

## CLIMATE CHANGE IN THE ALPS – THE "2°C TARGET" IN A PRACTICE CHECK

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**ABSTRACT:** The so-called "2°C Target" is a legally binding obligation for all member countries of the UN Climate Convention 1992 to limit global warming to considerably below 2°C relative to the pre-industrial level, including endeavors to lower global warming to below 1.5°C. The present analysis focuses on questions about the actual increase of the air temperature for the Southeast of the Alpine region during the last decades. It also explores the validity of defining mean annual temperatures.

**KEYWORDS:** Climate change, torrent monitoring, air temperature, adaption strategies.

### 1. WHAT IS THE ACTUAL INCREASE IN AIR TEMPERATURE IN THE SOUTH-EAST OF THE ALPS?

Data series from two measuring stations of the Federal Research and Training Center for Forests, Natural Hazards and Landscape (BFW) as well as ÖKS15 data from the CCCA data center (1) were used to answer these questions. The first measuring station of BFW is located just south of the main Alpine ridge, in the Möll valley, Carinthia, at an altitude of 1,210 m above sea level. The second measuring station is in the Carnic Alps in Gail valley, Carinthia, at an altitude of 980 m above sea level (Fig. 1).



Figure 1: Location of the BFW measuring stations "Fleissner" and "Pumpenhaus".

When analyzing the longest data series - covering 48 years - a comparison of the first and the last decade of the measurements shows an increase of the mean annual air temperature by +1.9°C or +34.5 percent. On the basis of linear curve fitting and when comparing the station's data with the closest ÖKS15 grid point data (derived from the CCCA data center), then, in both cases, a signifi-

cant temperature rise of 2.1°C is found (Fig. 2). That holds true for a period of 50 years.

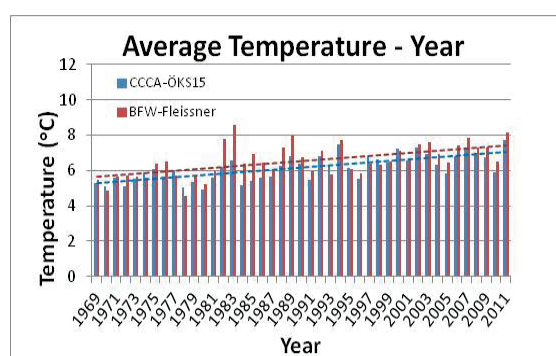


Figure 2: Comparison of the measured data at the BFW-Station "Fleissner" and the ÖKS15-model data set of the nearest grid network point (altitude 1271m a.s.l.).

The Gail valley measuring station revealed an even higher temperature rise. Therefore, we assume that the actual temperature increase is higher than the climate targets, at least in this part of the Alpine region. This is particularly valid when considering the fact that even the temperature measured at the beginning of BFW's measurements (in 1969) already exceeded the pre-industrial level.

### 2. WHAT IS THE SIGNIFICANCE OF MEAN ANNUAL TEMPERATURES FOR THE DEVELOPMENT OF CLIMATE ADAPTATION STRATEGIES?

The validity of mean annual temperatures can be well illustrated based on an analysis of the seasonal temperature distributions. These revealed significant variances from the mean annual temperatures. The strongest temperature rise at Möll valley was recorded in spring (+3.3°C; Fig. 3). The rise was lowest in fall: only +1.3°C.

At the BFW measuring point „Pumpenhaus“ (Gailtal) the temperature in spring rose +3.5°C. The CCCA-data of the nearest grid-point (altitude 961 m a.s.l.) to this measuring station showed a significant increase of the annual average temperature of +2.3°C

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(period of the data set for the calculation at this measuring station: 1969-2011).

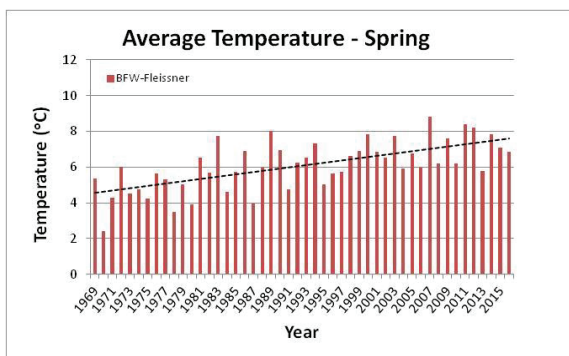


Figure 3: Development of the air temperature at the BFW measuring station "Fleissner" in spring.

For forestry issues, the considerable temperature increase in spring will become more and more important. Just think of problems such as the interplay of earlier begins of the growing season and an unchanged potential of occurrence of late frosts. Related to this - because of the distinctly different ability to regenerate after frost damage - there are also questions about the correct choice of tree species (examined for example, by Vitasse Y., et. al. (2017) and Lenz A., et. al. (2015)).

Ski resort operators will be particularly interested in the temperature changes in winter, which were in the present case at +1.8°C (Fig. 4), which means that the calculated winter average temperature will be close to the zero-degree line!

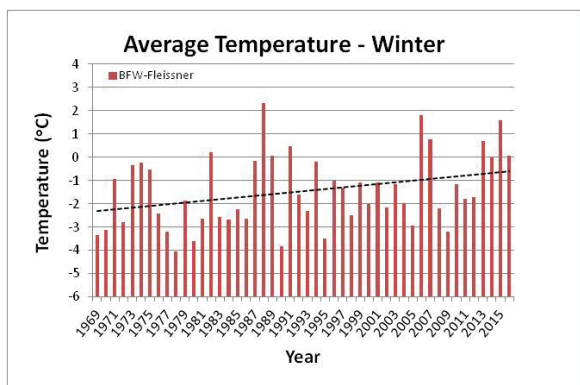


Figure 4: Development of the air temperature at the BFW measuring station "Fleissner" in winter.

The maximum daily average temperatures in winter even rose by +2.5°C (Fig. 5).

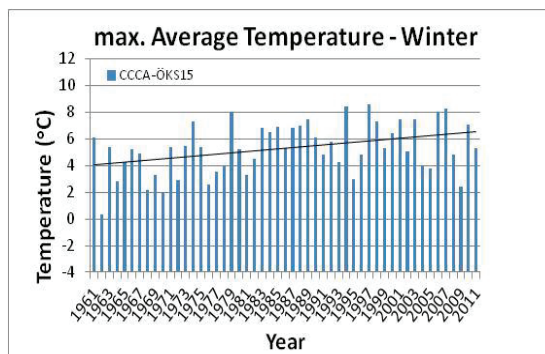


Figure 5: Development of the maximum daily average temperature at Gradenbach catchment (CCCA-Grid network point at 1271m a.s.l.).

### 3. SUMMARY

The binding political obligation to limit global warming to considerably below 2°C relative to the pre-industrial level has been and still is a decision that is absolutely correct and necessary. Moreover, it is groundbreaking to protect the global climate. Indeed, when looking at the analyzed data from the Alpine region it has to be emphasized that a) it currently appears as if the latitude for reaching this climate target has been used up already today (in particular in the Southeast of the Alpine region), and b) for developing an effective strategy on adaptation to climate change, it will not be sufficient to solely focus on a "2°C Target" of mean annual temperature values. It will rather be necessary that shorter periods of time (such as e.g. seasons, growing cycles etc.) and also further climate parameters (such as e.g. precipitation, global radiation, etc.) will be scientifically examined. This needs to be done with a high temporal resolution so as to draw the right conclusions for the future.

### REFERENCES

- Vitasse Y., Schneider L., Klein G., Rixen Chr., Rebetez M., 2017: Plant safety margin against frost damages has declined in Switzerland over the last four decades. 19th EGU General Assembly, EGU2017, proceedings from the conference held 23-28 April, 2017 in Vienna, Austria., p.13887.
- Lenz A., Hoch G., Körner Chr., Vitasse Y., 2015: Convergence of leaf-out towards minimum risk of freezing damage in temperate trees. At: Functional Ecology, British Ecological Society.
- (1) In the project ÖKS15, the Climate Change Center Austria (CCCA) provides modeled daily mean temperatures (<https://data.ccca.ac.at/group/oks15>), which were used for the comparison respectively verification of the meaningfulness of the BFW measurement data.