LadHyX Seminar – March 14, 10:45

Louis-Alexandre Couston
(British Antarctic Survey, Cambridge (UK))

On the interaction of turbulence, waves and large-scale flows in geophysical fluids

Energy transfers from small-scale turbulence and waves to large-scale flows are ubiquituous in oceans, atmospheres, planetary cores and stars. Therefore, turbulence and waves have a direct effect on the large-scale organization of geo/astrophysical fluids and affect their long-term dynamics. In this talk I will discuss recent direct numerical simulation (DNS) results of two upscale energy transfer mechanisms that emerge from the dynamics of a fluid that is self-organized in a turbulent layer next to a stably-stratified one. This self-organization in an adjacent "two-layer" turbulent-stratified system is ubiquituous in nature and is representative of e.g. Earth's troposphere-stratosphere system, the oceans' surface mixed layer-thermocline system, and stars' convective-radiative interiors. The first set of DNS results will demonstrate how turbulent motions can generate internal waves, which then force a slowly-reversing large-scale flow, akin to Earth's Quasi-Biennial Oscillation (QBO). The second set of DNS results will show how the stratified layer regulates the emergence of large-scale vortices (LSV) in the turbulent layer under rapid rotation in the regime known as geostrophic turbulence. I will demonstrate why it is important to resolve both the turbulence and the waves, as otherwise the natural variability of the QBO is lost and LSV cannot form. I will discuss future works and highlight how the results may change the implementation of upscale energy transfers in global earth system models.