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Influence of Different Data Fusion Methods on the Accuracy of Three-Dimensional Displacements Field

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Combining multi-source data can improve the accuracy and the spatial resolution of the three-dimensional (3-D) displacements field. How to effectively integrate multi-source data to obtain high-precision and high spatial resolution 3-D displacements field is worthy of further study. The stochastic model and fusion model of integrating multi-source data affect the accuracy of data fusion. In this paper, based on the least squares method, the effects of different stochastic models and data fusion models on the 3-D displacements field's accuracy are studied. The optimal method for estimating large-scale 3-D displacements field from integrated InSAR, leveling and GPS measurements is obtained. Then we realize the integrating InSAR, leveling and GPS measurements to obtain the high-precision 3-D displacements velocity field in Tianjin(China) from 2016 to 2018. The results are validated with GPS measurements at 6 independent stations, with the root mean squares (RMS) residuals of the discrepancies being 2.39mm/yr□2.54mm/yr and 2.83mm/yr in eastern, northern and vertical directions, respectively. By comparing different stochastic models, the 3-D displacements field obtained from multi-source data is optimized by the variance component estimation-least squares method, which is better than weighted least squares (WLS) method. By comparing different data fusion models, the accuracy of the horizontal displacements velocity is better than that of interpolated GPS results. The horizontal displacements component has a great influence on the vertical displacements velocity accuracy in the process of acquiring the 3-D displacements velocity by integrating InSAR, GPS and leveling measurements. This study provides a reference method for integrating multi-source data to obtain 3-D displacements field. This method effectively utilizes the advantages of GPS, InSAR and leveling measurements, and extends the limitations of single technical in describing surface-time scale applications. The 3-D displacements information with a large spatial scale and high spatial resolution provide a reliable data basis for studying the crustal movement and its dynamic mechanism.