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Young's modulus of Antarctic ice shelves derived by double-differential interferometric SAR

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In this study we observed the tidal deflection signal and physical properties of Ronne Ice Shelf and Ross Ice Shelf, Antarctica, by applying double-diffential interferometric synthetic aperture radar (DDInSAR) technique to a series of Sentinel-1A/B (2015) and ERS-1/2 (1996) SAR data. No significant changes of DDInSAR-derived grounding line were detected during 1996 and 2015 while the MODIS-based grounding line (2004) contains up to 7 km error due to inaccuracy of DEM-based observation. We defined the hinge zone width as a distance from the grounding line to the maximum deflection point of the free floating ice shelf due to tide. Based on the elastic beam model, we derived that the hinge zone width is proportional to ice thickness to the power of 0.75. The Young's modulus of the ice shelf was estimated by a linear regression between the hinge zone width and ice thickness provided by Bedmap2. The Young's modulus of Ronne Ice Shelf estimated by ERS-1/2 (1996) DDInSAR was 1.20±0.50 GPa while that of Sentinel-1A/B (2015) was 1.28±0.45 GPa. The Young's modulus of Ross Ice shelf observed by Sentinel-1A/B (2015) was 1.77±0.73 GPa. Those values are in good agreement with the previously reported ones observed by in situ methods.