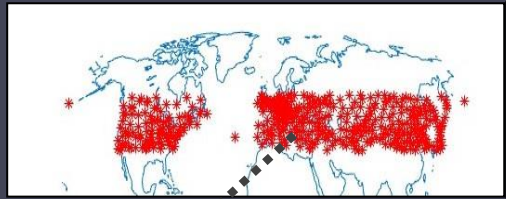
Boundary Layer Height Estimated and dynamic parameter comparison using Radiosoundings Observations around globe at mid-latitude region

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ABSTRACT

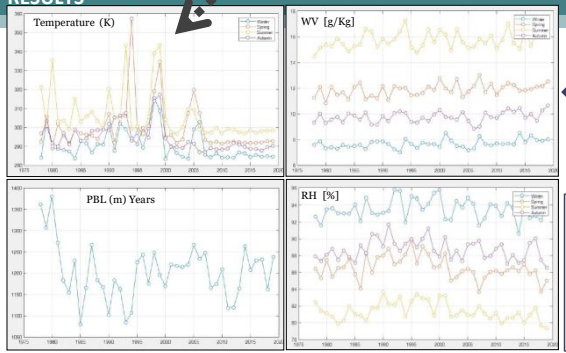
The exchange processes between the Earth and the atmosphere play a crucial role in the development of the Planetary Boundary Layer (PBL). Vertical profiles of atmospheric thermodynamic variables, i.e. temperature and humidity, or wind speed, clouds and aerosols can be used as proxy to retrieve the PBL height and other dynamic variables at different vertical and temporal resolutions. The present work aims to correlate the PBL height variability with other factors determining or interacting with the PBL, such as the mixing-ratio and CAPE . The study is focused on the mid-latitudes observations (30 ° N and 50 ° N). Radiosounding profiles from the Integrated Global Radiosounding Archive (IGRA) are used to estimate the PBL height, while the European Center for Medium-Range Weather Forecasts (ECMWF). Re-Analysis v5 (ERA5) and the GCOS Reference Upper-Air Network (GRUAN) Lindenberg station radiosounding data are used as intercomparison datasets for the study uncertainties in the trend analysis



Global radiosoundings are obtained from IGRA, which is the most comprehensive, authoritative collection of historical and near-real-time radiosonde and pilot balloon observations from around the globe, maintained and distributed by the National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NCEI). Data are taken from IGRA data version V2 released in August 2016 [16,17], which has several quality improvements with respect to the previous version (V1), such as an increased spatial coverage, and incorporates data from a considerably larger number of data sources, with an increased data volume by 30%.

The comparison of the decadal trends reveals an overall similar behavior for the two datasets at night, while some differences are present during the day. Nighttime decadal trends for IGRA have not a prevalent sign and oscillate between −10 and 20 m per decade, while for ERA5 values range within −10 and 10 m per decade for ERA5 and mainly positive (for both the dataset with the exception of few sites only). The trends for IGRA also show that positive values are more frequent at coastal stations while negative for the continental. During the day, the trend values of CBL height are mainly positive for ERA5, while IGRA has a narrow prevalence of positive values. It can be noted that ERA5 values are also less homogeneous than IGRA with values ranging between −30 and 50 m per decade, while IGRA values ranges between −10 and 10 m per decade, with the exception again of two sites with values smaller than −10 m.

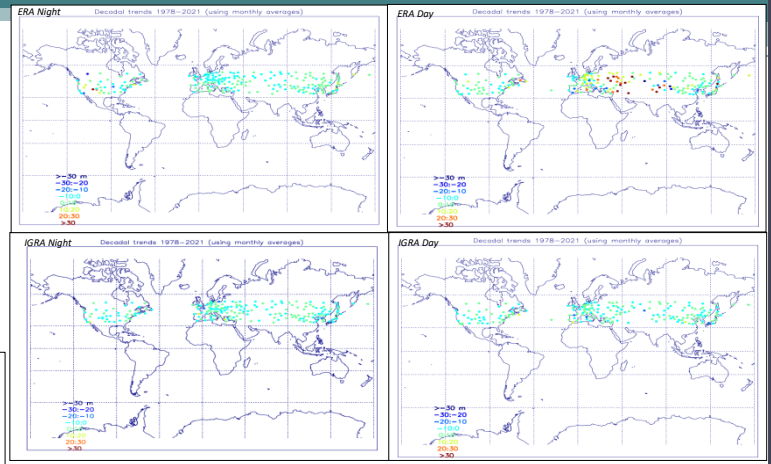
RESULTS



The BLH is estimated from the IGRA radiosoundings temperature profiles considering the location of the maximum potential temperature vertical gradient. The potential temperature is denoted with θ(z), and for a gas well approximated as ideal, is given by:

$$\theta(z) = T(z)\left(\frac{P_0}{P(z)}\right)^{\frac{R}{c_p}}$$

Maps of decadal trends of the nocturnal boundary layer (NBL, left panels) and convective boundary layer (CBL) height (right panels) retrieved from ERA5 (upper panels) and IGRA (lower panels) in the period 1978–2018. Color legend is reported in the bottom left corner of each panel. Dots are representative of the location of midlatitudes radiosounding stations with a data completeness larger then 75%.



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