St. Petersburg Institute for Informatics and Automation of RAS (SPIIRAS)

Service-Oriented Architecture of Intelligent GIS

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Motivation and objectives

The requirements of end users to GIS is to obtain high quality solutions in the shortest possible time.

Most part of the end users tasks are highly complicated.

Users requirements to the tasks that are being solved change very quickly.

Users in their activities need to account for diverse factors.

Number of GIS users can reach hundreds and the system is expected to get adapted to each user requirements and provide necessary information space.

Modern Intellectual GIS being multilevel heterogeneous systems due to use of integrated means of artificial intelligence can propose an efficient solution.

Plan of report

- Introduction
- SOA concept for IGIS
- Common SOA of IGIS
  - Application services
  - Data base, knowledge base, ontology services
  - End users services
- Case study
- Conclusion

Applications' server

JBoss™

Java

ORACLE WebLogic

bea weblogic

redhat Linux

WebSphere. software

IBM®

ORACLE APPLICATION SERVER 10g

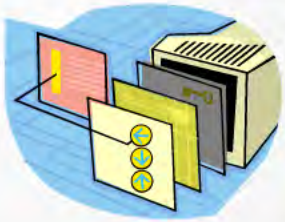
ORACLE®

Sun microsystems

Java

SOA concept for IGIS

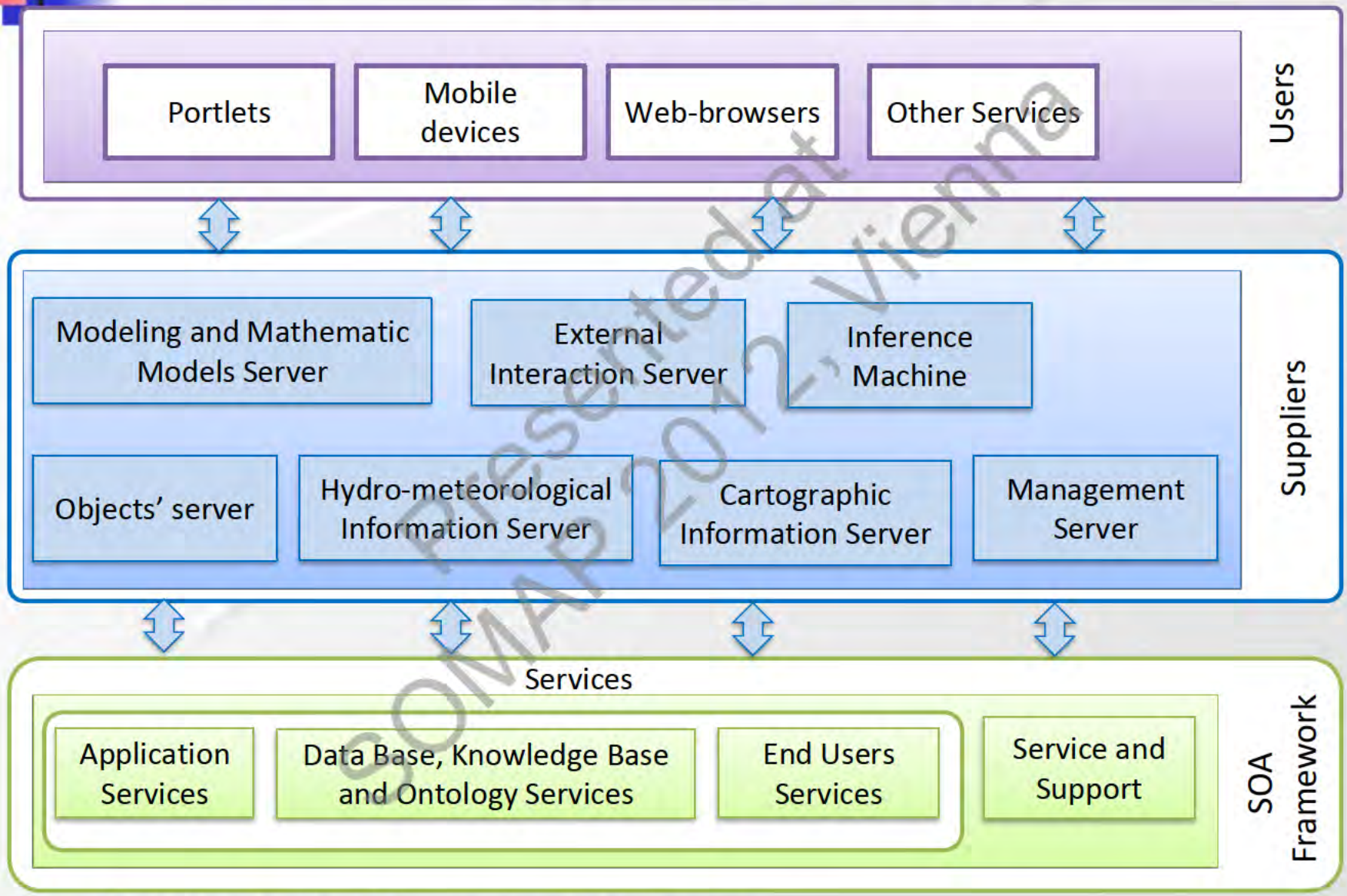
End users services



Applications services

Data bases & knowledge bases & ontology services

Common SOA of IGIS

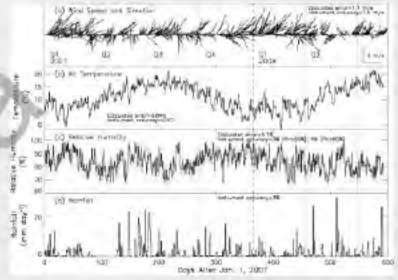


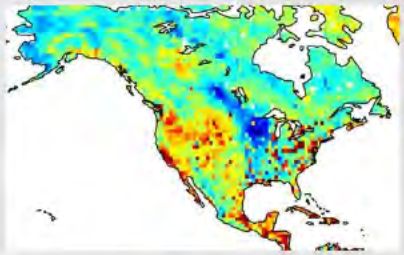
Cartographic information server

- Services accessing spatial data of different formats including Shape, S57, SXF, OpenStreetLayer, VPF
- Services of geodesic functions for a given projection and Earth model
- Services visualizing cartographic data
- Services importing-exporting spatial data to/from different formats

Hydro meteorological information server

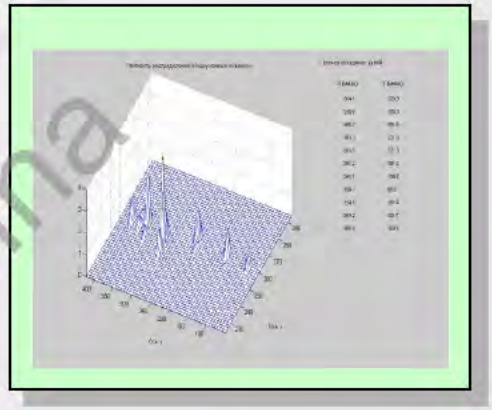
- Service of selection and attuning the channel for receiving hydro meteorological information from a source via tcp, ftp protocols and e-mail
- Service of filtering the flow of recipient information in accordance with the required types of hydro meteorological weather reports
- Service of sentence analysis of the recipient hydro meteorological information reports according to the international (World Weather Watch) and regional code forms
- Service of decoding and storing the values of given meteorological parameters
- Service of controll ng the server's given operation processes

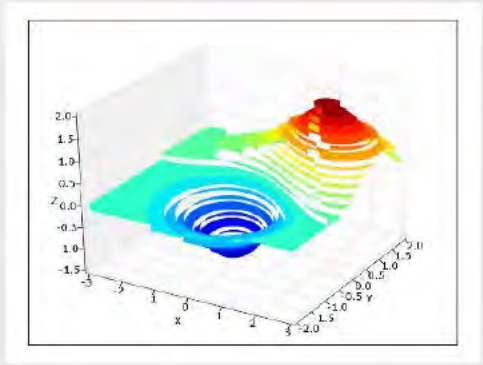


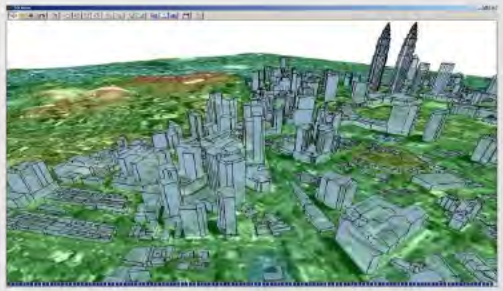


Modeling and mathematical models' server

- Service of universal time
- Services of mathematical problems (e.g., search theory, radio location, hydroacoustic)
- Services of multilevel data processing
- Services of simulation
- Services of 3D results' representation
- Services of objects' recognition and classification as well as tactical situations



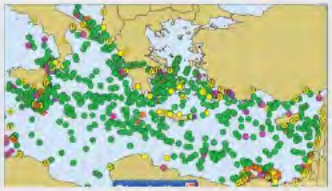




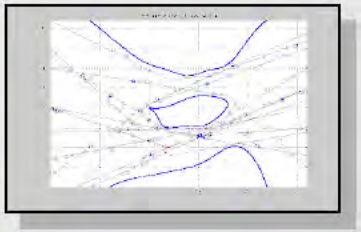
Interaction with external systems server

- Service of receiving information from external mobile objects and systems (e.g., transportation monitoring systems, permanently functioning network of oceanographic stations based on drifting gauge-buoys (ARGO project) and other)

- Service of receiving locations of sea and river vessels in the World Ocean based on AIS data



- Service of receiving locations of aircrafts based on the data from Automatic Dependent Surveillance - Broadcast (ADS-B) system's transponders



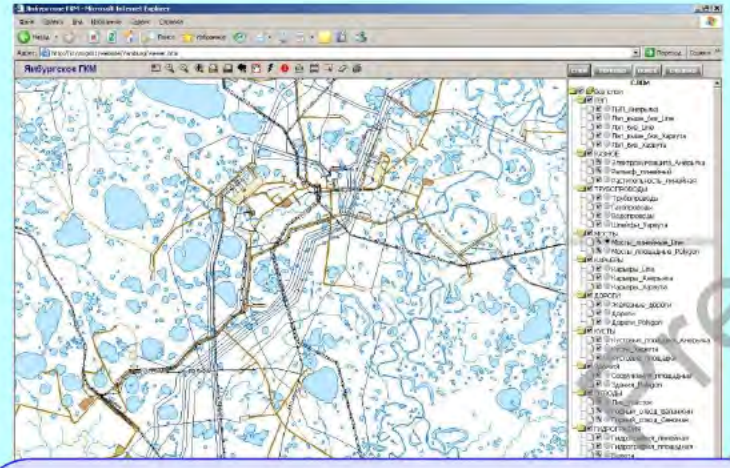
- Service of receiving locations of spacecrafts and calculation of their coverage zones based on open sources data, and a number of other services, being determined by a definite subject area

Administration (management) server

- Service of resources distribution
- Service managing the users' and other services access
- Service managing the IGIS tuning and operating modes
- Service of the IGIS operating journaling

Objects server. Unified information model

Dynamic unified information model



The dynamic information model represents a model of subject domain that during every moment of time contains data corresponding to the actual parameters of objects and environment in which they function.

The unified model of information presentation - the universal information and logical model providing to program components structure of entities, describing subject domain

The unified model of program interaction - the universal model providing to program components structure of entities containing in messages, transferred during information exchange.

Algorithm of information transformation to the unified model of program interaction, offering sequence of actions on information transformation from metamodels of borrowed components to unified model of information presentation

Information fusion concepts

Data Harmonization

Main properties of harmonization process is that the result of the process is easy to be received for a huge number of users.

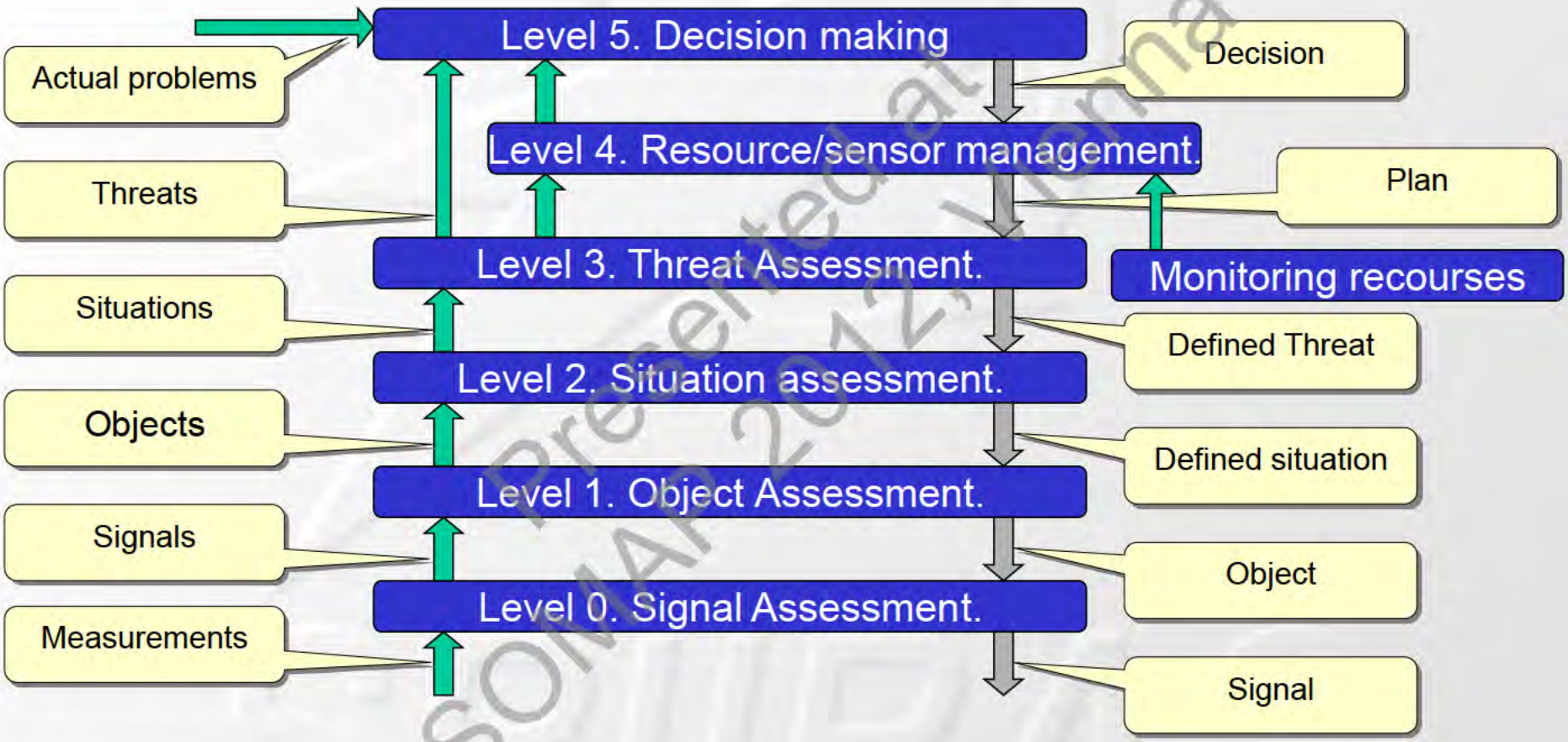
Data Integration

Main properties of DI is that the result of the process is oriented to the defined class of problem solving.

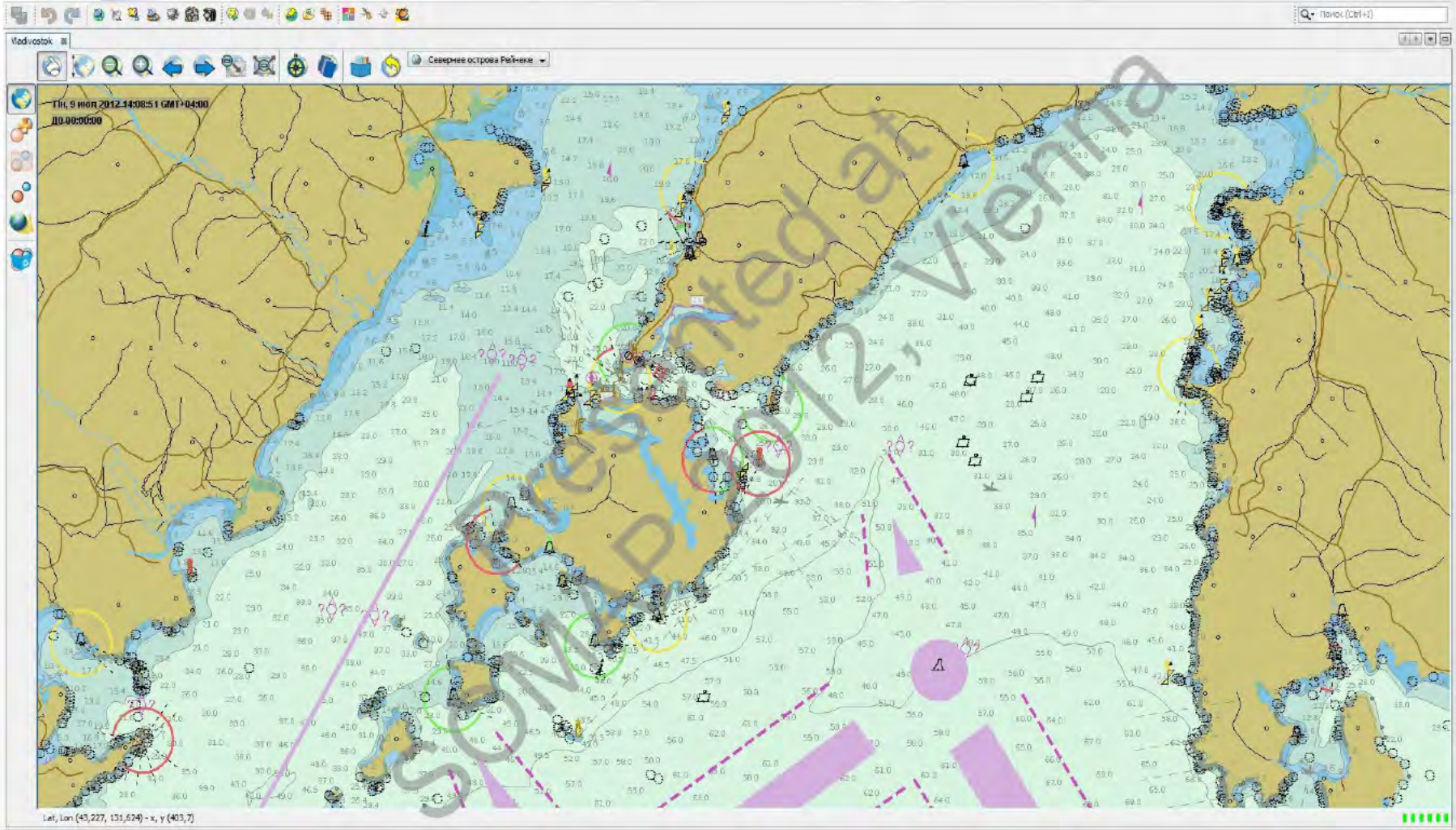
Data Fusion

Main properties of Data Fusion is to obtain a new property of data and to reduce a volume of data.

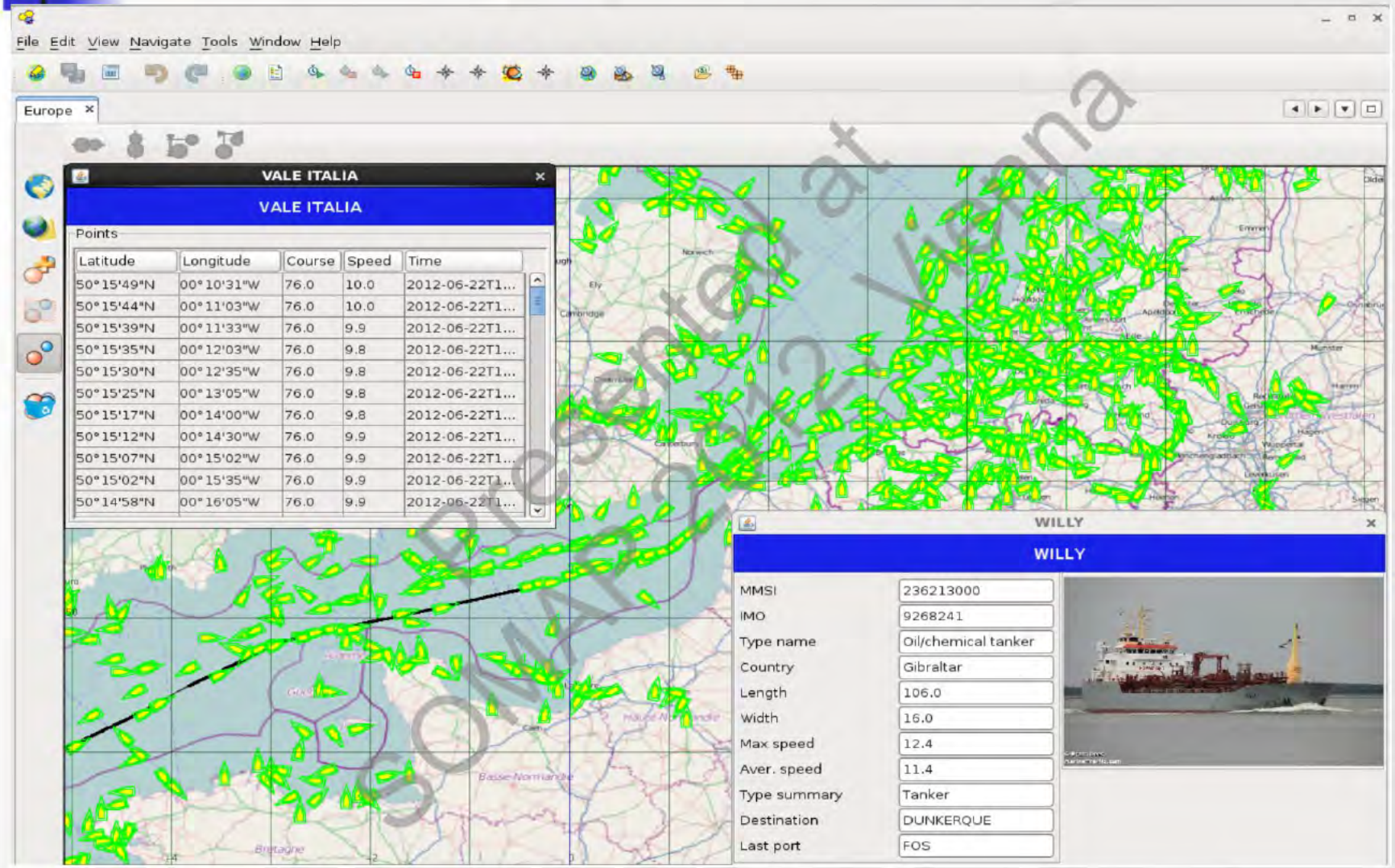
Generalized model of information fusion



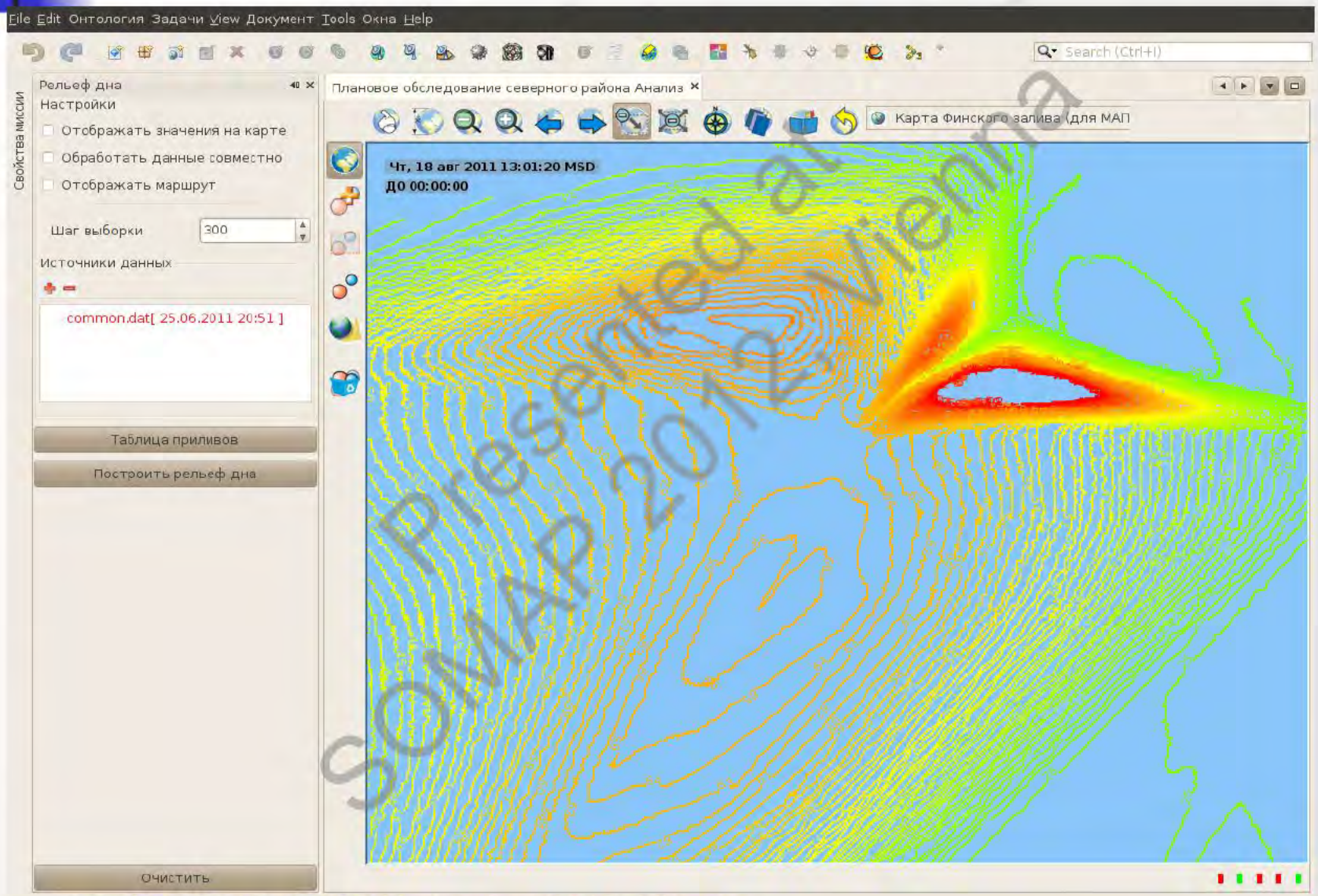
Cartographic data



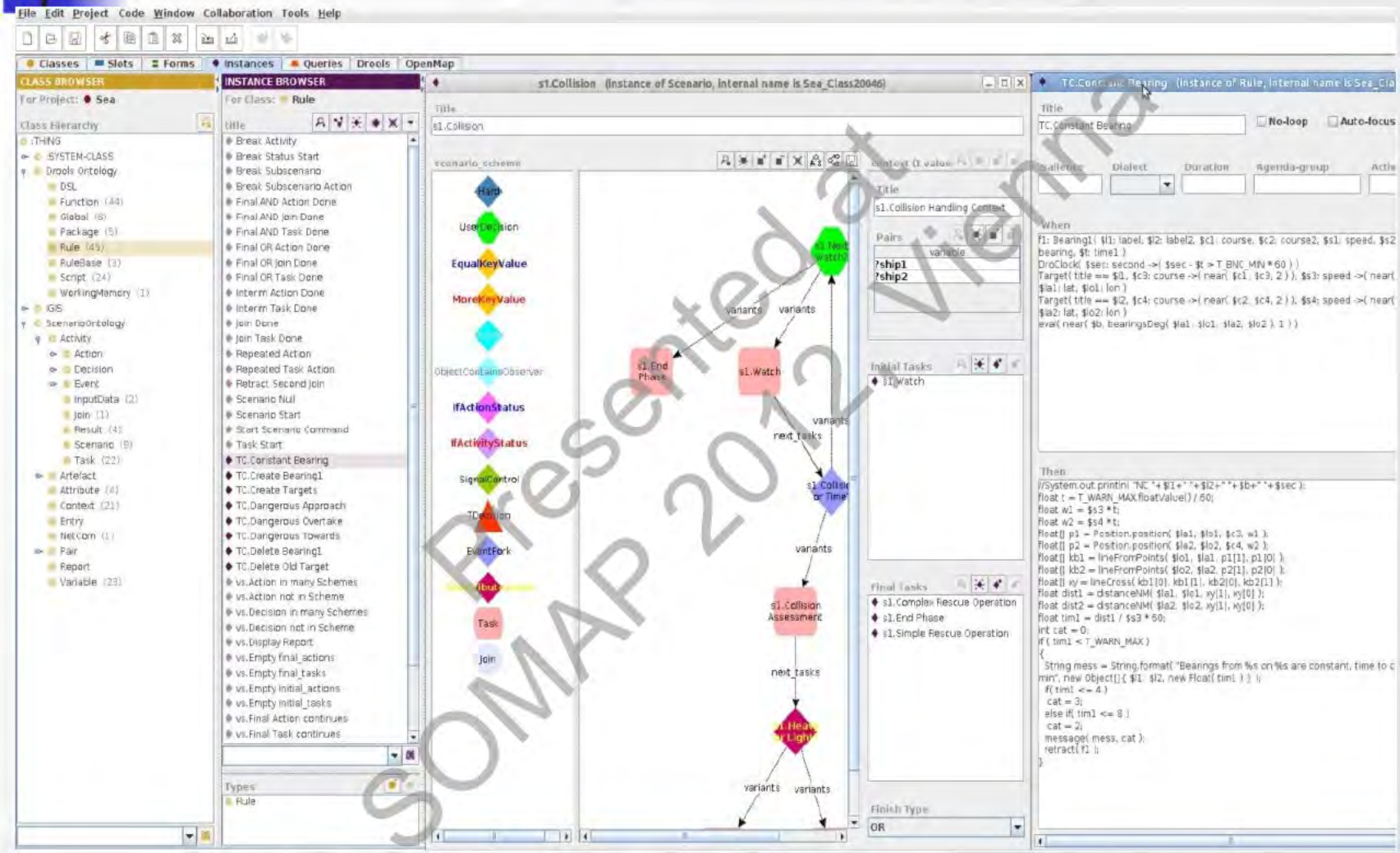
Objects' data



Data received from external sources



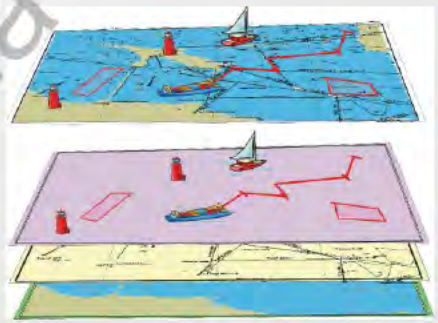
Scenarios


File Edit Project Code Window Collaboration Tools Help
Classes Slots Forms Instances Queries Drools OpenMap
CLASS BROWSER
INSTANCE BROWSER
s1.Collision (Instance of Scenario, internal name is Sea_Class20046)
TC.Constant Bearing (Instance of Rule, internal name is Sea_Cla
Presented at SOMAP 2012 Vienna

Data Base, Knowledge Base, Ontology Services

Data base

Data base is multiplatform service-oriented software for centralized storage, selection and provision of geospatial information. DB services and ontologies are consumers of BD services

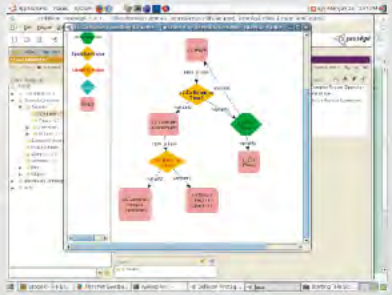


Ontology

Ontology service is a unified directory o information which is used to store the data needed to produce solutions to the problems faced by the user. It provides computer assisted formulation of the fundamental concepts and objectives of the knowledge domain and the relation between them This component provides interaction not only between stored data but also data received from external sources.

Knowledge base

Services of **knowledge bases** provide with data necessary for functioning of the IGIS expert system component, which provides overall information-consulting and functional support to the user and the complex modeling modes.



End Users Services

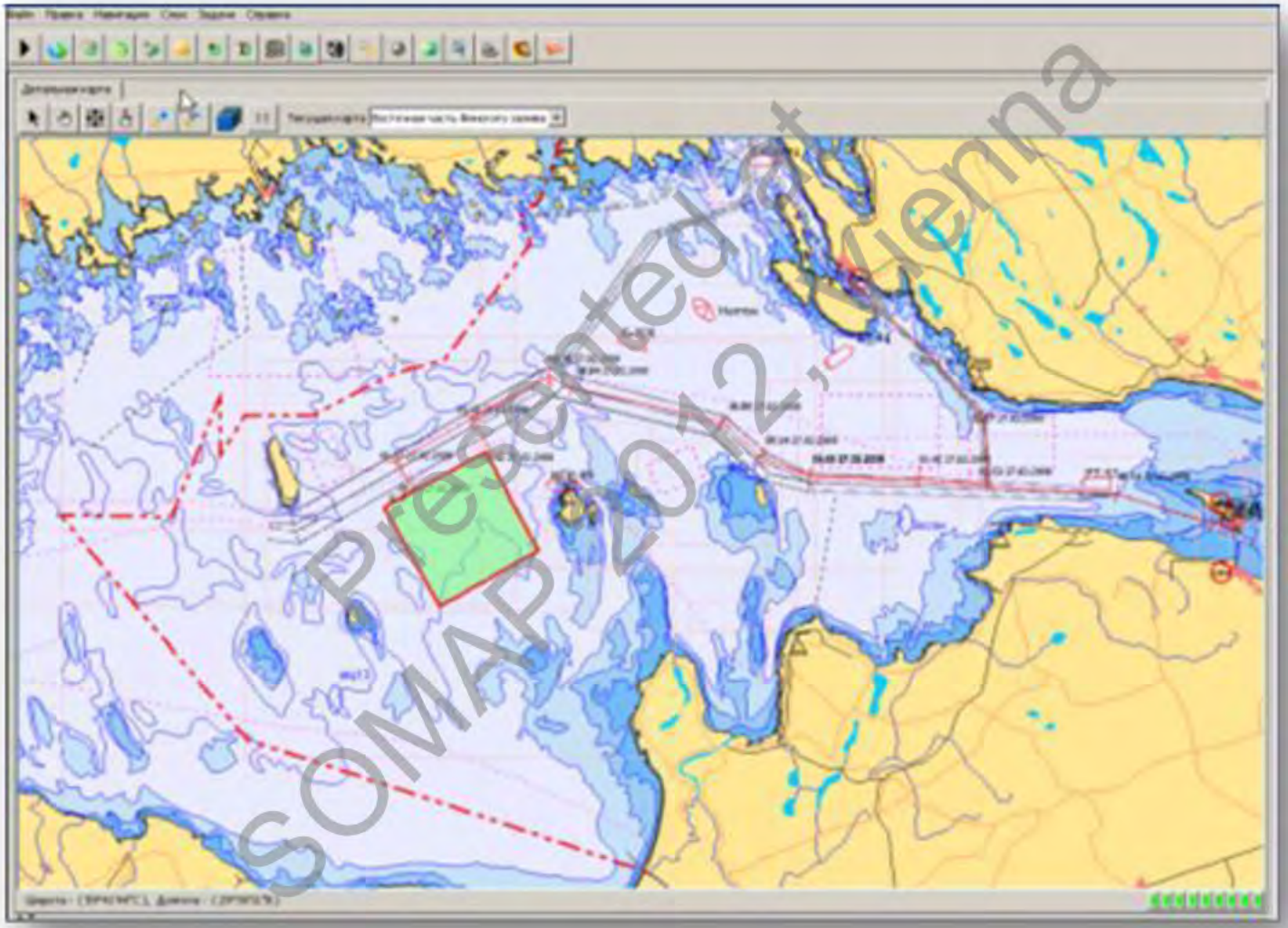
Common services

- Access to cartographic information
- Access to hydro meteorological information
- Mathematical problems modeling and solving (in theory of search, hydro acoustics, radio location, etc.)

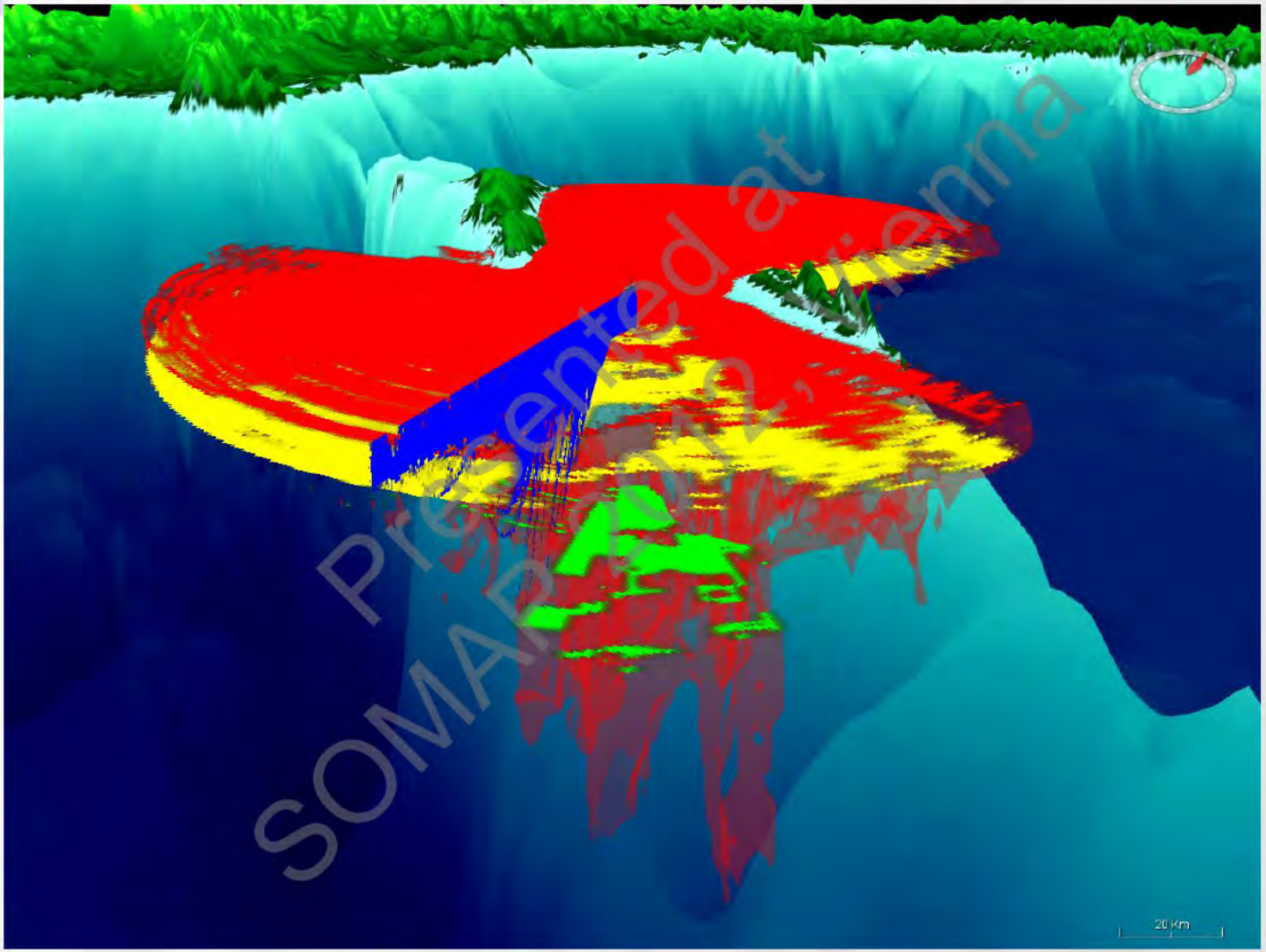
Users' services of the objects' server

- Subject area universal description
- Inheritance mechanism also including a multiple inheritance of the objects
- Separation of the object's stationary and transient data
- Universal mechanism of relations
- Access to the history of the objects properties' states
- Information filtering for different users' groups

Case Study
Situation monitoring system



Case study. Acoustic fields calculation



Case Study
Underwater acoustics modeling system

Tasks	IGIS components
Input of source modeling data, including the geographic binding of acoustic energy source and receiver to the given space area	Cartographic information server and interaction with external systems server
Managing the access to geospatial data of environment parameters determining parameters hydro acoustic fields	Objects' server
Providing with modeling management interface and derivation/displaying of modeling results in the user-friendly form	User's interface
Interaction of hydro acoustic calculations subsystem with other IGIS components based on the uniform ontology.	Objects' server
Performing calculations providing for predictive estimate of source data that characterize environment (medium), realization of various methods and algorithms of acoustic field calculations	Mathematical models' server
Intelligent support of the calculations management that involves an identification of calculations' reference conditions, choice of rational method for acoustic f eld calculations; choice of methods enhancing calculations' efficiency and accuracy, methods of output data approximation, etc.	Expert system

Conclusions

IGIS architecture should support an execution of a number of requirements, the main ones are:

- convenient and well-defined access to data and information;
- flexible and fast applications' modification;
- fast integration of new applications into operating system;
- support of data standard formats;
- high degree of source code and other information resources reuse;
- dynamic expansion of system functions without additional programming and/or the whole project reprogramming;
- possibility of IGIS operation in local as well as in distributed environment.

Contacts

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