Dezember 16, 2016
Edition 2

Energy Inflow

www.trr-energytransfers.de

'Tis the Season

By Meike Ruhnau

Dear colleagues,
An exciting year is nearly over, but we will not leave it without new information on our project. ☺

Before we get into the details, we would like to thank everyone again who helped realizing our vision. It has been a successful year and we are looking forward to the years to come.

What is inside this time?

We officially celebrated the start of our project with a Kick Off meeting in Hamburg on October 19. You can find a few impressions of the meeting in this issue.

Furthermore, you'll find reports on guest visits, publications as well as **new reports from the scientific front**!

We also give some insights on the making of the **TRR 181 explain video** and the planned **winter school** on Sylt.

Content

We wish all readers happy holidays and a good "slide" into the New Year!

Kicking it off

We officially kicked off our project with a large meeting in Hamburg on October 19. Around 50 scientists came together to celebrate the start of TRR 181 "Energy transfers in Atmosphere and Ocean"!

The day began with an introduction by our speaker Prof. Carsten Eden, who welcomed all new scientists who just started their work in the project. This was followed by a presentation on the coordination and outreach program by me.

Scientific talks with a special guest
After the introductions the meeting proceeded with selected talks given by project members and our special guest: Prof. Mojib Latif from GEOMAR. He talked about model errors in North Atlantic sea surface salinity values.

Three additional talks followed given by Dr. Urs Schaefer-Rolffs (IAP), Prof. Marcel Oliver (Jacobs University) and Prof. Monika Rhein (MARUM/University of Bremen).

Dr. Schaefer-Rolffs talked about using a dynamic Smagorinsky modell for stratified macro-turbulence, while Prof. Oliver gave us some insight on the work in area M. After lunch, Prof. Rhein continued with her presentation on observations of internal waves.

Videos of the talks can be found in the internal web area.

First general assembly
In the afternoon the official general assembly started with the election of new Vorstand members. Complementing our original Vorstand are Prof. Jin-Song von Storch as a representative for the Max Planck Institute of Meteorology and Dr. Brenda Quinn as the representative for the PhDs and Postdocs in the project.

Our new Vorstand (left to right): Carsten Eden, Erich Becker, Monika Rhein, Hans Burchard, Jin-Song von Storch, Brenda Quinn and Marcel Oliver. (missing: Valerio Lucarini)

We also voted on the composition of the first task groups. The "Gender and early career measures" group now consists of Carsten Eden, Maren Walter, Janna Köhler and Jens Rademacher.
The "Data and model code management" group is comprised of Ivan Ovsyannikov, Nikolay Koldunov, Johann Jungclaus and Sergey Danilov.
The groups will organize themselves and help improve those areas in the project.

The day was concluded by a small reception in a relaxed atmosphere.

We would like to thank everyone who attended the meeting and look forward to the next years of collaboration!






A broad exchange: Guests of the TRR

We welcomed several international guests for the exchange of knowledge and to strengthen international cooperation in 2016. We want to continue these fruitful visits in the future; hence if you want to invite a fellow scientist please let me know.

Prof. Edgar Knobloch visits Bremen
by Jens Rademacher
Prof. Edgar Knobloch is an expert in nonlinear fluid phenomena, multiscale analysis and modelling. His work is very relevant for the M2 area in general and project M2-2 in particular. His work on the influence of viscosity, scaling regimes and models in geophysical flow directly overlaps with the projects' fundamental questions. Inviscid models fail to account for the sometimes profound effect that viscous layers have on the bulk flow. Moreover, the energy flow through scales ultimately requires viscous dissipation and suitable driving.

During the visit also the question of the role of nonlinear waves in the energy flow were discussed and it seems that many questions remain open at this point. This is especially true in the context of geostrophic balance.

Visit from down under
by Christian Franzke
Dr. Terence O'Kane from CSIRO Atmospheres and Ocean, Hobart, Australia, is an expert on stochastic subgrid modeling, coupled data assimilation, predictability, turbulence, geophysical fluid dynamics and advanced time series analysis. He has pioneered subgrid modeling using statistical physics methods. His research is very relevant to project M2 but also projects M3 and M4.

As part of his visit he gave a TRR seminar entitled „Statistical Dynamical Subgrid Scale Parameterisation". First he introduced the overall methodology and then he showed how this approach

can be employed to atmospheric as well as ocean models with very good results. His seminar spark a lot of interest and subsequently Terry had many meetings with other TRR scientists but also non-TRR scientists from the Universität Hamburg and the Max-Planck-Institute.

Furthermore, we discussed energy consistent subgrid modeling and stochastic modeling approaches which are of particular importance to project M2. We started a joint project in which we will examine how stochastic subgrid scale parameterizations will affect coupled data assimilation and predictability.

We also finalized a book we are together editing on „Nonlinear and Stochastic Climate Dynamics“ to be published by Cambridge University Press later this year.

Winter school on List

We are organizing a Winter School on “Energy transfers in Atmosphere and Ocean” for all PhDs and Postdocs in our project. The school is held in List on Sylt from **February 6-10**.

The program comprises introductory courses on numerics, oceanography, meteorology and mathematics as well as more detailed presentations by our own postdocs.

The school brings together all young researchers from the project, not only crossing geographical distances but also disciplinary ones.

Preliminary agenda
The first day will more relaxed, with everyone arriving at around noon. In the afternoon we get to know each other before we start with the scientific talks.

Tuesday, Wednesday and Thursday will consist of scientific presentations as well as time for group work. Furthermore, we will discuss outreach and gender issues.

We are planning a field trip for Wednesday afternoon, where we will take a walk in the dunes. So please pack appropriate clothing for a walk at the North Sea in February.

On the last day, the groups present their outcome and in the end we summarize and evaluate the whole week. We leave Sylt around 2 pm on Friday.

Housing
We stay in the AWI Gästehaus Möbius (see picture).

There are 10 single rooms and 10 double rooms, which will be distributed beforehand. Two rooms always share a bathroom. Bed linen and towels are provided, but no hair dryers.

We have a big kitchen where we eat breakfast and cook dinner at least once all together.

On the first day we distribute the tasks for the group (e.g. getting bread rolls, making coffee etc.).

Child care
Do you need to bring your child with you? Please let me know! We are able to organize a child care service if it is needed.

We are looking forward to this week of science and fun!

First publications

We can already celebrate the first papers that have been published in connection with our project. If you also published your work and acknowledged the TRR, please get in touch with me.

Li, Q., Lee, S., & **Griesel, A.** (2016). *Eddy Fluxes and Jet-Scale Overturning Circulations in the Indo–Western Pacific Southern Ocean.* Journal of Physical Oceanography, 46(10), 2943-2959.

Ovsyannikov, I. I., & Turaev, D. V. (2016). *Analytic proof of the existence of the Lorenz attractor in the extended Lorenz model.* Nonlinearity, 30(1), 115.

Upcoming events

January 9, 2017: Parallel Programming Workshops
Introduction to parallel programming with MPI and OpenMP on January 9-13, 2017 at Jacobs University, Bremen.

January 12, 2017: TRR 181 seminar "Rockall Bank: Funky ocean physics, deep ocean mixing and cold water coral biogeochemistry"
The seminar is held by Dr. Frédéric Cyr (Aix-Marseille University)

January 19, 2017: TRR 181 seminar "Numerical Mixing - Sources, Quantification and Reduction"
The seminar is held by Dr. Knut Klingbeil (UHH/IOW).

February 6-10, 2017: TRR 181 Winter school
The school is held at the AWI on List, Sylt. More information above.

March 06-10, 2017: Winter school "Diversity of planetary circulation regimes, in our solar system and beyond"
The school is held at the Les Houches Physics center March 6-10, 2017. The school is supported by the TRR 181.

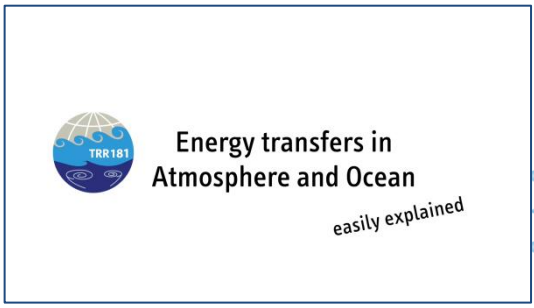
March 27, 2017: Conference "Scaling Cascades in Complex Systems"
A collaborative symposium with the SFB 1114 is held in Berlin March 2017 during a conference on "Scaling Cascades in Complex Systems".

TRR 181 easily explained

Our first explain video is now online in German and English. The video shows what we plan to do in our project. If you haven't seen it yet, do it now! ☺

At the moment we are working on seven additional movies on various topics from our project.

Step by Step to a movie
There is a meeting to discuss the possible content of the movie at the start. Our scientists do not need a specific movie idea beforehand, but rather provide information as an input for Explainity.



Afterwards, Explainity creates a script draft, which we evaluate and correct as much as needed. Sometimes the scientific facts have to be straightened, but Explainity always comes up with a good story.

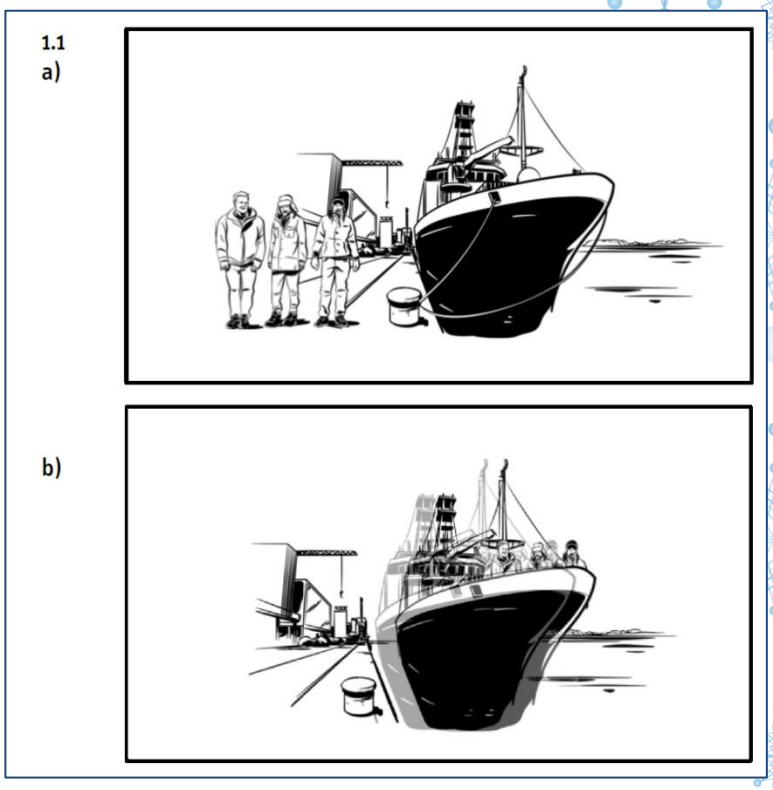
After the finalization of the script, they draft a storyboard, which visualizes the script and provides a first insight into the movie. Here you see on the right an example for a story board.

After last patch ups and corrections, the whole thing is ready to be filmed.

This is the point of no return!

All corrections need to be discussed beforehand; otherwise they cannot be changed as easily.

We would like to thank everyone who already provided their valuable time to create great stories and interesting movies.



Reports from the scientific front

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

Multi-scale instabilities and energy transfers
By Sebastian Schubert, Postdoc M1

Since September 2016, I work as a Post-Doctoral Researcher for the TRR. Previously, I was working as part of the DFG funded project MERCI after finishing my PhD at the International Max-Planch Research School at the Max-Planck-Institute for Meteorology in Hamburg.

My research is mainly focused on the various applications of dynamical system theory to geophysical models of simple to intermediate complexity. In particular, I have applied the theory of Covariant Lyapunov Vectors (CLV) to a quasi-geostrophic two layer model and studied the connection between the unstable and stable directions to their baroclinic and barotropic energy conversions (Schubert & Lucarini, 2015). This type of analysis also allowed it to illuminate some features of simple blocking like patterns (Schubert & Lucarini, 2016).

For the project **M1**, I will study the properties of multi-scale instabilities using CLVs. The presence of multi-scale features usually impedes efforts to make good predictions. I will investigate the connection between multi-scale instabilities and energy transfers between atmosphere and ocean using firstly a rather simple quasi geostrophic model of the atmosphere and ocean (MAOOAM). Secondly, my interest lies in exploring the multi-scale properties of linear instabilities in a primitive equation model (PUMA). With these investigations using new tools from dynamical system theory, we expect to foster the understanding of multi-scale processes that are slow evolving and are usually “hidden” behind the faster dynamics.

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Minimising spurious mixing in numerical ocean models

By Knut Klingbeil, Postdoc in M5

Hi. Last month I started working as a postdoctoral researcher in subproject **M5**. After being involved already in the project's proposal and review process, I am very happy to finally participate in this exciting TRR. As a co-developer of the coastal ocean model GETM, I am strongly interested in the development of energy-consistent modelling techniques. In ocean models the advective transport of water masses is prone to energetic inconsistency. On the discrete model level this transport is associated with truncation errors causing spurious diapycnal mixing, which artificially increases potential energy without any physical sources. Recently, I developed (together with PI Hans Burchard) a new analysis method that can quantify spurious mixing locally in every single grid cell. In M5 this method will be applied now to assess the new adaptive grid techniques and advanced advection schemes, that will be developed at UHH (PI Armin Iske), AWI (PI Sergey Danilov) and IOW (PI Hans Burchard) in order to reduce spurious mixing. I will be responsible for the development of algorithms that during runtime adapt the discrete model layers to the fluid flow (in order to minimise vertical transports across the layer interfaces), to isopycnals (in order to minimise diapycnal transports along the model layers) as well as to regions where high vertical resolution is needed (in order to minimise truncation errors) in an optimal way.

"The possibility for direct application of newly developed model techniques within leading national climate model systems is very stimulating."

Furthermore, I will successively implement all schemes and algorithms developed in M5 into GETM to identify promising combinations that should finally be included into FESOM (developed by Sergey Danilov), which is the ocean component of the state-of-the-art climate model system ECHAM6/FESOM. With Sergey Danilov and Armin Iske being also PIs in the synthesis project S2, this possibility for direct application of newly developed model techniques within leading national climate model systems is very stimulating. In the frame of the TRR I am looking forward for the close collaboration with experienced oceanographers, meteorologists and mathematicians, which offers an optimal academic environment for me as a young scientist. To foster the internal collaboration within M5, I will be first employed at UHH for 1.5 years and afterwards at IOW.

A more detailed overview about spurious mixing, its sources and reduction will be given in my seminar talk on 19 Jan 2017.

Investigating the Denmark Strait Overflow plume

By Ryan North, Postdoc T3

In October 2016 I joined the TRR 181 as a postdoc at the Universität Hamburg in the **T3 subproject: Energy transfers in gravity plumes**. Our subproject aims to improve our ability to parameterize the energetics and mixing within gravity plumes by investigating the Denmark Strait Overflow plume. This plume was chosen as an ideal study case because of its relevance to the global ocean circulation, and the long history of observational data in the Strait. My role within the subproject mainly involves working with this historical data and the collection of new data. The data will be used both on its own and for collaborative modelling work. Using the results of the observational and modeling components, we will investigate the role entrainment plays in the evolution of the plume. In particular, we are interested in investigating the hypothesis that enhanced entrainment occurs where the plume interacts with mesoscale eddies or topography. The modeling component will help to put the results in perspective across a range of scales, from the

"Using the results of the observational and modeling components, we will investigate the role entrainment plays in the evolution of the plume."

turbulent scale up to the mesoscale.

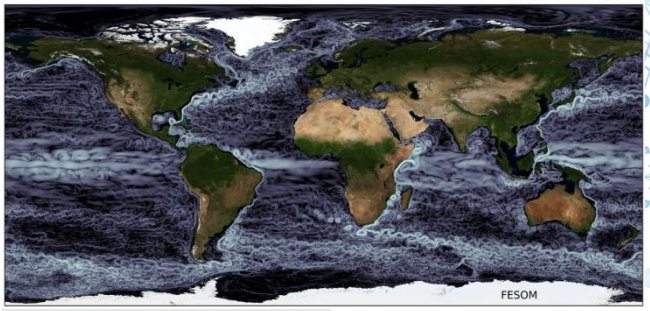
Prior to joining the Institute of Oceanography I followed a winding career path. Beginning at Canada's Queen's University, my career has taken me through structural and coastal engineering, lake, river and coastal hydrodynamic modeling, climate related hypoxia in lakes, and submesoscale eddies in the coastal ocean (at HZG in nearby Geesthacht). With this new position I have finally managed to move beyond inland waters and the coastal shelf break to reach properly deep water!

I am looking forwarding to meeting more members of TRR 181, and to opportunities to work together in the near future. Currently, I am onboard the FS Meteor helping out fellow TRR project members investigate filaments forming within the Benguela upwelling system off the coast of Namibia.

Metrics and Diagnostics for model improvements

By Nikolay Koldunov, Postdoc S1

I am Nikolay Koldunov, Post Doc at MARUM and Alfred Wegener Institute. Since October I begin to work at Research Project **S1: Diagnosis and Metrics in Climate Models**. The main aim of the project is to integrate and synthesize work done in other parts of the TRR181. In particular we will provide metrics and diagnostics to help access the impact of model improvements suggested by TRR181 on quality of the climate models. One of the main challenges is to create model diagnostics that would not only quantify improvements, but also allow to clearly identify the cause of changes in model behavior. In this respect the proper protocol and experiment setup for numerical experiments is crucial and its development will be important part of my work. The resulting diagnostics will become available for the wider research community through the ESMValTool that is going to be one of the main instruments of model analysis for the CMIP6 project.



FESOM ocean model. Ocean currents at 100m, time snapshot.

"The proper protocol and experiment setup for numerical experiments is crucial."

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Something funny for the end ...