Probing atmospheric phenomena using C-band synthetic aperture radar onboard Earth Observation Satellite-04

Abhisek Chakraborty*, Neerja Sharma, Neeru Jaiswal and Bipasha Paul Shukla

Atmospheric and Oceanic Sciences Group, Earth and Planetary Sciences and Applications Area, Space Applications Centre, Indian Space Research Organisation, Ahmedabad 380 015, India

Indian Space Research Organisation (ISRO) has successfully launched its second civilian C-band Synthetic Aperture Radar (SAR) mission onboard Earth Observation Satellite-04 (EOS-04). The SAR data monitors and measures various atmospheric features and parameters. In this paper, we report on the investigation of EOS-04 data for several atmospheric phenomena. One of the crucial parameters for studying atmospheric manifestations in SAR data is ocean surface winds and an algorithm for its retrieval has been developed using EOS-04 data. The wind speed products thus generated are evaluated using observations from the Advanced Scatterometer and subsequently used to study atmospheric phenomena like boundary layer structures. The EOS-04 SAR data is also demonstrated for studying structures associated with tropical cyclones, coupling of rain and wind imprints and distinct signatures of an atmospheric front. The study outcomes are used to interpret atmospheric phenomena and understand backscattering signals from EOS-04 SAR. This indicates the possibility and potential of a gamut of atmospheric phenomena that can be probed using EOS-04 SAR data.

Keywords: Atmospheric phenomena, EOS-04, SAR.

Introduction

polarization, etc.). Thus, by carrying out the mathematical inversion of the GMF, information on the ocean surface winds can be retrieved from the SAR data.

Rain often modifies SAR signatures and introduces errors in locating actual ocean surface features. In addition, rainfall over the ocean surface is the primary source of error in estimating ocean surface wind from SAR. Although rain signatures on SAR images were reported long back by Fu and Holt[1], the unambiguous detection of radar backscattering associated with rain is challenging.

The microwave sensors onboard polar-orbiting satellites such as active scatterometers and passive radiometers have the capability to provide observations over tropical cyclones (TCs) under all-weather conditions[2]. These instruments provide surface wind observations, which are highly valuable in understanding TC's inner core structure but have their limitation due to observation sampling and rain attenuations. SAR[3] have made possible the observations over TC's with high spatial resolution (~1 km × 1 km) giving a unique opportunity to investigate the relationship between TC structures and intensities.

In addition to the wind structure parameter estimation, SAR can provide unique observations to resolve the small scale features within the eye and eyewall of TCs[4]. SAR data from the Copernicus Sentinel-1 mission are discussed in many studies to examine the TC structure and