

**Earth System Grid  
Federation**  
**Face to Face meeting**  
**9-11 December 2014**  
*Livermore, California*



**<http://climate4impact.eu/>**

Bridging CMIP5 and CORDEX data infrastructure to impact users

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Max-Planck-Institut  
für Meteorologie



Royal Netherlands  
Meteorological Institute  
Ministry of Transport, Public Works  
and Water Management



## IS-ENES2 climate4impact.eu

<http://climate4impact.eu/>

- Dedicated to the climate impact community: based on 21 use cases from e.g, Deltares, Alterra, UvA.
- Dissemination of model results from both global and regional model experiments
- Extensive documentation for impact modelers: guidelines, warnings, do's and don'ts
- Facilitates interaction between climate modelers, companies and climate services
- Search, visualize and compute: from Petabyte to megabyte size reduction, drill down to the information needed, downscaling and indices

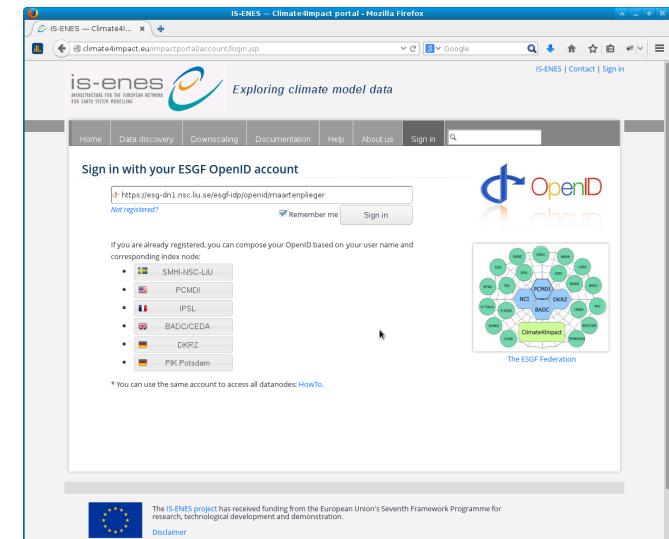
Builds on and contributes to ESGF global infrastructure:



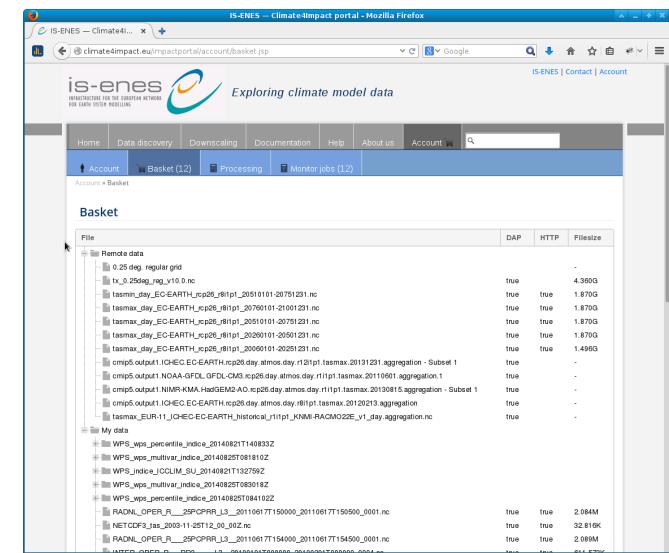
# Climate4Impact overview (IS-ENES2)

## Features and developments

- Login with ESGF open id identifier, system helps with OpenID composition
- Uses x509 client certificates for server side data access
- Search ESGF infrastructure for CMIP5 / CORDEX
- Visualize ESGF data using ADAGUC WMS
- WPS processing can be done on files in basket
  - ICCLIM indices calculation and time series
  - Processing results are put in your basket
- Everyone who logs in has a personal basket
  - Upload and store your own data
    - Data served again via OPeNDAP
  - Visualize your own data online!



The screenshot shows the sign-in page for the Climate4Impact portal. It features the IS-ENES logo and the text "Exploring climate model data". Below this is a form for signing in with an ESGF OpenID account, with fields for "Not registered?" and "Remember me". A "Sign in" button is also present. To the right of the form is a diagram titled "The ESGF Federation" showing a network of nodes connected by lines, representing the data distribution system.



The screenshot shows the "Basket" section of the Climate4Impact portal. At the top, there are tabs for "Home", "Data discovery", "Downscaling", "Documentation", "Help", "About us", and "Account". The "Account" tab is selected. Below the tabs, there are buttons for "Basket (12)", "Processing", and "Monitor jobs (12)". The main area is titled "Basket" and contains a table of uploaded files. The columns in the table are "File", "DAP", "HTTP", and "Filesize". The table includes rows for "Remote data" (such as tasmin\_day\_EC-EARTH\_rcp26\_r1i1p1\_20510101-20751231.nc) and "My data" (such as WPS\_wps\_percentile\_indexe\_20140821T140932.nc). The "File" column shows file names, and the "Filesize" column shows file sizes in bytes.

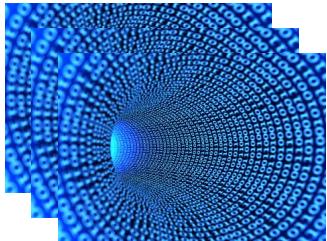
## Data → OPeNDAP → WCS → WMS

Work done on client



Data files

HTTP / FTP



Array based data

**OPeNDAP**

01001010010
01010010010
10010100100
10010011000

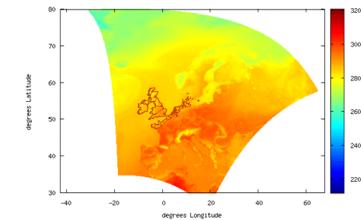


Referenced data  
**OGC® WCS**

49 32 47 24 29 26 45 23 35 21 54 53 16 55 32
27 33 44 47 43 41 39 26 27 22 26 47 56 58
46 41 38 40 40 44 47 44 32 29 41 36 54
45 42 37 34 31 37 36 41 35 33 44 47
14 42 42 34 31 37 36 41 35 33 44 47
31 40 36 23 30 32 43 48 44 45 41
39 36 33 26 36 46 48 50 44 30 31
14 41 42 39 39 46 38 48 54 51
14 42 38 42 45 34 21 23 14 25
36 50 45 38 39 29 37 48 47
18 36 42 39 56 54 34 32 1
12 24 38 49 54 43 25



Graphics  
**OGC® WMS**

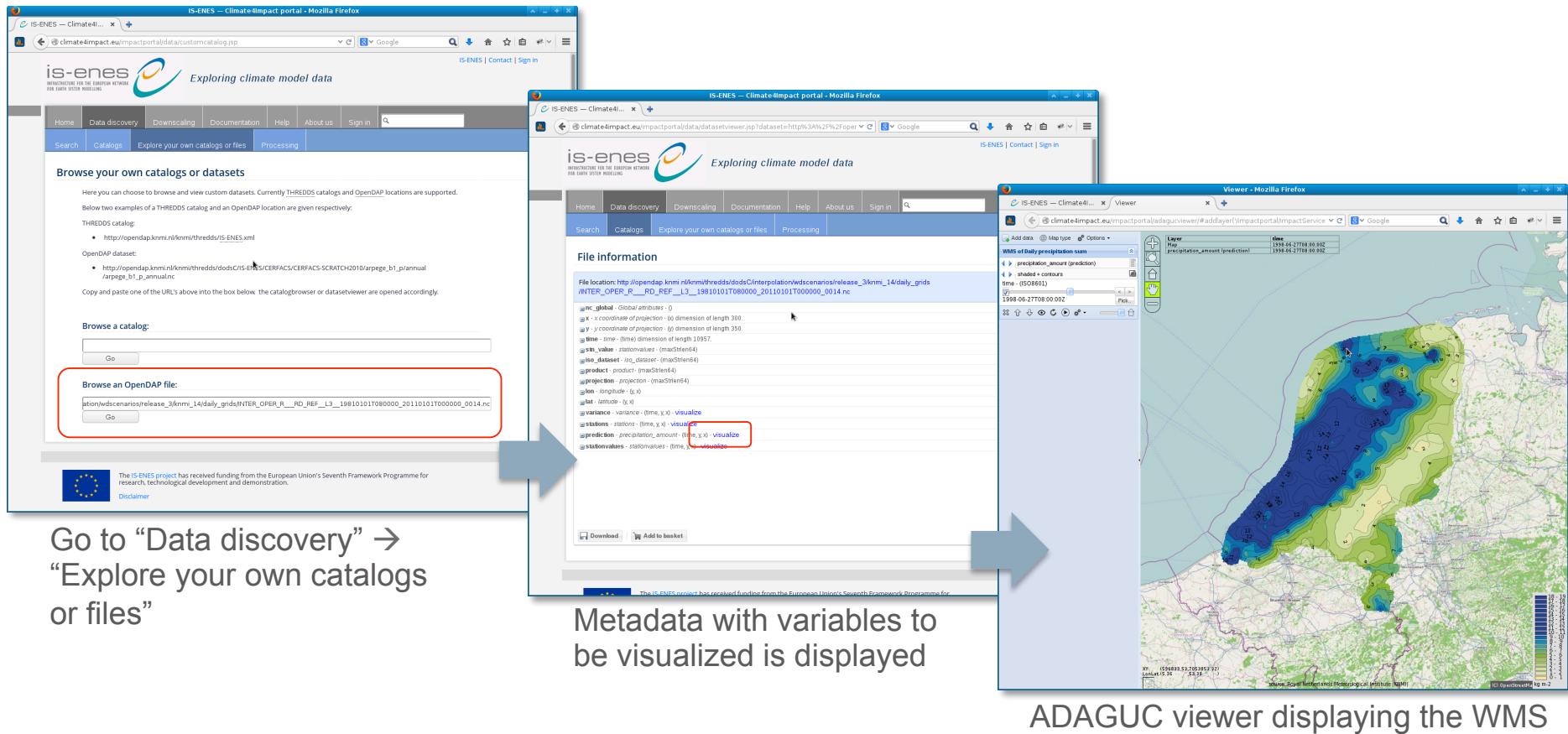


Work done on server

(de Boer & Plieger, 2014)

# Web Map Services based on OPeNDAP resources

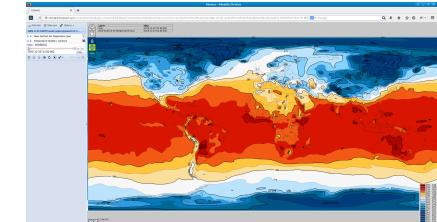
Climate4impact.eu allows for creation of WMS on OPeNDAP endpoints:



## How to create WMS services on OpenDAP at C4I

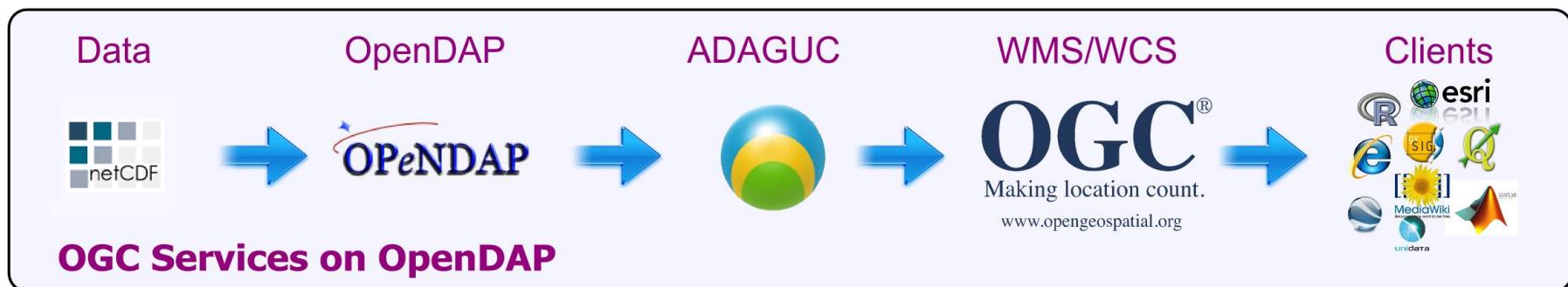
No additional configuration required!

- Provide your opendap URL as source parameter to the WMS service:

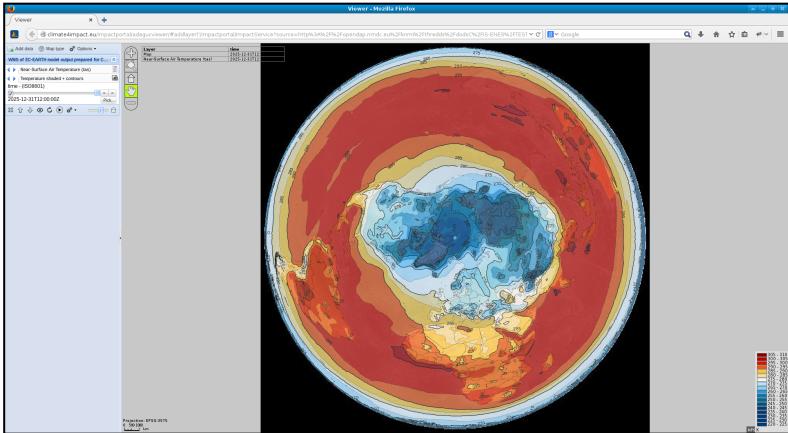


<http://climate4impact.eu/impactportal/ImpactService?source=<urlencoded opendap endpoint>&>

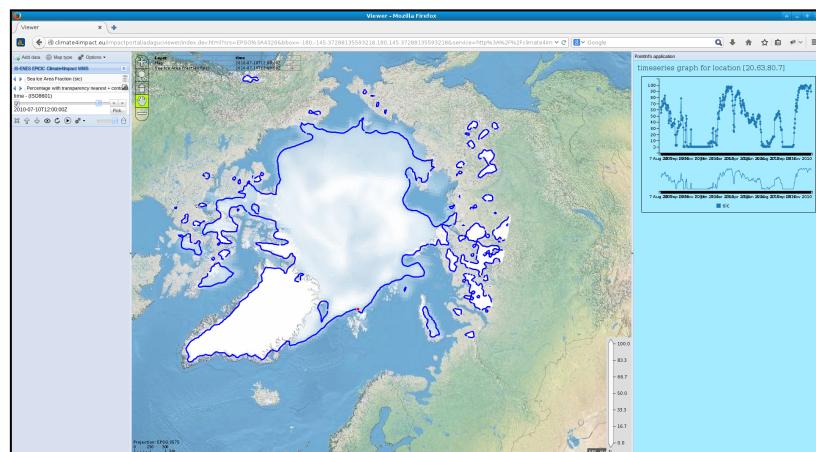
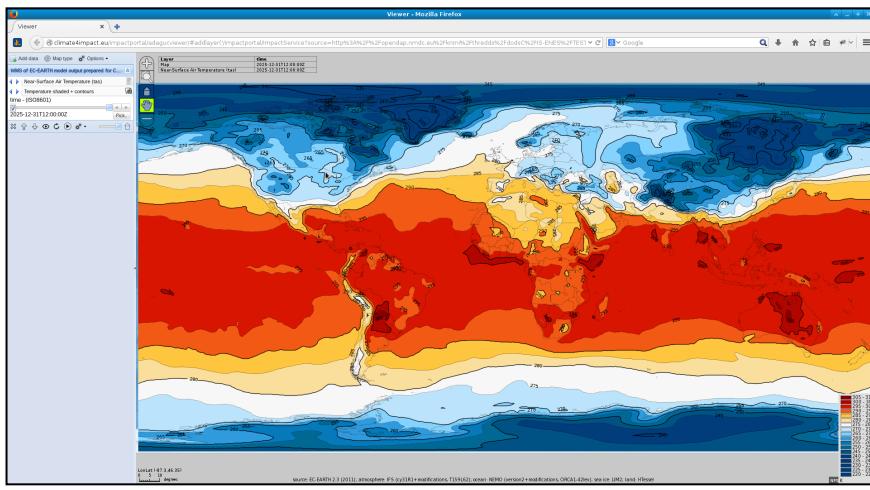
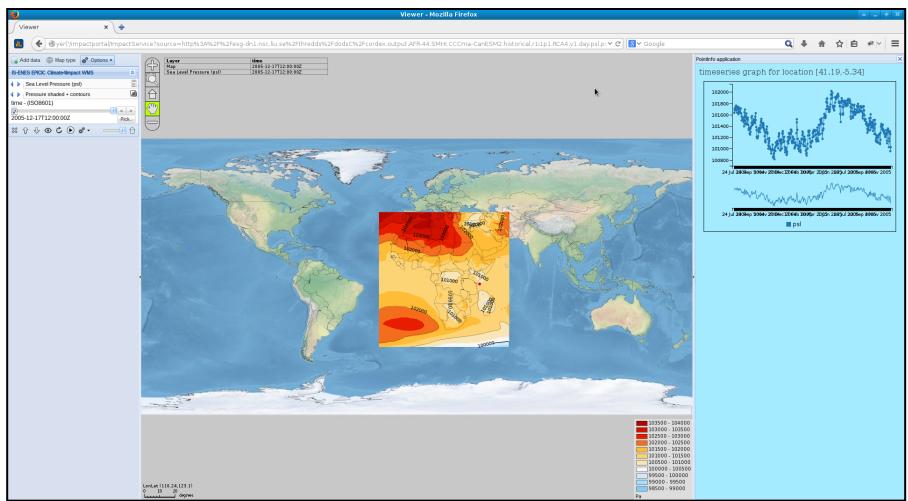
- For the rest, the service remains a standard WMS which works in many WMS clients!
- Graphical styling is based on standard names and units of the netCDF variable



## CMIP5



## CORDEX

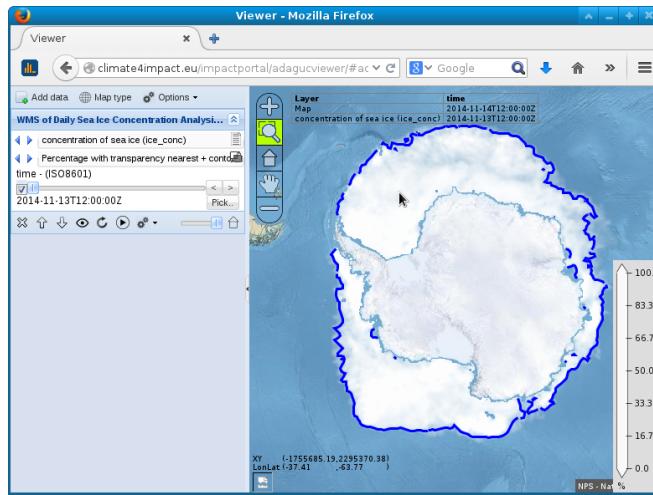
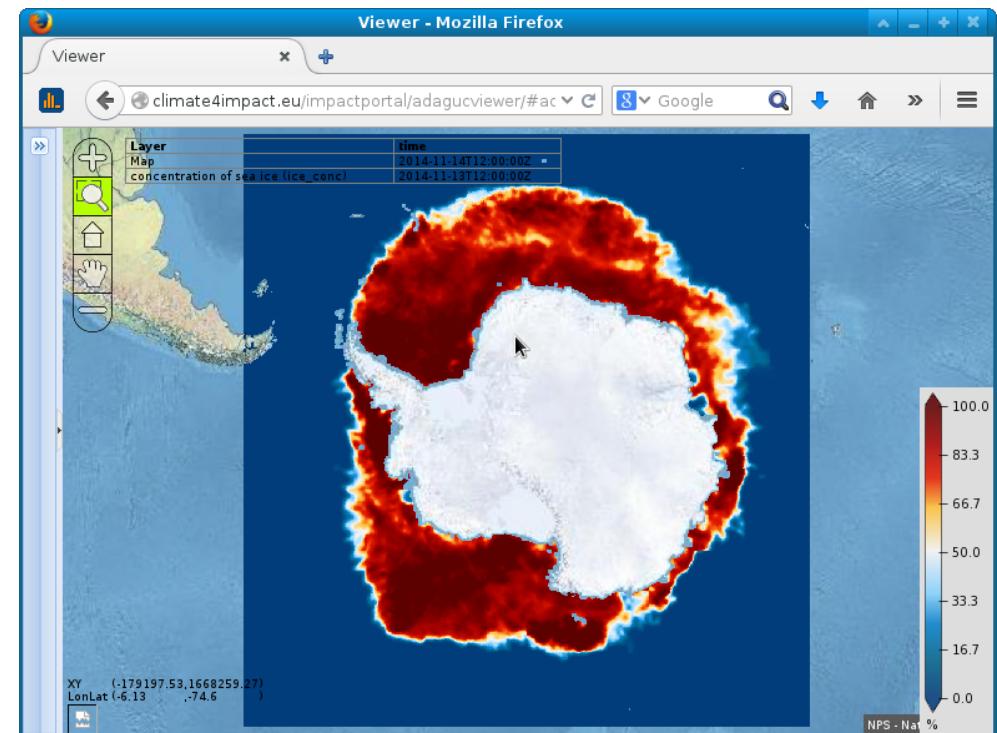
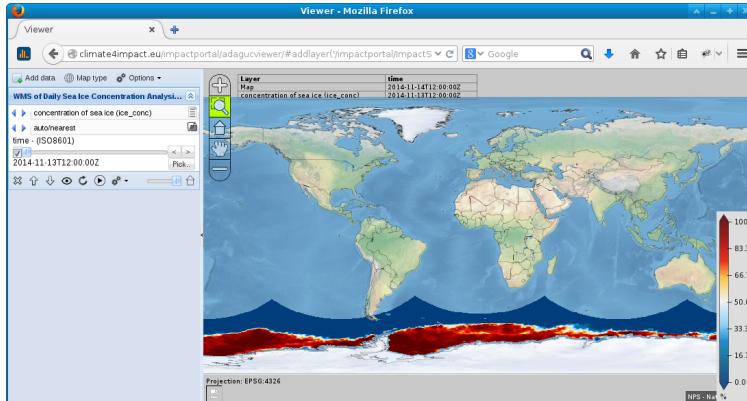


## EUMETSAT Ocean and Sea ICE SAF from Norwegian Meteorological Institute:

[http://met.no/Hav\\_og\\_is/English/Access\\_to\\_data/](http://met.no/Hav_og_is/English/Access_to_data/)

<http://thredds.met.no/thredds/catalog/osisaf/met.no/ice/conc/catalog.html>

[http://thredds.met.no/thredds/dodsC/osisaf/met.no/ice/conc/2014/11/ice\\_conc\\_sh\\_polstere-100\\_multi\\_201411131200.nc](http://thredds.met.no/thredds/dodsC/osisaf/met.no/ice/conc/2014/11/ice_conc_sh_polstere-100_multi_201411131200.nc)

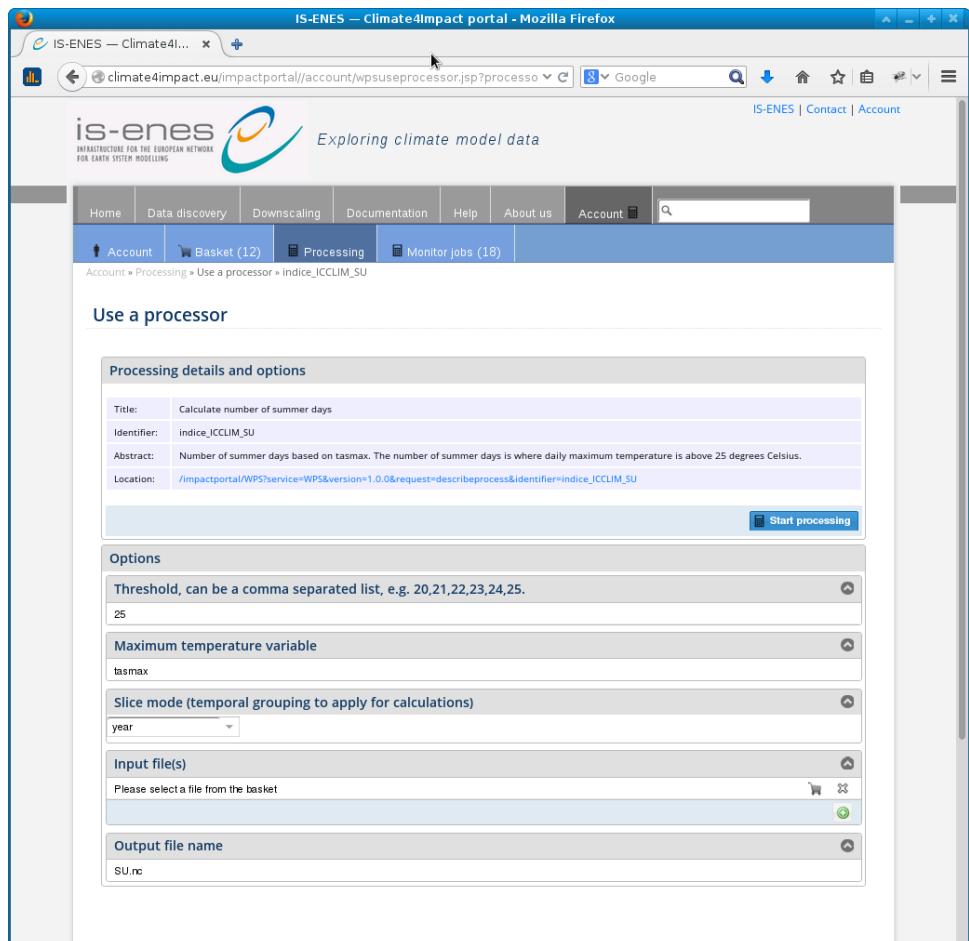


Concentration of sea ice for 2014-11-13

# Web Processing Service

## Calculating Climate Indices

- Uses PyWPS and ICCLIM
- User interface is build automatically based on DescribeProcess XML file.
- Interface supports:
  - Link to basket
  - Boolean elements
  - 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



The screenshot shows a Mozilla Firefox browser window displaying the IS-ENES Climate4Impact portal. The title bar reads "IS-ENES — Climate4Impact portal - Mozilla Firefox". The main content area is titled "Exploring climate model data" and shows the "Use a processor" page. The page displays processing details and options for calculating summer days using the ICCLIM\_SU processor. The "Processing details and options" section includes fields for Title (Calculate number of summer days), Identifier (indice\_ICCLIM\_SU), Abstract (Number of summer days based on tasmax. The number of summer days is where daily maximum temperature is above 25 degrees Celsius.), and Location (/impactportal/WPS?service=WPS&version=1.0.0&request=describeprocess&identifier=indice\_ICCLIM\_SU). Below this, there is a "Start processing" button. The "Options" section includes fields for Threshold (25), Maximum temperature variable (tasmax), Slice mode (temporal grouping to apply for calculations) (year), Input file(s) (Please select a file from the basket), and Output file name (SU.nc).

# Web Processing Service

Processing job list (asynchronous), can be viewed from everywhere

The screenshot shows the ENES Portal Interface for the Climate Impact Communities. The top navigation bar includes links for Home, Data discovery, Map & Plot, Documentation, Help, About us, Account, a shopping cart icon (9), and a search bar. Below the navigation is a secondary menu with Account, Basket (9), and Jobs (7). The main content area is titled "Processing jobs" and displays a table of processing jobs. The table has columns for Started on, WPS Identifier, Unique Id, Progress, View, and X. The data in the table is as follows:

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

# New faceted search




 A screenshot of a web browser displaying the IS-ENES Climate4Impact portal. The URL in the address bar is <http://bhw485.knmi.nl:8280/impactportal/data/esgfsearch.jsp>. The page title is "IS-ENES — Climate4Impact...". The header includes the IS-ENES logo and navigation links for Home, Data discovery, Downscaling, Documentation, Help, About us, Sign in, and a search bar. Below the header is a blue navigation bar with tabs for Search, Faceted Search (which is selected), Catalogs, Explore your own catalogs or files, and Processing. The main content area is titled "Faceted search". It features a "Filters" section with a purple background containing a grid of search terms and their counts: cf\_standard\_name (51), model (1), data\_node (3), experiment\_family (2), product (1), ensemble (1), project (1), institute (1), time\_frequency (1), realm (1), cmor\_table (1), experiment (1), variable\_long\_name (58), and variable (58). Below this is a "Selected filters" section with a green background, showing filters that have been applied: project : CMIP5, time\_frequency : mon, realm : atmos, experiment : rcp60, variable : tas, ensemble : r1i1p1, ensemble : r1i1p1, and model : MIROC5. The next section, "Datasets: Found 3, displaying 3 of 3 results.", has an orange background and lists three dataset entries: "cmip5.output1.MIROC.MIROC5.rcp60.mon.atmos.Amon.r1i1p1.v20120710", "cmip5.output1.MIROC.MIROC5.rcp60.mon.atmos.Amon.r1i1p1.v20120710", and "cmip5.output1.MIROC.MIROC5.rcp60.mon.atmos.Amon.r1i1p1.v20111104 Not found (404)". At the bottom left is the European Union flag, and the text: "The IS-ENES project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration." There is also a "Disclaimer" link.

Built in modular way, can be easily re-used at other sites

## Conclusion and next steps

- Conclusion
  - ESGF is a great tool for distributed data access
    - Search works great
    - But security is complex (OpenID, MyProxy, SSL, ports, delegation issues, etc...)
  - Climate4Impact makes extensive use of ESGF services
    - Search, OPeNDAP, Security
  - Climate4impact is flexible due to applied technologies
    - Web Processing Service (PyWPS), Web Map Service (ADAGUC), OPeNDAP (THREDDS)
  - 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
- Next steps:
  - Improve user interface → make more user friendly
  - Finalize the connection to the University of Cantabria downscaling portal
  - Climate indices calculation wizard
  - ... see the roadmap!

# THANK YOU !!!

(For detailed information please take a look at the backup slides  
at the end of this presentation or contact [maarten.plieger@knmi.nl](mailto:maarten.plieger@knmi.nl))

**(END)**

# OPeNDAP

## What is it and what can it do?

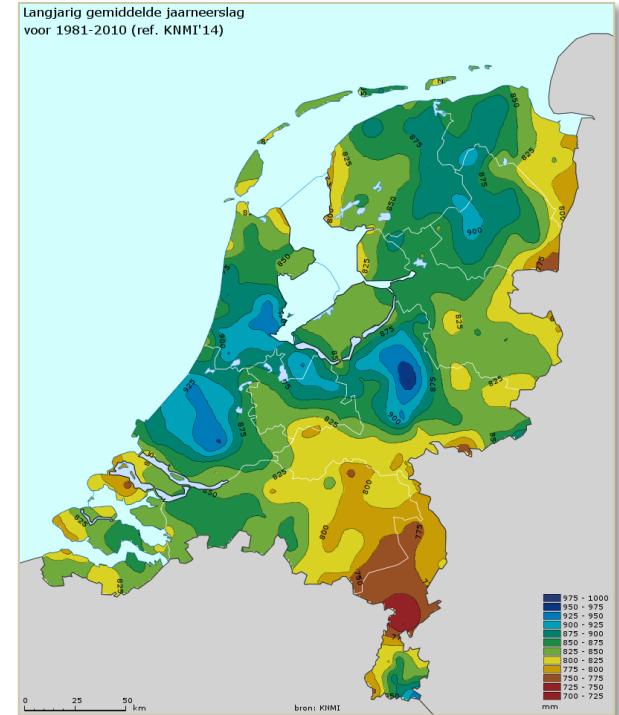
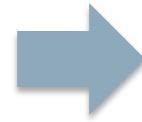


- OPeNDAP is the name of the organization and the name of the protocol
  - Open-source Project for a Network Data Access Protocol
- Data is stored at remote server
- Data model is similar to NetCDF's data model (with differences)
  - N-dimensional array container, with variables, dimensions and attributes
- 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

# Web Map Service

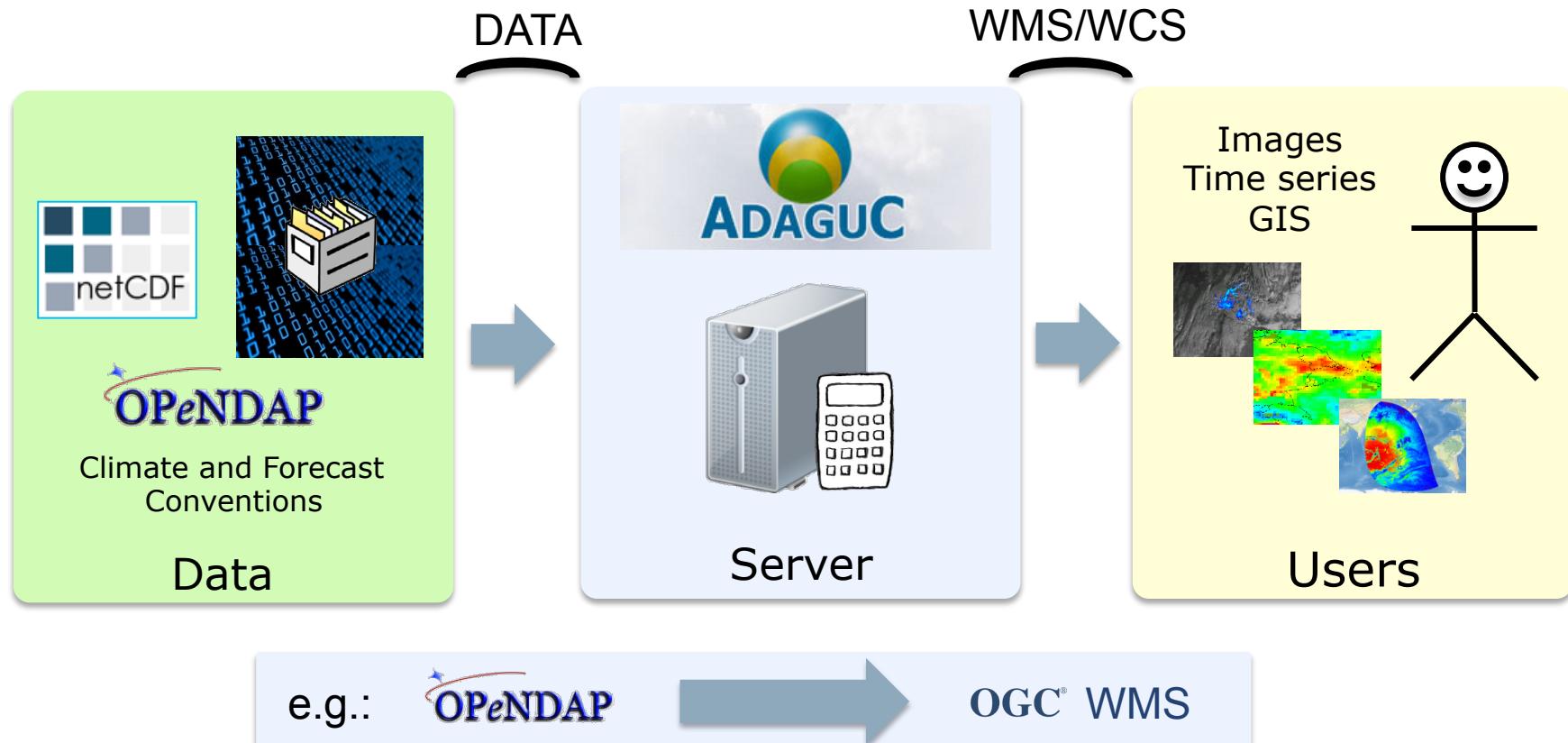
## What is it and what can it do?

- 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, ...



## ADAGUC Web Map and Web Coverage server

Geographical visualization framework using open standards and formats



## ADAGUC software



### Server details:

- C++
- NetCDF CF datafiles: grids / RGBA images / point data / swath vector data
- Multidimensional (time, elevation, ensemble members, etc): 4D, 5D, 6D
- Aggregate files by any dimension, supporting many files (100000+)
- Implements MetOcean best practices reference\_time and elevation
- Preconfigurable styling (based on standard\_name attribute)
- Autoconfigurable for example for visualization of WPS output
- Fast reprojection / regridding of large files
- Extensions:
  - GetReferenceTimes request
  - GetFeatureInfo/GetPointValue
    - Can also return timeseries data in JSON/JSONP
    - Multiple dimension values (e.g. elevation=\* returns data for all elevations)
  - The GetMap extensions found in ncWMS
  - Showlegend, showscalebar, title and subtitle options

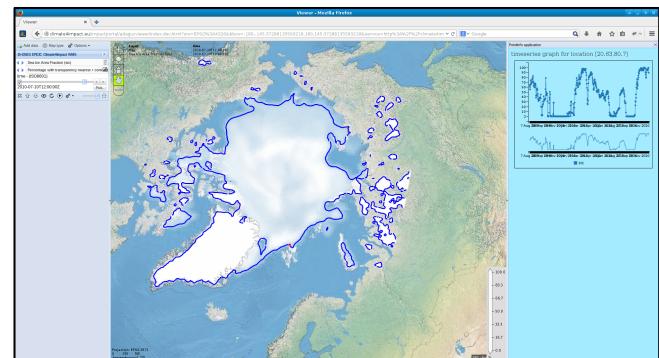


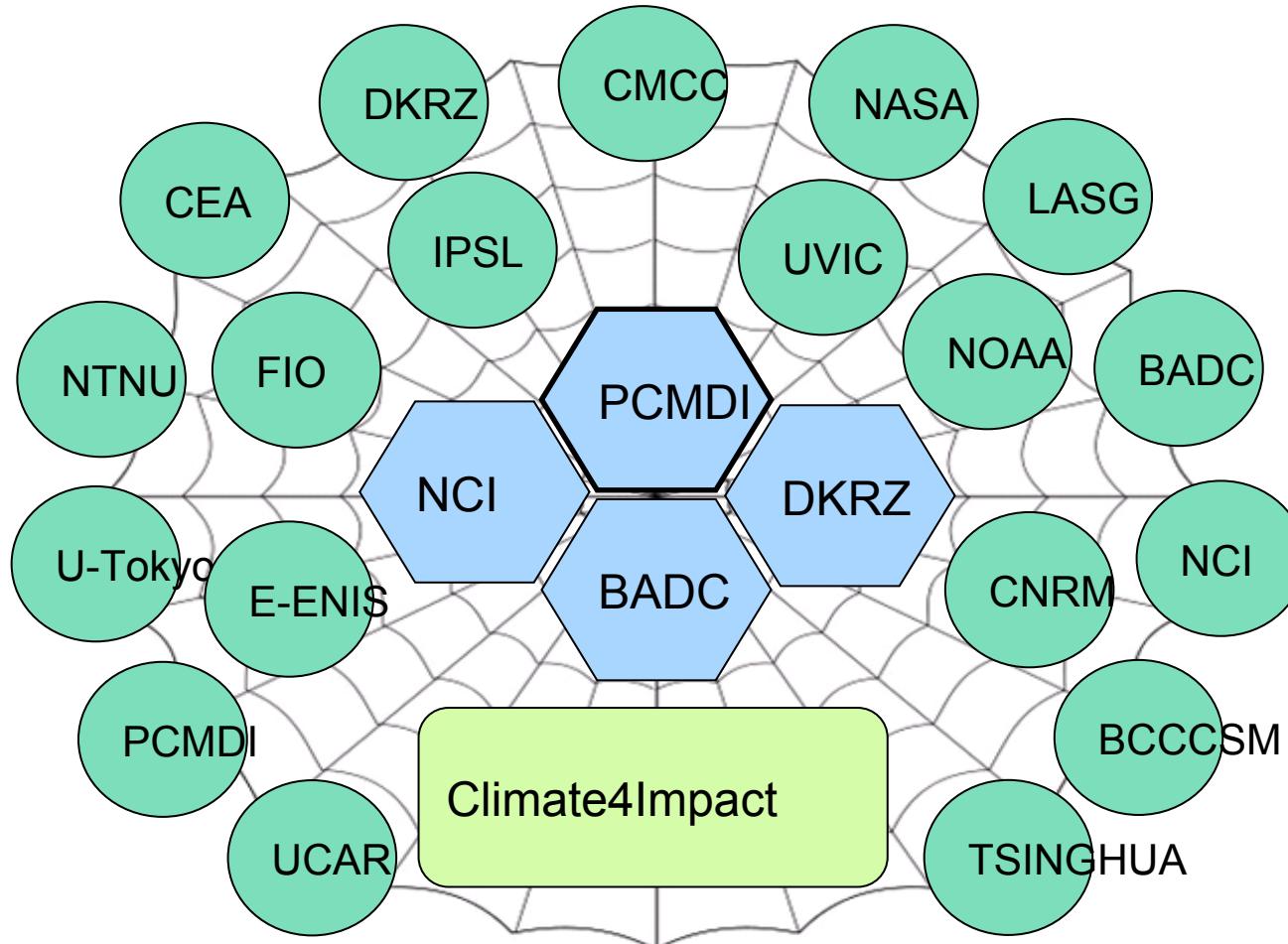
# ADAGUC software



## Viewer details:

- Supports WMS 1.1.1 and WMS 1.3.0
  - Tested with geoserver, ncwms, mapserver and adaguc
- Display legends, select styles, select dimensions
- Enables download/manipulation from WCS services
- Mapping component is embeddable in other web pages
- Mapping component is plain JavaScript,
  - Rich interface uses ExtJS
- Portals main purpose:
  - A simple way of combining layers from various WMS
  - In space and time
- Visible via <http://adaguc.knmi.nl>, with demonstration data
- Released as open source in June 2013





- Robust
- Distributed
- Data and processing
- IdP + Index nodes (blue)
- Data nodes (green)
- Climate4impact builds on and contributes to this global infrastructure