Intellectual Information Platform bringing together diverse data and models for the interdisciplinary projects implementation and environmental management

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Abstract. The structure of the Intellectual Information Platform (IIP) and examples of its application for decision-making support in environmental management are considered. The IIP structure is based on a service-oriented architecture. The flexible nature of IIP software allows to integrate a wide range of environmental parameters assessment models and diverse initial data, including earth remote sensing data. Results of case studies for different IIP applications such as water bodies monitoring, forestry management, flood forecasting, etc., showed full-scale implementation of the IIP required functionality.

1. Intellectual information platform composition
Comprehensive study of the environment and decision-making on its protection require simultaneous utilization of methods and models from different subject areas, as well as heterogeneous data processing, including earth remote sensing (ERS) data.

Today there exists a lack of information systems that could be adapted for a user who doesn't have special skills in information technologies and ERS data processing. This gap becomes a significant obstacle to wider use of accumulated and steadily growing volumes of ERS data and contemporary models for environmental monitoring and its safety provision.

In order to solve these problems information systems of a new level are required. These systems are to be aimed at integration of ERS and other data (both spatial and non-spatial) with models of environmental condition forecasting and proactive environmental management in automatic mode. A theoretical foundation for such systems creation is provided by methods of a new scientific direction – qualimetry of models and polymodel complexes [1]. This theoretical basis enables embodying the intellectual multi-criteria choice of models required for making the right decision and setting the models parameters without operator’s intervention. Along with that, contemporary information technologies open up new opportunities to design distributed systems. The joint use of these achievements has led to creation of the software intellectual information platform (IIP) based on a service-oriented architecture (SOA). The general structure of the IIP is provided in the figure 1.

The main units ensuring interaction of IIP components are as follows: a service bus, as a “backbone” of the platform’s architecture; business process execution language (BPEL) tools to implement components interaction scenarios; an intellectual interface for choosing particular models of environment components (forest, water bodies, tundra vegetation, etc.) and adjusting their
parameters in automatic mode; program interfaces and wrappers to ensure interconnection of diverse modules as web-services; user interface enabling easy access to the IIP operation results.

2. Case studies results
IIP enables processing and integration of in-situ data and data from various Earth observation satellites in order to create and provide decision-making support services in different modes – interactive, automated and fully automatic ones. Successful case studies have been performed for agricultural lands monitoring, forest management and forests’ condition changes detection, environmental protection, flood forecasting, etc. [2, 3]. Among them, an information system has been created and tested in 2014-2019 on the basis of the IIP for hydrological situation monitoring and flood forecasting of the Northern Dvina River in Russia. Within real-time testing the hydrological data was entered into the system from gauging stations, 4 types of hydrodynamic and hydrological models were used. The system worked in automatic mode and the discrepancy between the forecast data on flooded areas and current data obtained from satellite images was 7%. So case studies results were actively used by local governments, hydrometeorological and emergency services in scenario modeling and operational flood forecasting, as well as for the current analysis of the hydrological situation.

3. Conclusion
The analysis provided of existing and perspective technologies for integration of distributed information resources while solving tasks on decision-making support to ensure ecological security – showed that it is reasonable to utilize service- and event-oriented architectures, combined with technologies of platform-independent universal description, automatic search and web-services integration, as a basic approach to IIP creation. The approbation results show that this approach utilization ensures fulfillment of basic requirements to such systems, first of all: capability to integrate heterogeneous geographically-distributed information resources, including ERS data and diverse models, the fullest possible automatization of these processes, user-friendliness. In general, the developed platform is a universal constructor or software suite that allows producing decision-making support tools in environment protection and environmental management.

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