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Geomagnetic variations at 2009 total eclipse from the atmospheric general circulation - ionospheric dynamo coupled model

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Recently, an atmospheric general circulation - ionospheric dynamo coupled model has been developed and successfully reproduced several phenomena indicating the coupling between the lower-atmospheric phenomena and thermospheric/ionospheric ones such as the 4-wave pattern in the ionospheric electron density corresponding to thunderstorm activities on the surface of the Earth. Since this model contains dynamo process in the ionosphere, we can estimate the ionospheric current in the model. Consequently, by counting the geomagnetic effect from the ionospheric current by using Biot-Savart law, we calculate the geomagnetic variations from the model.

As the first attempt to estimating the ground magnetic variation from this model, we choose the 2 009 total solar eclipse event. As a preliminary attempt of this estimation, based on the ionospheric conductivity obtained elsewhere by considering decrease of UV radiation due to the eclipse, we directly calculate the ionospheric current by using both the electric field from the model and the conductivity.

As for the geomagnetic variation observed at the eclipse, it is reported that only the Z component at Kanoya geomagnetic observatory located in a vicinity of the total ecliptic zone exhibits a peculiar variation compared with those at Kakioka and at Memambetsu. Whereas, our numerical simulation shows that the influence of the solar eclipse on the geomagnetic Z component appears in a narrow area around the total ecliptic zone. This result is harmonized with the geomagnetic observation. However, the horizontal geomagnetic component exhibits some discrepancy between the observation and the simulation. This difference may be derived from our preliminary procedure of estimation of the ionospheric current. Namely, we do not use the current directly issued from the simulation in the present estimation.

As the next step, we try to reproduce the geomagnetic field variations with the ionospheric current obtained in the simulation. Furthermore, as a geomagnetic storm occurs in this event, we need to include the magnetospheric convection model in the atmospheric general circulation - ionospheric dynamo model as our next task.

Keywords: GCM - ionospheric dynamo coupled model, total solar eclipse, geomagnetic variation, numerical simulation