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An alternative approach to identify Antarctic subglacial lakes

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The discovery of many subglacial lakes provides clear evidence for the presence of water beneath the Antarctic ice sheet. Recent observations also indicate interactions between lakes over several hundred kilometers. It is important to understand these subglacial hydrodynamic networks as they are not only a key parameter in form of basal lubrication to ice flow modelling, but subglacial lakes are also considered to be possible unique ecological habitats. Until now subglacial lakes have been identified on satellite images by an unusual flat ice sheet surface slope or with airborne radio-echo sounding by conspicuous bright and flat radar reflections. Here we present an alternative method to detect potential basins where subglacial melt water might accumulate. We developed an algorithm to identify local minima in the hydrological potential of Antarctica (derived from the ALBMAP data set). With this method a first geometric restriction for the presence of subglacial lakes is given. In a second step the basal melt rate is estimated with the numerical thermodynamic ice flow model RIMBAY. This allows us to identify regions where subglacial water is generated. Finally, we compute volume and potential pathways of subglacial water flow from melting areas across subglacial lakes towards the Southern Ocean. The comparison of the subglacial lakes found by this method with already surveyed subglacial lakes shows a very good correlation. Especially the bigger lakes like Lake Vostok, 90 Degree Lake, Adventure Trench Lake, Lake Concordia and Lake Aurora are clearly identified. But our map also indicates until now undiscovered lakes. Some of them are planned to be surveyed in the upcoming field season by airborne radar measurements. Furthermore our method can easily be applied to updated data sets of Antarctica or to Greenland and hence is a universal tool to identify the locations of possible subglacial lakes under large scale ice sheets.