Evaluating clouds, precipitation and climate over Southern West Africa

Richard P. Allan | Peter Hill | Caroline Dunning | Emily Black | Christine Chiu

Motivation
- Southern West Africa region:
  - rapid growth in population and air pollution
  - variability of the West African monsoon rains
  - vulnerable to climatic impacts e.g. health, food security
- Earth Observation datasets vital in monitoring climate and evaluating/improving prediction models

Key Points
- Deficiencies in climate model simulations of cloud, radiation, and precipitation in southern West Africa identified
- Low cloud below high cloud limits cloud radiative heating of the atmosphere but is poorly captured in simulations
- Coupled climate models fail to capture Little Dry Season over coastal west Africa due to sea surface temperature biases

References

Acknowledgement: Work supported by NCEO and the EU DACCIWA project FP7/2007-2013

Contact information
- Department of Meteorology, University of Reading, Whiteknights, RG6 6AH
- Email: r.p.allan@reading.ac.uk | www.met.reading.ac.uk/~sgs02rpa

Figure 1: June–July mean MODIS cloud cover (2002-2014) & TRMM precipitation (2000-2014) with DACCIWA project region shown as box [Hill et al. 2016]

Figure 2: schematic of atmospheric energy budget (left) for box in Fig. 1. Variability in precipitation primarily balanced by dry static energy divergence [Hill et al. 2016]

Figure 4: Diverse depiction of diurnal cycle of cloud, precipitation and top of atmosphere radiation by atmospheric climate model simulations [Hill et al. 2016]

Figure 5: schematic of combined clouds and radiation satellite product (CCCM B1 release, see Kato et al. 2011) used to construct cloud radiative effect by primary cloud types over southern West Africa June-September 2006-2010 in Fig. 6 below.

Figure 6: radiative effect of cloud types over southern West Africa at surface, in the atmosphere and at the top of atmosphere: Hill et al. 2018

H = High
M = Mid
L = Low
x = vertically contiguous clouds
1 = single level cloud

Figure 7: Coupled climate models fail to simulate the Little Dry Season over coastal west Africa: daily precipitation from atmosphere-only AMIP & coupled CMIP simulations, satellite-derived observations Obs Dunning et al. 2017