Description and Validation of the CMEMS Near-Real-Time Wave Products derived from altimetry and SAR measurements

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CMEMS OCEAN WAVE TAC
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A – Near-Real-Time Wave Service

1. Types of products

Level 3 SPC

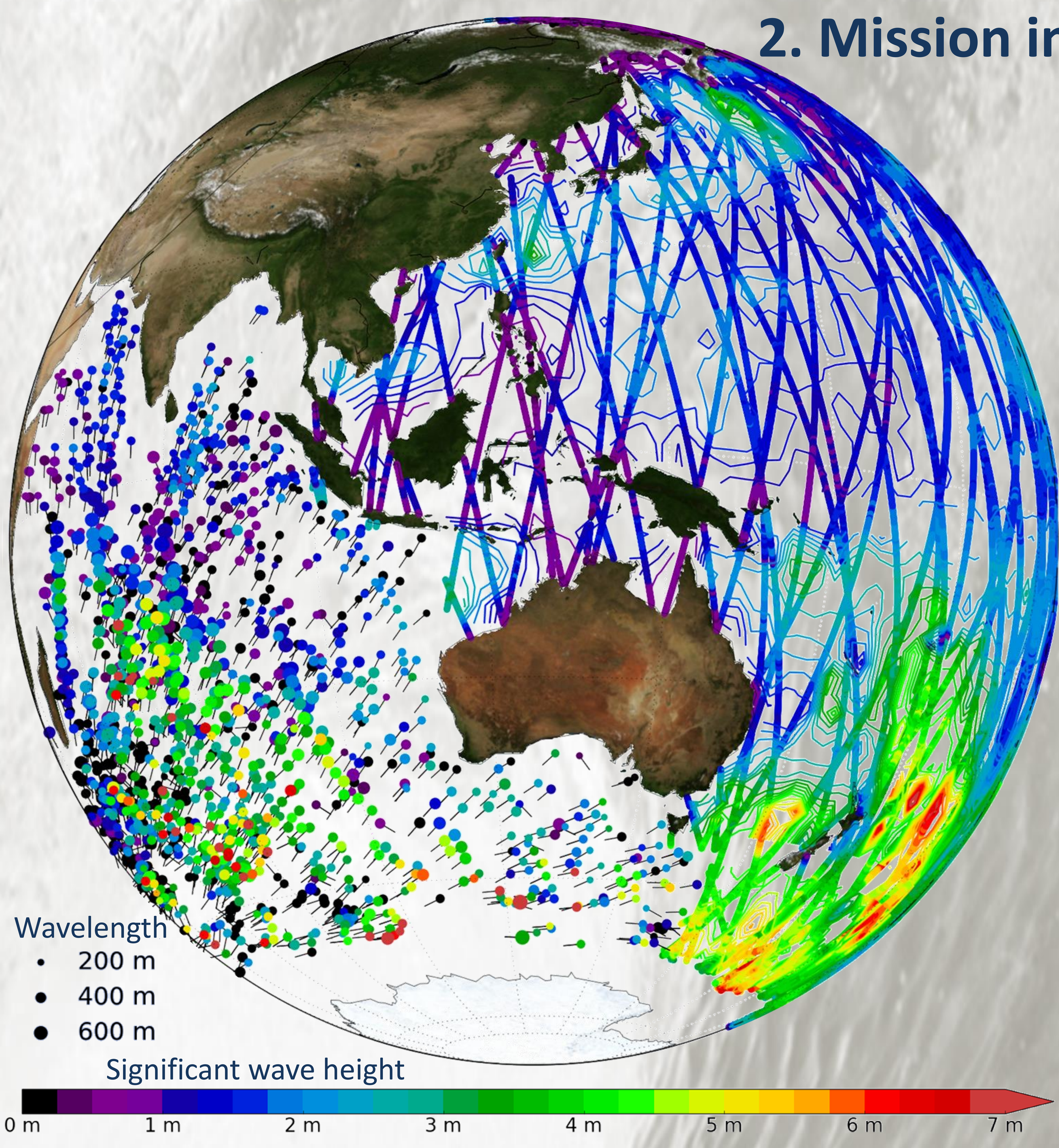
Extracted from Sentinel-1 wave SPeCtra (SPC). Swell integral parameters along track and along swell propagation track from storm source to the coast: significant wave height, peak direction and peak period, all quality flagged. Energy model used for dissipation along propagation follows [Ardhuin et al. 2009]. Observations available individually or grouped by swell event.

Level 3 SWH

Mono-mission 1Hz along-track significant wave height available for each mission, edited, inter-calibrated between altimeter missions and with respect to in-situ measurements and noise-filtered (EMD-based method, Quilfen and Chapron 2019).

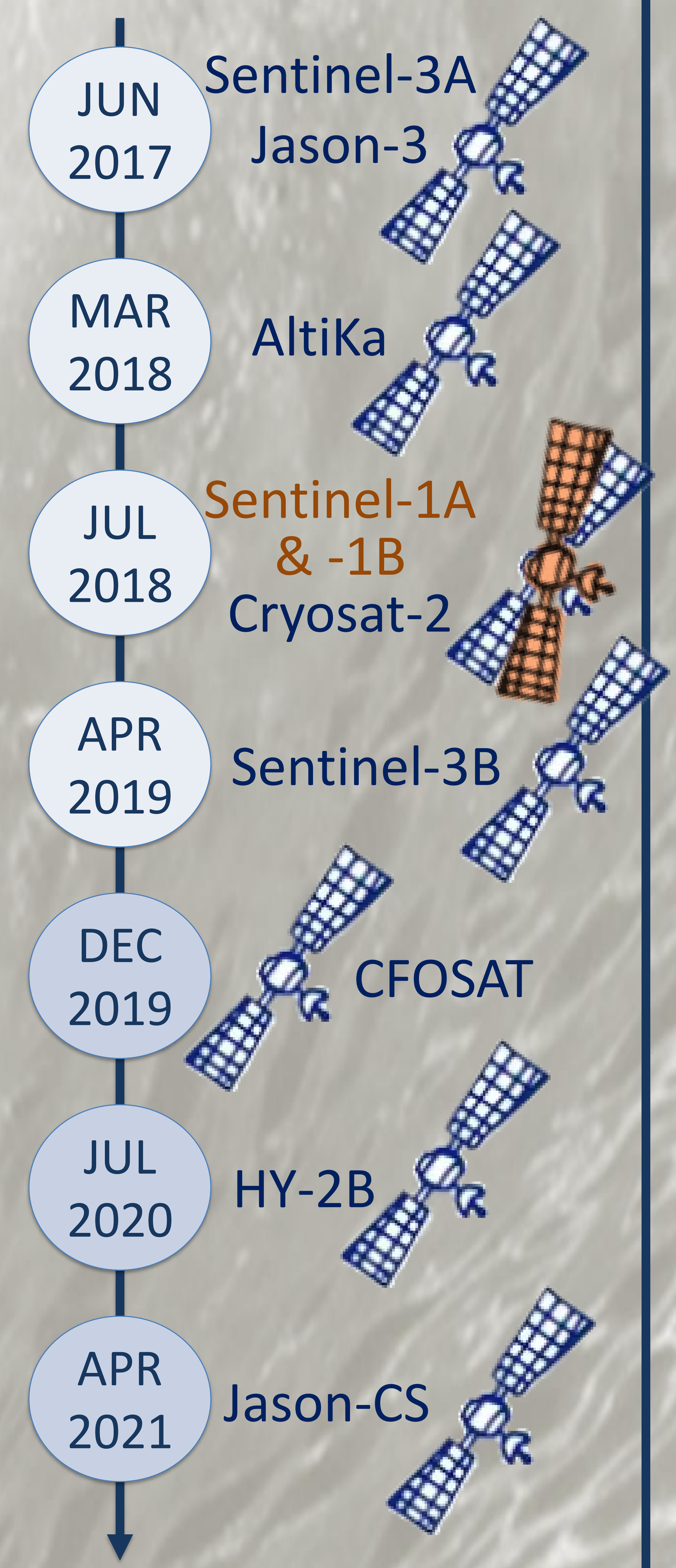
Level 4 SWH

Multi-mission gridded 2°x2° significant wave height fields merging all available Level 3 data into an estimate of the instantaneous wave field at 12UTC daily and daily statistics (mean, maximum, standard deviation, number of observations).



Left: SAR-derived swell conditions ; Right: Altimetry-derived along-track and gridded (contours) significant wave height

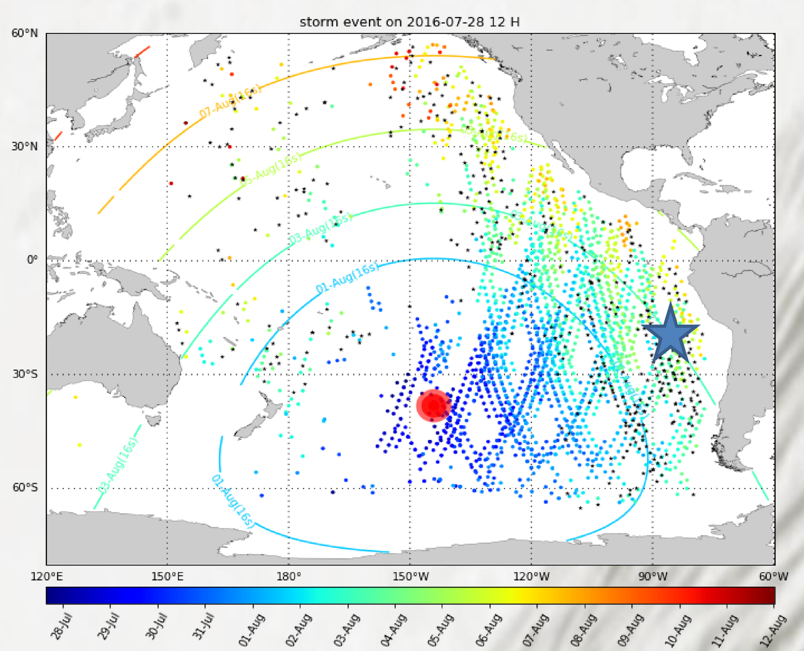
2. Mission integration timeline



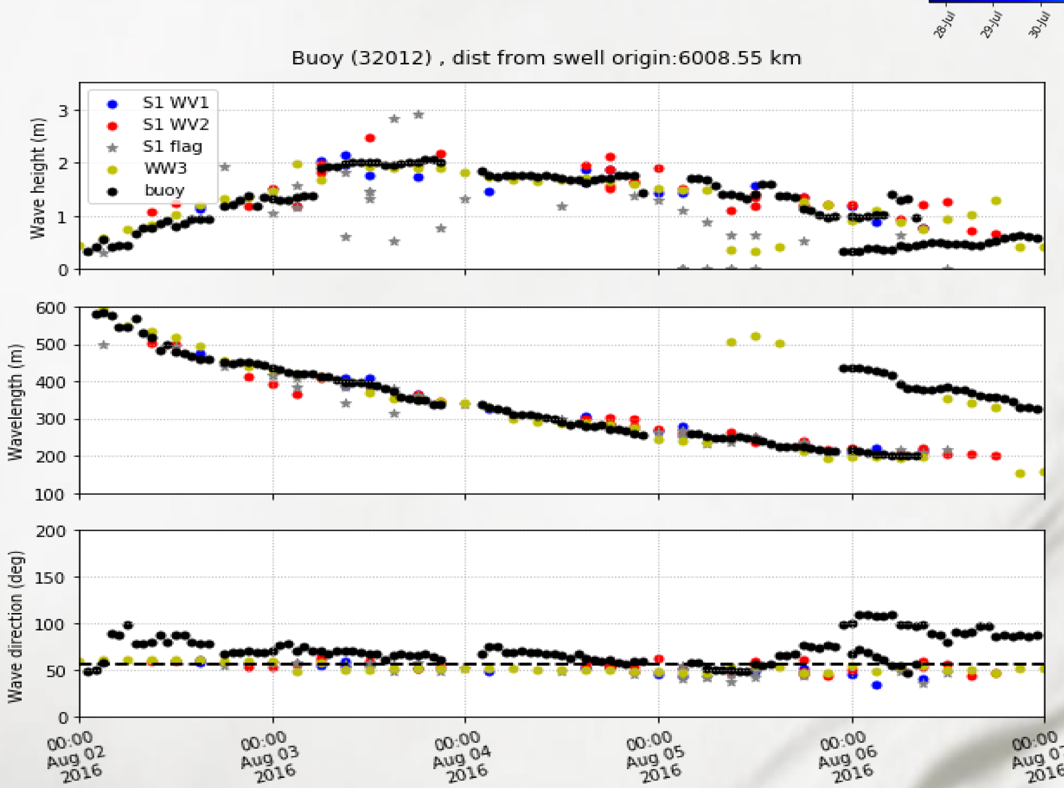
B - Validation

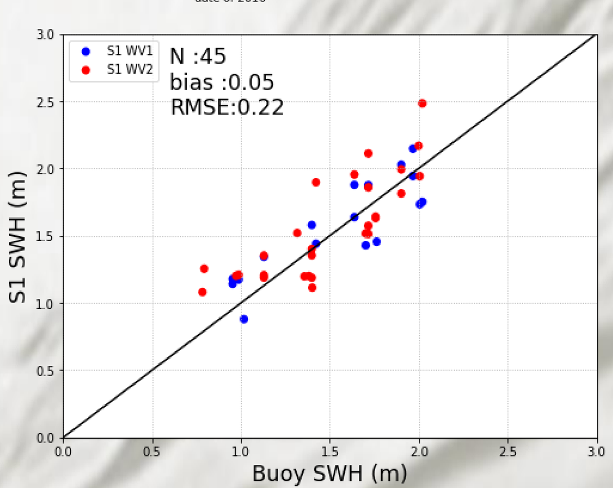
1. SAR irregularly gridded waves

L3 SPC products are compared against quality flagged in situ measurements (based on time consistency) and co-located WWIII® numerical wave model outputs. Illustrated here for an extra-tropical storm (more in [Wang et al. 2019]).



Locations of each wave observation part of the considered swell field. Color code indicates the time of the observations. Grey dots are data considered as bad quality when using the flag included in the product. The star location indicates the location of the buoy used for validation below (Stratus-32012). At refocusing time, the blended Ascat winds confirms occurrence of intense winds (not shown)





Good match between Sentinel-1 propagated waves and WW3 and the buoy

Significant wave height, peak wavelength and peak direction given by the L3 CMEMS SAR products at the buoy location compared to the WW3 model and in situ measurements

2. Altimetry significant wave heights

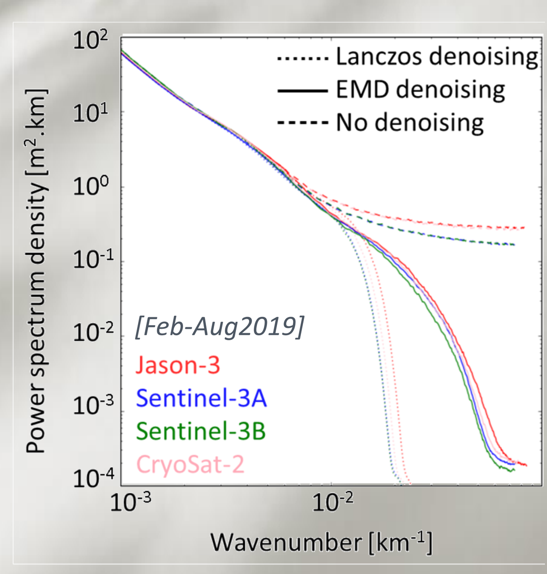
L3 and L4 SWH products are compared to in-situ measurements from 114 moorings (CMEMS InSitu-TAC) during the whole year 2018. Buoy data are compared to the average of L3 collocated values (within 50 km / 30 min of buoy record) and to the daily L4 instantaneous value.

Year-2018 comparison with in-situ:

	Nb of match-up	Bias	RMSE	SI	R
L3 Jason-3	1700	8 cm	5 cm	10%	0.99
L3 Sentinel-3A	1569	7 cm	5 cm	10%	0.99
L3 AltiKa	1667	9 cm	6 cm	10%	0.99
L3 CryoSat-2	1488	6 cm	5 cm	10%	0.99
L4 multi-mission	19 416	9 cm	29 cm	25%	0.86

Example at the Gascogne buoy (April 2018)

Impact of EMD noise-filtering on L3 SWH power spectra



Unfiltered data (dash lines) are contaminated by noise at scales lower than 100 km. Lanczos denoising method (dotted lines), applied to L3 SWH since Apr-2019 version, removes all fluctuations at scales smaller than 60km, therefore suppressing meso-scale signal of interest. This excessive smoothing is not present anymore with the EMD based method (solid lines). With an integration planned for Dec-2019 version, the EMD method allows to denoise the SWH down to scales of the order of 25km, where the signal to noise ratio is too low to recover the underlying signal (more details in Quilfen and Chapron, 2019)

In short

Product ID:
WAVE_GLO_WAV_L3_SPC_NRT_OBSERVATIONS_014_002
WAVE_GLO_WAV_L3_SWH_NRT_OBSERVATIONS_014_001
WAVE_GLO_WAV_L4_SWH_NRT_OBSERVATIONS_014_003
Product and documentation: http://marine.copernicus.eu
Animation and cal/val reports: http://satwave-report.cls.fr

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References

- Ardhuin, F., B. Chapron, and F. Collard. "Observation of Swell Dissipation across Oceans." Geophys. Res. Lett 36 (2009).
- Wang H., A. Mouche, R. Husson, B. Chapron, A. Grouazel and J. Zhu. "Assessment of a new dataset for ocean global swells based on Sentinel-1 Wave Mode measurements". Draft paper
- Quilfen, Y. and B. Chapron. Ocean Surface Wave-Current Signatures From Satellite Altimeter Measurements. Geophys. Res. Lett 46 (2019)

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