

## WaMoS<sup>®</sup> II: an automatic wave monitoring system based on marine X-Band radar technology to observe the sea state

---

The **Wave** and Surface Current **Monitoring System** **WaMoS<sup>®</sup> II**, based on commercial available nautical X-Band radar, was developed for real time measurements of directional ocean wave spectra. The system permits the objective measurements of the sea state. It is especially designed for operation from fixed and moving platforms in deep water, and on board all types of ocean going vessels as well as at coastal sites.

The sea state measurements are based on the backscatter of microwaves from the rough ocean surface that is visible as 'sea clutter' in all X-Band radar images. The spatial and temporal evolution of the sea clutter is analysed to derive the directional wave spectrum and the surface currents in real time. Sea state parameters such as significant wave heights, wave periods, wave lengths, wave directions and the surface currents are estimated by a straight forward analysis. The overall advantage of **WaMoS<sup>®</sup> II** is the continuous availability of wave data even in very rough seas, under harsh weather conditions and during night. The **WaMoS<sup>®</sup> II** wave information is displayed on site and also can be transferred to any PC via internet.

The operating range of **WaMoS<sup>®</sup> II** varies from 0.1 km up to 4.0 km depending on X-Band radar type and installation geometry. An average value for the spatial resolution is 7 m in range and 1° in angle. The update rate of the results is two minutes.

**WaMoS<sup>®</sup> II** needs a minimum wind speed of 3 m/s to be able to measure waves and currents. Then the system easily detects wave lengths from 15 m – 600 m and covers periods from 4 sec-20 sec. At coastal sites, **WaMoS<sup>®</sup> II** can only measure the spatial wave field beyond the wave breaking zone. Within the radar images, the area where the breaking occurs can be identified, as the radar return increases.

On board vessels and offshore **WaMoS<sup>®</sup> II** can be used to support save operations especially under extreme environmental conditions. In coastal areas sea state measurements are mainly required to survey port approaches to enhance safe shipping and to better understand the eroding mechanisms along beaches.

Many comparisons between in situ wave data and **WaMoS<sup>®</sup> II** data show the capabilities of navigational radars in providing absolute wave heights, wave periods and directions with a high degree of accuracy. Those data comparisons proved that **WaMoS<sup>®</sup> II** can reach about the same accuracy as a conventional wave rider buoy.

The **WaMoS<sup>®</sup> II** device is under continuous development with the areas of application being further expanded. The systems functionality has been extended by an extra software package: high resolution current and bathymetry measurements (HRC). Additional new features that are currently developed and will be implemented into the operational software are: single wave detection, small target detection, wind detection.

**WaMoS<sup>®</sup> II** was type approved in 2001 by the classification societies Det Norske Veritas (DNV) and Germanischer Lloyd (GL) with respect to the accuracy of the data output and functionality.

**WaMoS<sup>®</sup> II** does not affect the navigation performance of the radar unit from which the data stream is taken, so the radar can be used for both wave measurements and navigational purposes.

**WaMoS® II**: an automatic wave monitoring system based on marine X-Band radar technology to observe the sea state

**WaMoS® II** system requirements and benefits:

WaMoS® II - System Requirements	WaMoS® II - System Benefits
X-Band marine radar	Reliable: Based on standard marine X-Band radar
Minimum: 6 feet antenna	Risk Reduction: All equipment located on the vessel for optimum safety
Minimum: 24 rpm antenna rotation speed	Reduced Weather Downtime: High accuracy wave data even in hazardous sea states.
WaMoS II interface + PC	Cost Efficient: Low maintenance costs - No salvage costs

**WaMoS® II** output parameters and accuracy:

Wave and Current parameters	Accuracy <sup>**), ***)</sup>	Range	Resolution
Significant Wave height $H_s$	+/- 10% or +/- 0.5 m	0.5 – 20m <sup>*)</sup>	0.1 m
Peak direction $\theta_p$	+/- 2°	0 – 360°	1°
Peak period $T_p$	+/- 0.5 s	4 - 20s <sup>**)</sup>	0.1 s
Peak wave length $\lambda_p$	+/- 10%	15 – 600m <sup>**)</sup>	1 m
Current speed $U$	+/- 0.2 m/s	0 - 40 m/s	0.01 m/s
Current direction $U\theta$	+/- 2°	0 – 360°	1°

