Global measurements of isoprene from CrIS

Kelley Wells¹, Dylan Millet¹, Dejian Fu², Vivienne Payne²

¹University of Minnesota; ²JPL, Caltech

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Biogenic volatile organic compounds impact air quality and climate



Isoprene:

- Dominant emitted BVOC
- Emissions ~ methane, 4× anthropogenic VOCs
- Short lifetime (~1 hr)
- Key player in atmospheric oxidation and Nitrogen cycling



Isoprene emissions exhibit strong heterogeneity; bottom-up emission estimates span a wide range



Emission uncertainties due to:

- Model meteorology
- Land cover (vegetation type, LAI)
- Canopy parameterization
- Emission algorithm

Space-based HCHO often used as a proxy for isoprene emissions, but some limitations exist





- HCHO-isoprene relationship is a non-linear function of NO_x
- HCHO is NOT a unique marker for isoprene emissions

Space-based HCHO and isoprene measurements would provide constraints on both emissions <u>and</u> chemistry



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July 2013 GEOS-Chem

Recent lab measurements of the isoprene TIR cross section are allowing direct isoprene retrievals from SNPP-CrIS



Brauer et al., 2014

Isoprene signal is detectable in individual NPP-CrIS spectra over the Amazon



We employ a BT difference + artificial neural network (ANN) approach to look at global isoprene from SNPP-CrIS



BT difference approach: $\Delta BT = BT_{rhs} - BT_{peak}$

- e.g., for IASI NH₃ (Clarisse et al., 2009), methanol and formic acid (Razavi et al., 2011)
- Start from single footprint, subsetted Level 1B radiances
- **Pros:** quick way to process global data, no dependence on a priori
- **Cons:** does not account for instrument sensitivity, purely empirical

We employ a BT difference + artificial neural network (ANN) approach to look at global isoprene from SNPP-CrIS



- Has been used for retrievals of NH₃ from IASI (Whitburn et al., 2016)
- Training set based on one year of ELANOR simulations over land (~120,000 spectra)
 - Temp, H₂O from GMAO
 - Interferents (HNO₃, CFC-11/12, NH₃) based on climatology with noisy scaling
 - Isoprene profiles from GEOS-Chem assigned randomly with noisy scaling

We employ a BT difference + artificial neural network (ANN) approach to look at global isoprene from SNPP-CrIS



- 2 hidden layers with 6 and 3 nodes of sigmoidal transfer functions
- Use the mean of 10 random extractions of the data
- 50% of data used for training, 30% for testing, 20% for validation

SNPP-CrIS July 2013 monthly mean BT difference



Preliminary SNPP-CrIS July 2013 ANN-derived isoprene column



ANN input for July 2013 shows impact of primary interferences on NPP-CrIS BT difference





Preliminary SNPP-CrIS isoprene exhibits some features consistent with known isoprene sources

CrIS isoprene column

GEOS-Chem isoprene column





0.00e+00 6.67e+15 1.33e+16 2.00e+16 [molec/cm²]

Indirect evaluation with GEOS-Chem exhibits consistency with aircraft-model comparison over the Southeast US



Next steps and acknowledgments

- Refine training set and ANN prediction
- Evaluation of results over Amazon
- Comparison to OE retrievals (Dejian Fu)
- Science analysis with space-based HCHO measurements

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