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Observed Variability of Global Atmospheric Mixing Layer Height from 1971 to 2014

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It is important to determine the mixing layer height (MLH) for understanding the transport process in the troposphere, weather prediction, and climate monitoring. MLH is a key parameter in air pollution models which determines the volume available for pollutants to dispersion. The long-term variation of MLH can drive the change of surface air quality. Many methods have been proposed to estimate MLH from the temperature or atmospheric composition profiles provided by radiosonde and remote sounding systems. Radiosonde data are usually considered as a reference by other methods owing to its long-term history and direct observation. However, disagreements exist between MLHs derived from different variable profiles of radiosonde data. In this study, a method integrating the information of potential temperature, relative humidity, specific humidity, atmospheric refractivity and the effect of cloud on the boundary layer turbulence was applied to the global radiosonde data to generate long-term variation of the global MLH from 1971 to 2014. The radiosonde observations were released by the Integrated Global Radiosonde Archive (IGRA) of National Climatic Data Center (NCDC). The MLHs in the North America are fairly deep, with an average value between 1800 and 2200 m, however, the Europe and the Eastern Asia have shallow MLHs between 1200 and 1500 m. The majority of the North America and Australia stations showed a negative trend during the period of 1971 to 2014, while, for the Europe and Japan, the MLHs increased over time. The MLH had a negative correlation with surface relative humidity and a positive association with surface air temperature. Besides the effect of thermodynamic factors, the dynamical factors including the surface wind speed and its shear in the boundary layer influence the development of the boundary layer. However, there is no significant correlation between the surface wind speeds and MLH in this study. Weak negative association was found between boundary layer wind shear and MLH, but the scarcity of wind shear data reduced the reliability of the result. The combination effects of humidity and temperature dominated the variation of regional MLH, including Europe, Russia, Japan and the America.