Estonia Latvia Russia
ENPI cross border cooperation programme
part-financed by the European Union
united by borders

Project INFROM
"Integrated Intelligent Platform for Monitoring the Cross-Border Natural-Technological Systems"

Innovative information technologies for monitoring of natural-technological systems

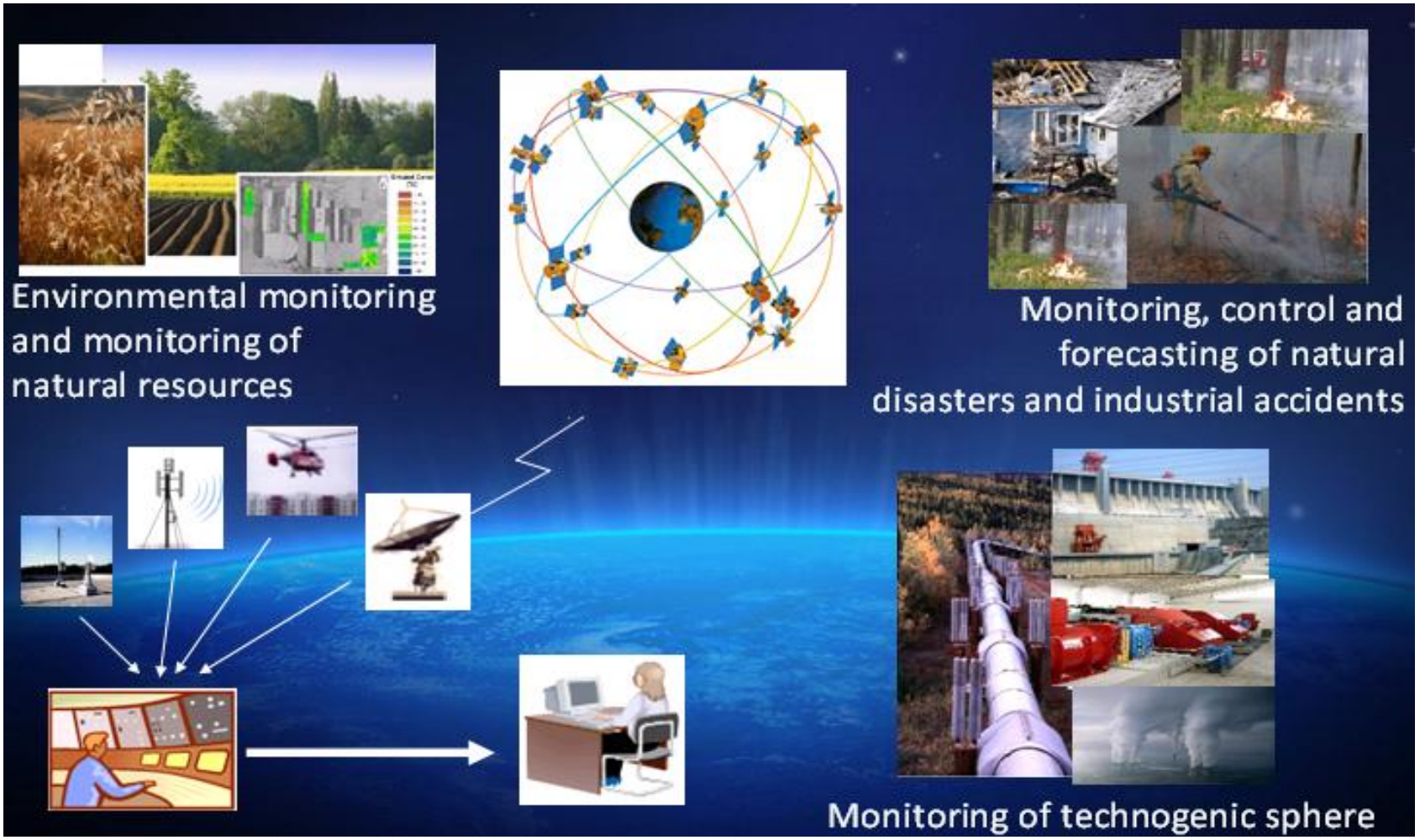
Asoc.Prof., Dr.sc.ing. A. Romānovs
Riga Technical University

INFROM technology: essence

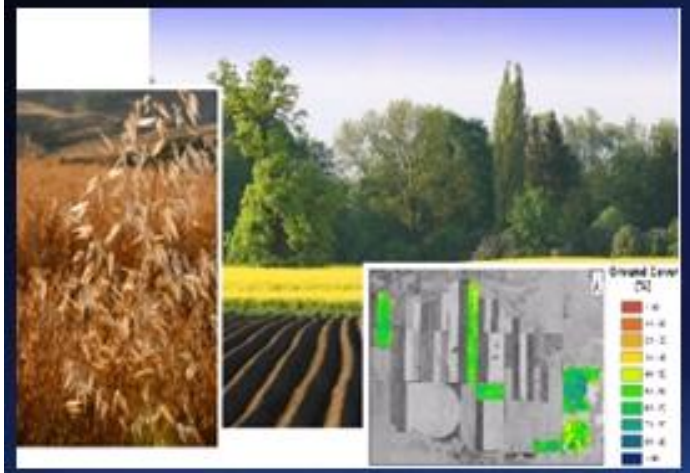
Essence of the INFROM project is the integration of the world-level instruments for monitoring and control into technology system, that:

- integrates expert knowledge and data received from both numerous orbital and ground facilities
- provides high degree of data processing automation and intellectualization and can be applied to the analysis and protection of the Latvian and Russian natural-technological systems

INFROM: target areas



Environmental and natural resources monitoring



The studies of the dynamics of ecosystems changes in varying degrees, study of the influence of various natural and anthropogenic factors on the ecosystem, evaluation of natural resource management regimes etc.

Possible objectives:

Monitoring of ecosystems:
- aerosols in atmosphere
- air pollution
- water pollution

Monitoring of natural resources:
- an inventory of agricultural land
- forecast yields
- soil and banks erosion
- deforestation
- forest inventory
- analysis of rivers, lakes, seas ice cover
- analysis of the dynamics of groundwater
- water content of the rivers and lakes

Monitoring of technogenic sphere

Diagnosis of the area topography, analysis and evaluation of forms, geometry and partition technogenic objects, the mapping of dangerous or potentially dangerous areas on the basis of different information available, diagnosis of soil corrosives, diagnosis of linearly extended objects with a precise identification of specific nodes and elements, etc.

Possible objectives:

- identification of the technogenic objects (tanks, industrial buildings, roads, pipelines, power plants, fuel and freight terminals, ports, etc.) and their characteristics
- assessment and diagnosis forms, geometry, size of the object
- identification of potentially dangerous objects
- analysis of the topography of territory nearby the object
- identification and analysis of the pipeline routes
- analysis and evaluation of the dynamics of flooding of the monitored area

Monitoring of natural disasters and industrial accidents

INFROM IT Technology Design and Development

OBJECTIVES:

- To develop methods for information representation under conditions of dynamics structure and data uncertainty;
- To develop methods for NTS integrated modelling and simulation including reconfiguration of these systems under degradation process of their structures;
- To develop an innovative information technology for analysis and synthesis of an integrated intelligent platform for cross-border NTS monitoring and control based on integrating heterogeneous information received from space and ground-based facilities.

INFROM IT Technology Design and Development

RESULTS:

- Models of NTS, as well as monitoring and control system in normal and emergency situations
- A model of integration heterogeneous data received from space and ground-based facilities
- A model and method of NTS monitoring and control systems dynamically reconfiguration
- An intelligent information technology platform for NTS monitoring and control considering integrated data from space and ground-based sources

Research: Models of NTS

1. MODELS OF NATURAL OBJECTS MONITORING:

A. Disaster Management Model
B. Flood mapping models
C. Wildfire Monitoring Models
D. Detection of Coastline Changes Models
E. Forest Land Cover Changes
F. Land Use Monitoring Models

Research: Models of NTS

2. MODELS OF TECHNOLOGIAL OBJECTS MONITORING:

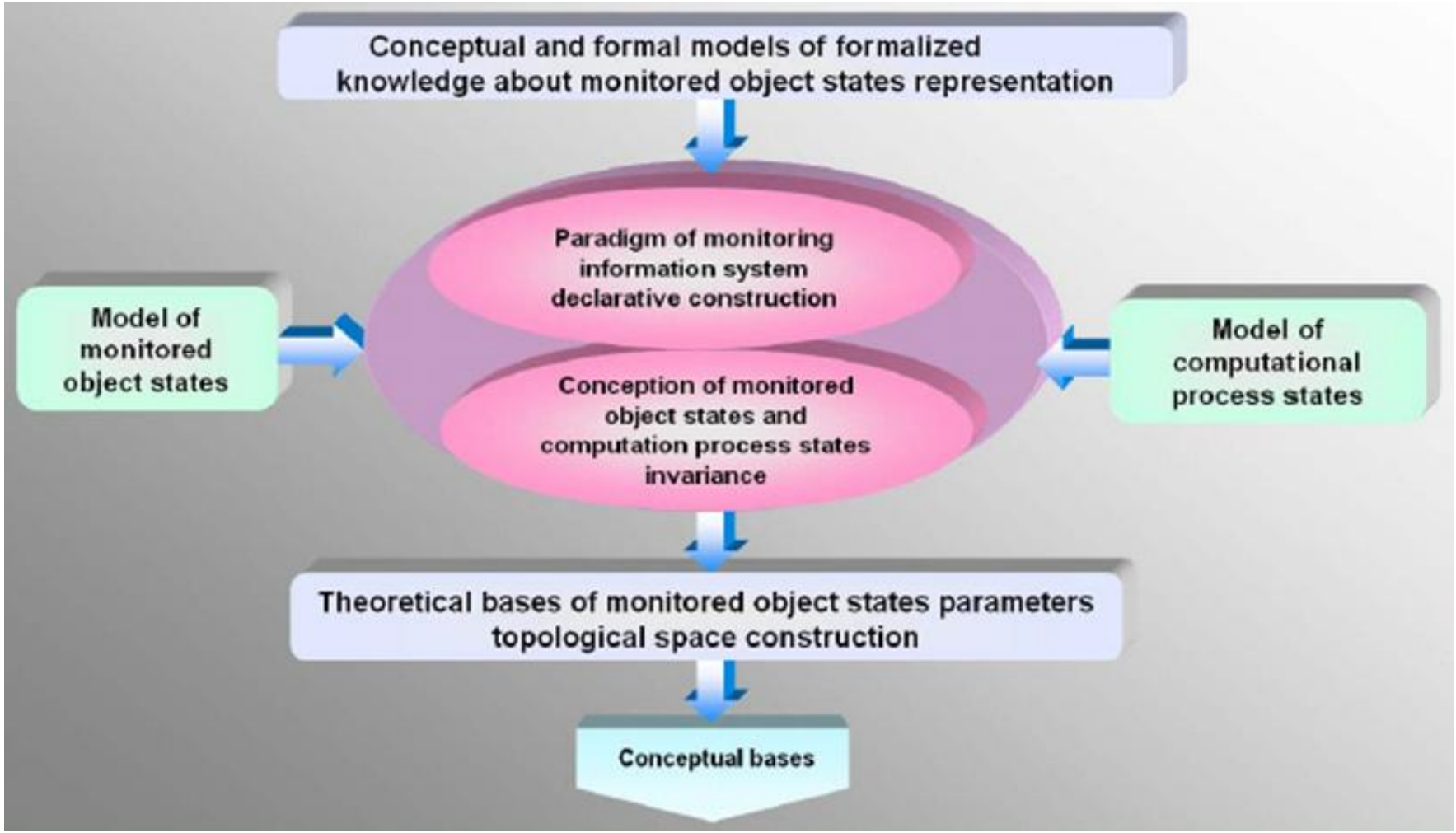
A. Monitoring of Cracks and Bowing in Structural Walls
B. Monitoring of Soil Undermining by Burst Water Main
C. Calculating the Amount of Available Power for Hydroelectric Power Station
D. Calculating the amount of available power for wind farms
E. Road Wear

Research: Models of NTS

3. MODELS OF MONITORING IN CRISIS SITUATIONS:

A. Monitoring Earthquakes
B. Extreme Temperatures
C. Floods
D. Wildfires
E. Hazardous Materials

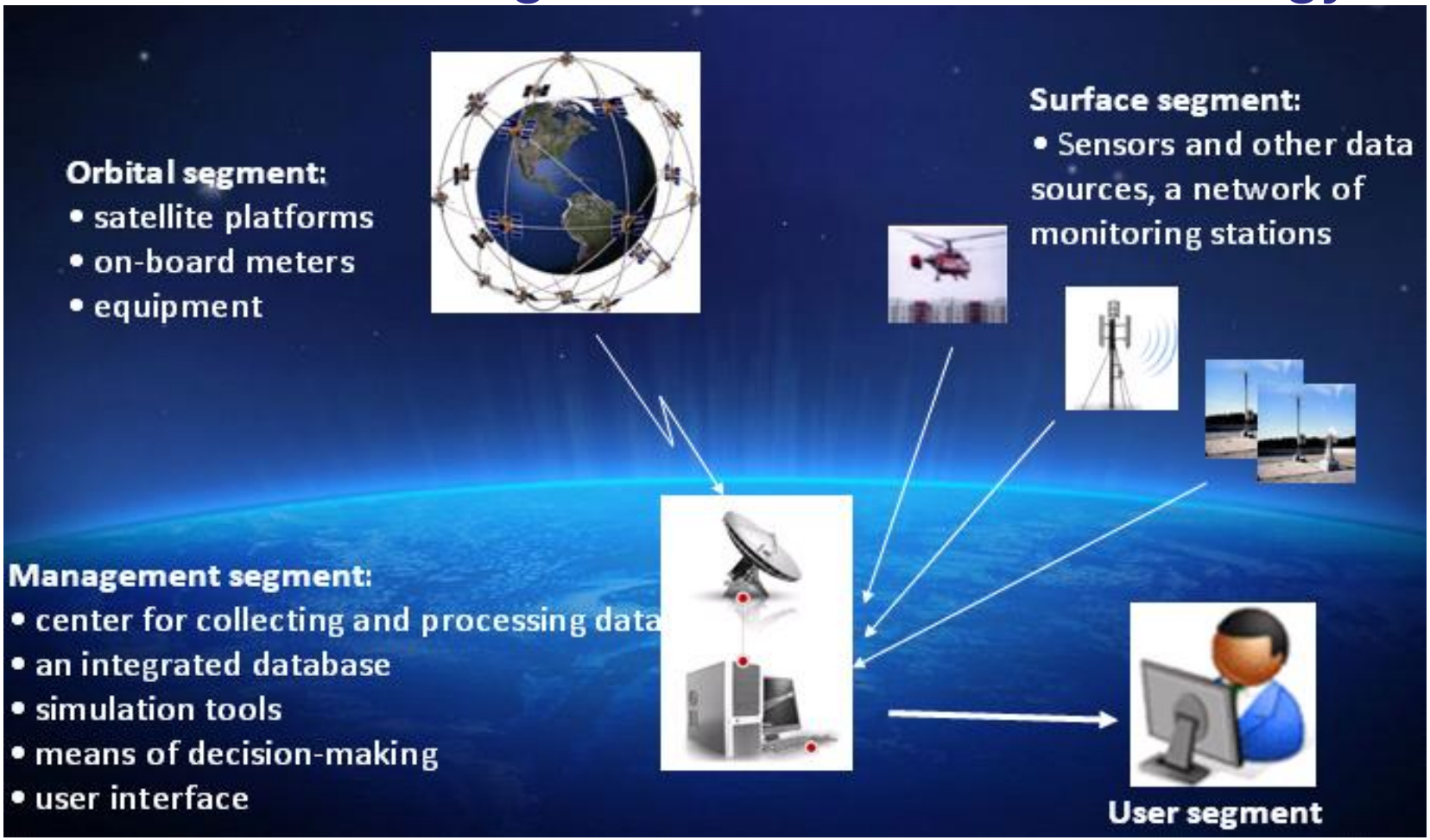
Fundamental scientific bases of INFROM IIT



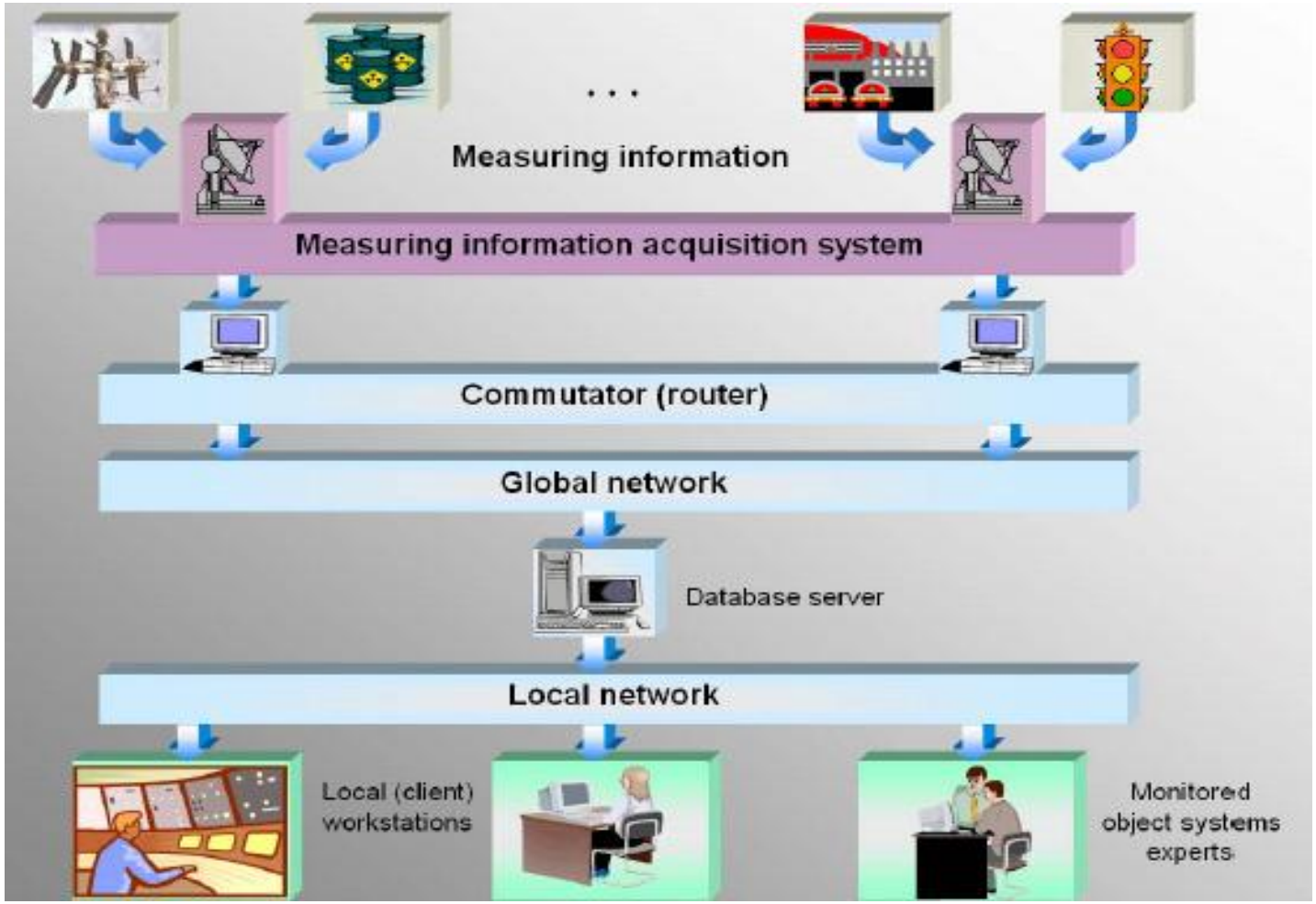
Intelligent information technology requirements

- Variety of types of the measuring information - by the physical nature, by the form representations, etc.
- Wide range tasks (supervision, control, diagnosing, forecasting, management), and types of monitoring objects
- High requirements to reliability and accuracy of the results of analysis, to the form and quality of representation of the results
- Rigid temporary restrictions, functioning in almost real-time mode, high efficiency of large data flows processing
- Low programming qualification of the personnel – developers and users
- Unification, modularity and scalability, the ability to quickly use of specialized hardware and software systems

Structural model of the INFROM intelligent information technology



IIT realization scheme

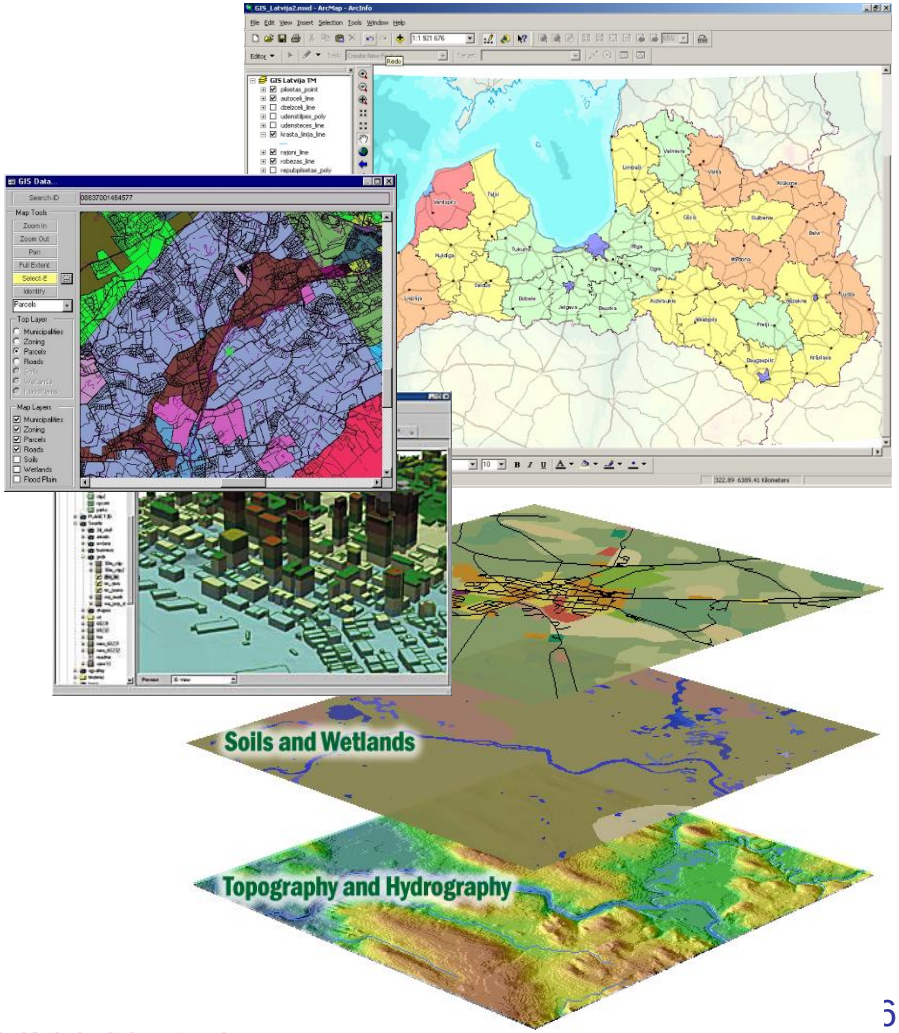


INFROM intelligent information technology & GIS

Nowadays, the most recognized tools of space and ground-based monitoring and forecasting are geographic information systems.

GIS integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

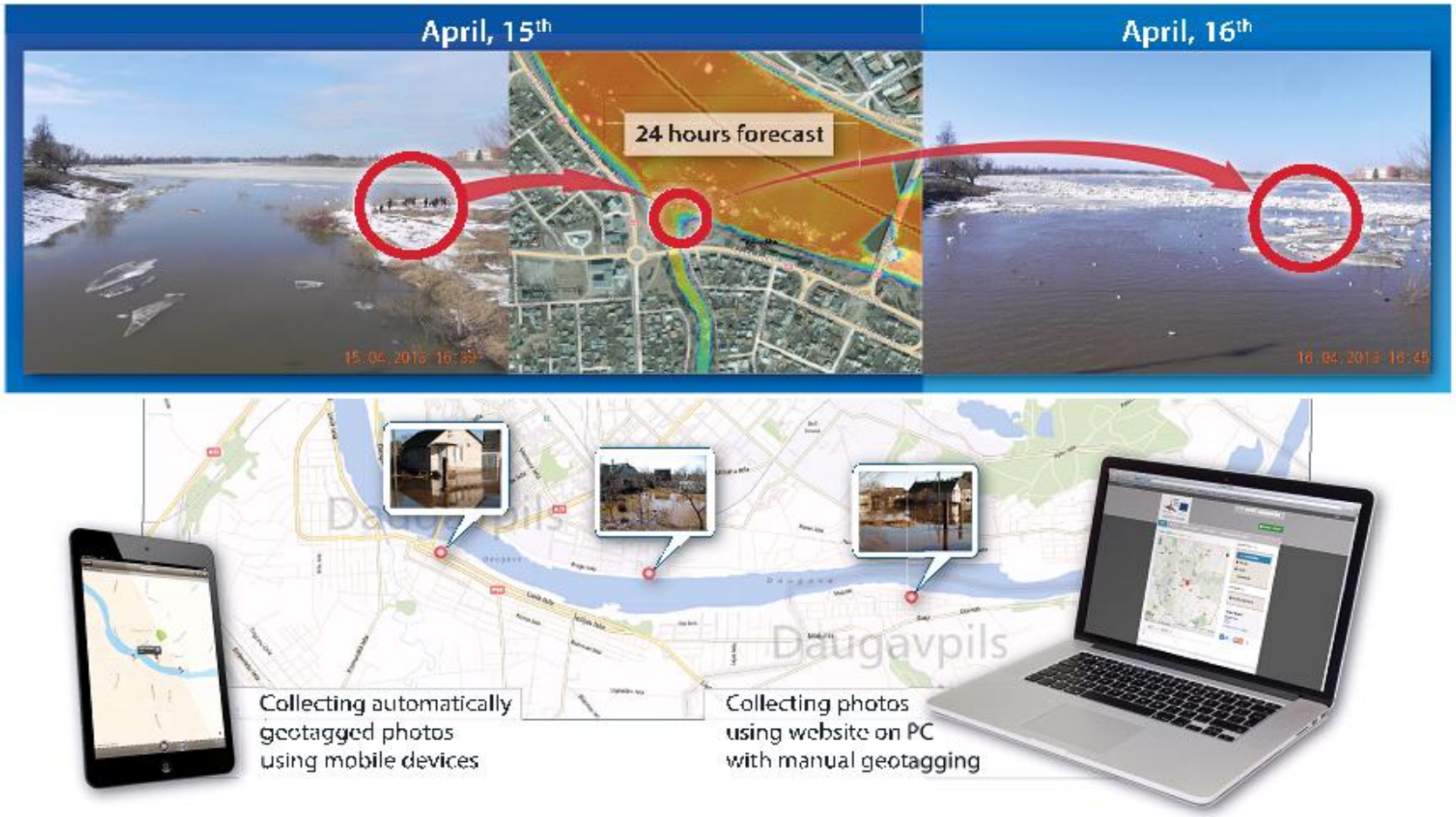
GIS allows users to view, understand, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.



Social and Sensor Data Fusion

- The two popular data types, social and sensor data, are in fact mutually compensatory in various data processing and analysis
- Participatory / citizen sensing, for instance, enables to collect people-sensed data via social network services over the areas where physical sensors are unavailable
- Simultaneously, sensor data is capable of offering precise context information, leading to effective analysis of social data
- Obviously, the potential of blending social and sensor data is high; nevertheless, they are typically processed separately, and the potential has not been investigated sufficiently

Crowdsourcing for Flood Modelling



INFROM intelligent information technology allow to:

- represent, analyze and manage spatial data of both surface and moving objects by using GSM, GPS, etc. channels
- perform on-line spatial-temporal analysis and graphical representation of an input data
- represent and process dynamical geo-event sequence, supported by the intelligent expert system
- analyse environmental risks of possible critical situation and develop common information space for solving monitoring and control issues in both countries interest
- implement integrated real-time monitoring and control systems of natural-technological facilities for non-professional users
- place fast and efficient GIS service to the Internet.

Thank You for Attention!