

Waves to Weather



Newsletter Oct/Dec 2020

Welcome to the final W2W newsletter of a very unusual year. Despite all the problems and work-arounds that home-office brings, we are proud to offer you a bumper crop of scientific results, reports on how we adapted our meetings and outreach activities to virtual events, and a special focus on our equal opportunity activities.

We hope that you are staying healthy, enjoying the holiday season, and looking forward to an exciting, but maybe more conventional New Year!

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 **ECS annual meeting** as well as a **presentation skill workshop** will be organized by and for the W2W early career scientists in 2021. More information will be available here soon:
<https://www.wavestoweather.de/meetings/ecs-annual-meeting-2021> and here
<https://www.wavestoweather.de/meetings/ecs-presentation-workshop2021>
- The **Kompaktseminar Numerik workshop** has been postponed to 8 – 10th September 2021 in the Pfalzakademie Lambrecht, between Karlsruhe and Mainz. More information will be available here:
<https://www.wavestoweather.de/meetings/kompaktseminar2021>
- The **7th W2W Annual Meeting** will take place from 8 – 10th November 2021 in Eibelsstadt.

Additional information on upcoming events can be found here:
<http://www.wavestoweather.de/meetings>

News



Mares Barekzai (LMU, project B4, Phase 1) defended his PhD on 22 October 2020. Congratulations Mares! We wish you all the best for your future endeavors.



Starting in January 2021, **Robert Redl** (LMU, project Z2) will take over a new permanent position as head of the IT group at the faculty of physics at LMU. He has been elected member of W2W at the last general assembly of W2W. Congratulations Robert! We look forward to continuing working with you!



Sebastian Lerch (KIT) received funding by the Vector Stiftung to build up his **young investigator group "Artificial Intelligence for Probabilistic Weather Forecasting"** within the framework "MINT für die Umwelt" starting in April 2021. Within the interdisciplinary oriented project, his group will develop AI methods for incorporating spatial, temporal and physical information into ensemble post-processing. Congratulations Sebastian!

Read more here: <https://www.wavestoweather.de/news>



Nina Crnivec (LMU, project B4, Phase 1) defended her PhD on 18 December 2020. Congratulations, Nina! We wish you all the best for your future endeavors.



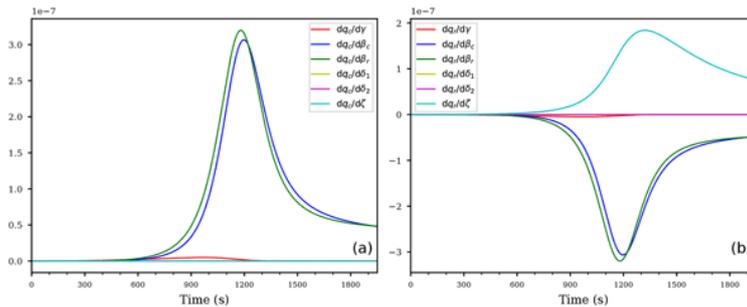
Christian Grams (KIT) has accepted the invitation to become ECMWF Fellow from 1 January 2021. During the initial three-year term, he will work closely with ECMWF on atmospheric dynamics and predictability at the extended range. Congratulations Christian!

Read more here: <https://www.wavestoweather.de/news>

Research Highlights

Here are some examples of recently published research from W2W.

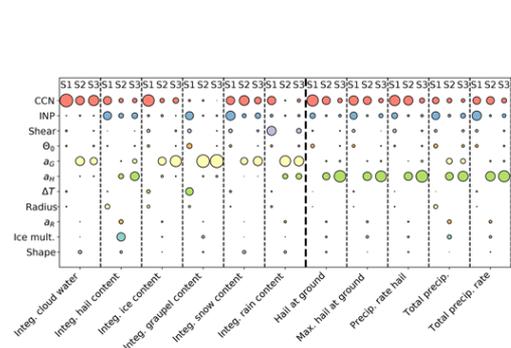
1. Algorithmic differentiation for cloud schemes (IFS cy43r3) using CoDiPack (v1.8.1) (M. Baumgartner, M. Sagebaum, N. R. Gauger, P. Spichtinger and A. Brinkmann)



Numerical models in atmospheric sciences need to include subgrid effects of many non-resolved physical processes such as the formation and evolution of cloud particles. Many cloud schemes have been proposed and they typically contain several uncertain parameters. We propose the use of algorithmic differentiation (AD) to identify parameters within the cloud scheme, to which the output of the cloud scheme is most sensitive. We analyze a scheme for liquid clouds, incorporated into a parcel model framework. Since the occurrence of uncertain parameters is not limited to cloud schemes, AD may help to identify the most sensitive uncertain parameters in any subgrid scheme and therefore help limiting the application of uncertainty quantification to the most crucial parameters.

Read the full article: <https://gmd.copernicus.org/articles/12/5197/2019/>

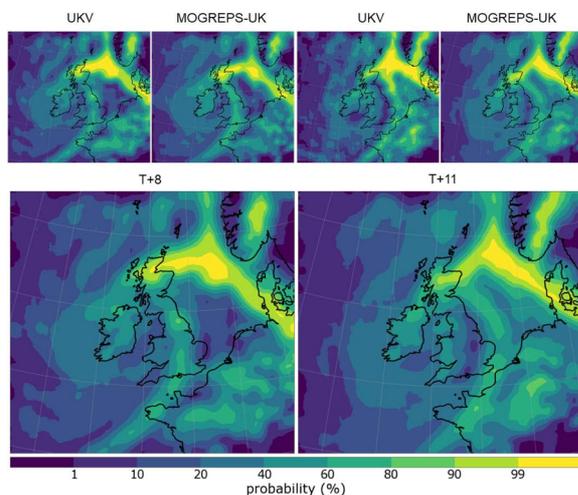
2. Comparing the impact of environmental conditions and microphysics on the forecast uncertainty of deep convective clouds and hail (C. Wellmann, A.I. Barrett, J.S. Johnson, M. Kunz, B. Vogel, K.S. Carslaw and C. Hoose)



Severe hailstorms may cause damage to buildings and crops. Thus, the forecast of numerical weather prediction models should be as reliable as possible. Using statistical emulation, we identify those model input parameters describing environmental conditions and cloud microphysics which lead to large uncertainties in the prediction of deep convection. We find that the impact of the input parameters on the uncertainty depends on the considered output variable.

Read the article: <https://acp.copernicus.org/articles/20/2201/2020/>

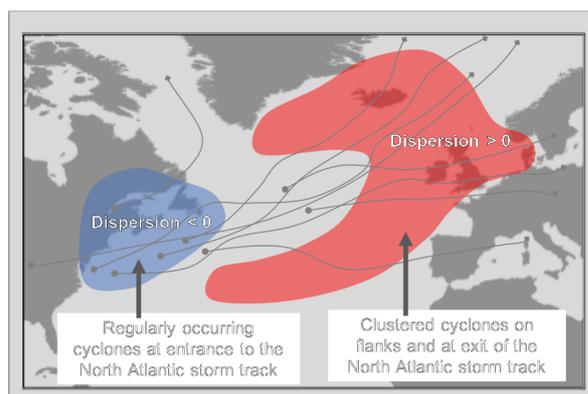
3. Statistical Postprocessing for Weather Forecasts – Review, Challenges and Avenues in a Big Data World (S. Vannitsem and coauthors)



Statistical postprocessing techniques are nowadays key components of the forecasting suites in many meteorological services, with the objective of correcting the impact of different types of errors on the forecasts. The final aim is to provide optimal, automated, seamless forecasts for end users. This review paper summarizes main activities going on in this area from theoretical developments to operational applications, with a focus on the current challenges and potential avenues in the field. A key challenge is the exponential growth of data that are available from both the model forecasts and the observations, accompanied by an ever-increasing need for very localized, yet seamless, forecast information.

Read the article: <https://doi.org/10.1175/BAMS-D-19-0308.1>

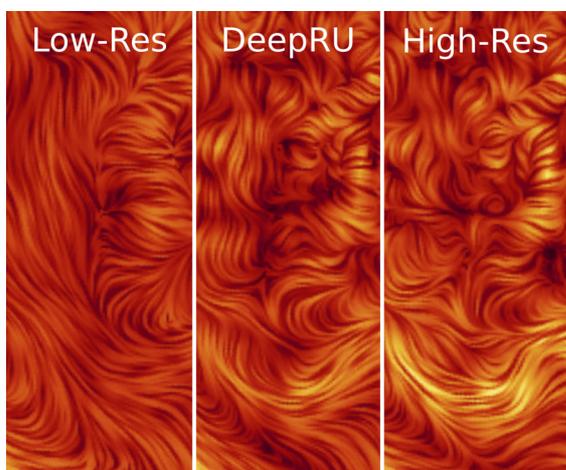
4. Serial clustering of extratropical cyclones: a review of where, when and why it occurs (H. F. Dacre and J.G. Pinto)



Serial clustering of extratropical cyclones describes the passage of multiple cyclones over a fixed location within a given time period. We provide an overview of current research activities including a review of serial cyclone clustering climatologies used to identify where clustering occurs. We review the dynamical mechanisms determining when and why serial cyclone clustering occurs for different timescales of interest. On daily timescales, serial cyclone clustering is often associated with a cyclone family and secondary cyclogenesis mechanisms. At longer timescales, variability is often associated with persistent large-scale flow patterns. Finally, we discuss the knowledge gaps and current research opportunities.

Read the article: <https://www.nature.com/articles/s41612-020-00152-9>

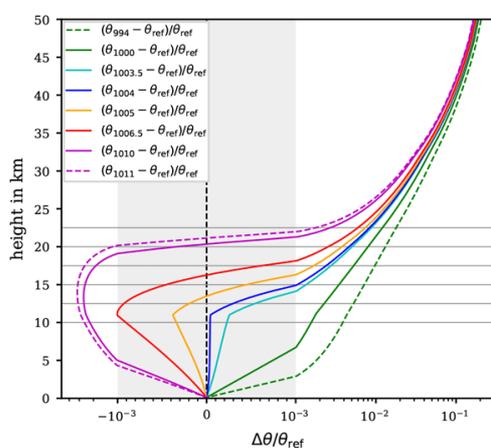
5. A comparative study of convolutional neural network models for wind field downscaling (K. Höhlein, M. Kern, T. Hewson and R. Westermann)



We explore the use of convolutional neural network (CNN) models for statistical downscaling of low-resolution wind forecast simulations to a higher spatial resolution. We compare different model architectures with respect to their predictive skills, and examine whether these skills can be enhanced by incorporating additional atmospheric variables. With DeepRU, we propose a novel CNN model for statistical downscaling that achieves superior downscaling quality. We finally discuss potential use cases of CNN-based downscaling in future forecasting applications.

Read the article: <https://doi.org/10.1002/met.1961>

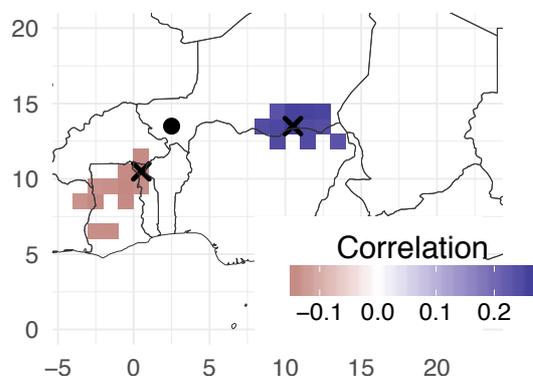
6. Reappraising the appropriate calculation of a common meteorological quantity: Potential Temperature (M. Baumgartner, R. Weigel, U. Achatz, A. H. Harvey, and P. Spichtinger)



The definition of potential temperature involves the specific heat capacity of dry air, which is traditionally assumed as constant. However, the literature provides different values of this allegedly constant parameter, which are reviewed and discussed in this study. We also derive the potential temperature for a temperature-dependent parameterization of the specific heat capacity of dry air, thus providing a new reference potential temperature with a more rigorous basis. The application of the new reference potential temperature is discussed for computations of the Brunt–Väisälä frequency, Ertel's potential vorticity, diabatic heating rates, and for the vertical sorting of observational data.

Read the article: <https://doi.org/10.5194/acp-20-15585-2020>

7. Statistical forecasts for the occurrence of precipitation outperform global models over northern Tropical Africa (P. Vogel, P. Knippertz, T. Gneiting, A.H. Fink, M. Klar and A. Schlüter)



We show that we can use satellite rainfall estimates from the previous two days to improve 1-day predictions of precipitation occurrence over northern tropical Africa, where numerical forecasts are poor. Such an approach works well during the summer monsoon from July to September, as rainfall systems tend to travel from east to west in connection with African easterly waves. The new method outperforms all other methods currently available on a day-to-day basis over the region, except for the dry outer tropics, where more predictable influences from mid-latitudes become more important.

Read the article: <https://doi.org/10.1029/2020GL091022>

Additional publications relevant to W2W are listed here:

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

Past activities

Machine Learning Workshop (by Seraphine Hauser, Kirsten Tempest and Jorge de Heuvel)

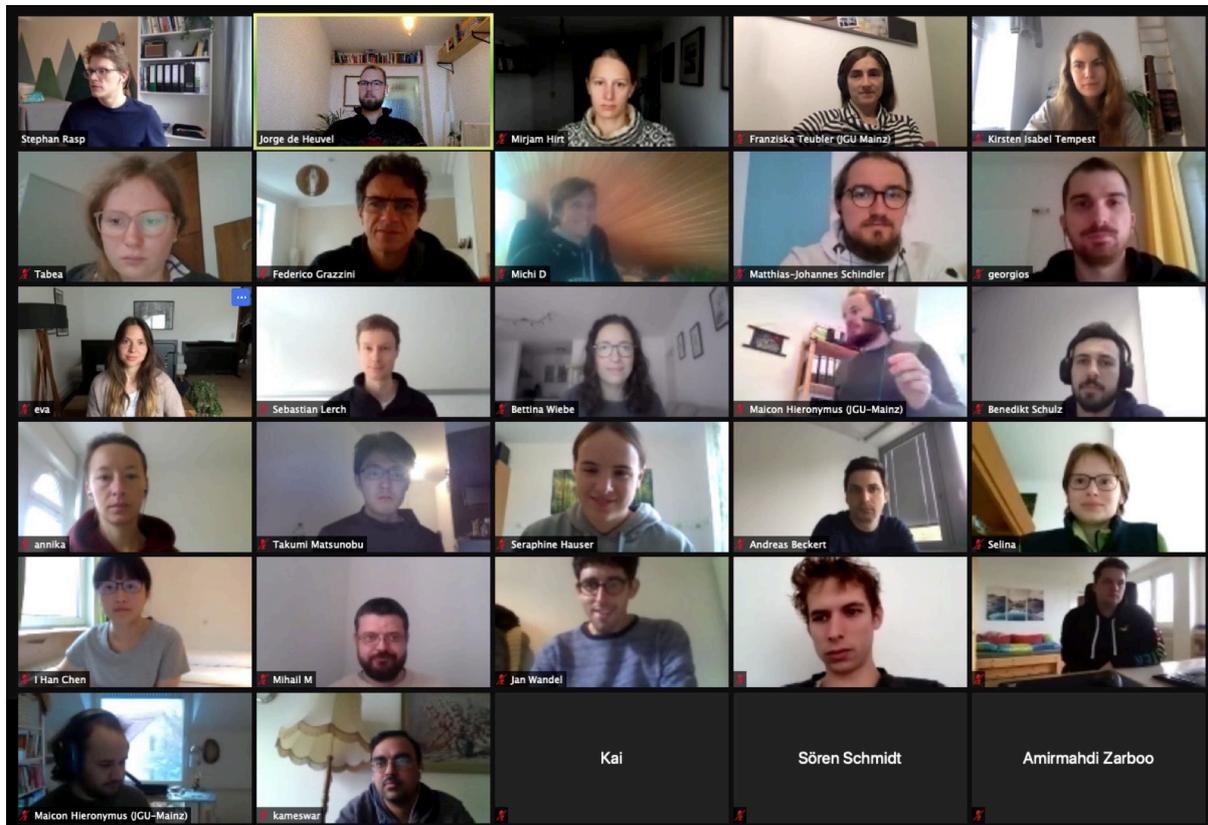
The ECS community of W2W gathered online for a three-day machine learning workshop from the 12th to 14th of October 2020. The workshop with around 35 participants was hosted by Stephan Rasp (W2W alumni), Sebastian Lerch (W2W) and Eva-Maria Walz (W2W).

A broad spectrum of topics was covered, from well-established machine learning techniques like multi-linear regression and random forests to state-of-the-art deep learning methods like neural networks, convolutional neural networks and transfer learning. Introductory presentations to each topic were paired with hands-on coding sessions. Addressing the participant's background, the coding exercises focused on datasets from atmospheric science. To work on the python-based exercises, the participants gathered in teams of three in online breakout rooms.

The teams not only worked closely together learning from each other, but also competed against other teams in two machine learning competitions on the platform Kaggle. Considering the relatively short workshop, our teams mastered the two competitions on weather forecast post-processing and satellite image classification with significant success.

In the shadow of the Covid-19 pandemic, we were lucky to hold the machine learning workshop in 2020. The online format worked out really well for everyone, not least because of the tutor's ingenious technical preparations.

In the name of all participants, the ECS committee would like to thank the three tutors Stephan, Sebastian and Eva-Maria for all their work and passion that went into this workshop.



Participants of the Machine learning workshop

More information is available here:

<https://www.wavestoweather.de/meetings/ecs-ml-workshop2020>

6th Annual Meeting of W2W

The 6th Annual Meeting of W2W took place from 16-18 November 2020, for the first time online.

Up to 89 participants attended the meeting hosted on QiqoChat. The keynote speakers were Daniela Domeisen (ETH Zürich), Tim Hewson (ECMWF, SAB member) and Axel Seifert (DWD). The meeting was attended by the Scientific Advisory Board: Ron McTaggart-Cowan (Canadian Meteorological Center), Michael Morgan (University of Wisconsin), Carolyn Reynolds (NRL), Sue van den Heever (Colorado State University) and Tim Hewson (ECMWF).

The keynote presentations, as well as research area (RA) overview talks, lightning talks from poster presenters, and reports from breakout group discussion took place in a plenary room. Additional virtual rooms were set up for smaller group discussions such as the poster sessions (each poster had a dedicated room), the RA breakout groups discussions, the ECS meeting, the general assembly for all members, the ice breakers, and the coffee breaks.

New features compared to previous annual meetings included sessions chaired by pairs of early career scientists (ECS), and virtual rooms set up for the keynote speakers to have an

informal conversation with the ECS in their RA. Topics of conversation included their key-note presentation and their career pathway.

Robert Redl (LMU) has been elected as a new W2W member, effective 1 January 2021.

The **new ECS committee** consists of Kirsten Tempest (LMU), Christopher Polster (JGU) and Seraphine Hauser (KIT).

The meeting was very successful given the technical constraints. Lots of informal discussions took place during the poster sessions and the coffee breaks so that the participants, and in particular those who started recently in W2W could get to know everyone and discuss their latest results and new ideas for collaborations. Thank you everyone for making this meeting so lively and fun!



Participants of the W2W Annual Meeting 2020

More information about the meeting is available here:
https://www.wavestoweather.de/meetings/annual_meeting6

Seminars and guest program

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

Dissemination

Newsletter of the KIT Climate and Environment Center

The aim and challenges of W2W, as well as Andreas Schlüter's current research were presented in the latest issue of the KIT Climate and Environment Center's newsletter. Read more about this here:

<https://www.wavestoweather.de/communication/dissemination-activities/publications/>

Past issues of this newsletter

Past issues of this newsletter are available here:

https://www.wavestoweather.de/communication/dissemination-activities/publications/quarterly_newsletter

Outreach

Presentation at the Deutsches Museum in Munich

Thomas Birner gave a presentation on the stratosphere at the Deutsches Museum in Munich within the seminar series "Wissenschaft für jedermann" on October 14th 2020.

He presented a historical review of stratospheric research, from its birth to its latest challenges, highlighted some surprising impacts of changes in the dynamics of the stratosphere on the troposphere, and vice versa, and finally illustrated the relevance of the stratosphere for weather forecasting. The presentation was available as live stream and about 50 participants were physically in the room.

Thank you, Thomas for this exciting talk!



Thomas at the Deutsches Museum on 14 October 2020



Thomas illustrates the challenge of weather forecasting with a double pendulum. Photos: A. Laurian

To read more about this event and watch the video of the presentation, visit:
<https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/deutsches-museum-oct-2020>

Presentation at the Science Festival EFFEKTE in Karlsruhe

Christian Grams, Michael Kunz and Peter Knippertz took part in the Science Festival EFFEKTE in Karlsruhe on 8 December 2020. They gave presentations on weather forecast, extreme weather and renewable energy, and answered questions from the journalist Hanna Sophie Lücke and from the audience via a live chat.



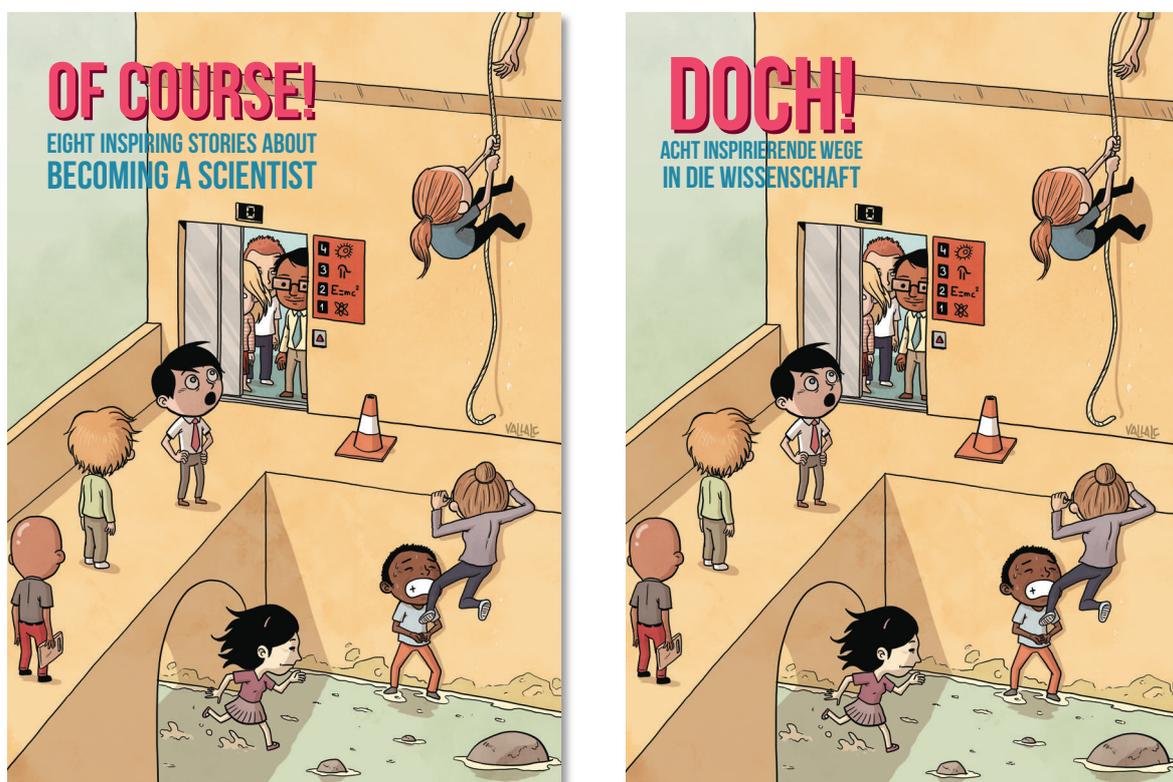
To learn more about this event, visit:

<https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/effekte-karlsruhe-2020>

Equal opportunity (EO) activities

Comic book

A comic book called “Of course!” (“Doch!” in German) has been designed and produced to address the systematic under-representation of women towards the top of the academic career path and to provide role models, women and men, to the students and scientific community. The comic book features eight illustrated interviews of researchers who experienced gender biases and imbalance at home, during their education, and at their work place. They actively made positive changes allowing them to lead a happy and fulfilled life as a scientist. The comic book has been distributed at the W2W Annual Meeting in November 2020. It will be distributed in schools early next year.



Cover of the 1st edition in English (left) and in German (right)

To read more about this project, click here:

https://www.wavestoweather.de/equal_opportunity/activities/comic-book

“Picture a Scientist”

The EO committee invited all W2W scientists to watch the movie “Picture a Scientist” between 20-23 December 2020. The documentary features biologist Nancy Hopkins, chemist Raychelle Burks, and geologist Jane Willenbring. They present their own experiences in the sciences, ranging from brutal harassment to years of subtle slights, cramped laboratories, and spectacular field stations. Social scientists, neuroscientists, and psychologists also provide new perspectives on how to make science itself more diverse, equitable, and open to all. More information about the movie is available here: <https://www.pictureascientist.com>

“The Hidden Heroines of Chaos”

Based on an article on Quanta Magazine about Lorenz’ discovery of chaos, by Mirjam Hirt

Most of us are probably aware of the discovery of the chaotic nature of the atmosphere by Edward Lorenz in his 1963 landmark paper, which revealed the Lorenz Attractor and later became famous via the butterfly effect. But what we are probably not aware of is that Lorenz did not achieve his findings alone, but with help from his team, most noteworthy the mathematicians and programmers Ellen Fetter and Margaret Hamilton. Lorenz even acknowledged the contributions from Ellen Fetter in his 1963 paper for “handling the many numerical computations and preparing the graphical presentations of the numerical material”. According to today’s standards, this would certainly justify a co-authorship. Should we start referring to the Lorenz Attractor as the Lorenz-Fetter Attractor?

If you would like to find out more, I recommend the original article on Quanta Magazine:

<https://www.quantamagazine.org/hidden-heroines-of-chaos-ellen-fetter-and-margaret-hamilton-20190520/>

Acknowledgments. The writer is indebted to Dr. Barry Saltzman for bringing to his attention the existence of nonperiodic solutions of the convection equations. **Special thanks are due to Miss Ellen Fetter for handling the many numerical computations and preparing the graphical presentations of the numerical material.**

Acknowledgments in Lorenz’ 1963 paper on “Deterministic nonperiodic flow”

EO measures in W2W

- Read about the EO committee:
http://www.wavestoweather.de/equal_opportunity/contact
- Read about the EO measures offered in W2W:
http://www.wavestoweather.de/equal_opportunity/eo_measures
- Read about the EO measures and activities already implemented:
http://www.wavestoweather.de/equal_opportunity/activities

Fall's highlight



Thunderstorm over Munich, July 2020. Photo: Alexander Kumpf

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