The battle against solid UFP-emissions from internal combustion engines without waiting for Euro VI

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A presentation for
FOCUS-Event
Cleaner Air for Megacities

19th ETH Conference on Combustion Generated Nanoparticles

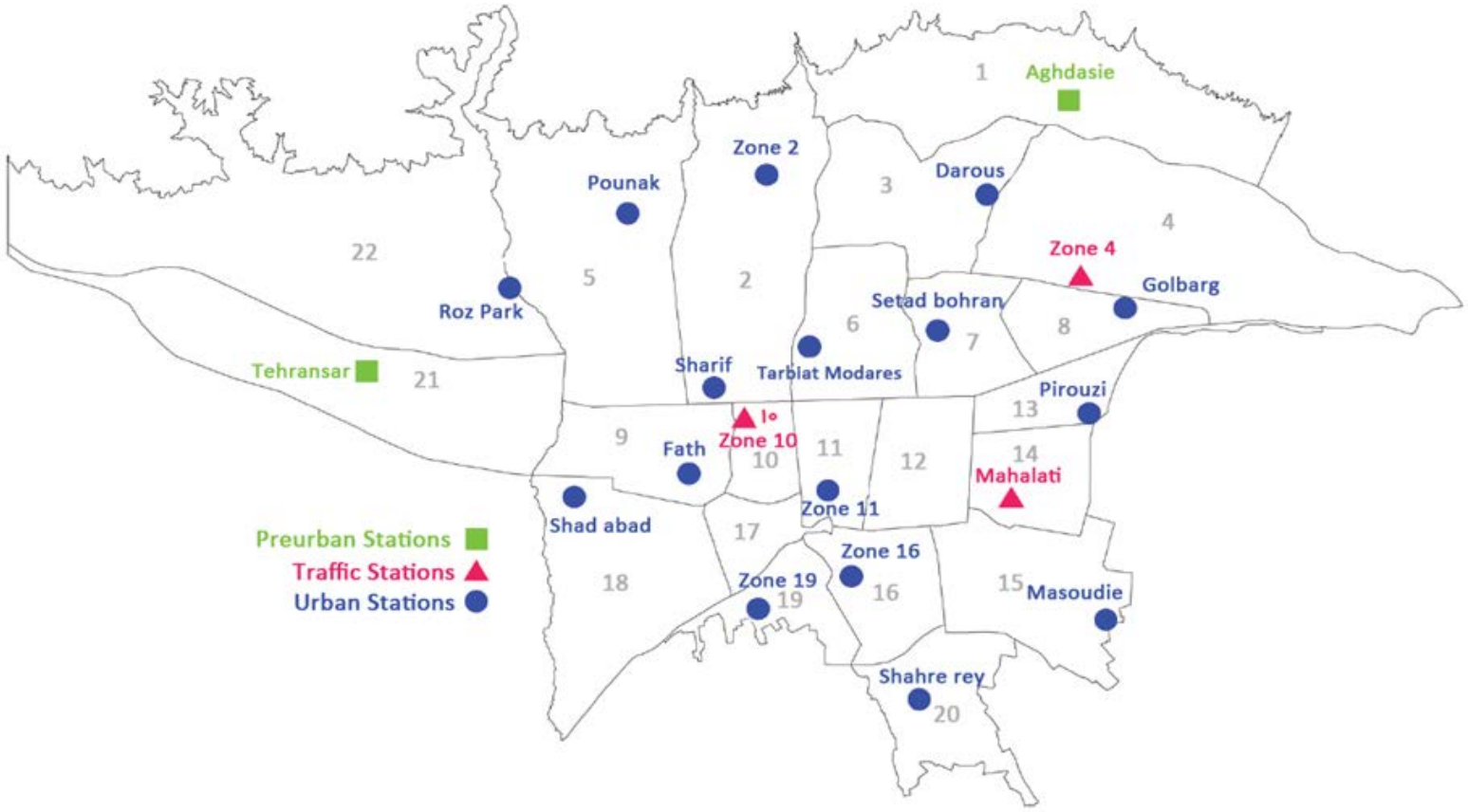
Zurich, June 28th – July 1st, 2015

Real-life experience !

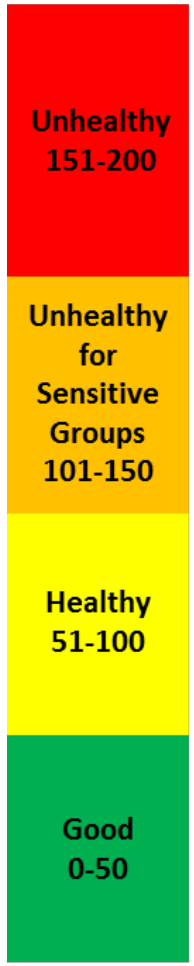
- My sincere apologies to 19th ETH nanoparticle conference organizers for not being able to present my talk on Tehran particle pollution.
- During last two weeks, I have suffered from a mild heart attack, diagnosed with Coronary Artery Disease, two of my major coronary arteries were almost blocked, the leading cause has been identified as air pollution !!
- The very reason that we people are working hard to identify/measure/understand/calculate health risks/mitigate UFPs and in general air pollution has caused serious troubles for myself, and for many others like me.
- I am not alone in this city of 8.5 millions. Hundreds of people at young age rush to the emergency wards everyday in Tehran as we encounter high concentrations (mass and number) of particles.

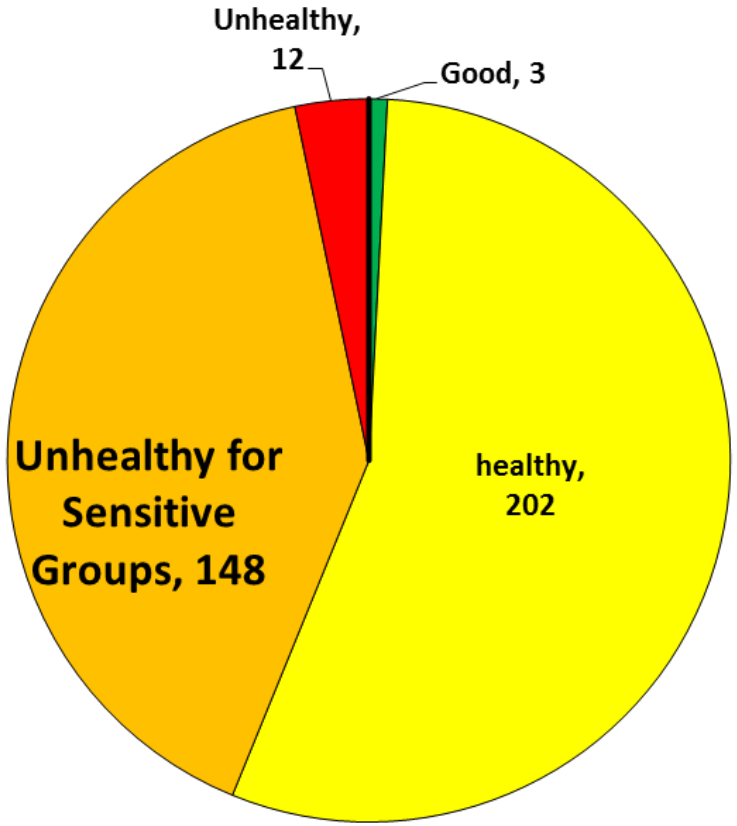
Tehran Air Quality

Tehran Air Quality Data, obtained from monitoring stations

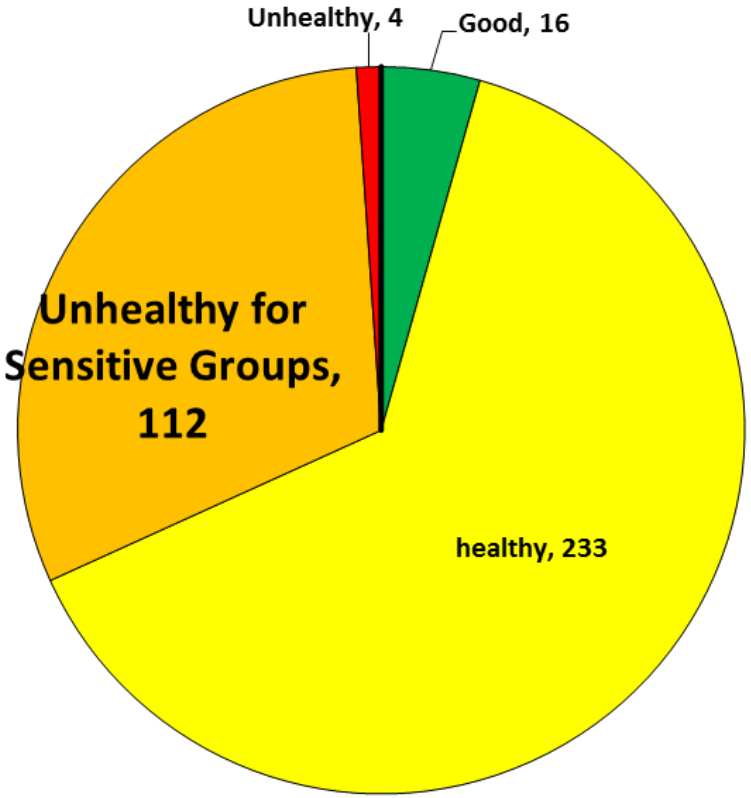


A comparison of the last two Iranian calendar years





1392 (21 March 2013 to 20 March 2014)

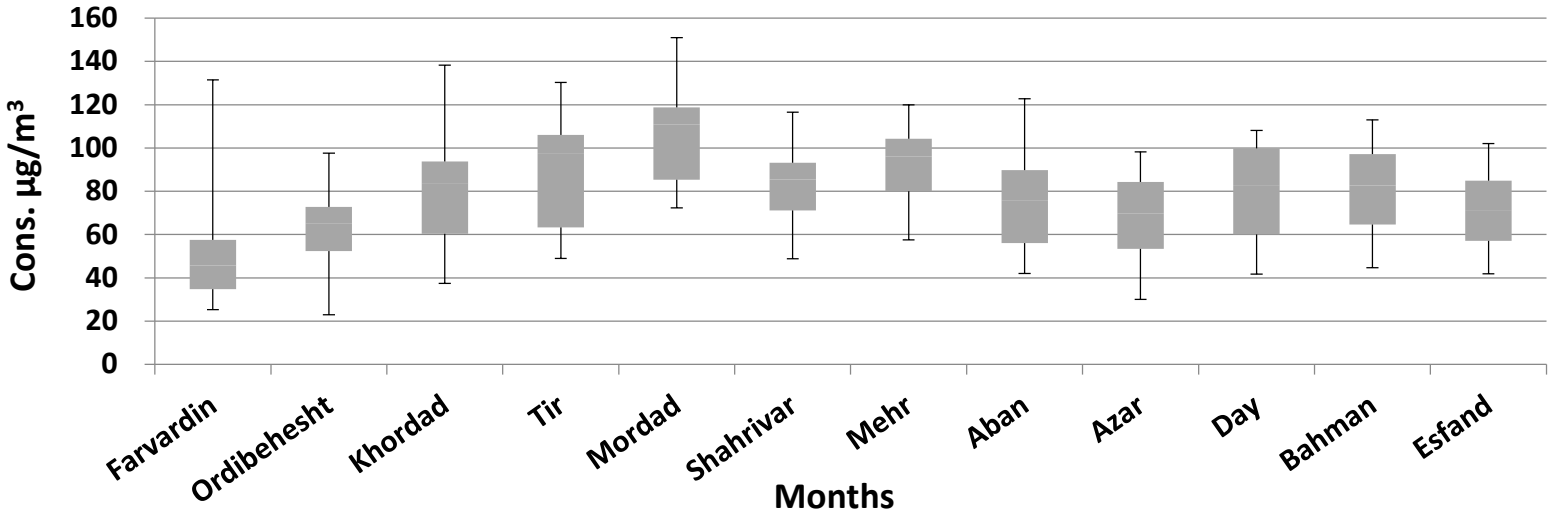


1393 (21 March 2014 to 20 March 2015)

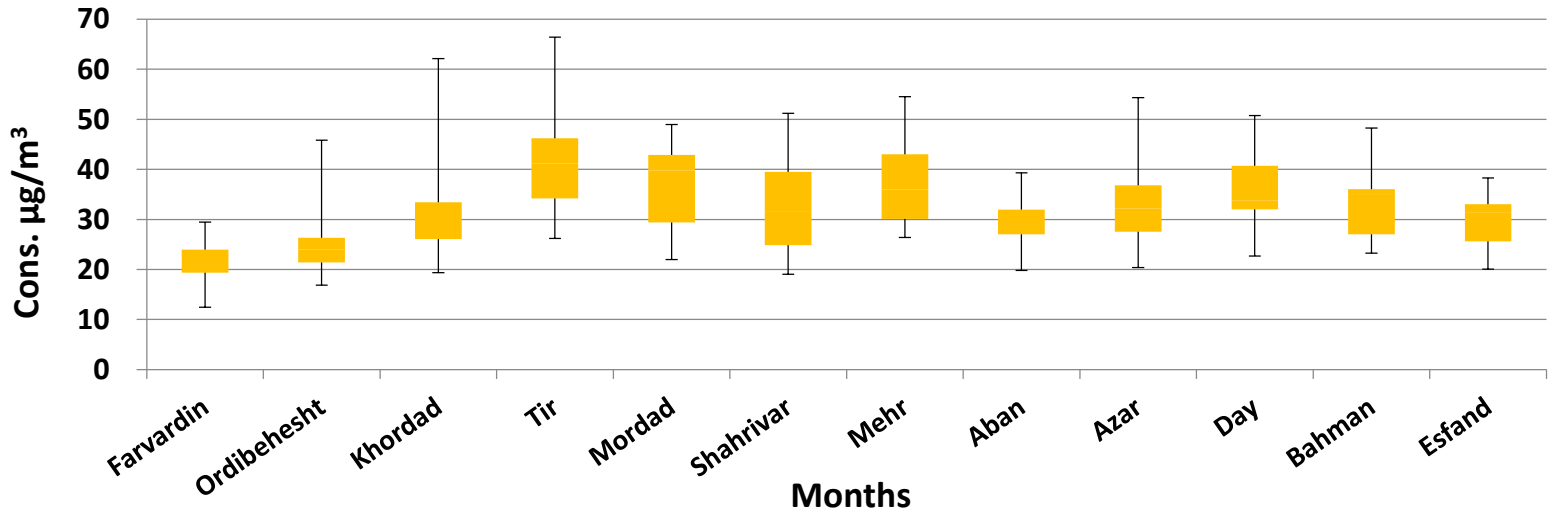
Monthly concentrations of PM_{10} & $PM_{2.5}$ during the year 1393

(21 March 2014 - 20 March 2015)

PM_{10}

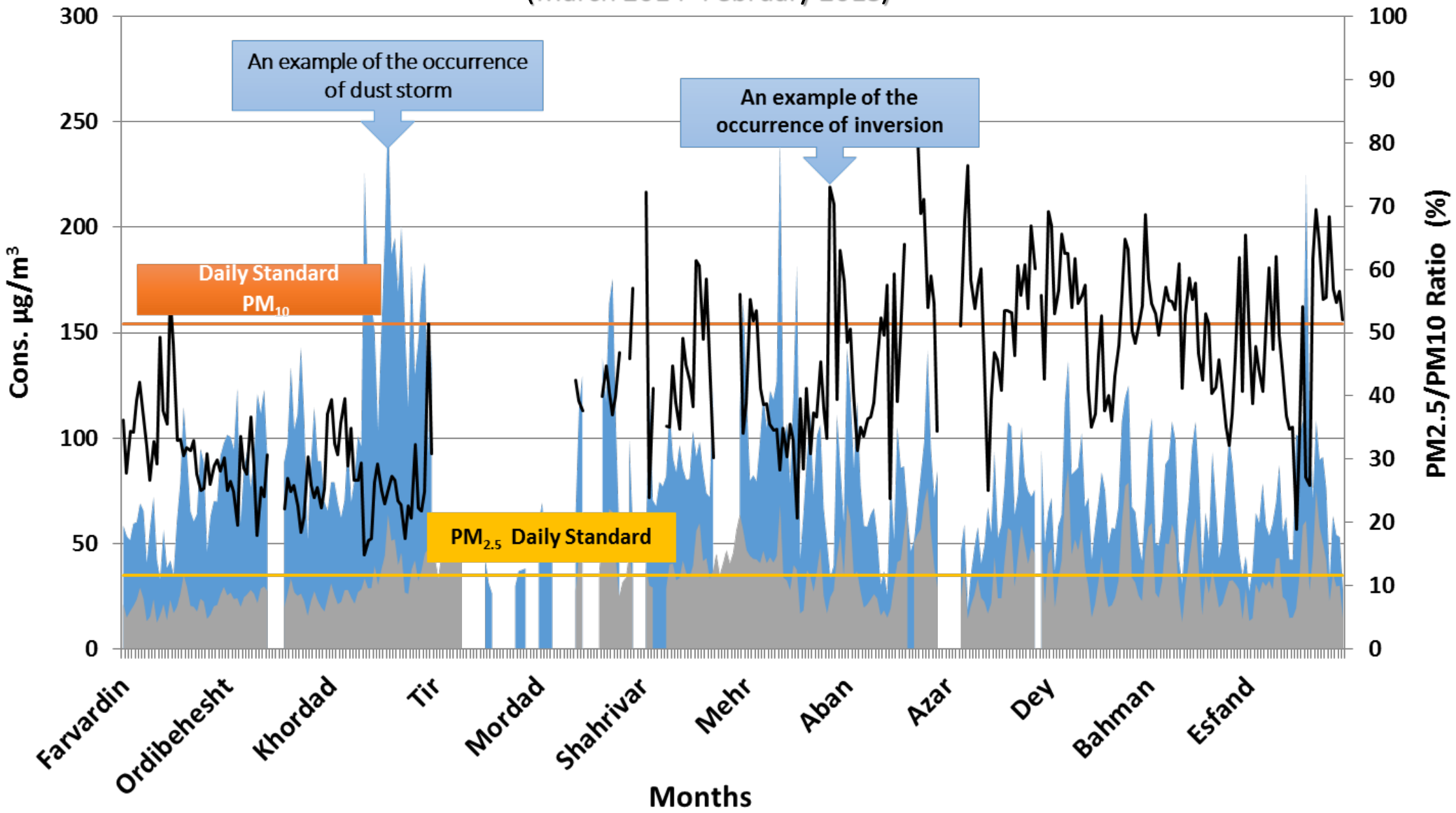


$PM_{2.5}$

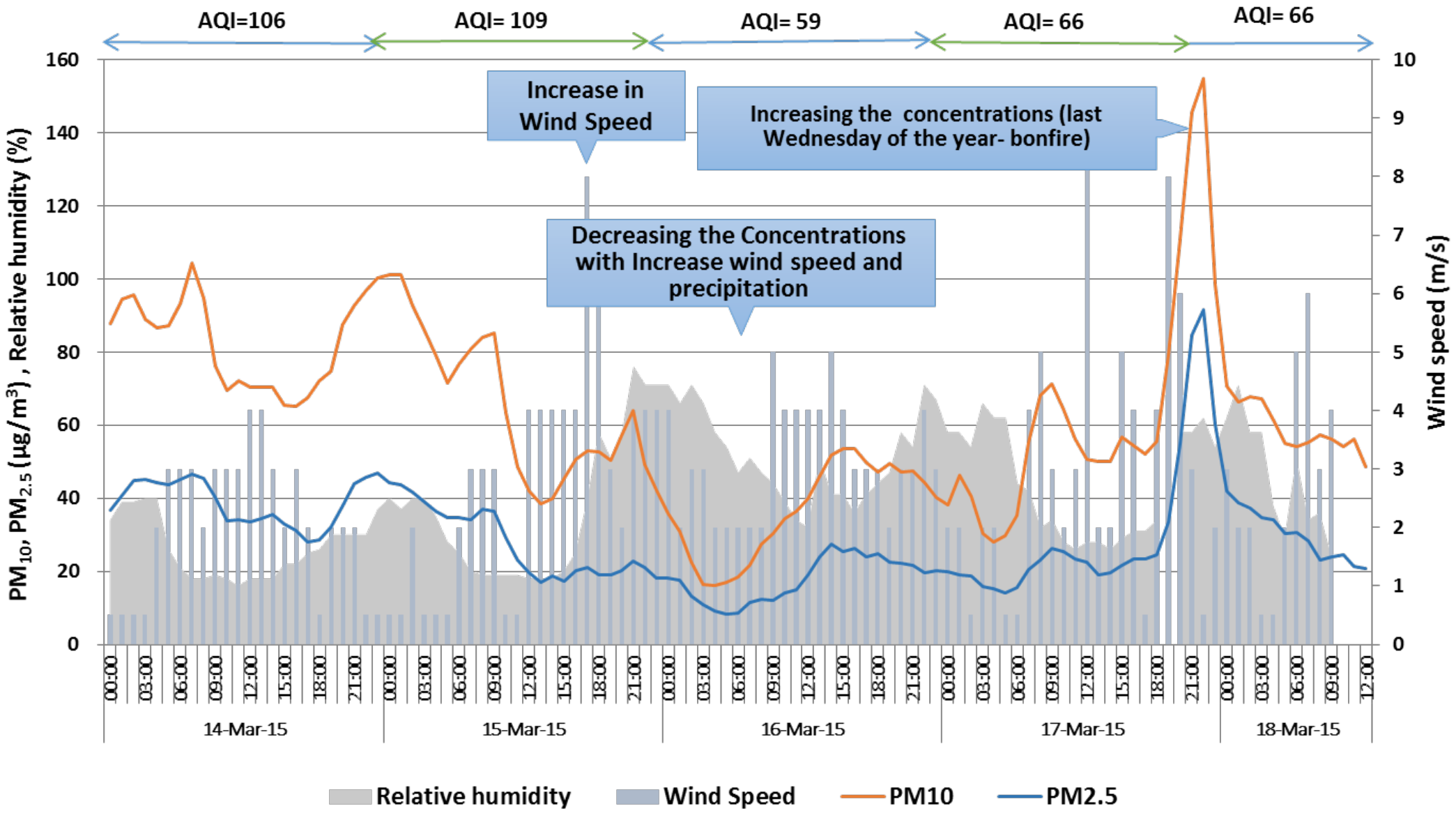


Daily Concentration of PM_{10} & $PM_{2.5}$ in a sample air quality monitoring station in Tehran

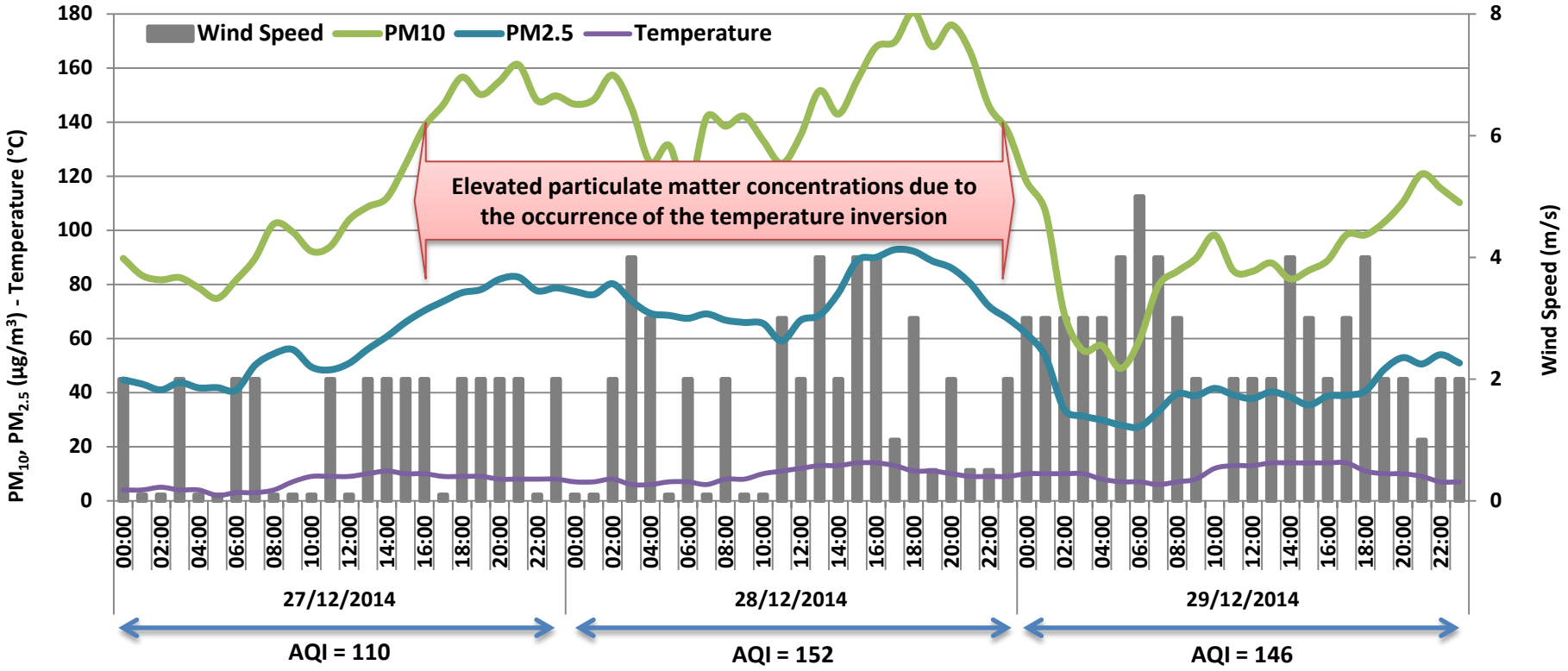
(March 2014- February 2015)

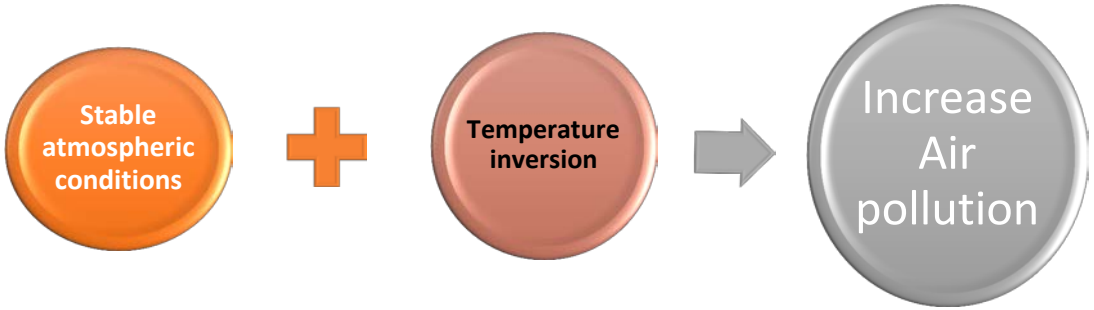


Hourly average concentration of PM_{10} & $PM_{2.5}$ in a selected air quality monitoring station (March 14-18, 2015)



The impact of temperature inversion phenomenon occurrence on PM_{10} & $PM_{2.5}$ Concentrations





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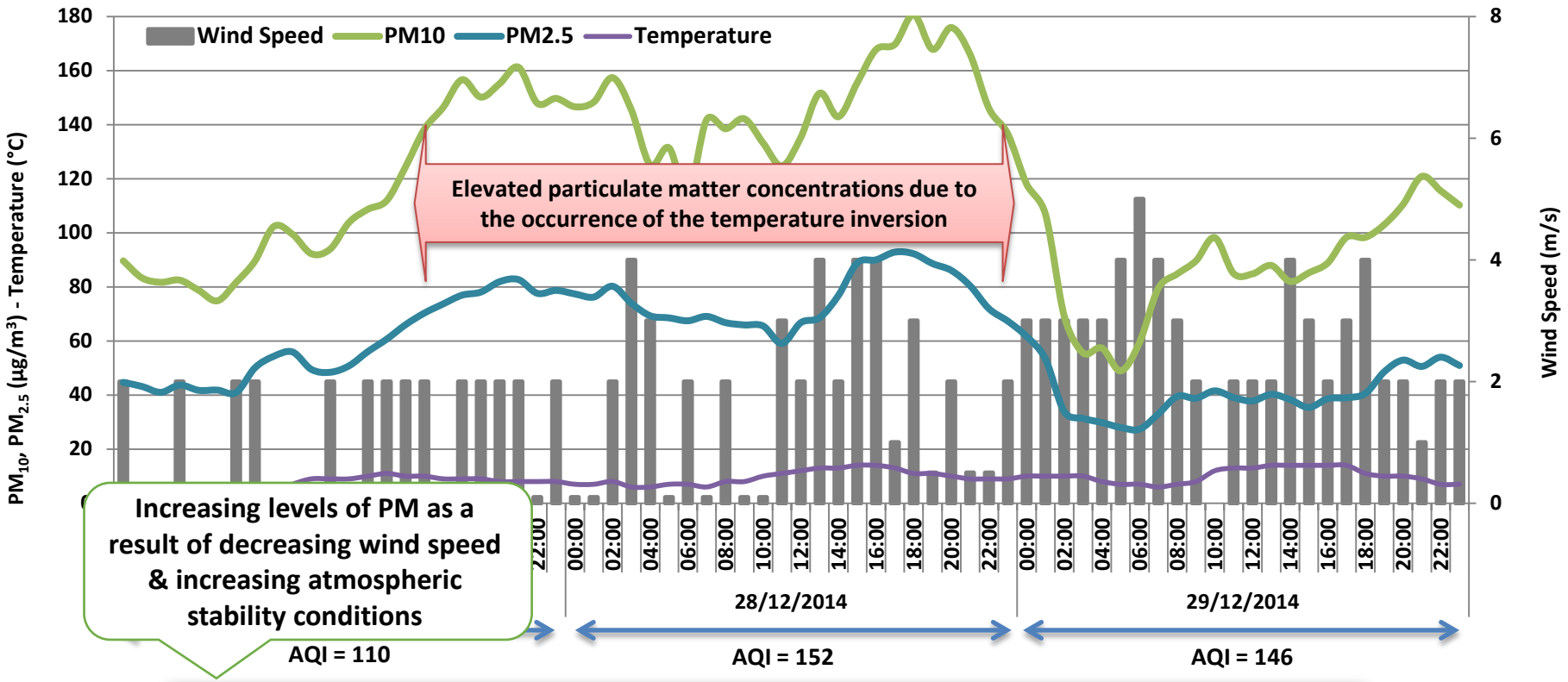

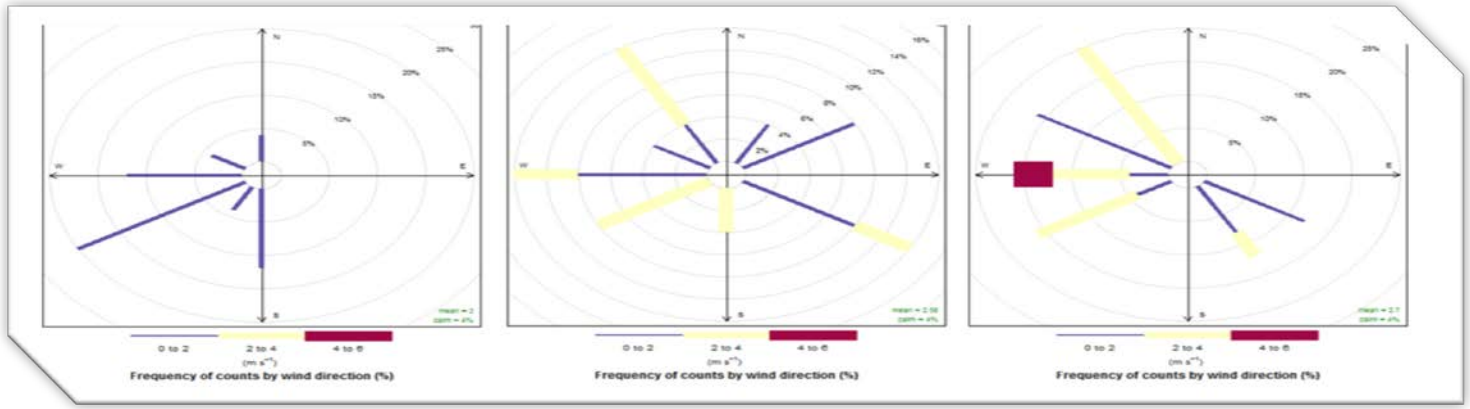

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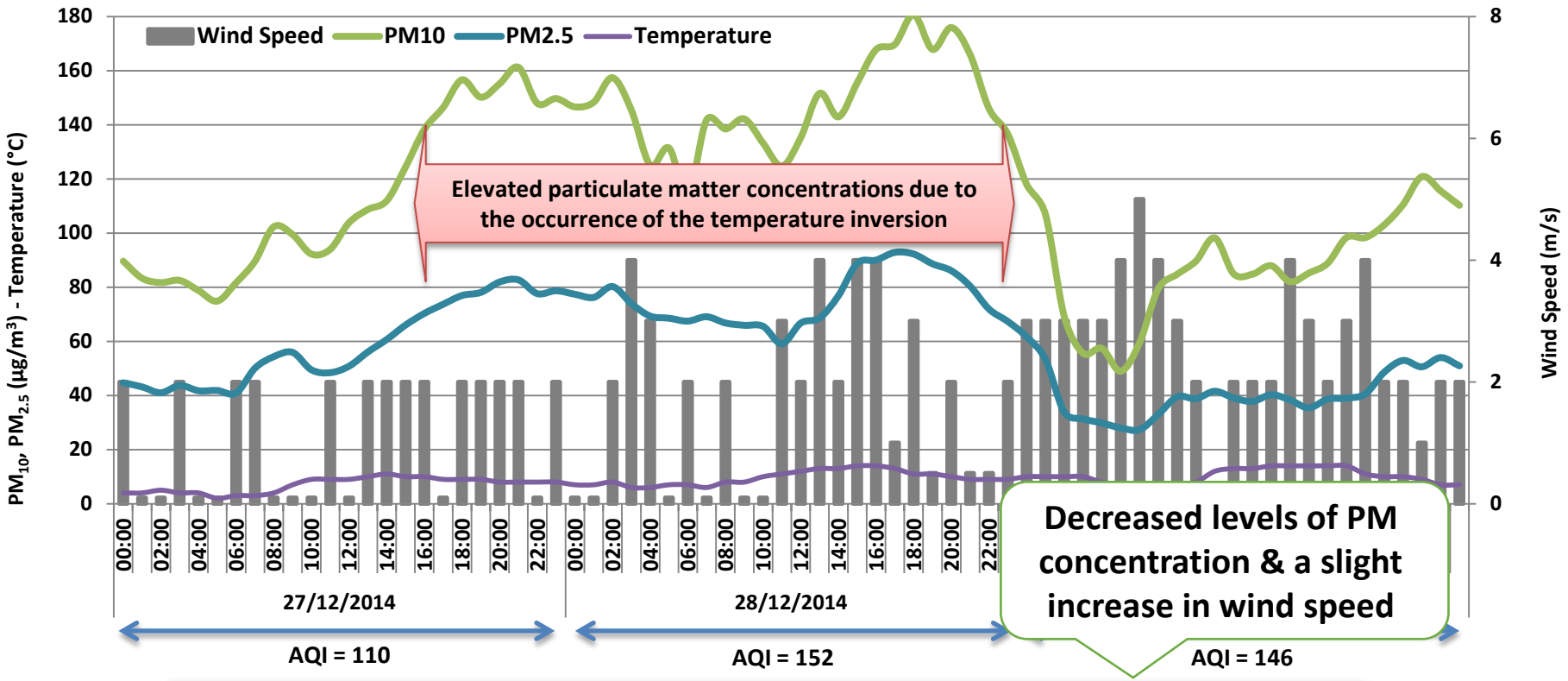
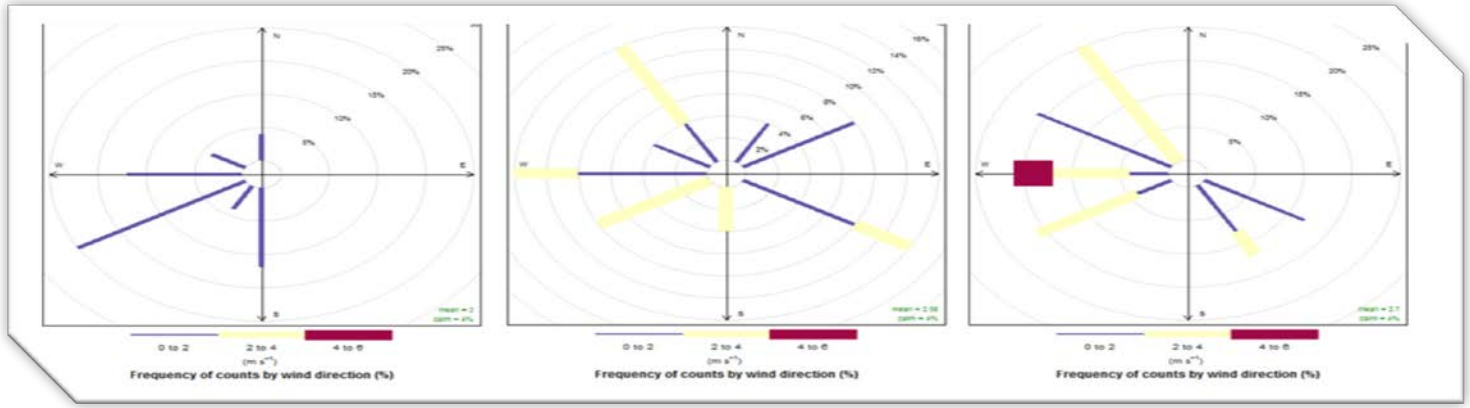
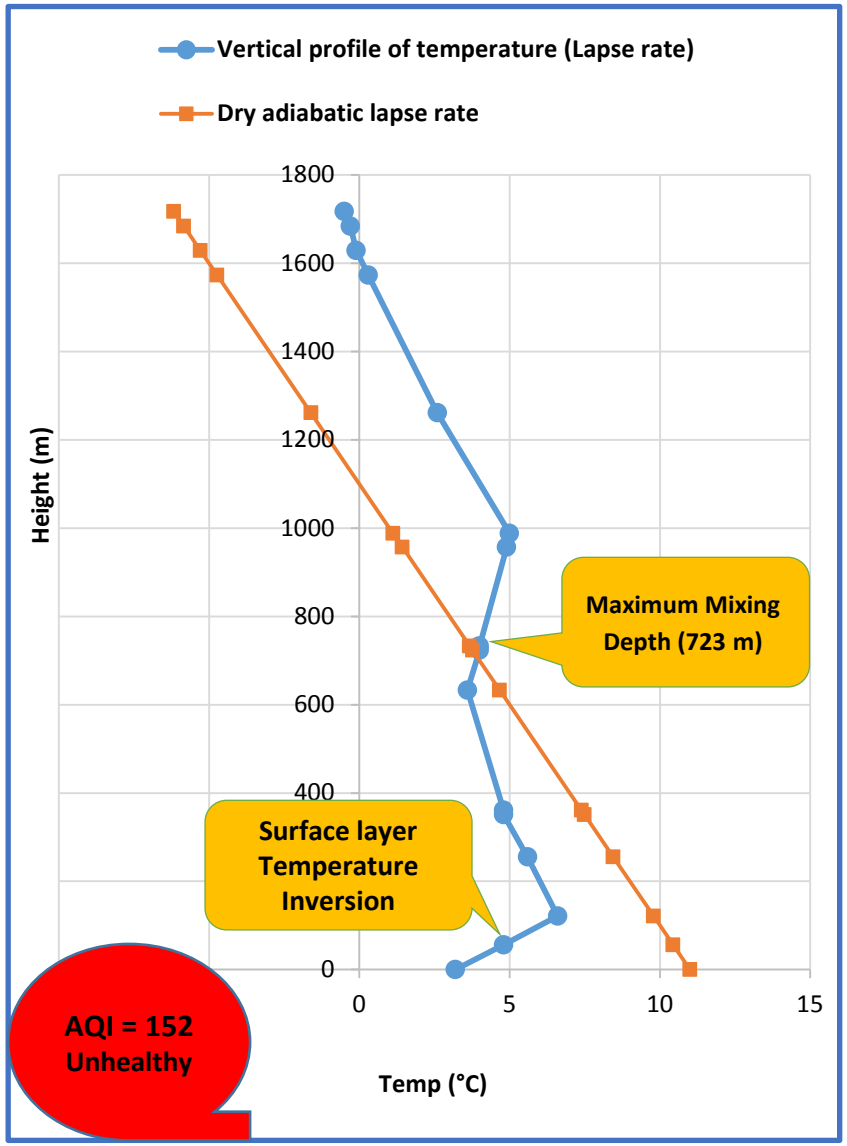
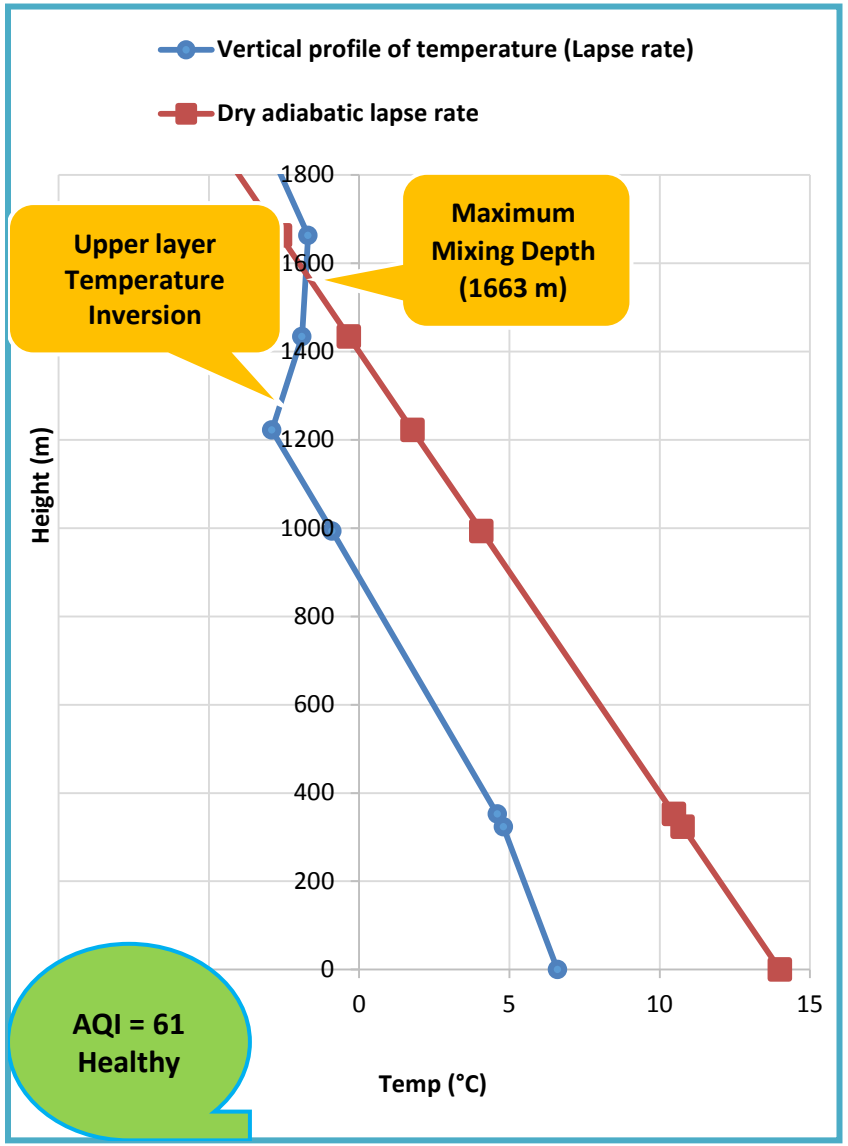


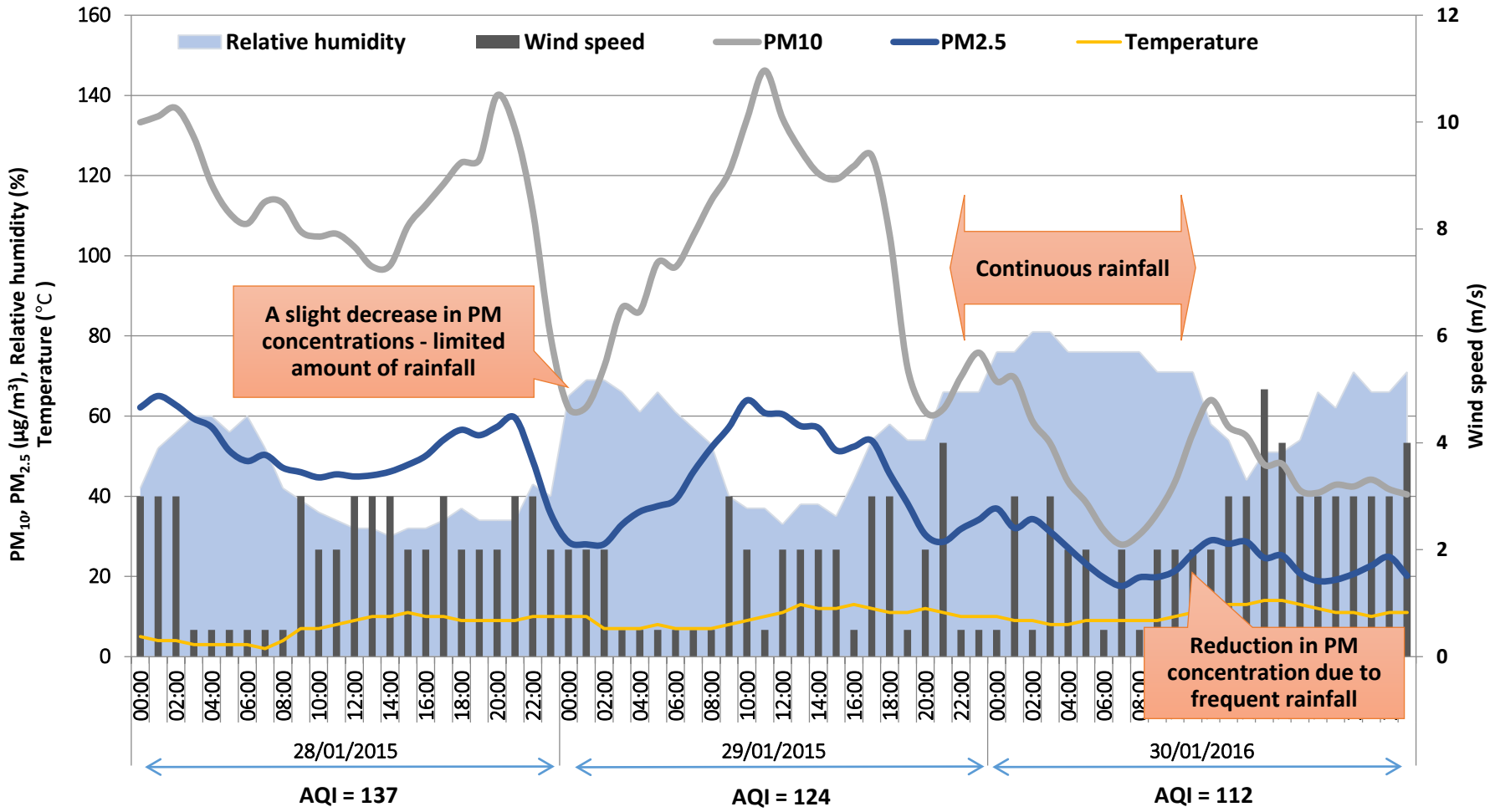


The impact of surface Temperature inversion & mixing depth on air quality



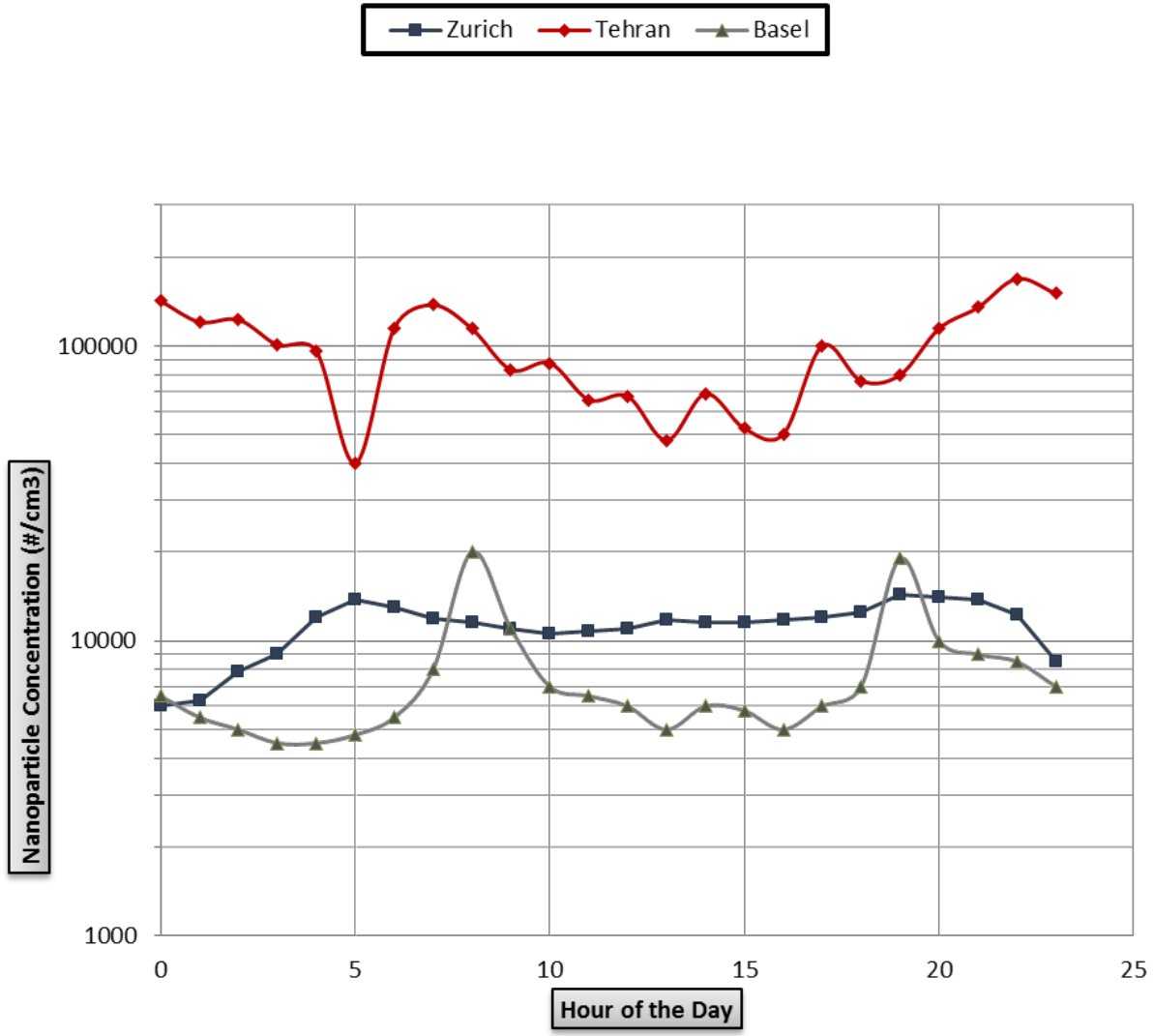


The impact of rainfall & relative humidity on PM_{10} & $PM_{2.5}$ Concentrations

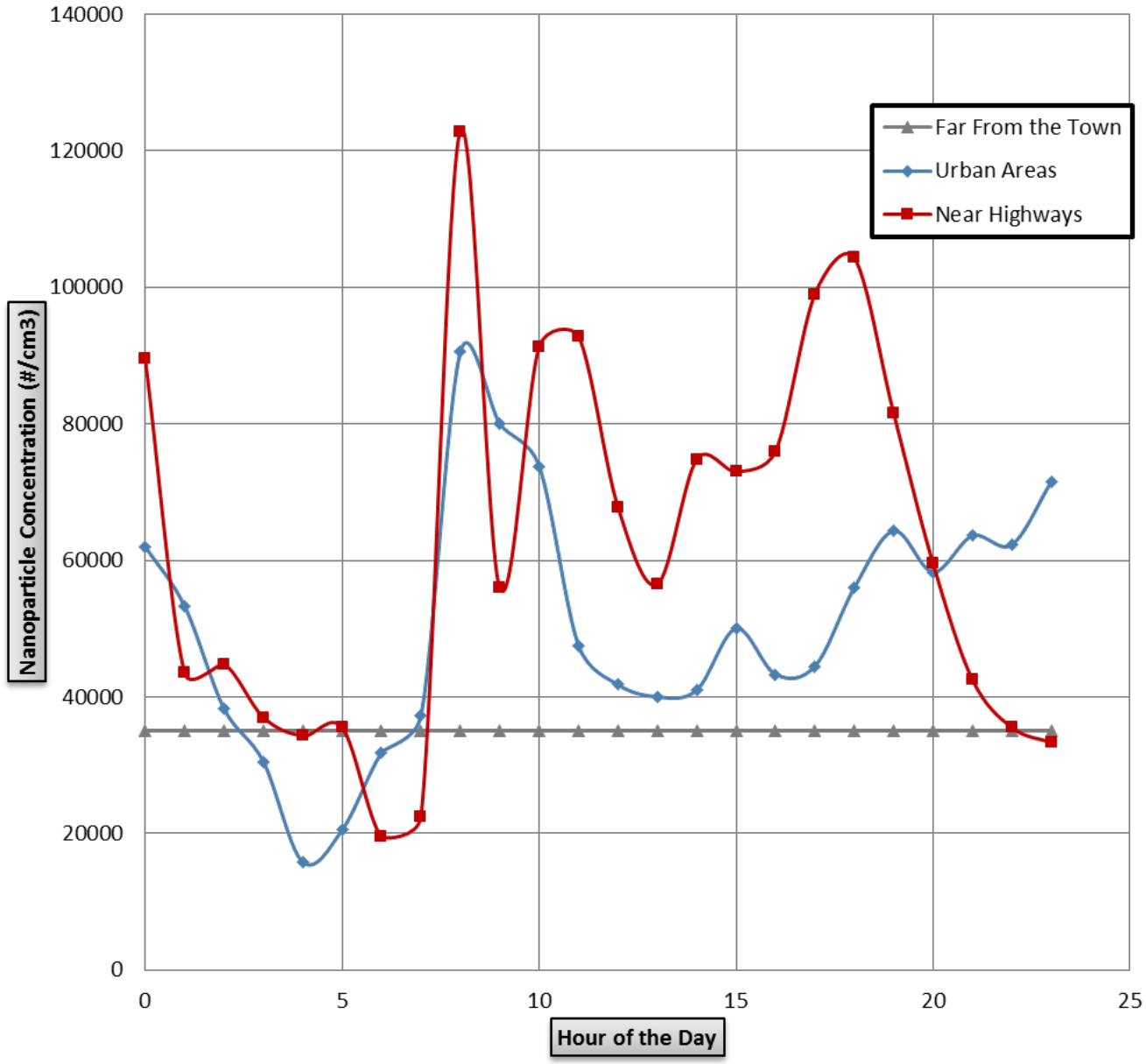


Patrice counting
Device: Matter Aerosol DiscMini
impactor size < 700 nm

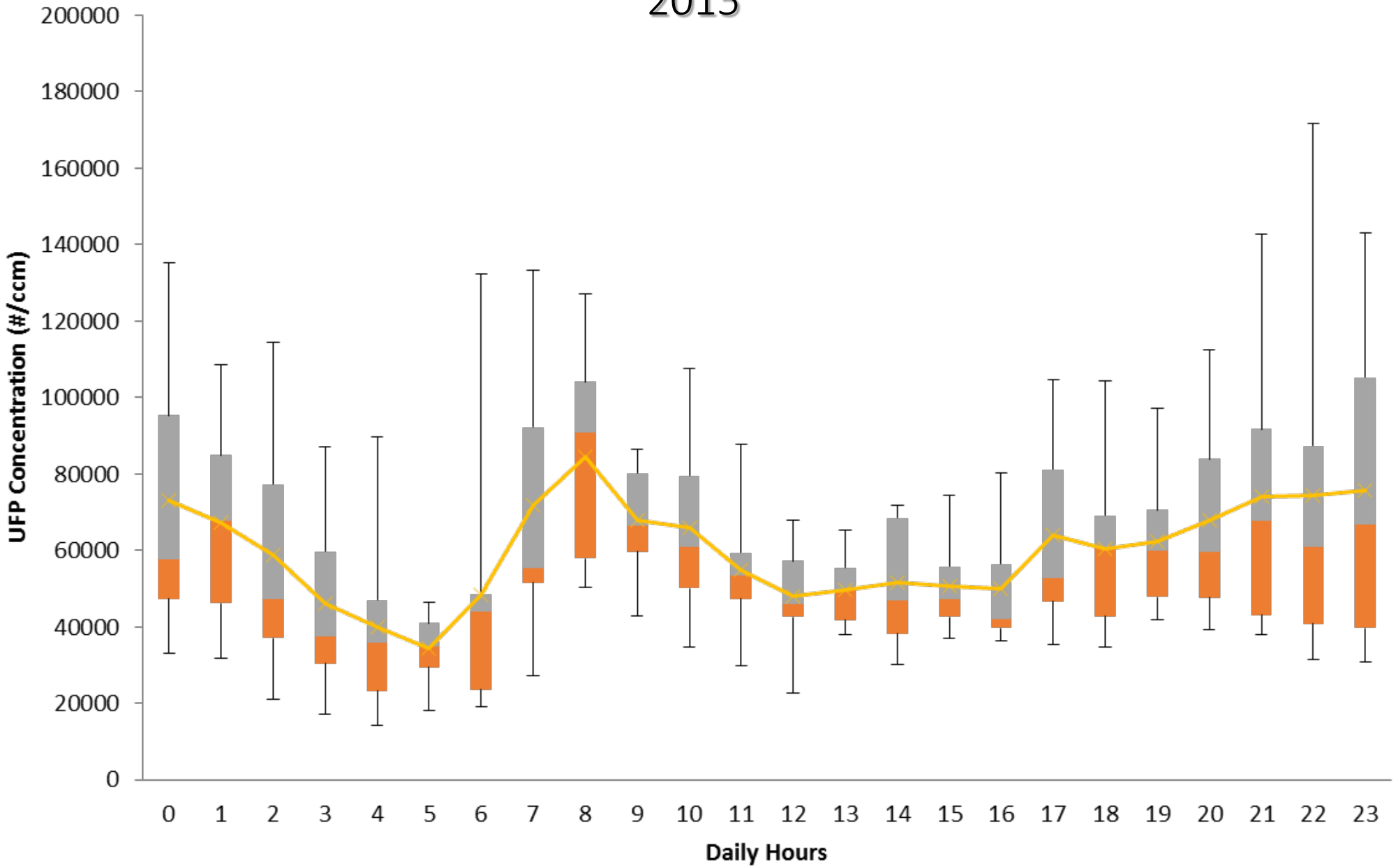
A Comparison of Diurnal Concentration of Nanoparticles Between Tehran, Zurich and Basel



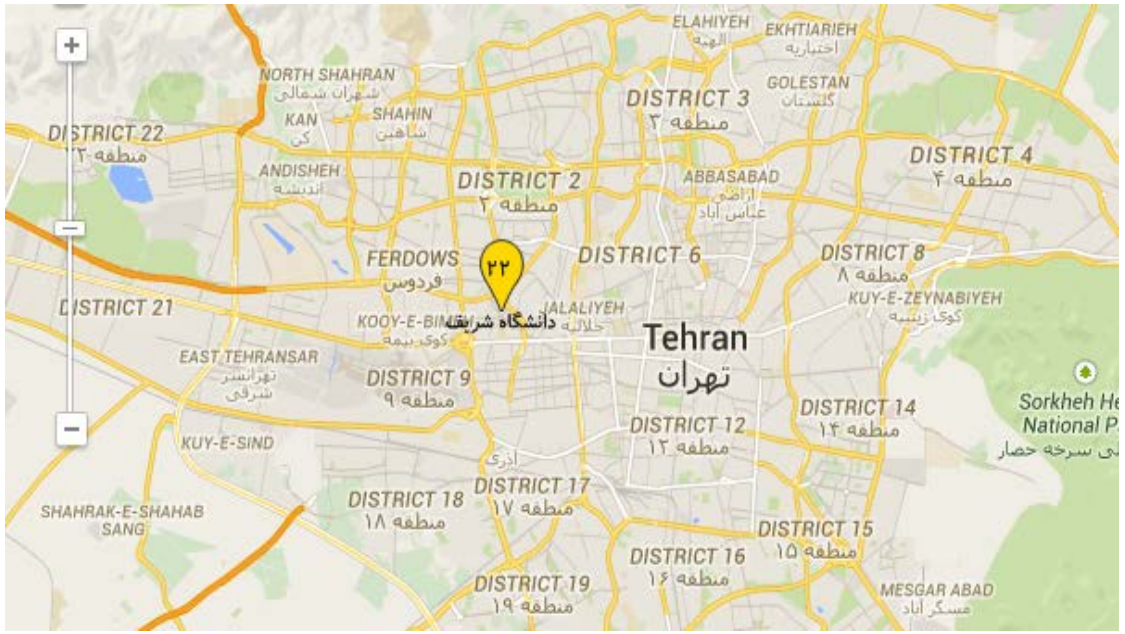
Daily particle number count in two traffic and urban stations, Winter 2015



Averaged values of particle counts over all air quality monitoring stations , Winter 2015



Source apportionment studies



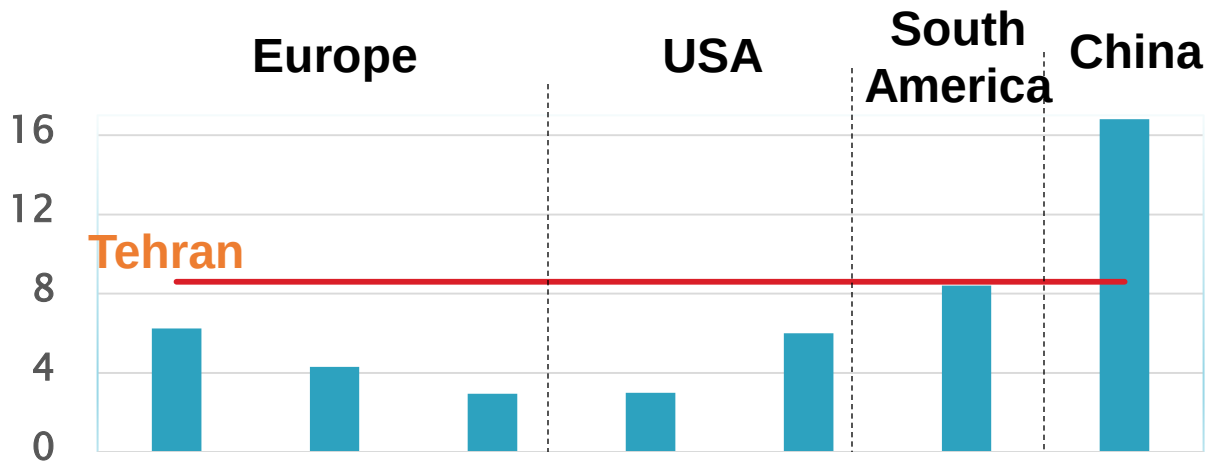
Study description

- First source apportionment study in Tehran
- Sampling site: Sharif University of Technology, Tehran
- 24-hour $PM_{2.5}$ samples collected on 47mm quartz and Teflon filters every 6^{th} day using BGI PQ200 sampler
- Analysis by Prof. Shauer and his team at University of Wisconsin-Madison
- Chemical measurements:
  - Elemental and organic carbon (ECOC)
  - Water-soluble organic carbon (WSOC)
  - Primary and secondary inorganic ions
  - Organic molecular marker compounds
  - Trace elements using ICP-MS
- Results:
  - Bulk composition of $PM_{2.5}$ in Tehran
  - Source apportionment using chemical mass balance (CMB) model

Comparison with other cities

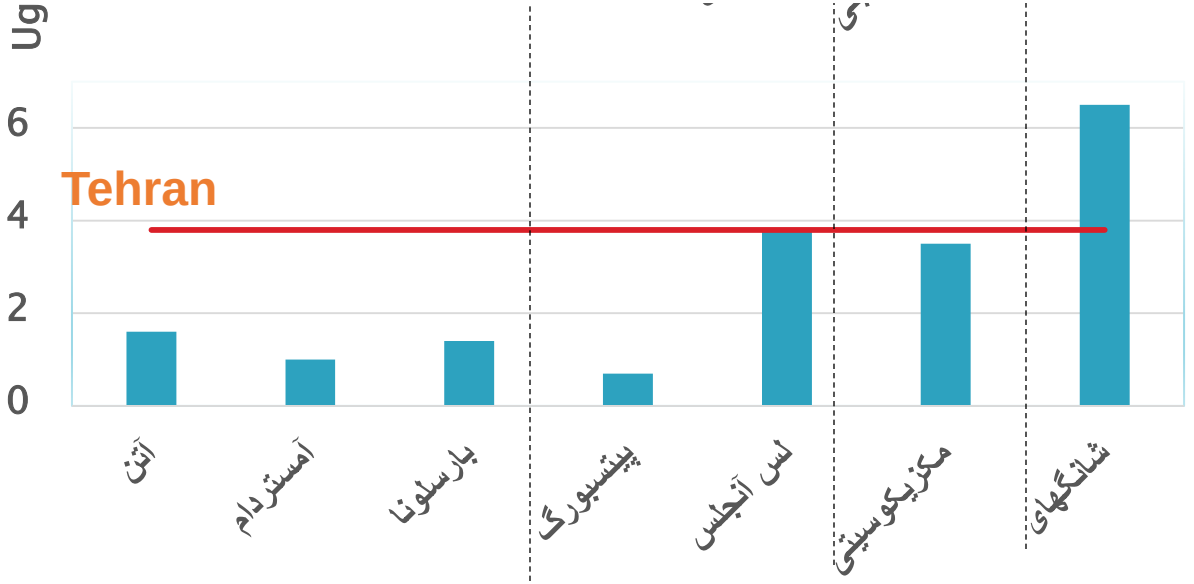
OC

Mobile sources and VOCs



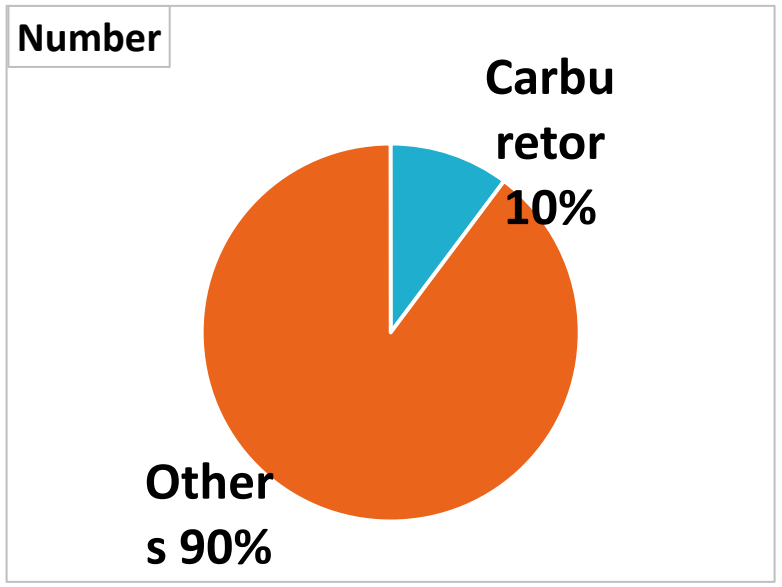
EC

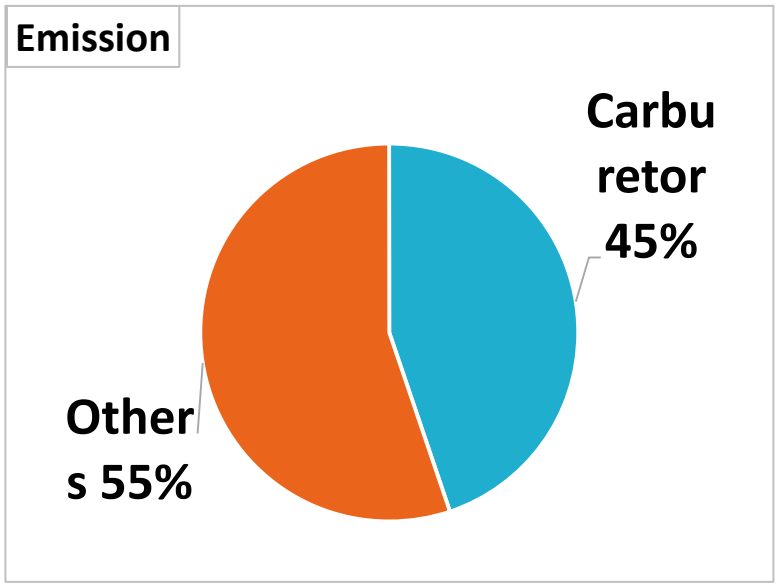
HDVs and heavy fuels



Tehran Emission inventory

Major traffic sources : gasoline carburetor vehicles



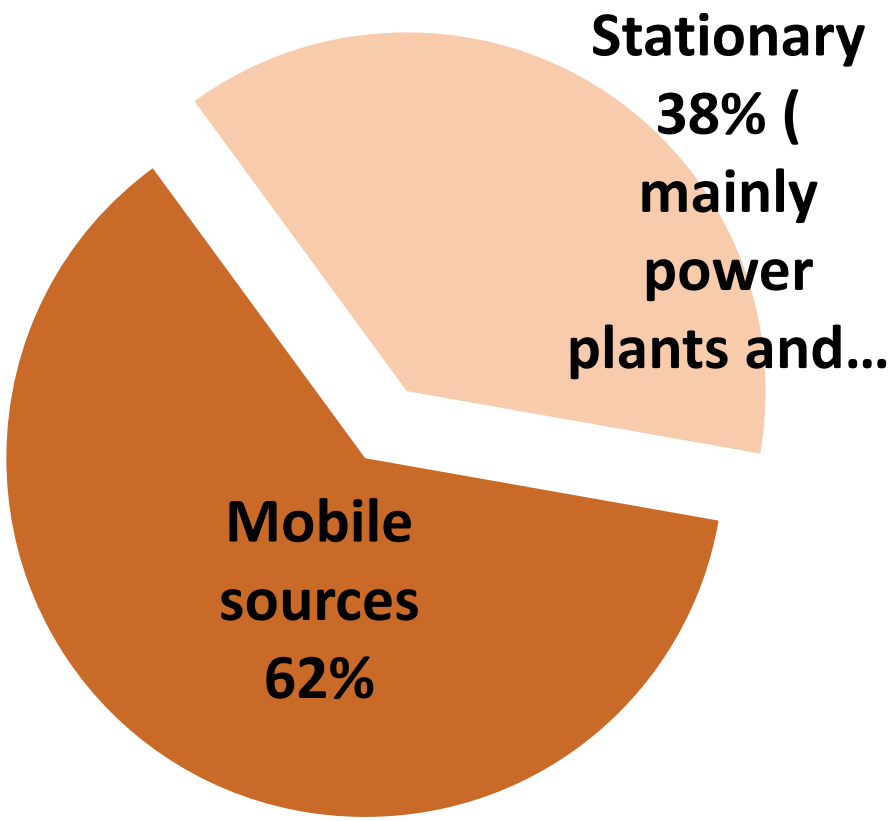


Total number of gasoline LDVs

3, 379, 741

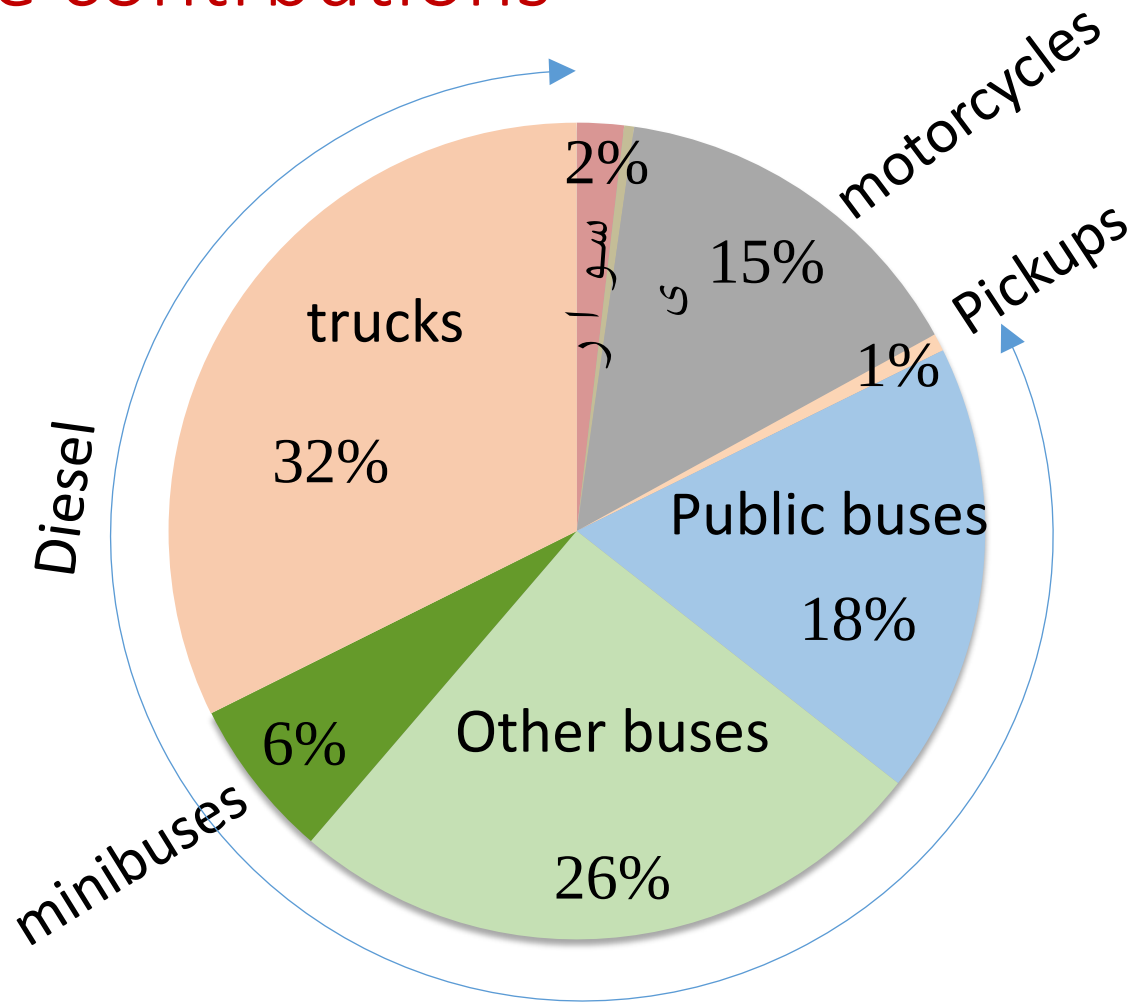
10% 0f LDV fleet emit 45% of total pollution !

Contribution of mobile vs. stationary sources of PM



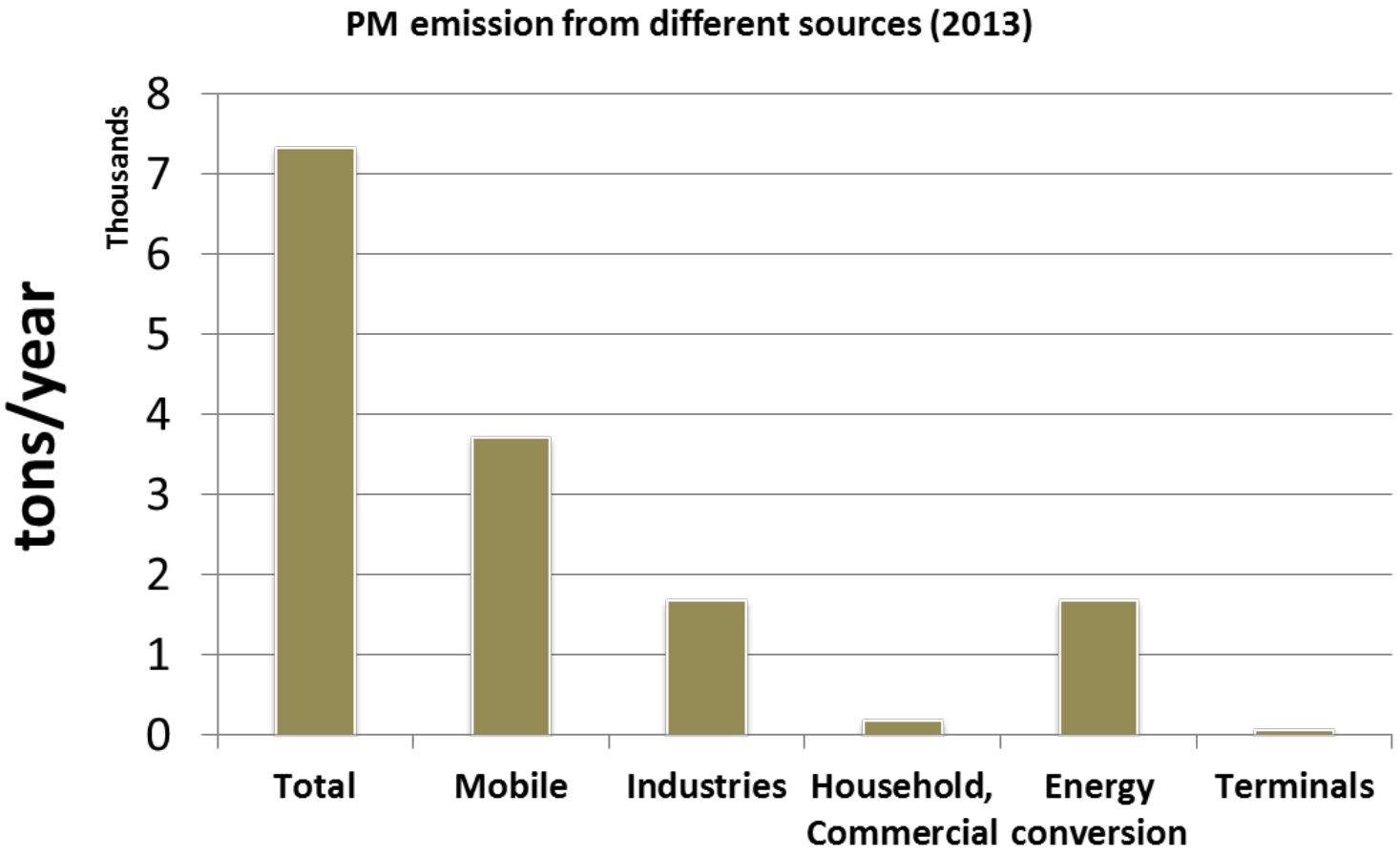
PM: 9,550 Tonnes/Year

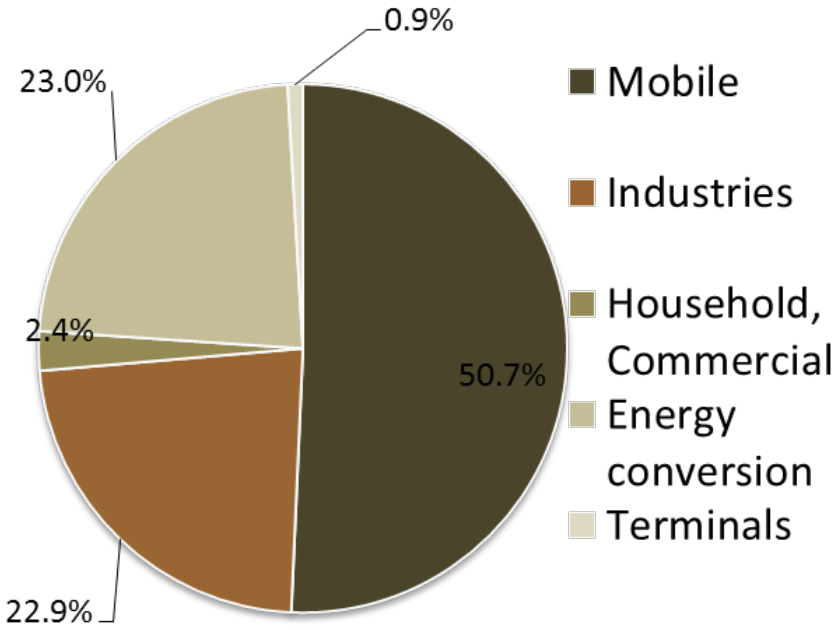
Mobile source contrbutions



6000 Tonnes/year

Tehran annual PM emission sources





Concluding remarks

- Tehran air particulate matter concentration has reached a very dangerous level and immediate actions are needed.
- Contribution of mobile sources to the particles is quite obvious.
- Black carbon (soot) fraction of particles are considerable.
- Mega cities like Tehran cannot wait for Euro VI vehicles to come, by then, thousands will be affected by UFPs.
- Retrofit and new-fit with BATs are immediate solutions, this mush be done with the current available fuel in the market.

Thanks for your attention

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