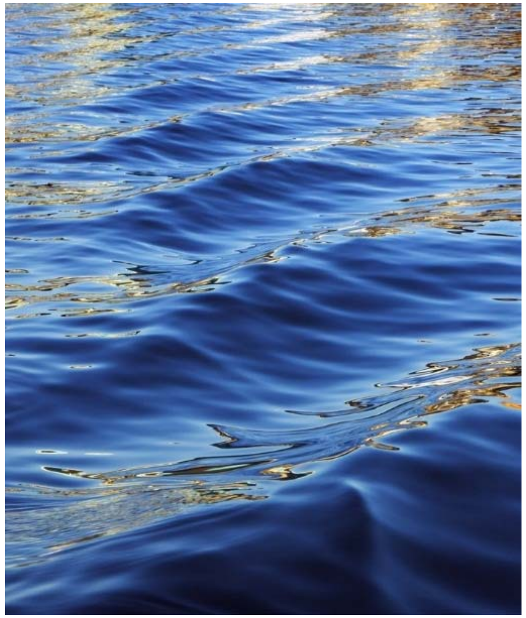
بسم الله الرحمن الرحیم

19th Annual Community Modeling and Analysis System (CMAS) Conference

Remote Sensing-Based Estimates of Waste Burning in Tehran, Iran



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October 2020

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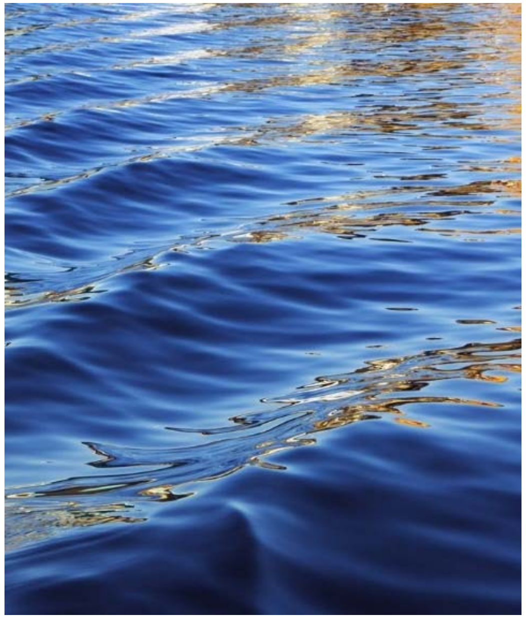
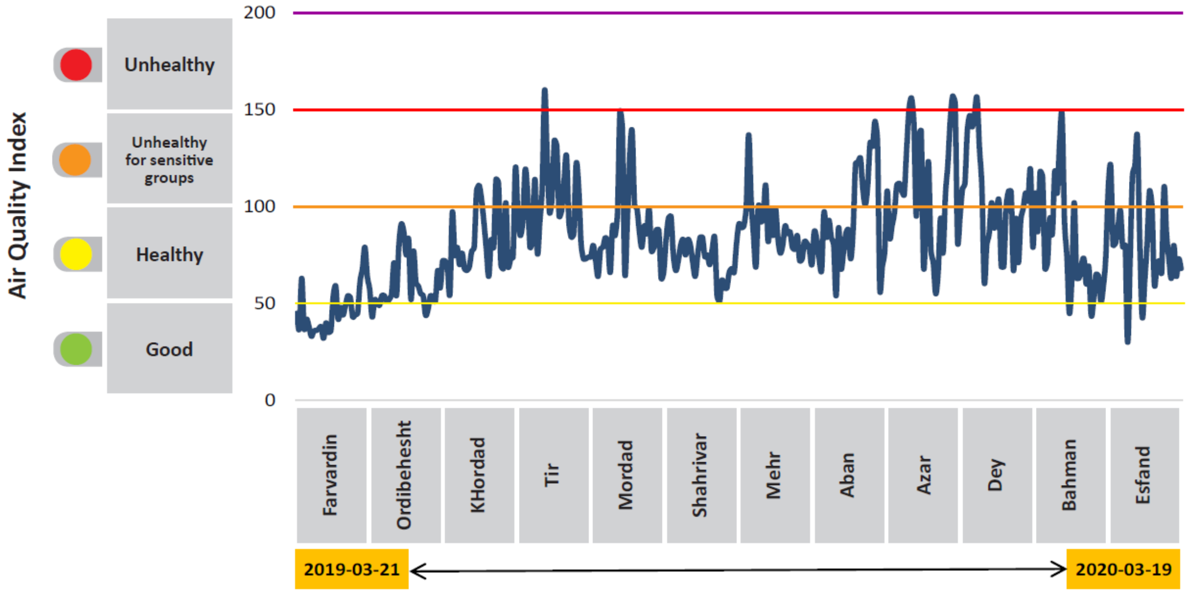


Introduction

- Tehran:
  - Population: 13,260,000 (2017)
  - Metropolitan area: 2,235 km²
  - Urban area: 1,200 km²
  - Agricultural area :44,858 hectares

Introduction

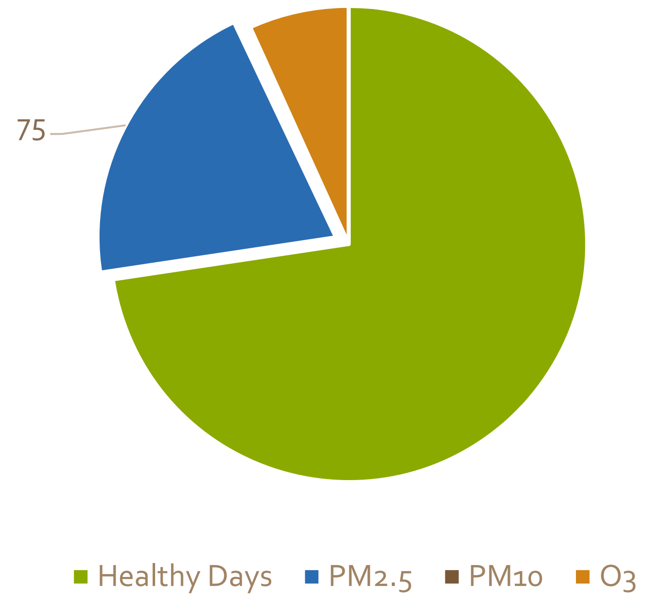
Air Quality in Tehran (March 2019 – March 2020)



Reference: Tehran Air Quality and Noise Report, Period of March 2019-March 2020, QM99/03/01(U)/1

Introduction

PM2.5: the criteria pollutant in Tehran



Reference: Tehran Air Quality and Noise Report, Period of March 2019-March 2020, QM99/03/01(U)/1

Introduction

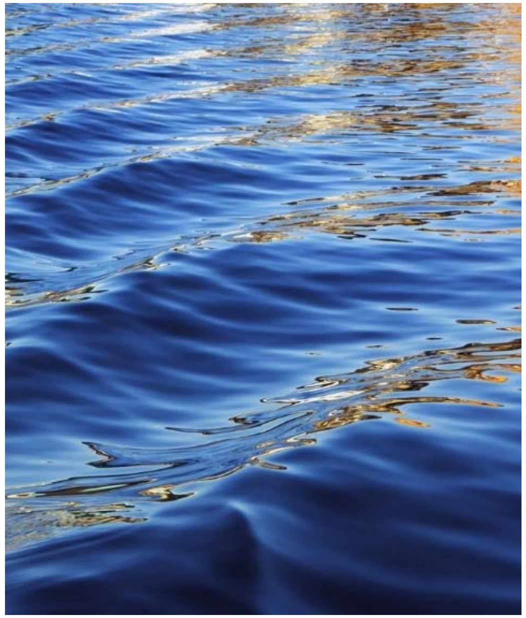
PM2.5: the criteria pollutant in Tehran

- According to official reports by TAQCC onTehran emission inventory, the largest share of PM emissions (roughly 61%) originates from mobile sources while the remainder stems from non-traffic related emissions (16.5% from energy conversion (including refineries and power plants), 18% from industries, 2.5% from household and commercial sources, and 2.5% from terminals.)[1]
- The agricultural emissions around Tehran are not accounted in TAQCC report.
- However, other studies on Tehran's PM2.5 emission inventory [2] show that the share of agricultural sector in Tehran PM2.5 emissions could be as high as 5% of total emissions.

Reference[1]: Shahidzadeh, H. (2018). Tehran emission inventory in 2017. Tehran, Iran, TAQCC.

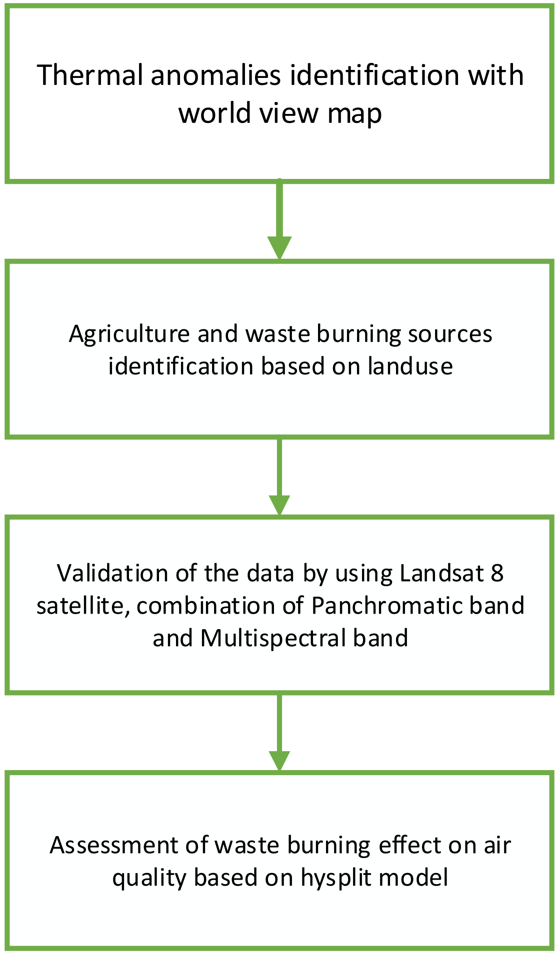
Reference[2]: Taksibi, Farzaneh, Hossein Khajehpour, and Yadollah Saboohi. "On the environmental effectiveness analysis of energy policies: A case study of air pollution in the megacity of Tehran." *Science of The Total Environment* 705 (2020): 135824.

Methodology



Methodology

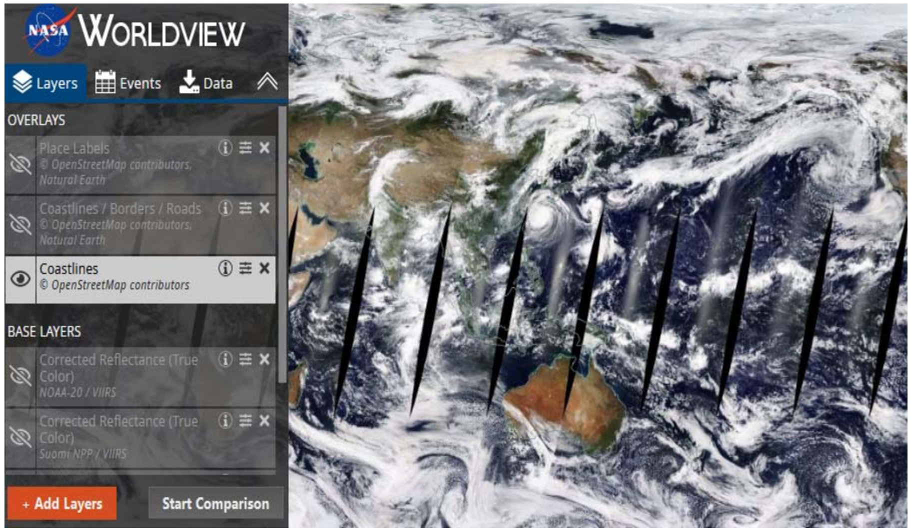
- Time and place of the thermal anomalies are identified with VIIRS night fire products in the ***World View Map*** from 2017 to 2019.
- Trajectory profile based on meteorological condition is studied with ***Hysplit*** model.
- The trajectory helps to check whether the emissions from the agricultural and municipal waste burning will impact Tehran's air quality.



Methodology

World View Map:

- Visually explores the past and the present from a satellite's perspective.
- A spatiotemporal pattern of heat-releasing of thermal anomalies is produced by ***The MODIS*** product and ***The VIIRS*** (Visible Infrared Imaging Radiometer Suite (Night, 375m)).



Reference: https://worldview.earthdata.nasa.gov

Methodology

Landsat 8

- High spatial resolution by two sensors:
  - Operational Land Imager (OLI)
  - Thermal Infrared Sensor (TIRS).
- OLI collects data at a 30-m spatial resolution with eight bands located in the visible, near-infrared and shortwave infrared regions of the electromagnetic spectrum, plus an additional panchromatic band at 15-m spatial resolution.
- In this satellite we can merge multi-spectral bands (with 30 meter spatial resolution) with panchromatic band (high spatial resolution 15 meter) to output high resolution images.

Reference: https://earthexplorer.usgs.gov

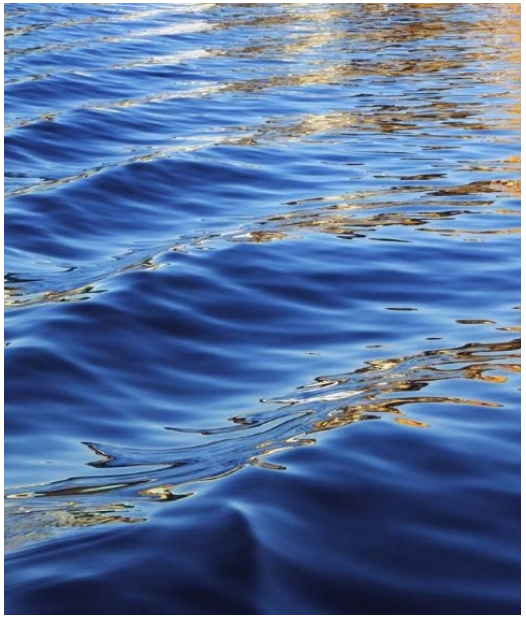
Methodology

Hysplit model

- The Air Resources Laboratorys' *HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT)* model is a complete system for computing both simple air parcel trajectories and complex dispersion and deposition simulations.
- The model calculation method is hybrid between the Lagrangian approach, which uses a moving frame of reference as the air parcels move from their initial location, and the Eulerian approach, which uses a fixed three-dimensional grid as a frame of reference.

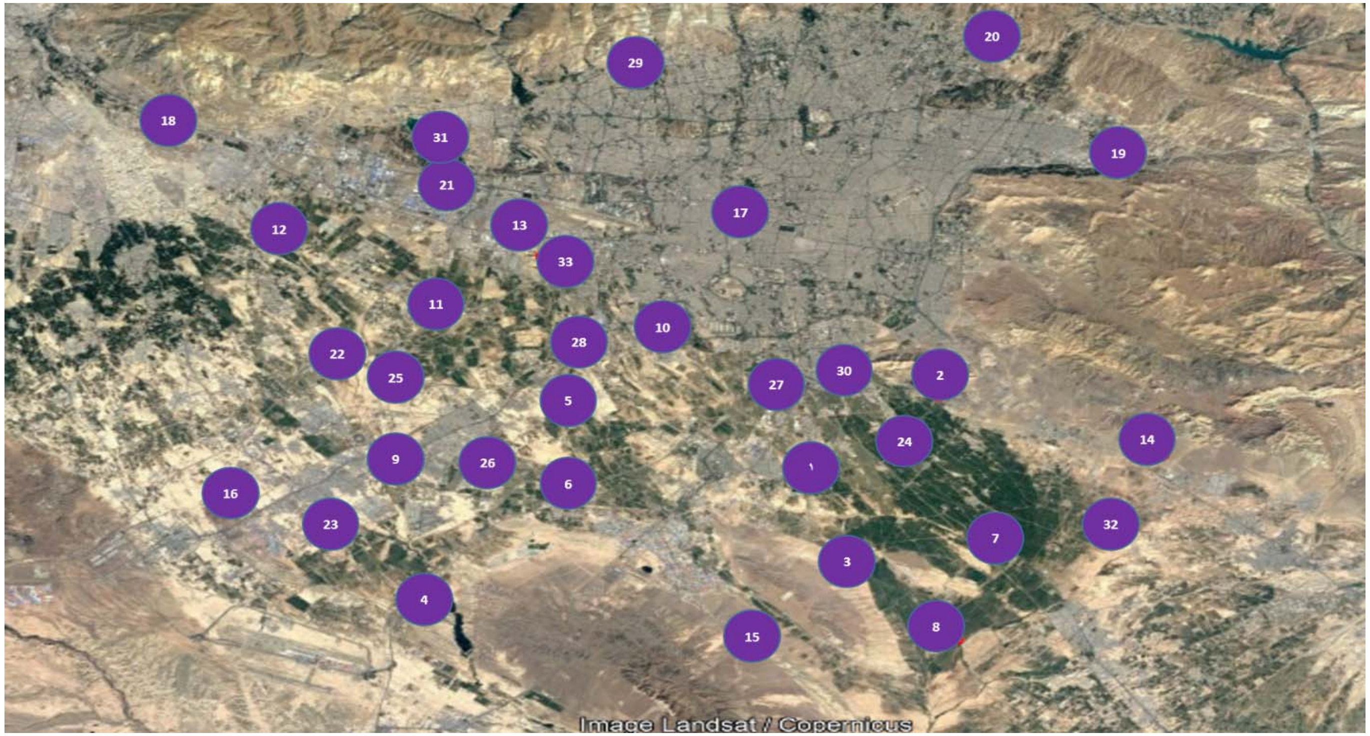
Reference: Draxler, R. R., and G. D. Rolph. "HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model access via NOAA ARL READY website (http://ready. arl. noaa. gov/HYSPLIT. php). NOAA Air Resources Laboratory." *Silver Spring, MD* 25 (2010).

Results



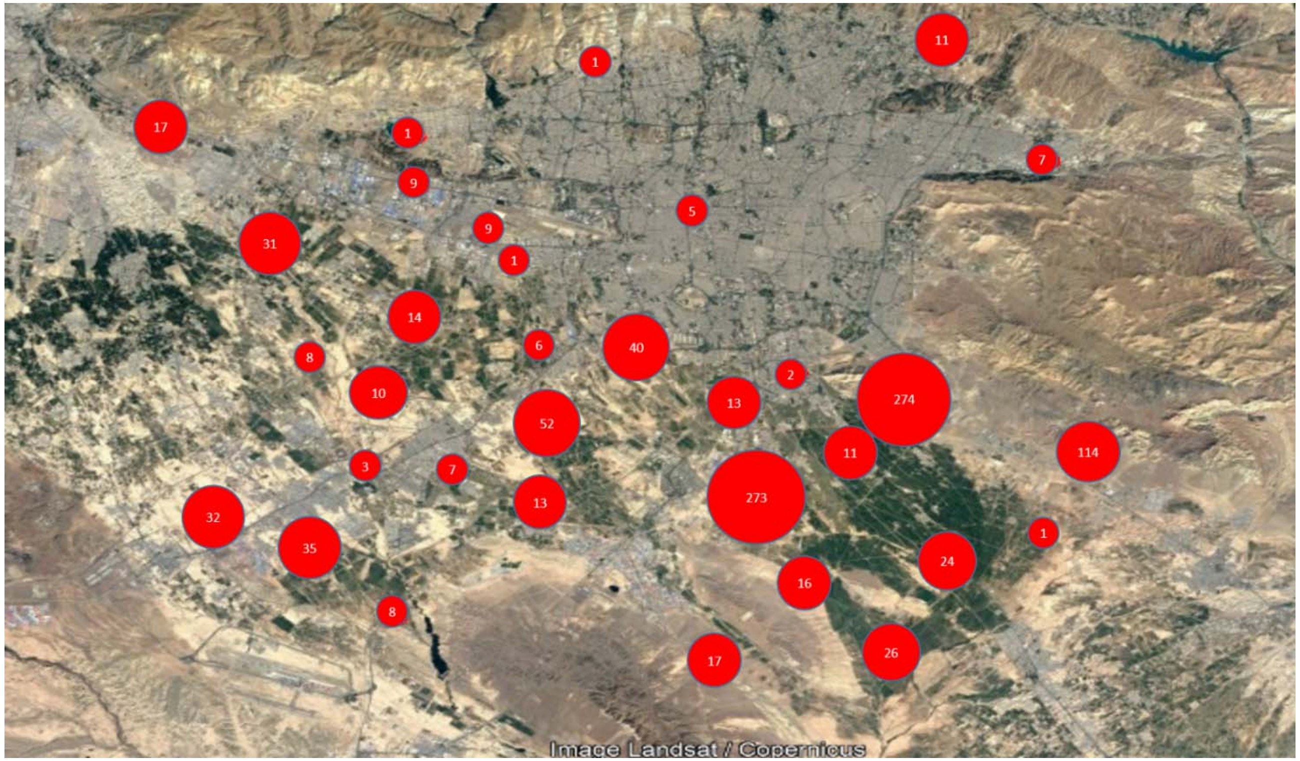
Results

Identified Thermal Anomalies



Results

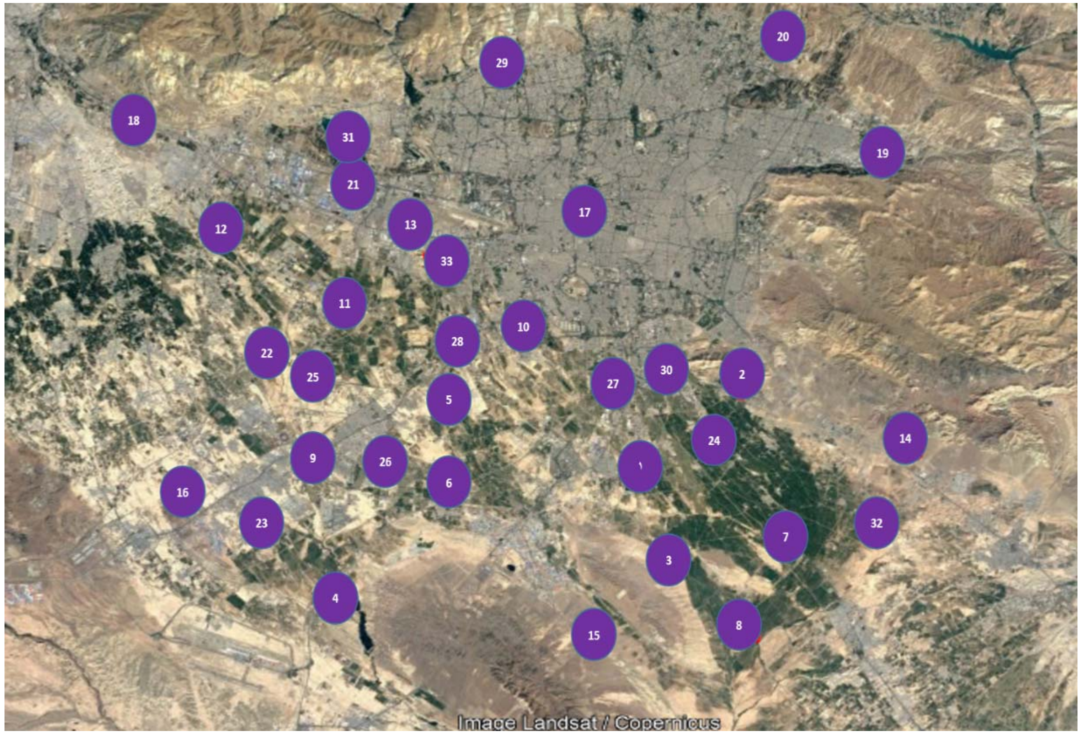
Frequency of Thermal Anomalies



Results

	peak time	2017	peak time	2018
1	Jun/Oct	273	June/Sep	228
2	Jun/Oct	274	June/Aug	245
2	Jun/Oct	20	June/Aug	16
3	Jan/June	16	June	7
4	May	8		0
5	May/June	52	June/July	33
6	July/Aug	13	July	6
7	June/July	24	June	17
8	June	26	March	19
9	Feb	3	Aug	2
10	May/June	40	July	29
11	Feb/April	14	March	6
12	June/July	31	May/July	21
13	June	9	Sep/Oct	4
14	May/June/Aug	114	June/July	90
15	July/Sep	17	June/July	22
16	June/Sep	32	Jan/Aug	10
17	March	5	March	9
18	April/May	17	Aug	5
19	May/June	7	June/July	15
20	July	11	March	4
21	June	9	May	6
22	May	8	July	7
23	June/July	35	June	28
24	June/July	11	June	13
25	June/Aug	10	April	5
26	June	7	June	7
27	June	13	Oct	1
28	July	6	June/July	18
29	July	1	June	1
30	August	2	June	15
31	Nov	1	Sep	5
32	Nov	1	June/July	21
33	Nov	1	July	1

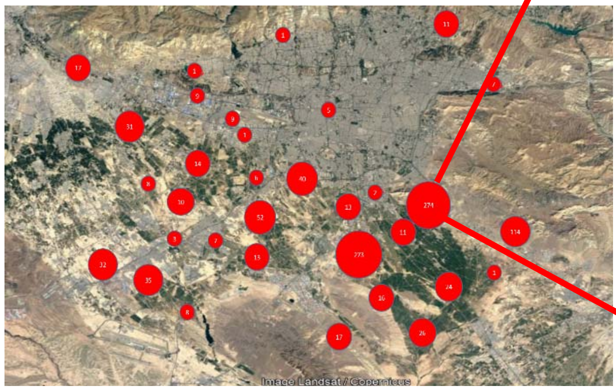
Types of Thermal Anomalies



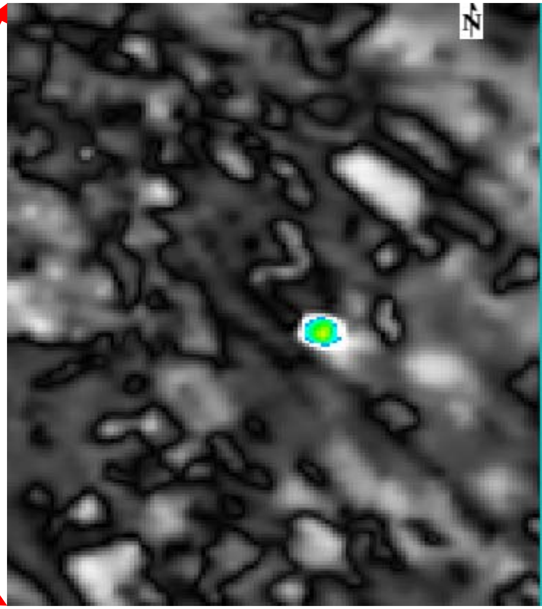
Results

Samples from Landsat 8 satellite

- Example of a Cement Plant



Thermal band

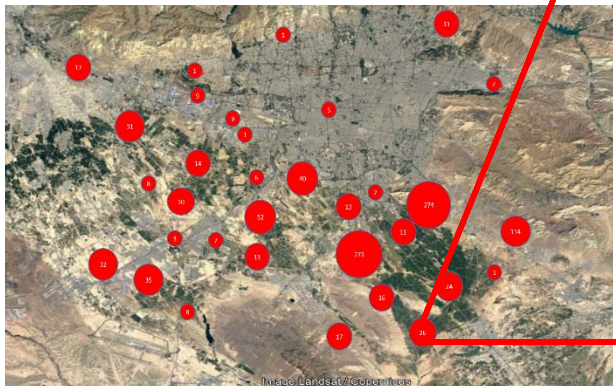


Panchromatic band combination with Multispectral band

Results

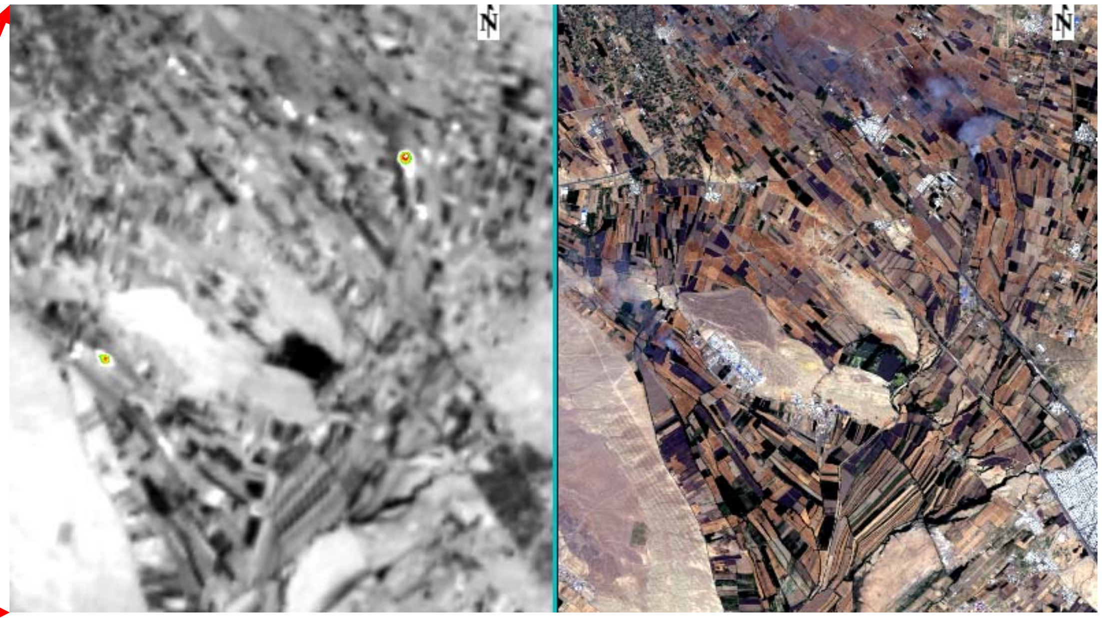
Samples from Landsat 8 satellite

- Example of an Agricultural Waste burning

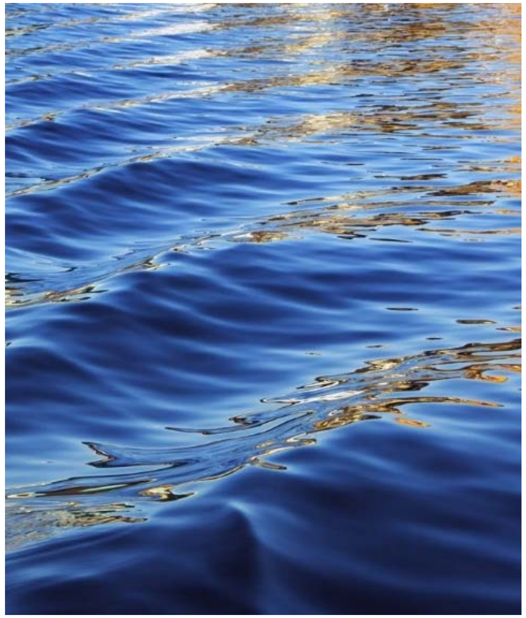


Thermal band

Panchromatic band combination with Multispectral band



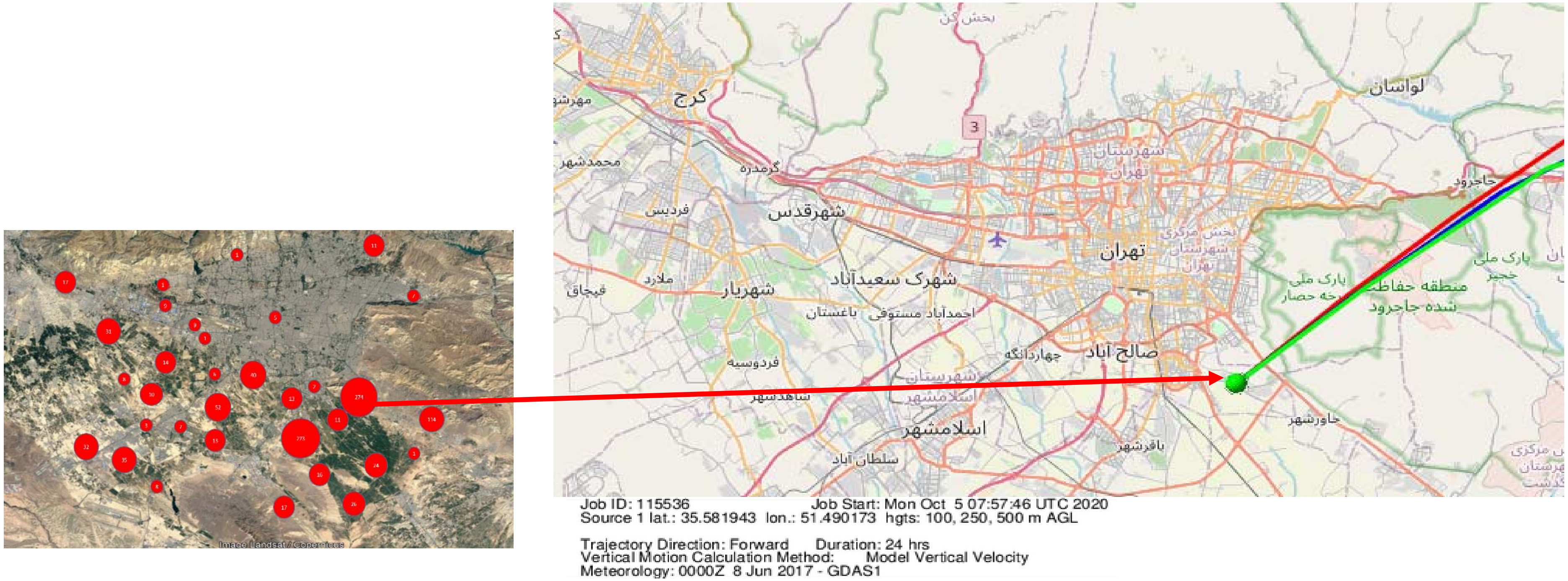
Discussion



Discussion

Pollutant Trajectory from Agricultural Sources

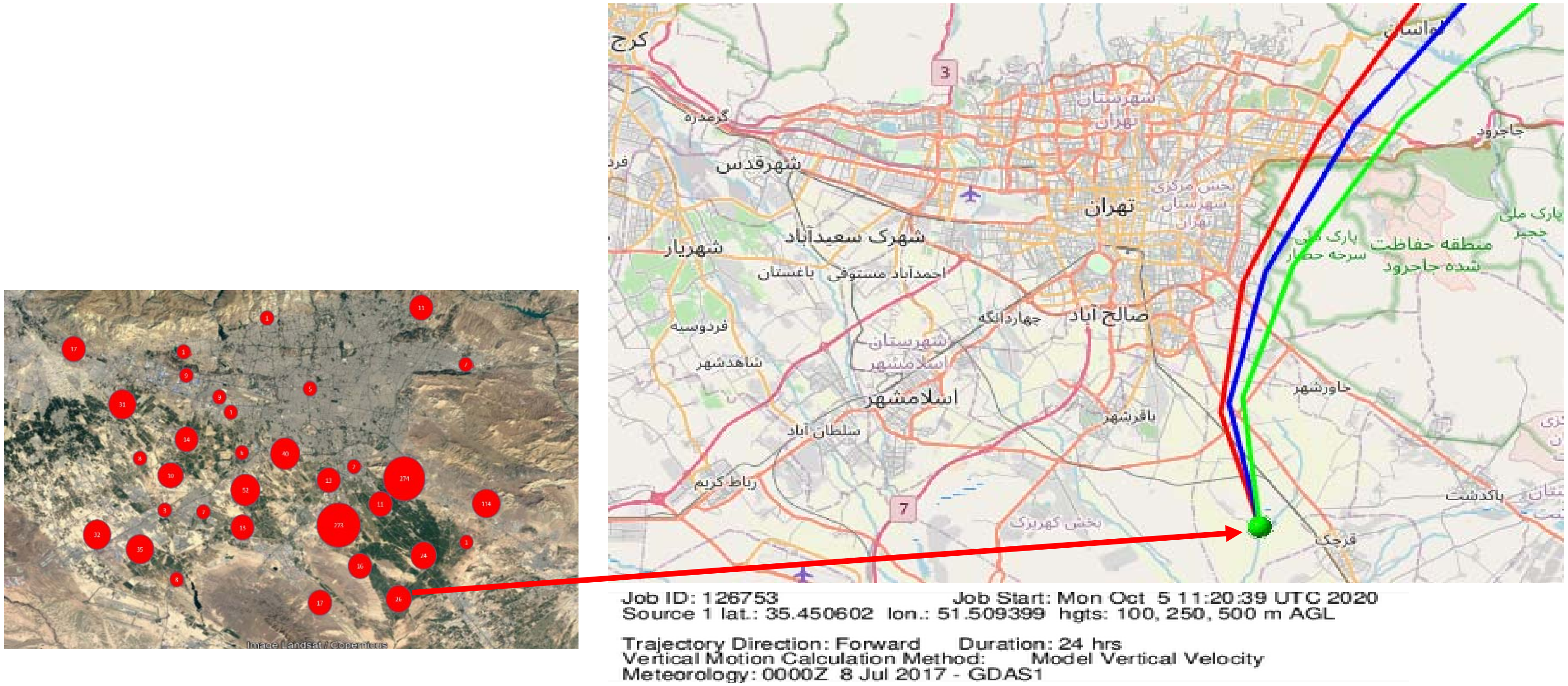
- Sample Livestock Production Plant



Discussion

Pollutant Trajectory from Agricultural Sources

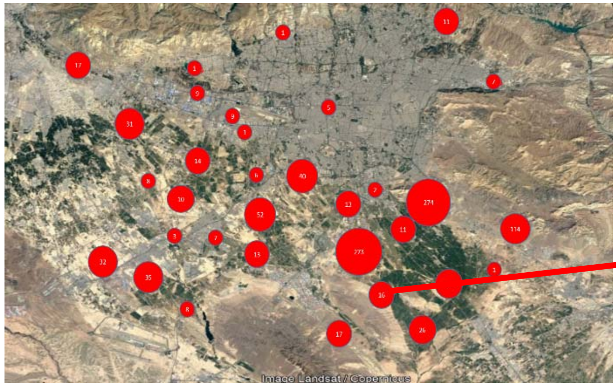
- Sample Agricultural Waste Burning

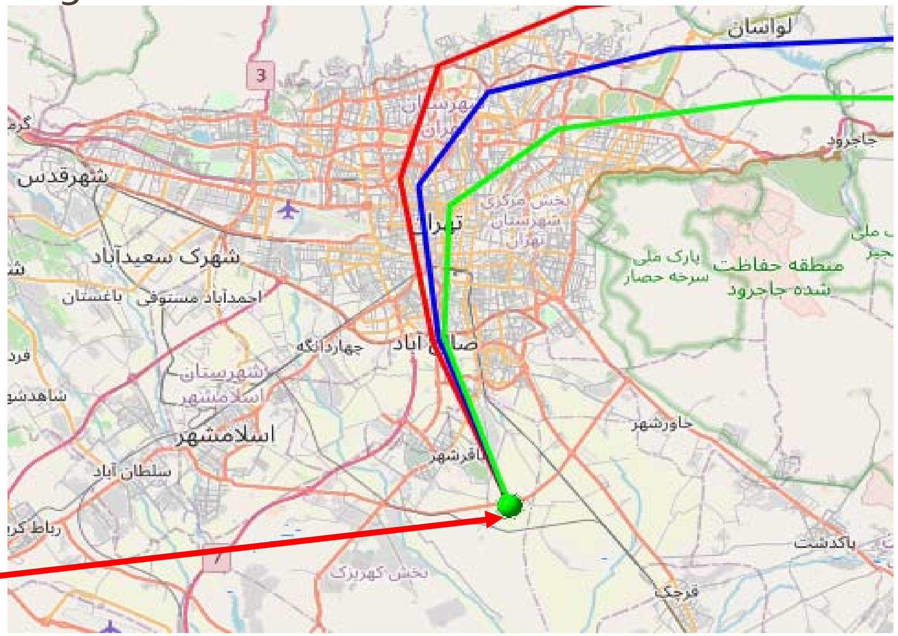


Discussion

Pollutant Trajectory from Agricultural Sources

- Sample Agricultural Waste Burning





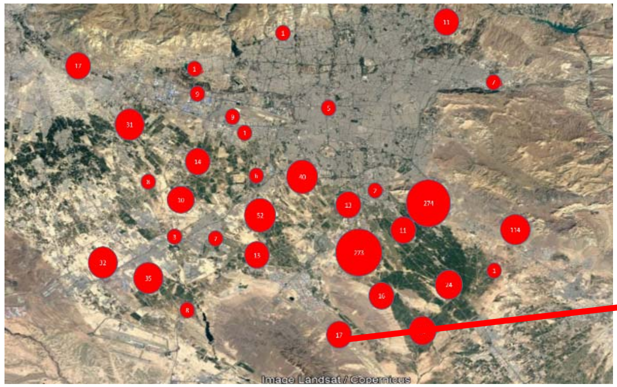
Job ID: 127403 Job Start: Mon Oct 5 11:31:11 UTC 2020
Source 1 lat.: 35.498692 lon.: 51.444855 hgts: 100, 250, 500 m AGL

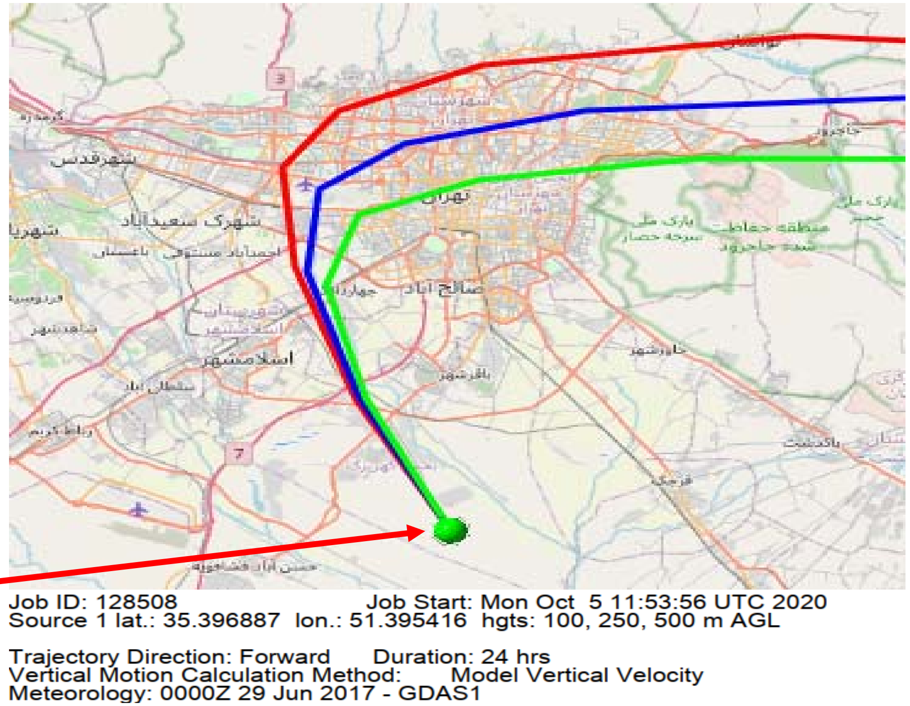
Trajectory Direction: Forward Duration: 24 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 29 Jun 2017 - GDAS1

Discussion

Pollutant Trajectory from Agricultural Sources

- Sample Agricultural Waste Burning

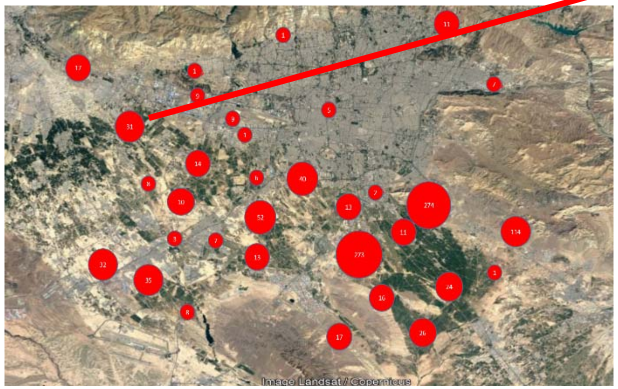


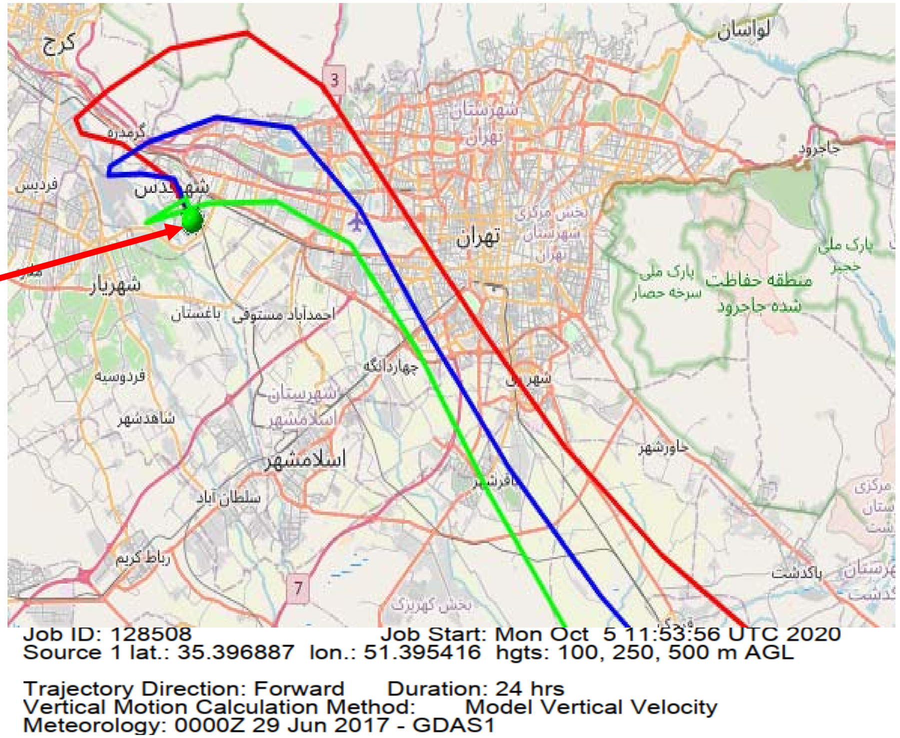


Discussion

Pollutant Trajectory from Agricultural Sources

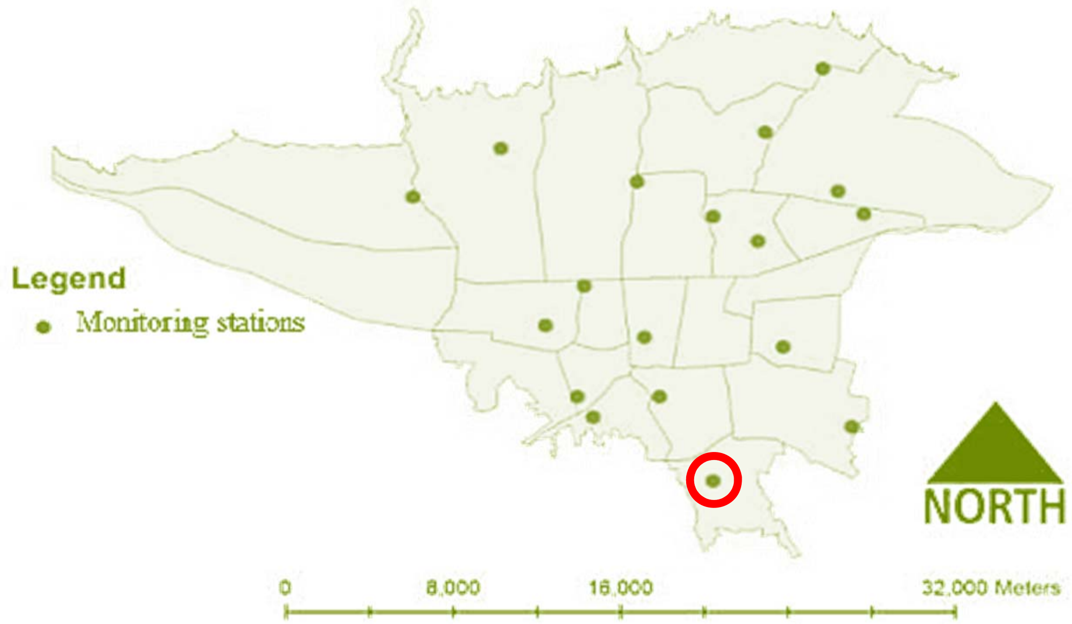
- Sample Waste Burning





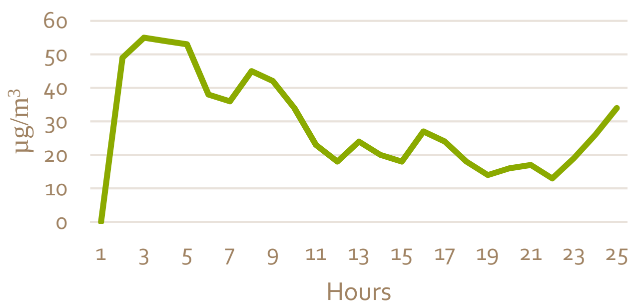
Discussion

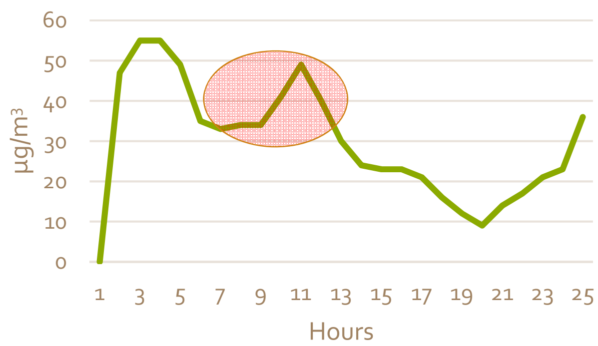
Tehran monitoring stations map



Discussion

Hourly PM2.5 concentration in the ShahreRey station

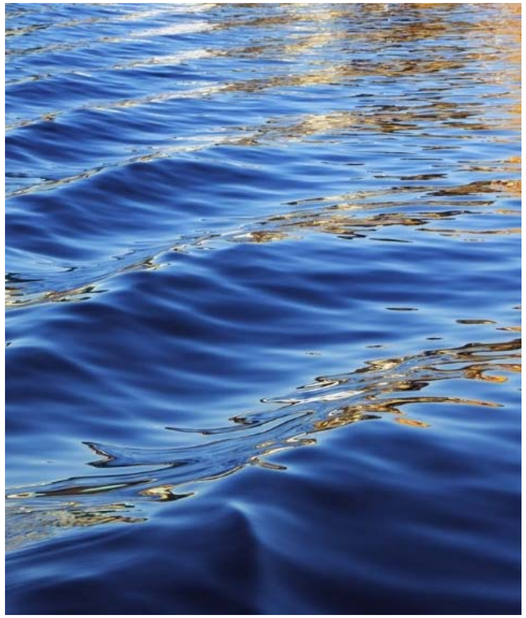




No agricultural active point in the area Date :06/30/2017	5 active agricultural points in the area Date: 06/28/2017

According to the measured concentration near the agricultural waste burning areas, the PM2.5 concentration increased slightly during 9:00 to 13:00 AM.

Conclusion



Conclusion

- Crop residue burning and city waste burning considered among the main sources of air pollution in developing countries.
- In the previously developed Tehran's emission inventory, the agricultural waste burning and city waste burning has been neglected. While can account for 5% of the total PM2.5 emissions.
- Municipal waste burning was more often in June and September in 2017.
- Number of times anomalies have been observed in this area increased in 2018.
- Crop residue burning have occurred in 4 points in Tehran's surroundings.

Conclusion

- Agricultural waste burning mainly happened in June and July which are considered less polluted seasons in Tehran
- The number of times anomalies have been observed in these areas decreased in 2018.
- The *Hysplit* model indicates that some non-systematic emissions related to agricultural wastes and crop residue burning can effect Tehran's air quality in the peak times of burnings.
- Therefore, considering agricultural waste burning and waste management is essential in air quality control and management.

Thank you for your attention!

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