**Mesoscale Meteorology**

Spring Semester 2025

Lecturer

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Assistant (homework grading)

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References

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- Dynamics in Atmospheric Physics, 1990, R. S. Lindzen, Cambridge University Press, 310 pp. Chapters 8 and 10: Internal Gravity Waves
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- Atmospheric Convection, 1994, K. A. Emanuel, Oxford University Press, 580 pp.
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- Advances in Geophysics, 1979, Vol. 21, Academic Press. The Influence of Mountains on the Atmosphere, R. B. Smith.
- Topographic Effects in Stratified Flows, 1995, P. G. Baines, Cambridge University Press, 482 pp.
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Grading

mid-term exam: 30%

final exam: 30%

homework: 30%

presentation: 10%

Lecture Contents

1. Overview

   scales of atmospheric motions, generation mechanisms of mesoscale phenomena, scale interactions, atmospheric predictability, N-S problem

2. Governing Equations and Approximations

simplified equations governing mesoscale motions, approximations to the governing equations (anelastic, Boussinesq)

3. Some Theorems for Stratified Flows

Taylor-Goldstein equation, Bolton's theorem, Miles' theorem (shear instability), Howard's semicircle theorem, Eliassen-Palm theorem, applications to stratified atmospheric flows

4. Atmospheric Gravity Waves

roles of gravity waves in the atmosphere, generation mechanisms of gravity waves, detection of gravity waves, pure gravity waves, inertia-gravity waves, gravity-wave reflection, WKB approximation, critical level

5. Orographically Forced Flows

flows over sinusoidal mountains, stationary-phase method, flows over an isolated mountain, mountain drag, lee waves, severe downslope windstorms, gap winds

6. Thermally Forced Flows

shear flow with low-level heating, uniform flow with elevated heating, parameterization of convectively forced gravity-wave drag, thermally forced mesoscale phenomena

7. Deep Moist Convection and Severe Weather