



# An approach to monitoring, data analytics, and decision support for levee supervision

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# ISMOP: a computerized levee monitoring system

**Comprehensive research project** on monitoring and assessment of levees which comprises:

- Construction of an artificial levee
- Design and construction of sensors for levee instrumentation
- Design and development of a sensor communication infrastructure
  - Optimal collection and transmission of sensor data
- Levee modeling and simulation
  - Comparison of simulated and real levee behavior
- **Central System:** software platforms for execution management, data management, visualization and decision support



# ISMOP – Consortium

- Department of Computer Science AGH
- Department of Hydrogeology and Engineering Geology AGH
- Department of Geoinformatics and Applied Computer Science AGH
- NeoSentio, Kraków
- Sweco Hydroprojekt Kraków

in collaboration with the Czernichów Community

Project leader: Prof. Krzysztof Zieliński



# ISMOP: target users

Main goal: support the decision-making for

- Flood protection
- Levee maintenance

Target users:

- National and regional flood protection agencies
- Local authorities (levee maintenance)

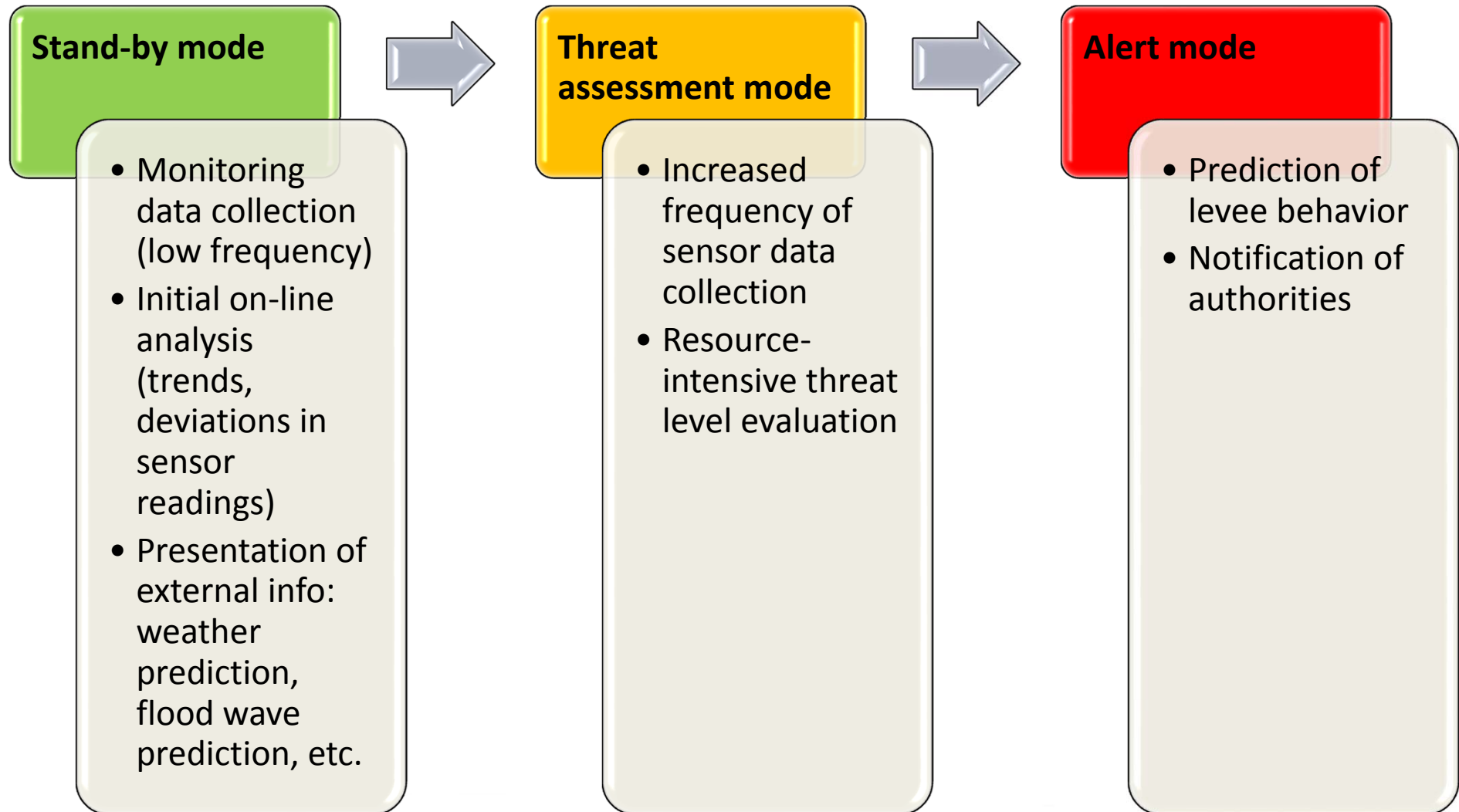


# ISMOP central system

- Visualization & decision support
- Execution management
- Data management



# Monitoring & decision support high-level workflow





# Visualization & decision support: selected challenges

**Interoperability with external systems** (e.g. ISOK, regional flood protection agencies)

- Solution
  - Leveraging open standards (OGC, INSPIRE) for data & metadata models

**Visualization of relevant information** to effectively support the decision making process

- Solution: research in progress...

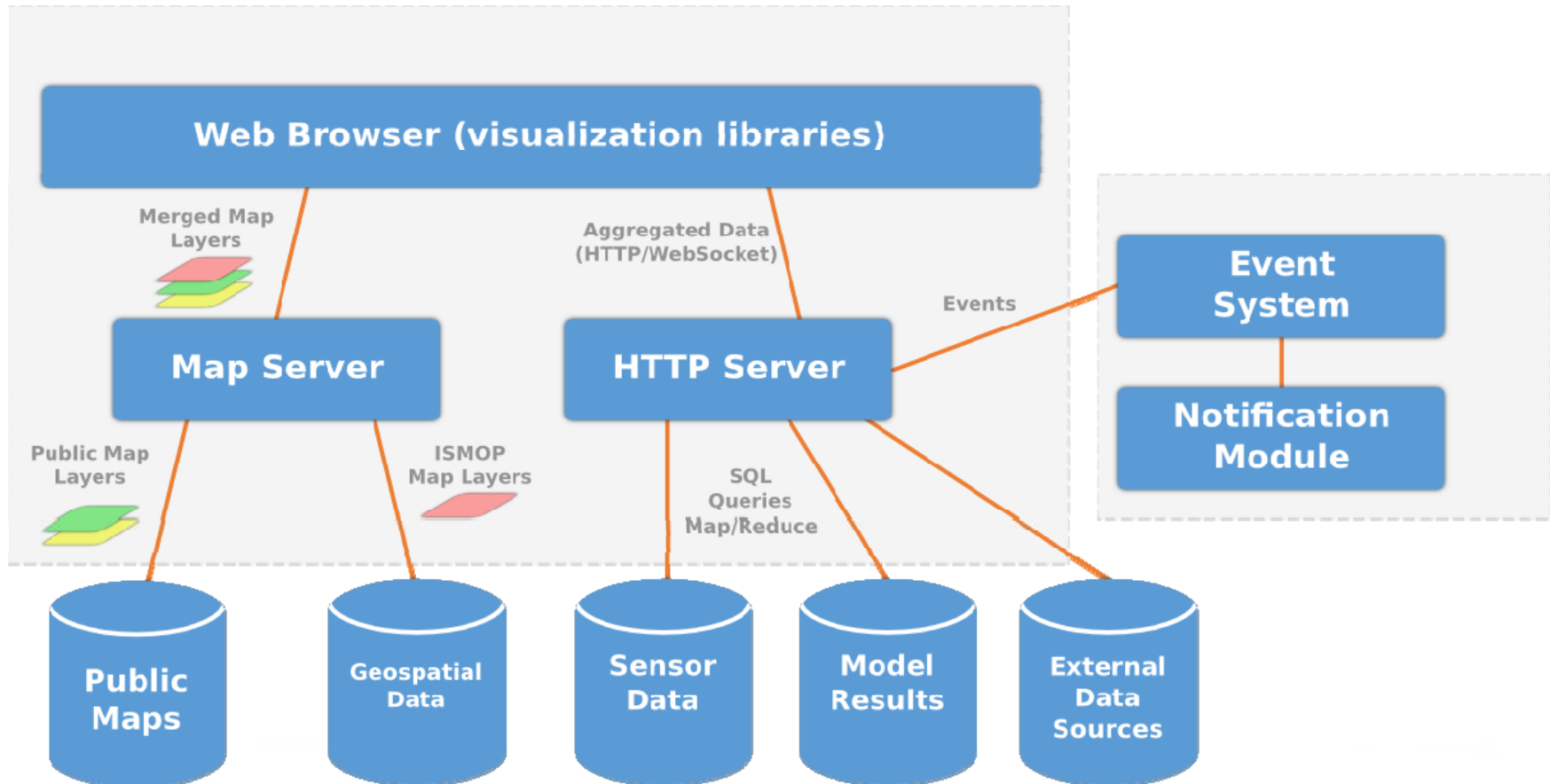
**Adaptability to other domains** (e.g. monitoring of communication infrastructure)

- Solution
  - Open domain-agnostic design (metadata and public APIs design are crucial)



# Visualization & decision support system

Users







# Execution management: selected challenges

**Scale up to 100s-  
1000s kilometers  
of levees**

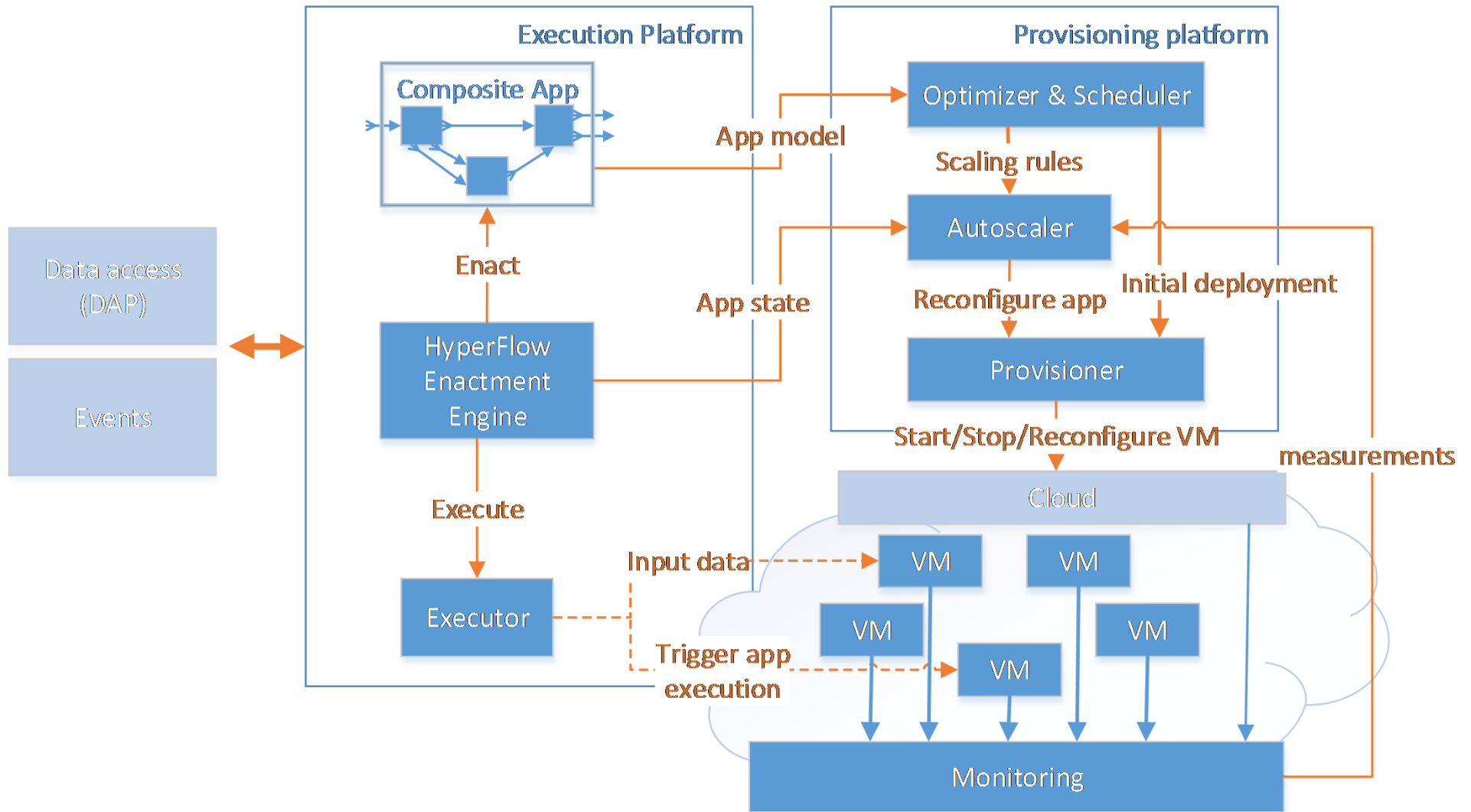
- Solution
  - Monitored area divided into sections
  - Managed by multiple instances of a Monitoring Application, dynamically deployed on-demand

**Highly variable  
resource demands:  
from very low in  
standby mode to  
high in risk  
assessment mode**

- Solution
  - Dynamic provisioning of resources from private or public clouds
  - Autoscaling algorithms and policies



# Execution and Provisioning Platform (EXP)





# Data management: selected challenges

**Diverse data sets**  
(spatial, time series,  
binary, metadata) **and**  
**data usage patterns**

- Solution
  - Multiple data stores and models to address diverse needs

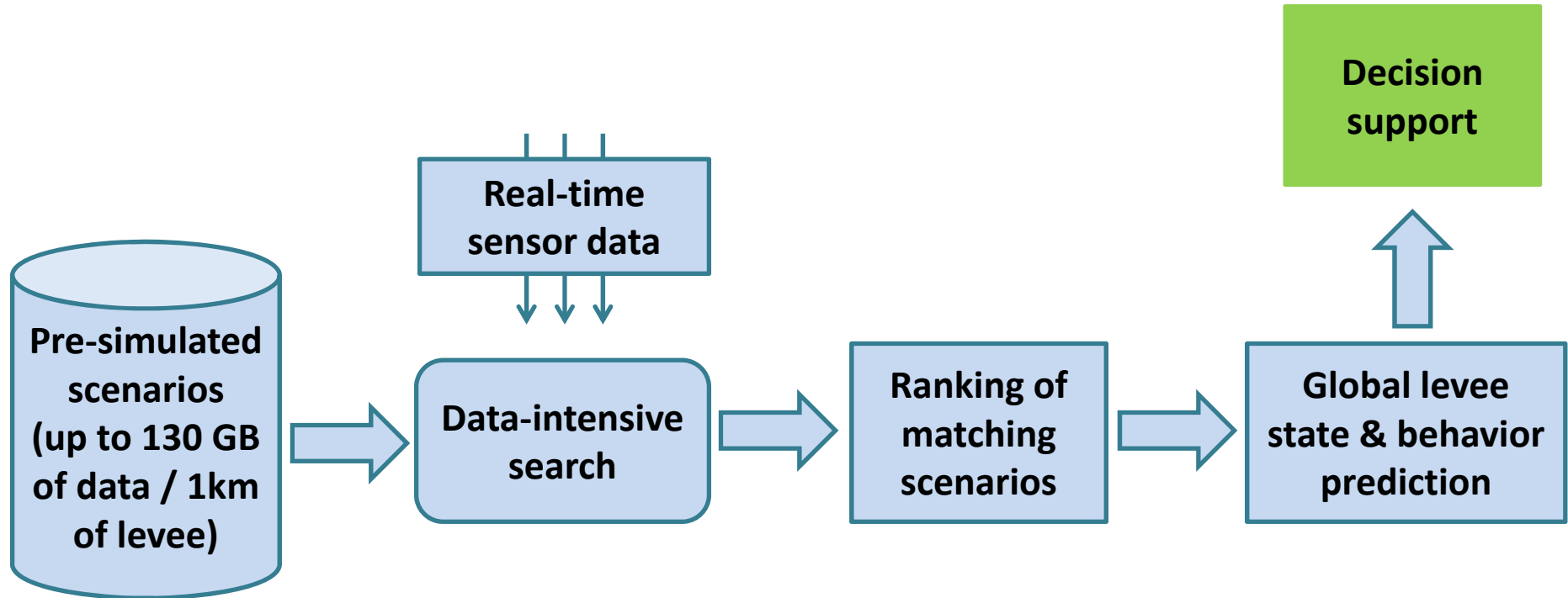
**Data-intensive  
processing**

Threat level evaluation  
scenario: up to 130 GB  
of data to search per  
1km of a levee

- Solution
  - Big data infrastructure
  - Map-Reduce data search

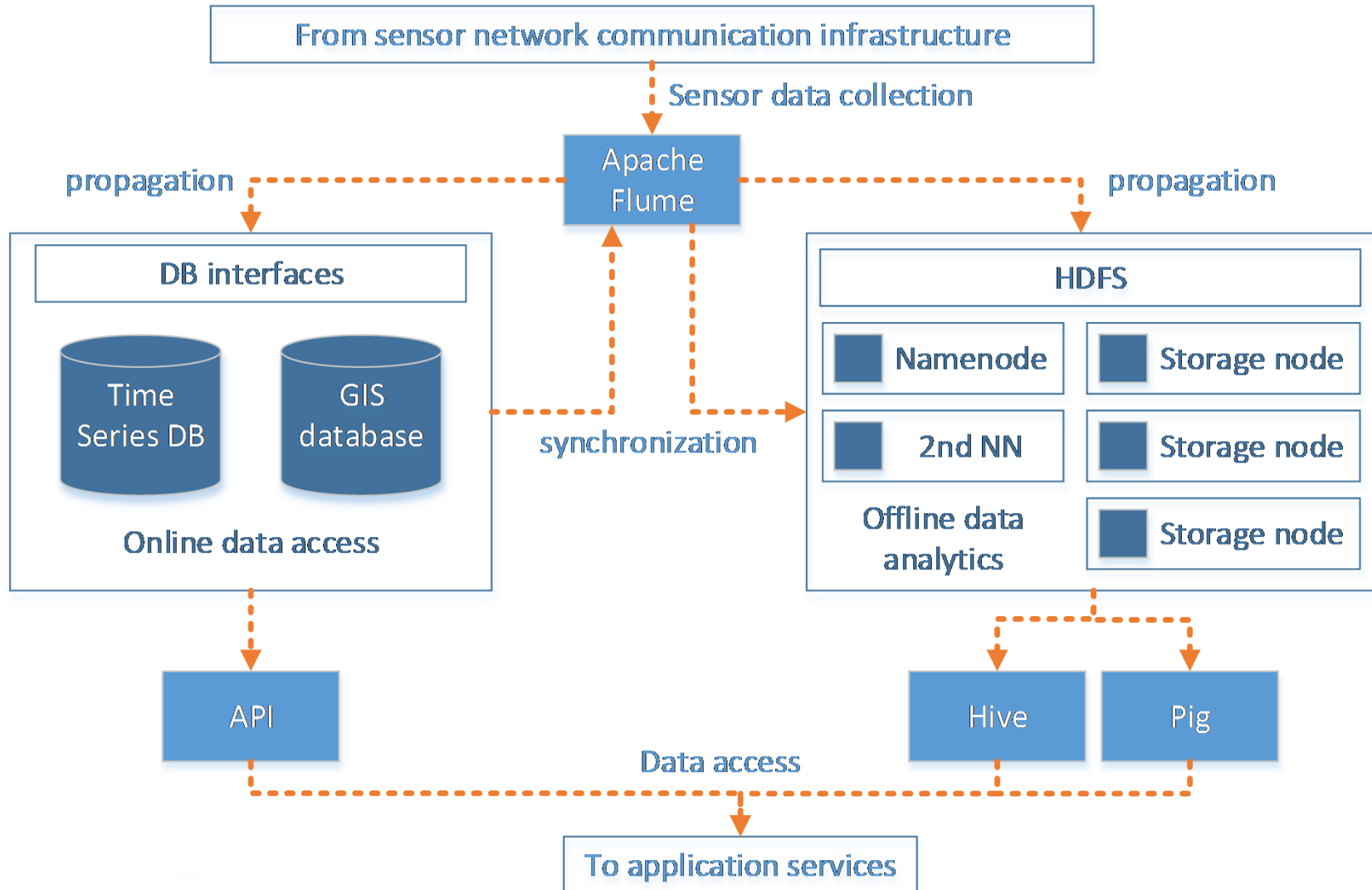


# Example of data-intensive analysis: threat level evaluation



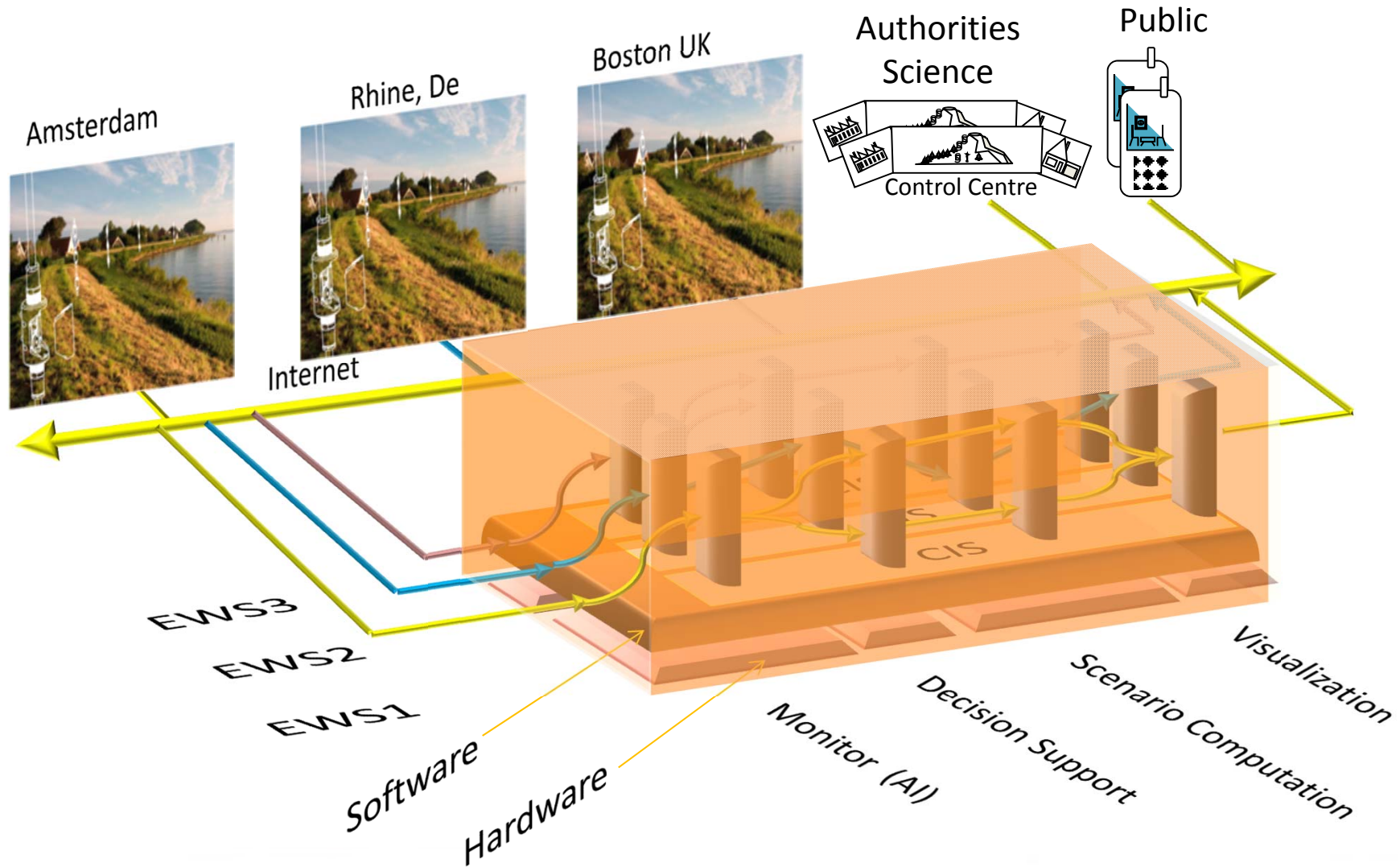


# Data Access & Analytics Platform (DAP)





# Previous experience: **UrbanFlood** – Online Flood Early Warning System





# Conclusion

- ISMOP: comprehensive solution for levee monitoring & decision support
- Currently at the initial stage of research
- ISMOP Central System: visualization & decision support, execution management, data management

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