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Lake storage changes in the Tibetan Plateau using GRACE and ICESat data

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Combining the latest ICESat and GRACE data, this study compares lake mass increase with total mass gain in the inner Tibetan Plateau and analyzes typical lake level changes from 2003 to 2009, which is explained by Weather Research and Forecasting Model. An improved automated method was used to obtain lake level changes. Lakes without ICESat observations were linearly interpolated and underestimation due to lake area expansion and lake density was considered. The results demonstrate that GRACE recorded a comprehensive mass gain (11.93 gt/a $\pm$ 1.25 gt/a) in the inner Tibetan plateau, of which only 64% comes from lake mass increase (7.53 $\pm$ 0.56 gt/a) using ICESat. The main residual signal was found in the northwest, where new lakes are emerging and soil moisture is likely to increase as a result of increasing net precipitation. Generally, the spatial distribution of lake level change concurs with the distribution of net precipitation, which is increasing in the inner Tibetan Plateau and decreasing in the upstream area of the Indus and Brahmaputra Rivers. An excess of rainfall in the northeastern Tibetan Plateau in the summer of 2005 and 2009 caused a simultaneous large increase in water level in many lakes. The correlation of lake changes with net precipitation demonstrates that net precipitation rather than glacial melt is the main cause of lake level change in most places. Nonetheless, supplementation from meltwater is considerable for lakes near glaciers such as Selin Co and Nam Co. Lake level is thus an important indicator of climate changes.