

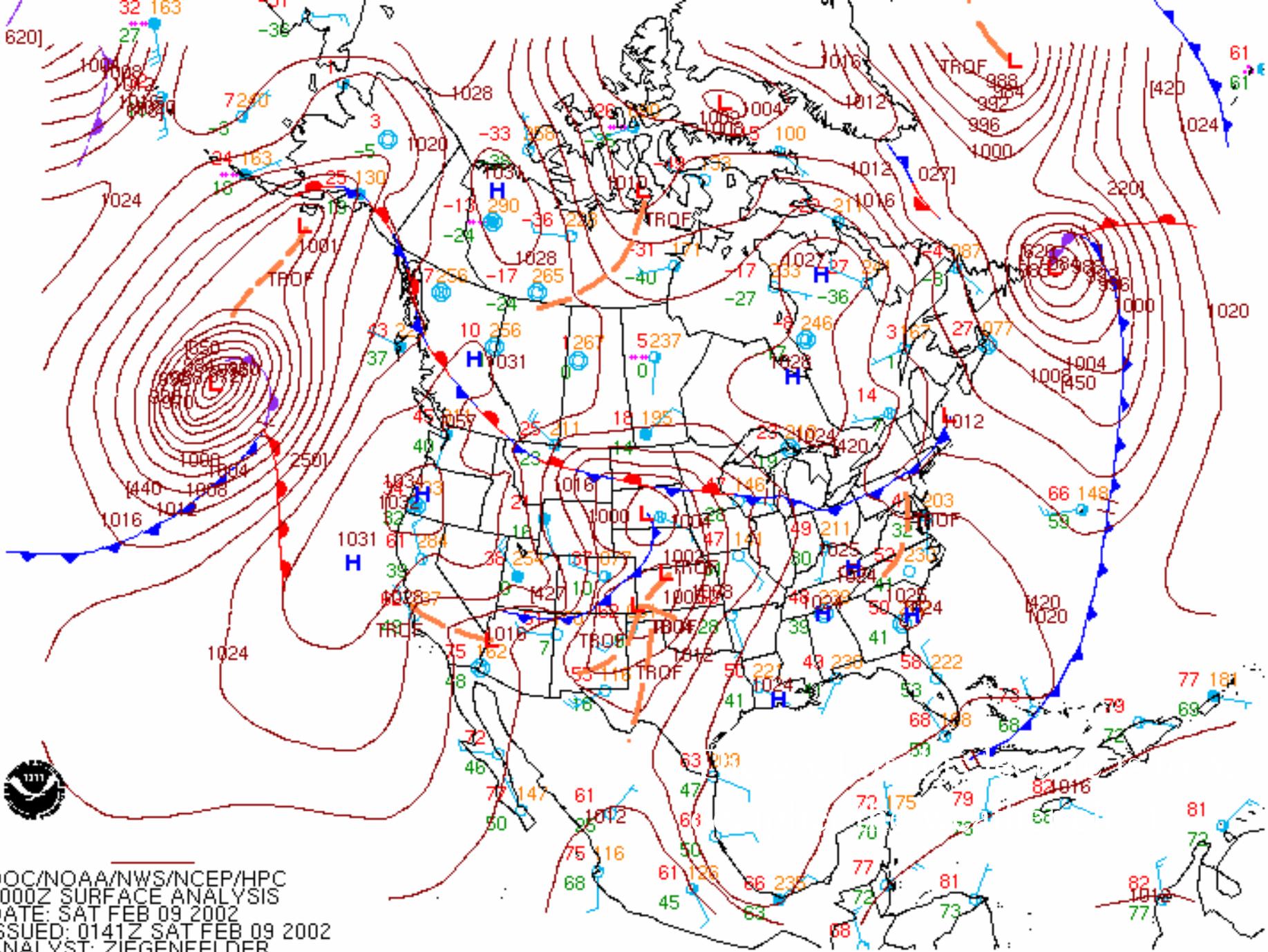


# Weather for the Mariner

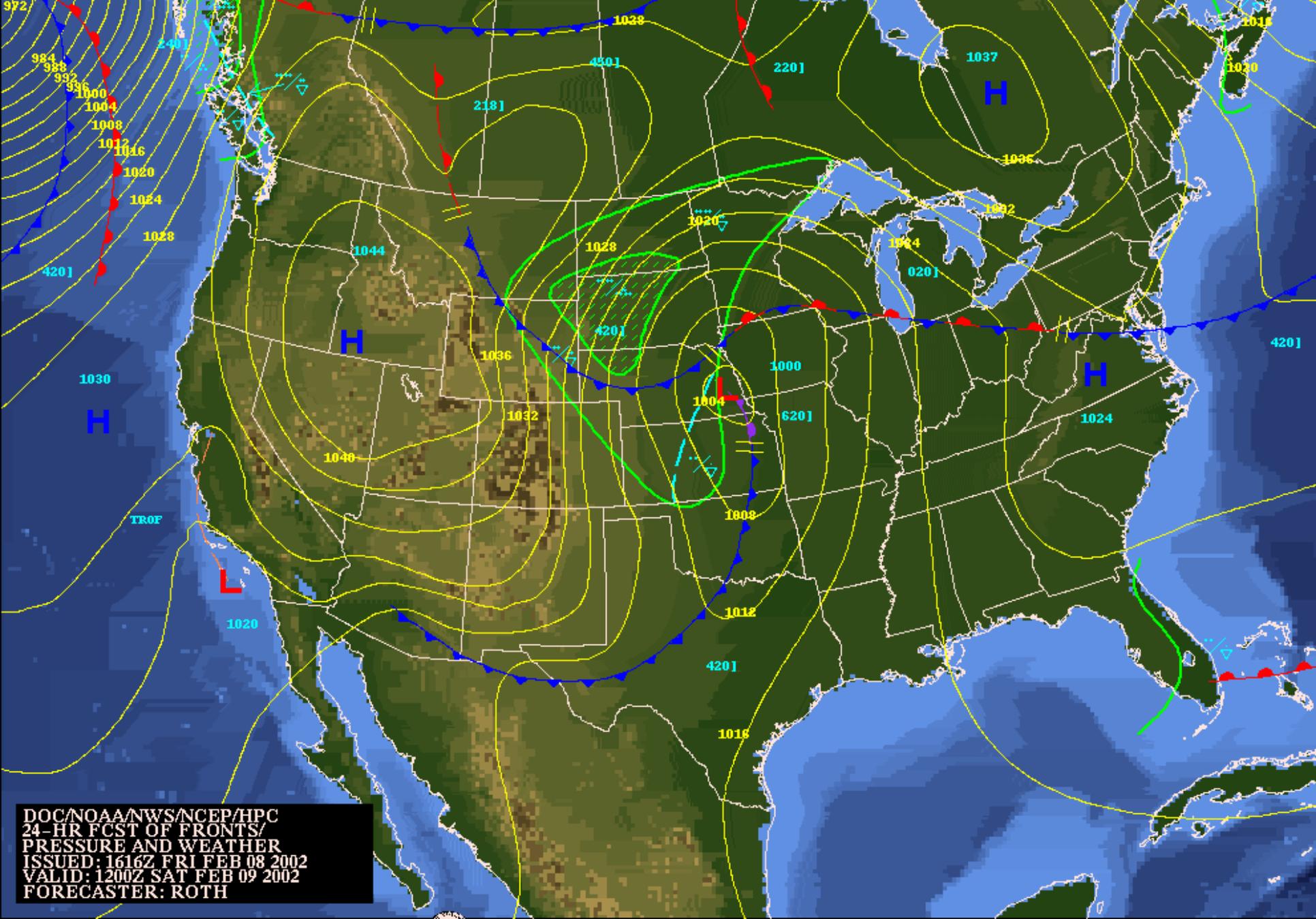
CDR Donna Sengelaub, USN (ret)  
USNA 1982

# Weather Tools Available On Navy 44

- Barometer
- Weather facsimile
- VHF radio -- local area broadcasts
- HF radio
- Cell phone
- MK-1 eyeball



DOC/NOAA/NWS/NCEP/HPC  
 0000Z SURFACE ANALYSIS  
 DATE: SAT FEB 09 2002  
 ISSUED: 0141Z SAT FEB 09 2002  
 ANALYST: ZIEGENFELDER



DOC/NOAA/NWS/NCEP/HPC  
24-HR FCST OF FRONTS/  
PRESSURE AND WEATHER  
ISSUED: 1616Z FRI FEB 08 2002  
VALID: 1200Z SAT FEB 09 2002  
FORECASTER: ROTH





# Nautical Weather Sayings

- Red sky at night, sailor's delight. Red sky in the morning, sailor take warning.
- Mackerel skies and mare's tails make tall ships carry low sails.
- First rise after very low indicates a stronger blow.
- But what do they mean?!!

# Mariner's Rules of Thumb

- In the mid latitudes weather systems (pressure centers) move from west to the east.
- Pressure Centers generally move in sequence with high pressure replaced by low pressure and low pressure replaced by high pressure
- Be aware that your boat is moving relative to moving weather systems.
- Pay attention to changes in cloud formation and the direction from which clouds approach.
- Clouds are the mariner's best visual indicator of changing weather.
- Pay attention to the direction of the true wind.

# Mariner's Rules of Thumb

- Observe the sea surface condition in relation to weather conditions. Gradually increasing ripples on the water are first indication of increasing wind.
- Long parallel streaks in the water where foam and flotsam/jetsam line up (called Langmuir Circulation) runs parallel with the wind and is a good indicator of true wind direction.
- Generally, warm, moist air fuels low pressure. So warm currents such as the Gulf Stream can cause dying low pressure systems to redevelop and deepen.
- Low Pressure systems are associated with storms and high pressure systems serve to block these storms.

# Mariner's Rules of Thumb

- Changes in air pressure, wind direction, humidity and temperature are excellent indicators of changing weather.
- If wind barbs indicate that temperature and dew point differ by 5 degrees expect fog. If temperature and dew point differ by 3 degrees or less expect rain.
- Use Buys Ballot's law to locate general location of high and low pressure centers.



# Air Masses

- Air masses are vast bodies of air with uniform temperature and moisture
- Air is modified based upon it's source region or in other words, where the air is modified
- Modified to be:
  - Cold or warm
  - Continental (dry air) or Maritime (moist air)



# Air Masses

- The types of air masses are:
  - Maritime polar
    - cool and moist
  - Arctic
    - very cold and dry
  - Continental polar
    - cold and dry
  - Continental tropical
    - Hot and dry
  - Equatorial/Maritime tropical
    - (always warm and moist)





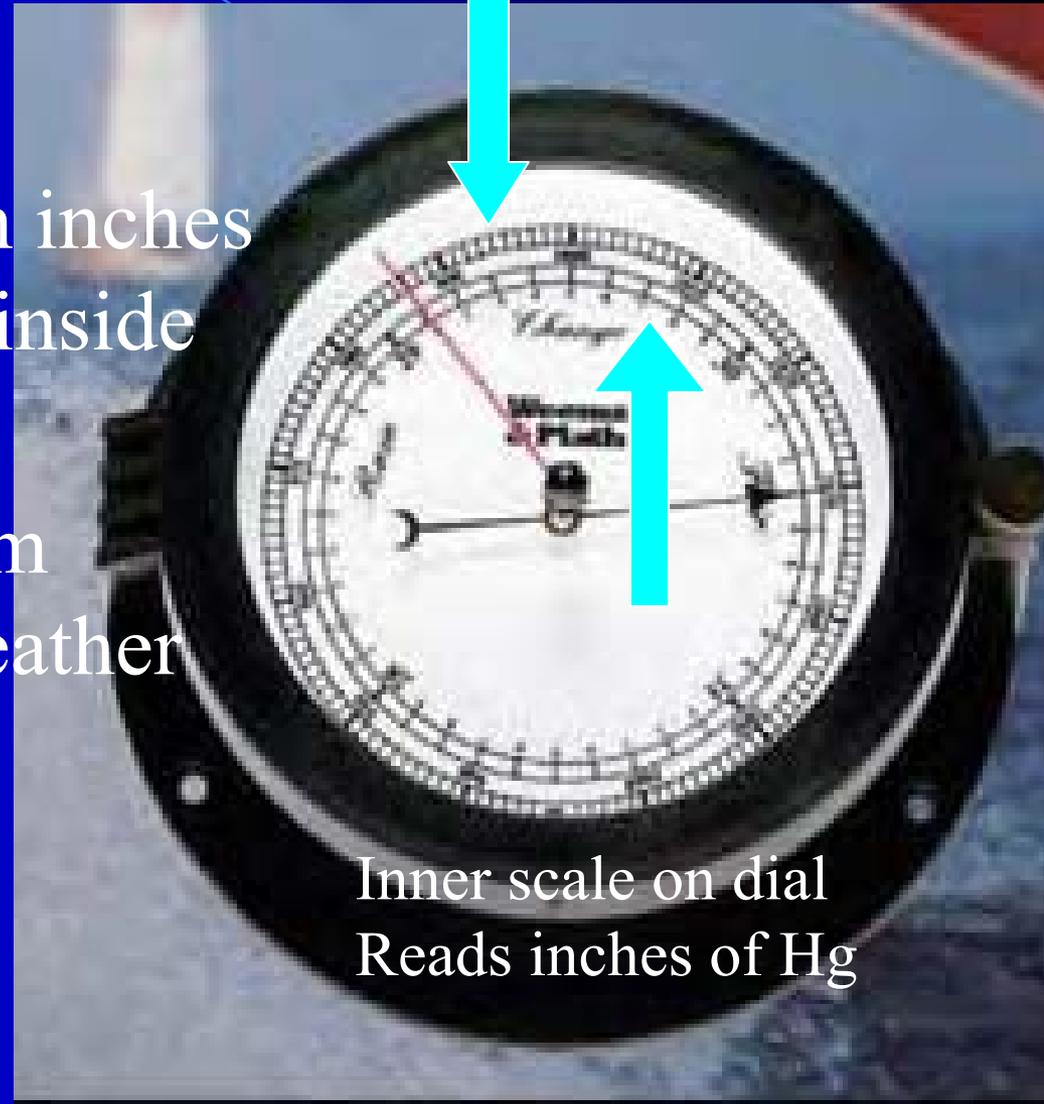
# Air Pressure and Pressure Trends

- Barometers are instruments that measure air pressure.
- Barometric pressure is one of the best indicators of impending weather
- Barometric pressure should be logged every hour along track





- Pressure is measured in inches of mercury (read from inside dial) ...or
- millibars mb (read from outside dial used on weather charts)



Outer scale on dial  
reads millibars

Inner scale on dial  
Reads inches of Hg

A small icon in the top-left corner showing a yellow sailboat on a white sea against a dark blue background.

# Air Pressure and Pressure Trends

- Watching barometric pressure *trends* is one of the best indicators of impending weather
- It is important to keep track of pressure trends— use a 3 hour trend with a barometer
- Rapid pressure changes
  - Over 6 mb fall (or rise) in 3 hours
- Moderate pressure changes
  - 3-6 mb fall (or rise) in 3 hours
- Slow pressure changes
  - 3 mb fall (or rise) in 3 hours



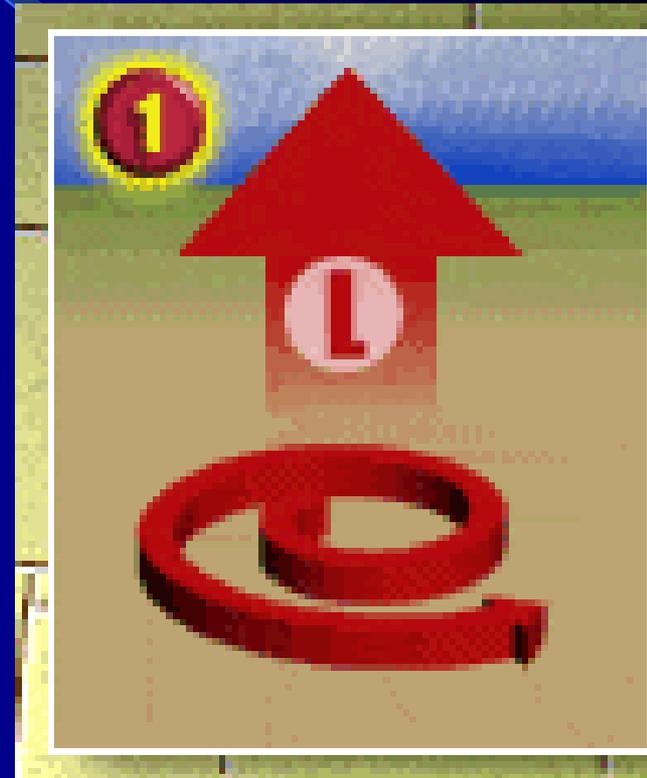
# Pressure

- Two types of air pressure:
- High pressure
  - Think of high pressure as a mound or hill of air
- Low pressure
  - Think of low pressure as a depression of air

# Low Pressure



- Air rises at the center of low pressure
- Air circulates around low pressure centers counter clockwise and pulls the surrounding air inward like a vacuum
- Low pressure centers are the anchoring points for fronts.
  - 950 mb is a very deep low pressure system (results in an intense storm)
  - 988 mb is a moderately deep low pressure system
- Associate low pressure with storms or deteriorating weather





# High Pressure

- Air sinks at the center of high pressure
- Air circulates around high pressure centers clockwise and deflects the air outward.
- High pressure tends to block or deflect approaching bad weather
- High pressure indicates fair and dry weather
  - 1035 mb is a very strong high pressure center
  - 1012 is a moderately strong high pressure center





# Wind and Pressure

- Wind is the result of high and low pressure differences and the atmosphere's attempt to equalize the pressure differences.
  - air will flow from high pressure (mound of air) in toward the low pressure (depression of air)

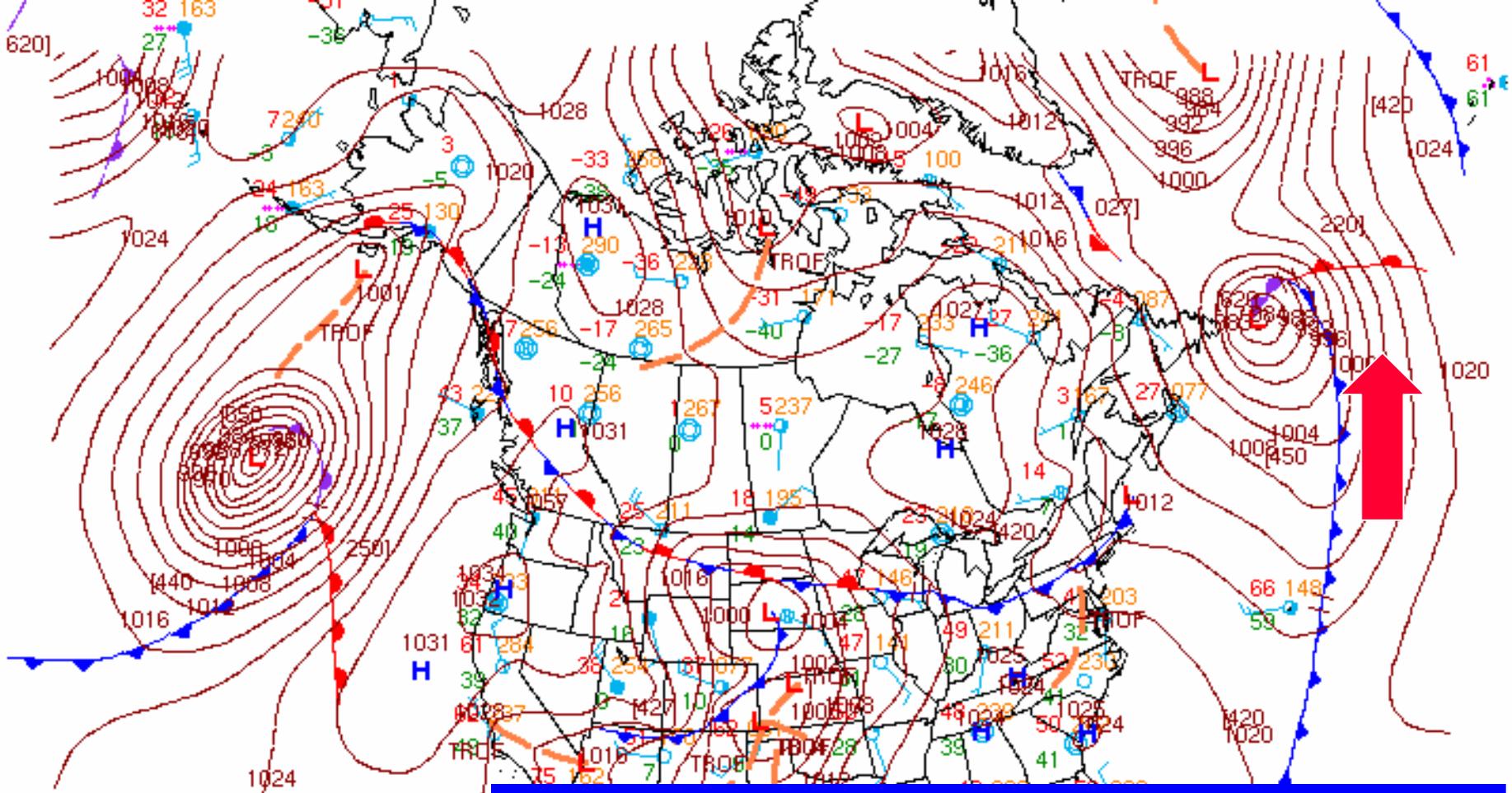


# Wind and Pressure

- The greater the pressure difference between high and low pressure, the greater the wind speed
- Wind direction is always indicated from the direction the wind is blowing
  - For example, NE wind blows from the NE
  - A southerly wind blows from the south

# Wind and Pressure

- Isobars on a weather chart are contours of pressure around a high or low pressure center
- Isobars are indicated in millibars (mb)—
  - barometric Pressure is lowest at the center of a low
  - barometric Pressure is highest at the center of a high
- Tightly packed isobars on a weather chart indicate a strong gradient or wind.



The red arrow indicates your boat's location.

1. Are you closest to a high or a low?
2. From what direction is the wind blowing?
3. Where are the highest winds on this chart?

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# Buys Ballot Law

- Its important to know where the low pressure center is located.
- This is thumb rule to use to locate the low pressure system relative to your location.
  - Stand with the wind at your back
  - Turn 15 deg to your right
  - Low pressure will be to your left and high pressure will be to your right



# Air Masses and Frontal Systems

- When two different air masses collide, the boundary of the collision is called a front.
- Four Types of fronts:
  - Cold front
  - Warm front
  - Occluded front
  - Stationary front





# Cold Front

- Cold Air pushes underneath warm air and causes the air to rise violently and rapidly
  - Cold fronts move fast 20- 35 kts
  - Generally move E-SE
  - Weather deteriorates rapidly
  - Approaching clouds seen 50-150 miles ahead of cold front





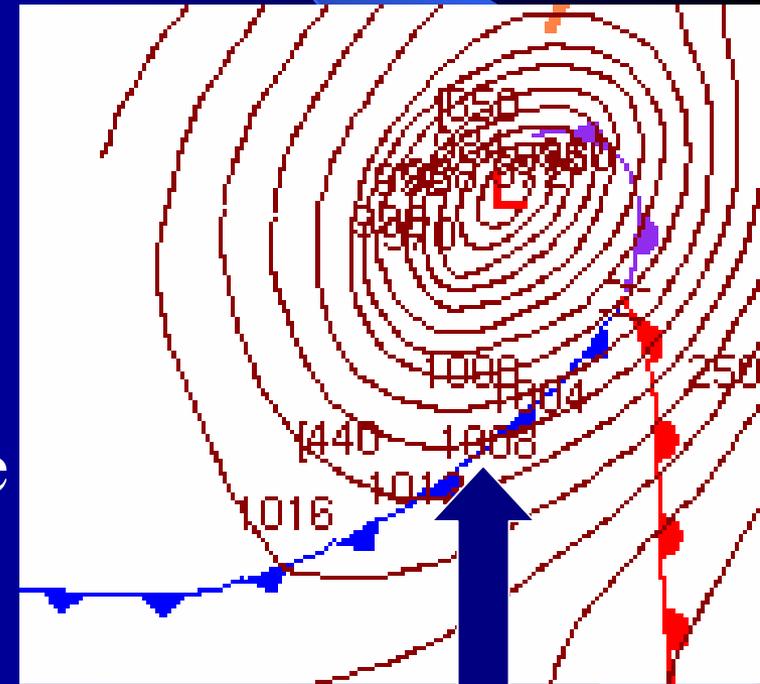
# Cold Front Weather

- Heavy rain
- Thunder and lightning
- Tornados
- Hail

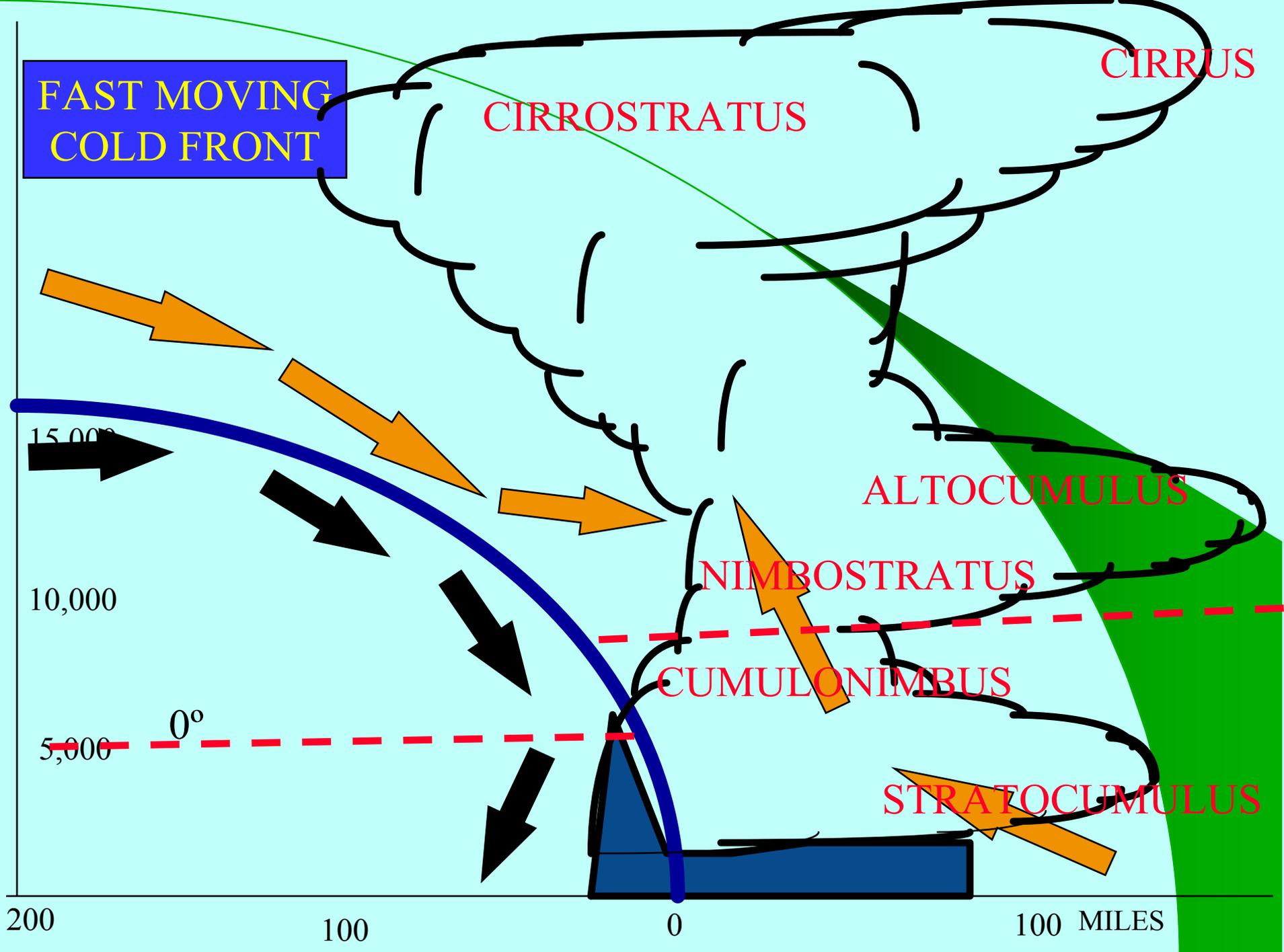


# Cold Front Weather Sequence

- Winds steady from SW
- Altocumulus (**Ac**) clouds (mid-level puffy clouds) on W or NW horizon
- Barometer pressure falls
- Clouds progressively lower and thicken
- Cumulonimbus (**Cb**) clouds or Thunderheads form
- Symbol to mark the boundary of the front is a line with blue triangles (cold air is behind the line)



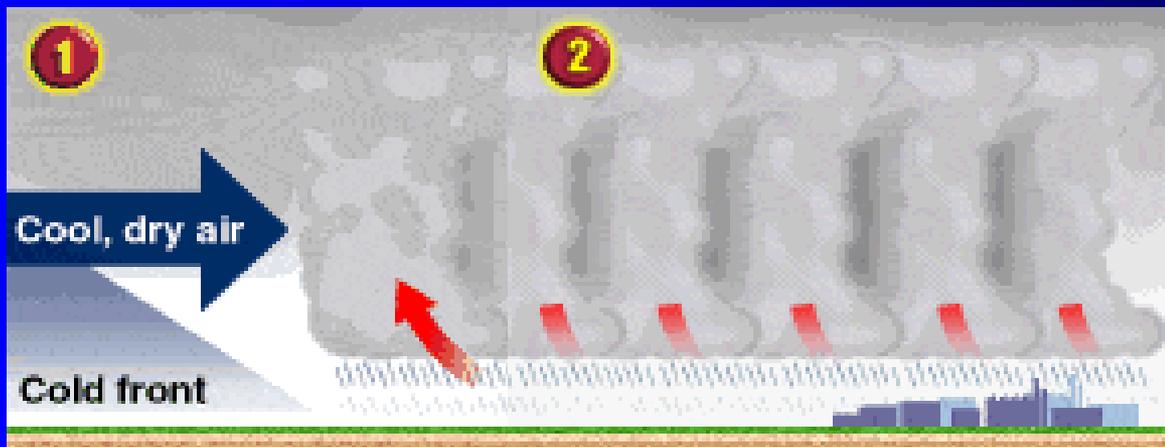
Cold front symbol





# Cold Front Weather Sequence

- Squalls: precede front by 5-6 hours
  - Intense black clouds
  - Violent gusty winds
  - Cold blast of wind several miles ahead of front





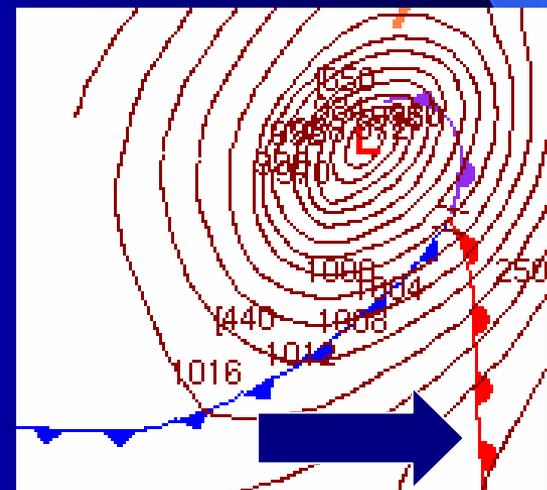
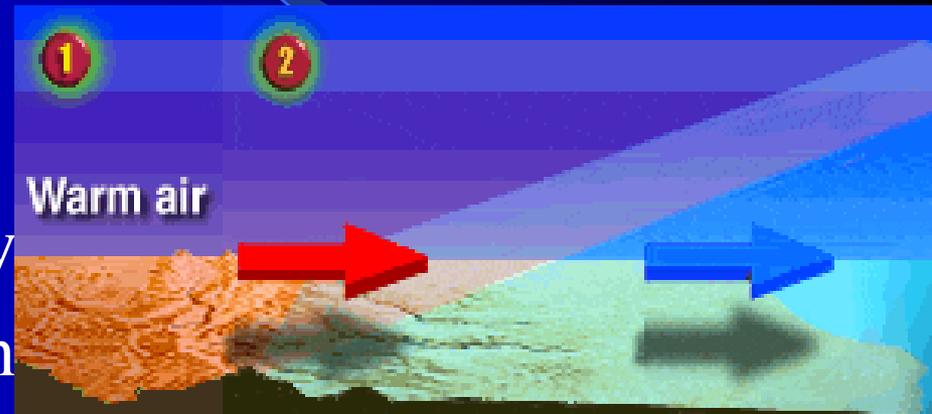
# Cold Front Weather Sequence

- As front passes, weather is as follows:
  - Wind veers (moves clockwise) from SW to W-NW
  - Barometer pressure at lowest
  - Rain or squall
  - Thunder and lightning
  - Rapid clearing of sky
  - Strong gusty winds from W-NW
  - Air temperatures become colder



# Warm Front

- Warm air slides over cold air
- Moves slowly 10-15kts
- Weather deteriorates gradually
- Approaching clouds seen from 1000+ miles
- Symbol marking the front is a line with red half circles (warm air is behind the line)



Warm front symbol



# Warm Front Weather

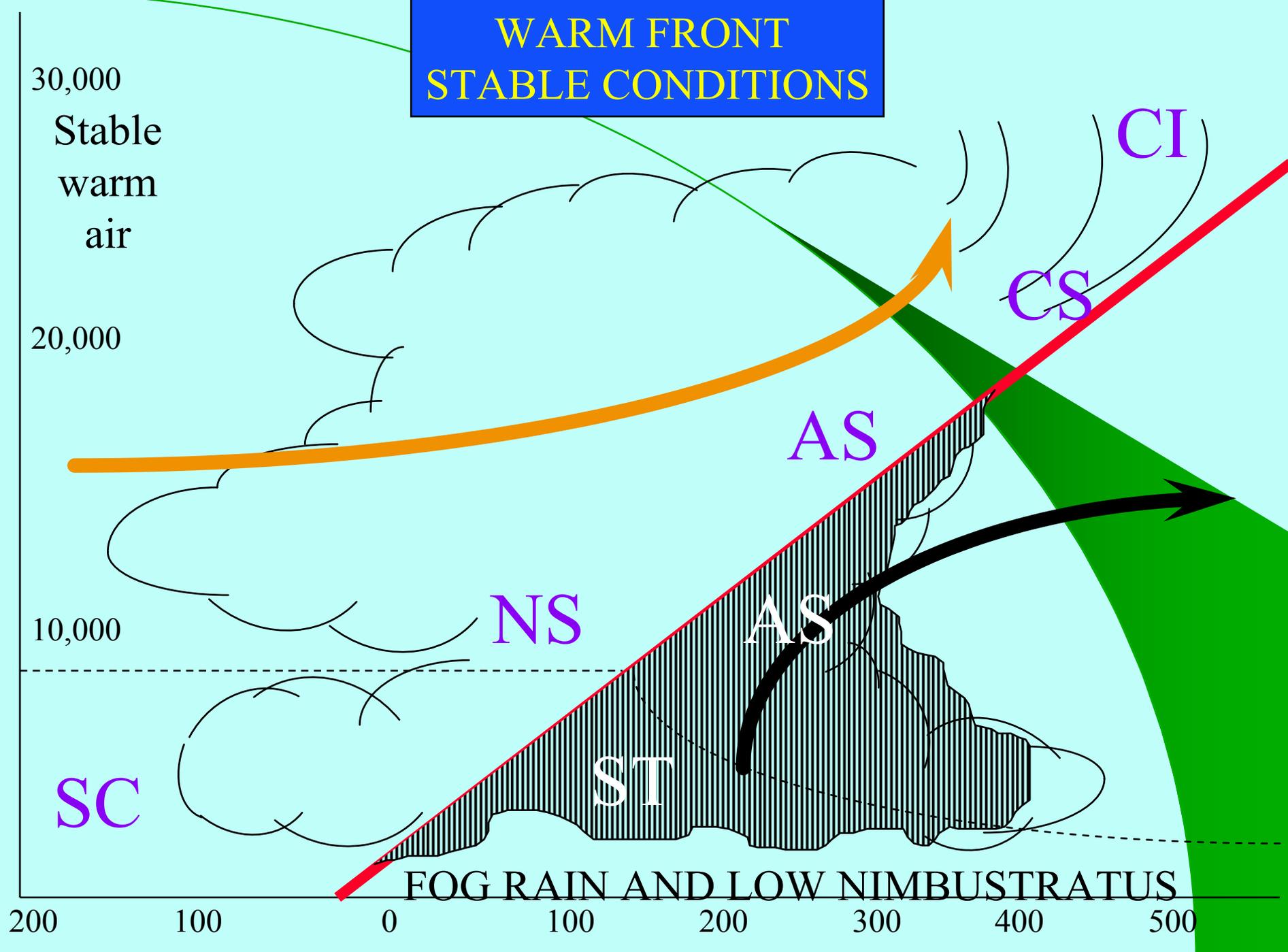
- Cirrus clouds (**Ci**) (high clouds) thicken to Cirrostratus (**Cs**) then Altostratus (mid-level) clouds, then Ns (low dark rain clouds)
- Steady light rain
- Persistent fog
- Barometer pressure falls



# Warm Front Weather Sequence

- Front passes gradually, less intense than cold front
- Wind veers (rotates clockwise) from S-SE to SW
- Drizzle and fog may persist
- Rain and thick clouds diminish
- Air temperatures become warmer

**WARM FRONT  
STABLE CONDITIONS**



SC

NS

AS

CS

CI

FOG RAIN AND LOW NIMBUSTRATUS

200 100 0 100 200 300 400 500

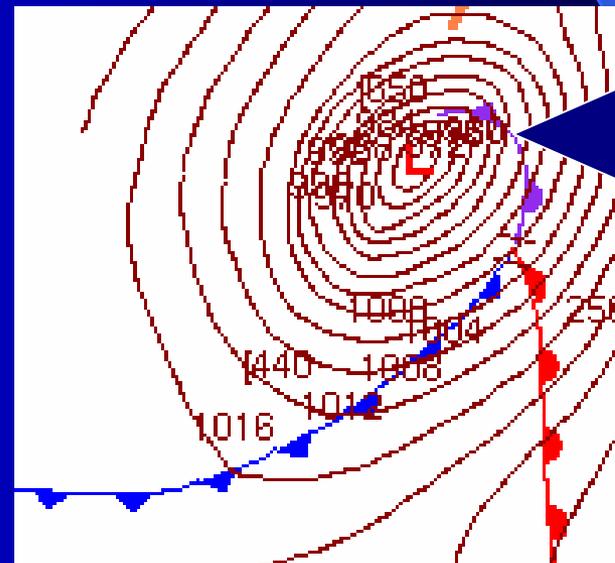
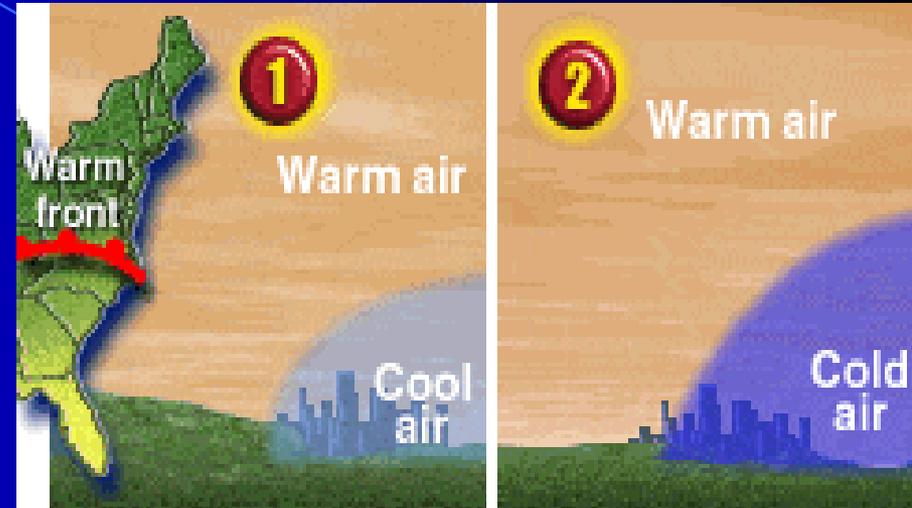
30,000  
Stable  
warm  
air

20,000

10,000

# Occluded Front

- Occurs when cold front overtakes the warm front
- Weather is a combination of cold steady, misty rain and drizzle
- Notice the symbol to mark the occluded front is a purple combination of a cold and warm front symbol

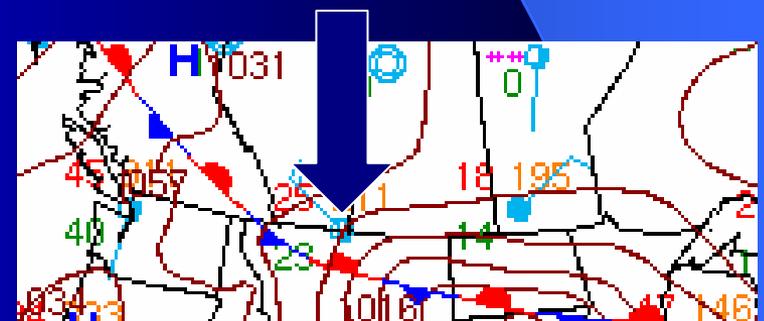
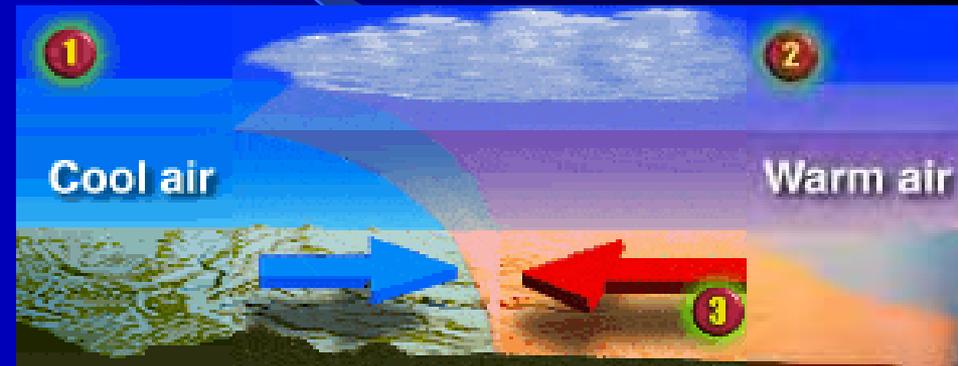


Occluded  
Front  
symbol



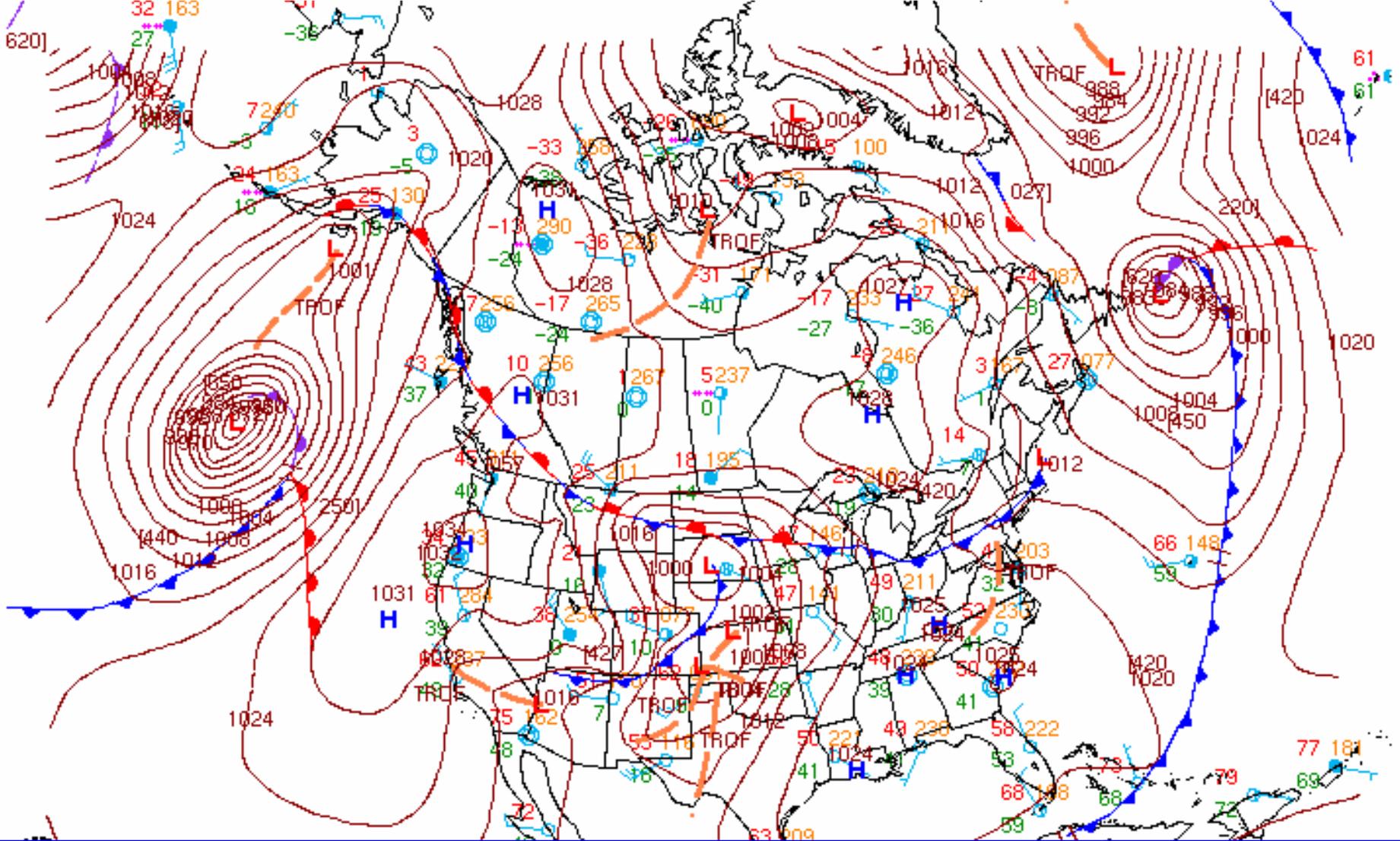
# Stationary Front

- Occurs when the frontal boundary either moves very slowly or does not move
- Notice that the symbol marking the stationary front is alternating red half circle on the warm air side and blue triangles on the cold air side



Stationary front symbol

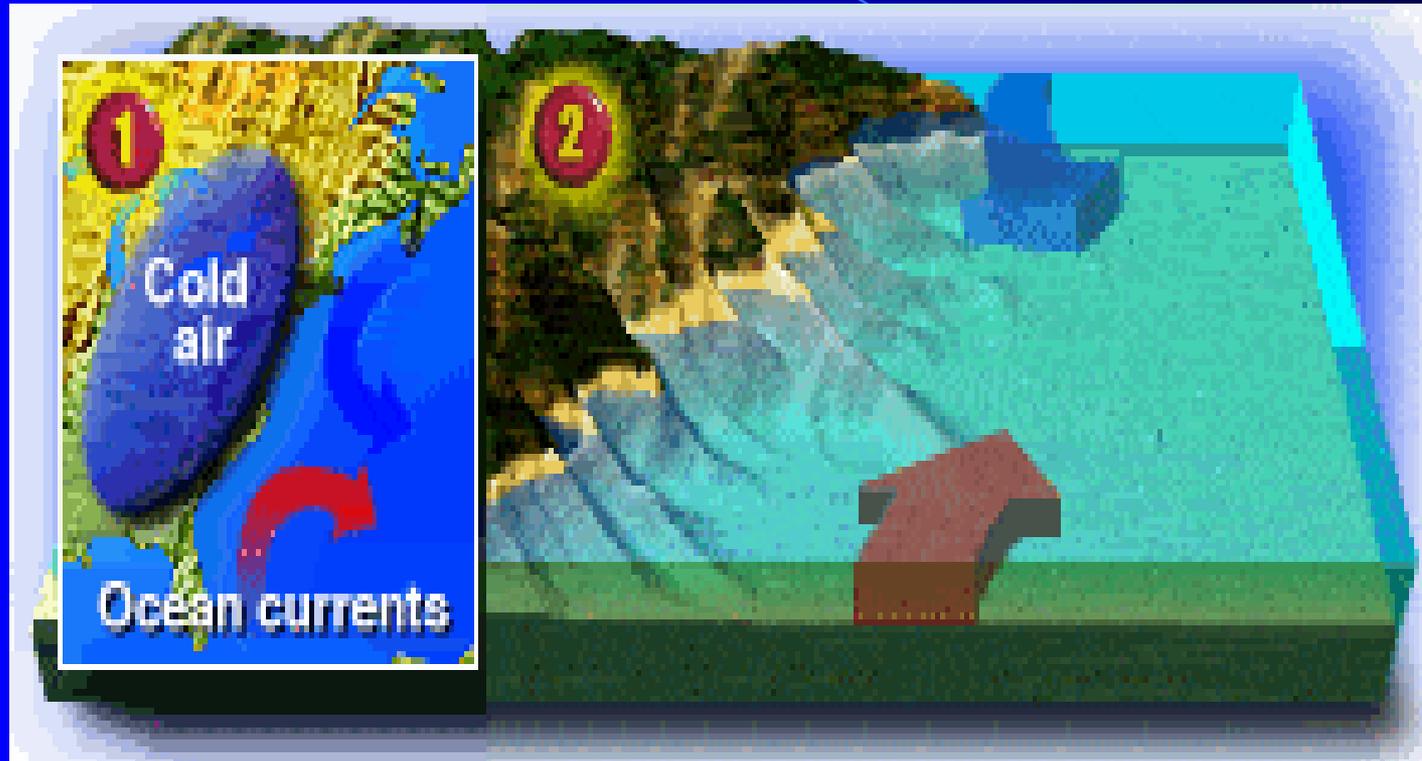




Can you pick out the cold fronts, warm fronts, occluded fronts and stationary fronts?  
 What type of weather is associated with each?  
 How does the wind shift with each type of frontal passage?

# Cape Hatteras

## Conditions for the “Perfect Storm”?



Warm moist air from ocean currents will add fuel to low pressure systems moving offshore.

Therefore, the warm sector of the Gulf Stream can cause a dying low pressure system moving offcoast to redevelop.



# Nautical Weather Sayings

- Red sky at night, sailor's delight. Red sky in the morning, sailor take warning.
- Mackerel skies and mare's tails make tall ships carry low sails.
- First rise after very low indicates a stronger blow.

# Clouds

- To understand some of these nautical weather rhymes we need to talk about clouds
- Clouds are a mariner's best visual indicator of changing weather.



# Clouds

Clouds are classified by:

Height : stratus (low), alto (mid-level) and cirrus (high- level)

Texture: cumulus (little white puffies) or stratus (flat)

Latin	Translation	Example
cumulus	heap	fair weather cumulus
stratus	layer	altostratus
cirrus	curl of hair	cirrus
alto	height, upper air	altocumulus
nimbus	rain	cumulonimbus



# Forecasting weather using clouds

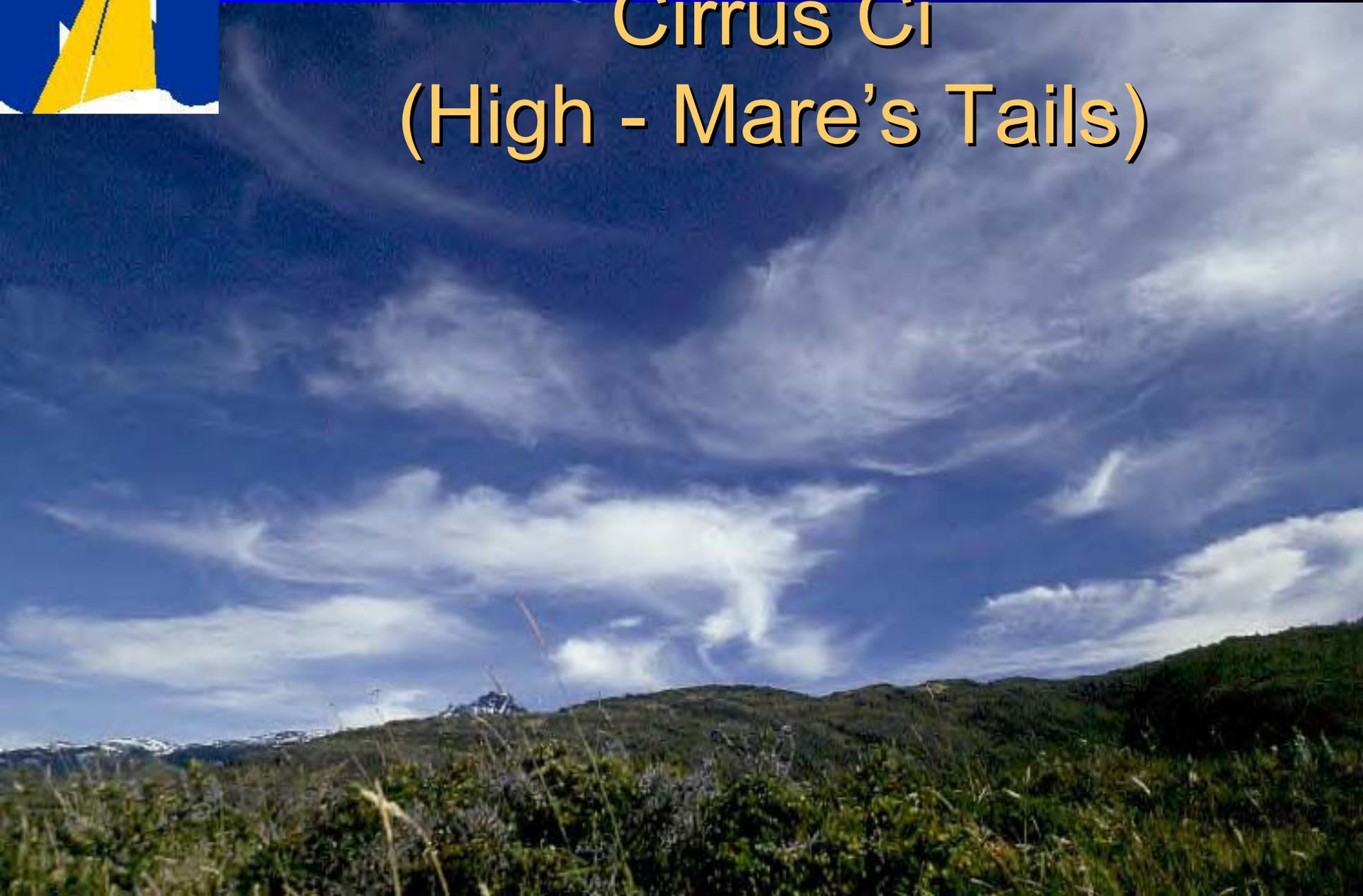
- If clouds appear high and then thicken (cumuloform clouds) and lower, a cold front is approaching.
- If clouds appear high and then flatten out and lower (strataform clouds), a warm front is approaching.



# Clouds

## Cirrus Ci

(High - Mare's Tails)

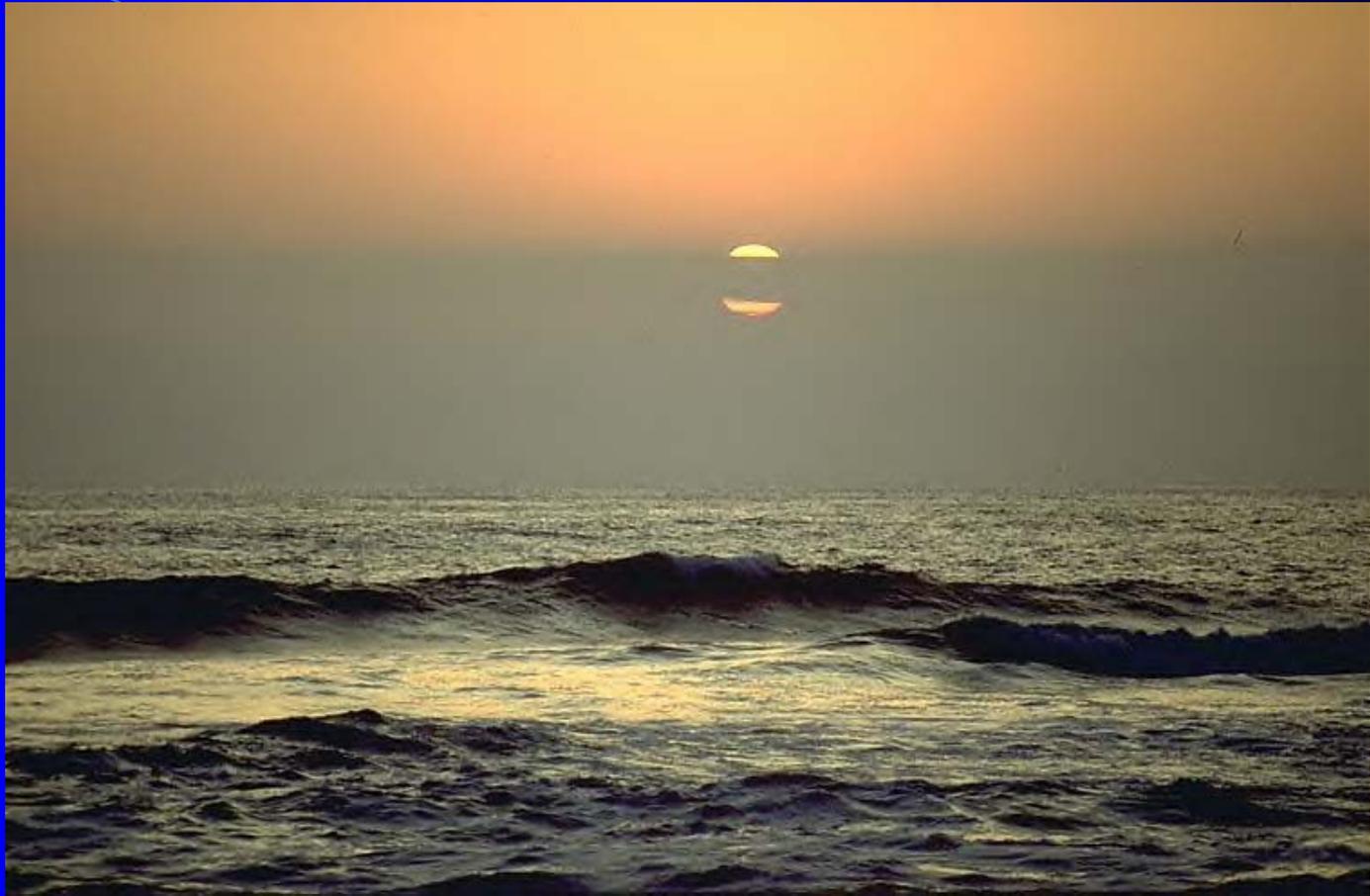


# Clouds

Altostratus Ac  
(mackerel skies)



# Clouds Stratus (low flat)





# Clouds

cumulus Cu (heap)





Cumulonimbus Cb (Thunderheads)  
extreme vertical extent from surface to  
~ 20,000 - 35,000 ft  
anvil top indicates strong wind shear





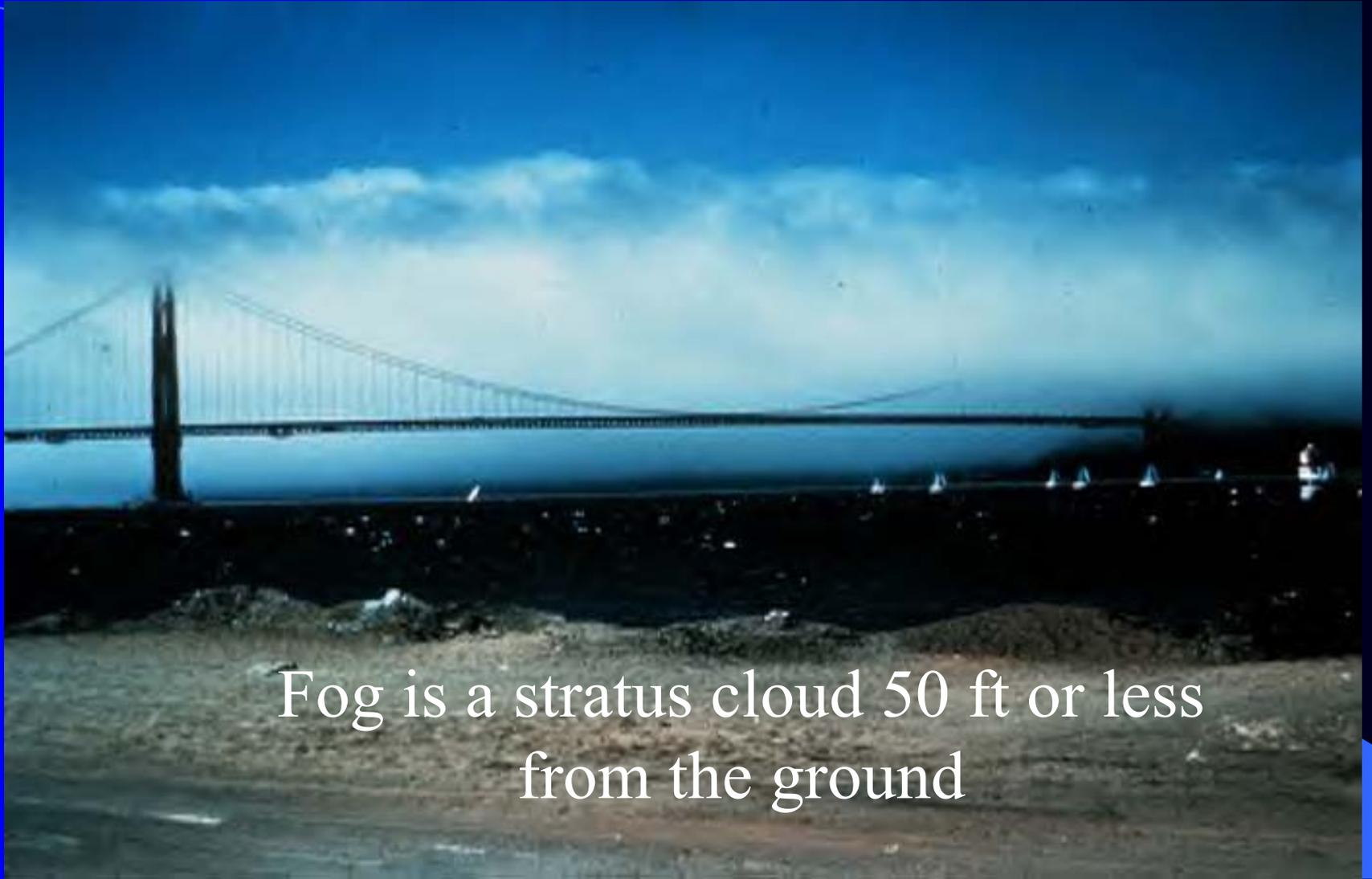
# Clouds

## Cumulonimbus Cb





# Clouds Fog



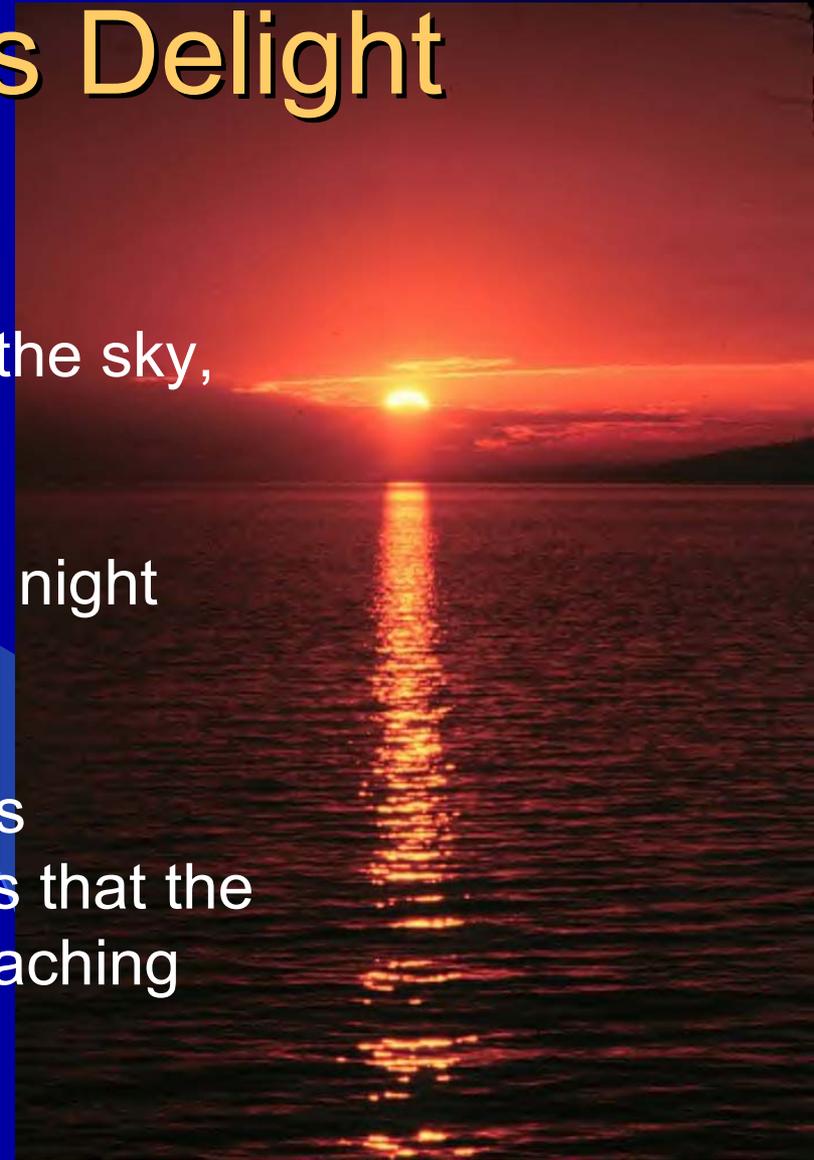
Fog is a stratus cloud 50 ft or less  
from the ground



# Red Sky at Night Sailor's Delight

As the sun sets and moves lower in the sky, the colors observed are those in the longer wavelengths of the spectrum (orange and red). At night the sun is in the western sky.

A red sky indicates clear weather in west. Since weather generally moves from west to east, a red sky indicates that the west is clear and there are no approaching weather making systems.





# Red Sky in the Morning... Sailor Take Warning

In the morning, the sun rises above the eastern horizon, and the red colors observed are those in the longer wavelengths of the spectrum. A red sky in the morning therefore indicates clear weather in east. However, since weather generally moves from west to east, a red sky indicates that the east is clear and therefore deteriorating weather is approaching from the west.



# Mackerel Skies and Mare's Tails Make Tall Ships Carry Low Sails

Mackerel Skies (Alto cumulus or cirrocumulus Clouds) and Mare's Tails (Cirrus Clouds) indicate an approaching cold front as warm air is rapidly pushed up in advance of the front.



Mare's tails (Cirrus)



Mackerel Skies  
(alto cumulus  
or cirrocumulus)

# “First rise after a very low indicates a stronger blow.”

- Refers to the rise in barometric pressure following a period of low pressure.
- Wind is caused by the difference between high and low pressure and the atmosphere's attempt to equalize the two.
- The greater the pressure differences, the stronger the wind.

# Other Weather resources

Internet: NOAA weather charts obtained from

- internet prior to sailing
  - [www.noaa.gov](http://www.noaa.gov)
  - [www.nlmoc.navy.mil](http://www.nlmoc.navy.mil)
- Weather observations passed from other boats
- Buoy reports
  - obtained from HF weather facsimile chart
  - Dial-a-Buoy (Eldridge 2004 pp 204-205)

# VHF Radio

- Local area broadcasts are prerecorded messages provided by NOAA and provide current weather conditions and forecasts for specific areas.
- NOAA provides local area weather updates on
- VHF channels 1-8. VHF radios have a Wx button
- with which to quickly access these broadcasts.

# SSB or HF Radio

- Voice Broadcasts are also located on HF frequencies (Check Reeds for specific HF frequencies and times of broadcast)
- Caution: Weather information is perishable
- information and local area broadcasts are good only for a SPECIFIC area at a SPECIFIC time.
- Herb Hilgenberg
  - Begins broadcasts at 1600 EST
  - 12.359 MHz
  - Before voyage contact him by fax (905) 681-7114

# Official Use Only Resources

Naval Atlantic Meteorology and Oceanography Center NLMOC  
(Norfolk, VA) (757) 444-7750

Naval Atlantic Meteorology and Oceanography Detachment  
(Patuxent River, MD) (301) 342-3174

Naval Atlantic Meteorology and Oceanography Detachment  
(Brunswick, ME) (207) 921-2356

For Gulf Stream or Hurricane information

[www.nlmoc.navy.mil](http://www.nlmoc.navy.mil)

# Weather Charts via HF Facsimile

- Weather Charts can be accessed via HF facsimile
- Various weather charts are disseminated on a set schedule by NOAA.
- Reeds provides the schedule and HF frequencies via which these charts can be accessed.
- One can pre-program the Furuno Weather Facsimile machine to automatically access the HF signal at the time that these charts are broadcast.

# Weather Charts

- Weather charts are 2 dimensional depictions of the atmosphere which is 3 dimensional.
- They are also snapshots in time.
- On a Navy 44 at sea, weather charts are obtained by weather facsimile.



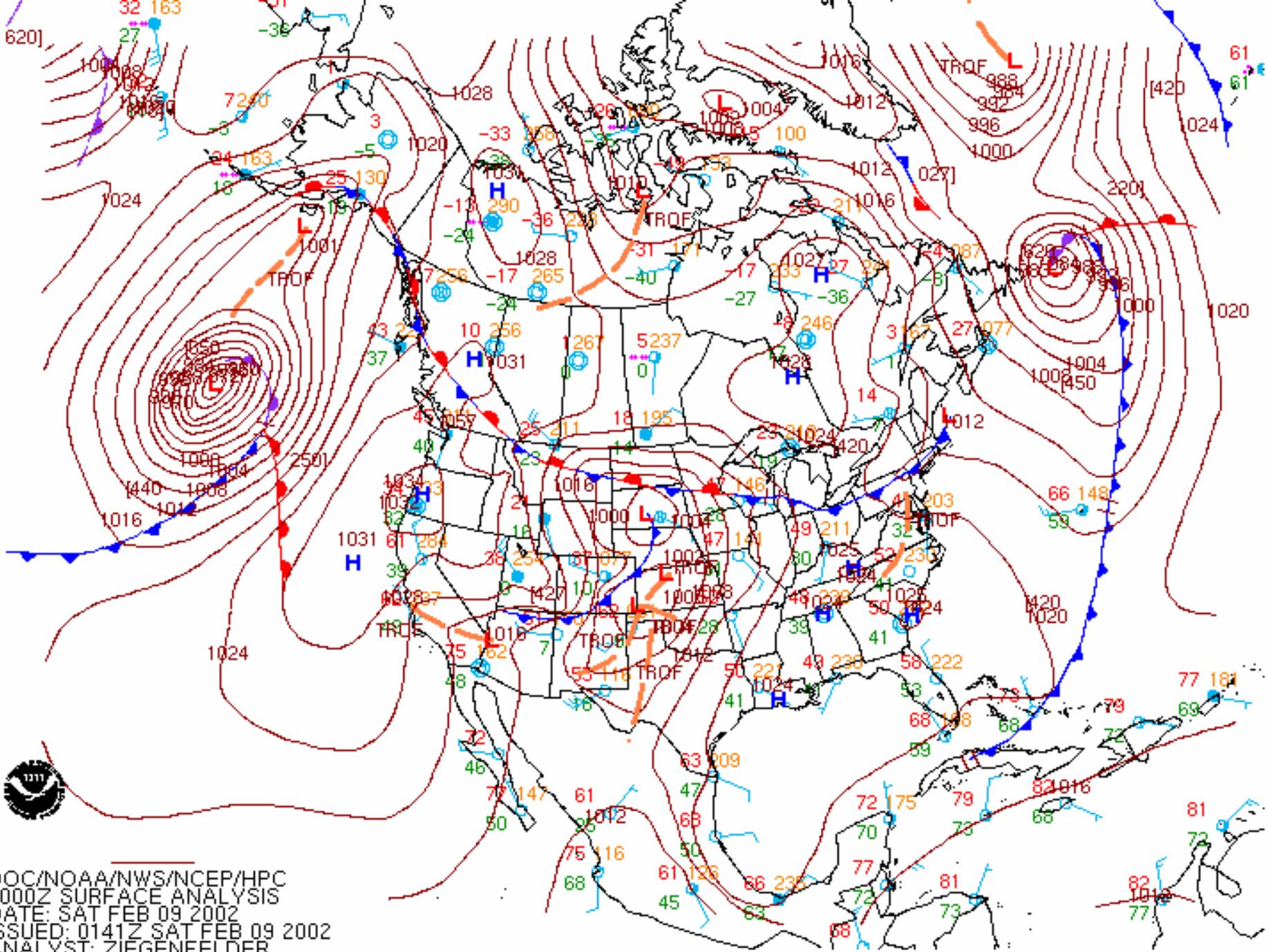
# Weather Charts

- Weather Charts can be divided into two types:
  - Analysis Charts (charts that tell you what the weather did)
  - Prognostic (Forecasting) Charts (charts that try to predict what the weather will do)

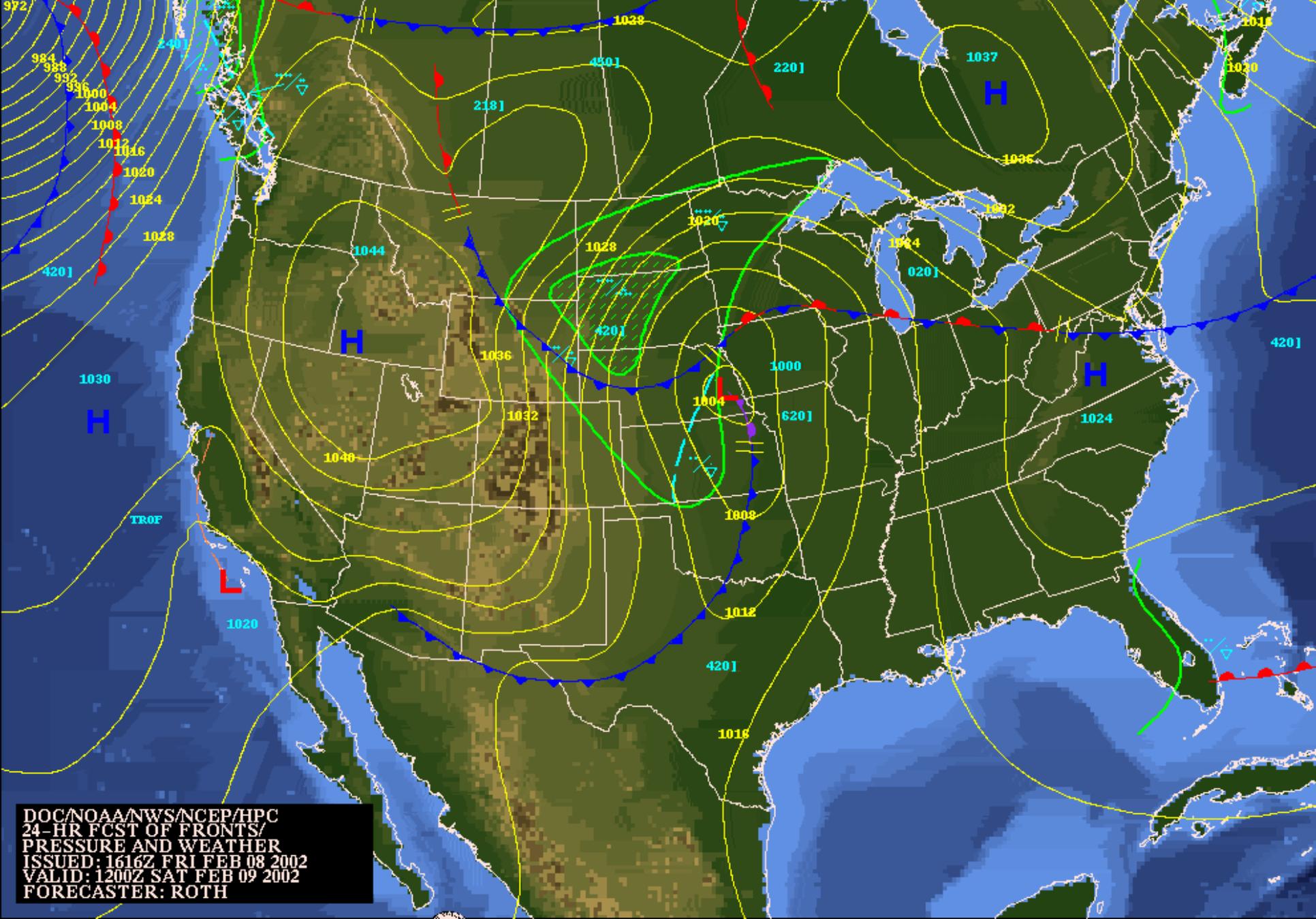


# Weather Charts

- When reading a weather chart it is important to first check:
  - Is it an analysis or prognostic chart?
  - If it is an analysis chart, how old is the analysis?
  - If it is a prognostic chart, when is the forecast valid?



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# Weather Charts

- When reading a weather chart it is also important to determine if that analysis or prognostic chart gives you the surface weather information or if it gives you the upper level weather information
- For the mariner the surface analysis or the surface prognostic chart provides the most useful information
- For aviators, the upper level charts provide additional useful information



# Weather Charts

- Upper level charts are indicated by atmospheric level
- For example 700mb, 500 mb, 400mb etc.



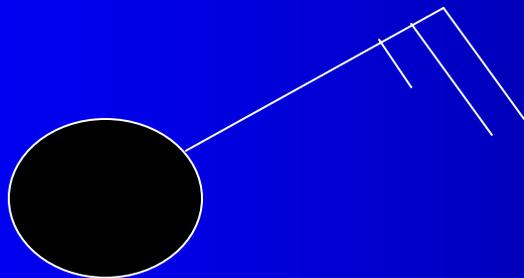
# Weather Charts

- Surface charts will be entitled surface and can give you information regarding different parameters
- For example: surface pressure, surface wind direction



# Weather Charts and Symbols

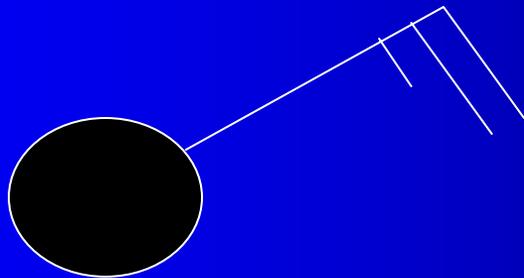
- Surface weather charts will show cold, warm, occluded and stationary frontal boundaries
- Wind barbs, which indicate wind direction and speed are also shown and look like





# Weather Charts and Symbols

- Wind barbs are located on surface analysis charts and give the wind and weather conditions that occurred at various weather stations





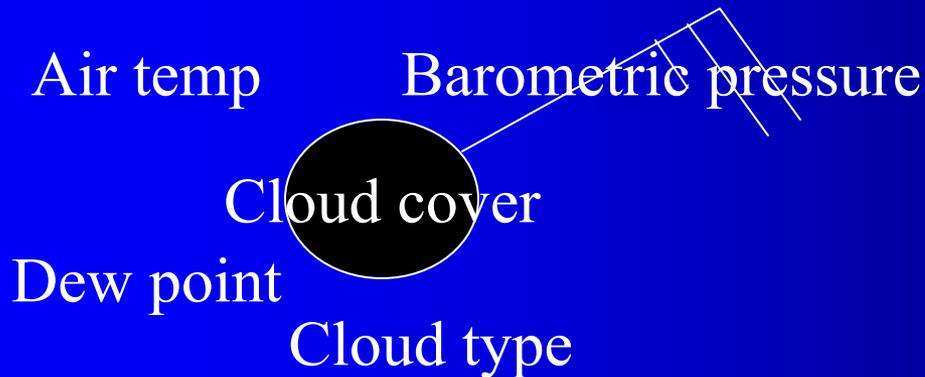
# Deciphering Wind Barbs

- Wind barbs give information regarding
  - cloud cover
  - wind direction
  - wind speed
  - Barometric pressure
  - Air temperature
  - Dew point



# Deciphering Wind Barbs

Wind direction and speed  
(each long barb 10 kts; short barb 5kts)  
Wind is from NE in this example



For Barometric Pressure:

0153 means 1015.3 mb

803 means 980.3 mb

(if 1<sup>st</sup> digit is 0 put a 1  
before it)

(if 1<sup>st</sup> digit is 5,6,7, 8 or  
9, put a 9 before it)



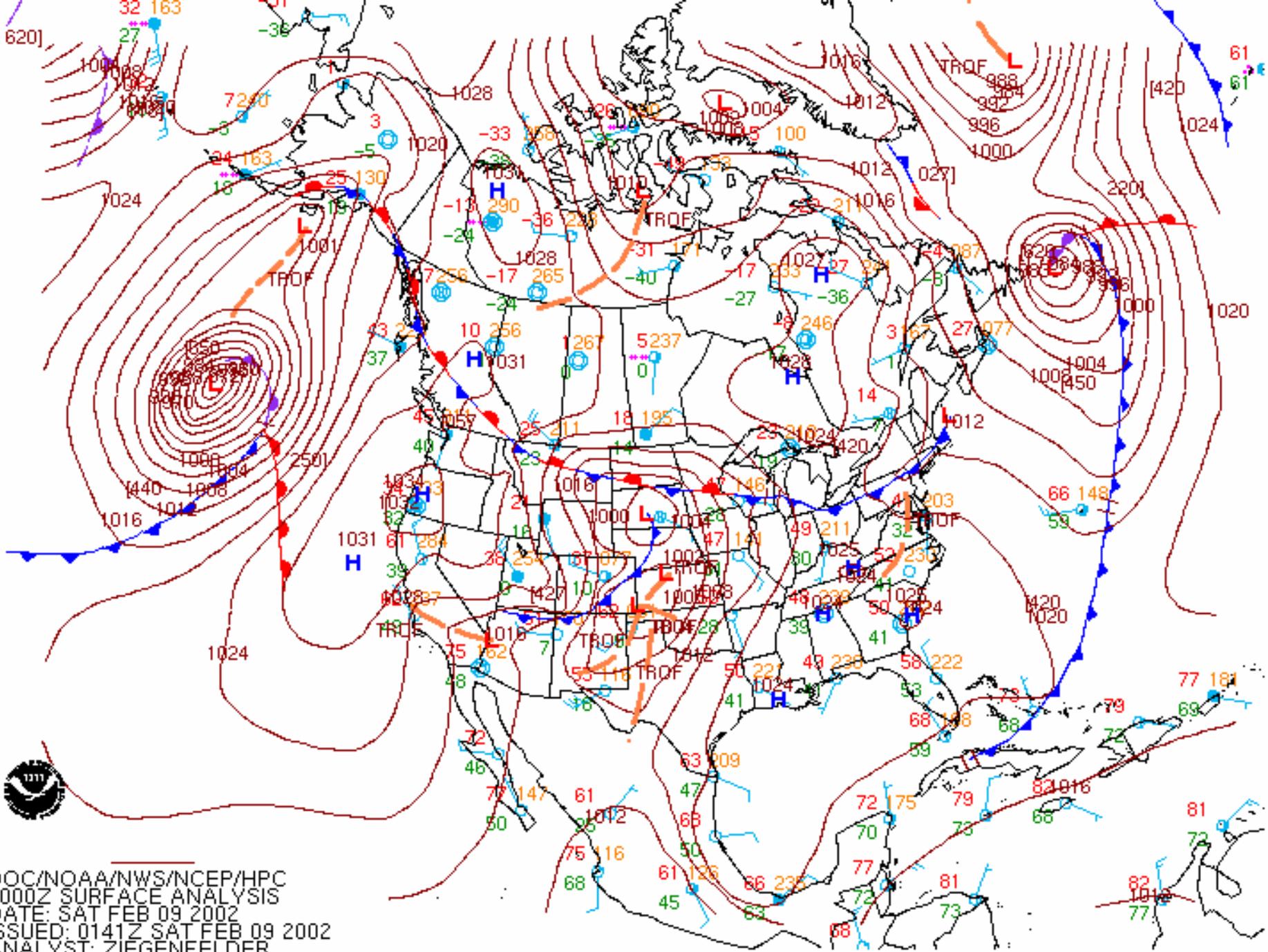
# Weather charts and wind

- Some weather charts may not show wind barbs.
- Wind can also be determined by looking at the isobars (the lines of constant pressure) surrounding the low or high pressure
  - The tighter the spacing between isobars, the stronger the wind



# Weather Charts and Wind

- Around a low pressure center, wind blows parallel, but slightly crosses the isobars in toward low pressure
  - Slightly inward and counterclockwise around a low
- Around a high pressure center, wind blows parallel, but slightly crosses the isobars outward from high pressure clockwise
  - Slightly outward and clockwise around a high

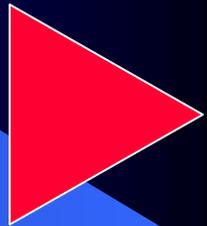


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# Wind Warnings

- **Small Craft Warnings: 18 - 33 kts**
  - A *Small Craft Advisory* is issued to alert operators of small craft whenever sustained winds of 18 to 33 knots inclusive, and/or seas of 7 feet or greater, are either ongoing or forecasted to develop within the next 12 hours.

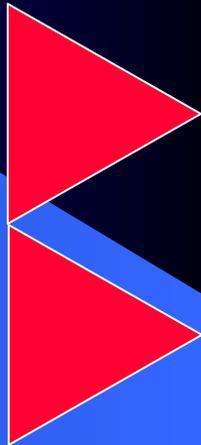




# Wind Warnings

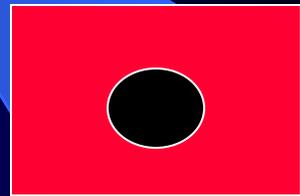
## Gale Warnings: 34 - 47 kts

- A ***Gale Warning*** is issued to alert all mariners whenever sustained winds of 34 to 47 knots, associated with a nontropical system, are either ongoing or forecasted to develop within the next 12 hours.

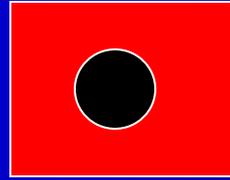
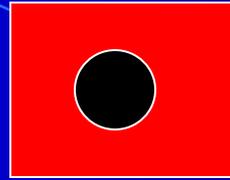


# Wind Warnings

- Storm Warnings: 48 + kts.
- Sustained winds above 48 knots of non-tropical (extratropical) origin. Does not have closed cyclonic rotation.
- Such storms are infrequent within the Chesapeake, however when they do occur, happen in fall or early spring.



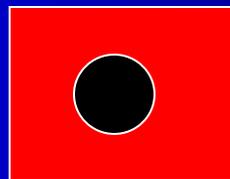
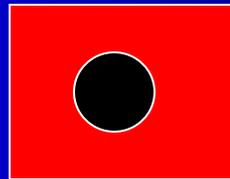
# Hurricane Warnings



- Definite Closed Cyclonic (CCW) Rotation
- Winds in this range associated with a system developing from a tropical depression would be covered under a *Tropical Storm Warning* (34 to 63 knots). Differs from a midlatitudes or extratropical storm in that it has a closed cyclonic (CCW) rotation

# Hurricane Warnings

- Tropical Depression >34 kts
- Tropical Storm Warning 34-63 kts
- Hurricane Warnings: 64 + kts
- Atlantic Hurricane season lasts from June- Nov
- Peak time frame for Atlantic August - October



# Direction of travel -

## Hurricane Bonnie

Dangerous Semicircle:

Right side of the hurricane's track.

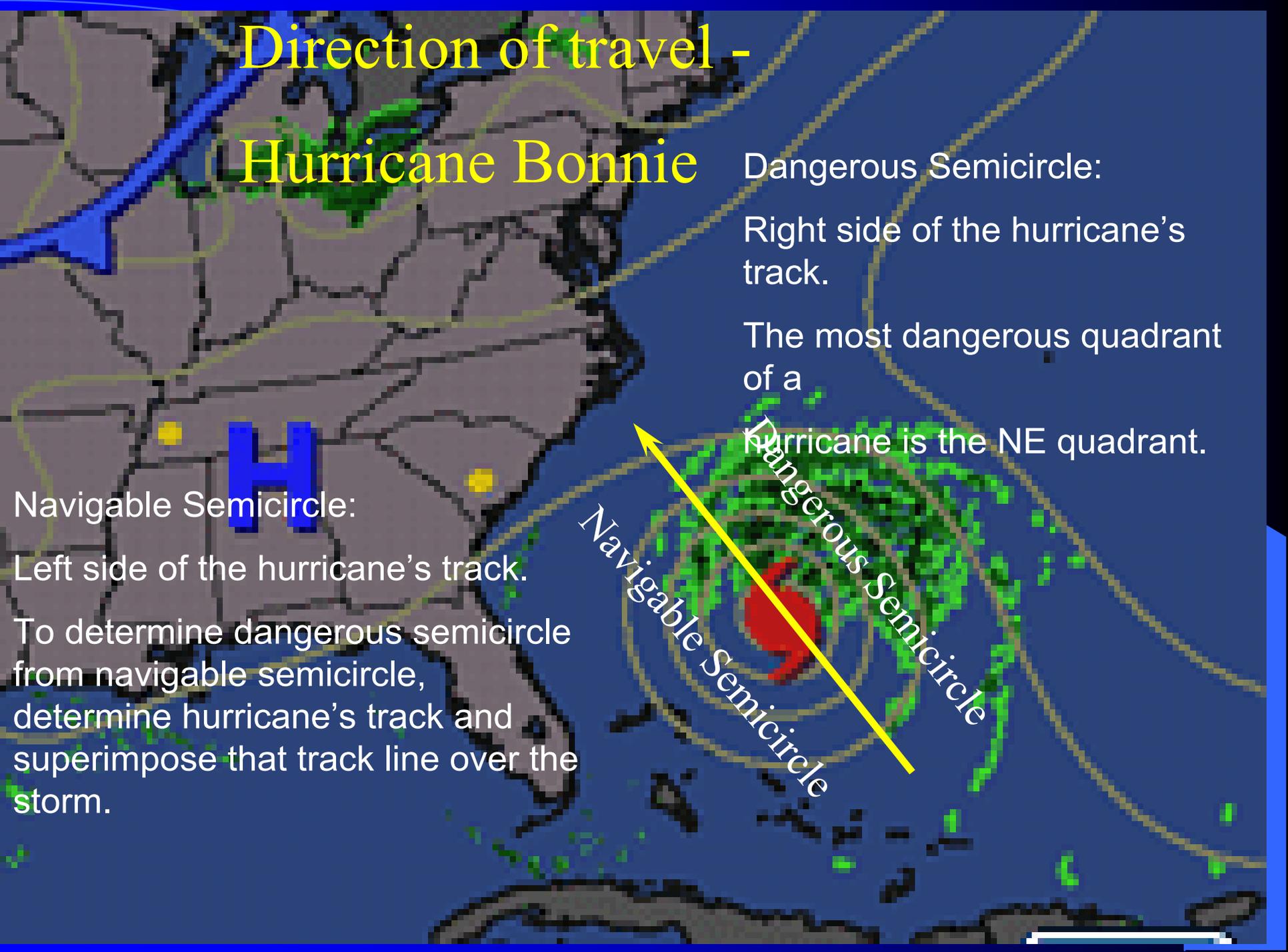
The most dangerous quadrant of a

hurricane is the NE quadrant.

Navigable Semicircle:

Left side of the hurricane's track.

To determine dangerous semicircle from navigable semicircle, determine hurricane's track and superimpose that track line over the storm.



Dangerous Semicircle

Navigable Semicircle

# Questions???



H.C.

The first naval meteorologist