K-Scale, towards km-scale global simulations

Richard W Jones[1], Claudio Sanchez[1], Huw Lewis[1], James Warner [1] and Dasha Shchepanovska[1] (1: RMED, foundation science)

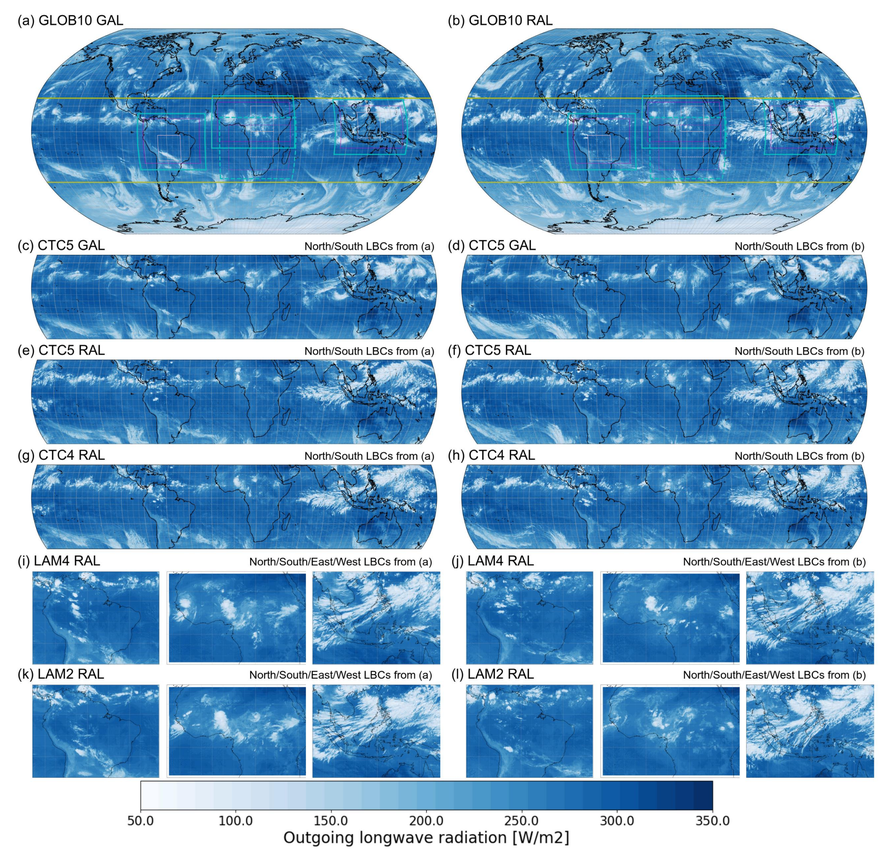
1. What is K-Scale? Why?

1-10 km pseudo-global models:

- *Convection partially resolved (but not fully, shallow conv needed?).*
- *Unknow performance on the large-scale flow (e.g. planetary scales)*
- *Next for operational oper. global NWP implementation (now at 12km)*

2. K-scale Hierarchy:

A traceable application of model configurations across a range of domain extent – from global to continental, grid resolutions – from 10 km to 2 km, and model physics – **GAL** (with convective parametrization) and **RAL** (without).

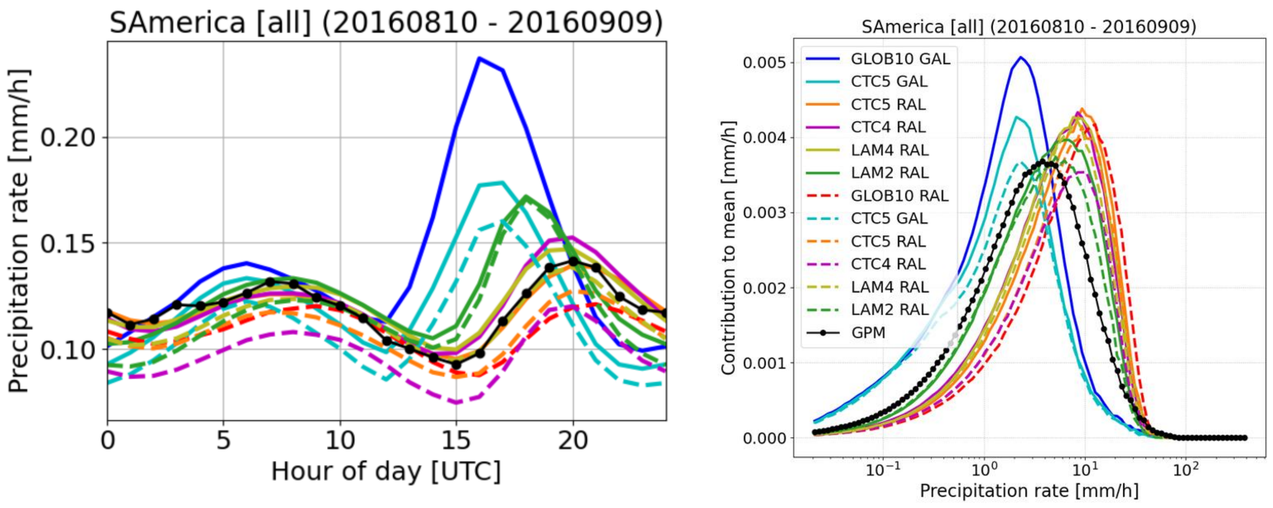


[Top]: Illustration of K-Scale model hierarchy domains, grid spacing and science configurations. Maps show inst. OLR at 0600 UTC on 10 August 2016

3. Precipitaiton:

RAL simulations show an improved Diurnal cycle over S.America and Africa to **GAL** sim., less over SE Asia, also improved relative to LAM2.

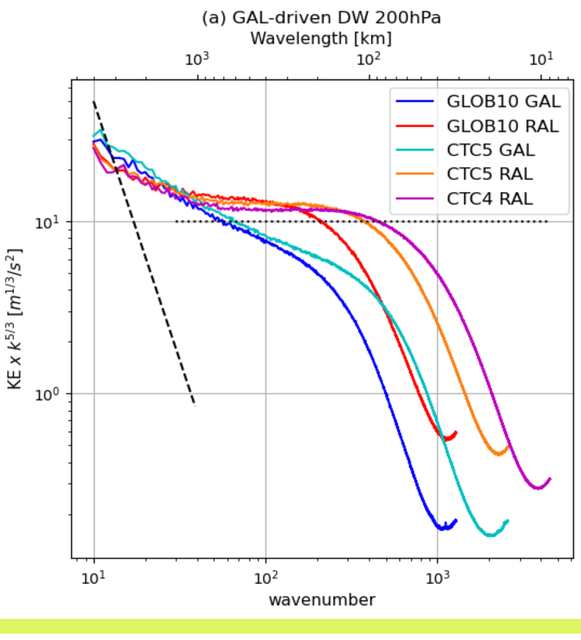
Low-intensity rainfall too frequent in **GAL**, high intensity too freq. in **RAL**. Compared to GPM-IMERG.



[Top]: (left) Diurnal cycle of mean precipitation rate and (right) frequency distribution of precipitation rate as contribution to mean rainfall. For South America, Summer case. Solid lines: GLOB10 GAL9-driven. Dashed lines: GLOB10 RAL3-driven

4. Kinetic Energy power spectra:

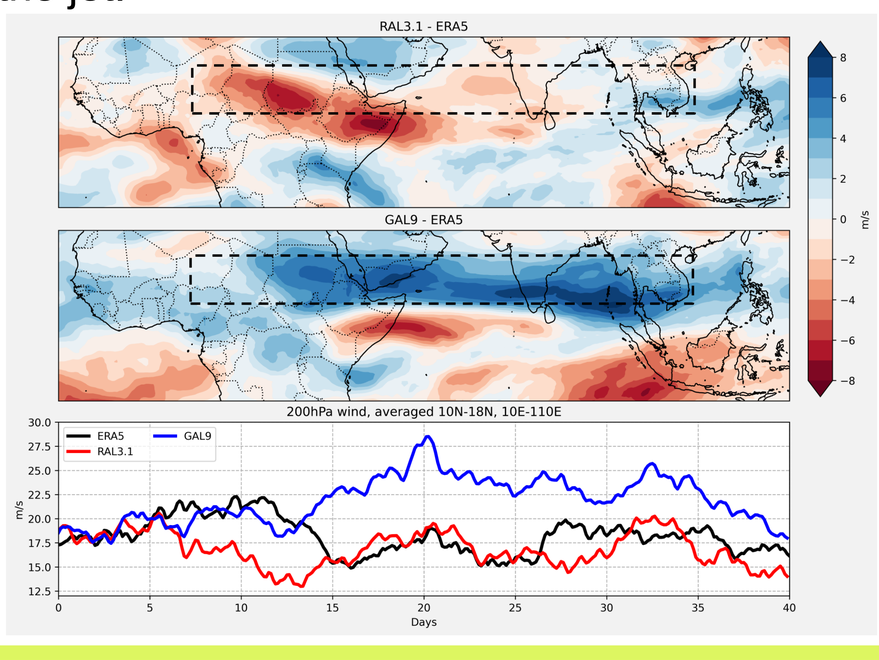
A model 's ability to reproduce the Kinetic Energy power spectra indicates whether it is faithful to the dynamics of the atmosphere. **RAL** simulation show better alignment to the -5/3 slope.



[Left]: KE power spectra for 10S-10N at 200hPa. Scaled to $k^{-5/3}$. Winter case, CTCs driven by GLOB10-GAL

5. Tropical Easterly Jet (TEJ):

The TEJ is substantially stronger with **GAL** across the Indian Ocean, **RAL** compares better to ERA5 reanalysis after 15 days. Variations in the jet strength are related to both heating variations and convection under the jet.



[Left]: wind speed GLOB10 RAL (top) and GAL (mid) biases to ERA5. Bottom domain average timeseries over dashed box

6. Summary and future work:

- The KE energy spectra captures the -5/3 slope at the mesoscales in simulations with RAL (without convection)
- Diabatic heating from precipitation over Africa and Indian ocean improves the TEJ in simulations with RAL.
- There is a higher sensitivity to a science configuration (GAL or RAL) than horizontal resolution.

❑ The K-Scale hierarchy is being employed by colleagues within MOAP to investigate MCS and equatorial waves.
❑ Further analysis of the TEJ and attribution to diabatic processes + Scale interaction in a "reduced K-Scale ensemble"
❑ Aiming to get involved in the DYAMOND3 model comparison.

Met Office Hadley Centre, FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: +44 1392 885680 Fax: +44 1392 885681
Email: richard.w.jones@metoffice.gov.uk