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Geospace Measurements from the Antarctic Polar Cap: Fundamental Plasma Physics in Earth's Natural Laboratory[1]

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The near-Earth geospace environment is mostly controlled by the geomagnetic field that protects our technological and biological infrastructure from a variety of solar-produced phenomena, such as major solar storms caused by solar flares and coronal mass ejection. For example, these solar storms can severely impact artificial satellites/spacecraft, GPS systems, power distribution, and radio communication. The polar caps are specific areas around the Earths geomagnetic poles where the geomagnetic field lines are open and directly interact with the interplanetary magnetic field (i.e., the extended magnetic fields of the Sun). These regions thus allow unique studies of solar wind and magnetospheric coupling, and therefore are 1) at the cusp of space weather impacts, and 2) form a natural laboratory for studies of fundamental plasma physics. Though many geospace-monitoring stations are deployed over the northern polar cap and auroral zone on a regular basis the southern polar cap and auroral zone are left much behind due to the enormous logistical difficulties associated with Antarctic research. This talk will review a number of studies of interrelated geospace phenomena observed at the southern high latitudes through the coordinated and collaborative effort associated with deploying and maintaining respective instrumentation at the U.S. Antarctic stations, namely McMurdo, South Pole, and Palmer, as well as from the Automatic Geophysical Observatories (AGOs). The entire suite of geospace instrumentation at all of these stations has a sustained track-record of robust operation and community support, and includes fluxgate and search-coils magnetometers, ELF and VLF receivers, imaging and broadband riometers, sky-looking optical systems, GPS scintillation-rated receivers, and several other instruments. Measurements collected from these instruments can be synergistically combined for the studies of synoptic variability of the magnetospheric open-closed boundary and associated cusp structures, understanding ELF whistler events and their relationship to ionospheric conditions, doing VLF and HF diagnostics of magnetospheric conditions, and investigating the GPS signal scintillation occurrence and strength in relation to the magnetosphere-ionosphere coupling processes.

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