The solar wind influences plasmasphere electron content

MAGNETOSPHERIC plasma convection has been reviewed in detail by Axford[1]. A viscous-like interaction between plasma and magnetic field and magnetic-field-line merging have been suggested as mechanisms producing magnetospheric convection. In either model, convection is sustained by a dawn–dusk electric field (E_{conv}) which has been shown[2–4] to depend on solar-wind speed V_{sw}. Vasyliunas[2] suggested a linear dependence, but Mendillo and Papagiannis[3] estimated that the convection electric field varies nearly quadratically with solar wind speed—this conclusion was supported by Kivelson[4]. The convection field E_{conv} and hence solar wind speed have important roles in determining the location of plasmaspause[5,6]. Model calculations assuming enhancement of the solar wind showed the plasmapause everywhere to be located at smaller L coordinates[7] (L is the McIlwain[8] magnetic shell number). The location of the duskside bulge of the plasmapause has been shown to be inversely related to the solar wind speed[3]. The total plasmasphere electron content (N_P) is supposed to increase with increase in L, the rate of increase being dependent on the density distribution assumed and the L values under consideration[9]. Thus one expects an increase in N_P to be associated with a decrease in V_{sw} and vice versa. In this letter we give an experimental verification of this for two magnetic storms associated with large changes in V_{sw}, and for which N_P and V_{sw} data are available. The results will prove useful in interpreting the disturbed time behaviour of N_P.

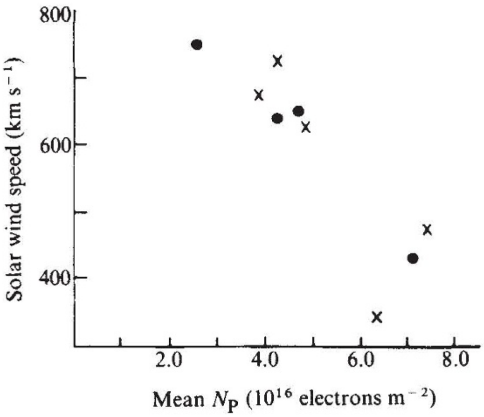

Fig. 1 Solar wind speed plotted against daily mean N_P for the two storms (see Table 1). ●, Storm of 1-5 Nov. 1975; ×, storm of 28 Nov.-2 Dec. 1975.

Electron content measurements were made between October 1975 and July 1976 at Ootacamund (11.4° N, 76.6° E, mag dip 6°) by Faraday rotation and the group delay techniques using radio beacon signals from the geostationary satellite ATS-6 at 35° E. The difference in electron contents measured by these techniques gives the electron content of the plasmasphere[10]. The details of the techniques and the accuracies involved are discussed by Davies *et al.*[11,12]. The daily mean N_P values for the pre-storm and during-storm days are compared with the corresponding solar wind speeds in Table 1. For the first storm the pre-storm solar wind data are not available for the first day. Solar wind speeds are plotted against mean N_P for the corresponding days in Fig. 1. All three pre-storm days have large mean N_P values but low solar wind speeds (~400 km s^{-1}) whereas the during-storm solar wind speeds were greater by a factor of 1.5 with mean N_P correspondingly decreased. This is the first experimental evidence from an equatorial station confirming an inverse relationship between plasmasphere electron content N_P and solar wind speed V_{sw}. The correlation coefficient between N_P and the V_{sw} is -0.92 ± 0.05. A linear relationship between N_P and V_{sw} is obtained by the least square method and is given by $N_P = 12.5(1 - V_{sw}/1000)$ where V_{sw} is the solar wind speed in km s^{-1} ($V_{sw} \lesssim 750$).

Table 1 Comparison of pre-storm and during-storm plasmasphere electron content and solar wind speed

Storms	MPO	Maximum D_{ST} (γ)	Days	V_{sw} (km s^{-1})	Daily mean $N_P \times 10^{16}$ electrons m^{-2}
1-5 Nov. 1975	2 Nov. 1100 UT	−76	1* Nov.	—	4.5
			2*	430	7.0
			3	650	4.6
			4	750	2.5
			5	640	4.2
28 Nov.- 2 Dec. 1975	29 Nov. 0700 UT	−53	28* Nov.	350	6.7
			29*	475	7.3
			30	625	4.7
			1 Dec.	675	3.8
			2	725	4.2

MPO is the main phase onset; D_{st} is the ring current intensity index.
* Pre-storm days.

Storm-time behaviour of N_P has been discussed by various workers[13–15]. Consideration of solar wind speeds is important in interpreting the observed results and a detailed study of storm-time behaviour of N_P at Ootacamund is underway.

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A new amorphous silicon-based alloy for electronic applications

THERE is a need for alternative energy sources. Photovoltaics are an attractive possibility, but their application has been limited by economic considerations in single-crystal materials, and for physical reasons such as grain boundaries in polycrystalline materials. Amorphous semiconductors are especially attractive in this regard because they are basically much less expensive than their crystalline counterparts and because they possess a direct band gap with a high value for the optical absorption coefficient. We report here the development of a new

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