NOAA Climate Forecast System Reanalysis (CFSR) model-level data

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Introduction

• Analysis of the Upper Troposphere-Lower Stratosphere (UTLS) requires sufficient vertical resolution in the region of the tropopause, but most reanalysis products are interpolated onto a limited number of pressure-levels.

• Model-level output has much higher vertical resolution and is available for most reanalyses, and has been useful for the SPARC Reanalysis Intercomparison Project (S-RIP; Fujisawa et al. 2017).

• NOAA CFSR (Saha et al. 2010) model-level output was previously only provided in an undocumented binary file format using spectral coefficients, with different formats between CFSRv1 (1/1979-3/2011) and v2 (4/2011-12/2014). We have created a 6-hour global CFSRv1/v2 reanalysis model level data set in CF-compliant netCDF format, provided on a regular latitude-longitude grid (0.5° x 0.5°) instead of its native horizontal resolution of T382, from 1979-2014.

• 64 model levels compared to 37 pressure levels.

Advantages of CFSR Model-Level data for UTLS studies

• Improved detection of tropopause height/cold-point temperature

• Improved characterization of single versus multiple tropopauses

Methodology and Data Accessibility

• Binary CFSR model-level data are available at NCEI/NOMADS: https://nomads.ncdc.noaa.gov/data/

• We downloaded a subset of the data (Table 1). CFSRv2 (2011-2014) only includes category (1) and (2) data.

• We regridded the data to a regular 0.5° x 0.5° lat/lon grid.

• We converted the data to CF-compliant netCDF files with clear metadata.

• We can share the data from our servers where the data is currently hosted at NOAA ESRL. Full dataset size is ~ 1TB/yr from 1979:2014. Contact: Sean.m.davis@noaa.gov.

Table 1. The 3 categories of model-level data available in netCDF format. Names in black show currently available data.

<table>
<thead>
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<th>Category</th>
<th>Description</th>
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| (1) Analysis and (2) 6-hour forecast | Convective gravity wave drag zonal acceleration (cgwdw), Convective zonal momentum mixing acceleration (tmmac), Gravity wave drag zonal acceleration (tmmgwdw), Longwave heating rate (tlnlw), Shortwave heating rate (tntsw), Vertical diffusion zonal acceleration (vdifza), vertical diffusion heating (vdifht), deep convective heating (cvntsh), shallow convective heating (shcndt), large scale condensation heating (lgcre), vertical diffusion moistening (vdifmr), deep convective moistening (cvntcm), shallow convective moistening (sscmr), large scale moistening rate (lgcmt), vertical ozone diffusion (votoz), ozone production (pot), ozone tendency (tndz), ozone production from T term (tndpp), ozone production from column ozone term (pcot), vertical diffusion meridional acceleration (gwdv), convective meridional momentum mixing acceleration (cmvnm), convective gravity wave drag meridional acceleration (cgwmdv), non-convective cloud (ccldv).

(3) 6-hour Ancillary | Specific Humidity (shus), pressure on model levels (pfull), surface pressure (ps), Relative divergence of wind (relv), Relative vorticity (relv), Air temperature (ta), Ozone mixing ratio (tro3), Eastward wind (uav), Northward wind (vav), Geopotential height (ge), relative humidity (rh), stream function (stream), velocity potential (vpot), cloud mixing ratio (clmrw).

Conclusions

• Model-level data are now available in a documented netCDF format for the NOAA Climate Forecast System Reanalysis product.

• Biases in CPT/tropopause height substantially reduced in model-level data compared to pressure-level data.

• Modern reanalysis model-level products show a colder, higher tropical tropopause that more closely captures observed values compared to the pressure-level product.

• Model-level data detect more frequent multiple tropopauses.

• This dataset will be useful for number of additional analyses, including gravity wave characterization (personal comm, James Anstey) and improved tropopause dynamics.

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