

# Bayesian modeling and prediction of solar particles flux

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The impact of subatomic particles ejected from the upper atmosphere of the sun on the electronic devices and humans is the subject of many studies. Besides the spacecraft systems, manned space-flights and launchers, the exposition to space weather has effects on high-altitude air flights, where the penetrating particles must be taken into account as well. The solar particles may pose problems both on human beings and the electronic devices installed in modern airplanes, where the potential malfunctions might be very dangerous, e.g. in the positioning and navigation systems, the communication systems, autopilots etc. These effects comprise the SEE (Single event effects), arising from ionising interactions of the solar particles and leading to both soft errors involving single or multiple bits and hard errors like burn-outs. However, there has been increasing evidence of SEE on equipment even in the sea-level systems.

During the last two decades or so, the researches of the effects of ionisation on aircrew and frequent flyers were undertaken. The increasing awareness of the health risks lead in Europe to Directive 96/29/EU-RATOM, which specifies the demands posed on the

aircraft operators in connection with the exposure to the ionising energy.

In face to this facts, the mathematical modeling of the particles flux becomes still more and more significant, because it would allow to issue early warnings on its increase and therefore the increase in the health and SSE risks.

The prediction of solar particle events can be made upon several physical facts, related to the solar activity, e.g. the hardening of the X-ray flare spectrum etc. Our paper deals with a Gaussian autoregression model, developed in the Bayesian framework and describing the dependency among the measurements of the particle flux. To suppress the impact of old and potentially outdated values, the modeling is based on finite data window combined with the partial forgetting method, allowing to track the possibly slowly varying parameters of the flux. For demonstration purposes, the data are gathered on regular basis directly from the National Oceanic and Atmospheric Administration (NOAA) server, where the satellite measurements from the *Geostationary Operational Environmental Satellite (GOES)* system are available online and updated every 5 minutes.