Supporting Information for "Detecting Urban Emissions Changes and Events with a Near-Real-Time-Capable Inversion System"

John Ware[1,2], Eric A. Kort[2], Riley Duren[3], Kimberly L Mueller[2,4], Kristal Verhulst[3], Vineet Yadav[3]

[1]Department of Physics, University of Michigan, Ann Arbor, Michigan, USA

[2]Department of Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, Michigan, USA

[3]NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

[4]National Institute of Standards and Technology (NIST); Gaithersburg, MD, United States of America

Contents

Corresponding author: John Ware, johnware@umich.edu

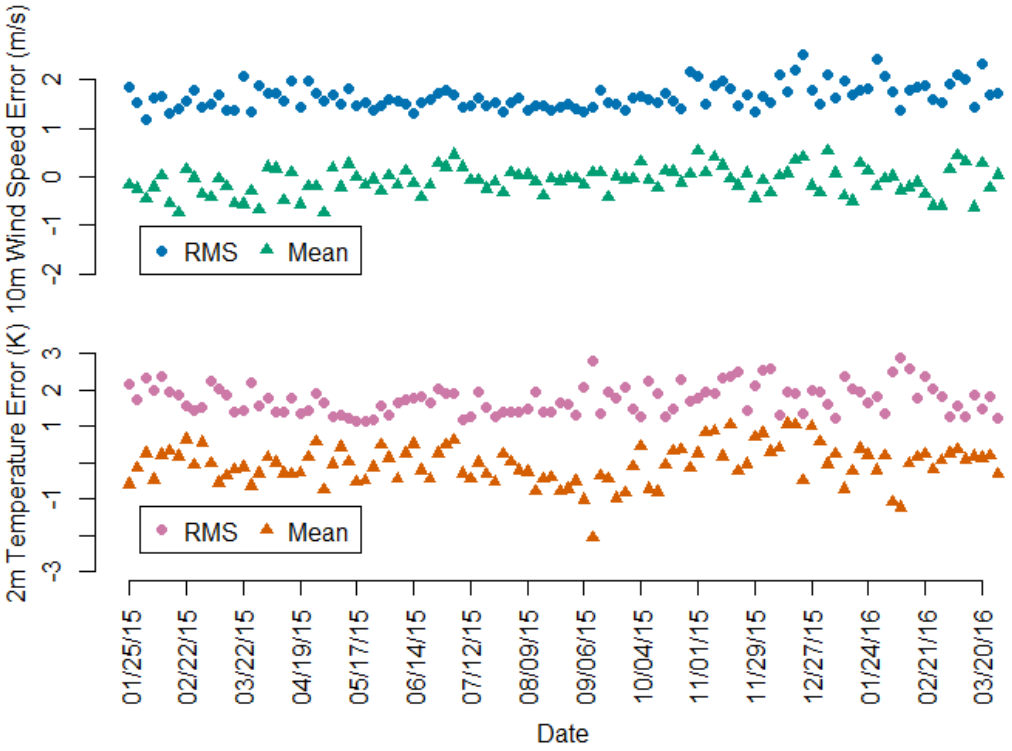

Figure 1. Time series of bias and RMS errors in WRF-simulated 2 m temperature (bottom) and 10 m wind speed (top) as compared to surface station observations.

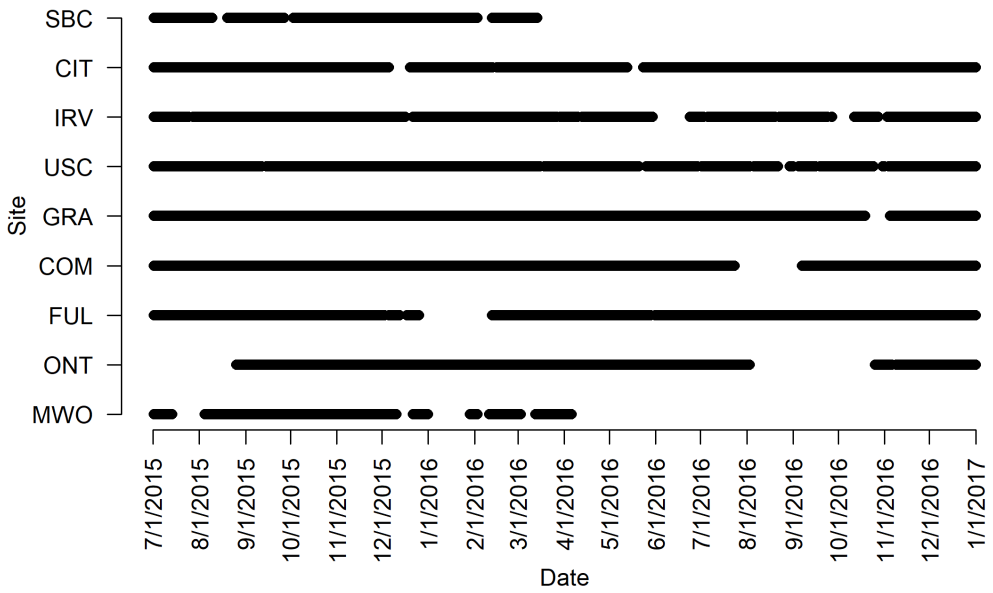

Figure 2. Availability of mole fraction data for each of the nine sites within the SOCAB domain used in this study.

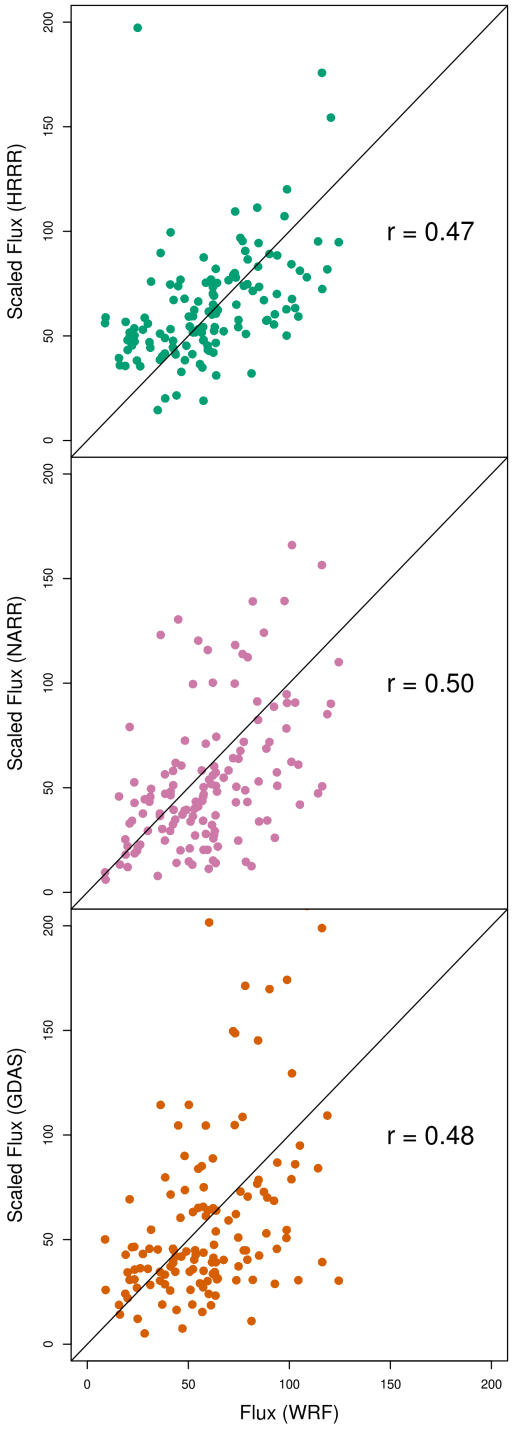

Figure 3. Scatter plots of four-day methane flux estimates from the WRF-driven inversion as compared to the corresponding fluxes from the HRRR-, NARR-, and GDAS-driven inversions after applying calibration. The correlation coefficient between the calibrated fluxes and the WRF-derived fluxes is inset in each case.

Option	Description
Land Surface	Noah land-surface model with Monin-Obukov (Janic) surface layer
Urban Canopy	None
PBL Package	MYNN 2.5-level scheme
LW Radiation	RRTMG
SW Radiation	RRTMG
Microphysics	WSM 5-class scheme
Convection	Grell-3d (in outer domains)
Nesting	One-way
Nudging	None
Advection	5th-order horizontal, 3rd-order vertical, monotonic advection for moisture and scalars
Diffusion	2nd-order horizontal diffusion using Smagorinsky first-order closure

Table 1. Summary of WRF options used.

	HRRR		NARR		GDAS	
Period	Predicted	Actual	Predicted	Actual	Predicted	Actual
1	106%*	70%	76%*	121%	158%*	194%
2	94%*	52%	64%*	91%	139%	154%
3	64%	60%	52%*	151%	122%*	176%
4	65%	55%	54%	52%	97%*	68%
5	66%*	43%	45%*	102%	71%*	113%
6	65%*	32%	45%*	68%	58%*	92%
7	71%	54%	42%	60%	67%	86%
8	83%*	46%	38%*	81%	62%*	100%
9	88%*	43%	37%*	82%	55%	73%
10	64%	56%	36%*	120%	59%*	174%
11	85%*	65%	54%*	110%	97%*	140%
12	76%	70%	60%*	81%	92%*	154%
13	93%*	62%	56%*	98%	104%*	135%
14	76%	80%	54%*	109%	116%*	184%
15	88%	81%	73%	78%	145%*	196%
16	81%	76%	54%*	116%	132%*	168%
17	110%*	57%	68%*	214%	113%	115%
18	88%*	51%	70%*	101%	89%	72%
19	86%*	56%	64%*	107%	70%*	140%

Table 2. Actual: total mean sensitivity of observations in each of nineteen 28-day periods according to STILT footprints driven by HRRR, NARR, and GDAS, relative to sensitivity according to footprints driven by WRF. Predicted: Sensitivity relative to WRF, over the same time period, predicted as in Equation 3 on the basis of residence time, near-surface fraction, and mixing height. Predicted values marked with asterisks differ from actual values by more than 20 percentage points.