User manual v. 2014.03.25

This document presents the main features of the Lancelot web application.

Introduction

In recent years, the awareness of the importance of an integrated approach to face climate challenges has progressively increased. In particular, it appears now evident that the integration of data and information produced with climate, impacts and economic models would substantially improve our capability to provide more reliable assessments of the possible consequences that global warming might exert on a number of social and economical sectors.

One of the main objectives of the Lancelot web application is to provide a tool and framework for visualizing, exploring and discussing the possible climate change signal projected according to future scenarios and the related impacts in a number of different sectors, including their possible social and economical implications. This tool, thus, harmonizing and combining data and information coming from different modeling sources, represents a first step towards an integrated approach to the evaluation of projected future hazards and their impacts and consequences.

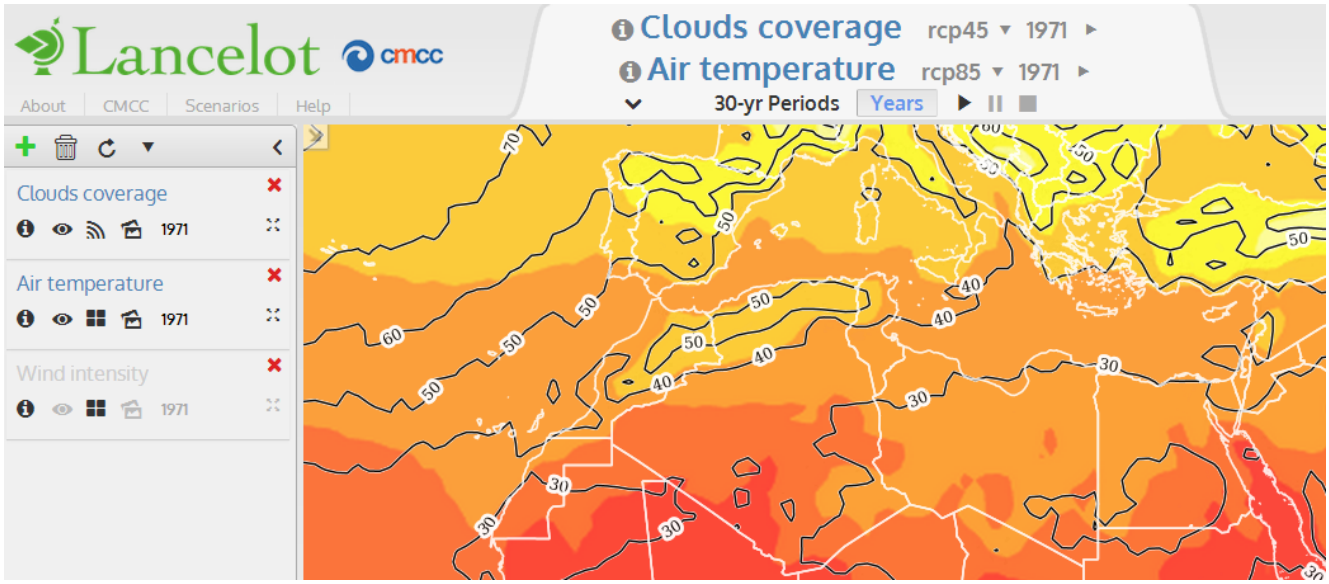


Figure 1: two variables on the same map.

Specifically, Lancelot allows collecting a broad set of climate-related information and data produced with different models and present them in the most effective way.

Currently available data types categories include:

- Physical climate data
- Impacts data
- Socio-economic data

Even though these categories are generated in independent research fields they still are different faces of the same global system, and therefore are mutually influenced one by the other and many of them can be part of a common climate issue.

With Lancelot the user can bring together such large and complex sources of data onto a single map (Figure 1) and build charts and tables, which can present the aggregated information (Figure 2). In order to improve its interpretation, understanding and presentation, the resulting information can then be manipulated and presented in different forms (pie charts, time tables, etc.).

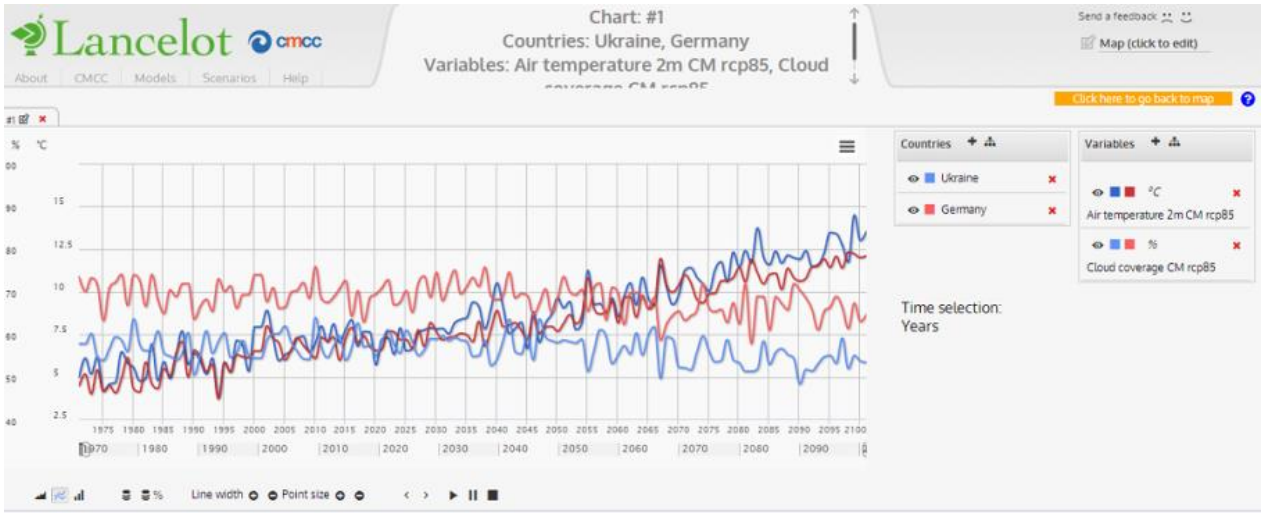


Figure 2: two variables (air temperature and clouds coverage) and two countries (Ukraine and Germany) on the same chart.

In this way the user can obtain a simple representation of the correlation and dependency between two or more variables (Figure 3, Figure 4). Because of this Lancelot can become a useful tool to help decision makers and research activities understand environmental problems.

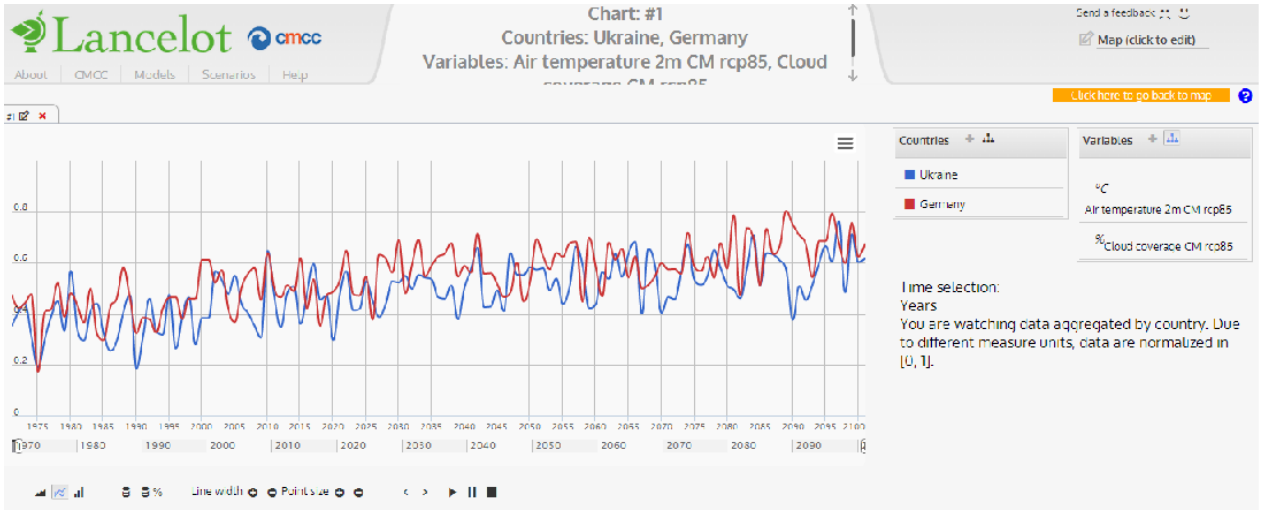


Figure 3: this chart presents the aggregation of the two variables. Each line on the chart is the merge of air temperature and clouds coverage.

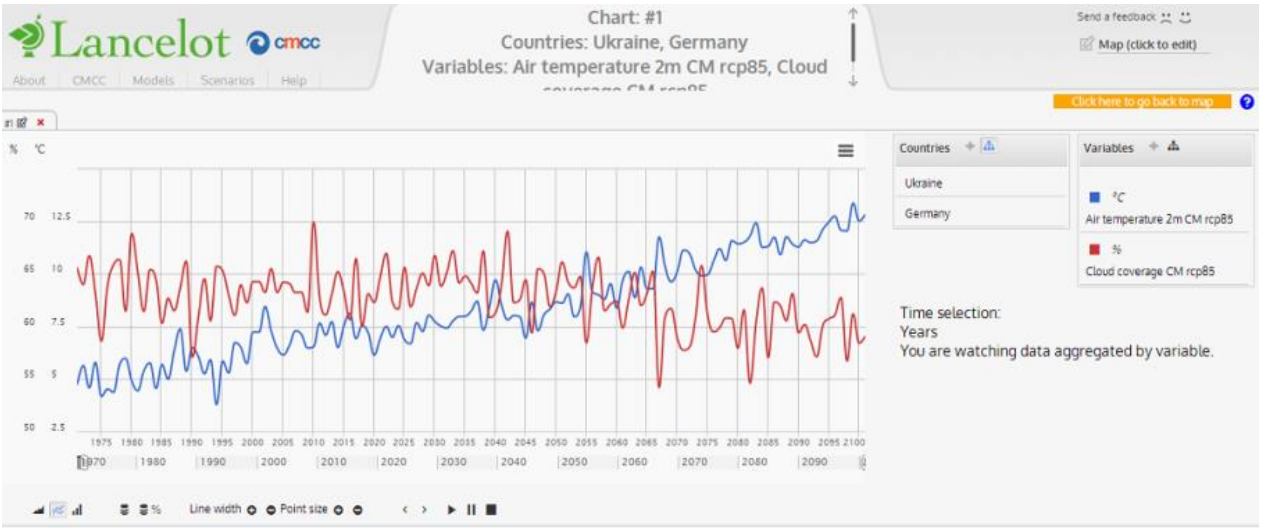


Figure 4: this chart presents the aggregation on the two countries. Each line on the chart is the merge of the two countries.

Future enhancements on Lancelot will explore and expand these features, in terms of data manipulation and visualization, allowing improved integrated assessments for studying complex climate change issues.

Developing status

The system is being tested with the mainly used web browsers and operating systems and is ready to publishing.

Startup

When the application starts, information about map, data and countries are loaded into the application. A default map is presented to the user (Figure 5).

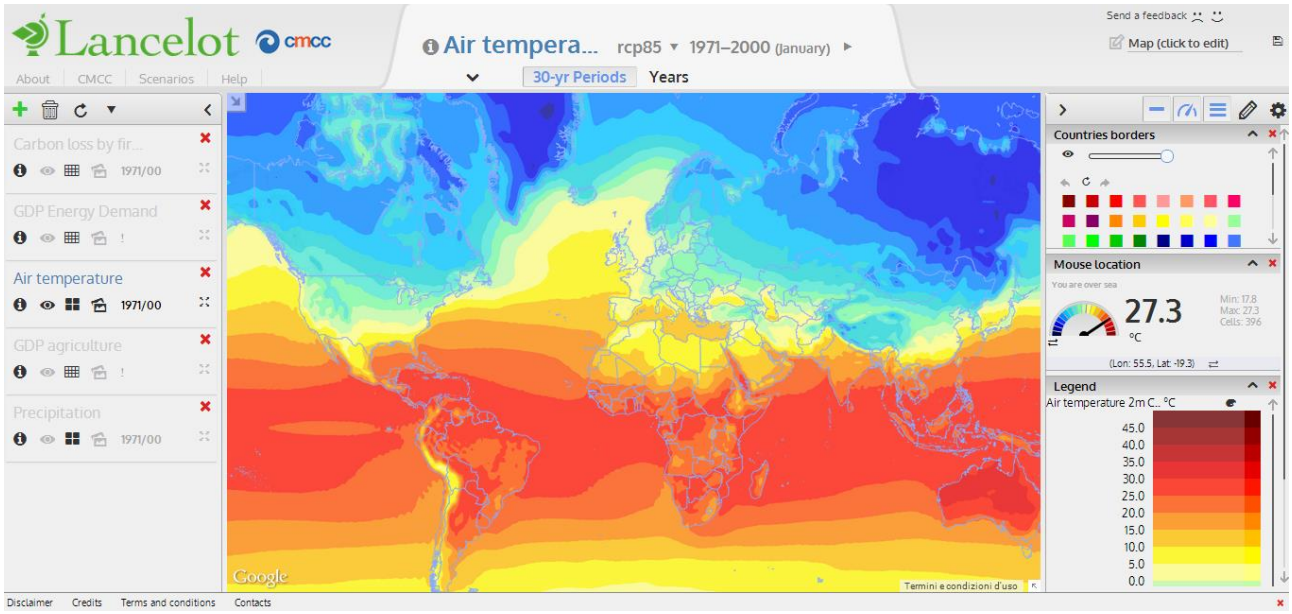


Figure 5: initial page

The first time the user loads the application, an introductive video and a basic tutorial (Figure 6) present the main features of the project.

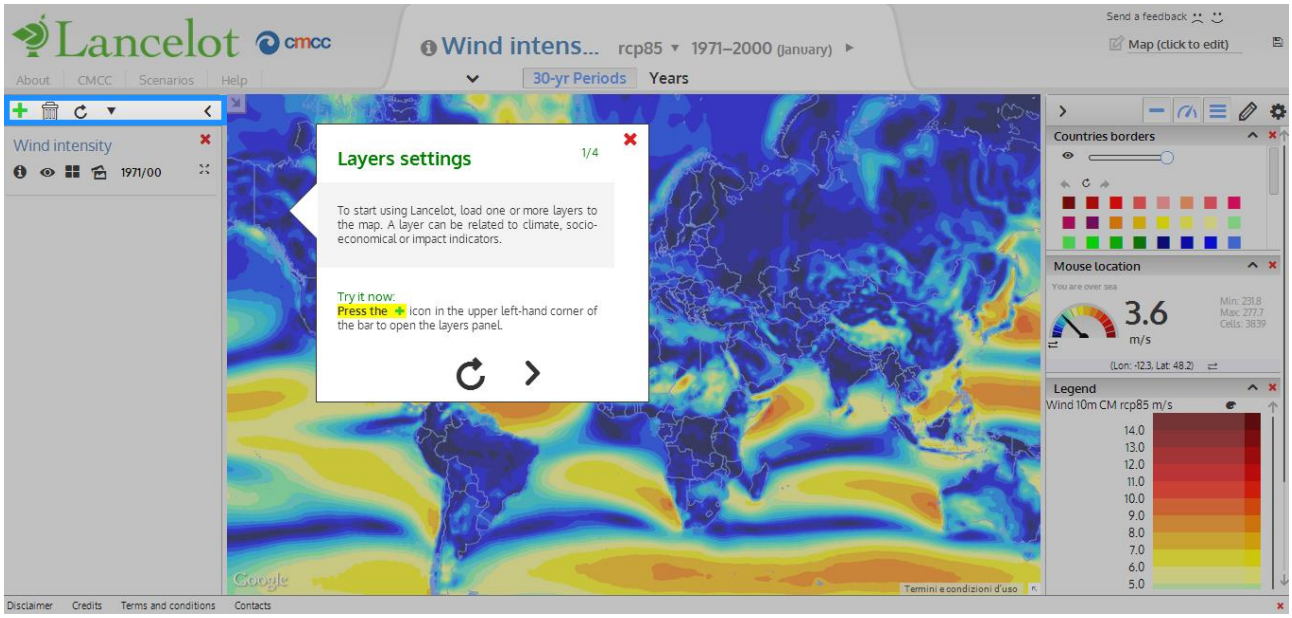


Figure 6: the first step of the basic tutorial

Usage

A set of data (a variable) is usually called a “layer”. The layers can be added to the underlying map by clicking on the **+** symbol on the left bar. The user selects the category, choosing among Climate, Socio-Economic and Impacts (Figure 7). The number between brackets represents the amount of variables currently available in each category. When on adding variable mode, the list of layers on the left bar is compressed and they can’t be modified.

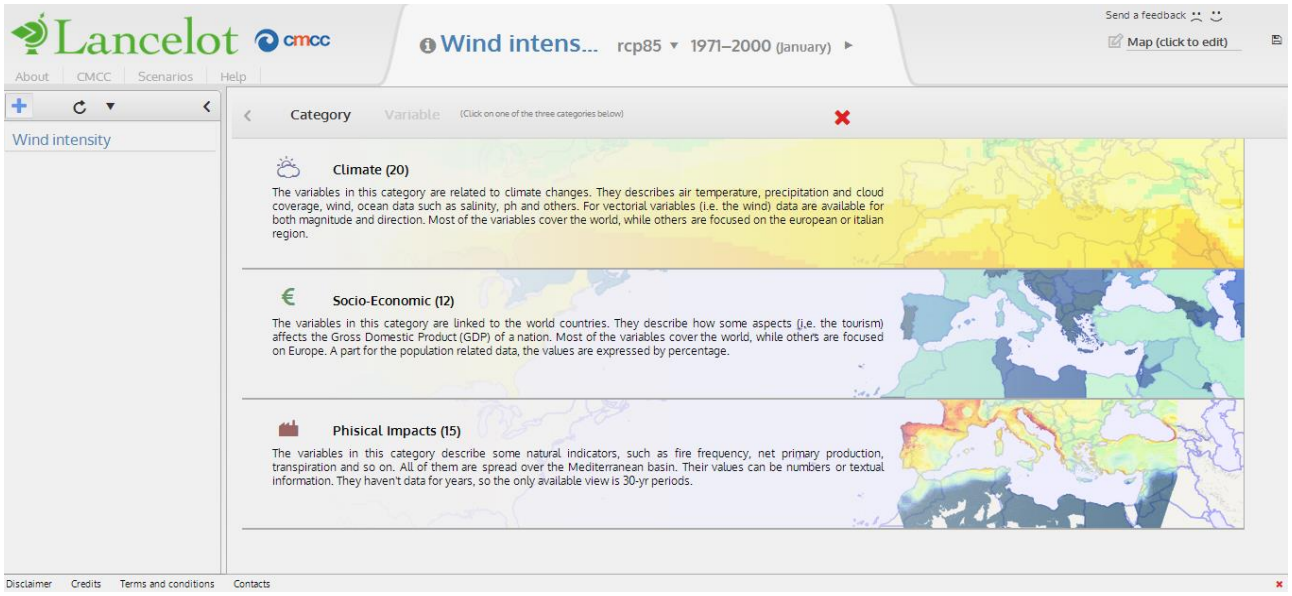


Figure 7: category selection

Then, a list presents the available layers for the chosen category. By moving the mouse over a variable the user can refresh the content on the right side, where it can select a scenario and a time period (years or 30-yr periods). The image on the top-right corner is a preview of the selected layer (Figure 8). A layer can be added to the map by clicking over it.

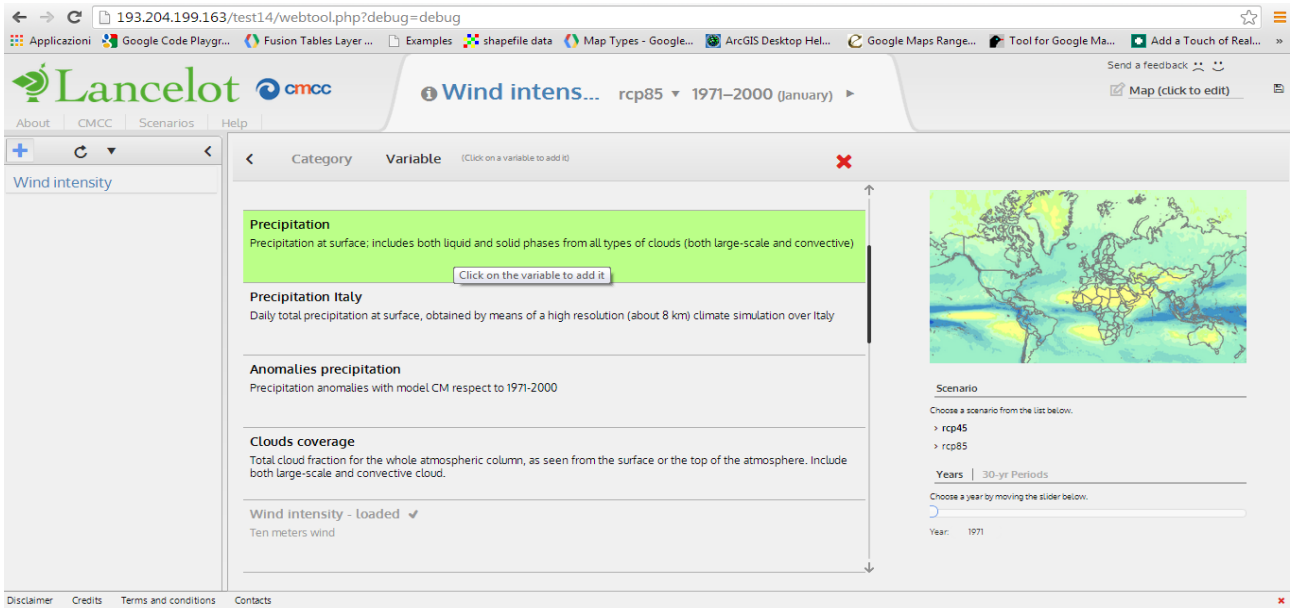


Figure 8: variable and parameters selection

The loaded variables are listed into the left bar. Their order can be changed by drag&drop (Figure 9). The order of the layers in the left bar corresponds to the order they are rendered on the map. In this way contour and vector layers can be placed over shaded and gridded layers.

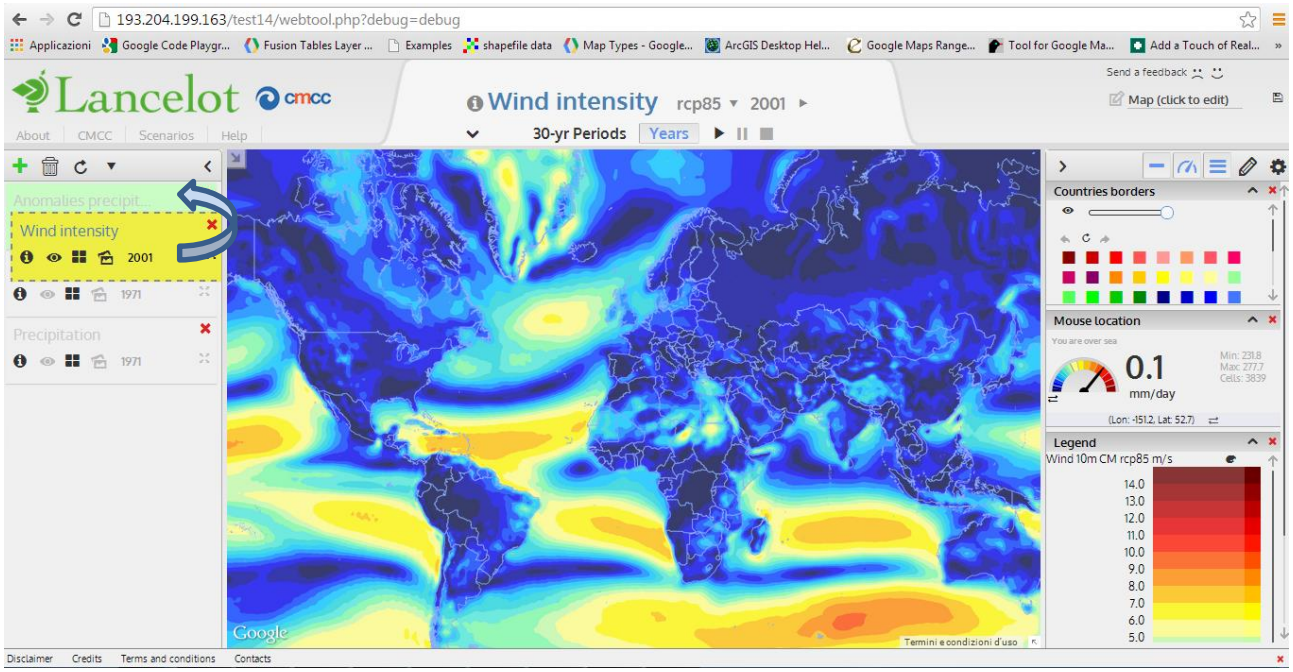
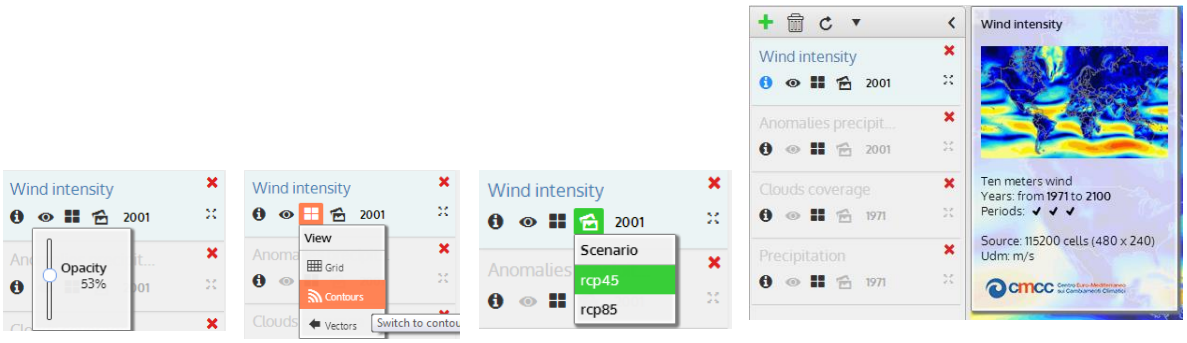


Figure 9: drag & drop

Once a variable is loaded, from the left bar the user can (Figure 10):

- Change its opacity
- Change the visualization from grid to shade, contours or vectors
- Change the scenario
- Get information about the variable



Opacity Visualization Scenario Information

Figure 10: variable's settings

Scenario and time can be changed also from the header options.

By pressing on the zoom-to-extent symbol the map is centered to best fit the selected layer.

Underlying countries borders

The “Countries borders” settings manage the borders of the countries. The user can change thier visibility and theier opacity and, by moving the mouse over colored cells, it can select the color of the borders, their weight and their dashes (Figure 11).

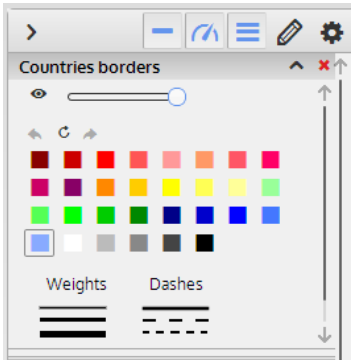


Figure 11: borders options

Application components

The application components can be resized by moving and clicking their borders (Figure 12).

The bars can be resized by dragging their border with the mouse (they have default minimum and maximum values of resizability); they can also be collapsed by clicking on the arrow symbol. Once a bar is collapsed, just a little portion of it still remains visible, to let the user click on it and restore the previous size. The panels (charts, legend, etc.) can be resized by dragging their border and by pressing the arrow symbol. The header of the application can be collapsed too.

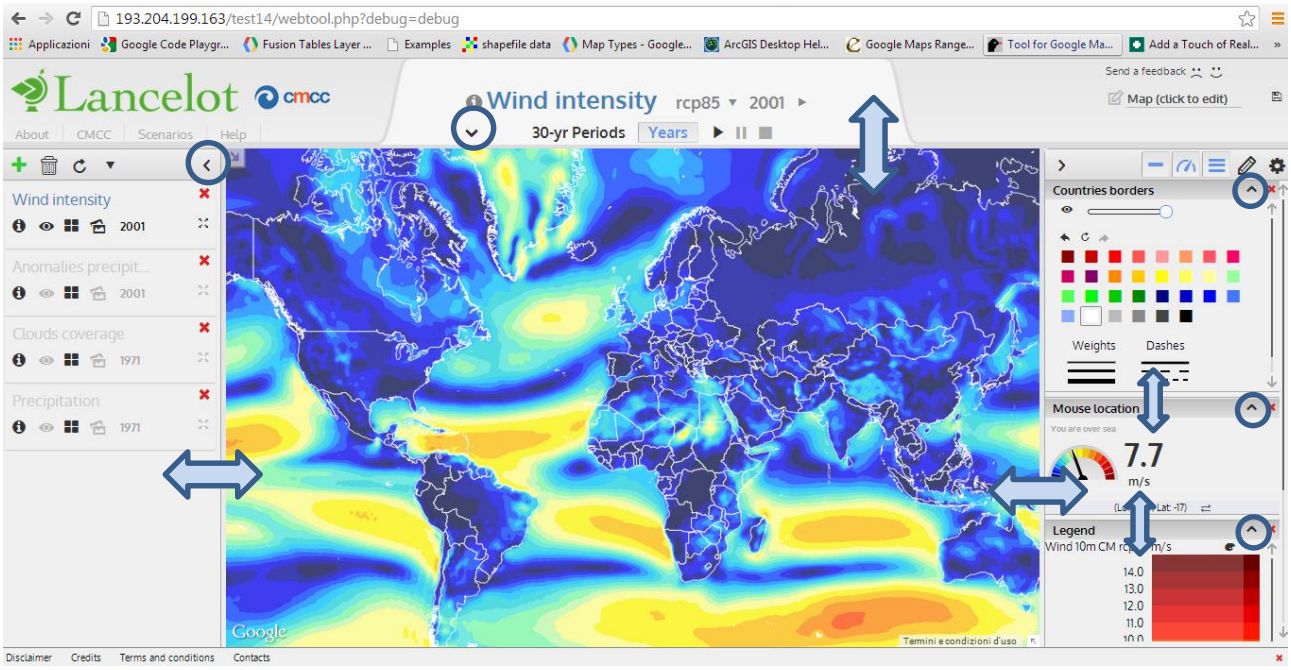


Figure 12: map objects resizing

Data features

The term “basemap” refers to the underlying world map which remains always visible.

The left bar allows the user to view this data:

- *Grid data*: these layers refer to continuous data (e.g. the air temperature) and discrete data (data split into classes, e.g. a list with “forests”, “deserts”, …). One gridded dataset can be loaded on the basemap at a time.
- *Shade data*: these layers refer to continuous data, and represent an interpolation of grid data. One shaded dataset can be loaded on the basemap at a time.
- *Grid data (as countries)*: these layers refer to countries-related data (e.g. economic impacts), which have a single value for an entire state or region. One gridded dataset can be loaded on the basemap at a time.
- *Contours*: these layers show contour lines. One of these datasets can be loaded on the basemap at a time. Gridded data and contours can overlap.
- *Vectors*: these layers show vector data represented as arrows with magnitude and direction. One of these datasets can be loaded on the basemap at a time. Gridded data and vectors can overlap. Contours and vectors can’t overlap.

Loaded layer type	Can show a grid at the same time?	Can show a shade at the same time?	Can show a contour at the same time?	Can show a vector at the same time?
Grid	no	no	yes	yes
Shade	no	no	yes	yes
Contour	yes	yes	no	no
Vector	yes	yes	no	no

Table 1: data overlapping

Currently available datasets

A list of available variables follows.

#	Data type	Variable name	Description
1	Climate	Air temperature	Two meters air temperature
2	Climate	Air temperature High Resolution	Two meters air temperature over land, obtained by means of a high resolution (about 8 km) climate simulation over Italy
3	Climate	Anomalies Air temperature	Two meters air temperature anomalies with model CM respect to 1971-2000
4	Climate	Anomalies Precipitation	Precipitation anomalies with model CM respect to 1971-2000
5	Climate	Cloud coverage	Total cloud fraction for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include both large-scale and convective cloud.
6	Climate	Keetch-Byram Dryness Index	Mean KBDI value. The KBDI (Keetch-Byram Drought Index) is a drought model whose output is a number (dimensionless) representing the effect of evapotranspiration and precipitation in the moisture content of upper soil layers and deep duff, and is thus related to the flammability of organic material in the ground.
7	Climate	Max Keetch-Byram Dryness Index	Max Keetch-Byram Dryness Index. The KBDI (Keetch-Byram Drought Index) is a drought model whose output is a number (dimensionless) representing the effect of evapotranspiration and precipitation in the moisture content of upper soil layers and deep duff, and is thus related to the flammability of organic material in the ground.
8	Climate	Min Keetch-Byram Dryness Index	Min Keetch-Byram Dryness Index. The KBDI (Keetch-Byram Drought Index) is a drought model whose output is a number (dimensionless) representing the effect of evapotranspiration and precipitation in the moisture content of upper soil layers and deep duff, and is thus related to the flammability of organic material in the ground.
9	Climate	Ocean Salinity	Sea water salinity
10	Climate	Ocean temperature	Sea Water Potential Temperature
11	Climate	Ocean velocity	Sea water velocity at surface
12	Climate	Ocean velocity (meridional)	Sea water velocity at surface (meridional component)
13	Climate	Ocean velocity (zonal)	Sea water velocity at surface (zonal component)
14	Climate	Ph	Negative log of hydrogen ion concentration with the concentration expressed as mol H kg-1
15	Climate	Precipitation	Precipitation at surface; includes both liquid and solid phases from all types of clouds (both large-scale and convective)
16	Climate	Precipitation High Resolution	Daily total precipitation at surface, obtained by means of a high resolution (about 8 km) climate simulation over Italy
17	Climate	Primary Organic Carbon Production	Vertically integrated total primary (organic carbon) production by phytoplankton. This should equal the sum of intpdiat+intpphymisc, but those individual components may be unavailable in some models.

18	Climate	Wind	Ten meters wind
19	Climate	Wind (meridional)	Ten meters wind meridional component
20	Climate	Wind (zonal)	Ten meters wind zonal component
1	Socio-economic	GDP Agriculture	% Change in GDP induced by climate impacts on land productivity
2	Socio-economic	GDP All Impacts	% Change in GDP induced by a set of climate impacts (land productivity, ecosystems, energy demand, fishery, floodings, forest net primary productivity, human health, sea level rise, tourism)
3	Socio-economic	GDP Ecosystems	% Change in GDP induced by climate impacts on ecosystems
4	Socio-economic	GDP Energy Demand	% Change in GDP induced by climate impacts on energy demand (oil, gas, electricity)
5	Socio-economic	GDP Fishery	% Change in GDP induced by climate impacts on fishery sector
6	Socio-economic	GDP Floodings	% Change in GDP induced by climate impacts related floodings
7	Socio-economic	GDP Forestry	% Change in GDP induced by climate impacts on forest net primary productivity
8	Socio-economic	GDP GDP/Population	GDP per capita trends
9	Socio-economic	GDP Health	% Change in GDP induced by climate impacts on human health (job on performance)
10	Socio-economic	GDP Population	Population trends
11	Socio-economic	GDP Sea Level Rise	% Change in GDP induced by sea level rise
12	Socio-economic	GDP Tourism	% Change in GDP induced by climate impacts on tourism demand and correlated income transfers
1	Impacts	Carbon Loss by Fire	Annual amount of carbon emitted to the atmosphere each year through vegetation burning (gC/m2)
2	Impacts	Evaporation	Component of the water balance representing the annual amount of water (mm) evaporated from soil and plants. When added to transpiration, it represents the evapotranspiration: i.e. the quantity of water actually removed from a surface due to the processes of evaporation and transpiration
3	Impacts	Fire Frequency	Probability to have fire in one year (unitless)
4	Impacts	Heterotrophic Respiration	Amount of carbon released through the decomposition of dead organic matter (gC/m2*y)
5	Impacts	Interception	Component of the water balance representing the annual amount (mm) of precipitation that does not reach the soil, but is instead intercepted by the leaves and branches of plants and the forest floor
6	Impacts	Land Suitability	Land Suitability for Spring Health

7	Impacts	Land Use Change	The land use represents the type of utilization for a given territory by human activities (e.g. for agriculture, urban, forestry, livestock grazing) but it also included the natural land cover (unmanaged forests, grasslands, deserts). Both anthropic and natural use/cover of lands was and is changing in time and space, and it is expected to be under continue transformation in the future as driven by socio-economy and climate Land Use Change (LUC) modeling experiment version "0" was performed under FUME and GEMINA projects at CMCC. The simulation was driven by CMCC-MED simulations for the EUMENA-Med domain at about 80 km resolution under the A1B SRES scenario. The simulation assumes that actual Protected Areas (PAs) will be maintained fixed in the future without allowing LUCs inside them. The variable LUC represents the code of land use type as indicated in the legend.
8	Impacts	Litter Carbon	Amount of natural carbon stored in dead organic matter (gC/m2)
9	Impacts	Net Primary Production	Production of organic matter from atmospheric carbon dioxide by plants in an ecosystem minus losses of carbon resulting from plant respiration (gC/m2*y)
10	Impacts	Runoff	Component of the water balance representing the annual amount of water (mm) flowing on the soil surface
11	Impacts	Soil Carbon	Amount of natural carbon stored in the soil (gC/m2)
12	Impacts	Soil Water Content Layer 1	Annual soil water content (mm) in the upper layer of soil (0-50 cm depth)
13	Impacts	Soil Water Content Layer 2	Annual soil water content (mm) in the lower layer of soil (50-150 cm depth)
14	Impacts	Transpiration	Component of the water balance representing the annual amount of water (mm) transpired by plants. When added to evaporation, it represents the evapotranspiration: i.e. the quantity of water actually removed from a surface due to the processes of evaporation and transpiration.
15	Impacts	Vegetation Carbon	Amount of natural carbon stored in live vegetation (gC/m2)

Table 2: available datasets

Legend

The legend panel shows the color palette and the values of the currently loaded variable. The palette can list numerical values or textual information (Figure 13).

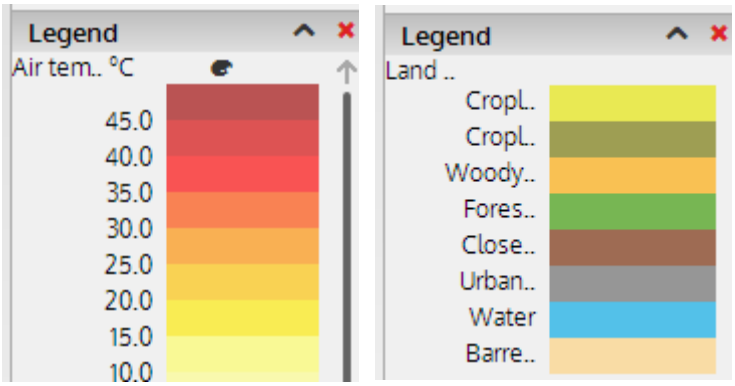


Figure 13: numerical legend and textual legend

Each variable has a predefined set of colors. The user can change the colors of the palette by moving the mouse over the palette symbol (Figure 14); the customized palettes are usually slower than the default one.

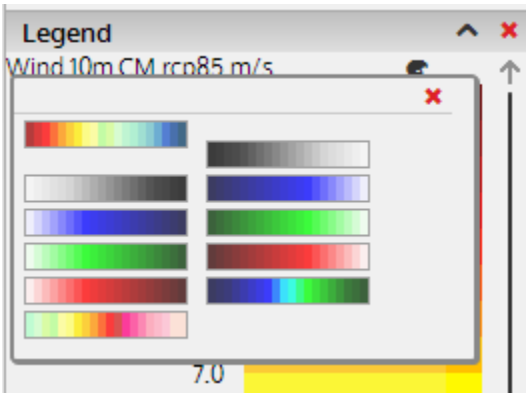


Figure 14: legend configuration

In this version the user can't change the value intervals of the palette.

Map interactions

This paragraph presents the interactions between the user and the map.

Basic controls

As for the usual Google's map environment, the map can be moved by dragging it with the mouse and zoomed in and out by using the mouse scroll.

The map can be moved or dragged also by using the controller in the top-left corner (Figure 15).

Figure 15: map browsing control

Mouse passage

The most immediate user interaction takes place when passing the mouse over the nations of the world: a box shows the value of the dataset currently in use at country or region level; in case of continuous data it's the average value for that country or region, accompanied by the minimum, the maximum, and the number of cells on which the statistic is based (Figure 16), while in the case of discrete data (divided into classes) the presented values are expressed as percentages and organized into a pie chart.

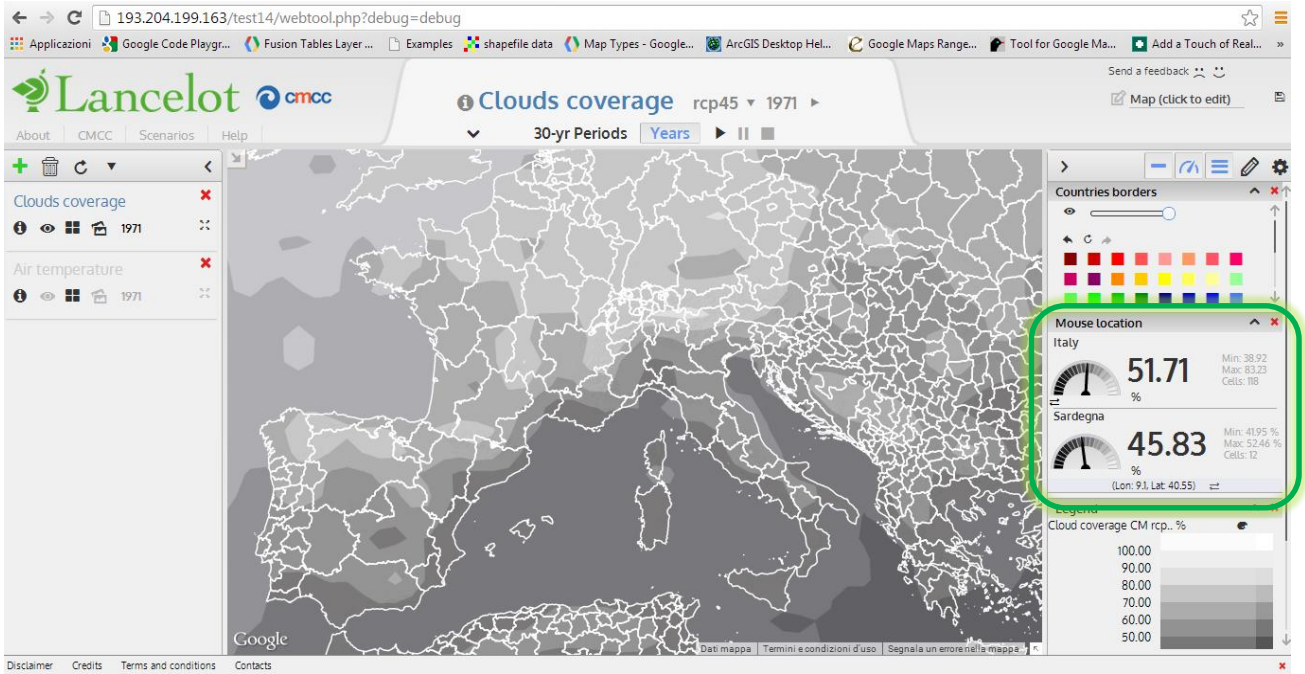


Figure 16: gauges

Mouse click

From here on, "country" means both a country and an administrative region.

By clicking with the mouse on a country, a contextual menu allows the user to plot:

- a chart showing on a temporal axis the mean values for that country (the chart is discussed in the next paragraph);
- a table having average, minimum and maximum of the selected dataset in the case of continuous data, for each year or month (Figure 17);
- a pie chart in the case of discrete data; in this case is currently not possible to scroll over several years (Figure 18);
- a vector chart in the case of vectorial data; also in this case is currently not possible to scroll over several years (Figure 19).

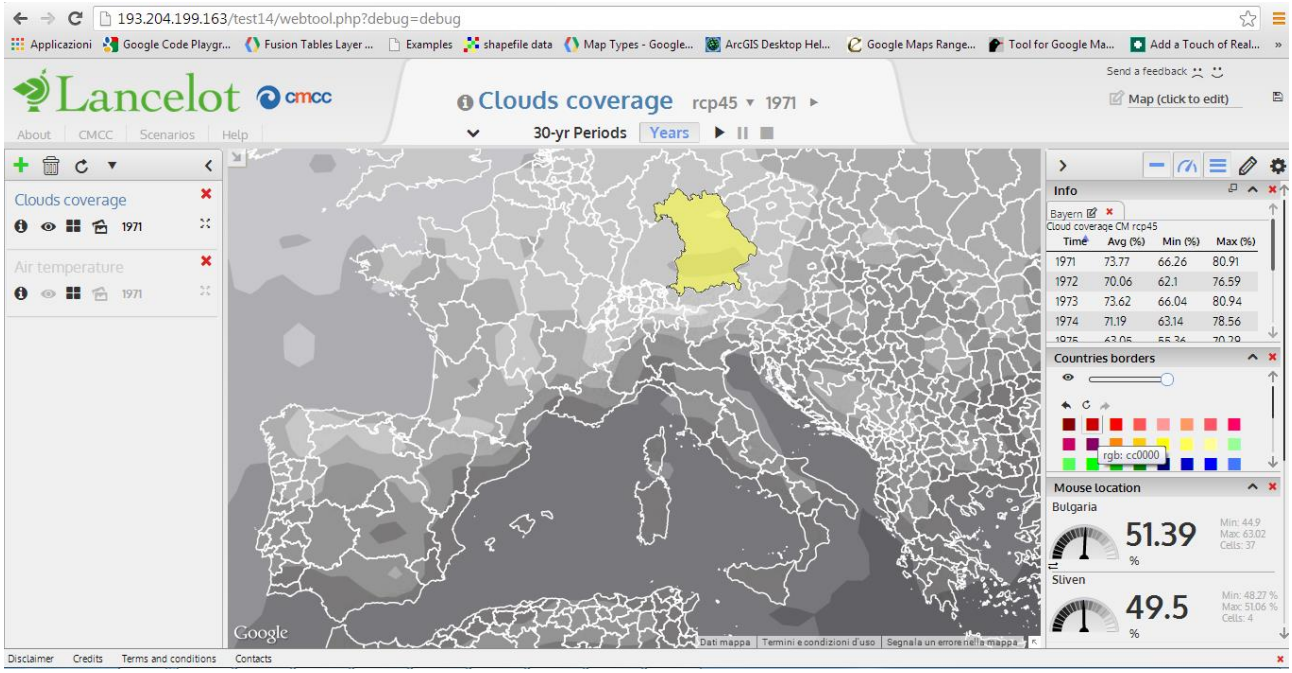


Figure 17: data represented as table

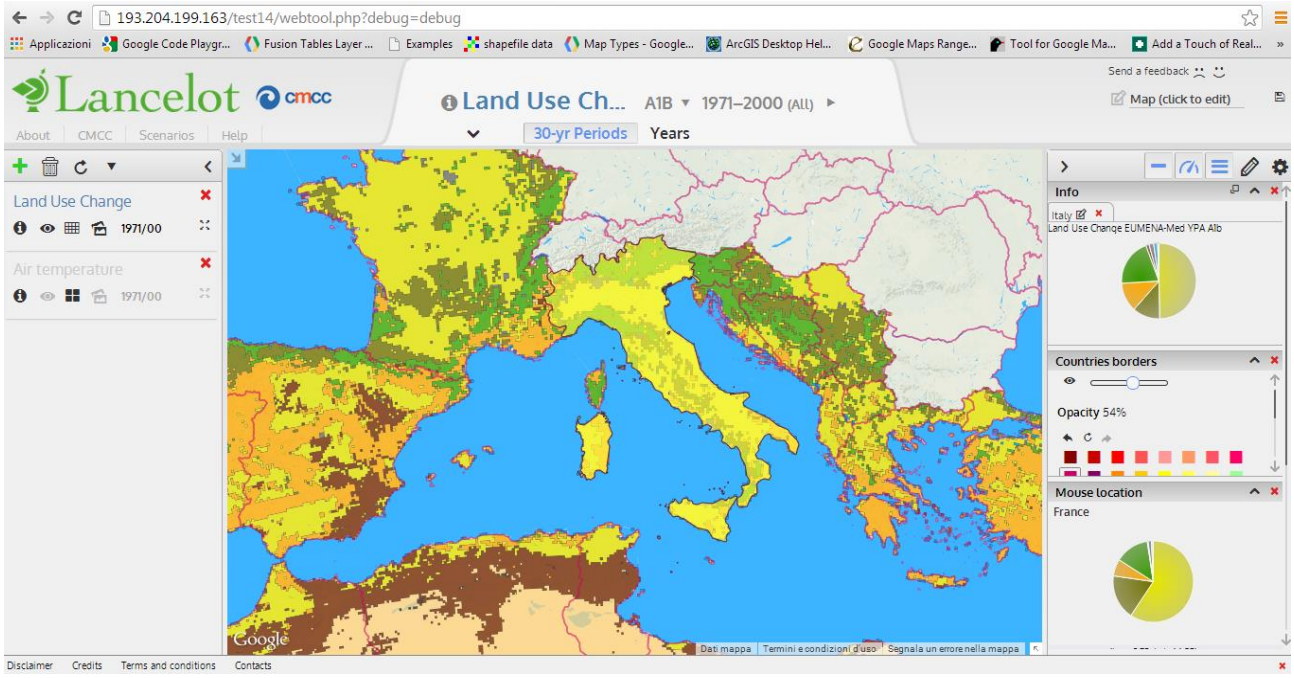


Figure 18: pie chart

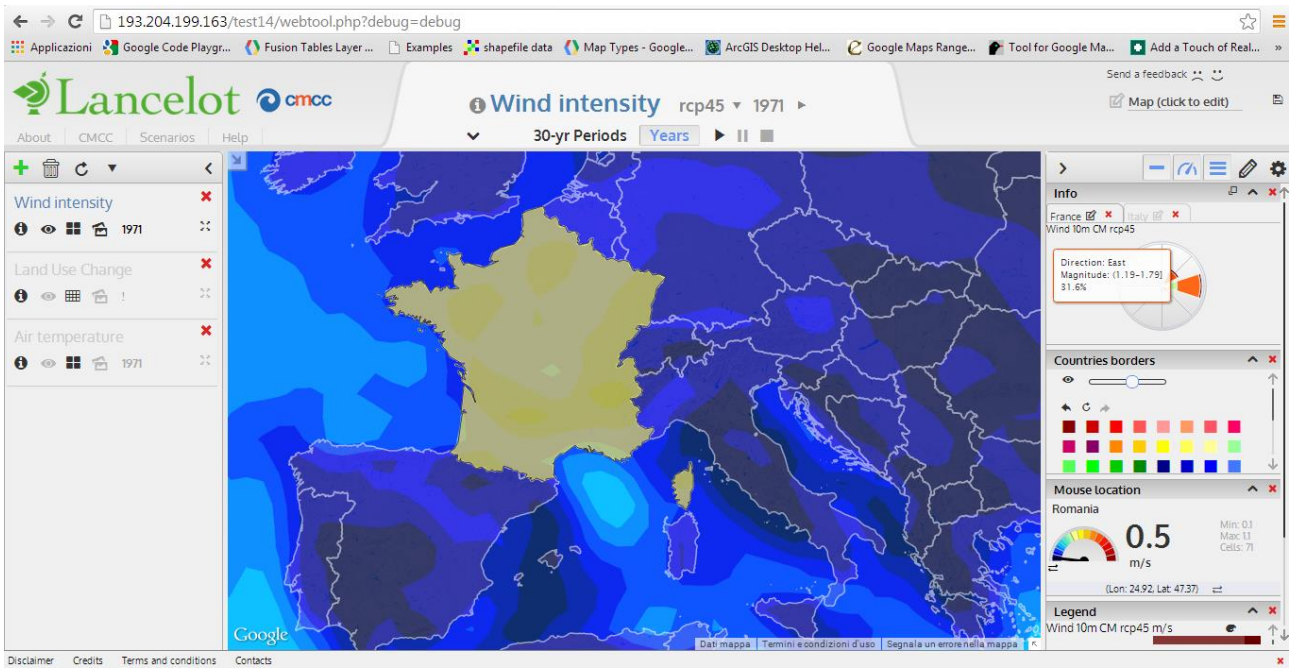


Figure 19: wind chart

Both charts and tables can be renamed.

CTRL button

By pressing CTRL (CMD on a mac), many states can be selected at the same time.

Chart

The chart shows the evolution over time of one or more variables, related to one or more countries. To display the chart, the user selects one or multiple countries (Figure 20) by holding down the CTRL /CMD button, and clicks with the mouse button on one of the selected.

The chart is reported in the right bar.

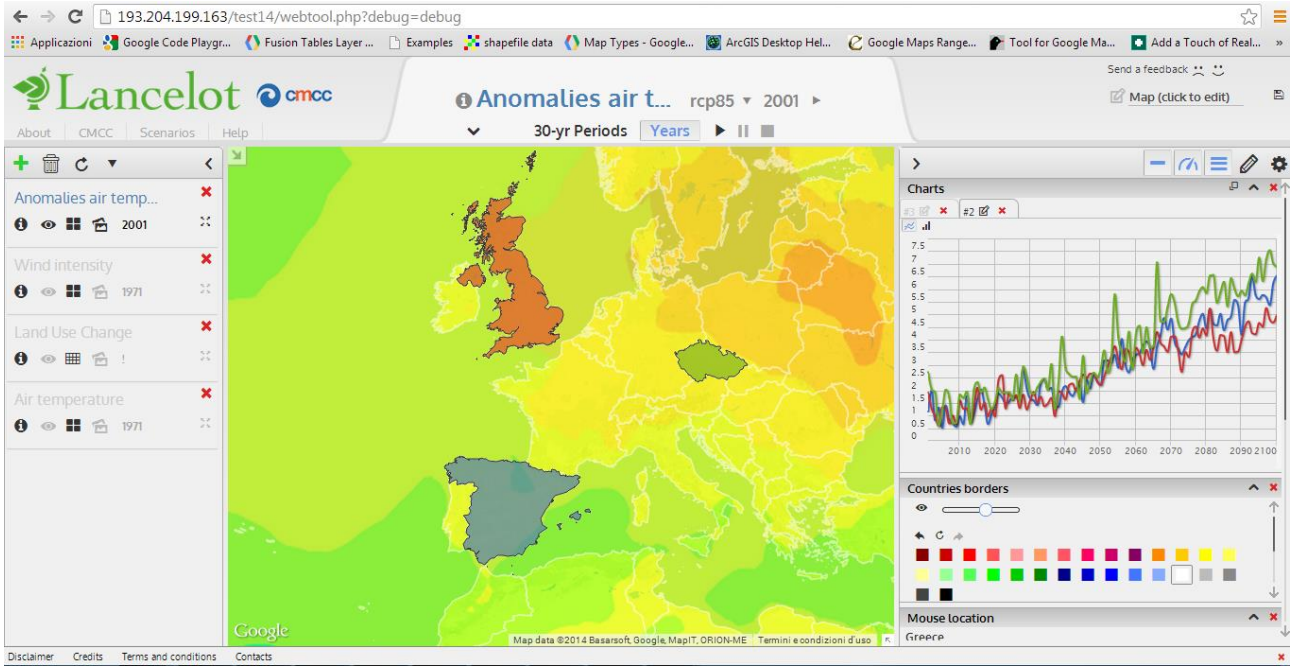


Figure 20: chart with multiple state selection

By clicking on the button  the user can open the chart to full screen, and get additional features (Figure 21).

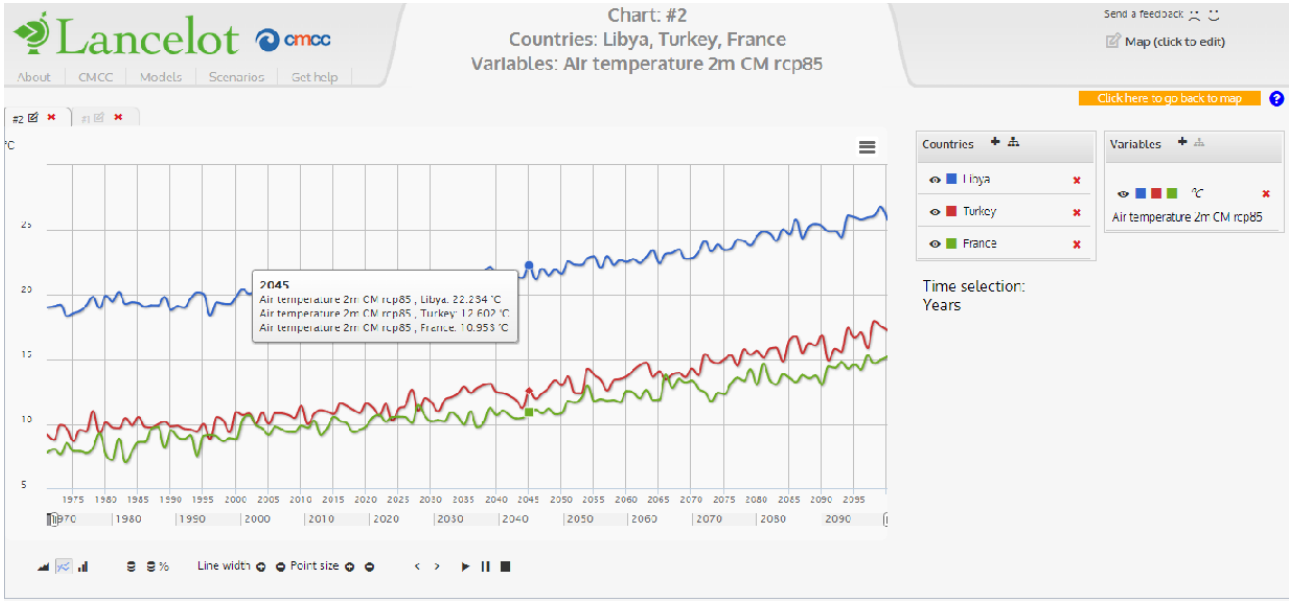


Figure 21: full screen chart

Chart's options

The buttons in the chart window allow customizing the chart:

- chart data can be shown in the form of lines (points and lines size can be changed), filled lines or columns (columns width can be changed)
- the time axis can be scrolled left or right
- by holding down the left mouse button the chart can be zoomed to a specific area
- in the case of multiple selection, the data can be seen in aggregate form, by aggregating countries or variables (in this case data are normalized into [0, 1] due to possible different measure units)
- variables can be removed or added to the chart
- countries can be removed or added to the chart
- the chart can be animated over time

A chart can be exported to various formats as png, jpeg, pdf, svg.

When the user creates a chart, the corresponding countries are painted with the same colors of the chart series. The variables are distinguished with different shades of the same color.

Shapes

From the right menu it's possible to draw shapes on the map (circles, rectangles, and polygons with an arbitrary number of points). Once drawn a figure (Figure 22) it's possible to:

- get over it with the mouse and see the average, maximum, minimum and the number of cells from the underlying data;
- click with the mouse button and plot tables and charts with the trend of time-varying;
- modify the shape; if the user modifies a shape, all the charts and tables related to it are destroyed.

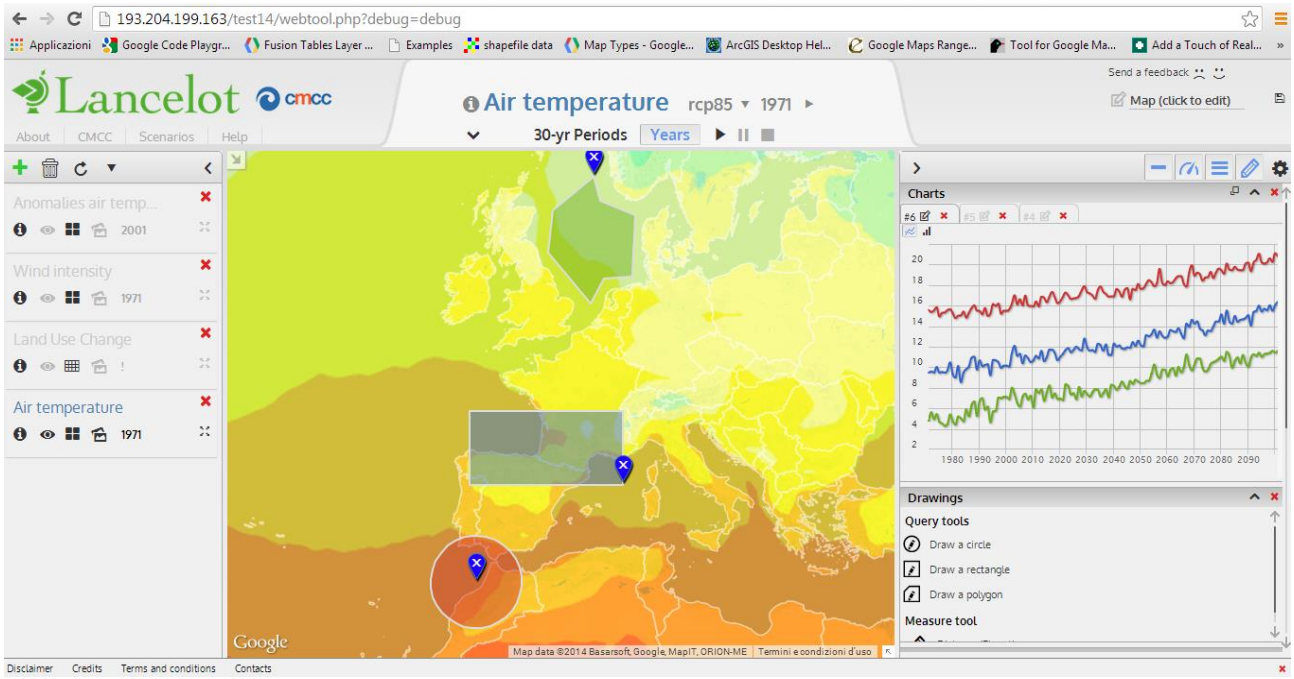


Figure 22: shapes with related chart

The measure tool allows the user to draw a line and get information about the distance between two points and the elevation of the underlying path (Figure 23).

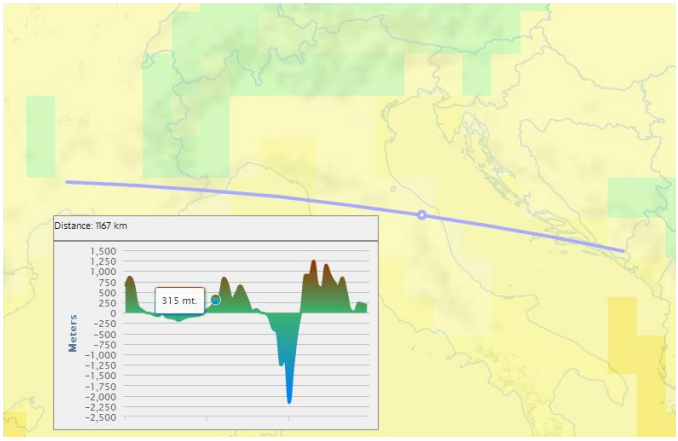


Figure 23: distance tool

Time box

By pressing the arrow at the bottom of the screen the user can open the box for time management. Time can refer to years or periods.

In the case of multiple selected data (for example dataset of temperature and wind vectors) multiple time bars are displayed.

In this version there are some future scenarios and only one historical scenario for each variable. The historical scenario is always shown alongside the future scenario.

Years

The years visualization shows the available years for the selected variable (Figure 24).

If a time instant is not available for a certain variable, it isn't displayed. The meaning of the color of a point in bar is:

- red: the currently shown time
- black: a future time which is available
- blue: during the animation, it represents an old time instant
- shades of gray: during the animation, data which are loading

The user can change the current year by clicking on one of the corresponding rectangles. Different time bars can display different times.

If for a certain time there isn't data to display for the selected layer/contour, an alert message is displayed on the top-left corner, warning the user about the missing data on the map projection.

Animation

By pressing the "play" arrow the user starts an animation that goes from the selected year until the last available year. The user can also change the speed of the animation. Every user interaction with the map during the animation causes the animation to stop.

Figure 24: time controller for years

Periods

In the case of time periods (named 30-yr periods), the time controller allows to select a period and, where available, a month (Figure 25).

Figure 25: time controller for periods

Map options

From the left menu the following settings (Figure 26) can be enabled or disabled:

- show satellite images
- show a map with colors
- show a black colored map
- show a Map Quest's map
- show an Open Street Map's map
- show administrative names (not if in satellite view)
- show meridians and parallels
- show the division between the day and the night
- allow to zoom until the maximum zoom level
- show the scale indicator on the map
- show regions instead of states
- enlight a country when the mouse passes over it (not if total zoom depth is selected)
- set legend opacity according to layer opacity

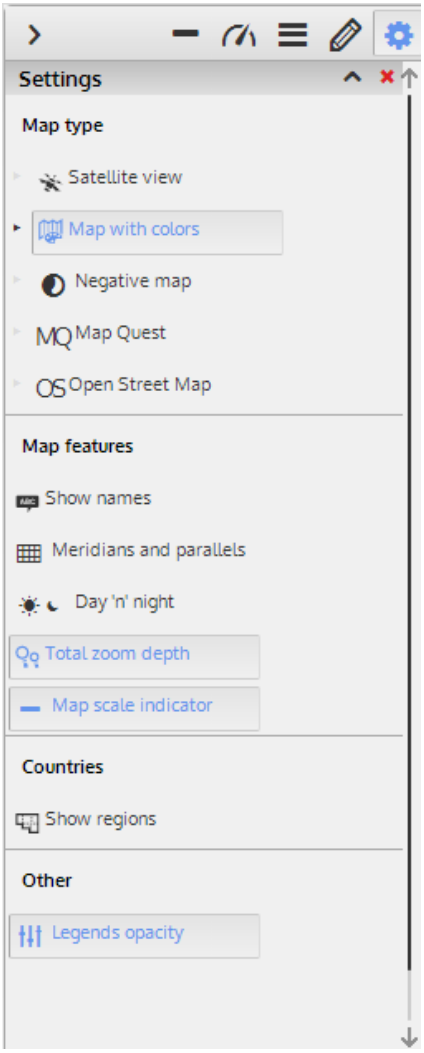
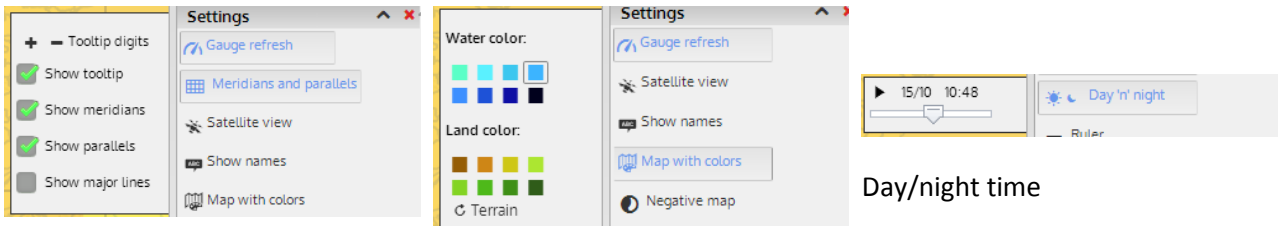


Figure 26: settings

Some settings have also additional options (Figure 27):



Meridians and parallels

Map colors for water and terrain

Day/night time

Figure 27: map settings additional options

Map saving

The map status can be saved by clicking on the floppy disk symbol (Figure 28) on the top right corner of the application. The user obtains a link (Figure 29), to copy and paste on the browser's URL in order to restore the saved map. The map status includes information about loaded variables, time parameters, map settings, charts and tables.

Figure 28: map saving button

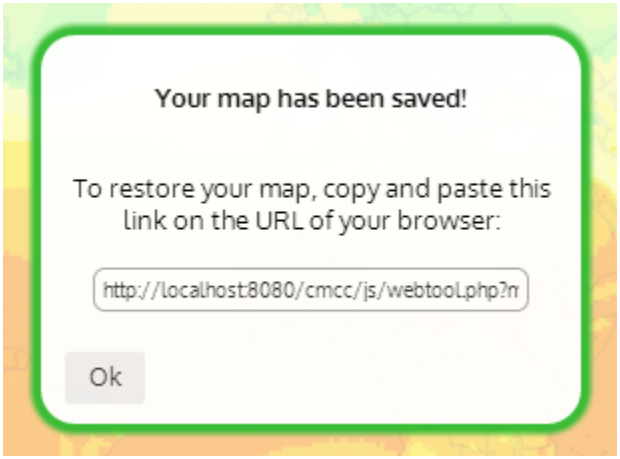


Figure 29: the confirm of map saving with the link

Feedback

By clicking on the feedback symbols (Figure 30) the user can submit a positive feedback (Figure 31) or a negative report.

Figure 30: feedback symbols

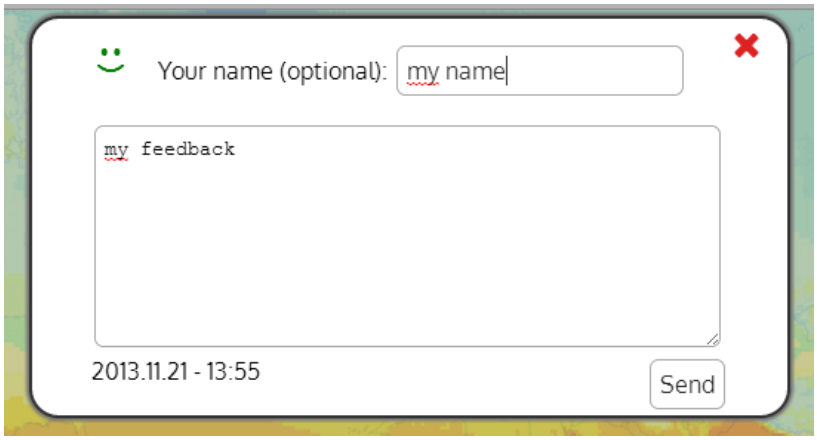


Figure 31: feedback form

Help

From the main menu the user can run two interactive tutorials:

- the basic tutorial explains the basic knowledge to use the application, in order to browse among the variables and change their times and scenarios;
- the advanced tutorial explains how to change the basic settings and how to use the query tools.

The help section (Figure 32) contains also the pdf manual, a list of frequently asked questions (FAQ) (Figure 33) and a welcome message (Figure 34) which shows to the user some use case screenshots.

Figure 32: the help section

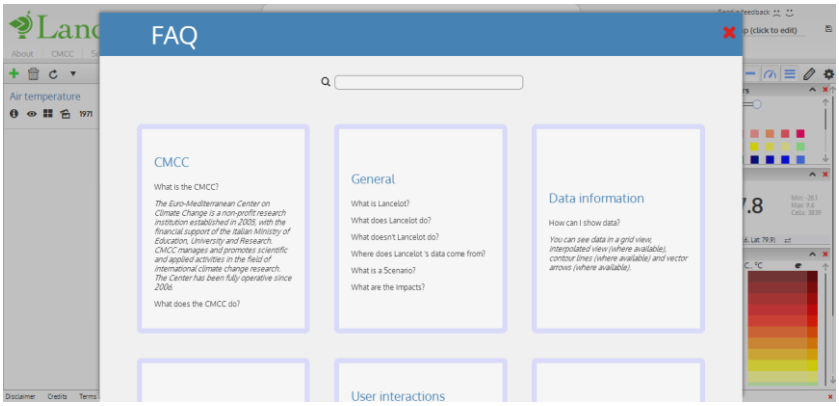


Figure 33: FAQs

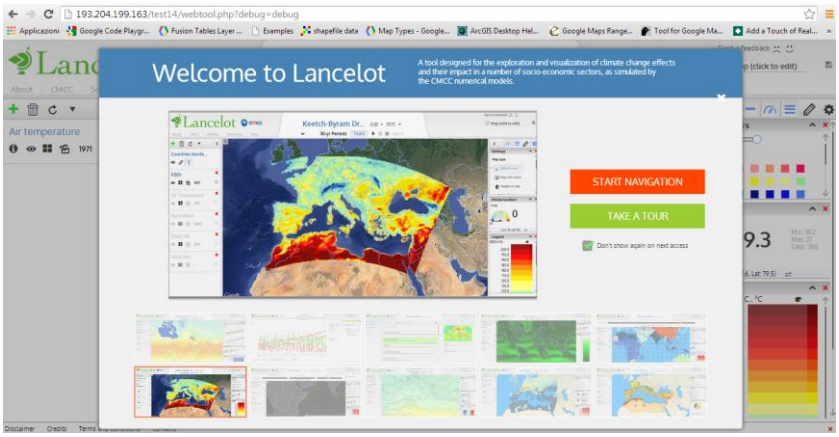


Figure 34: welcome message

System requirements

Lancelot works with the following browsers:

- Google Chrome 30 or later
- Mozilla Firefox 10 or later
- Apple Safari 5 or later
- Internet Explorer 9 or later (some functionalities are missing)

Lancelot is being tested with these systems:

- Mac OS X 10.5
- Mac OS X 10.6
- Mac OS X 10.7
- Windows XP
- Windows 7
- Windows 8
- Linux (Ubuntu)

System architecture

The architecture is based on a JavaScript environment which interacts with the Google maps API. The front end is provided by using standard free visualization libraries. Data and queries are obtained by a Postgis database with Postgis extension. Data tiles are provided by a cascading caching system and a Geoserver service.