A STUDY OF THE CONNECTION BETWEEN ELECTROMAGNETIC SMOG, AEROSOL POLLUTION AND CLOUD FORMATION

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Abstract: Some important discrepancies in weather forecast for urban area during frontal zones’ transitional periods are constantly observed, when air pollution is combined with electromagnetic smog. Often the days’ lasting phenomenon is due to an unstable phase in humidity transition, which is generated by electromagnetic smog stimulation of anthropogenic aerosol aggregation. This result is a fog-like cover which intensifies pulmonary illness and allergies.

Key words: clouds, air pollution, electromagnetic smog

INTRODUCTION

Air pollution causes millions of deaths all over the world, according to the United Nations. Some parts of the world have a detailed view of local air quality from ground sensor networks and forecast models that generate public alerts. But for much of the world this type of information and warning are not available. Pollution plumes from cities and forest fires could be seen moving downwind hundreds of miles. For big cities recently wind and rain, the usual air-cleaning factors, some times turn to be harmful (e.g. acid rains, contamination of areas which are distant from the pollution source). Spacecraft are orbiting the Earth with instruments to track pollutants (carbon monoxide, nitrogen dioxide, sulfur dioxide and particulates). Most sensors work by taking in a jumbled spectrum of light scattered or absorbed when sunlight interacts with molecules and particles. Each pollutant has a unique "spectral" fingerprint that scientists tease out of the atmospheric soup with algorithms they continually fine-tune. The information about air pollution coupled with that from weather-satellites could better unravel the complex ebb and flow and mixing of pollutants from different sources. This would be a more solid scientific foundation for smart strategies to cut air pollution [1].

In the last decades a new anthropogenic subtle, complex danger emerges. “Electromagnetic smog” (EMS) is a term used to refer to a mix of low-level electromagnetic fields that exist in the modern environment. This "smog" is not just generated by mobile phones, but also by Wi-Fi routers, tablets, laptops, power lines and cell towers (Fig. 1).

The synergism of air-pollution and electromagnetic smog is harmful not only for human health (cancer, pulmonary diseases, allergies etc.), but for urban infrastructure elements too.

For Sofia city and its suburbs in the isolated by mountains Sofia field in the recent couple of years an irregular increase in the discrepancies between weather-forecast and real situation in regard to precipitation is witnessed: visually observed a pre-rain cloud system above a highly urbanized district is in an unstable equilibrium without raining for at least a day; later it dissipates, sometimes after 2-3
days, which is too long for the normal natural weather-‘thermodynamic’ water-transformation cycle. This seems to be strange, at least due to the fact that the models and the computer are constantly improved. The commented meteo-phenomenon happens after a couple of days with negligible gradients in the meteo-parameters values, during quiet (without wind) cold days and air-temperature near the dew point. Usually such situation is typical for the periphery of already transformed to weak (Atlantic) cyclones, where the differences in dynamic between the warm and cold regions are relatively small. For open areas (Bourgas, Stara Zagora, Plovdiv) such abnormalities aren’t registered. This suggests that the combined influence of local topographic space-scales and cloud-formation phenomena-scales could be of some significance too, besides something unknown.

THEORY

Our decision, besides the field in situ meteo-data [2] to use satellite (from TERRA and AQUA) images too, is because the latter provides a friendly useful, large-scale and long term, complex picture of the phenomena evolution. From the space data-bank for atmospheric pollution and clouds for a ten years’ period [3], collected in the Space Research and Technology Institute, several cases were chosen, some depict more than one day lasting situations with the above mentioned conditions. The studied cases are 2 multi-days (8-11.01.2007, 6-8.03.2007) and 5 one-day (10.12.2006, 10.11.2012, 7.02.2014, 19.12.2015, 16.01.2015) and each comprises 2 regions: Sofia and Stara Zagora, or Bourgas. For all of them there was no temperature-inversion, the moisture is ~> 80%, the wind speed is<2 m/s, the surrounding temperature is around and below the dew-point temperature (Td), the stable St-cloud cover is low (H~1 km), rarely alternatively is changed to fog and vice versa. This is typical for unstable equilibrium, i.e. sensitive to in narrow margins of local meteo-parameters – the ‘small’ governing factors’ effect. For all these cases, which are part of vast areas (L~<100 km), the weather forecast probability >80% was for steady raining which was really valid, except for the commented Sofia region. The latter is surrounded by mountains, i.e. some ‘wall’-type effect could reflect the atmospheric flows, thus influencing the scales cloud formation process. An example is shown on Fig. 2:

Fig. 2. Smog over Sofia region at 11.01.2007 (image from Aqua)

Our attention is focused on the possibility that obviously the ‘governing’ influence of some ‘tiny’ factor(s) is omitted in the theory. The suspicion is that they should be newly emerging, highly probable are anthropogenic (probably a result from the urbanization). The first defied targets were the urban ‘thermic cap’, the differently modified albedo. The concentration of high buildings and their effect on local vertical atmospheric circulation, due to their relatively rare distribution which perturbs the vertical air-flow, couldn’t be effective too.

The next point of interest are the different anthropogenic aerosols’ concentrations above large-scale (L>10km) 2-D-areas around traffic high-ways (the “Sofia South Arc”) where the specific surrounding topography (Vitosha mountain) assists the formation of long-lasting smog. But there are other urban areas with smog too and with usually low wind dynamic due to the concentration of buildings, where the pre-rain cloud cover doesn’t show the commented behavior. Of importance is that both area types are with high concentration of broad spectra electromagnetic smog generated by different antenna fields.

Clouds develop from condensation of water vapor to water droplets and ice particles. The rain-
probability depends critically on the saturated vapor pressure and therefore on the temperature conditions in the saturated atmosphere layer. But it also depends on the size (radius), shape, and surface tension of the condensing water droplet, which is determined by its chemical constituents. The relative humidity correlates with the temperature and the size of the water droplets that condense at cooler surfaces or other condensation points.

Not all raindrops are created equal. The size of falling raindrops depends on several factors, including where the cloud producing the drops is located on the globe and where the drops originate in the cloud. The drop size distribution is one of many factors that determines how big a storm will grow, how long it will last and how much rain it will ultimately produce. Without knowing the relationship or the ratio of those large drops to the smaller or medium sized drops, we can have a big error in how much rain we know fell and that can have some big implications for knowing long term accumulations which can help with flash flood predictions. Drop size distribution influences storm growth by changing the rate of evaporation of rain as it falls through dry air. Smaller drops, for instance, will tend to evaporate faster and subsequently cool the air more. This leads to stronger flow of downward moving air that can cause damaging winds when they reach the ground. However, these same down-drafts can interfere with the upward flowing air that fuels the storm and cause the storm to weaken or dissipate.

![Fig. 3. A conceptual picture, showing how the size and distribution of raindrops varies within a storm.](image)

Fig. 3 [12] represents a conceptual greyscale image showing how the size and distribution of raindrops varies within a storm. The grey peripheral zones (blue and green ones in the original image) represent small raindrops that are 0.5-3mm in size. The bright central zones (yellow, orange, and red ones in the original image) represent larger raindrops that are 4-6mm in size. A storm with a higher ratio of yellows, oranges, and reds will contain more water than a storm with a higher ratio of blues and greens.

![Fig. 4. Illustration of coagulation and coalescence mechanisms](image)
For coagulation (Fig. 4) its rate sharply decreases with the increase of the aerosols’ charge, but for the diffuse coalescence the charge value doesn’t matter. The latter is an auto-model process—the aerosol’s distribution function $f$ for $u/u_{crit}$ isn’t time dependent, while for $u_{crit} \sim t$, where $t$ is a time.

![Fig. 5. Distribution of aerosol size ($u$) in case of diffusion coagulation](image)

In reality the processes are very sensitive to different non-linear combination of multiple factors (drop’s: size, electric charge, temperature, concentration, specific reaction times, chemical composition; relation between specific reaction time and time for equilibrium for different processes; molecular forces (evaporation rate); cloud’s vertical size and height above the ground; wind speed; altitude; atmospheric pressure) whose real values vary in order. On the Fig. 5 we illustrate the distribution of aerosol sizes. All these arguments mean that the water phase transition (cloud, fog, rain) is a multitude of irregular processes situated in the cloud volume. They all are highly sensible for molecular, i.e. small-scale electromagnetic forces.

![Fig. 6. Typical time scales for system, containing aerosols and water vapor](image)

Does electromagnetic smog influence the water transition cycle? How? Why in such a polar manner?

Our suspicions are based on some sound reason speculations. The urban aerosols in the clouds are like water-droplets dimmers, but with a more complex polarization being a weak electrolyte. Besides to temperature, their sensitivity to EMS could change the electric charge exchange, i.e. the cloud condensation nuclei formation and evolution [4]. On the Fig. 6 we show characteristic times system, containing aerosols and water vapor in the case of 1 Atm pressure and 0°C temperature. The liquid aerosols are electrically charged when grouped in two ways: coalescence- when both the steam and the aerosols’ pressures are at equilibrium the water molecules are attached to bigger aerosols and smaller evaporate; coagulation- when two aerosols merge to one drop. On the Fig. 7 we show averaged electrical potential for different time for reaching double value of water vapor molecules.
The human generated electromagnetic radiation is contributing to global warming by diverting kinetic energy limiting electrostatic attraction (KELEA) from its presumed association with cosmic rays. It is viewed as normally participating in the formation of cloud condensation nuclei (CCN) [7]. It may do so by transforming electrostatically inert particles into electrostatic aerosols capable of acting as CCN. The resulting clouds act as a reflective barrier to some of the infrared radiation from the sun and, thereby, reduce the Earth’s heat. The increasing level of electromagnetic radiation in the atmosphere is reducing the capacity of cosmic rays to deliver adequate KELEA to maintain climate stability through optimal cloud formation. Specifically, the fluctuating electrical fields accompanying electromagnetic radiation may do so by competitively withdrawing some of the KELEA from the incoming cosmic rays.

Introducing electrically charged droplets into a naturally occurring cloud will affect the collision probabilities and hence the rate of droplet coalescence to produce rain drops and depending on the nature of the cloud result in increased rain drop growth. Initially, negative ions are generated from a corona discharge wire array [8]. The ions become attached to particles in the atmosphere, which later act as cloud condensation nuclei (CCN). The ions are conveyed to the higher atmosphere by wind, atmospheric convection and turbulence. The electric charges on these particles are transferred to cloud droplets; and the electrostatic forces on droplet interaction aid the coalescence of the cloud droplets. This results in enhanced raindrop growth rate and ultimately increasing rainfall downwind.

In 1990’s, MIT’s Atmospheric Laboratory conducted field trials in non-conventional weather modification technologies. Through further studies, atmospheric researchers developed a theory that identified macroscale weather chaos as ‘the key’ to influencing weather. During late 1990’s an independent research team in Australia stumbled on an ‘atmospheric mechanism’ whilst exploring origins of this theory [9]. Experimental trials revealed that “small amounts of electromagnetic energy, applied intelligently,” could force change into weather, based on atmospheric sine wave patterns. This research culminated in the development of an atmospheric resonance technology [10]. The “Aquiess” weather modification is based on frequencies that are discoverable, code and algorithms, which can enable (an apparent) direct connectivity between programming operations and atmospheric systems. Using this ‘resonance mechanism’ it is possible to demonstrate modification of atmospheric streams of gentle soaking rain. Electromagnetic wave forms are utilized to deliver signals toward a target weather system that may be as remote as beyond the visible horizon. Proprietary technologies which draw upon data from locally applied hardware and software as well as disparate sensors, are deployed to modify the patterns forming ‘oceanic corridors’ that deliver rain. Scientific analysis of the “Aquiess” results, shows what is described as ‘resonance technology’,
has both a vast reach and incremental scalability. The "Aquiess" gentle soaking rain and micro-weather modification can assist in a range of applications: drought mitigation, flood reduction, frost avoidance, hail mitigation, heat wave mitigation, precipitation, wind reduction.

In future research some ideas from dust plasma research probably could be helpful. The latter's variability determine the open and non-Hamilton character of the system and change the non-linear screening. These have one physical cause – the aerosol charges and their flows, modulated by electromagnetic smog [11].

All these processes shouldn’t be mistakenly regarded to the hailstone and graupels interactions in Cu-Nb which has nothing in common with the topic of this work.

**CONCLUSION**

Our future work on the topic of this paper should include detailed *in situ* measurements of aerosols and meteo-parameters plus amplitude, frequency, modulation mode and work regime of electromagnetic antenna fields. Because of some preliminary suspicions about the perturbations the electromagnetic smog causes to radar (“Sentinel"-1) images of the 2015-yr.-cases, a further study is necessary too. Although precise computational work won’t be of great key help, after preliminary a “sound reason” based qualitative analysis, some studies of extreme parameters’ combinations should be done. A broader program which uses different types of satellite images is aimed at the research of artificial sporadic and on-purpose influences on natural processes, the procedures for their detection and the ecologic impact. Another step is risk assessment of such hazards in order, if not to prevent, at least to minimize some negative results.

NASA and other spacefarers are now taking a pursuit of the air-pollution lethal global health hazard to a new level with science and technology projects – build a rigorous in-house science infrastructure to develop new space sensors, fly airborne field experiments to directly sample the atmosphere, conduct laboratory work and comparisons of data from space- and ground- based instruments and develop computational models. Of great use will be the GPM, launched in 2014 which is the first Dual-frequency Precipitation Radar (DPR) to fly in space, as well as a multi-channel GPM Microwave Imager (GMI). The DPR makes detailed 3D measurements of rainfall, while the GMI uses a set of 13 optimized frequencies to retrieve heavy, moderate, and light precipitation measurements at the Earth’s surface. As GPM improves our understanding of precipitation from space, that information will be vital in improving weather models and forecasts.

The MAIA sensor (Multi-Angle Imager for Aerosols) will analyze the sizes, compositions and quantities of particulate air pollution [12]. Scientists will combine that information with public health records to probe connections between particulate pollution and specific health impacts, such as adverse cardiovascular and respiratory diseases and premature deaths. An international constellation of three separate sensors NASA TEMPO (Tropospheric Emissions: Monitoring of Pollution) will collect hour-to-hour air pollution measurements over North America from a fixed position directly over this hemisphere should be in operation by 2022.

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ИЗСЛЕДВАНЕ НА ВРЪЗКАТА МЕЖДУ ЕЛЕКТРОМАГНИТЕН СМОГ, АЕРОЗОЛНО ЗАМЪРСЯВАНЕ И ОБЛАКООБРАЗУВАНЕ

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Резюме: Наблюдават се сериозни несъответствия в метео-прогнозите за градски области при преходни периоди, когато атмосферно замърсяване се комбинира с електромагнитен смог. Явлението продължава до няколко дни и се дължи на нестабилен фазов преход на влажността, който се създава от електромагнитен смог, стимулиращ агрегацията на атмосферни аерозоли. Резултатът е явление подобно на мъгла, което усилва алергичните и дихателните болести.

Ключови думи: облаци, атмосферно замърсяване, електромагнитен смог

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