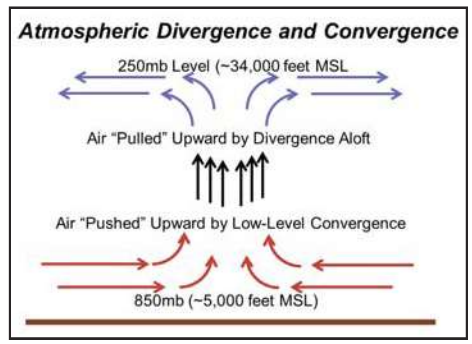
WEATHER TO FLY

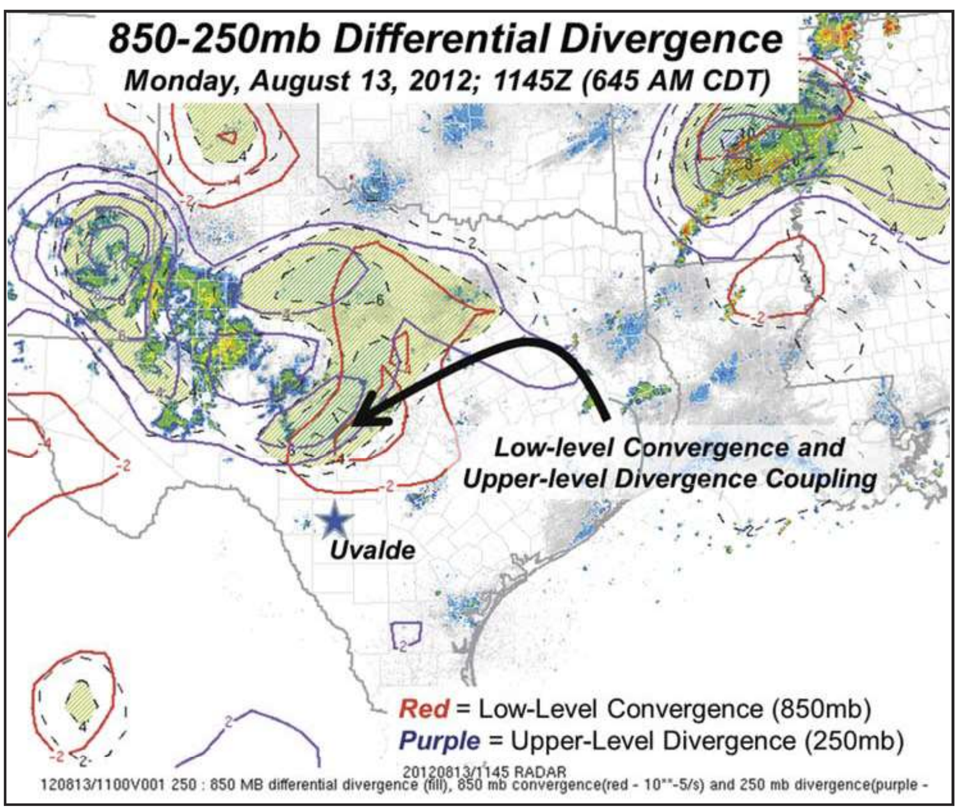
BY DAN GUDGEL

The "*850-250mb Differential Divergence*" Chart

The gathering of weather information is obviously essential for determining soaring potential and the information comprising a formal *Pilot Weather Briefing* is necessary for safety-of-flight issues. A soaring pilot needs basic knowledge of weather services and products. During the recently concluded World Gliding championships (WGC) at Uvalde, Texas, I occasionally referenced an experimental chart that provided insight into atmospheric upward motion potential, the ***"850-250mb Differential Divergence"*** (*See* ***Chart: "850-250mb Differential Divergence"****; and,* ***Text Box: "Differential Divergence Chart Generation"***).

So what is this chart and what does it convey? Remembering that air is a fluid with mass that must be "conserved," any type of convergence (or divergence) of the wind streamline field at a level of the atmosphere must be compensated by mass forced out of (or being pulled into, respectively) that level of the atmosphere. *Convergence* is the merging of the streamlines of the wind field whereas *divergence* is spreading of the streamlines. The existence of convergence at the lower levels of the atmosphere (often depicted at or near the surface) will result in some form of upward vertical motion. As air merges in convergent flow and due to the conservation of mass, upward vertical motion results. Conversely, the wind streamline field diverging at upper levels of the atmosphere will also result in upward vertical motion as air must ascend from below to replace that mass of air moved aside in the divergence area *(See* ***Diagram: "Atmospheric Divergence and Convergence")****.* Either convergence at the lower atmospheric levels or divergence aloft will encourage upward vertical motion. However, the combination of convergence at the lower levels of the atmosphere and divergence at another level aloft will result in an enhanced upward force on the mass of air. The combination of an unstable atmosphere due to its temperature lapse rate and/or moisture configuration and some form of upward force due to low-level convergence and upper-level divergence coupling often leads to convective activity. Thus, the *850-250mb Differential Divergence Chart* was referenced by the meteorology team to the international pilots in supplying the background for forecasts of thunderstorms in areas in and around the WGC tasking area.





On Monday, August 13 (WGC Contest Day #8), the day was again forecasted to be quite warm at the surface over Southwest Texas with temperatures near 100 degrees F. Combined with cooler air aloft, large temperature lapse rates resulted. Favorable lift conditions were forecasted for the tasking area. The difficulty in deciding on soaring tasks in favorable lift conditions, however, is often a fine-line between expectations for very good thermal lift or one that becomes an active area of convection resulting in extensive thunderstorm coverage. One of the tools used by Walt Rogers and myself to help define a potential area for convective over-development was the referenced divergence chart. On Monday, the 13th, the "Hill Country" with surface elevations from 1500 to 2500 feet above sea level north of Uvalde was flagged by the 1145Z (0645 AM CDT) *850-250mb Divergence Chart* depicting dynamic lift by virtue of its low-level convergence and upper-air divergence coupling. Responding to the meteorological threat to the north, reinforced by the divergence chart, the WGC Contest Tasking Committee of Sam Zimmerman, Al Tyler, and John Good restricted tasks for the three classes; utilizing airspace only in the areas from the southwest counter-clockwise to the east of Uvalde, and thereby avoiding the Hill Country.

Specifically looking at the example *850-250mb Differential Divergence,* note that the red color depicts low level convergence over the Hill Country northwest of Uvalde. In combination, there is a purple isopleth of divergence aloft coupled in proximity to the low-level convergence. With an already marginally unstable atmosphere based on temperature lapse rates, the divergence chart supported the meteorology team's forecast analysis that a severe weather threat from thunderstorms existed in the Hill Country just north of Uvalde by the late-afternoon hours. In the post-analysis, the Hill Country had extensive thunderstorm cloud cover with radar echo tops as high as 52,000 feet msl by 1730CDT *(See **Image: "CoSPA Visible Satellite / Radar Overlay and Echo Tops")**.* This thunderstorm activity was intense enough to generate an outflow boundary that reached Uvalde around 1730CDT, but due to the tasking south of Uvalde the feature was not a threat and was inconsequential for the contest day.

A weather evaluation for lift potential and/or convective over-development can be enhanced by the information provided on the divergence chart. A soaring pilot's weather information websites should include a chart that depicts low-level and upper air convergence/divergence coupling. In coming installments of Weather To Fly, I will continue to introduce some of the newer weather information charts that can provide useful information for purposes of soaring flight and/or safety-of-flight considerations.

REFERENCES

1. NWS (National Weather Service) Storm Prediction Center Website

< http://www.spc.noaa.gov/ >

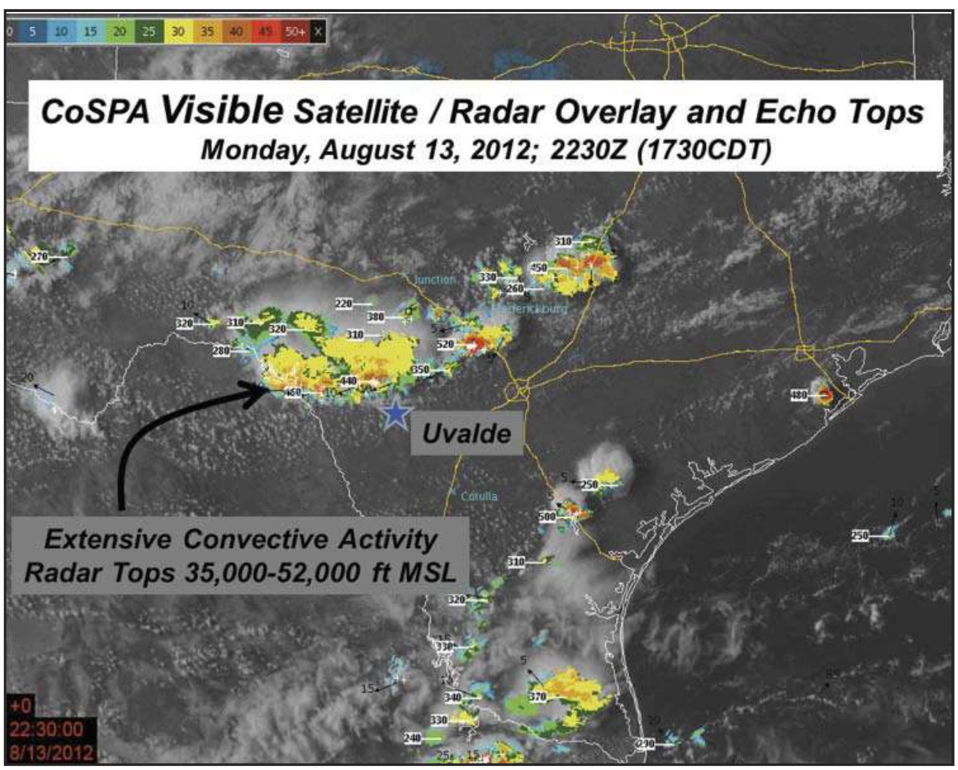
2. NWS Storm Prediction Center "850-250mb Differential Divergence":

< ***http://www.spc.noaa.gov/exper/mesoanalysis/*** >

• *Go to the "NWS Storm Prediction Center Website" (reference point #1 above)*

• *On the Left Side Menu under "**Research**": Click "**Forecast Tools**"*

• *Note the "**Mesoanalysis Graphics**" Section; and,*



Click on the U.S. map in the desired region.

• *The "SPC **Mesoscale Analysis**" Page will appear; and,*

*Rest the "cursor" on "**Basic UA**" and select "**850-250mb Diff. Divergence**" that appears on the drop down menu from "Basic UA."*

3. Consolidated Storm Prediction for Aviation (CoSPA)

Massachusetts Institute of Technology (MIT) Lincoln Laboratories.

Aviation Weather Research funded by the Federal Aviation Administration (FAA)

[Note: CoSPA special courtesy of FAA and MIT through the NWS Southern Region Headquarters for safety-of-flight at the World Gliding Championships.]

Differential Divergence Chart Generation

So how is the *Differential Divergence Chart* generated? As displayed on the NWS Storm Prediction Center website, the referenced chart is a combination of both observed real-time Doppler Radar data, and a very short-term (1-hour) numerical model forecast. The chart actually updates through the hour as each new volume scan of the Doppler Weather Radars in the region generates a composite radar image, but the forecast divergence field remains unchanged through the hour. The divergence field is generated by and utilizes the new Rapid Refresh (RAP) Model that has recently superseded the Rapid Update Cycle (RUC) Model. The RAP Model covers North America and is updated hourly. It has a 13 kilometer horizontal resolution and computes across 50 vertical levels of the atmosphere.

A "*850-250mb Differential Divergence*" chart specifying "observed data" at 1100Z, as an example, is really comprised of composite radar data from the most-recent radar volume scans and a one-hour "first guess" forecast from the RAP. Even though it is technically a forecast, the divergence field is near real-time and generated by utilizing the RAP Model's ingestion of aircraft soundings, weather radar vertical wind profiles, satellite cloud drift, and observed surface weather data from the previous hour. Again using a chart with a time of 1100Z, the radar data is relatively current (depicting completed volume scans in the last 5 to 15 minutes). The divergence field, though, is a one-hour forecast with a 1100Z verification time, but the observed weather data utilized to generate the forecast field would be cut off in the 0945-0950Z time period.

While the divergence field is a forecast, its constant one-hour "refreshing" with observed data makes the field nearly "observed" in its nature. Certainly, the divergence/convergence field is useful in terms of accurately showing enhancement of the upward vertical motion.

Acknowledgement: Background help provided courtesy of National Weather Service Storm Prediction Center Lead Forecaster Rich Thompson.