Imperial College London

NATURAL ENVIRONMENT RESEARCH COUNCIL

Changing Water Cycle
Hydrological Extremes and Feedbacks

Imperial College London

UCL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

University of Reading

Imperial College London

Main Objective

Objective

Looking at the hydrological impacts of climate change in the UK

↓

A system approach that couples atmosphere, land surface and groundwater processes

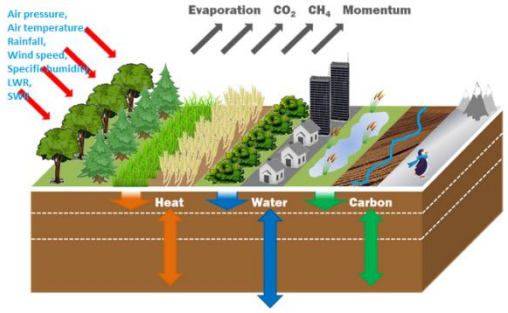
Imperial College London

Methodology

Objective

Looking at the hydrological impacts of climate change in the UK

A system approach that couples **atmosphere, land surface** and groundwater processes



JULES
Joint UK Land Environment Simulator

JULES provides a framework to assess the impact of modifying a particular process (surface energy balance, hydrological cycle, carbon cycle, dynamic vegetation, etc.) on the ecosystem as a whole

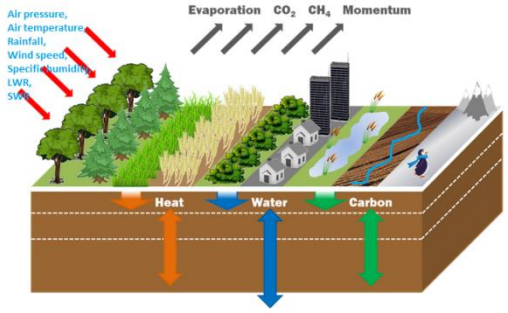
Imperial College London

Methodology

Objective

Looking at the hydrological impacts of climate change in the UK

A system approach that couples **atmosphere, land surface** and groundwater processes



JULES
Joint UK Land Environment Simulator

NERC SCIENCE OF THE ENVIRONMENT
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
Met Office

Applied at 1x1 km^2:

- *soil data*
- *land-use*

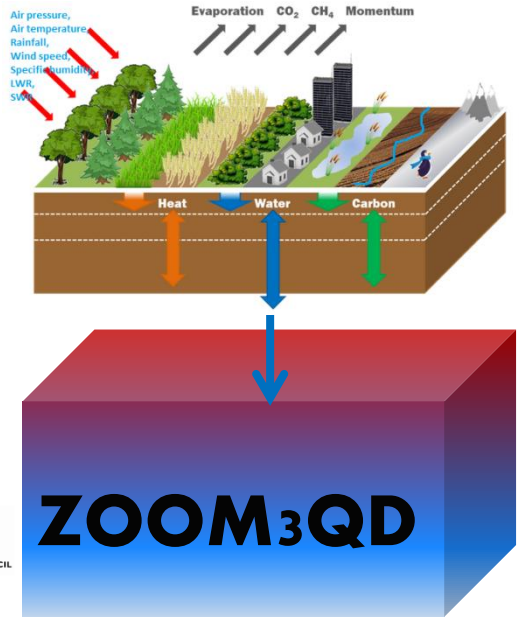
Imperial College London

Methodology

Objective

Looking at the hydrological impacts of climate change in the UK

A system approach that couples atmosphere, land surface and **groundwater processes**



ZOOMQ3D is a numerical model, which simulates GW flow in aquifers

Imperial College London

Methodology

Consistent with changing large-scale synoptic conditions as obtained e.g. from reanalysis products or GCMs

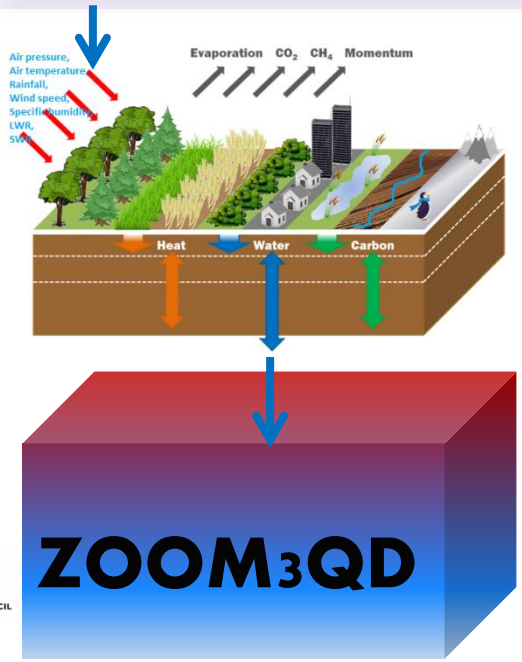
UCL University of Reading

NERC SCIENCE OF THE ENVIRONMENT

Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL

Met Office

Statistical weather generator



British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL

Objective

Looking at the hydrological impacts of climate change in the UK

A system approach that couples atmosphere, land surface and groundwater processes

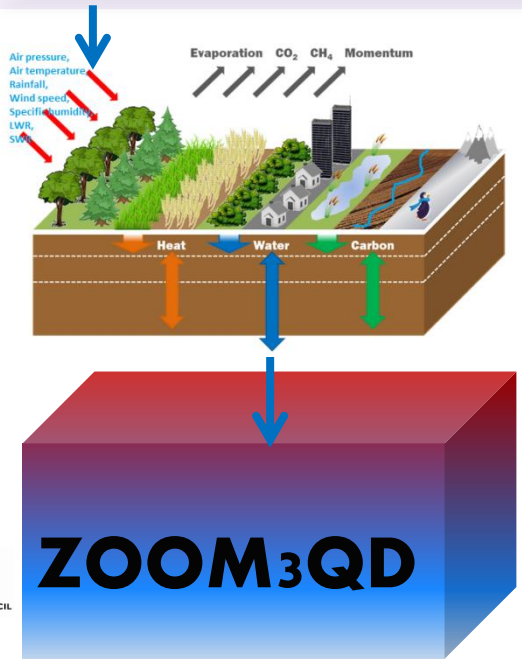
Imperial College London

Methodology

build statistical model for each variable in turn & simulate from these models to produce mutually consistent set of daily time series

UCL
University of Reading
NERC SCIENCE OF THE ENVIRONMENT
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
Met Office
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Statistical weather generator



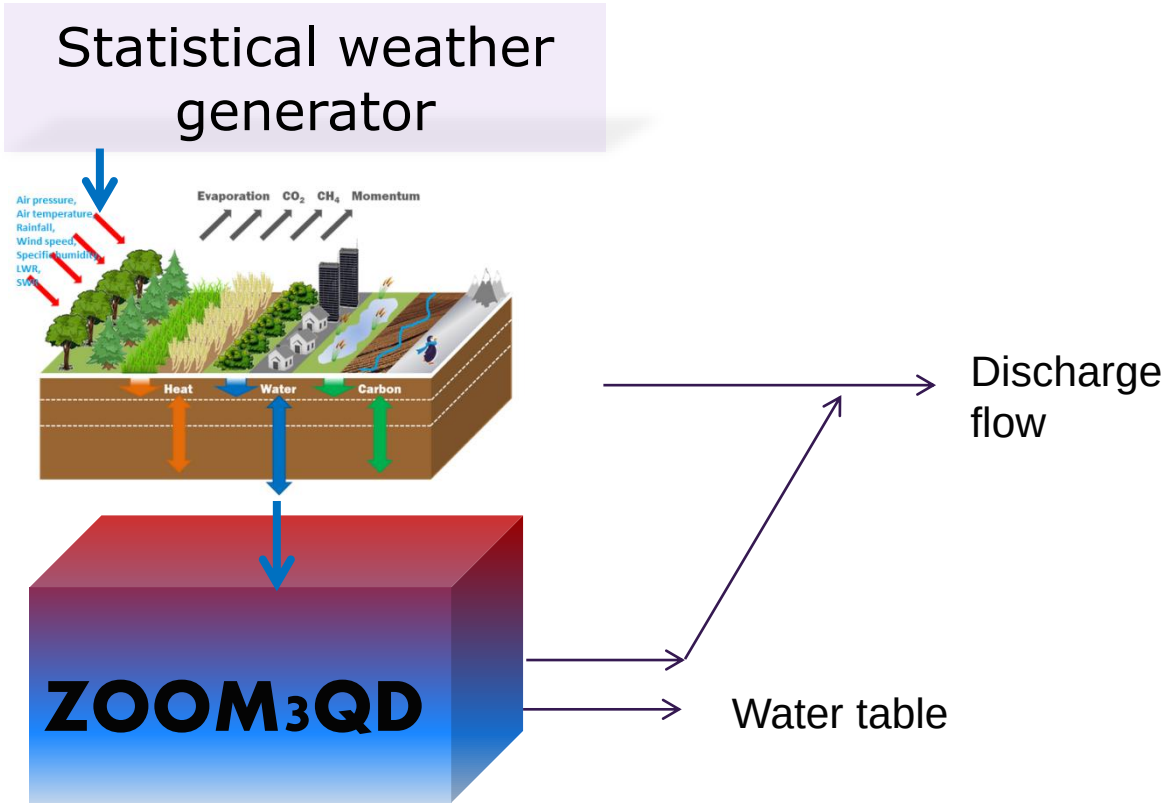
Objective

Looking at the hydrological impacts of climate change in the UK

A system approach that couples atmosphere, land surface and groundwater processes

Imperial College London

Methodology



Imperial College London

What we learnt

" A new hydrology for JULES" was needed

To provide meaningful hydrological predictions in a deep groundwater chalk catchment :

- Increase standard soil layer depth - UK can have depths to the water table as much as 100 m [Jackson et al. 2008]
- Modify JULES's lower boundary condition to persistent gradient. It is generally assumed as a unit gradient (free drainage), which can result in drier lower soil layers [Li et al. 2008]
- Modify JULES modules to represent chalk dual behavior of fractures and matrix

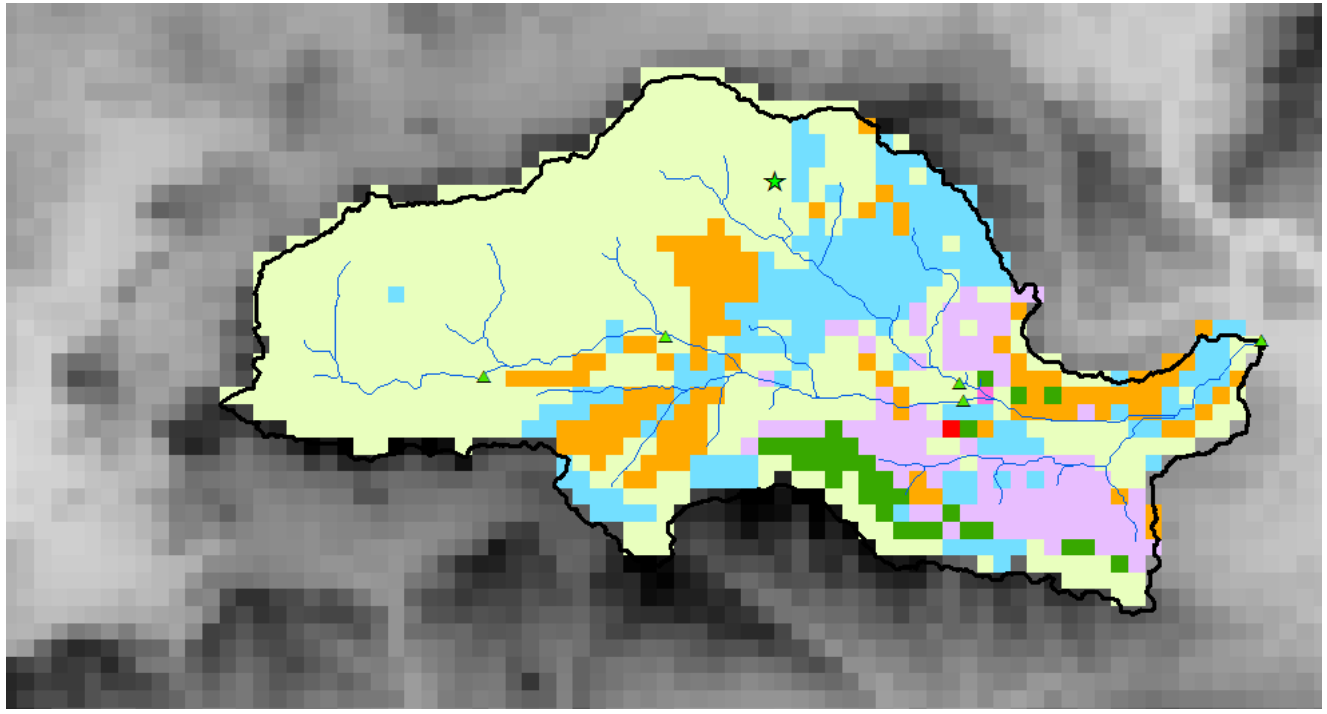
Imperial College London

What we learnt

" A new hydrology for JULES" was needed

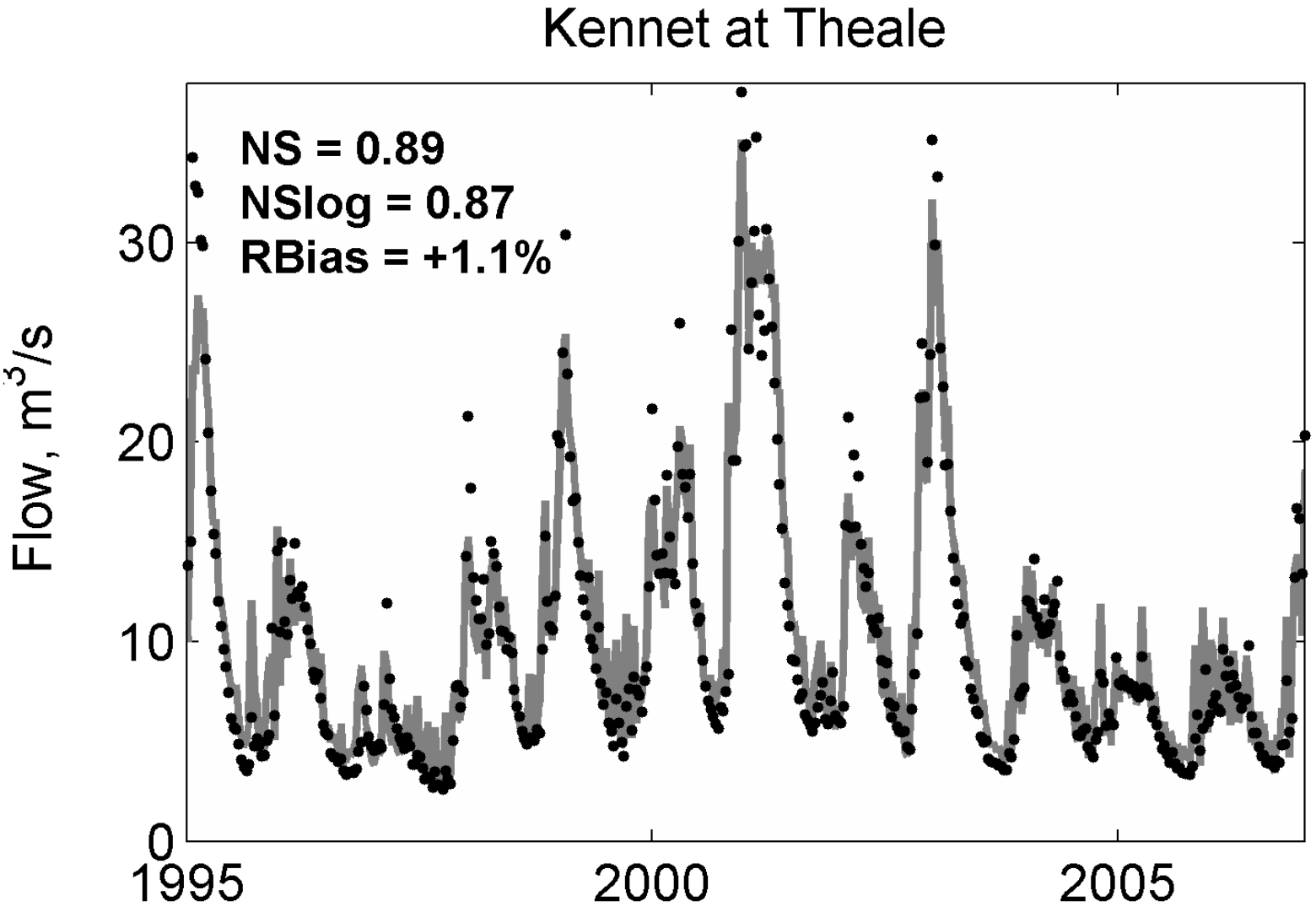
To accurate represent the saturation excess processes regionalized values of BFIHOST (base flow indexes) were used to define the PDM model within JULES

PDM
b = BFIHOST



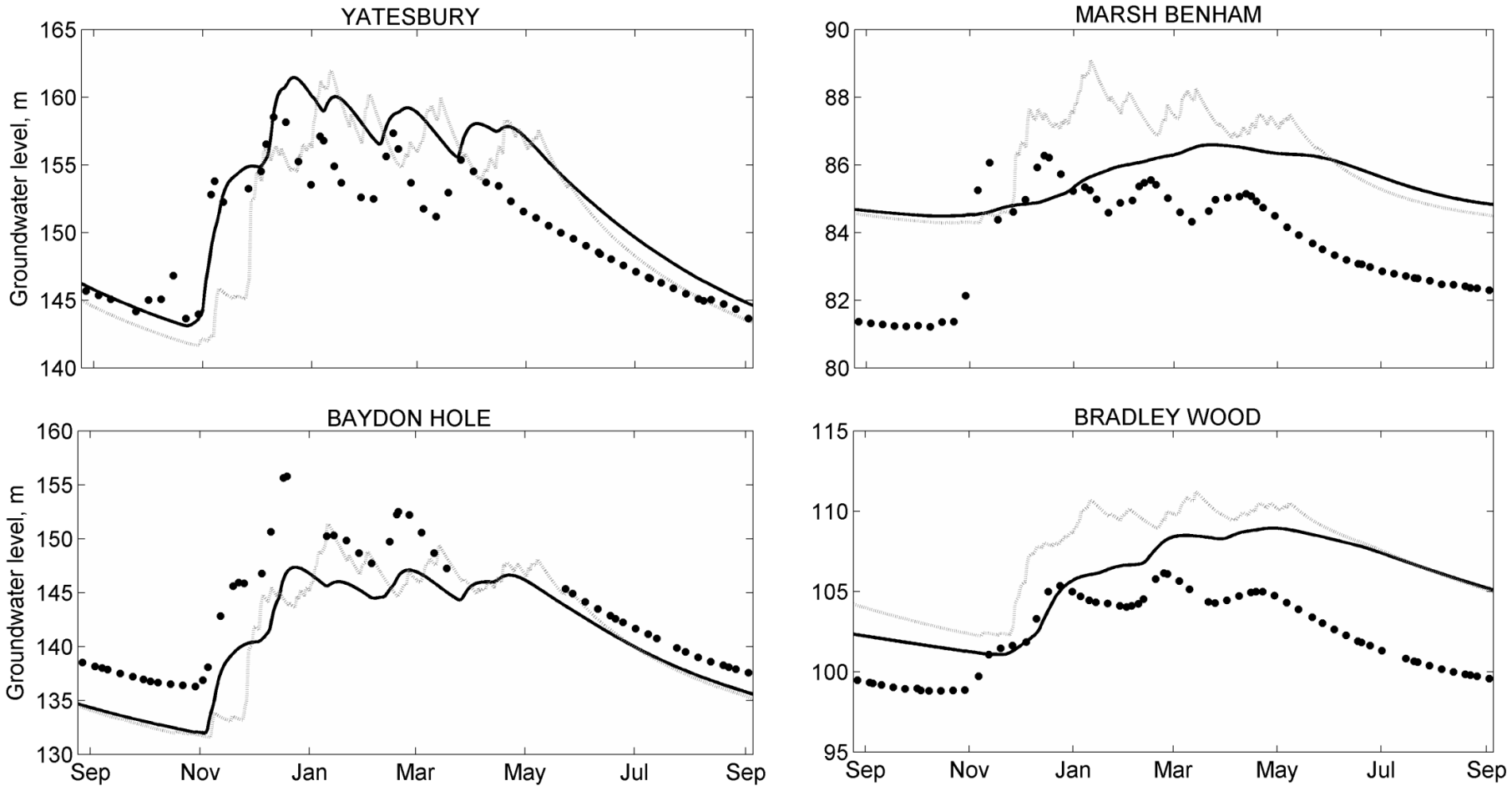
Imperial College London

Results



Imperial College London

Results



Dots: observed levels ; black line: JULES+ZOOMQ3D ;
grey line: Jackson, 2012 (groundwater model)

Imperial College London

Application

Thames water drought plan in the Kennet catchment: