EGU21-6488
https://doi.org/10.5194/egusphere-egu21-6488
EGU General Assembly 2021

The Science of Space Weather: From Bit Flips to Exoplanets

Janet G Luhmann
Space Sciences Laboratory, University of California, Berkeley, CA, United States of America (jgluhman@ssl.berkeley.edu)

While the term 'space weather' remains to some synonymous with operational anomalies on spacecraft, communications interruptions, and other practical matters, its broader implications extend across the EGU and beyond. Much of the science underlying space weather has to do with how our star, the Sun, affects the space environment at Earth's orbit. We are lucky to be living at a time where information from both remote sensing (especially imaging at visible, x-ray and EUV wavelengths) and in-situ measurements (of plasmas, magnetic fields, and energetic particles) have provided unprecedented pictures of the Sun and knowledge of its extended atmosphere, the solar wind. Building on early forays into interplanetary space and deployments of coronagraphs with the Helios and SMM missions in the 70s and 80s, the Ulysses mission reconnaissance far above the ecliptic and the launch of Yohkoh's and SOHO's imagers in the 90s, and the long-term 'monitoring' of both the Sun and the conditions upstream of the Earth on SOHO, WIND and ACE, the STEREO mission opened a floodgate to research focused on solar activity and its heliospheric and terrestrial consequences. Physics-based, often semi-empirical 3D models increasingly came into widespread use for reconstructing and interpreting the multiple imaging perspectives and multipoint in-situ measurements that the twin STEREO spacecraft, combined with Earth-viewpoint assets (including the GONG ground-based network, and as of 2010, SDO magnetographs), provided on a regular basis. These observations and models together transformed perceptions of phenomena ranging from coronal structure to solar wind sources to eruptive phenomena and consequences, and the tools used to study and forecast them. Now Parker Solar Probe and Solar Orbiter are probing details of the still unexplored regions closer to the Sun than Mercury's orbit, with the goal of completing that part of the solar/solar wind connection puzzle. And the overall science results from these observations and analysis efforts have not been confined to heliophysics, having especially influenced planetary science and astrophysics. They are seen in recreations of long-past scenarios when our Sun and solar system were evolving, in investigations of solar activity impacts including auroral emissions at the planets, and in applications to distant planetary systems around other 'Suns'. That these lofty implications are related to the bit flips and static 'noise' first identified with 'space weather', provides one of the interesting connections, and still ongoing journeys/stories, within EGU's research universe.