Project: **688**
Project title: **Zirren in der Tropopausenregion**
Project lead: **Peter Spichtinger**
Report period: **2016-01-01 to 2016-12-31**
Text: maximum of two pages including figures.

Progress report:

1. subproject CIRRUS-GW

In this project (DFG research group MSGWaves, project GW-TP) we investigate the feedbacks between tropopause dynamics and gravity waves and their feedbacks on cirrus clouds. For this purpose we conducted 2D and 3D simulations of gravity waves propagating vertically from the troposphere through the tropopause into the stratosphere. We investigate different scenarios, changing background stratification, environmental wind conditions and wavelengths in the prescribed waves. Beside idealized simulations we investigate case studies for the DEEPWAVE campaign, which took part over New Zealand in summer 2014. For this purpose, radiosonde profiles and meteorological analysis data from ECMWF were used in order to prepare realistic conditions for the EULAG simulations. For three different cases we run simulations in order to compare our findings with observations.

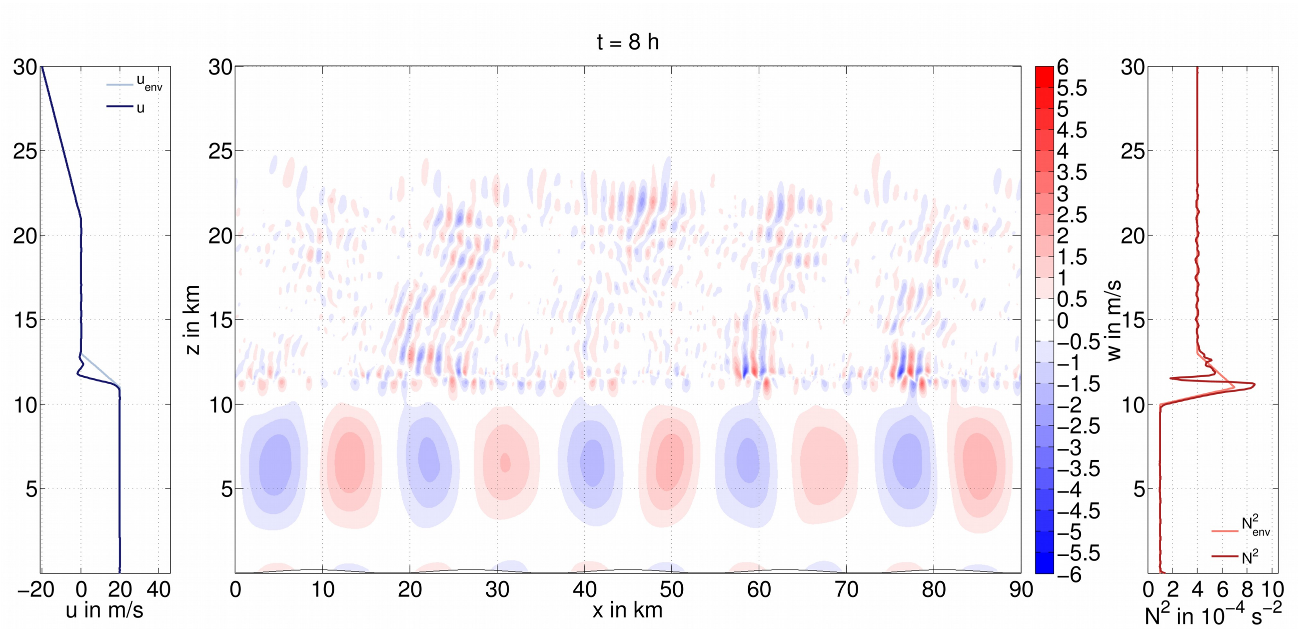

Figure 1: Case study of gravity waves near a critical layer in the vicinity of the tropopause.

In the case as shown in figure 1, secondary wave formation near a critical layer in the tropopause region could be observed. At the moment it is not clear how this wave generation is triggered and which processes are interacting to form this kind of small waves.

Our investigations are still going on. In addition, we started to implement a version of the ice microphysics into the latest dynamical version of EULAG. This model version will be used in the following project period for investigating the impact of waves on cirrus clouds.

2. subproject CIRRUS-INH

In this subproject, inhomogeneities of cirrus clouds as triggered by instabilities are investigated using the EULAG model. We investigated idealised cases of shallow cirrus convection, similar to the realistic simulations in Spichtinger (2014), in order to investigate the sensitivity of the resulting cirrus clouds due to changes in stratification, wind shear and additional aerosol loading.

Additionally, we reinvestigated Kelvin-Helmholtz instabilities using very different setups for the environmental conditions of temperature and humidity. It turned out that there are at least two regimes, which constitute an important interaction between dynamics of shear instabilities and ice supersaturation and ice clouds, respectively.

In the first scenario, the instability is strong enough to trigger ice formation; if the wave signature is large enough and the wavelengths corresponds with the internal time scales of the microphysical processes, the Kelvin-Helmholtz wave became visible in the cloud fields (see figure 2).

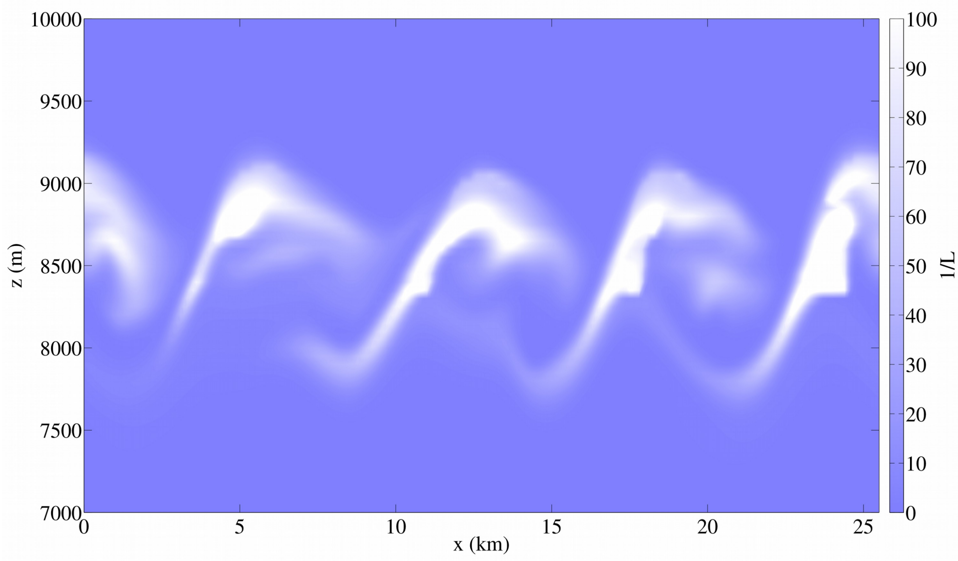

Figure 2: Nucleation as triggered by Kelvin-Helmholtz instability

In the second scenario, the Kelvin-Helmholtz instability occurs inside an existing ice cloud. If again the timescales are in correspondence with the wave, the dynamic signature becomes visible (figure 3.)

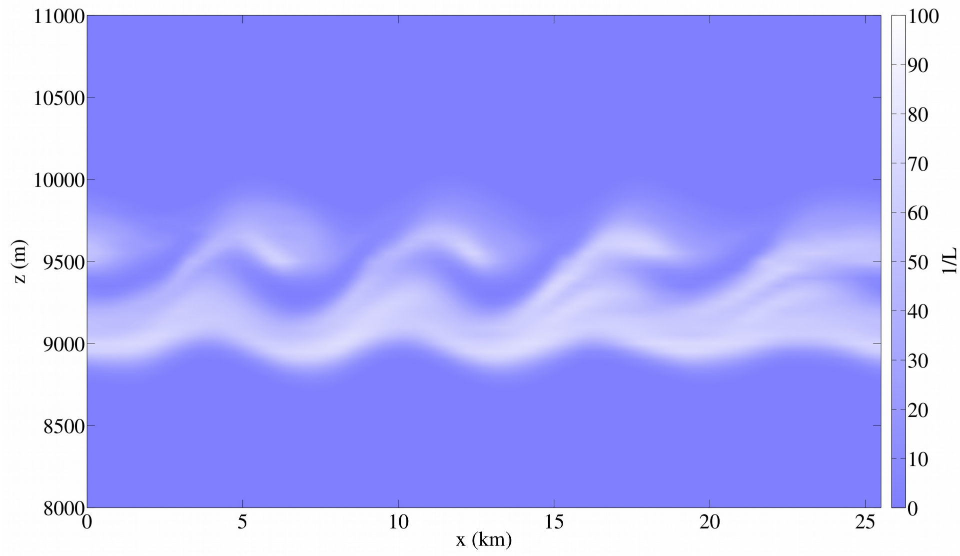

Figure 3: Kelvin-Helmholtz instability occurring inside an existing ice cloud.

3. subproject CIRRUS-EXT

In this subproject we investigate the impact of convective cells on the exchange of tracers close to the tropopause. For this purpose we simulate cirrus clouds in potentially unstable layers close to the tropopause and investigate the exchange of air parcels. During this funding period we could not spend much time on this project. We run some simulations, also in the context of gravity waves and tropopause inversion layer. However, we are still working on the evaluation of these simulations.