Project: **1102**

Project title: **SFB-Transregio (TRR181)**

Principal investigator: **Nils Brüggemann**

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Within the underlying DKRZ project, we aim to perform ocean simulations which resolve submesoscale dynamics and tides. During the past year, we were successful in performing two of these simulations over two month each with a telescoping grid configuration. Both simulations only differ with respect to the season of the simulation period where one is in summer (high submesoscale eddy activity) and the other one in winter (low submesoscale eddy activity). They both have submesoscale resolving resolution (<600m) in the South Atlantic and both apply a tidal forcing. Therefore, they are part of the SMT-WAVE framework. Currently, we are extending the simulations, the target will be to have both simulations for at least four months by the end of this year.

In the previous proposal, we planned for two more simulations, one without tidal forcing and another one with a filtered wind stress to exclude two important sources for internal waves. This allows us to study the relevance of these internal wave sources for ocean energy pathways. Due to the transition from Mistral to Levante and since an important member of our project left, our progress was slightly delayed. In particular in the first half of the year, we were not so successful in running the SMT-WAVE configuration partly due to technical issues and partly due to time constraints of the involved scientists. Since we still consider these simulation as extremely valuable, we will apply for compute resources to perform these simulations in 2023.

A further complication developed since the SONETT research cruise was postponed to March this year as a consequence of the COVID-19 crisis. Since the SMT-WAVE simulations were particularly designed to support diagnosing the results of this research cruise, we waited with our winter simulation until the cruise took place and the ERA5 forcing data became available.

A first analysis of the data shows very promising results. A snapshot of the local Rossby number of the attached figure indicates a rich sub-mesoscale eddy field. Inspection of the vertical velocity field shows furthermore a strong activity of internal waves (not shown). These simulations will now be collaboratively explored with a diverse amount of researchers from different research institutes (Max Planck Institute, Universität Hamburg, Universität Bremen, Helmholtz-Zentrum Hereon, IOW Warnemünde).

These simulation will provide a unique opportunity for the scientists of the TRR181 to study the interactions of processes on time and space scales which could not been resolved so far. The data usage by such an interdisciplinary and in parts unexperienced group of scientists certainly obeys several challenges. To facilitate the data usage, we provide several tools for analysing ICON data of such high resolution. A gitlab project with example Jupyter Notebooks was installed (https://gitlab.dkrz.de/m300602/smt-wave/). Furthermore, we started an extensive documentation regarding the simulations, their spinup, ways how to obtain data access, introduction into data analysis and preliminary results, all of which can be found at https://m300602.gitlab-pages.dkrz.de/smt-wave/index.html.

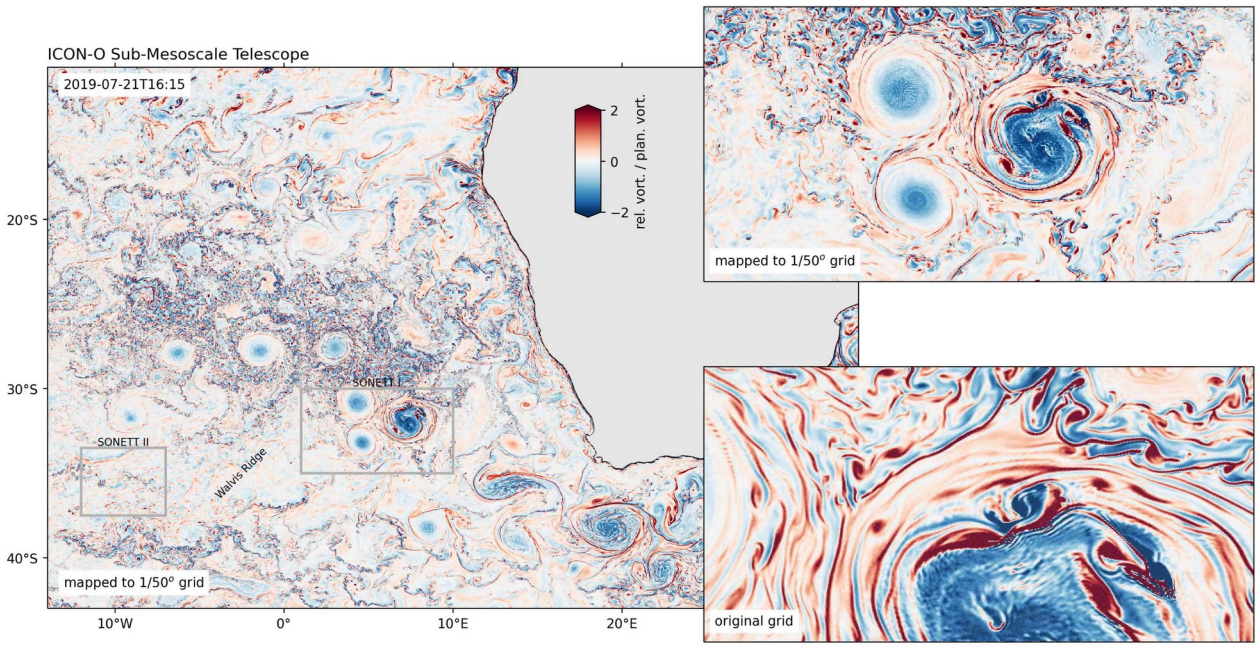

Figure 1: Local Rossby number as fraction of relative vorticity over planetary vorticity within the focus area of the SMT-WAVE simulation (east of Africa in the south Atlantic). The two panels on the right show close-ups on three and ultimately on one Agulhas eddy. A strong submesoscale eddy field with ageostrophic dynamics is apparent by its structure and the high Rossby numbers. The two rectangles in the main figure indicate two study areas of the TRR181 covered by a previous research cruise (SONETT I, March 2022) and an upcoming cruise (SONETT II, presumably February 2023).