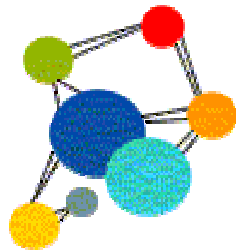


# Grid Computing in Projects of IISAS



**PELLUCID**  
*a new platform for organisationally  
mobile public employees*

**Ladislav Hluchý**

hluchy.ui@savba.sk

www.ui.sav.sk

Tel/Fax: + 421 2 5477 1004



# Research and Development Activities

## •Parallel and Distributed Programming:

- research into task allocation tools e.g. **mapping** and **dynamic load balancing** that allocate tasks to the processors of distributed parallel computers so that an objective function, modelling the program execution time, is minimized,
- performance evaluation** of the network routing with regard to the different communication algorithms and strategies; performance analysis and runtime **monitoring** of parallel programs

## •Large-scale HPCN and Grid applications:

- design and implementation of **problem solving environments** (PSE) for modeling and simulation applications (virtual organisations for environmental problems)
- developing and maintaining of infrastructures for **Grid computing**
- design** of parallel application programs and their implementation using MPI

## •Multi-agent systems (MAS)

- Architecture, design and development
- Decision making, communication, negotiation and coordination among agents
- Ontology, reasoning and their utilization in multi-agent systems
- Cooperation between multi-agent systems and workflow management/tracking system (WfMS/WfTS)



## II SAS projects related to cluster computing

---

### Projects within IST 4FP

PPTIRD: 977100 (INCO-Esprit Keep in Touch) - Parallel Processing Tools: Integration and Result Dissemination (KIT) (1998-99) *The book written by the SEPP consorcium is already published by Nova Science.*

SEIHPC: COP-94-00774 Stimulation of European Industry through High Performance Computing, EU Copernicus Network (1995-98)

SEPP: CIPA-CT93-0251 Software Engineering for Parallel Processing, EU Copernicus (1994-97)

HPCTI: CP-93-5383 High Performance Computing Tools for Industry, EU Copernicus (1994-96)



## II SAS projects within IST 5FP

- ANFAS: IST-1999-11676 : data fusion for Flood Analysis and decision Support (2000-03) *When a flood is going to happen, decision makers have to decide what are the most appropriate reactions: evacuation of the population, reinforcement of dykes, etc. The ANFAS project will develop a support decision system for flood prevention and protection, integrating the most advanced techniques in data processing and management. This tool will help decision takers to limit flood damage.*
- CROSSGRID: IST-2001-32243 Development of Grid Environment for Interactive Applications (2002-2005) *Project will develop, implement and exploit new Grid components for interactive compute and data intensive applications like simulation and visualization for surgical procedures, flooding crisis team decision support systems, distributed data analysis in high-energy physics, air pollution combined with weather forecasting.*
- PELLUCID: IST-2001-34519 A Platform for Organisationally Mobile Public Employees (2002-04) *Project will design, develop and validate a flexible software platform for an important kind of knowledge management: to assist organizationally mobile workers at middle and higher levels of public sector organization.*



# Data Fusion for Flood Analysis and Decision Support

## IST-1999-11676, 5FP (2000-2003)

---

### Objectives

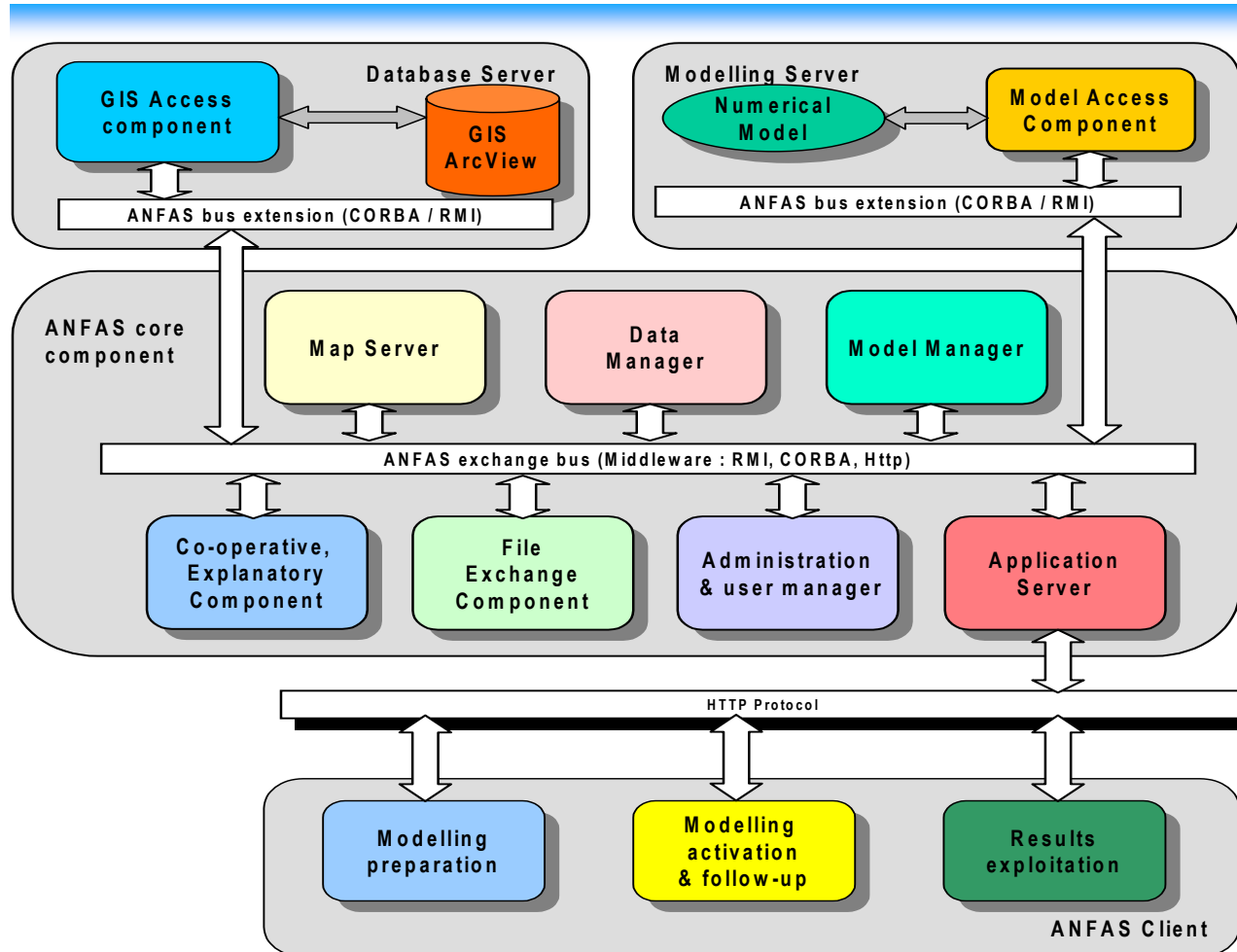
- Development of a Geographical Information System database
- Scene modelling from images
- Flood modelling and simulation
- Pilot operations (Vah River, Loire River, Yangzi River)
- System Integration
- Assessment and evaluation
- Dissemination and implementation



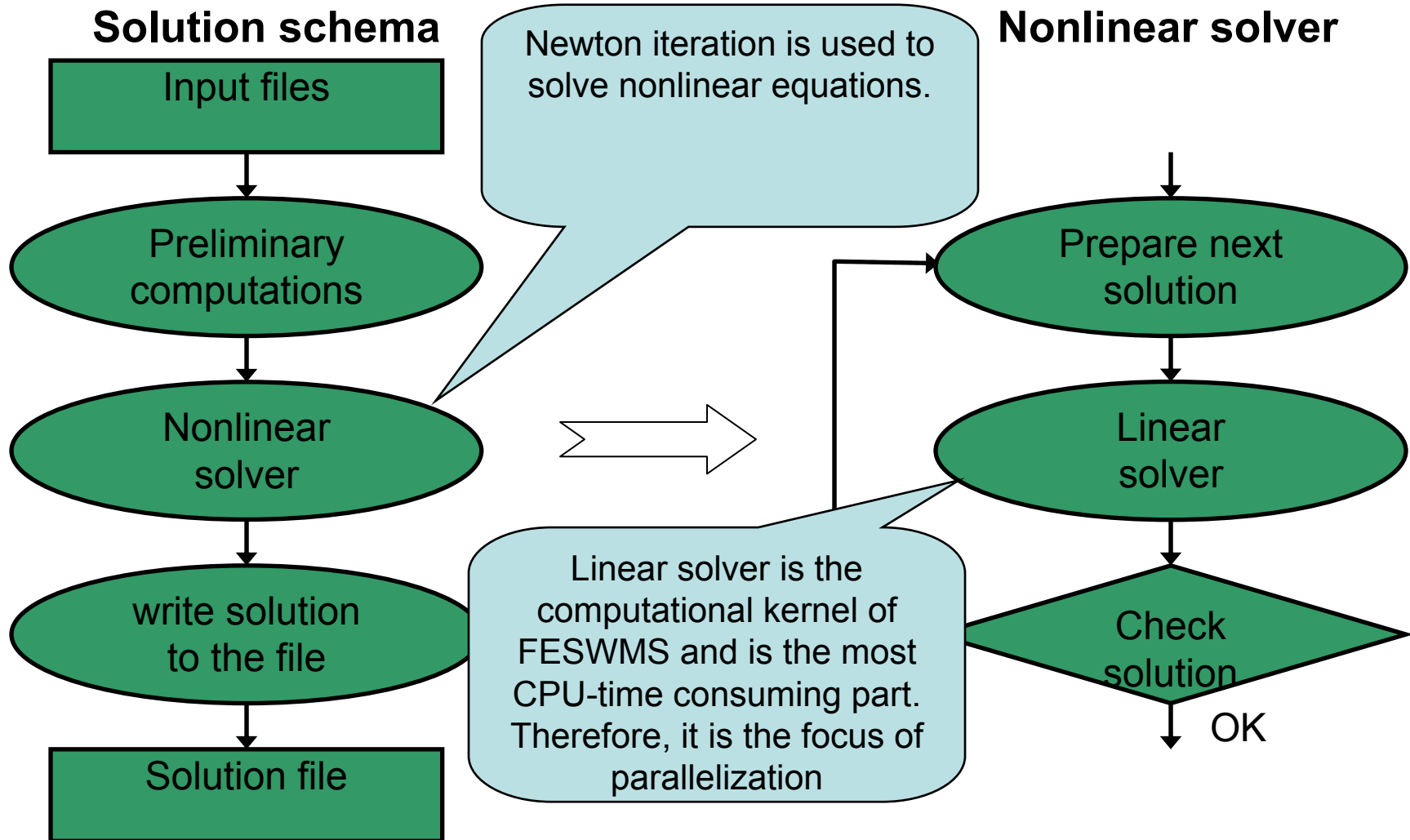
# Partners

- ERCIM (European Research Consortium for Informatics and Mathematics)
- Matra System & Information (France)
- Bureau de Recherches Geologiques at Minieres (France)
- Reading University (United Kingdom)
- Foundation for Research and Technology - Hellas (Greece)
- Institute of Informatics, Slovak Academy of Sciences (Slovakia)
  - Subcontractor: Water Research Institute (Slovakia)
- Council for the Central Laboratory of the Research Council (United Kingdom)
- Institute of Automation, Chinese Academy of Sciences (China)
- Institute of Remote Sensing Applications, Chinese Academy of Sciences (China)
- Institute of Atmospheric Physics, Chinese Academy of Sciences (China)
- Institut National de Recherche en Informatique et en Automatique (France)

# ANFAS Architecture



# Detailed FESWMS structures

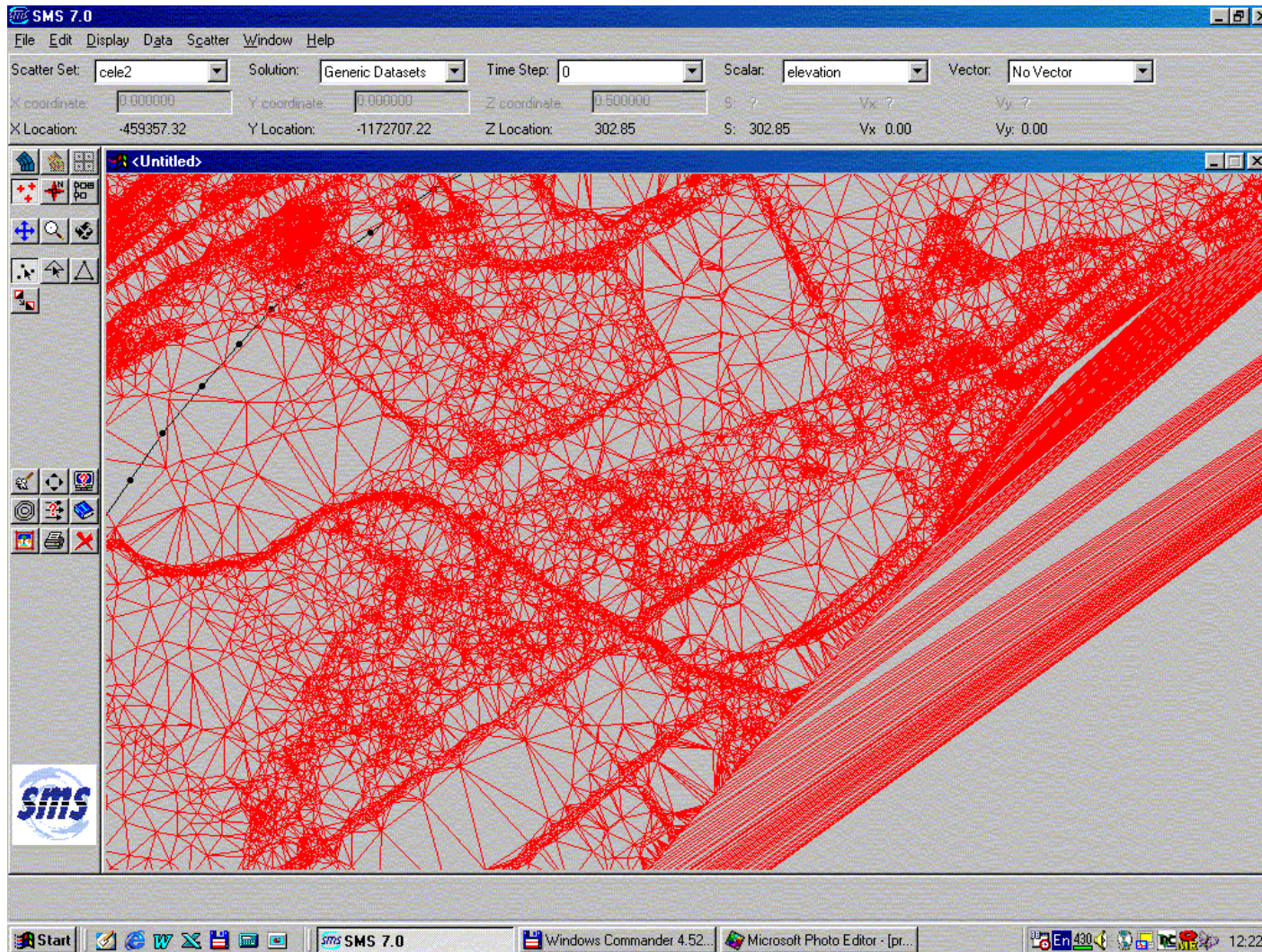




# Parallel iterative solvers:

- Conjugate Gradient (CG): the most powerful iterative solver which contains only vector and matrix operations  
→ is trivially parallelized.
- Existing libraries with iterative solvers: PINEAPL (developed in ESPRIT IV projects), PETSc, Aztec, ...
- Advantages (in comparison with direct solvers):
  - less expensive (in terms of memory and CPU time)
  - higher parallelism, easier to parallelize
- Disadvantages
  - does not guarantee to converge (direct solvers always do)

# TIN network at Predmier

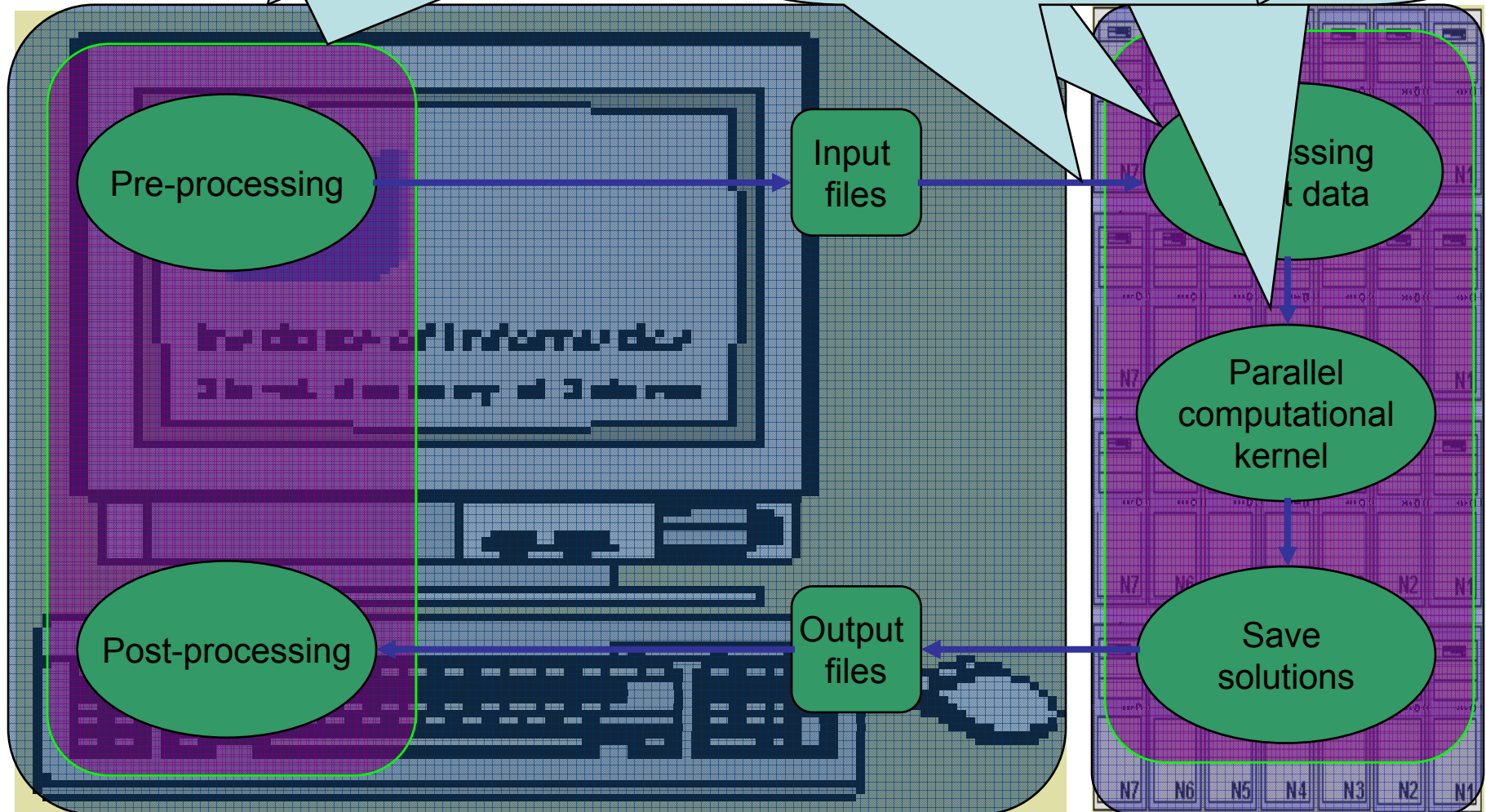




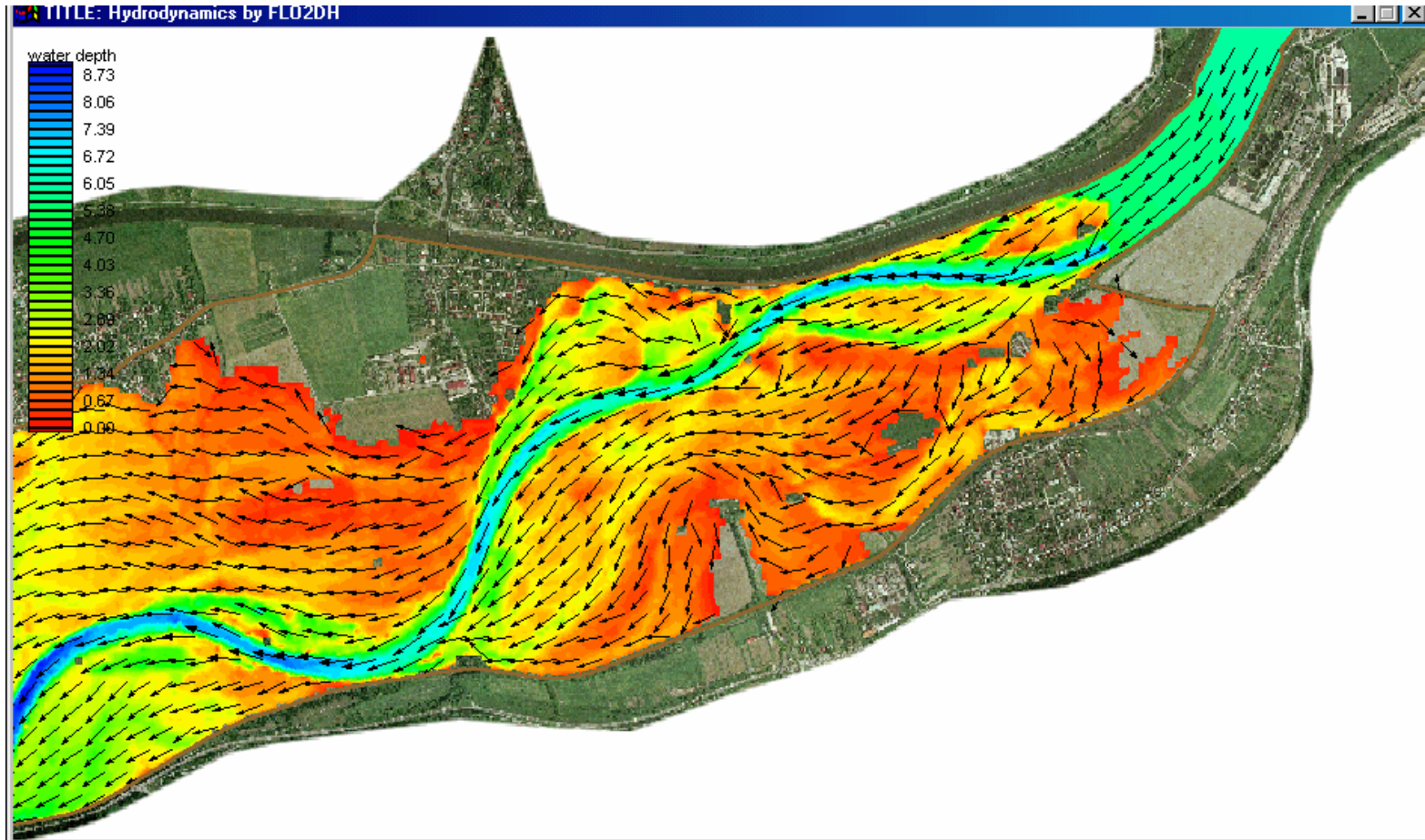
GUI (SMS) will run on P  
terminals

Com  
(SMS  
(FES  
standa  
HTTP,...)

Parallel computational module  
(FESWMS) will run on HPCN  
platform (supercomputers,  
clusters of workstations)



# Results: flow + water depths

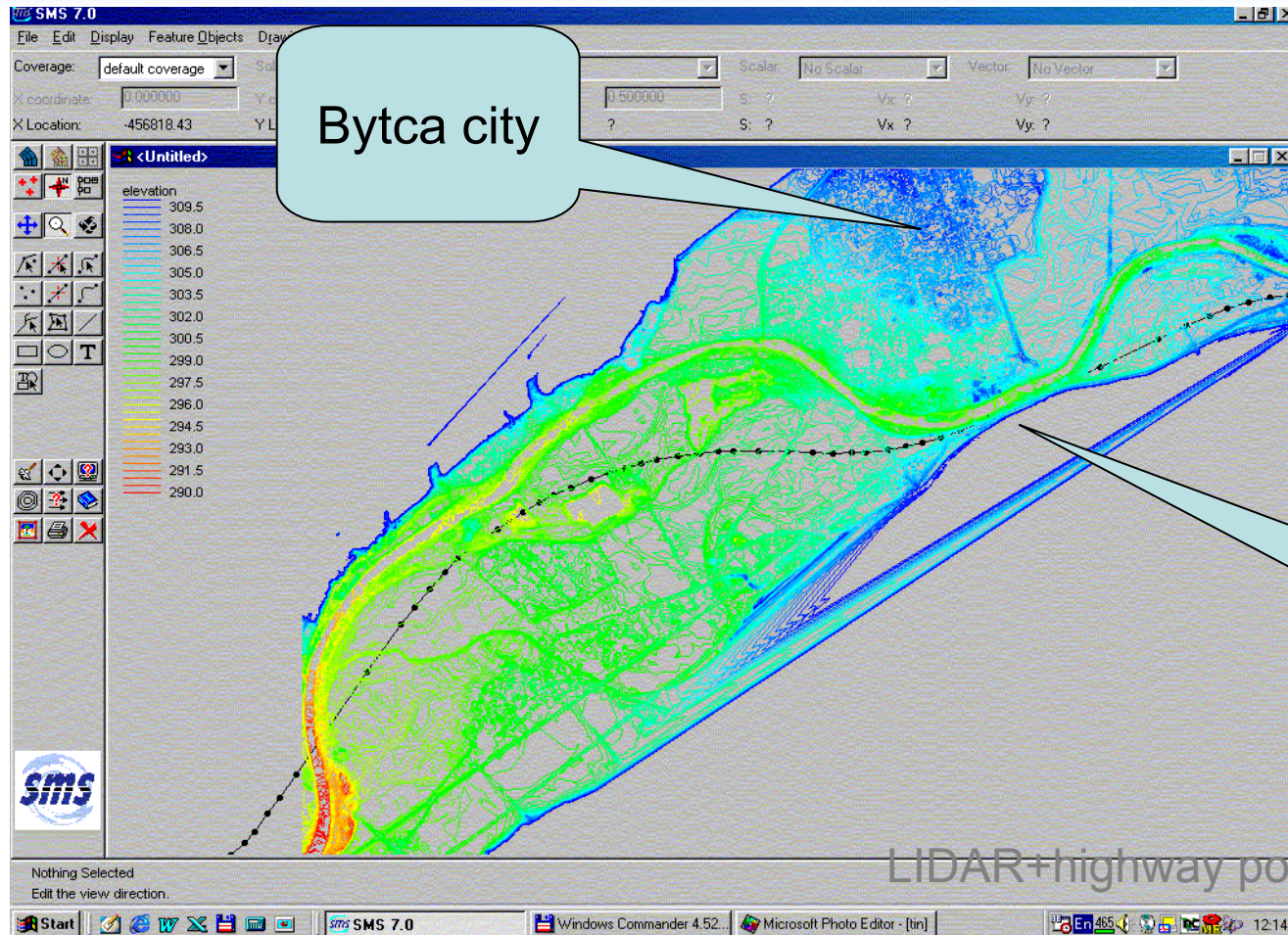


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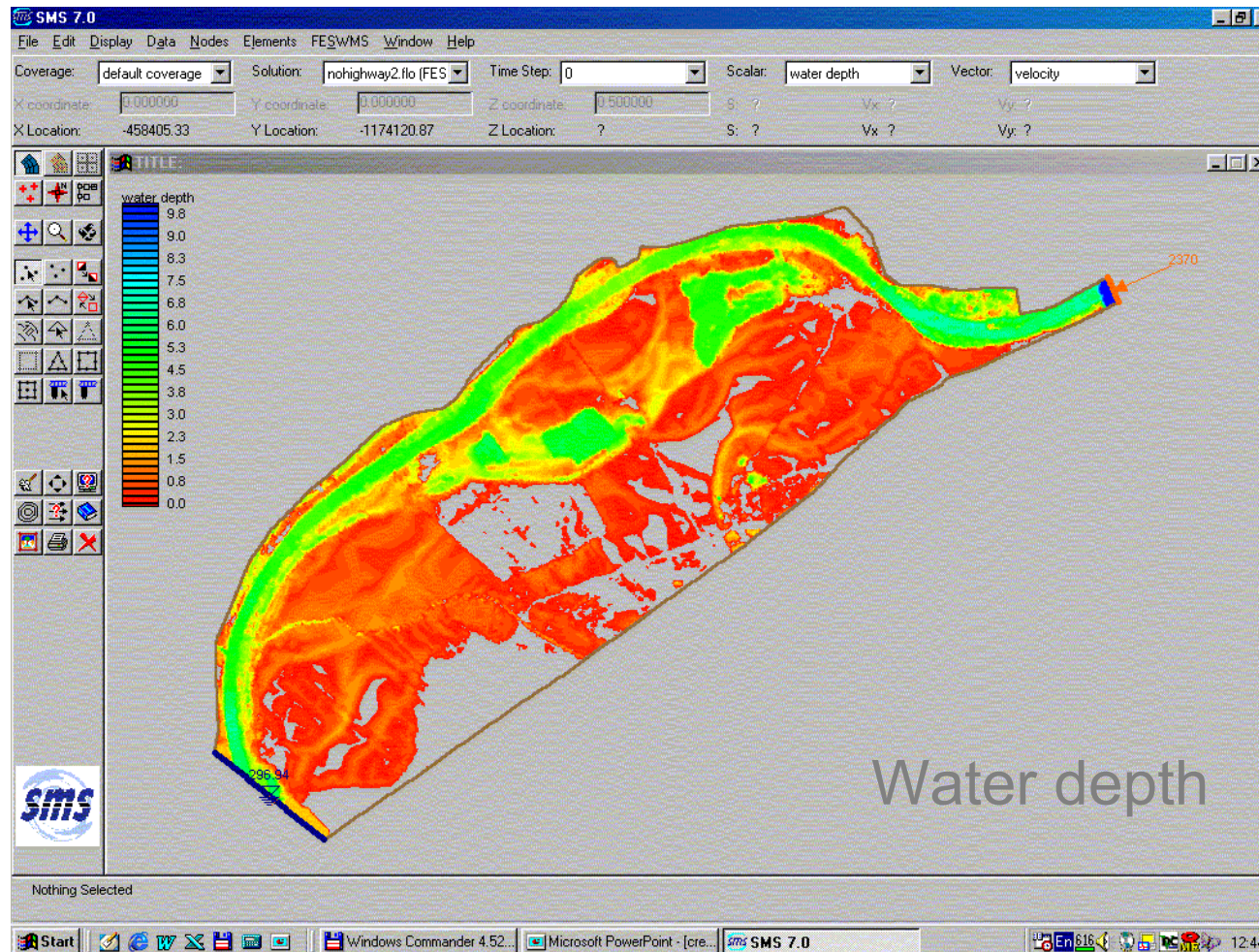


# Results: main part affected by highway





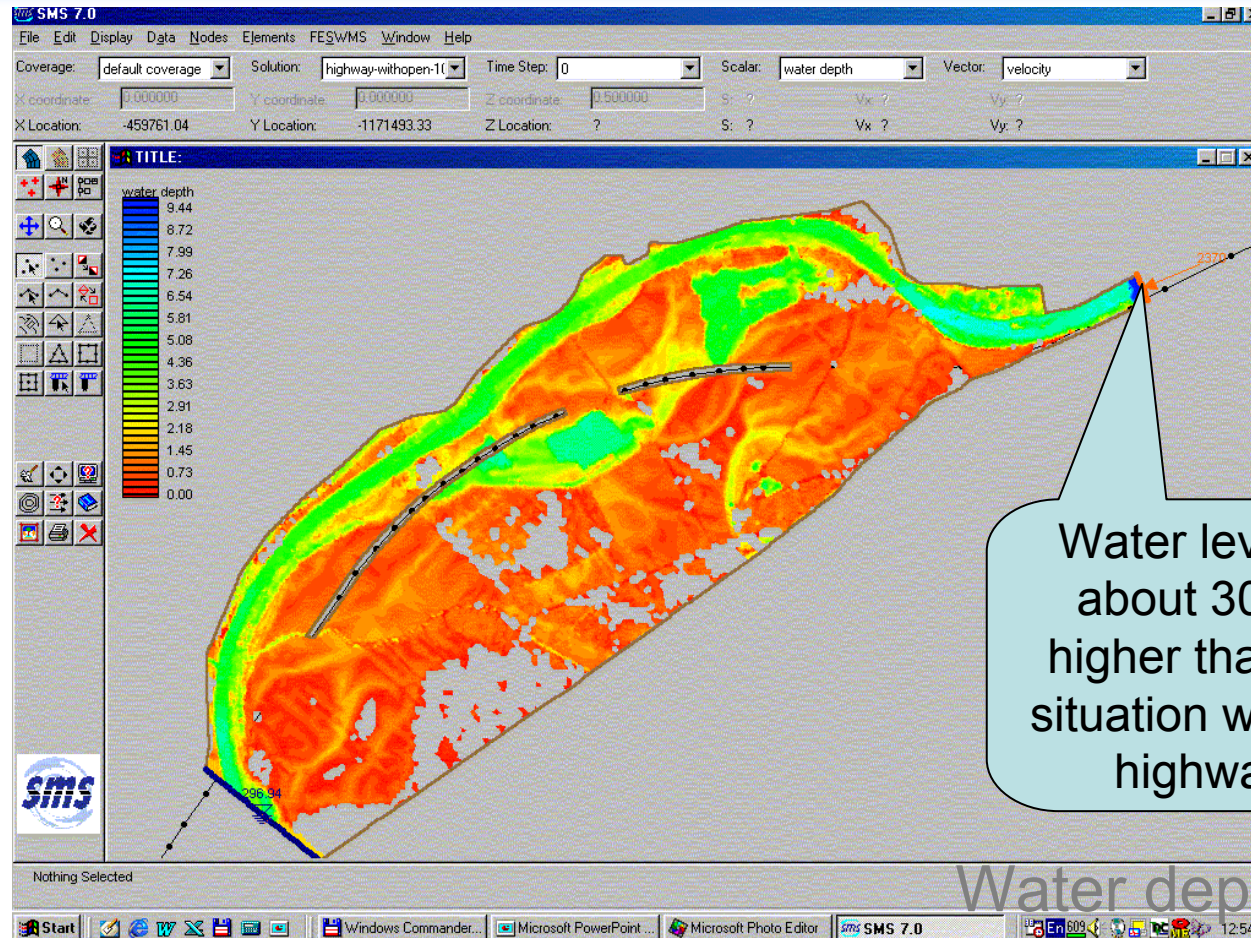
# Scenario: Water level for current terrain situation (Q-100-year)







# Results: water level for highway with 2 bridges (Q-100-year)



Water depth



# Development of Grid Environment for Interactive Applications IST-2001-32243, 5FP (2002-2005)

---

## Objectives

- CrossGrid application development
- Grid application programming environment
- New Grid services and tools
- International testbed organisation
- Dissemination and exploitation





# Partners

- CYFRONET Academ.Comp.Centre of Uni of M&M Krakow, PL
- University of Warsaw, Interdiscipl.Centre f.Math.&Comp.Modell., PL
- H.Niewodniczanski Institute of Nuclear Physics, Krakow, PL
- A.Soltan Institute for Nuclear Studies, Warsaw, PL
- Universiteit van Amsterdam, Faculty of Science, Amsterdam, NL
- Institute of Informatics, Slovak Academy of Sciences, Bratislava, SK
- Inst. f.Technische Informatik und Telematik, J.Kepler Uni Linz, A
- Forschungszentrum Karlsruhe GmbH, C.Inf&Comm.Tech.dpt, D
- Uni Stuttgart, Rechenzentrum, D
- Technische Uni Muenchen, L.f.Rechentechnik...,Fak.f.Informatik, D

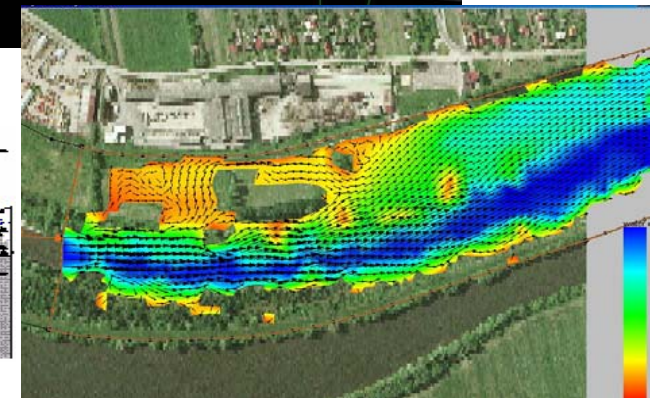
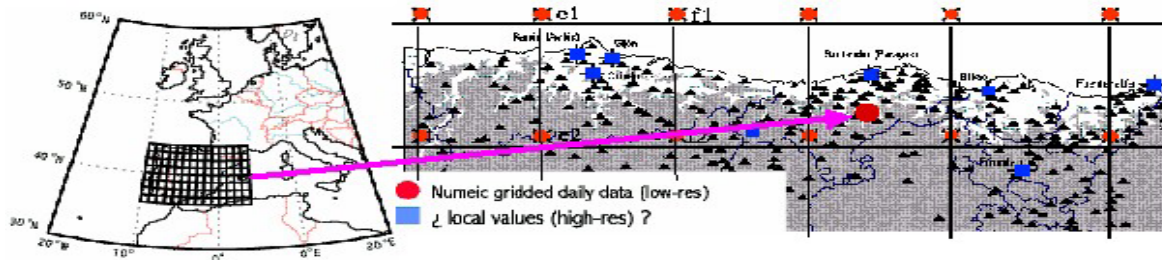
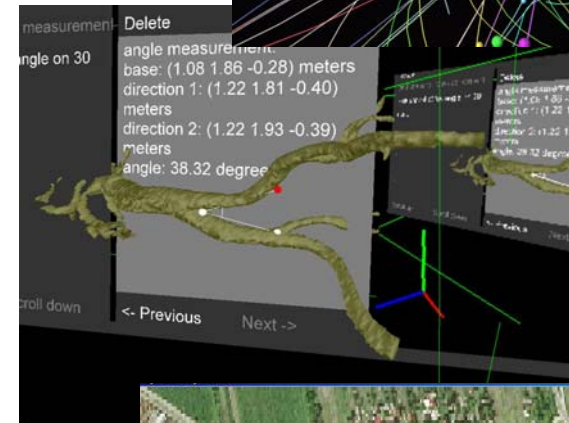
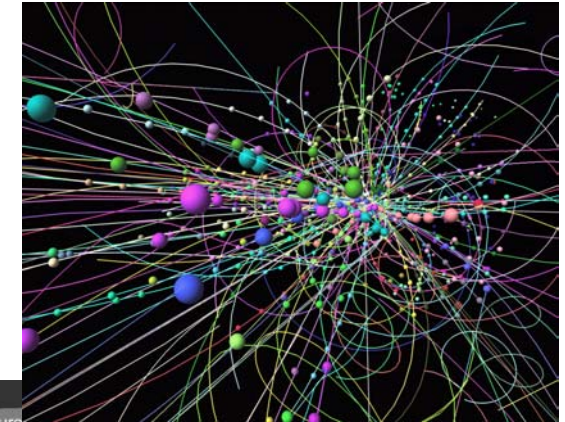


# Partners

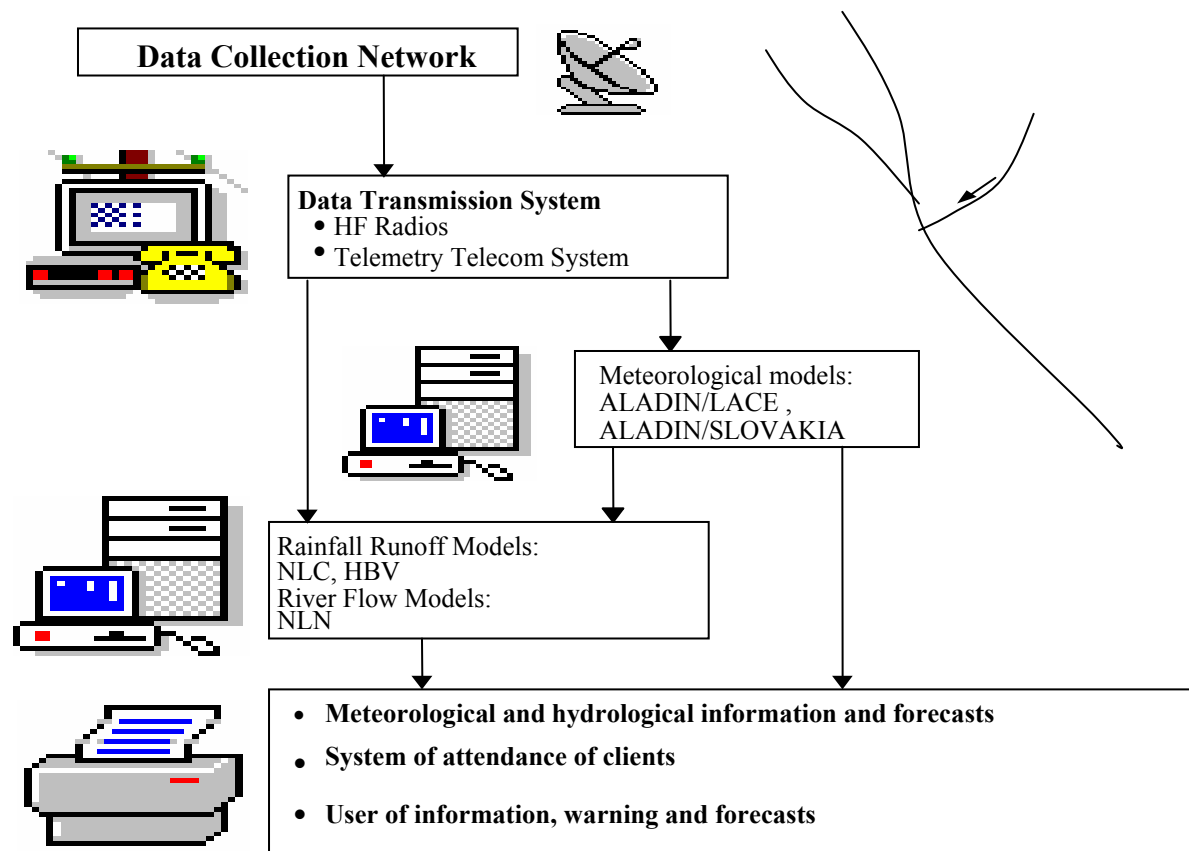
- Poznan Supercom&Networking Center, Inst.o.Bioorganic Chem., PL
- Uni of Cyprus, Dpt.o.Computer Science, Nicosia, CY
- DATAMAT Ingegneria dei Sistemi S.p.A., Roma, I
- Dept. of Computer Science, Trinity College Dublin, IRL
- Consejo Superior de Investigaciones Cientificas, IFCA, Santander, E
- Uni Autonoma de Barcelona, Arq.d.Ordinadors i Sistemes Operatius, E
- Uni de Santiago de Compostela, Inst.d.Informatica, E
- Uni Autonoma de Madrid, Dept. de Fisica Teorica, E
- Nat.Centr.f.Scient.Research DEMOKRITOS, Inst.o.Nucl.Physics, EL
- Aristotle Uni of Thessaloniki, Div.o.Nuclear&Part.Physics, EL
- Lab.de Instrumentacao e Fisica Exp.de Particulas, Comp.C., Lisboa, P
- Algosystems S.A., Applied Research Dept., Piraeus, EL

# CrossGrid

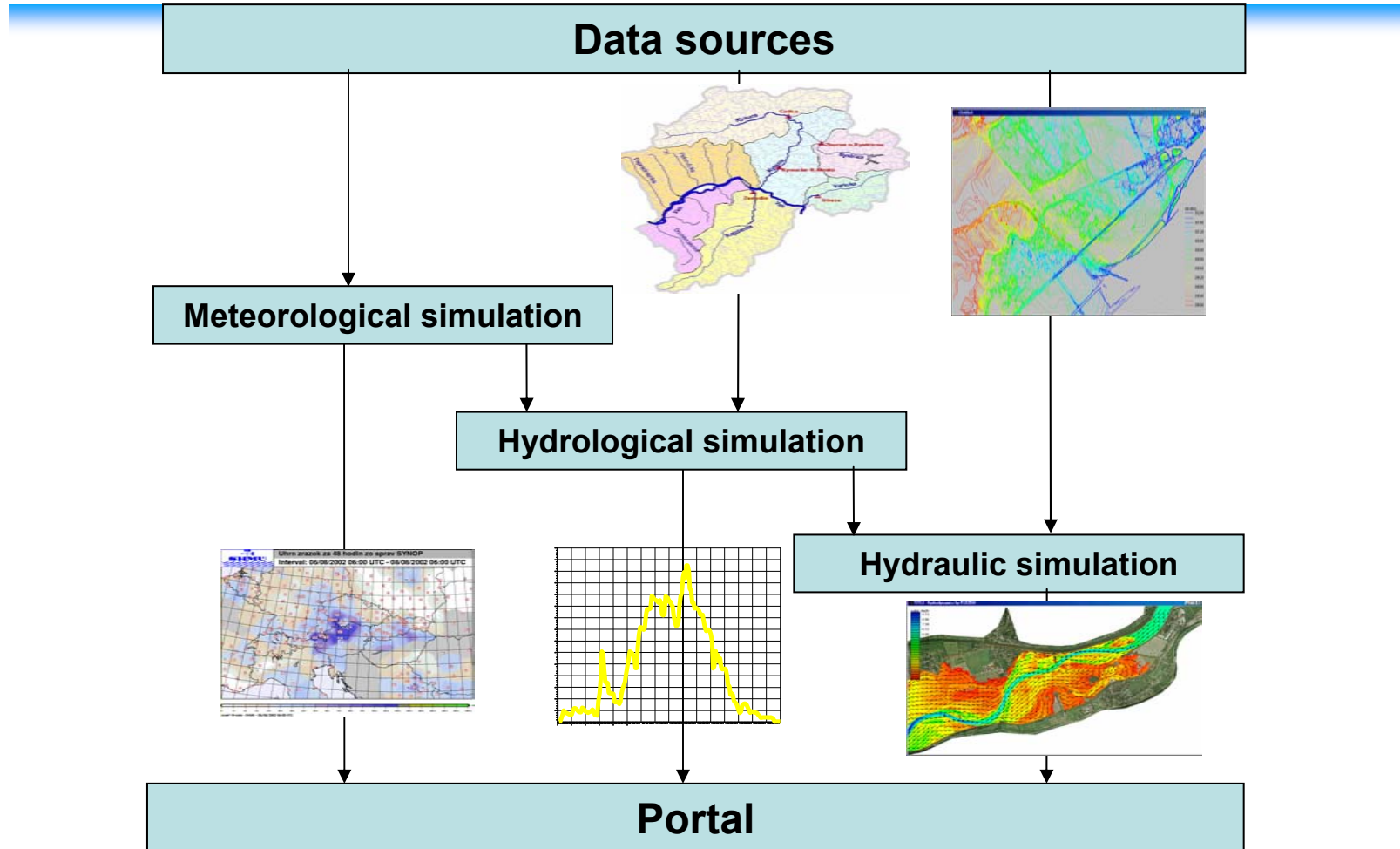
- 1. Interactive biomedical simulation and visualization
- 2. Flooding crisis team support
- 3. HEP distributed data analysis
- 4. Weather forecasting and air pollution modelling



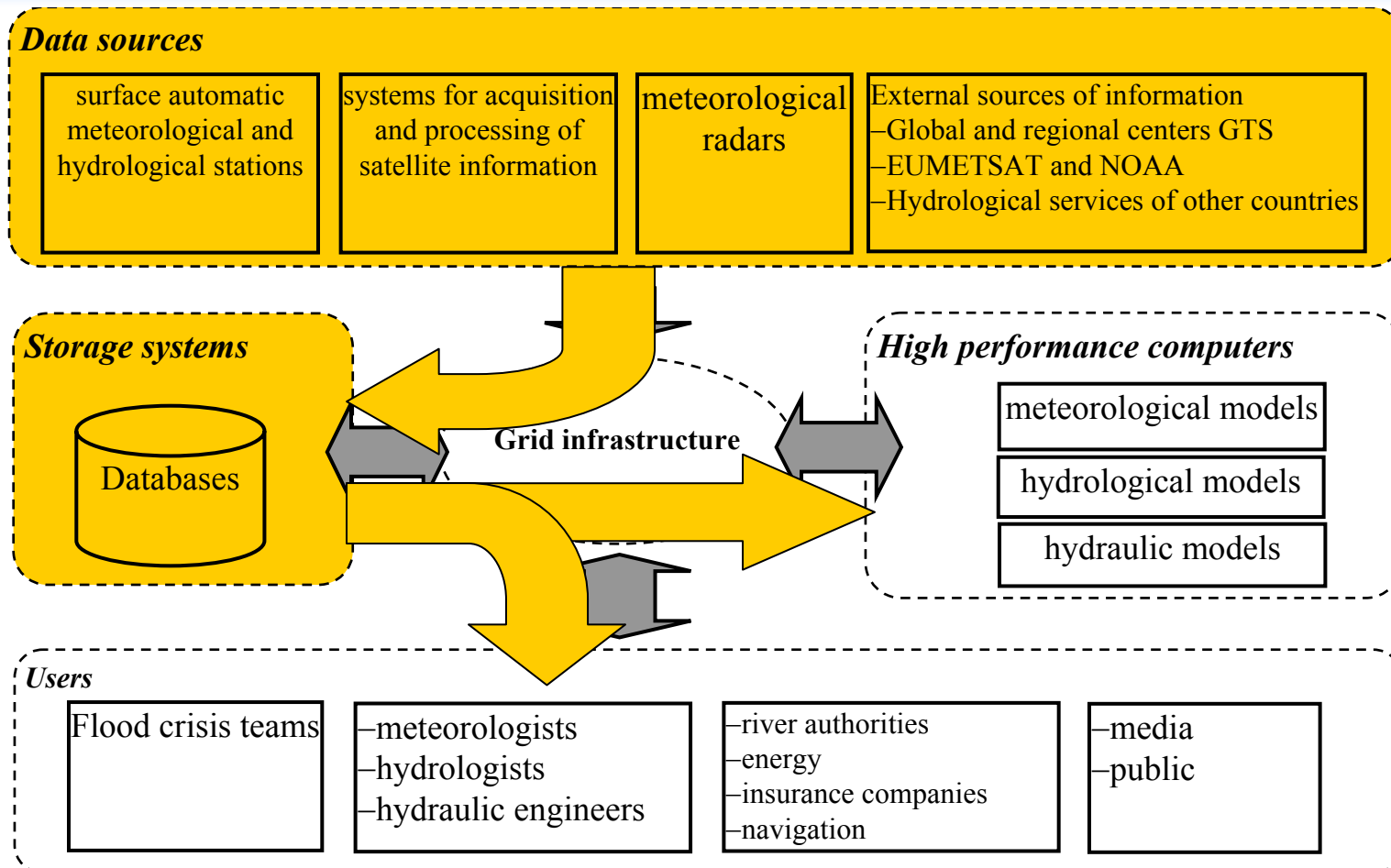
# Flood Warning and Forecasting System



# Flood Warning and Forecasting System

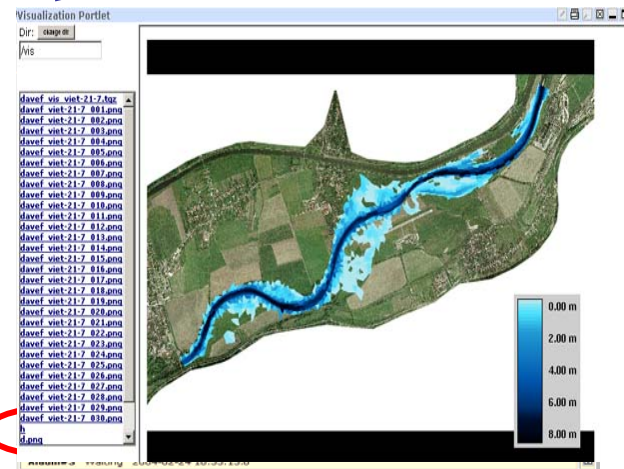
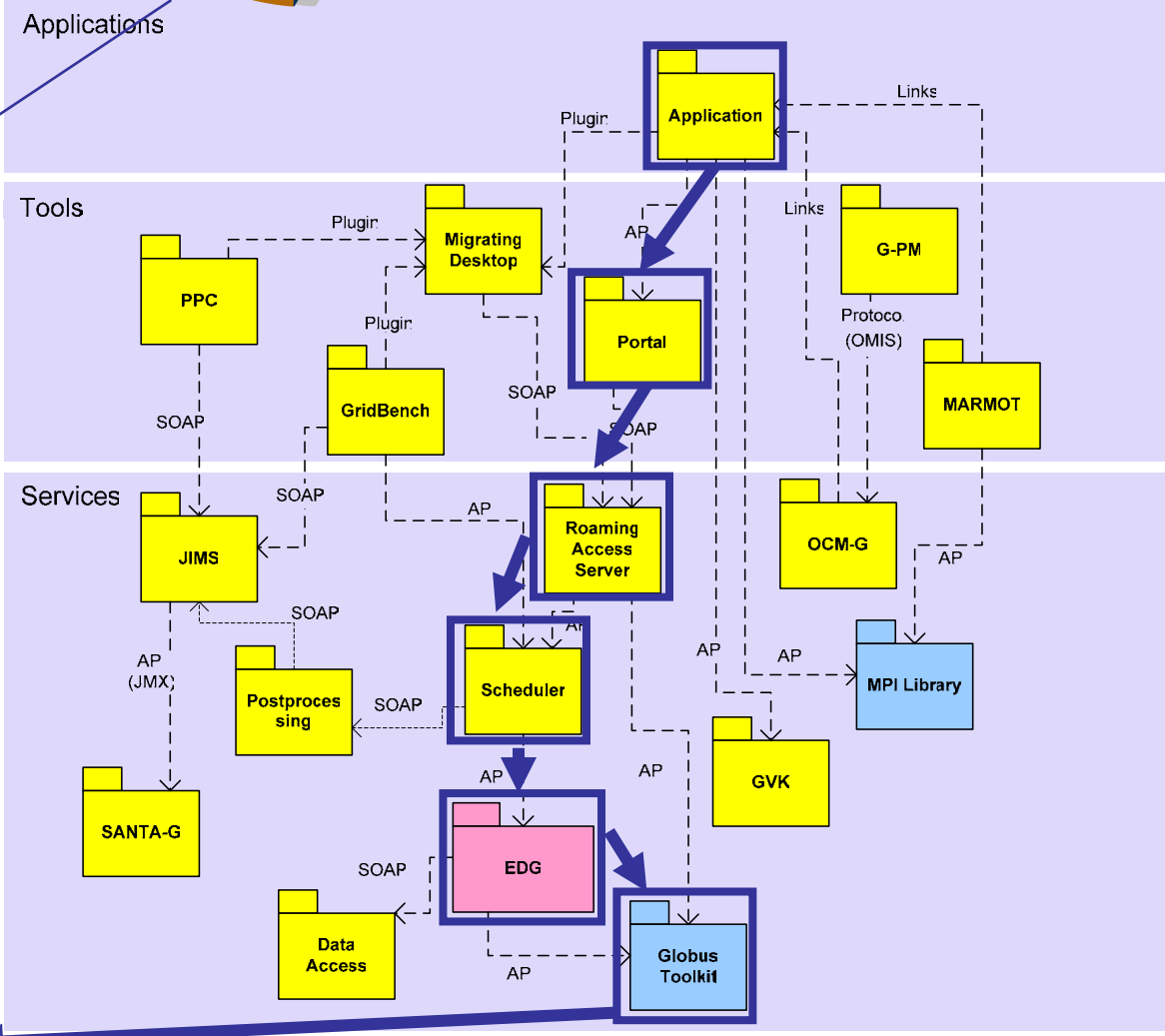
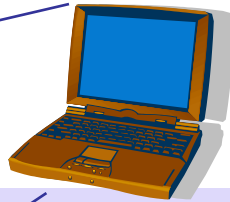


# Flood Virtual Organisation data transfer

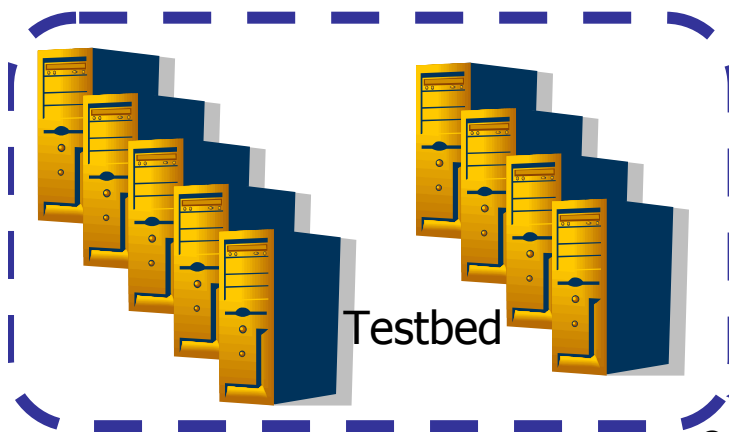




# Application Portal



Simulation Output



Testbed

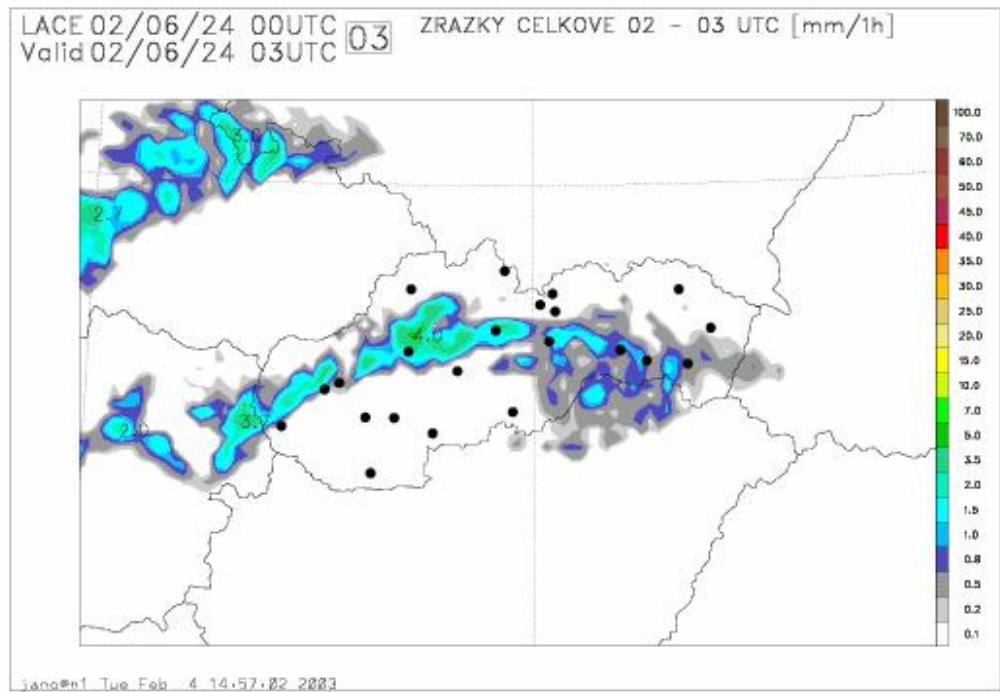
# Results: GridPort

# Flood Grid Portal

Institute of Informatics, Slovak Academy of Sciences

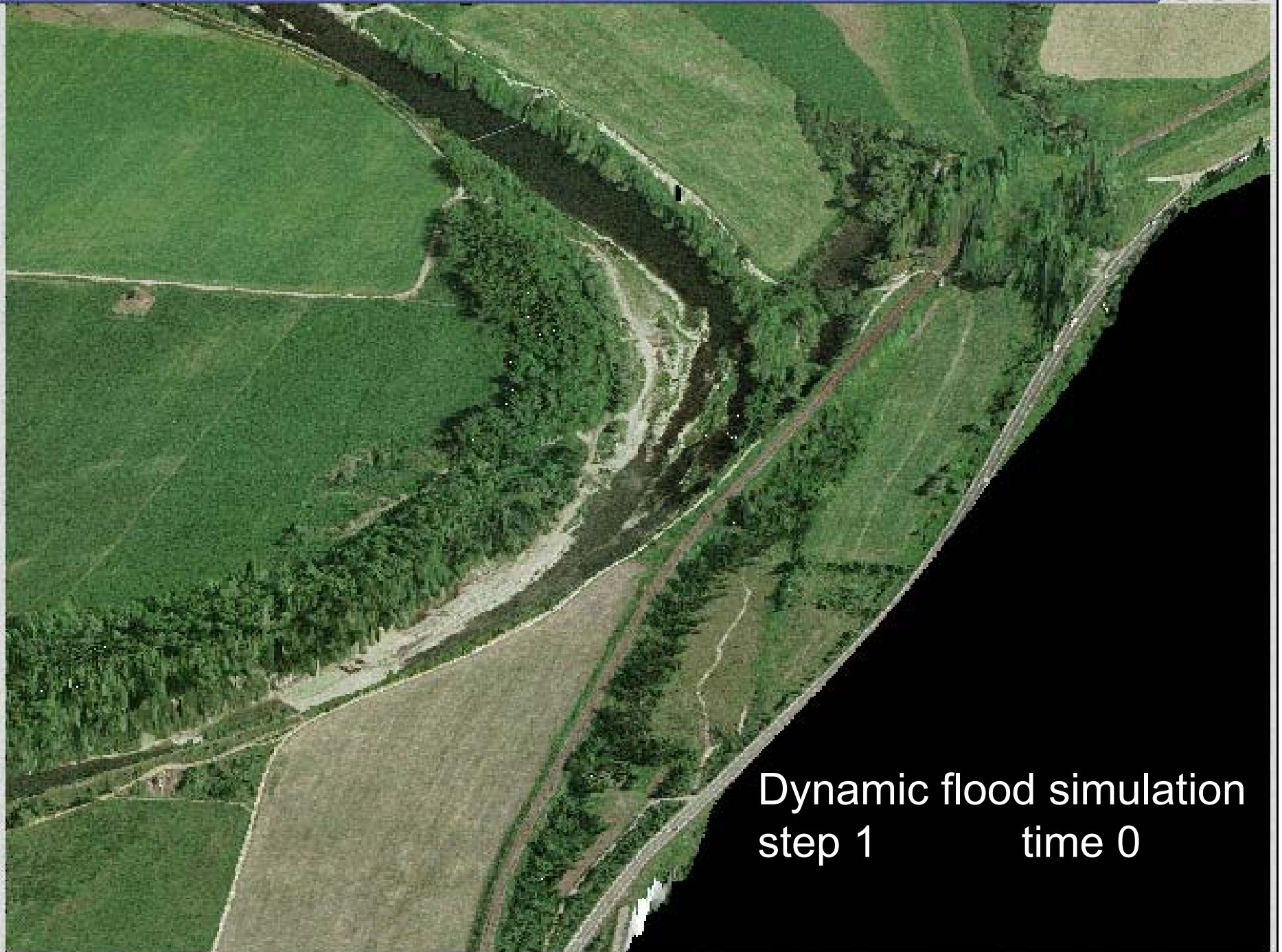
- Authentication
  - Login
  - Logout
  - Check Login State
- Meteorology
  - Submit ALADIN
  - ALADIN vis
  - ALADIN animation (experimental)
- Hydrology
  - Submit HSPF
- Hydraulics
  - Submit FESWMS
  - FESWMS vis
- Job management
  - Run Job
  - Submit Job
  - Submit Test Job
  - List Jobs
- File management
  - List Files
  - Run X Server
- Grid File Transfers
  - Put File
  - Get File
  - gridFTP Put File
  - gridFTP Get File
  - 3rd Party Transfer

Precipitation forecast for 24.06.2002 00 + 3 View [Prev](#) [Next](#)

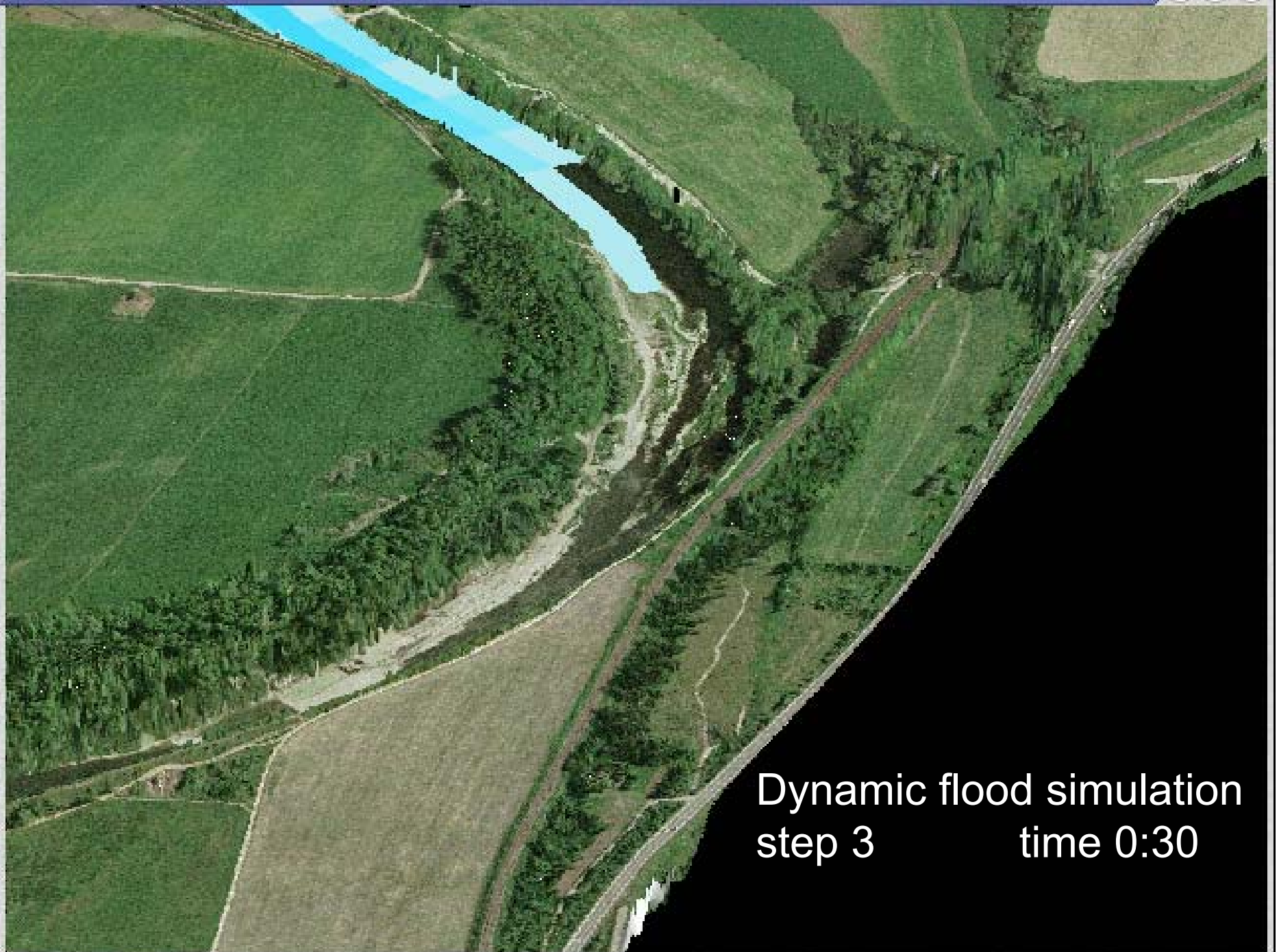


```
Precipitation from model ALADIN/SLOVAKIA
integration: 24-06-2002 00 UTC
period:      +02 to +03 h
```

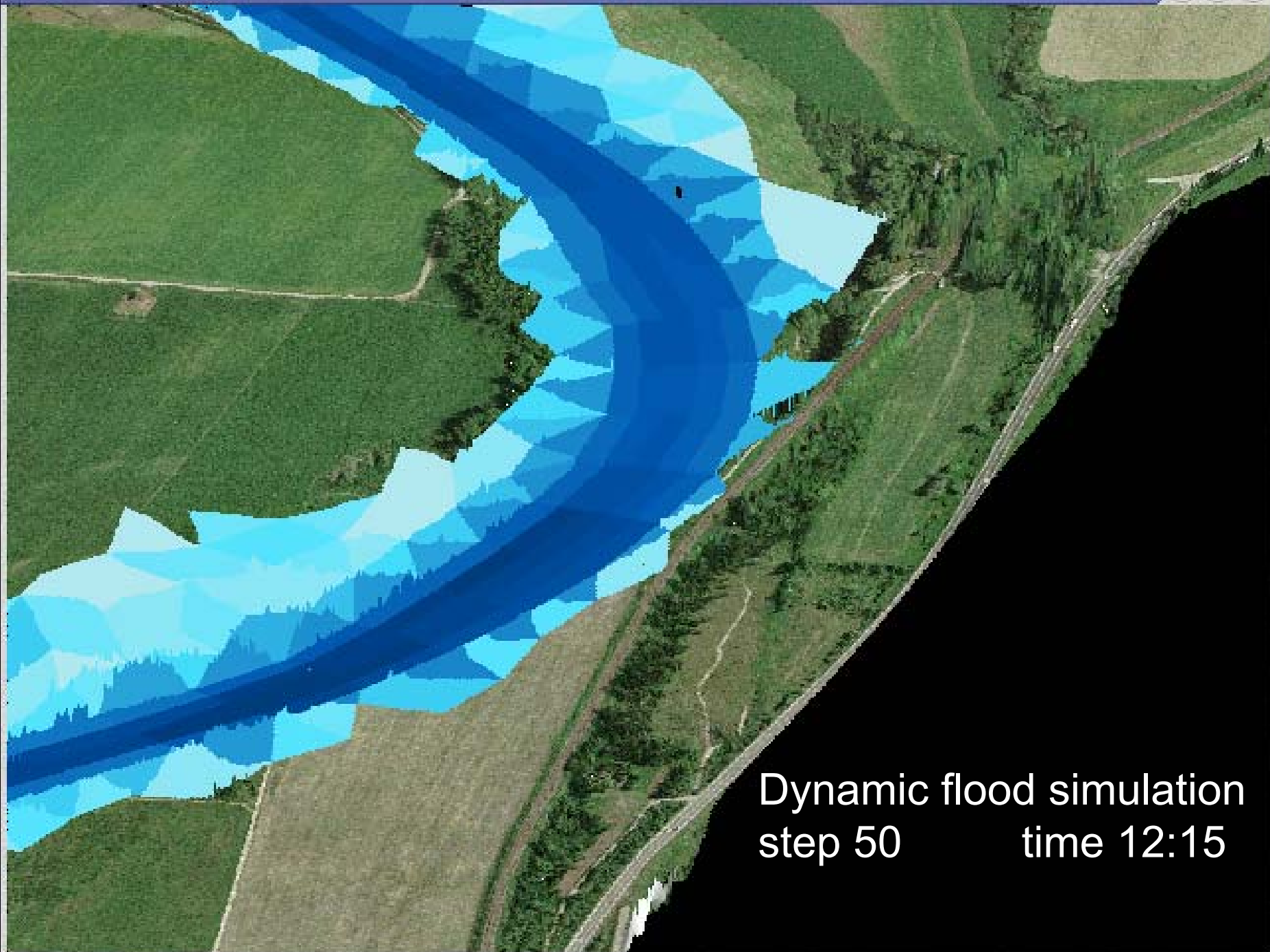




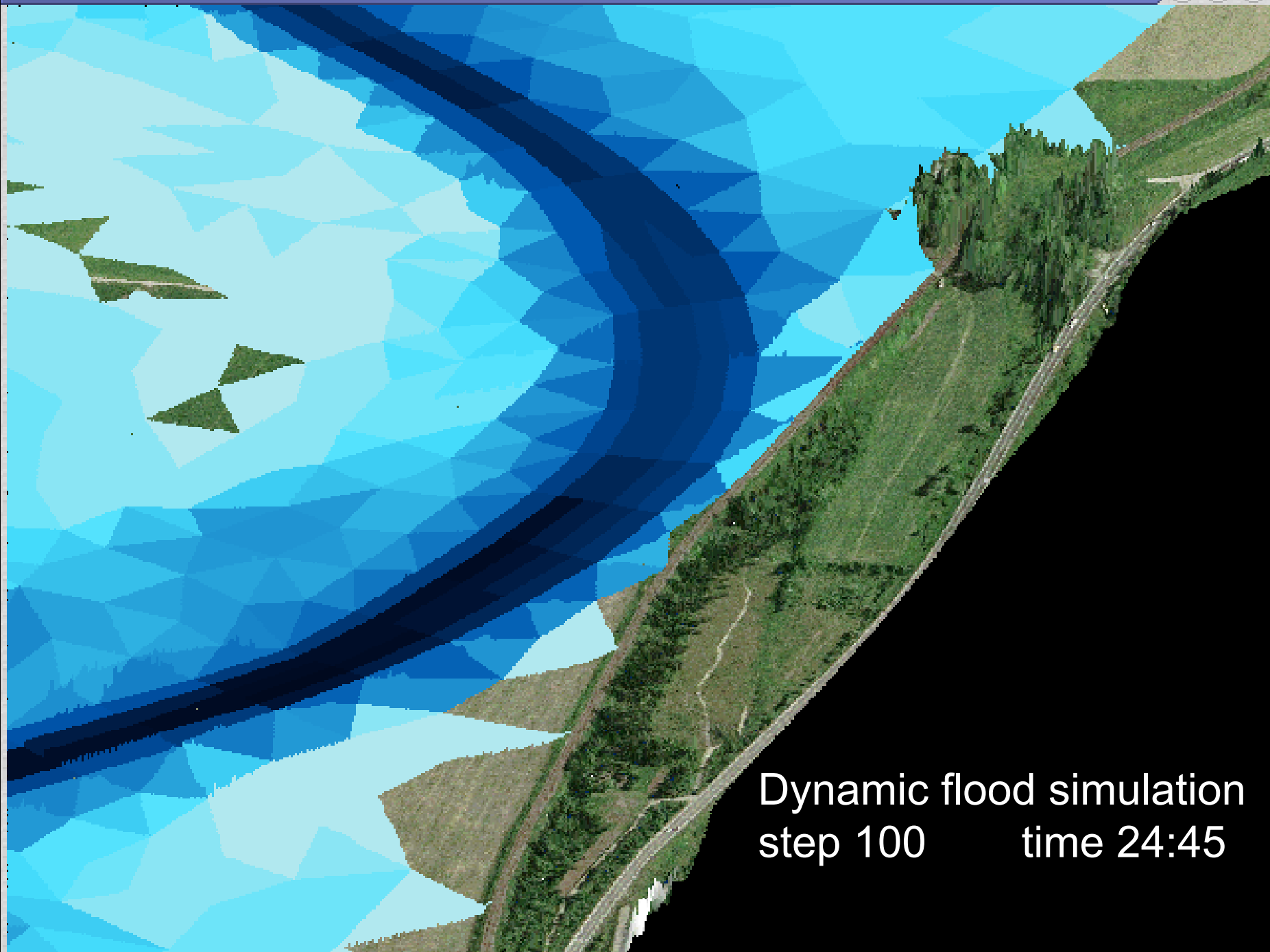
Dynamic flood simulation  
step 1                      time 0



Dynamic flood simulation  
step 3                      time 0:30



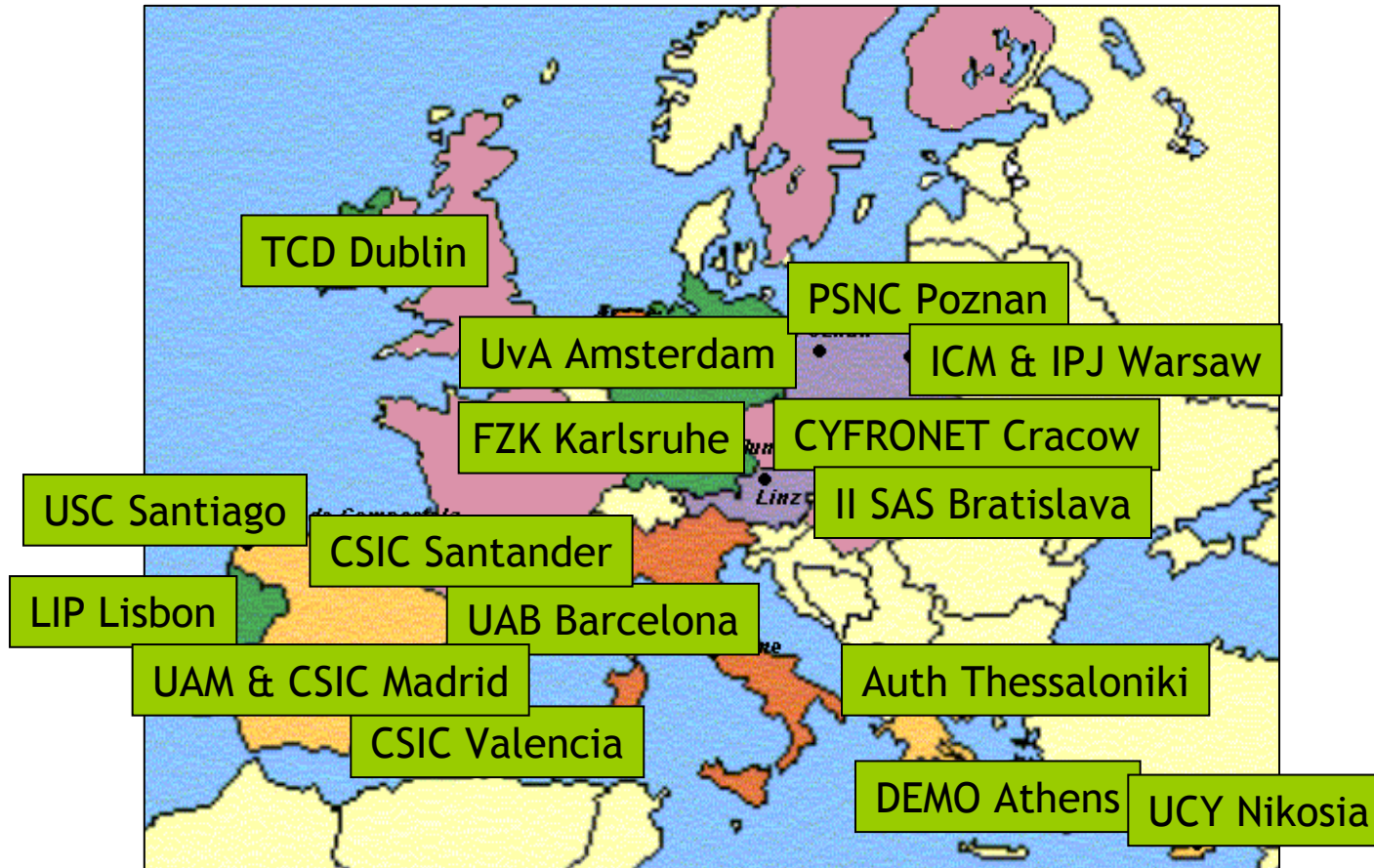
Dynamic flood simulation  
step 50      time 12:15



Dynamic flood simulation  
step 100      time 24:45



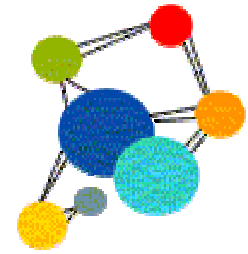
# CROSSGRID testbed



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# A Platform for Organisationally Mobile Public Employees IST-2001-34519, 5FP (2002-2004)



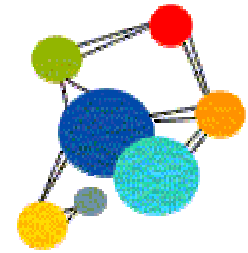
**PELLUCID**

*a new platform for organisationally mobile public employees*

## Objectives

- Analysis of public sector working environments and tasks
- Definition of generic system architecture
- Development of the interaction layer
- Development of the process layer
- Development of the access layer
- Development of the organisational memory
- Integration of the platform
- Pilot site customisation, operation and evaluation



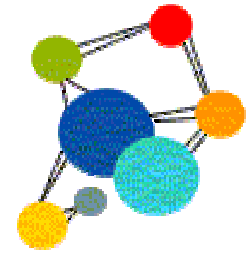


PELLUCID

*a new platform for organisationally  
mobile public employees*

# Partners

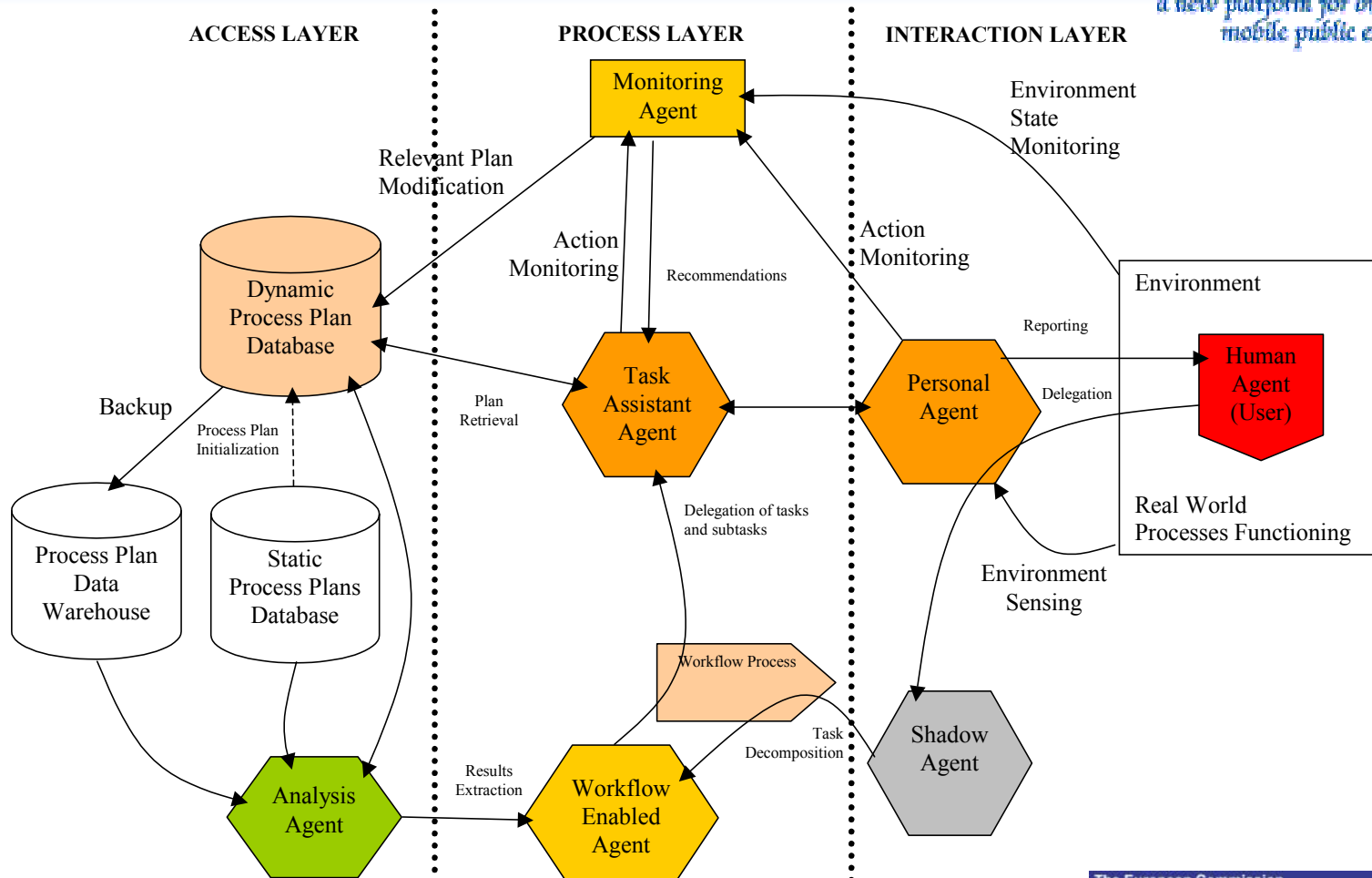
- SADIEL, Spain
- Softeco, Italy
- Cyfronet, Poland
- CCLRC, UK
- II SAS, Slovakia
- Comune di Genova, Traffic & Mobility Directorate, Italy
- Mancomunidad de Municipios del Bajo Guadalquivir, Spain



PELLUCID

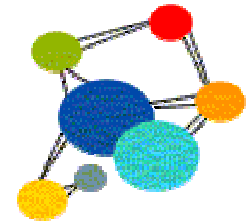
a new platform for organisationally mobile public employees

# Pellucid Architecture



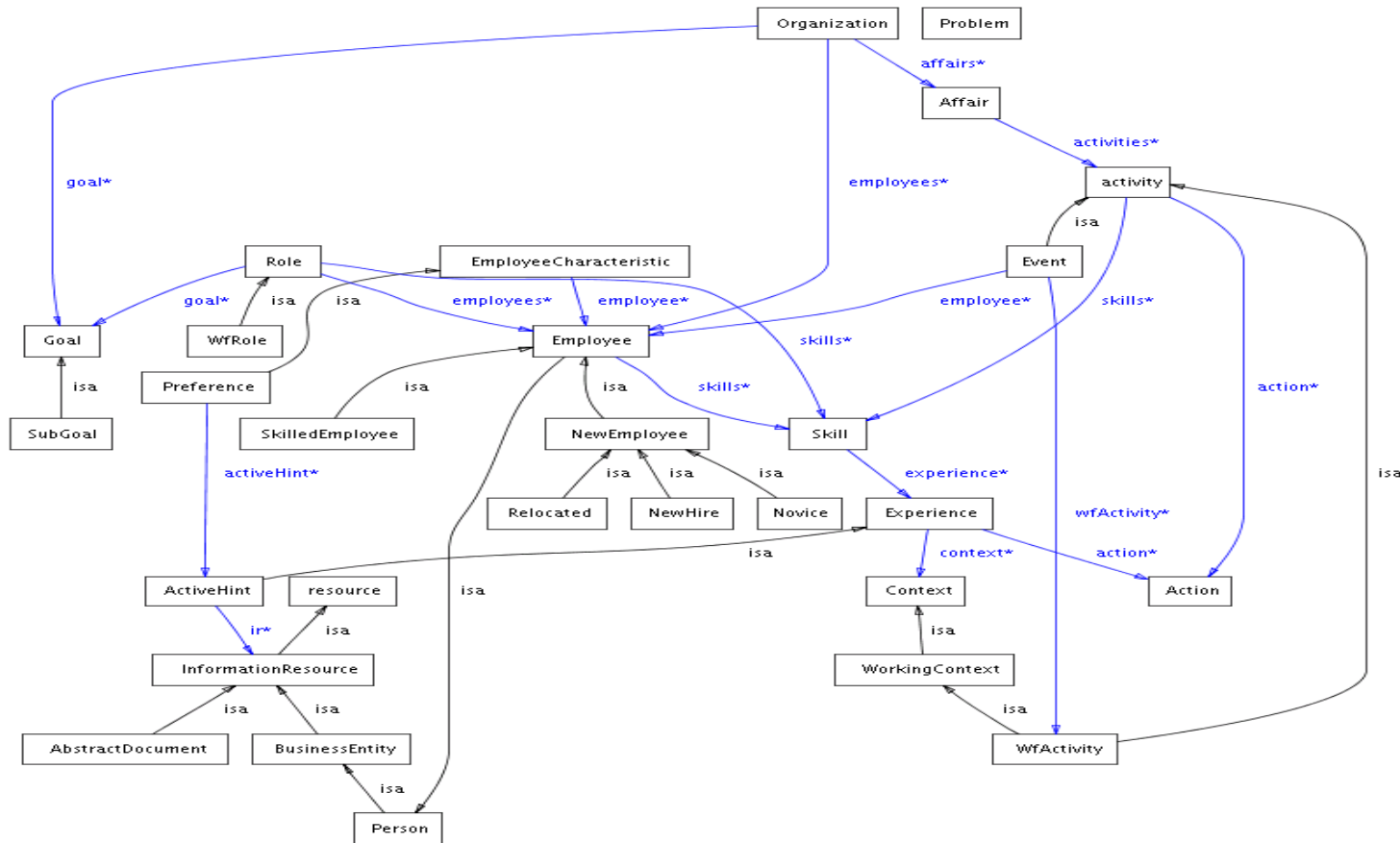
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# Results: Pellucid Ontology

PELLUCID  
a new platform for organisationally mobile public employees





## II SAS projects within IST 6FP

- ***EU 6FP RI (III) project: Enabling Grids for E-scienceE (2004-2006) INFISO-RI-508833***

*Project started on April 1, 2004 (70 partners from Europe and USA). The vision of the EGEE Integrated Infrastructure Initiative (III) is to create and deploy Grid technologies to enable the widespread uptake of e-Science applications throughout the European Research Area. To achieve this vision, EGEE will focus on four key objectives: \* integrating Grid technological developments from across Europe; \* establishing a Europe-wide Grid infrastructure for science and industry with a focus on heterogeneity and interoperability; \* enabling the creation of e-Science applications from across the scientific and industrial spectrum; \* ensuring the timely delivery of the projects programme of work, guided by the needs of academic and industrial partners.*

- ***EGEE II proposal is in the hearing stage (April 2006 – March 2008)***

# EGEE Project Structure

32 Million Euros EU funding over 2 years starting 1<sup>st</sup> April 2004

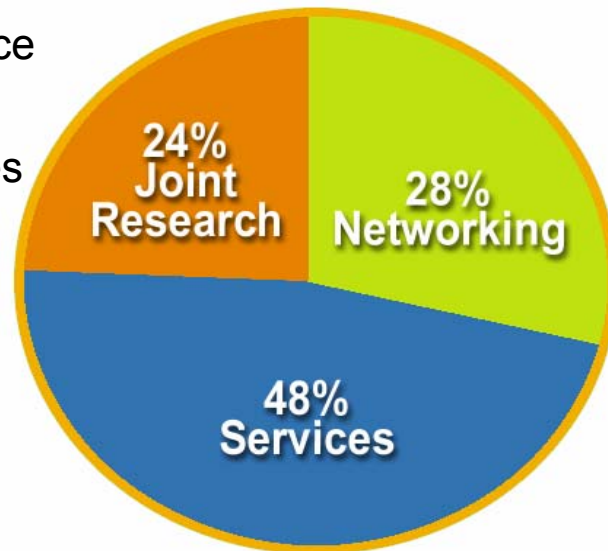
## 24% Joint Research

**JRA1:** Middleware Engineering and Integration

**JRA2:** Quality Assurance

**JRA3:** Security

**JRA4:** Network Services Development



## 48% Services

**SA1:** Grid Operations, Support and Management

**SA2:** Network Resource Provision

## 28% Networking

**NA1:** Management

**NA2:** Dissemination and Outreach

**NA3:** User Training and Education

**NA4:** Application Identification and Support

**NA5:** Policy and International Cooperation

Emphasis in EGEE is on operating a production grid and supporting the end-users

# Grid Applications

- **Medical/Healthcare** (*imaging, diagnosis and treatment*)
- **Bioinformatics** (*study of the human genome and proteome to understand genetic diseases*)
- **Nanotechnology** (*design of new materials from the molecular scale*)
- **Engineering** (*design optimization, simulation, failure analysis and remote Instrument access and control*)
- **Natural Resources and the Environment** (*weather forecasting, earth observation, modeling and prediction of complex systems*)



# CERN: Data intensive science in a large international facility

- The Large Hadron Collider (**LHC**)
  - The **most powerful instrument** ever built to investigate elementary particles physics
- Data Challenge:
  - 10 Petabytes/year of data !!!
  - 20 million CDs each year!
- Simulation, reconstruction, analysis:
  - LHC data handling requires computing power equivalent to ~100,000 of today's fastest PC processors!



# MEDIGRID — EU 6FP Sustainable development, global change and ecosystems project

## Mediterranean Grid of Multi-Risk Data and Models

### *Main objectives:*

1. Define a multi-risk assessment platform based on distributed spatial digital data and data processing models
2. Work on the standardization of the structure of data sets that can be useful for risk models testing and multi-risk assessment
3. Create a validation framework for models developed in the context of previous R&D projects
4. Interface to the content of distributed networks of disaster data and
5. Develop web based risk assessment applications, using distributed data

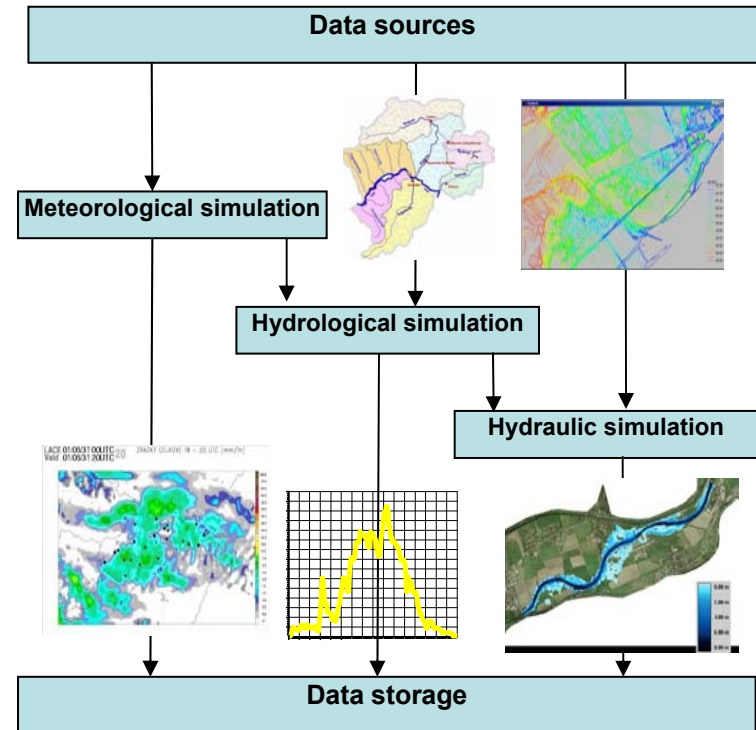
### *Consortium:*

1. ALGOSYSTEMS SA, Kalithea, Greece 
2. Associação para o Desenvolvimento da Aerodinâmica Industrial, Coimbra, Portugal 
3. EIPFEI/CEREN, Gardanne, France 
4. TECNOMA SA, San Sebastián de los Reyes, Spain 
5. Institute of Informatics SAS, Bratislava, Slovakia 
6. University of Newcastle upon Tyne, United Kingdom 



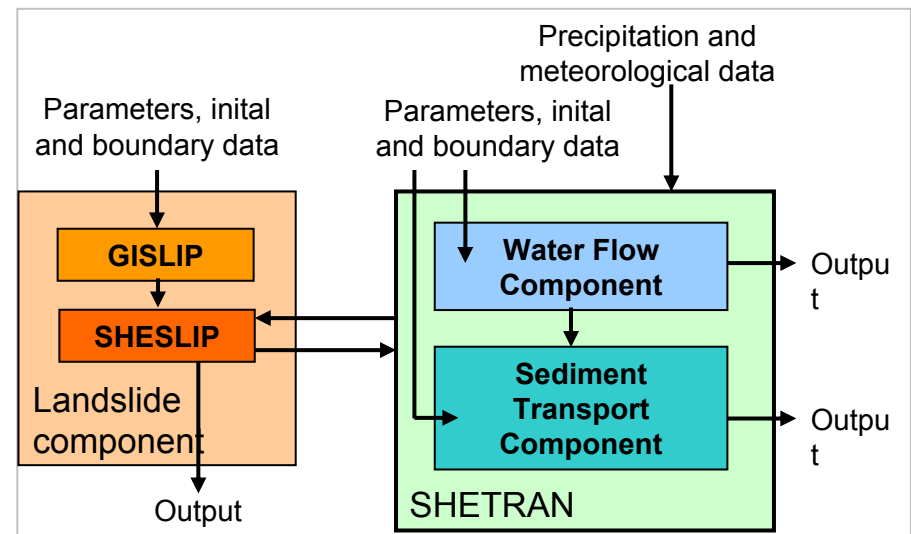
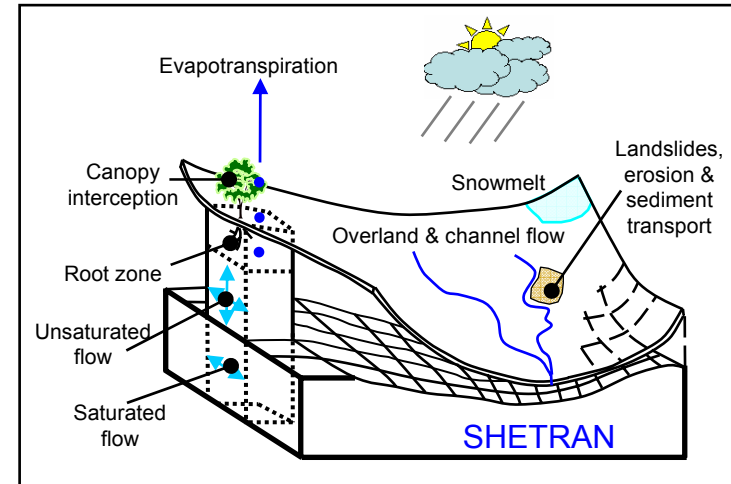
# Applications – Flood modeling

- Consists of several simulation models (meteorological, hydrological and hydraulics) and appropriate post-processing tools:
  - MM5 meteorological model forecasts precipitation
  - HSPF hydrological model computes the discharge of the river
  - DaveF hydraulics model computes the possible flood and flooded area
  - All the models generate binary output data, which are then used by post-processing tools to generate pictures visualizing the situation



# Applications – Landslides

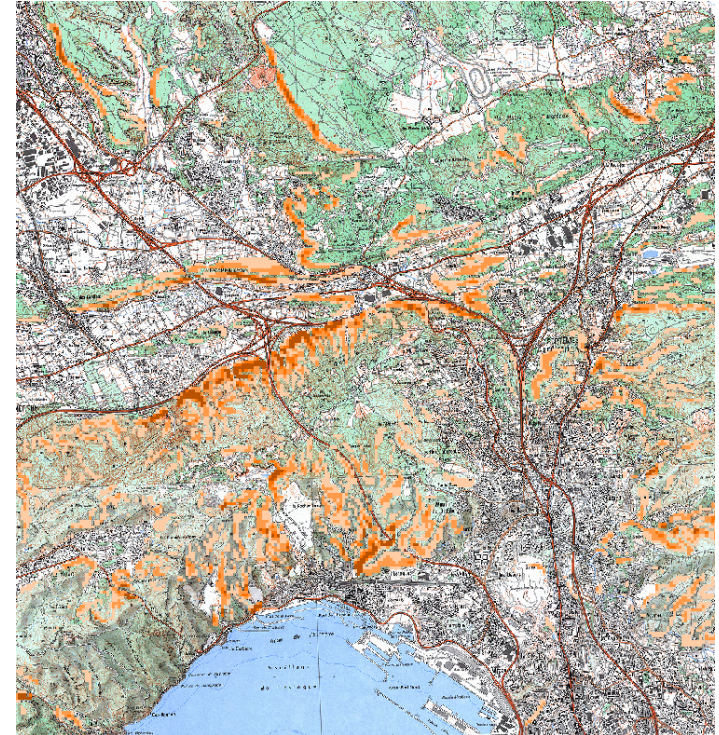
- Using SHETRAN model
  - Physically based, spatially distributed, integrated surface/subsurface modelling system for water flow and sediment transport in river basins
  - A component is available for modelling shallow landslide erosion and sediment yield
  - can be applied to a single complete basin or to parts of a basin or to groups of contiguous basins up to an area of about 5000 km<sup>2</sup> using a grid resolution of 500 to 2000 m





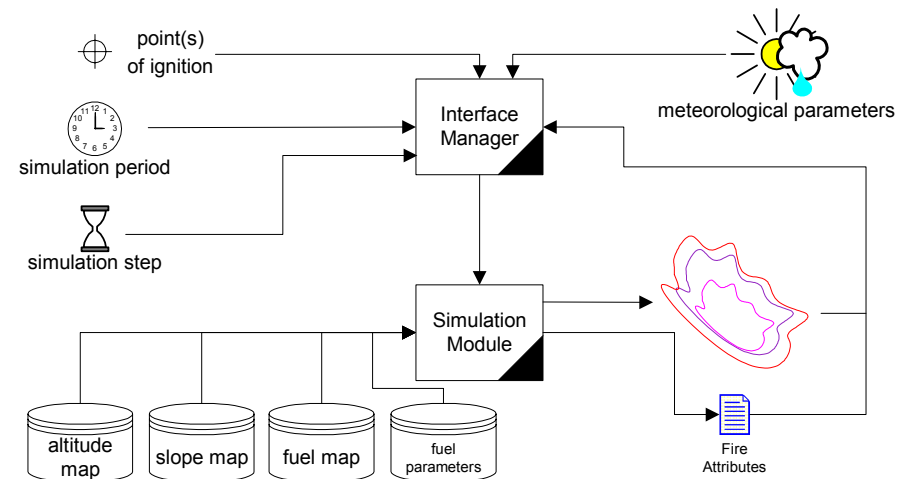
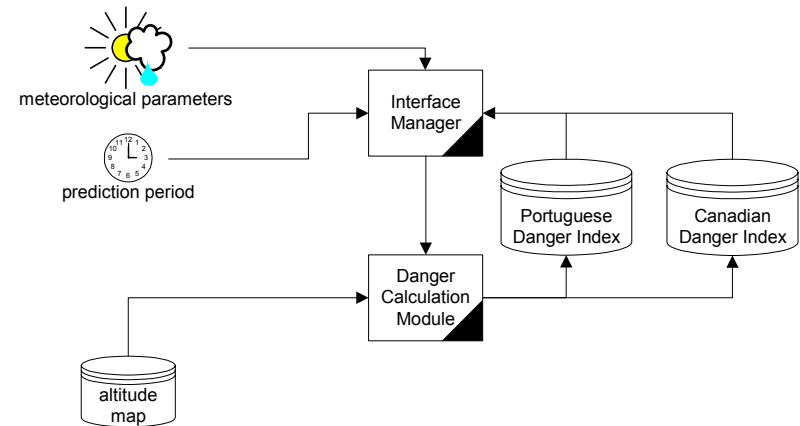
# Applications – Soil erosion

- Provides answer to the highest soil erosion risks after the passage of a forest fire in definite climate conditions



# Applications – Fire Danger and Propagation

- Calculates the danger of occurrence of a forest fire in a known geographical target area and simulates the propagation of such a fire, which is deemed to have started within this area
- Two main modules:
  - Danger Calculation Module yields the possibility of there being a fire
  - Simulation Module simulates what will happen if a fire actually occurs



# Applications – Forest fire

- Simulation of fire spread over complex topography
- Semi-empirical model for fire rate of spread, which takes as input local terrain slope, parameters describing fuel properties as well as the wind speed and direction
- Two different models are implemented for the simulation of the wind field
- Outputs: the time evolution of the fire shape, fire rate of spread, fire intensity and other related parameters
- Secondary outputs: the Fire Weather Indexes and the 3D wind field calculation

# K-WfGrid

[www.kwfgrid.net](http://www.kwfgrid.net)



- Fraunhofer FIRST (Berlin, Germany)
- UIBK (Innsbruck, Austria)
- IISAS (Bratislava, Slovak Republic)
- CYFRONET (Cracow, Poland)
- LogicDIS S.A. (Athens, Greece)
- Softeco Sismat SpA (Genoa, Italy)

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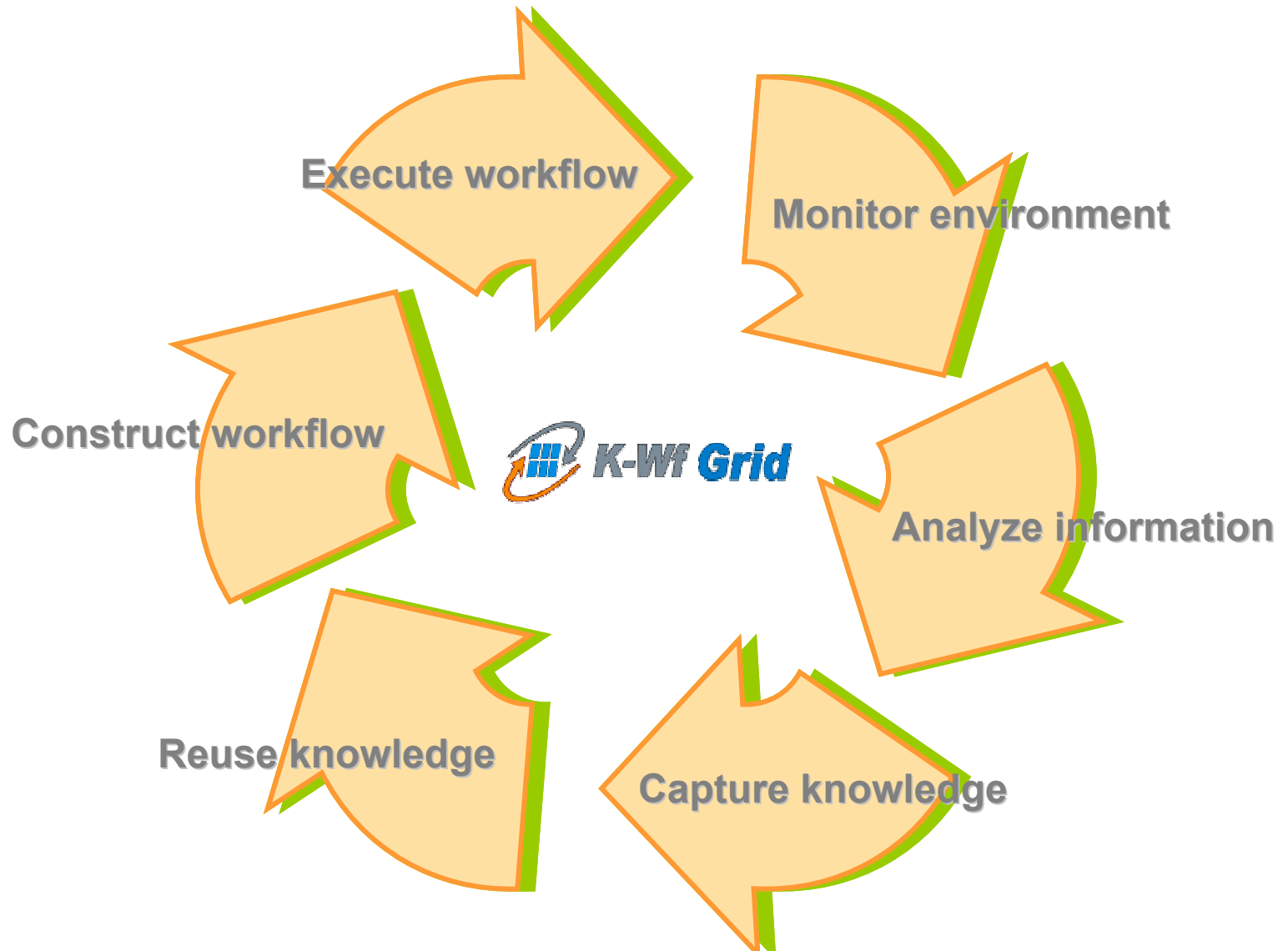
# K-Wf Grid Objectives

- **Integrating services into coherent application scenarios**
- **Enabling automatic construction and reuse of workflows with knowledge gathered during operation**
- **Involving monitoring and knowledge acquisition services in order to provide added value for end users**

*Technologies: WSRF & service-oriented Grid architecture, workflows, ontologies, dynamic instrumentation*

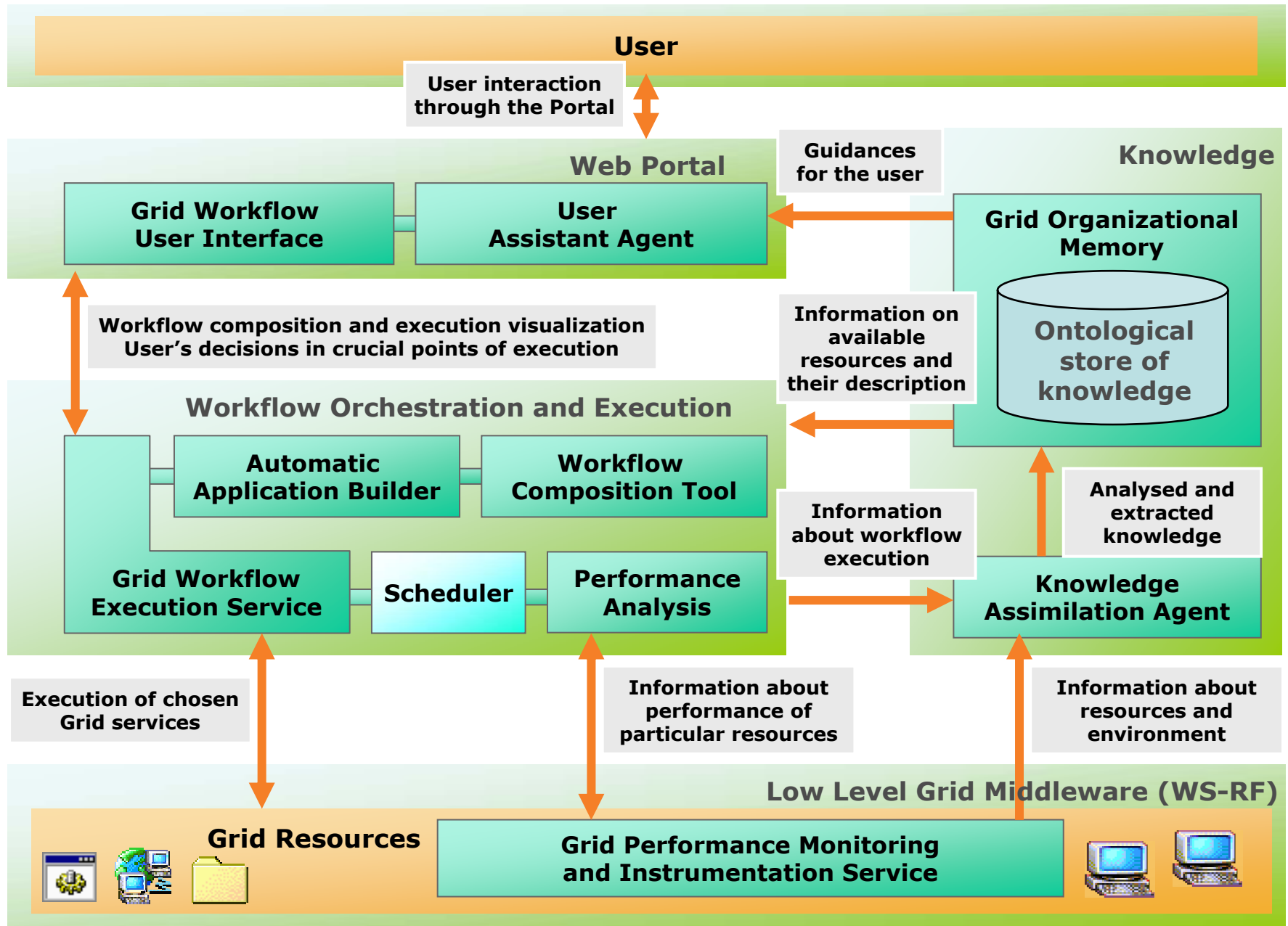


# K-Wf Grid Model



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# Architecture and Flow of Actions



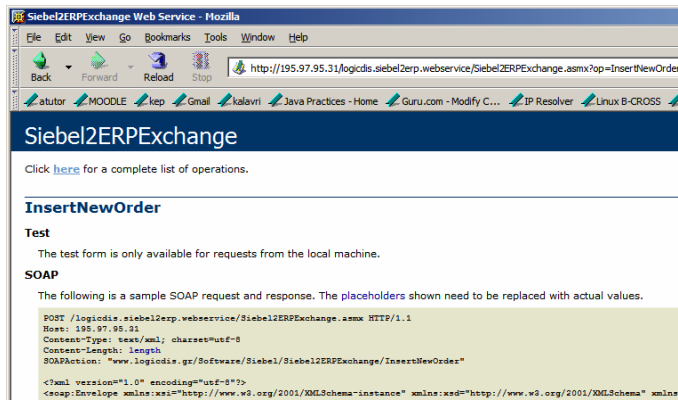
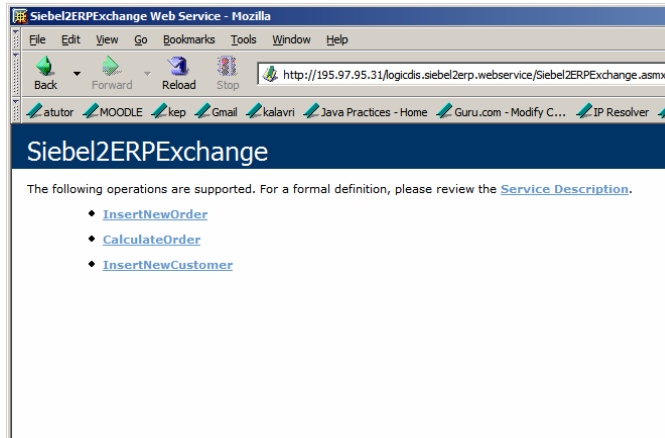
# Pilot Applications



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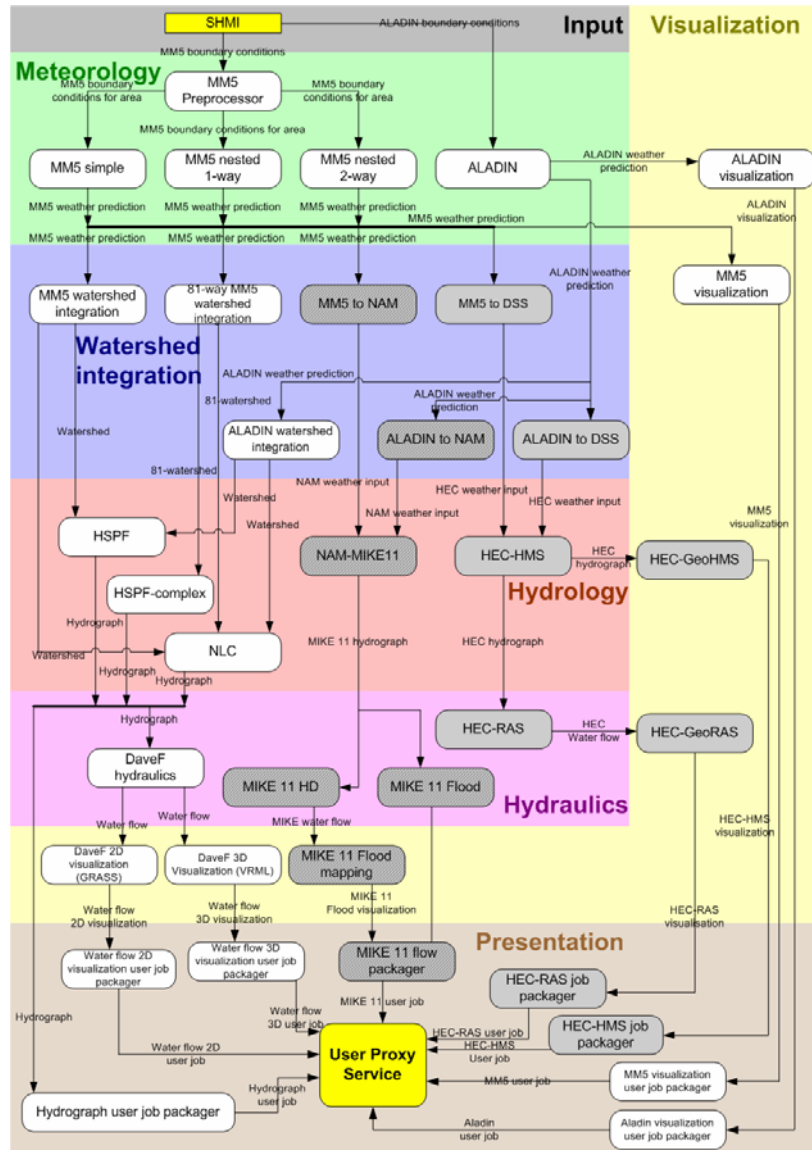
# LogicDIS – Enterprise resource planning



- ERP counting thousands of installations in Greece
- Microsoft technology (SQL Server, COM business logic)
- Three Web Services (MS .NET) Available:
  - Calculate New Order
  - Insert New Order
  - Insert New Customer
- Six additional WS wrappers (J2EE) implemented:
  - User request input through a HTML form
  - Visualization of processing results



# Flood Forecasting Application



- Flood forecasting based on a series of simulations
- Several simulation models for
  - Meteorology
  - Hydrology
  - Hydraulics
- 2D/3D visualization
- Implementation using GT4 WSRF
- Being extended
  - More models
  - More services – towards risk management

# Planned next projects within 5<sup>th</sup> call of 6FP

- EGEE II
- EU-Interactive Grid
- GRISK
- ScodeGrid
- DEGREE
- GENEVA
- GRISYS

Ďakujem za pozornosť

**Vaše otázky?**