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Abstract

We use data from the MAVEN and MEX spacecraft to study pressure balance boundaries in the Martian dayside magnetosphere. We use 15 orbit segments from year 2015 when MAVEN and MEX simultaneously were within SZA<60°. The altitude of the derived pressure balance boundaries are estimated and compared to the induced magnetospheric boundary (MB), the ion composition boundary (ICB), the photoelectron boundary (PEB), and the ionopause-like boundary.

1. Introduction

Earlier studies, e.g., [1], [2], have used MEX data to investigate the pressure balance at the MB. For quiet solar wind conditions, a pressure balance was found between the solar wind dynamic pressure $P_{d,sw}$, the thermal pressure P_t of the magnetosheath, and the magnetic pressure P_M of the pile-up region. Thanks to MAVEN and its full plasma package we are now able to also examine the pressure balance at lower altitudes and compare the Martian dayside structure and dynamics with recent simulation results, e.g., [3], [5].

2. Results

For each orbit segment, MEX/IMA measurements are used to measure $P_{d,sw}$, which is compared to P_t and P_M measured by MAVEN. The Morschhauser model [4] below 400 km is used to estimate the crustal field P_M. Figure 1 shows one of the studied orbits, where the estimated pressure terms are shown in the upper panel and the spacecraft trajectories are presented in MSO coordinates in the lower panels. Figure 1, upper panel, includes the approximate altitude of the ICB, given as the vertical black lines.

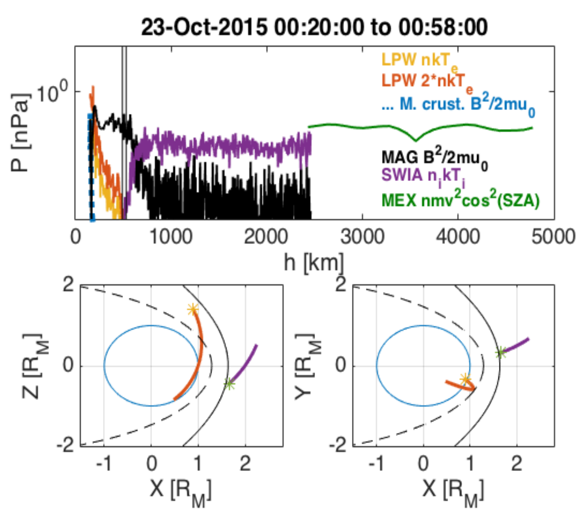

Figure 1: Estimated $P_{d,sw}$ (green), magnetosheath P_t (purple), P_M (black), and ionospheric P_t (yellow (electron P_t) and orange (total P_t, assuming $T_i = T_e$)) against altitude for October 23 2015. The crustal field P_M (blue dashed) is very low until a sharp increase around 155 km. The black vertical lines give the altitude of the ICB, obtained from the STATIC mass spectrum. The lower panels show the MAVEN (orange) and MEX (purple) trajectories in MSO coordinates. The markers show the beginning of the orbit segments. The black lines mark the bow shock (solid) and magnetic pile-up boundary (dashed) given by Vignes et al., 2000 [5].

For quiet solar wind conditions a balance is found between the P_t of the ionosphere and the P_M in the pile-up region, but crustal fields, that are difficult to differentiate from the piled up magnetic field at low altitudes, commonly provides a disturbing factor. The altitude of the pressure balance interfaces are compared to the altitudes of the induced MB, the ICB, the PEB, and the ionopause-like boundary. The measurements show that the pressure balance boundary is shifted from the ICB with around 0.05 R_M, in agreement with earlier simulation results [6].

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