THE PBL AND OTHER THERMODYNAMIC INDICES FOR THE STUDY OF CLIMATE CHANGE

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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 red stars represent the radiosondes in the selected range.

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:

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

Evolution of the PBL range [m]
1978-2020
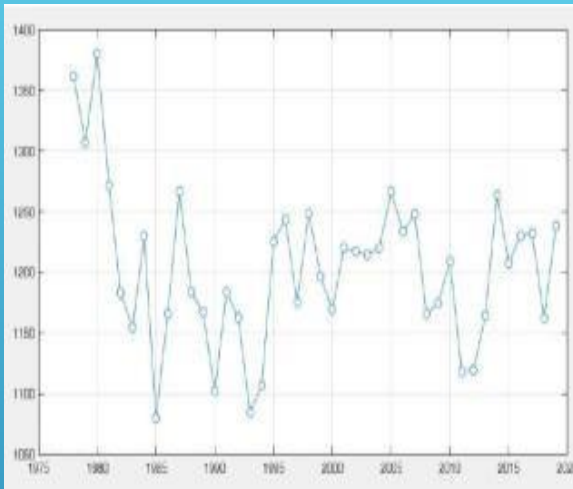
Data are taken from IGRA data version V2 released in August 2016, which has several quality improvements with respect to the previous version (V1), such as an increased spatial coverage, and incorporates data from a considerably larger number of data sources, with an increased data volume by 30%.
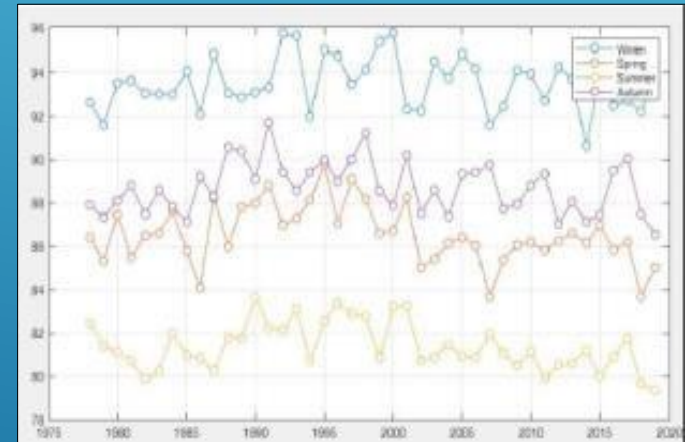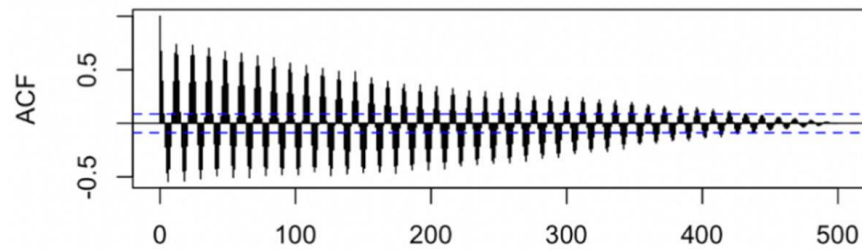

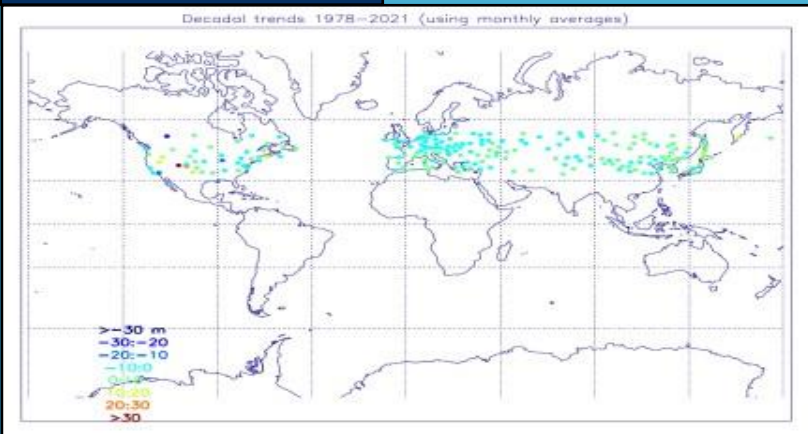T [K] different seasons
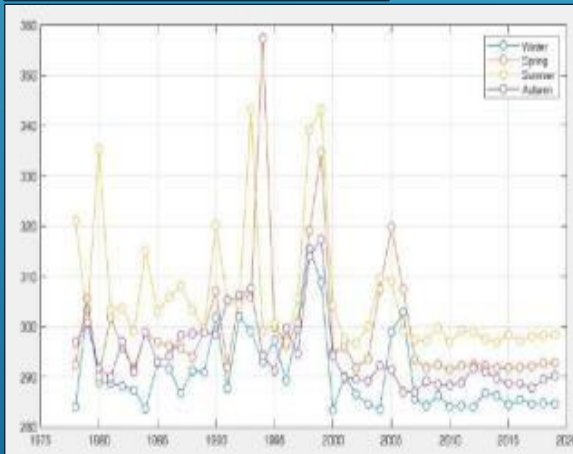
[WV] [g/Kg] different seasons
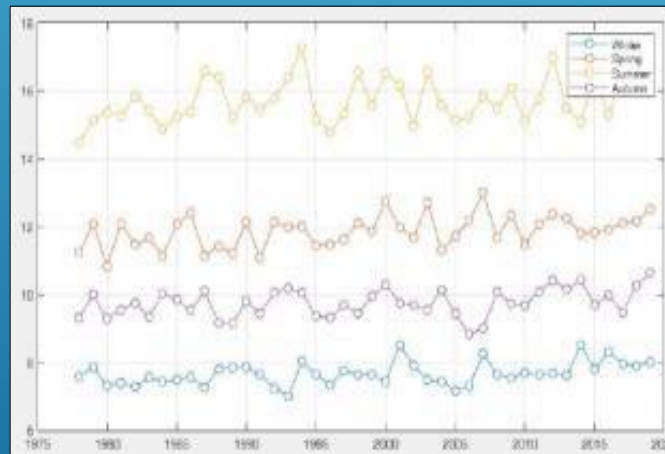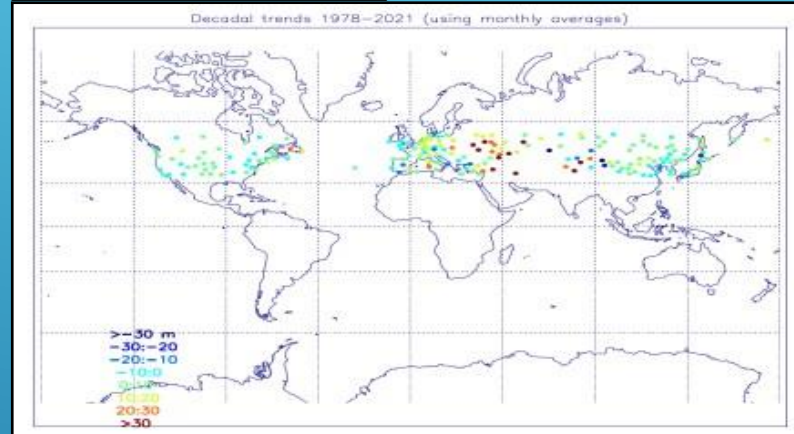

RH [%] idifferent seasons

Top panel, autocorrelation of the boundary layer top height (BLH) monthly averages for the selected station since 1978;
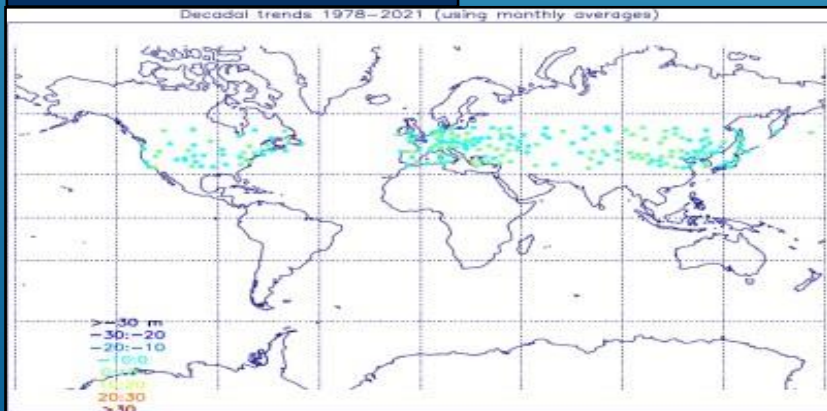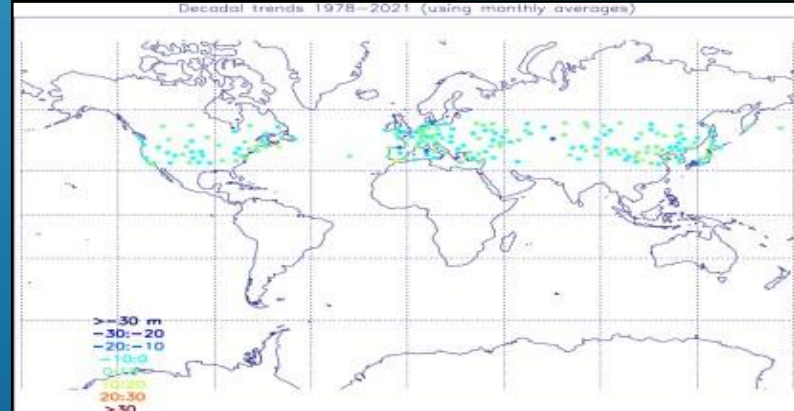
Era5 Night

Era5 Day

IGRA Night

IGRA Day

COCLUSION:

❑ 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.

Ref:
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▪ Seidel, D.J.; Ao, C.O.; Li, K. Estimating climatological planetary boundary layer heights from radiosonde observations: Comparison of methods and uncertainty analysis. J. Geophys. Res. Space Phys. 2010, 115, 16113.