Meteorology 100, Fall 2011
Summary Exam #3
End of Chap 4, Chap 5-7 and through currents in Chap 8 (p 130-241)

Chap 4 Water in the Atmosphere
weather modification
- dry ice
- silver iodide

forms of precipitation: rain, drizzle, snow, graupel, sleet, freezing rain, hail

Chap 5 Observing the Atmosphere
temperature
- bulb thermometers
- shelters
- sunshields

humidity
- chilled mirror dew point
- psychrometer – wet bulb

pressure
- aneroid

wind
- vane & cups
- sonic anemometer

precipitation
- tipping bucket
- weighing rain gauge

radiosondes
- measure temp, humid, pres

track balloon to get winds
release at noon & midnight GMT
cloud ceiling – ceilometer
visibility
Scattering – Rayleigh and Mie
satellite images
- polar and geostationary
- visible, infrared, water vapor

radar
- precipitation location and movement
- winds (doppler)

wind profiler

Chap 6 Atmospheric Forces and Wind
Newton's laws of motion
convergence and divergence at aloft and surface
upper level charts constant pressure surface
Ridge – high height region – high pressure
Trough – low height region – low pressure
forces causing motion
- 2 forces independent of velocity
- 3 forces depending on velocity

gravity – gravitational attraction of earth
- effects vertical motion only

slightly greater (<1%) at poles than equator
Pressure Gradient Force
away from high, towards low
represented on weather map by closeness of isobars
Causes of pressure gradient
cold air is more dense i.e. more molecules
dry air is more dense than moist
vertical – most pres grad is in vertical
hydrostatic balance – gravity and vertical pressure gradient
horizontal – even if small, it will cause motion
coriolis force due to rotating earth, right in NH, left in SH, perpendicular to wind
latitude – coriolis is proportional to sine of latitude, zero at equator
velocity – coriolis is proportional to wind speed, zero force if zero velocity
for equal Coriolis, if you increase latitude, the velocity decreases
geostrophic wind – balance between horizontal pres grad & coriolis
wind is parallel to isobars since PG perpendicular to isobars
centrifugal force – body in motion wants to move in straight line
Cf centrifugal force acts away from center of curvature & perpendicular to wind
gradient wind - balance between PG, Co & Cf
circulation about low - cyclonic
PG must balance Co + Cf
note motion is counterclockwise
winds in a cyclonic gradient flow are less than geostrophic for same PG
circulation about high - anticyclonic
now Co must balance PG + Cf
note motion is clockwise
winds in anticyclonic gradient flow are greater than geostrophic for same PG
friction - retards motion – acts in direction opposite to motion
depends on surface roughness, convection and wind speed
wind in friction layer
F friction slows down wind – thus Co less & PG dominates
wind turns in direction of PG & balance when net of Co & F = PG
thus where friction not negligible the wind crosses isobars from H to L
draw all four forces around high or low
NH: winds go counterclockwise & in about L – thus rising air
winds go clockwise & out about H – thus sinking air
SH: winds go clockwise & in about L
winds go counterclockwise & out about H
convergence and divergence
horizontal convergence near surface causes rising air
horizontal divergence near surface causes sinking air
opposite if convergence or divergence is near tropopause
law of Buys Ballot
thermal wind – west to east motion in atmosphere
lake and sea breeze – land breeze
scales of motion – microscale, mesoscale, synoptic scale, planetary scale

Chap 7 Global Scale Winds (general circulation of the atmosphere)
heat transport by atmosphere and ocean
conservation of angular momentum
Hadley cell, Ferrill cell, Rossby waves
polar jet at boundary between warm & cold air masses

actual Hadley cell 0 to 30° latitude (see slides)
    rain forests, doldrums, subtropical jet, subtropical highs, deserts, horse latitudes
ITCZ, trade winds
    ITCZ moves N in summer and S in winter, average in NH
relation of subtropical high to deserts (see slide: east and west of subtropical high)
movement of subtropical highs causes rain in winter, dry in summer in California (see slide)
continentality
monsoon circulation – wind change with seasons
    may cause wet and dry seasons
    hottest just before rain starts
    monsoon in India and SE Asia
    monsoon in Africa
        variability of monsoon in Africa can cause drought in Sahel
polar jet stream (Rossby Waves)
    N to S temperature gradient causes west to east jet stream
    zonal and meridional flow
    greater temperature variation under meridional flow
air over the mountain – rainshadow

Chap 8 Atmosphere-Ocean Interactions
energy transport
ocean currents
    wind pushes water
    temperature gradients in ocean
    salinity gradients in ocean
    turning of currents with depth (Ekman spiral)
upwelling
    along west coast
    at ITCZ
water temperature – thermocline
ocean surface currents (warm and cold)
influences of currents on climate (see slide)
deep ocean currents
    water sinking due to cold and salt
    thermohaline current