TRR 181 NEWSLETTER

ENERGY INFLOW

WE'RE KICKING IT OFF!

We warmly welcome all new TRR 181 members on board! For everyone who is new: In our newsletter ENERGY INFLOW we inform you about what happened in the project, give an overview of who is who and what will happen in the next weeks.

With the new start of phase 2 we are starting a lot of new things: an own research training group, a group of young project leaders, an own outreach project, new mercator fellows...these are interesting times, that let us almost forget about the pandemic circumstances.

During our first Winter School we welcomed almost 60 people, a lot of the new PhDs joined the meeting from different countries, even though they haven´t officially started yet. We are amazed by the group spirit even in pandemic times via online meetings and are very much looking forward to 3,5 years working with you!

In this Newsletter you find:

- a **report on Digital Winter School**
- **a report from the first Mercator fellow meeting on Eddies and Internal Waves**
- **reports** from our new PhDs in T2 and M3.

Enjoy!
Jennifer and Lea

Group picture from Digital Winter School

DIGITAL WINTER SCHOOL REPORT

From March 10-12, 2021 our new PhDs of Phase 2 met online to get an introduction of the project's topics. Up to 60 TRR 181 members gathered in the three-day Zoom meeting, we are amazed by the positive spirit of everyone!

As everything is a little bit different during the ongoing pandemic, this year's Winter School was held online. All early career scientists had the opportunity to meet and get to know each other during this virtual event. Although everyone would probably prefer to meet in person, the online Winter School was a full success, nevertheless.

Day 1
The first day started with some welcoming words and introduction for the new PhDs by TRR speaker Carsten Eden, as an upbeat for three days full of interesting talks and vivid discussions. After a short coffee break, Dirk Olbers gave insights about how the circulation in the ocean works – as promised it was an easy to digest talk with not so many equations. Before the lunch break, all TRR members had the chance to get to know each other better with fun icebreaker questions. In order to have a slightly more social setting aside the Zoom talks, the online platform gather. town was used, which provided the opportunity to get in touch with everybody.

The afternoon was filled with introductions to the different research areas M (Mathematics, new concepts and methods), T (Turbulence and boundary layer), W (Wave processes), L (Large-scale and balanced processes) and S (Synthesis with climate models) of the project, with contributions by the Young Project Leaders (Young PLs) of the respective research groups.

Day 2
The second day of the Winter School started with an overview into the functioning of the atmosphere by Almut Gaßmann, aimed at all those investigators who are usually dealing with the ocean. Especially the aspects that are important to understanding the interactions of both systems were underlined. As a second talk of the day, Nikolay Koldunov held a talk about the software and technical skills that will make life easier for any researcher in the TRR.

In the afternoon, the coordinators contributed some organizational issues of the project, like the structure of the TRR's new graduate school, the RTG ENERGY. Among other things, the RTG includes an advisory panel system for the PhD students and a mentoring program, which were explained by Lea Diederichsen. Jennifer Fandrich presented the newly implemented outreach project Art&Science: ENERGY TRANSFERS. The basic idea is that scientists collaborate with artists to create a new form of communication and presenting science to the public and explain our fundamental research in a new way.

For sure one of the highlights of the Winter School was the pub quiz in the evening, hosted by Jan Streffing. The questions ranging from science and history to sports and pop culture provided ample opportunity for wrong but entertaining guesses and the whole quiz was a great deal of fun for everyone involved.

Day 3
The last day of the Winter School started with an insightful talk by Ryan North about how measurements are actually taken out in the field, or more precisely – at sea. This presentation gave everyone who never had the opportunity yet to attend a scientific expedition impressions of what it is like to gather all the information in-situ that the project is working with. As Carsten Eden predicted on the first day, this talk definitely provided "cool stuff". After a quick coffee break, Marcel Oliver gave a mathematics talk on a virtual whiteboard, that contained a lot of (not so) easy to digest equations by nature, providing helpful mathematical knowledge for the work in the TRR.

"For sure one of the highlights of the Winter School was the pub quiz in the evening."

In the afternoon, the Early Career Scientists could seize the chance to anonymously ask any (not so) stupid question in a Q&A about all issues related to the TRR. After a coffee break, the PhD and Postdoc representatives for the RTG Board were elected before this successful first Winter School of the second phase came to an end.talk on a virtual whiteboard, that contained a lot of (not so) easy to digest equations by nature, providing helpful mathematical knowledge for the work in the TRR. In the afternoon, the Early Career Scientists could seize the chance to ask any (not so) stupid question in a Q&A. After a coffee break, the RTG Board members were elected, before this successful first Winter School of the second phase came to an end.

EDDIES AND INTERNAL WAVES: FLOW DECOMPOSITION AND PARAMETERISATIONS

by Manita Choucksey

TRR-181, 16th -18th March, 2021
The meeting on eddies and waves has been the first TRR-181 meeting of the recently funded second phase of TRR-181, together with the TRR Mercator fellows: Laure Zanna (NewYork University, US), David Marshall (University of Oxford, UK), Kevin Lamb (University of Waterloo, Canada), and Jacques Vanneste (University of Edinburgh, UK).

This meeting is a follow up of the workshop held on 20th November 2018 on 'Un/Balanced Flow Decomposition Methodologies' that I organised in Hamburg. This time we further broadened the discussions to bring together the recent advancements in flow decomposition methodologies, wave and eddy parameterizations. The meeting comprised of talks and discussions on the aforementioned topics over three afternoons.

Day 1 of the meeting began with the talk on 'Inertia-gravity-wave scattering by geostrophic turbulence' by the TRR Mercator fellow Jacques Vanneste, after a welcome and an overview of TRR-181 by Carsten Eden and myself. The rest of the afternoon featured talks on waves to tides to multi-scale oceanic motions, wave emission to wave scattering, and laboratory experiments to numerical simulations. A wavy closure to the first day was brought about with the talk on 'Internal wave generation by tidal currents at super-critical latitudes' by TRR Mercator fellow Kevin Lamb.

Day 2 of the meeting began with 'Symmetric instability in cross-equatorial western boundary currents', a joint research work by TRR Mercator fellow David Marshall and Fraser Goldsworth. The 2nd session began with the talk by the speaker of TRR-181, Prof. Carsten Eden on 'A closure for lee wave drag on the large-scale ocean circulation'. The rest of the afternoon was filled with exciting topics spanning oceanic and atmospheric spectra, near-inertial waves, surface waves, and breaking internal waves. The second day of the meeting came to an energetic closure of with the talk on 'Ocean transport and eddy energy: Climate Process Team', by TRR Mercator fellow Laure Zanna.

To add a touch —or rather an illusion— of reality, we as hosts thought of brining some glimpses of Hamburg through pictures during the dramatic winter followed by a dramatic transition to spring, to make up for the the missed opportunities of exploring Hamburg. A group photo of smiling participants brought an end to the second meeting day. The smiles were reassuring that the meeting had been prolific so far, and gave the hint of an excitement to look forward to another day of talks!

Day 3 brought in more shades of eddies and waves: from energy dissipation to wave-vortex interactions, to cross-scale energy transfers, including theory, fronts, stirring, and mixing— after a lot of energetic eddies and waves around for the first two days. And thus we concluded the final day of the meeting with exciting talks on fascinating topics and a lot of motivation for science!

Further meeting details, the meeting recording, as well as the book of abstracts can be found at the meeting link: https://www.trr-energytransfers.de/events/event/meeting-on-eddies-and-internal-waves

The 3-day TRR-181 Eddy-Wave meeting saw a fantastic set of talks and discussions - many from our enthusiastic friends across the Atlantic who had to be up before the sun did - only for science! We've run 3 afternoons of fully virtual meeting on 3 online platforms parallel in 8 time zones(!!), with our friends attending the meeting before sunrise and at some places until shortly before the next sunrise! Still, there were no complaints; instead came the response: 'It's better than jet-lag!'

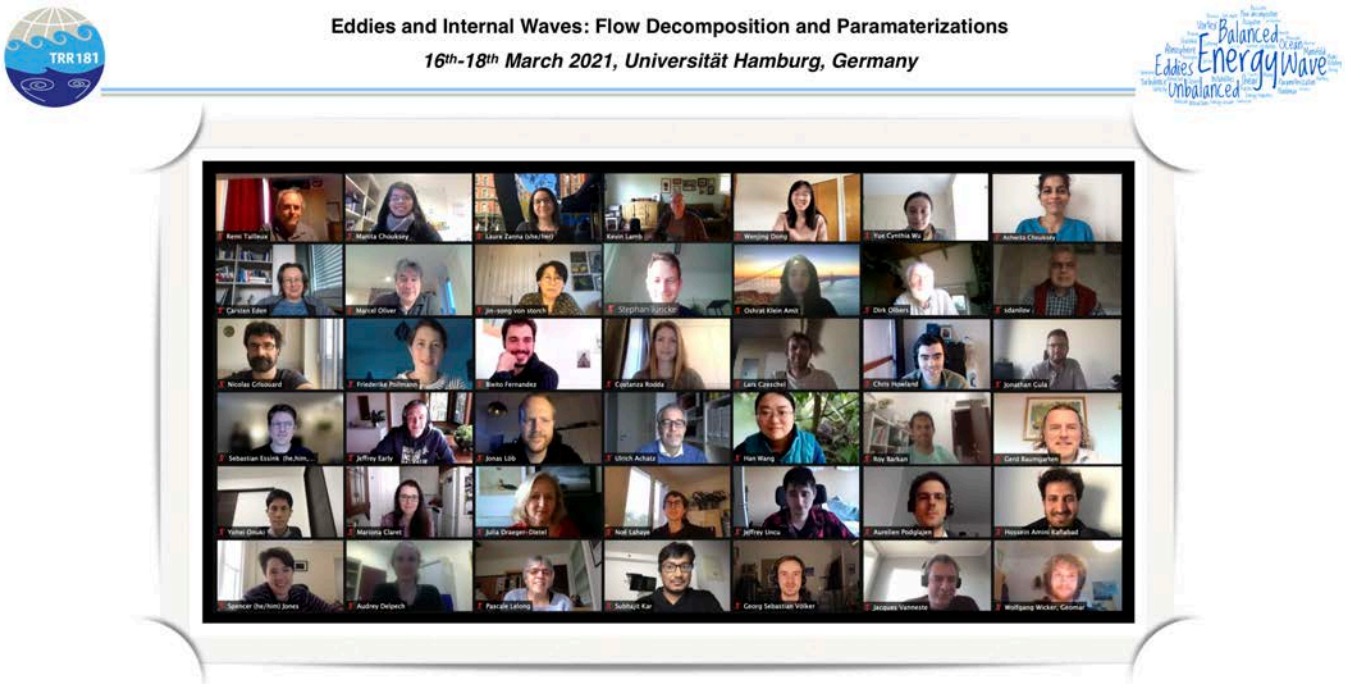
It has been indeed intense but exciting, and an invaluable experience as an organiser (at the same time a participant!)— with so much to learn about organising an event of that scale, along with the technical aspects, as well as ensuring a smooth experience for all! Here, I take the opportunity to thank Stephan Juricke, for the help in setting up and managing the livestream of the meeting and other technical aspects together with me. I thank Prof. Carsten Eden for supporting me to organise this conference, and guiding us all throughout with an ocean of patience for all our questions.

To summarise: 3 days - 3 online platforms - 8 time zones - 15 hours online meeting - 29 talks - 150 participants - and unlimited science! Another aspect to these numbers is the reduction in Carbon footprint (had this been an in-person meeting) which was reduced by ~50 tonnes! The satisfaction of contributing to the health of our planet, however, comes at the cost of missing out on the simple pleasures of life outside the digital world, and consequently the in-person social interaction was heavily missed. Hopefully we will be able to meet in-person in a not-so-distant future!

I hope all the participants had a wonderful meeting experience and a lot of sciencinspiration!

Thank you everyone for being a part of this!

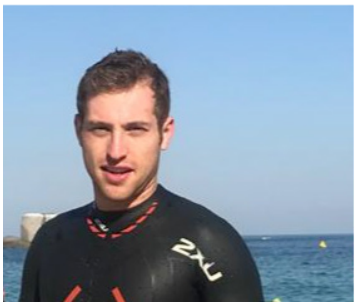
Best wishes and stay healthy,
Manita Chouksey



LES SIMULATIONS OF ENERGY FLUXES IN THE SURFACE

by Josh Pein, PhD T2

I am a physical oceanographer working as a PhD at the University of Hamburg under the supervision of Dr. Nils Brüggemann (Universität Hamburg),



Dr. Jeff Carpenter (Helmholtz Zentrum Geesthacht), Dr. Lars Czeschel (Universität Hamburg).

I am investigating the energetics in the oceanic surface mixed layer.

I studied a dual major in `Environmental Sciences` as well as `Atmospheric and Ocean Sciences a the University of Cape Town, a true amalgamation of the earth sciences. Following a successful research cruise in the Southern Ocean in 2015, I moved my studies to the IfM in Hamburg.

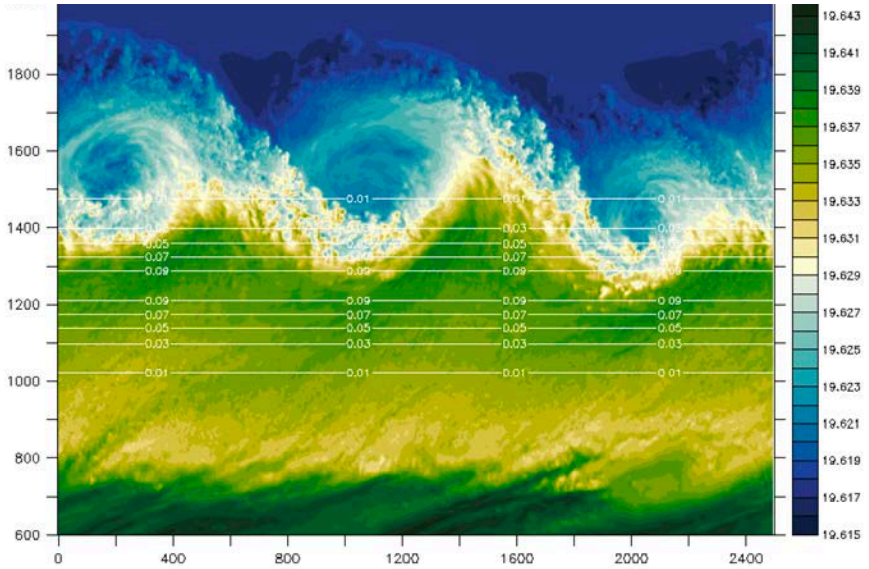
I am a member of the TRR subproject T2 "Ocean Surface Layer Energetics". The importance of the upper-ocean Surface Mixed Layer (SML), an interface between the ocean and Atmosphere goes without saying. It is responsible for communicating atmospheric fluxes into the ocean interior, and is the most energetic part of the ocean! Processes in the SML interact to produce a variety of energy transfers. However at Submesoscales, a lack of observations means that it is not yet clear which process dominate in energy dissipation. Consequently, climate models often artificially create or *dissipate energy. T2 seeks to rectify this!* Using a combination of observations and large eddy simulations, the main aim of our subproject is to identify, quantify and parameterize these dominant processes. Ultimately, this will expand our understanding of the conceptual energy cycle of the ocean, providing more energetically consistent surface mixed layer parameterisations for climate models.

"However at Submesoscales, a lack of observations means that it is not yet clear which process dominate in energy dissipation."

I am responsible for running, and the analysis of the LES. One set up of interest, and common place in the upper ocean, are oceanic fronts. Often close to thermal wind balance, not quite in equilibrium, they are unstable to a "family" of possible submesoscale instabilities.

The figure below, produced from one of our runs, is an example of such a set up. It shows the evolution of a baroclinic front in the mixed layer. The colour scale gives the buoyancy and the white contours indicate the associated eastward jet.

After 6 hours symmetric instability develops at the southern flank of the jet, as the relative vorticity of the background flow reduces the potential vorticity below zero (a necessary condition for symmetric instability). After 24h we can see the development of baroclinic instability on a much larger scale. The development is not symmetric around the background jet as the symmetric instability has already re-stratified large parts of the southern flank. We are especially interested in the impact of the so called 'secondary instabilities', such as Kelvin-Helmholtz instability, which accompany symmetric and baroclinic instabilities. In order to explore the role of the 'secondary instabilities' for the mixing and energy dissipation in the mixed layer, our LES simulations demand grid resolutions of (O)1m.



FIRST STEPS IN STOCHASTIC OCEAN MODELLING

by Ekaterina Bagaeva, PhD M3

My name is Ekaterina and I'm a PhD Student of project M3 "Towards Consistent Subgrid Momentum Closures". I work at Jacobs University in Bremen and at AWI in Bremerhaven as well. Due to Corona pandemic the personal contacts are quite limited, but I was lucky enough to meet already my colleagues in AWI and also regularly meet the colleagues in Jacobs University.

Before joining to TRR I've got a master degree in Mathematical Modelling following an Erasmus Program in Europe. My master thesis was related to stochastic modelling of the evolution of an epidemic. The stochastic area of my thesis brings me to the current work in TRR.

My global aim in the projects is to improve the representation of ocean variability that represents by ocean eddies. Some ocean eddies are already resolved for certain degrees of resolution, but still there are variations where explicit simulation is not possible. Some of these variabilities could be resolved by bringing back to the model

kinetic energy, so called kinetic energy backscatter, obtained through the stochastic parametrization. And to find a good stochastic kinetic energy backscatter parameterization is my local aim so far.

To date, we are on the second stage of the project, so the first months of my work were devoted to acquaintance with the FESOM model, its configurations and code itself. The other significant part was related to understanding of papers which were published by members of M3 during the first stage of the project. Currently I start to implement the idea of identifying the process based on EOF (Empirical Orthogonal Functions) analysis of kinetics energy difference between realization of the model on the fine and coarse grids.

I see the evolution of my work in the application of smarter and more sophisticated approached of stochastic parametrization, preserving the model intuitively understandable and available for computation.

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.

Ma, Q., **Lembo, V. & Franzke, C. L.** (2021). T**he Lorenz energy cycle: trends and the impact of modes of climate variability.** Tellus A, doi: https://doi.org/10.1080/16000870.2021.1900033.

Chrysagi, E., Umlauf, L., Holtermann, P., K**lingbeil, K. & Burchard, H. (2021). High resolution simulations of submesoscale processes in the Baltic Sea: The role of storm events.** J. Geophys. Res.-Oceans, doi: https://doi.org/10.1029/2020JC016411.

Gassmann, A. (2021). **Inherent Dissipation of Upwind-Biased Potential Temperature Advection and its Feedback on Model Dynamics.** J. Adv. Model Earth Sy., doi: https://doi.org./10.1029/2020MS002384.

Carpenter, J. R. , Rodrigues, A., **Schultze, L. K. P.**, Merckelbach, L. M., Suzuki, N., Baschek, B. & **Umlauf, L.** (2020). **Shear Instability and Turbulence Within a Submesoscale Front Following a Storm.** Geophys. Res. Lett., doi: https://doi.org/10.1029/2020GL090365.

UPCOMING EVENTS

April 8, 2021
RTG Meeting for PhDs and Postdocs
We'll meet every second Thursday for 1.5h at 3 pm.

April 13, 2021
IDEMIX and more: Discussion meeting on FESOM/ICON developments
We discuss (ocean) modeling topics related but not limited to IDEMIX that link TRR scientists across subprojects and institutions on Tuesday, 11am.
This Time: FESOM/ICON developments with Nils Brüggemann, Nikolay Koldunov and Patrick Scholz

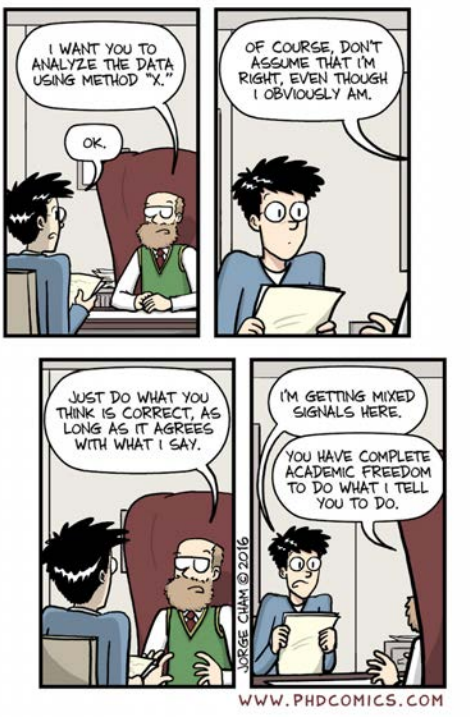
April 15, 2021
TRR 181 Seminar
The TRR 181 seminar is held by André Paul (UHB) on April 15, 11 am.

April 27, 2021
IDEMIX and more: Discussion meeting on flow decomposition
We discuss (ocean) modeling topics related but not limited to IDEMIX that link TRR scientists across subprojects and institutions on Tuesday, 11am.
This Time: Flow decomposition.

September 22-24, 2021
TRR 181 Retreat
The TRR 181 Annual Retreat is the Annual meeting for all TRR 181 members.

December 5-9, 2021
Warnemünde Turbulence Days
10th Warnemünde Turbulence Days (WTD) on "Interfaces and turbulent boundary layers"

SOMETHING FUNNY (?) FOR THE END



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