Stratospheric Radar Observations of Convection and Precipitation

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A long-standing community need exists for a Doppler radar with top-down views to capture atmospheric processes. Current remote sensing sampling capabilities fall short in holistically capturing the required fundamental dynamics and microphysics for many weather-related science and applications. While the vertical dimension is key to understanding the characteristics of storms and precipitation, most weather radars, either ground-based or space-borne, only provide discontinuous and/or infrequent vertical sampling. Balloon-borne stratospheric radar observations have the potential to revolutionize our understanding of atmospheric processes. Not only would it enable long-term continuous vertical observations with quasi-stationary positioning or Lagrangian tracking of targeted meteorological phenomena, but it would also provide a quantity of prime meteorological interest most challenging to obtain - vertical motion. Past community workshops have identified critical needs to develop new radar technologies to make observations in remote or inaccessible regions (tropics, polar and mountainous regions) and better capture atmospheric fluxes. We introduce a Stratospheric Observations of Earth Systems (SOES) concept that would allow first-of-its-kind stratospheric balloon-borne radar experiments to obtain revolutionary observations of atmosphere processes and high-impact weather events. Profiles of dual-polirization radar moments and velocity are both needed to document dynamics and microphysics from top to bottom, and 3D coverage over the thunderstorm life cycle is needed to provide details regarding the evolution of the breadth, depth, strength, or tilt of convective updrafts/downdrafts. For example, SOES capabilities would provide unprecedented 4D observations of tropical cyclones (TC) with the first continuous radar measurements of TC from tropical cyclogenesis to a mature TC. Such data would be invaluable improving forecasts of these high-impact events. By providing unprecedented insights into microphysical and dynamical properties of storms through highly complementary observations to existing or future Earth Observing Systems such as GOES-16, GPM or A-CCP, this platform has the potential to fill long-standing observational and science gaps.

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