Long-term measurements of aerosol *Oxidative Potential* in an urban site, Athens, Greece

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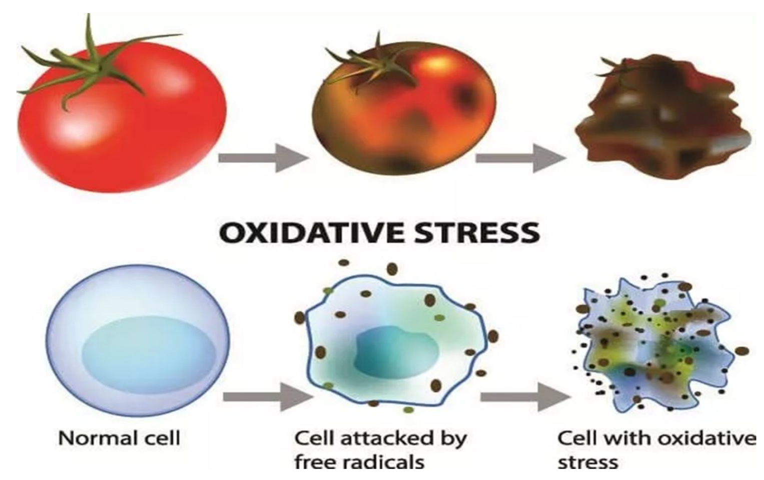
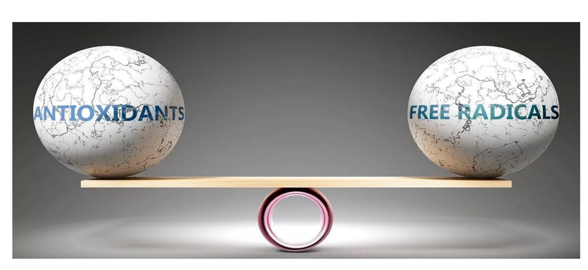
https://www.noa.gr



https://biologydictionary.net/oxidative-stress/

Oxygen carrying molecules with an uneven number of electrons → Free radicals

Antioxidants → cause the free radical to stabilize and become less reactive.



When there is an imbalance, it leads to Oxidative Stress → *Cell damage*

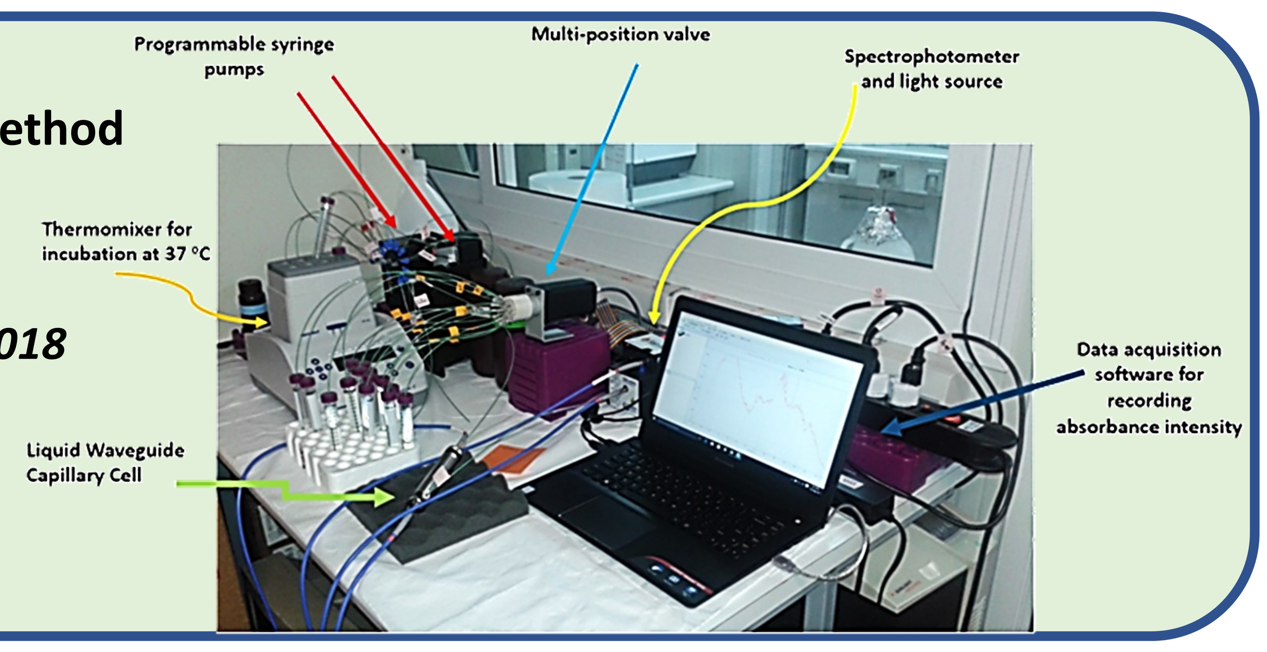
Oxidative Potential (OP)

Semi automated system → DTT assay method

Fang et.al., 2015, Atmos. Meas. Tech., 8: 471-482.
Paraskevopoulou et al., 2019, Atm. Env., 206: 183–196

City center Sampling: *July 2016 – July 2018*

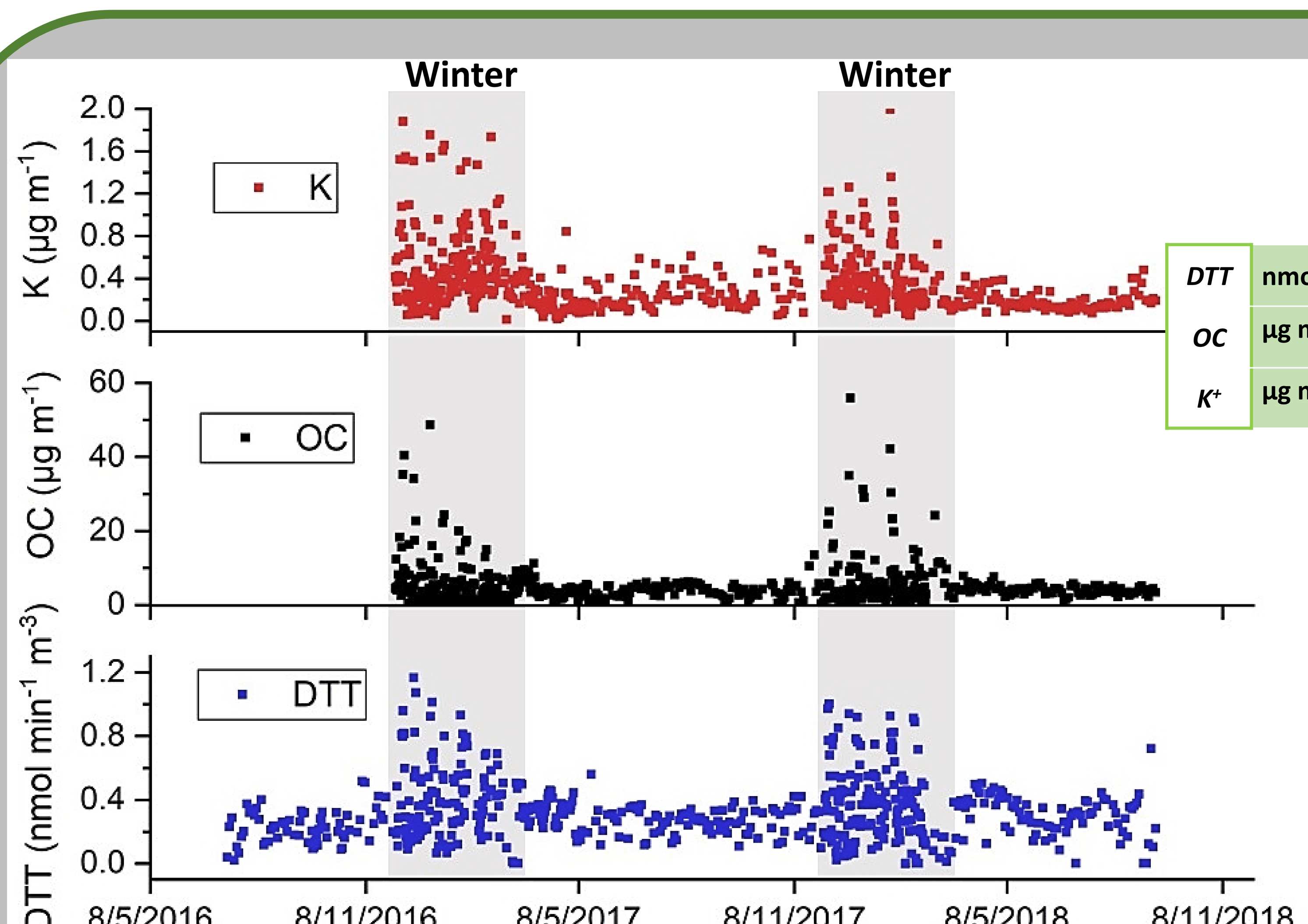
- $PM_{2.5}$ mass concentrations
- Anions and Cations
- Organic and Elemental Carbon
- Trace metals and Elements



ABSTRACT

Oxidative potential (OP) has been identified as a parameter better linked with adverse health outcomes than particulate matter (PM) concentration (e.g. Tong *et al*, 2018). It is thought that OP is correlated with the oxidative stress induced by the inhalation of PM, owing to the generated Reactive Oxygen Species (ROS) that deplete antioxidant levels in cells throughout the body.

Several cellular and acellular assays are used for studying the toxicological impact of aerosols to the oxidative and inflammatory activity inside the human organism. The current study uses the chemical (acellular) assay of Dithiothreitol (DTT) (Fang *et al*, 2015), which provides instant estimation of the aerosol OP without requiring strict controlled conditions. This method is highly sensitive to oxygen, while it is representative of the in vivo depletion of antioxidants deriving from the PM constituents.

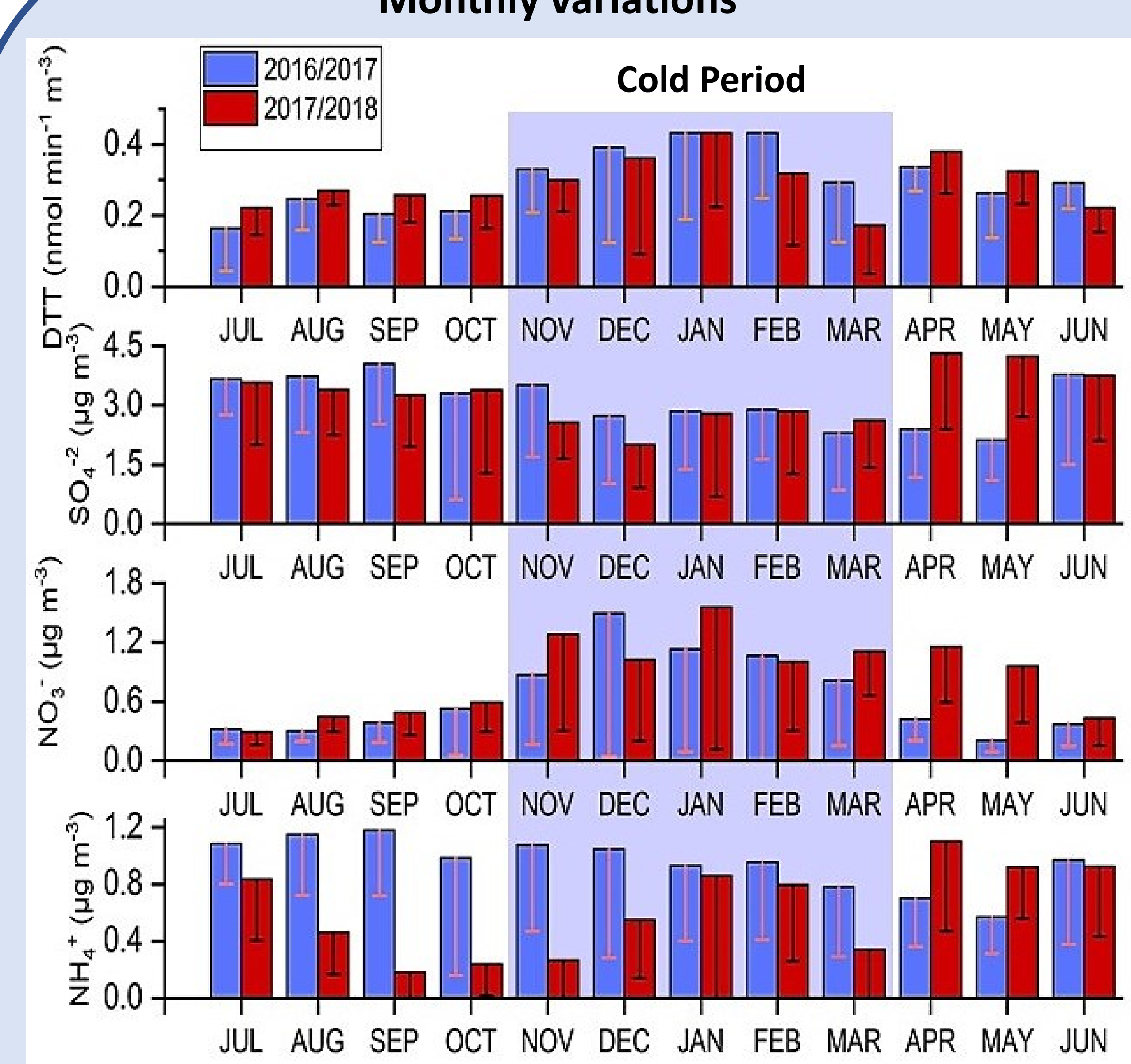


Two years daily variability

		Average	Range
DTT	nmol min^{-1} m^{-3}	0.33	1.16 - 0.01
OC	μg m^{-3}	5.11	55.8 - 0.20
K^+	μg m^{-3}	0.38	1.99 - 0.01

During winter, DDTv presents covariance with K^+ and OC, suggesting that these components could possess considerable OP; while a link to biomass burning sources is highlighted.

Monthly variations



		Warm	Cold
DTT	nmol min^{-1} m^{-3}	0.26 ± 0.10	0.38 ± 0.23
SO_4^{-2}	μg m^{-3}	3.57 ± 1.57	2.71 ± 1.59
NO_3^-	μg m^{-3}	0.39 ± 0.31	1.21 ± 1.14
NH_4^+	μg m^{-3}	0.85 ± 0.48	0.85 ± 0.64

During the coldest period of the year biomass burning dominates, while in the warmest months, there is significantly higher contribution of secondary aerosol processing.

In the warmest period - although we cannot exclude the organic part of the aerosol - it appears that long-range transport of inorganic aerosol dominates in the OP of fine particulate matter.

Regression Analysis

Oxidative Potential vs. Chemical composition of aerosol

	DTTv	K	OC	EC	NH_4	NO_3	SO_4	Al	Cr	Co	Fe	Cu	Ni
Cold period	R^2	**0.35**	**0.41**	**0.42**	**0.59**	**0.48**	0.24	0.04	**0.30**	**0.23**	**0.30**	**0.27**	0.10
	n	*284*	*290*	*290*	*282*	*284*	*284*	*95*	*95*	*58*	*90*	*95*	*93*
Warm period	R^2	0.07	**0.34**	**0.36**	**0.48**	0.03	**0.48**	**0.21**	0.07	0.12	**0.38**	**0.35**	0.10
	n	*82*	*527*	*527*	*72*	*72*	*72*	*35*	*35*	*37*	*35*	*35*	*35*

Better Pearson correlation in the *winter-time* → K^+, NO_3^-, Cr and Co
In *summer* → SO_4^{-2} and Al → better correlations compared to the coldest period of the year.

Long-range transport of inorganic aerosol → dominates in the OP of fine particulate matter during summer, along with the presence of Fe and Cu; while organic aerosol as well appears to contribute to a lesser extend.

ACKNOWLEDGMENTS

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CONCLUSIONS

- OP higher values during wintertime → wood burning dominant source of aerosol → combustion major source of water-soluble OP, both as primary and secondary emission
- Winter regression analysis → toxicity of aerosol is significantly associated with OC and NO_3 → Once again, significant impact of combustion, both as primary and secondary product emission.
- During summer → an impact of long-range transportation and water-soluble metals in aerosol toxicity is shown.
- Combination of various PM chemical parameters → scarce identification of various aerosol OP sources → temporal basis, in the area of Eastern Mediterranean.

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