The Copernicus Climate Change Service (C3S) contribution to EO activities

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[2] Met Office, Exeter, UK
[3] VITO, NV, Mol, Belgium
[4] UNVIE, Vienna, Austria
[5] DWD, Offenbach, Germany
[6] EODC, Vienna, Austria
[7] CLS, Ramonville-Saint-Agne, France
[8] CNR, IMAA, Potenza, Italy
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[10] SPASCIA, Ramonville-Saint-Agne, France
[11] EUMETSAT, Darmstadt, Germany
[12] Maynooth University, Ireland
[13] KNMI, De Bilt, The Netherlands

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C3S EO activities: A European effort

Climate Change

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The C3S mission

To support European adaptation and mitigation policies by:

- Providing consistent and authoritative information about climate (past, present, future)
- Building on existing capabilities and infrastructures (nationally, in Europe and worldwide)
- Stimulating the market for climate services in Europe

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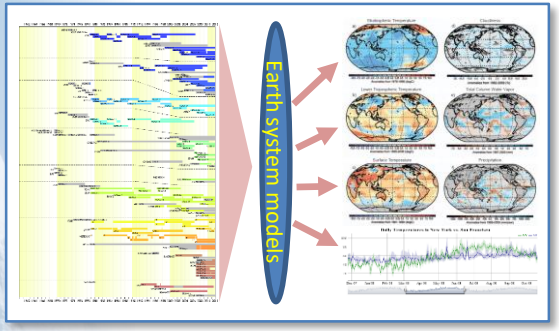
C3S: ACCESS TO PAST, PRESENT AND FUTURE CLIMATE INFORMATION

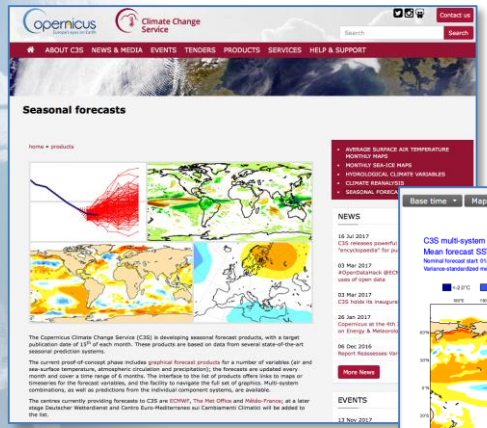


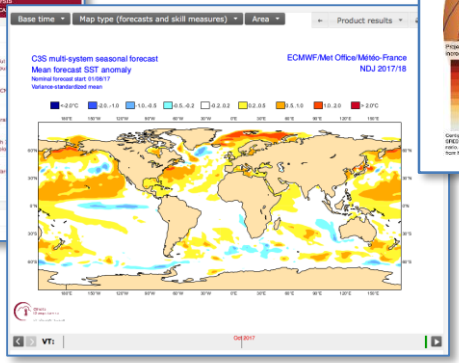
Observations and climate reanalyses

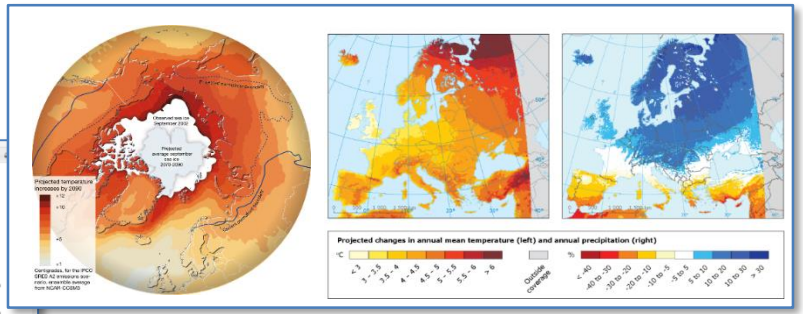
Seasonal forecast data and products

Climate model simulations

Sectoral climate impact indicators







http://climate.copernicus.eu

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Current EO activities in C3S

C3S_311a	**Data rescue activities**	Lot1: Coordination of data rescue activities	Started 2017Q2/ End 2021Q2
		Lot2: Harmonised access to Global Data Archives	Started 2017Q2 / End 2021Q2
		Lot3: Harmonised access to data from reference networks	Started 2017Q2 / End 2021Q2
C3S_311c		Lot1: Satellite data rescue, mainly prior to 1978	Started 2018Q4 / End 2021Q2
		Lot2 : Upper-air data rescue	Started 2018Q4 / End 2021Q2
C3S_311b	**Reprocessing**	Reprocess of EUMETSAT L1 satellite data	Started 2016Q3 / End 2021Q2

Gridded datasets

C3S_311a	Lot4: High-resolution ECV products for Europe	Based on E-OBS	Started 2017Q2 / End 2021Q2
C3S_312b	ECV products from satellite observations → **22 ECVs** organized in 5 Lots	Lot1: Atmospheric Physics	Started 2018Q3 Will end 2021Q2
		Lot2: Atmospheric Composition	
		Lot3: Ocean	
		Lot4: Hydrology & Cryosphere	
		Lot5: Land Biophysics	

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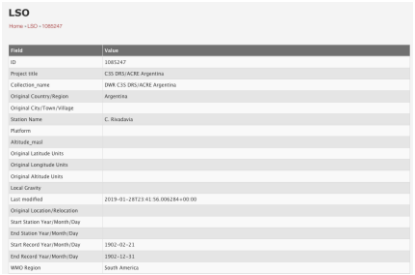
Support services for data rescue

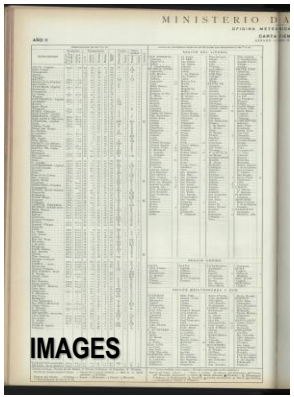
→ facilitate climate data rescue that builds upon existing WMO International Data Rescue activities.

- Linking of WMO I-DARE (https://idare-portal.org/) with new C3S DRS portal (https://data-rescue.copernicus-climate.eu/)
- Melding of various data registries with the new C3S DRS registry and portal
- Tools, Techniques and Best Practise Guidelines
- Capacity Building Workshops

PORTAL

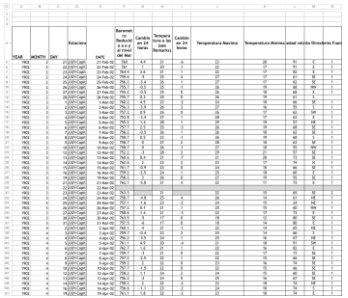


REGISTRY



IMAGES

RAW TRANSCRIPTIONS.xls



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Global land and marine observations database

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→ Delivering fundamental holdings of near-surface meteorological parameters

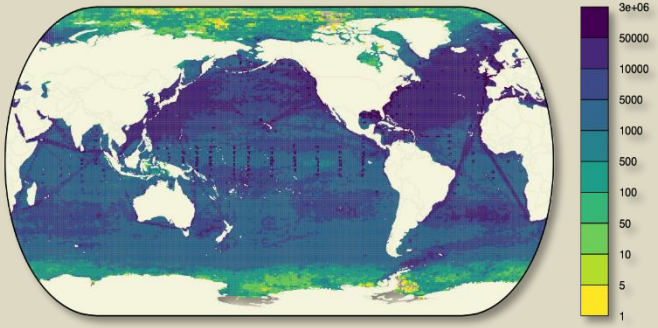
Land

- Collect a vast wealth of data sources across all timescales and ECVs
- Harmonise, merge, and quality control
- Serve as integrated holdings consistent across ECVs and across sub-daily to monthly timescales

Locations of land data acquired to date

Marine

- Use the raw data files underlying the latest ICOADS release
- Extract additional supplemental data
- Use improved ship tracking and quality control procedures
- Serve as integrated holdings



Marine observations by 1 degree gridbox 1918-2017

Maynooth University National University of Ireland Maynooth
Met Office
National Oceanography Centre
National Centers for Environmental Information
Science & Technology Facilities Council

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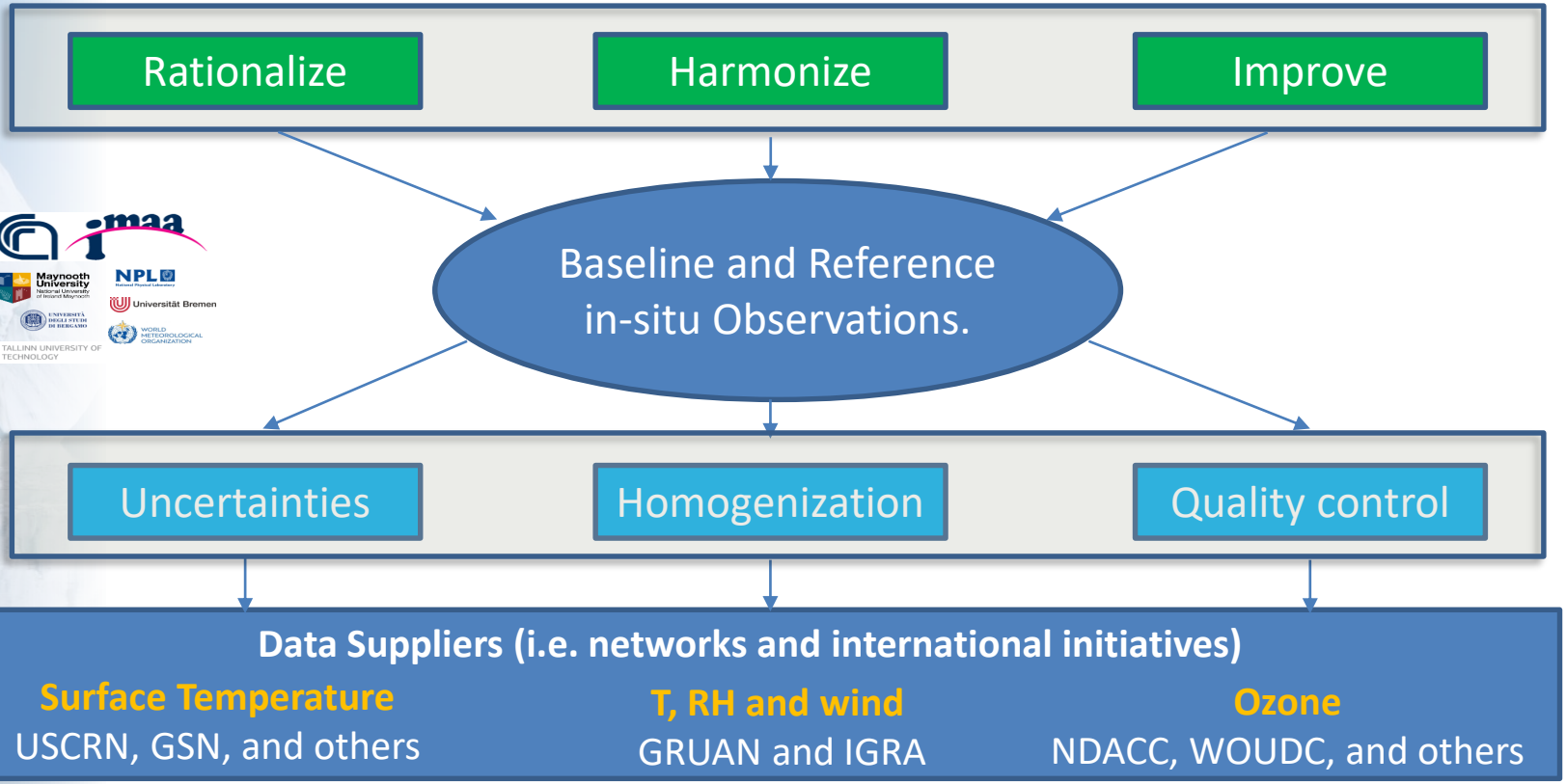
Access to observational in-situ data records



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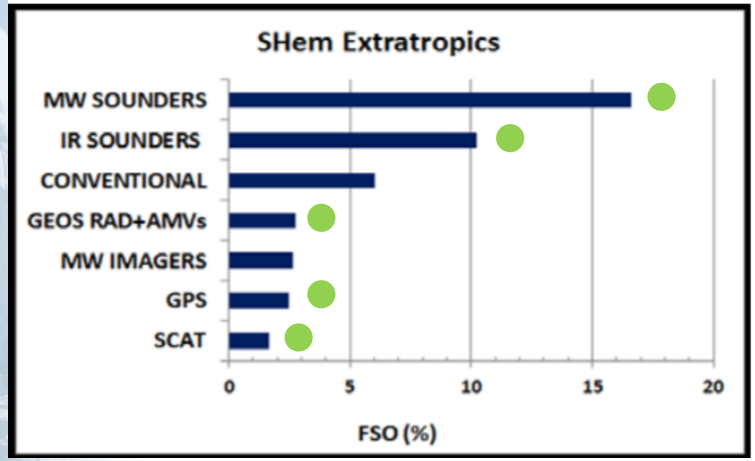
EUMETSAT provides high impact CDRs for ERA6 back to the 1970s



Ranked contributions to forecast error reduction estimated by Adjoint Sensitivity Diagnostics averaged over the test period in the Southern Hemisphere. From McNally (2014).

- Atmospheric Sounding Radiance (Microwave and Infrared)
- Meteosat Radiance and Atmospheric Motion Vectors
- Radio Occultation bending angle profile
- Metop ASCAT backscatter
- Meteorological CDRs:
  - Metop global and polar Atmospheric Motion Vectors (LEO)
  - Metop multi-sensor aerosol AOD product

Aims at going back in time as far as possible, best possible individual instrument correction, error flagging, advanced uncertainty estimates and harmonisation over the time series.

Analysis of NIMBUS-6 HIRS-1 Data

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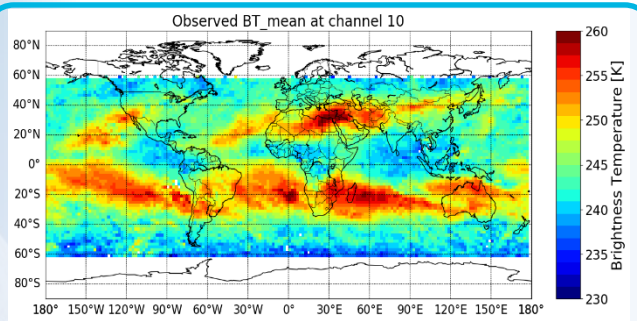
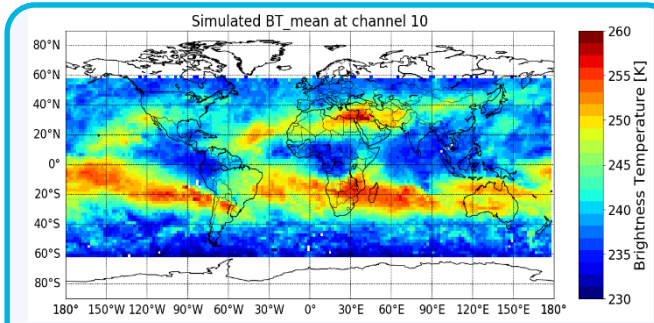
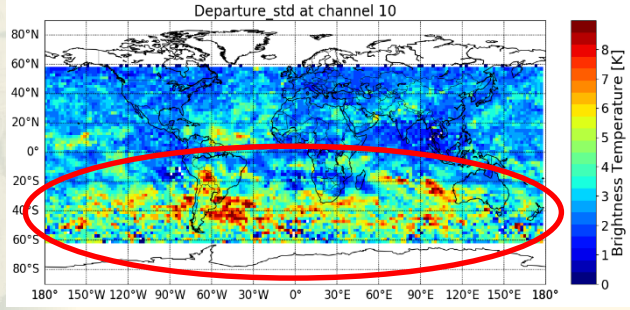


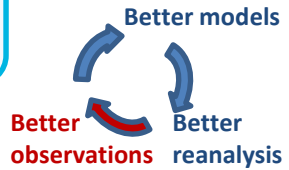
Nimbus-6 (Aug 1975)



ERA5 (Aug 1975)



Standard Deviation
Nimbus-6 – ERA5 departures



- **Departure-based assessment of data quality**. Reanalysis provides a tool to analyse historical data in absence of satellite and ground-based references;
- High standard deviations in SH may point to additional information from HIRS-1 if assimilated.

EUMETSAT

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Support for climate reanalysis including satellite data rescue

Sensor	Task					
	2 Data provision	3 Quality assessment	4 RT modelling	5 Quality control	6 Uncertainty assessment	7 Bias modelling
Early infrared sensors						
PMR	✓	✓	?	✓	✓	✓
HIRS-1	EUMETSAT	EUMETSAT	?	?	EUMETSAT	✓
MVIRI	EUMETSAT	✓	?	?	✓	✓
IRIS	?	✓	✓	✓	✓	✓
VTPR	✓	ECMWF	✓	✓	✓	✓
HRIR	✓	LP	LP	LP	LP	LP
MRIR	✓	LP	LP	LP	LP	LP
SIRS	✓	LP	LP	LP	LP	LP
THIR	✓	✓	✓	✓	✓	✓
Early microwave sensors						
SMMR	CM SAF	✓	CM SAF	?	?	✓
SSM/T-2	EUMETSAT	✓	✓	✓	FIDUCEO	✓
Reprocessed radiance data						
HIRS-2→-4	FIDUCEO	✓	?	ECMWF	FIDUCEO	ECMWF
SSU	?	✓	✓	✓	✓	✓
MSU	✓	ECMWF	✓	ECMWF	✓	ECMWF
SSM/I	CM SAF	✓	CM SAF	ECMWF	CM SAF	ECMWF
SSMIS (imaging channels)	CM SAF	✓	CM SAF	ECMWF	CM SAF	ECMWF
MVIRI	EUMETSAT	✓	?	?	?	✓
Reprocessed wind retrievals						
AVHRR	EUMETSAT	✓	NA	?	?	NA
MVIRI	EUMETSAT	✓	NA	?	?	NA

SPASCIA

University of Reading, Met Office, Météo France, icare, Capital High Tech

Satellite Data Rescue

- Focus on early datasets
- Range of activities: data provision → bias modelling and uncertainty assessment
- Start Q4 2018

Historic Upper Air Data

- Focus on observations prior to 1979
- Includes development of bias adjustments and uncertainty estimates
- Start Q4 2018

universität wien

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High-resolution datasets for Europe

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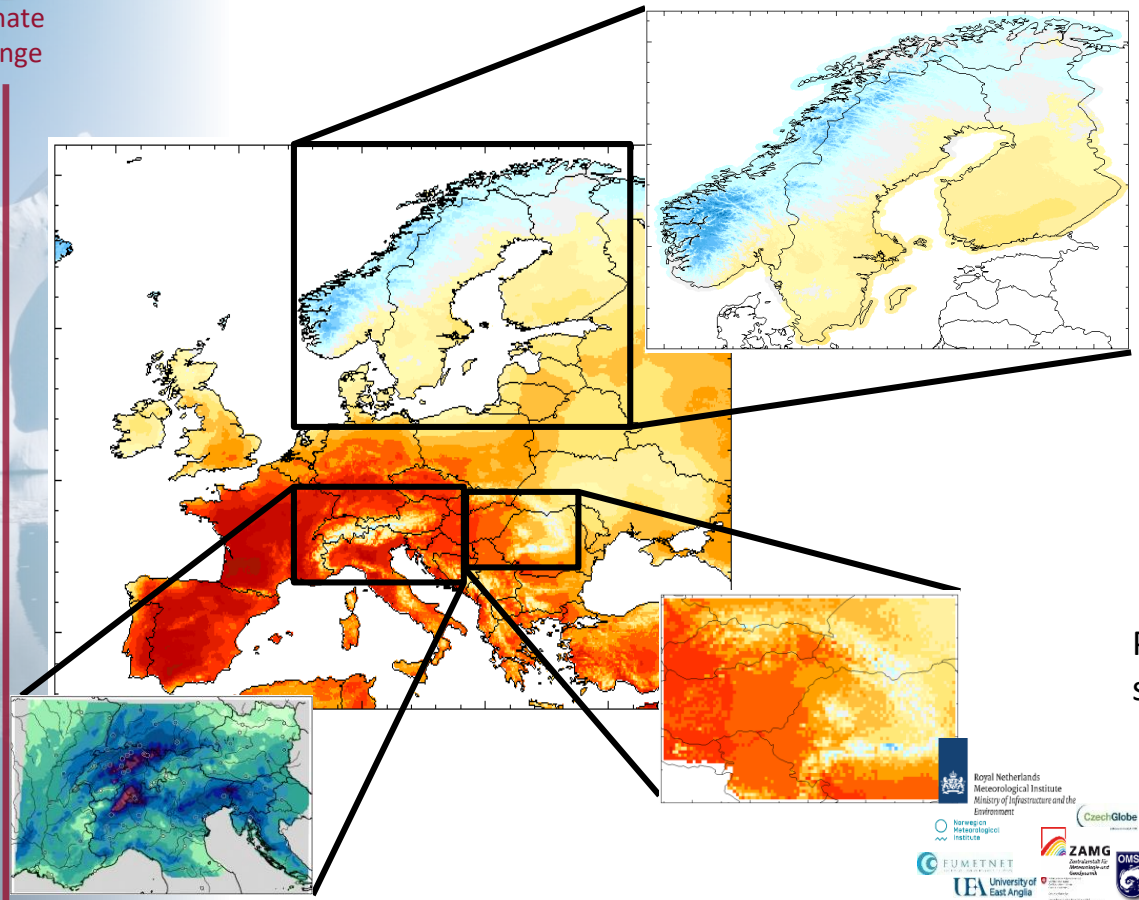
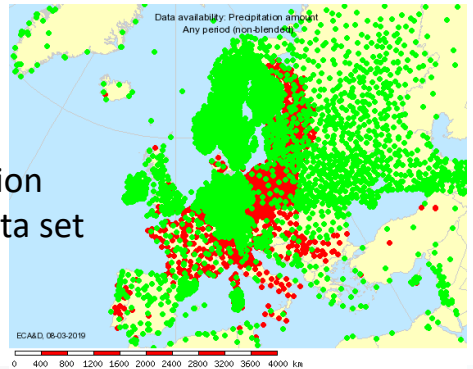


Observation-based products

- Pan-European E-OBS gridded dataset
- High-resolution datasets for the Carpathians , the Alpine region and the Nordic countries
- Sector-specific indices

Precipitation station data set



Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment
Norwegian Meteorological Institute
CzechGlobe
EUMETNET
ZAMG
OMSZ
University of East Anglia
MeteoSwiss
ECMWF
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ECVs evolution in C3S (satellite data)

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			C3S_312a				
				C3S_312b			
		GCOS	2017	2018	2019	2020	2021
Atmospheric physics							
	Precipitation	4.3.5		Lot 1			
	Surface Radiation Budget	4.3.6					
	Water Vapour	4.5.3					
	Cloud Properties	4.5.4					
	Earth Radiation Budget	4.5.5					
Atmospheric composition							
	Carbon Dioxide	4.7.1	Lot 6		Lot 2		
	Methane	4.7.2	Lot 6				
	Ozone	4.7.4	Lot 4				
	Aerosol	4.7.5	Lot 5				
Ocean							
	Sea Surface Temperature	5.3.1	Lot 3		Lot 3		
	Sea Level	5.3.3	Lot 2				
	Sea ice	5.3.5	Lot 1				
	Ocean Colour	5.3.7					
Land hydrology & cryosphere							
	Lakes	6.3.4			Lot 4		
	Glaciers	6.3.6	Lot 8				
	Ice sheets and ice shelves	6.3.7					
	Soil moisture	6.3.16	Lot 7				
Land biosphere							
	Albedo	6.3.9	Lot 9		Lot 5		
	Land Cover	6.3.10					
	Fraction of Absorbed Photosyntheti	6.3.11	Lot 9				
	Leaf Area Index	6.3.12	Lot 9				
	Fire	6.3.15					
			2017	2018	2019	2020	2021

Coordination with CM-SAF / ROM SAF / ESA CCI / Uni. Maryland / NASA / NOAA

Coordination with ESA-CCI and other national projects

Coordination with ESA-CCI

Coordination with ESA-CCI, GloboLakes, Arc-Lake, HydroWeb

Coordination with ESA-CCI, CGL, QA4ECV, LSA-SAF

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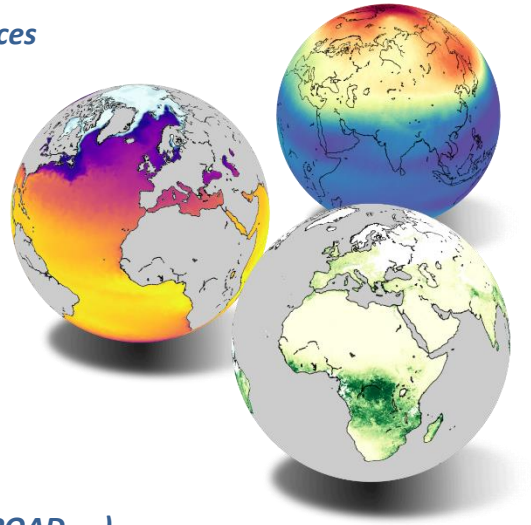
ECVs operational services

With products that are

- State-of-the-art products
  - ***Coordination with ESA CCI, EUMETSAT, etc., & other Copernicus services***
- Long-term, consistent , complete (CDR)
  - **Single/Multi sensor approach**
- Regularly extended in time (ICDR)
  - **Frequent updates of data records**
- Gridded, aggregated
  - **Meeting user requirements**



- *Accessible & Tracible*
  - ✓ *Access through the Climate Data Store*
    - ✓ ***Creation of adaptors, integration in CDS Toolbox***
  - ✓ *Documentation*
    - ✓ ***Frequently supporting documentation produced in C3S (ATBD, PQAD, …)***
  - ✓ *Evaluation and Assessment*
    - ✓ ***EQC, own QC procedures, benchmarking, evaluation of cross-ECV consistency***
  - ✓ *User support*
    - ✓ ***Service desks opened for many services***

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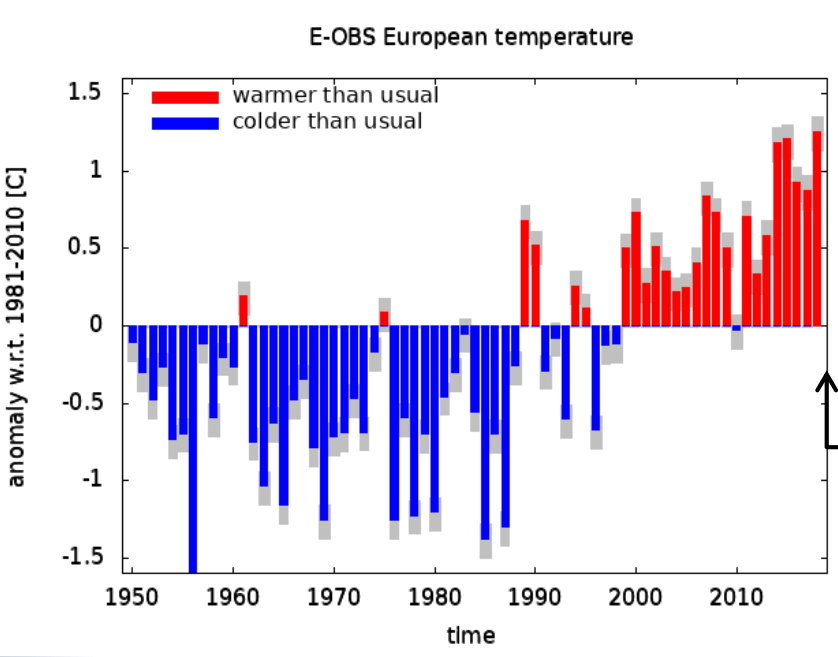
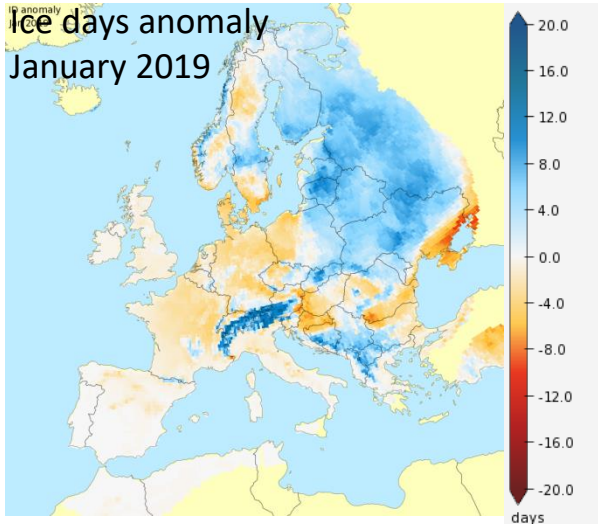
Gridded Climate Data Records

- Monthly State of the Climate for Europe
- Annual State of the Climate (with ECMWF)





http://surfobs.climate.copernicus.eu/stateoftheclimate/january2019.php

2018 in top-3 of *warmest* years

→ ***Presentation of the 2018 European State of Climate today at 14h00***

Conclusion: What C3S offers to its users (EO)

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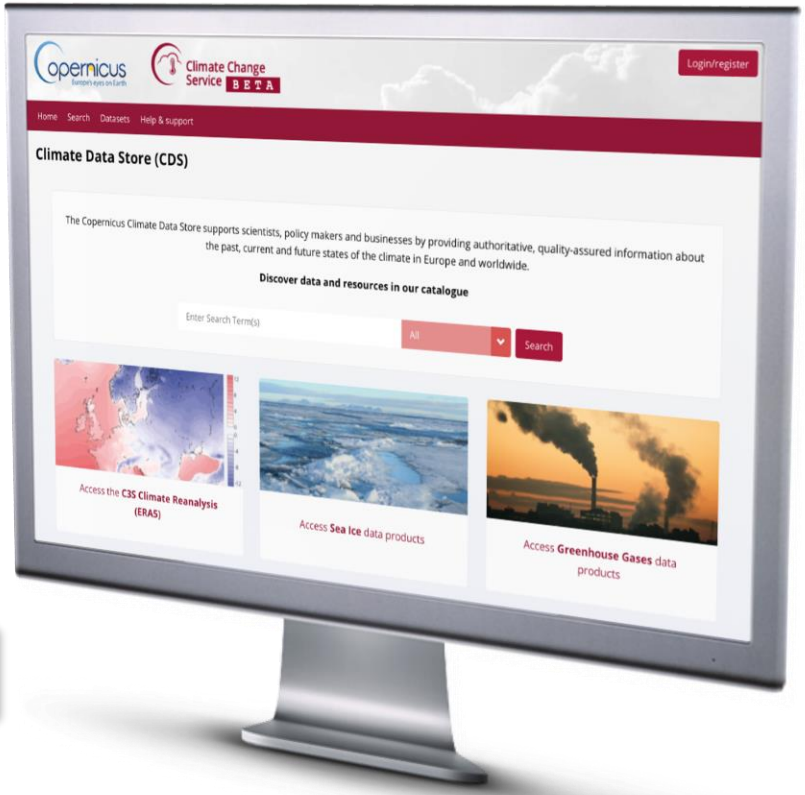
- Access to climate data
- Tools needed to use the data
- Quality assurance
- User support and training
- Climate change assessments
- Outreach and communication

A one-stop Climate Data Store



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Thank You

Get involved with the Copernicus Climate Change Service

Copernicus C3S; https://climate.copernicus.eu

Climate Data Store; https://cds.climate.copernicus.eu/

@j_munoz_sabater

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Back up slides

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THE COPERNICUS PROGRAMME OBJECTIVES

Copernicus

The Union Earth Observation and monitoring programme

Protect people and assets

Increase general knowledge on the state of the Planet

Improve environmental policy effectiveness

Monitor the environment

Facilitate adaptation to climate change

Foster downstream applications in a number of fields

Help managing emergency and security related situations

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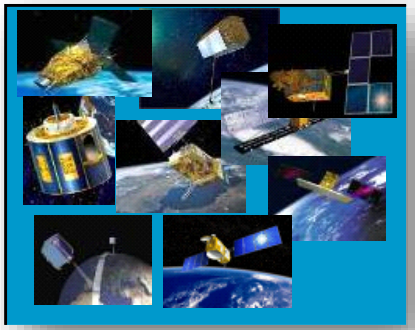
PROGRAMME ELEMENTS

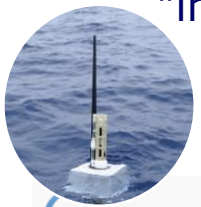
Copernicus Sentinels

6 services use Earth Observation data to deliver …



Other Satellites

"in-situ"



…added-value products

Monthly climate bulletins

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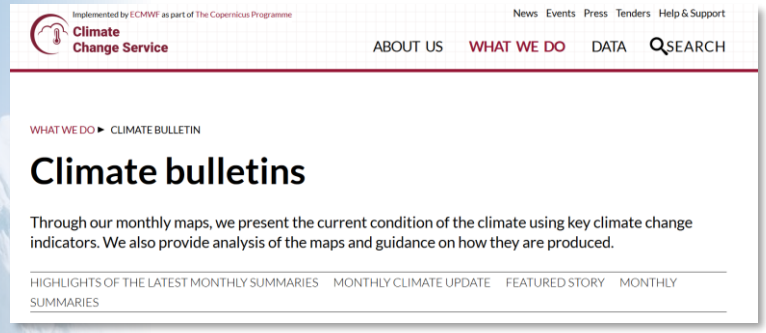

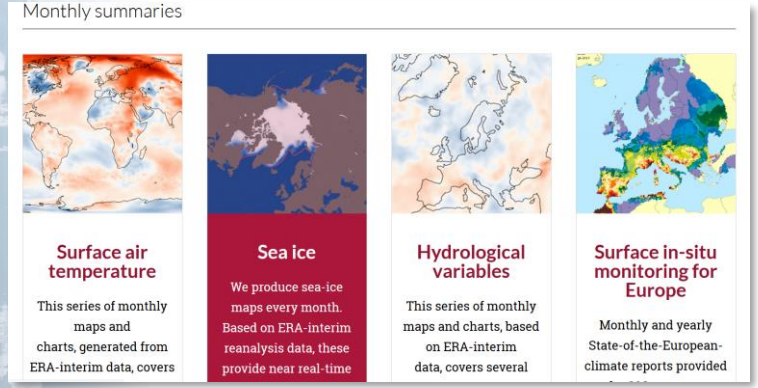

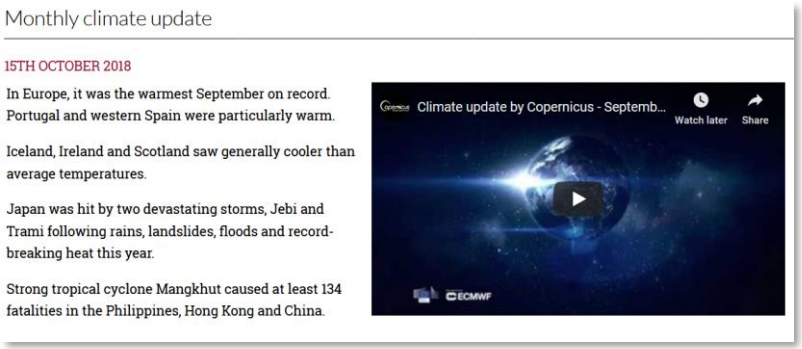

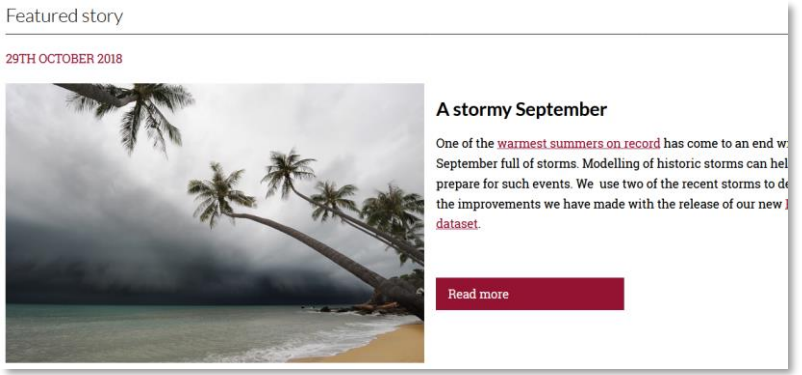

➢ climate.copernicus.eu/climate-bulletins

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C3S 311a Lot 1: the C3S Data Rescue Service (DRS)

(https://insitu.copernicus.eu/news/the-c3s-data-rescue-service)

This service brings together fourteen partners in a consortium led by the Met Office to provide a service to facilitate climate data rescue that builds upon existing WMO International Data Rescue activities. The service will run an online repository (portal and registry) of information about past, current and planned climate data rescue, provide a wide range of data rescue tools and run capacity building workshops. The consortium has existing relationships and experience of working with ACRE (Atmospheric Circulation Reconstructions over the Earth) (http://www.met-acre.net).

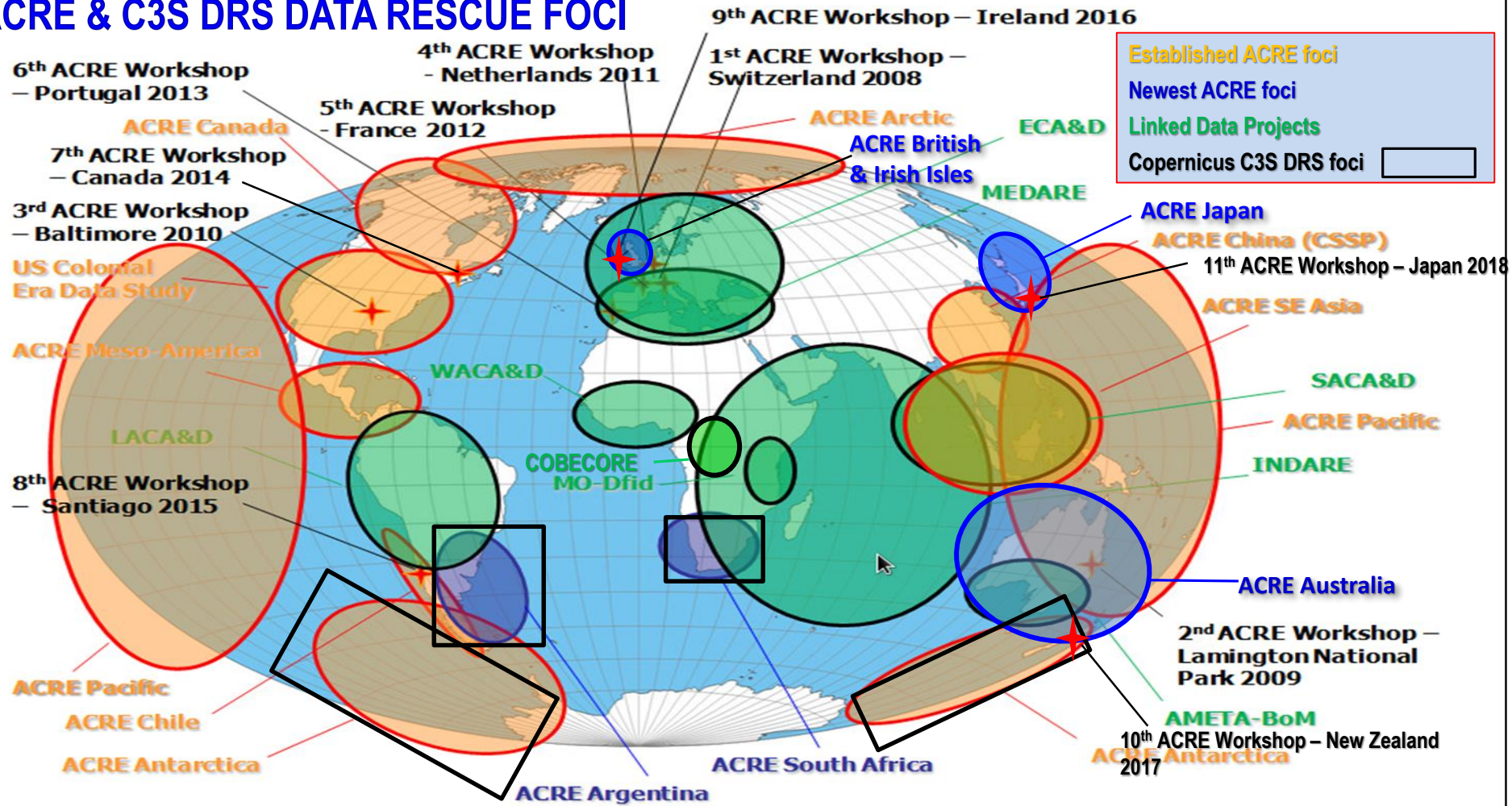
WP 1: Linking of WMO I-DARE (https://idare-portal.org/) **with new C3S DRS portal** (https://data-rescue.copernicus-climate.eu/)
WP 2: Melding of various data registries with the new C3S DRS registry and portal
WP 3: Tools, Techniques and Best Practise Guidelines
WP 4: Capacity Building Workshops

Thus, the service will develop and maintain the technical support services needed by users to facilitate all steps of the data rescue procedure; from consolidating paper archives to imaging data formatting and quality control, whilst piloting the use of new techniques and approaches to data digitisation.

The service has identified three high priority regions for financial support to facilitate data rescue work as part of the C3S DRS. These regional projects are ACRE Antarctica, ACRE South Africa and ACRE Argentina.

C3S DRS is closely linked to C3S 311a Lot 2, and these efforts are served via the Copernicus Climate Data Store (CDS) to end-users.

ACRE & C3S DRS DATA RESCUE FOCI



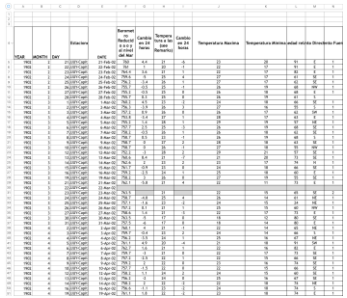
C3S DRS (Lot 1) and Lot 2 interactions and work flows

Portal

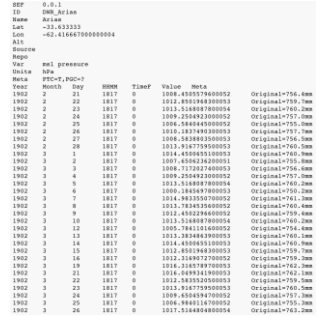
Registry

C3S DRS

Images

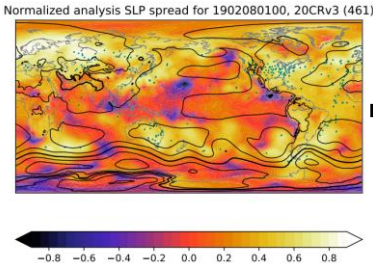


Raw transcriptions.xls



Exchange format.sef

Big Hopper



Experimental Products
e.g. 20CR 4.6.1

Services and Impacts

Operational Products
e.g. HadCRUT5?

Harmonised Holdings

Lot 2

Copernicus

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