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Adapting JULES for groundwater dominated catchments

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Outline

- Kennet at Theale
- JULES
- Data
- Stepwise changes:
  - Parameterisation
  - Lower boundary condition
  - Groundwater
  - Surface runoff
  - Surface runoff routing
- Summary

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Kennet at Theale

- A mainly pervious catchment, but the lowest quarter is largely impermeable.
- A primarily rural catchment.
- Area = 1,033.4 km^2.
- Average annual rainfall = 759 mm.
- BFI = 0.87

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JULES

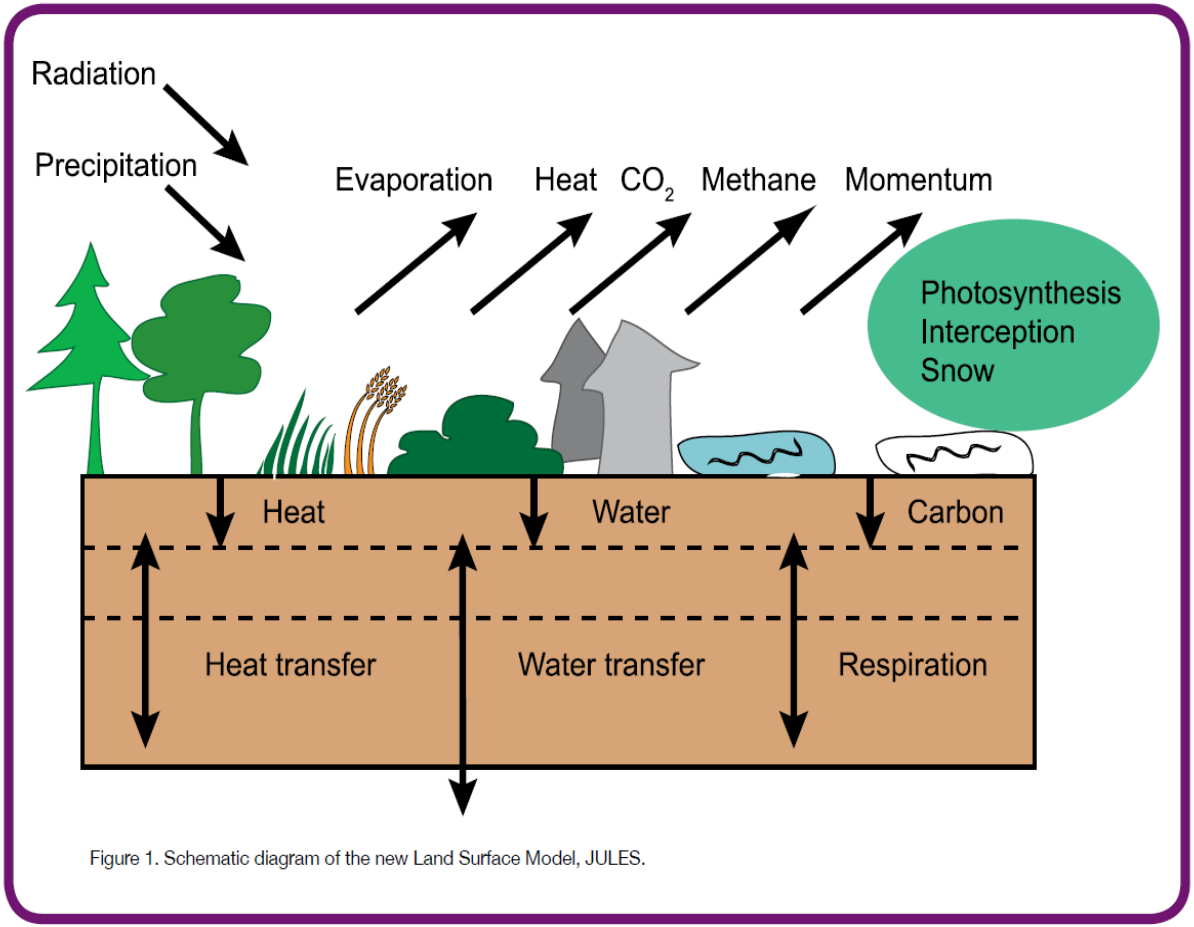

Figure 1. Schematic diagram of the new Land Surface Model, JULES.

Note:

Hydrology in standard JULES assumes

- Free drainage lower boundary;
- No interaction between grids;
- No deep groundwater representation;
- No surface water routing.

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Data

JULES input type	Source data description	Source
1 km catchment grid	1) 50 m resolution raster file 2) catchment outlet	http://edina.ac.uk/digimap/ ttp://www.environmentagency.gov.uk/hiflows/station.aspx?39016
Vegetation cover	1) IGBP 2007 land cover map 2) Land use reclassification scheme (from 17 IGPB classes to 9 JULES classes) (Smith et al, 2006)	http://webmap.ornl.gov/wcsdown/dataset.jsp?ds_id=10004
Soil parameters	1 km NSRI soil maps (Brooks and Corey parameterisation) based on Mayr & Jarvis (1999)	http://www.landis.org.uk/data/
Meteorological inputs	Daily, 1 km CHESS data	CEH (personal communications)
Observations	Daily flow data	http://www.ceh.ac.uk/data/nrfa/data/search.html

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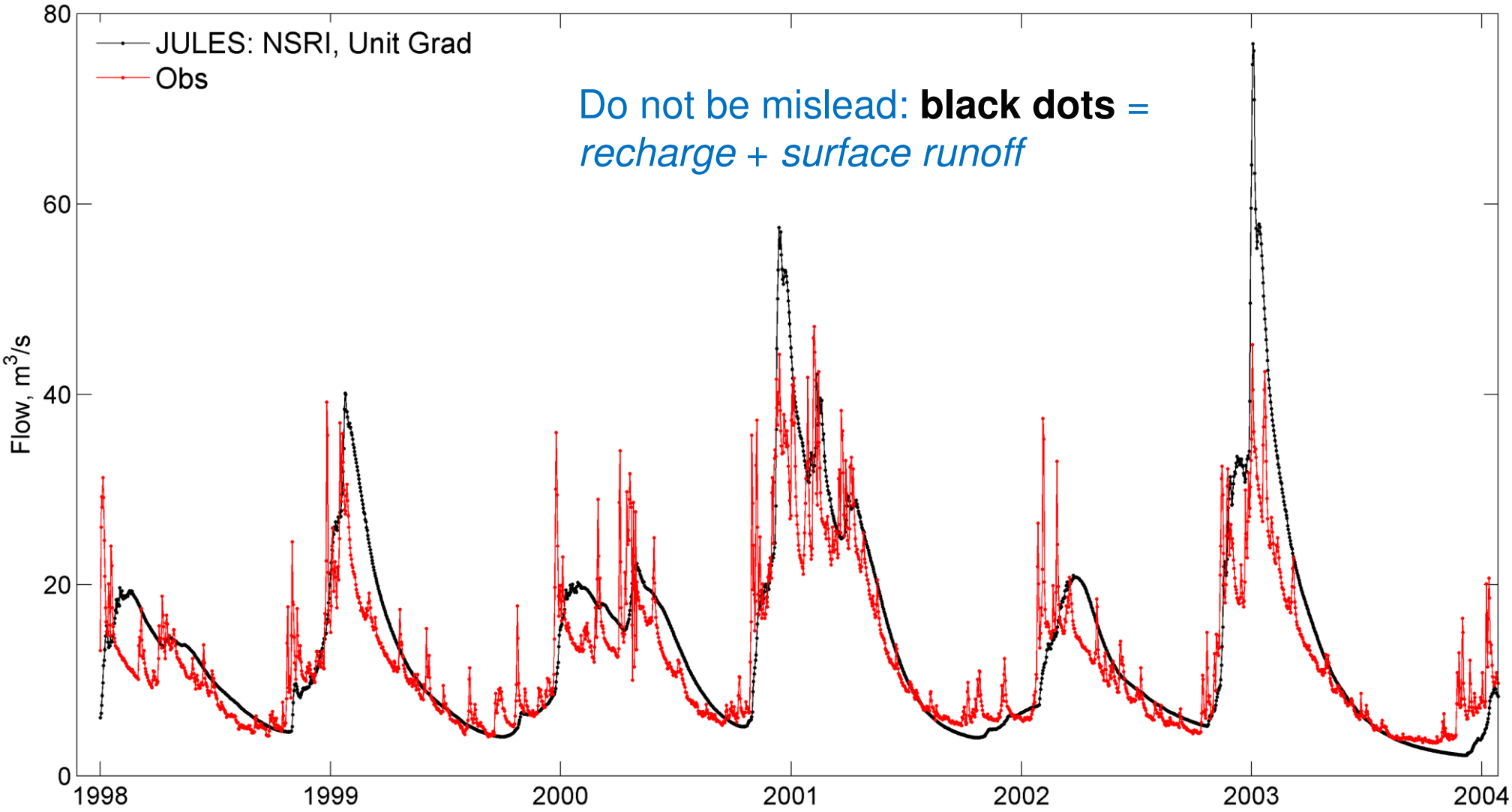
Right answers for the wrong reasons?



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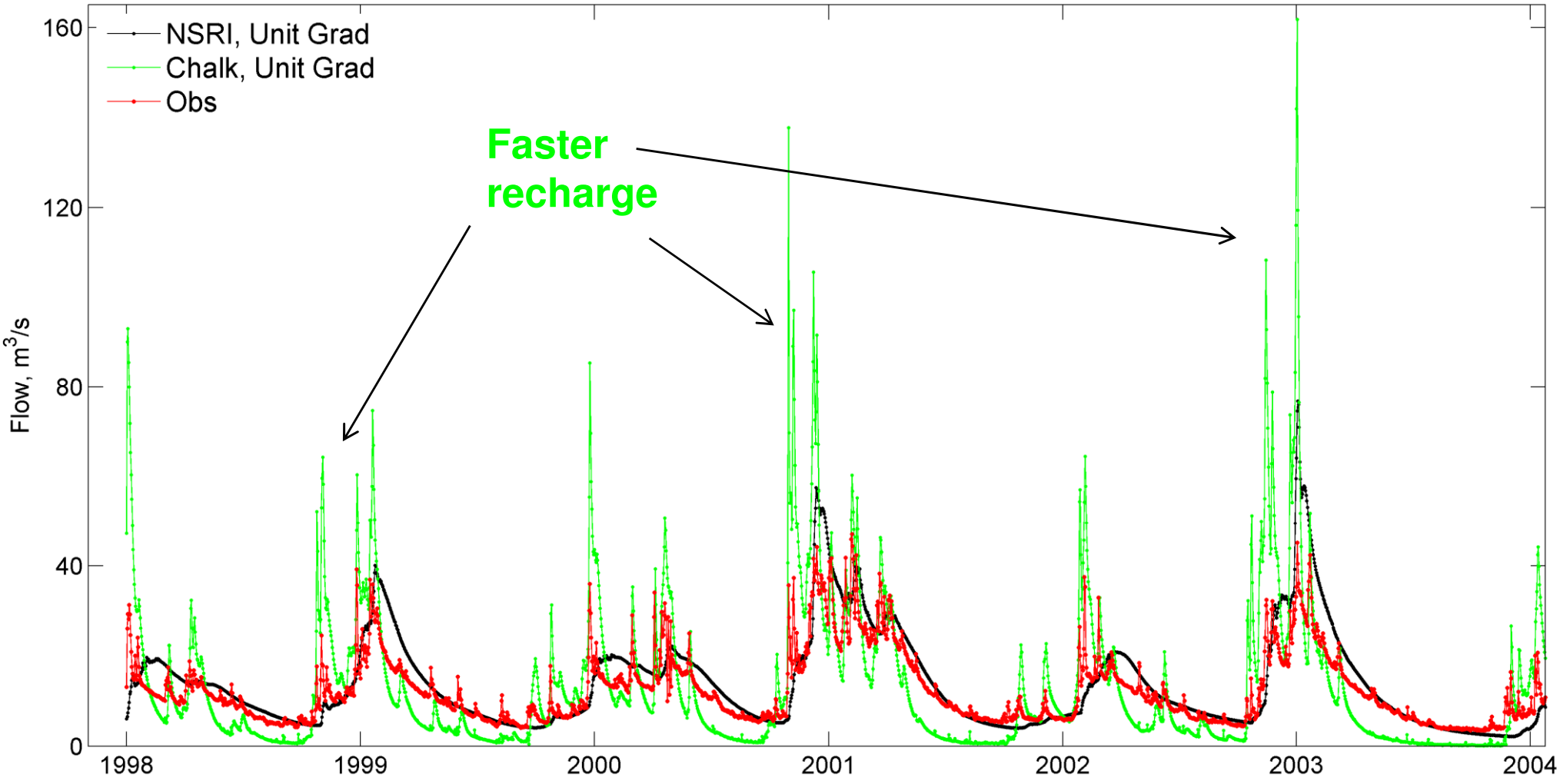
Account for chalk hydraulics



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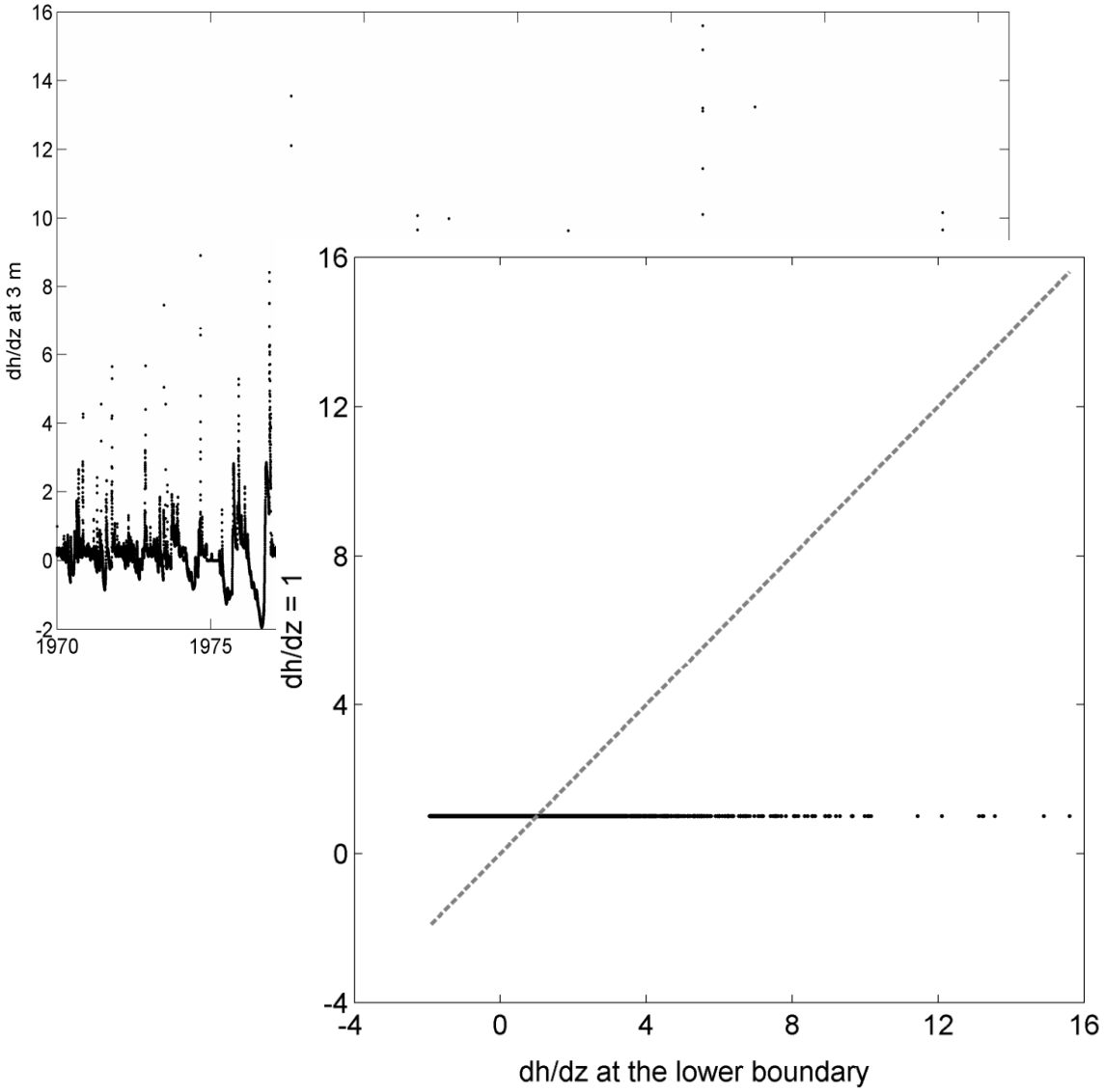
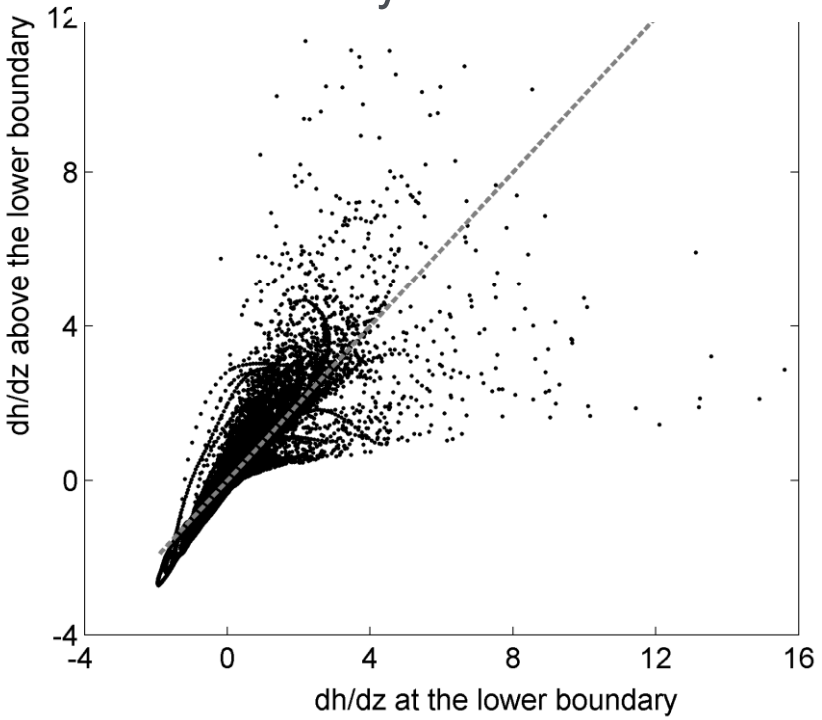
Which Lower Boundary Condition? (1 of 2)



‘Persistant gradient’ correlates well with modelled gradient at the boundary



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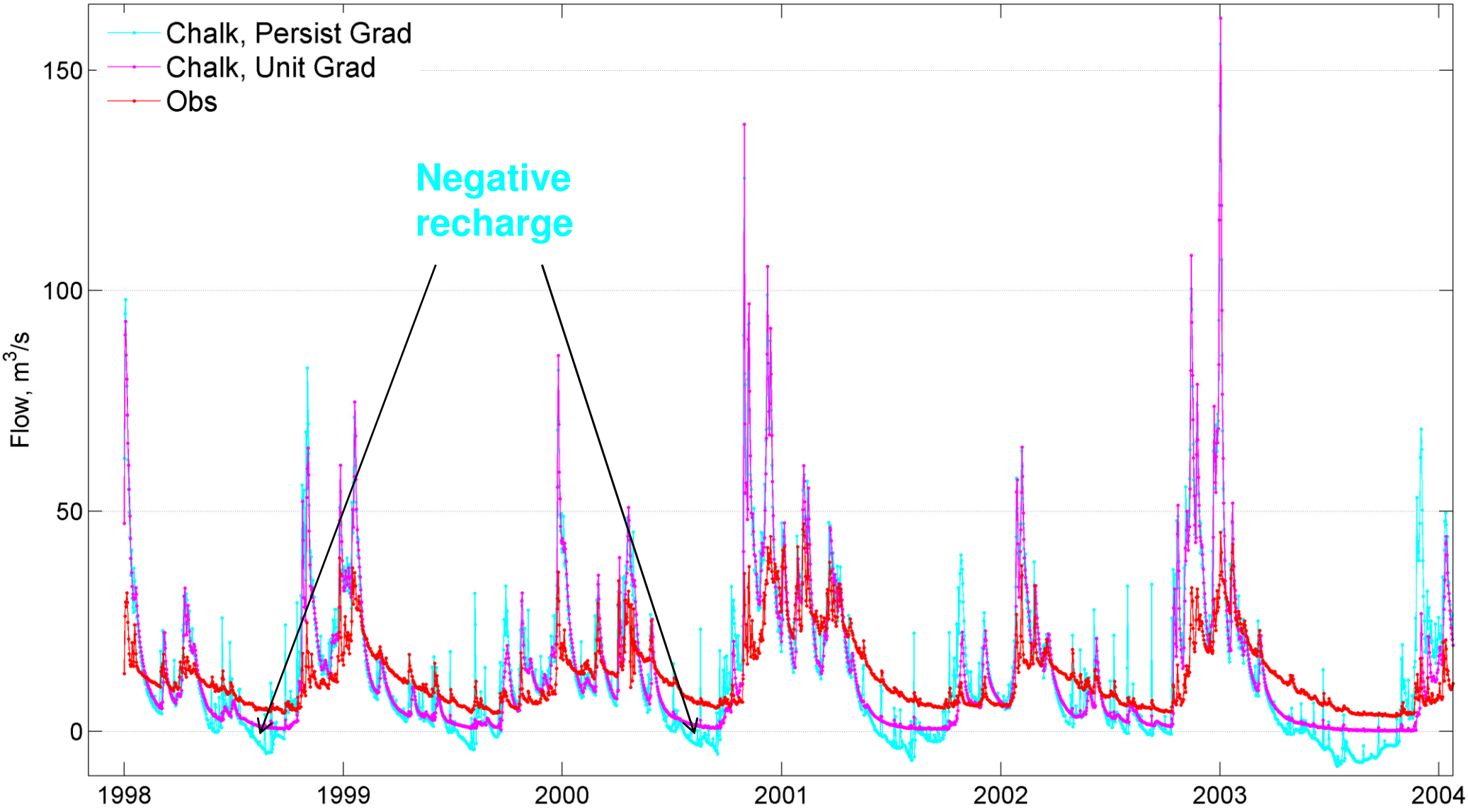
Which Lower Boundary Condition? (2 of 2)



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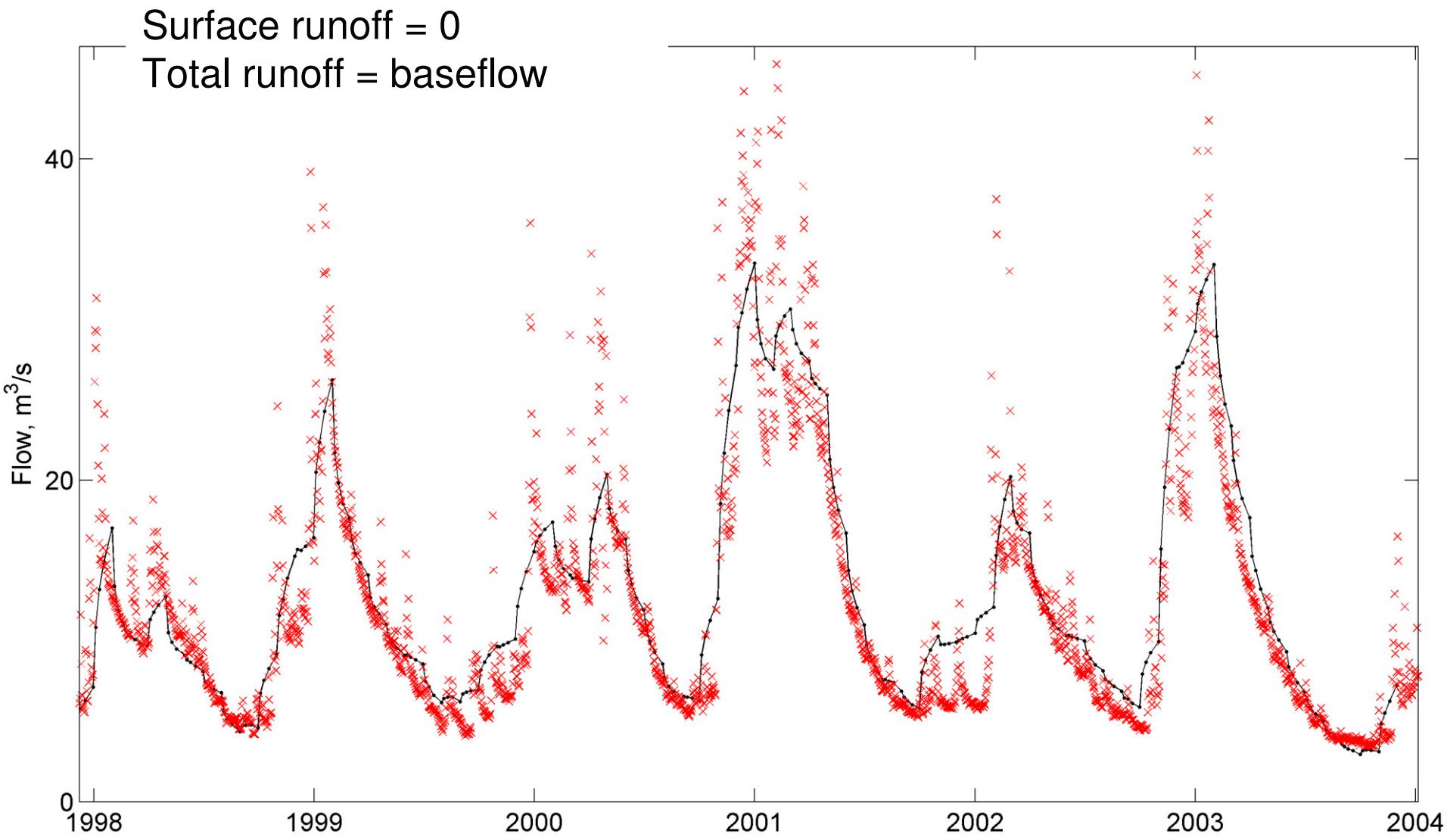
Groundwater representation: ZOOMQ3D



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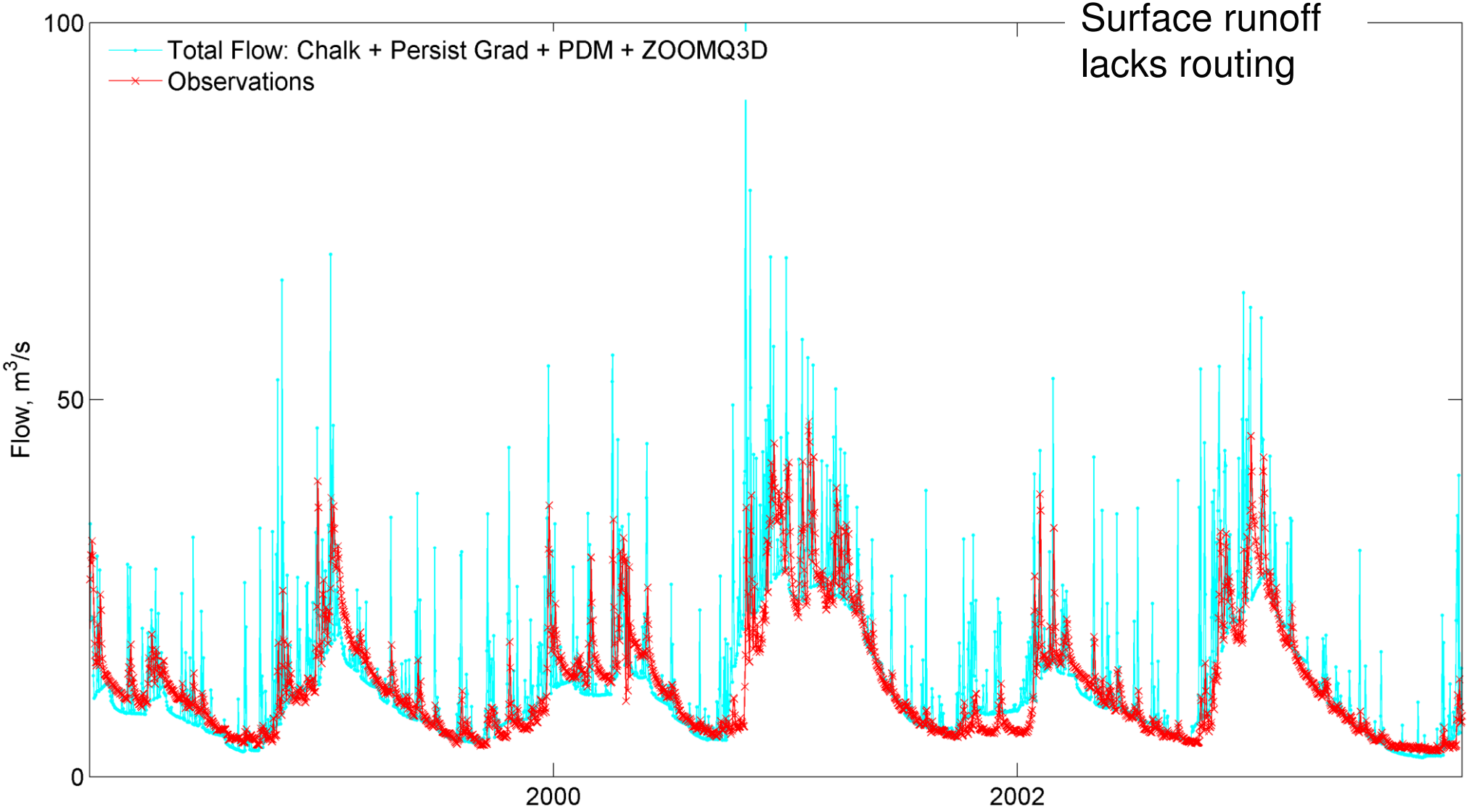
Surface Runoff (1 of 2)



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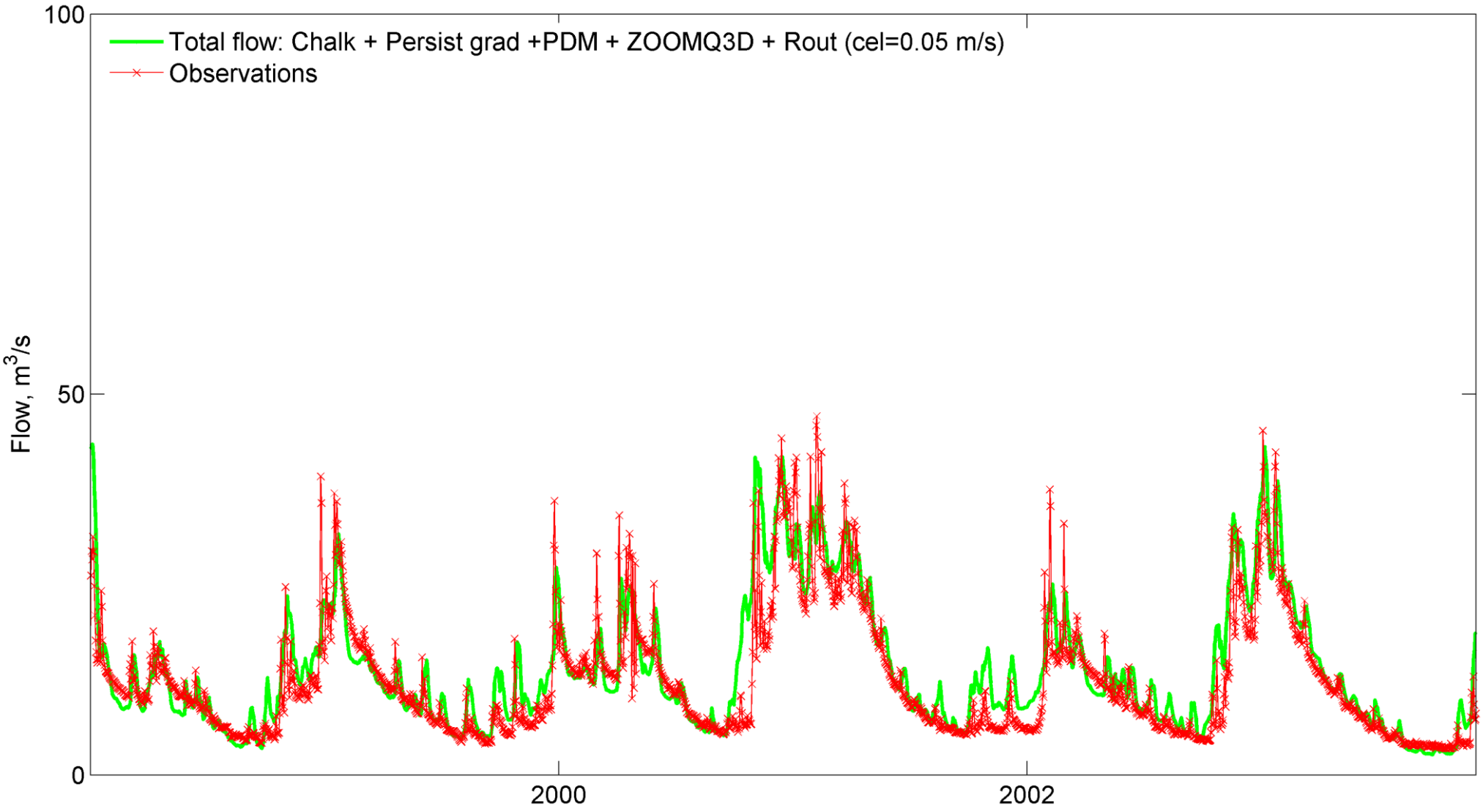
Surface Runoff (2 of 2)



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Summary

A number of changes are introduced to the standard JULES configuration (and soil physical properties data) to represent a groundwater dominated catchment:

1)NSRI data set was complemented with ‘chalk’;

2)Lower boundary condition was chosen to be a ‘persistent’ hydraulic gradient condition;

3)Groundwater model ZOOMQ3D was used to model baseflow;

4)PDM model was used to represent near-surface heterogeneity and allow producing surface runoff (restricted by regionalised data);

5)Surface runoff was routed using a simple constant celerity model.

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Recharge vs. Fluxes at 3 m in chalk