Understanding Sail Dynamics - by Dave Newberg

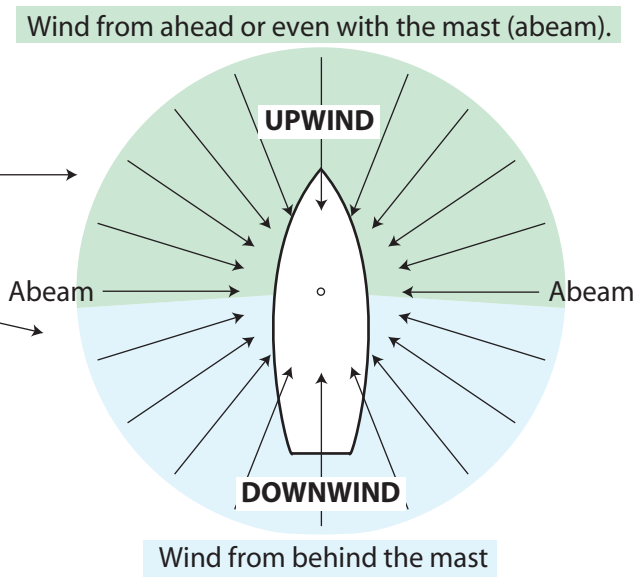
There are additional nuances to a complete understanding of sail dynamics - this explanation gives a simplified overview.

There are two distinct states or conditions to consider when discussing sail dynamics, upwind and downwind.

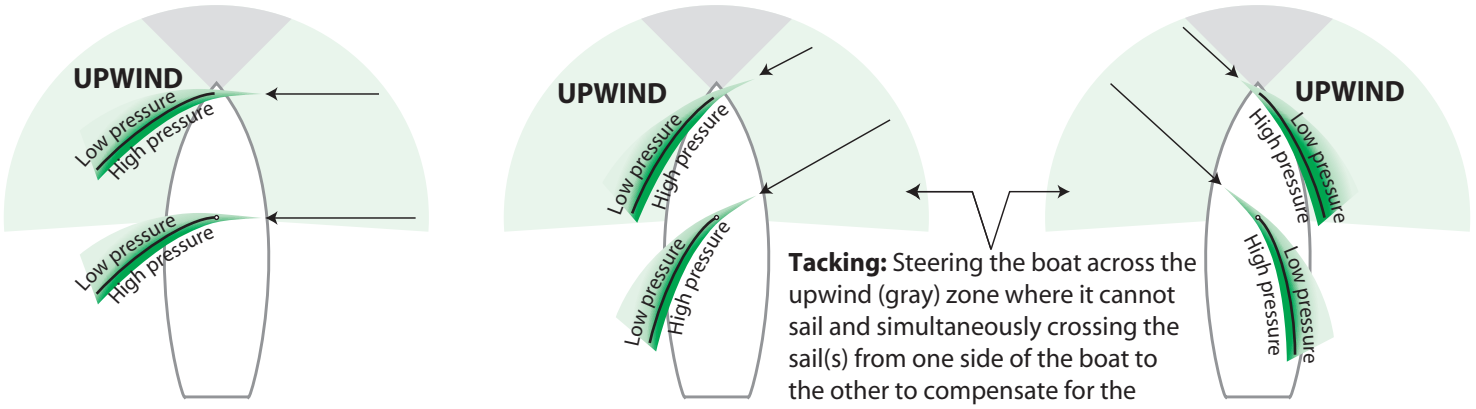
1. When the wind is crossing the boat from ahead of the mast or directly abeam (even with the mast) the condition is upwind.

2. When the wind is crossing the boat from behind the mast (astern or behind the beam) the condition is downwind.

For the purpose of this discussion we will consider only "apparent wind" vs. "true wind". Apparent wind is the wind that the boat (and you) feel when moving. The boat's forward movement adds a breeze from ahead which has an affect on sail dynamics. For example, if the boat is motoring faster than the wind, the condition would be upwind regardless where the "true wind" was coming from.

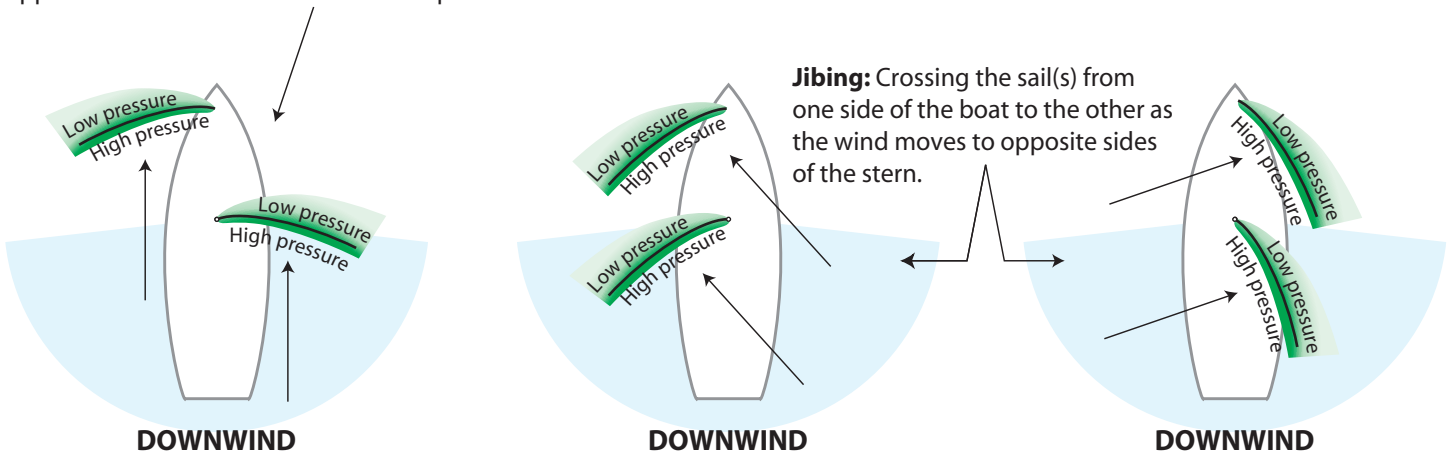


UPWIND SAILING: When sailing upwind, a sailboat cannot sail directly into the wind (gray region). The average sailboat can sail in a zone roughly at 40 degrees off the wind and greater. SETTING THE SAIL: With upwind conditions the sail's leading edge (luff) should point directly at the direction of the wind. The leading edge of sail(s) should split the wind - the wind should pass equally over both sides of the sail(s) where it first meets the wind. This is the reason you see telltails (often 6-10" pieces of yarn) attached near the front edge of sails. When the telltails are both blowing backwards, the air is moving smoothly over both sides of the sail at that location. As the wind (moving air particles) moves further aft over the curved sail it is compressed, building greater pressure on the inside of the curve and lower pressure on the outside. Because the higher pressure is behind the lower pressure and the keel prevents the boat from sliding sideways, the boat is pushed in a forward direction.



Tacking: Steering the boat across the upwind (gray) zone where it cannot sail and simultaneously crossing the sail(s) from one side of the boat to the other to compensate for the wind's/boat's directional change.

DOWNWIND SAILING: When sailing downwind, there is no limitation to the direction a boat can sail as is the case for upwind. SETTING THE SAIL: With downwind conditions the sail(s) should be essentially perpendicular to the direction of the wind. Because the sail is curved and the rigging can get in the way, this exact orientation virtually impossible to accomplish; roughly adjusting the sails to approximate the perpendicular orientation is all that is necessary. When the wind is from near directly astern, two sails can be set on opposite sides of the boat in order to capture more wind.



Jibing: Crossing the sail(s) from one side of the boat to the other as the wind moves to opposite sides of the stern.