

## Empirical Modeling of the Ring Current

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### Abstract

By using theoretical models of plasma dynamics, it is possible to reconstruct the evolution of many magnetospheric processes; nevertheless, these models need the support of both electric and magnetic field models, and they can simulate known processes only. Conversely, the empirical models are mainly based on statistical analysis; hence, they start from observations, not from processes. Statistical analyses and the derived empirical models are important complements to theoretical models and simulations since the former represent the actual conditions. The empirical models of the inner magnetosphere ion distribution MODEM and of the pitch angle distribution PADEM have proved to be successful in deriving average features of the ring current as well as in obtaining the long-term development of the ion distributions during quiet and disturbed periods. The major goals of this approach are: (1) the description of the equatorial proton population during quiet times and the quantitative characterization of their spatial and energetic distribution; (2) the evidence of some key features of the proton distribution strictly connected to the solar wind characteristics; (3) the investigation of the evolution of magnetospheric ion populations during geomagnetic disturbances and their role in the ring current development. In this paper we review the above-mentioned studies.

**Key words:** ring current, inner magnetosphere, plasma circulation, pitch angle distribution.