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Toward Complete Three-Dimensional Movements for Alpine Glacier in Qinghai-Tibetan Plateau by Integrating D-InSAR, MAI and Offset-Tracking Measurements

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As the largest cryosphere except the poles, the Qinghai-Tibetan Plateau is the main aggregation area of the alpine glaciers in the low latitudes. Since characterized by small size and steep terrain, the change of the alpine glaciers in the Qinghai-Tibetan Plateau are more sensitive to the global climate change than that of the polar ice sheets, and has become the most uncertain factor with respect to the water resources and sea level change. Therefore, it is significant to monitor the alpine glacier movement, particularly with high accuracy and three-dimensional nature, in order to have proper knowledge of the water migration in the Qinghai-Tibetan Plateau and its responses to the global change. Three-dimensional (3-D) movements of the Dongkemadi Glacier in the Qinghai-Tibetan Plateau during 2007 and 2010 are full determined by using the L-band ALOS PALSAR ascending acquisitions and the C-band ENVISAT ASAR descending acquisitions. In order to yield an optimal 3-D solution, the D-InSAR and MAI measurements derived from the PALSAR data and the Offset-Tracking measurements derived from the ASAR data are integrated by a variance component estimation (VCE) algorithm. By exploiting the heterogeneous InSAR measurements themselves to infer the weighting scheme, the novel approach results in an accuracy of centimeter to decimeter per year for all the three velocity vectors. The horizontal estimation shows four main tributary streams in the Dongkemadi Glacier, which are all flow from the central area to the surroundings. The glacier thickening or thinning is also resolved from the vertical estimation by subtracting the down-slope movement. This can be used as a good indication of the ice dynamics and the location of the subglacial water in the alpine glacier.

Key words: alpine glacier, 3-D movements, Qinghai-Tibetan Plateau, SAR, VCE

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