Geophysical Research Abstracts
Vol. 14, EGU2012-10041-1, 2012
EGU General Assembly 2012

Temperature Fluctuations underneath the Ice in Diamond Lake, Minnesota

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Autonomous temperature sensors, data loggers, were placed in the Diamond Lake in Minnesota, Minneapolis, USA. Hourly measurements have been obtained from the snow-covered ice frozen over the shallow lake and as well as from the water directly under the ice. The sensors that were frozen within the ice showed dumped and delayed thermal fluctuation from the surface. The sensors that were deeper within the ice showed continuous, almost constant, temperature near the freezing. All of the sensors that were within the liquid water below the ice showed a thermal variation with 12 but mostly 24 hour periods of amplitudes up to 0.2°C. The analysis of the vertical temperature profile shows that the source of periodic water heating is located below the lake bottom. The absence of daily temperature variations of the ice cover rules out the possible influence of the air temperature. We attribute the heating process to the periodic inflow of ground water to the lake and the cooling to the heat diffusion to the overlying ice cover. The periodic ground water inflow is explainable by solid Earth tides, which cause periodic fluctuations of the ground water pressure head.