Weather for the Mariner

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USNA 1982
Why Should You Care?

- Going to Sea is all about being prepared and...
- It’s all about controlling risk.
- It’s all about making preparations to maximize the things you can control and…
- It’s all about making preparations to minimize the things you can’t control.
My Point?

- Click to link to BT Global Challenge video
- www.youtube.com
  - BT Global Challenge 2000
Decisions Affected by Weather:

Crew

- Clothing.
  - Foul Wx gear
  - Tech vests
- Meals.
- Sea sickness medicine?
- Crew Training and Experience
- Crew Rotation. Who can stand watch?
  - Navigation or Helm or Deck?
Decisions Affected by Weather:

Equipment

- Sail combination?
- Reef, change head sail or rig storm sails?
- Missile hazards – are things lashed down or stowed properly?
- Is equipment in good repair?
- Is RACOR filter bowl clear of debris?
Decisions Affected by Weather:

**Navigation**

- Should you alter your route?
  - Go outside Long Island vs through New York City

- Are you Offshore?
  - Should you stay on track or head closer to shore?

- Are you in a Narrow Channel?
  - If the wind increases in strength or shifts in direction can you navigate safely?
  - If visibility decreases can you navigate safely?
Decisions Affected by Weather:

**Departure Time and Date**

- Departure time and date may very well be the most important decision you make!
Weather Tools Available On Navy 44

- Barometer
- Wind Instruments
- Clouds and sea surface
- Weather facsimile – prints onboard weather charts
- VHF radio -- local area broadcasts
- SSB radio -- HF weather broadcasts
- Satellite phone or cell phone
- Reeds Nautical Almanac – provides weather fax schedules and frequencies
Weather Tools Available On Navy

Barometer
SSB HF Radio
Weather Fax
VHF speaker switch
GPS
B&G
SSB/Fax selector switch
VHF Radio
Gravity switches (under desk)
Weather Tools Onboard Navy 44

- Chapter on Weather Fundamentals
- Provides Weather Fax Frequencies
- Provides photos of cloud types
- Provides photos of wind and sea state
- Herb Hilgenberg contact info
The goal of this lecture is to make sense of weather information you have available.
Typical chart received onboard a Navy 44 via the weather fax.

Conditions off shore 0600 UTC 04 Mar 2008
Forecasted Conditions Offshore
Valid 0000 UTC 05 Mar 2008
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.
- What do they mean?!!
Marine Weather Thumb Rules

• Be aware that your boat is moving relative to moving weather systems.

• Weather information is perishable information! Update and assess regularly. Make it a watch turnover item.

• Clouds are the mariner’s best visual indicator of changing weather.

• Pay attention to changes in cloud formation and the direction from which clouds approach.
Marine Weather Thumb Rules

• Pay attention to the speed and direction of the wind.

• Pay attention to the sea surface conditions and how it changes over time. Gradually increasing ripples on the water are first indication of increasing wind.

• Long parallel streaks in the water where foam and debris line up (called Langmuir Circulation) runs parallel with the wind and is a good indicator of true wind direction.
Marine Weather Thumb Rules

- Weather systems (High/Low pressure centers) in the mid-latitudes move from west to the east in a band of wind called the prevailing Westerlies.
Marine Weather Thumb Rules

Low and High pressure centers generally move in sequence. High pressure replaced by low pressure and low pressure replaced by high pressure.

- Low Pressure systems are associated with storms and high pressure systems serve to block these storms.
Warm, moist air fuels low pressure. Therefore warm currents such as the Gulf Stream can cause dying low pressure systems moving offshore to explosively redevelop.
Marine Weather Thumb Rules

- Changes in air pressure, wind direction, humidity and temperature are excellent indicators of changing weather.
- If 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.
Weather Fundamentals

- Air Masses
- Pressure
- Wind
- Fronts and Weather
- Clouds
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 temperature and moisture content modify the air.

Modified to be:
- Cold or warm
- Continental (dry air) or Maritime (moist air)
Air Masses

- The types of air masses are:
  - Arctic
    - very cold and dry
  - Continental polar
    - cold and dry
  - Continental tropical
    - Hot and dry
  - Maritime tropical
    - (always warm and moist)
Infrared temperature gradient showing air masses and air mass boundaries

Can you pick out the 5 types of air masses?

**Air Masses**

- **Continental Arctic (cA)**: very cold, dry
- **Continental Polar (cP)**: cold, dry
- **Maritime Polar (mP)**
- **Maritime Tropical (mT)**: warm, moist
- **Maritime Tropical (mT)**: warm, moist
Pressure

Jet Stream moves pressure centers westward and causes them to meander north and south.

Two Types:
- High Pressure
- Low Pressure
The Earth is always throwing the atmosphere out of balance and Mother Nature is always trying to restore balance. Lows and Highs act like gears to pull hot air toward the poles and cold air toward the equator.
Low Pressure

- Air circulates around low pressure centers counter clockwise and pulls the surrounding air inward like a vacuum (or the drain in a bath tub)
- Air converges at the center of low pressure and rises to form clouds.
- Associate low pressure with storms or deteriorating weather
- 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
High Pressure

- Air circulates around high pressure centers clockwise and deflects the air outward.
- High pressure is a mound of dense sinking air.
- 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
Barometers are instruments that measure air pressure.

Barometric pressure is one of the best indicators of impending weather.

Barometric pressure should be logged hourly!
Atmospheric pressure is measured either:

- Millibars (preferred)
  - Outside scale of barometer
  - NOAA weather charts

- Inches of mercury
  - Inside scale of barometer
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<th>POSITION</th>
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- Record hourly barometer readings
- Note if pressure rises or falls
- Rapidly, moderately or slowly
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 or water as it goes down the bath tub drain
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 always flow from high pressure (mound of air) in toward 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.
Weather charts are topographic charts of the atmosphere – made up of contours of hills, depressions and slopes (gradients).

These contours are called isobars and indicate the pressure gradient around a high or low pressure center.
  - Tightly packed isobars indicate a steep slope or strong wind gradient.

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.
Wind flows around the contours of constant pressure (isobars).

However… due to surface friction, wind cross the isobars slightly.

Surface winds move clockwise around high pressure and are deflected outward.

Surface winds move counterclockwise around a low and are pulled inward across the isobars.
1. What is moving toward you, a high or a low?
2. From what direction is the wind blowing?
3. Where are the highest winds on this chart?
Buys Ballot Law

- It's important to know where the low pressure center is located.

- This is a 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
  - In other words, the storm center is to your left and clear weather 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
  - Stationary front
  - Occluded front
Air Masses and Frontal Systems

- 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
- White Squall (Microburst)
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 Weather

- Squalls: precede cold 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
Microburst Sequence

202  Developing microburst, p. 508
203  Microburst series: 2 of 4, p. 508
204  Microburst series: 3 of 4, p. 508
205  Microburst series: 4 of 4, p. 508
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 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
Cirrus (Ci) → Cirrostratus (Cs) 
Nimbostratus (Ns) → Altostratus (As)
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
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
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?
If you were going north, what kind of weather would you expect?

Typical chart received onboard a Navy 44 via the weather fax.
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 offshore to explosively 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.
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
Altocumulus 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
Cumulonimbus Mammatus
Clouds
Cumulonimbus with waterspout
Fog is a stratus cloud 50 ft or less from the ground.
In evening sun sets in the west.

A clear sky shows the colors of the spectrum.

When sun is low in the sky the colors are the long wave colors red and orange.

Weather moves from west to east.

Therefore, clear sky (clear weather) is moving east.
In morning sun rises in the east.
A clear sky shows the colors of the spectrum.
When sun is low in the sky, the colors are the long wave colors red and orange.
Weather moves from west to east.
Therefore, clear skies in the east will be replaced by weather from the west.
“Mackerel Skies and Mare’s Tails: Make Tall Ships Carry Low Sails.”

Mackerel Skies (Altocumulus 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.
“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.

Steep gradient behind this low pressure center. Steep pressure gradient = high winds.
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.nl moc.navy.mil
### Other Weather Resources

<table>
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<tr>
<th>Web Site Name</th>
<th>Internet Address (URL)</th>
<th>Description</th>
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<tr>
<td>National Hurricane Center and Tropical Prediction Center</td>
<td><a href="http://www.nhc.noaa.gov/">http://www.nhc.noaa.gov/</a></td>
<td>Excellent source of up-to-date information about existing and developing hurricanes. Also has marine weather for tropical areas.</td>
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</table>
Location of NOAA Buoys
Dial-A-Buoy

Call 888-701-8992
Location of NOAA Buoys
Location of NOAA Buoys
VHF Radio

- Local area broadcasts are prerecorded messages provided by NOAA and provide current weather.

- NOAA provides local area weather updates on channels 1-8.

- Caution: local area broadcasts are good only for a SPECIFIC AREA at a SPECIFIC TIME.

Wx button to access info quickly

Or dial weather info on VHF Channels 1-8
SSB or HF Radio

- Voice Broadcasts are also located on HF frequencies (Check Reeds Nautical Almanac for specific HF frequencies and times of broadcast)
- Caution: Weather information is perishable!
- Weather 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
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 extratropical system (not of tropical origin), are either ongoing or forecasted to develop within the next 12 hours.
Wind Warnings

- Storm Warnings: 48 + kts.
- Sustained winds above 48 knots of extratropical (non-tropical) 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.
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.
Tropical Depression >34 kts
Tropical Storm Warning 34-63 kts
Hurricane Warnings: 64 + kts
Hurricanes and Tropical Storms

- Atlantic hurricane season lasts from June - Nov
- Peak time frame for Atlantic August - October
Direction of travel -

**Hurricane Bonnie**

First sign of a hurricane is the long period swell.

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:
Right side of the hurricane’s track.

The most dangerous quadrant of a hurricane is the NE quadrant.
Weather Charts can be accessed via HF facsimile

Various weather charts are disseminated on a set schedule by NOAA.

Reeds Nautical Almanac provides the schedule and HF frequencies from which these charts can be accessed.

The Furuno Weather Facsimile machine can be preprogrammed 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?
Weather Chart Symbols

World wide convention also uses the following wind vectors at all levels:

- Calm
- 5 Knots
- 10 Knots
- 15 Knots
- 20 Knots
- 50 Knots
- 65 Knots

Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign
Weather Charts

- Surface charts will be titled 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 are found on sfc analysis charts and 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

Air temp
Barometric pressure
Cloud cover
Dew point
Cloud type

For Barometric Pressure:
0153 means 1015.3 mb
803 means 980.3 mb

(place a 1 or 9 in front of first
digit, whatever makes the
number closest to 1000)
Deciphering Wind Barbs

What is the direction and speed of the wind?
What is the temperature?
What is the dewpoint?
What is the pressure?
What kind of weather can you expect?

For Barometric Pressure:
0153 means 1015.3 mb
803 means 980.3 mb

(place a 1 or 9 in front of first digit, whatever makes the number closest to 1000)
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
Weather Chart Symbols

**GRAPHICAL PRODUCTS LEGEND (01 OCT 2002)**

- **H**: 30
  - 24HR HIGH PRES MOVMT AND PRES IN MBS
- **1024**
  - HIGH PRES CENTER WITH PRES IN MBS
- **996**
  - LOW PRES CENTER WITH PRES IN MBS
- **30**: MODERATE ICING
- **99**: HEAVY ICING
- **WIND BARBS:**
  - 5 KT
  - 10 KT
  - 15 KT
  - 20 KT
  - 25 KT
  - 30 KT
  - 35 KT
  - 40 KT
  - 50 KT
  - 60 KT
  - 65 KT
  - 70 KT
  - 75 KT
  - 80 KT
  - 90 KT
  - 100 KT
  - 110 KT
  - 120 KT

**TEXT ABBREVIATIONS:**
- GALE = 34–47 KT
- STORM = 48–63 KT
- HURCN => 64 KT
- KT = KNOTS, G = GUSTS
- HR = HOUR
- MBS = MILLIBARS
- PRES = PRESSURE
- HURCN = HURRICANE
- DSIPT = DISSIPATED
- STNRY = STATIONARY
- WKNG = WEAKENING
- RPDLY = RAPIDLY
- FRMG = FORMING
- MOVG = MOVING
- TROF = TROUGH
- INLD = INLAND
- TRPCL = TROPICAL
- DVLPG = DEVELOPING
- COMB = COMBINING
- DCRS = DECREASING
- INCR = INCREASING
- INTSFYG = INTENSIFYING
- PSN = POSITION

**NOTE:** WHEN APPROPRIATE THIS CHART MAY BE REPLACED WITH A BULLETIN DETAILING RADIOFAX PROGRAM CHANGES
Typical Station Plot

85
65
250

Mostly cloudy, temp 85, dewpoint 65, wind SE 25 knots, ceiling 25,000 feet

Cloud Cover

- clear
- scattered
- moderate
- overcast
- M overcast

Thunderstorms

- thunder
- normal
- severe

Drizzle

- light
- moderate
- heavy

Rain

- light
- moderate
- heavy

Snow

- light
- moderate
- heavy

Cloud Symbols:

- occluded
- stationary
- wind east 15k
- wind west 50k
- fog
- haze
- ice pellets
- freezing rain
- rain shower (light)
- rain shower (heavy)
Four Surface Analysis Charts Daily

0000Z 0600Z 1200Z 1800Z

West Atlantic Surface Analysis
Surface Forecast Charts for 24 hr  48 hr and 96 hr  forecasts
24-HOUR WIND & WAVE FORECAST (F03)
FROM: 12 UTC 04 Mar 2007
VALID: 12 UTC 05 Mar 2007
FCSTR: SCOVIL

SIGNIFICANT WAVE HEIGHT IS SHOWN [THE AVERAGE HEIGHT OF THE HIGHEST ONE-THIRD OF THE WAVES]

FORECAST GULFSTREAM POSITIONS
NORTH WALL = THICK SOLID LINES
SOUTH WALL = THICK DASHED LINES

NWS/NCEP - Ocean Prediction Center
www.opc.ncep.noaa.gov
Heading south from Newport enroute to USNA... Would you have head seas or following seas? What sea heights would you expect along the track?
Remember what the bold 564 isoheight on the 500 mb chart tells you about wind and seas along your track?
Forecast or Analysis?
Is it current?
Upper Level Weather Charts

- Upper Level Charts are good forecasting tools because they show the general upper level flow which is unimpeded by surface friction.
- 500 mb chart available via weather fax. It shows the isoheight contours (meters) of 500mb pressure.

- The “bold” 5640 meter isoheight shows the southern extent of:
  - the Beaufort Force 7 seas (13.5-19 ft) and winds (28-33 kts) in winter
  - the Beaufort Force 6 seas (5-13 ft) and winds (22-27 kts) in summer.
5640 isoheight (bold line) shows the southward extent of the:
Force 7 seas (13.5-19 ft) and winds (28-33kts) -- in winter
Force 6 seas (5-13 ft) and winds (22-27kts) -- in summer
5640 isoheight (bold line) shows the southward extent of the:
Force 7 seas (13.5-19 ft) and winds (28-33kts) -- in winter
Force 6 seas (5-13 ft) and winds (22-27kts) -- in summer
Sea State

Sea State is determined by the following factors:

- **Fetch:**
  - Size of the area over which the wind blows.
- **Duration:**
  - Length of time the wind has been blowing.
- **Wind speed:**
  - How hard the wind blows
- **Areas where there are abrupt depth changes**
  - such as Georges Banks off of the Grand Bands

The larger the fetch area the higher the waves.
Why is Sea State Important?

Because it’s the seas that will kill you!!!

- 1 gal of water = approximately 8 lbs per gal
- 1,000,000 gals of water with the force of wind behind it can destroy a concrete building.
**Force 0:** Wind Speed less than 1 knot.
*Sea:* Sea like a mirror.

**Force 1:** Wind Speed 1-3 knots.
*Sea:* Wave height .1m (.25 ft); Ripples with appearance of scales, no foam crests.

**Force 2:** Wind Speed 4-6 knots.
*Sea:* Wave height .2-.3m (.5-1 ft); Small wavelets, crests of glassy appearance, not breaking.

**Force 3:** Wind Speed 7-10 knots.
*Sea:* Wave height .6-1m (2-3 ft); Large wavelets, crests begin to break, scattered whitecaps.
**Force 4:** Wind Speed 11-16 knots.

**Sea:** Wave height 1-1.5m (3.5-5 ft); Small waves becoming longer, numerous whitecaps.

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**Force 5:** Wind Speed 17-21 knots.

**Sea:** Wave height 2-2.5m (6-8 ft); Moderate waves, taking longer form, many whitecaps, some spray.

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**Force 6:** Wind Speed 22-27 knots.

**Sea:** Wave height 3-4m (9.5-13 ft); Larger waves forming, whitecaps everywhere, more spray.

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**Force 7:** Wind Speed 28-33 knots.

**Sea:** Wave height 4-5.5m (13.5-19 ft); sea heaps up, white foam from breaking waves begins to be blown in streaks along direction of wind.
**Force 8: Wind Speed 34-40 knots.**

**Sea:** Wave height 5.5-7.5m (18-25 ft); Moderately high waves of greater length, edges of crests begin to break into spindrift, foam is blown in well marked streaks.

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**Force 9: Wind Speed 41-47 knots.**

**Sea:** Wave height 7-10m (23-32 ft); High waves, sea begins to roll, dense streaks of foam along wind direction, spray may reduce visibility.

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**Force 10: Wind Speed 48-55 knots.**

**Sea:** Wave height 9-12.5m (29-41 ft); Very high waves with overhanging crests, sea takes white appearance as foam is blown in very dense streaks, rolling is heavy and shocklike, visibility is reduced.

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**Force 11: Wind Speed 56-63 knots.**

**Sea:** Wave height 11.5-16m (37-52 ft); Exceptionally high waves, sea covered with white foam patches, visibility still more reduced.
These are the existing conditions off shore today.

If you were to head south from Newport enroute to USNA, what kind of weather would you expect along your track?

What other weather resources could you use to help predict the conditions and plan ahead?
Remember what the bold 564 isoheight on the 500 mb chart tells you about wind and seas along your track?
Heading south from Newport enroute to USNA...
Would you have head seas or following seas?
What sea heights would you expect along the track?
Questions???

I'm tellin' ya Noah... blue skies and dry conditions for oh, say thirty or forty days.

No kidding?

The first naval meteorologist