Chapter 1: The Earth’s Atmosphere

- Overview of the Earth’s atmosphere
- Vertical structure of the atmosphere
- Weather and climate

Overview of the Earth’s Atmosphere

- The atmosphere, when scaled to the size of an apple, is no thicker than the skin on an apple.

Composition of the Atmosphere

- permanent gases
  - roles of nitrogen and oxygen
- variable gases
  - role of water vapor

Composition of the Atmosphere

- Carbon dioxide and the greenhouse gases
- ozone
- aerosols
- pollutants

- Ozone at high altitudes (stratosphere) is “good”; ozone at low altitudes (troposphere) is “bad.”
The Early Atmosphere

- the first atmosphere (H and He)
- outgassing and the second atmosphere
- evolution of the atmosphere: carbon dioxide and oxygen

- The evolution of life and the atmosphere are closely linked.

Vertical Structure of the Earth’s Atmosphere
A Brief Look at Air Pressure and Air Density

- air density
- air pressure
- sea-level pressure

- Baseballs travel further in higher-altitude air (Denver) than they do in lower-altitude air.

1013.25 mb = 29.92 in Hg ~14.7 lbs/in²

Layers of the Atmosphere

- vertical temperature profile
- troposphere
- stratosphere
- mesosphere
- thermosphere

- Temperatures, winds, humidity and pressures high above the ground are measured twice-daily by radiosonde.

The Ionosphere

- electrified regions of the atmosphere
- D, E and F regions
- radio waves

- When the radio was invented by G. Marconi in the early 20th century, it was not known how radio waves traveled long distances through the atmosphere.
Weather and Climate

Elements of Weather
- air temperature
- air pressure
- humidity
- clouds
- precipitation
- visibility
- wind

- Certain weather elements, like clouds, visibility and wind, are of particular interest to pilots.

Climate
- average weather
- extremes

A Satellite’s View of the Weather
- geostationary satellites
  - Atmospheric observation from satellites was an important technological development in meteorology. Other important developments include computers, internet, and Doppler radar.

Storms of all Sizes
- midlatitude cyclonic storms
- hurricanes and tropical storms
- thunderstorms
- tornadoes

- Storms are very exciting, but they also play an important role in moving heat and moisture around throughout the atmosphere.
A Look at a Weather Map

- wind speed and direction
- cyclones and anticyclones
- fronts

  - Wind direction is defined in the opposite way as ocean currents: a southerly current means water is moving towards the south.

Weather and Climate in our Lives

- wind chill, frostbite and hypothermia
- heat exhaustion and heat stroke
- cold spells, dry spells and heat waves
- severe thunderstorms and flash floods

  - The mathematical formula for determining the wind chill temperature has recently been revised due to new experiments.

Mike Salsbury, The Chronicle
April, 1997 Red River flood—Grand Forks, North Dakota

A Centralia neighborhood near Mellen Street sits flooded Tuesday as a result of severe storms that caused record flood levels on the Chehalis River.
The Chehalis River floods large areas of Chehalis, and also submerges several sections of Interstate 5. The river was almost 10 feet over flood stage. (Steve Bloom/The Olympian)

A Centralia neighborhood is submerged. Flood damage to a segment of the interstate in the Chehalis area will keep the highway closed until Friday at the earliest, a transportation department official said. STEVE RINGMAN / THE SEATTLE TIMES

Flood waters from the Chehalis River inundate a neighborhood in Centralia. STEVE RINGMAN / THE SEATTLE TIMES

You can't actually see Interstate 5 in this photo, it's under the flood water. Notice the exit sign on the bottom of the photo, just a little left of center, and the freeway overpass in the middle of the photo. Dec. 4, 2007. WA DOT

SR 6 under a massive mud slide near Pe Ell