NIWA

Taihoro Nukurangi

LFRic vs. NZ – finding the limits of LFRic

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Climate, Freshwater & Ocean Science

Early RAL-LFRic Adoption

- Regular meetings with Ben Shipway and Christine Johnson
- Porting and testing of individual LFRic tools
  - um2lfric / mesh generation
  - LBCs created
  - Installed and used SLAM

Early HPC Memory issues

- NZCSM using LFRic is too big to fit on current NIWA HPC
- Per-core memory consumption large (even at 192GB/node)
- Is approx. x4 number of grid points that standard SEUKV domain

- Conducted memory analysis using MAP and Intel vTune

- Restrictive partitioner with multigrid means a very large HPC node footprint – too large to be practical on our current XC50
- Needed to interleave XIOS server ranks with LFRic ranks and distribute servers across HPC nodes, to reduce memory pressure per node
- Used far fewer XIOS server than the Rose stem configuration for the proto-RAL UK model

Getting an upgrade

- Current HPC systems at NIWA limit what we can realistically test with
- Gen4 HPC coming in 2025 but may still give some limits on the size of the domains we can run

measure of compute	*Maui*	*Kupe*	*Maui+Kupe*	*each site*	*Primary+Sec*
compute nodes	464	104	568	160	320
compute cores	18,560	4,160	22,720	30,720	61,440
system memory (GB)	66,816	9,984	76,800	122,880	245,760
memory per core (GB)	3.6	2.4	3.4	4.0	4.0
peak teraflops	1,425	319	1,745	1,180	2,359
Unified Model performance	*0.82*	*0.18*	*1.00*	*1.75*	*3.50*

Testing Plan

- Using LFRic capable RNS
- Still gathering all required GAL ancillaries but code builds all working okay
- Fixing up (local) issues as we go

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- Using LFRic capable RNS
- *Still* gathering all required GAL ancillaries but code builds all working okay
- Fixing up (local) issues as we go
- *As part of preparation for LFRic User Tutorial can now run the Global LFRic workflow (u-df942) at C48 and C64 and the RNS (u-by395) Darwin domain. Still working on complete local NZ set up.*

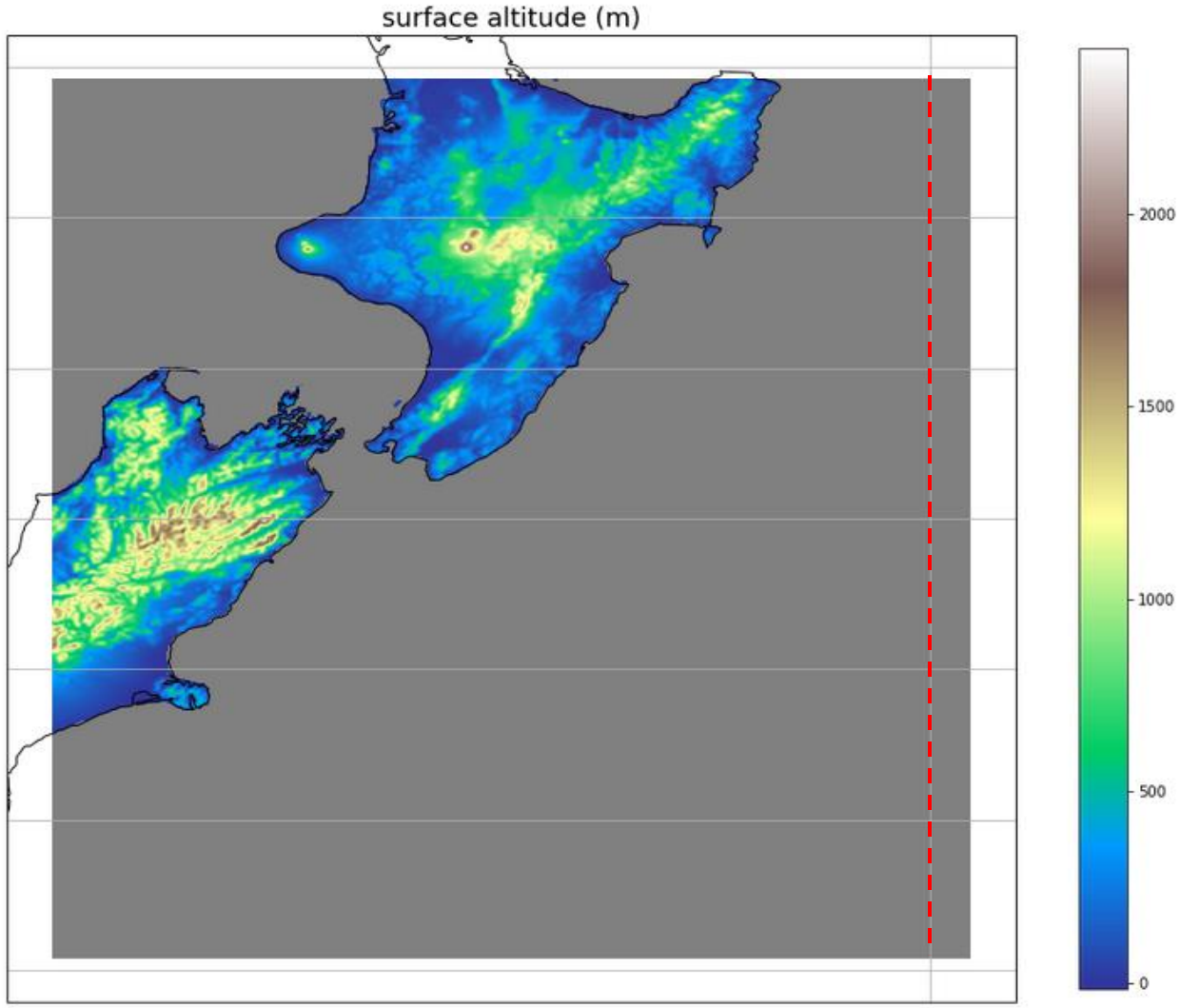
What scientific tests are we concentrating on?

- Can RAL-LFRic deal with NZ's complex terrain? How stable is it at current operational resolution(s)?
- Initial performance for (extreme) weather events (wind and rain)
- HPC profiling
- Identify current limitations for testing over NZ

Case Study #1: Complex Terrain

Crosses dateline

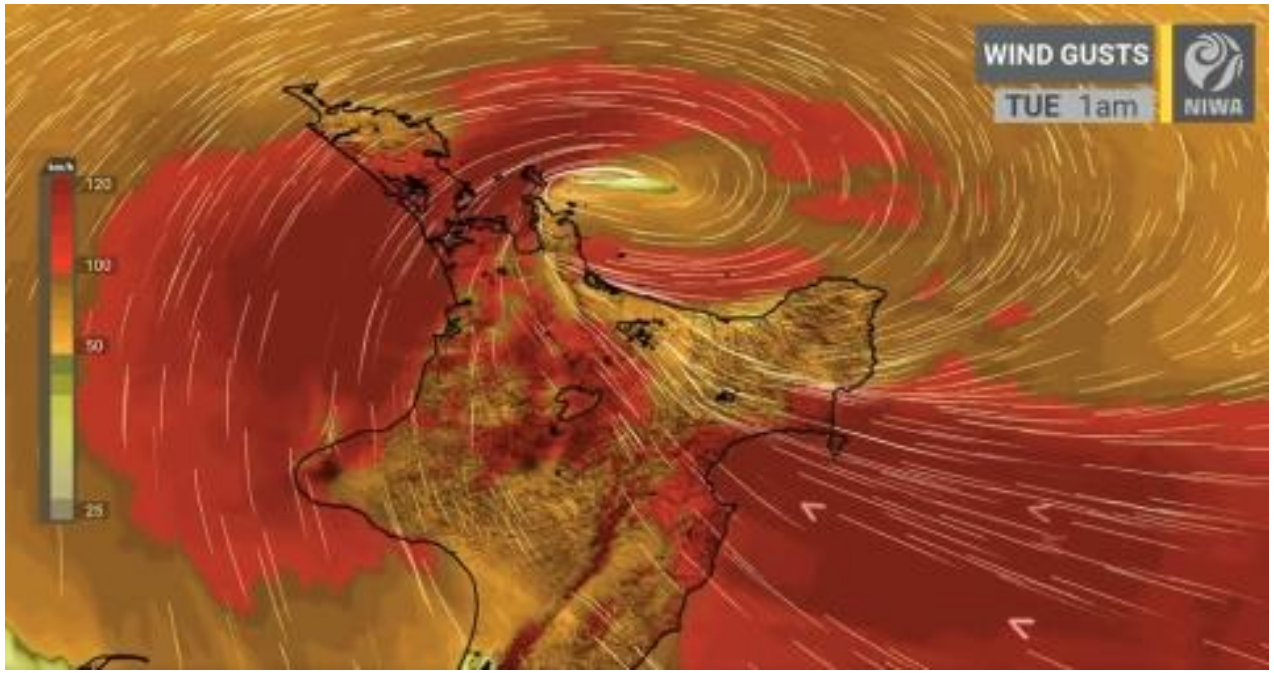
Top of S. Alps so high peaks, steep slopes

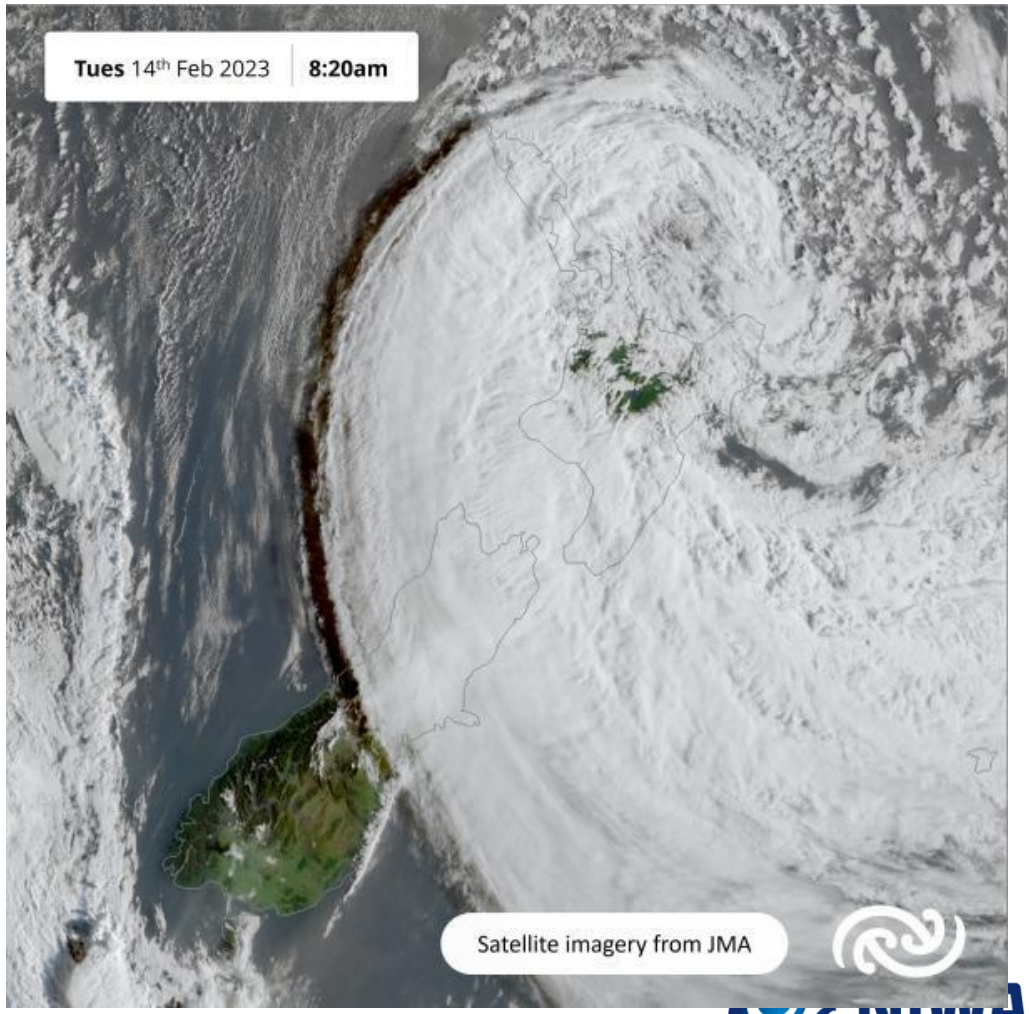


Case Study #2 – exTC Gabrielle

Coping with extremes

- Wind gusts in excess of 120kph
- Gisborne rainfall of 185.3mm until power loss
- Napier Airport rainfall of 175.8mm in 24 hrs





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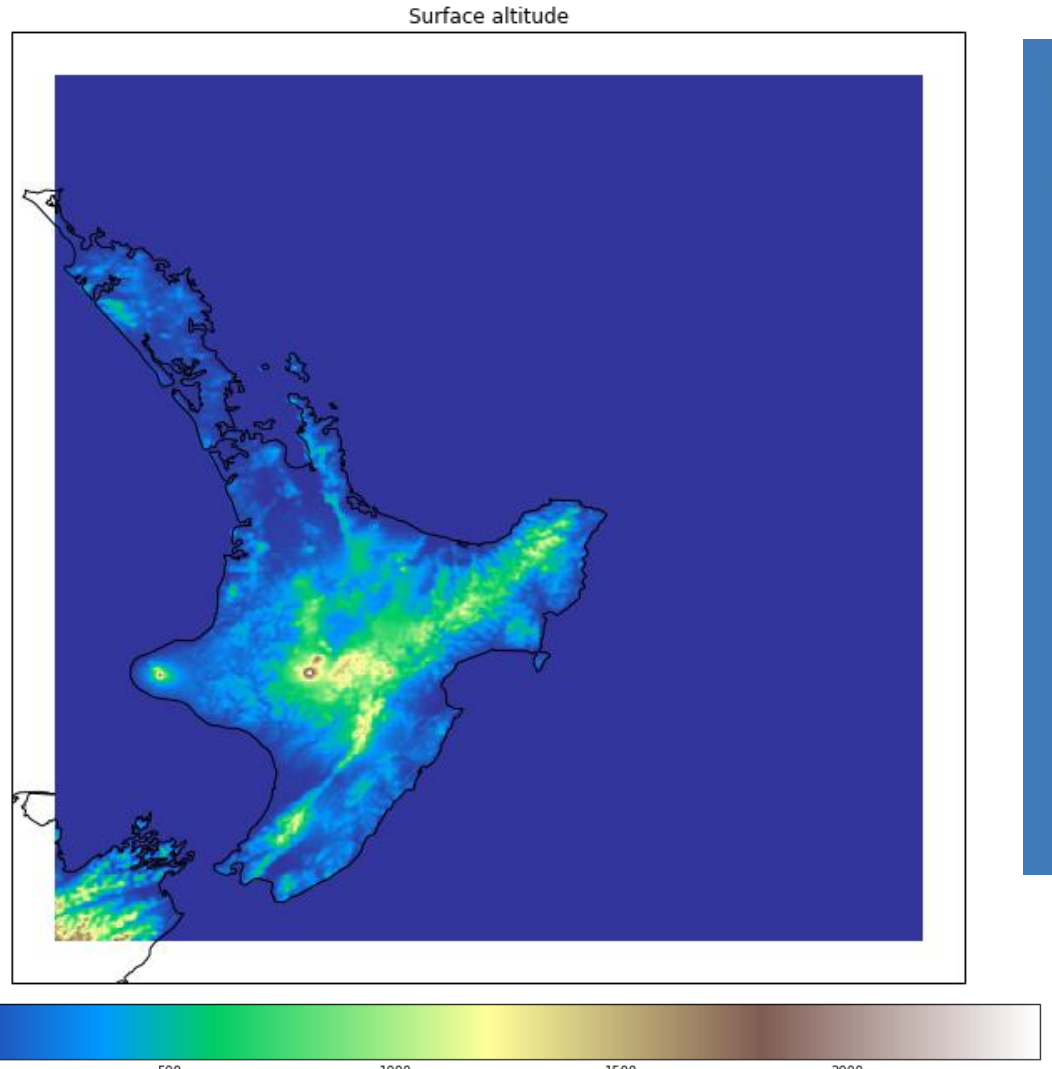

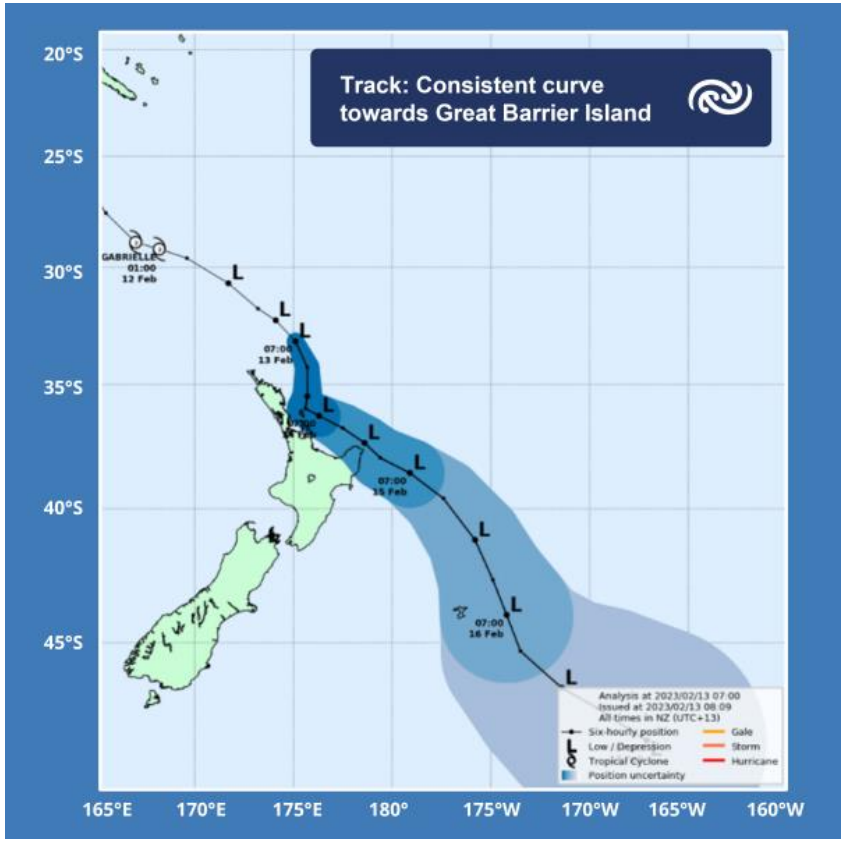

Considerations

https://code.metoffice.gov.uk/trac/rmed/ticket/592#comment:40

- https://code.metoffice.gov.uk/trac/roses-u/changeset/291820/
- *"I've managed to run two case studies for the Melbourne domain with some adjusted settings. I've put these in as optional configuration files, so for Melbourne we should run with the exp_blending and the mix_mol options, but these are not recommended for any other domains at present. Having different settings for different domains is far from ideal so we should see this as a temporary solution until Christine and team have a chance to work out how to deal with the orography in the boundaries."*

- Likely NZ will experience similar issues so something to be wary of given our test domains…
- Should we test on smaller domains and coarser resolutions first?

Summary and Further Work

- Continue with porting of RNS and running case studies
- Document issues and contribute to Partnership effort to get RAL-LFRic ready
- Plan to extend testing to national scale on Gen4 HPC

Thank you

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