GPS and the Bayesian Neural Network Approach in Tidal-Level Forecasting of Nivlisen Ice Shelf, East Antarctica

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The mass loss of continental ice sheets in Antarctic regions are mainly controlled by the ice streams, outlet glaciers and basal melting beneath them, which discharge either into ice shelves or directly into open ocean. As the Polar Regions contribute significantly to global sea-level change, it is therefore crucial to determine the mass balances of the Antarctica Ice sheets. To study the reliability of ice-sheet dynamics and tidal-level forecasting, we conducted GPS measurements at two grounding line points near to the Indian Antarctic Research Base Station MAITRI and one point in Nivlisen Ice Shelf (NIS), East Antarctica during the 2005 austral summer season. In this paper we describe in detail about the diurnal velocity variations in the grounding line points which are spatially correlated with the topography, subsurface undulations, fractures/crevasses and three dimensional motions of the NIS which are mainly modulated by the ocean tides, under water currents. We also employ the Bayesian neural network approach with Hybrid Monte Carlo (HMC)/ Markov Chain Monte Carlo (MCMC) optimization technique for prediction of tidal heights. Posterior probability distribution is estimated using the Bayes' rule. In MCMC algorithm, each trajectory is updated by approximating the Hamiltonian differential equations through a leapfrog discretization scheme using the principle of statistical mechanics in Hamiltonian dynamics. The uncertainty in prediction is analyzed by estimating standard deviation of posterior covariance matrix at the network output. The results are further authenticated by the perdition correlation analysis. The new Bayesian neural network-based modeling approach provides excellent alternative tools for precise prediction of tidal heights and deeper insights into the Hydro-Dynamic Ocean Tide Model behavior.