GTGN "Semi-Operational" Data Feed User Guide

The Graphical Turbulence Guidance Nowcast (GTGN) product has been developed as a tactical aid for aviation. GTGN provides a nowcast of the current turbulent state of the atmosphere over the Continental United States (CONUS) in near real-time, updating every 15 minutes (Pearson and Sharman 2017). The basis for the nowcast is the most recently available short-term (1 or 2-hour) forecast from the Graphical Turbulence Guidance (GTG) forecast whose valid time is closest to the current update time. Recent observations of turbulence are then used to update the GTG forecast and create a blended nowcast. Currently, aircraft observations from pilot reports (PIREPs) and automated in situ EDR reports as well as EDR estimated from ground based radar observations via the Nexrad Turbulence Detection Algorithm (NTDA) are used. The output of GTGN is eddy dissipation rate to the one third power or EDR, whose units are $m^{\frac{2}{3}}\ s^{-1}$. This is an atmospheric, aircraft independent metric of turbulence. The GTG forecast is based on NOAA's 13-km RAP model over the CONUS, and thus its domain serves as the horizontal domain for GTGN. The vertical resolution of the nowcast starts at the surface (100 feet) and is output at every 1,000 feet up to 50k feet. For 18,000 feet and above Flight Levels (pressure altitudes) are used. Levels below 18,000 feet are based on altitude above mean sea level. GTGN satisfied the requirements of the FAA's Safety Review Management Panel (SRMP) completed in November 2019.

The University Corporation for Atmospheric Research (UCAR) Research Applications Laboratory (RAL) has been tasked by the FAA to run the GTGN system as a "semi-operational" product and make the data available to users who have signed the license agreement with UCAR. Since UCAR is not a standard operational facility it does not have support 24/7 and as such there is no guarantee of data availability. UCAR may cease making the data available at any time if FAA funding is discontinued. UCAR will provide notice to users of planned and unplanned outages to the best of its ability. It is recommended that users of the GTGN data have a backup plan to utilize the operational GTG forecast data available from NOAA in the event of any outage of the GTGN data from UCAR.
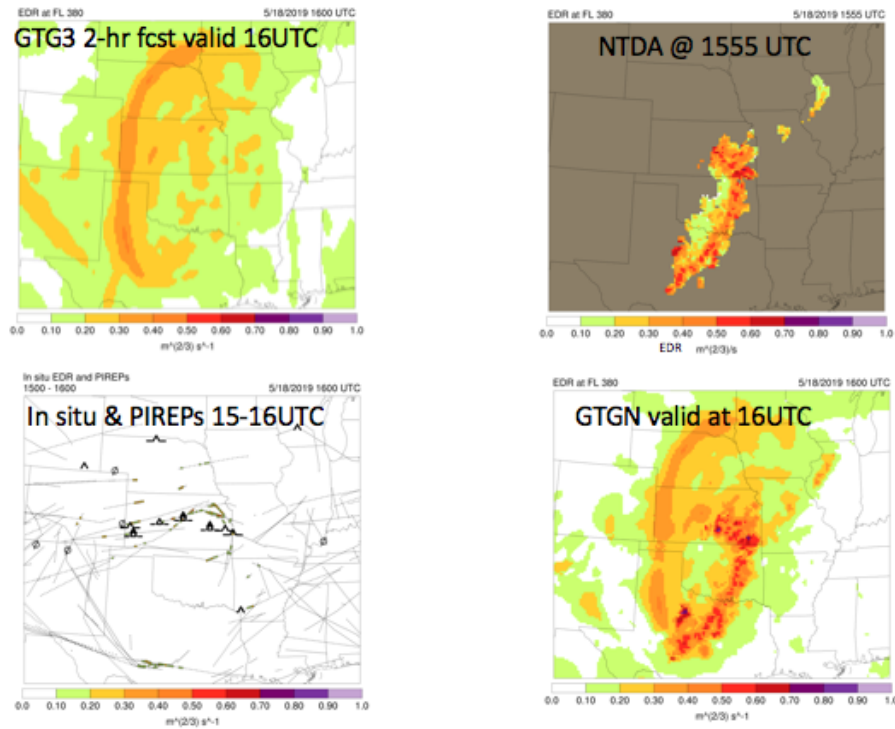
18 May 2019 at 16UTC FL380

Figure 1: Example GTGN output (lower right) and GTGN inputs which are comprised of the output of GTG (upper left), NTDA (upper right) and in situ as well as pirep observations (lower left).

ICAO definitions used for null, light, medium and heavy aircraft are:

- Light < 15,500 lbs maximum takeoff weight (examples are Cessna 320, Piper Cub, LJ23)
- Medium (or large) 15,500 - 300,000 lbs maximum takeoff weight (examples are A320, B737, Gulfstream, MD80)
- Heavy > 300,000 lbs maximum takeoff weight (examples are A330-A380, B747, B777)

Aircraft class-specific thresholds used to translate EDR to turbulence categories are:

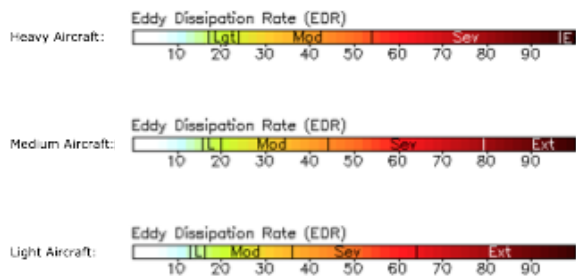| AC weight class	Estimated EDR Threshold * 100			
	Light	Moderate	Severe	Extreme
Light	13	16	36	64
Medium (Large)	15	20	44	79
Heavy	17	24	54	96

Figure 2: GTGN EDR interpretation: Conversion tables for turbulence categories from EDR for light, medium and heavy aircraft types.

The GTGN output data provided to users is in the form of Gridded Binary edition 2 (GRIB2). The data is on a Lambert Conformal grid with a 13.545km resolution. The horizontal grid spacing matches the WRF-RR CONUS cutout grid. Access to the data is provided via a Local Data Manager (LDM) client, server system. A local LDM client program will need to be installed and configured to request data from the UCAR LDM server. Once installed and ready please contact UCAR for the IP address to pull data from.
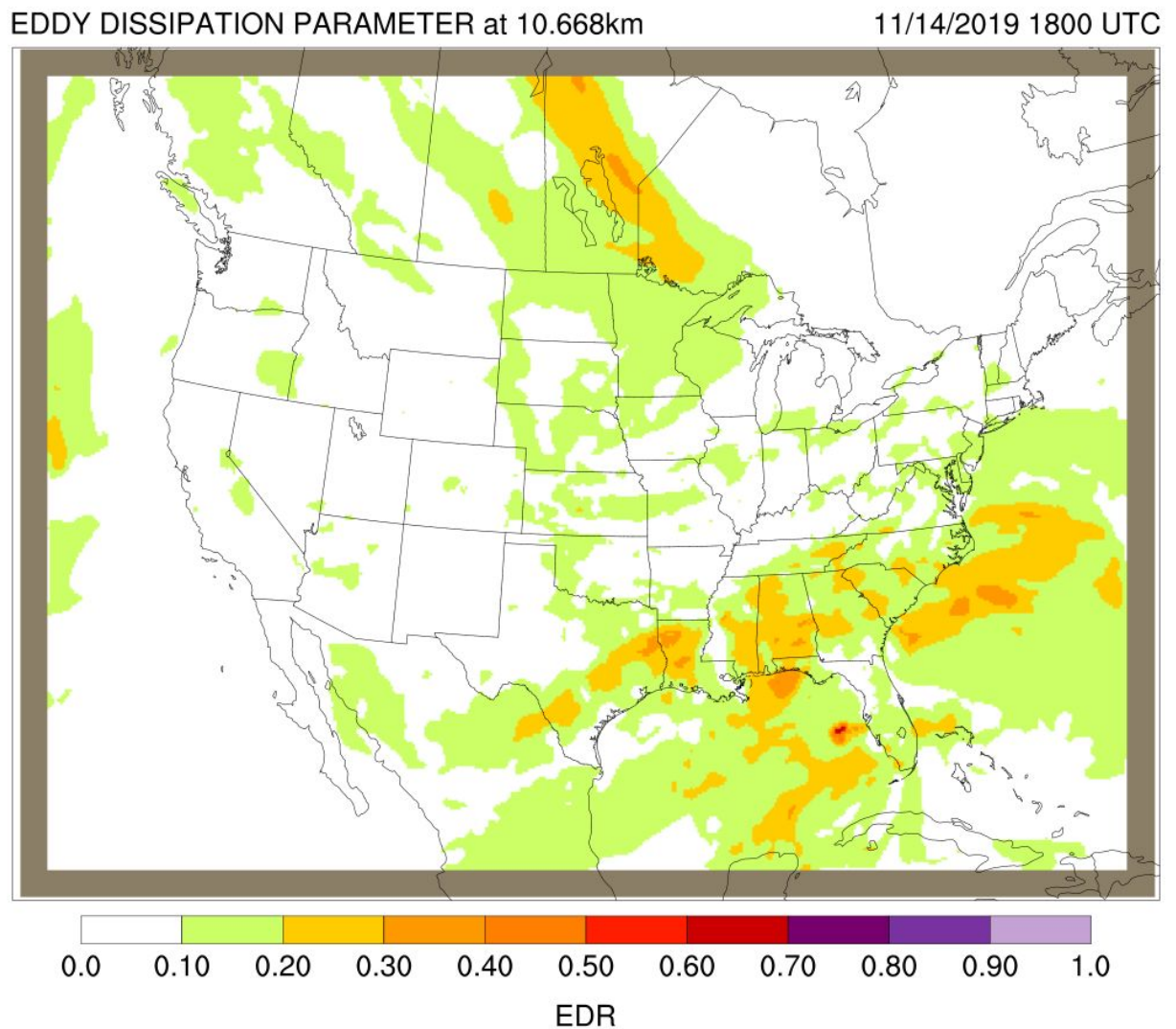

Figure 3: GTGN output at 350FL from the example GTGN grib2 file that is included with this user guide for use in verifying the GTGN grib2 files are read successfully.

GTGN Output details:
Format: Grib2
Units: m^(⅔)/s   (Eddy Dissipation Rate)
Projection: Lambert Conformal
Dx: 13.545087 km
Dy: 13.545087 km
Nx : 451
Ny: 337
Standard Parallel 1: 25.0
Standard Parallel 2: 25.0
Central Meridian: -95.0
Grib2 Parameter Discipline: 0
Grib2 Parameter Category: 19
Grib2 Parameter Number: 30
Grib2 Parameter name: "EDPARM", "Eddy Dissipation Parameter"
Altitude levels: 100ft, then 1,000ft to 50,000ft in 1kft intervals (51)
File Name Format: gtgn.tHHMMz.edr.f000.grb2   HH = 2 digit hour   (00-23)
                                                                          MM = 2 digit minute (00,15,30,45)
                                                                          GTGN forecast hour is always 0hrs

LDM Feedtype: EXP
LDM Server IP: Please contact UCAR to request the IP address.
LDM Request Example: REQUEST   EXP   "^gtgn.*grb2"
LDM Action Example: EXP   ^gtgn.t([0-9]+++)z.edr.f(0-9++).grb2   FILE
/d1/ldm/data/gtgn/%Y%m%d/gtgn.t\1z.edr.f\2.grb2

GRIB2 format resources:
https://www.wmo.int/pages/prog/www/WMOCodes/Guides/GRIB/GRIB2_062006.pdf
https://www.nco.ncep.noaa.gov/pmb/docs/grib2/

LDM Program resources:
https://www.unidata.ucar.edu/software/ldm/

GTG Forecast Data from NOAA:
https://tgftp.nws.noaa.gov/SL.us008001/DC.avspt/DS.gtggb/PT.grid_DF.gr2/