Investigating the effect of subglacial lakes on the force balance of Byrd Glacier

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Byrd Glacier is an outlet glacier where ice drainage transitions from sheet flow to shelf flow. It has one of the largest catchment basins in Antarctica and drains approximately 20.5 km^3 of ice into the Ross Ice Shelf annually. Previous studies indicate that the main restive force controlling Byrd Glacier's flow dynamics is due to basal drag. Spatial calculations of the force balance produce smaller regions of higher basal drag, known as "sticky spots". There have been several studies into the dynamics of sticky spots found on ice streams, but very little literature exists on those on outlet glaciers. In recent literature, it has been hypothesized that sticky spots cause water to collect in smaller regions and form a subglacial lake. Other studies posit that the low values of hydro-potential around subglacial lakes are the cause of sticky spots. In the basin of Byrd Glacier, both of these theories potentially describe the cause and effect of the sticky spots. There are five regions in the basin where surface elevation changes have been recorded from altimeter LiDAR. These surface elevation changes are believed to be the result of water filling into, or draining from subglacial lakes. Two of the lakes in the catchment of Byrd Glacier were recorded draining accompanied by a 100 m/yr increase in ice velocity. Analysis of the bed topography, hydro-potential data, and other possible subglacial lake locations in this region show that these lakes likely are nourished by water sources upstream. In addition, there are other, much smaller lakes within the basin. These smaller lakes are isolated in the lower regions within areas of high relief and the hydro-potential results provide no indication that these lakes are filling from remote water sources. In this study, the effect of subglacial lakes on Byrd Glacier's force balance ("sticky spots") is being investigated. We are also exploring the possibility of lake formation due to basal melt by analyzing localized basal melt around the. It is hypothesized that these smaller lakes form from local basal melt due heat produced by friction heat. Our investigations use a combination of force balance and geothermal heat flux modeling. The spatial patterns of the results will be used to assess the correlations of high basal drag values and areas of potential bed melt.