

# Emanuele Bevacqua

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## Postdoctoral work experience

- 01/2021– **Research Scientist.**  
Present Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany.
- 03/2019– **Postdoctoral Research Assistant/Fellow.**  
12/2020 Department of Meteorology, University of Reading, UK.
- 09/2018– **Postdoctoral Research Scientist.**  
02/2019 Wegener Center for Climate and Global Change, University of Graz, Austria.

## Research interests

I study the impact of past and future climate change on extreme events via focusing on compound events, i.e. impacts caused by the combination of multiple drivers/hazards. For example, my research has focussed on long-lasting precipitation events caused by consecutive cyclones, compound flooding happening in low-lying coastal areas due to co-occurring precipitation and sea level extremes, and droughts in combination with heatwaves. I employ climate models, outputs from hydrological models, and statistical tools to understand the physical mechanisms driving these extreme events and associated future changes, with a focus on uncertainties. I am interested in climate model evaluation, multivariate statistics (copulas and pair copula constructions), statistical downscaling, regional climate modelling, and *storylines* as an approach to explore future climate risk. .

## Education

- 11/2014– **PhD (Dr. rer. nat) in Physics (Climate Science).**  
09/2018 2016–2018: Wegener Center for Climate and Global Change, University of Graz, Austria.  
2014–2015: GEOMAR – Helmholtz Centre for Ocean Research Kiel, Germany.  
*Pass with distinction.*
- Thesis *Multivariate statistical modelling and analysis of compound events.*  
Supervisor Prof. Douglas Maraun.
- 2012–2014 **Master of Science in Physics (Astrophysics and Geophysics).**  
University of Calabria, Cosenza, Italy.  
*Cum laude, and honourable mention for career.*
- Thesis *Analysis of the magnetohydrodynamic turbulence anisotropy based on a novel definition of the mean magnetic field.*

2009–2012 **Bachelor's degree in Physics.**

University of Calabria, Cosenza, Italy.

*Cum laude, and honourable mention for career.*

Thesis *Focus on the last glacial period: the dynamics of the Dansgaard–Oeschger events.*

## Publications

- Villalobos-Herrera, R., **Bevacqua, E.**, Ribeiro, A.F.S., Auld, G., Crocetti, L., Mircheva, B., Ha, M., Zscheischler, J., and De Michele, C. (2021). "Towards a compound-event-oriented climate model evaluation: a decomposition of the underlying biases in multivariate fire and heat stress hazards". *Natural Hazards and Earth System Sciences*, 21, 1867–1885, DOI: 10.5194/nhess-21-1867-2021..
- **Bevacqua, E.**, Shepherd, T.G., Watson, P.A.G., Sparrow, S., Wallom, D., and Mitchell, D. (2020). "Larger spatial footprint of wintertime total precipitation extremes in a warmer climate". *Geophysical Research Letters*, DOI: 10.1029/2020GL091990.
- Messori, G., **Bevacqua, E.**, Caballero, R., Coumou, D., De Luca, P., Faranda, F., Kornhuber, K., Martius, O., Pons, F., Raymond, C., Ye, K., Yiou, P., and Zscheischler, J. (2020). "Compound climate events and extremes in the mid-latitudes: dynamics, simulation and statistical characterisation". *Bulletin of the American Meteorological Society*. DOI: 10.1175/BAMS-D-20-0289.1.
- Zappa, G., **Bevacqua, E.**, and Shepherd, T. G. (2020): "Communicating potentially large but non-robust changes in multi-model projections of future climate", *International Journal of Climatology*, 41: 3657– 3669. DOI: 10.1002/joc.7041.
- **Bevacqua, E.**, Vousdoukas, M. I., Zappa, G., Hodges, K., Shepherd, T. G., Maraun, D., Mentaschi, L., and Feyen, L. (2020). "More meteorological events that drive compound coastal flooding are projected under climate change". *Communications Earth & Environment*, 1, 47, DOI: 10.1038/s43247-020-00044-z.
- **Bevacqua, E.**, Zappa, G., and Shepherd, T. G. (2020). "Shorter cyclone clusters modulate changes in European wintertime precipitation extremes". *Environmental Research Letters*. DOI: 10.1088/1748-9326/abbde7.
- **Bevacqua, E.**, Vousdoukas, M. I., Shepherd, T. G., and Vrac, M. (2020). "Brief communication: The role of using precipitation or river discharge data when assessing global coastal compound flooding". *Nat. Hazards Earth Syst. Sci.*, 20, 1765–1782, DOI: 10.5194/nhess-20-1765-2020.
- Zscheischler, J., Martius, O., Westra, S., **Bevacqua, E.**, Raymond, C., Horton, R., van den Hurk, B., AghaKouchak, A., Jézéquel, A., Mahecha, M. D., Maraun, D., Ramos, A. M., Ridder, N., Thiery, W., Vignotto, E. (2019). "A typology of compound weather and climate events". In press, *Nature Reviews Earth & Environment*. DOI: 10.1038/s43017-020-0060-z.
- Jézéquel, A., **Bevacqua, E.**, D'Andrea, F., Thao, S., Vautard, R., Vrac, M., Yiou, P. (2020). "Conditional and residual trends of singular hot days in Europe". *Environmental Research Letters* 15, 064018. DOI: 10.1088/1748-9326/ab76dd.

- **Bevacqua, E.**, Maraun, D., Vousdoukas, M. I., Voukouvalas, E., Vrac, M., Menzies, L., and Widmann, M. (2019). "Higher probability of compound flooding from precipitation and storm surge in Europe under anthropogenic climate change". *Science Advances*, Vol. 5, no. 9, eaaw5531. DOI: 10.1126/sciadv.aaw5531.
- Manning, C., Widmann, M., **Bevacqua, E.**, Van Loon, A. F., Maraun, D., and Vrac, M. (2019). "Increased probability of compound long-duration dry & hot events in Europe during summer (1950-2013)". *Environmental Research Letters* 14, 094006. DOI: 10.1088/1748-9326/ab23bf.
- Manning, C., Widmann, M., **Bevacqua, E.**, Van Loon, A. F., Maraun, D., and Vrac, M. (2018). "Soil moisture drought in Europe: a compound event of precipitation and potential evapotranspiration on multiple timescales". *Journal of Hydrometeorology*, 19(8), 1255-1271. DOI: 10.1175/JHM-D-18-0017.1.
- **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. (2017). "Multivariate statistical modelling of compound events via pair-copula constructions: analysis of floods in Ravenna (Italy)". *Hydrology and Earth System Sciences*, 21, 2701-2723. DOI: 10.5194/hess-21-2701-2017.
- Alberti, T., Lepreti, F., Vecchio, A., **Bevacqua, E.**, Capparelli, V., and Carbone, V. (2014). "Natural periodicities and Northern Hemisphere–Southern Hemisphere connection of fast temperature changes during the last glacial period: EPICA and NGRIP revisited". *Climate of the Past*, 10, 1751-1762. DOI: 10.5194/cp-10-1751-2014.

#### Under review/Submitted

- Maraun, D., Knevels, R., Mishra, A. N., Truhetz, H., **Bevacqua, E.**, Proske, H., Zappa, G., Brenning, A., Petschko, H., Schaffer, A., Leopold, P., and Puxley, L. "A severe landslide event in the Alpine foreland under future climate and land-use changes". In Review.

#### Software package and dataset

- **Bevacqua, E.**, Watson, P., Sparrow, S., and Wallom, D. (2020). "Multi-thousand-year simulations of December-February precipitation and zonal upper-level wind", (Version 1.0.0) [Data set], Zenodo, DOI: 10.5281/zenodo.4311221..
- **Bevacqua, E.** (2017). "CDVineCopulaConditional: an R package for conditional sampling from multivariate copula decomposed via C- or D-vines". R-package. DOI: 10.13140/RG.2.2.28442.85445.

#### PhD Thesis

- **Bevacqua, E.** (2018). "Multivariate statistical modelling and analysis of compound events". PhD thesis, University of Graz, Graz, Austria.

### Honours, awards, and grants

- 2019 Grant awarded for a *Short Term Scientific Mission* from the COST action DAMOCLES.
- 2018 Grant. Secondary proposer of the funded COST Action "DAMOCLES: UnDerstanding And Modeling cOmpound CLimate and weather EventS", CA17109.

- 2018 Winner of the *Outstanding Student Poster and PICO (OSPP) Award contest of the EGU General Assembly 2018, including a fee waiver for the EGU General Assembly and for a publication in a EGU journal.*
- 2017 Winner of the *SWGEN-Hydro conference young scientist travel support.*
- 2012, 2014 Winner of scholarship for merit *John R. Mott Scholarship Foundation.*
- 2013 Grant. Selected international graduate student for attending the TOSCA training School "Impact of Solar Variability on Climate").
- 2006 Winner at the regional stages of the *Olympics of mathematics*. Participation by invitation in the national stage of the *Olympics of mathematics*, obtaining an *Honourable Mention*.

## Outreach and appearances in media

### Interviews

- 03/2020 Sciences et Avenir (French science magazine), about the anomalous stormy season in France and its potential association with climate change.
- 03/2019 BBC, about future changes in compound flooding.
- 03/2019 New Scientist, about future changes in compound flooding.

### Blog posts

- 12/2019 "Climate change increases the "perfect storm" coastal flood potential". Meteorology blog of the University of Reading [Link] .
- 04/2019 "Towards a categorisation of statistical methods to study compound events". Blog of the COST action DAMOCLES.
- 04/2019 "Session report: Understanding and modelling compound climate and weather events and their impacts". Blog of the COST action DAMOCLES.
- 11/2018 "Climate change visualizations". Blog on personal website [Link].
- 09/2017 "Recent major compound flooding in Texas". Blog on personal website.

### Appearances in media and Mentions

- 11/2018 The movement *Historians for future* (<https://historiansforfuture.org>) uses some of my global warming visualisations on their homepage and as profile picture on Twitter.
- 03/2019 Our Science Advances paper on future changes of compound flooding was largely discussed by the media. [Link to some articles].
- 03/2019 "Visualizzazione dei cambiamenti climatici, cosa sta succedendo?" Scopriamone di più". Published on calabrianews24.it and MeteoCalabria.net.
- 12/2018 "Visualizzazione dei cambiamenti climatici, perchè è importante conoscere questa minaccia? Scopriamone di più. PARTE 1", Published on calabrianews24.it and MeteoCalabria.net.
- 11/2018 Eguraldia show (EiTB TV) discussed global warming based on some visualisations developed by my self.

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## Skills

### Computer skills

**Programming languages:** R, Bash; previous experience with IDL, Fortran, C, and C++.

**Operating Systems:** Linux, Windows.

**Geophysical models:** FES astronomical tide model, experience with COSMO-CLM (Regional Climate Model).

### Languages

Italian (mother tongue), English (fluent), German (conversant), French (basic).

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## Research stays

- 03/2019 **Laboratoire de Météorologie Dynamique (LMD)**, Paris, France. One-week short term scientific mission (STSM) within DAMOCLES project.
- 06/2015–12/2015 **Laboratoire des Sciences du Climat et de l'Environnement**, Gif-sur-Yvette, France. Development statistical model for the CE:LLO project (supervisor: Dr. Mathieu Vrac).
- 02/2015 **Norwegian Computing Center**, Oslo, Norway. Training in Pair-copula constructions (supervisors: Dr. I. Hobaek-Haff and Prof. A. Frigessi).

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## Experience

### Teaching and Supervision

- 03/2020 Exam marking for the Master programme (MTMG05: Professional Skills module) at the Department of Meteorology, University of Reading.
- 02/2020 Supervisor of a group project ("Present and future changes in tropical cyclone translation speeds") undertaken by a group of five master students. Department of Meteorology, University of Reading.
- 09/2019 Trainee at the "Training School on Statistical Modelling of Compound Events" (together with Prof. Carlo De Michele): supervision and organisation of the group project "Model evaluation of bivariate relationships with copulas", undertaken by a group of six among PhD students and early Postdocs.
- 10/2019 Invited lecturer at the "Training School on Statistical Modelling of Compound Events": "Physical processes driving compound flooding (CF) and its future changes".

### Organisation and management

- 2021-Present Leader of the Working Group 4 ("New statistical approaches for model development and evaluation") of the COST Action "DAMOCLES" (CA17109), <http://damocles.compoundevents.org/core.php>.
- 11/2020 Organiser, workshop "Bottom-up identification of key elements of compound events" funded by the COST Action "DAMOCLES" (CA17109), *Tirana, Albania (held online due to COVID-19 restrictions), November 3-6 2020*.

- 10/2020 Co-organiser, workshop "Using and reconciling statistical and process-based approaches for modelling compound events" funded by the COST Action "DAMOCLES" (CA17109), *Malta (held online due to COVID-19 restrictions), October 21,22, and 27; 2020.*
- 2019-2020 Management committee (MC) member for the United Kingdom in the COST Action "DAMOCLES" (CA17109).
- 2019-2020 Manager, Group Workspace "storycc" on the JASMIN computing infrastructure.
- 2018-2019 Management committee (MC) member substitute for Austria in the COST Action "DAMOCLES" (CA17109).
- 2016-2019 Organiser, seminar series ("Challenges in Regional Climate Research") for the Reloclim group at the Wegener Center for Climate and Global Change.
- 2016-12-15 Moderator, T4Science seminar "How to ask good scientific questions? A panel discussion" at the University of Graz.
- 2013-2015 Student representative at the Physics Department of the University of Calabria.
- 2012-2014 Co-organiser, seminar series for the CuboRisonante group at the Physics Department of the University of Calabria.

### Memberships

- 2018-present Member of the funded COST Action "DAMOCLES: UnDerstanding And Modeling cOmpound CLimate and weather EventS", CA17109.
- 2015-present European Geosciences Union (EGU).
- 2013-2014 Member of the amateur weather association "Cosenza Meteo".

## Conference and workshop presentations

### Oral presentations

- 03/2021 **Bevacqua, E.**, Zappa, G., and Shepherd, T. G., "Shorter cyclone clusters modulate changes in European wintertime precipitation extremes". vEGU General Assembly 2021 **(Highlight)**.
- 02/2021 **Bevacqua, E.**, "Projections of changes in meteorological events that drive compound coastal flooding". American Society of Civil Engineers Virtual Workshop on Compound Flooding **(Invited)**.
- 01/2021 **Bevacqua, E.**, Zappa, G., and Shepherd, T. G., "Shorter cyclone clusters modulate changes in European wintertime precipitation extremes". Workshop on Compound Weather and Climate Events.
- 01/2021 **Bevacqua, E.**, "More meteorological events that drive compound coastal flooding are projected under climate change". Workshop on Compound Weather and Climate Events.
- 11/2020 **Bevacqua, E.**, "Projections of the compound flooding potential from coastal processes and cyclone clusters". Colloquium in Climatology, Climate Impact and Remote Sensing. Institute of Geography, University of Bern **(Invited)**.

- 11/2020 **Bevacqua, E.**, "The relevance of using an impact-related metric for studying temporally compounding events: Cyclone clusters in Europe". Workshop "Bottom-up identification of key elements of compound events, Tirana, Albania (held online due to COVID-19 restrictions).
- 10/2020 **Bevacqua, E.**, "More meteorological events that drive compound coastal flooding are projected under climate change at most locations worldwide". Risk-KAN Working Groups – Webinars **(Invited)**.
- 09/2020 **Bevacqua, E.**, "Global projections of meteorological drivers of compound coastal flooding". (Virtual) Workshop on Mid-Latitude Compound Climate Extremes, originally planned at Uppsala University **(Invited)**.
- 03/2020 **Bevacqua, E.**, "Projections of precipitation extremes driven by cyclone clusters in Europe". Seminar series HHH, University of Reading.
- 10/2019 **Bevacqua, E.**, "Physical processes driving compound flooding (CF) and its future changes". Climate and Ocean Dynamics (COD) group Seminars, University of Reading.
- 04/2019 Maraun, D., and **Bevacqua, E.** (co-presenter), "Storylines of a future precipitation extreme event - what is the event, what are the storylines, and are they sensible?". Workshop on physical modeling supporting a "storyline approach". Oslo Science Park, Norway.
- 04/2019 **Bevacqua, E.**, Maraun, D., Voudoukas, M. I., Mentaschi, L., Voukouvalas, E., Zappa, G., and Vrac, M. "Changing compound flood probability at the global scale under anthropogenic climate change". EGU General Assembly 2019, Vienna, Austria.
- 03/2019 **Bevacqua, E.** Assessing the impact caused by compound events, with a focus on the future changes in the compound flooding hazard, Workshop on Compound Events, Paris, France.
- 01/2019 **Bevacqua, E.**, Maraun, D., Voudoukas, M. I., Voukouvalas, E., Vrac, M., Mentaschi, L., and Widmann, M. "Higher compound flood probability in Europe under anthropogenic climate change". Jour-fixe, University of Graz, Austria.
- 10/2018 **Bevacqua, E.**, Piazza, M., Maraun, D., and Truhetz, H. "An attempt to estimate the climate change effect on the June 2009 Austrian extreme event based on the storyline approach". Annual CORDEX-FPS meeting on Convection over Europe and the Mediterranean, University of Lisbon, Portugal.
- 09/2018 **Bevacqua, E.**. "Multivariate statistical modelling and analysis of compound events". Public PhD defence, University of Graz, Austria.
- 11/2017 **Bevacqua, E.**, Maraun, D., Voudoukas, M. I., Voukouvalas, E., Vrac, M., Mentaschi, L., and Widmann, M. "Increasing likelihood of compound flooding over northern Europe in response to anthropogenic climate change". Compound flood events meeting, European Joint Research Centre, Ispra, Italy **(Invited)**.
- 11/2017 **Bevacqua, E.**, and Maraun, D. "On the link between cyclones and potential compound flooding". Compound flood events meeting, European Joint Research Centre, Ispra, Italy **(Invited)**.

- 09/2017 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Multivariate statistical modelling of compound events via pair-copula constructions: analysis of floods in Ravenna (Italy)". International Workshop on Stochastic Weather Generators for Hydrological Applications (SWGen-Hydro), Berlin, Germany.
- 04/2017 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Multivariate statistical modelling of compound events via pair-copula constructions: analysis of floods in Ravenna (Italy)". EGU General Assembly 2017, Vienna, Austria.
- 04/2017 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "The R-package CDVineCopulaConditional for modelling Compound Events". Workshop on Addressing the Challenge of Compound Events, ETH Zurich, Switzerland **(Invited)**.
- 09/2016 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Statistical modeling of compound events via pair-copula constructions: Ravenna flooding case study". Statussymposium "Extremes" 2016: VolkswagenStiftung, Hannover, Germany **(Invited)**.
- 06/2016 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "A model based on Pair-Copula Construction to analyze and represent Compound Flooding". The 13th International Meeting on Statistical Climatology, Canmore, Canada.
- 03/2013 **Bevacqua, E.** "What surface temperature response would one expect from a change in total solar irradiance of 0.1%?". 1st TOSCA training school "Sun2Climate school", Thessaloniki, Greece.

#### Poster presentations

- 04/2018 **Bevacqua, E.**, Maraun, D., Voudoukas, M. I., Voukouvalas, E., Vrac, M., Mentaschi, L., and Widmann, M. "Changing risk of compound flooding over Europe in response to climate change". EGU General Assembly 2018, Vienna, Austria.
- 09/2017 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "The R-package CDVineCopulaConditional for modelling Compound Events". International Workshop on Stochastic Weather Generators for Hydrological Applications (SWGen-Hydro), Berlin, Germany.
- 04/2017 **Bevacqua, E.**, Maraun, D., Voukouvalas, E., Voudoukas, M. I., Widmann, M., Manning, C., and Vrac, M. "Analysis of present and future potential compound flooding risk along the European coast". EGU General Assembly 2017, Vienna, Austria.
- 04/2017 **Bevacqua, E.**, Maraun, D., Voukouvalas, E., Voudoukas, M. I., Widmann, M., Manning, C., and Vrac, M. "Analysis of present and future potential compound flooding risk along the European coast". Workshop on Addressing the Challenge of Compound Events, ETH Zurich, Switzerland **(Invited)**.
- 04/2016 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Statistical Modelling of Compound Floods: a Sensitivity Analysis". EGU General Assembly 2016, Vienna, Austria.
- 04/2016 **Bevacqua, E.**, Maraun, D., Vrac, M., Widmann, M., and Manning, C. "Statistical Modelling of Compound Floods". 17th Austrian Climate Day - "KlimaTag", Graz, Austria (Pitch and Poster).



- 11/2015 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Multivariate Statistical Modelling of Compound Floods". Statistical and mathematical tools for the study of climate extremes, Cargèse, France.
- 08/2015 **Bevacqua, E.**, Maraun, D., Haff, I. H., Widmann, M., and Vrac, M. "Statistical Modelling of Compound Floods". 14th Swiss Climate Summer School - "Extreme Events and Climate", Ascona, Switzerland.
- 03/2013 Alberti, T., **Bevacqua, E.** (presenter), Capparelli, V., Lepreti, F., Vecchio, A., and Carbone, V. "Natural periodicities and North–South hemispheres connection of fast temperature changes during the last glacial period: EPICA and NGRIP revisited". 1st TOSCA training school "Sun2Climate school", Thessaloniki, Greece.