Copernicus Climate Change Service (C3S)

Climate Change Analysis & Modelling: [Some] User Needs & Applications

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Climate change refers to a “change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity”

Intergovernmental Panel on Climate Change (2007, p 30)
Climate Change Detection and Attribution

Mean Annual Precipitation Birr Castle 1850-2010

Long term, high quality, homogenous, time series of climate parameters are an essential requirement in change detection and subsequent attribution studies.

(Data Source: Noone et al., 2015)
Creating homogeneous, complete data sets from disparate collections is a fundamental challenge facing the climate research community (WMO).
Climate Analysis: Gridded Observations

Long term, quality controlled, climate observations are necessary for analysing and understanding spatial changes in the climate system.
Climate reanalysis or ‘historical forecasts’ provide a consistent, globally complete and detailed record of the evolution of the atmosphere over past decades, achieved through the assimilation of in-situ and remotely sensed observations with a numerical weather model.
Observed climate information (e.g. in-situ, gridded, reanalysis, remotely sensed) is necessary to reduce vulnerability to the occurrence of present day climate related hazards; developed adaptation options can be tested for robustness against future climate narratives and non-climatic pressures.

(Source: Wilby and Dessai, 2010)
**User Needs**

**Climate Data Record (CDR)**
A time series of measurements of sufficient length, consistency and continuity to determine climate variability and change.

**Climate Information Product (CIP)**
A time series derived from CDRs and related measurements to provide specific information about an environmental phenomena of importance to science and society.
### The Essential Climate Variables

<table>
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<th>Domain</th>
<th>Essential Climate variable</th>
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| **Atmospheric** (land, sea and ice) | Surface: Air temperature, wind speed and direction, water vapour, pressure, **precipitation**, surface radiation budget.  
Upper-air: Earth radiation budget (including solar irradiance), temperature, wind speed and direction, water vapour, cloud properties, lightning.  
Composition: Carbon Dioxide, methane, other long-lived greenhouse gases (GHGs), ozone, aerosols, aerosol properties. |
| **Oceanic**             | Surface: Sea surface temperature, sea surface salinity, sea level, sea state, sea ice, currents, ocean colour (for biological activity), carbon dioxide partial pressure, **surface heat flux**.  
Sub-surface: Temperature, salinity, currents, nutrients, ocean tracers, ocean colour, phytoplankton, marine habitat properties. |
| **Terrestrial**         | River discharge, water use, groundwater, lake levels, soil moisture, snow cover, glaciers and ice caps, permafrost and seasonally frozen ground, albedo, land cover (including vegetation type), fraction of absorbed photosynthetically active radiation (fAPAR), land surface temperature, leaf area index (LAI), below- and above-ground biomass, soil carbon, fire disturbance, ghg fluxes |

Measurements of variables in bold type are largely dependent on satellite observations.

**Essential Climate Variables (ECVs)** for which global observation is currently feasible and that satisfy the requirements of the UNFCCC (e.g. IPCC) and broader user communities.
Global Framework for Climate Services (GFCS)

“A global response to the need for climate information for decision making”

(Source: EUMETSAT)

Copernicus (C3S) represents the fundamental European contribution to the Global Framework for Climate Services (GFCS), providing information at global, national, regional and local scales
The CDS will provide Essential Climate Variables (ECVs), climate indicators and other relevant information about the past, present and potential future evolution of the climate system.
Copernicus C3S: The Climate Data Store (CDS)

The CDS will provide Essential Climate Variables (ECVs), climate indicators and other relevant information about the past, present and potential future evolution of the climate system.
Aim to provide data and tools to support increased knowledge and understanding of the climate system leading to improved climate information for use in adaptation and mitigation decision making at all scales.
C3S is developing seasonal forecast products, with a target publication date of 15th of each month. These products are based on data from several state-of-the-art seasonal prediction systems.
The EDgE (End to end Demonstar for improved decision-making in the water sector in Europe) project combines climate data and state of the art hydrological modelling to deliver hydrological services for decision makers.
Forecast of ‘Streamflow’ for Jan 2010

- X 535  Y 627  Upstream catchment area (km²): 0
- Dominant value: High
New Research Opportunities
“Big data are no panacea, but if carefully used, they provide an enormous and untapped opportunity to diversify our understanding of adaptation and inform decision-making”

Ford et al. (2016)
Selected References:

Ford et al. (2016) Opinion: Big data has big potential for applications to climate change adaptation. PNAS, 113(39), 10729–10732.


