This outline contains some questions which may help you to study for the midterm. Dates listed for the topics are the approximate dates when the material was covered in class. The exam will be based on class notes, and only those sections of each chapter that were discussed in class will be covered on the exam. Also, keep in mind that in some cases the material covered in class goes beyond the discussion in the book.

In addition, please review the homework assignments. Solutions to the homeworks are posted on the class website.

**Chapter 5** (February 21st to March 4th)

Water vapor in the atmosphere:

* What are the phases of water? What is latent heat? What are CCN and why are they important?

* Measures of water vapor content:
  ○ Specific humidity and mixing ratio: what are they, how are they different, which one changes the most when you add water vapor?
  ○ What is water vapor pressure? What is Dalton’s Law of Partial Pressure, and how can you use it to figure out the vapor pressure from the total pressure (2/23)?
  ○ Note: Relative humidity and dew point temperature are defined later. See notes from 2/25 and 2/28.

* Saturation:
  ○ What is it? What kind of equilibrium is involved? (2/23)
  ○ Why is a water surface essential to the definition? Why is saturation VP different over ice? How is this difference important for raindrop formation (this is in chapter 8, notes from 4/1)?
  ○ Can air be supersaturated with water vapor? What is required to prevent supersaturation in the atmosphere?
  ○ How and why does saturation vapor pressure depend on temperature (fig. 5.10)? Does saturation VP depend on the presence of dry air?
  ○ What is boiling? How large does the saturation VP have to be for water to boil? Why does water boil at a lower temperature on a mountain top? How is this related to figure 5.10? (2/25)

* Relative humidity (2/25):
  ○ What is it, how is it defined? How can you use fig. 5.10 to find it? What are the two ways you can change it?
  ○ How/why does it vary over the course of a day (fig. 5.11)?
Why does air in houses have low RH in winter? How can you figure out the inside RH using 5.10?

* Dew Point temperature (2/28 – 3/4):
  * What is it, how is it defined, how can you find it given the actual temperature and RH?
  * How can you change it? Why does it have a smaller daily variation than RH? Would you expect higher dew point temperatures in polar air or desert air?
  * Why are summertime dewpoint temperatures higher in the Gulf states than they are on the Pacific coast (fig. 5.12b)? What causes muggy summers in the Southeast US (fig. 5.15, notes from 2/28)?

Chapter 6: Condensation – Dew, Fog, Clouds (March 4th to March 11th)

* What is dew (frost), how does it form? What are the ideal conditions for it, and why?
* What is haze? Why are haze droplets small?
* Kinds of fog: what are they, how do they form, where do you expect to find them?
  * Radiation fog: under what conditions do you expect it to form?
  * Advection fog: where do you find it, and why?
  * What are steam fog, Arctic sea smoke, and precipitation fog? What do they have in common?
  * What is evaporation - mixing fog, and how is it related to fig. 5.10 (see hw4, problem 2)?

* Clouds:
  * How are they related to rising motions? How does the type of rising motion affect the basic shape of the cloud?
  * What are the basic meanings of stratus, cumulus, nimbus, and cirrus? Which types would you find associated with showers, drizzle, sunny summer days? Which one is made of ice only?
  * How does the Hildebransson and Abercromby 10 category cloud scheme work? What are the categories, what cloud attributes do they involve? You should be able to mix and match the suffixes and prefixes (e.g. alto + stratus = altostratus: what can you say about this cloud type based on the two root words?)

Chapter 7: Stability and cloud development (March 11th to March 30th)

* Lifting of air parcels: name/describe four ways in which parcels are lifted (3/11).
* Buoyancy: What is it? What is Archimedes’ Principle? How is buoyancy related to density?
* Stability:
  - How is stability related to buoyancy? What is the definition of stability?
  - How is buoyancy related to temperature? How is temperature related to stability? When does warm air rise?
  - What kind of clouds do you find in an unstable atmosphere? A stable atmosphere?

* Lapse rates:
  - What is an adiabatic process? Why do air parcels cool as they rise? What assumption do we make when we say that a parcel rises adiabatically? How is the temperature of a rising parcel related to figure 1.8 (notes from 3/16)?
  - DALR, MALR, ELR, DPLR: what do they mean, why are they important, what are the typical values?
  - Why and how are lapse rates related to stability?

* Lapse rates, levels, and stability:
  - LCL and LFC: what do they mean – what happens at these levels (3/18, 3/28)?
  - How is convection produced in a conditionally unstable atmosphere? What does the triangle mean? How is the DPLR involved?
  - Why does dew point temperature decrease with height?

* Limits on rising motion: what are they? Why is the top of the anvil cloud flat?

* Flow over mountains: why is the parcel temperature higher after the parcel goes over the mountain?

**Chapter 8: Precipitation formation** (March 30th to April 6th)

* Why is it hard to make raindrops out of cloud droplets?

* Collision-coalescence:
  - What is it, where do you find it?
  - What is terminal velocity? What property of terminal velocity is crucial for the collision-coalescence process?

* The Ice-Crystal (Bergeron) process (4/1):
  - What is it, where do you find it (even in summer)?
  - What is supercooled water? Why is it important? How is fig. 5.10 related to fig. 8.9? How many supercooled droplets are there for every ice crystal?
  - Ice nuclei: what are they? Why is the scarcity of ice nuclei important?
* Rimming and aggregation:
  ○ What is graupel? How does it form? How is it related to terminal velocity? In what layer in fig. 8.6 does it form?
  ○ How is aggregation different from riming (see fig. 8.12)? How does aggregation depend on temperature? How does this dependence affect snow on the ground?

* Kinds of precipitation:
  ○ Drizzle, virga: how are they different from just plain rain? What kind of clouds produce drizzle?
  ○ Snow: what determines the shapes of snowflakes? What’s the difference between snowflakes and graupel?
  ○ Sleet and freezing rain: what’s the difference? Which one is more dangerous, and why?
  ○ What are the typical temperature profiles for snow, sleet, freezing rain, and rain (fig. 8.22)?
  ○ Hail: how is it formed? Why does it happen in summer rather than winter? What’s a hail embryo? Why do large hailstones have bands? What do the bands tell you?