



*Supplement of*

## **Simulating out-of-sample atmospheric transport to enable flux inversions**

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## 1 S1 Complete training data (in-sample FootNet)

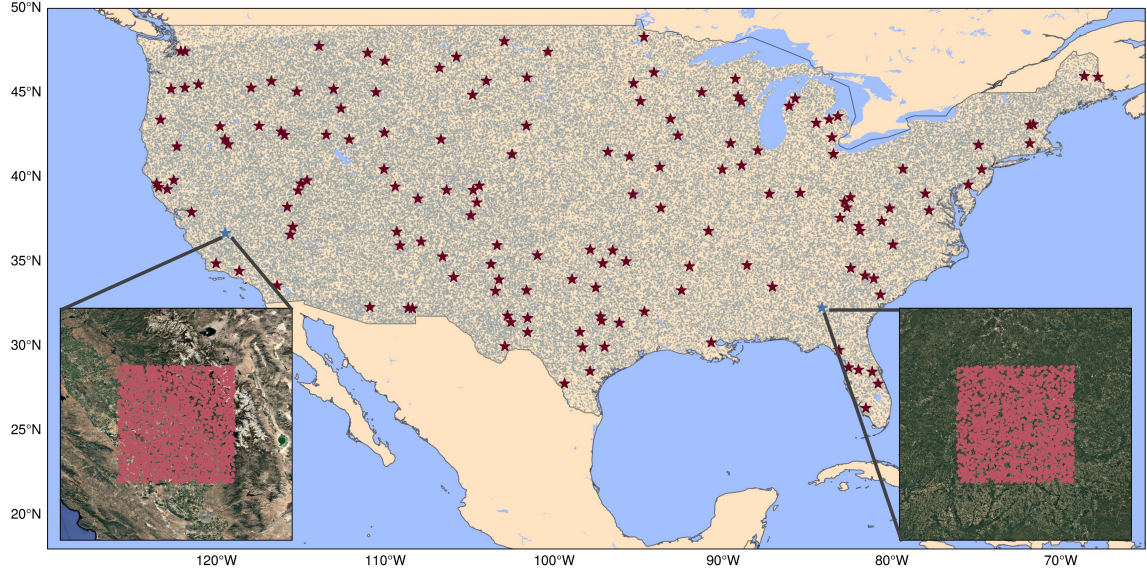


Figure S1: Receptor locations sampled for the in-sample FootNet model training. The grey dots represent receptors randomly sampled across the entire CONUS to ensure generalizability. The red stars represent randomly sampled 400 km×400 km regions in which further 2500 receptors were sampled. Background satellite imagery is taken from © Google Maps.

## 2 S2 Feature importance

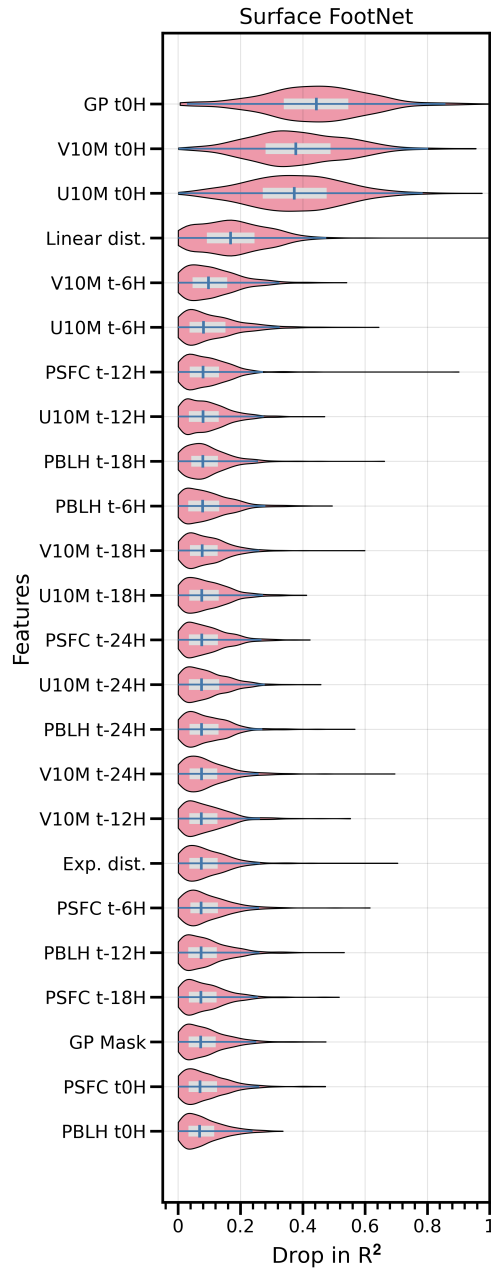


Figure S2: The complete feature importance analysis for Surface FootNet model. Here Gaussian Plume is referred to as “GP”. Suffixes on the variable names indicate the timestep (e.g., “V10M t0H” means the v-component of the 10-meter winds at the receptor time whereas “V10M t-6H” is from 6 hours before the receptor time).

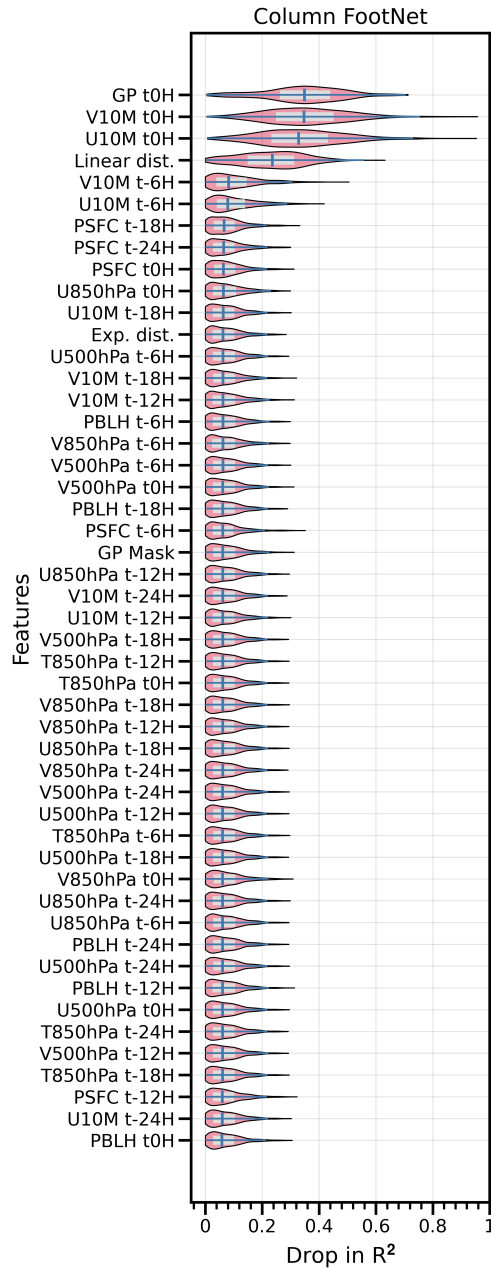


Figure S3: The complete feature importance analysis for Column FootNet model. Here Gaussian Plume is referred to as “GP”. Suffixes on the variable names indicate the timestep (e.g., “V10M t0H” means the v-component of the 10-meter winds at the receptor time whereas “V10M t-6H” is from 6 hours before the receptor time)

<sup>3</sup> S3 Flux Differences between FootNet and STILT/X-STILT

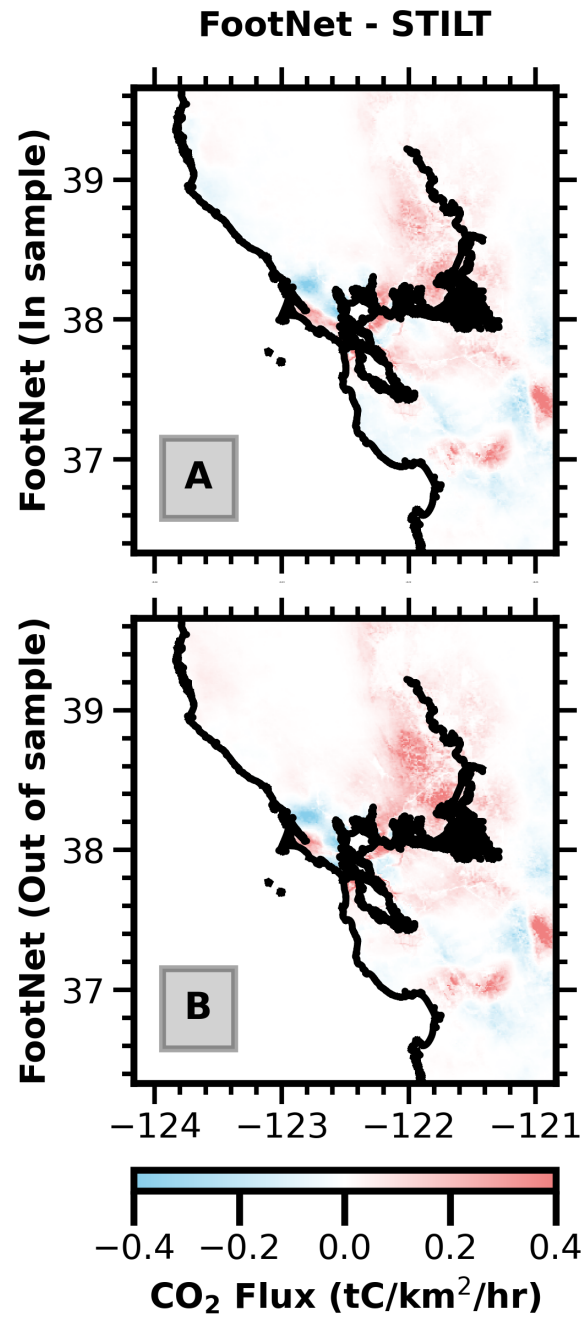


Figure S4: The difference between average CO<sub>2</sub> fluxes computed with FootNet and STILT footprints.

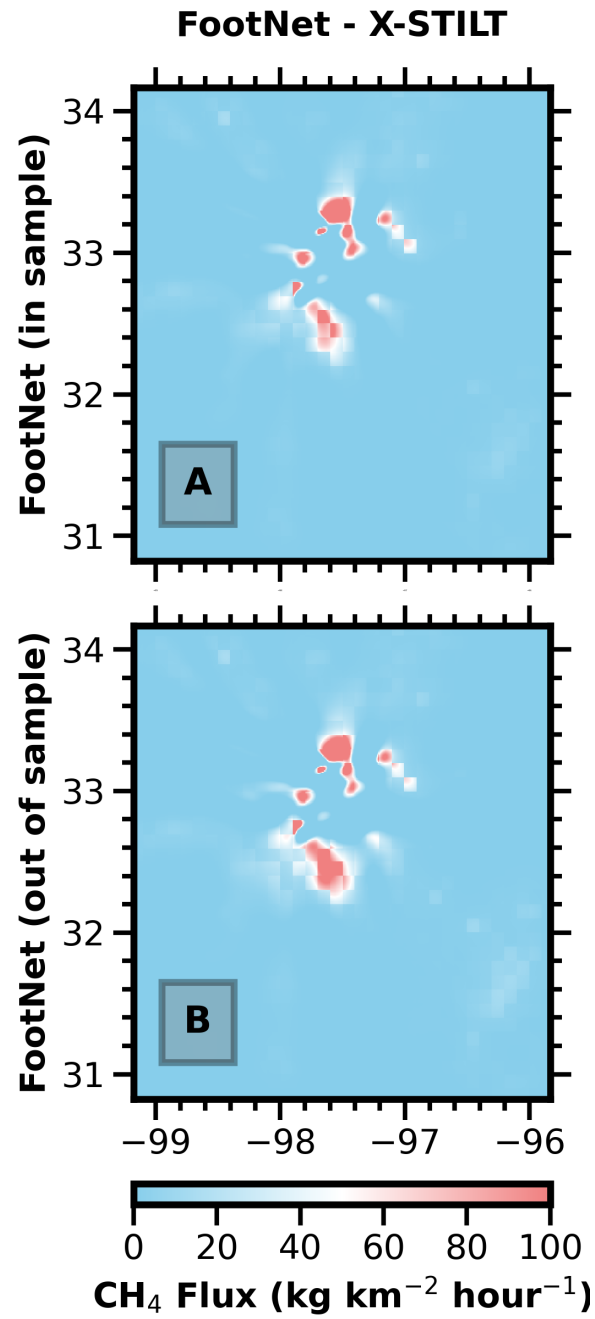


Figure S5: The difference between average CH<sub>4</sub> fluxes computed with FootNet and X-STILT footprints.

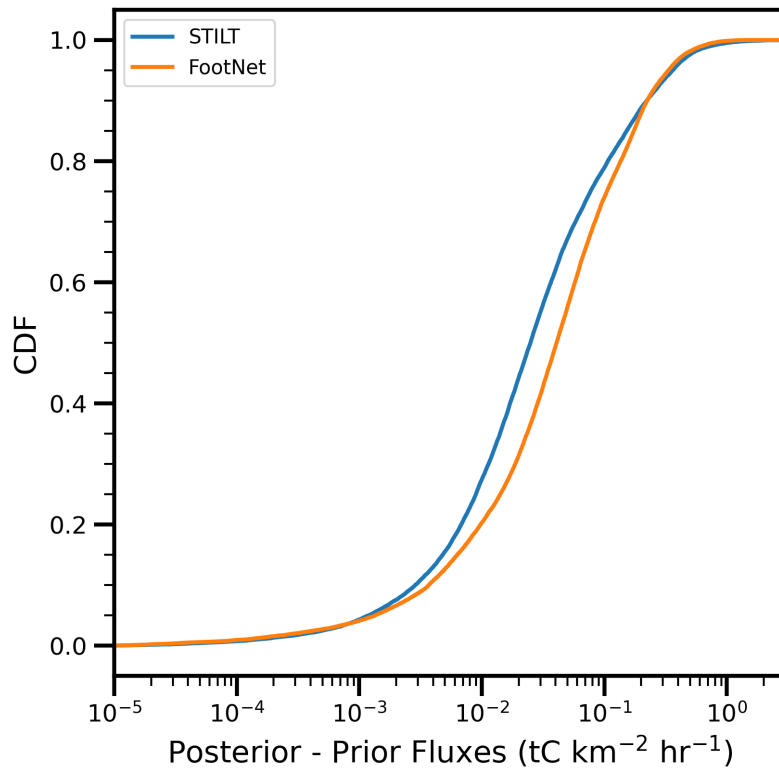


Figure S6: Cumulative Distribution Functions (CDFs) of posterior and prior differences for STILT and FootNet footprints in the San Francisco Bay Area.

#### 4 S4 Footprints computed by out-of-sample FootNet

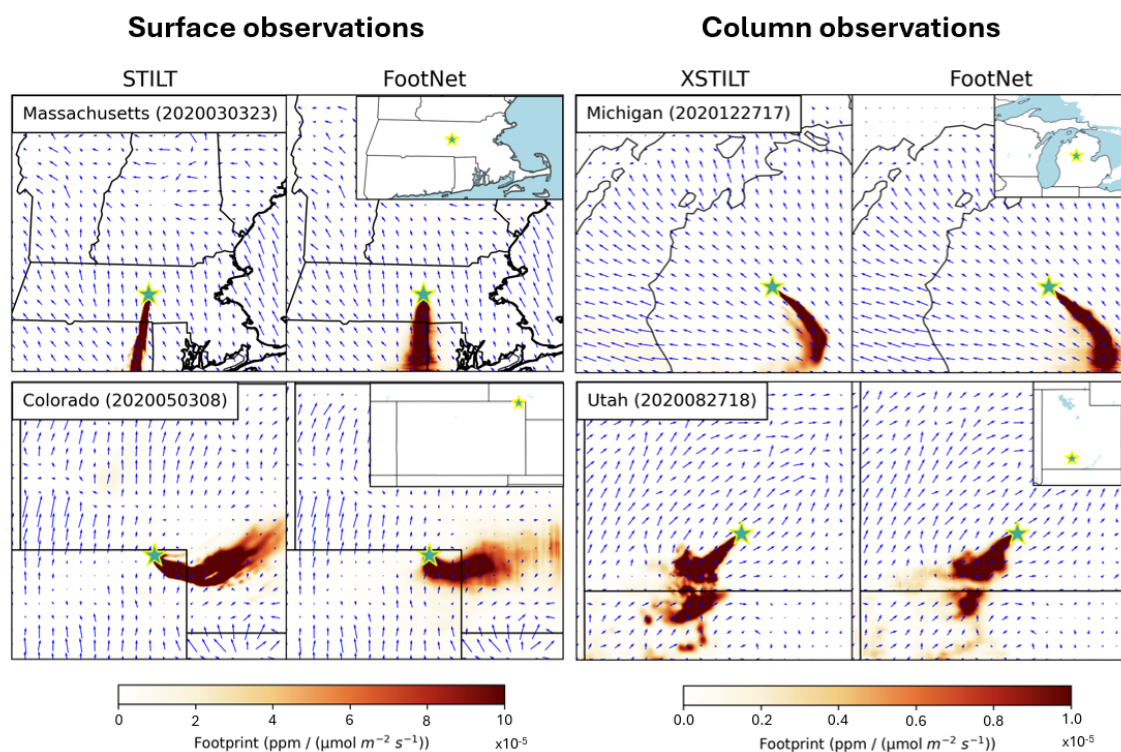


Figure S7: Footprints computed by out-of-sample FootNet for receptors sampled in year 2020. Out-of-sample FootNet was trained on footprints from 2021.