Supplemental Material

Skill of global raw and postprocessed ensemble predictions of rainfall over northern tropical Africa
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Supplementary material

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Figure S1 shows skill scores for the climatological reference forecast (extended probabilistic climatology, EPC) with different lengths of the window around the considered day, relative to using ±2 days (EPC-2) as in the main paper. The optimal length of the window depends on the scoring rule, observation type, accumulation time, monsoon season, and region. In a majority of settings, longer training periods improve EPC, and make it a tougher reference standard. However, across years the average skill score relative to EPC-2, indicated by the black line, is only slightly positive, hence our conclusions are insensitive to this choice.

Figures S2 through S5 show the skill of EMOS and BMA postprocessed forecasts with different lengths of the rolling training period, relative to the same forecast with 20 training days as in the main paper. The figures consider 1-day and 5-day accumulated precipitation, and both station and $0.25° \times 0.25°$ TRMM observations, with the results stratified by region and year. For EMOS, we show scores for lengths of the rolling training period from 10 to 50 days in increments of 5 days, and for the computationally intense BMA method for lengths of 20, 30, and 40 days.

Generally, across the eight monsoon seasons the average skill score relative to using 20 days, indicated by the black line, is about zero. However, for shorter training periods a clear deterioration is found. Therefore, a rolling 20-day training period is a reasonable choice.

To illustrate the difficulties with the raw ensemble forecasts, Figure S6 shows maps of 1-day accumulated precipitation as forecasted by the ECMWF HRES run and observed by TRMM on 14 July 2014. Precipitation over Guinea and Mali is well forecast in terms of location, even though the organization seems less well captured. However, most of the forecasted precipitation over Nigeria did not to materialize, and in the East Sahel region precipitation occurred over Sudan rather than the Ethiopian Highlands.

Figure S7 shows time series of 1-day accumulated ECMWF precipitation forecasts along with the respective station and TRMM observations. The titles of the panels include the WMO station number or in case of TRMM the longitude and latitude coordinates of the center of the considered $0.25° \times 0.25°$ gridbox. For both types of observations, there is a modest degree of agreement between forecasts and observations. However, many precipitation events are either not predicted at all, are strongly underpredicted, or are predicted by (almost) all ensembles members (with varying amounts of precipitation), yet do not occur.

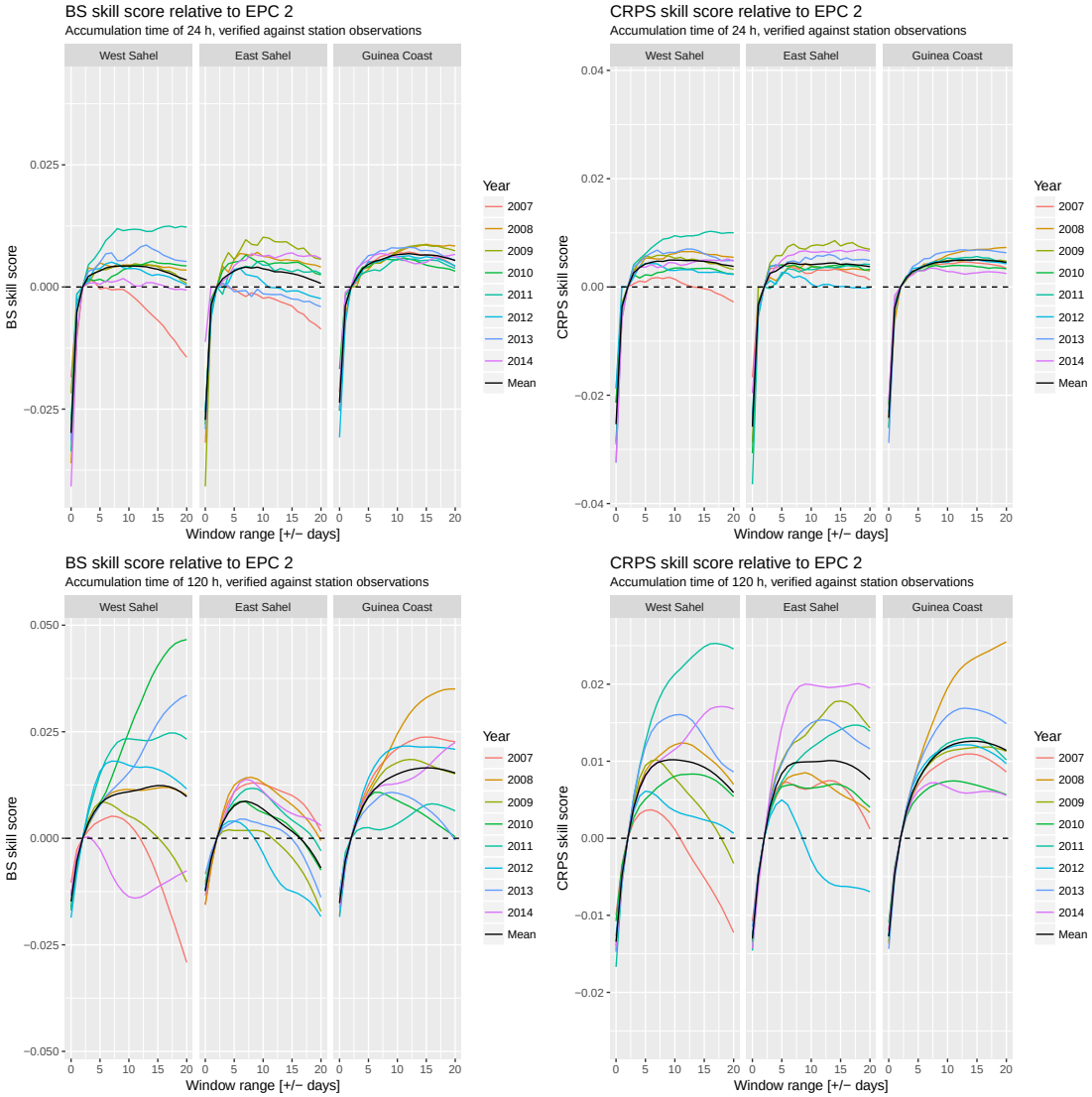

Figure S1: Brier score (BS) and CRPS skill score for EPC forecasts with different lengths of the window around the considered day, relative to using ±2 days, for 1-day (top row) and 5-day (bottom row) accumulation periods, verified against station observations, and stratified by region and year.

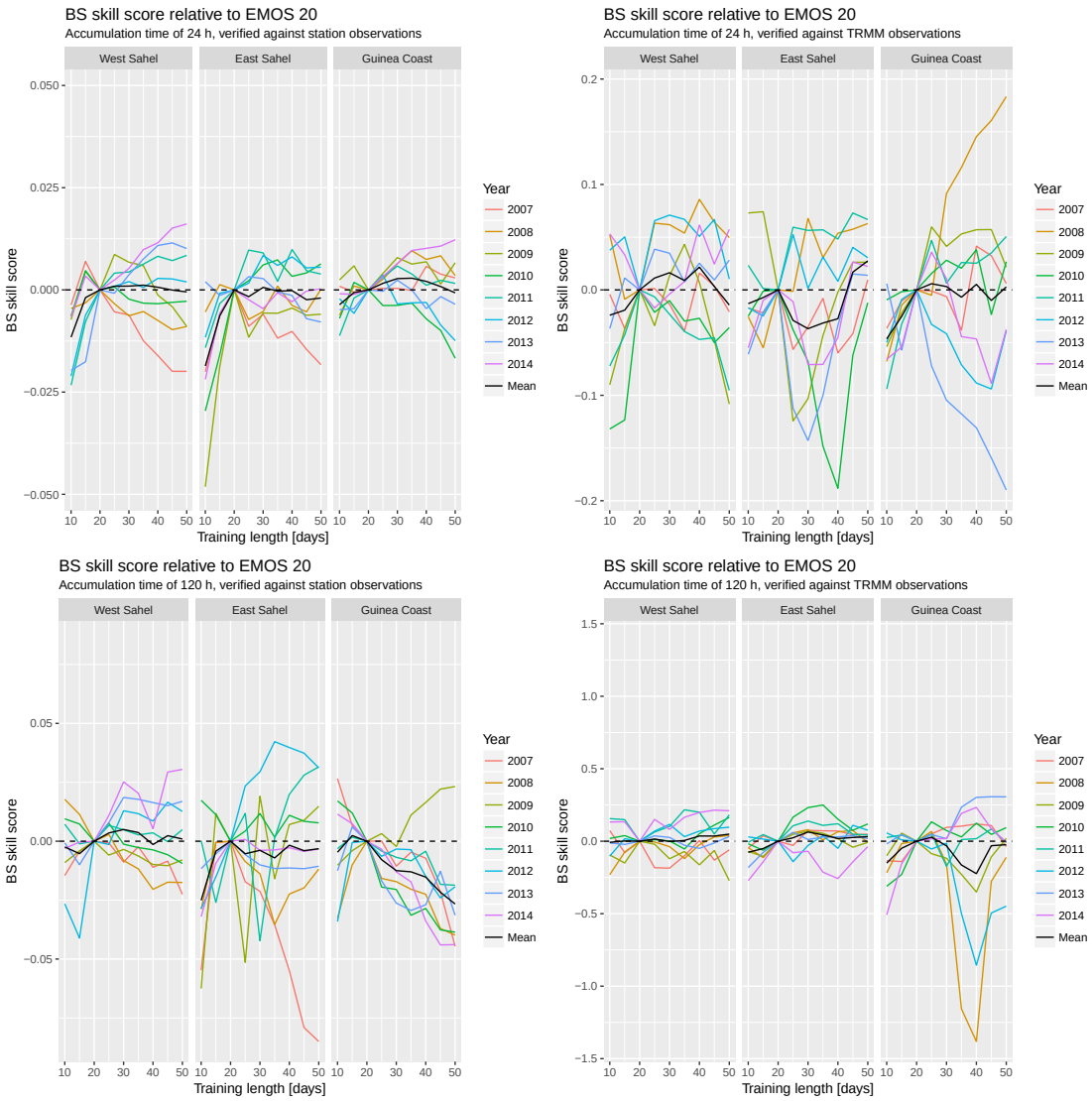

Figure S2: Brier score (BS) skill for EMOS GEV forecasts as a function of the length of the rolling training period relative to using 20 days, for 1-day (top row) and 5-day (bottom row) precipitation accumulations, verified against station (left column) and $0.25° \times 0.25°$ TRMM (right column) observations, and stratified by region and year.

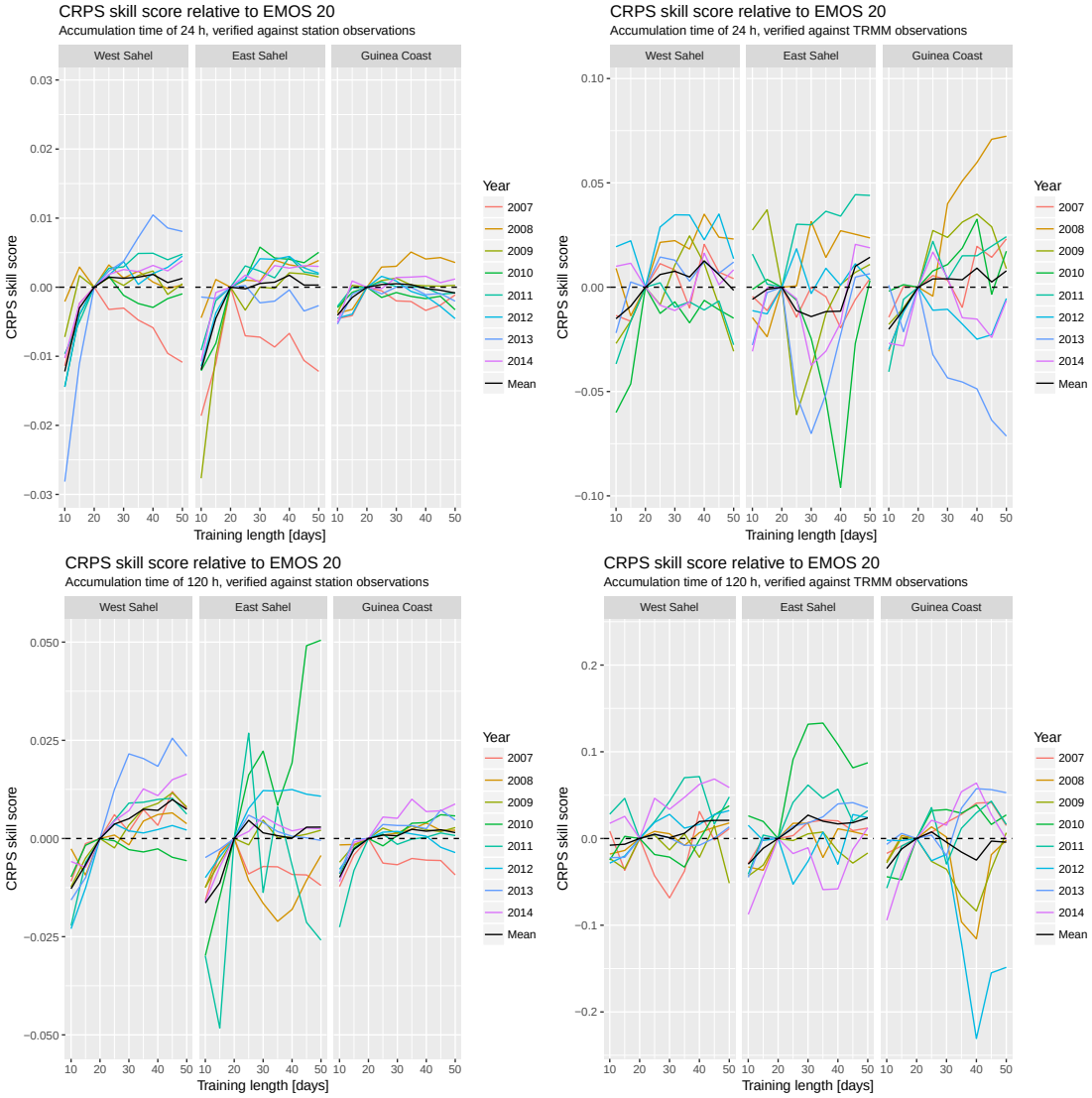

Figure S3: Same as Figure S2, but for the CRPS.

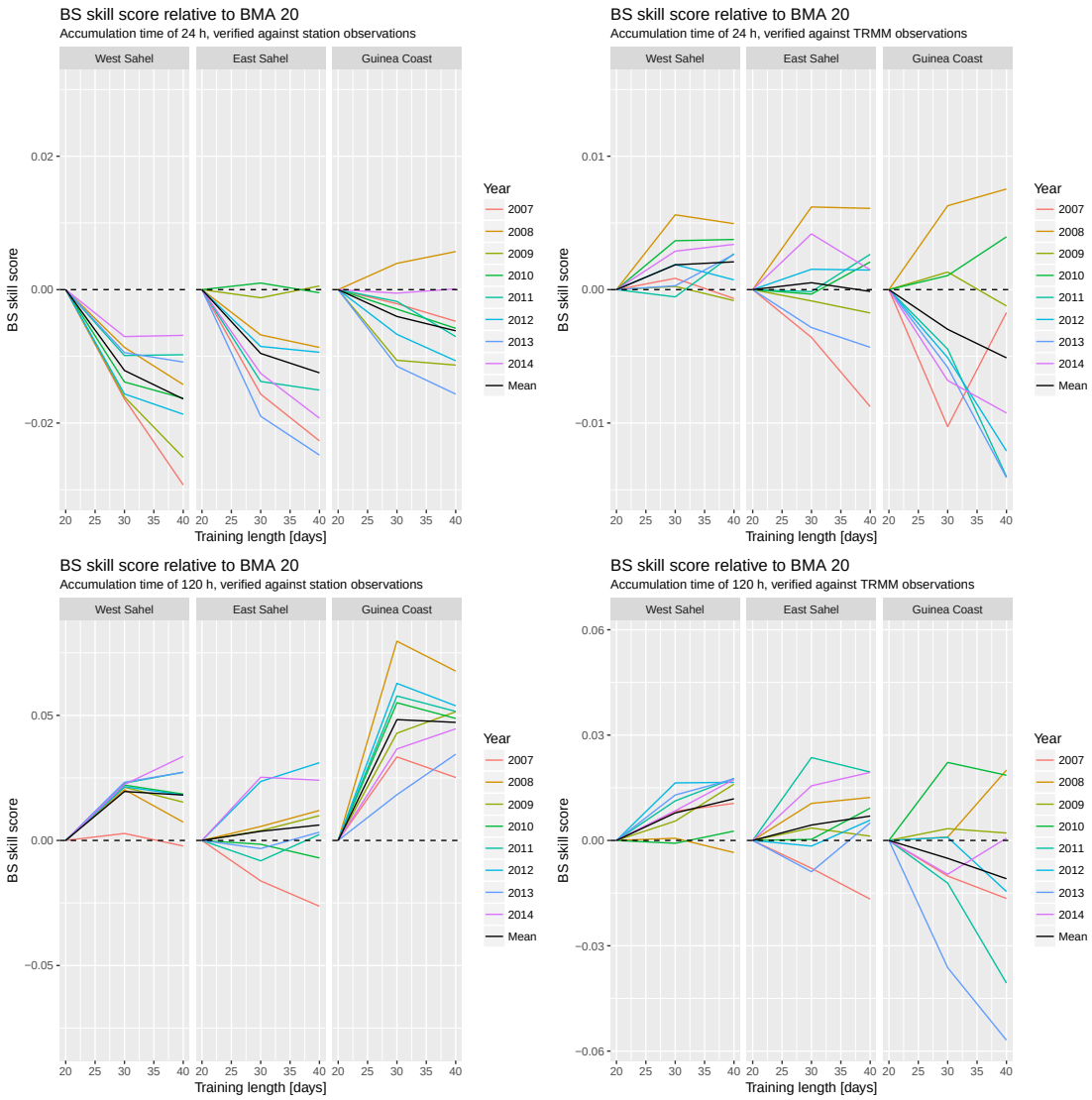

Figure S4: Brier score (BS) skill for BMA forecasts as a function of the length of the rolling training period relative to using 20 days, for 1-day (top row) and 5-day (bottom row) precipitation accumulations, verified against station (left column) and $0.25° \times 0.25°$ TRMM (right column) observations, and stratified by region and year.

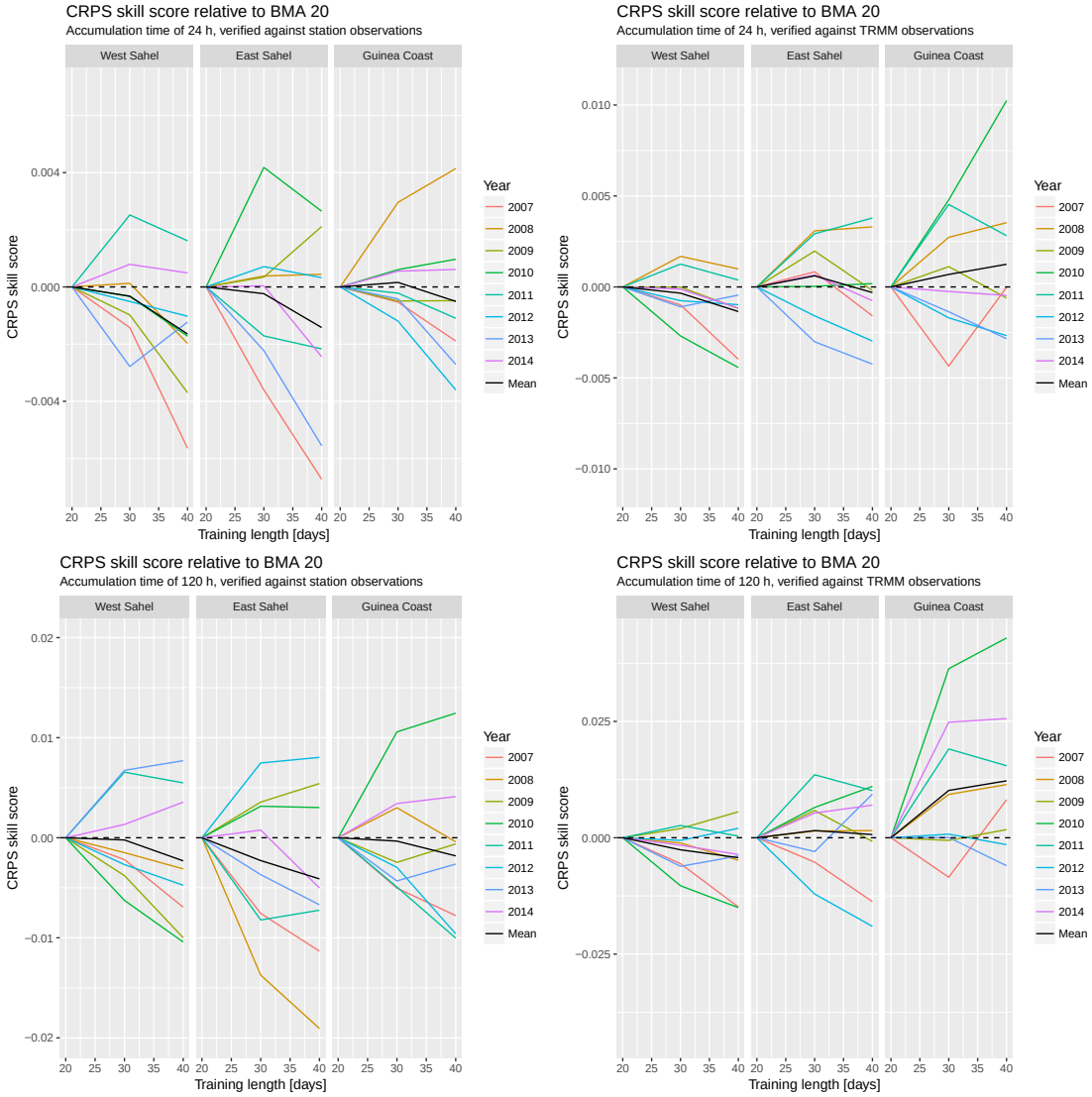

Figure S5: Same as Figure S4, but for the CRPS.

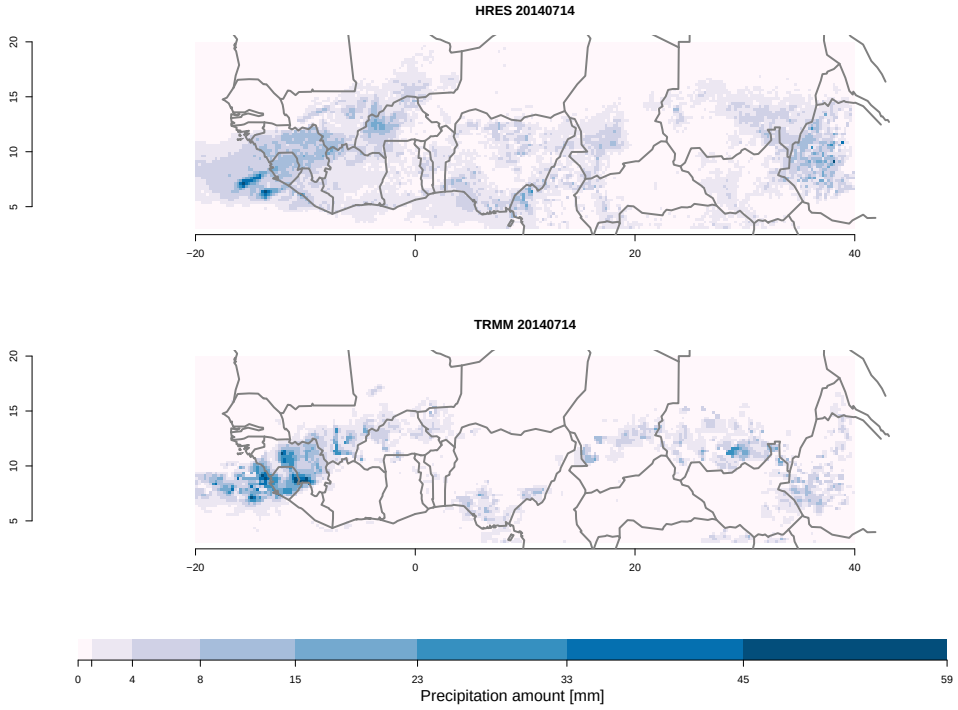

Figure S6: 1-day accumulated precipitation on 14 July 2014 as forecasted by the ECMWF HRES run and observed by TRMM at a resolution of $0.25° \times 0.25°$.

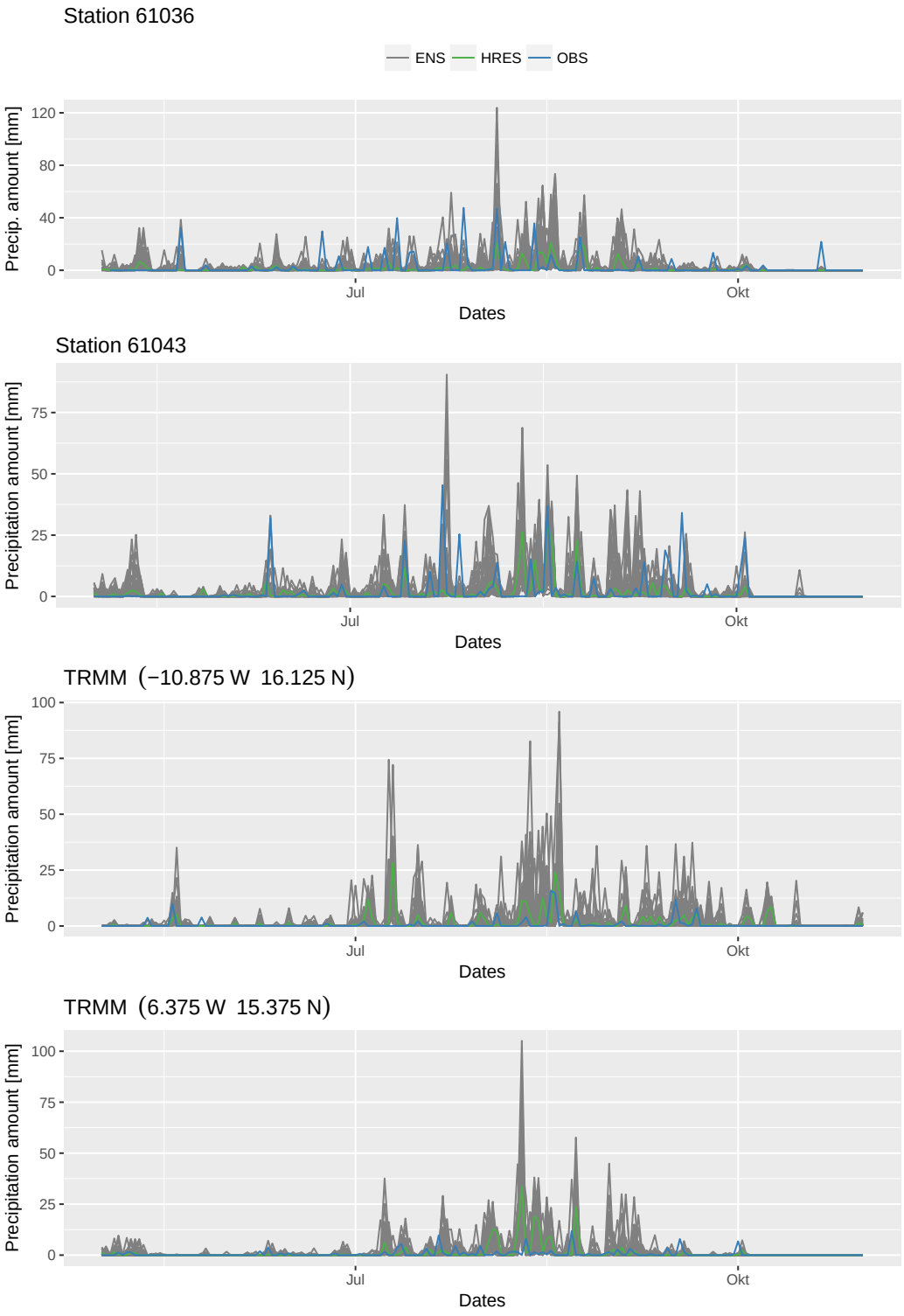

Figure S7: ECMWF ensemble forecasts over West Sahel in 2014 along with respective station or $0.25° \times 0.25°$ TRMM observations. The CNT run is plotted along with the 50 perturbed members.