MET 4410 Remote Sensing: Radar and Satellite Meteorology
MET 5412 Remote Sensing in Meteorology

Lecture 1: Introduction and overview

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Introduction

- Please see instructor's self-introduction on Canvas (under course home)
- Please go over the full syllabus on Canvas
- Please print out the simplified syllabus under Module 1
- Please pay special attention to **Discussion, Quizzes, Assignments, Late Policy, and Course Calendar sections** under syllabus for course modules, topics, and assessment due dates.

What is Remote Sensing?

- **Sensing**: Using instruments/devices to measure parameters

  Examples: Thermometers measure temperature, radar guns measure the speed of passing cars

- **Two categories of sensing**: **in-situ sensing** and **remote sensing**

- **In-situ sensing**: **In-situ sensing/measuring devices are in contact with the medium or object they are sensing**.
  - Numerous in-situ sensing devices are used to measure meteorological conditions. These devices can be found at ground level, in the water, or in the air. Some buoys, such as the one shown in the photo below (left), measure certain meteorological conditions at sea
  - Think of a hurricane reconnaissance plane (middle photo below) flying inside a storm. It measures atmospheric pressure and winds in-situ
  - You have probably seen devices in streams that measure water levels, such as the staff stream gauge in the photo below (right)

buoys

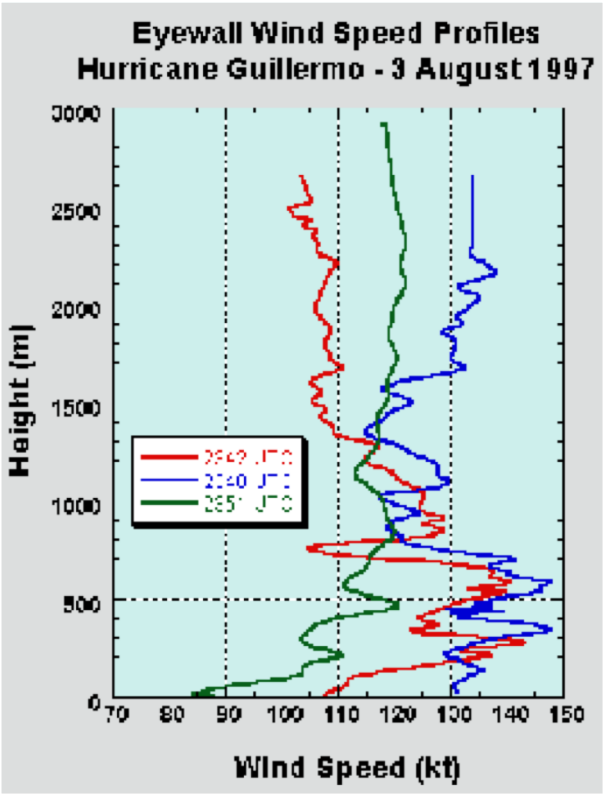
reconnaissance plane

staff stream gauge

NOAA Annual Hurricane Field Program Airborne Observations

- **In-situ measurements:**
  - Measure wind, pressure, temperature
- **Expendables**
  - Dropsondes
  - AXBT, AXCP, buoy
- **Remote Sensors**
  - Doppler Radar
  - SFMR (stepped frequency microwave radiometer)
  - DWL (ONR)
  - WSRA
  - Scatterometer/ profiler
  - UAS (unmanned aircraft system)

Dropsondes



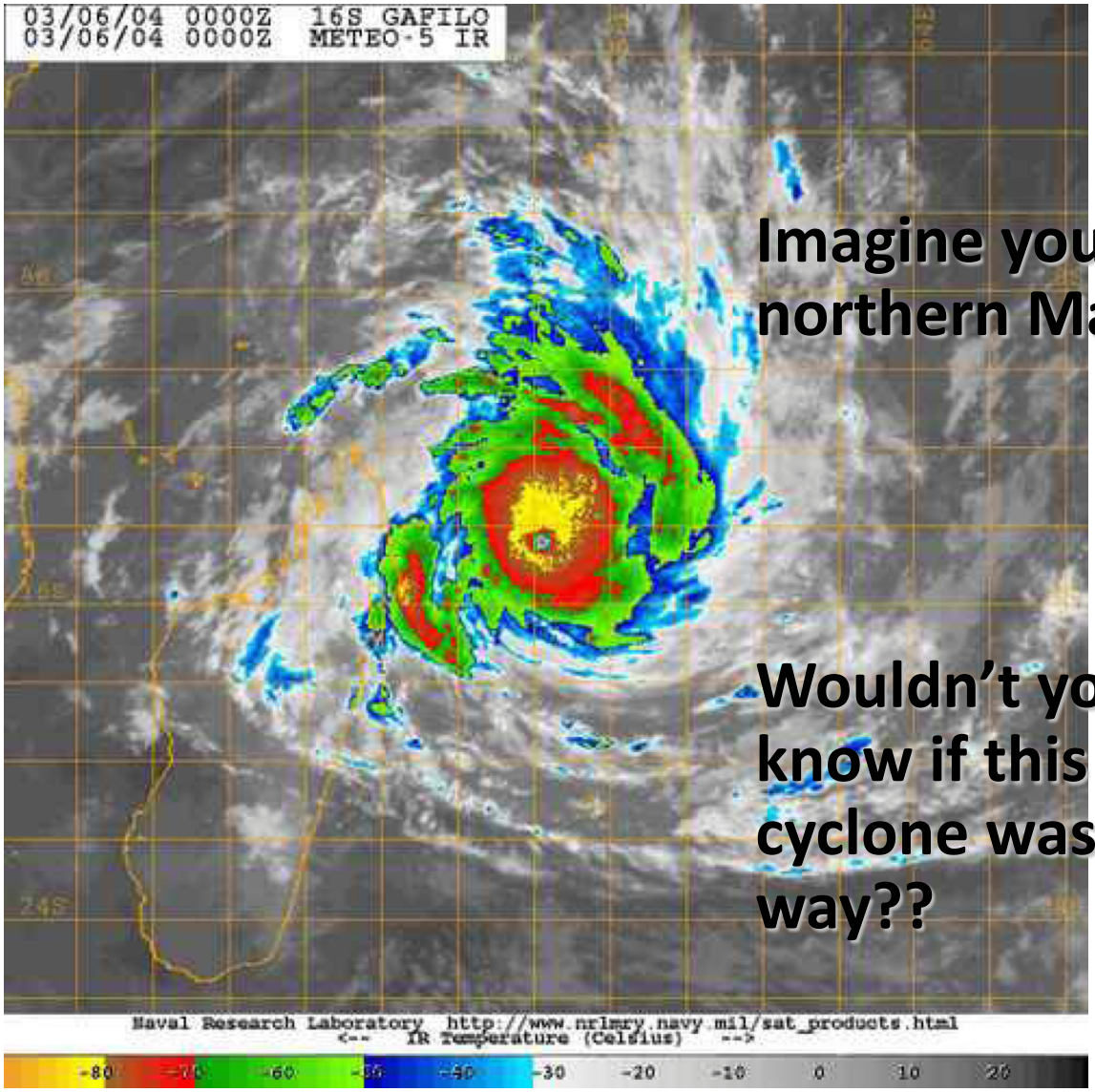
What is Remote Sensing? (Cont.)

- Remote Sensing :

  Remote sensing measurement devices are *not* in direct contact with the objects they sense.

- Example of Remote Sensors:
  1. Camera
  2. Satellite visible sensor
  3. Metal detector
  4. X-ray
  5. Radar

Why Remote Sensing?

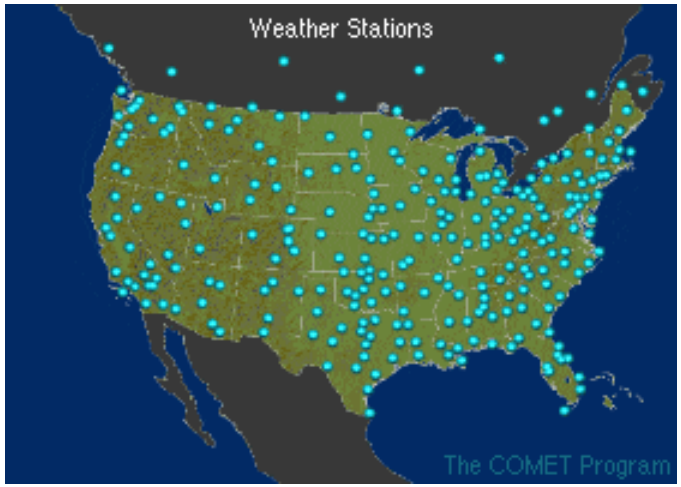


Imagine you are living in northern Madagascar.

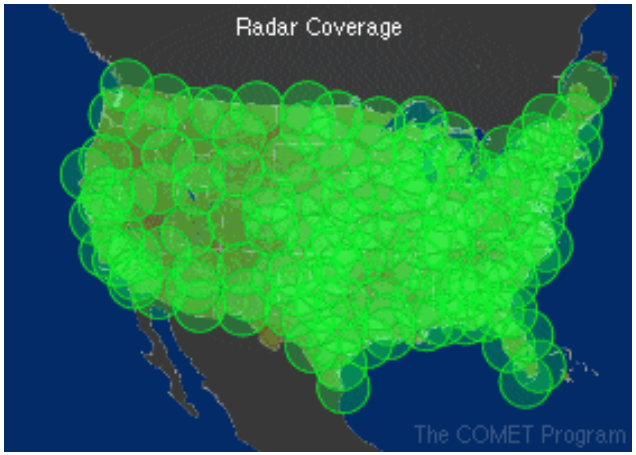
Wouldn't you want to know if this tropical cyclone was on its way??

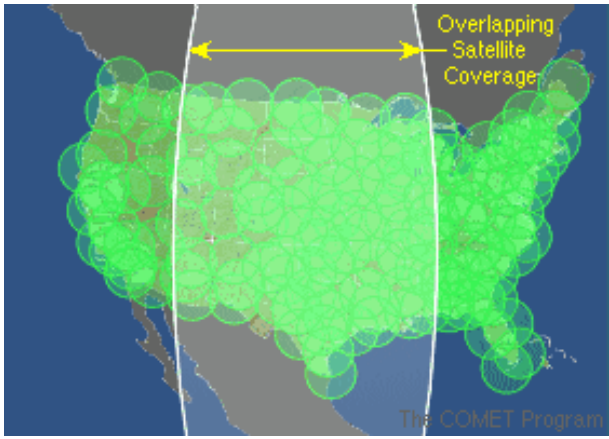
Why Remote Sensing? (Cont.)

- In-situ 'observing' network of stations have gaps spatially and temporally.



- Remotely sensed data (satellite and radar) are vital to operational weather forecasters because they fill in the spatial and temporal gaps left by the in-situ observing network.





Sensors versus Platforms: sensors (instruments) are carried by platforms

Meteorological Remote Sensing Platforms :

(both aircraft & satellite are platforms carrying sensors)

Meteorological Remote Sensing Sensors on Different Platforms

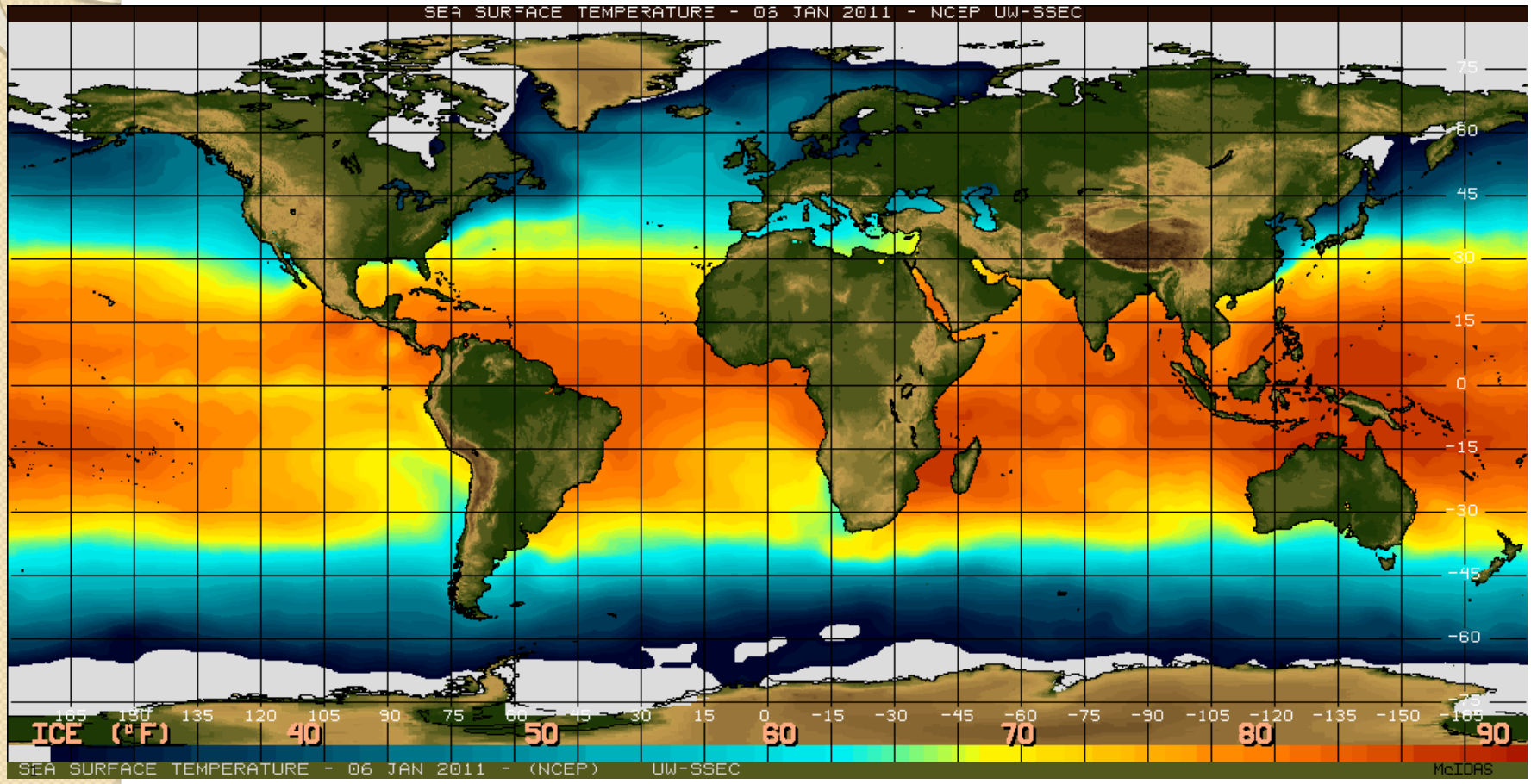
Mobile Radar (radar on truck)

Doppler Radar on Mounting Tower

Wind Profiler on Van

Using Remote Sensing

Global Sea Surface Temperature (SST)



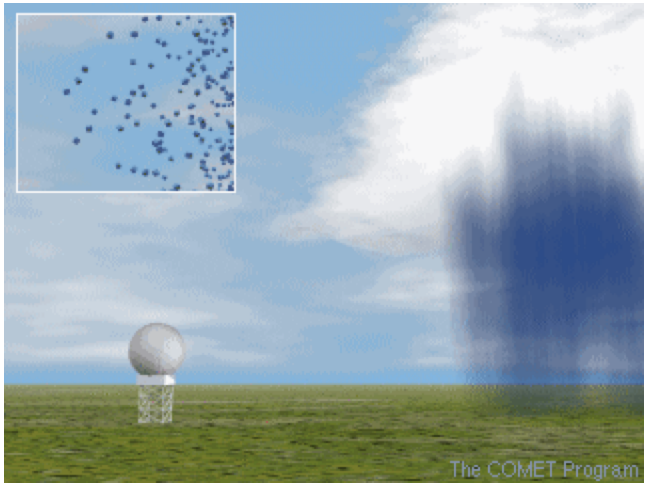
People in Remote Sensing

- Those who study the physics of light in the atmosphere, **radiative transfer.**
- Those who design and build **sensors.**
- Those who design and build **platforms.**
- Those who work on **data processing.**
- Those who develop **data applications.**
- YOU, the **data end user.**

Active vs. Passive Remote Sensing

- Active remote sensors emit electromagnetic waves that travel to an object and are reflected back toward the sensor.

  Examples: X-Ray, Radar, Lidar



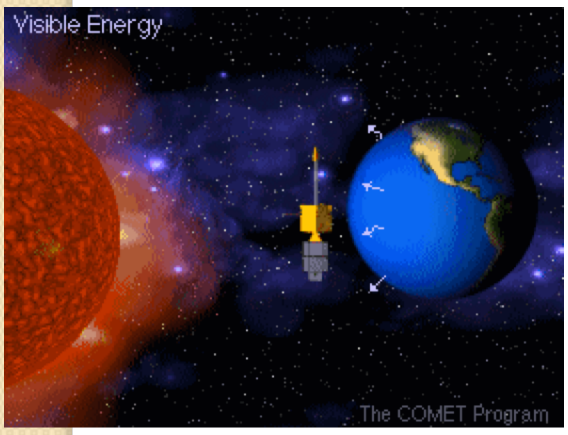
- How does radar work? Radar works by transmitting a pulse of electromagnetic energy. Objects (raindrops, ice, snow, birds, insects, terrain, and buildings) reflect that energy. Part of the reflected energy is received back at the radar. Once the radar receives the reflected signal, computer programs and meteorologists interpret the signal to determine where it is precipitating.

Active vs. Passive Remote Sensing (Cont.)

- Passive remote sensors observe electromagnetic waves emitted by objects.

  Example: Camera;
  Satellite infrared (IR), Visible, Passive Microwave sensors

- Satellite visible sensors: visible imagery is available only during daylight hours since sunlight is reflected only during that period.



- Satellite IR sensors: Infrared energy is emitted 24 hours a day from the earth's surface and the atmosphere and is sensed by satellites continuously.