Temporal Improvements for Modeling Emissions by Scaling (TIMES) and spatial improvements to Canadian fossil fuel CO_2 emission data

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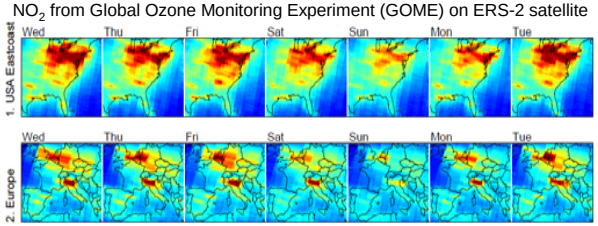
Overview and Summary

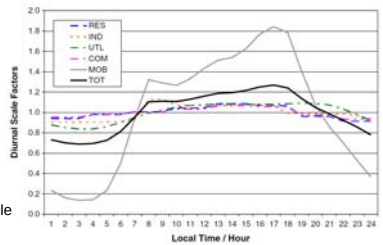
- Variability of fossil fuel CO_2 emission on diurnal or weekly cycles is usually neglected in modeling
- Temporal Improvements for Modeling Emissions by Scaling (TIMES) is a new modular product to represent variability of CO_2 emissions on these scales for use with CDIAC, ODIAC, EDGAR, etc.
- TIMES uses Vulcan, EDGAR, Canada's National Inventory Report and knowledge of NO_2 variability from satellites to derive 0.25°x0.25° global scale factor maps for diurnal & weekly scaling

NO_2 from Global Ozone Monitoring Experiment (GOME) on ERS-2 satellite

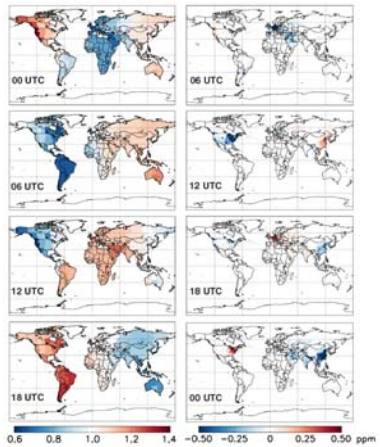


Vertical Column Density: 10^{15} molecules / cm^2. **Reference:** *Beirle et al.* (2003), Weekly cycle of NO_2 by GOME measurements: a signature of anthropogenic sources, ACP, 3, 2225.

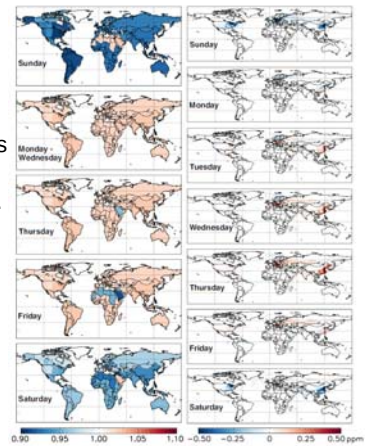
Diurnal Variability from Vulcan



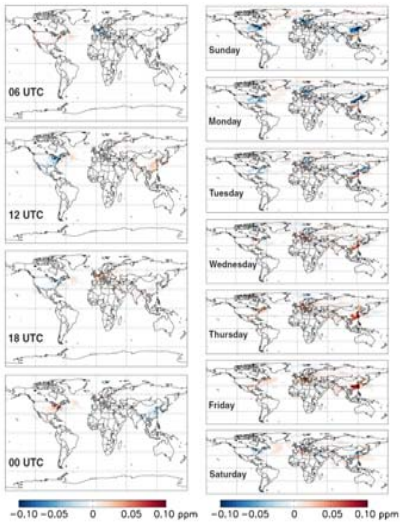
TIMES for Diurnal and Weekly CO_2 Variability at Surface



- Perturbation in surface atmospheric CO_2 (ΔCO_2), determined as CO_2^{scaled} - $CO_2^{unscaled}$ from 2 GEOS-Chem simulations
- Max/Min move west over time. Time lag between emission and roughly co-located ΔCO_2 over urban areas
- Diurnal scaling effects are more intense than weekly, but weekly scaling impacts are more long-lived

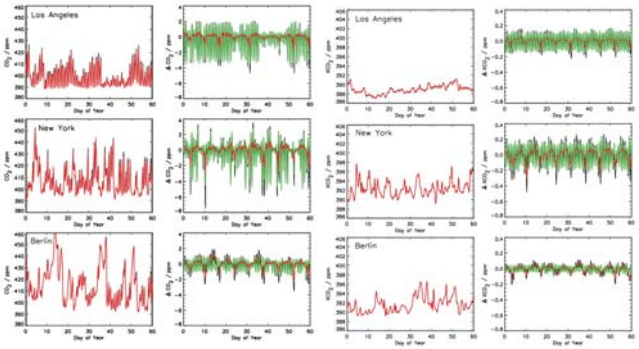


Effects on XCO_2



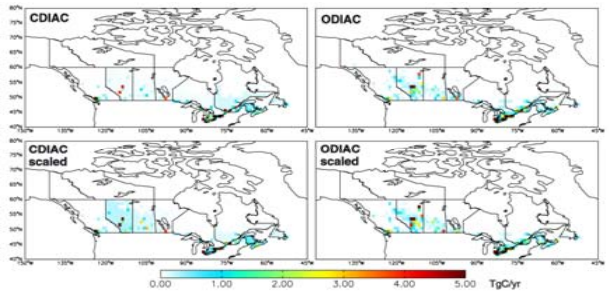
- Impacts on XCO_2 are important for CO_2 flux estimation using satellite data from GOSAT, OCO-2 and future missions
- Although XCO_2 impacts are smaller than for surface CO_2, they are not negligible in comparison to precision target of OCO-2 (~1 ppm) or ~0.25 ppm precision quoted for validation data from Total Carbon Column Observing Network (TCCON)

CO_2 Over Major Urban Areas



- Impacts on CO_2 and XCO_2 are largest near major urban areas
- ΔCO_2 of 8 ppm and ΔXCO_2 0.5 ppm for New York

Canadian Spatial Redistribution



- 1°x1° Canadian spatial redistribution scale factors make CO_2 emissions consistent with province values in Canada's National Inventory Report
- Larger changes imposed for CDIAC compared with ODIAC suggesting that its point source + nightlight approach is more reliable for Canada

Access to the Data Product

Publicly available through the CDIAC web/FTP site:
ftp://cdiac.ornl.gov/pub/Nassar_Emissions_Scale_Factors/

Publication

R. Nassar, L. Napier-Linton, K.R. Gurney, R.J. Andres, T. Oda, F.R. Vogel, F. Deng (2013), Improving the temporal and spatial distribution of CO_2 emissions from global fossil fuel emission datasets, *Journal of Geophysical Research*, 118, doi:10.1029/2012JD018196

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