Four-Dimensional Observation Impact on the US Navy's Atmospheric Analyses and Forecasts: System Development and Test

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Effective monitoring and assessing of the impact of huge amount of observations on the atmospheric analyses and forecasts is critical to the daily operations at the operational NWP centers around the world. In recent years, various adjoint techniques have been developed and used to assess the impact of the observations. To use the adjoint based monitoring techniques, it is necessary to have the adjoint of the forecast model and the adjoint of the data assimilation system. An 3D-Var based adjoint system has been successfully used at the US Navy on daily base in the past several years to assess the impact of various observations on the US Navy's short term global forecasts. With the upgrade of the US Navy's current 3D-Var to an 4D-Var operational data assimilation system, we have developed and tested the adjoint of the 4D-Var data assimilation system to be used in monitoring the fourdimensional observation impact. In this presentation, we mainly focus on the formulation, implementation, and validation of the adjoint of the 4D-Var data assimilation system. We will present examples that highlight the capability of the adjoint system.