



Met Office

The development of a coupled surface water inundation model

JULES general science meeting - 17th & 18th December 2012

Heather Ashton¹, Martin Best¹, Jeff Neal², Gustavo De Almeida², Paul Bates², Brian Golding¹

¹UK Met Office, FitzRoy Road, Exeter, EX1 3PB, UK

²School of Geographical Sciences, University of Bristol, University Road, Bristol, BS8 1SS, UK



Overview

Table of Contents

- Model Description
- Case Study
- Summary & Further Work



Model Description

JULES

- Joint UK Land Environment Simulator
- Community model
- Land surface model used in the Met Office operational weather and climate models
- Calculates surface fluxes of momentum, heat, water, carbon, etc.
- Tiled scheme for surface heterogeneity
- 4 soil layers, with Darcian flow for water fluxes.
- Surface runoff is generated if canopy throughfall & snowmelt exceed infiltration rates of soil.

Coupled by interpolator

Surface Runoff mapped onto Lisflood points



Feedback of inundated water onto surface energy balance

LISFLOOD-FP

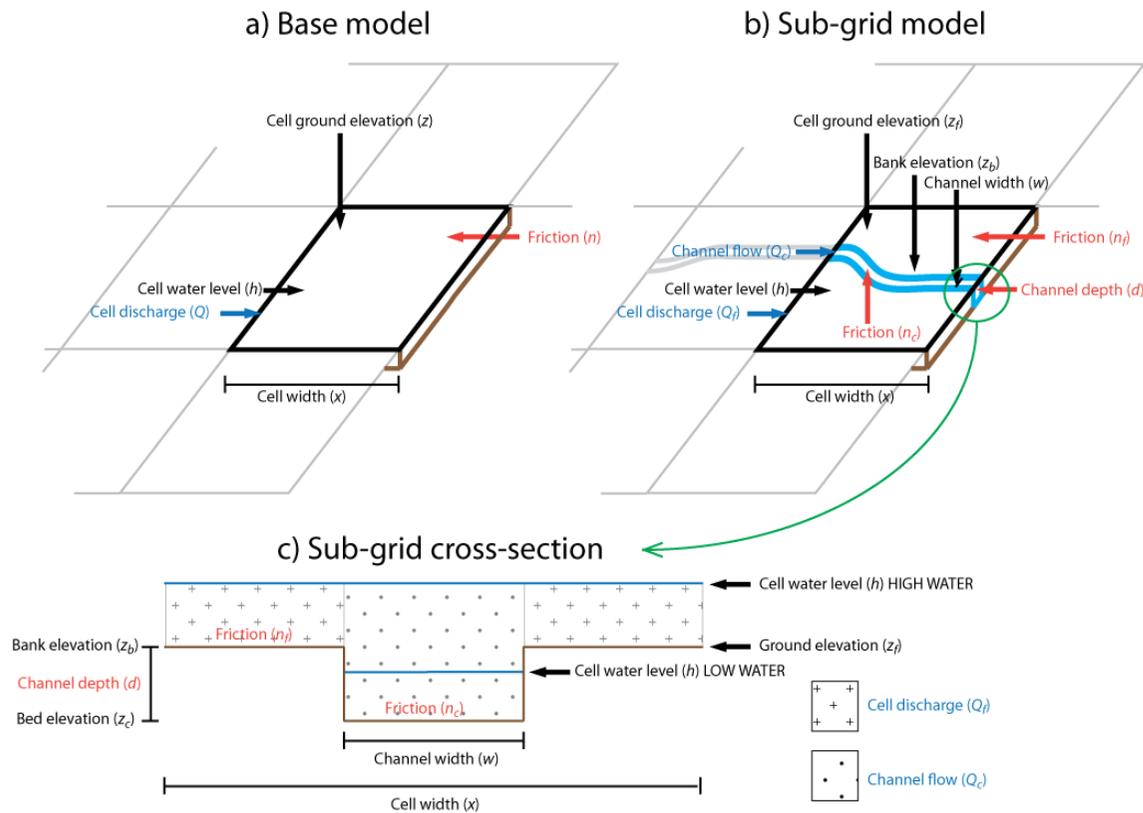
Bristol University, UK

2D hydrodynamic model designed to simulate flood plain inundation over complex topography

- Ability to forecast water depths & simulate propagation of flood waves over flood plains.

Very high spatial resolution (10-100m cell sizes)

LISFLOOD-SGC¹



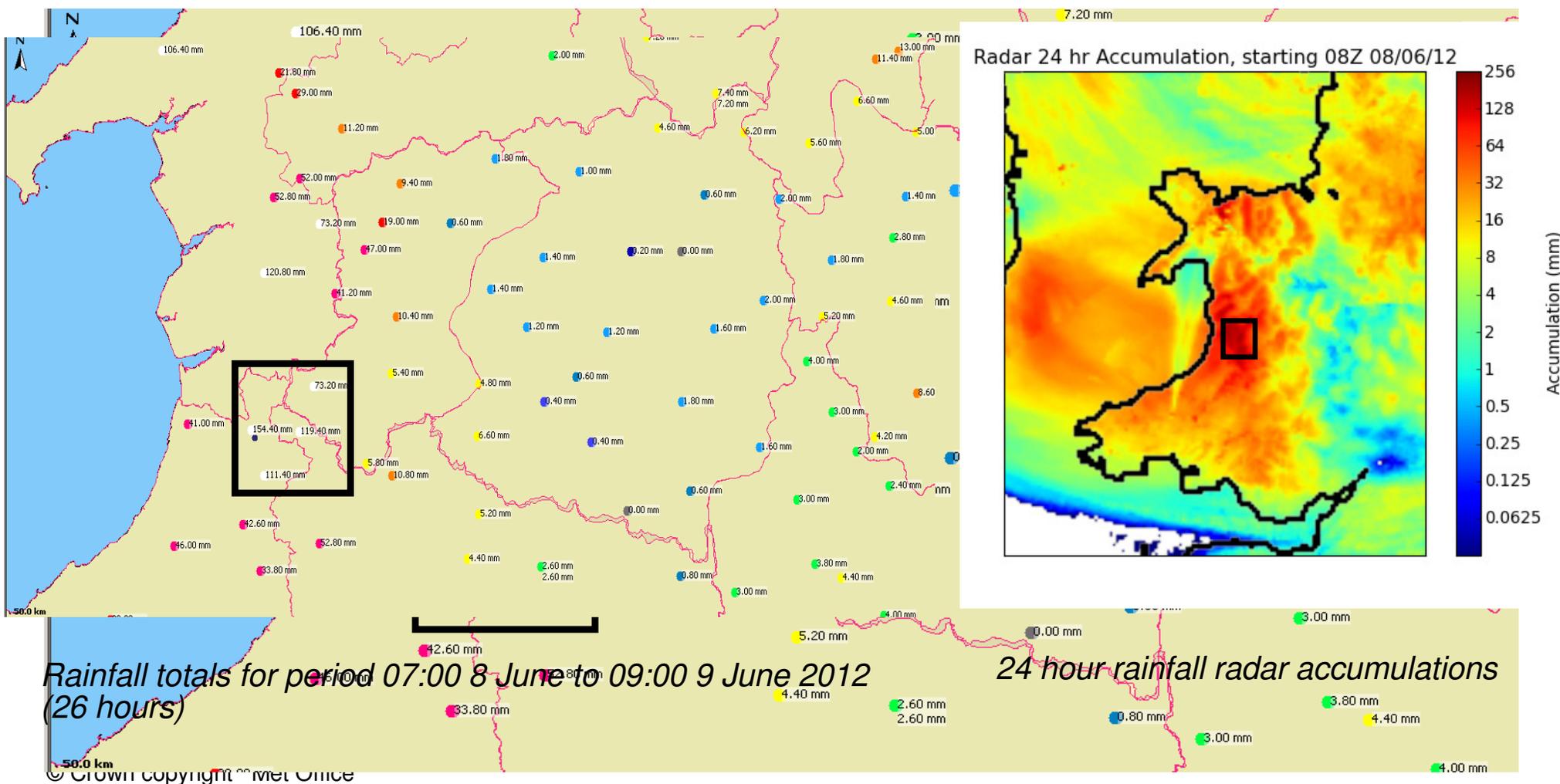
- Base model - Shallow water wave equations without advection, Bates et al (2010)
- Explicit finite difference scheme
- Variable timestepping
- Continuity of mass in each cell
- Continuity of momentum between cells
- Sub-Grid Model – channel network represented
- Channel depth estimations

¹ Neal et al (2012). A simple model for simulating river hydraulics and floodplain inundation over large and data sparse areas. *Water Resources Research*, Vol. 48.



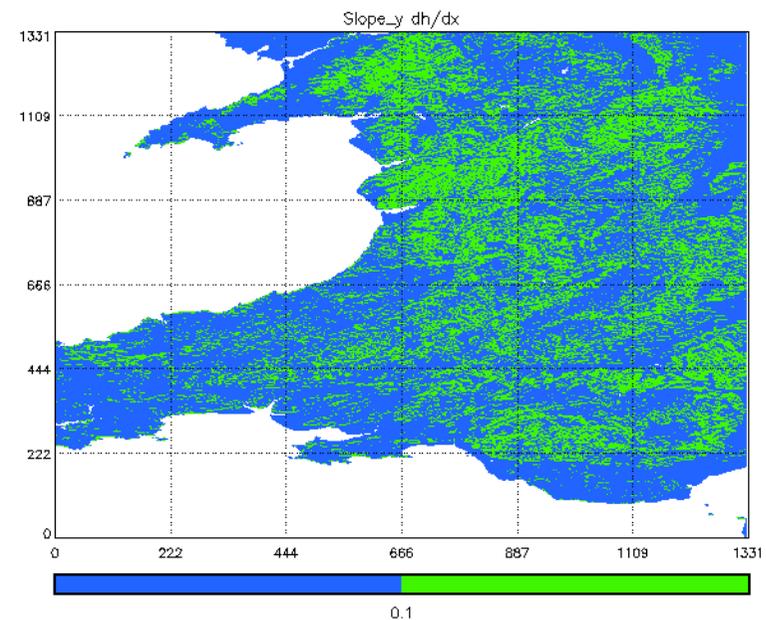
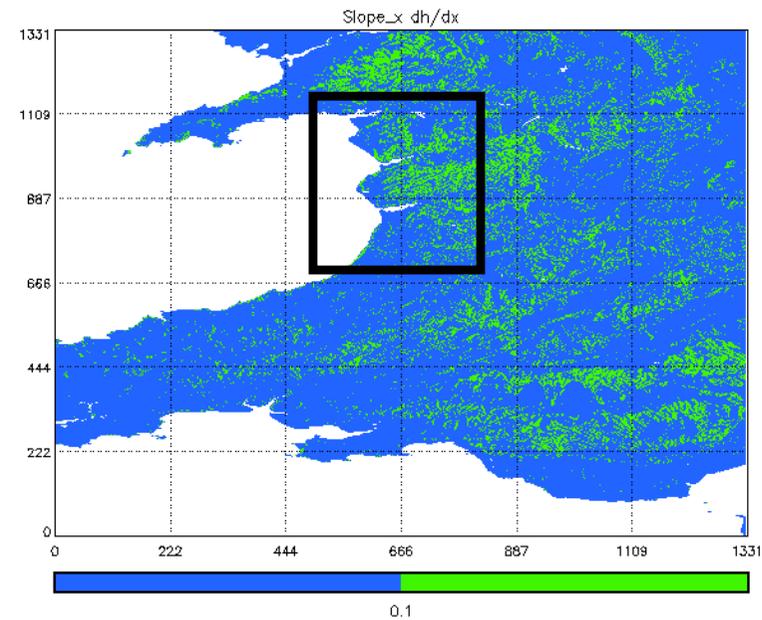
Wales Flood Event - June 2012

- Severe flooding 8/9th June 2012
- 180mm rainfall to Mid/West Wales in 34 hours



Limitation of Slope

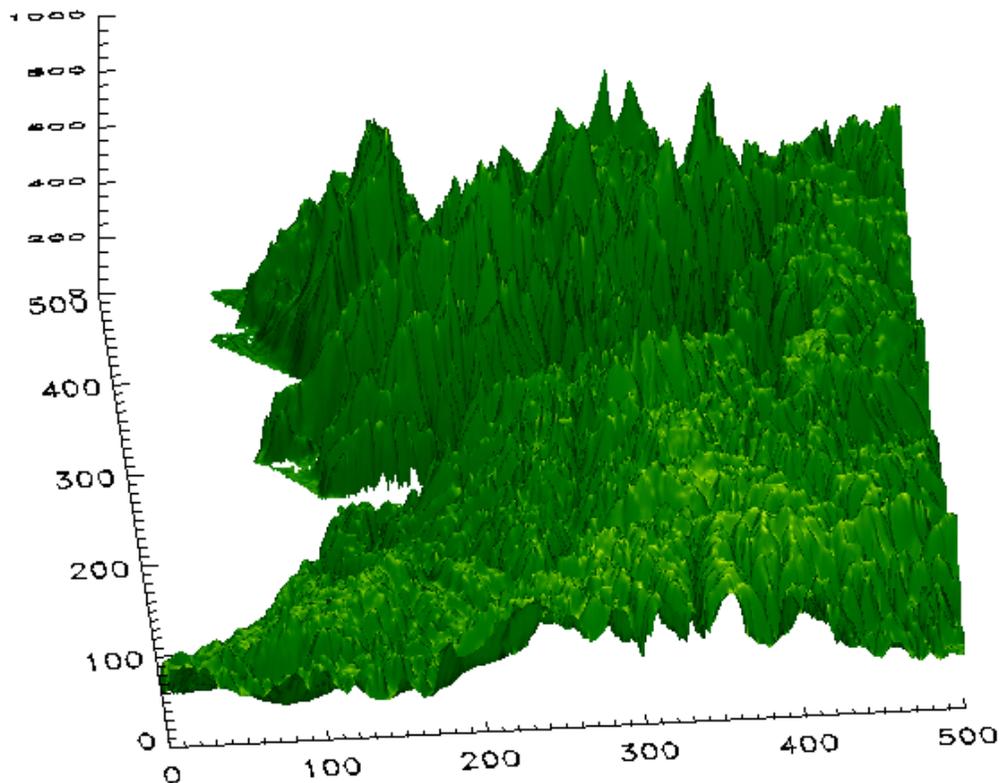
- Slope = dh/dx
- Numerical scheme puts a restriction on the maximum slope...
- Steep slopes = fast and shallow flow = model unphysical
- Suggested slope < 0.1
- A lot of Wales is steeper than 0.1 (green areas)



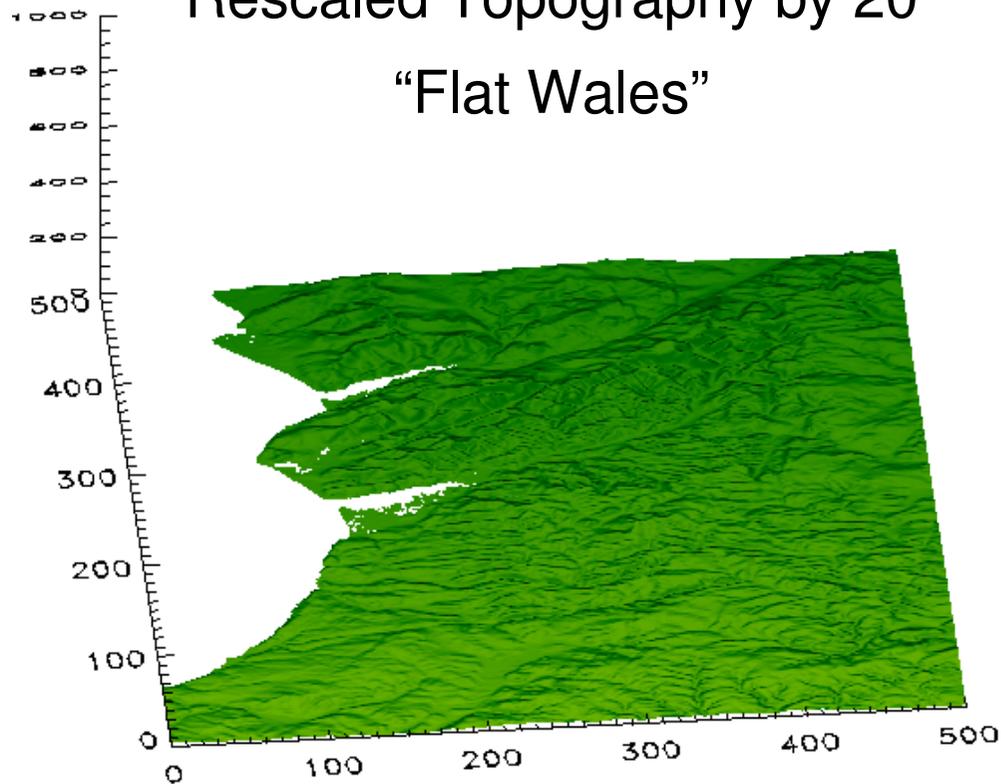


Impacts on Topography

Topography has been rescaled to meet the criteria of 0.1



Rescaled Topography by 20
"Flat Wales"

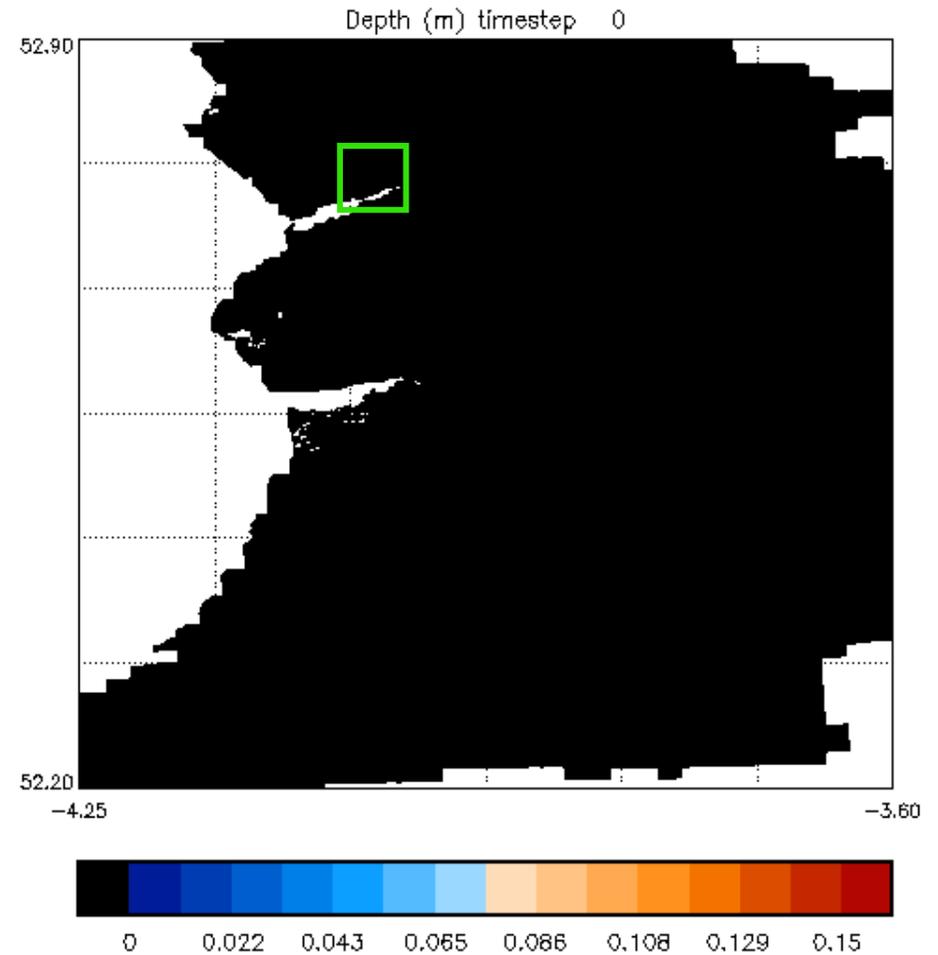
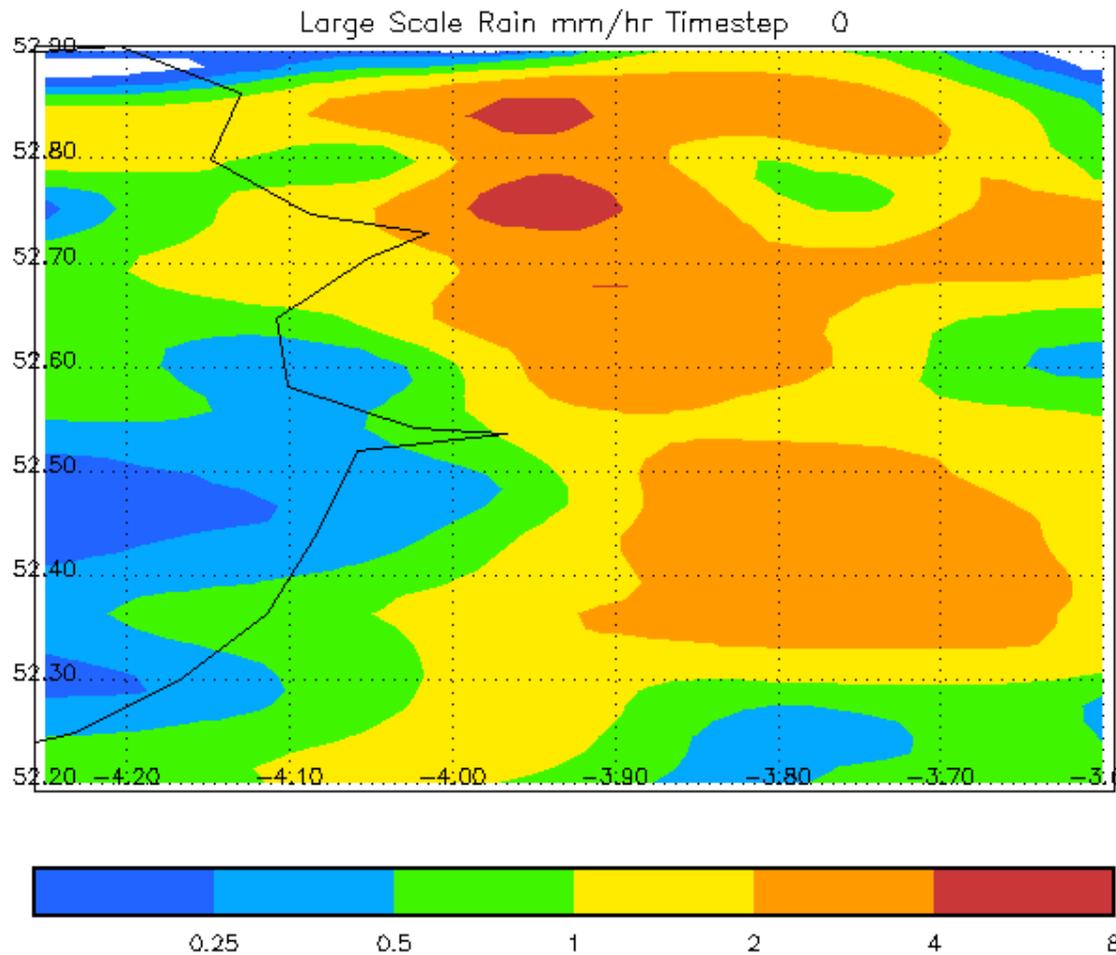


Topography (m)

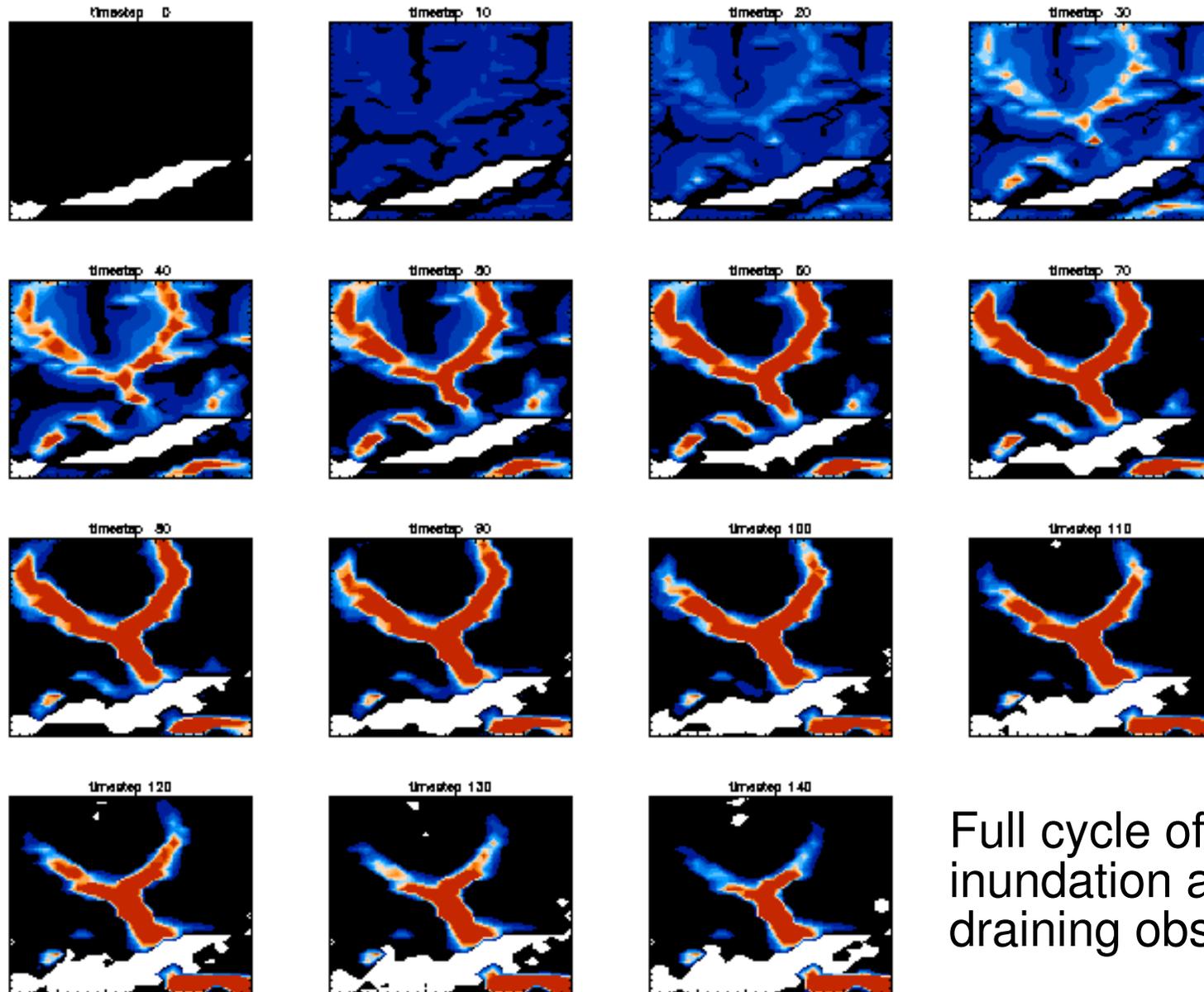
DEM Shuttle Radar Topography Mission



Results - Rainfall & Cell Water Depth



Cell Water Depth Evolution



Full cycle of
inundation and
draining observed



Summary & Further Work

- Successfully channels runoff down slopes and into rivers/sea.
 - But, limitation on slope for stability
- Possible solutions:
 - Include river in LISFLOOD
 - Domain defined by slope criteria
 - Lateral boundary condition: river discharge from routing model
- Investigate the impact of feedbacks



Met Office



Questions and answers