Geophysical Research Abstracts
Vol. 13, EGU2011-1911, 2011
EGU General Assembly 2011

Tropopause folding detection using WRF 30 km resolution simulations initialized with JRA data

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The work presented is enclosed in a major research project that will lead to a 10 year (1999-2008) climatology of tropopause folding covering the European area. The dynamical tropopause is an important meteorological concept, that under adiabatic and frictionless conditions acts as a material surface between the troposphere and the stratosphere, and special deformations of this layer such as foldings have an important influence on midlatitude weather systems. Moreover, nonconservative processes in the decaying phases of tropopause foldings are a major mechanism of stratosphere-troposphere exchange. In the vicinity of folds, large vertical and horizontal gradients of Potential Vorticity (PV) are found, so that high resolution data is required for a direct characterisation of these structures. For this reason, the folding detection is carried out over the Japanese 25-year reanalysis (JRA-25) dataset refined through WRF (Weather Research and Forecasting) model simulations in order to downscale the data until a 30 km resolution grid. In the vertical, other aspects have been improved to better simulate the dynamical tropopause: extension of the upper boundary model domain up to 10 hPa and increase of the vertical levels from 24 to 50 with special emphasis on the lower stratosphere and upper troposphere. About 25 of the 50 levels cover the relevant region for folds between 600 and 100 hPa. This refinement clearly recreates finer physical features not observed in the original global dataset leading to a significant improvement in the folding detection. Pressure and potential temperature maps over the 2 PVU (1PVU = 10^{-6} m^2 s^{-1} K kg^{-1}) surface serve as a topography for a dynamical characterization of the tropopause. A three dimensional geometric algorithm based on a topographic definition of the folded dynamical tropopause is used for the final folding detection following a similar method used in Sprenger et al. (2003). The methodology applied allows us to distinguish between different fold depths and requires no assumptions on the dynamical origin of foldings. Satellite Water Vapor (WV) images (MSG 6.2 μm) have been used in order to assess tropopause folding episodes. According to Santurette & Georgiev (2005), data from WV channels (MSG 6.2 μm and 7.3 μm) provide useful information on the flow patterns in the middle and upper troposphere. Potential Vorticity fields and satellite WV channel counts show correlation in the circulation system of extratropical cyclones (Appenzeller and Davies, 1992). Superposition between satellite data and PV fields shows the ability of WV 6.2 μm channel images to represent the upper-level dynamics. In summary, the combined use of WV images, outputs of mesoscale numerical models and PV analysis constitutes an ideal tool to characterize the tropopause structure and its evolution. Results over one year of data show good agreement with other existent tropopause folding climatologies.

References

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Sprenger, M., M. Croci Maspoli, and H. Wernli, Tropopause folds and cross-tropopause exchange: A global investigation based upon ECMWF analyses for the time period March 2000 to February 2001, J. Geophys. Res., 108(D12), 8518, 2003.

used to initialize the model and nudge the boundaries of the coarse domains. As showed in Figure 1 and Table 2, two model setups were established according to the GFS resolution used as input data. The nested domains DOM3(0.5-deg) and DOM4(1-deg) matched in terms. of geographical location and number of grid points.Â It seems that higher resolution input data is required to the model better characterize the meteorological information at very high resolutions (2 km and lower). The use of data assimilation and new types of observations resulting in better initial conditions for the atmospheric models may contribute to improve. Object detection and classification in imagery using deep neural networks (DNNs) and convolutional neural networks (CNNs) is a well-studied area.Â Rotated bounding boxes of the vehicle class, calculated using the segmentation masks labels, are shown in green. In most application contexts, imagery is collected from an egocentric viewpoint (like a mobile phone camera), with most objects being aligned vertically (a person) or horizontally (a car). This means that most of the objects in the image can be considered to be axis-aligned and can be described by four bounding box parameters: xmin, ymin, width and height. The simulation was initialized at 00 UTC on 4 June 2005 using 1Âº Global Forecasting System analysis data and then integrated for 30 hours. Upon completion of the model simulation, the CIMSS forward radiative transfer modeling system was used to compute simulated radiances for each ABI band. See appendix C for further details on the simulation process.Â Figure 30. Four bands of the ABI are shown here from a simulated Katrina data set. The simulated ABI data for Katrina can be used to show some of the same relationships of the ABI spectral bands and various phenomena, such as cloud-top phase or the location of convection. 35. Pacific (West) Simulations. Stratospheric Intrusions & Tropopause Folds. â€¢ Stratospheric intrusions and tropopause folds can be identified by the presence of high potential vorticity and warm, dry, ozone-rich air. (Danielson 1968).Â â€“ Demonstrate the impact of assimilation of high resolution satellite data on WRF* Model Forecasts. â€“ Clarify the ability of numerical models to resolve stratospheric intrusions and associated high winds.Â â€¢ Forecast cycling mimics the operational NAM â€¢ Initialized with GFS data â€¢ Lateral boundary conditions every 3 hours â€¢ 12 km Domain & 35 vertical levels* â€¢ 5 m resolution geographic data â€¢ Scheme choices follow operational NSSL WRF. â€“ MP scheme: WSM6 â€“ PBL Scheme: MYJ â€“ LW Radiation: RRTM â€“ SW Radiation: Dudhia â€“ LSP: Noah Land-Surface. the data from the WRF model is using the netCDF libraries. One may also need to add /path-to-netcdf/netcdf/bin to your path so that one may execute netcdf command, such as ncdump and ncgen. Hint: If one wants to compile WRF codes on a Linux system using PGI (Intel) compiler, make sure the netCDF library is installed using PGI (Intel) compiler, too.Â Several of the data sets are available in only one resolution, but others are made available in resolutions of 30â€, 2â€™, 5â€™, and 10â€™. The user need not download all available resolutions for a data set, although the interpolated fields will generally be more representative if a resolution of source data near to that of the simulation domain is used.Â 2. Extract meteorological data from GRIB data sets for the simulation period with.