RAL3-LFRic simulations and plans for tropical domains

Richard Jones, Mike Bush, Charmaine Franklin, Anke Finnenkoetter, Dave Lee, Anne McCabe, James Warner, Mark Weeks

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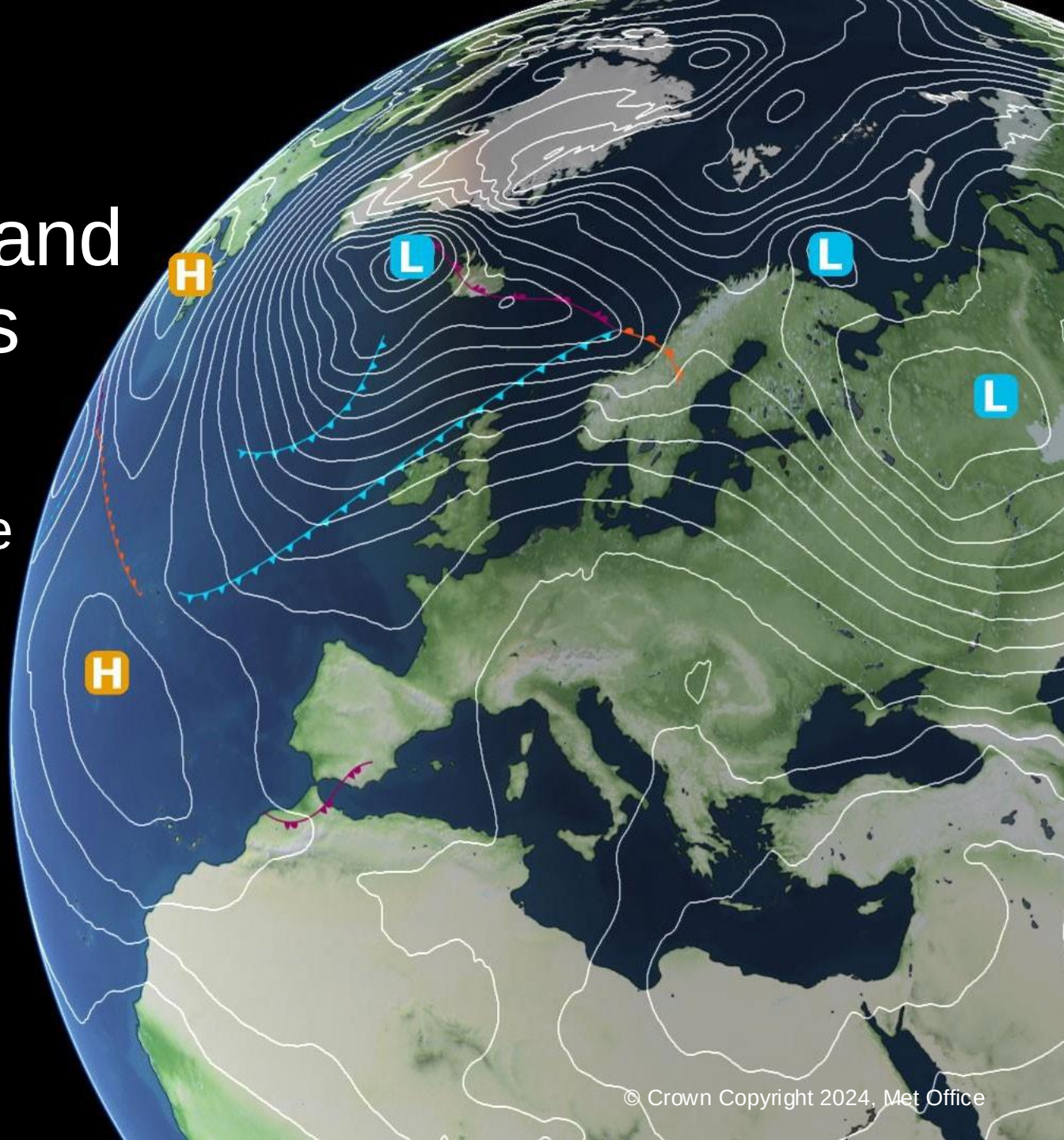

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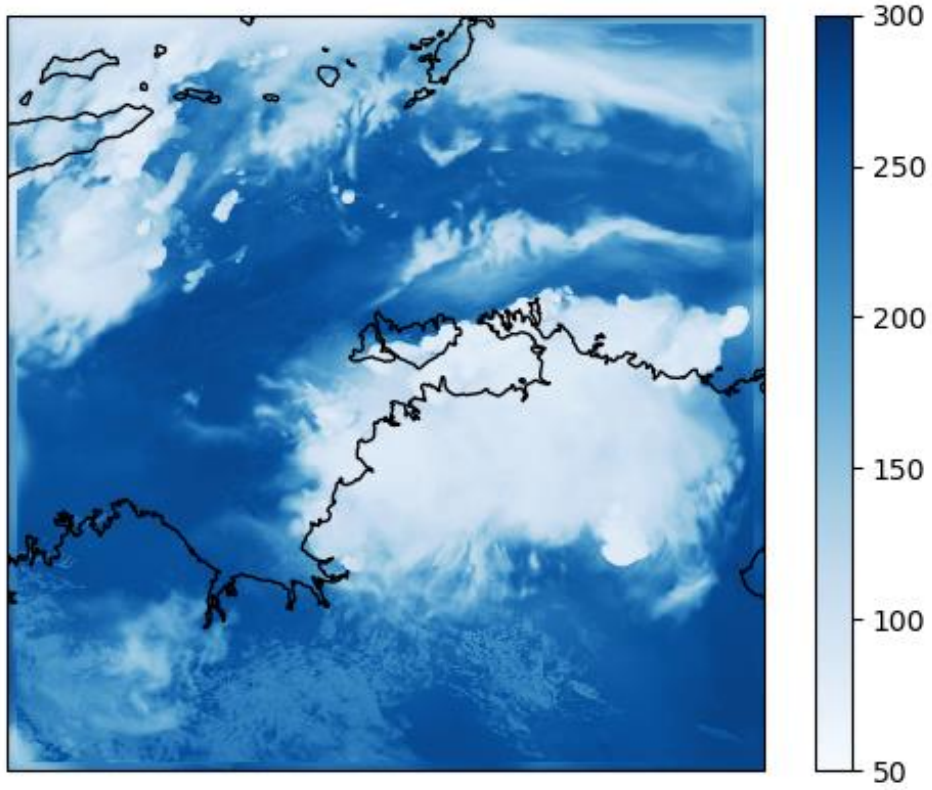
Darwin domain RNS setup



Example OLR plot for the Darwin 1.5 km domain.

- 1.5 km resolution grid spacing (fixed resolution)
- 2-day simulations T+0 to T+48
- 768 by 768 grid point domain size
- **Using the mmol transport scheme and experimental blending** (failures had been reported previously by Dave Lee when using the FFSL transport scheme).
- 14 deterministic case studies – a mixture of targeted cases and random (1st of month)
- RAL3-LFRic seems stable with just 1 failing case identified so far.

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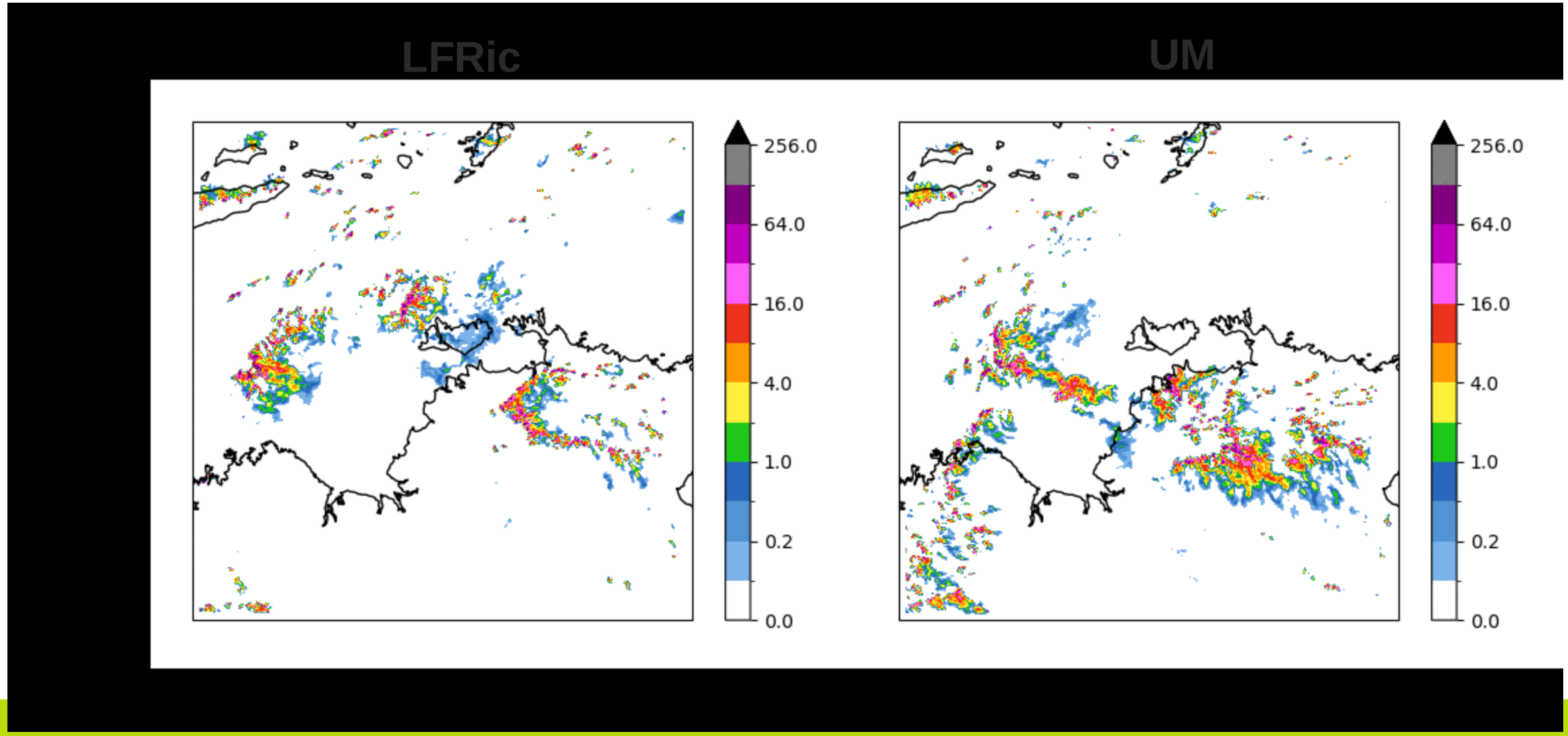
Precip. animation for a tropical convection case study



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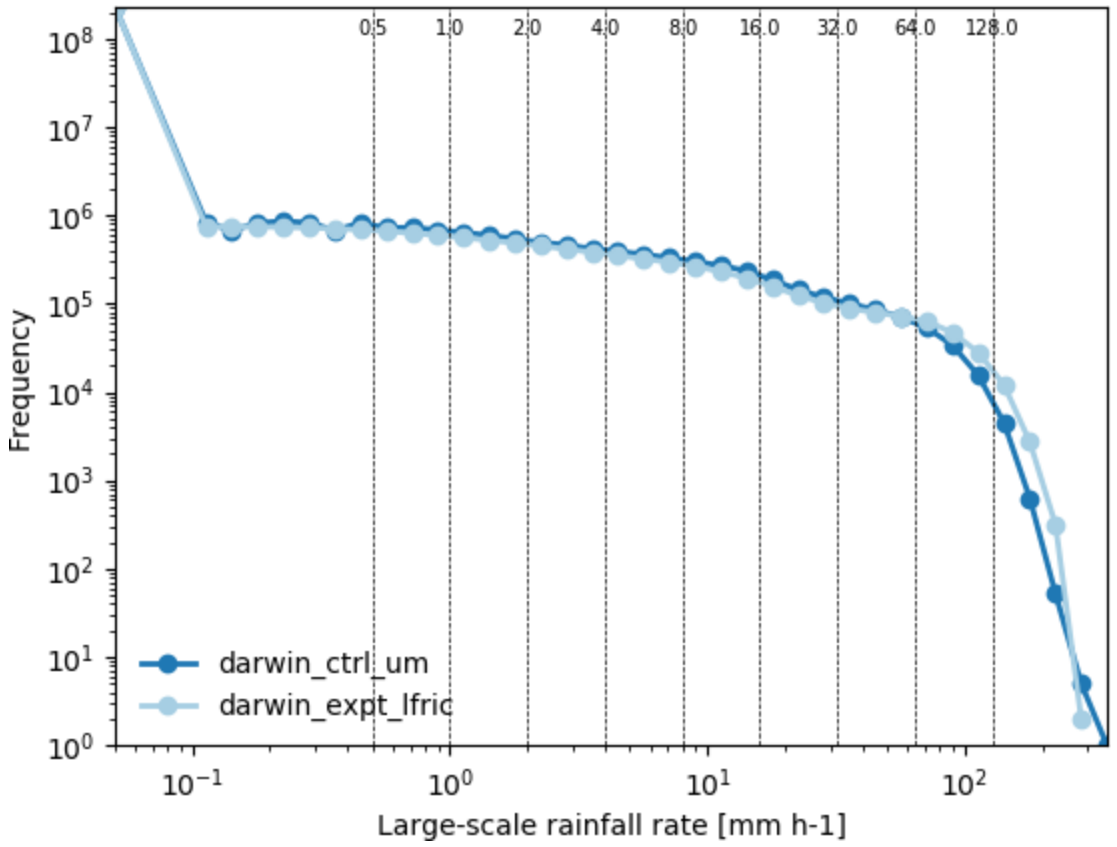
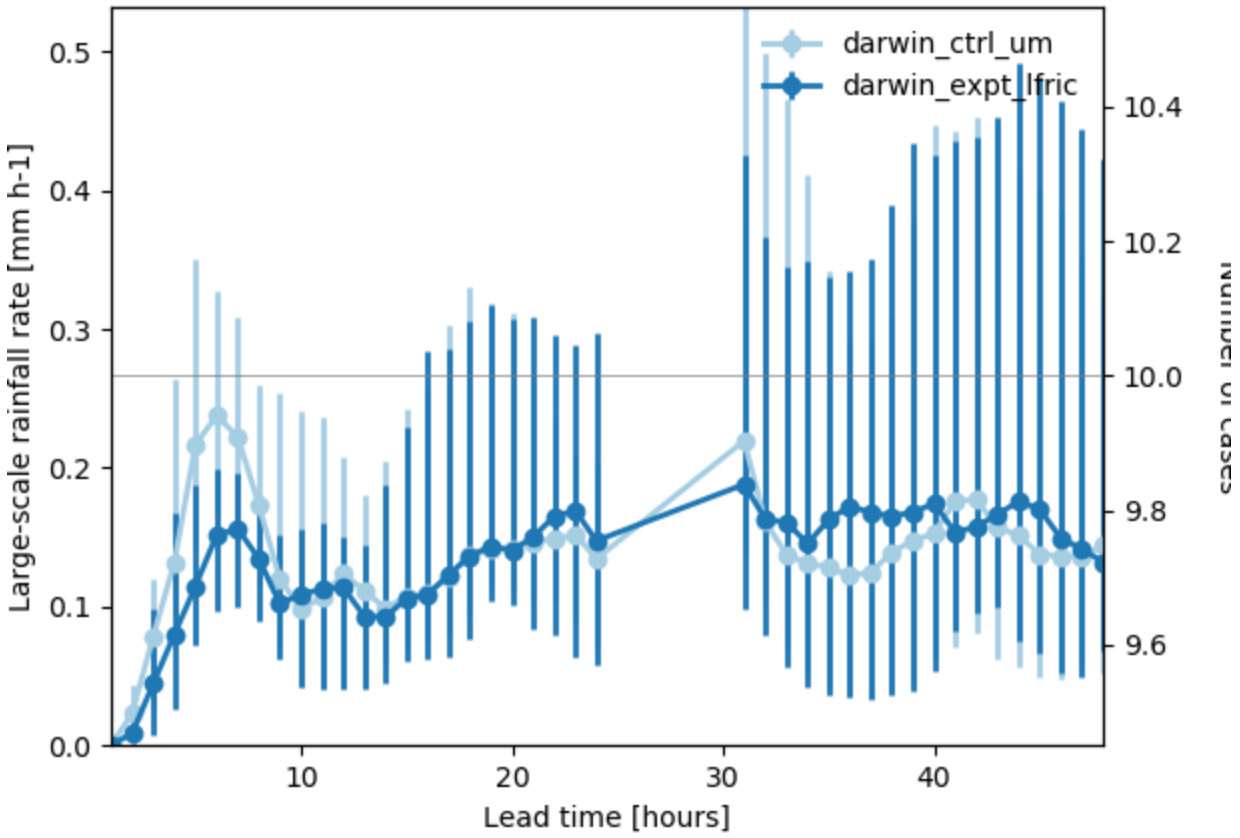
Comparing deterministic UM and LFRic - Darwin

RES output (10 cases) – instantaneous precip. rate





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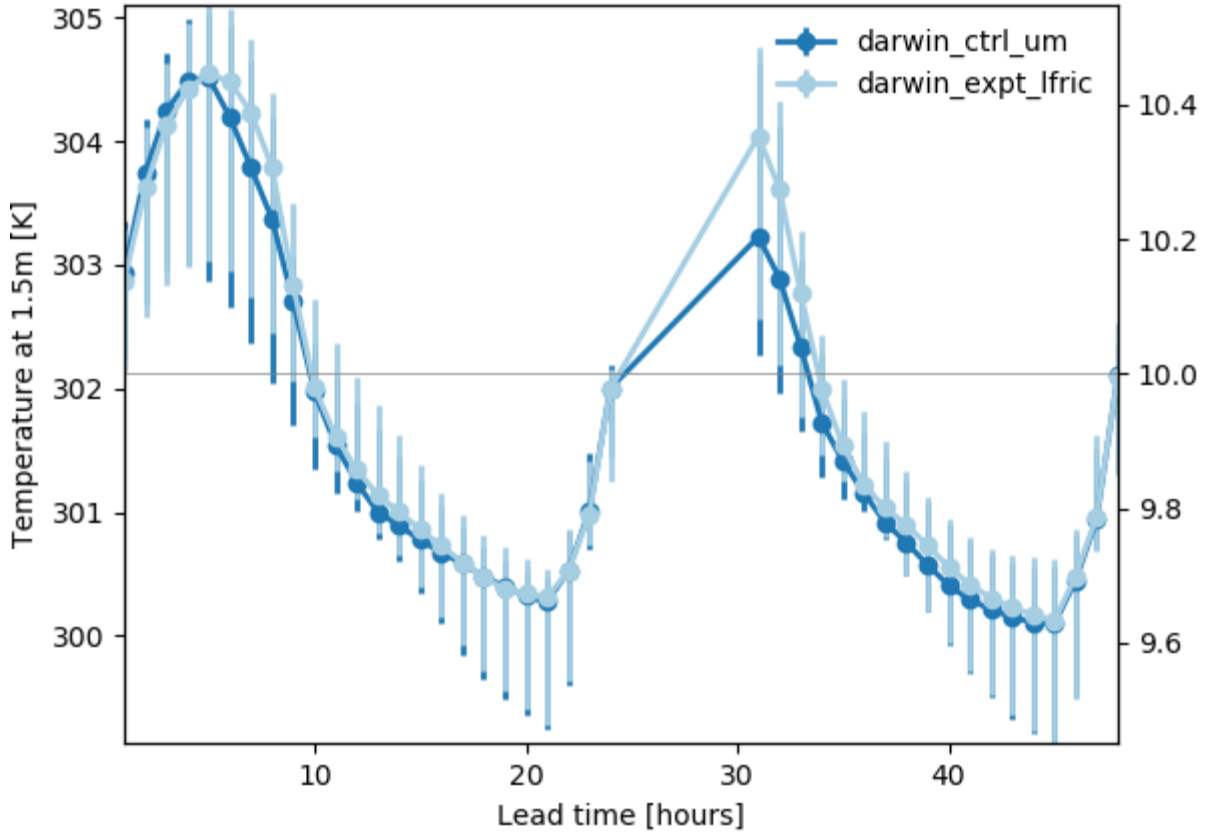
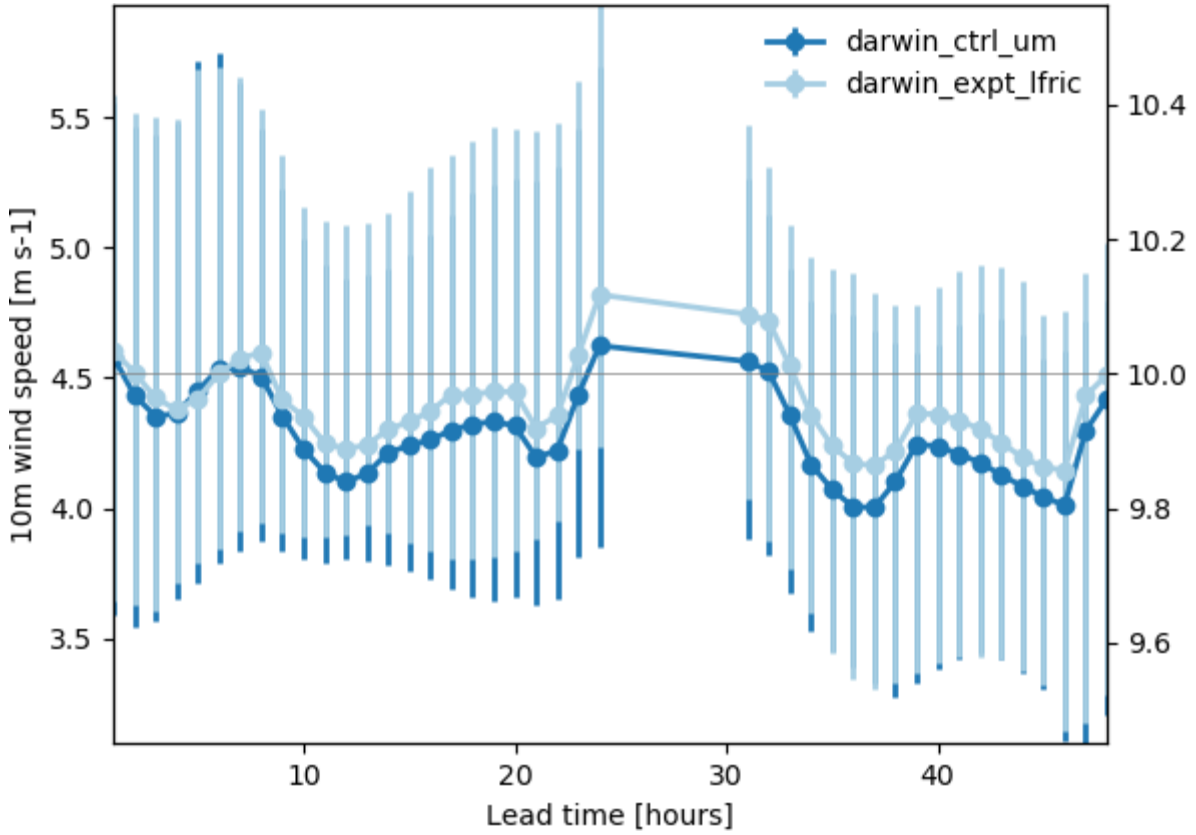
Comparing deterministic UM and LFRic - Darwin

RES output (10 cases) – 1.5 m Temperature and 10 m wind speed





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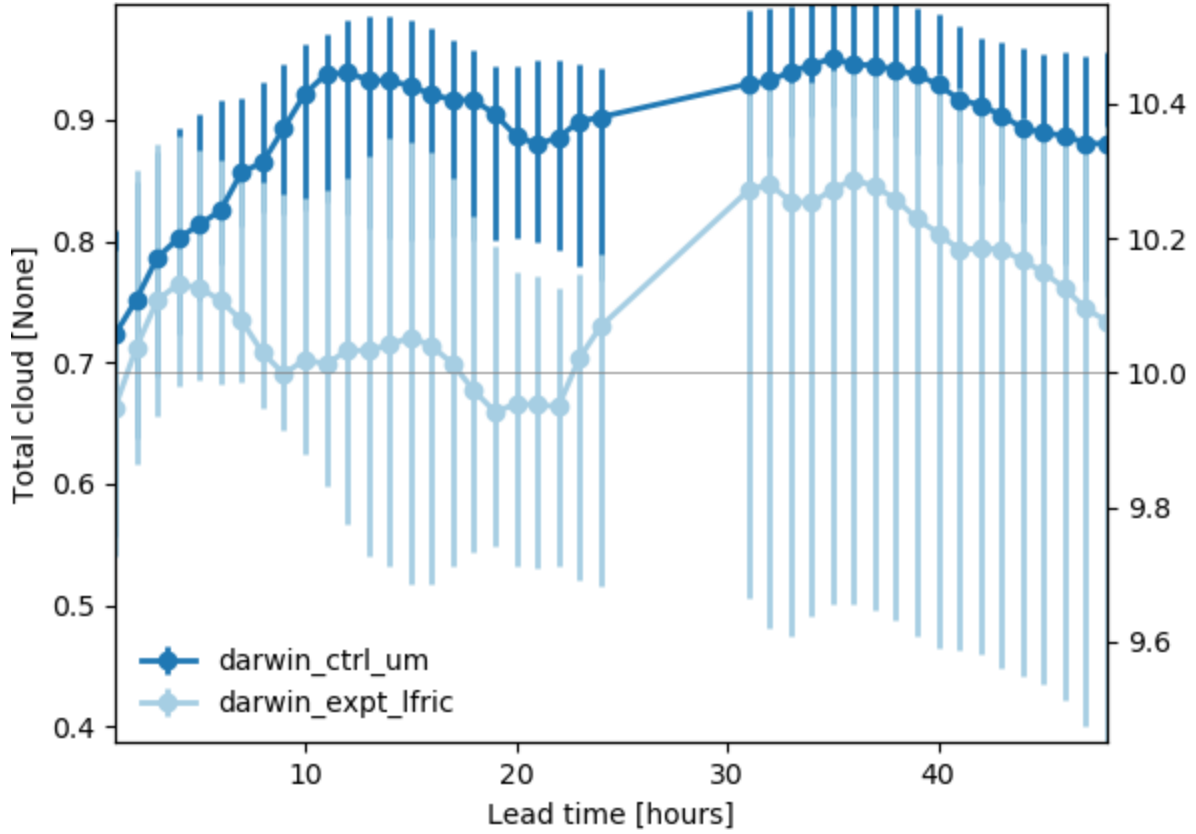
Comparing deterministic UM and LFRic - Darwin

RES output (10 cases) – Total cloud cover

- Reduced cloud cover in LFRic compared with UM
- Increased frequency of clear skies in LFRic, reduced frequency of total cloud cover.
- Slight increase in broken cloud conditions in LFRic.
- Decrease in total cloud cover in LFRic is driven by a reduction in high cloud – also seen in UK cases, investigation work ongoing



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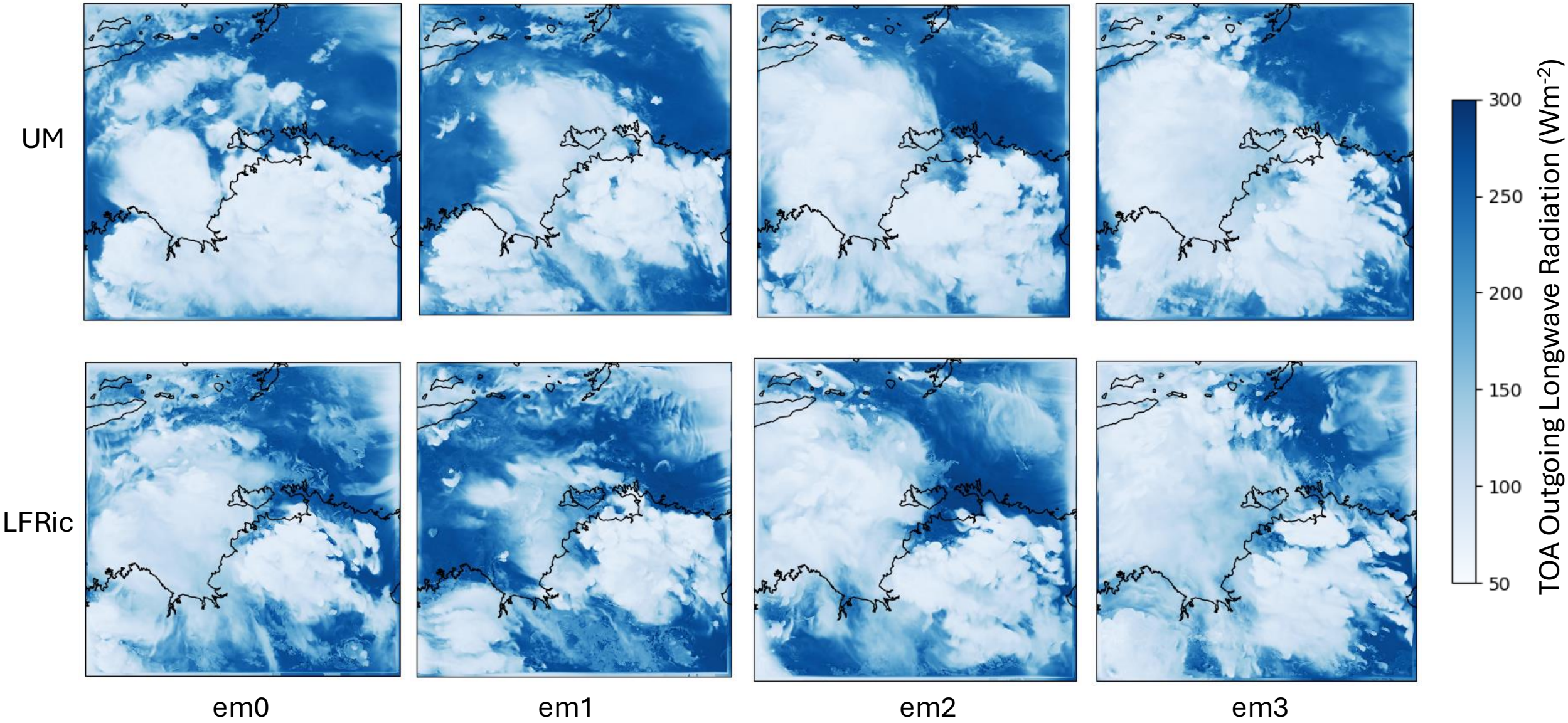
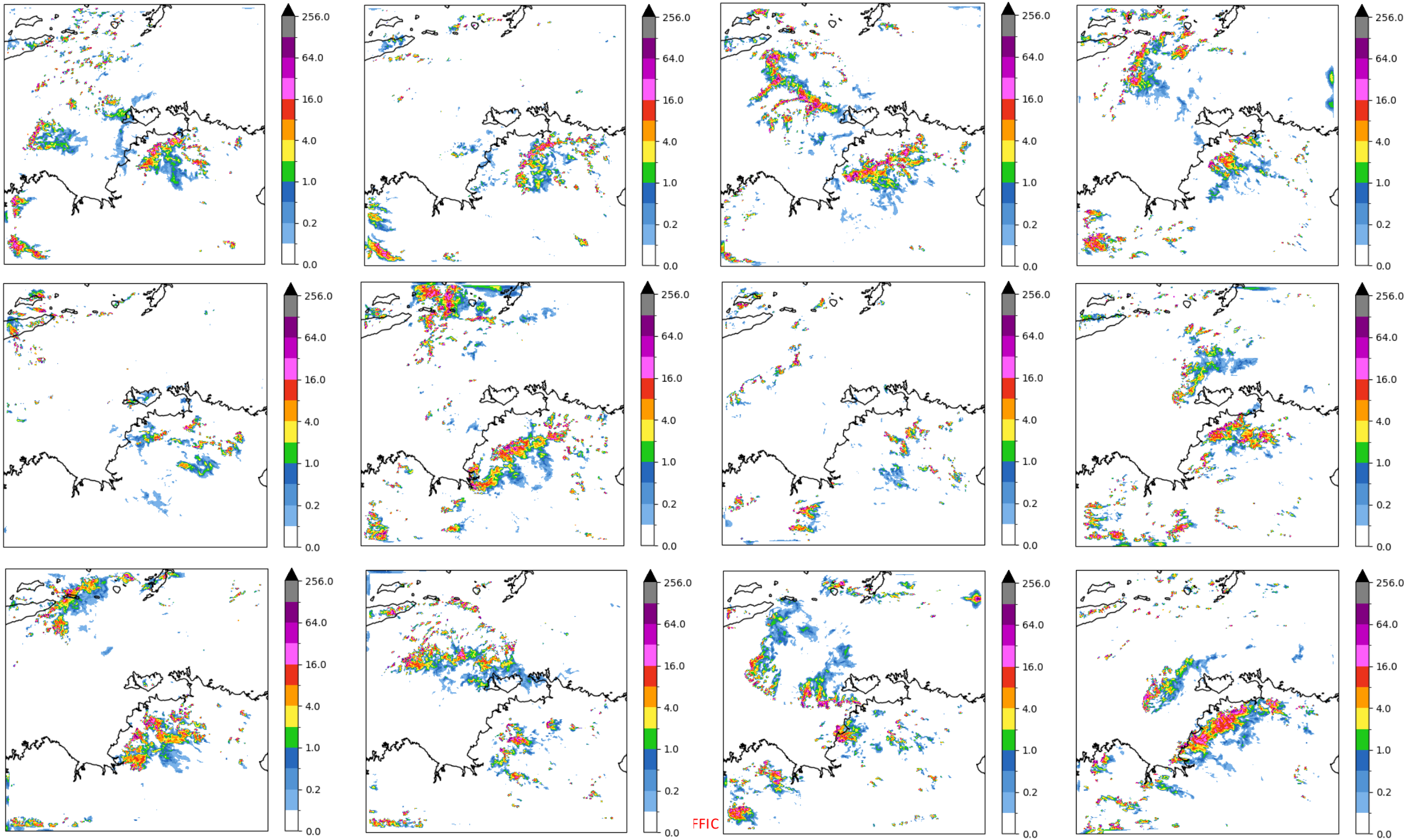
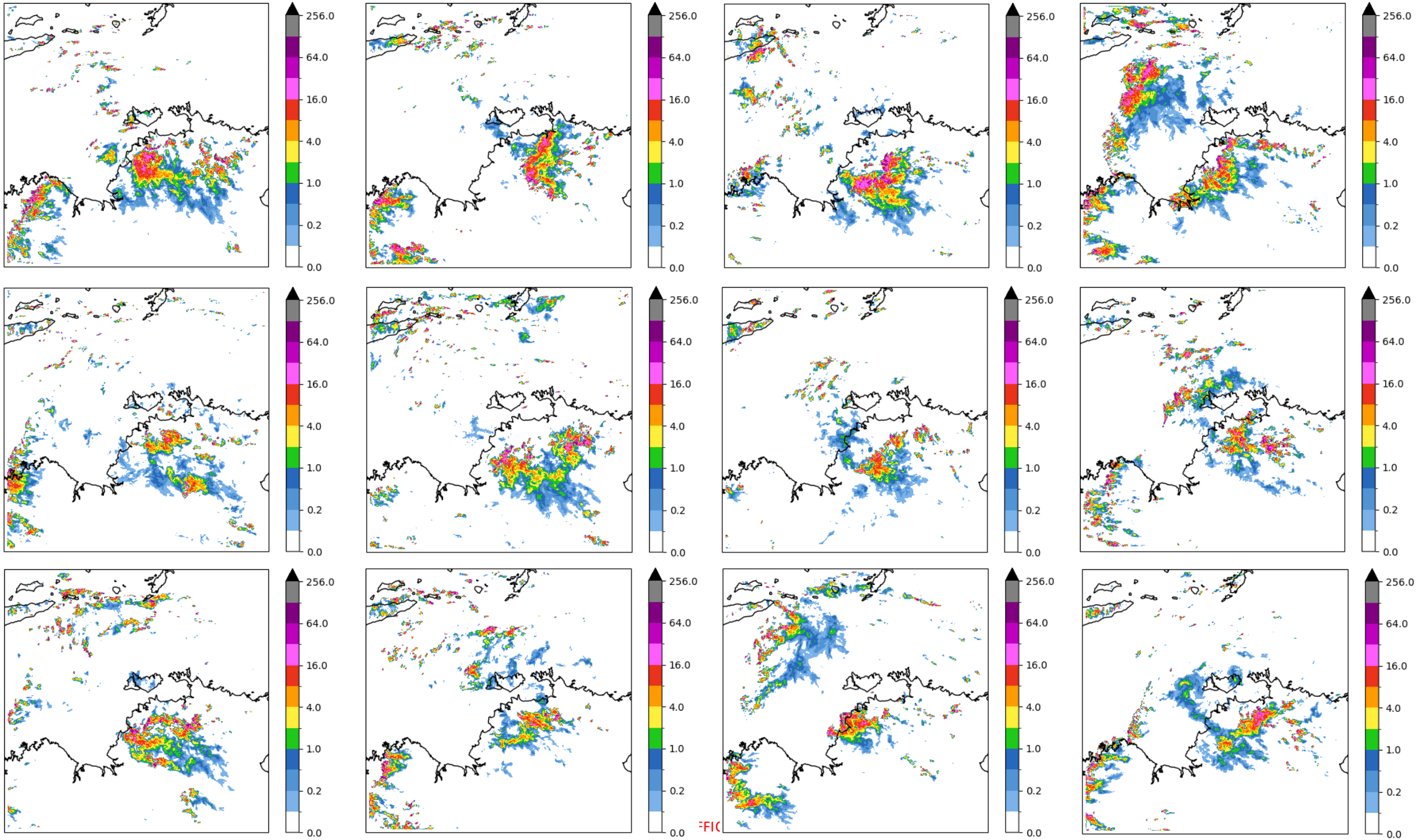
Progress with the ENS for tropical domains

- Successfully run 3 targeted case studies focussing on impactful convective events in the vicinity of Darwin (2021/2022).
- 12-member ensembles for LFRic and UM run within a single workflow (copy of the ENS branch for ticket #595).
- One LFRic ensemble member failed in one of the forecast cycles (1 of 36)
- All LAM forecasts nested inside re-run MOGREPS-G.
- Mmol transport scheme and experimental blending using (same setup as RNS case studies)
- Example plots shown below are from 6th Jan 2021 case study when there widespread thunderstorms in the vicinity of Darwin (85mm in 1 hour)

ENS - OLR comparison UM and LFRic







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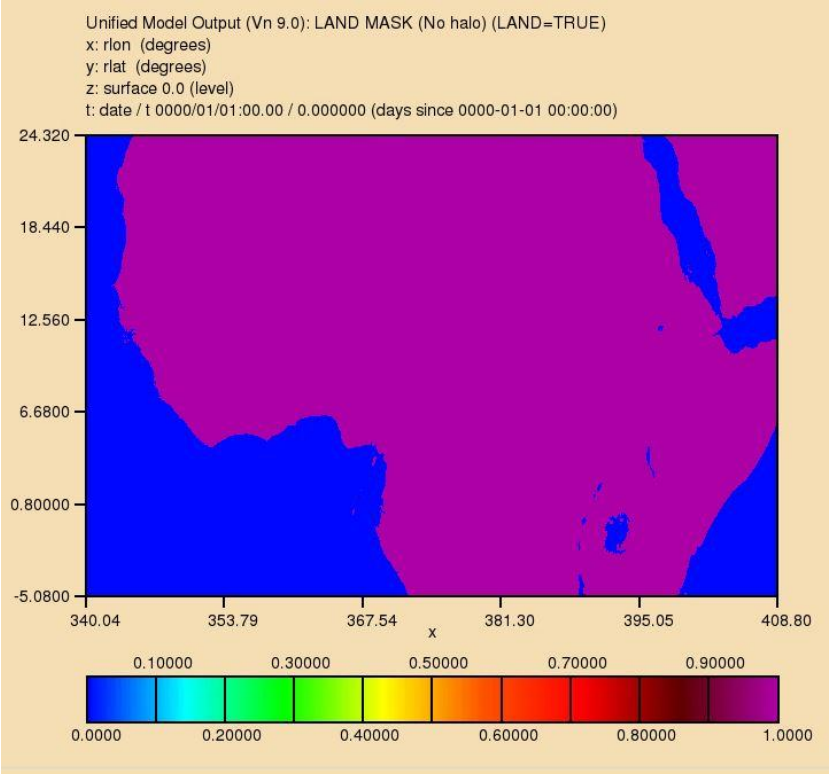
Progress and technical challenges with RAL3-LFRic testing over Tropical Africa

- James Warner leading on tropical Africa testing and has been testing a non-square domain 600 by 504.
- Setting number of processors to 525 (25 x 21 intended) but default decomposition is using 21 x 25 instead which causes a failure. Investigation work ongoing but may need an RNS fix to set nprocx and nprocy in a similar way as is currently done for the UM. Shows the value in testing different domains and configurations across the partnership
- Also some ancillary and domain size issues (real-time tropical Africa domain is around twice this size).
- RNS case studies over Africa planned through Oct 2024 – Jan 2025 period.



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Future plans for RAL3-LFRic tropical testing

- Darwin RNS simulations for earlier case dates (2017 and earlier) to coincide with and compare with CPOL radar data.
- Simulations over the maritime continent using the SE Asia domain (at 4.4 km resolution?)
- Targeted simulations to assess tropical cyclones e.g. Super Typhoon Goni (2020), Typhoon Rai (2022)…
- Evaluation of ensemble simulations for the Darwin domain for a variety of weather types & events.
- All plans are tentative at this stage and very open to discussion and further testing ideas.

Technical challenges, user errors and unresolved questions

- Running simulations for pre-existing (or well used) domains that are not square (e.g. SE Asia, Tropical Africa…)
- For fixed resolution simulations (in particular) – take care with the jump in horizontal resolution between driving model and LAM
- [User error] – make sure to set up both your UM STASH and LFRic diagnostics files correctly (if you want to compare like-with-like).
- Over Darwin 1 LFRic ensemble member failed (12 ens. Members x 3 case studies) – relatively stable.
- Tropical cyclone case studies will provide a good stability test (and useful information about model behaviour).