WeSenseIt: Sensor Data

Sensors, Citizens, Information and Models

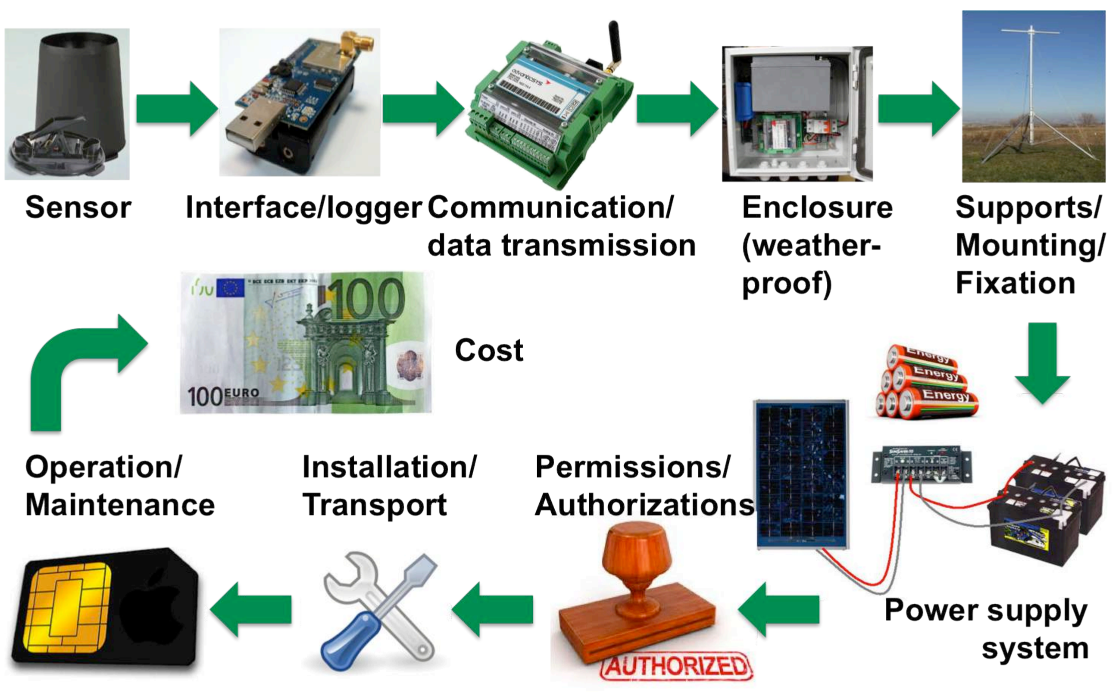
Sensing for Citizens' Observatories: selected examples

Objective:

Collection of physical and social data including:

1. Development of new / innovative sensors
2. Adapting / optimising existing sensors for use in citizen observatories
3. Large-scale data extraction from social networks (crowd sourcing)
4. In-vivo evaluation of physical/social sensors (IT, NL, UK)
5. Cost reduction for sensing technology & commercial dissemination (SMEs)

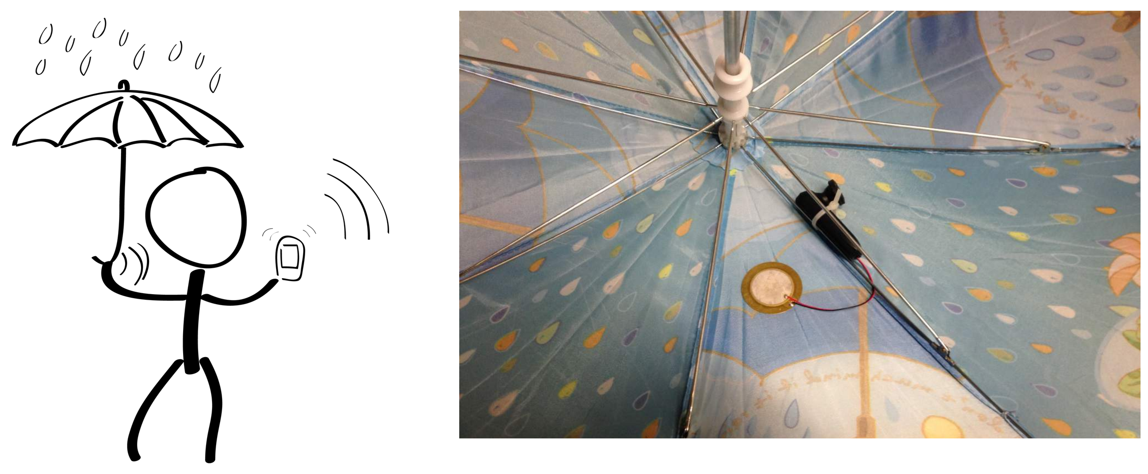
Data in a Server – the WeSenseIt definition of a CO sensor:



QR code based systems: water level and snow depth

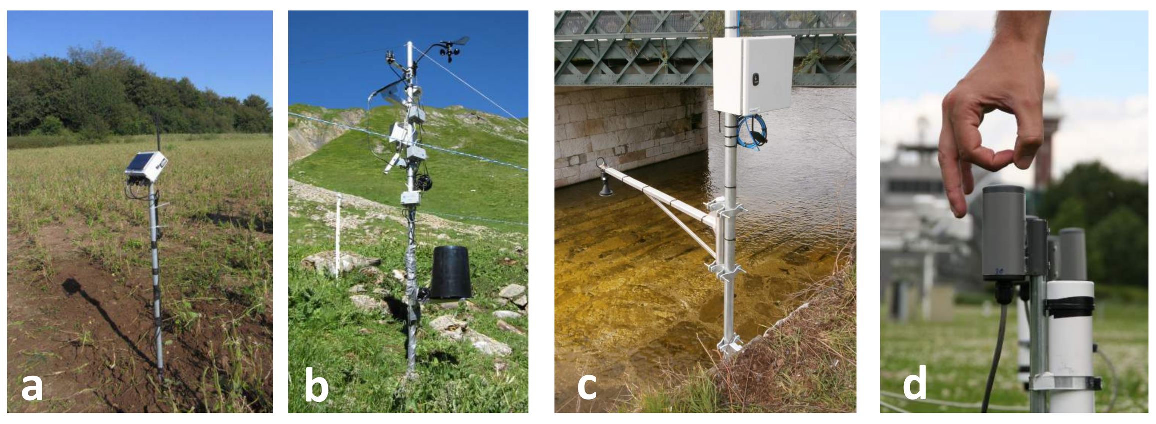
Panels instruct citizens who use their smartphone and the WeSenseIt App and send measurements and/or photos, reports etc.

Rain sensing umbrella



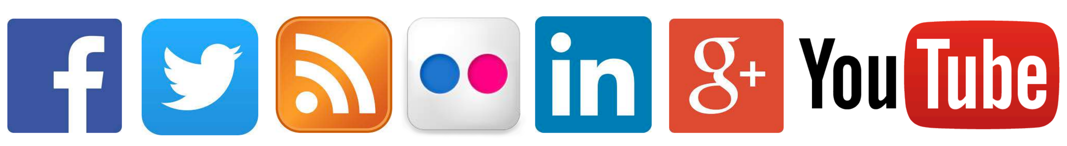
Acoustic rain sensor (piezo element) integrated in umbrella tissue, data transmission by Bluetooth to iPhone, then data push to server.

Autonomous wireless sensor networks



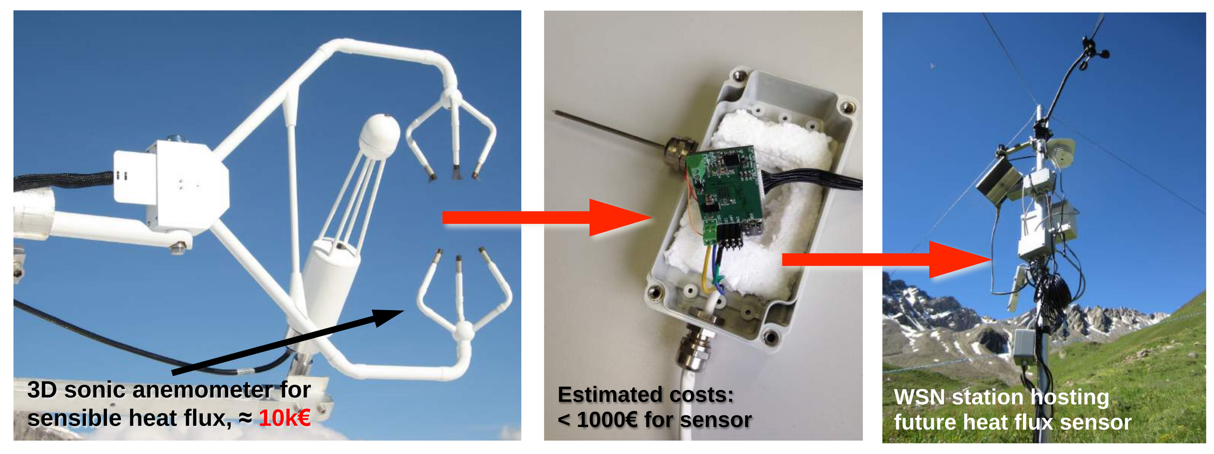
(a) Soil moisture and soil temperature, (b) wind speed and direction, air and surface temperature, air humidity, solar radiation, soil moisture, rain fall, (c) water level, (d) rain fall (with novel disdrometer).

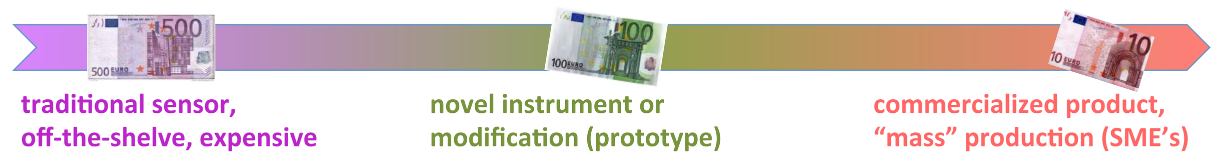
Information extraction from social media: crowd sourcing



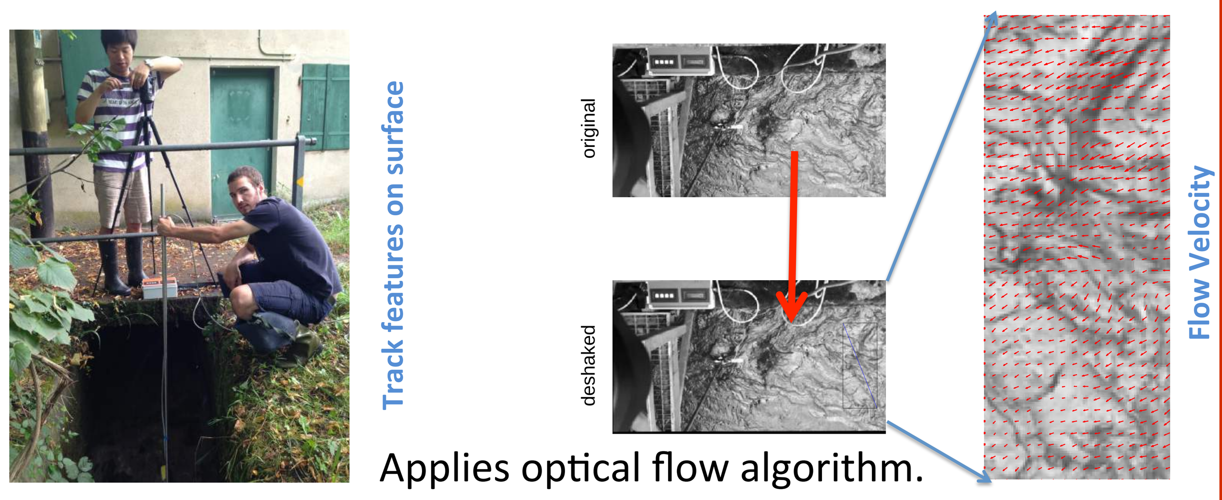
Large scale and efficient extraction of information based on keywords and locations (geo-referenced). Details, method, and results below.

Cost reduction in environmental sensing technology: heat flux



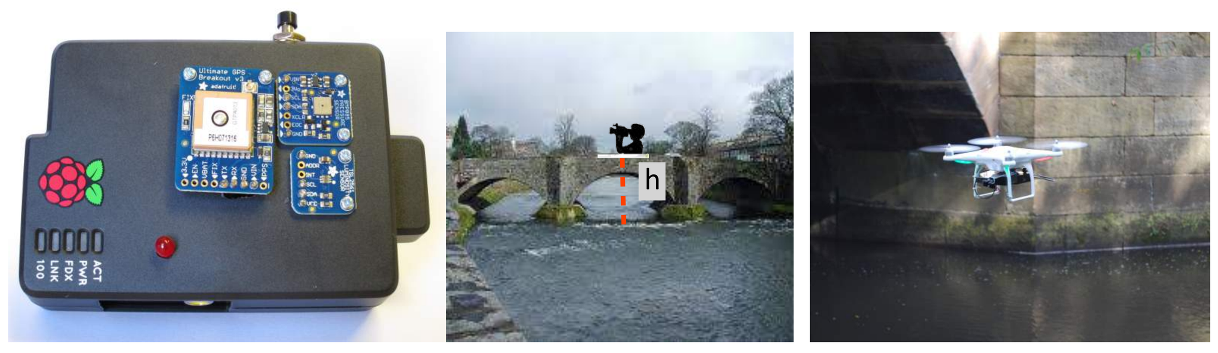


Stream flow velocity from smartphone video clips



Applies optical flow algorithm.

Pi-Box: a new low-cost citizen sensor

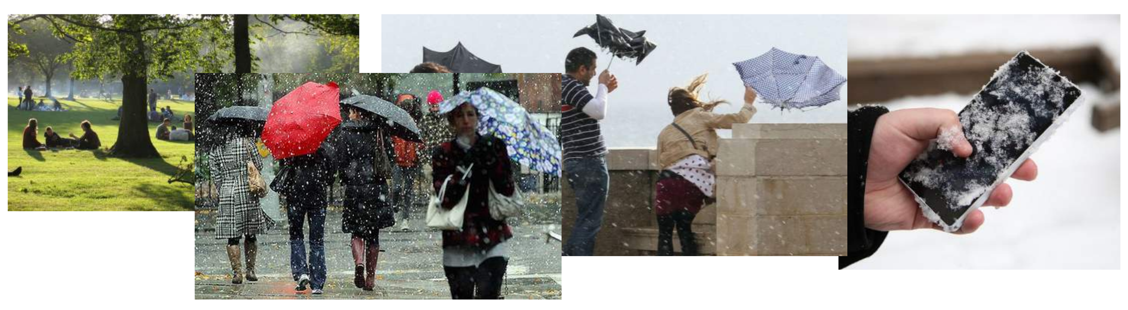


- Measures flow velocity tracking a floating object.
- Intended for flood wardens, authorities and motivated citizens.
- Potential use on a drone in hazardous and inaccessible terrain.

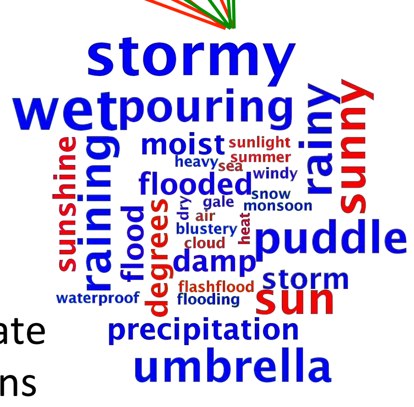
From Citizens' Observatories to Networks to Water Models

From Social Sensors to Physical Observations

People discuss their experience on social media.

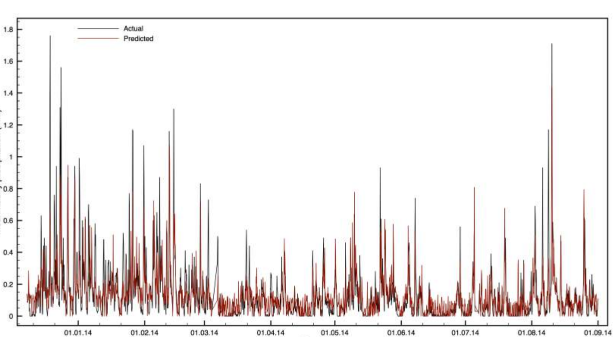


The TRIDS framework is used to captured relevant social media messages. From which hydrological and related information is extracted.



A predictive model is generated to estimate physical observations from the correlations with (textual) social signals.

The predictive performance is dependent on the type of observation and the required spatiotemporal accuracy.



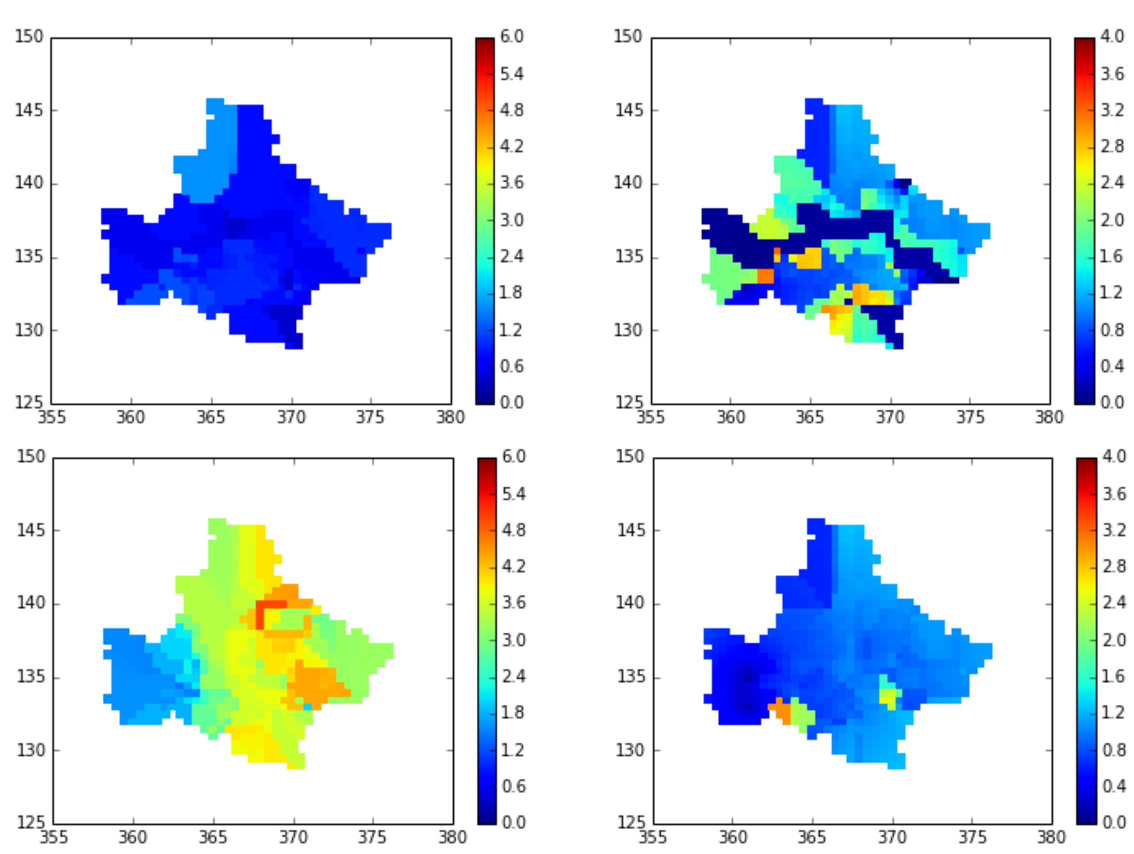
	Daily				Hourly	
	Linear Regression		Support Vector Regression		Linear Regression	
	Train	10-fold	Train	10-fold	Train	10-fold
Temperature	0.99	0.92	0.99	0.93	0.87	0.86
Sunshine	0.97	0.82	0.96	0.86	0.81	0.80
Precipitation	0.98	0.78	0.97	0.86	0.75	0.73
Wind	0.97	0.81	0.96	0.83	0.76	0.75
Humidity	0.95	0.67	0.94	0.70	0.78	0.77
Snow	0.78	0.12	0.71	0.27	0.23	0.15

Heterogeneous sensor network optimisation

Optimisation of heterogeneous networks aims to exploit the benefits of using different sensing techniques for environmental variables, boosting its interoperability, complementing each other weaknesses.

Characteristics	Remote sensors	Conventional Gauges	Dynamic Sensors	Citizens Observations
Spatial resolution	Distributed	Fixed point	Dynamic point	Dynamic point
Temporal resolution	High	High	On demand	Unpredictable
Accuracy	Mid	High	High	Low
Availability	Mid	Mid	low	High

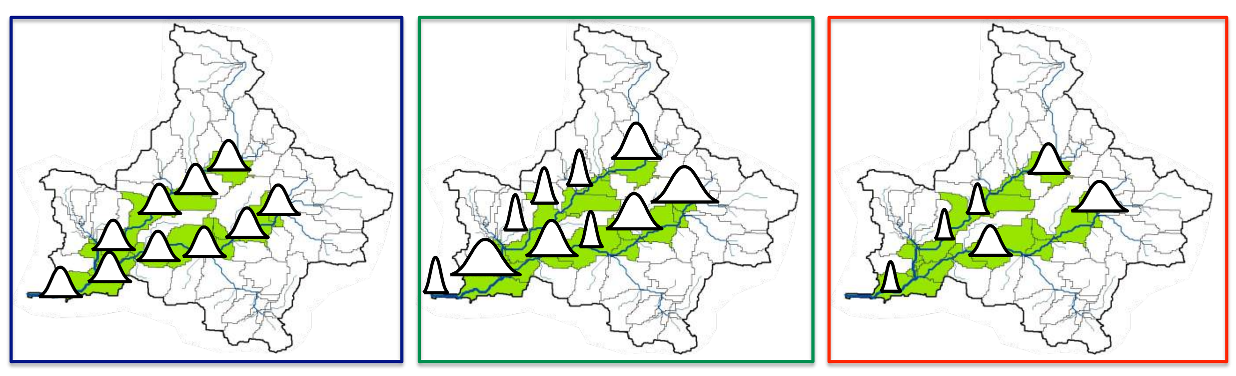
Under different precipitation intensities (high / low – shown on left), lack of information varies (shown on right). This lack of information drives the optimal heterogeneous sensor network design, considering that the contribution of information by each sensor has particular characteristics.

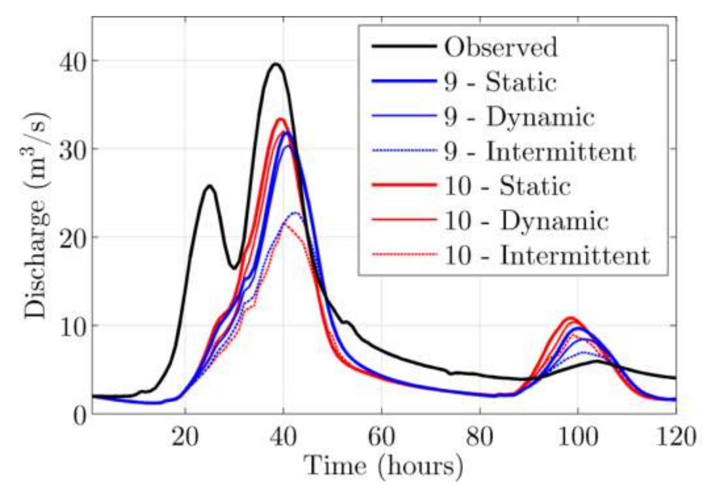


Incorporate heterogeneous, uncertain data into models

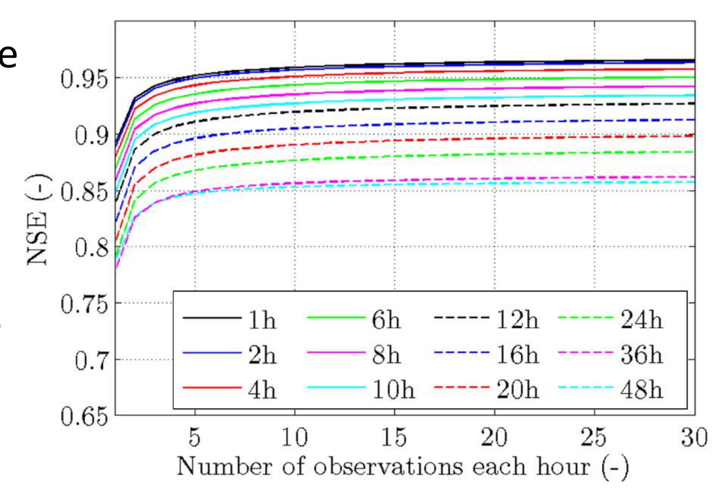
Incorporation of biased, uncertain and incomplete information is the key in the use of citizen's observatories information into hydrological operational forecasting models. The idea consists not in disregarding poor quality information, but to use it in awareness of its quality.

Experiments carried out in hypothetical conditions reveal that this approach is feasible, and may provide more accurate forecasts in the case of flood forecasting. **Static**, **dynamic** and **intermittent** sensors were tested.





In common practice streamflow observations are assumed available (or intermittent) at each model time step, usually 1 hour. However, in case of social sensors, these observations might arrive at any random moment different than the model time step.



To find out more about the WeSenseIt project, visit http://wesenseit.eu or contact the Project Coordinator: Prof. Fabio Ciravegna (f.ciravegna@sheffield.ac.uk), Department of Computer Science, University of Sheffield, Regent Court, 211 Portobello, Sheffield, S1 4DP, UK.
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