ExaJULES
Model design for a JULES LFRic miniapp

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UK Centre for Ecology & Hydrology

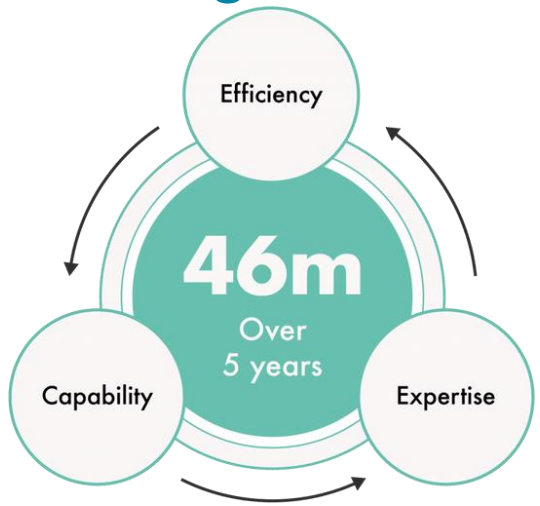
Strategic Priorities Fund: ExCALIBUR

Exascale Computing ALgorithms & Infrastructures Benefiting UK Research

Research programme to deliver the next generation of high-performance simulation software for the highest priority fields in UK research

Four themes:

1. High priority use cases
   - Weather & climate
   - Fusion modelling system
2. Emerging requirements for High Performance Algorithms
3. Cross-cutting research
4. Hardware and enabling software



Separation of concerns	Co-design
Data science	Investing in people

ExCALIBUR Weather & Climate Use Case

Redesigning current simulation codes to exploit upcoming radical changes to supercomputer architecture

Commissioned by Met Office

Three WPs:

1. Component model co-design
2. System co-design
3. System integration

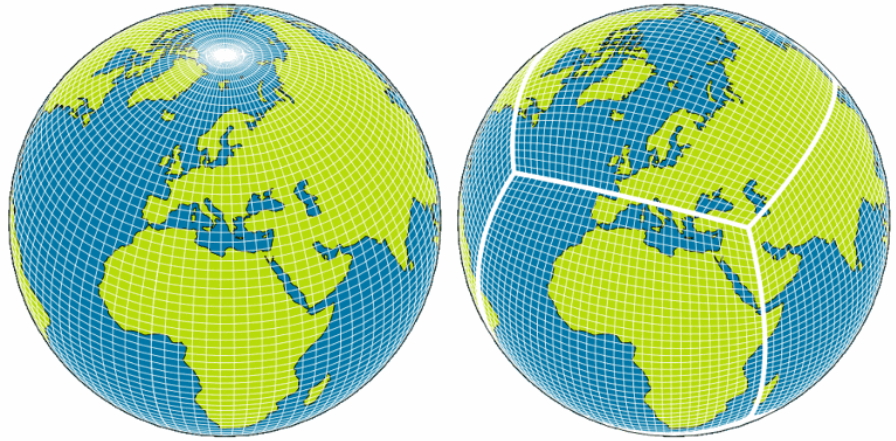
LFRic and Momentum

Momentum
The Unified Earth Environment Prediction Framework

Met Office

Science and Technology Facilities Council

- LFRic software infrastructure to replace UM
  - Take advantage of next generation exascale platforms
  - GungHo: New dynamical core
  - Psyclone: Auto-generation of parallel code
  - Xios: New approach to i/o
- Forecasts running in parallel with UM



Science code should be agnostic to how it's being called

JULES in LFRic

- JULES code is ‘LFRic ready’ in as much as it can be compiled as part of atmosphere BUT
  - Not good separation of concerns
  - JULES standalone can’t take advantage of the LFRic technical advances

- LFRic technical infrastructure designed around ‘miniapps’

ExaJULES project will design a prototype JULES LFRic miniapp

ExaJULES

- Develop a prototype JULES standalone LFRic miniapp
  - Benchmarking
  - Performance improvements
  - Coupling components on varying grids
  - Engage with JULES and ExCALIBUR communities
  - Apr 2023 – Oct 2024

UK Centre for Ecology & Hydrology

- Emma Robinson
- Rich Ellis
- Doug Clark

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

- Bryan Lawrence
- Grenville Lister
- Simon Wilson
- Dave Case
- David Livings

Met Office

- Rich Gilham
- Martin Best
- Nigel Wood

Benefits

- Simplified pull through of science from JULES to coupled model
- Shared technical infrastructure
- Allows JULES to exploit developments in supercomputer infrastructure
- Potential performance gains
- Unlock new possibilities

Miniapp design

Will not affect science code!

1. Technical infrastructure of miniapp to replicate current JULES capabilities in LFRic repository
2. Coupling interface between JULES and atmosphere and more

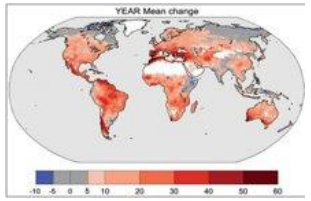
Must be able to carry out all standalone JULES supported grids and time resolutions

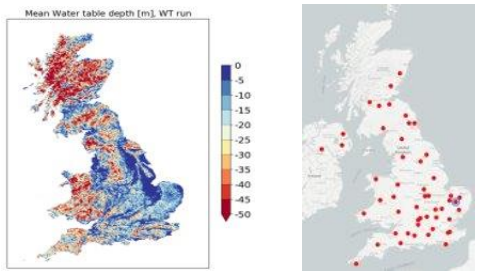
Ocean

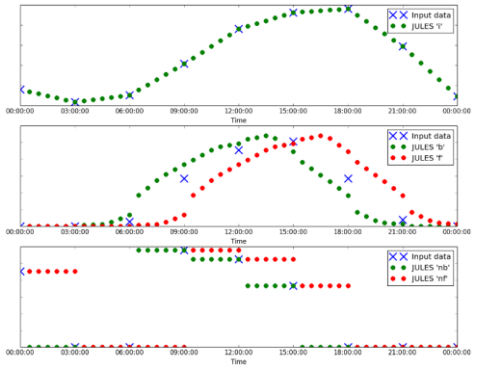
JULES

DA

GW



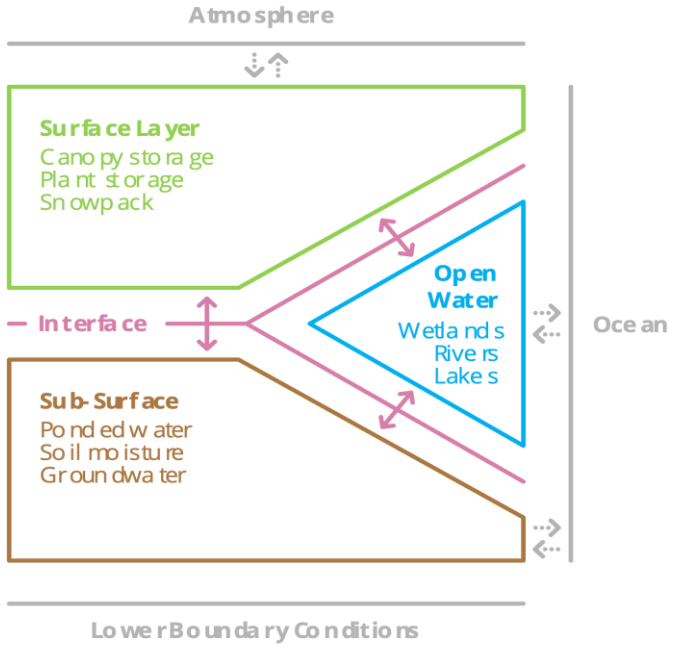


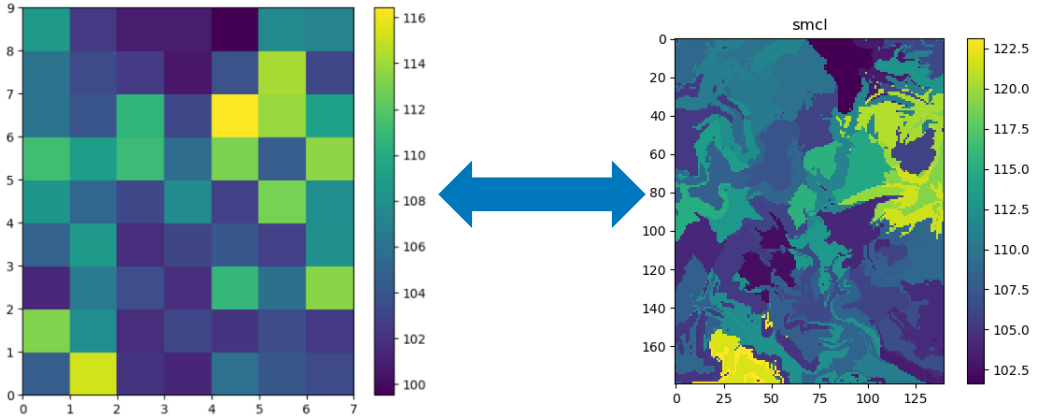


Meshes and coupling

Hydro-JULES

- Currently everything (except rivers) must run on the same grid
- Potential for coupling varying meshes
  - Land-atmosphere coupling
  - Coupling between land components
- Relationship to Hydro-JULES
- How does this interact with standalone rivers developments?





Benchmarking

- Benchmarking with JULES-PL suite
  - 170 flux sites
  - Standard metrics
- Soil carbon spin-up test case
  - Centennial scale run
  - Test on different architectures
  - Assess performance gains

Model performance

- Identifying
  - Profiling and kernel analysis
- Seizing
  - Implementing developments
- Measuring
  - Using soil carbon test case

What does this mean for JULES users?

- No immediate impact on workflows
- Prototype miniapp to be developed by Oct 2024

- Technical overhead

Benefits:

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Thank you

For more information
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Find me in the technical break out session

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Ecology & Hydrology