RAL3-LFRic Regional Model Evaluation

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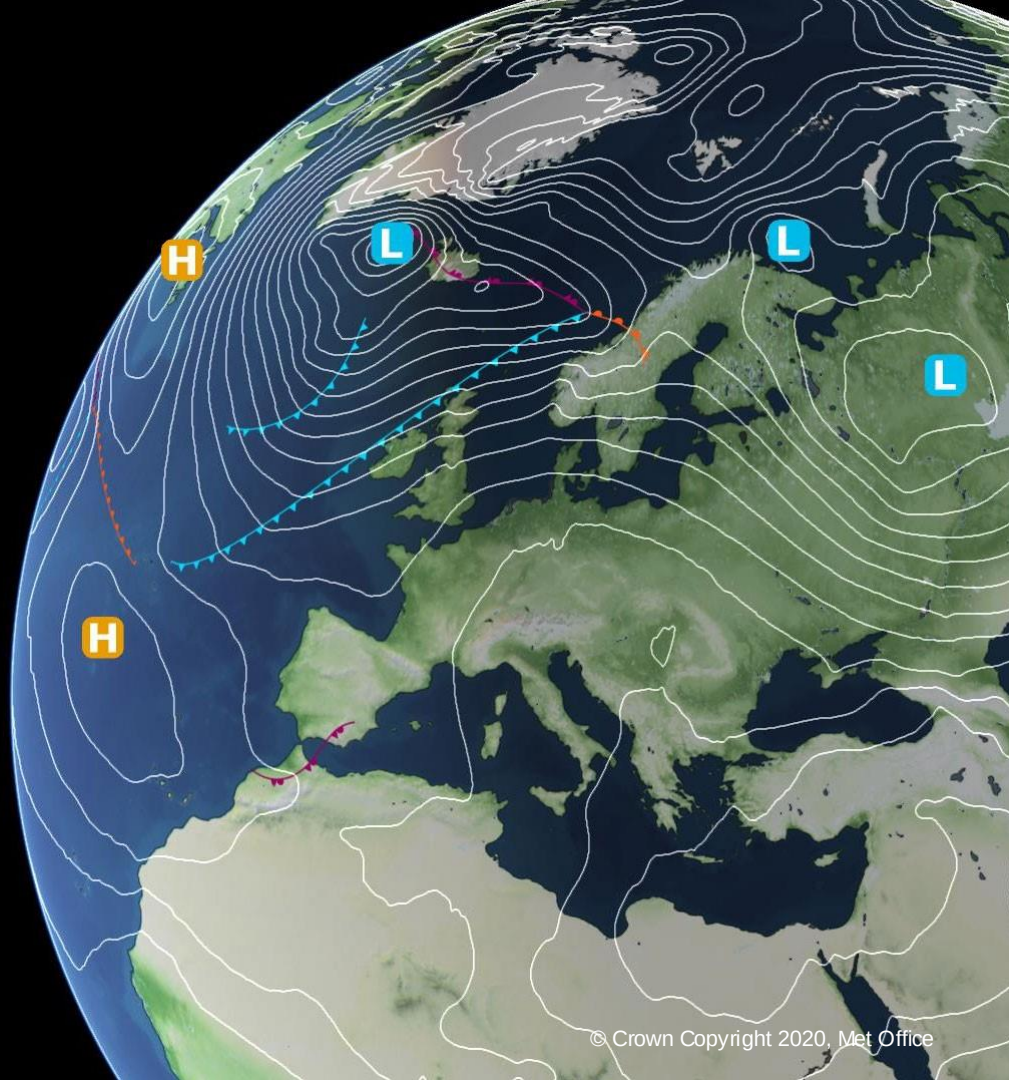

RAL3-LFRic Acceptance Criteria

RAL3-LFRic research configuration to act as well-tested baseline for operational-ready RAL4.

RAL3-LFRic evaluation process similar to previous RAL development cycles featuring partner contributions and increasing experiment complexity over time.

Relative to RAL3-UM, RAL3-LFRic should show no (significant) degradation to

Scientific plausibility	Ensemble Skill	Numerical Stability
Climate extremes, trends, or mean biases	NWP verification scores	Sensitivity to model resolution

RAL3-LFRic Acceptance Criteria Document can be found in RAL Ext - Project Board Meetings - All Documents (sharepoint.com)

Current Status of Suite Development

- Successfully used the Regional Nesting Suite (RNS) to run LFRic LAM forecasts nested in the UM at the Met Office and Bureau of Meteorology
- Partners working on getting LFRic running on site (e.g., NIWA, MSS)
- Added a post processing task outputting LFRic data on a structured grid
- LFRic functionality is currently being added to the ENS (ensemble suite) and RCS (coupled suite)
- Conversion of UM ancillaries to LFRic ancillaries is currently being added to the RAS (ancillary suite) so it can be used by our UM partners

Met Office

Differences working with LFRic data

UM LAM grids and LFRic LAM grids *look* the same, but file structure differs

- LFRic outputs unstructured ugrid files
  → Fields are stored as 1D array with mesh data containing information about connectivity

- Meta data is different from UM
  → Existing scripts relying on STASH codes or certain coordinate names no longer work

- File sizes typically larger → need to work around memory issues

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RNS post processing task

slam conversion

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"UM-ification" of meta data

- File sizes typically larger → need to work around memory issues

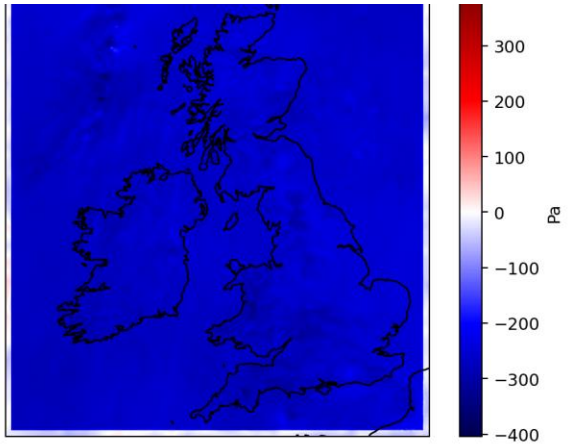
Evaluation of UM-driven LFRic LAMs

Phase 1a	• Focus on limited number of case studies • Rule out any obvious degradation or issues in RAL3 LFRic • Testing of technical tools and workflows
Phase 1b	• More in-depth evaluation of process representation in RAL3-LFRic • Verification against observations • Testing and evaluation across the Momentum Partnership
Phase 1c	• Preliminary coupled Atmosphere-Ocean simulations • Wave coupling simulations when this functionality is available
Phase 1d	• Data assimilation testing
Phase 1e	• Climate characterisation of RAL3-LFRic

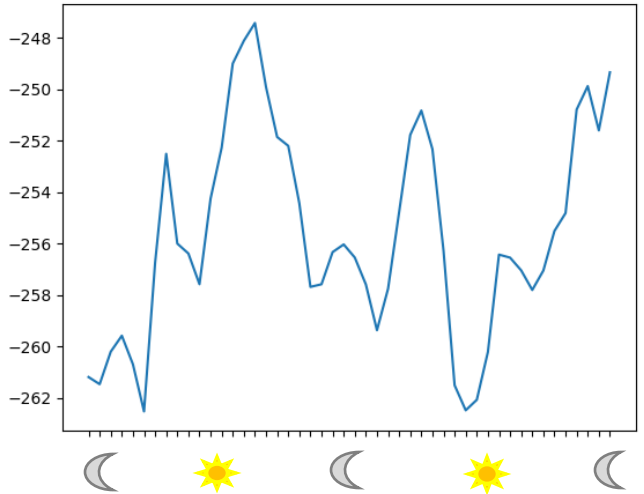
Mean Sea Level Pressure

- MSLP lower in LFRic, domain average difference typically 2-3 hPa
- Vertical balancing of LBCs included in last RNS LFRic upgrade did not solve the issue
- Work ongoing to change the way pressure is initialised in LFRic (LFRic Apps Ticket 292)

MSLP Difference LFRic - UM



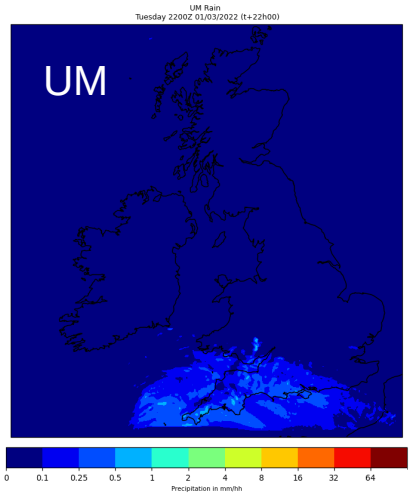
Domain Mean Difference over time

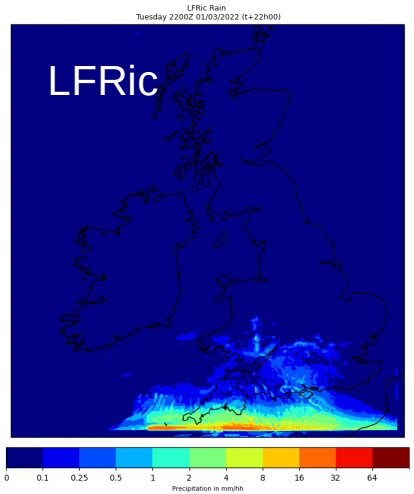


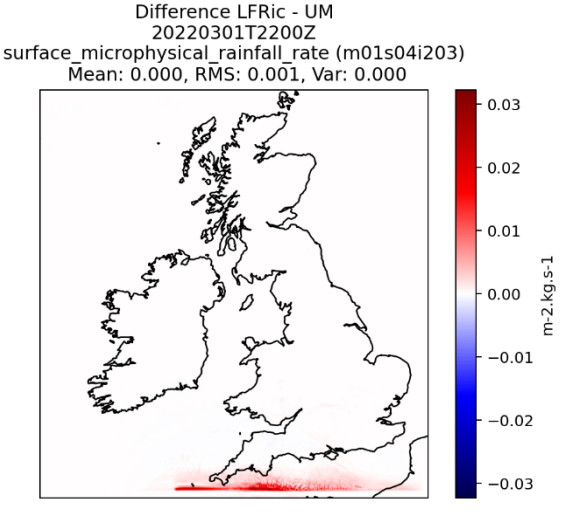
Met Office

Near-boundary behaviour

- Many cases are showing instances of unphysical behaviour near the lateral boundaries
- This often manifests in high rain rates
- “Features” can be seen in several other fields, including temperature, visibility, and wind
- LFRic apps ticket [#277]







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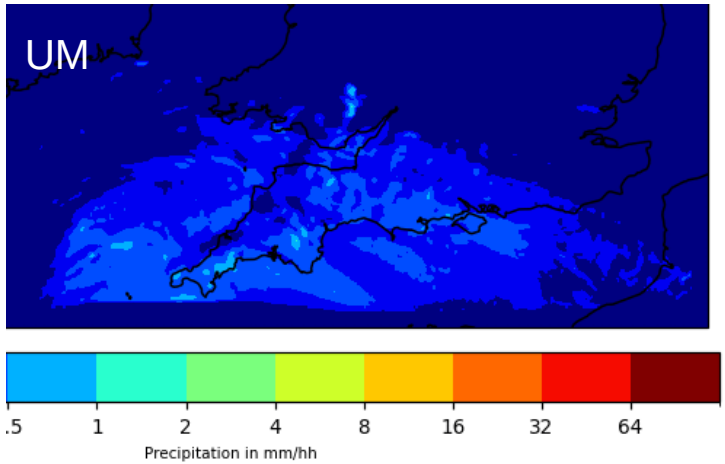
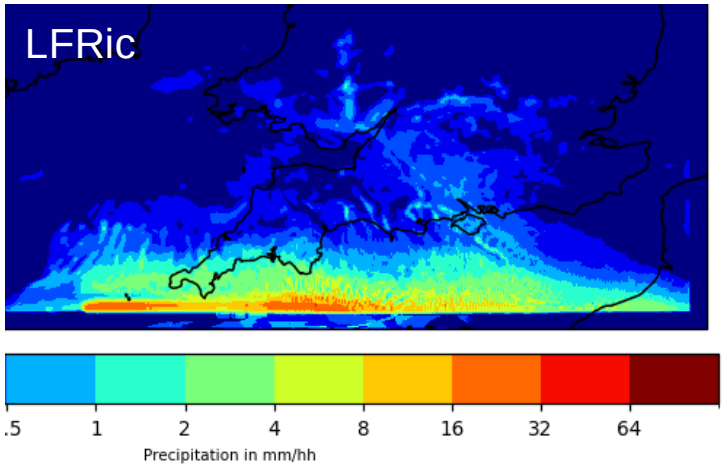
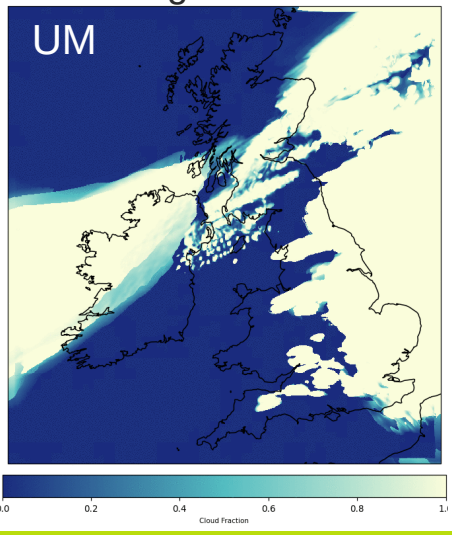




Cloud Cover

- Total cloud cover typically lower in LFRic
- Reduced cloud cover in LFRic driven by large reduction in high cloud
- GC5-LFRic have seen similar behaviour

High Cloud



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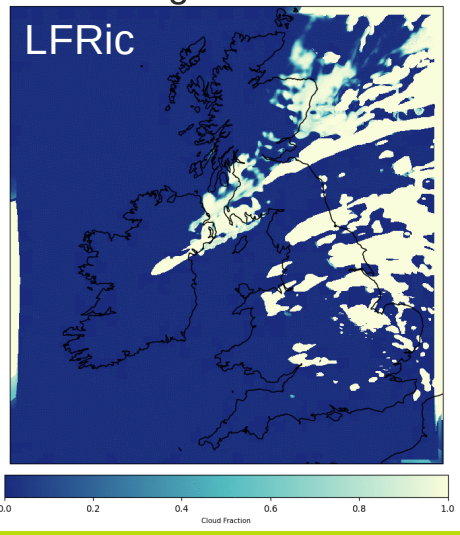
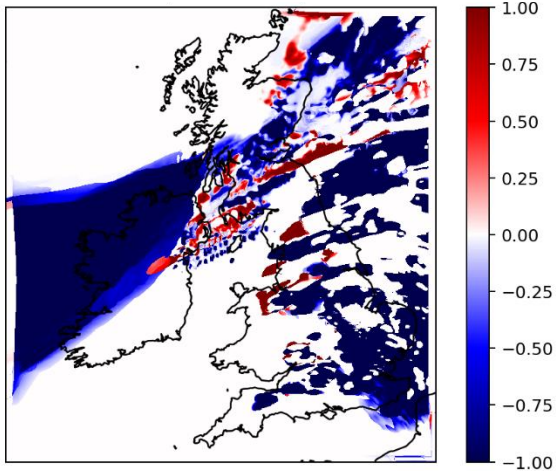
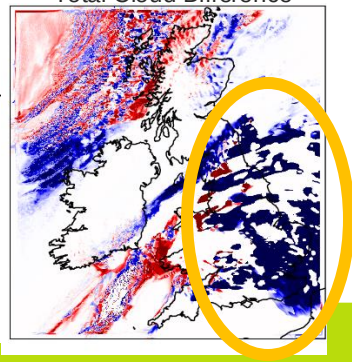


High Cloud Difference LFRic - UM

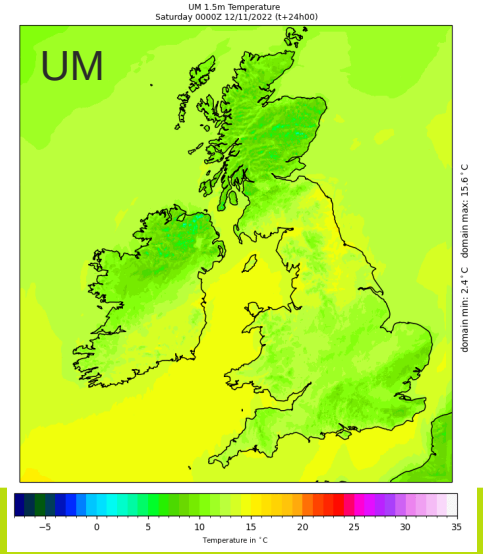


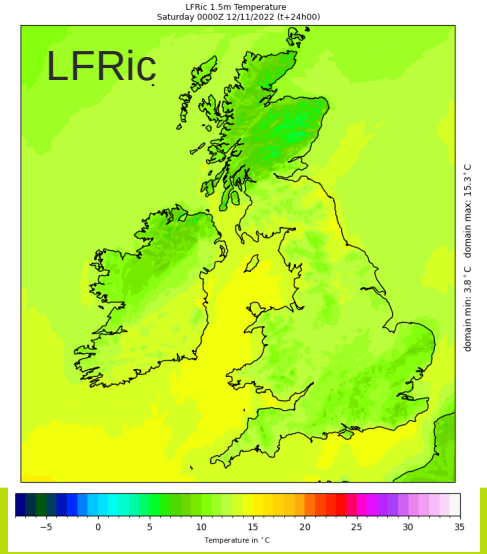
Total Cloud Difference



1.5 m Temperature

- Large local differences
- Domain average difference typically < 0.5 K
- LFRic domain average temperature often slightly colder than UM





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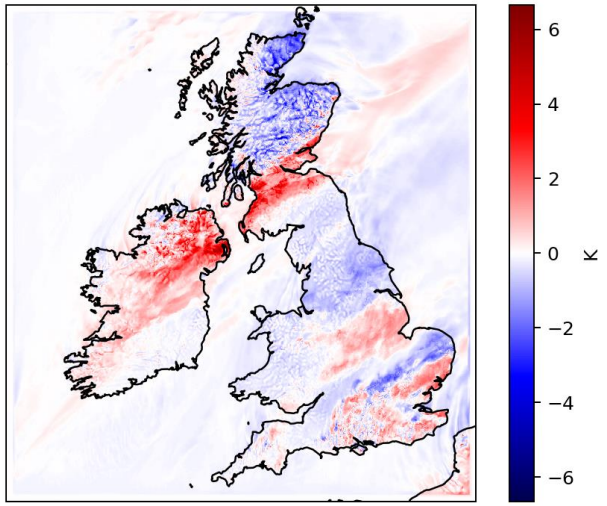

Next Steps

- LFRic changes addressing the large MSLP bias are under development
- Unphysical near-boundary behaviour to be understood further and addressed
- Understand whether tuning radiation parameters can address large differences in high cloud
- RNS to be upgraded to LFRic apps vn1.1 and to include specific fixes as soon as available and tested
- Focus on technical capability development (LFRic upgrades / fixes, variable resolution, sub-km nests, evaluation tools) before re-running (subset of) Phase 1a experiments .