



Case Studies of CO signatures in convective clouds and anvils during CRYSTAL-FACE

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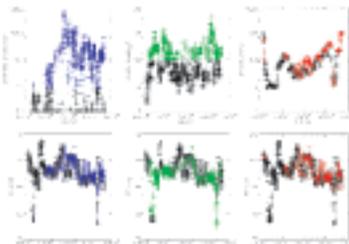
Overview

Dickerson *et al* (1987) found convective systems to be an important mechanism in the transport of boundary layer air to the upper troposphere. During Crystal-Face, there were two flights, in particular (July 11 and July 26), that showed strong enhancements of CO relative to the free troposphere. The majority of flights, however, showed little or no enhancement of CO mixing ratios due to convective transport. This poster shows 3 different case studies of CO enhancement in convective systems.

Method

In order to determine when the WB-57 was in a cloud, I used 3 different indicators: a) Aerosol number concentration >1 (CAS/MASP) (see blue below), b) Relative Humidity >100% (see green) and c) Harvard total water greater than Harvard water vapor (see red). Data was binned in 2 second time bins to match the CO sampling time. It was found that using the aerosol number concentration at 2 second bins was the most robust method for indicating cloud presence. Additionally, at the initial stages of this analysis, there was disagreement among the water measurements.

In the top panel of the Figure below, the three cloud indicators are shown on a time series plot. The colored regions are indication of a cloud presence. The bottom panel shows the CO data colored when in clouds. While they all give similar results, the aerosol number concentration shows more instances when in clouds.



Flight Descriptions from CF website

July 11

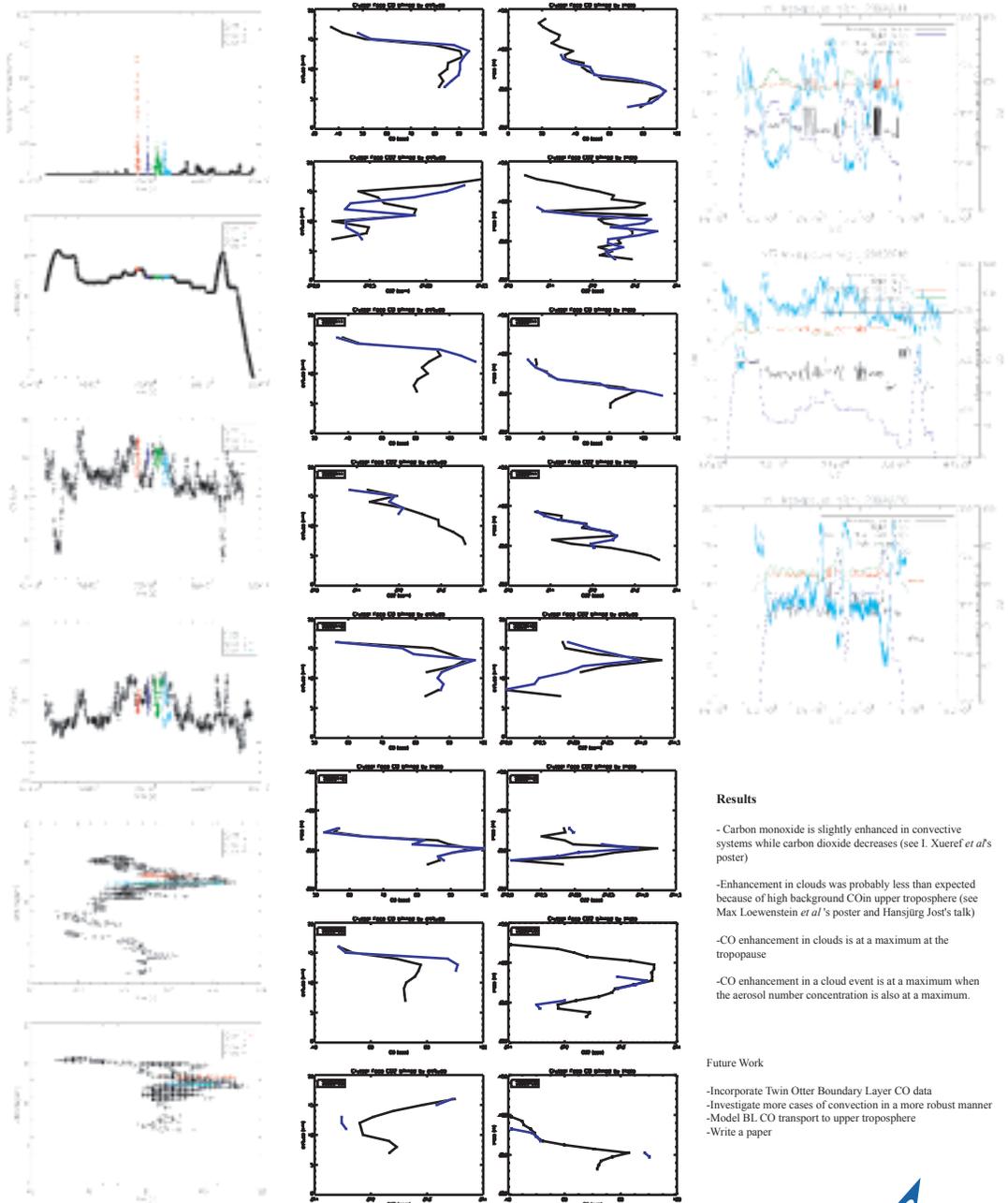
The flights today provided Terra validation data and a convection/cirrus anvil case study. By around noon, a line of convection developed that was aligned NE-SW over the Everglades. After the Terra run, the ER-2 and Proteus flew two legs over this convection line, and the WB-57F was directed to fly in the developing anvil blow-off to the west of this line. Then the remote-sensing aircraft were put on the same line as the WB-57F. Later in the afternoon, the Citation flew along the same line, sampling the lower levels of the anvil line, and the Twin Otter flew along the southwestern end of the ER-2 line for radiation measurements. The P-3 measured the southern end of the convection line, as well as the cirrus sampled by the higher aircraft. Today's flights should provide an excellent case study for modeling and analysis of the physical processes controlling cirrus-anvil evolution.

July 16

A relatively isolated convection system and its persistent anvil were sampled extensively on this flight. This case should be useful for modeling studies. Sea-breeze convection kicked off on the east peninsula around 1600Z and developed a fast-moving anvil that traversed west rapidly over the western ground site by around 1830Z. Afternoon isolated Cbs in south central Florida began around 1930Z. A cirrus deck developed and moved west, and was sampled extensively by the WB-57F and Citation. The P-3 made measurements of the same line as the other planes on the south side of the convective activity.

July 26

The WB-57 did a southern track coordinating with the ER-2, bobbing up and down across the tropopause between altitudes of 48 and 51 kft. At 1819Z, they were flying through some thin clouds at 47.8 kft, but



Results

- Carbon monoxide is slightly enhanced in convective systems while carbon dioxide decreases (see I. Xueref *et al's* poster)
- Enhancement in clouds was probably less than expected because of high background CO in upper troposphere (see Max Loewenstein *et al's* poster and Hansjürg Jost's talk)
- CO enhancement in clouds is at a maximum at the tropopause
- CO enhancement in a cloud event is at a maximum when the aerosol number concentration is also at a maximum.

Future Work

- Incorporate Twin Otter Boundary Layer CO data
- Investigate more cases of convection in a more robust manner
- Model BL CO transport to upper troposphere
- Write a paper

