Altimeter and sampling of extremes

DE CARLO Marine
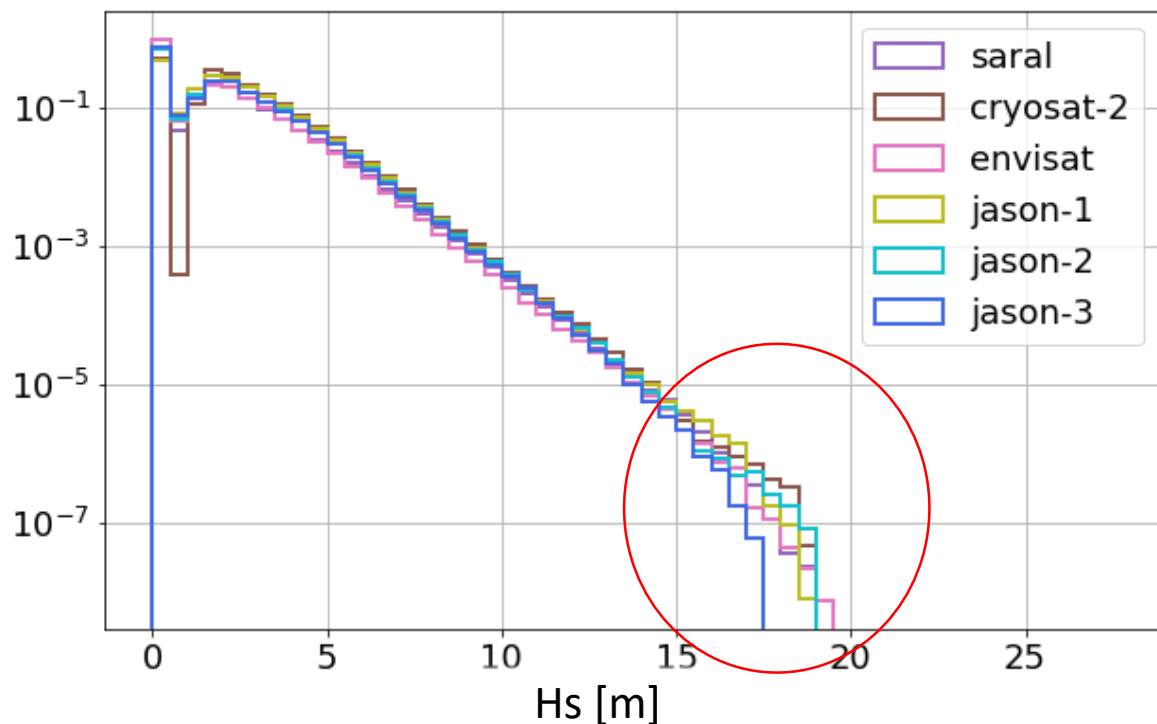
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LOPS, Brest
with Fabrice ARDHUIN

Context – studying extremes

- Distributions of SWH detected by altimeter (from CCI v2, *Dodet et al 2020*)

- Tail of de distribution is highly variable + sensitive to outliers

$\Rightarrow$ Which is the physical part?

$\Rightarrow$ Are the statistics reliable?

$\Rightarrow$ Adressing sampling issue

Methodology

Here: **'Hs event' point of view** vs all measurements

CCI SeaState database (looking at altimeters only) :

- Look at local maxima of Hs along the satellite tracks
- + flag to avoid coastal or sea ice effects
- Select only for Hs max > 10 m (20,886 values)
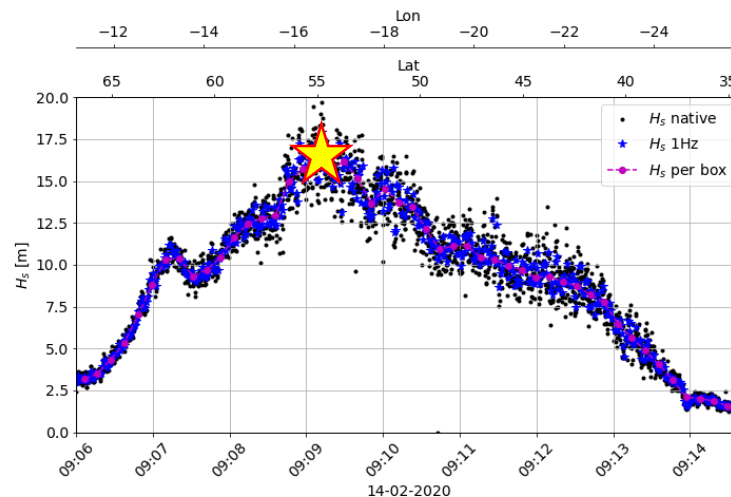
Methodology


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WW3 wave model (Hindcast database, Alday et al 2021):

- Detection of zones of high Hs + tracking
- (adapted from eddy tracking algorithm)
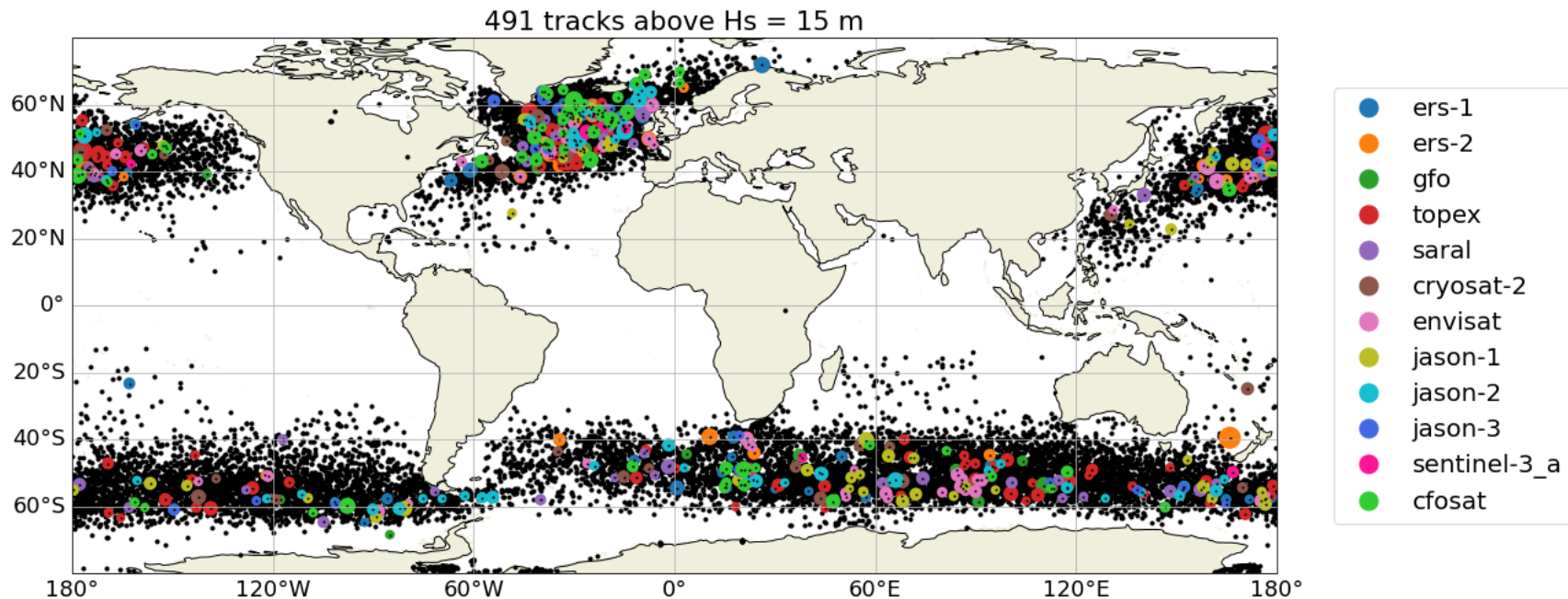- Select 'Hs storm' if max(Hs) > 10 m (13,840 tracks)
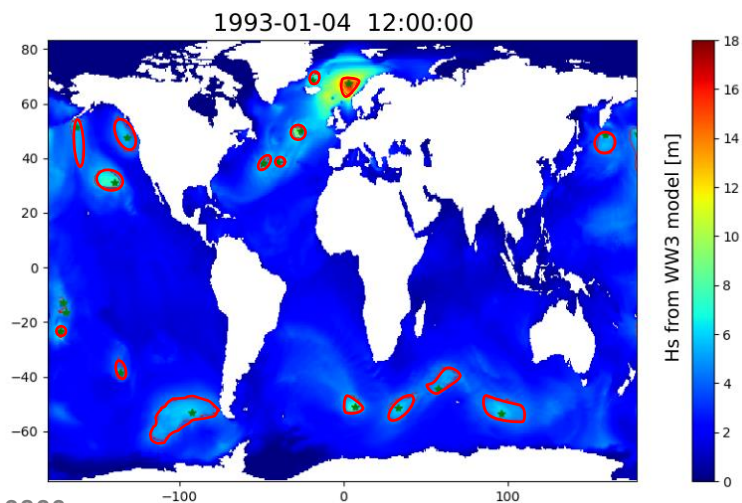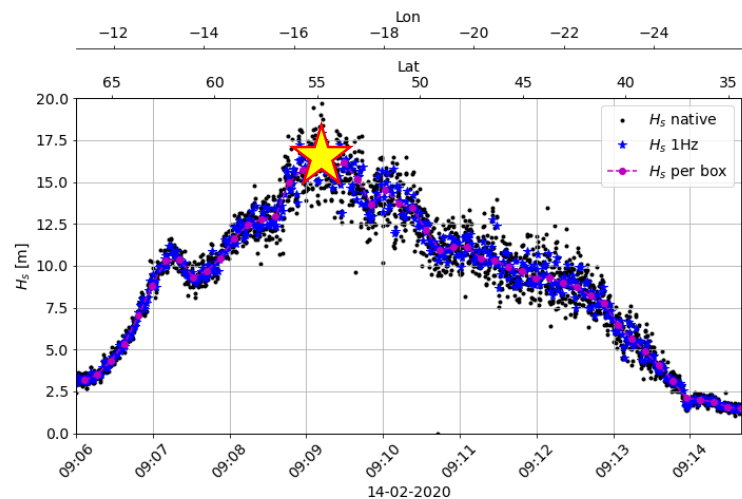
Results – CCI SeaState

- Latest version (v3)
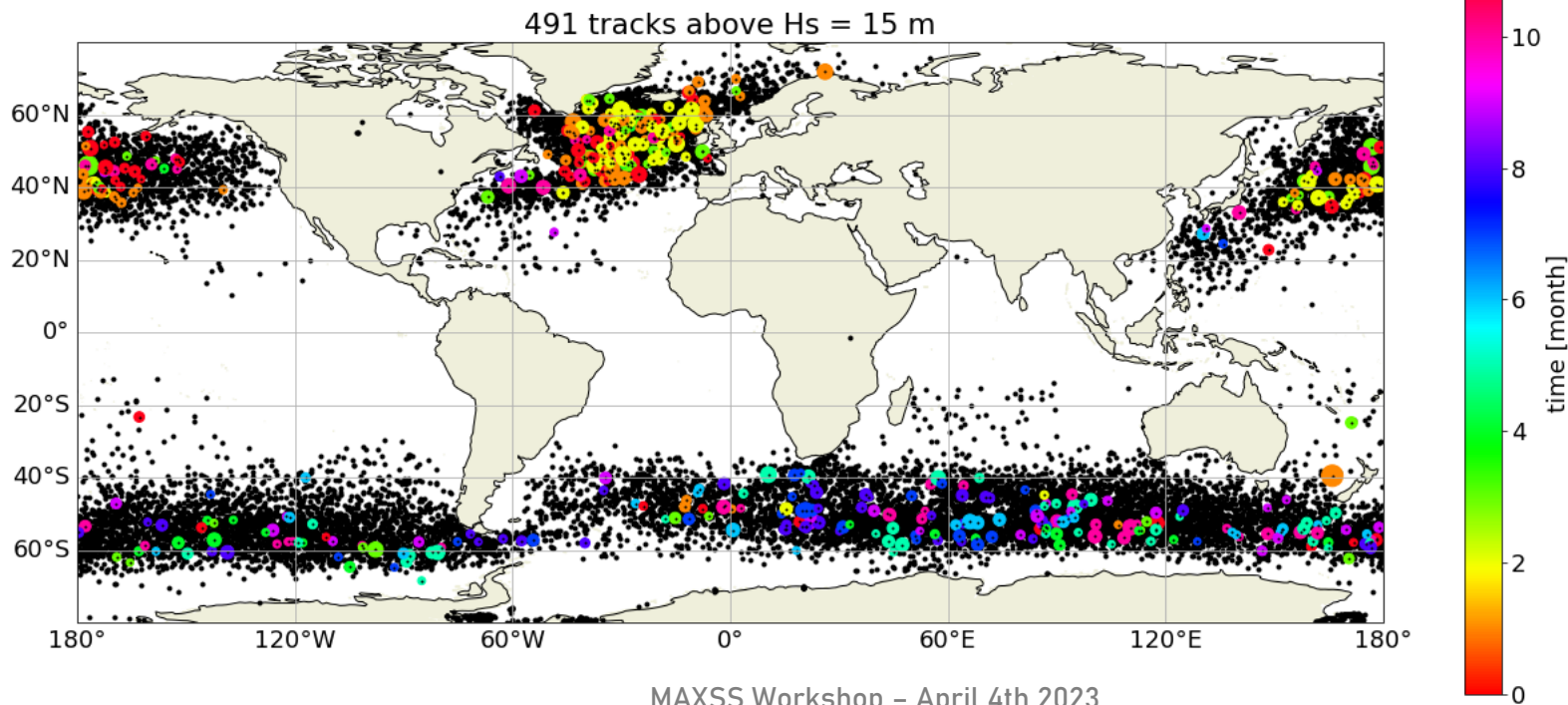- + v1 for satellites not in v3 (or bad : e.g. saral)
- 20,886 values

Results – CCI SeaState

- Local maxima in satellite tracks (1991 - 2020)

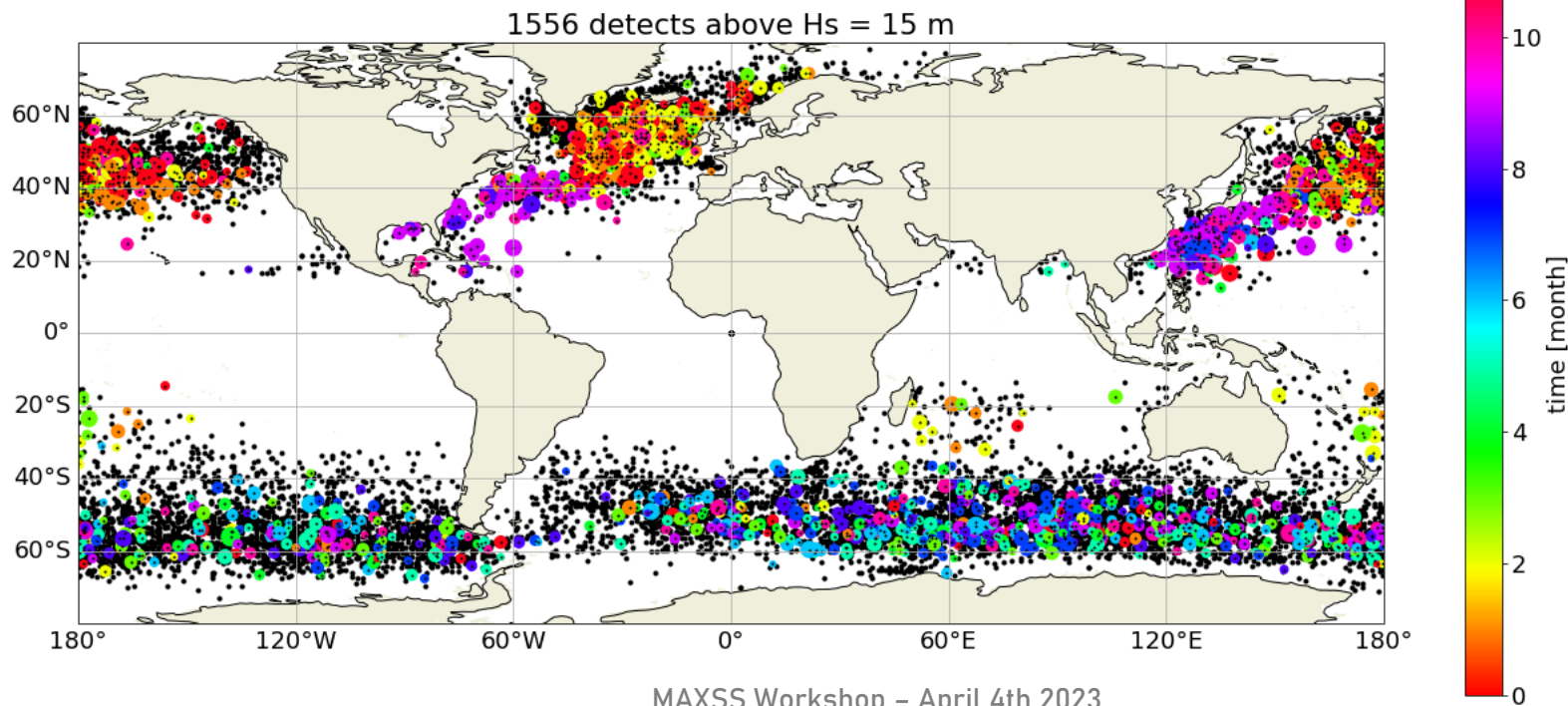- Black dots Hs > 10 m

- Colored Hs > 15m : color = satellite

491 tracks above Hs = 15 m

Results – CCI SeaState

- Local maxima in satellite tracks (1991 - 2020)

- Black dots Hs > 10 m
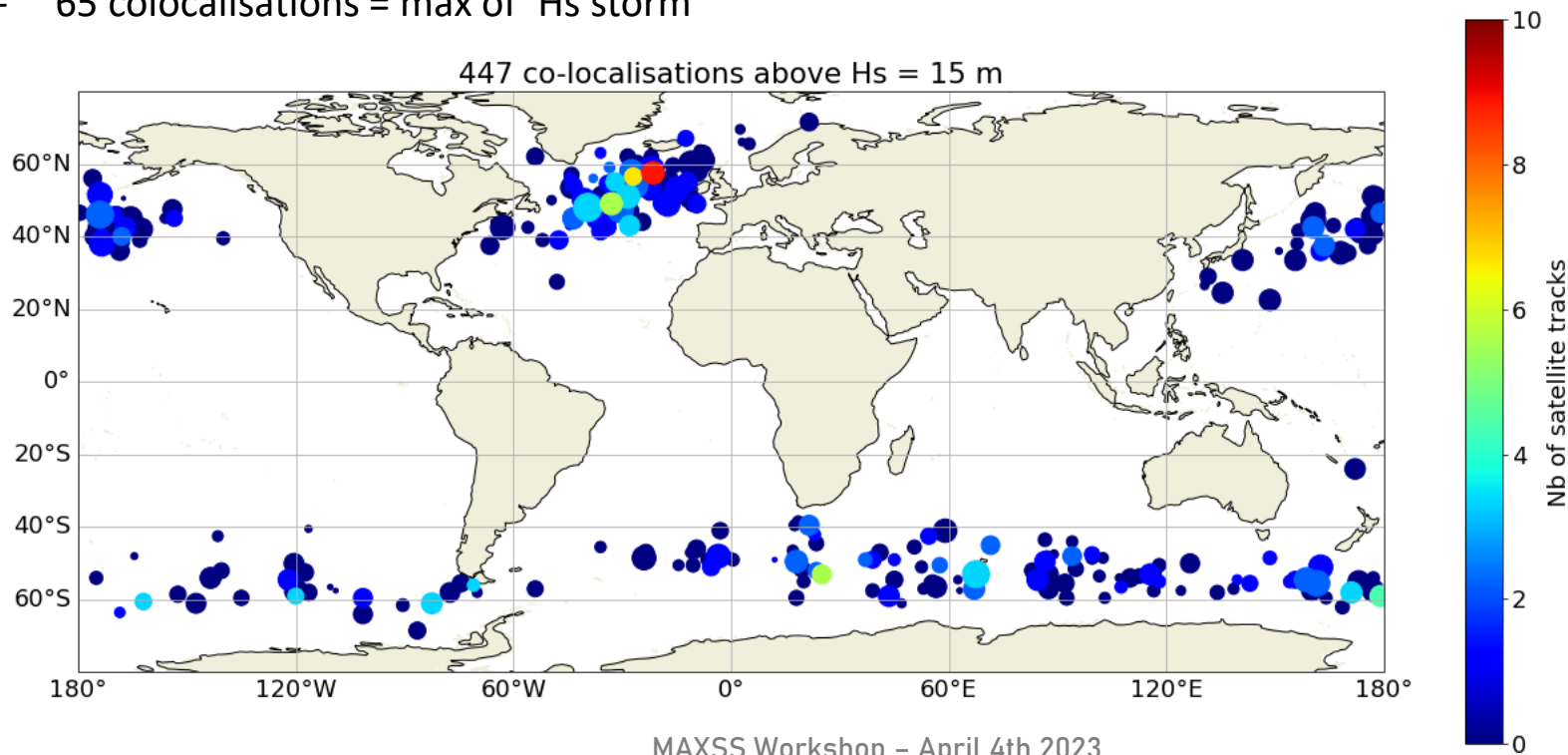
- Colored Hs > 15m : color = month of measurement

491 tracks above Hs = 15 m

Results – Model

- Select 'Hs storm' if Hs_max > threshold

- Black dots Hs > 10 m

- Colored Hs > 15 m : color = month of measurement

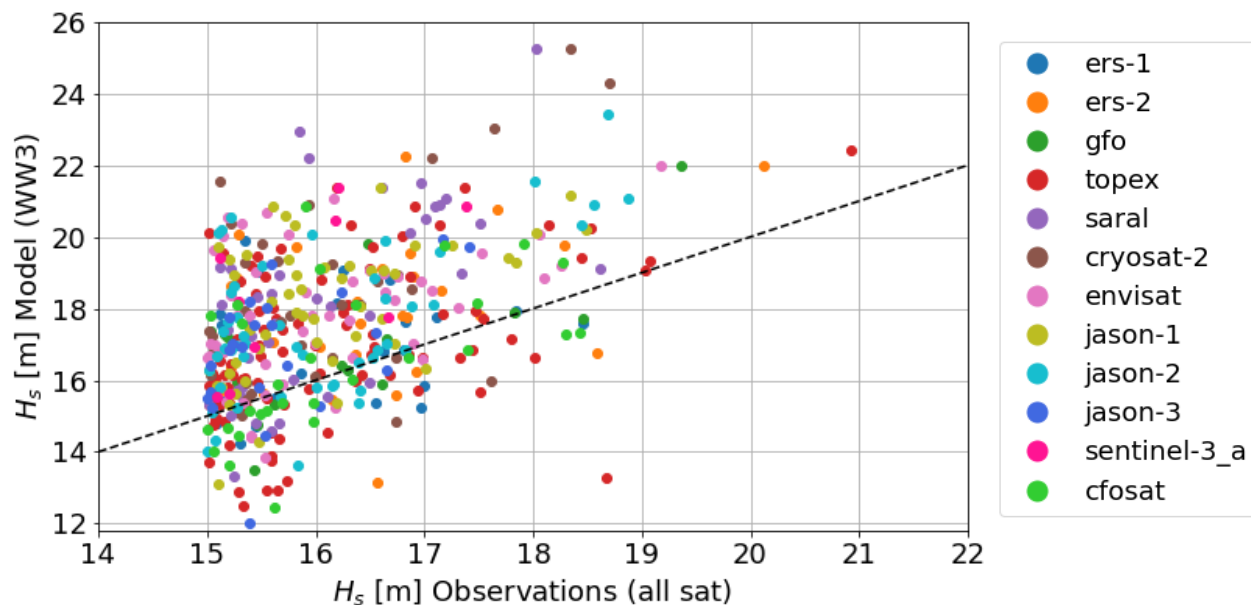1556 detects above Hs = 15 m

Results – Colocalisations

- 447 Colocalisations between satellite maxima and model 'Hs storms'

- Mean distance between obs. and model = 172 km
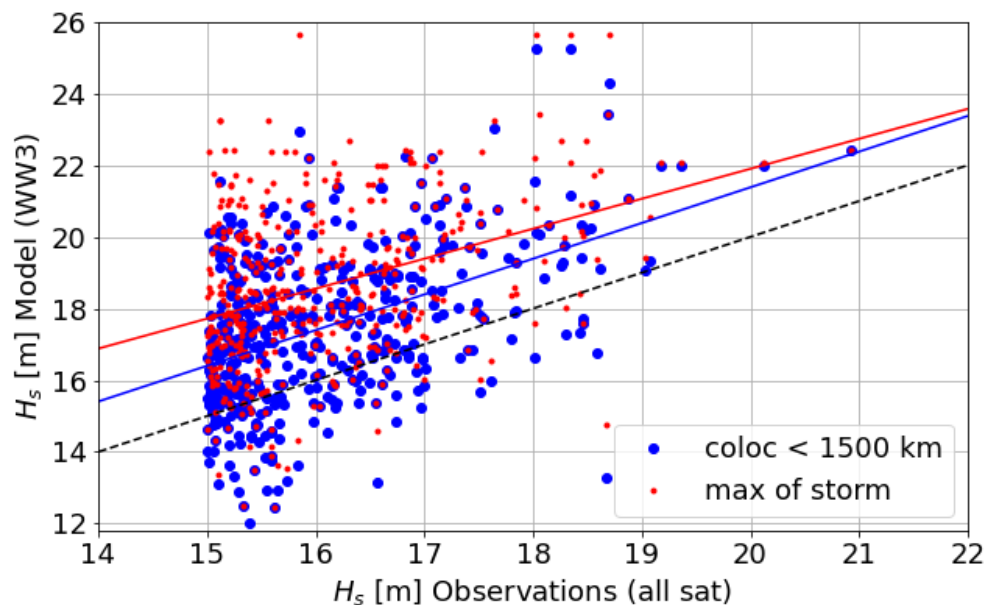
- 65 colocalisations = max of 'Hs storm'

447 co-localisations above Hs = 15 m

Results – Colocalisations

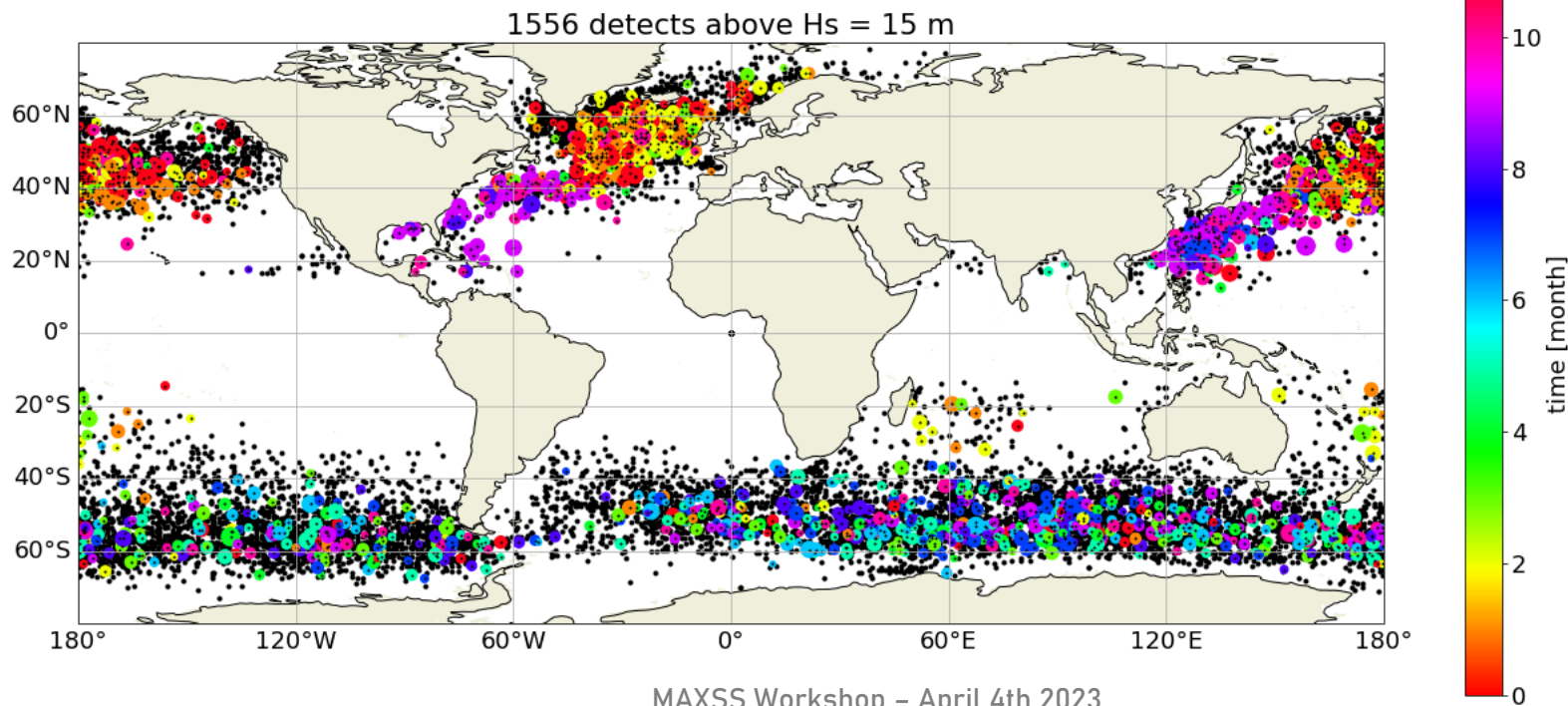- Hs observed vs model : model > obs

Results – Colocalisations

- Hs observed vs model : model > obs (known issue of the parameterization due to excessive 'wind boost')

$\Rightarrow$ offset = 1,6 m

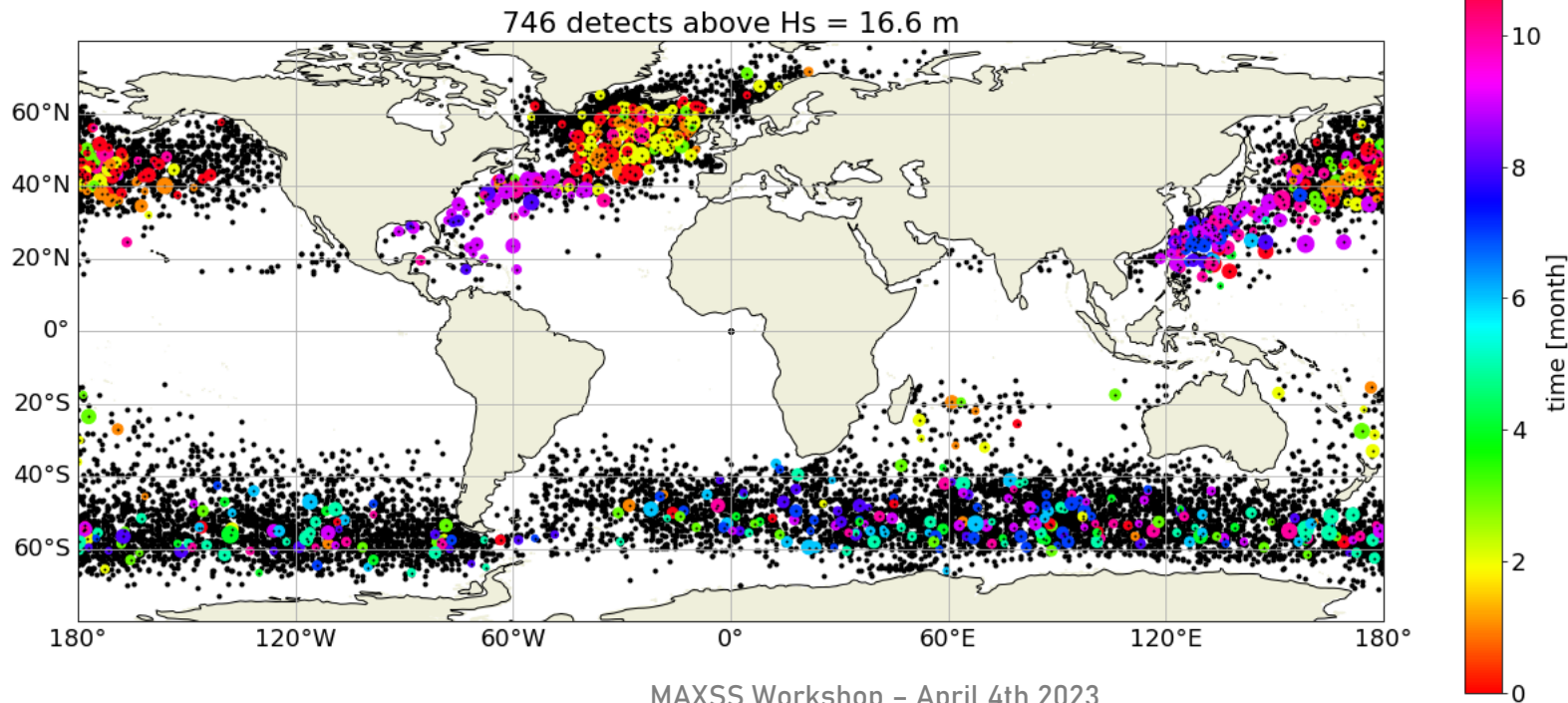- In red : value max for 'Hs storm' = even when colocalisation max(Hs) may not be seen

Results – Model

- Select 'Hs storm' if Hs_max > threshold

- Black dots Hs > 10 m
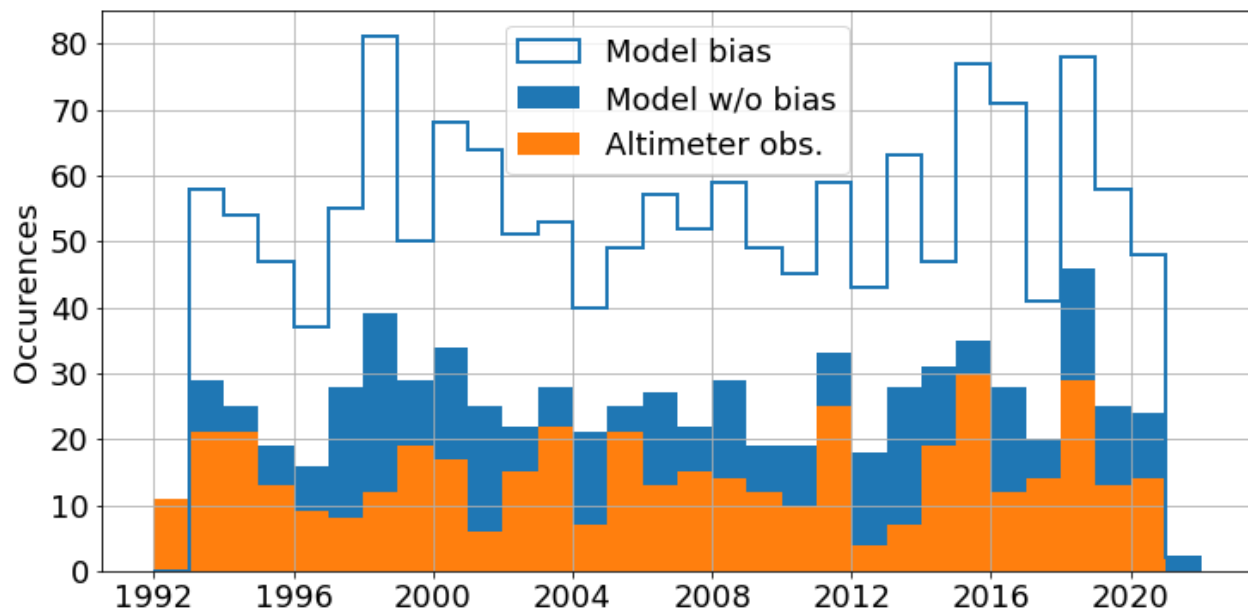
- Colored Hs > 15 m : color = month of measurement

1556 detects above Hs = 15 m

Results – Model

- Select 'Hs storm' if Hs_max > threshold

- Black dots Hs > 10 m

- Colored Hs > 15 **+ 1,6 m** : color = month of measurement

746 detects above Hs = 16.6 m

Results – Comparisons

- Number of storms seen/predicted by year.

- With Hs shift for the model: ~ 25 storms with Hs > 15m by year

- With the CCI SeaState (altimeters only): ~ half those storms are detected

- Merely 16 storms have been sampled 3+ times.

Work in progress …

- First results of the study
- To Do :
  - Include v4 CCI SeaState when available
  - Investigate sampling vs number of altimeters
  - Look at other sources of data (such as SAR, seismic data)

Thank you
for your attention