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13. Atmospheric predictability, phenology and seasonality

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13. Atmospheric predictability, phenology and seasonality

Michael Sprenger & Tobias Grimbacher, This Rutishauser, Martine Rebetez

Swiss Meteorological Society,
Swiss Commission for Phenology and Seasonality

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13.1

Seasonal observations with automated camera (PhenoCam)

Markus Eugster[1], Dr. Werner Eugster[2], Simon Eugster[3], Iris Huber[2]

[1]Sekundarschule, Schoentalstrasse 2, 9244 Niederuzwil (markus.eugster@schule-uzwil.ch)
[2]ETH Zurich, Institute of Agricultural Sciences, LFW C56, Universitaetsstrasse 2, 8092 Zurich,
(werner.eugster@usys.ethz.ch / huberir@student.ethz.ch)
[3]ETH Zurich, Rämistrasse 101, 8092 Zurich (simon.eu@gmail.com)

Introduction

This project arose when GLOBE Switzerland collaborated with the ETH CCES@school project. I present you the result of collaboration between scientists and students. It also shows a way to connect science and education. Scientists are friendly invited to join in, use this project and give feedback.

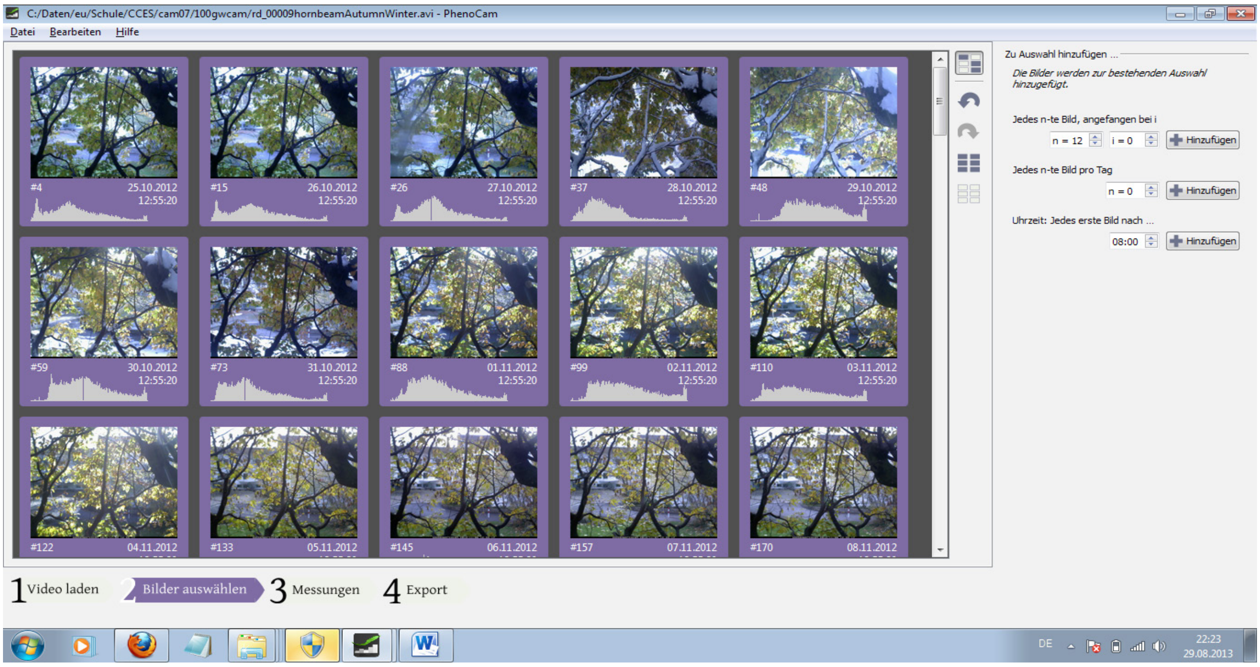
Investigation

The original aim was to detect green-up with automated cameras which delivered a film that was analyzed by an existing software for green-fraction. As the project's target group was Sek I we decided to develop a borrowable box with all the material, a powerful and easy to use specific software and to use a modular structure for the different applications. As there is no official colour model for phenological phases we decided to choose among existing colour models and propose an interesting solution: the HSV colour model.

Solution

Short overview of what will be presented in detail:

1. Film: (Figure 1) Load all the pictures into a computer and choose the appropriate ones which are converted into a time lapse clip.



Zu Auswahl hinzufügen ...

Die Bilder werden zur bestehenden Auswahl hinzugefügt.

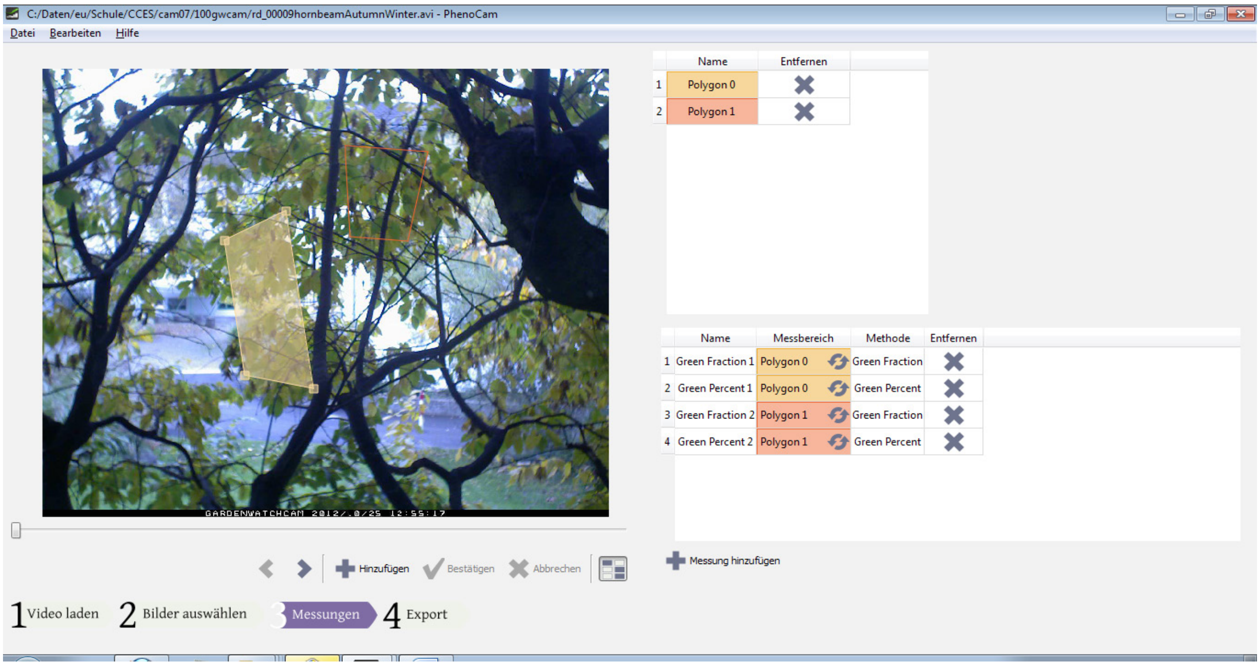
Jedes n-te Bild, angefangen bei i
n = 12 i = 0 Hinzufügen

Jedes n-te Bild pro Tag
n = 0 Hinzufügen

Uhrzeit: Jedes erste Bild nach ...
08:00 Hinzufügen

Figure 1: overview of the selected pictures

2. Analysis: (Figure 2) Define the area(s) and the method the colour analysis is conducted with.



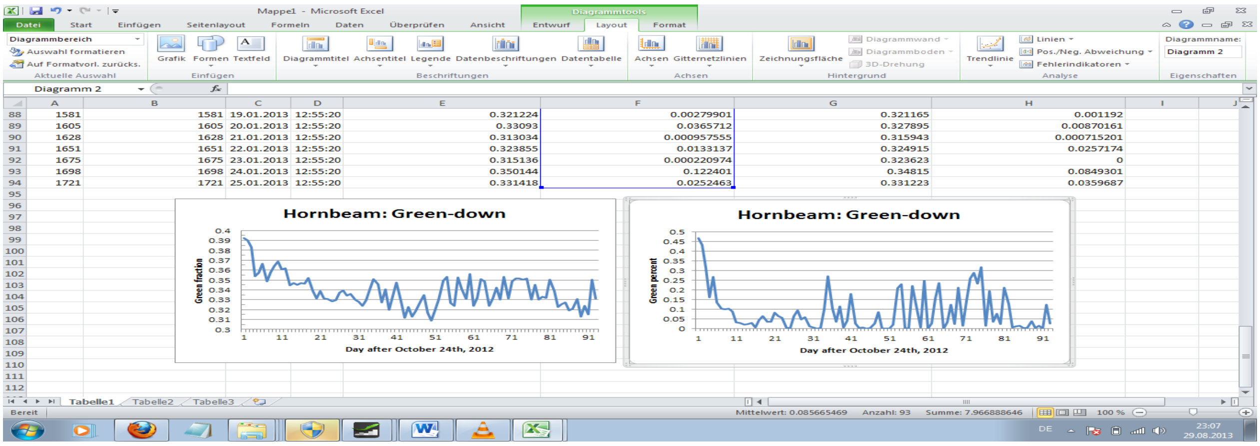
	Name	Entfernen
1	Polygon 0	✖
2	Polygon 1	✖

	Name	Messbereich	Methode	Entfernen
1	Green Fraction 1	Polygon 0	Green Fraction	✖
2	Green Percent 1	Polygon 0	Green Percent	✖
3	Green Fraction 2	Polygon 1	Green Fraction	✖
4	Green Percent 2	Polygon 1	Green Percent	✖

Figure 2: Definition of the areas to analyze and the methods

3. Export: Export the colour analysis results into tables.

4. Results: (Figure 3) Convert the data into graphics. Interpret the graphics.



	A	B	C	D	E	F	G	H
88	1581	1581	19.01.2013	12:55:20	0.321224	0.00279901	0.321165	0.001192
89	1605	1605	20.01.2013	12:55:20	0.33093	0.0365712	0.327895	0.00870161
90	1628	1628	21.01.2013	12:55:20	0.313034	0.000957555	0.315943	0.000715201
91	1651	1651	22.01.2013	12:55:20	0.323855	0.0133137	0.324915	0.0257174
92	1675	1675	23.01.2013	12:55:20	0.315136	0.000220974	0.323623	0
93	1698	1698	24.01.2013	12:55:20	0.350144	0.122401	0.34815	0.0849301
94	1721	1721	25.01.2013	12:55:20	0.331418	0.0252463	0.331223	0.0359687

Figure 3: The diagrammed data of Polygon 0, analyzed with two different methods, shows the decreasing green in October 2012.

Practice and references

There are many possible uses for this project as for example green-up, crystallization, cloud formation, green-down, snow and ice cover, blooming period, etc.

Download of the software: http://phenocam.granjow.net/download.html
The project's web page will be: http://www.swissfluxnet.ch/phenocam

13.2

Forecast errors of Rossby waveguides

Giannakaki Paraskevi[1], Romppainen-Martius Olivia

[1]*Institute of Geography, Oeschger Center for Climate Change Reasearch, University of Bern, Hallerstrasse 12, 3012 Bern (paraskevi.giannakaki@giub.unibe.ch)*

The significance of upper level Rossby wave trains (RWTs) for weather forecasting has long been recognised. More recently Langland et al. (2002) found that RWTs originating over Western Pacific may play an important role for the middle and long range predictability of high impact weather events over North America and beyond. Dirren et al. (2003) analysed forecast errors from a PV perspective and they found that errors are concentrated along the waveguide of RWTs due to amplitude or phase errors of RWTs. However, our knowledge of the factors limiting the predictability of RWTs and the forecast skill of numerical weather prediction systems with respect to RWTs is still limited.

Our research is focused on the forecast errors of spatially localized areas of high PV gradients which act as waveguides for the RWTs (Schwierz et al. 2004). An object based spatial forecast verification tool has been developed which compares form, amplitude and location characteristics of waveguide objects in the analysis and in a forecast. As input ECMWF analysis and deterministic forecast data of ECMWF›s Integrated Forecast System (http://www.ecmwf.int/research/ifsdocs/) were used. A short climatology of forecast errors is presented for the period 01/2008-12/2010 for short and medium range forecast lead times (1day-10days). These climatology is used to derive error statistics as a function of season and location and to identify time periods where large errors occur.

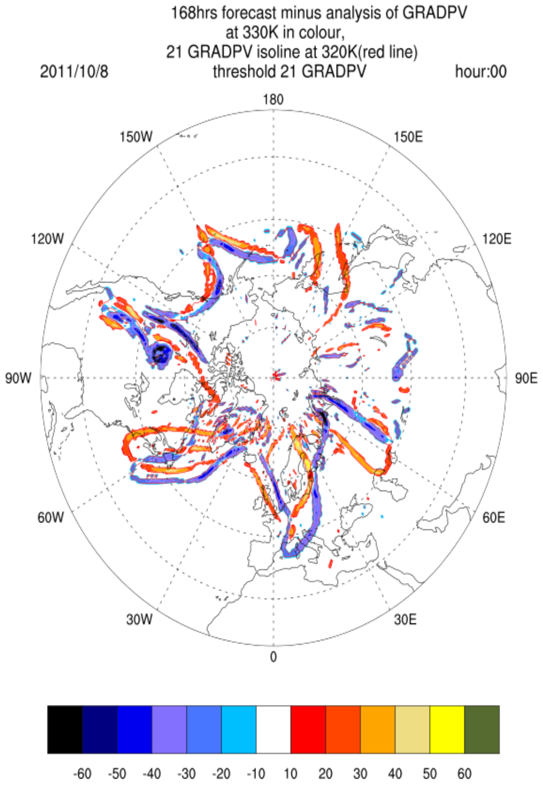


Figure 1. (08/10/2011,00UTC) 7days Forecast minus analysis of GRAD(PV) @ 330K in colour using a threshold of 18 pvu/1000km.

REFERENCES

Dirren, S., M. Didone, & H.C.Davies, 2003: Diagnosis of forecast-analysis differences of a weather prediction system. Geophys. Res. Let. 30 (20),2060.

Langland, R., M. Shapiro, & R.Gelaro, 2002: Initial condition sensitivity and error growth in forecasts of the 25 January 2000 East Coast snowstorm. Monthly Weather Review, 130, 957-974.

Schwierz, C., S.Dirren, and H.C.Davies. 2004: Forced waves on a zonally aligned jet stream. J. Atmos Sci.,61,73-87.

13.3

Forecast uncertainty for the midlatitude flow

Christian M. Grams[1]

[1]*Institute for Atmospheric and Climate Science, ETH Zürich, Universitätstrasse 16, 8092 Zürich, Switzerland (christian.grams@env.ethz.ch)*

The large-scale midlatitude flow is dominated by a strong horizontal temperature gradient that serves as the midlatitude wave guide and results in the upper-level midlatitude jet. Deflections of the midlatitude wave guide, so-called Rossby waves, trigger synoptic-scale weather systems, i.e. extratropical cyclones or anticyclones, which in turn are responsible for local surface weather. Despite the overall progress in numerical weather forecasting periods with poor forecast skill for the large-scale midlatitude flow still occur and the correct prediction of individual weather systems, their track, structure, intensity, and associated (high impact) weather remains a challenge for general circulation models. In this presentation forecast uncertainty for the midlatitude flow is discussed by elucidating interactions on various temporal and spatial scales based on examples from current research.

First, basic concepts for quantifying the forecast error of the large-scale midlatitude flow are introduced. A recent example of an Alpine flooding event reveals caveats of this approach and how also relatively small error in the representation of the Rossby wave pattern lead to significant forecast error of local surface weather. Then the interaction of tropical cyclones with the midlatitude flow during extratropical transition serves as an illustrative example on how individual weather systems can modify the upper-level flow. It is shown that during extratropical transition rapidly ascending air streams, so-called warm conveyor belts, are able to modify or trigger upper-level Rossby waves so that a Rossby wave train may emerge that significantly alters the weather in downstream regions. This interaction crucially depends upon the phasing of the tropical cyclone and the midlatitude flow which is an important source for forecast uncertainty. Finally extratropical cyclones linked to high impact weather and their forecast error in the deterministic ECMWF model is investigated based on a two-year climatology. The outlook emphasises the need for a better understanding of the basic physical and dynamical processes that govern the interactions on the various scales associated with the midlatitude flow.

13.4

Rapid phenological responses to arctic climate change across trophic levels

Høye, T.[1]

[1]*Arctic Research Centre and Department of Bioscience, Aarhus University, Denmark (toh@dmu.dk)*

Advancing phenology in response to global warming has been reported across biomes raising concerns about the temporal uncoupling of trophic interactions. Phenological responses in the Arctic have been shown to outpace responses from lower latitudes and recent studies suggest that differences between such responses for e.g. plants and their flower visitors could be particularly pronounced in the Arctic. The evidence for phenological uncoupling is scant because relevant data sets are lacking or not available at a relevant spatial scale. One notable exception is the long-term monitoring program at Zackenberg in North-east Greenland, where detailed phenological observations have been carried out since 1996. North-east Greenland has experienced a dramatic rise in temperatures in the past two decades. In this talk, I present evidence of rapid phenological changes to recent dramatic warming at Zackenberg across plants, arthropods and birds. Our results demonstrate important landscape scale spatial variation in phenological responses. As an example, we found a climate-associated shortening of the flowering season and a concomitant decline in flower visitor abundance. The shortening of the flowering season arose through spatial variation in phenological responses to warming. Our results demonstrate that the dramatic climatic changes currently taking place in the Arctic are strongly affecting individual species and ecological communities, with implications for trophic interactions.

13.5

Snow cover from satellite data: valuable information for phenological investigations

Hüsler Fabia[1,2], Jonas Tobias[3], Wunderle Stefan[1,2]

[1] *Geografisches Institut der Universität Bern, Hallerstrasse 12, CH-3012 Bern (fabia.huesler@giub.unibe.ch)*
[2] *Oeschger Center for Climate Research, Universität Bern, Zähringerstrasse 25, CH-3012 Bern*
[3] *WSL Institute for Snow and Avalanche Research SLF, Flüelastrasse 11, CH-7260 Davos Dorf*

Alpine plants may be very sensitive indicators of ecosystem response patterns to climatic changes. Therefore, they are considered to be particularly suitable for studies of a variety of phenomena on relatively small spatial scales as the complex topography results in highly variable climatic zones on short horizontal and vertical distances. Particularly in these regions snow cover duration is an important factor, which determines the timing of the flowering and limits the growing season length of plants. Hence, it is of great interest to consider knowledge of snow onset, snow duration as well as snow melt-out information in phenological investigations. Complementary to pointwise station data, snow cover parameters derived from optical satellite imagery offer an attractive option to gain comprehensive information even in complex terrain and remote areas.

The University of Bern receives and archives daily full resolution (1.1 km) satellite data over Europe acquired by the Advanced Very High Resolution Radiometer (AVHRR) since 1984. This historical dataset offers a unique source of information for understanding long-term changes and interannual variability in alpine snow cover extent and duration. Hence, we present the first comprehensive space-borne 1-km snow extent climatology for the Alpine region for the period 1985-2011 and demonstrate the potential of such data to be used in phenological applications. Parameters such as snow cover area percentage, snow onset day, snow cover duration, and melt-out date were calculated and employed to analyze the spatio-temporal variability and interannual differences in the seasonality of snow cover over the course of the last three decades. The dataset will be made available for research purposes upon request.

REFERENCES

Hüsler, F., Jonas, T., Riffler, M., Musial, J. P., and Wunderle, S.: A satellite-based snow cover climatology (1985–2011) for the European Alps derived from AVHRR data, The Cryosphere Discuss., 7, 3001-3042, doi:10.5194/tcd-7-3001-2013, 2013.

13.6

Improvement of a windgust parametrization with an application using the Canadian Regional Climate Model over Switzerland

Kuszli Charles-Antoine; Goyette Stéphane ; Martin Beniston

Université de Genève

Severe winds recorded during a number of winter storms are simulated over the period 1990 to 2011 with the Canadian Regional Climate Model (CRCM) at a high spatial resolution. Flow fields are first downscaled from NCEP-NCAR reanalyses and then down to 2-km grid spacing in the horizontal through a self-nesting technique. During this last step, different windgust schemes of different complexities were tested and their performances compared one to each other and to observations from MeteoSwiss national network. Simple schemes reproduced the surface observations in an overall realistic manner but differences are noticed in the hourly maximum values. In order to improve one of the simple schemes, an empirically fixed parameter in the formulation is now allowed to vary in the horizontal where values have been calibrated using the MeteoSwiss stations hourly wind maximum. Then, these unequally-spaced values are interpolated onto the model surface computational grid. The CRCM using this modified scheme is applied on the 2-km grid in order to qualify and quantify the changes of the hourly gust values. The improvements are noticeable where hourly differences between observed and simulated values are reduced at several stations. This modified simple gust scheme would be useful in numerical weather prediction modelling where an application is envisaged in the near future.

13.7

The interannual variability of Foehn - Linking the long Foehn timeseries at Altdorf with the 20th Century Reanalysis

Sprenger M, Meyer D., Piaget N.

ETH Zurich

A long time series (1864-2010) of Foehn for Altdorf shows a pronounced interannual variability. In this study, the variability is analysed based on the twentieth century reanalysis dataset (20CR). The aim of the study is to see whether the Foehn variability is related to corresponding weather type variations in 20CR.

In a first approach, the Weusthoff classification, with 18 different classes, is used. For the whole 20CR period (1871-2010) the weather type is determined, and monthly probabilities P(weather type) are calculated. Conditional probabilities P(foehn|weather type) are established based on a training period from 1980-2010. Then, the 20CR data are used to reconstruct a model-based Foehn timeseries, which is compared to the observed one. It turns out that the two timeseries do not strongly correlate, i.e. that the interannual Foehn variability cannot be explained based on the Weusthoff weather classification.

The same methodology is repeated with a second weather classification which is specifically constructed based on relevant Foehn characteristics. The parameters extracted from the 20CR are: pressure difference across the Alps, wind speed and direction at 700 hPa and wind at 500 hPa. Weather types are defined based on the typical values during Foehn. The outcome justifies the special choice of a Foehn-related classification: The correlation between reconstructed and observed timeseries improves, although it still is not able to explain the strong interannnual variability.

Based on the partly negative outcome of the reconstruction, the possible reasons for disagreement are discussed and further, more refined methodologies are presented.

13.8

Seasonality of freezing resistance in temperate trees

Yann Vitasse, Armando Lenz, Günter Hoch, Christian Körner

Institute of Botany, University of Basel, 4056 Basel, Switzerland.
[1]*Corresponding author. Yann Vitasse. Tel. +41 (0)61 267 35 06, Fax: ++41 (0)61 267 29 80, e-mail: yann.vitasse@unibas.ch*

Trees have evolved to optimize their phenology against the risk of freezing injuries in autumn, winter and early spring. Here we aim to give new insights about the relationship between phenology of various tree species, species-specific freezing resistance and the risk that trees encounter freezing damage in the Swiss Alps.

Specifically, we showed that (i) the level of freezing resistance of buds in winter during dormancy strongly depends on preceding temperatures, so that a cold spell in winter can substantially harden tree buds; (ii) the most critical period for temperate trees occurs during flushing in spring when the freezing resistance reaches the lowest value; (iii) the timing of leaf-out converges towards a similar risk of freeze damage within species among different sites and among species within a same site; (iv) young trees exhibit similar freezing resistance as adult trees during flushing, but are more prone to undergo freeze damage due to their earlier spring phenology.

13.9

Quantifying the uncertainty of spatial precipitation analyses with observation ensembles

Vogel Raphaela[1], Erdin Rebekka[1], Frei Christoph[1]

[1] *Federal Office of Meteorology and Climatology MeteoSwiss, Krähbühlstrasse 58, CH-8044 Zürich (raphaela.vogel@meteoswiss.ch)*

It has become popular to call for precipitation analyses at higher and higher spatial resolution. Finer grid spacing may satisfy these requests from a purely technical viewpoint, but the scales effectively resolved in such "high-resolution" analyses are constrained by the resolution and accuracy of the underlying observations. As a result, there are large uncertainties, which may be relevant for the outcome of an application. However, there is little quantitative information about these uncertainties. We propose to frame knowledge about spatial precipitation distributions by ensembles of fields, randomly generated, but conditioned on measurements. They shall quantify uncertainties due to limited observation density. In this study, we develop an ensemble approach for a radar rain-gauge combination over Switzerland and present results of km-scale, daily precipitation ensembles for several cases.

The ensemble simulation is based on the stochastic concept of random Gaussian fields with a spatially varying mean and a second order stationary covariance. The concept is identical to that for kriging rain-gauge observations using radar as external drift. Our implementation involves a case dependent data transformation to better comply with the Gaussian model and the stationarity assumption. Uncertainty estimates obtained with this stochastic concept turned out to be reasonably reliable (in a statistical sense) as was verified by cross-validation. Our applications suggest that there can be considerable residual uncertainty in km-scale precipitation patterns, even when radar information is included. The degree of uncertainty, however, varies considerably from case to case with typically larger ensemble spread for convective cases. The ensembles bare plausible dependencies upon aggregation scale (mean over catchments of different size) and network density. Observation ensembles may be a promising alternative to "best estimate" grid datasets, especially when uncertainties are large and when it is desirable to propagate them into application models.

13.10

Observation errors in historical upper-air observations

Wartenburger Richard[1], Brönnimann Stefan[1], Stickler Alexander[1]

[1]*Oeschger Centre for Climate Change Research & Geographical Institute, University of Bern, Hallerstr. 12, CH-3012 Bern*

Upper-air observations are a fundamental data source for global atmospheric data products, but uncertainties, particularly in the early years, are not well known. Most of the early observations, which have now been digitized, are prone to a large variety of undocumented uncertainties (errors) that need to be quantified, e.g. for their assimilation in reanalysis projects. We apply a novel approach to estimate errors in upper-air temperature, geopotential height and wind observations from the Comprehensive Historical Upper-Air Network (CHUAN (Stickler et al. 2010); 1904 – 1966). We distinguish between random errors, biases, and a term that quantifies the representativity of the observations. The method is based on a comparison of neighboring observations and is hence independent of metadata, making it applicable to a wide scope of observational datasets. The estimated mean random errors for all observations within the study period are 1.5K for air temperature, 1.3hPa for pressure, 3.0ms^{-1} for wind speed and 21.4° for wind direction. The estimates are compared to results of previous studies and analyzed with respect to their spatial and temporal variability. Figure 1 shows the mean vertical error profiles.

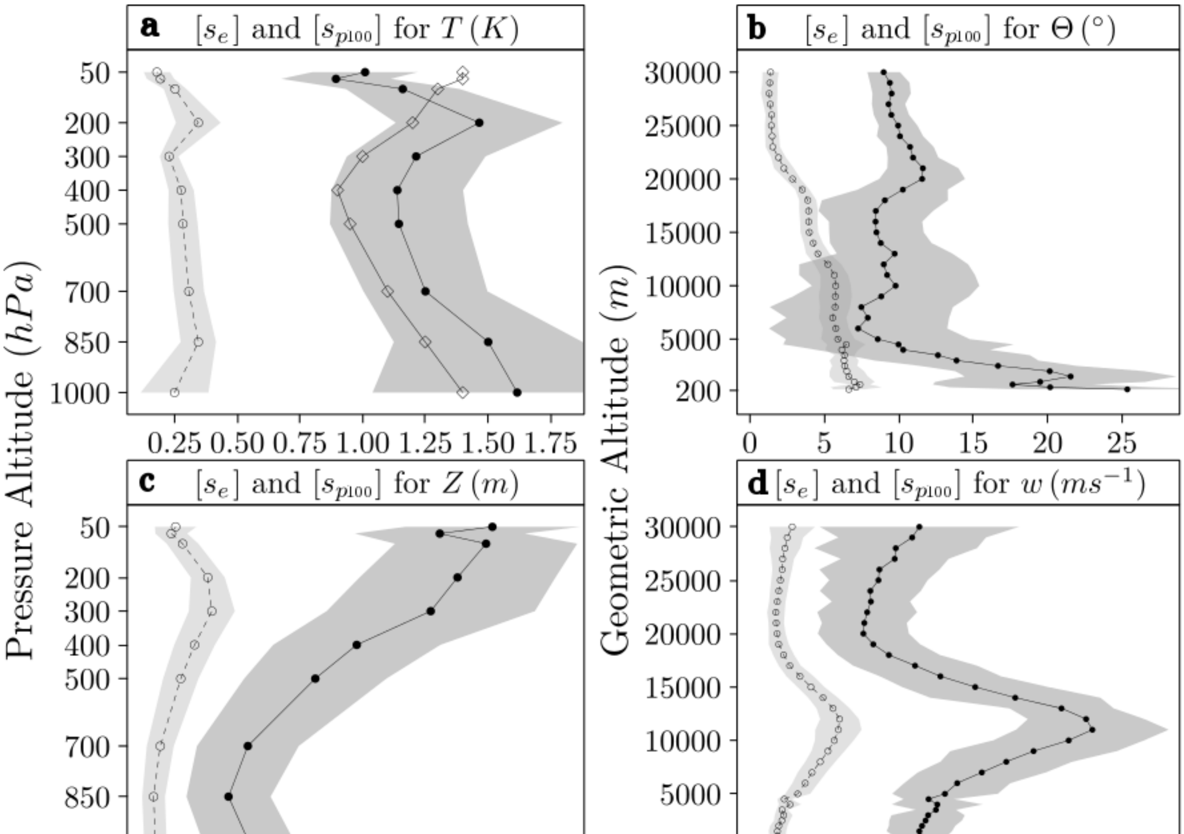


Figure 1: Profiles of estimates of mean random errors [s_e] (solid lines with filled circles) and representativity errors [s_p100] (dashed lines with open circles) for a) temperature, b) wind direction, c) geopotential height, and d) wind speed. Open diamonds correspond to observation errors assumed in the ERA-Interim reanalysis. Shaded bands indicate the standard deviations of the random errors (medium gray) and representativity errors (light gray) for all stations; their overlap is printed in dark gray. Levels with less than 30 error estimates were omitted.

REFERENCES

Stickler, A., A. Grant, T. Ewen, T. Ross, R. Vose, J. Comeaux, P. Bessemoulin, K. Jylhä, W. Adam, P. Jeannet, A. Nagurny, A. Sterin, R. Allan, G. Compo, T. Griesser, and S. Brönnimann (2010), The Comprehensive Historical Upper-Air Network, B. Am. Meteorol. Soc., 91, 741-751.

13.11

Longer, warmer, less productive: the effects of early snowmelt and warming on alpine shrub Salix herbacea

Wheeler Julia[1],[2] Wipf Sonja[1], Hoch Guenter[2], Cortes Andres[3], Sedlacek Janosch[4] & Rixen Christian[1]

[1] *WSL Institute for Snow and Avalanche Research SLF, CH-7260 Davos, Switzerland (julia.wheeler@slf.ch)*
[2] *University of Basel, Institute of Botany, CH-4056 Basel, Switzerland*
[3] *University of Uppsala, Evolutionary Biology Centre, 752 36 Uppsala, Sweden*
[4] *University of Konstanz, Department of Biology, 78457 Konstanz, Germany*

Growing seasons are beginning earlier in many alpine systems due to accelerating snowmelt. Currently, it is poorly understood whether longer growing seasons will benefit alpine shrubs. Determining species-specific responses, particularly in common and dominant species, is critical for understanding how alpine communities will alter or adapt to changing climates. We studied a wide range of fitness traits in *Salix herbacea*, a prostrate dwarf shrub, along elevational and snowmelt gradients for two seasons, in order to determine the overall response to an unmanipulated extended growing season and overall warmer temperatures.

We recorded phenology, reproductive capacity, growth and leaf damage for 480 *S. herbacea* shrubs. The shrubs were marked from 2100-2800 m asl, representing the core species range on three mountains, in two snow microhabitat types (early-exposure ridges and late snowbeds) and were monitored weekly for two seasons. Snowmelt date and soil temperatures were recorded.

From snowmelt to each phenophase (leaf open, flowering, fruiting), shrubs required fewer days to develop with later snowmelt and at lower elevations, suggesting temperature accumulation thresholds required for development. Percent stems flowering decreased with elevation and with later snowmelt, while percent stems fruiting decreased significantly with elevation but were consistent across the snowmelt gradient. Stem density, leaf area and fall wood NSCs all increased with later snowmelt. Likelihood of leaf herbivory and gall damage decreased with later snowmelt, while lower elevation shrubs were more likely to be damaged by fungi.

Although *S. herbacea* appears to allocate more energy to flower production under early snowmelt, fruit production is constant along the snowmelt gradient. Warmer temperatures at lower elevations lead to more fruit and larger leaves but this does not translate to increased local growth or competitive advantage. Increased likelihood of leaf damage during early snowmelt and at warmer temperatures could lead to long-term reductions in fitness. Longer development time to each phenophase under early snowmelt could lead to increased exposure to frost during vulnerable early development stages. Thus, we conclude an overall detrimental effect of a longer growing season and warmer temperatures for *S. herbacea*.

P 3.1

Linking long-term European mushroom productivity and phenology to climate variability

Egli Simon[1] & Büntgen Ulf[1],[2]

[1] *Swiss Federal Research Institute WSL, Birmensdorf, Switzerland (simon.egli@wsl)*
[2]*Oeschger Centre for Climate Change Research (OCCR), Bern, Switzerland (ulf.buentgen@wsl.ch)*

Fruit-body production of wild forest mushrooms fluctuates considerably from year to year, mainly due to interannual meteorological variability. Water availability and temperature during summer are recognized to be the key factors for fruit-body formation (Büntgen et al. 2012a).

New findings reveal short-term weather fluctuations to be superimposed on long-term trends of climate change. An analysis of weekly fruit-body counts of 115,417 mushroom species from permanent Swiss inventories between 1975 and 2006 exhibit an average autumnal delay of 12 days after 1991 compared with before Büntgen et al., 2013). Intra- and interannual coherency of symbiotic and saprotrophic mushroom fruiting, together with little agreement between mycorrhizal yield and tree growth suggests direct climate controls on fruit body formation of both nutritional modes.

These findings are in agreement with European-wide phenological observations (Kauserud et al. 2012). Mushroom records of 486 autumnal fruiting species from Austria, Norway, Switzerland, and the UK commonly describe an extended annual fruiting season during the 1970-2007 period.

These two examples are indicative for positive effects of climate change on ecosystem functioning and productivity. In contrast depicts the high-valued Périgord truffle, another mycorrhizal species, a negative example of how climate change can affect fungal yield. A continuous decline in Périgord truffle production has been reported for many Mediterranean habitats and the past four decades. Increasing summer temperatures and decreasing precipitation totals may cause fading harvests, which subsequently trigger local economic uncertainty and global prize inflation (Büntgen et al. 2012b).

If climate change will continue as predicted by climate model ensembles, the distribution range of European truffle species will be highly affected by increasing summer drying. *T. melanosporum* may be less productive in its traditional Mediterranean habitats, whereas *T. aestivum* could even benefit from a slightly warmer climate north of the Alpine arc. Even though only some edible mushrooms are among the world's most expensive delicacies, most of them are mycorrhizal and thus essential for forest ecosystem health.

A better understanding of growth-climate interactions therefore describes a direct ecological and economic interest, especially for populations in more rural areas of Europe.

REFERENCES

Büntgen, U., Peter, M., Kauserud, H. & Egli, S. 2013: Unraveling environmental drivers of a recent increase in Swiss fungi fruiting. Global Change Biology 19, 2785-2794.

Büntgen, U., Kauserud H., Egli S. 2012a: Linking climate variability to mushroom productivity and phenology. Frontiers in Ecology and the Environment 10(1), 14-19.

Büntgen, U., Egli, S., Camarero, J.J., Fischer, E.M., Stobbe U., Kauserud, H., Tegel, W., Sproll, L., Stenseth, N.C. 2012b: Drought-induced decline in Mediterranean truffle harvest. Nature Climate Change 2, 827-829.

Kauserud, H., Heegaard, E., Ulf Büntgen, U., Halvorsen, R., Egli, S., Boddy, L., Senn-Irlet, B., Greilhuber, I., Dämon, W., Sparks, T., Nordén, J., Høiland, K., Kirk, P., Semenov, M., Stenseth, N.C. 2012: Warming-induced shift in European mushroom fruiting phenology. PNAS 109 (36), 14488-14493.

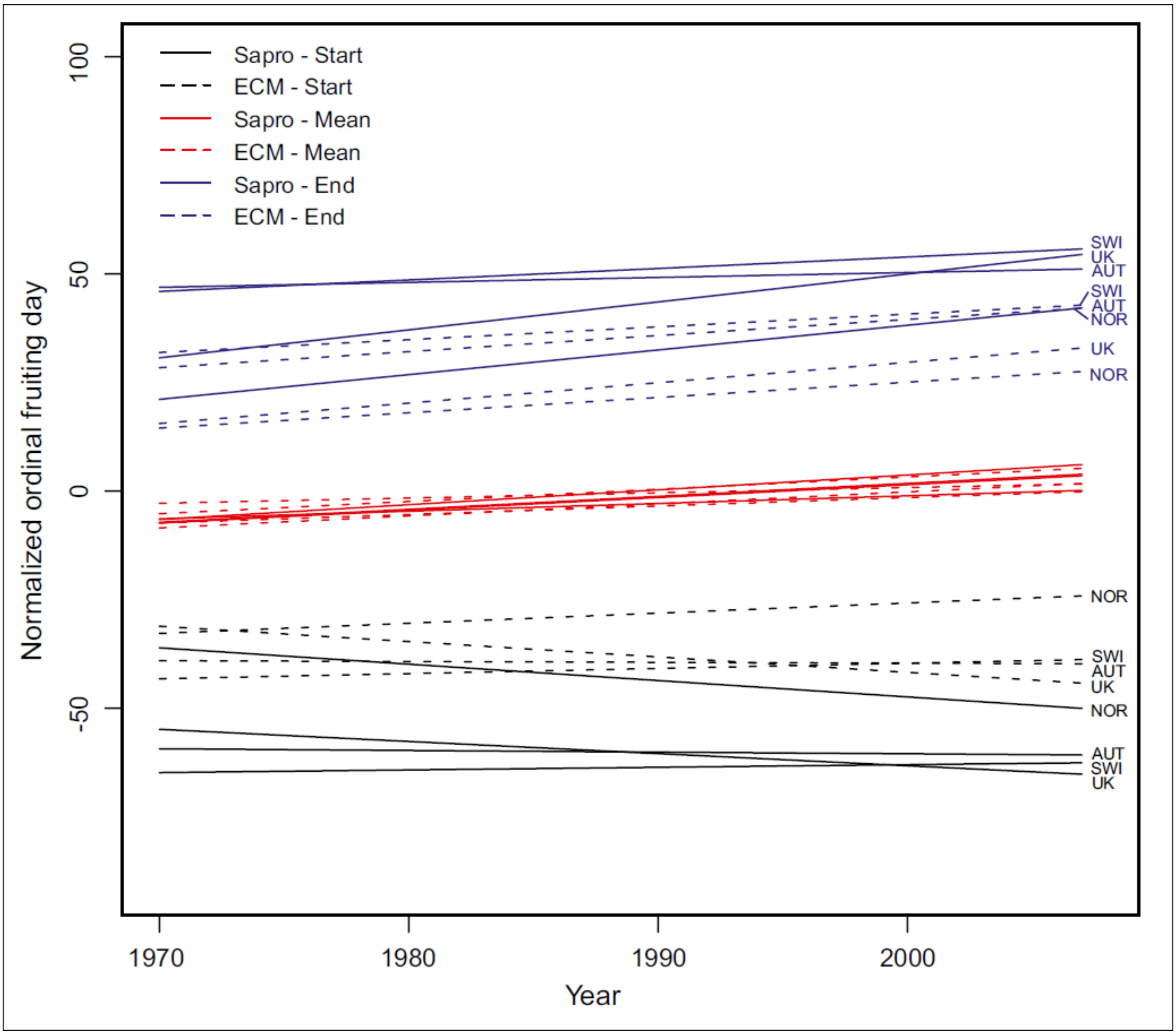


Figure 1. The number of days of change in start, mean, and end of fruiting season during the period 1970–2007, averaged over all species and split according to countries and nutritional mode (saprotrophic or ECM). The 2.5th percentiles reflect changes in season start and the 97.5th percentiles changes in season end. The sampling intensities are accounted for within the model, and the plots here illustrate the expected trends at average intensities, ln(N + 1) = 2.2 – 10 individuals per year. Abbreviations: AUT, Austria; ECM, ectomycorrhizal fungi; NOR, Norway; sapro, saprotrophic fungi; SWI, Switzerland (from Kauserud et al., 2012).

P 13.2

www.pep725.eu – the Pan European Phenological database

Koch Elisabeth[1], Jurkovic Anna[1], Lipa Wolfgang[1], Ungersböck Markus[1], Zach-Hermann Susanne[1]

[1] *Zentralanstalt für Meteorologie und Geodynamik, 1190 Vienna, Austria (pep725@zamg.ac.at)*

Modern phenology is the study of the timing of recurring biological events in the animal and plant world, the causes of their timing with regard to biotic and abiotic forces, and the interrelation among phases of the same or different species. Leaf unfolding, flowering of plants in spring, fruit ripening, colour changing and leaf fall in autumn as well as the appearance and departure of migrating birds and the timing of animal breeding are all examples of phenological events. And phenology is perhaps the simplest way to track ecological changes due to climate change.

PEP725 is a 5 years project with the main object to promote and facilitate phenological research by delivering a pan European phenological database with an open, unrestricted data access for science, research and education. PEP725 is funded by EUMETNET (the network of European meteorological services), ZAMG and the Austrian ministry for science & research bm:w_f.

So far 17 European national meteorological services and 7 partners from different national phenological network operators have joined PEP725. At present more than 8 500 000 phenological events are available in the PEP725 database coming from 31 European countries and from more than 15 000 observation sites. Most of them are in the UK and Germany. A huge number of reports came from the agriculture sector (e.g. Barley - Hordeum vulgare 8% of all observations, Potato - Solanum tuberosum 6% and Wheat - Triticum aestivum 5%) but there are also other plants common (Horse Chestnut - Aesculus hippocastanum with 7% or Oak - Quercus robur). The data set starts in 1868 with a fast development of the observation network in the 1950s. Until now most of interest for our users are Birch (Betula), Sweet Cherry (Prunus avium) and Oak (Quercus robur). On request of our users there is also a link to freely available meteorological datasets from the European Climate Assessment & Dataset project (eca.knmi.nl) over our map-based station browser. Quality checking is also a big issue. At the moment we study the literature to find some appropriate methods.

Another objective of PEP725 is to bring together network-operators and scientists by organizing workshops and symposia. So far three meetings were organized. Invited speakers gave presentations spanning the whole study area of phenology starting from observations to modeling. PEP725 is a co-convener of the phenology session at EGU2014 in Vienna.

P 13.3

“OpenNature” for climate impact science with citizens

Rutishauser This[1], Brönnimann Stefan[1], Rebetez Martine[2], Eugster Werner[3] & project collaborators

[1] *Oeschger Centre for Climate Change Research and Institute of Geography, University of Bern, Hallerstrasse 12, CH-3012 Bern (rutis@giub.unibe.ch)*
[2] *University of Neuchâtel, Neuchâtel, and Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Neuchâtel, Switzerland*
[3] *Institute of Agricultural Sciences, ETH Zurich, Zurich, Switzerland*

With a changing climate, seasons shift, too. The Swiss National Science Foundation (SNF) AGORA science communication project “Open the Book of Nature” aims at collecting evidence seen in daily life, that can also be used to quantify climate change impacts. Data are collected using a “Citizen science” approach to climate change impact research. Interested laypersons engage in documenting shifts in seasonal timing of their environment. Citizen scientists collect geo-referenced and precisely dated field observations and photographs in one or more of the four topics plants, animals, landscapes, and climate extremes. These topics are considered chapters of the Book of Nature that shall be opened and filled with content by these laypersons. Scientists in return will provide observation guidelines (protocols), information from the science community and interpretation to the public.

The main goal of the project is the launch of the “OpenNature” website. In addition, “Open the Book of Nature” plans to deliver a collaboration concept to assure information exchange and technical compatibility, a website and strong links with social media sites for presenting information and fostering discussions. In this project a well-established network of climate change researchers is supported by communication experts in print and web-content journalism, as well as by internet graphics and technical designers. “Open the Book of Nature” builds on existing observations programs (e. g. phaeno.ethz.ch, ornitho.ch, ...) and partnerships in Switzerland under the auspices of the Swiss Academy of Natural Sciences SCNAT. The project is funded by the Swiss National Science Foundation via its AGORA program from 2012–2015. A possible continuation is envisaged in partnership with SCNAT, the educational GLOBE Swiss program, the Global Climate Observation System (GCOS), the phenological observation program by the Swiss Meteorological Office MeteoSwiss and environmental observation programs by Federal Office for the Environment FOEN.