Climate Change

Seasonal and decadal prediction services from C3S

Anca Brookshaw
Copernicus Climate Change Service (C3S)
ECMWF

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Copernicus Programme - Description

- European Union´s Earth Observation Programme
  - Managed and coordinated by the European Commission
  - Implemented in collaboration with EU member states, ESA, EUMETSAT, Mercator Océan, ECMWF, other international organisations and EU agencies
  - ~4300 M€ in the current multiannual financial framework (2014-2020)
- System based on Earth Observation satellite data and “in-situ” observations

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- System based on Earth Observation satellite data and “in-situ” observations
- **Free, full and open access** to data and services for any citizen or organization
  - Improve citizens´ life
  - Offer (to administrations and businesses) tools for decision-making

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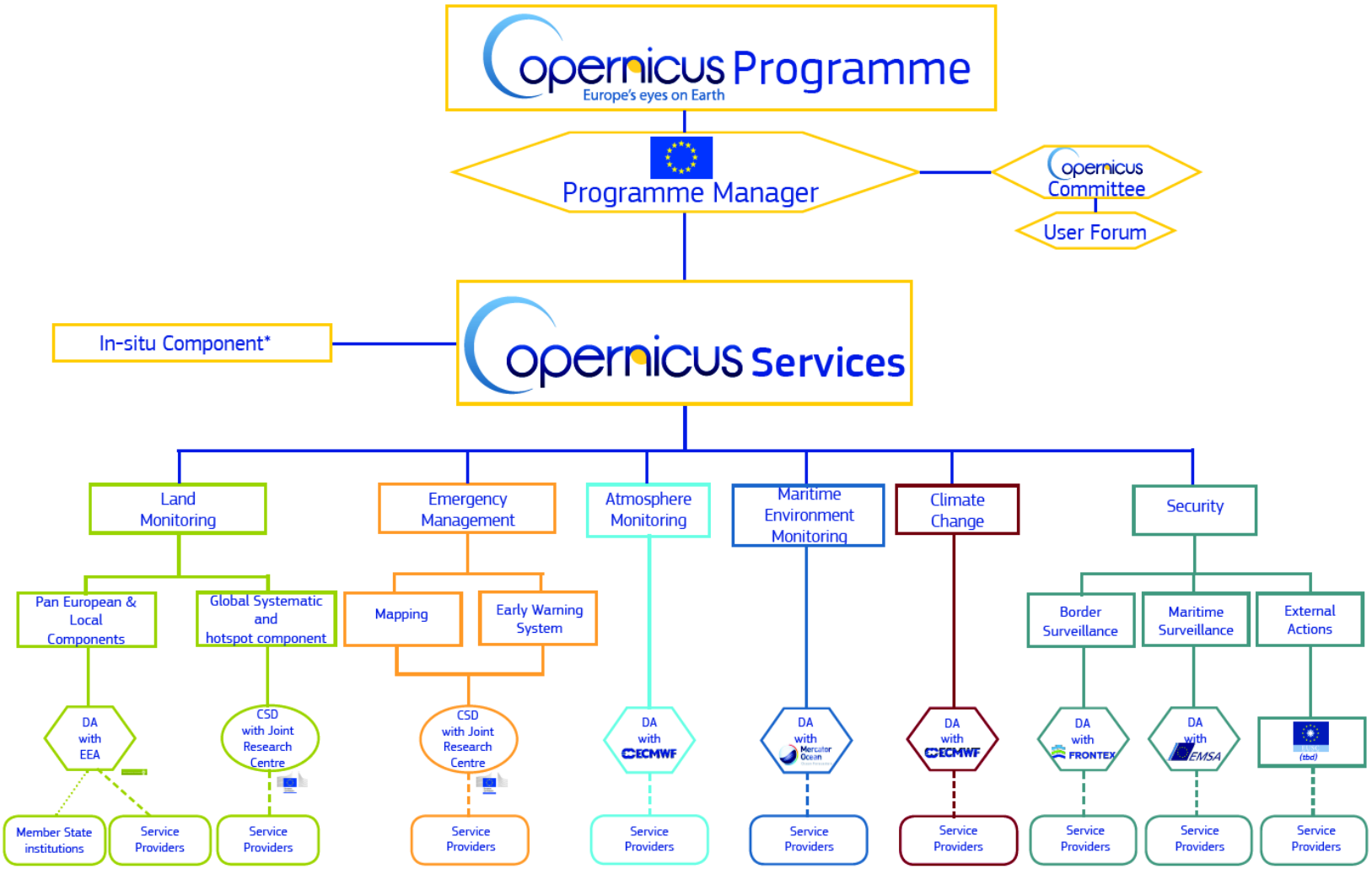

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The C3S mission

To support European adaptation and mitigation policies by:

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

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C3S - Components

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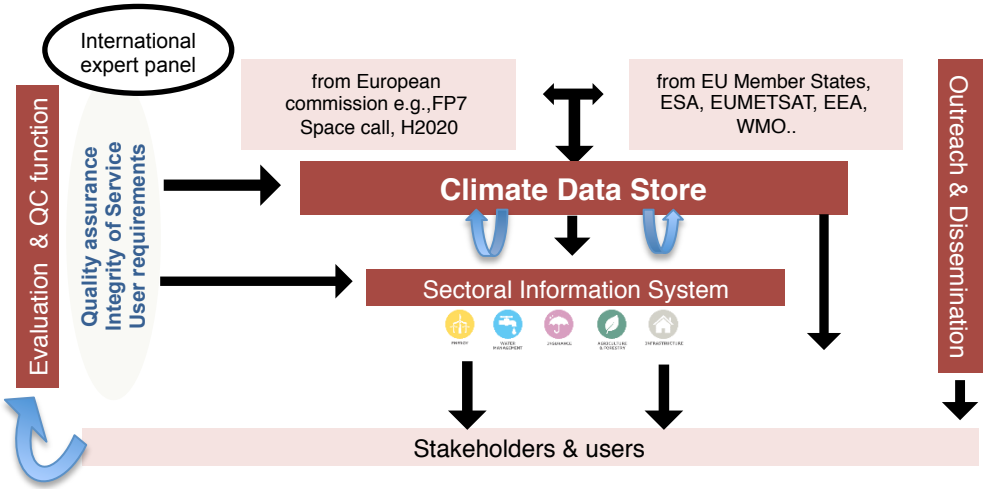

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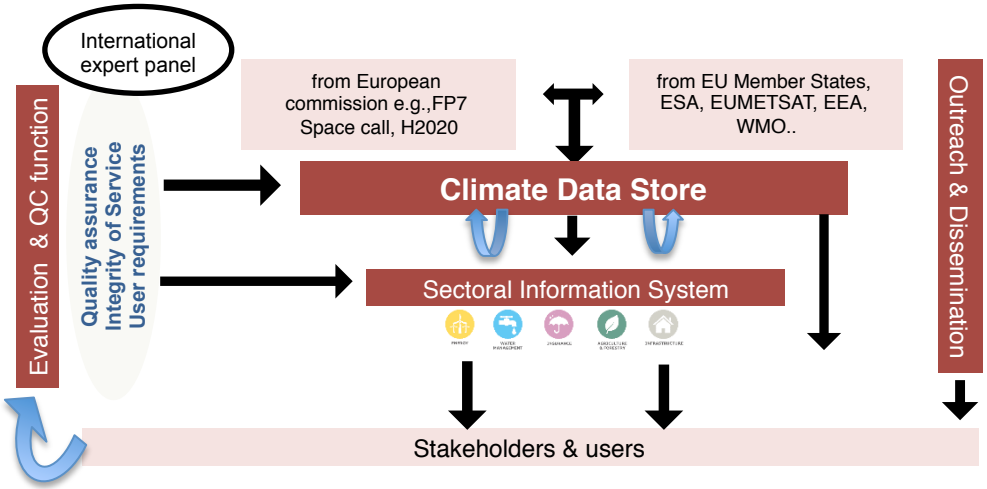

CDS: infrastructure for access to quality assured data, tools and information for users

SIS: proof-of-concept climate services, to demonstrate the value chain with end-to-end examples. In operational phase, C3S will enable downstream climate services, by providing/brokering high quality, sector relevant climate data and indicators, good practices, tools and by supporting compelling use cases.

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C3S – CDS content

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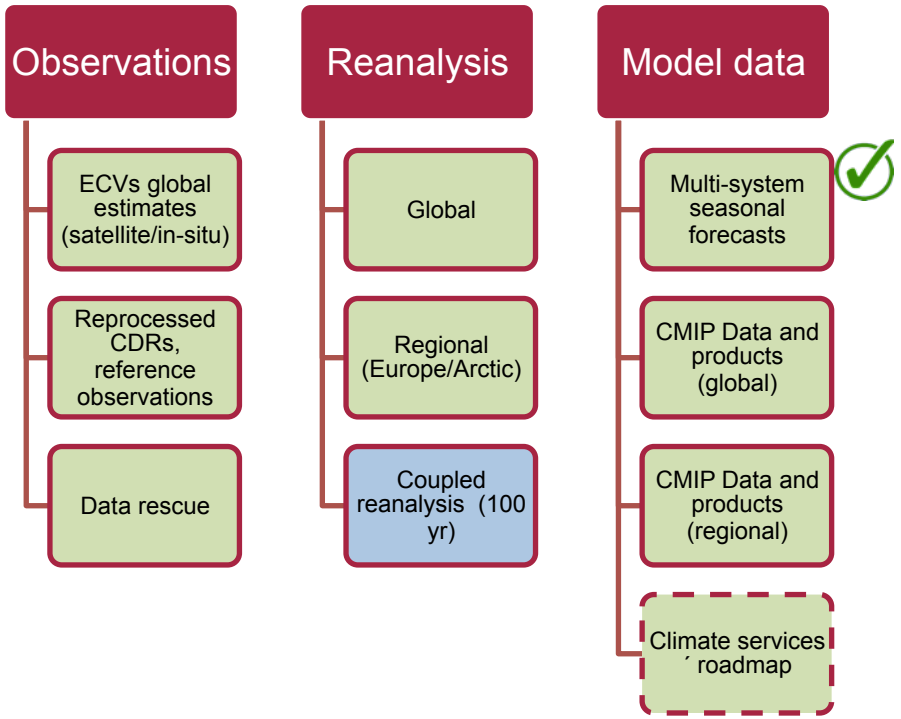

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C3S Seasonal Forecast Service

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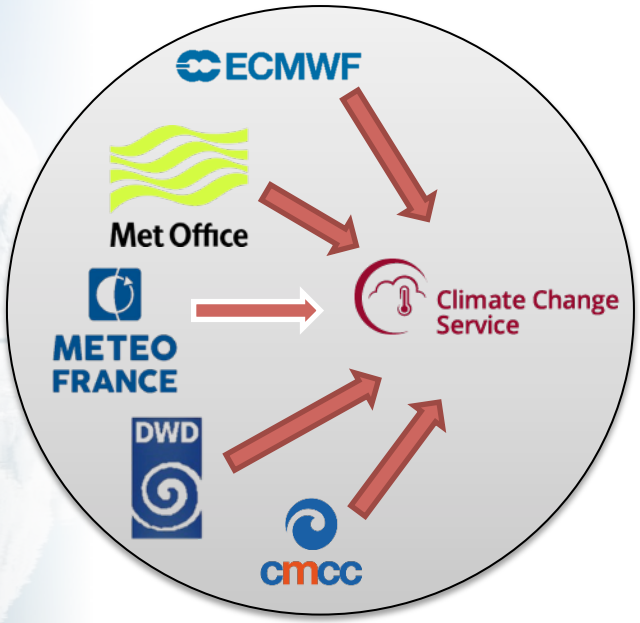
multi-system setup



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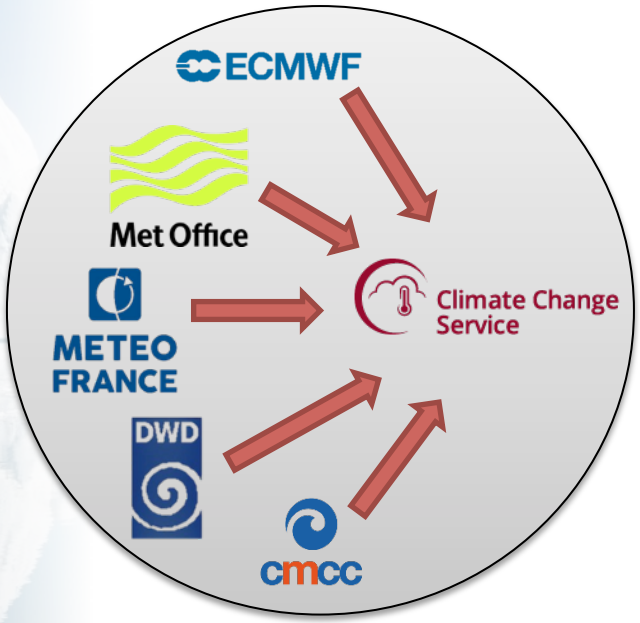

Protocol:
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- ensemble size (forecasts: ~50 members; hindcasts: ~25 members)
- reference period: 1993-2016 (24 years)

Data:
Variables
- Surface
  - 7 vars every 6h
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- Pressure (11 levels, from 925 hPa to 10 hPa)
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Horizontal grid: global 1deg x 1deg

Agreed netCDF specification C3S-0.1 (based on CF)

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C3S Seasonal Forecast Service

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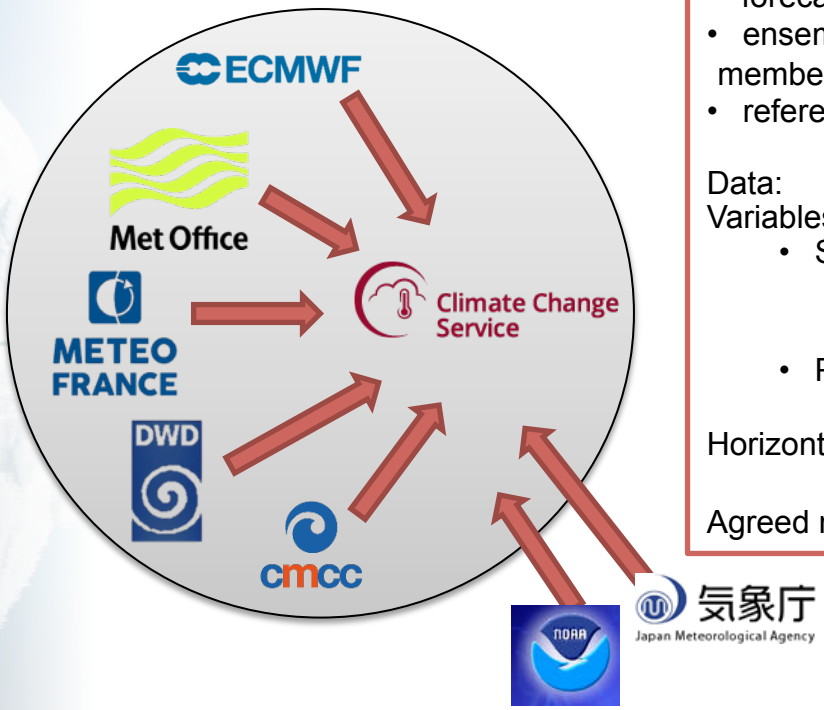

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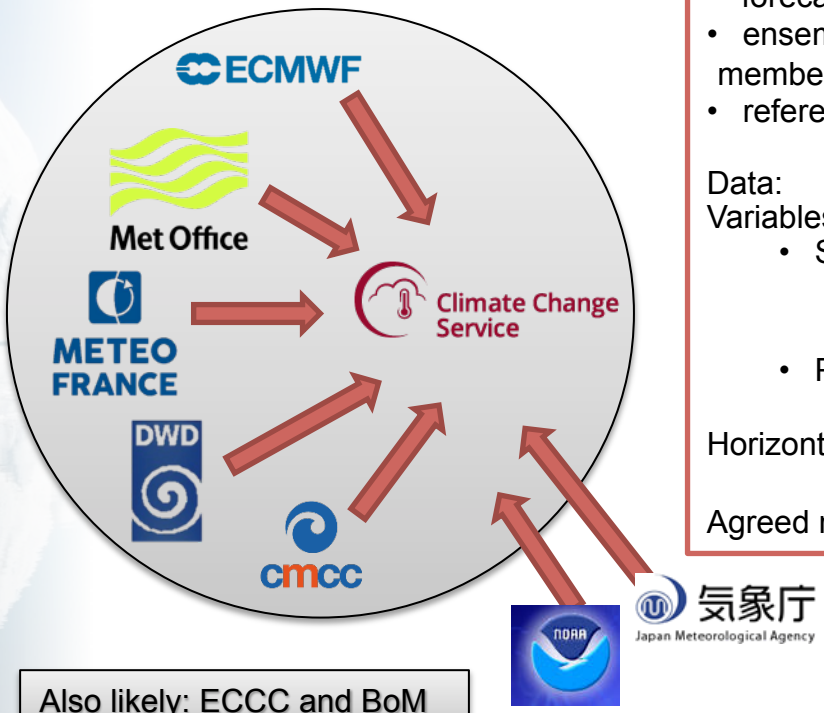

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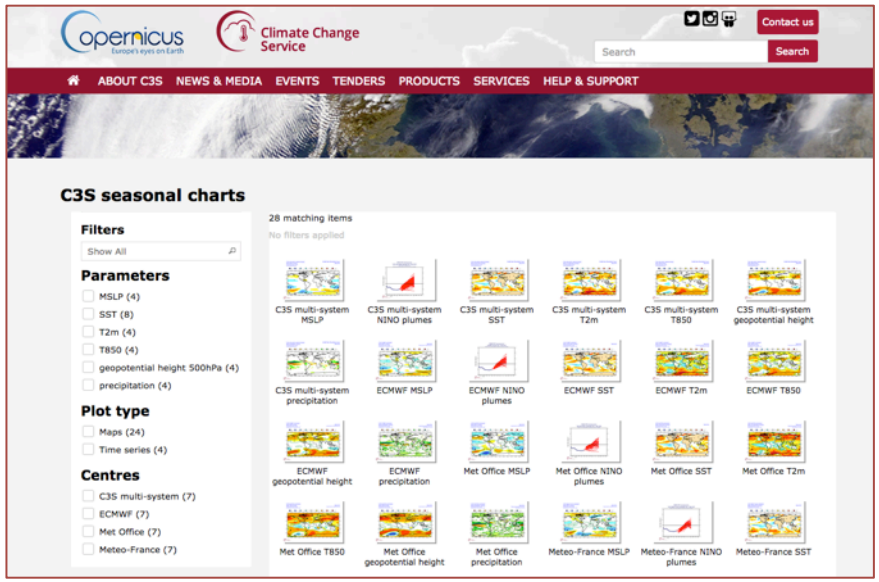
C3S Seasonal Forecasts – Graphical Products



https://climate.copernicus.eu/charts/c3s_seasonal/

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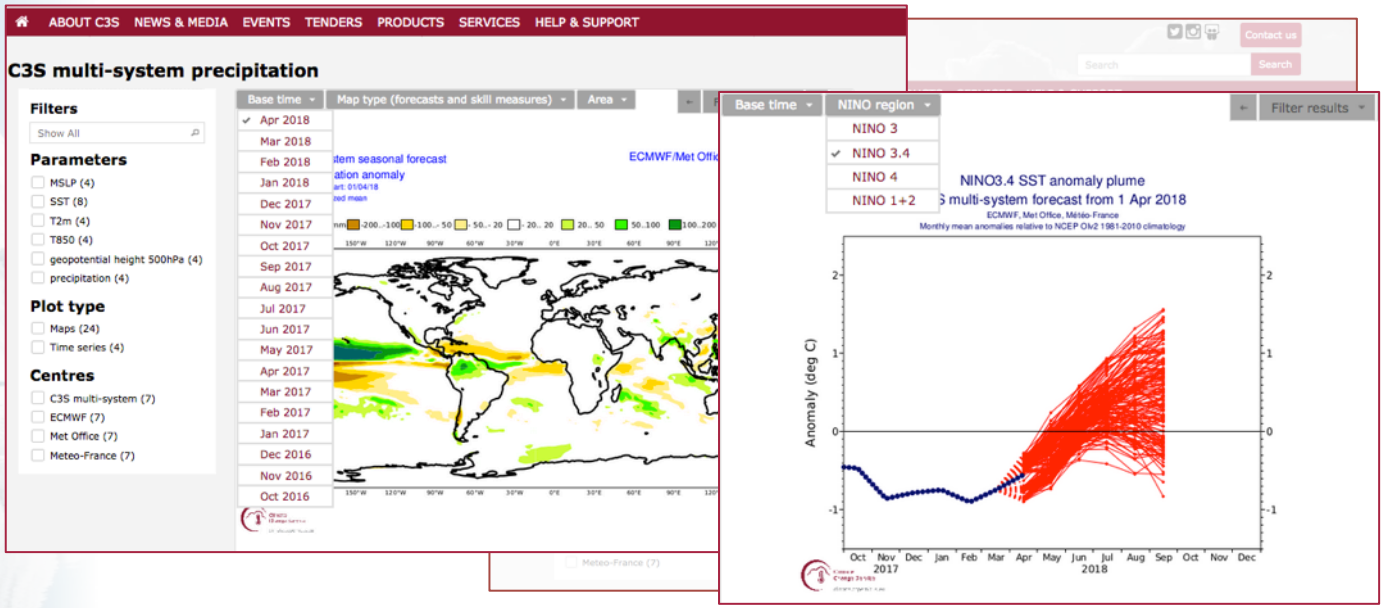

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C3S Seasonal Forecasts – Data Products

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Scope of the data service

- Original provider data (1 deg gridded data sets for many variables; high temporal resolution: 6h-24h)
- Processed data, including data represented in the graphs
- Forecasts from individual systems and multi-system combinations
- Information on (average) skill will accompany forecast products wherever possible.

http://climate.copernicus.eu/seasonal-forecasts/

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Current status – data service using CDS API

Nominal start dates	ECMWF		Météo-France		Met Office		DWD	CMCC
	System 4	SEAS5	System 5	System 6	GloSea5 - GC2	GloSea5 - GC2 (C3S-0.1 netcdf)	GCFS2	SPSv3
September 2017 - October 2017	✓	✗	✓	✗	✓	✗	✗	✗
November 2017 - January 2018	✗	✓	✓	✗	✓	✗	✗	✗
February 2018 - present	✗	✓	✓	✗	✗	✓	✗	✗

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C3S Seasonal Forecasts – Forecast Systems

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Models

- **Current model configurations:**
  - ECMWF (Seas5): IFS atmosphere (TCo319, equivalent to N320: ~30km and 91 levels), NEMO ocean (0.25 deg, 75 levels), LIM sea ice
  - Met Office (GloSea 5): UM atmosphere (N216, ~50 km and 85 levels) , NEMO ocean (¼ deg, 75 levels), CICE sea-ice
  - Météo France (System 5): ARPEGE atmosphere (TL255), NEMO ocean (1 deg, 42 levels), GELATO sea-ice
  - CMCC (SPS.v3): CSEM atmosphere (1 deg, ~100 km, 46 levels), NEMO ocean (¼ deg, 50 levels), CICE sea-ice
  - DWD (GCFS 1.0): ECHAM6 atmosphere (T63, ~300 km, 47 levels), MPIOM ocean (1.5 deg, 40 levels; includes sea ice)

- **Versions planned for 2017/2018, where applicable:**
  - Météo France (System 6): ARPEGE atmosphere (TL359, ~60km, 91 levels), NEMO ocean (1 deg, 75 levels), GELATO sea-ice
  - DWD (GCFS 2.0): ECHAM6 atmosphere (T127, ~150 km, 95 levels), MPIOM ocean (0.4 deg, 40 levels; includes sea ice)
  - Met Office: update likely, but not to resolution

Ensemble generation: lagged or burst, with or without perturbations to initial conditions.

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C3S Seasonal Forecasts – Evaluation and Quality Control

- assessment of ***user needs***
- ***scientific assessment*** and ***gap analysis*** of information available to users
- ***usability*** of service and products (from technical perspective)
- ***software*** for on-demand evaluation of seasonal forecast products by users
- recommendations for ***bridging identified gaps***

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C3S Seasonal Forecasts – Next Steps

- Generate and display **verification scores for products** presented in the graphs
  - Add monthly-mean graphical products

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- Add **new providers to the multi-system**; regularly generate data and graphical products from all contributors
  - CMCC and DWD by the end of 2018
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- Introduce **new products** in the C3S suite of outputs
  - probability forecasts for ENSO indices
  - indices of atmospheric circulation (NAO, SOI)
  - products based on within-season statistics (frequency/length of spells)

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Decadal Prediction Service (Prototype)

- Rationale:

  Surveys of user requirements surveys and discussions with C3S stakeholders indicate interest in **information at decadal timescales**, **in economic sectors** such as energy, infrastructure, transport, water and urban issues, etc., where planners and policy makers need to make decisions about future investment, resource allocation, etc.

- Process:

  The proposed approach is to organise **a workshop** (*probably Q1 2019*) involving key stakeholders, **the scientific and user community**, in order to assess **the level of maturity of decadal prediction science** (including verification), and **the level of ambition of a possible operational service**.

- Objective:

  Prototype service (2019-2020), followed by operational service (2021-..)

- Heritage:

  EU projects (e.g. SPECS), Copernicus Roadmap for European Climate Projections (C3S_34a lot 3), WCRP international Conferences on Subseasonal to Decadal Prediction (Boulder - October 2018), WMO workshops on Operational Climate Prediction 2018, etc.

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C3S and Climate Predictions

- Products/data from state of the art prediction systems (e.g. seasonal forecasts), for climate services
- Technical infrastructure for data access and processing (CDS and toolbox)
- ‘Quality’ information (operational evaluation and quality control)
- Ingredients for climate prediction producers (reanalyses)

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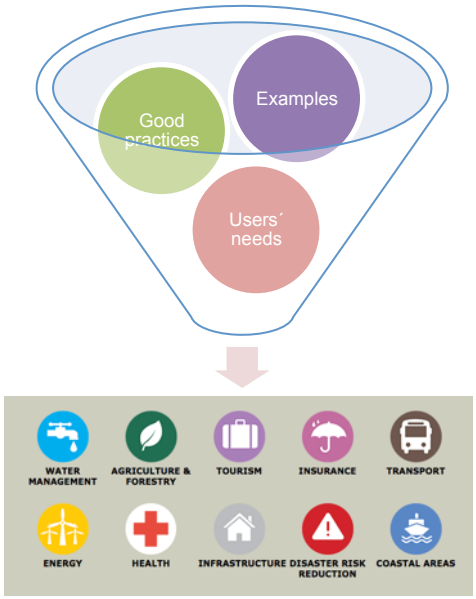
C3S – Sectoral Information System (SIS)



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C3S – Sectoral Information System (SIS)

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Contract name	Plan to use seasonal predictions?	How?
EU-Storm-surges	No	N/A
Global Impacts	**Yes**	Global production of hydrological indicators via global Hype driven by System5
Global Agriculture	**Yes (marginally)**	Prediction of agricultural related indicators (low priority output)
EU-Op-Water	**Yes**	Multi-model seasonal predictions of hydrological variables in Europe
EU-Op-Energy	**Yes**	Seasonal indicators for energy
EU-Tourism	**Yes**	Forest fire index for Europe (in coordination with EFIS)
Global Shipping	**Yes**	Seasonal climatology and shipping indicators
EU Fisheries	No	N/A
EU-Health	**Yes**	Seasonal prediction of vector borne diseases outbreaks in some E-European countries in Summer
EU-Op-Insurance	No	N/A

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Thank you

C3S Seasonal Forecasts - Introduction

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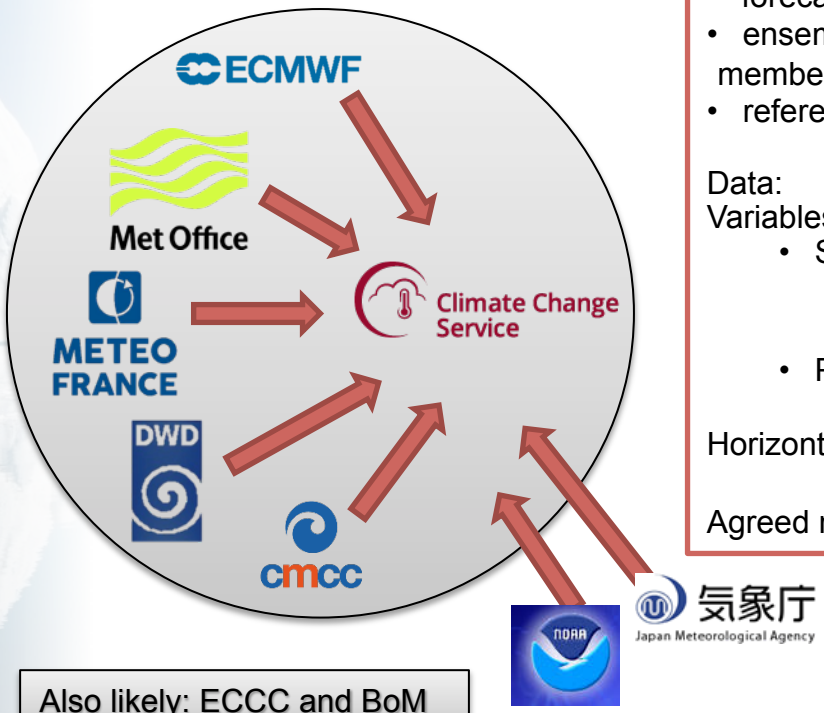

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