Forecasting
AOSC 200

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Class Web Site: http://www.atmos.umd.edu/~tcanty/aosc200

Topics for today:

Hurricanes and Forecasting

Lecture 25
Nov 21, 2019

Anatomy of a Hurricane

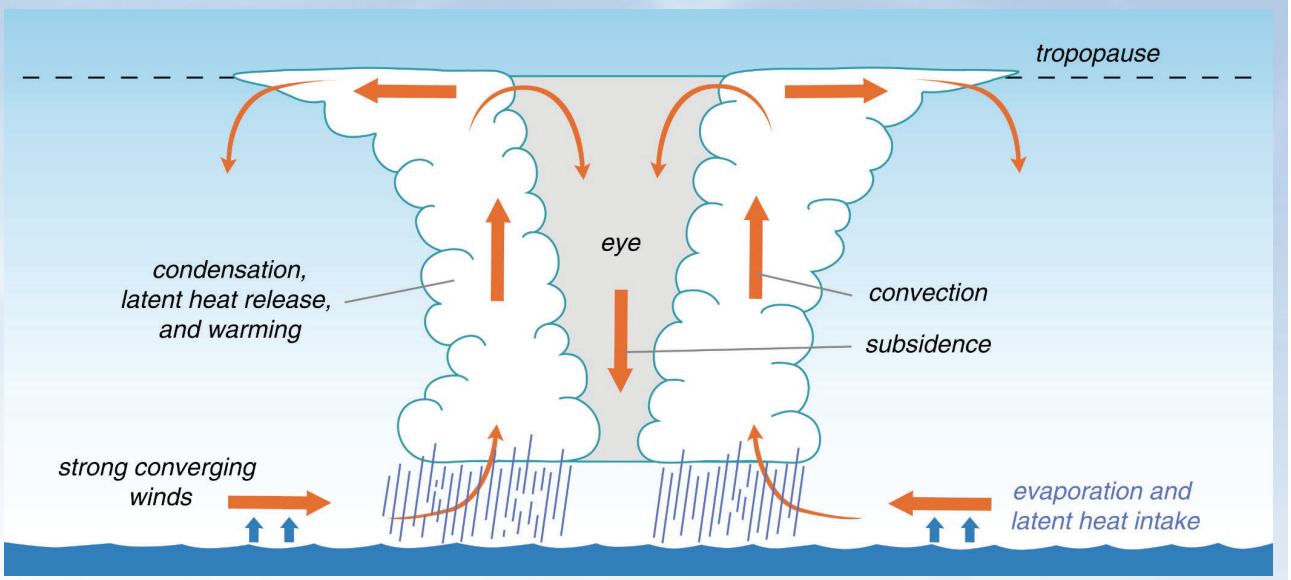
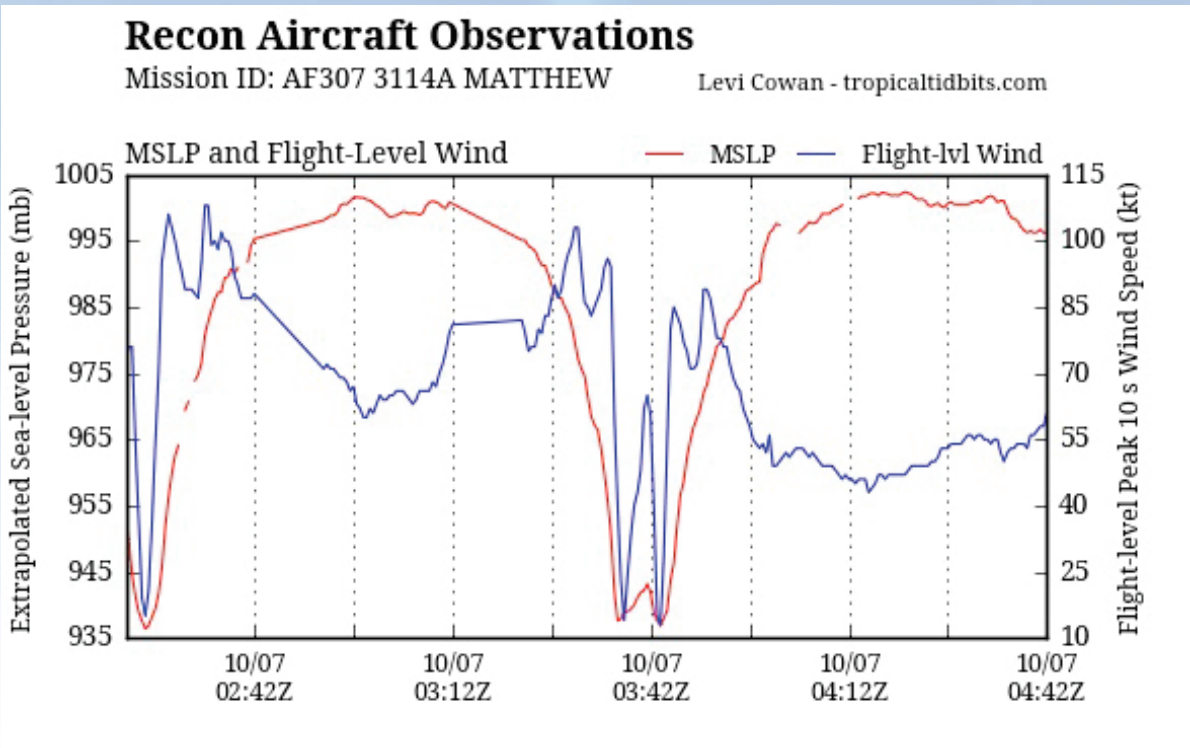


Fig 12-4 *Weather A Concise Introduction*

Anatomy of a Hurricane



Aircraft observations of Hurricane Matthew

https://www.wunderground.com/blog/JeffMasters/comment.html?entrynum=3470&page=5

Anatomy of a Hurricane

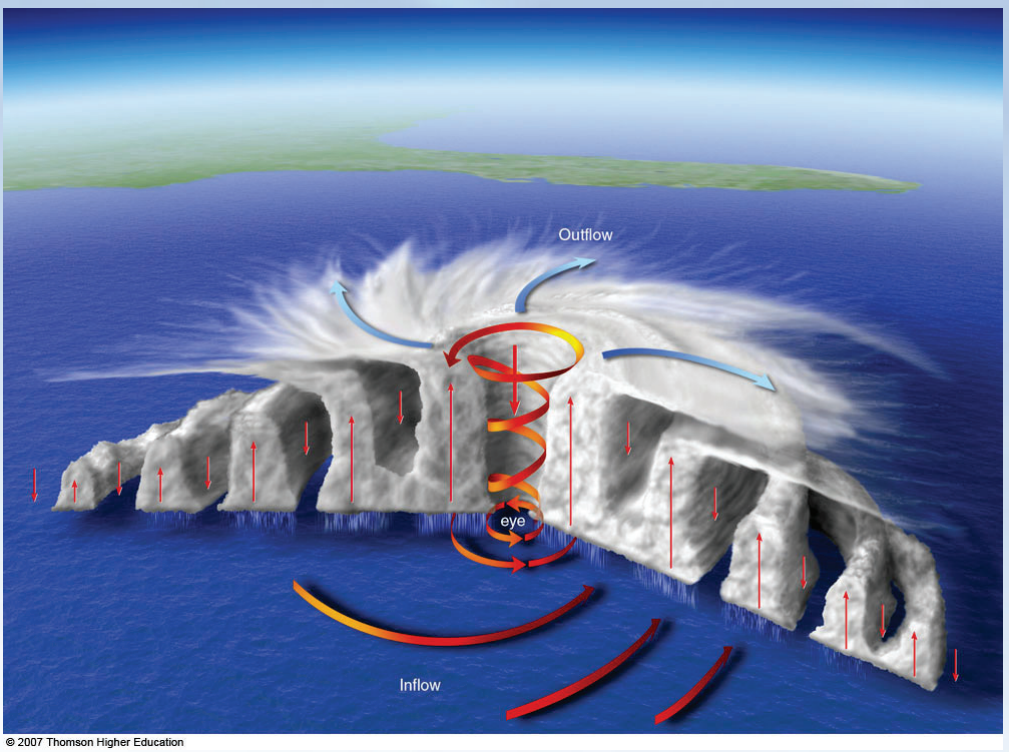
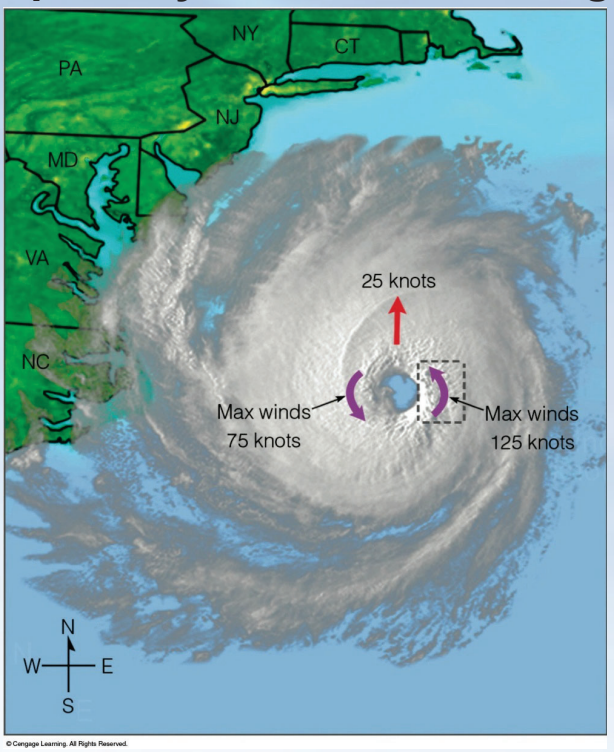


Fig 11-3 *Essentials of Meteorology*

Tropical Cyclone: Wind Damage

Winds on the left side blow in the opposite direction as the hurricane is moving. Subtract the two speeds.

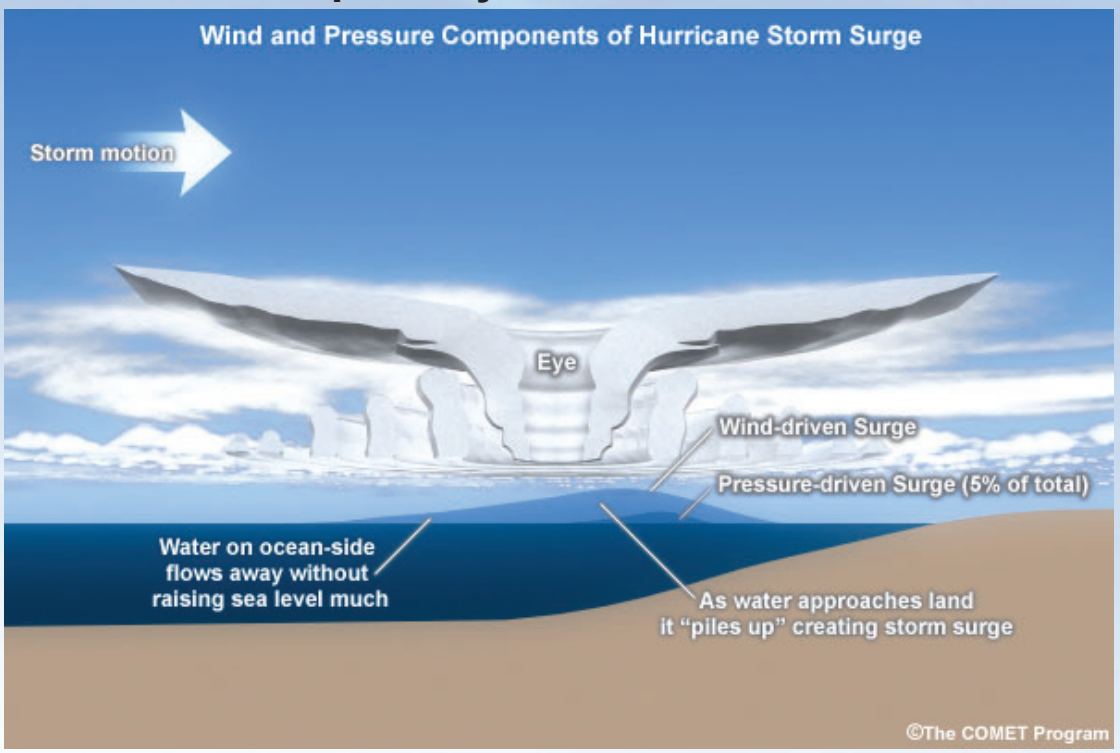


Winds on the right side blow in the same direction as the hurricane is moving. Add the two speeds together.

Hurricane winds can be increased or reduced along path
Can spin off tornadoes

Fig 11-16 *Essentials of Meteorology*

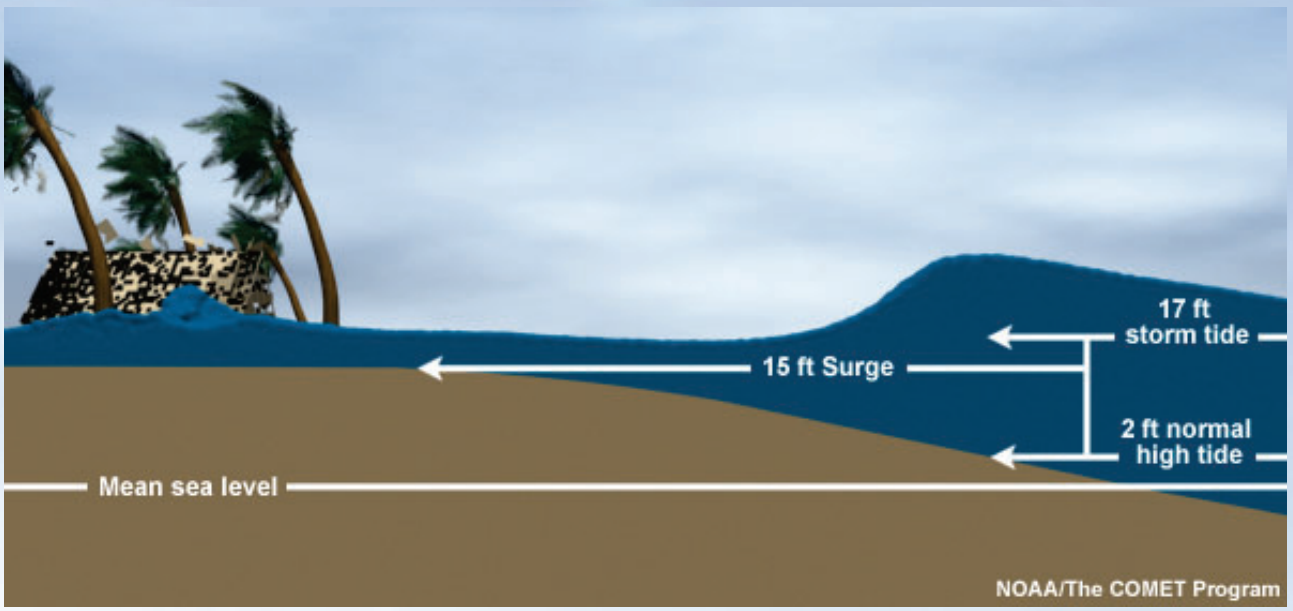
Tropical Cyclone: Seawater



Ocean water "piles up" in front of storm due to winds and low pressure

http://www.nhc.noaa.gov/surge/

Tropical Cyclone: Seawater



Storm surge can combine with normal tidal variations
Surge can greatly erode beaches

http://www.nhc.noaa.gov/surge/

Weather Forecasting

People have been trying to predict the weather for thousands of years.

In the past, forecasts were based on experiences and passed down from one generation to the next

"Red sky at night, sailor's delight
Red sky in the morning, sailors take warning"

This is an example of a folklore forecast but what does it mean?

Folklore forecast

“The higher the clouds, the finer the weather”

“Ring around the moon? Rain or snow soon”

–

These forecast don’t have to rhyme

“Cows lay down ahead of storms”

“Wooly caterpillars predict severe winters”

“The fat squirrel survives the winter”

Persistence forecast

“The weather tomorrow will be like the weather today”

Fair
47°F
8°C

Humidity	47%
Wind Speed	Calm
Barometer	30.28 in
Dewpoint	27°F (-3°C)
Visibility	10.00 mi
Last update	21 Nov 9:35 am EST

More Information:
Local Forecast Office
More Local Wx
3 Day History
Mobile Weather
Hourly Weather Forecast

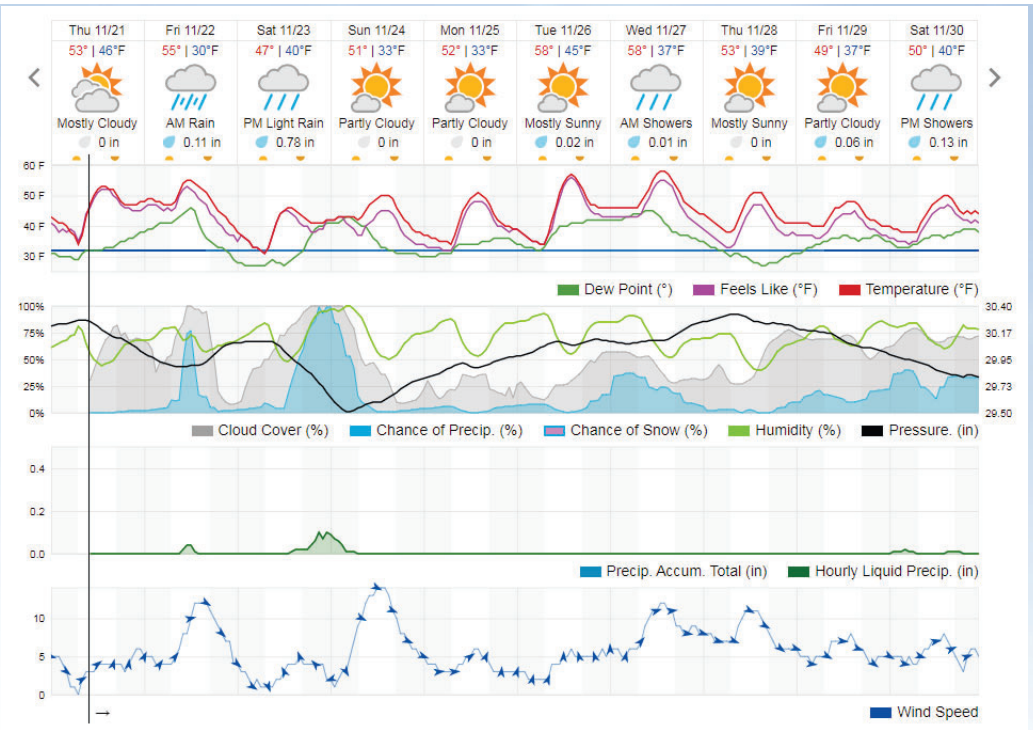
Extended Forecast for
College Park MD

Today	Tonight	Friday	Friday Night	Saturday	Saturday Night	Sunday	Sunday Night	Monday
		 50%		 60%	 90%			
Mostly Sunny	Mostly Cloudy	Scattered Showers	Mostly Clear	Mostly Sunny then Rain Likely	Rain	Partly Sunny	Mostly Clear	Sunny
High: 53 °F	Low: 45 °F	High: 57 °F	Low: 33 °F	High: 46 °F	Low: 40 °F	High: 50 °F	Low: 34 °F	High: 52 °F

http://forecast.weather.gov/MapClick.php?lat=38.98881034861978&lon=-76.94056627621188#.VkH-6dKrTVQ

Persistence forecast

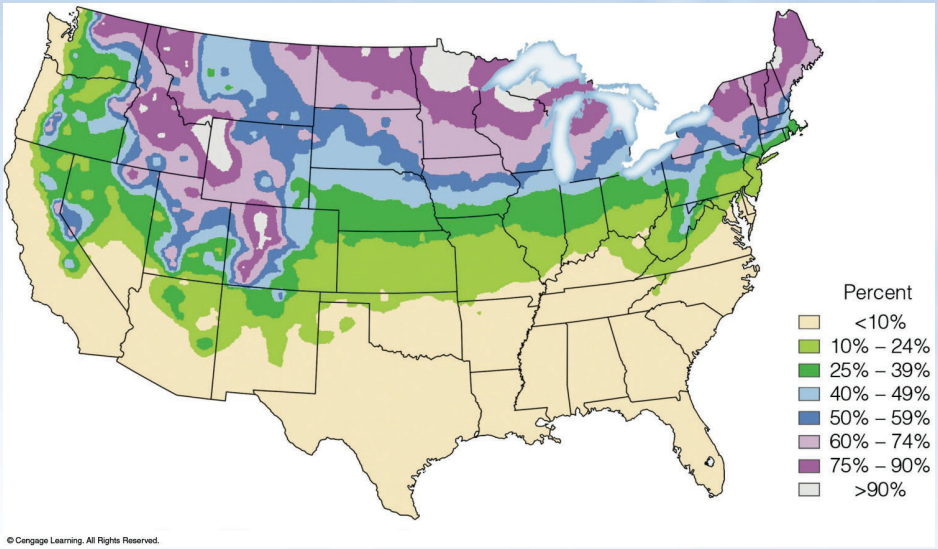
“The weather tomorrow will be like the weather today”



http://www.wunderground.com/weather-forecast/US/MD/College_Park.html

Probability forecast

“The probability of weather on a specific day will be like the long–term average of weather for that day”



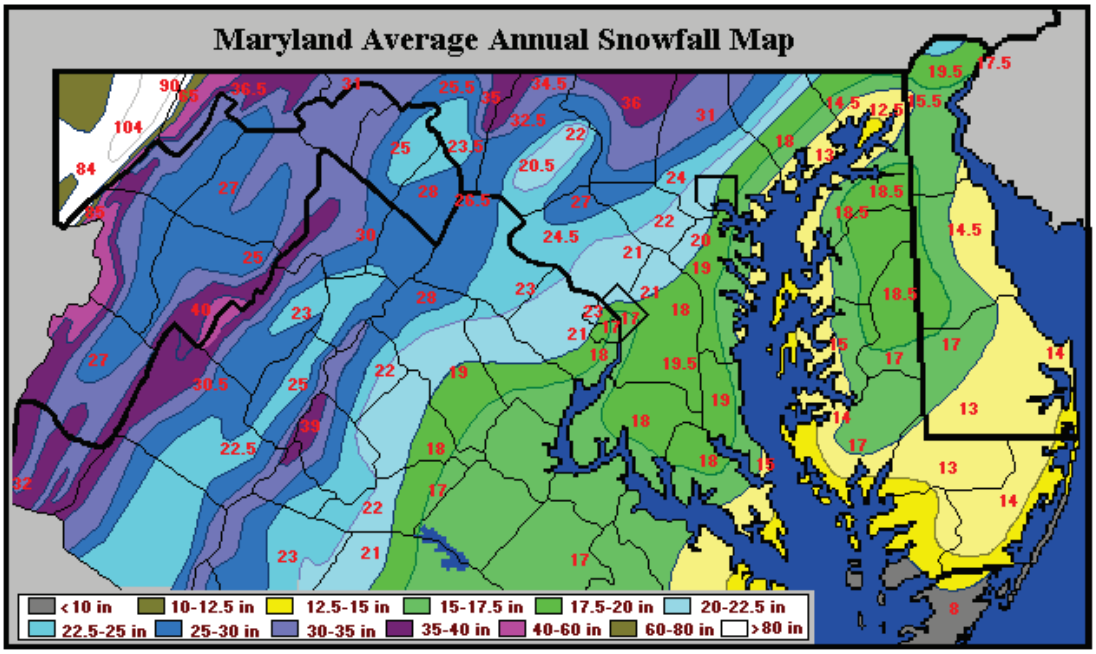
Probability of snow on December 25th

Assumes short term variations are “averaged out” and there is little long-term variation in climate.

Fig 9.8: *Essentials of Meteorology*

Climatology forecast

"The weather this season will be like the long–term average of weather for this season"



http://www.erh.noaa.gov/lwx/Historic_Events/DC-Winters.htm

Types of Forecasts

Folklore: based on traditional proverbs, sometimes accurate. Uses behavior of animals and other creatures as predictors of future weather.

Persistence: assumes that the weather will not exhibit large day to day fluctuations. The weather tomorrow will be like the weather today

Probability/Climatology: assumes the weather for a day or a season will be close to the average weather for that day or season.

← Wide brown stripe = mild winter

Cows lie down before weather to save warm, dry spot →

Problems with these forecasts

Persistence: we know that, at some point, this will be wrong because eventually the weather WILL change

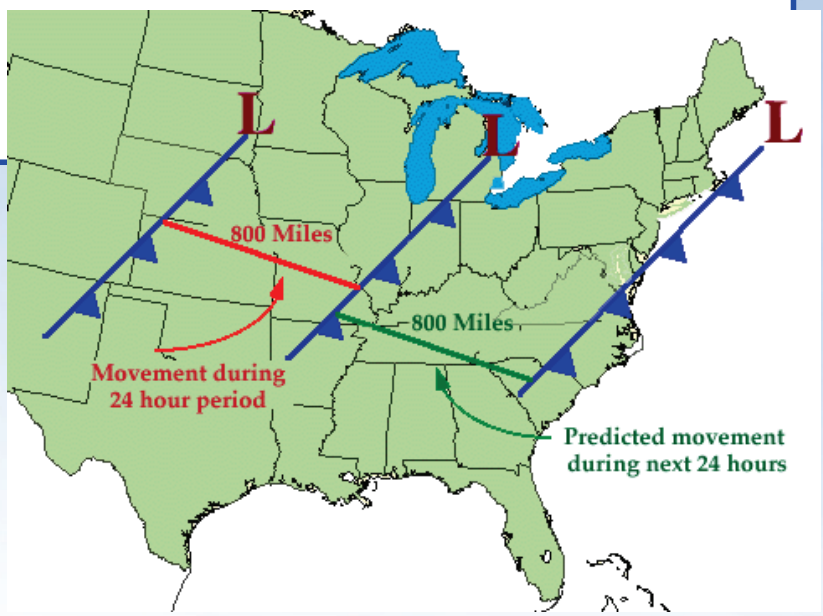
Probability/Climatology: we know that, at some point, this will be wrong because eventually the weather WILL deviate from the average

We know that weather changes at a particular spot because weather features move… but do the weather features themselves change?

Trend Forecast

Recognizes that weather causing patterns move but assumes the following remain unchanged:

- **speed**
- **intensity**
- **size**
- **direction**



http://ww2010.atmos.uiuc.edu/(Gl)/guides/mtr/fcst/mth/trnd.rxml

Analog Forecast

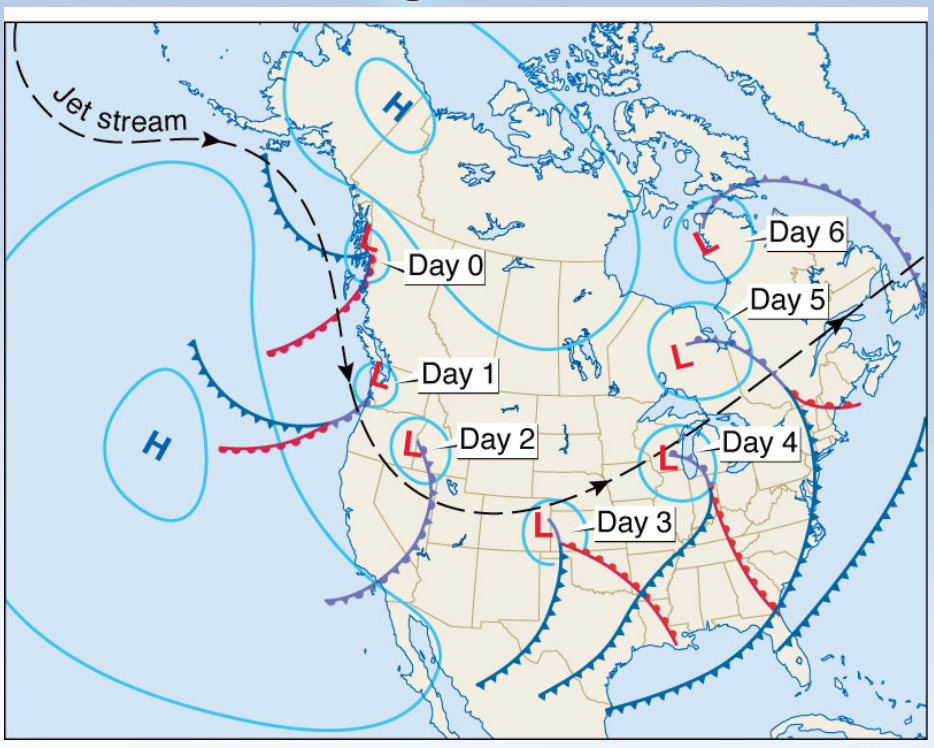
Recognizes that weather causing patterns change but assumes:

- **weather will always behave the same way under a specific set of conditions**

In other words, weather repeats itself

If you find the last time current conditions existed, you can use the historical data to determine how conditions will change

Analog Forecast



The weather today is "analogous" to weather at a time in the past

Fig 13-4 *Meteorology: Understanding the Atmosphere*

Statistical Forecast

Uses *Model Output Statistics* (MOS)

Statistically weighted analog forecast

- **looks at model output that best forecasted past events to make future predictions**

Numerical Weather Prediction

Astronomers could predict eclipses 100's of years before meteorologist started to predict weather

Why?

Numerical Weather Prediction

Uses a series of equations (prognostic equations) that represent the physics of the atmosphere to predict atmospheric conditions in the future.

Need to understand current conditions (a.k.a. "initial conditions") to make predictions

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How can you use information to make predictions?

Example: You know where a car is right now and you know how fast it's moving.

With this information you can predict where the car will be at some time in the future.

Numerical Weather Prediction: Observations

Step 1: Collect observations

- **ASOS**
- **sondes**
- **ships**
- **buoys**
- **aircraft**
- **satellites**
- **wind profilers**
- **etc.**

Numerical Weather Prediction: Assimilation

Step 2: Data Assimilation

- Data does not cover the entire globe at all times
- Data is smoothed and interpolated to model grid

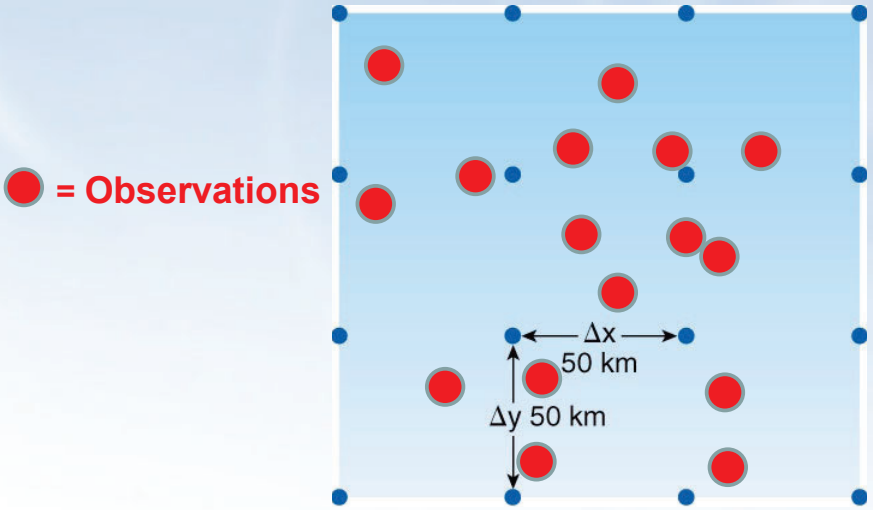

Fig 13-13 *Meteorology: Understanding the Atmosphere*

Numerical Weather Prediction: Integration

Step 3: Model Integration

- Assimilated data is used to solve equations that describe the atmosphere
- Determines state of atmosphere at next time step

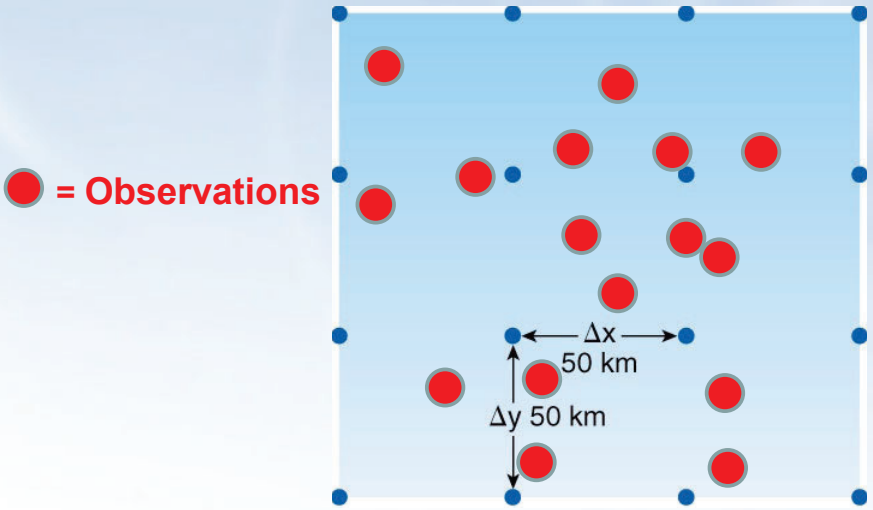

Fig 13-13 *Meteorology: Understanding the Atmosphere*

Numerical Weather Prediction: Tweaking

Step 4: Tweaking and Broadcasting

- Analyze model output accounting for known biases in models
- Combine model output with knowledge of local weather (small scale winds that models can't predict) to create forecasts

Forecast Range

Nowcasting	A description of current weather parameters and 0-2 hours description of forecasted weather parameters
Very short-range weather forecasting	Up to 12 hours description of weather parameters
Short-range weather forecasting	Beyond 12 hours and up to 72 hours description of weather parameters
Medium-range weather forecasting	Beyond 72 hours and up to 240 hours description of weather parameters
Extended-range weather forecasting	Beyond 10 days and up to 30 days description of weather parameters, usually averaged and expressed as a departure from climate values for that period.
Long-range forecasting	From 30 days up to two years

http://www.wmo.int/pages/prog/www/DPS/GDPS-Supplement5-AppI-4.html

Ensemble Forecasts

Ensemble forecasts:

Run model numerous times for slightly different initial conditions

Perform statistical analysis of all the model runs

Ensemble Forecasts

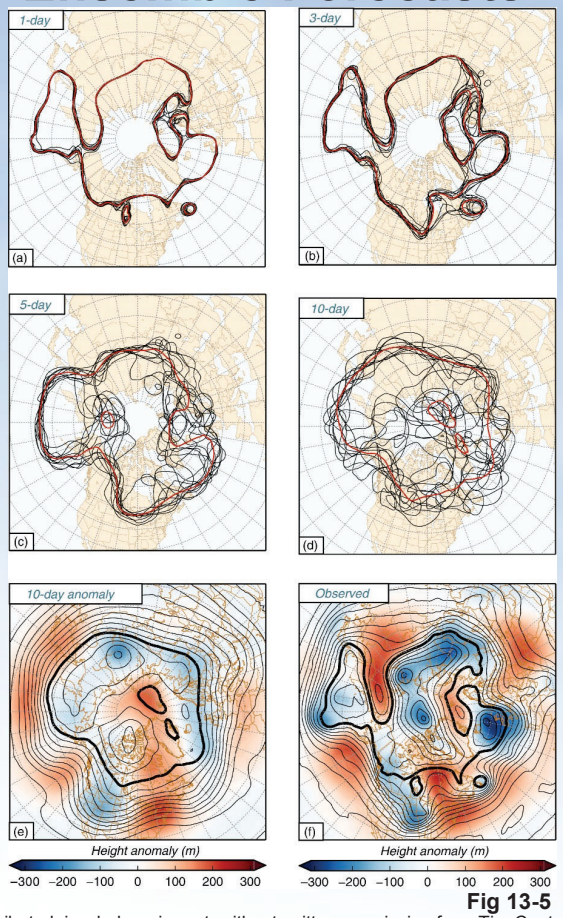

Fig 13-5 *Weather A Concise Introduction*

Why aren’t forecasts perfect?