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First complete regional view of the Pensacola-Pole Basin from PolarGAP radar data

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The broad region around South Pole, including the Support Force Ice Stream, is one of the most poorly understood on our planet. Critically, uncertainties in bedrock elevation of over a kilometre in this area have been shown to generate variations in modelled volumes of ice loss under warmer climatic scenarios equivalent to 1.68 m global sea level change. During the 2015-16 field season the European Space Agency PolarGAP project collected ∼38,000 km of new integrated aerogeophysical data across this region. The focus of this successful survey was collecting airborne gravity data to fill the southern polar gap in satellite gravity coverage required for global geoid models. Coincident airborne radar, aeromagnetic and airborne Lidar data will make a significant additional contribution to understanding this critical, but poorly understood region.

Here we present the first compilation of the airborne radar data from the PolarGAP survey. To assess the impact of sub-ice topography on ice flow we compare the new bedrock topography with satellite measurements of ice flow velocity. We show that the upstream part of the Support Force Ice Stream flows within the ∼150 km wide Pensacola Pole Basin, which is generally 650 m below sea level and extends from the coast to South Pole. The fastest ice flow is offset from a ∼25 km wide over-deepened axial trough, up to 1800 m below sea level. Our data broadly supports the patterns of bed roughness and internal layer deformation identified by previous authors, with presently enhanced ice flow linked to smooth bed and buckled ice sheet internal layers. Upstream of South Pole limited internal layer deformation suggests that the observed smooth bed morphology is a relict feature. Together our new dataset provides both new constraints for ice sheet models and gives new information about the evolution of the East Antarctic Ice sheet in this previously un-explored region.