Waves to Weather

Newsletter Jan/Mar 2021

Dear Colleagues and Friends,

I hope you had a wonderful break over Easter!

It is our great pleasure to announce a new program that may be of special interest to readers of this newsletter: W2W Fellows. Our aim is to promote contact and collaboration with international scientists at the highest level, and if you are curious, we would encourage you to get in touch, either with me or any W2W scientist that you are already in contact with.
As always, we feature a selection of scientific highlights and community activities, notably the second edition of the comic book "Of course!".

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 **ECS annual meeting** will be organized by and for the W2W early career scientists on 7-9 April 2021. More information will be available here soon: https://www.wavestoweather.de/meetings/ecs-annual-meeting-2021
- The **Research Area C meeting** will take place online on 9th June 2021. More information will be available here shortly: https://www.wavestoweather.de/meetings/racmeeting2021
- 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 Eibelstadt, if possible.

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

News

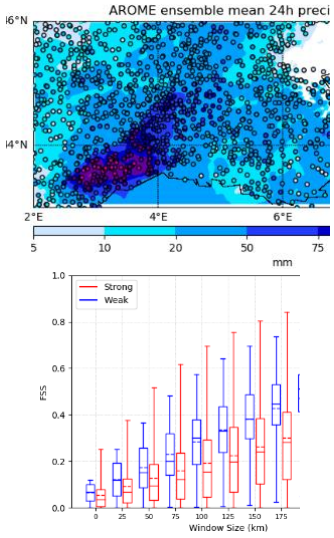
A **W2W Fellows program** has recently been established. To learn more about the terms and conditions to be eligible to become a W2W Fellow, visit:
https://www.wavestoweather.de/guest

Please contact us if you have any questions.

Research Highlights

Here are some examples of recently published research from W2W.

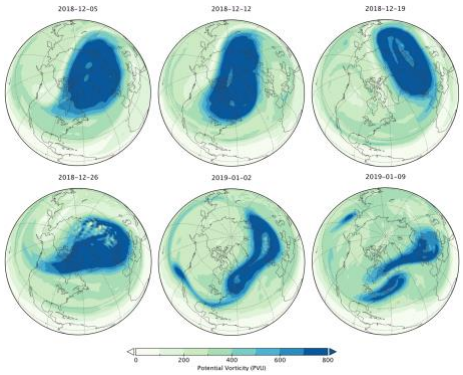
1. Dependence of predictability of precipitation in the northwestern Mediterranean coastal region on the strength of synoptic control (C. Keil, L. Chabert, O. Nuissier and L. Raynaud)



During strong synoptic control, which dominates the weather on 80 % of the days in the 2-month period in autumn 2012 (HyMeX-SOP1), the domain-integrated precipitation predictability assessed with the normalized ensemble standard deviation is above average, the wet bias is smaller and the forecast quality is generally better. In contrast, the spatial forecast quality of the most intense precipitation in the afternoon, as quantified with its 95th percentile, is superior during weakly forced synoptic regimes.

Read the full article: https://doi.org/10.5194/acp-20-15851-2020

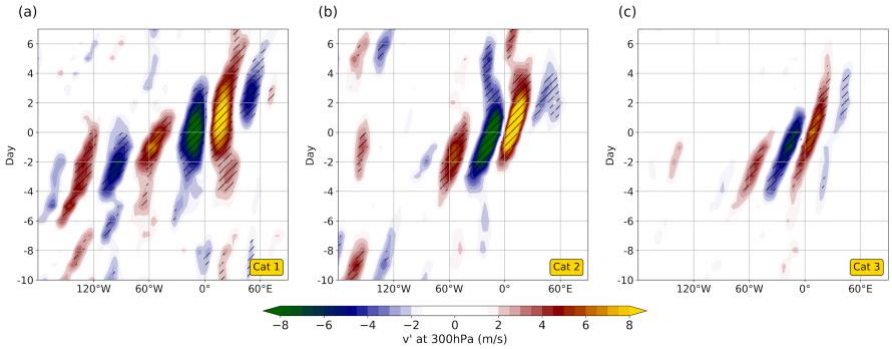
2. Sudden stratospheric warmings (M. P. Baldwin, B. Ayarzagüena, T. Birner, N. Butchart, A. J. Charlton-Perez, A. H. Butler, D. I. V. Domeisen, C. I. Garfinkel, H. Garny, E. P. Gerber, M. I. Hegglin, U. Langematz and N. M. Pedatella)



Sudden stratospheric warmings (SSWs) are impressive fluid dynamical events in which large and rapid temperature increases in the winter polar stratosphere are associated with a complete reversal of the climatological wintertime westerly winds. SSWs are caused by the breaking of planetary-scale waves that propagate upwards from the troposphere. During an SSW, the polar vortex breaks down (see example left), accompanied by rapid descent and warming of air in polar latitudes. The rapid warming and descent of the polar air column affect tropospheric weather, shifting jet streams, storm tracks, and making cold air outbreaks over North America and Eurasia more likely. SSWs are also seen as a key process to analyze in climate change studies and subseasonal to seasonal prediction. This work reviews the current knowledge on the most important aspects of SSWs, from the historical background to dynamical processes, modeling, chemistry, and impact on other atmospheric layers.

Read the full article:
https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020RG000708

3. Extreme precipitation events over northern-central Italy. Part (II): Dynamical precursors (F. Grazzini, G. Fragkoulidis, F. Teubler, V. Wirth and G. C. Craig)

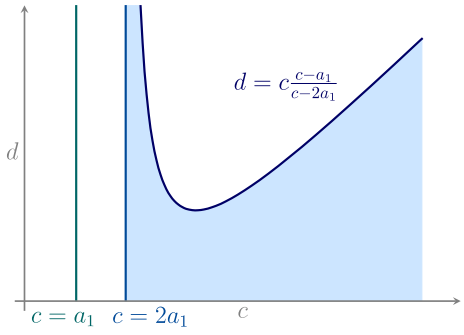


Several studies on extreme precipitation events (EPEs) in the alpine area reported, as the main triggering factor, a meridionally elongated upper-level trough as part of an incoming Rossby wave packet. We investigate a wide number of EPEs occurring between 1979 and

2015 in northern-central Italy. The EPEs are subdivided into three categories (Cat1, Cat2, Cat3) according to thermodynamic conditions over the affected region. The three categories differ not only in terms of the local meteorological conditions, but also in terms of the evolution and properties of the large-scale circulation leading to these events. The relevant physical processes inducing different dynamical evolutions are further investigated through composite analysis and a recently developed PV tendency framework. Rossby wave packets associated with the strongest EPEs, namely the ones falling in Cat2, undergo a substantial amplification over the western N. Atlantic due to anomalous ridge-building two days before the event; arguably due to diabatic heating sources. This type of dynamical evolution induces a downstream trough which is highly effective in focusing water vapor transport towards the main orographic barriers of northern-central Italy and favoring the occurrence of EPEs.

Read the full article: https://doi.org/10.1002/qj.3969

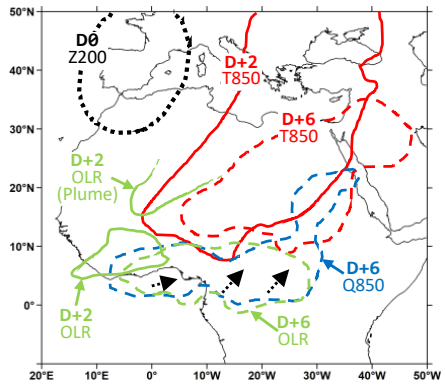
4. Pattern formation in clouds via Turing instabilities (J. Rosemeier and P. Spichtinger)



We investigate if the Turing mechanism may be responsible for the emergence of patterns in clouds. A generic scheme for warm clouds, which contains several parameters, is considered. We show that for some parameter choices Turing instabilities cannot occur. This is especially the case when we choose the parameters which are used in the cloud scheme incorporated in COSMO or the Wacker scheme. However, if a weakly nonlinear parameterization for the microphysical process accretion is used, the Turing mechanism can lead to pattern formation. Such a nonlinear parameterization is incorporated in the IFS model. There exist cloud schemes that allow for pattern formation through the Turing mechanism but the application of parameterizations that prevent or allow for Turing patterns is not consistent in the weather prediction models.

Read the full article: https://doi.org/10.1515/mcwf-2020-0104

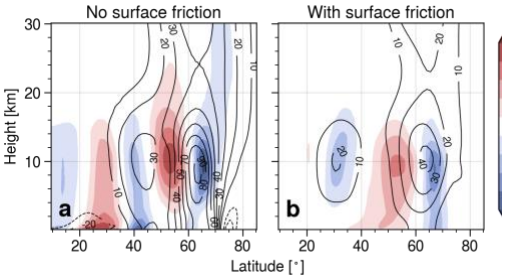
5. Synoptic timescale linkage between midlatitude winter troughs Sahara temperature patterns and northern Congo rainfall: A building block of regional climate variability (N. Ward, A. H. Fink, R. J. Keane, F. Guichard, J. H. Marsham, D. J. Parker and C. M. Taylor)



The impact of troughs over the Mediterranean on rainfall in the northern Congo Basin during the boreal winter (Dec. - March) "drier" season has been investigated. A synoptic process chain that leads to wet spells has been disentangled: The troughs lead to a subsequent warming in the eastern Sahel, with an ensuing enhancement and northward migration of the wintertime heat low with moist equatorial air in its wake, and enhanced near equatorial 600-hPa easterlies that increase low-level wind shear over northern Congo Basin. As a consequence (organized) convection is more likely at the northern fringe of the seasonal tropical rainbelt (ITCZ). The Mediterranean troughs are thus obvious candidates to be used as predictors in hybrid forecast systems during boreal winter.

Read the full article: https://doi.org/10.1002/joc.7011

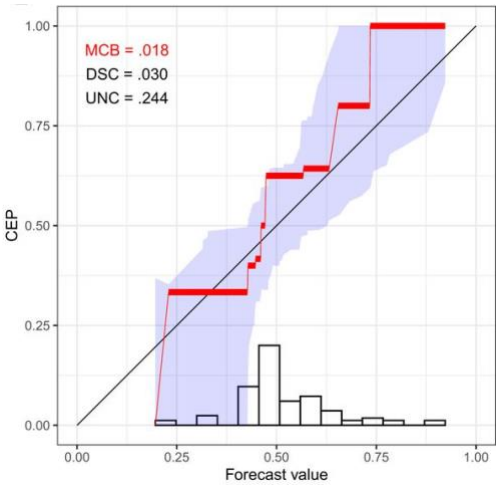
6. Tropospheric eddy feedback to different stratospheric conditions in idealised baroclinic life cycles (P. Rupp and T. Birner)



We use the simple framework of an idealised baroclinic life cycle to study the tropospheric eddy feedback to different stratospheric conditions and, hence, obtain insights into the fundamental processes of stratosphere–troposphere coupling – in particular, the processes involved in creating the robust equatorward shift in the tropospheric mid-latitude jet that has been observed following sudden stratospheric warming events.

Read the full article: https://wcd.copernicus.org/articles/2/111/2021/

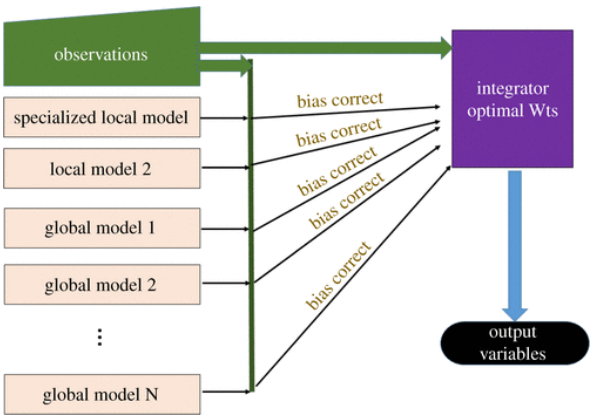
7. Stable reliability diagrams for probabilistic classifiers (T. Dimitriadis, T. Gneiting and A. I. Jordan)



Probabilistic classifiers assign predictive probabilities to binary events, such as rainfall tomorrow, a recession, or a personal health outcome. Such a system is reliable or calibrated if the predictive probabilities are matched by the observed frequencies. In practice, calibration is assessed graphically in reliability diagrams, and quantified via the reliability component of the mean Brier score. Extant approaches to plotting reliability diagrams and computing score decompositions rely on binning and counting and have been hampered by ad hoc implementation decisions, a lack of reproducibility, and inefficiency. Here we introduce the CORP approach, which uses the pool-adjacent-violators (PAV) algorithm to generate provably statistically Consistent, Optimally binned, Reproducible, PAV-based reliability diagrams, along with a numerical measure of miscalibration based on a revisited score decomposition.

Read the full article: https://www.pnas.org/content/118/8/e2016191118

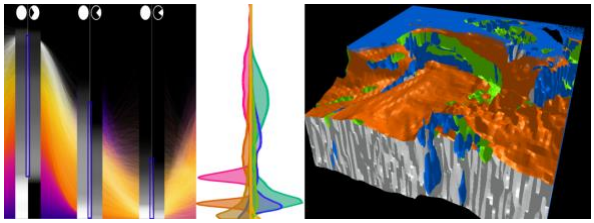
8. Towards implementing artificial intelligence post-processing in weather and climate: proposed actions from the Oxford 2019 workshop (S.E. Haupt, W. Chapman, S.V. Adams, C. Kirkwood, J.S. Hosking, N.H. Robinson, S. Lerch and A.C. Subramanian)



We provide an overview of post-processing with AI for weather and climate models. Deriving from the discussion at the 2019 Oxford workshop on Machine Learning for Weather and Climate, this paper also presents thoughts on medium-term goals to advance such use of AI, which include assuring that algorithms are trustworthy and interpretable, adherence to FAIR data practices to promote usability, and development of techniques that leverage our physical knowledge of the atmosphere.

Read the full article: https://doi.org/10.1098/rsta.2020.0091

9. Visual Analysis of Multi-Parameter Distributions across Ensembles of 3D Fields (A. Kumpf, J. Stumpfegger, P. F. Hartl and R. Westermann)



This work presents methods to display and compare multi-parameter distributions which are present in numerical weather prediction data. Representative structures can be identified and searched for in other simulations by their multi-parameter distributions. The accompanying open-source tool "PCViewer" facilitates interactive analysis and comparison of said structures using different 3D rendering techniques, parallel coordinates plots and extended violin plots.

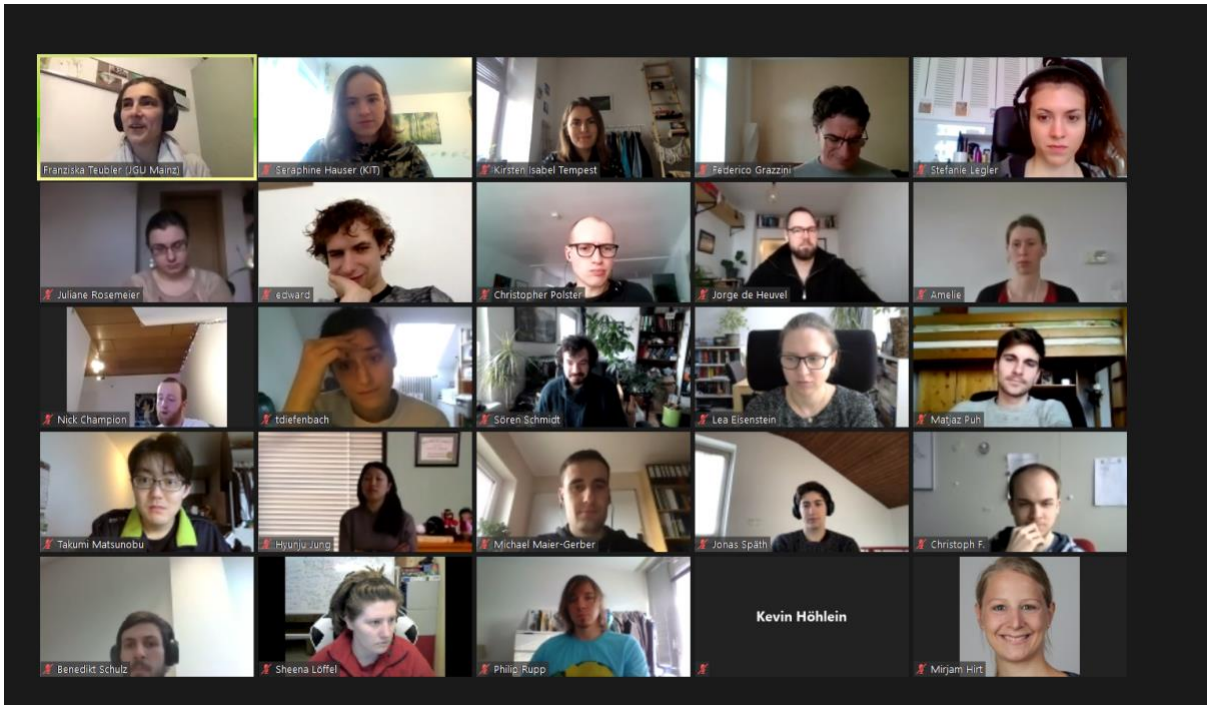
Read the full article: https://ieeexplore.ieee.org/document/9362264

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

Past activities

ECS Mini-Workshop (17 Feb. 2021)

A mini-workshop for all early career scientists (ECS) of W2W was organized by the ECS committee and held virtually on 17 February 2021. With a maximum number of 40 participants the mini workshop was a great success! The workshop started with a session led by Franziska Teubler (project A8) on the basics of potential vorticity (PV) and the “PV thinking” concepts. In a hands-on session, the participants performed their own piecewise PV inversion on jupyterhub. Christopher Polster (project A8) then introduced the basic idea of ensemble sensitivity analysis and offered a practical exercise. Mirjam Hirt (project A1) then gave a presentation on “causation vs. correlation”. After reviewing the theory in a “linear world”, Mirjam showed how this approach can be used in meteorological applications, and the ECS discussed a practical example in small breakout groups. To finish the day, the participants presented online tools they find useful for their research. A variety of tools, learning materials, as well as a scientific “correlation” game were presented.



Participants of the Mini-Workshop on 17 February 2021

Thank you to Franziska, Christopher and Mirjam for your contributions!

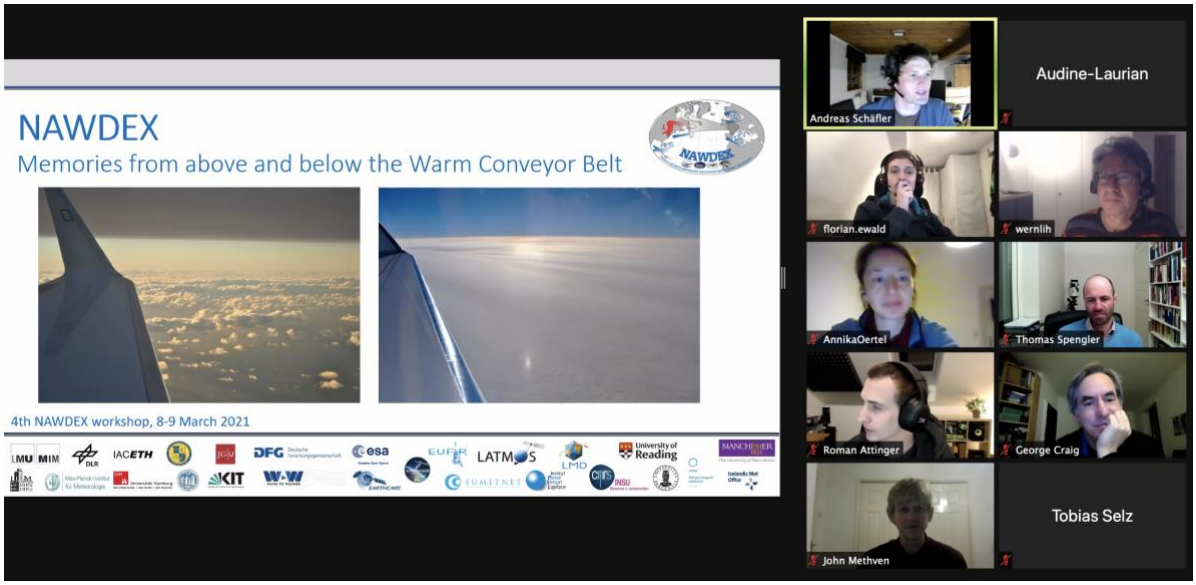
For more information, visit:
https://www.wavestoweather.de/meetings/ecs-mini-workshop-feb2021

4th NAWDEX workshop (8-9 Mar. 2021)

About 45 participants from the USA, Canada, the UK, Switzerland, France, Norway, the Netherlands and Germany took part in the 4th NAWDEX workshop from 8-9 March 2021 online.
The latest results using the unique NAWDEX observational database were presented and next steps beyond NAWDEX have been discussed. Fruitful plenary discussions and lively exchanges at poster sessions, as well as lively informal discussions, for instance during the social event on 8 March presenting photos of Iceland where the NAWDEX campaign took place in Sep.-Oct. 2016 were made possible by the online platform QiqoChat.

Thank you to all the contributors, and to the technical support team!

Read more about this workshop here:
https://www.wavestoweather.de/meetings/nawdex-workshop_2021

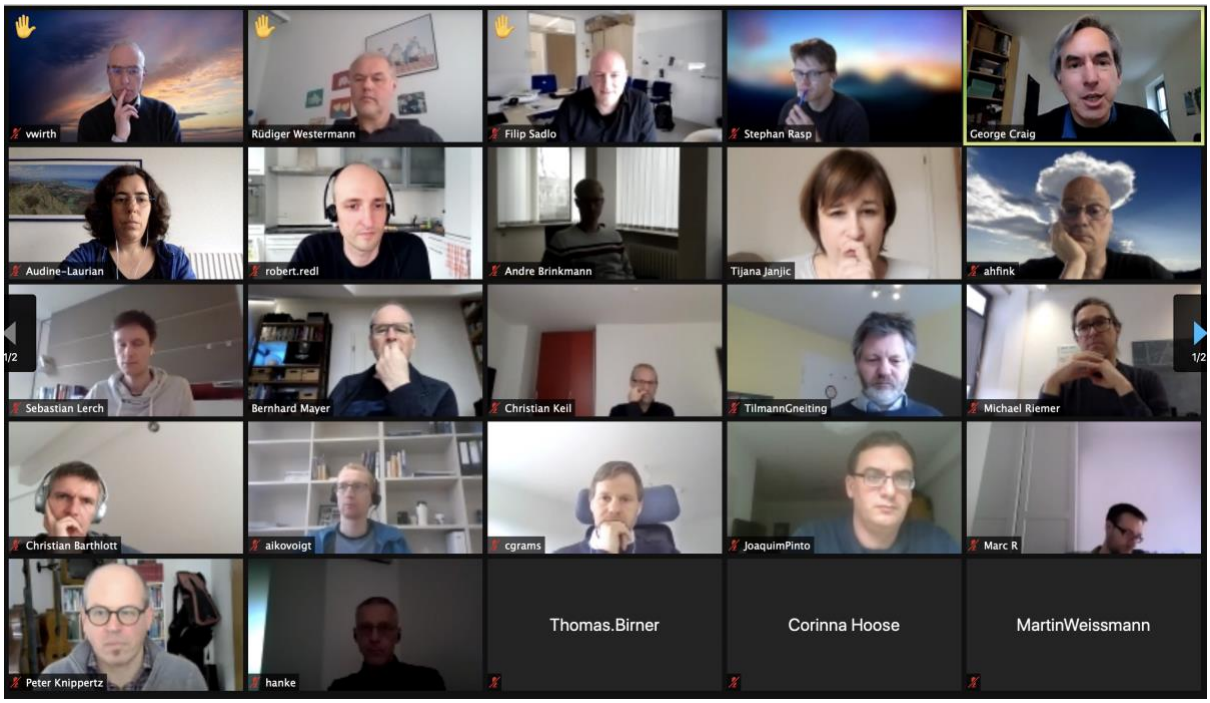


Some NAWDEX workshop participants at the social event on 8 March.

PI retreat (15-16 Mar. 2021)

A meeting for all W2W project leaders and members took place online on 15-16 March 2021. On the first day, a session on Machine Learning let to fruitful discussions. Topics such as scientific priorities, tools and infrastructure, joint activities and transfer to operational community were discussed on the second day in smaller groups.

Read more about this meeting here:
https://www.wavestoweather.de/meetings/pi_retreat2020

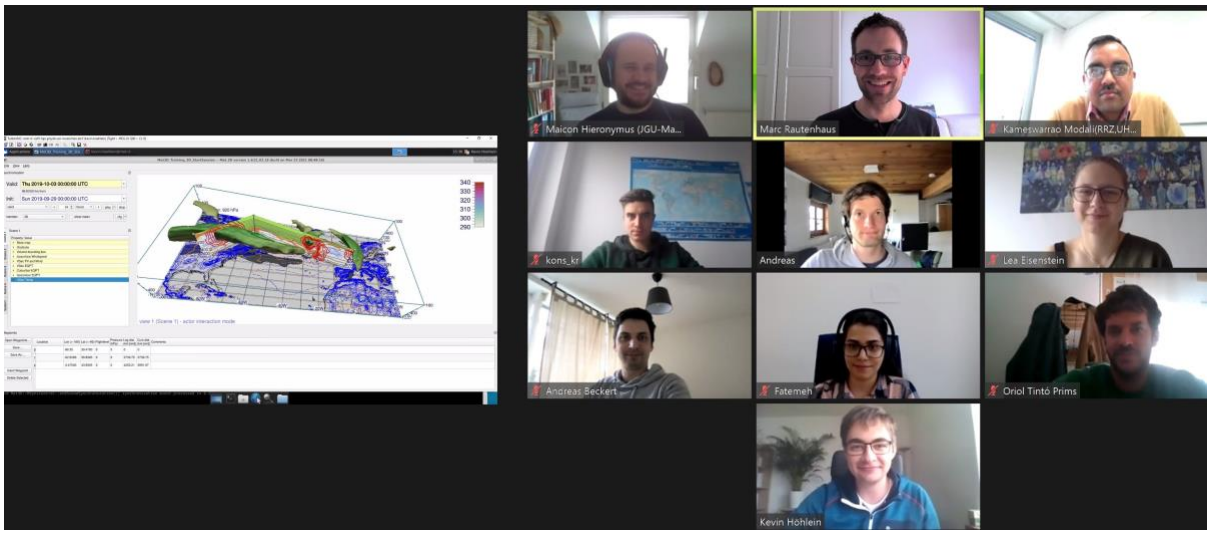


Some participants of the meeting on 15 March

Visualization workshop (23 Mar. 2021)

The W2W Met.3D visualization workshop, hosted by Marc Rautenhaus, Andreas Beckert and Kamesh Modali (UHH), took place online on 23 March 2021. After a brief introduction to Met.3D and its origins, the participants learned in multiple hands-on sessions in break-out groups how to use the software on the W2W remote visualization servers to visually analyze an ECMWF ensemble forecast. Several tasks had to be solved to get accustomed to Met.3D interactive visual analysis functionality, including interactive maps and vertical sections, 3D isosurfaces and volume rendering, trajectories, Skew-T diagrams, and basic ensemble functions. Andreas and Kamesh introduced recent developments for stereographic projection support and front analysis.

If you are also interested in using Met.3D, have a look at the online documentation resources at:
https://collaboration.cen.uni-hamburg.de/display/Met3D



Group picture of the workshop participants

More information about the workshop is available here:
https://www.wavestoweather.de/meetings/vis-workshop2021

Seminars and guest program

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

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

Press release

The article on "Stable reliability diagrams for probabilistic classifiers" published in PNAS and written by Tilmann Gneiting and his colleagues has been featured in the HITS news. To read more about this article, visit:
https://www.wavestoweather.de/communication/dissemination-activities/publications/hits-news-2021

Past issues of this newsletter

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

Outreach

Interview in the „Schleswig-Holsteinischer Zeitungsverlag"

On 8 March 2021, Peter Knippertz was interviewed about the effects of large companies such as Google and Apple investing in weather forecast data. To read more, visit:
https://www.wavestoweather.de/news/interview-in-the-shz-2021

Collaboration with the Deutsches Museum in Munich

Provided that in-person meetings are possible again Corinna Hoose (KIT) will give a presentation at the Deutsches Museum in Munich on 13 October 2021. This event is part of the seminar series "Wissenschaft für jedermann" addressed to the general public.

Equal opportunity (EO) activities

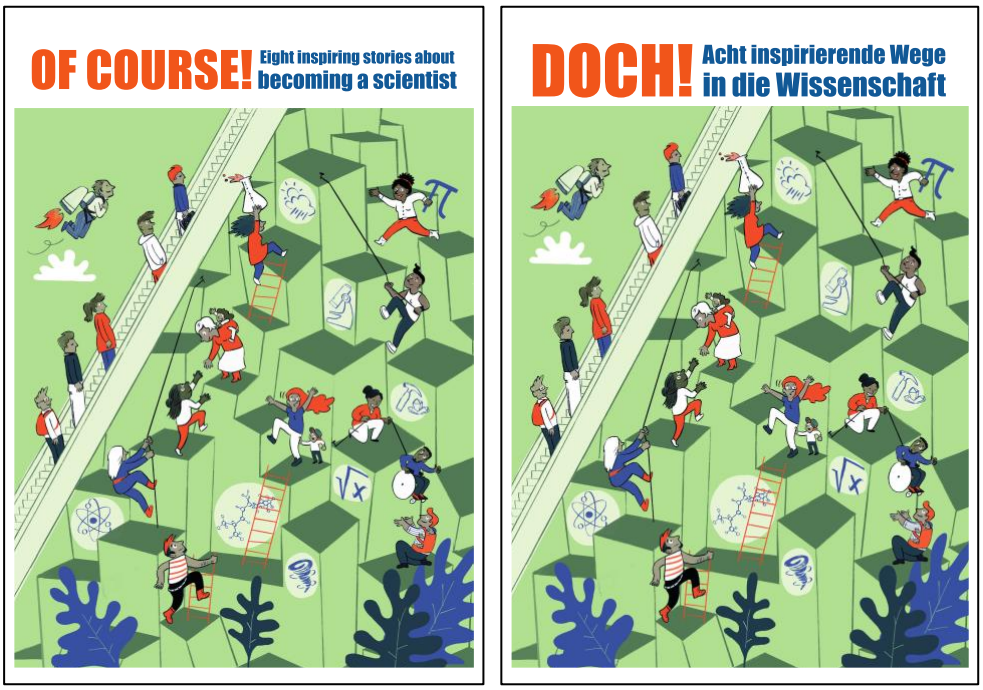
Comic book "Of course!"

The comic book featuring female and male role models in STEM fields (science, technology, engineering, and mathematics) has been distributed and advertised end of 2020. The project has received very positive feedback and three examples of such response are listed below:

1) The story of Costanza Rodda (Univ. Grenoble, France) was featured in the comic book and she has been interviewed in the Italian newspaper "Il Piccolo" on 26 January 2021. The article talked about her involvement in the project and how fundamental the encouragement from other women (but men too) can be fundamental to pursue a career in science. To read more about this interview, click here:
https://www.wavestoweather.de/communication/outreach-activities/press-releases/interview_il_piccolo2021

2) Audine Laurian was invited to present the project at an Equal Opportunity Lunch Seminar at the University of Bergen on 18 February 2021. About 25 scientists took part in the event, sharing their personal experience and discussing cultural differences in addressing gender imbalance, positive discrimination, and other relevant issues. To read more about this event, visit: https://www.wavestoweather.de/communication/dissemination-activities/meetings/international-day-2021
3) The comic book project was featured in the LMU magazine. Read more here: https://www.wavestoweather.de/communication/dissemination-activities/publications/muenchneruni-magazin

The **second edition** of the comic book is now available. It features a new cover, minor corrections and some additional features.



Cover of the 2nd edition in English (left) and in German (right)

Click here to download the comic book:
https://www.wavestoweather.de/equal_opportunity/activities/comic-book

Girls' Day (22 April 2021)

Girls' Day is a countrywide event to introduce schoolgirls to disciplines and careers in which women are usually underrepresented. This year, it will take place online on Thursday 22 April 2021. Female scientists in W2W in Munich, Mainz and Karlsruhe will offer online workshops on weather and weather forecast. The participants will learn about meteorology and they will discover the everyday life of a scientist at our institutes.
To read more about this event, visit:
https://www.wavestoweather.de/equal_opportunity/activities/girlsday-2021

Female role models in natural sciences: NASA scientist Katherine Johnson

Based on an Article in Spiegel Online and Wikipedia, by Christian Barthlott

In W2W, we make a constant effort to support and encourage women and girls to pursue a career in our fields by inviting, and providing success stories of female role models. Ellen Fetter and Margaret Hamilton were featured in the previous issue of this newsletter. We now present a portrait of Katherine Johnson.
Katherine Johnson was an American mathematician who is remembered as the woman who sent men to the moon. She died in 2020 at the age of 101. Johnson was considered a mathematical genius and worked for NASA's first space missions in the 1960s. She played a key role in sending the first humans to the moon as her work included calculating trajectories, launch windows, and emergency return paths. She earned a reputation for mastering complex manual calculations and helped pioneer the use of computers to perform the tasks. Johnson decided on a career as a research mathematician, although this was a difficult field for African Americans and women to enter. Her role as a black woman in a male-dominated industry and a deeply racist society is told in the Oscar-winning film "Hidden Figures – Unrecognized Heroines". Until 1958, due to the racial segregation practiced at the time, Johnson and other black women worked in a separate computer unit at what is now the Langley Research Center in Hampton, Virginia. At the age of 97, Johnson received the Presidential Medal of Freedom, the highest civilian honor in the country.
Christine Darden who also worked at NASA is featured in this short video:
https://www.youtube.com/watch?v=UVrORjy7PDk&t=8s

References:

https://www.spiegel.de/wissenschaft/raumfahrt-pionierin-katherine-johnson-ist-tot-a-6c43fbd3-3513-42e9-8fa7-f1af7c372053
https://en.wikipedia.org/wiki/Katherine_Johnson

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

Saharan dust over Mase, Switzerland on 6 February 2021 (no filter used!). Photo: Yvonne Ruckstuhl

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