is-enes
INFRASTRUCTURE FOR THE EUROPEAN NETWORK FOR EARTH SYSTEM MODELLING

European Geosciences Union 2015
Vienna, Austria

CAPACITIES

INTRO

Real use of open standards and technologies http://climate4impact.eu/

How open source software and open standards for data access and exploration are successfully applied in the "Climate for impact" portal.

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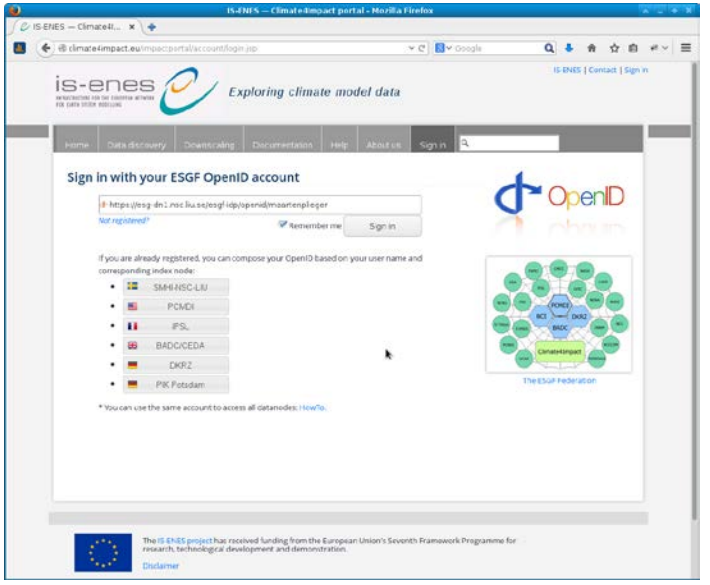
INTRO

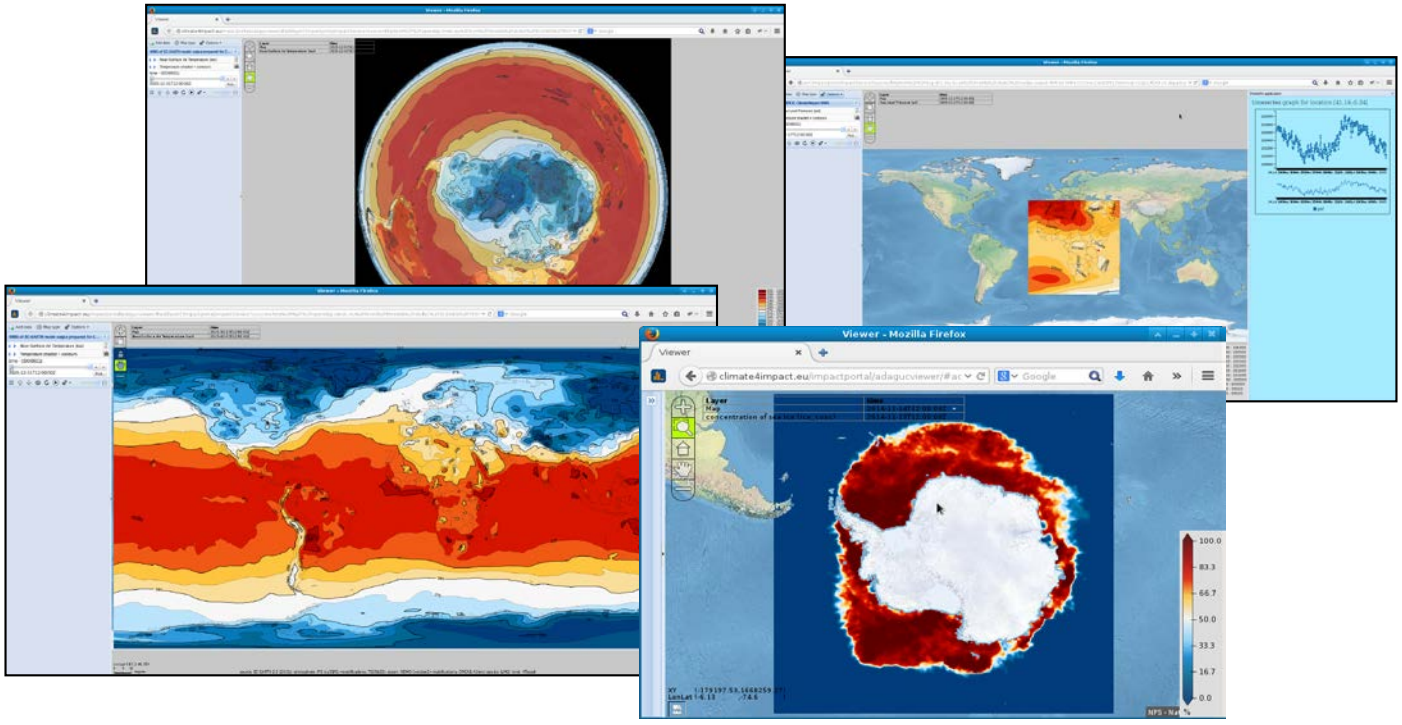
http://climate4impact.eu/

- Platform for impact researchers to explore climate data and perform analysis
- Current phase:
  - Implementing real use cases from impact researchers
  - Bulk download, bulk processing, etc…
- Search ESGF infrastructure for global climate models and regional climate models (CMIP5 / CORDEX)
- Visualize ESGF data - using ADAGUC Web Map Services
- Perform calculations / process data - PyWPS and ICCLIM
  - Climate indices calculation and data reduction
  - Personal store for processing outcomes
- Upload and store your own data
  - Visualize your own data online!
  - Process your own data online!



Real use of open standards and open source software:

- Data access over OPeNDAP → THREDDS
- Online analysis using Web Processing Services → PyWPS and ICCLIM
- Online visualization using Web Map Services → ADAGUC WMS
- Single Sign On using OpenId, delegation using MyProxy X509



Interested? Come and take a look at PICO screen 1.2 !!!

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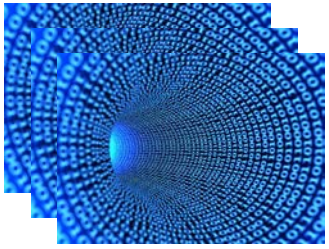
Data standards

Work done on client

Data files
HTTP / FTP

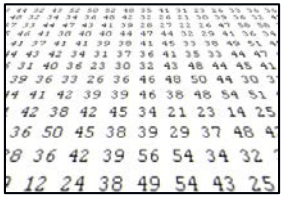


Array based data

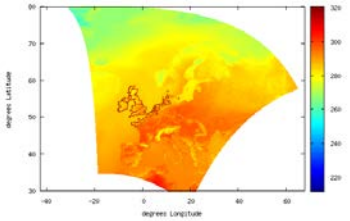
OPeNDAP

01001010010
01010010010
10010100100
10010011000

Referenced data
OGC WCS



Graphics
OGC WMS



Work done on server

(de Boer & Plieger, 2014)

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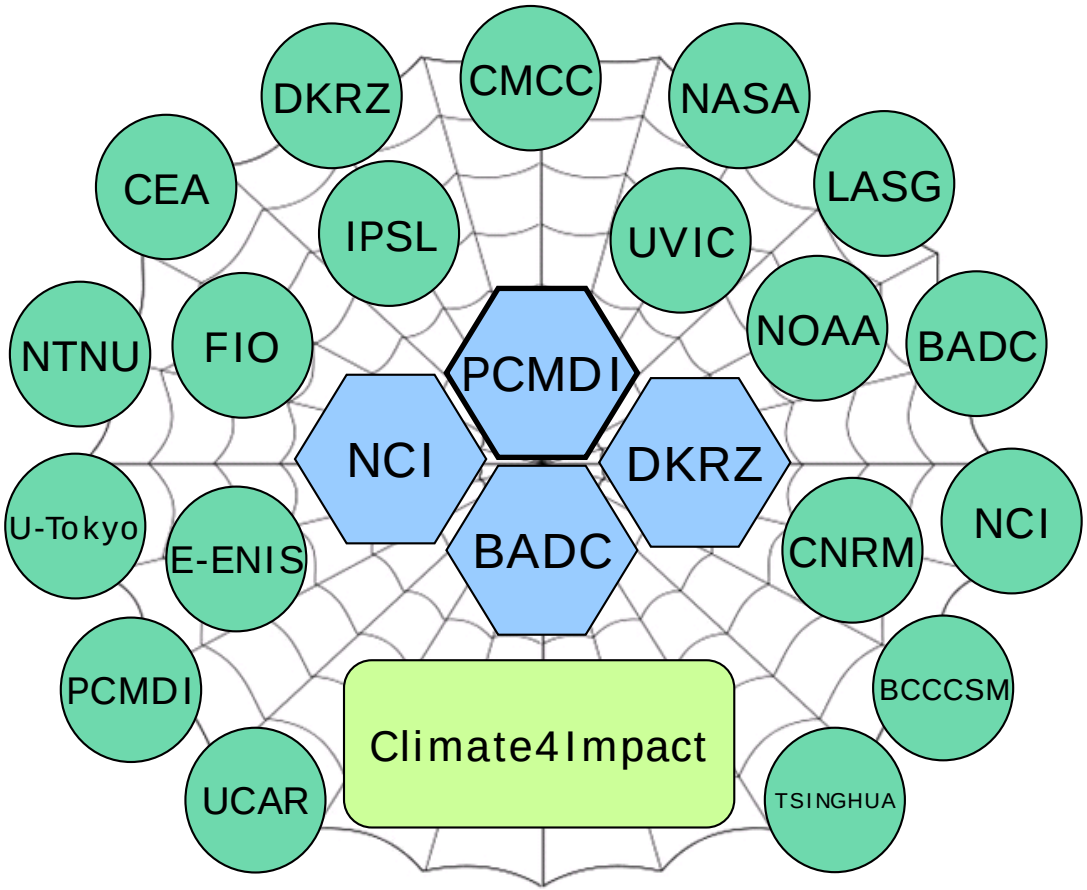
Earth System Grid Federation



ESGF
Earth System Grid Federation

- Robust and distributed
- Index nodes (blue)
- Data nodes (green)
- Global Climate Model Data (CMIP5)
- Regional Climate Model Data (CORDEX)
- ~3 Petabyte of data
- Security: OpenId and X509
- **Search API offered**
- **OpenDAP data access offered**

- Climate4impact builds on and contributes to this global infrastructure

OPeNDAP – for data access and subsetting

- OPeNDAP is the name of the organization and the name of the protocol
  - Open-source Project for a Network Data Access Protocol
- Data is stored at remote server
- Data model is similar to NetCDF's data model (with differences)
  - N-dimensional array container, with variables, dimensions and attributes
- Only requested pieces of data are sent
  - Accessing small pieces of large files on a remote server can still be quick
  - Data is requested based on sub-setting along dimensions
- OPeNDAP resources can be opened locally on your computer as if it were local files using the NetCDF library
  - Local files versus remote files is transparent
- The concept of a file is gone, an OPeNDAP endpoint can represent thousands of files aggregated along a dimension
  - E.g. Usually concatenate a large time series observation to one endpoint using the time dimension

OPeNDAP within ESGF is served using the THREDDS data server

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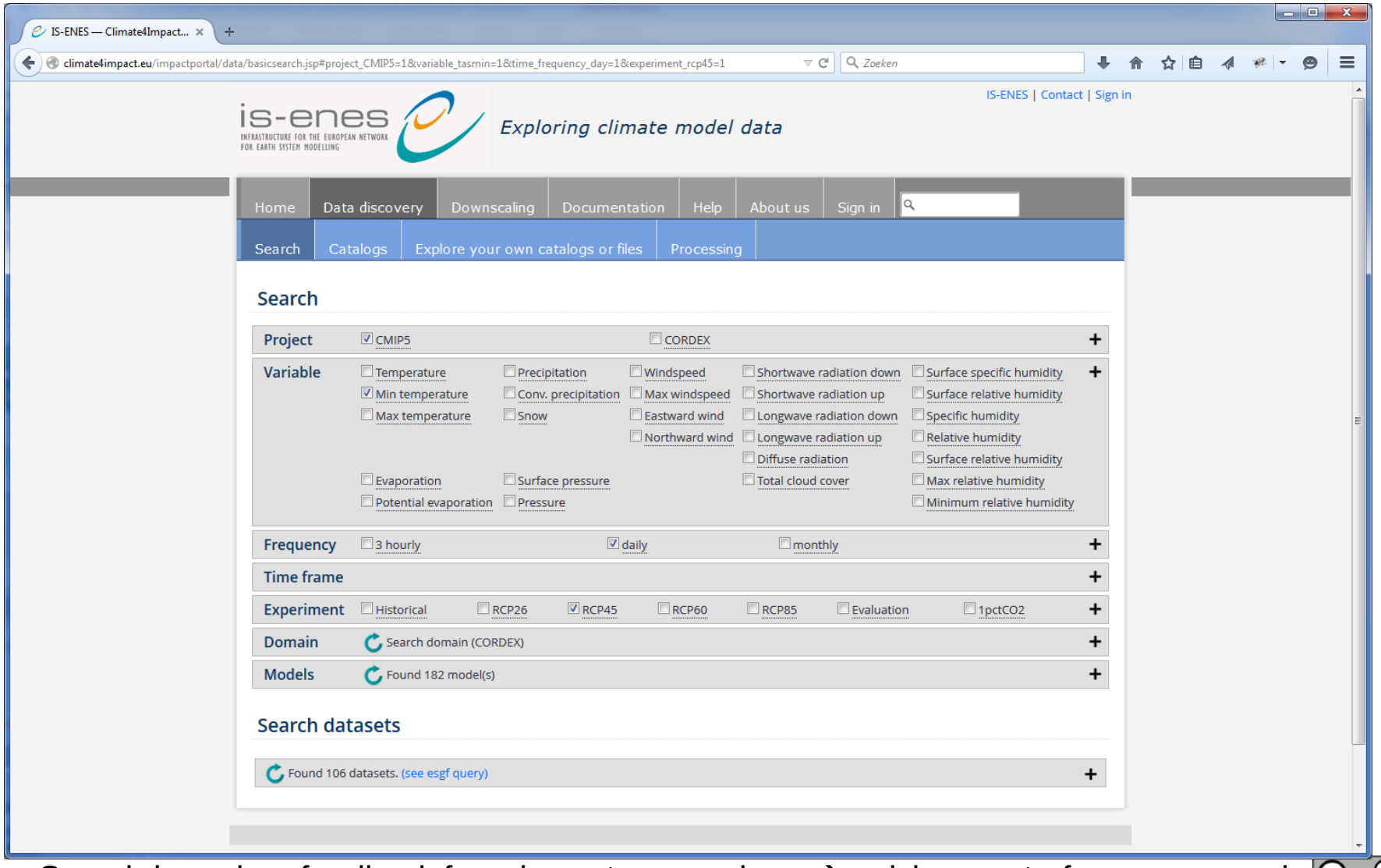
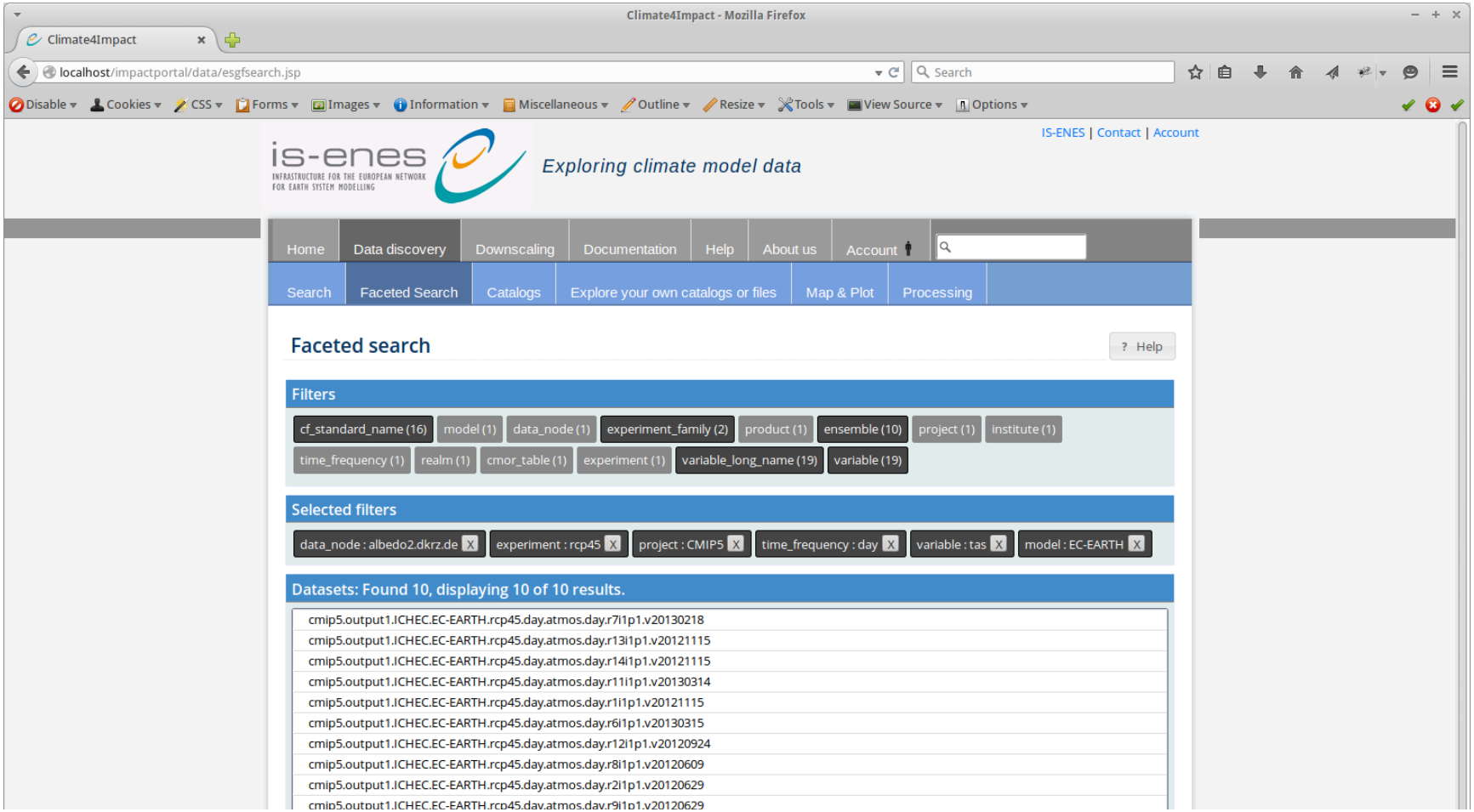


Search based on feedback from impact researchers → quick preset of common queries

New faceted search

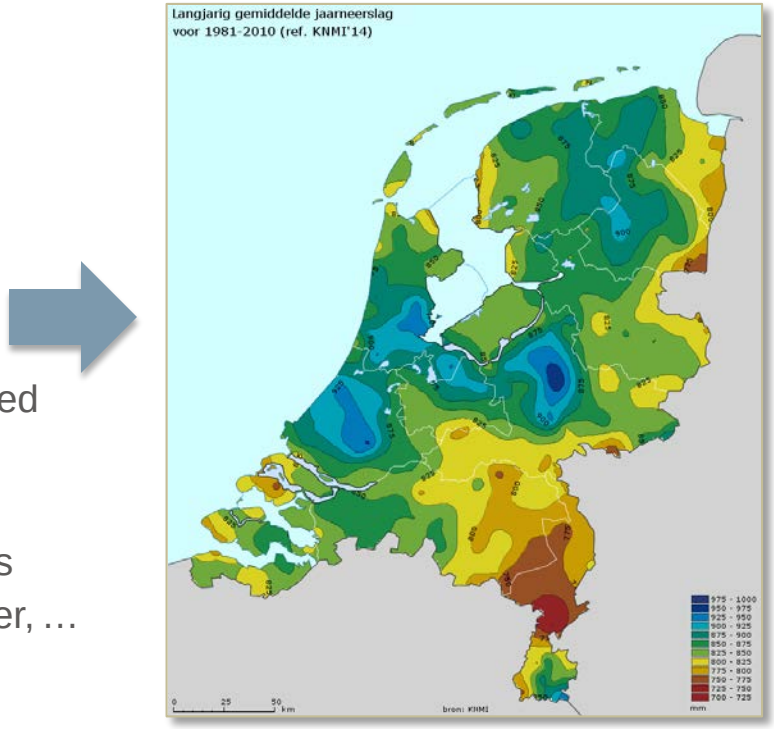


Faceted search allows to drill down search results using available filters in the federation
Results from a search query are treated as a new dataset

Web Map Service – for visualizations

- Generates visualizations of geospatial data in the form of 2D images, suitable for transfer over the internet (JPG/PNG/GIF)

- REST based:
  - Compose an URL with key value pairs,
    and you will get an image!
- Standard is developed and maintained by the Open Geospatial Consortium
- Generated images are geo-referenced
  - Images from several sources can be easily combined
- Images have dimensions
  - Time, elevation, member
- WMS services can be viewed in many web based clients
  - OpenLayers, Leaflet, GoogleMaps, ADAGUC viewer, …



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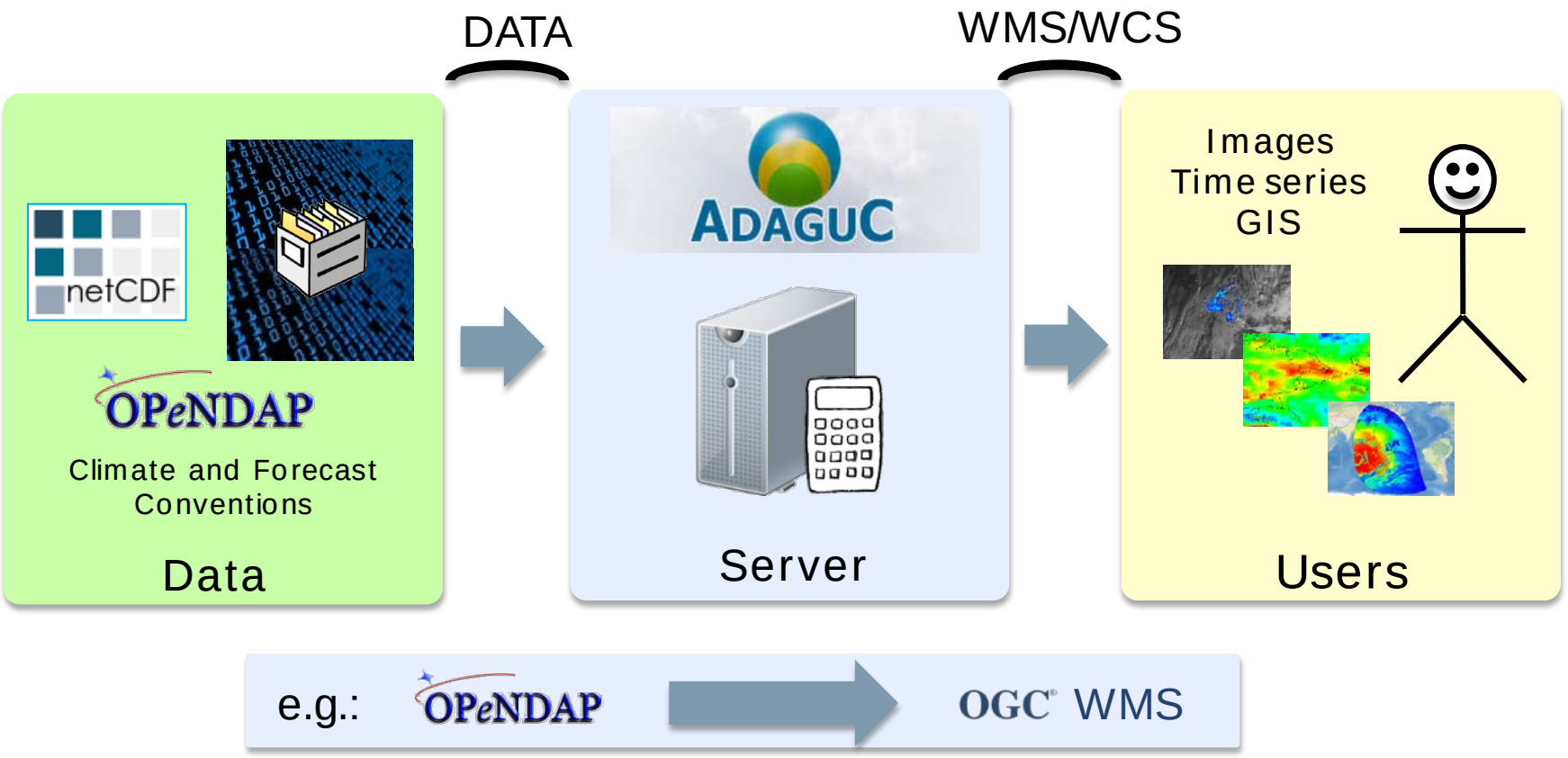
ADAGUC Web Map and Web Coverage server



Geographical visualization framework using open standards and formats: http://adaguc.knmi.nl/

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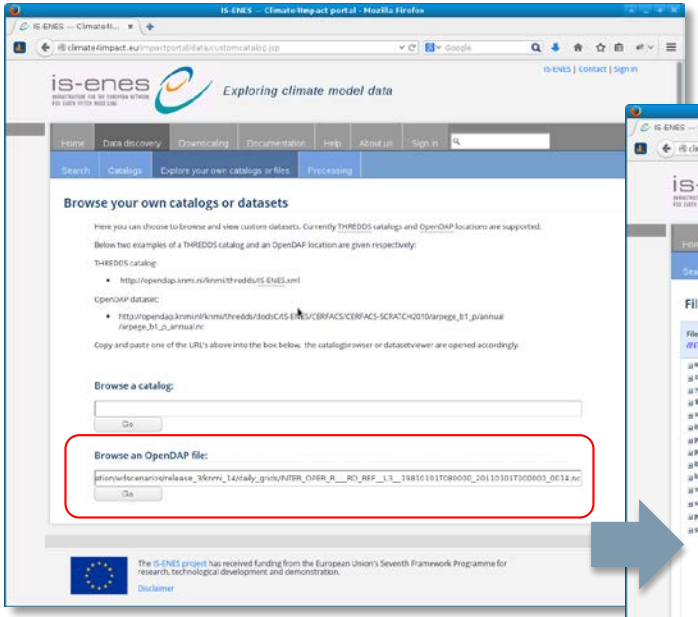
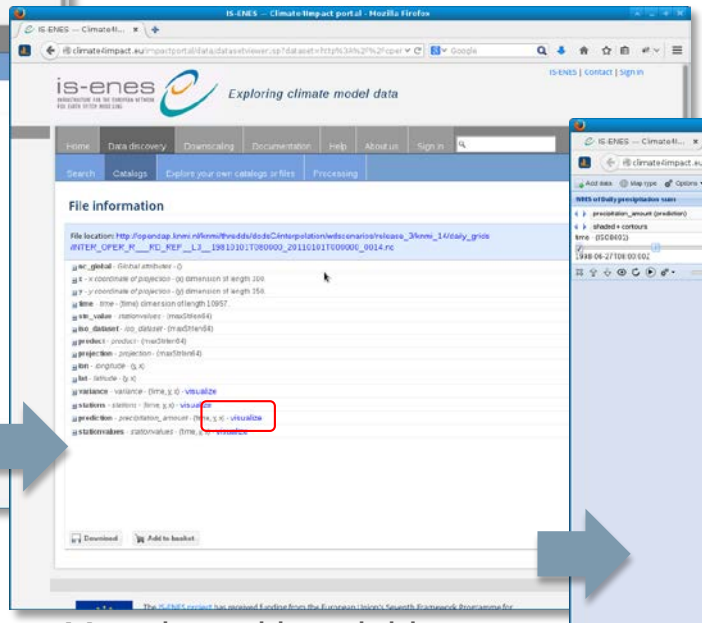
Web Map Services based on OPeNDAP resources

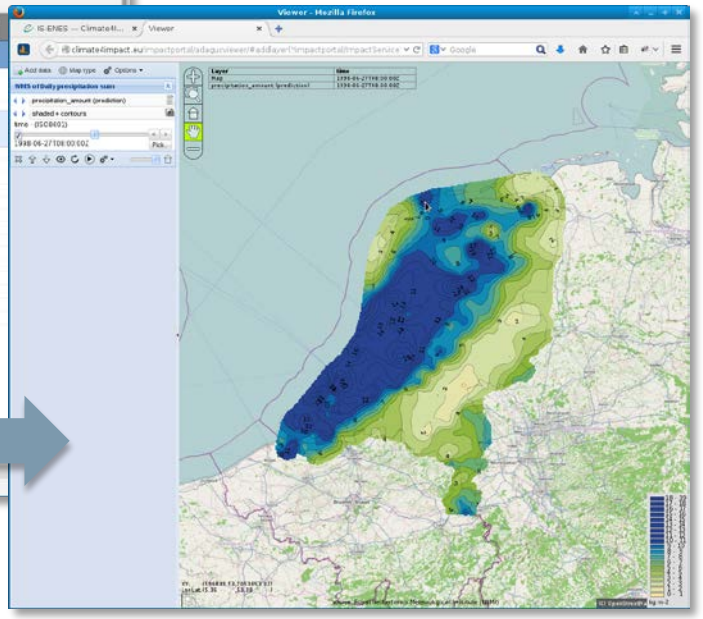
Climate4impact.eu allows for creation of WMS visualizations on OPeNDAP endpoints:



Go to “Data discovery” → “Explore your own catalogs or files”



Metadata with variables to be visualized is displayed



ADAGUC viewer displaying the WMS

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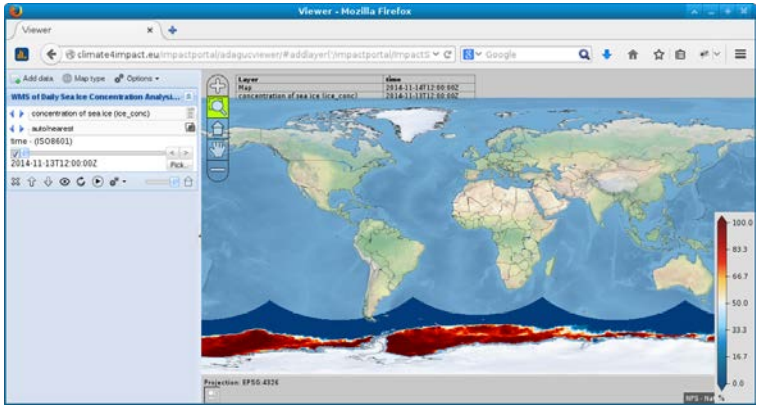
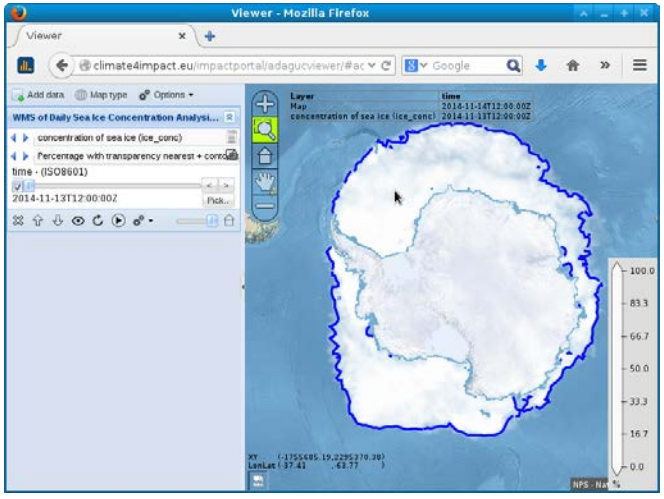
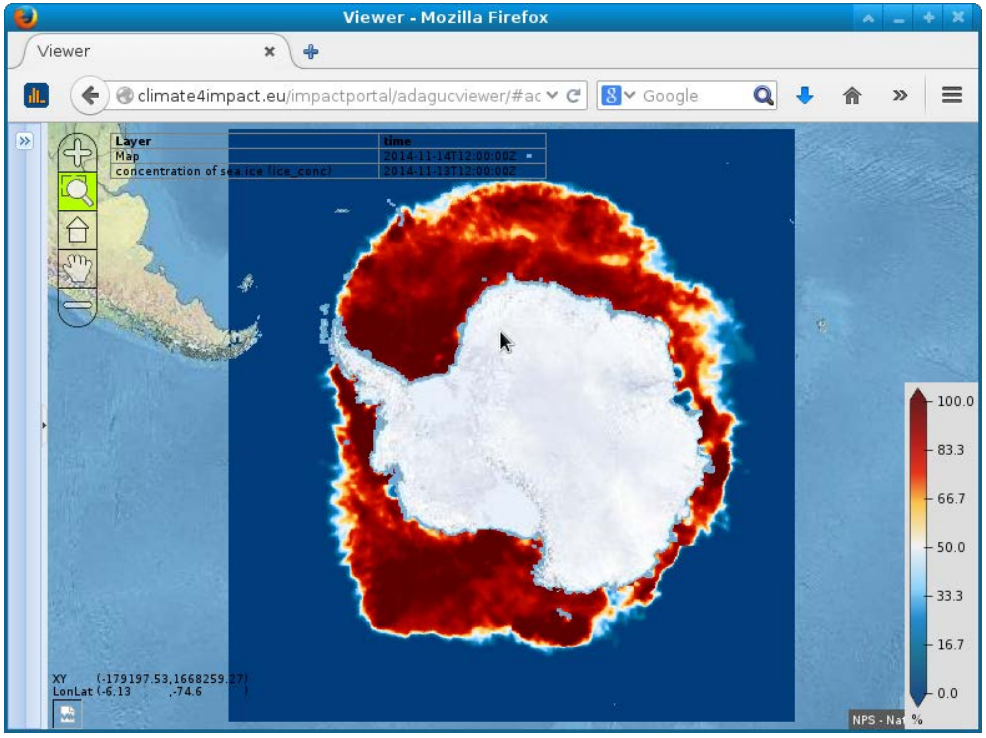
Example: Many existing resources with OpenDAP enabled can already be visualized!







Concentration of sea ice for 2014-11-13

EUMETSAT Ocean and Sea ICE SAF from Norwegian Meteorological Institute

http://met.no/Hav_og_is/English/Access_to_data/

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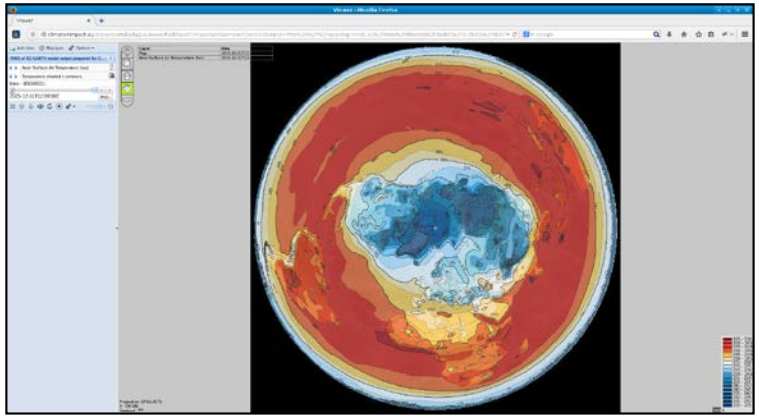
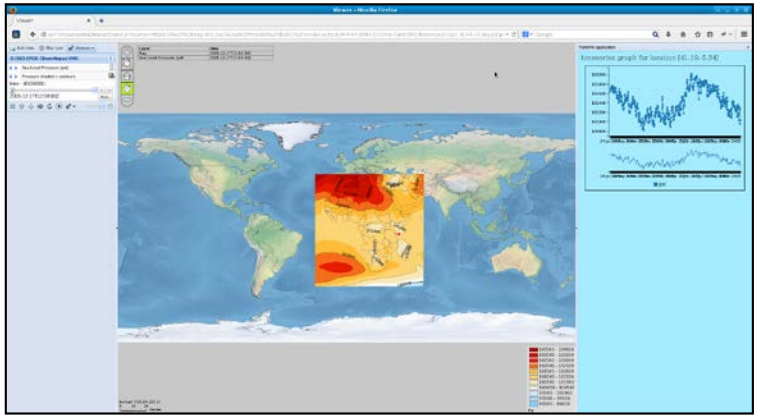
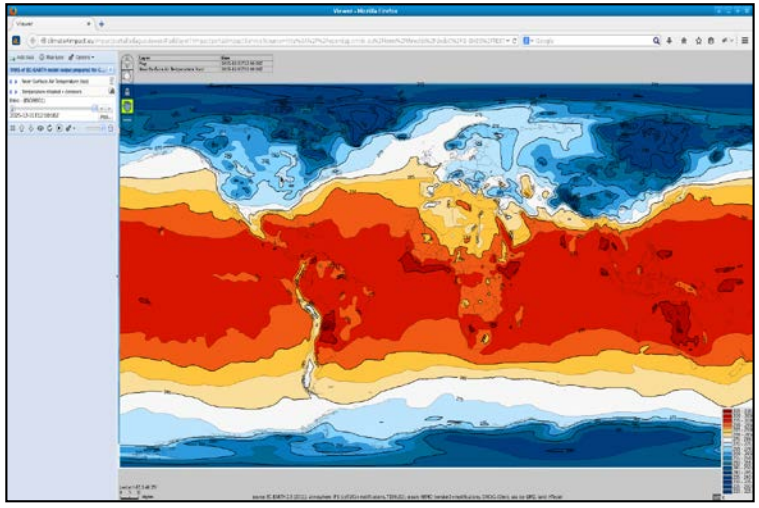
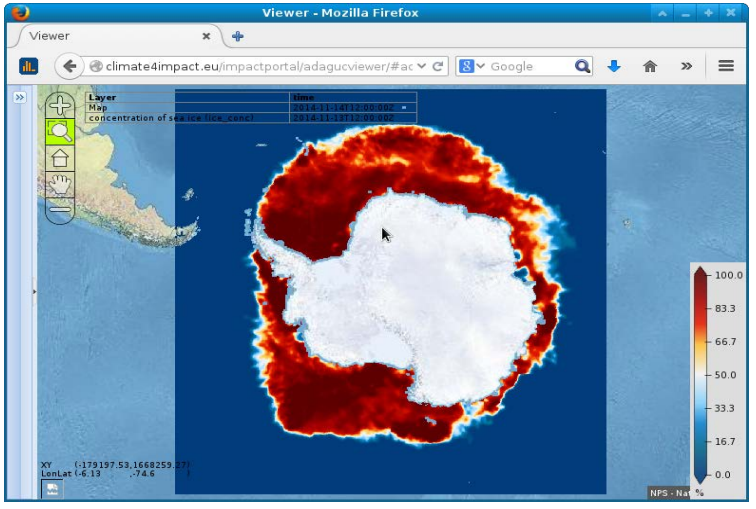
Example: Many existing resources with OpenDAP enabled can already be visualized!









CMIP5 - global climate models

CORDEX - regional climate models

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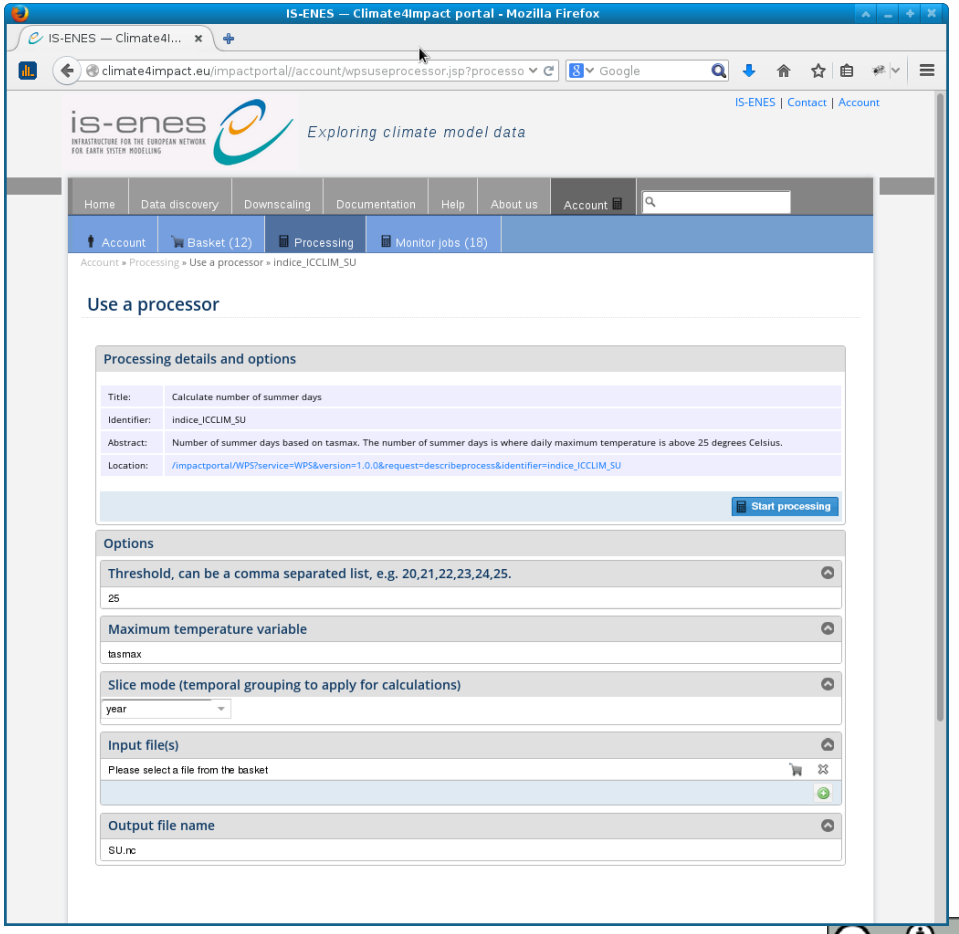
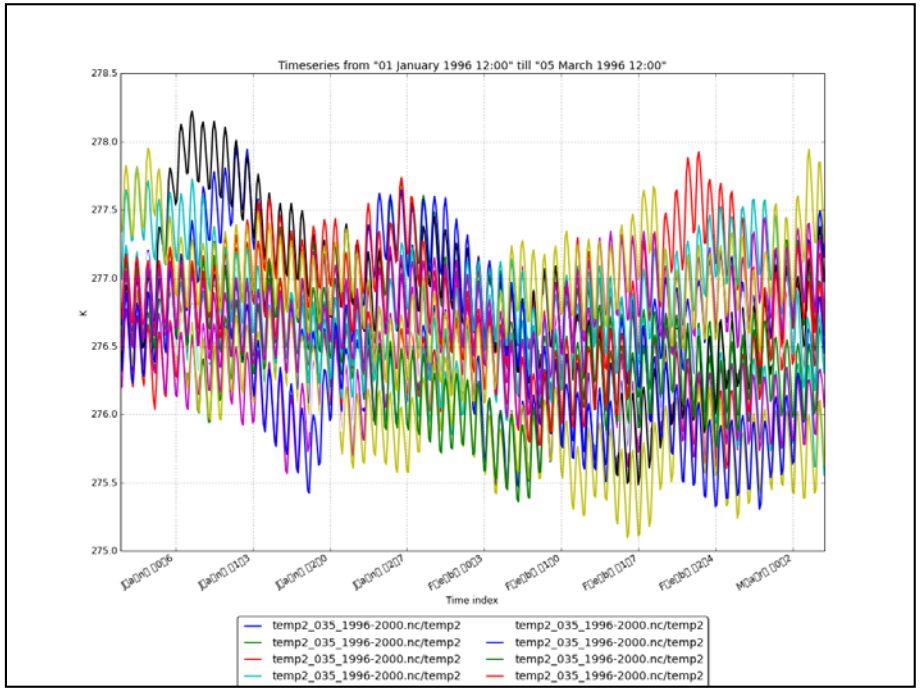
Web Processing Service for climate indices calculations

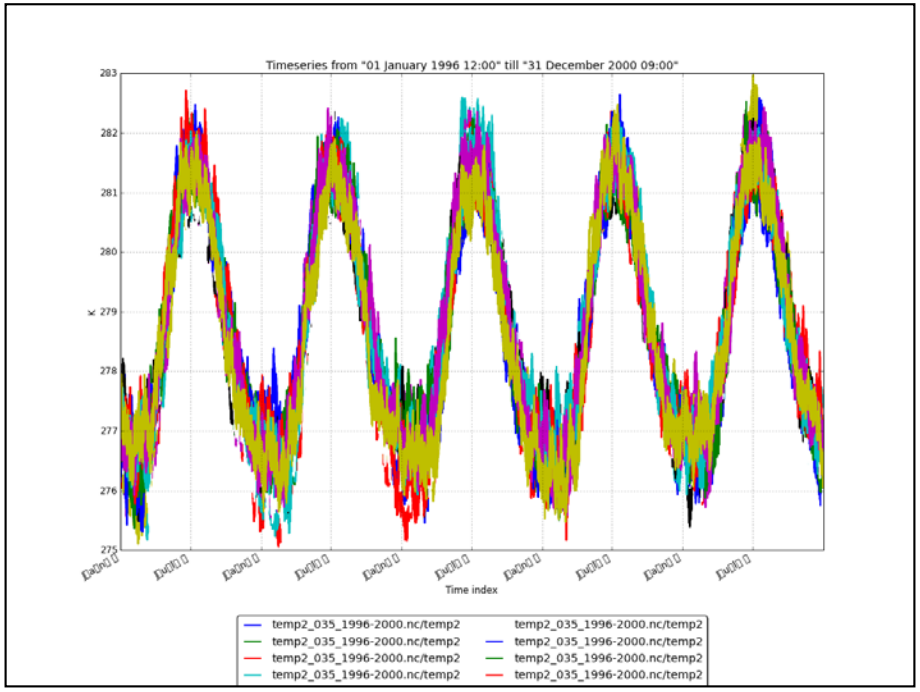
- Uses PyWPS and ICCLIM
- User interface is build automatically based on DescribeProcess XML file.
- Interface supports:
  - Link to basket
  - Comboboxes / select from list
  - Strings/text elements
- IS-ENES2 is working on an indices wizard for user friendly indices calculation
- Climate4impact WPS can be interfaced to other processing packages
- Climate indices calculations have added value!



Multi member timeseries – created with WPS



3 months



5 years

Temperature for several ensembles from the ESSENCE dataset

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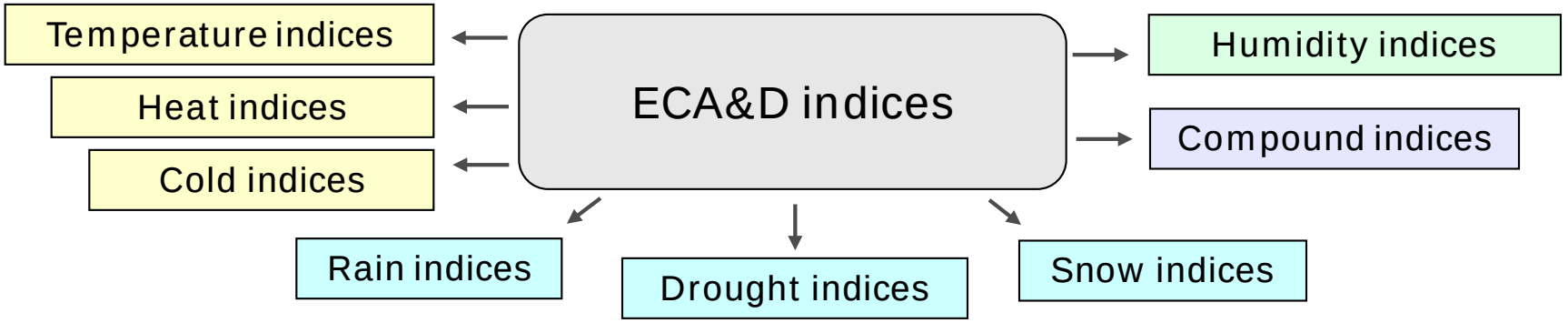
Indices calculation using ICCLIM – developed in IS-ENES



- Intra-period extreme temperature range [° C] - **ETR**
- Warm days (days with mean temperature > 90th percentile of daily mean temperature) - **TG90p**
- Summer days (days with max temperature > 25 ° C) - **SU**

- Python code developed at CERFACS, started in September 2013
  - Generic and modular approach, can be reused in other environments
  - C functions called for optimization
- I/O interface is structured for optimal performance, with wrapper functions
- Some percentile-based indices (TG10p, TX10p, TN90p, etc): **OpenClimateGIS**

ICCLIM source code and documentation is available via https://github.com/cerfacs-globc/icclim

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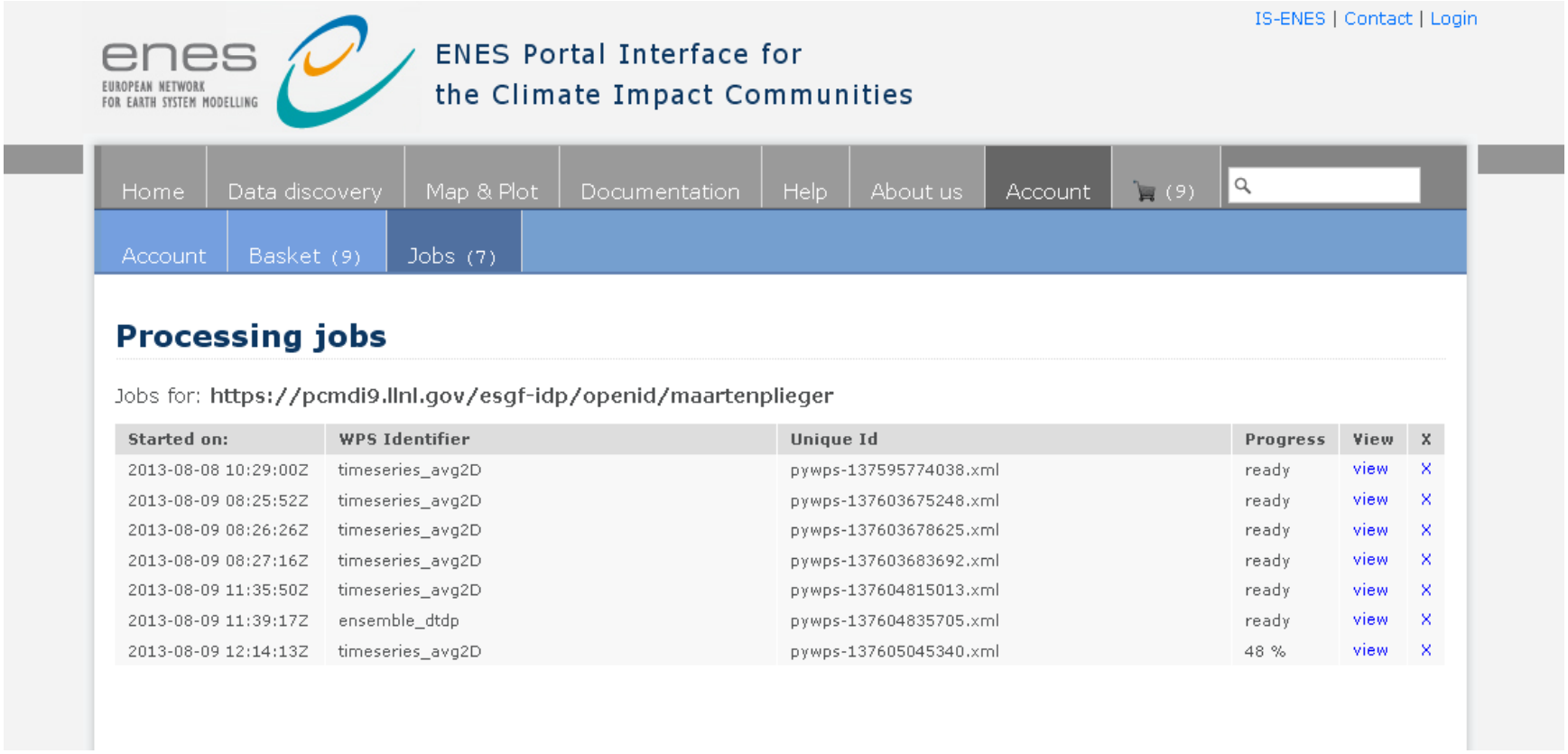
Web Processing Service

Job progress can be viewed from anywhere



Started on:	WPS Identifier	Unique Id	Progress	View	X
2013-08-08 10:29:00Z	timeseries_avg2D	pywps-137595774038.xml	ready	view	X
2013-08-09 08:25:52Z	timeseries_avg2D	pywps-137603675248.xml	ready	view	X
2013-08-09 08:26:26Z	timeseries_avg2D	pywps-137603678625.xml	ready	view	X
2013-08-09 08:27:16Z	timeseries_avg2D	pywps-137603683692.xml	ready	view	X
2013-08-09 11:35:50Z	timeseries_avg2D	pywps-137604815013.xml	ready	view	X
2013-08-09 11:39:17Z	ensemble_dtdp	pywps-137604835705.xml	ready	view	X
2013-08-09 12:14:13Z	timeseries_avg2D	pywps-137605045340.xml	48 %	view	X

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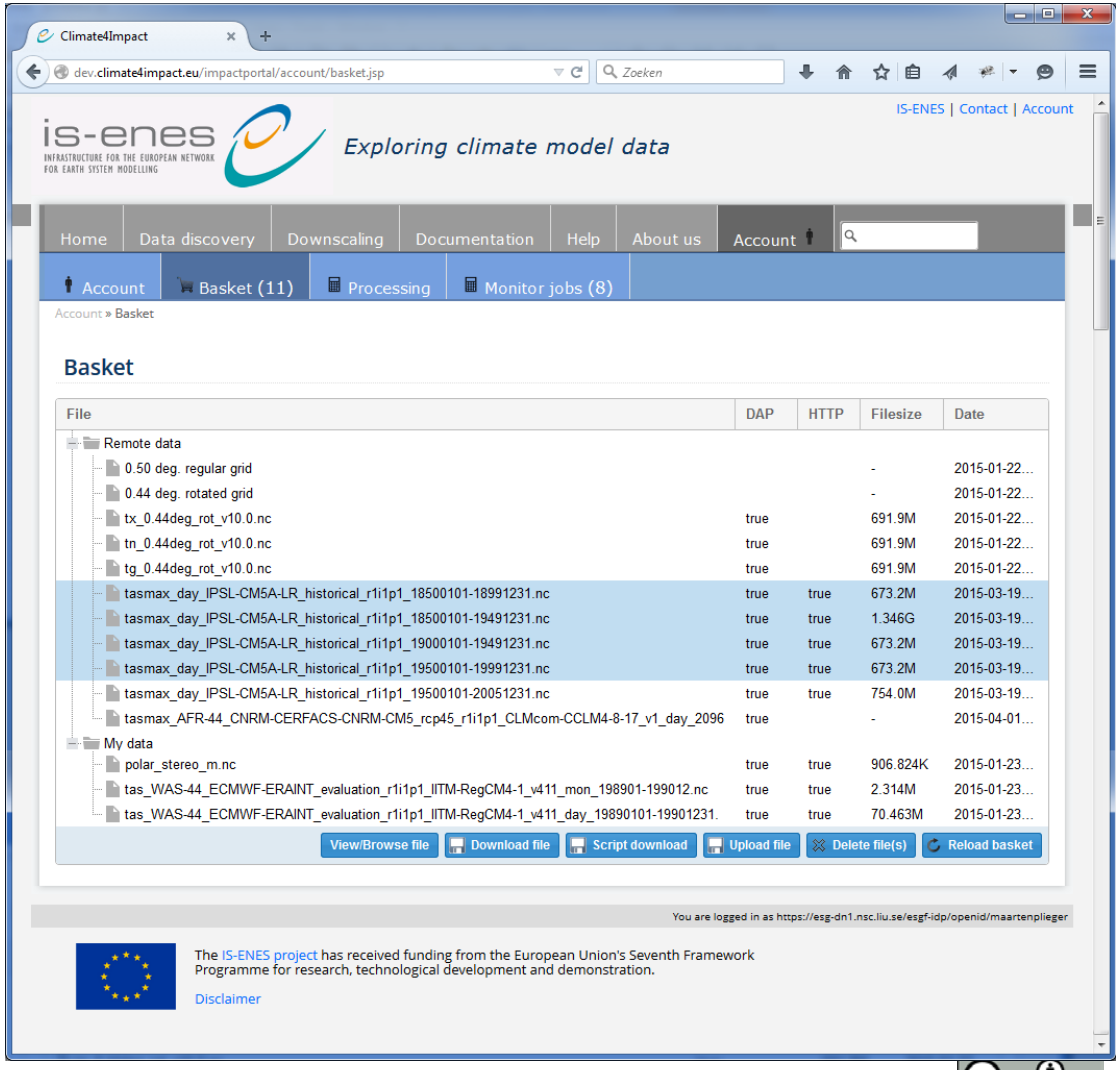
- By default the basket contains:
  - "Remote data" for links
  - "My data" for your own data
- Script based download allows to select and download multiple files
- Client certificate (x509) is embedded in download script
  - No need for MyProxy login
  - No need for firewall changes
- The basket allows for uploading your own files
  - Can be used in processing or visualization



Conclusion and next steps

- Climate4impact enables impact research

- Climate4impact is flexible due to applied technologies and standards
  - ADAGUC WMS can be used to visualize local and remote files
  - PyWPS with ICCLIM is suitable as generic processing framework for climate indices
  - OPeNDAP can be used to access small bits of large files over the internet quickly

- Climate4Impact enables easier use of ESGF services
  - Search many datasets from several projects
  - Data access and visualization via OPeNDAP
  - Security is offered in a more user friendly way

- Next steps:
  - Improve user interface → make more user friendly
  - Implement use cases from climate impact researchers
  - Finalize the connection to the University of Cantabria downscaling portal
  - Climate indices calculation wizard

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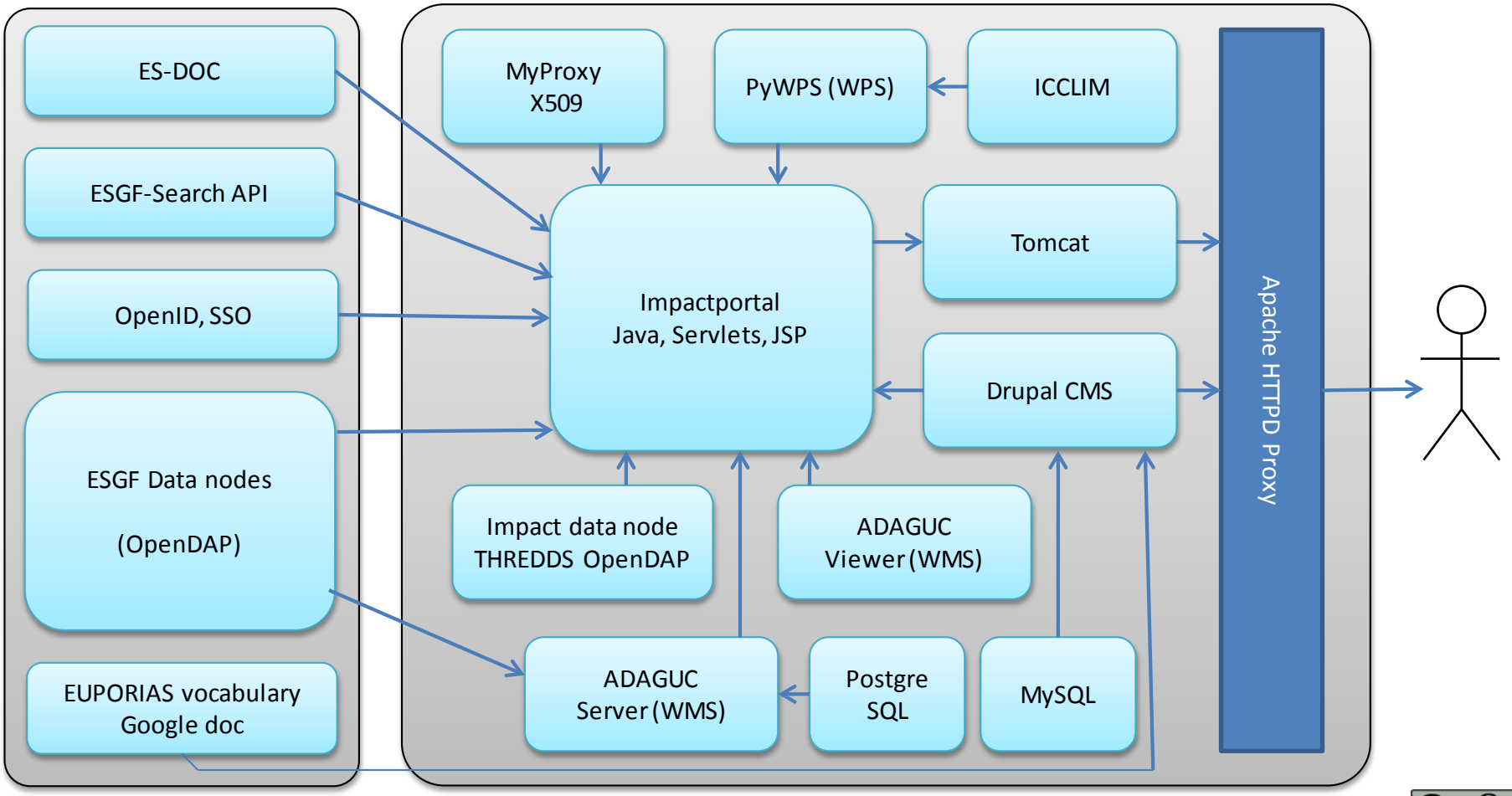
How components fit together