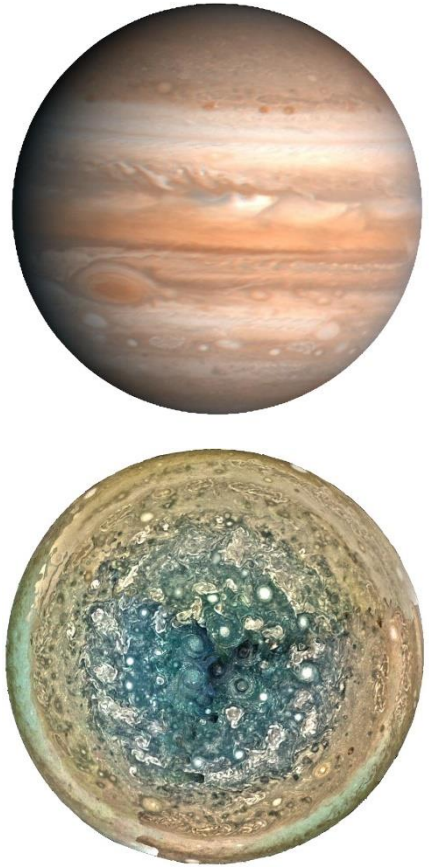
Scaling properties of heat transport in idealized planetary atmospheres and oceans

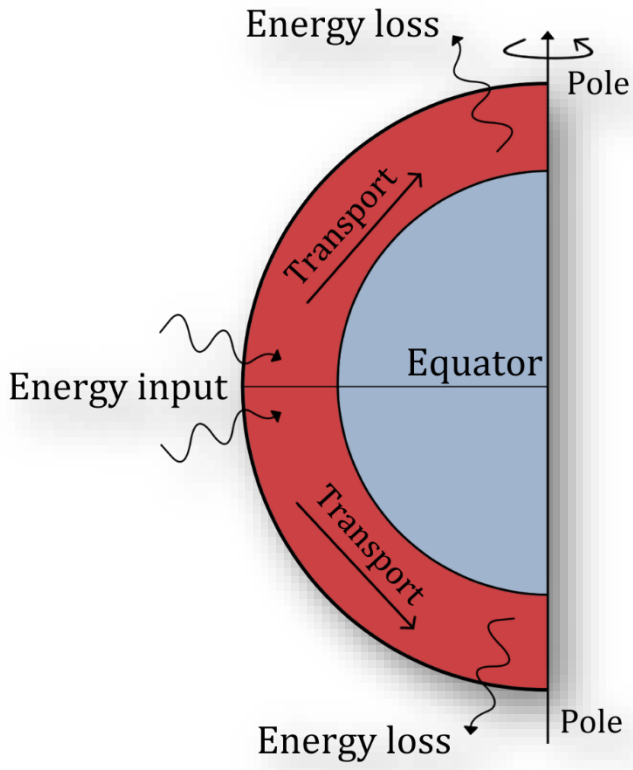
Gabriel Hadjerci and Basile Gallet



Different views of Jupiter

Starting point of the development of a theory of climate:

- The baroclinic instability is one of the main ingredient in the **heat transport** between the equator and the poles.
- The triggered flow is **turbulent**. For a large-scale climate model, small scales have to be parameterized.
- Introduction of a turbulent diffusivity as a closure for the large-scale heat transport equations.
- Main parameter: **friction at the bottom**

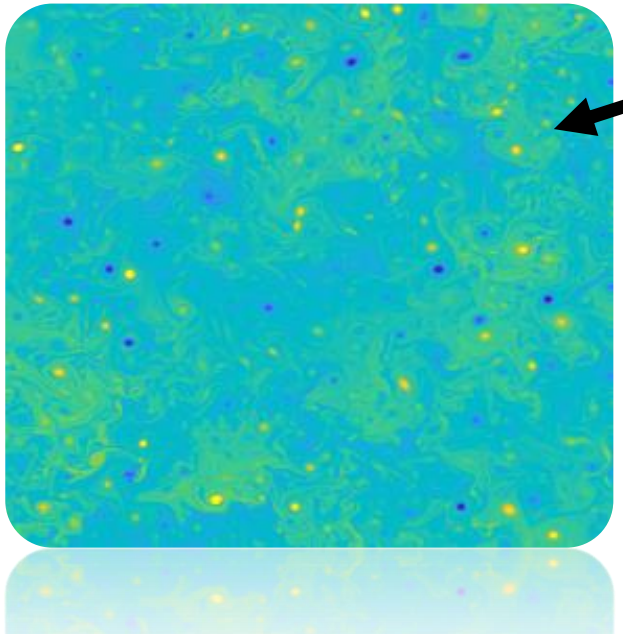


Objective: Meridional heat flux ***VS*** *friction*

Scaling properties of heat transport in idealized planetary atmospheres and oceans

To answer this question:

1. We develop a **scaling theory** starting from a simplified model, analyzing the **structure of the flow** and constructing scaling arguments out of it.
2. We express in a quantitative way the asymptotic dependence on the **vertical stratification** profile without adding any fitting parameter.
3. We compare our results to **DNS**.



At low drag, the flow is like a vortex gas

$$D^* \sim (\mu^*)^{-\frac{4}{3}}$$