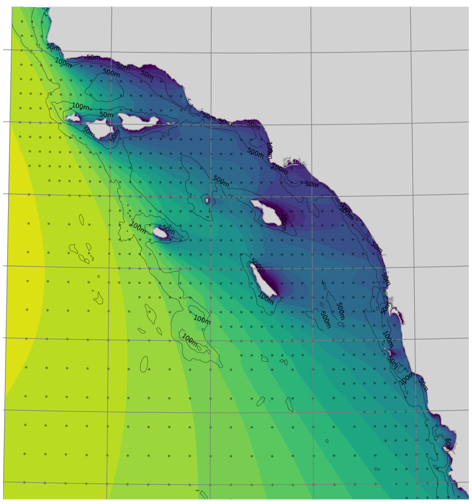
Technical Note on Specification and Validation of the Oceanum SW North America Wave Hindcast

August 2024

Model	SWAN 41.31
Period	Feb 1979 - Updating
Spatial resolution	0.02 to 0.1 degree
Temporal resolution	1 hourly
Region	124W - 115.5W
	30N - 36N
Forcings	ERA5 winds and Oceanum spectra



Dataset description

The Southwest North America wave hindcast dataset provides a detailed account of ocean wave parameters in the region between Baja California and South California (Figure 1). Wave spectra are computed over a 45-year period between 1979 and 2024 using the SWAN (Simulating WAves Nearshore) third-generation spectral wave model. The model is driven by inputs from the Oceanum Global Wave Model for spectral boundaries and the ECMWF ERA5 reanalysis for wind data. Bathymetry is derived from the GEBCO 2023 400 m grid and nautical charts. The wave data have been calibrated against satellite altimeters (Figure 2) and NDBC buoy data (appendix A), ensuring a high level of accuracy and reliability in capturing real-world conditions.

The modelling setup employs the ST6 source term parameterisations. Spectra are discretized into 36 directional bins and 32 frequency bins, spanning the range of 0.037 to 0.7102 Hz at 10% logarithmic increments. The local model employs a 3-stage nest, featuring a parent nest (*swna*) at 10 km resolution, an intermediate nest (*cali*) at 2 km resolution and a nearshore nest (*ense*) at 200 m resolution around the region of Ensenada Bay as illustrated in Figure 1. The nesting approach enhances the resolution and accuracy of the wave hindcast, particularly in key geographical areas, making it a valuable resource for diverse applications in marine and coastal studies.

The dataset provides hourly estimates for an extensive array of ocean wave parameters including spectral quantities integrated over the full spectrum and for spectral partitions (defined from both the 8-second splits and the Watershed method). This data is stored across grids at native resolution. Additionally, frequency-direction wave spectra are available at over 1000 sites across the three SWAN nests, with resolution increasing from deep ocean areas towards the coast (see Figure 1).

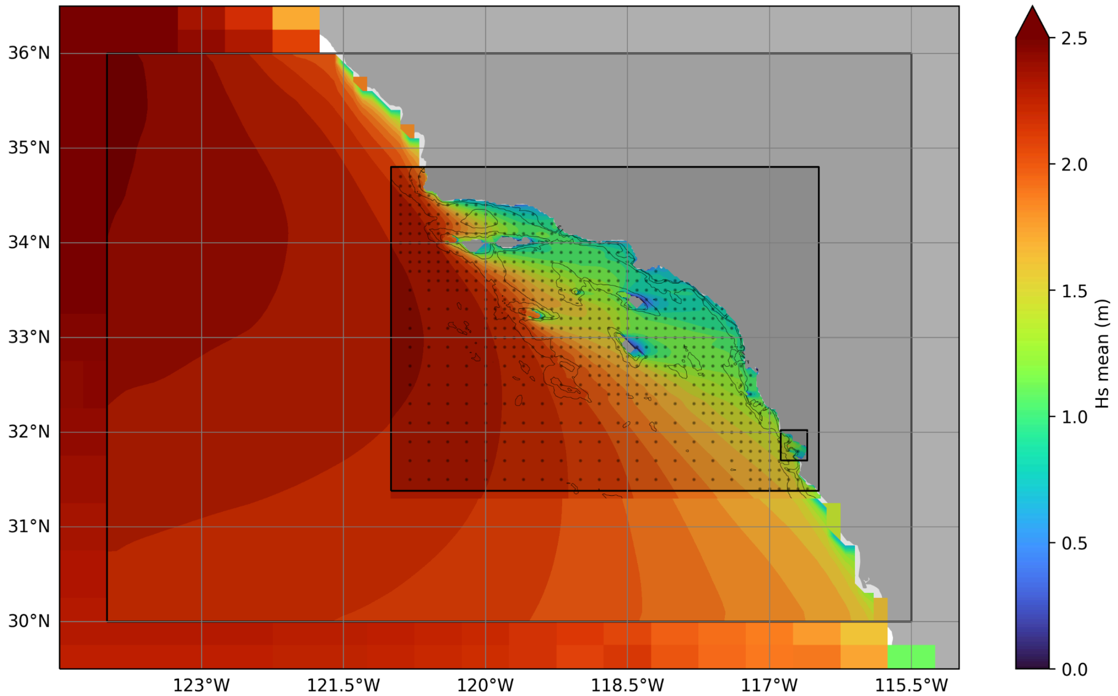


Figure 1. Mean significant wave height from the different hindcast domains. Black rectangles show the extents of the different SWAN nests: swna 10km, cali 2km, ense 200m. The locations of 2D spectra from the cali nest are shown by the black dots.

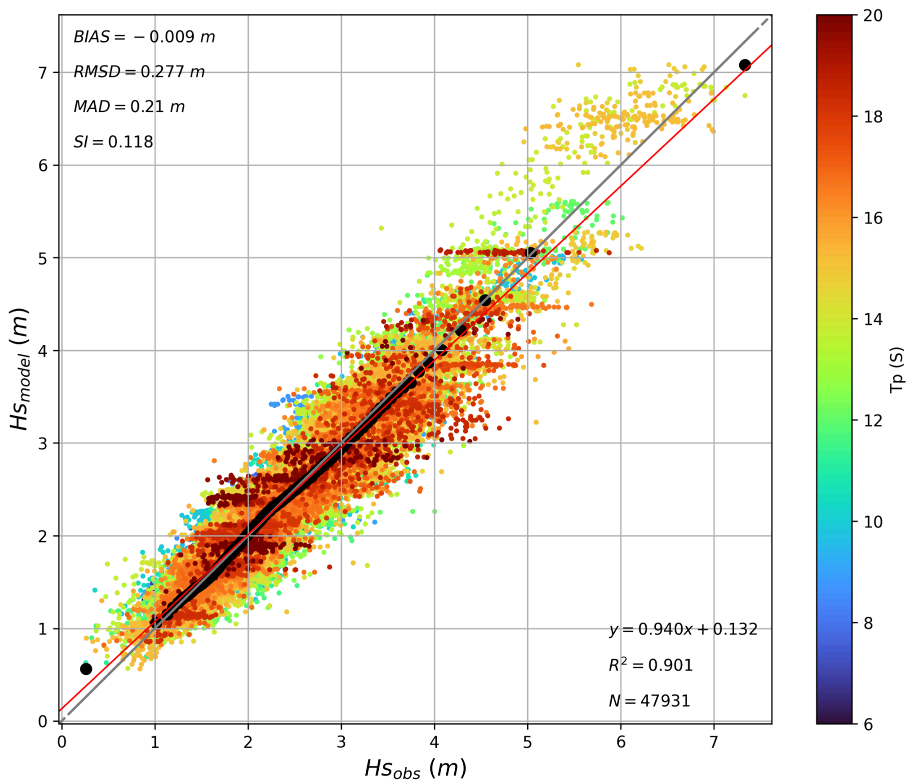


Figure 2. Model significant wave height Hs against satellite altimeters for 2016. Results for the approximate area of the swna 10km domain are presented.

Table 1. Data description.

Title	Oceanum Southwest North America wave hindcast
Institution	Oceanum
Access	Oceanum Datamesh
Source	SWAN 41.31A
Source terms	ST6
Temporal coverage	1979-02-01 to present (updating)
Temporal resolution	Hourly
Spatial coverage	Southwest North America 10km: [-124, 30, -115.5, 36] at 0.1 degree California 2km: [-121, 31.38, -116.5,34.8] at 0.02 degree Ensenada 200m: [-116.88, 31.7, 116.6, 32.02] at 0.002 degree
Spectra output sites	1044
Frequency discretisation	32 frequencies between 0.037 - 0.7102 Hz at 10% logarithmic increments
Direction resolution	10 deg
Bathymetry	GEBCO 2023 Grid and digitalised nautical charts
Winds	ERA5 Reanalysis
Boundary	Oceanum Global WW3 ERA5
Linked Datamesh datasources	Oceanum SW North America 10 km wave parameters Oceanum SW North America 10 km wave spectra Oceanum California 2 km wave parameters Oceanum California 2 km wave spectra Oceanum Ensenada 200 m wave parameters Oceanum Ensenada 200 m wave spectra

Validation against NDBC buoys

The wave hindcast was validated against historical wave spectra from selected NDBC buoys over 2016 (Figure 3).

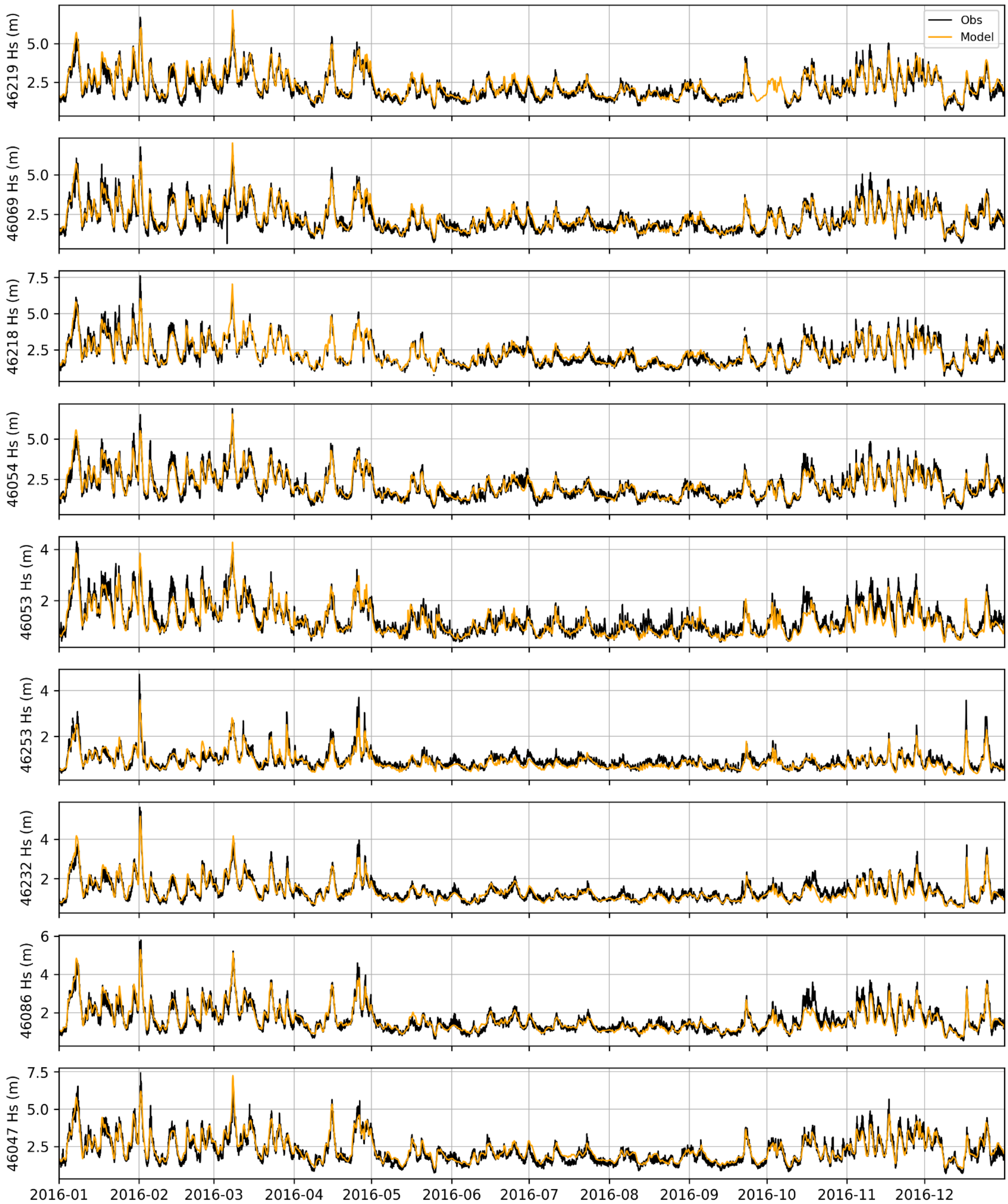


Figure 3. Time series of modelled and observed significant wave height for selected NDBC buoys.

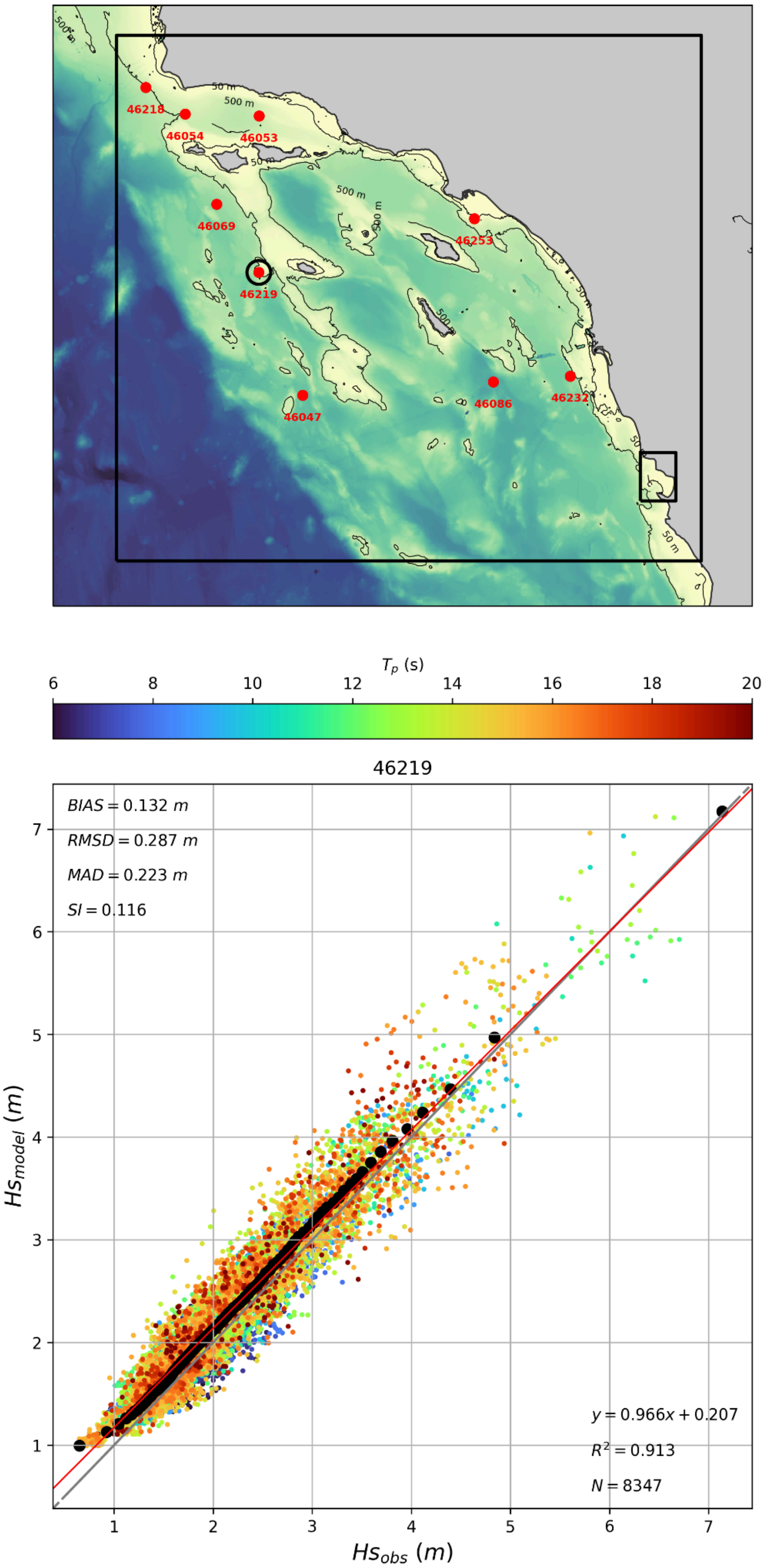


Figure 4. Validation against NDBC 46219: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

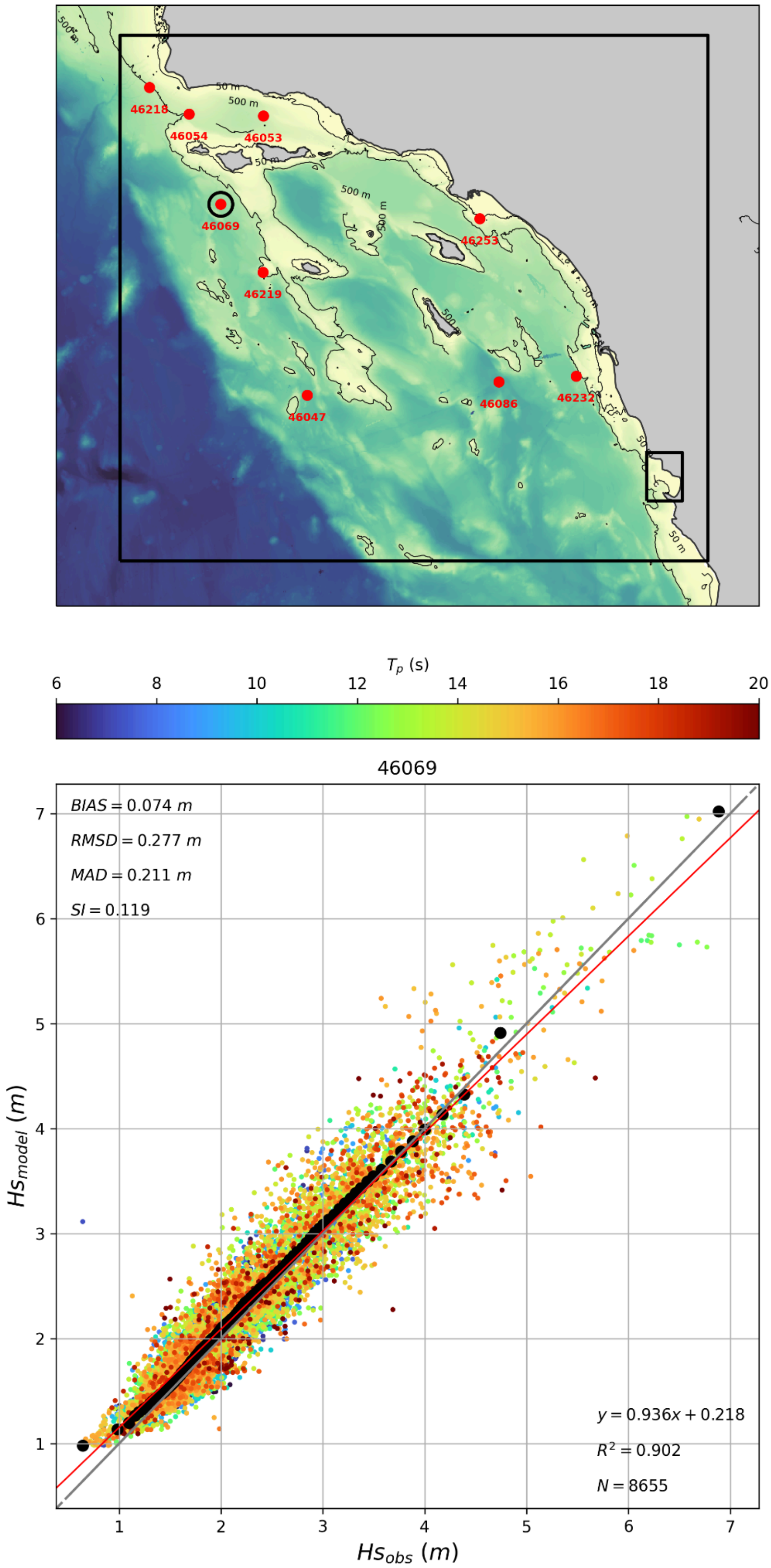


Figure 5. Validation against NDBC 46069: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

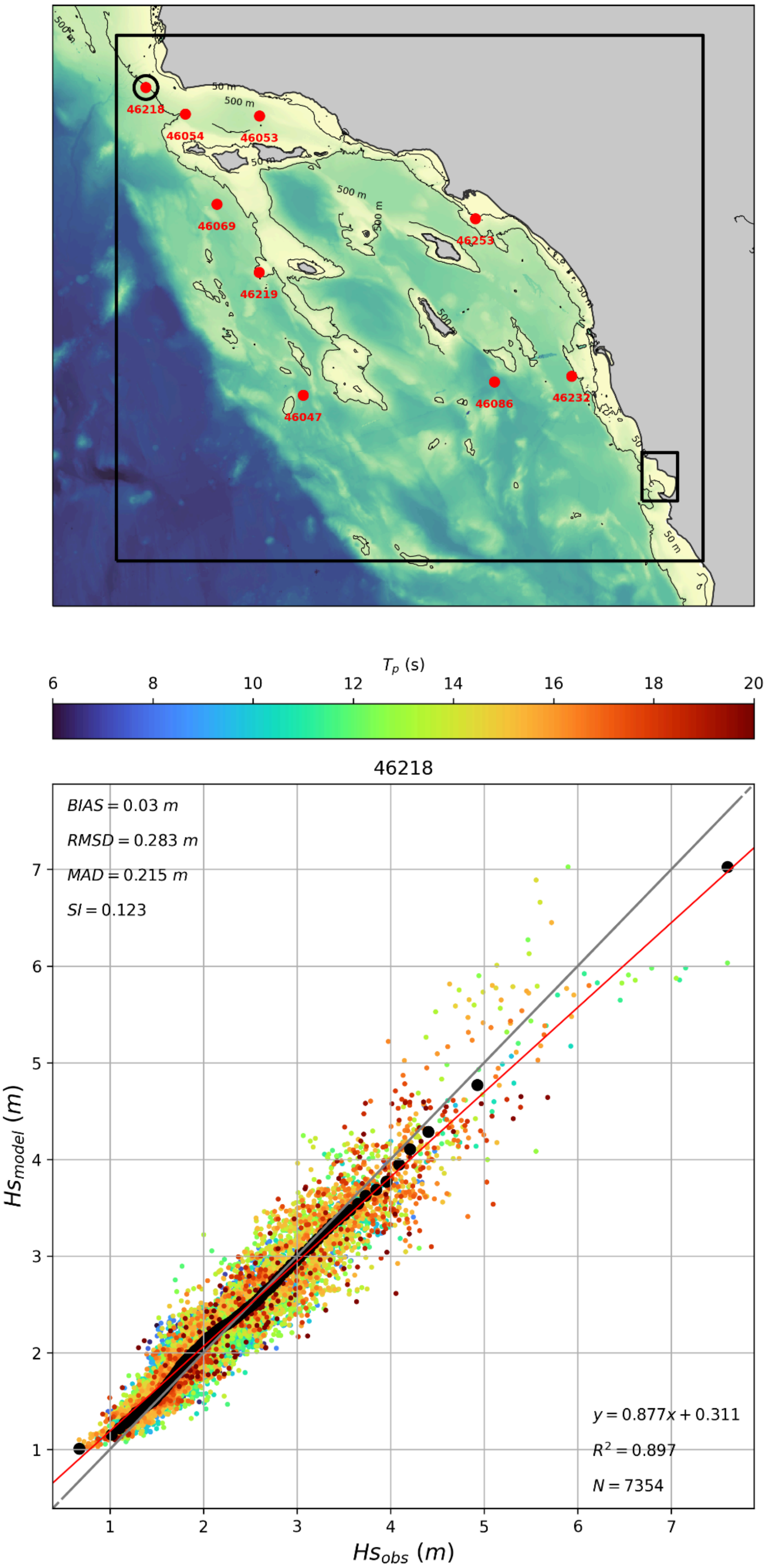


Figure 6. Validation against NDBC 46218: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

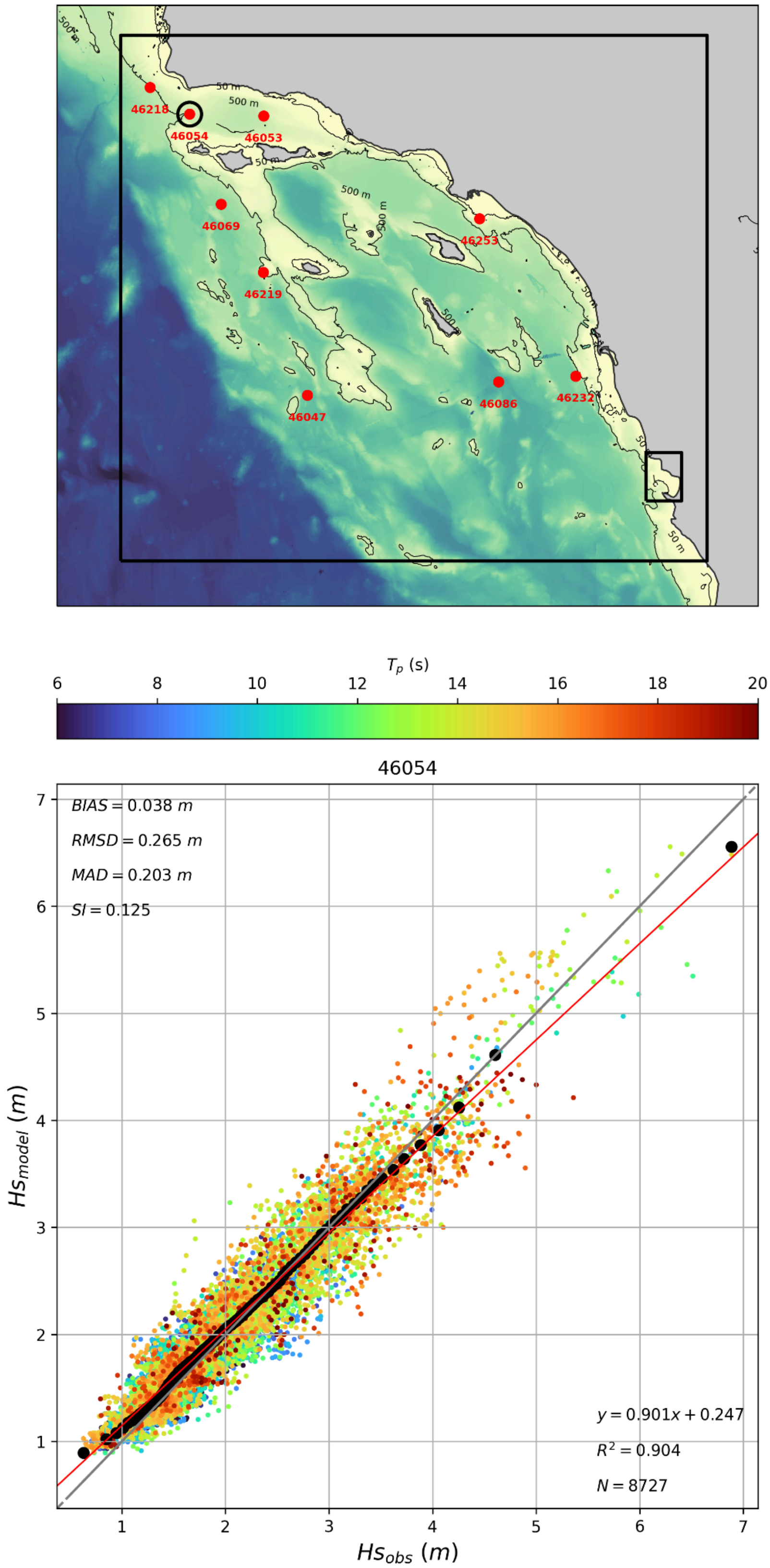


Figure 7. Validation against NDBC 46054: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

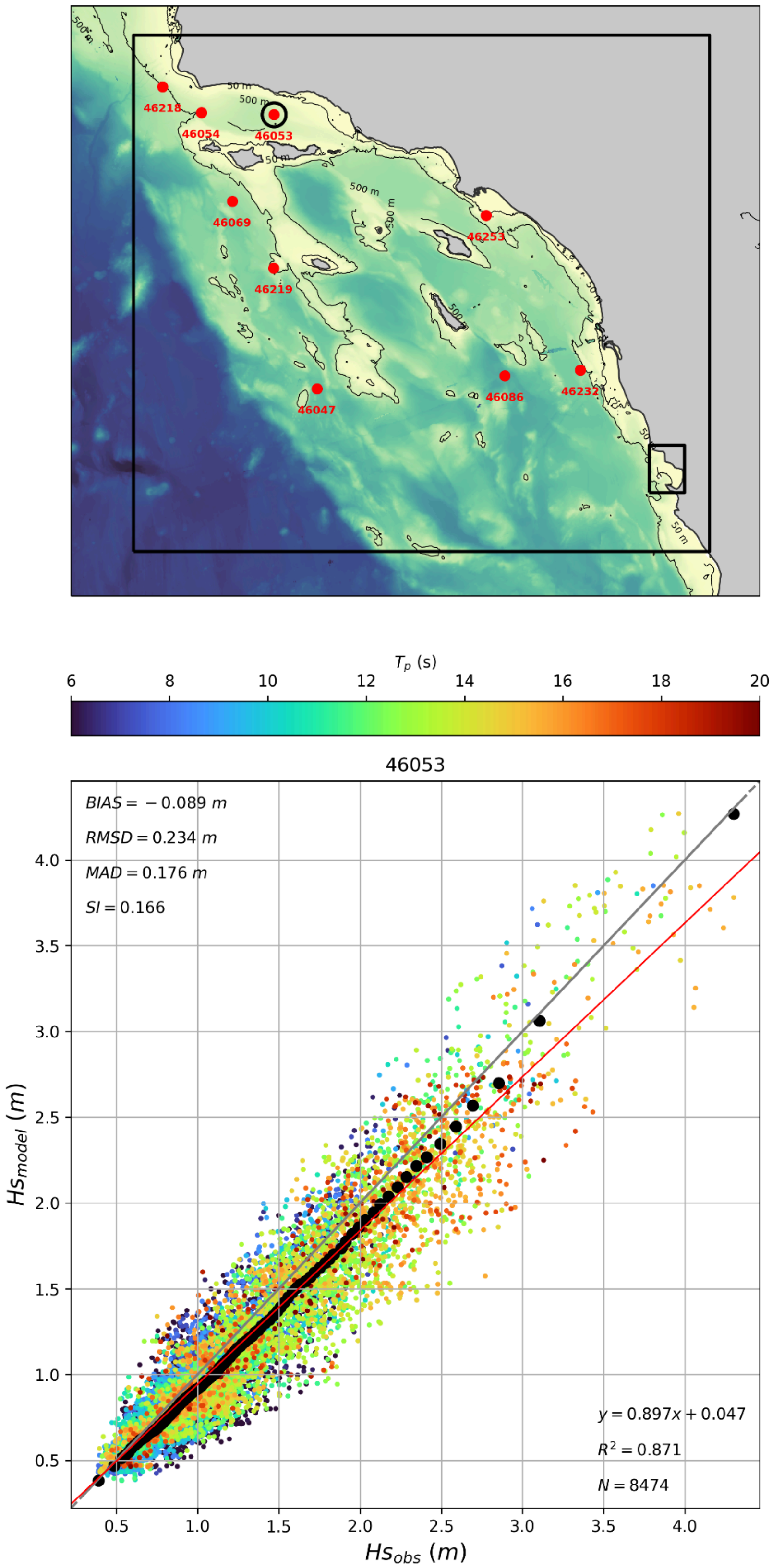


Figure 8. Validation against NDBC 46053: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

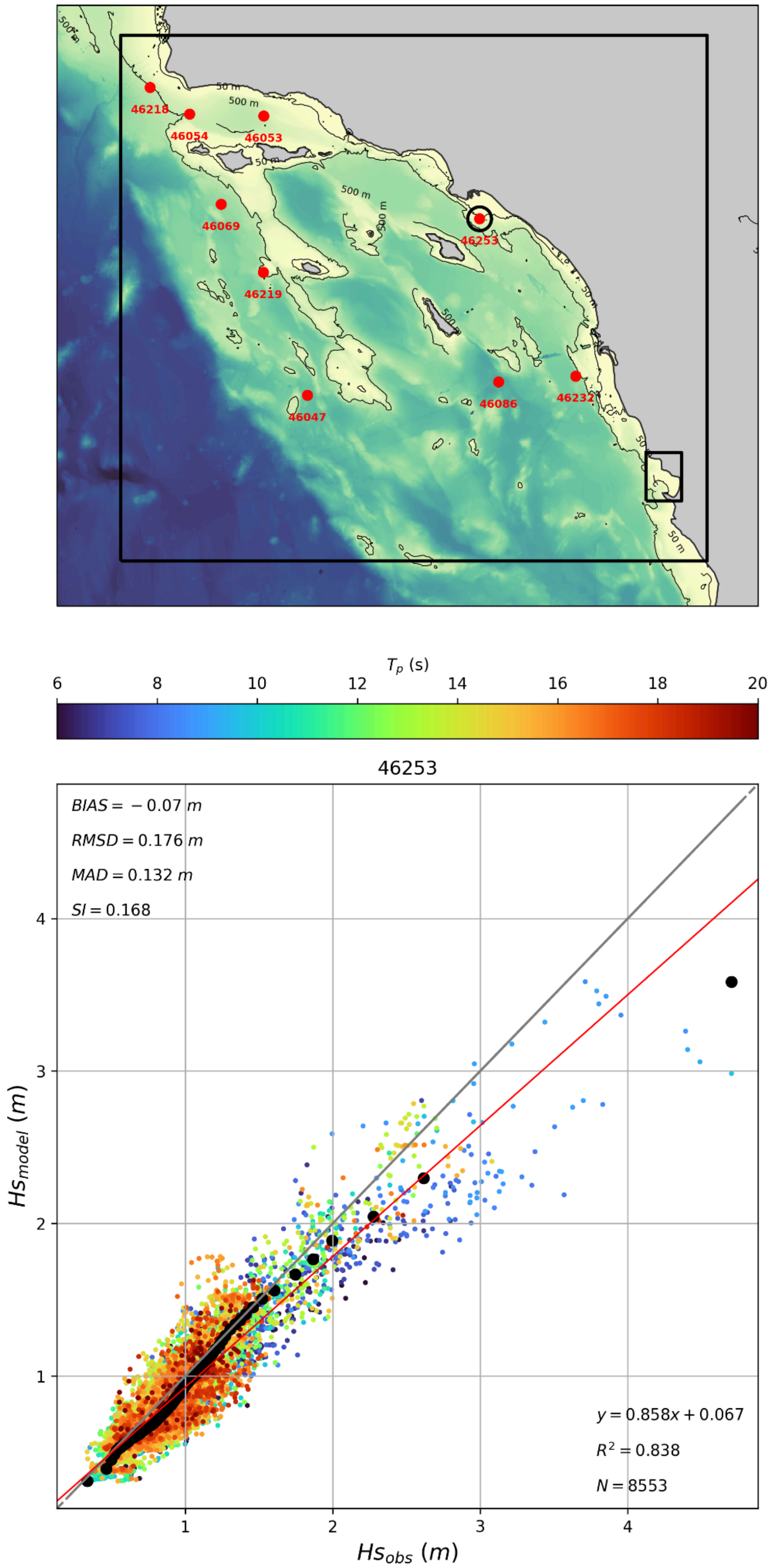


Figure 9. Validation against NDBC 46253: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

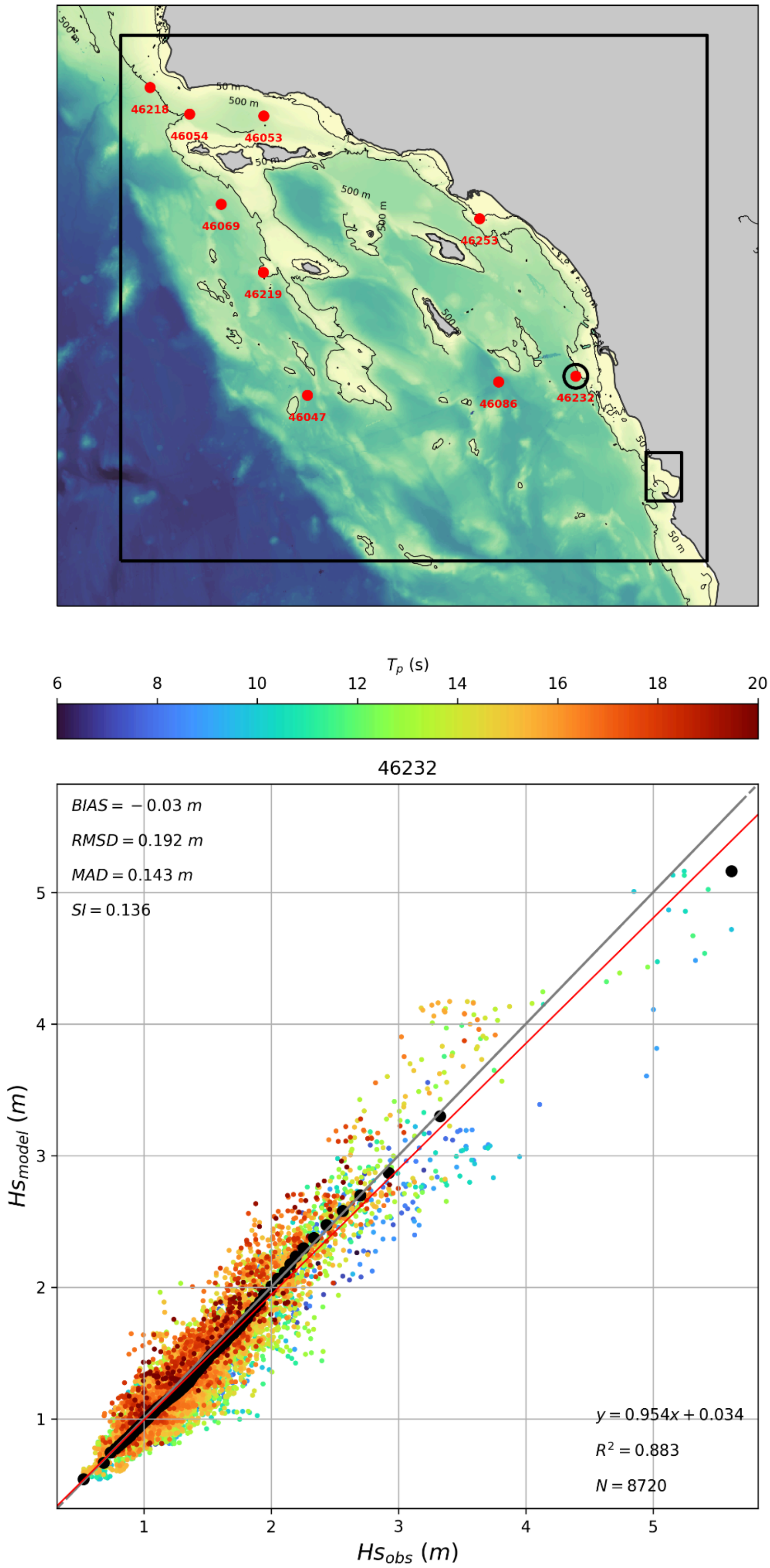


Figure 10. Validation against NDBC 46232: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

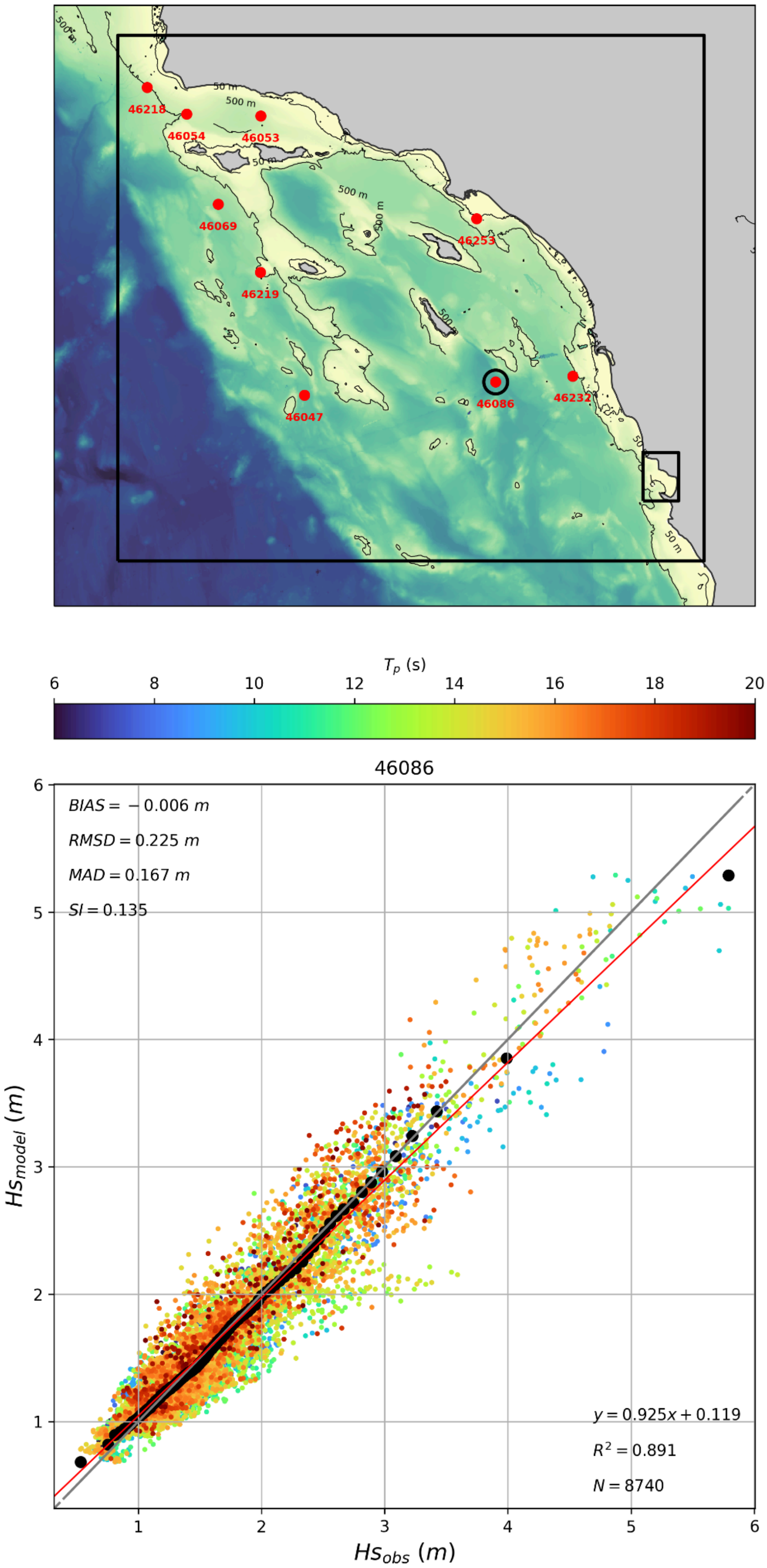


Figure 11. Validation against NDBC 46086: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

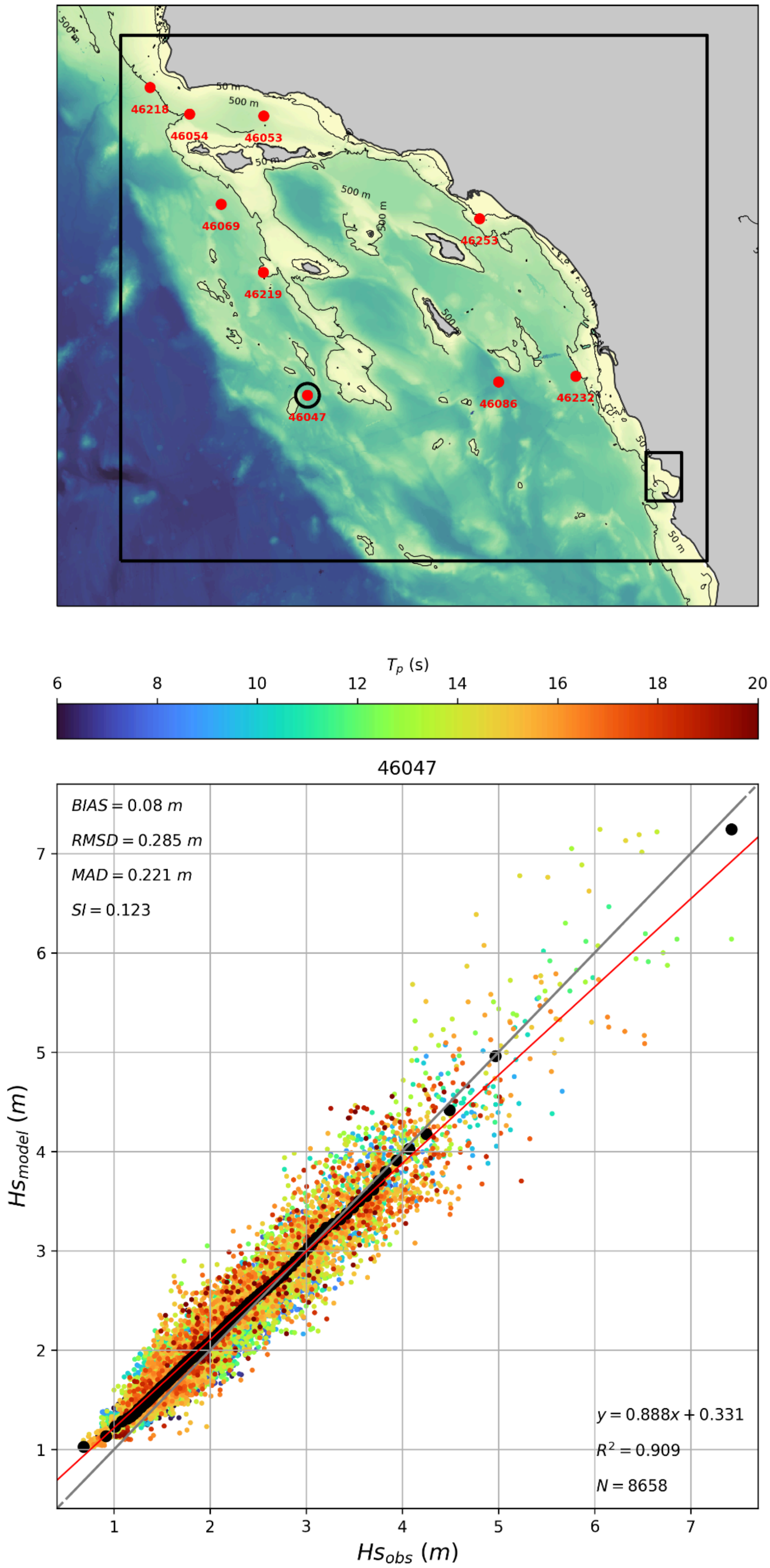


Figure 12. Validation against NDBC 46047: (top) bathymetry with black circle highlighting the buoy location, and (bottom) modelled vs. observed Hs where colours indicate the peak wave period, black circles show 0.01 quantiles and red line represents linear regression.

Integrated parameters gridded output

Integrated wave parameters are stored hourly over all domains at the native model resolution. Table 2 describes long names and units of all gridded output parameters.

Table 2. Gridded output parameters.

Variable	Long Name	Units
depth	depth below sea surface	m
dpm	mean direction at the spectral peak of wind and swell waves'	degree
dpmsea	mean direction at the spectral peak of wind waves below 8 seconds period	degree
dpmswe	mean direction at the spectral peak of swell waves above 8 seconds period	degree
dspr	directional spreading of wind and swell waves	degree
fspr	normalised width of the frequency spectrum of wind and swell waves	-
hs	significant height of wind and swell waves	m
hsea	significant height of wind waves under 8 seconds period	m
hswe	significant height of swell waves above 8 seconds period	m
pdir0	directional spreading of wind waves	degree
pdir1	directional spreading of primary swell waves	degree
pdir2	directional spreading of secondary swell waves	degree
pdir3	directional spreading of tertiary swell waves	degree
pdspr0	directional spreading of wind waves	degree
pdspr1	directional spreading of primary swell waves	degree
pdspr2	directional spreading of secondary swell waves	degree
pdspr3	directional spreading of tertiary swell waves	degree
phs0	sea surface wind wave significant height	m
phs1	sea surface primary swell wave significant height	m
phs2	sea surface secondary swell wave significant height	m
phs3	sea surface tertiary swell wave significant height	m
ptp0	sea surface wind wave period at variance spectral density maximum	s
ptp1	sea surface primary swell wave period at variance spectral density maximum	s
ptp2	sea surface secondary swell wave period at variance spectral density maximum	s
ptp3	sea surface tertiary swell wave period at variance spectral density maximum	s
pwlen0	mean wavelength of wind waves	m
pwlen1	mean wavelength of primary swell waves	m
pwlen2	mean wavelength of secondary swell waves	m

pwlen3	mean wavelength of tertiary swell waves	m
tm01	mean absolute wave period of wind and swell waves from the first frequency moment	s
tm02	mean absolute wave period of wind and swell waves from the second frequency moment	s
tps	smooth relative peak wave period of wind and swell waves	s
tpssea	smooth relative peak wave period of wind waves below 8 seconds period	s
tpsswe	smooth relative peak wave period of swell waves above 8 seconds period	s
xwnd	eastward component of wind velocity	m/s
ywnd	northward component of wind velocity	m/s