Africa-CORDEX and drought risk assessment for food security.

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Africa-CORDEX

Objective of this study is to test the potential added value of high-resolution dynamical downscalings of climate simulations for for impact studies in the sector of food-security.

We use the risk assessment platform – Africa RiskView (ARV) - developed by the office of **Climate and Disaster Risk Solutions of WFP** as the underlying impact model.

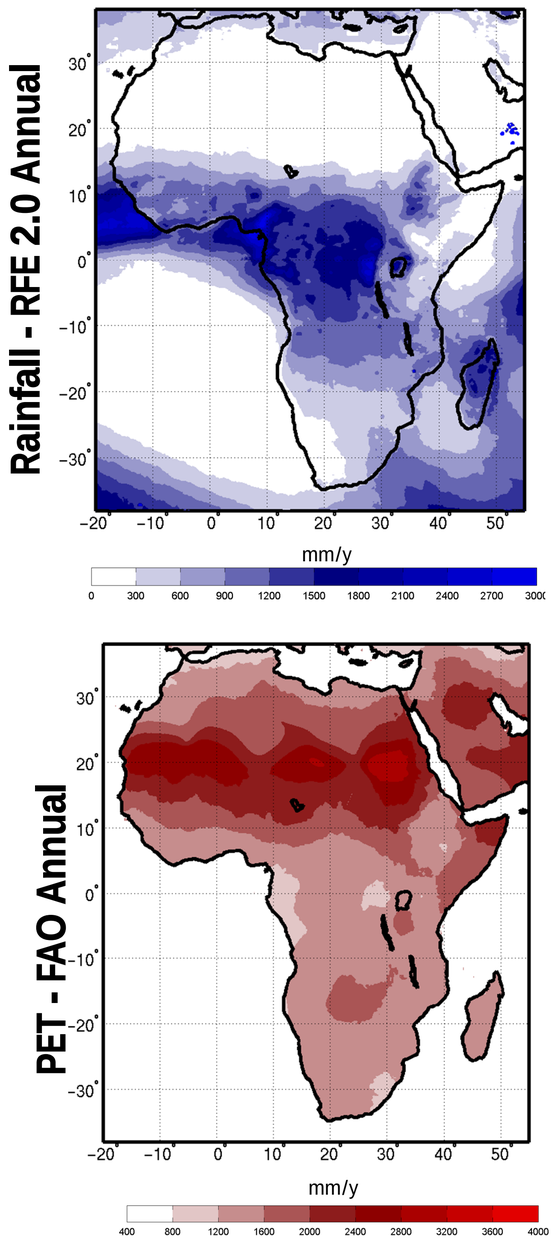
As a test, retrospective case, we consider the ERA-Interim reanalysis and three downscalings performed by **Swedish Meteorological and Hydrological Institute (SMHI)** at three different horizontal resolutions (44Km, 22Km and 11 km). Aim is to compare the outcome of the impact model under different climate forcings with a unique historical record of humanitarian interventions maintained by WFP.

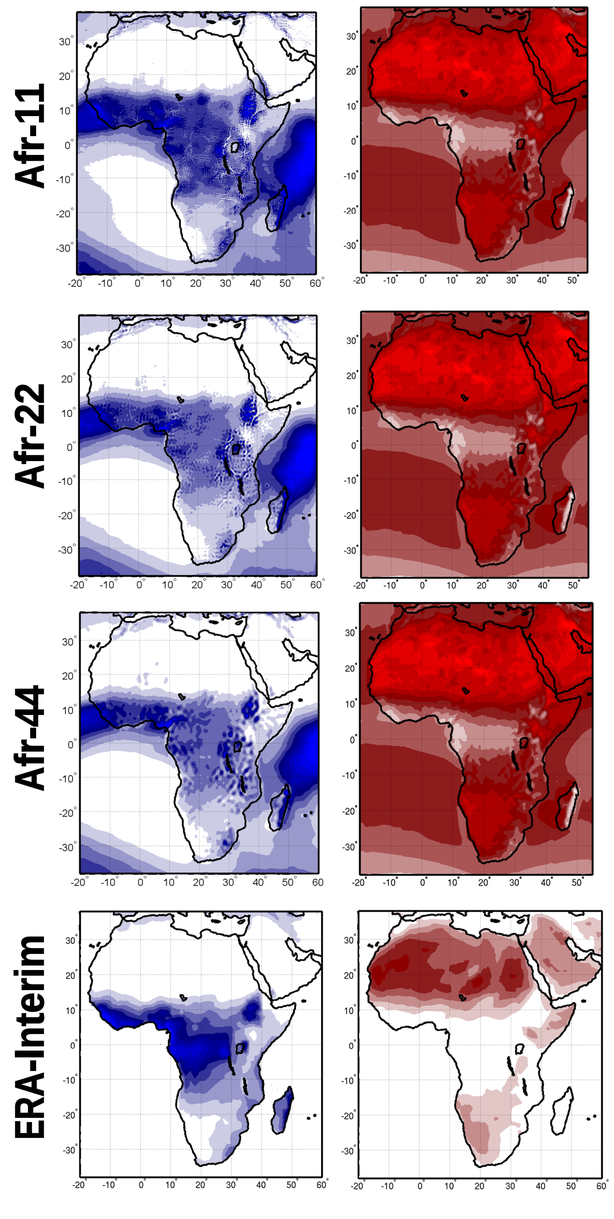
ARV (see box-below) routinely uses rainfall and potential evapotranspiration as input. Rainfall is routinely derived from the RFE2.0 African Rainfall Estimation Algorithm (Xie and Arkin, 1996) based on the merging of satellite and daily GTS rain gauge data observations. Potential evapotranspiration is derived from the FAO monthly climatology based on the Penman-Monteith (P-M) formulation (http://www.fao.org/nr/water/infores_databases_climwat.html).

The **Italian Agency for New Techonologies, Energy and Sustainable Economic** Development (ENEA) has worked on bridging the gap between the climate model output and the data input requirements of the impact model ARV.

Modeled annual rainfall show noisy patterns at intermediate resolution (44Km) that tend to disappear when the horizontal resolution increases. The coarser resolution downscalings generally produce an overall rainfall deficit in central Africa. However rainfall over the main topographic features (for example East Africa) are well captured.

The FAO climatology of potential evapotranspiration (PET) is based on a rather sparse set of ground based observations. Therefore , an examination of spatial patterns would not be very indicative of specific model deficits. However, a significant systematic bias in the model based PET is observed. Model PET is computed by applying P-M from the model output and an appropriate bias-correction strategy should be designed.





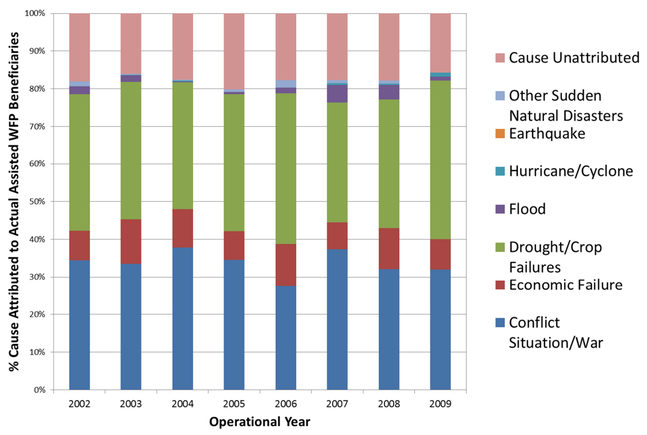
Africa RiskView

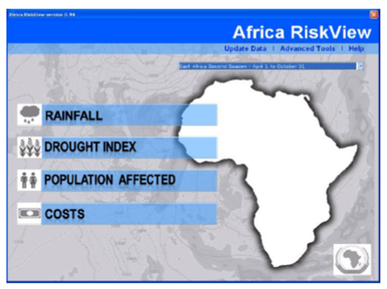
Drought accounts for an average 36% of all WFP operations (Emergencies, Protracted Relief and Recovery, Country Development Programmes) in Sub-Saharan Africa.

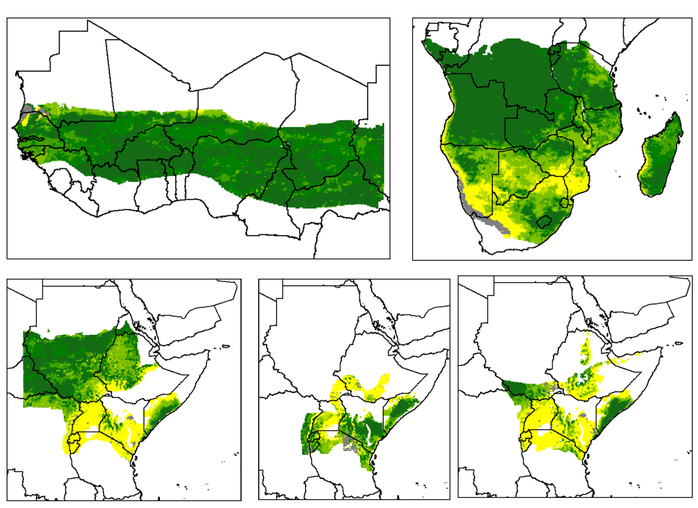
Africa RiskView is designed to enable users to quickly access products concerning weather related food security risks for the areas of interest. The user can select her or his region/season of interest, then access the products of the successive steps in the analytical process chain (**Rainfall > Drought Index > Population Affected > Costs**).

ARV considers rainfall and potential evapotranspiration data and uses the **Water Requirement Satisfaction Index (WRSI)** as the underlying drought index.

WRSI is a simple water balance model developed by the Food and Agriculture Organization (FAO), which compares the amount of water available throughout the season to how much a plant needs in its different stages of growth and has good agreement with actual crop yields. The panels on the right show an example **of WRSI maps for 2004**, a severe drought year in East Africa

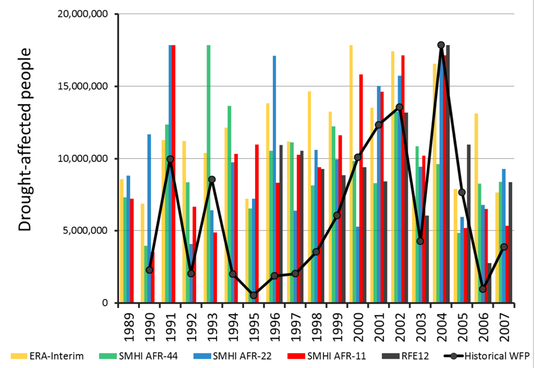






Validation

The historical records of WFP operations in response to African droughts are compared to different ARV outputs. Note, the historical record includes only WFP internal operations, affected by several factors such as funds availability, interactions with other national and international operations. Furthermore, they capture only a portion of the overall livelihood stress experienced in any given year and are subject to trends in population and vulnerability over time. ARV is therefore expected to overestimate historical records, particularly in the early 1990s, although not uniformly over the years. Records are considered more reliable after the year 2000. The table shows the **correlation of ARV output subject to different model data with historical records.** Starting year for computing correlations is indicated in the column to the left. End year is always 2007.



	ERA-Interim	SMHI AFR-44	SMHI AFR-22	SMHI AFR-11	RFE 2.0
1996	0.52	0.10	0.49	0.80	0.70
1997	0.57	0.15	0.73	0.80	0.77
1998	0.56	0.25	0.70	0.82	0.85
1999	0.64	0.20	0.74	0.83	0.89
2000	0.66	0.31	0.74	0.84	0.89

Conclusion

The analysis shows that work is still needed before model data collected under Africa-CORDEX can be used for the production of reliable projections of future food-security scenarios. However, the preliminary comparison with a unique record of the disaggregated effect of recent droughts (to our knowledge available only at WFP), shows a consistent picture in which coarser donwscalings imply a downgrading of the predicting skills of the impact model with respect to the driving glabal scale data. Some skill is recovered at intermediate horizontal resolution and finally the **11-Km resolution downscaling shows a predicting skill that is in line with that of the rainfall observations is routinely adopted at WFP for monitoring and early warning**. The calibration of climate model output for Africa RiskView is still in the testing phase under the EU project IMPACT2C (**www.impact2c.eu**).