The exploration of Sensor web technology for highly dynamic geo-processes

Hydrological events as example

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Motto of Aschbacher (2003), of Beven (2007)

" (Earth) space-derived information generally needs to be combined with *in-situ measurements* and *models* to obtain a holistic picture of the Earth's environment. There is no Sustainable Development *without* adequate information about the state of the Earth and its environment."

" It is the improvement of the *representation of sites and boundary conditions* that will be critical in the development of a *new generation of environmental models* that are geared towards the management of specific places, *rather than* general process representations."

Contents presentation:

- Hydrological events
- Water management issues
- Sensor Web
- Sensor types needed
- In-situ sensors
- Matching
- What is going on nowadays
- Research questions
- Conclusions

Where do we talk about?

Water excess on a meadow;

Source: Water Board WV

Water excess on streets in a city;

Source: Water Forum

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Hydrological events (I)

Characteristics:

- Important topic all over the world
- Will become even more important due to climate change with heavier rain showers and due to higher claims by both water managers and the public
- Are highly dynamic and spatial versatile by nature; uncertainty in occurence: where and when do they occur, and how severe? How will they develop in time and space?

Hydrological events (II)

- As a consequence: events are difficult to monitor and the possibility of modelling events both in time and space is limited
- It is expected that Sensor web will fulfill these requirements
- Problem is not the lack of knowledge of the hydrological processes themselves but the lack of data: amount, time, location and coordination

Water management issues

With:

- Both location as time specific data
- High data amounts
- Data about large areas

Improvements of operational water management by means of a Sensor web would become possible:

- Predict water excess
- Adaptive management
- Offer public warnings

Sensor web

What are its necessary characteristics?

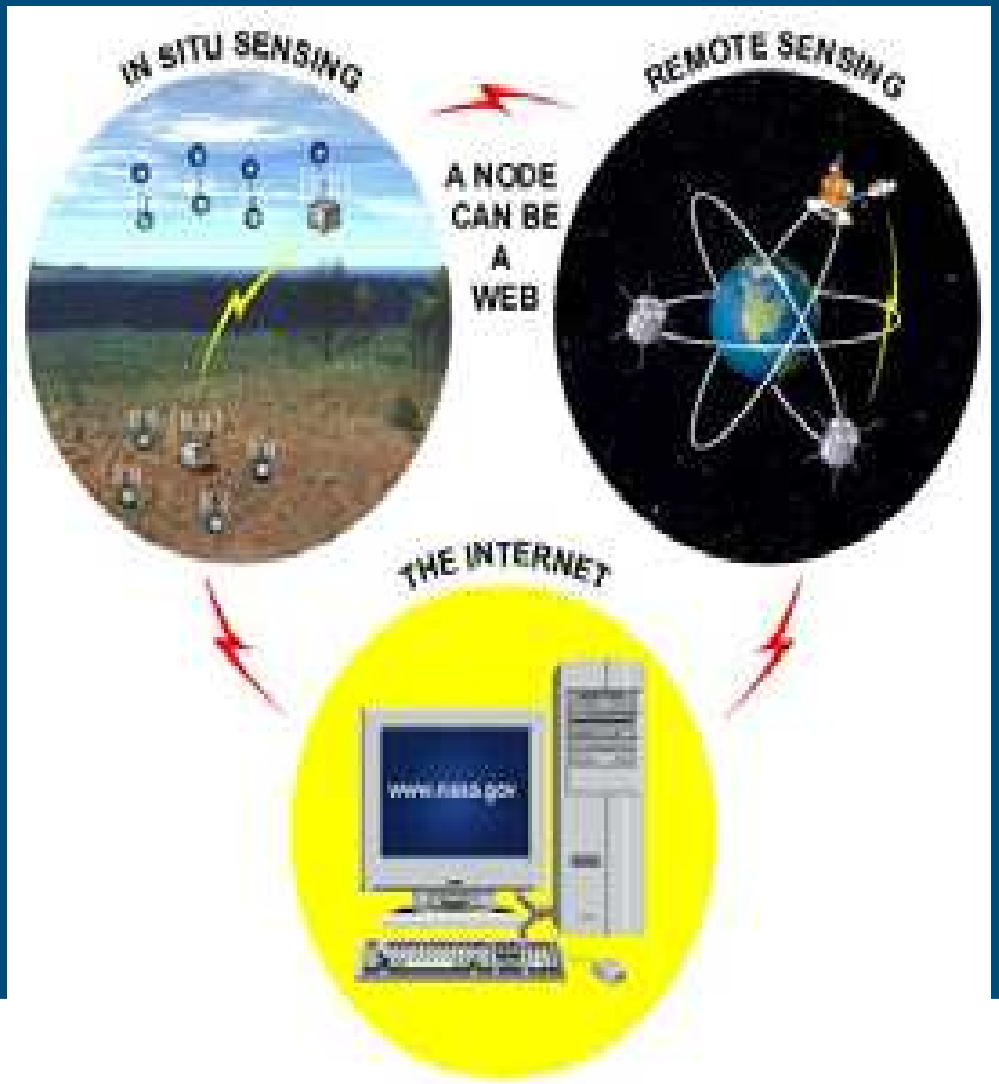
- real-time acquisition of measurements
- multi-sensor acquisition of measurements
- measuring in high spatial densities and at high frequencies
- remote access and control
- possibilities of feedback between Sensor web and model

Sensor types needed

- Remote sensors:
  - large areal coverage
  - remote measurements
- In-situ sensors:
  - high spatial density
  - high temporal resolution
  - cheap deployment

Source:
Delin et al.,
2005.

Generalized concept of Sensor web, incl. both in-situ and remote sensors: Integrated Sensing



Source:

Delin et al., 2005

In-situ sensors (I)

Properties:

- limited area coverage
- continual presence
- instant response time
- high temporal resolution
- cheap hardware/deployment
- dense spatial coverage

In-situ sensors (II)

Functions:

- continuous and real-time data at specific locations;
- reference data for satellite-based retrievals
- (on-line) calibration data for model parameter assessments (and relations between parameters)
- (on-line) validation data for modelling processes on earth

Matching

Processes with:

*high dynamics

*spatial variability

Spatial-temporal monitoring and action or control

Sensor web with:

*in-situ sensors:
high spatial density,
high temporal resolution

*remote sensors:
large areal coverage

What is going on nowadays? (I)

- Study the potential of flood monitoring (Delin et al., California)
- Flashy flood monitoring (Moe, Nasa):
  - Rain gauge input in forecasting potential flood conditions
  - Flood forecast model triggers the EO-1 tasking event
- Early warning flood systems based on wireless sensor networks (Rus and Basha, Massachusetts; Walkowski, Münster)

What is going on nowadays? (II)

- Rainfall measurement by use of communication networks (Leijnse et al., Wageningen)
- Future directions: event management (Murray, Southampton), node to node data fusion (Delin et al., California)

Central research question

How to explore the potentials of a Sensor web to study hydrological events in order to improve

- their understanding
- their forecasting
- their impacts on operational water management?

Sub-questions

- How can we monitor wet events with in-situ sensing by means of a Sensor web?
- How can we combine RS data with in-situ data and obtain more reliable area representative data?
- How can we use monitoring data to improve the quality of the forecasts of wet events?
- How can we change operational water management in order to adapt or even to anticipate to wet events with better models and with more reliable data?

Conclusions

- The lack of data limits up till now the progress in monitoring and modeling hydrological events; Sensor web might overcome this lack of data
- Application of a Sensor web stresses the concept of Beven (2007): The collection of in-situ data or site-specific observations is an essential source of information
- Sensor web as new monitoring technology must acquire and integrate those data so that they fulfil user's demands
- End user, its management strategy and the associated costs determine the eventual utilities of a Sensor web

Thank you for your contribution!

- Suggestions?
- Questions?
- Remarks?

The end

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