1. Objective

The goal of this research effort was to forecast the location of ozone enhancements in the troposphere that result from Stratospheric/Tropospheric Exchange (STE). Reverse domain filling (RDF) trajectories and Lagrangian Reverse Domain Filling Trajectories were used to develop and examine mixing in the troposphere.

2. RDF Trajectories

Reverse-domain-filling is a trajectory mapping technique. Parcel trajectories are initialized on a uniform grid at the intended time (a forecast or an analysis time). In the first case presented, we used a 48-hour forecast with STE. In this sense, they have operational value, allowing us to diagnose STE in near real-time. We used both satellite imagery and gridded observations of upper tropospheric ozone to evaluate RDF forecasts made during the recent summer 2004 NOAA/INTEX mission. We also illustrate the value of post-mission RDF analyses to diagnose mixing in an event of STE observed during the 2000 Tropospheric Ozone Production Study.

3. GLASH Imagery

GLASH is a derived product image developed at UVA. It is based on a linearization of the relationship between GOES Imager 6.7 um channel brightness temperature and layer average relative humidity for the troposphere. Using the virtual weighting function for the channel along with empirical relationships from a meteological model, images can be "corrected" for temperature and zenith angle biases (Moody et al., 1999). The result is a GOES product that represents layer average specific humidity (GLASH). The GLASH signal is influenced by moisture variations from 250 to 500 hPa, with the peak contribution from about 350 hPa. The imagery shows a minimum gradient in moisture along the tropopause break, where dry and moist air masses meet, and a maximum gradient on the surface. The location of the gradient is evident in the imagery as a region of high to low specific humidity. The distribution of specific humidity that occur along the lengthening boundary between subtropical moist air and dry, ozone-rich polar stratospheric air.

4. Results from the INTEX/NA Summer 2004

4.1. TopSE Example of Upper Tropospheric Mixing Associated with STE

Measurements from TOPSE were used to show that GLASH gradients closely delineate the three-dimensionally varying location of the individual tropopause breaks. We illustrate this with an example of upper tropospheric ozone boundary (obtained in the satellite imagery). The model data is obtained from a 1-hr interval of an upper tropospheric ozone boundary (obtained in the satellite image). The TOPSE data is obtained from model data obtained from 1-hr interval of an upper tropospheric ozone boundary (obtained in the satellite image). The TOPSE data is obtained from model data obtained from 1-hr interval of an upper tropospheric ozone boundary (obtained in the satellite image).

5. Conclusions

RDF analyses and forecasts of Lagrangian mixing were compared with gradients in real-time observations of GOES Layer Average Specific Humidity (GLASH), a derived satellite image of upper tropospheric moisture. Strong mixing is associated with gradients in specific humidity which are available with tropopause filling through previous work and with new observations shown here. The results provide a new reference for examining and validating. Moreover, they illustrate the potential value of these forecasts. They could be used with future missions, like INTEX-B, in the spring of 2005 to assist planning, and to predict and diagnose mixing of stratospheric and tropospheric air in the troposphere.