

Supporting Information for "Evaluation of inverse estimates of North American net ecosystem exchange of CO₂ from different observing systems using ACT-America airborne observations"

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This supplement includes six figures as the supporting analysis. Detailed descriptions are contained in Text S1.

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Introduction

Text S1. The averaged CO₂ NEE flux maps corresponding to each campaign time period are shown in Figure S1, to illustrate the estimation of CO₂ NEE flux from the different products. In the study, we evaluated the four flux products for the ecoregions in the three domains with the day/night intervals during the campaign. We only evaluated the spatially and temporally resolved fluxes which were constrained by the aircraft campaign.

Figure S2 shows the comparisons between background values of CO₂ mole fractions along flight tracks (> 4,000 m MSL) and the ACT-America measured CO₂. The difference (> 4,000 m MSL) between the background values and the ACT CO₂ measurements up to 1.1, 0.45, 0.65, and 0.37 ppm, for the four campaigns, respectively. The differences are much smaller than the ambient CO₂ mole fractions.

In this study, the suitable regions restricted by $H^T H$ are analyzed. For the computational efficiency, we only focused on the grid cells associated with the large values of influence functions. Specifically, the grid cells associated with the values of the accumulated influence functions (each campaign) that are greater than the 65th percentile of the accumulated influence functions are considered. The corresponding maps are shown in Figure S3.

Figure S4 shows the eco-regions are considered for each campaign in the study. The eco-regions are defined in CarbonTracker system (https://www.esrl.noaa.gov/gmd/ccgg/carbontracker/CT2019B_doc.php#tth_sEc9). ACT-America covers 17 different ecosystems. We aggregate the grid cells by ecosystems in each of the three domain (shown in Figure 3) to obtain the grid clusters used in our analysis.

The spatial map of ε values, at the seasonal level, refer to the daily, daytime and nighttime flux estimation from the four flux products are shown in Figure S5, Figure S6 and Figure S7, respectively.

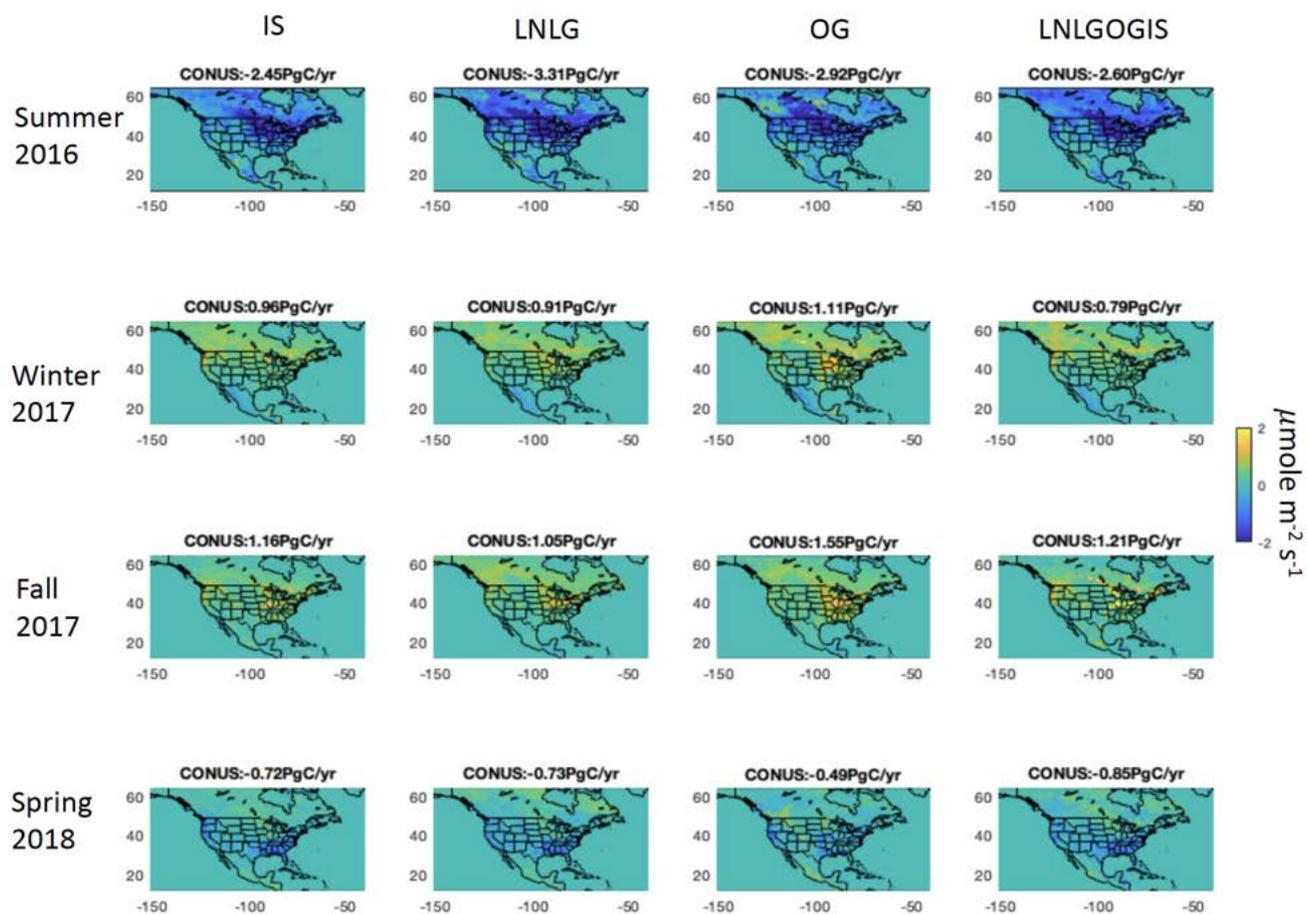


Figure S1. Average CO₂ NEE from four flux products corresponding to the ACT-America campaign periods, respectively. ACT-Summer2016: July-August; ACT-Winter2017: January-March; ACT-Fall2017: September-November; ACT-Spring2018: April-May.

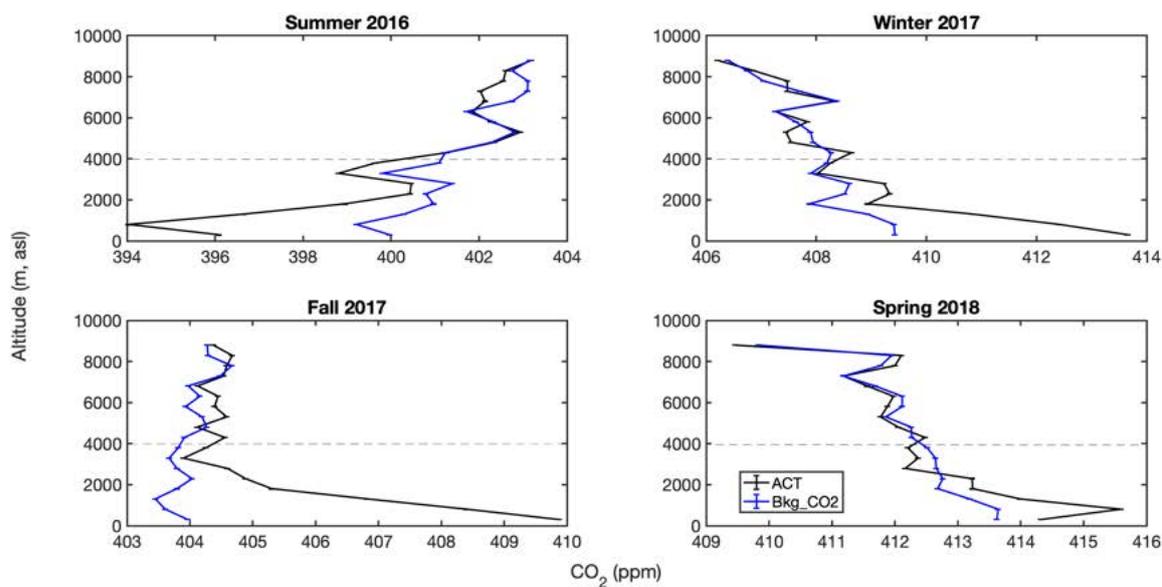


Figure S2. Vertically (every 500m interval) averaged CO₂ mole fractions are shown from the ACT-America measurements (“ACT”) as well as the background values simulated by WRF-Chem (see Feng et al., 2019a, “Bkg_CO₂”), for each campaign. All flight data are included except take-off and landing portions.

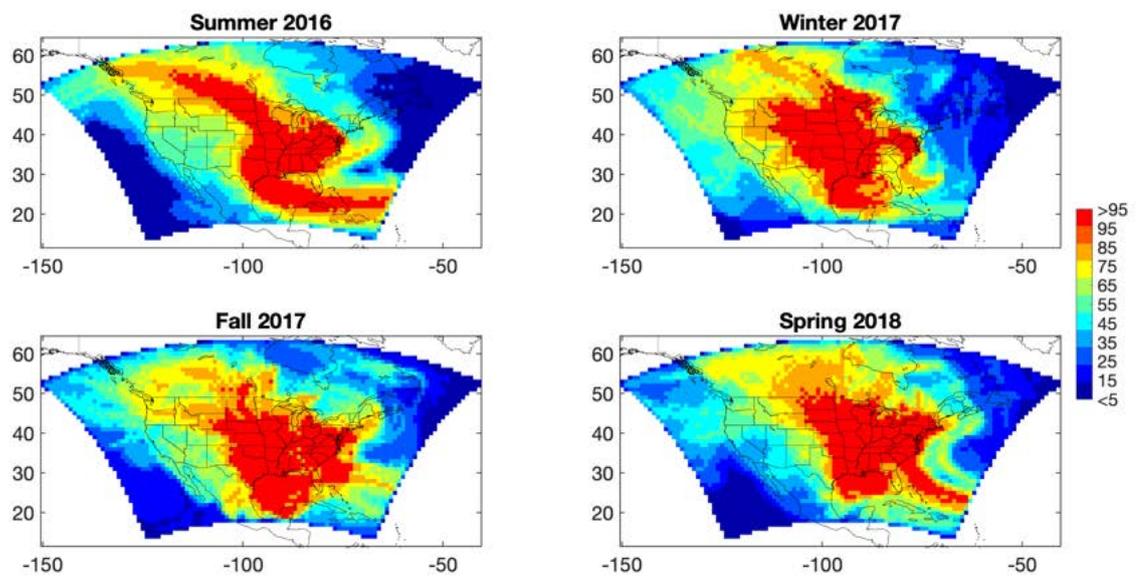


Figure S3. The values of the accumulated influence functions colored by percentile levels, for each campaign.

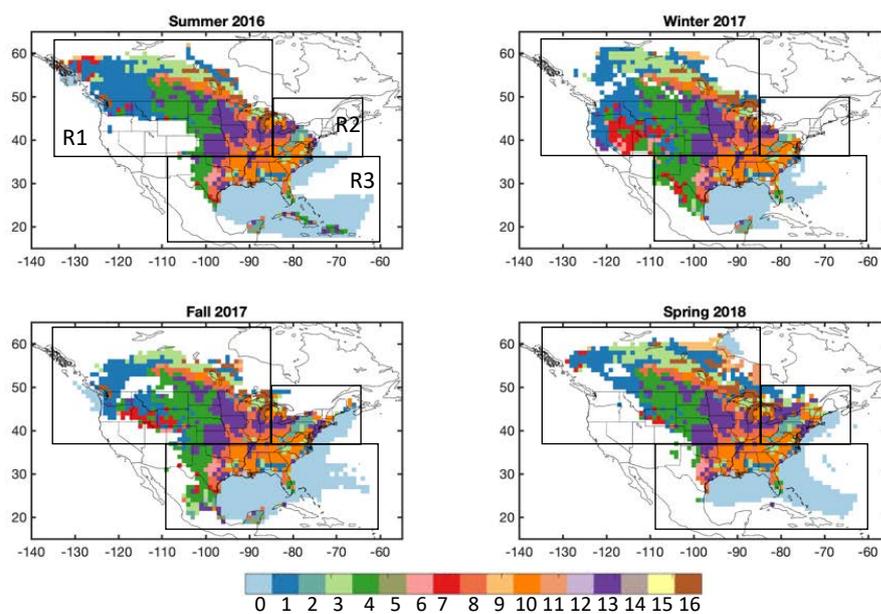


Figure S4. The maps of ecoregions are considered in the study for each campaign.

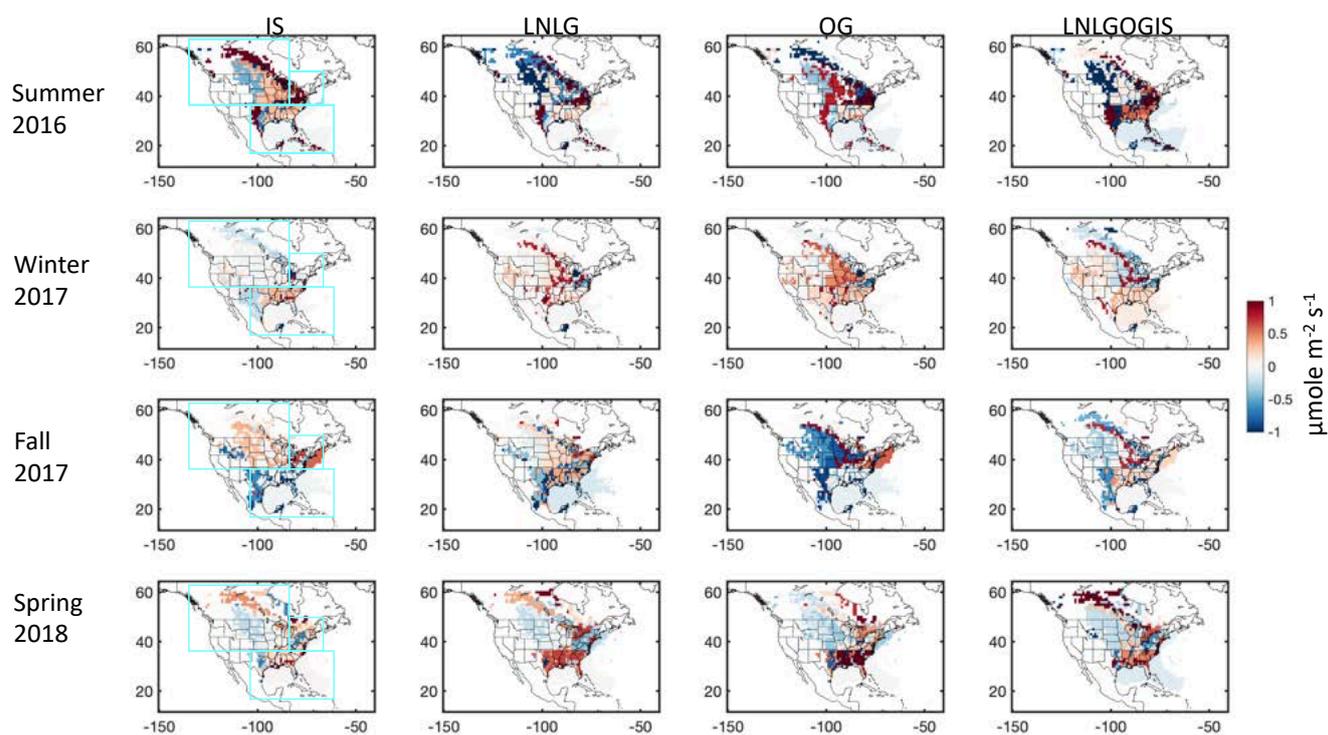


Figure S5. The spatial map of ϵ values refer to the daily mean flux estimation from the four flux products shown for each ACT-America campaign, respectively.

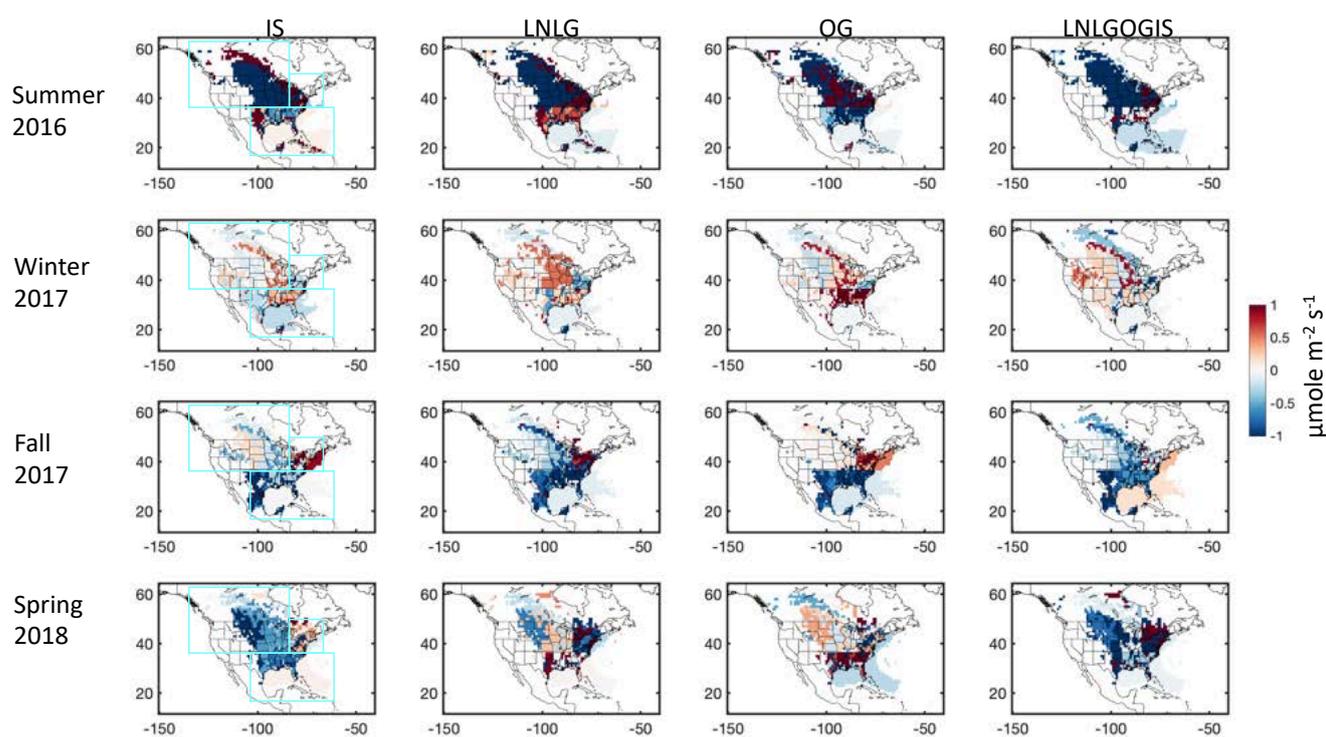


Figure S6. The spatial map of ϵ values refer to the daytime flux estimation from the four flux products shown for each ACT-America campaign, respectively.

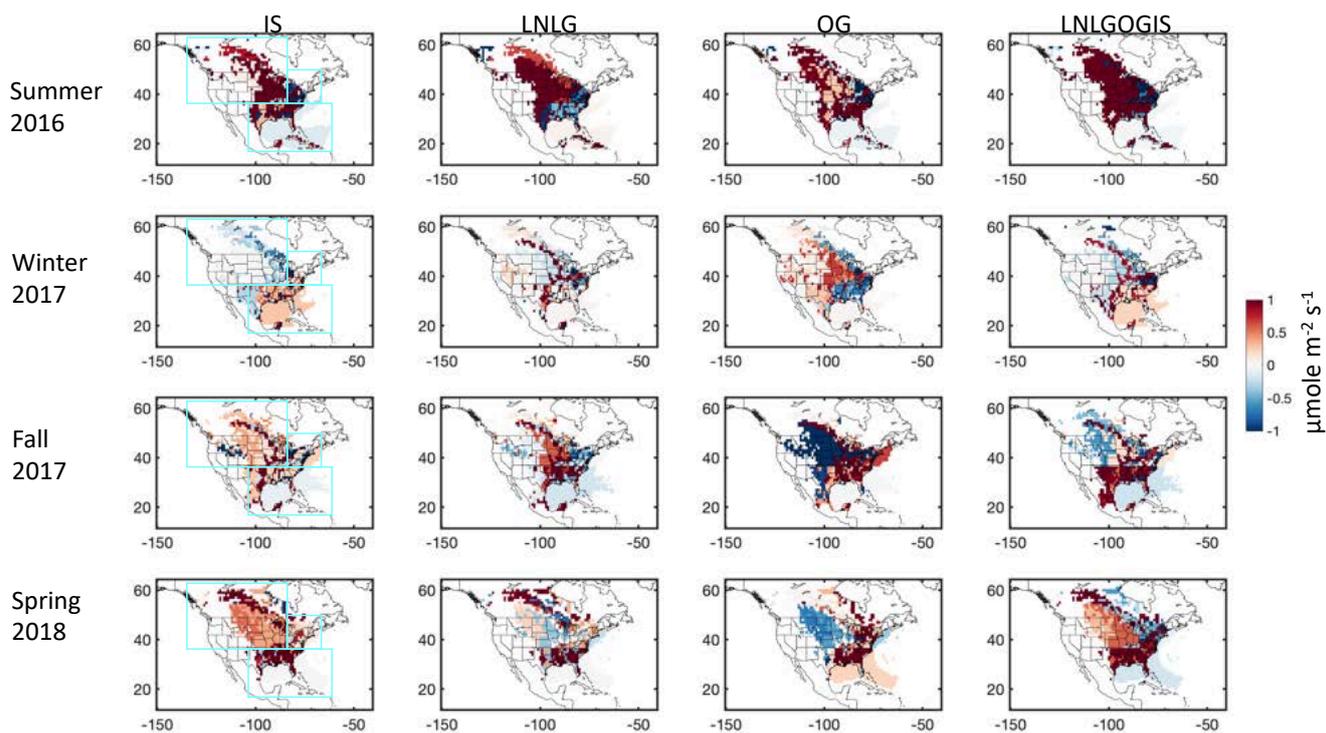


Figure S7. The spatial map of ϵ values refer to the nighttime flux estimation from the four flux products shown for each ACT-America campaign, respectively.