Flood mapping and soil moisture retrieval for improved water management

NIKO VERHOEST, HANS LIEVENS
Ghent University

LUCIEN HOFFMANN, PATRICK MATGEN
Centre de Recherche Public
Gabriel Lippmann

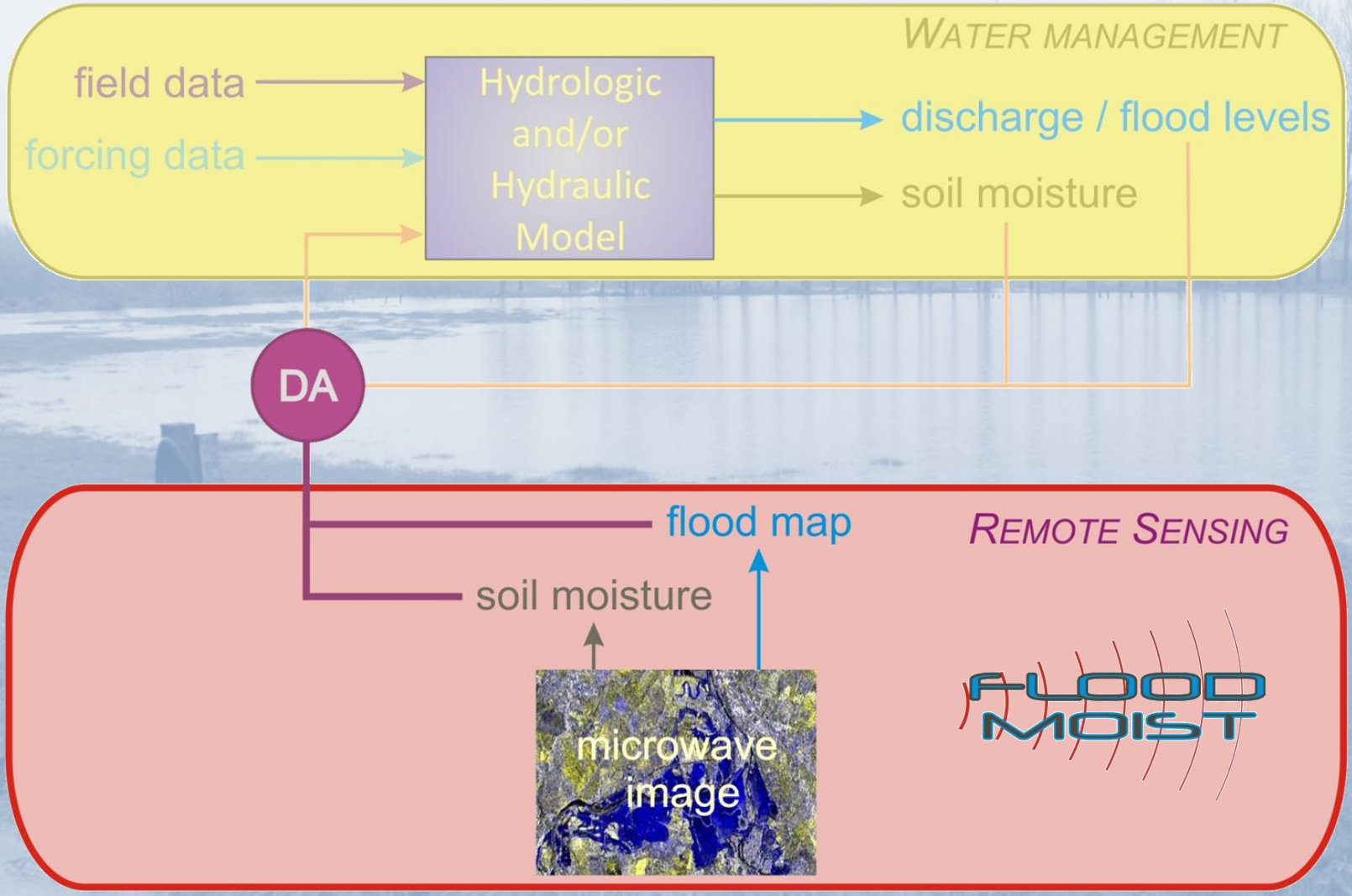
PAUL BATES
University of Bristol

Remote Sensing and Water Management

"... SAR data ... can be used in two important ways for flood monitoring. Firstly, the data can be used to continuously monitor how much water is stored in the soil as this determines the amount of runoff resulting from rain and secondly, by observing inundated areas during a flood because radar can penetrate through clouds and even rain."

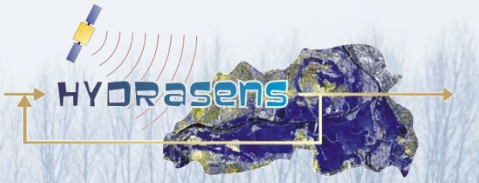
prof. Wolfgang Wagner
TU Wien

Remote Sensing and Water Management



SPIN-OFF OF HYDRASENS

HYDRASENS

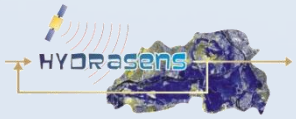


- 3 main themes:
  - SAR-remote sensing of soil moisture and flooding
  - High-resolution soil moisture using GPR
  - Data-assimilation in hydrologic and hydraulic models

- Open research questions identified:
  - Use of coarse scale remote sensing for soil moisture retrieval
  - Use of uncertainty in flood mapping
  - Joint assimilation of soil moisture and flooding in a coupled hydrologic-hydraulic model

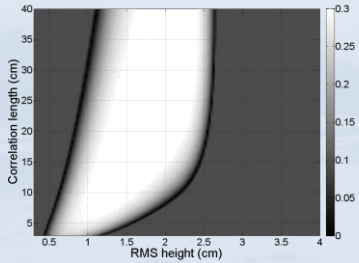
OBJECTIVES OF THE PROJECT

Objective 1: Retrieve soil moisture from microwave remote sensing

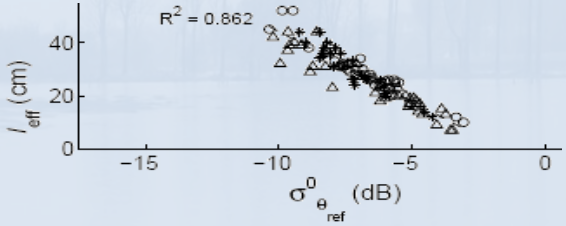


Problem: Roughness parameters measurements: prone to errors

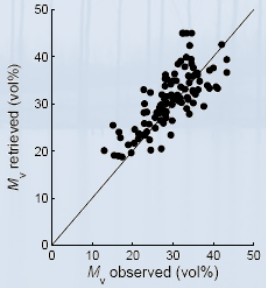
Solution: Method of effective roughness parameters



1. calibrate roughness



2. model roughness parameter



3. retrieve soil moisture

630 IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL. 6, NO. 4, OCTOBER 2009

Parameterization of the Land Parameter Retrieval Model for L-Band Observations Using the NAFE'05 Data Set

Richard A. M. de Jeu, *Member, IEEE*, Thomas R. H. Holmes, Rocco Panciera, and Jeffrey P. Walker

Abstract—The Land Parameter Retrieval Model (LPRM) has been successfully applied to retrieve soil moisture from space-borne passive microwave observations at C-, X-, or Ku-band and high incidence angles (50°–55°). However, LPRM had never

Consequently, they designed an experiment to estimate soil moisture from aircraft observations with L-, Ku-, and Ka-band microwave radiometers. They discovered the strongest rela-

describes the parameterization and performance of LPRM using aircraft and ground data from the National Airborne Field Experiment 2005. This experiment was undertaken in November 2005 in the Goulburn River catchment, which is located in southeastern Australia. It was found that model convergence could only be achieved with a temporally dynamic roughness. The roughness was parameterized according to incidence angle and soil moisture. These findings were integrated in LPRM, resulting in one uniform parameterization for all sites. The parameterized LPRM correlated well with field observations at 5-cm depth ($r = 0.93$

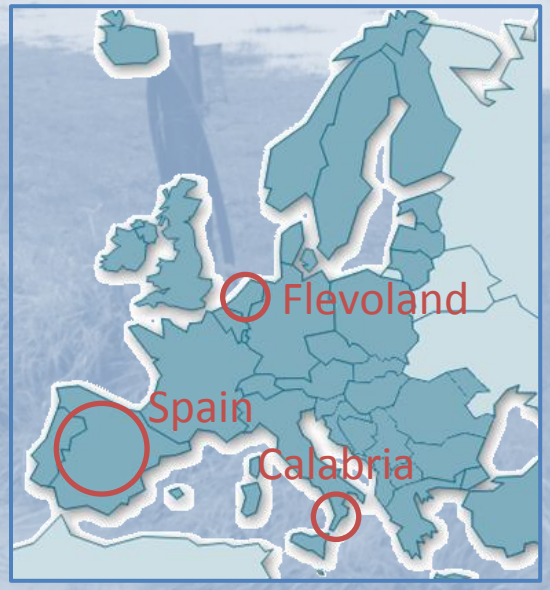
Use effective roughness parameter for soil moisture retrieval from radiometry?

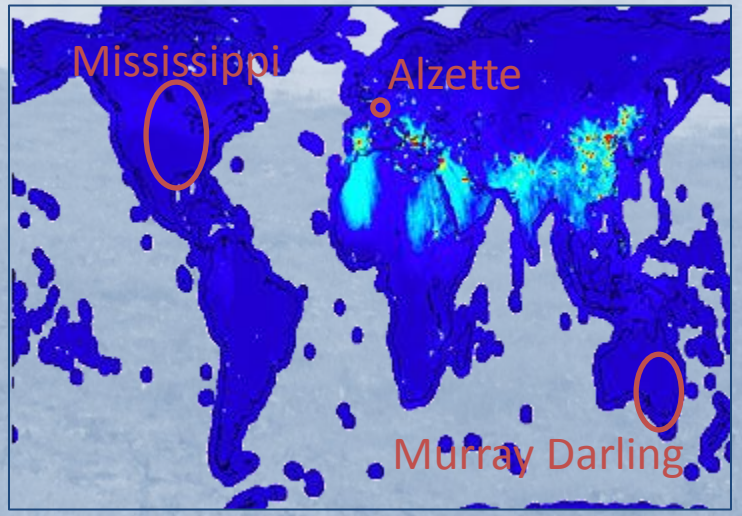
Objectives of the project

Objective 1: Retrieve soil moisture from microwave remote sensing

Science questions:

1. How robust is method of effective roughness parameters for SAR?
2. Is a similar retrieval approach valid for radiometer data (SMOS)?

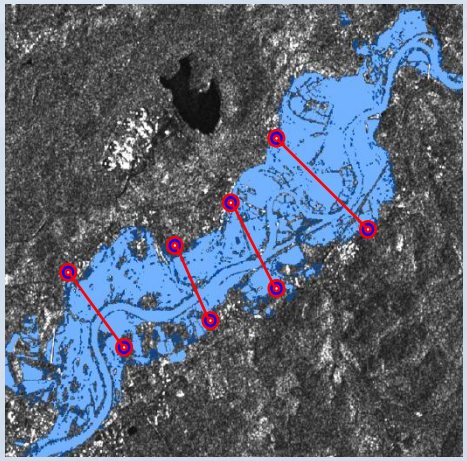


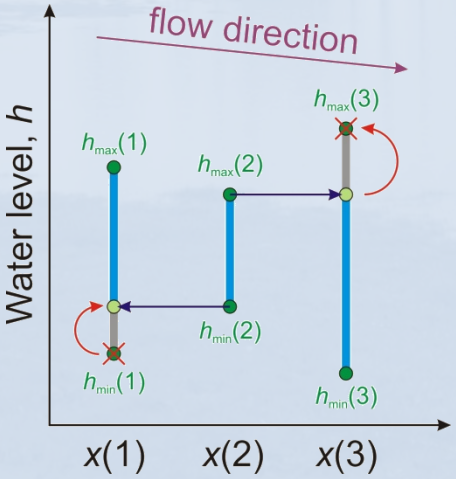


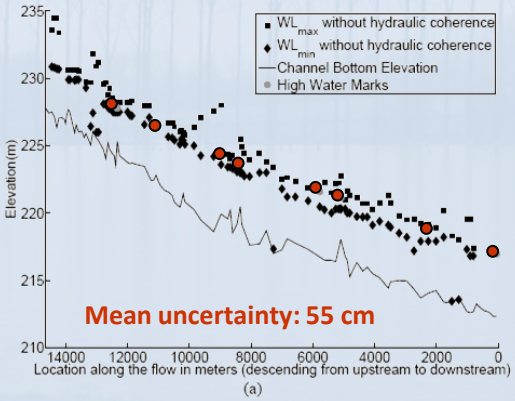
Objective 2: Include uncertainty in flood mapping from SAR

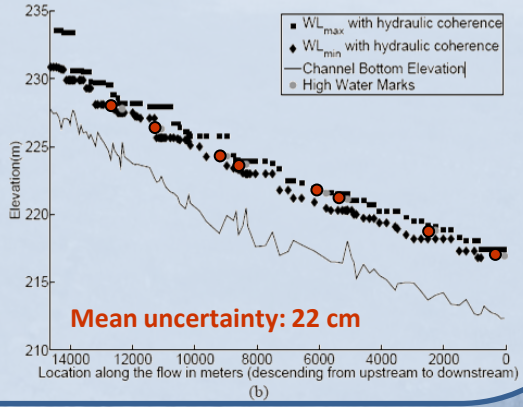
Problem: Floodplain delineation prone to errors and uncertainty

Solution: 1. Make use of DEM





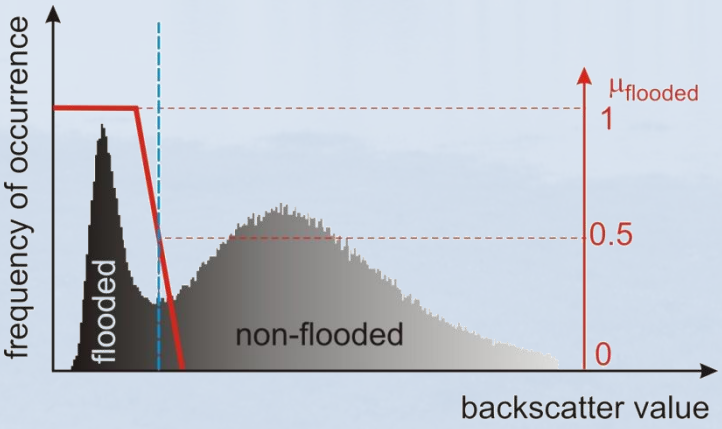


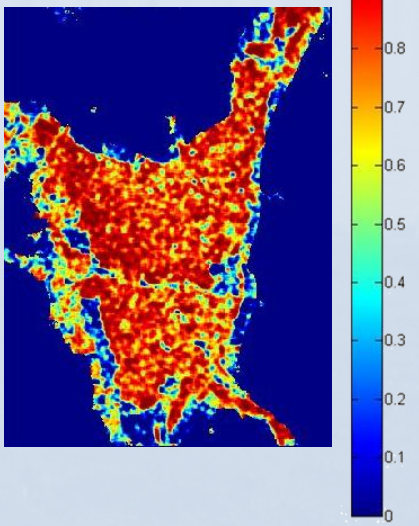


Objectives of the project

Objective 2: Include uncertainty in flood mapping from SAR

Problem: Floodplain delineation prone to errors and uncertainty
Solution: 2. Produce 'fuzzy' flood maps

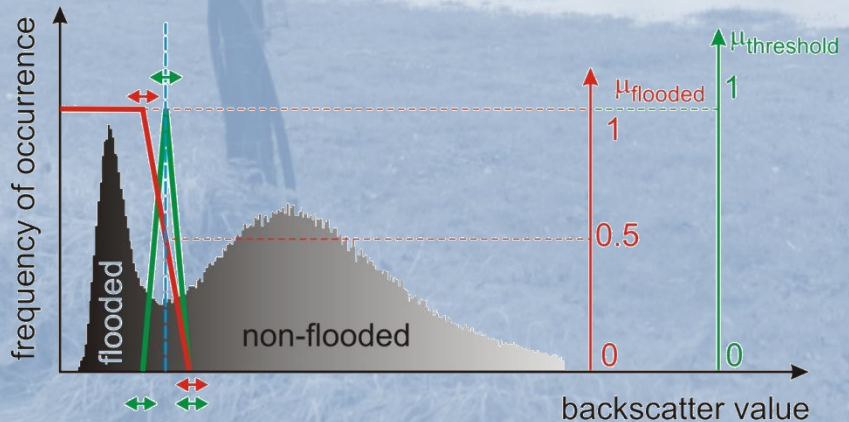


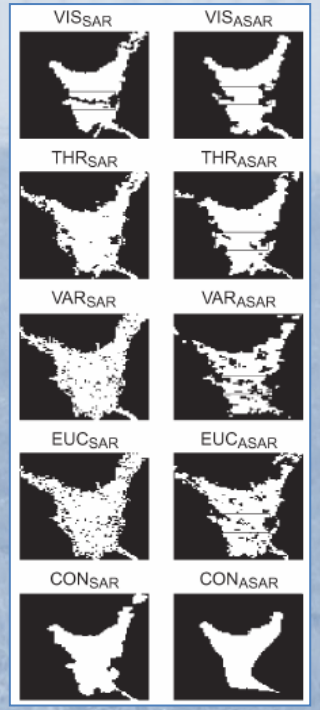


Objective 2: Include uncertainty in flood mapping from SAR

Science questions:

1. How to estimate uncertainty in a SAR-based flood map/flood edge height map?
2. How to merge flood maps from different algorithms?
3. How to fuse uncertain remote sensing-derived flood edges with a DEM?



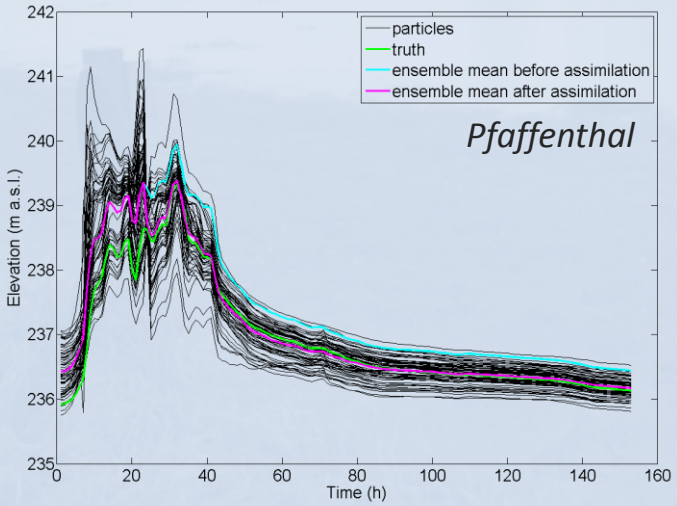


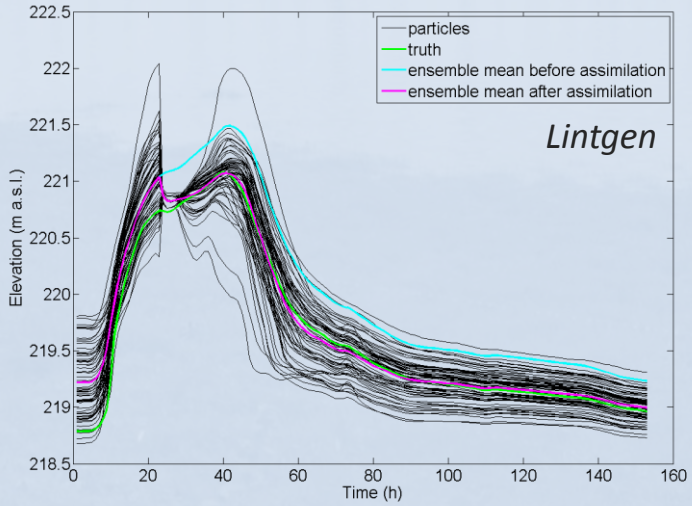
OBJECTIVES OF THE PROJECT

Objective 3: Joint assimilation of the remote sensing products

Problem: use remotely sensed soil moisture and flood maps for updating hydrologic and hydraulic modelling

Solution: 1. development of coupled hydrologic-hydraulic model
2. development of particle filter-based data assimilation scheme



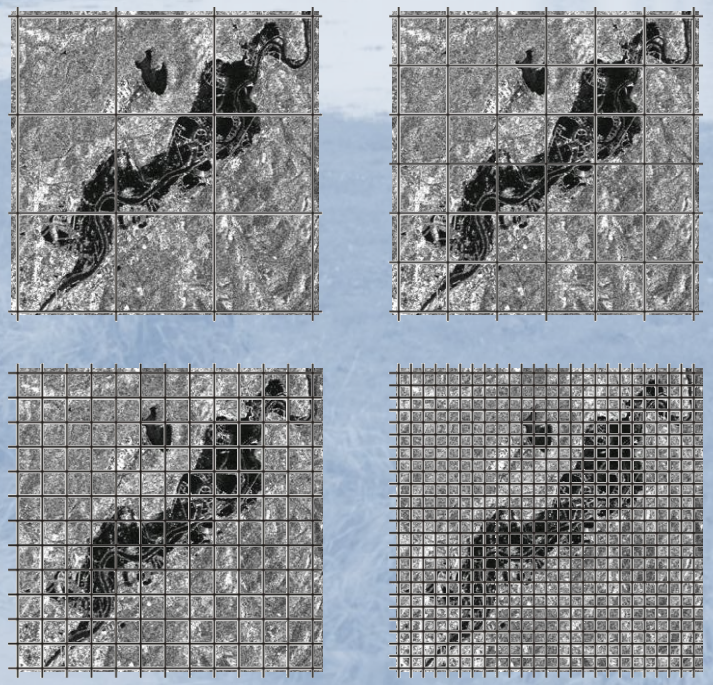


Objectives of the project

Objective 3: Joint assimilation of the remote sensing products

Science questions:

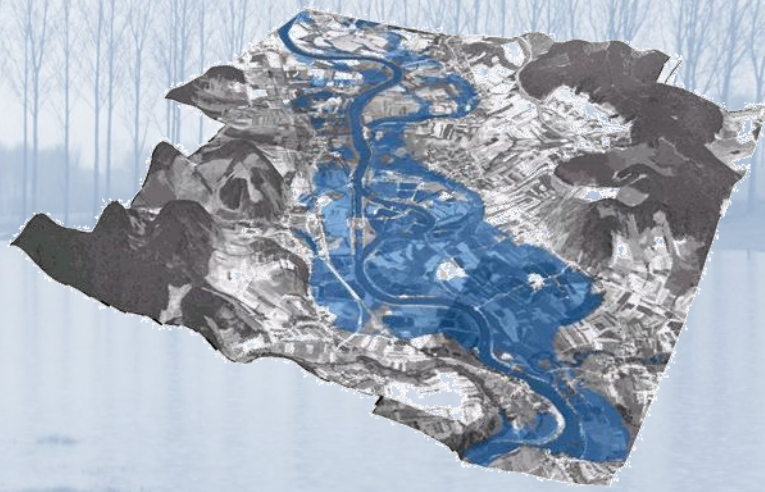
1. How to optimize the assimilation if observations and model have different scale?
2. How to account for uncertain water elevation measurements in a hydraulic model?
3. How to jointly assimilate soil moisture and water elevation?



TEST SITES AND DATA AVAILABILITY

Alzette River Basin (Luxembourg)

In situ datasets
soil moisture
flood maps and stages
LiDAR data



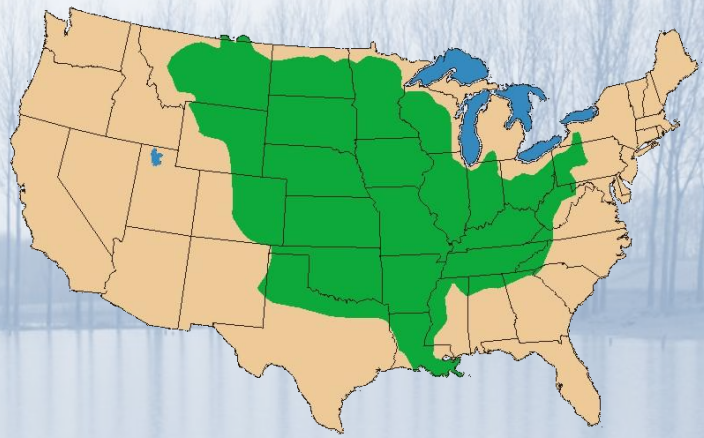
Remote sensing datasets
ENVISAT, RADARSAT,
TerraSAR-X, SMOS, …

Hydrologic and hydraulic models
CLM, HEC-RAS, LISFLOOD-FP, …

Data assimilation schemes
EnKF, particle filter

TEST SITES AND DATA AVAILABILITY

Mississippi and Murray-Darling basin



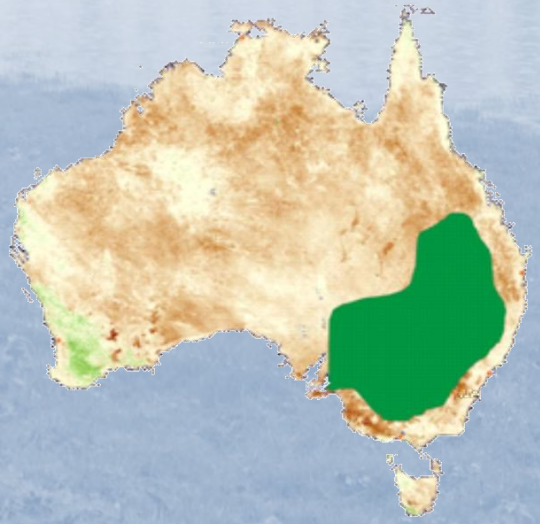
In situ datasets

soil moisture

flood maps and stages

Remote sensing datasets

SMOS



Hydrologic model

VIC, …

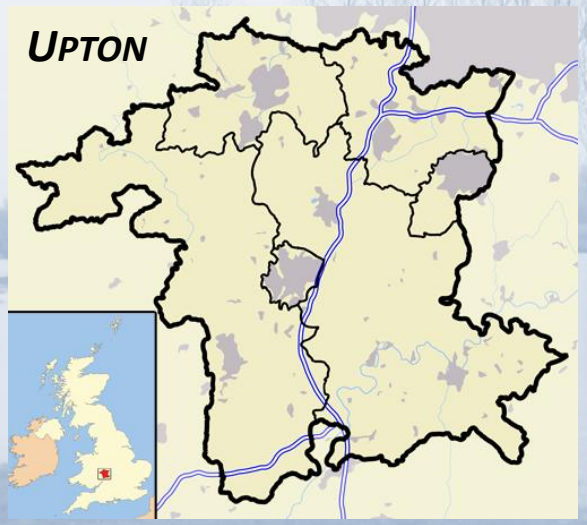
Data assimilation scheme

EnKF

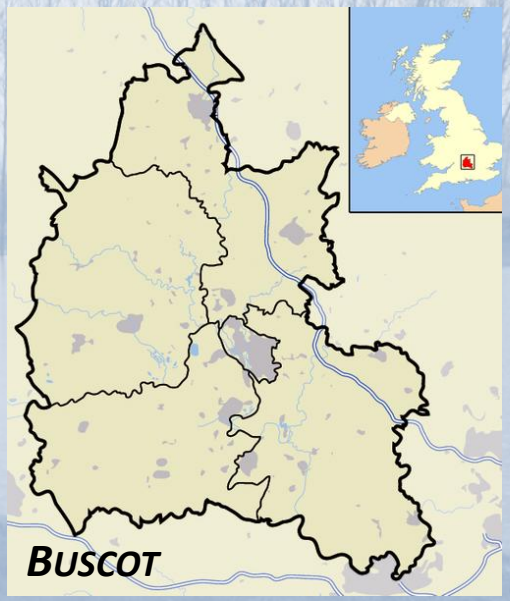
TEST SITES AND DATA AVAILABILITY

Tewkesbury, Upton and Buscot (UK)

River Severn



River Severn

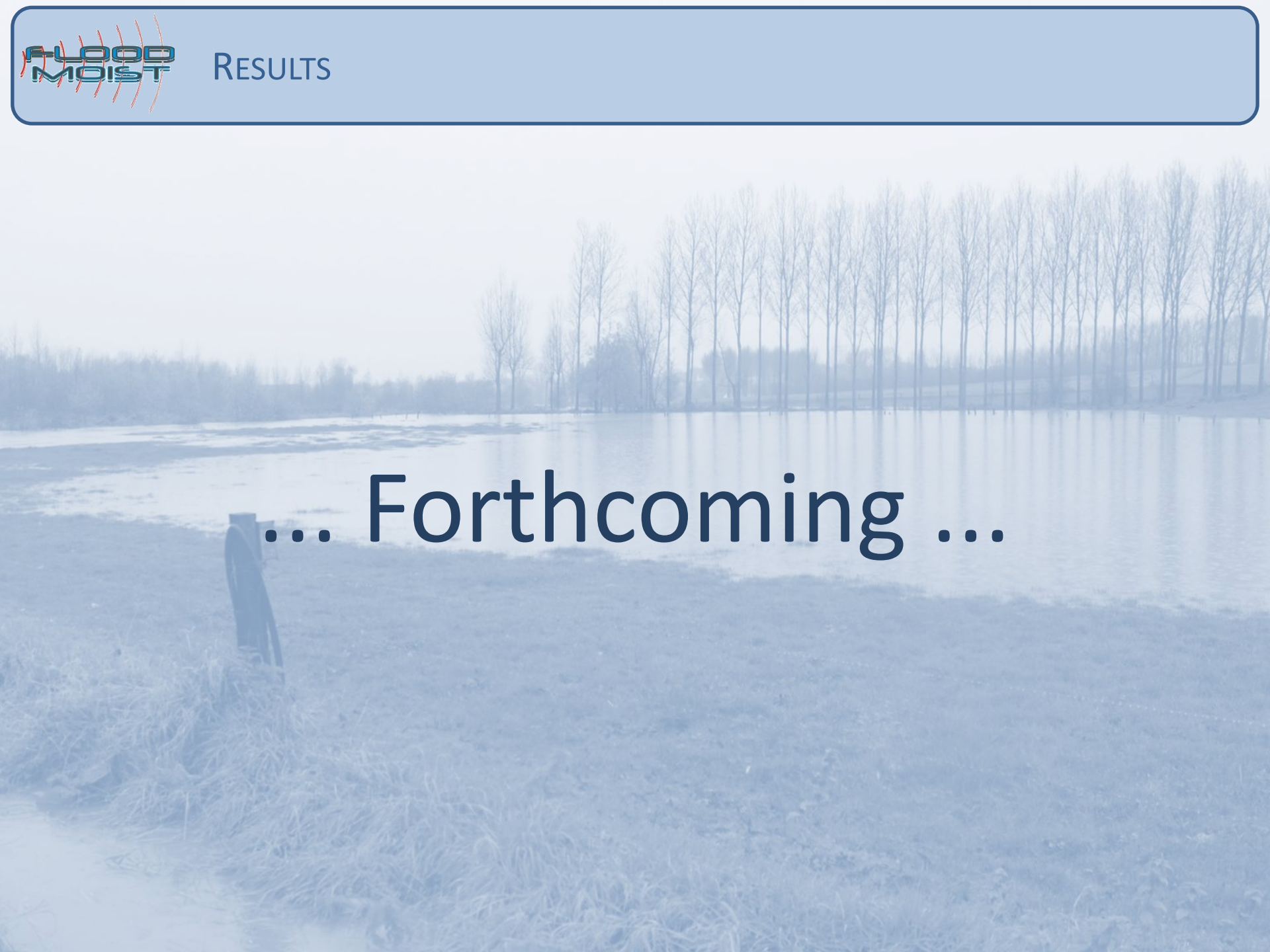


River Thames

In situ datasets
flood maps
flood stages
LiDAR data

Remote sensing datasets
ENVISAT, RADARSAT, TerraSAR-X, …

Hydrologic and hydraulic models
HBV-Light, HEC-RAS, LISFLOOD-FP, …



... Forthcoming ...

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FLOOD MOIST

thank you for your attention

NIKO VERHOEST, HANS LIEVENS
Ghent University

LUCIEN HOFFMANN, PATRICK MATGEN
Centre de Recherche Public
Gabriel Lippmann

PAUL BATES
University of Bristol

UNIVERSITEIT GENT

LHWM

Centre de Recherche Public Gabriel Lippmann

University of BRISTOL