APPLIED ACHIEVEMENTS OF PHYSICS AND MODERN TECHNOLOGIES IN CHANGING THE CLIMATE

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Abstract - The status of global warming and climatic change of the different regions of the world has led to more attentiveness of academic communities to the future crises caused by drought and climatic change in mountainous areas and deserts. Desired control of local and regional climate is directly depended on recognition of interaction of the particles in the atmosphere. Full dominance on the processes is important for optimal and effective use of modern equipment and technologies the discussions of climatic change from the fertility of clouds to controlling the atmosphere conditions at the developed countries has possessed large amount of research budgets. At the developed countries, different methods are used for fertility of clouds and changing the local and regional climate. With the managerial perspectives to this field, scholars tend to extend their strategic-military power. Hence, recognition of modern equipment affecting atmosphere and analysis of their operation mechanism in management of climate of developing countries in improvement of local and regional climate plays key role in the sustainable development. According to the effect and interaction of atmosphere particles, in the recently used academic sources, using powerful electric fields from the ground surface is considered because of low cost and easiness of implementation of applied projects. In all proposed models, identification of physical and chemical interactions of cloud environment and atmosphere space is important. Hence, this study has emphasized the evolution of particles and their interaction in atmosphere and has studied the effect of additional electromagnetic fields on change in the process of atmosphere rainfall.

Index terms - Climatic Changes, Atmosphere Ionization, Electric Discharge, Condensation, Precipitation

INTRODUCTION

This study is produced by a part of studies and results of updated achievements of theoretical and applied studies of modern sciences in field of ability of mankind in controlling climate and atmosphere processes.This issue is one of the most underlying global challenges in superior levels of the government and academic communities. Searching academic strategy, knowledge-based solution to solve the big challenge has gained attention of thinkers and the authorities of technology for many years. Analyzing the status and structure of atmosphere and the effective results of knowledge-based interference in the process of different atmosphere phenomena has left direct managerial effect on the drought, Tsunami, flood and many other unexpected and critical accidents (Berlyand, 1975, 1985). Hence, analysis and review of the technologies used in current equipment of climate change and the suggestion of modern phenomena affecting climatic processes, especially decline of heavy and destructive rainfalls is very important. At the same time, studies on the injection processes on atmosphere are being followed at different countries, which have left considerable results in fertility of clouds and increased atmospheric rainfalls based on the relevant studies. Hence, the main objective of this study is to present a review on initial and basic concepts of physics, which is one of the methods of artificial interaction methods and affecting climatic change and improvement of atmospheric conditions. In this method, the environment and atmosphere particles are affected by electromagnetic fields and the climatic conditions are changed through synthetic injection of effective particles (useful ions) to achieve ultimate goal of changing climatic conditions (Brunauer, 1945).

II. PHYSICAL EFFECTS ON ATMOSPHERE AND RAIN MASSES

The literature of academic studies are relevant to theoretical studies on physical and applied issues of climatic change, which were established during 1930-1995 with presentation of the suggestion of applying external electromagnetic field and interference in ion interactions in atmosphere. Synthetic injection of fertilized molecules through capsules carried on cloud fertilization airplane and injection of fertilized molecules using ground bombers (powerful electromagnetic effect of ground surface, lower layers and upper layers of atmosphere) have been designed from the past to the date in unique way in line with long-term goals of change in rain volume and type of atmospheric precipitations. Hence, it is necessary to study the process of physical structure change of water molecules in atmosphere, a part of which is affected by ionized particles intensified because of ionization and the effect of additional external electric discharge. Over the years, the main reason for paying attention to this issue and using modern technologies and making modern equipment for climate change is practically one of the fundamental branches to achieve sustainable development and military and nonmilitary mutations in industries depended on regional climate change. In this regard, it is necessary to identify the effect and interaction of external electromagnetic field (Wales, 1985), to

analyze the fuzzy transits and physical-chemical nature of water structure and the effect of effective interaction of particles with water molecules. This study has investigated the physical structure of ionization equipment of atmosphere and the effect of fertilized particles on water molecules.

III. INTERACTION OF EXTERNAL FIELD WITH THE ATMOSPHERE

The modern equipment based on electromagnetic wave propagation has been designed to have direct effect on troposphere to ionosphere layers. The equipment can be divided to 3 parts and under titles of high-frequency, laser and ionization. Over the years, using the modern achievements and mechanisms of ionization of air in stratosphere to ionosphere layers by electromagnetic and laser waves have been operationalized clearly in different regions of the world with the aim of changing the climate and affecting troposphere. In ionization process, similar to atoms, molecules in facing particles, electromagnetic waves and other items are changed into fertilized molecule with adding or decreasing electron from the layer of atom capacity. In this regard, one of the main mechanisms of ionization is ionization of air, using electric discharge and using avalanche ionization. In this ionization, air molecules are fertilized with energy emission and are converted to ion by means of crashing to accelerated electrons extracted from discharging electrodes. Although a few electrons are created at the first, at the rest of direction, the electrons needed for next ionizations and cascade ionization are provided. Repeating the process in modern industrial and environmental technologies using fixed and alternative flow in electric discharge can provide plasma environment, which can directly affect the atmosphere interactions. The main issue in ionization process is the effect of external parameters in intensity of emission of ion avalanche. Hence, the amount of ion production and the way of controlling cascade ionization and movement of particles is important and is depended on the voltage-amperage of feed source, form and type of electrodes. In fact, voltage-amperage of the feed source and electrodes are the main part of the differences created in different types of electric discharge. Therefore, plasma is referred as the neutral gas with same behavior and with generally equal free electrons and positive ions. Hence, fertility of inter-electrode space can convert the ionization zone to a very good conductor to transfer the flow and electron/ion floe. In some cases, the compressible fluid even acts better than metal conductors. As it is illustrated in figure 1 (right hand), around the discharging electrode, two different ionization and drift zones are created and as a result of ionization, the particles are accelerated with speed close to light speed (left hand). Exit of free ion and electrons with high speed can cause consecutive ionization of air or atmosphere and electron flow can happen.

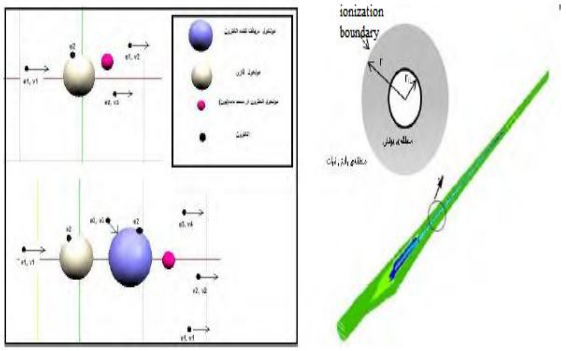

Figure 1: right: different regions in electric discharge; left: up: collision ionization; low: phase ionization

IV. PHYSICAL EQUATIONS OF FIELD IN ELECTRIC DISCHARGE

In electric discharge, the movement path of particles can be determined and estimated using physical equations and equations depended on force and intensity of electric field in electrodynamics, which is mathematical model dominated on fluid dynamics such as fluids or gases. Accordingly, in this section, the dynamic equations of flow and electric charge flow in the space around the electrodes can be simplified in most general state using Navier–Stokes equation and charge continuity as follows (Zhao, Adamiak, 2005):

$$\rho\left(\frac{\partial \vec{v}}{\partial t} + \vec{v}\cdot\vec{\nabla}\vec{v}\right) = \vec{\nabla}T - \vec{\nabla}P + \vec{F}_f + \vec{F}_{ext} \quad (4)$$

$$\frac{\partial \rho}{\partial t} + \vec{\nabla}\cdot\vec{J} = \sigma \quad (5)$$

$\vec{v}$ - Is the fluid velocity, -P is pressure, T is temperature, V is the kinetic viscosity and $\vec{F}f$ – is the fluid strength, P is the density of electric volume charge, t is the time, J is the density of electric flow, σ is the produced electric charge per time unit. Electric discharge and ion cascade are begun with special voltage on electrodes called critical voltage. Determining critical voltage at the beginning of ionization is vital and to obtain its numerical value, the equation of field potential difference is placed in the equation of charge continuity:

$$\vec{\nabla}\rho\cdot\left(\vec{\nabla}U\right) = \frac{\rho^2}{\varepsilon} \quad (6)$$

For simplification, the equations are placed in polar coordinates:

$$E_r = -\frac{\partial U}{\partial r}, E_\varphi = -\frac{\partial U}{\partial \varphi} \quad (7)$$

Equation 6 is extended as follows:

$$\frac{\partial \rho}{\partial r} E_r + \left(r \frac{\partial \rho}{\partial \varphi} \right) \cdot (r E_\varphi) = -\frac{\rho^2}{\varepsilon}$$

(8)

As the aim by electric discharge is just ionization and fertilization of the environment, the boundary conditions of the criterion parameters of electrodes and field in the above presented equations should be selected in such way that the size of initial field intensity in level of discharging electrode cannot lead to beginning of the chemical reaction in ionization region. In other words, if $U0$ is the initial voltage in beginning of electric discharge, U is the secondary voltage; the voltage of accumulating electrodes is equal to 0 and the intensity of electric field in electrode level if fixed; the condition of the Capt Law is provided $U \geq U0$ for lack of chemical reactions and should remain constantly (Raizer, 1991). Hence, the boundary conditions can be change in density of electric charge at the level of discharging electrode from p=0 to p(r0), intensity of electric field in level of discharging electrode is equal to E(r0)= E0 and the diameter of discharging electrode is equal to r0 and the limit of potential difference on electrodes is from U0 to U (Zhao, Adamiak, 2005). On the other hand, in electric discharge, the type, size, ordering and potential difference given on electrodes can also affect change in status and intensity of ionization. Hence, the density of volume charge is only depended on parameters including feed source, geometry of electrodes and fluid and should follow Peek Law (Peek, 1915). The effect of effective quantities of the field can make the density of volume charge increase or decrease significantly in level of electrodes to the internal and external points of ionization area. In calculation of overlap of fields, the density of volume charge density is required and hence, it is necessary to obtain it through extracting intensity of the field and velocity of movement of electrons or ions in ionization area from electrodynamics equations. With interference of dependence of colon force ($\vec{F}$), field intensity ($\vec{E}$), ion charge density (p), density of electric discharge density ($\vec{J}$) and constant ion transfer (α):

$$\vec{F} = \rho \cdot \vec{E} = \frac{\vec{J}}{\alpha}$$

(9)

Equations 4 and 5 are simplified:

$$(\vec{v} \cdot \vec{\nabla})\vec{v} = \frac{1}{\rho_0}(\vec{F} - \vec{\nabla} P) + \upsilon \Delta \vec{v}; \quad \vec{\nabla} \cdot \vec{v} = \vec{\nabla} \cdot \vec{J} = 0$$

(10)

In electrodynamics discussions, if the free particle flow happens under fixed pressure, particle derivatives f pressure are same and equal to 0 in all areas, except for nearness of accumulating electrodes. Hence, to use it in next section, radius and angle components [5], the main values of field in polar space:

$$\vec{v} = \vec{v}_r + \vec{v}_\varphi, \quad \vec{F} = \vec{F}_r + \vec{F}_\varphi, \quad \vec{E} = \vec{E}_r + \vec{E}_\varphi$$

(11)

Are placed in partial derivatives of velocity laplastin and field force components and are presented with placement in equation 10 as follows:

$$\Delta \vec{v}_r = \frac{\partial}{\partial r}\left(r \frac{\partial \vec{v}_r}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 \vec{v}_r}{\partial \varphi^2}; \Delta \vec{v}_\varphi = \frac{1}{r} \frac{\partial}{\partial r}\left(r \frac{\partial \vec{v}_\varphi}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 \vec{v}_\varphi}{\partial \varphi^2}$$

(12)

$$x = \rho Sin\varphi \quad ; y = d - \rho Cos\varphi$$

(13)

$$F_x = FCos(\varphi - \alpha); \; F_y = FSin(\varphi - \alpha); \alpha = arctan(F_x / F_y)$$

(14)

Careful determination of two values of colon force and intensity of electric field on each other and the effect of lateral parameters on both values in electric discharge is very important (Chen, Davidson, 2002). Till before 1914, the ratio of flow intensity and outlet potential difference of electrodes are estimated using following approximate equations (Townsend, 1915):

$$i = kU(U - U_0) \quad (15)$$

$$i = k(U - U_0)^2 \quad (16)$$

i Is electric flow, u is secondary voltage, U0 is least primary voltage, k is the coefficient of proportion and is depended on the system setting and a function of geometric parameters of electrodes. However, since 1915, for more accuracy of estimations and placing the important parameters in this ratio, Peek's semi-empirical law (eq.17) was presented (Peek, 1915):

$$E_0 = E_c m_v \delta^2 \left(1 + \frac{0.03}{\sqrt{\delta r_0}} \right) \quad (17)$$

Peek determined the least field intensity in least distance from discharge electrode surface needed for beginning electric discharge using his semi-empirical formulation and obtained the equation between electric field intensity and discharge electrode potential difference as follows:

$$E_w = E(r_0) = U / r_0 ln\left(\frac{2d}{r_0} \right) \quad (18)$$

In 1991, Raizer presented more comprehensive and general law of voltage-amperage and the impact factor of important parameters of electric discharge on type and structure of electrodes. In this study, to determine the relation between intensity of field and potential difference with criterion parameters of electrodes, Raizer law is selected. Therefore, to determine the voltage and flow ratio in electric discharge in Raizer law, two equations of 14 and 18

and the condition $d \gg r0$ are used and the equation is obtained as:

$$U_0 = E_c m_v \delta^2 r_0 \left(1 + \frac{0.03}{\sqrt{\delta r_0}}\right) ln\left(\frac{2d}{r_0}\right) \quad (19)$$

U0 is the potential difference of beginning of electric discharge, Ec is critical potential gradient of the air and is equal to 3*106v/m. δ is the parameter of gas density index, which is depended on pressure and temperature between electrodes and is equal to 1 in standard conditions. mv is the parameter to determine impurity effect of electrode surface and its value is equal to 1 for smooth and uniform electrodes. Under applied and practical conditions, it can be changed depending on type of wire in range of 0.85 to 0.98 and be determined through geometric parameters of distance and diameter of electrodes. Now, the above equation is used to present the potential difference and flow in crown field as follow:

$$\frac{i}{l_0} \cong \frac{2\pi\varepsilon_0\mu}{r_0 d\left(ln\frac{2d}{r_0}\right)^2} U(U - U_0) \quad (20)$$

The t/L0 ratio is same quantity of electric flow per length unit, which is relevant to electric charge density in ionization area. ε0 is the vacuum transit coefficient, L0 is length of electrodes, μ is sir displacement coefficient, r0 is wire radius, d is the distance of two cathode and anode electrodes, i is the flow in discharge electrode, U0 is the initial potential difference and U is the potential difference of beginning of electric discharge. In this step, intensity of electric field E(r) and electric charge density p(r) in ionization area is obtained from eq.20 and the Poisson state as follows:

$$\frac{1}{r}\frac{d(rE)}{dr} = \frac{\rho(r)}{\varepsilon_0} \quad (21)$$

The effect of ionization process on air masses is in close relation with electric charge value (Q). The numerical value of electric charge in the inter-electrode distance with integration of charge density function in limit of discharge electrode to the distance L from that is estimated by equation 22 and the numerical result of the integral is indirectly relevant to field force F2 and F1:

$$Q = \int_{r_0}^{l} 2\pi r\rho(r)\, dr = 2\pi\varepsilon_0 \int_{r_0}^{l} d(rE) = 2\pi\varepsilon_0(r_0 E_w - lE_c) \quad (22)$$

With regard to the theoretical equations presented above, making initial potential difference more than 10kw and choosing electrodes with radius of 5*10-6m in distance of 0.01m from each other can make distribution of F1 in discharge electrode to F2 in accumulative electrode be presented as F1>F2. This can show downward process of force with distance from discharge electrodes and shows that the highest amount of ionization happens in same region and hence, the electric charge density is also reduced in certain distances from discharge electrodes compared to outside area of ionization with increase in distance. For effectiveness in lower layers of atmosphere in macro scale, it is necessary to increase the potential difference between electrodes considerably, so that the decline of ionized particle volume is compensated in far distance of electrodes. High potential difference is an equivalent for more power in ionization and increase in source power in ion production. This issue is exactly same goal needed for affecting the sir masses in troposphere. Hence, the more the ion production is increased, the more the electrostatic balance of aerosol particles and water drops in cloud masses is changed and ultimately, the condensation and nucleus creation processes can be manageable and controllable.

DISCUSSION AND CONCLUSION

Interference in condensation process and crystallization of water drops with applying external field, electron synthetic injection and stimulation of atmosphere ions can be a method applied recently in studies on local and regional climate change. One of the methods of interference in climatic change and atmospheric parameters can be ionization of lower layers of troposphere. According to the mentioned, the effect of ionization can be summarized as follows: the electric discharge process in lan scale of local and regional troposphere has direct effect on water freezing temperature. The closer the aerosols and water drops are to ionized particles in limit of electric discharge, more ions can be precipitated on water drop surface. Hence, the effect of synthetic field on decreasing freezing temperature, increased density and crystallization is significant. In fact, with regard to initial and ultimate energy of system, before and after ionization, the different of energy of interaction between two phases (ΔG) can be:

$$\Delta G = G_f + G_i = (\mu_f + \mu_i)n_v + \sigma_{fi}S + A_E; A_E = A_{Ef} + A_{Ei} \quad (23)$$

μf Is chemical potential of desired phase, nv is the number of molecules precipitated on the nucleus, σfi is surface stretch in initial phase boundary, S is the surface area of nucleus, AE is the parameter (Flomer, 1986) that shows the effect of electric field intensity on quantity of AG. According to the properties of the environment and particles, number of collisions of water drops with aerosols in volume and T time can be obtained as (Smirnov, 1972):

$$N(r_1q_1, r_2q_2) = \\ = (r_1 - r_2)^2 . \sqrt{\left(5.4\left(\frac{\varepsilon}{\upsilon}\right)^{\frac{1}{2}}\left(\left(\frac{2\rho}{9\upsilon\rho\rho_0}(r_1 - r_2)\right)^2\right) + 2.9\left(\frac{\varepsilon^3}{\upsilon}\right)(r_1 - r_2)^2\right)} . E(r_1q_1, r_2 \\ = (r_1 - r_2)^2 . \sqrt{\left(5.4\left(\frac{\varepsilon}{\upsilon}\right)^{\frac{1}{2}}((t_1 - t_2)^2) + 2.9\left(\frac{\varepsilon^3}{\upsilon}\right)((r_1 - r_2)^2)\right)} . E(r_1q_1, r_2q_2) . n_1n_2 . \tau$$

(24)

($r1q1,2q2$) Is trapping coefficient, √א is turbulence coefficient, q and r refer to radius and charge of drops, ε is consumption rate/velocity and turbulence energy dissipation per time unit on cloud mass unit, V is air viscosity kinetic coefficient, t is rest time of drops in stokes time, P0 and P are volume mass of water and air, n is density of collision drops and T is the time of collision of drops. Because of influence of turbulence in environment, the process of collision of drops is along with increase in condensation and decrease in density. According to adsorption rules in physical interactions, for each time interval and based on intensity of taking the two processes, calculation of accumulated electric charge on surfaces is necessary. The main objective is to show that electric discharge at the air or synthetic injection of electric load by means of aerosols in cloud masses can increase interaction of fertilized particles with water drops and increase the effective collisions for precipitation of fertilized particles along each other and on surface of nucleus, which can cause more effectiveness of gravity on particles and increase in intensity of precipitations. The history of fighting with drought and shortage of precipitations dates back to many years ago in the time of increased global warming and so on. Hence, different methods used to be applied to gain water. Some part of the measures was relevant to changing the agriculture type, water storage, using aqueduct and finding reasonable ways. Today, analysis of the effects on structure of clouds in increasing precipitations using various methods under the titles of cloud fertilization using methods such as silver iodide, dry ice, cement mortar, ionization, electromagnetic waves and so on, in which the process of interactions and applied effects have made positive results. Under such conditions, the flow of particles is restricted and only accumulation of particles is increase. Therefore, the electrons caused by additional electric discharge in space between earth and ionosphere come on the neutral molecules or aerosols and create an effective system with high half lifetime of fertilized particles with nucleus made by condensation material. The particles are placed in the direction of flow of upward flows with speed more than speed of mobility of electrons and speed of 1-5cm/s. negative particles are directed upward in rain process. On the other hand, to begin condensation in atmosphere, it is necessary for water vapor to reach temperature lower than dew point in cloud layers. Also, plenty of condensation nucleuses should be available (ions and aerosols), so that the condensation process can be done on them.

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