Waves to Weather

Newsletter Jan/Mar 2023

Waves to Weather is in the last six months of its second Phase. This is very exciting, because, on the one hand, all of the project scientists are writing up their results and we have an especially large crop of paper summaries for you to read. On the other hand, the PhD students have been writing their dissertations, while the PIs have been writing the Phase 3 proposal and preparing for the review meeting. But there is always time for a little fun, and we close this newsletter with a ChatGPT-generated article about the great American meteorologist June Bacon-Bercey. We hope you enjoy it!

George Craig

Contents

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 **Early Career Scientists workshop on "Applying successfully, for academics with non-academic ambitions" – Part II** will take place online on 14 April 2023. It will focus on the oral application, e.g., the job interview. See a report on **Part I** below. To learn more, visit: https://www.wavestoweather.de/meetings/career-workshop-2023
- The **workshop on scale interactions, data-driven modeling, and uncertainty in weather and climate** is being held jointly with TRR 181 "Energy transfers in Atmosphere and Ocean" (https://www.trr-energytransfers.de) from 27-30 March 2023 in Ingolstadt. For more information, visit: https://www.wavestoweather.de/meetings/joint-workshop2023
- The Meteorological Institute in Munich will celebrate its **100th anniversary** on 30 March 2023. Find out more: https://www.wavestoweather.de/meetings/mim-anniversary2023
- The **ECS annual meeting** will take place from 3-5 May 2023 in Hamburg. To learn more, visit https://www.wavestoweather.de/meetings/ecs-ann-meet-may2023
- The **NAWDIC workshop** will take place on 12 May 2023. Stay tuned for more information!
- A **workshop on "fair recruitment: finding and hiring the right colleagues"** will be offered to all PIs in W2W on 15 May 2023 online. For more information, visit: https://www.wavestoweather.de/meetings/workshop-fair-recruit-2023

- The KIT Center for Mathematics in the Sciences, Economics and Engineering (MathSEE) organizes its **second symposium on the applications of mathematical methods** from 27-29 September 2023 at KIT in Karlsruhe. For more information, visit: https://symposium.mathsee.kit.edu
- A joint **SPARC DynVar - SNAP meeting on "The Role of Atmospheric Dynamics for Climate and Extremes"** will take place from 9-13 October 2023 at the LMU in Munich. For more information, visit: https://www.wavestoweather.de/meetings/sparc-snap-2023
- Upon funding, the **W2W Annual Meeting** (kick-off) will take place on 27-29 November 2023 in Landau.

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

News

Michael Maier-Gerber (C3, KIT) defended his PhD on 27 January 2023. Congratulations, Michael, for passing with a straight 1 and distinction! We wish you all the best at ECWMF in the DestinE initiative (https://www.ecmwf.int/en/about/what-we-do/environmental-services-and-future-vision/destination-earth)!

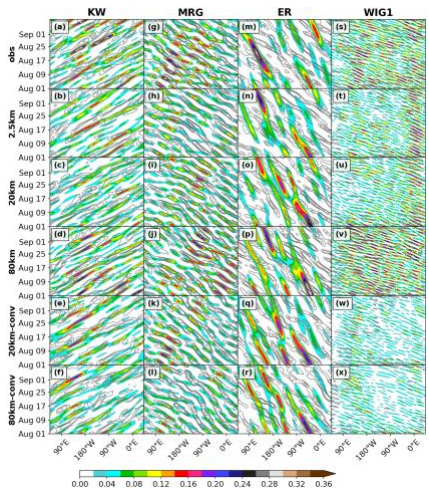
The presentation of **Hyunju Jung** (B6 project, KIT) entitled "Physically Understanding the Distribution of Mean Precipitation in Tropical Aquachannel Simulations" was selected for 1st Place - **Best Poster Presentation** in the Fifth Special Symposium on Tropical Meteorology and Tropical Cyclones at the 103rd AMS Annual Meeting. Congratulations, Hyunju for this recognition from peers in the community!

Jonas Späth received the **best oral presentation award** at the 7th SPARC General Assembly for his talk about “Predictors of Arctic Oscillation Variability as Revealed by Subseasonal-to-Seasonal Forecasts”. Congrats, Jonas!
Read more: https://www.sparc-climate.org/meetings/7th-sparc-general-assembly/

Research Highlights

Here are some examples of recently published research from W2W.

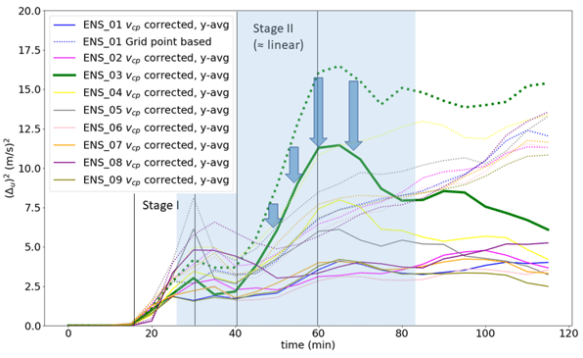
1. Link between the time-space behavior of rainfall and 3D dynamical structures of equatorial waves in global convection-permitting simulations (H. Jung and P. Knippertz)



Equatorial waves (EWs) control a considerable portion of tropical rainfall variability but numerical models often struggle to capture them. Increased computing power now enables global simulations with resolved deep convection, which is believed to produce more realistic EWs. We identify EWs in global ICON simulations with varying horizontal resolution by (a) filtering rainfall based on space-time spectral analysis and (b) projecting wind and geopotential onto theoretical wave patterns. The simulations demonstrate that Kelvin, mixed-Rossby gravity and equatorial Rossby waves are consistently represented, regardless of model resolution and convective treatment. Surprisingly, the associated rainfall signals are not accompanied by corresponding wind patterns but appear to be connected to mesoscale convective systems.

Read the full article: https://doi.org/10.1029/2022GL100973

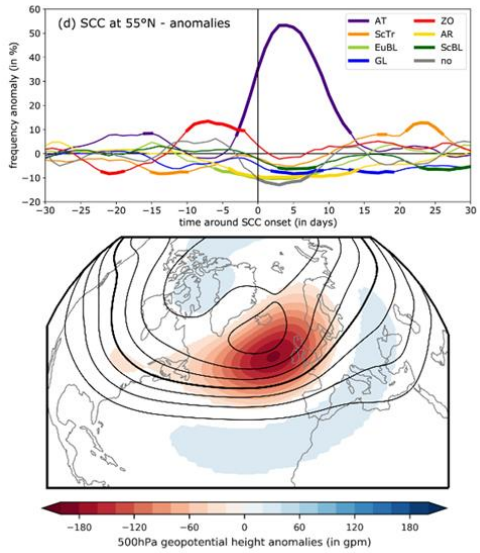
2. Evolution of squall line variability and error growth in an ensemble of LES (E. Groot and H. Tost)



Thunderstorm systems play an important role in the dynamics of the Earth's atmosphere and some of them form a well-organized line: squall lines. Simulations of such squall lines with very small initial perturbations are compared to an unperturbed control simulation. The evolution of perturbations and processes amplifying them are analyzed. It is shown that the formation of new secondary thunderstorm cells (after the initial primary cells) directly ahead of the line affects the spread strongly.

Read the full article: https://doi.org/10.5194/acp-23-565-2023

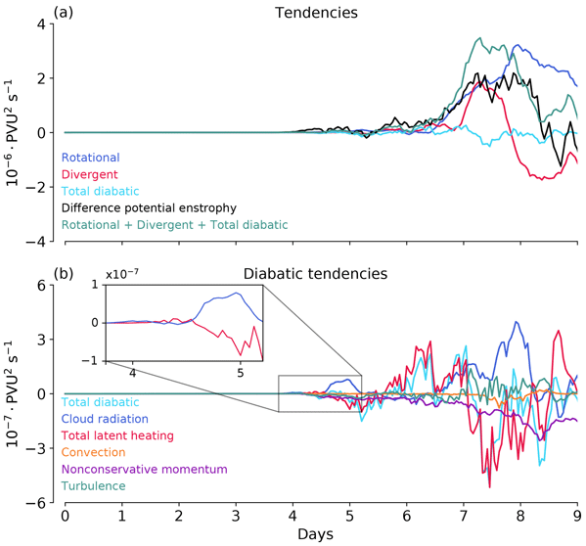
3. The Linkage of Serial Cyclone Clustering in Western Europe and Weather Regimes in the North Atlantic-European Region in Boreal Winter (S. Hauser, S. Mueller, X. Chen, T.-C. Chen, J. G. Pinto and C. M. Grams)



We analyze the relationship between serial cyclone clustering (SCC) in Western Europe and so-called weather regimes (WRs) in the North Atlantic-European region in boreal winter. These regimes describe slow evolving and enduring large-scale atmospheric circulation patterns. Relationships with certain regime types are identified but depend on the latitude at which the clustered frequency of extra-tropical cyclones is found. When SCC occurs in low latitudes (45°N), it mostly appears coincident with anticyclonic large-scale flow patterns. In contrast, SCC in mid and high latitudes (55°N, 65°N) often occurs simultaneously with different cyclonic regimes. We find that periods of SCC occur typically within WR life cycles pointing to the fact that both, the WRs and SCC periods, are interlinked. This relationship may facilitate forecasting storm series and associated impacts on time scales beyond 2 weeks.

Read the full article: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2022GL101900

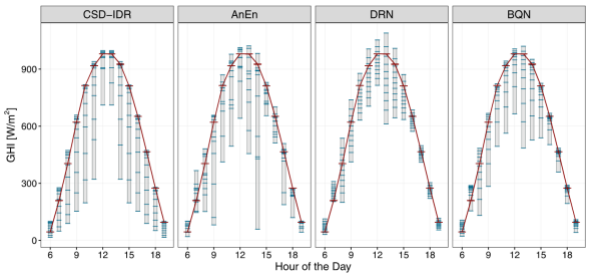
4. Cloud-radiative impact on the dynamics and predictability of an idealized extratropical cyclone (B. Keshtgar, A. Voigt, C. Hoose, M. Riemer and B. Mayer)



Forecasting extratropical cyclones is challenging due to many physical factors influencing their behavior. One such factor is the impact of heating and cooling of the atmosphere by the interaction between clouds and radiation. In this study, we show that cloud-radiative heating (CRH) increases the intensity of an idealized cyclone and affects its predictability. We find that CRH affects the cyclone mostly via increasing latent heat release and subsequent changes in the synoptic circulation.

Read the full article: https://doi.org/10.5194/wcd-4-115-2023

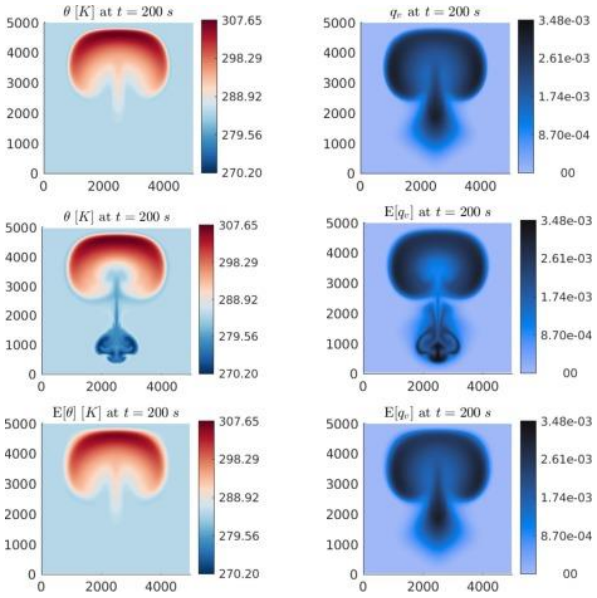
5. Probabilistic solar forecasting: Benchmarks, post-processing, verification (T. Gneiting, S. Lerch and B. Schulz)



This invited perspective paper proposes a probabilistic benchmark for solar forecasts based on a deterministic prediction of clear-sky irradiance, introduces new methods for post-processing that merge statistical techniques with modern neural networks, discusses methods for spatio-temporal scenario forecasts, and illustrates the assessment of predictive ability via proper scoring rules and calibration checks.

Read the full article: https://doi.org/10.1016/j.solener.2022.12.054

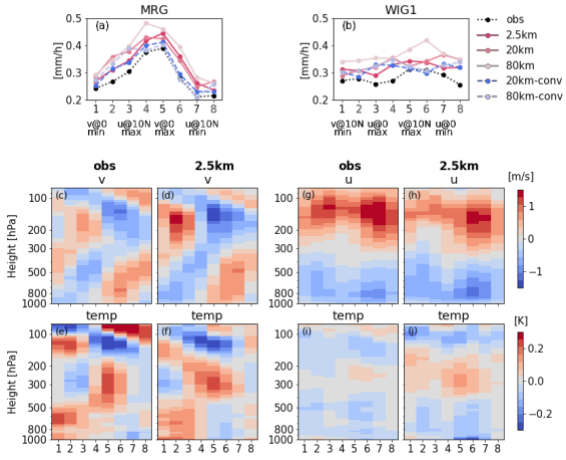
6. Stochastic Gelerkin method for cloud simulation. Part II: A fully random Navier-Stokes-cloud model (A. Chertock, A. Kurganov, M. Lukácová-Medvidová, P. Spichtinger and B. Wiebe)



We study uncertainty propagation in warm cloud dynamics of weakly compressible fluids. The mathematical model is governed by a multiscale system of PDEs in which the macroscopic fluid dynamics is described by a weakly compressible Navier-Stokes system and the microscopic cloud dynamics is modeled by a convection-diffusion-reaction system. In order to quantify uncertainties present in the system, we derive and implement a generalized polynomial chaos stochastic Galerkin method. We study a fully random Navier-Stokes-cloud model in which we include randomness in the macroscopic fluid dynamics as well. We conduct a series of numerical experiments illustrating the accuracy and efficiency of the developed approach.

Read the full article: https://doi.org/10.1016/j.jcp.2023.111987

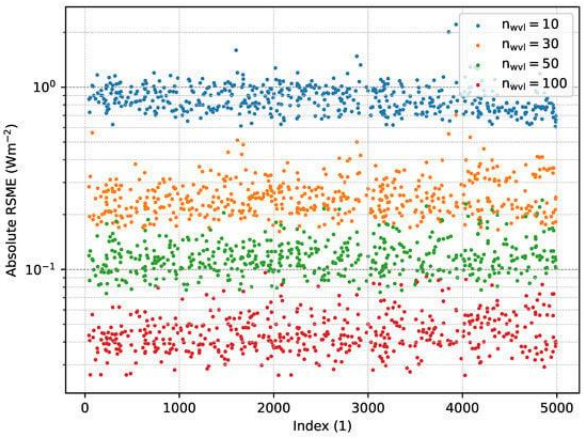
7. Link between the time-space behavior of rainfall and 3D dynamical structures of equatorial waves in global convection-permitting simulations (H. Jung and P. Knippertz)



Weather and climate models often fail to capture equatorial waves realistically and convection-permitting simulations are thought to resolve this problem. To test this, we identify equatorial waves in global ICON-NWP runs from 80 km to 2.5 km by (a) isolating rainfall from space-time spectrum and (b) projecting dynamical fields onto theoretical wave patterns. ICON robustly produces large-scale waves regardless of model resolution and convective treatment. However, small-scale inertio gravity waves show rainfall signals with no corresponding wind patterns because the space-time spectrum method filters out mesoscale convective systems as the waves.

Read the full article: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2022GL100973

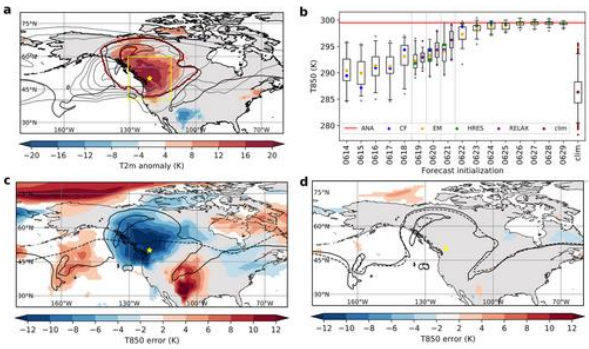
8. Optimized Wavelength Sampling for Thermal Radiative Transfer in Numerical Weather Prediction Models (M. de Mourgues M., C. Emde and B. Mayer)



Radiative transfer calculations of wavelength-integrated quantities such as irradiance and heating rate are computationally expensive, requiring a high spectral resolution for accurate NWP and climate modeling. We introduce a method that could highly reduce the cost of integration in the thermal spectrum by employing an optimized wavelength sampling method. Different optimized sets of wavelengths and corresponding weights are identified, allowing for accurate integrated quantities to be computed as a weighted sum, reducing the computational time by several orders of magnitude.

Read the full article: https://www.mdpi.com/2073-4433/14/2/332

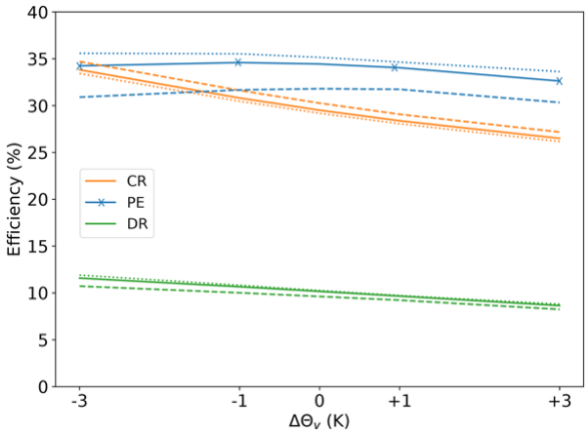
9. Everything hits at once: How remote rainfall matters for the prediction of the 2021 North American heat wave (A. Oertel, M. Pickl, J.F. Quinting, S. Hauser, J. Wandel, L. Magnusson, M. Balmaseda, F. Vitart and C. M. Grams)



In June 2021, Western North America experienced an intense heat wave with unprecedented temperatures and far-reaching socio-economic consequences. Anomalous rainfall in the West Pacific triggers a cascade of weather events across the Pacific, which build up a high-amplitude ridge over Canada and ultimately lead to the heat wave. We show that the response of the jet stream to diabatically enhanced ascending motion in extratropical cyclones represents a predictability barrier with regard to the heat wave magnitude. Our results highlight the key role of the sequence of individual weather events in limiting the predictability of this extreme event.

Read the full article: https://doi.org/10.1029/2022GL100958

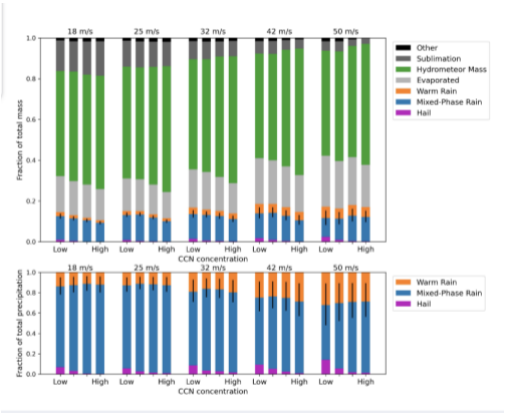
10. Temperature and cloud condensation nuclei (CCN) sensitivity of orographic precipitation enhanced by a mixed-phase seeder–feeder mechanism: a case study for the 2015 Cumbria flood (J. Thomas, A. Barrett and C. Hoose)



We study the sensitivity of rain formation processes during a heavy-rainfall event over mountains to changes in temperature and pollution. Total rainfall increases by 2 % K−1, and a 6 % K−1 increase is found at the highest altitudes, caused by a mixed-phase seeder–feeder mechanism (frozen cloud particles melt and grow further as they fall through a liquid cloud layer). In a cleaner atmosphere this process is enhanced. Thus the risk of severe rainfall in mountains may increase in the future.

Read the full article: https://doi.org/10.5194/acp-23-1987-2023

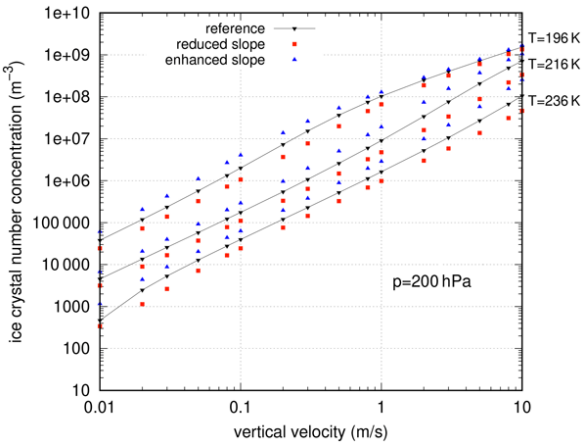
11. Microphysical pathways active within thunderstorms and their sensitivity to CCN concentration and wind shear (A. I. Barrett and C. Hoose)



The impact of cloud condensation nuclei (CCN) concentration on microphysical processes within thunderstorms and the resulting surface precipitation is not fully understood yet. In this work, an analysis of the microphysical pathways occurring in these clouds is proposed to systematically investigate and understand these sensitivities.

Read the full article: https://doi.org/10.1029/2022JD036965

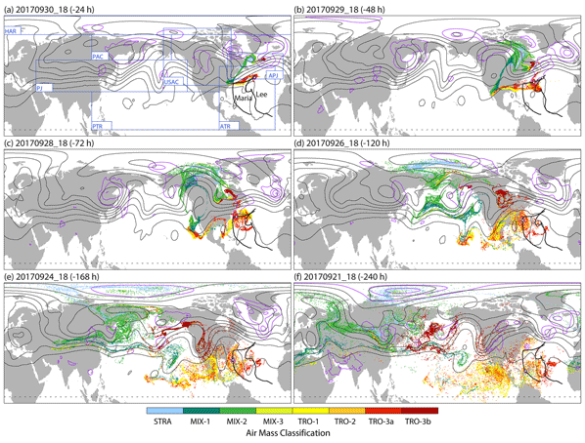
12. Impact of formulations of the homogeneous nucleation rate on ice nucleation events in cirrus (P. Spichtinger, P. Marschalik and M. Baumgartner)



We investigate the impact of the homogeneous nucleation rate on nucleation events in cirrus. As long as the slope of the rate is represented sufficiently well, the resulting ice crystal number concentrations are not crucially affected. Even a change in the prefactor over orders of magnitude does not change the results. However, the maximum supersaturation during nucleation events shows strong changes. This quantity should be used for diagnostics instead of the popular nucleation threshold.

Read the full article: https://doi.org/10.5194/acp-23-2035-2023

13. Case study on the influence of synoptic-scale processes on the paired H2O-O3 distribution in the UTLS across a North Atlantic jet stream (A. Schäfler, Sprenger, M., Wernli, H., Fix, A. and Wirth, M.)



In this study, airborne lidar profile measurements of H2O and O3 across a midlatitude jet stream are combined with analyses in tracer–trace space and backward trajectories. We highlight that transport and mixing processes in the history of the observed air masses are governed by interacting tropospheric weather systems on synoptic timescales. We show that these weather systems play a key role in the high variability of the paired H2O and O3 distributions near the tropopause.

Read the full article: https://doi.org/10.5194/acp-23-999-2023

14. Meeting Summary: Challenges and Prospects for Numerical Techniques in Atmospheric Modeling (J. Li, Y. Li, J. Steppeler, A. Laurian, F. Fang and D. Knapp)

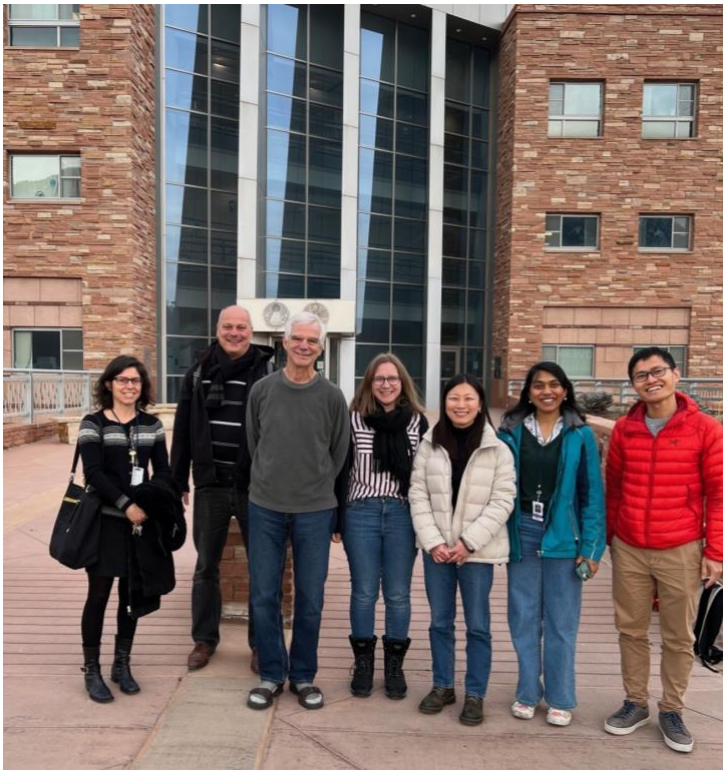
The Mathematics of the Weather workshops (MOW) address the numerical aspects of atmospheric models. This year, the MOW workshop was held in hybrid form in Bad Orb, Germany, from 4-6 October 2022. Thirty-five participants presented and discussed recent developments in machine learning, data assimilation, numerical modeling of the atmosphere, as well as in regional climate modeling.

Read the full article: https://doi.org/10.1175/BAMS-D-22-0269.1

Additional publications relevant to W2W are listed here:
http://www.wavestoweather.de/publications

Past activities

W2W participants of the AMS Conference in Denver, USA (https://annual.ametsoc.org/index.cfm/2023) on 11 January 2023. From left to right: Christian Grams, Lea Eisenstein, Andreas Fink, Hyunju Jung, Seraphine Hauser.



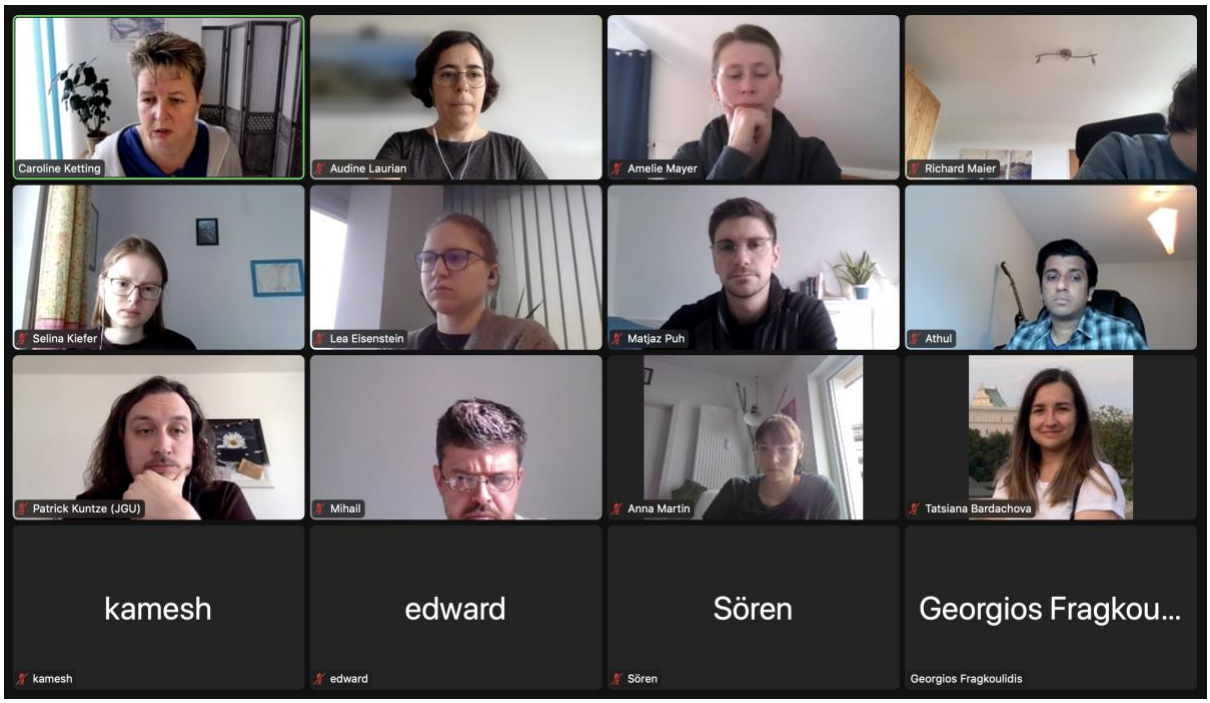
From left to right: Juliana Dias, Andreas Fink, George Kiladis, Lea Eisenstein, Hyunju Jung, Pragallva Barbanda and Yuan-Ming Cheng in front of the NOAA PSL (https://psl.noaa.gov) building on 13 January 2023.

Review meeting

The Review Meeting for Phase 3 of W2W took place in the "Akademie der Wissenschaften und der Literatur" in Mainz from 23-24 February 2023. The W2W scientists presented results from Phase 2 and plans for Phase 3 to an international review panel. The final results will be shared by the DFG on 17 May 2023.
For more information, visit: https://www.wavestoweather.de/meetings/review-meeting-feb-2023.

Participants of the Review Meeting on 23 February 2023 in Mainz

The first part of a **career workshop on "Applying successfully, for academics with non-academic ambitions"** took place online on 10 March 2023. The workshop focused on the application documents (e.g. cover letter and resume). About fifteen ECS (Master students, PhD students, postdoctoral fellow, etc.) from most locations (LMU, JGU, KIT, UHH) participated. To learn more, visit: https://www.wavestoweather.de/meetings/career-workshop-2023



Participants on 10 March 2023

Seminars and guest program

Talia Tamarin-Brodsky will visit W2W colleagues in Mainz and Karlsruhe from 13-18 May 2023. For more information, visit: https://www.wavestoweather.de/guest/talia-tamarin-brodsky

Read 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

Communication

Dissemination

Past issues of the newsletter

Past issues of this newsletter are available here:
https://www.wavestoweather.de/communication/dissemination-activities/publications/quarterly_newsletter

Outreach

Weather Day at the Deutsches Museum

The collaboration between W2W, the meteorological institute in Munich (MIM), and the Deutsches Museum will take the form of a Weather Day on **6 May 2023** in the museum. About 10 activities will be offered to the regular visitors of the museum by scientists from MIM and DLR. For more information, visit:
https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/weather-day-2023

Presentation at the Deutsches Museum

Bernhard Mayer will give a presentation within the seminar series "Wissenschaft für jedermann" at the Deutsches Museum in Munich on **20 September 2023**. For more information visit:
https://www.wavestoweather.de/communication/outreach-activities/presentations-general-public/deutsches-museum-sep-2023

Equal opportunity (EO) activities

Girls' Day 2023

W2W scientists and their colleagues will offer workshops at LMU, JGU and KIT for school girls on **27 April 2023**. Read more about this event here:
https://www.wavestoweather.de/equal_opportunity/activities/girlsday-2023

Breaking Barriers: The Pioneering Contributions of June Bacon-Bercey in Meteorology – by Philip Rupp and ChatGPT

The following article about June Bacon-Bercey was fully AI-generated! As the number and quality of tools that allow computer-assisted working is increasing rapidly, we have to ask ourselves if and how we could use this concept in meteorological sciences, public outreach or other areas. To explore the potential of AI-generated texts and images for academic purposes I used the currently very popular engines "DALL-E" and "ChatGPT" developed by OpenAI to write an article about a female role model in meteorology. ChatGPT suggested June Bacon-Bercey, a famous meteorologist and TV-presenter, and promptly wrote a 400-word article. It only required a minimal amount of tweaking and rephrasing of the input-request and, e.g., asking for more specific information in some of the paragraphs to

generate the text below. DALL-E then generated two images, based on actual images of June Bacon- Bercey's face (which I imported from Google). I tried to fact-check everything, but please take all information in this article with a grain of salt. However, despite maybe some factual mistakes, I hope that this article sparks some interest and awareness about, not only the capabilities of modern-day AI, but also the remarkable achievements of June Bacon-Bercey and the many obstacles that some women had to face in science (and to some extent might still face today). And of course, everyone should decide for themselves what they think about the quality and style of ChatGPT's writing.

June Bacon-Bercey was an American meteorologist who made significant contributions to the field of meteorology during her career. Born in 1932 [she was actually born in 1928], Bacon-Bercey grew up in a time when opportunities for women in science were limited. Despite these challenges, she was always drawn to the natural sciences, and she excelled in her studies in high school and college.

June Bacon-Bercey's passion for meteorology was sparked during her undergraduate studies at the University of Kansas, where she earned a Bachelor of Science degree in meteorology in 1954 [she actually got this degree from UCLA]. This was a significant accomplishment at the time, as few women pursued degrees in science and even fewer in meteorology. In an interview, Bacon-Bercey shared that "it was tough for women then, but I was determined." Her determination led her to continue her studies, and she went on to earn a Master of Science degree in meteorology from the University of California, Los Angeles, in 1955. Reflecting on her experience, Bacon-Bercey stated, "I was very interested in science, and I knew that's where I wanted to go, but it was not easy. It was a male-dominated field, and it still is."

Figure 1: June Bacon-Bercey receiving her degree in meteorology from a professor. The grey box indicates the actual image of her face that I used as input, everything outside the box is AI-generated.

Despite her academic successes, June Bacon-Bercey faced numerous challenges and obstacles as a Black woman pursuing a career in meteorology. One such example occurred during her master's degree studies at UCLA, where she was the only woman and person of color in the program. In an interview with the American Meteorological Society, she recalled, "It was a challenge to convince myself that I belonged there and that I was capable of doing it, and to try to convince my classmates and others that I was capable of doing it as well." Bacon-Bercey also faced barriers when applying for jobs in meteorology, with many

employers unwilling to consider her for positions due to her gender and race. Despite these challenges, she persevered and became a trailblazer in the field, paving the way for other women and minorities to pursue careers in meteorology. "I went into this field because I wanted to make a difference. I had to prove myself, and I was successful in doing that. I did not allow discrimination or prejudice to stop me from pursuing my dreams."

In terms of the science she developed, Bacon-Bercey's primary area of expertise was in the study of weather patterns and their impact on aviation. During her time at the National Oceanic and Atmospheric Administration (NOAA), she conducted research on the behavior of the jet stream and its impact on aircraft performance. Her work on the jet stream was groundbreaking and helped to improve the understanding of how weather patterns influence air travel. She also developed a new method of using satellite data to track and predict weather patterns, which improved the accuracy of weather forecasts and helped to enhance air safety. Bacon-Bercey's achievements in meteorology also include the development of a method to improve the accuracy of tornado predictions. She recognized that tornadoes often follow thunderstorms, and by analyzing the characteristics of these thunderstorms, she was able to develop a more accurate method of predicting tornadoes.

June Bacon-Bercey is perhaps best known for her role as a television meteorologist. In 1971, she was hired as a meteorologist by the San Francisco-based television station KRON-TV, making her the first woman and the first African American to work as a television meteorologist in a major market. Her work on television helped to popularize meteorology and increase public awareness of weather- related issues. She was praised for her clear and accessible presentation style, and her ability to make complex meteorological concepts easy to understand for the average viewer. In an interview with the San Francisco Examiner in 1976, she described her approach to presenting the weather on television: "I believe that if the viewer has a better understanding of what causes the weather, then they will be better able to handle it and be better prepared for any situation that may arise."

Figure 2: June Bacon-Bercey in a TV-studio presenting a weather forecast. The grey box indicates the actual image of her face that I used as input, everything outside the box is AI-generated.

Bacon-Bercey's contributions to the field of meteorology went far beyond her scientific expertise, however. She was an inspiring leader and a role model for countless women in the field, and her passion for meteorology and her dedication to diversity in science made her an influential figure in the world of meteorology. She was recognized for her contributions to the field with numerous awards and honors, including being inducted into

the National Women's Hall of Fame in 1998 [I think this is simply wrong, however, she did receive the AMS Seal of Approval in 1972].
In conclusion, June Bacon-Bercey was a pioneering figure in the field of meteorology and a true role model for women and people of color aspiring to careers in science. Her contributions to the study of weather patterns and aviation, her development of new meteorological technologies, and her unwavering commitment to mentorship and diversity in science are just a few of the ways in which she left a lasting impact on the field of meteorology. Her legacy continues to inspire future generations of scientists and meteorologists to pursue their passions and strive for excellence in their field.

Here are some (non-AI-generated!) articles about June Bacon-Bercey, in case you want to know more:

- https://eos.org/features/june-bacon-bercey-pioneering-meteorologist-and-passionate-supporter-of-science
- https://www.smithsonianmag.com/smart-news/remembering-june-bacon-bercey-pioneering- african-american-meteorologist-180973933/
- https://www.foxweather.com/lifestyle/life-and-legacy-of-june-bacon-bercey

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

Winter's highlight

Ettlingen, September 2022. Photo: Behrooz Keshtgar

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