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Applications of Operational Atmospheric Motion Vector (AMV) Retrieval Algorithms to Simulated Images from High-resolution NWP Fields – Status Report

In response to CGMS Recommendation 34.16

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The Cooperative Institute for Meteorological Satellite Studies (CIMSS) is conducting research on satellite-derived atmospheric motion vectors (AMVs) using the NOAA/NESDIS operational AMV algorithm on simulated output from Numerical Weather Prediction (NWP) models. Using the model wind fields themselves as "truth", the algorithm and also new satellite data types can be benchmarked for quality and sensitivity to input variations. Two types of simulated datasets are being examined: 1) Simulated Meteosat-8 images are derived from a high-resolution version of the European Center for Medium-Range Weather Forecasts (ECMWF) global model, and 2) The Weather Research and Forecasting (WRF) model is used to simulate images from a hyperspectral sounder similar to the Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS). Single field of view water vapor retrievals are used as input into the AMV algorithms.

The Meteosat-8 images are simulated from a T_L2047 forecast run of the ECMWF global model. This forecast has an approximate 10km resolution between grid points and is re-sampled to match the Meteosat-8 resolution of 3km. The model was allowed to run out to 24 hours. Then, from hour 24 to hour 30, model data was output every 15 minutes. Meteosat-8 radiances are simulated using the model profiles of temperature, specific humidity, cloud cover, ice water, liquid water, and the Radiative Transfer for Television and Infrared Sounder (RTTOV) model. AMVs are then calculated in both the simulated 10.8 (IR) and 6.2 (WV) micron channels from a 3-image sequence using processing strategies currently employed on real Meteosat-8 data at CIMSS.

To date, we have initially tested a couple of different processing strategies. First, 2 sets of AMVs using the CIMSS real-time processing settings for Meteosat-8/9 were derived. One used the ECMWF model as the first guess; the other used the United State's Navy's Operational Global Atmospheric Prediction System Model (NOGAPS). Second, as in above, but with the gross error checks against the model U and V components severely relaxed. Resulting Binary Universal Form

for the Representation of meteorological data (BUFR) files have been provided to ECMWF at each stage of the AMV processing. The evaluation will include qualitative and quantitative comparisons to AMVs that were derived using real Meteosat-8 data, as well as against model U/V fields. The effects of the model first guess choice will also be examined.

Simulated hyperspectral retrieval moisture fields from GIFTS have been derived by the soundings team at CIMSS. These retrievals are being converted to image triplets of constant pressure-level moisture analyses and will be used to calculate clear sky atmospheric AMVs. Processing AMVs from many pressure levels can then be used to construct vertical profiles of AMV, which is the goal of this effort. This simulation encompasses a very large domain that approximates a geostationary satellite footprint. The WRF model is used to generate the initial simulated atmospheric profiles. Top of atmosphere radiances (TOA) are then determined using these profiles along with the GIFTS forward radiative transfer model. From these TOA radiances, single field of view vertical temperature and water vapor retrievals are then calculated in cloud-free regions, which are analyzed at 101 pressure levels. If a strong water vapor signal exists in a given analysis, clear sky AMV can be derived by tracking advecting moisture features in three successive retrieved fields. Only the simulated GIFTS retrievals are available at this time. Code still needs to be written to generate the input data needed for the AMV retrieval algorithm.