Measurement methods in cryogenic flows: local velocity and flow visualisation. Application to convection, thermal plumes and internal gravity waves

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Cryogenic liquid helium is an interesting fluid for laboratory models of geophysical flows such as atmospheric plumes. Indeed, the Prandtl number of liquid helium is of order 0.6, close to that of air, while allowing much larger Reynolds numbers. In this talk, I will characterize how the background temperature in the liquid helium bath stably statifies over time, and how this can be leveraged to study turbulent thermal plume in homogeneous or stratified background.
The penetration of the thermal plume in the stratified layer enables the propagation of internal gravity waves which are a source of mixing and energy transport in geophysical settings.
One challenge is to obtain quantitative data in the cryogenic configuration. To that end, we use both local sensors such as cantilever anemometers, and optical methods, in particular shadowgraphy and schlieren.
We show that shadowgraphy and schlieren are suitable non-invasive methods for thermal flows in Helium I.