

Measuring Air Pollution Near Unconventional Oil and Gas Development in Colorado

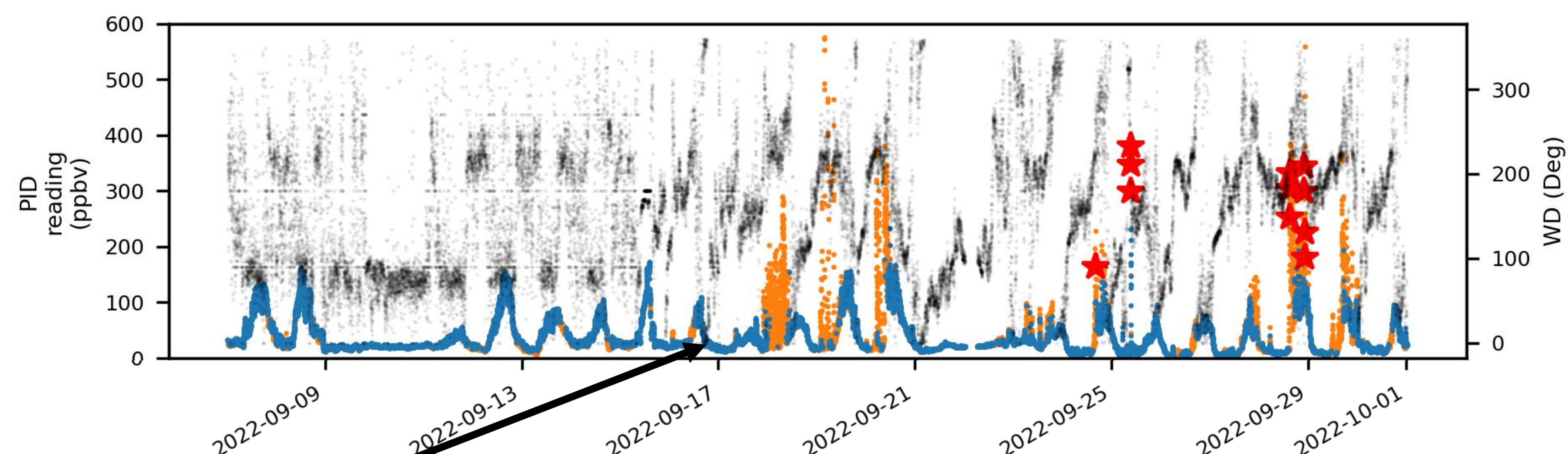
- Air Sample Collection and Analysis Methods -

Recolección de muestras y análisis

① Real-Time Monitoring

The SENSIT® SPOD system offers real-time continuous monitoring. Two of the systems will be placed near the pads. These systems:

- Respond to changing levels of a suite of Volatile Organic Compounds (VOCs).
- Record meteorological conditions (temperature, wind speed and direction, etc.)
- Trigger canister collection to characterize plume events
- Document short-term exposures

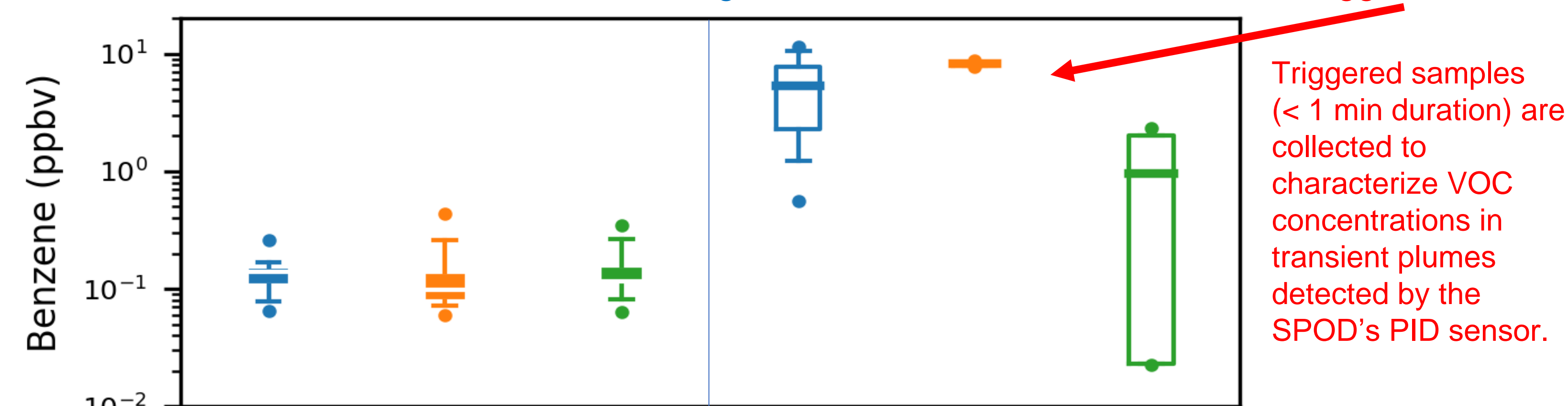


Drilling started

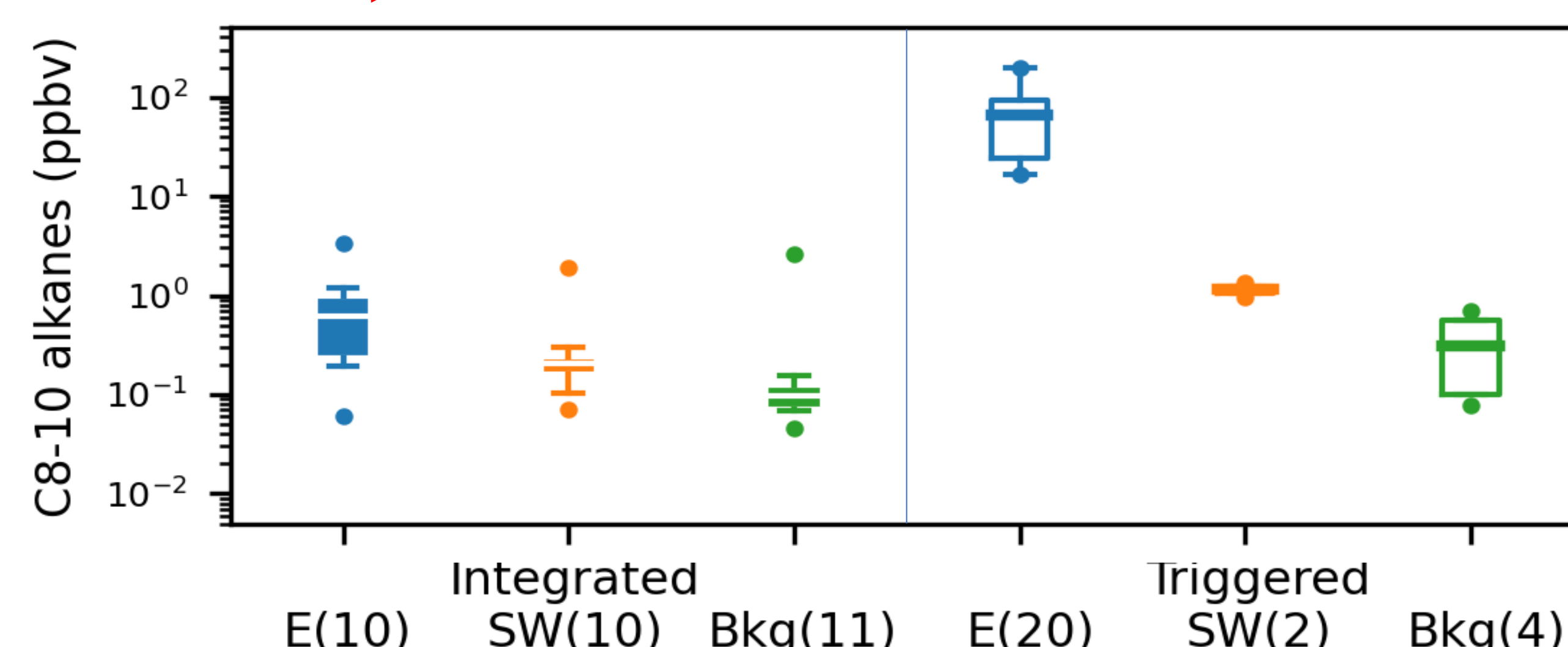
SPOD readings with winds from the well pad

SPOD readings with winds from other directions

Triggered events



Triggered samples (< 1 min duration) are collected to characterize VOC concentrations in transient plumes detected by the SPOD's PID sensor.



Heavy alkanes can contribute to ozone formation.

② Integrated Canisters

7-day integrated VOC canister samples will:

- Be deployed at two locations near the well pad and a background location
- Document longer-term exposures

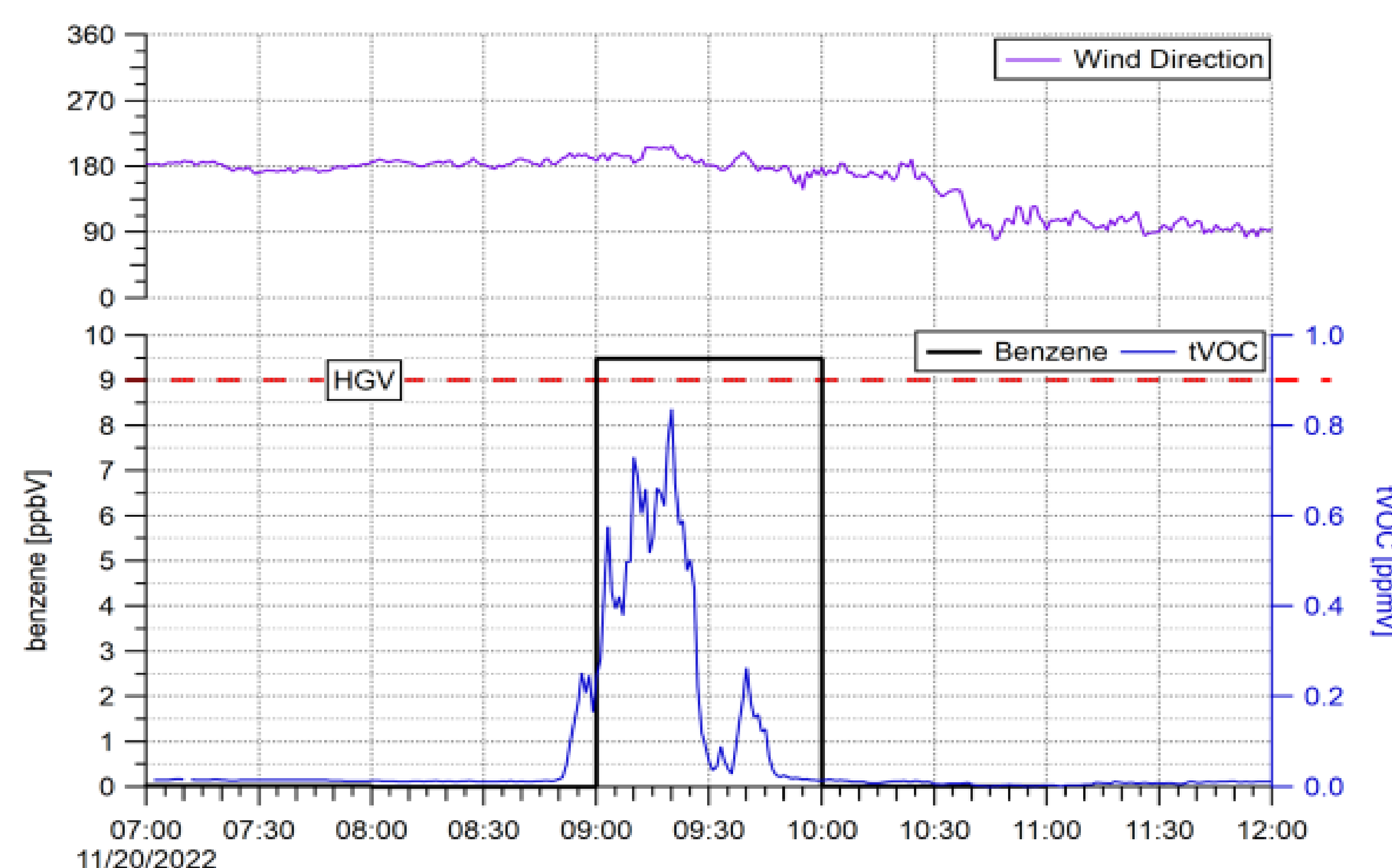
- The canister samples are analyzed for 51 VOCs and methane concentrations by gas chromatography in our lab at CSU.



③ CDPHE CAMML Trailer

The CDPHE Colorado Air Monitoring Mobile Lab (CAMML) collects information about the air around oil and gas operations. The CAMML measures:

- Speciated VOCs (online gas chromatograph, 1-hr resolution)
- CH₄ (Picarro methane analyzer, 1-min resolution)
- PM_{2.5} (optical particle counter, 1-min resolution)
- NO_x (chemiluminescence analyzer, 1-min resolution)
- Meteorological data



④ Mobile Monitoring

The CSU mobile plume tracker will conduct spatial surveys, hunt sources of plumes, and help document emission events. It is equipped with:

- GPS and meteorological instruments
- AROMA-VOC analyzer (CH₄, CO₂, & several VOC classes, 5-seconds resolution)
- Canisters for plume sampling

- Once a plume is identified by the AROMA-VOC analyzer, we will collect canister samples for additional speciated VOC analysis by off-line gas chromatography.

