

Retrieval of High Resolution (sub-km) Ocean Surface Winds from Synthetic Aperture Radar Data

Abhisek Chakaborty and Raj Kumar, Space Applications Centre (ISRO), Ahmedabad, INDIA

ABSTRACT

Synthetic Aperture Radar (SAR) data provide a unique opportunity to retrieve high resolution coastal as well off-shore winds in all weather, day-night conditions. Indian Space Research Organization (ISRO) has recently launched RISAT-1 carrying a C-band (5.35 GHz) SAR capable of providing data with variable resolutions 3-50m. Towards development of algorithms for retrieving ocean surface winds from RISAT-1 SAR, a pre-launch in-house algorithm has been developed using EnviSAT SAR data.

DATA

Envisat-ASAR-WSM Images (for retrieval), winds from TMI, SSM/I, JASON-2, ECMWF, OSCAT (for validation), GTOPO30 (for land masking)

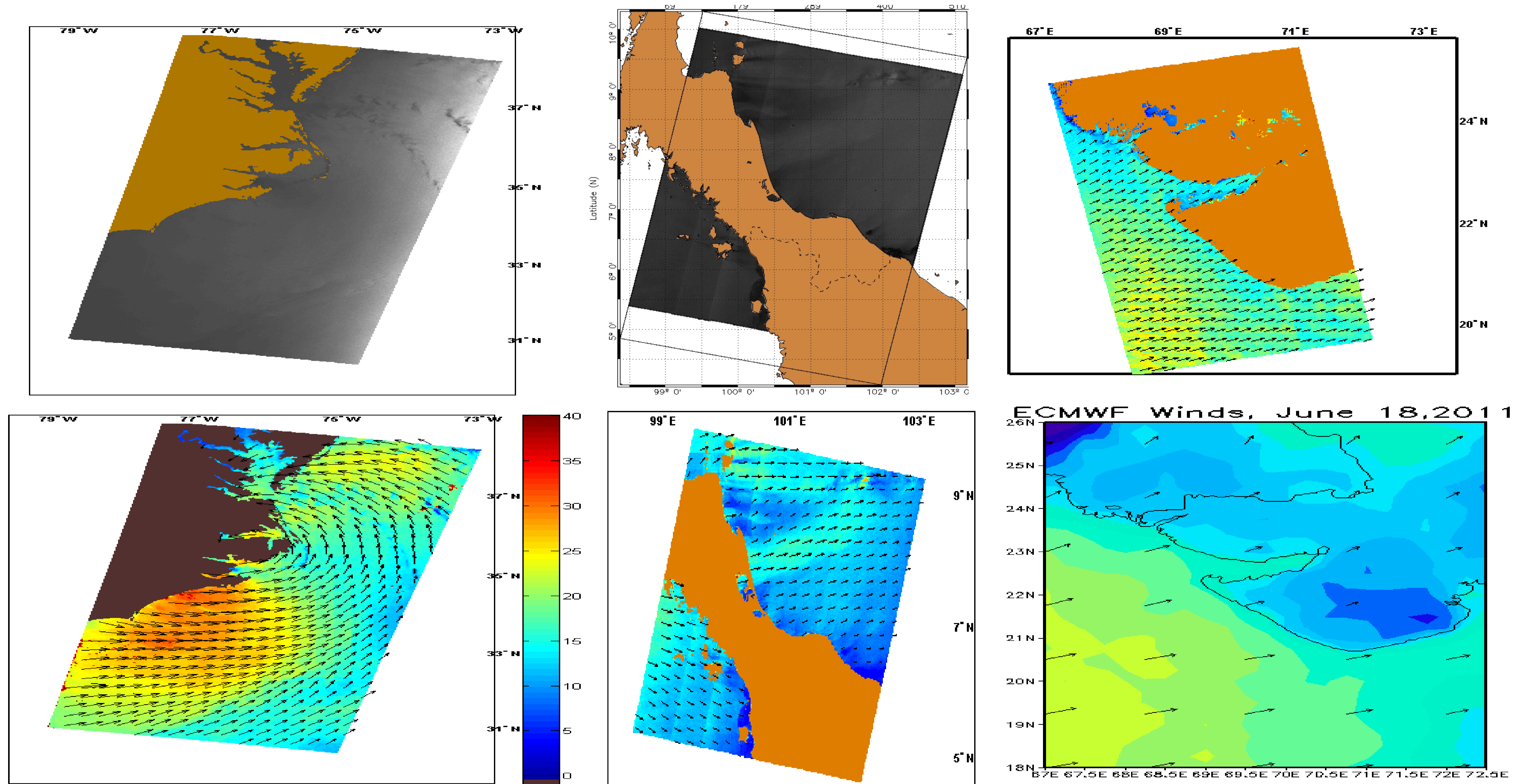
METHODOLOGY

- (1) Speckle Filtered using Gama-Map
- (2) Land Masking using GTOPO30
- (3) Down-Scaling the Input Image
- (4) Radiometric Calibration
- (5) Ancillary wind direction from NCEP-GFS
- (5) Inversion of CMOD4 using the Cost Function

$$J = \left(\frac{\sigma_m^0 - \sigma_{CMOD}^0}{\Delta\sigma} \right)^2 + \left(\frac{u - u_{NCEP}}{\Delta u} \right)^2 + \left(\frac{v - v_{NCEP}}{\Delta v} \right)^2 \quad \text{Presently } \Delta\sigma = 0.078 \text{ times measured } \sigma, \Delta u = 2\text{m/s}, \Delta v = 2.0 \text{ m/s}$$

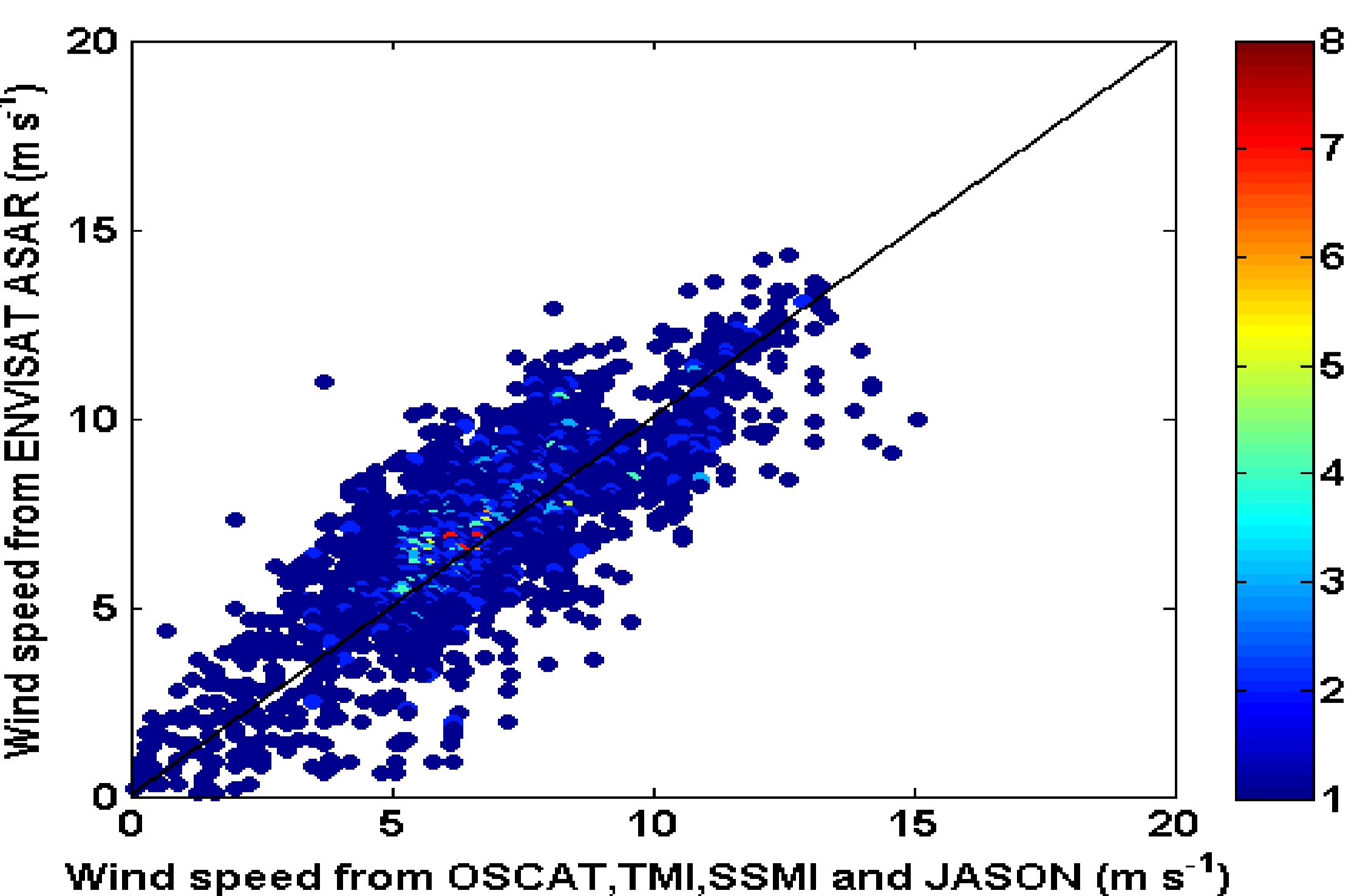
EnviSAT WSM mode data of 75m pixel size has been downscaled to 975 meter with an anti-aliasing low-pass filter to reduce noise and speckle. The ASAR wind speed retrieval have been performed by following a Bayesian approach of minimizing the cost function between ASAR observed and CMOD4 simulated values using an initial wind information from NCEP GFS model. The analysis has been performed for the number of EnviSAT WSM images for different wind conditions. The retrieved winds have also been compared with winds obtained from other spaceborne sensors. The validation shows a RMS error of 1.4 m/s with a bias of 0.3m/s.

RESULTS



VALIDATION

Performed with ECMWF, OSCAT, TMI, SSM/I, Jason-2 for 26 ASAR WSM Data Sets



| Data | NP | Bias (m s ⁻¹) | Std (m s ⁻¹) | Cor Coef (R) |
|--|------|---------------------------|--------------------------|--------------|
| OSCAT / ASAR | 629 | 0.87 | 1.17 | 0.94 |
| TMI / ASAR | 1641 | 0.48 | 1.51 | 0.89 |
| SSMI / ASAR | 634 | 0.38 | 0.99 | 0.93 |
| Jason-2 / ASAR | 217 | 0.04 | 1.33 | 0.88 |
| (OSCAT + TMI + SSM/I + Jason-2) / ASAR | 3121 | 0.35 | 1.40 | 0.91 |

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