A new solution to improve climate change observations and modelling

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Abstract

The climate-change monitoring concept is one of the key result from the EuroClim project. It includes distributed sub-systems for extraction of cryospheric variables from remote sensing data, climate modelling, statistical analysis and a web-based system presenting the results. The concept may be generalised to other types of monitoring tasks, in particular tasks addressed by the GMES and GEO initiatives.

1. Introduction

Climate scenario modelling indicates that our environmental conditions will change with increasing speed in the coming years with one of the most significant changes being a warming of the global climate. Europe is maybe the most sensitive region of the world, and it is not known whether we will experience regional cooling or warming in a future warmer world in general. Therefore, monitoring climate change in Europe is of utmost importance for preparedness and counteractions.

The EuroClim project is funded under the EU Information Society Technology (IST) programme. The system, which now is in its final stage of development, includes sub-systems for extraction of cryospheric variables from remote sensing data. Cryospheric variable products are stored in an advanced, distributed database system connecting all the storage and processing sites comprising the EuroClim network. Each database in the network is an innovative storage system for multi-dimensional raster data. Sub-systems for climate modelling and statistical analysis apply the cryospheric variables in order to do scenario analysis, trend estimation, uncertainty assessments, etc. A web-based system presents the results – from

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cryospheric products to high-level information showing possible climate changes and consequences thereof.

2. Overall functionality

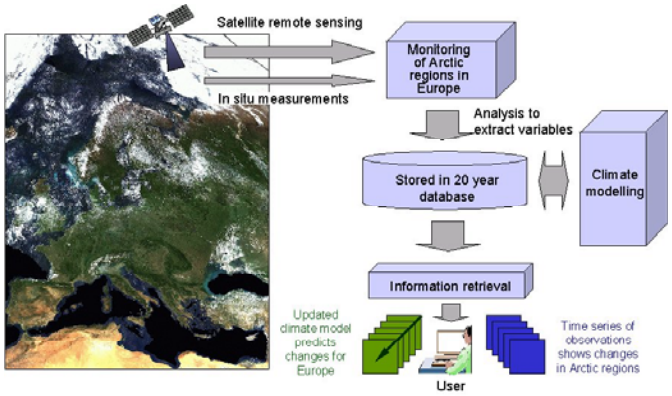
The system has three main components for production and distribution of products:

- A satellite-data oriented system producing a portfolio of observation products
- A climate model producing a portfolio of climate model output products
- A web-based service (portal) providing climate information

The observation products cover the whole Arctic basin, Greenland, Svalbard and Fennoscandia. The EuroClim system monitors changes in sea ice, snow and land ice. The climate model products are produced by a regional climate model. Historical runs as well as scenarios are available. It will be possible to access both the observation data and the modelled data from EuroClim via the web. The data can be viewed on screen as maps and charts or downloaded as products for local analysis. EuroClim is intended to be an operational long-term monitoring service from early 2005.

3. Conceptual approach

The EuroClim concept for system architecture consists of a network of processing and storage nodes together with a web portal node for service delivery. Each processing and storage node is based on a generic framework handling the basic functions for processing satellite data in an automatic processing line. The specific geophysical variable retrieval algorithm is implemented on top of this framework. One framework can handle a set of algorithms, which means that one node will usually produce a set of different products. All the products are then stored in the local database in a specific format (HDF). The nodes are linked to the web portal node, which conveniently



provides a one-stop-shopping solution to the user.

The service provided by EuroClim is entirely web-based. The EuroClim portal has defined the user categories *scientific*, *professional/operationa*l and *public*. The services provided are then tailored to the typical specific needs of each type of user. The basic observational products are maps describing a geophysical variable within a particular timeframe. Examples of variables are sea ice concentration, sea ice thickness, snow cover, snow albedo, snow temperature, snow wetness and glacier mass balance. Monthly, seasonal and annual products have been defined in EuroClim. However, the system is entirely flexible on the length of the aggregation period. Additionally, there are derived products. Typically *climate indicator variables*, e.g., the maximum total sea-ice concentration for the Arctic basin for a given year, and a trend product providing a statistical trend analysis result for a given variable, region and time period.

4. Implementation

The EuroClim application is built into the Java 2 Enterprise Edition Framework (J2EE). The EuroClim Information Portal (EIP) provides the link between the user and EuroClim's distributed functionality and data. The EIP communicates with EuroClim Web Services (EWS) to respond to the user actions. The EWS is a web service running on, possibly, any machine in the EuroClim network. The EWS receives request from the EIP, processes it, and returns a response. The communication of web service request/response is to send XML documents over HTTP communication channels. In EuroClim, the EWS provides a known set of interface methods that are called by the EIP to set and retrieve the necessary information.

5. Conclusion

One of the greatest threats to mankind is climate change. The EuroClim project develops an advanced climate monitoring and projection system for Europe. It is a distributed system where climate observations are collected by climate research institutes across Europe and integrated into a network of databases with a unified user-interface. The project has established an automatic mechanism to acquire, process, and store cryospheric data, and analyse long time-series of observed and modelled data to estimate trends and make predictions of future climate. Users will retrieve data via a web-based high-performance information system. There are plans to include the observing system and service into the GMES initiative.