Towards local-scale global weather and climate simulations

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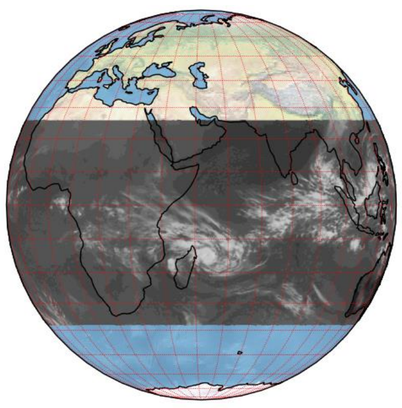
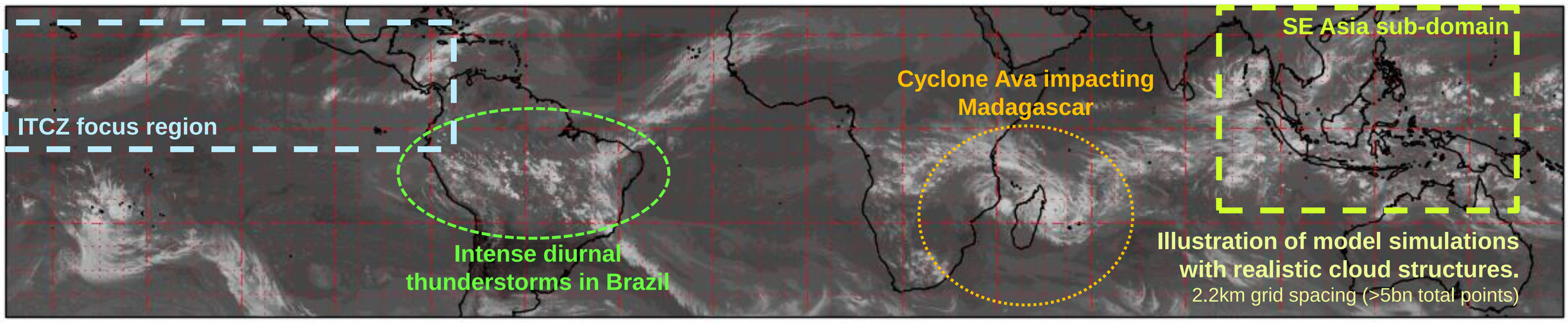


Motivation

As our climate changes, the prediction of local weather and climate risk is increasingly important.

Current global weather and climate models, such as those used to inform decision makers at COP26, are unable to explicitly represent processes such as atmospheric deep convection. This is critical for simulating the global water cycle.

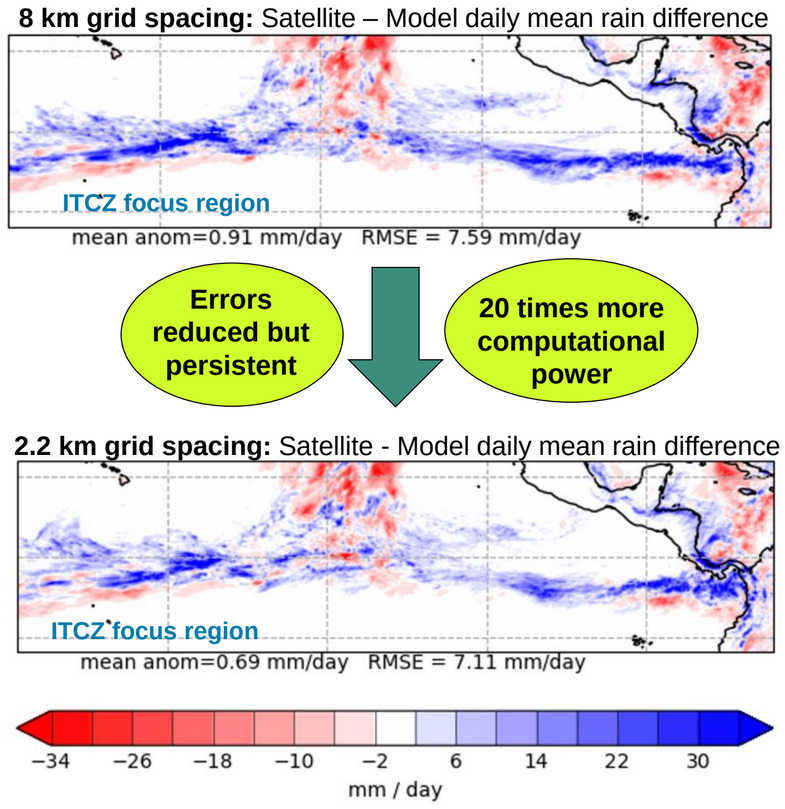
Significant technical development and new computing technology allows Met Office Unified Model simulations to span a tropical model domain with > 5 billion grid points. Enabling us to explore the next frontier by resolving processes associated with individual clouds and thunderstorms.



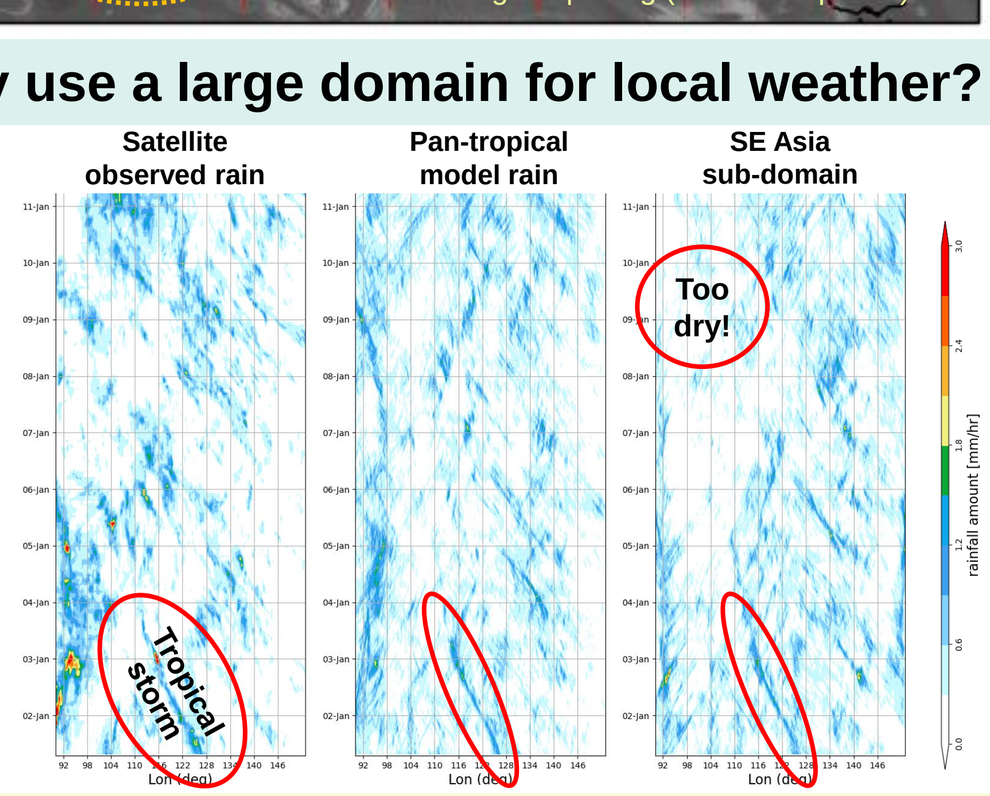
Why use more model grid points?

Using more grid points in simulations is *not* in itself a panacea for reducing biases found in coarser resolution global models

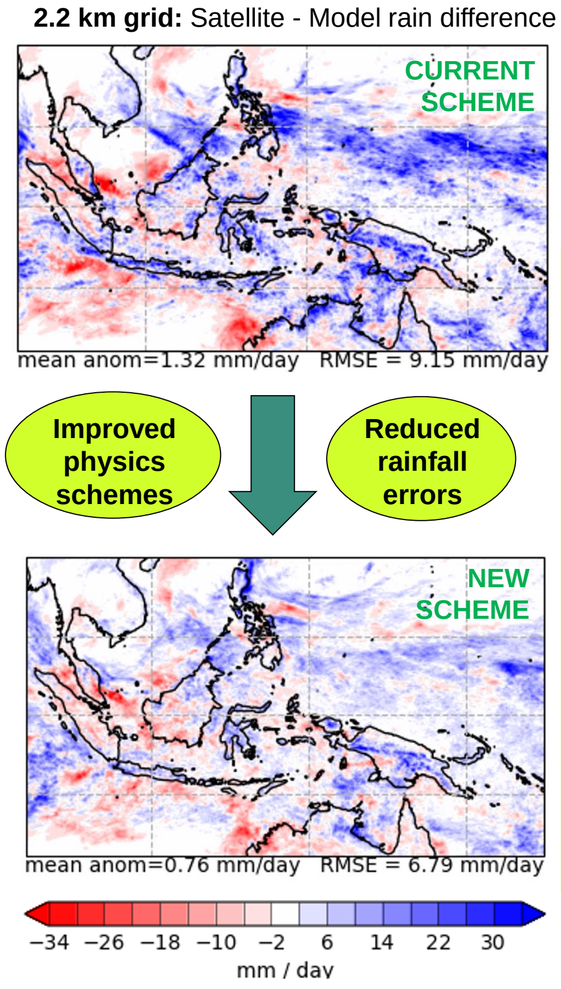
For example, the bias towards too much rain in the equatorial inter-tropical convergence zone (ITCZ) persists between 8 km and 2.2 km grid simulations.



Why use a large domain for local weather?



The pan-tropical domain is less constrained by lateral boundaries. The SE Asia sub-domain uses the same grid but is drier in the west and at longer lead times



Improving model physics formulation

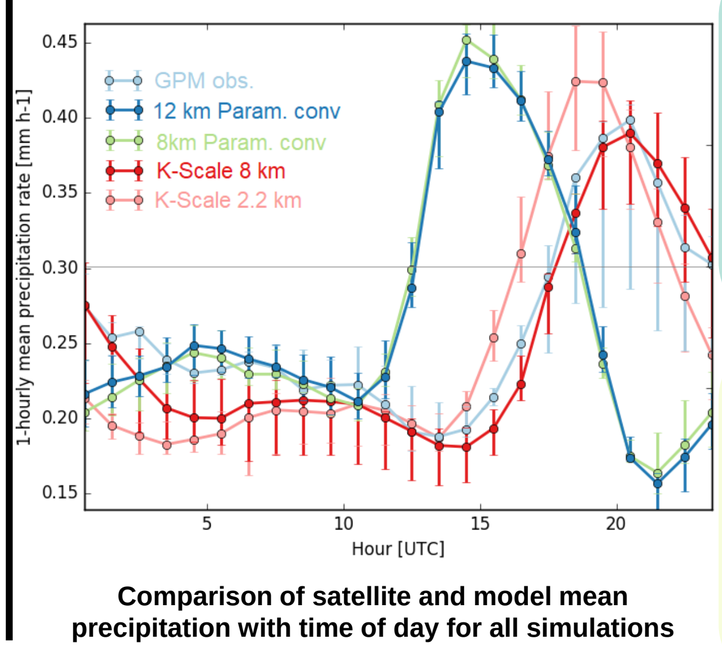
We have reduced model errors in precipitation across the west Pacific region by introducing new model schemes to represent cloud and precipitation processes.

The new, more complex, physics schemes increase computational cost of simulations by ~25%, represents const-effective use of supercomputing compared to ~20x increase from changing grid spacing.

Impacts and conclusions

Weather and climate models capable of representing local-scale detail across broad regions are becoming feasible.

Improving cloud and precipitation requires understanding of trade-offs between size, grid spacing and physics schemes.



Comparison of satellite and model mean precipitation with time of day for all simulations

Improving simulations of the diurnal cycle of rain in the tropics is critical to information on water availability for billions of people.

Future collaboration

Towards global domain local-scale simulations with enhanced physics, on longer timescales

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