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Identification of characteristic properties in different vessel wake signals

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The potential threat in terms of environmental protection and safe navigation posed by wake waves from high-speed ferries and fast conventional ships is well documented. Vessels that travel in the near-critical regime (depth Froude number ≈ 1) at some sections along their ship tracks can generate packets of large, solitonic, very long and long crested waves. The heights and periods of the leading waves, excited at near-critical speeds, may be much larger than those of conventional ferries or vessels travelling at even slightly slower speeds. However, it is difficult to determine a general characterization of such wakes at the coast, due to the transient and nonlinear nature of this phenomenon, and the fact that wake impact is influenced by the local bathymetry and coastline configuration. Such a characterization is required in order to set reasonable limits to wake wash that are sufficient for protection but not excessively restrictive for ship navigation. This paper investigates the potential benefits of wake analysis by means of a time-frequency technique (windowed Fourier transform), which is well known in signal analysis but has only recently been applied in wake analysis. Analysis of ship wakes have been performed based on instrumental data of sea surface elevation recorded at different sites in Tallinn Bay, the Baltic Sea, which is characterized by very intense ship traffic and provides a very rich collection of vessel-wake signals. Results show that the wake signals are easily identified in spectrograms. The method is particularly useful for identification of low frequency signals that may easily be masked by high frequency noise in the wave record. Furthermore, the spectrogram provides an image of the wake that makes it possible to associate wake events with individual ships at a given location. This approach also opens a new direction for the statistical description of wakes, applicable to the characterization of the "wake climate" for sites with intense vessel traffic.