

VARIATIONS OF SOLAR WIND PARAMETERS OVER A SOLAR CYCLE:
EXPECTATIONS FOR NASA'S SOLAR TERRESTRIAL RELATIONS
OBSERVATORY (STEREO) MISSION

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The solar wind is plasma that flows outward from the sun into the heliosphere. Plasma consists of energetic particles, or electrically charged gas. Although the Sun is at the center of our solar system, not much is known about the origins of the different types of solar wind. Especially important to investigate are the origins of coronal mass ejections (CMEs), which are the largest explosions in the solar system, and are capable of exploding a billion tons of material off of the Sun at one time, at speeds up to one million miles an hour. These CMEs can disrupt the magnetic field of the Earth as they pass by, resulting in effects ranging from a large Aurora Borealis to the shutting down of power grids and satellites. In addition, these solar storms can be particularly dangerous to astronauts outside the protection of Earth's magnetic field.¹

Because of the mysterious manner of these phenomena, NASA launched the Solar Terrestrial Relations Observatory (STEREO) mission in October 2006 to monitor the solar wind. This mission, consisting of two nearly-identical satellites orbiting the Sun at 1 AU, will return the first stereo data of the Sun: for the first time, scientists will be able to see the Sun in 3D.

The Sun's activity level varies on an 11-year cycle. STEREO has launched into solar minimum conditions. Solar wind parameters such as speed, density, direction, and thermal speed can vary greatly over a complete solar cycle.² To study an entire solar cycle, we analyze data from the Proton Monitor on the SOHO spacecraft, the SWE instrument on the WIND spacecraft, and the SWEPAM instrument on the ACE spacecraft. With this combined data set we look for trends and patterns, as well as extremes in these solar wind parameters. In addition to data analysis from these instruments over the solar cycle, we use remote image data from SOHO to characterize what the Sun actually looks like during each stage of the solar cycle. We attempt to correlate Sun surface conditions with passing solar wind conditions. By studying the many states of the solar wind parameters over an entire solar cycle, we are able to discuss the possible conditions that can be expected in the early phases of the STEREO mission, in particular for the Plasma and Suprathermal Ion Composition (PLASTIC) Investigation. STEREO launched on October 25, 2006 into solar minimum conditions. Consequently, special attention is paid to the SOHO/WIND observations of interplanetary coronal mass ejections during the previous solar minimum.³

¹ National Aeronautics and Space Administration Science Mission Directorate, *STEREO Science Writer's Guide*, pg. 6-16

² P.R. Gazis, *Solar Cycle Variation in the Heliosphere*, *Reviews of Geophysics*, 34, 3, August 1996, pg. 379-402

³ C. J. Farrugia, et al., *Wind and ACE observations during the great flow of 1-4 May 1998: Relation to solar activity and implications for the magnetosphere*, *Journal of Geophysical Research*, Vol. 107, No. A9, 1240, 2002