Forecasting E-Sporadic (ES) New point of views from the space on E-Sporadic events

By Flavio Egano, I3KXTV and Tony de Longhi, IZ2ESV

Abstract

There is strong evidence that the E-Sporadic layer at the tempered latitudes should origin from events occurring outside the Earth. Investigations in last years showed a high amount of meteoric power inside E region, which is sub-micrometrically stored in ultra-dense ion layers thanks to the turbulence generated by the so called jet stream. In this way E-Sporadic layer is caused by the metallic ions scattering as meteorites are formed. This mechanism is an important role for the ionization of the layers (as their ions is by ES event intensity depends on the residual attraction (as it happens to any satellite losing Earth's atmosphere, thanks to the gravitational waves raising from the gravitational waves raising from the troposphere, powerful generic ionosphere forbidden). Meteoric airtightness and ionisation at the temperate latitudes should origin from events occurring outside the Earth. Our researches showed a high amount of meteoric power inside E region, which is sub-micrometrically stored in ultra-dense ion layers thanks to the turbulence generated by the so called jet stream. In this way E-Sporadic layer is caused by the metallic ions scattering as meteorites are formed. This mechanism is a true vertical compression, that generates thin layers with high electronic concentration (called N_e), with a thickness of 2-4 Km, localised between 30 and 110 Km over the Earth surface. Normally their extension doesn’t exceed 30 or 100 km in diameter (at tempered latitudes) but the main feature is that volume concentration of ions/cm^3 is higher than ordinary E layer. The possibility to have an increased ions concentration inside these highly ionised layers is granted by metallic ions, which have slower recombination rates than other chemical elements: among them we can recall Magnesium (Mg^+), Iron (Fe^+) an Nickel (Ni^+). A slower recombination rate means that ion-state can be maintained for a “long” time before ions can go back to a stable configuration of the atomic structure, as an ion is chemically an atom which has lost (positive ion) or has gained (negative ion) one or more electrons.

Recently it has been shown that ES curtains have a high amount of metallic ions, beside Oxygen and his Nitrates ions (default present as normal atmospheric composition). Metallic ions come completely from meteors entering Earth’s atmosphere, thanks to the gravitational attraction (as it happens to any satellite losing his orbit and entering back on Earth at the end of his high-mile life). In this way meteorites and their ablation can catalyse intense ES events, not being the main cause for the event itself (specially for frequencies between 50 and 144 MHz).

We can assume that, as a main concept, the ES event intensity depends on the residual ionisation of the layers (their ions are by default and statistically located in the ionosphere, the extent of heavy ions (metallic ions, indeed) generated by meteorites and the strength of the high-altitude winds mentioned above (in particular their speed-change rate related to the altitude, as they’re responsible of the ions storing in the curtains).

Chemical composition of a meteorite

The main composition of a meteorite is shown in the table. The main elements are Iron, Magnesium, Nickel and Aluminium. Meteorites can be Iron or Stony, regarding the elements they contain. In ES formation there is no difference among iron meteorites, their ablation can catalyse intense ES events, although it seems that openings happen mainly during low activity, but this probably could be related to a more quiet geomagnetic set. This enforces the evidence that meteoritic ablation is partly responsible of the ES openings, taking part on what are the complex mechanisms leading to layer formation. On a long range analysis we have built a map relating ES openings and Geomagnetic activity. We concluded (as you can desume) that ES events are mainly in summertime, this could be related to ES localisation and distribution, with a significant statistical relation.

AGW and Ionosphere winds AGW (Atmospheric Gravity Waves) should act with ionosphere winds to press together ions, leading to ES curtains, as we already have seen. AGW are waves with a typical neutral pression at a very long wave length (with a T period between 10 and 180 Minutes); they stay on the thermosphere and they’re generated by the up-down movement of great air cells, oscillating thanks to atmospheric and other events, as thunderstorms, surface winds, hurricanes and the Jet Stream itself. At high latitudes these waves are localised on the upper atmosphere and are caused by Joule-effect heating. Lorenz forces and particle ‘rains’ depending on magnetic field of the Earth and Sun rays. Because of the different insulation on the two emispheres, these waves are deeply different depending on the season, and the effects are somehow seasonal. E region is completely affected by this kind of waves; this is due to high compression specially during thunderstorms, where there are winds (in the upper troposphere) blowing at 300 Km/h. ES and Sun Activity ES layers formation and Sun Activity is not so striking, anyway. A long range analysis on 50 MHz about K index (geomagnetic activity) and related ES events, has clearly shown that is easier to have good conditions with lower activity (K is lower); when K index is higher, ES propagation and overall conditions were defeating. Generally, a quiet magnetic situation is a good sign for DXers, as propagation should be good. This may be true also for ES. Geomagnetic calm means that layers are more stable, absorption of radio waves is reduced and the probability for ES clouds to form is higher, as ions are not scattered and recombine with a slower rate. Turbulence (no

Signals on 2 Meters it is necessary to have hyper-dense ionised curtains on the E layer, and as we’ve seen this is not so common. But if we consider meteoric activity peaks, it is not so difficult to notice that on 19th November 2003 probably Leonids helped the opening which raised up MUFs up to the 144 MHz. Daylight has, by the way, an important role: as openings occur mainly during daylight hours, solar activity should help ES events. But it is not so uncommon to have ES openings during night time, specially during winter months. There is no statistical evidence that the eleven-year cycle should have something to share with ES events, although it seems that openings happen mainly during low activity, but this probably could be related to a more quiet geomagnetic set. This enforces the evidence that meteoritic ablation is partly responsible of the ES openings, taking part on what are the complex mechanisms leading to layer formation. On a long range analysis we have built a map relating ES openings and Geomagnetic activity. We concluded (as you can desume) that ES events are mainly in summertime, this could be related to ES localisation and distribution, with a significant statistical relation.

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matter what is its origin) is always deteriorating conditions to have reflecting clouds, at any layer (not only ES), at any frequency. Relationship between ES and sunspots is not so clear; but on long range analysis approach is shown that with a lower number of spots, ES openings are more often. High number on sunspots is improving ionisation in F and Normal-E layers (as we should expect) but seems not affecting ES.

**FORECAST MODEL**

On what we have said up to now, considering Meteorites as a good way to produce ES events, analysing long range data on 50 and 144 MHz, we can try to forecast ES, although there so many variables that make everything harder (as it is in Natural World), in this way:

- Geomagnetic Activity should be low, with Kp<3;
- Check meteorites streams; on maximum peaks probabilities are higher;
- Check day time, referring to the two tables (winter and summer) showing opening probabilities, considering local time;
- Consider the month, as there is different incidence;
- During summertime (June and July) probabilities are the highest;
- Check the frequency; the higher it is, the lower is the probability.

**Last discussion**

This is not a fail-proof handbook on ES events; it is a first approach on forecasting something that, by definition, is hard to understand. But day by day professional science is collecting data which are suggesting a deep relation between meteorites and ES. It is known that AGW themselves are really important but they depend on the geographical location, as Earth surface is characterised by magnetic anomalies; this could explain, for example, why ES clouds seem to form over specific areas (specially here in Europe). These anomalies are so huge that only on the Italian area we can consider six of them, making each effort harder to investigators.

Anyway, what we can do is enjoying our beautiful activity, having fun on the air and trying to do a little scientific research; we cannot afford large investigations or field campaigns, but we can do a little. And, of course, little by little, step by step, knowledge is round the corner.

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