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Dynamics and predictability of heavy precipitation events over West Africa – sensitivity experiments with the global model GME

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In January and March 2002 two exceptionally heavy precipitation events hit western Africa. The first event, which occurred over Senegal and Mauritania, had harmful impacts on human lives. It caused several casualties, loss of harvest and livestock, and devastation of the local infrastructure. The second event, which affected the border region between Morocco and Algeria, led to some flooding but also replenished water reservoirs for irrigation. Both events were accompanied by the development of intense potential vorticity (PV) streamers at upper levels that originated over the extratropical North Atlantic and penetrated towards the West African coast. This kind of tropical-extratropical interaction is important to focus the moisture supply and to release the heavy rainfall.

The two events were simulated with the operational global model GME of the German Weather Service (DWD) with a horizontal resolution of 40 km and 40 vertical layers. The model runs were initialized by European Centre for Medium-Range Weather Forecasts (ECMWF) analysis data. In addition to several control runs with different start dates, sensitivity experiments were conducted to investigate the importance of different physical processes on the dynamical development of the PV streamers and the precipitation events themselves. This includes local influences like the modification of the sea surface temperature (SST) and orography, but also remote influences like the wave development in the extratropics.

The first event is captured remarkably well by the GME control runs, even in the medium range forecast (5-7 days before the rainfall began). The second event is poorly

predicted in the medium range, but accurately in the short range. This can be traced back to mistakes in the simulation of the upper level PV field in the runs with earlier starting times. According to the sensitivity experiments, the SST and orography have only weak impacts on the development of the events and, in contrast to similar case studies, also upstream latent heating is a factor of second order. On the other hand the large scale upper-level wave structure over the extratropical Atlantic several days before the events is crucial for the formation of the PV streamers in front of the West African coast and the following precipitation. This fact might favour the satisfactory predictions of these events in comparison to other more convectively driven cases of heavy tropical and subtropical rainfall.