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Recent Advances and Applications of WRF-Chem/DART to Chemical Weather Forecasting and Assimilation of Observations of Atmospheric Composition

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Mizzi et al. (2016) introduced WRF-Chem/DART for quasi-realtime regional chemical weather forecasting and ensemble assimilation of atmospheric composition observations. WRF-Chem/DART incorporated the Weather Research and Forecasting (WRF) model with on-line atmospheric chemistry (WRF-Chem) into the Data Assimilation Research Testbed - an ensemble Kalman filter data assimilation system. WRF-Chem/DART can assimilate: *in-situ* observations of atmospheric composition and remote satellite observations such as MOPITT and IASI CO total and partial column retrievals, IASI O_3 total and partial column retrievals, OMI NO_2 total column retrievals, and MODIS AOD retrievals. It can assimilate retrieval profiles as raw retrievals or as "compact phase space retrievals" (CPSRs). It uses the "state augmentation method" to adjust emissions and can do the atmospheric composition assimilation in physical or log space. Finally, WRF-Chem/DART uses localization to control the observation/state variable interactions. Its recent advances include an extension of the CPSR algorithm from assimilation of full retrieval profiles to assimilation of truncated profiles where elements of the profile with large expected errors are not assimilated.

WRF-Chem/DART has been used in a variety of research and applied settings. Mizzi et al. (2016 and 2018) applied it to a June 2008 case study over the CONUS for the assimilation of MOPITT CO raw retrieval profiles and CPSR profiles. Their results showed that the assimilation of MOPITT CO CPSRs reduced the computation costs by ~30% for MOPITT CO and ~50% for IASI CO with improved

analysis and forecast skill. Mizzi et al. (2016) showed improved skill relative to conventional retrieval assimilation methods when compared to the assimilated observations (MOPITT CO). Mizzi et al. (2018) showed improved skill when compared to independent observations (IASI CO and MOZAIC/IAGOS CO). WRF-Chem/DART has been applied for: (i) assimilation of OMI NO_2, Liu et al. (2017), (ii) assimilation of MOPITT and IASI CO, MODIS AOD, and AirNow observations in a retrospective forecast study of results from the Front Range Air Pollution and Photochemical Experiment (FRAPPE) in Colorado (manuscript in preparation), (iii) assimilation of MOPITT CO and MODIS AOD in a retrospective study of results from the Korea/United States air quality experiment (KORUS-AQ) in Korea, (iv) studying/forecasting air quality over eastern China (several groups in China and western Europe are applying WRF-Chem/DART in this application), (v) studying/forecasting air quality over central Mexico, and (vi) studying/forecasting air quality over the eastern United States.

In this poster, we will present an overview of WRF-Chem/DART, its recent advances and applications. It will highlight results from the various research group applications of WRF-Chem/DART and contain sections on recent technical advances.