Quantifying extratropical storms by their swell imprints on the world oceans.

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Extratropical storms typically have very strong winds and can cover very large geographical areas. The forcing of these powerful winds onto the ocean surface can lead to the development of large and sometimes extreme waves. Several factors contribute to the generation of extreme waves by extratropical storms:

Wind Speed: The primary factor influencing wave height is the wind speed. The stronger the winds, the larger the waves that can be generated. Extratropical storms often have very strong and sustained winds.

Fetch: Fetch is the distance of open water over which the wind blows. In extratropical storms, the large fetch created by the expansive wind field allows waves to build up over a significant distance, resulting in larger and more powerful waves.

Duration of Wind: The longer the duration of strong winds, the more time waves have to develop and grow. Extratropical storms can persist for several days, providing ample time for waves to reach extreme heights.

Besides extreme wave height, very long wavelengths and forerunners are the imprint of such extreme extratropical storms even if observed far from the storm source. Recent remote sensing systems such as SWOT are now able to document the occurrence of such very long swells up to km scale and back-propagation of such long swells can be used to identify and quantify their storm source. A general framework applicable to satellite observations but also drifting or moored wave buoys and seismometers will be presented to help quantify the most powerful extratropical storms.

It's important to note that extreme waves generated by extratropical storms can pose significant risks to coastal areas, shipping, and offshore structures. Monitoring and predicting these waves are crucial for mitigating potential hazards and ensuring the safety of maritime activities.