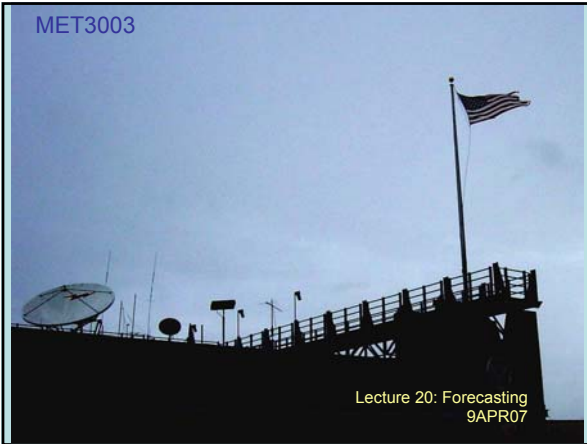


MET3003



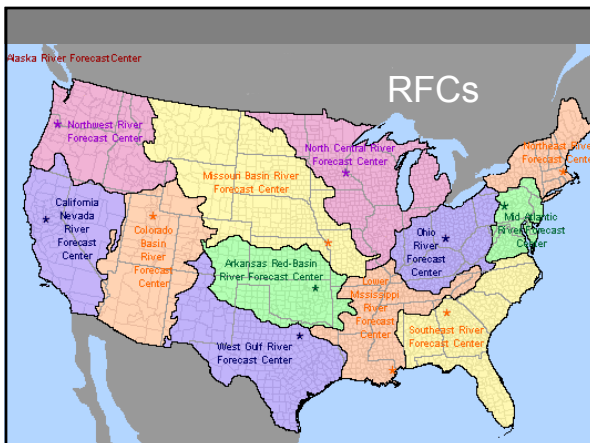
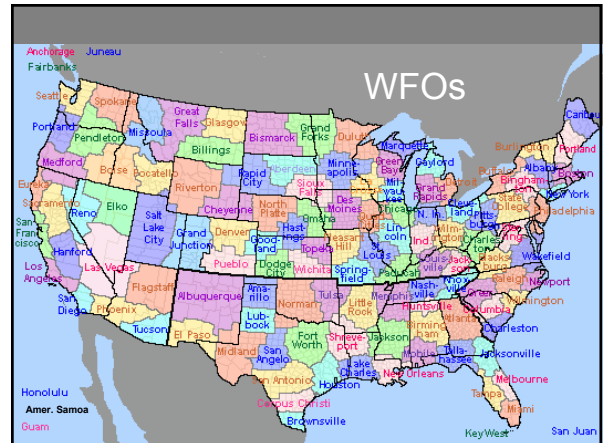
Lecture 20: Forecasting
9APR07

Weather Forecasting

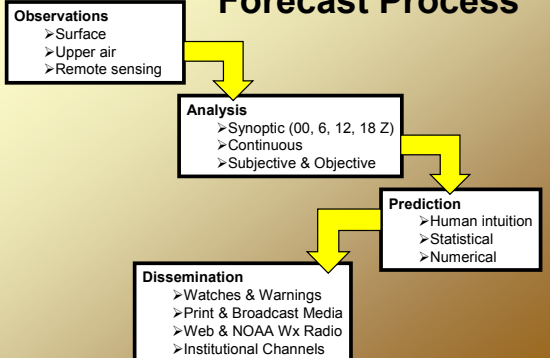
- A scientific estimate of one or more weather elements at some future time.
- Who does forecasting
 - National Weather Service (NWS)
 - Broadcast meteorologists
 - Private consulting meteorologists
 - Enterprise staff meteorologists
 - Military
 - Academics
 - Amateurs

Weather Service Organization

- **Weather Forecast Offices (WFOs)**
 - **Local responsibility**
 - 126 (119 in "lower 48" + 7 outside).
 - Organized into 6 regions
- 13 River Forecast Centers
- 6 Regional Climate Centers
- 10 **National Centers for Environmental Prediction (NCEP)**,
 - Camp Springs MD (Environmental Modeling Center—EMC)
 - Norman OK (Severe Storms)
 - Miami FL
 - NOAA Facility on FIU Campus contains the Miami WFO and TPC, one of the NCEP Centers



Forecast Process



Communication of Weather Information

• NWS Advisories

- **Watch:** Conditions favor hazardous weather
- **Warning:** Hazardous weather is happening or will happen soon.
- **Statement:** Describes conditions in more detail

• NOAA Weather Radio

• Media broadcasts

• Web (NWS & Private)

• High-tech communications (cell phone)

• Low-tech communications (flags, sirens)

Weather Observations

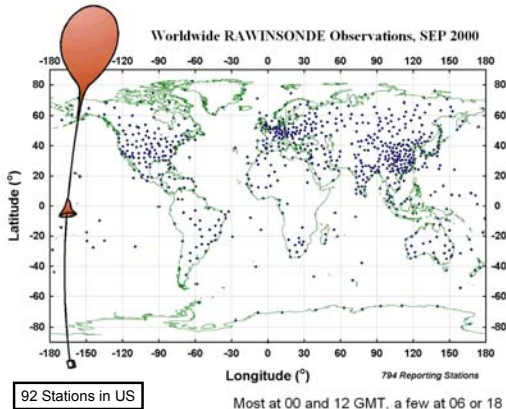
• Synoptic Method

- Simultaneous, standardized observations worldwide
- Transmitted to central sites for analysis
- Synoptic times 00, 06, 12, 18 UTC
- Sometimes every 3 hours
- Upper-air at 00 & 12

• Transmitted over *Global Telecommunications System* (GTS)

• Asynoptic

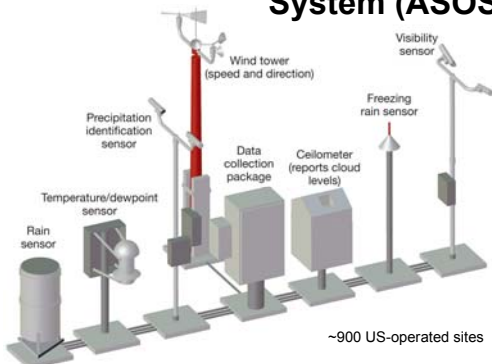
- Random (or continuous) times and positions
- Primarily remotely sensed (Satellite, Radar, Aircraft)
- Increasingly important



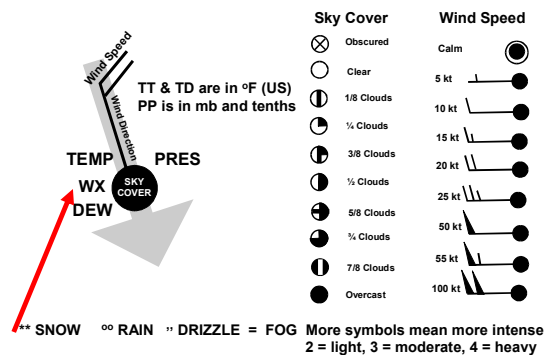
“Surface” Weather Elements

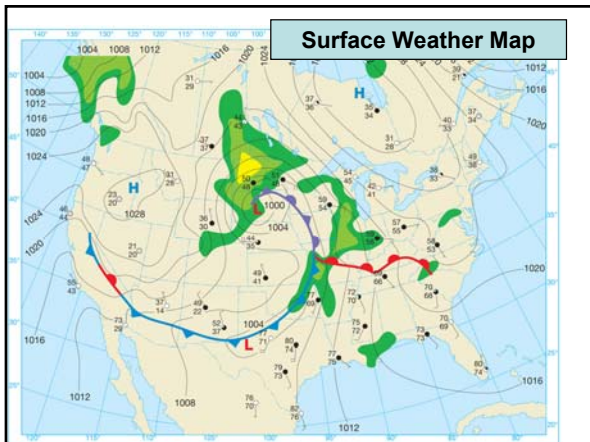
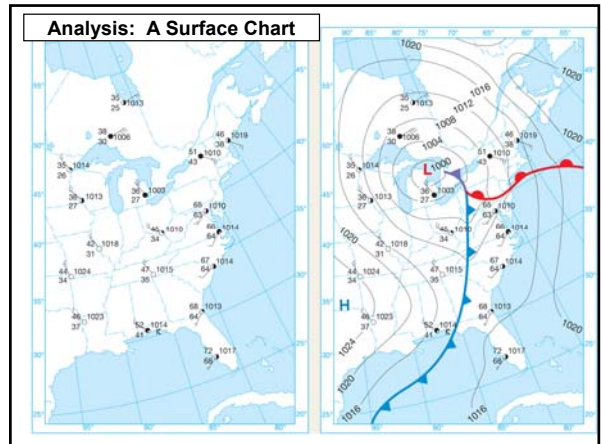
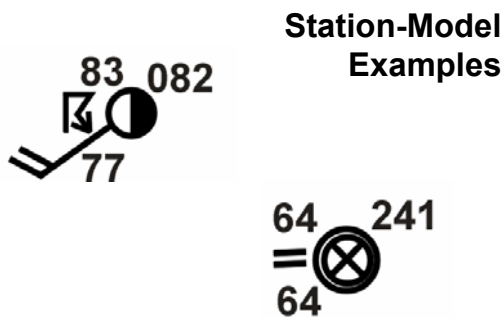
- Wind direction and speed
- Temperature
- Dew point or relative humidity
- Visibility
- Precipitation
 - Presence or absence
 - Accumulation
 - Kind
- Cloud type and coverage
- Fog, mist, ...
- Lightning
- More than 10,000 fixed sites and 7,000 ships worldwide

Automated Surface Observing System (ASOS)



Surface Station Model (See Appendix B)





Kinds of Forecasts

- Intuitive based upon meteorological acumen
 - Single station (barometer, wind, visual obs)
 - Weather map (synoptic model)
- Statistical, based upon past relationships between observed predictors and future predictands
- Numerical Weather Prediction (NWP)
 - Integrates meteorological equations of motion
 - To generate prognostic charts or “progs”

More Kinds of Forecasts

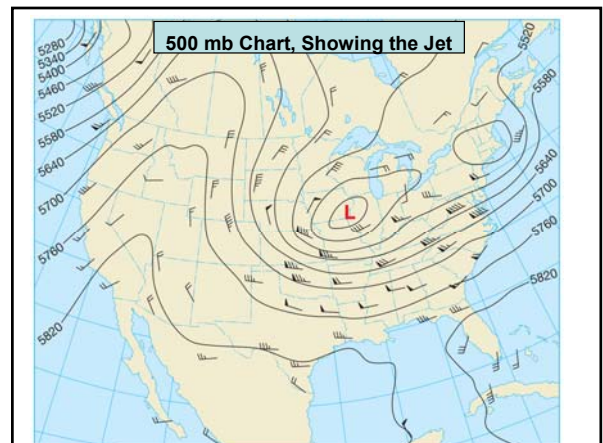
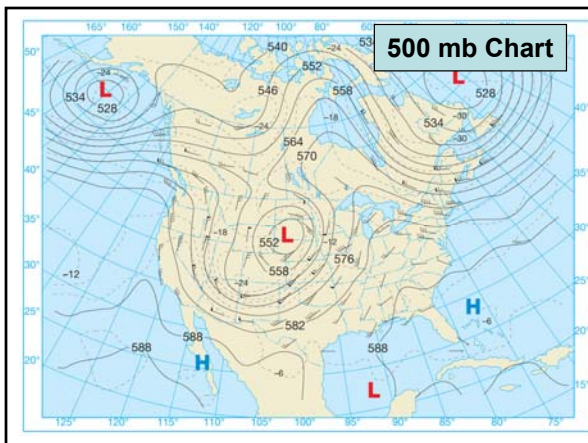
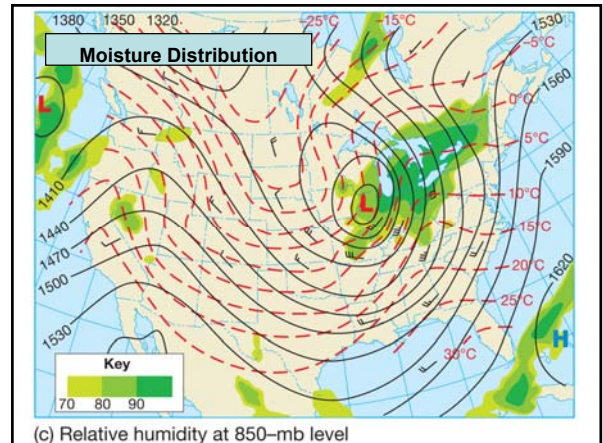
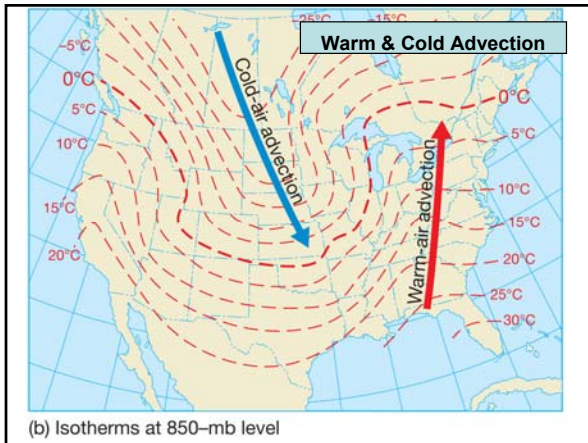
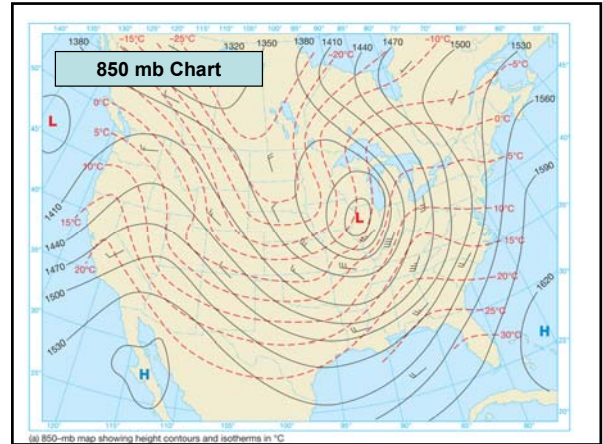
- **Ensembles:** Run several NWP forecasts based upon slightly different starting weather
- **Model Output Statistics (MOS)** Predict weather elements using numerically generated predictors
- **Persistence:** What’s happening now will go on
- **Climatology:** What usually happens will happen
- **Analog:** Find a day in the past like today and convince yourself that the following days will be like the ones that happened then.
- **Nowcasting:** Forecasting severe weather using current conditions and trends

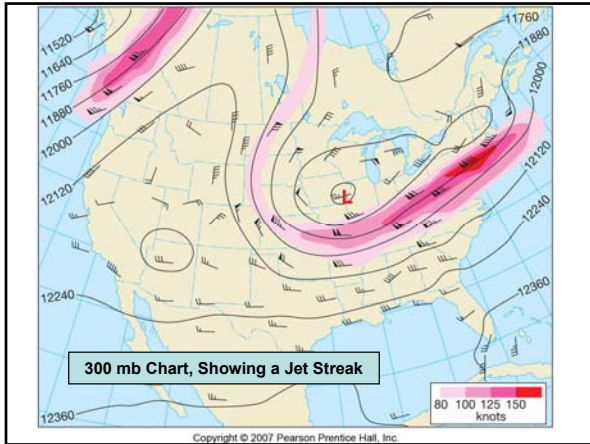
Forecast Accuracy and Lead-Time

- **Skill:** The amount that a forecast improves on climatology or persistence, distinct from **Accuracy**
- **Very Short Range:** (0-12h), mostly mesoscale.
- **Short Range:** (12-72), motion and intensification of synoptic-scale systems
- **Medium Range:** (3-7 days), also synoptic scale, but much more difficult
- **Extended range:** (week 2). Increasingly dicey NWP
- **Monthly to Seasonal Outlooks** (forecasts): Often statistical

Upper-Air Charts in Forecasting

- **850 mb**
 - About 1500 m altitude
 - Used for temperature forecasting
 - Warm & cold advection
 - 0°C Isotherm is the boundary of snowfall
- **700 mg**
 - About 3000 m altitude
 - "Steering level" for air mass thunderstorms
 - If $T_{700} > 14^{\circ}\text{C}$ don't expect thunderstorms
- **500 mb**
 - About 5500 m
 - Frontal cyclone move in the direction of the 500 mb flow
 - With about half its speed
- **200-300 mb**
 - At 9 and 12 km
 - Jet stream level
 - Jet streaks
 - Forced ascent in right entrance and left exit of straight streaks
 - Forced ascent in exit of troughs and entrance to ridges in curved streaks

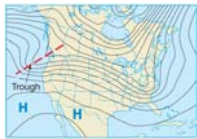




Expectations Based Upon Upper Flow Patterns

- **Zonal Flow**
 - Wind blows more or less straight from west
 - Weather systems move rapidly and are not strong
 - Rapidly changing weather with few extremes
- **Meridional Flow**
 - Lots of N-S meandering superimposed on weaker westerlies
 - Slow-moving intense systems
 - Slowly changing, extreme weather
 - Stationary highs in summer produce heat wave and stationary troughs in winter cause polar outbreaks
- **Long-Wave Troughs & the Jet**
 - Controls distribution of temperature and precipitation over North America
 - Cold and dry on the W side, warm and moist on the E
 - Location (and amplitude) fluctuates on a time scale of weeks to month
 - Basis of seasonal outlooks

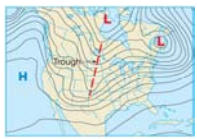
Upper-level trough amplifies as it crosses North America



(a) February 1, 2003



(b) February 2, 2003

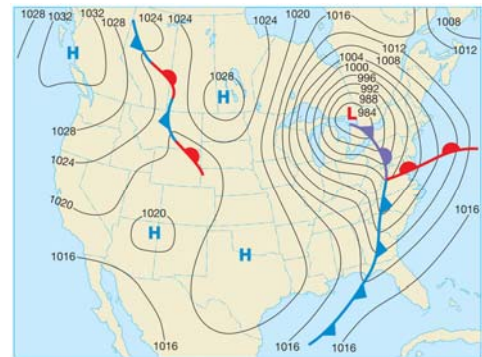


(c) February 3, 2003



(d) February 4, 2003

Resulting Occluded Cyclone

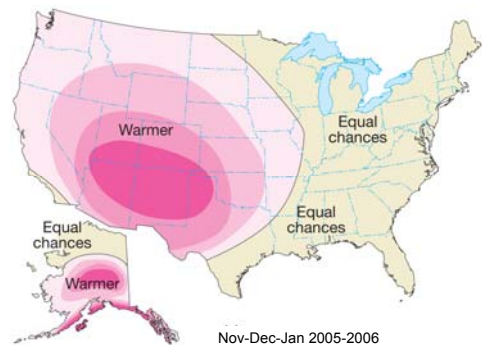


(f) Surface map February 4, 2003

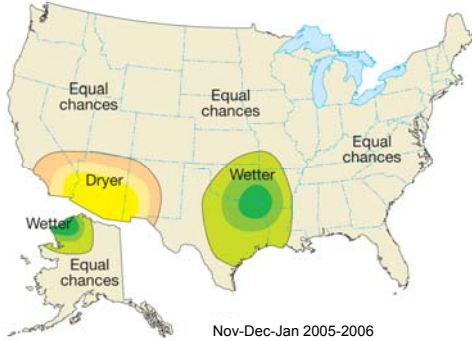
Impact of the Long-Wave Trough



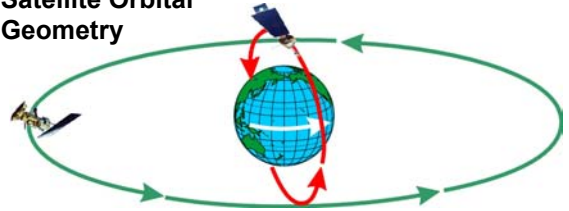
90-Day Temperature Outlook



90-Day Precipitation Outlook

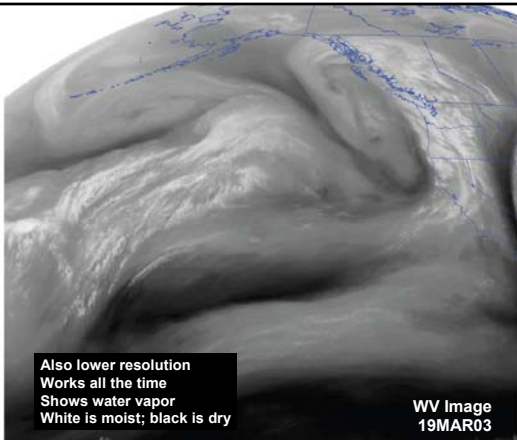
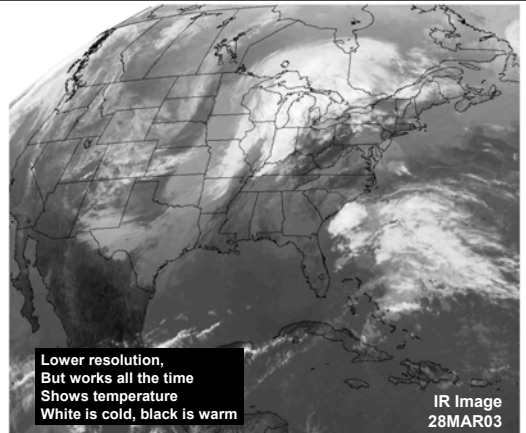
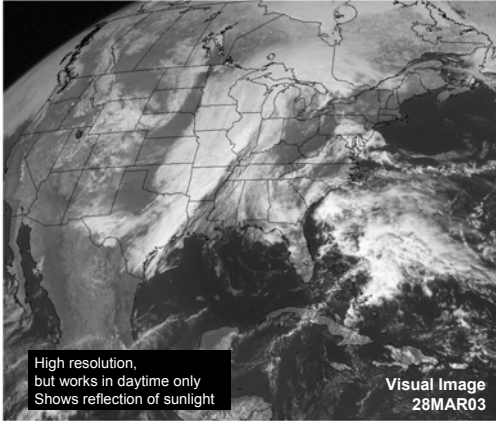


Satellite Orbital Geometry



- Polar—TIROS, DMSP, POES & NPOES (since 1960)
 - Relatively low (~850 km)
 - Earth rotates under satellite
 - Satellite passes overhead once during the day once at night
 - Or sunrise and sunset
- Geosynchronous—GOES (since 1975, SMS in 1974)
 - High (35,000km)
 - Earth Rotates with satellite
 - Satellite remains above a fixed point on the surface

Book is wrong



Summary

- Know the general organization of the NWS
- Know the components of forecasting: Observation, Analysis, Prediction & Dissemination
- Know how surface and upper-air obs are obtained
- Be able to interpret simple plotted surface observations
- Understand how upper-level flow controls surface weather in frontal cyclones
- Understand how Zonal and Meridional flow and the position of the long wave trough control medium-range and longer forecasts
- Know the difference between polar and geosynchronous orbits and the general characteristics of VIS, IR & WV imagery