

## Ionosphere response to Ring Current and Lightning Current during different geomagnetic storm and lightning intensities in Southern China coastal region

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The understanding of the physical interactions between space events in the various layers of the atmosphere are very important due to the impact they could have on navigation and communication systems. Various currents in the atmosphere could contribute to these adverse effects. In this study, we look at the impact of ring current (RC) and lightning current (LC) on the ionosphere under different thunderstorm and magnetic storm intensities in the low latitude region of Southern China coastal region. Three categories of intensity were identified (moderate, intense and super). RC and LC under each of the intensity was paired with each other. For example, RC under moderate intensity was paired with all categories of LC and vice versa. The Rate of Total Electron Content Index (ROTI) obtained from a local Global Navigation Satellite System (GNSS) network was used to characterize the ionosphere disturbance. ROTI > 0.5 indicates a disturbance.

The results show that on days of super lightning-moderate magnetic storm pair, intense lightning-moderate magnetic storm pair and super lightning-intense magnetic storm pair, ROTI > 0.5 was recorded. Correlation between RC and ROTI and LC and ROTI as seen in table 1 indicate that RC could be the most probable cause of the ionosphere disturbance for the first and second pair of conditions while LC for the last pair. The first two pairs of condition exhibiting ionosphere disturbance are all under moderate magnetic storm intensities. It could be inferred from table 1 but not conclusively that moderate magnetic storm intensity pair with an intense or high lightning activity pair could result in ionosphere disturbance as compared to super or intense magnetic activity in the study area. Further studies are required to explain such behaviour.

| Day            | Pair Condition                       | <b>Correlation coefficients</b> |                            |      |
|----------------|--------------------------------------|---------------------------------|----------------------------|------|
|                |                                      | Ring Current-<br>ROTI           | Lightning Current-<br>ROTI | ROTI |
| 20th Sept 2015 | Super lightning-Moderate magnetic    | 0.023                           | 0.004                      | 1.8  |
| 8th Sept 2015  | Intense Lightning-Moderate magnetic  | 0.340                           | -0.006                     | 0.8  |
| 9th Sept 2015  | Moderate Lightning-Moderate magnetic | 0.057                           | 0.177                      | 0.35 |
| 22nd June 2015 | Super Lightning-Intense magnetic     | -0.053                          | -0.250                     | 0.6  |
| 7th Oct 2015   | Moderate Lightninig-Intense magetic  | 0.243                           | 0.148                      | 0.3  |
| 23rd June 2015 | Intense Lightning-Super magnetic     | -0.108                          | 0.226                      | 0.25 |

 Table 1 Correlation between ring current, lightning current and ROTI under different conditions of lightning and magnetic activities