OVERVIEW OF THE STANDARDS AND METRICS OF OCEAN SURFACE VECTOR WIND BY SPACEBORNE MICROWAVE REMOTE SENSING

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ABSTRACT

Decades of ocean surface vector wind (OSVW) data acquired from space-based radar scatterometry have been providing short and long-term researches and applications information about ocean surfaces. The main objective of the project, *stands and metrics of ocean surface vector wind by space-borne microwave remote sensing*, of Working Group on Calibration and Validation of the Committee on Earth Observation Satellites (CEOS WGCV) , is to develop the standard and guideline for the requirement, procedure, processing and assessment for the spaceborne radar scatterometer measurement calibration, wind retrieval approaches, wind data validation and assessment for OSVW, which will be used to assure the consistency of the data quality of these satellites and instruments are the prerequisite for related scientific researches and applications. This synthesizes calibration, standardized practices of retrieval approaches for ocean surface winds, development of guidelines/standards of validation of ocean surface winds, and identifying and organizing collocation related data. This presentation will provide an overview of the project and the recent progresses.

Index Terms— Scatterometry, Calibration, Metrics, Data quality.

1. INTRODUCTION

Spaceborne scatterometers have been providing ocean surface vector wind products retrieved from measured backscattering coefficient of global ocean surfaces, since SEASAT-A in 1978. Series of spaceborne scatterometers had been developed and operated by different agencies in United States, ESA and EUMETSAT, Japan, India, and China, which made very important contributions to weather and oceanic prediction, disaster monitoring and mitigation, climiate and global change research. Scatterometers in different working modes have been developed while mainly working in C- or Ku-band on different orbits. To investigate and develop standards and metrics for differences in wind retrieval due to differences in scatterometer systems, including operation frequencies, and calibration as well as higher level processing methods for a consistent wind products is necessary to obtain the consistency of wind products, benefiting both scientific researches and applications. This triggers the project of Committee on Earth Observation Satellites (CEOS) plan, *stands and metrics of ocean surface vector wind by space-borne microwave remote sensing*, whose main objective is to develop the standard and metrics of space-borne radar scatterometer backscattering measurement calibration, wind retrieval approaches, wind data validation and assessment for ocean surface vector winds. This covers: 1) Calibration, including cross-calibration of L1 and L2 data; 2) Validation of scatterometer wind data; and 3) Quality indices of L1 and L2 data. And involves institute of the National Oceanic and Atmospheric Administration (NOAA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), The Indian Space Research Organization (ISRO), the Royal Netherlands Meteorological Institute (KNMI), Institut de Ciencies del Mar (ICM – CSIC) in Spain, National Satellite Oceanic Application Service (NSOAS) and Nanjing University of Information Science and Technology (NUIST), and is managed by the National Space Science Center of the Chinese Academy of Sciences (NSSC, CAS). In the following content, Firstly, the tasks of this project is provided in detail, then after characterization of the instruments applied, the main outcomes of the CEOS project is given.

2. MAIN TASKS

Space-borne scatterometers are well-acquainted instruments that can provide 10-meter-height ocean surface wind products efficiently with high and stable accuracy, as well as large swath coverage. Decades of data acquired from space-based wind scatterometry have provided vital contribution in short and long-term researches and applications. The existing scatterometers operated at either C or Ku-band, are being flown on different satellites, which form the virtual constellation and can provide vast and near real-time observations with spatial and temporal continuity and internal physical consistency. However, the consistency of the data quality of these satellites and instruments are the prerequisite for the success of this virtual constellation, while inter-calibration/comparison can offer spatial and temporal characteristics of the observing systems to enable the consistency. This motivates the main specific tasks to include:

1) Development and validation of algorithms and methods for calibration of the Normalized Radar Cross-section (NRCS, Sigma 0) using different reference or metrics. This includes documentation of the calibration process and the data properties, and evaluation and assessment. The latter is realized by specifying requirements, methodology and procedure as well as quality control data in of calibrations from active calibrator and that from global ocean data.

2) Standardization/best practices of retrieval approaches of ocean surface winds (L2b data) by radar scatterometer data and guidelines to users. This involves Geophysical model function development and assessment, auxiliary data assembling, retrieval and direction ambiguity-removal algorithms and quality control.

3) Development of guidelines/standards of validation of ocean surface winds (L2b data) by radar scatterometer data, including reference, auxiliary data and data quality control method, methodology and procedure descriptions and determination of evaluation criteria, as well as evaluation and error assessment.

4) Identifying and organizing collocation data, including both satellite data and in-situ measurements, for calibration and validation for ocean surface vector wind, which aims at the portal for calibration and validation of spaceborne scatterometer measurements for ocean surface vector winds.

5) Demonstration of applications and establishment of portal.

3. CHARACTERIZATION OF THE INSTRUMENTS

Existing space-borne scatterometers operated at Ku-band started from the scatterometer on National Aeronautics and Space Administration of the United States NASA's SeaSat-A satellite launched in 1978 [1], followed by the NASA scatterometer (NSCAT) onboard Advanced Earth Observing Satellite "Midori" (ADEOS)-I [2], and SeaWinds scatterometer onboard Quikscat and ADEOS-II missions. The series satellite with Ku-band scatterometers developed by the India Space Research Organization (ISRO) [3] and Chinese HY-2 series are with similar performances as SeaWinds, and the scatterometer onboard the Chinese-French Oceanic SATellite (CFOSAT) [4], [5] uses a different rotating fan-beam system design. The C-band scatterometers started from ESA's ERS-1 and 2 satellites, followed by the Advanced Scatterometer (ASCAT) onboard the MetOP-A, B, and C series satellites of EUMETSAT [6]. In near future, more satellites will be launched to improve the temporal coverage, especially by combination of different orbits including both polar and inclined ones.

TABLE 1: Existing Scatterometers

	Launch date	Working band / polarization	Orbit
ASCAT-A / MetOp-A	October 19, 2006	5.255GHz, C-band / V	Sun-synchronous orbit, LTAN = 9:30 pm
ASCAT-B / MetOp-B	September 17, 2012	5.255GHz, C-band / V	Sun-synchronous orbit, LTAN = 9:30 pm
ASCAT-C / MetOp-C	November 7, 2018	5.255GHz, C-band / V	Sun-synchronous orbit, LTAN = 9:30 pm
CSCAT / CFOSAT	October 29, 2018	13.575GHz Ku-band / H, V	Sun-synchronous orbit, LTAN = 7:00 pm
HSCAT-B / HY-2B	October 25, 2018	13.256GHz Ku-band /H, V	Sun-synchronous orbit, LTAN = 6:00 pm
HSCAT-C / HY-2C	September 21, 2020	13.256GHz Ku-band / H, V	Drifting orbit with 66 degree inclination
OSCAT-2/SCATsat-1	September 26, 2016	13.515GHz Ku-band / H, V	Sun-synchronous orbit, LTAN = 8:45 pm

4. ACTIVITIES, EXPECTED OUTCOMES AND PROGRESSES

The common requirements for realizing the objectives proposed are data processing, reprocessing and calibration methods. The contributions and cooperation from agencies taken part in this project endorsed by the CEOS WGCV and OSVW-VC forms the basis for the implementation of this project. The main expected outcomes will be CEOS guidelines/international standards for calibration and validation, retrieval guidelines, best practices of calibration and validation data sharing and collaborations, which covers the following scopes:

1) Calibration, including cross-calibration of L1 and L2 data;
2) Validation of scatterometer wind data;
3) Quality indices of L1 and L2 data.

Currently, data set formation and sharing between groups within the project has been achieved. Further work based on the working plan with data shared are carrying on.

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