Trend reversal of boundary layer height in China and its influential factors

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Our knowledge concerning the trend in boundary layer height (BLH) in China is limited due to the unavailability of reliable and high-resolution radiosonde measurements. In this talk, we will present the trend of BLH over China, using the radiosonde observations (at 08:00 pm) at 89 stations for the period 1979–2016. Overall, the annual mean BLH averaged over all the available stations in China exhibits a distinct west-to-east negative gradient. Most stations exhibit an increasing trend in BLH during 1979-2003 and shift to a declining trend in BLH during 2004-2016. The trend of seasonal mean BLH bears resemblance to annual mean BLH. The meteorological influence on the temporal disparity of the BLH trend is investigated as well, showing that BLH at most sounding sites is negatively associated with the soil moisture, lower tropospheric stability (LTS) and surface relative humidity, but positively associated with the near-surface temperature. An increase of BLH (9.4m yr^{-1} during 1981-1988,14.0m yr^{-1}during 1989-2003) from 1979 to 2003 is found to be related to an increase in near-surface temperature (mean=0.04 ºC yr^{-1}), a reduction of soil moisture (mean=-2.18 kg $m^{-2}yr^{-1}$), a reduction of LTS (mean=-0.03 K yr^{-1}), a decrease in surface relative humidity (mean=-0.007 % yr^{-1}) during 1979-2003.A weakening of near-surface temperature and the increase of soil moisture, LTS and surface relative humidity are found to contribute to the decreasing trend of BLH during 2004-2016. The major findings obtained from this study help us better understand the climatology of BLH over China and its association with related meteorological variables.

Keywords: Boundary layer height, radiosonde, trend reversal, China

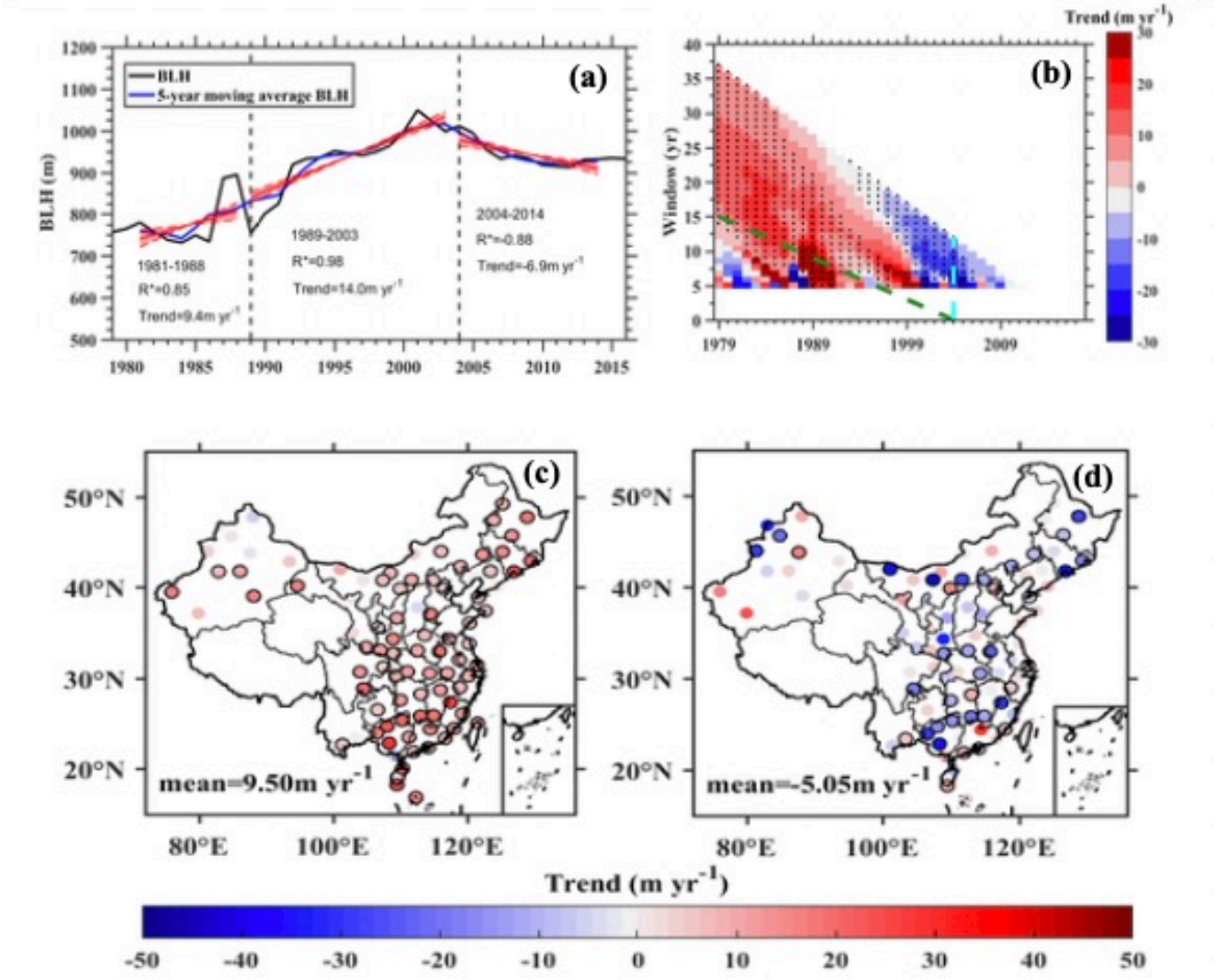

Figure 1. (a) Time series of annual mean BLH (black line) and 5–year moving average BLH (blue line) for 89 stations in China at 2000 BJT for the 1979–2016 period. The red lines denote the least-square linear fitting trend, the climate shifts in the time series of BLHs are marked by vertical dashed black lines in 1989 and 2004, respectively. Red shading areas and dash lines represent 95% confidence intervals. (b) Running window linear trends in annual mean BLH during 1979–2016. The x-axis represents the start year of the analysis period, while the y-axis represents the length of the analysis period. The dashed green line denotes all linear trends that end with the year 2004, while the dashed cyan line indicates trends that start with the year 2004. Trends that are statistically significant at the 95% confidence level are indicated by black dots. Note that running windows with lengths less than 5 years are not considered. Also shown is the spatial distribution of the trend (color shaded dots) of annual mean BLH in China during the periods of 1979–2003 (c) and 2004–2016 (d). Circles outlined with black indicate that trends are statistically significant ($p<0.05$), and the overall value of trend is given for each panel as well.

