Benchmarking Deep Soil Simulator against permafrost thermal characteristics measurements

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Results of simulation and observations of the permafrost thermal state in the north of the West Siberia is compared. To simulate of soil state, off-line numerical experiments are performed with the Deep Soil Simulator (DSS) [1, 2]. The DSS is forced by the air temperature and snow depth (shown the red lines in Fig. 1) for 01.2012-12.2013.

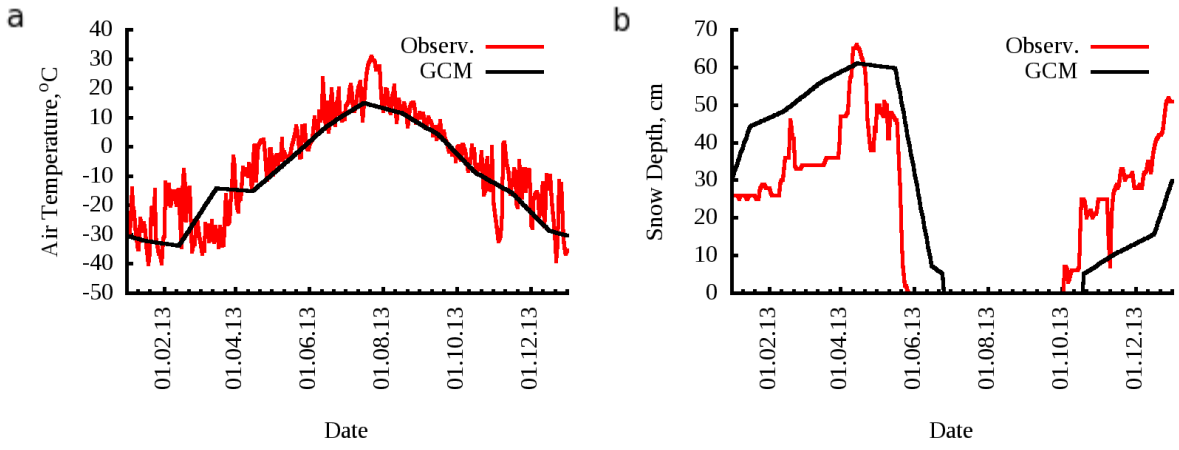

Fig. 1. Simulated using MIROC5 GCM (black lines) and measured at the Tazovskiy weather station (red lines) air temperature (a) and snow depth (b), respectively.

The daily means these meteorological parameters are calculated using the archive of the Tazovskiy weather station WMO ID 23256 (67°28'N, 78°43'E) (http://rp5.ru). The active layer thickness (ALT) and soil temperature is measured at experimental site of the tundra zone (67°22'N, 78°37'E) for 07.2013-10.2013 [3]. Simulated and measured soil temperatures at 1.5 m and 3 m are shown in Fig. 2a. The active layer thickness are shown in Fig. 2b. Simulated values are in the good agreement with the measured.

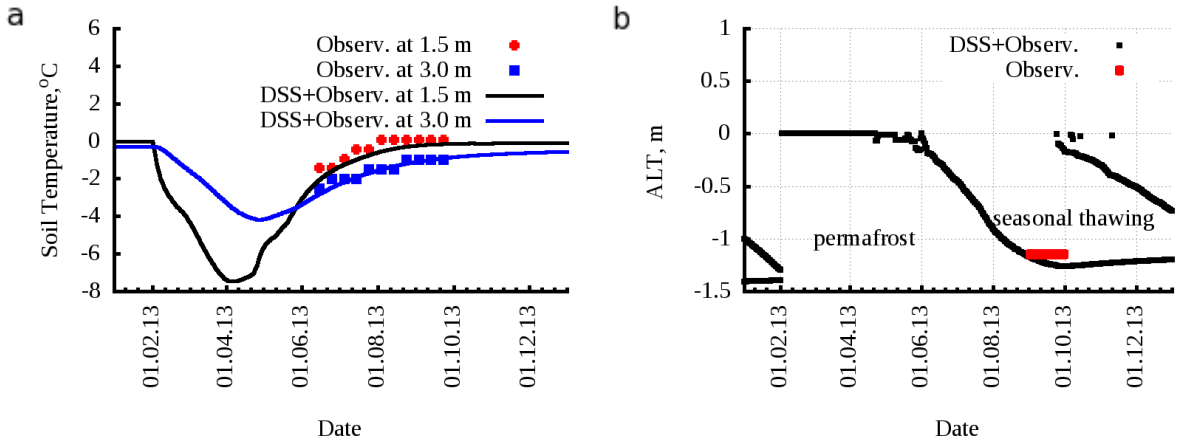

Fig. 2. Simulated and measured soil temperatures at 1.5 m and 3 m (a) and active layer thickness (b).

To assess the soil regime dynamics during the 21st century the DSS is forced by the MIROC5 GCM air temperature and snow depth under RCP 8.5 anthropogenic scenario. Comparison of simulated and observed values of these parameters is shown in Fig. 1. Results of numerical experiments with DSS forced by the MIROC5 GCM are shown in Fig. 3. Simulated soil thermal regime is changed since 2060s (Fig. 3a). Soil thaw depth increased from the 2010s to the 2060s (Fig. 3b). For this experimental site talik formation occurred about 2063-2064.

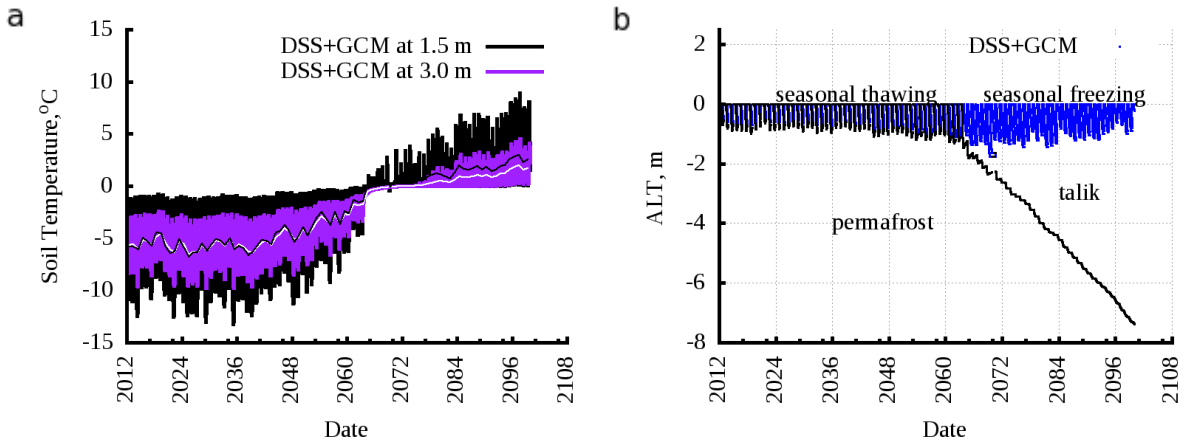

Fig. 3. Simulated yearly means and amplitudes of the soil temperatures at 1.5 m (black line) and 3 m (purple line) (a) and active layer thickness (b) for 2012-2100.

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