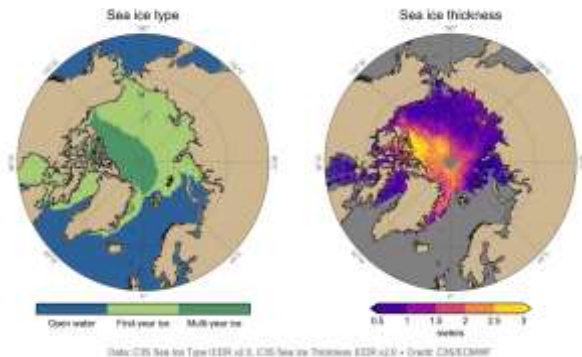




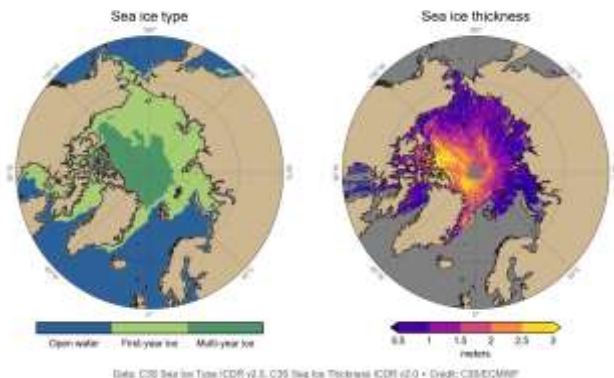
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Sea ice: Beyond sea ice extent and concentration

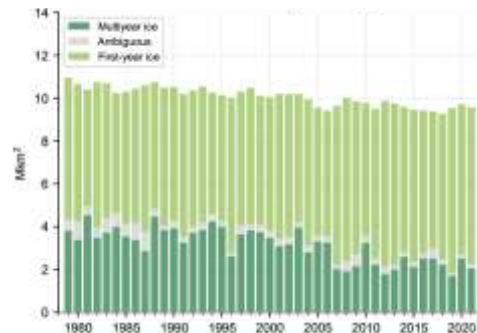
Arctic **sea ice type** and **sea ice thickness** in Dec 2020



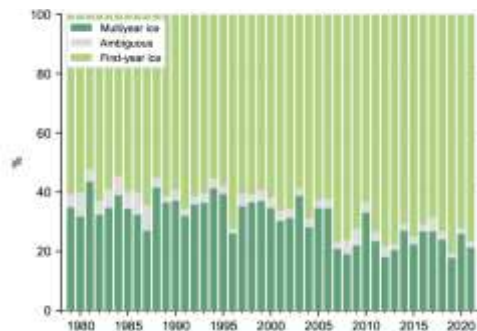
Arctic **sea ice type** and **sea ice thickness** in Dec 2021



Total sea ice area by **sea ice type** in Jan-March



Percentage of sea ice area by **sea ice type** in Jan-March



<https://climate.copernicus.eu/climate-indicators/sea-ice>



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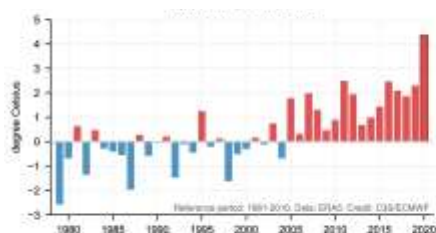
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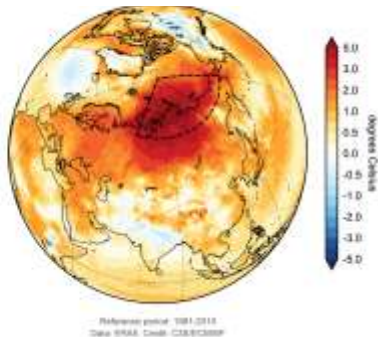
Low sea ice in the Laptev Sea in 2020

European State of the Climate in 2020 – Arctic section

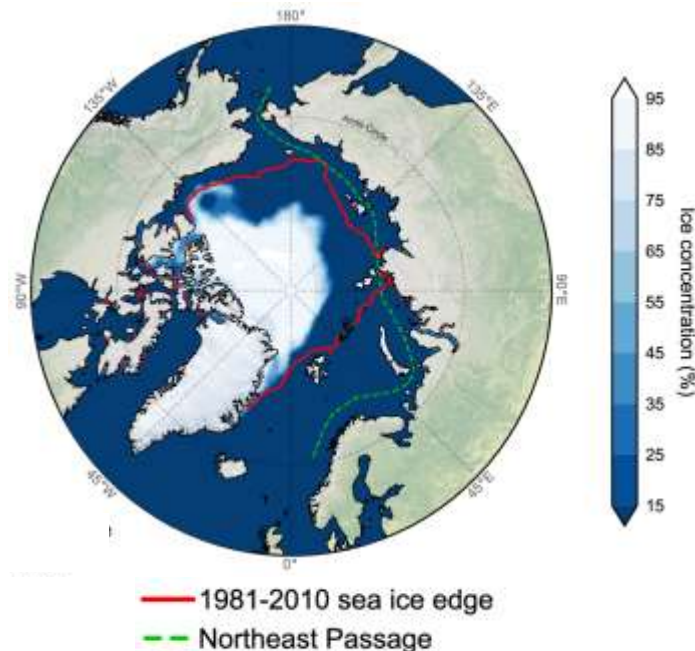
Annual surface temperature anomalies
for Arctic Siberian land



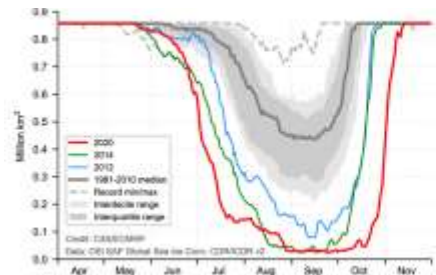
Surface temperature anomaly for 2020



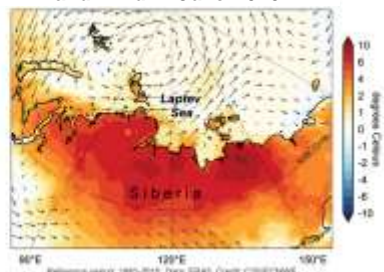
Sea ice concentration in Sept 2020



Daily sea ice extent in the Laptev Sea



Surface temperature anomaly
and wind in June 2020



<https://climate.copernicus.eu/esotc/2020/arctic-sea-ice>

Data: OSI SAF Global Sea Ice Concentration CDR/CDR v2, C3S Sea Ice Edge CDR/CDR v1





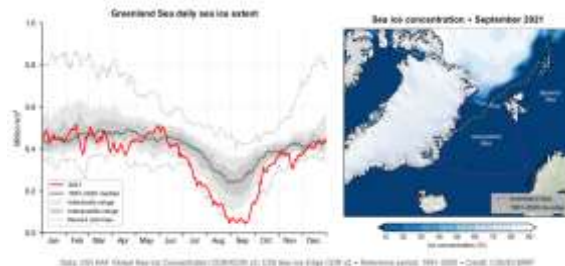
Low sea ice in the Greenland Sea in 2021

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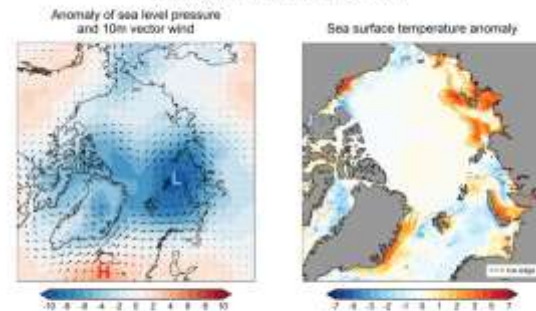
Month sea ice summary Sept 2021

European State of the Climate in 2021 – Arctic section

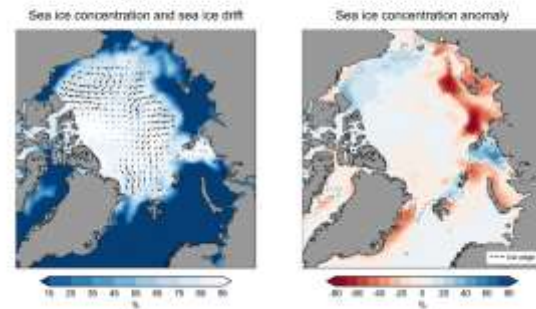
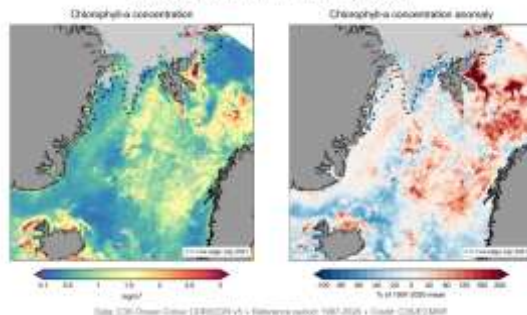
Sea ice extent in the Greenland Sea



Monthly mean fields for July 2021



Chlorophyll-a in the Greenland Sea in July 2021



The series of monthly mean sea ice extent anomalies of September months from 1979 to 2021 for two Arctic sectors: the Greenland Sea (left) and the Barents/Chukchi Sea (right). The anomalies are expressed as a percentage of the September average for each sector during 1991-2020. The grid maps outline the countries used to compute the data series. Data source: EUMETSAT OSI SAF Sea Ice Concentration (OSIAC) v2 and Sea Ice Edge (OSI-IE) v2. Credit: Copernicus Climate Change Service (C3S)/EUMETSAT.

Download the original image

One notable feature of Arctic sea ice cover in September 2021 was a record low extent in the Greenland Sea, an area also characterized by much slower ice melt and surface temperature. In contrast, on the near opposite side of the Arctic Ocean, sea ice extent in the Barents/Chukchi Sea sector reached its highest value in 35 years (since 1986). It is noteworthy that these two areas of the Arctic Ocean often - but not always - display sectoral extent anomalies of opposite signs, depending among other factors on the influence of atmospheric circulation patterns. This contrast was particularly pronounced in 2012, the year with the lowest sea ice minimum for the Arctic as a whole.

<https://climate.copernicus.eu/sea-ice-cover-september-2021>

<https://climate.copernicus.eu/esotc/2021/low-sea-ice-greenland-sea>



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Communicating about changes in the Cryosphere

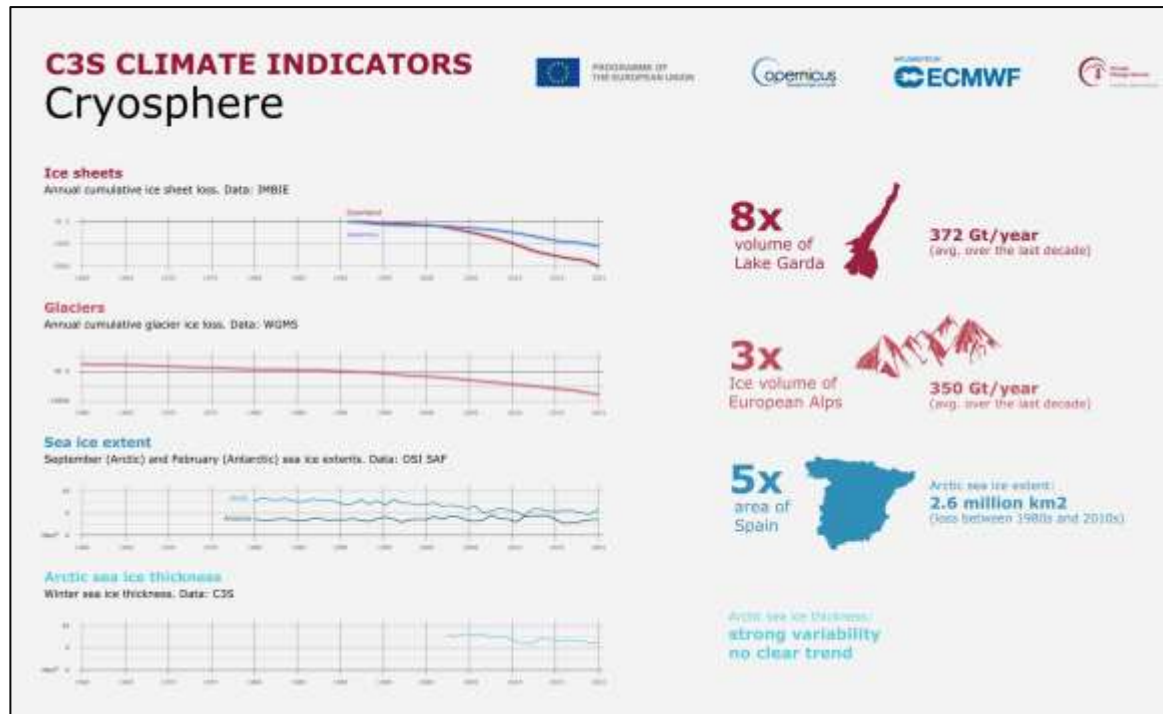
- **Opportunities**
 - Stunning landscapes
 - Can foster emotion and interest
 - Very visible changes (glaciers)
 - Connections to other components of the climate system
 - Climate change mechanisms (feedback loops)
- **Challenges**
 - Remoteness
 - Timescales of changes (short/long, seasonal/decadal)
 - Need to clarify key concepts (land/sea ice, melting)
 - Differences Arctic vs Antarctic
 - Data availability
 - Numbers hard to relate to

The Breiðamerkurjökull Glacier in Iceland. Credit: European Union, Sentinel-2 imagery





Turning climate data into meaningful numbers



Screenshots from ESA video:
<https://youtu.be/5GvMm4A7dFA>

<https://climate.copernicus.eu/climate-indicators/cryosphere>





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