Tales from the JULES river bank

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With thanks to Alberto Martinez, Simon Dadson, Helen Davies, Vicky Bell, Toby Mathews, ...
Towards integrated environmental models of everywhere: uncertainty, data and modelling as a learning process

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Abstract
Developing integrated environmental Water Framework Directives in Europe raises questions about system of places, which might well be treated value of different types of data in a pedagogy of such uncertain prediction.

Keywords: hydrological models, key

A unified approach for process-based hydrologic modeling: 1. Modeling concept


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Towards more integrated approaches to natural hazard prediction

From the National Flood Resilience Review to future capability
Challenges

• Skilful hydrology predictions everywhere, all the time?
• Additional model complexity, additional constraints
• Additional model parameters (and calibration?)
• Moving from 1D vertical problem to 3D connectivity
• River flow assimilation and balance with sfc exchange
• …
Towards coupled prediction?

ATMOSPHERE
- Wind
- Surface stress
- Wind, Pressure, Temperature, Radiation, Surface fluxes
- SST, Currents

WAVES
- Wave height, Sfc stress, Btm stress, Dissipation
- Currents, Depth

OCEAN
- Currents, Bottom stress
- Freshwater, Nutrients, Temperature

LAND SURFACE
- Radiation, Temp, Precip, Evap
- Surface fluxes

SEDIMENTS/BIOGEOCHEM
The building blocks are in place…

39001, PDM, $b=0.15$, $z_{pdm}=1.0$, $S_0/S_{max}=0.0$

39001, PDM, $b=0.25$, $z_{pdm}=1.0$, $S_0/S_{max}=0.25$

39001, PDM, $b=0.4$, $z_{pdm}=1.0$, $S_0/S_{max}=0.5$

39001, PDM, $b=2.0$, $z_{pdm}=1.0$, $S_0/S_{max}=0.75$

[Alberto Martinez de la Torre, CEH]
Applying slope dependent $S_0$

[Alberto Martinez de la Torre, CEH]
Test $c_r$ river wave speed sensitivity

[Alberto Martinez de la Torre, CEH]
Regional coupled prediction at high resolution
1.5 km river flow predictions

Met Office Unified Model rainfall
UKA3g Precipitation rate (mm h⁻¹)
[201506300100 T+01]

JULES kinematic wave routing river flow
UKA3g Discharge to sea from rivers (m³ s⁻¹)
[201506300037 T+00]

[Huw Lewis, Met Office]
UKV-driven standalone JULES initialisation run (2010-2015)
Implementation in UKC2

UM-JULES

E.g. Initialising sub-surface runoff
12 km resolution global atmosphere
Towards $1/12^\circ$ resolution global ocean

...and what about land surface science??
Prototype 0.1 deg flow directions in blue. Base 0.00833 deg flow directions in red.

River visible at catchment area > ~2000km²
Increasing resolution of river routing grid

JULES run:
0.5 deg. WFDEI forcing
1981-2000
dt = 30min
Kinematic wave routing

[In collaboration with Helen Davies and Vicky Bell, CEH]
JULES routing infrastructure

- From 2D (pre vn4.8) to 1D (vn4.8+) standalone routing

- RFM “vs” TRIP
  - Both similar implementations of kinematic wave routing
  - Need to support additional infrastructure (e.g. irrigation, inundation) consistently
  - TRIP looping algorithm becomes increasingly slow at higher resolution! Quicksort??

- Future development
  - Rationalising UM vs standalone routines; consolidating TRIP ‘vs’ RFM
  - Evolving from kinematic wave to diffusion wave representation
  - Towards integrated land surface+hydrology and data assimilation….
And not to forget….

…forcing characteristics continue to evolve!

- UKV2 PS38 (LS)
- UKV2 PS38 + convection scheme (LS + conv)
- Radar

Scale: 0.2 - 256.0 mm h⁻¹
End-to-End Assessment of Risk: From Global Weather to Local Impact

N x Global simulations at ~10km: Synoptic drivers

< N x Regional simulations at ~1km: Local meteorology

e.g. Flooding scenarios:

….and for the hour, day, week, month, year, decades ahead
Thank you

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