Partitioning CO sources using TERRA measurement.

Ron Drori, Ilan Levy and Uri Dayan.

Department of Geography, The Hebrew University Of Jerusalem, Israel.

Introduction.

Recent publications show that CO has a significant inter-annual variation, assumed to be attributed to biomass burning (Simmonds 2005).

A first step towards the understanding of biomass burning relative role as a CO source is to differentiate between CO emitted from biomass burning and that emitted from anthropogenic sources.

The proposed algorithm.

Edwards (2004) had shown that for biomass burning there is a high correlation between CO total column (CO_{tot}) and Fine Mode aerosol Optical Depth (FMOD) and a low correlation for urban sources.

Based on the assumption that only biomass burning emits simultaneously CO and small aerosols, an objective algorithm is presented to differentiate between anthropogenic and biomass burning emission sources.

MOPITT (CO_{tot}) and MODIS (FMOD) daytime data where used to test this algorithm by computing the correlation (S_{corr}) between them for each data cell (1° x 1°) on a global domain.

For each data cell, the correlation was computed from the surrounding cells (Fig. 1), defined by a box of (x,y) dimensions, where more then 25% of valid data existed.

The sources where differentiated by the following criteria:

1. Biomass burning sources: $S_{corr} > 0.5$ and FMOD >0.1.
2. Urban sources: $-0.3 \leq S_{corr} \leq 0.3$ and $CO_{tot} > 2$ mol/cm3.

Based on sensitivity tests a X=Y=10 box was adopted.

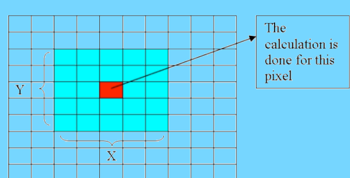

Fig. 1. Correlation calculation: each grid cell gaining its correlation from the surrounding neighbors.

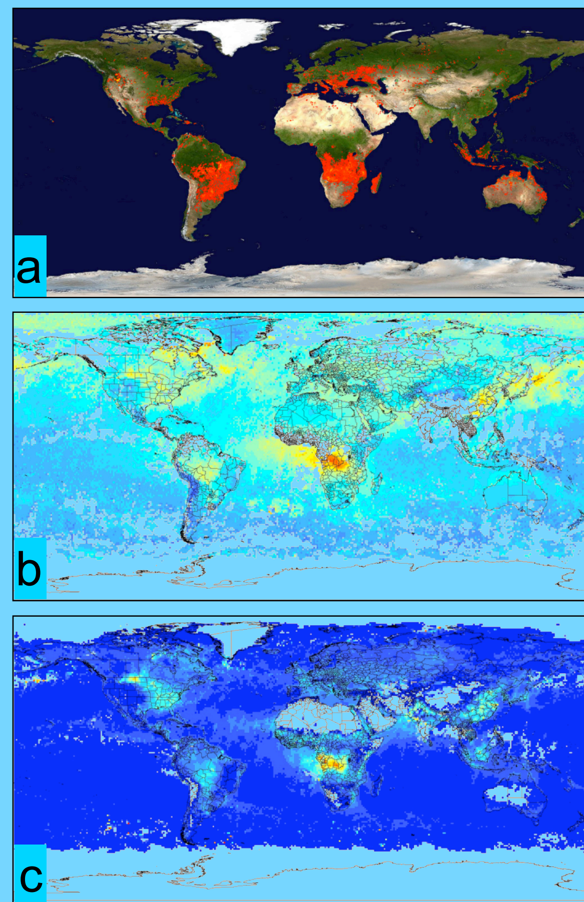

Fig. 2. Mean distribution of: (a) MODIS fire counts, and (b) MOPITT CO and of (c) MODIS Fine Mode aerosol Optical Depth for 18-27/8/2000.

Results:

The algorithm was tested for the period studied by Lamarque (2003) : 18-27/8/2000, where extensive forest fire occurred over North America (Fig. 2).

A good agreement was found between MODIS fire counts and detection of biomass burning CO by the algorithm (Fig. 3). Furthermore, a collocation between major cities and detection of urban CO sources was identified.

At North America (Fig. 3a) and East Asia (Fig. 3b) a clear distinction is observed between biomass burning generated CO (red) and anthropogenic CO emitted from major cities (gray).

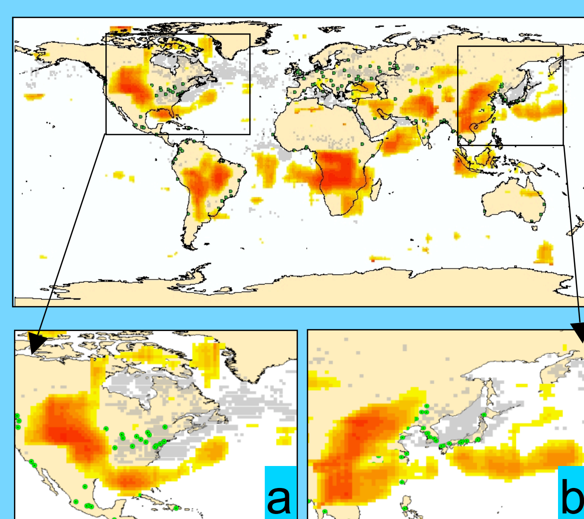

Fig. 3. Algorithm results. Biomass burning (red) and urban (gray) CO are collocated with MODIS fire counts and major cities (green circles) respectively.

Conclusions:

The synergy of MOPITT and MODIS is shown to be very fruitful and such a synergy has to be in mind in future missions.

Further studies are needed in order to improve the algorithm and resolve the relative contribution of each CO emission source over regions influenced by both source types.

Reference:

1. Edwards, D.P., et al., Observations of carbon monoxide and aerosols from the Terra satellite: Northern Hemisphere variability, J. Geophys. Res., 109, D24202, doi:10.1029/2004JD004727, 2004.

2. Lamarque, J.-F., et al., Identification of CO plumes from MOPITT data: Application to the August 2000 Idaho-Montana forest fires, Geophys. Res. Lett., 30(13), 1688, doi:10.1029/2003GL017503, 2003.

3. Simmonds et al., 2005: A burning question. Can recent growth rate anomalies in the greenhouse gases be attributed to large-scale biomass burning events?, Atmos. Environ. 39, 14 , 2513-2517.