

## Response of the D-region ionosphere to lightning using Asia VLF observation network (AVON) and VLF/LF data in Japan

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It is known that the electromagnetic pulse (EMP) originated from cloud-to-ground and inter-cloud lightning discharges can couple directly into the D-region ionosphere. The conductivity in the D-region changes due to the EMP. When VLF/LF waves propagate under the disturbed D-region, the amplitude and phase or the reflection height of the VLF/LF waves varies largely. For example, 'early VLF events' show large variations in amplitude and phase and are caused by the coupling between the D-region and lightning. Early/fast events, early/slow events, and long recovery events are included in the term of 'early VLF events'. The descent (rise) of VLF/LF reflection height corresponds to increase (decrease) in electron density in the D-region. We have conducted Asia VLF observation network (AVON) in South-East Asia: Taiwan, Thailand, Indonesia, Philippines, and Vietnam since 2007. The observations in Taiwan, Thailand, and Indonesia are performed at present, while we will construct a new observation system in Philippines in February, 2013. We also have a plan of a new observation system in Vietnam after the Philippine construction within 2013. The aim of the AVON is to monitor the lower ionosphere and lightning in South-East Asia. We observe North-South and East-West broadband magnetic components with loop antennas, a vertical broadband electric component with a dipole antenna, and amplitude and phase of narrowband LF transmitter signals with a monopole antenna. We investigate the VLF/LF perturbations associated with the lightning discharges using both the AVON data and the VLF/LF data observed in Japan. In the presentation, we show several early VLF events and discuss the coupling between the D-region and lightning.