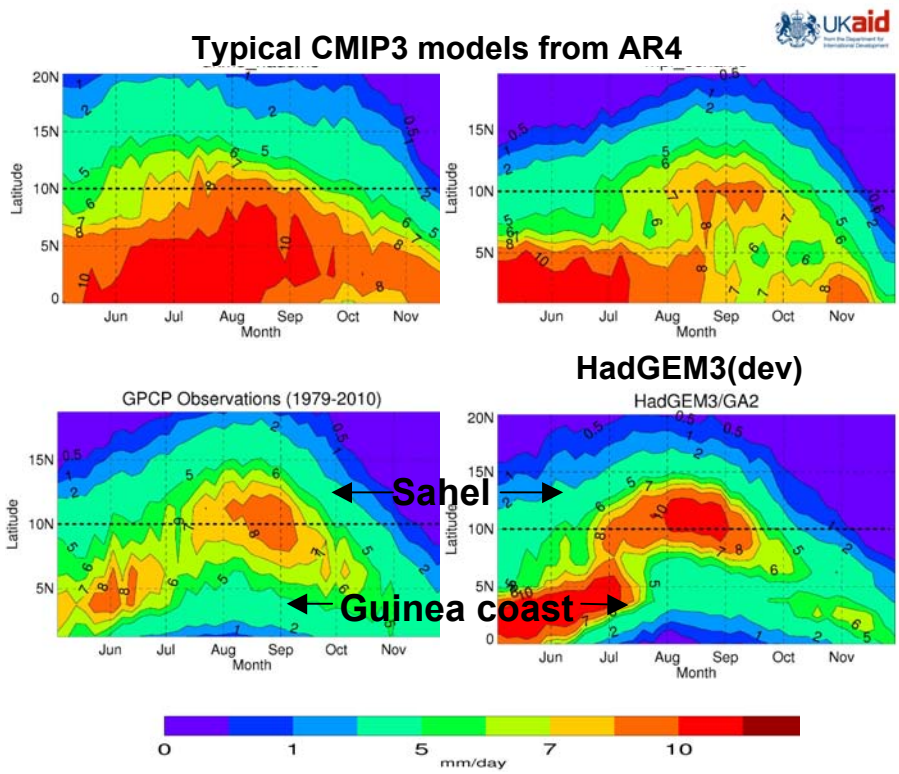
CSRP: model testing – African climate systems

Climate models used in the IPCCs 4th Assessment Report (AR4) show no consensus in the sign of future precipitation changes over West Africa. Improvement of climate models may reduce this uncertainty. How well is the primary rain-bringing system – the West African Monsoon (WAM) – currently represented in climate models?

Simulation of the northward progression of rains during the WAM is typically inadequate in AR4 models (compare typical results from 2 models (row 1) with the observed average progression (row 2, left). The horizontal (time) axis runs from May to December. A reference line at 10ºN is drawn on the vertical (latitude) axis. Shading shows the intensity of rain (mm/day) averaged over the east-west strip 10ºW-10ºE. In general the AR4 models do not achieve sufficient advancement of the rains north of 10ºN into the Sahel ('Sahel onset'). The timing at which the most intense rain shifts from the Guinea coast to the Sahel, early July in observations, is reasonable in some models but not in others (e.g. too late in row 1, far right).



This less than adequate representation of the WAM likely hinders both reliable seasonal prediction of rainfall and projections of regional climate change.

A development version of the Met Office HadGEM3 model has been found to have a relatively good representation of the WAM (row 2, right), with realistic northward advancement of the rains and good Sahel onset timing. This good simulation suggests that factors controlling onset are realistically represented in HadGEM3, and that we can use the model as a proxy for the real atmosphere to learn more about the important processes controlling onset. Results have identified global patterns in sea surface temperature variations that influence onset timing and an important role for the land surface over the Sahel, particularly soil moisture.

Understanding of this kind is required to help improve climate models and to establish a physical basis for reduced prediction uncertainty.

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