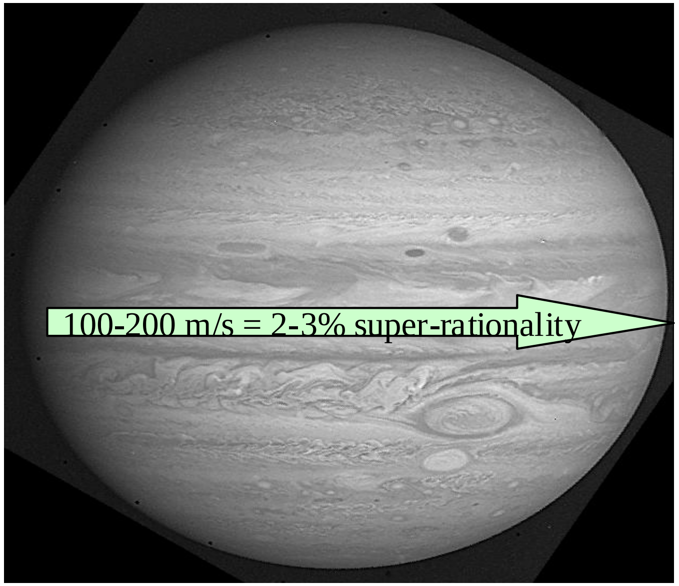
Coriolis IV

-More about the meaning of it all

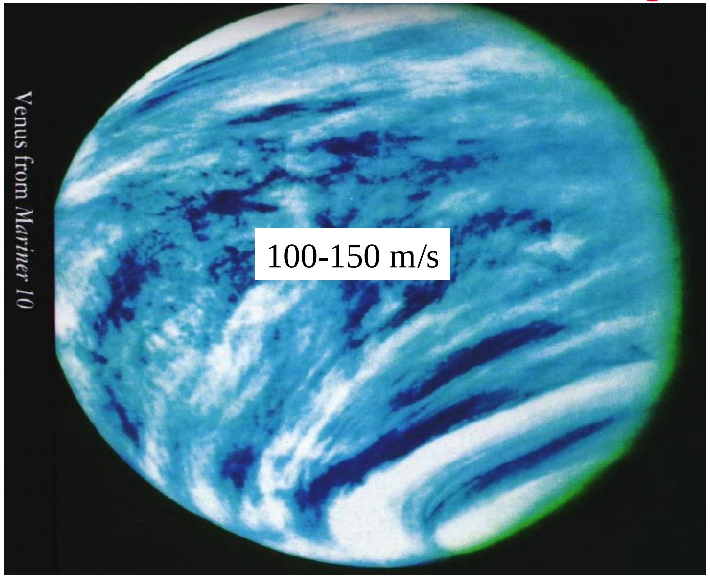
6. Winds on other planets

The circulation with other rotations (Jupiter and Venus)

The equatorial jet circulation on Jupiter



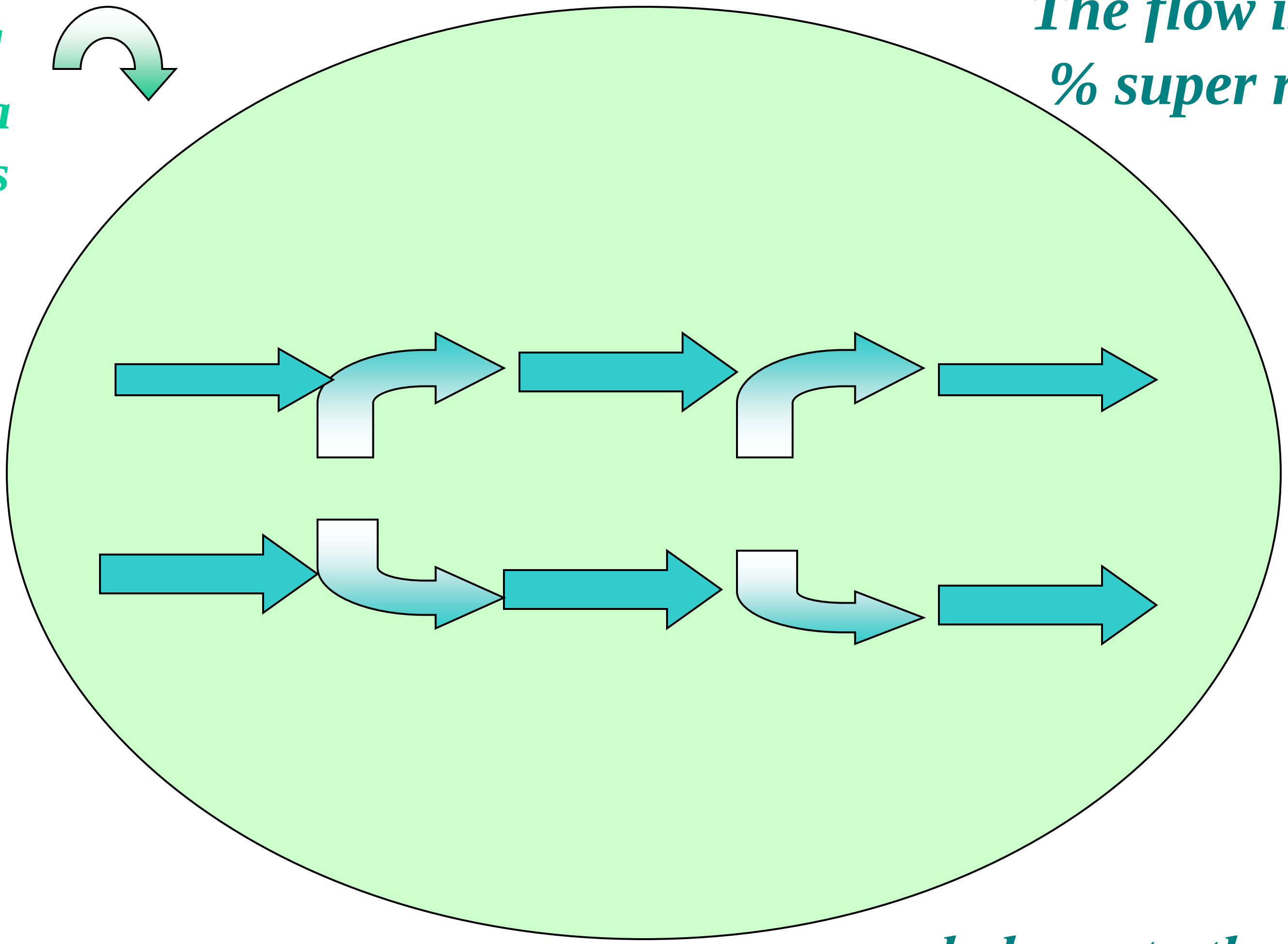
The hurricanes on the slow rotating Venus



High rotation - strong Coriolis force

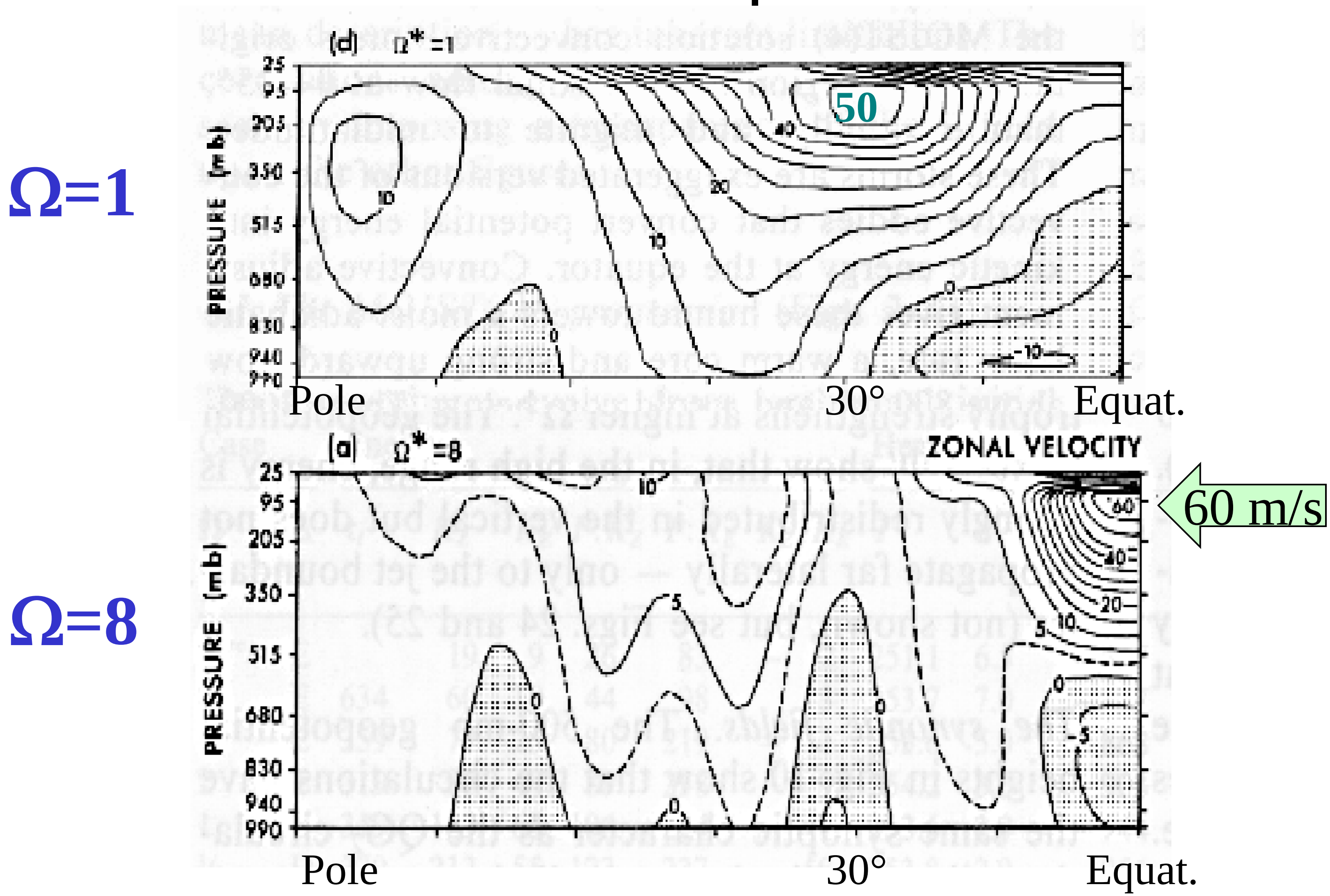
Small inertia circles

The flow is only a few % super rotational...

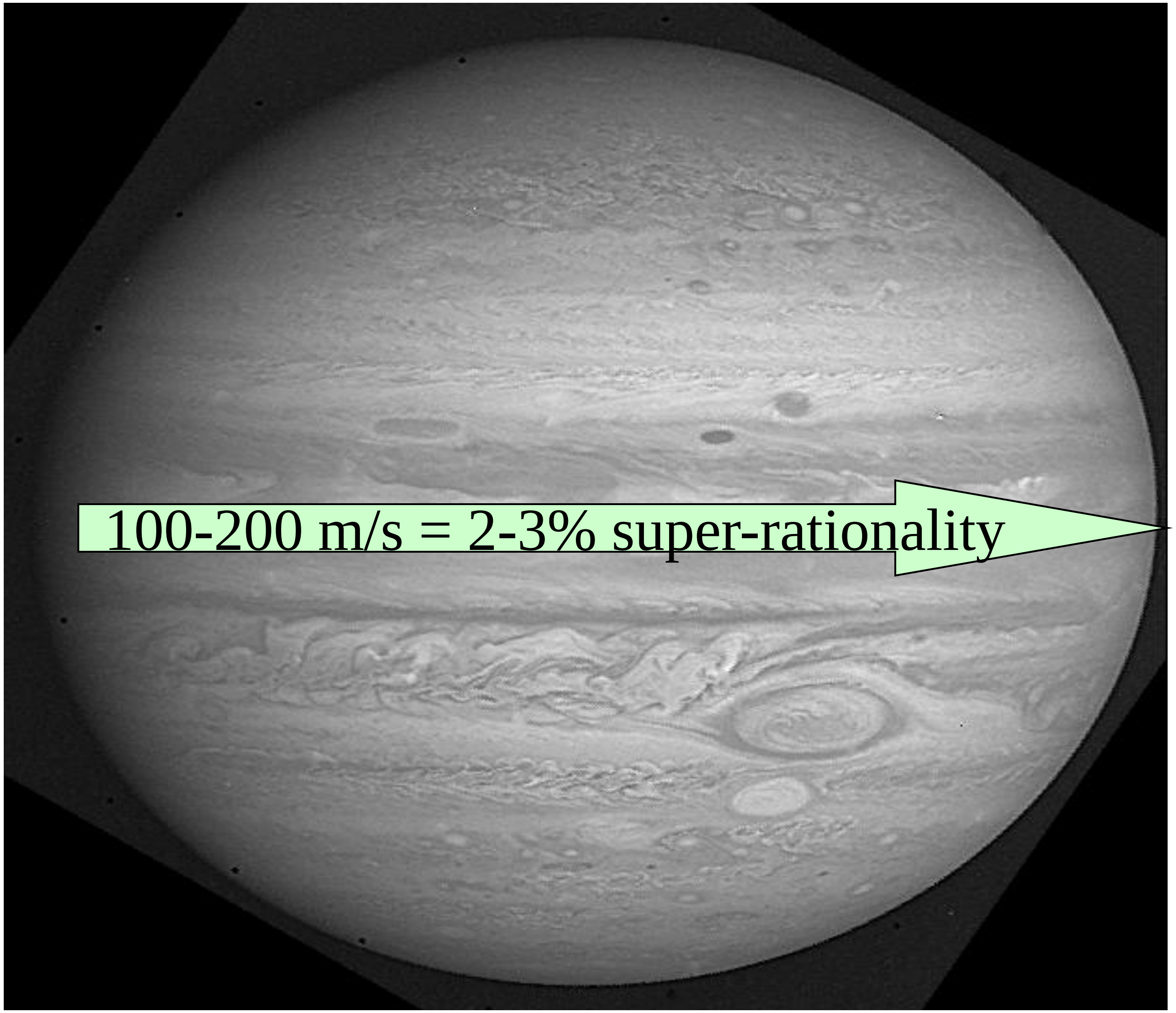


… and closer to the equator

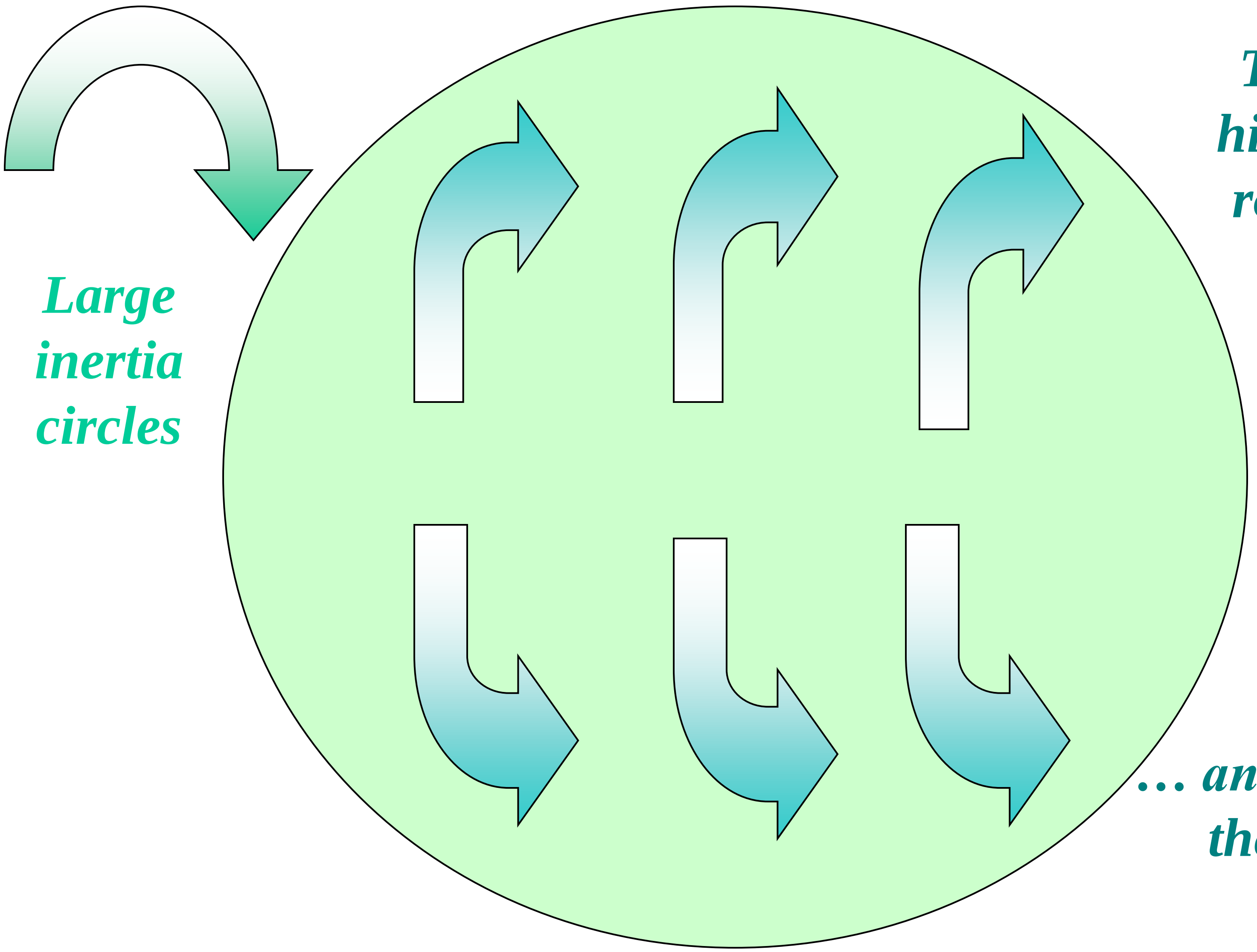
P-G. William's computer simulations



The weak equatorial jet stream on the fast rotating planet Jupiter



Slow rotation - weak Coriolis force



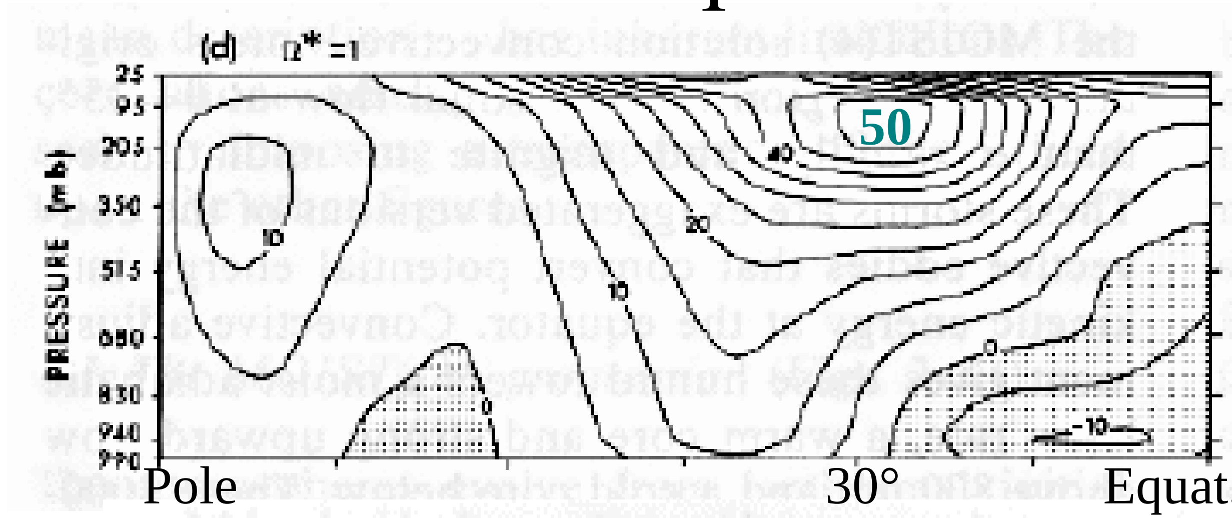
Large inertia circles

The flow is highly super rotational...

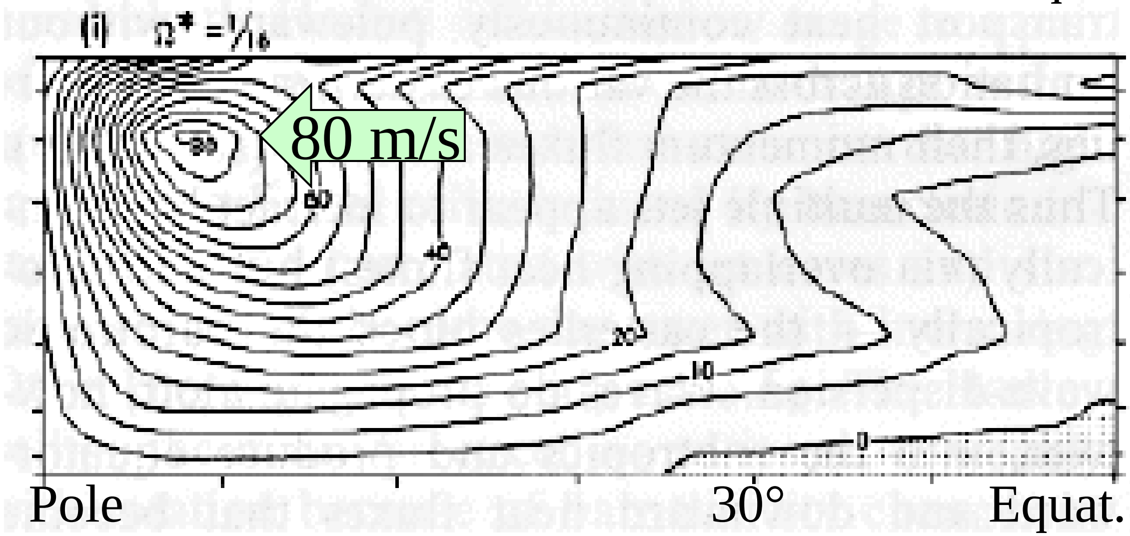
… and away from the equator

P-G. William's computer simulations

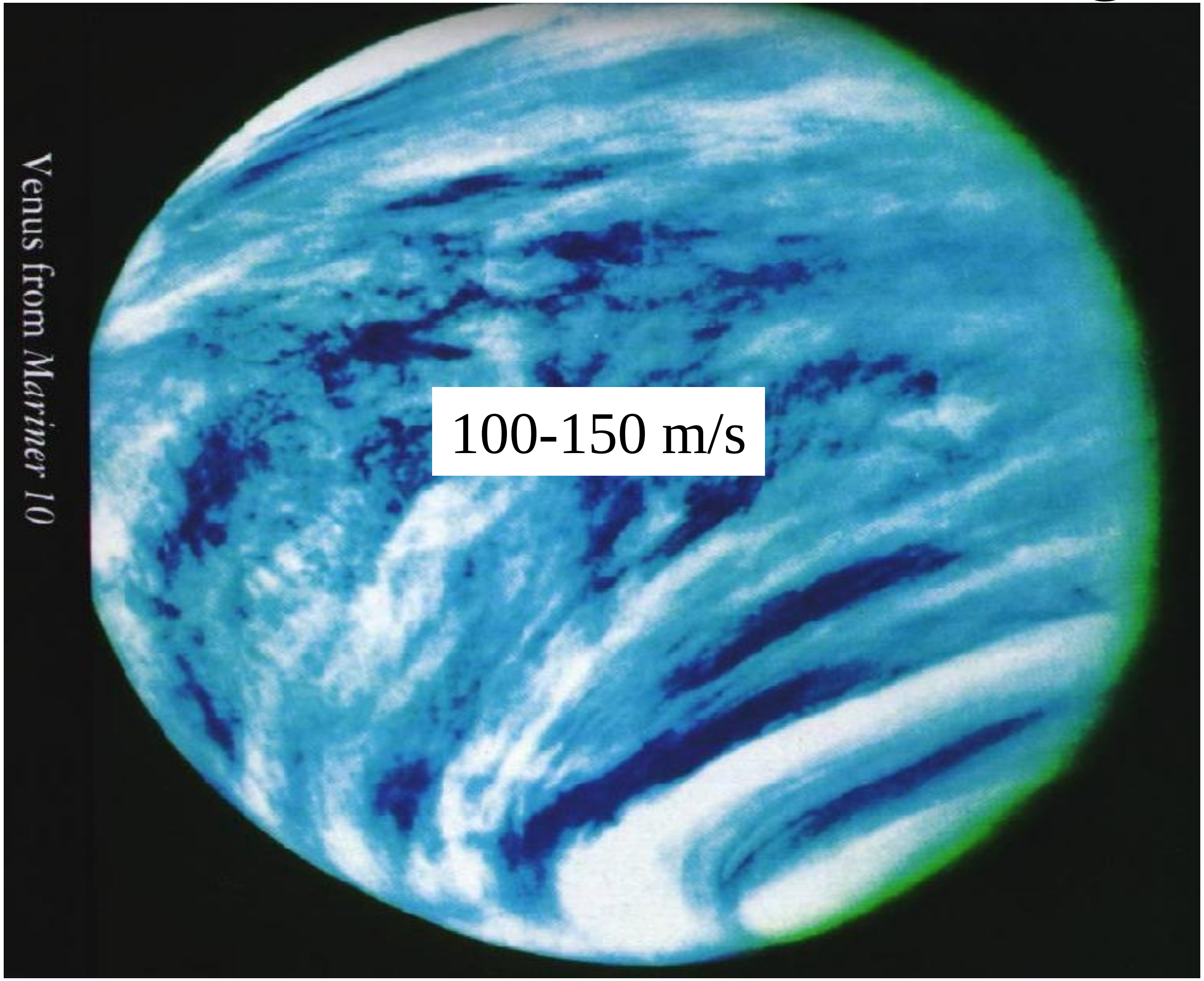
Ω=1



Ω=1/16

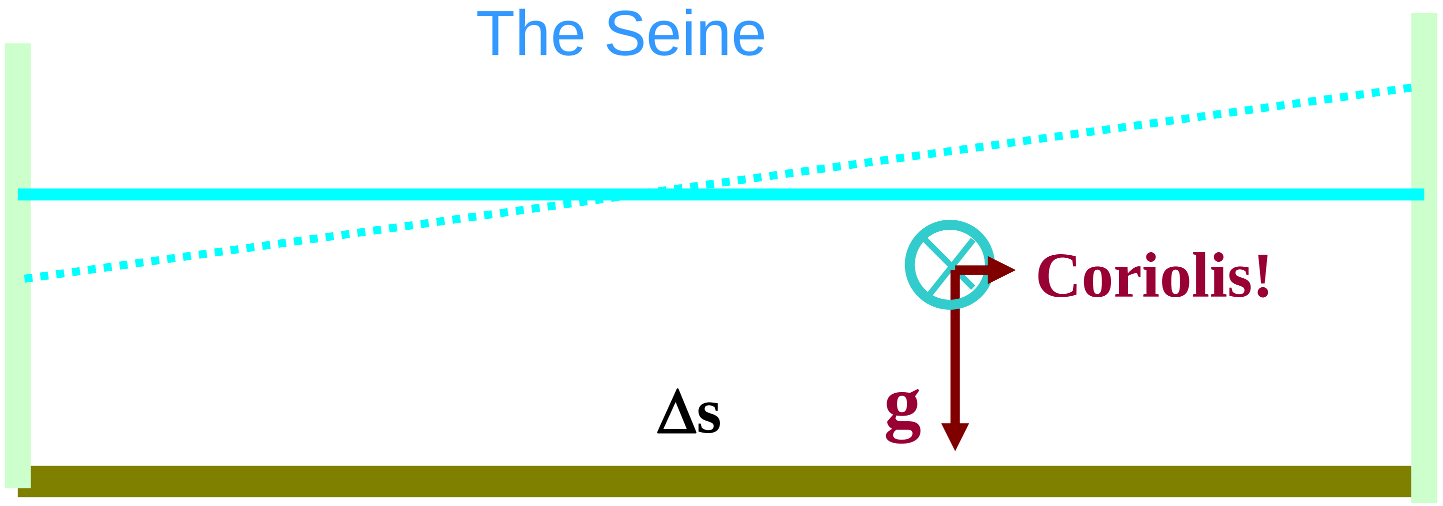


The hurricanes on the slow rotating Venus

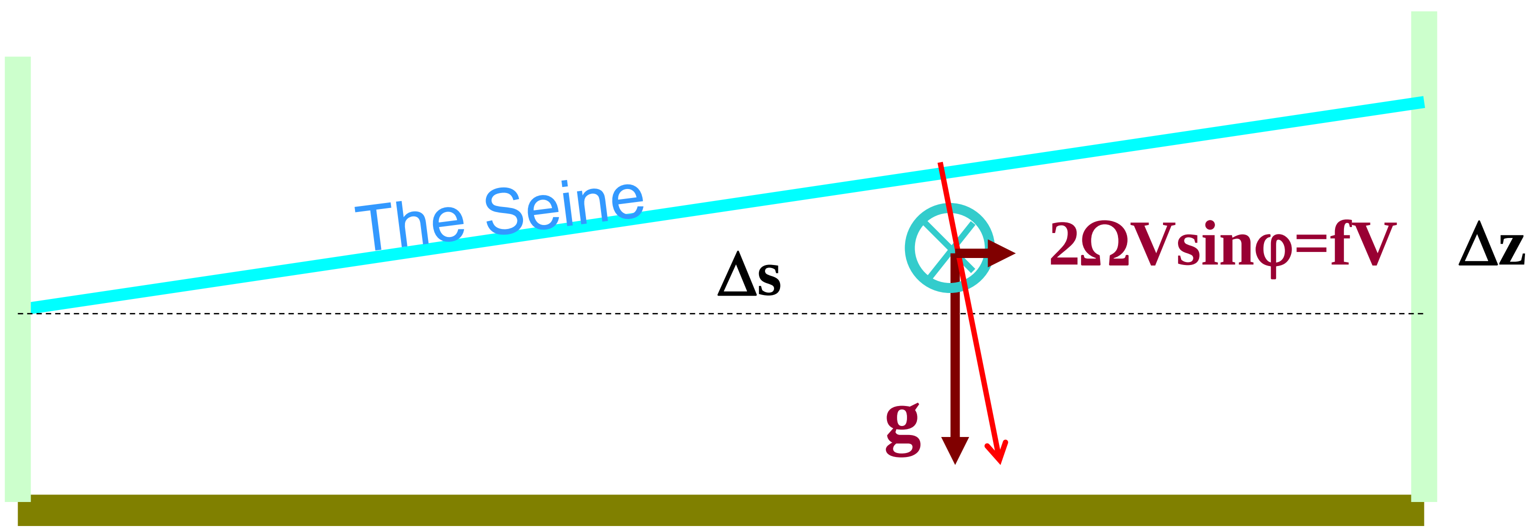


7.Geostrophic wind

How the French Academy derived the geostrophic equation without knowing it!



$$\frac{\Delta z}{\Delta s} = \frac{fV}{g} \Rightarrow V = \frac{g}{f}\frac{\Delta z}{\Delta s}$$

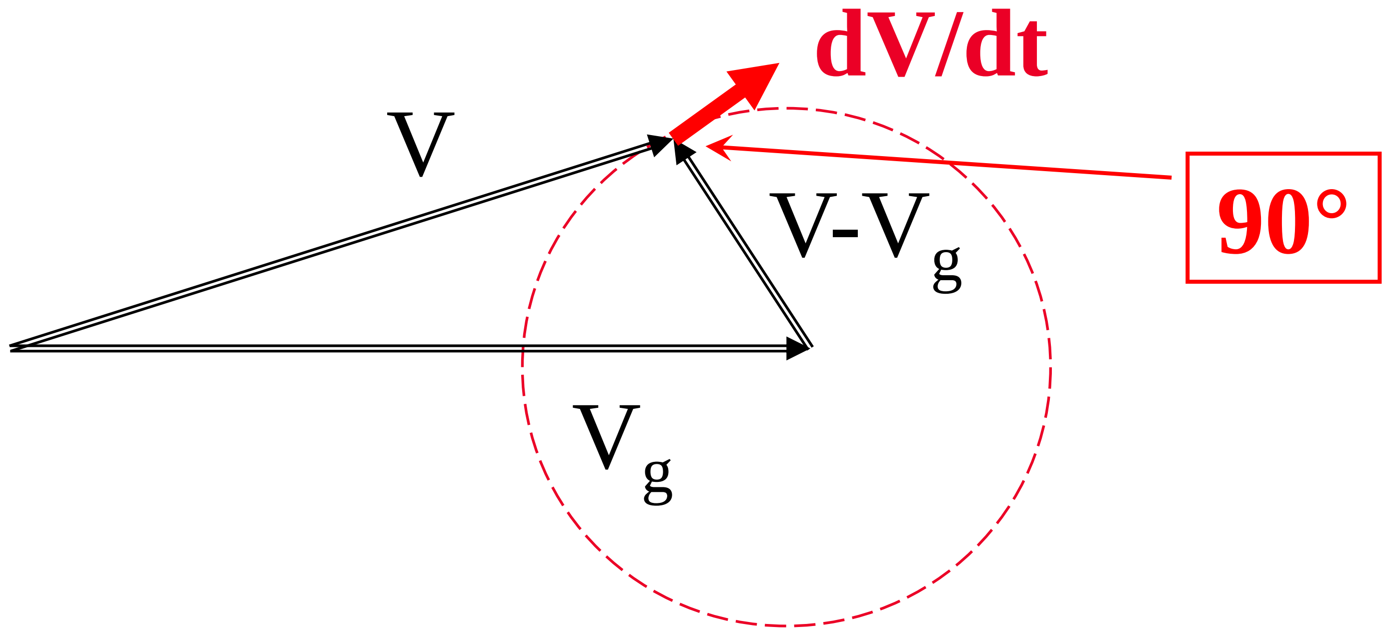


8. More on the geostrophic wind

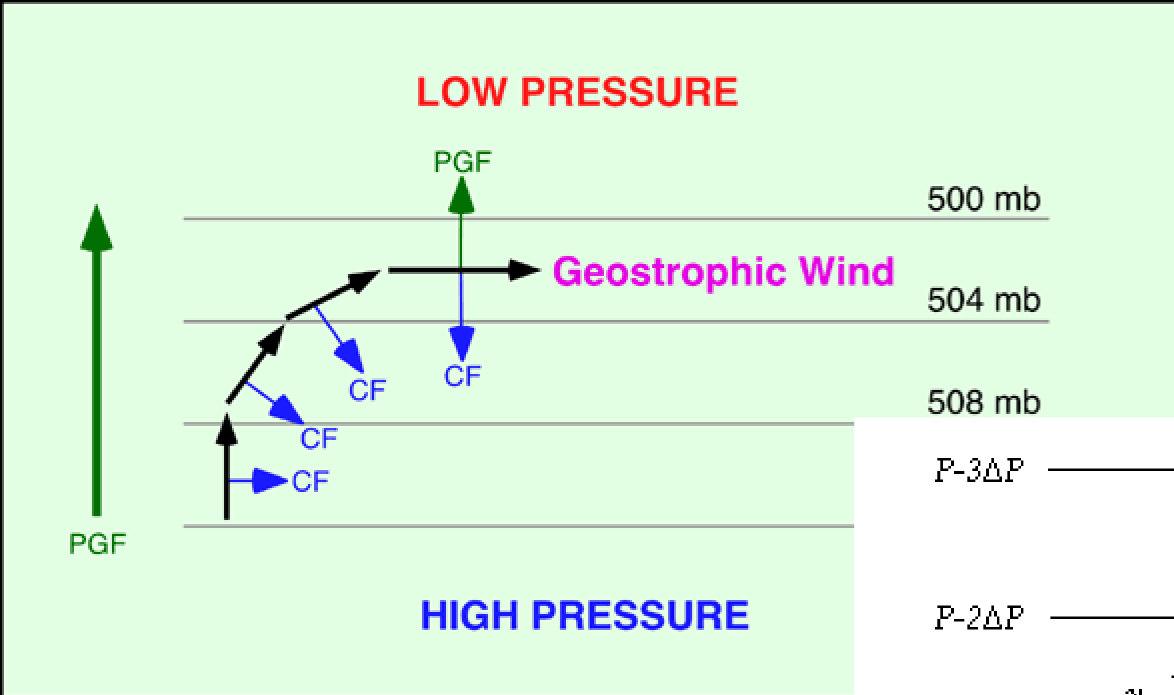
“The Heart of Dynamic Meteorology“

R.C.Sutcliffe, 1981

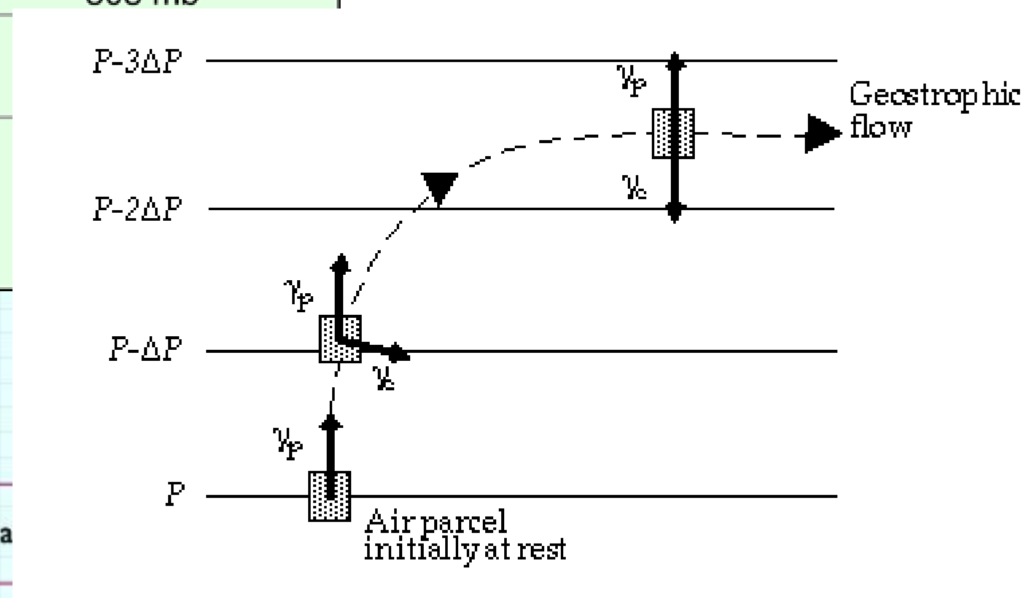
$$\frac{d\mathbf{V}}{dt} = -f\,\mathbf{k}\times\left(\mathbf{V}-\mathbf{V_g}\right)$$

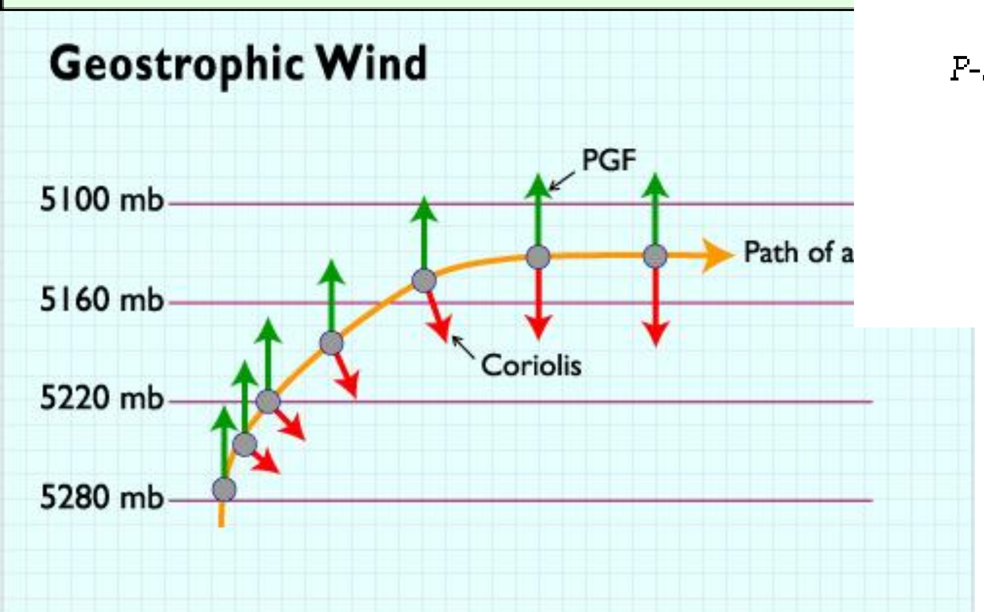


The acceleration is orthogonal to the ageostrophic wind



The web is full of images like these



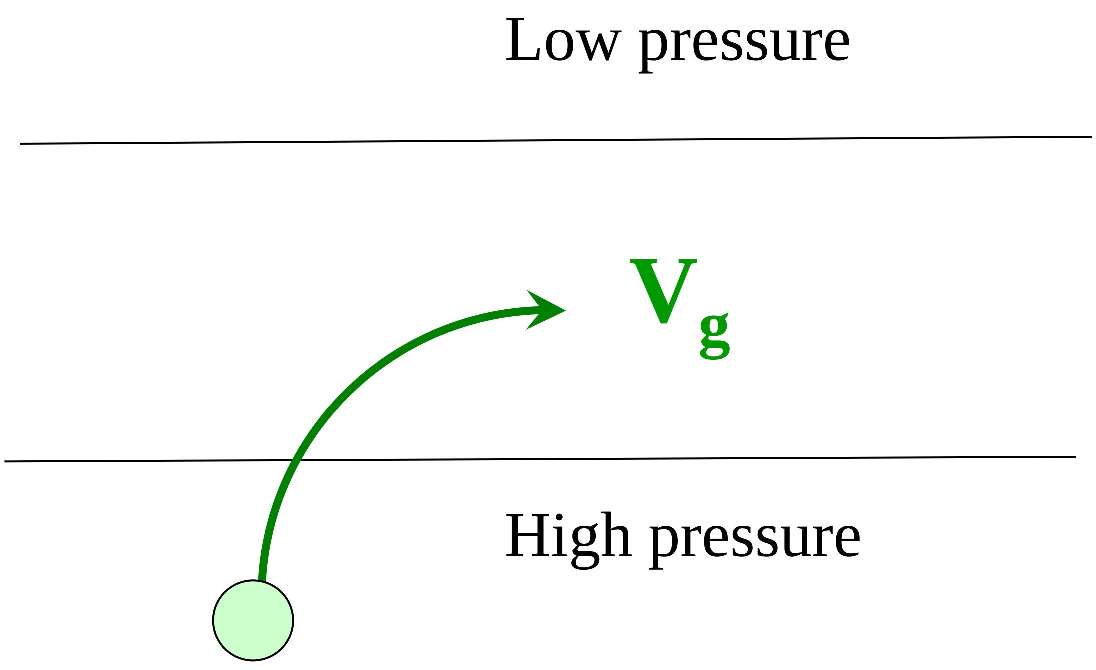


. . .and in not so few meteorological text books and articles

The erroneous text book image of geostrophic adjustment in a constant pressure field

$$\frac{du}{dt} - fv = 0$$

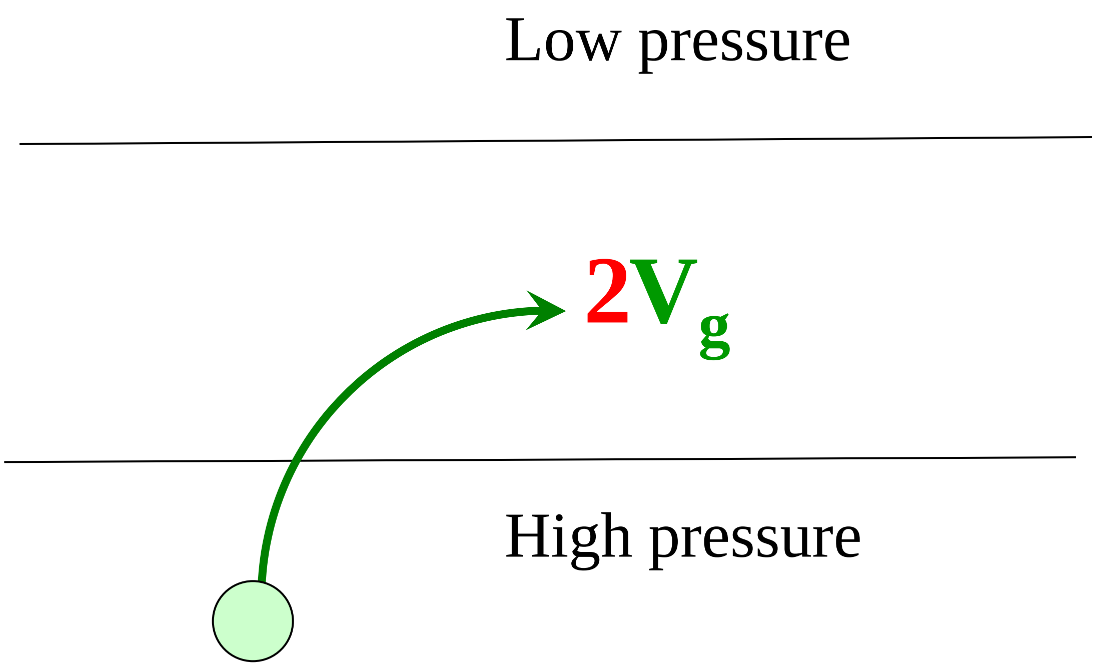
$$\frac{dv}{dt} + fu = -\frac{1}{\rho}\frac{\partial P}{\partial y} = G$$



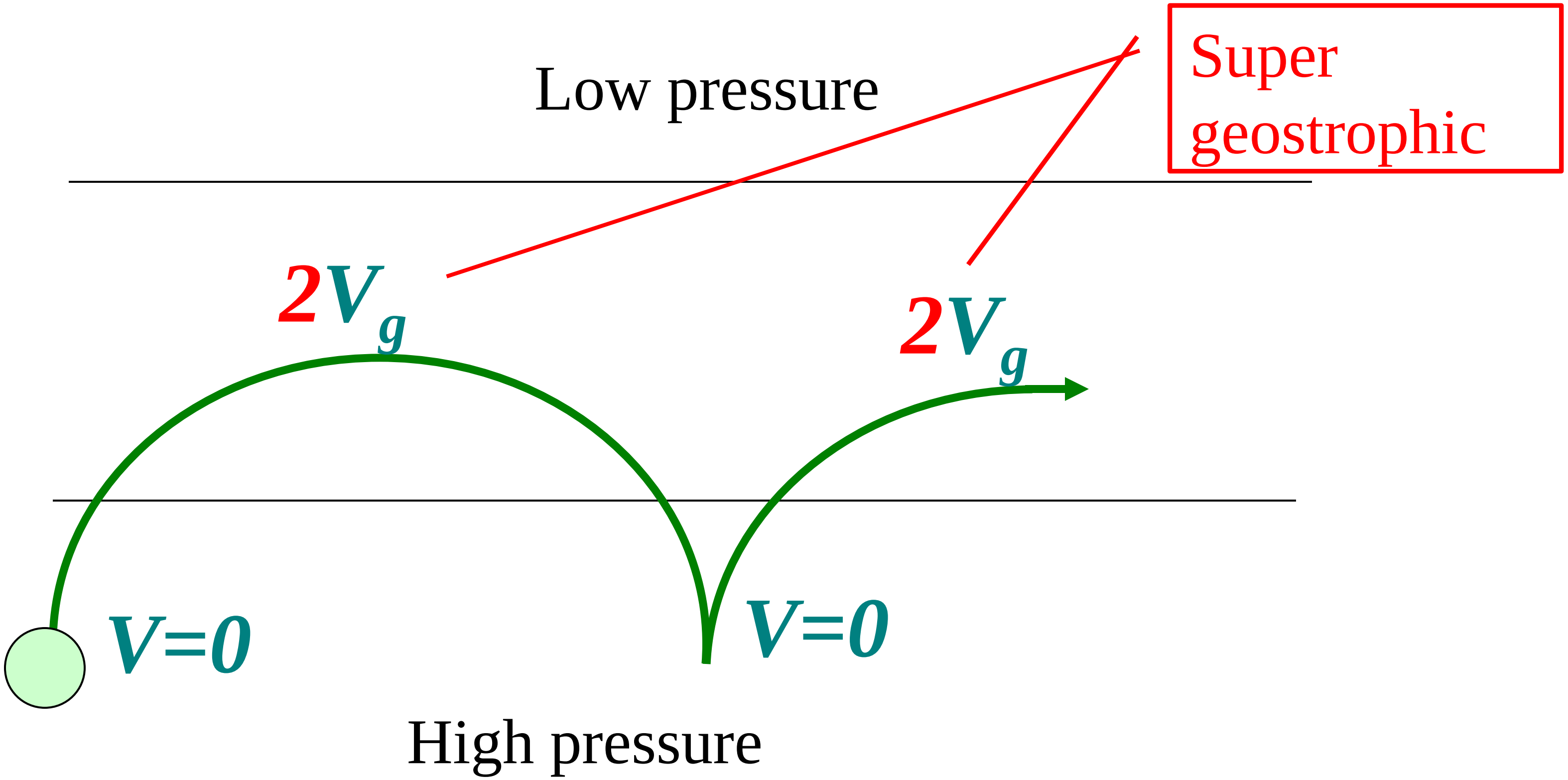
A correct image of a geostrophic approach in a constant pressure field

$$\frac{du}{dt} - fv = 0$$

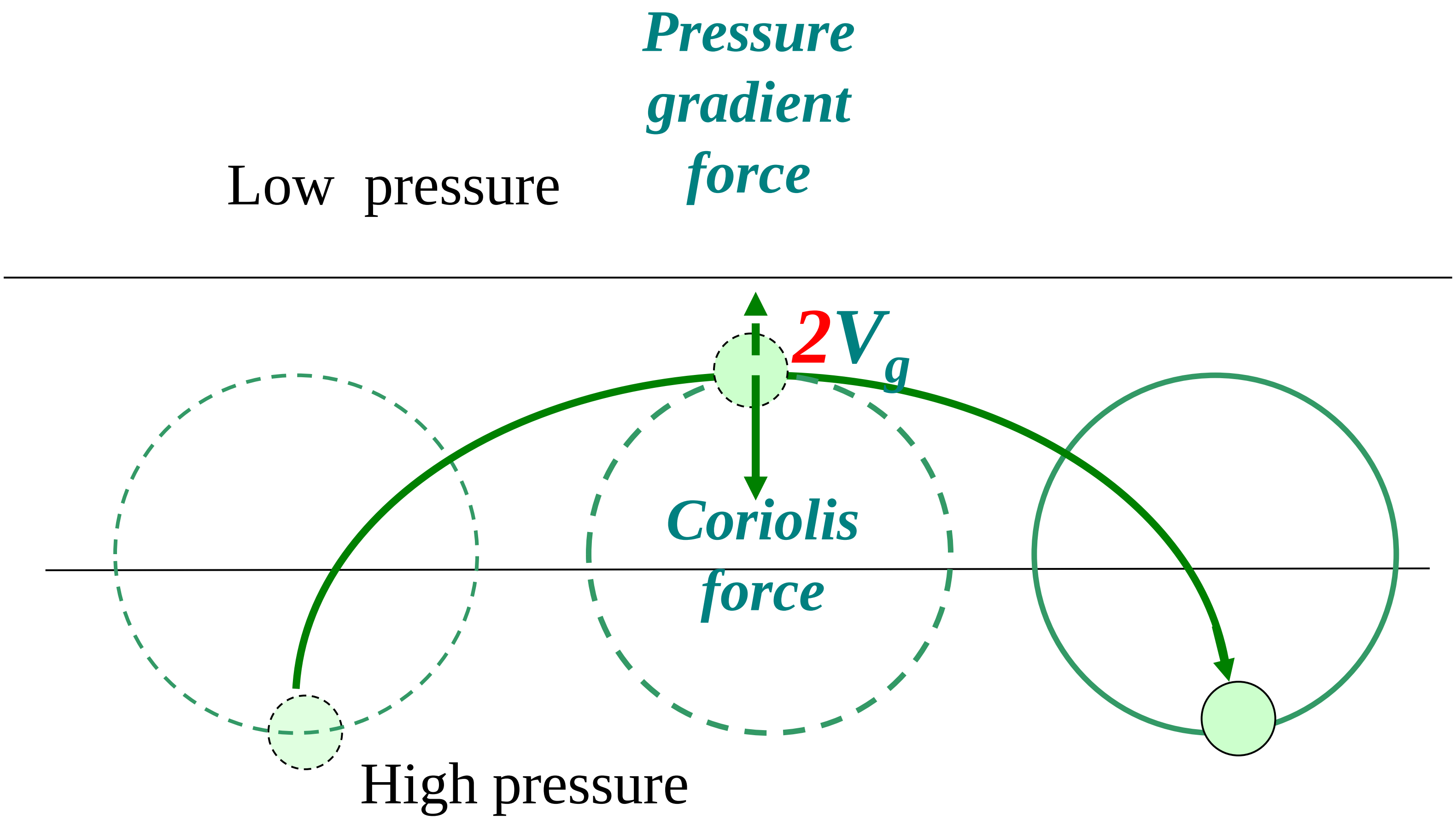
$$\frac{dv}{dt} + fu = -\frac{1}{\rho}\frac{\partial P}{\partial y} = G$$



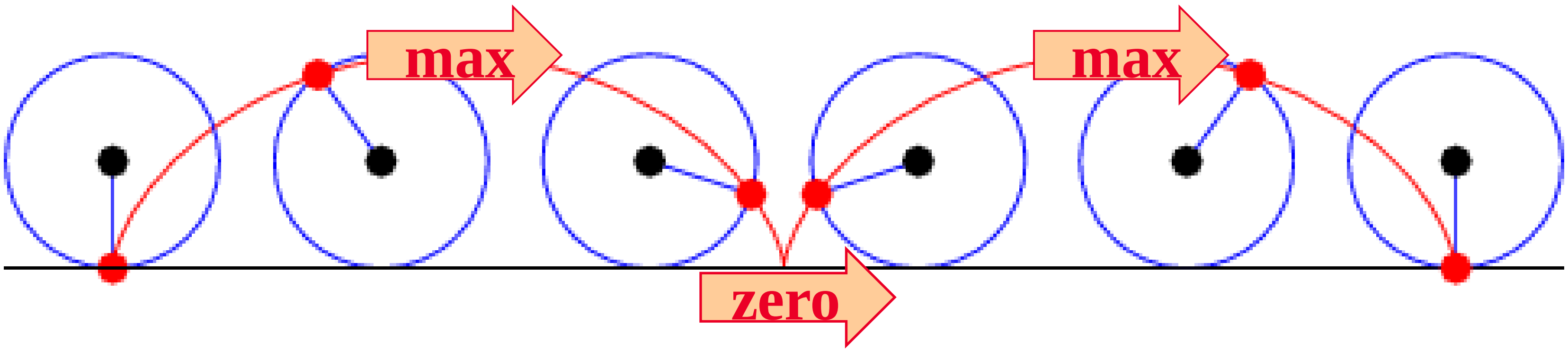
The real image of motion of an air parcel in a **constant** pressure field



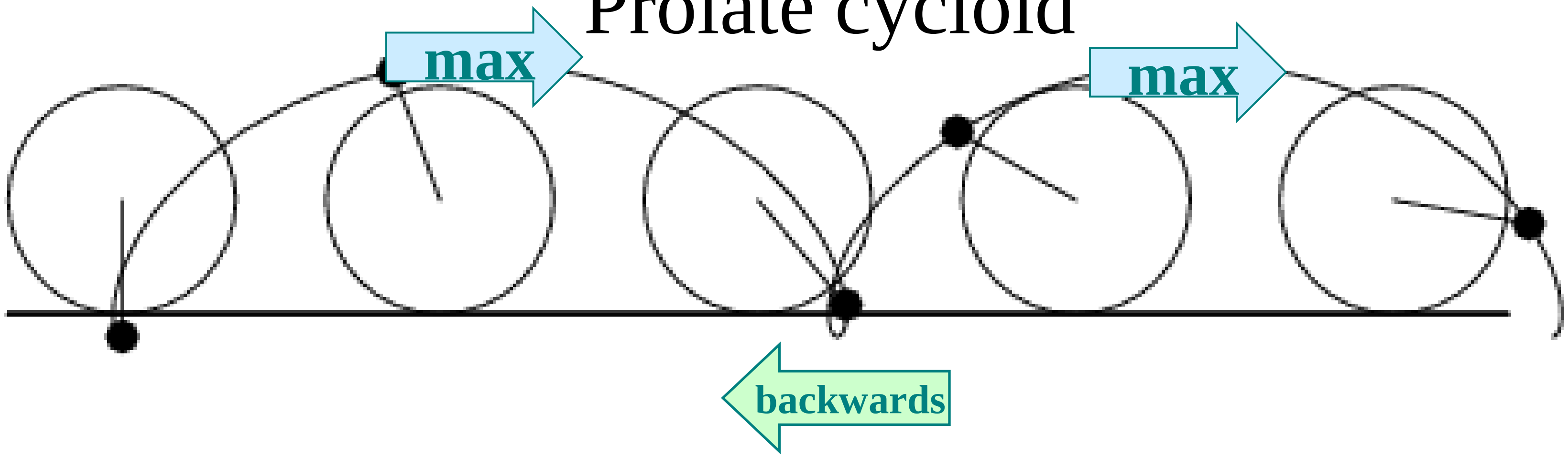
The motion can be seen as a combination of straight acceleration and inertia circle motion



The motion evolves into cycloids



Prolate cycloid



This is not playing with mathematics but opens up to an understanding of three important meteorological features:

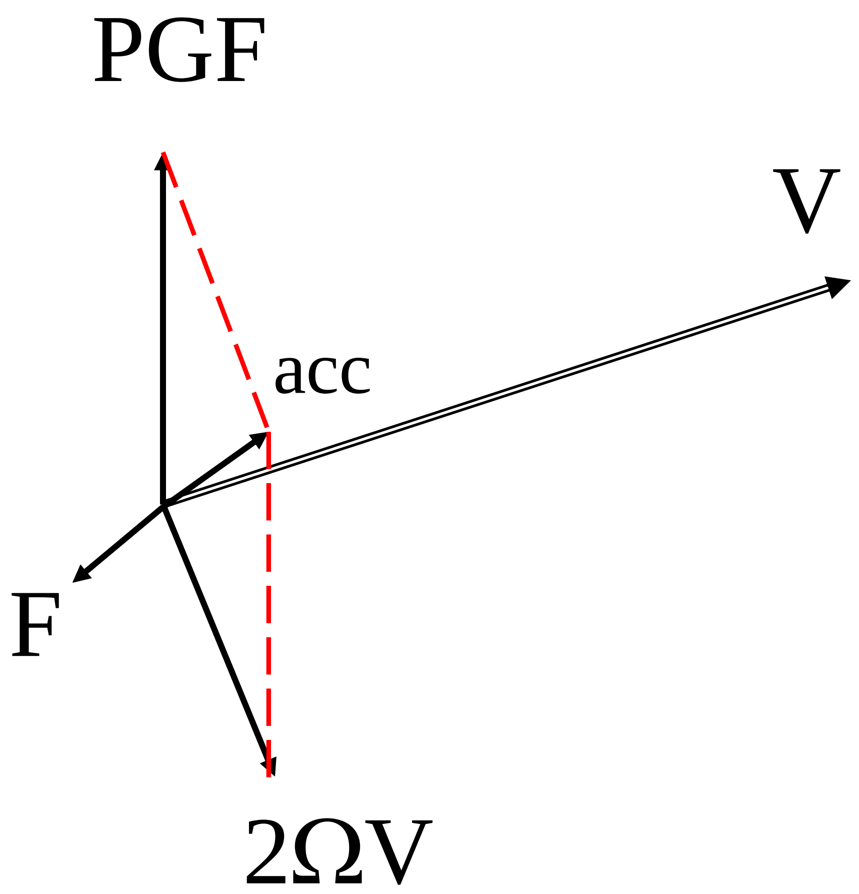
9.1 Nocturnal jet stream

9.2 Synoptic scale jet streams

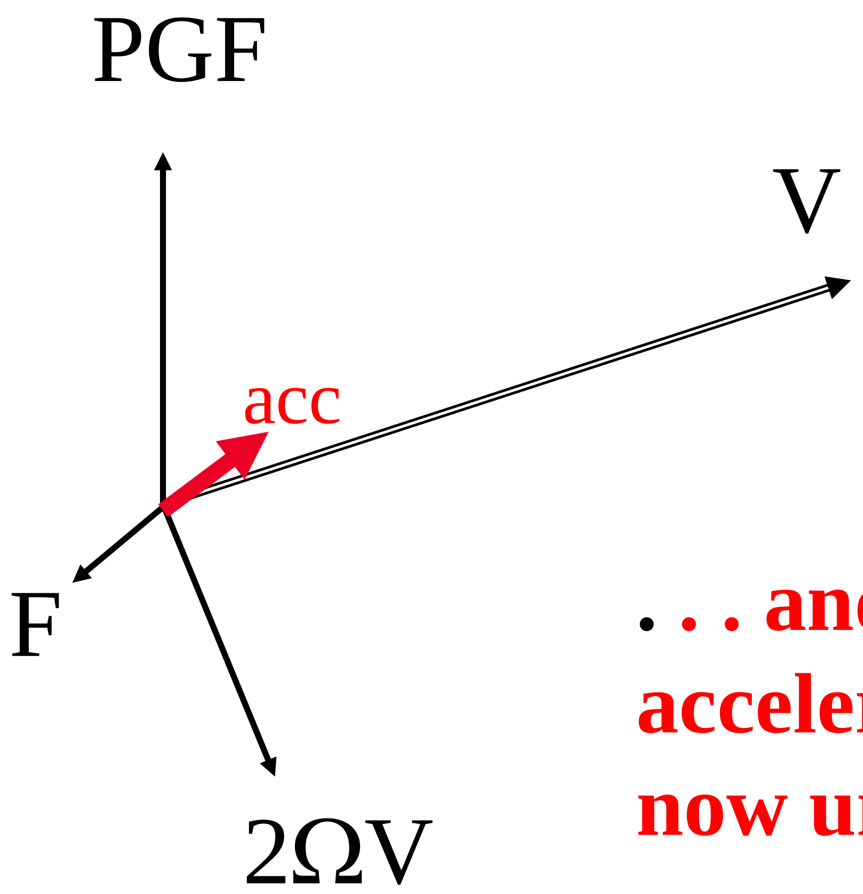
9.3 Aspects of the general circulation

9.1 Nocturnal jet streams

The forces acting on a moving air parcel (wind) with pressure gradient force (PGF), Coriolis force (2ΩV) and friction balancing each other

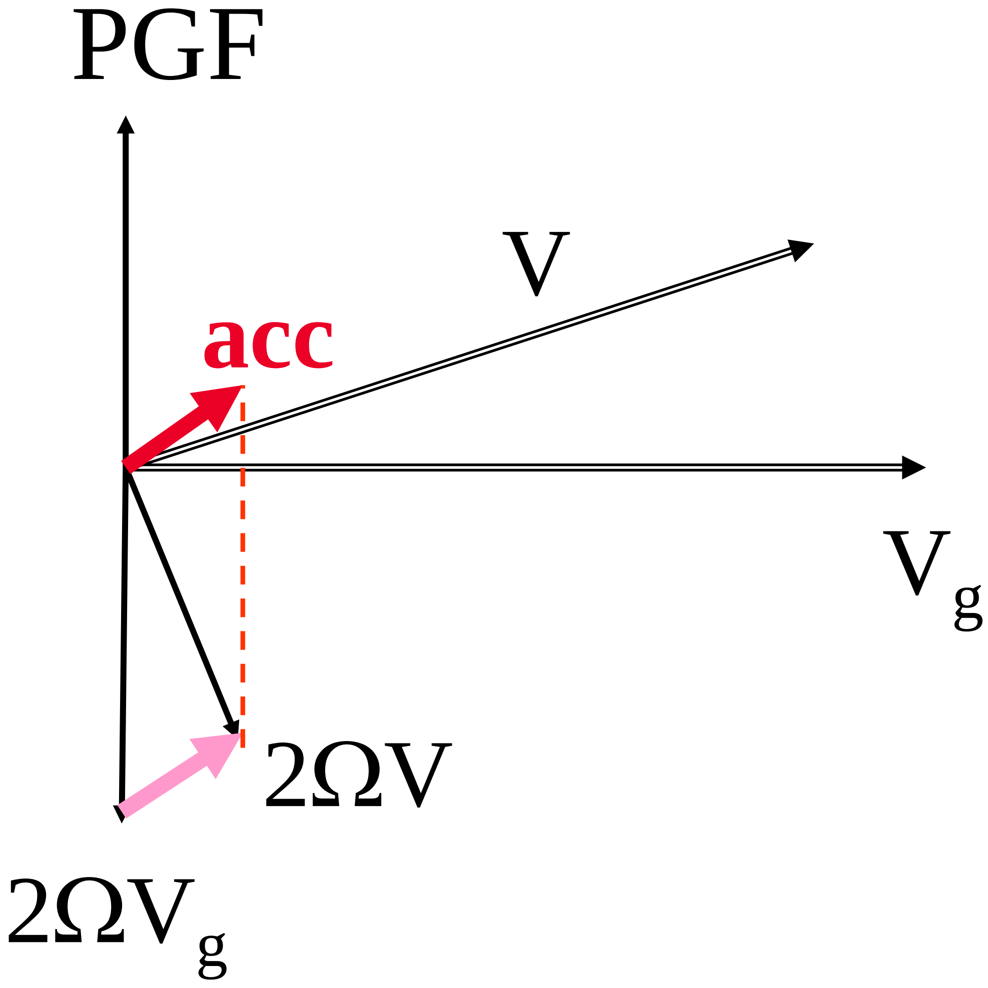


When night falls the winds above the friction layer loses contact with the ground and the frictional resistance

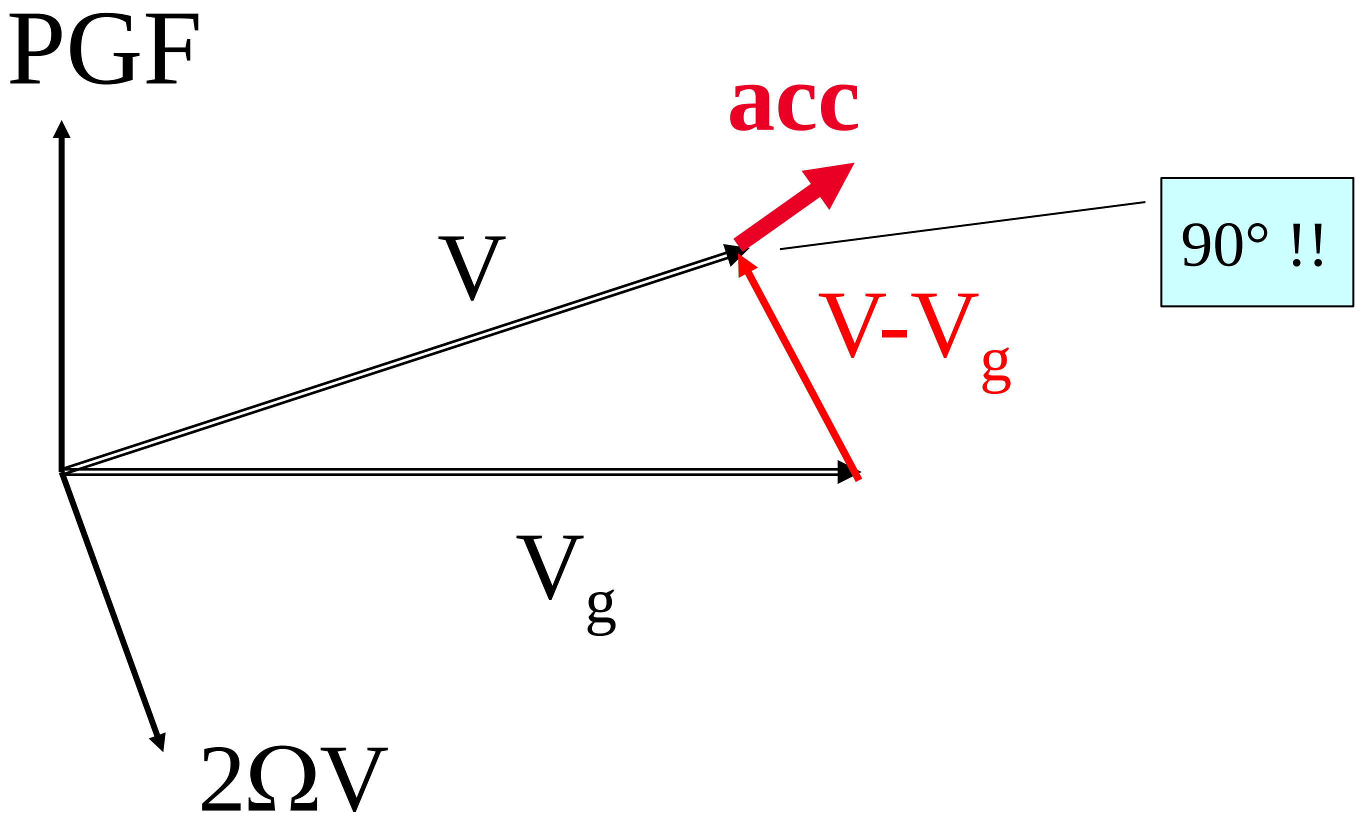


. . . **and the net acceleration returns, now unbalanced**

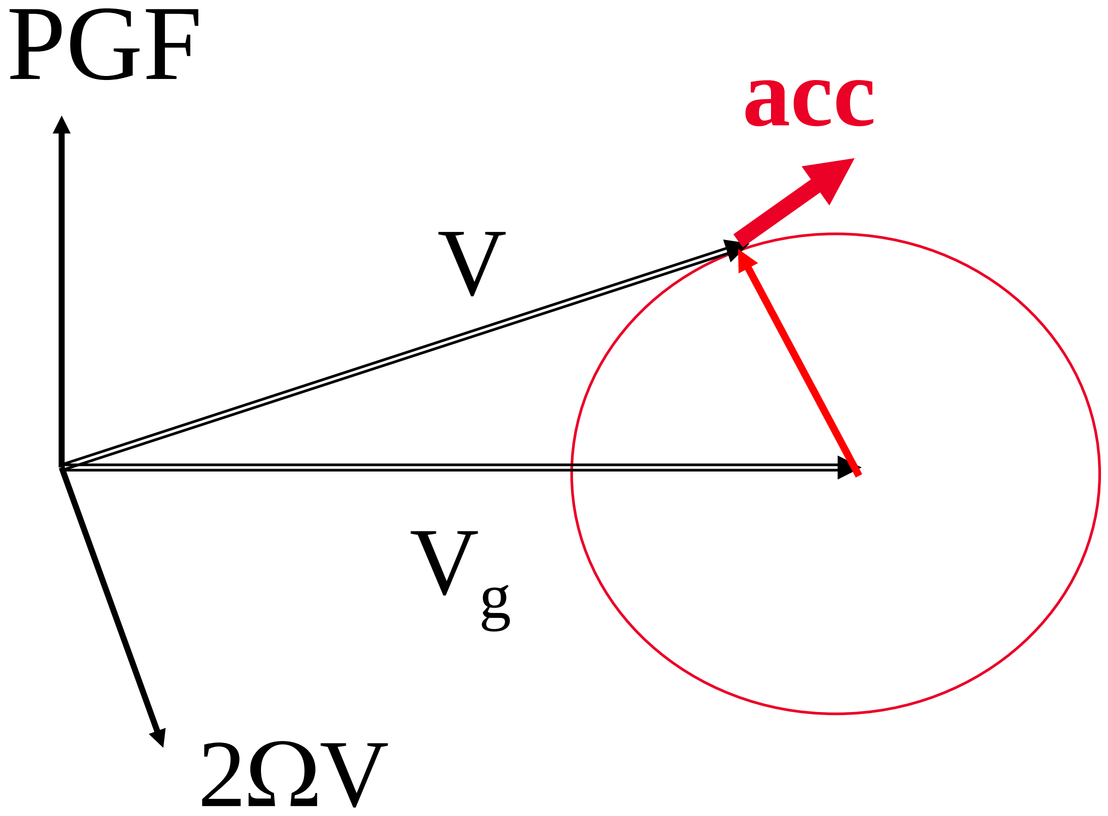
We now introduce the geostrophic wind V_g



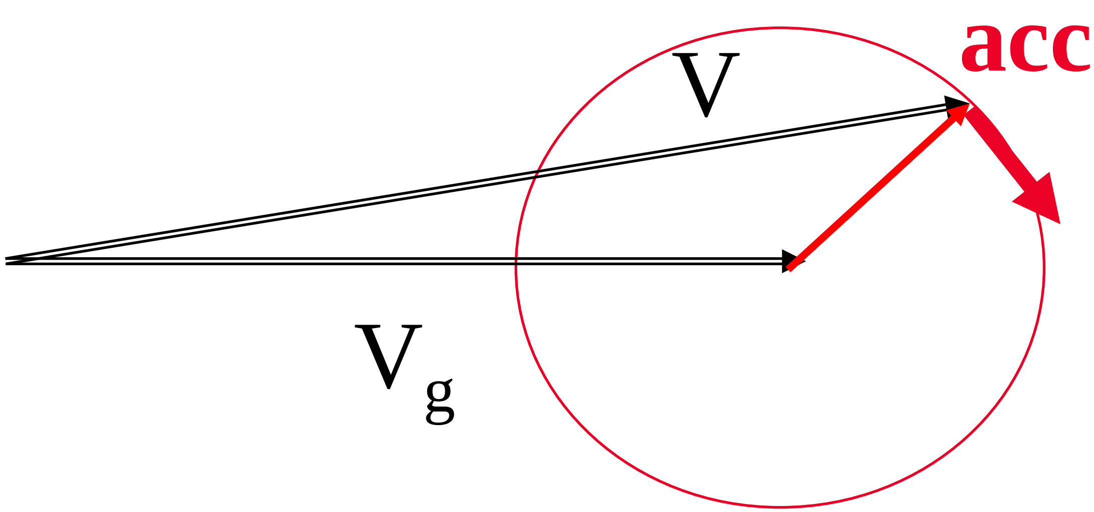
We now introduce the difference between the geostrophic and ageostrophic winds $V-V_g$



The acceleration is orthogonal to the ageostrophic wind

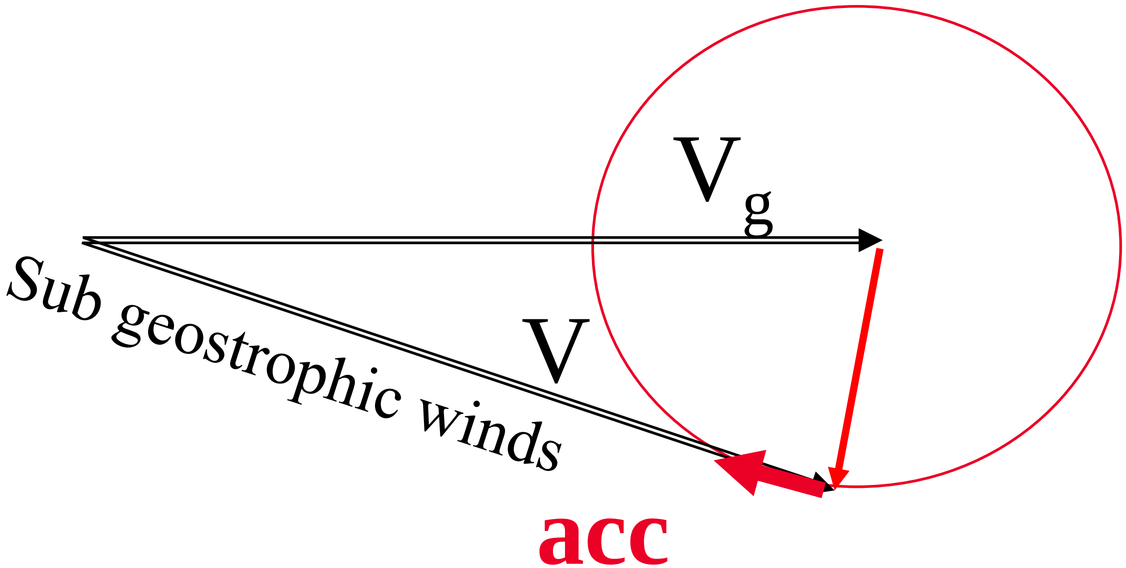


The acceleration carries the air parcel around

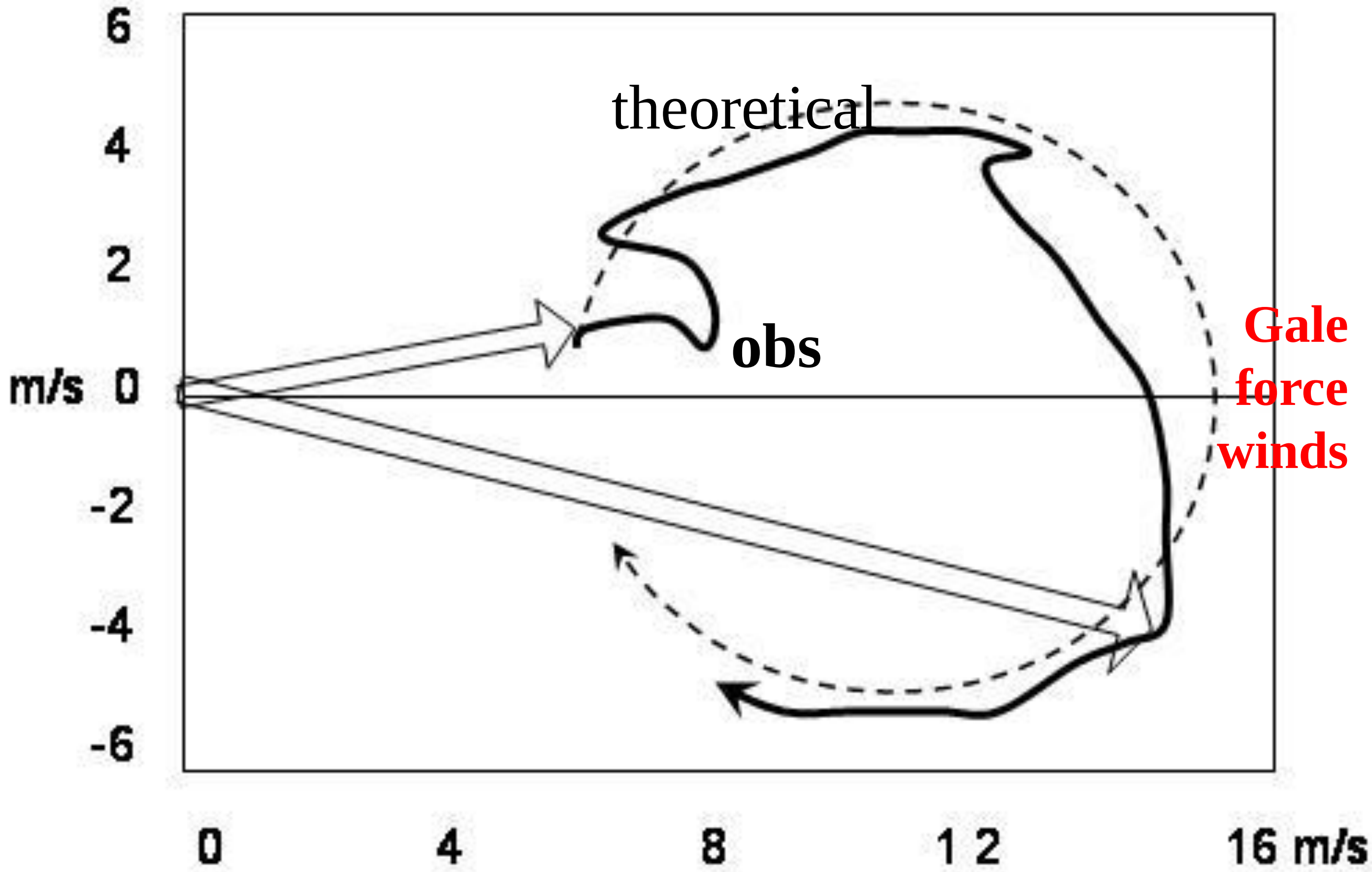


Super geostrophic winds

The acceleration carries the air parcel around



Authentic inertial oscillation, “nocturnal jet” over 14-15 hours (Netherlands)



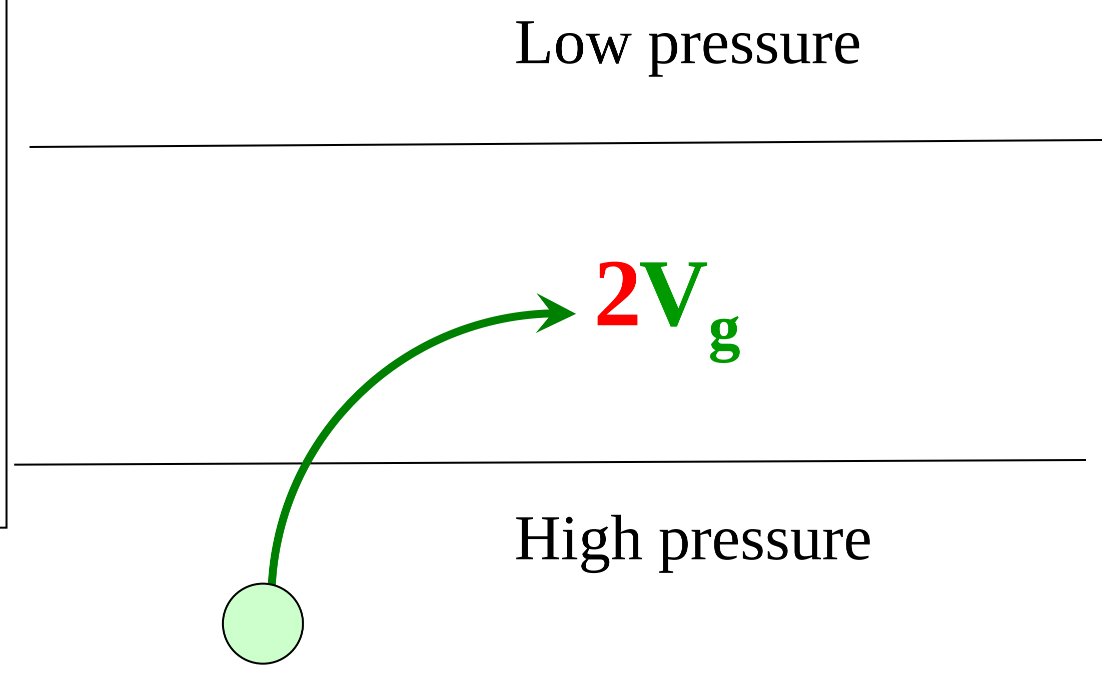
In this nocturnal jet the wind varies between 5 and 16 m/s

9.2 Synoptic jet streams

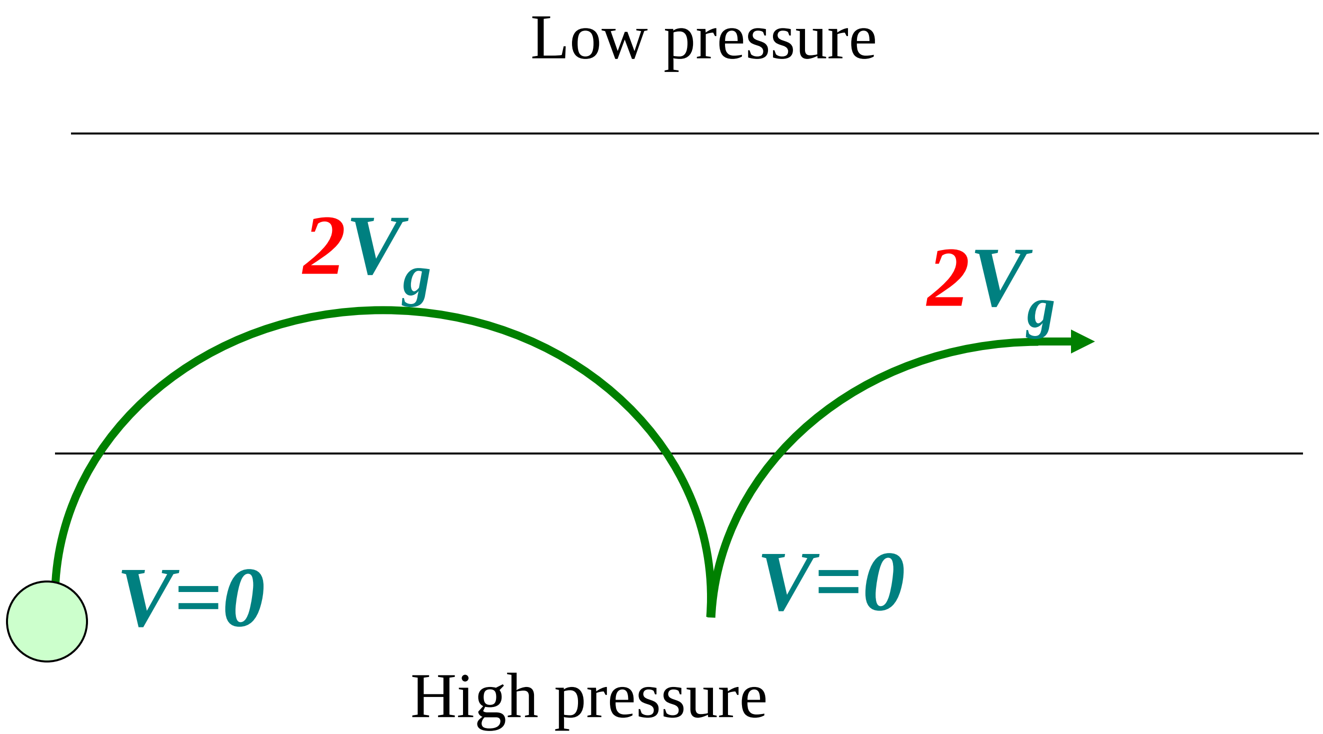
Again – a correct image of a geostrophic approach in a constant pressure field

$$\frac{du}{dt} - fv = 0$$

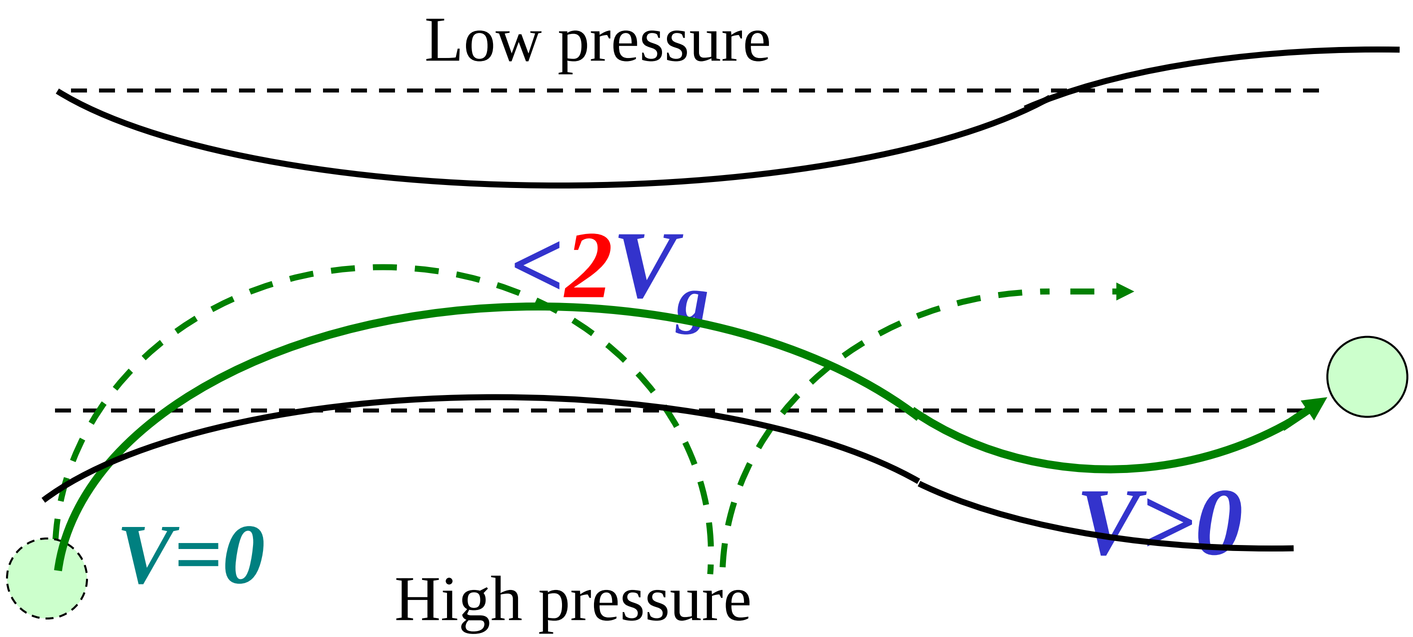
$$\frac{dv}{dt} + fu = -\frac{1}{\rho}\frac{\partial P}{\partial y} = G$$



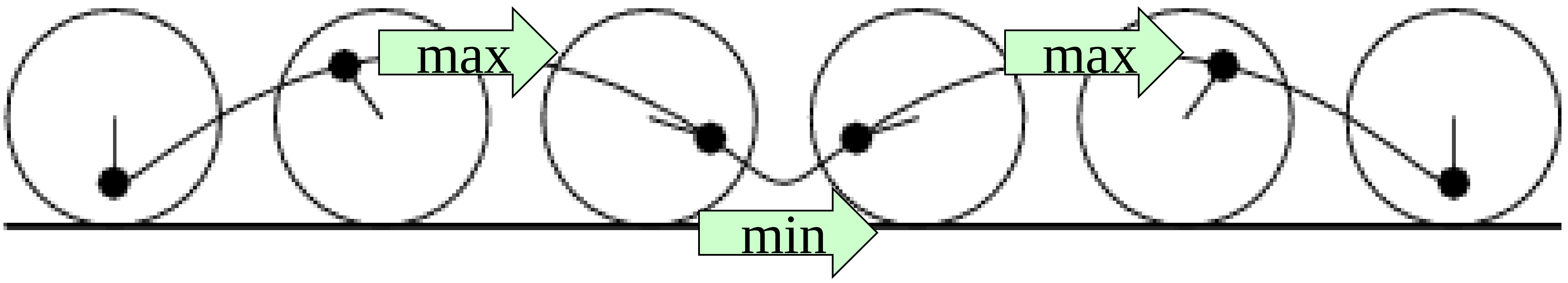
The real image of motion of an air parcel in a **constant** pressure field



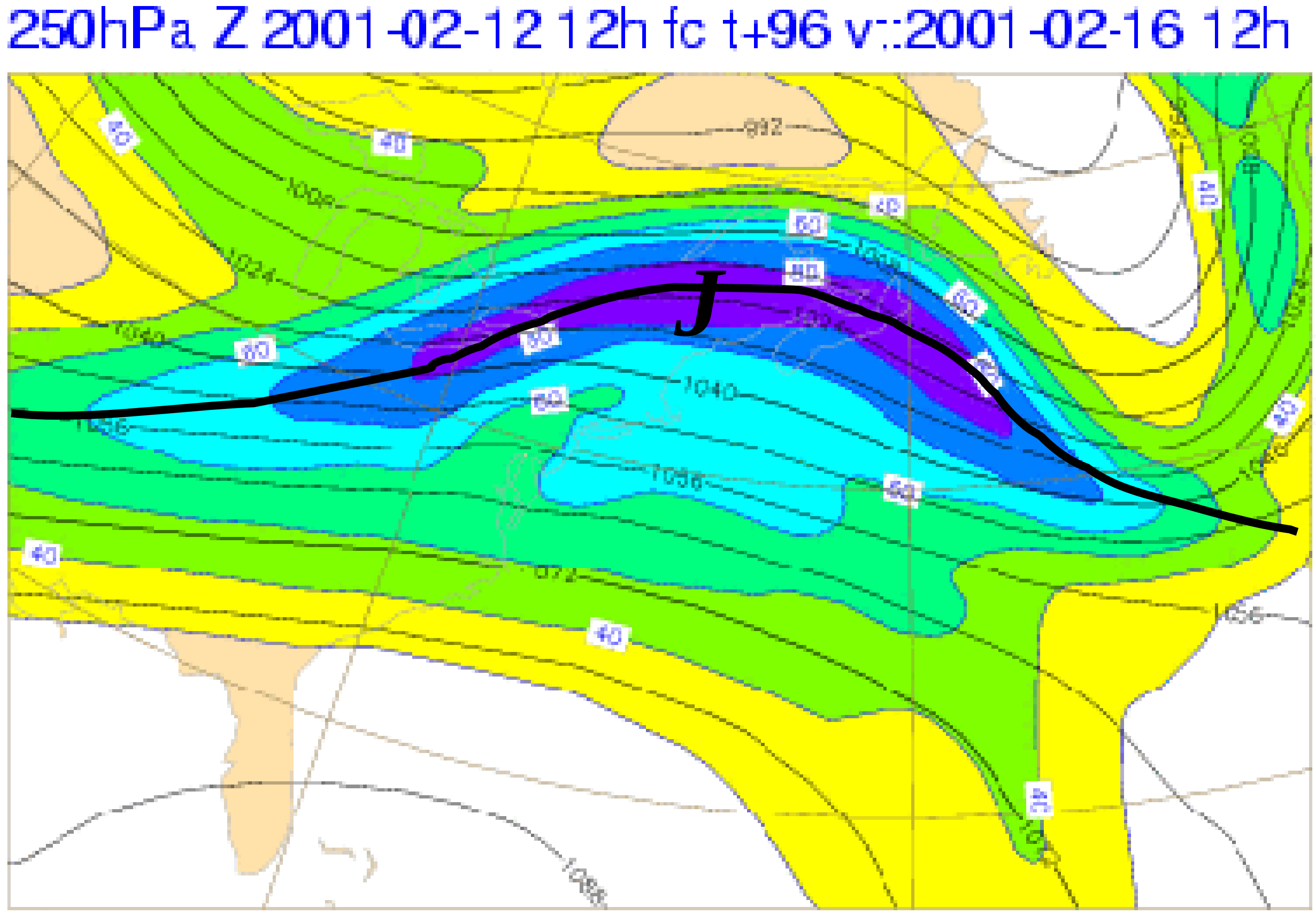
The pressure field and the winds will **mutually** adjust to each other and stretch the cycloid from a **normal** to a **curtate**



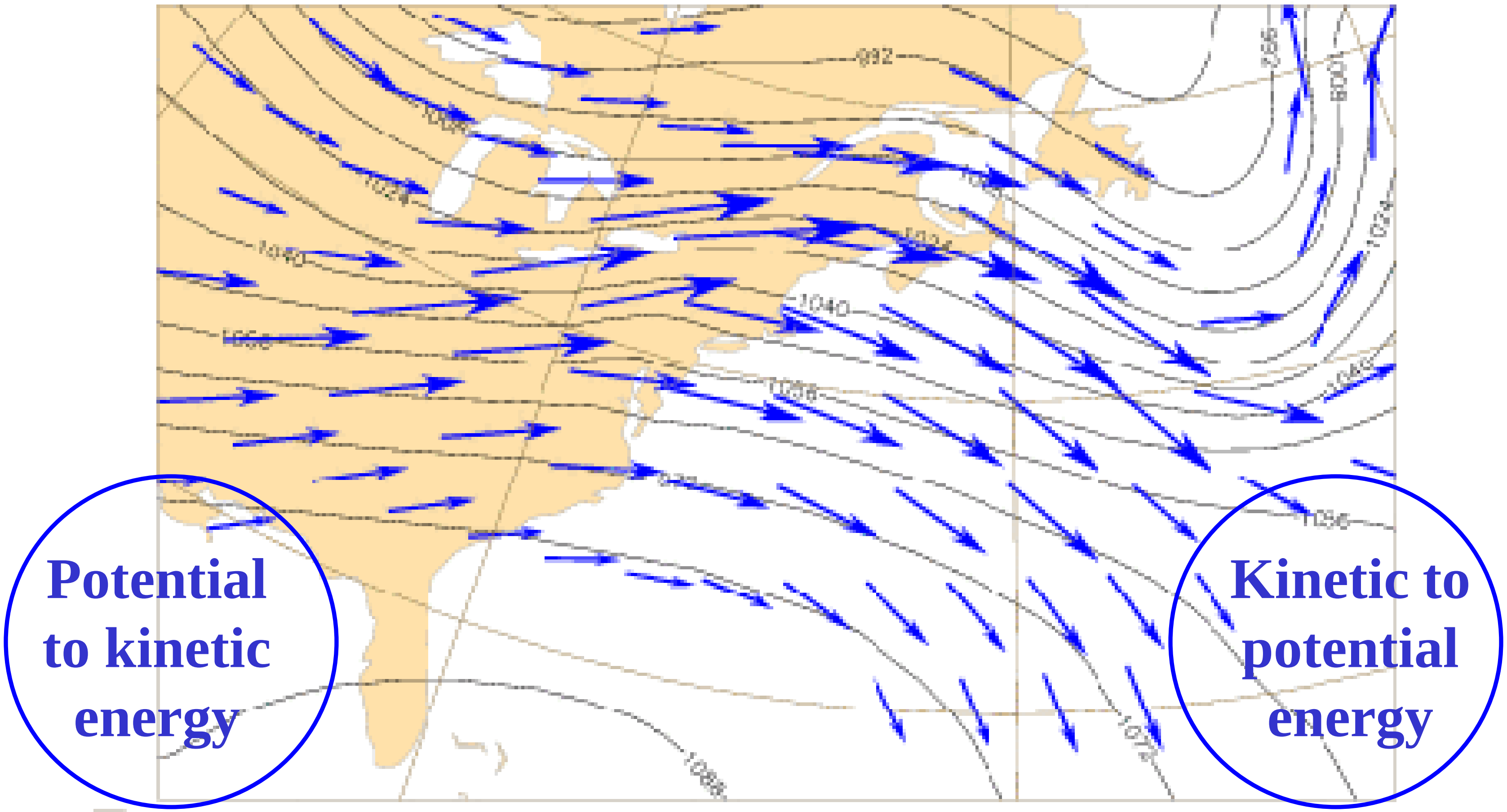
In this case the motion evolves into this type of **curtate** cycloid



The unperturbed mid-latitude jetstream (similar to the Subtropical in appaearance)



The typical flow and energy conversions



END