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Unloading deformation due to a draining of ice-dammed lake detected by ERS/Envisat InSAR

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Lake Tininnilik is an ice-dammed lake ($\sim 40km^2$) located in the south of Jakobshaven Icefiord, Greenland. Although it has been known that the lake drains almost every 10 years (Braithwaite and Thomsen 1984), there has been no systematic measurements of the lake level due to the lack of monitoring techniques. It would be curious to see how the lake is filled up with water, and to predict when a draining episode takes place. Here we show a detection of ground displacements associated with the draining event in 1993 and 2004, using ERS and Envisat radar interferograms as well as intensity images. Also, we model the ground displacement as caused by the associated unloading of water, thereby enabling us to infer the water volume.

We generated three independent differential interferograms using ERS data and one differential interferogram using Envisat data; those data are along the track 82 of descending orbit, and covers the frame 2205 to 2259. The pairs are 20-Aug-1992 and 25-May-1997, 24-Sep-1992 and 22-Sep-1996, 18-Mar-1993 and 7-Sep-1997, 10-Nov-2002 and 1-Aug-2004. In order to get rid of errors due to digital elevation model, all those pairs have perpendicular baselines of less than 20-40 m. The derived maximum changes in the radar line of sight approaches $\sim$1.5cm. Using a simple elastic loading model, we estimate the water volume changes to be $\sim$2 km^3.

Long-term monitoring of this lake by satellite remote sensing would be interesting, since a variability in water influx rate can potentially modify the timing of draining episode and might give us another indicator of global warming.