The Seasonal Predictability of UK and Northwest European Spring Temperature

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Summary

Forecasts for March-April-May (MAM) air temperature over the UK and Northwest Europe are made using a simple regression model utilising the persistence of February air temperature. This model has highly significant skill dating back 275-years. Persistence is largest close to water and is thought to be driven by SST anomalies coupled to a stable lower atmosphere which is then advected onto land. Forecast skill has increased since 1970, which may be due to increased persistence of the region's primarily NAO-driven circulation.

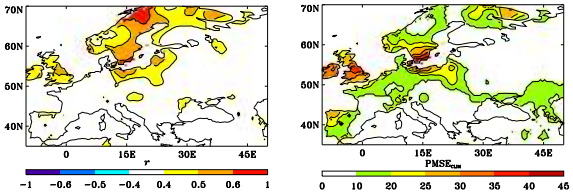

Figure 1.
a) Correlation skill for 0.5-degree MAM air temperature forecasts 1950-1999. Colour-bar levels are 0.95, 0.99 & 0.999 significance levels corrected for autocorrelation (two-tailed test).
b) as a) except showing percentage improvement in forecast model mean-square-error ($PMSE_{CLIM}$) over a prior 30-year climatology.

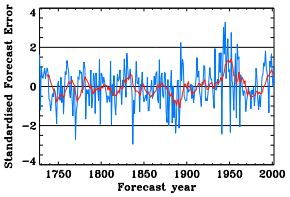

Figure 2.
Blue line shows standardised forecast error for MAM Central England Temperature (CET) 1728-2002 (observed minus predicted values standardised by observed MAM temperature variance in training period). Red line is the 10-year moving average.

What We Know

- Persistence in air temperature is strongest close to water bodies (Figure 1)
- Persistence occurs in both warm and cold years
- CET model forecasts display a long-term (275-year) correlation skill of 0.39 and $PMSE_{CLIM}$ of 16%
- Forecast correlation skill has increased to 0.7 since about 1970
- Around 10% of the skill is explained by linear trend
- Persistence shows significant interannual variability, even since 1970 (figure 2)
- Persistence occurs only is the lowest 10-100m of the atmosphere

What We Believe

- Local SST anomalies provide heat energy source
- Persistent circulation provides advection mechanism
- Long-lived static stability enables air-sea coupling only in a thin 10-100m boundary layer
- This atmospheric 'memory' mixed vertically over land
- Interannual variability linked to discontinuity in circulation from February to MAM (figures 3 and 4)

What We're Working On

- How circulation discontinuity can destroy persistence through static instability and changes in cloud cover
- Increased NAO persistence from February into spring since 1970 may be the cause of recent high skill
- Using the UKMO Mesoscale Model we will attempt to resolve these problems

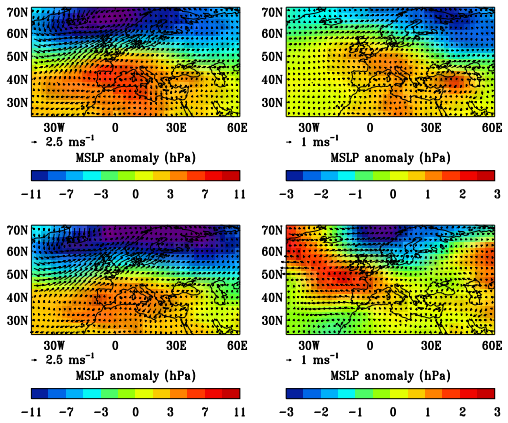

Figure 3.
Composite of February (left panel) and MAM (right) MSLP and 10m wind anomalies for years when significantly warm February CET anomalies were (a) followed by significantly warm MAM CET anomalies (top plots) and (b) were followed by average MAM CET anomalies (bottom). Number of cases: a) N=9 b) N=3. 'Significant anomalies' are defined to have magnitude one-half the standard deviation of all data.

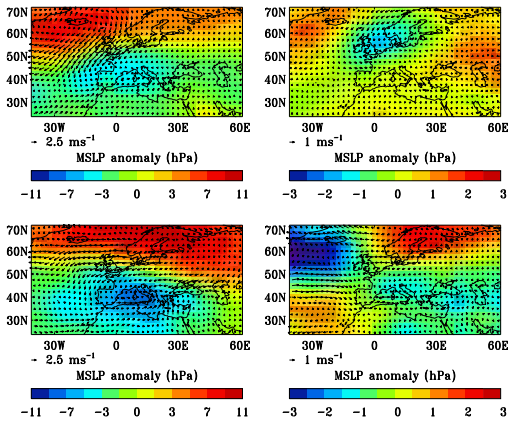

Figure 4.
As figure 3 but for significantly cool February CET anomalies followed by (a) significantly cool MAM CET anomalies (top plots) and (b) average MAM CET anomalies (bottom). Number of cases: a) N=9 b) N=4.

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