EOSC 112: THE FLUID EARTH

ATMOSPHERIC STRUCTURE AND DYNAMICS

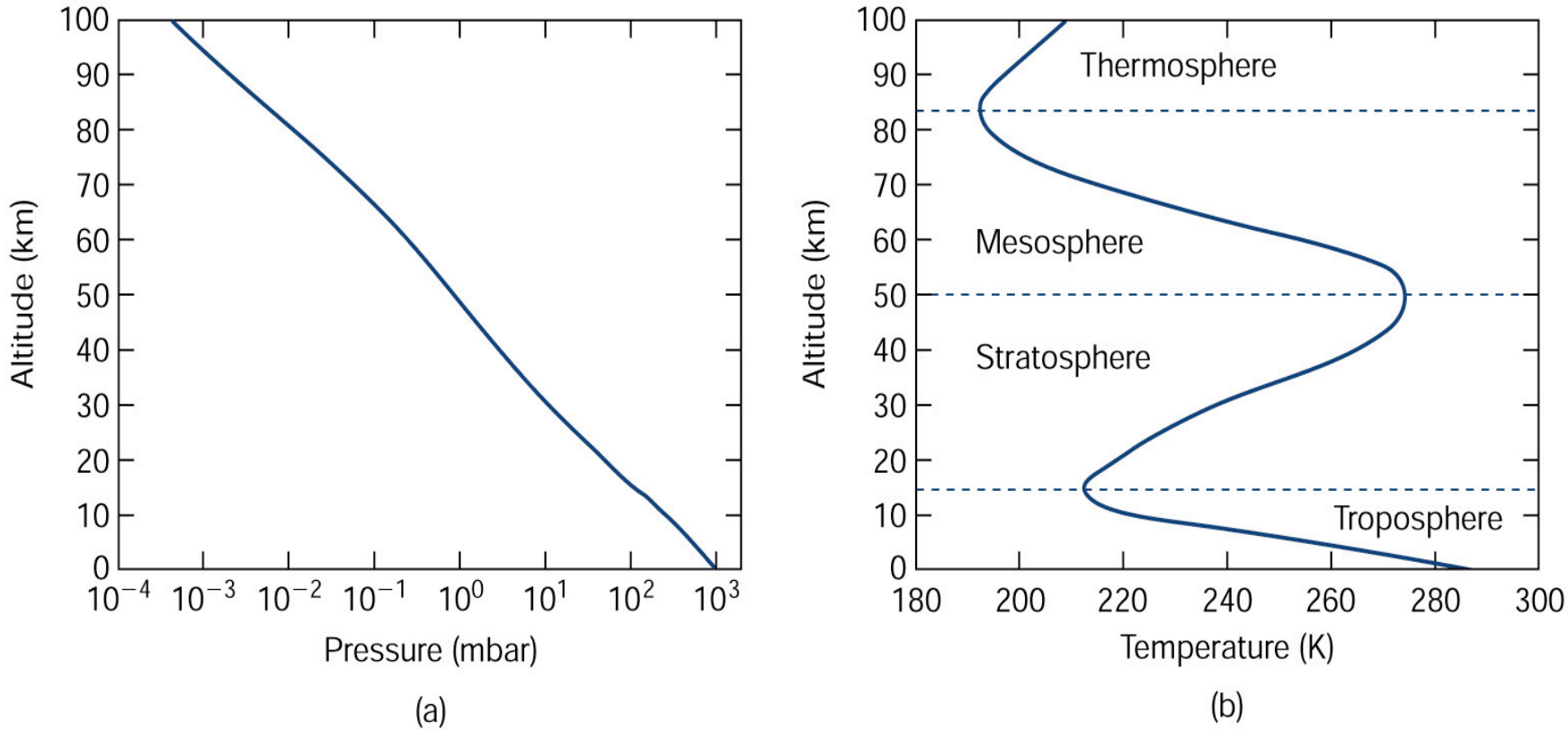
Atm12

Read: Kump et al. Chap.3, p. 44-45; Chap.4, p. 55-61.

Objectives:

1. **To describe how atmospheric pressure and temperature vary with altitude;**
2. **To explain why air moves;**
3. **To describe what sets the global atmosphere in motion;**
4. **To describe the general pattern of Global Winds on a non-rotating planet.**

1. Figures representing P change and T change with height



Atmospheric pressure

- **Pressure = Force per unit area.**
- **Pressure decreases *exponentially* with height.**
- **10 mbar (milliBar) = 1 kPa (kiloPascal)**

Atmospheric Temperature

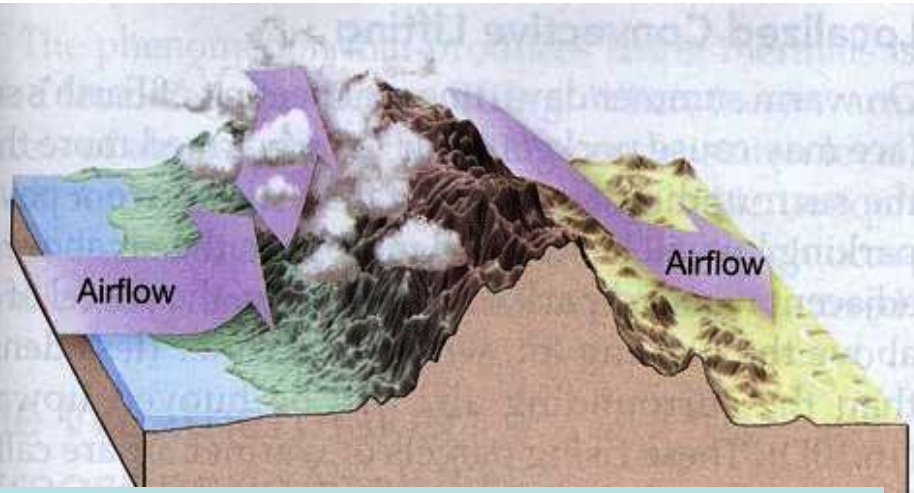
- **Troposphere: ground to about 12km (16km in Tropics, 10km in Arctic)**

  Unlike the other layers, it is subjected to constant vertical mixing (convection).

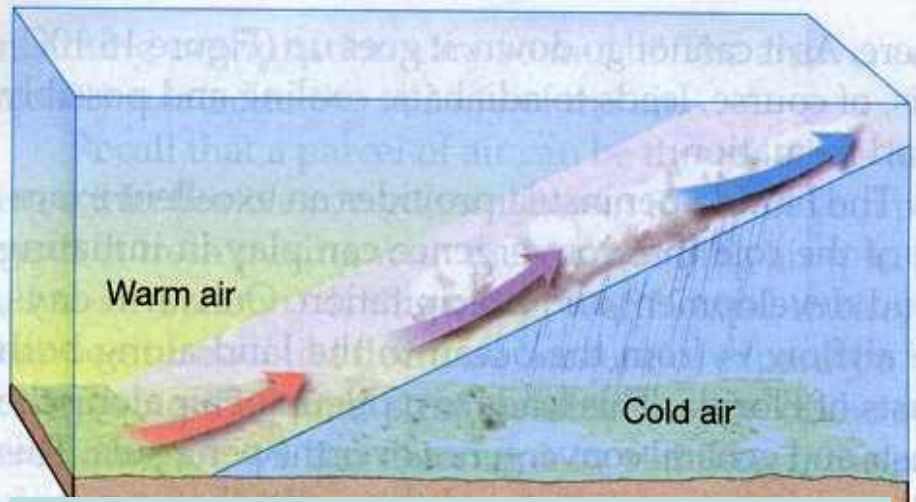
  It is this mixing process, through rising thermals and moist convection (followed by release of latent heat), that carries heat energy from the ground to cloud levels where it is radiated to space in the form of infrared radiation.

- **Stratosphere (12km to 50km) is a stratified layer of dry air. It contains most of the ozone.**

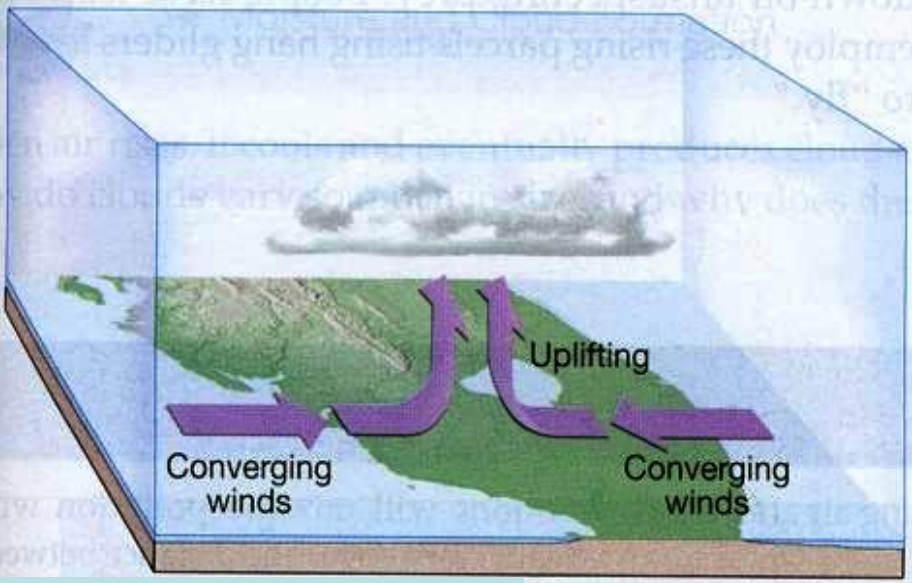
2. Vertical Movement



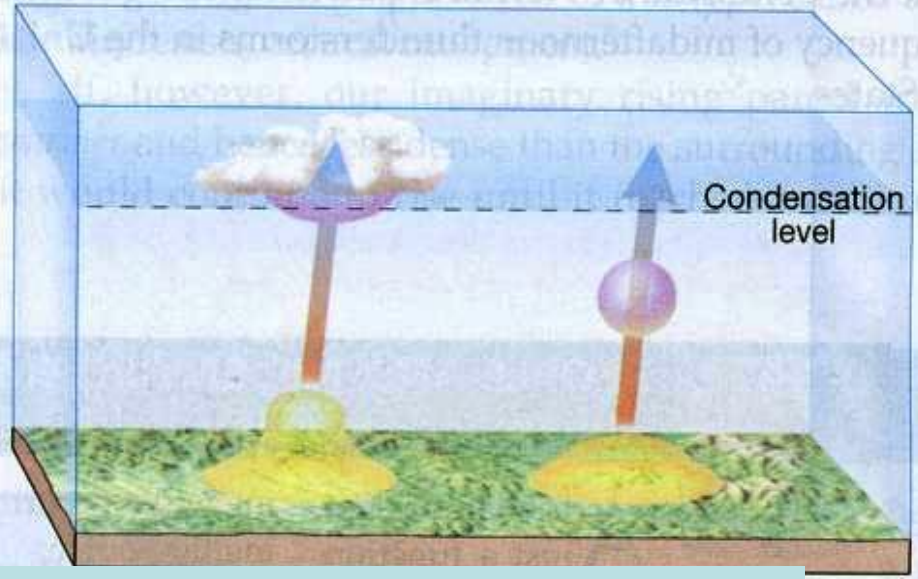
Topographic uplifting



Frontal wedging

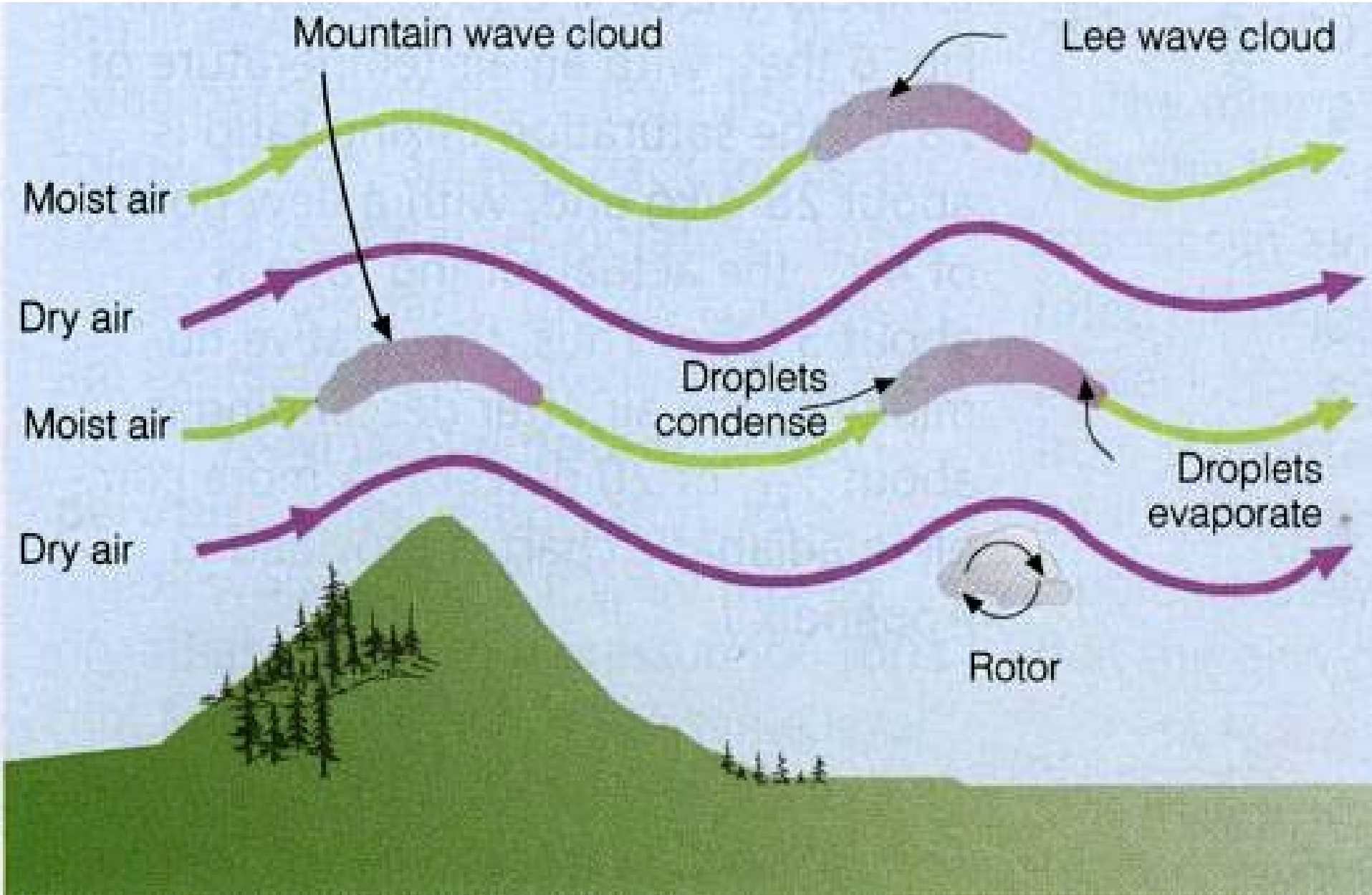


Convergence



Localized convection

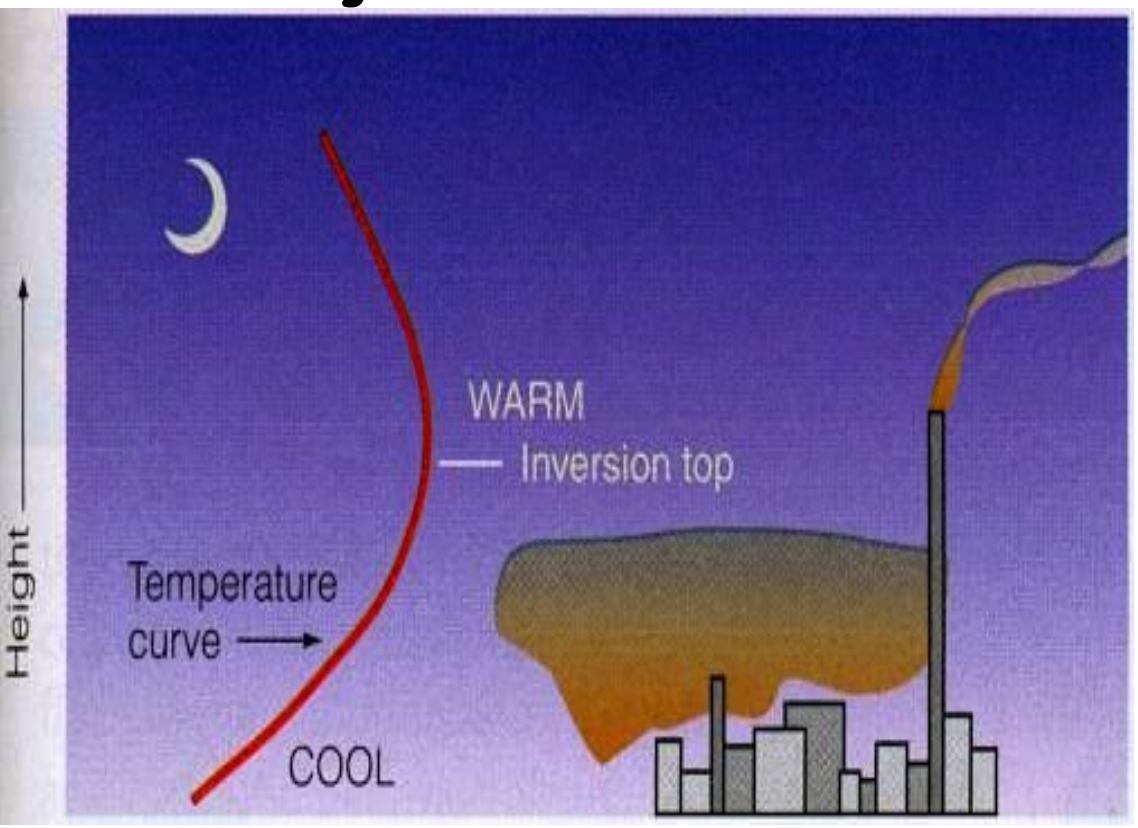
Mountain wave clouds & lee wave clouds



Lenticular (lense-shaped) clouds (mountain wave clouds)

Example: T inversion and Pollution

- During night & early morning, clear sky => ground much cooler than air above
  => radiation (or surface) inversion
- Inversion has warm air above cool air
  => very stable. Pollutants cannot disperse upw.

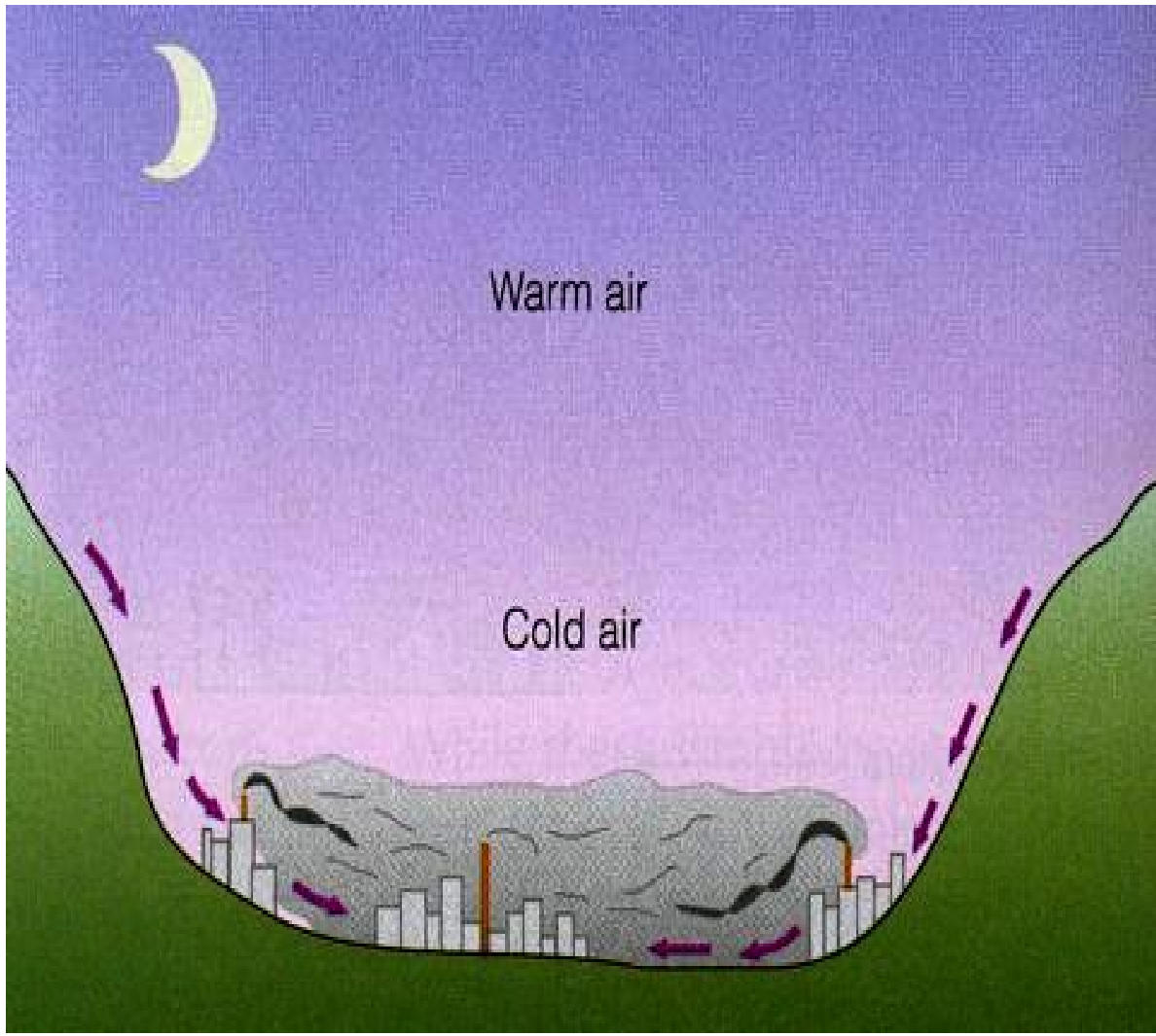


- Tall chimney goes above inversion layer => effective dispersion
- Daytime, ground warms => inversion disappears => pollutants disperse.

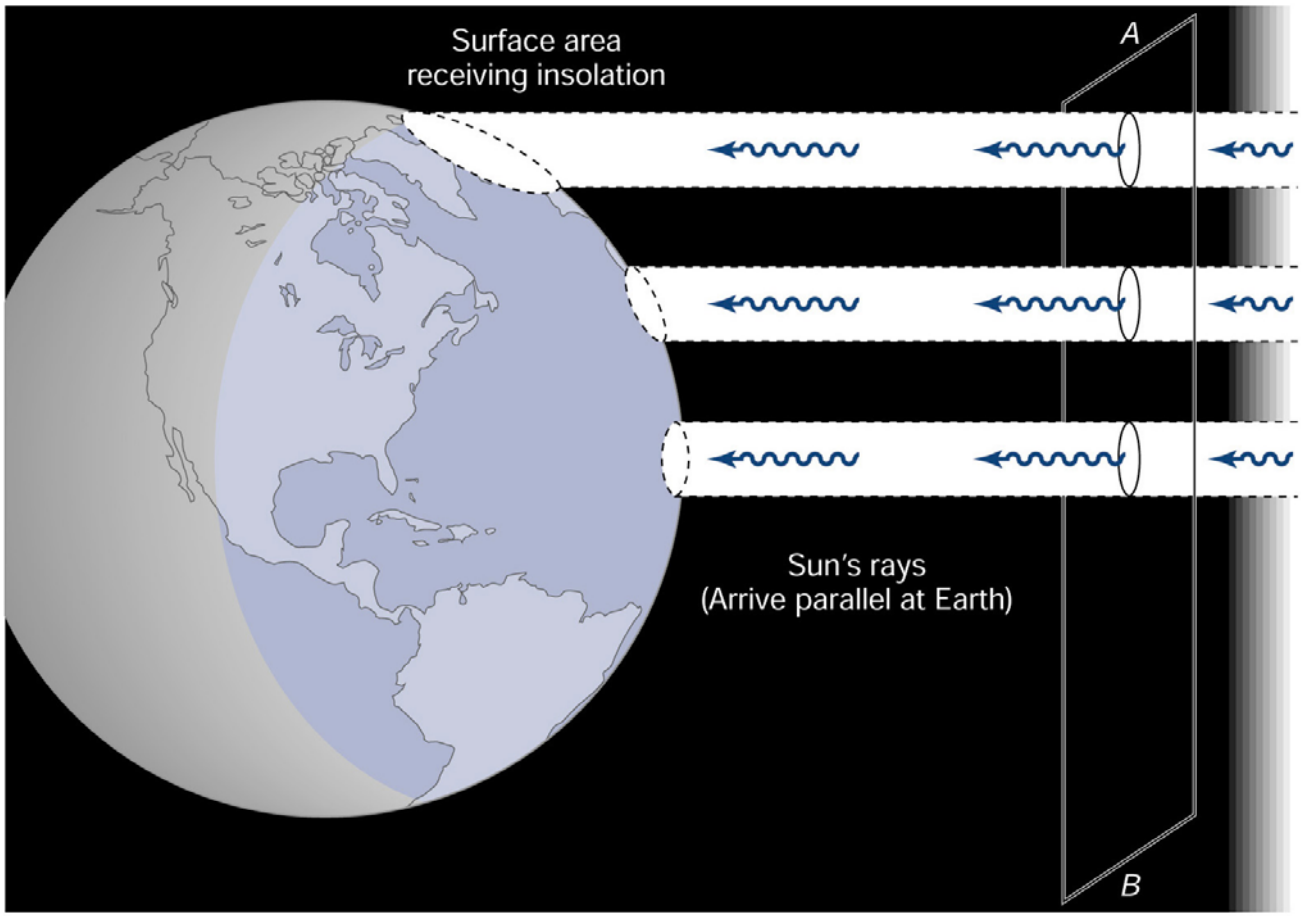
Example: Inversion in valleys

Night time: cool air drains downhill, settling into valleys.

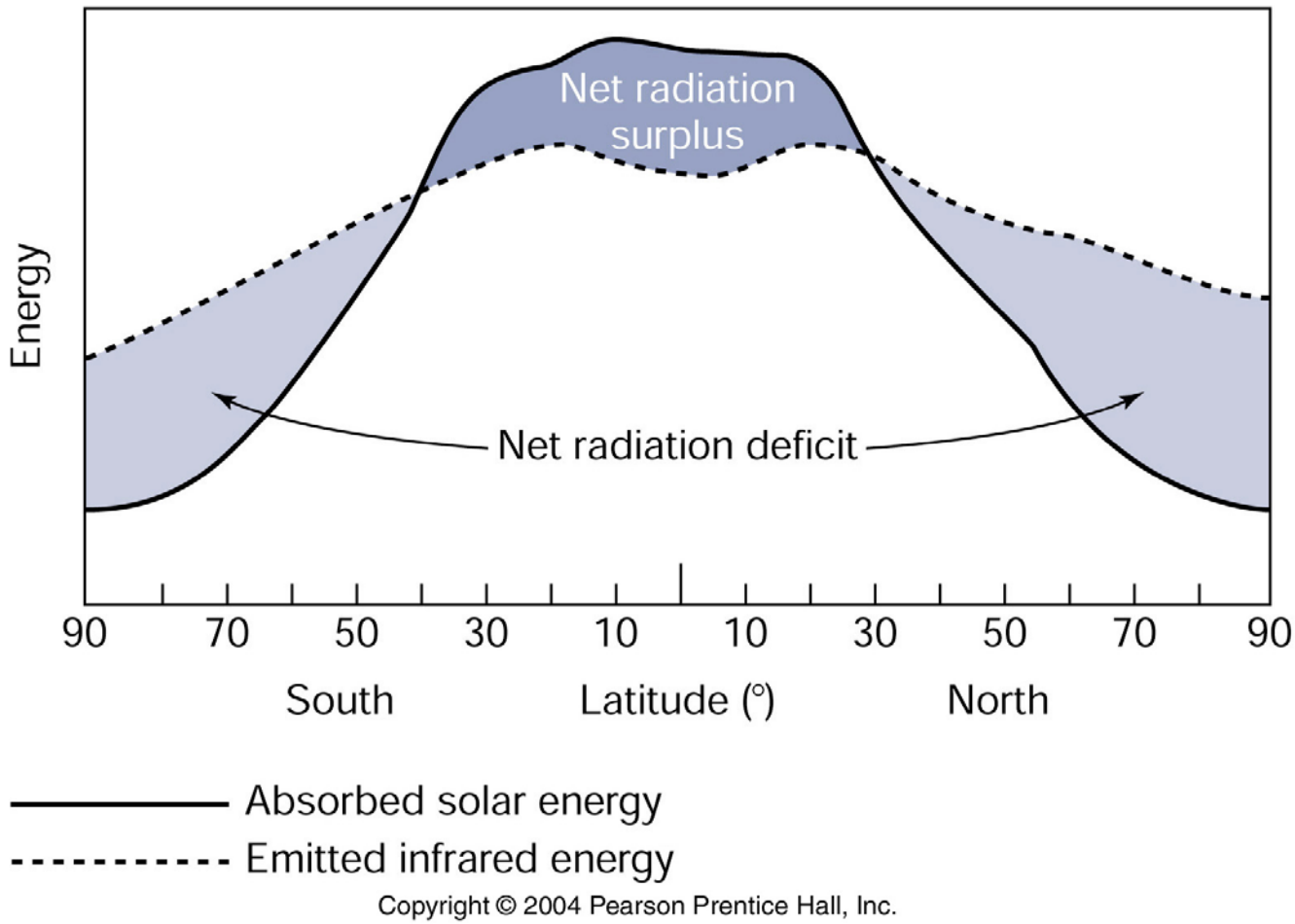
- Inversion at valley
- Pollutants trapped in valley.



3. The driving Force



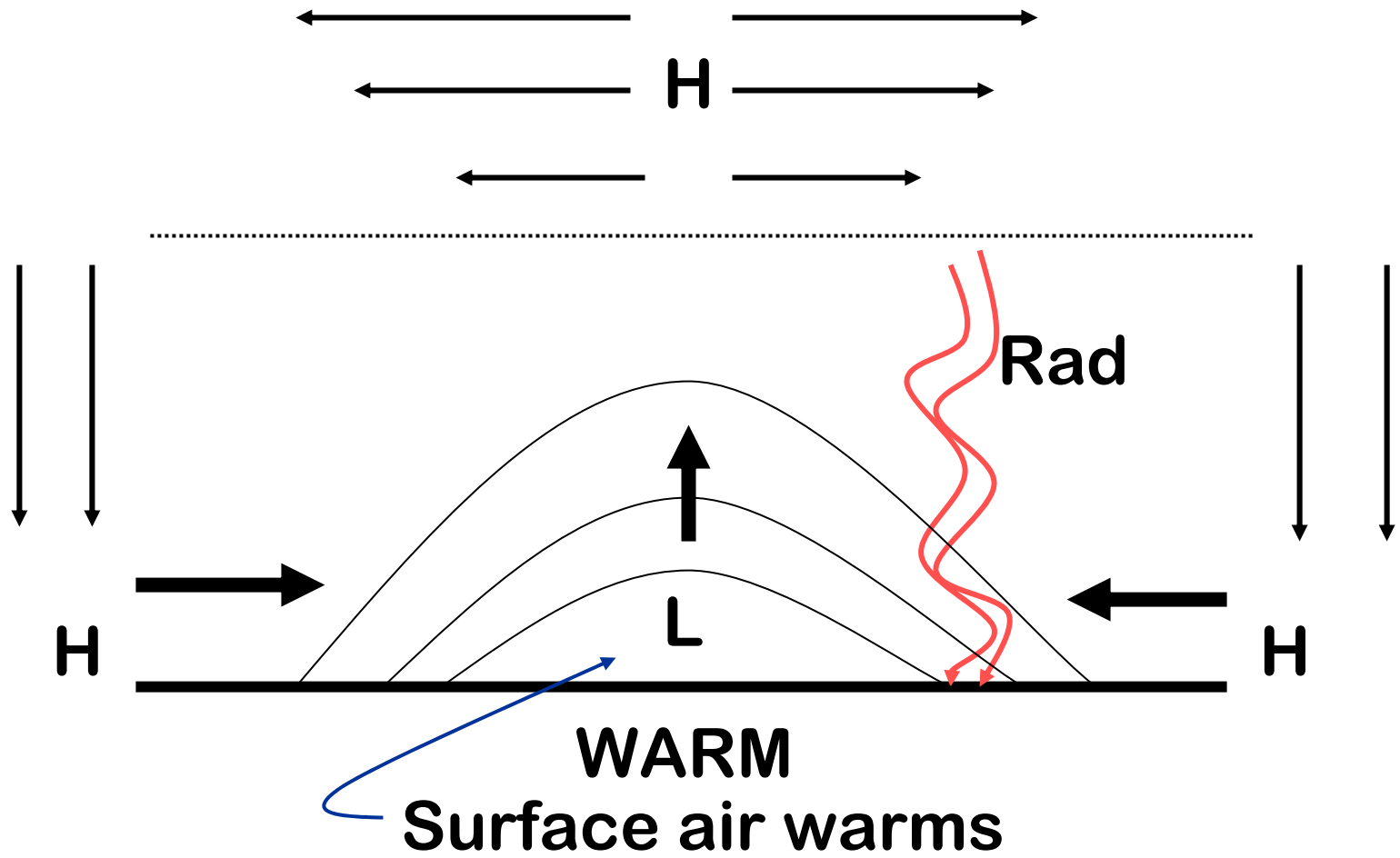
Global Energy Distribution



4. Global winds – vertical and horizontal

Horizontal movements:

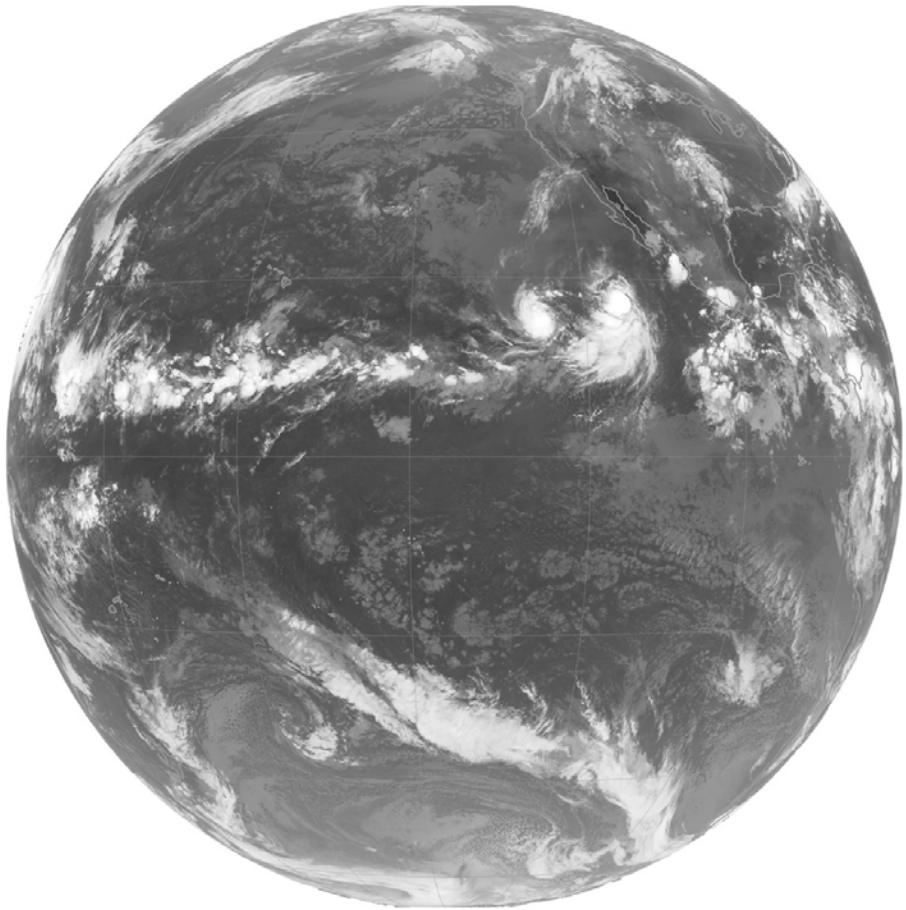
Temp. changes => Pressure changes => Winds



Horizontal Motions: "7-step" development

1. Radiation absorbed by Earth's surface – Surface warms
2. Air above ground warms by conduction – Air expands, density drops
3. Air becomes unstable – Convection sets in
4. Air rises – Pressure aloft increases
5. Air aloft pushed laterally away from warm surface – Surface pressure drops
6. Surface pressure around warm area increases – Air converges toward warm area
7. Air subsides around warm surface – Complete convection cell established

Satellite view of the ITCZ



Global winds on a non-rotating planet