EARTH
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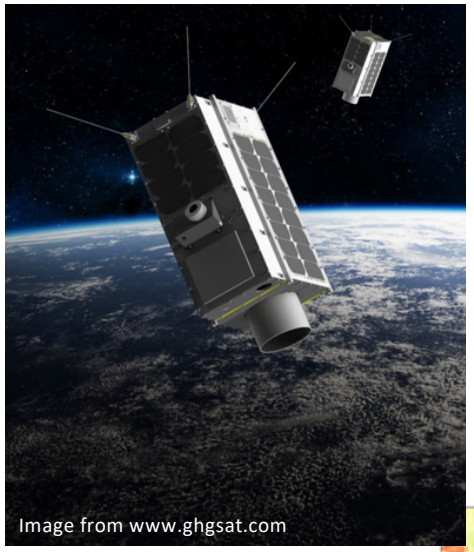
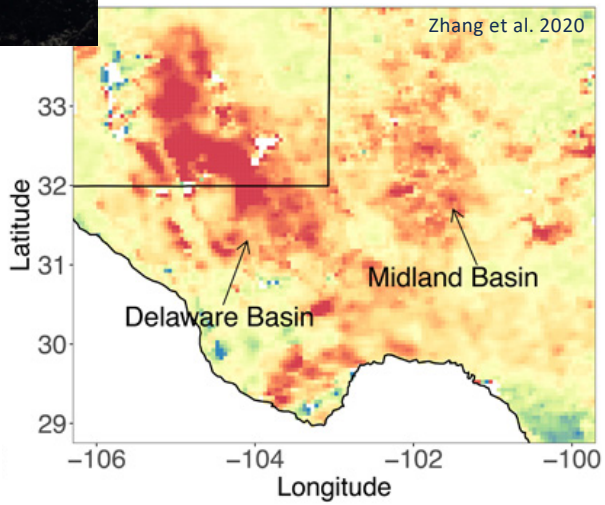
November 17, 2020

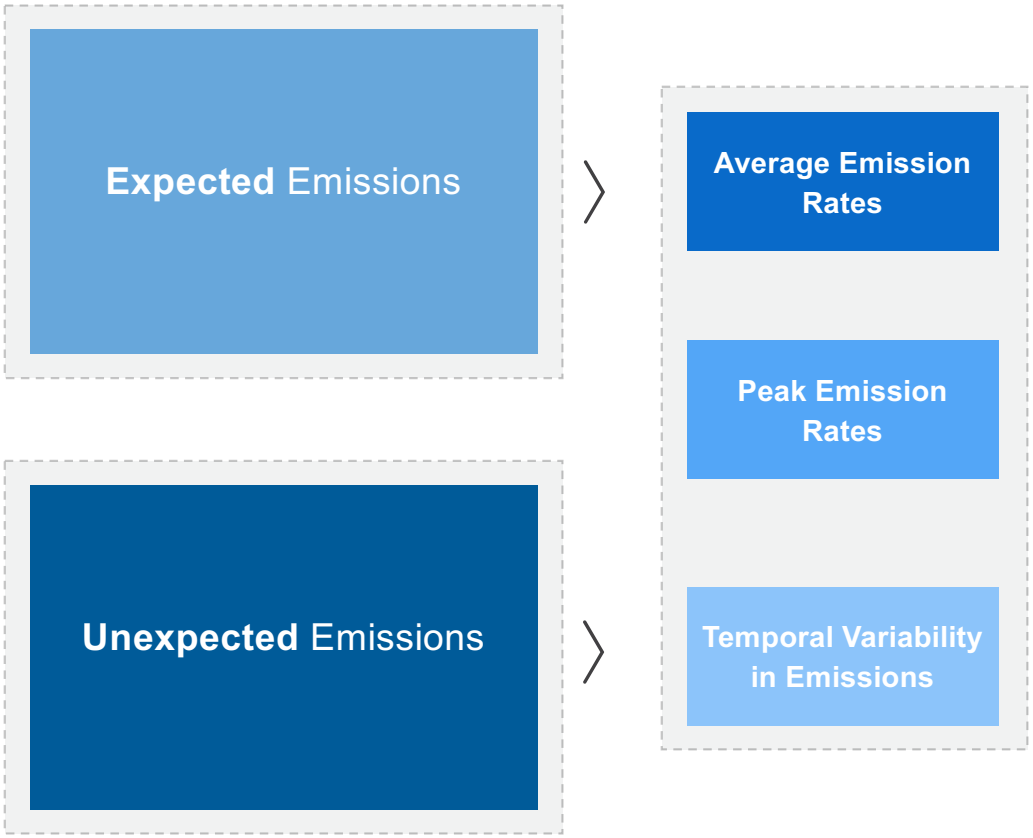
Remote Sensing Based Monitoring of Emissions **from Oil and Gas Production Sources**

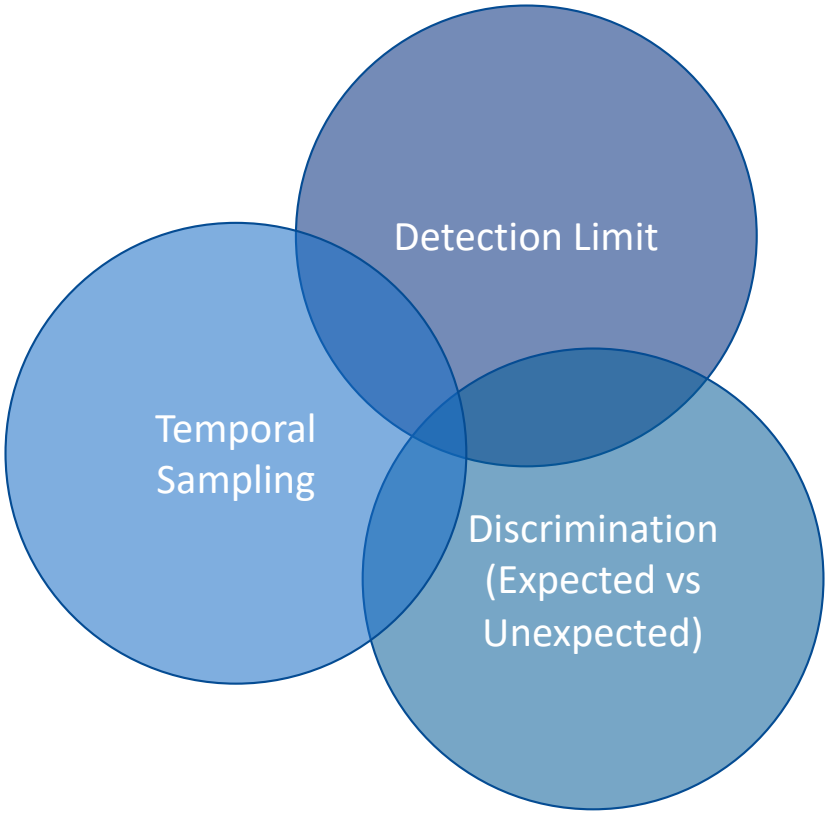




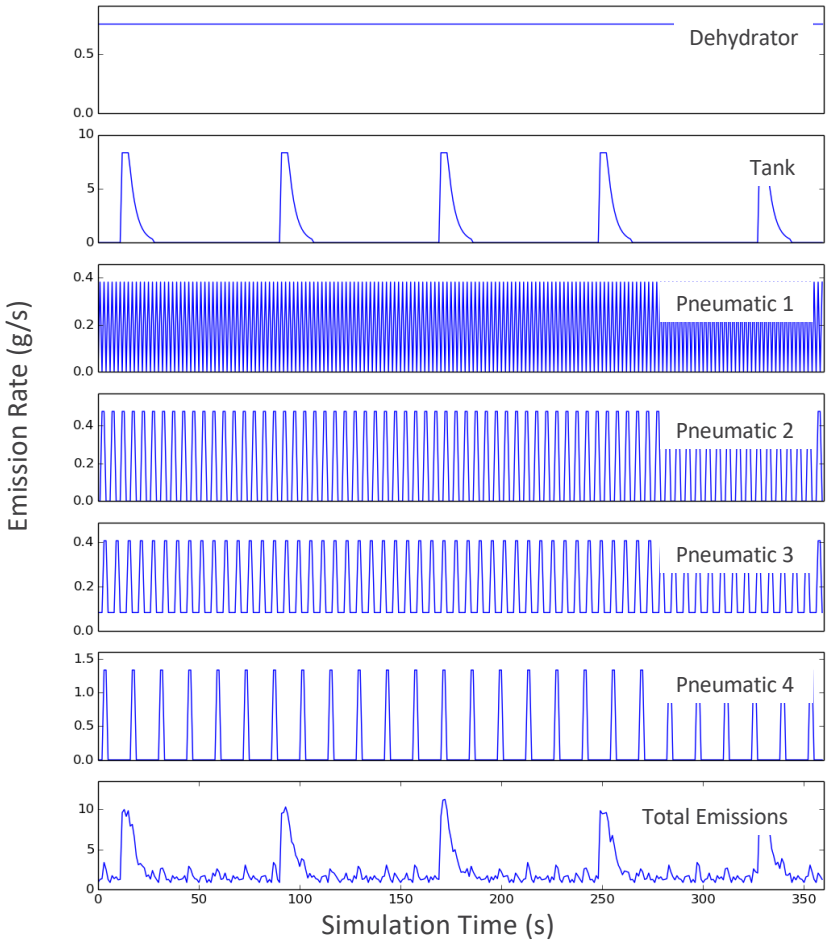
Nicole Downey, Ph.D.
nicole.downey@earthsystemsciences.com

Understanding Methane Emissions from Oil and Gas Operations is Key to Designing Effective Sampling Strategies



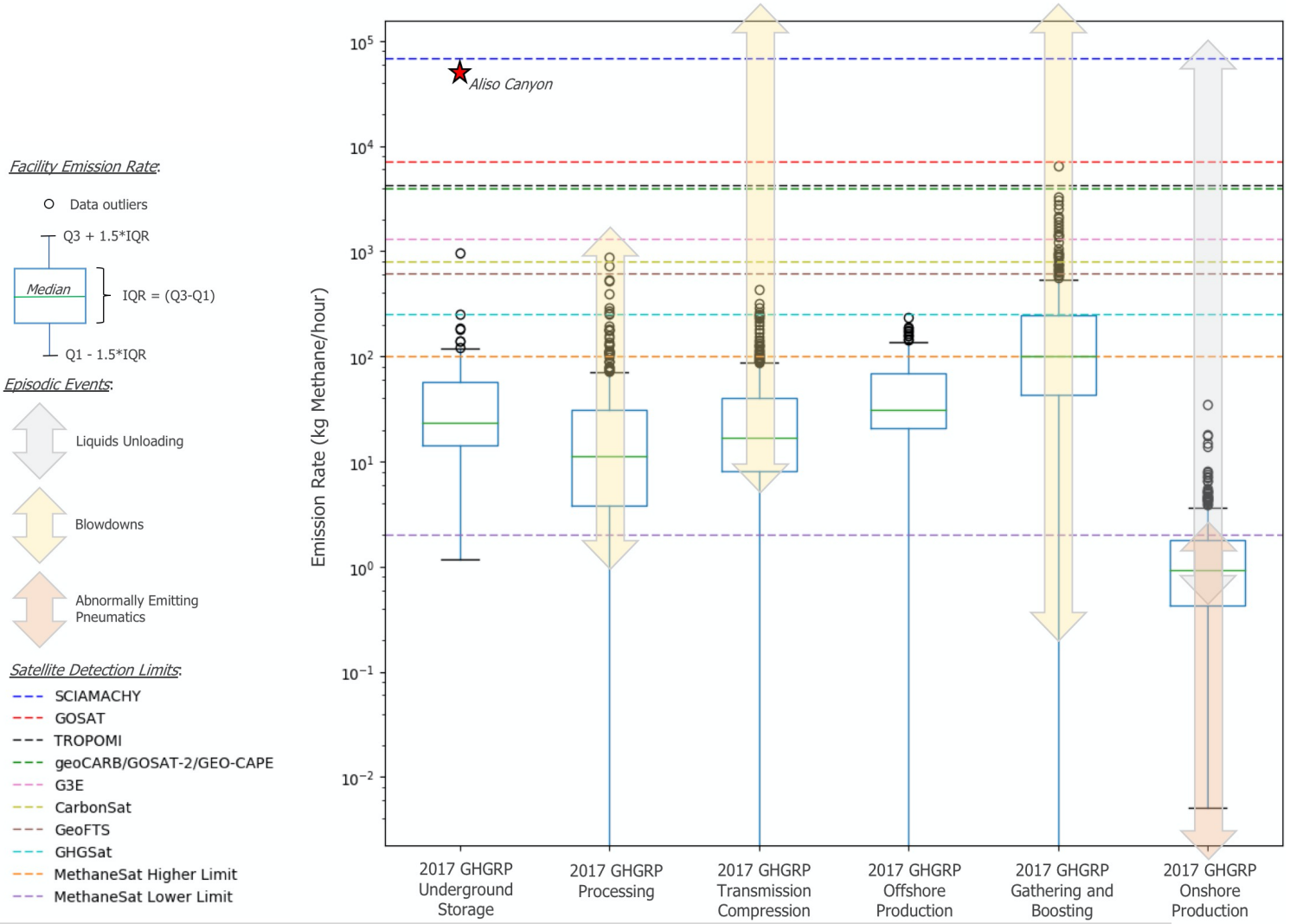


Routine Variability in Emissions

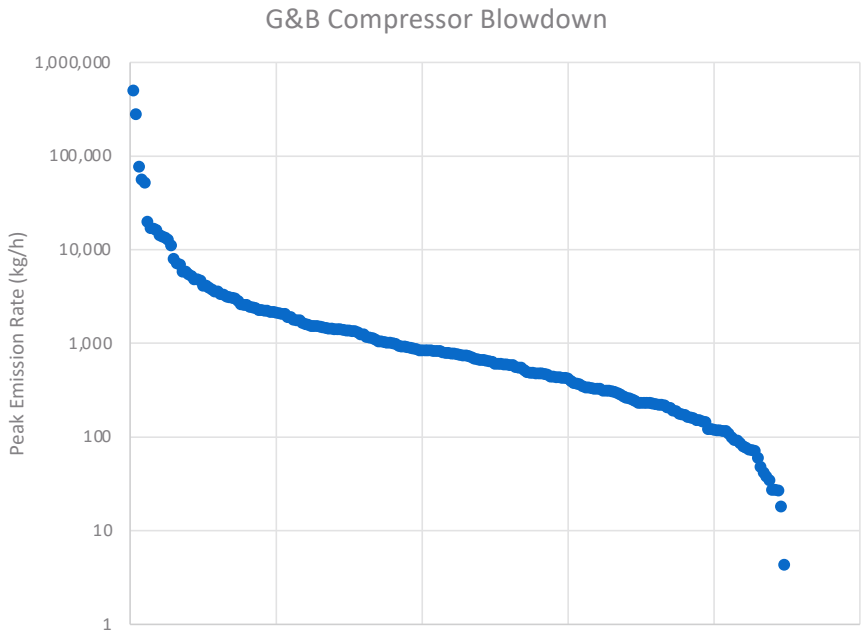


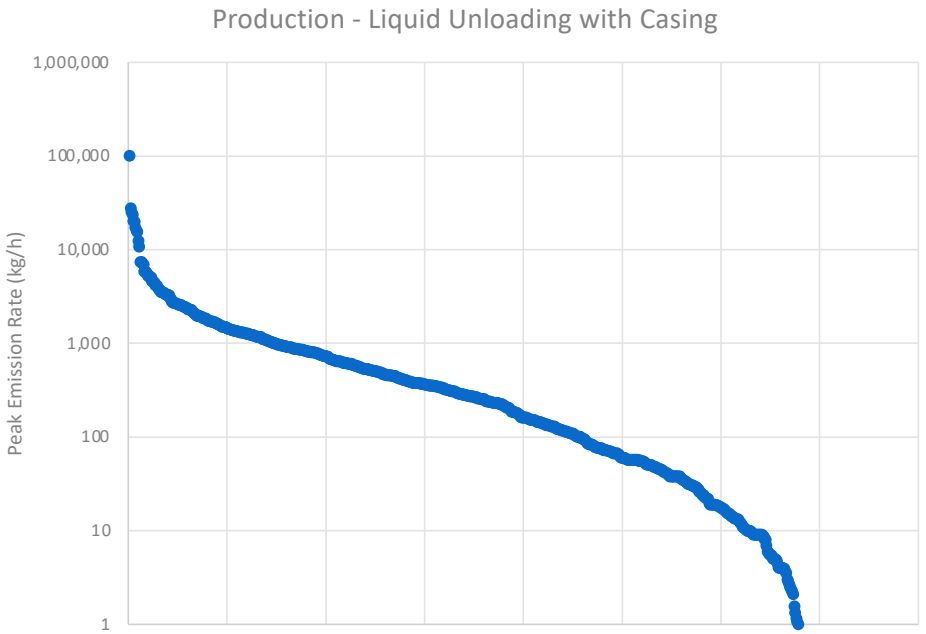
- To the left is an example simulation of emissions from different sources on a typical well-pad from the ESS Emission Simulator
- These are routine emissions with **no** operational upsets
- This demonstrates that there is tremendous variability in emissions driven by the episodic nature of many sources
- Several common 'routine' emission sources are episodic, [high peak emission rates occurring for a short duration]
  - Liquids Unloading
  - Tank Flashing
  - Compressor Blowdowns
  - Other Equipment Blowdowns/Maintenance
  - Pipeline Blowdowns/Maintenance
- The detection limit of satellite (and aircraft) based sensors intersects with both malfunction and routine emission events
- Many routine emission events are not randomly distributed temporally [work hours/work days]

Episodic Emissions



Example distributions of emissions from ‘routine’ sources





Data extrapolated from information in the EPA GHGRP (2017)

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