Hurricane Dean tracked from space

August 21 2007

This Envisat MERIS image of Hurricane Dean was acquired on 19 August 2007 (14:52 UTC) and shows the storm passing off the South coast of Haiti. At the time of image acquisition, Dean was a Category-4 hurricane on the Saffir-Simpson Hurricane Scale, with winds at 230 km per hr. The MERIS image is in Reduced Resolution mode with a spatial resolution of 1200 metres. Credits: ESA

ESA satellites are tracking the path of Hurricane Dean as it rips across the Caribbean Sea carrying winds as high as 260 km per hour. The hurricane, which has already claimed eight lives, is forecast to slam into Mexico's Yucatan Peninsula on Tuesday morning.

Dean was upgraded early Tuesday to a Category 5 – the highest on the Saffir-Simpson scale – before pummelling the peninsula. Knowing the strength and path of hurricanes is critical for issuing timely warnings; satellites are the best means of providing data on the forces that power the storm, such as cloud structure, wind and wave fields, sea surface temperature and sea surface height. Instruments aboard ESA's Envisat and ERS-2 satellites allow them to peer through hurricanes. Envisat carries both optical and radar instruments, enabling researchers to observe high-atmosphere cloud structure and pressure in the visible and infrared spectrum.

Dean off coast of Haiti The Medium Resolution Imaging Spectrometer (MERIS) optical instrument shows the swirling cloud-tops of a hurricane, while radar instruments such as the Advanced Synthetic Aperture Radar (ASAR) pierce through the clouds to show how the wind fields shape the sea surface and estimate their likely destructive extent.

ERS-2 uses its radar scatterometer to observe the hurricane's underlying wind fields. The scatterometer instrument works by firing a trio of high-frequency radar beams down to the ocean, then analysing the pattern of backscatter reflected up again. Wind-driven ripples on the ocean surface modify the radar backscatter, and as the energy in these ripples increases with wind velocity, backscatter increases as well. Scatterometer results enable measurements of not only wind speed but also direction across the water surface.

What makes ERS-2's scatterometer especially valuable is that its C-band radar frequency is almost unaffected by heavy rain, so it can return useful wind data even from the heart of the fiercest storms.

Winds around eye of Hurricane Dean Dr. Ad Stoffelen of the Royal Netherlands Meteorological Institute (KNMI), which processes ESA's scatterometer images, said: "Observed winds from hurricane Dean by

ESA's ERS-2 scatterometer are provided to meteorologists within the hour. This C-band radar wavelength scatterometer peeks right into the ‘eye’ of a hurricane like Dean, providing timely and precise information on its position and force.

"The wind field derived from the ESA ERS-2 scatterometer measurements are distributed via a EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites) project to a registered database of a few hundred users, originating from all over the world, such as the Americas, Australia, Asia and Europe. Scatterometer winds are used directly by shift meteorologists in forecast rooms and to initialise Numerical Weather Prediction models aiding the forecasting of hurricanes 5 days ahead."

Dean leaving Martinique Another Envisat instrument called the Radar Altimeter-2 (RA-2) uses radar pulses to measure sea surface height (SSH) down to an accuracy of a few centimetres. Near-real time radar altimetry is a powerful tool for monitoring a hurricane's progress and predicting its potential impact because anomalies in SSH can be used to identify warmer ocean features such as warm core rings, eddies and currents.

Water temperatures are the main underlying energy reservoir that power hurricanes; together with the correct atmospheric conditions, temperatures need to exceed 26ºC in order to form and maintain a tropical cyclone. Because warm water expands, scientists can locate warm underwater ocean features by detecting bulges in the ocean surface height, as detected by RA-2.

Dean's path and category level The thermal energy of warm water, which partly powers a hurricane, is known as tropical cyclone heat potential (TCHP). Warm waters may extend to at least 100 meters beneath the surface in many of these oceanic features, representing waters of very

high heat content. Several hurricanes have intensified when their tracks pass over eddies or other masses of warm water with high TCHP values.

Source: European Space Agency