

**Review of PhD thesis of Ms. Blanka Gvoždíková with the title  
“Relationship among moisture flux anomalies, extreme precipitation,  
and floods in Central Europe”**

The thesis of Ms Gvoždíková consists of, 5 scientific papers, accompanied by an introduction, a conclusion and additional passages which help to join the different parts. In this review I will refer to the publications using numbers:

1. Müller, M., Kašpar, M., Valeriánová, A., Crhová, L., Holtanová, E., Gvoždíková, B. (2015) Novel indices for the comparison of precipitation extremes and floods: an example from the Czech territory. *Hydrology and Earth System Sciences*, 19, 4641–4652.
2. Gvoždíková, B., Müller, M. (2017) Evaluation of extensive floods in western/central Europe. *Hydrology and Earth System Sciences*, 21, 3715–3725.
3. Gvoždíková, B., Müller, M., Kašpar, M. (2019) Spatial patterns and time distribution of central European extreme precipitation events between 1961 and 2013. *International Journal of Climatology*, 39, 3282–3297.
4. Gvoždíková, B., Müller, M. (2021) Moisture fluxes conducive to central European extreme precipitation events. *Atmospheric Research*, 248.
5. Gvoždíková, B., Müller, M. (submitted) Predictability of moisture flux anomalies indicating central European extreme precipitation events. Submitted to *Quarterly Journal of the Royal Meteorological Society*

Four of these papers (1-4) have been successfully published in different scientific journals. The final paper (5) has been submitted. As most of the papers have already been carefully

reviewed prior to publication, I will not review them again here. Instead, I will focus on the overall contribution of Ms. Gvoždíková's work to forward scientific advancement.

With respect to the individual papers, the first paper stands out as it introduces a clever way to objectively measure the severity of floods and precipitation events, which is well suited to rank these events. This paper alone is already a compelling scientific accomplishment. However, the contribution of Ms Gvoždíková to this paper does not become clear. As she is the last author in a relatively long list of coauthors, which seems to be ordered by the amount of work invested in the study, I have to assume that her contribution to this research is rather minor. I will therefore not consider publication 1 in order to evaluate Ms. Ms Gvoždíková scientific abilities.

From the papers Ms Gvoždíková published/prepared as the first author, it is possible to see a development of the scientific skills of the PhD candidate. Paper 2 presents a ranking of Central European floods. It uses an existing method and compares three different thresholds. The spatial and seasonal distribution of the events is analysed. The analysis is carefully conducted and well presented but the methods and results are not overly innovative. Paper 3 presents a classification of the most extreme precipitation events in Central Europe, identified using the method introduced in paper 1. Groups of events with similar seasonal and spatial characteristics are identified. For this analysis Ms Gvoždíková also applies tools that haven't been used in this context before. This approach is a suitable way to advance research. Paper 4 builds on these results and identifies large-scale moisture flux patterns which are able to explain the similarities and dissimilarities between the different classes of extreme precipitation events. Ms Gvoždíková shows her ability to conduct research by successfully searching for common causes leading to extreme precipitation events. The complexity of the observations is reduced by analysing anomalies in large-scale patterns. Paper 5 aims at making the results of paper 4 applicable to improve forecasting of extreme flood-relevant precipitation events. The approach is tested in an idealized forecast scenario which uses the same reanalysis model for observations and forecasts. The fact that the potential of the approach to improve forecasting of such extreme events turned out to be limited, does not change the fact that this paper again illustrates the ability of the PhD candidate to forward research.

Overall, I only have some minor criticism. When reading all publications together one notices that the reference lists are all rather short and show a lot of overlap. Statements are mostly corroborated by a single reference (mostly not the one including the pioneering research) without indicating (by using "e.g.") that other research covering the subject also exists. The work of other Czech authors seems to be over proportionally represented. Ms Gvoždíková could have shown that she has a broad overview of related research by citing a larger variety of publications. In addition, I would like to mention that I found it extremely difficult and time consuming to understand some of the nice-looking but rather complex figures of papers 4 and 5. Sometimes information using different levels of standardization and rescaling were combined in one figure. The papers would have benefitted from a more detailed description explaining the benefit (necessity) of combining different levels of standardization (e.g. in figure 7 in paper 4 and figure 2 in paper 5 colour coding seems at first sight to be in contradiction to position of points). Using less abbreviations also would have made paper 4 more readable.

Finally, I would like to acknowledge that the number of publications prepared and successfully published/submitted for this thesis is impressive. All papers have a common research theme and build on each other. Together they considerably advance research on flood relevant extreme precipitation events in Central Europe. Ms. Blanka Gvoždíková has clearly proven her ability to conduct scientific research. I recommend the thesis for defence.

Dr. Katrin Nissen