Wind and Force Vector Diagrams

This exercise will help you to familiarize yourself with force vector diagrams relevant to the atmosphere. A force vector diagram is useful in examining how each force affects the speed and direction of the wind. Use the "Ekman" computer program to answer the questions below. The program will show you a force vector diagram for an air parcel moving in a straight line. Each arrow represents a force or wind:

- yellow arrow represents pressure gradient force
- red arrow represents frictional force
- blue arrow represents Coriolis force
- solid white arrow represents the wind (which is the vector addition of all these forces)
- white outlined arrow represents the geostrophic wind balance.

You can change the surface friction from smooth (wind blowing over land) to very rough (wind blowing over mountains). You can also change the altitude. Play with the different options for a little while before answering the following questions.

(a) Sketch the pressure gradient, frictional and Coriolis forces together with the wind direction over land (surface drag of 0.0045) at an altitude of 210m. Clearly label every force and the wind. Scale the vectors according to the strength of the forces.
(b) Sketch the pressure gradient, frictional and Coriolis forces together with the wind direction over land (surface drag of 0.0045) at an altitude of 1 km. Clearly label every force (you can use the standard abbreviations) and the wind. Scale the vectors according to the strength of the forces.
(c) Identify two differences between the balance of forces between your answers to 5a and 5b.
(d) What is the name for the balance of forces found at 1 km?

** Click on the Southern Hemisphere option to answer the remaining questions. **

(e) How does the direction of the Coriolis force in the Southern Hemisphere compare to the direction in the Northern Hemisphere?
(f) Look at the direction of the (total) wind at a height of 200 m (for any surface roughness). Is the wind blowing towards higher or lower pressure? Is this the same or different than the Northern Hemisphere?
(g) Imagine that instead of the wind blowing in a linear path (like in the diagram), the air is rotating around a low pressure center. Will it rotate clockwise or counterclockwise? (Note: you are still in the Southern Hemisphere.) What direction would you expect to the wind to blow around a low pressure center in the Northern Hemisphere?

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