
Extreme sea states: CFOSAT data in the context of other satellite data and numerical hindcasts

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Résumé

Observing the Sea State climate at global scales is difficult due to the sparse nature of the available measurements and the relatively short records of instruments, especially when looking at extreme and thus rare events. Here we focus on "phenomenal sea states" ($H_s > 14$ m) in measurements made by the nadir beam on CFOSAT, other satellite altimeter data from the ESA Sea State Climate Change Initiative project (<https://climate.esa.int/en/projects/sea-state/>) and a recent numerical model hindcast by Alday et al. (2021, <https://doi.org/10.1002/essoar.10505476.2>). Starting with the year 2019 we identified 55 events for which the global model hindcast gave phenomenal sea states, with a maximum modeled value of 21.4 m for storm Fabien on 21 December 2019 in the North Atlantic. For each of these events we looked for occurrence of nadir altimeter measurements that have $H_s > 12$ m, and when this occurred we defined this event as "caught" by an altimeter. Although the measurements from CFOSAT, SARAL, Sentinel 3 and Jason-3 are not co-located we find a general agreement in the distribution of large H_s values. CFOSAT was able to catch 5 events that were not caught by the other missions. In general, each mission contributed uniquely to the sampling of extreme events and the definition of the climatology of these phenomenal seas for which numerical models still have important errors. Although most of the phenomenal storms are found in the middle of the North Atlantic, North Pacific and Ross sea, their evolution and propagation away from their peak can determine the extreme wave climate for a large part of the open ocean coasts too. This study will be extended to other years using the full ESA Sea State Climate Change Initiative project and the behaviour of different instruments for these extreme wave conditions will be compared. Future work will also include using the off-nadir beams from CFOSAT to investigate spectral properties in such events.

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