

Forward modelling, from waves and currents to SKIM-simulated currents

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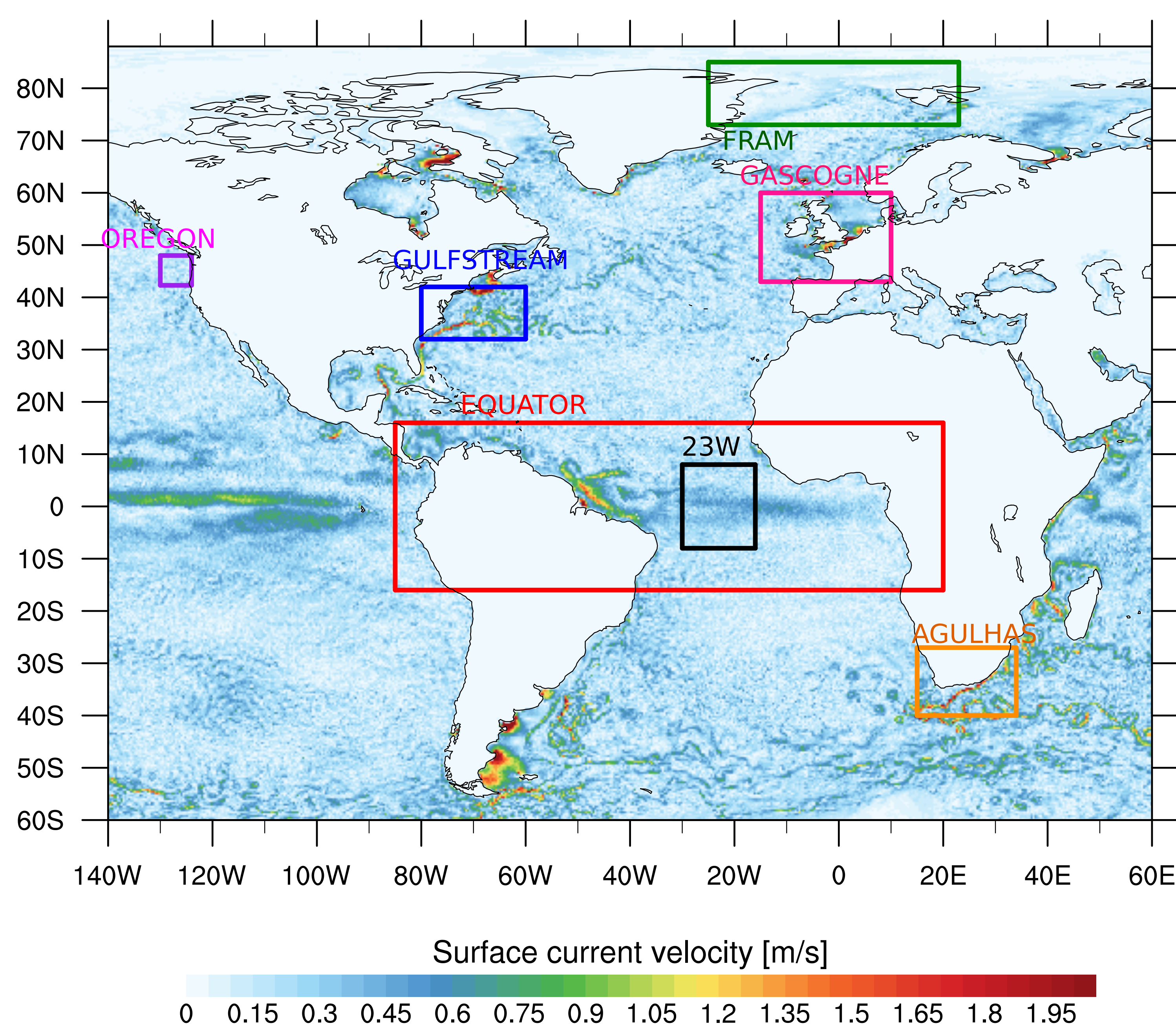


High resolution waves and currents simulations

SKIM is a satellite mission proposal running for the ESA Earth Explorer 9 program. If chosen, SKIM will provide direct measurements of surface currents and ocean wave spectra at a global scale from its launch in 2025.

The SKIM end to end simulator aims at simulating the level 3 data that SKIM would provide. In order to conduct a realistic estimation, the SKIMulator needs to be fed by high resolution waves and currents measurements.

MITgcm simulated currents provided by D. Menemenlis, JPL



WAVEWATCH^(R) III ocean waves simulations run from high resolution geophysical fields :

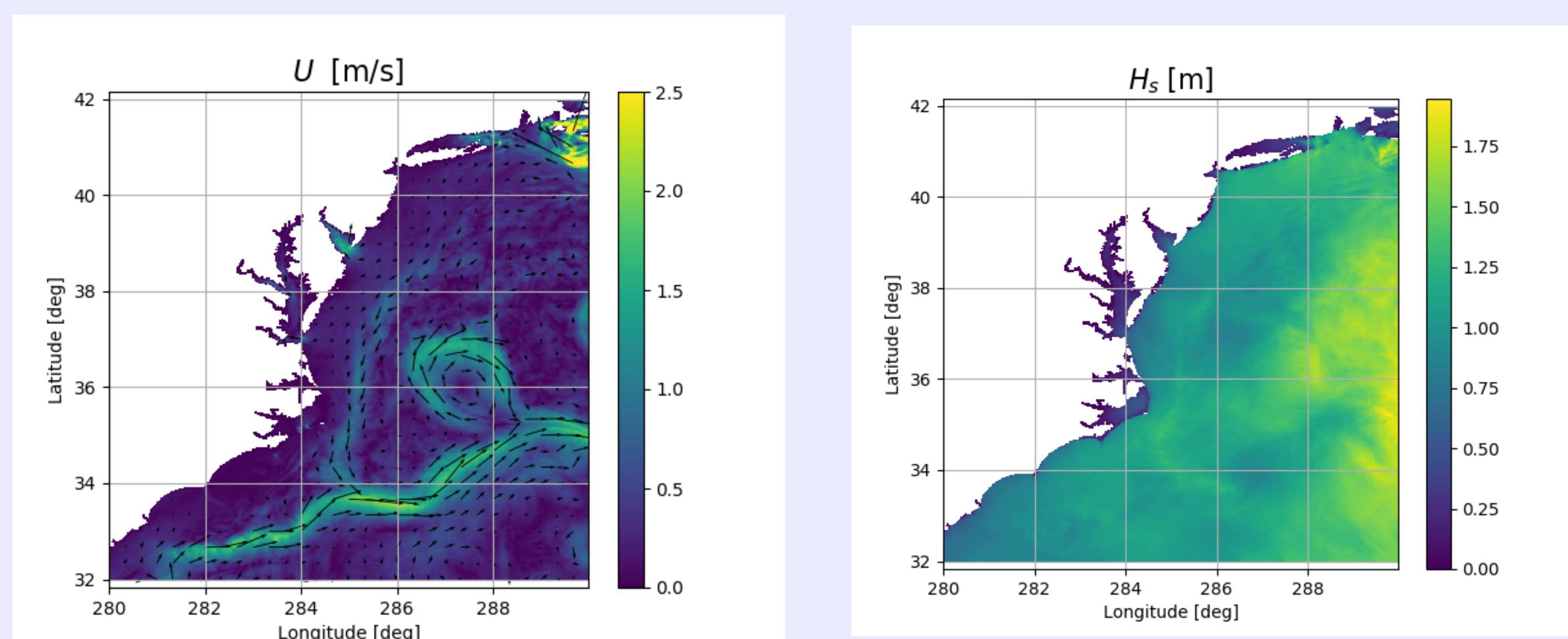
- 6 regional grids
- MITgcm llc_4320 surface currents (1/48° resolution at equator)
- ECMWF reanalysis surface winds and ice fields
- 1 year time range (2011.11.15 to 2012.11.15)
- hourly outputs
- high spatial resolution
- full wave spectra outputs at SKIM footprint resolution (6 km)
- high resolution maps of various integrated parameters : Hs, directional surface roughness, Stokes drift, etc ... relevant to SKIMulator.

Grid	Spatial resolution	Extent
GULF STREAM	1'	80W→60W 32N→42N
AGULHAS	2'	15°E→34°E 40°S→27°S
FRAM	6' (lon) 1' (lat)	25°W→23°E 73°N→85°N
EQUATOR	4.5'	85°W→20°E 16°S→16°N
23W	1.5'	30°W→16°W 8°S→8°N
OREGON	0.6' (lon) 1.2' (lat)	130°W→124°W 42°N→48°N
GASCOGNE	1'	15°W → 10°E 43°N → 60°N

Space-time variability of currents and waves

The effective resolution of waves and currents measurements depends on their space-time variability. Currents can exhibit very fast spatial variations, while ocean waves vary at larger scales.

However, the small scale variability, although weak, is largely influenced by the currents spatial gradients (Ardhuin et al. JGR, 2018). This is why high resolution coupled currents and waves simulations are required.



Wave bias parametrization

SKIM surface current retrieval is based on a Doppler frequency shift measurements, induced by the velocity of the sea surface. surface current signal is "polluted" by a wave bias signal, which is a complicated function of the wave spectrum.

$$U_{Doppler} = U_{wave\ bias} + U_{true\ current}$$

From our wave spectrum data base, we are able to construct a parametrization of the wave bias as a function of the wave spectrum.

