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# Remote-sensing based analysis of glacier change and glacier lake hazards in the outer ranges of the Tien Shan mountains

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In order to better understand the relationship between recent changes in glacier cover and the development of glacier lakes in the Tien Shan mountains of Central Asia, we studied airphotos and satellite images from Corona, Landsat, ASTER, and ALOS. Four study regions were examined: Pskem region, Kyrgyz region, Ile-Kungöy region, and Teskey region, all in the outer ranges of the Tien Shan mountains. These regions showed pronounced glacier shrinkage over the last 30 years as found by comparing Corona satellite photographs from 1968–1971 with Landsat 7 ETM+ satellite images from 1999–2002. The number of ice-contact and supra-glacial lakes, which have a particular probability for glacial lake outburst floods (GLOF) increased since 2000. The appearance of glacier lakes differed among the four study regions in relation to the different recent glacier shrinkage rates in each of the mountain ranges investigated. In particular the Ile-Kungöy region contains many large glacier lakes (>0.001 km2). We carried out field work at several potentially dangerous glacier lakes. Some glacier lakes that were found in the Corona images over the Ile-Kungöy region, were involved in GLOFs during the 1960s and1970s. Many glacier lakes have now again developed a size similar to the one they had in the 1970s. Since many people live downstream of these lakes along the outer ranges of the Tien Shan mountains, the lakes pose a increasingly serious problem.