THE HYDROLOGIC CYCLE AND GLOBAL WATER RESOURCES

- TIBETAN PLATEAU
  - Tibetan plateau: a virtual"Water Tower" for Asia
  - Temperatures here are rising twice the global average
  - What will happen to water supply and hydrology in a warmer climate?
- THE GLOBAL WATER CYCLE
  - How does this thing work, anyway?
- PRECIPITATION
  - Water holding capacity is a function of temperature
  - Precipitation is initiated by cooling of air
- HOW DOES AIR COOL OFF?
  - Convective: due to heating of the surface
  - Orographic: Air rises over an obstacle
  - Convergence: Air is lifted due to a low pressure zone Lifting…
- OROGRAPHIC PRECIPITATION
  - Tibetan plateau is dry, arid
  - Reason is partly due to orographic effects
- GLOBAL PRECIPITATION
  - Annual average over land is ~750 mm per year
- PRECIPITATION VARIABILITY
  - Red line is global average (over land)
- DRAINAGE BASINS
  - Land areas that drain to a specific river
- INFILTRATION
  - Water that seeps into the soil
  - As particle size decreases:

    i) capacity of soil to hold water decreases

    ii) maximum infiltration rate decreases
- TWO TYPES OF RUNOFF
  - Overland flow runoff: water that cannot infiltrate into the soil flows overland until it enters the stream network
- SLOPE AND RUNOFF
  - As slope increases, infiltration decreases and runoff increases
  - Steep slopes produce more runoff

- STORAGE

• Biggest natural reservoirs (in order): glaciers&snow, groundwater, lakes, soil moisture, artificial reservoirs

• These are roughly in reverse order of ease of access

- ARTIFICIAL STORAGE CAPACITY
  - Shasta Reservoir, California
  - Height: 600 feet ~ Capacity: 1.265 billion gallons
- EVAPOTRANSPIRATION
  - Evaporation: From soil
  - Transpiration: From plants
  - Globally, 60% of precipitation over land returns to atmosphere
- EVAPOTRANSPIRATION REGIMES

•Water limited

- Evaporation is about equal to precipitation
- Increasing precipitation will increase evaporation
- Dry arid areas

• Energy-limited

- Wet, humid areas
- Increasing temperature will increase evaporation

- AVERAGE P-E OVER TIBETAN PLATEAU
  - What could this tell us about the flow paths?
- EVAPORATION OVER OCEANS
  - 40% of rain over land comes from the ocean
  - Key: River flow into ocean is balanced by water vapor transport from the oceans
- RUNOFF RATIOS
  - The ratio of runoff to precipitation
- VARIATIONS IN RUNOFF RATIO
  - Most variability explained by evaporation and soils
- WHAT HAPPENS IN A WARMER CLIMATE?

•The air can hold more water

•Evapotranspiration will increase air water content

•When storms occur, there is more water in the air, and precipitation will increase

•Increasing precipitation will increase evaporation, in water-limited areas

•This leads to what is called intensification of the water cycle

- EVIDENCE OF INTENSIFICATION?
  - Impossible to say, of course…
- PRECIPITATION & FLOODING
  - Throughout most of the Ohio River basin, 2011 was the record wettest year
- EVIDENCE OF INTENSIFICATION?
  - Impossible to say, of course…
- MISSISSIPPI RIVER FLOODING
  - Levee destroyed by USACE in order to save Cairo, IL
- GLOBAL FLOOD DAMAGES IN 2004
  - 7,000 deaths
  - 116 million affected
  - $7.5 billion in losses and damages