OBSERVATIONS OF THE FEATURE OF THE ATMOSPHERIC BOUNDARY LAYER THERMAL REGIME AT THE ARID AREA IN A HOT SEASON

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ABSTRACT

Results of atmospheric boundary layer temperature profile measurements obtained during field expedition to the arid region (July-August 2007, Russia, Kalmykian Black Lands) are presented at the report. Measurements were provided by the using of microwave temperature profiler MTP5 with altitude range 0-600 m and accuracy of temperature profiles measurements 0.5 C. Simultaneously were provided measurements of aerosol with the using of different nephelometers, wind measurements by sodars and turbulence measurements by ultrasonic anemometers.

Introductions

Climate changes and climate variability will likely have a significant impact to the arid and semi-arid areas which comprise about 30% of earth surface (Slingo et al, 2006; Huang et al, 2007). At July-August 2007, the field expedition was provided at the south part of Russia, at the Kalmykian Black Lands (45^o 21′ N, 46^o 02′ E) with participations of scientists of Russian Academy of science and from the Central Aerological observatory. Researchers, led by Dr. Igor Granberg, used measurements of atmospheric temperature and wind profiles, and ground- based retrievals of aerosol optical properties-such as aerosol optical thickness and reflectivity-as input to radiation models to assess their ability to simulate the impact of the dust on solar radiation balance. It was found that in a hot season in absence of dust storms convective processes lift up dust particles into the atmospheric boundary layer (ABL) from sandy landscapes of Kalmykia and Sub-Aral regions(Golitsyn et al, 2003). The increasing of fine aerosol concentration was found at air temperature above 25 ^{o}C, surface temperature above 50 ^{o}C, and relative humidity less than 40%. Vertical distribution of aerosol concentration depends from ABL stability and so it will be useful to have continuous measurements of ABL temperature profiles. Such measurements were provided by the using of microwave temperature profiler MTP5. It was in continuous operation in field conditions from 18 July up to 30 July and measured temperature profiles in altitude range surface - 600 m each 5 minute. During period of observation temperatures at altitude 2 m above surface were changing from +16 ^{o}C at night up to the +39 ^{o}C at day time (from ultra-sonic anemometer data).

The quantitative parameters of ABL thermal regime at arid region will be presented in the report: temperature inversion parameters, feature of temperature gradients at different altitudes and in different weather conditions, diurnal temperature variations at different altitudes.

Fig.2. Microwave temperature profiler MTP5 at arid region.

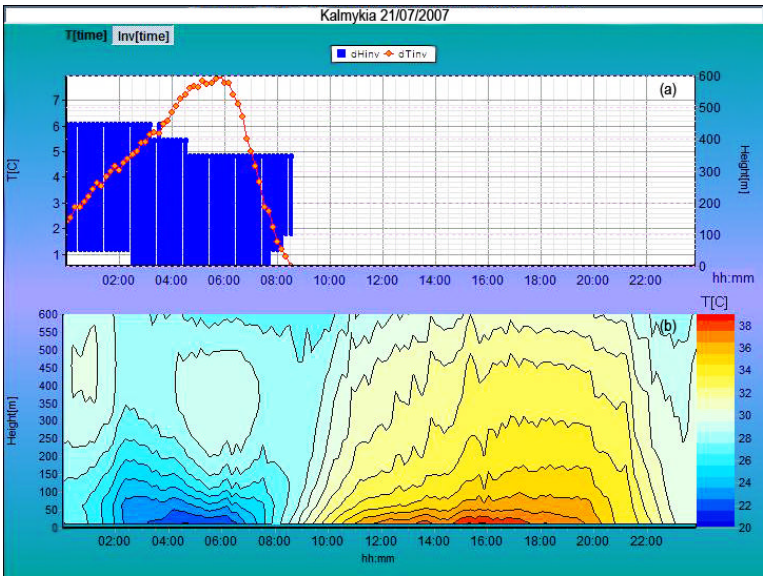
Observation result

In the field conditions for continuous ABL temperature profile measurements was used microwave temperature profiler MTP5-an angular scanning single-channel radiometer with the central frequency 60 GHz (Kadygrov and Pick, 1998). The first temperature profile (after checking and on-site calibration of the MTP5 instrument) was measured at the 21 July, 2007. All at all, more then 2500 temperature profiles were obtained during the expedition in different weather conditions.

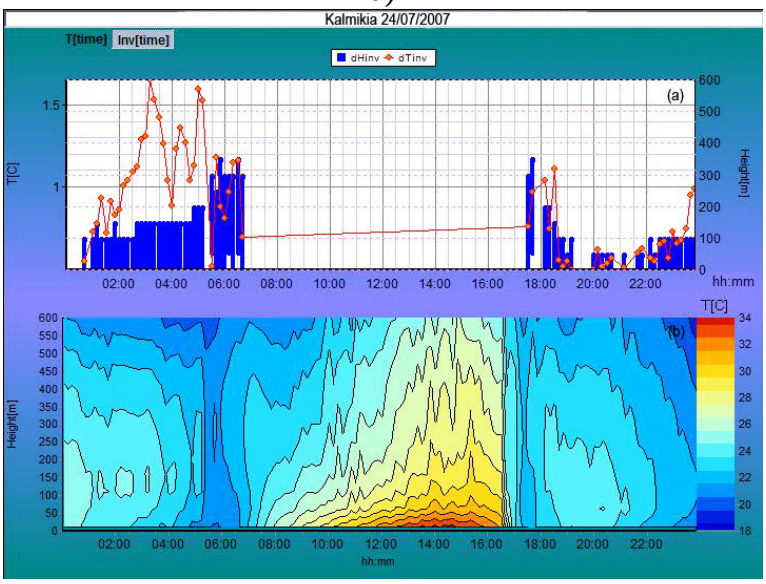
At 21 July was sunny day without rain, temperature near surface was changing from +39 C at day time up to 20 C in night time, some clouds were observed after 06 p.m. At night time was strong temperature inversion up to the 09 a.m. Temperature gradient at the first 100 m was -4.59 C at 05 a.m. and +3.93 C at 01 p.m. Diurnal variations of temperature at different altitudes at 21 July and temperature inversion parameters are shown at Fig.2 a, and diurnal variations of temperature gradient (inverted) are shown at Fig.3a.

At the 24 July was wind 5-7 m/c and rain from 04 p.m. up to the 06 p.m. Temperature near surface was changing from +34C at day time up to the +18 C in night. Temperature inversion was indicated from 01 a.m. up to 07 a.m. Diurnal variations of temperature at different altitudes at 24 July and temperature inversion parameters are shown at Fig.2 b, and diurnal variations of temperature gradient (inverted) at the lowest 100 m are shown at Fig.3 b.

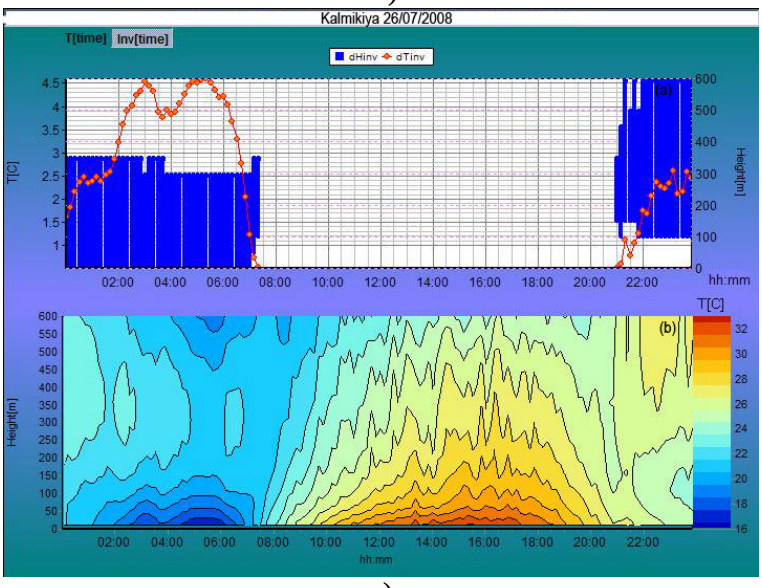
At 26 July was sunny day but with wind about 10 m/c which gave not strong duststorm in the evening. It was day with the lowest temperature for all period of observations. Temperature at 2 m altitude was changing from +34 C in a day time up to the +16 C in night. Ground-based temperature inversion was from midnight up to 07 a.m., elevated temperature inversion was indicated in night time after 09 p.m. Temperature gradient at the lowest 100 m was changing from -3.19 C up to +3.28 C. Diurnal variations of temperature at different altitude in the range 0-600 m and parameters of temperature inversion are shown at Fig.2 c, and diurnal variations of temperature gradient (inverted) are shown at Fig.3 c.



a)

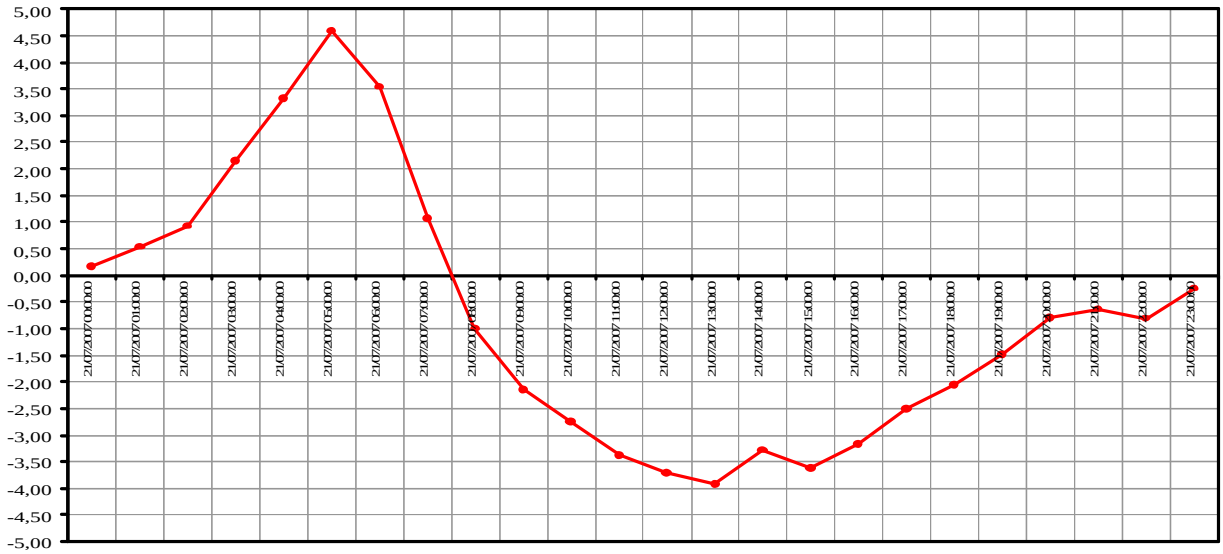


b)

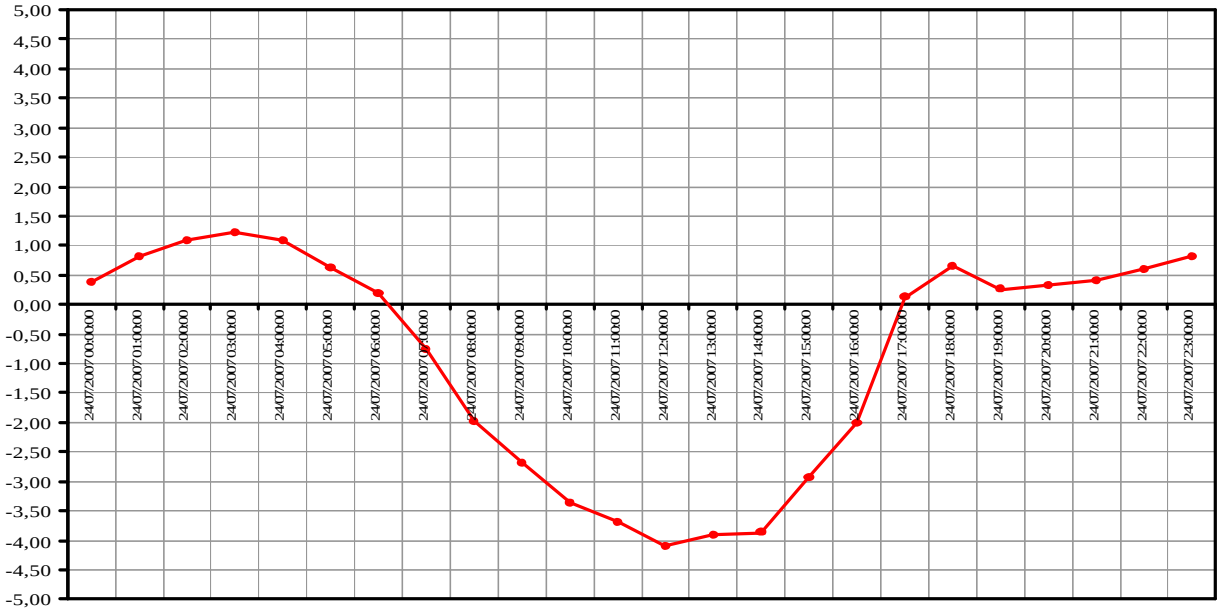


c)

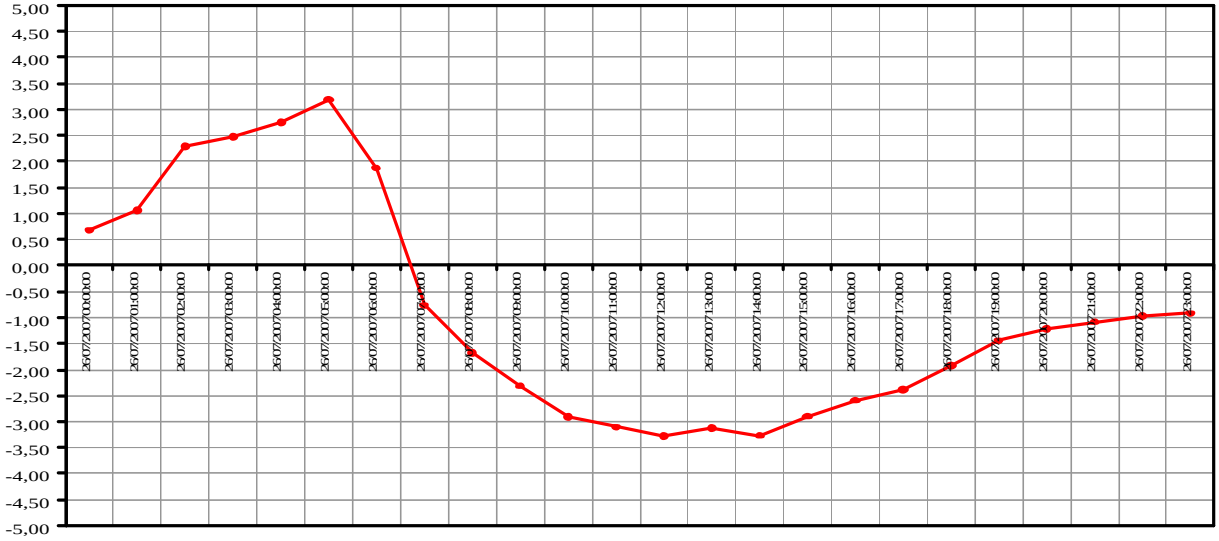
Fig.2 (a,b,c). Diurnal variations of temperature at altitude range 0-600 m and diurnal variations of temperature inversion parameters at 21 July 2007 (a), at 24 July 2007 (b) and 26 July 2007 (c) measured by a microwave temperature profiler MTP5.



a)



b)



c)

Fig.3 (a,b,c). Diurnal variations of temperature gradient (inverted) at the lowest 100 m at 21 July 2007 (a), at 24 July 2007 (b), and at 26 July 2007 (on the basis of the microwave temperature profiler MTP5 data).

Conclusion

During field expedition to arid region of Russia (Kalmikia, Black Lands) firstly in July 2007 was used microwave temperature profiler MTP5 for continuous measurements of atmospheric boundary layer temperature profiles. Obtained results shows that it can give useful information about stability of the low troposphere (0-600 m) even at the hot season in arid region. This information can be useful for aerosol investigation in arid region.

Acknowledgements

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