The ice-flux into Merzbacher Lake, Inylchek Glacier, Kyrgyzstan

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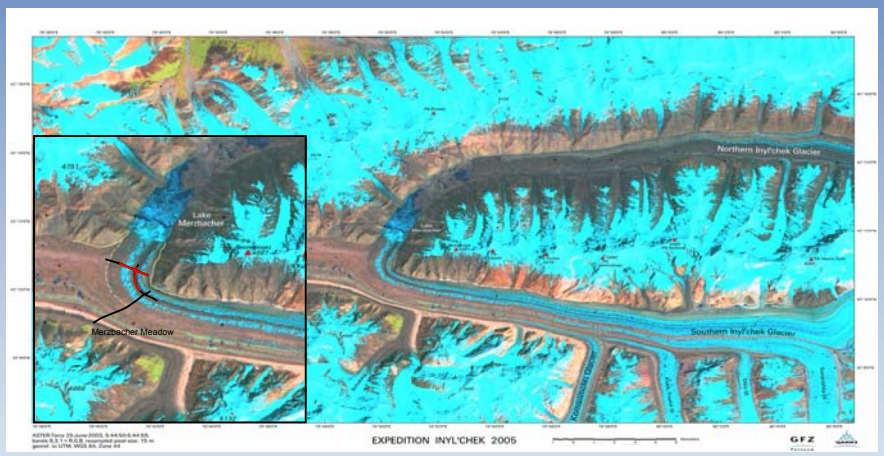
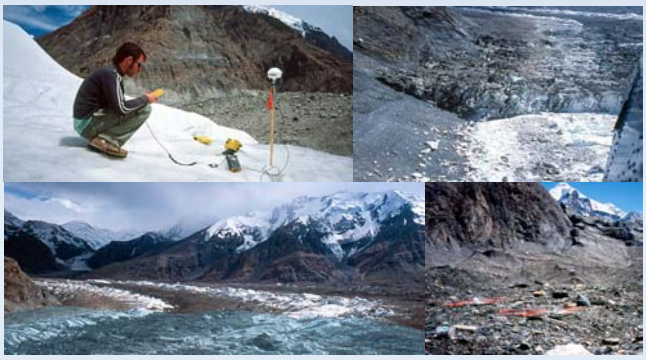
Introduction

Merzbacher Lake exhibits one of the most regular glacier outburst floods (GLOF) of known glacier dammed lakes. This lake forms regularily during the early sommer months in a northern tributary valley of Southern Inylchek glacier in the Central Tian Shan. Almost every year the rising lake level, mainly due to melt water from Northern Inylcheck glacier, initiates a seepage of lake water underneath the glacier tongue. Subsequent fast erosion of the water channels creates massive GLOFs with outflow rates of more than 1000 m³/s.

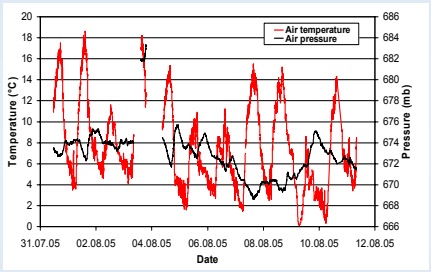
During the refilling of the lake in spring also large amounts of ice are discharged into the growing lake from the ice dam. In the summer 2005 glaciological investigations focussed on the determination of mass fluxes involved in the dynamic response of the ice dam. For this purpose surface ablation, ice thicknesses and ice velocities were measured along several transects on the ice dam and adjacent areas. Weather information recorded at base camp, situated on the lateral moraine, provides the necessary input for spatial and temporal extrapolation of the ablation stake measurements.



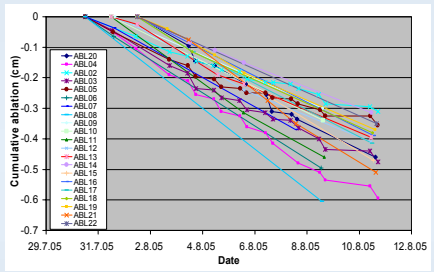
Map of Inylchek glacier and Merzbacher Lake. The lake is dammed by Southern Inylchek glacier, whereas the main water contribution into the lake is from melting of Northern Inylchek glacier. The inset shows the location of the stake pofiles (black) and the radar profiles (red). Yellow lines indicate glacier and flow boundaries. On the Aster image the lake is about halfway filled (80% of the area).



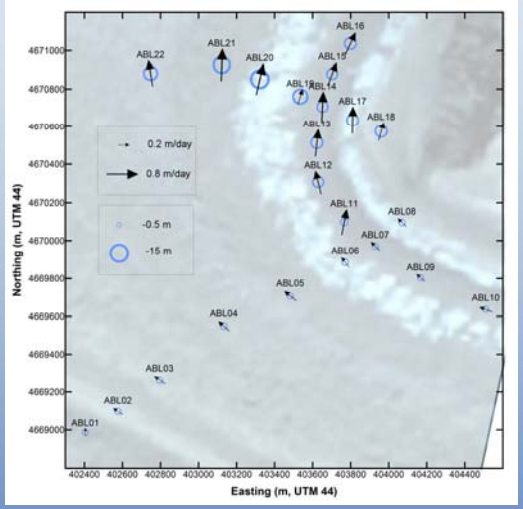
Upper left: GPS measurements on clean ice; upper right: Ice dam of Merzbacher Lake, on the left strand lines of former lake levels are visible; lower right: the area of investigation, the blue coloured region is affected by strong sinking; lower right: difficult conditions for ice penetrating radar.



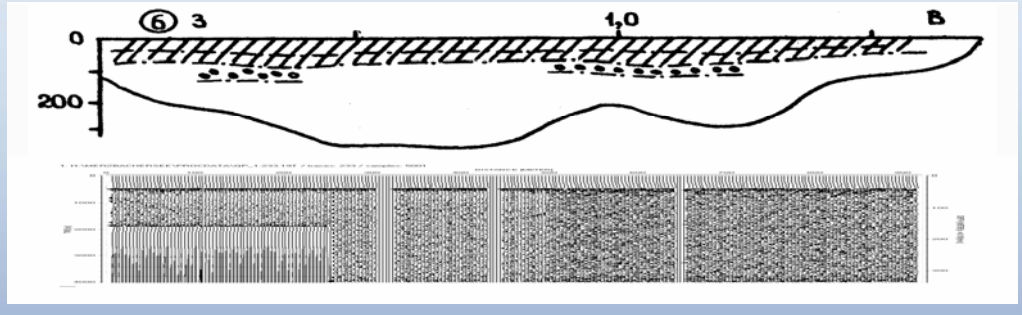
Air temperature and air pressure at Merzbacher Meadow base camp (3440 m) during the period of the field measurements.



Accumulated ice ablation at all stakes of the network. Ablation varies from 3.7 cm/d to 7 cm/d for different locations and debris thickness.



Surface velocity at the stakes, measured for 8-10 days (arrows are proportional to the ice velocity). The rings indicate vertical motion of the ice surface not related to ablation during the observation period.



Profile of ice penetrating radar measurements across the inflow of Southern Inylchek glacier into Merzbacher Lake (see location map, ABL21-ABL18). The interpretation is rather difficult, due to the widespread debris cover and the abundance of surface meltwater. For comparison results from radar measurements on a similar profile in 1990 are given above (Macheret al., 1993)

Results

Despite difficult conditions, due the abundance of melt water and a rather widespread debris cover, ground penetrating radar investigations showed ice thicknesses of more than 300 m in the vicinity of the ice dam. Ice velocity measurements across the glacier resulted in a mean surface velocity of about 230 m/yr at the location of the radar profile. First estimates of ice discharge into the lake are 7x10⁷ m³/yr, in case of only small variations of ice velocities throughout the year. This would be about 30-35% of the estimated lake volume.

The estimated ice flux through the upper cross section (ABL04-ABL08), however, is only 2x10⁷m³/yr (mean surface velocity: 103 m/yr, flow band width: 1100 m, mean ice thickness : 180 m (Macheret et al., 1993)). This implies that the ice flux in the vicinity of the ice dam is at least increased by a factor 3 during the final filling and the subsequent discharge of the lake.

References:

Macheret, Yu.Ya., S.A. Nikitin,A.N. Babenko A.V. Vesnin, L.I. Bobrova & L.V. Sankina, Thickness and structure of the Uzhniy Inylchek Glacier from the data of radio echo sounding, *Materyaly Glatsiol. Isledovaniy*, Vol. 77, pp. 86-97 (Russian), 1993.

Wetzel, H.U., A. Reigber, A. Richter & W. Michajljow , Gletscher-monitoring und Gletscherseebrüche am Inyltschik (Zentraler Tienshan) - Interpretation mit optischen und Radarsatelliten, report, unpublished, 2005.

Acknowledgements:

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