NATS 101, Section 13, Spring 2010
Midterm Examination #2
Study Outline

Chapter 5: Condensation: Dew, Fog, and Clouds

Cloud condensation nuclei (CCN): Why are these necessary for cloud drops to form? Typical size of CCN and cloud drops.
Fog: What are the various types of fog and the physical mechanisms of how they form?
Clouds: Be able to identify all the different types of clouds, their location in the atmosphere, and under what circumstances they occur.

Chapter 6: Stability and Cloud Development

First law of thermodynamics: How does it relate to the behavior of a parcel of air as it ascends or descends? What is an adiabatic process? How does condensation of water affect the change in temperature of a parcel of air as it is rising?
Stability: What does it mean when the atmosphere is stable, unstable, or conditionally unstable? How are the dry and moist adiabatic lapses used to determine stability? What types of clouds form in stable and unstable atmospheric conditions?

Chapter 7 – Precipitation

Precipitation Processes: What are the various physical processes that lead to the growth of cloud drops one condensation has occurred on cloud condensation nuclei? How do clouds grow into raindrops by the collision coalescence process in warm clouds? In cold clouds, why do ice crystals grow at the expense of supercooled cloud drops? How do ice crystals grow to produce precipitation? Why is the growth of snowflakes maximized at certain temperatures?
Precipitation types: Know the temperature profile differences between rain, snow, sleet, freezing rain, snow grains, snow pellets and hail.

Chapter 8 – Air Pressure and Winds

Pressure: *SI Units:* m^{-1} kg s^{-2} = Pa (Pascal)
The typical unit of atmospheric pressure is millibars
1 mb = 100 Pa
1 Atm = 1013 mb = 29.92 in Hg
What happens with air pressure as you increase in altitude?

Be able to understand and use the Ideal Gas Law, Boyle's Law (temperature constant) and Charles's Law (density constant)
What is the concept of a gradient? How is the gradient in air pressure related to strength of the wind?
How is air pressure measured?
Newton's 1st and 2nd laws of motion. You should be able to state or explain each law. Acceleration can be a change in speed and/or a change in direction.
Forces That Influence the Wind: What are the different force balances that explain why the wind blows (i.e. geostrophic, gradient, cyclostrophic, gradient with friction)? Know which forces are present for each balance (i.e. Pressure gradient force (PGF), Coriolis force (CF), centripetal force (CENT) and friction(F)) Know the rules that determine the direction and strength of these forces. Which force can start stationary air moving? Which of these forces will only change the direction of the wind and not the wind speed? Which one of these forces can only change the speed of the wind? Be able to give examples of situations where each force balance applies.
Surface Winds vs Upper-Level Winds: Why do surface winds tend to cross the isobars, whereas upper level winds tend to be parallel to the isobars (or height contours)? What is the difference in the balance of forces?
Troughs and Ridges: How do these influence vertical motion in the atmosphere by curvature of the flow? What is the relationship between upper-level troughs and ridges to surface lows and highs?

Chapter 9 – Wind: Small-Scale and Local Systems

Scales: Be able to differentiate the scales of different atmospheric motion (turbulent eddies vs. general circulation just as an example)
Turbulence: Different mechanisms that cause turbulence, both mechanical (wind shear) & thermal (convection). What are signs of each type of turbulence in the atmosphere as indicated by types of clouds (e.g. billow clouds, lenticular clouds, cumulonimbus clouds)
Local Wind Systems: How do differences in surface heating cause sea/land breezes and mountain/valley winds? What is a monsoon and why does the strongest monsoon occur in India? Why do we have a monsoon in Arizona and how does the occurrence of our late season rains relate to the evolution and positioning of upper level features (i.e. the monsoon ridge). What are the physical causes of katabatic winds, such Chinooks, boras, and Santa Anas?

Chapter 10 – Wind: Global Systems

General circulation: What is the primary function of the general circulation and how does it accomplish this function in the tropics vs. mid-latitudes? Know the three-cell model of the general circulation and its salient features. How does this

model relate to the geographic distribution of wet and dry areas of the world? What are the causes of the subtropical and polar jet streams?
Atmosphere-Ocean Interactions: How do the oceans transport heat from equator to pole through the gyre circulations? What is the structure of these gyres in relation to the surrounding continents (i.e. where do warm and cold currents typically occur). Know the concept of winds and upwelling of the oceans. What is ENSO and how does it influence climate in the tropical Pacific and beyond? Know the differences between El Nino/La Nina and the normal state. What are some other atmosphere-ocean interactions besides ENSO?