Statistical Seasonal Forecasts in Europe

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Abstract
Statistical seasonal forecasting techniques are used at KNMI to support the interpretation of the dynamical seasonal forecasts from the ECMWF. The only ENSO teleconnection was found to be spring precipitation. Persistent SST gives predictability over climatology in coastal regions, especially on monthly time scales in summer and winter. The speed at which snow melts in spring adds temperature predictability in eastern and northern Europe in spring. These and other relationships an easily be epxlored using a freely available web application, the KNMI Climate Explorer.

1 Seasonal Forecasts at KNMI

Since summer 2000 the KNMI has an experimental public web page with seasonal forecast information, www.knmi.nl/exp/seizoen. It contains

- an introduction to seasonal forecasting and its uncertainties,
- the current situation: SST anomaly plot and description,
- a short summary of the forecasts,
- links to the ECMWF, UKMO, NCEP, IRI web pages and
- climatology and persistence in the Netherlands.

To gauge the level of confidence we can put in the dynamical seasonal forecasts, mainly from the ECMWF, we use statistical forecast techniques.

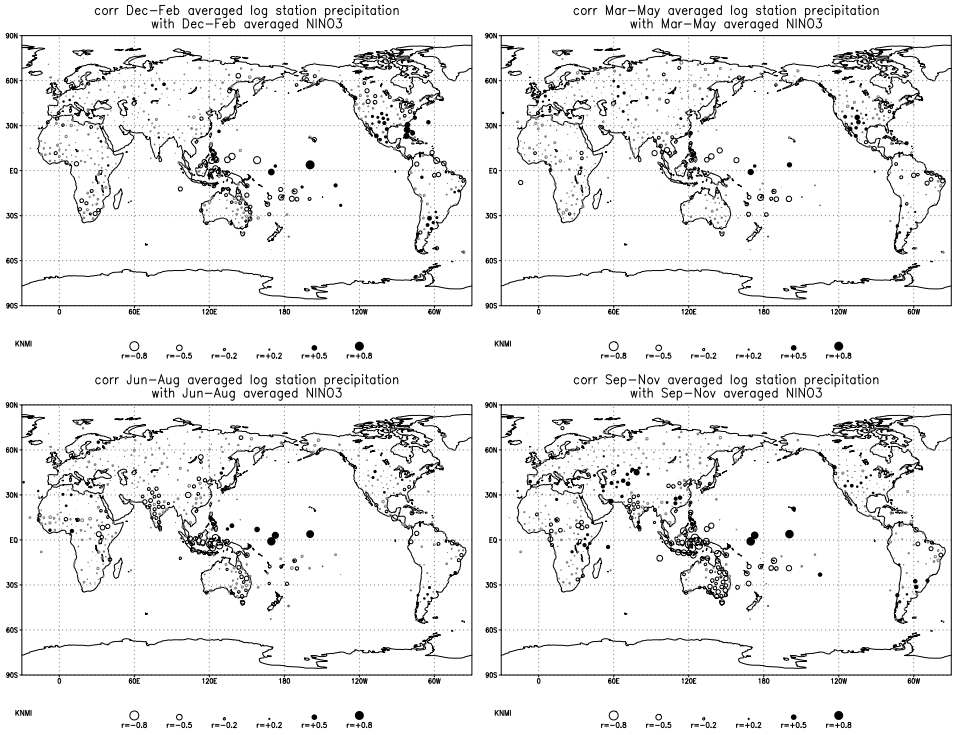
2 Statistical Forecasting Techniques

This is a very old game, see e.g. Hildebrandsson (1897). Take historical observations (1880-now), find a pattern with a time lag, verify this pattern and use it to make forecasts, including uncertainties.

However, there are pitfalls. Looking at 70 scatter plots with white noise, you have a 50% chance of finding one with a "99% significant" relationship. There might also be 7 climatologist each looking at 10 plots, or 7 plots with 10 independent regions. We therefore demand independent verification and a plausible mechanism.

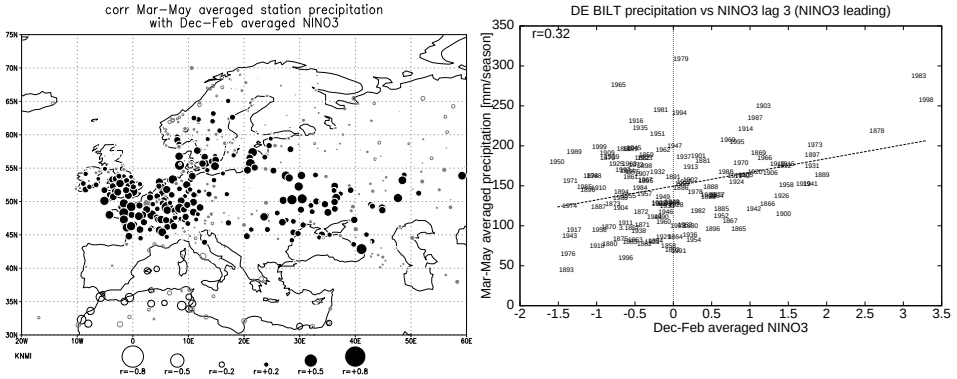
3 ENSO teleconnections

ENSO is predictable up to half a year ahead of time and has teleconnections to many parts of the globe. These depend strongly on the season. We take the traditional four seasons and consider linear correlations of log precipitation and temperature for GHCN stations with at least 50 years of data and at least 3° apart.



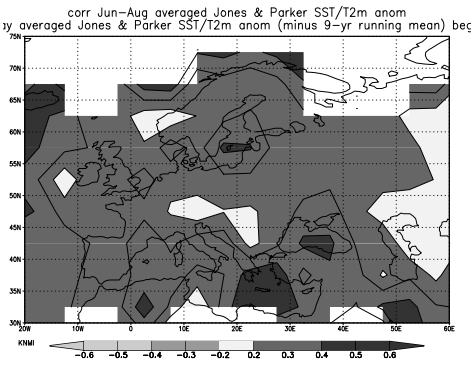
The strongest signals are in the West Pacific and in East Indonesia ($r \approx 0.8$). Around this there are many regions with $r \approx 0.6$, e.g. the Dutch Carribean, Guyana, Florida (van Oldenborgh and Burgers, 2001). The only signal in Europe is spring precipitation ($r \approx 0.3$), which can be used for forecasts after a big El Niño (van Oldenborgh et al., 2000).

For the European plots all GHCN station with more than 80 years of data where selected.



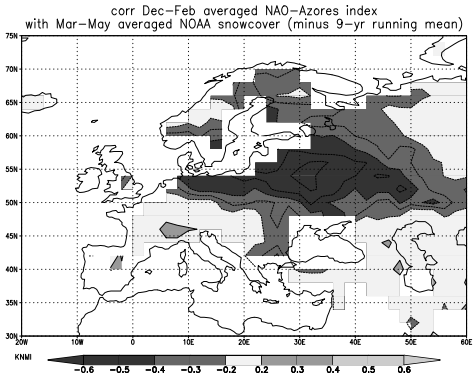
4 Persistent SST

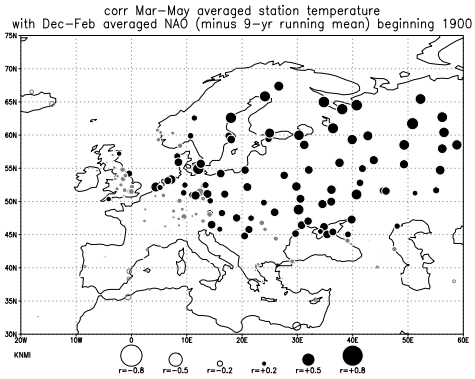
Another way to obtain the time lag needed for seasonal forecasts is to use persistence of SST followed by a simultaneous influence of SST on temperature or precipitation. Again, this works much better in the tropics than in Europe. We apply a 10-yr running mean to get rid of decadal signals. In Europe, there is only a signal in temperature, not in precipitation. (There are precipitation signals in West Africa, Mexico, South-East Asia and South China.)



5 Snow

The amount of snow that falls in winter influences the weather at the time it melts. In northern and eastern Europe (and the U.S. and Canada) this gives a predictable component to spring/early summer temperature apart from SST persistence.



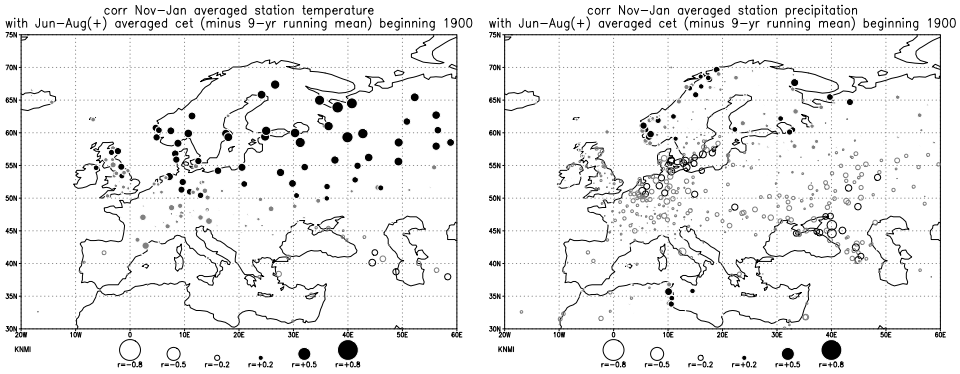


6 Summer

Colman (1997) found that winter Atlantic SST predicted summer Central England (in fact, northwestern Europe; Colman and Davey, 1999) temperature quite well in 1950-1995. A mechanism is hard to propose. We verified that the relationship also holds, though weaker, in 1900-1949. The centre of the correlation patterns is over land, not over sea: Scandinavia and Canada. There is also a correlation with precipitation in this area, leading to a snow hypothesis:

Milder, wetter winter in Scandinavia
⇒ more snow there in winter
⇒ snow melts later in late spring
⇒ ? more chance of a blocking high over Scandinavia in summer
⇒ nice weather in England and the Netherlands

Evidence for this chain comes from the positive correlation of summer CET with winter precipitation in Scandinavia, but more research is needed to establish whether the relationship is real.



7 Conclusions

Statistical forecasts are a useful check on model forecasts, but care has to be taken in verifying promising patterns. Europe is one of the least predictable parts of the globe. There is a weak ENSO teleconnection to spring precipitation. Persistence of SST and snow cover also lead to useful correlations over climatology. The summer signal based on winter Scandinavian and Canadian temperatures needs more research.

A Climate Explorer

All figures were made using a publicly available web application, the KNMI Climate Explorer, http://climexp.knmi.nl. It allows one to investigate and correlate freely available monthly climate data. At the moment it contains GHCN precipitation, temperature and pressure stations, PSMSL & JASL sealevel stations, RivDis & HCDN river discharge stations, some climate indices (NINO, SOI, NAO, QBO, NP, AIR, CET, ...), gridded observations of temperature (Jones&Parker), precipitation (Hulme, Xie&Arkin), sea surface height (DEOS), snow cover (NOAA), wind (CERSAT), TAO data, reconstructions of SLP (Parker, Luterbacher) and SST (Kaplan), and a selection of NCEP/NCAR40 and ERA15 reanalysis fields. The possibility exists to add one's own data to the system.

References

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