Modelling Natural Flood Management in the LANDWISE project

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Outline

- Flooding mechanisms in lowland catchments
- Processes we simulate
- NFM scenarios we aim to address
- Initial results of ongoing work
- Modelling challenges

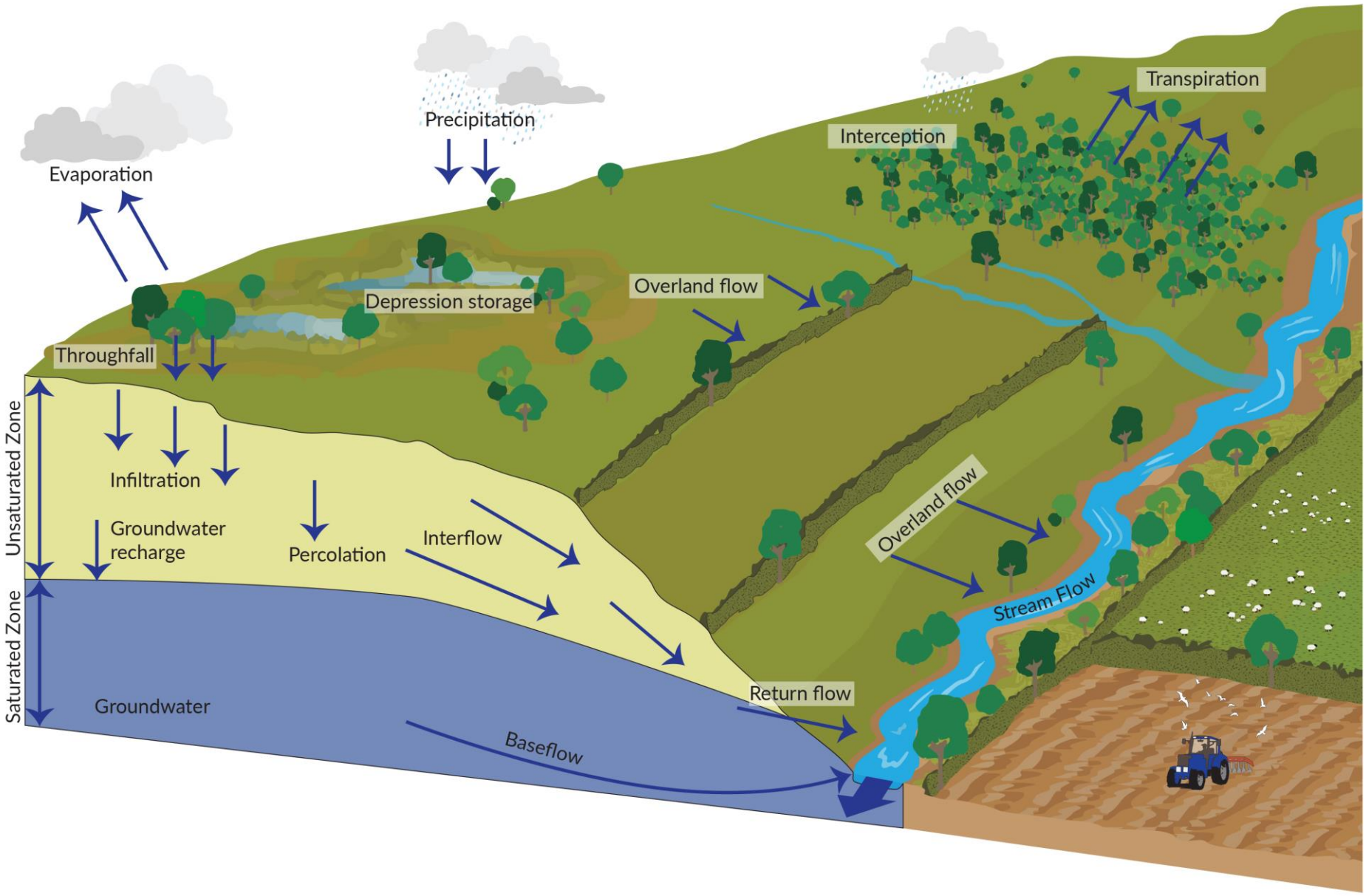
Flooding mechanisms in lowland catchments

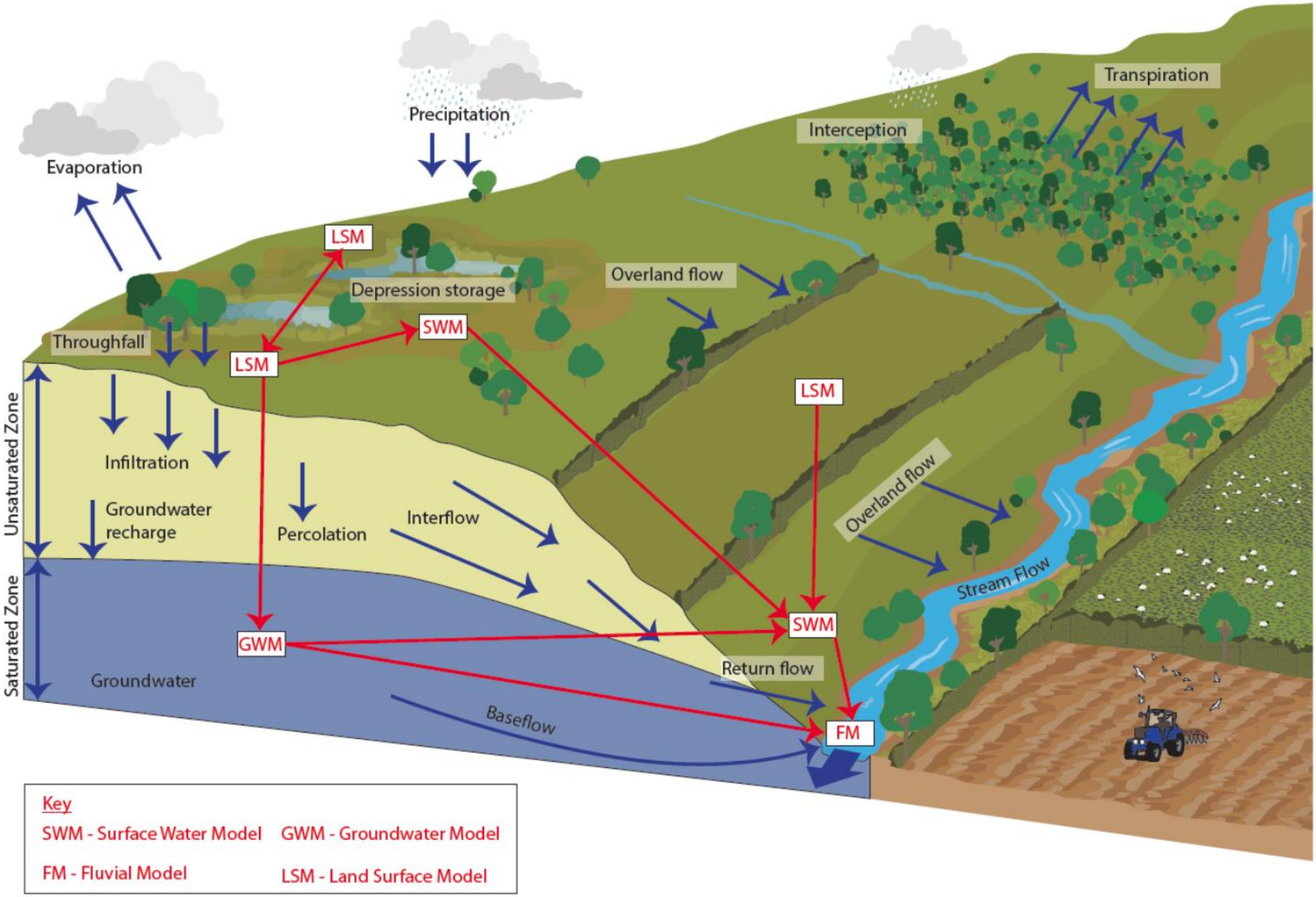
surface runoff

pluvial flooding

river flooding

groundwater flooding


Evaporation
Precipitation
Interception
Transpiration
Depression storage
Overland flow
Throughfall
Unsaturated Zone
Infiltration
Groundwater recharge
Percolation
Interflow
Overland flow
Stream Flow
Saturated Zone
Groundwater
Return flow
Baseflow


Evaporation
Precipitation
Transpiration
Interception
LSM
Depression storage
Overland flow
SWM
Throughfall
LSM
LSM
Unsaturated Zone
Infiltration
Groundwater recharge
Percolation
Interflow
Overland flow
Stream Flow
Saturated Zone
GWM
SWM
Groundwater
Return flow
Baseflow
FM
Key
SWM - Surface Water Model
GWM - Groundwater Model
FM - Fluvial Model
LSM - Land Surface Model

Land surface modelling

- Purpose:
  - runoff generation - feeds into surface flow models
  - groundwater recharge - feeds into groundwater flow models
- Simulates:
  - Infiltration/evapotranspiration
  - changes in soil water storage
  - runoff generation
  - soil water drainage
- Data inputs:
  - soil and vegetation properties (WP2)
  - weather data

Surface runoff/fluvial modelling

- Purpose:
  - routes runoff across the land surface and in water courses
  - includes rainfall-runoff and groundwater discharge
- Simulates:
  - shallow water flow - simplification of complex water flow processes
  - reinfiltration of water to the ground where not fully saturated
  - river flow and extent of flood waters on floodplain
- Data inputs:
  - High resolution topography (WP3)
  - Rainfall
  - Land surface roughness

Groundwater flow modelling

- Purpose:
  - routes water through the subsurface
- Simulates:
  - groundwater flows and levels
  - groundwater discharge at the ground surface and as baseflow to water courses
- Data inputs:
  - aquifer properties
  - groundwater recharge (WP4)

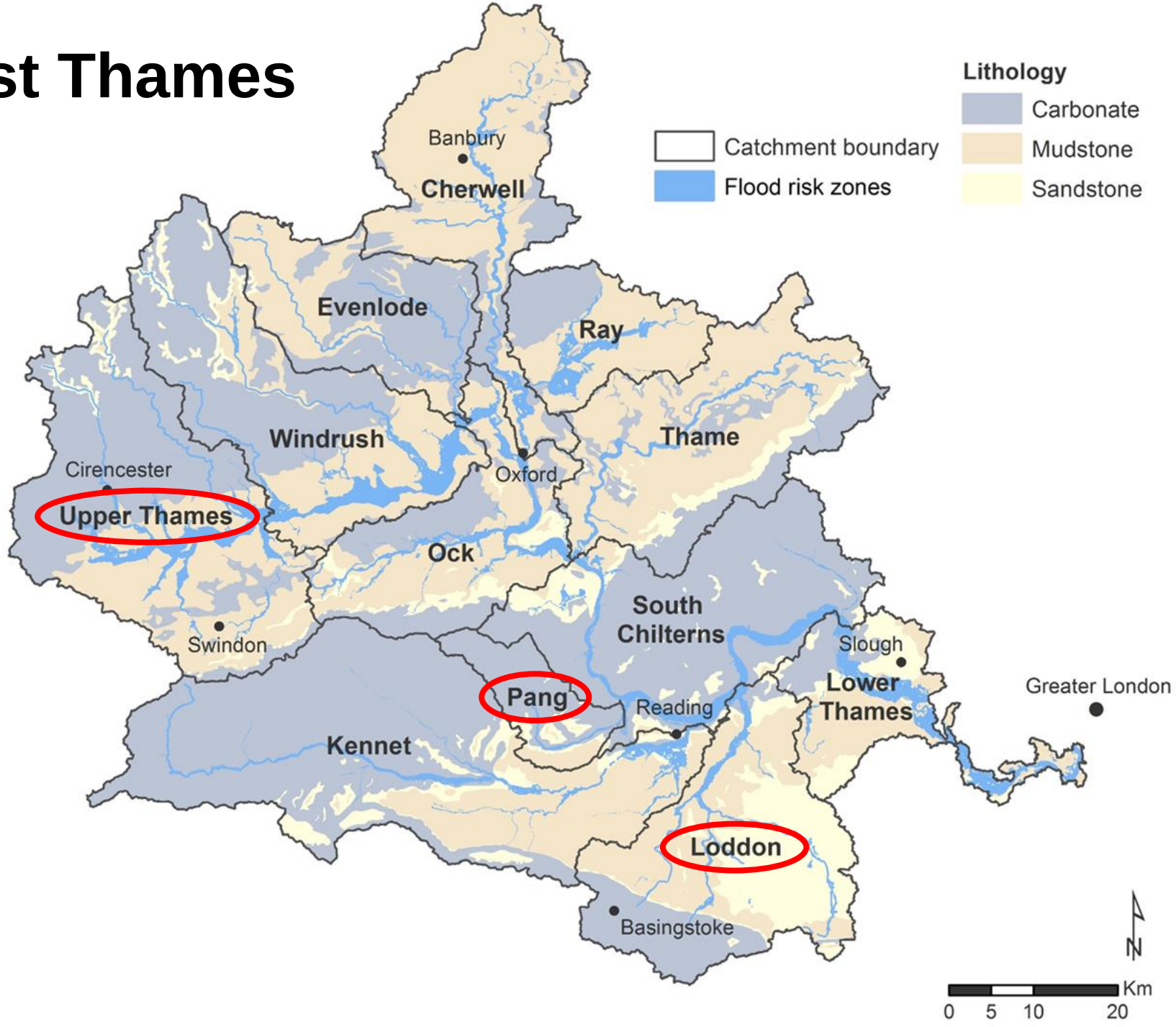
Verification data

- river flows and levels
- surface runoff flows
- groundwater levels
- soil moisture & evapotranspiration (WP3)

Examining implications of NFM measures

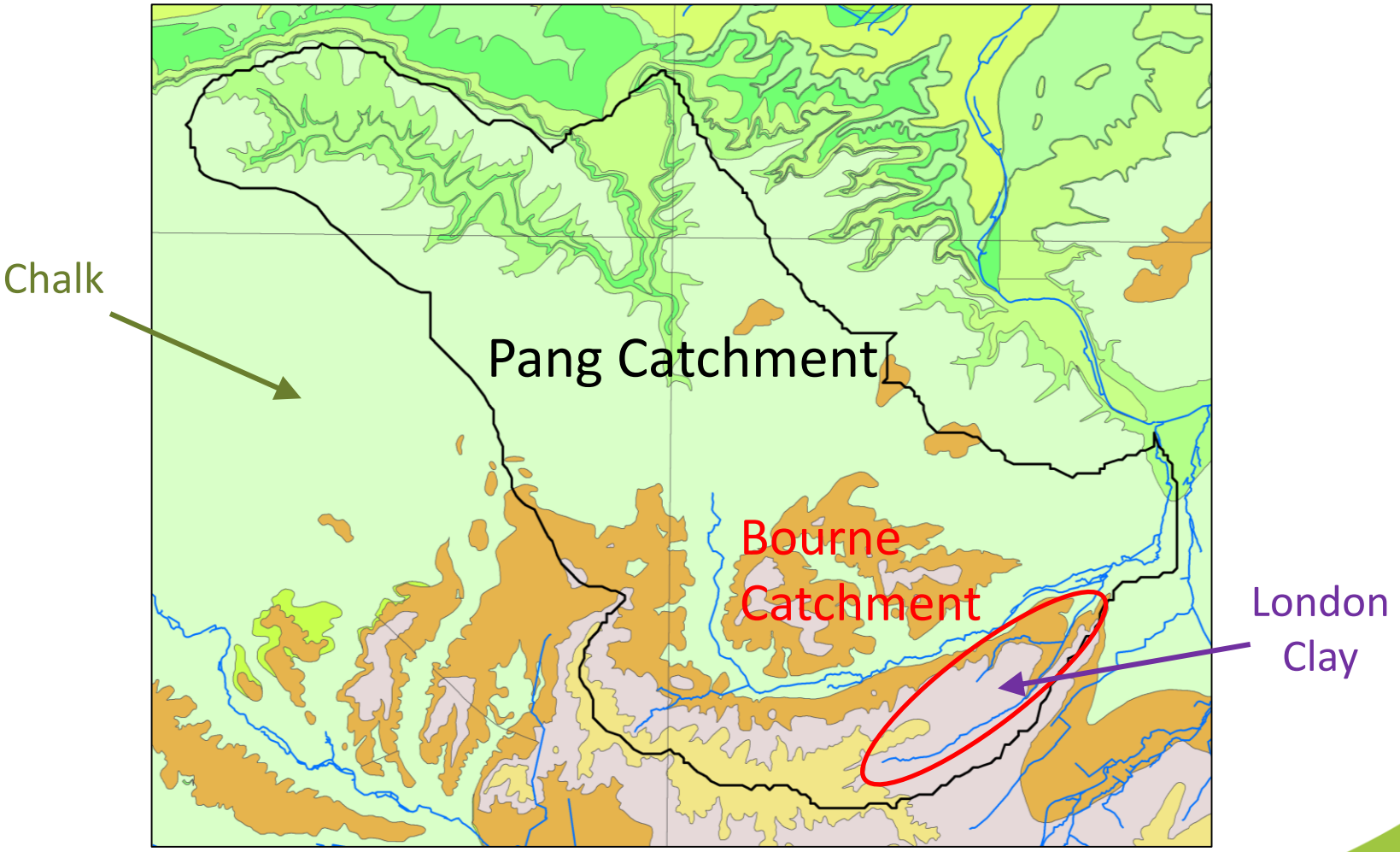
- changing soil and land management, e.g.:
  - soil tillage
  - crop choice and timing of planting
  - woodland planting
- introduction of structures that slow surface water flows
- use of riparian buffers
- implications of changing groundwater recharge on risk of groundwater flooding and river baseflow
- potential for pumping boreholes during flood events to mitigate groundwater flooding

West Thames


Lithology
Carbonate
Mudstone
Sandstone
Catchment boundary
Flood risk zones
Banbury
Cherwell
Evenlode
Ray
Windrush
Thame
Cirencester
Oxford
Upper Thames
Ock
South Chilterns
Swindon
Slough
Lower Thames
Greater London
Pang
Reading
Kennet
Loddon
Basingstoke
N
Km
0 5 10 20

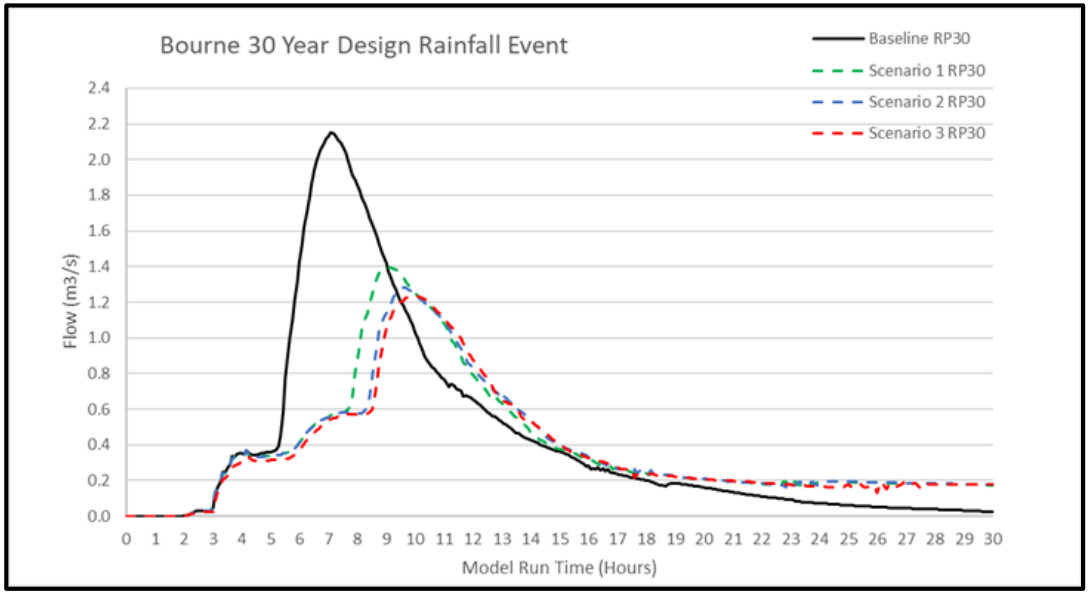
Some initial results

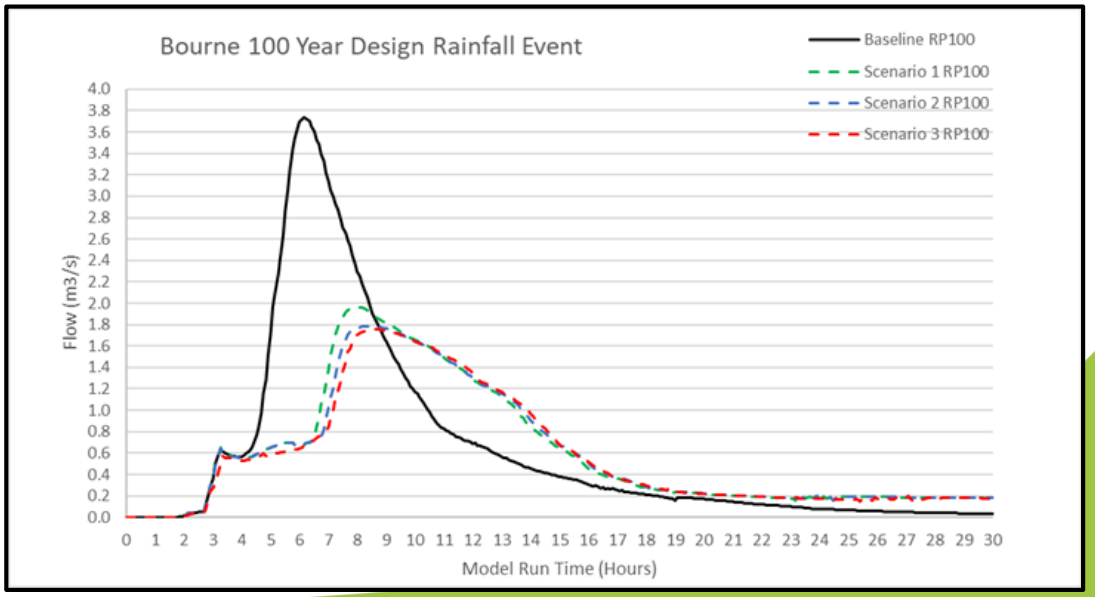
NFM measures in Bourne sub catchment



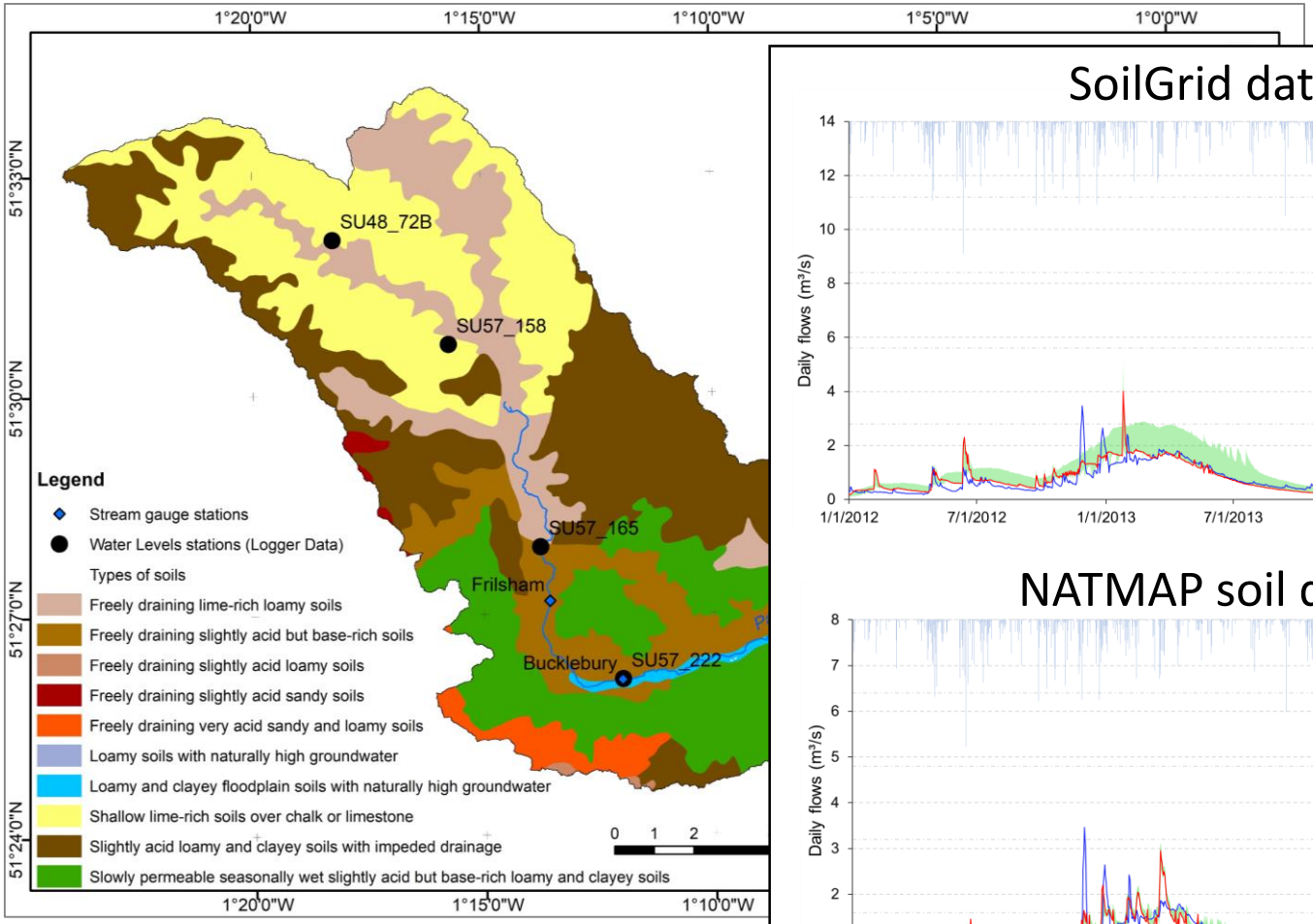
NFM measures in Bourne Catchment

- Scenario 1
  - 21 Leaky Barriers
  - 3 Online Bunds
- Scenario 2
  - 21 Leaky Barriers
  - 42 Additional Leaky Barriers
  - 3 Online Bunds
- Scenario 3
  - 21 Leaky Barriers
  - 42 Additional Leaky Barriers
  - 3 Online Bunds
  - Riparian Buffer Strip alongside all watercourses (105,180 m²)

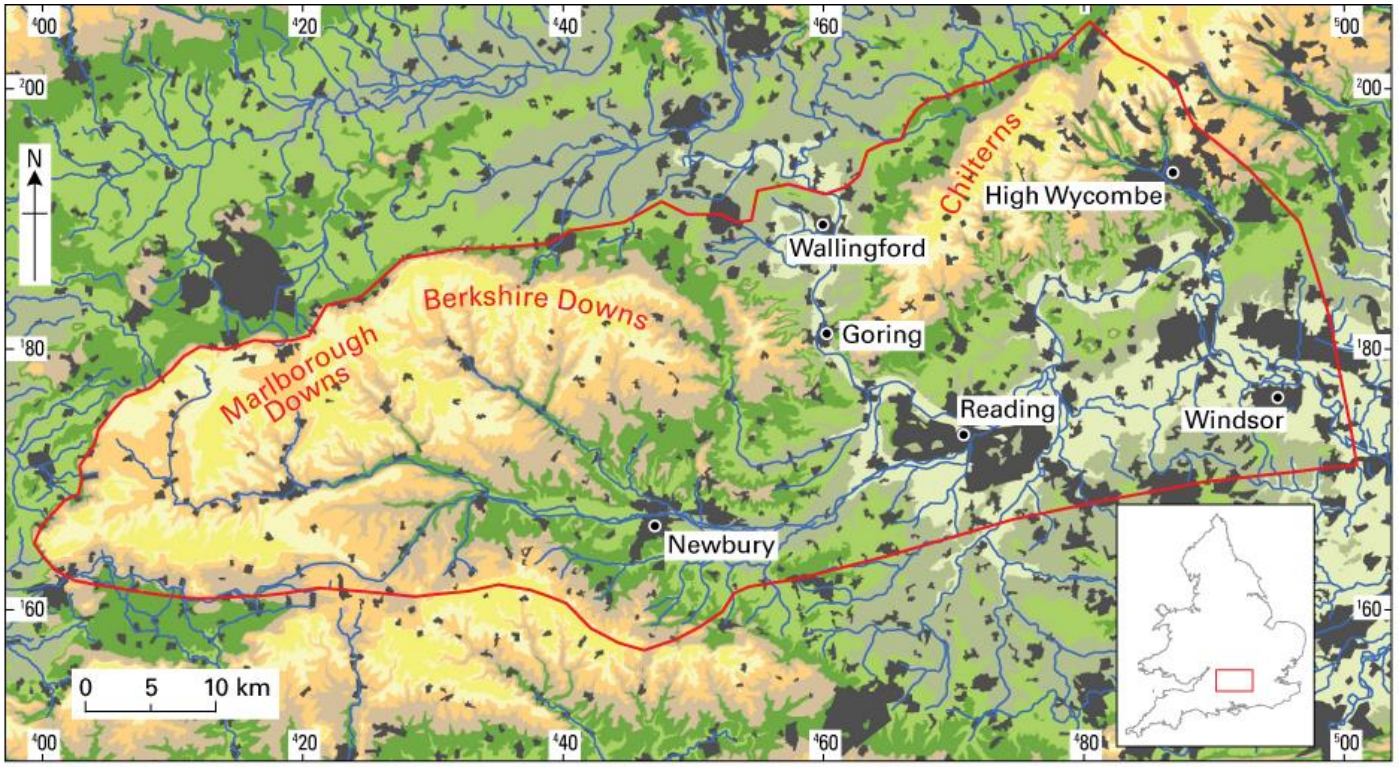




Sensitivity of river flows to land surface model parameters

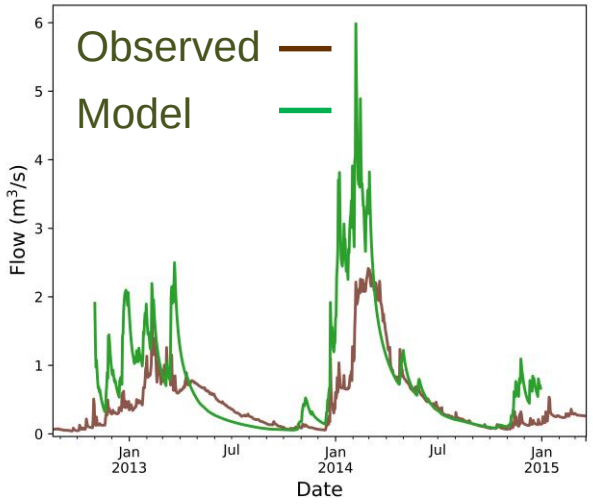


Linking groundwater & surface water models in Pang catchment

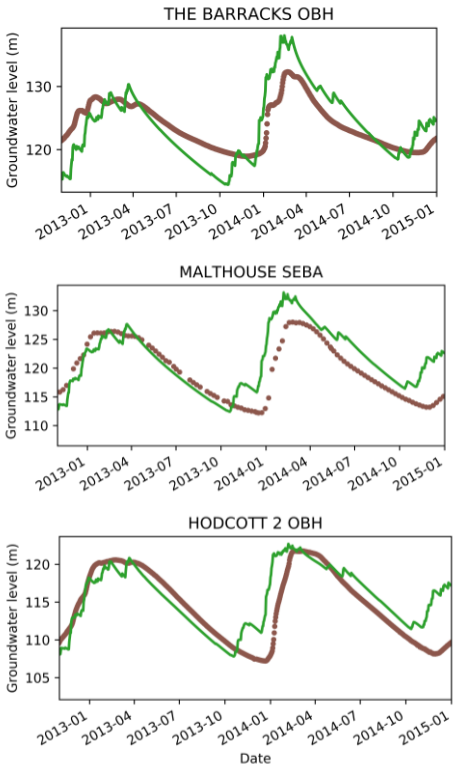


Linking groundwater & surface water models in Pang catchment

river levels



groundwater levels



Modelling challenges

- simulating catchments to sufficient accuracy to be able to assess changes associated with NFM
- developing models with the necessary resolution that run fast enough to examine uncertainties
- estimating model parameters after NFM measures have been introduced

Thank you