

# Waves to Weather



## Newsletter Jul/Sep 2022

Welcome once again to the W2W newsletter. In this issue, we are pleased to announce our new Fellowship program, where we sponsor distinguished guests for extended visits to share their knowledge and develop collaborations with W2W scientists. In the other direction, we have always sponsored international visits by our early career scientists, and we have a report on one of the first such visits since travel restriction have been relaxed. It's starting to feel like scientific life is returning to normal!

George Craig

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If you have any questions or comments about this newsletter or W2W in general, we would be happy to hear from you!

## Upcoming events

- The **Mathematics of the Weather conference** will take place from 4-6 October 2022 in Bad Orb with the support of W2W and in collaboration with the HIWeather programme of WMO. For more information about the program, abstracts, venue, and much more, visit: <https://www.wavestoweather.de/meetings/mow2022>
- The **W2W Annual Meeting** will take place from 28-30 November 2022 in Würzburg. For more information, visit: <https://www.wavestoweather.de/meetings/w2w-ann-meet-2022>

Additional information on upcoming events can be found here:

<http://www.wavestoweather.de/meetings>

## News

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**Markus Bachmayr** accepted a professorship (W3) at RWTH Aachen, starting in July 2022. He says: “I certainly hope to keep in touch with people on our common interests, and keep the ongoing interactions with W2W people.” Congratulations and good luck, Markus!



**Michael Maier-Gerber (C3 project, KIT)** works at ECMWF in Bonn since 1 July 2022. He writes: “I am very grateful for all the experiences that I was able to gain as part of W2W.” Congratulations, Michael, and good luck with the new exciting challenges ahead of you!



**Judith Berner and Ihan Chen (NCAR)** visited W2W colleagues from the meteorological institute from 5-9 September 2022 to discuss collaborations between NCAR and W2W in Phase 3, in particular regarding the B3 project.

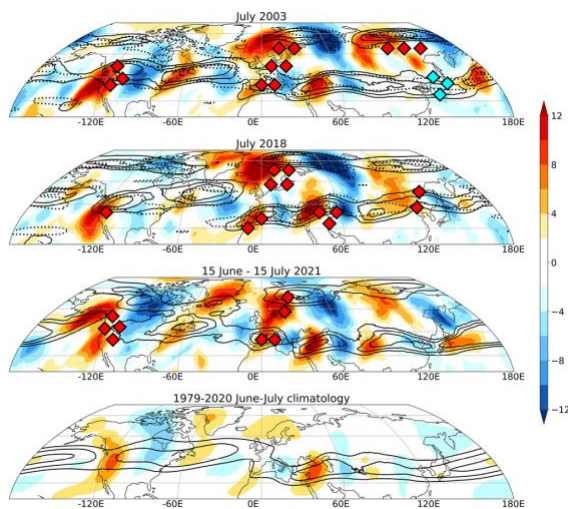


## Research Highlights

Here are some examples of recently published research from W2W.

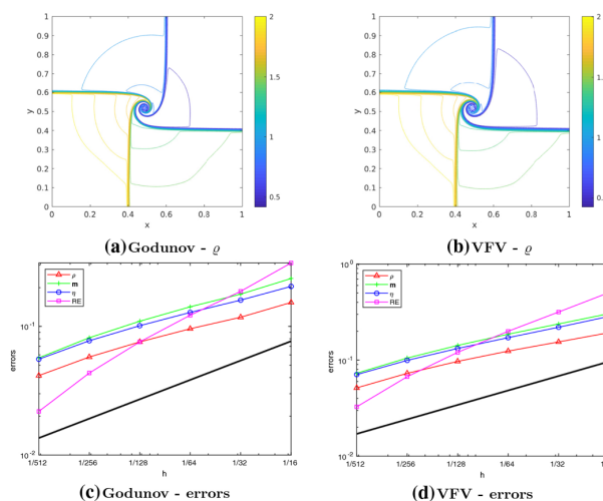
### 1. From atmospheric waves to heatwaves: A waveguide perspective for understanding and predicting concurrent, persistent and extreme extratropical weather (R. H. White, K. Kornhuber, O. Martius and V. Wirth)

A notable number of high-impact weather extremes have occurred in recent years, often associated with persistent, strongly meandering atmospheric circulation patterns known as Rossby waves. Because of the high societal and ecosystem impacts, it is of great interest to be able to accurately project how such extreme events will change with climate change, and to predict these events on seasonal-to-subseasonal (S2S) time scales. By focusing on the Rossby waveguide, it may be possible to circumvent some model biases in later links. We recommend exploring these links in model hierarchies of increasing complexity, developing fundamental theory, exploiting novel large ensemble datasets, harnessing deep learning, and increased community collaboration.



Read the full article: <https://doi.org/10.1175/BAMS-D-21-0170.1>

### 2. Error estimate of the Godunov method for multidimensional compressible Euler equations (M. Lukacova-Medvidova, B. She and Y. Yuan)



We derive a priori error estimates of the Godunov method for the multidimensional compressible Euler system of gas dynamics. To this end we apply the relative energy principle and estimate the distance between the numerical solution and the strong solution. The numerical results presented are consistent with our theoretical analysis.

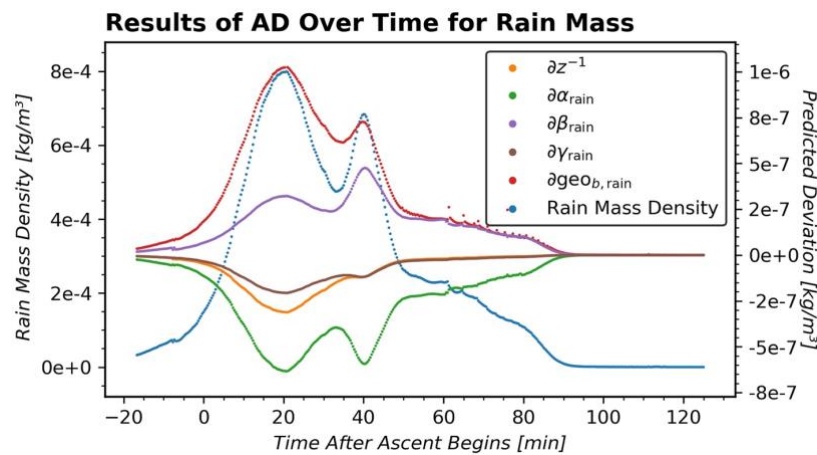
Read the full article: <https://link.springer.com/article/10.1007/s10915-022-01843-6>

### 3. Approximating viscosity solutions of the Euler system (E. Feireisl, M. Lukáčová-Medvid'ová, S. Schneider and B. She)

Applying the concept of S-convergence, based on averaging in the spirit of Strong Law of Large Numbers, the vanishing viscosity solutions of the Euler system are studied. We show how to efficiently compute a viscosity solution of the Euler system as the S-limit of numerical solutions obtained by the viscosity finite volume method. Theoretical results are illustrated by numerical simulations of the Kelvin–Helmholtz instability problem.

Read the full article: <https://doi.org/10.1090/mcom/3738>

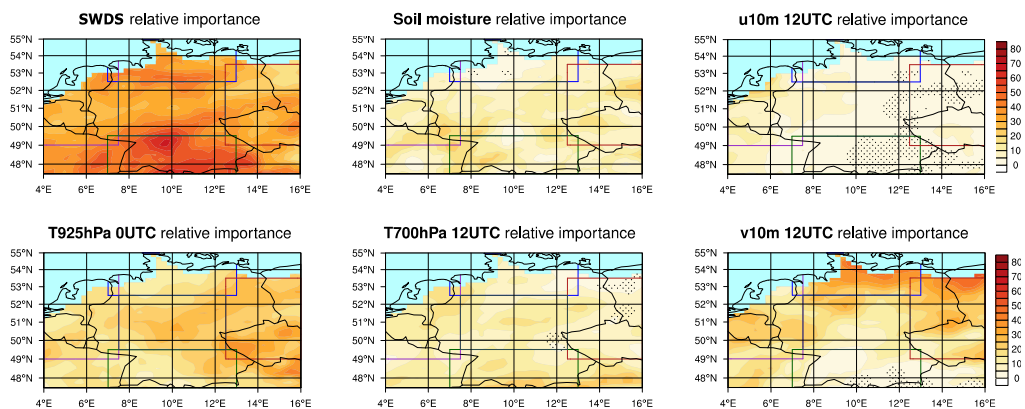
### 4. Algorithmic Differentiation for Sensitivity Analysis in Cloud Microphysics (M. Hieronymus, M. Baumgartner, A. Miltenberger and A. Brinkmann)



The formation of clouds is determined by processes that act on smaller scales than weather prediction models can resolve. Consequently, a parameterization with typically hundreds of parameters is constructed to determine the effects of these processes on the resolved larger scales. These parameters are a well-known source of uncertainty in weather and climate models. Classical attempts to quantify this uncertainty are typically limited to a few parameters. We propose algorithmic differentiation (AD) as a tool to detect parameters with the largest impact for any of the hundreds of parameters on multiple model state variables at every time step in our simulation. This increases the computational cost by roughly a third. The relevance of the AD-estimated impact is demonstrated by comparing the AD results with ensemble simulations, where different parameter settings are used in the various ensemble members.

Read the full article: <https://doi.org/10.1029/2021MS002849>

## 5. Identifying causes of short-range forecast errors in maximum temperature during recent Central European heatwaves using the ECMWF-IFS ensemble (A. Lemburg and A. Fink)

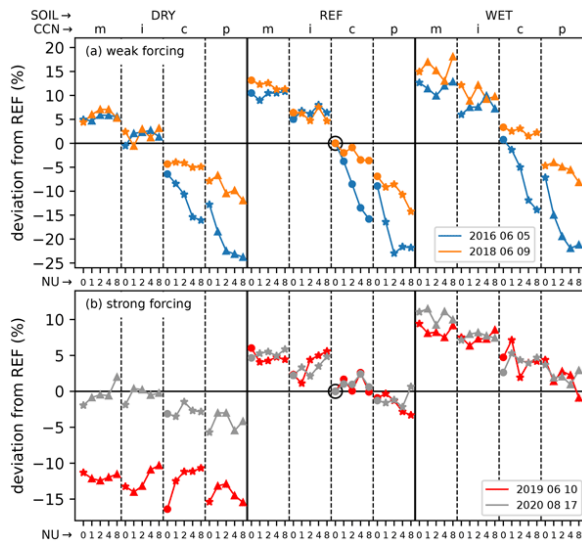


Most studies focus on the predictability of heatwaves on medium-range to subseasonal time scales (5-30 days). However, also short-range (3-day) forecasts of maximum temperature (Tmax) can exhibit substantial errors even on larger spatial scales. Analyzing ECMWF operational ensemble forecasts for the summers 2015-2020, we find that outside of heatwaves, errors in 3-day Tmax forecasts are predominantly caused by incorrectly predicted downwelling short-wave radiation, mainly due to errors in low cloud cover. During heatwaves, other error sources gain importance: the second most important error source is over- or underestimation of nocturnal temperatures in the residual layer. Lagrangian trajectory analysis suggests a link to accumulating errors in near-surface diabatic heating of air masses associated with forecast errors in residence time over land and cloud cover. Regionally, other physical processes can be of dominant importance during heatwaves, such as errors in predicted near-surface wind along the coasts or errors in soil moisture further inland.

Read the full article: <https://journals.ametsoc.org/view/journals/wefo/aop/WAF-D-22-0033.1/WAF-D-22-0033.1.xml>



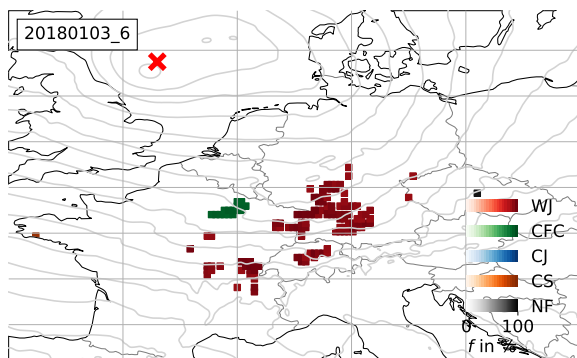
## 6. Impacts of combined microphysical and land-surface uncertainties on convective clouds and precipitation in different weather regimes (C. Barthlott, A. Zarboo, T. Matsunobu and C. Keil)



The relevance of microphysical and land-surface uncertainties for convective-scale predictability is evaluated with a combined-perturbation strategy in realistic convection-resolving simulations. We find a large ensemble spread which demonstrates that the uncertainties investigated here and, in particular, their collective effect are highly relevant for quantitative precipitation forecasting of summertime convection in central Europe.

Read the full article: <https://doi.org/10.5194/acp-22-10841-2022>

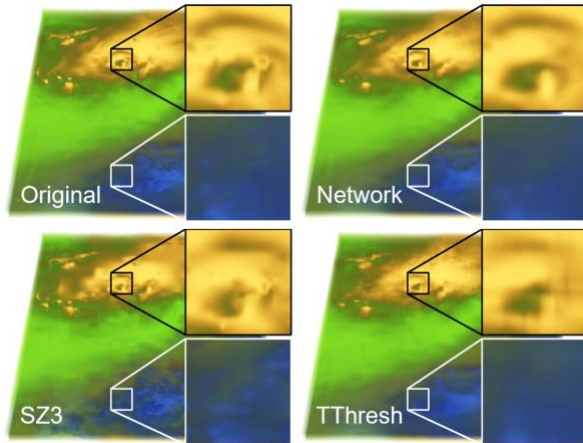
## 7. Identification of high-wind features within extratropical cyclones using a probabilistic random forest. Part I: Method and case studies (L. Eisenstein, B. Schulz, G.A. Qadir, J.G. Pinto and P. Knippertz)



Mesoscale high-wind features within extratropical cyclones can cause immense damage. A novel approach, called RAMEFI, objectively identifies the different wind features, including the warm jet, cold and sting jet, cold-frontal convection and cold sector winds, based on a probabilistic random forest. This method enables a wide range of applications such as probabilistic predictions for the occurrence, a multi-decadal climatology of these features or a forecast error analysis.

Read the full article: <https://doi.org/10.5194/wcd-2022-29>

## 8. Evaluation of Volume Representation Networks for Meteorological Ensemble Compression (K. Höhle, S. Weiss and R. Westermann)



We evaluate the capabilities of fast volume scene representation networks (fV-SRNs) in compressing meteorological multi-parameter and ensemble data. Particular emphasis is put on the impact of data normalization schemes on learning quality, as well as on the quantitative and qualitative comparisons of the method against classical floating-point compressors. We find that the network approach yields competitive reconstruction accuracy at high compression ratios, while avoiding the injection of artificial high-frequency noise and stripe-like error patterns, as seen in the classical competitors.

Read the full article: <https://diglib.eg.org/handle/10.2312/vmv20221198>

**Additional publications relevant to W2W** are listed here:

<http://www.wavestoweather.de/publications>

## Past activities

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**Towards the understanding of synoptic-scale processes and teleconnections in shaping different pathways to Greenland Blocking – My research stay at the University of Wisconsin-Madison (USA)**  
by Seraphine Hauser

In the early summer of 2022, I was given the opportunity by W2 to do a short-term research stay at the University of Wisconsin-Madison. After more than 2 years of the pandemic, I was very happy to meet other scientists and discuss my PhD topic with external partners in person and above all - to see and live in a new place.

In the first part of my PhD I developed a quasi-Lagrangian framework based on potential vorticity (PV) which traces upper-tropospheric anticyclonic PV anomalies that are associated with blocking episodes in the North Atlantic-European region. After a long period of adjustments on the framework based on applications to single blocking cases, I was ready to apply the finalized quasi-Lagrangian perspective to a specific blocked weather regime type from a climatological perspective: The Greenland Blocking. Using my framework, we were able to gain new insights into the dynamics of Greenland blocking and saw that there are three pathways for the PV anomalies that later constitute the Greenland 'block'. The next goal was to work out which dynamics are behind these pathways and which processes are crucial for the development and amplification of the anomalies on their way to Greenland. I

couldn't be happier to have the chance to work with Prof. Jonathan Martin and Dr. Stephanie Henderson from the department 'Atmospheric and Oceanic Sciences' in Madison on this topic together!



*On my bike ride to university*

With Jonathan, I focused on the role of synoptic-scale processes and the role of extratropical cyclones. His long-standing expertise in dynamics with focus also on more local phenomena over the US is very helpful to understand the different pathways to Greenland blocking. While in two of the three pathways PV anomalies exist days before and are advected into the region, one pathway stands out in boreal winter where the PV anomalies associated with the block develop in-situ southwest of Greenland - a region where extratropical cyclones can develop explosively. With Stephanie, I worked on the remote and more tropical influences on Greenland Blocking. Here we looked at the effect of El Niño Southern Oscillation (ENSO) and the Madden-Julian Oscillation (MJO) on Greenland blocking to see if a certain status of ENSO and MJO is associated with a preferred pathway of PV anomalies. We were able to get new and super interesting insights looking at ENSO and see pathway preferences during La Niña, El Niño and ENSO neutral winters. During my time in Madison, I also met Prof. Michael Morgan who is part of the Scientific Advisory Board in W2W. He gave me helpful feedback on the current status of my project. In my last week at the University, I was invited to give a public seminar talk to the scientists in the department and received very positive feedback and some further ideas to work on. So, in summary, the 3.5 weeks in the US were a great start to a valuable collaboration.





*Office view*

I would also like to report about how my life looked like during these weeks. First of all, I fell in love with this stunning city. From the first day I was welcomed, and I got a lot of support in settling in. I decided to live in a shared apartment and I can highly recommend it to every ECS who is thinking about a stay abroad. The bike network in Madison is insane and I reached the campus within a few minutes from the bike along the lake. Outside of my work hours, I saw a lot of the city, swam in the lake, attended concerts, and took various canoe and bike tours. I was also very lucky to have the support of Dr. Maria Madsen who is a Postdoc from Madison in project A8 - she organized a lot and made sure that I could connect right away with other people.

My research stay was more than a few weeks ago and I am back at my usual workplace in Karlsruhe. But the collaboration with Jonathan and Stephanie continues virtually. I am excited to see what the next weeks and months of collaboration will bring, but we already closed some gaps in the understanding of the pathways and a fairly complete understandable picture of the dynamics of Greenland Blocking is already emerging. Last but not least, I would like to take this opportunity to thank W2W and the ECS Committee for the funding without which this stay would not have been possible. This research stay in Madison has advanced my research but also left positive effects personally and for that, I am very grateful. I can only recommend it to every ECS to go on this adventure and to step out of one's comfort zone.

## ECS Annual Meeting



*Participants of the ECS annual meeting on 6-8 July 2022 in Speyer*

The ECS gathered in person to join their annual meeting from 6-8 July 2022 in Speyer. The meeting started with a keynote talk by Maria Madsen (project A8) on characterizing optimal wintertime Atlantic-European blocking precursors. Maria gave a summary about the weather regimes and blocking events forecasts and explained the linear inversed model technique (LIM) for characterizing the dynamics of weather regimes. The meeting continued with interactive group work where the ECS from different research areas formed small groups to discuss their research topics and brainstorm on potential collaboration and new research questions. The ECS were asked to make a poster about their research idea and present it to the other participants. Lisa-Ann Kautz was the second keynote presenter and talked about atmospheric blocking and extreme events. Lisa gave an overview of blocking dynamics, a comparison of different indices, and examples of surface extreme events and blocking occurrences in a warmer climate.

On the second day, the ECS participated in the hands-on data management workshop organized by Oriol Tinto (project Z2). Oriol gave a presentation about research data management and introduced the archive tool iRODS. The ECS practiced how to archive and make a public ticket for their data repository using iRODS. To better learn the iRODS commands, the ECS took part in an escape game where they had to find the key to obtain their digital certificate. The meeting continued with a discussion on topics such as documentation and data transfer strategies and collaborations within W2W projects. Ideas that came out of this discussion will be used for future ECS activities. In the afternoon, the ECS visited the Technic Museum of Speyer. For an optional evening activity, Edward Groot gave a talk about “predictability thought experiment” and the ECS discussed their ideas and views.

On the last day, the meeting started with a showcasing session where some ECS presented and shared knowledge about useful tools. These include Flotplot, Autosubmit, Proplot, Packaging (S2S tools), and an introduction to Dask. The meeting continued with a session on enhancing graphics for publication and presentation. Examples of step-by-step figure

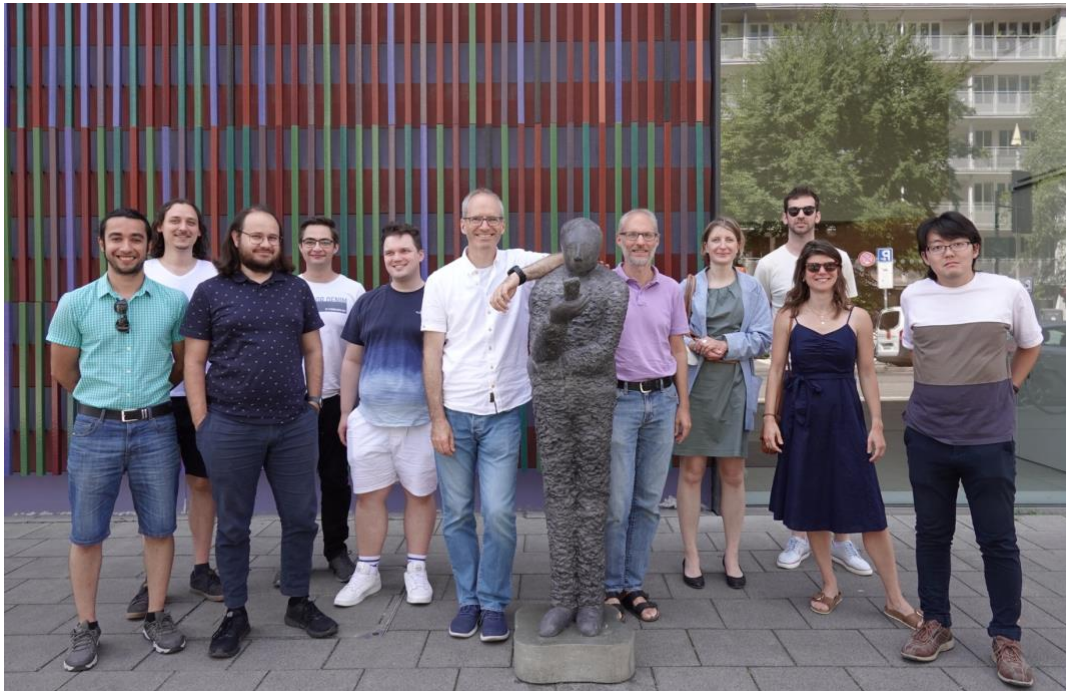
improvements were given and the ECS then practiced with-in smaller groups how to improve their figures through feedback rounds. The meeting came to an end with an ECS general assembly where ideas about future meetings and workshops were discussed.

Thank you to everyone who participated and helped to organize and make this meeting happen. It was a wonderful experience!

To read more about this meeting, visit:

<https://www.wavestoweather.de/meetings/ecs-annual-meeting-2022>

### Research Area B meeting



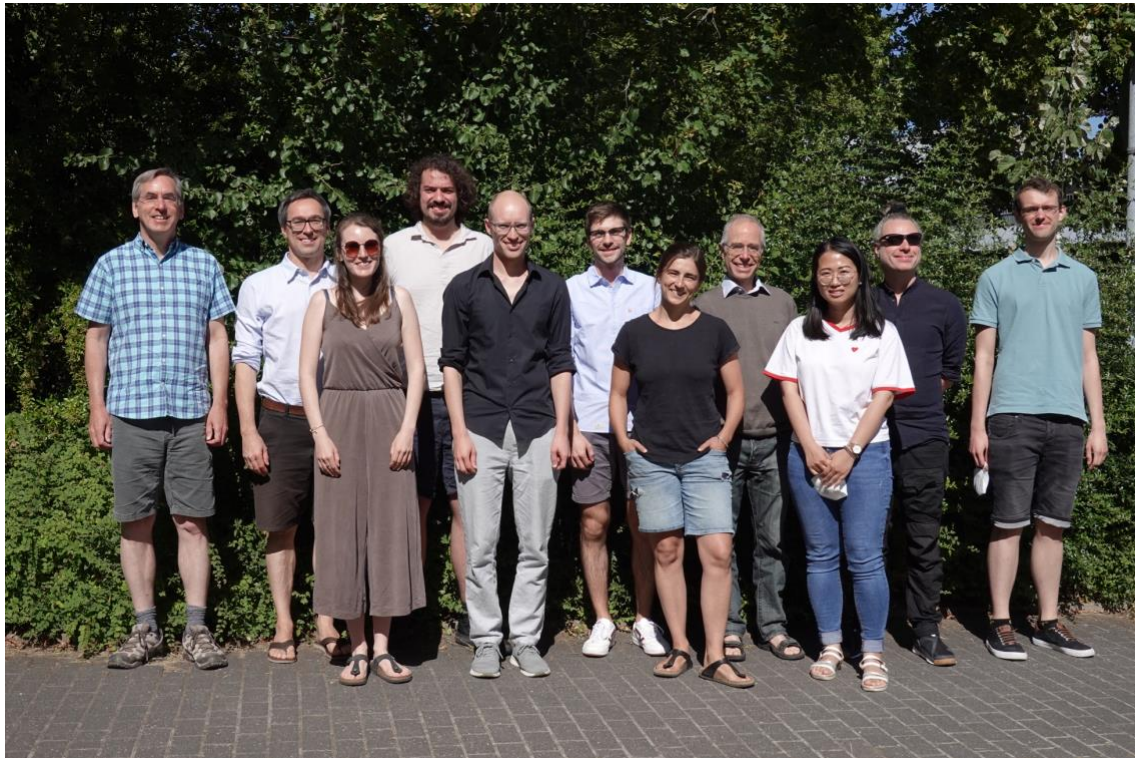
*Participants of the RA-B meeting on 14 July 2022*

The Research Area B meeting took place on 14 July 2022 in Munich. About 25 participants from Mainz (JGU), Karlsruhe (KIT), Munich (LMU, TUM) and Canada (Environment Canada) attended the meeting, in person or online. The excellent talks by the ECS presenting exciting results were followed by lively discussions, making the meeting very enjoyable and successful. The active participation of Linda Schlemmer (DWD), the new SAB member with expertise in RA-B, and the contribution of Ron Mc Taggart-Cowan were some highlights of this meeting. For more information, visit:

<https://www.wavestoweather.de/meetings/ra-b-meeting-2022>



## Research Area A meeting



*Participants of the RA-A meeting on 19 July*

The RA-A meeting took place in Mainz on 19 July 2022. Twenty-seven participants took part in the meeting, half of which in person. The ECS presented their recent results and ongoing work and lively discussions followed. The insights from Carolyn Reynolds and Ron McTaggart-Cowan (SAB members) were as usual extremely valuable. The research questions from the research area were discussed, in particular with focus on Phase 3.

Thank you to all presenters for your excellent talks!

For more information about this meeting, visit:

<https://www.wavestoweather.de/meetings/ra-a-meeting-2022>

## AMS Collective Madison meeting

Corinna Hoose (B1, B6, B8 projects), Patrick Kuntze (B1 project), Annika Oertel (B8 project) and Lena Frey (B1 project) took part in the “AMS Collective Madison meeting” in Madison, Wisconsin, from 8-12 August 2022. The meeting was combining four different conferences: the 25<sup>th</sup> Conference on Satellite Meteorology, Oceanography, and Climatology, the 17<sup>th</sup> Conference on Polar Meteorology and Oceanography, the 16<sup>th</sup> Conference on Cloud Physics and the 16<sup>th</sup> Conference on Atmospheric Radiation. The meeting was held at the Monona Terrace Community and Convention Center, which was a nice spacious location directly at Lake Monona. It was in general well organized, with enough time scheduled for lunch and coffee breaks, which were great for networking. There were talks in the morning and in the afternoon and it was nice to be able to switch between the different conferences. The poster sessions were well attended.



Read more about this meeting here:

<https://www.ametsoc.org/index.cfm/ams/meetings-events/ams-meetings/collective-madison-meeting/>

## Seminars and guest program

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**Linus Magnusson** (ECMWF), **Daniel Kirshbaum** (McGill University) and **Juliana Dias** (NOAA) are the **W2W Fellows 2023** for Research Area A, RA-B, and RA-C, respectively. We are looking forward to exciting and intensive collaborations between the three Fellows and W2W!





*Linus Magnusson (RA-A)*

*Daniel Kirshbaum (RA-B)*

*Juliana Dias (RA-C)*

Read more about the **W2W Fellows program** here:

<https://www.wavestoweather.de/guest>

Information about previous **guest scientists** invited by W2W is posted here:

<http://www.wavestoweather.de/guest>

Past and upcoming **W2W seminars** are listed here:

<http://www.wavestoweather.de/seminars>

The seminars and colloquium are broadcasted live using **Adobe Connect**. If you would like to receive a link to listen to the presentation, please contact us.

## Communication

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### Dissemination

#### Past issues of this newsletter

Past issues of this newsletter are available here:

[https://www.wavestoweather.de/communication/dissemination-activities/publications/quarterly\\_newsletter](https://www.wavestoweather.de/communication/dissemination-activities/publications/quarterly_newsletter)

### Outreach

#### Interview in the KIT Campus Report

Benedikt Schulz gave an interview about the early warning of hurricane gusts using AI to the KIT Campus-Report. His interview (in German) is available here:

<https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview-kit-2022>

#### Interview in the “Stuttgarter Zeitung”

Andreas Fink gave an interview to the Stuttgarter Zeitung on 13 July 2022 about the early warning for heat waves. Read more:

[https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview\\_stuttgartzeitung2022](https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview_stuttgartzeitung2022)

#### Interview in the “Südkurier”

Andreas Fink gave an interview to the Sürkurier on 18 July 2022 about reoccurring heatwaves above 45°C and how we should prepare. Read more:

[https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview\\_suedkurier2022](https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview_suedkurier2022)

## Spielstadt Mini-München



*Top left: weather forecast produced by the young meteorologists. Top right: Observing, measuring and reporting. Bottom: Research online to learn about large-scale transport, fronts, etc.*

Mini-Munich is a summer program for children between 7 and 15 years old. It takes place every two years, and took place this year from 1-19 August in Munich. Mini-Munich is a model of the big city where children can work and study, and actively take part in academia, politics, administration, culture and public life in general. The children experience an urban community and social life through play, but in roles and functions that are taken seriously. Four W2W Early Career Scientists together with two scientists from the meteorological institute ran the “weather headquarters”. An average of 5 young meteorologists worked simultaneously every day (from 3-5 August) to observe and measure temperature, wind and humidity in different conditions (e.g. height, shade), to research online and to produce a weather forecast for the week. They then met with the Mini-Munich media (newspapers, radio and TV) to make sure that their weather report was communicated to the whole Mini-Munich. The participants were highly enthusiastic and motivated. On Wednesday for instance, they worked together with the neighboring garden nursery to explore the effect of cooling by evaporation associated with vertical gardening.

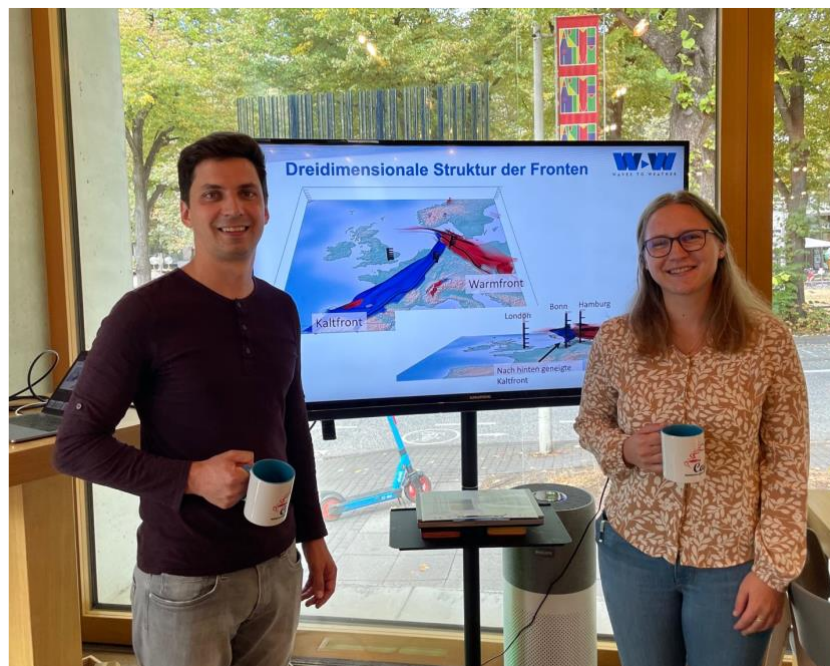
To open the weather headquarters, Peter Köpke gave a presentation on “UV radiation, sunburn and health” within the children university. The topic was of interest to about 45 children who asked many questions at the end of the presentation. The weather was

wonderful, the children were curious and engaged. Together with the colleagues from the meteorological institute, they shaped the activity to their needs and questions. Thank you to the scientists involved for making this event a great success!

Read more about this event: <https://www.wavestoweather.de/communication/outreach-activities/open-day-schools/mini-muenchen2022>

### Café Météorologique

Lea Eisenstein (C5, KIT), Andreas Beckert (C9, UHH), Sebastian Lerch (C5, KIT) and Peter Knippertz (B6, C2, C5, KIT) gave presentations to the general public within the “Café Météorologique” organized during the EMS annual meeting in Bonn from 5-9 September 2022. They addressed topics such as winter storms, Met.3D, post-processing and weather forecast, in general. Thank you to the four of you!



At the Café Météorologique. Top: Andreas and Lea. Bottom: Peter and Sebastian.



At this occasion, the comic book “Of course!” was distributed to the general public.

Read more about this event:

<https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/cafe-meteo-2022>

### Deutsches Museum

Christian Grams gave a presentation within the seminar series “Wissenschaft für jedermann” at the Deutsches Museum in Munich on 21 September 2022. He talked about renewable energies, weather regimes and weather forecast to about 160 participants (60 in person, 100 online). Thank you for this highly relevant, exciting and clear presentation, Christian! For more information visit:

<https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/deutsches-museum-sep-2022>



*Christian Grams in the Auditorium of the Deutsches Museum in Munich on 21 September 2022*

## Equal opportunity (EO) activities

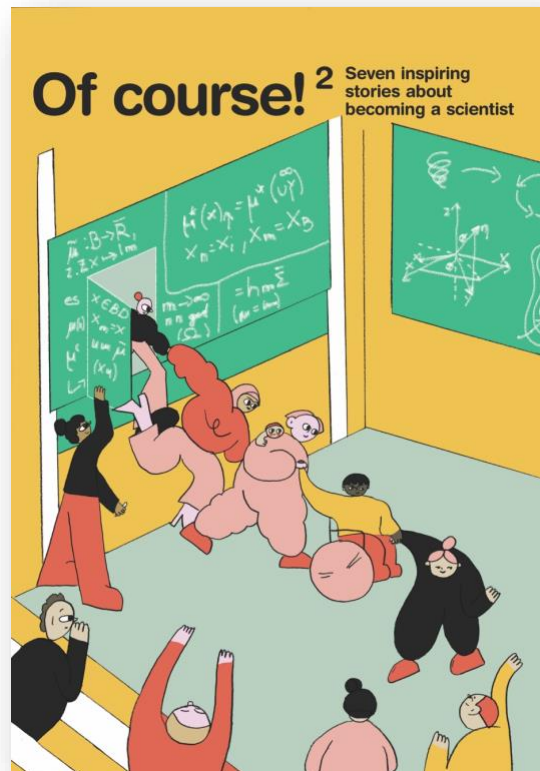
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### Distribution of the “Of course!” comic book

1. The **second volume** of the comic book “**Of course!**” is now available online, in English and in German (see cover below).

Thank you to all the contributors, scientists and artists! Read more about this project here:

[https://www.wavestoweather.de/equal\\_opportunity/activities/comic-book](https://www.wavestoweather.de/equal_opportunity/activities/comic-book)



2. The comic book has been distributed during the outreach event “**Café Météorologique**” for the general public during the EMS annual meeting in Bonn in September.

Visit <https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/cafe-meteo-2022> for more information.

3. Audine Laurian was invited to present the comic book at the “**Gender Equity in Academia: A First Aid Kit**” workshop organized by the ORIGINS Excellence Cluster on 14 September 2022. Read more here:

<https://www.wavestoweather.de/communication/dissemination-activities/meetings/equity-workshop2022>





*Presentation at the hybrid workshop at the LMU in Munich on 14 September 2022*

4. Audine Laurian and Aurelia Müller (MS-GWaves) will attend the **“MINT-EC-Schulleitungstagung 2022”** organized in Koblenz by the national excellence school network MINT-EC every year. From 4-5 November 2022, the school managements of all MINT-EC schools will come together to meet and exchange across federal state borders. This will be an excellent occasion to establish links with schools in Germany, to advertize and distribute the comic book. More information is available here: <https://www.mint-ec.de/veranstaltungen/1547-save-the-date-mint-ec-schulleitungstagung-2022/>

#### **German Conference of Women in Physics**

W2W is contributing financially to the German Conference of Women in Physics (“Deutsche Physikerinnentagung”), which will take place this year in Karlsruhe from 24-27 November 2022. This conference offers female physicists of different areas and at different career levels the possibility for networking and professional exchange. The program of the conference covers scientific talks from different areas of physics, the presentation of professional perspectives for physicists, school and didactic events as well as events on topics like equal opportunity, work-life balance, or career management.

To learn more, visit:

[https://www.wavestoweather.de/equal\\_opportunity/activities/physikerinnen-tagung-2022](https://www.wavestoweather.de/equal_opportunity/activities/physikerinnen-tagung-2022)

### EO measures in W2W

- Read about the EO committee:  
[http://www.wavestoweather.de/equal\\_opportunity/contact](http://www.wavestoweather.de/equal_opportunity/contact)
- Read about the EO measures offered in W2W:  
[http://www.wavestoweather.de/equal\\_opportunity/eo\\_measures](http://www.wavestoweather.de/equal_opportunity/eo_measures)
- Read about the EO measures and activities already implemented:  
[http://www.wavestoweather.de/equal\\_opportunity/activities](http://www.wavestoweather.de/equal_opportunity/activities)

## Summer's highlight

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*Sunset with a view towards the Rheingau, May 2021. Photo: Volkmar Wirth*

## Contact

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