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Solar eclipse and subtle changes of ionospheric in-situ plasma density detected by Swarm

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Solar eclipses offer a unique opportunity to study the response of the Earth‘s ionosphere to a known variation of solar radiation.
The occurrence of a solar eclipse produces geophysical effects on different altitude levels, from the ionosphere and thermosphere down to the geomagnetic field measured on the Earth’s surface. Bottom side ionosphere up to the F2-layer peak responds differently than the topside ionosphere, and the impact on the topside layer is more complex as well as harder to quantify. While ionospheric response to solar eclipses is mostly studied by ground-based radio remote sensing techniques, radar, GPS TEC receivers which focus on the study of bottom side ionosphere, comprehensive analysis of the upper layer with in-situ ionospheric measurements remains quite challenging.

With the constellation of three Swarm satellites and registrations from Langmuir probes mounted on-board, we triple our chances for detection of solar eclipse signatures in the ionospheric plasma. The current study examines 5 different solar eclipses which occurred during the Swarm mission. Results from the analysis show, that observed effects vary from cases to case. In general, reduction in in-situ electron density is lower than predicted in the modeling studies, however, the subtle changes are confirmed by the pair of two satellites flying side by side.