16D.4 | **The suitability of historical satellite imagery for investigations of the cryosphere** (#1422)

<u>T. Pieczonka</u>[1], N. Holzer[1], J. Peters[1], T. Bolch[1,2], M. Buchroithner[1]

[1]TU Dresden, Institute of Cartography, Germany; [2]University of Zurich, Department of Geography, Zuerich, Switzerland

The cryosphere represented by glaciers, snow, permafrost and seasonally frozen ground forms a large natural storage of fresh water. In combination with non-glacial runoff they are an important water source for sustaining the lives of 1.4 billion people living downstream the large Asian rivers such as the Tarim, Indus, Brahmaputra and Ganges. The climate system and the cryosphere are linked in numerous ways, as an increased annual runoff at several gauges show. Thus, changes in the cryosphere and the local climate may have severe consequences for the future livelihood of local people. Long-term information about the glaciers´ behaviour in such remote mountain areas are however scarce, and field based data collection and research is often hampered by highly inaccessible terrain and harsh climatic conditions. However, remote sensing technologies offer even in such regions the possibility to investigate important characteristics of the glaciers and their variations over the last decades. Satellite missions for scientific purposes dates back to the 1970s; however, the first space images, dedicated to military purposes (e.g. Corona), originate in the early 1960s. The declassification and accessibility of high resolution reconnaissance images such as Corona and Hexagon offer huge potentials for historical research. This long period of recording makes it possible to compare the state of the cryosphere at different time steps and to trace changes. Our investigations aim to detect such changes comprising glacier area and thickness. Here, we want to show the possibilities and potentials of current and historical satellite data to fulfill the expectations in terms of accuracy and reliability. We specify the data used, discuss their benefits and disadvantages and present methods to enhance their usability and accuracy. A central part of these investigations are glacier thickness changes which can be assessed using high-resolution stereo imagery to generate digital terrain models (DTM). The stereo capability of the missions offers possibilities by combining results from stereo Corona and Hexagon with recent remote sensing data as from SPOT-5, ALOS PRISM and Cartosat-1. We were able to generate multi-temporal DTMs for the Mt. Everest Area for 1962, 1970, 1984, 2002 and 2007. For the Central Tien Shan DTMs for 1974/76 and 2009, and for the Mustag Ata / Kongur Shan region DTMs of 1973 and 2009 could be produced. The main challenge of employing Corona imagery is the complex panoramic distortion. It has to be handled by a mathematical approach or empirically using ground control points (GCPs). The KH-9 data of the Hexagon mission do not have such panoramic distortion. Moreover, they contain a Reseau grid, which can be used to remove internal film distortions. Beside these geometrical problems the images feature radiometric errors like vertical stripes probably inserted in the digital scanning process. A bundle of semi-automatic pre-processing methods was used to handle the mentioned drawbacks considering particularly the limitation of ground truth references. In order to obtain accurate results, careful co-registration of multi-temporal DTMs is required. This was obtained by using an analytical approach describing the relation between the measured elevation differences of non-glacial areas and the corresponding slope and aspect values at a certain pixel position. Work is underway to analyse the volume changes more in detail and to extend the investigated glaciers to further areas on the Tibetan Pleateau and the Central Tien Shan within the framework of the Sino-German projects “Aksu-Tarim”, “SuMaRiO”, “TiP”, and “WET”.