Annales Geophysicae

ISSN: 0992-7689 (printed version)
ISSN: 1432-0576 (electronic version)

Abstract Volume 12 Issue 4 (1994) pp 286-295

Plasma pressure and anisotropy inferred from the Tsyganenkomagnetic field model

F. Cao, L. C. Lee

Max-Plank-Institut für Aeronomie, Postfach 20, D-37191 Katlenburg-Lindau, Germany
(2) Geophysical Institute, University of Alaska, Fairbanks, Alaska 99775, USA

Received: 16 July 1993/Revised: 4 January 1994/Accepted: 11 January 1994

Abstract. A numerical procedure has been developed to deduce the plasma pressure and anisotropy from the Tsyganenko magnetic field model. The Tsyganenko empirical field model, which is based on vast satellite field data, provides a realistic description of magnetic field configuration in the magnetosphere. When the force balance under the static condition is assumed, the electromagnetic **J**×**B** force from the Tsyganenko field model can be used to infer the plasma pressure and anisotropy distributions consistent with the field model. It is found that the **J**×**B** force obtained from the Tsyganenko field model is not curl-free. The curl-free part of the **J**×**B** force in an empirical field model can be balanced by the gradient of the isotropic pressure, while the nonzero curl of the **J**×**B** force can only be associated with the pressure anisotropy. The plasma pressure and anisotropy in the near-Earth plasma sheet are numerically calculated to obtain a static equilibrium consistent with the Tsyganenko field model both in the noon-midnight meridian and in the equatorial plane. The plasma pressure distribution deduced from the Tsyganenko 1989 field model is highly anisotropic and shows this feature early in the substorm growth phase. The pressure anisotropy parameter <alpha>$_P$, defined as <alpha>$_P$=1-$P_{\text{\Vert}}P_{\text{⊥}}$, is typically \sim0.3 at x\approx-4.5R_E and gradually decreases to a small negative value with an increasing tailward distance. The pressure anisotropy from the Tsyganenko 1989 model accounts for 50% of the cross-tail current at maximum and only in a highly localized region near x\sim-10R_E. In comparison, the plasma pressure anisotropy inferred from the Tsyganenko 1987 model is much smaller. We also find that the boundary conditions have significant effects on the plasma pressure distributions and have to be considered carefully.

Article not available online
