SUPPORTING INFORMATION FOR:
A generalized approach to generate synthetic short-to-medium range hydro-meteorological forecasts

Zachary P. Brodeur[1], Scott Steinschneider[2]
Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY

1. Graduate Research Assistant, 111 Wing Drive, Riley-Robb Hall, Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY, 14853. Email: zpb4@cornell.edu, Phone: 607-255-2155 (Corresponding Author).

2. Assistant Professor, 111 Wing Drive, Riley-Robb Hall, Department of Biological and Environmental Engineering, Cornell University, Ithaca, NY, 14853. Email: ss3378@cornell.edu, Phone: 607-255-2155.

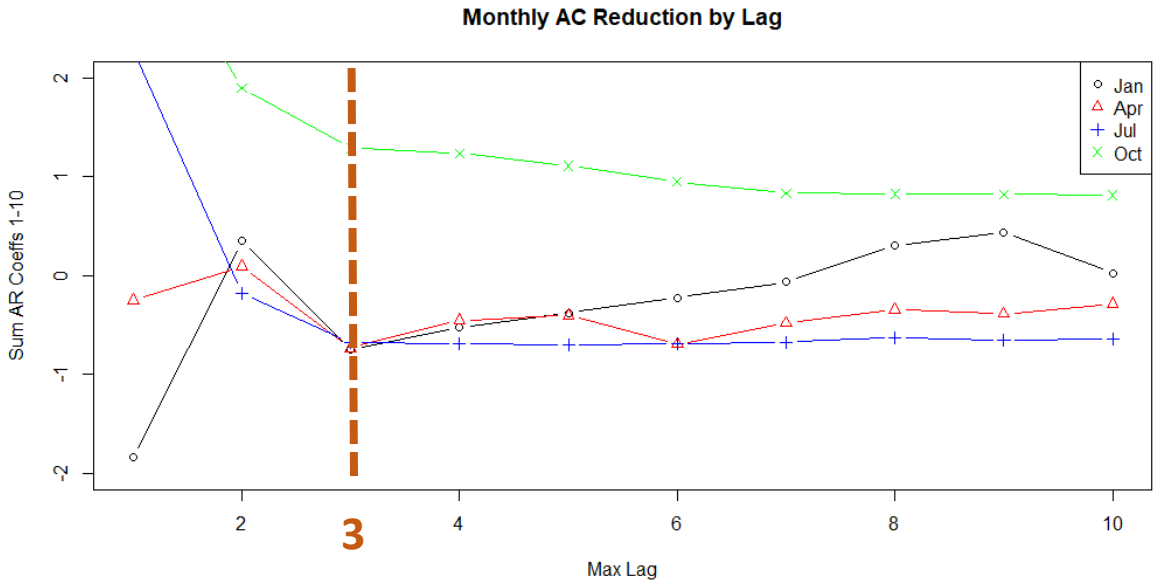

Figure S1: Summed auto-correlations coefficients (lags 1-10, all lead times) for Folsom reservoir forecast residuals after VAR decorrelation. The x-axis indicated the maximal lag-order in the BigVAR model and lines are shown for selected monthly subsets. Dark orange line demarcates maximal lag order chosen for this study.

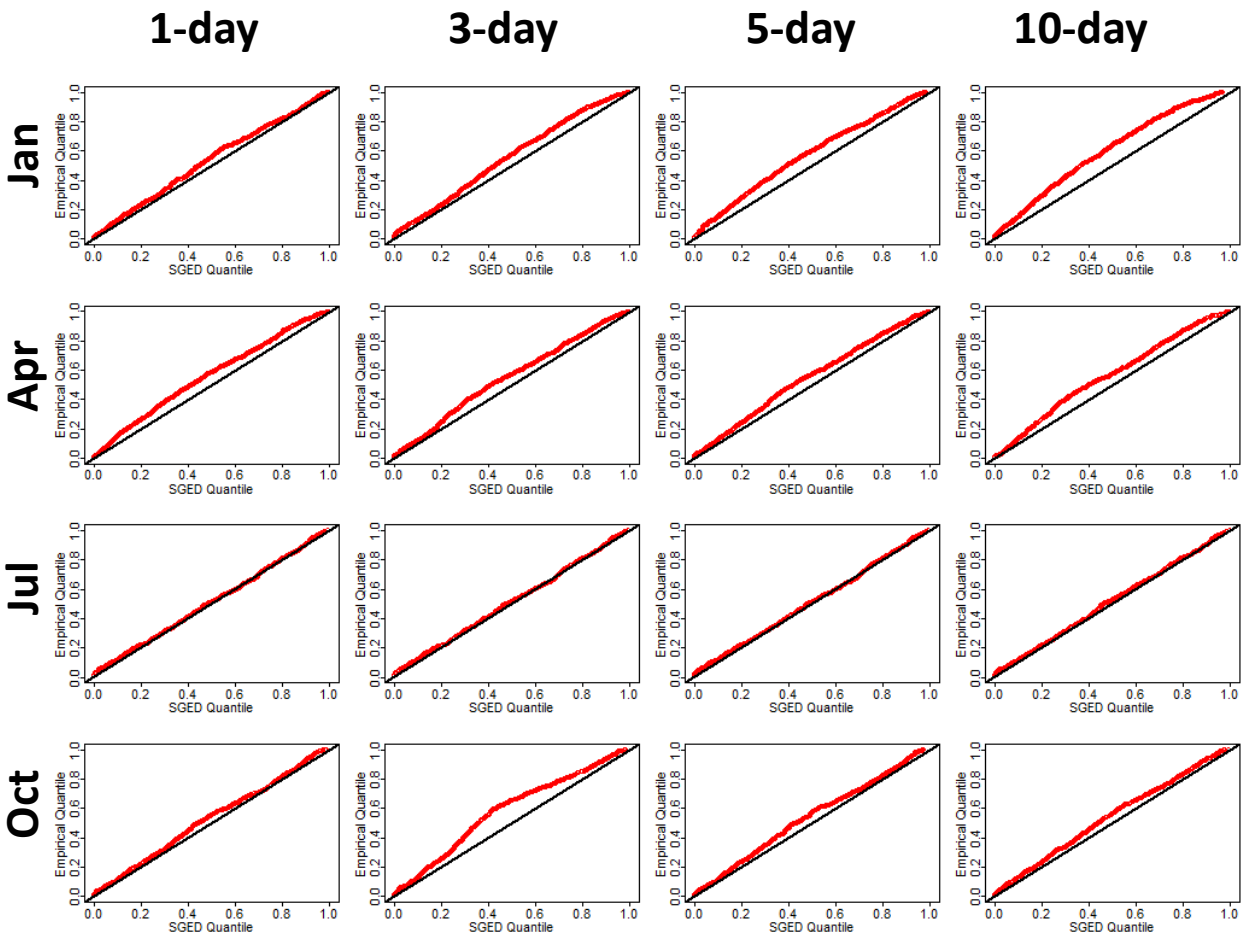

Figure S2: Q-Q plots across selected months (rows) and lead times (columns) for HEFS streamflow forecast transformed residuals (a_t). The black line is theoretical perfect correspondence between modeled and empirical quantiles (1:1) and red line shows the actual correspondence from the SGED model for the a_t residuals.

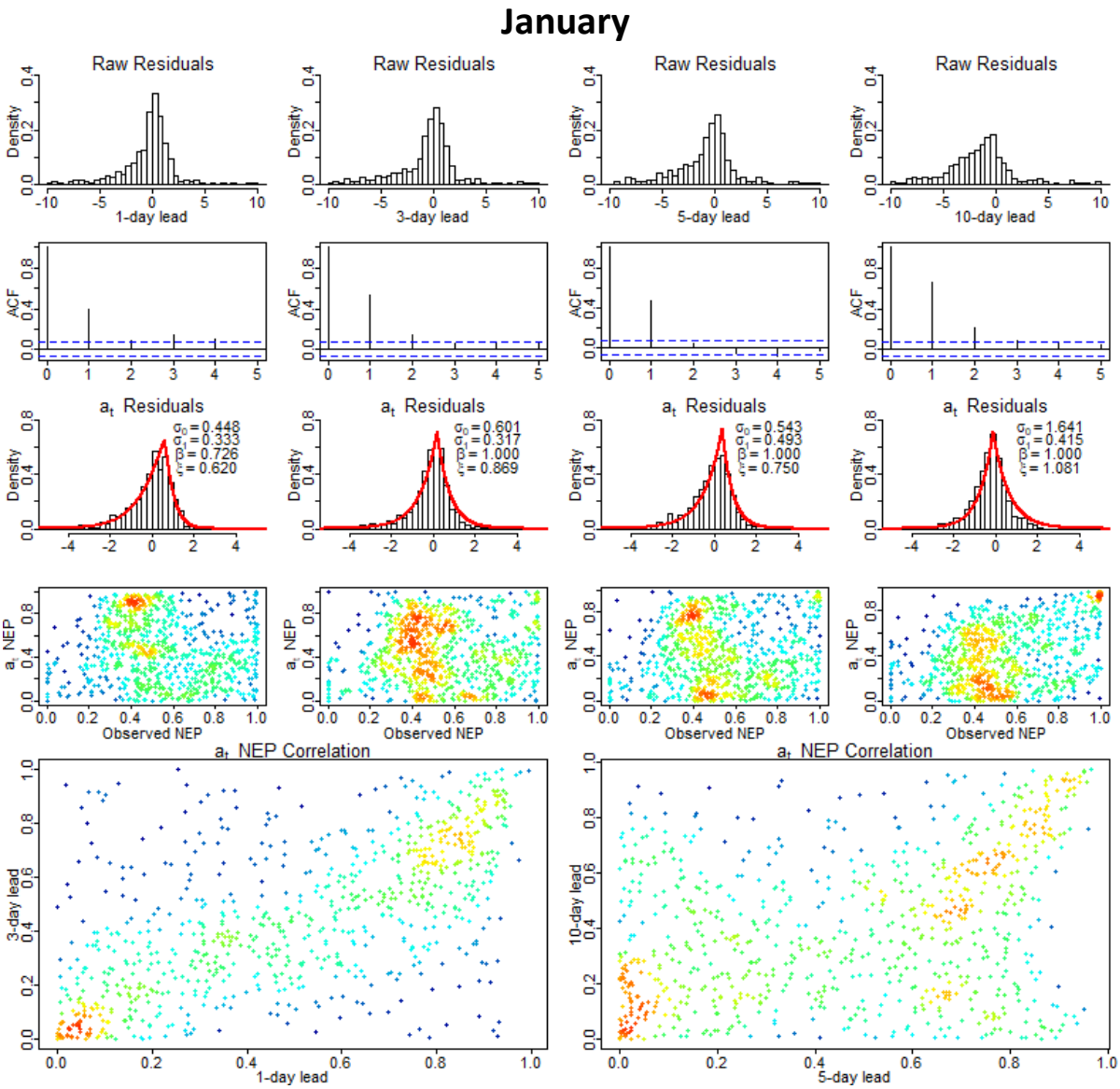

Figure S3: As in Figure 4, but only for month of January and across lead times of 1, 3, 5, and 10 days. Bottom row shows 1 to 3-day lead a_t NEP correlations in left panel and 5 to 10-day lead a_t NEP correlations in right panel.

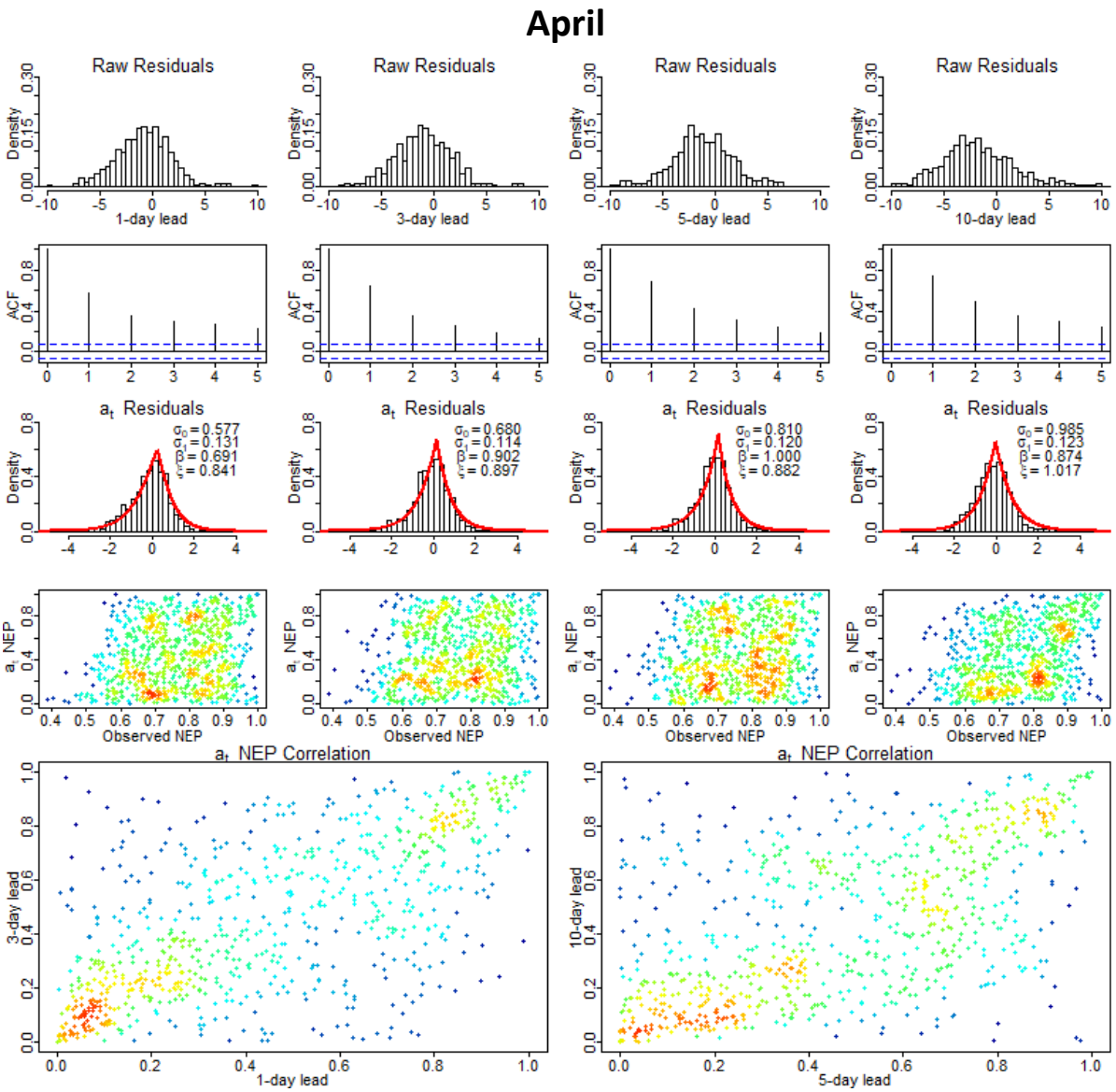

Figure S4: As in Figure 4, but only for month of April and across lead times of 1, 3, 5, and 10 days. Bottom row shows 1 to 3-day lead a_t NEP correlations in left panel and 5 to 10-day lead a_t NEP correlations in right panel.

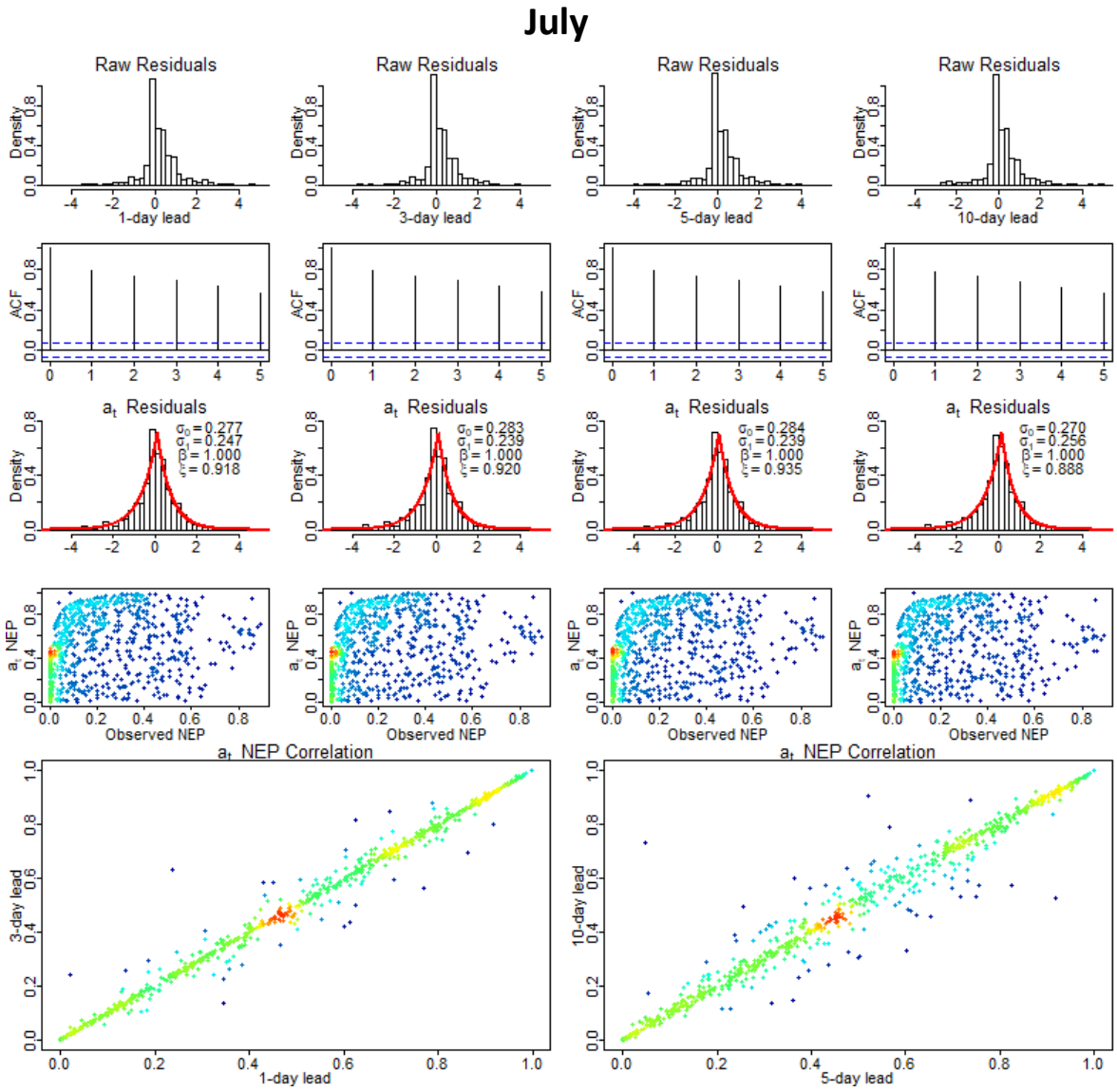

Figure S5: As in Figure 4, but only for month of July and across lead times of 1, 3, 5, and 10 days. Bottom row shows 1 to 3-day lead a_t NEP correlations in left panel and 5 to 10-day lead a_t NEP correlations in right panel.

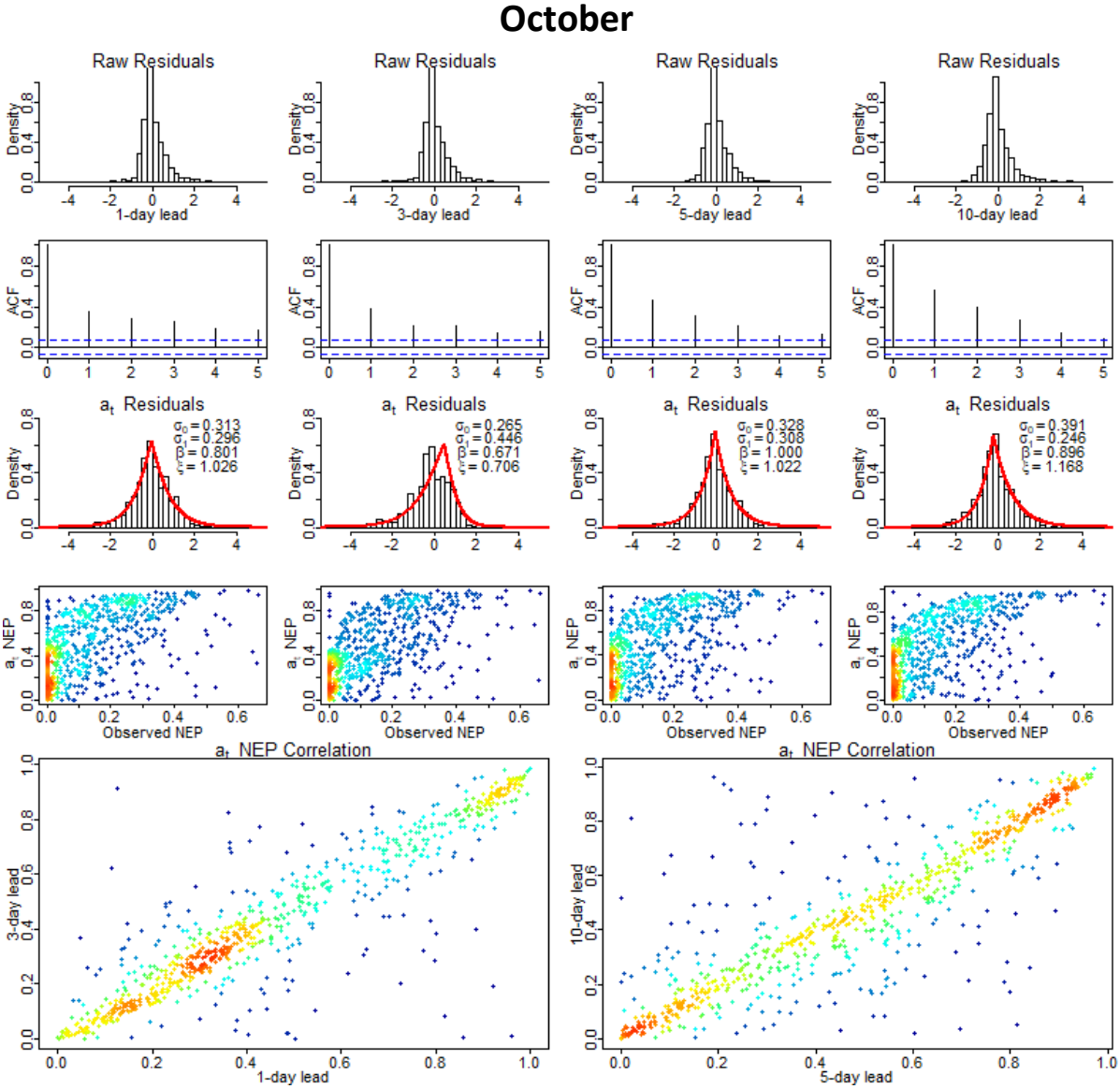

Figure S6: As in Figure 4, but only for month of October and across lead times of 1, 3, 5, and 10 days. Bottom row shows 1 to 3-day lead a_t NEP correlations in left panel and 5 to 10-day lead a_t NEP correlations in right panel.

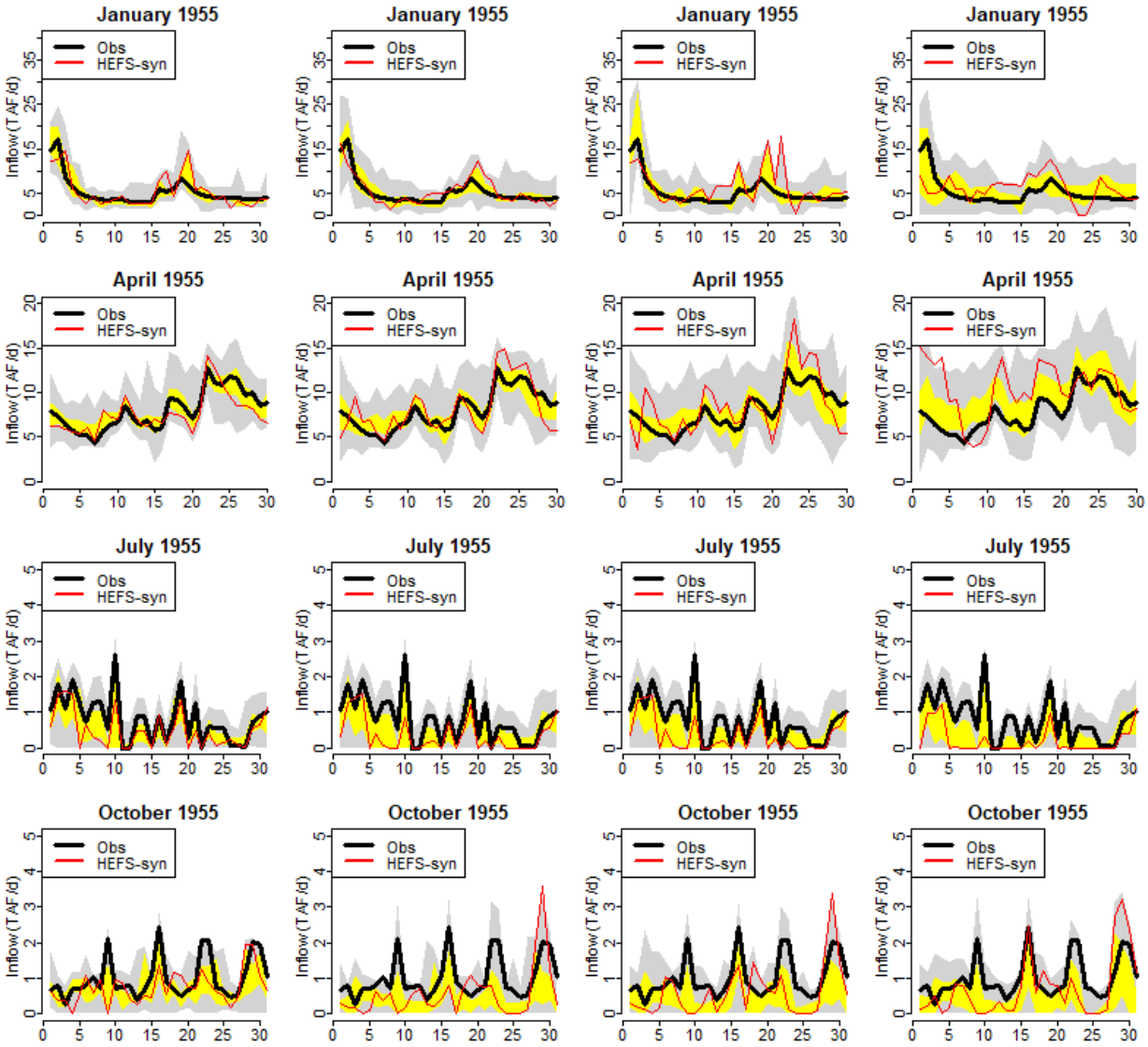

Figure S7: As in figure 6 but for 4 selected months in 1955 (i.e. synthetic period samples). Only observed full-natural-flow and synthetic data are shown since no actual HEFS hindcasts are available in this period.

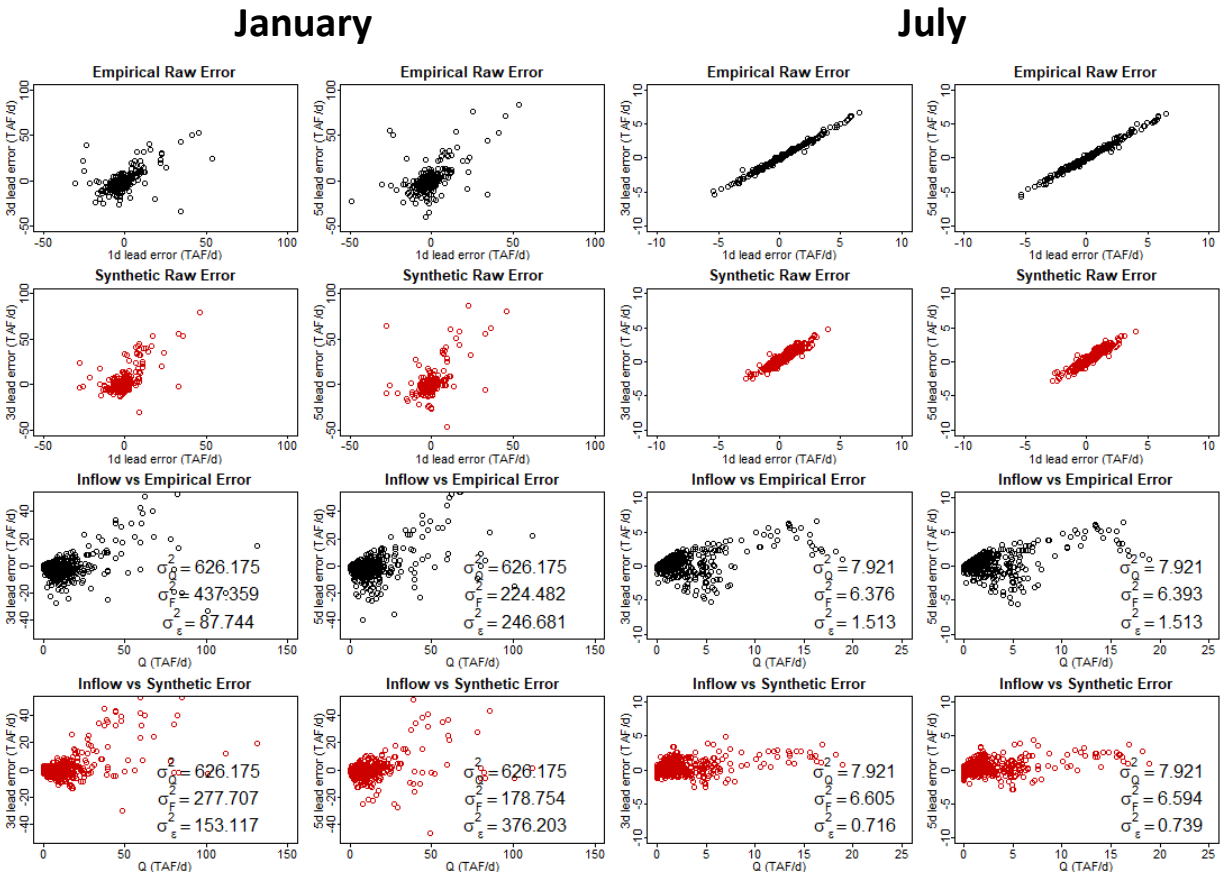

Figure S8: Raw error scatterplots for January (left two columns) and July (right two columns). Top row – Empirical raw error scatterplot (black) between 1 to 3-day forecast leads (1st and 3rd panel) and 1 to 5-day forecast leads (2nd and 4th panel). 2nd row – As for top row, but with synthetic raw error scatterplot (red). 3rd row – Observed flow versus empirical raw errors (black) at 3-day lead (1st and 3rd panel) and versus 5-day lead errors (2nd and 4th panel). Variance in observed flow (σ_Q^2), forecast (σ_F^2), and errors (σ_ϵ^2) are indicated top to bottom by text in the figure. Bottom row – As in 3rd row but for synthetic raw errors (red).

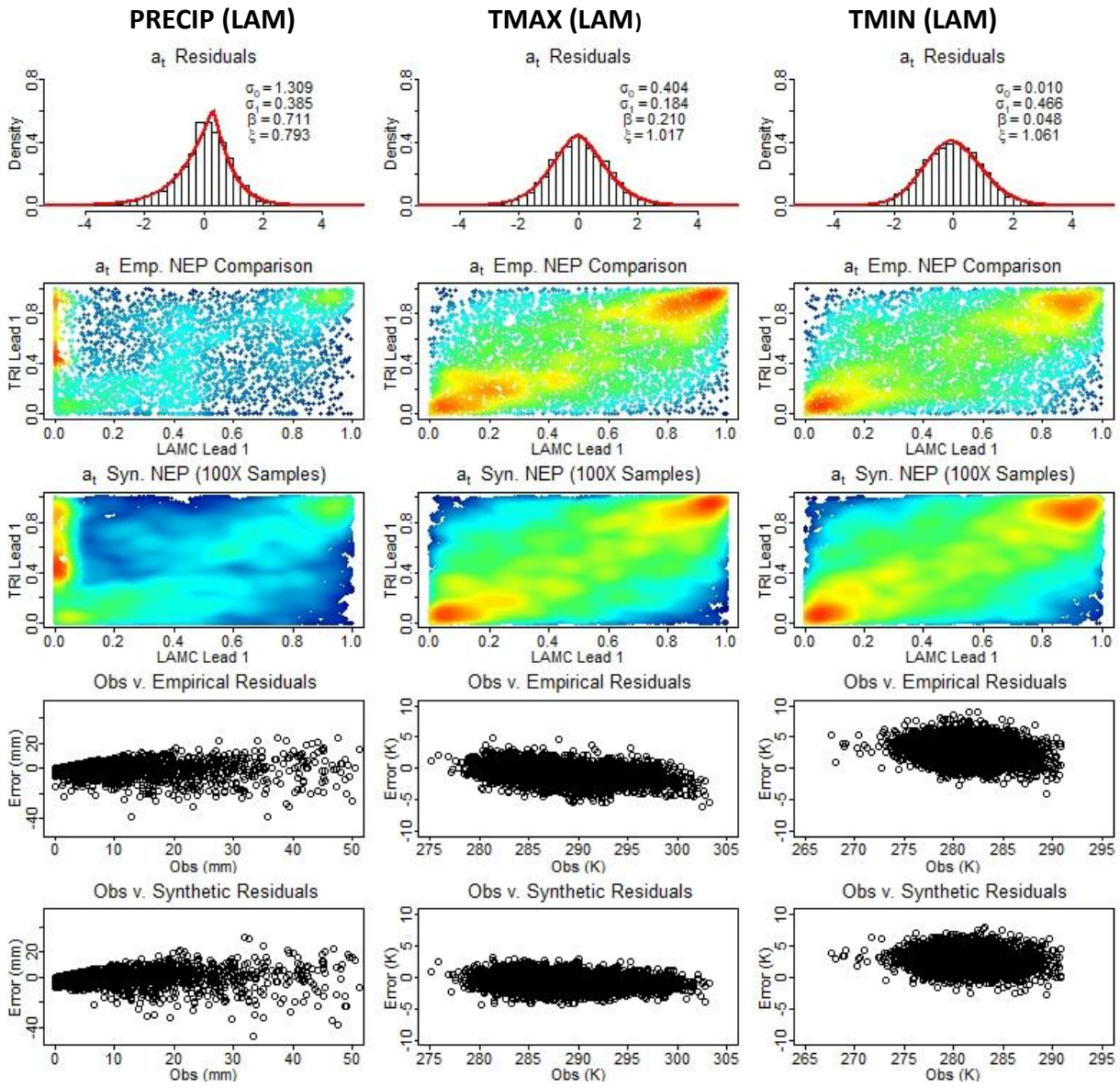

Figure S9: As in Figure 7 but for 1-day forecast lead and including TMIN column (rightmost)

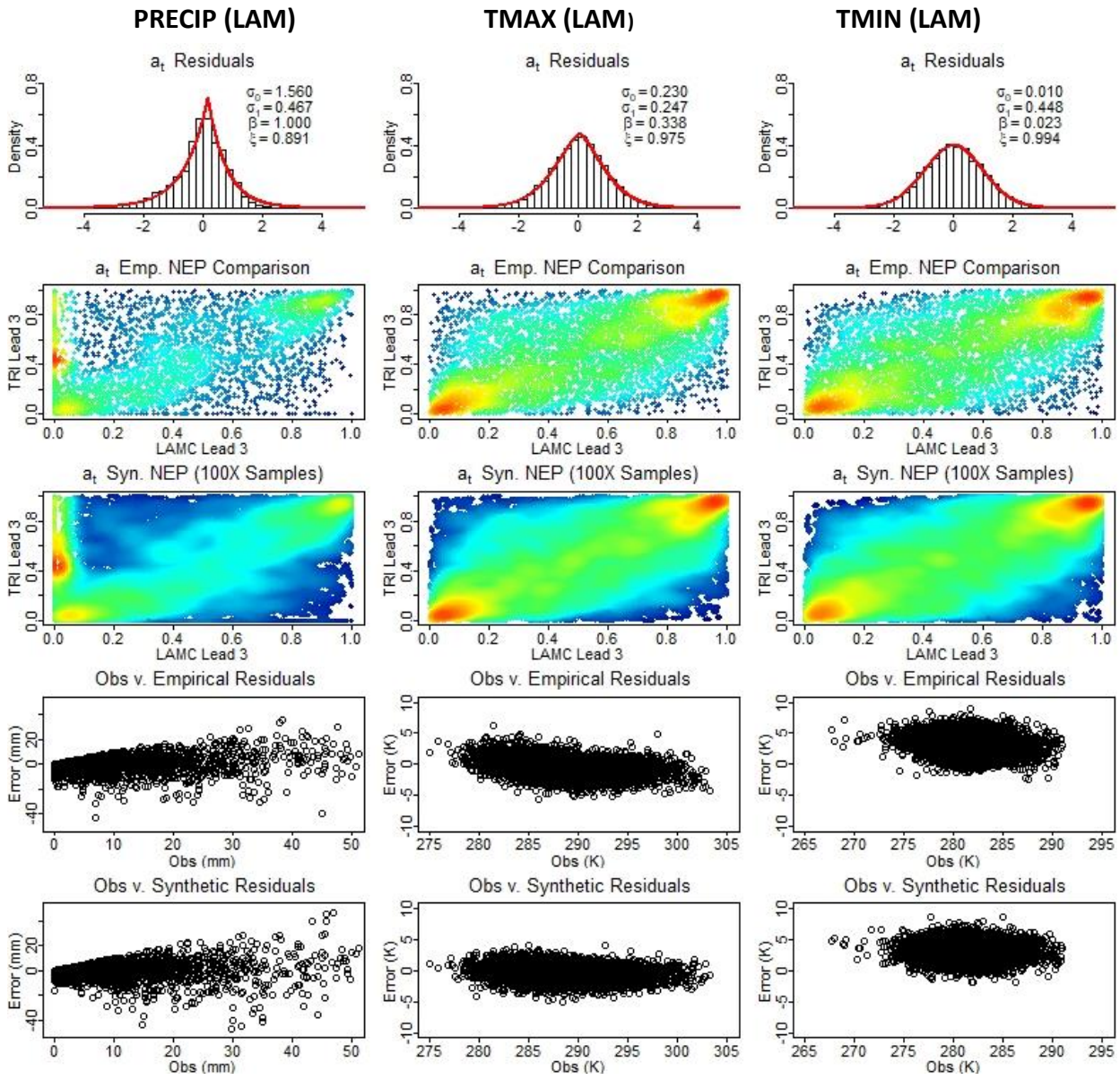

Figure S10: As in Figure 7 but for 3-day forecast lead and including TMIN column (rightmost)

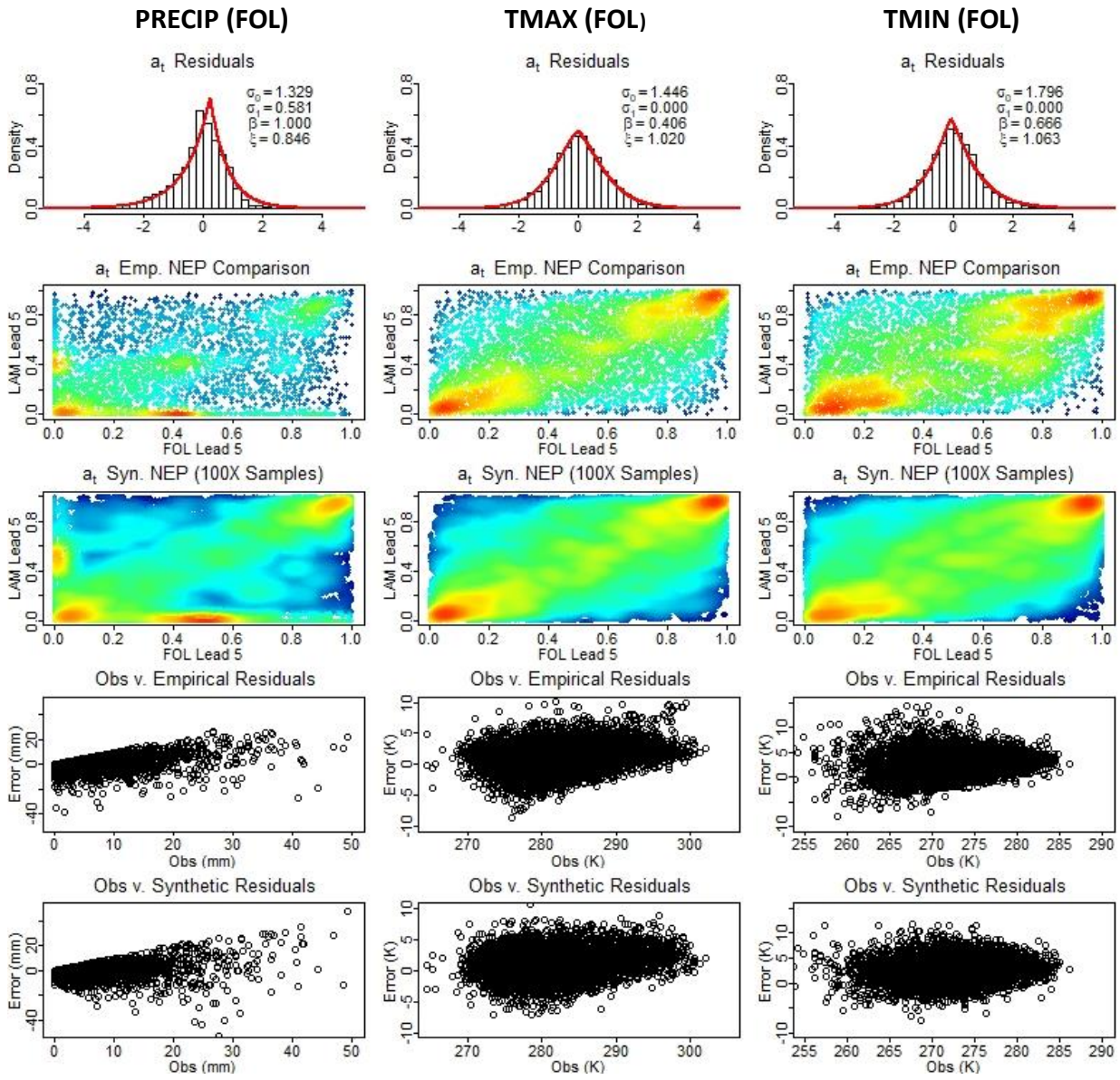

Figure S11: As in Figure 7 but with the Folsom Reservoir (FOL) grid cell compared against the Lake Mendocino (LAM) grid cell at a 5-day lead and including TMIN column (rightmost).

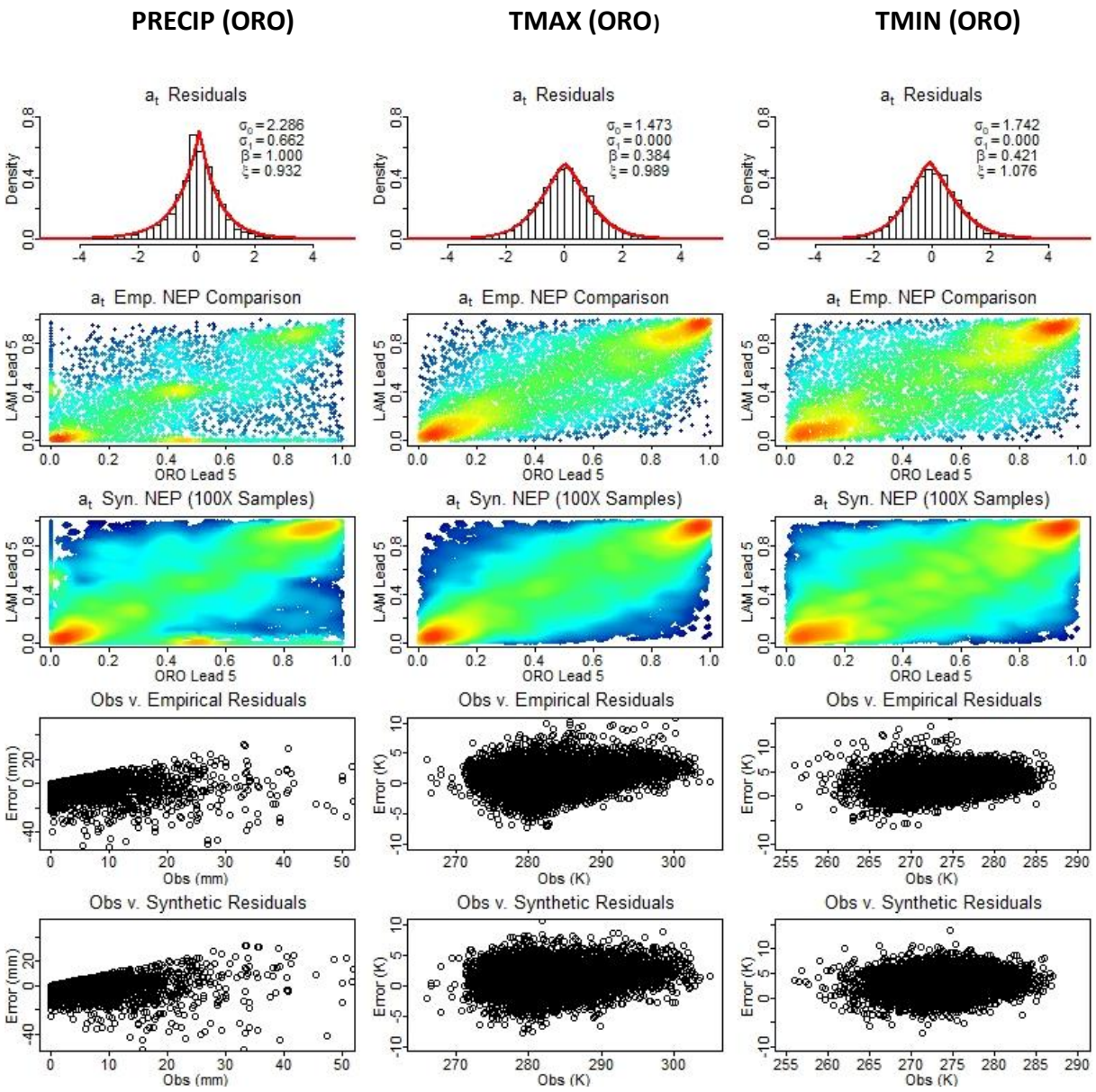

Figure S12: As in Figure 7 but with the Oroville Reservoir (ORO) grid cell compared against the Lake Mendocino (LAM) grid cell at a 5-day lead and including TMIN column (rightmost).

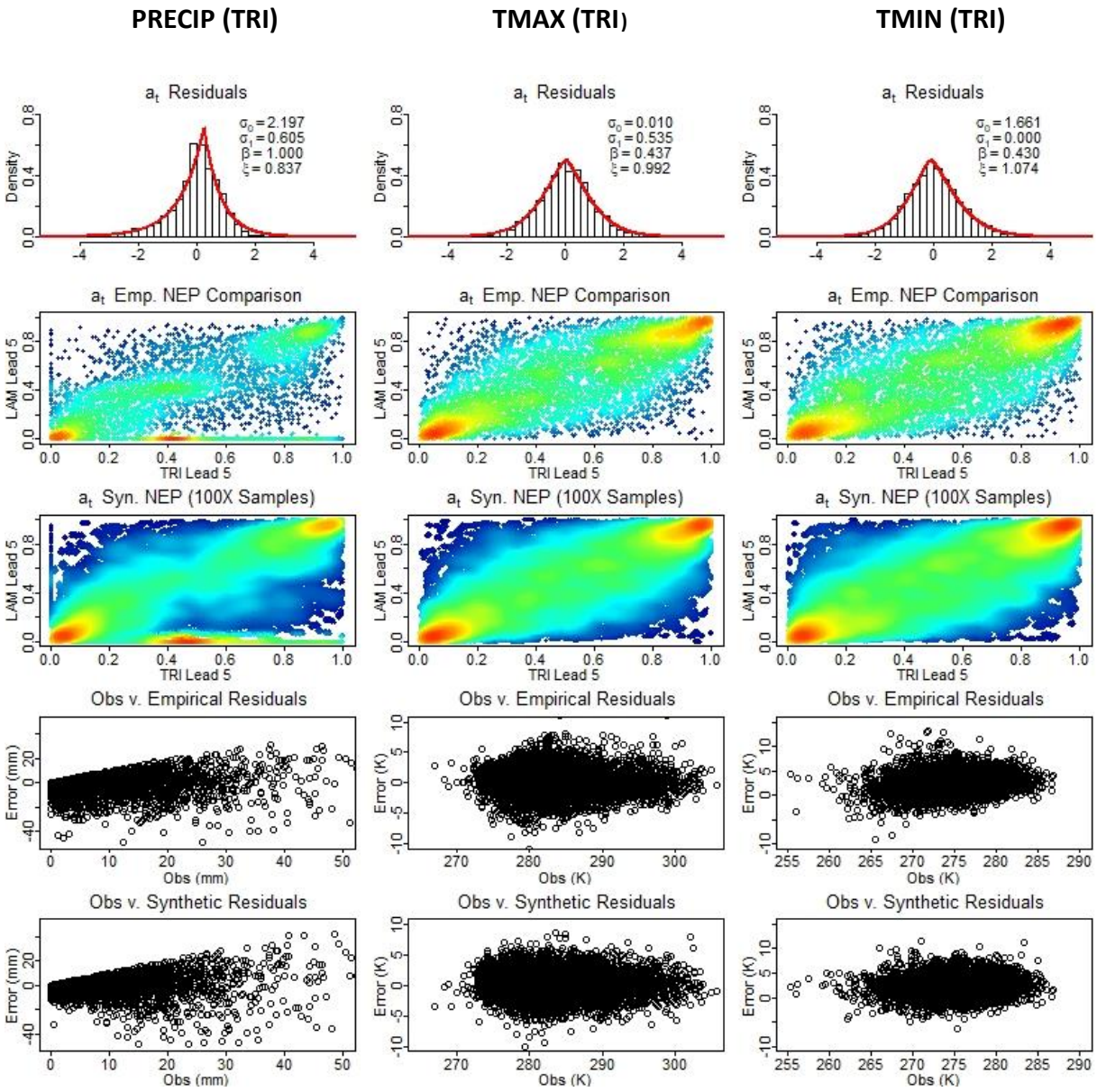

Figure S13: As in Figure 7 but with the Trinity Reservoir (TRI) grid cell compared against the Lake Mendocino (LAM) grid cell at a 5-day lead and including TMIN column (rightmost).

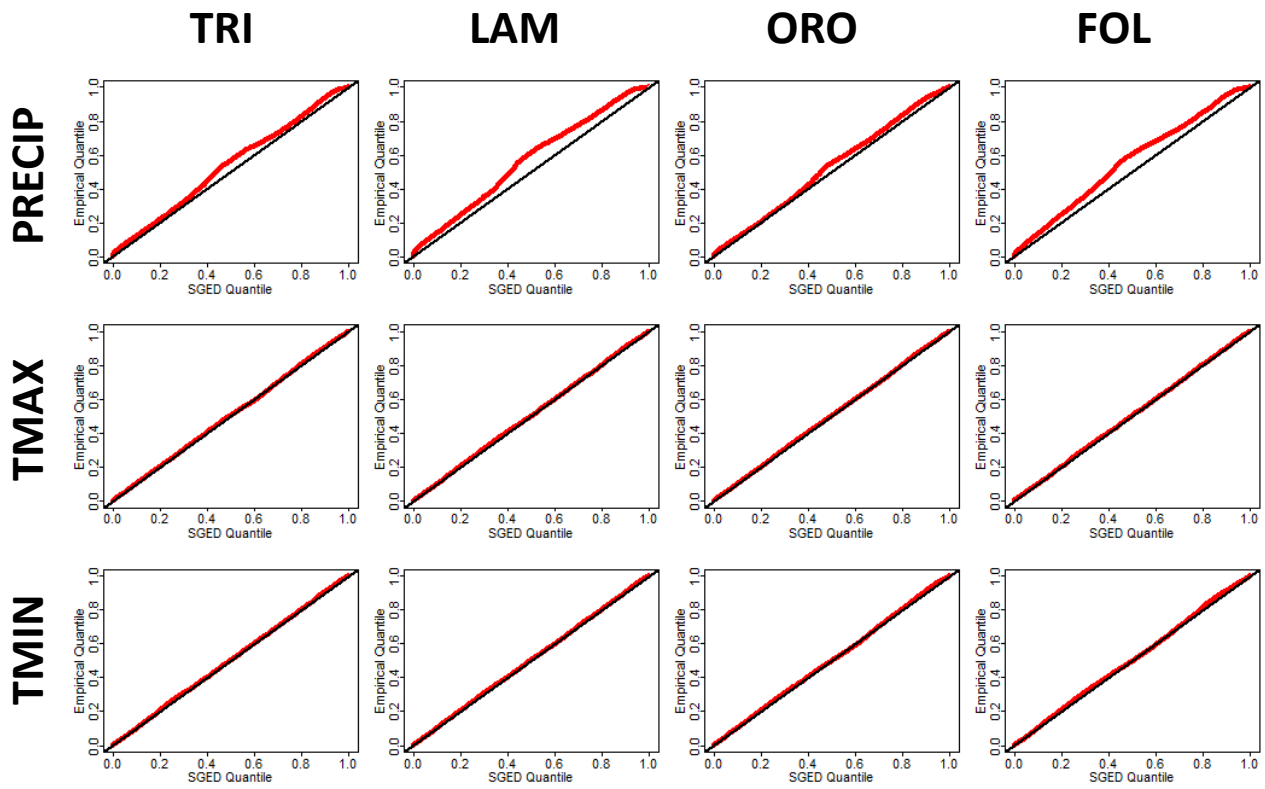

Figure S14: Q-Q plots across selected variables (rows) and basin grid cells (columns) for GEFS forecast transformed residuals (a_t) at a 5-day lead in cold-season (ONDJFM). The black line is theoretical perfect correspondence between modeled and empirical quantiles (1:1) and red line shows the actual correspondence from the SGED model for the a_t residuals.

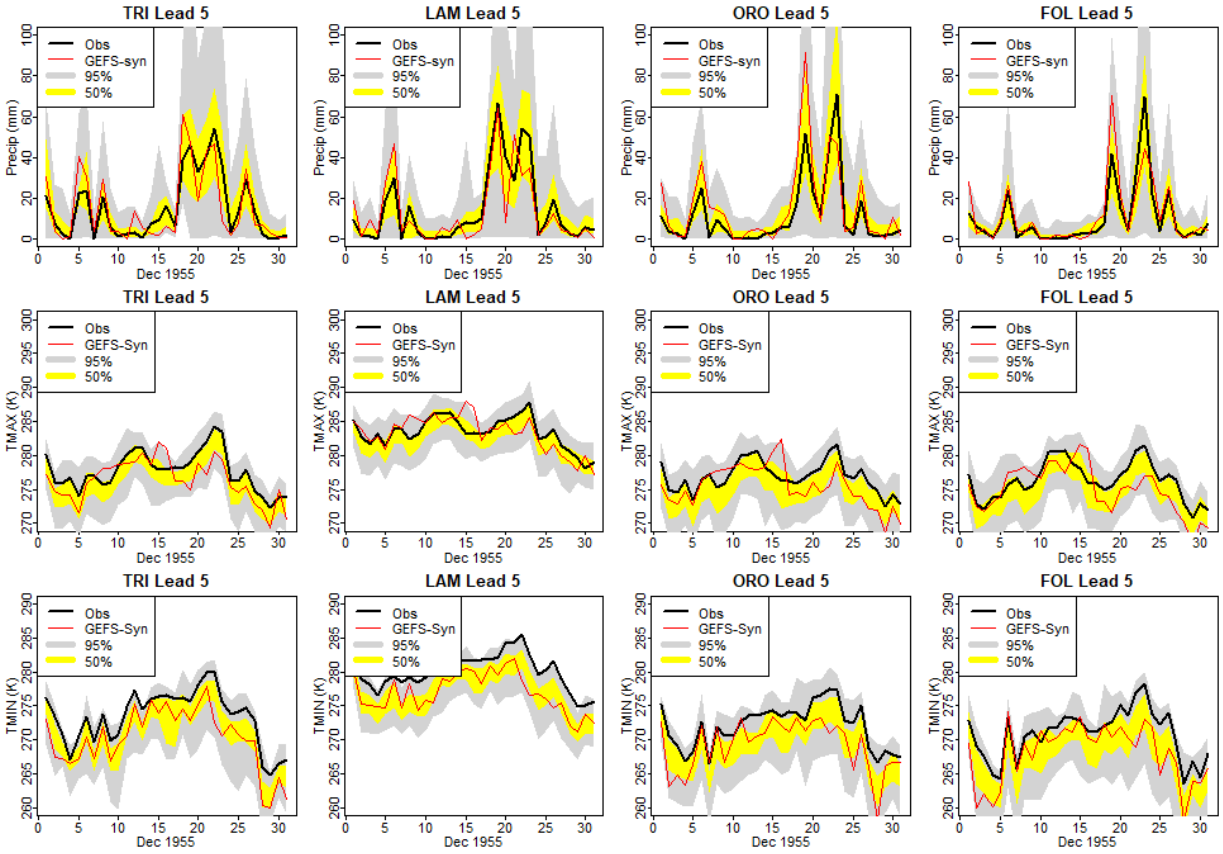

Figure S15: As in Figure 9 but for synthetic period (December 1955). Only observed (black) and synthetic forecast (red) values are shown since no GEFS hindcasts are available in this period.