

The background of the entire image is a photograph of a beach. In the foreground, there is a sandy beach with gentle waves washing onto it, creating white foam. The water is a vibrant blue. In the middle ground, a line of sailboats with tall masts is visible on the horizon. The sky is blue with some white clouds. The text is overlaid on the upper portion of the image.

**//Norderelbe GmbH**

**OCEANORDE4**





# OCEANOGRAPHIC APPLICATIONS OF COASTAL RADAR

HF radar technology offers a unique insight to coastal ocean variability by providing high resolution data at the interface between ocean and atmosphere. HFR data are a powerful tool for understanding the coupled ocean-atmosphere system and the different coastal circulation processes like ocean waves, mixing and heat fluxes, wind induced currents and inertial oscillations.

Moreover, since HFR data provide measurements of currents with a relatively wide spatial coverage and high spatio-temporal resolution in near real time, they have become invaluable tools in the field of operational oceanography. HFR systems are now an integrating technology of many coastal observatories with proved potential for monitoring and even providing short-term prediction of coastal currents and inputs for the validation and calibration of numerical ocean forecasting models, especially near the coast.

## Oceanorde 4

The shore-based Oceanorde 4 provides reliable data of ocean surface currents and significant wave height and direction over long distances (100-300 km) with outstanding spatial and temporal resolution for SAR and environmental protection images. This robust shore-based system delivers reliable data even under extreme weather and very dynamic ocean current conditions.

The surface current image depicted in figure 1 was taken by Oceanorde 4 which models the current velocity and sea surface salinity.

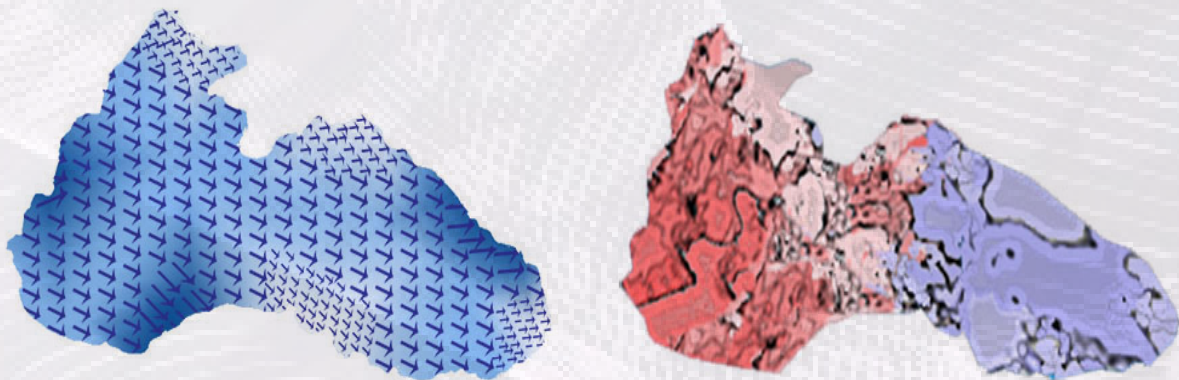


Figure1: Instantaneous image, current velocity (left) and sea surface salinity (right)

### Applications:

- \* Characterization of the ocean surface circulation, wind direction and height of waves
- \* Current and object tracking
- \* Trajectory modelling
- \* Determination of water quality coefficients (salinity, ...)
- \* Wave energy resource characterization

### Main Features:

- \* Advanced signal processing provides the best signal to noise ratio.
- \* Due to the use of array receiver, Oceanorde 4 has a high angular resolution.
- \* The Oceanorde 4 system core can operate over a broad frequency range from 10 to 26 MHz to provide longest ranges of more than 200 km or highest resolution for short ranges.

### Hardware:

#### 1. Antenna (Tx & Rx)

The transmitter antenna is a quasi-LPMA. The transmitter antenna needs to be isolated from the receiver antenna. This is achieved by a physical separation of at least 100 metres.

The receiver array is made up of 12 (or 16) aerials in a line. The receiver array using beam-former (linear) construction has a field of view  $\pm 50^\circ$  (or  $\pm 60^\circ$ ) around the cross-shore axis.



Figure 2: Transmitter (left) and receiver array (right) of the Oceanorde 4

## 2. Control unit

In general, the control unit coordinates the transmitter, receiver and signal processing units. The main tasks of this unit:

- \* Generate the transmitted pulses
- \* Command to start the system
- \* Control the digital boards
- \* Collect data from the receiver
- \* Send the received data to the signal processing unit

## 3. Signal processing unit

Here are some of the main specifications of this unit:

- \* Taking advantage of fast FPGA-based processor
- \* Optimized matched filter and doppler processing
- \* Accurate beamforming and parameter calculations
- \* Built-in test and calibration setup

## 4. Display

The output of the control unit after signal processing will be delivered to the monitor and the following items will be displayed:

- \* Ocean surface current
- \* Wind direction
- \* Wind speed
- \* Sea water salinity
- \* Height of the ocean waves

**Table 1: Specification of Oceanorde 4**

Parameter	Plan I		Plan II	
Frequency (MHz)	10-14		22-26	
Wavelength (m)	21-30		11-13	
Maximum Range (km)	200		100	
Bandwidth (kHz)	100		200	
Range resolution (m)	1500		750	
Blind range (km)	5		2	
Pulse width (μs)	200		100	
PRI (ms)	1.1		0.6	
PRF (Hz)	909		1666	
Frequency resolution (Hz)	0.005		0.005	
Scan time (min)	8		8	
Current accuracy(cm/s)	7.5		3.25	
Number of transmitter antenna	1		1	
Transmitter antenna height (m)	6		3	
Receiver antenna height (m)	4.5		2	
polarization	Vertical		Vertical	
Peak power (Watt)	100		100	
Number of receiver antenna	12	16	12	16
Array length (m)	137	187	69	94
Azimuth beamwidth (degree)	8.5	6	8.5	6
Angular field of view (degree)	100	120	100	120
Angular Accuracy (degree)	0.37	0.25	0.37	0.25

NORDER



Norderelbe GmbH  
Überseeallee 1, 20457, Hamburg, Germany

Tel/Fax: +49 40210912719

E-Mail: [info@norderelbe-gmbh.de](mailto:info@norderelbe-gmbh.de)  
Web: [www.norderelbe-gmbh.de](http://www.norderelbe-gmbh.de)