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The interplanetary magnetic field influences middle-latitude surface atmospheric pressure

Mai Mai Lam, Gareth Chisham, and Mervyn Freeman
British Antarctic Survey, Cambridge, United Kingdom (mml@bas.ac.uk)

Results have been published over several decades that indicate a meteorological response in the polar regions to fluctuations in the east-west component of the interplanetary magnetic field (IMF), B_y. There is evidence that this Sun-weather coupling occurs via the global atmospheric electric field. It has been assumed that the effect maximises at high latitudes and is negligible at low and mid latitudes because the IMF-induced convection electric field is concentrated in the polar ionospheres. However, the spatial variation of the IMF-weather coupling has not previously been investigated in detail, neither have the global consequences of such forcing on the atmosphere. Here we demonstrate a previously unrecognised influence of IMF B_y on mid-latitude surface pressure. The difference between the mean surface pressure for high positive and high negative values of IMF B_y possesses a statistically-significant mid-latitude wave structure, similar in location and form to the cyclones and anti-cyclones produced by the action of atmospheric Rossby waves on the jet stream. Thus our results indicate that a mechanism that is known to produce atmospheric responses to the IMF in the polar regions is also able to modulate pre-existing weather patterns at mid-latitudes. A relatively localised and small amplitude solar influence on the upper atmosphere could therefore have an important effect, via the nonlinear evolution of storm tracks, on critical processes such as European climate and the breakup of Arctic sea ice.