The Use of Red Green Blue (RGB) Air Mass Imagery to Investigate the Role of Stratospheric Air in a Non-Convective Wind Event

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The Problem
- Non-convective winds cause as many fatalities as thunderstorm straight-line winds
- Tropopause folds and the sting jet are responsible for non-convective winds, however the sting jet is only known to occur in North Atlantic Shapiro-Keyser cyclones
- The global distribution of sting jet cyclones is unknown and questions remain whether cyclones that impact the U.S. develop sting jet features
- Analyses of the new RGB Air Mass imagery, show the utility of future GOES-R products in forecasting non-convective wind events

Background
- Stratospheric intrusions and tropopause folds can be identified by high-potential vorticity, warm, dry, ozone-rich air
- 1.5-2 PVU represents the dynamic tropopause
- A low pressure system over the Ohio Valley merged with a system off the East Coast by 0000 UTC 09 February 2013
- At 0000 UTC the low pressure system developed a bent-back feature analyzed as an occluded front (compare to III and IV in Fig. 2)
- Two distinct storms the previous day, circled regions on Fig. 6 represent possible stratospheric air
- Two storms from previous day, shown in Research Image, show the utility of future GOES-R products in forecasting non-convective wind events

Event Analysis
- Stronger 300 hPa winds downstream established confluent flow and Shapiro-Keyser characteristics were able to develop
- By 0300 UTC 09 February a distinct sting-jet like wind maximum developed south of the low center (Fig.8)
- The region of stratospheric air in Fig. 8 is confirmed by overlaying model PV

The 850 hPa temperature field resembled the Shapiro-Keyser model with a stronger gradient associated with the warm front and fronts appear perpendicular. The features were sharply defined by 0900 UTC 09 February (Compare to III in Fig. 2)

Anomalies were calculated as a percent of normal using AIRS Total Column Ozone and a satellite derived stratospheric ozone climatology

Recent literature classifies stratospheric air as ozone values 125% of normal

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The RGB Air Mass product is able to identify temperature, moisture and location of tropopause fold, descent of dry air, and high near-surface winds

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GOES Sounder 1701 UTC 08 Feb 2013

Red/Orange represent suspected stratospheric air

AirS 1730-1748 UTC 08 Feb 2013

Figure 1. Schematic of a tropopause fold

Figure 4. 0900 UTC 09 February 2013 (Compare to III in Fig. 2)

Figure 6. MODIS 0930 UTC 09 Feb 2013

30 m/s wind west of the L center

Red/Orange represents suspected stratospheric air

Figure 7. MODIS 0330 UTC 09 Feb 2013

MODIS 0930 UTC 09 Feb 2013

Red and Orange shading for ozone values ≥ 125 % of climatology, which are displayed as stratospheric air

High potential vorticity correlated with Red/Orange coloring confirm stratospheric air

SPoRT AIRS Ozone Anomaly

• Warm, moist upper level air

Summary
- AIRS ozone and model PV analysis confirm the stratospheric air in RGB Air Mass imagery
- Trajectories confirm winds south of the low were distinct from CCB driven winds
- Cross sections connect the tropopause fold, downward motion, and high near-surface winds
- Comparison to conceptual models show Shapiro-Keyser features and sting jet characteristics were observed in a storm that impacted the U.S. East Coast
- RGB Air Mass imagery can be used to identify stratospheric air and regions susceptible to tropopause folding and attendant non-convective winds

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13-km RAP analysis of frontogenesis (Fig. 13), shows features similar to the sting jet conceptual model
- Rapid weakening of the bent-back front creates a region of frontolysis
- Maximum winds are downstream of the frontolysis (see Fig. 13 inset)

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