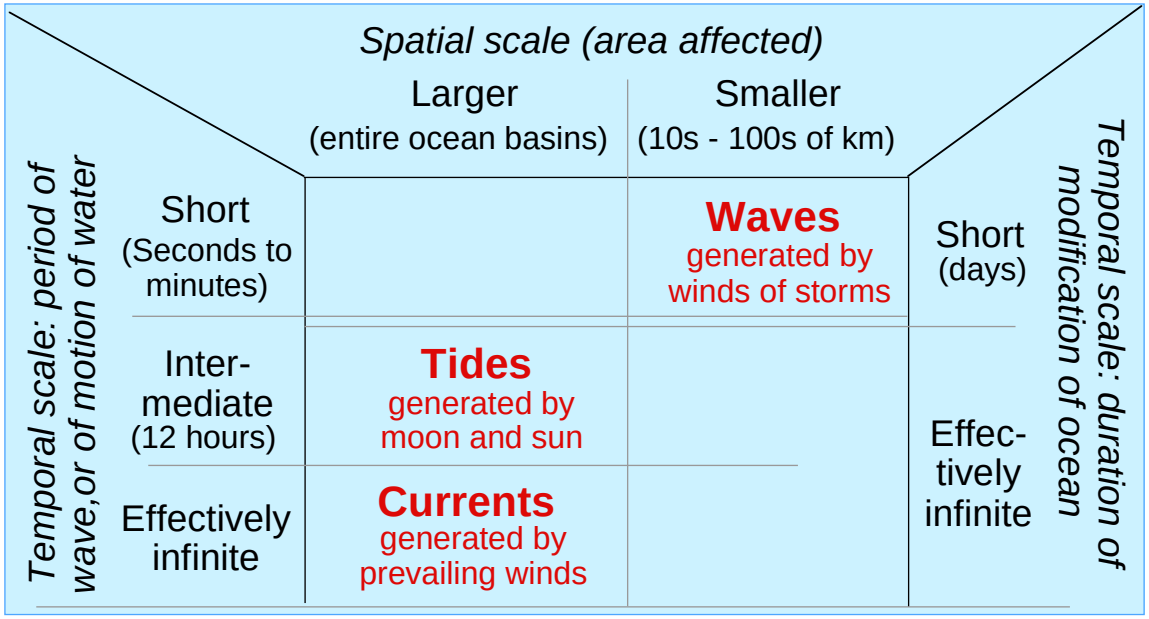
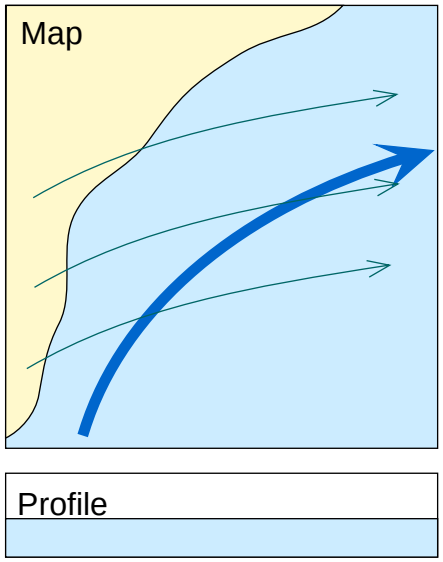
The contrasting scales of currents, tides, and waves

The currents, tides, and waves can present a seeming conundrum. For example, if currents are driven by winds and waves are generated by winds, how can waves move in different directions than currents? Also, if currents move clockwise in the northern hemisphere, how can the tides move counterclockwise through the same water?

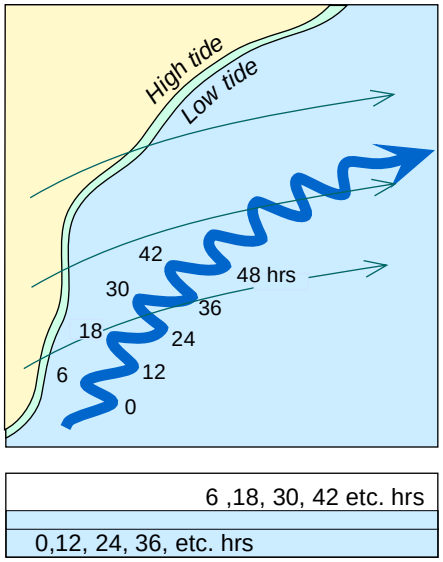
The answers are largely matters of scale. Currents are long-term motions of vast amounts of water across which the tides are regular but much smaller oscillations or ripples running backwards across the currents. Waves are much shorter-term and smaller-scale disruptions of the sea surface (but not motions of water at any significant scale) generated by winds that may deviate from the prevailing patterns.



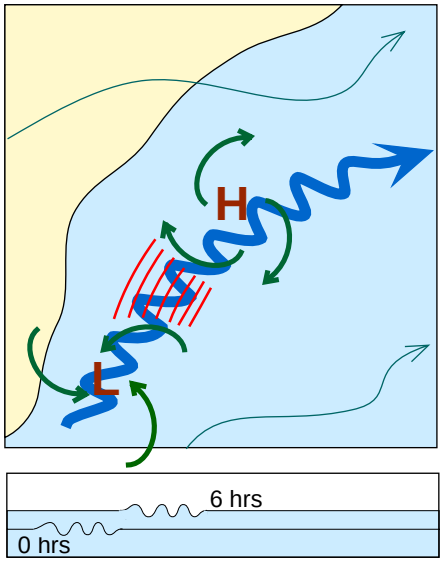
Long-term low-resolution view: current driven to NE by prevailing southwesterly winds



Long-term high-resolution view: water in current driven to NE moves with tides



Short-term view #1: storm winds generate waves on surface of current that wiggles with tides



Short-term view #2: storm moves on to generate more waves elsewhere; previous waves move out as swell.