MGSS PG 14 Completion Article – Mark Scerri

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From 2013 to 2019 I read for a doctor of natural sciences (Dr.rer.nat) at the Institute of applied geosciences of the Technical University of Darmstadt (Germany). My doctoral research focussed on the characterisation and source identification of airborne dust, particularly the PM_{10} and the $PM_{2.5}$ fractions. The main reason for choosing to carry out my research within this institution was the fact that researchers at this institute have published numerous peer reviewed articles on the characterisation of aerosols. Additionally, I pursued doctoral studies *via* the cumulative route that is through the publication of three research articles in peer reviewed journals of international repute.

The first of the papers to be published was related to the isolation of the natural contributions to the PM_{10} dust fraction at a rural site in Gozo. This research related to this paper involved the collection and analysis of PM_{10} samples from the rural background site in Għarb (Gozo) operated by the Environmental Resources Authority. The ensuing data analysis showed that the contribution of the natural sources (sea salt and Saharan dust) levels of PM_{10} at this site was jointly approimately equal to 40%, this is at the upper end of the 0.5 – 58% range determined for Europe in other studies. The main reason for studying the natural contribution to PM_{10} is the fact that European Legislation allows Member States to deduct the contribution of natural sources from exceedances of the standards for PM_{10}, for the simple reason that despite the fact that health effects for natural contributions to dust can't be excluded however there is nothing, which can be done to prevent them. One major recommendation resulting from this study was that future revisions of the Ambient Air Quality Directive should include an obligation on Member States to issue advanced warnings informing the general public about the occurence of these events.

The second paper was related to the characterisation of the sources of $PM_{2.5}$ at a traffic hotspot in Msida. Most of the population in Malta lives in an urban set – up and is therefore exposed to aerosol levels, which are higher than those registered at a rural background site. The main focus of this paper was to outline strategies for the reduction of $PM_{2.5}$ levels in order to achieve the WHO guidelines for this dust fraction. The reason for the choice of the finer aerosol fraction is the fact that this is the more relvant fraction especially when one considers health effects arising from chronic expsoures to this pollution. 7 main sources of aerosol were identified for this receptor. These were (in order of importance) traffic, secondary aerosol, saharan dust, aged sea salt, shipping, fresh sea salt and fireworks. This study showed that $PM_{2.5}$ levels are also significantly affected by Saharan dust intrusions. It is important at this stage to state that the European Commission's guidelines on the subtract of natural dust contributions, do not (so far) allow the possibility of deducting natural contributions to $PM_{2.5}$, as it is argued that this fraction is due to anthropogenic activity. One surprising result from this study was the fact that the letting of fireworks (a activity associated with the summer festa season) is significant enough to contribute to the annual levels of $PM_{2.5}$. This is signifcant because in Malta perchlorate salts are used as oxidisers in fireworks and it is a known fact that perchlorate interfers with the uptake of iodine in the thyroid gland. The major conclusion from this study was that the traffic ocntribution should decrease by around a half in order to achieve the WHO guidelines. In the long run the policy makers should also consider targetting shipping, because this also contributes measurable to urban levels of $PM_{2.5}$ and dust particles from shipping were shown to be laden with elemental carbon, which raises health concerns.

The third and final study aimed to answer a fundamental methodological issue, which was related to the minimum number of samples, which are required in order to run the model, which was used in the previous two studies. This was done because there are conceivable

situations in which samples smaller than suggested by most guidelines can be taken. The results of this model were validated against two other models.

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