CMS Series #2:

Reconciling bottom-up and top-down emissions estimates

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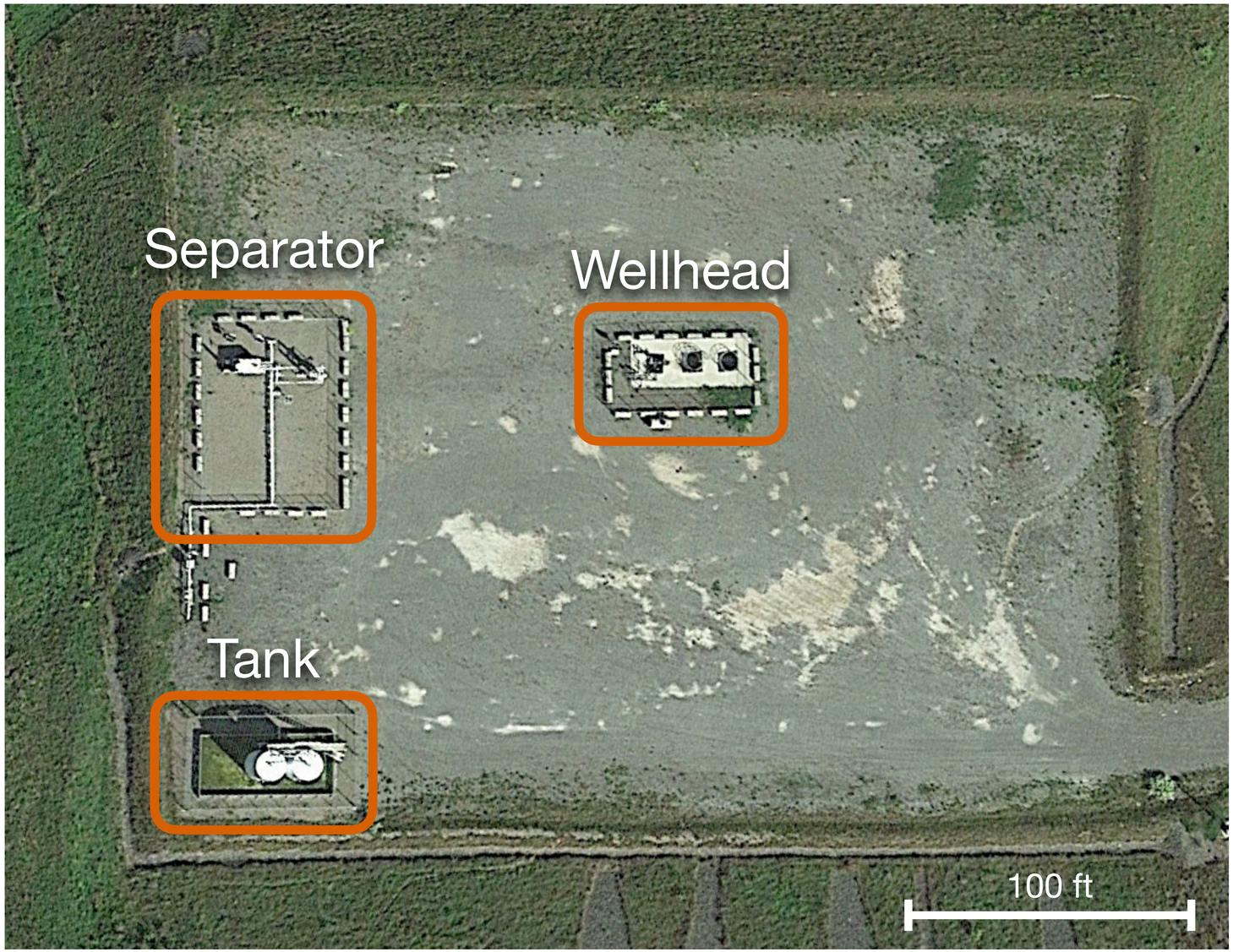
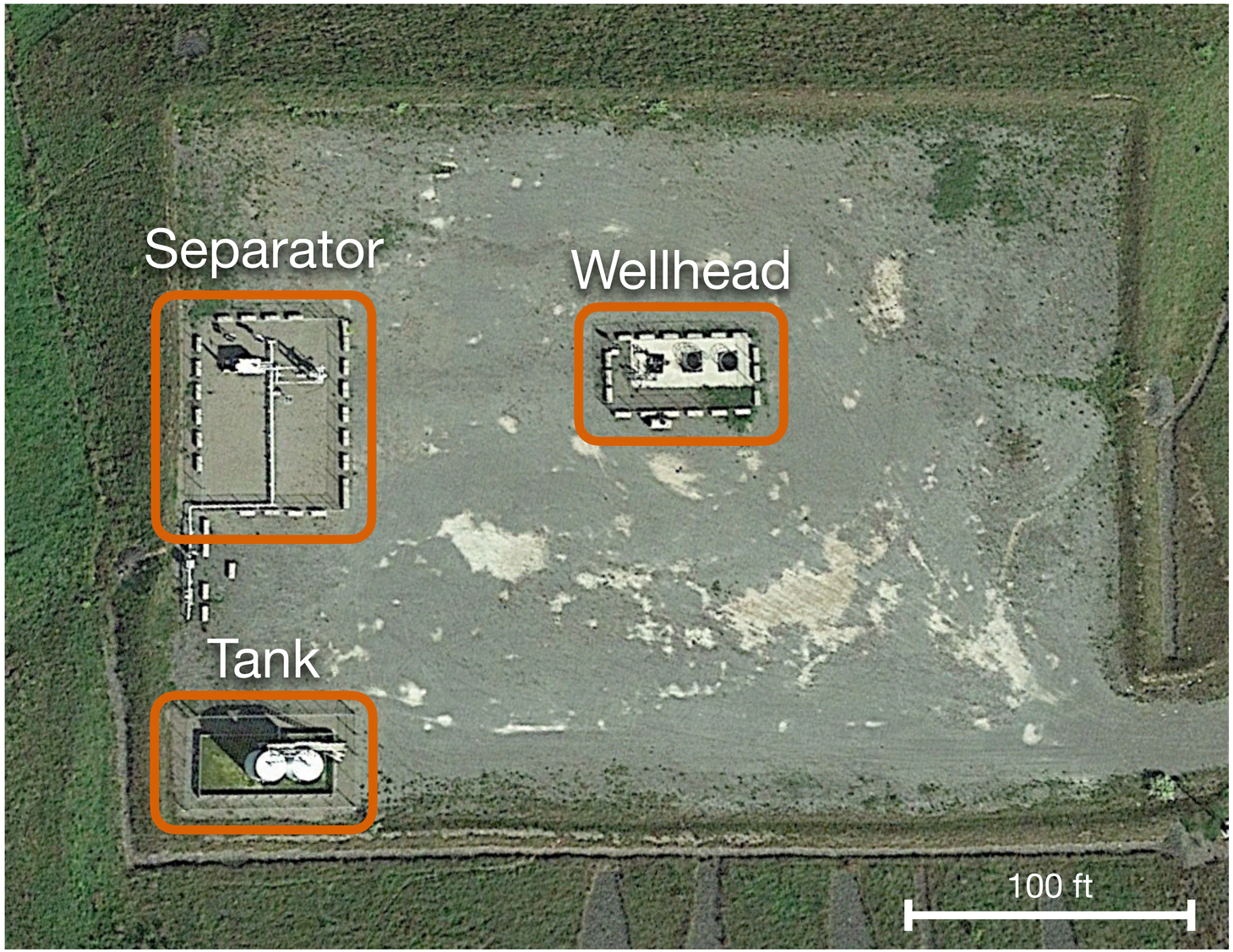
COLORADO SCHOOL OF MINES

Example production oil and gas site

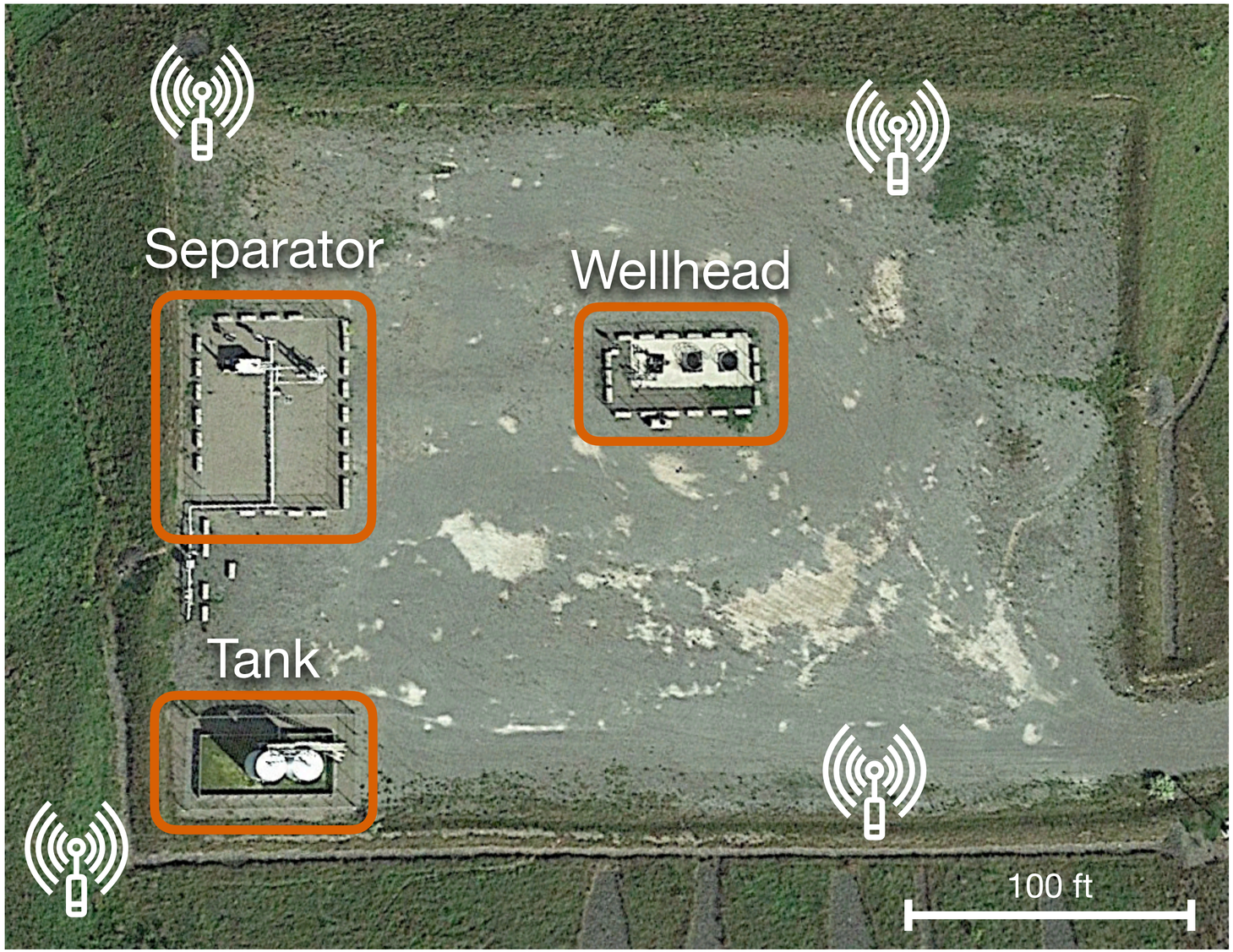


Example production oil and gas site



Continuous monitoring system (CMS)

Example production oil and gas site



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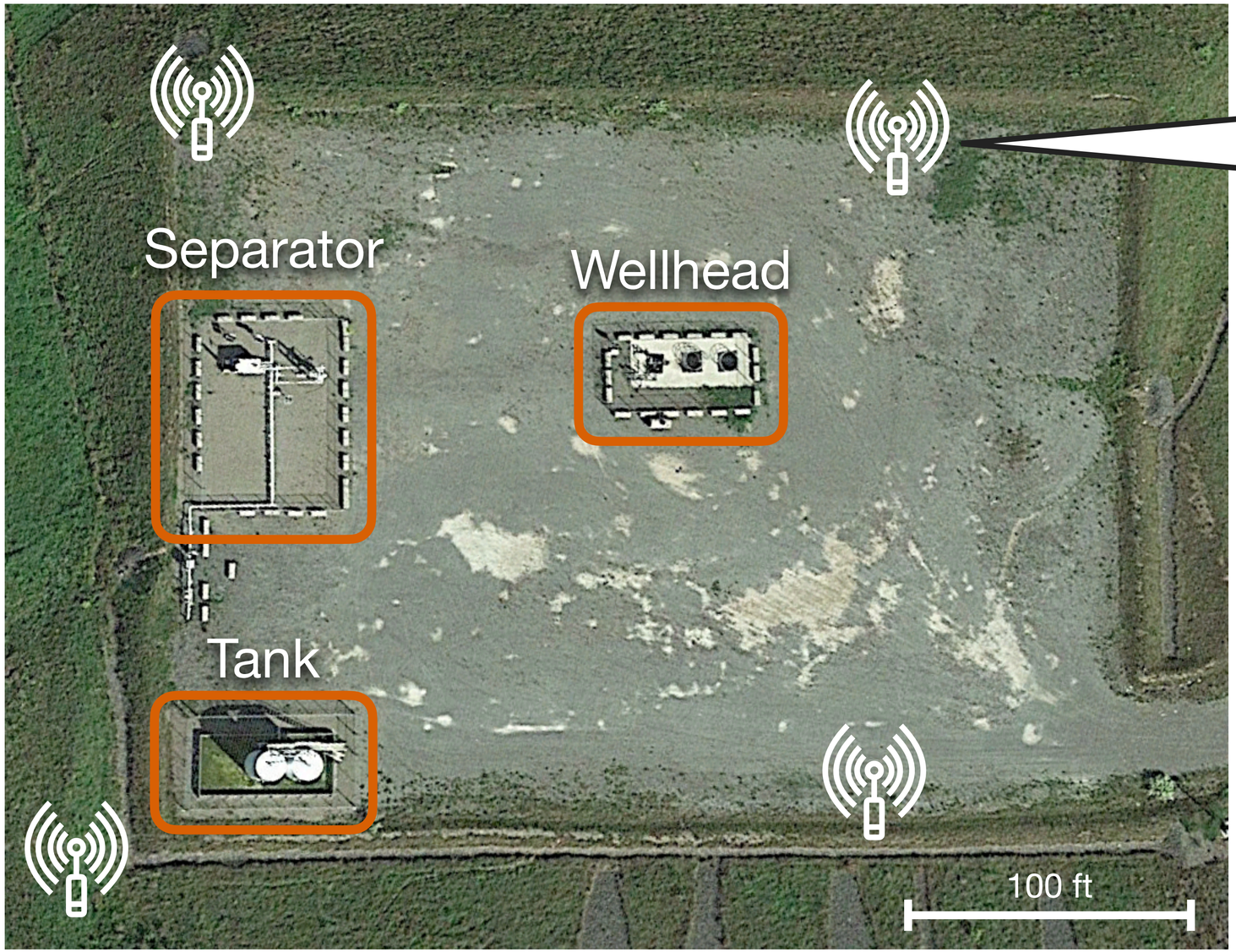
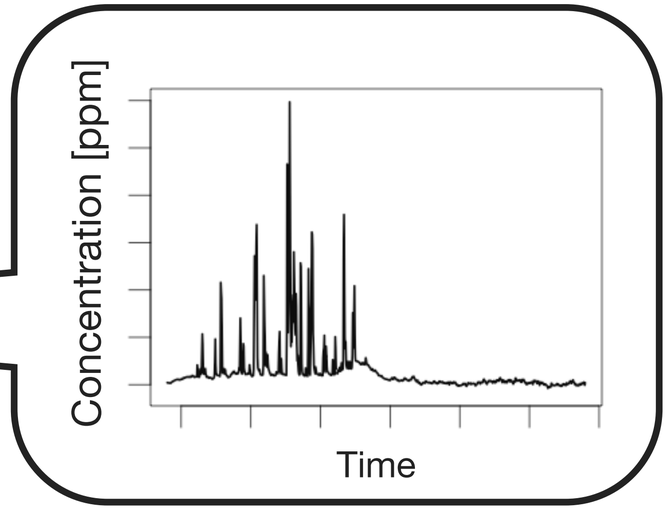
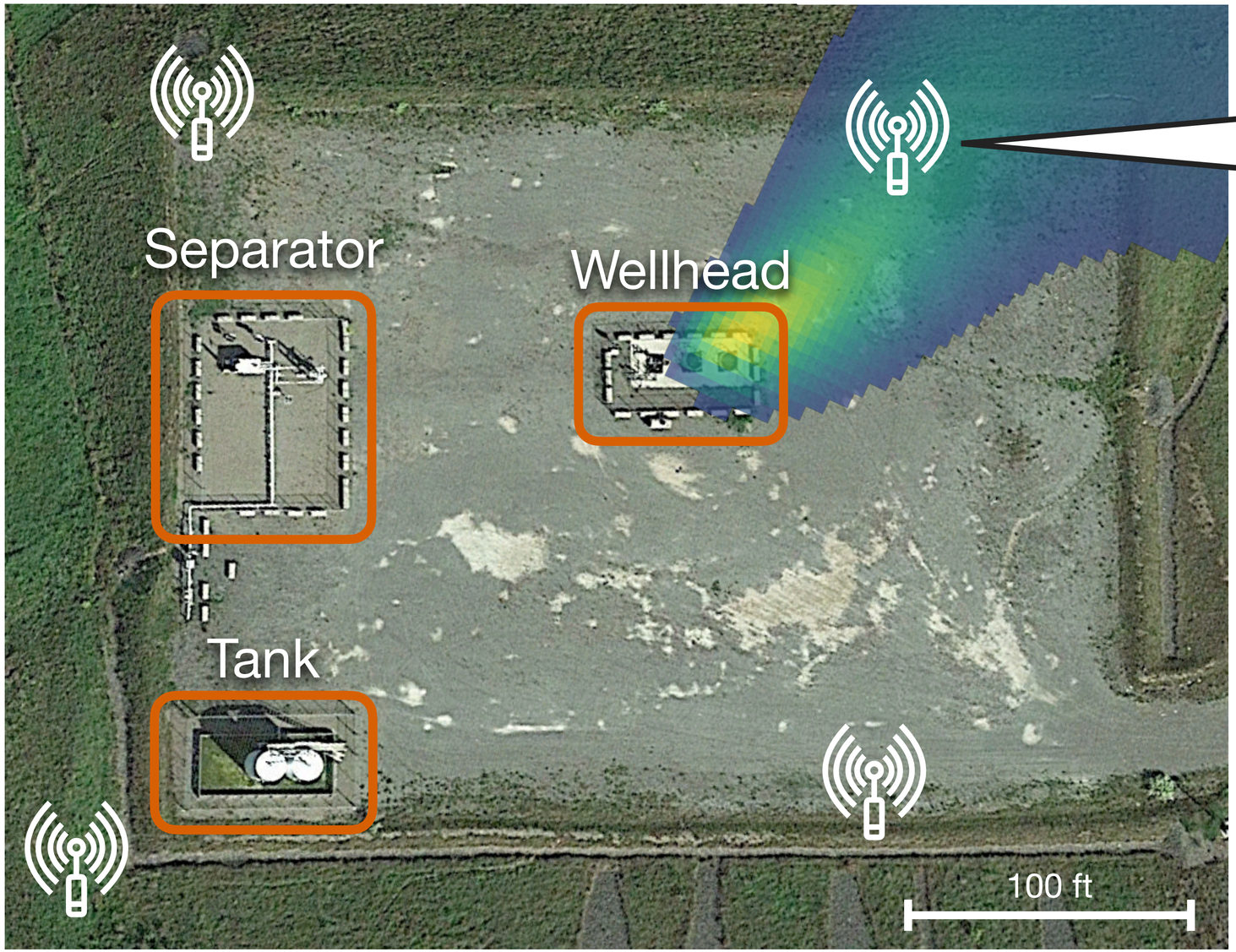
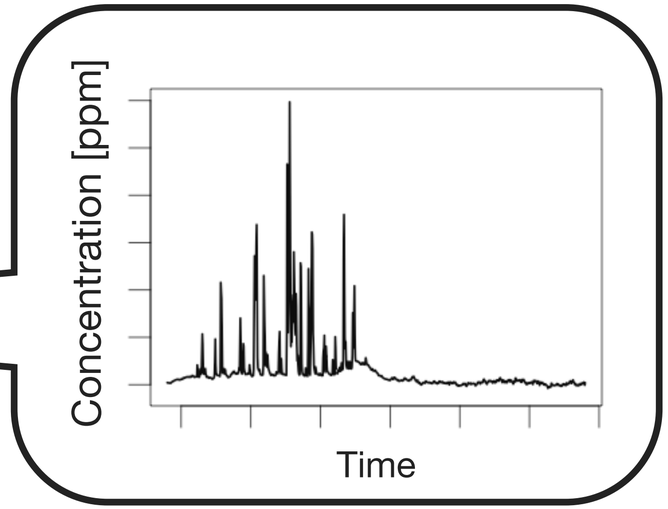
Example production oil and gas site





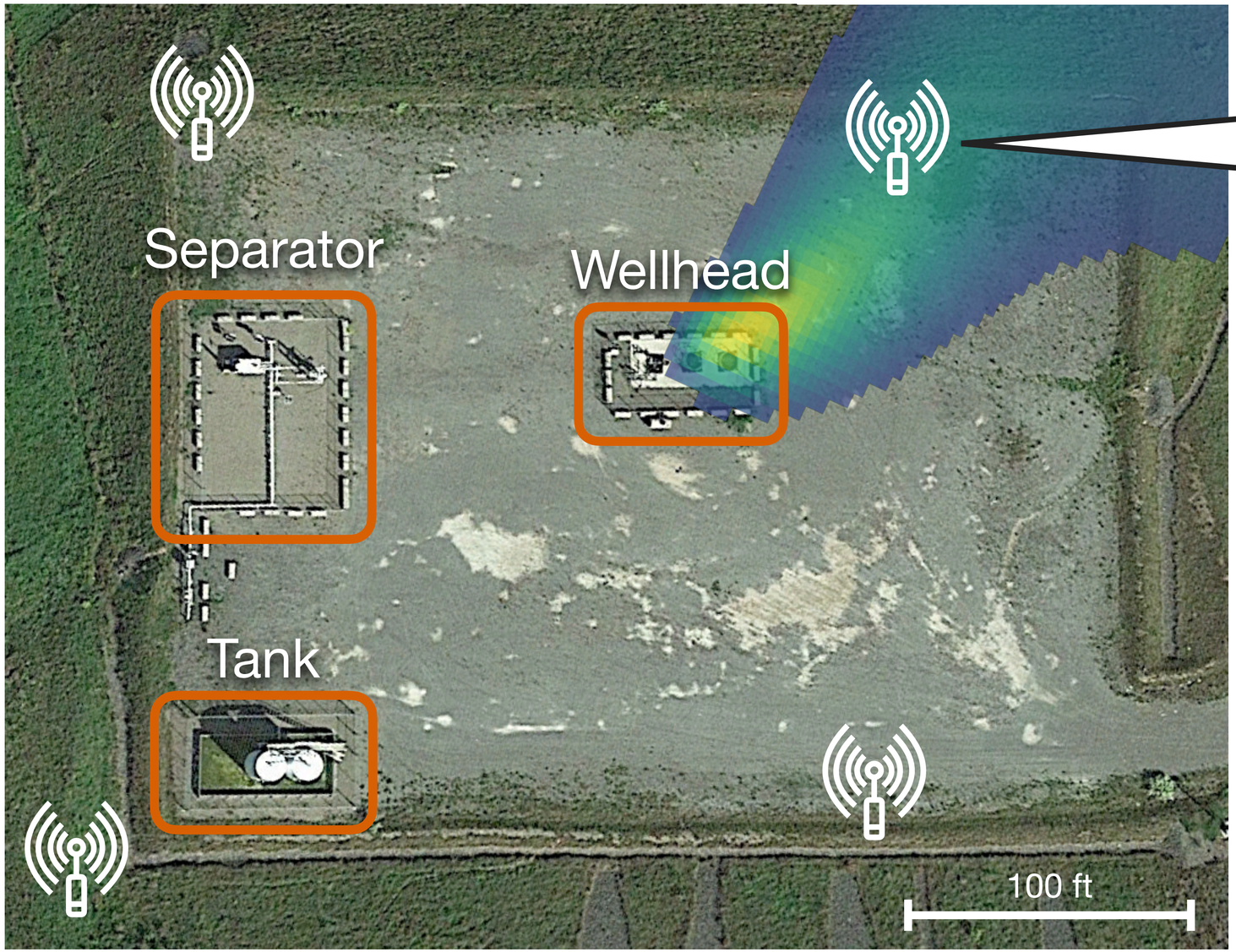
Example production oil and gas site

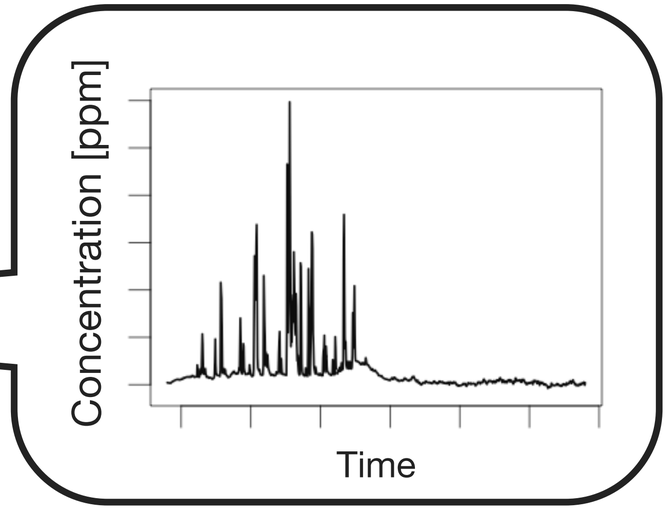




Aerial measurement technology

Example production oil and gas site



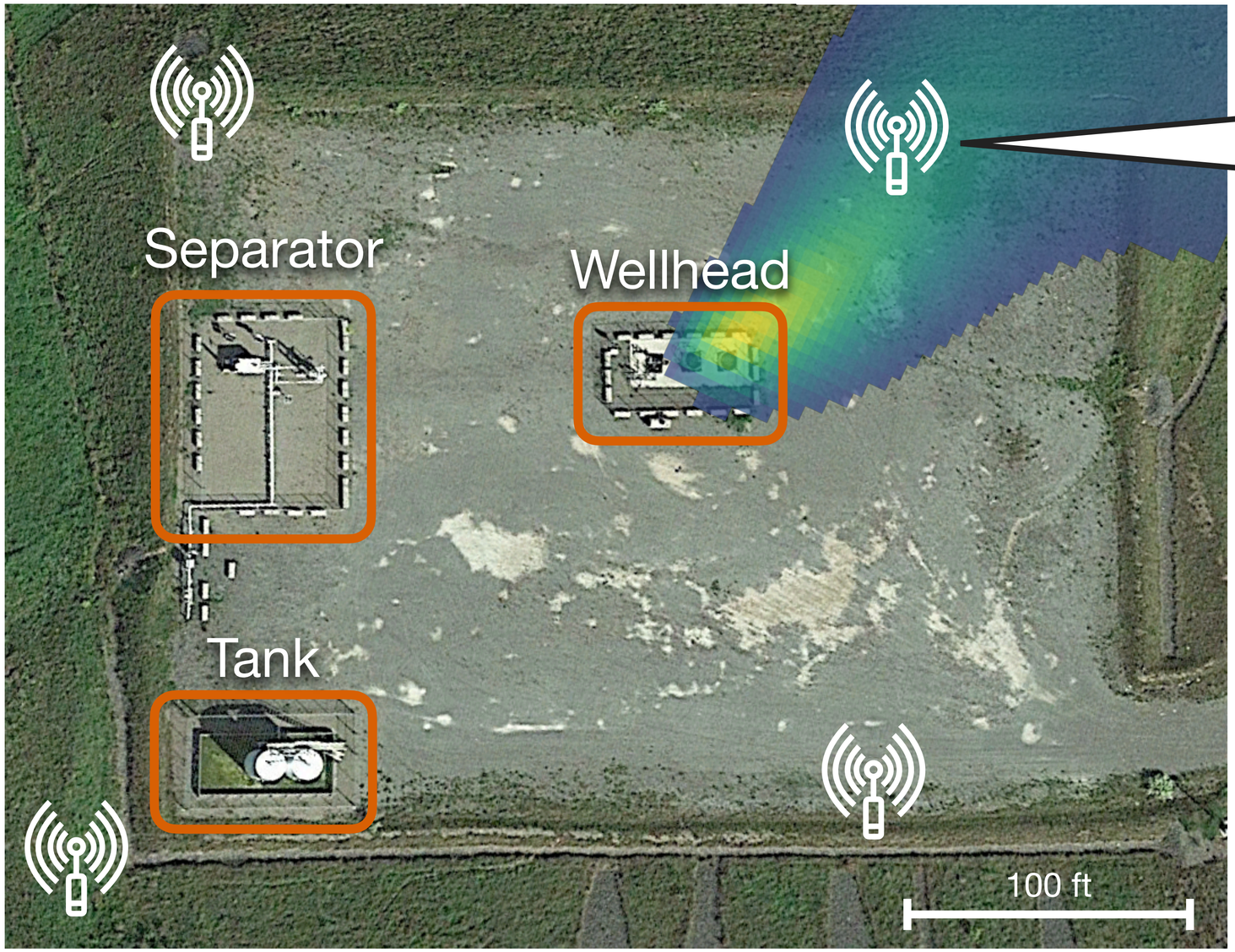


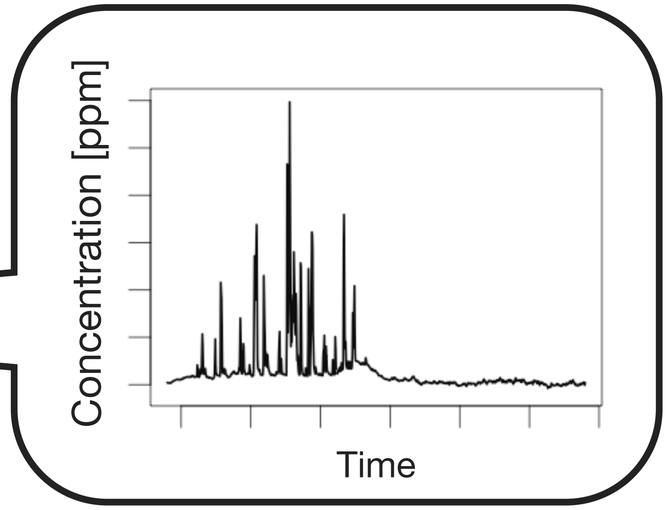
Aerial measurement technology

Bottom-up inventory estimate =

1 wellhead	x	wellhead emission factor	+
1 separator	x	separator emission factor	+
1 tank	x	tank emission factor	

Example production oil and gas site





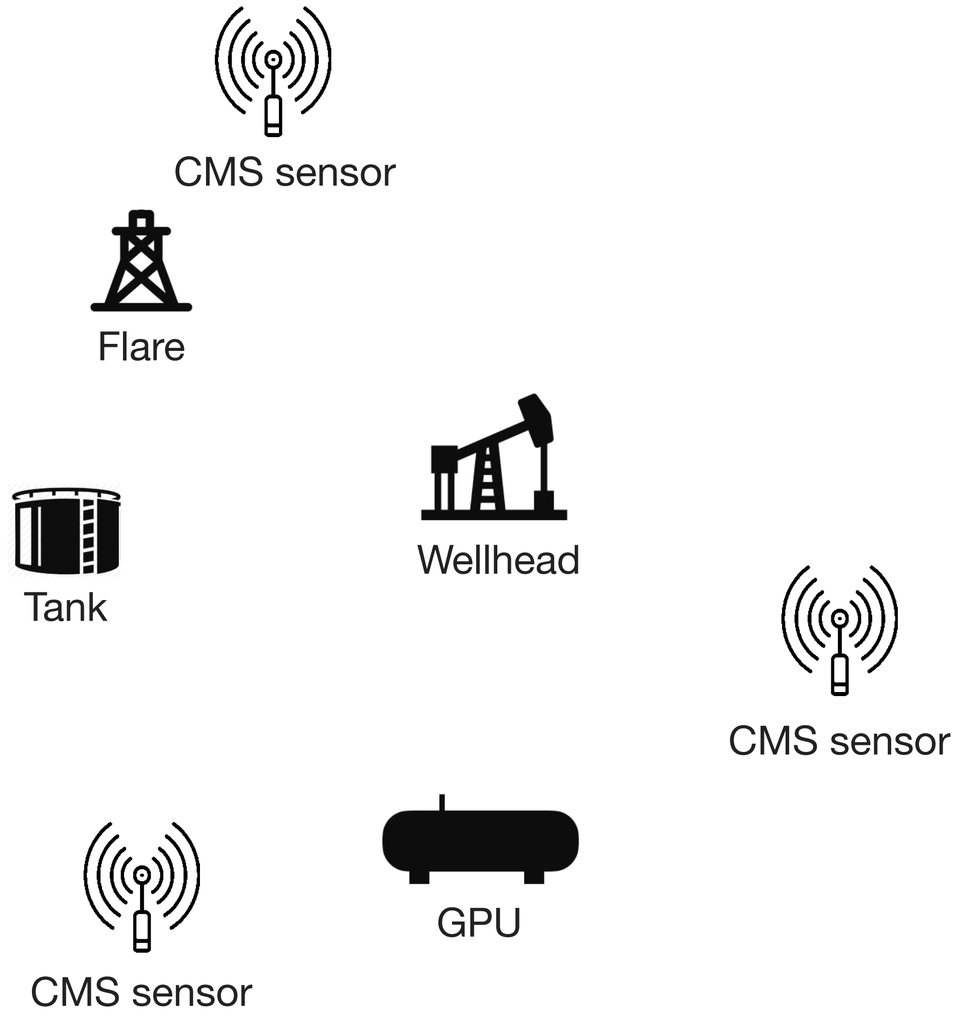
Event detection:
When is an emission happening?

Localization:
Where is the emission coming from?

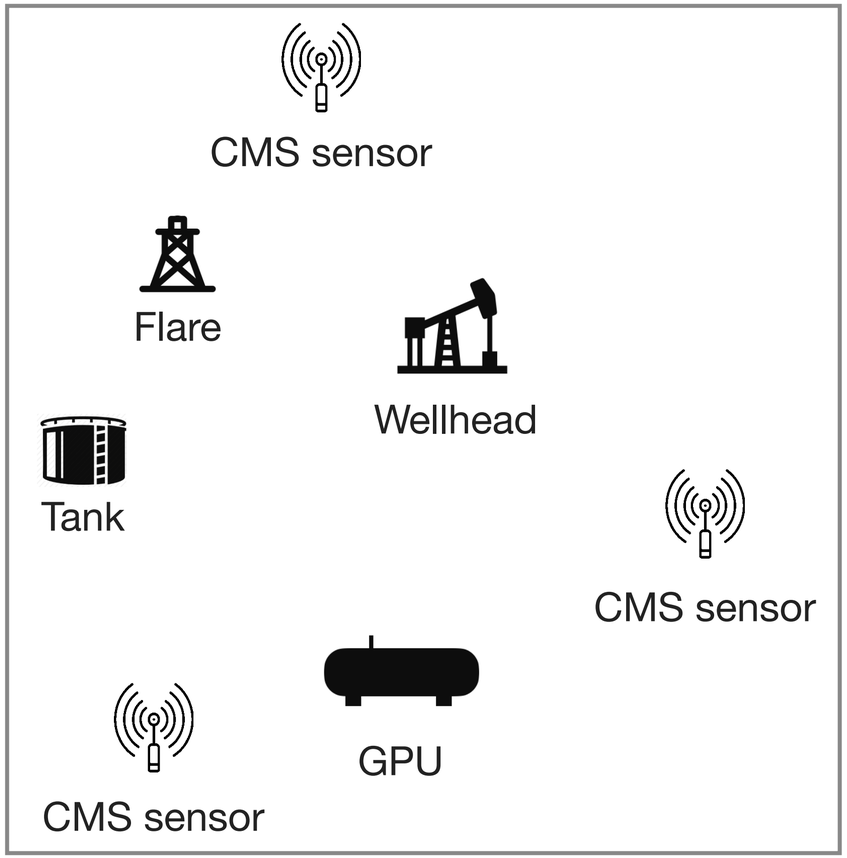
Quantification:
How much is being emitted?

Chapter 2:

Reconciling aerial measurements and bottom-up inventories

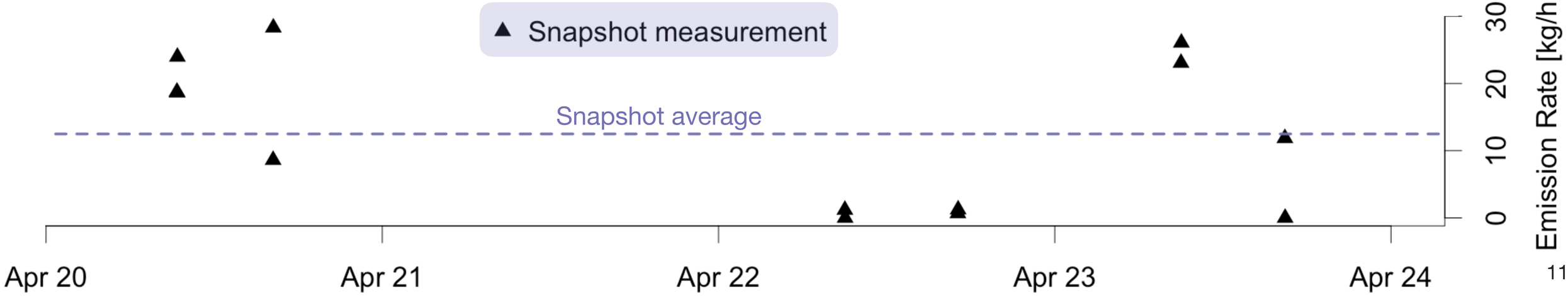


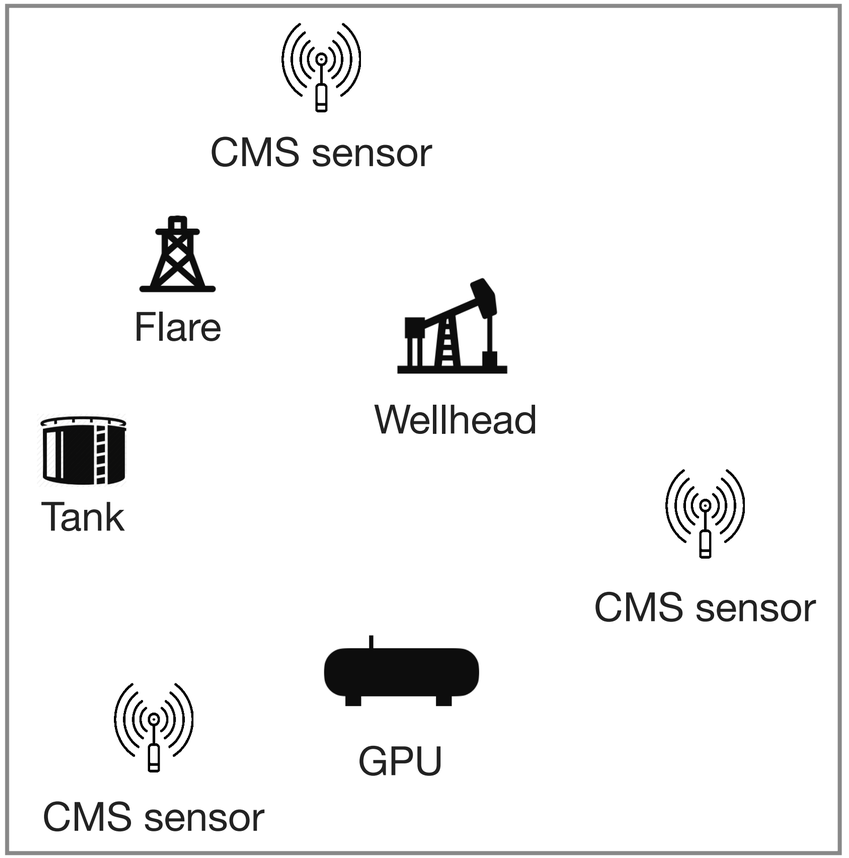
Bottom-up top-down reconciliation case study



13 snapshot measurements over 4 days

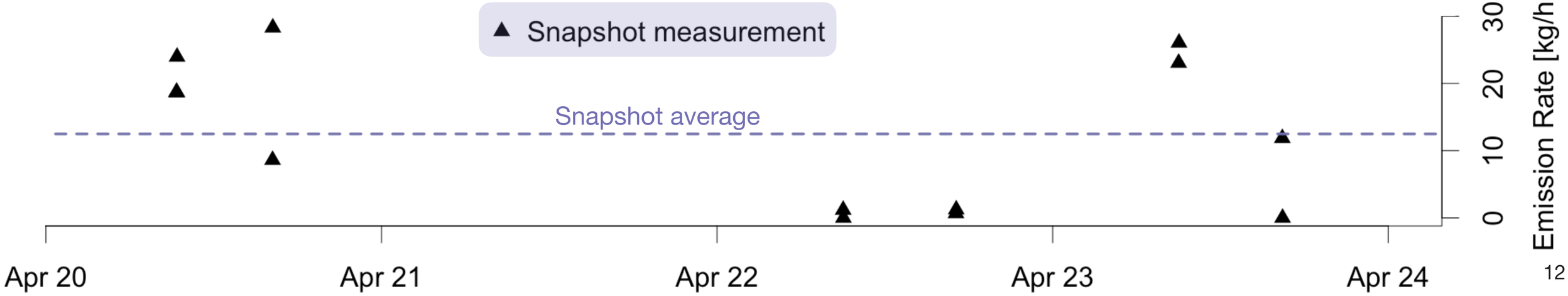
average = 12.5 kg/hr

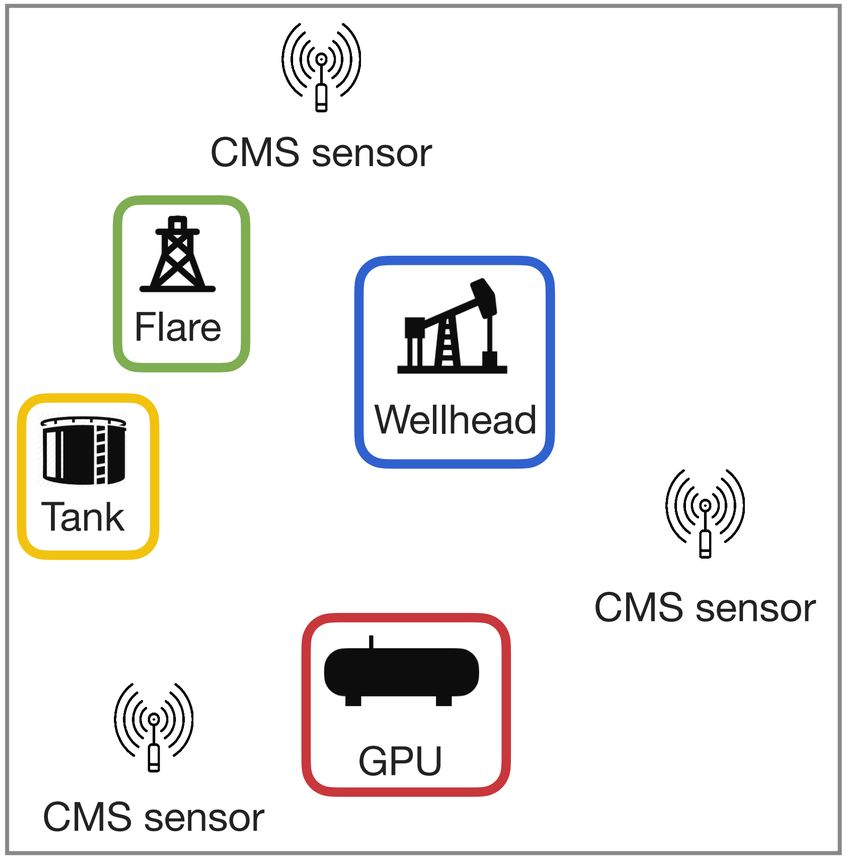




13 snapshot measurements over 4 days → average = 12.5 kg/hr

Bottom-up inventory during snapshot measurements → 0.8 kg/hr





Snapshot average

Company emissions inventory (shown as bars)

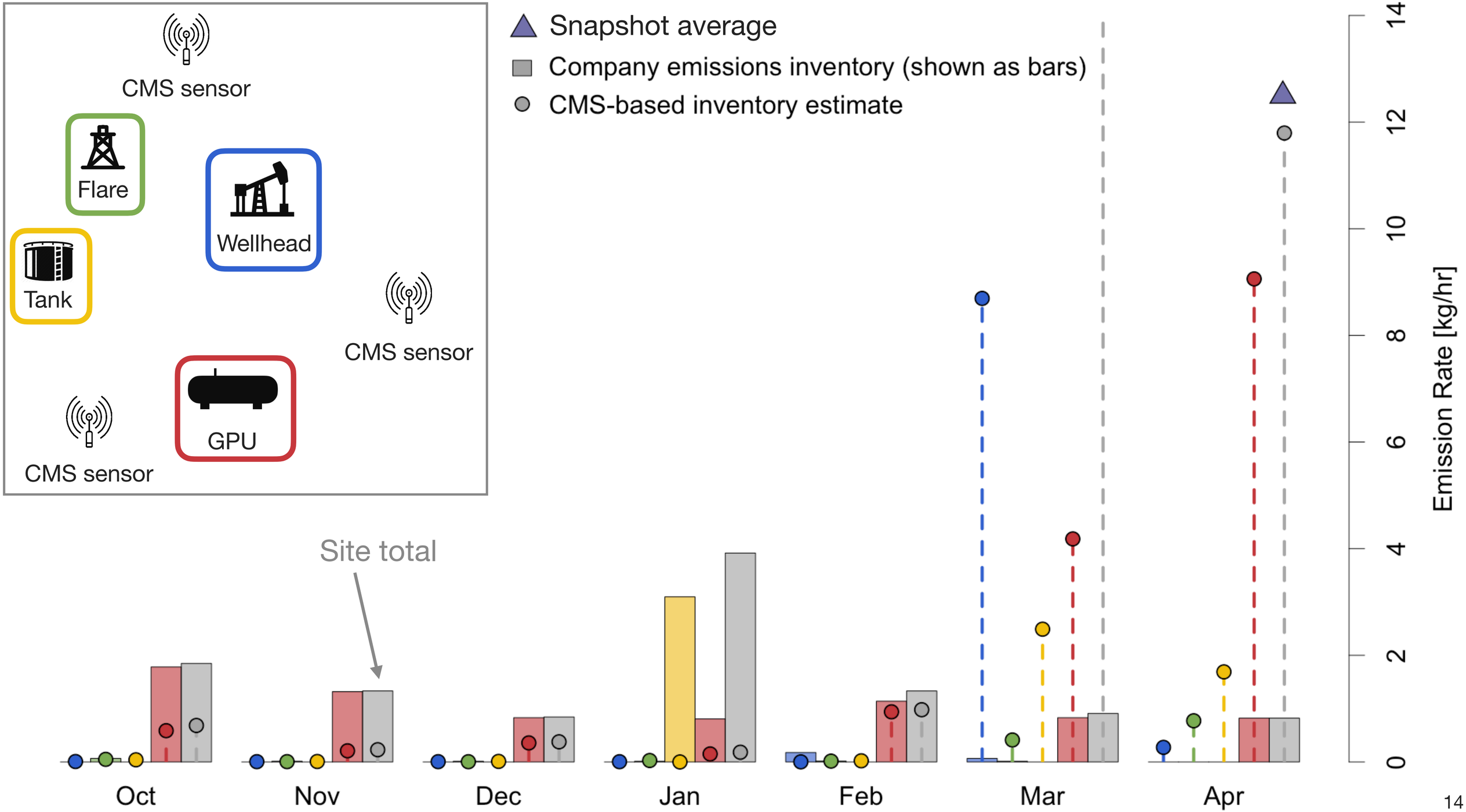
Average snapshot measurement

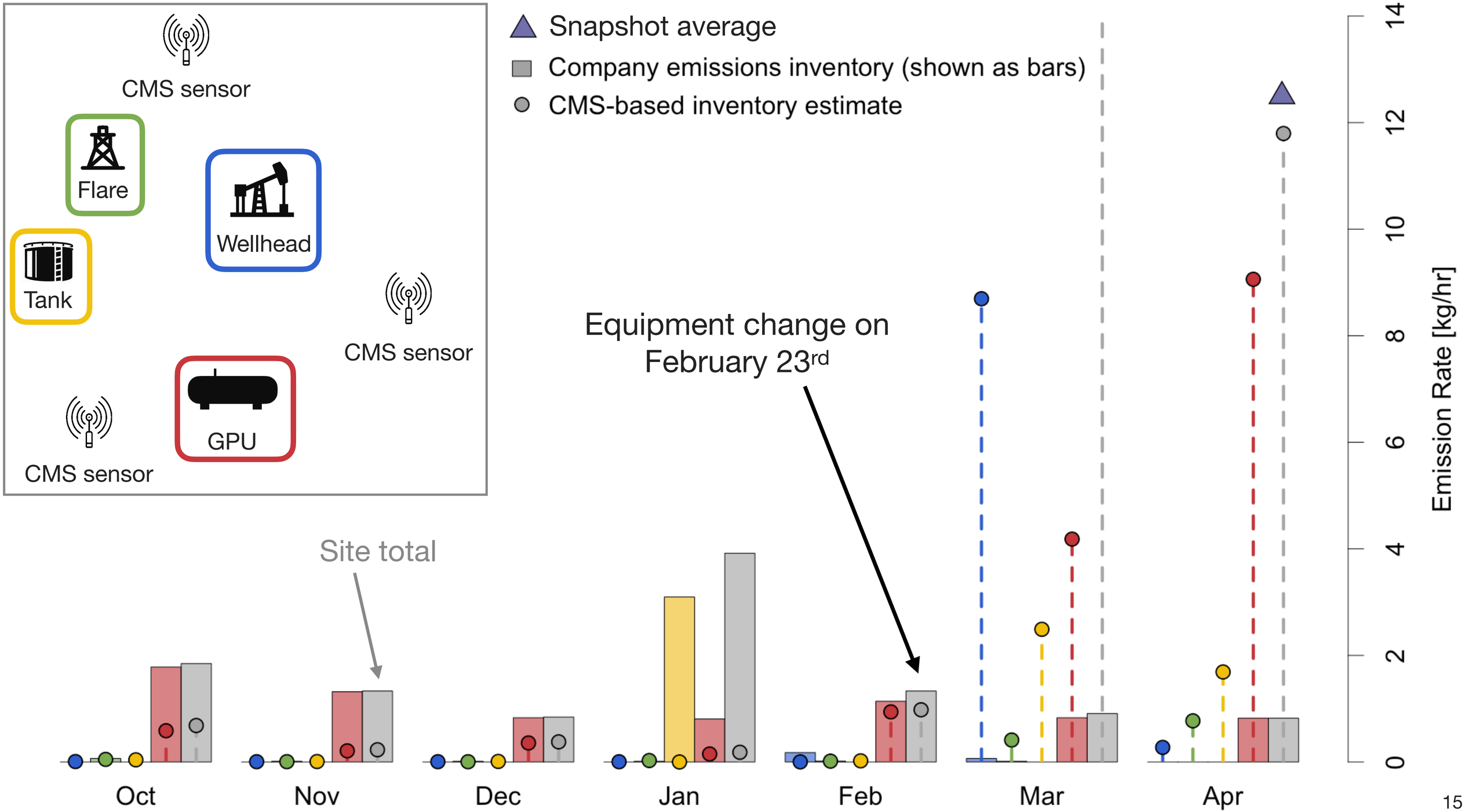
Site total

Oct
Nov
Dec
Jan
Feb
Mar
Apr

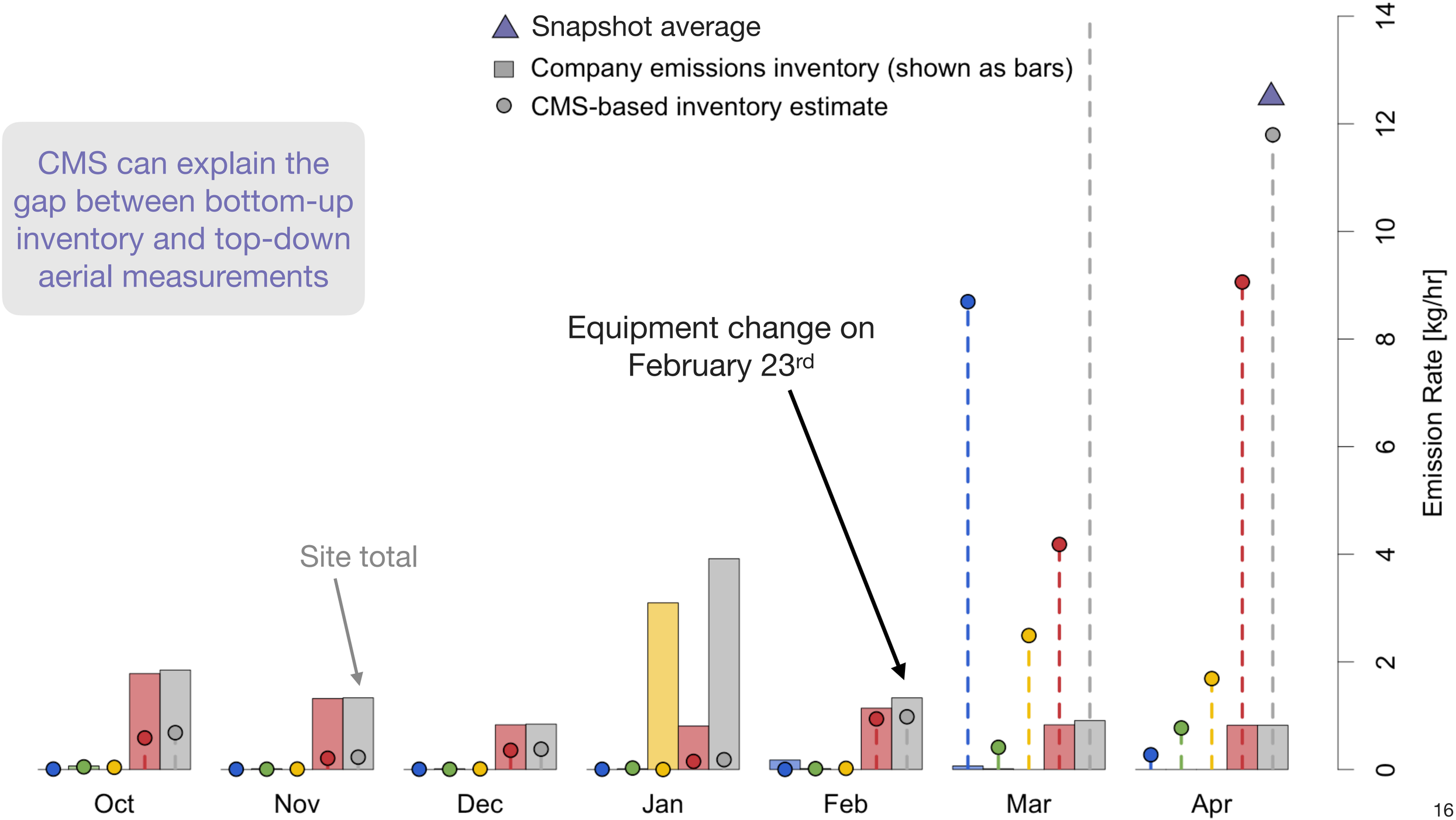
0
2
4
6
8
10
12
14

Emission Rate [kg/hr]


CMS sensor
Flare
Wellhead
Tank
CMS sensor
GPU
CMS sensor
Snapshot average
Company emissions inventory (shown as bars)
CMS-based inventory estimate
Site total
Oct
Nov
Dec
Jan
Feb
Mar
Apr
0
2
4
6
8
10
12
14
Emission Rate [kg/hr]


CMS sensor
Flare
Wellhead
Tank
CMS sensor
GPU
CMS sensor
Snapshot average
Company emissions inventory (shown as bars)
CMS-based inventory estimate
Equipment change on February 23rd
Site total
Oct
Nov
Dec
Jan
Feb
Mar
Apr
0
2
4
6
8
10
12
14
Emission Rate [kg/hr]

CMS can explain the gap between bottom-up inventory and top-down aerial measurements



CMS Series #2:

Reconciling aerial measurements and bottom-up inventories

Towards multiscale measurement-informed methane inventories: reconciling bottom-up site-level inventories with top-down measurements using continuous monitoring systems.

William Daniels, Jiayang (Lyra) Wang, Arvind Ravikumar, Matthew Harrison, Selina Roman-White, Fiji George, Dorit Hammerling. *Environmental Science and Technology,* 57(32), 11823-11833, (2023).

Multi-scale methane measurements at oil and gas facilities reveal necessary framework for improved emissions accounting.

Jiayang (Lyra) Wang, **William Daniels**, Dorit Hammerling, Matthew Harrison, Kaylyn Burmaster, Fiji George, Arvind Ravikumar. *Environmental Science and Technology,* 56(20), 14743-14752, (2022).

Thank you!

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EEMDL
Energy Emissions Modeling and Data Lab

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