20th ANNUAL CMAS Conference
Nov 1-5 | Virtual

Study on the effect of ventilation coefficient and anthropogenic emissions on $PM_{2.5}$ concentration in the atmosphere above Tehran, Iran

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Table of contents

Why atmospheric air pollution studies is important in our region

Topographic map provided by SRTM (https://dds.cr.usgs.gov/) of main desert region (Black text) located in global dust belt (Dotted line).

The importance of this study

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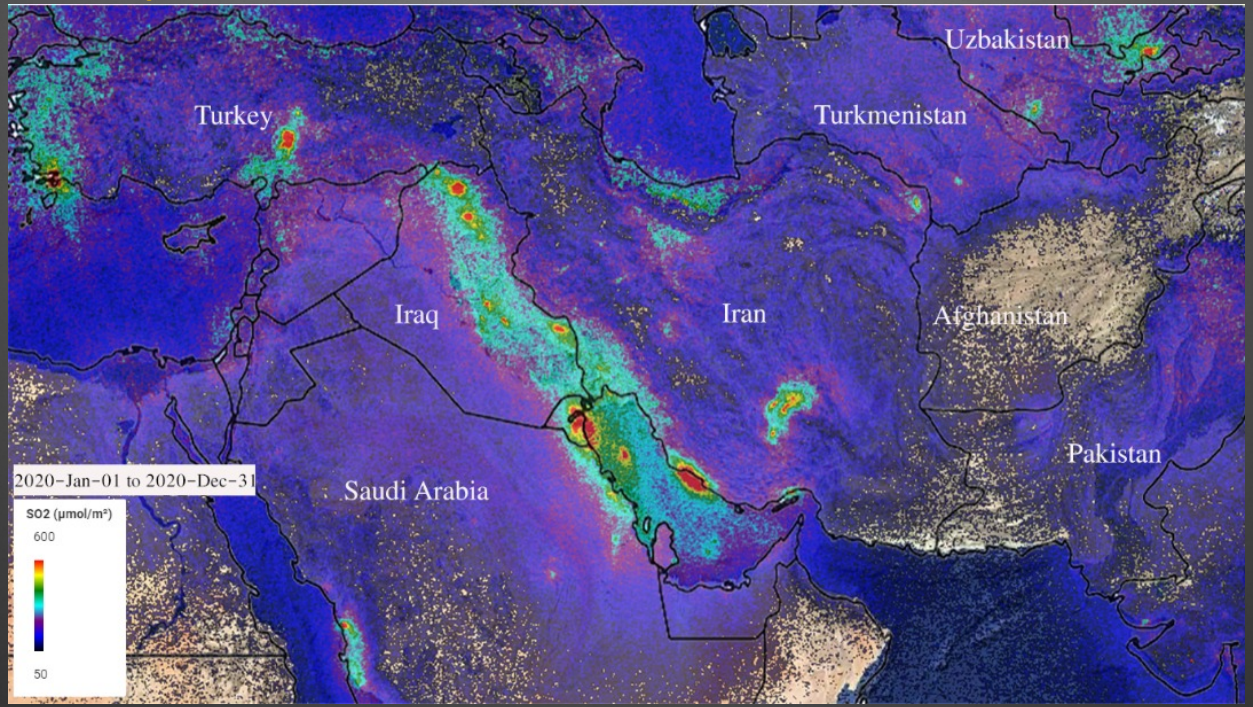
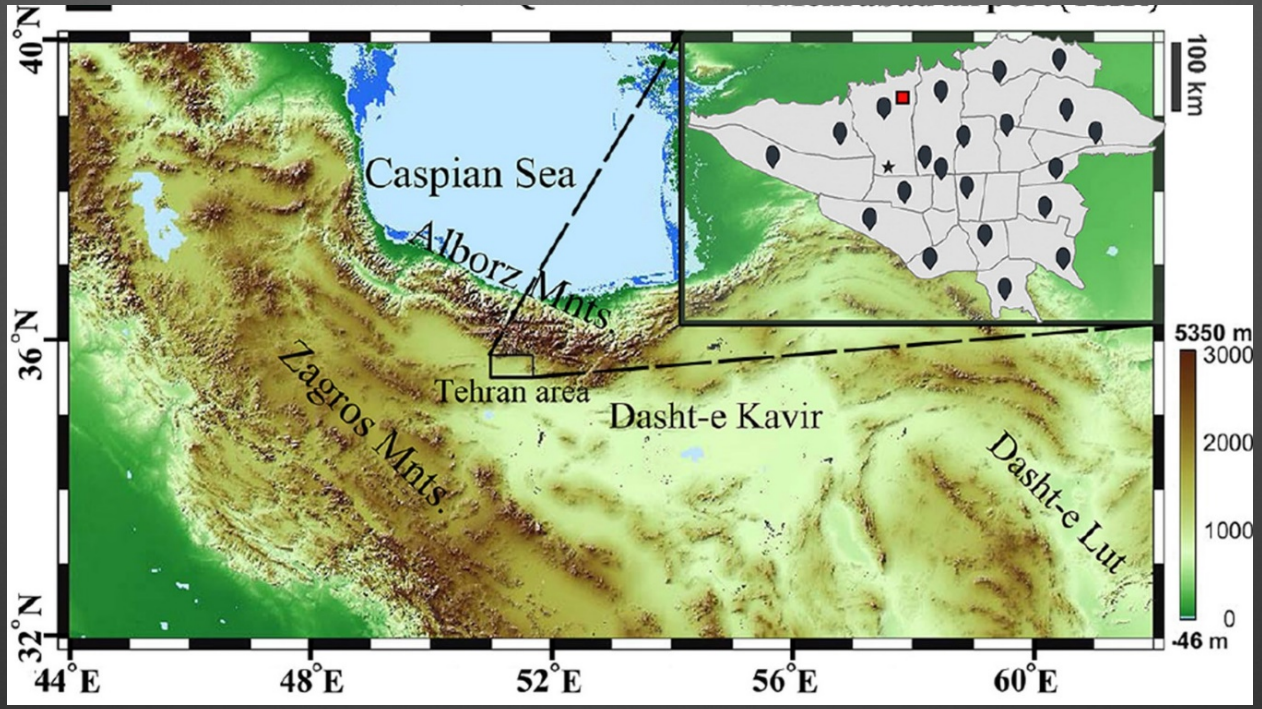
The importance of this study



Spatial distribution of tropospheric SO2 measured by Copernicus Sentinel-5p over Middle-East and Central Asia during 2020.

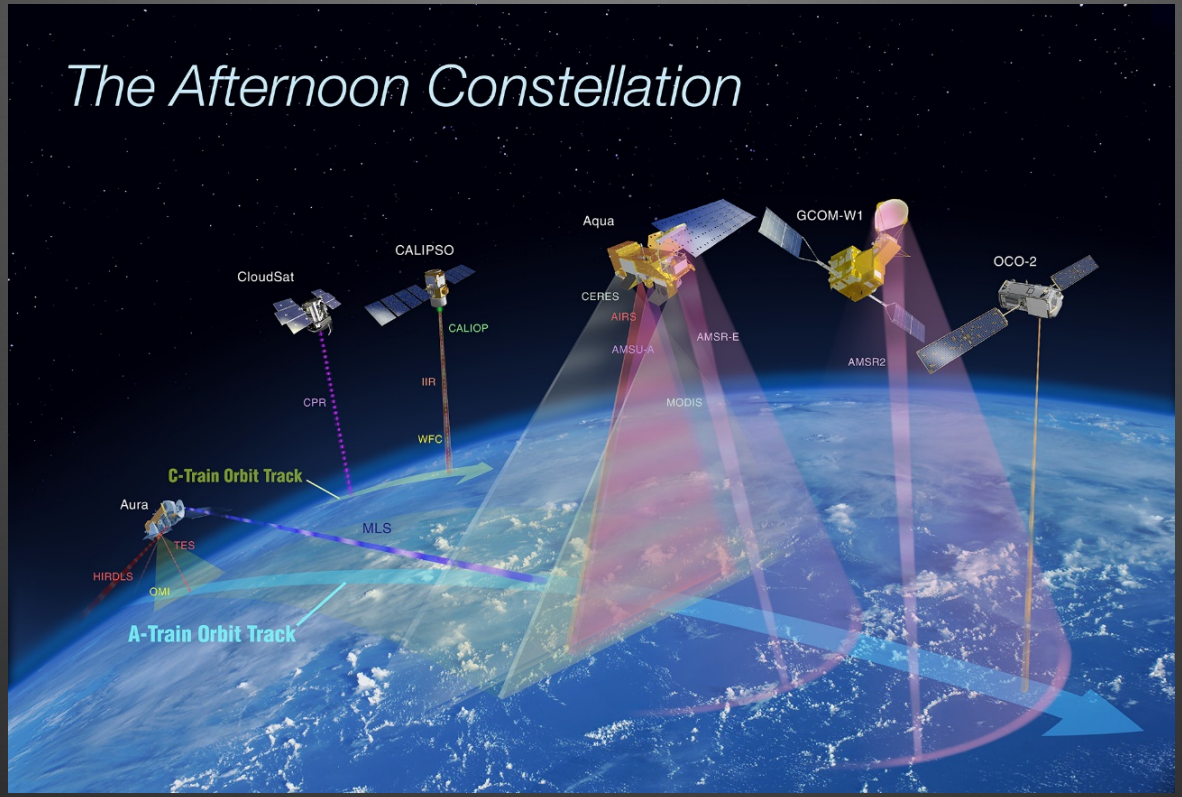
Ground-based station



NO, NO_2
SO_2
PM_{10}, $PM_{2.5}$
CO, CO_2

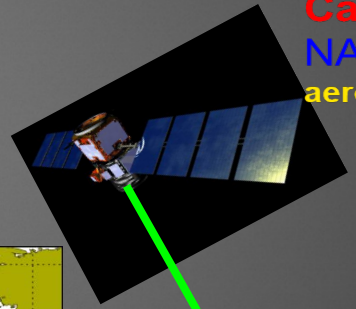
the AQCC stations (black balloons) in municipal district of Tehran

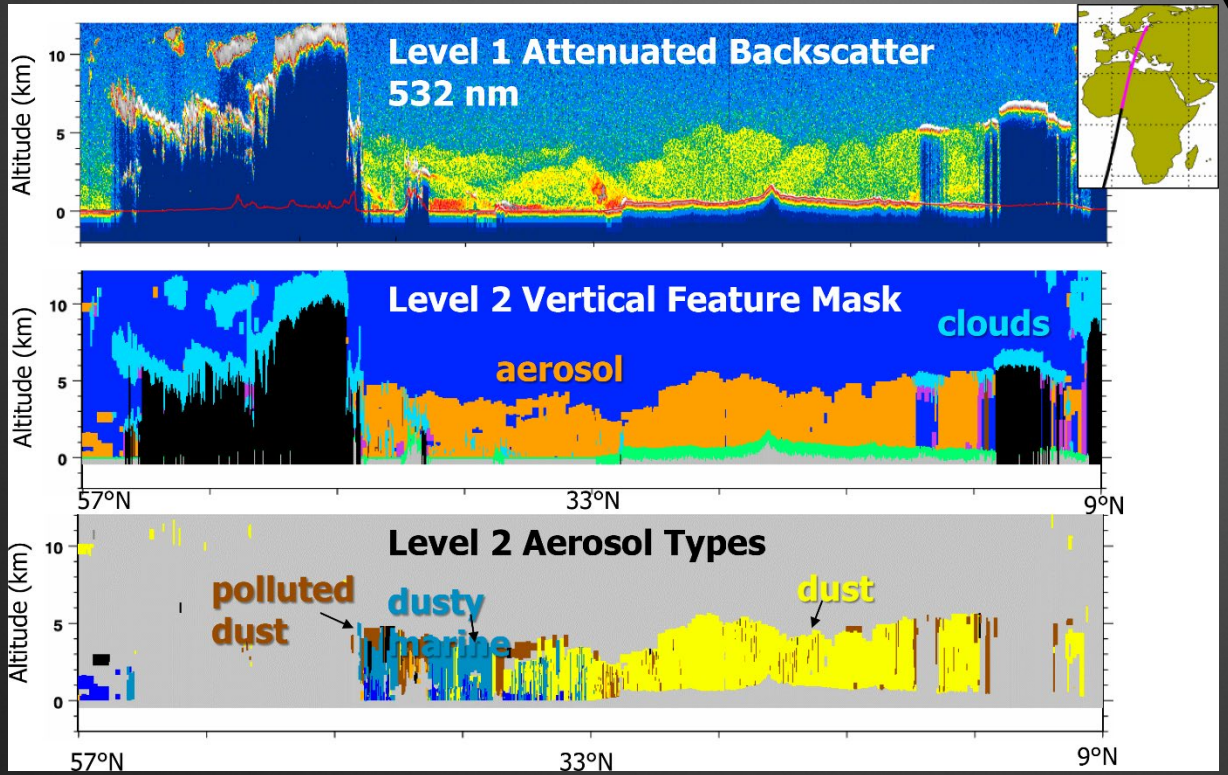
Air Quality Observations from Space



Space-borne lidar measurements

Calipso/CALIOP
NASA, launch 2006
aerosol and clouds





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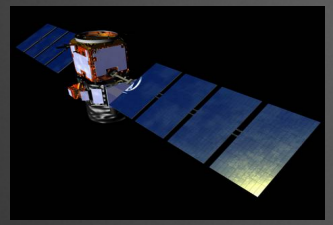

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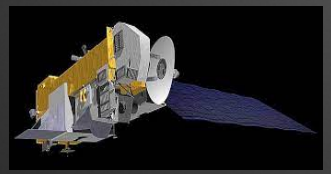
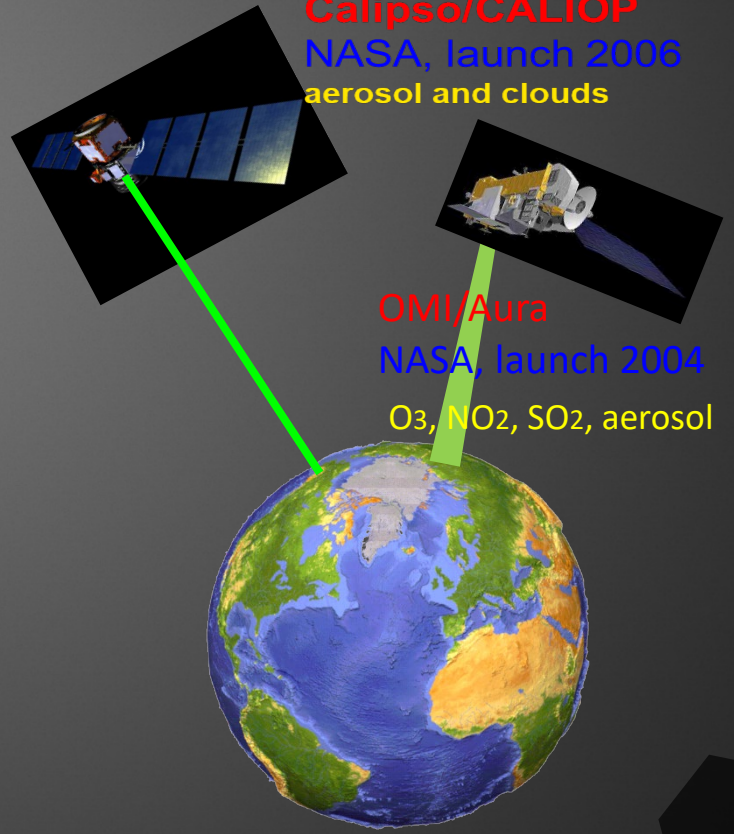
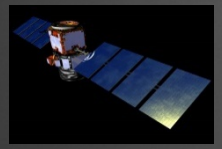


OMI/Aura
NASA, launch 2004
O_3, NO_2, SO_2, aerosol



OBSERVING OUR FUTURE



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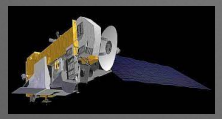

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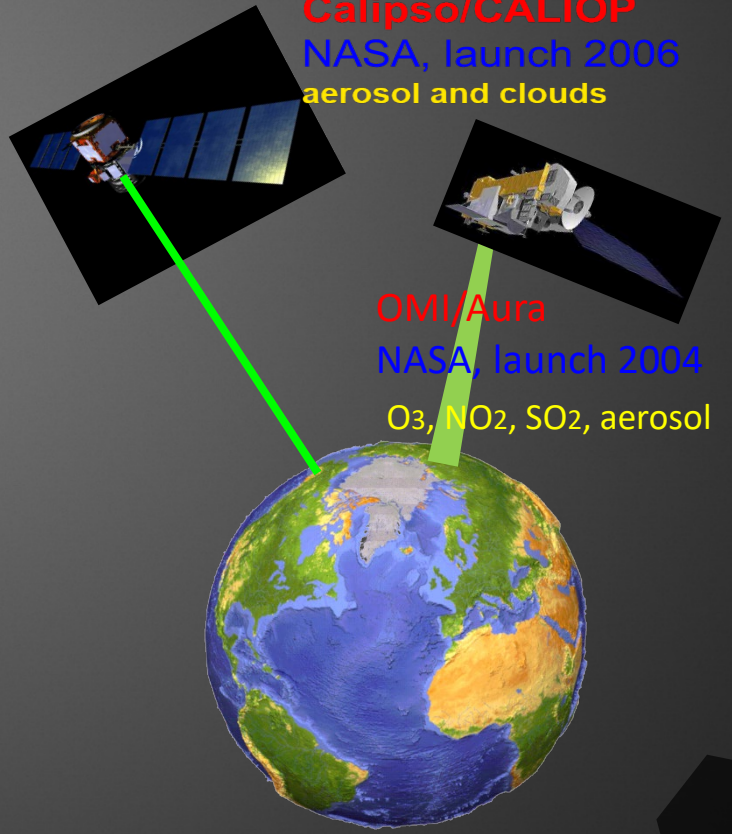


The TROPOspheric Monitoring Instrument (TROPOMI) on board the Copernicus Sentinel-5 satellite.

ERA5 ECMWF

ERA5 provides hourly estimates of a large number of atmospheric, land and oceanic climate variables.

- 10m u-component of wind
- 10m v-component of wind
- Boundary layer height
- Vertical velocity

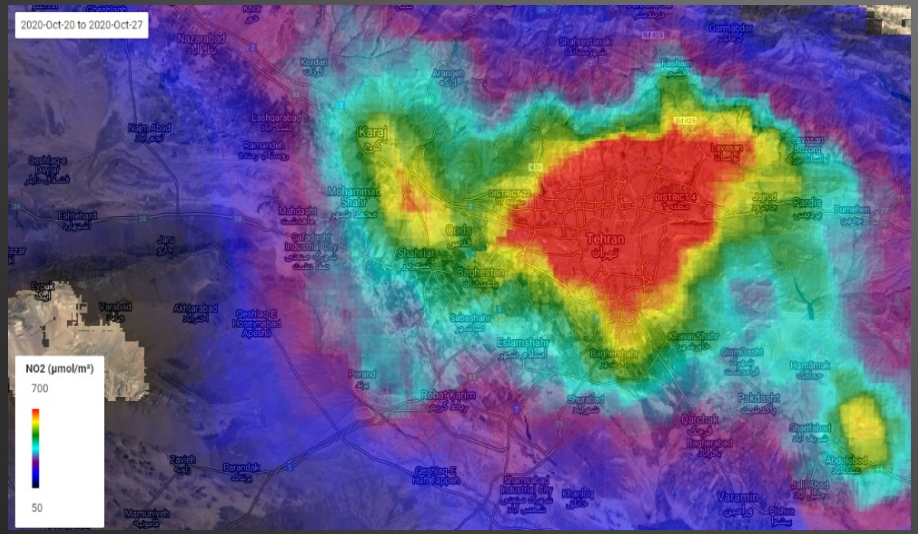
What are we looking for?

Air pollution is a major environmental issue for Tehran and particulate matter (PM) concentrations frequently exceed healthy levels based on the world health organization (WHO) standards.

We are looking to understand how much is the contribution of human activity and meteorological factors in the urban air pollution in the atmosphere above Tehran ?

How severe is Air pollution in Tehran?

Oct 20 to Oct 27, 2020



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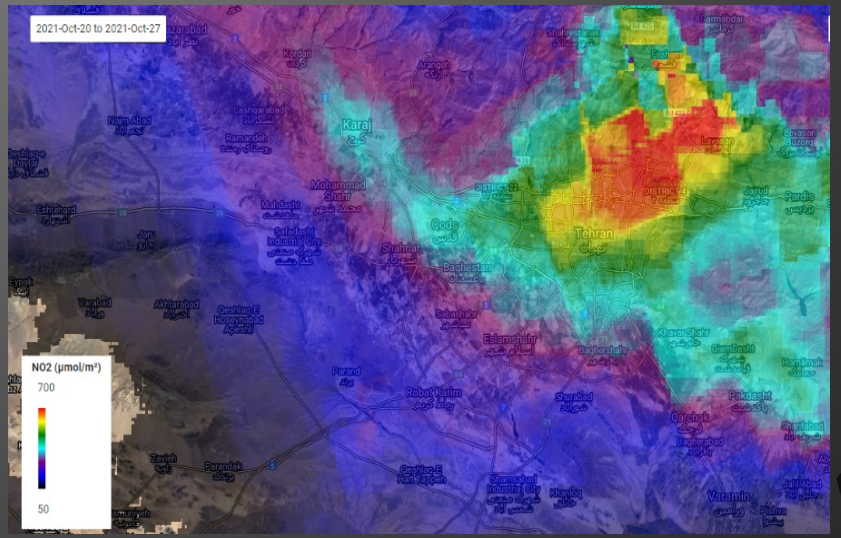

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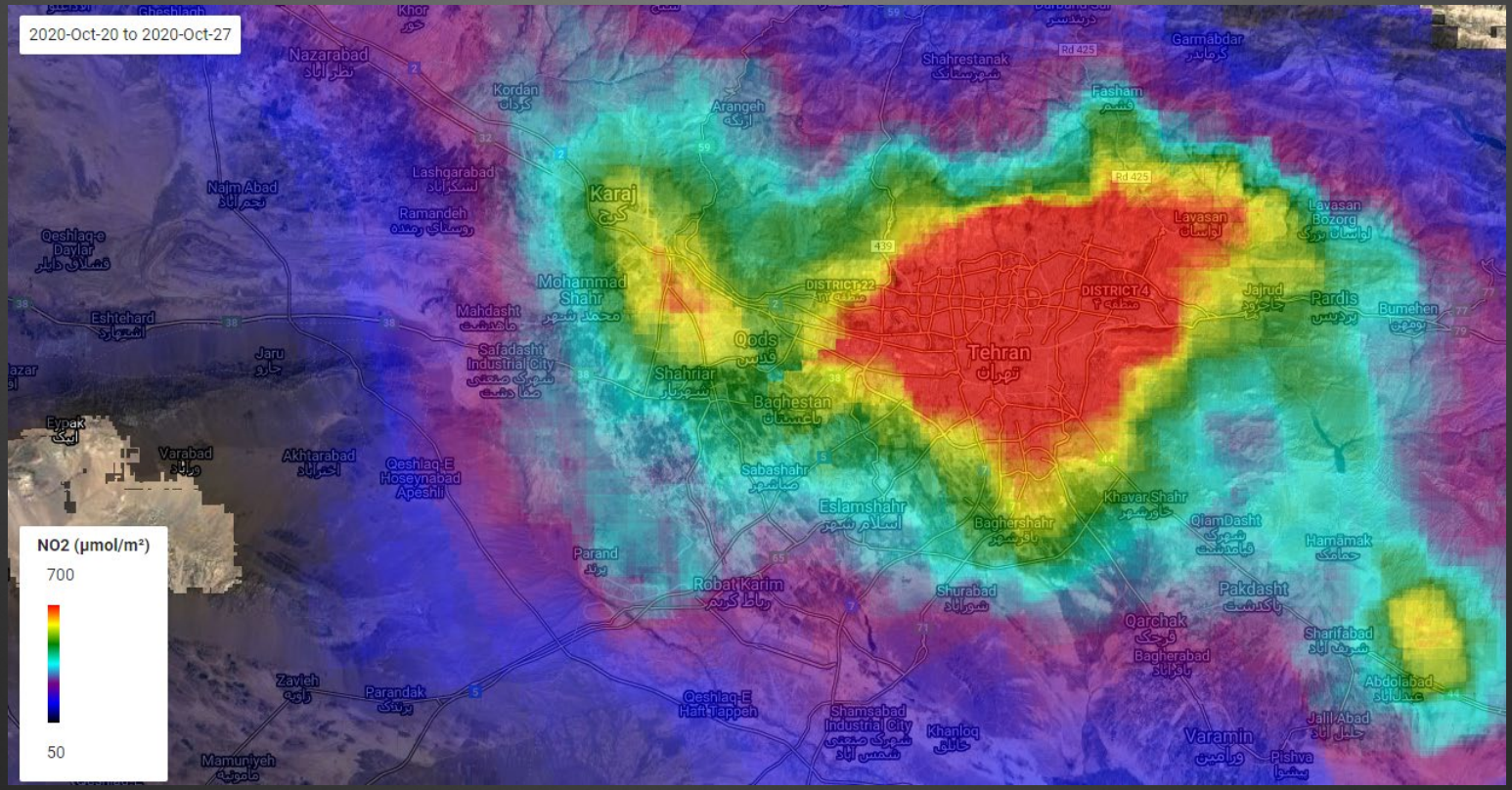

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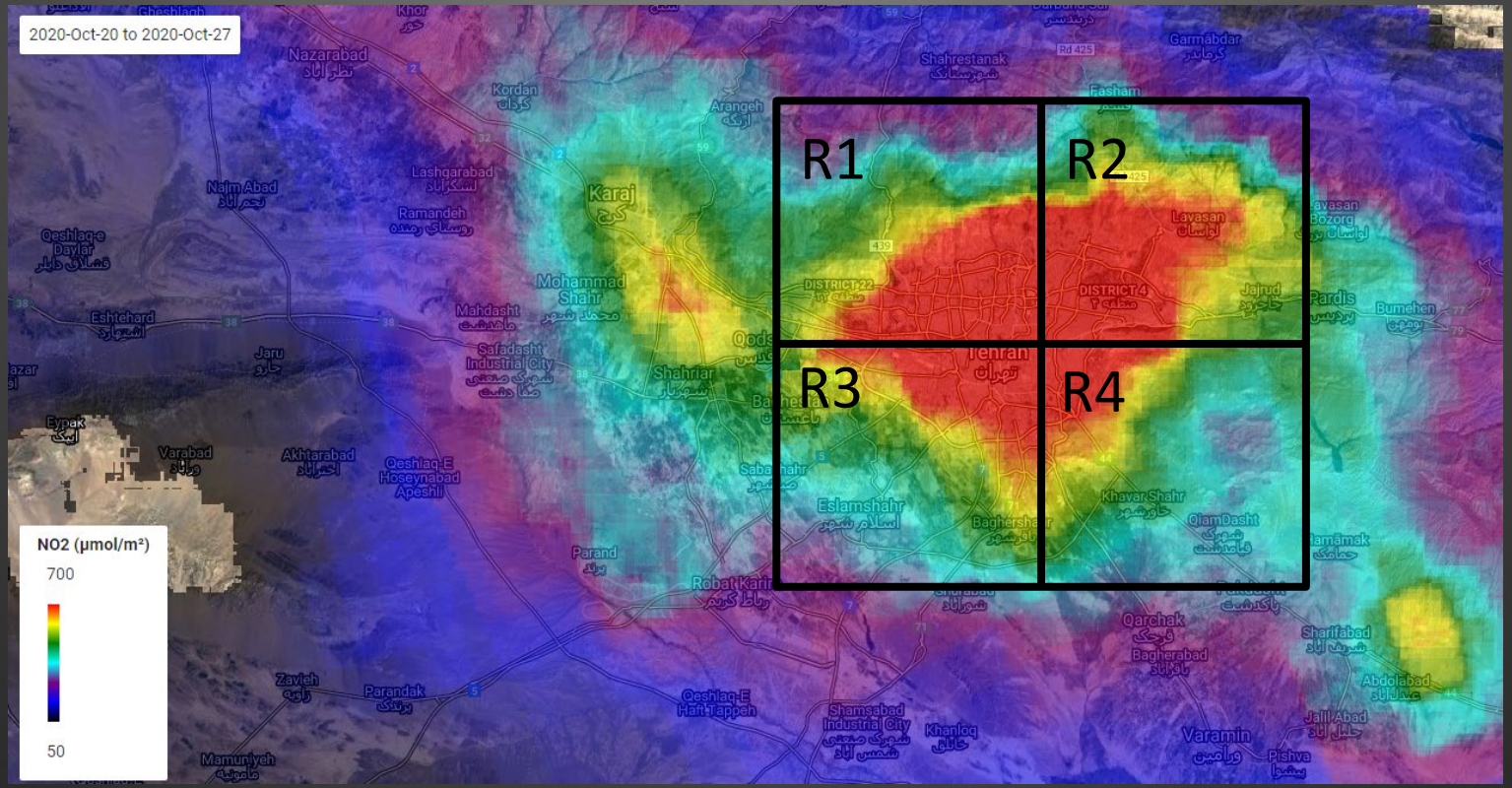


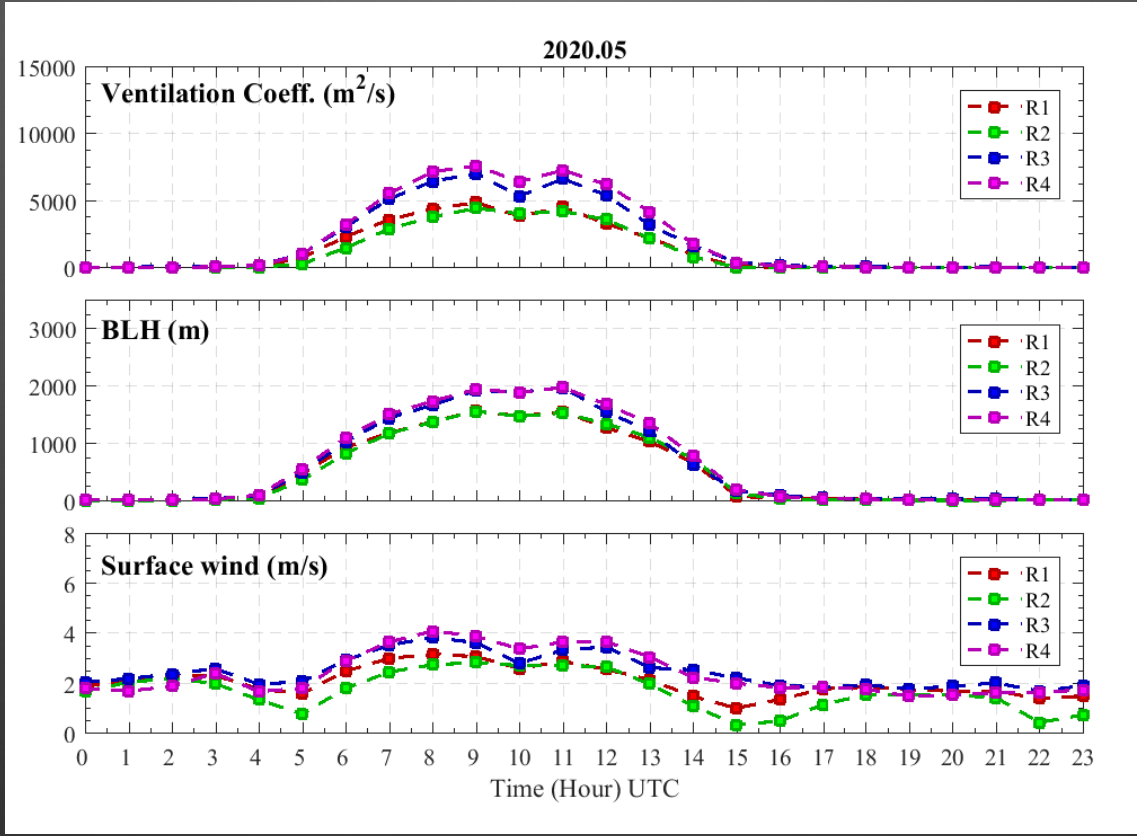
Ventilation coefficient

$$Ventilation\ coefficient = Wind\ speed\ \left(\frac{m}{s}\right) \times mixing\ layer\ height\ (m)$$ Ref 1

According to The US National Meteorological Centre and Atmospheric Environment Services, Canada, high pollution potential or low assimilative capacity occurs during afternoon, when ventilation coefficient is < 6000 m2s-1 and mean wind speed does not exceed 4 m s-1 and during morning hours, when mixing height is < 500 m.

Ref1: Ashrafi, Shafie-Pour, & Kamalan, 2009.

Diurnal cycle of Ventilation coefficient



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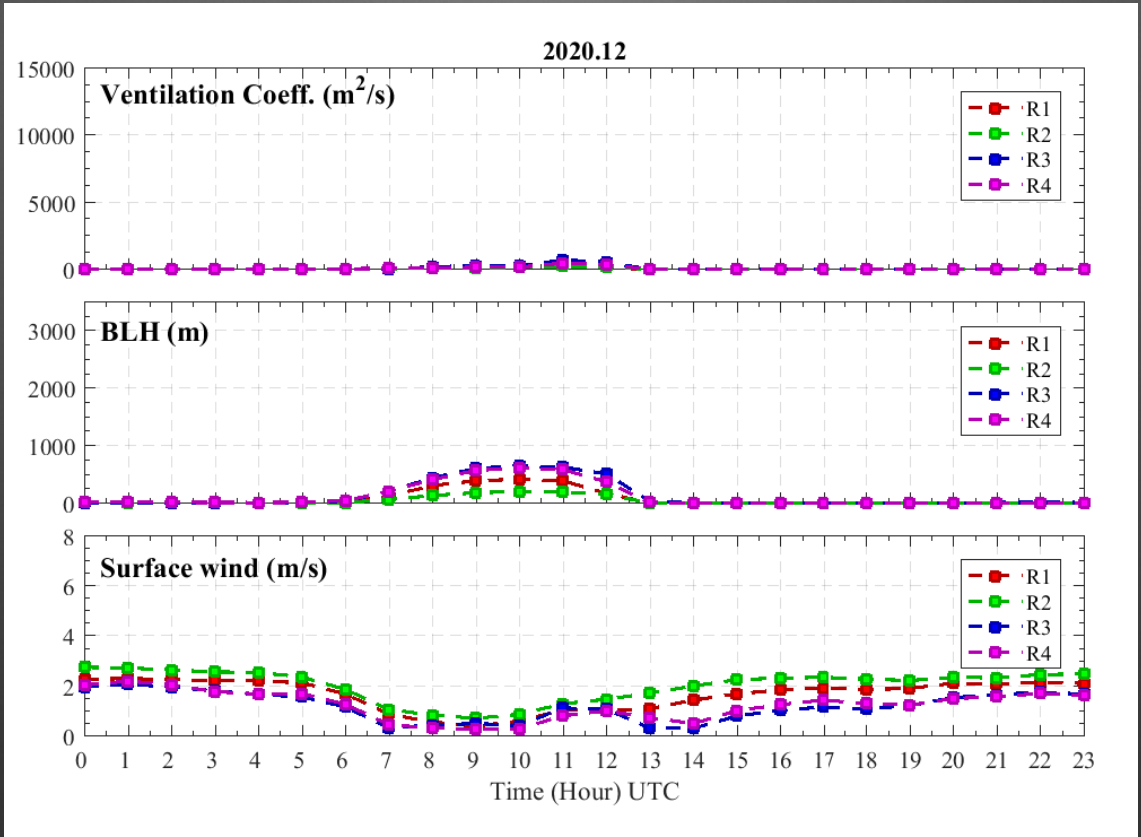
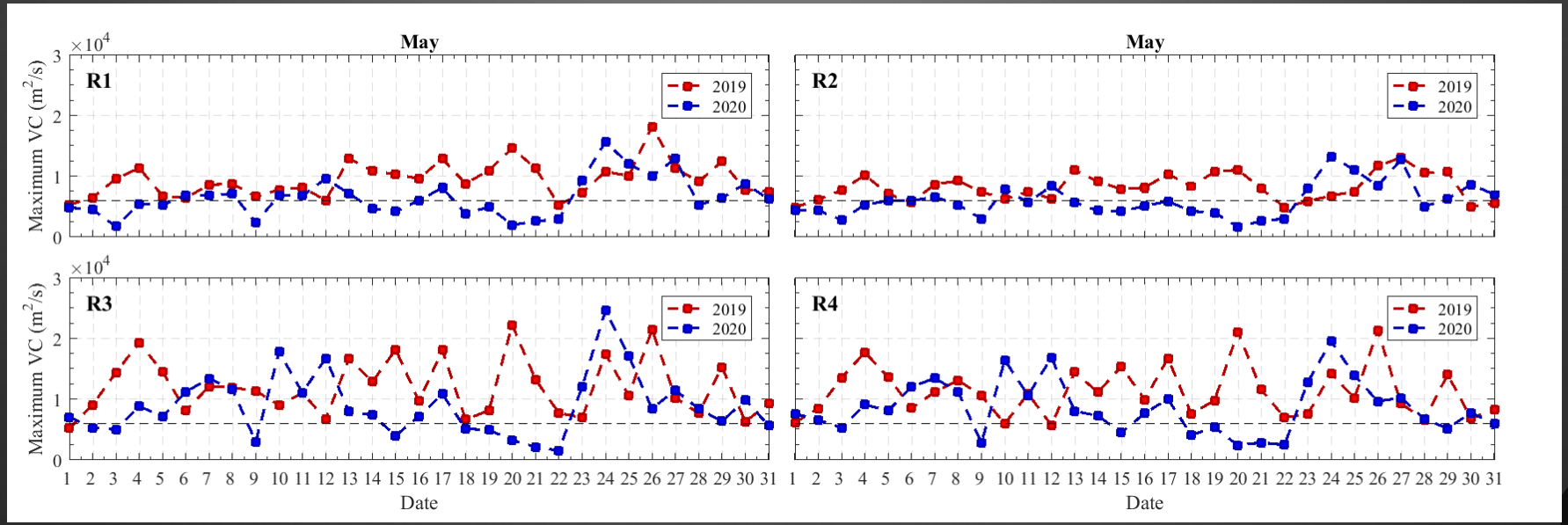


Daily variation of Ventilation coefficient



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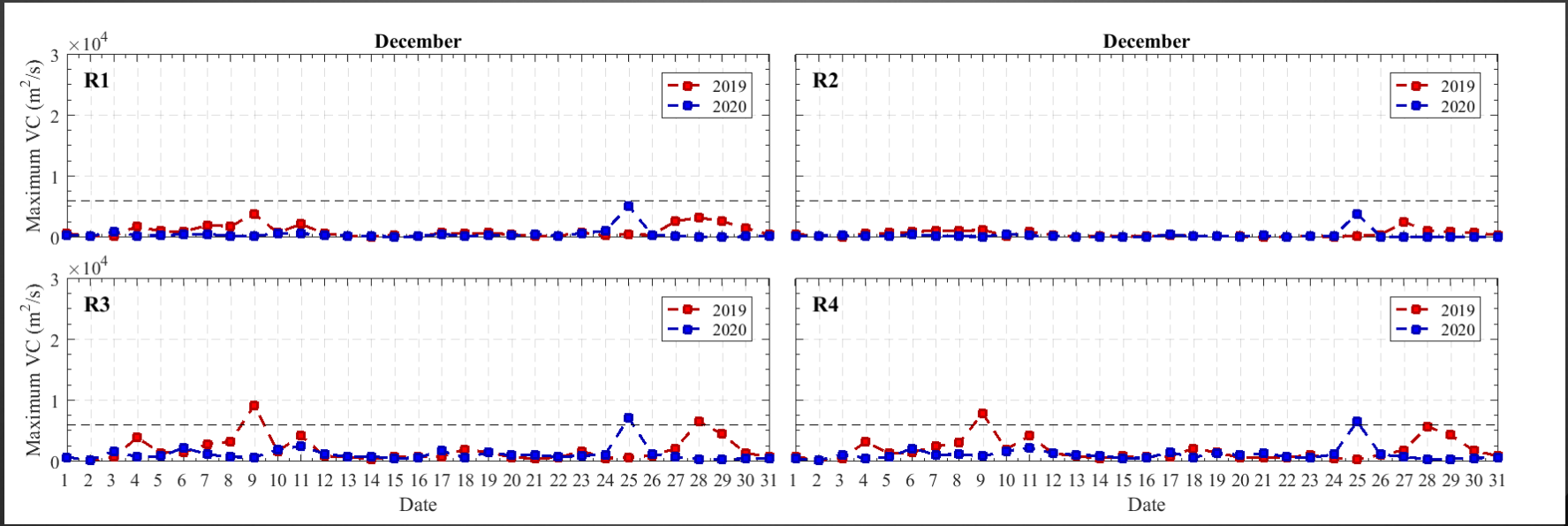
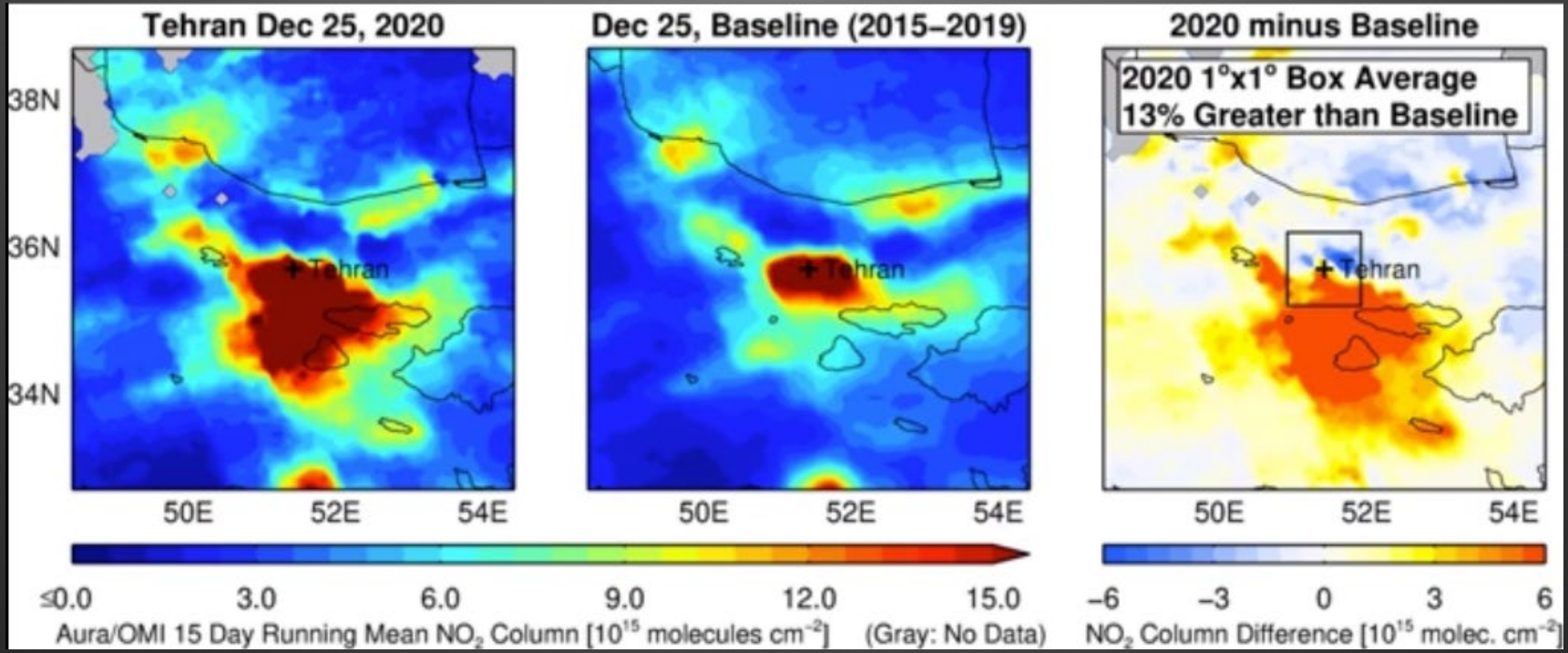
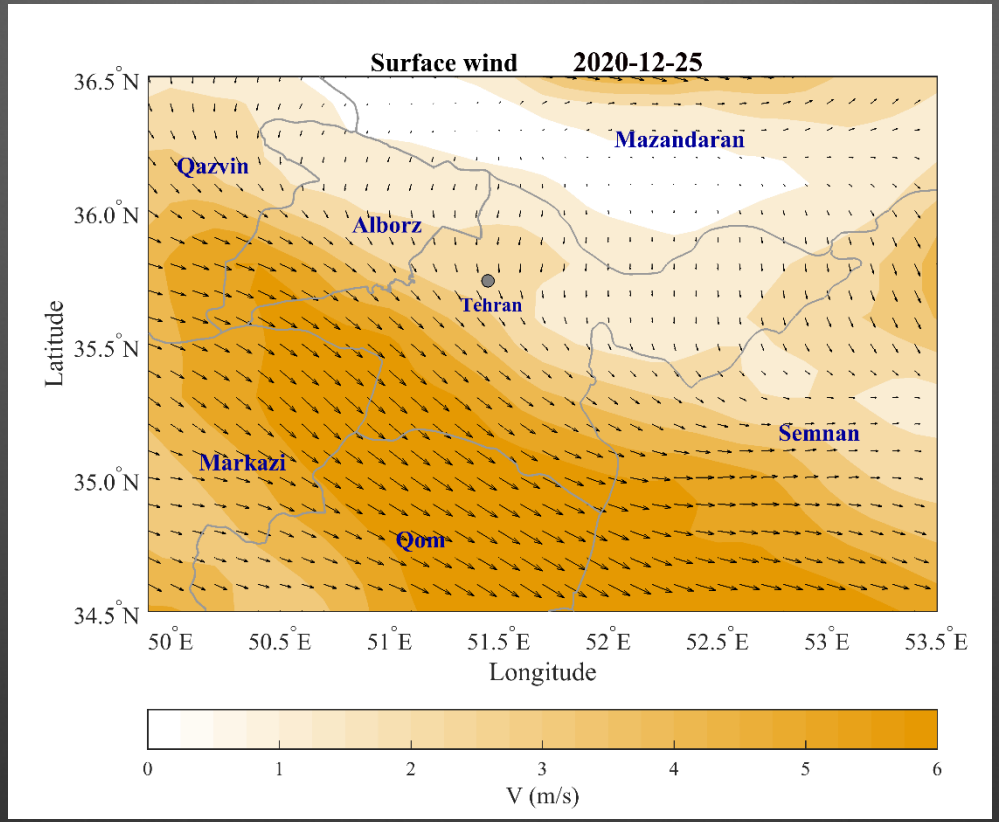


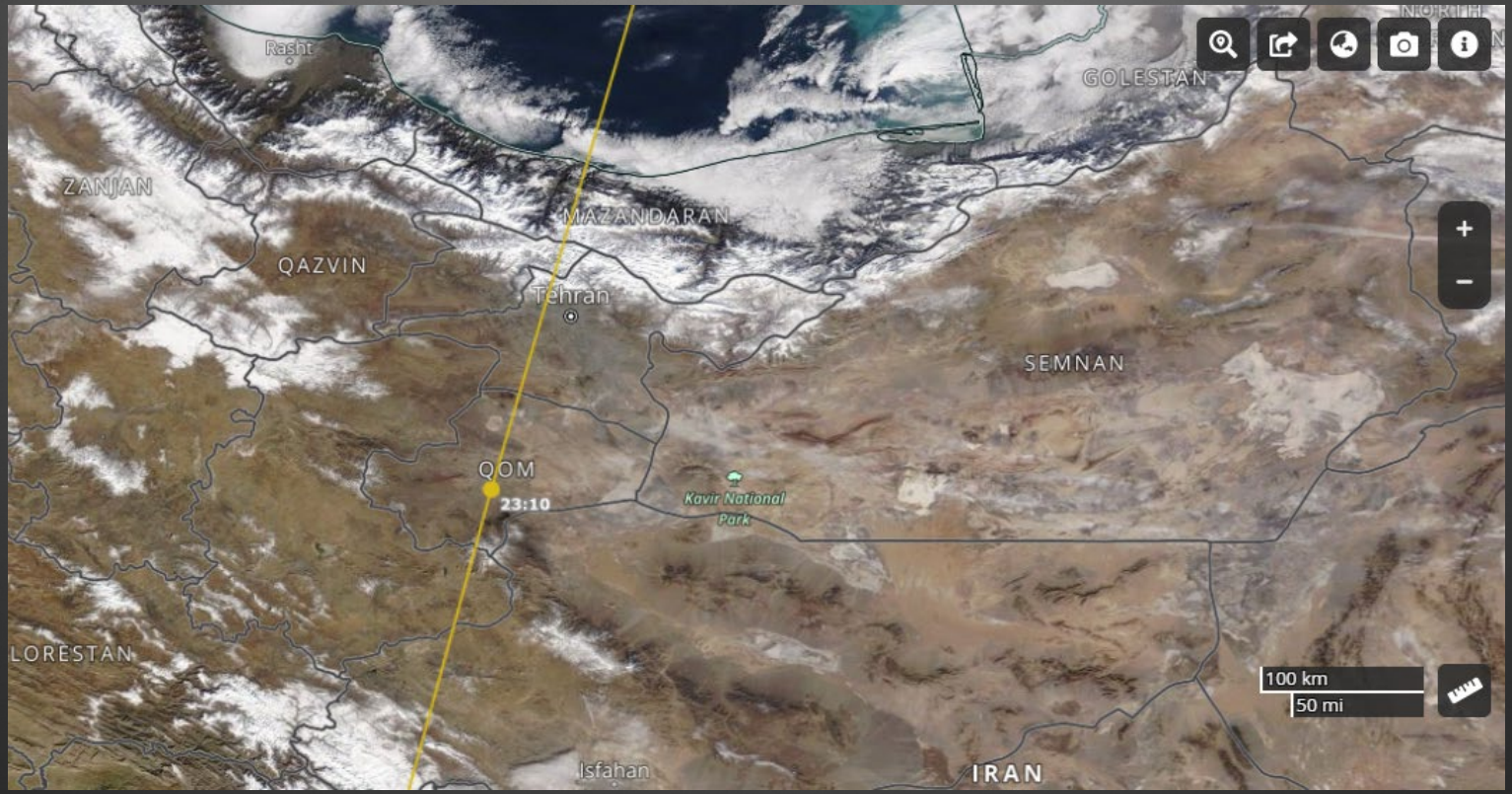
OMI tropospheric total column of NO_2



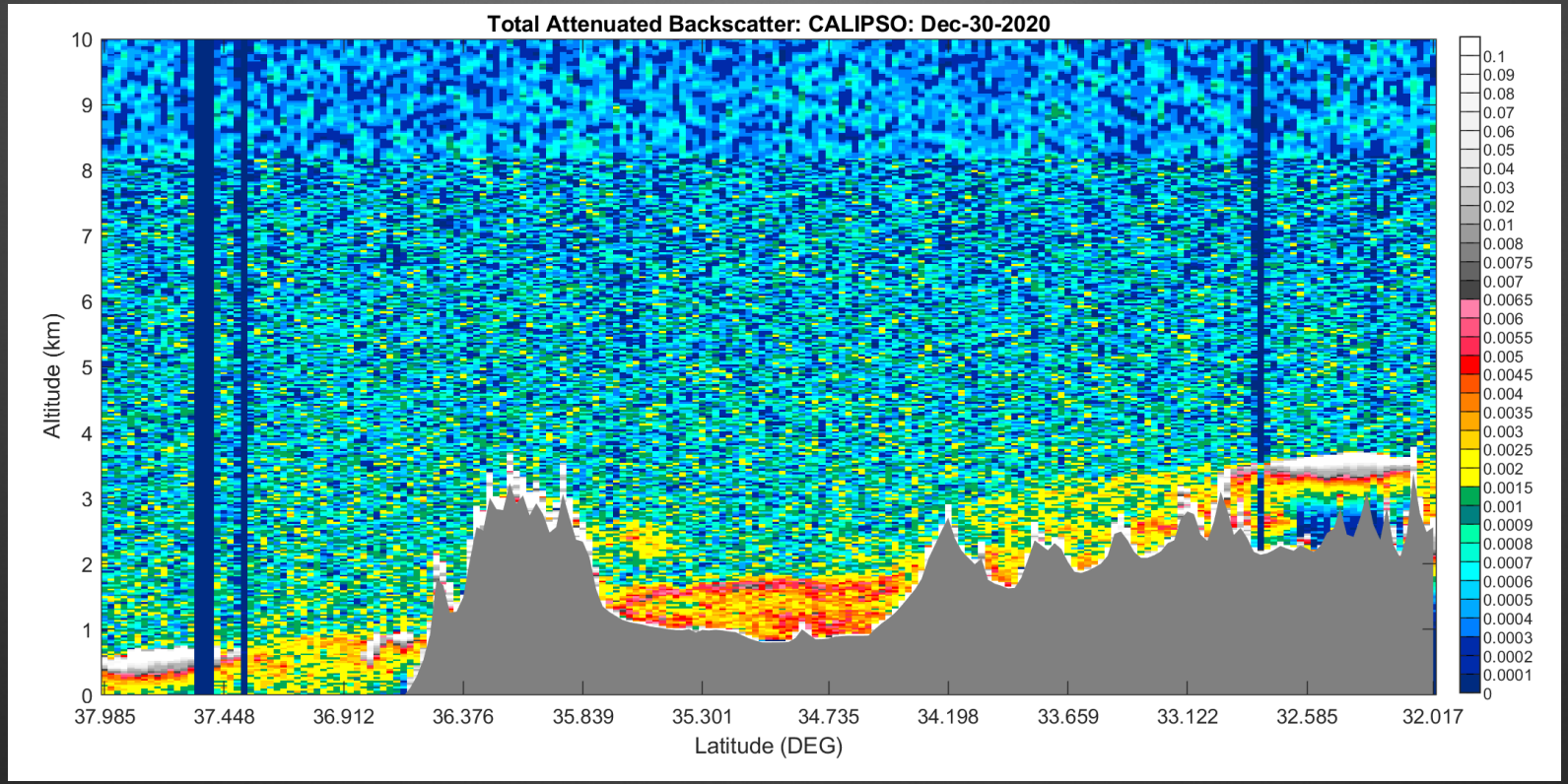
Spatial pattern of surface wind speed and direction



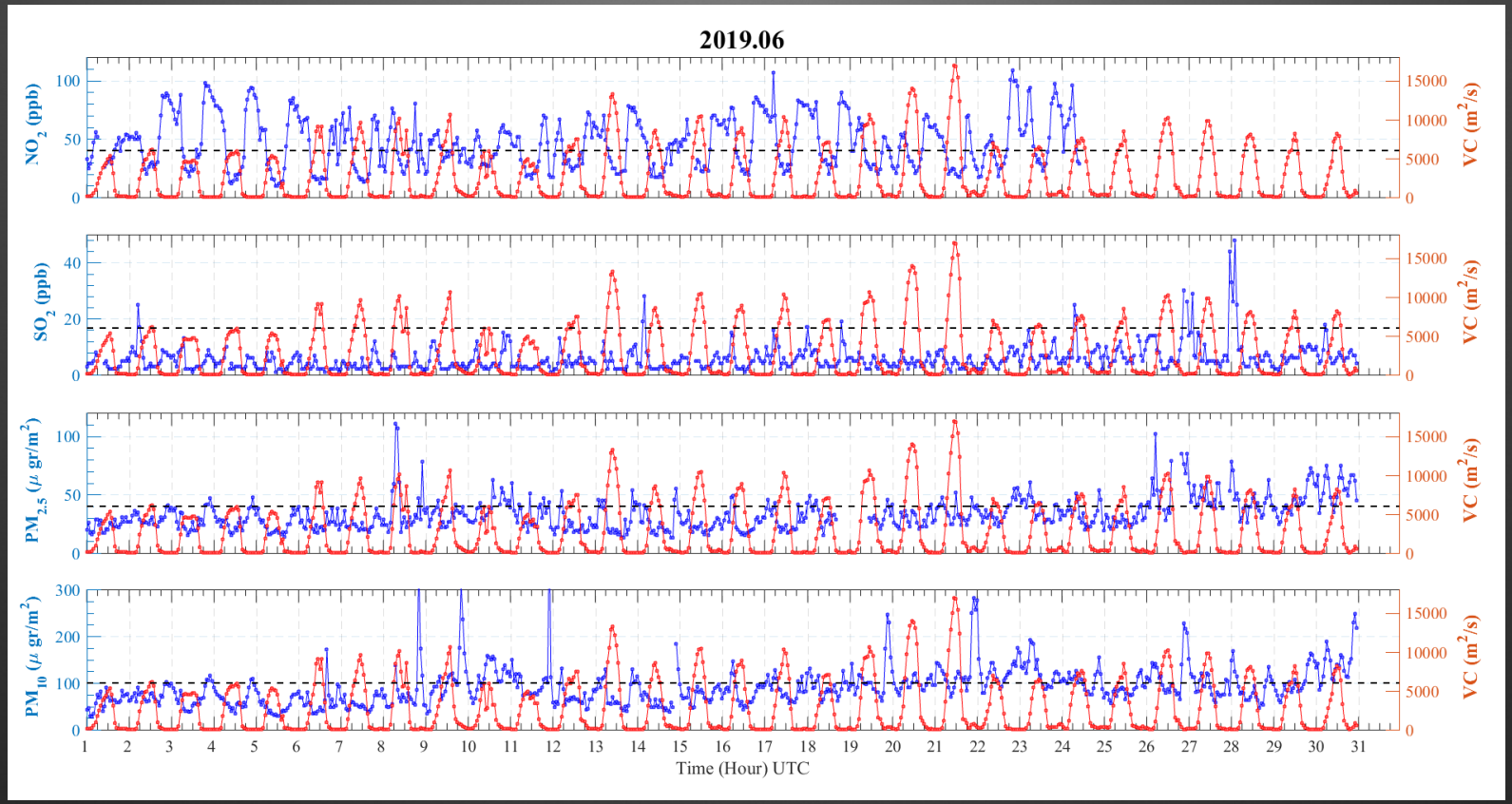
Calipso ground track on 30 Dec, 2020



Cross section of attenuated backscatter coefficient at 532 nm



Correlation of Ventilation coefficient with pollutant



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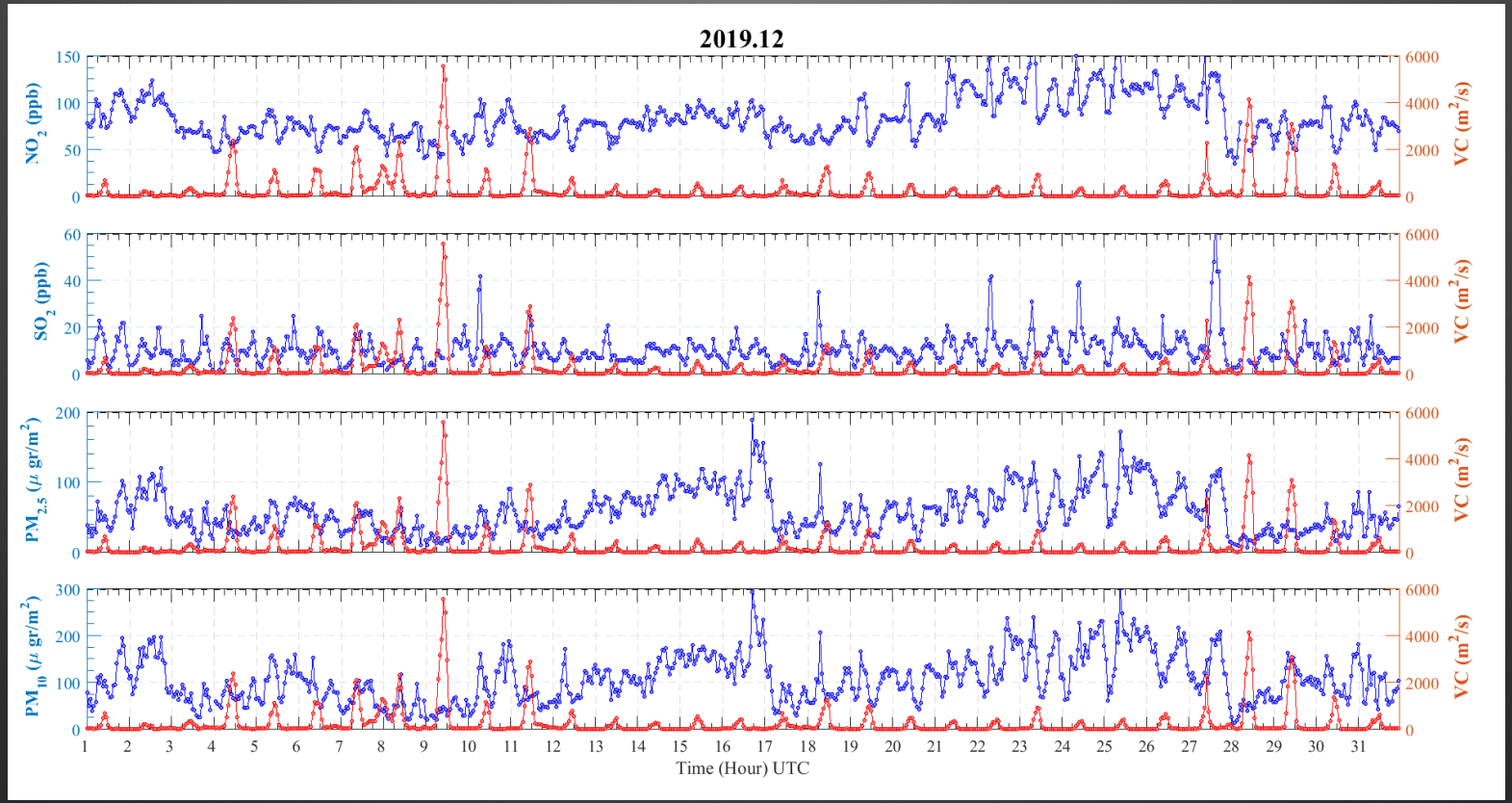

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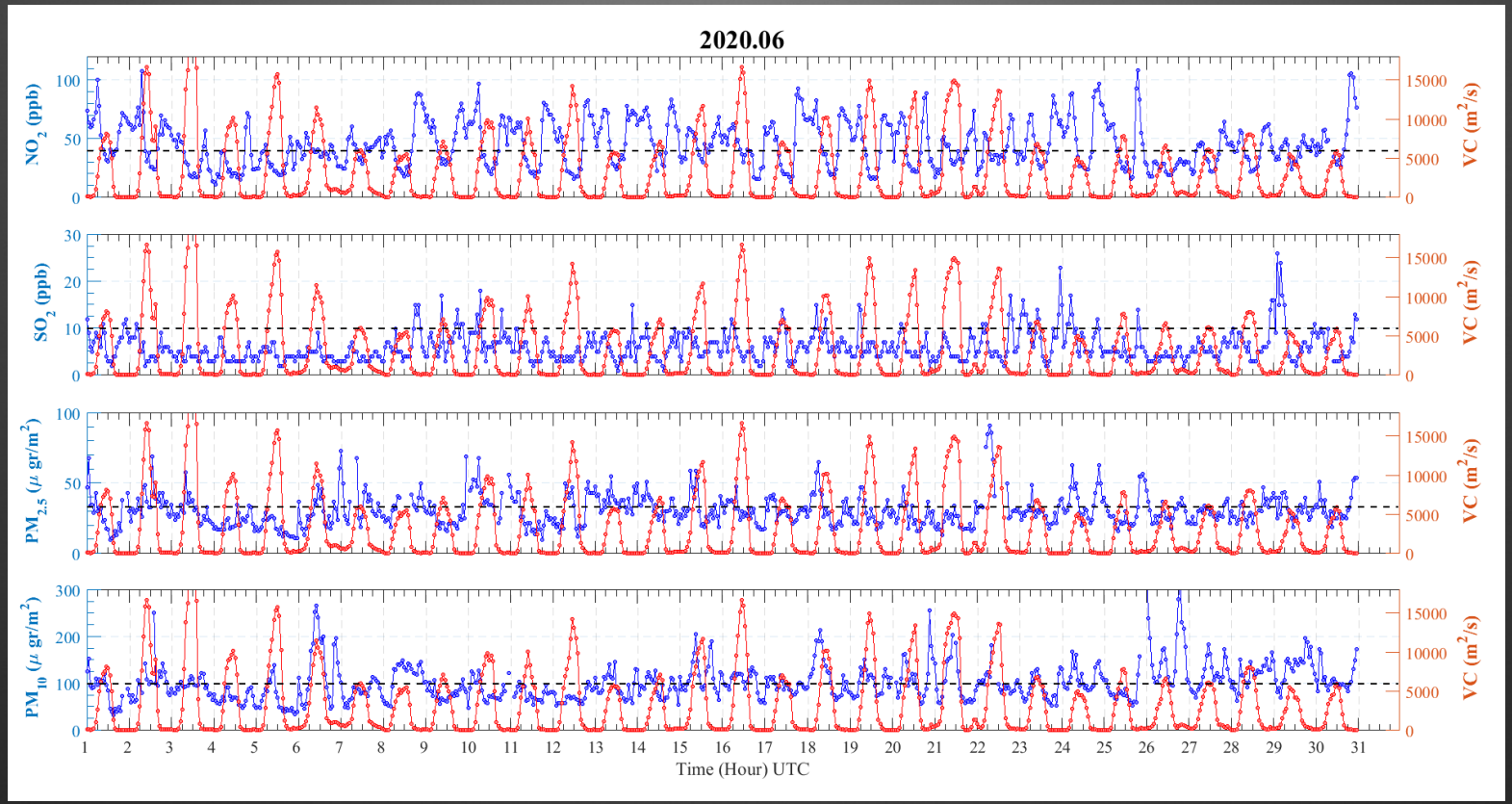

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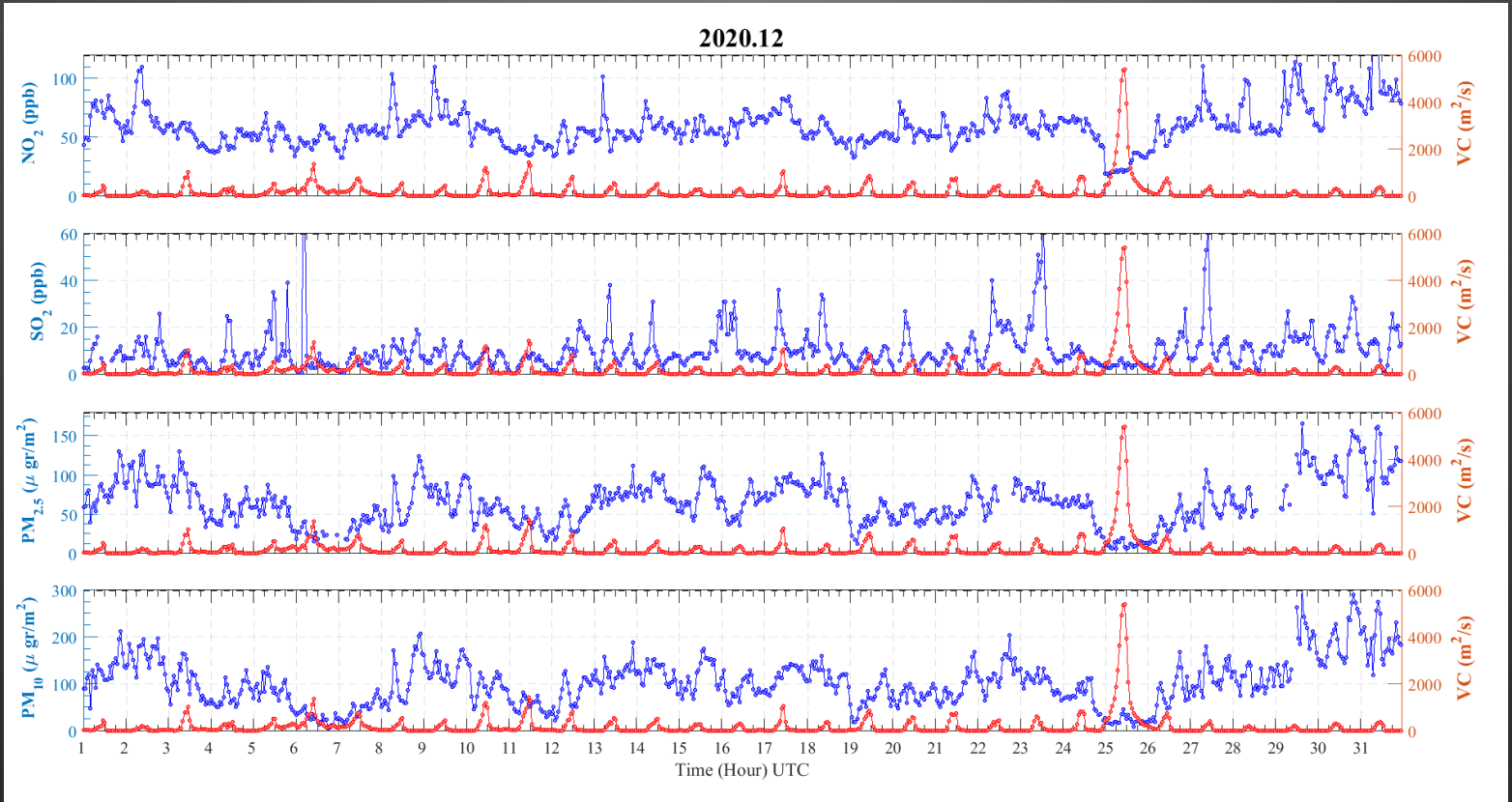

Summary

- The highest value of VC observed was during summer, due to high values of BLH compared to the other seasons. It mainly remain below 6000 m^2/s during cold seasons.
- When the BLH and VC are low, the pollutant concentration is higher and vice versa. This means that the dispersion of pollutants in the lower atmosphere is due to convective mixing.
- High VC values could dilute air pollutants, and the anthropogenic air pollution in Tehran has a considerable impact on the atmosphere of neighboring cities.

Thank You

- Questions