WIND AND TIDE

BY METSERVICE AMBASSADOR BOB MCDAVITT

A falling barometer and strong on-shore winds produces a marked rise in the sea level called a storm surge

"Choppy when wind opposes the tide" is a phrase added to the Auckland recreational forecast on those days with a tidal range of three metres or more. Days with large tidal ranges have strong tidal currents, usually timed mid-way to three-quarters between the high/low tides.

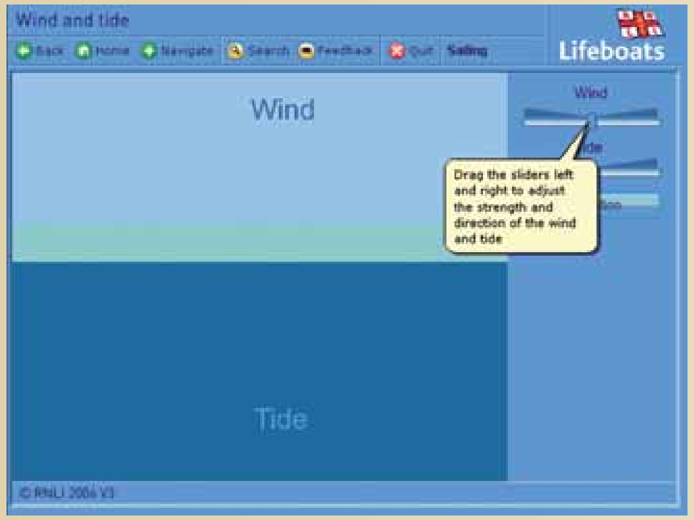
You've probably been through the scenario – a light offshore wind at dawn and an outgoing tide to help you on your way under sunny skies with smooth seas. Then, in the afternoon when you are about to return to harbour on the incoming tide, blow me down but that offshore wind strengthens a little. Because of the combination of wind against tide, the sea becomes choppy, and some waves splash over the side. Clouds cut out the sun and the wind chill becomes noticeable – so what was a wonderful trip out in the morning turns into a grouchy and challenging trip on the way home.

It is said that, as far as wave making is concerned, one knot of current is the equivalent of 10 knots of wind. To see the impact of this try out the 'wind and tide' wave maker simulator at

http://www.rnli.org.uk/upload/complete_eCD/fscommand/pop_up_safety.htm

(click on the Navigate /Sailing then Navigate /Weather and Tide/Wind and Tide).

The explanation box is empty, but you can play with wind and tide scales and see how waves grow quickly when wind and tide oppose each other and flatten when they are in cahoots.



Have you noticed that the actual tide doesn't always measure up with what you are expecting from the tide tables? It can be higher or lower, and reach low or high sometimes half an hour ahead of or behind the nominated times. These influences are being caused by the wind and passing weather pressure systems that you can check from the weather map. Tide tables give you the timings and heights of the astronomical affects (gravitational pulls of moon and sun), but, so far, no one is providing forecasts for the meteorological or "inverted barometer" tide or the wind tides. See http://www.linz.govt.nz/hydro/tidal-info/tidal-intro/meteorological-effects/index.aspx for more information.

THE INVERTED BAROMETER EFFECT

Average air pressure at sea level is 1013.26 hectopascals (hPa). At any time there is as much of the global weather map above this point as there is below. Lowering air pressure 1 hPa can allow the sea to rise 1cm above normal. The water level doesn't change immediately – it reacts to an average change over a large area. The sea gets depressed downwards under a HIGH on a weather map and is drawn upwards under a LOW.

THE ONSHORE/OFFSHORE WIND EFFECT

Strong on shore winds blowing over a large area for a long time pile the sea onto a coast. During periods of strong westerly winds in the Tasman Sea, inland water ways such as Manukau, Kaipara, and to some extent Hokianga Harbour, do not evacuate as much as expected (low tides are later and less extreme). Then, when the winds relax, the next low tide may be more extreme than normal.

STORM SURGE

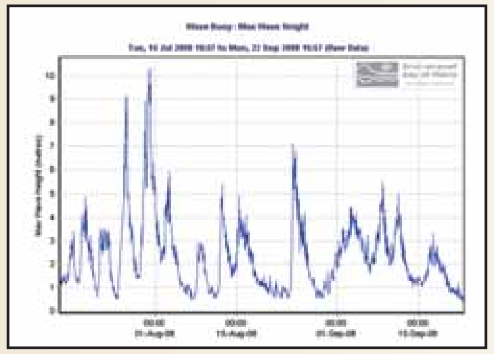
A falling barometer and strong on-shore winds produces a marked rise in the sea level called a storm surge. This is worst in Bay of Plenty whenever there is a LOW on the weather map north of New Zealand. Under these conditions check the reports for the Environment Bay of Plenty Wave Buoy at the http://www.envbop.govt.nz site .

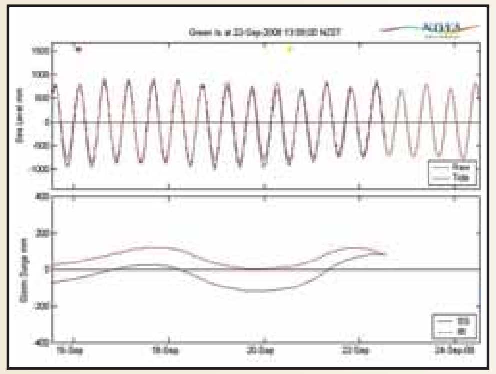
The Tauranga buoy experienced maximum wave heights of nine metres on July 26, then 10 metres on July 30, 2008.

Environment Bay of Plenty wave buoy at Tauranga , significant wave and maximum wave heights from http://www.envbop.govt.nz Click on Coast at top, then Wave Buoy under 'Your Favourites' on the right.

Strong offshore winds and a high barometer produce a

Storm surge July 26, 2008: Devonport Scout hall and Yacht Club pounded by two metre plus waves formed by severe gale force winds near high tide when the sea level was lifted about a third of a metre above normal. Photo: Trevor Whelan, used with permission.
A write up of this storm is available at www.meteservice.com: click on Learning Centre and select monthly feature for August 2008.





marked drop in sea level called a negative storm surge. This creates unusually shallow water, and is worst in New Zealand along the East Coast, between Gisborne and Dunedin, whenever a HIGH is moving off to the east of New Zealand.

NIWA Sea level measurements at Green Island near Dunedin (upper graph) showing a negative storm surge (blue line= lower than normal low tides). The Inverted Barometer effect (red line in bottom graph) was slightly positive, so the main cause of the negative storm surge is strong offshore winds. See http://www.niwascience.co.nz/services/free/sealevels for more information.

HOW TO COMBINE SWELLS

Sometimes the forecast gives various component swells but not the total combined waves eg "Westerly swell four metres, southwest swell three metres".

To compute the combined waves: take the square of each of the components, add these, and then take the square root of the result. For most of us it requires a calculator.

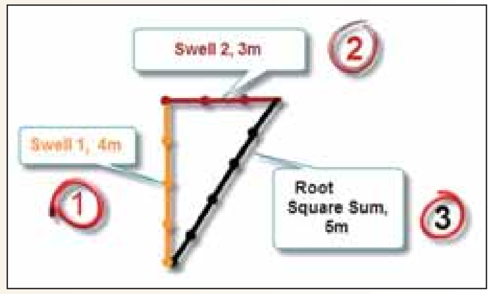
A neat trick that one of my colleagues showed me, allows us to do this computation with pencil and ruler. It is best done on graph or ruled paper but can be done accurately enough on blank paper.

Draw a line vertically measuring out the first component to suitable scale.

In the example shown, four cm for a four metre swell.

Draw the second line from where the first ends off, this time horizontally (in other words, at right angles to the first), using the same scale.

In the example shown, three cm for a three metre swell.



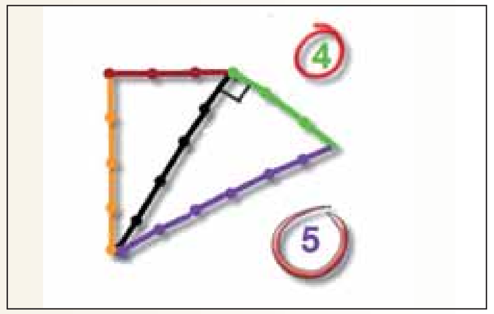
Draw a line from the end of the second line to the start of the first line.

Its length, measured by that ruler, is the combined wave height.

This is the hypotenuse of the right-angled triangle, and in our example we have chosen the well know 3-4-5 triangle, so it is five cm for a combined height of five metres.

This simple method has the added bonus that you can add further components as much as you like, as follows.

To add another component do as in two above and draw a line at right angle from the end of the previous components line, using the same scale. In the example below adding a three cm line to represent another three metre swell.



As in three above draw a line from the end of line 4 back to the start of line one and measure it. In the example above its 5.8 cm for a combined height of 5.8 metres.

Steps four and five can be repeated onwards, and you will end up with the outer rim spiraling outwards and the spokes growing slowly, like an expanding snail shell.