Contribution ID: **48** Type: **30 minute oral presentation**

The Influence of Exascale Architectures on Earth System Modeling in NASA

Wednesday, 26 September 2018 11:30 (30 minutes)

The Goddard Earth Observing System (GEOS), developed by the Global Modeling and Assimilation Office (GMAO) at NASA Goddard, has been using a finite-volume cubed sphere (FV3) dynamical core since the development of FV3 back in 2007. The scalability of this unique dynamical core has allowed the GEOS modeling system to explore the boundaries of global atmospheric prediction since its inception. FV3 has supported a wide range of modeling requirements within NASA from MERRA-2 reanalysis runs at 50km global resolution all the way down to global cloud resolving applications of GEOS first at 3km in 2009 and then 1.5km in 2015 with a non-hydrostatic version of FV3.

Similar to most Earth system models, the future requirements for GEOS over the next 10 years include significant increases in resolution and complexity in order to build a fully coupled model. The computational and storage requirements for the resulting large-scale coupled simulations is driving NASA toward Exascale architectures. However, many application questions have emerged, including the scalability of GEOS on the emerging Exascale architectures. The influence of machine learning and deep learning on the current and near future of high performance computing is clear in systems like Summit at the Department of Energy. Can the current application approach in GEOS continue to be evolved to meet future research requirements on these new systems or is a different approach necessary? In addition to presenting recent GEOS results, this presentation will discuss how the introduction of machine learning models into applications can combine conventional computing techniques with machine learning to create a viable approach for future Exasacle Earth system models.

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Track Classification: 18th Workshop on high performance computing in meteorology