Refinery Contribution to Emissions at the Ports of Los Angeles/Long Beach: *In Situ* Surface Mobile Validation of Airborne Remote Sensing Emissions and Sample Fusion to Estimate non-Remotely Sensed Trace Gas Emissions

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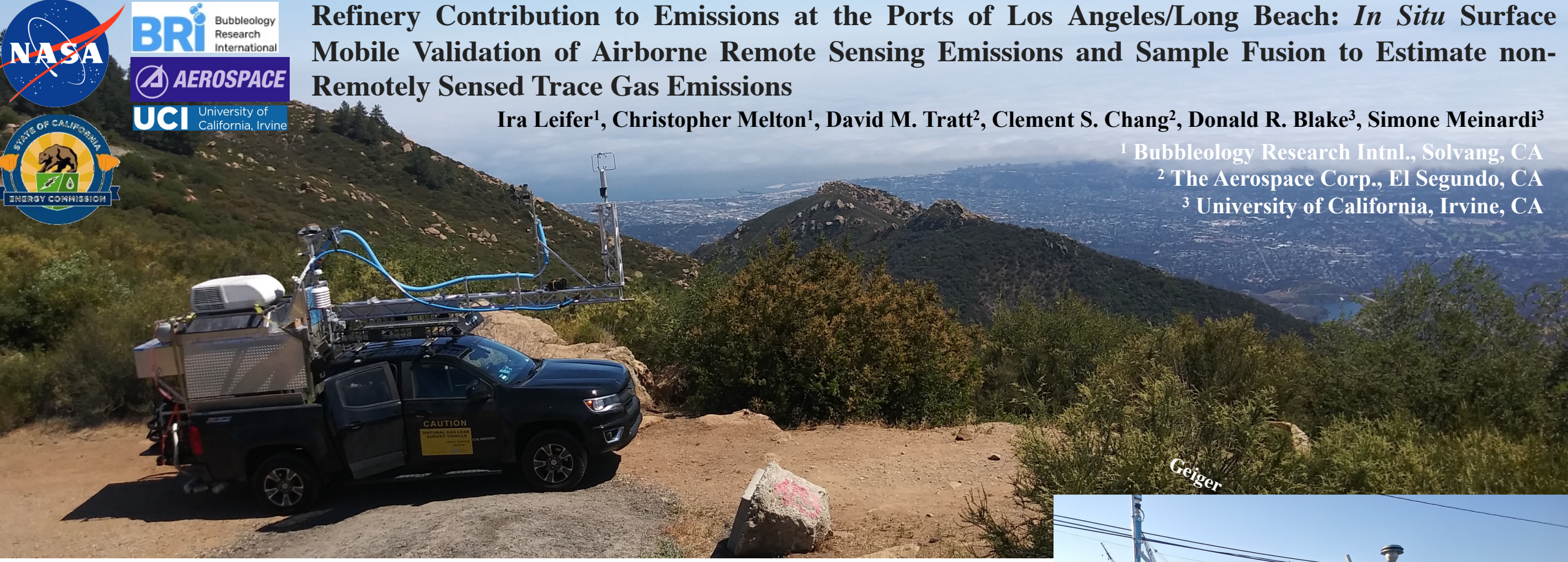


Collect simultaneous *in situ* SISTER & Mako airborne data for Port of LA refinery.

Compare SISTER plume inversion informed and uninformed models.

Altitude-varying wind veering was important.

Mako – 2.18 Gg yr^{-1}; Informed SISTER 2.73 Gg yr^{-1}, Uninformed SISTER 2.51 Gg yr^{-1}.

Collect targeted samples to profile health trace gases that cannot be remotely sensed.

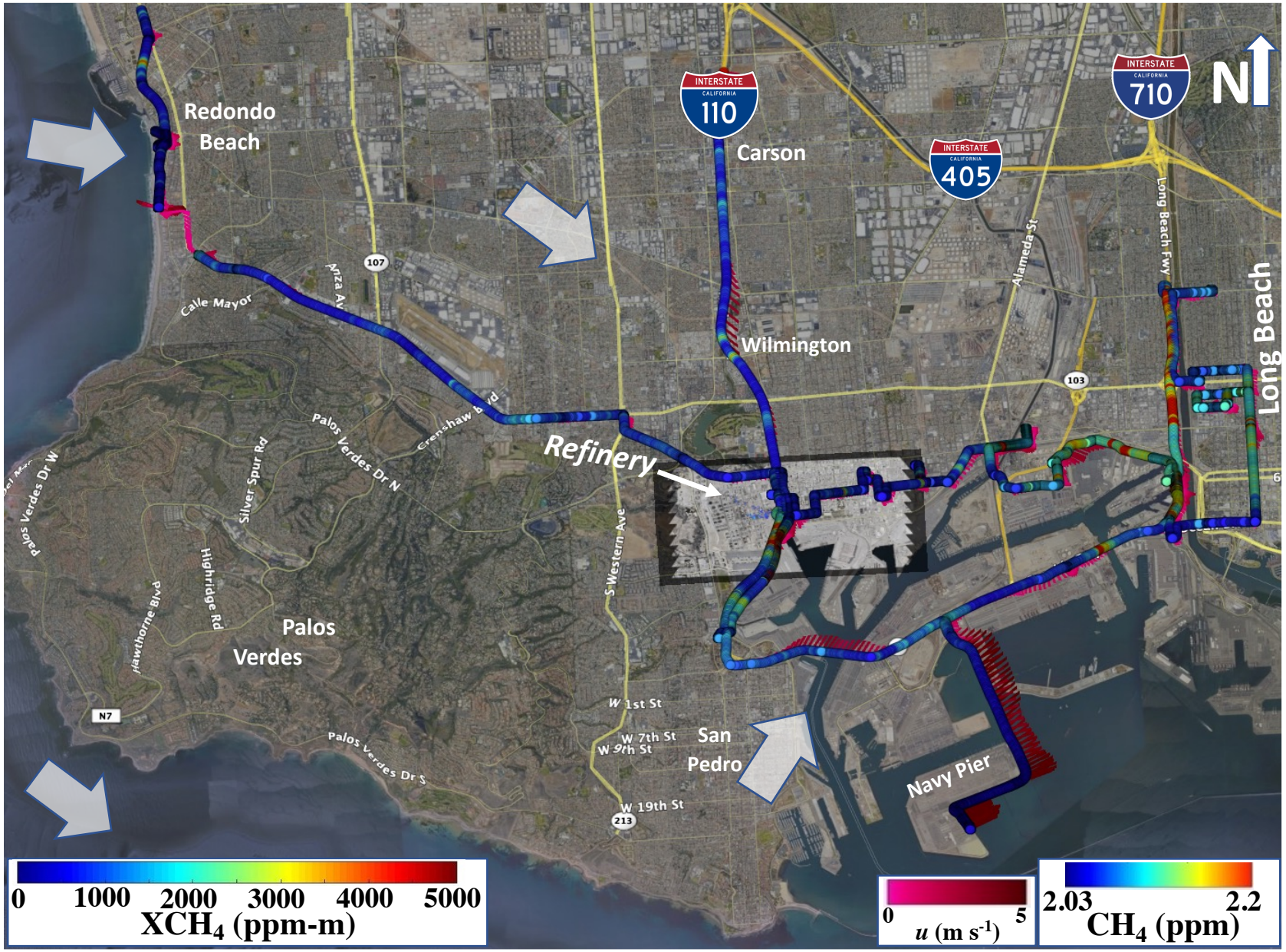
Concurrent Mako TIR Imaging Spectroscopy and SISTER *In Situ*

Winds diverge around Palos Verdes reconnecting near the refinery.

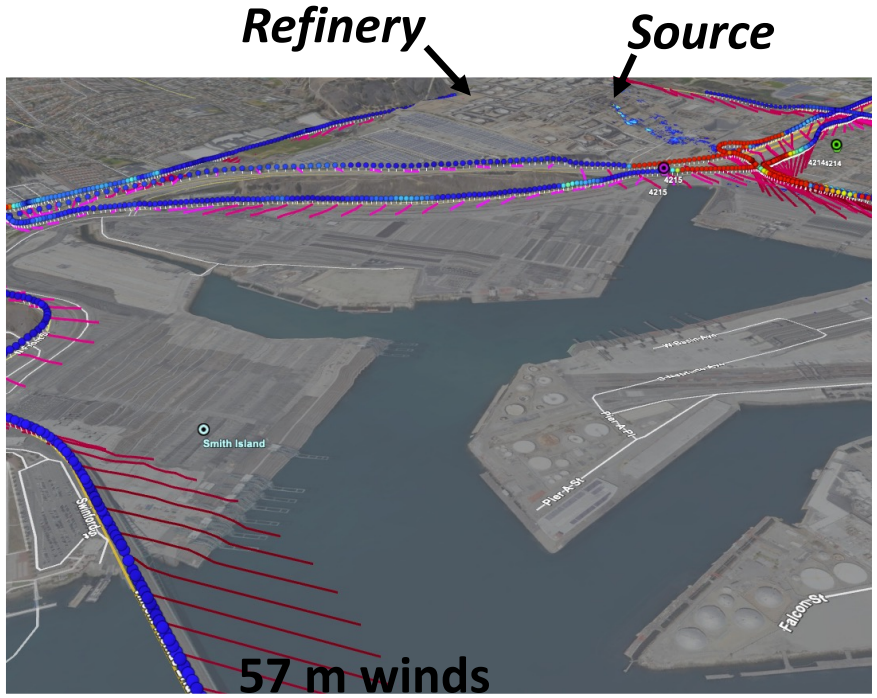
Refinery source at ~60 m altitude.

SISTER downwind data (10 m, u~2.3 m s^{-1}.

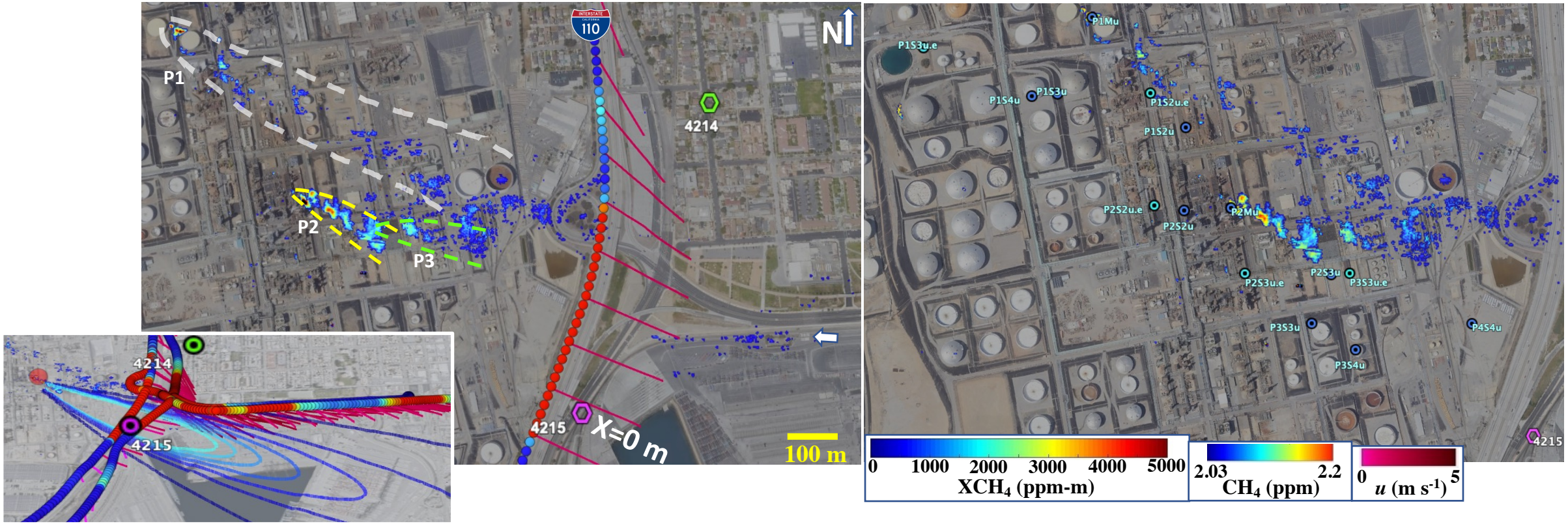
SISTER Bridge data (56 m, u~4.6 m s^{-1}).



16 June 2020



Mako shows three plumes – 2.18 Gg yr^{-1}



Informed models w/Mako source locations (including veering) : 2.73 Gg yr^{-1}

Uninformed models not using Mako data maps sources south : 2.51 Gg yr^{-1} (wind veering)

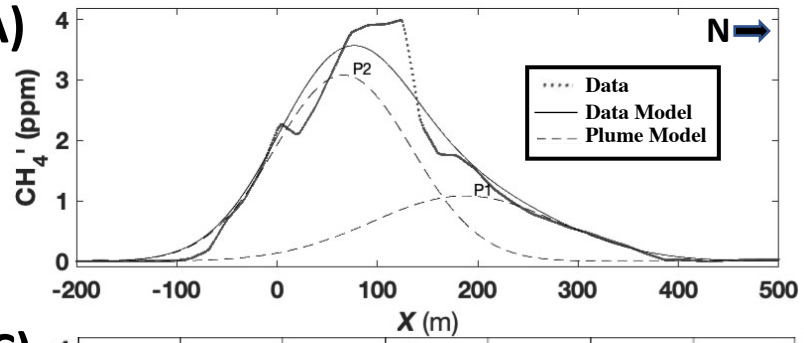
Sample canister locations shown

Models

Mako - 2.18 Gg yr^{-1}

A)

P_{T2u}



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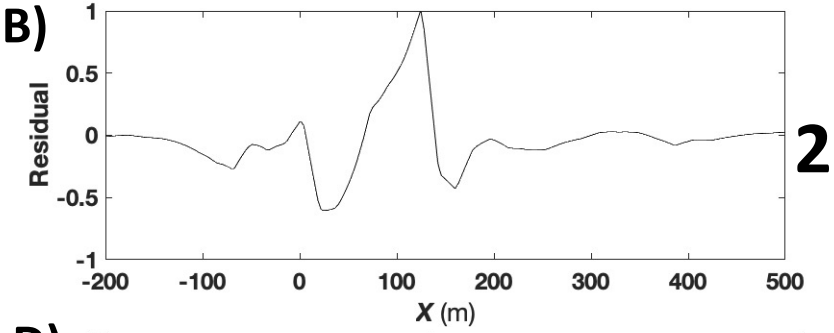
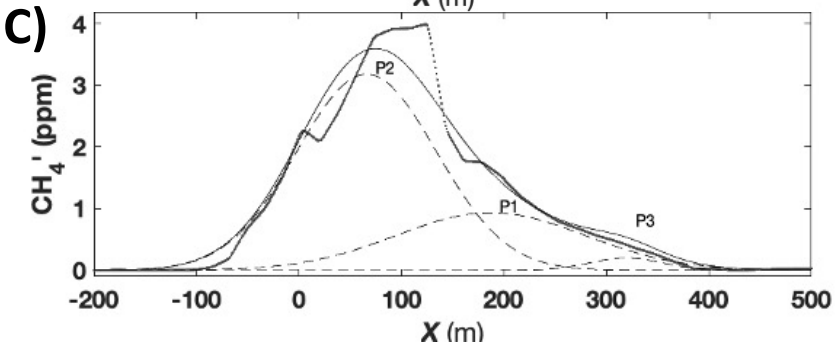


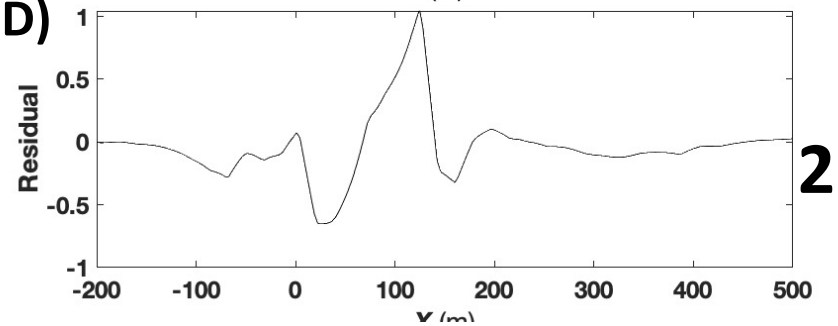
2.72 Gg yr^{-1}

C)

P_{T3i}



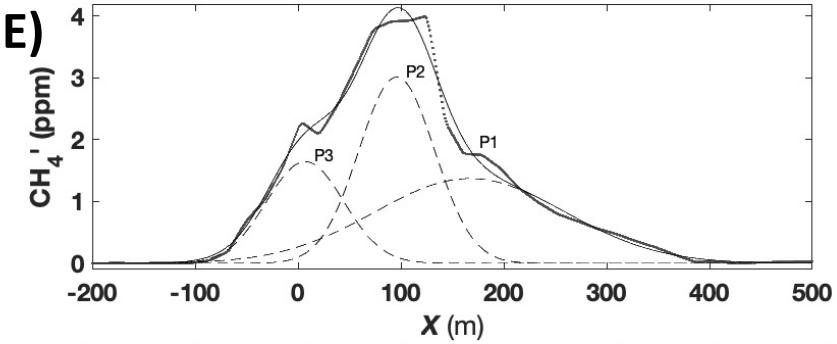
D)



2.73 Gg yr^{-1}

E)

P_{T3u}



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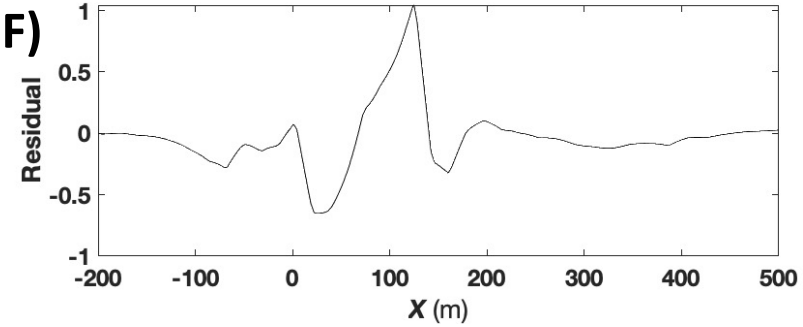
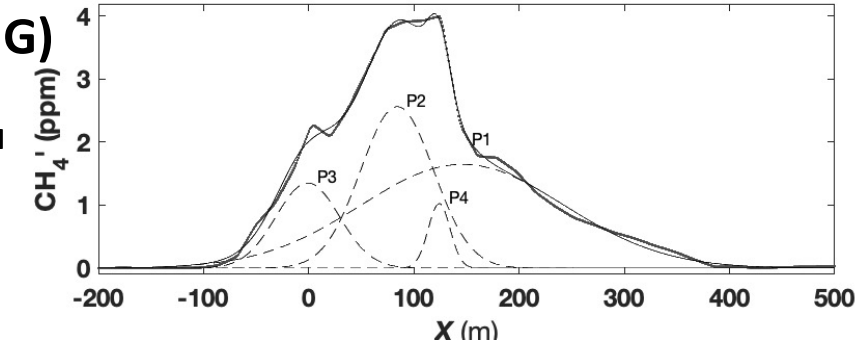


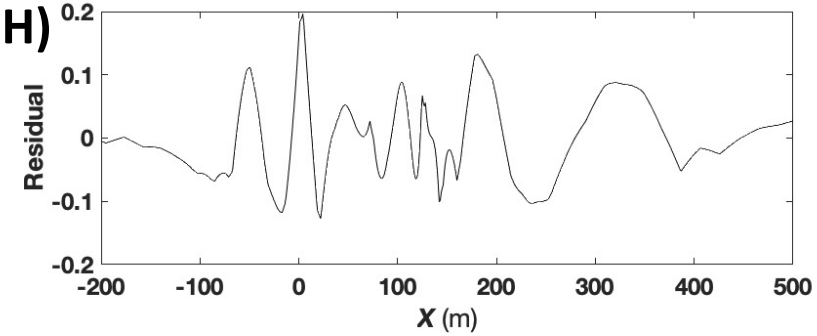
2.41 Gg yr^{-1}

G)

P_{T4u}



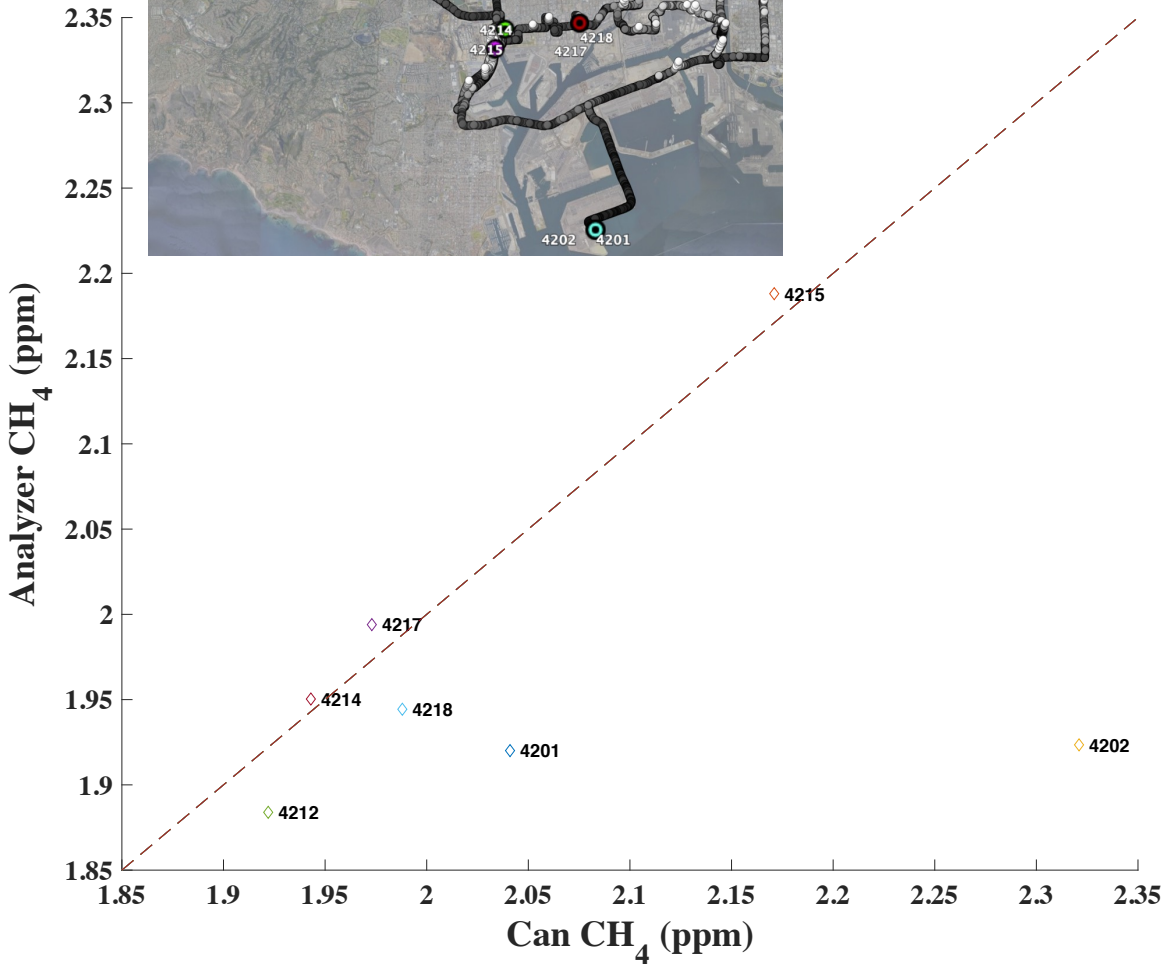
H)

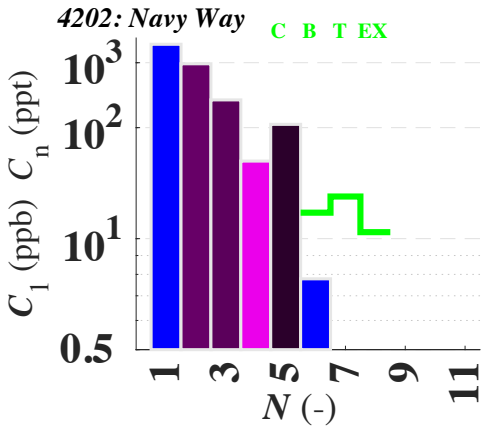


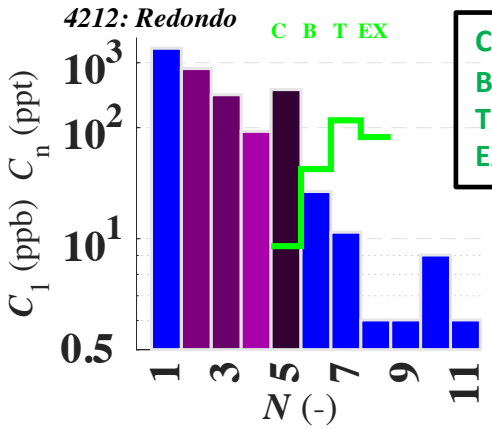
2.51 Gg yr^{-1}

Other Trace Gas Emissions

4201 – Navy Pier - Marine
4202 – Navy Pier - Marine
4212 – Redondo Beach - Marine
4214 – Refinery Background
4215 – Refinery Plume
4217 – Oil Well
4218 – Oil Well



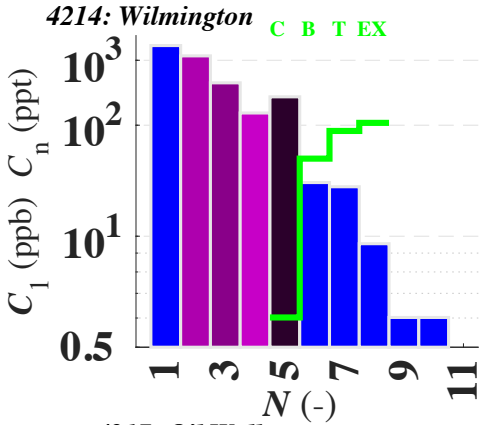


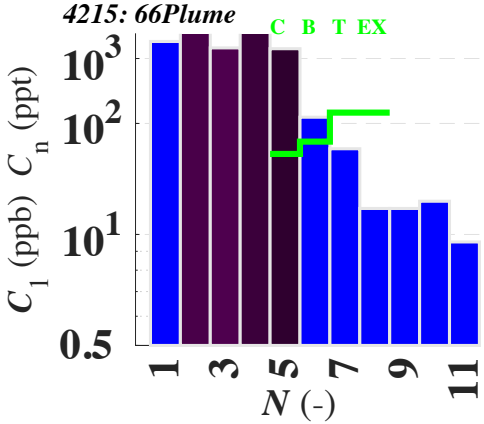


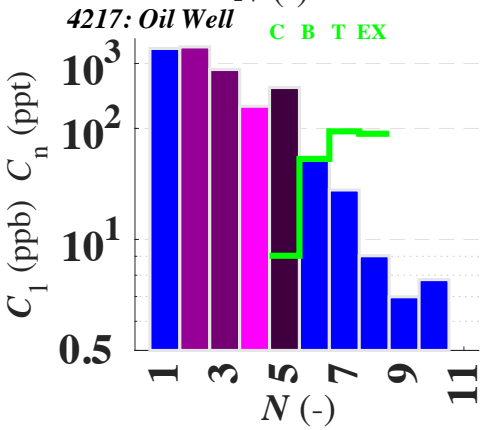
C - Cyclohexane
B - Benzene
T - Toluene
EX- Ethylbenzene + Xylene

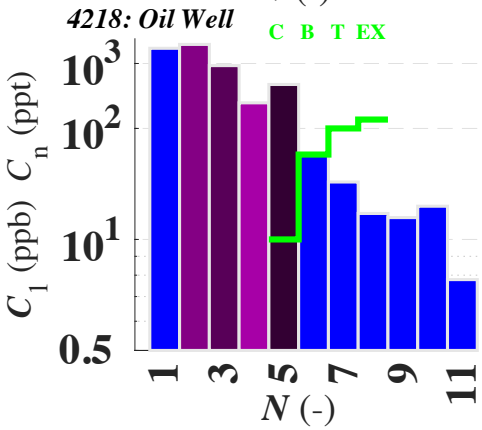
alkenes *alkanes*
>1.0 S (-) <0.1 ND

$S = \frac{\text{(alkene+alkyne)}}{\text{(alkane)}}$









Summary

Very good agreement Mako versus *In Situ*

20% informed
13% uninformed

Wind veering led to misallocation of plume emissions and incorrect source

SISTER leveraged a bridge to characterize wind profiles

Good to excellent agreement between samples and in situ (given can filling variabilities).

Refinery plume NMHCs and CBTEX much higher, much less saturated, and very distinct profile.