SWELL, WIND, WAVES, AND THE EFFECTS OF LANDFORMS

Swells are moving hills of heavy, dense energy that can have dramatic effects on the topography of the sea surface, and result in heightened Fun or Fear in a paddler.

Wind, above all environmental variables, has the greatest impact on the paddler. Predicting wind speed and direction, and understanding the impact they have on the texture of the sea, is essential to good seamanship. Winds are the movement of air caused by differences in temperature and pressure.

Wind Direction: where wind is blowing FROM. (Current direction is where it is headed TO.)

SUMMARY OF EFFECTS ON WAVES

Opposing winds or currents will STEEPEN WAVES.
Underwater ledges or irregularities CONFUSE WAVES.
Narrow funneling passages HASTEN WAVES.
Points of land BEND WAVES.
Steep shorelines or bulkheads BOUNCE WAVES.
Shallows, exposed rocks, beaches BREAK WAVES.

WAVES AND SHORELINE TOPOGRAPHY

Waves can travel for long distances without losing any energy… until they hit something. Understand the impacts and effects of wind, shallows, various shores, tidal currents on wind and swell shape.

Waves are usually generated by a wind's three primary variables:

Wind velocity
Duration: how long it's blowing from a certain direction.
Fetch: the distance that a particular wind is blowing over the ocean surface.

So waves will be bigger with increased wind speed, duration, distance traveled over the water.

BREAKING WAVES & SURF

Spilling waves are the one's where the white water slides down the front of the surf wave.

Dumping waves are the 'Hawaii Five O' type with a curling, plunging, powerful 'dumping' of the leading edge of the wave. Most of us can learn to handle or manage Spillers up into the 6-8 foot size; but Dumping surf can be a dynamic, violent experience to a kayaker once over 3 foot size.

Performance Objectives

Obtain useful marine forecasts predicting wind direction and speed.
Predict the texture of the sea based on wind direction and speed.
Understand the effects of wind and waves on the kayak and how to compensate for them.

Marine Forecasts for wind speed and direction

Weather radio/VHF, Television, Internet, Newspaper
Local knowledge – experienced mariners
Make your own predictions – watch the sky and the critters

Barometer's rate of change in pressure is highly relevant, and can be a key data point for what may happen in the next hour. Understand the rate of change info.

NOAA Marine Weather Forecast, local and offshore. National Weather Service Advisories and Warnings; General meanings for kayakers

Wind weather warnings:

0 – 17 knots: Be aware of wind against current and local conditions.

18 – 33 knots: Small Craft Advisory

Beginners stay home.
Intermediates have their hands full.
Advanced looking for surf.

34 – 47 knots: Gale Warning

Beginners and intermediates stay home.
Advanced have their hands full.

48+ knots: Storm Warning

72 knots: Hurricane

Special Marine Warning

Lightning and kayaking don't mix well. Know, understand and apply the 5 seconds per mile Rule. Understand the variable is frontal versus thermal lightning storms. Thunderstorms and squalls are usually associated with approaching cold fronts. They form along the front or on a line 100 miles ahead of the front. Squall lines are usually moving at 25 knots, so gusts of 40-60 knots are not uncommon. Keep an eye on the sky, and listen to weather radio frequently.

Local conditions can vary significantly from the weather forecast. Keep an eye on the sky; understand cloud formations.

Near-Shore Conditions and Coastal wind direction and speed can vary from a forecast. Winds blowing offshore usually veer and pick up speed. Due to Coastal Convergence, stronger winds are created.

Sea and Land Breezes

Differential heating and cooling of the land and the sea. Afternoon onshore breezes are common in the summer along the New England Coast. Onshore clouds forming, onshore breeze beginning. Offshore clouds dissolve, sea breeze beginning.

Funneling and Channeling

Winds take the path of least resistance. Funnel between and wrap around islands and/or headlands.

Describing Waves

Wave length – distance between crests or troughs.

Wave height – distance from base to the crest.

Wave period – Time for a wave peak to pass a point. Gives some sense for the amount of energy in waves. A wave's energy is proportional to wave height squared. A four foot wave has 4 times the energy of a two foot wave. A long WL and large WH = lots of water involved.

Wave Generators/Types
Wind Waves. Generated by local winds. Irregular and short-wavelength.
Swell Waves. Waves get organized into larger and longer forms. Can travel thousands of miles without losing energy.
Waves caused by Currents
Waves are either stationary or move slowly upstream. Wind against current = steep breaking waves.
Seismic Activity & Glacial Calving
Tidal waves have very long wavelength periods. Waves from icebergs breaking off can capsize even big boats.
Boat Wakes. Some can be surprisingly big and fast

Shallow Water Waves
When depth of water < half the WL (wavelength), swells begin to feel the bottom and the leading front slows down. As the wave length shortens, the wave height increases; the period remains the same, so the wave must get steeper.

Breaking Waves
Waves will steepen until water depth is 1.3 times wave height, then will begin to break. Winds & Current can vary this from 2x to .5x wave height.

Spillers and Dumpers
The way the wave breaks is determined by the shape of the seabed. Boomers require a watchful eye, and may have an undertow. Spillers are ok for play.

Refraction
Wave over shoal slows while deeper portion continues on. Can refract up to 180 degrees. Clapotis on sheltered side. Zones of convergence (building waves) and divergence (reduced waves) on beaches due to bars.

Reflection
Like a ball off a wall. Remember water depth and wave height (WH) equation.

Clapotis
Wave pattern often created by reflected waves combining with the incoming waves, causing an area of disturbed water where wave heights can explosively spike.

Wave-Current Interaction
Waves moving against a current receive energy from the current. WL decreases, WH increases. Rapid steepening can lead to breaking. Example: a wind wave will nearly double on a 5 knot opposing current. Consider a land or bathymetry's points, narrows, constrictions which can create tidal races and overfalls. Study the geography, visualize the ocean bottom.