TERRASAR-X OBSERVATIONS OVER THE ANTARCTIC ICE SHEET

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1. INTRODUCTION

The knowledge of ice flow and its variations is of great importance for glacier and ice sheet mass balance. The reaction of ice sheets to climate changes and their impact on sea level can not be understand and predicted without knowledge of ice dynamics and the amount of ice discharge to the ocean.

So far the Antarctic Ice Sheet velocity field has been derived mainly from Radarsat-1 data acquired during the Radarsat-1 Antarctic Mapping Project (RAMP) in 1997 and 2000. By rotating the satellite to collect data left of the orbital track, Radarsat-1 was the first SAR sensor capable of imaging areas south of about 80°S latitude and to the pole. Although RAMP offered the first high resolution mapping of the entire continent the interferometric coverage below 80°S was limited due to mission constraints.

Eleven years later as part of the International Polar Year (IPY) 2007-2008 the TerraSAR-X satellite initiated high resolution acquisitions in left looking mode over specific sites close to the South Pole [1]. The imaged areas of scientific interest are located in the Transantarctic Mountains and Ross Ice Shelf (Fig.1) as well as on the Ronne-Filchner Ice Shelf.

2. SAR DATA and METHODOLOGY

Our investigations are based on TerraSAR-X data acquired in stripmap mode starting with October 2008 and continuing through 2009. The repeat pass data in 11-days cycles cover glaciers basins in the Transantarctic Mountains and ice streams on the Ross and Ronne-Filchner ice shelves. At 45^{o} incidence angle the slant range and azimuth resolution of the single look complex (SSC) product are about 3 m. The size of a standard TerraSAR-X product is 30 km x 50 km in range and azimuth, respectively.

The 11-day repeat pass TerraSAR-X data are highly coherent because no melting is present at these latitudes where snow drift or snow fall is minimal. Different methods for ice motion studies based on TerraSAR-X data are presented. For fast moving areas the SAR signal may decorrelate in 11 days, but cross-correlation can be applied to repeat pass amplitude images [2]. The surface velocity vector can be calculated by tracking stable amplitude features which can be easily observed in the crevassed sections of the glaciers. On the smoother areas and on slowly moving ice the 11-day repeat pass images are highly coherent. In this case phase interferometry and speckle tracking can be applied because both techniques do not need distinct amplitude features. Although phase interferometry is more accurate than speckle tracking [3] it has the disadvantage to provide only the line of sight component of velocity. The combined techniques allow the calculation of two-dimensional velocity field revealing details of ice flow.

An analysis of the dynamics of several glaciers close to the South Pole derived from recent TerraSAR-X images is presented and compared with Radarsat-1 based results from 1997, where available.

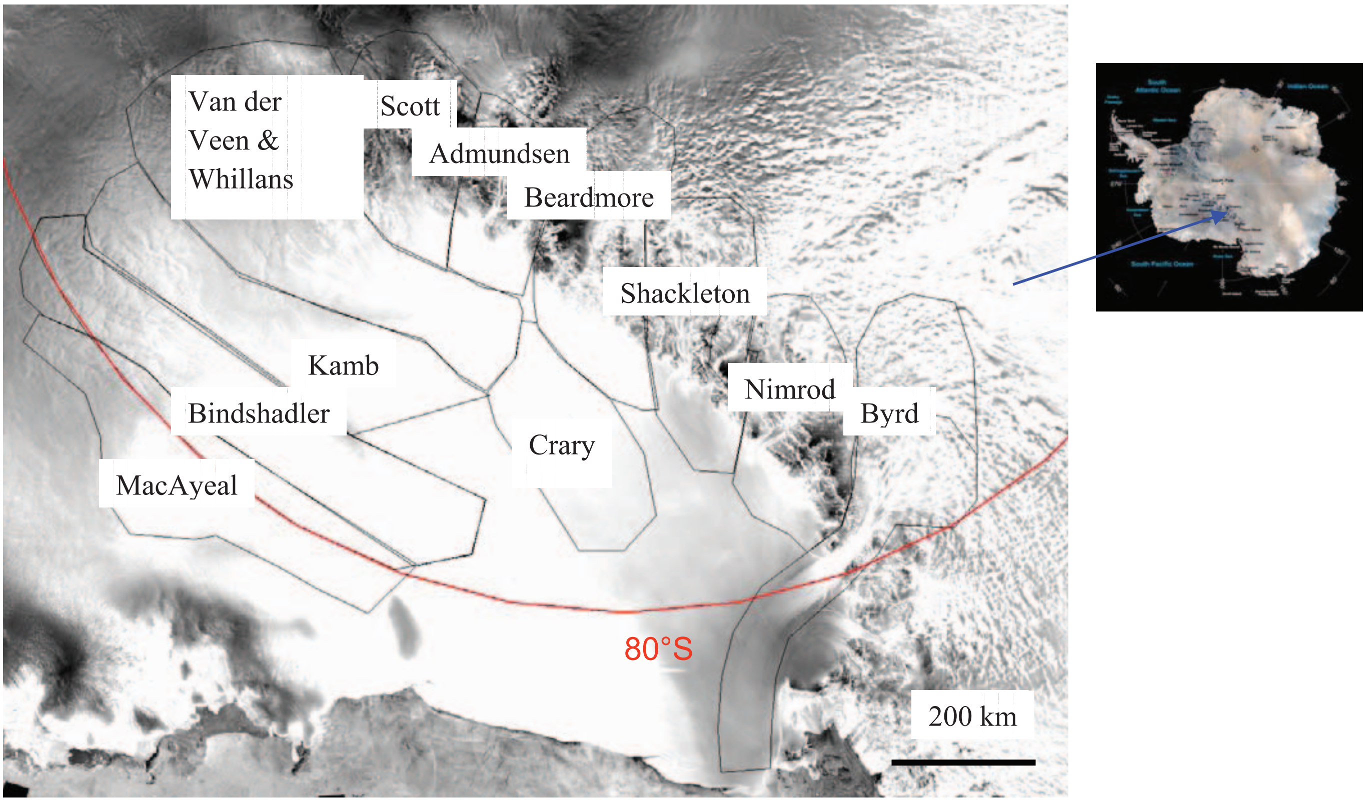

Fig.1: Glacier basins in the Transantarctic Mountains and Ross Ice Shelf South of 80°S where TerraSAR-X acquisitions are ongoing. In the background Radarsat-1 image. The location is shown in the insert upper right.

3. REFERENCES

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