The implementation of lateral flows in stand alone JULES

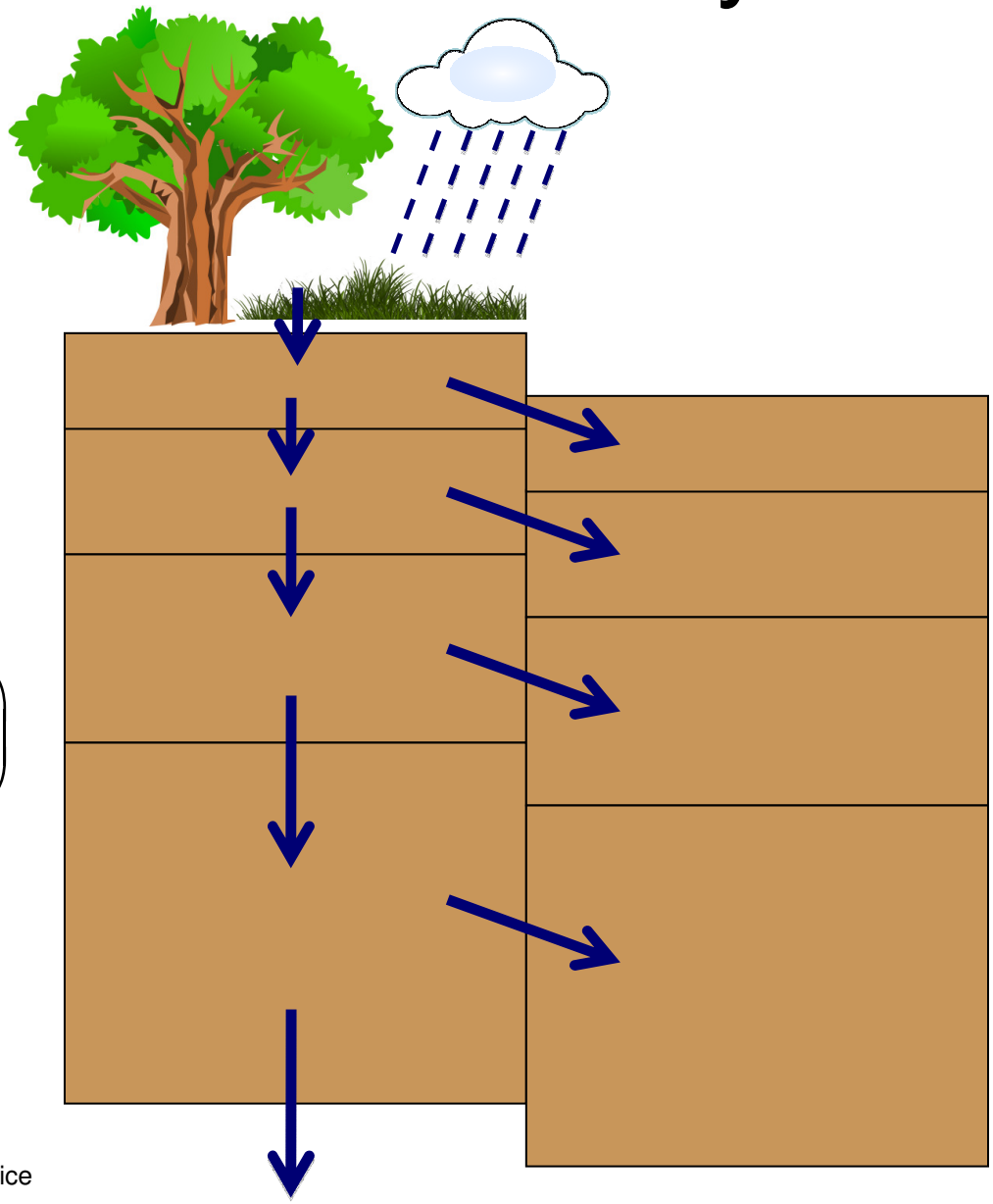
Heather Ashton, Martin Best + others

JULES Meeting, 19th-20th June 2013

Overview

- What are lateral flows?
- Why?
- How?
- First results
- Future work

What do I mean by “lateral flows”?



JULES Vertical Flow

$$W_z = K\left(1 + \frac{\partial \psi}{\partial z}\right)$$

Lateral flow

Motivation?

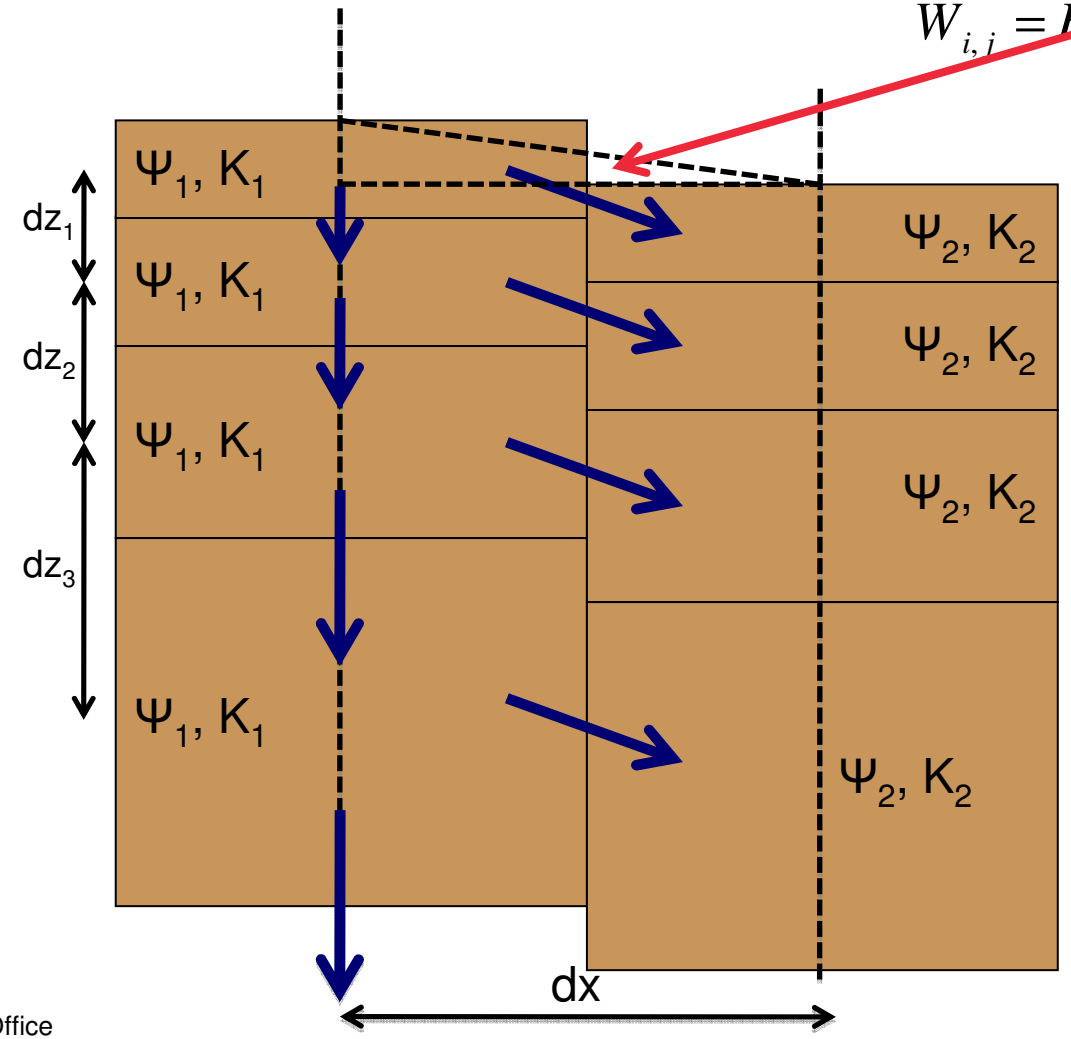
- High resolution soils need lateral flows
  - NWP models at high resolution (1.5km)
  - Plans to test impact of running high resolution soil in low res model (EMBRACE)
- Orography is resolvable
  - Orographic enhancement & wet valleys
- Continental warm bias?
- Impacts on things we care about…
  - River flow, inundation, surface water flooding

How?…

$$W_{i,j} = K_{min}\left(\sin\alpha + \frac{\partial \psi_{i,j}}{\partial x}\right)$$

JULES Vertical Flow

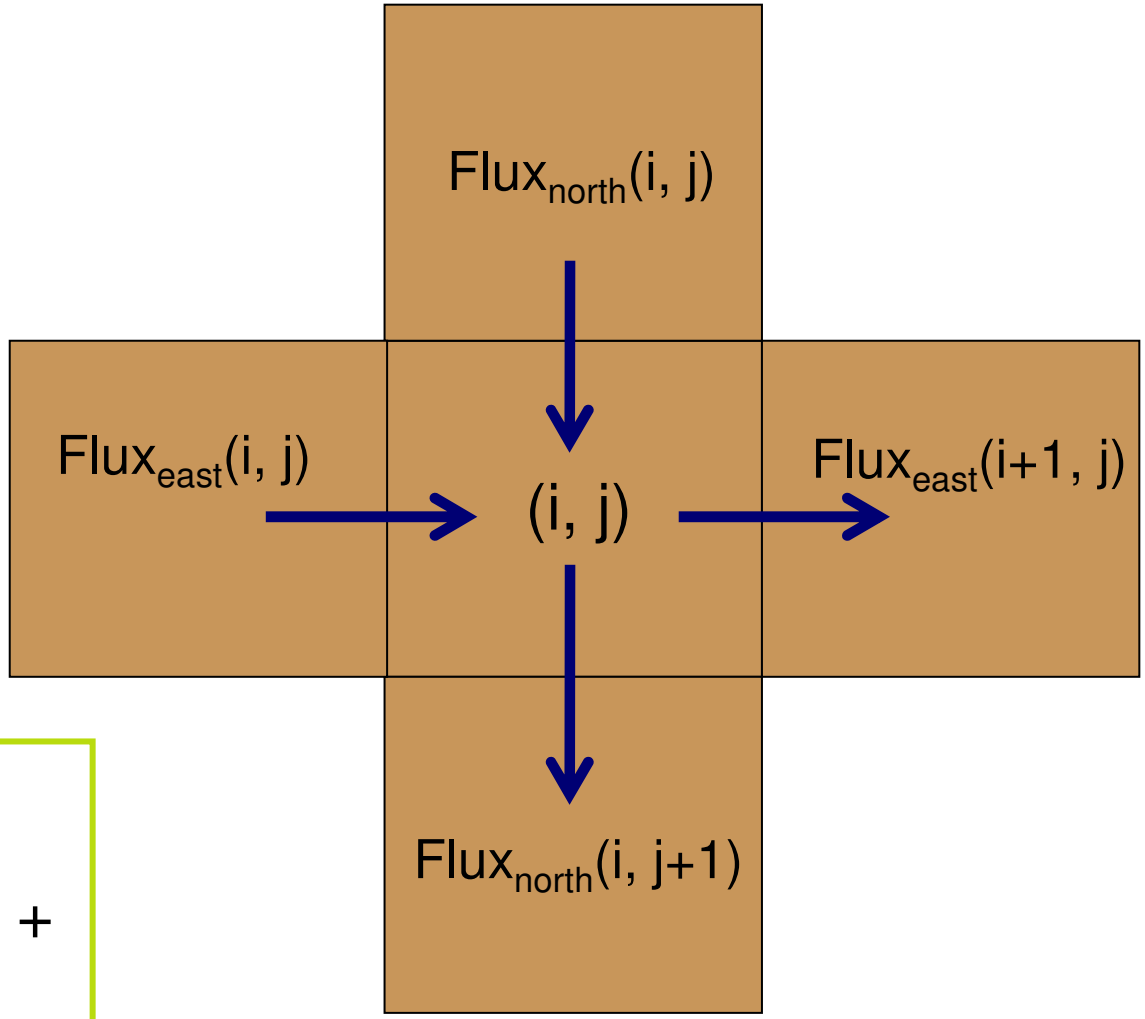
$$W_z = K\left(1 + \frac{\partial \psi}{\partial z}\right)$$



Lateral flow

How?…

- Fluxes converge
- Explicit increment added to soil_hyd
- Vertical flows deal then with super sat.



Lateral flow inc(i,j) =

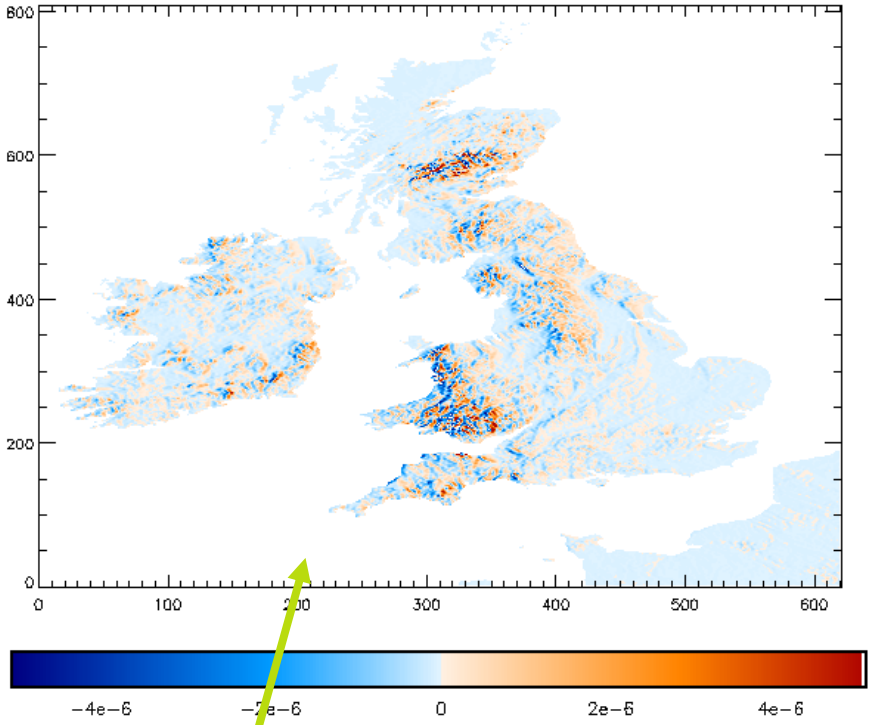
$flux_{east}(i,j) - flux_{east}(i,+1,j) +$

$flux_{north}(i,j) - flux_{north}(i,j+1)$

- Tested using MetUM UKV driven JULES
- Surface water flooding event in Wales…

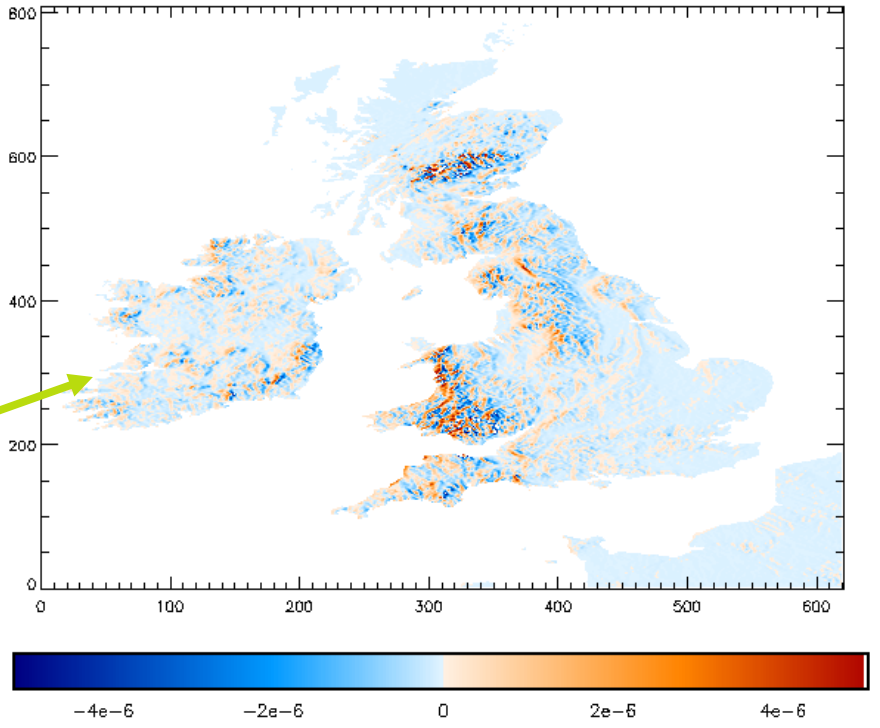
Results – Slopes & Lateral Fluxes

East Flux



- Similar, but opposite sign
- Slope more important than $\left(\frac{\partial \psi_{i,j}}{\partial x}\right)$

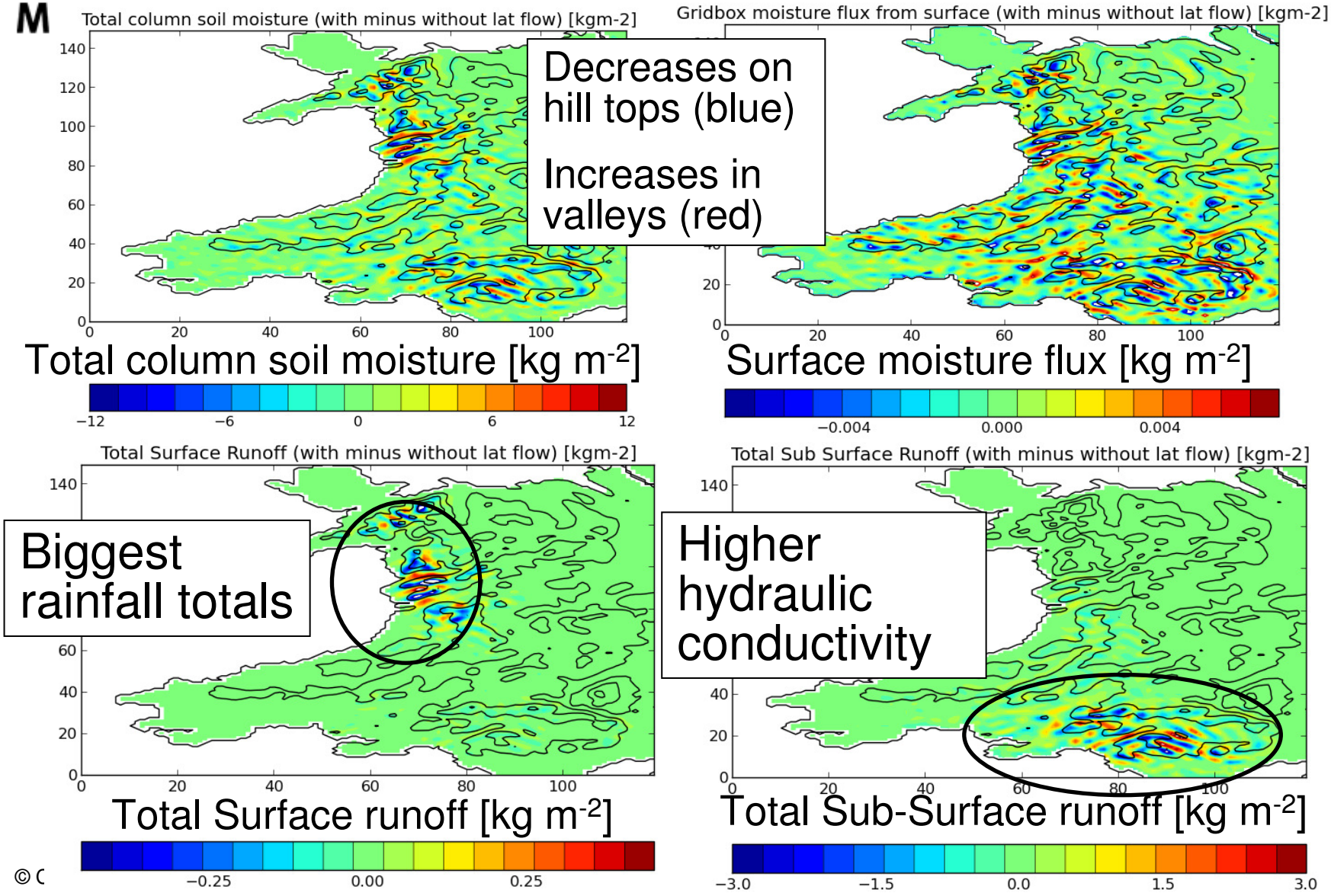
East Slope * K_{min}



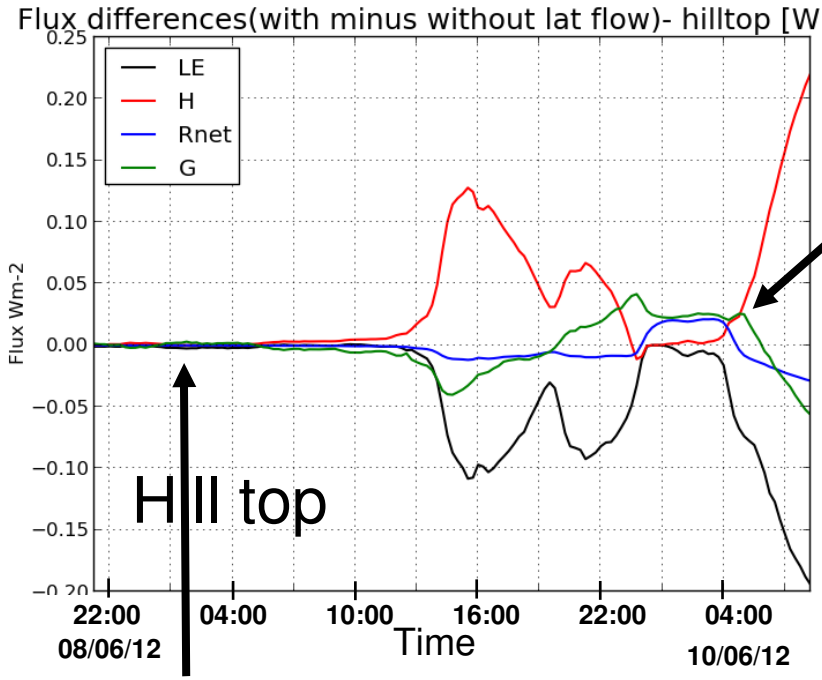
$$W_{i,j} = K_{i,j}\left(\sin\alpha + \frac{\partial \psi_{i,j}}{\partial x}\right)$$

Results: Cumulative water fluxes

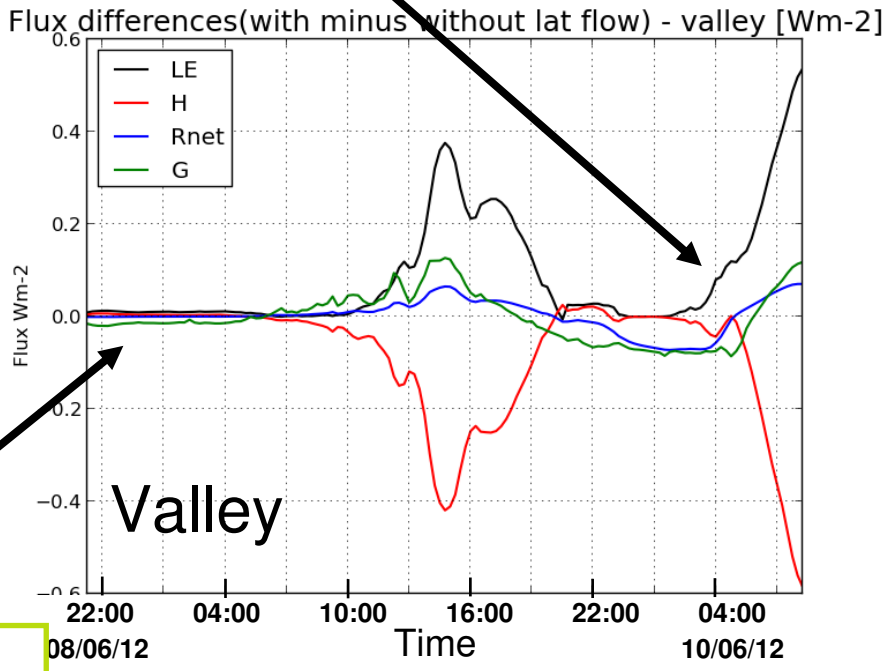
Contours – UKV 1.5km Orography (source: DTED 1km)



Results: Time series of surface energy fluxes differences



Sunrise



Very little change until rain stops

Overall, small change

Hilltops - LE decrease, H increase

Valleys - opposite

$$LE + H = R_n - G$$

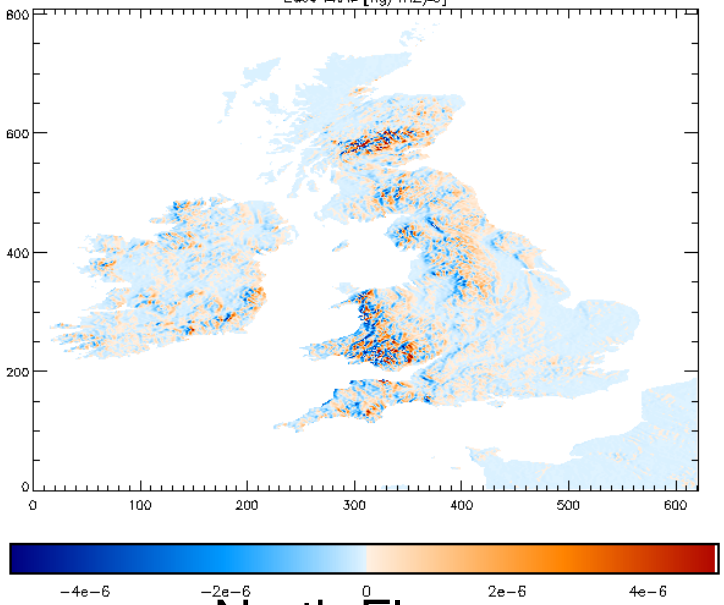
Future Work

- Standalone JULES running with high res soils & lateral flows forced with WFDEI
- Integrate high res soils & lateral flows into UM
  - Parallelization?
- Aggregating over soils?

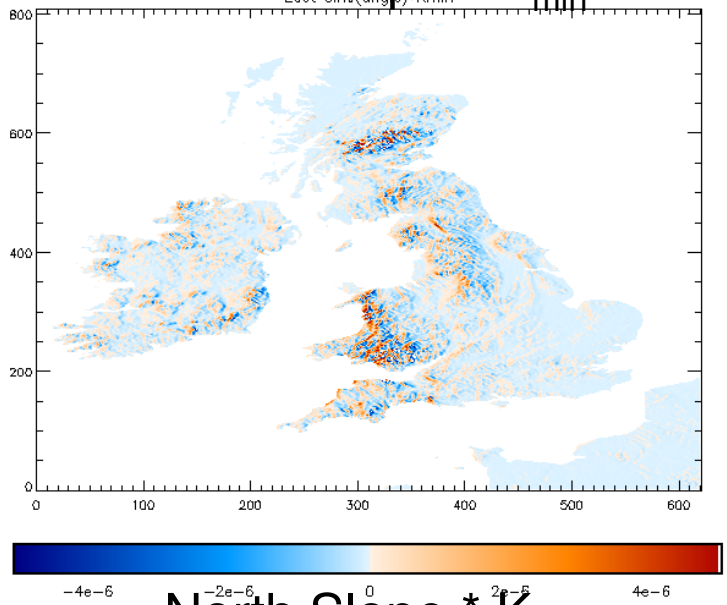
Any Questions?

Results – Slopes & Lateral Fluxes

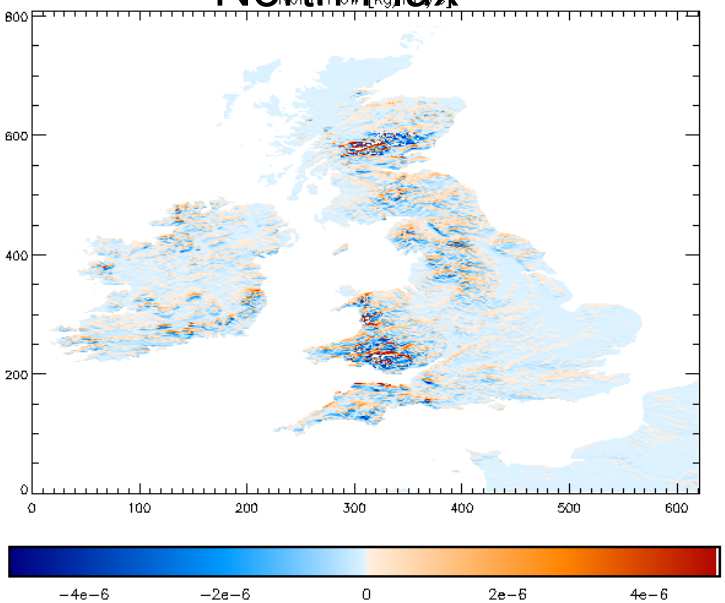
East Flux



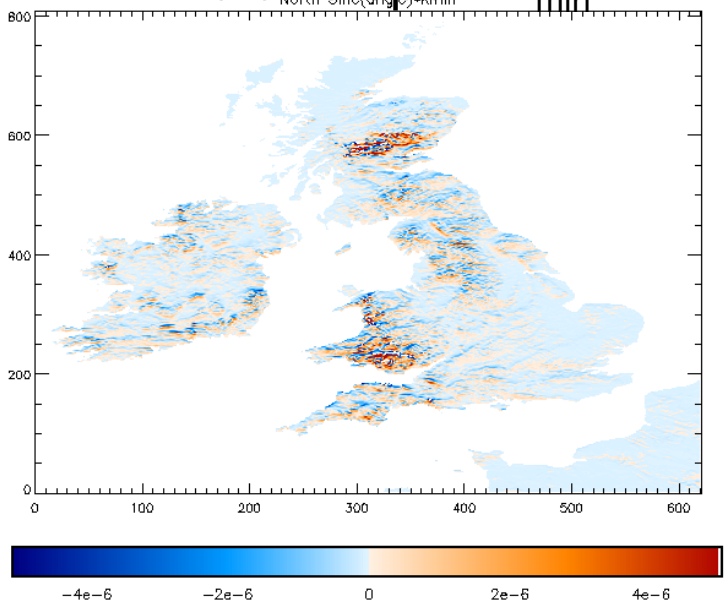
East Slope * K_{min}



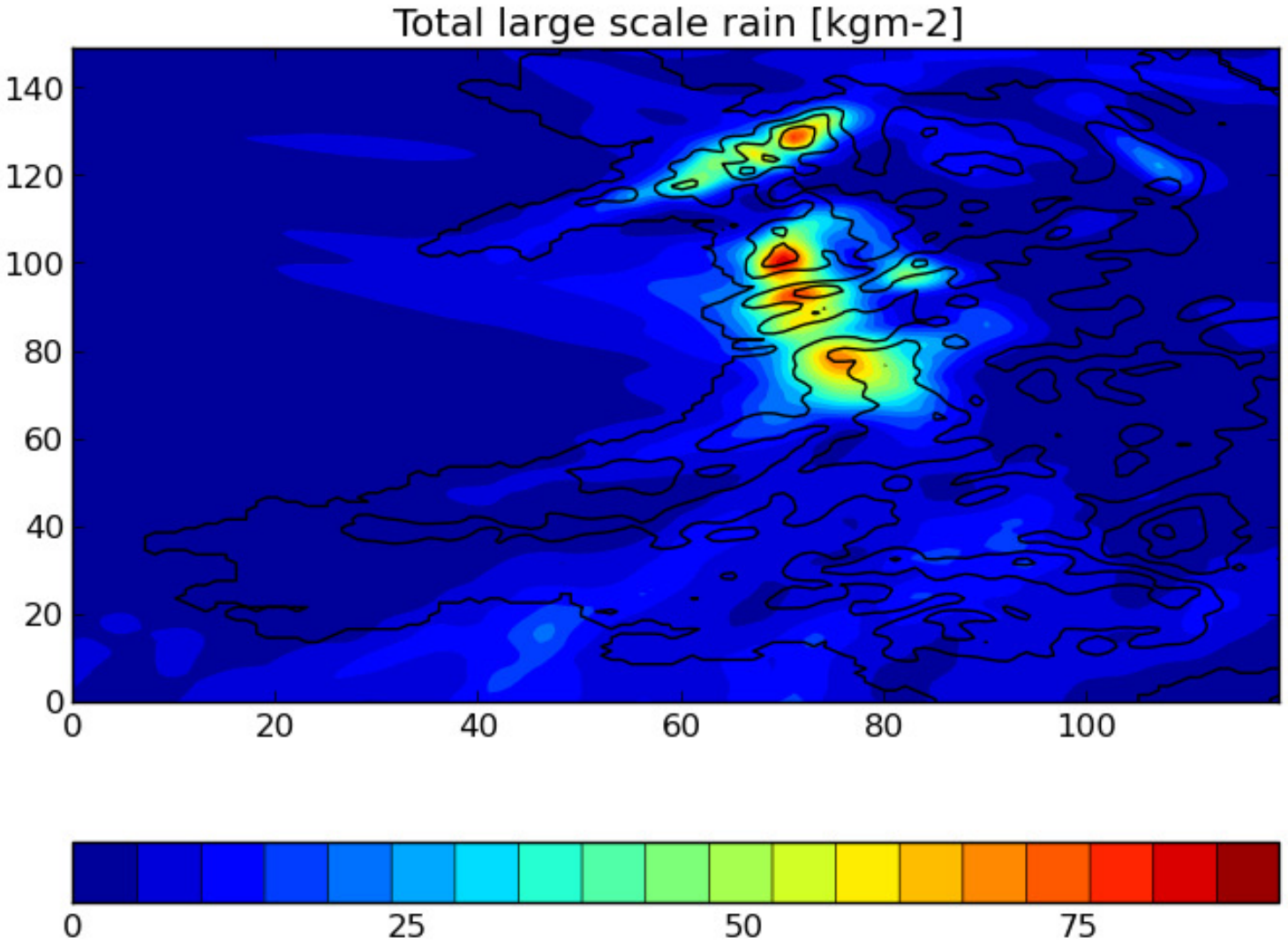
North Flux



North Slope * K_{min}



Total Large Scale Rain



Hydraulic conductivity (K_{min}) [$kgm^{-2}s^{-1}$]