



Overview of available data and tools for monitoring of the climate system

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De Bilt, The Netherlands

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Outline

- ▶ ECA&D, ICA&D (LACA&D, SAC&D)
- ▶ Climate monitoring
- ▶ Climate explorer
- ▶ climate4impact: Climate platform for Copernicus



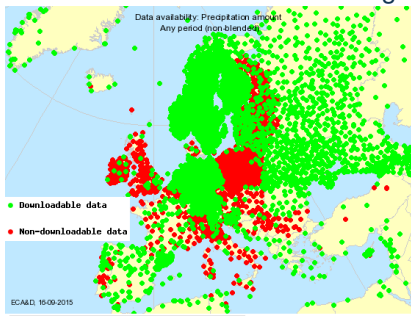
European Climate Assessment & Dataset

ECA&D introduction I

- ▶ ECA&D started in 1998 with few series
- ▶ Partly funded by EUMETNET until 2008
- ▶ Currently maintained by KNMI
- ▶ Regional Climate Center on Data for WMO Region VI

⇒ Objective:

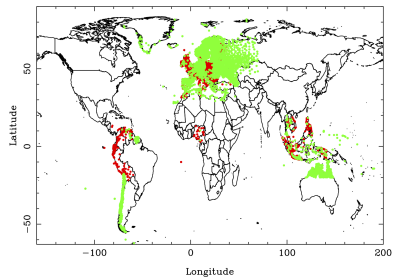
to analyze the climate of WMO region VI, with special focus on trends in climatic extremes observed at meteorological stations.





ICA&D

- ▶ Combines WMOs Expert Team on Climate Change Detection and Indices (ETCCDI) and WMOs Data Rescue (DARE) activities
- ▶ based on the concept developed for the ECA&D
- ▶ ICA&D combines the climate monitoring and assessment activities developed in ECA&D with DARE activities.
- ▶ New Products LACA&D (LACA-OBS), SACA&D (SACA-OBS)





ECA&D introduction II

- ▶ Today, ECA&D is receiving data:
 - ▶ 66 participants for 62 countries
 - ▶ ECA dataset contains 41600 series of observations for 12 elements at 10388 meteorological stations (RR, TN, TG, TX, PP, HU, SS, SD, FG, FX, DD, CC)
 - ▶ E-OBS gridded version (RR, TN, TG, TX, PP)
 - ▶ Europe and the Mediterranean
 - ▶ 77% of these daily series can be downloaded and used for non-commercial research and education.
 - ▶ Participation to ECA&D is open to anyone maintaining daily station data.
 - ▶ If you want to join please contact us. Data policy





ECA&D technical background

- ▶ Web-based information system
- ▶ Regional daily climate data
 - ▶ Recent data
 - ▶ Rescued digitized data
- ▶ Meta information
- ▶ Derived climate monitoring products
 - ▶ Indices of extremes
 - ▶ Maps with trends, anomalies, etc
- ▶ Historical perspectives integrated with monitoring of current climate





ECA&D technical background

Monthly updates:

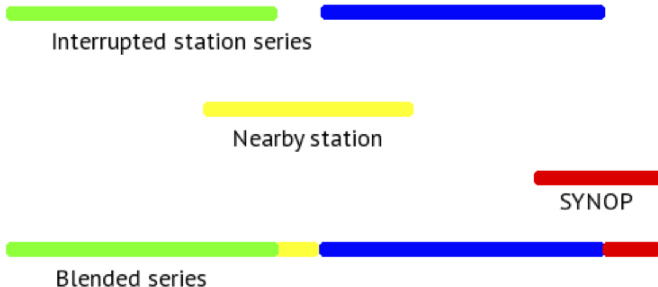
- ▶ Including new data
- ▶ Quality control
- ▶ Blending with nearby stations
- ▶ Homogeneity check
- ▶ Indices calculation
- ▶ Climatology calculation
- ▶ Trend calculation





ECA&D Blending details

- ▶ Fill in and extend with other series, nearby stations and/or synop
- ▶ Nearby stations: within 25 km and 50m height difference





ECA&D Homogeneity details I

- ▶ 80% non-missing in period
- ▶ 4 test (Wijngaard et al. 2003):
 - ▶ Standard Normal Homogeneity Test (SNH, Alexandersson (1986))
 - ▶ Buishand Range test (BHR, Buishand (1982))
 - ▶ Pettitt test (PET, Pettitt (1979))
 - ▶ Von Neumann Ratio test (VON, von Neumann (1941))
- ▶ First 3 give year of break

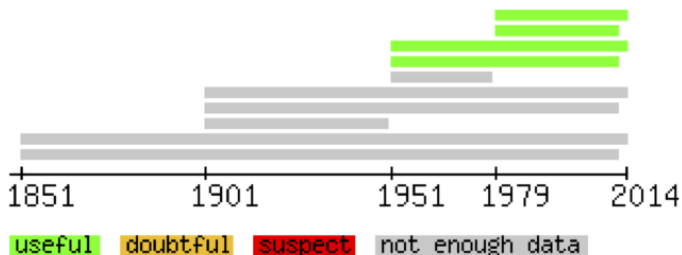




ECA&D Homogeneity details: II

Homogeneity results

Homogeneity for temperature series GRAL BERNARDO O'HIGGINS,



- ▶ Useful: 0 or 1 tests detect break
- ▶ Doubtful: 2 tests detect break
- ▶ Suspect: 3 or 4 detect break

⇒ Useful & Doubtful used in ECA&D monitoring

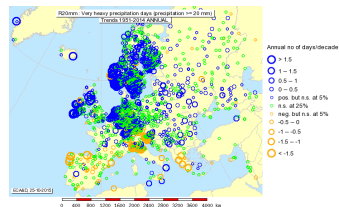
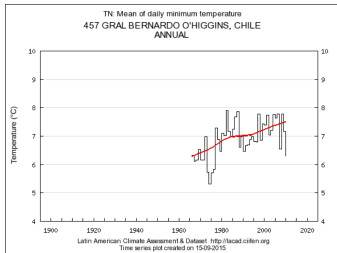




ECA&D Climate monitoring

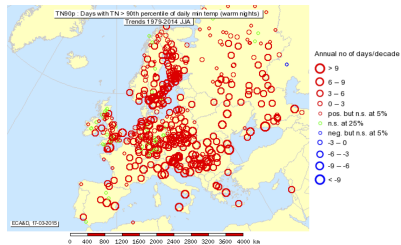
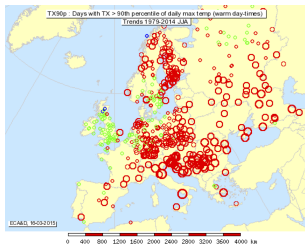
Indices of extremes - Climate impact indices (ETCCDI , eca indices)

- ▶ Indices dictionary
- ▶ Time series plots
- ▶ Trend/anomaly/climatology maps





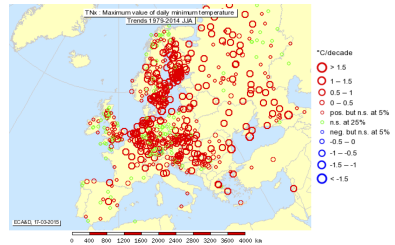
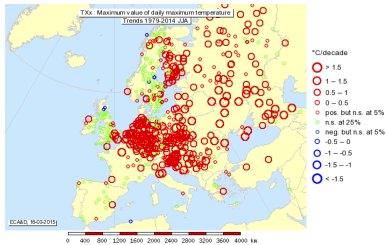
Trends - Some interesting aspects



Trend (1979-2014) in number of warm day-times vs. warm nights (JJA)



Trends - Some interesting aspects

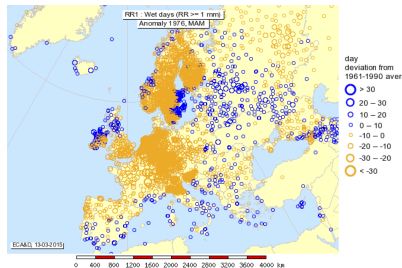
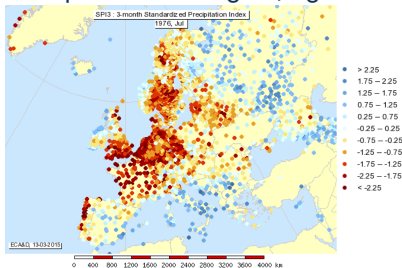


Trend (1979-2014) in maximum of daily maximum and minimum temperature (JJA)



ECA&D example on SPI & RR1mm anomaly

Descriptions of droughts, eg. 1976

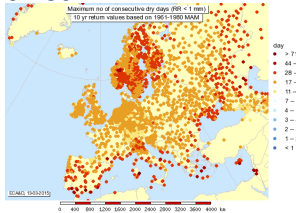


Combination of SPI-3 and anomalous number of rainy days (RR1)

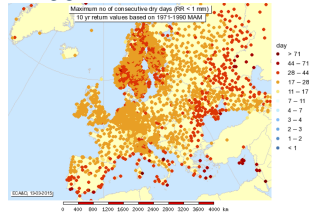


ECA&D - return values

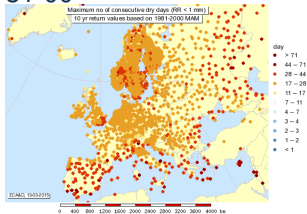
61-80



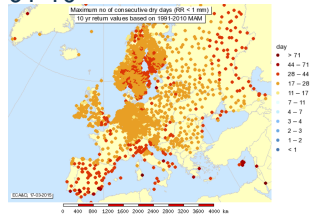
71-90



81-00



91-10

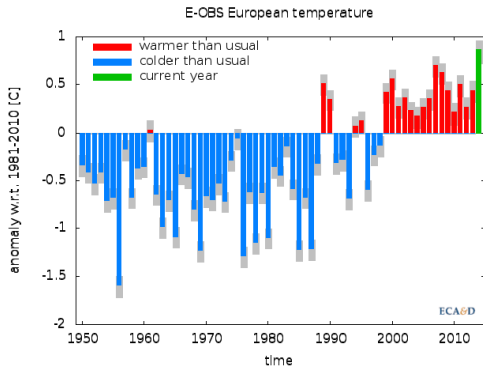


Changes in 10-yr return values for CDD in Spring



Climate Indicator Bulletins I

European average temperature

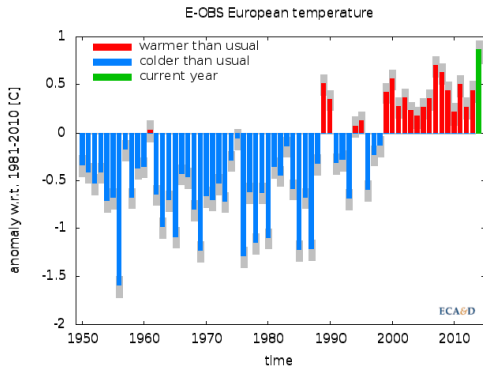


- ▶ 2014 warmest year on record
- ▶ *not* exceptional in terms of extremes

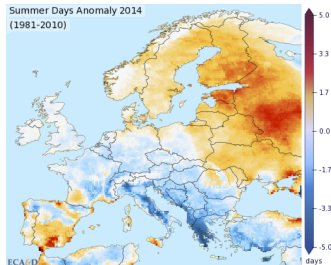


Climate Indicator Bulletins II

European average temperature



<http://cib.knmi.nl>, EURO4m

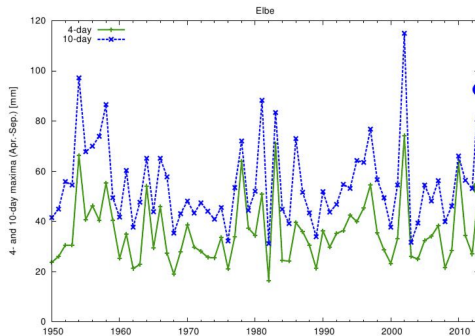
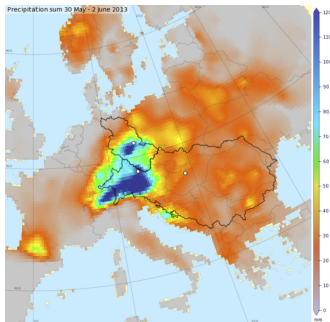


Number of Summer days
($T_X \geq 25^\circ\text{C}$) *lower than usual*



Climate Indicator Bulletins III

Central European flooding of 2013



<http://cib.knmi.nl>



E-OBS v11.0 climate impact indices (CII)

Select period & Index ?

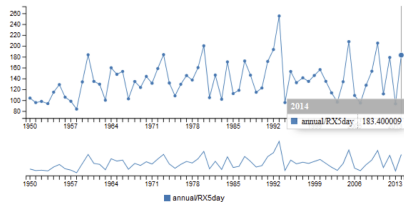
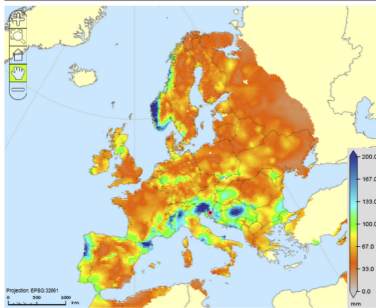
annual RX5day: Highest 5-day precipitation amc

Select year

2014

Define range min: 0 max: 200

Timeseries for a location (click on map & scroll down)





E-OBS v11.0 climate impact indices (CII)

Select period & Index [?]

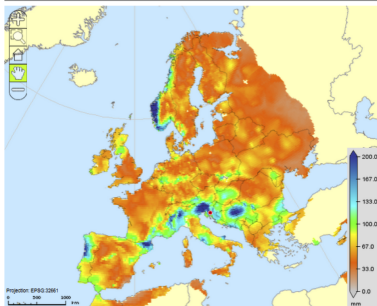
annual RX5day: Highest 5-day precipitation amc < >

Select year

2014

Define range min: 0 max: 200

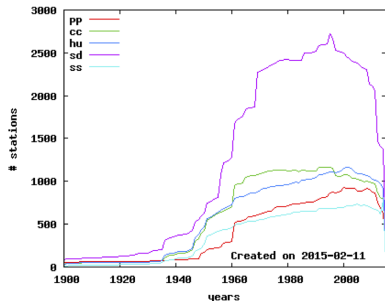
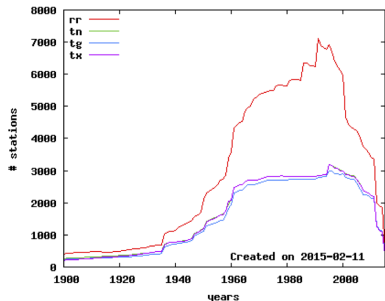
Timeseries for a location (click on map & scroll down)



- ▶ CII developed within EUPORIAS
- ▶ Extensive contribution together with MeteoSwiss to R packages `climdex.pcic` & `climdex.pcic.ncdf` developed by PCIC
- ▶ CII calculated using seasonal forecast
- ▶ Introducing uncertainties into the CII visualization



Monitoring requires access to data



- ▶ Monthly updates from cz, de, si, se, fi, ie, lu, no, ch, nl, pt
- ▶ Data updates are sometimes hard to get
- ▶ Although a trend towards a more liberal data policy is present, some countries provide a (very) small part of their network
- ▶ *Access to data and Getting it right are the hard parts*



New data contributions

- ▶ Meteorological Service of Catalonia - updates for 2015 and revised series for snow depth
- ▶ Sogrape S.A. (Portugal) now contributes data
- ▶ number of NMSs contributing monthly updates increases
(cz, de, si, se, fi, ie, lu, no, ch, nl, pt)
- ▶ contacts with regional weather services in Italy (ARPA-SIMC, ARPA Valle d'Aosta)





New developments

- ▶ start with homogenizing *daily* data in ECA&D
EU-FP7 EUSTACE project
- ▶ daily updates of E-OBS on the basis of data from GTS
provides input for near real-time attribution of
extreme events (KNMI, University of Oxford, University of
Melbourne and Australia National University)
- ▶ coupling of E-OBS to ECMWF seasonal forecast (EUPORIAS)
- ▶ 'continuous' updates of climate indices
- ▶ NMSs use ECA&D for providing ECMWF with daily & sub-daily
monthly deliveries to be used for their forecast verification
program.
- ▶ development of existing gridding techniques to improve the high
resolution of E-OBS and make it more suitable for high resolution
model validation, important for hydrological impact studies
(EUPORIAS, UERRA)



Climate explorer



Climate Explorer

- ▶ Developed and maintained by Geert Jan van Oldenborgh at KNMI.
- ▶ Setup in the late 1990s to analyse the teleconnections from the big El Niño event in 1997-98
- ▶ Essentially a website with a lot of data & programs for statistical analysis behind it:
 - ▶ hosts data for easy access to user
 - ▶ allows users to search for a given dataset and download direct from source
- ▶ designed to make sense of all data





Climate Explorer

Climate Explorer European Climate Assessment & Data KNMI

Search in the Climate Explorer

Help News About Contact Seasonal forecast verification Climate Change Atlas

Starting point

Welcome, anonymous user

Please enter the KNMI Climate Explorer, a research tool to investigate the climate. This web site collects a lot of climate data and analysis tools. Please verify yourself that the data you use is good enough for your purpose, and report errors back. In publications the original data source should be cited, a link to a web page describing the data is always provided.

Start by selecting a class of climate data from the right-hand menu. After you have selected the time series or fields of interest, you will be able to investigate it, correlate it to other data, and generate derived data from it.

If you are new it may be helpful to study the examples.

Share and enjoy!

Some restrictions are in force, notably the possibility to define your own indices, to upload data into the Climate Explorer and to handle large datasets. If you want to use these features please log in or register.

oath-log-plot-box-GIS-global-temperature-gist-t_gt_n_12month_low-pass_box_90

News

- 19-oct-2015 Updated CRU TS to 3.23 with data up to 2014. stations is not yet available.
- 17-oct-2015 Fixed a bug in the AMO time series generation, due to a language setting, the global mean temperature was not subtracted correctly anymore.
- 14-oct-2015 The server has been saying it was too busy twice today for 10 minutes, but did not go down. The new precautions seem to be working, I could not find one cause for it, looks like just a very busy day.

- ▶ Upload your own time series / fields.
- ▶ Make EOFs.
- ▶ Calculate extremes
- ▶ Download data in different formats (inc netCDF) for your analysis
- ▶ Create and download your own figures (.png, .eps)
- ▶ a tool for seasonal predictions and skill scores
- ▶ email support...also for reporting bugs!
- ▶ hands-on tutorial by Jonathan Eden



climate4impact.eu

- ▶ Climate Information Platform for Copernicus
- ▶ Bridging CMIP5 and CORDEX data infrastructure to impact users
- ▶ CERFACS, KNMI, University of Cantabria, SMHI, Wageningen University, CMCC, STFC, IPSL
- ▶ Platform for impact researchers to explore climate data and perform analysis
- ▶ Current phase in IS-ENES2 project: Implementing real use cases from impact researchers
- ▶ requires registration

is-enes
INFRASTRUCTURE FOR THE EUROPEAN NETWORK
FOR DATA SYSTEMS MODELING

Exploring climate model data

IS-ENES | Contact | Sign in

Home Data discovery Downloading Documentation Help About us Sign in

IS-ENES climate4impact portal

Welcome to the IS-ENES climate4impact portal, oriented towards climate change impact modellers, impact and adaptation consultants, as well as other experts using climate change data.

Here you will find access to data and quick looks at global climate models (GCM) scenarios, as well as regional climate model (RCM) and downscaled higher-resolution climate data. The portal provides data transformation tools for labelling data to your needs and reusing & getting capabilities.

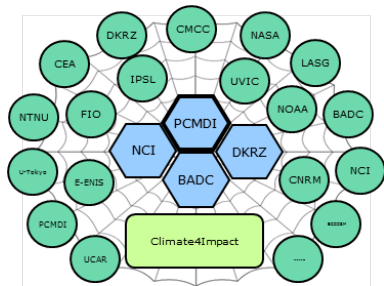
Guidance on how to use climate scenarios, documentation on the climate system, frequently asked questions and examples in several impact and adaptation themes are presented and described, along with the steps required to go from GCM data to impact model input data.

The climate4impact portal is now operational (15 April 2014): [read more](#).

 Agriculture/Forestry	 Energy	 Health	 Infrastructure/Transport
 Water Coastal	 Nature/Biodiversity	 Urban	 Urban Management

Click on one of these images to go to a specific climate change impact and adaptation theme.

- ▶ Search ESGF infrastr. (CMIP5 / CORDEX) climate4impact builds on and contributes to this global infrastructure
- ▶ Visualize ESGF data -using ADAGUC Web Map Services
- ▶ Downscaling - University of Cantabria



- ▶ Perform calculations / process data:
PyWPS & ICCLIM
Climate indices calculation and data reduction
Personal store for processing outcomes

- ▶ 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

is-enes *Exploring climate model data* IS-ENES | Contact | Account

Home Data discovery Downscaling Documentation Help About us Account

Search Faceted Search Catalogs Explore your own catalogs or files Map & Plot Processing

Faceted search ? Help

Filters

cf_standard_name (16) model (1) data_node (1) experiment_family (2) product (1) ensemble (10) project (1) institute (1)

time_frequency (1) realm (1) color_table (1) experiment (1) variable_long_name (16) variable (17)

Selected filters

data_node: albedo2.dkrz.de experiment: rcp45 project: CMIP5 time_frequency: day variable: tas model: EC-EARTH

Datasets: Found 10, displaying 10 of 10 results.

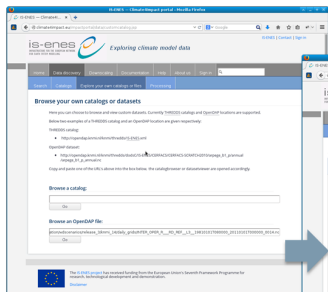
cmip5.output1.JCHEC-EC-EARTH.rcp45.day.atmos.dayr711p1.v20130218
 cmip5.output1.JCHEC-EC-EARTH.rcp45.day.atmos.dayr1311p1.v20121115
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 cmip5.output1.JCHEC-EC-EARTH.rcp45.day.atmos.dayr1111p1.v20130314
 cmip5.output1.JCHEC-EC-EARTH.rcp45.day.atmos.dayr111p1.v20121115
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Add results to basket

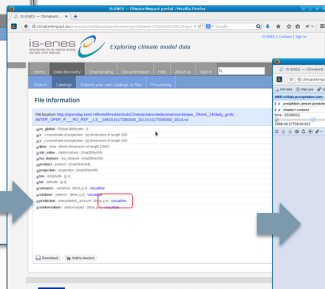
You are logged in as https://open4is.eu/ingrid/clip/ingrid@open4is.eu

Web Map Services based on OPENDAP resources

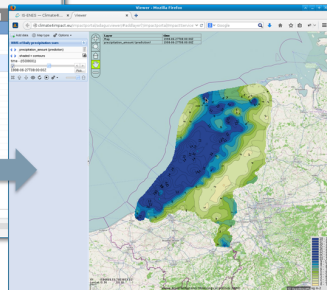
climate4impact.eu allows for creation of WMS visualizations on OPENDAP endpoints:



Go to "Data discovery" →
"Explore your own catalogs
or files"

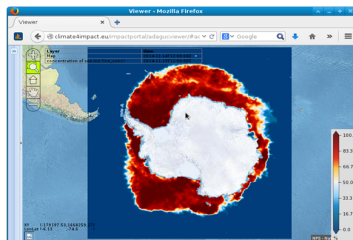
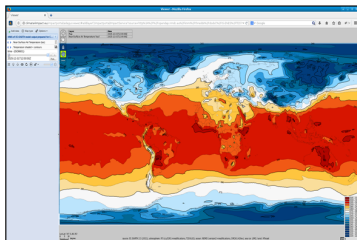
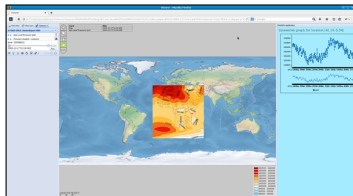
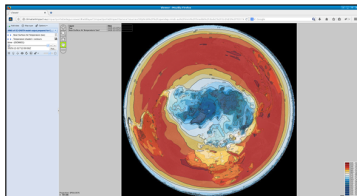


Metadata with variables to
be visualized is displayed



ADAGUC viewer displaying the WMS

Visualization of remote and local resources



CMIP5 - global climate models

CORDEX - regional climate models

On-demand calculations: statistical downscaling & climate indices

- ▶ C4I Statistical downscaling
 - ▶ Services provided by Uni. of Cantabria serves
 - ▶ Friendly user interface on C4I
- ▶ C4I Climate indices
 - ▶ All ETCCDI indices & simple statistics available
 - ▶ High performance iclim software (fully validated against climdex.pci)
 - ▶ Currently expanded to climate indicators as well (CLIPC)

The screenshot shows the 'is-enes' web interface for 'Exploring climate model data'. The main navigation bar includes 'Home', 'Data discovery', 'Downscaling', 'Documentation', 'Help', 'About us', and 'Account'. Below this, there are tabs for 'Documentation', 'Subscription', and 'Create'. The 'Load saved downscalings' section shows a dropdown menu set to 'NorthAtlantic downscaling'. The 'Configure your Downscaling' section has a 'Variable' dropdown set to 'TEMPERATURE'. Under 'Predictand', there are radio buttons for 'Thmax' and 'Tmin', with 'Tmin' selected. A 'List of matched predictands' shows three options: 'NorthAtlantic1_TX' (selected), 'TbMaxTempUSA', and 'TbUSAPacific'. The 'Downscaling methods' section has radio buttons for 'mean10' (selected) and 'regreTxSPC'. A 'Download validation report' link is visible. On the right, a map shows the North Atlantic Ocean region with a blue box highlighting the area of interest.

Download

- ▶ By default the basket contains
 - ▶ “Remote” data for links
 - ▶ “My data” for your own data
- ▶ Script for downloading & selecting 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

The screenshot shows the ClimateImpact web interface. At the top, there is a navigation bar with links for Home, Data discovery, Downloading, Documentation, Help, About us, and Account. Below this is a 'Basket (11)' section with a table of files. The table has columns for File, DAP, HTTP, Filesize, and Date. The files are categorized into 'Remote data' and 'My data'.

File	DAP	HTTP	Filesize	Date
0.50 deg. regular grid	-	-	-	2015-01-22
0.44 deg. rotated grid	-	-	-	2015-01-22
tr_0.44deg_rot_v10.0.nc	true	true	691.9M	2015-01-22
tr_0.44deg_rot_v10.0.nc	true	true	691.9M	2015-01-22
tr_0.44deg_rot_v10.0.nc	true	true	691.9M	2015-01-22
tasmax_day_IPSL-CM5A-LR_historical_r11p1_18500101-19991231.nc	true	true	673.2M	2015-03-19
tasmax_day_IPSL-CM5A-LR_historical_r11p1_18500101-19491231.nc	true	true	1.346G	2015-03-19
tasmax_day_IPSL-CM5A-LR_historical_r11p1_19000101-19491231.nc	true	true	673.2M	2015-03-19
tasmax_day_IPSL-CM5A-LR_historical_r11p1_19500101-19991231.nc	true	true	673.2M	2015-03-19
tasmax_day_IPSL-CM5A-LR_historical_r11p1_19500101-20051231.nc	true	true	754.0M	2015-03-19
tasmax_4PR_44_CMRM-CERFACS-CMRM-CM1_cpafis_r11p1_CUMosm-COLM-8-17_v1_day_2096	true	-	-	2015-04-01
prdat_sleros_m.nc	true	true	506.824K	2015-01-23
tas_VIAS-44_ECMWF-ERAINT_evaluation_s1tp1_3Tm-RegCM-1_v411_mon_198901-199012	true	true	2.314M	2015-01-23
tas_VIAS-44_ECMWF-ERAINT_evaluation_s1tp1_3Tm-RegCM-1_v411_day_198901-19901231	true	true	79.463M	2015-01-23

At the bottom of the interface, there is a disclaimer: "The IS-ENES project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration." and a "Disclaimer" link.



www.ecad.eu, eca@knmi.nl
christiana.photiadou@knmi.nl

LACA&D:
<http://lacad.ciifen.org>, laca@ciifen.org

SACA&D:
<http://sacad.database.bmkg.go.id/>, sacad.database@bmkg.go.id

ICA&D:
<http://www.ecad.eu/icad.php>

Climate explorer
climexp.knmi.nl

climate4impact.eu