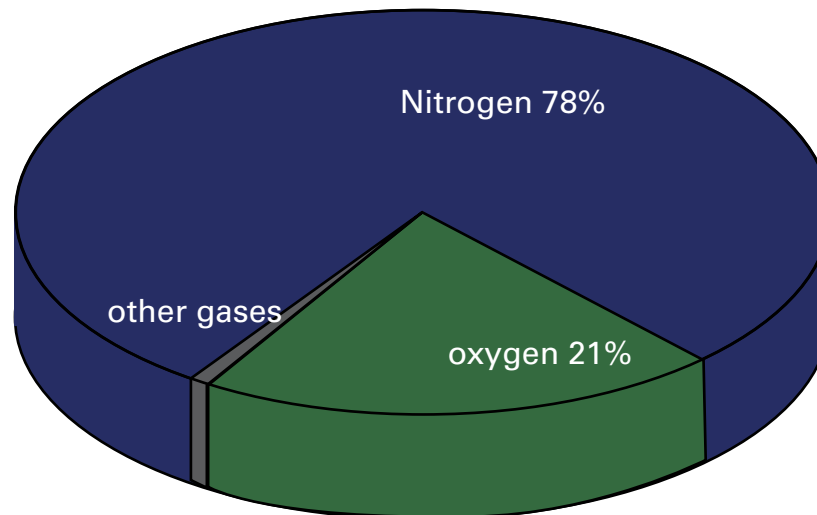


WEATHER



THE ATMOSPHERE

- The air we breath is made up of mostly Nitrogen and Oxygen, with small quantities of other gases.
- Water vapor: small but varying amounts (~1%)
- Warm air contains more water vapor than cold air.

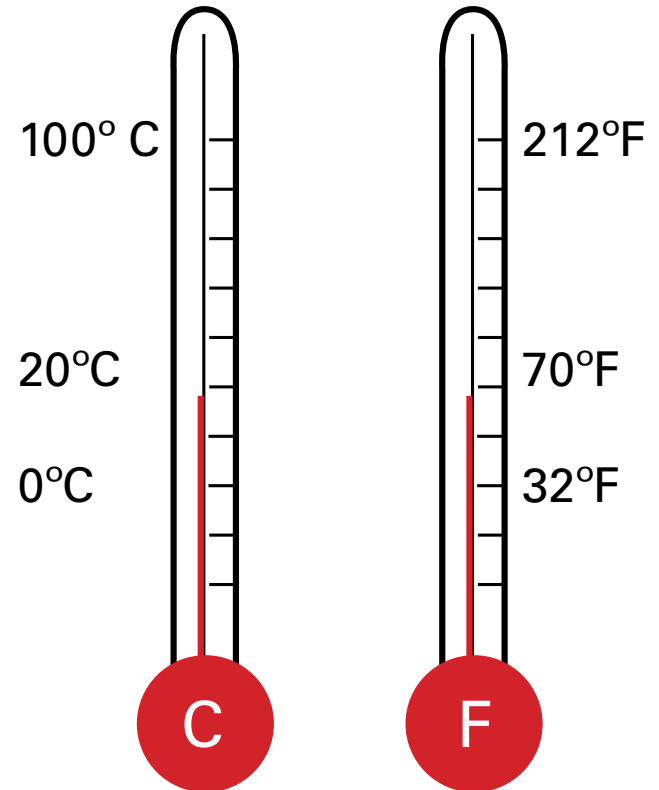


MEASURING TEMPERATURE

- Thermometers
 - Mercury filled

Changing from Fahrenheit to Celsius:

$$C = (F - 32) \times 1.8$$

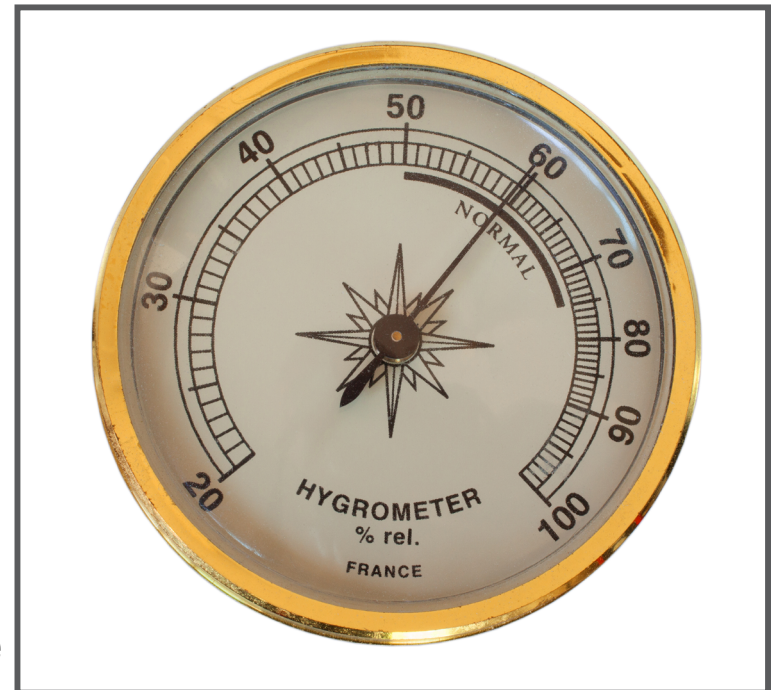


HUMIDITY

Relative Humidity: Amount of moisture in the air at a certain temperature compared to how much moisture the air can actually hold at that temperature.

- Expressed as %
- Measure with psychrometer (wet and dry bulb thermometer)

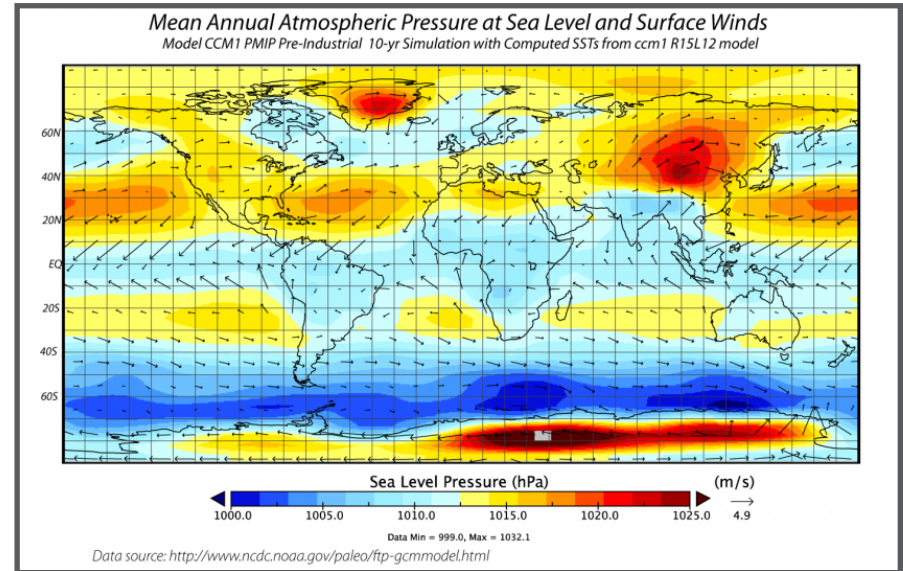
Dew Point: Temperature to which air must be cooled in order to become saturated.



WINDS AND PRESSURE

Atmospheric Pressure

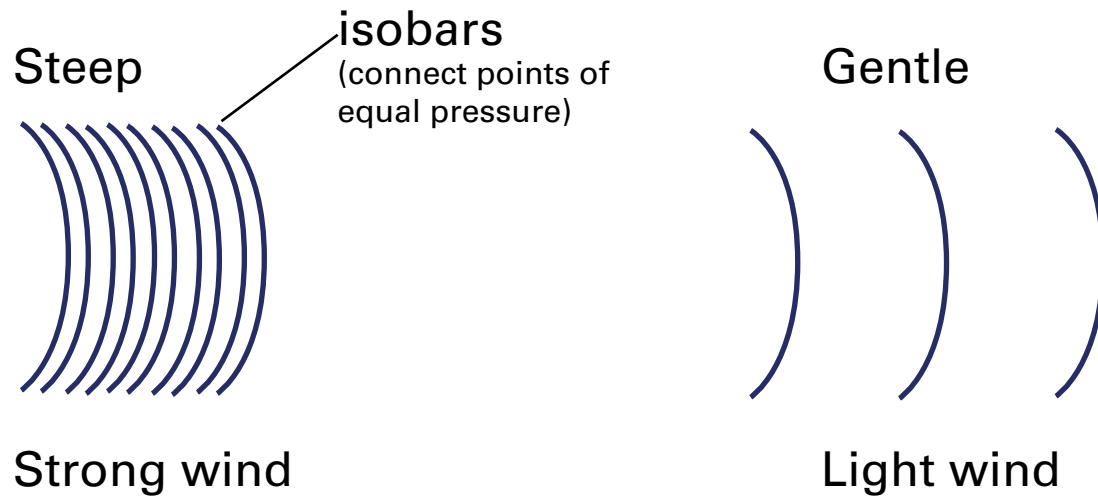
- Weight of the atmosphere
- Measured using a barometer
- Inches of mercury or millibars
- 29 inHg / 1013 mb



WIND

Air moves from high-pressure areas to low-pressure areas

- Pressure gradient
- Wind Velocity varies based on the pressure gradient.

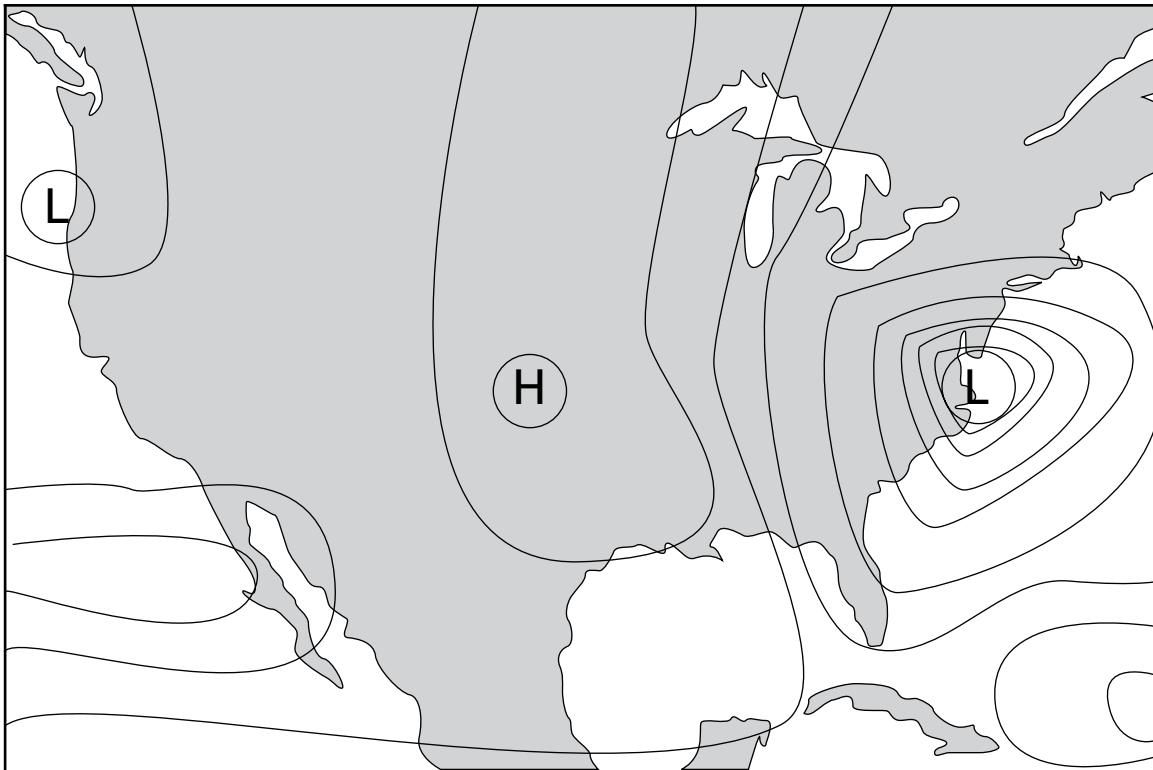


WEATHER

WIND

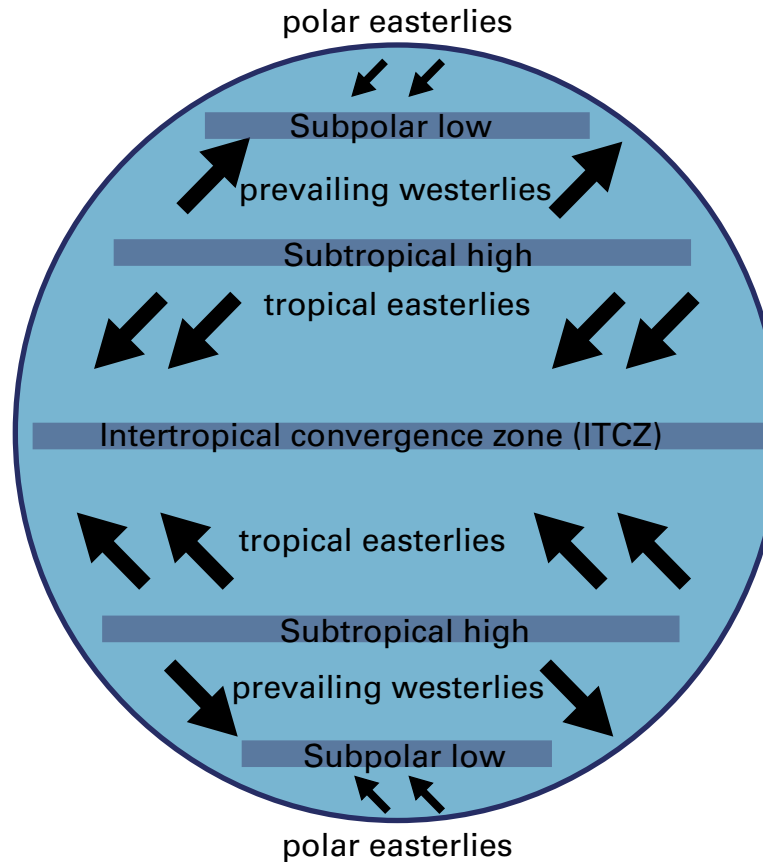
The closer the spacing of the isobars, the steeper the pressure gradient.

The steeper the gradient, the stronger the winds.

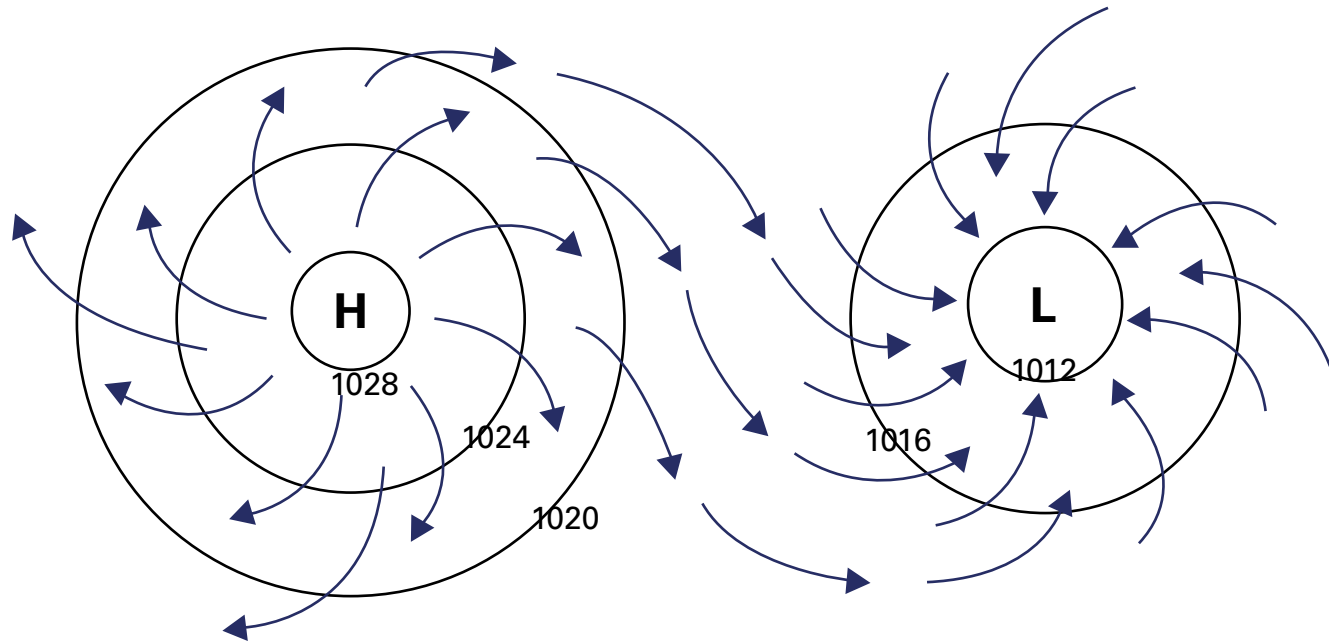


WIND

Named from the direction from which it is blowing.

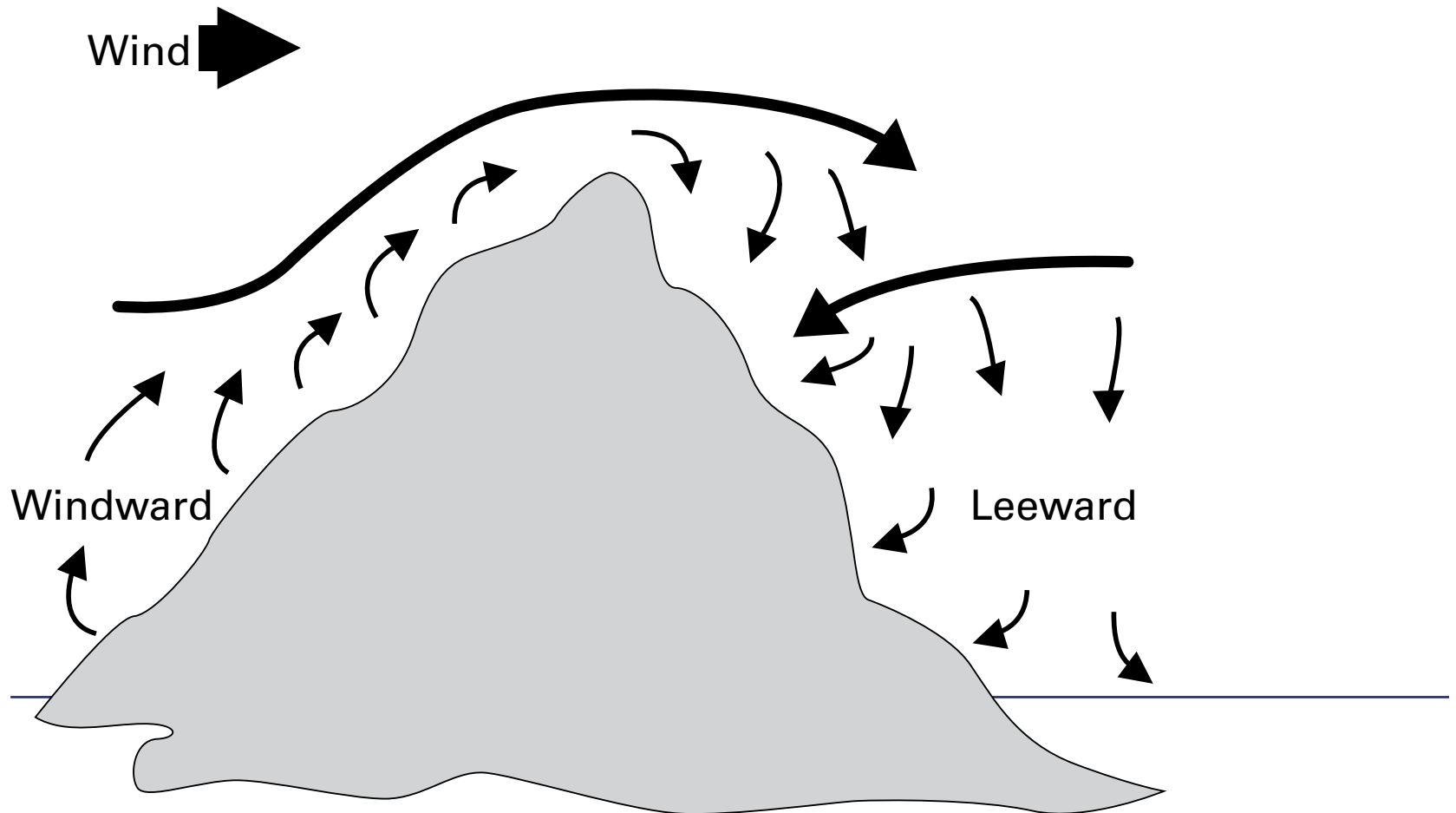


HIGHS AND LOWS



A high pressure and a low pressure center with wind directions in the northern hemisphere. Circles are isobars with pressure in mb.

FRICTION WITH MOUNTAINS



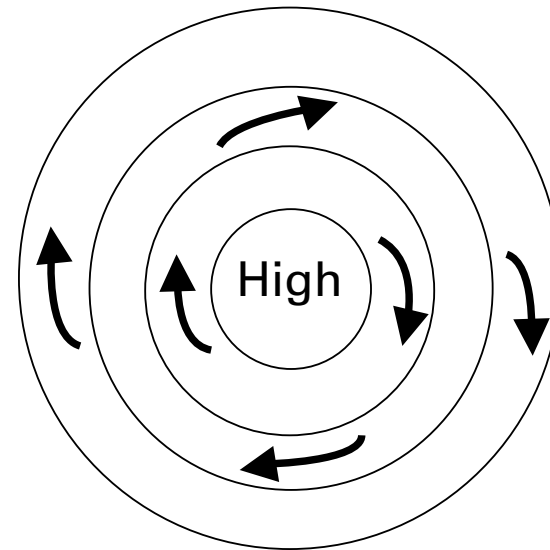
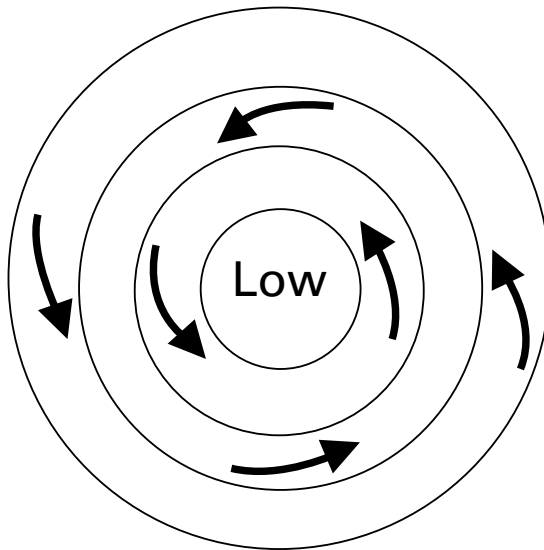
CYCLONES AND ANTICYCLONES

Cyclones: Low pressure area. Counterclockwise, winds moving toward center.

- Precipitation, poor weather

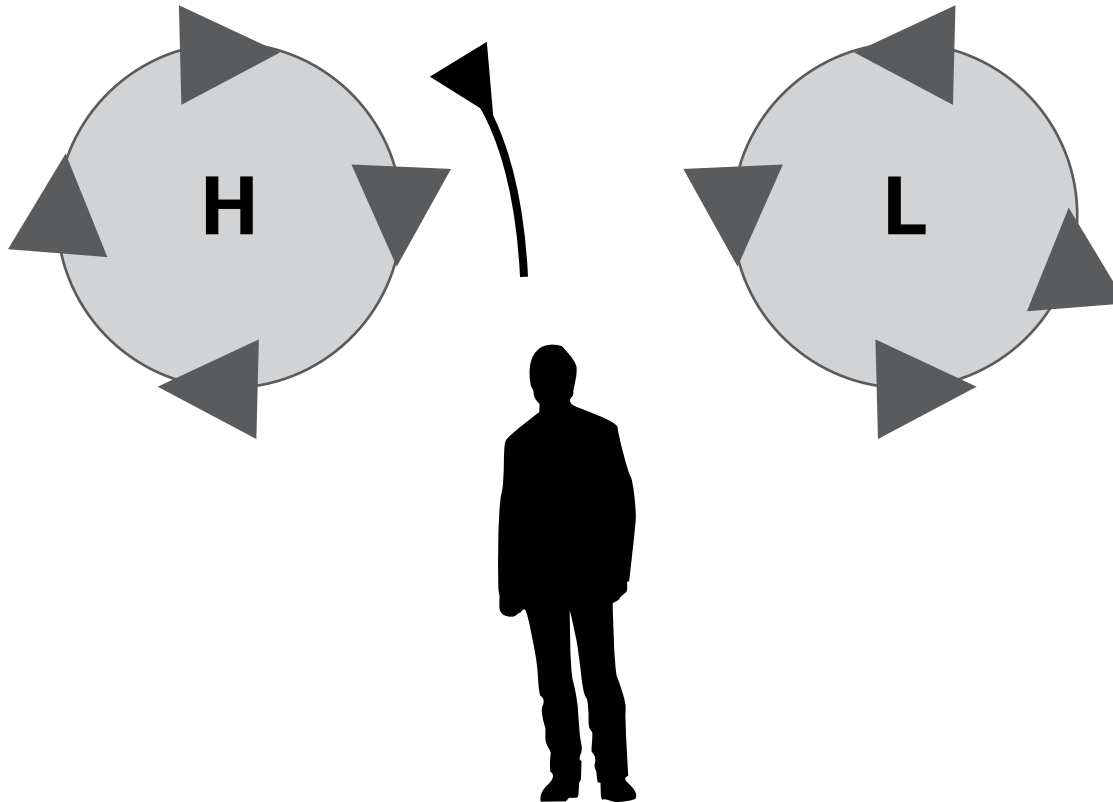
Anticyclones: High pressure area. Clockwise winds, moving away from center.

- Nice, calm weather



BUY BALLOT'S LAW

In the Northern Hemisphere if a person stands with their back to the wind, the low pressure area will be on their left.



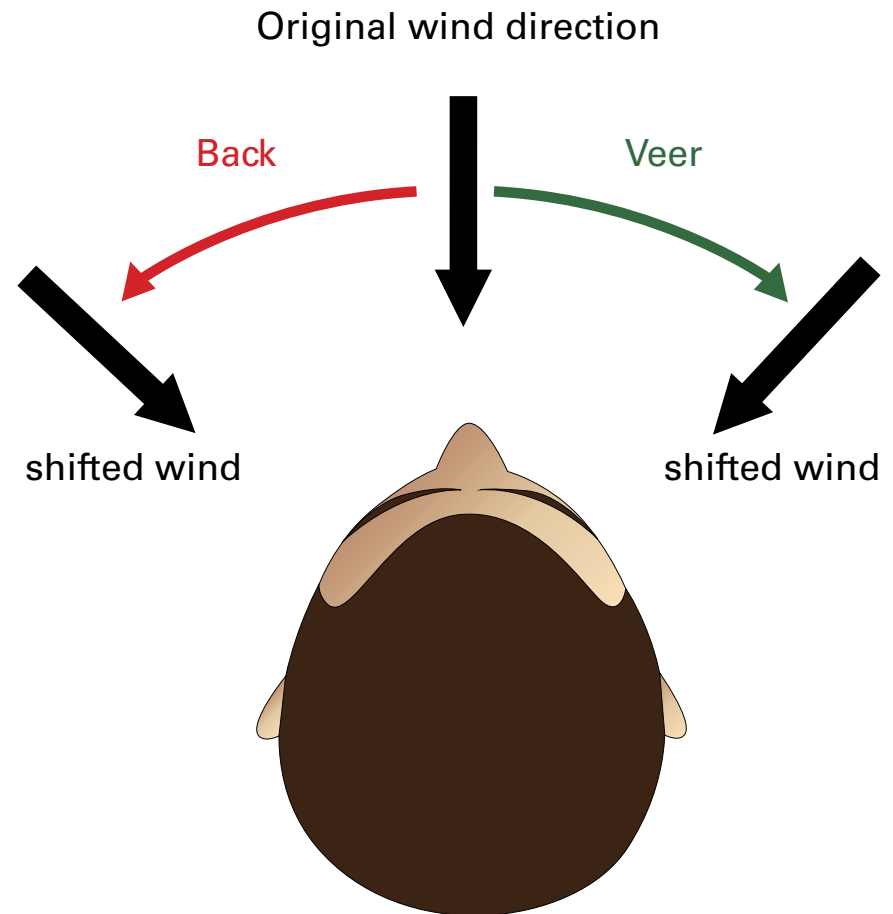
WIND SHIFTS

Backing: Counterclockwise shift of wind.

- Ex. Southeast to Northeast
- Pressure system will pass to your south

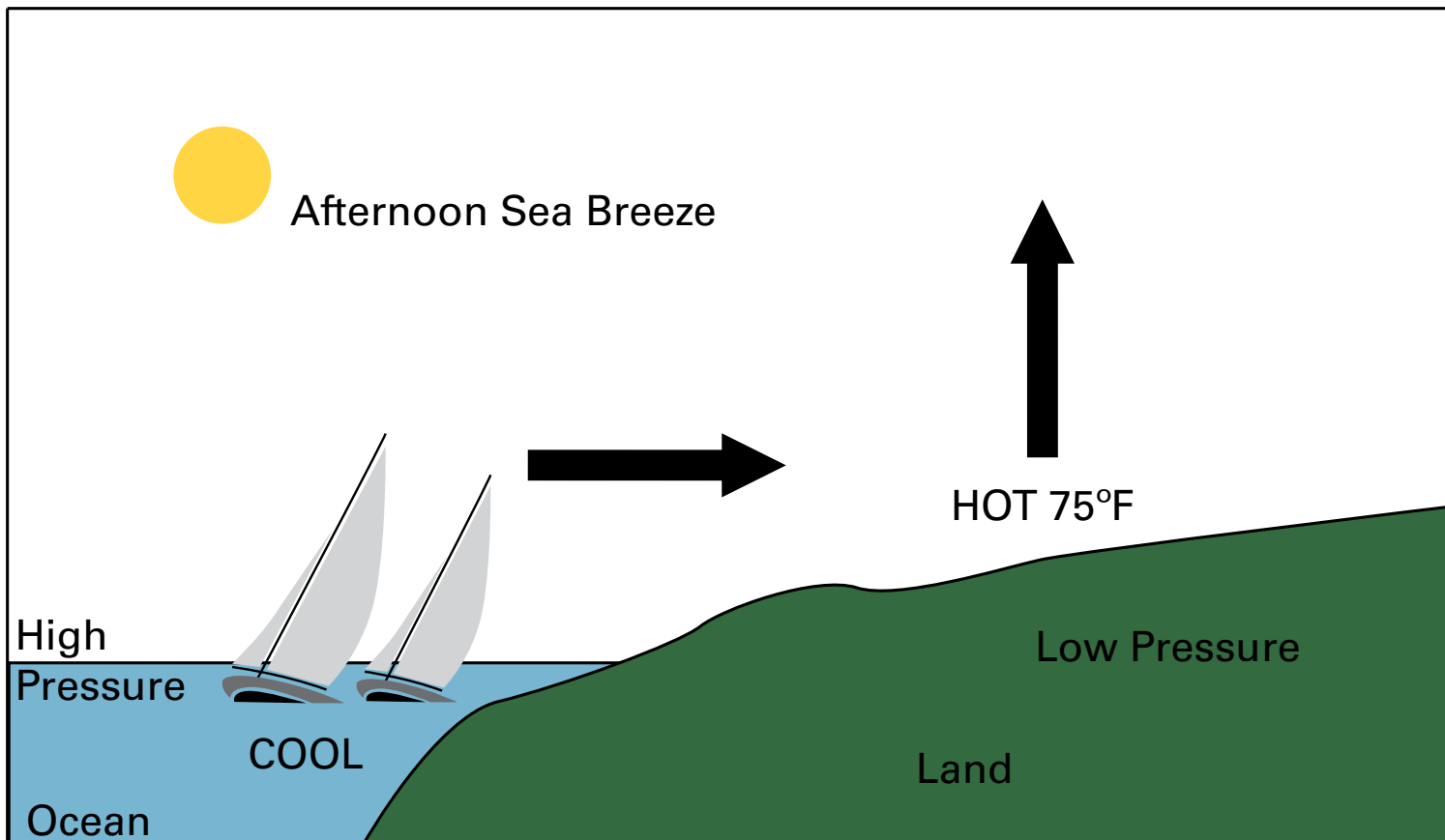
Veering: Clockwise shift of wind.

- Ex. Southwest to West
- Pressure system will pass to your north



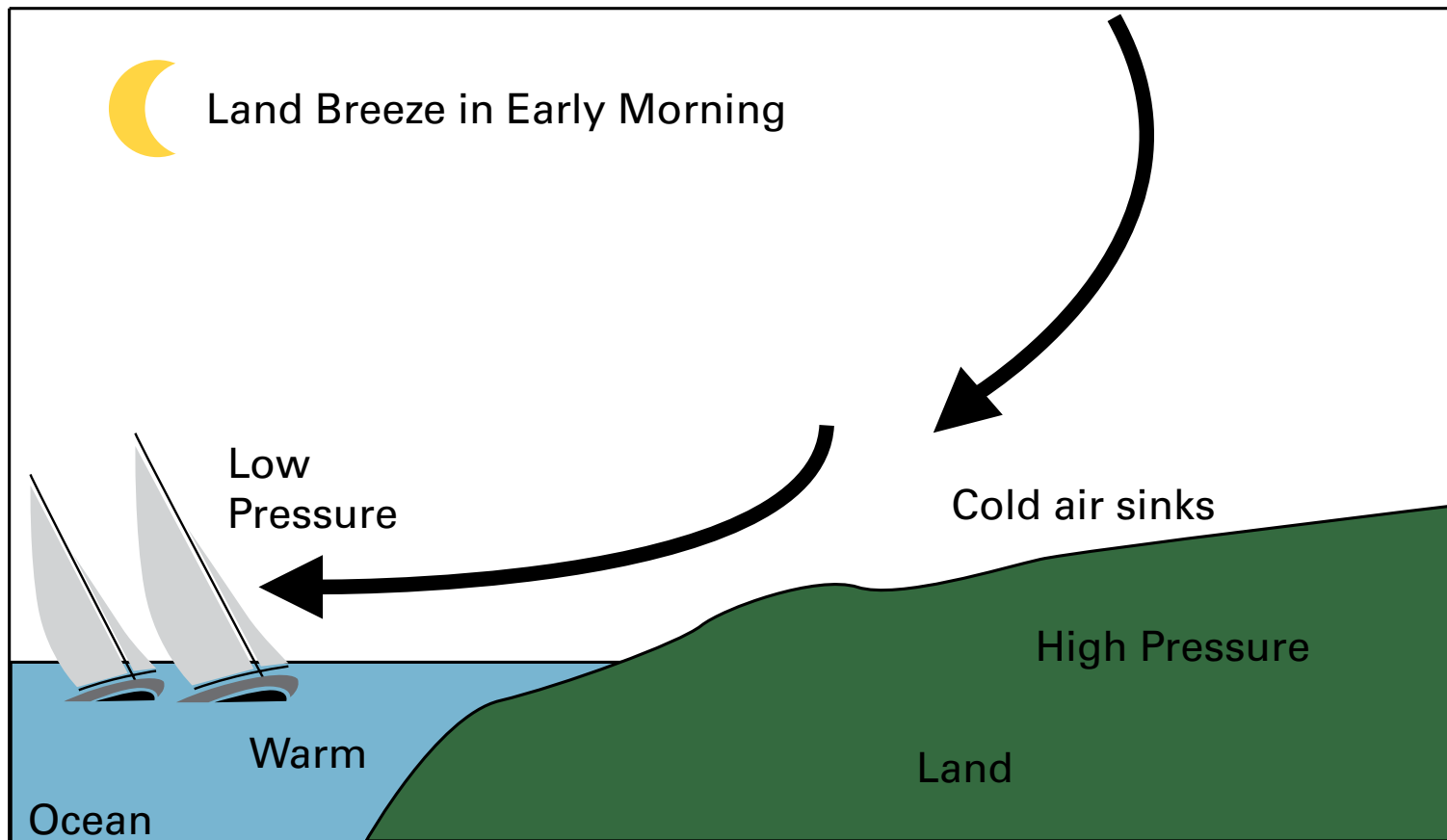
SEA BREEZE

Wind blows off the ocean



LAND BREEZE

Wind blows off the land

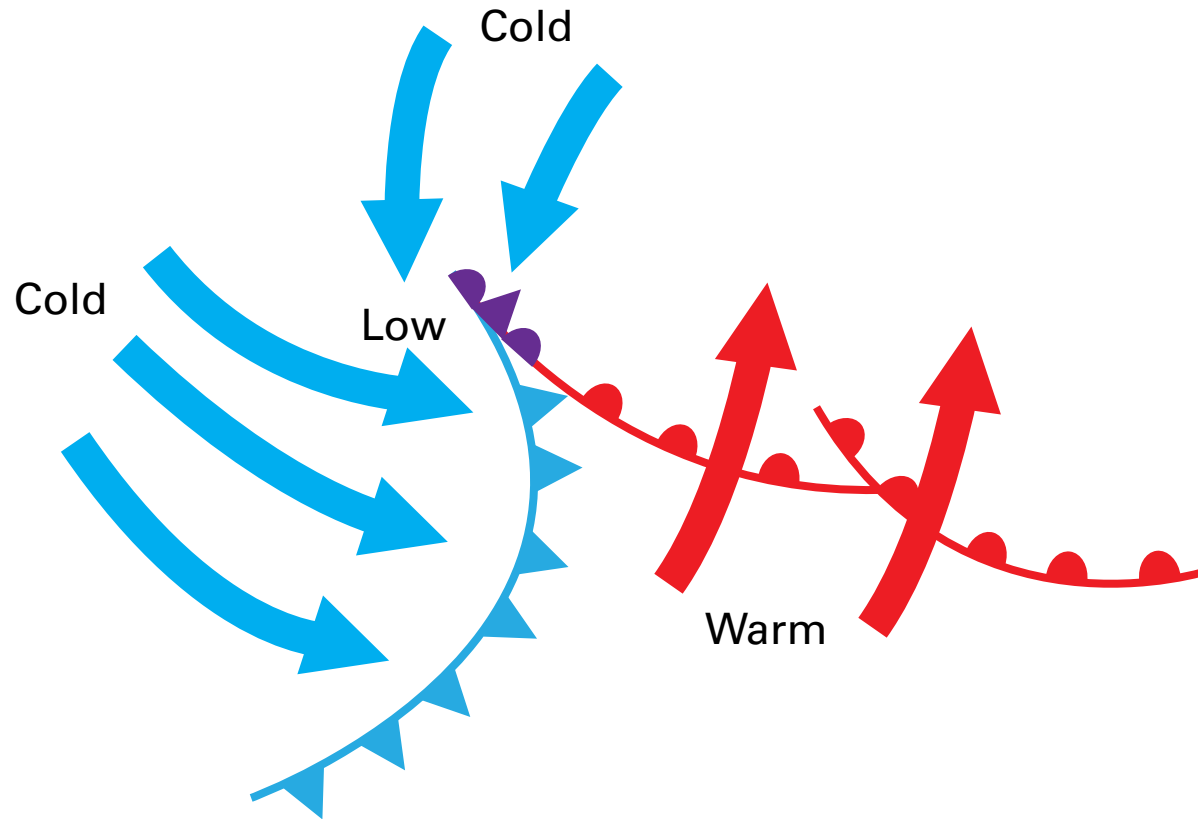


BEAUFORT SCALE

Force	Speed (knots)	Name	Conditions at Sea
0	< 1	Calm	Sea like a mirror.
1	1-3	Light air	Ripples only.
2	4-6	Light breeze	Small wavelets (0.2 m). Crests have a glassy appearance.
3	7-10	Gentle breeze	Large wavelets (0.6 m), crests begin to break.
4	11-16	Moderate breeze	Small waves (1 m), some whitecaps.
5	17-21	Fresh breeze	Moderate waves (1.8 m), many white caps.
6	22-27	Strong breeze	Large waves (3 m), probably some spray.
7	28-33	Near gale	Mounting sea (4 m) with foam blown in streaks downwind.
8	34-40	Gale	Moderately high waves (5.5 m), crests break into spindrift.
9	41-47	Strong gale	High waves (7 m), dense foam, visibility affected.
10	48-55	Storm	Very high waves (9 m), heavy sea roll, visibility impaired. Surface generally white.
11	56-63	Violent storm	Exceptionally high waves (11 m), visibility poor.
12	64+	Hurricane	14 m waves, air filled with foam and spray, visibility bad.

WEATHER

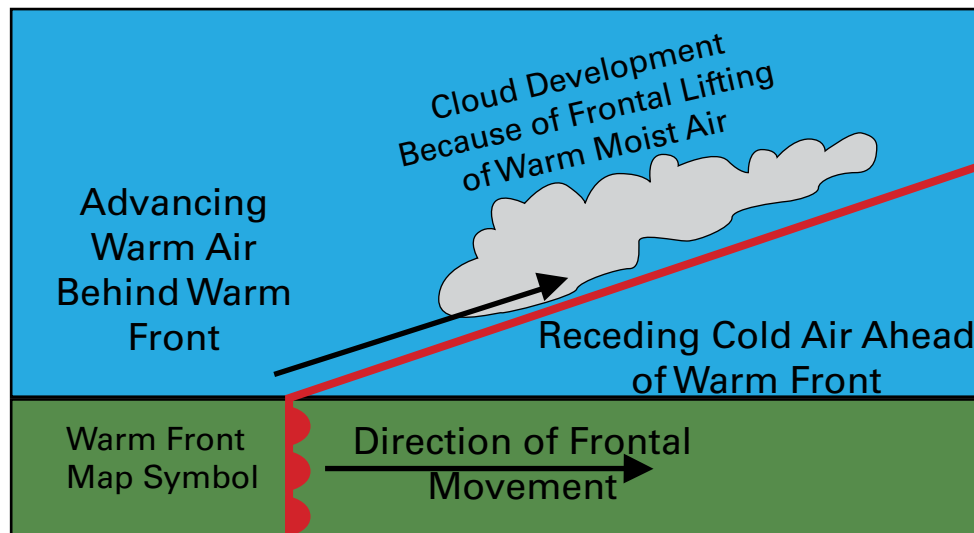
FRONTS



WARM FRONT

Cold air mass advances and overtakes warm air mass

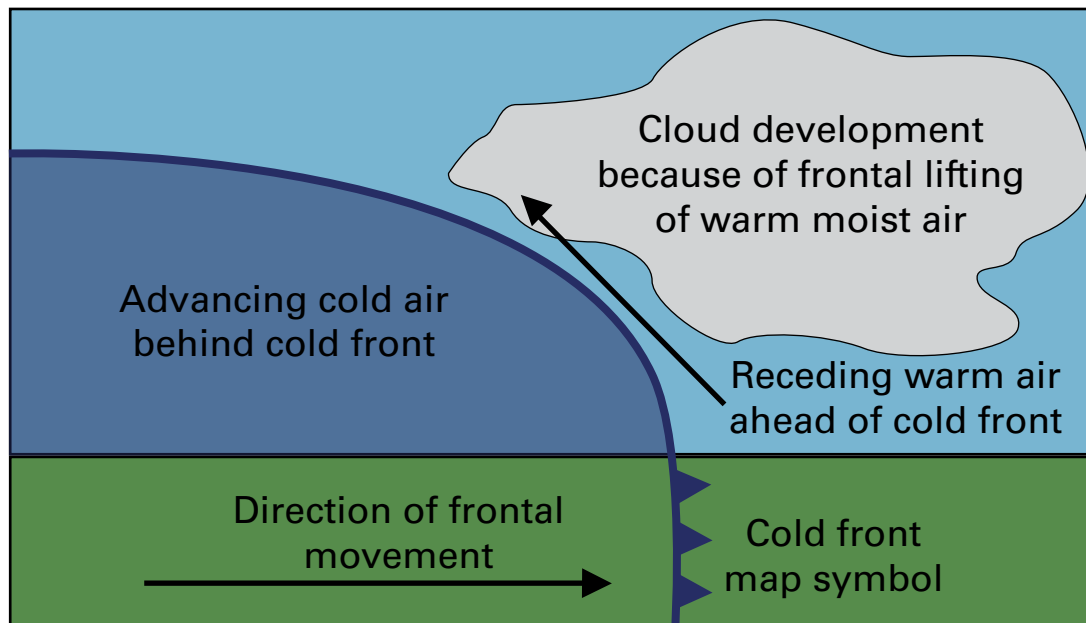
- Warm air mass is less dense
- Slow moving
- Several days of grey rainy weather



COLD FRONT

Warm air mass advances and overtakes cold air mass

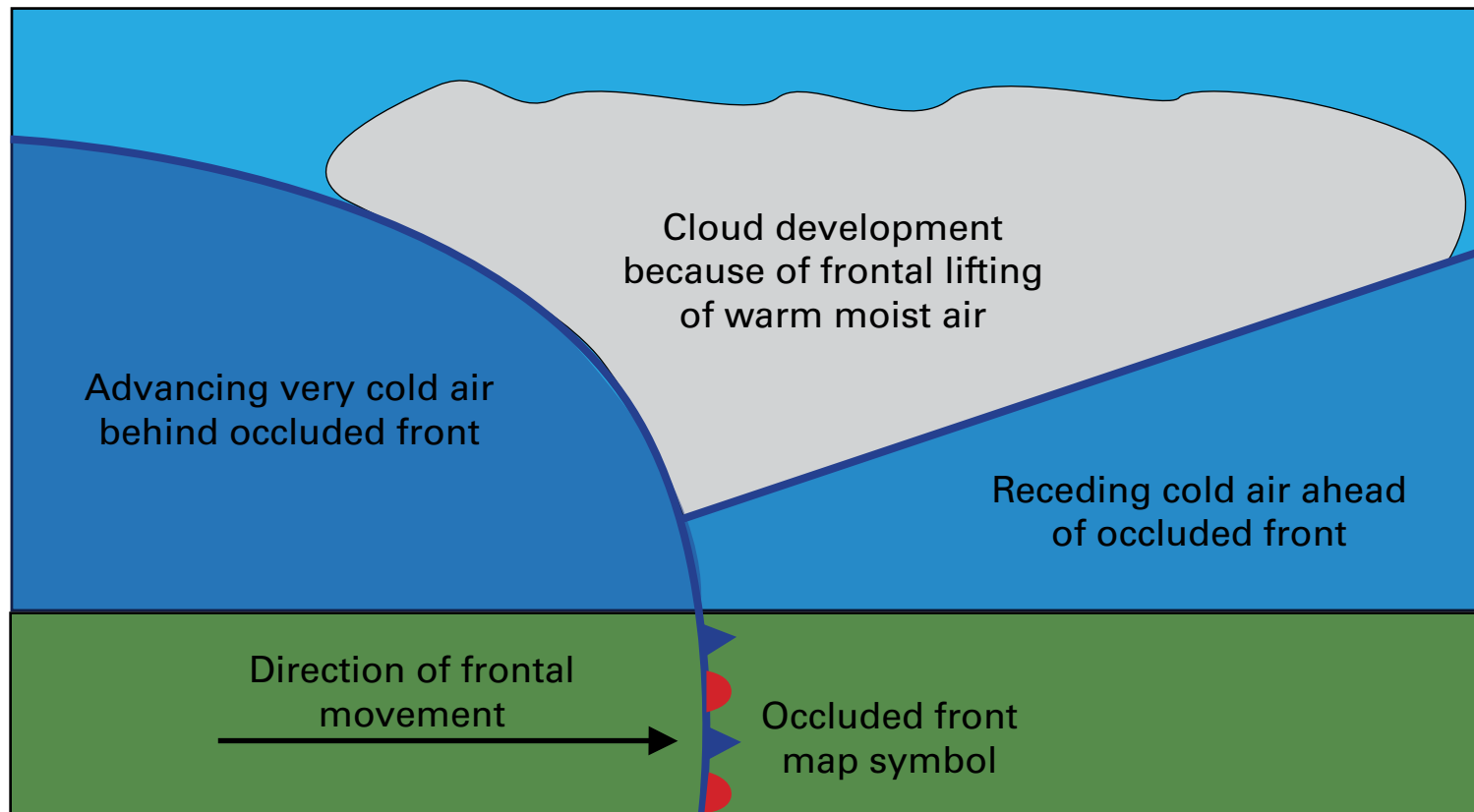
- Cold air is denser, buries under warm air and lifts it up
- Faster and more intense than warm front



OCCCLUDED FRONT

Formed as a cold front

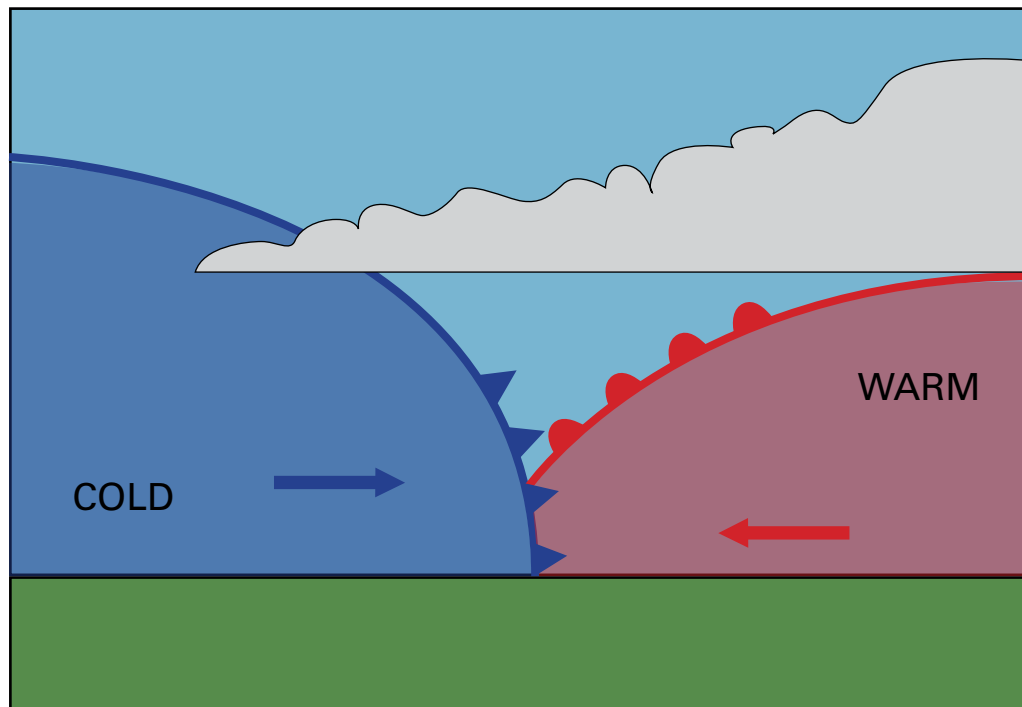
- Overtakes a warm or or quasi-stationary front



STATIONARY FRONT

Front between cold and warm air masses that is moving very slowly or not at all.

- Wind blow parallel in opposite directions on either side of the front



WEATHER

	APPROACH OF A WARM FRONT	AT WARM FRONT	IN THE WARM SECTOR	AT THE COLD FRONT	WHEN COLD FRONT IS PAST
WIND DIRECTION AND STRENGTH	Back S. to S.E. and increases	Veers to S.W. May increase, often squally	Steady S.W. May continue to increase	Sudden veer W. to N.W. with strong squalls	W. to N.W. strong, gusty, moderating
PRESSURE	Falls quickly	Stops falling	Steady	Rises quickly	Rise slows down progressively
TEMPERATURE	Small rise	Rises	Steady	Falls quickly	Falls slowly
CLOUDS	Cirrus	Nimbostratus	Thin, low stratus clouds	Cumulonimbus	Cumulus clearing
RAIN	Rain starts	Heavy rain	Drizzle	Heavy rain, perhaps thunder	Showers dying off
HUMIDITY	Slow increase	Rapid increase	Steady	Slow decrease	Quickly decreases
VISIBILITY	Slowly decreases	Poor	Poor	Poor	Improves quickly becoming good

CLOUDS

Formation: air rises, expands, and cools.
If it cools to below dew point, water droplets form clouds.

Condensations: Gas to liquid.

- If air can no longer hold moisture:
rain, snow, sleet, hail.



TYPES OF CLOUDS

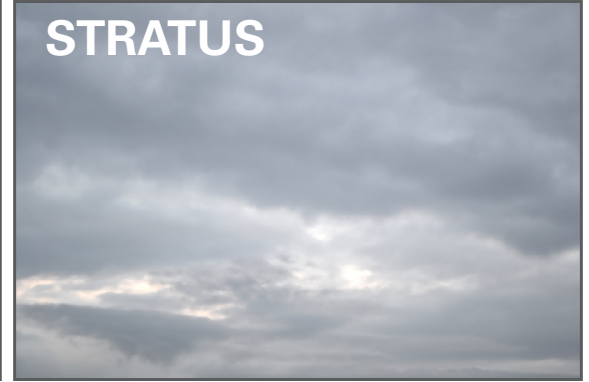
CIRRUS



CUMULUS



STRATUS



ALTOCUMULUS



CIRROCUMULUS



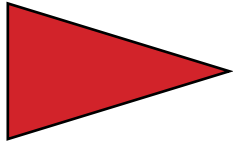
ALTOSTRATUS



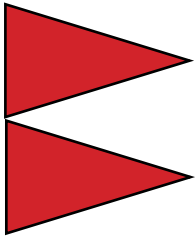
WEATHER

US WARNING SIGNALS

Day Warning Displays



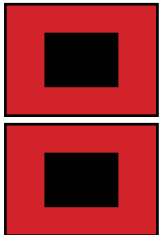
Small Craft Advisory
Conditions dangerous to small craft
0 - 33 kts



Gale Warning
Conditions dangerous to all boats
34 - 47 kts

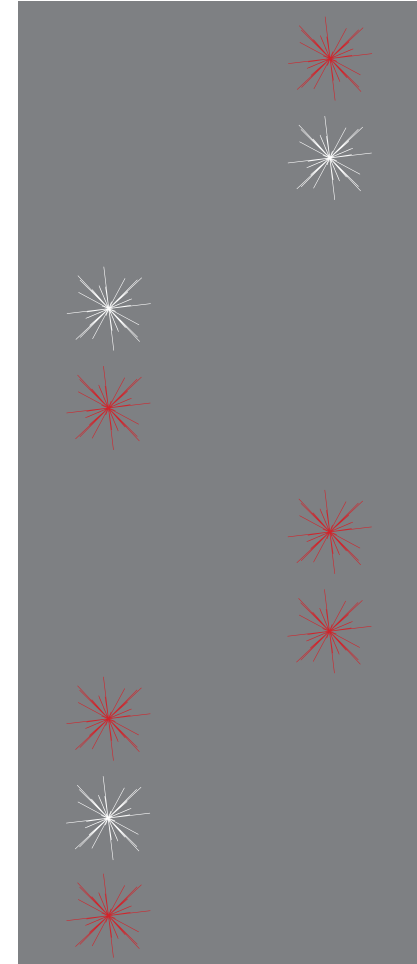


Storm Warning
Very dangerous conditions
48 - 64 kts



Hurricane Warning
Most dangerous conditions
64 + kts

Night Warning Displays



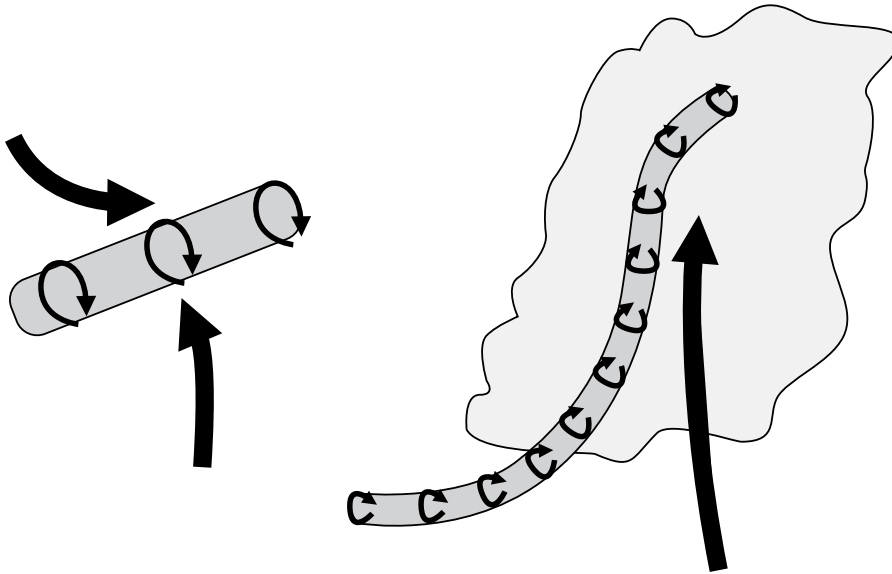
TORNADOES

Violently rotating column of air extending from a thunderstorm to the ground.

- Small diameter (<1 mile)
- Associated with strong frontal systems
- Wind speed 250 mph or more

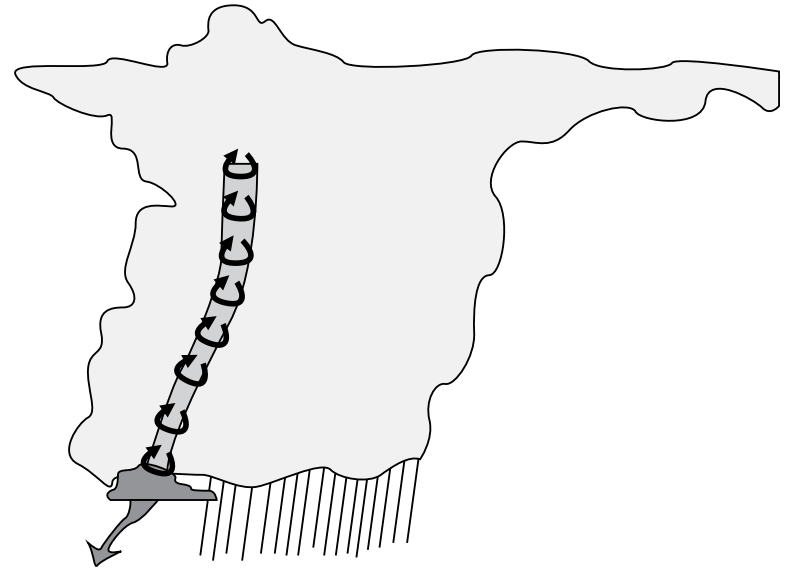


FORMATION OF TORNADOES



Before thunderstorms develop, a change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere.

Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical



An area of rotation, 2-6 miles wide, now extends through much of the storm. Most strong and violent tornadoes form within this area of strong rotation.

SQUALL

- Sudden, sharp increase in wind speed caused by atmospheric instability
- Increase in sustained winds over a short time interval



WATERSPOUTS

Intense columnar vortex that occurs over a body of water



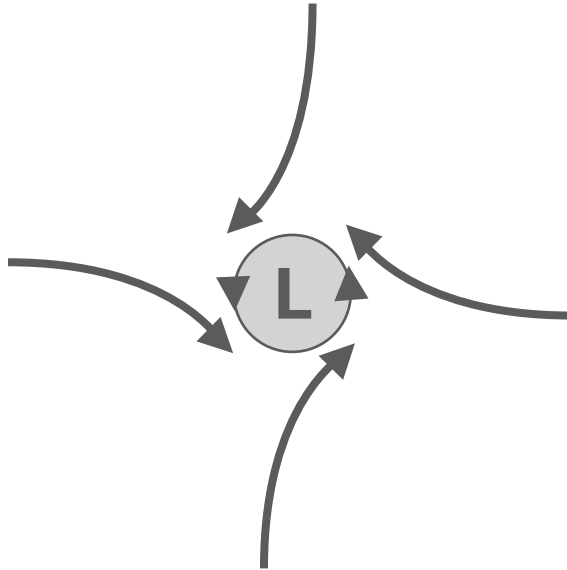
HURRICANES

Tropical cyclone

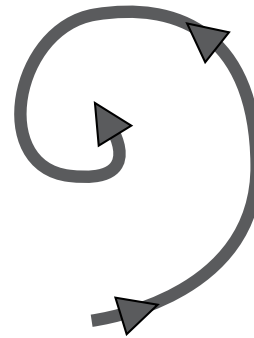
Atlantic, Northeastern
Pacific, West Indies



IN THE NORTHERN HEMISPHERE



Vortex created in a low pressure system



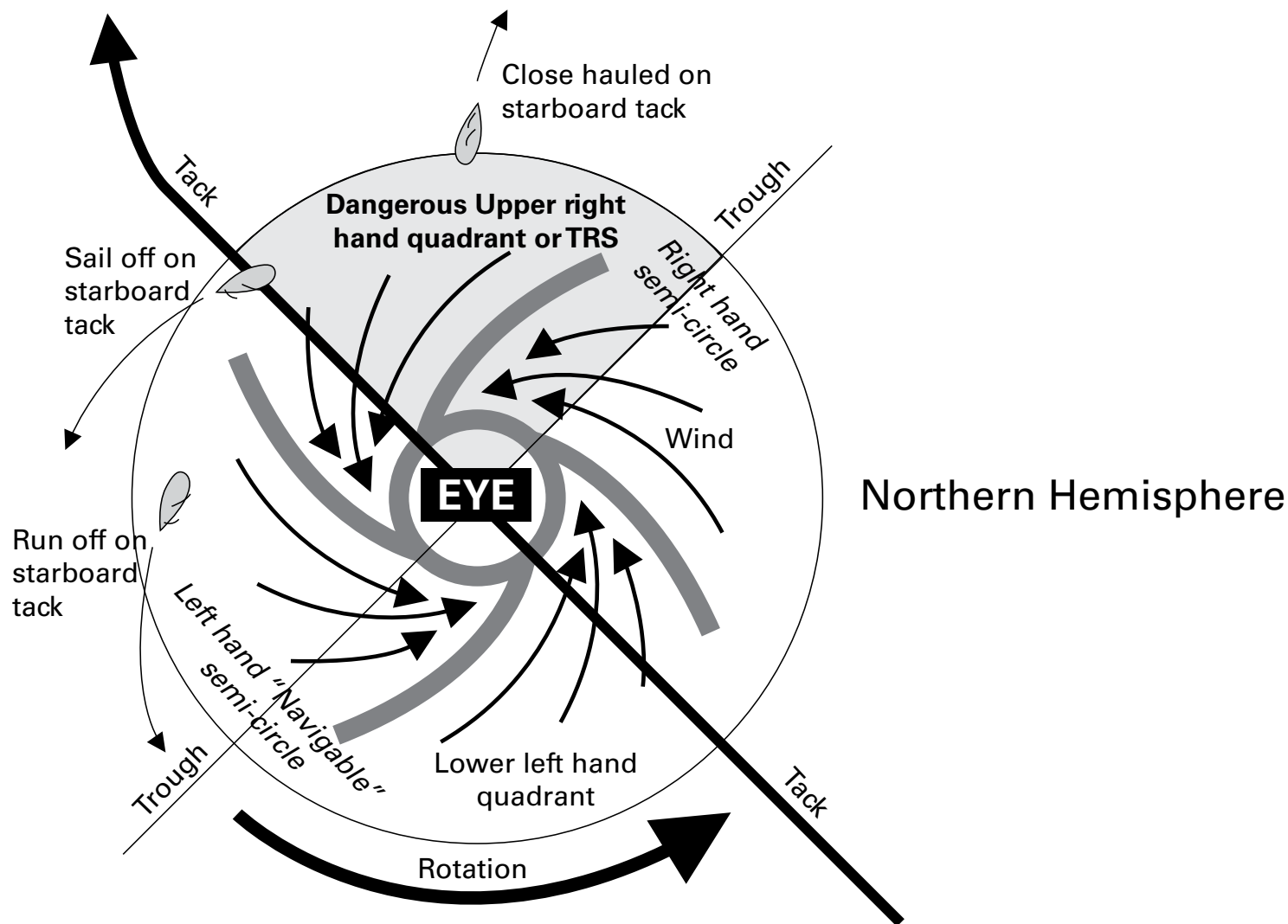
Wind direction

PREDICTING A STORM

- Extreme drop in pressure
- Strong winds
- Steady rain
- Change in cloud formation
 - Mare's tails



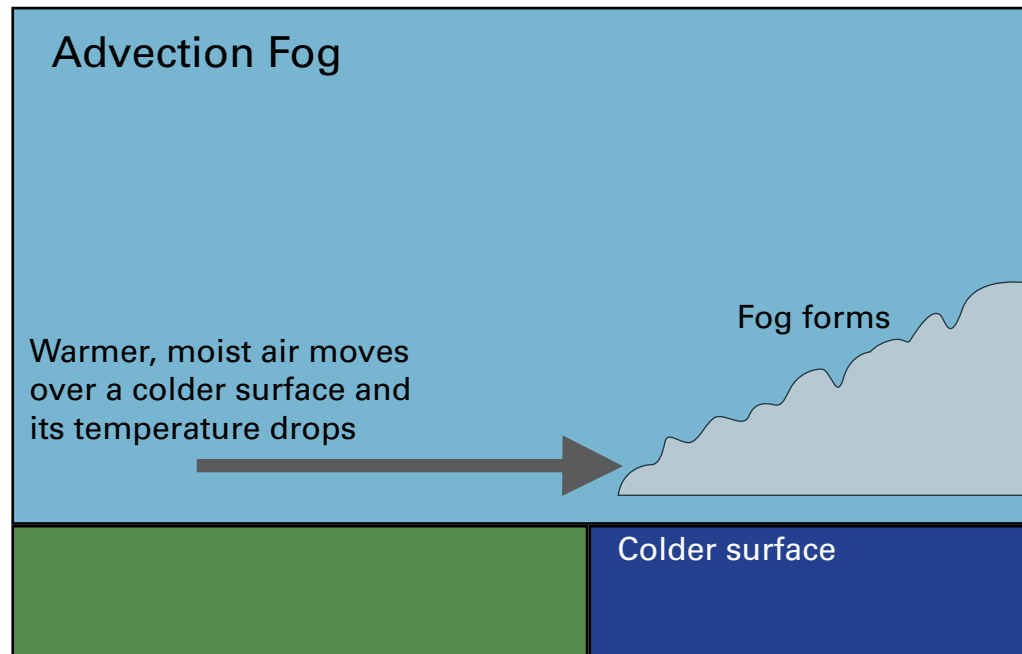
WEATHER



TYPES OF FOG

Advection Fog:

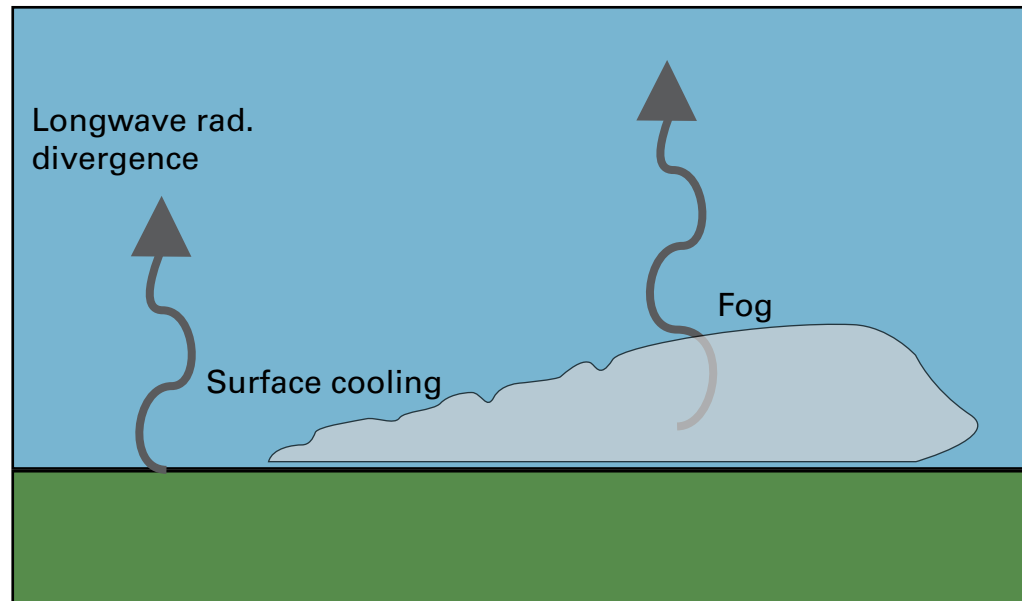
- Warm moist air moves over cold water
- Also called coastal fog



TYPES OF FOG

Radiation Fog:

- Produced at night over land when radiation cooling reduced air temperature to or below its dew point
- Also called ground fog



TYPES OF FOG

Steam Fog:

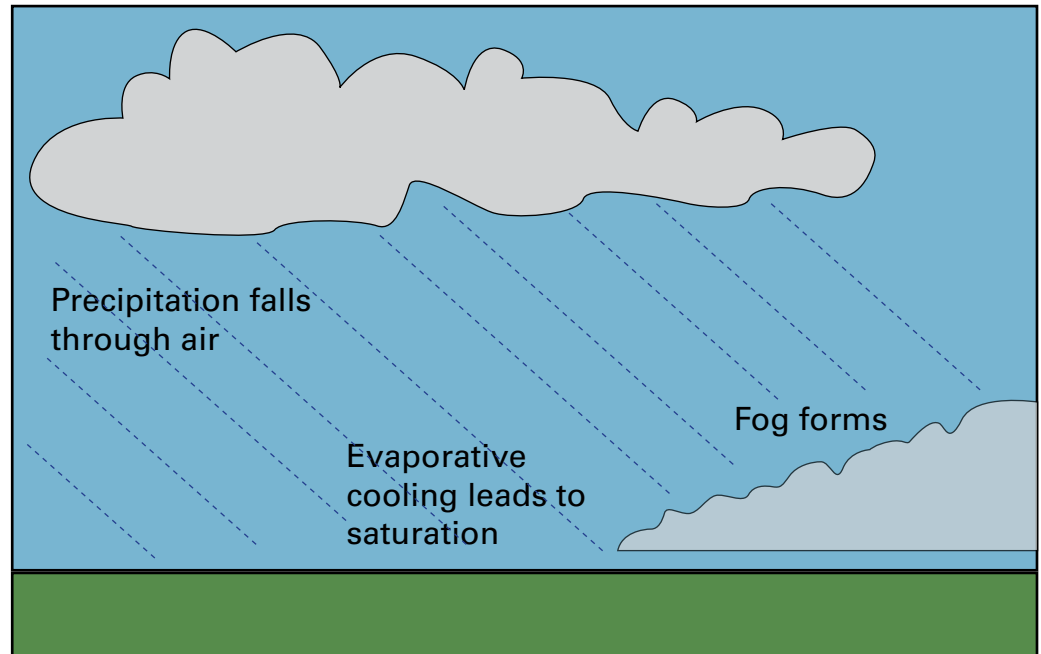
- Cooler air lies over warmer water
- Also called sea smoke



TYPES OF FOG

Frontal Fog:

- Rain falls from warm air down through cold air. Additional water vapor causes air to reach dew point.
- Also called rain fog



WEATHER MAP SYMBOLS

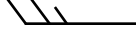
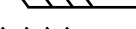
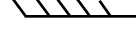
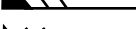
SKY COVER

	No clouds
	One-tenth or less
	Two-tenths or three-tenths
	Four-tenths
	Five-tenths
	Six-tenths
	Seven-tenths or eight-tenths
	Nine-tenths or overcast with openings
	Ten-tenths or completely overcast
	Sky obscured

PRESENT AND PAST WEATHER

	Sandstorm of duststorm, or drifting snow
	Fog, ice fog, thick haze or thick smoke
	Drizzle
	Rain
	Snow, or rain and snow
	Showers
	Thunderstorm

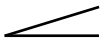
WIND SPEED

	Knots
	Calm
	1-2
	3-7
	8-12
	13-17
	18-22
	23-27
	28-32
	33-37
	38-42
	43-47
	48-52
	53-57
	58-62
	63-67
	68-72
	73-77
	103-107

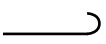
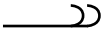
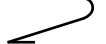
LOW CLOUDS

	Cumulus of fair weather
	Cumulus of considerable development
	Stratocumulus
	Cumulonimbus

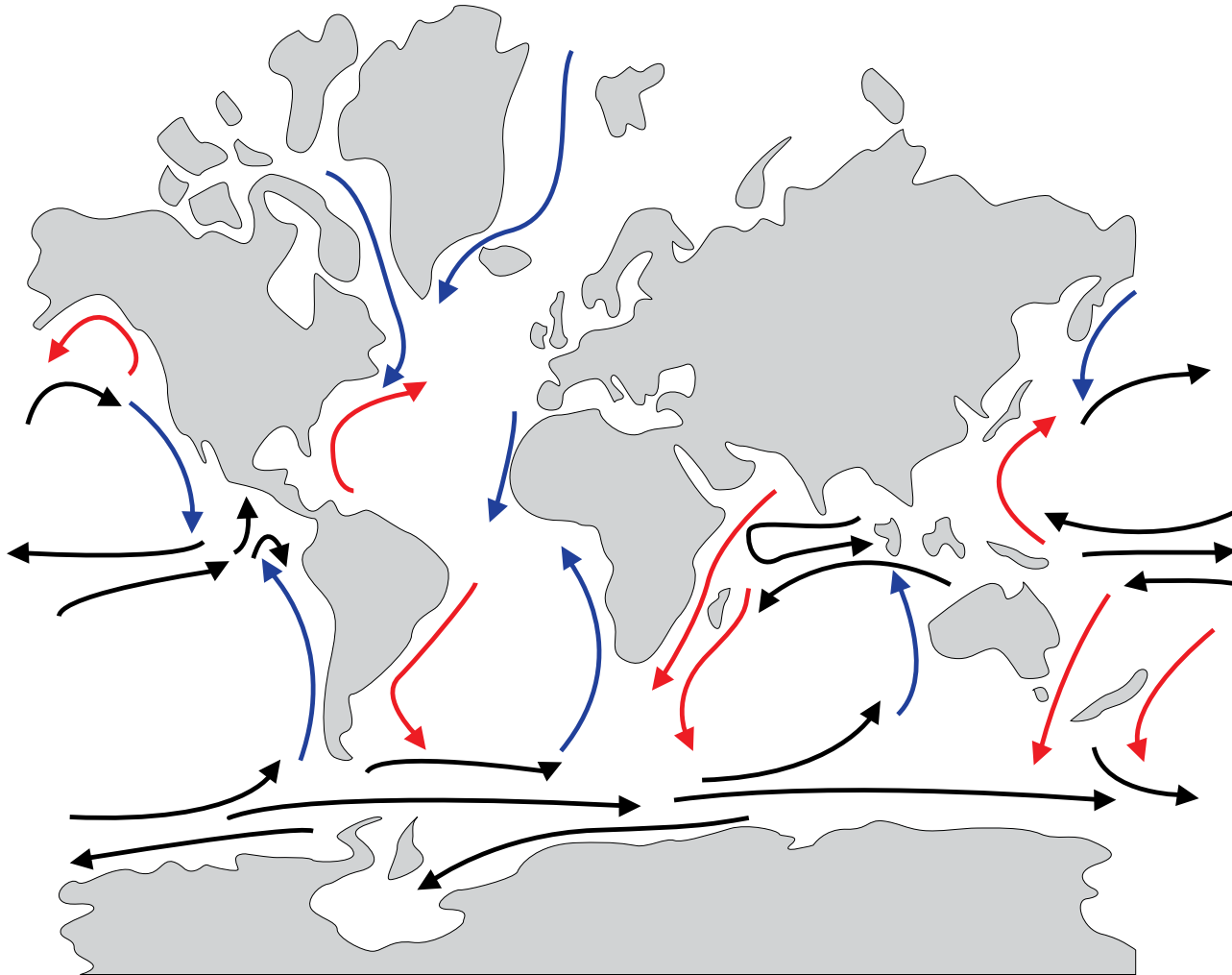
MIDDLE CLOUDS

	Thin altostratus
	Thin altostratus in patches
	Thin altocumulus in bands
	Altocumulus of a chaotic sky

HIGH CLOUDS

	Filaments of cirrus, or "mare's tails"
	Dense cirrus in patches
	Cirrus, often hook shaped
	Cirrus and cirrostratus
	Cirrostratus not increasing

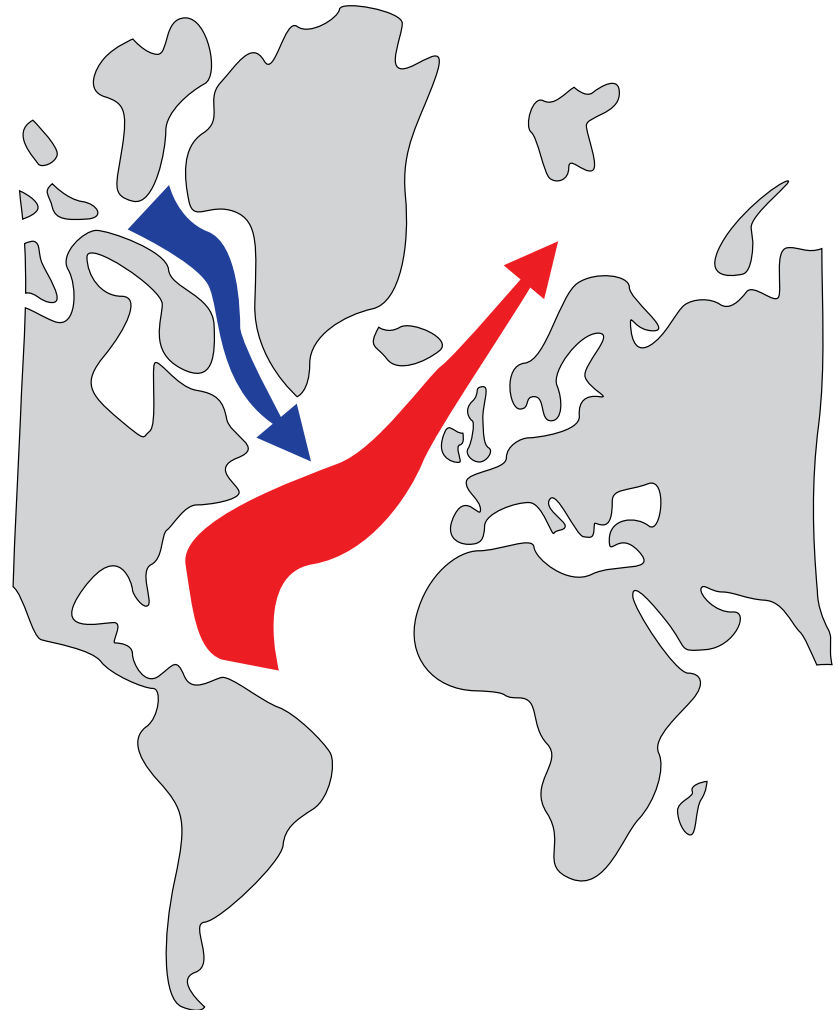
OCEAN CURRENTS



OCEAN CURRENTS

Tidal Current: Speed or direction changes cyclically at somewhat regular intervals.

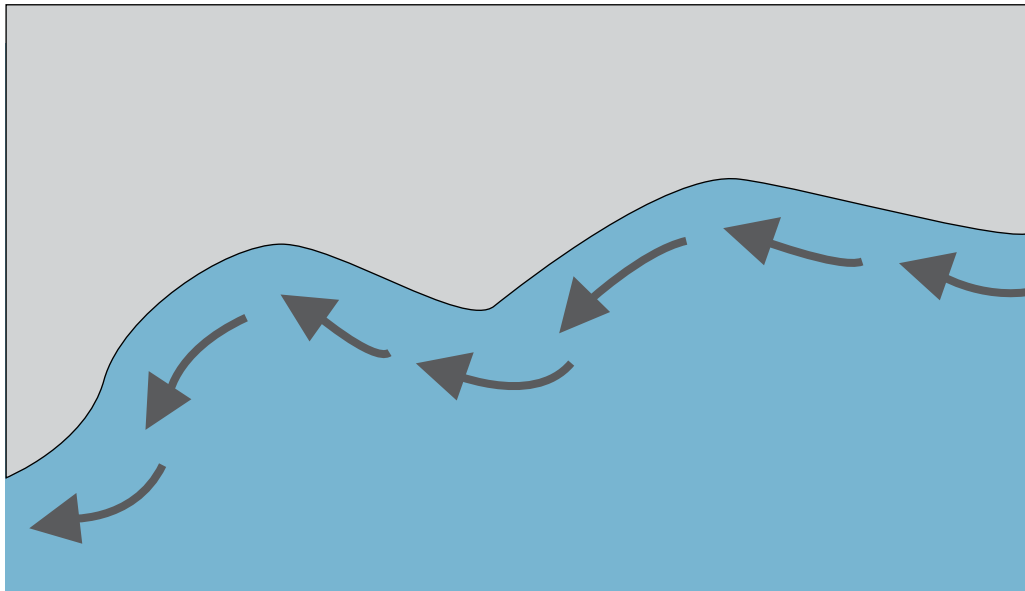
Steam Currents: Narrow, deep, fast moving current.



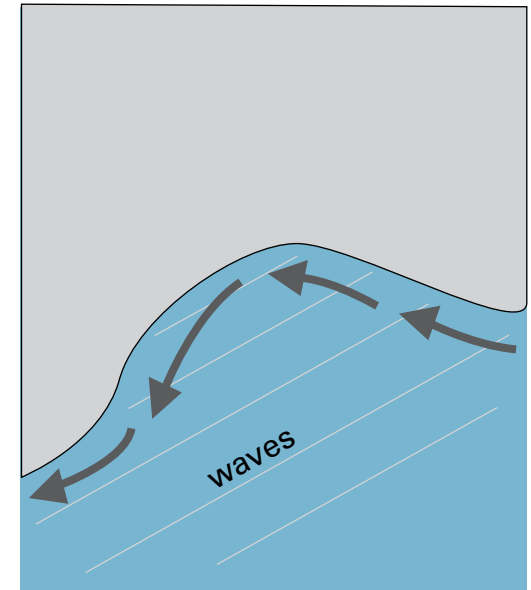
OCEAN CURRENTS

Coastal Current: Flows parallel to coast outside surf zone.

Longshore Current: flows parallel to coast inside surf zone.



Coastal



Longshore

OCEAN CURRENTS

- Offshore current: any current some distance away from the shore
- Inshore current: any current close to shore
- Surface current: current at the surface
- Sub-surface current: current below the surface