The importance of radiation in regional climate models for Africa

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SUMMARY

The representation of the surface radiation budget is important in climate modeling, as well as in hydrological and vegetation modeling. Our studies show that:

1) The radiation budget for Africa is simulated with large uncertainties in regional climate model simulations
2) These uncertainties influence the simulation of the West African Monsoon (WAM) and
3) Simple considerations of topographic effects can improve regional models.

UNCERTAINTIES

- There are large errors in radiation flux components simulated by regional climate models for Africa (Fig. 1)
- Quantifications of the impact of errors in cloud fraction (ΔCFR), surface albedo (ΔALB), and surface temperature (ΔTS) on net radiation fluxes showed:
  - ΔCFR and ΔALB explain more than 50% of the uncertainty in the short-wave radiation components; ΔCFR is predominant over the ocean but over land, ΔCFR and ΔALB have similar impacts (Fig. 2)
  - In long-wave spectrum strong influence of ΔCFR (>60%) and negligible impact of ΔTS in oceanic regions; comparable impact of ΔCFR and ΔTS over land (>30%)
  - ΔALB most important factor for uncertainties in the Sahara and Sahel region

WEST AFRICAN MONSOON

- Our evaluation showed that the regional climate model COSMO-CLM is able to reproduce main features of the WAM and that the model adds value on topographic effects (Fig. 4)
- Adding of a strong and weak zenith angle dependence of surface albedo for direct parallel radiation and topographic correction of direct solar radiation at the surface have regional impact of more than 1 K (not shown)

OUTLOOK

- Evaluation of new surface albedo parameterization and of final model setup within the COSMO-CLM (www.clm-community.eu) and the CORDEX (wcrp.ipsl.jussieu.fr/RCD_CORDEX.html) communities
- Realization of regional climate projections for the next IPCC assessment report and the BiK-F Climate Atlas (cf. Fig. 5)

REFERENCES


"There are errors, which have an impact on results, but we can fix some of them."