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Evaluation of West African monsoon processes and feedbacks: Second West African Monsoon Modeling and Evaluation Project Experiment (WAMME II)

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Despite recent progress in the understanding of the West African monsoon (WAM), its interactions with oceans, land, and aerosols, are still not well understood. The West African Monsoon Modeling and Evaluation project (WAMME) is a project comprised of both general circulation models (GCMs) and regional climate models (RCMs) to collectively investigate WAM processes and feedbacks between WAM and external forcings. WAMME activities are closely coordinated with AMMA activities.

Recent observational evidence has supported the notion that there are strong decadal climate variabilities in the West Africa from the 1950s to the 2000s, not only in precipitation, but also in spatial distributions of sea surface temperature (SST), vegetation cover, land use and land cover (LULC) change, and aerosols. In WAMME-2, multi-model intercomparison experiments are further designed to test whether seasonal and decadal variability of WAM precipitation is associated with these forcings. The WAMME-2 objectives are established as: (a) to improve our understanding of impacts of these forcings on the regional water cycle of the WAM, (b) to evaluate the sensitivity of the seasonal and decadal variability of the West African climate to those external forcings, and (c) to assess their relative contributions in producing/amplifying the WAM seasonal and decadal climate variability. The WAMME-2 strategy is to apply observational data-based anomaly forcing, i.e. "idealized but realistic" forcing, in GCM and RCM simulations to test the relative impacts of such forcings. Ten GCMs and six RCMs are participating in this experiment. African scientists are also closely involved in this activity. In all these experiments, data from the AMMA Project are used for evaluation and analyses.

In the SST experiment, in addition to the global SST effect, each ocean's role is also evaluated. To test this, anomalies of SST forcing in each ocean are removed sequentially from the global SST anomalies, which differs from common practice, i.e. adding each ocean basin's SST anomalies one by one. The preliminary results from most GCMs consistently indicate that SST has a pronounced impact on the WAM decadal variability, and that the effect of the Pacific Ocean is quite dominant. However, the models differ in producing other oceans' contribution to WAM decadal variability. In the LULC change experiment, a newly available land use change map is applied. A consistent change in the vegetation maps is proposed for each WAMME modeling group. The simulated LULC change impact is also substantial, compatible to the SST forcing. The critical factors in producing the LCLU change effect and the consensus among the models are discussed. In the dust experiment, the direct impact of dust on the radiation budget and its influence to the WAM rainfall are evaluated using GOCCARD and MATCH dust data and are compared with other external forcings. The discrepancy and consistency among the model results are discussed.