TRR 181 NEWSLETTER

ENERGY INFLOW

SAME PROCEDURE AS ...

every year! During September we held our annual retreat in Schleswig, where we meet all together and have time to concentrate on science. This year we discussed the proposal, talked about results from the first phase and for some of us how to improve presentation skills.

In this issue, you can also read about the **price Melinda** received, **Stephan representing the TRR 181 at the Maritime Festival in Bremen,** upcoming events, new publications as well as **travel reports and scientific reports** from M4, T1, W4, S1 and S2!

Enjoy!
Jennifer and Meike

Group picture from the annual retreat

ANNUAL RETREAT IN HOTEL WALDSCHLÖSSCHEN

We held our annual retreat at Hotel Waldschlösschen from September 16 to 19. It started on Monday with a one day workshop for the PIs on "Gender awareness in personnel selection" that was held by Jun.-Prof. Brooke Gazdag (LMU Munich

This year we started on time. No delay due to a late bus. Nearly all PIs gathered on Monday, September 16 for a workshop on "Gender awareness in personnel selection". We decided on this topic for the workshop since our next phase hopefully starts in 2020 and there will be many new positions that need to be filled. Jun.-Prof. Brooke Gazdag held the workshop from the LMU Munich, she already gave a "Gender awareness" workshop during our 2017 retreat in Jesteburg. During the workshop, we talked about unconscious biases and subtle gender discrimination. We watched some interesting videos that showed typical situations of gender discrimination in science and although they seemed exaggerated, in the end everybody had similar stories to tell from their personal experiences. After all, we got some insights on how to handle applications and how to

adapt our webpages to seem more appealing. With this input, we like to create an even more divers and inclusive atmosphere in our project.

In the evening, we further discussed the TRR movie idea that came up during the winter school in Ratzeburg. However, we still had to insist on hiring Helen Mirren and Meryl Streep, so it may continue being a dream.

On the second day, the PhDs and Postdocs joined the PIs in Schleswig. Next program point were three extensive poster sessions. Each subproject presented at least one poster on the highlights and "loose ends" of phase 1. All participants had plenty of time to go around and discuss the results or issues that need to be fixed until the end of the first phase. In the evening, we organized a very German activity: Kegeln (bowling/ skittles). Most of the Germans had not played since they were kids and our foreign colleagues did not knew the game. The common résumé was: Kegeln is much harder than you think.

The third day program was split: the PIs and everyone interested in the second phase had a whole day of presentations regarding the proposal, the PhDs and some of the Postdocs attended a workshop on "Make the most of your presentations" held by Dr. Jean-Luc Doumont. The outcome at the end of the day was positive on all sides. The PIs saw that the proposal comes together very nicely and just a few issues need to be sorted out. The workshop by Jean-Luc had an overwhelming response: every single participant gave us positive feedback and thought the workshop was helpful for their own presentations.

In the morning of the last day, our external guests Kevin Lamb (University of Waterloo) and Richard Greatbatch (GEOMAR) gave us

feedback on the proposal. Luckily, they found our project to be very important for the whole community and encouraged us to continue our good work. The PhDs also gave feedback on some communication issues in the project. It will help us to further improve in the future. Afterwards, we split into break out groups on data management, highlight and loose ends of phase one, outreach and gender/early career to discuss issues and ideas for these topics.

Overall, the retreat was a full success, the location in Hotel Waldschlösschen was well received with excellent local food and unusual decorated rooms (example fish decoration) and we are excited about the last months of phase 1 and hopeful of the continuation in phase 2.

You can find the pictures of the retreat on our internal webpage.

TRR181 POSTDOC MELINDA GALFI AWARDED WITH TURCOTTE AWARD

We are very happy that our Postdoc Melinda Galfi has been awarded the 2019 Turcotte award for best PhD dissertation in the area of nonlinear geophysics by the American Geophysical Union.

Melinda Galfi did her BSc and MSc studies in Meteorology at Universtät Hamburg and then obtained her PhD in Geosciences in 2018 as an IMPRS student also at Universität Hamburg. The Donald L. Turcotte Award is given annually to one honoree in recognition of outstanding dissertation research that contributes directly to nonlinear geophysics. The Turcotte awardee is required to deliver an invited talk on his/her dissertation topic at the AGU Fall Meeting. You can finde more details on the Turcotte award here.

We asked Melinda:

How was the application process for the Award?

I am very thankful for my PhD supervisor, Prof. Valerio Lucarini, for nominating me for the award. The application process was – for me, at least – quite simple and fast. I just had to prepare an extended summary of about 5 pages of my thesis containing the major findings and their significance. Valerio took care of the whole submitting procedure.

How do you feel about receiving the Award?

I was very surprised and very happy about actually receiving the award. I'm looking forward to travel to the fall meeting of the AGU in San Francisco this December, to present my dissertation there and to receive the award certificate. I'm sure that it will be a great experience, also because it will be my first AGU fall meeting and my first travel to the US.

TRR 181 @MARITIME FESTIVAL WEEK IN BREMEN

Our Postdoc Stephan Juricke from Jacobs University attended the Science Fair at Maritime Festival Week in Bremen. The "Maritime Festival Week" presented large parts of the Bremen and Bremerhaven research landscape on the Weser promenade on September 21 and 22.
Written by Stephan Juricke

The TRR 181 participated at the Science Fair during the Maritime Festival Week in Bremen this year, sharing a tent with MARUM and Haus des Wissens Bremen. On Saturday, September 21, our colleagues from MARUM and Haus des Wissens offered shelter in their tent for TRR outreach for a few hours, and an opportunity to have some lively discussions with the interested public strolling along the Bremer Schlachte. We showed some of the explainity outreach videos and explained the background of the project.

The general feedback was that it is very much appreciated when scientists engage with the public to present their findings and contribute to a better understanding of the pressing questions in climate science, especially now since the topic has attracted a lot of attention in the media – with often quite controversial coverage – and is generally of great societal relevance. It was also nice to strengthen our connections to the outreach infrastructure provided by institutions such as Haus des Wissens and research institutes such as MARUM. We are looking forward to future collaborations.

Pictures: MARUM, Universität Bremen

UPCOMING EVENTS

October 19, 2019
TRR 181@ Frankfurter Buchmesse
The editors of the TRR181 publication "Energy transfers in Atmosphere and Ocean" will present the book at the Frankfurter Buchmesse 2019.

October 24, 2019
TRR 181 Seminar
The first seminar is held by Gökce Tuba Masur (PhD in L2) at AWI, 11 am.

November 7, 2019
TRR 181 Seminar
The seminar is held by Artur Prugger (PhD in M2) in tba at 11 am.

November 14, 2019
TRR 181 Seminar
The seminar is held by Rachael Ewins (PhD in W4) in tba at 11 am.

November 21, 2019
TRR 181 Seminar and Career Lunch
The seminar is held by Lesley de Cruz (Royal Meteorological Institute of Belgium) in Hamburg at 11 am. Her talk is followed by a Career Talk Lunch.

November 21, 2019
Workshop "Gendered Innovations: How integrating sex and gender analysis into research enhances excellence and discovery"
This workshop is held by Prof. Londa Schiebinger (Stanford University). and it can help prepare researchers secure funding. More information can be found on our webpage.

November 21, 2019
Open evening lecture "Gendered Innovations"
We are honored to welcome scientist Prof. Londa Schiebinger to Hamburg, where she will give insights to her research. More information can be found on our webpage.

November 22, 2019
Workshop "Funding opportunities"
This workshop is held by Prof. Londa Schiebinger and it can help young researchers secure funding. More information can be found on our webpage.

November 22, 2019
Workshop "Gender Issues in Career Development"
This workshop is a casual Q&A with Prof. Londa Schiebinger. More information can be found on our webpage.

November 28, 2019
TRR 181 Seminar
The seminar is held by Stylianos Kritsotalakis (PhD in T3) in tba at 11 am.

December 5, 2019
TRR 181 Seminar
The seminar is held by Margarita Smolentseva (PhD in M5) in tba at 11 am.

December 12, 2019
TRR 181 Seminar
The seminar is held by Jen-Ping Peng (PhD in T2) t the Warnemünde Turbulence Days at 11 am.

PUBLICATIONS

Have you also published your work, but cannot find it here? Please get in touch with the project coordination. Members of the TRR 181 are printed in bold.

Koldunov, N. V., Aizinger, V., Rakowsky, N., **Scholz, P.**, Sidorenko, D., **Danilov, S., & Jung, T.** (2019). **Scalability and some optimization of the Finite-volumE Sea ice-Ocean Model, Version 2.0 (FESOM2)**, *Geosci. Model Dev., 12*, 3991–4012, https://doi.org/10.5194/gmd-12-3991-2019

Wang, Q., Wang, X., Wekerle, C., **Danilov, S., Jung, T., Koldunov, N.**, Lind, S., Sein, D., Shu, Q., Sidorenko D. (2019). **Ocean heat transport into the Barents Sea: Distinct controls on the upward trend and interannual variability.** *Geophys. Res. Lett., 46*. doi. org/10.1029/2019GL083837

Badin, G., Behrens, J., F**ranzke, C., Oliver, M., & Rademacher, J.** (2019). **Introduction**, *Geophys. & Astrophys. Fluid Dyn., 113:5-6*, 425-427, DOI: 10.1080/03091929.2019.1655259

Chirilus-Bruckner, M., van Heijster, P., Ikeda, H., & **Rademacher, J. D.** (2019). **Unfolding symmetric Bogdanov-Takens bifurcations for front dynamics in a reaction-diffusion system.** *J. Nonlin. Sc.*, 1-43, doi.org/10.1007/s00332-019-09563-2.

Noethen, F. (2019). **Computing covariant Lyapunov vectors in Hilbert spaces**. arXiv: 1907.12458.

Dwivedi, S., **Franzke, C. L.,** & Lunkeit, F. (2019). **Energetically Consistent Scale Adaptive Stochastic and Deterministic Energy Backscatter Schemes for an Atmospheric Model.** *Q. J. Roy. Meteorolo. Soc.* https://doi.org/10.1002/qj.3625.

Strommen, K., Christensen, H. M., MacLeod, D., **Juricke, S.,** & Palmer, T. (2019). **Progress Towards a Probabilistic Earth System Model: Examining The Impact of Stochasticity in EC-Earth v3. 2.** *Geosci. Model Dev.,* 12(7).

Eden, C., Chouksey, M., & Olbers, D. (2019). **Gravity wave emission by shear instability**. *J. Phys. Oceanogr*.

Rackow, T., Sein, D. V., Semmler, T., **Danilov, S., Koldunov, N. V.,** Sidorenko, D., Wang, Q., & **Jung, T.** (2019). **Sensitivity of deep ocean biases to horizontal resolution in prototype CMIP6 simulations with AWI-CM1.0**, *Geosci. Model Dev., 12*, 2635-2656, https://doi.org/10.5194/gmd-12-2635-2019.

Czeschel, L., & **Eden, C.** (2019). **Internal wave radiation through surface mixed layer turbulence.** *J. Phys. Oceanogr.*, https://doi.org/10.1175/JPO-D-18-0214.1

Lembo, V., Messori, G., Graversen, R., & **Lucarini, V.** (2019). **Spectral decomposition and extremes of atmospheric meridional energy transport in the Northern Hemisphere midlatitudes.** *Geophys. Res. Lett., 46*, https://doi.org/10.1029/ 2019GL082105.

Schaefer-Rolffs, U. (2019). **Corrigendum to: The scale invariance criterion for geophysical fluids**, *Eur. J. Mech. B Fluids, 78*, 147–149, dx.doi.org/10.1016/j.euromechflu.2019.06.003.

Smyth, W. D., & **Carpenter, J.** (2019). **Instability in Geophysical Flows**, *Cambridge University Press*.

Voelker, G. S., Myers, P. G., **Walter, M.**, & Sutherland, B. R. (2019). **Generation of Oceanic Internal Gravity Waves by a Cyclonic Surface Stress Disturbance.** *Dyn. Atmosph. Oce*.

NEW PUBLICATION BY OUR POSTDOC VALERIO LEMBO AND PI VALERIO LUCARINI

Our postdoc Valerio Lembo and our PI Valerio Lucarini contributed to a new paper published in the journal "Geoscientific Model Development" titled: "TheDiaTo (v1.0) – a new diagnostic tool for water, energy and entropy budgets in climate models".

Finally published: A new tool for diagnosing several aspects of the thermodynamics of the climate state-of-the-art climate models - postdoc Valerio Lembo is very excited about this. We asked him a few questions:

What is your work in TRR in general about?
I am a Postdoc researcher in the S1 subproject, dealing with diagnosis of climate model improvements. I work with datasets produced in climate model simulations, trying to detect inconsistencies and measure how model improvements eventually help in reducing or removing such inconsistencies.

What is new about the tool you developed?
TheDiaTo gathers some existing techniques aimed at diagnosing the model performances in a quantitative way. These techniques are here related with each other in order to give an integrated view of the thermodynamics of the climate system. In other words, the climate at the global scale is seen as a thermal engine (as it is, for instance, the engine of a car, or a coal power plant), taking up heat from the Sun and converting it into work used to set the atmosphere and the oceans in motion. We adopt this basic framework as a robust constraint to the behavior of the system, and we measure if and how far is a simulated climate from such constraints.

What to you hope will change in your field with your publication?
We have included the TheDiaTo collection in the ESMValTool community diagnostics, and we expect that it will be used in the analysis of the CMIP6 model outputs. These are the datasets based on which the 6th Assessment Report of the IPCC is being redacted, meaning that they are meant to set the new standard for our knowledge of climate change. We hope that this diagnosis effort will lead to a precise evaluation of model biases, and through that, to focused studies on how models code and structure can be consistently improved. The TRR181 is a unique opportunity to assess improvements in the ICON-FESOM coupled model, deriving from the inclusions of novel energetically consistent parametrizations of turbulent fluxes in the atmosphere and the ocean. The synergy between the parametrization and diagnostics development on one side, and the model implementation on the other side, is precisely the motivation behind the TRR181, and TheDiaTo will be essential in understanding the physics linking thermodynamics and the energy transfers in turbulent fluxes.

"MIXING PROCESSES IN THE OCEAN" REPORT FROM THE IUGG IN MONTRÉAL, CANADA

From July 8th to July 17th the 27th International Union of Geodesy and Geophysics (IUGG) General Assembly with approximately 5000 participants was held in the Palais des Congrès in Montréal, Quebec, Canada. Janna Köhler, Friederike Pollmann and Jonas Löb visited the Conference and wrote the report for us.

The International Association for the Physical Sciences of the Oceans (IAPSO) is one of eight Associations of the IUGG which, in turn, is one of the 40 scientific Unions and Associations presently grouped within the International Science Council (ISC). The IUGG General assembly is held every four years, alternating with assemblies of a subset of the associations forming the IUGG, including the IAPSO.

In the framework of the TRR 181 especially the session on "Mixing Processes in the Ocean" was of great interest: In roughly 40 talks (including our own) and the additional poster session a wide variety of studies was presented and discussed. Due to the numerous attendance of well known experts in the field we could get a broad overview of current and planned projects in the fields of observational and theoretical oceanography. During the coffee breaks and poster sessions we had ample opportunity to strengthen and expand our network in the internal wave and mixing community. The discussions with our project partner Zhongxiang Zhao from the University of Seattle as well as with other attendants were fruitful and helped to identify new collaboration possibilities.

An early career event organized by the IAPSO provided a very good framework to set up a new network for early career scientists in the field of physical oceanography. The newly founded early career network is intended to grow within the next months with a mailing list as a first step for the regular distribution of information relevant for early career scientists. Later, the setup of a mentoring program is planned to bring together IAPSO scientists from early and later career stages. The networking event was a nice evening where we got to know several other early career scientists from countries all over the world. It was also a good opportunity to have a chat with members from the IAPSO executive committee.

In addition to mixing processes a variety of other oceanographic topics such as "The Meridional Overturning Circulation: Mean State and Variability", "Oceanic Boundary Current Systems", "The Southern Ocean: Where Ocean, Ice and Atmosphere Meet", "Tides of the Oceans, Atmosphere, Solid Earth, Lakes and Planets" was covered during this week. These sessions gave a good overview of the current results and questions in the respective areas and also provided helpful background information for the upcoming proposal for the next phase of the TRR181.

The IUGG General Assembly was an inspiring and successful conference for us and we would be glad to participate in the next IAPSO meeting in 2021 and the next IUGG General Assembly in 2023, which (as was decided in Montreal) will be held in Berlin.

TRAVEL REPORT FROM THE WORKSHOP ON CLIMATE PREDICTION IN THE ATLANTIC-ARCTIC SECTOR AND THE LARGE ENSEMBLES WORKSHOP

This summer, our postdoc Valerio Lembo (S1), got the opportunity to visit the Workshop on Climate Prediction in the Atlantic-Arctic sector in Bergen, Norway and the Large Ensembles Workshop in Boulder, Colorado, USA.

On 5-7 June 2019 I attended the Workshop on Climate Prediction in the Atlantic-Arctic sector, jointly organized by the Bjerknes Climate Prediction Unit and EU Modelling Cluster. The workshop was meant to gather expertise from a number of projects funded by the Horizon 2020 European framework, namely Blue-Action, APPLICATE, PRIMAVERA and CRESCENDO, but was opened to any contribution. The 3-days of discussions included talks about mechanisms related to climate predictability and the investigation of the predictability limits, as well as about climate services and data assimilation. The workshop featured contributions from leading scientists in disparate fields, e.g. Eugenia Kalnay, Paul Kushner, Johann Jungclaus (that is also part of our TRR181 Project), or Francisco Doblas-Reyes. During the panel discussions on climate services, I was given the opportunity to actively contribute on the discussion about how to implement a more efficient interaction between the hardware development companies and the modellers' community, in order to implement solutions specifically designed to run more powerful climate models. Another interesting topic was the synergy between climate scientists, the stakeholders and civil protection. As examples of efficient collaboration, two talks from the Norwegian Institute of Marine Research addressed the usage of climate prediction in ecosystem modelling in order to understand future levels of fishery stocks, and the interaction between weather forecasters and the search-and-rescue patrolling service on the prediction of iceberg probability, respectively. During the poster session, I had the chance to present a poster describing the application of the linear response theory to the investigation of the slow modes of the oceanic circulation. I received much interest and many positive feedbacks that helped me to better focus on the main outcomes of the study and to better highlight them in the paper that I am finalizing.

On 24-26 July 2019 I attended the Large Ensembles Workshop at the MesaLabs of the NCAR in Boulder, Colorado. The workshop was organized by the USClivar and hosted discussions on the main outcomes of the analysis of the MPI-ESM and CESM Large Ensembles, as well as on the main problematics associated with the development and usage of large ensembles. The workshop was a unique opportunity to meet a considerable part of the North American climate science community, including influent researchers, such as Clara Deser, Lorenzo Polvani, Pedro DiNezio, Tom Delworth. The topics of discussion were mainly on how to detect the climate natural variability and how to isolate it from theforced response of the system, the usage of machine learning in climate science,interdisciplinary applications of the large ensemble datasets. A lot of time was devoted tothe poster session: each poster was introduced by a pitch and the posters were on displayduring the whole day in the coffee break area, allowing for very insightful discussions. Myposter on the application of the linear response theory for the investigation of the slow modes of the oceanic circulation was given relevant attention, and interesting conversations were started, that might lead to possible future collaborations. I also took part to the breakout sessions, where I could share ideas on what issues are better addressed through the usage of large ensembles, how a large ensemble shall be designed and how many members it shall feature. The discussion was quite introductory, suggesting that there is still a lot of room for improvement. That is why one outcome of the workshop was the opening of the Single Model Initial-condition Large Ensemble (SMILE) mailing list.

This is a branch of the newly started SMILE project, aimed at an integrated and coordinated effort for the development and study of Large Ensembles. During the workshop, the special issue on Large Ensemble has

been introduced, hosted by the Earth System Dynamics Copernicus publication. Editors of this special issue are our PI Valerio Lucarini, MPI postdocs Nicola Maher and Sebastian Milinski. Besides the activities of the workshop, my stay in Boulder allowed me to get in touch with new colleagues, such as Matt Newman and Cecile Penland (NOAA-CIRES), with whom a new collaboration on the study of ENSO variability might possibly start in the next future.

IMPLEMENTATION OF LEE WAVES IN IDEMIX

by Thomas Eriksen, PhD W4

The purpose of my project is to investigate what and how big of a role lee waves play in transferring energy between large scale geostrophic motions and small scale turbulent mixing. Lee waves are formed when geostrophic motions interact with bottom topography. They radiate away from the topography and eventually break. When they break, the kinetic

energy that they contain is used for dissipation, which, ultimately, raises potential energy. The issue of their role in the general circulation has been raised due to observed increased mixing rates near the ocean bottom in the Drake Passage and the Scotia Sea.

Previous estimates of the energy transfer from geostrophic motions into lee waves are around 1/3 of the energy input into gravity waves from winds. However, they are very few and differ roughly by a factor of 4. Furthermore, this energy transfer estimate has so far only been diagnosed and not used as in integral part of an ocean model. The contribution of lee waves in driving the large scale motions themselves – the overturning circulation, for example – are therefore largely unknown. The proper way of including lee waves in an energetically consistent ocean model would thus be to diagnose the energy contained in lee waves everywhere in the ocean, let this energy travel and eventually be used for dissipation – in my case using an internal wave model – and then subtract it from its source.

This is exactly what is done in my model. The objective of my study is therefore to extend the IDEMIX model with an inclusion of lee wave energetics. This means that the energy being transferred into lee waves will be able to affect the rest of the ocean through diapycnal diffusivity – similarly to other types of gravity waves.

So far in my study, I have diagnosed the global energy transfer into lee waves to around 0.3TW. This is in accordance with previous estimates. The implementation of lee wave energetics into IDEMIX is underway. The lee wave energy flux is split into four directional compartments (N, S, E, W) will enter the gravity wave field as a bottom boundary flux, and the wave energy will thus be able to travel in the same manner as energy from other gravity waves. This is a fundamentally different way of treating lee waves compared to previous studies.

"I'm investigating what and how big of a role lee waves play in transferring energy between large scale geostrophic motions and scmall scale turbulent mixing."

The next step is to study the differences in diapycnal diffusivity in model runs with and without lee waves. To what degree lee waves are able to account for the observed increased mixing rates in the deep Southern Ocean is still an open question, which I would like to answer. After this, I would like to address the question of what role lee waves play in setting the overturning circulation.

DECODING THE ENERGY SPECTRUM USING ICON-IAP

by Kesava Ramachandran, PhD T1

Hi, my name is Kesava Ramachandran from subproject T1. My work deals with the implementation of Dynamical Smagorinsky Model (DSM) to

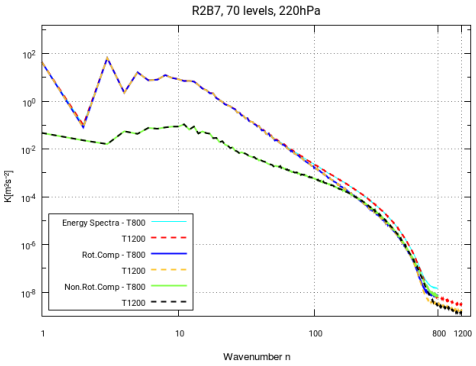
understand the effects of stratified turbulence due to gravity-wave breaking in the MLT region using high-resolution non-hydrostatic ICON-IAP model. In this context, the investigation of energy cycle by analyzing the spectral budgets of kinetic energy and potential energy will be carried out.

Numerical models are widely used for investigations of atmospheric conditions and behaviour. It is unrealistic to expect the numerical models to exactly simulate the real atmosphere for all observed phenomena since the atmospheric flows are turbulent in nature. The set of mathematical equations that describe such flows are nonlinear and it is impossible to solve them exactly. At least till now, no one has solved the complete set of equations. This leads to use of different modelling techniques where we resolve the wide range of time and length scales. Such atmospheric models normally consist of a dynamical core and physical parametrization.

"It is unrealistic to expect the numerical models to exactly simulate the real atmosphere for all observed penomena since the atmospheric flows are turbulent in nature."

ICON-IAP is one such atmospheric model with a novel discretization for strict representation of the conservation laws by the dynamical core. An issue not normally considered in the circulation models is the inherent diffusion due to the numerical formulation of the dynamical core. This inherent diffusion cannot be interpreted as physical dissipation. ICON-IAP discretizes the Poisson-brackets of the Hamiltonian system and guarantees consistent reversible energy pathways. As a reference for comparing, we have the observation data from Nastrom & Gage, where a -3 slope in the synoptic scale and -5/3 slope in mesoscale scale is noted for horizontal wind and temperature.

It is important to have an elaborate understanding of the different processes that contribute to the energy cycle and the interaction between different dynamical regimes since it will give us an idea on the scales at which the transport occurs. With respect to this, the governing equations are transformed so that the processes that do not contribute are made invisible. Using the transformed equation we can disentangle the contribution of the horizontal and vertical flux terms. We can also compare the spectral budgets of kinetic and available potential energy and the individual fluxes between the transformed and the untransformed equation.



Analysing the kinetic and available potential energy spectrum will result in understanding the scales of the primary gravity waves transport of momentum from lower to middle atmosphere and a reasoning as to whether the concept of Stratified Macroturbulence applies when averaging about individual wave packet and to the energy cascade induced by the gravity wave breakdown in the mesosphere.

COARSE-GRAINING, ENTROPY AND THE UNSEEN

by Bastian Sommerfeld, PhD M4

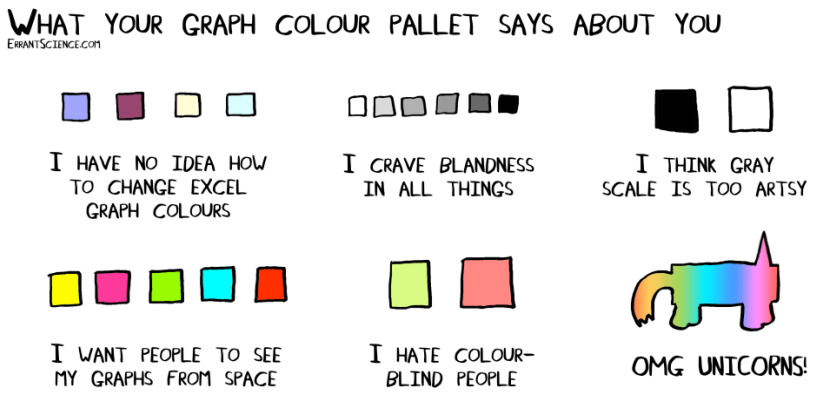
My name is Bastian and I'm currently a PhD student at the IAP, working in the subproject M4 "Entropy Production in turbulence parameterisations". Our goal is to unify two approaches currently taken to formulate closures for climate and weather simulations.
The nature of weather and climate is such that their equations may not directly be solved mathematically. This forces us to use computer models. In these models we define the necessary equations on grids. Each grid-box represents one set of values associated with the volume that grid-box covers. This usually affords us horizontal resolutions between 10 and 100 km and vertical resolutions between several hundred down to a kilometer.

Not unlike the picture of a tree, which from far enough away seems convincing enough, but from close up lacks the details to show the little squirrel on that branch, we struggle with small scale contributions to the motions in our simulations. Namely such that would be small enough not to be resolved in our model, but large enough to have a significant effect on the model dynamics. We try to account for these using mathematical and physical models to incorporate the effects of what we cannot resolve on what we resolve, in order to get the dynamics right, thus correctly predicting the rain on your granny's birthday party – or how quickly the polar caps melt. These models are called parameterizations.

"Our goal is to unify two approaches currently taken to formulate closures for climate and weather simulations."

My particular task is to retrieve the statistics and distribution of fluxes of energy between the resolved and unresolved part of the simulated atmosphere, in order to learn how to better model said fluxes in a physically stringent way. This means to find formulations which do not only improve our model data, but are in line with the fundamental laws of energy conservation and the second law of thermodynamics. I do this by programming informed routines, which effectively slice our model data into another poor resolution model and high resolution reality. Computing the fluxes between these two regimes I hope to be able to extrapolate into what we don't know.
So far I've had some very exciting findings, which indicate that we have good reason to apply new types of parameterizations, called backscatter parameterizations in conjunction with our old approaches. In addition to that there are hints to how to find formulations which do not violate our understanding of physics, which will then afford us a better understanding of the processes in our atmosphere and climate.

SOMETHING FUNNY FOR THE END



Main content created by
Jennifer Fandrich and Meike Ruhnau
other authors are credited respectively

E-Mail: trr181.cen@uni-hamburg.de

Web: www.trr-energytransfers.de

Twitter: @TRREnergy

Youtube: TRR 181 Energy transfers in Atmosphere and Ocean