



ENERGY INFLOW

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One year TRR 181

Dear colleagues,
Summer is over, we can no longer try to deny it. Fall has arrived and with this we like to give you some new information on what has happened in the last three months of our first year TRR 181.

What is inside this time?

Our first Annual Retreat was held in September and now you can read up on what happened these two days in Jesteburg.

You can find a direct link to our new explainity video on climate models and get an update on the progress made with the other videos. Also included is the final draft as well as the journey to this draft of our second info graphic "Mesoscale Eddies".

As always, you'll find new publications, upcoming events and **new reports from the scientific front!**

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Upcoming:

A report from Maren Walter about the expedition to the Subtropical Atlantic.



Research Vessel Poseidon in Punta Delgada on the Azores, the starting point of the expedition

Retreat: Discover, what we get excited about!

Our first Annual Retreat took place at the Tagungshotel Jesteburg in Jesteburg starting September 11 to 12. About 60 participants met in the German Nordheide to get to know each other, collaborate and learn about the TRR 181 disciplines under the overarching topic "Mathematics and climate sciences – Opportunities and Problems".

Day 1: General Assembly and Gender Awareness

Some of our colleagues from Kühlungsborn already arrived on Sunday evening and had hopefully a good night sleep, before Monday morning – after everybody arrived at the destination in Jesteburg - began with the General Assembly. There the members elected a new Vorstand member, Thomas Jung from AWI. Also three

new TRR 181 members were elected: David Marshall (University of Oxford), Markus Jochum (Niels Bohr Institute, University of Copenhagen) and Ulrich Achatz (Johann Wolfgang Goethe-Universität Frankfurt/Main). Later several topics like new Task Groups, a Scientific Advisory Board and the next Winter School were discussed.

Then our external guest Karina von Schuckmann (Mercator Océan) kicked off the first day with her illuminating talk on "the role of the ocean in the earth energy budget".

The whole afternoon was reserved for the main theme "Gender Awareness". First, Maren Walter from

the Gender Task Group reported the last year's actions of the Task Group. Following this, Brooke Gazdag from LMU München delivered an empowering talk on Gender Awareness issues. After the talk the whole group split up in two separate groups: one group of PIs and Postdocs and one group of PhD students. Brooke Gazdag stayed with the PI and Postdoc group in the main seminar room and discussed about practices and policies in science. Meanwhile Marie Lutz from University Hamburg accompanied the PhDs to another seminar room for the workshop part, where a lively discussion about the definition of Gender Awareness started.

The overall evaluation of the talk and group work was mixed between satisfactory and very good. As you can read in the comments of the evaluation, a lot of you liked the objectivity of the trainer. Some asked for more time for discussions and the possibility to talk more about personal experiences. Others would like to have more data and statistics about positive steps on solving gender issues. Nonetheless, we think with this format we attained our first goal to bring the gender based issues to everyone's mind and initiate a thought process.

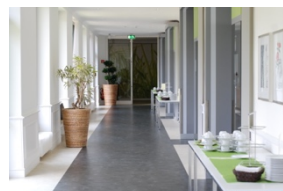
As the day slowly began yawning, we enjoyed together a joint dinner and a campfire outside. Some used their leftover energy for more sporty activities in the cellar's game room playing table football or table tennis.

Day 2: It's all about science!

Our speaker Carsten Eden started the second day with an introduction to the TRR 181 and on the overarching topic "Mathematics and climate sciences – Opportunities and Problems". Then talks from two of our PIs followed: Christian Franzke from Universität Hamburg on „Systematic Stochastic Parameterizations: Towards Improved Climate Models" and Jens Rademacher from University Bremen with a mathematical view on some qualitative aspects in idealised geophysical flow.

In the afternoon, we had several group meetings like the Data and Model Code Management Task Group and the Scrollytelling Outreach meeting with the

project managers from the Hamburg based agency studio ahoi. Furthermore there were discussions, e.g. what geophysicists can learn from mathematicians or how the PhDs can try to collaborate and network between the different institutions and subprojects.



Impressions from the Annual Retreat

We would like to thank everyone for your participation at the Annual Retreat and your effort and contributions to have a good and informative time together. All talks, videos from the talks and pictures are stored on the internal web page.

Publications

Have you also published your work, but cannot find it here? Please get in touch with me.

Conti, G., & **Badin, G.** (2017). Hyperbolic Covariant Coherent Structures in Two Dimensional Flows. *Fluids* 2017, 2(4), 50. doi: 10.3390/fluids2040050

Bódai, T., **Franzke, C.**, (2017). Predictability of fat-tailed extremes. *Physical Review E*. doi: 10.1103/PhysRevE.96.032120

Kutsenko, A. A. (2017). Application of matrix-valued integral continued fractions to spectral problems on periodic graphs with defect. *Journal of Mathematical Physics* 58, 063516 (2017), doi: 10.1063/1.4989987

Kutsenko, A. A., Nagy, A. J., Su, X., Shuvalov, A. L., Norris, A. N. (2017). Wave Propagation and Homogenization in 2d and 3d Lattices: A Semi-Analytical Approach. *Q J Mechanics Appl Math* (2017) 70 (2): 131-151. doi: 10.1093/qjmam/hbx002

Dritschel, D. G., Gottwald, G. A., & **Oliver, M.** (2017). Comparison of variational balance models for the rotating shallow water equations. *Journal of Fluid Mechanics*, 822, 689-716.

Upcoming events

October 13-14, 2017: Workshop "M-Day" at Jacobs University in Bremen

A TRR 181 Workshop for the Mathematics subprojects will take place on October 13-14 at Jacobs University in Bremen. M-Day is an informal workshop where members of project area M ("Mathematics, new concepts, and methods") of the Transregio SFB 181 as well as interested others can meet, present their work and discuss.

December 11-15, 2017: AGU Fall Meeting 2017

The AGU (American Geophysical Union General Assembly) is the largest Earth and space science meeting in the world and takes place on 11-15 October in New Orleans, USA. Our project will be represented at the "Research in Germany" booth in the exhibitor hall. Please get in touch if you are a project member who plans to attend the AGU.

More things easily explained

We made progress with our explainer movie adventure. We finalized the Climate Models video in [German](#) and [English](#) and are currently working on two leftover Clips: Eddies/Energy Cycle and Numerics in Ocean Models.

You can watch the videos [online](#) or download them on the internal web page. The mp4 file is archived on the internal web page. You are free to use it for talks or public events.



Short update on the progress:

- Climate models: Finished
- Eddies/Energy Cycle: Script phase
- Numerics in Ocean Models: Storyboard phase

Info Graphic

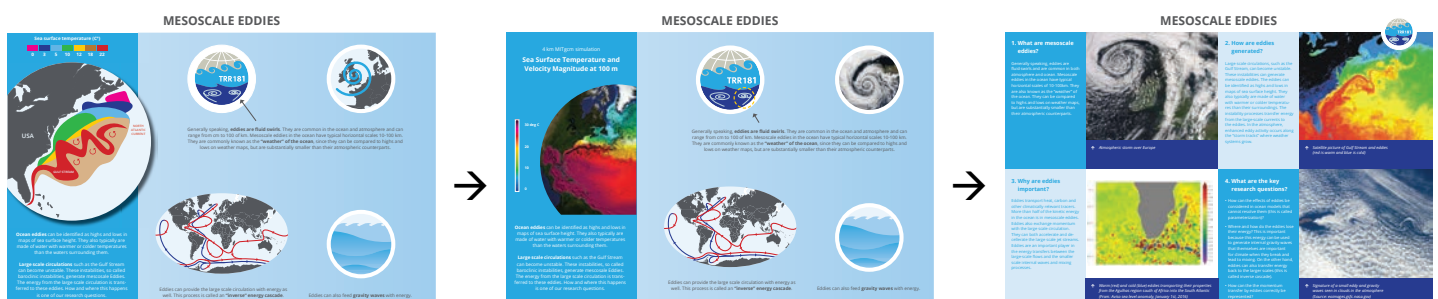
Finally and just in time to present it in our September issue of Energy Inflow, we finalized the second Info Graphic on mesoscale eddies. It will be uploaded soon to our website. Please contact the project coordination, if you want to use it for presentations or public events.

MESOSCALE EDDIES



The journey to the final Info Graphic:

See the first drafts and with this the progress we made. Thanks a lot to Alexa Griesel for her input and her time working on this together with us 😊



Reports from the scientific front

Each newsletter will contain short reports from our scientists on their work and the progress they made. So everyone can keep up on the new findings in the project. Enjoy!

The making and breaking of waves

By Nicolas Scharmacher, PhD M6

Hey, my name is Nicolas and I'm a PhD student currently working on the subproject M6: Techniques for atmosphere-ocean wave coupling, together with my supervisor Prof. Dr. Michael Hinze and also Dr. Jeff Carpenter and Dr. Marc Buckley from the HZG.

" My job will be the numerical analysis and implementation of the model."

The energy transfer from the wind to the ocean surface and the energy dissipation caused by breaking waves accounts for the largest transfer of energy from the atmosphere to the ocean. However, despite the importance of the processes involved in surface wave generation and breaking, there are still fundamental gaps when it comes to modeling these processes.

Meso-scale energy cascades in the lower and middle atmosphere

By Serhat Can, PhD T1

Hi, I am Serhat from subproject T1. As a PhD candidate, my task is to extend the recently developed parameterization for friction/diffusion for atmospheric flows to the middle atmosphere, including full accounting of the spectral budget for kinetic and available potential energy. Complex flows cover a wide range of spatial and temporal scales and it becomes practically illogical to expect existing computational technology to simulate a realistic atmosphere for all observed phenomena. Thus, the emergence of accounting for the effects of unresolved scales is inevitable, resulting in what is known as the turbulence closure problem.

We hope that the diffuse interface methods developed for the Cahn-Hilliard/Navier-Stokes model we are using will provide an improved method to deal with the current shortcomings of the simulation of the air-water interface. We believe that the method is well suited for that purpose due to its thermodynamical consistency, its mass-conserving property and its ability to handle topological changes, which might occur in breaking waves.

My job will be the numerical analysis and implementation of the model in order to be able to provide direct numerical simulations of the air-water interface in three dimensions, with focus on the formation and breaking of wind-generated surface waves. This requires, for example, the development and implementation of energy-stable time-integration schemes, efficient solvers and appropriate ways to incorporate the wind-forcing. Once finished, we will compare our simulations with measurements from laboratory experiments our colleagues at HZG have conducted.

" My task is to extend the recently developed parameterization for friction/diffusion for atmospheric flows to the middle atmosphere."



Closure is handled via the so-called Dynamic Smagorinsky Model (DSM), in the Kühlungsborn Mechanistic general Circulation Model (KMCM). This scheme eliminates ad hoc tuning for the parameterization and allows a space-time dependent mixing length, fully determined by the resolved flow.

Observational data from Nastrom & Gage point to transition from synoptic -3 slope to -5/3 in meso-scales for horizontal motion and temperature, providing a solid reference information for comparison. Atmosphere being strongly effected by gravity, anisotropic formulation is needed for DSM and the arguments of Stratified Macro Turbulence (SMT) comes into play for the aid, yielding an additional constraint on the dependence of vertical form of DSM on its horizontal part.

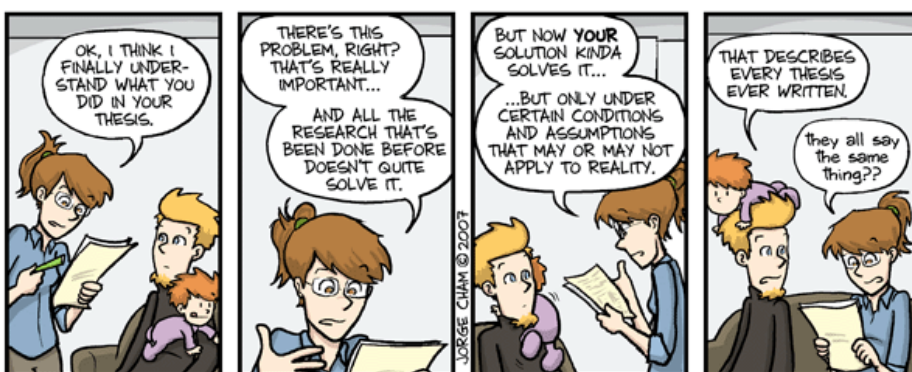
On top of all these intertwined descriptions of turbulence, scale invariance sets the tone and dictates equations to keep their forms unchanged for inertial regimes, including parameterizations. A dynamically determined mixing length complies with this requirement and definition of parameterization is completed. It should be emphasized that sub-grid scale motion is considered as a modelling of friction from a thermodynamic point of view. In this manner,

only forward energy cascade with no backscatter must result on average from the spectral analyses of the circulation model.



Reasoning for a unidirectional energy cascade stems from the Lorenz Energy Cycle, where the conversions between kinetic, available and unavailable potential energy drives the climate. To appropriately represent this cycle detailed description of entropy production, i.e. friction due to motion is crucial. DSM appears as a comprehensive method to address above-mentioned demands in general circulation modelling. As a result, friction/diffusion in atmosphere represented in the framework of turbulence modelling creates an exciting meeting of seemingly distant fields.

Something funny for the end ...



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