ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Verification of extreme weather warnings in Austria

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- Public warnings verified against automatic weather stations
- Framework allowing certain fuzzyness / uncertainties
- Operational implementation and use of spatial analysis data to get higher coverage

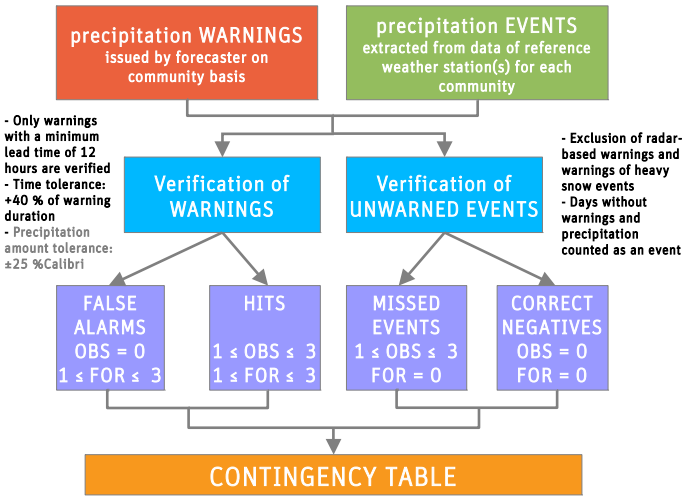
Introduction

Public warnings are based on model guidance, meteorological experience and knowledge about local effects of topography. Duty forecasters identify regions of **significant weather** and the expected amount of precipitation or wind speed. Warning levels are decided by the system autonomously, based on return levels of the meteorological parameter in each community.

A **dense observational network** is beneficial to observe and resolve local effects of precipitation and wind. The observational network of ZAMG is providing data from 250 automated weather stations every 10 minutes. Especially when observing extreme wind events, a high number of station needs to be excluded from the verification process because of **poor representativeness**.

Warnings, as well as observations of extreme events are afflicted with a number of uncertainties like the exact timing and amount of events. Warning levels, however, are exact numbers and an observation close to the warning level would be verified as NO-event if it does not exceed the alert level. Furthermore missed events and correct negatives need to be determined applying an algorithm based on forecasters experience. Given this high grade of uncertainty, the verification system allows a certain **inaccuracy** or **fuzziness** of timing and expected extremeness of an event.

Verification framework



1) Forecasted warning levels were evaluated against levels of corresponding observed precipitation events ("Hits"). Events that did not correspond to any precipitation event were counted as "False Alarms".
2) All other events not be linked to a warning as well as null-events were evaluated. Events with a warning level > 0 were counted as "Missed Events", all others as "Correct Negatives".

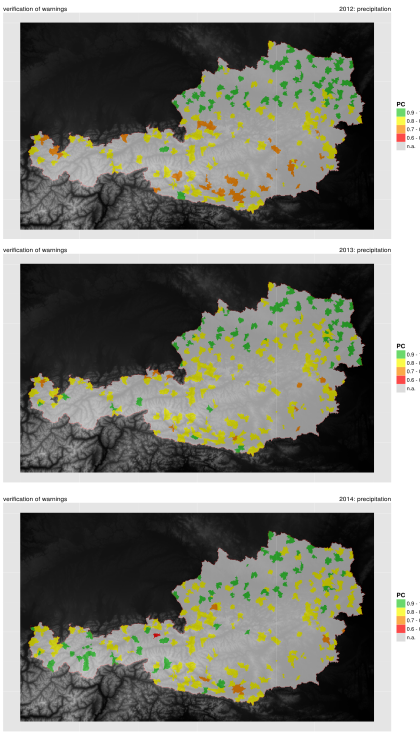
Verification results

Figures show overall verification results based on 4 warning levels (0 = green, 1 = yellow, 2 = orange and 3 = red). Every community has an individual set of warning level thresholds based on extreme value statistics. Verification is available only for municipalities with **repre-sentative stations**.

From the contingency table a number of scores can be calculated: Percentage correct (PC, accuracy) has been chosen as main score in the management report, despite its strong dependency on the most common category of the contingency table (0 = no event). However it is **simple and intuitive**.

PC is generally higher than 0.7 (overall, more than 70% of the warnings were correct) and has been **increasing** over the years.

PC seems to be systematically **higher in north-eastern Austria** as compared to the **inner alpine regions** and the south-eastern Austria.



Accuracy (PC) of precipitation warnings issued by duty forecasters in Austria 2012 – 2014.

Resume

- When verifying warnings it is important to **reflect the way duty forecasters are working**. Inherent uncertainty and fuzziness need to be taken into account.
- There are many possibilities how an extreme event (worth warning) can look like. Thus it's **not trivial to define and event from observations**.
- A simple and intuitive score is needed to be **understood by people that are not familiar with verification scores or meteorology** in general.
- Need to **close spatial gaps** (municipalities without verification) using a spatial analysis (INCA) of warning parameter(s).

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