Ground thermal and active layer monitoring on Sub-Antarctic Marion Island and Western Dronning Maud Land, Antarctica.

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A key focus in climate research is the incorporation of change detection in the terrestrial cryosphere and it's coupling with the climate system. Permafrost, which covers almost a quarter of global ice-free area, is a central component of polar and sub-polar environments. Because permafrost is a thermal condition of the ground, its distribution and behaviour is sensitive to climate change. As the climate warms, the increased thaw of the uppermost permafrost and thickening of the active layer, results in ground subsidence, accelerated erosion and related hydrological and geochemical changes, as now observed in northern polar regions[1]. In order to determine short- and long-term thermal conditions, ground temperature measurement and spatial modelling is being undertaken on Sub-Antarctic Marion Island and Western Dronning Maud Land (WDML), Antarctica. We have shown that, while no permafrost remains, Marion Island has a distinctive diurnal soil frost regime due to a maritime, sub-Antarctic setting[2,3]. Diurnal freezing and associated sediment displacement increases in intensity-frequency-duration with altitude. Cloud cover, snow and latent heat exchange are now recognized as important factors influencing the ground climate and its responses to current climate change. This has direct and indirect consequences for terrestrial ecosystem dynamics on the island. The first detailed inventories of periglacial landforms and ground thermal monitoring in WDML has been undertaken. Ground thermal monitoring stations have been established at a number of locations, while short-term temperatures data were collected from Vesleskarvet. One minute interval data show evidence of latent heat release from freezing of soil moisture, indicating frost activity in patterned ground. Initial inventories of periglacial landforms were established for a number of Nunataks in WDML indicate that the availability of moisture and fine material, together with aspect and wind direction, are important controls on the dynamics of the active layer. First active layer observations for WDML suggest that it varies in depth from 60 cm at the coast to less than 10 cm at 1200 m.a.s.l. The impact of recent climate change is likely to be complex, given that land surface temperatures since 1982 in WDML show warming trends near the coast and cooling in the interior[4].

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