



Objective 3: Exploitation of Earth System Models

General talk: Copernicus and C4I portal

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DKRZ: Stephan Kindermann

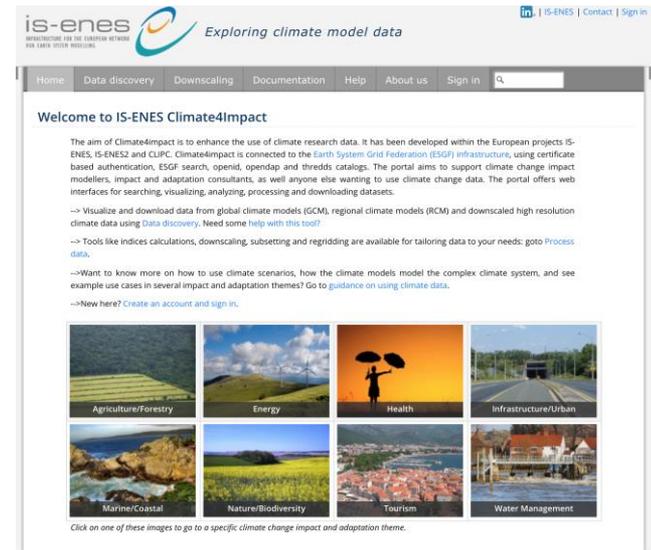
SMHI: Lars Bärring

UKRI: Martin Jukes

CNRS-IPSL: Sébastien Denvil



- **C4I Platform**
 - Current Status
 - Related projects
 - IS-ENES3 C4I developments
- **C3S IS-ENES Activities (Previous and Planned)**
- **Links between C3S and C4I Activities**



<https://climate4impact.eu>



C4I Status

- CMIP6 data findable and can be processed (ICCLIM, subsetting)
- Hardware failure in October 2018 (downtime)
- Migrated to AWS, will be moved to SurfSara
- MyProxy replaced by OAUTH2 with certificates
- Average of 2.100 unique users each month (AWStats)

The screenshot shows the is-enes search interface. The top navigation bar includes 'Home', 'Data discovery', 'Downscaling', 'Documentation', 'Help', 'About us', and 'Sign in'. Below the navigation bar, there are search filters for 'Project (1)', 'Parameter (738)', 'Access (5)', 'Date', 'Geobox', and 'Free text'. A 'Quick select Project' dropdown is set to 'All Project properties (44)'. The search results list includes:

- 8) cmip5-pp (7719)
- 9) CMIP6 (43213)
- 10) CORDEX (103720) Coordinated Regional Climate Downscaling Experiment
- 11) CORDEX-Adjust (927) Bias-adjusted CORDEX simulations
- 12) cordex-pp (2708)
- 13) CORDEX-Reklies (5071)

 The 'Selected filters' section shows 'Project: CMIP6'. Below this, it states 'Found 43213 datasets. Displaying page 1 of 1729'. A list of dataset entries is visible, including 'CMIP6.CMIP-IPSL-EC-Earth3-LR.piControl.r11p1f1.Omon.thetao.gn.v20190103'.

Search showing CMIP6 data

The screenshot shows the is-enes interface with a visualization of CMIP6 data. The 'Selected filters' section shows 'Project: CMIP6' and 'Parameter: tas'. Below this, it states 'Found 309 datasets. Displaying page 1 of 13'. A 'NetCDF Metadata retrieved via OPeNDAP' window is open, showing metadata for 'tas (time, lat, lon) - Near-Surface Air Temperature'. The main visualization is a world map showing temperature anomalies, with a color scale ranging from blue (cooler) to red (warmer). The map shows significant warming over land and in the mid-to-high latitudes. The interface includes a 'Text filter' and a list of dataset entries, including 'CMIP6.CMIP-IPSL-EC-Earth3-LR.piControl.r11p1f1.Omon.thetao.gn.v20190103'.

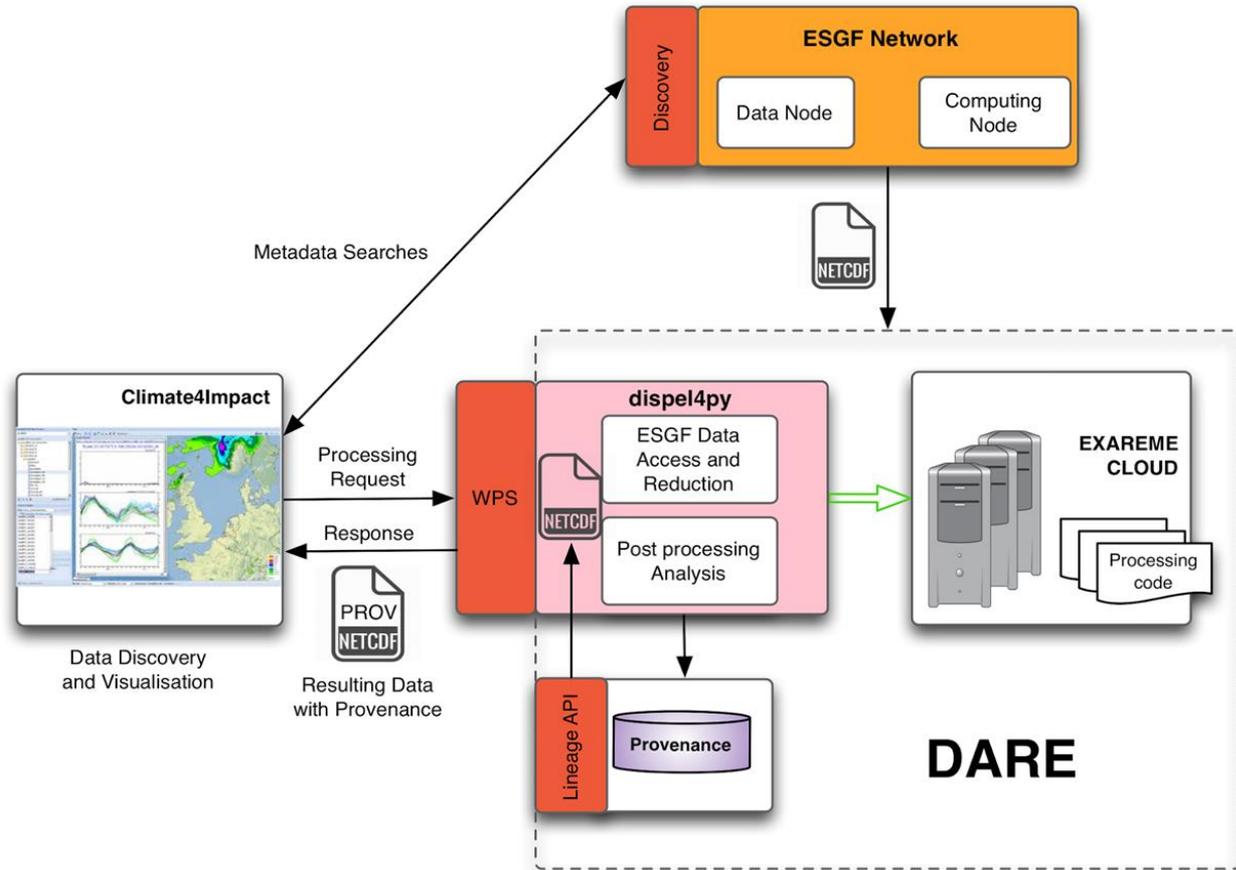
Visualization of CMIP6 data



H2020-DARE: 01/18-12/20

ENES - DARE Interactions

- Services →
- Execution Environments →
- Resource Mapping →





Planned C4I Tasks in IS-ENES3

- Task in WP3, WP7 and WP10 (virtual WP....)
 - WP3: Community building, standards (metadata), requirements
 - WP7: Operational C4I service
 - WP10: Developments of C4I

Goals

- Users' engagement: climate research community, climate impact community as well as interdisciplinary research community
- Make all ESGF climate model data and services (CMIPs, CORDEX) accessible
- Separate computing and portal infrastructure
- Provide advanced data processing and new user-friendly interfaces for data analytics



<https://climate.copernicus.eu/>

Climate Data Store

Sectoral Information System

Evaluation and Quality Control

Outreach and Dissemination



- ECVs past, present and future
- Observed, reanalysed and simulated
- Derived climate indicators

- Monitors quality of C3S products and services
- Ensures C3S delivers state-of-the-art climate information to end-users

- Web content
- Public outreach



- ★ **Global projections** [from CMIP-5 Core and Tier-1 simulations]
 - ★ Pre-industrial control with prescribed, non-evolving concentrations of atmospheric gases and aerosols;
 - ★ Historical ensemble, 1850 to at least 2005, imposed changing concentrations and forcings, minimum of 3-member ensemble [Tier-1];
 - ★ AMIP ensemble, 1979 to at least 2008, prescribed SST and sea-ice concentration, other forcings as in Historical ensemble above, minimum of 3-member ensemble [Tier-1];
 - ★ Projections following RCP 4.5 and 8.5 concentration scenarios, years 2006-2100, **preferably from models with multi-member ensembles**
 - ★ Optionally: Projection following RCP 2.6 and 6.0 emission scenario, years 2006-2100, **preferably from models with a 3-member ensemble**

- ★ **Regional projections:**
 - ★ Existing simulations from the Euro-CORDEX and Med-CORDEX projects
 - ★ New CORDEX simulations for a pan-European domain based on an agreed “3-D matrix” of regional climate models, boundary conditions from global models, concentration scenarios (RCPs)



C3S IS-ENES activities in C3S

IS-ENES provides backbone services for C3S for climate data

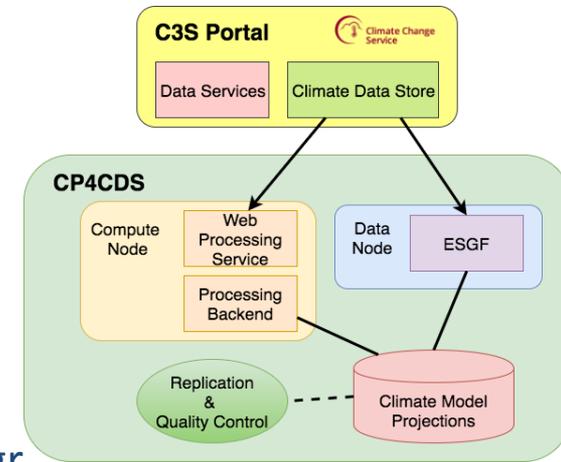
7 projects by IS-ENES3 partners in C3S:

- CP4CDS
- CORDEX4CDS
- C3S MAGIC
- CRECP Roadmap towards a reference set of climate projections for Europe
- PRINCIPLES
- DECM: Data evaluation for climate models
- C3S 512

Relevant for C4I development shortly explained on next slides



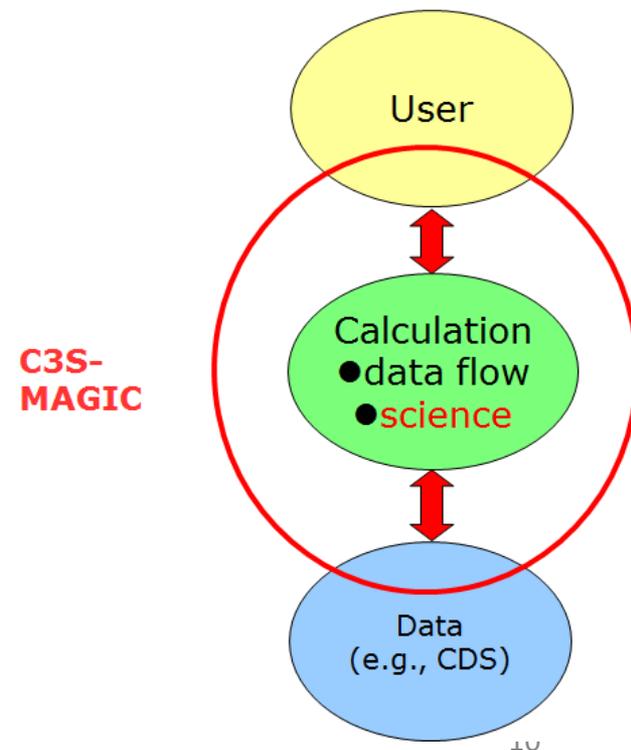
- **CP4CDS: (CEDA, DKRZ, CNRS)**
 - Focus: provide quality controlled subset of CMIP5 data for the CDS
 - Technical focus:
 - ESGF node interfaces integration
 - compute node development. MAGIC code integration
 - high availability load balanced service provisioning



- **CORDEX4CDS (IPSL, DKRZ, CEDA)**
 - Focus: build on CP4CDS to support CORDEX
 - Technical focus
 - Compute services to interpolate regional grids
 - Compute services to ease access to CMIP boundary conditions



- **C3S MAGIC** (KNMI, DLR, NLeSC, BSC, ISAC-CNR, UREAD-NCAS, SMHI)
 - Focus: Software for calculating standardized characteristics (metrics, statistics, time series) from CMIP5 data
 - Technical focus:
 - ‘Containerization’ of C4I
 - New user interface (previews)
 - Workflow
 - Integration of metrics
 - Integration of Birdhouse WPS
 - Enhanced ESMValtool (2.0)





MAGIC Tailored product page - using reusable components

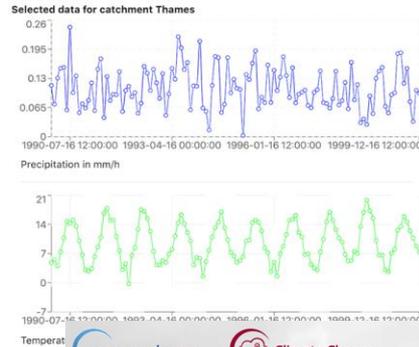
Opennicus Climate Change Service

Home Tailored Products Metrics & Diagnostics Calculate Explore Data About

Feedback Sign in

Hydrology - catchment selector

Impact modelers are often interested in data for irregular regions best defined by a shapefile. With the shapefile selector tool, the user can extract time series or CII data for a user defined region. The region is defined by a user provided shapefile that includes one or several polygons. For each polygon, a new timeseries, or CII, is produced with only one time series per polygon. The spatial information is reduced to a representative point for the polygon ('representative') or as an average of all grid points within the polygon boundaries ('mean_inside'). If there are no grid points strictly inside the polygon, the 'mean_inside' method defaults to 'representative' for that polygon. An option for displaying the grid points together with the shapefile polygon allows the user to assess which method is most optimal. In case interpolation to a high input grid is necessary, this can be provided in a pre-processing stage. Outputs are in the form of a NetCDF file, or as ascii code in csv format. Please check the [shapefile selection metric](#) to calculate.



Opennicus Climate Change Service

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Components like mapping, graphs and page structure will be reused for new setup of C4I

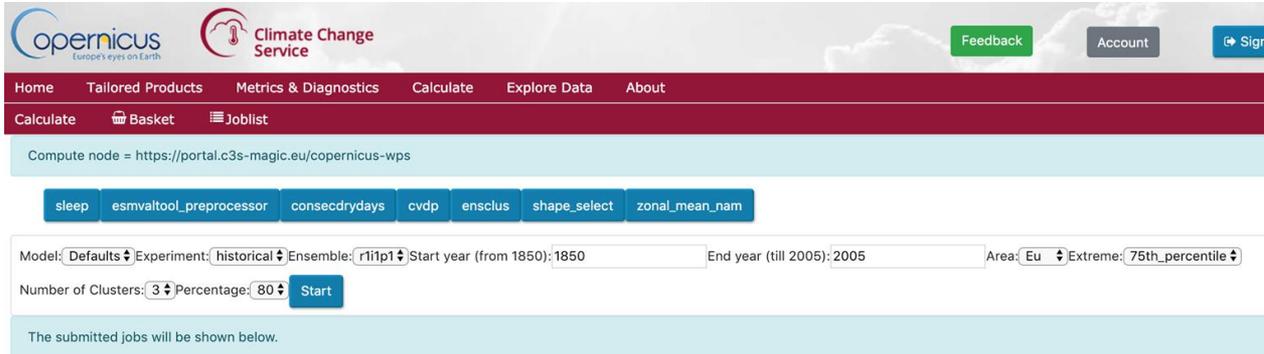
Surge height estimator

Estimates surge levels along the coast of the North Sea from anomalies in mean sea level pressure and wind components. Please check the [surge height diagnostic](#).





MAGIC Calculation page - using reusable components



Your processing results:

0) PyWPS Process Recipe for sub-ensemble selection finished

100

recipe - (recipe)

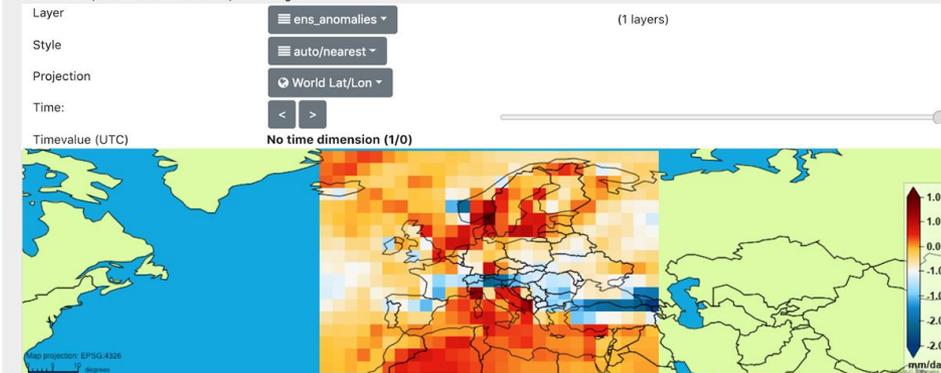
ESMValTool recipe used for p...

```

"root": {
  "documentation": {
    "description":
      string "Recipe for sub-
      ensemble selection"
    "authors": [
      string "mavi.ir"
    ]
  }
}
    
```

Data - (data)

Generated output data of ESMValTool processing.



Statistics - (statistics)

Clustering Statistics

Calculations through WPS version of ESMValtool

Output accessible for the user (recipe, log file, output plots, data and tarball will all outputs)



Frequently users request [tailored] climate indices

- Core set of indices well established through WCRP & WMO Expert Teams
- Widely used, e.g. in IPCC assessment cycles
- C4I implements all core indices, and more
- A key component of many/most C3S Sectoral Information System (SIS) projects

Consistent metadata description is currently lacking

- Different data services provide inconsistent/insufficient metadata
- Hampers streamlined publication and data fusion for high-level analyses and interpretation
- Has been identified as an issue in several C3S/SIS projects (→ ad hoc "solutions")

IS-ENES-3 activities

- Build on existing CF Conventions machinery to define metadata for core indices
- Technical expert workshop to explore possibilities to extend CF Conventions or provide/suggest extensions, and identify outstanding issues (WP3/NA2)
- Interaction with user communities (WP3/NA2)
- Implement the metadata standard in ICCLIM and C4I (WP10/JRA3)



- ★ **Improved reliability** in the access to climate projection data through the Climate Data Store
- ★ **Products computed from models** which show **good fidelity** in the simulation of climate during the recent decades (as quantified by appropriate **metrics**)
- ★ Improved **estimates of uncertainties** allowed by focusing on models that provide ensemble simulations of individual scenarios
- ★ **User defined indices and products** tailored to specific application sectors
- ★ **Quality and usability of products tested** by an Evaluation and Quality Control consortium



- **C4I**
 - Focus making all ESGF climate model data (CMIP, CORDEX) available for climate research community, climate impact community as well as interdisciplinary research community
 - Tailored tools and visualizations
 - WPS processing (birdhouse pyWPS), interactive and batch
 - Userspace for storing results, which can be shared
 - Science/research community focus
 - Metadata Standards developed for new products (indices, ...)

- **C3S**
 - Provide authoritative information about the past, present and future climate, as well as tools to enable climate change mitigation and adaptation strategies by policy makers and businesses.
 - Quality controlled climate data
 - Subset of CMIP/CORDEX
 - Generic toolkit, interactive usage
 - Industry/policy focus



- **ESGF & C3S**

- Currently provide data services linking C3S to CMIP5 data;
- Data and services are parallel to global ESGF federation ... duplication of resources;
- CP4CDS funding does not cover hardware costs incurred;
- Can we reduce duplication of effort here?
 - Option A: deliver data instead of services (C3S now has storage) ...
 - + simplify interface to C3S;
 - creates barrier to future integration of services;
 - Option B: improve ESGF architecture to remove requirement for duplication ...
 - + preserves clean IPR management of ESGF;
 - unfunded development work required;



First steps for enabling cooperation:

- Agree C3S and IS-ENES-C4I are complementary
- Setup communication

Possibilities for cooperation:

- Connect to CDS from C4I:
 - Valuable asset for impact researchers
 - Use in C4I toolset (calculations, visualizations)
- Provide expertise on data, processing,
 - WPS, ESMValtool, ...
 - Cooperation on user engagement and requirements
 - Use C3S experience and network
- Link to each others portals
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