

Waves to Weather



Newsletter Jan/Mar 2019

This has been a busy few months for everyone associated with Waves to Weather. We have submitted our proposal for the second funding period (400 pages!) and presented it to a panel of international reviewers. Now we are eagerly awaiting the decision. At the same time (how do they do it?) our doctoral students are busy writing their dissertations, and as you will see below, several have already successfully defended their work. This edition of the newsletter also features many new publications and outreach activities. Happy reading!

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 **19th Cyclone Workshop** will be organized by W2W and will take place in Seon (Bavaria, Germany) from September 29th – October 4th 2019. The abstract submission deadline is **April 15th 2019**. More information about the program, the venue, support to Early Career Scientists, etc. is available here: <http://www.wavestoweather.de/meetings/19th-cyclone-workshop>
- The **Kick-of meeting of W2W**, upon successful outcome of the review meeting for a second four-year funding, will take place from November 4th – 6th 2019 in Eibelstadt close to Würzburg (Germany).

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

Please contact us if you have any questions.

News

PhD defenses

We would like to congratulate the W2W PhD students who defended their PhD this month and we wish them all the best for their future:



Linda Schneider (project B3) defended her PhD on December 7th 2018.



Constanze Wellmann (project B1) defended her PhD on February 1st 2019.



Peter Vogel (project C2) defended his PhD on February 6th 2019. He will start working as a statistician at CSL Behring in Marburg (<https://www.cslbehring.de>).

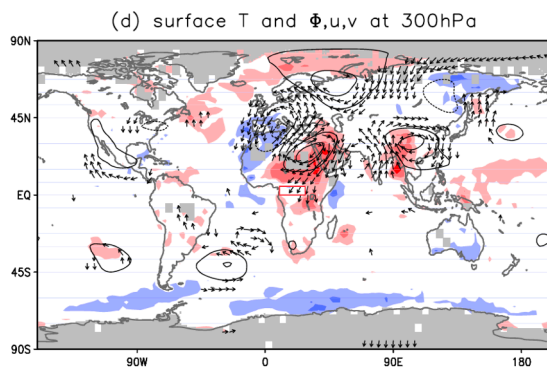


Stephan Rasp (project A6) defended his PhD on March 15th 2019.

Research Highlights

Here are some examples of recently published research from W2W.

1. Earlier seasonal onset of intense Mesoscale Convective Systems in the Congo Basin since 1999 (C.M. Taylor, A.H. Fink, D.J. Parker, C. Klein, F. Guichard, P.P. Harris and K.R. Knapp)

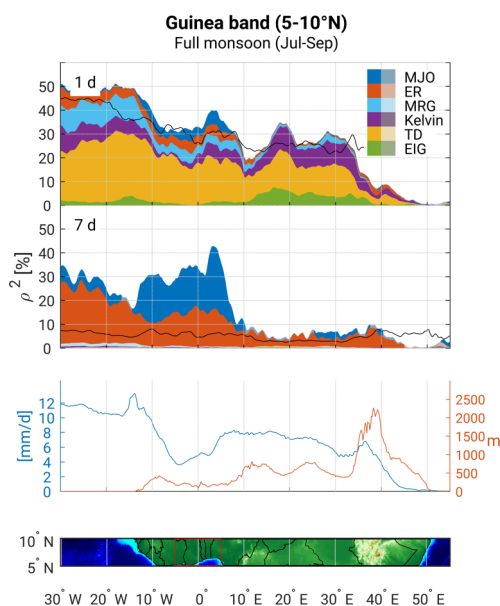


Using satellite data, we find a remarkable increase post-1999 in intense Mesoscale Convective Systems (MCS) frequency over the Congo Basin during the month of February. This earlier onset of the spring rainy season has been accompanied by strong increases in the February meridional temperature gradient and associated wind shear. This mechanism works both on weather and climate time scales and is related to an upper-level wave pattern in the extratropics suggesting potential for sub-monthly predictability.

Read the full article:

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018GL080516>

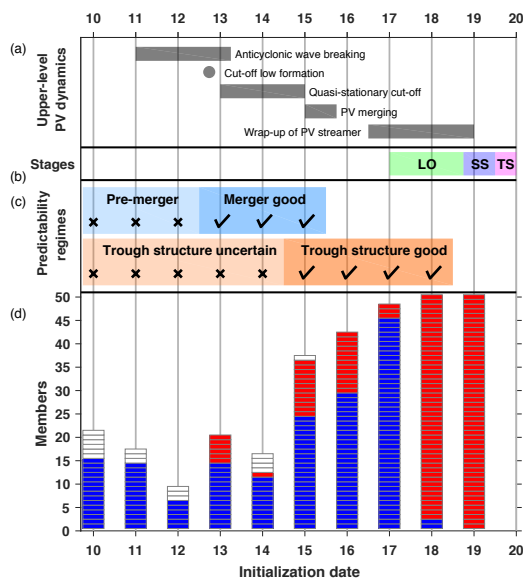
2. A systematic comparison of tropical waves over northern Africa. Part I: Influence on rainfall (A. Schlüter, A. H. Fink, P. Knippertz and P. Vogel)



The first systematic comparison of the impact of six tropical wave types on precipitation over northern tropical Africa during the transition and full monsoon seasons is presented, using two satellite products and a dense rain gauge network. Composites of rainfall anomalies show comparable modulation intensities in the West Sahel and at the Guinea Coast, varying from less than 2 to above 7 mm/d depending on the wave type. African Easterly Waves and Kelvin waves dominate the 3-hourly to daily timescale and explain 10-30% locally. On longer timescales (7-20d), only the MJO and equatorial Rossby waves remain as modulating factors and explain about up to one third of rainfall variability. The results stress that more attention should be paid to tropical waves when forecasting rainfall over northern tropical Africa.

Read the full article: <https://journals.ametsoc.org/doi/10.1175/JCLI-D-18-0173.1>

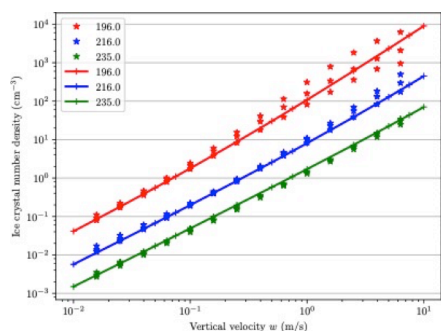
3. Tropical Transition of Hurricane Chris (2012) over the North Atlantic Ocean: A Multi-Scale Investigation of Predictability (M. Maier-Gerber, M. Riemer, A.H. Fink, P. Knippertz, E. Di Muzio, R. McTaggart-Cowan)



This study uses operational ECMWF ensemble predictions to investigate the tropical transition (TT) of North Atlantic Hurricane Chris (2012), whose formation was preceded by the merger of two potential vorticity (PV) maxima, eventually resulting in the cyclone-inducing PV streamer. The main goal is to elucidate the dynamic and thermodynamic processes governing the predictability of Chris' cyclogenesis and subsequent TT. A systematic investigation of consecutive ensemble forecasts shows that sudden changes in ensemble statistics of cyclone metrics are linked to specific events. A novel combination of Eulerian and cyclone-relative ensemble forecast analysis tools allows inference of physical causes of abrupt changes in predictability.

Read the full article: <https://journals.ametsoc.org/doi/abs/10.1175/MWR-D-18-0188.1>

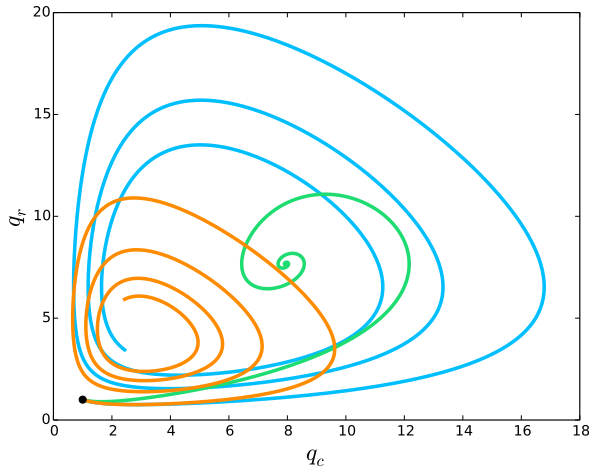
4. Homogeneous nucleation from an asymptotic point of view (M. Baumgartner and P. Spichtinger)



The major formation pathway of ice crystals in the low-temperature regime below 235K is homogeneous freezing of solution droplets. This mechanism is known to be very sensitive to environmental conditions, i.e., temperature and humidity. Nucleation events are characterized by an explosive increase in ice crystal number concentrations. We consider the description of a single nucleation event using a slightly simpler system, which features the same sharp increase in ice crystal number concentration. We analyze the simpler system using asymptotic methods and construct a leading order approximation to the exact solution. This gives insight into a single homogeneous nucleation event from a mathematical perspective, without introducing further assumptions apart from the transition to the simplified system.

Read the full article: <https://doi.org/10.1007/s00162-019-00484-0>

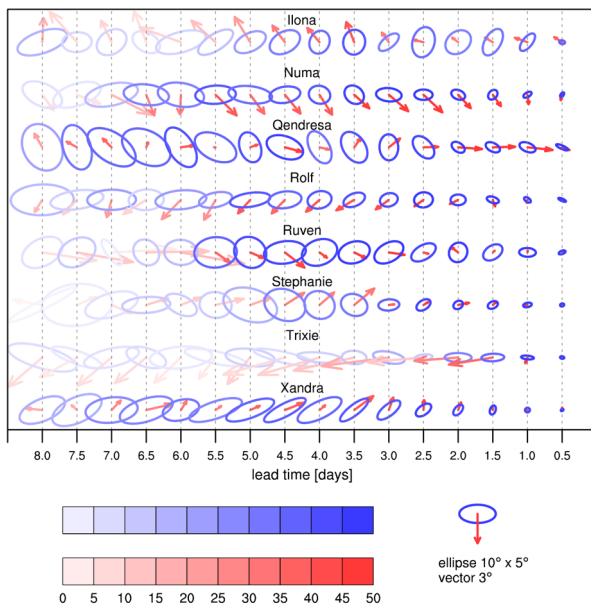
5. Intercomparison of warm-rain bulk microphysics schemes using asymptotics (J. Rosemeier, M. Baumgartner and P. Spichtinger)



Cloud schemes are not derived from first principles and many different cloud schemes therefore exist. Our work is devoted to warm-rain schemes. In particular, we focus on the cloud schemes which can be found in the COSMO and IFS documentations and in Wacker (1992). The schemes are formulated as systems of ordinary differential equations. We investigate and compare the cloud schemes using the theory of dynamical systems together with asymptotic techniques to infer their behavior on different timescales. Both similarities and differences could be detected between the schemes. The differences might affect the modeled flow realization.

Read the full article: <https://doi.org/10.1515/mcwf-2018-0005>

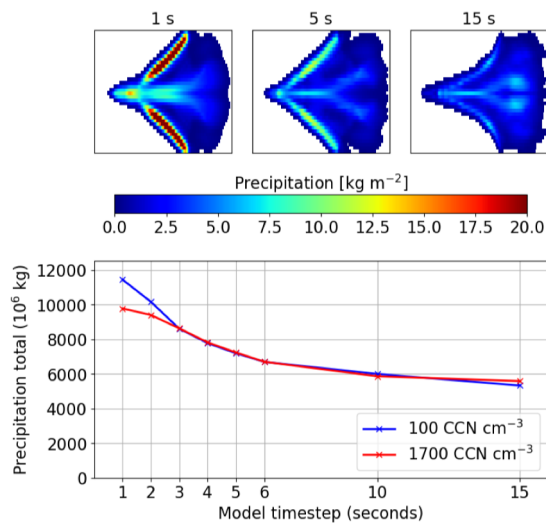
6. Assessing the predictability of Medicanes in ECMWF ensemble forecasts using an object-based approach (E. Di Muzio, M. Riemer, A. Fink and M. Maier-Gerber)



The predictability of Medicane is studied using ECMWF operational ensemble forecasts by means of an object-based approach, which allows to focus on specific storm features while tolerating small shifts in time and space. Forecast accuracy tends to strongly improve at short lead times, indicating that ensemble forecasts can adequately reproduce Medicanes, albeit only few days in advance. A rapid increase in the probability of cyclone occurrence (“forecast jump”) is seen in most cases, while the uncertainty and bias of cyclone position shows a rather consistent evolution with lead time.

Read the full article: <https://doi.org/10.1002/qj.3489>

7. One step at a time: how model timestep significantly affects convection-permitting simulations (A. I. Barrett, C. Wellmann, A. Seifert, C. Hoese, B. Vogel and M. Kunz)

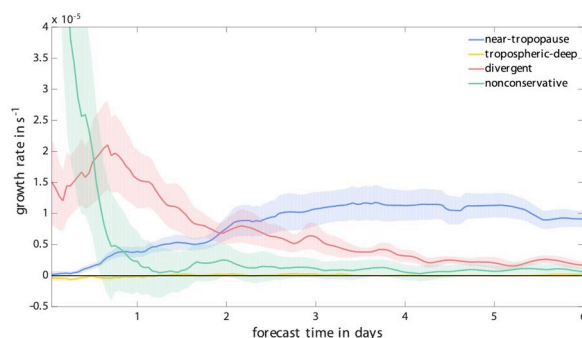


Precipitation totals from simulated thunderstorms with the COSMO model were found to reduce by over 50% when longer model time steps were used (see figure). This was caused by how the model dynamics and cloud microphysics were linked in the model. Calculating one step at a time, model dynamics first and cloud microphysics afterwards, gives results that are very sensitive to the time step used. However, when both model dynamics and cloud microphysics were calculated simultaneously, the sensitivity to model time step was almost completely removed. This paper documents the sensitivities, explains their physical causes and examines which model processes are affected by the change to the order of calculations.

Read the full article:

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018MS001418>

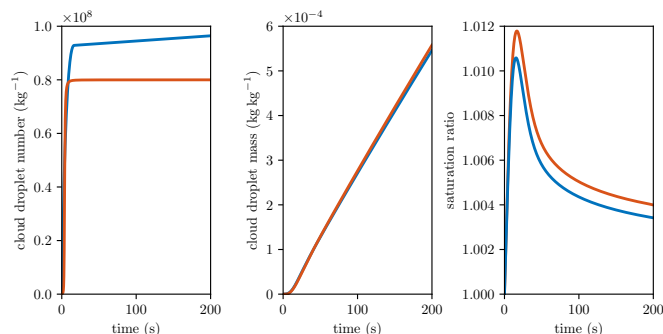
8. Quantitative view on the processes governing the upscale error growth up to the planetary scale using a stochastic convection scheme (M. Baumgart, P. Ghinassi, V. Wirth, T. Selz, G.C. Craig and M. Riemer)



We investigate upscale error growth from a process-based perspective using a potential-vorticity and envelope framework. As illustrated in the figure, we could identify three distinct stages of upscale error growth, in which the following processes dominate the error growth: 1) latent heating, 2) upper-tropospheric divergence, and 3) near-tropopause dynamics. A new fourth stage of planetary-scale error growth could be identified with the envelope framework. Compared to previous studies, we provide a novel interpretation of the processes governing upscale error growth.

Read the full article: <https://journals.ametsoc.org/doi/10.1175/MWR-D-18-0292.1>

9. A model for warm clouds with implicit droplet activation, avoiding saturation adjustment (N. Porz, M. Hanke, M. Baumgartner and P. Spichtinger)



We present a new model of intermediate complexity (a one-and-a-half moment scheme) for warm clouds, which is derived from physical principles. Our model consists of a system of differential-algebraic equations, which allows for supersaturation and comprises intrinsic automated droplet activation due to a coupling of the droplet mass and number concentrations tailored to this problem. For the numerical solution of this system we recommend a semi-implicit integration scheme, with efficient solvers for the implicit parts.

Read the full article: <https://www.degruyter.com/view/j/mcwf.2018.4.issue-1/mcwf-2018-0003/mcwf-2018-0003.xml>

Additional publications relevant to W2W are listed here:

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

Past activities

The **review meeting** for a second four-year funding period of W2W took place in Karlsruhe from March 12-13th 2019. Thank you to everyone who contributed! The DFG will send the final decision on May 21-22nd 2019.

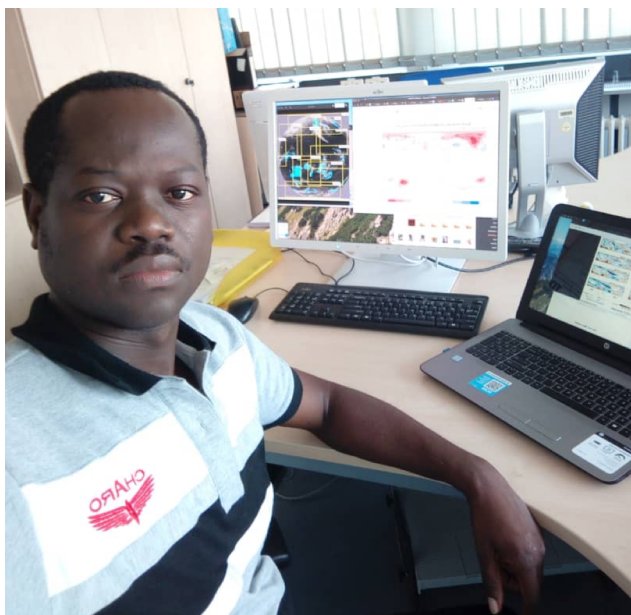


A few participants, from left to right: George Craig, Nikolas Porz, Bettina Wiebe, Yvonne Ruckstuhl, Kevin Bachmann, Matthias Schindler, Paolo Ghinassi and Federico Grazzini. Photo: Federico Grazzini.

Seminars and guest program

Pascal Moudi Igri (Douala, Cameroon) currently works as a visiting scientist at KIT within the working group of Peter Knippertz and Andreas Fink. His three-month stay until mid-April 2019 is funded by the TWAS–DFG (The World Academy of Sciences – Deutsche Forschungsgemeinschaft) Cooperation Visits program (<https://twas.org/opportunity/twas-dfg-cooperation-visits-programme>). During his research stay, Pascal will investigate extreme rainfall events in Cameroon using observations and convection-permitting WRF simulations. In his home country, Pascal works as a forecaster in the SAWIDRA-AC project (Satellite and Weather Information for Disaster Resilience in Africa – Afrique Centrale; <http://www.sawidra-ac.org>), which is operated by the newly-established CAPC-AC (“Centre d'Application et de Prévision Climatologique de l'Afrique Centrale”). The SAWIDRA-AC project aims to provide national weather services of the Central African Economic and Monetary Community with weather forecasts that are based on dynamic weather forecasting models. The latter shall be run at a new HPC infrastructure to be established at CAPC-AC. The researchers in the C2 project will discuss with Pascal how to augment the use of availa-

ble forecast data and maps for better multi-day forecast for the member states of the Central African Economic and Monetary Community, i.e. Cameroon, Gabon, Chad, Central African Republic, and Equatorial Guinea.



Pascal Moudi Igri

Shira Raveh-Rubin (Weizmann Institute of Science, Israel) will visit the W2W institutes from May 13-17th 2019. She will visit JGU-Mainz on Monday 13th where she will discuss with W2W researchers. On Tuesday 14th - Wednesday 15th she will visit KIT-Karlsruhe and give a seminar at the IMK-Colloquium on Tuesday. She will then visit LMU-Munich on Thursday 16th - Friday 17th and give a seminar in the Theoretical Meteorology group meeting on Thursday.

To read more about her research and her presentations at KIT and LMU, visit:

<http://www.wavestoweather.de/guest/shira-raveh-rubin>

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.

Outreach and equal opportunity activities

Open day at JGU Mainz

This year's "open day" took place on January 30th. About 13.000 high school students visited the campus of the Johannes Gutenberg-Universität in Mainz and participated in the numerous activities. The Department of Physics, Mathematics and Computer Science, which almost all JGU W2W researchers are part of, presented joint activities featuring a large science exhibition called "Science Square" (photo, top left), and a joint inter-disciplinary presentation called "Science AllStars". The Science Square featured for example the "Cloud in a Box" exhibit (photo, top right) of the Institute of Atmospheric Physics (IPA). In addition, Holger Tost gave a brief highlight talk on weather prediction and forecast uncertainty (photo, bottom). The students could then test their forecasting skills by taking part in a balloon competition and estimating the landing position of their balloons.

The Science Square exhibition was a great opportunity to get in touch with many high school students with general interests in physics, mathematics, and computer science and we are looking forward to welcoming some of them as our students in the future.



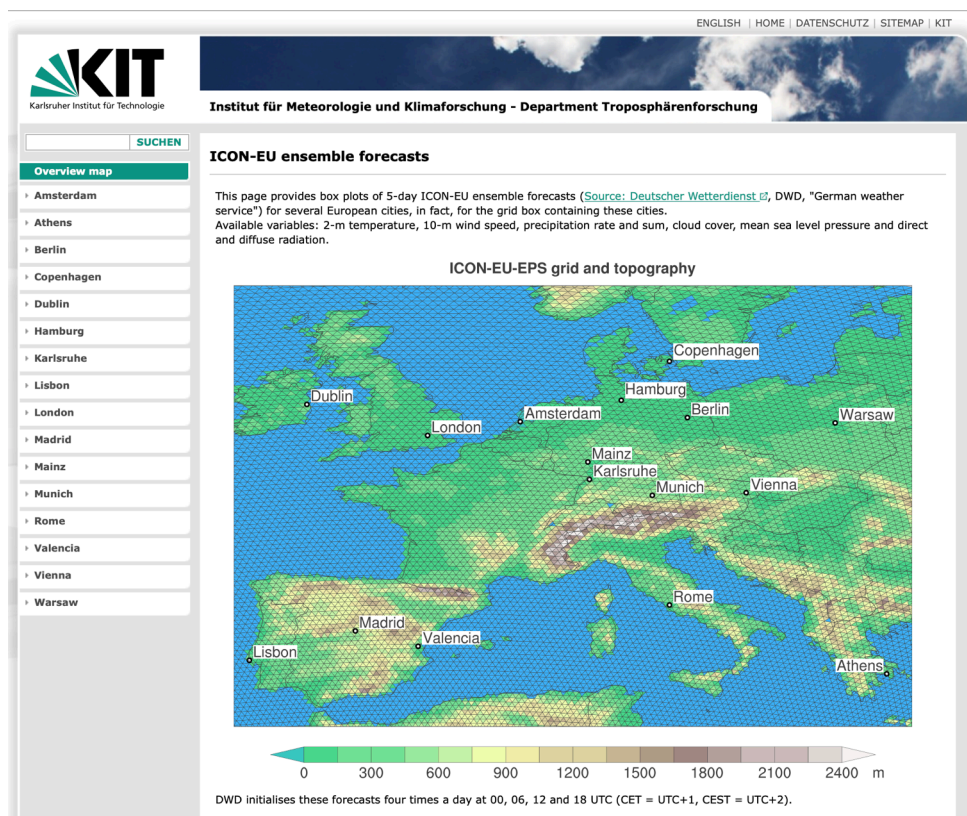
Top left: Science Square. Top right: "Cloud in the Box" exhibit. Bottom: introduction to weather prediction and forecast uncertainty by Holger Tost. Photos: Heiko Bozem (IPA)

To read more about this event, click here:

<http://www.wavestoweather.de/outreach/open-day-jgu-2019>

ICON-EU ensemble forecasts

A W2W-funded student in Karlsruhe (KIT) is downloading ICON ensemble forecasts from the DWD open data server to feed the following webpage, which is updated every 6 hours: www.imk-tro.kit.edu/8625.php



Screenshot of the webpage

The page features ICON EU EPS meteograms (5-day forecasts) for several locations in Europe, including the W2W institutions (Munich, Mainz, Karlsruhe, Hamburg). Several surface variables are displayed at several initial times.

Other charts will be added, e.g., the charts that will help to monitor “forecast barriers” in real time.

Open Day of the Faculty of Physics at LMU

On May 4th 2019, the Faculty of Physics at LMU opens its doors to the general public to present the research at the Faculty. In addition to presentations by, e.g., Thomas Birner and Harald Lesch, there will be stands and a large exhibit on the physics of climate change. To read more about this event, click here (link in German):

https://www.physik.uni-muenchen.de/aus_der_fakultaet/veranstaltungen/tdot2019

Presentation at the Deutsches Museum

Bernhard Vogel has been invited to give a presentation within the series “Wissenschaft für jedermann” at the Deutsches Museum in Munich on **October 16th 2019**. He will talk about “More than temperature and precipitation: the future of weather forecast” (preliminary title). To read more about the current program of talks at the Deutsches Museum, click here (link in German):

<https://www.deutsches-museum.de/angebote/vortraege/fuer-jedermann/>

Girls' Day

The country-wide outreach event for school girls **"Girls' Day"** will take place on March 28th 2019. Early Career Scientists in W2W and at the partner institutes will offer workshops on weather, weather forecasting, and climate.

To read more about this event, click here:

http://www.wavestoweather.de/equal_opportunity/activities/girlsday-2019/

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

Past issues of this newsletter are available here:

http://www.wavestoweather.de/outreach/quarterly_newsletter

Winter's highlight



Füssen, Germany (photo: Matthias Schindler)

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