Processing, Quality Control and Presentation of Wave's Spectral Data

- L.R. Centurioni

IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
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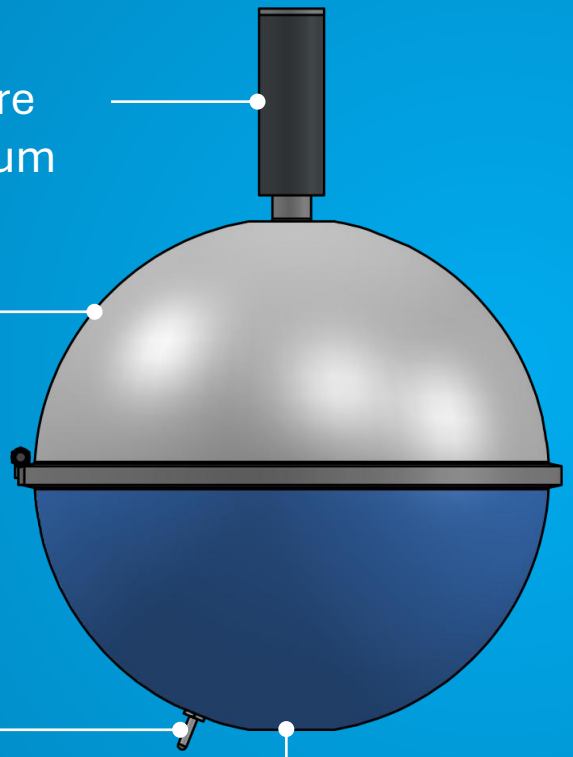
The Wave Drifter: a little refresher

LDL's Directional Wave Spectra Barometer Drifter (DWSBD)



Sea level barometric pressure port (±0.55 hPa total maximum error)

35 cm sphere surface float

Sea surface temperature sensor (±0.05 K accuracy)

Eyebolt for nearshore mooring

HIGHLIGHTS

- GPS-based tracking and wave engine
- Iridium Short Burst Data (SBD) telemetry
- Onboard datalogger with up to 16 GB of storage
- Fourier coefficients a0, a1, b1, a2, b2
- 1/256 Hz bandwidth from 0.03–0.50 Hz
- User-programmable sampling window
- Freely drifting or restrained mooring configurations
- One-year lifespan

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Reconstructing the Directional Spectra

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These five coefficients obtained from the FFT algorithm can be combined into a truncated Directional wave spectra in which the a_0 term provides the total wave energy and the other four terms provide the directional information. An example of a model for F from Longuet-Higgins (1962) is

$$F_1(\sigma, \phi) = \tfrac{1}{2}a_0 + (a_1 \cos\phi + b_1 \sin\phi) + (a_2 \cos 2\phi + b_2 \sin 2\phi),$$

Other more advanced methods (e.g. Maximum Entropy Method) to estimate *F* exist:

Further readings:

Longuet-Higgins, M. S. (1962), The Directional Spectrum of Ocean Waves, and Processes of Wave Generation, *Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences*, *265*(1322), 286-315.

BENOIT, M. (1997), Analysing multidirectional wave spectra: A tentative classification of available methods, paper presented at Proc. IAHR Seminar on Multidirectional Waves and Their Interaction with Structures, 27th IAHR Congress, National Res. Council of Canada.

Herbers, T. H. C., P. F. Jessen, T. T. Janssen, D. B. Colbert, and J. H. MacMahan (2012), Observing Ocean Surface Waves with GPS-Tracked Buoys, *J Atmos Ocean Tech*, *29*(7), 944-959, doi:10.1175/JTECH-D-11-00128.1.

Centurioni, L., L. Braasch, E. Di Lauro, P. Contestabile, F. De Leo, R. Casotti, L. Franco, and D. Vicinanza (2017), A new strategic wave measurement station off Naples port

Integral Wave Parameters from the DWS™ drifter

Zero Moment: $m_0 = \pi \Delta f \sum_{i=1}^{n} a_{0,i}$

First Moment: $m_1 = \pi \Delta f \sum_{i=1}^{n} f_i \cdot a_{0,i}$

Second Moment: $m_2 = \pi \Delta f \sum_{i=1}^{n} f_i^2 \cdot a_{0,i}$

- Significant Wave Height (**3 waves of amplitude 2*Hmo can be expected every hour**)

$$H_{mo} = 4\sqrt{m_0}$$

- Average Period

$$T_{av} = \frac{m_0}{m_1}$$

- Peak Period (estimated at max a_0)

$$T_p = \frac{1}{f_{peak}}$$

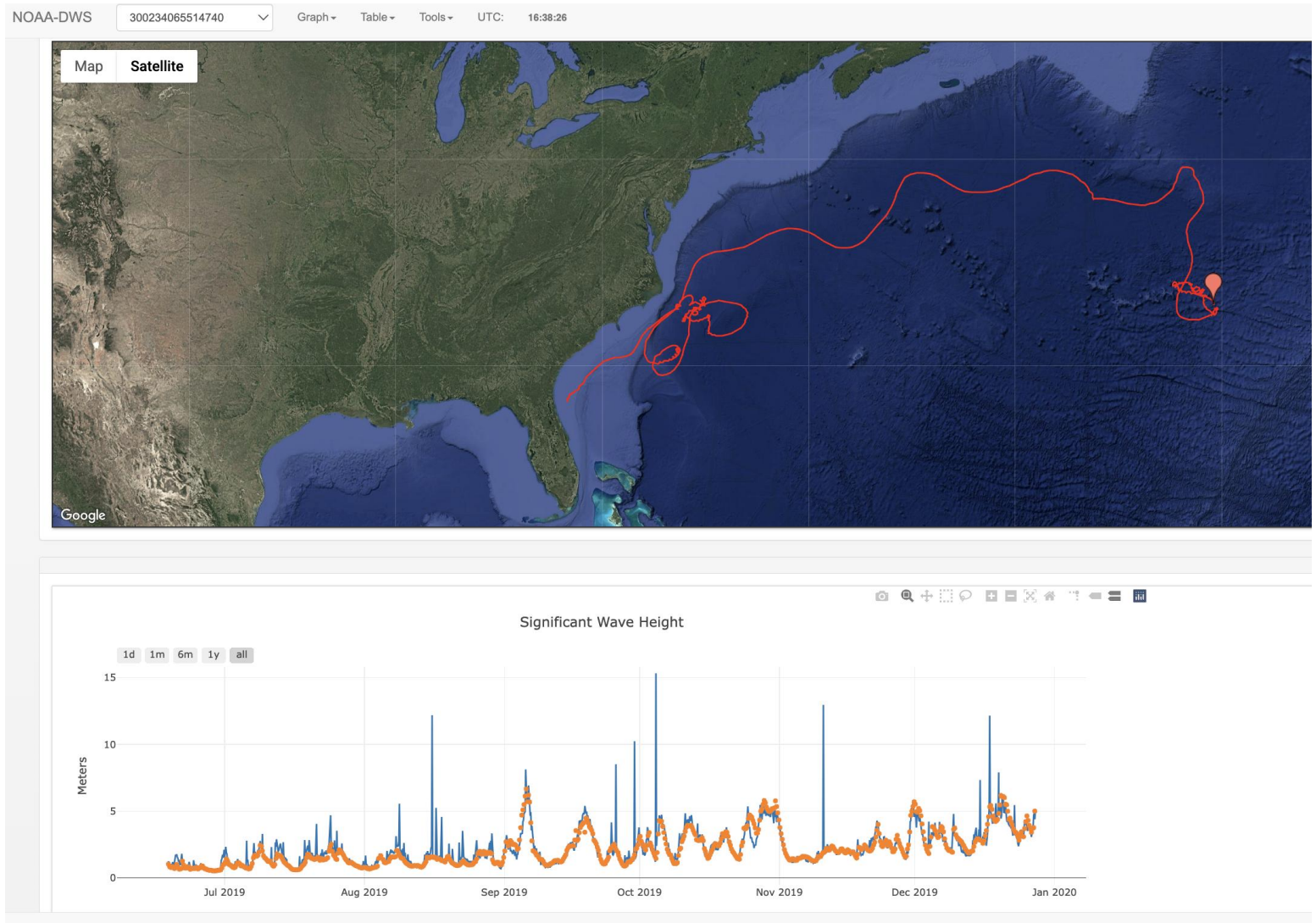
Mean wave direction

$$\theta_1 = \arctan\left(\frac{b_1}{a_1}\right)$$

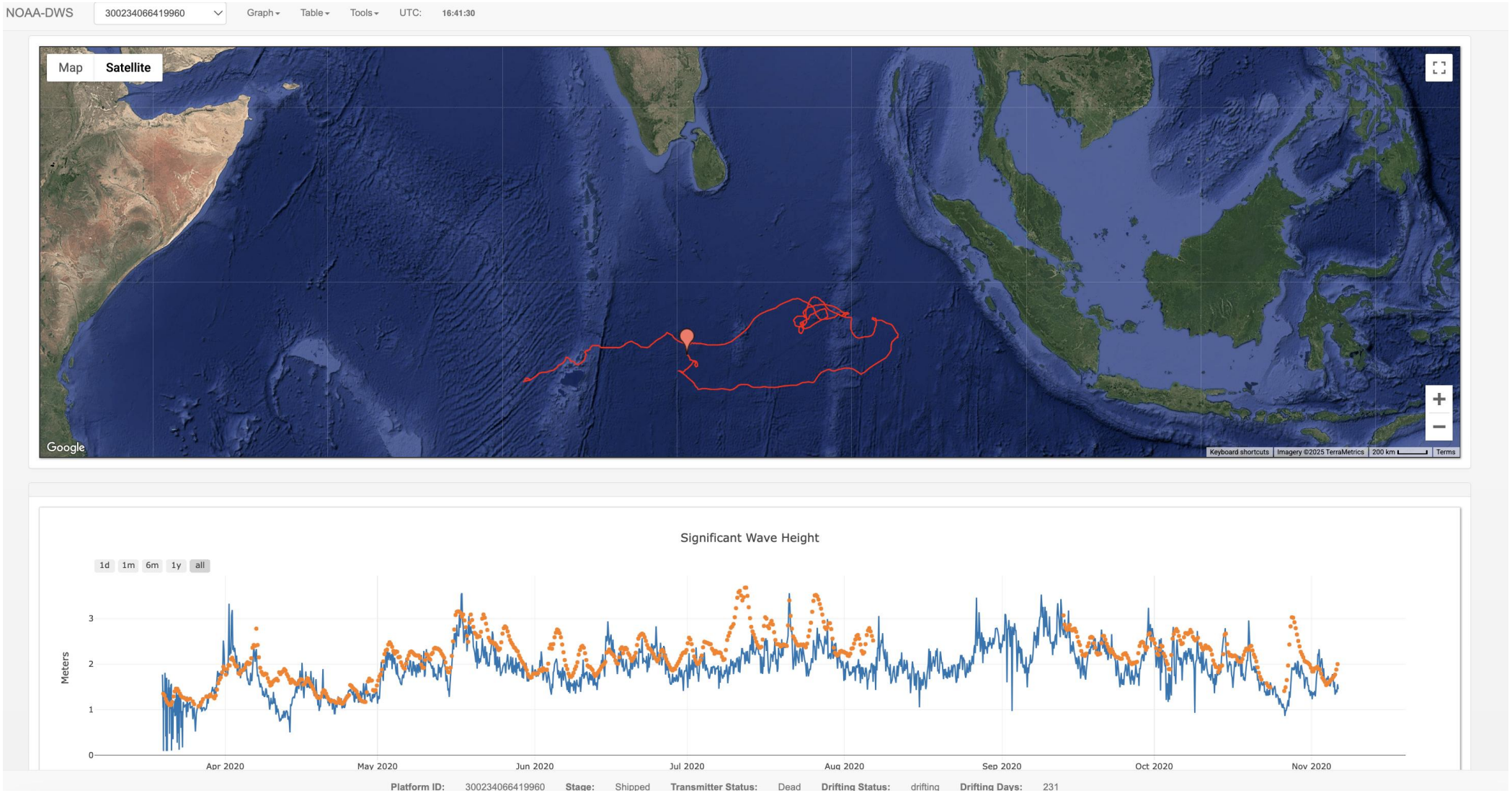
Principal wave direction

$$\theta_2 = \frac{1}{2}\arctan\left(\frac{b_2}{a_2}\right)$$

Quality Control of wave’s spectral data is not an easy task because waves conditions can evolve quickly. Our QC procedure of spectral wave data os L2, and, for the most part, we let the user decide which data should be be discarded. Curated datasets, however, also exist



Blue: DWS
Orange: WW3 model



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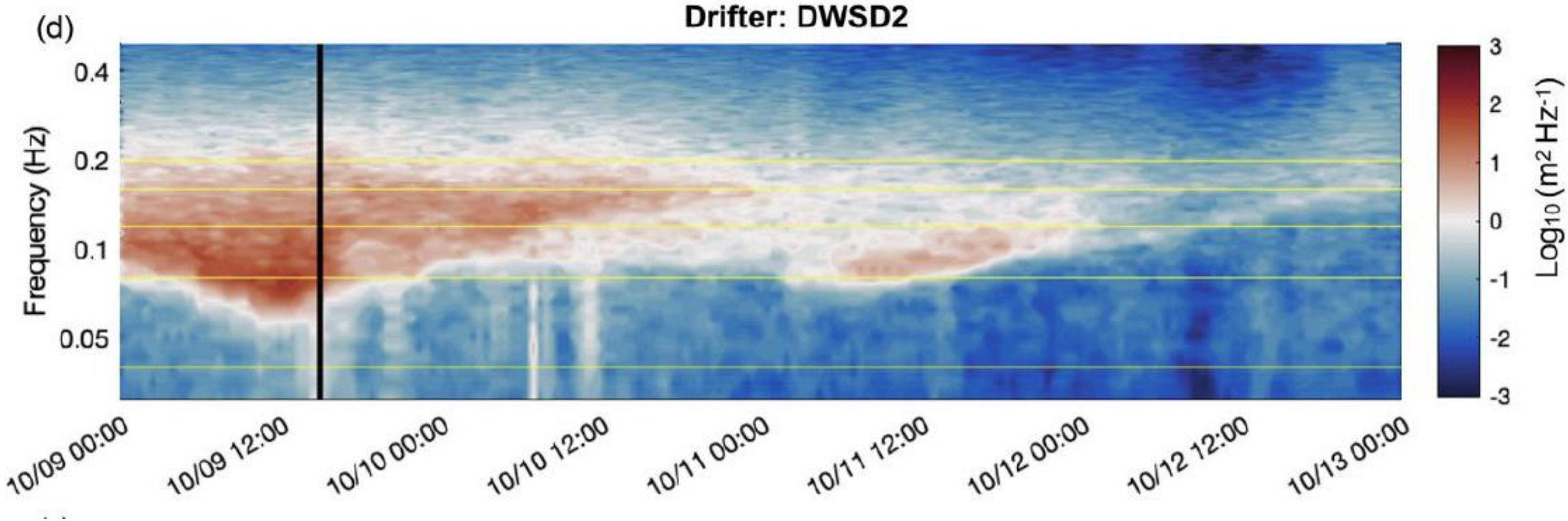
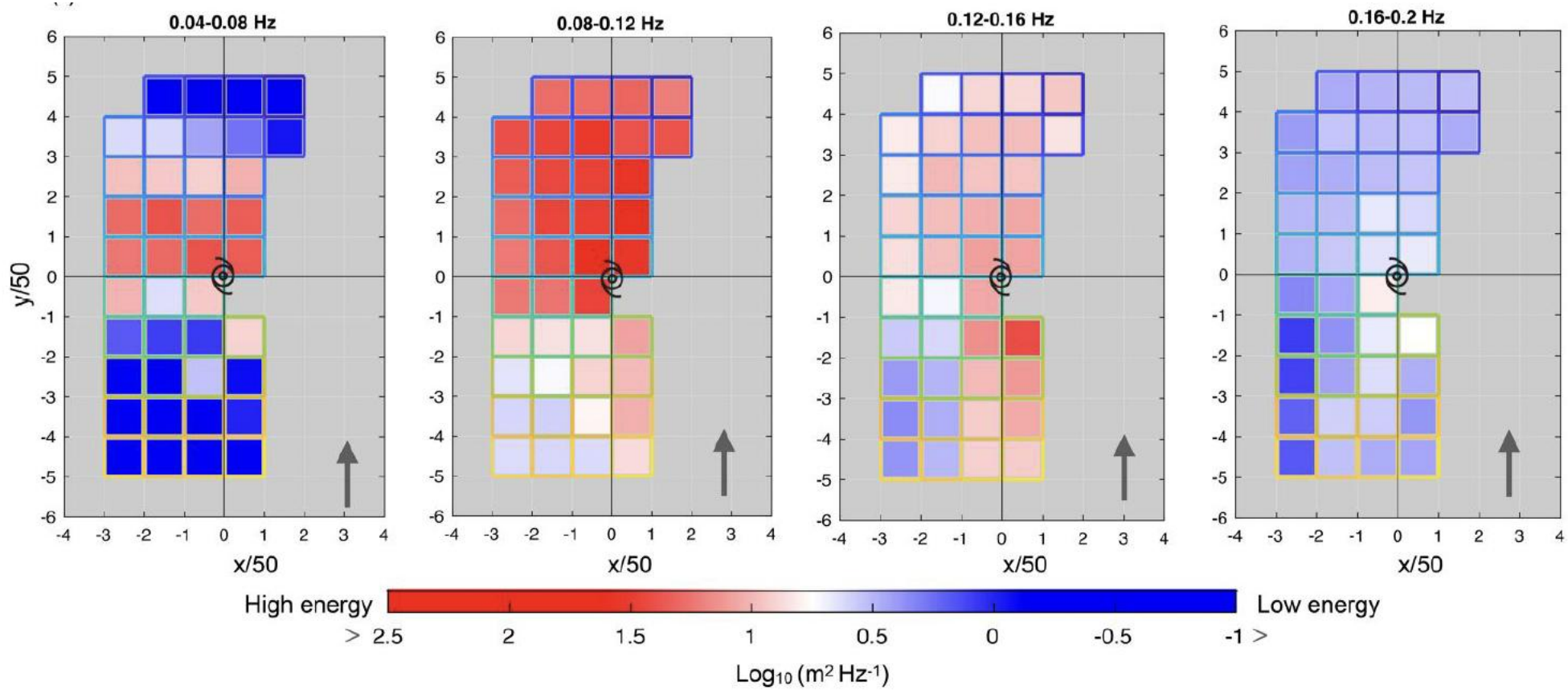

(d)
Drifter: DWSD2
Frequency (Hz)
0.4
0.2
0.1
0.05
10/09 00:00
10/09 12:00
10/10 00:00
10/10 12:00
10/11 00:00
10/11 12:00
10/12 00:00
10/12 12:00
10/13 00:00
3
2
1
0
-1
-2
-3
Log10 (m2 Hz-1)


0.04-0.08 Hz
0.08-0.12 Hz
0.12-0.16 Hz
0.16-0.2 Hz
y/50
x/50
High energy
Low energy
> 2.5
2
1.5
1
0.5
0
-0.5
-1 >
Log10 (m2 Hz-1)

THANKS!

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