








Coastal flood risk – from storm surge and waves
to inundation
CIRIA, London, 26 May 2011

Inundation

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of Oxford

www.floodrisk.org.uk      EPSRC Grant:
EP/FP202511/1



Inundation






Introduction



Adaptive Quadtree Grid
Generator

Shallow flow solver

Inundation of Walcott

Concluding Remarks






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European Flood Disasters

Date	Location Origin	Deaths
1342	St Mary Magdalene, Europe River	> 6,000
1362	Grote Mandrenke, Holland Storm surge	> 25,000
1421	St Elizabeth's Flood, Holland Storm surge	2,000-10,000
1530	St Felix's Flood, Holland Storm surge	> 100,000
1634	Buchardi Flood, Holland Storm surge	8,000-15,000
1953	North Sea Flood, UK+Holland Storm surge	2,400

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Coastal flood inundation of Walcott, 8-9 November 2007





Google satellite image

Daily Mail 9 November 2007



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Flood flows ...

Three aspects:-



- wet-dry fronts
- steep-fronted trans-critical flows
- complicated terrain



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Adaptive Quadtree Grid Generator






Automatic grid generation by domain decomposition

Computationally efficient



Easy to adapt dynamically

Useful for flood simulation

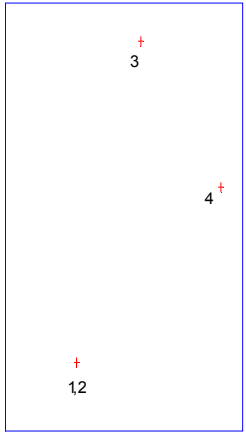
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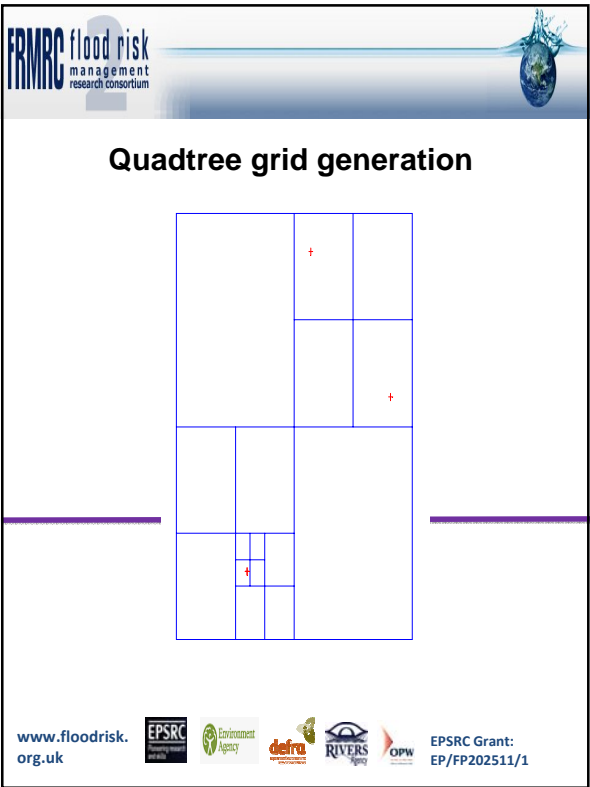
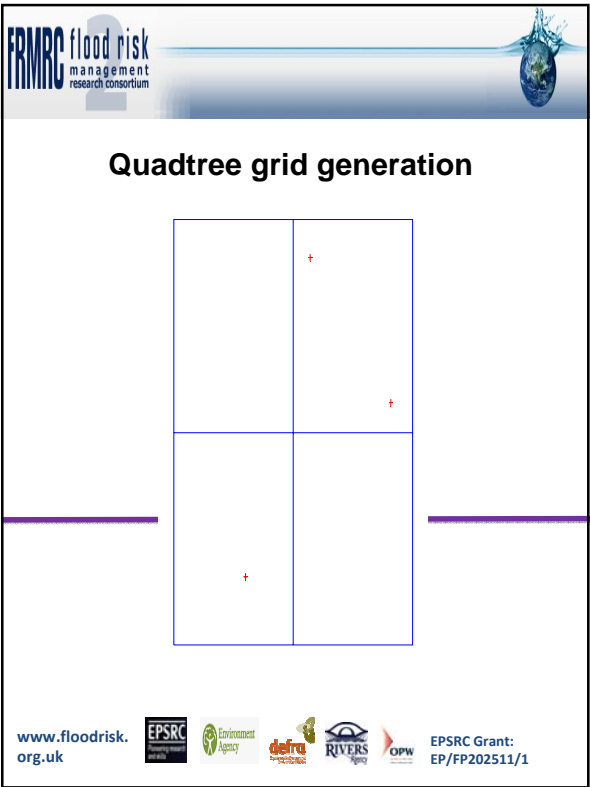
Quadtree grid generation

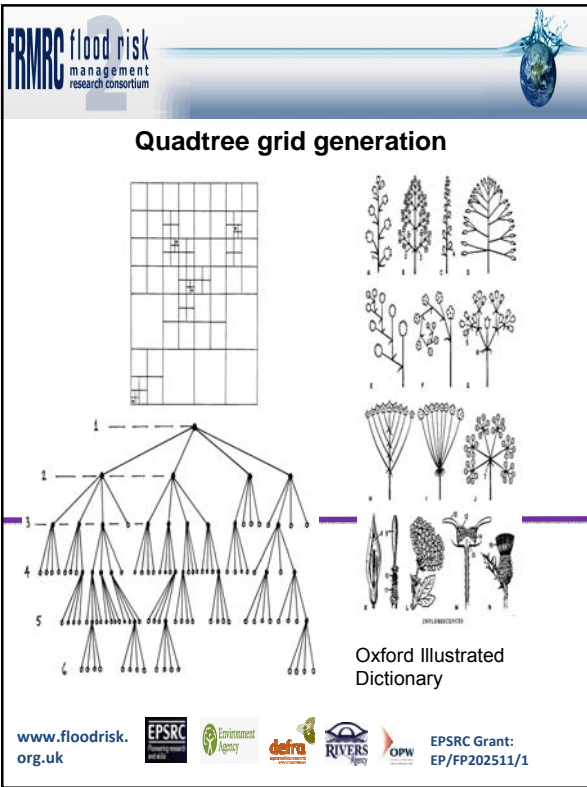
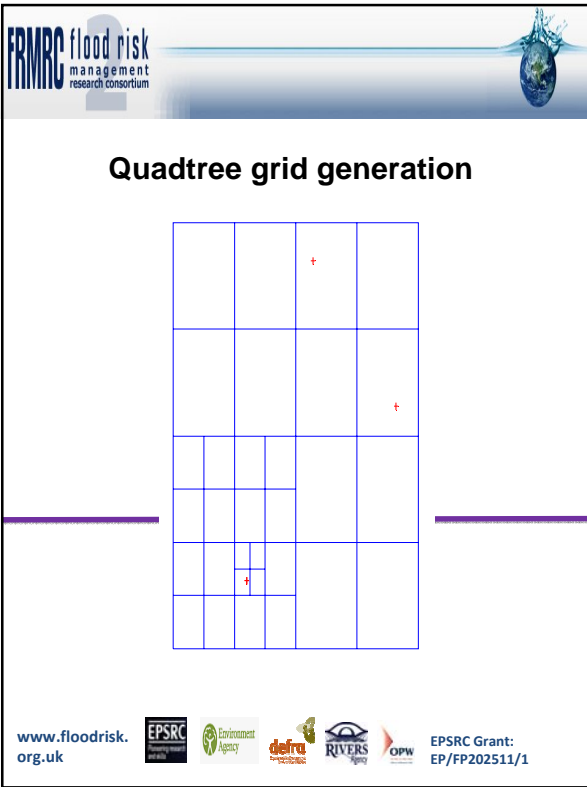


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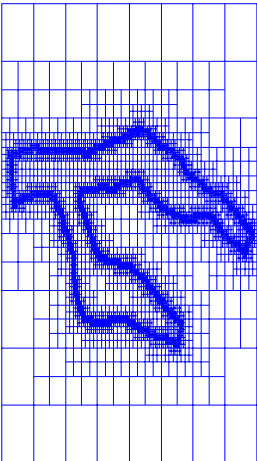
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Example quadtree grid for river bifurcation



Yiu *et al.* 1996,
Borthwick *et al.* 2000

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Shallow water-sediment Solver



Governing equations:

- Mass conservation for water-sediment mixture
- Momentum conservation for water-sediment mixture
- Suspended sediment transport equation
- Bed load transport formula


Bed material conservation equation

Solved using shock-capturing finite volume scheme


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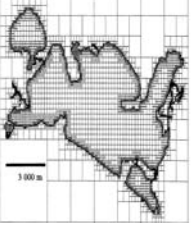
Shallow lakes and lagoons








Lake Balaton, Hungary

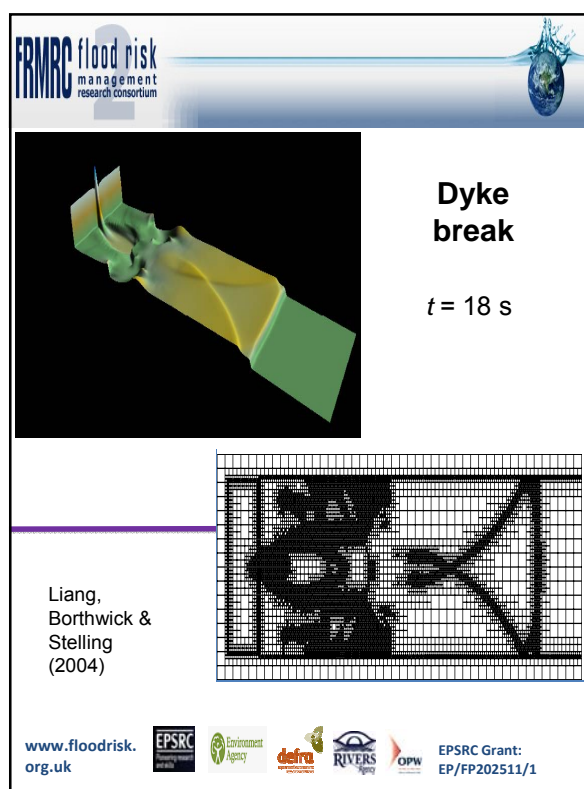
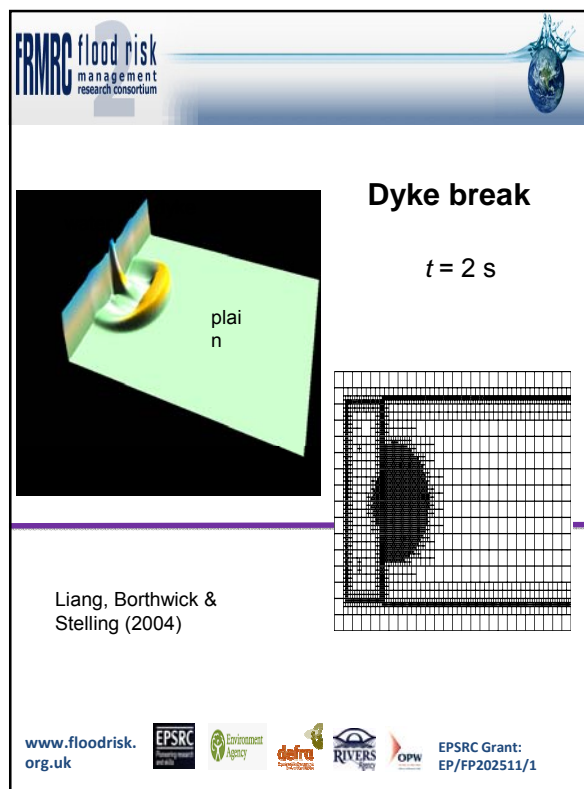


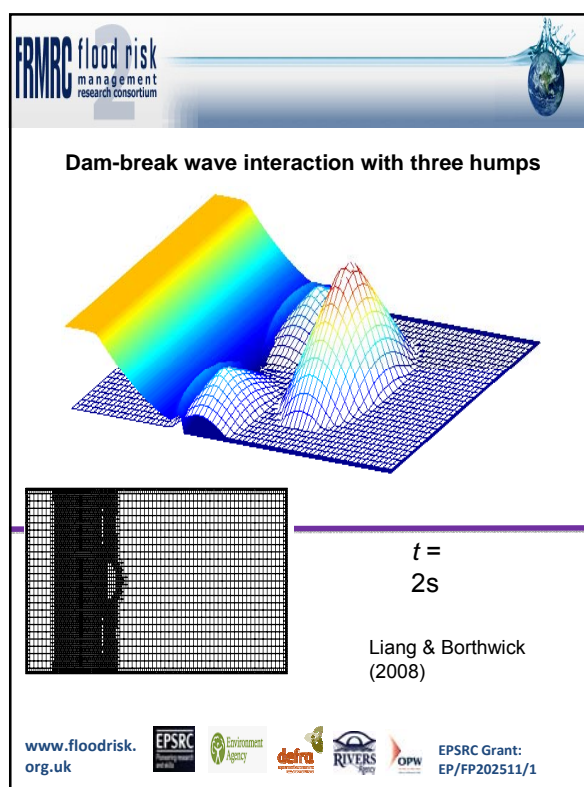
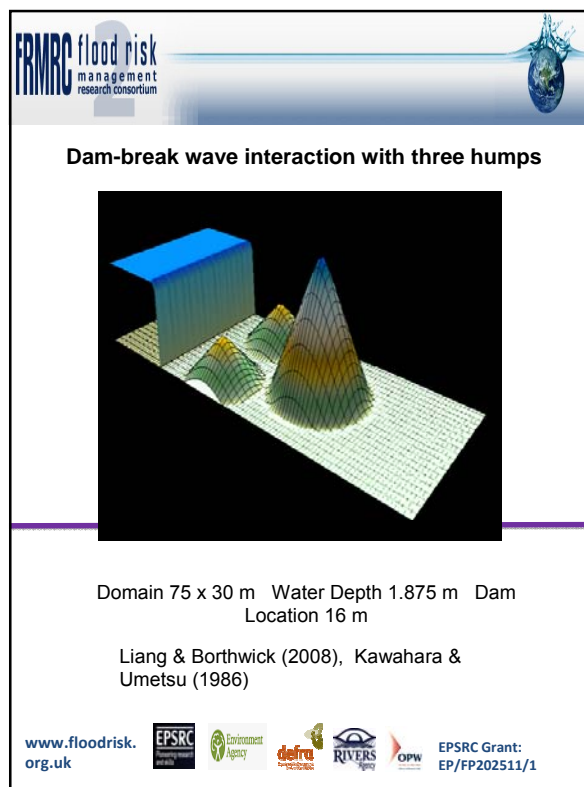
Nichupté Lagoon, México

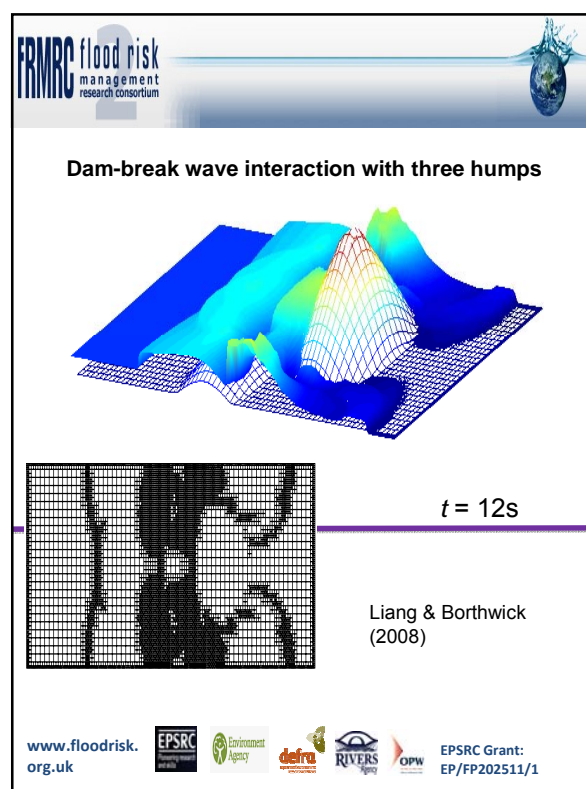
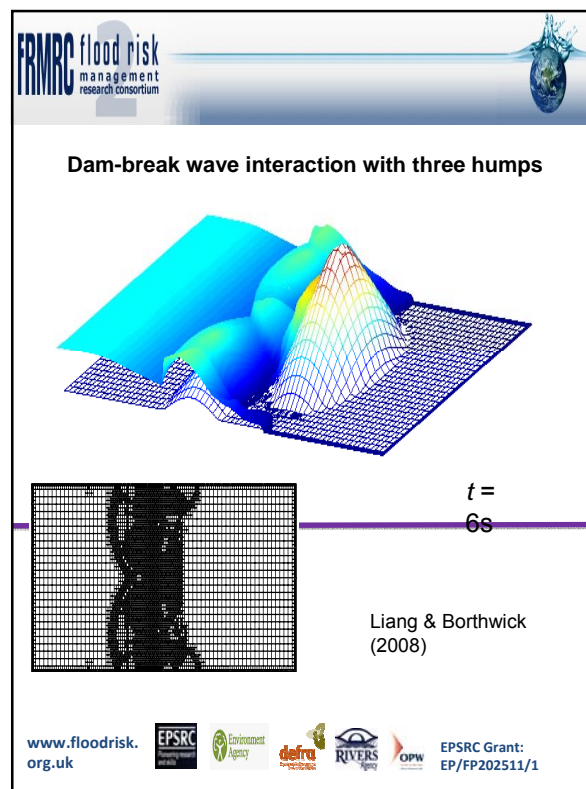


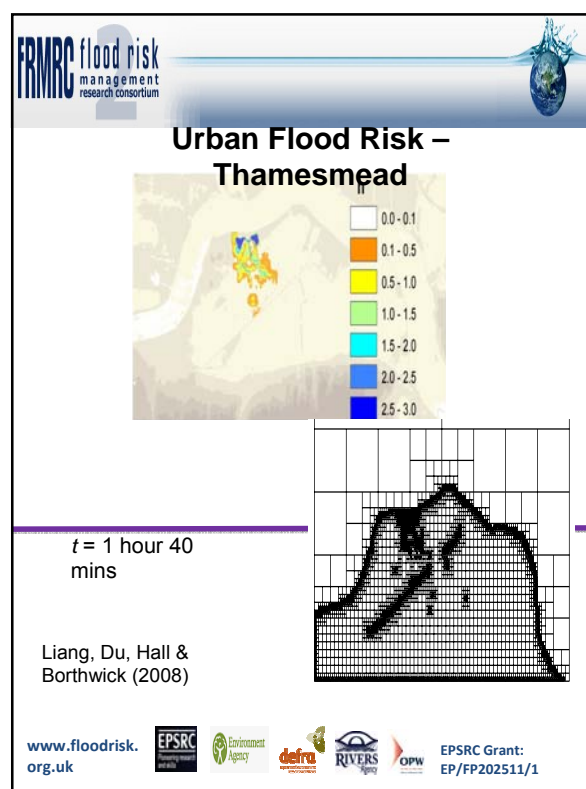
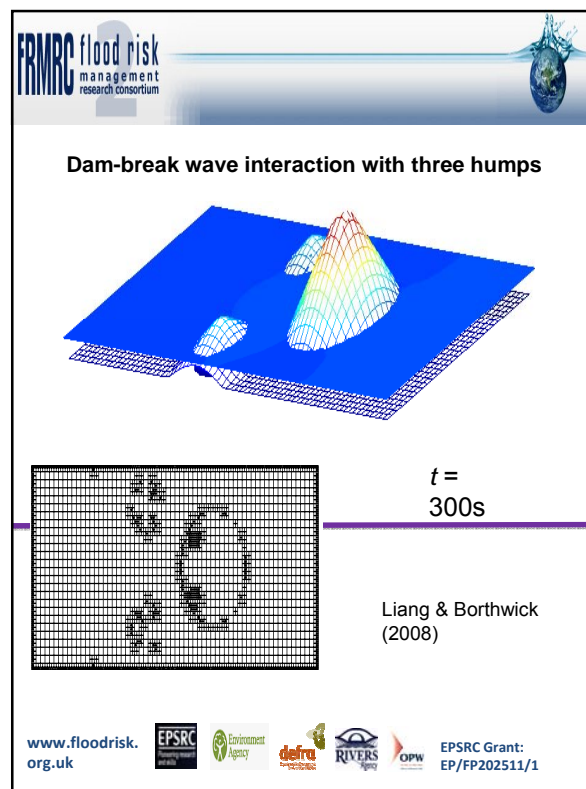
Borthwick, Cruz León, and Józsa (2001)

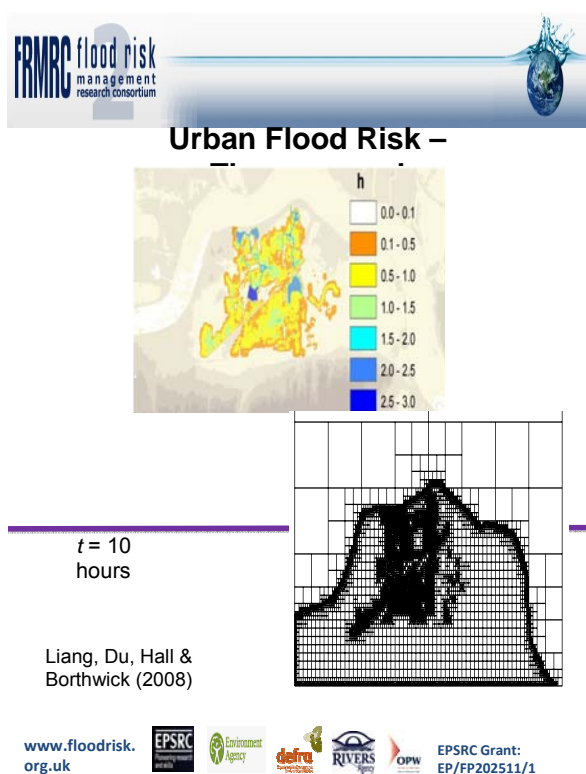
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Photographs of Walcott, 14 January 2010




Yan (2010)

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Photographs of Walcott, 14 January 2010

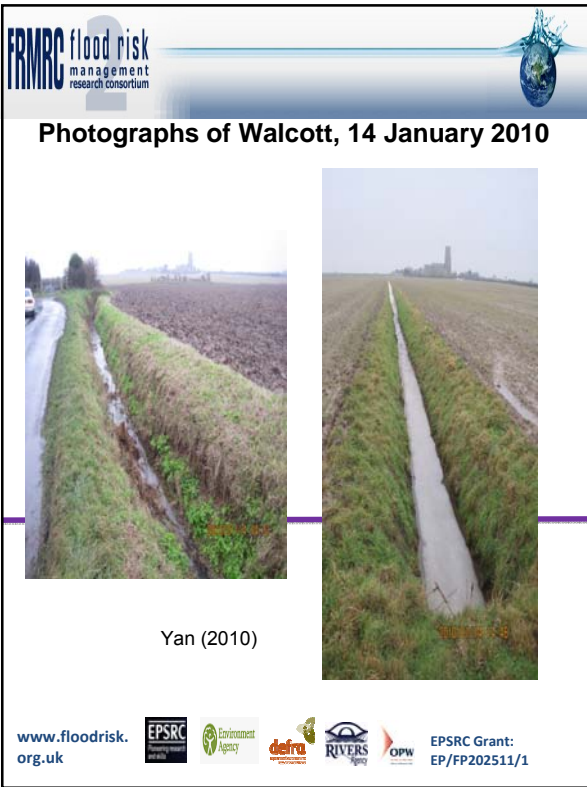
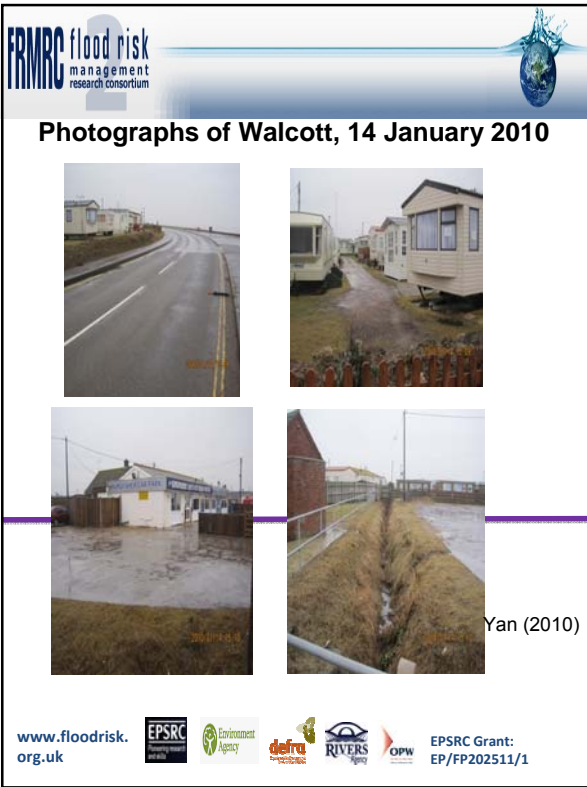


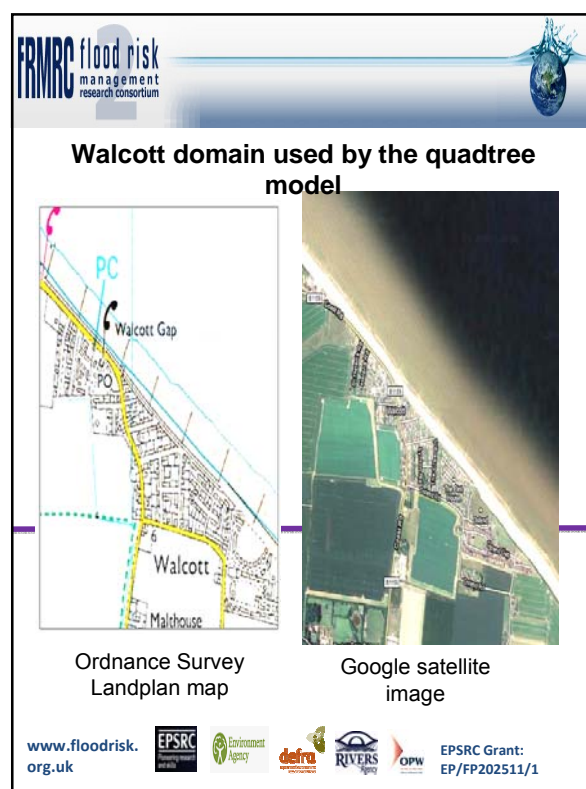
Yan (2010)

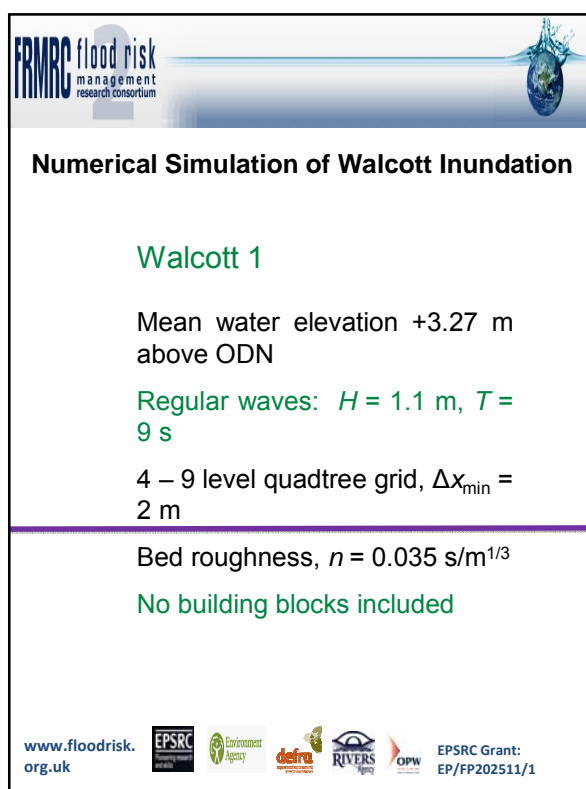
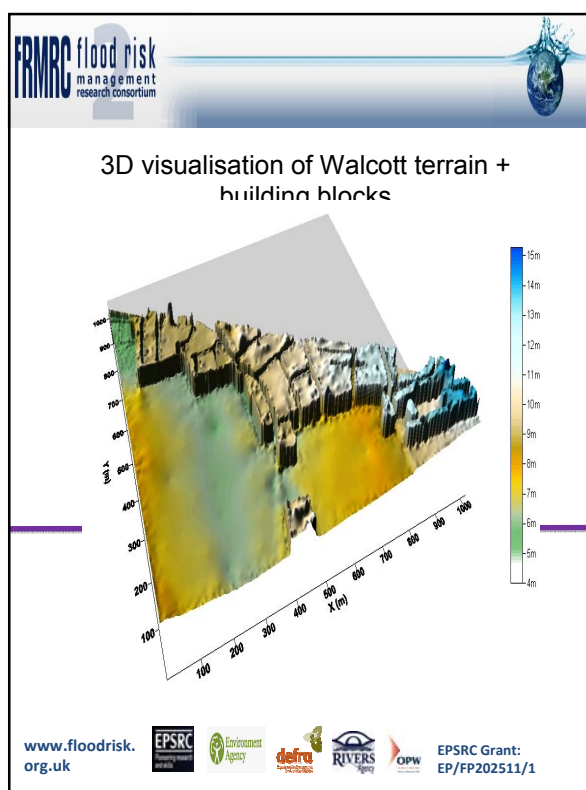
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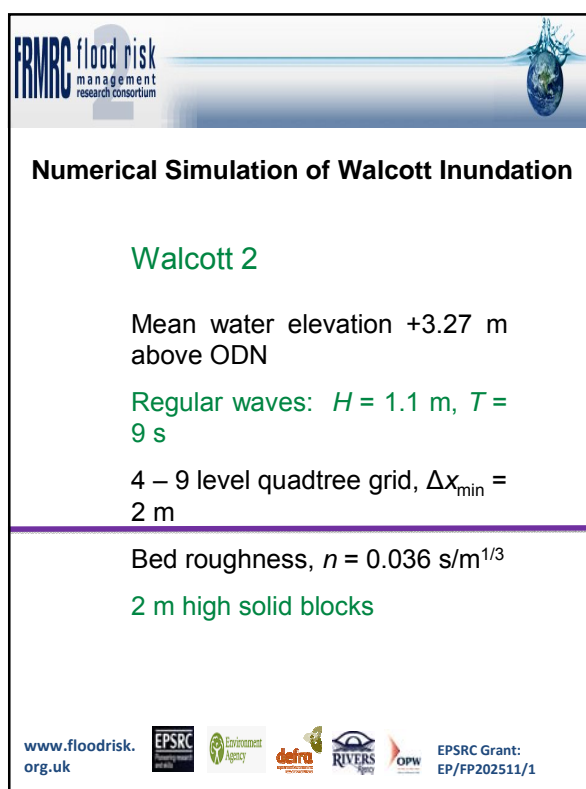
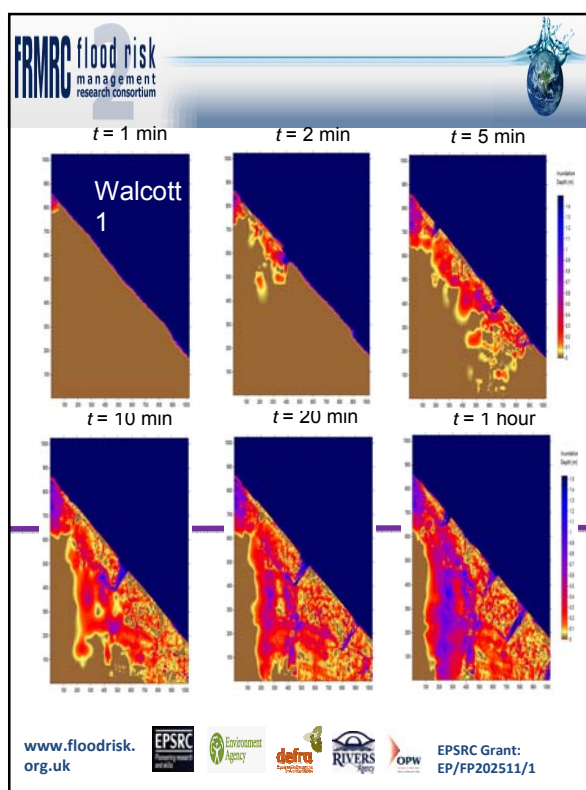


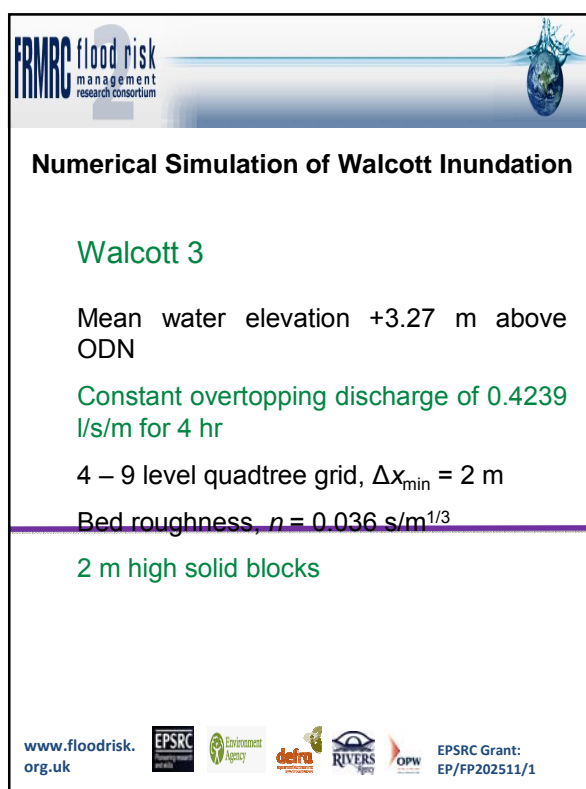
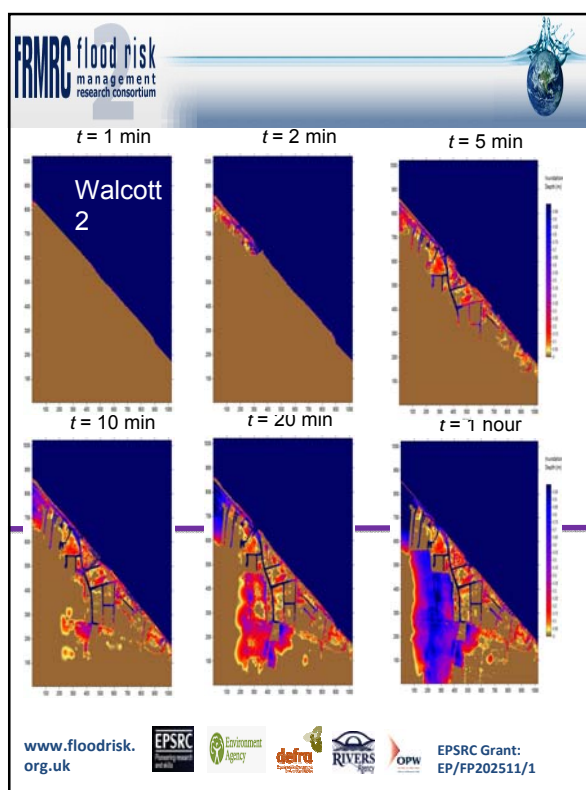
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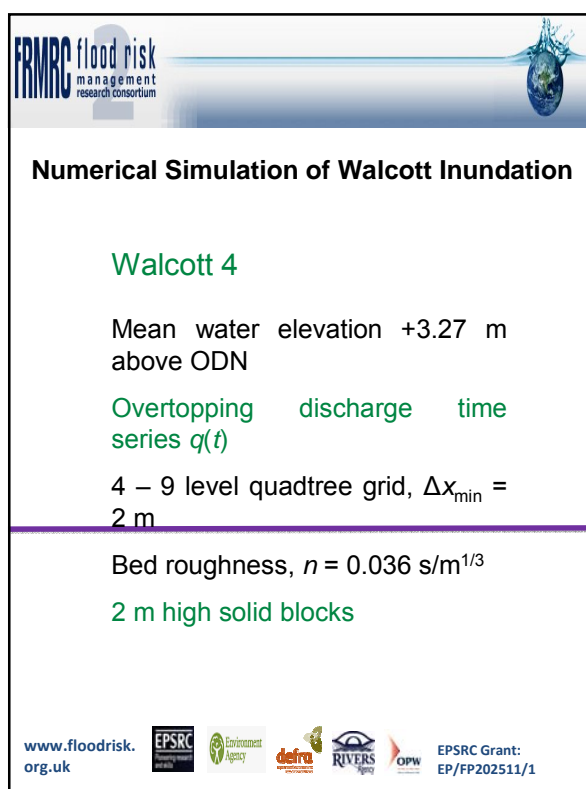
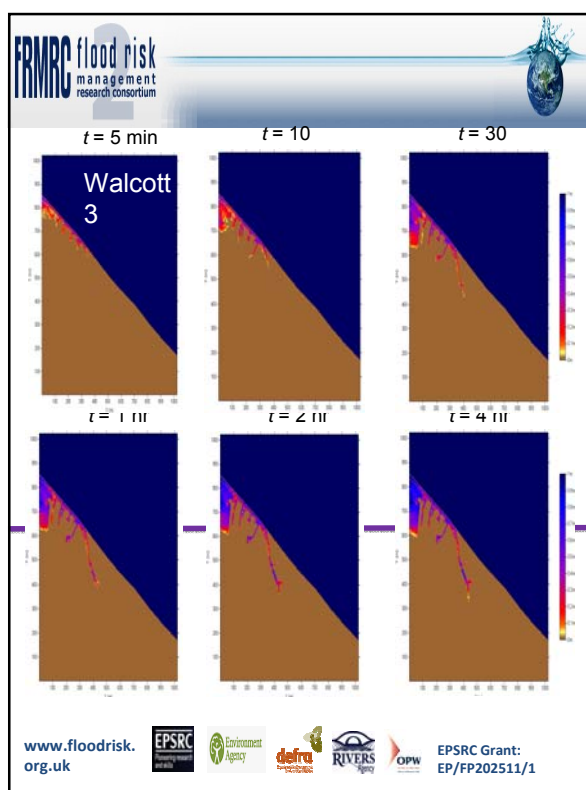


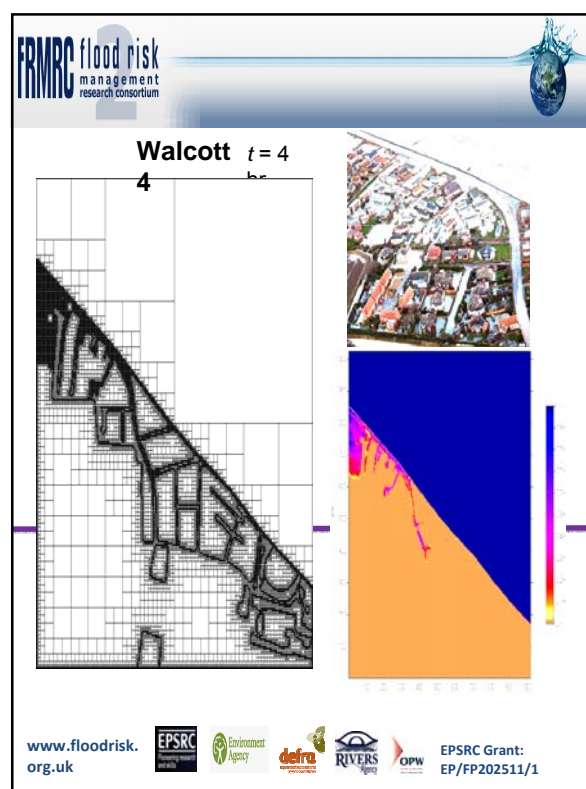
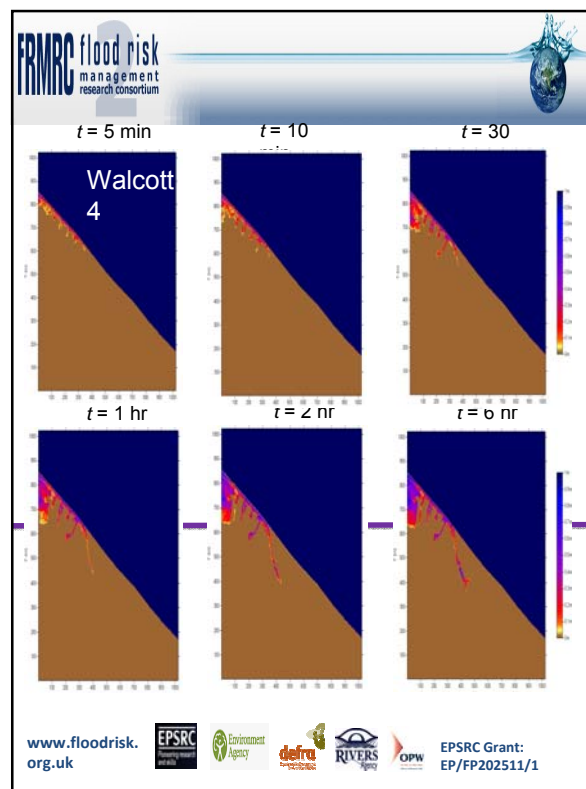
















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Conclusions






Dynamic quadtree grids useful in simulating flood inundation

Recommended that buildings are represented as solid obstacles rather than using bed roughness or porosity

Simulation of Walcott inundation reveals importance of hydraulic network of road channels and ponds (fields)

Similar flood evolution maps for constant and time-dependent wave overtopping events in Walcott

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