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High-resolution weather simulation for sub-Saharan Africa on the World Community Grid

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Rainfall in Africa is difficult to estimate accurately due to the large spatial variability. Most of the monsoon rainfall is generated by convective rainstorms that can be very localized, sometimes covering less than 100 km2. The goal of the African Rainfall Project is to run the Weather and Research Forecast (WRF) model for sub-Saharan Africa at a convection-permitting resolution in order to better represent such rainfall events. The resolution will be 1km, which is finer than most studies over Africa, which typically use resolutions of 3km or more. Running WRF for such a large area at such a high resolution is computationally expensive, which is where IBM's World Community Grid comes in. The World Community Grid (WCG) is part of the Social Corporate Responsibility of IBM that crowdsources unused computing power from volunteers devices and donates it to scientific projects.

The simulation was adapted to the WCG by dividing the simulation of one year over sub-Saharan Africa in many smaller simulations of 48h over 52 by 52 km domains. These simulations are small enough to be calculated on a single computer of a volunteer at the required resolution. In total, 35609 overlapping domains are covering the whole of sub-Saharan Africa. During the post-processing phase, the smaller simulations are merged back together to obtain one consistent simulation over the whole continent.

Our main focus is rainfall, as this is the variable with the highest socio-economic impact in Africa. However, the outputs of the simulations include other variables such as the 2m-temperature, the 10m-wind speed and direction. These variables are outputted every 15min. At the end of this project, we will have over 3 billion files for a total of 0.5 PB. The data will be reorganized so that the different variables can be stored, searched and retrieved efficiently. After the reorganization, the data will be made publicly available.

The first validation step will be to examine the impact of dividing sub-Saharan Africa into many smaller domains. This will be done by comparing the simulation from this project to one large simulation. This simulation is obtained by running WRF at a 1km resolution on a large domain (500km by 1000km) for a shorter period, using Cartesius, the Dutch national computer. The second validation step will be to compare the simulations with satellite data and with in-situ

measurements from the TAHMO network (www.tahmo.org).