S2S and early warning of severe conditions

How far in advance can we predict changes in large-scale flow leading to severe cold conditions over Europe?

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The prediction of extreme events is one of the major challenges of S2S forecasting due to their high human and financial cost. (S2S sub-project).

Extremely events that the S2S forecast could predict are long lasting, large scale extreme weather hazards which occur on a scale of 1000 km with a lifetime ranging from a week to a few months. These events can be particularly destructive.

S2S models will probably not have skill to predict the daily variations of these extreme events, but they are expected to provide guidance on their genesis, time evolution, intensity and decay on at least a weekly basis.
Summer of 2018:

warmest and driest for northern Europe

Time series of daily 12 UTC 2m temp (thin lines) 7day running mean thick lines
Climatology (dashed lines) for St and M from the 1 of April to 31 August 2018
Composites of weekly 2mt anomalies range 12-18 days from some S2S models valid from 7 May to 12 August:

2mt weekly anomalies range 12-18 days composites valid for 20180507 to 20180812

ECMWF

CMA

MET. FRANCE

NCEP

Bom

JMA
Evolution of weekly 2mt anomalies over 60-50N 10-20E:

- Forecast range 8-14: Cor = 0.72
- Forecast range 12-18: Cor = 0.04
Severe cold spell end of February 2018:

2mt over Europe
weekly means anomalies at 19-25 days
How far in advance this cold event was predicted?

Predictions initialized at different time and verifying the 3-days mean (27 Feb to 1 March)

Persistent high pressure systems are associated with severe events: cold spell in winter and heat waves in summer.

Circulation regimes, usually associated with global teleconnections, play an important role in the atmospheric predictability on sub-seasonal time scale.
From: the S2S Museum @University of Tsukuba, Japan
Dr. Mio Matsueda

http://gpvjma.ccs.hpcc.jp/S2S/S2S_NAO.html
How far in advance we predict changes in large scale flow leading to a severe cold spell over Europe?

- ±EOF1 and +EOF2 represent quite well ±NAO and BL.
- Trajectories in phase space summarise regime evolution.

Regime projection 20091201 12

Regime projection 20131201 12

Blocking

BL: record-breaking cold temperatures over Europe

+NAO: exceptional storminess, but mild temperatures over Europe.
2M Temp anomalies for DJF:

2009/2010

Blocking

NAO-

NAO+

2013/2014

Blocking

NAO-

NAO+
Distribution of severe winter (NDJF) events in era-interim (1980-2015)

When for 60% grid points in each box the daily 2mt < 10th quantile of daily climate for at least 4 consecutive days
a) ENS from 29/04/2017

b) ENS from 03/05/2017

ENS extended range from 27/04/2017
Regime transitions:

Lin et al. (2008)