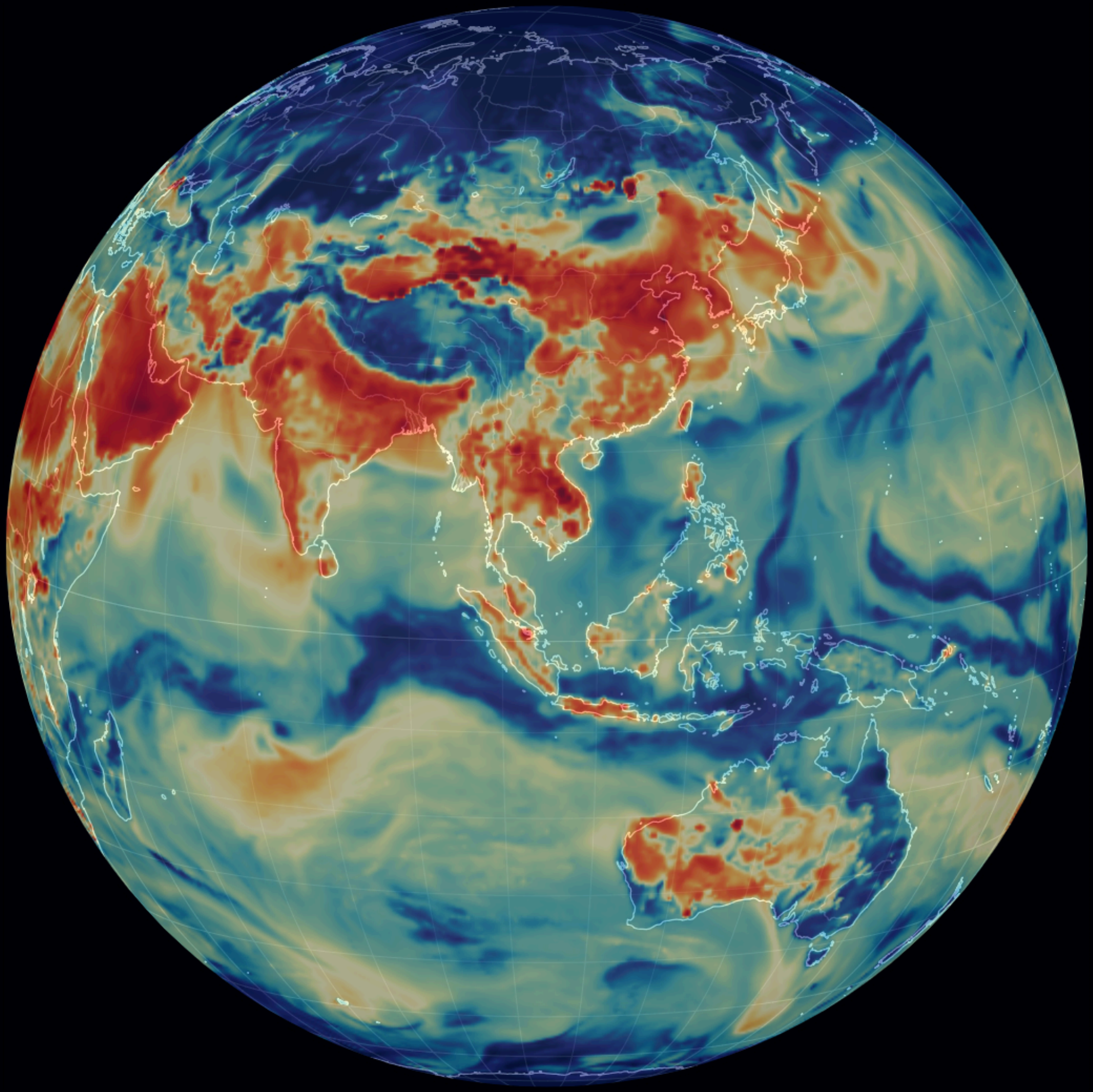
SGS6833: 대기과학

2019년 1학기

hajsong.github.io/SGS6833

양해를 구합니다.

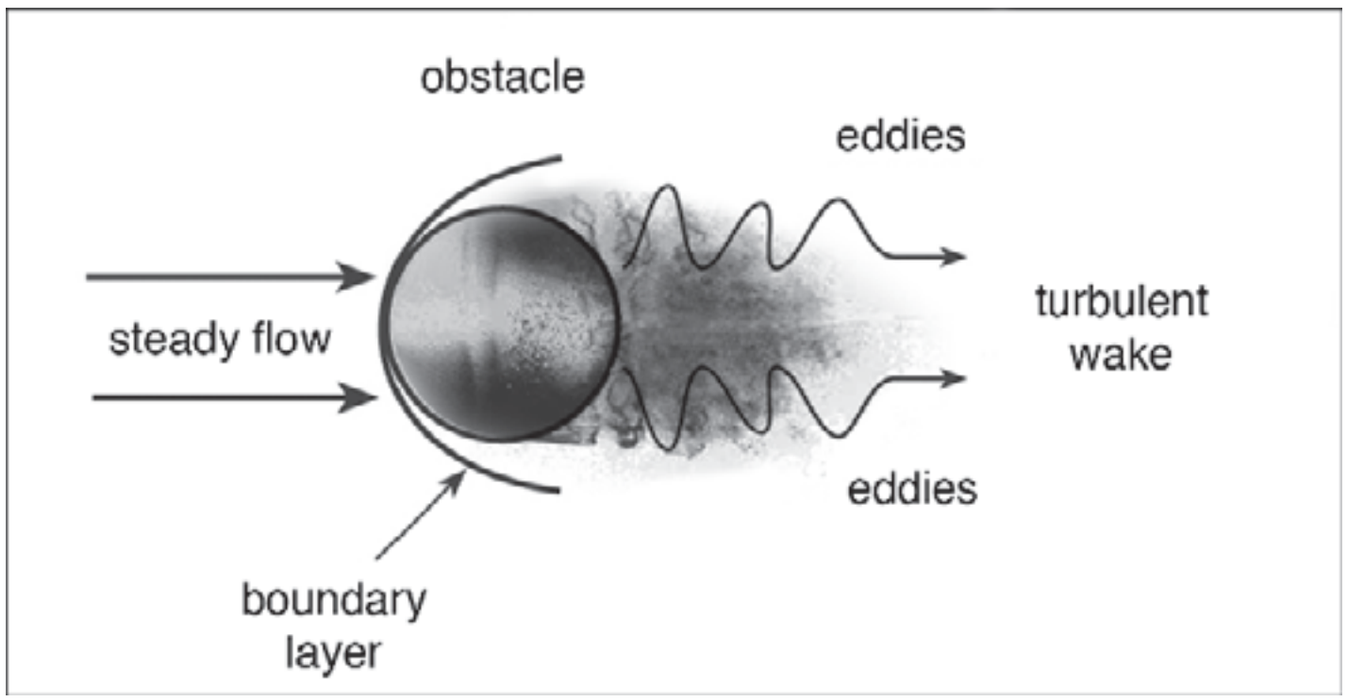
- 용어
- 휴강 (보강?)
- 소개



earth

Fluid dynamics on earth

- Fluid dynamics is commonly studied in engineering.
- Typically, people consider a fluid of constant density as in the figure.
- The energy drives the turbulent wake comes from **kinetic energy in the fluid.**

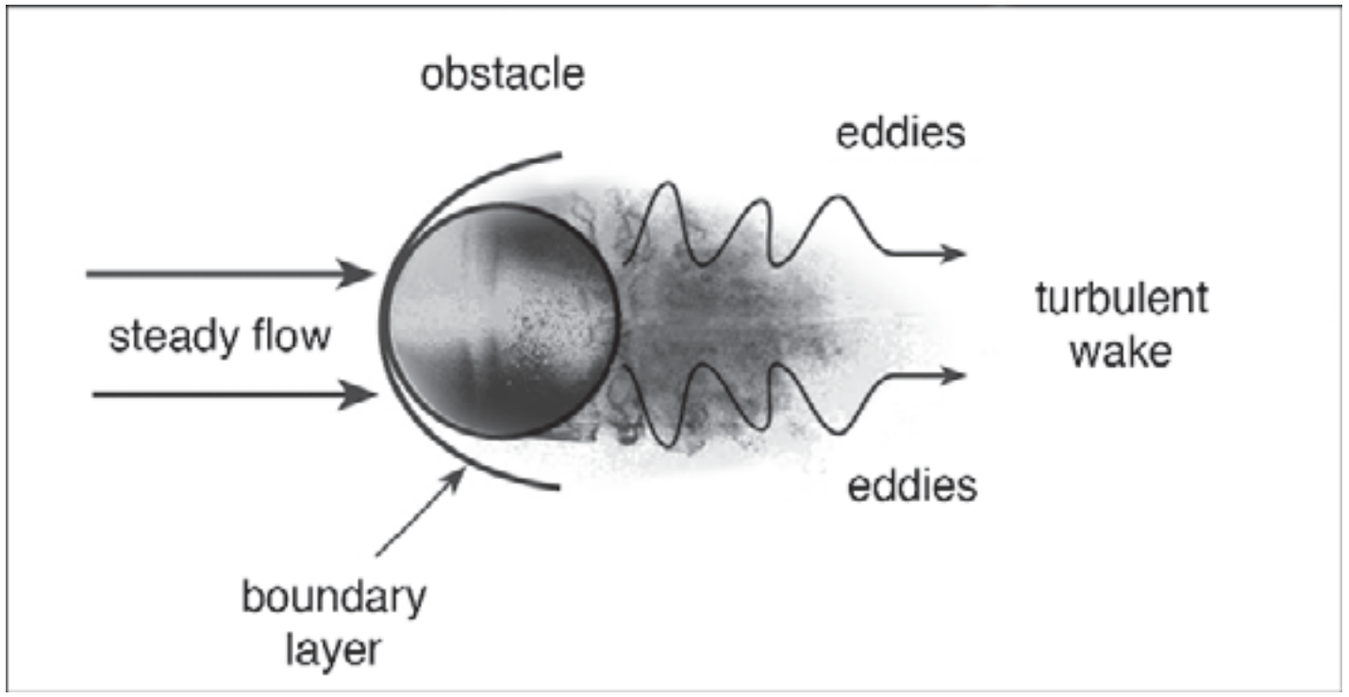


Fluid dynamics on earth

- This type of problems can be studied experimentally or mathematically (Fluid dynamics class by Prof. Noh).

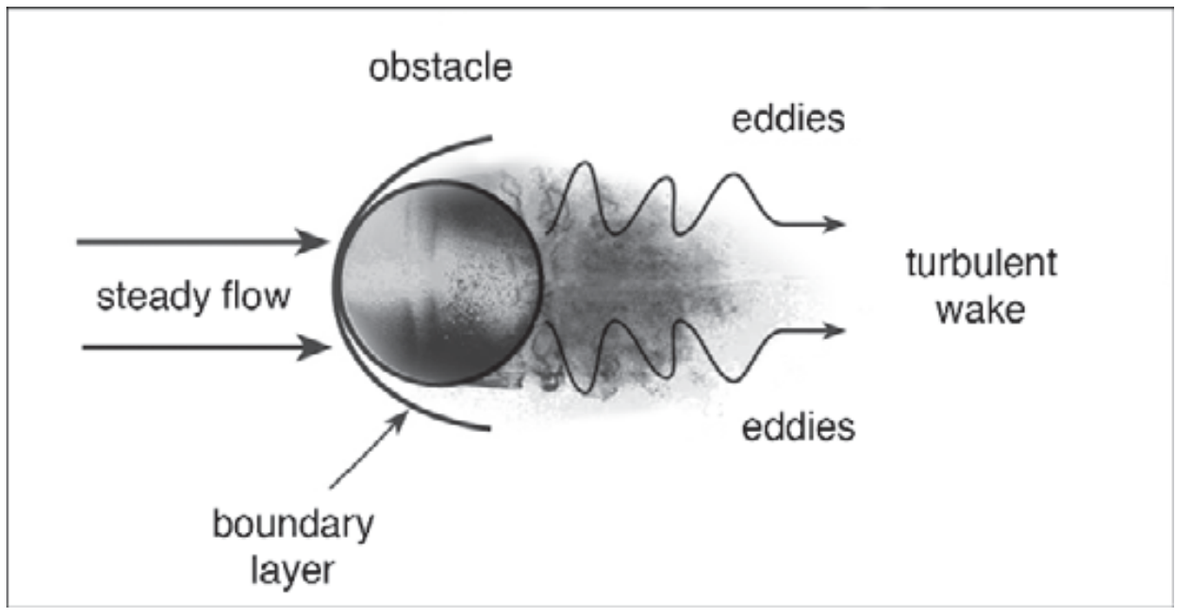
- **But it is not directly applied to the atmosphere or the ocean because of the assumption of the constant density.**

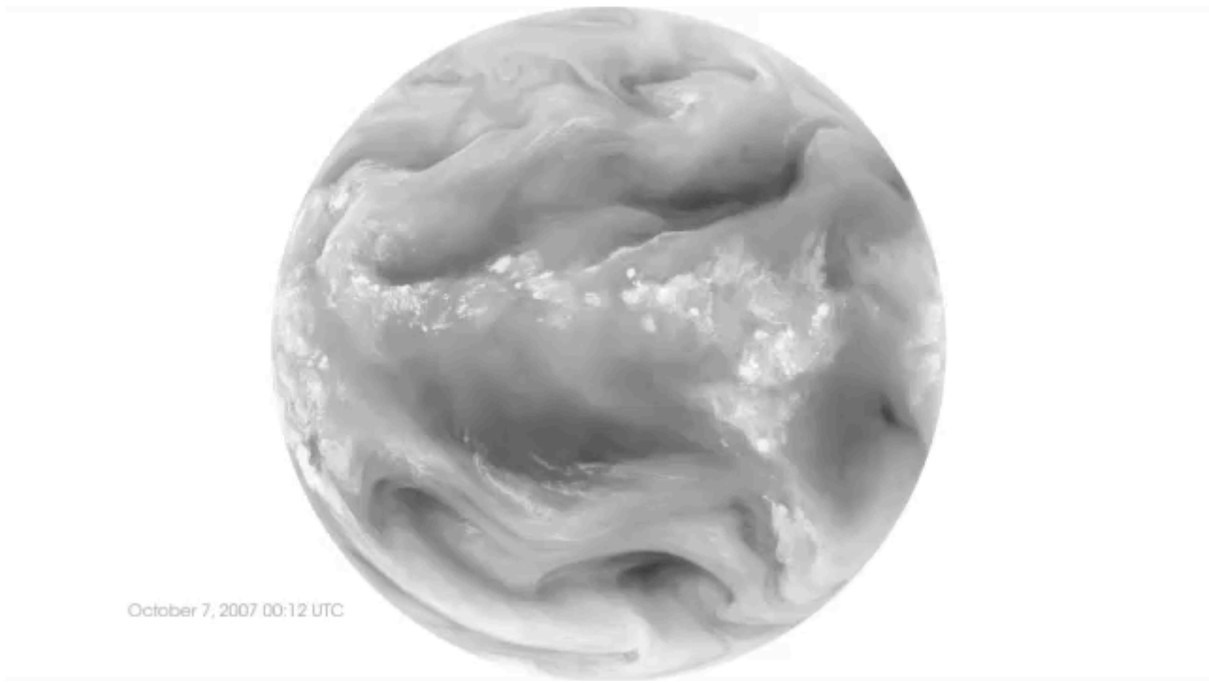
- **Or more precisely,** $\rho = \rho(P)$



Fluid dynamics on earth

- There is a resemblance to the atmosphere…





the distribution of water vapor over
Africa and the Atlantic Ocean

- But there is a fundamental difference between them.

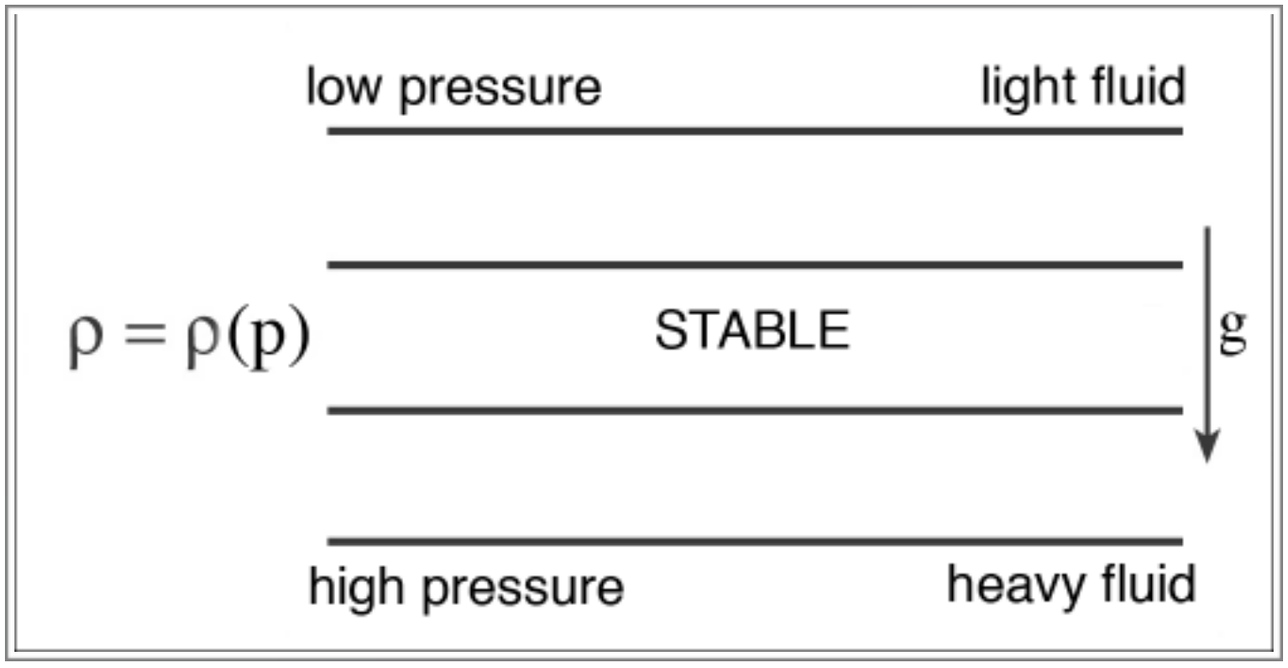
Fluid dynamics on earth

- Let's consider that the atmosphere and ocean is no different from the classical fluid dynamic problem.

$$\rho = \rho(P)$$

- Because of gravity, pressure increases downward.
- In a stable state, light fluid is always on top of heavy fluid.
- Also, assume that there is no obstacles to bend the fluid.
- What do you expect to see?

Fluid dynamics on earth



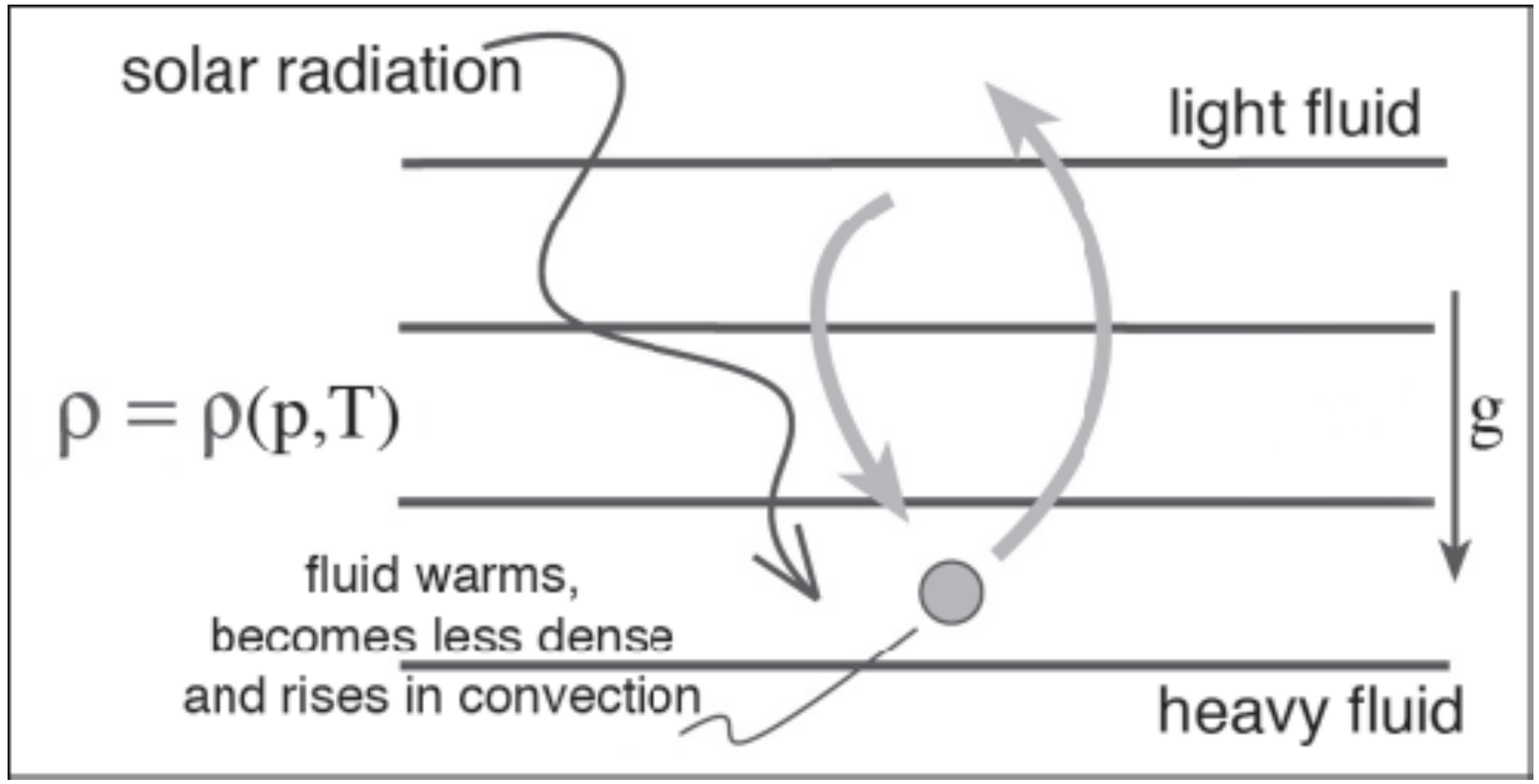
Fluid dynamics on earth

- Our earth is a lot more dynamic place!
- The key component is

$$\rho = \rho(P, T)$$

Fluid dynamics on earth

- Heating and cooling change the density of the fluid, making dynamical motions.
- Thermal energy can be converted to kinetic energy.

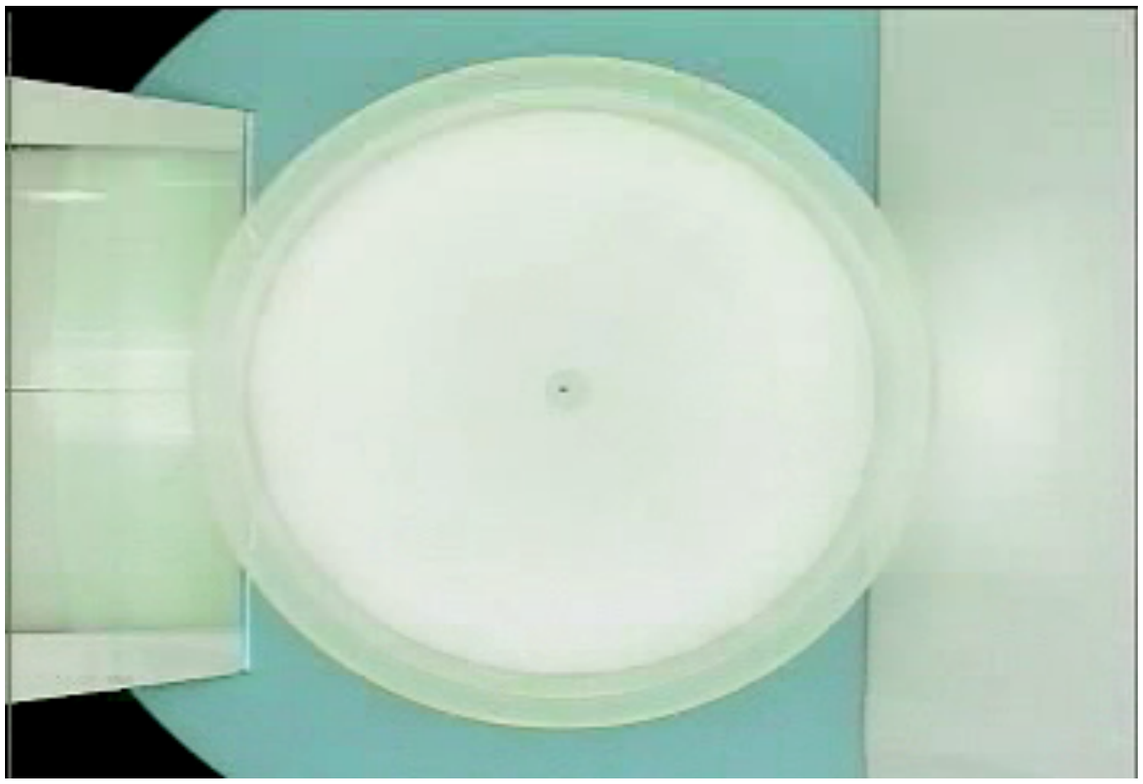


Fluid dynamics on earth

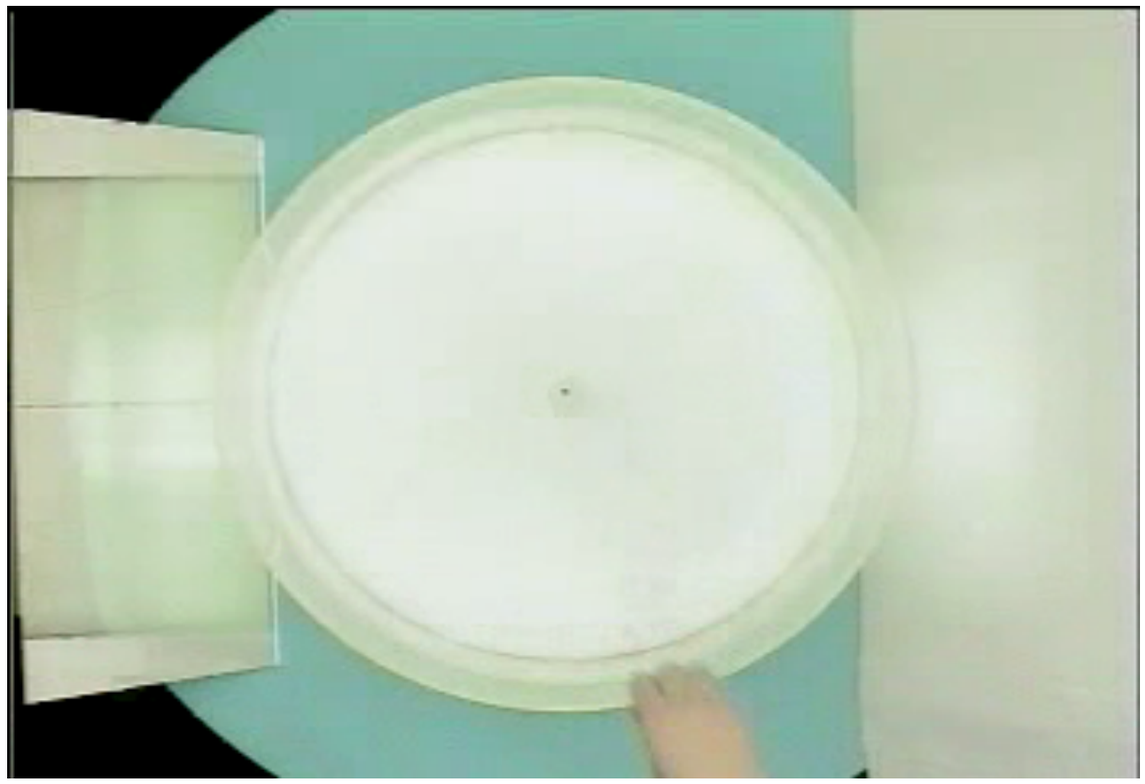
- Another important ingredient in fluid dynamics on earth is

rotation

Fluid dynamics on earth



Dissipation

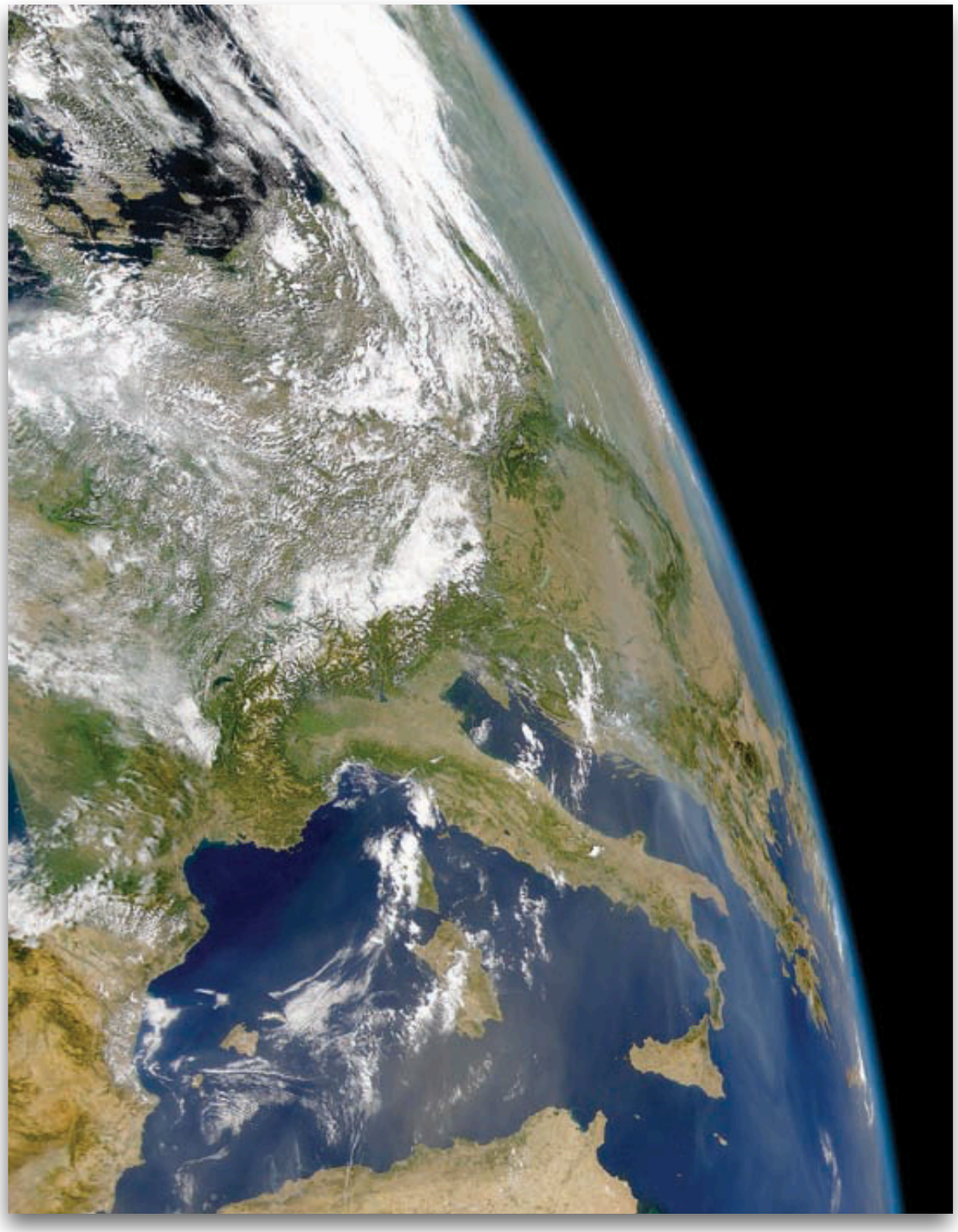


Streaks of dye falling vertically

Flows of vertical columns

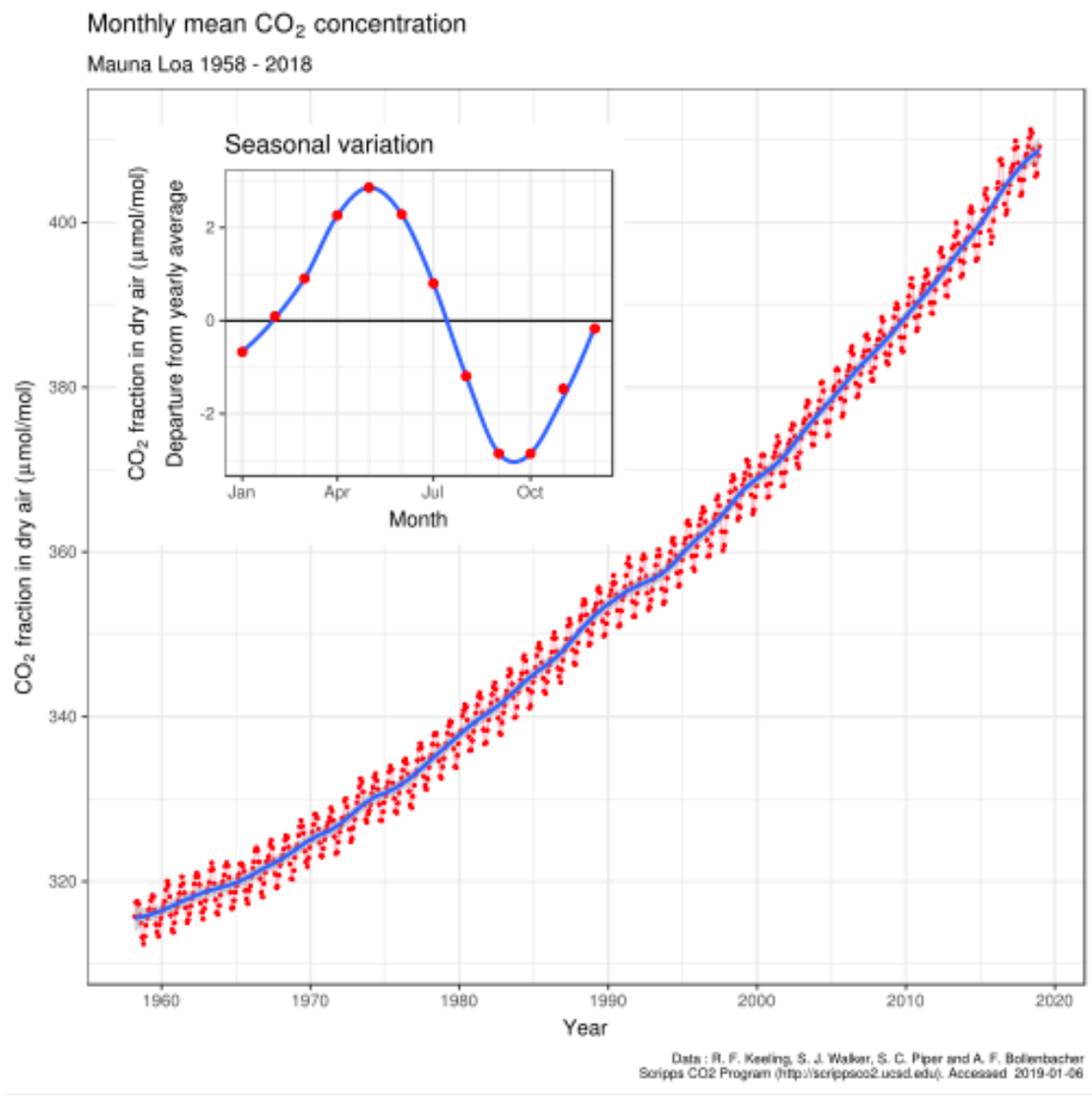
Characteristics of the Atmosphere

- Very thin
  - About 80% of the mass of the atmosphere in 10 km
  - 10 km << 6400 km
  - A constant gravity assumption
- Continuous around the globe
- Water vapor



Characteristics of the Atmosphere

- Atmospheric water vapor is present in variable amounts.
- Important for radiative transfer (greenhouse effect)
- Another gas important for greenhouse effect is CO_2.

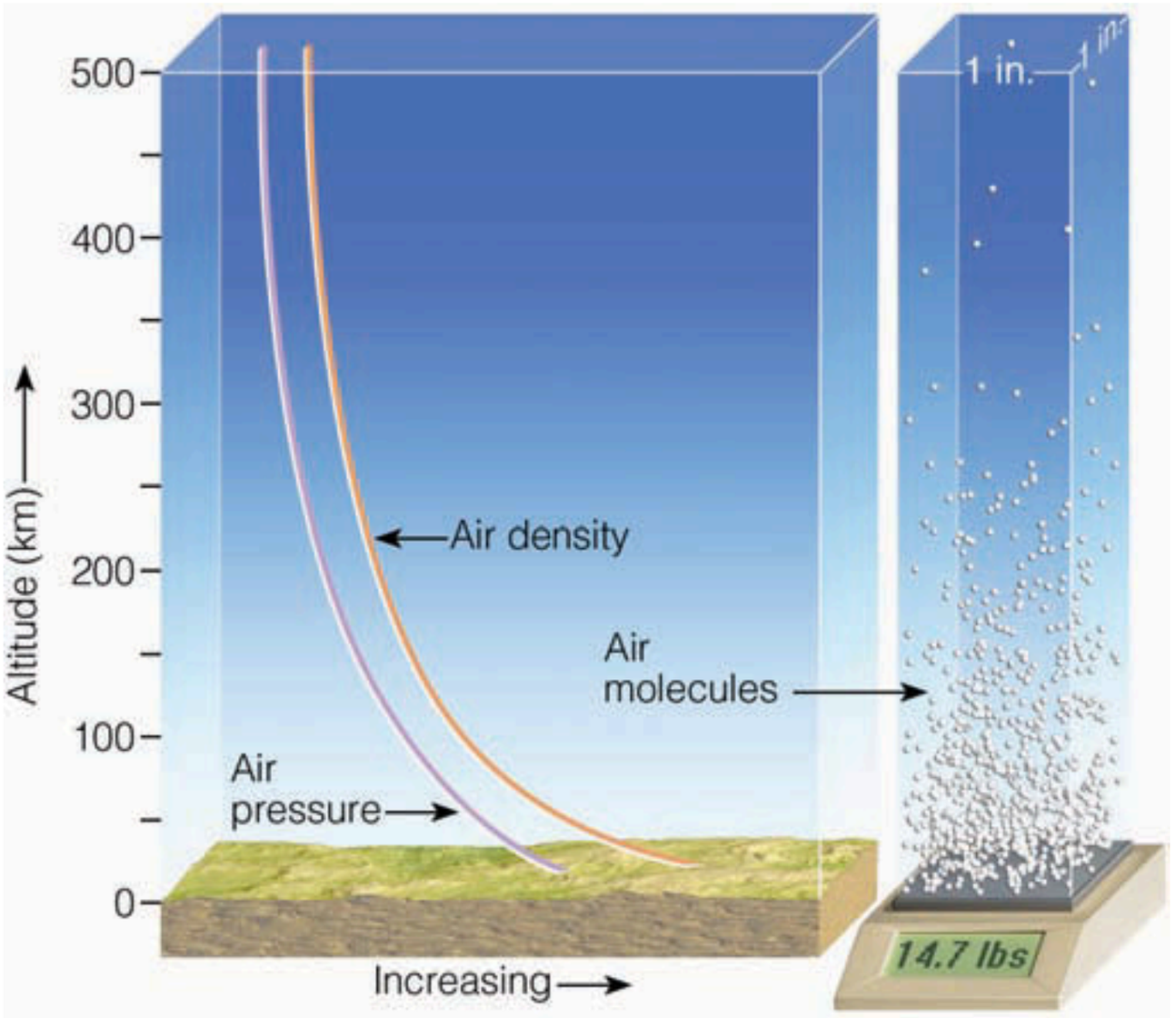


대기의 연직구조

- 밀도 (density) =
(공기분자들의 총 질량) / 부피

- 공기분자들은 지표면 근처에 많음
  - 공기 밀도는 고도에 따라 감소

- 압력 = 힘 / 면적



14.7 lbs / inch^2 ≈ 1.0335 kg / cm^2

대기의 연직구조

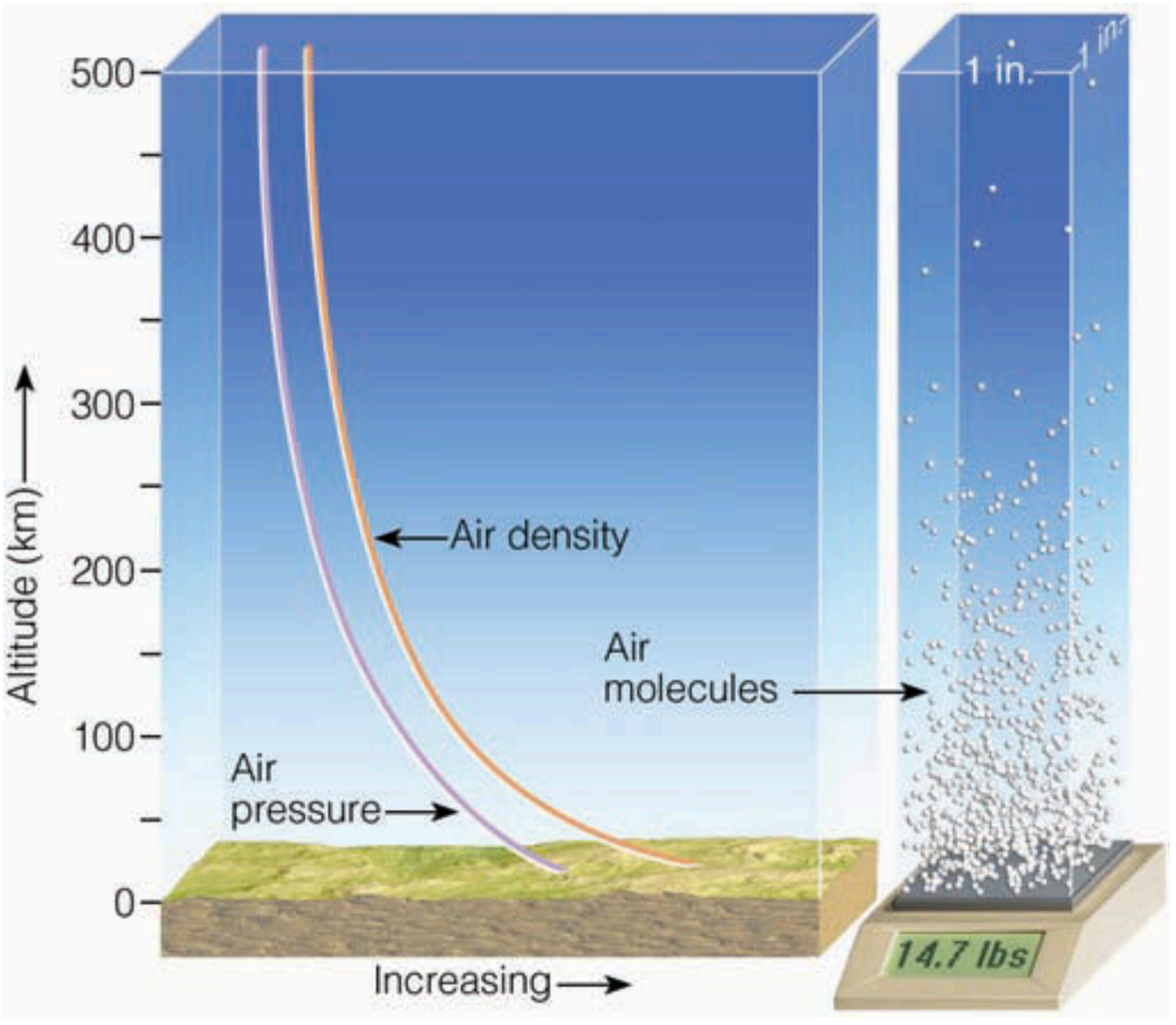
- 압력 = 힘 / 면적

  = 무게 x 가속도 / 면적

  = 1.0335 kg/cm^2

  x 9.81 m/s^2

  = 1.013 x 10^5 N/m^2



해수면 기압 = 1.013 x 10^5 N/m^2

= 1.013 bar

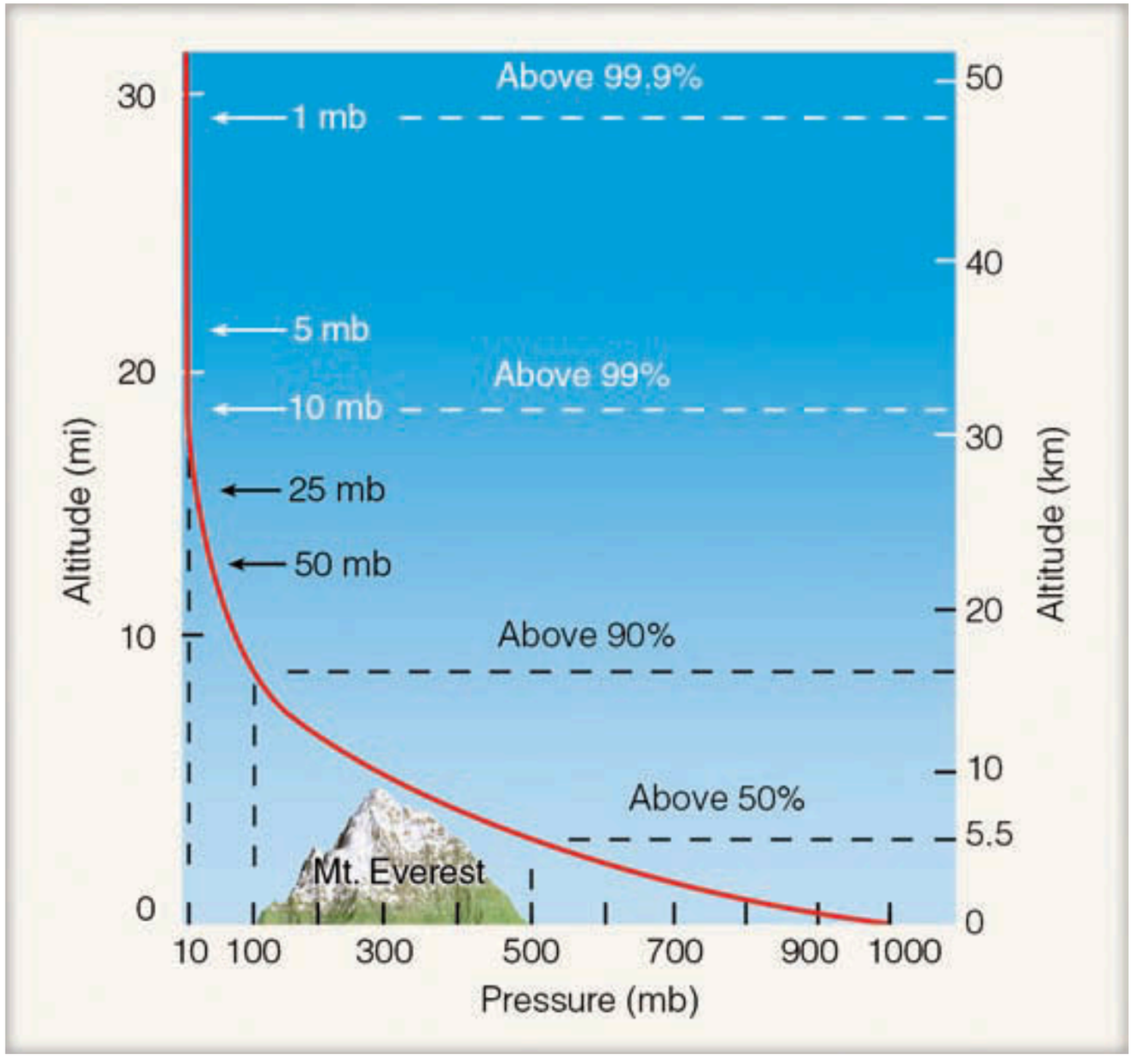
= 1013 mbar

= 1013 hPa

1 기압 = 1013.25 hPa

14.7 lbs / inch^2 ≈ 1.0335 kg / cm^2

고도에 따른 기압


Above 99.9%
1 mb
5 mb
Above 99%
10 mb
25 mb
50 mb
Above 90%
Above 50%
Mt. Everest
Altitude (mi)
Altitude (km)
30
20
10
0
50
40
30
20
10
5.5
0
10 100 300 500 700 900 1000
Pressure (mb)

대기의 층

- 대류권
  - 온도 감소 (평균 6.5°C/1km)
  - 날씨
  - 대류권계면
- 성층권
  - 온도 증가 (오존층)
- 중간권
  - 낮은 공기밀도
- 열권
  - 우주선 궤도영향 (Solar Max, Mir)