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Cyclogenesis and Severe Weather in the Vicinity of the Atlas Mountains: Modelling Studies with a Nonhydrostatic Mesoscale Model

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ABSTRACT: Northwest African climate is affected considerably by the Atlas Mountains. Several typical weather phenomena - as extra tropical fronts, orographically forced convection, mountain lee cyclogenesis - are connected to the water supply in arid and semi-arid regions. One of the goals of the project IMPETUS West Africa is to enhance the knowledge about rainfall variability in the Drâa river valley, which is located on the southern slope of the High Atlas Mountains. A hierarchy of models ranging from global scale to microscale is established in this region of subtropical mountains in order to examine precipitation variability and to perform climate scenarios within the next years. One of the regional climate models used is the Lokalmodell (LM) of the German Weather Service, which provides a non hydrostatic atmospheric dynamic together with robust formulations of physical parameterizations. Thus, the LM is used to perform precipitation forecasts in mountainous regions on horizontal scales of less than 10 km grid size. In a first step, typical sources of rainfall have been categorized. Case studies with the LM for members of each category allowed evaluation of model forecast quality. Modelled phenomena include extra tropical fronts approaching the Atlas Mountains, frontal cyclogenesis, severe thunderstorms caused by strong tropical / extra tropical interactions and typical Saharan cyclogenesis events. Since the LM is also used for seasonal forecasts and scenario runs, the model should be able to forecast not only average rainfall but also its variability, especially in extreme situations. In order to focus on extreme events, two recent cases with severe damages and loss of lives - the Alger mud flood on Nov 9/10, 2001 and severe floodings in Morocco near Rabat in the week of Dec 3-7, 2002 - are investigated in more detail. The role of the Atlas Mountains is of great importance in these cases, since they act as barrier for maritime moist air and on the other hand as a source of potential vorticity for cyclogenesis. Sensitivity studies on land use characteristics, use of different physical parameterizations, corrections of the initial state of the atmosphere and a simple model output statistics technique contribute to a substantial improvement of rainfall predictions.