Creation of an Austria-wide event database and evaluation of correlations between local scale weather developments and extreme events

Katharina ENIGL[1], Christoph MATULLA[2], Franz SCHMID[3], Theresa SCHELLANDER-GORGAS[2]

[1] Institut for Meteorology and Geophysics, University of Vienna, Vienna – Austria, [2] Climate Impact Team, Zentralanstalt für Meteorologie und Geodynamik, ZAMG, Vienna – Austria, [3] Federal Ministry of Sustainability and Tourism

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1. Introduction and Motivation

The study presented here contributes (in alliance with two others X5.387 , X5.386) to a programme maintaining the high level of civil protection in Austria under climate change. Main targets of this study are: (i) the assemblage of a comprehensive, long-term database (from 1948 onwards), which we call 'event space', containing landslide events, floodings and heat-spells/droughts - and (ii) detection and quantification of weather processes potentially triggering these events. This is done by blending the 'event space' with a 'meteorological space' i.e. daily based meteorological information provided by the ZAMG (SPARTACUS and WINFORE).

2. Background

Austrian disaster protection and relief organizations report that their workload has significantly increased along with climate change and that climate change is heavily felt by them (Hollosi and Matulla 2015). This is apparently in line with Figures presented by MunichRe and assessments carried out by the World Economic Forum making clear that non-adaption to climate change is ahigh-risk option for action.

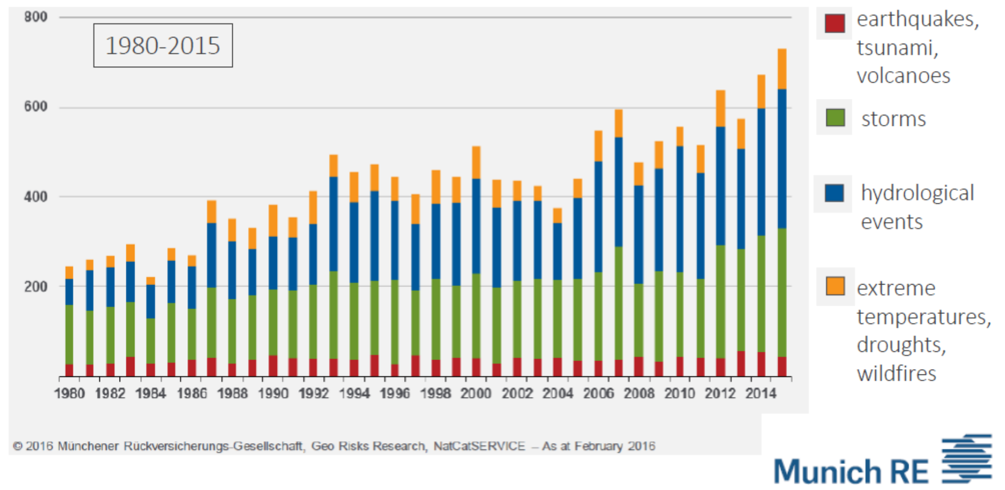


Figure 1: Global losses caused by natural hazards (in billion Euros).

3. Data

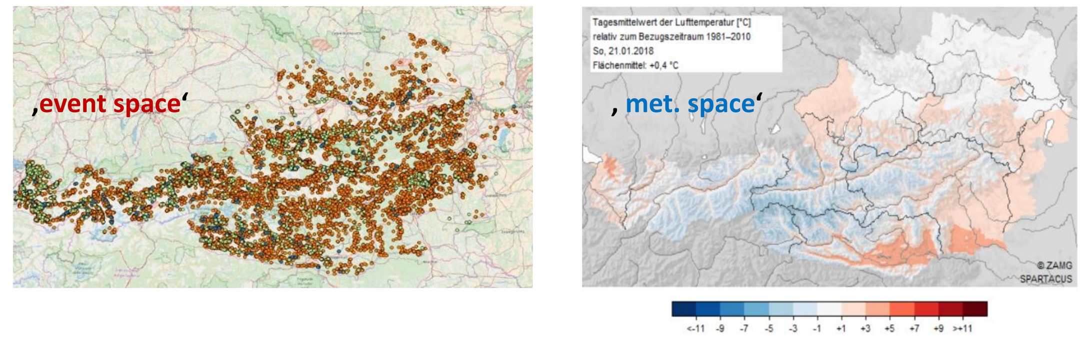
our ‚event space‘ is compiled from:

WLV Data (Wildbach und Lawinen Verbauung)
- Considered Period : 1948-2017
- Incidents covered : landslides, floodings
- Incidents recorded : LS 1357, FL 16.458

GBA Data (Geologische Bundes Anstalt)
- Considered Period : 1948-2017
- Incidents Covered : Landslides
- Incidents recorded : 3.656

VIOLA Dataset (ZAMG)
- Period : 1948-2017
- Incidents covered : Landslides, floodings, Heatspells & droughts
- Incidents recorded : LS 1.181, FL 9.246, HD 289

in summary, this results in our ‚event space‘
- Period : 1948-2017
- Incidents covered : Landslides, floodings, Heatspells & droughts
- Incidents recorded : LS 5.500, FL 16.317, HD 289



our ‚meteorological space‘ is assembled from:

Spartacus (Hiebl and Frei 2016, 2017) & Wettrax Data (ZAMG)
- Considered Period : 1950-2017
- Meteorological Elements : daily temperature & precipitation
- Spatial resolution : (4 x 4 km up to 1960) 1 x 1 km 1961 onwards

Winfore Data (ZAMG)
- Considered Period : 1961-2017
- Element covered : ground moisture
- Spatial resolution : 1 x 1 km

in summary, this results in our ‚ meteorological space‘
- Period : 1950-2017
- Covered elements : daily temperature, precipitation, ground moisture
- Incidents recorded : 1 x 1 km

4. Methods

Development of incidents since 2000: Floodings, Landslides and Heatspells/Droughts as captured in our ‚event space‘

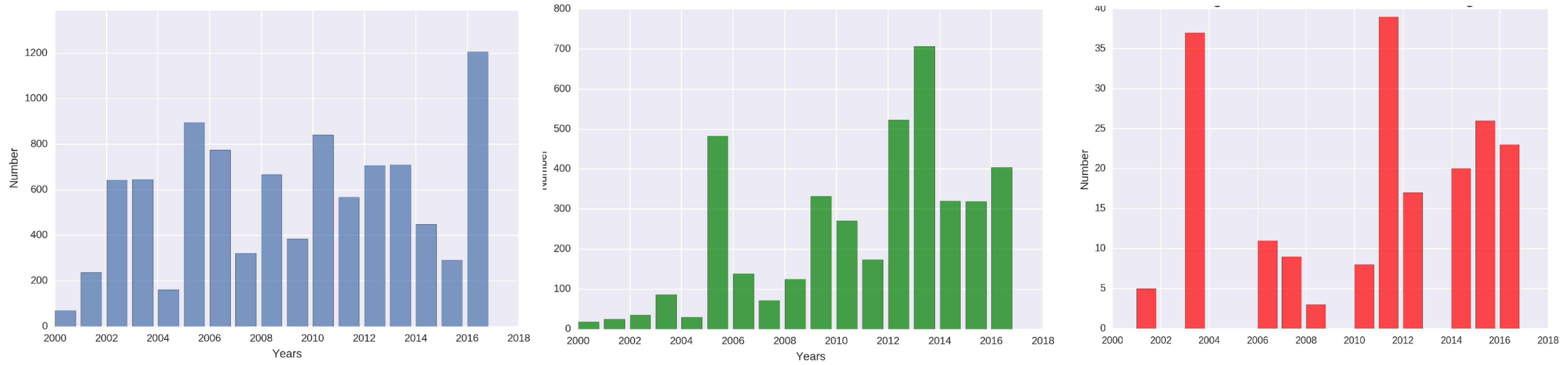


Figure 3: Evolutiuon of potential loss events corresponding to floodings (left, blue) landslides (middle, green) and heatspells/droughts (right, red) in Austria since 2000 as pictured by the ‚event space' assembled from WLV, GBA and VIOLA records.

Case Study: Flooding 2002 which was expereinced in many parts of Central Europe (north of the Alps)

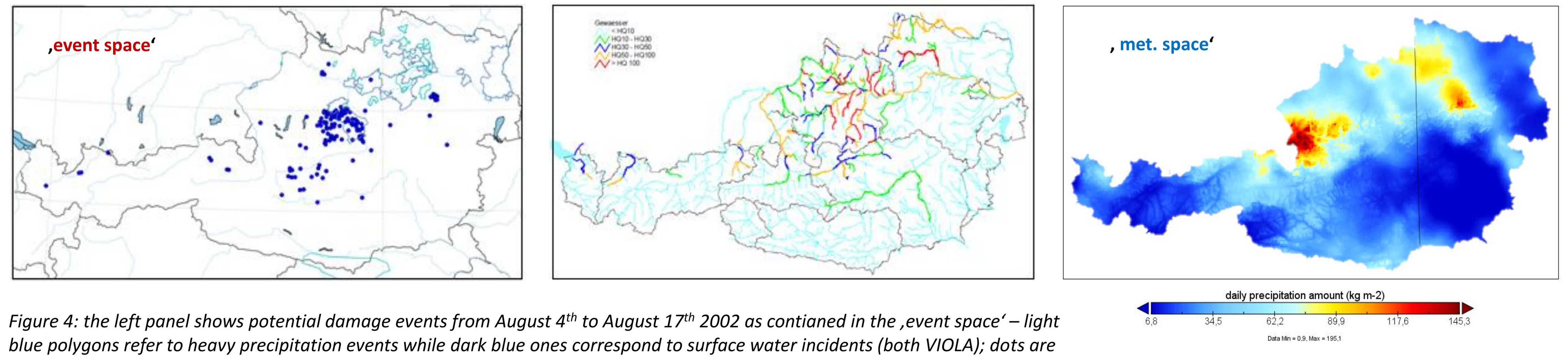


Figure 4: the left panel shows potential damage events from August 4th to August 17th 2002 as contianed in the ‚event space‘ – light blue polygons refer to heavy precipitation events while dark blue ones correspond to surface water incidents (both VIOLA); dots are associated with events depict by WLV data. middle panel: return periodes of floodings (BMNT 2002). right panel: precipitation totals at August 6th 2002 (SPARTACUS, ‚meteorological space‘) – most affected: Tyrol, Salzburg, Upper Austria and Lower Austria to Vienna.

Case Study: Heat Wave 2003 that affected the whole of Europe

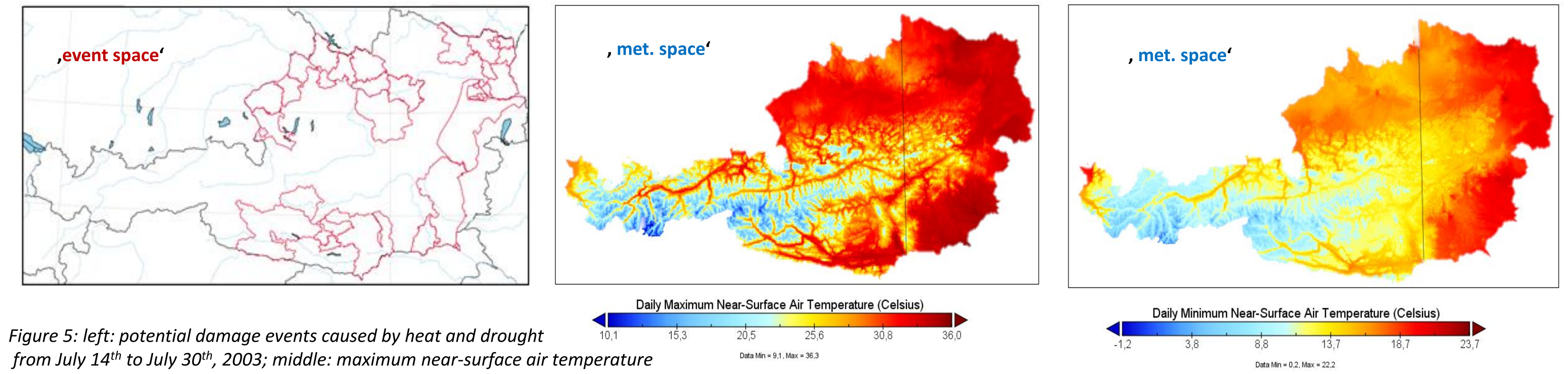


Figure 5: left: potential damage events caused by heat and drought from July 14th to July 30th, 2003; middle: maximum near-surface air temperature July 22nd, 2003 given by SPARTACUS, ‚meteorological space‘ the maximum was attained at 36.3 °C ; right: minimum near-surface air temperature on July 22 nd 2003 - minimum temperatures during night didn fell below 22.2 °C in eastern parts of Austria.

4. Methods

Climate Indices (CIs) stand for meteorological conditions favouring the occurrence of particular phenomena. ‚rutting events‘, for instance, stand for track-groove formation on asphalt roads and highways. These have been described as series of five hot days interrupted by tropical nigths (Matulla et al. 2017). Shallow landslides in some regions have been found to be triggered by precipitation periods exceeding certain thresholds (Guzetti et al. 2008). Case studies as those depict by Figure 4 and Figure 5 shall be understood as examples representing the character of blending. Based on this concept we use ‚event space‘ and ‚meteorological space‘ to detect and quantify CIs – as those just described above -- between atmospheric processes and potential damage events. This may be attained by straight forward comparison or by detecting areas, which are particularly risk prone and thereon based analyses of variances or the like (Matulla et al. 2003).

5. Outlook

• Integration of additional meteorological information and more focus on WINFORE • Development of a categorization that on the one hand accounts for most prominent classes within ‚flooding‘, ‚landslides‘, and ‚heat&drought events‘ and on the other hand ensures sufficient numbers of cases in such class • Identification of geographical regions where events occur particularly frequent • spatio-temporal clustering & two-way approaches and the application of validation experiments.

References

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Contact

Katherina Enigl, katherina.enigl@gmx.at
Priv. Doz. Dr. Chrisotph Matulla christoph.matulla@zamg.ac.at
MR DI Franz Schmid franz.schmid@bmnt.gv.at