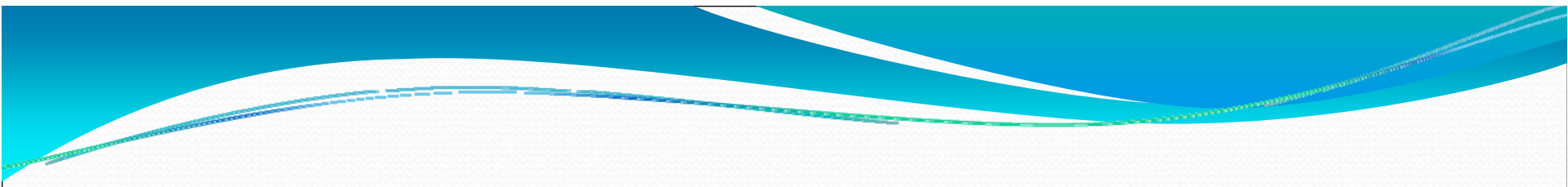


Upstream Oil and Gas Emission Measurement Project

Robin Segall
US EPA

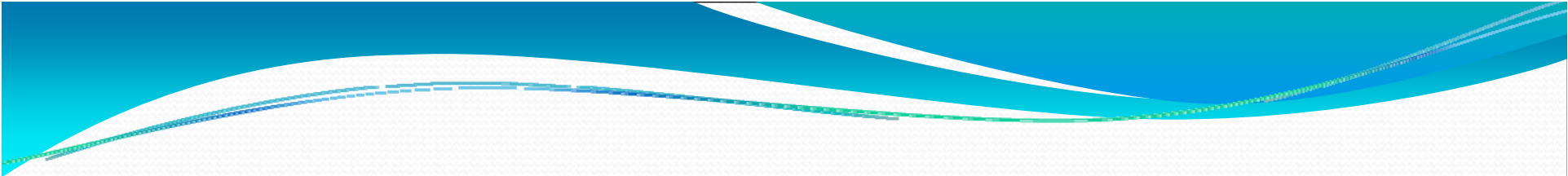
Office of Air Quality Planning and Standards
Measurement Technology Group

Emission Inventory Conference
Baltimore, MD
April 15, 2009



How did OAQPS get involved?

- Region 8 requested OAQPS assistance with understanding the VOC emissions from the upstream oil and gas production due to public concern and ozone exceedences
- Emissions sources and activities for this sector are extremely difficult to measure due to the complex nature, quantity and variety
- Almost no VOC data exists for this sector from actual field testing



EPA Team

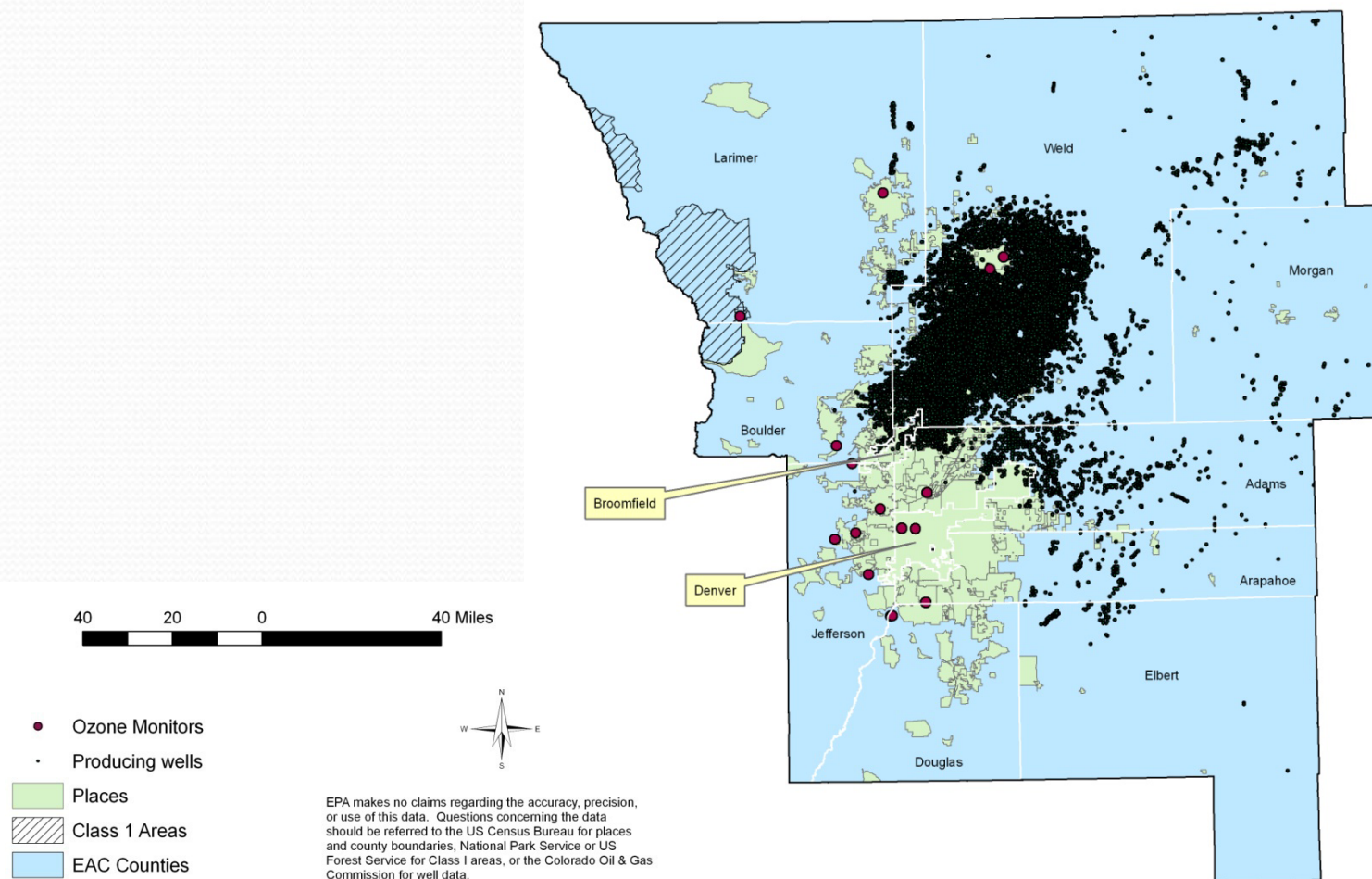
- Jason DeWees
- Dennis Mikel – MTG
- Eben Thoma, PhD
- Buddy Thompson – ORD
- Paul Groff – ORD
- Cindy Beeler – Region 8
- Michael Copeland – Region 8

Historical Oil and Gas Production

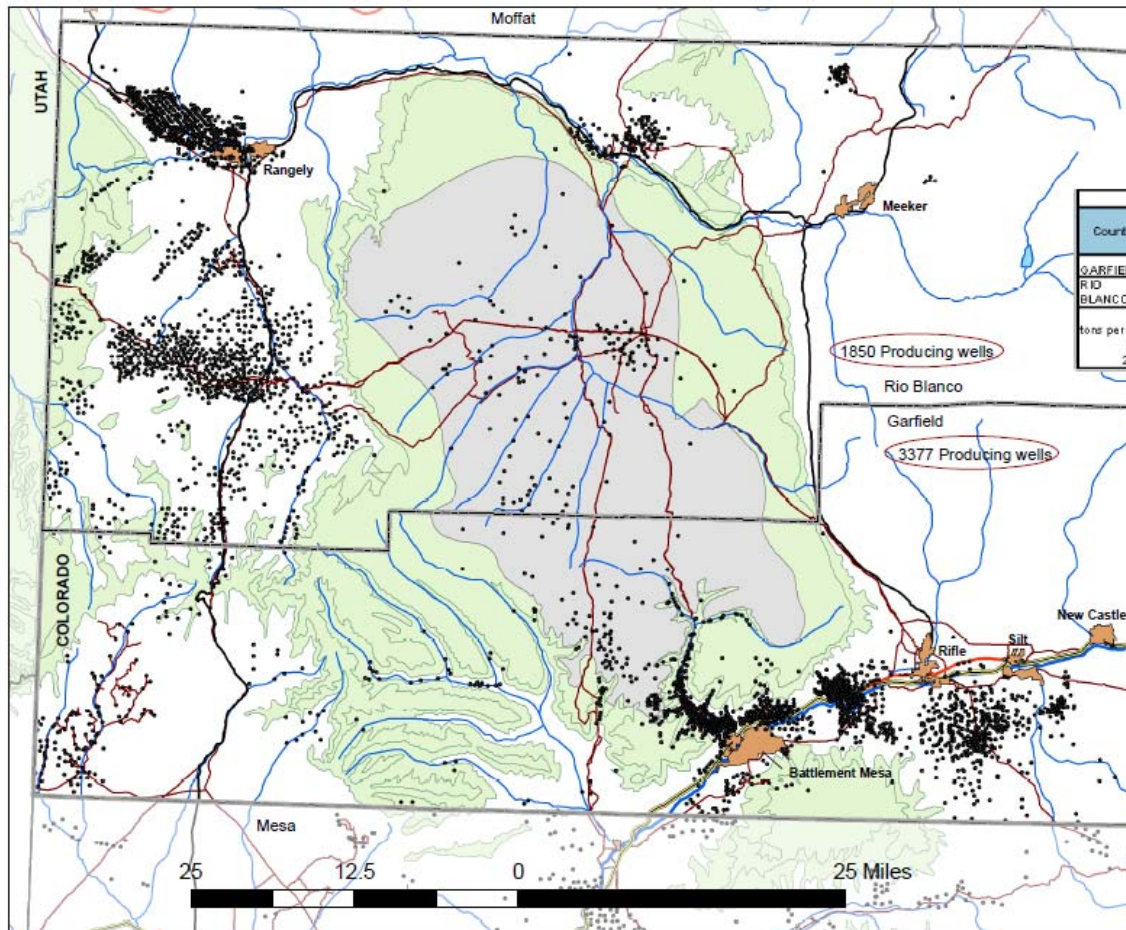
from 1900-2005



Weld County, CO – O&G Activity



Garfield/Rio Blanco County, CO – O&G Activity



Garfield & Rio Blanco Counties Oil & Gas Development

County	2006 Production			
	Oil Production (million barrels)	VOCs from flash emissions (tons)	Gas Production (B.C.F.)	Water Production (million barrels)
GARFIELD	1.1	5,519	329.7	9.9
RIO BLANCO	5.6	29,194	43.1	105.0

tons per year of VOCs from flash emissions = oil production x CDPHE VOC emission factor / lbs
10.0 CDPHE VOC emission factor for condensate tanks (lb/bbl)
2000 lbs to Tons

Legend

- Producing Oil and Gas Wells (Feb. 2007)
- Place
- County
- <all other values>
- Rio Blanco
- Garfield
- State and Federal Highways
- Interstate
- State Hwy
- US Hwy
- Rivers/Streams
- <all other values>
- Colorado River
- Lakes
- R&B Pipelines
- Natural Gas
- Potential Oil Shale Development
- Oil Shale Basin (Green River Formation)

May 30, 2007

Disclaimer:
EPA makes no claims regarding the accuracy, precision, or use of this data.
Questions concerning the data should be referred to the source agencies.

Sources:
Data on oil shale and tar sands deposits was provided by Argonne National Laboratory.
Data on oil and gas well locations are from Colorado Oil and Gas Commission.
Pipeline data is from EPA intranet server.
Places, State and county boundary data are from TeleAtlas 2006.
Rivers and lakes data are from USGS National Atlas.

Emission Sources and Activities

- Drilling
- Well Completion
- Well Workovers
- Production Well Pads
- Produced Water Treatment
- Unloading/Loading and Transport of Oil, Gas, and Water
- Mobile Sources



Drill Rig - CO

Pollutants

- Greenhouse Gases (Methane and Carbon Dioxide)
- Volatile Organic Compounds (Air Toxics and Ozone Precursors)
- Nitrogen Oxides
- Particulate Matter



Production Well Pad – CO

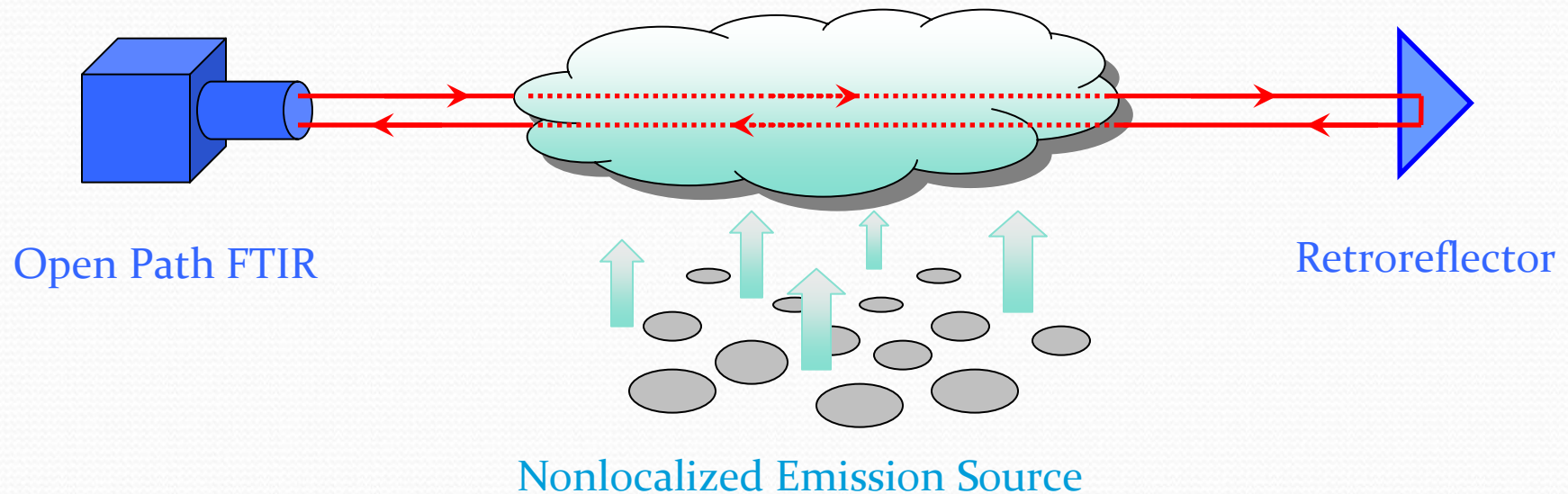
Instruments and Methods

- EPA Other Test Method 10 (OTM 10)
 - Open Path FTIR
 - Broadband instrument (Multiple Compounds at once)
 - Monostatic (Source and Detector in one instrument)
 - Mounted on Orbital Scanner
- Summa Canisters
 - TO – 14A – GC/FID
 - TO – 15 – GC/MS
- Met Station
- FLIR Camera



FLIR Camera

Optical Remote Sensing (ORS) Path-Averaged Concentration Data

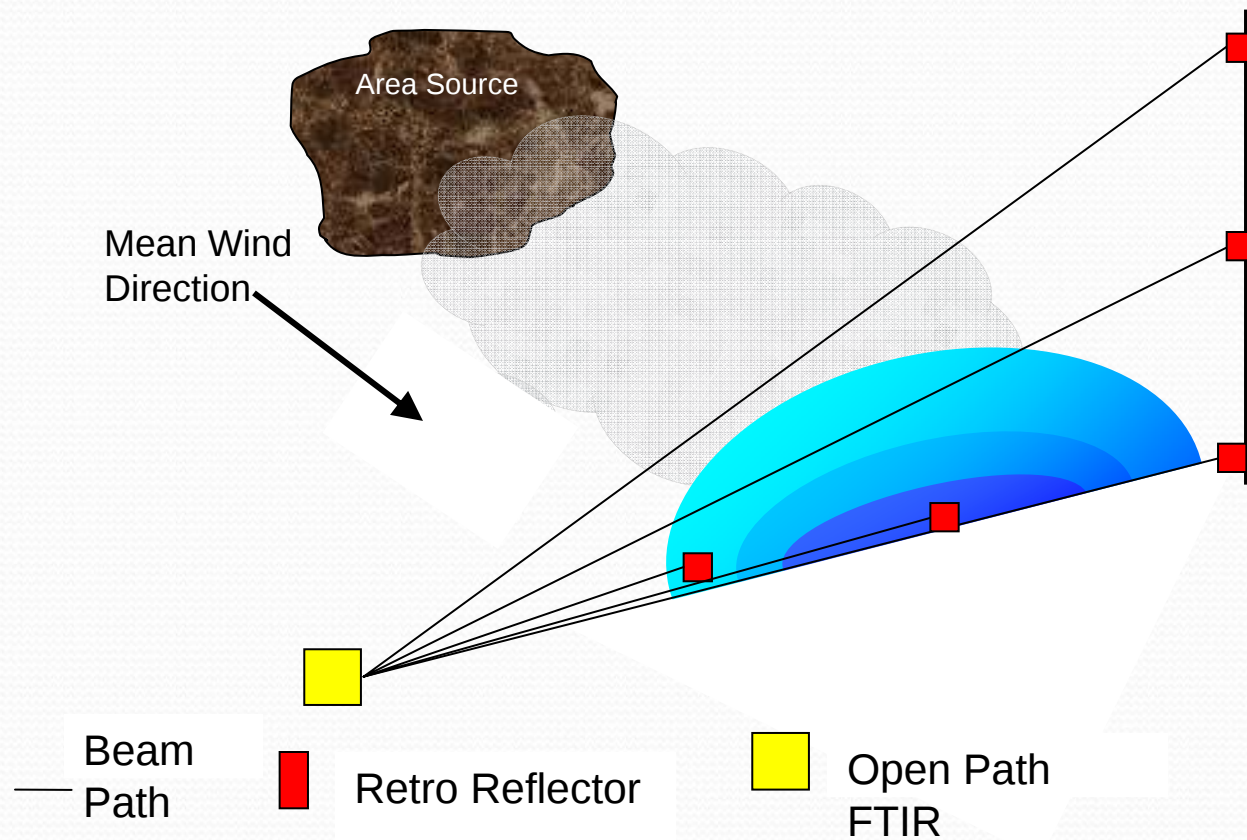


Average of the concentration over the entire beam path length
Not directly comparable to point and flux box measurements

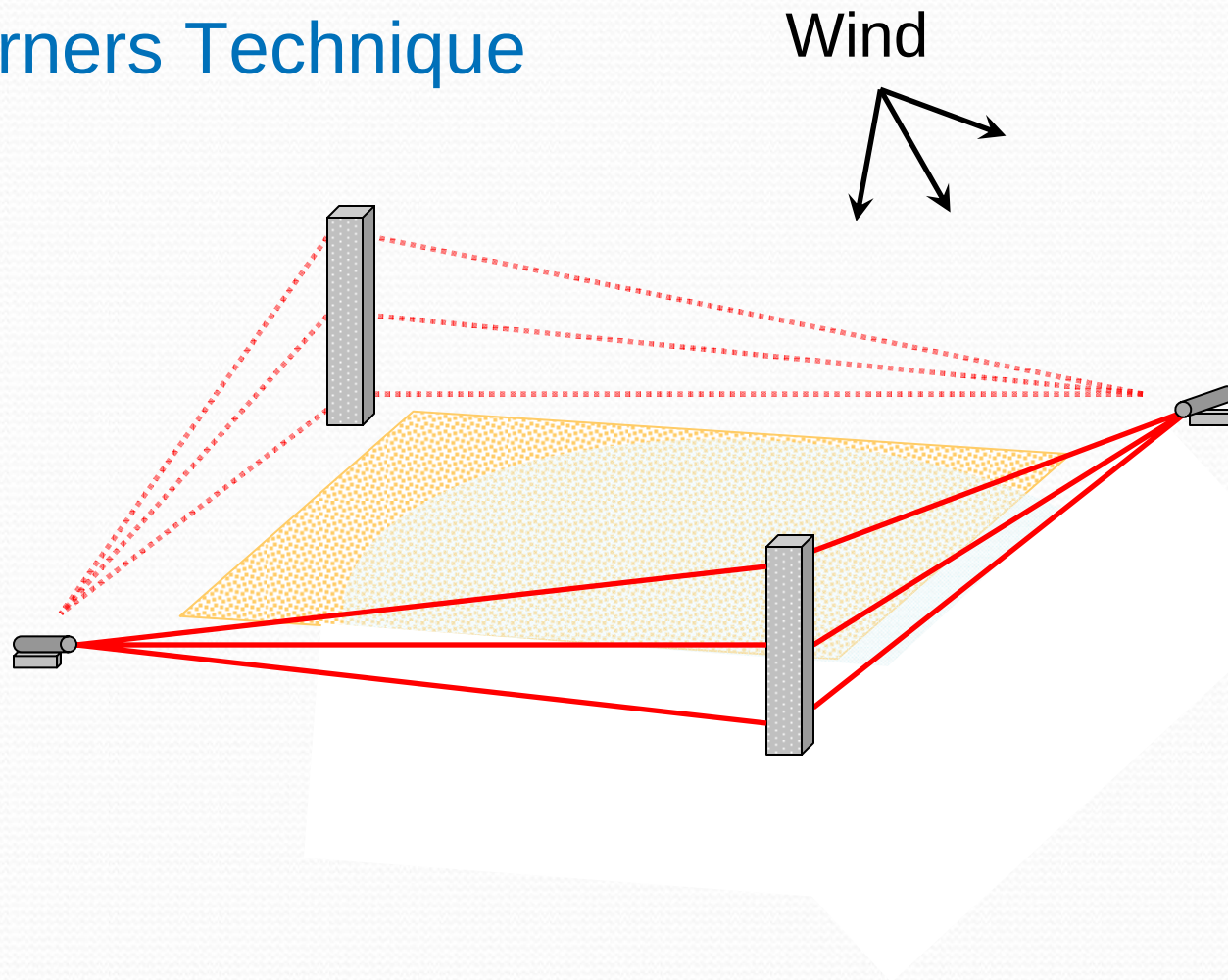
Other Test Method 10

- Measure multiple path integrated concentrations (PAC)
- Measure wind speed and direction
- Optimization algorithms used to reconstruct mass equivalent plume in a plane downwind from source and generate concentration “maps”
- Plane integrated concentration x wind speed (taking angle into account) = emission mass flux
- Collaboration of DoD, ORD, ARCADIS and OAQPS
- www.epa.gov/ttn/emc/methods.html

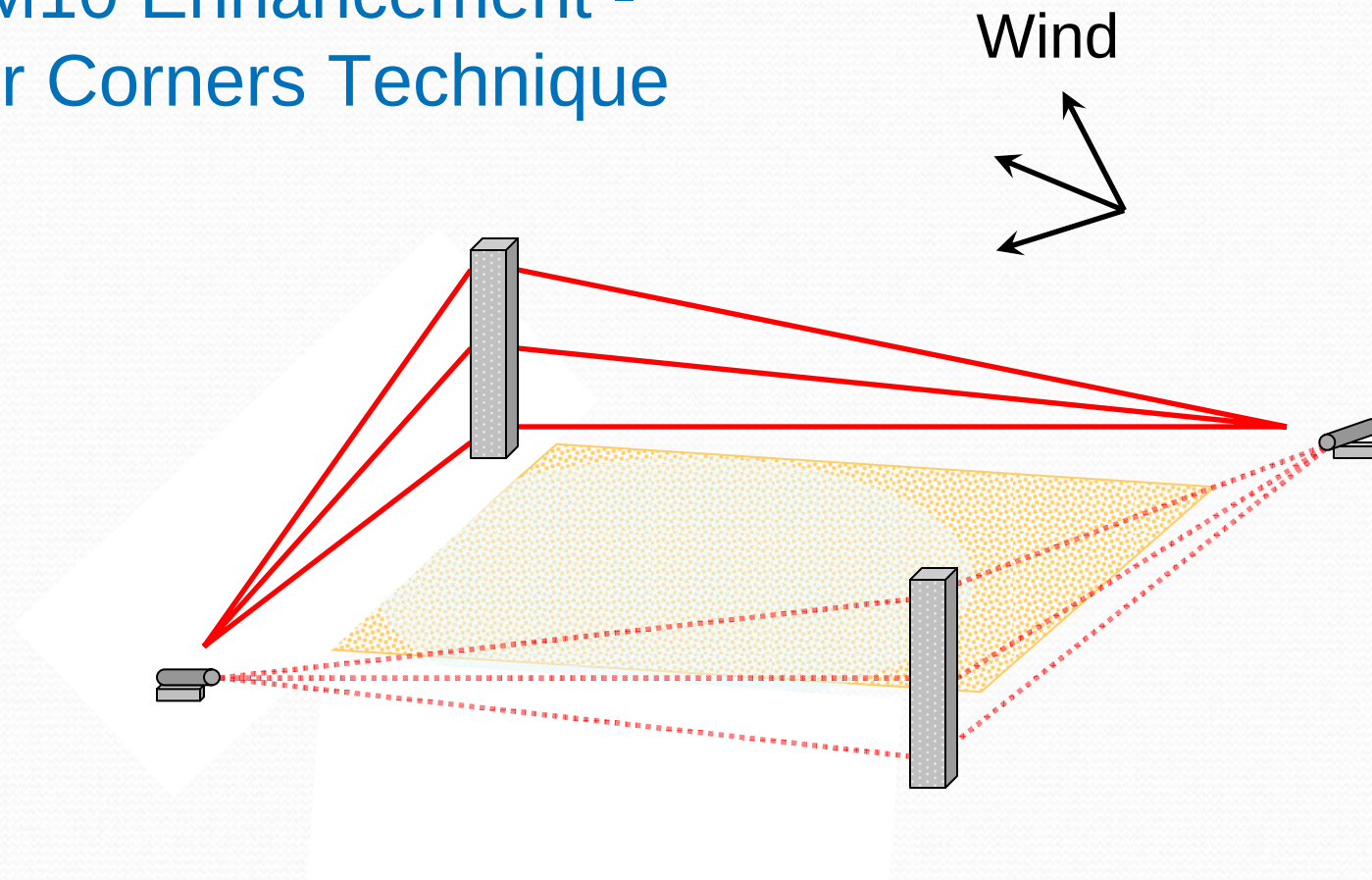
OTM 10 Vertical Radial Plume Mapping



OTM10 Enhancement - Four Corners Technique



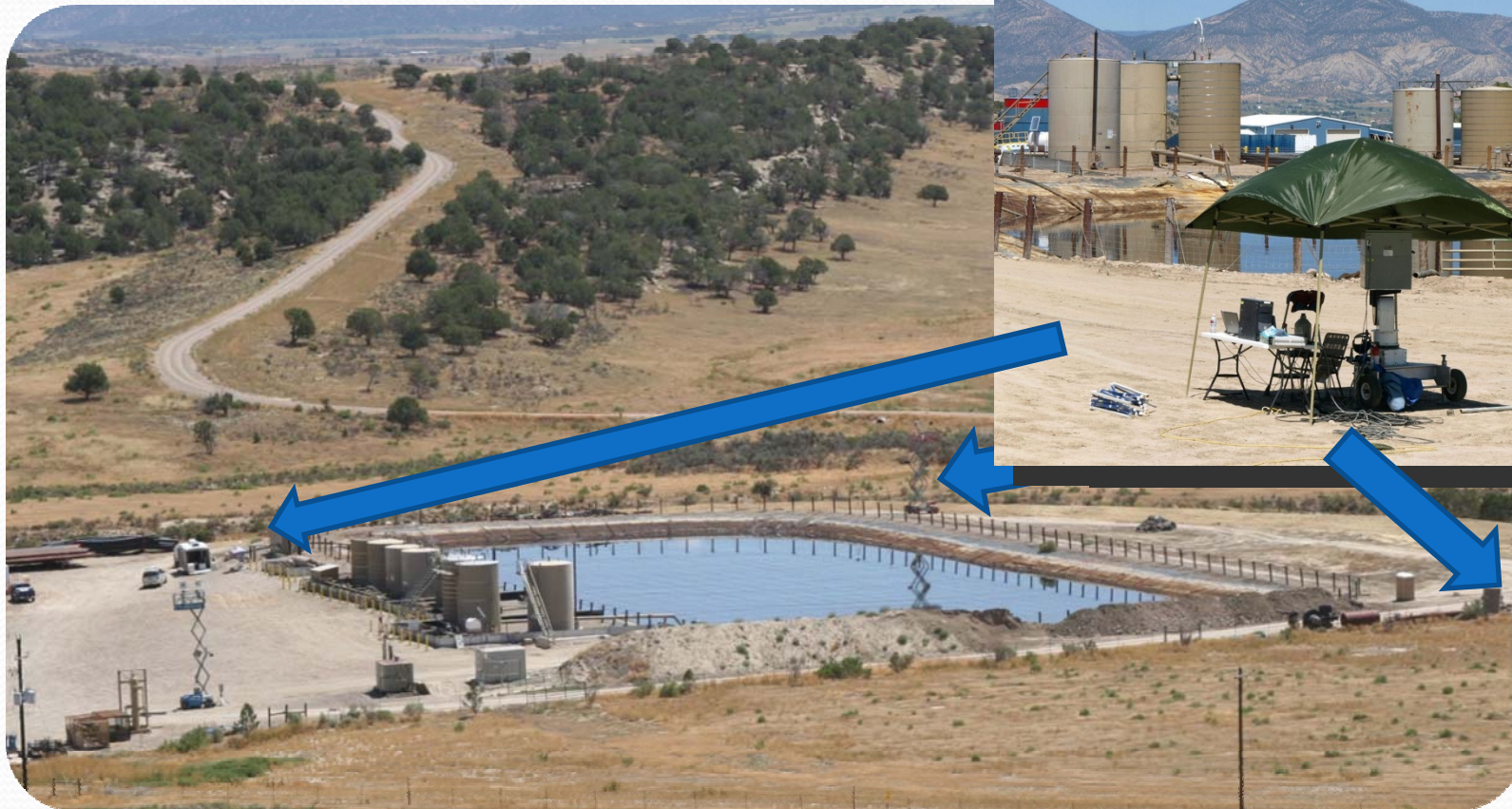
OTM10 Enhancement - Four Corners Technique



4-Corners Technique is more forgiving to wind direction changes
Set up and leave configuration for a long period of time

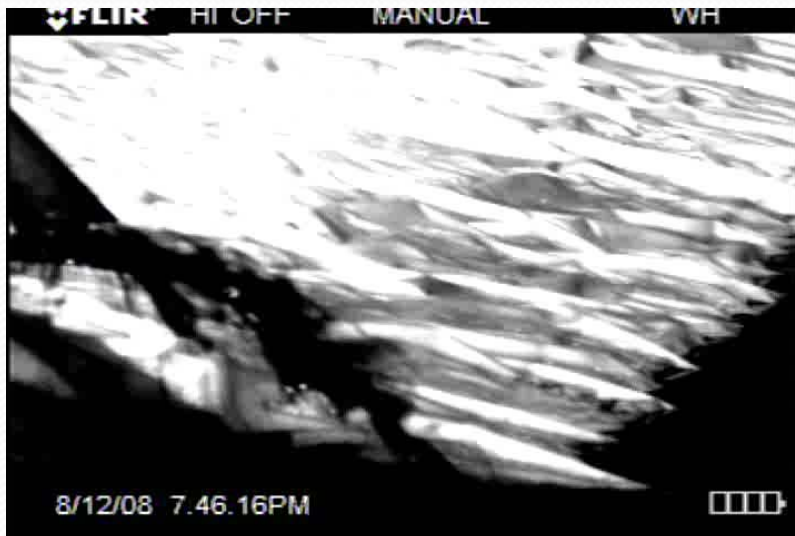
Produced Water Evaporation Pit





Produced Water Evaporation Pit

Produced Water Evaporation Pit



Produced Water Treatment Facility



Produced Water Treatment Facility (Four Corners)



-  Retroreflectors
-  Scanning OP FTIR
-  VRPM Optical Paths

Produced Water Treatment Facility



Produced Water Treatment Facility



Where do we go from here?

- Finish Report and QA Clearance Process
- Provide States and Industry with guidance on possible future OTM-10 testing for produced water treatment facilities
- Plan future testing focused well production pad and drilling emissions



Well Production Pad - CO

Questions?



Production Well Pad Condensate Tank next to a Bible School