# Space-Time Dynamics of Extreme Floods

SPATE

Newsletter

# Edition 4

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**Final year of first funding period**

Dear colleagues and followers of the SPATE research unit,

the first two years of our funding period of three years are over and it is time for us to make up a balance. Looking backwards to all our meetings, the works published and the presentations given, we have to admit that we are very proud of what has been done in the last 24 months. Although our first funding period is not over yet and we hope to obtain funding for another three years, the results and research developed within the research unit is extraordinary. Especially the cooperation between the subprojects must be an example for future work. According to this, this newsletter shows three examples of the great cooperation and international presence of the research unit. First, we are honoured that we could welcome two excellent researchers and experts on their field for our symposium in February: Prof. Jürgen Kurths and Prof. Uwe Ulbrich. But also our international symposium on *Floods: Processes, Forecasts, Probabilities, Impact Assessments and Management* at the last IUGG General Assembly in July, which was organised together with the two commissions ICWRS and ICSH of IAHS as well as UNESCO and WMO, was a tremendous success and we would like to thank all participants for their intensive discussions and interesting presentations. But of course also publishing is an important way to make our results available for the whole research community. In a joint work the whole research unit created a review paper on flood typology, a basic tool for all subprojects. More details are given in this newsletter.

We hope you find some interesting research in this newsletter for you!

On behalf of the whole SPATE-project, with kind regards,

Svenja Fischer and Andreas Schumann

**Members of the SPATE-project**

Prof. Dr. Andreas Schumann, Dr. Svenja Fischer, Philipp Bühler
Subproject 1 (Ruhr-University Bochum)

Prof. Dr. Bodo Ahrens, Dr. Cristina Primo Ramos, Amelie Krug
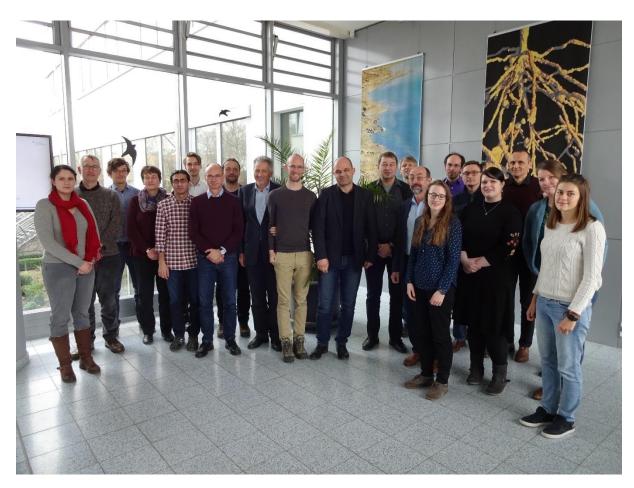Subproject 2 (Goethe-University Frankfurt)

Prof. Dr. Bruno Merz, Dr. Heidi Kreibich, Dr. Sergiy Vorogushyn, Dr. Björn Guse, Luzie Wietzke
Subproject 3 (GFZ Potsdam)

Prof. Dr. Ralf Merz, Larisa Tarasova
Subproject 4 (UFZ Halle/Saale)

Prof. Dr. András Bárdossy, Dr. Jochen Seidel, Faizan Anwar
Subproject 5 (University of Stuttgart)

Prof. Dr. Günter Blöschl, Dr. Andrea Kiss, David Lun
Subproject 6 (Technical University of Vienna)

Prof. Dr. Uwe Haberlandt, Dr. Anne Fangmann, Luisa Thiele
Subproject 7 (Leibniz University Hannover)



*Members of the research unit SPATE at the first SPATE-symposium in Halle*

**First SPATE-Symposium**

In February 2019, the first SPATE-symposium took place at the University of Stuttgart. At three days, the newest results of the research group were discussed with external guests from the TU Vienna, University of Bristol, PIK Potsdam and FU Berlin. A special highlight were the two talks of Uwe Ulbrich (FU Berlin) and Jürgen Kurths (PIK). Professor Ulbrich's talk "Assessing the changing nature of extreme precipitation over Europe" linked the research question of the nature and future risks of



extreme flood events directly to extreme rainfall and possible methods to improve estimation of climate change effects with high-resolution. Different future climate scenarios showed the potential danger of future extreme precipitation events and hence also extreme floods. This meteorological perspective lead to interesting discussions on the coherence with certain flood types developed within the research group. A very different perspective on the complex climate network was given by Professor Kurths and his talk "Predictability of Extreme Climate Events via a Complex Network Approach". He proposed the use of complex networks together with non-linear synchronisation techniques to detect global circulation patterns in oceans as well as atmospheres. Some surprising connections between very different climate zones again emphasized the complexity of the climate and the challenges one has to face when analysing the complex structures of extreme events. Using the example of the Indian

summer monsoon, it was shown that with this knowledge on the critical factors the predictability of the timing of the monsoon can be improved significantly. Here, a direct connecting factor with possible predictions of Vb weather patterns which are critical for extreme floods in Europe can be made. Both talks contributed to a better understanding of global climate patterns and lead to many interesting discussions. It is planned to have another symposium at the end of the first funding phase of our research group with the focus on changing hydrological regimes.

## International SPATE-Symposium at the IUGG General Assembly 2019

The IUGG General Assembly that is held every four years at different cities around the globe is one of the largest conferences on geosciences of the world with more than 4000 participants. In 2019, the 100th anniversary of the IUGG, it took place from 8-18 July in Montreal, Canada. Since the research group SPATE is highly connected with the subcommission IAHS of the IUGG (Günter
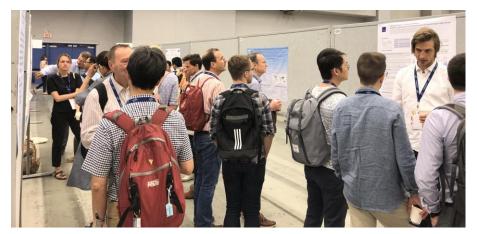


*Conveners: S. Fischer, S. Grimaldi, A. Viglione, A. Schumann and T. Koike (from left to right)*

Blöschl is president of the IAHS, 3 more SPATE members have positions at the IAHS bureau), it was a natural choice as the framework for the international SPATE symposium. Under the topic of *Floods: Processes, Forecasts, Probabilities, Impact Assessments and Management* a symposium was organised and all participants were invited to contribute to it. The research group was supported by the IAHS commissions on statistical hydrology (ICSH) and on water resource systems (ICWRS) as well as the WMO, UNESCO and ICHARM. The response was overwhelming with 50 contributions of six different continents and the symposium became the largest of the IAHS with

24 oral talks and 26 posters. The topics of the talks were grouped in four main categories: processes, forecast and change, probabilities and impact from global to local. We are especially proud that 5 oral talks as well as 7 posters presented work from all subprojects of the research group and lead to

fruitful discussions with the audience. Two highlight talks were one given by Andreas Schumann, who gave an overview of all works of the research group and their collaborations, as well as the invited talk by Günter Blöschl. What was special on this symposium was the broad variety of the topics:



from new methods to very practical applications form all around the globe multiple topics were presented. From the "hidden flood" to new methods to obtain data in ungauged basins but also a worldwide questionnaire on the local flood protection systems or new statistical models - everything related to floods found its place and an interested audience with more than 400 people in total.

Being such a success it was decided by the IAHS that this session will from now on be part of any future IAHS meeting.

**Joint paper of research group on flood classification**

Recently a joint review paper on causative classification of river flood events by Tarasova et al. (2019) was published in *Wiley Interdisciplinary Reviews: Water.* It consists of several contributions of all subprojects under the lead of the colleagues from Halle and condenses the basis of flood typologies used by all subprojects. This paper emerged from fruitful discussion among all subprojects during SPATE Symposium organized in Halle in February 2018 and Joint Workshop of SPATE and SYSTEM-Risk projects on Event Definition and Characterization in Vienna in July, 2018.

This work has aimed to critically review a large body of existing studies on causative classification of instrumental and preinstrumental series of river flood events, to discuss their validity and applications for various hydrological purposes, and to identify opportunities for moving towards more comprehensive approaches. The review has shown that there is no unified definition of causative mechanisms of flood events exists. The existing frameworks adopt three different perspectives: hydroclimatic (large-scale circulation patterns and atmospheric state at the time of the event), hydrological (catchment scale precipitation patterns and antecedent catchment state) and hydrograph-based (indirectly considering generating mechanisms through their effects on hydrograph characteristics). Each of these perspectives has merits and weaknesses. Hydroclimatically-defined groups of flood events can be directly linked with the probability of specific weather system type to occur in a certain region, and can be related to global atmospheric processes at longer time scales. They can be useful for addressing flood hazard estimation under non-stationary conditions. However, they neglect flood generation mechanisms at the catchment scale. These mechanisms can be better understood by hydrological classifications, which reflect short-term rainfall-delivering mechanisms and their interplay with catchment conditions. Since they only require runoff time series, hydrograph-based classifications can be easily applied at the location of interest, especially when no other data is available. These application-oriented approaches offer parsimonious solutions to improve at-site flood frequency estimates.

Application of causative classifications of river flood events has a crucial role for strengthening the hydrological basis of flood estimation and prediction procedures and aids shifting from statistical flood frequency analysis to flood frequency hydrology. However, their application is still mainly limited to derivation of flood-type-based compound distributions for improving at-site flood frequency analysis. Moreover, despite usefulness of existing approaches, uncertainty analysis with respect to indicators, classification methods, and data to assess the robustness of classification are rarely performed which limits the transferability across different geographic regions.

The review concluded that the benefit of causative classification of flood events has to be explored beyond local flood frequency analysis, especially for regionalization and flood change detection and attribution. Developing uncertainty analyses and testing procedures for causative classifications seems necessary to understand their reliability and limitations. More diverse and quantitative multi-criteria classification approaches are needed to encompass the wide spectrum of possible flood generation mechanisms and foster a wider use of causative classifications of floods in hydrological science and practice. If the future frameworks will comply with the above mentioned recommendations, causative classifications will become a powerful tool for deciphering possible changes in flood generation mechanisms and assessing flood hazards in a changing world.

The initiative was led by subproject 4 and included valuable contributions from all subprojects. Subproject 6 has performed the review of existing classification approaches of preinstrumental series of flood events. In collaboration with subproject 3, an investigation of the issues in the existing frameworks and a development of recommendations for more robust and comprehensive approaches has been made. Subproject 2 and 5 took part in the review of existing causative classifications of hydroclimatic perspective, including the possibility of using atmospheric circulation patterns for such approaches. Subproject 1 has contributed their expertise and experience on hydrograph-based classifications of flood events and their application for flood frequency analysis. Subproject 7 has contributed to the analysis of existing practices for uncertainty analysis of causative classifications and the way to improve robustness of existing frameworks.

Günter Blöschl was honored with the John Dalton Medal 2019 by the European Geoscience Union for his outstanding research in hydrology.

Svenja Fischer was elected to be Early Career Representative for the ICSH commission in the IAHS for the period 2019-2021.

Svenja Fischer was elected to be vice-president of the ICSH for the period of 2019-2023.

Andreas Schumann was awarded with the prize of the German Hydrological Society (Deutscher Hydrologiepreis der DHG) for his outstanding research in hydrology with relevance for science and practice.

Andreas Schumann was designated as distinguished member of the European Water Resources Association (EWRA).

**Publications**

**1)  Publications in journals**

**Published since last newsletter:**

Akhtar, N., **Krug, A. (SP2)**, Brauch, J., Arsouze, T., Dieterich, C., **Ahrens, B. (SP2)** 2018: European Marginal Seas in a regional atmosphere-ocean coupled model and their impact on Vb-cyclones and associated precipitation. Climate Dynamics.

Barendrecht, M.H., **Viglione, A. (SP6), Kreibich, H. (SP3), Merz, B. (SP3), Vorogushyn, S. (SP3), and Blöschl, G. (SP6)** (2019): The value of empirical data for estimating the parameters of a socio-hydrological flood risk model. - Water Resources Research, 55, 2, 1312-1336.

**Blöschl, G. (SP6)**, Marc F.P. Bierkens, Antonio Chambel, Christophe Cudennec, Georgia Destouni, Aldo Fiori, James W. Kirchner, Jeff J. McDonnell, Hubert H.G. Savenije, Murugesu Sivapalan, Christine Stumpp, Elena Toth, Elena Volpi, Gemma Carr, Claire Lupton, Josè Salinas, Borbála Széles, **Alberto Viglione (SP6)**, Hafzullah Aksoy, Scott T. Allen, Anam Amin, Vazken Andréassian, Berit Arheimer, Santosh Aryal, Victor Baker, Earl Bardsley, Marlies H. Barendrecht, Alena Bartosova, Okke Batelaan, Wouter R. Berghuijs, Keith Beven, Theresa Blume, Thom Bogaard, Pablo Borges de Amorim, Michael E. Böttcher, Gilles Boulet, Korbinian Breinl, Mitja Brilly, Luca Brocca, Wouter Buytaert, Attilio Castellarin, Andrea Castelletti, Xiaohong Chen, Yangbo Chen, Yuanfang Chen, Peter Chifflard, Pierluigi Claps, Martyn Clark, Adrian Collins, Barry Croke, Annette Dathe, Paula C. David, Felipe P. J. de Barros, Gerrit de Rooij, Giuliano Di Baldassarre, Jessica M. Driscoll, Doris Düthmann, Ravindra Dwivedi, Ebru Eris, William H. Farmer, James Feiccabrino, Grant Ferguson, Ennio Ferrari, Stefano Ferraris, Benjamin Fersch, David Finger, Laura Foglia, Keirnan Fowler, Boris Gartsman, Simon Gascoin, Eric Gaume, Alexander Gelfan, Josie Geris, Shervan Gharari, Tom Gleeson, Miriam Glendell, Alena Gonzalez Bevacqua, María P. González-Dugo, Salvatore Grimaldi, A. B. Gupta, **Björn Guse (SP3)**, Dawei Han, David Hannah, Adrian Harpold, Stefan Haun, Kate Heal, Kay Helfricht, Mathew Herrnegger, Matthew Hipsey, Hana Hlaváčiková, Clara Hohmann, Ladislav Holko, Christopher Hopkinson, Markus Hrachowitz, Tissa H. Illangasekare, Azhar Inam, Camyla Innocente, Erkan Istanbulluoglu, Ben Jarihani, Zahra Kalantari, Andis Kalvans, Sonu Khanal, Sina Khatami, Jens Kiesel, Mike Kirkby, Wouter Knoben, Krzysztof Kochanek, Silvia Kohnova, Alla Kolechkina, Stefan Krause, David Kreamer, **Heidi Kreibich (SP3)**, Harald Kunstmann, Holger Lange, Margarida L. R. Liberato, Eric Lindquist, Timothy Link, Junguo Liu, Daniel Peter Loucks, Charles Luce, Gil Mahé, Olga Makarieva, Julien Malard, Shamshagul Mashtayeva, Shreedhar Maskey, Josep Mas-Pla, Maria Mavrova-Guirguinova, Maurizio Mazzoleni, Sebastian Mernild, Bruce Dudley Misstear, Alberto Montanari, Hannes Müller-Thomy, Alireza Nabizadeh, Fernando Nardi, Christopher Neal, Nataliia Nesterova, Bakhram Nurtaev, Vincent Odongo, Subhabrata Panda, Saket Pande, Zhonghe Pang, Georgia Papacharalampous, Charles Perrin, Laurent Pfister, Rafael Pimentel, María J. Polo, David Post, Cristina Prieto Sierra, Maria-Helena Ramos, Maik Renner, José Eduardo Reynolds, Elena Ridolfi, Riccardo Rigon, Monica Riva, David Robertson, Renzo Rosso, Tirthankar Roy, João H.M. Sá, Gianfausto Salvadori, Mel Sandells, Bettina Schaefli, **Andreas Schumann (SP1)**, Anna Scolobig, Jan Seibert, Eric Servat, Mojtaba Shafiei, Ashish Sharma, Moussa Sidibe, Roy C. Sidle, Thomas Skaugen, Hugh Smith, Sabine M. Spiessl, Lina Stein, Ingelin Steinsland,

Ulrich Strasser, Bob Su, Jan Szolgay, David Tarboton, Flavia Tauro, Guillaume Thirel, Fuqiang Tian, Rui Tong, Kamshat Tussupova, Hristos Tyralis, Remko Uijlenhoet, Rens van Beek, Ruud J. van der Ent, Martine van der Ploeg, Anne F. Van Loon, Ilja van Meerveld, Ronald van Nooijen, Pieter R Van Oel, Jean-Philippe Vidal, Jana von Freyberg, **Sergiy Vorogushyn (SP3)**, Przemyslaw Wachniew, Andrew Wade, Philip Ward, Ida Westerberg, Christopher White, Eric F. Wood, Ross Woods, Zongxue Xu, Koray K. Yilmaz & Yongqiang Zhang (2019): Twenty-three Unsolved Problems in Hydrology (UPH) – a community perspective, Hydrological Sciences Journal, DOI: 10.1080/02626667.2019.1620507

Brázdil, R., **Kiss, A. (SP6)**, Luterbacher, J., Nash, D., and Režnicková, L. (2018): Documentary data and the study of past droguhts: a global state of the art. *Climate of the Past* 14, 1915-1960.

Buttinger-Kreuzhuber, A., Horváth, Z., Noelle, S., **Blöschl, G. (SP6)**, &andWaser, J. (2019): A new second-order shallow water scheme on two-dimensional structured grids over abrupt topography. *Advances in Water Resources*.

Diederen, D., Liu, Y., Gouldby, B., Diermanse, F., and **Vorogushyn, S. (SP3)** (2019): Stochastic generation of spatially coherent river discharge peaks for continental event-based flood risk assessment. - Natural Hazards and Earth System Sciences (NHESS), 19, 1041-1053.

**Fangmann, A.**, and **Haberlandt, U. (both SP7)** (2019): Statistical approaches for identification of low-flow drivers: Temporal aspects. Hydrology and Earth System Sciences 23(1), 447-463. DOI: https://doi.org/10.5194/hess-23-447-2019.

**Fischer, S.,** and **Schumann, A**. **(both SP1)** (2019): Spatio-temporal consideration of the impact of flood types on flood statistics. Stochastic Environmental Research and Risk Assessment, DOI: 10.1007/s00477-019-01690-2.

Hofstätter, M., and **Blöschl, G. (SP6)** (2019): Vb cyclones synchronized with the Arctic-/North Atlantic Oscillation. *Journal of Geophysical Research: Atmospheres*.

**Kiss, A. (SP6)** (2019): Before and after the great heat and drought of 1540. Multiannual trends of grape and grain harvest dates in the Vienna Hospital Accounts. In: Mérai, D. (chief ed.). Genius Loci. Laszlovszky 60. Budapest: Archaeolingua 2018, pp. 117-120.

**Kreibich, H. (SP3),** Blauhut, V., Aerts, J.C.J.H., Bouwer, L. M., Van Lanen, H.A.J., Mejia, A., Mens, M., and Van Loon, A.F. (2019): How to improve attribution of changes in drought and flood impacts. - Hydrological Sciences Journal - Journal des Sciences Hydrologiques, 64, 1, 1-18.

Kuil, L., Carr, G., Prskawetz, A., Salinas, J. L., **Viglione, A., Blöschl, G. (both SP6)** (2019): Learning from the Ancient Maya: Exploring the Impact of Drought on Population Dynamics. *Ecological Economics*, *157*, 1-16.

Mewes, B., and **Schumann, A. (SP1)** (2019): An agent-based extension for object-based image analysis for the delineation of irrigated agriculture from remote sensing data. International Journal of Remote Sensing 40 (12), 4623-4641.

Mewes, B., and **Schumann, A. (SP1)** (2019): Das Potential der Kombination von Maschinellen Lernen und Agenten-basierter Methoden in der Wasserbewirtschaftung. Proceedings: Tag der Hydrologie 2019, Karlsruhe.

Müller, H., and **Haberlandt, U. (SP7)** (2018): Temporal rainfall disaggregation using a multiplicative cascade model for spatial application in urban hydrology. Journal of Hydrology, 556, 847-864. DOI: https://doi.org/10.1016/j.jhydrol.2016.01.031.

Picciafuoco, T., Morbidelli, R., Flammini, A., Saltalippi, C., Corradini, C., Strauss, P., and **Blöschl, G. (SP6)** (2019): On the estimation of spatially representative plot scale saturated hydraulic conductivity in an agricultural setting. *Journal of Hydrology*, *570*, 106-117.

**Primo, C. (SP2)**, Kelemen, F.D., Feldmann, H., and **Ahrens, B. (SP2)** (2019): A regional atmosphere-ocean climate system model (CCLMv5.0clm7-NEMOv3.3-NEMOv3.6) over Europe including three marginal seas: on its stability and performance. Geosci. Model Dev. Discuss.,https://doi.org/10.5194/gmd-2019-73.

Stadler, P., **Blöschl, G. (SP6)**, Nemeth, L., Oismüller, M., Kumpan, M., Krampe, J., and Zessner, M. (2019). Event-transport of beta-d-glucuronidase in an agricultural headwater stream: Assessment of

seasonal patterns by on-line enzymatic activity measurements and environmental isotopes. *Science of the Total Environment*, *662*, 236-245.

Steirou, E., Gerlitz, L., Apel, H., Sun, X., **Merz, B. (SP3)** (2019): Climate influences on flood probabilities across Europe. - Hydrology and Earth System Sciences, 23, 1305-1322.

**Tarasova, L. (SP4), Merz, R. (SP4), Kiss, A. (SP6), Basso, S. (SP4), Blöschl, G. (SP6), Merz, B. (SP3), Viglione, A. (SP6), Plötner, S. (SP7), Guse, B. (SP3), Schumann, A. (SP1), Fischer, S. (SP1), Ahrens, B. (SP2), Anwar, F. (SP5), Bardossy, A. (SP5), Bühler, P. (SP1), Haberlandt, U. (SP7), Kreibich, H. (SP3), Krug, A. (SP2), Lun, D. (SP6)**, Müller-Thomy, H., **Pidoto, R. (SP7), Primo, C. (SP2), Seidel, J. (SP5), Vorogushyn, S. (SP3), and Wietzke, L. (SP3)**, (2019): Causative classification of river flood events. Wiley Interdiscip. Rev. Water 1–23. https://doi.org/10.1002/wat2.1353

Winter, B., Schneeberger, K., Nguyen, D., Huttenlau, M., Achleitner, S., Stötter, J., **Merz, B. (SP3),** and **Vorogushyn, S. (SP3)** (2019): A continuous modelling approach for design flood estimation on sub-daily time scale. - Hydrological Sciences Journal - Journal des Sciences Hydrologiques, 64, 5, 539-554.

## 2) Publications in anthologies, book contributions and chapters

Kiss, A. (SP6): Floods and Long-Term Water-Level Changes in Medieval Hungary. Springer, 2019.

## 3) Software

Anwar, F., and Bárdossy, A. (both SP5): Python/Cython module wcpc for weather circulation pattern classification. This package incorporates previous and newly proposed methods to find weather circulation patterns based on several criteria to maximize a given combination of objective functions using the Simulated Annealing algorithm (link: github.com/faizan90/wcpc).

Anwar, F., and Bárdossy, A. (both SP5): Python module appdis for detection of events in a time series that are unusual in the depth space. The inputs are allowed to have N-dimensions. It can easily detect phenomenon such as data inhomogeneity, comparison of simulated versus observed model dynamics and climatological extremes (link: github.com/faizan90/appdis).

Anwar, F. and Bárdossy, A. (both SP5): Python/Cython/C++ module depth_funcs for computing depths of N-dimensional data points using the Tukey's depth function. Functions generating unit vectors that slice an N-dimensional space uniformly are also part of this module (link: github.com/faizan90/depth_funcs).

## Talks

### 1) Invited talks:

Bárdossy, A. (SP5): Problems with Space vs. Time in Hydrology. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Haberlandt, U. (SP7): Stochastic precipitation for hydrologic design. Kolloquium Boden, Wasser, Luft – Uni Freiburg, 30.01.2019

Kreibich, H. (SP3) "Probabilistic, multi-variable flood loss modelling" solicited talk at EGU General Assembly 2019 in Session NH1.5 Flood Risk Assessment and Management, 11.4.2019.

Merz, B. (SP3), Steirou, E., Gerlitz, L., Apel, H., Sun, X., 2018: Linkages between Flooding and Climate Variability across Europe, NH44B-05, invited talk, AGU Fall Meeting 2018, Washington D.C., 10-14 Dec 2018.

Schumann, A. (SP1): Hydrologische Daten – hydrologische Informationen – wasserwirtschaftliche Entscheidungen? Über den Umgang mit der unsicheren Wahrheit. Medal lecture for the German hydrology award, Tag der Hydrologie in Karlsruhe, March 2019.

Schumann, A. (SP1): Challenges in flood risk management. EWRA 2019, Madrid, Spain, 26.-28.06.2019

## 2) Other talks on conferences

Barendrecht, M.H., A. Viglione (SP6), S. McCarthy and G. Blöschl (SP6): Comparative socio-hydrology for the human-flood systems of the regions of England. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Fischer, S. (SP1): The Detection of Changes in Flood Type Frequencies and Magnitudes and their Impact on Annual Flood Statistics. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Fischer, S., and Schumann, A. (both SP1): Detection of changes in flood types and their impact on flood statistics. AGU General Assembly 2018, Washington DC, USA, 10.-14.12.2018.

Fischer, S., and Schumann, A. (both SP1): Anatomy of Floods – Flood Event Analyses and their Utilization. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Fischer, S., and Schumann, A. (both SP1): Is the peak the appropriated characteristic to specify flood probabilities? IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Guse, B. (SP3), Wietzke, L. (SP3), Viglione, A. (SP6), Merz, B. (SP3), and Vorogushyn, S. (SP3): What is the role of flood wave superposition for the severity of extreme floods? EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Kalantari, Z., Martinez, F., Viglione, A. (SP6) and Di Baldassarre, G.: Understanding the interaction between Hydrological Extremes, Water Management and Society in the Anthropocene. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Krug, A. (SP2), Fischer, S. (SP1), Primo, C. (SP2), Ahrens, B. (SP2), and Schumann, A. (SP1): Impact of atmospheric oscillations and climate change on snow-cover variability over Germany during the past century. Meteorologentagung DACH. Garmisch-Partenkirchen, Deutschland, 18.–22. März 2019.

Krug, A. (SP2), Fischer, S. (SP1), Primo, C. (SP2), Ahrens, B. (SP2), and Schumann, A. (SP1): Atmospheric drivers of Germany-wide flood events. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Krug, A. (SP2), Ahrens, B. (SP2), and Schröder, M.: Water transport diagnostics: satellite, model, and reanalysis based. CMSAF User Workshop 2019, Mainz, Germany, 03.06. — 05.06.2019

Krug, A. (SP2), Fischer, S. (SP1), Primo, C. (SP2), Ahrens, B. (SP2), and Schumann, A.: Atmospheric drivers of Germany-wide flood events during the 20th century. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Merz, B. (SP3), Steirou, E., Gerlitz, L., Apel, H., and Sun, X.: Klima-informierte Analyse von Hochwasserhäufigkeiten, Tag der Hydrologie in Karlsruhe, March 2019.

Metin, A. D., Dung, N. V., Schröter, K., Guse, B. (SP3), Kreibich, H. (SP3), Vorogushyn, S. (SP3), and Merz, B. (SP3): To what extent does the spatial dependence affect the regional flood risk estimation, EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Mewes, B., and Schumann, A. (SP1): Looking Beyond Data: Information-theory based criteria to evaluate different machine-learning approaches for hydrological problems. AGU General Assembly 2018, Washington DC, USA, 10.-14.12.2018.

Mewes, B., and Schumann, A. (SP1): Das Potential des Maschinellen Lernens und agentenbasierter Methoden in der Hydrologie und Wasserwirtschaft. Tag der Hydrologie in Karlsruhe, March 2019.

Persiano, S., Salinas, J.L., Stedinger, J.R., Farmer, W.H., Viglione, A., Blöschl, G. (both SP6) and Castellarin, A.: Looking beyond spatial correlation in regional flood frequency analysis: exploring the potential of Generalized Least Squares and Top-kriging. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Primo, C. (SP2), Kelemen, F.D., Feldmann, H., and Ahrens, B. (SP2): A Regional Climate Atmosphere-Ocean System over Europe for the 20th Century and its Impact Describing Regional Climate Change. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Purr, C., Brisson, E., and Ahrens, B. (SP2): How will convective storms change in the future? A COSMO-CLM modeling study for Central Europe. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.

Schumann, A. (SP1), Blöschl, G. (SP6), Merz, B. (SP3), Merz, R. (SP4), Fischer, S. (SP1), and Vorogushyn, S. (SP3): The Contributions of Hydrology to Flood Risk Management. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Viglione, A. (SP6): Understanding and Estimating River Flood Hazards across Timescales: from Flood Events to Long-Term Dynamics. EGU General Assembly 2019, Vienna, Austria, 08.04.-12.04. 2019.


## 3) Poster

Ahrens B. (SP2), Primo C. (SP2) and Kelemen F.: 20th Century Coupled Regional Climate Simulations. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Anwar, F., and Bárdossy, A. (both SP5): Hydrological model parameters for different applications. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Banerjee, A., Goswani, B., Marwan, N., Merz, B. (SP3), and Kurths, J. (2019): Recurrence Analysis of Flood Events. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Bárdossy, A., Anwar, F., and Seidel, J. (all SP5): Clustering von Standorten mit gleichzeitigem Auftreten von Extremwerten, Tag der Hydrologie in Karlsruhe, March 2019.

Bárdossy, A. (SP5), and Pegram, G.: Simultaneous occurrence of floods in different catchments. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Barendrecht, M.H., Viglione, A. (SP6), Kreibich, H. (SP3), Merz, B. (SP3), Vorogushyn, S. (SP3), and Blöschl, G. (SP6): The value of empirical data for estimating the parameters of a socio-hydrological flood risk model. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Bertola, M., Viglione, A. (SP6), and Blöschl, G. (SP6): Towards the attribution of patterns of flood regime change in Europe to decadal oscillations of atmospheric, catchment and river system drivers. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Bertola, M., Viglione, A. (SP6), and Blöschl, G. (SP6): Towards the attribution of patterns of flood regime change in Europe to decadal oscillations of atmospheric, catchment and river system drivers. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Borzí, I., Sivapalan, M., Viglione, A. (SP6), and Bonaccorso, B.: Socio-hydrological modeling to guide communities towards environmentally sustainable behaviour: Case study of Alcantara River Basin System (Italy). EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Fangmann, A., Haberlandt, U. (both SP7), Fischer, S. (SP1), Tarasova, L., and Merz, R. (both SP4): Assessing the Benefits of Stratified Flood Statistics. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Fischer, S., and Schumann, A. (both SP1): Consideration of heavy rain events in precipitation statistics, AGU General Assembly 2018, Washington DC, USA, 10.-14.12.2018.

Guse, B. (SP3), Wietzke, L. (SP3), Merz, B. (SP3), and Vorogushyn, S. (SP3) (2019): Charakterisierung von Hochwasserwellenüberlagerungen an Zusammenflüssen in Deutschland, Tag der Hydrologie in Karlsruhe, March 2019.

Guse, B. (SP3), Wietzke, L. (SP3), Viglione, A. (SP6), Merz, B. (SP3), and Vorogushyn, S. (SP3): What is the role of flood wave superposition for the severity of extreme floods? IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Haberlandt, U., and Plötner, S. (both SP7): Disaggregation of daily to hourly rainfall using k-nn resampling for derived flood frequency analysis. AGU General Assembly 2018, Washington DC, USA, 10.-14.12.2018.

Haberlandt, U. (SP7), Shehu, B., and Primo C. (SP2): Reconstruction of long daily precipitation fields using additional information from re-analysis data and analogous observed rainfall pattern. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Kemter, M., Merz, B. (SP3), and Marwan, N.: Using multi-layer complex networks to understand interrelationships and changes in extreme flood generation, EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Krug, A. (SP2), Liman, J., Akhtar, N., Schröder, M., Ahrens, B. (SP2): Water vapor transport in observations and in the regional climate model COSMO-CLM. Meteorologentagung DACH. Garmisch-Partenkirchen, Deutschland, 18.–22. März 2019.

Lun, D., Viglione, A. (both SP6), Fischer, S. (SP1), and Blöschl, G. (SP6): Decadal changes of flood probabilities - Detection of flood rich and flood-poor periods in hydrological time series. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Merz, R. (SP4), Tarasova, L. (SP4), and S. Basso (SP4) (2019): Towards regional consistent parameters of distributed hydrological models, EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Modiri, E., and Bárdossy, A. (SP5): Identifying Joint Peaks Behavior in Neighboring Catchments. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Pidoto R., and Haberlandt, U. (both SP7): Rainfall synthesis conditioned on circulation patterns. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Pidoto R., and Haberlandt, U. (both SP7): Rainfall Synthesis Conditioned on an Optimized Objective Fuzzy Rule CP Classification. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Pothapakula P.K., Primo C. (SP2) and Ahrens B. (SP2): Quantification of information exchange in idealized and climate system applications. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Primo, C., and Ahrens, B. (both SP2): Impact of the Reanalyses on Regional Simulated Climates over Europe. ICCARUS 2018, Offenbach, Germany, 26 February - 6 March 2018.

Primo, C., and Ahrens, B. (both SP2): Impact of the Reanalyses on Regional Simulated Climates over Europe. Deutsche Klimatagung 2018, Frankfurt, Germany, 5-8 March 2018.

Primo, C. (SP2), Kelemen, F.D., Obermann, A., and Ahrens, B. (SP2): The effect of coupled marginal seas on precipitation extremes and heat waves in 20th century CCLM simulation. CLM Assembly, Karlsruhe, Germany, 18-21 Sept. 2018.

Salinas, J.L., Kiss, A. (SP6), Viglione, A: (SP6), Viertl, R., and Blöschl, G. (SP6): A fuzzy Bayesian approach to flood frequency estimation with imprecise historical information. IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Tarasova, L. (SP4), Basso, S. (SP4), Viglione, A. (SP6), and R. Merz (SP4) (2019): Towards hierarchical process-based classification of runoff events, EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Tarasova, L. (SP4), Basso, S. (SP4), Viglione, A. (SP6), and R. Merz (SP4) (2019): Towards hierarchical process-based classification of runoff events, Gordon Research Seminar, Andover, NH, 22.-23.06.2019.

Tarasova, L. (SP4), Basso, S. (SP4), Viglione, A. (SP6), and R. Merz (SP4) (2019): Towards hierarchical process-based classification of runoff events, Gordon Research Conference, Andover, NH, 23.-28.06.2019.

Tarasova, L. (SP4), Basso, S. (SP4), Viglione, A. (SP6), Wendi, D., Guse, B. (SP3), Vorogushyn, S. (SP3), Merz, B. (SP3) and R. Merz (SP4) (2019). Development of Hierarchical Process-Based Classification of Runoff Events, IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Thiele, L., and Haberlandt, U. (both SP7) (2019): A regional approach for subdaily extreme rainfall estimation – a case study in Northern Germany. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Ullrich, S. (SP3), Hegnauer, M., Dung, N.V., de Bruijn, K., and Merz, B. (SP3), Kwadijk, J., Vorogushyn, S. (SP3): Comparative evaluation of two types of stochastic weather generators coupled to hydrological models for flood estimation, IUGG 2019 General Assembly, Montreal, Canada, 8.-12.08.2019.

Volpi, E., Di Lazzaro, M., Bertola, M., Viglione, A. (SP6) and Fiori, A.: Reservoir effects on flood hazard. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.


## 4) PICO

Lun, D., Viglione, A. and Blöschl, G. (all SP6): Detection of flood-rich and flood-poor periods in hydrological time series. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

Wietzke, L. (SP3), Guse, B. (SP3), Kreibich, H. (SP3), Gerlitz, L., Vorogushyn, S. (SP3), Merz, B. (SP3) (2019): Comparative analysis of scalar upper tail indicators. EGU General Assembly 2019, Vienna, Austria, 8.-12.04.2019.

### Thesis

Maged, I. (2019): Comparison of different rainfall input data to derive design floods using hydrological modelling. Master thesis, Leibniz University Hannover. Supervisors: L. Thiele and U. Haberlandt (both SP7).

Shah, S. M. Q. F. (2019): Being right for the right reasons – process understanding in conceptual hydrological modeling. Master Thesis, Leibniz University Hannover. Supervisors: S. Plötner and U. Haberlandt (both SP7).

Ullrich, S. (2019): A comparison of different weather generators for generating synthetic discharge series in the Rhine basin. Master Thesis. TU Berlin. Supervisor: S. Vorogushyn (SP3)

### Visits

Philip Bühler (SP1) visited SP5 for developing a scheme that allows to swap the characteristics of extreme precipitation events in time and space among each other and observe the effects of the newly generated time series on discharge.

Ross Pidoto (SP7) and Amelie Krug (SP2) visited SP5 in Stuttgart between the 7th and 8th of January 2019 to work on the weather generator and the classification of circulation patterns based on rainfall events.

Larisa Tarasova (SP4) has attended MLSS2019 Machine Learning Summer School 7-18.01.2019 in Stellenbosch, South Africa

### Workshops, Conferences

#### EGU General Assembly 2019, 08-12 April, Vienna, Austria

Several Sessions at the last EGU General Assembly were organized by members of the SPATE-project.

**HS2.2.4:** From observations to models – journey of model development

Convener: Shervan Gharari, Co-conveners: Björn Guse (SP3), Sina Khatami, Charles Luce, Luis Samaniego, Simon Stisen.

**HS2.4.2:** Space-time dynamics of floods: processes, controls, and risk

Convener: William Farmer, Co-conveners: Heidi Kreibich, Luis Mediero, Alberto Viglione, Sergiy Vorogushyn

**HS3.2:** Spatio-temporal and/or geostatistical analysis of hydrological events, extremes, and related hazards

Convener: Emmanouil Varouchakis, Co-conveners: Gerald A. Corzo P., Svenja Fischer, A.B. Bárdossy, Dionissios Hristopulos, Andreas Schumann, Ross Woods

**HS7.7:** Hydroclimatic and hydrometeorologic stochastics: Extremes, scales, probabilities

Convener: J.L. Salinas, Co-Convener: M. Borga, A. Gires, R.A.P. Perdigão and A. Viglione


#### IUGG General Assembly 2019, 08-12 August 2019, Montreal, Canada

**H16:** Floods: processes, forecasts, probabilities, impact assessments and management

Convener: A. Viglione, S. Fischer, B. Merz, A. Schumann, C. White, S. Grimaldi, P. Pilon, A. Amani and T. Koike

**H24:** Modeling hydrological processes and changes under a changing environment

Convener: J. Zhou, Y. Chen, M. Borga, H. Aksoy, A. Gelfan, A. Viglione, G. Mahé and H. Kunstmann

**JS06:** Old data for new knowledge: preservation and utilization of historical data in the geosciences

Convener: J. Batlló Ortiz, A. Viglione, J. Ádám, E. Cliver, K. Harper, B. Raup, F. Fetterer, E. Pattabhi Rama Rao and R. Carniel