ELECTRIC CURRENT SYSTEMS INDUCED BY SOLAR WIND COUPLING WITH VENUS.
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Introduction: The solar wind transfers energy to the Venusian upper atmosphere mainly through electrodynamic coupling with the planet's ionosphere, powering atmospheric heating and escape. The interaction induces electric currents which electrically connect the two plasma domains and facilitate the transfer of energy from the solar wind to the ionosphere. Globally measuring these currents would, in principle, enable us to quantify many properties of planetological importance, including the rate of Joule heating in the upper atmosphere and the amount of power available and limiting the rate of atmospheric ion escape [1,2].

Method: Alas, directly measuring geospatial electric currents is difficult and typically requires a small fleet of formation-flying spacecraft. Instead, here we adapt a method recently developed to derive the average net current densities from single-spacecraft measurements at Mars [3] and apply the method to Venus Express (VEX) magnetometer measurements from 2006-2014 (the mission lifetime).

Results and discussion: Preliminary results from the investigation (example shown in Figure 1) indicate the strength of the Venusian current systems while reproducing the overall large-scale features expected of current systems in induced magnetospheres [4]. While our results demonstrate the applicability of the method in the Venusian environment these also reveal some of the limitations inherent to VEX measurements in studying the effects of the solar wind on the evolution of the Venusian atmosphere.

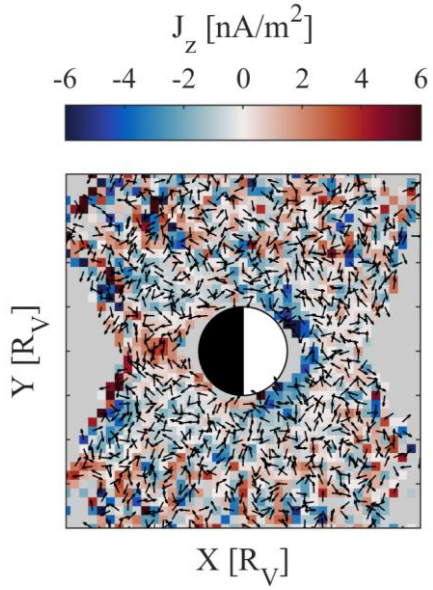

Figure 1: Electric current densities at Venus derived from Venus Express magnetometer measurements. The panel shows a slice of a 3-dimentional map defined in the Venus-Sun-Electric field (VSE) reference frame with the solar wind motional electric field pointing out of the plane and the solar wind flowing from the right.

References:

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