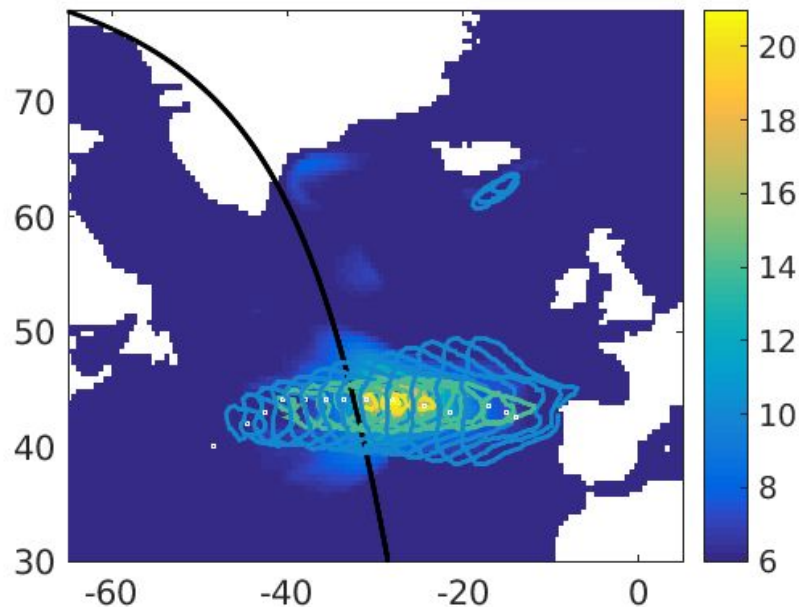
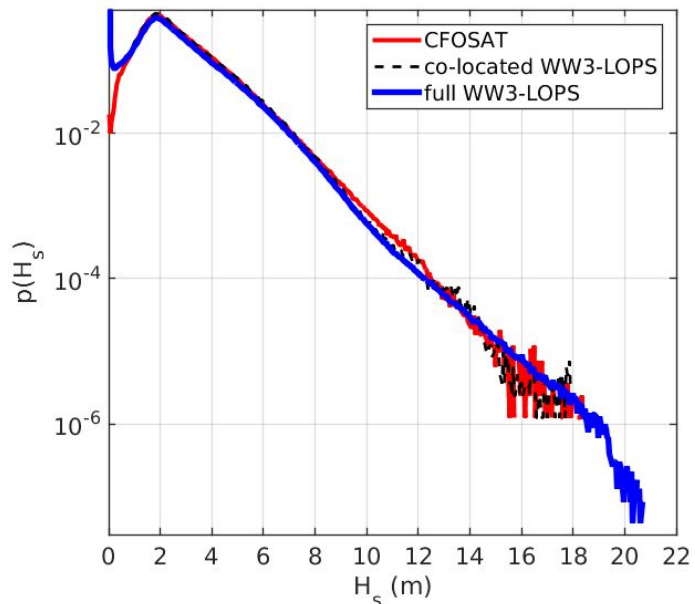


Extreme sea states

CFOSAT data in the context of other satellite data & numerical hindcasts



Fabrice Ardhuin & Guillaume Dodet



1. A virtual constellation for sea state measurements

Satellite missions with dedicated sea state measurements include altimeters, SARs with “wave mode”, and CFOSAT.

The Sea State Climate Change Initiative is an ESA-funded project

⇒ seamless database for climate applications.

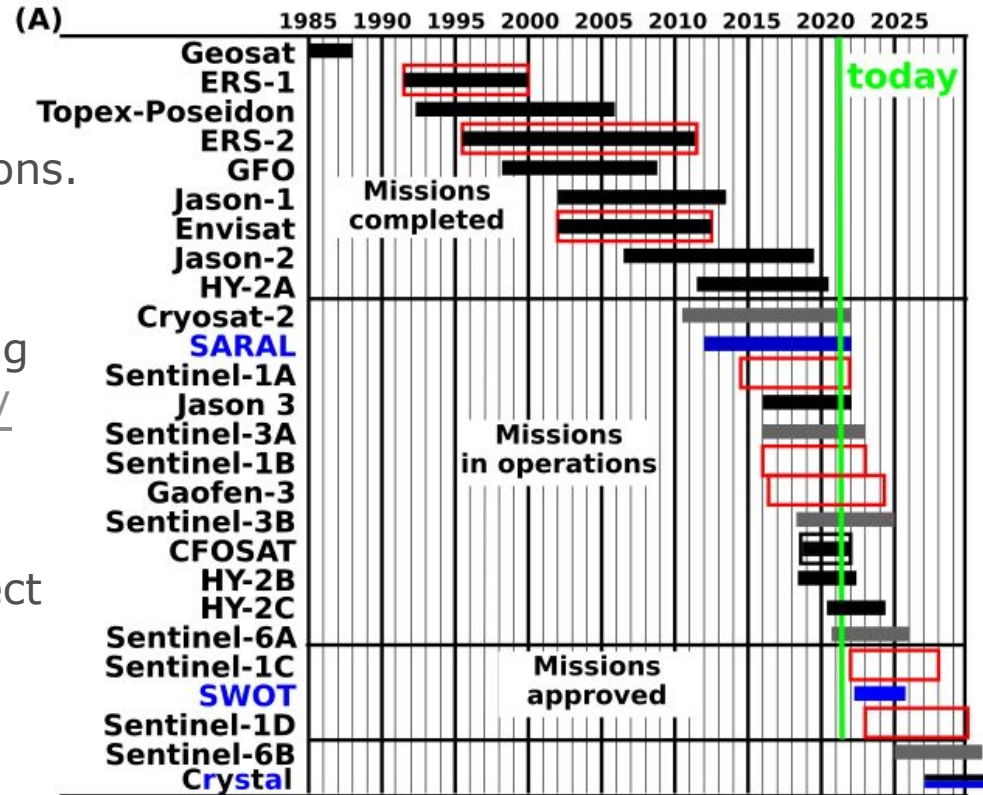
Dodet et al. (2020): CCI-v1 dataset

Next week: CCI User Consultation meeting

<https://seastatecci-ucm.sciencesconf.org/>

CCI-v2 to be released next week

ongoing preparations for phase 2 of project



2. Global extremes

Very large wave heights can be important for engineering design, in general restricted to a particular region but using very long time series. Also extreme H_s are associated with global swell fields (see Hanafin et al. BAMS 2012).

How accurate are estimates of H_s for very large values?

Is CFOSAT behaving like other missions for $H_s > 14$ m?

Is there some specific numerical model tuning needed?

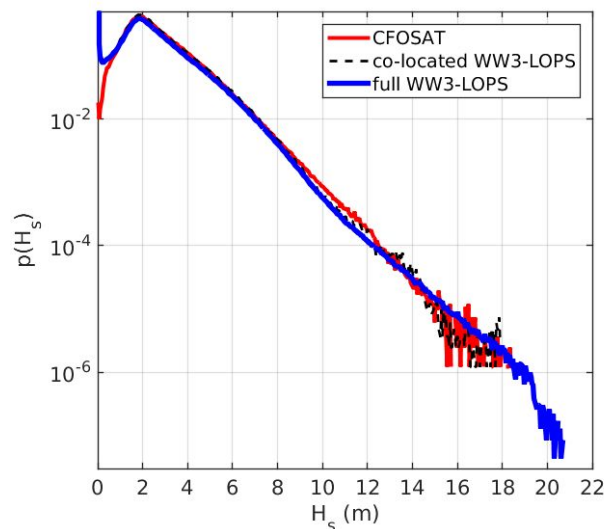
Are there specific physical processes?

Here we use CFOSAT nadir data

+ WW3 hindcast (Alday et al. 2021)

(uses ERA5 winds with high wind bias correction

+ Globcurrent currents)



Starting with year 2019

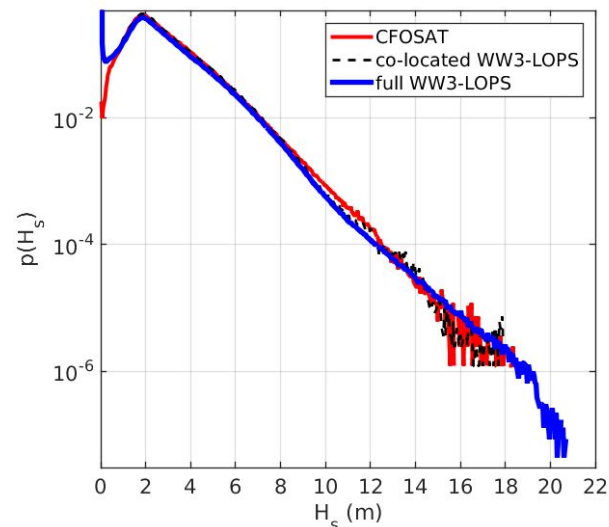
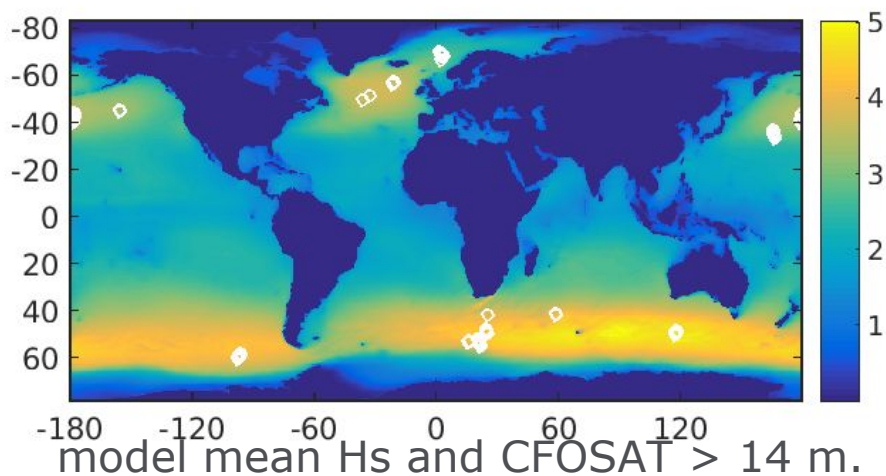
CFOSAT Science Team meeting - March 2021



2. Global extremes

The first difficulty is sampling: CFOSAT extreme events are a subset of all extremes: 11 events with $N > 3$ consecutive values > 14 m. Compared to 55 events with $H_s > 14$ m in the model.

Are they the same events? Even if CFOSAT does not catch the peaks of model events, what do we learn about model accuracy? What about other satellites?



2. CFOSAT & Sentinel 3, SARAL ...

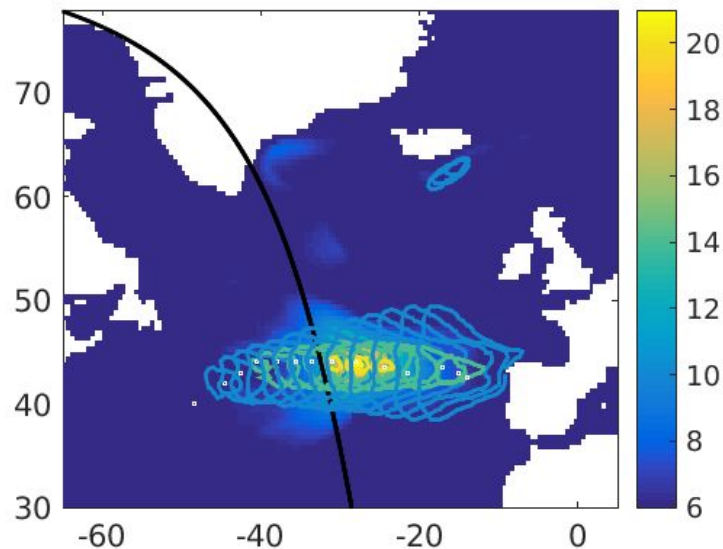
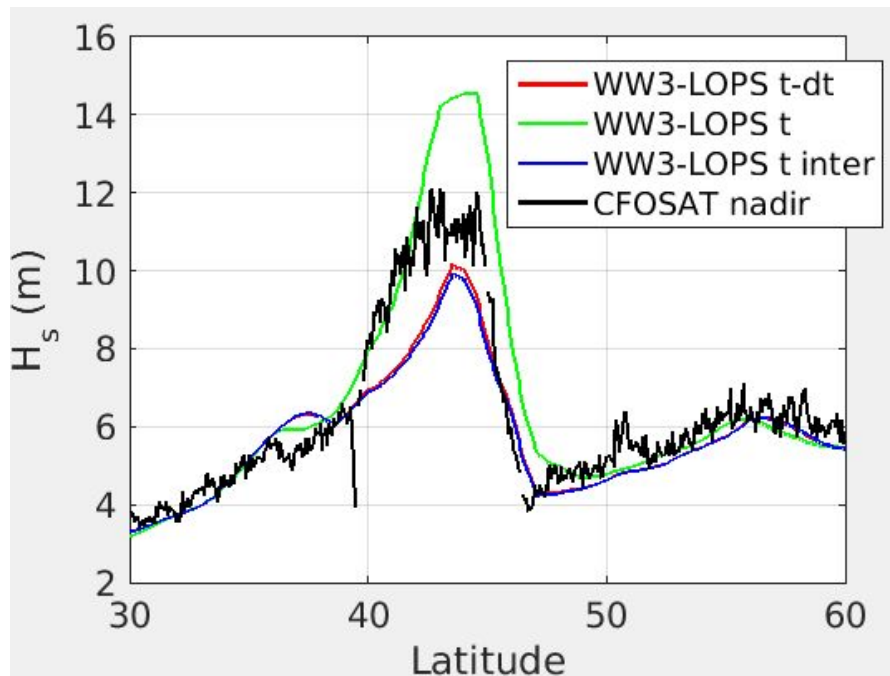
Same analysis for other missions: figures coming ...

but the analysis is much more difficult for other missions due to a much larger number of outliers



3. Storm Fabien: a flash in the North Atlantic, 20 & 21

Although CFOSAT nadir beam did not catch the peak of the storm (according to model), it still had $H_s > 10$ m, 6 hours before the model peaked



3. Storm Fabien: Hs across the CFOSAT swath

Check on positions of off-nadir beams



4. Preliminary conclusions

Extreme storms are short-lived and relatively compact: for storm Fabien the diameter with $H_s > 14$ m is about 500 km although the max H_s is 21 m (model).

A few nadir satellite missions are not enough to capture these events

Today's "golden age" of nadir altimetry allows to verify sampling of extremes

CFOSAT measurements up to $H_s = 18$ m appear reasonable

Use of "swath" measurements, as allowed by CFOSAT/SWIM can give a much better sampling of extremes ...

