All things were made through him and without him
was not any thing made that was made.
John, 1.3

K-BEARING STRATOSPHERIC AEROSOLS AS INDICATORS OF LOW ENERGY ELECTROMAGNETIC POLLUTION

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Abstract. During the past five years, a team of Agrogeological Division of the Hungarian Geological and Geophysical Institute has studied the nutrient elements potential of the East-Hungarian sandy soils. Among these elements, the natural potassium sources are insufficient, i.e. neither the soil forming sediments, nor the groundwater cannot satisfy the consumption of the plants. Therefore, the unique K-source seems to be the meteoric water. The authors consulting more than three hundred geochemical, ecological, meteorological, astrophysical and radiological articles, identified the origin of atmospheric K-bearing aerosols

Thus, in this paper, the K-salts, as the main aerosol particles in ice and rain nucleation, with stratospheric origin were discussed, mainly based on references. In the stratosphere, the solid particles show a well expressed stratification: aerosols from desertic, volcanic and anthropogenic origin are concentrated mainly at 20 km altitude, the cosmogenic particles are observable at 50–60 km, while the measurements prove a relatively uniform distribution of K bearing particles, decreasing abruptly in the troposphere, under cloud formation level. K-bearing aerosols form micron sized, soft flakes built up by very thin acicular crystals. They represent ideal nuclei for ice split and rain drop formation. Therefore, we suppose, that the stratospheric potassium is formed by cosmic radiation induced Ar/K reaction, the reverse of K/Ar decay. The increased K^+ content in rainwater (or snow) samples above of highly populated centers is explained by the same Ar/K reaction, which is induced by low energy electromagnetic waves (UHF smog) due to (experimented) their Tunnel effect.

Key words: Stratospheric dust, K-capture decay, Argon isotopes, Raindrop nucleation, K-cycle, Tunnel effect, UHF smog

1. INTRODUCTION

The idea of this study was raised up from an agrogeological project on the main and trace element balance of sandy soils (Kerék *et al.*, 2016). Knowing the mineralogical composition of these soils and the consequences of the climatic changes in progress on the vegetal cover, the soluble element supply in rainwater seems to become more important than other geological or biological sources. In East Hungarian region with dune relief, the water extractible K^+ appears under detection limit in the soil forming eolian sand; the groundwater table is situated at 5–8 m depth below the surface, while the rainwater analysis indicates small, but constant K^+ content (0.3–1.5 mg/l) in this area. Thus, the following question arises: what is the origin of atmospheric potassium? Reviewing a huge number of physical, analytical and meteorological articles, we come across a study about low energy nuclear processes (Megré, 1987), where the reverse of K/Ar decay was argued. Hereafter, we present this phenomenon in connection with UHF pollution of large urban sites – one of the least studied negative effects of IT civilization.

2. MATERIAL AND METHODS

The physical and chemical properties of flying solid particles of high atmosphere were studied by remote-sensing optical and infrared instruments (AIRS, 2011), by extensive in situ (localized) measurements, by mechanical collection (filters and impactors) (Fig. 1), from aircrafts and balloons (Hofmann and Rosen, 1977; Toon *et al.*, 2012) and by scattered-light detection (Turco *et al.*, 1982) as well. Presently, there is a trustable image about the nature and the spatial distribution of these particles (Sun *et al.*, 2012).

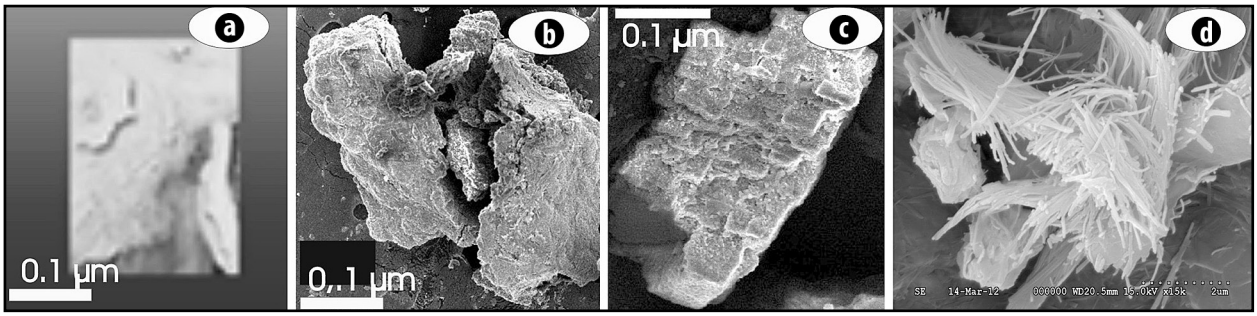

Fig. 1. SEM micrographs of some aerosol particles of mechanical collection. a. Euhedral iron micrometeorite grain with melting traces (after Turco *et al.*, 1982); b. Cracked slag particle (after Redemann *et al.*, 2000); c. Salt (epsomite) crystal of oceanic origin (after Moreda-Piñero *et al.*, 2014) d. Fibrous K-salt flake (after Lee *et al.*, 2009)

3. RESULTS AND DISCUSSIONS

3.1. The stratospheric dust: composition, stratification and sources

The origin of stratospheric aerosols and nanoparticles may be terrestrial (volcanic ash, desert storms), biological-microbial, cosmogenic (meteoric impacts and cosmic dust), and anthropogenic (mining activity, metallurgic and power plants, urban dust and smoke).

The terrestrial particles consist in minerals (mainly quartz, micas, clay minerals, maritime salts, lime and gypsum powder and volcanic glass). A special case is the presence of organic matter, as plant fragments and microorganisms (bioaerosols) carried up by high circulation systems. The size of these particles varies between 0.01 μm and a few μm. Theirs shape is irregular, often crystal like fragments (mica tables, salt cubes and prisms), or spherule like drops in the case of volcanic glass. Due to their origin and dimensions, these particles appear no higher than the limit of the lower stratosphere, i.e. to 20 km (Redemann *et al.*, 2000).

The cosmogenic particles are constituted of silicate glass and metallic (mainly iron) spherules with 10^{-4}–10^{-2} μm size. Apart from accidental micrometeorites (Fig. 1 a), falling toward the Earth surface, these nanoparticles are of ablation origin, i.e. they represent drops from the melted surface of meteors, during their impact in the atmosphere. Thus, the cosmogenic particles characterize mainly the highest level of the stratosphere: between 20 and100 km above the Earth surface (Turco *et al.*, 2012).

The anthropogenic particles show various sizes and shapes, and their composition varies too. Mineral and glassy slag particles (Fig. 1, b), carbon (smut) pellets, bitumen and other HC drops and various organic fragments fly up as far as 20 km (Fig. 2), mainly above the industrial and urban centers.

K bearing particles can be identified as terrestrial, cosmogenic and anthropogenic ones, but apart from some sea salt crystals they were not found neither as raindrop nucleus, nor as soluble components of rainwater (DeMott *et al.*, 2003). One single exception: the crystalline nanoparticles of K-salts, which will be described as following.

3.2. Flying K-salts: discovery, properties and distribution

The presence of (undifferentiated) K-compounds up to troposphere has been proved by remote sensing measurements and by scattered-light detection in various sites (e.g. Turco *et al.*, 1982; Redemann *et al.*, 2000). Detailed information about these particles tied mainly to the ice nucleation we found in Zhang and Carmichael (1999) and Khain *et al.* (2005). Toon (in Shin *et al.*, 2012) discusses the models of aerosol formation and evolution, without explaining the strange shape and the peculiarity of vertical distribution of K-salt nanoparticles (Fig. 2), in spite of their important role in water and ice nucleation.

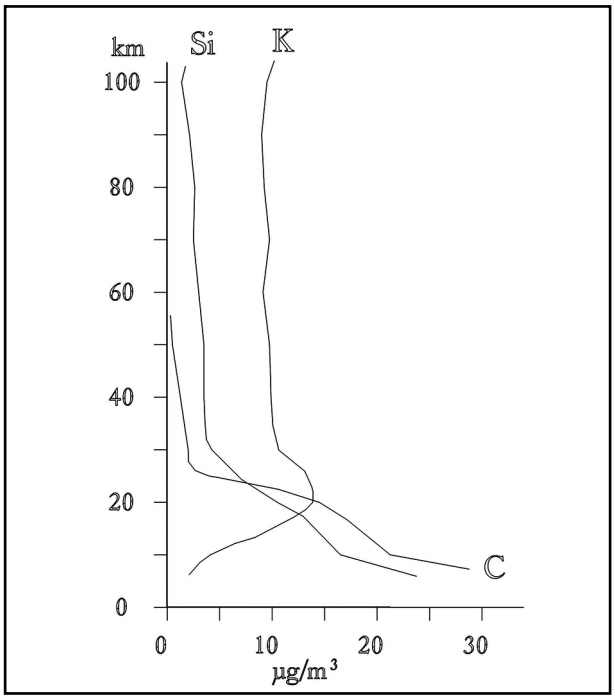

Fig. 2. The concentration of K, Si and carbon (smut) pellets in the stratosphere, after the numeric data of Shin *et al.* (2012)

Thus, these ultrafine particles form max. 0.02 μm prisms, associated in flakes (Fig. 1 d), as acicular or hair like spherical buildups, flying free in the air, like imponderable objects – from the highest part of the stratosphere to the top of cirrus clouds. Because they are consumed by cloud forming nucleation, it seems that there is a continuous supply from the heights, presumable through the action of cosmic factors. At the same time, Moreda-Piñeiro *et al.* (2014) underline that an increased K content appears in rainwater samples from urban and suburban areas. These observations were confirmed for other highly populated megapolises, as Karachi, Sao Paolo or Moscow (Sobolyeva *et al.*, 2011). Our theory answers why these particles appear in the stratosphere and what is the explanation of (alternatively) their anthropogenic origin.

3.3. Potassium and Argon: a geochemical couple

K and Ar are tied not only by their vicinal position in the Periodic table. They form a geochemically–cosmochemically determined couple, strongly bound to each other from the beginning of the first days of Earths' history.

Potassium as a main lithogenetic element gives the principal rock forming minerals as feldspars, micas and other phyllosilicates. It is present in the composition of the volcanic glass and ash, in some salt deposits and in living or dead organic matter.

Potassium has three natural isotopes: ^{39}K (93.26%) and ^{41}K (6.73%) as stable, and ^{40}K (0.012%) as radioactive isotope. Being an element in the middle of the Periodic table, ^{40}K is lighter than the stable isotopes of the same element and decays by electron capture or positron emission resulting ^{40}Ar (10.7% of the decays); alternately, ^{40}K decays to ^{40}Ca by beta minus emission (89.3% decays) (Megré, 1987):

$$^{40}K + \varepsilon_k \rightarrow {}^{40}Ar + \nu + \gamma\ (1.46\ MeV) \qquad [1]$$

The captured electron is one of the atom's own electrons from the k-shell, and not a new, incoming electron, as could be supposed from the reactions above written (Megré, 1987).

After Attendorn and Bowen (1997) the presence of ^{40}K with $1.277.10^9$ y half-life — this time notably shorter than the age of Solar System — is due to the fact that the pure electron capture can be inhibited if it is fully ionized in exploding supernovae. So, ^{40}K does not undergo radioactive decay as long as does not encounter electrons in outer space. Comparing to the Earth age (~4 Ga), the quantity of ^{40}K isotope is still higher than the calculated amount (Attendorn and Bowen, 1997). The authors explain this fact by (unverified) cosmogenic supply. Contrarily, we suggest a continuous *recycling* of ^{40}K, strictly in the frame of terrestrial environment.

Argon is the most abundant noble gas, forming 0.934% of the atmosphere and 1.5×10^{-4}% of the Earth crust as well (Hwang *et al.*, 2005).

The main isotopes of argon found on Earth are ^{36}Ar (0.34%), ^{38}Ar (0.06%), and ^{40}Ar (99.6%). Instable ^{39}Ar with 269 years half-life is present in the atmosphere too, consuming by way of cosmogenic neutron capture a part of ^{40}Ar. Note, that in stars' atmosphere (including the solar one) and in interplanetary gas clouds as well, the ^{36}Ar dominates (Emsley, 2001; Lodders, 2008; Quenna, 2013), as the primary product of exploding supernovae. Thus, the atmospheric argon of the Earth is almost entirely of terrestrial origin, i.e. it results by ^{40}K decay.

In this situation, the question 'is the reaction [1] reversible or not?' is entirely justified.

Experiments using high energy γ radiation confirmed that exciting ^{40}Ar, beta radiation is emitted, resulting ^{39}K:

$$^{40}Ar + \gamma \rightarrow \beta + \nu + {}^{39}K\ (\gamma>1.565\ MeV) \qquad [2]$$

Within cosmic radiation, gamma photons having such energy are obviously present, therefore the presence of uniformly distributed K-bearing aerosols in stratosphere is explained. However, the cosmic gamma induced K-supply does not explain the increased amount of these ones at the bottom of the stratosphere, i.e. where the watery clouds are generated — and it is fully produced above the great urban agglomerations.

3.4. Ar/K conversion at low energy

Following the idea of Andrey Dimitrievich Sakharov on "two sheets theory" (Sakharov and Novikov, 1970), a similarity of microcosmos of atomic nuclei with the existence of bridges between the "sheets", as corresponding to wormhole domain in macrocosmos, due to complete CPT asymmetry (Sakharov, 1972), can be found in microcosmos of atomic nuclei, too (Sakharov, 1972). This is the explanation of so called *tunnel effect*, when a high energy nuclear process becomes possible, using a narrowly calibrated low energy spectrum, for obtaining the same results.

Following some technical solutions suggested by Jevremovich (2009), the experiments initially performed in the laboratory of the Armenian Polytechnic University (Ohanesian, 2006) and continued in Moscow (Ohanesian and Obrucheva, 2014) demonstrated that the conversion Ar/K could be induced by using eight different channels of decimeter sized UHF waves of which energy — between 1.0–1.2 μeV was ~10^{-12} times lower that the cosmic gamma photon energy. It is true that the productivity of this reaction is quite small: 22–35 $\mu g/m^3$/year, but it correlates with the concentration of K salts in rainwater. It is important to know that this waves have the frequency we use for television, broadcasting, cell phones, satellite communication including GPS, personal radio services including WiFi and Bluetooth, walkie-talkies, cordless phones and numerous other applications, too.

3.5. ^{40}K in the sky: ice and raindrop nucleation

The ^{40}K decay generates radiogenic argon released in atmosphere by volcanic eruption and by weathering of K-bearing minerals. ^{40}Ar, excited by cosmic gamma photons in the

whole stratosphere, and by tunnel effect of UHF frequencies at the bottom of them, is transformed again in potassium atoms, as a highly reactive alkaline metal.

We present here the hypothetical chemical reactions, possible in stratospheric P-T conditions. Thus, meeting a bi-atomic oxygen molecule, K-peroxide will be formed:

$$K + O_2 \rightarrow KO_2 \quad [3]$$

KO_2 is an unstable compound, reacting instantly with atmospheric carbon dioxide:

$$2KO_2+CO_2 \rightarrow K_2CO_3 +2O_3 \quad [4]$$

K-peroxide reacting with atmospheric (bi-atomic) nitrogen molecule, potassium nitride will be formed:

$$6KO_2+N_2 \rightarrow 2K_3N+4O_3 \quad [5]$$

Nitride formed reacts with water vapor:

$$K_3N+N_2+6H_2O \rightarrow 3KNO_2+6H_2 \quad [6]$$

The hydrogen formed in reaction [6] will consume a part of the ozone of reaction [4] and [5] (Zhang and Carmichael, 1999). In this way, the main K-salts synthesized in the full section of the stratosphere (Fig. 2) fall slowly as 0.8–3.0 μm sized snowball-like pellets to the top of the troposphere, where reach 0.9–2.0 μg/m^3 concentration. Both K-salts, crystallizing in triclinic, thin prisms with high surface energy are ideal nuclei (Leroy *et al.*, 2006; Lee *et al.*, 2009) that around the undercooled water vapor can freeze resulting micron sized ice splints (Berezinski *et al.*, 1988). Sun *et al.* (2012) described the cloud and aerosol interaction model, where either the ice aerosols become nucleus of the rain drops, or by continuous enlarging itself, become hailstone pieces.

3.6. K in rainwater: the geochemical cycle of potassium

In different rainwater (and snow) samples high precision analyses for various compounds constantly put in evidence the presence of K^+ cation, varying between 0.3–125 μg/l (Hansson *et al.*, 1988; O'Dowd *et al.*, 1997, Vet *et al.*, 2014, López *et al.*, 2015) (Fig. 3). Note, that in some cases, (i) K^+ cation content shows a linear correlation with the concentration of summed NO_2^-+NO_3^- anions (Sobolyeva *et al.*, 2011), confirming equation [6] presented above and (ii) no significant differences between K^+ content of rain and snow water were observed (Hoffmann et al, 1997).

These observations come to modify our idea about the geochemistry of potassium. Therefore, the 40K-bearing minerals, formed in depth or on the surface of the Earth by k-electron capture radioactive decay release the main (terrestrial) 40Ar isotope. Because of the cosmic irradiation with hard gamma photons, 40Ar newly become 40K (Fig. 4).

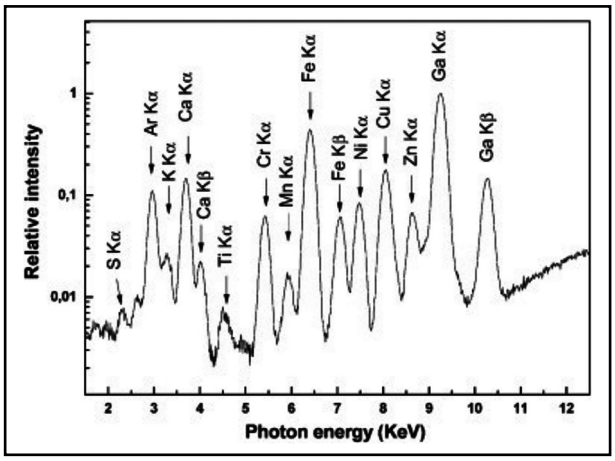

Fig. 3. The base of high precision analyze of rainwater samples: normalized SR-TXRF Spectrum Fluorescent emission lines of elements found in this sample are indicated: S, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, and Zn, after López *et al.*, 2015.

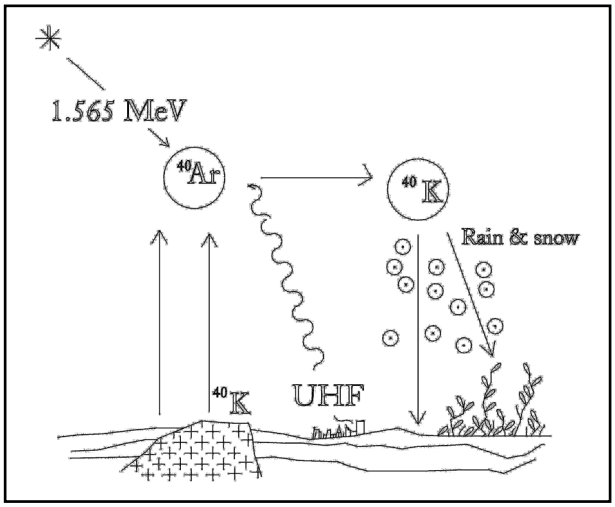

Fig. 4. The ^{40}Ar released by k-capture decay of ^{40}K under cosmic radiation and by UHF tunnel effect is transformed newly in ^{40}K. Salts of potassium, forming nuclei of raindrops or of snow crystals return in plants and in soil

The studies on the gas inclusions in minerals with different geological ages showed that from Caledonian orogenesis until present days the isotopic composition of Ar has not changed. It is probable that between K and Ar isotopes, a dynamic equilibrium was realized in time: a part of Ar released from rocks is consumed by (cosmic induced) Ar–K transmutation, then K returns in bio- and geosphere.

3.7. UHF induced Ar–K transformation and the weathering of agglomerations

Saying that the continuous study of rainwater composition is important in order to preserve the quality of human environment, sampling rainwater during monsoon season (July to September, 2013) from eighteen different towns of Karachi agglomeration, Pakistan were followed. Mahwish *et al.* (2014) studied the variation of the chemistry of rainwater

and the areal distribution of the soluble components of that. The study presents a large table with analytical data of daily measurements. In that table, apart from the conclusions about the air quality significant inverse correlation between the soluble ion concentrations and the time? parameters? of each rainfall (i.e. the intensity of them) were found. Grouping different concentration data in the area of agglomeration, irregular and time variable iso-lines were resulted, excepting K^+ values. They present an apex? a peak that encircles? characterizes? the densely populated centre of Karachi, where the concentration was three times higher than the peripheral measurements taken as background (Fig. 5).

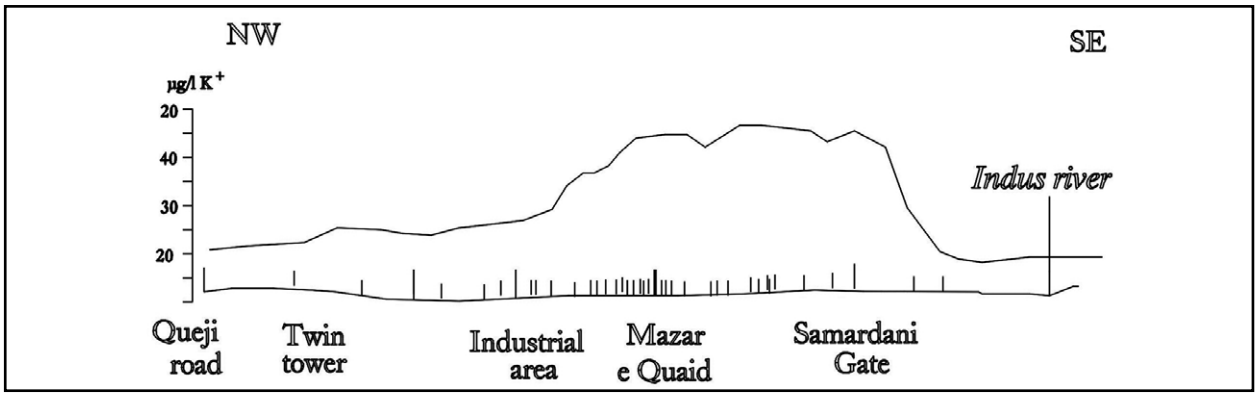

Fig. 5. The concentration of K^+ ions in rainwater samples above Karachi agglomeration, Pakistan, after time balanced analytic data published by Mahwish et al, 2014. The section was drawn perpendicularly to Monsoon wind direction.

The measurements presented by Sobolyeva *et al.* (2011) show similar conclusion for Moscow agglomeration. Increased K concentrations up to Sao Paolo were evinced repeatedly by lidar (light detection and ranging) measurements above the agglomeration (Moreda-Piñeiro *et al.*, 2014).

What is this so? What is among the multitude of (anthropogenic) air pollutants, only K appears above the localities, forming a quasi symmetric halo above them?

The explanation consists in the widespread utilization of UHF engines. Nowadays, most of the people own one or more mobile phone. There aren't homes without TV and more and more people use computers (laptops, tablets or smartphones). The wireless connection seems to become general. All of these engines generate and spread electromagnetic waves just knocking on low energy windows of Sakharovs' "tunnels" One of the billions of e-mails' and internet surfing minutes', of "call me later!" bips' UHF wave come to bit an ingenuous ^{40}Ar atom, generating ^{40}K — part of a future raindrop nucleus. More nuclei, make more raindrops — the right way toward catastrophic rainfalls above the city.

The environmental consequences are known as the so called UHF smog.

4. CONCLUSIONS

Searching the sources of nutrient element supply in sandy soils, the sources of K-salts in rainwater were studied. For this purpose, the composition and the distribution of stratospheric nanoparticles were examined, using data of the remote-sensing optical and infrared instrumental measurements and the results of mechanical collection of such particles. Among them, a part of potassium bearing particles seems to result by reverse of K/Ar decay: the Ar/K conversion induced by cosmic, high energy gamma radiation. This is the explanation of the uniformly distributed K-bearing particles in the high stratosphere, the concentration of them in the cloud forming 20 km high zone – and the suddenly decreasing K-contents below this level.

The nanoparticles of different K-salts are the ideal nucleus for water drops or snow crystals. The distribution of them have important role in the frequency and the intensity of precipitation.

Measuring the concentration of K^+ ions in rain- and snow water in different agglomeration and in surrounding area, an evident concentration of them was observed in the highly populated zone. The recent experiments as regarding the low energy induced nuclear reactions (the so called tunnel effect) prove that the Ar/K conversion may be possible using UHF waves, identically with the radio frequencies. These ones are widespread utilized in TV, in communication, in wireless computers, in smartphones, generating the so called UHF smog of cities – responsible for increased risk of rainstorms in these areas.

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