CLIMATOLOGY OF VB-CYCLONES, PHYSICAL MECHANISMS AND THEIR IMPACT ON EXTREME PRECIPITATION OVER CENTRAL EUROPE

INTRODUCTION

- Extreme weather situations are of major relevance for society, since they lead to disastrous events.
- VB-cyclones (Fig.1) are an important source of extreme precipitation and large floodings across Central Europe (W. J. Van Bebber 1891).
- State of research: either case studies or simple climatologies are performed.
- Thus, an extensive study on physical mechanisms and their impact on extreme precipitation is needed.

MOTIVATION

- 15% of all extreme precipitation days (99 percentile) are triggered by VB-cyclones.
- VB-cyclones are very rare events, as on average only 2.4 events happen per year.
- In the extended summer season 20% of them are associated with high precipitation amounts, while others trigger almost no precipitation (Fig. 2).

What is the reason for the large variability in precipitation during summer VB-events?

We study the 10 heaviest precipitation events (HPE) and the 10 weakest precipitation events (WPE) triggered by VB-cyclones during summer in more detail.

RESULTS

DIFFERENCES IN MOISTURE

- Mean precipitable water in the atmosphere is much higher for HPE (Fig. 3a) than for WPE (Fig. 3b).
- But case-to-case variability is very large as some HPE show less precipitable water in the atmosphere than some WPE.
- Precipitable water allows no clear separation between the HPE and WPE.

DIFFERENCES IN DYNAMICS

- Composites of geopotential height fields on several pressure levels reveal substantial differences in HPE and WPE.
- HPE show distinct and deep depression, including a westward tilt of the depression (Fig. 4a-c).
- WPE show at lowest level weak depression in the storm’s centre (Fig. 4d).
- WPE are influenced by a strong depression northwest of the actual cyclone centre (Fig. 4d-f).
- Largescale dynamic variables allow a clear distinction between HPE and WPE.

CONCLUSIONS

- Following a VB-trajectory is not a sufficient criterion for a cyclone to trigger extreme precipitation amounts.
- Additionally, thermodynamic variables, i.e. moisture, play only a minor role in triggering high-impact events.
- Largescale dynamics seem to be the major reason for the high variability in summer VB-events.

What is the reason for the large variability in precipitation during summer VB-events?

\[ \text{Differences in the atmospheric moisture content between HPE and WPE} \]

\[ \text{Differences in the geopotential height field between HPE and WPE} \]

REFERENCES:

- Martina Messmer1,2, Juan José Gómez-Navarro1,2 and Christoph C. Raible1,2
- WPE
- HPE

Corresponding author: messmer@climate.unibe.ch
Acknowledgment: The authors thank the Bretscher-Fund for the support provided in this project.