

"Composite distribution of North Atlantic extreme wind waves inferred from satellite altimetry data".



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ABSTRACT. The north Atlantic Ocean is regularly traversed by extratropical cyclones and winter low pressure systems originated in the Western part of the basin that can potentially generate dangerous extreme sea states. In this paper we study the significant wave height distribution of extratropical cyclones using merged satellite altimetry data to produce composite maps of this sea state variable. Although there are large variations among individual cyclones, the compositing method allows obtaining general features. We find that the higher waves are in the south-eastern quadrant of the cyclone, due to the extended fetch mechanism. The highest wave heights are found during the 48h period when the cyclone's strength is maximum. The strongest cyclones have higher waves over most of the eastern half, due to their northward propagation tendency.

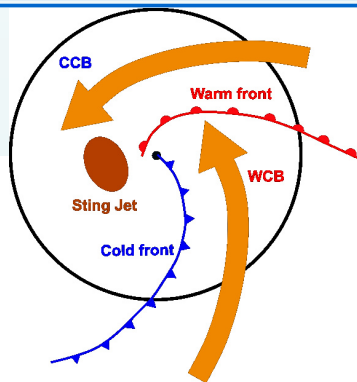


Fig. 1 Diagram of characteristic airflows in an idealized extra-tropical cyclone WCB (Warm conveyor belt), CCB (Cold conveyor belt).

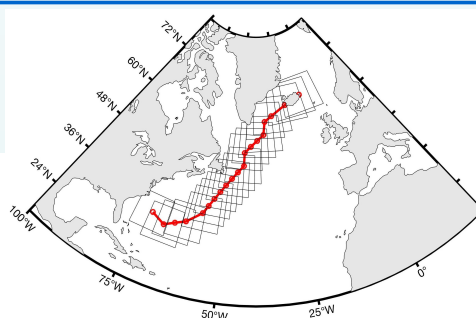


Fig. 2 Trajectory of ETC #7 of 2009 (red line) with center positions (red open circles) and the cyclone centred squares used to identify altimeter tracks that cross the cyclone path. The cyclone was tracked from 16/2/2009 12UTC to 21/2/2009 18UTC.

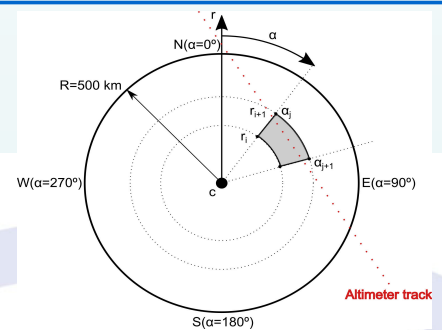


Fig. 3 The cyclone centred coordinate system used in the mapping procedure. Dotted line represents an altimeter track. The Hs of the segment (shaded area) is the average of the Hs altimeter measurements that fall inside the segment.

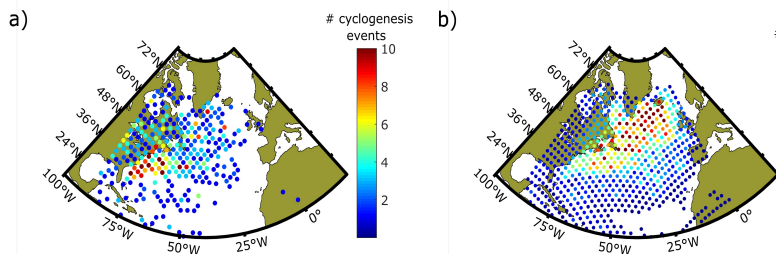


Fig. 4 Cyclone characteristics. a) Map of cyclogenesis location. b) Map of cyclone tracks.

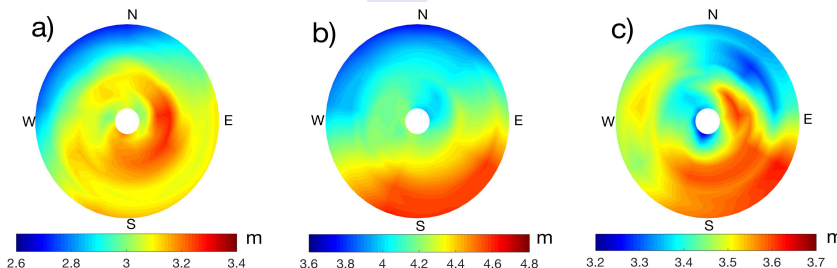


Fig. 6 Hs composite in the cyclone life cycle stages. a) Development stage: up to 24 h before SLP minimum; b) Maximum strength stage: from 24h before to 24h after SLP min; c) Decay stage: from 24 h after SLP minimum to cyclone lysis. Note the different colour bar scales for each panel.

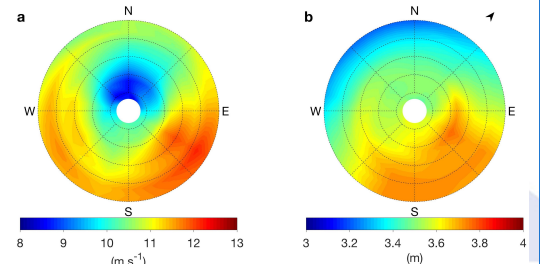


Fig. 5 Altimeter derived composites of a) 10 - m wind speed and b) significant wave height for the 1998-2012 period.

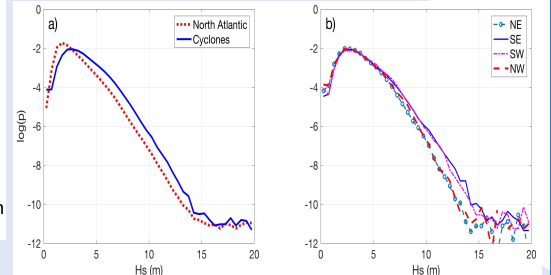


Fig.7 Normalized probability density function of significant wave height. a) North Atlantic basin and cyclones; b) by quadrant

Conclusions. The composite analysis performed on the Hs maps, obtained from 15 years of satellite altimetry measurements, highlighted common features of the Hs distribution under extra-tropical cyclones in the North Atlantic. The main feature of this distribution (Figure 6b) is the maximum in the SE quadrant of the composite cyclone, due to the extended fetch mechanism. This finding agrees with the results of Kita et al (2018) that used composites of hindcasted significant wave height in the NW Pacific to reach the same conclusion.

The maximum track density (Figure 5b) is collocated with the extreme Hs region of Takbash et al. (2018), which signals the dominant role of extratropical storms in setting the wave climate in the North Atlantic. In this region, wind-sea dominates and the correlation.

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