

The land surface dynamics in the first half of 2014 were affected by exceptional high temperatures, leading to:

- Unusually short snow cover period during winter and spring in most of Europe
- A very early start of vegetation phenology

Those extreme events were the opposite of the extreme events of spring 2013.

Snow cover period shorter than one month

The winter and the early spring 2014 were marked by exceptionally high temperatures over almost all Europe (Figure 1). Norway had been 4.2°C above the mean temperature in December according to its meteorological institute. In Hungary, it was the 3rd warmest winter since national records began in 1901, with temperatures 2.6°C higher than normal.

The mild temperatures lead to an unusual short snow cover period. A large part of West and South of Europe did not get snow at all. The snow cover duration in the South of Scandinavia, Baltic countries, Belarus, Western Russia and mountains of Central Europe was in average one month shorter than usual. In mid-February, more than 700.000 km² were exceptionally without snow (Figure 2). This unusual absence of snow is observed in areas characterized by a snow occurrence probability larger than 0,8. Probabilities of snow cover were computed from satellite images dataset (2000 to 2012) at 500 m spatial resolution.

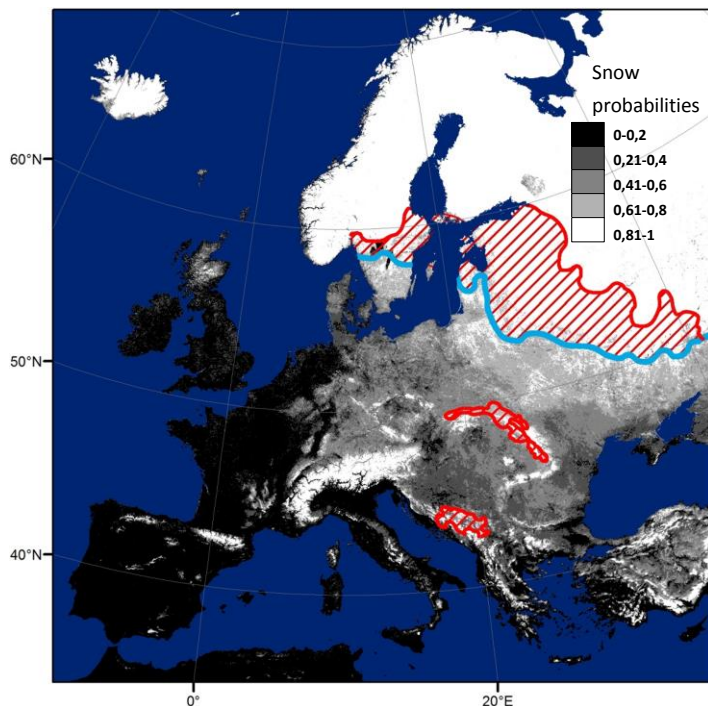


Figure 2: Exceptional absence of snow (red) in the 3rd week of February compared with the usual snow front (blue). The different grey levels represent the probabilities of snow cover at this period.

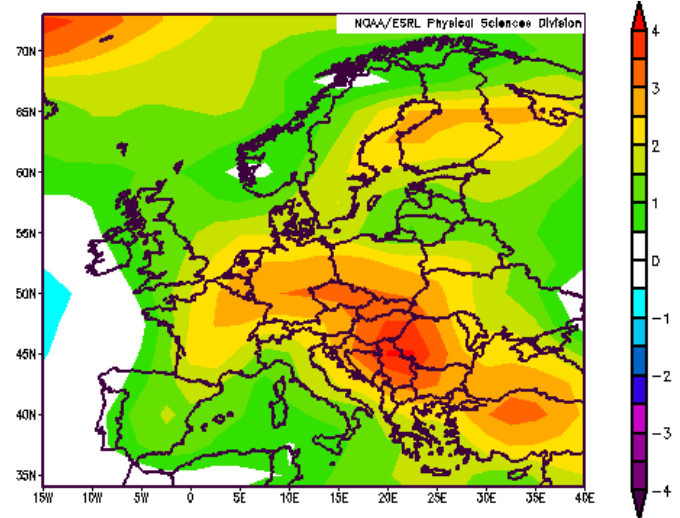


Figure 1: Surface air temperature (K) composite anomalies for January to April 2014, this period was marked by high temperatures. Figure modified from www.esrl.noaa.gov.

Animal activities started earlier

In Scandinavia, the combination of warm temperatures with rainy weather and sporadic snow disrupted the slumber of brown bears (*Ursus arctos*). These particular weather conditions brought them out of hibernation earlier than usual. At this time of the year, not much food is available for them (Figure 3). But it is not their only problem: these conditions really stressed the *Ericaceae*, such as bilberry. Berry production is thus likely to be affected in autumn when bears will need it most.

During the first months of the year, unusually high numbers of birds have been spotted in the northern border of their winter range, including chiffchaff (*Phylloscopus collybita*) and stonechat (*Saxicola rubicola*). Naturalists saw these species twice more compared to the usual observations at this time.



Figure 3: Weather conditions in winter 2014 allowed the brown bears to leave their dens earlier in Scandinavia © Willems Tomas.

Exceptional advance of vegetation phenology

Temperature is one of the main drivers of vegetation phenology. In 2014, remarkable mild temperatures had a strong influence on vegetation, leading to a precocious start of the growing season over most of Europe. At the end of March, the vegetation greenness was significantly higher than usual in the Continental, Pannonian and Steppic Biogeographic regions (Figure 4).

In the Mediterranean region, the higher temperature also induced an early start. However, this growth has then been limited by the lack of water in the western part. For example, South-East of Spain received little rainfall (Figure 5). This drought led to significantly lower values of vegetation greenness in March (Figure 6).

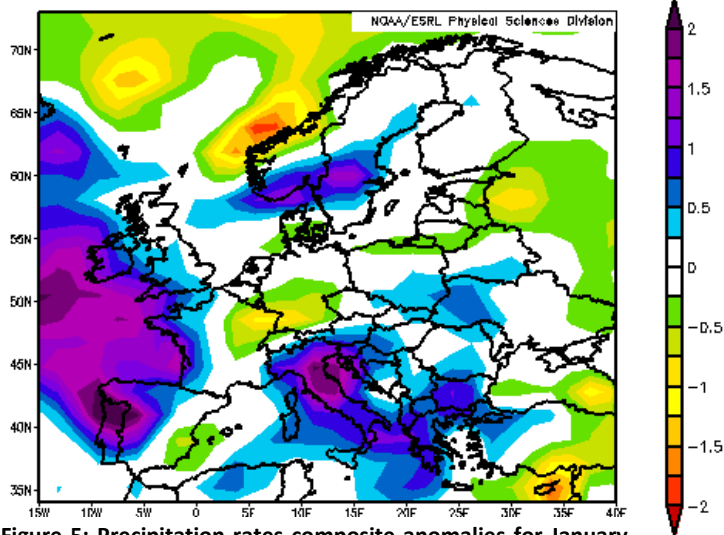


Figure 5: Precipitation rates composite anomalies for January to April 2014, precipitations were very variable from a region to another during this period. Figure from www.esrl.noaa.gov.

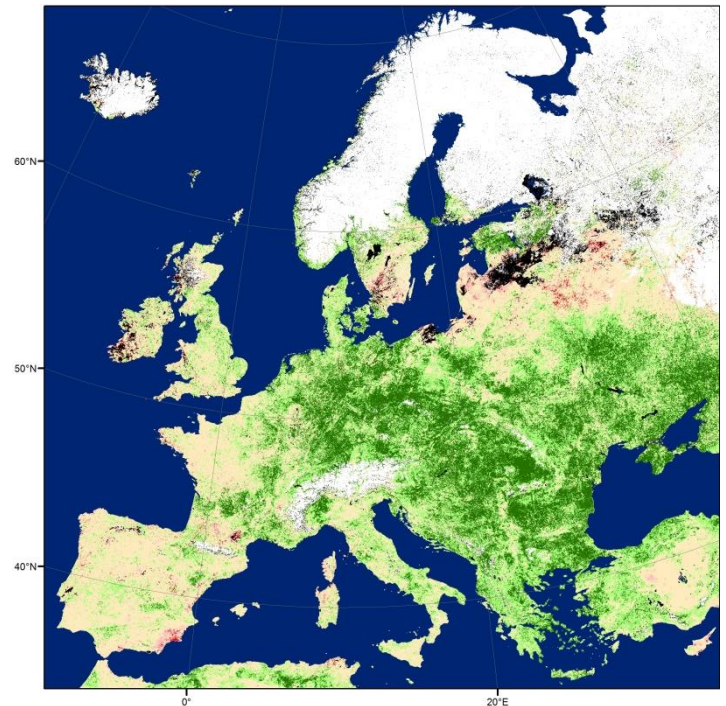


Figure 4: Vegetation greenness anomalies in the last week of March 2014. Significantly higher vegetation greenness values (dark green) occur over major parts of Europe without snow cover (white), while significant smaller values (dark red) occur just in few places.

Flowering date anomalies observed on the field

In Belgium, from January to May, it is usually very rare to observe yarrow (*Achillea millefolium*) and wild carrot (*Daucus carota*) blooming. But, in 2014, the flowers of these plants have been consistently seen during each of those months.

Caterpillars of some species need specific plants to feed. Hence, their emergence has to be synchronized with the development of the plant species. The caterpillar of Violet Copper (*Lycaena helle*) feeds only on the bistort (*Persicaria bistorta*). In 2013, a year with very cold weather, the first Violet Copper was seen on the first week of May in Belgium, almost two weeks after their usual coming up. In 2014, the first individuals were observed around April the 10th, two weeks before usual. These observations show that this species is very well adapted. Indeed, the shift in the butterfly phenology seems to align with the vegetation phenology data derived from remote sensing: a late start of the growing season in 2013 and an early start in 2014.

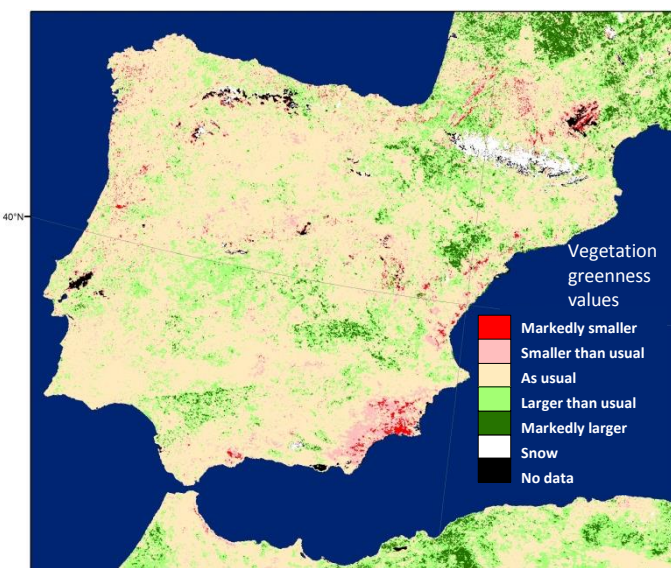


Figure 6: South-East of Spain had significantly lower values of vegetation greenness (dark red) in March 2014 which is linked to a lack of precipitation in the previous months.

Succession of two opposite extremes in 2013 and 2014

Early 2013 and early 2014 were both exceptional in terms of weather conditions, presenting opposite patterns of temperature anomalies (Figure 7).

Winter and spring 2013 were exceptionally cold leading to significantly larger snow cover than usual over the northern half of Europe (Figure 8) and to a delay in vegetation phenology (Figure 9). On the other hand, large amounts of precipitations in Pannonian and Mediterranean biogeographic regions led to higher vegetation greenness values (Figure 9).

Winter and spring 2014 were remarkably hot (Figure 7) and some areas got large precipitation rates leading to short snow cover (Figure 8) and advances in vegetation phenology (Figure 9).

A difference of more than 3.2 millions of square kilometres has been observed between the snow cover extents at the ends of March 2013 and 2014. This remarkable difference represents more than ten times the surface of Poland (Figure 8).

The exceptional weather conditions of early 2013 were associated with a negative phase of the North Atlantic Oscillation, whereas the weather conditions of early 2014 were due to Polar vortex over US bringing abnormal mild weather to Northern Europe.

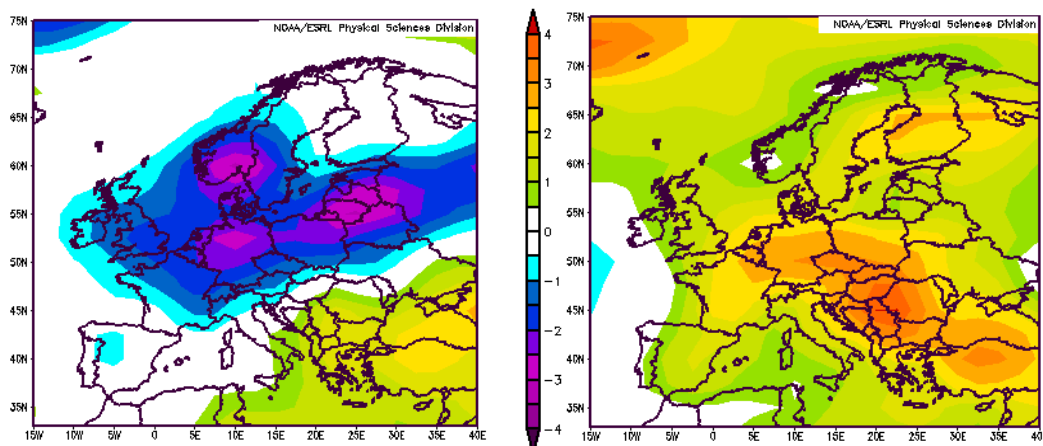


Figure 7: Temperature (K) anomalies in January to April, in 2013 (left) and in 2014 (right). The temperatures of these two periods were exceptional and showed very different patterns.

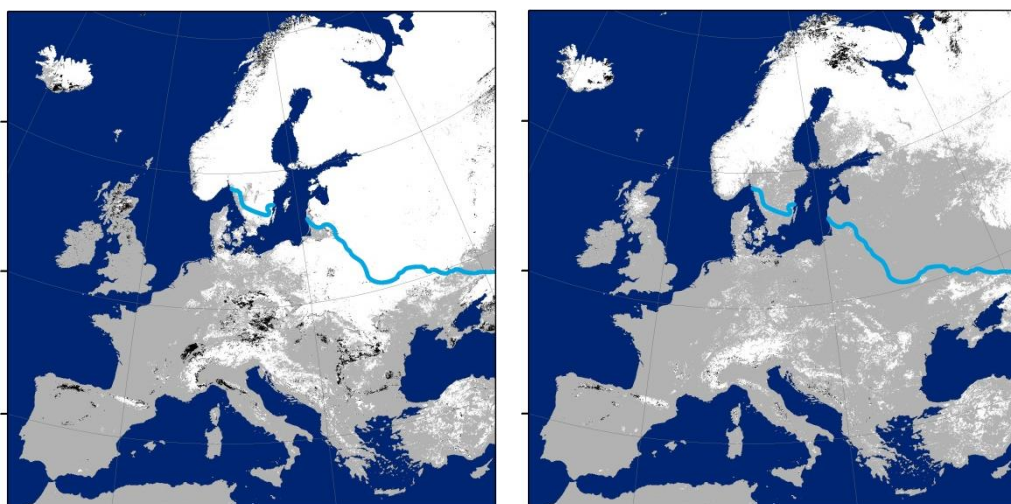
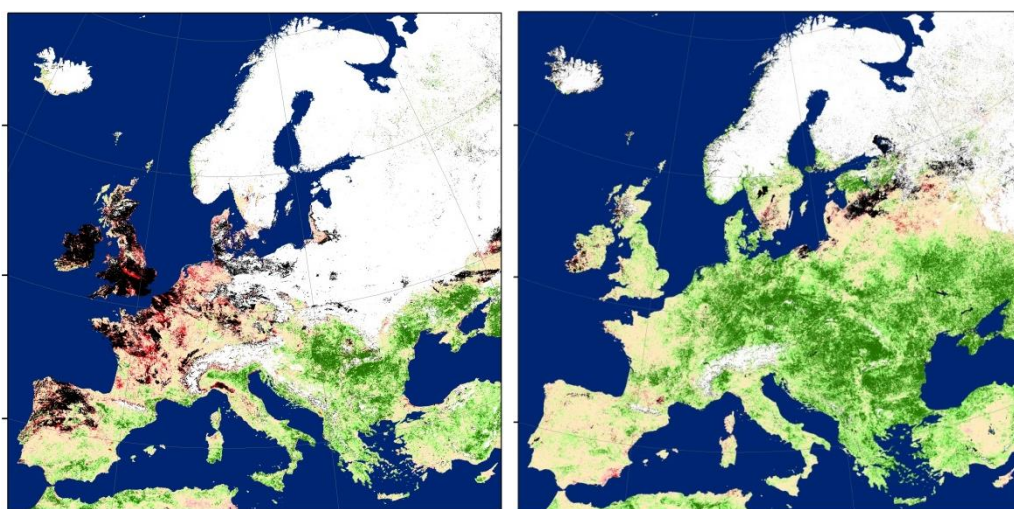


Figure 8: Snow cover (white) at the end of March 2013 (left) and 2014 (right), the blue line represents the usual snow front at this period. There is a difference of snow cover of more than 3.2 million km² between both periods. Grey represents the land without snow and black the absence of data.



Vegetation greenness values anomalies
 Markedly smaller, Smaller than usual, As usual, Larger than usual, Markedly larger, Snow, No data

Figure 9: Vegetation greenness anomalies in last week of March 2013 (left) and 2014 (right). In 2013, significantly smaller values (95% confidence) mainly occurred in UK, France, BENELUX, and Germany, whereas in 2014, higher values occurred all over Europe.

This second bulletin of the LifeWatch-WB project summarizes two land surface dynamics during the first half of the year 2014 in Europe: the snow and the vegetation phenology. All these information can be viewed from the web portal www.uclouvain.be/lifewatch (Figure 10) where a point based extraction tool is also provided with a Creative Common licence. At the end of the year, all layers will be available for download.

All data are regularly updated. Follow us on Twitter to get the latest news @LifeWatch_WB. For comments, suggestions or unusual data request, you can contact us at lifewatch@uclouvain.be

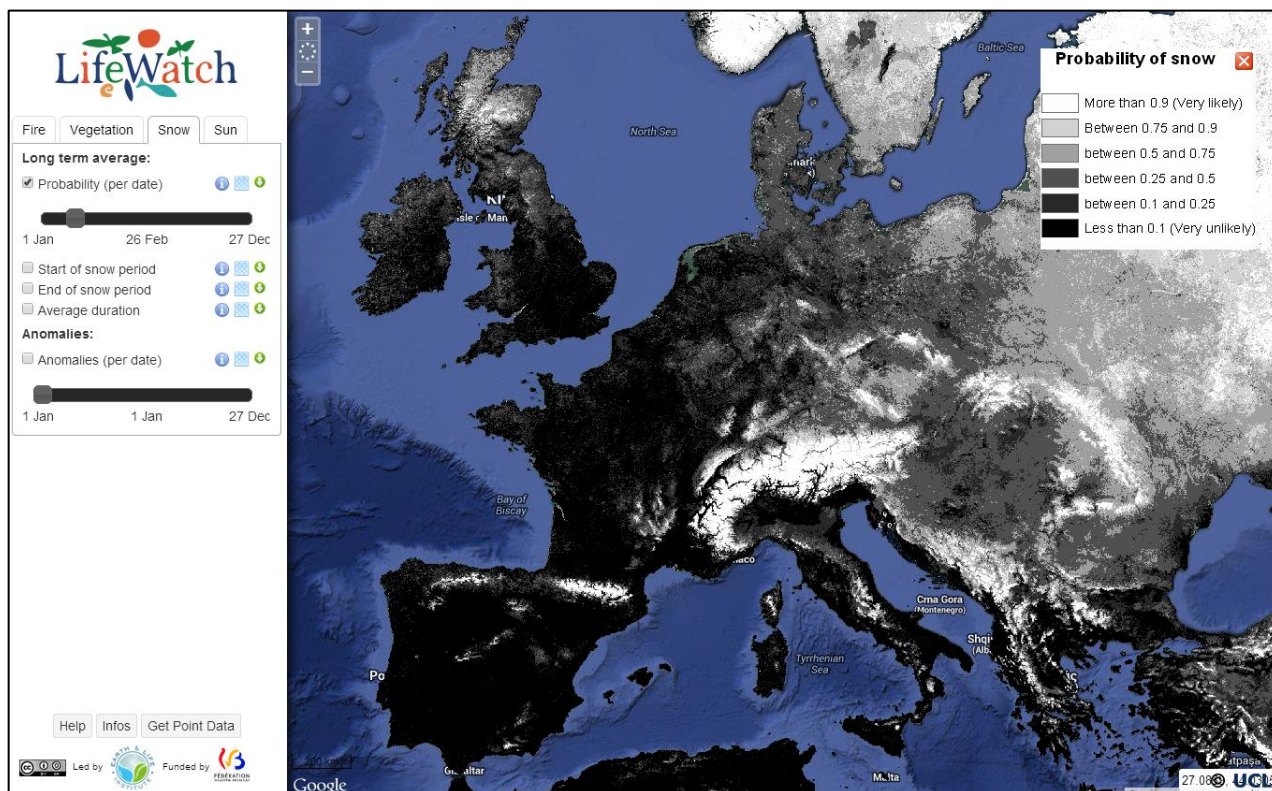


Figure 10: View of the different options and different layers available on the web portal with a focus on snow layers.

LifeWatch Wallonia-Brussels is one of the Belgian contributions to the European Research Infrastructure Consortium for Biodiversity and Ecosystem research (LifeWatch). It is funded by the Fédération Wallonie-Bruxelles. Information about the other Belgian contributions to Lifewatch can be found on www.lifewatch.be.

LifeWatch is a new European infrastructure in development. It is one of the most ambitious European initiatives for the study of biodiversity and ecosystems. LifeWatch is not a research project, but an infrastructure that offers services and tools to the scientific community, the policy makers and the public. In addition, LifeWatch will provide opportunities to construct personalized 'virtual labs', also allowing entering new data and analytical tools. More information about LifeWatch can be found on: www.lifewatch.eu

Methods: the summarized land surface dynamics are developed from remote sensing time series of daily observations by satellites. Satellite images allow the observation of some ecosystem variables with a high temporal frequency. Statistics of these variables have been derived from time series of different remote sensing products. This bulletin focused on snow cover, vegetation phenology. The complete time series derived from MODIS and SPOT VEGETATION projects have been used: MOD10A2 was used for the snow cover (Hall *et al.*, 2002, Remote Sens. Environ.), and the vegetation phenology was derived from SPOT VEGETATION NDVI images (Verhegghen *et al.*, 2014, Int. J. Remote Sens.). The input datasets were filtered and summarized in order to provide reliable statistics.