

# ECMWF Feature article

from Newsletter Number 104 – Summer 2005



## COMPUTING

### Developing and validating Grid Technology for the solution of complex meteorological problems



*This article appeared in the Computing section of ECMWF Newsletter No. 104 – Summer 2005, pp. 22–24.*


# Developing and validating Grid Technology for the solution of complex meteorological problems

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At its fourteenth Congress held in 2003, the World Meteorological Organization (WMO) approved the concept of a WMO Information System (WIS). The WIS will provide a single coordinated global infrastructure for the collection and sharing of information in support of all WMO and related international programmes. It will be based on three main components and a network able to interconnect them: National Centre (NC), Global Information System Centre (GISC) and Data Collection and Production Centre (DCPC). Further information about WIS, can be found at: [www.wmo.int/web/www/FWIS-Web/homefwis.html](http://www.wmo.int/web/www/FWIS-Web/homefwis.html)

As a first step towards the establishment of the WIS, the Regional Association VI of WMO decided to create a project for the development of a prototype GISC. Deutscher Wetterdienst (DWD), Météo-France and the UK Met Office volunteered to jointly design and implement a Virtual GISC (V-GISC) shared by their Services and to include ECMWF and EUMETSAT as DCPCs in the concept. They proposed that ECMWF lead a sub-project of the EU-funded SIMDAT project (Data Grids for Process and Product Development using Numerical Simulation and Knowledge Discovery), with the view to preparing the necessary elements of the V-GISC.

## SIMDAT

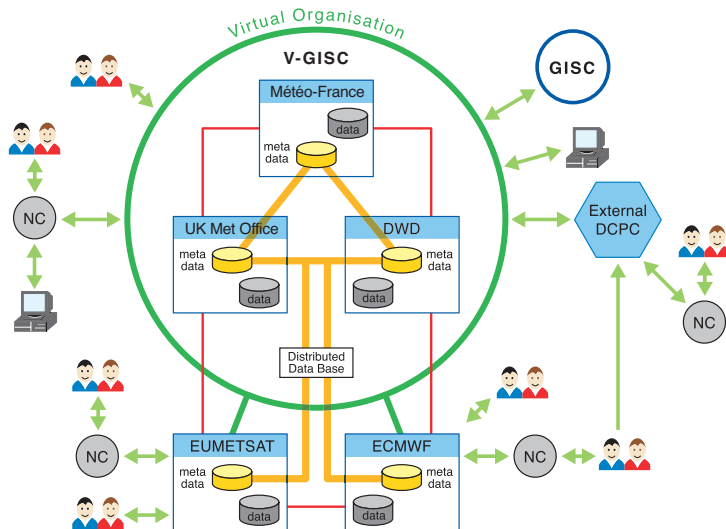
**SIMDAT**  SIMDAT is a four-year European FP6 Integrated Project. The SIMDAT contract was signed on 1 September 2004. The project aims at developing generic Grid Technology for the solution of complex data-centric problems and validating the effectiveness of the Grid Technology in several application sectors.

Development of large-scale products and services poses complex problems. The processes used to develop these products and services typically involve a large number of independent organisational entities at different locations grouped in partnerships and supply chains. Offering connectivity plus interoperability, Grids are a major enabler of improved collaboration and of virtual organisations; they are needed to connect diverse data sources and to enable flexible, secure and sophisticated levels of collaboration.

The four application sectors selected to cover the full range of issues to be addressed in design, development and production of complex products and services are aerospace, automotive, pharmacy and meteorology. For each application sector a complex problem has been identified as a use-case for the project. The consortium also comprised leading software and process system developers and Grid technology specialists.

Seven key technology layers have been identified as important to achieving SIMDAT's objectives.

- An integrated Grid infrastructure, offering basic services to applications and higher-level layers.
- Transparent access to data repositories on remote Grid sites.
- Management of Virtual Organisations.
- Scientific workflow.
- Ontology (i.e. specification of conceptualization).
- Integration of analysis services.
- Knowledge services.



**Figure 1** The SIMDAT Infrastructure will provide access to distributed meteorological databases through the Virtual Global Information System Centre (V-GISC).

### Virtual Global Information System Centre (V-GISC)



The objective of SIMDAT for the meteorology sector is to develop a virtual information centre to support research and operational activities of the European meteorological community. This virtual centre will offer users a consistent view of all meteorological data distributed in the real-time and the archive databases of the partners, and provide a secure, reliable and efficient mechanism to collect, exchange and share these distributed data.

ECMWF, in cooperation with Météo-France, DWD, the UK Met Office and EUMETSAT, and with the help of SIMDAT technology specialists, plans to develop and deploy a common system for the collection and sharing of distributed meteorological data. The V-GISC partners will form a cluster, with partners enjoying equal rights and supporting one another. By the use of Grid technologies and standards and protocols for metadata, data discovery, transport and on-line browsing, the V-GISC infrastructure will improve the load distribution and availability of the system. In addition it will provide a uniform external interface to the users allowing them to easily locate, access and use the diverse distributed forms of data and their associated metadata.

ECMWF hosted the first SIMDAT/V-GISC workshop from 6 to 9 December 2004. The workshop reviewed the technical and functional requirement of the WIS and started to identify and capture the requirements of the V-GISC. The initial datasets that will be available through the virtual centre were also discussed during the workshop.

### V-GISC infrastructure

The project will develop an infrastructure that brings together the data of the partners and provide access to distributed meteorological databases through the virtual organisation. Figure 1 shows the infrastructure within the WIS architecture. Users and systems can either access the V-GISC or can access directly the National Centres or the Data Collection and Production Centres. The V-GISC will be seen as a normal GISC and will fulfil the WIS technical requirements. Consequently the V-GISC will:

- Improve visibility and access to data through a comprehensive discovery service based on metadata development;
- Add value to existing data sets;
- Offer a subscription services and a variety of reliable delivery services;
- Provide a global access control policy managed by the partners and integrated into their existing security infrastructure.

### V-GISC architecture

The project will develop Grid-based software to collect and exchange data. Metadata systems, delivery and access tools will be developed to provide users with Grid services linking data discovery across distributed databases to dataset delivery. Figure 2 shows the conceptual architecture of the V-GISC. Users search and retrieve data, subscribe to services, subject to authentication and authorization, through a distributed portal located on each partner's site. The following services are available.

- **Virtual database Service:** it is the core of the system and provides a single view of partners' databases.
- **Discovery Service:** provides data searching facilities.
- **Subscription Service:** provides delivery scheduling.
- **Transport Service:** provides data acquisition and delivery mechanisms.
- **Analysis Service:** provides post-processing facilities.
- **Security Service:** verifies user identity and provides authorization credentials (data policy).
- **Management Service:** provides administrator with management facilities.
- **Monitoring Service:** provides operators and users with monitoring facilities.

To validate that the V-GISC can be built on a distributed and loosely coupled Grid architecture a demonstrator is being developed by the partners. The initial list of data to be accessible through the demonstrator was agreed between the partners during the second SIMDAT/V-GISC workshop held at ECMWF in March 2005. These data will be discoverable through the V-GISC catalogue that conforms to WMO Core Metadata Profile. Grid technologies and web services will be used to offer external interfaces to the virtual centre and to federate the partners' legacy data repositories.

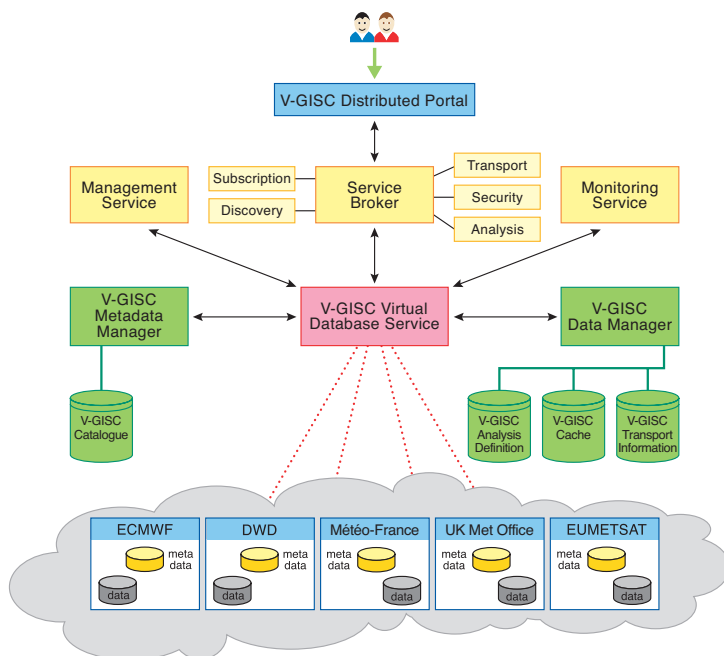


Figure 2 The conceptual view of the Virtual Global Information System Centre (V-GISC).

### International impact

The results of the SIMDAT project should become the foundations for the Virtual Global Information Systems Centre, an innovative service of the centres involved. The software developed within SIMDAT will be made freely available to the WMO community. It is expected that the project will develop standards for the WIS. Meteorological centres from other WMO Regional Associations could then use the outcome of this project to build virtual organisations.

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