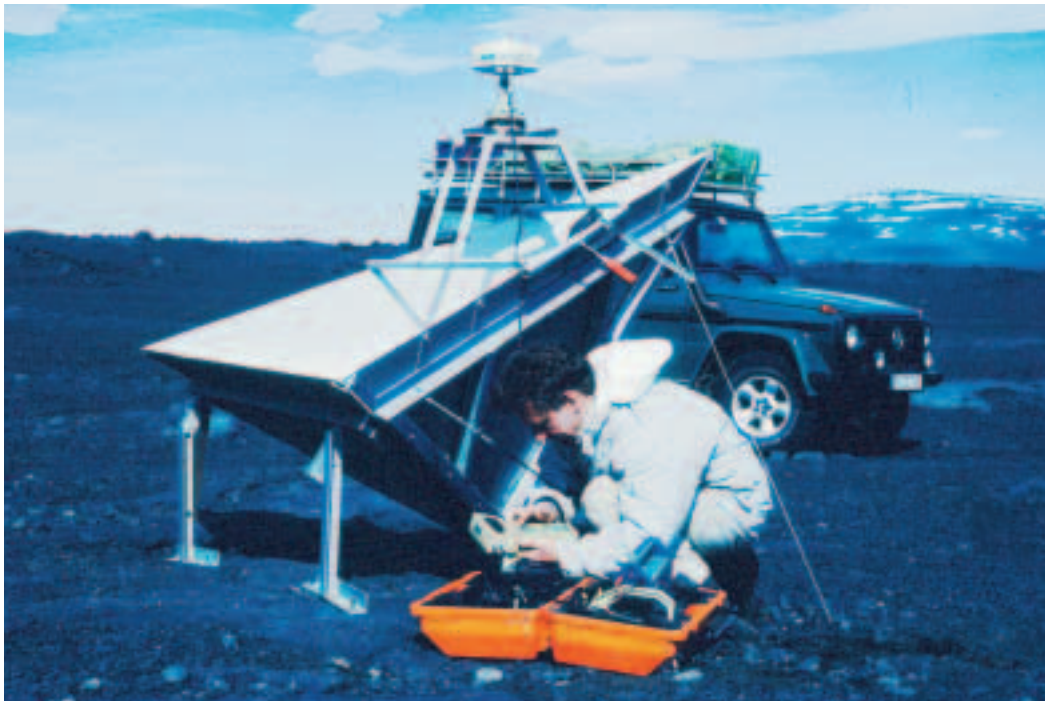
Europe's Earth Observation Satellite – ENVISAT

Envisat is in a near-polar Sun-synchronous orbit at a mean altitude of 800km. The satellite has ten different instruments mounted on-board, many of which are a development of those from ERS-1 and ERS-2. This means that it will be possible to make comparisons between conditions observed during Envisat's lifetime and those recorded during the past 10 years. Envisat is carrying three imaging devices: the Advanced Synthetic Aperture Radar (ASAR), the Advanced Along Track Scanning Radiometer (AATSR), and the Medium Resolution Imaging Spectrometer (MRIS). The remaining instruments are designed to measure certain atmospheric parameters and many of the actual constituents of the atmosphere helping scientists to understand each part of the Earth system and to predict how changes in one part will affect others. There is a dual-frequency radar altimeter (RA-2) to help with the determination of the surface topography of the oceans and also a DORIS microwave Doppler tracking system to provide precise orbital data.

Nowhere is volcanism more impressive and varied than on the largest volcanic island of the earth – Iceland. During the last decade the European Space Agency (ESA) has supported a number of disaster monitoring research projects utilizing the radar satellites ERS-1 and ERS-2. Following the recent launch on 1 March 2002 of the ENVISAT – Europe's newest polar-orbiting scientific satellite – it is envisaged that this continuing research will be greatly improved.

Dr Ulrich Münzer from the Institute of General and

ENVISAT research project uses Leica GPS for disaster monitoring in Iceland



Dr Th. Bahr with a Leica GPS200 System at the corner reflector V5 (Vatnajökull North) with sign-post volcano Trölladyngja (Photographs: Dr U. Münzer)

Applied Geology at the Ludwig-Maximilians University in Munich is conducting ongoing ESA projects in Iceland together with scientists from Germany, Iceland and Austria. Following volcanic eruptions in 1996 and 1998 in the Vatnajökull glacier of Iceland, an ESA project was initiated to investigate the possibilities of radar remote sensing to observe glaciers and volcanic areas.

Seismic activity in glaciers

Volcanic and seismic activity is common in Iceland, which is located on the Mid-Atlantic ridge where the plates of North America and Eurasia spread apart. In the south of the island some of the volcanoes and geothermal areas are covered by glaciers, making it a particularly interesting place for the study of glacier-heat and glacier-volcanic interactions. In several of the sub-glacial geothermal areas, destructive "jökulhlaups" – sudden bursts of water from the glacier – can occur causing extensive damage to the landscape and large vegetated areas, forming canyons, and transporting huge amounts of sediments. During the volcanic eruption in 1996, the water travelled up to 53,000 cubic meters per second. Jökulhlaups are caused when ice melts continuously within the geothermal areas forming a reservoir of the melt-water underneath the glacier. When the water level has reached a position high enough to over win the overburden ice pressure, the water rushes out and a jökulhlaup starts.

Radar remote sensing

The ERS-1/2 Tandem Satellite Missions in 1995-1996 and the Check Outs up to 2000, offered a unique opportunity to investigate the possibilities of radar remote sensing to observe the ongoing dynamical processes. Research aimed at detecting changes on glaciers due to sub-glacial geothermal areas and volcanic activity, and observing the geomorphologic effects of the jökulhlaups.

Improved features on ENVISAT

ENVISAT contains a number of new instruments that are designed to provide additional information about the Earth's land and sea surfaces. A number of instruments from Leica Geosystems have been used on Iceland for this disaster monitoring. Aerial photographs were taken over the Vatnajökull glacier with a Leica RC30 aerial camera, precise photogrammetric elevation model was developed with the workstation DPW770, and documentation photos made with Leica R7 and R8. A GPS measuring campaign was also made with the Leica GPS 200 system.

Purpose-built corner reflectors

In the active zone of south Iceland, a total of 30 Corner Reflectors were purpose-designed and built. Due to their positioning in areas with only minor surface roughness they show excellent signal reflection capabilities, and therefore are used as tie points for the ERS-1/2 Tandem mission processing and for geocoding the SAR data. With help from the Leica GPS 200 equipment, all reflectors were aligned to the Azimuth of the satellites with the highest precision; the determination of the position and the height (WGS 84) was carried out with differential GPS, and was reached in a measurement time of two hours with centimeter precision. Since the ENVISAT has the same satellite orbit as the ERS-1 and ERS-2, the corner reflectors can now be used for the new ENVISAT Project "Hazard Assessment and Prediction — Long-term Observation of Icelandic Volcanoes and Glaciers Using ENVISAT-ASAR and Other Radar Data" making a valuable contribution to the project in general.

Dr. Ulrich Münzer (left) and Uwe Bacher work on the corner reflector V4 (Vatnajökull North).