

Introduction to Geophysical Fluid Dynamics

scales + processes relevant to atmosphere + ocean

$$\vec{F} = m\vec{g} \text{ for air + water}$$

LARGE SCALE
↑
SMALL SCALE
↓

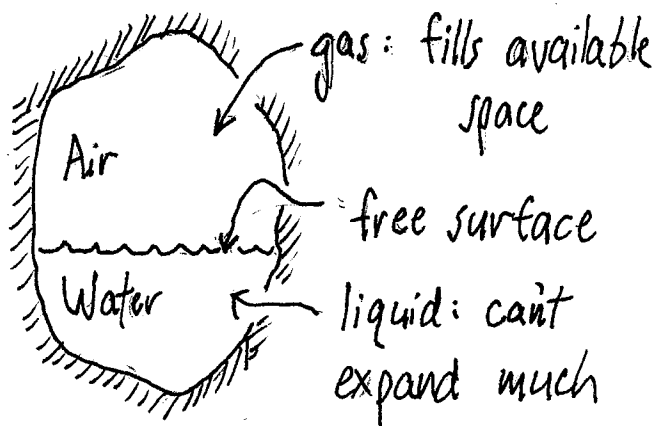
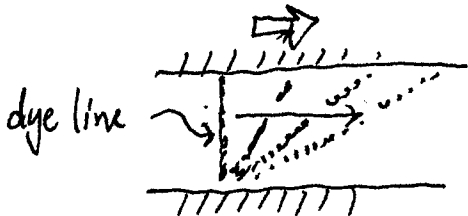
Human made	Natural	Waves
Global Warming	Climate	Tides
	Ocean Gyres	Rossby waves
	Weather	Internal Waves
	Clouds	
Supersonic Flight		
Irrigation / Dams		
Windmills		
Light aircraft		Surf / Sound
Refineries	Birds + Fish	
Cooking / Plumbing	Lungs / Heart	
Combustion		Capillary
Lubrication	Zooplankton	
	Flagellates	
	Bacteria	
	Fluid Continuum	
	Molecular interactions	

ROTATING
STRATIFIED
TURBULENT
VISCIOUS

FLUID - a large collection of interacting molecules

- no preferred shape

- deforms continuously under shear stress



CONTINUUM HYPOTHESIS:

Averaging over many molecules & their interactions we find macroscopic fluid properties

- density
- velocity
- pressure
- temperature
- viscosity
- etc....

e.g. for air: $\sim 10^{17}$ molecules / mm^3

mean free path $\sim 5 \times 10^{-8}$ m

a molecule has ~ 5 collisions every nanosec (10^{-9} s)