

DYNAMICS OF THE ATMOSPHERE AND THE OCEAN

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Theoretical exam – questions

1. List and explain forces acting on a parcel (elementary volume) of air.
2. Explain differences between equation of motion of atmospheric and oceanic flows.
3. Discuss various scales of atmospheric flows and associated phenomena.
4. Why do we perform scale analysis of the equations of motion?
5. Explain primitive equations.
6. Explain the geostrophic approximation.
7. Explain the balanced flow approximation.
8. Explain horizontal motion in high and low pressure system
9. Explain the hydrostatic approximation.
10. Geopotential: what is it?
11. Explain advantages of pressure coordinates.
12. Why sometimes Boussinesq approximation is useful? In which problems?
13. Explain principle of the anelastic approximation.
14. Explain the shallow water approximation.
15. Explain thermal wind.
16. Explain planetary and relative circulation.
17. In hydrostatic approximation the vertical accelerations and vertical velocities cannot be calculated from momentum equation. Does this mean that the vertical velocities in hydrostatic atmosphere are constant? How we do estimate vertical velocities?
18. Explain atmospheric and oceanic Ekman layer.
19. Explain effects of surface friction on synoptic-scale circulations.
20. Write and explain Bjerkness circulation theorem.
21. Which component of 3D vorticity vector is the most important in geophysical fluid dynamics? Why?
22. Which term in vorticity tendency equation can generate vorticity in an initially zonal flow with no relative vorticity. What are necessary conditions for vorticity generation. Explain the mechanism.
23. Explain potential vorticity.
24. How does barotropic, zonal flow react on meridional mountain range?
25. Using quasi-geostrophic vorticity equation, sketch and explain absolute vorticity advection in different sectors of a baroclinic wave.
26. Explain derivation of dispersion relationship in Rossby waves and analyze phase velocity.
27. Explain Rossby Waves.
28. Explain the available potential energy.
29. Explain source of kinetic energy of atmospheric circulations.
30. Explain Lorenz energy cycle.