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Nine year active layer thermal monitoring at Fildes Peninsula, King George Island, Maritime Antarctica

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Most global circulation models predict enhanced rates of climate change, particularly temperature increase, at higher latitudes witch are currently faced with rapid rates of regional climate change (Convey 2006, Vaughan et al. 2003, Quayle et al. 2002), Antarctic ecosystems are expected to show particular sensitivity and rapid responses (Freckman and Virginia 1997, Quayle et al. 2002, 2003). The active layer and permafrost are important components of the cryosphere due to their role in energy flux regulation and sensitivity to climate change (Kane et al., 2001; Smith and Brown, 2009). Compared with other regions of the globe, our understanding of Antarctic permafrost is poor, especially in relation to its thermal state and evolution, (Bockheim, 1995, Bockheim et al., 2008). The active layer monitoring site was installed in the summer of 2008, and consists of thermistors (accuracy ± 0.2 °C) arranged in a vertical array (Turbic Eutric Cryosol 60 m asl, 10.5 cm, 32.5 cm, 67.5 cm and 83.5 cm). All probes were connected to a Campbell Scientific CR 1000 data logger recording data at hourly intervals from March 1st 2008 until November 30th 2012. We calculated the thawing days (TD), freezing days (FD); thawing degree days (TDD) and freezing degree days (FDD); all according to Guglielmin et al. (2008). The active lawyer thickness was calculated as the 0 °C depth by extrapolating the thermal gradient from the two deepest temperature measurements (Guglielmin, 2006). The temperature at 10.5 cm reaches a maximum daily average (5.6 °C) in late January 2015, reaching a minimum (-9.6 °C) in in early August 2011, at 83.5 cm maximum daily average (0.6 °C) was reached in mid March 2009 and minimum (-5.5 °C) also in early August 2011. The years of 2008, 2009 and 2011 recorded thaw days at the bottom of the profile (62 and 49 in 2009 and 2011), and logged the highest soil moisture contents of the time series (62%, 59% and 63%). Seasonal variability of the active layer shows disparities between different years, especially in bottom most layer, where high summer temperatures trigger a increase in soil moisture content that can endure for several seasons. The winter of 2014 also deserves special attention, being the mildest winter recorded during the studied period; in July minimum monthly temperatures were -3.2 °C and -1.9 °C at 10.5 cm and 83.5 cm, it experienced 17 FD summing -0.61 FDD, average for the whole period was -7.5 °C, -3.9 °C, 27 FD and -55 FDD (2008 also had a mild winter but still hold 21 FD and -0,88 FDD at 83.5 cm in July). The summer of 2009 was the warmest facing 31 thawing days and summing 105 thawing degree days at 10.5 cm in January (28.7 thawing days and 66.3 thawing degree days average). The profile showed a increase in soil water content annual during warm summers, persisting for the following seasons, average is 44 % in 2008, 32 % in 2012 closing the time series with a annual average of 27 % in 2016, all values at 83.5 cm. Active layer thickness varied between 86 cm (max of 2015, March) and 117 cm (max of 2009, March). The active layer thermal regime over a 9 year period at Fildes Peninsula shows great variation between years, 2008, 2009 and 2011 presenting warm summers and 2014 being abnormally warm during Winter. Temperature fluctuations can affect the active layer in depth and the effects of warmer temperatures in the bottom of the profile can increase soil water content for several seasons.