Cold Spell and Snowfall in Serbia – April 2017, case study

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What meteorologist can and what can not predict; between the needs and limits

seasonal forecast → extended range forecast → medium range forecast

ECMWF seasonal ensemble forecast

Long range forecasts provide information about atmospheric and oceanic conditions averaged over the next few months.

Dynamic ensemble model with 50 members plus control run
Issued monthly, seven months ahead
Horizontal resolution about 83km

Seasonal forecasts provide a range of possible climate changes that are likely to occur in the season ahead.
Because of the chaotic nature of the atmospheric circulation, it is not possible to predict the daily weather variations at a specific location months in advance.
It is not even possible to predict exactly the average weather, such as the average temperature for a given month.

ECMWF extended range forecast

The extended-range forecast provide an overview of the forecast for the coming month, focusing mainly on the week-to-week changes in the weather.

IFS ensemble model with 50 members plus control run
Issued every Monday and Thursday for the coming 46 days
Horizontal resolution about 36km

Re-forecast /model climatology
is a 11-member ensemble of 46-day ENS integrations, starting on the same day and month as each real time forecast for each of the past 20 years.
The 11-member ensemble is thus integrated with 20 different starting dates.
This represents a total of 220 integrations.
Real-time forecasts are calibrated using a 1- week window of re-forecasts, which represents a total of 660 (3 start dates x 20 years x 11 members) re-forecast integrations.

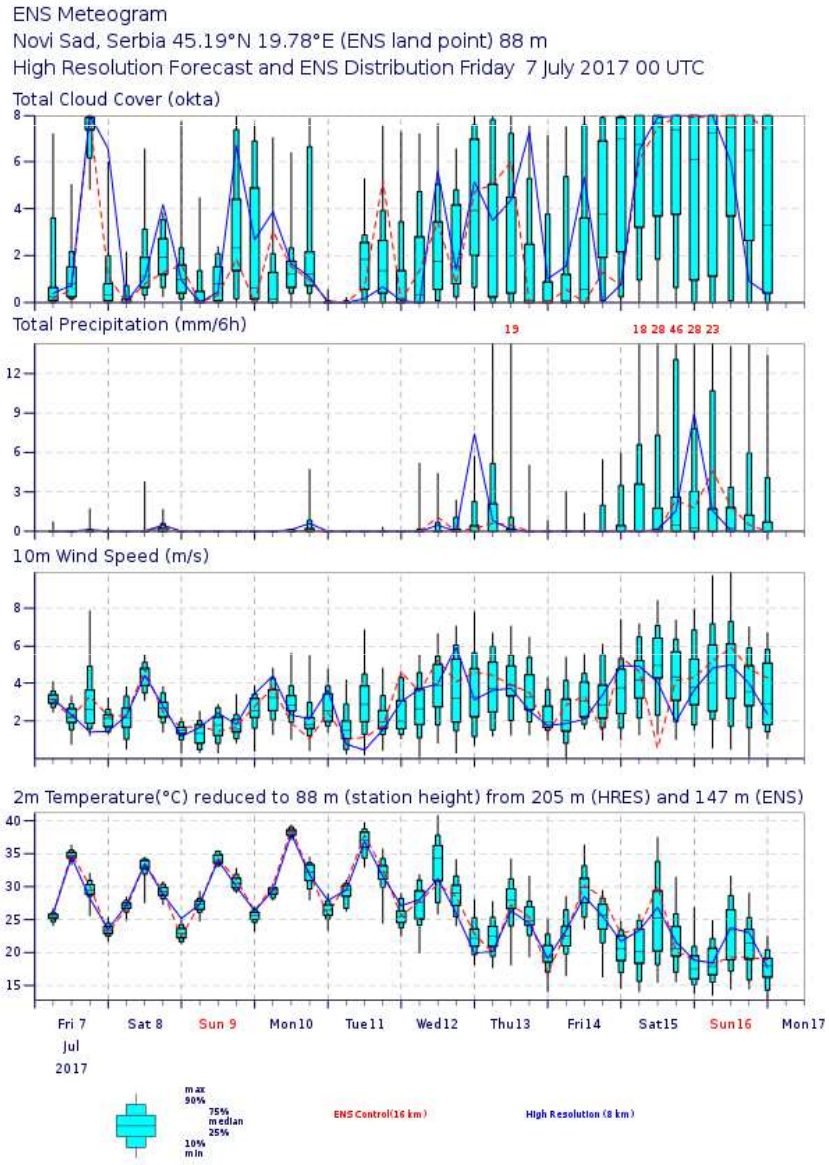
ECMWF medium range forecast

Range of possible future weather states.

Issued twice a day
IFS High resolution model,
9km horizontal resolution

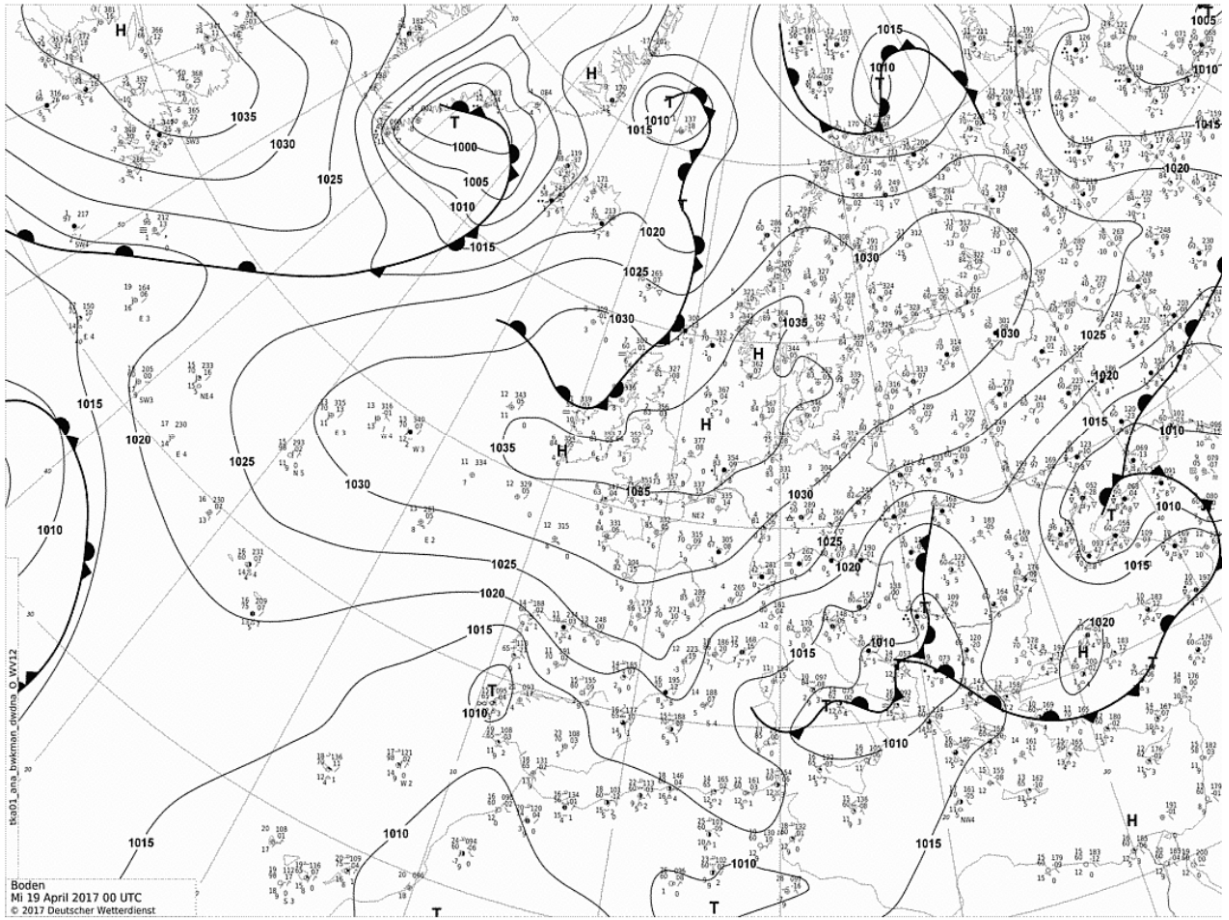
ENS 50 members + control run,
18km horizontal resolution

In comparison with averaged area of orchard…



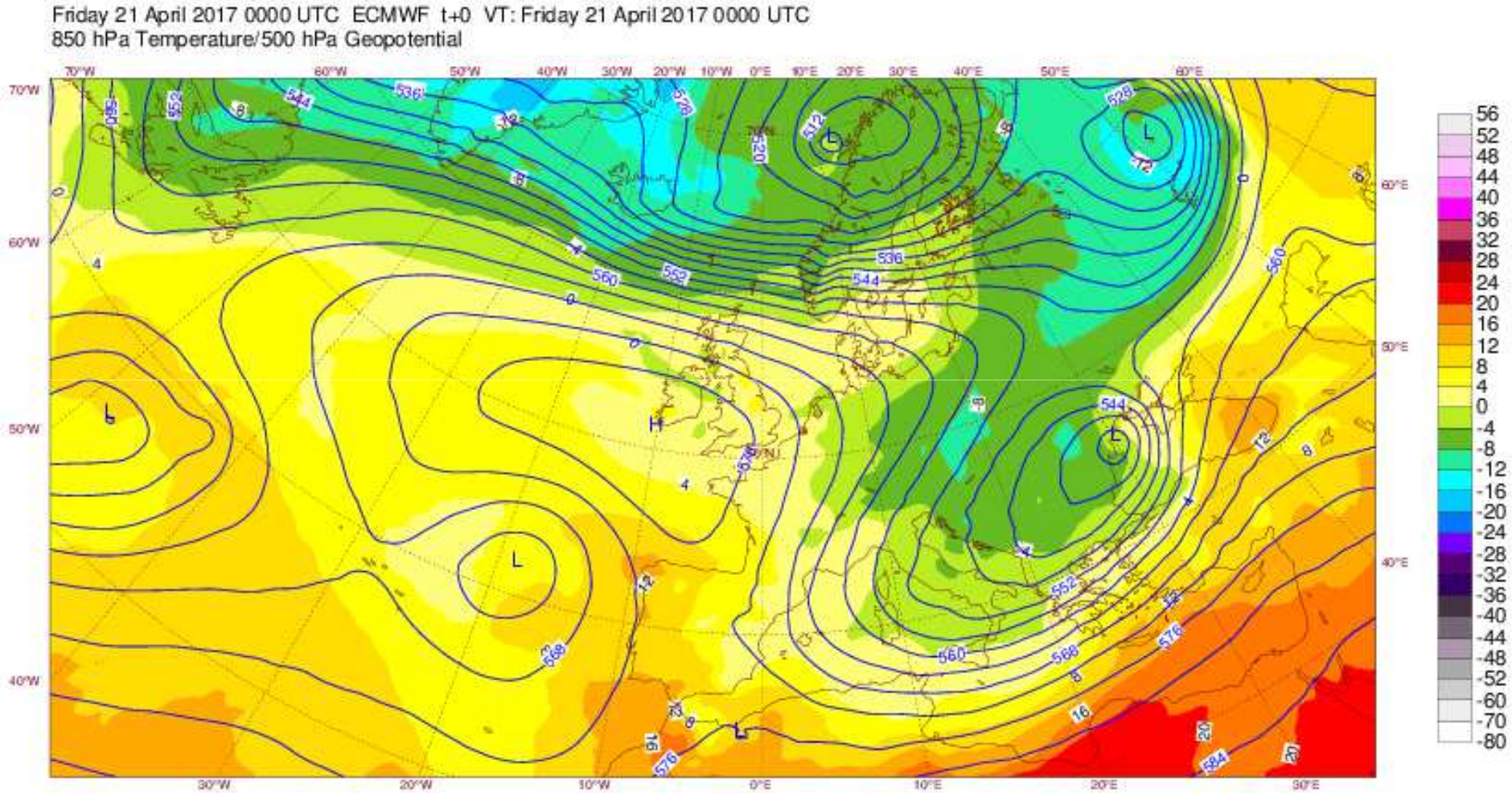
Description of the event

From 18th April 2017 unseasonably deep trough in upper levels and cyclogenesis over Genoa caused inflow of cold and unstable air from western Europe also in the lower layers of the atmosphere.
In this circulation cold front was moving forward to north east.



Description of the event

This system brought very cold arctic airmass with the temperatures at 850 hPa between -5 and -12 deg C. In this cyclonic circulation extremely low temperature and widespread stratiform precipitation shield was observed.



Description of the event

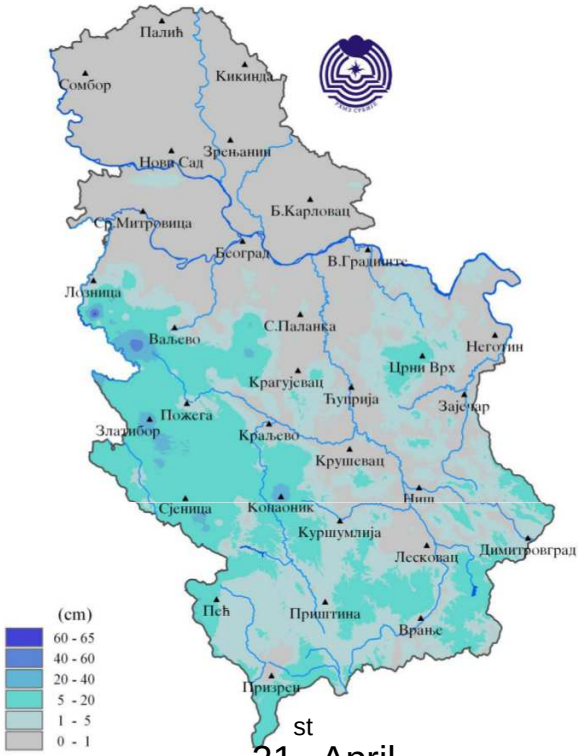
In the week 17 to 23 April unseasonal cold spell and snowfall hit the most of Europe. Cold and cloudy weather with sleet and snow fall forming snow cover on west and southwest of Serbia was observed.

Most of the different types of fruit, especially strawberries and raspberries, was in flowering in April and very sensitive to the spring frosts. Wet snow that fell can cause the breaking of a twig in raspberry also.

Observed snow depth

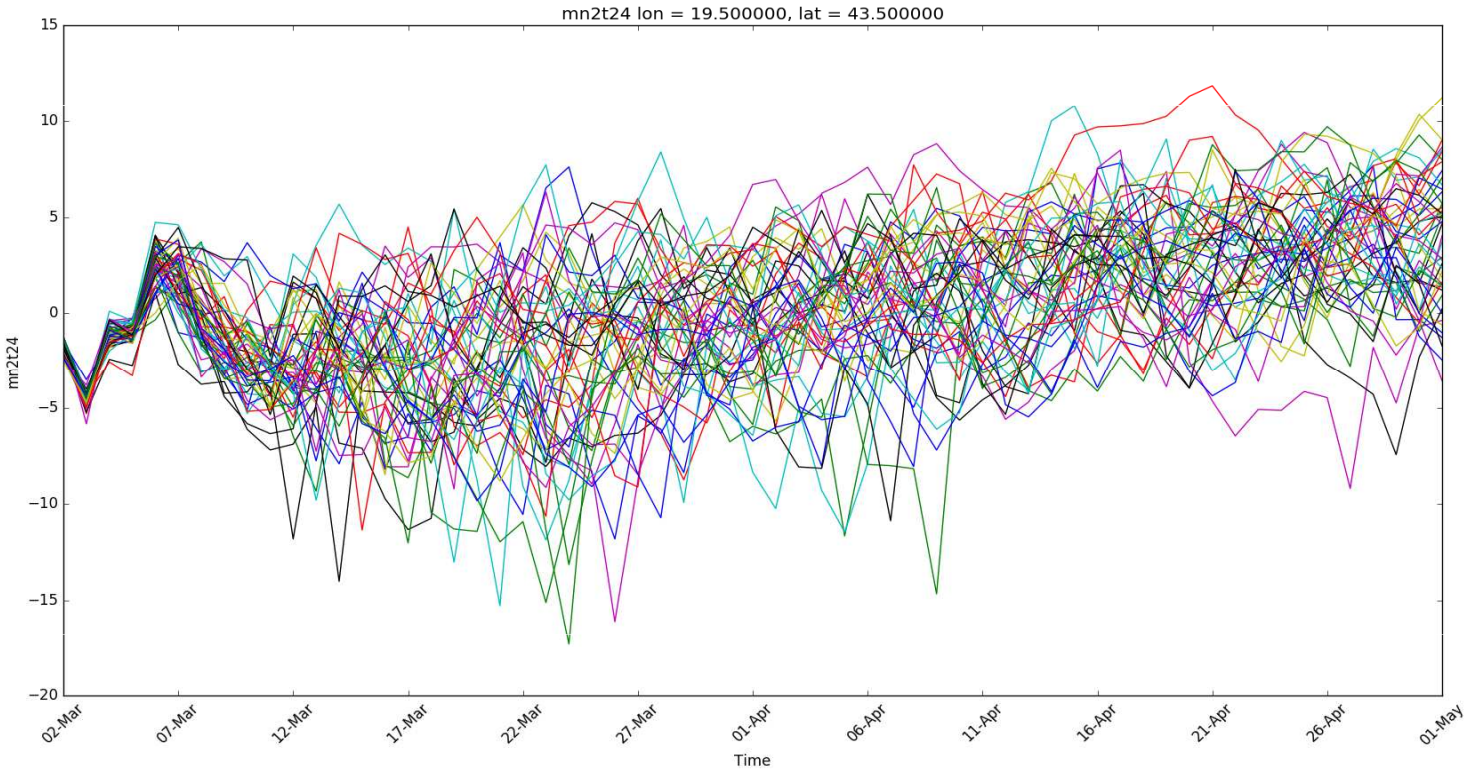
19th April

20th April



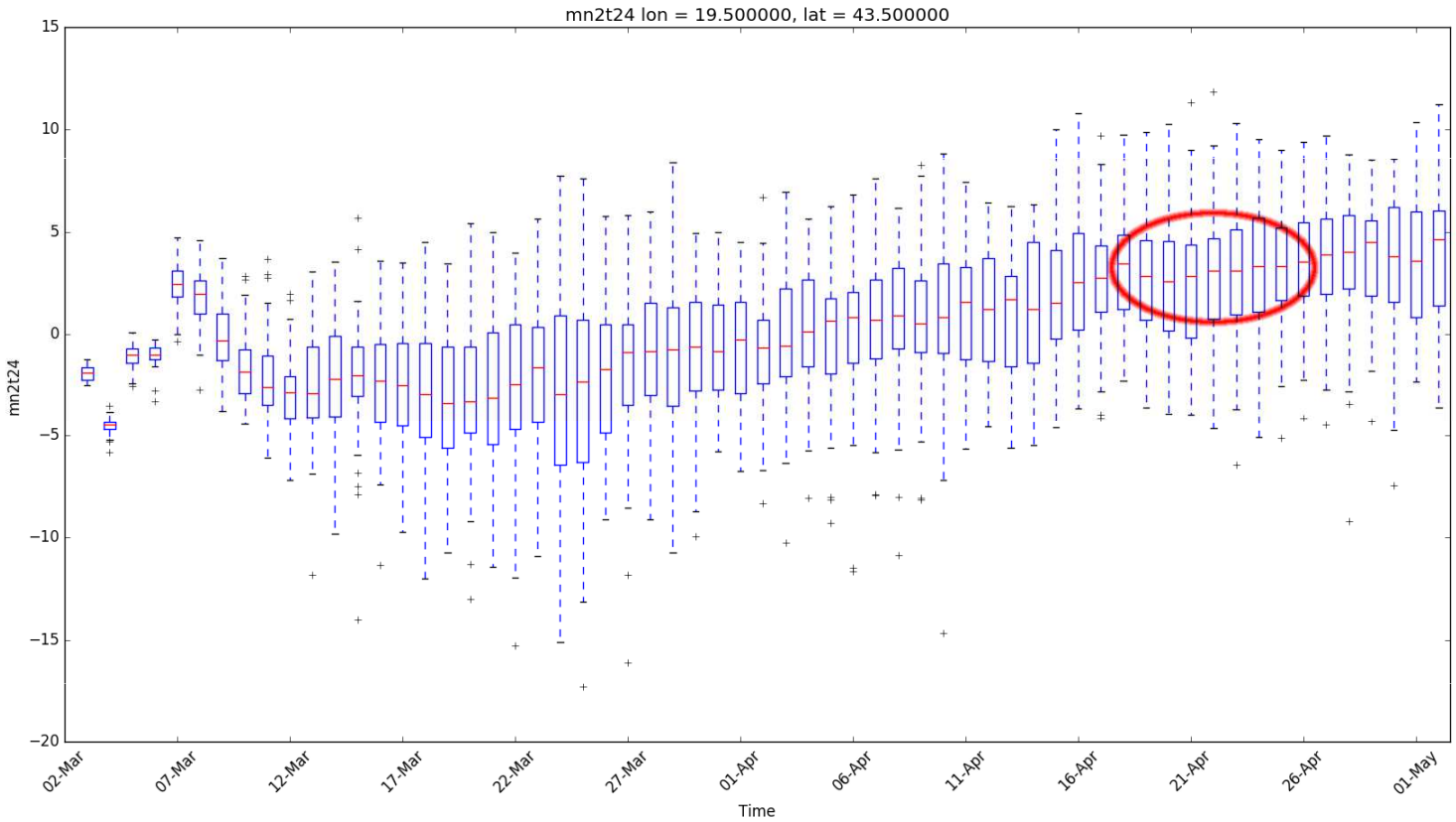
21st April

ECMWF ensemble seasonal forecast



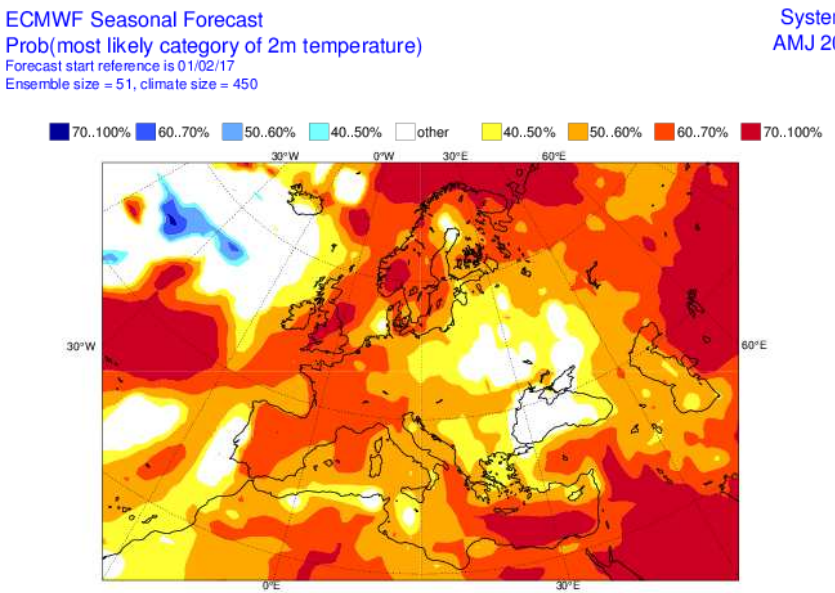
Two month forecast issued 1st march 2017;
2 meter temperature; one location; 50 members,
time series, raw data.

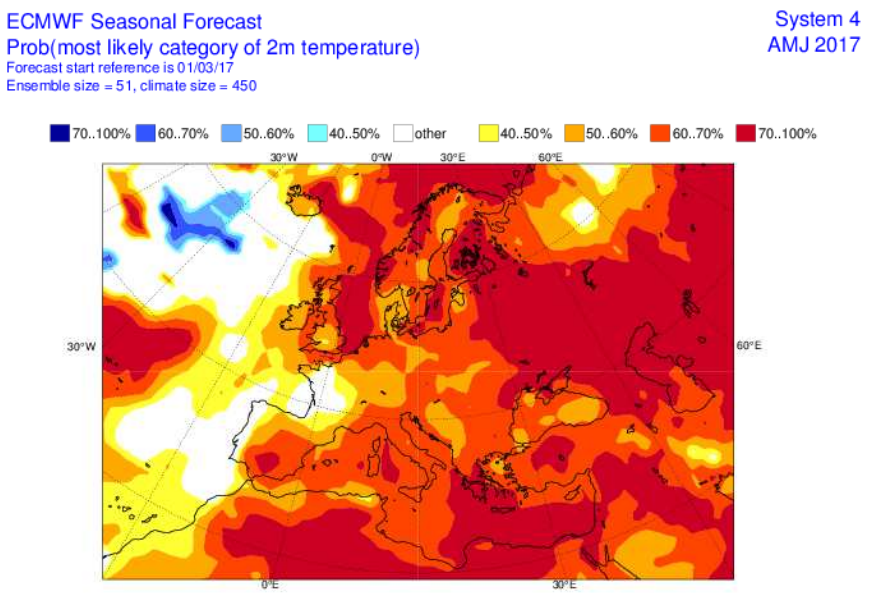
ECMWF ensemble seasonal forecast, different presentation



Boxes and medians : showing the quartiles and the median's confidence 25%-75% whiskers: the vertical lines extending to the most extreme, n-outlier data points. 15%-85% fliers: points representing data that extend beyond (sic) the whiskers (outliers). Below 15% and over 85%

ECMWF ensemble seasonal forecast; probability



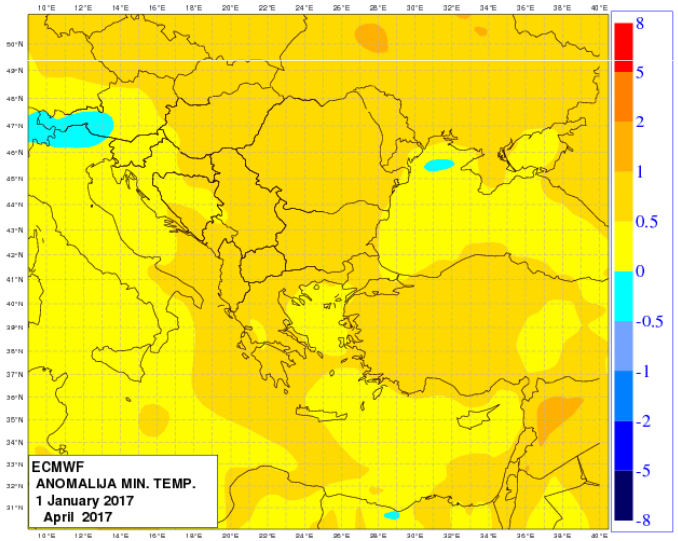


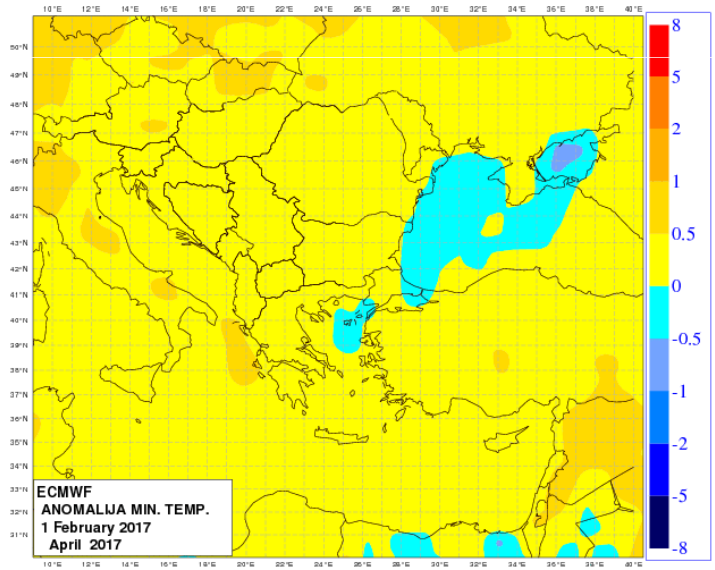
Model climate

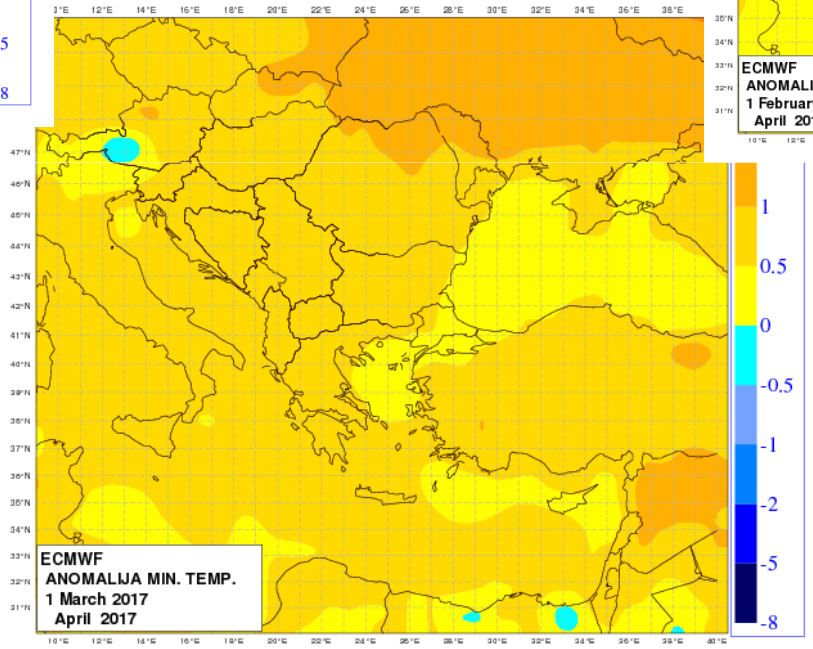
Every seasonal forecast model suffers from **bias** - the climate of the model forecasts differs to a greater or lesser extent from the observed climate. Since shifts in predicted seasonal climate are often small, this bias needs to be taken into account, and must be estimated from a previous set of model integrations. Also, it is vital that users know the skill of a seasonal forecasting system if they are to make proper use of it, and again this requires a set of forecasts from earlier dates.

A set of re-forecasts (otherwise known as hindcasts or back integrations) are thus made starting on the 1st of every month for the years 1981-2010. They are identical to the real-time forecasts in every way, except that the ensemble size is only 15 rather than 51. Model climatology consists of 450 members.

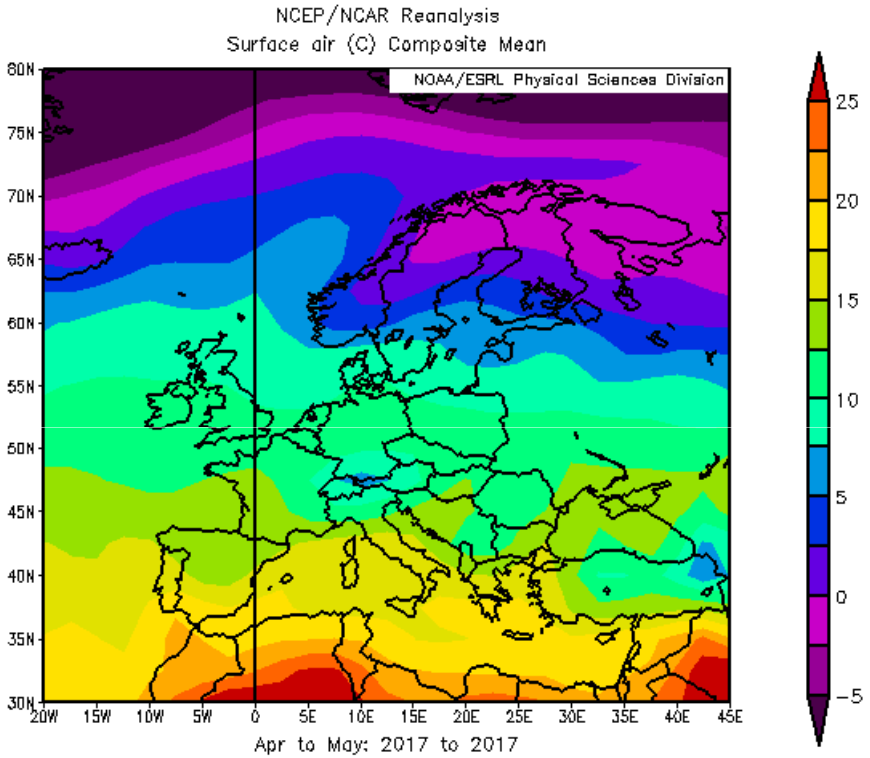
Seasonal forecast – monthly anomalies T min

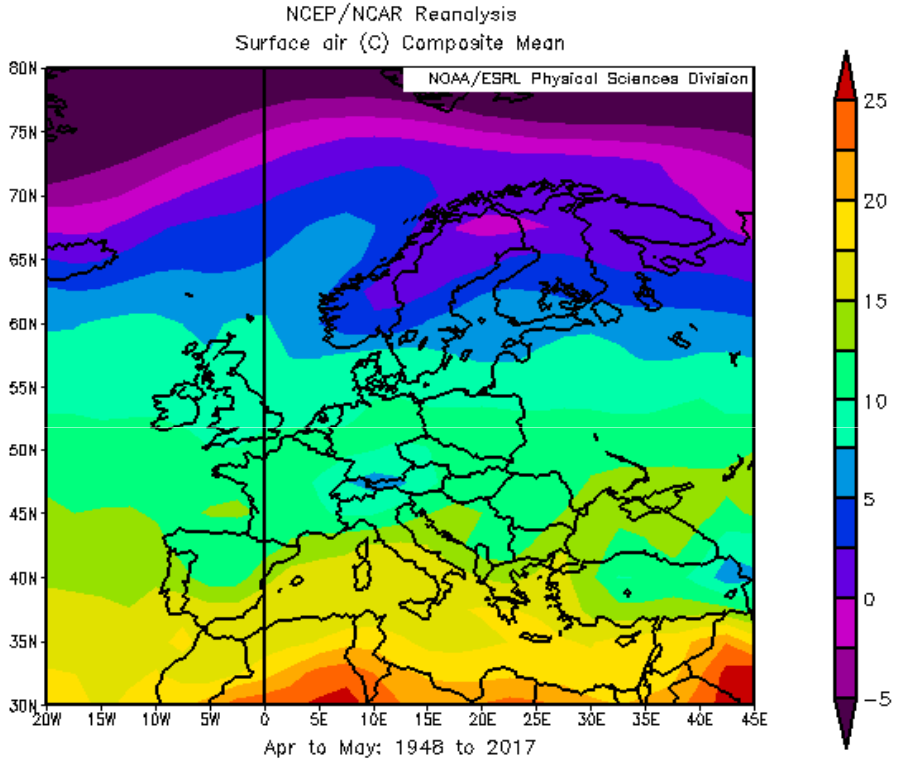






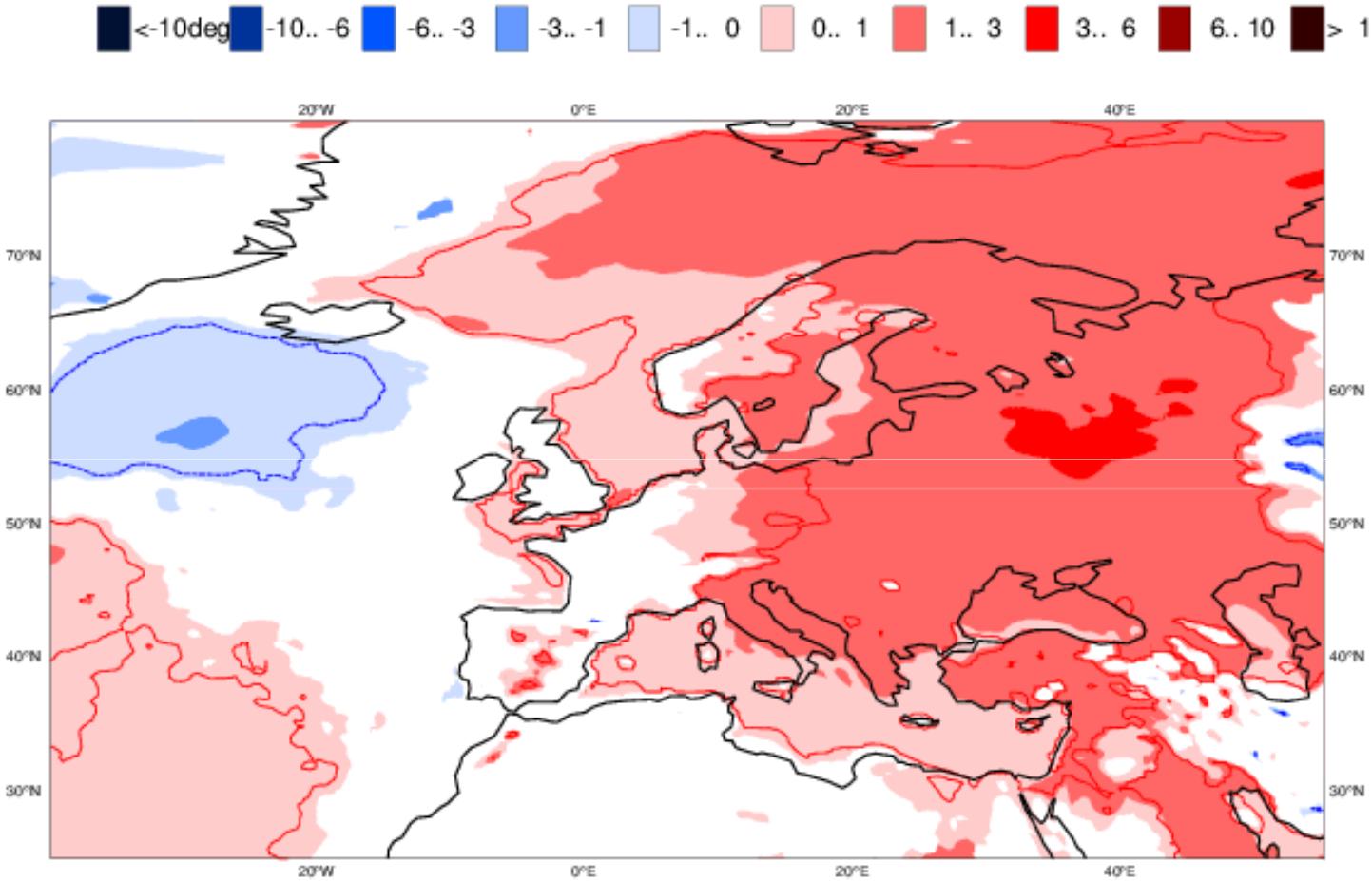
Observed temperature in April 2017 compared with NCEP reanalysis 1948-2017





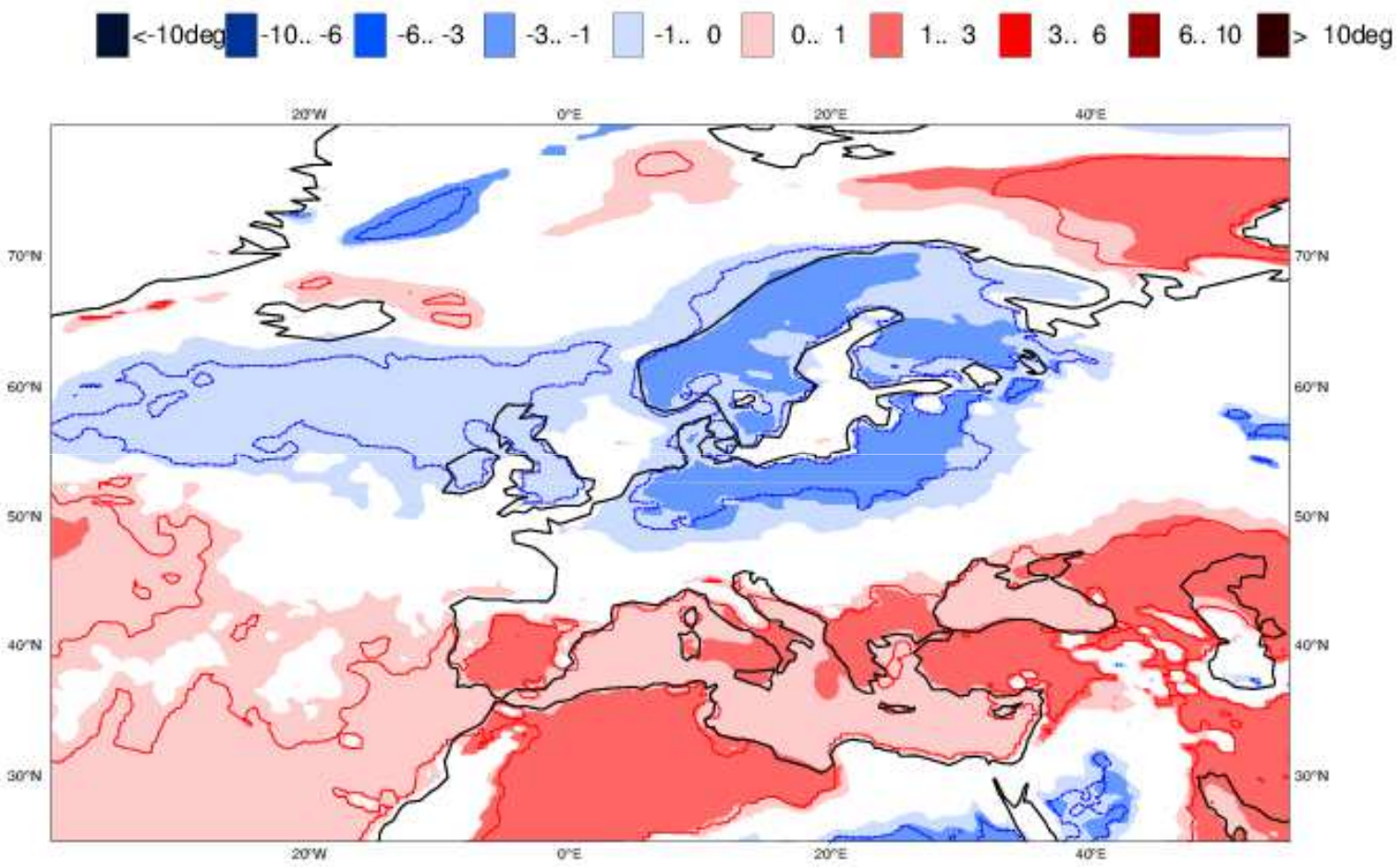
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 03-04-2017
ensemble size = 51 ,climate size = 660

Day 15-21
17-04-2017/TO/23-04-2017
Shaded areas significant at 10% level
Contours at 1% level



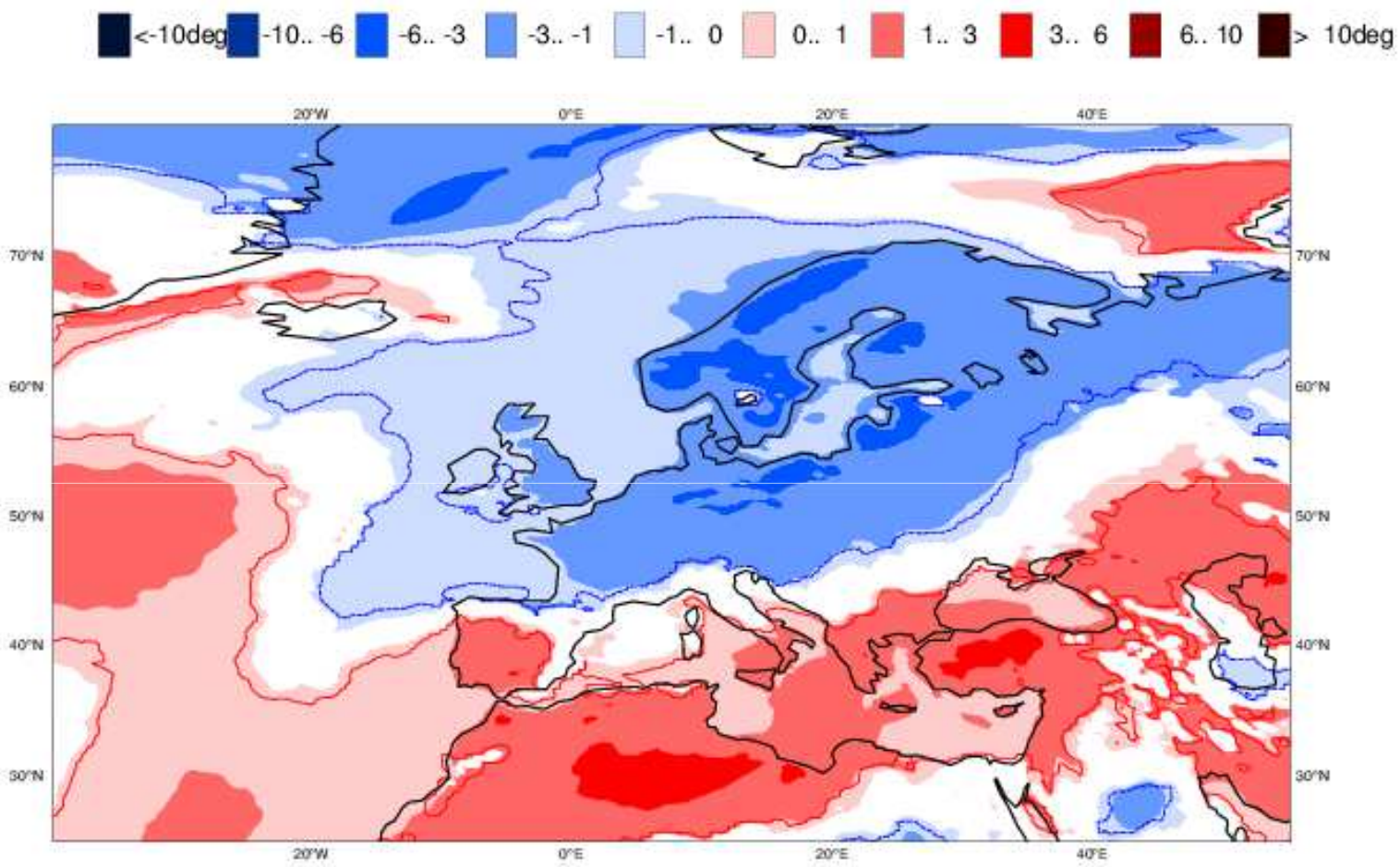
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 06-04-2017
ensemble size = 51 ,climate size = 660

Day 12-18
17-04-2017/TO/23-04-2017
Shaded areas significant at 10% level
Contours at 1% level



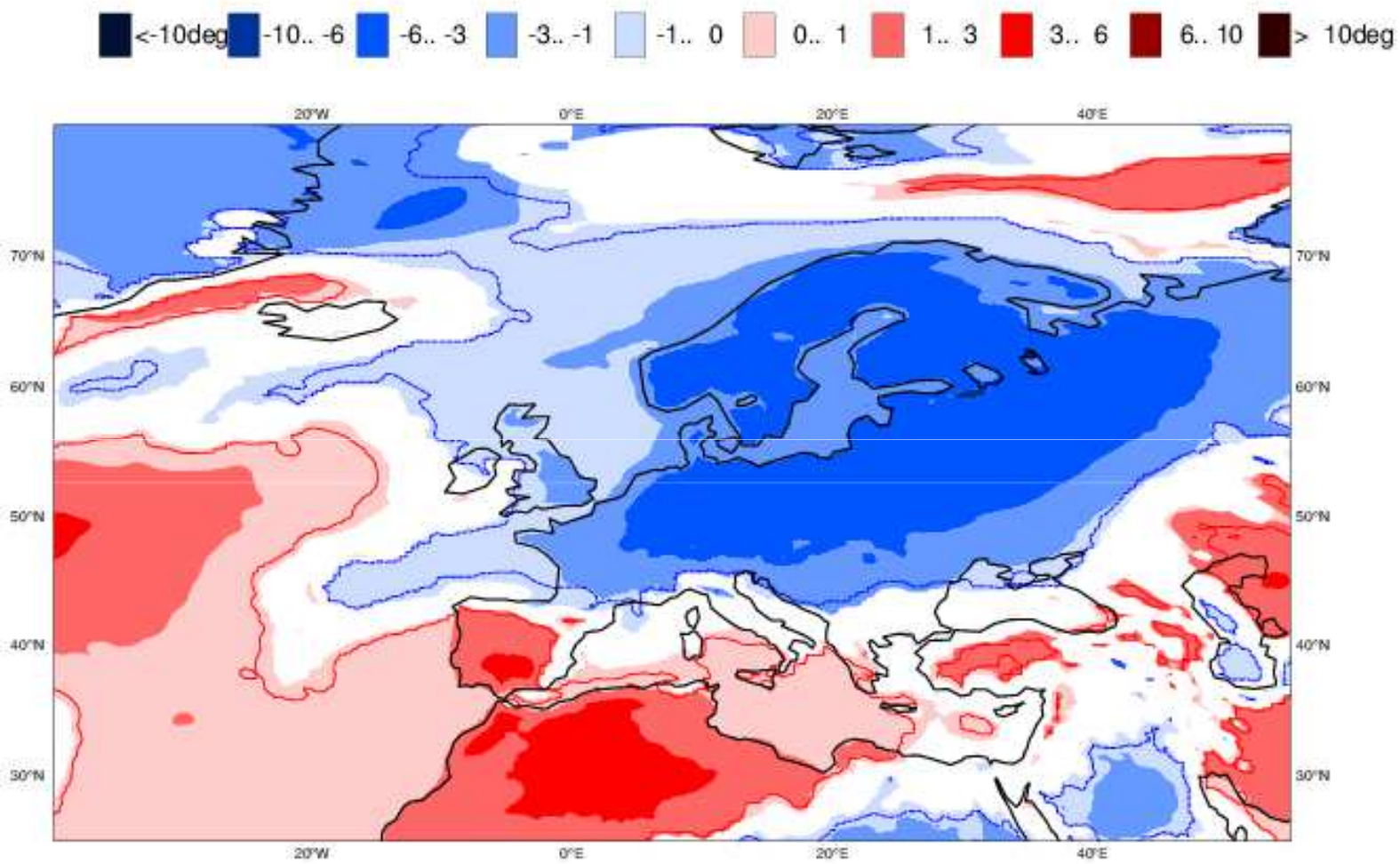
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 10-04-2017
ensemble size = 51 ,climate size = 660

Day 8-14
17-04-2017/TO/23-04-2017
Shaded areas significant at 10% level
Contours at 1% level

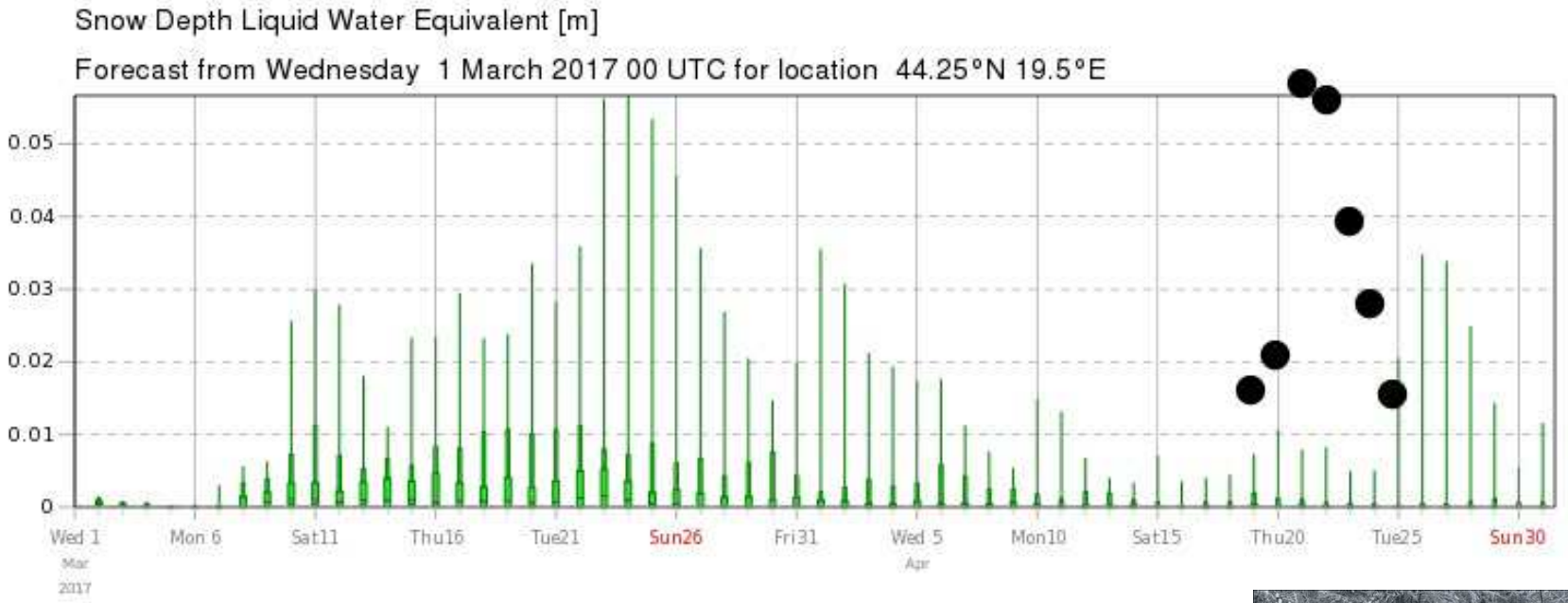


ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 13-04-2017
ensemble size = 51 ,climate size = 660

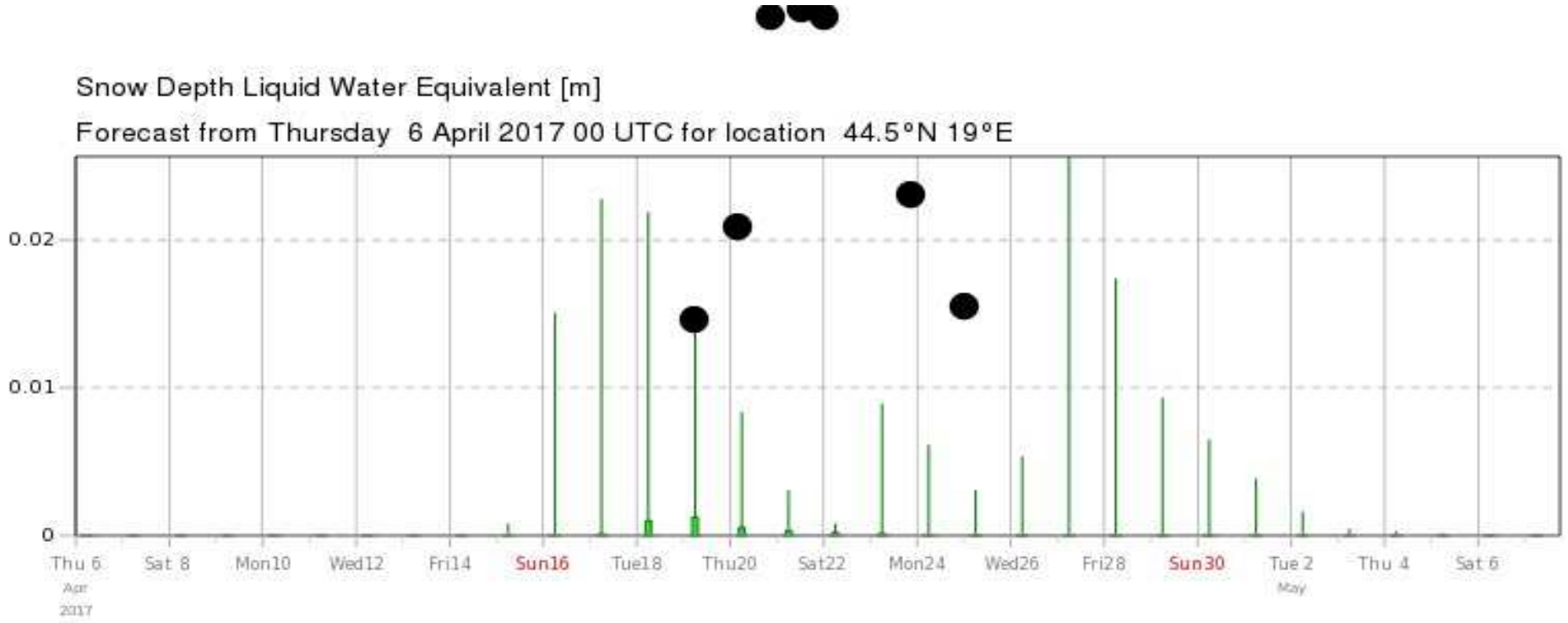
Day 5-11
17-04-2017/TO/23-04-2017
Shaded areas significant at 10% level
Contours at 1% level



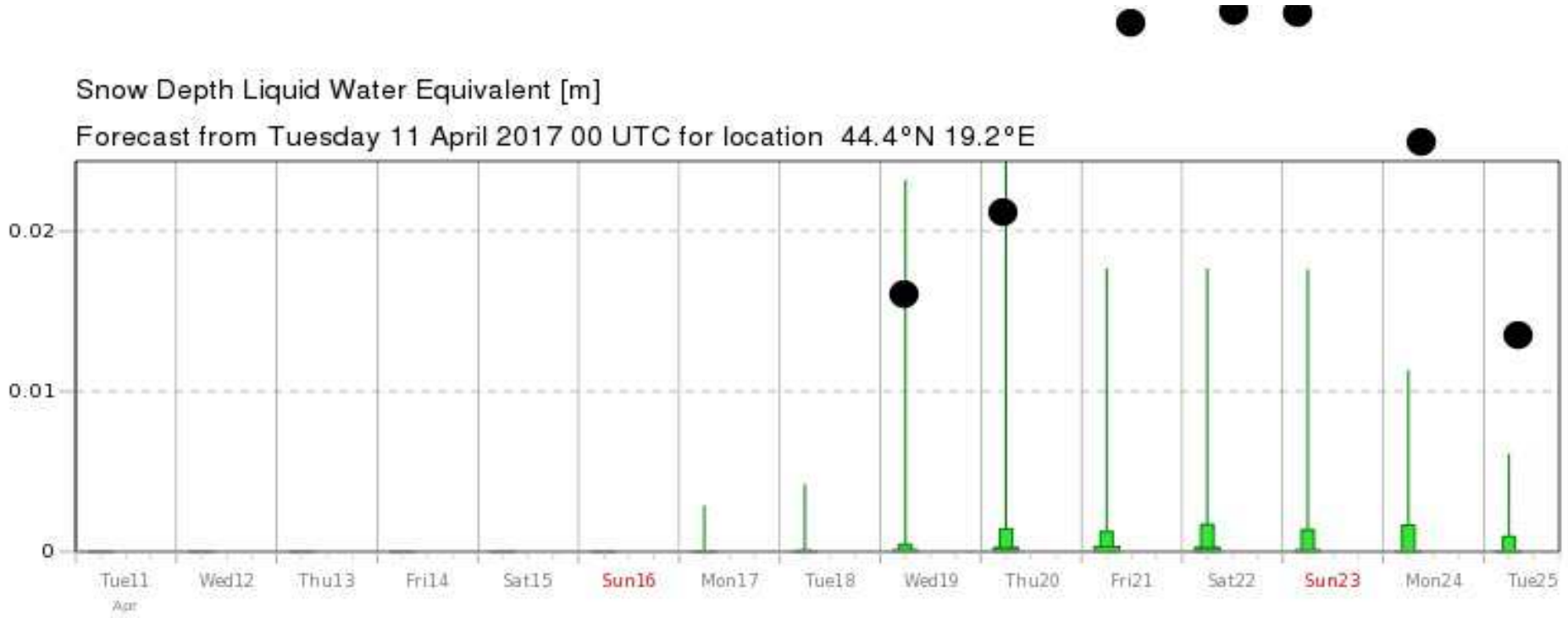
Long range snow depth forecast start 1th March 2017



Extended range snow depth forecast start 6th April 2017



Medium range snow depth forecast start 6th April 2017



Ten days in advance medium range forecast was successful in predicting snow fall!!!

Instead of conclusions

- We can benefit only if we learn and exchange information
  - What seasonal, monthly and medium range are able to predict
  - Accuracy of numerical weather prediction model
  - How to understand and apply forecast
  - How long in advance
  - How spacious are areas
  - Add …
- Define products that can be used
- Create new products (humidity is the weakness of all models)
- Continually develop and test

Thank you.