

# COMMENT

“Isn't it time to review the nature and role of school boards?”

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## Rogue waves not uncommon in B.C. waters

JOHANNES GEMMRICH

Media reports and online discussions of Sunday's whale-watching accident off Tofino often include the terms "rogue wave" or "unexpected wave."

Although the investigations are ongoing and have not established the role of waves in the accident, it is worthwhile to explain these terms, especially since their use outside of scientific literature is not consistent.

Waves are generated by the wind, with their ultimate size depending on the speed, distance and length of time over which the wind blows.

Ocean waves obey basic laws of physics, so that, in deep water, long waves travel faster than short waves. Furthermore, wave energy is transported by groups of waves. A particular "sea state" can be considered as the sum of many individual wave trains, all propagating in their own direc-

tion, with their own speed.

The resulting sea is therefore not a regular train of waves but rather an irregular jumble, albeit with a dominant wavelength and a characteristic wave height (from trough to crest) called the "significant wave height," which is the average height of the largest one-third of the waves.

In gale-force winds, given enough time, the significant wave height can reach well over 10 metres. Many boating incidents attributed by the media to "rogue" waves have occurred during times where routine forecasts predicted very large waves in general, as a consequence of strong winds.

Additionally, wave fields generated by storms can travel entire ocean basins, ending up several days later as swell and surf on local beaches. For example, a wave field generated by the recent hurricane off southern Mexico would take about four days to reach southern B.C.

Scientifically, a rogue wave is

an individual wave with a height of at least 2.2 times the significant wave height; that is, it is large compared to the prevailing wave field, but not necessarily large in absolute height if the sea state is mild. Rogue waves occur when enough crests of the underlying wave trains coincide at one location.

Theory predicts that such a wave happens about every one to two days. However, only at relatively high sea states would such a wave be of concern. Modern research is investigating situations where rogue waves might be larger or might occur more frequently than predicted by simple theory.

There is also interest in situations where large waves come from a direction significantly different to the main wave direction.

When waves generated in the open ocean encounter shallow water near the coast, they slow down and grow in size. They can also become larger as they

encounter strong currents. Many reported incidents of very large and damaging waves have occurred in regions such as southern Africa, where waves generated by strong winds in the Southern Ocean meet the opposing Agulhas Current.

Interestingly, waves can be completely stopped when an opposing current reaches just a quarter of the speed of the wave crests before they encounter the current. This can often be observed locally on ferries crossing to the mainland; narrow bands of breaking waves indicate that the tidal current has reached this critical value and the wave field cannot propagate any further.

Rogue waves are often part of a set of larger waves. The first waves in the set might give some warning of an even higher wave to come. Sometimes, however, a large "unexpected wave" can occur after many much smaller waves.

This unexpectedness can be as important as the wave height,

even if the wave does not qualify as a rogue. Theoretical simulations, as well as observations off the B.C. coast and elsewhere have shown that, perhaps surprisingly, a wave twice as high as any of the preceding 30 tends to occur about once a day, and slightly more frequently as one approaches the shore.

While being on the water for a period of five minutes or so in relatively calm conditions might lead to assumptions that the sea state is calming down, this can be followed by a large wave without any warning.

Rogue waves and unexpected waves are not uncommon in B.C. waters. Much of the physics is understood, but the topic is still one of active research.

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