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3D cloud structure information is important for weather and climate research, most notably for aviation. While satellites have provided valuable cloud observations, data from conventional passive radiometers is often limited to cloud top properties. We have developed a statistical Cloud Base Height algorithm using NASA A-Train satellite data as part of the NOAA Enterprise Cloud Algorithm Suite, which allows us to provide vertically extended cloud layer fields beyond limited 2D cloud top views. Interacting with operational forecasters and pilots, we recently introduced satellite-based cloud vertical cross-sections for flight routes to maximize the use of satellite cloud products into the vertical dimension for aviation weather applications. It is based on newly-processed 3D cloud data combining multiple satellite cloud products and additional environmental datasets. Leveraging these research efforts with NOAA satellites, we are extending our work to generate global 3D cloud fields by applying cloud retrieval algorithms to multiple satellite sensors (both geostationary and polar) and incorporating various cloud properties into one global framework, which is supported by the U.S. Navy Office of Naval Research. To enhance global cloud structure information, we adopt AI/Machine Learning (ML) approaches and develop various AI/ML-derived products such as vertical cloud water profiles, synthetic passive microwave imagery, and global radar data. These advanced AI/ML tools are also employed to optimize the blending process and minimize seams between sensors. Validation activities are ongoing in parallel to comprehensively evaluate new 3D cloud fields against ground-based and future space-borne active sensor measurements. The demonstration of practical applications of global 3D cloud analysis is an important part of our research. A deterministic cloud-free line of site (DCFLOS) application, for example, utilizes near real-time 3D cloud data analysis to quantify cloud-induced visibility constraints between a source and target. The outcomes of our work will not only support a wide range of Navy missions to analyze and predict environmental conditions in global operations, but civilian and commercial interests as well.
Presentation file
Yoo-Jeong-Noh-dod-2023.pdf
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DoD Cloud Post-Processing and Verification Workshop