Is the Cross Sea Dangerous?
Investigation of Sea State using SAR and ASAR Wave Mode Data

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SAR Wave Mode Data from ERS and ENVISAT
New: Significant Wave Height available from SAR without first guess

ERS-1/2 UWA spectra (image spectra)
Since 1991

Reprocessed ERS-2/SAR wave mode complex data

SAR raw data

Standard ESA ENVISAT product--WVI

High level products
Observation of crossing Swell Systems in the South Pacific
Is significant wave height predicted correctly?
Model Validation by Altimeter and ASAR_CWAVE

Altimeter cross-over measurements of Radar Altimeter

**Collocation criteria:**
- Distance < 100 km
- Time < 1 hour

**Background**
DWD Model

**Correlation:** 0.94
**Bias (CWAVE_ENV−JASON):** -0.13m
**RMSE:** 0.43m
**Scatter Index:** 0.13
**Entries:** 862
**Period:** 2007 Jan & Feb.

**Sign. Wave Height [m]**

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*Figures and data provided by DLR*
Validation Results for SWH, H_{12} and Period

**SWH**
- Correlation: 0.89
- Bias/CRAWF_ENV-Buoy: -0.05m
- RMSE: 0.72m
- Scatter Index: 0.24

**H_{12}**
- Correlation: 0.93
- Bias/CRAWF_ENV-ECMWF: -0.02m
- RMSE: 0.43m
- Scatter Index: 0.16

**T_{m02}**
- Correlation: 0.96
- Bias/CRAWF_ENV-DWD: -0.09m
- RMSE: 0.51m
- Scatter Index: 0.10

**Location of Collocated Buoys**

Period: 2006/2007 DJFM


SAR and Altimeter SWH can be used for joint Assimilation
ASAR WVW Significant and Swell Wave Height saturates at 4m

\[ H_{12} = 4 \sqrt{\int_{f<1/12} E(f, \theta) df d\theta} \]
Global Maximum Significant Wave Height (CWave 1.0, modified) of Imagettes in 200 km Surrounding

Significant Wave Height

September 1998 - November 2000

Derived with CWAVE from ERS SAR without additional model information
Sea State Statistics derived from ASAR

Annual (June 2006 ~ May 2007) SWH maps

- ASAR wave mode
- Collocated ERA-Interim (reanalysis wave model) (lon: 1.5°, lat: 1.5°)
- Collocated NOAA Wave model (WW3) (lon: 1.25°, lat: 1°)

Seasonal SWH maps (DJF)

- ASAR wave mode
- Collocated ERA-Interim Wave model (WAM)
- Collocated NOAA Wave model (WW3)
Is long Swell dangerous? The La Reunion Case

La Reunion May 12, 2007
Global Map of Steepness derived from ASAR

Joint distribution of SWH and $T_{m02}$ - - wave steepness

Wave steepness

$$S = \frac{2\pi H_s}{g T_{m02}^2}$$

Global Map of Mean Steepness derived by CWave_ENV from ASAR Wave Mode Data (2006/2007)
Parametric Rolling of Polarstern in the South Atlantic

Background: DWD wave model
Investigation of Cold Air Outbreaks

MSG-1 image acquired on Nov 1, 2006, 10:30 UTC

MERIS FR LEVEL 2 acquired on Nov 01, 2006

ASAR WSM acquired on Nov 1, 2006 10:26 UTC with overlayed windfield

Storm Britta

S. Brusch et al., IEEE JSTARS
TSX Observation of Cross Sea behind Islands

Conclusions

- Significant Wave Height can be derived from ASAR with SI below 18%
- Global Sea State Statistics compiled for several years of SWH data
- Global Map of Steepness derived
- Swell warnings should include SWH in addition to wave length
- Parametric Rolling can occur even at sea state as low as 4 meters
- Cross Seas behind Islands are observable with TSX
Thank you for your Attention!