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The Scientific achievements of ESA's Ice mission Cryosat

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THEME: SENS – Airborne and innovative remote sensing platforms and techniques: The Scientific Achievements of ESA's Earth Explorer Missions

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ABSTRACT:

CryoSat-2 is ESA's first satellite mission dedicated to measuring changes in the polar land ice and sea ice cover. Following its launch in April 2010, we have examined the performance of the instrument over the continental ice sheets of Antarctica and Greenland, the Artic Ocean, and, for the purposes of calibration, over the oceans. We have confirmed the engineering performance at system level of the interferometer demonstrating that it measures across-track surface slopes with a precision of 25 micro-radians and an accuracy of 10 micro-radians, greatly exceeding the pre-launch specifications (100 micro-radians). Over the polar ice sheets, we have examined the performance of the range estimation, and determined the range precision to be 19 cm RMS at 20 Hz. We have examined the retrieval of the phase information over the ice sheets, and found the phase estimates to be robust and little affected by the uncertain ice sheet topography. Based on the calibration of the interferometer, the contribution of the across track slope error is, at 0.4 mm, negligible. Over marine sea ice, we have verified the discrimination of sea ice and ocean lead returns using contemporaneous SAR imagery from ENVISAT, and we have estimated the precision of individual (20 Hz) measurements to be 2 cm. In summary, with the corrected data products, we are able to confirm that the system performance of CryoSat-2 will meet or exceed its specification over the continental and marine ice sheets.

This presentation summarises the key outcomes of the mission performance, and presents a series of example case studies where CryoSat-2 data have been applied to study changes in Earth's land and sea ice cover. We show that in 4 years CryoSat has been able to detect changes in the mass of the Antarctic and Greenland ice sheets with an accuracy comparable to that of the past 20 years of conventional satellite altimetry and that important changes have occurred in these regions, we show that CryoSat has been able to quantify changes in the volume of sea ice across the entire northern hemisphere for the first time and that unexpected changes have occurred, and we show that the mission has been able to detect changes in the volume of rugged, glaciated terrain, that were beyond the capability of past altimeter missions and that are in places extreme in comparison to past observations.