In principle, the difference between the sea surface height changes measured by tide gauge and altimeter is the vertical motion at the tide gauge. Combining long-term tide gauge and decadal altimetry observations to infer vertical motion of the solid Earth has been proposed by prior studies. An attempt to use this technique resulted in vertical motion solutions with uncertainties >2 mm/yr, rendering the technique not as viable. Here we describe a novel technique, which is an improved algorithm used by Kuo et al. [2004] which used long-term tide gauge records (>30 years) and decadal TOPEX altimeter and a stochastic network adjustment approach in the semi-enclosed Baltic Sea and in the Great Lakes to determine vertical motion at tide gauge sites at an accuracy <0.5 mm/yr. This extended algorithm could potentially apply to worldwide tide gauges for improved determination of vertical motions, which the primary purpose to improve sea level determination to also potentially include more sites which previously are not used because of unknown vertical motions, including tectonic activities.

Glacial isostatic adjustment (GIA) of the solid Earth due to deglaciation since the last Ice Age is characterized primarily by its viscous rebound on the mantle as a result of relaxation of the shear stresses inside the Earth. In addition to models e.g., the ICE-4G (VM2 model) (Peltier, 1994), the model used from Wu et al. (2005), and the model based on BIFROST data (Milne et al. [2001]), GIA uplift has been recently measured using long-term GPS (e.g., the BIFROST project) (Milne et al. 2001).

We used satellite altimetry and tide gauges to determine secular (crustal uplift) motion in the Great Lakes region. Results indicate reasonable agreement with GIA models and Maunville and Craymer [2002]. Result in Baltic Sea agrees well with GPS solution. In addition, a vertical motion due to postseismic deformation in Alaska region has been computed. Preliminary result of postseismic deformation in Alaska region has been computed and Craymer [2003] agree well with GPS. We used satellite altimetry and tide gauges to determine secular motion at tide gauge sites at an accuracy <0.5 mm/yr. This extended algorithm could potentially apply to worldwide tide gauges for improved determination of vertical motions, which the primary purpose is to improve sea level determination to also potentially include more sites which previously are not used because of unknown vertical motions, including tectonic activities.