PennState College of Education | CSATS Center for Science and the Schools

Research Experiences for Teachers

PennState College of Earth and Mineral Sciences

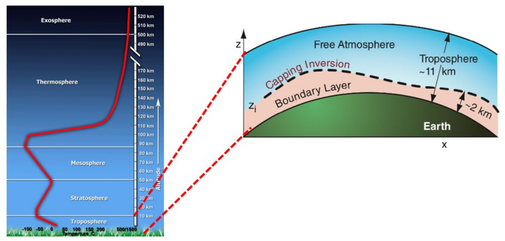
"Assessing the Uncertainty in Dual-Polarization Boundary Layer Depth Estimates from Inhomogeneous Environments: A Case Study in Melbourne, FL."

Fabiola Guillaume[1], David Stensrud[2], Lyn Comer[2], Braedon Stouffer[2]

1. Orange County Public Schools, 2. The Pennsylvania State University

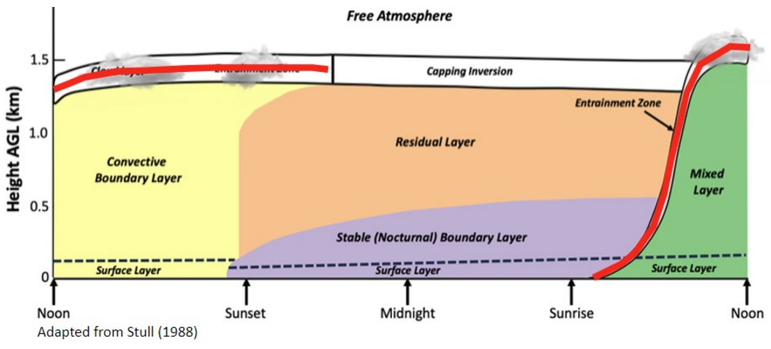
Background

The planetary boundary layer (PBL) is the lowermost layer of the Earth's atmosphere, which interacts directly with the Earth's surface.



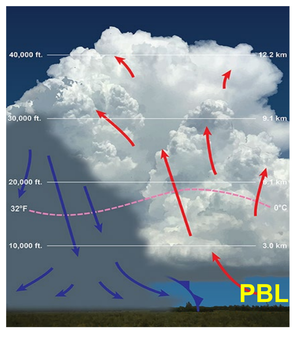
The depth of the PBL is not constant and undergoes significant changes over the course of a day in response to solar heating and cooling.

- During the day, the Earth's surface absorbs solar radiation causing the boundary layer to deepen. As the sun sets, the surface loses its heat rapidly through radiation leads to a shallowing of the boundary layer during the nighttime hours.



Adapted from Stull (1988)

The PBL influences air quality and has a significant impact on whether thunderstorms can form and their severity.



PBL Observation Methods

There are several methods used to observe the planetary boundary layer (PBL). Two of these methods are currently used in this research project.

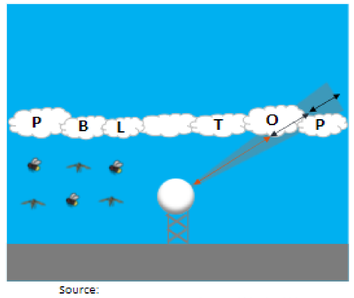
1) Radiosondes:

- Launched twice a day over hundreds of locations throughout the U.S.

2) Dual-Polarization Radar:

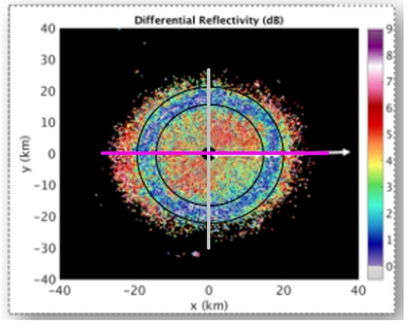
- Used over the last decade.
- Detects CBL depths
- Allows measuring of the boundary layer every 10 minutes.

Dual-Polarization Radar



Source: http://www.roc.noaa.gov/wsr88d/dualpol/default.aspx

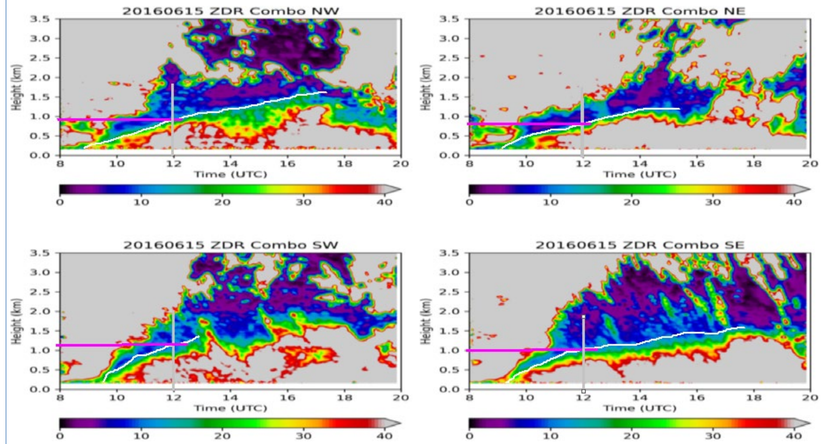
Differential Reflectivity (Z_{DR})

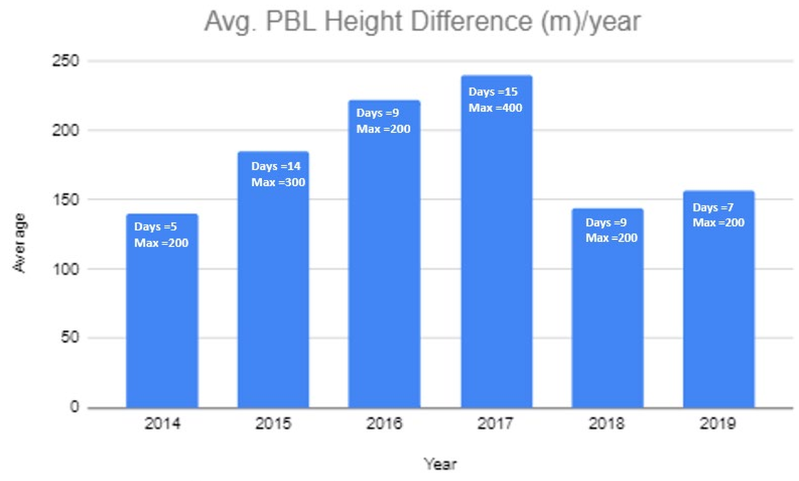


Objectives

- Use radar data observations from Melbourne, Florida and determine the estimations of the PBL depth in each quadrant.
- Calculate the difference in PBL height observed in all four panels using the QVP data collected.
- Analyze data to assess the assumption o uniformity across the PBL when measuring its depth.

Results





- Average difference of approximately 200m which represents a 10-15% error when using this method of measuring the PBL depth.
- Difference from the quadrant not large enough to invalidate the assumption of uniformity across the PBL.
- Current method of measurement is good to use for assessing the PBL depth.

Future Research

Investigating the physical processes responsible for the uniformity of the PBL can lead to a deeper understanding of the atmospheric dynamics.

Reference

Stull, R., 2017: "**Practical Meteorology**: An Algebra-based Survey of Atmospheric Science" -version 1.02b. Univ. of British Columbia.

The RET for Teachers is funded by the National Science Foundation Grant AGS-2045504.