Regional-scale correlation between CO₂ fire emissions, burned areas, and mid-tropospheric CO₂ diurnal variations retrieved from MetOp-A/ATOVS observations (2007-2011) over Southern Africa.

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1-Introduction

Fires emit annually more than 2 GtC in the atmosphere, an amount which represents about one third of anthropic emissions, and which plays a key role in the interannual variations of three major gases: CO₂ (90% of the emissions), CO (9%) and CH₄ (<1%).

2-Definition of Daily Tropospheric Excess (DTE)

Infrared sounders onboard polar satellites overpass every point twice a day. TOVS/ATOVS onboard NOAA and MetOp-A platforms, observes CO₂ by day and by night, allowing to study the night minus day difference of retrieved CO₂. We call this difference the Daily Tropospheric Excess (DTE) of CO₂ (Chédin et al. (2005, 2008)) have shown for NOAA10 observations that DTE is closely related to fire emissions. Here, we present the results obtained with the ATOVS instrument onboard MetOp-A that can be directly compared to classical fire products over the same period.

3- Retrievals of midtropospheric CO₂ column from MetOp-A/ATOVS

ATOVS (The Advanced TIROS Operational Vertical Sounder):

- HIRS/4 (High Resolution Infrared Radiation Sounder version 4):
  - 20 channels between 650 and 2500 cm⁻¹
  - Here, we use 5 HIRS channels given below:
    - T (K):
    - 2 3 4 5 6
    - 0.05 0.00 0.09 0.12 0.12

- AMSU-A (Advanced Microwave Sounding Unit-A):
  - 15 channels (mostly sensitive to the temperature profile).
  - Here, we use 2 AMSU-A channels: number 6 and 8.

4- Daily Tropospheric Excess (DTE) cycle of CO₂ in Southern Africa

- Southern Africa is divided into 10 sub-regions following Hoelzemann (2006) in the tropics [25S-0] with different vegetation characteristics. We define two large regions SAIN (Southern Africa, North : grouping together sub-regions 1, 2, 3, 4, 5 and 6) and SAIS (Southern Africa, South : grouping together sub-regions 7, 8, 9 and 10).
- CO₂ DTE retrievals are compared to the GFEDv3.1 (Global Fire Emissions Database version 3 (Giglio et al., 2010)).
- BA: Burnt areas MODIS Database (Roy et al., 2008).

5-Conclusion

- Infrared sounders enable to monitor the diurnal evolution of CO₂ emitted by fires.
- Qualitatively, our study highlights the diurnal cycle of tropospheric CO₂ in Southern Africa, which is in good agreement with the fire activity. Quantitatively, the DTE signal intensity is too small or to high as would be expected from the classical fire products.
- This study confirms the results obtained with the TOVS instruments onboard NOAA10 and highlights the interest of reprocessing the whole time series of the TOVS/ATOVS instruments (more than 25 years) to derive information on fire emissions before the MODIS era.
- Another step in this study will be to apply the same method of CO₂ retrievals and derived the CO₂ DTE, using the IASI instrument onboard MetOp-A (Crevoisier et al., 2004 2009a,b) and compared with the present results.