Department of Meteorology

Evaluating clouds, precipitation and climate over Southern West Africa

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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

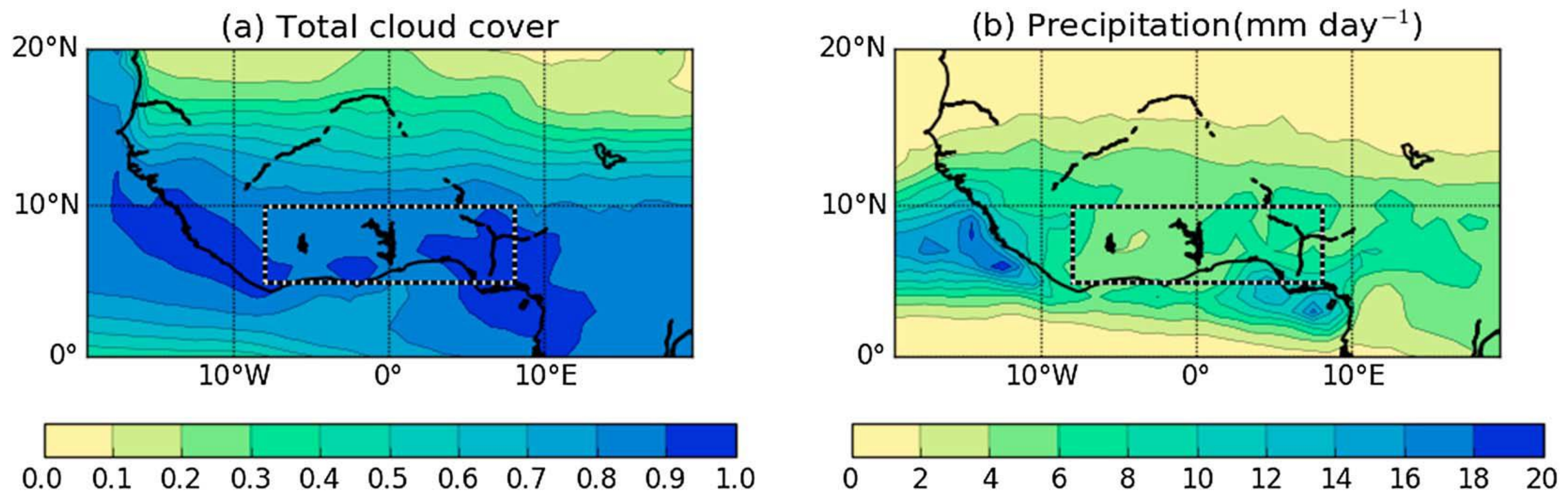


Figure 1: June–July mean MODIS cloud cover (2002-2014) & TRMM precipitation (2000-2014) with DACCIWA project region shown as box [Hill et al. 2016]

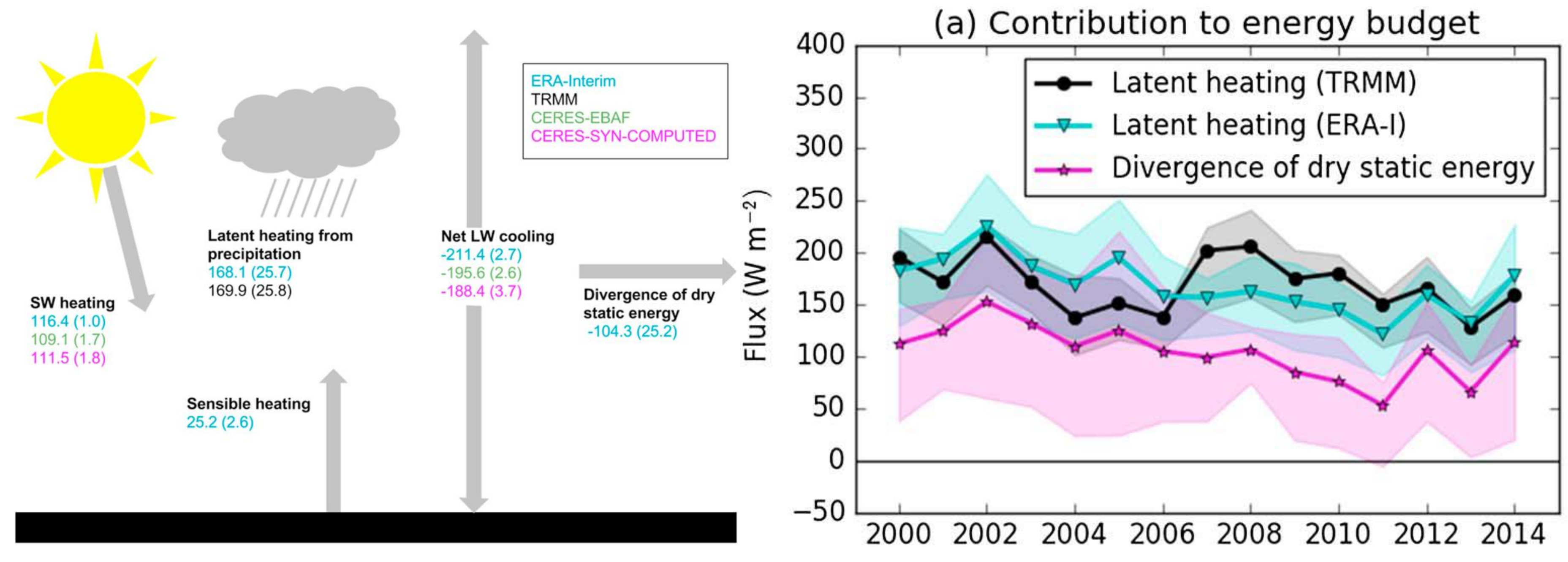


Figure 2: schematic of atmospheric energy budget (left) for box in Fig. 1. Variability in precipitation primarily balanced by dry static energy divergence [Hill et al. 2016]

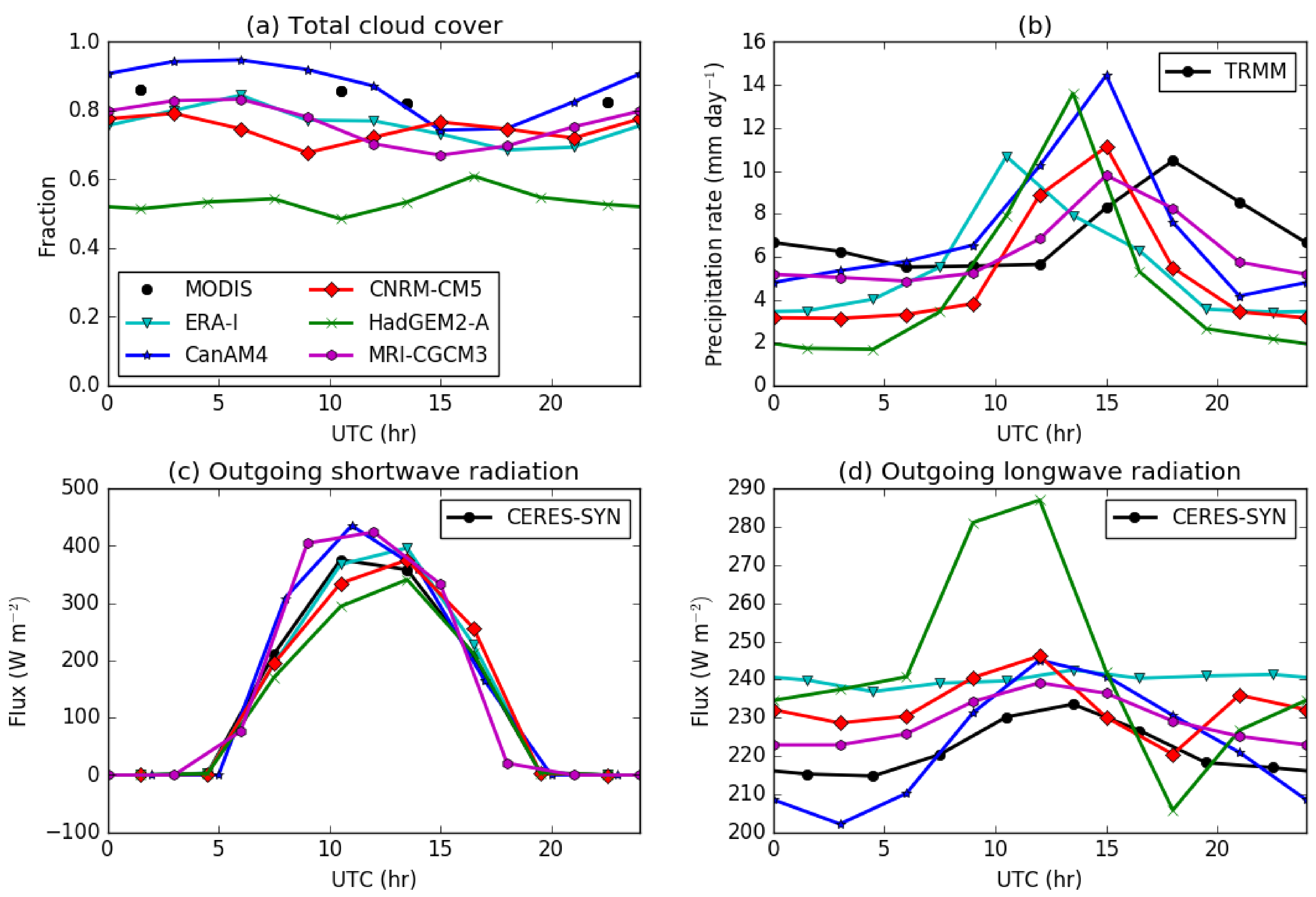


Figure 4: Diverse depiction of diurnal cycle of cloud, precipitation and top of atmosphere radiation by atmospheric climate model simulations [Hill et al. 2016]

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.

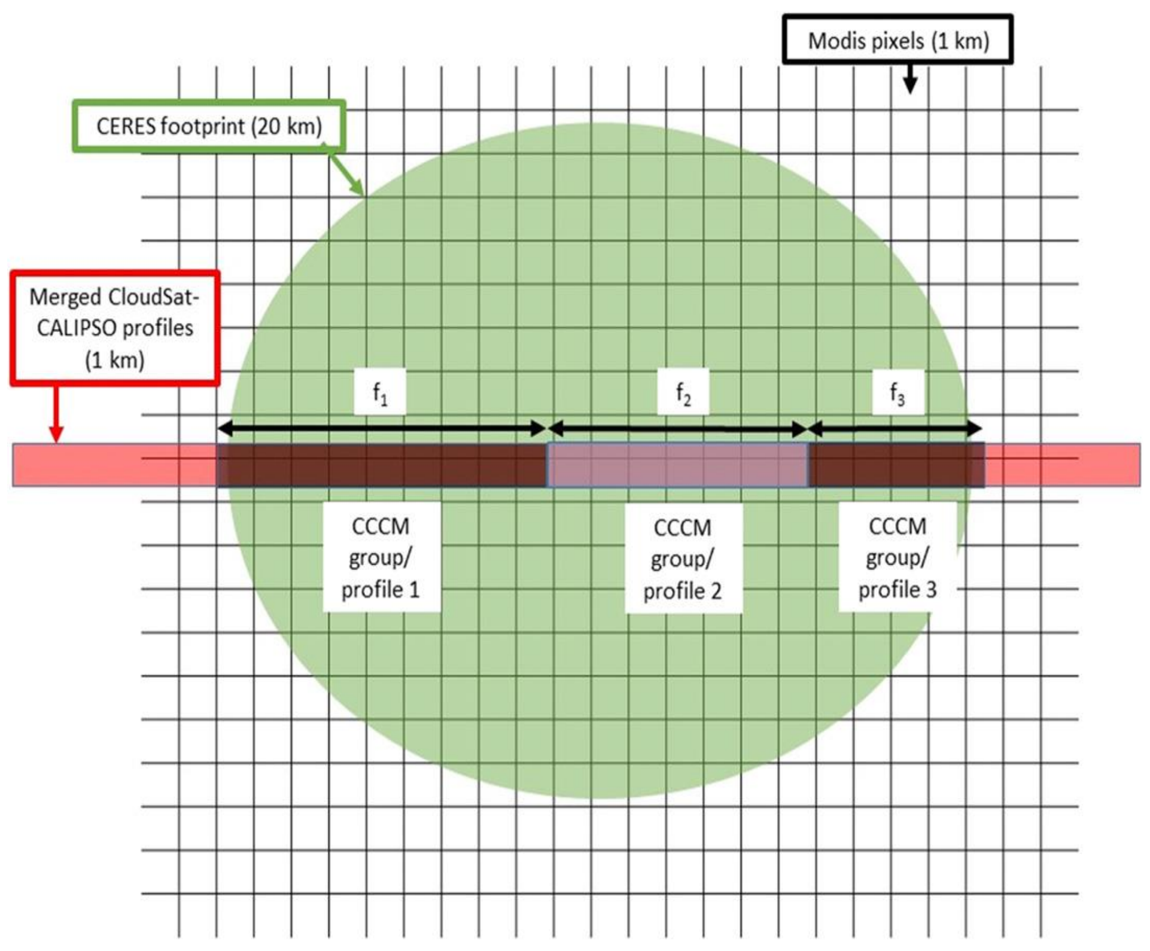
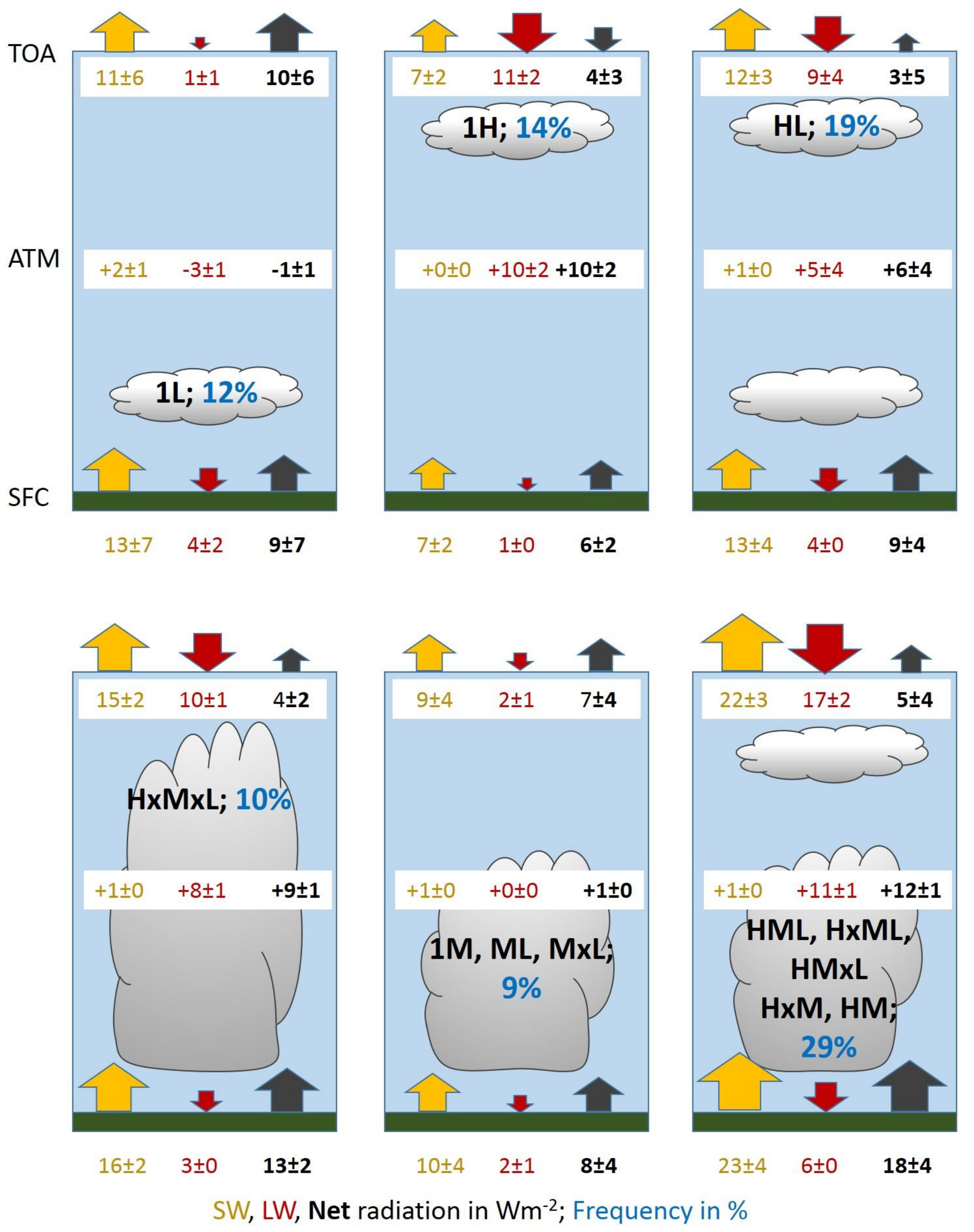


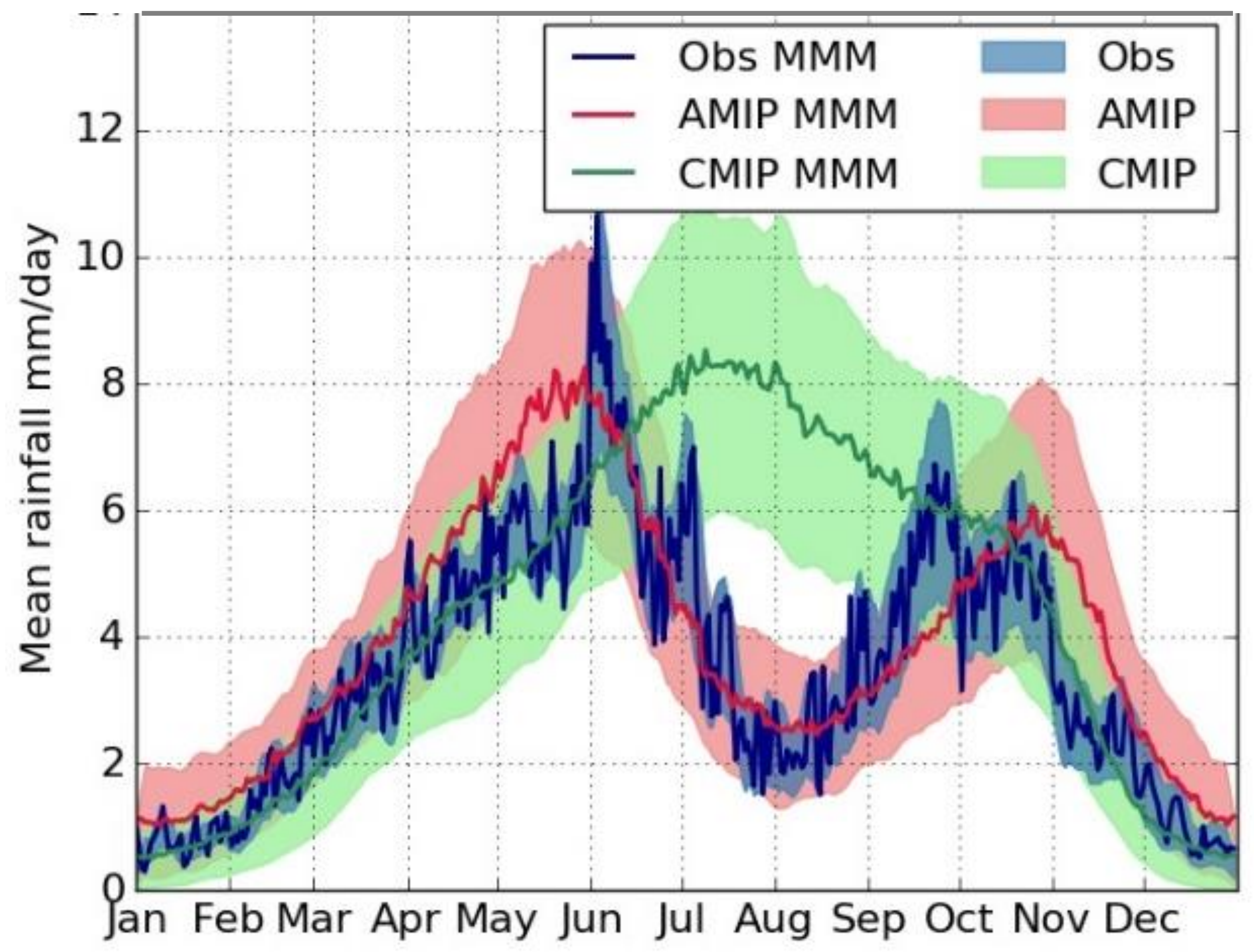
Figure 6: radiative effect of cloud types over southern West Africa at surface, in the atmosphere and at the top of atmosphere: Hill et al. 2018

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



SW, LW, **Net** radiation in Wm^{-2}; Frequency in %

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



References

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Kato, S., et al. (2011), Improvements of top-of-atmosphere and surface irradiances with CALIPSO, CloudSat, and MODIS derived cloud and aerosol properties, J. Geophys. Res., 116, D19209, doi:10.1029/2011JD016050.

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