PBLH Analysis Using Ceilometers and Models for the Paso del Norte Region/ The High Ozone Episode Case

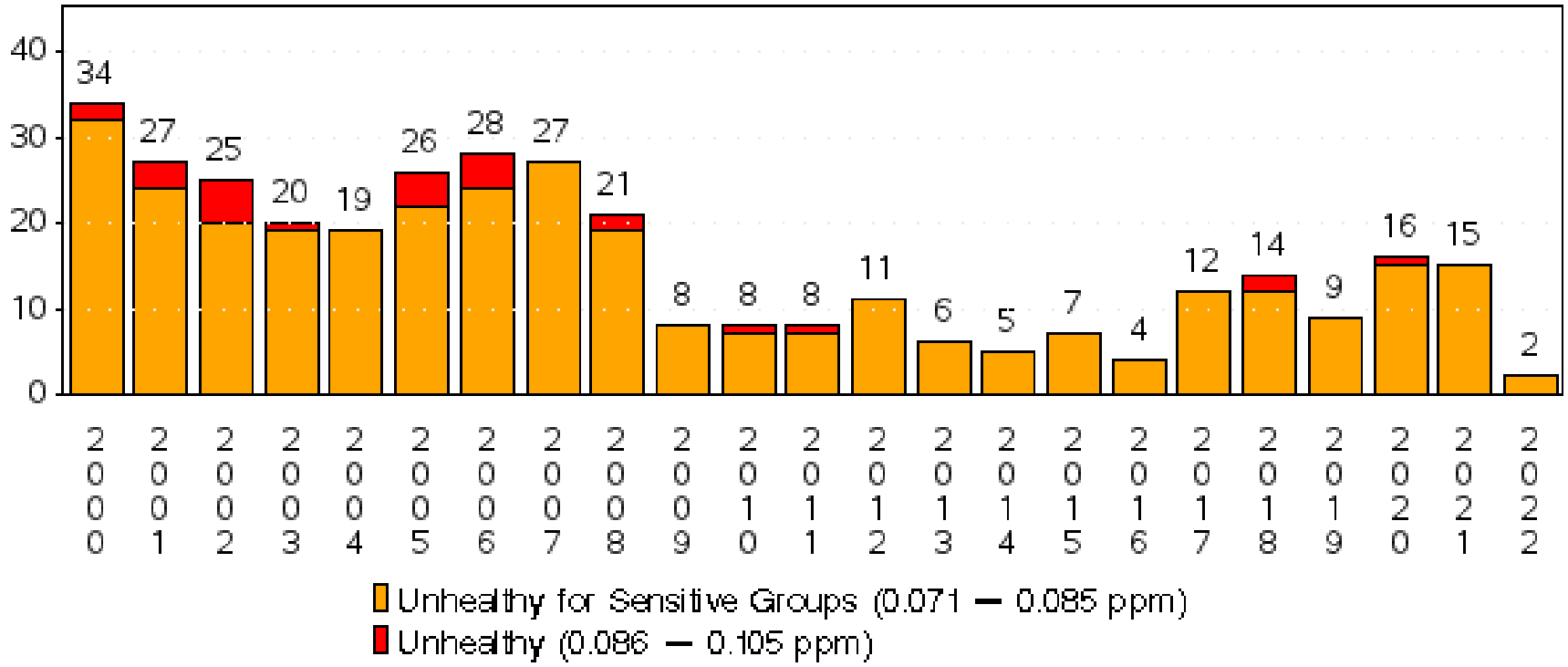
Rosa Fitzgerald[1], Nakul Karle[1], William Stockwell[1], Suhail Mahmud[2]

[1] Physics Department, The University of Texas at El Paso

[2] Earth and Environmental System Institute, Pennsylvania State University

Number of Days 8-hr Ozone Daily Max > 0.070 ppm

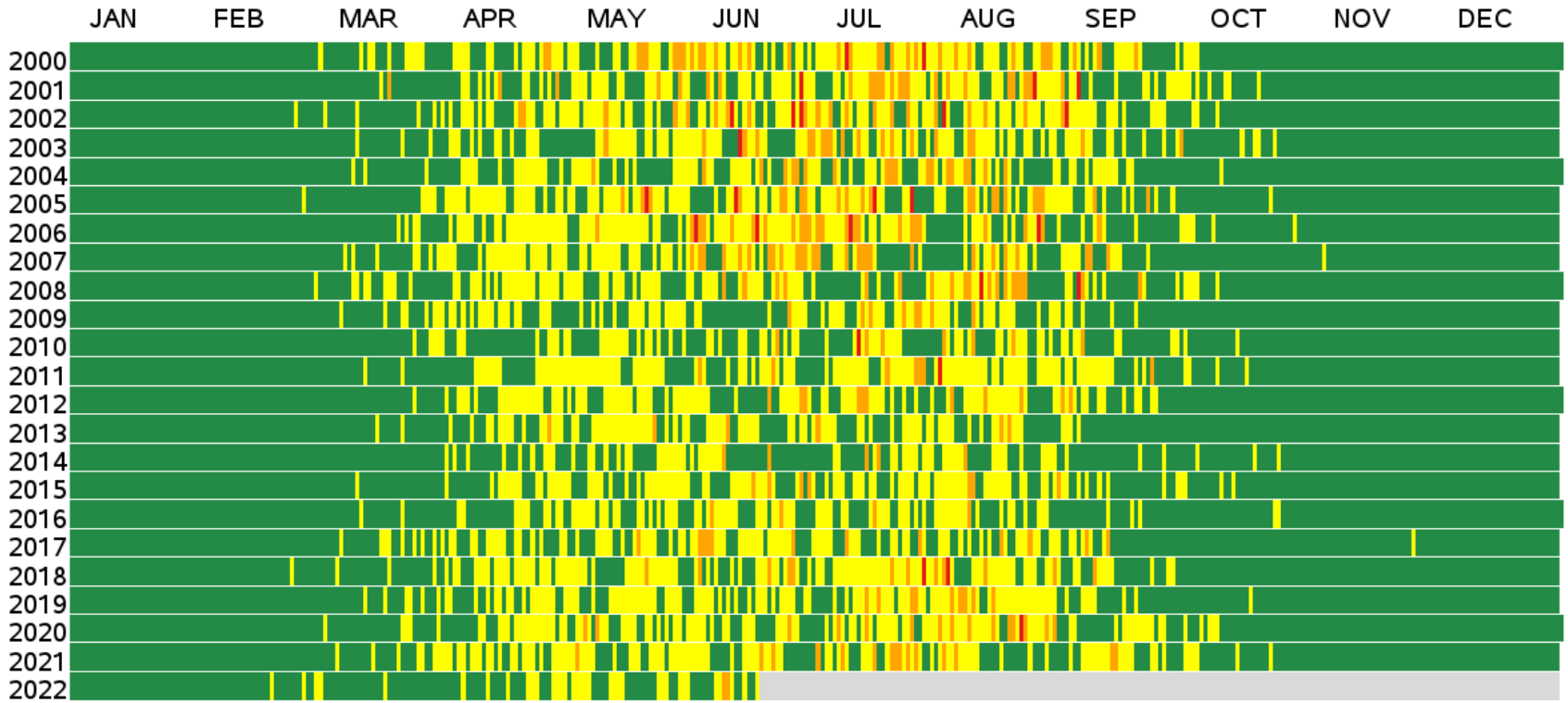
2000-2022
in El Paso, TX



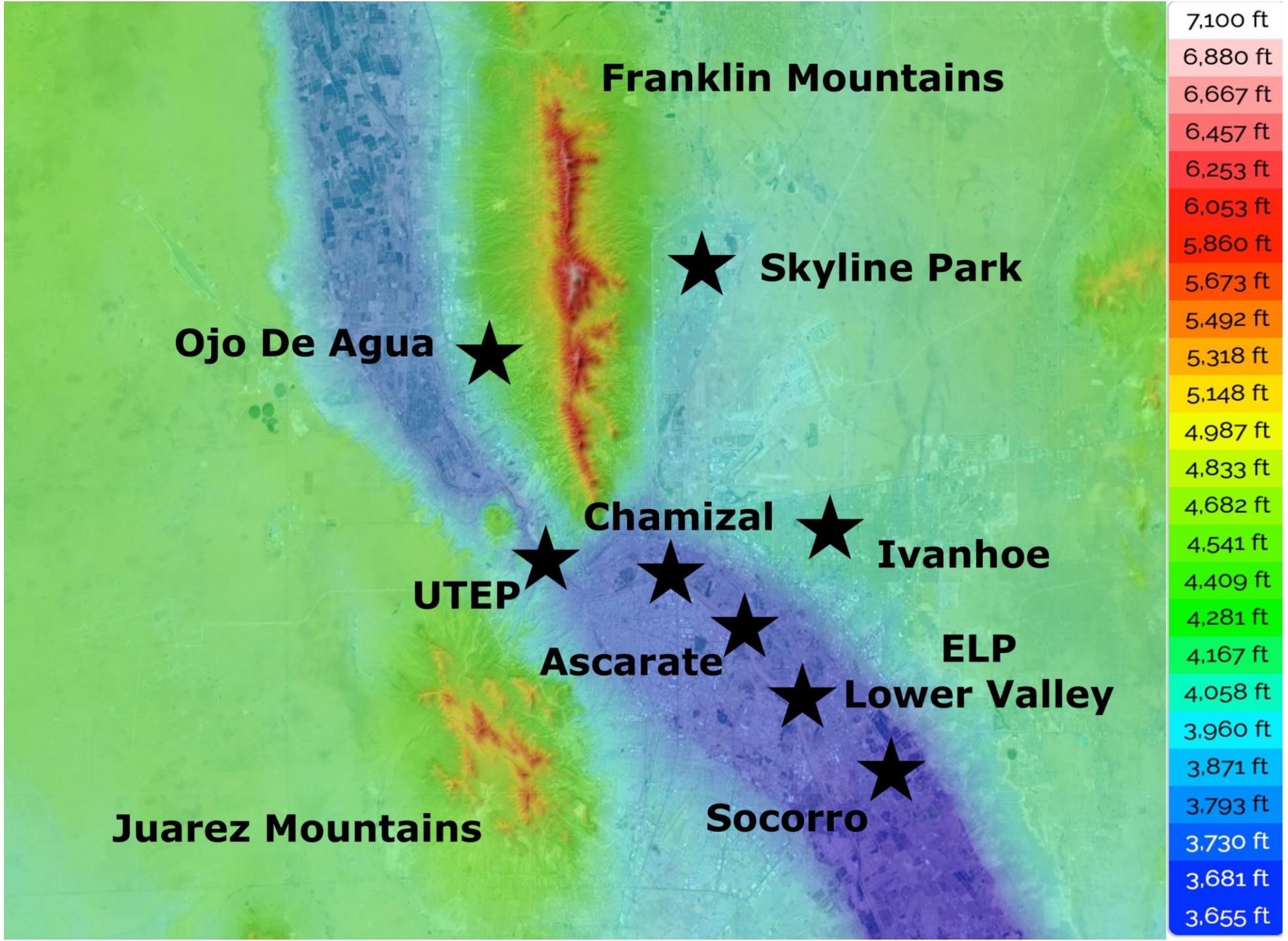
Note: Based on ALL sites
Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: June 20, 2022

Ozone Daily AQI Values, 2000 to 2022

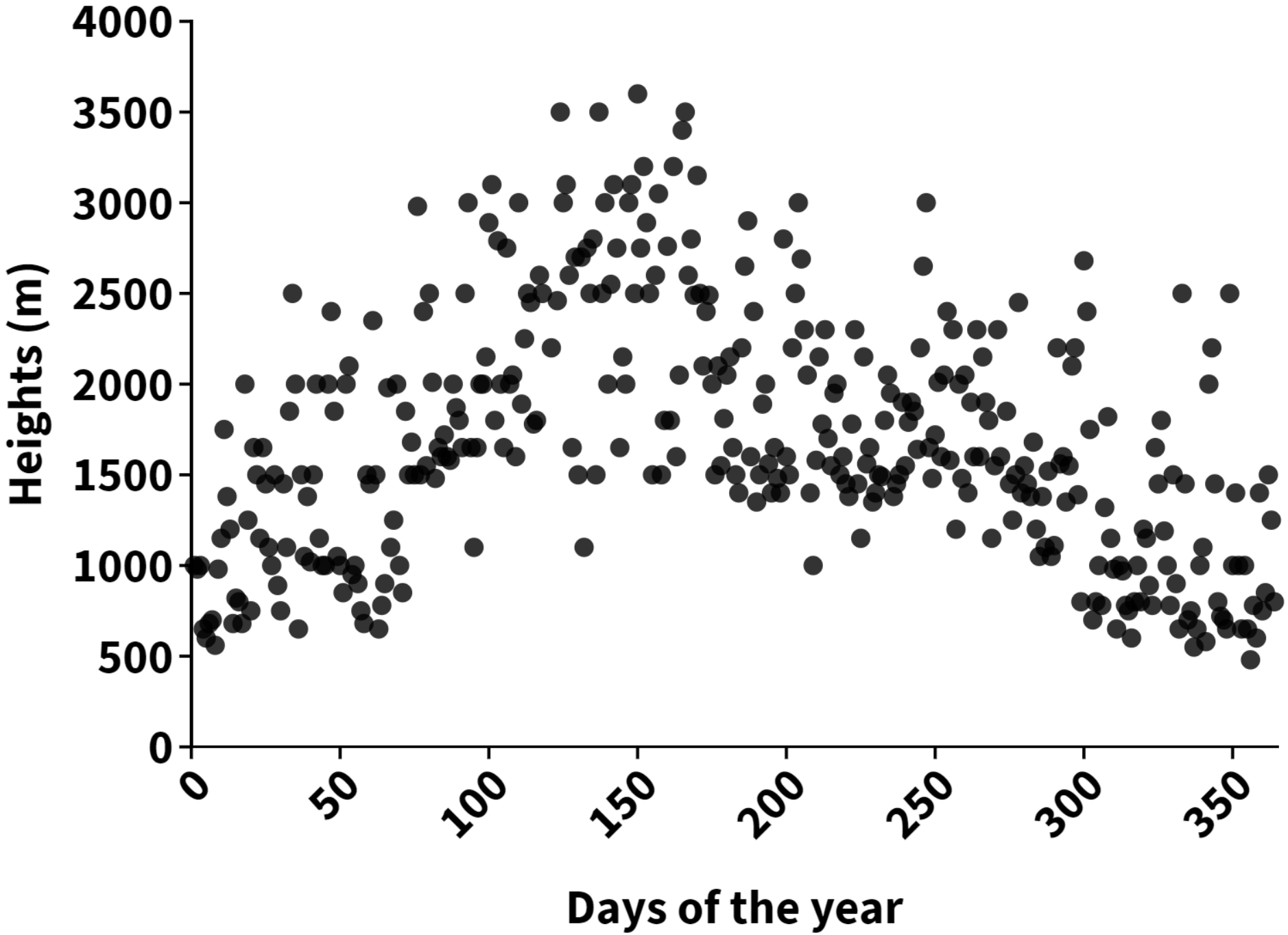
El Paso, TX



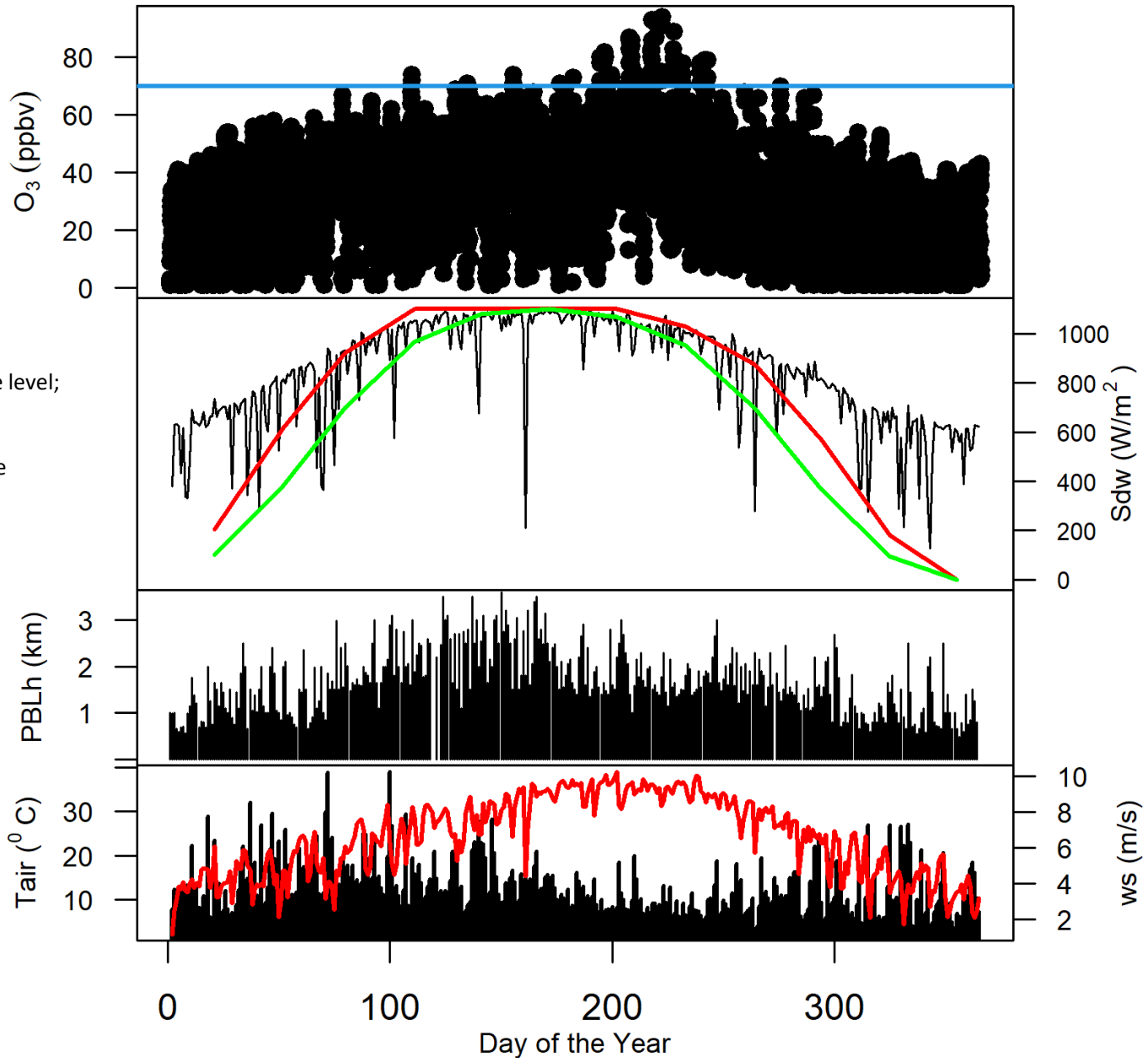
Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: June 20, 2022

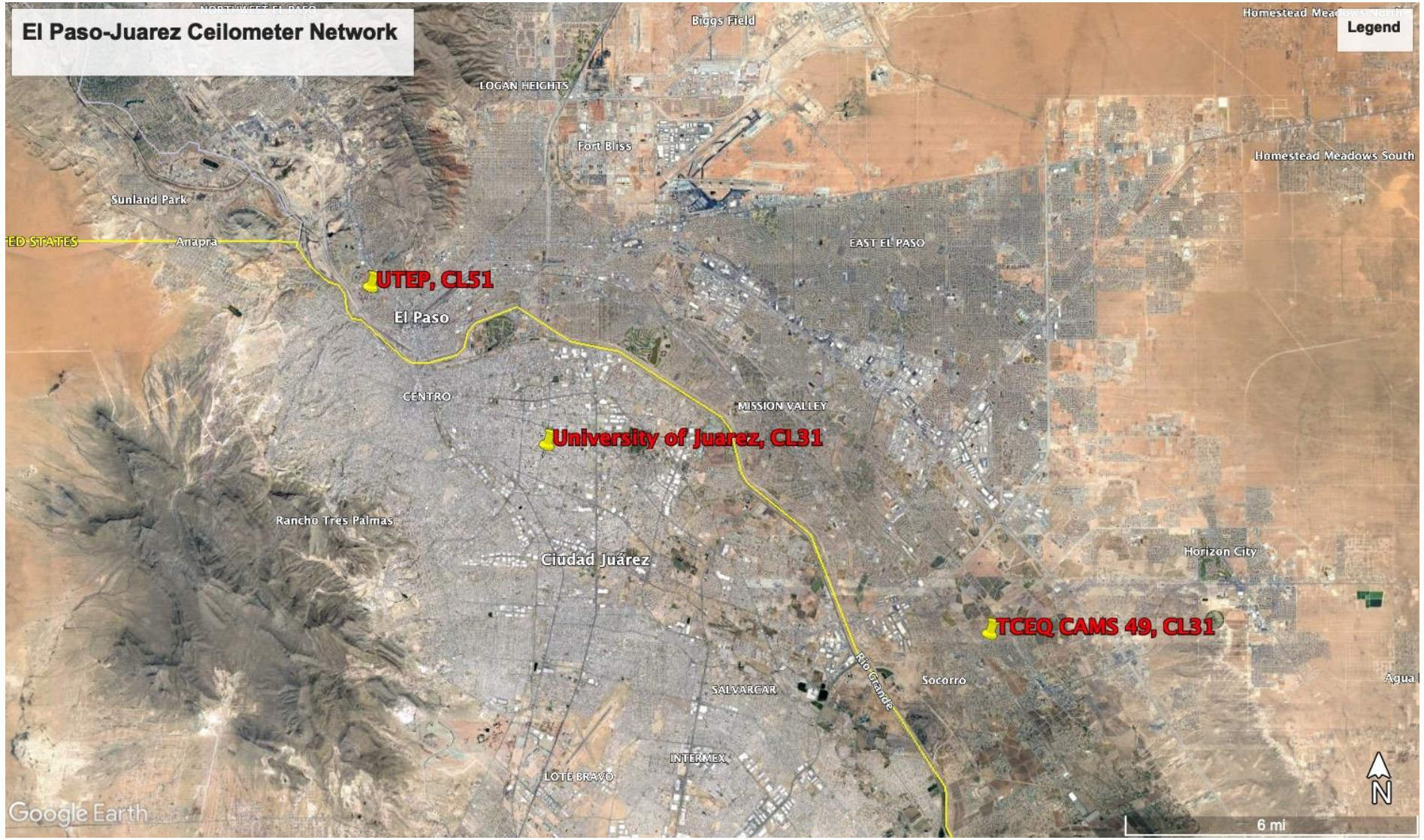

Franklin Mountains
Skyline Park
Ojo De Agua
Chamizal
Ivanhoe
UTEP
Ascarate
ELP
Lower Valley
Socorro
Juarez Mountains
7,100 ft
6,880 ft
6,667 ft
6,457 ft
6,253 ft
6,053 ft
5,860 ft
5,673 ft
5,492 ft
5,318 ft
5,148 ft
4,987 ft
4,833 ft
4,682 ft
4,541 ft
4,409 ft
4,281 ft
4,167 ft
4,058 ft
3,960 ft
3,871 ft
3,793 ft
3,730 ft
3,681 ft
3,655 ft

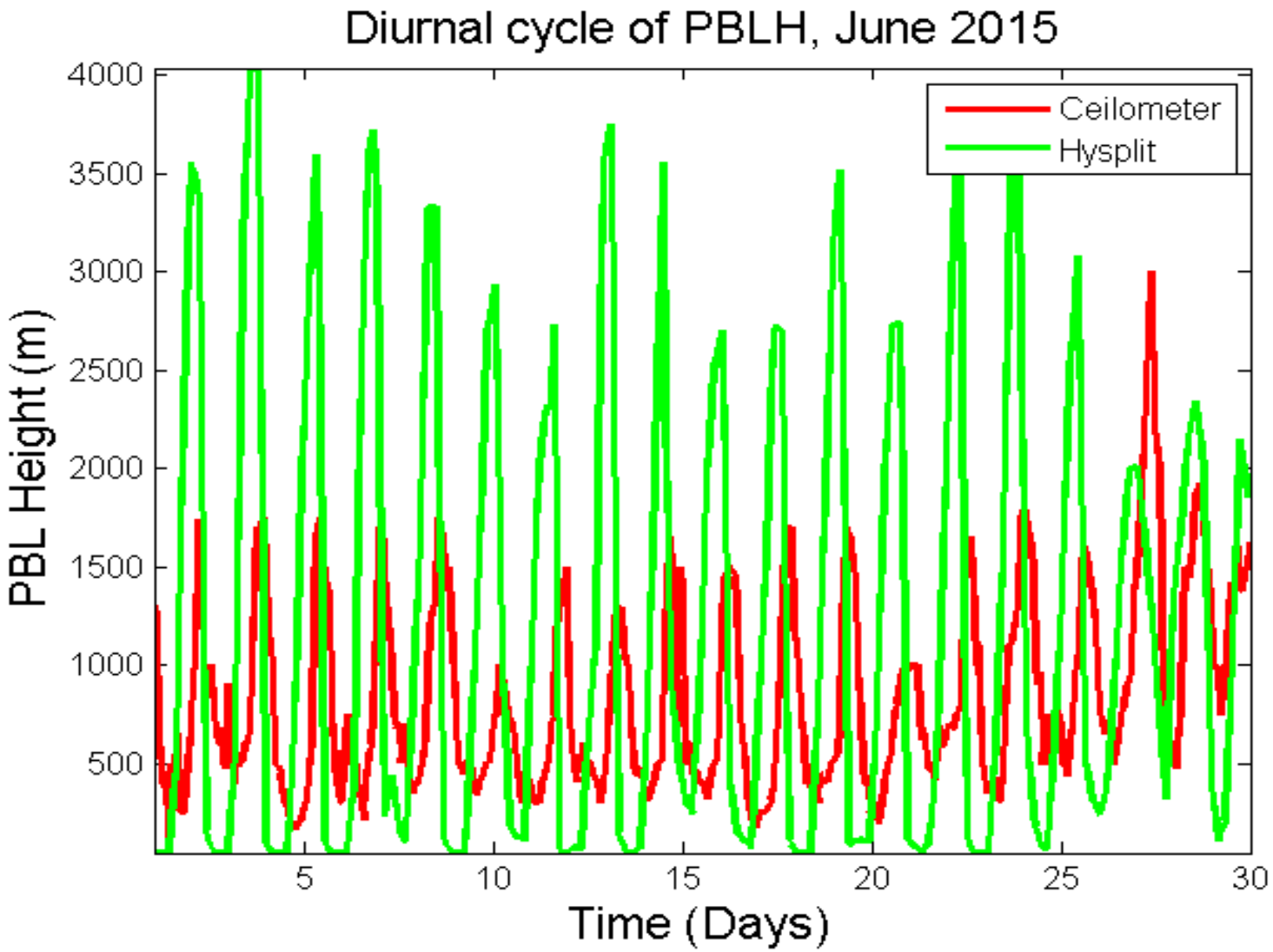
Daily Max PBLH at UTEP, 2019

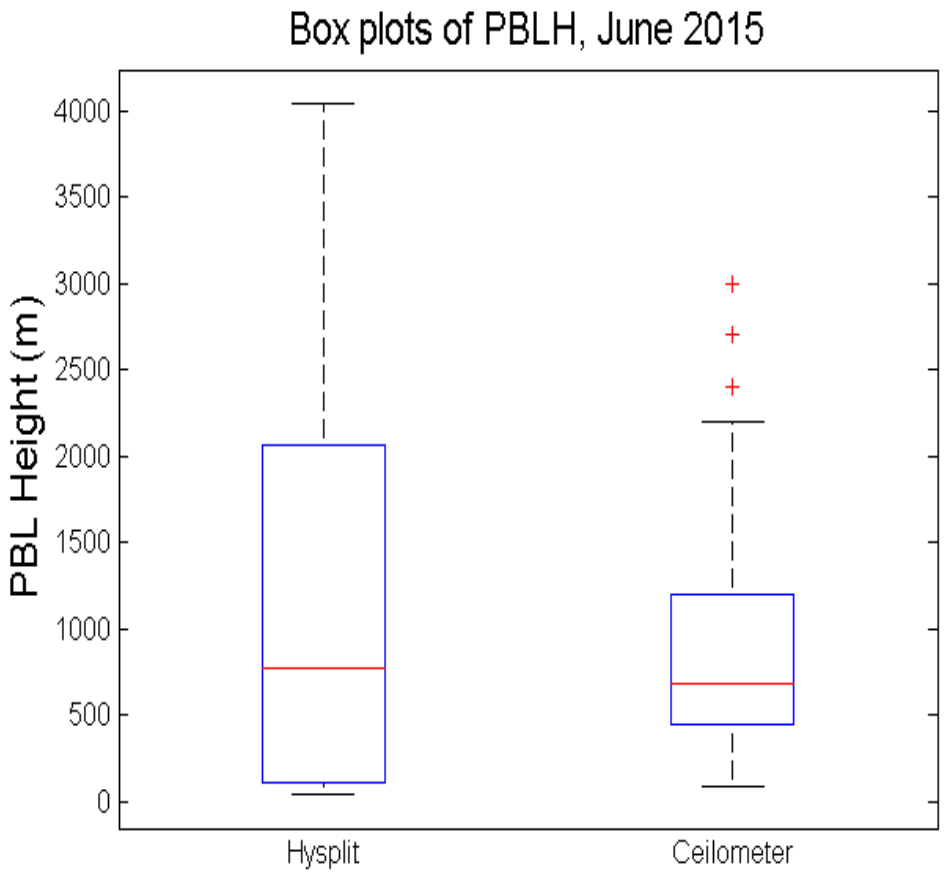


Daily hourly ozone concentration in ppbv (top), the blue line at the top marks the 71 ppbv of ozone level;
Downward solar radiation (Sdw), photolysis frequencies of NO2 (red) and O3 (green);
Maximum daily PBLH in (km);
Afternoon average wind speeds in black (between 13–17 p.m.) and daily maximum air temperature in red (bottom) for the year 2019..



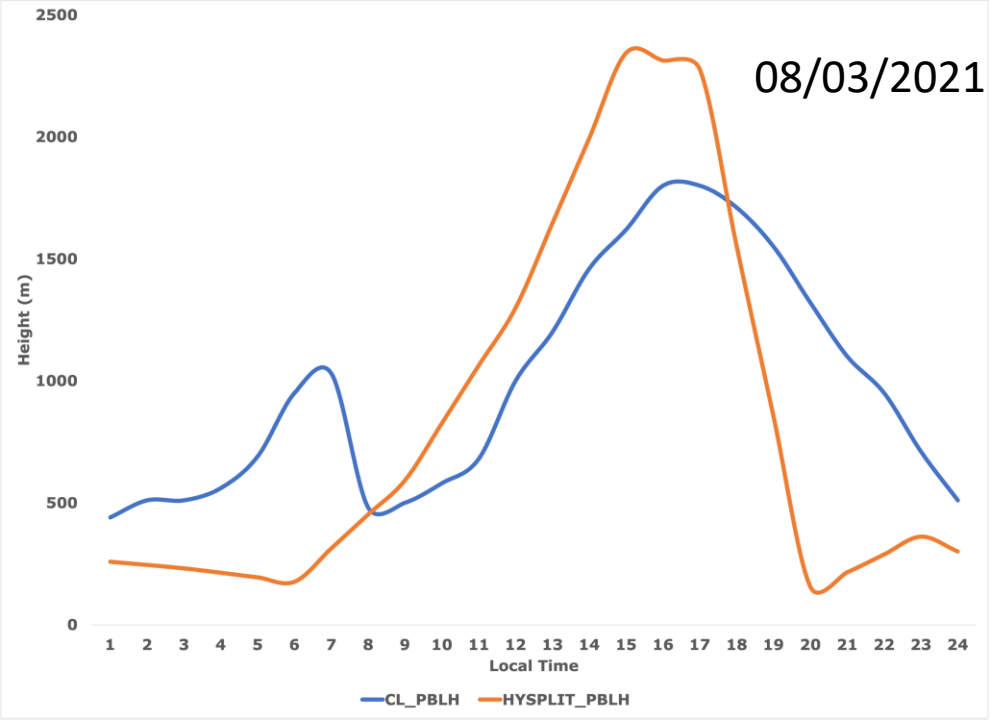

El Paso-Juarez Ceilometer Network
Legend
Biggs Field
LOGAN HEIGHTS
Fort Bliss
Homestead Meadows South
Sunland Park
Anapra
EAST EL PASO
UTEP, CL51
El Paso
CENTRO
MISSION VALLEY
University of Juarez, CL31
Rancho Tres Palmas
Ciudad Juárez
Horizon City
TCEQ CAMS 49, CL31
Rio Grande
Socorro
SALVARCAR
INTERMEX
LOTE BRAVO
Google Earth
6 mi
N

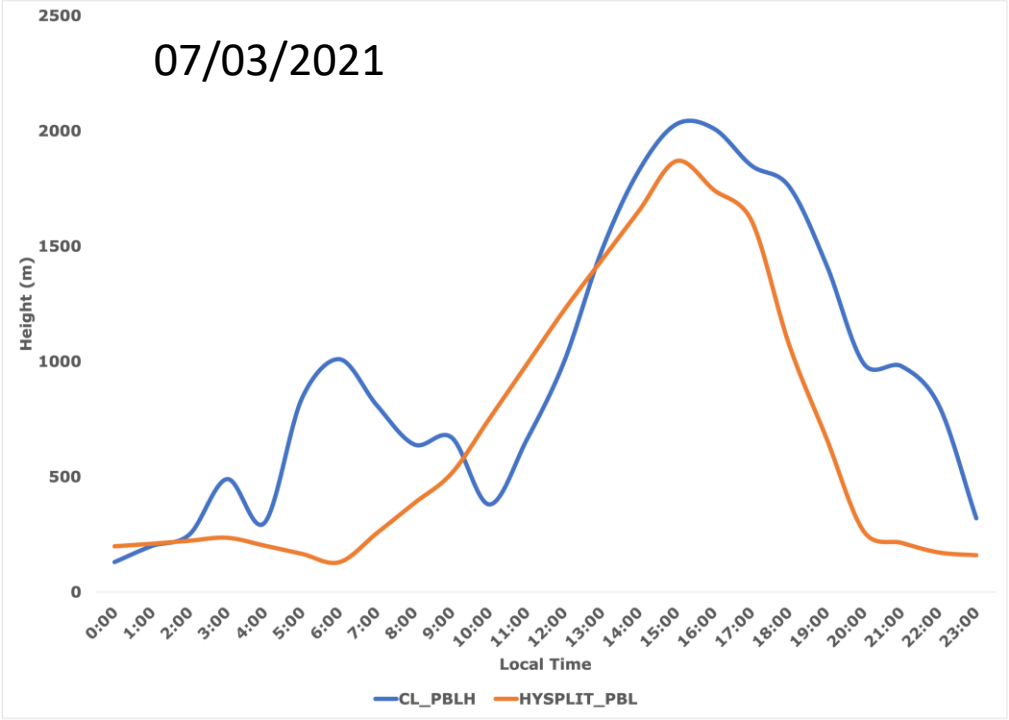


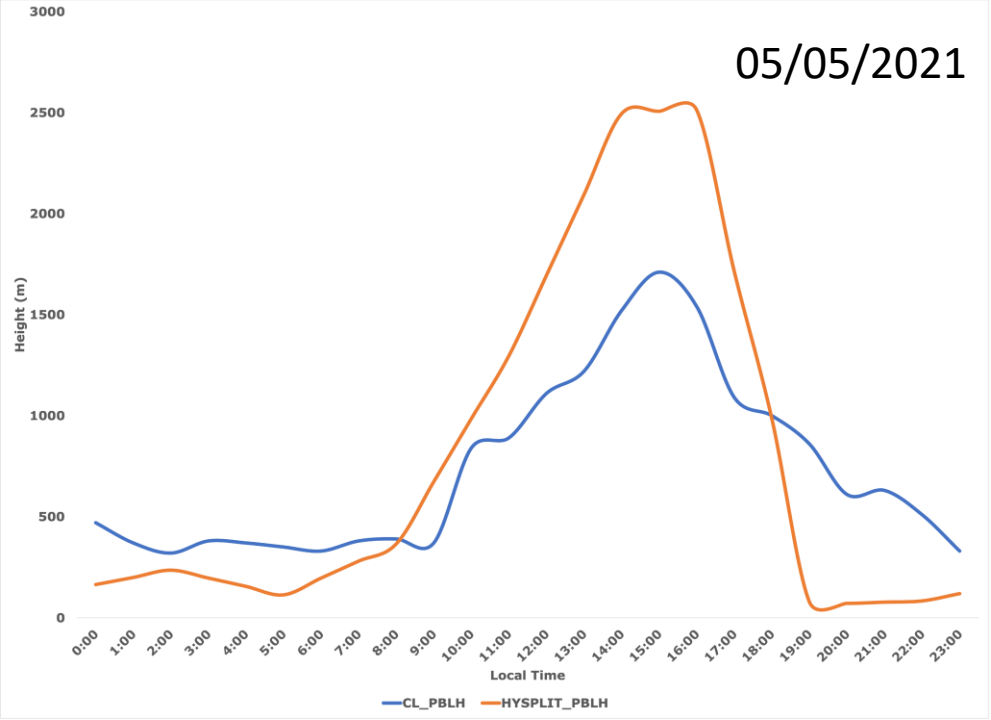


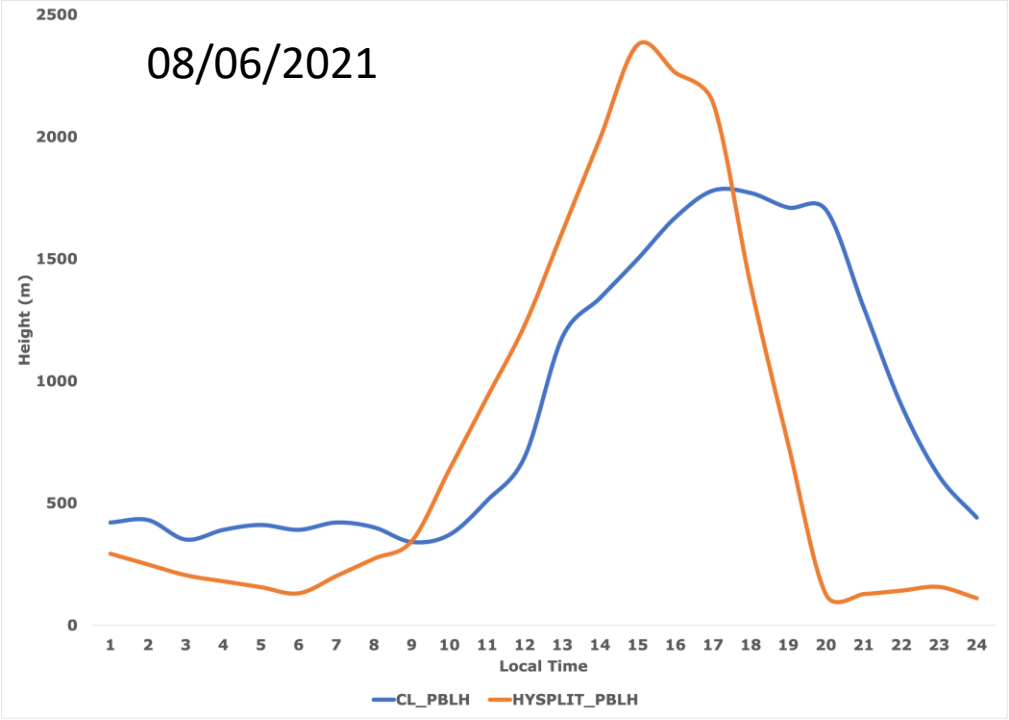
PBLH Using CL31 and HYSPLIT

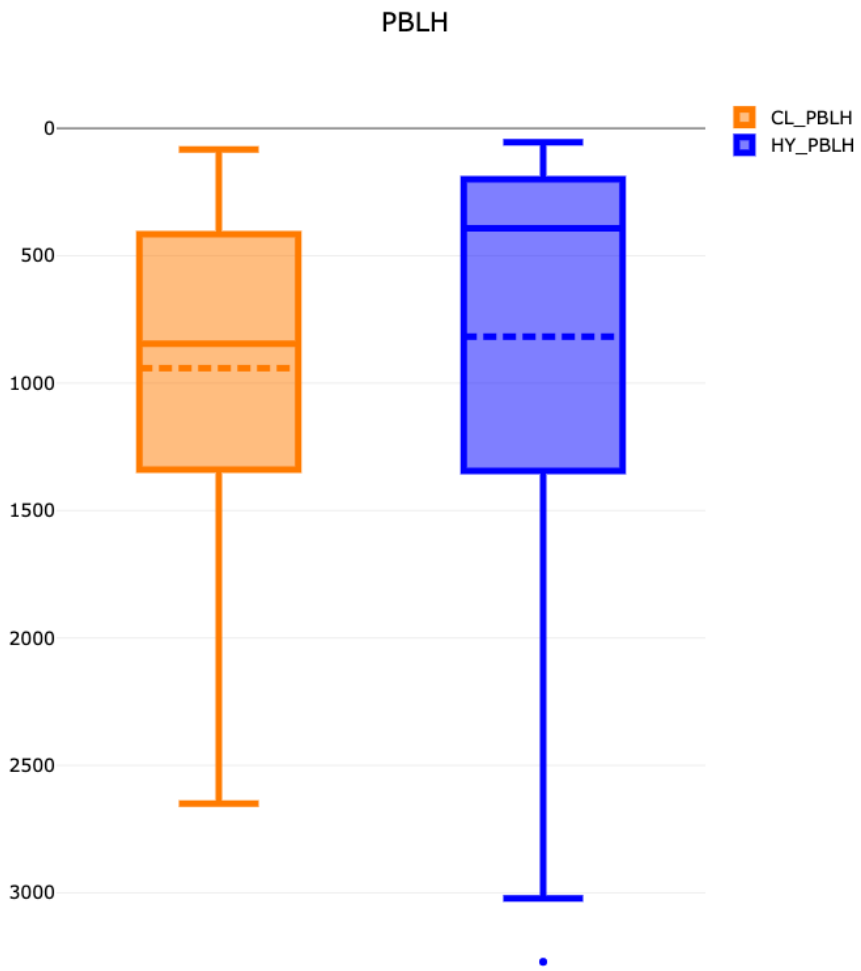
HYSPLIT-CL 51 PBLH Inter-comparison

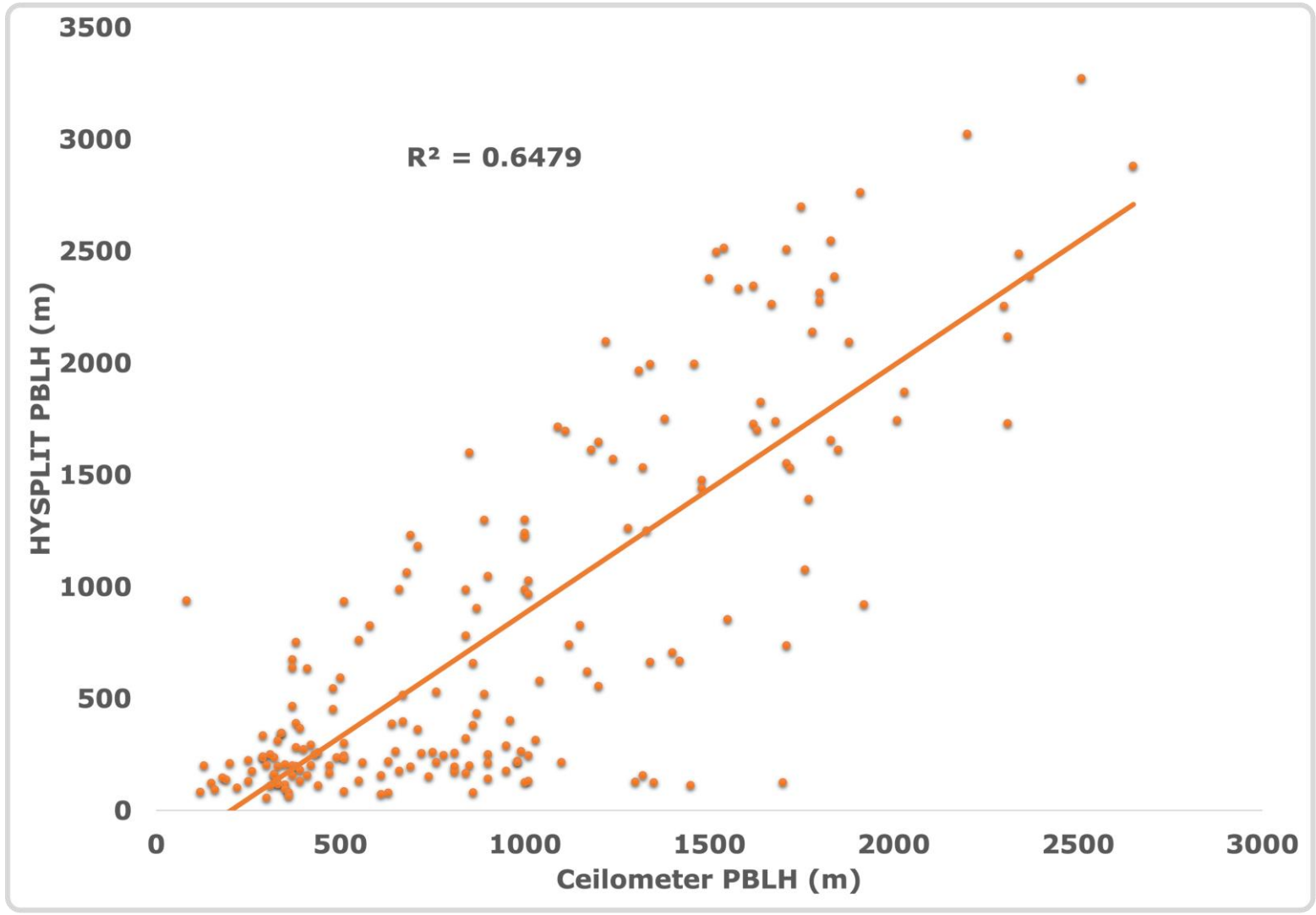




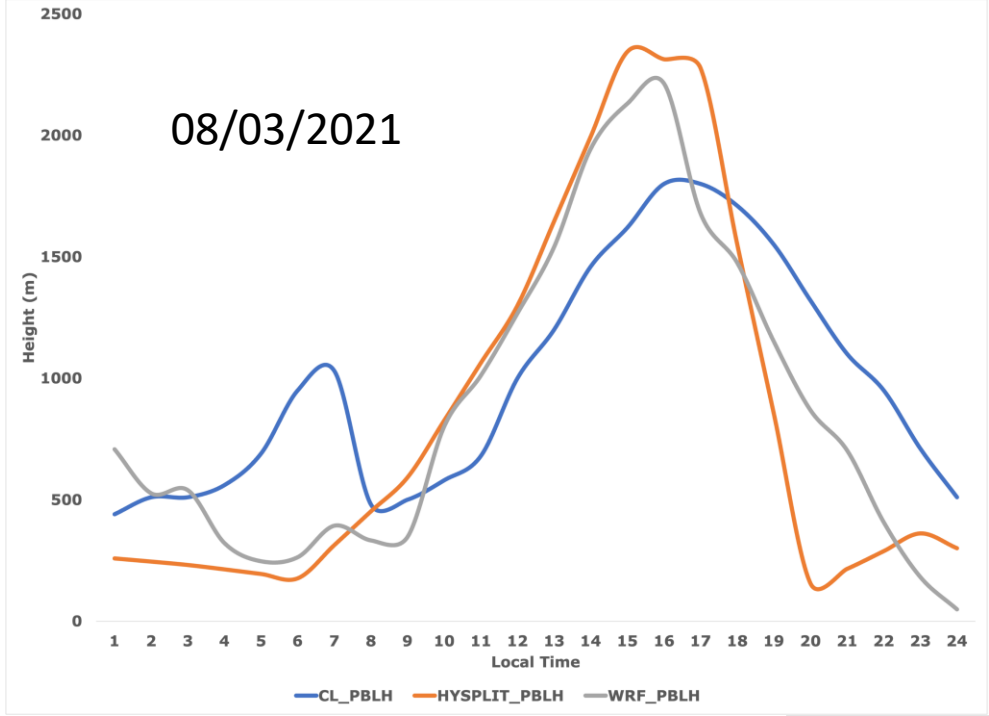




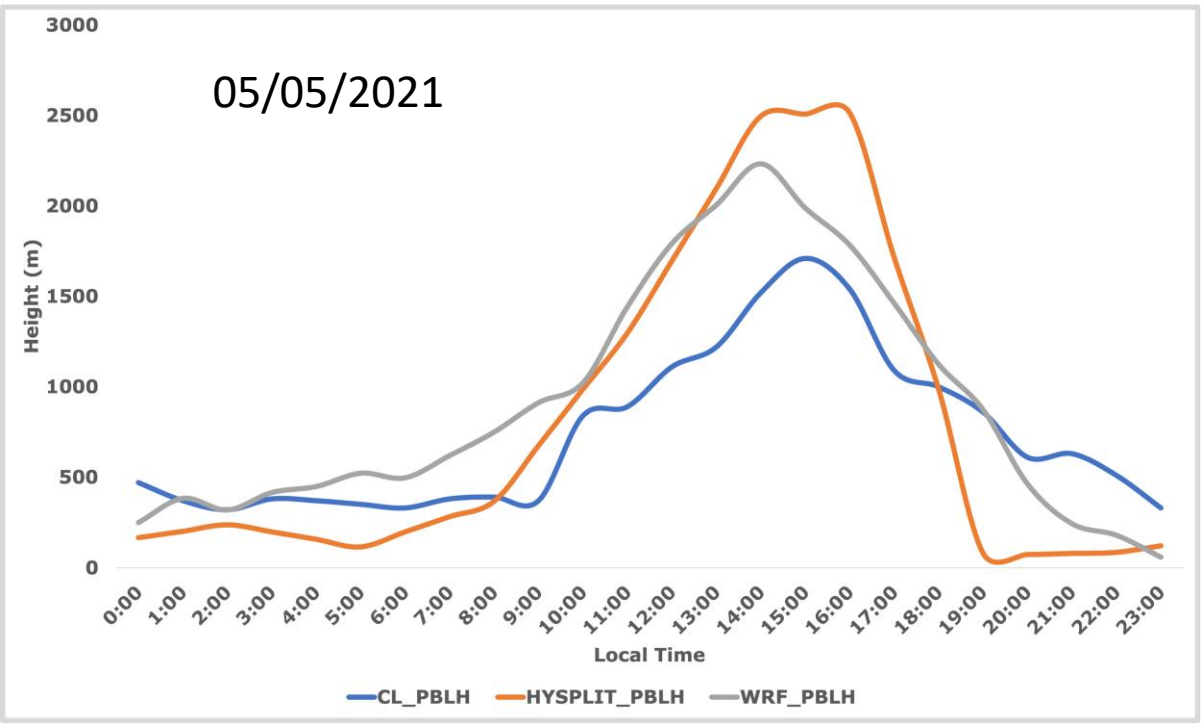


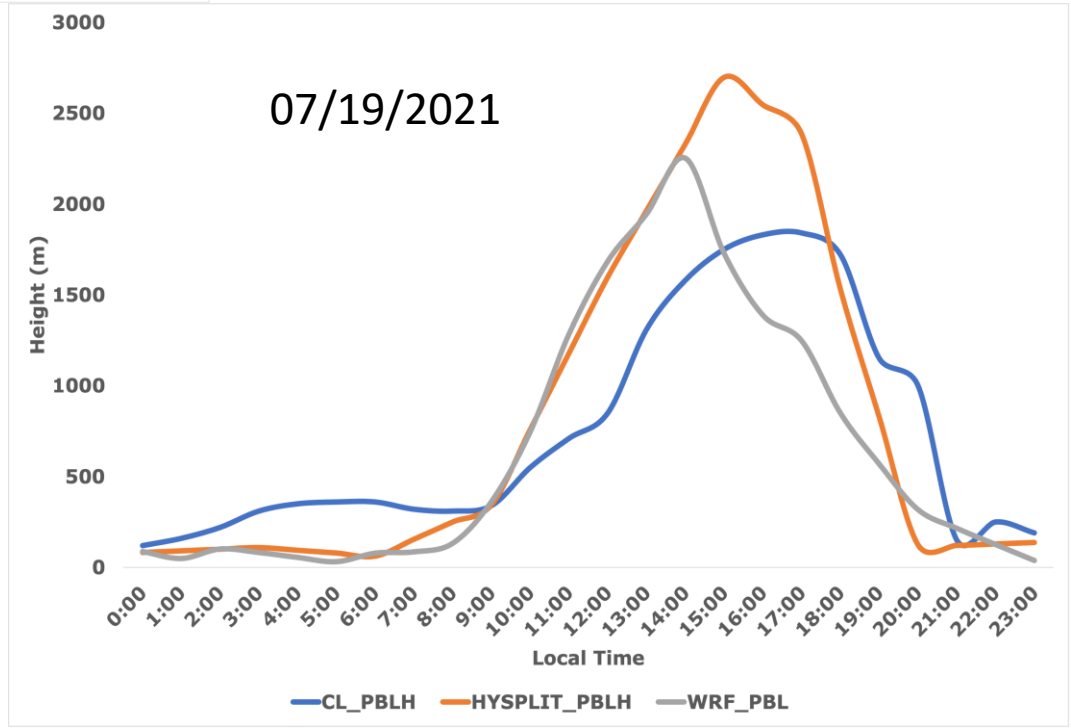


CL51 PBLH and HYSPLIT PBLH are in acceptable agreement

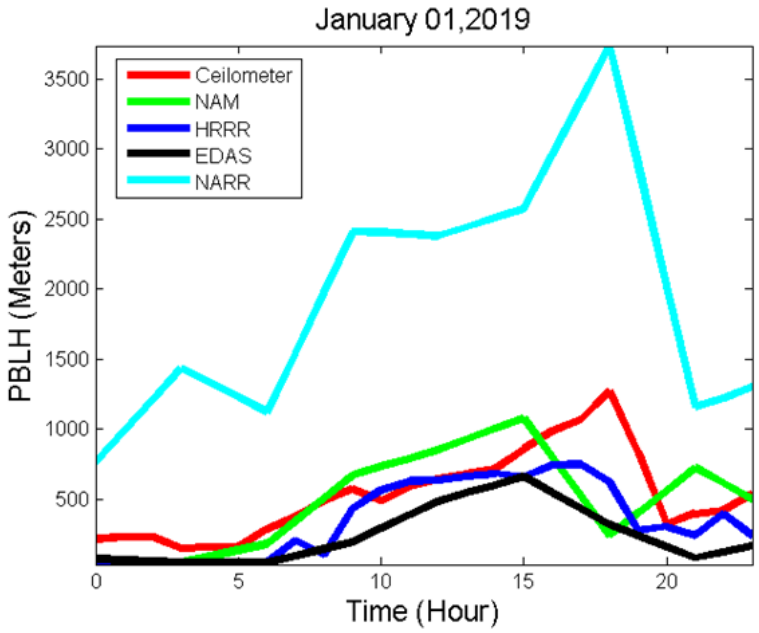


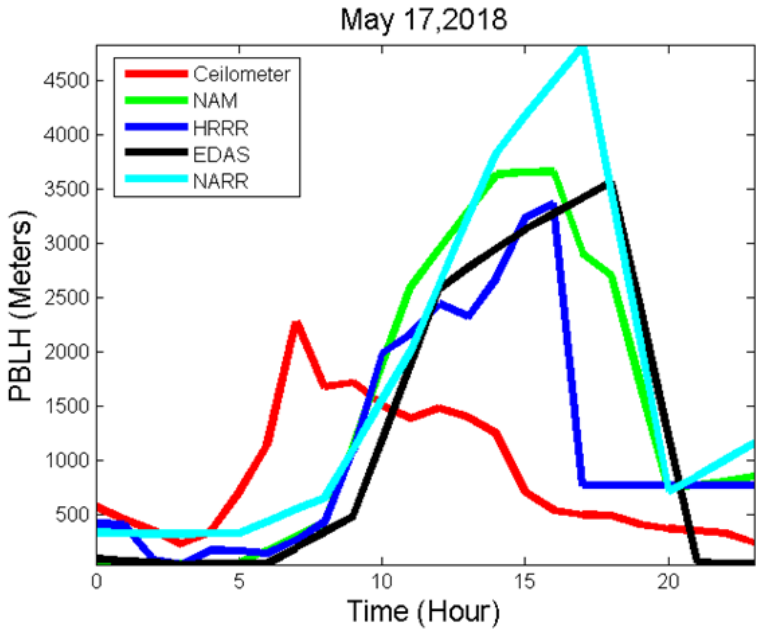
An Improvement Observed Using WRF as Input into HYSPLIT

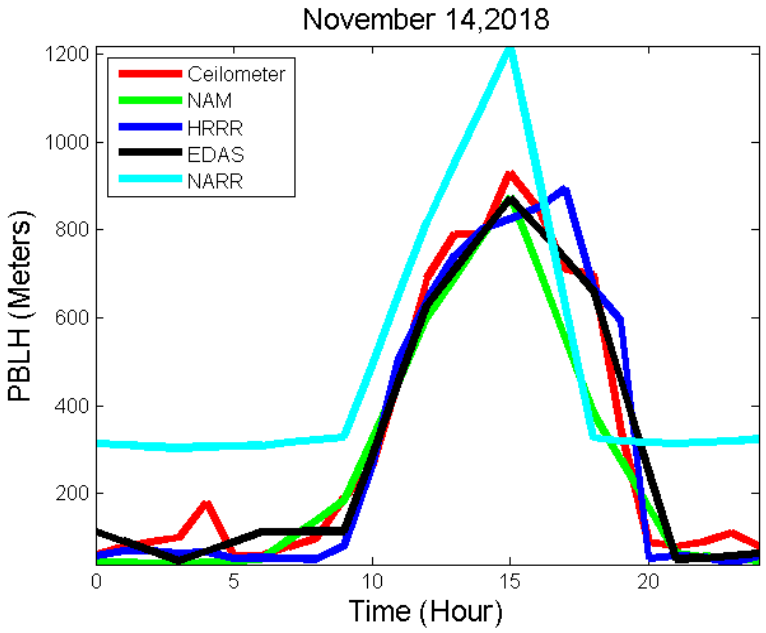


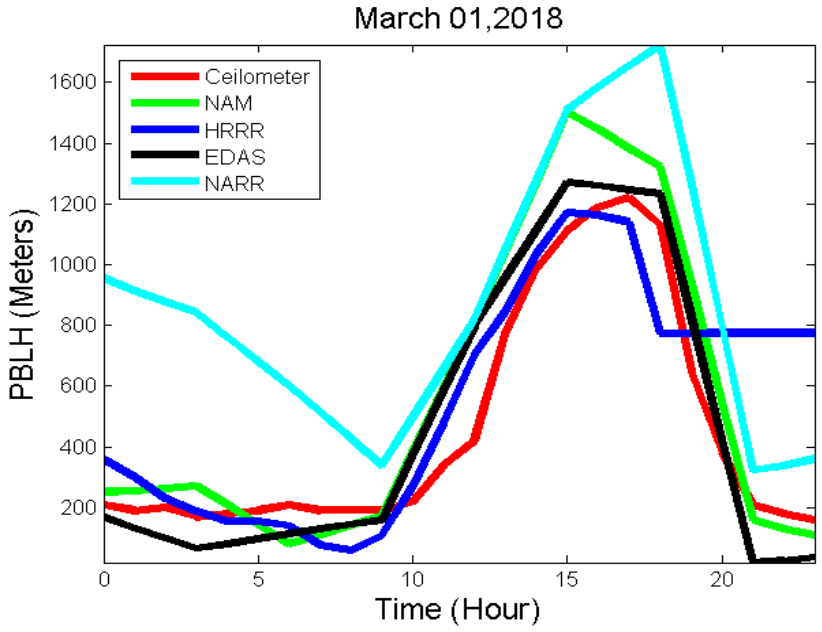


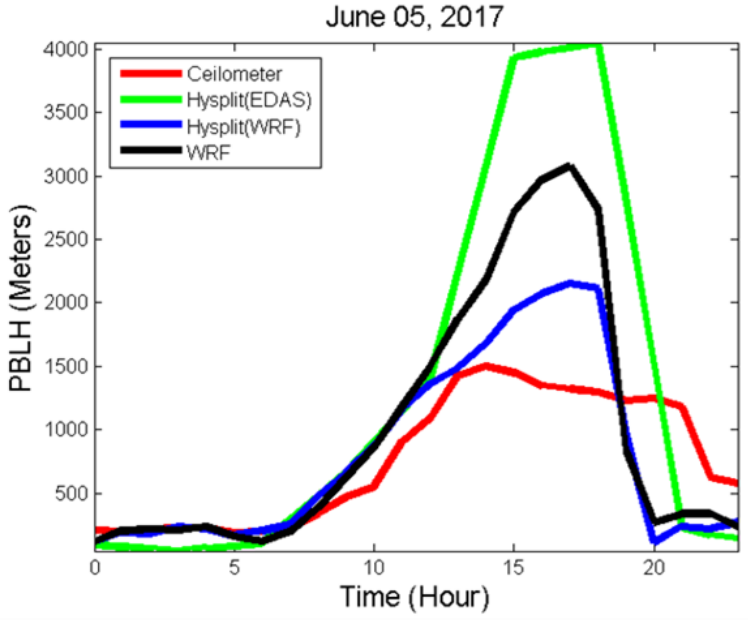
PBL Results Using Different Inputs of HYSPLIT Compared With Ceilometer Values

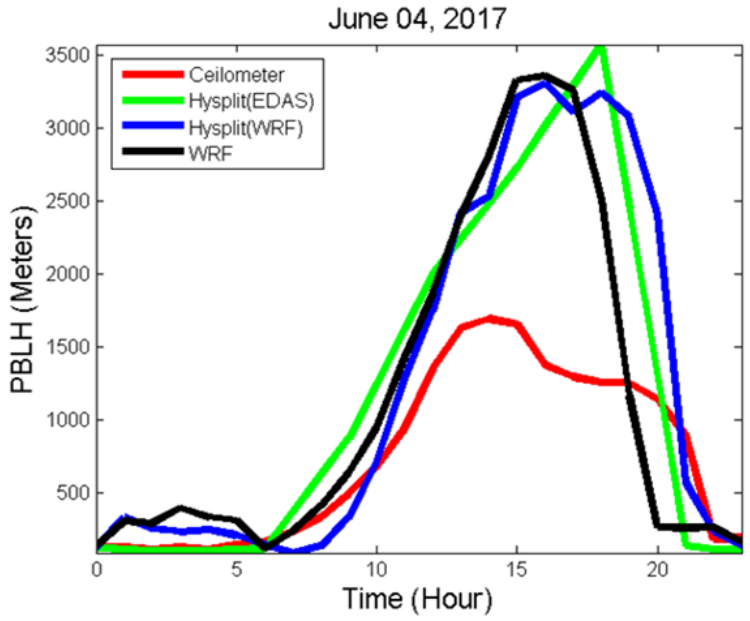


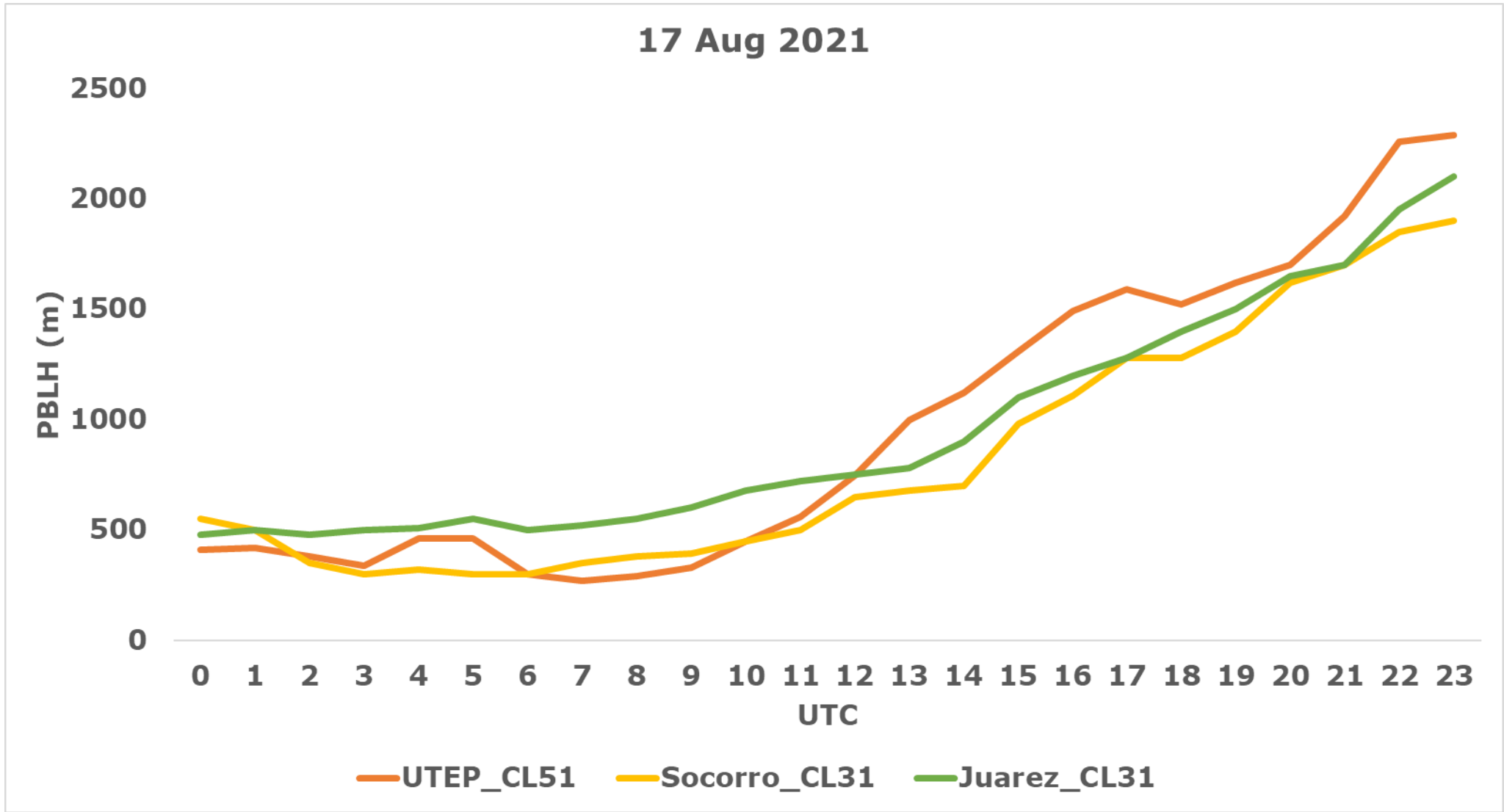











17 Aug 2021
2500
2000
1500
1000
500
0
PBLH (m)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
UTC
UTEP_CL51
Socorro_CL31
Juarez_CL31

atmosphere

MDPI

Article

Multi-Scale Atmospheric Emissions, Circulation and Meteorological Drivers of Ozone Episodes in El Paso-Juárez Airshed

Nakul N. Karle [1], Rosa M. Fitzgerald [1,*], Ricardo K. Sakai [2], David W. Sullivan [3] and William R. Stockwell [1]

[1] Physics Department, The University of Texas at El Paso, El Paso, TX 79902, USA; nnkarle@utep.edu (N.N.K.); William.R.Stockwell@gmail.com (W.R.S.)
[2] Atmospheric Science Department, Howard University, Washington, DC 20705, USA; ricardo.k.sakai@howard.edu
[3] Center for Energy and Environmental Services, University of Texas at Austin, Austin, TX 78758, USA; sullivan231@mail.utexas.edu
* Correspondence: rfitzgerald@utep.edu

Abstract: Ozone pollution has been prevalent in the El Paso-Juárez Airshed (EPJA), especially in the past few decades, and it has been on the rise recently. The spatial and temporal distribution of the tropospheric ozone and several key meteorological factors that influence its concentration has not been adequately understood. Therefore, this investigation comprehensively examined 57 high and 48 low ozone episodes occurring in this region during 2013–2019. We found that the interannual ozone concentration in EPJA was strongly affected by anthropogenic emissions. On the other hand, seasonal ozone variations are due to meteorological variables (among them, solar radiation, planetary boundary layer, and winds) in addition to biogenic emission factors. High ozone events are characterized by calm winds, shallow planetary boundary layer (PBL), whereas low ozone events were marked with strong winds, precipitation, and deep PBL. Synoptic and mesoscale wind patterns for these ozone episodes were identified and characterized. Most of the high ozone episodes occurred when an anticyclonic circulation aloft was associated with a 500-mile middle and upper tropospheric high-pressure region over the EPJA. During these events, stable air masses with convective available potential energies (CAPE) values of less than 450 J/kg were found. The importance of surface topography is illustrated by the fact that stations close to the Rio Grande River show a bimodal distribution of wind direction according to the valley axis. High ozone episodes occur with a surface easterly wind that is decoupled from winds above the Franklin mountains.

check for updates

Citation: Karle, N.N.; Fitzgerald, R.M.; Sakai, R.K.; Sullivan, D.W.; Stockwell, W.R. Multi-Scale Atmospheric Emissions, Circulation and Meteorological Drivers of Ozone Episodes in El Paso-Juárez Airshed. *Atmosphere* **2021**, *12*, 1575. https://doi.org/10.3390/atmos12121575

Academic Editor: Eugene Rozanov

Conclusions

- Ceilometers Successfully Installed in the Paso del Norte Region.
- The Impact of Meteorological Variables during High Ozone events has been analyzed.
- PBLH Inter-comparisons Between HYSPLIT and Ceilometer were performed, showing better correlation with the CL51 ceilometer than with the CL31 ceilometer.
- Analysis of PBL Results using HYSPLIT with Different Inputs was analyzed.
- Preliminary PBL results for the Paso del Norte network.