Atmospheric Dynamics
Geostrophic Wind and Thermal Balance

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Abstract

Analysis of atmospheric dynamics including geostrophic balance, thermal wind, and jet stream formation.

1 Introduction

Atmospheric dynamics governs weather and climate through pressure, temperature, and wind relationships.

2 Geostrophic Wind

$u_g = -\frac{1}{f\rho}\frac{\partial p}{\partial y}$, $v_g = \frac{1}{f\rho}\frac{\partial p}{\partial x}$

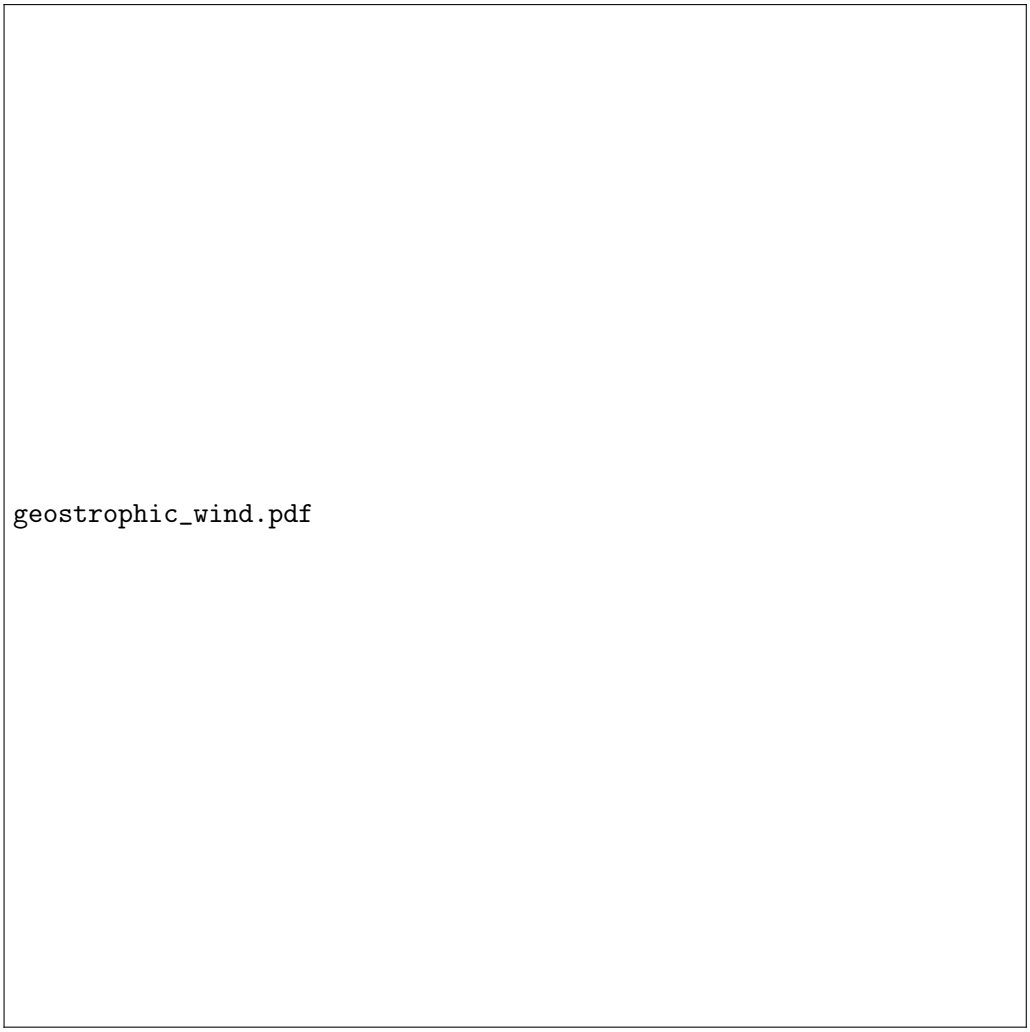

Figure 1: Geostrophic wind speed dependence on latitude.

3 Thermal Wind

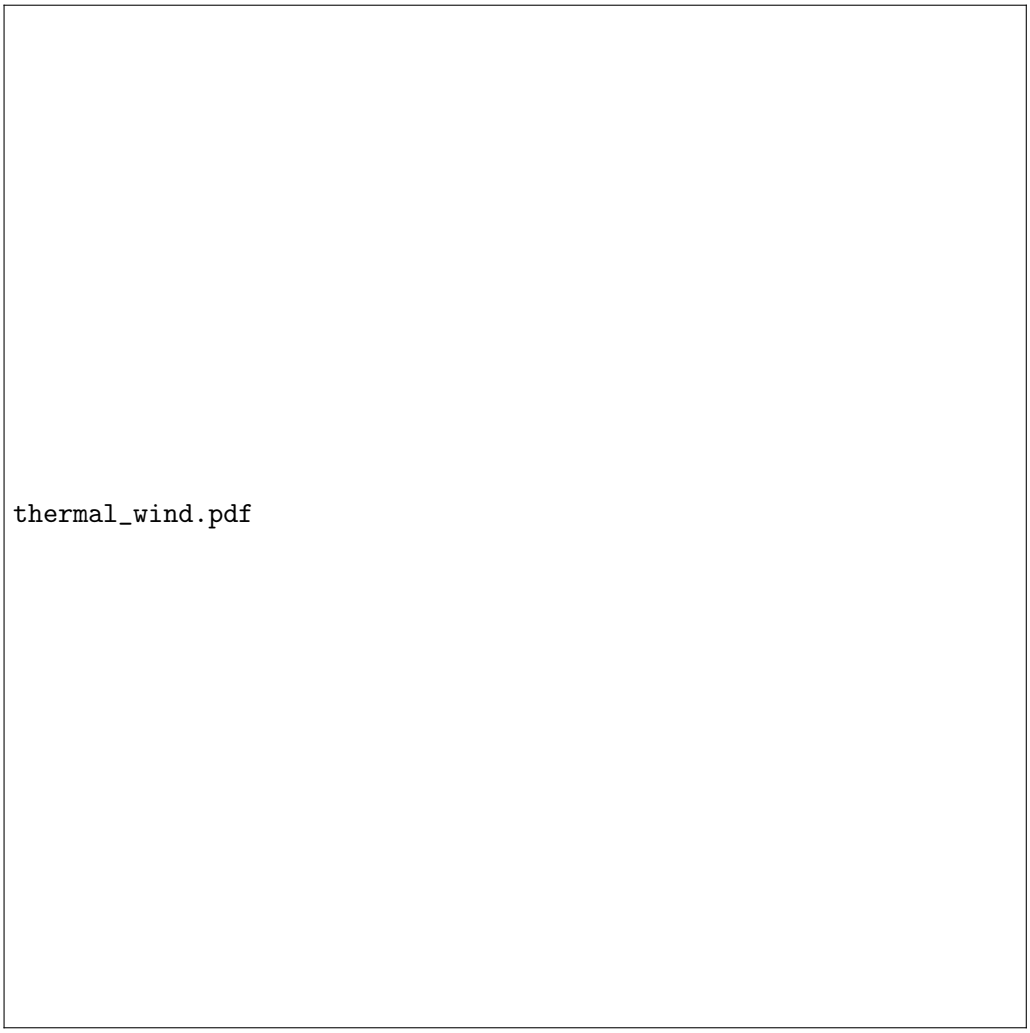

Figure 2: Thermal wind shear as function of altitude.

4 Rossby Number

$Ro = \frac{U}{fL}$

Figure 3: Rossby number for different latitudes and scales.

5 Jet Stream

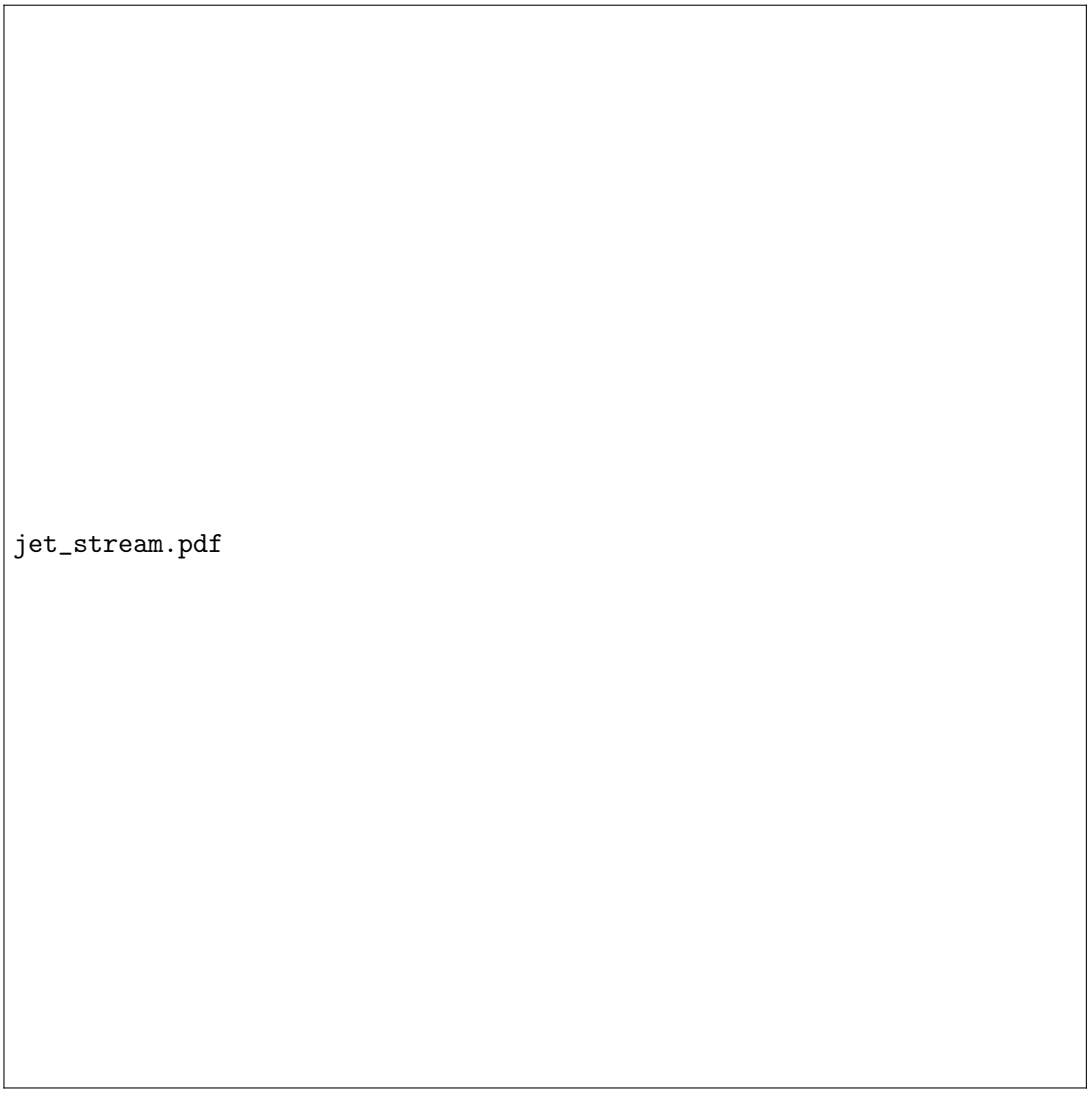

Figure 4: Cross-section of jet stream wind speed.

6 Potential Vorticity

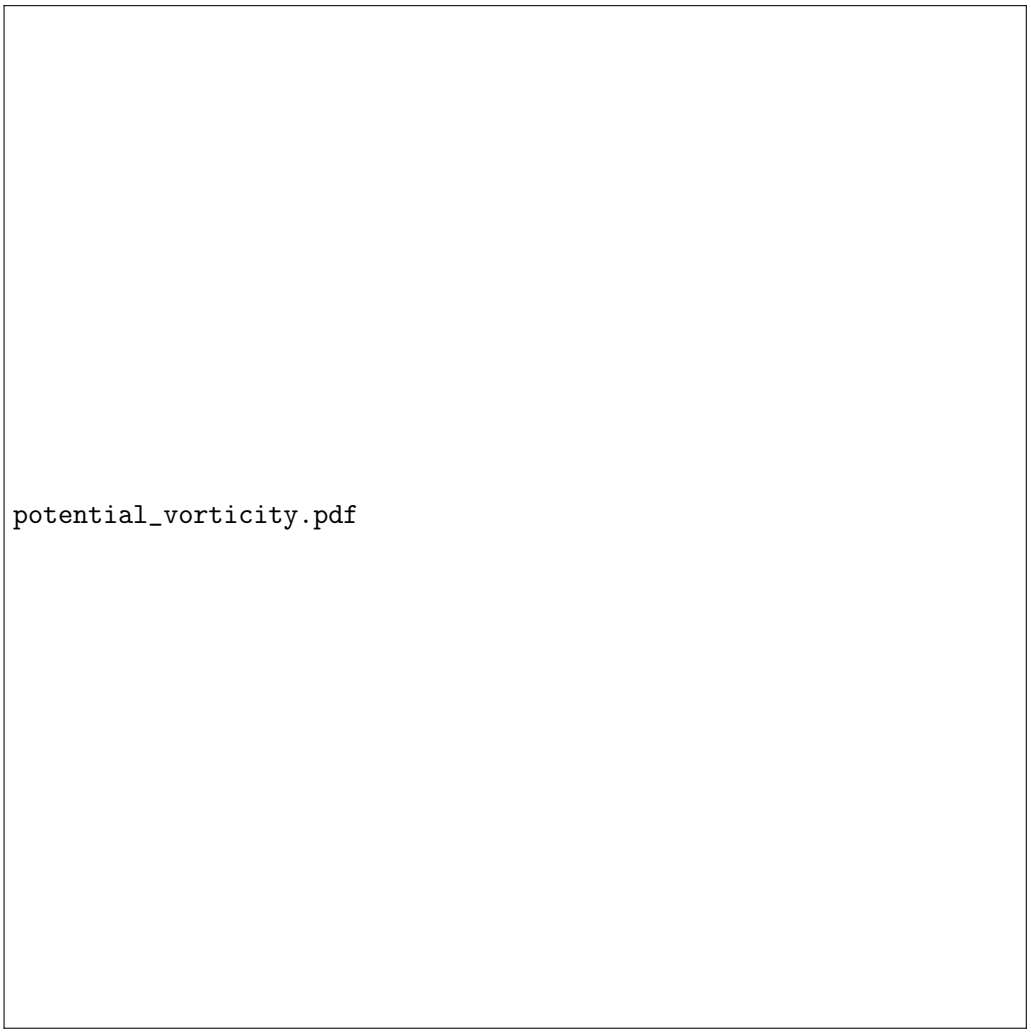

Figure 5: Potential vorticity on isentropic surfaces.

7 Ekman Spiral

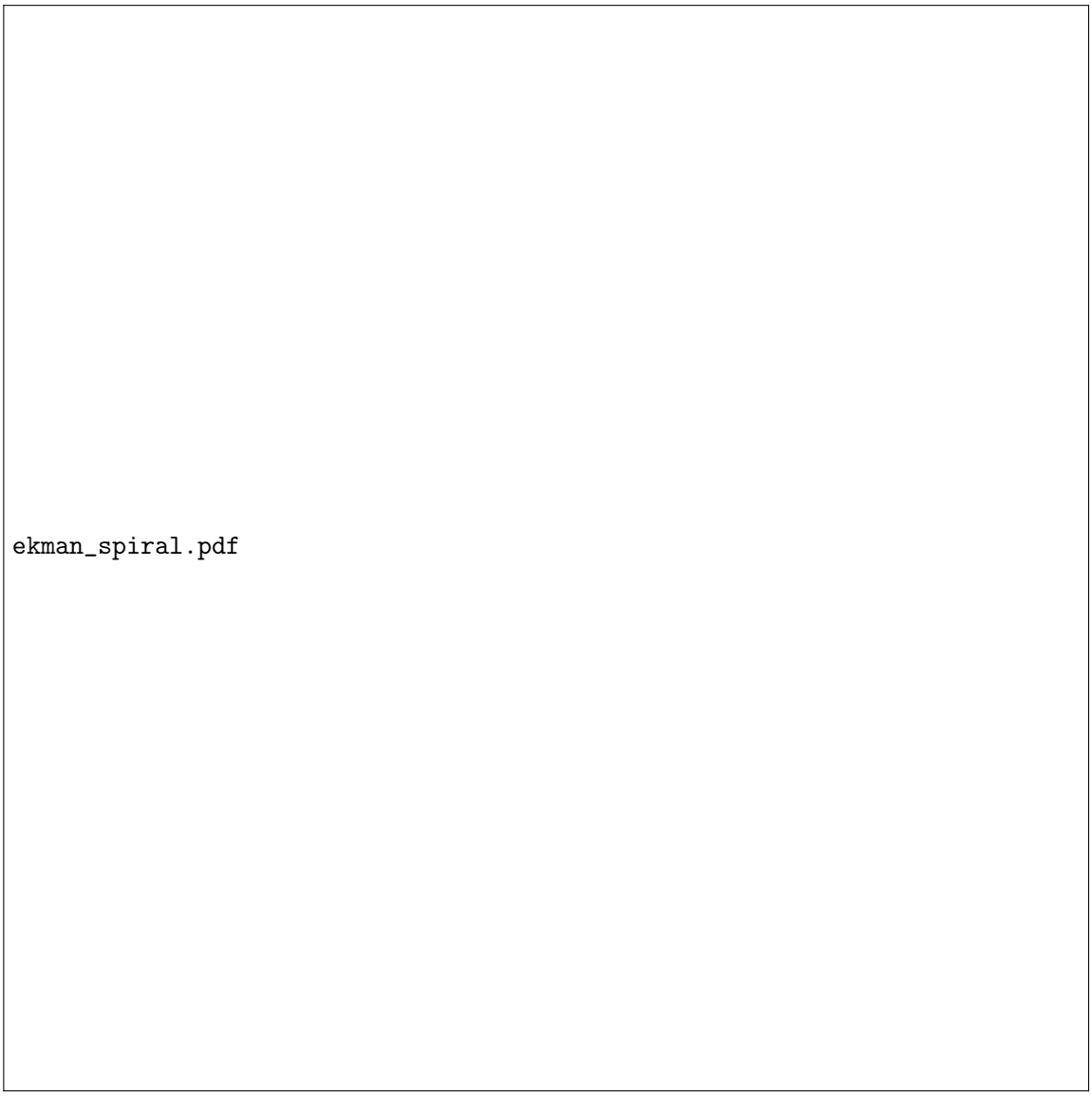

Figure 6: Ekman layer wind profile and spiral.

8 Results

9 Conclusions

Atmospheric dynamics is governed by the balance between pressure gradient, Coriolis, and frictional forces.