

WaMoS II Wave Monitoring System

- An application of WaMoS II at Duck -

Katrin Hessner, K. Reichert, J. Dannenberg
OceanWaveS GmbH, Germany

Kent Hathaway, Don Resio
Engineering Research Development Center Us Army Corps of Engineers, USA

9th INTERNATIONAL WORKSHOP ON
WAVE HINDCASTING AND FORECASTING

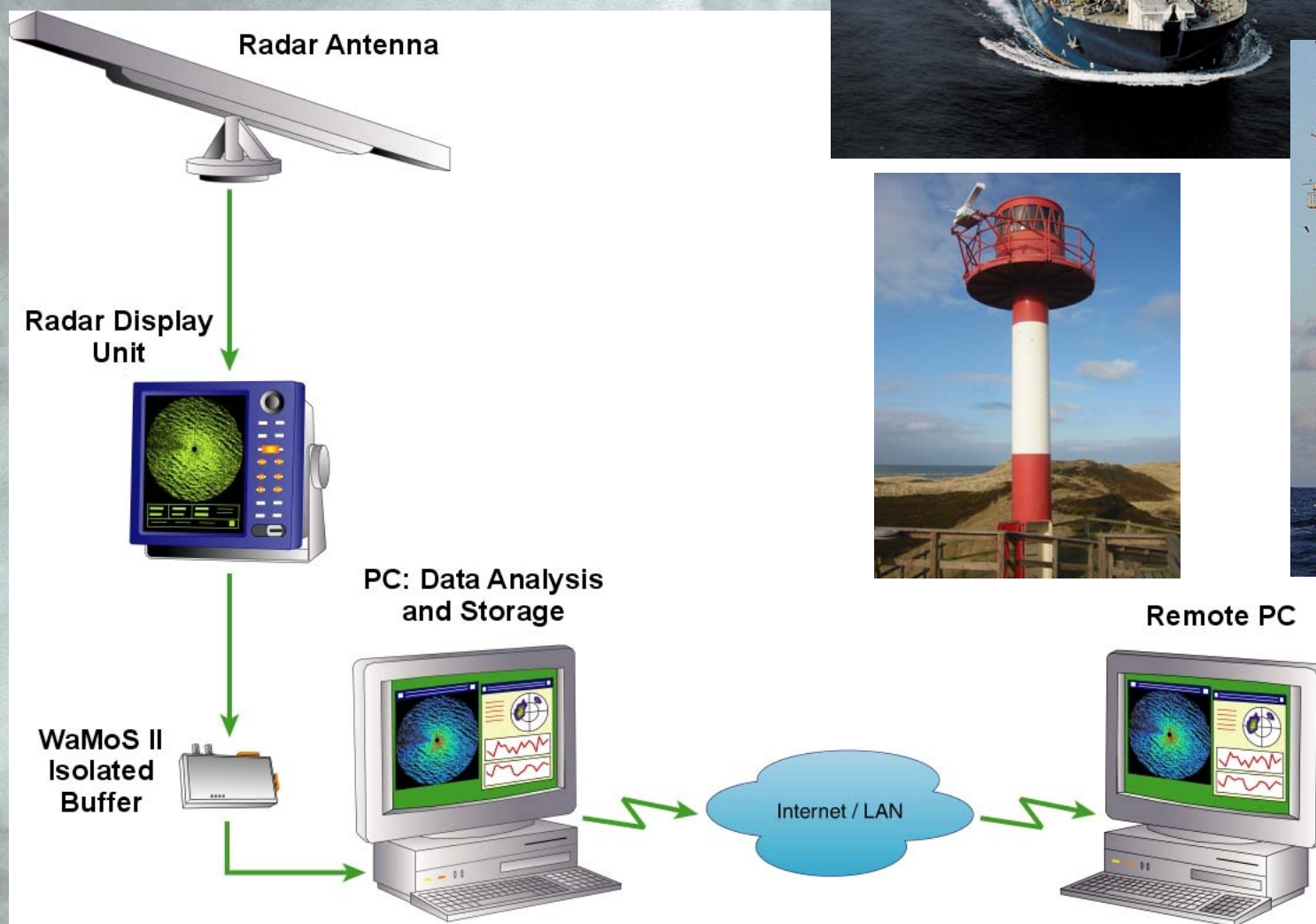
VICTORIA, B.C., CANADA, September 24-29, 2006



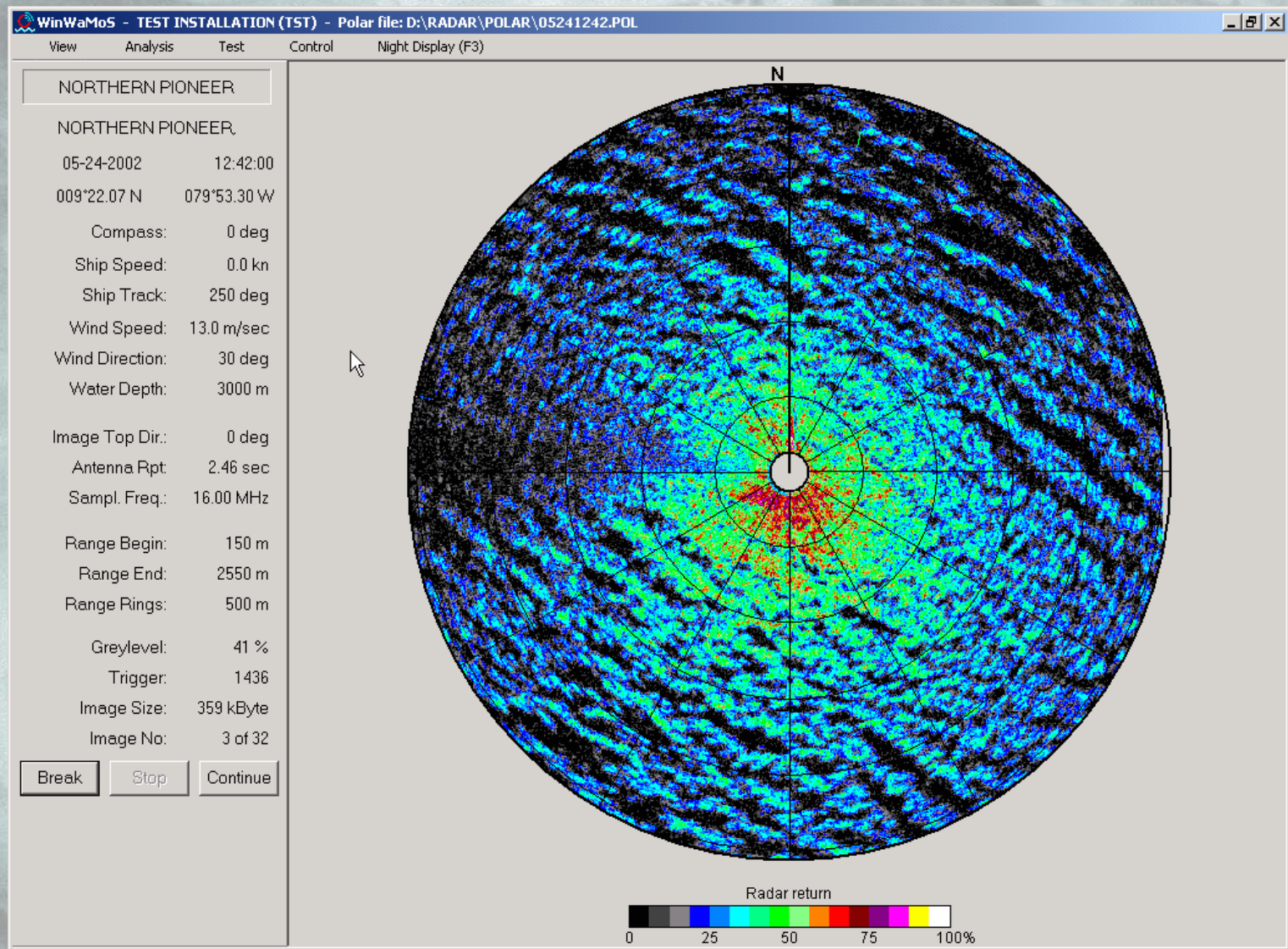
Outline

- WaMoS II
 - Installation at Duck
 - Statistical wave parameters
 - Sea surface elevation maps
 - Summary and Outlook

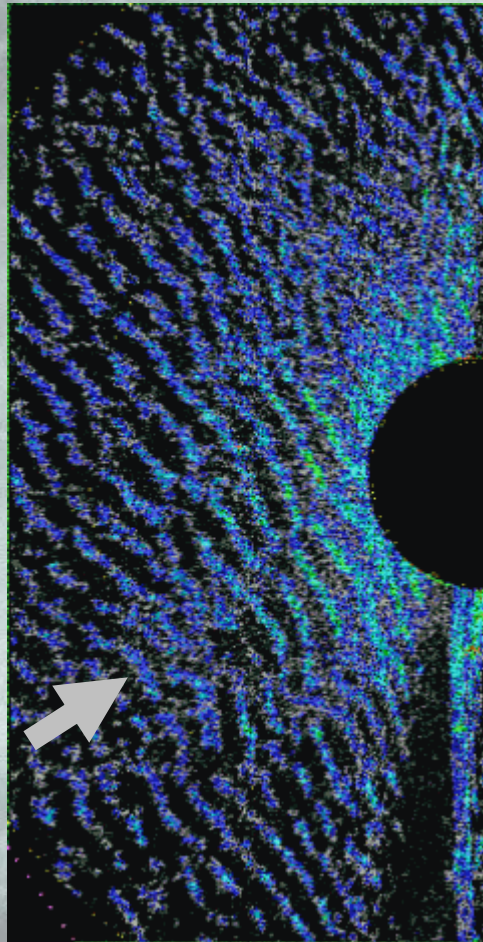
Components of WaMoS II and applications



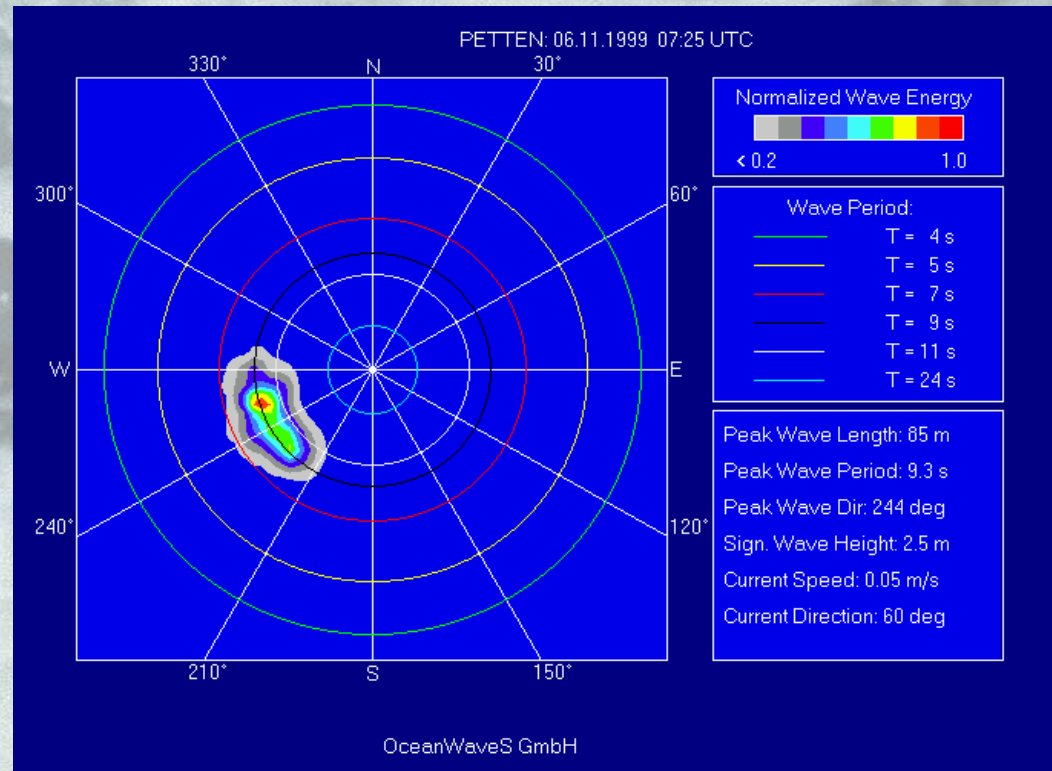
X-Band Radar image: Sea clutter



WaMoS II radar images from the Dutch coast: Time series of 'sea clutter' image with directional unambiguity



Corresponding frequency-direction spectrum



Standard WaMoS II Output Parameters

- 2-dimensional frequency direction spectrum
- 2-dimensional wave number spectrum
- 1-dimensional spectrum - mean direction - spread
- Wave length peak swell wind sea
- Wave direction peak swell wind sea
- Wave period peak swell wind sea
- Significant wave height total swell wind sea
- Surface current speed and direction

Type approved for accuracy by DNV and GL:

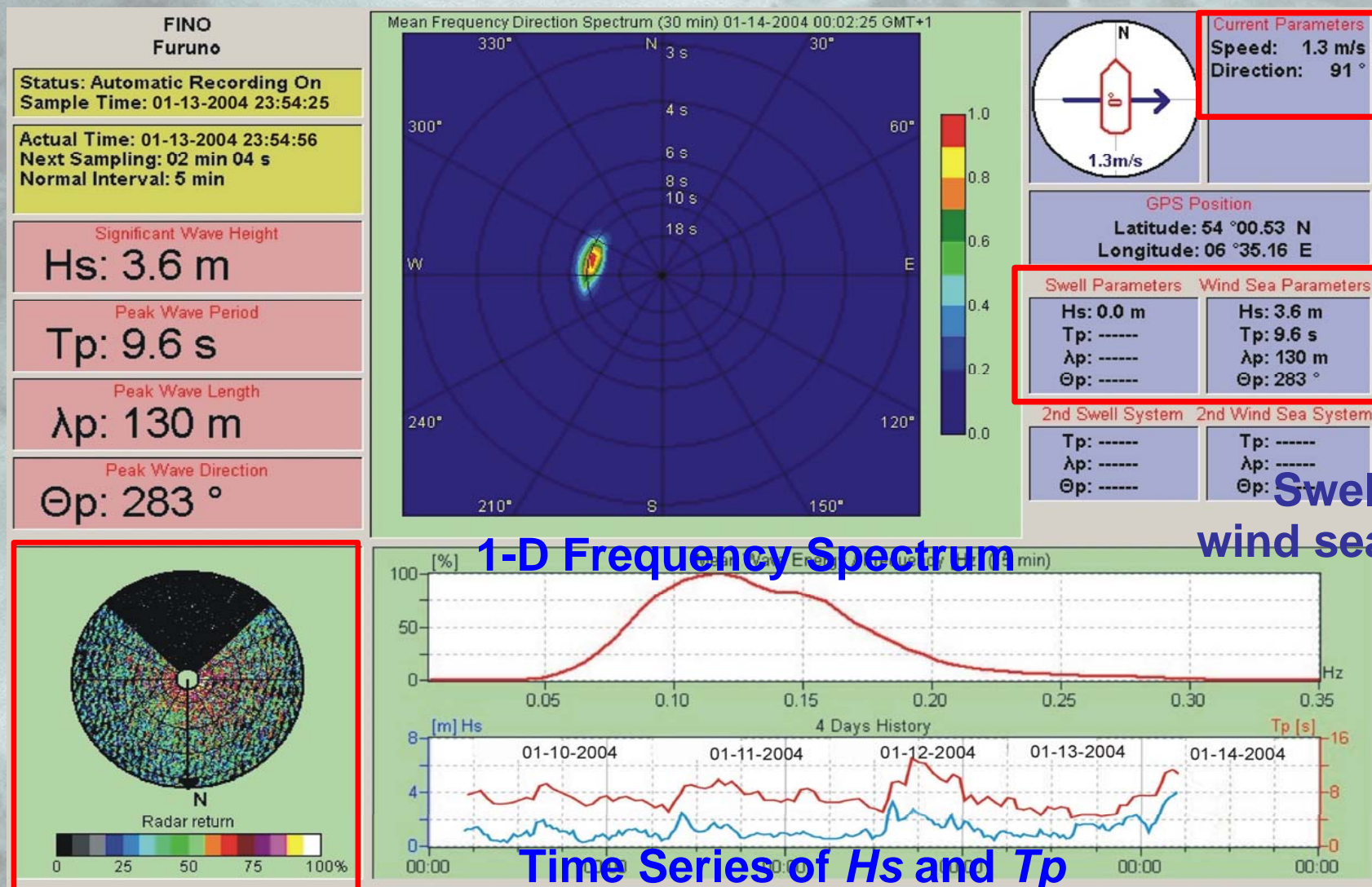
- Significant wave height +/- 10% (max. +/- 0.5 m)
- Wave period +/- 0.5 s
- Wave direction +/- 2°
- Wave length +/- 10%

WaMoS II User Interface

Individual configuration

Directional Wave Spectrum

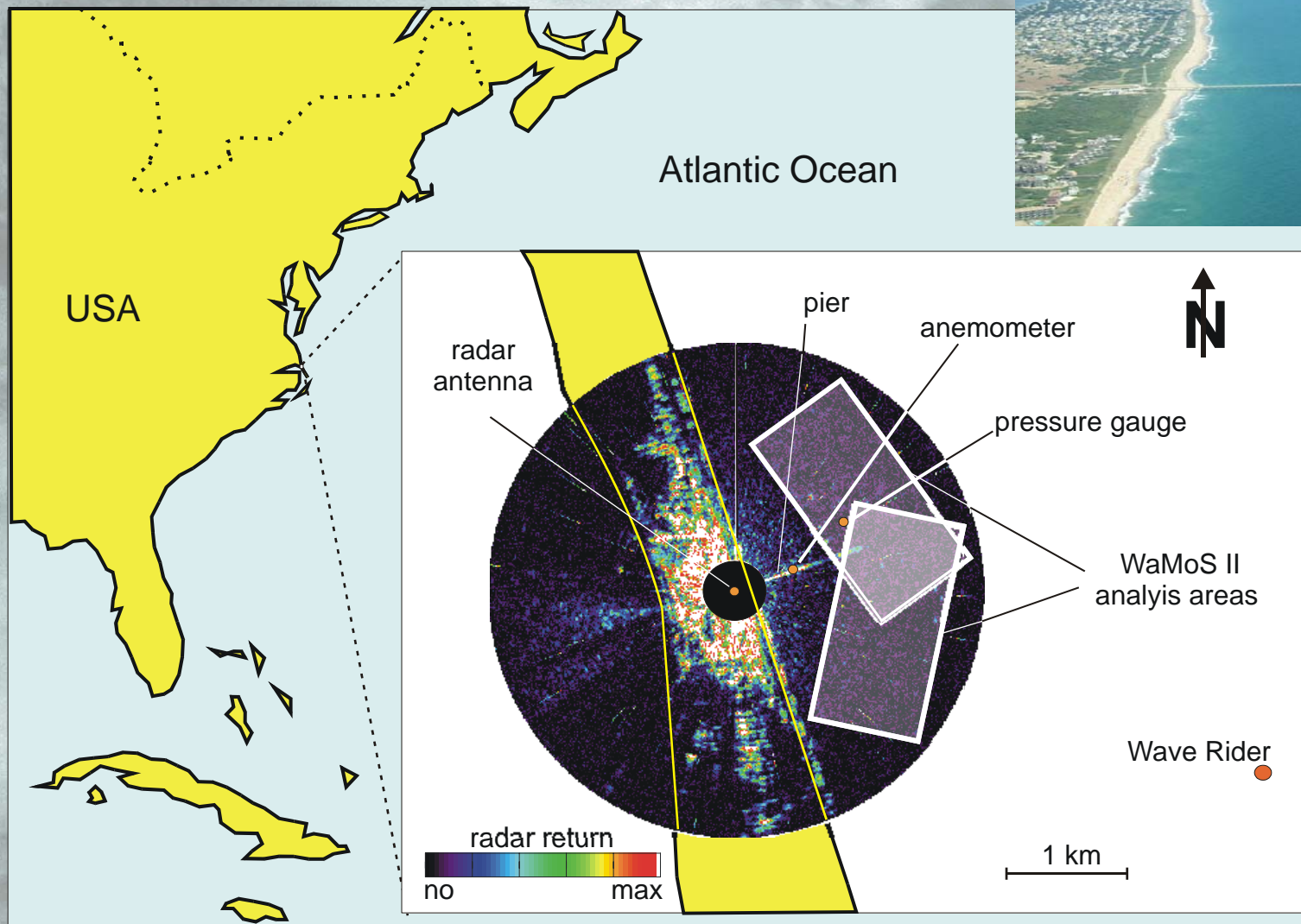
Average
Surface
Current
Vector



Swell and
wind sea system

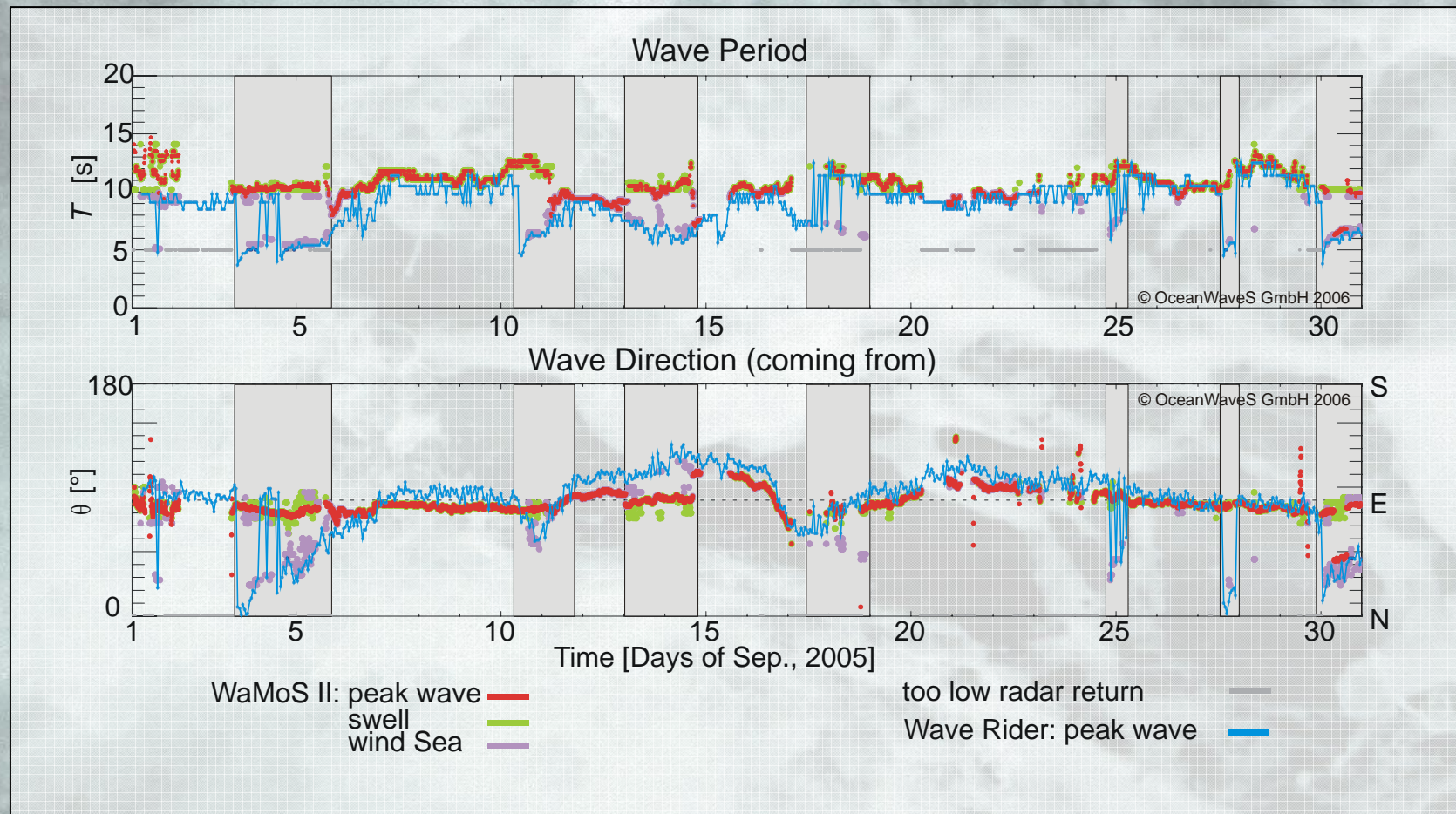
USACE Field Research Facility at Duck, North Carolina, USA

From February to October 2005.



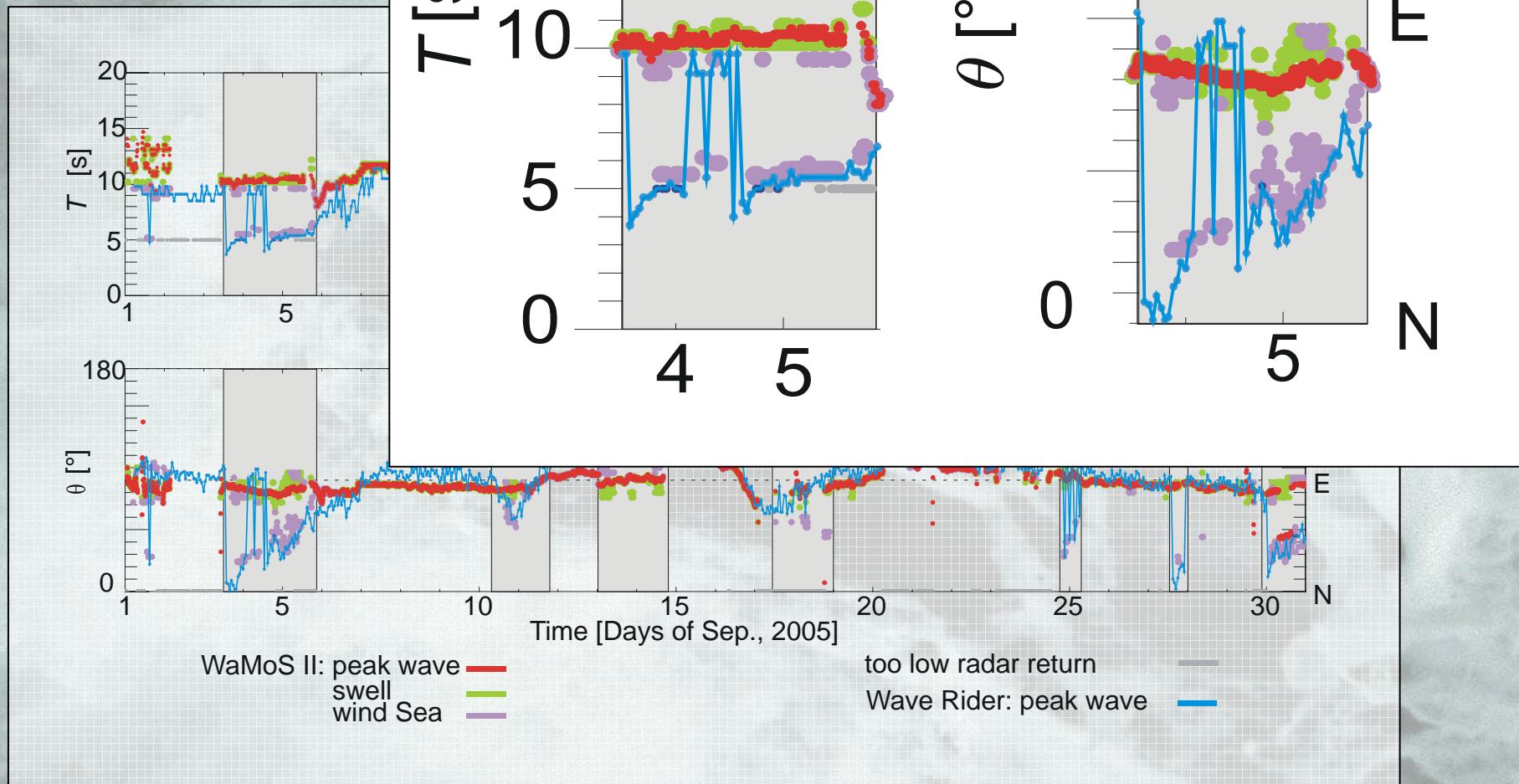
USACE Field Research Facility at Duck, North Carolina, USA

Directly measured sea state parameter: Peak wave period (T_p)
 Peak wave direction (θ_p)



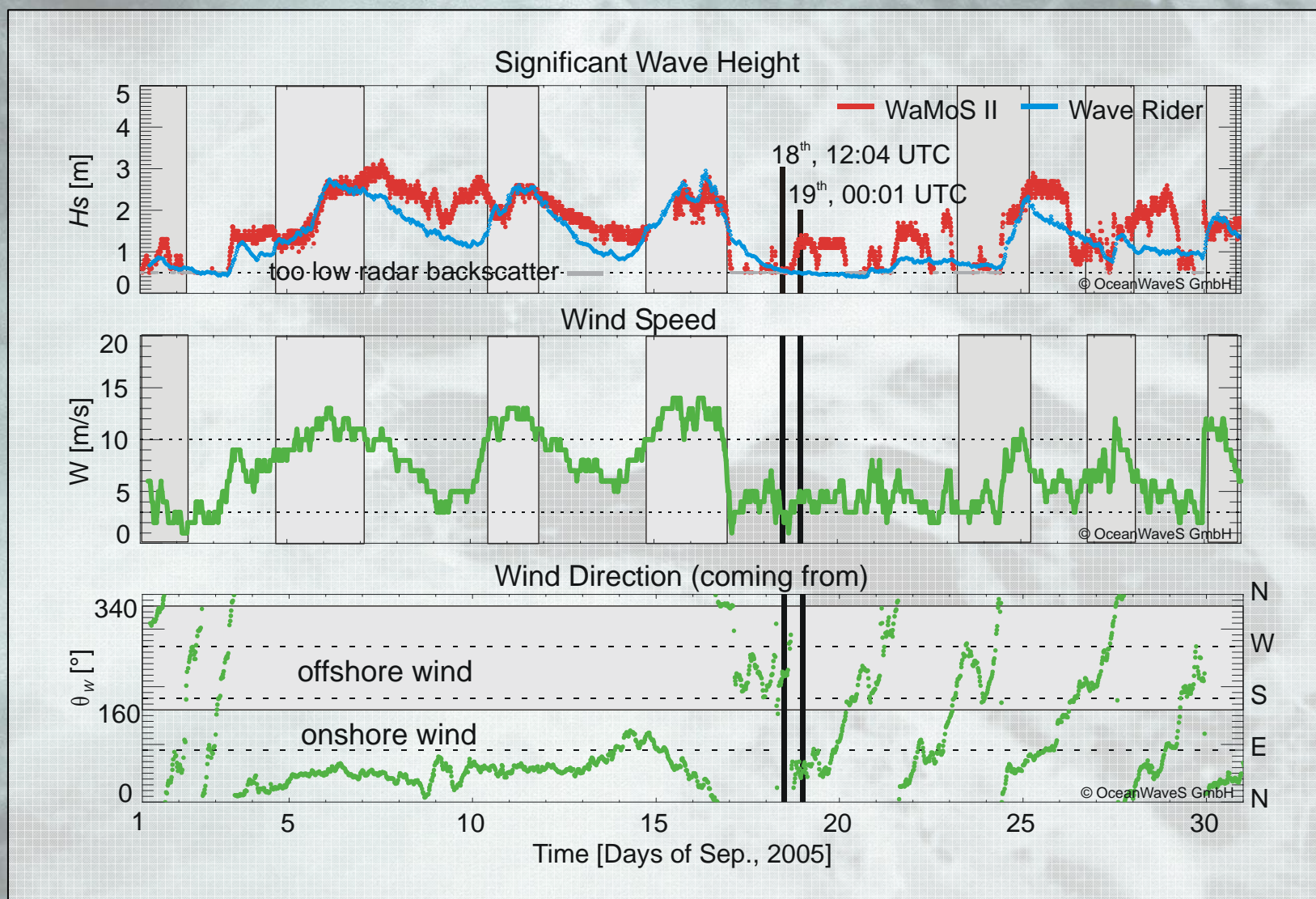
USACE Field Re

Directly measured



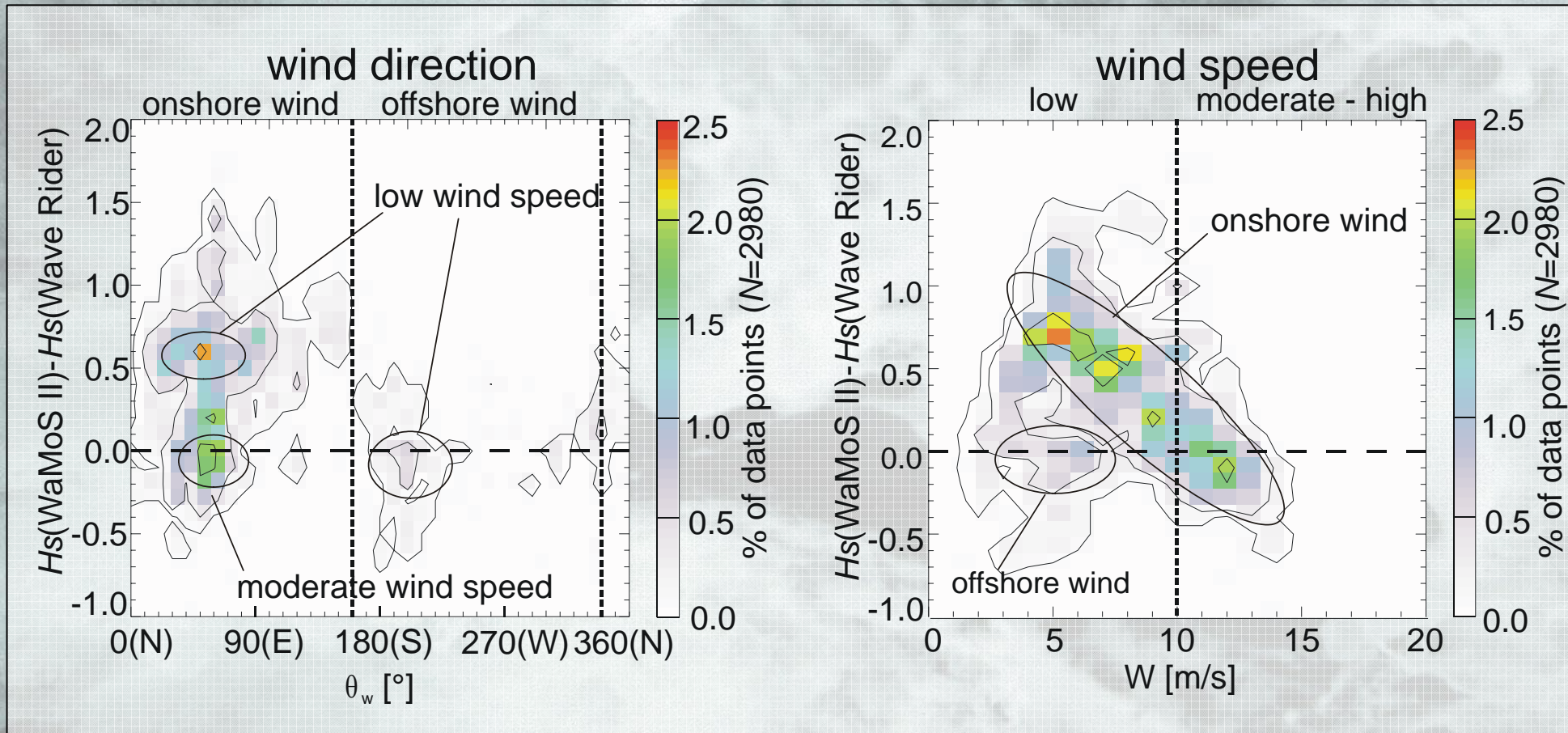
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Indirectly measured sea state parameter: Significant wave height (H_s)
 Wind at the pier



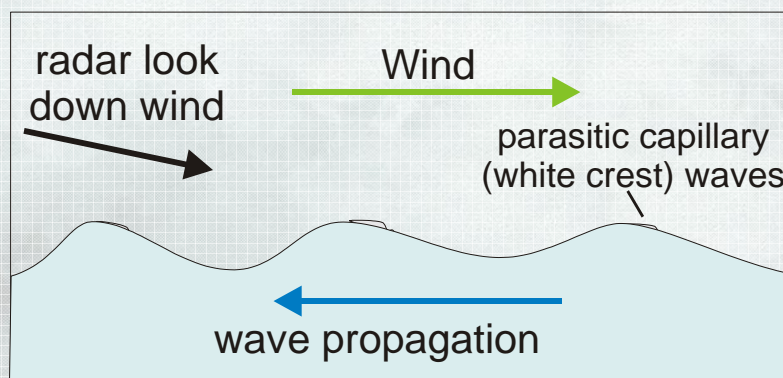
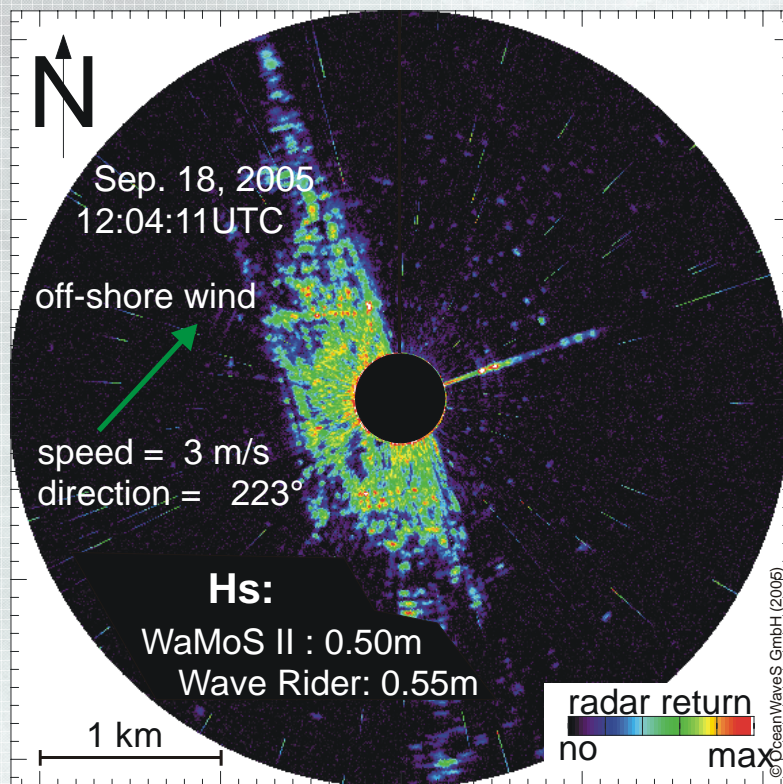
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Correlation between H_s variation and wind

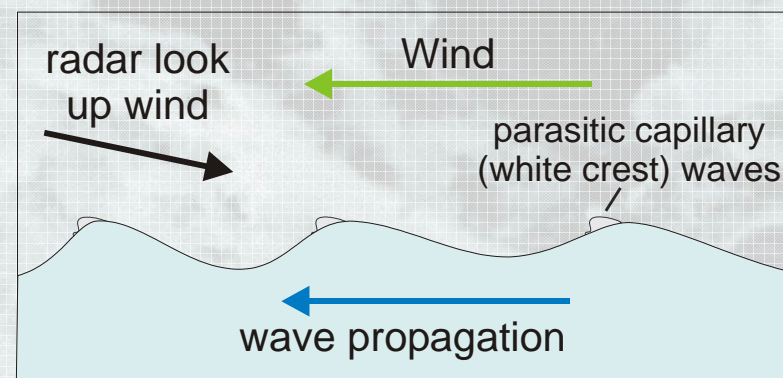
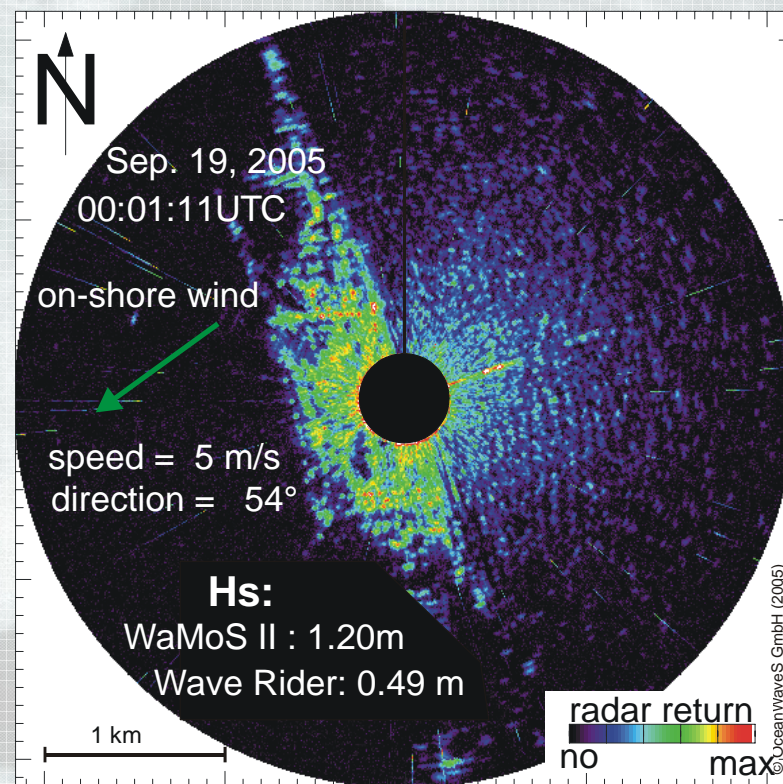


Radar imaging mechanism

Off-shore wind condition

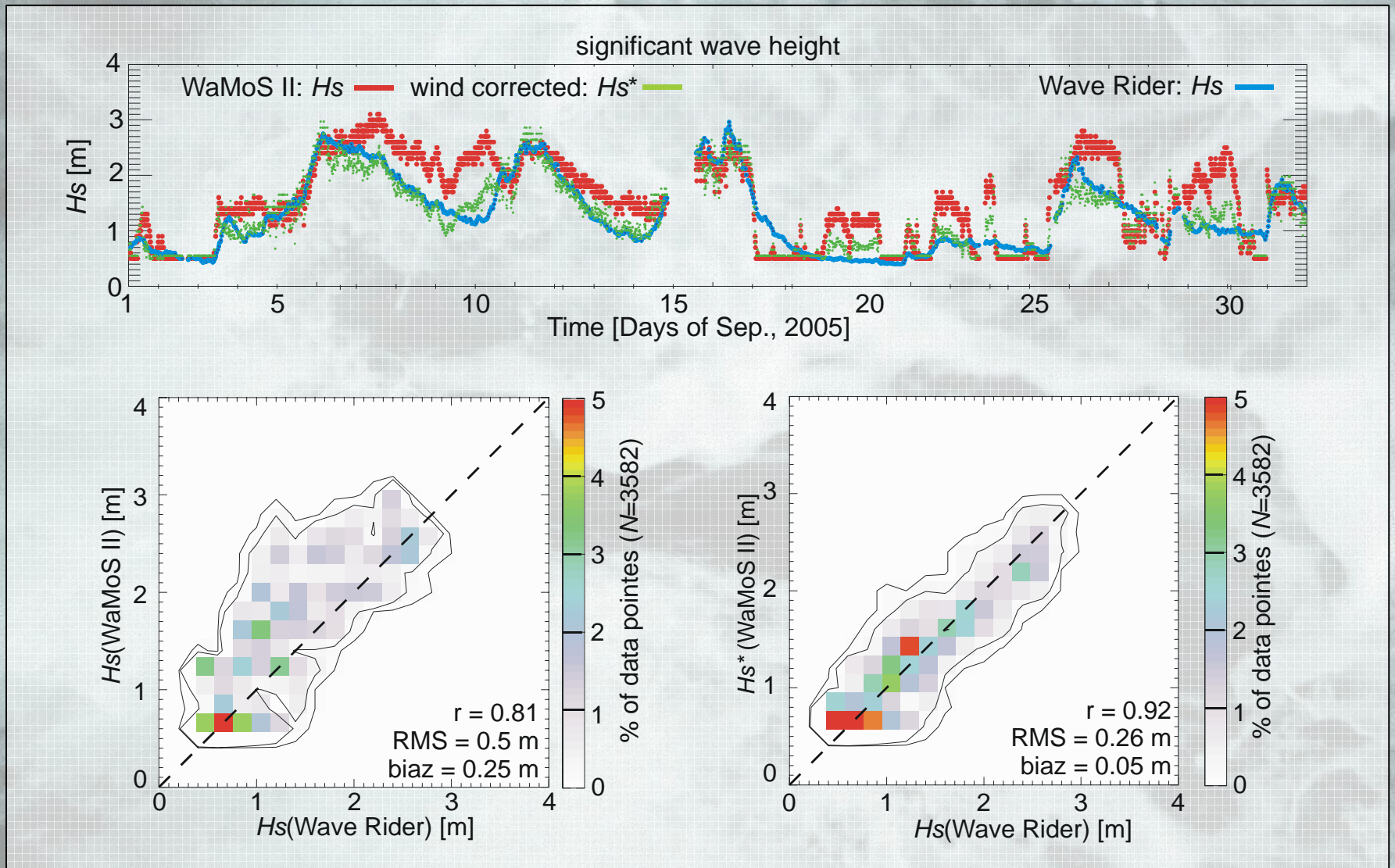


On-shore wind condition



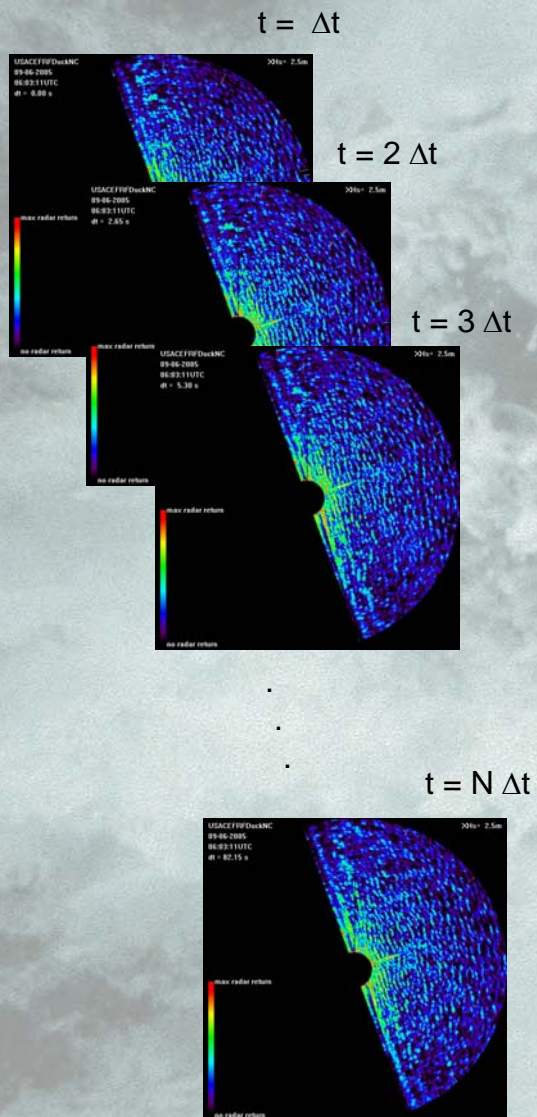
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Correlation between H_s variation and wind

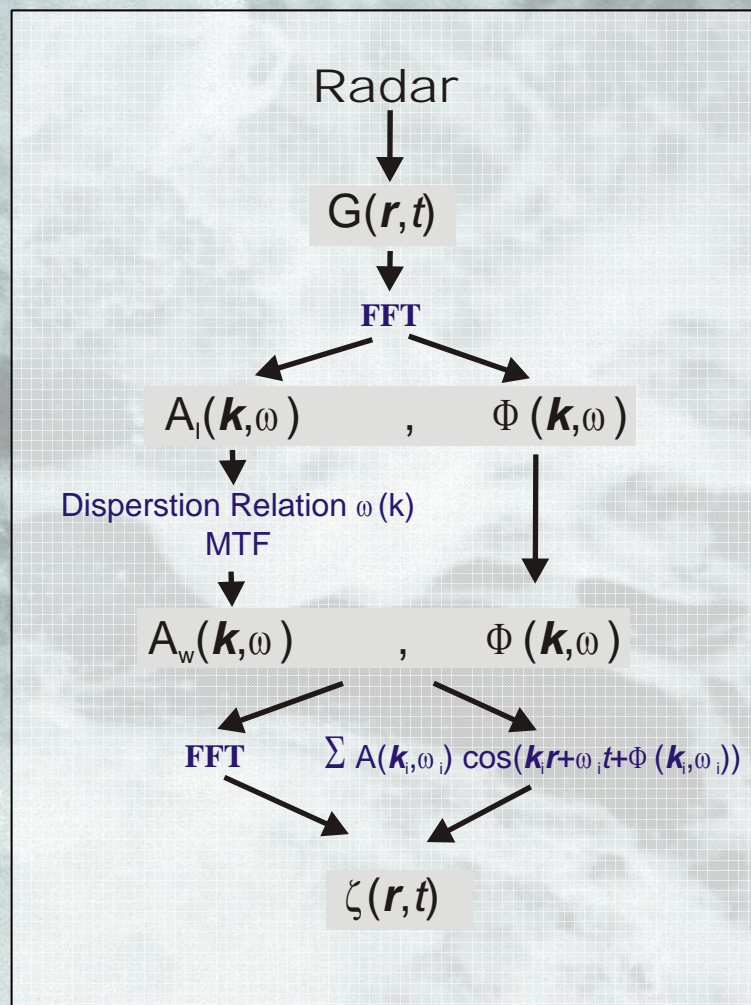
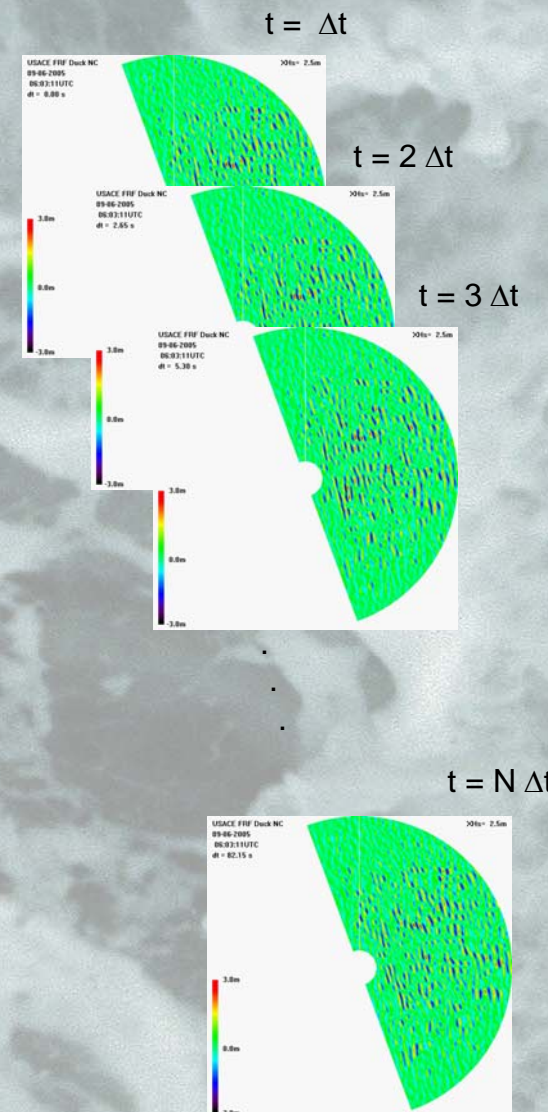


Inversion Scheme (Nieto et al., 2004)

Radar Images

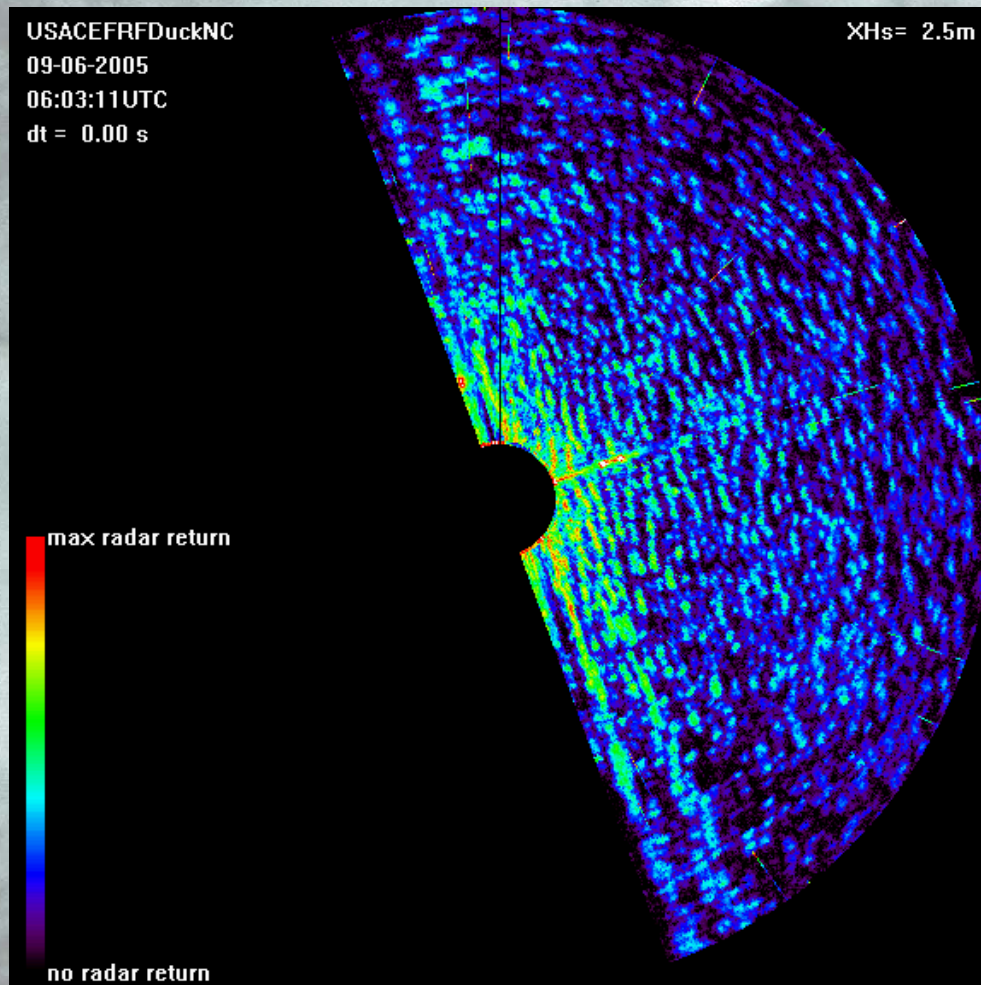


Sea Surface Elevation Maps



Radar Backscatter Image

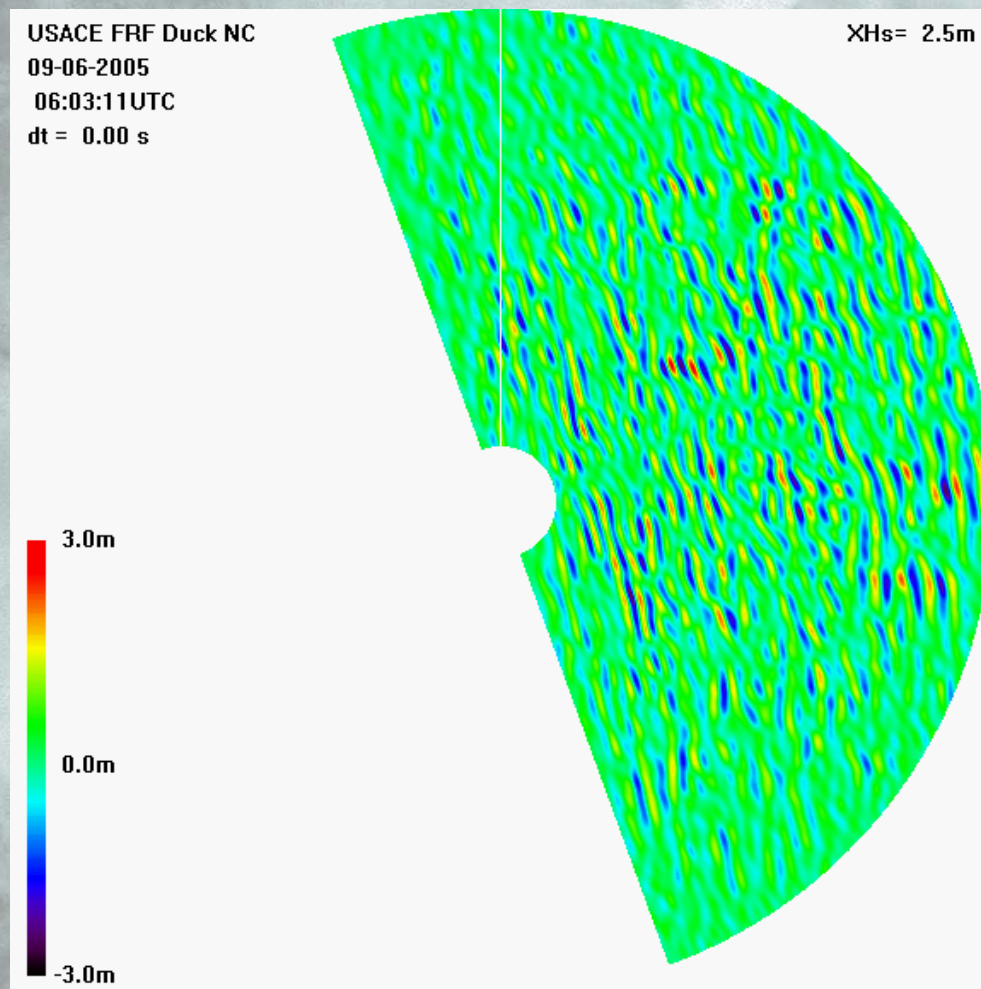
Duck, Sep. 6, 2005, 6:03 UTC



	H_s	T_p
WaMoS II:	2.50m	9.9s 70°
Wave Rider:	2.66m	8.5s 73°
Pressure gage:	2.66m	8.2s 78°

Sea surface elevation map

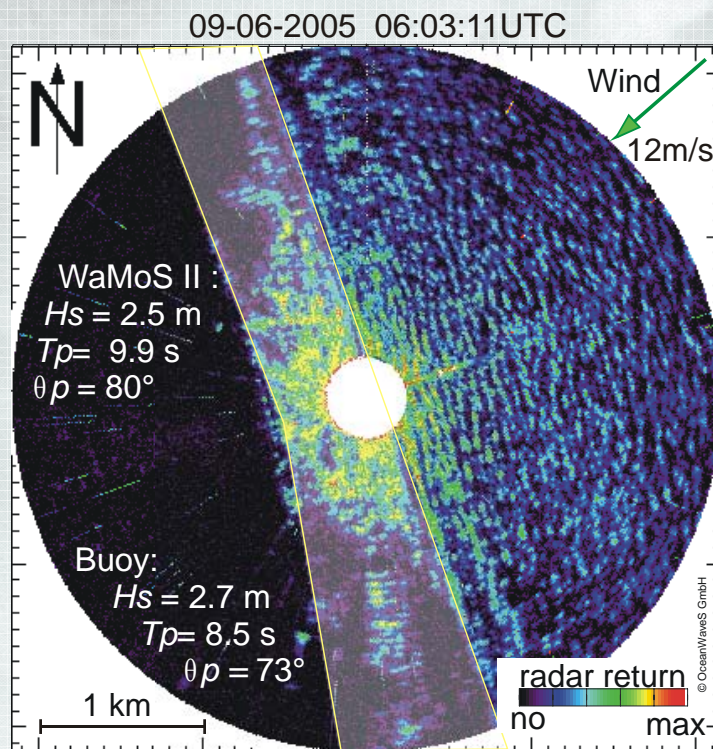
Duck, Sep. 6, 2005, 6:03 UTC



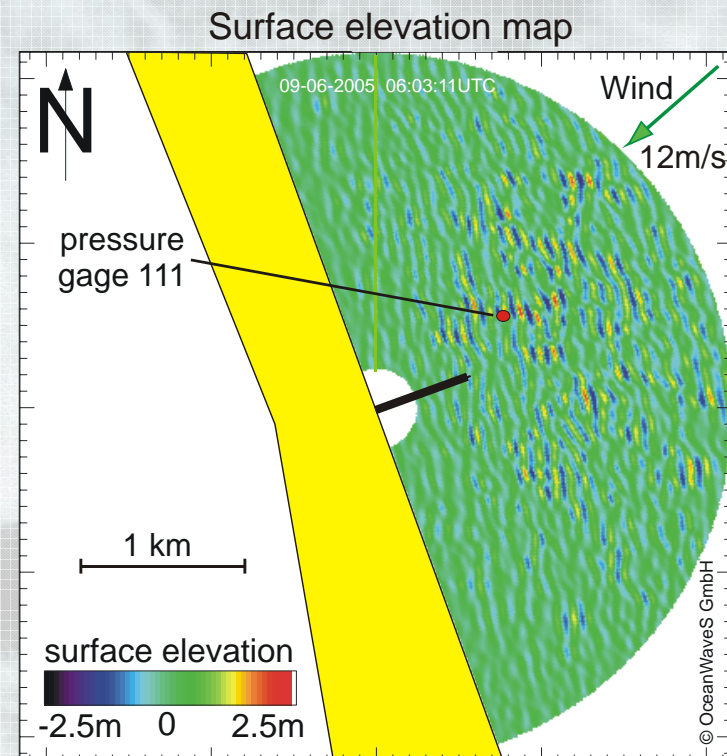
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X-Band Radar image

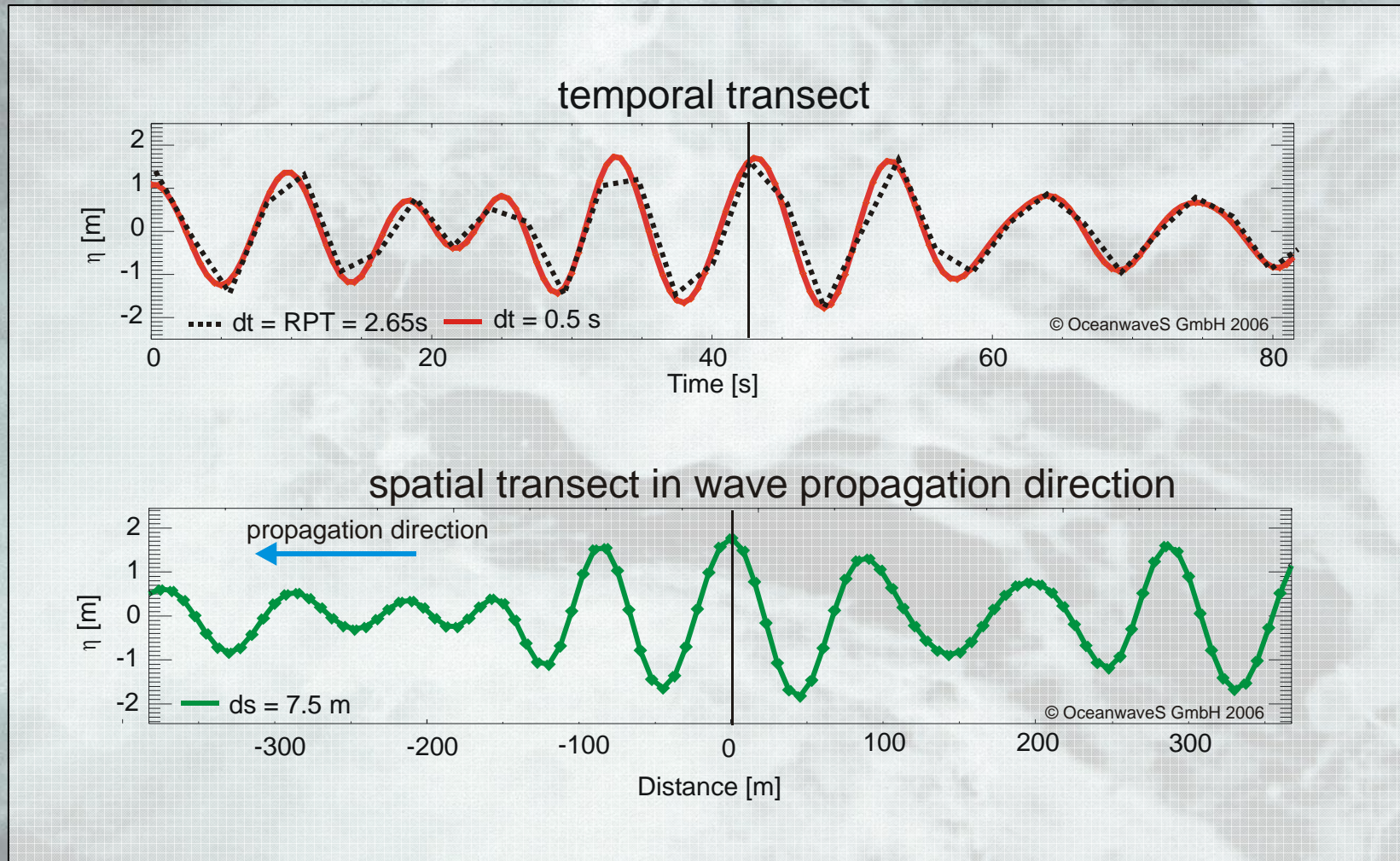


Sea surface elevation



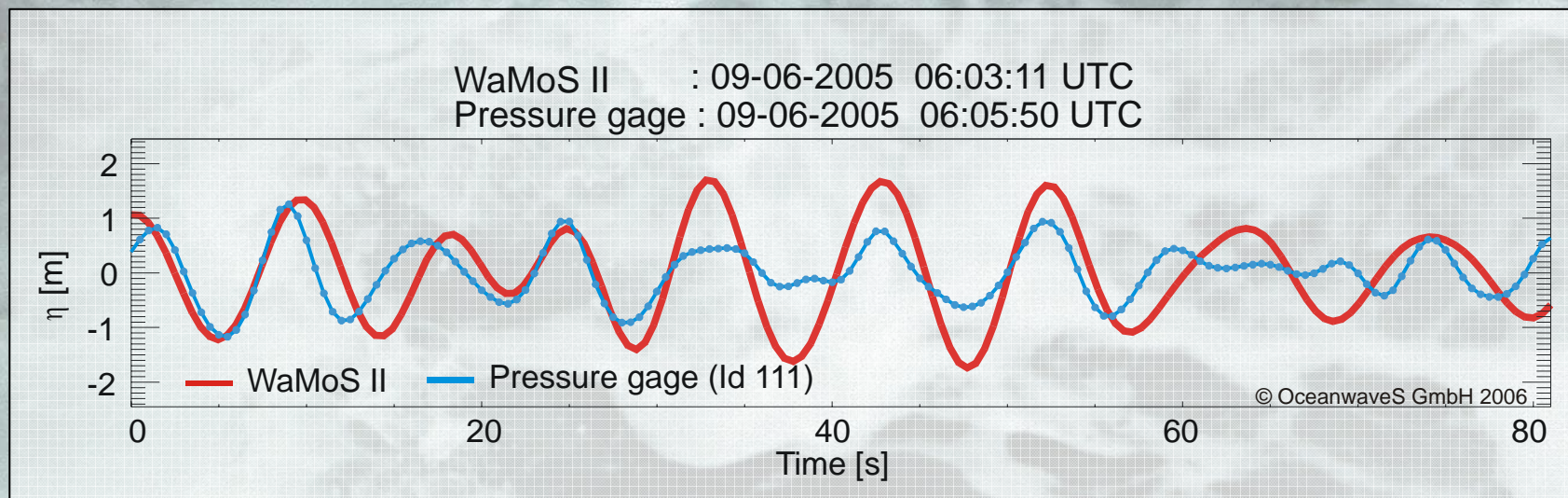
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WaMoS II: Sea surface elevation Sep. 6, 2005, 06:03 UTC
at the estimated position of the pressure gage 111



Sea surface elevation comparison

Sea surface elevation at the estimated position of the pressure gauge
 WaMoS II : red Pressure gage(ID 111): blue



- No exact location of the pressure gauge relativ to the radar antenna
- No time sychronisation between the two sensors

$H_s \approx 4$ standard deviation of the surface elevation

$H_s = 1.87$ m (pressure gage 111)

$H_s = 2.66$ m (total pressure gage 3111)

Conclusions and outlook

- WaMoS II delivers directional wave spectra and current parameters in real time on an operational basis
- Directly measured wave data (peak wave period and direction) are in good agreement with reference data
- Due to coastal effects at Duck, the indirect measured wave parameter significant wave height is effected by the local wind
- The wind effect can be corrected, therefore independent wind measurements are recommended for specific coastal WaMoS II installations like at Duck
- Validation of wind correction algorithm
 - Duck
 - Other coastal installations
- Validation of WaMoS II sea surface elevation
 - Collocation of WaMoS II and pressure gage data

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