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Ensemble approach to disaggregation of seasonal rainfall forecasts in the context of crop yield prediction. Case study: maize yield in Ethiopia.

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In many parts of the world, seasonal rainfall forecasts are used to provide early warning of anomalous rainfall totals. Particularly in Africa, there is a great need for seasonal forecasts which are sufficiently accurate to give useful prediction of end-of-season crop yield. Currently, most operational seasonal forecasts in Africa are based on statistical correlation with sea surface temperatures and are delivered as tercile estimates of a wet, normal or dry rainy season. While these forecasts are of some use in alerting relevant authorities to the possibility of future problems, they are not sufficient for the calculation of quantitative crop yield amounts. These require daily rainfall totals at the spatial scale of the crop-growing districts.

Here we present a method for disaggregating total seasonal rainfall forecasts into an ensemble of daily rainfall time series which can then be used to give a range of possible crop yield values. The disaggregated ensemble must fulfil three constraints

• the distribution of seasonal rainfall totals is consistent with the operational tercile forecast;
• the daily time series is consistent with the climatological rainfall statistics for the region;
• each ensemble member exhibits the correct spatial correlation for both rainfall occurrence and rainfall amount for each day.

The ensemble is computed by making use of the geostatistical technique of sequential simulation together with a standard, point-based weather generator to ensure that both spatial and temporal rainfall patterns are consistent with climatological information.

The ensemble of time series is then fed through a mechanistic crop simulation model (the General Large Area Model for annual crops (GLAM)) to give a distribution of possible crop yields. This distribution then reflects the full information content of the original operational forecast and the known climatology of the region. The methodology is intended to form part of an operational system which also makes use of real-time, satellite-based rainfall monitoring. The system has been tested against Ethiopian maize yield observations using seasonal weather hindcasts for which results will be presented.