The land surface dynamics in 2013 were marked by some extreme events:

- Unusually long snow cover period during spring (up to one month longer in some countries)
- Delayed vegetation phenology (up to three weeks)
- Mild temperatures at the end of the year that reduced snow cover and extended vegetation greenness

These events affected animal life cycles.

ONE MONTH LONGER OF SNOW COVER IN SPRING 2013

The highlight of the year 2013 was the exceptional snow cover in March and April over large parts of Europe, as shown on Figure 1. The snow cover duration in Poland was one month longer than usual. Exceptional snow is defined on the basis of snow occurrence probability lower than 0,1. Probabilities of snow cover were computed from satellite images dataset (2000 to 2012) at 500 m spatial resolution.

This exceptional presence of snow was the observable consequence of a climatic anomaly. Indeed, high atmospheric pressure in the North blocked the milder Atlantic air, leading thereby to very low temperatures. March 2013 was the second coldest March in the UK since 1910 and among the 6 coldest March since 1881 in Germany (Figure 2). On the other hand, in late April and early May, absences of snow have been highlighted over Finland and Republic of Karelia (Russia), where snow occurrence probability is larger than 0,9 at that period (Figure 3).

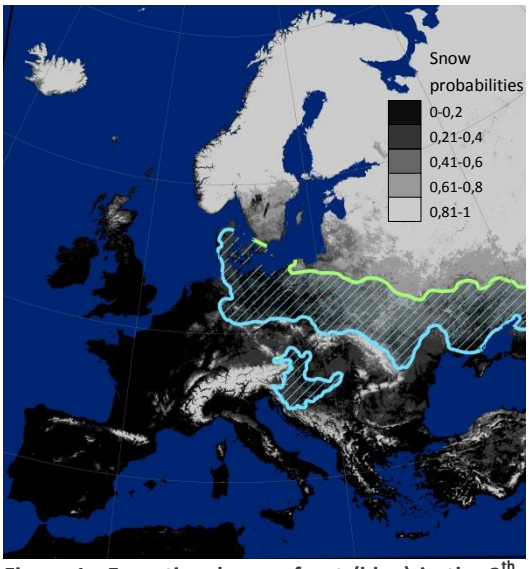


Figure 1 : Exceptional snow front (blue) in the 3th weeks of March compared with the usual snow front (green). The different grey levels represent the probability of snow cover at this period.

Impacts of the unusual spring conditions on bird movements

The significant presence of snow over large parts of Europe in spring 2013 had severe effects on living beings. Unusual movements of birds have been observed. The snow covering large part of Germany and Poland is responsible for observations of huge flocks of skylarks (*Alauda arvensis,* Figure 4) and northern lapwings (*Vanellus vanellus*) in Belgium and the Netherlands. In March 2013, eight times more skylarks and seventy times more lapwings were seen migrating in these countries (www.waarneming.nl & www.observations.be).

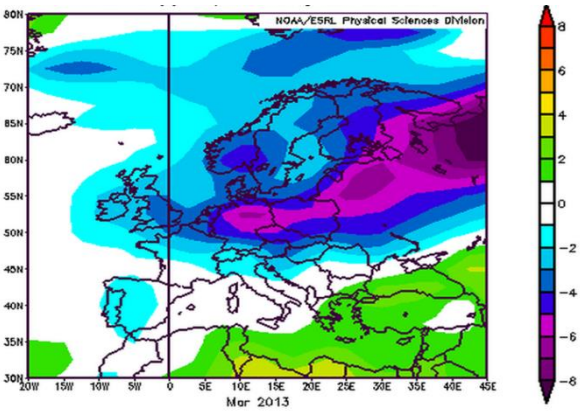


Figure 2: Surface air temperature composite anomalies for March 2013 compared to data of 1981 to 2010 over Europe, Figure from www.esrl.noaa.gov.

Figure 3: Exceptional snow absence (red) in the end of April 2013 compared with the usual snow front (green). The different grey levels represent the probability of snow cover at this period.

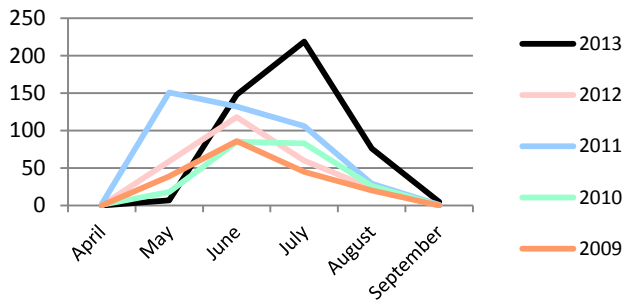
Figure 4: Eurasian skylark (*Alauda arvensis*) in the snow don't have access to their usual food, Belgium, March 2013 (©Marc Fasol).

VEGETATION PHENOLOGY DELAYED IN SPRING

The cold weather of the spring led to a noticeable delay of the vegetation phenology over large parts of Europe (mainly in the UK, France, BENELUX, Germany and Central Europe). This delayed vegetation start was highlighted by lower vegetation greenness (based on Normalized Difference Vegetation Index, NDVI) than the previous years (1999 to 2012) at the same period (Figure 5). In May, this delay was almost caught up except in Central Europe (Figure 6). Between January and May, unusually high precipitations occurred. This could explain the higher vegetation greenness index observed in Spain, Italy and Balkans (Figure 5 and 6) since precipitations drive the vegetation phenology in Mediterranean region. Finally, earlier than usual greenness was noticed in Finland and Karelia (Figure 6) as a result of the early snow melt in April (Figure 3).

Data from fruit trees illustrate the greenness delay (Figure 7). The grapevine flowering in Herault (south of France) occurred on June 10th while the last decade, the flowering occurred between the 17 and the 27 of May; In Belgium, the peak of common bluebell (*Hyacinthoides non-scripta*) observations occurred in May instead of April. Animals had to adapt to this late start of the vegetation period. In Belgium, butterflies appeared more than two weeks later than the average of the 4 previous years (Graph 1).

Graph 1: Temporal distribution of the butterfly *Boloria selene* observations for the 5 last years in Belgium (www.observations.be)



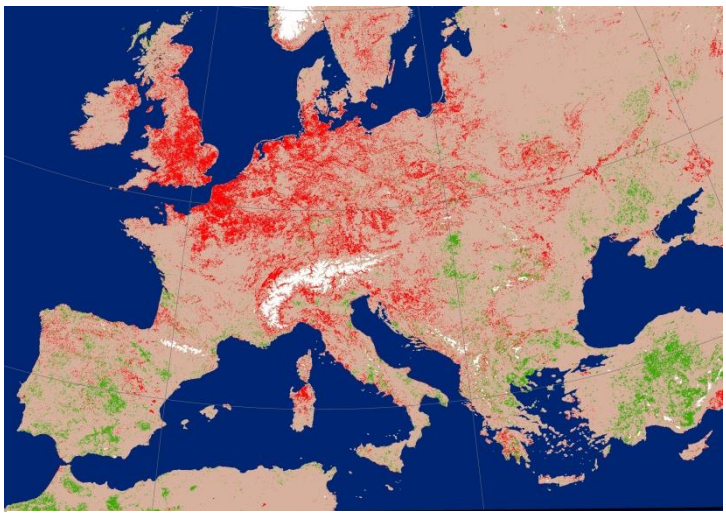


Figure 5: Vegetation greenness anomalies in the first week of April. Significant smaller values (red) mainly occur in UK, France, BENELUX, Germany and Central Europe. In some Mediterranean areas, vegetation greenness appeared significantly higher than usual (green). Snow cover is in white.

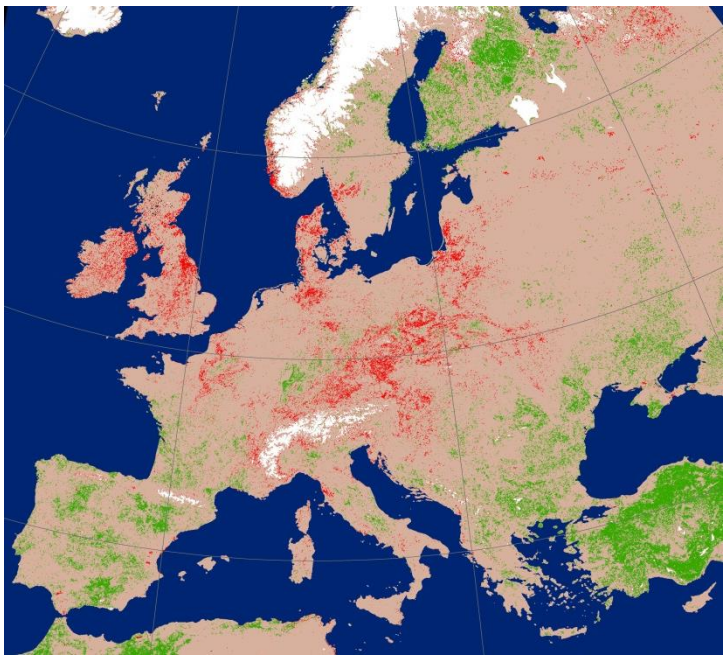


Figure 6: Vegetation greenness anomalies in the first week of May. The significant delay (red) decreased compared to April (Figure 5). Vegetation greenness appeared significantly higher than usual in Turkey and Karelia. Snow cover is in white.

Figure 7: Differences of phenology between 2012 (left) and 2013 (right) on April 5th. In 2013, the cherry tree had no flowers compared to 2012, France (© Kristan Cuny).

MILD WINTER TEMPERATURES AFFECT SNOW AND VEGETATION GREENNESS

At the end of 2013, the European weather was marked by unusually high temperatures. Scandinavia was particularly affected: the temperatures of Norway and Finland reached 4 to 5° C above the normal. Similarly, the temperatures in the United-Kingdom, Belgium, Poland and other countries of central Europe reached 2 to 3° C above the normal. On the other hand, Mediterranean countries had normal weather conditions.

Together with these high temperatures, the snow was exceptionally absent in Eastern Europe and Balkans countries (Figure 8). Moreover, large lakes did not freeze, such as the lake Ladoga near Saint Petersburg (Figure 9). This also explains the unusual greenness that has been observed across Europe in autumn and winter (Figure 10).

The weather anomalies had substantial impacts on living beings. The number of common cranes (*Grus grus*) observed in Lake Der-Chantecoq (France) in December was markedly higher (44 000) than previous records available since 1999 (LPO Champagnes-Ardennes). Usually, they migrate in the South-West of France or in Spain at this period.

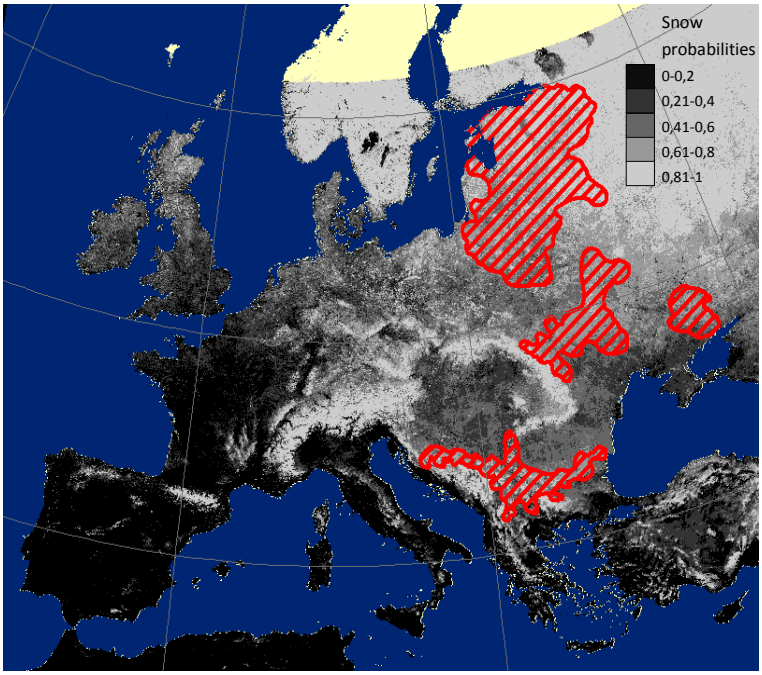


Figure 8: Exceptional snow absence (red) in the end of December 2013, Eastern Europe and Balkans were the most affected. The different grey levels represent the probability of snow cover at this period and the yellow represents area with no data.

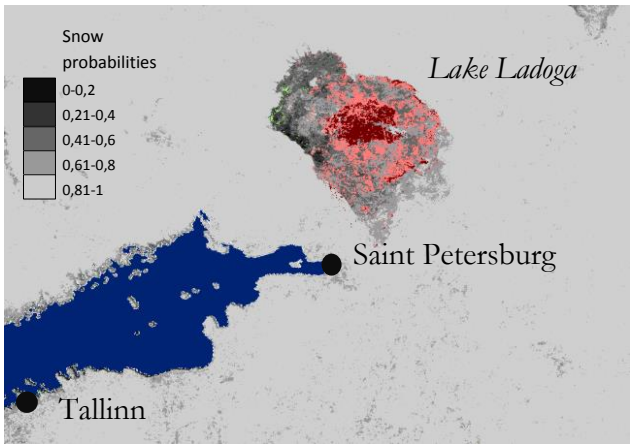


Figure 9: The center of the Lake Lagoda (Russia) was not frozen in mid-January 2014 (dark red). The 12 previous years, ice had always been detected. The different grey levels represent the probability of snow cover at this period.

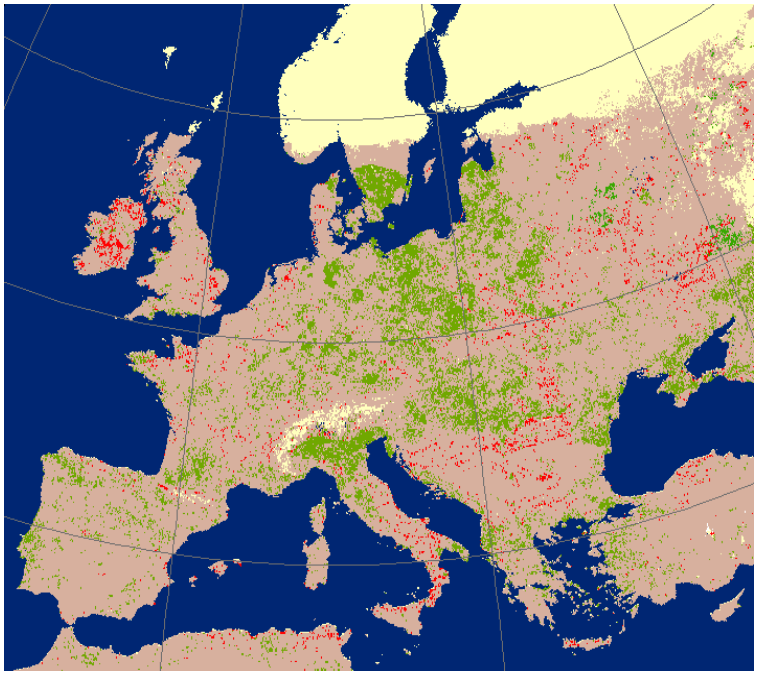


Figure 10: Unusually high vegetation greenness values (green) in autumn persisted from the end of 2013 until start of 2014. Small patches also showed significantly smaller vegetation greenness values (red), No data partially due to snow is in yellow. The first week of December is illustrated here.

USUAL FIRES OCCURRENCES

There were no unusual fire events in 2013. Fires occurred in the same regions and with the same range of extent as the observed fires over the last 13 years (Figure 11). Most of the fires were detected in Ukraine and in the South of Russia where fields are often burnt after harvest. Fires also occurred in the Mediterranean countries and in the Russian taiga, but within their usual extent.

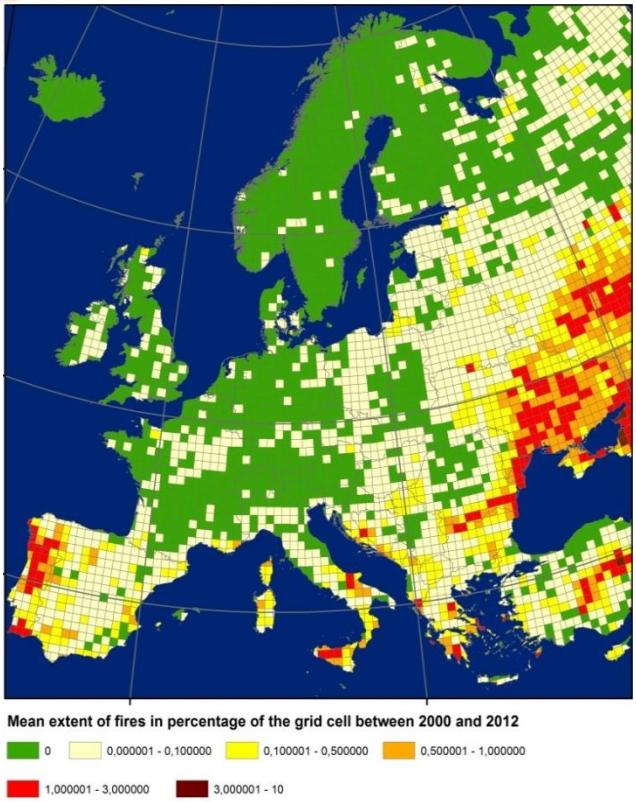


Figure 11: Mean extent of fires from processing 13 years of fires extent product 2000 to 2012. Mediterranean regions and Eastern Europe are the most affected.

This first bulletin of the LifeWatch-WB project summarizes three land surface dynamics during the year 2013 in Europe: the snow, the vegetation phenology and the fires extent. All these information can be **downloaded freely** from the web portal www.uclouvain.be/lifewatch. This data is regularly updated. Follow us on Twitter to get the latest news @LifeWatch_WB

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For comments or suggestions, you can contact us at lifewatch@uclouvain.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 presented land surface dynamics are developed from remote sensing time series of daily observations by satellites. Satellite images allow observing some ecosystem variables, and statistics of these variables have been derived from time series of different remote sensing products. This bulletin focused on snow cover, vegetation phenology and fires occurrence. 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.), MCD64A1 for fires (Giglio *et al.*, Remote Sens. Environ., 2009) 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.

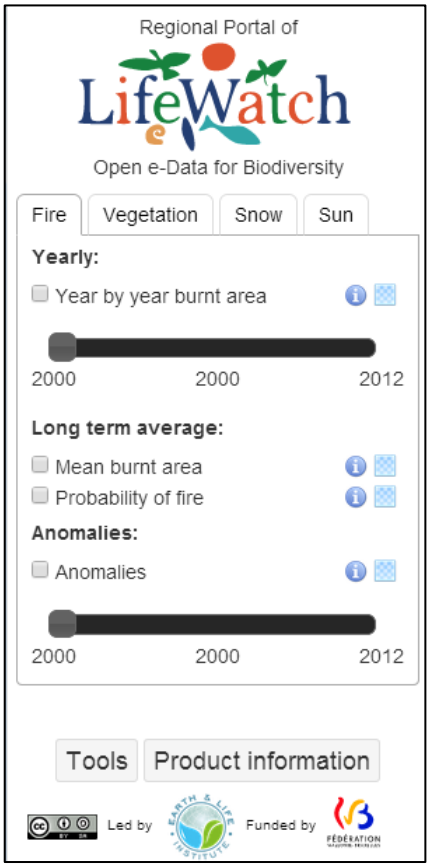

Figure 12: different options of visualisation of land surface dynamics available on the web portal.