Convection-permitting modelling for South America

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ANDEX workshop, Santiago, Chile. 23rd October 2018.

Outline

- What is convection-permitting modelling (CPM)? Benefits of CPM.
- Some results from other projects
- Plans / model setup (CSSP Brazil)
- Potential relevance to ANDEX

What is CPM?

- A resolution at which larger convective storms and deep convection are ‘permitted’ i.e. explicity resolved (Kendon et al, 2017, BAMS) .

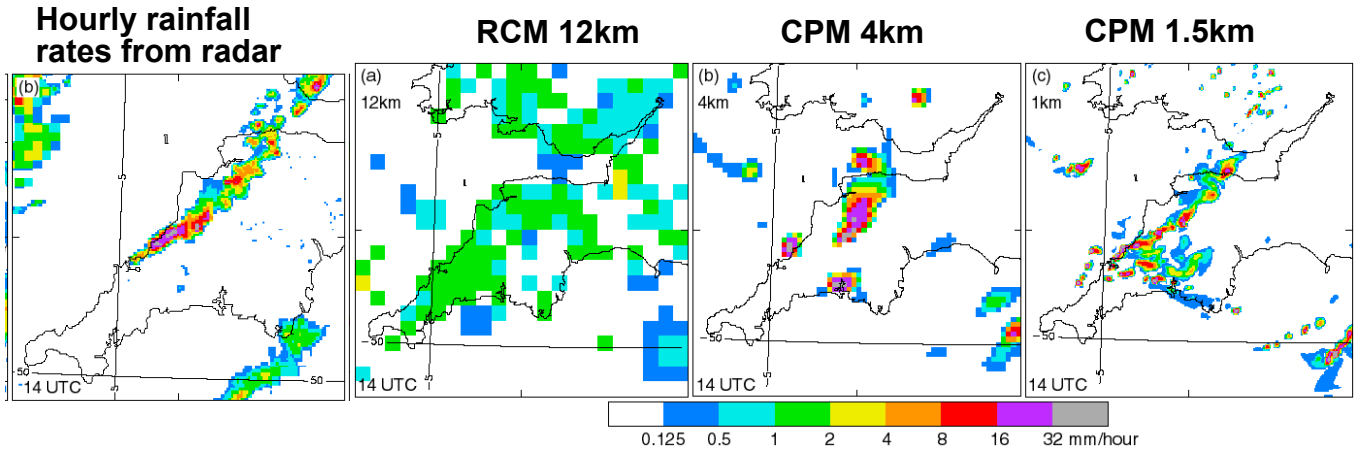
  Typically < 5km.

Note: shallow plumes and convective clouds still parameterized.

Benefits of CPM

- Improvements to the diurnal cycle of precipitation
- Improved representation of precipitation extremes.
- Adds value in areas of steep topography or high surface heterogeneity (Prein et al, 2015, Rev. Geophys)

  i.e. of soil moisture / land cover



Case study: Boscastle, 16th Aug 2004; Courtesy: Nigel Roberts

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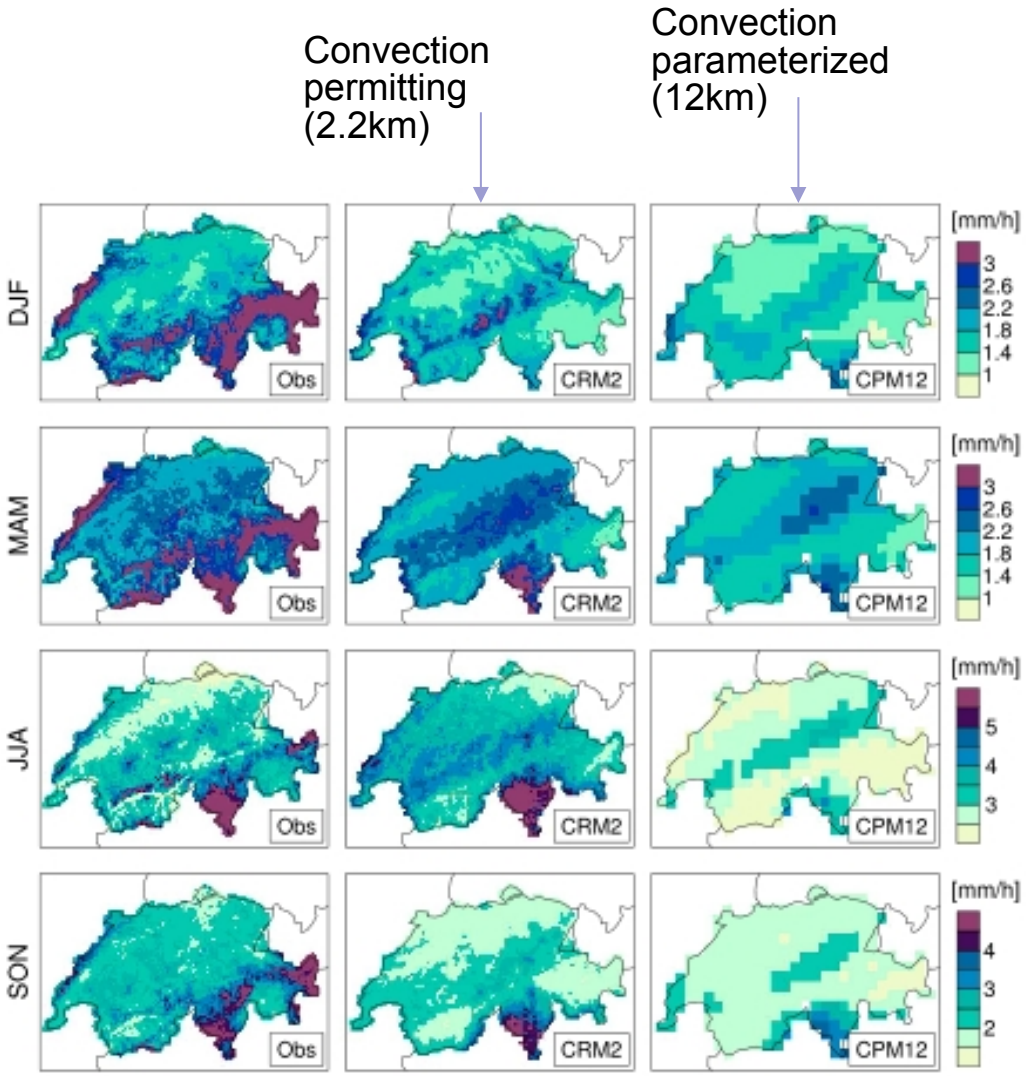
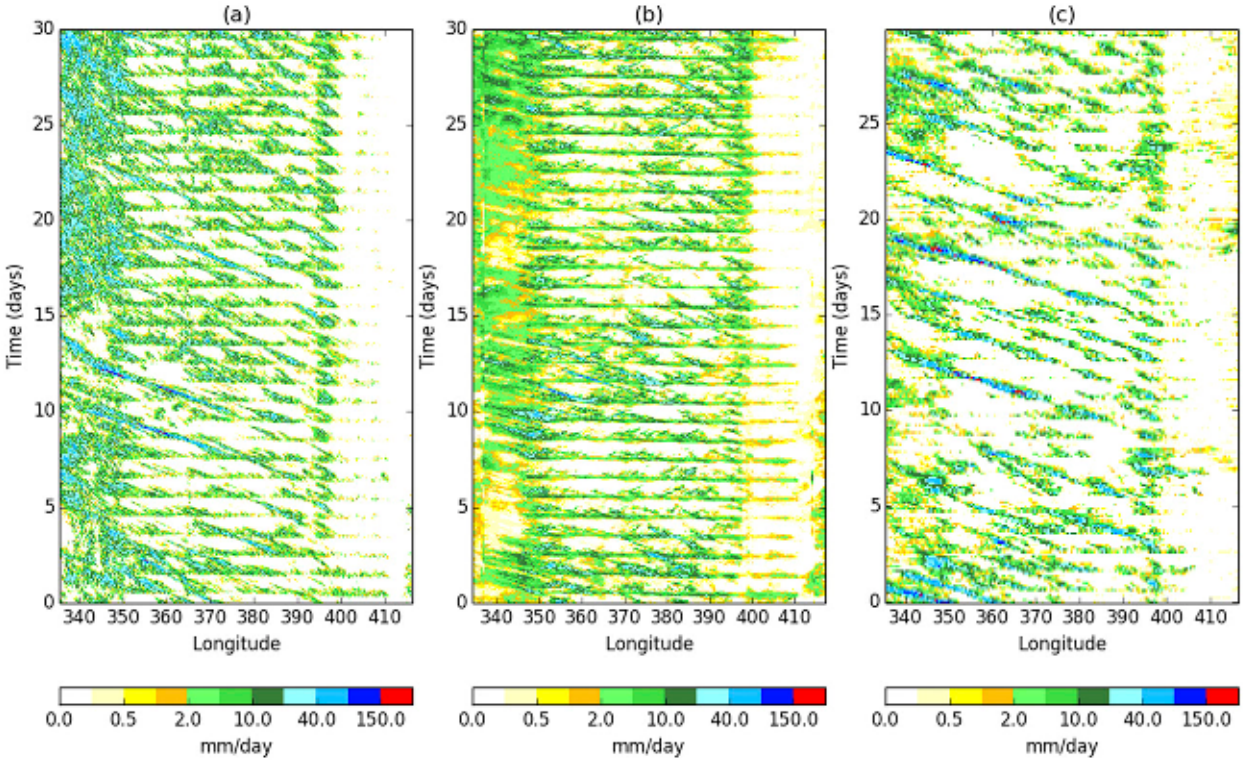
90th percentiles of hourly precip



Ban et al (2014). JGR Atmos.

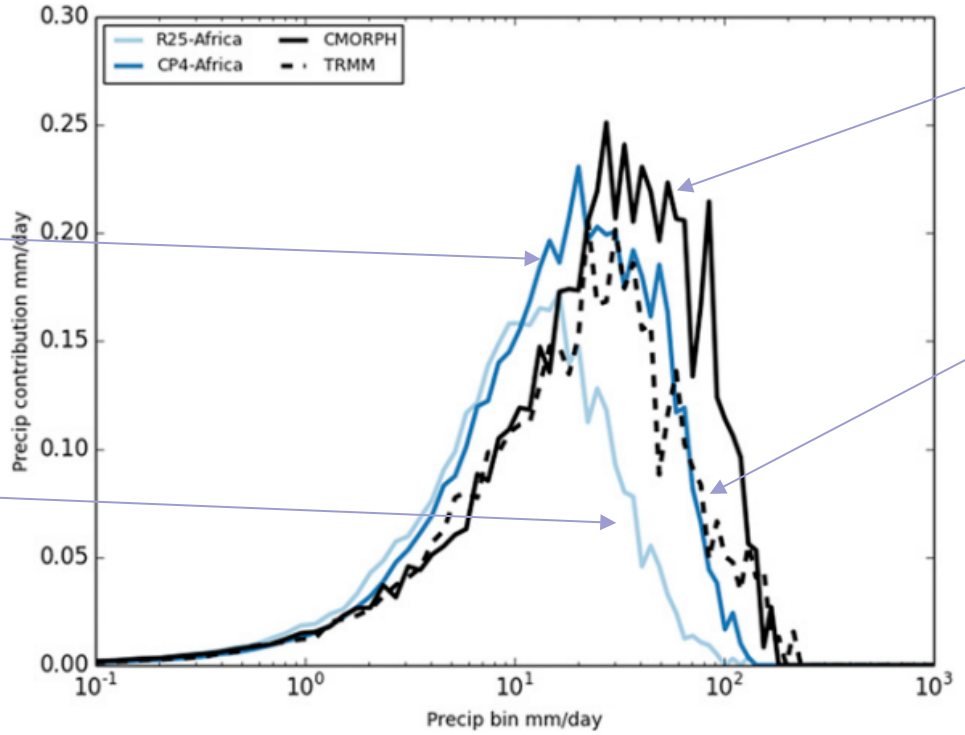
5-15degN latitude band – Africa, June 1998

4.5km | 25km | 3-hourly TRMM



Stratton et al (2018). J. Climate

West Africa – JJAS 1997 – contribution of 3-hourly precip events to the average 3-hourly precip rate



4.5km

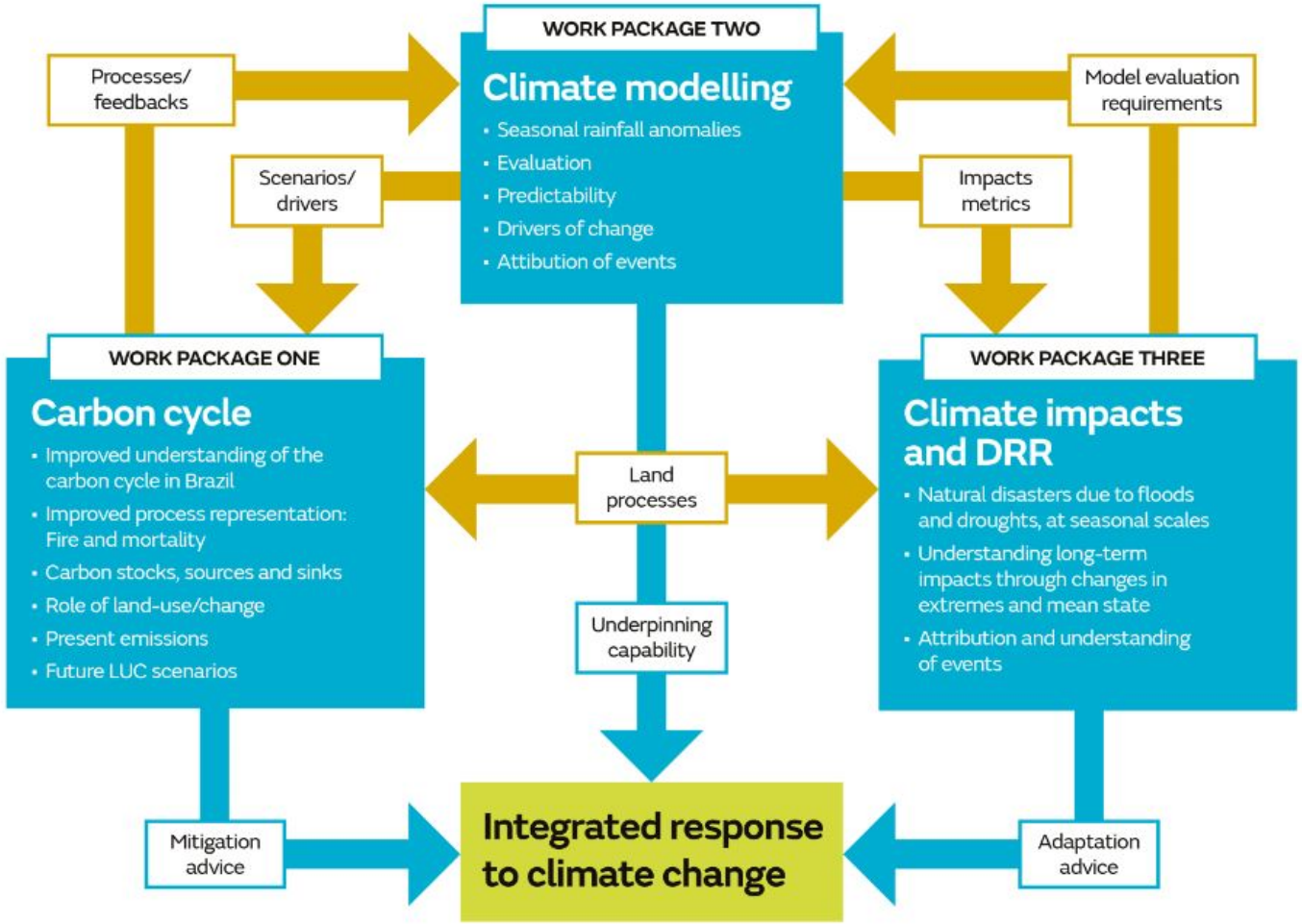
25km

CMORPH

TRMM

Stratton et al (2018). J. Climate

CSSP (Climate Science and Services Partnership) Brazil project



https://www.metoffice.gov.uk/research/collaboration/newton/cssp-brazil

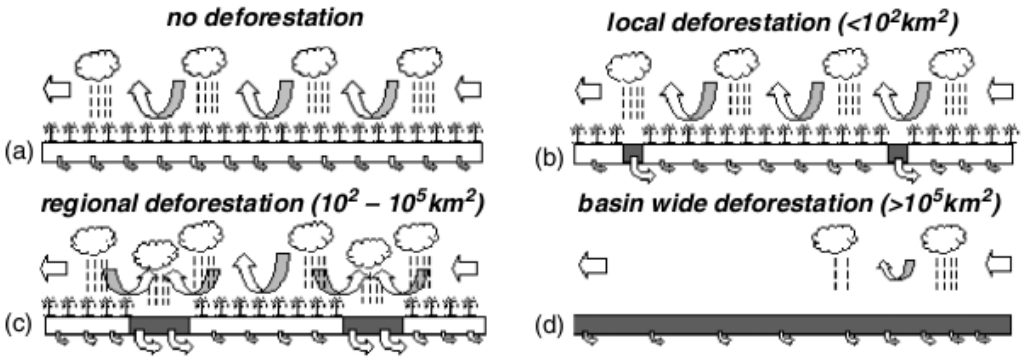
CPM for South America

- Present day **HadGEM3** test simulations driven by ERA-Interim.
  75km → 12km → 4.5 km, 80 vertical levels

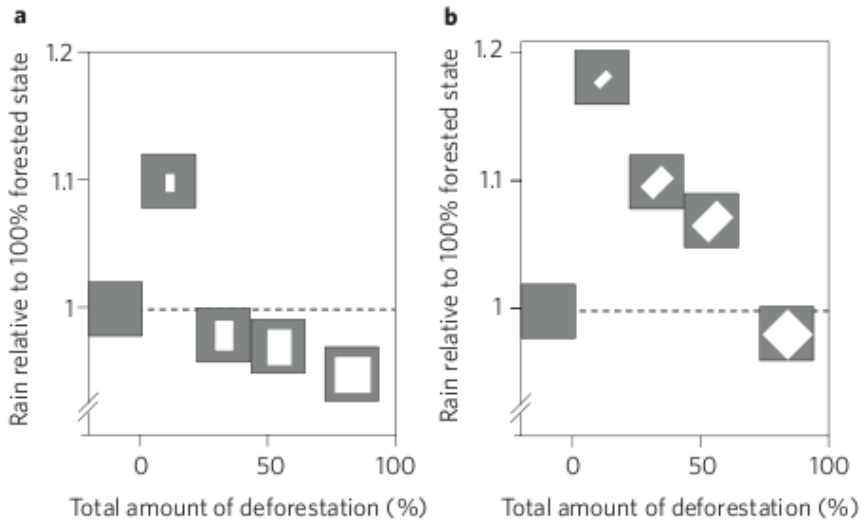
- Two **10-year** timeslices (present day and ~2100) driven by global atmosphere only runs.
  25km → 4.5km, 80 vertical levels
  (only GHG, SST and sea ice will be changed in the future experiment; land cover will not be changed)

- Potential additional experiments:
  higher resolution timeslices for smaller regions exploring
  -deforestation scenarios (including land-use change)
  -urban environments
  -biomass burning aerosol effects
  4.5km -> 1-2 km

CPM for South America – land use

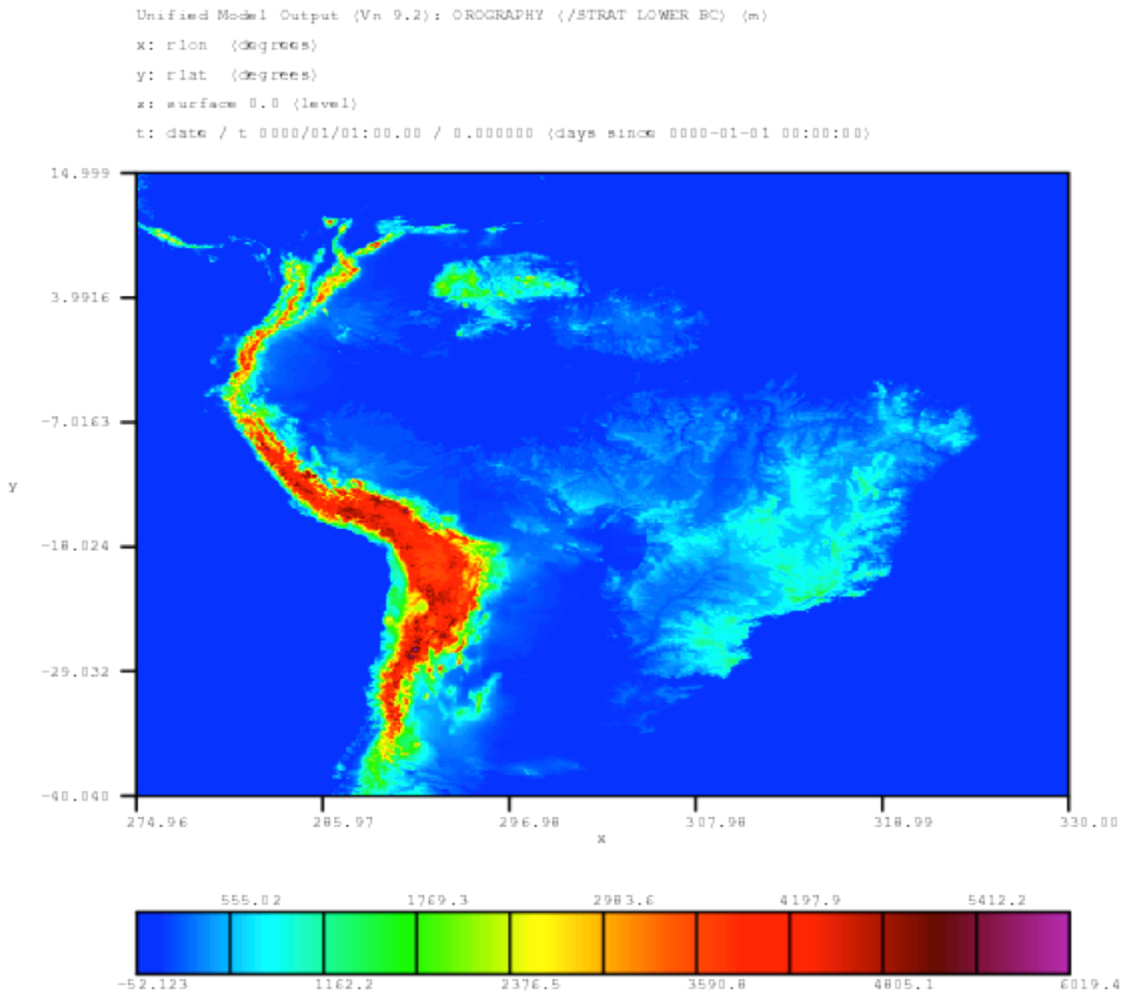


D'Almeida et al (2007)

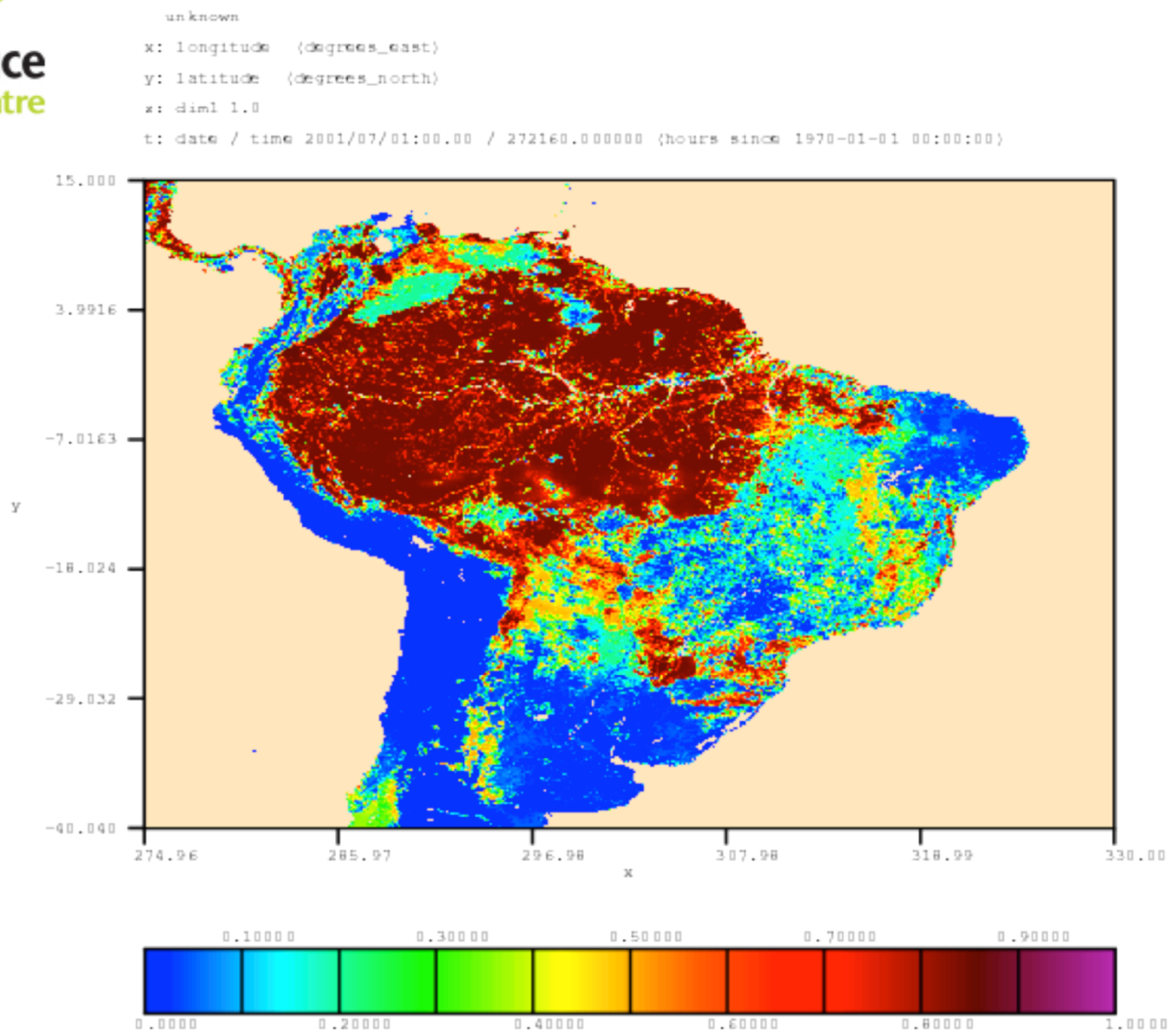


Lawrence & Vandecar (2015)

Orography



Broadleaf tree fraction



Challenges/caveats

- Biases in the driving model remain in the CPM.
- An improvement in annual, seasonal and even daily means would **not** necessarily be expected.
- Grid-point storms caused by ascent of moist air up steep slopes – may require smoothing of orography.
- Soil properties poorly constrained.
- Management of output data volumes. Which variables to output and at what temporal resolution?

Potential benefit to ANDEX

- Improved representation of
  - precipitation duration / intensity
  - short duration precipitation extremes.
  - spatial patterns of precipitation over steep orography.

- High temporal and spatial resolution output data (4.5km scale) could be used to drive impacts / hydrological models for specific regions. **Please contact me if there are specific variables that you need for this**.

Note: data volumes are very high so we would recommend a visit to the UK Met Office in order to collect data/undertake analysis.

Requests to ANDEX participants

- Can we coordinate with other CPM experiments (in the style of CORDEX) ?
- Validation of the output data (especially precipitation) for Andean region.

- high spatial/temporal resolution precipitation data. TRMM will be used but ideally combined with station data.

- Validation of the land cover data set.

- ESA CCI or IGBP ? ?

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Questions ?

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