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New GOES High-Res Magnetic Measurements: Characterization of ULF Waves

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This presentation describes the development of a new 20+ year archive of science-quality, high-cadence geostationary measurements of the magnetic field from eight NOAA spacecraft (GOES-8 through GOES-15) and preliminary scientific results using these data. The era of NOAA operational observations of the geomagnetic field started with SMS-1 in May 1974 and continues to this day with GOES-13-16 (on-orbit). GOES magnetic observations provide an early warning of impending space weather, are the core geostationary data set used for the construction of magnetospheric magnetic models, and can be used to estimate electromagnetic wave power in frequency bands important for plasma processes. Many science grade improvements are being made across the GOES archive to unify the format and content from GOES-8 through the new GOES-R series (launched November 19, 2016). A majority of the 2 Hz magnetic observations from GOES-8-12 have never before been publicly accessible due to processing constraints. Now, a NOAA Big Earth Data Initiative project is underway to process these measurements starting from original telemetry records. Overall the new archive will include vector measurements in geophysically relevant coordinates (EPN, GSM, VDH), comprehensive documentation, highest temporal cadence, best calibration parameters, recomputed means, updated quality flagging, full spacecraft ephemeris information, a unified standard format and public access. We are also developing spectral characterization tools for estimating power in standard frequency bands (up to 1 Hz), and detecting ULF waves related to field-line resonances. We present the project status and initial findings, including in-situ statistical and extreme ULF event properties, and case studies where the ULF oscillations along the same field line were observed simultaneously by GOES near the equator in the magnetosphere, the ST-5 satellites at low altitudes, and ground magnetometer stations. For event studies, we find that the wave amplitude of poloidal oscillations is amplified at low altitudes but attenuated on the ground, confirming the theoretical predictions of wave propagation from the magnetosphere to the ground.