Assessments of Assimilation of TEMPEST-D into the NCEP Global Forecast System

Ting-Chi Wu\textsuperscript{1,}, Milija Zupanski\textsuperscript{1,}, Lewis Grasso\textsuperscript{1,}, James Fluke\textsuperscript{1,}, Heather Cronk\textsuperscript{1,}, Anton Kliewer\textsuperscript{1,}, Richard Schulte\textsuperscript{2,}, Wesley Berg\textsuperscript{2,}, Christian Kummerow\textsuperscript{1,2,}, Philip Partain\textsuperscript{1,}, and Steven Miller\textsuperscript{1}

\textsuperscript{1}Cooperative Institute for Research in the Atmosphere, Colorado State University, Fort Collins, Colorado, United States of America (ting-chi.wu@colostate.edu)

\textsuperscript{2}Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado, United States of America

Unlike large, expensive, and high-risk operational satellites, small/cube satellites (SmallSats) are a small, inexpensive, and a low-risk type of satellite. As a NOAA Cooperative Institute with specialties in satellite data processing and data assimilation, CIRA is funded by a Technology Maturation Program (TMP) research project to help NOAA exploit upcoming constellation of SmallSats to be considered for use in operations. In this research, a CSU-led technology demonstration mission entitled “the Temporal Experiment for Storms and Tropical System - Demonstration (TEMPTEST-D)” is used as an example to explore quick and agile methodologies to entrain SmallSats into the NOAA processing stream. Specifically, a workflow that enables TEMPEST-D data for assimilation into the NCEP Global Forecast System (GFS) with Finite-Volume Cube-Sphered (FV3) dycore (FV3GFS) under the Gridpoint Statistical Interpolation (GSI) based hybrid 4DEnVar system is established.

One objective of this TMP research project is to assess the impact of SmallSat data on NOAA modeling and assimilation systems used in operations. We begin by asking whether the use of TEMPEST-D data is as good as the use of those obtained from well-established operational satellite sensors. Since the radiometric specification of TEMPEST-D is similar to the Microwave Humidity Sounder (MHS), we address the above question by directly comparing the following three cycled FV3GFS data assimilation and forecasting experiments: 1) the control experiment, which includes all routinely assimilated observations, but only assimilates MHS from the NOAA-19 and MetOp-B platforms, 2) the AddMHS experiment, which is the control plus MHS from the MetOp-A platform, and 3) the AddTEMPEST experiment, which is the control plus TEMPEST-D.

By differentiating the AddMHS and AddTEMPEST experiments against the control experiment, we will be able to demonstrate that a cost-effective TEMPEST-D is as beneficial as a well-established operational satellite like MHS, in terms of aiding operational global weather forecasting. In addition, results from this research offers implications of the utility of a constellation of SmallSats microwave radiometers for global weather forecasting.

\textbf{How to cite:} Wu, T.-C., Zupanski, M., Grasso, L., Fluke, J., Cronk, H., Kliewer, A., Schulte, R., Berg,