Statistical forecast adjustment with seasonally and spatially smoothed statistics

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Linearly adjusted forecast

Regression improved anomaly forecast at a grid point i for a season s is given by

$$\widehat{F}_{i,s} = r_{i,s} F_{i,s}$$

where $F_{i,s}$ is the raw anomaly forecast at grid point i and season s, $\widehat{F}_{i,s}$ is the adjusted anomaly forecast.

The least-square estimate of the regression coefficient $r_{i,s}$ is

$$r_{i,s} = \frac{\mathrm{Cov}(F_{i,s}, X_{i,s})}{\mathrm{Var}(F_{i,s})}$$

Estimated regression coefficients

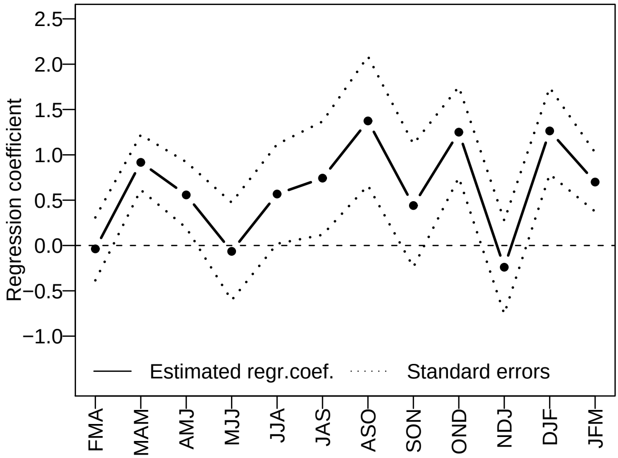


Figure: Estimated regression coefficients $r_{i,s}$ for each season for global Z500 0-lead HFP2 hindcasts at a grid point near the North Pole.

Seasonally smoothed regression coefficients

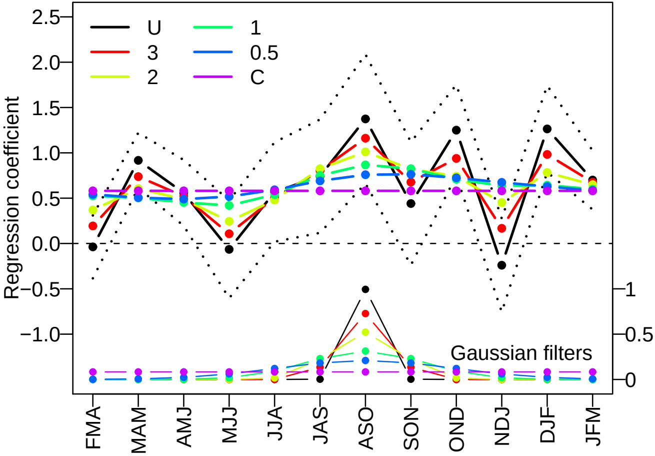


Figure: Seasonally smoothed regression coefficients $r_{i,s}$ for each season for global Z500 0-lead HFP2 hindcasts at a grid point near the North Pole.

Spatial smoothing of regression coefficients

Spatial "smoothing" of regression coefficients is done in spectral domain using an isotropic triangular truncation (T47, T21, T10, T5)

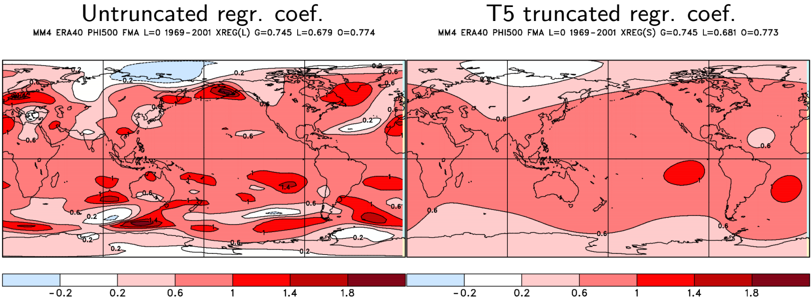
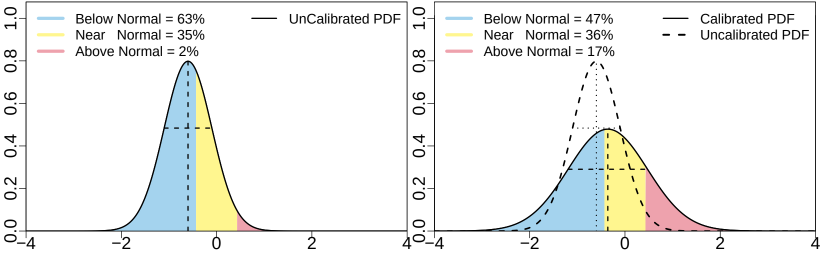


Figure: Regression coefficients for global Z500 0-lead FMA HFP2 hindcasts: *(left)* untruncated, *(right)* truncated at T5.

Calibrated probability HFP2 hindcasts

Calibration method is described in Kharin and Zwiers (2003):

- parametric probability estimator is used by fitting a normal distribution $\mathcal{N}(aX_U, b\sigma_U)$ to the forecast ensemble.
- rescaling coefficients a and b are determined by optimizing the Brier score for each season and grid point.
- rescaling coefficients a and b are smoothed seasonally and spatially.



Global TAS 0-lead HFP2 hindcasts

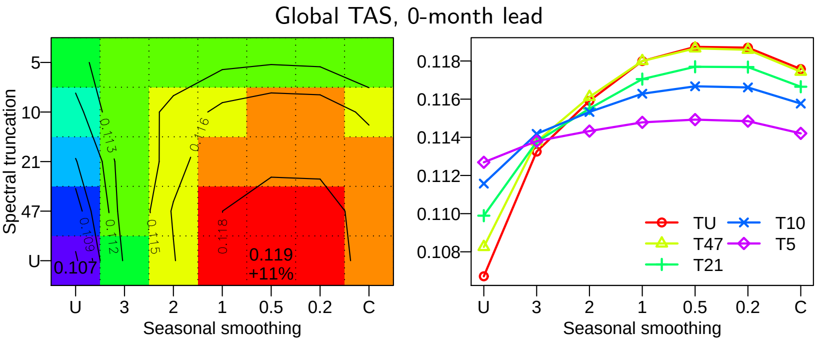


Figure: The 12-season mean BSS of 0-month lead global TAS as the function of the seasonal smoothing parameter (x-axis) and the spherical expansion truncation (y-axis).

TAS 0-lead HFP2 hindcasts over land and in Canada

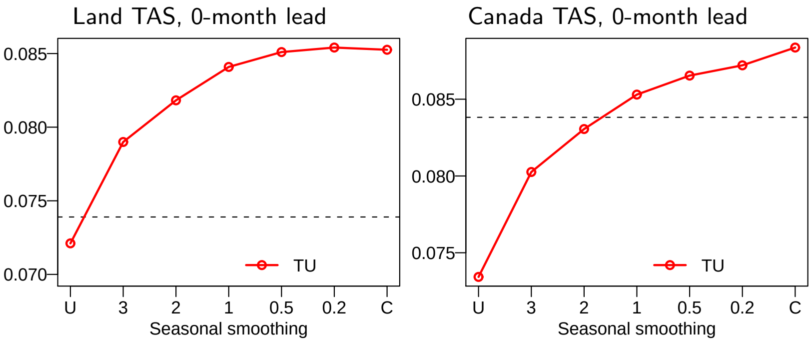


Figure: The 12-season mean BSS of 0-month lead TAS hindcasts over land and in Canada as the function of the seasonal smoothing but for spatially untruncated rescaling coefficients.

BSS, 0-lead TAS hindcasts, Canada

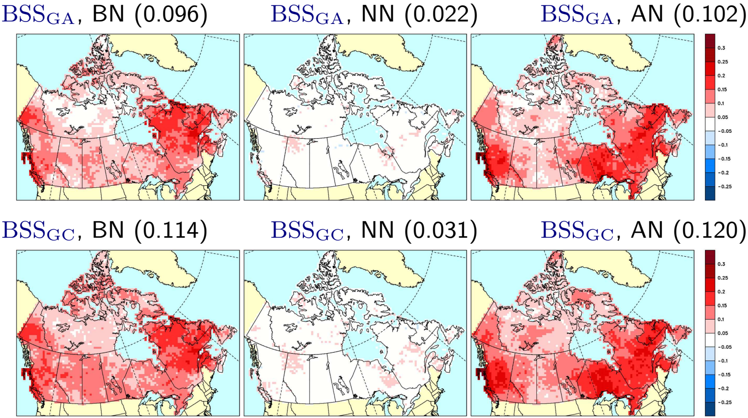


Figure: The 12-season mean Brier skill score of multimodel seasonal probability forecasts of TAS in Canada for 0-month lead. *Top:* adjusted in each season independently P_{GA}. *Bottom:* adjusted with seasonally constant rescaling coefficients.

Reliability diagrams for TAS over land

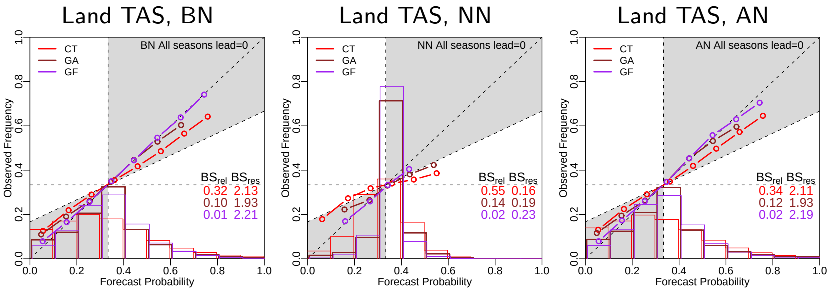


Figure: Reliability diagrams for 0-month lead TAS probability hindcasts over land: count-method (red), adjusted in each season independently (brown), and adjusted with seasonally constant rescaling coefficients (purple).

Conclusions

- A calibration method using seasonally and spatially smoothed coefficients is superior to an older calibration procedure for each season/grid point.
- The best skill improvement is typically achieved for seasonally constant rescaling coefficients. There is little benefit from additional spatial smoothing.
- The reliability and often the resolution of calibrated probability hindcasts of TAS over land is improved using the new method.

Calibrated probability forecasts on a web site

http://www.cccma.ec.gc.ca/data/seasonal_forecast/sf.shtml

Username: cccmasf
Password: seasforum