CE 30460 – Fluid Mechanics

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Course Objectives

- Learn the fundamental physics behind fluid flows
- Apply these principles to solve engineering problems
- Acquire basic knowledge for other courses such as
  - Hydraulics
  - Hydrology (Groundwater)

What is Fluid Mechanics

A couple of questions

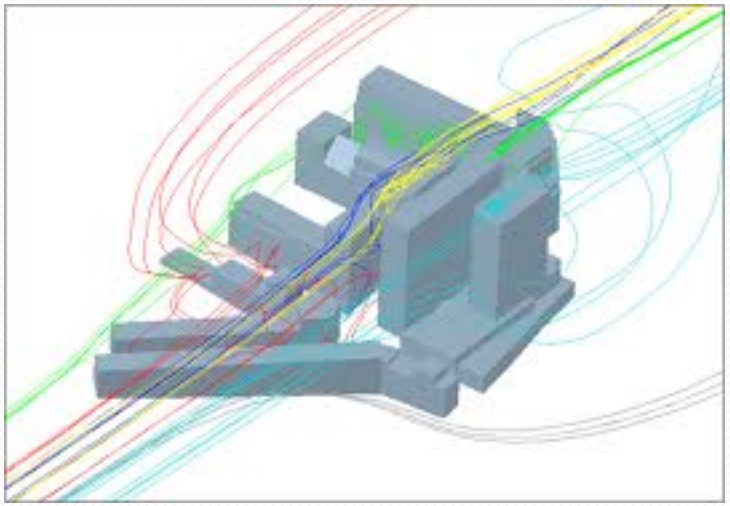
- Why do engineers care about fluid mechanics?
- Why do civil engineers care?
- Why should you specifically care?

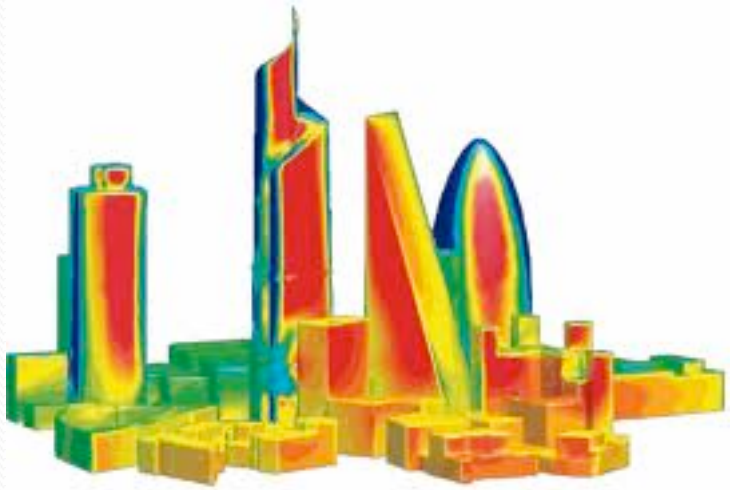
Breakout session (1 minute)

Let's take a look at our department

http://nd.edu/~ceees/

Structural Engineering





Flow around buildings – Forces that must be understood

Take a look at:

http://www.nd.edu/~nathaz/

http://www.nd.edu/~cpssl/

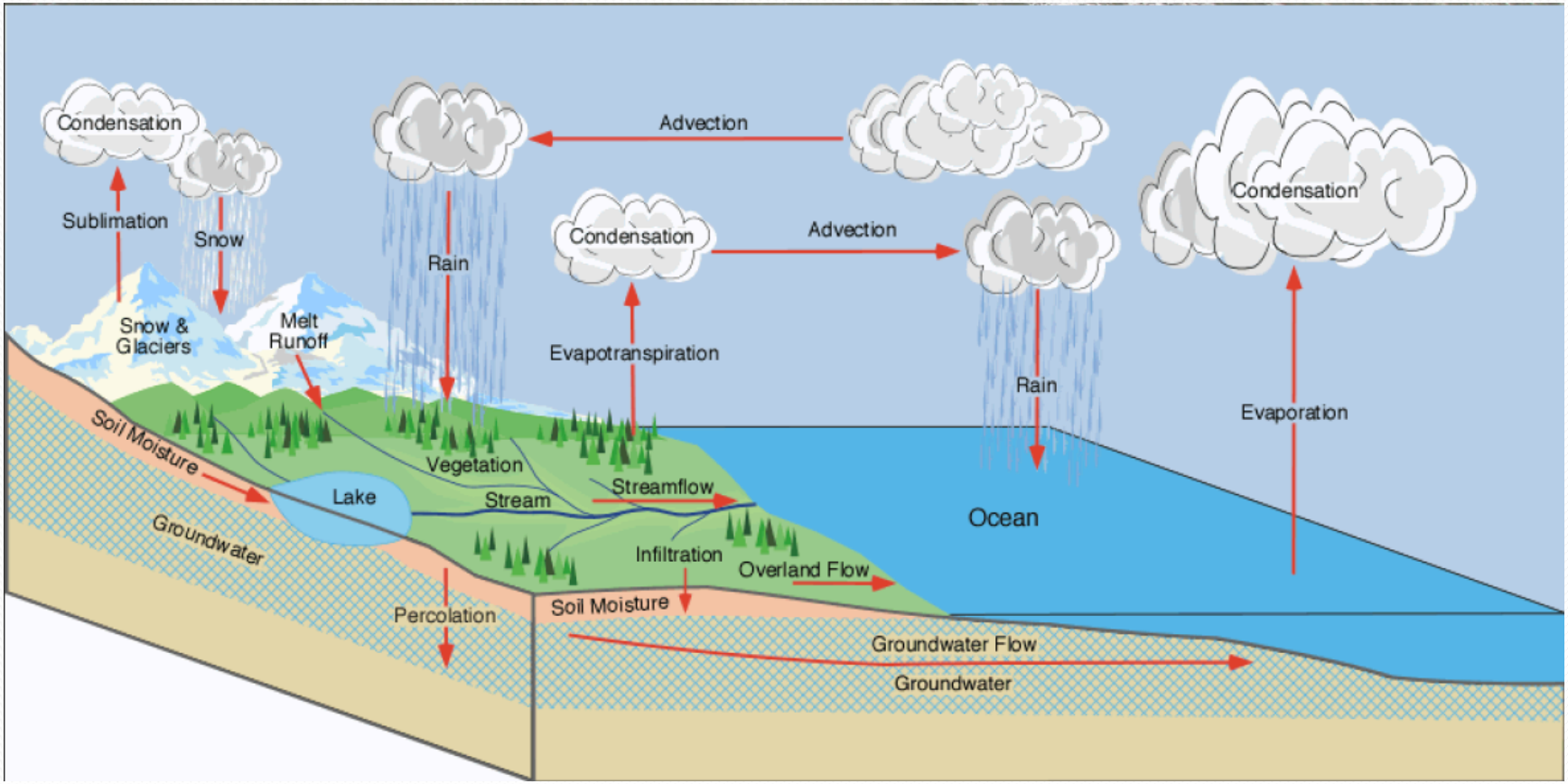
Other Structural Problems

Geotech

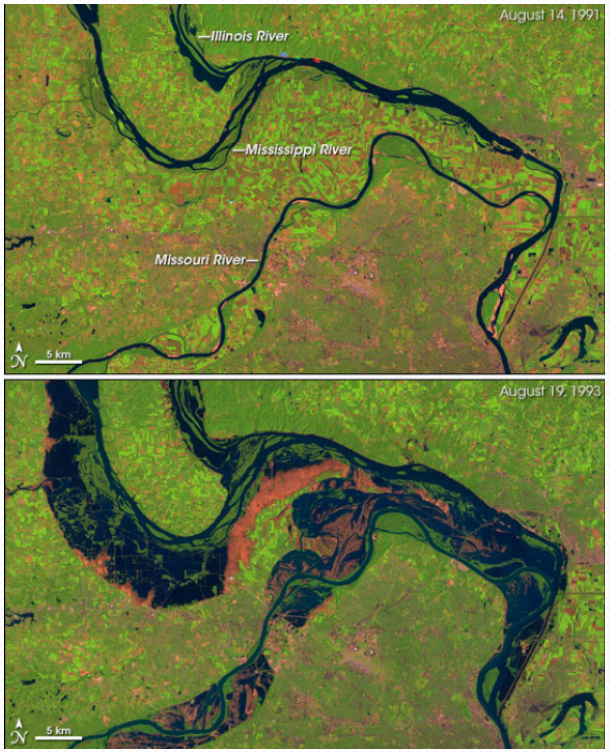
Dams, Hydroelectric Plants, Flood Control

Environmental Fluid Dynamics

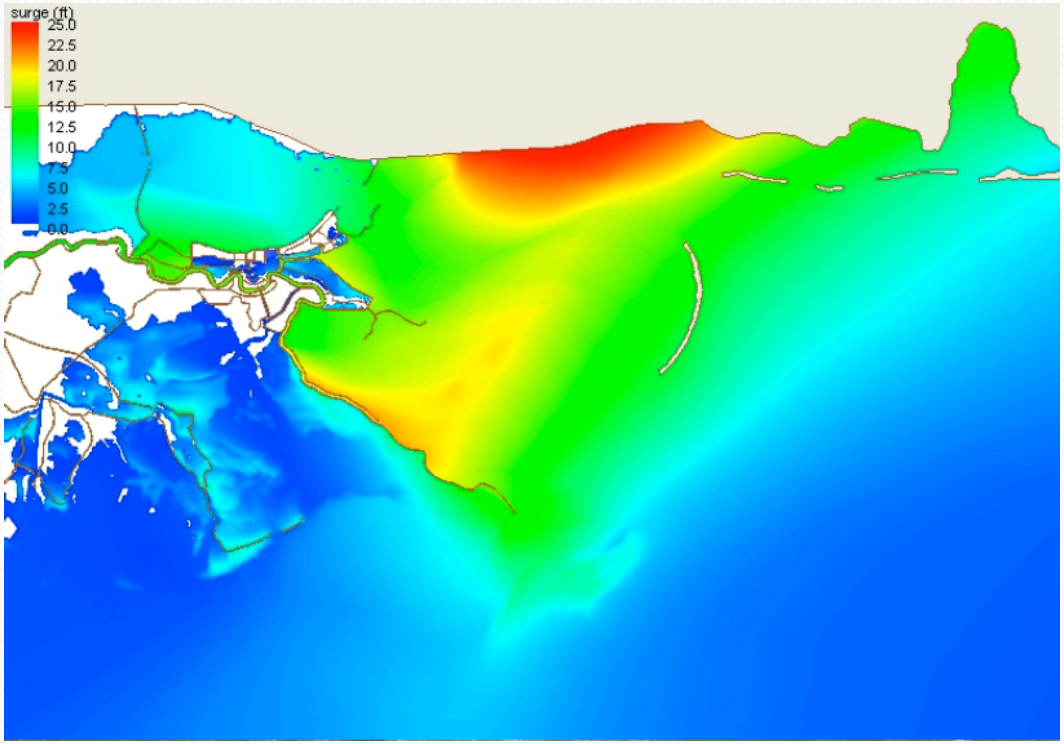
Water Cycle



River/Canal Dynamics



Predicting Hurricanes



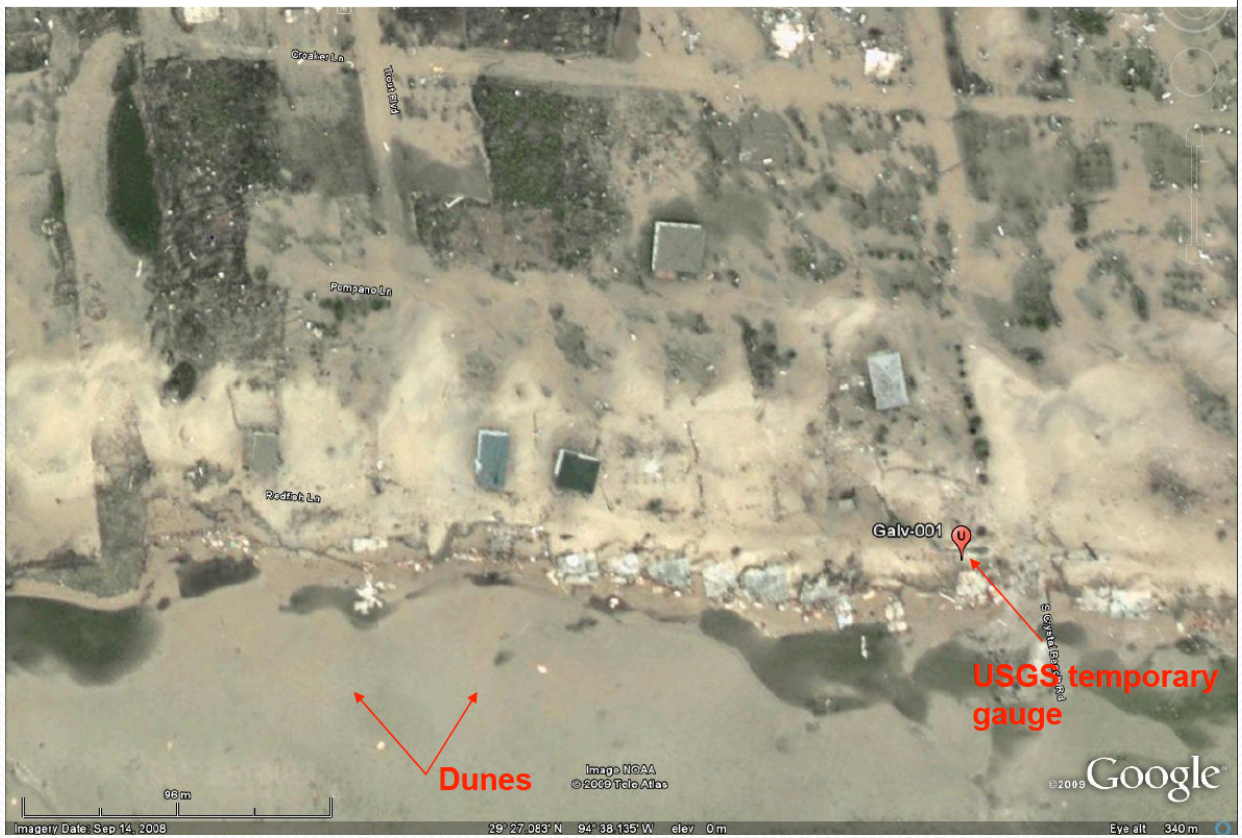
http://nd.edu/~coast

Hurricane Damage

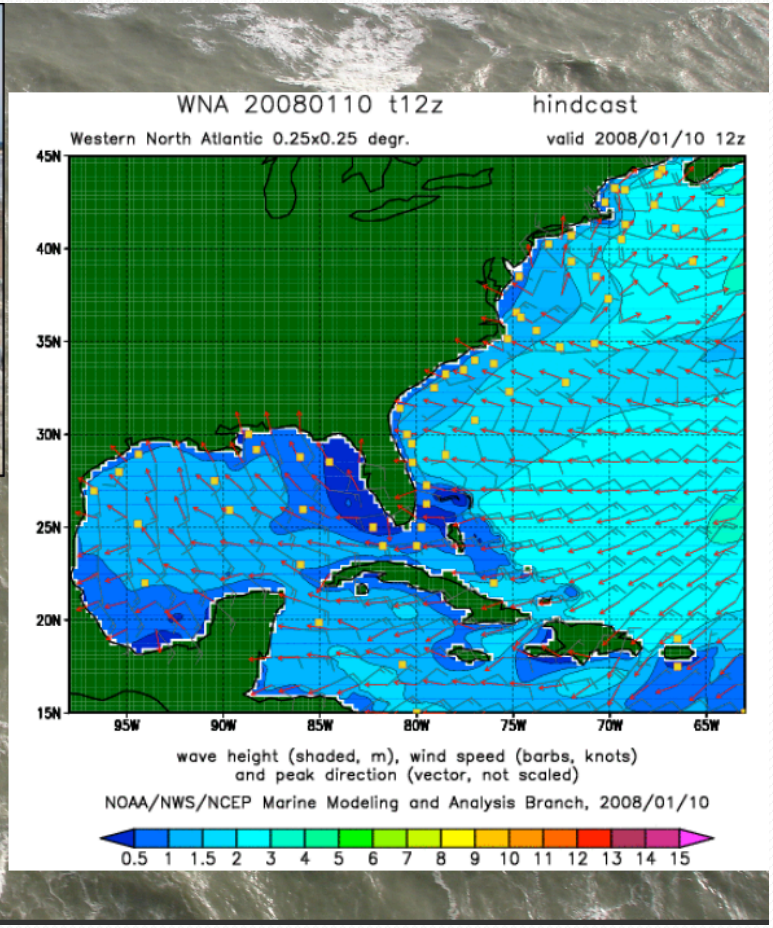
Bolivar Peninsula, Pre-Hurricane Ike

Hurricane Damage

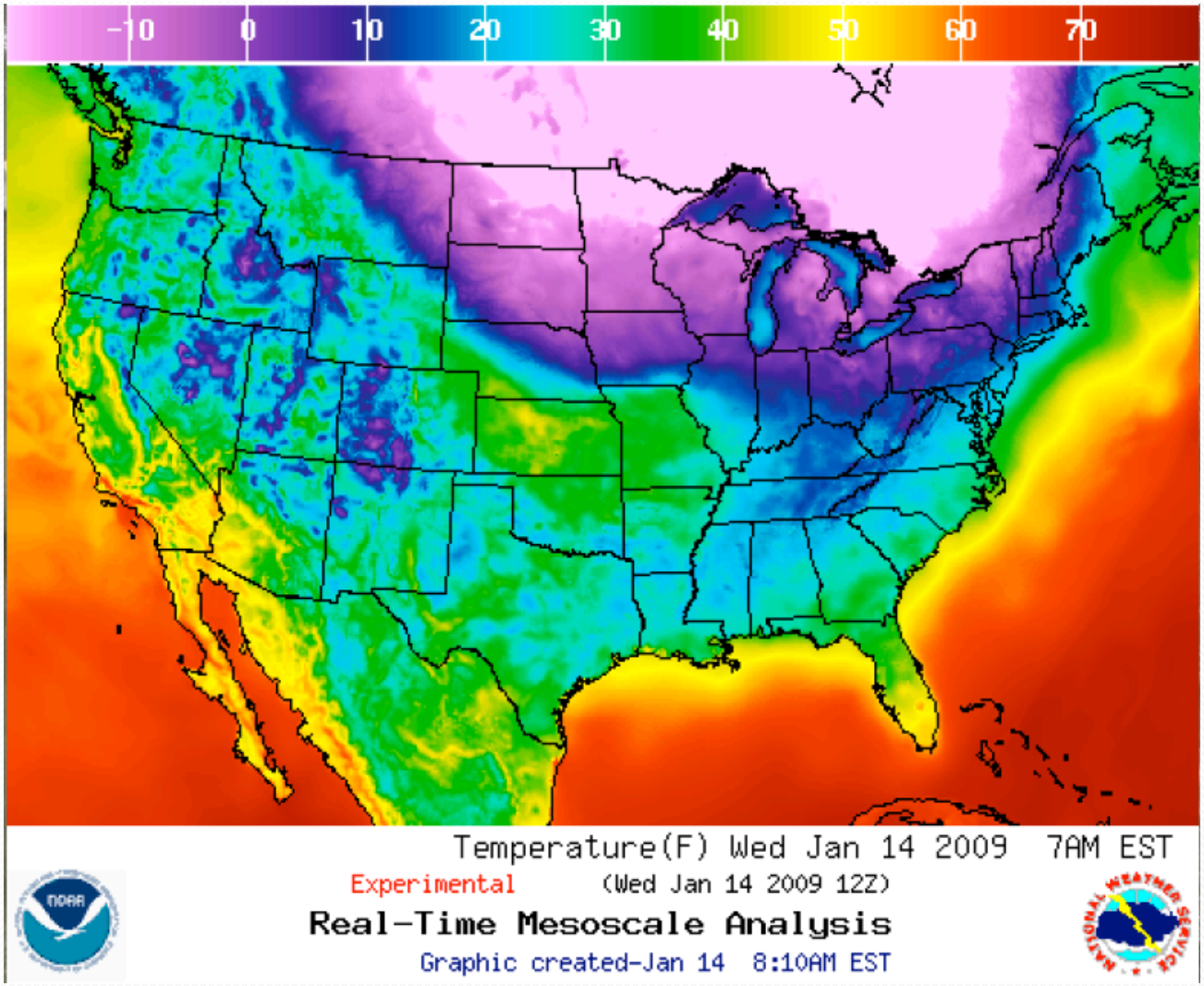
Bolivar Peninsula, Post-Hurricane Ike



Coastal Erosion (Slower, but Severe)

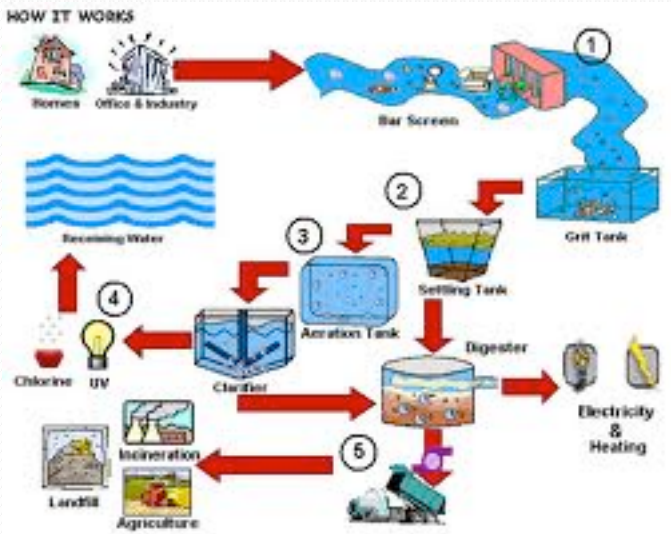


Atmospheric and Ocean Science

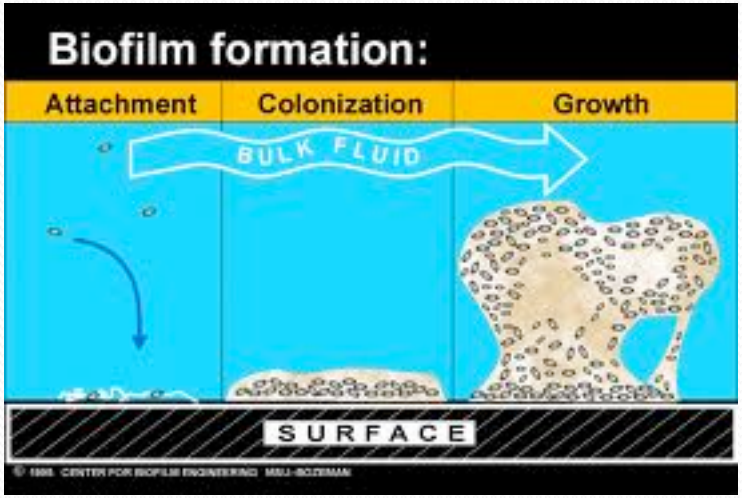


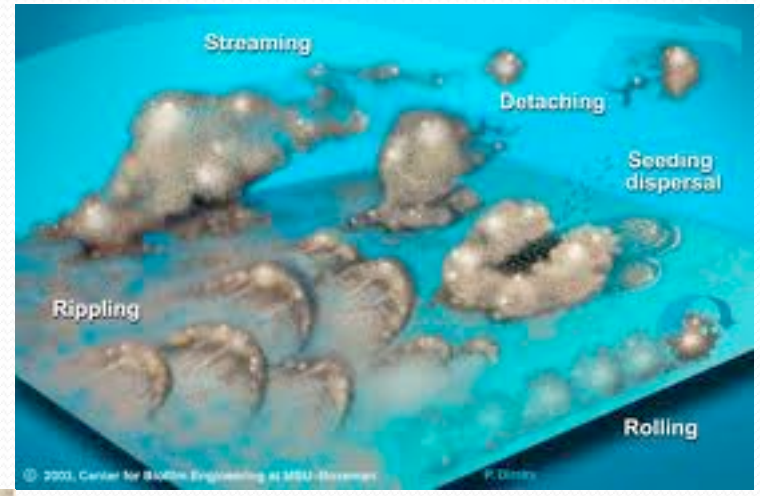
Environmental Engineering

Wastewater Treatment



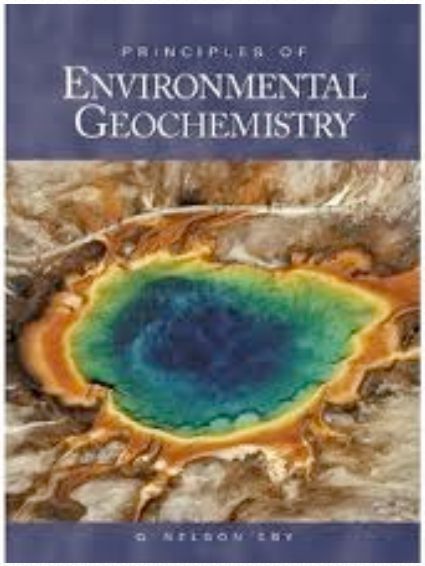
Biofilms


Biofilm formation:
Attachment
Colonization
Growth
BULK FLUID
SURFACE


Streaming
Detaching
Seeding dispersal
Rippling
Rolling

Pollutant Transport

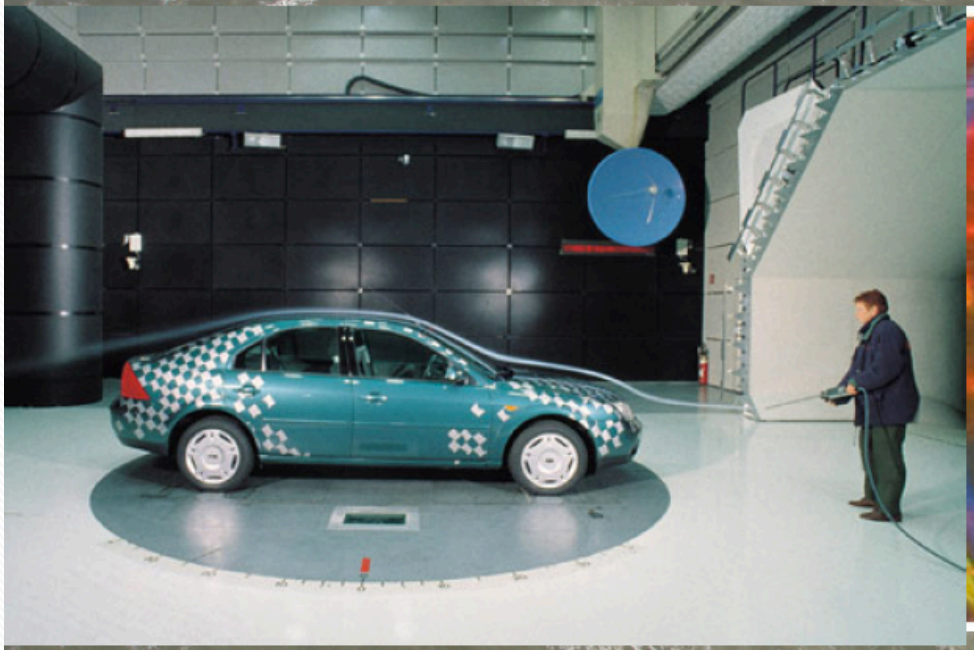
Earth Sciences (most of you are Engineers I know)



General Engineering Applications

Infrastruture

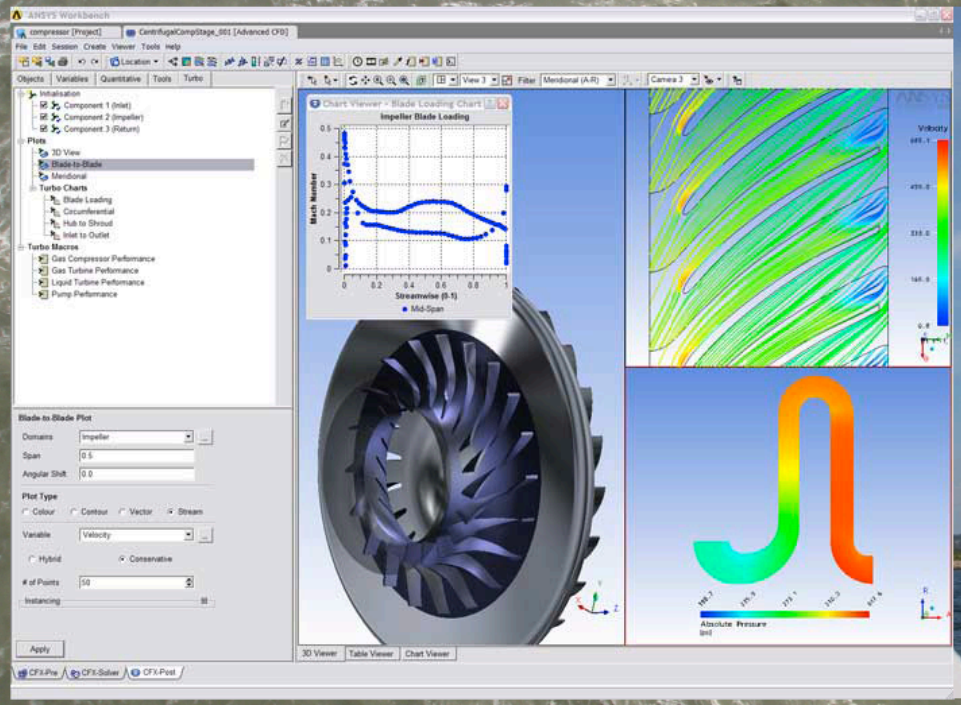
Model Testing



Full scale

Small scale

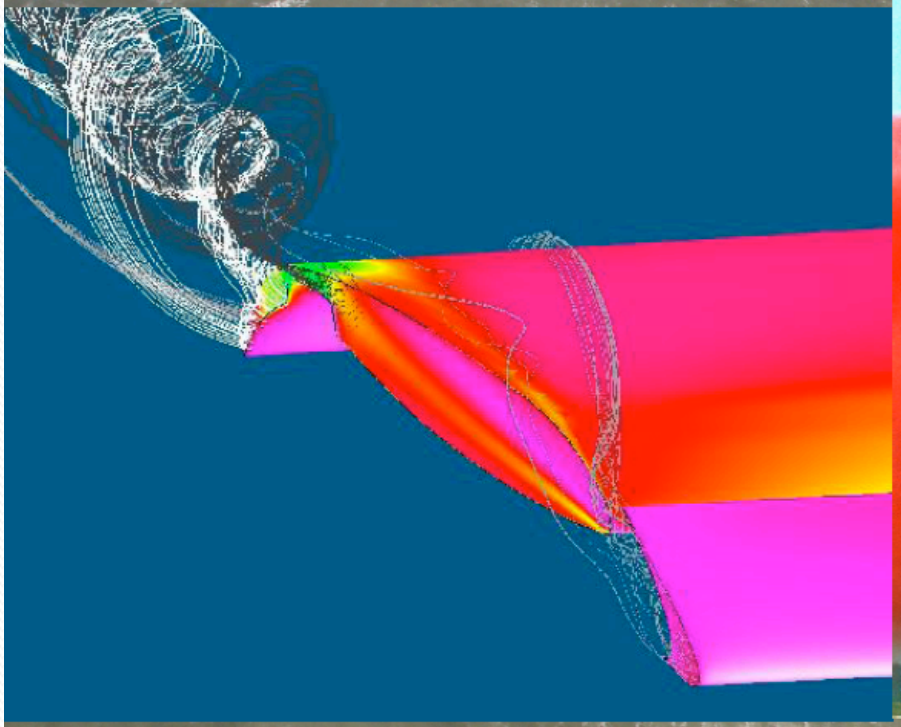
Turbomachinery-pumps, turbines



Turbine impeller

Wind Turbine

Computational Fluid Dynamics (CFD)



Computed Vortex

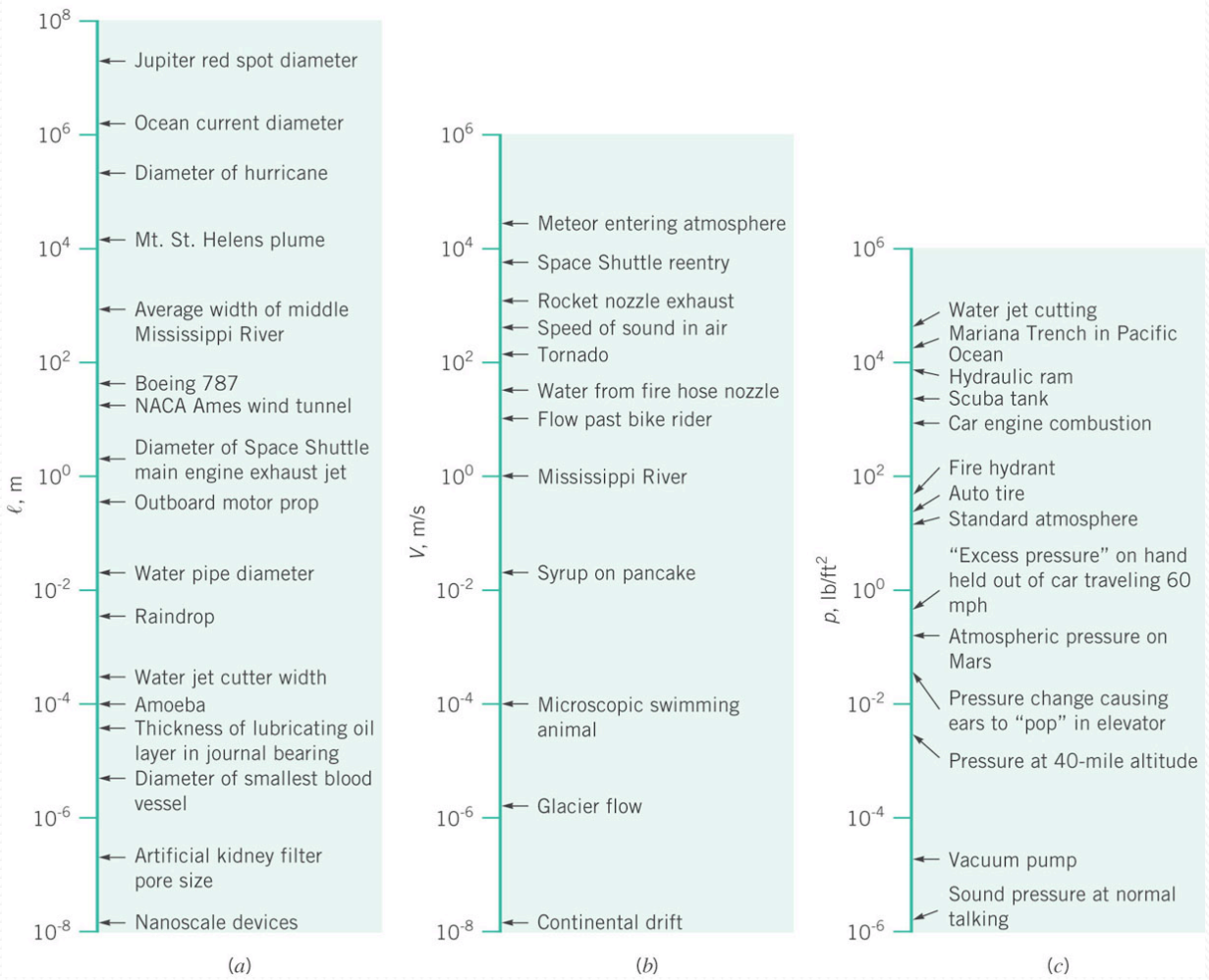
Actual Vortex

Fluid Dynamics in the News

- Kelvin Helmholtz Waves in Alabama:
  - http://www.alabamawx.com/?p=55225
  - http://www.youtube.com/watch?v=dcwOn4VeJOE
- News stories relating to fluids research
  - http://www.physorg.com/tags/fluid+mechanics/
- Stories about professors in our department:
  - http://newsinfo.nd.edu/news/22057/
  - http://newsinfo.nd.edu/news/22131-engineering-professors-receive-muri-grants/
  - http://newsinfo.nd.edu/for-the-media/nd-experts/faculty/joannes-westerink/
  - http://newsinfo.nd.edu/news/25718-researcher-ndrew-kennedy-is-observing-hurricane-irene-s-storm-surge/
  - http://newsinfo.nd.edu/news/16293-silliman-named-darcy-distinguished-lecturer-in-ground-water-science/

Scales of Interest – HUGE VARIATION

very few other subject you study will be this wide



Course Outline

- Ch 1: Fluid Properties
- Ch 2: Hydrostatics
- Ch 3: Bernoulli's Equation
- Ch 4: Kinematics
- Ch 5: Control Volumes
- Ch 6: Differential Analysis
- Ch 7: Similitude and Dimensional Analysis
- Ch 8: Pipe Flows

Notes

- This is a mechanics (fundamentals) class and one of the last you may have
  - Be patient – fundamentals are necessary to understand and solve more complicated and interesting problems

Notes

- In class demos will try to illustrate some of the basic physics
- You are encouraged to suggest in class demos and topics of discussion that are of interest to you (we will try to oblige).