Contribution from oxygen ions to plasma pressure in the inner magnetosphere: Spatial distributions and contributing energies

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The ring current is mainly controlled by the ion pressure and its spatial gradient. The ion pressure is dominated by ions with energies of a few to a few 100s keV. Oxygen ions of ionospheric origin, O+, can be energized in the plasma sheet and/or the inner magnetosphere up to a few tens to a few hundreds of keV. O+ can make a significant contribution to the ion pressure during geomagnetically active periods. This study is focused on spatial distributions of the O+ contribution and O+ contributing energies which we term an energy range that makes the dominant contribution to the total plasma pressure.

Since the launch on 20 December 2016, the Arase spacecraft have explored the inner magnetosphere and measured plasma with a wide energy range. We primarily use data from the MEP-i (Medium-Energy Particle experiments - ion mass analyzer) which measures ions with energies of ˜10 to 180 keV/q and distinguishes between different ion species. We analyze the MEP-i data during six magnetic storms in Year 2017 with the Dst minimum smaller than -50 nT. The results show that the inner part (L lower than ˜5) is dominated by relatively low-energy protons adiabatically transported from the plasma sheet by enhanced convection. At higher L shells (L higher than ˜5), the contributing energies are higher for O+ than for H+, suggesting a significance contribution from mass-dependent acceleration processes such as O+ effective/selective acceleration during substorm activity to the buildup of the outer part the ring current. We will also discuss about high oxygen-to-proton pressure ratios (greater than 1) that have been observed both in the deep inner magnetosphere (L lower than 3) and near the Arase apogee (L higher than 6).