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The 26 November 2008 glacial lake outburst flood in the Zackenberg River (NE Greenland)

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A sudden glacial lake outburst flood (GLOF) event took place on 26 November 2008 in the Zackenberg River drainage basin in northeast Greenland (74˚ N, 21˚ W), and was detected from satellite thermal IR (TIR) imagery from the NOAA AVHRR sensor as a pronounced surface temperature anomaly. A significant amount of water reached the fjord outlet and spread out over a fan-shaped area on top of the snow-covered sea ice. Due to unfavourable cloud cover in the region, information about the very onset of the event is only partly available. However, Synthetic Aperture Radar (SAR) data from the ESA ENVISAT ASAR instrument show a distinct signal over the fjord, resulting from the very different surface roughness of the flooded area vs. the surrounding areas. This dataset shows that within a couple of days the affected area spanned almost the entire width of Tyrolerfjord (locally about 5 km), approaching the northern shore of Clavering Island and covering an area in excess of 12 km^2 over the fjord. The area is adjacent to the Zackenberg Research Station and also close to Daneborg, where the Sirius Patrol is based and operates year-round. It was therefore possible to have several pictures of the fjord and the river delta taken on 30 November 2008. It can be seen that significant amounts of water were still running four days after the onset of the flood.

Within the Zackenberg River drainage basin the only plausible source for such a large amount of water is an unnamed glacier dammed lake some 35 km upstream of the river delta into Tyrolerfjord. This lake is 1.7 km long and 0.4 km wide, has an unknown depth and is dammed by an outlet glacier from the A.P. Olsen ice cap. The lake has been observed to be at its highest ever level at the end of the 2008 summer season, based on a number of satellite images, maps and aerial photos. Sudden floods of the Zackenberg River have been known to occur, and are considered to be GLOFs from this lake, but all previous events are known from the summer season only.

A previous major flood occurred on 25 July 2005 and is documented in the literature, with a measured peak discharge of 152 $m^3 s^{-1}$ at the hydrometric station located about 2 km upstream of the outlet into the fjord, and involved an estimated volume of 9 x 10^6 m^3. In that occasion, maximum air temperatures had reached as high as 20 to 30 ˚C at low elevations in the river catchment, but no data is available from the glacier and the lake area. For the 2008 flood instead, data is available from two permanent Automatic Weather Stations that had been setup in March 2008 on the glacier damming the lake. One of these stations is transmitting quasi real-time observations via a satellite link, and data show that air temperatures varied between about -12 to -20 ˚C in the days preceding the GLOF. An automatic camera had also been setup to take daily pictures of the lake, but data will only be retrieved during the next field visit and low light conditions may reduce the quality of these images.

Finally, some preliminary results obtained by using all of the available MODIS TIR data to further investigate the timing and magnitude of the flood show that, in spite of the moderate resolution of this dataset, the strong surface temperature anomaly still allowed detecting the passage of the flood along the Store Sødal valley and down to the fjord. Further fieldwork is planned to take place during 2009 to investigated the processes involved in the draining of the lake and to better define the geometry and volume of the glacier dammed lake, and to monitor water level fluctuations.