Methane Monitor: An Airborne, Wide-Swath, Methane Mapping Instrument

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Abstract

Ball Aerospace flew its Methane Monitor system in the San Juan basin of Colorado and New Mexico in February 2018. The primary campaign objective was to map methane from compressor facilities in a joint effort with Colorado State University. Secondarily, the team took advantage of the opportunity to map a section of the Fruitland Outcrop, a region known for its natural methane seeps. This presentation covers some of our early findings from both industrial and natural sources in that region.

Instrument Overview

The Methane Monitor is a differential absorption lidar system that measures the total column density of methane from an airplane flying 1,000 meters above the ground. The instrument can measure plumes with emission rates on the order of 50 Standard Cubic Feet per Hour (SCFH) while maintaining sufficient dynamic range to capture the largest plumes. The instrument can measure concentration path lengths up to 100,000 ppm-m before saturating. (The highest concentration path length measured to date is about 60,000 ppm-m.)

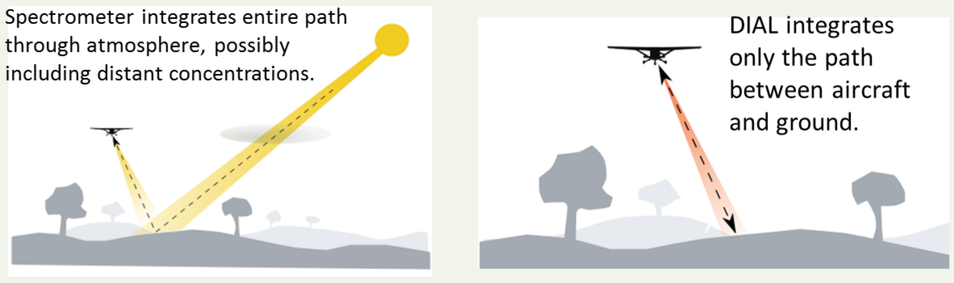


Fig 1. (Above): A passive airborne spectrometer using reflected sunlight is restricted to absorption features within the limits of the solar spectrum while DIAL systems bring their own light sources (lasers) and can operate day or night on any selected feature. (Better where there is no sunlight.)

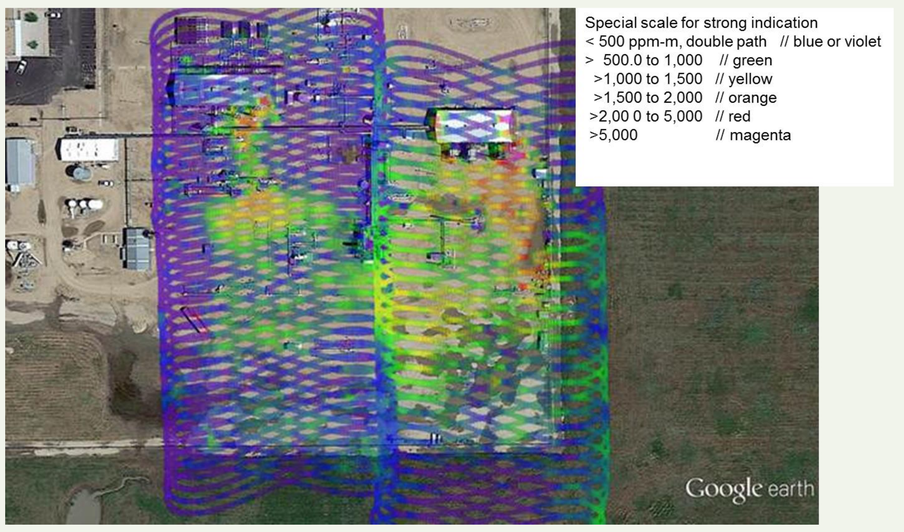


Fig 2. (Middle): The instrument scans the terrain at 10 Hz with 10,000 pulses per second to create dense tracks of information. The methane plumes here are of a compressor facility in northeast Colorado.

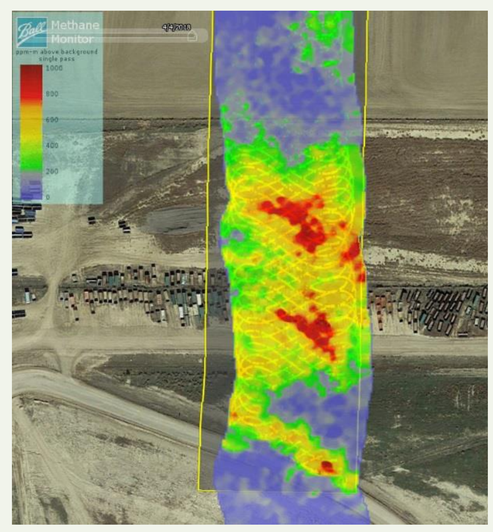
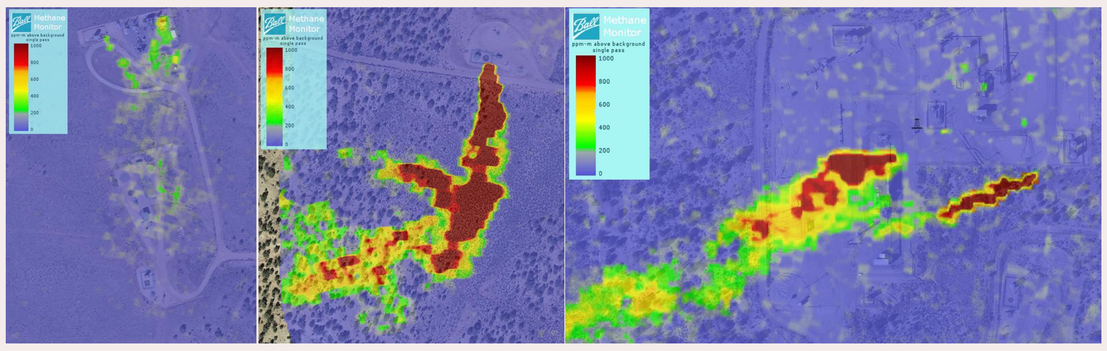


Fig 3: (Right): View of methane coming from a landfill near Ft. Collins, Colorado. The instrument has a swath width up to 300 meters wide.

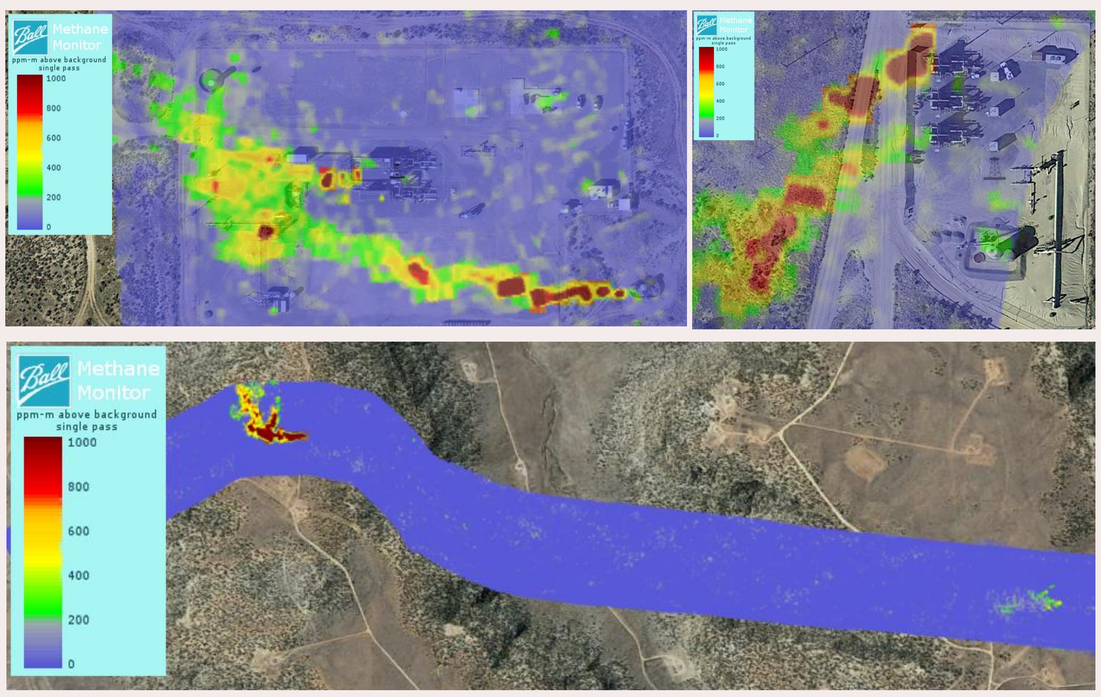
Compressor Stations

Fifty compressor stations from New Mexico and Colorado were mapped multiple times to investigate temporal effects on plume releases. Stations were chosen without regard to ownership and many companies were represented. The results here are preliminary with final results expected in a joint paper with Colorado State University.

Finding 1: Thirty of the fifty compressor stations exhibited methane plumes
Finding 2: Of the thirty stations, roughly 25% exhibited multiple plume sources
Finding 3: The only noticeable variation in time was wind direction.



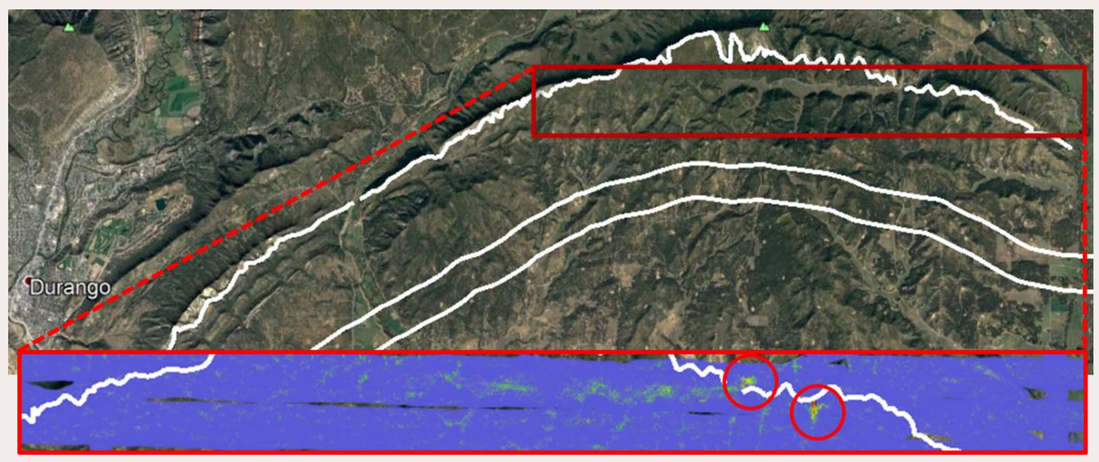
Figures: *Example plume detections from the San Juan Basin campaign. Many locations exhibited multiple plume sources with geolocation allowing precision identification of which assets were the source of the methane plumes. The bottom-most image is a typical flight path result with a 300-meter swath and two plumes detected.*



Fruitland Outcrop Methane Seeps

The figure below shows the outline of the Fruitland outcrop in the chosen area with white lines while the red box roughly bounds the mapped area. This region was chosen due to knowledge of two seeps detailed in a January 2015 report from the Colorado Oil and Gas Conservation Commission.

The region was fully mapped on February 26th, 2018 with five flight lines, and partially mapped on February 27th with three flight lines. Both flights took place in the morning to take advantage of low thermal activity. Although no wind information was available for the specific region, the Durango airport reported calm winds.



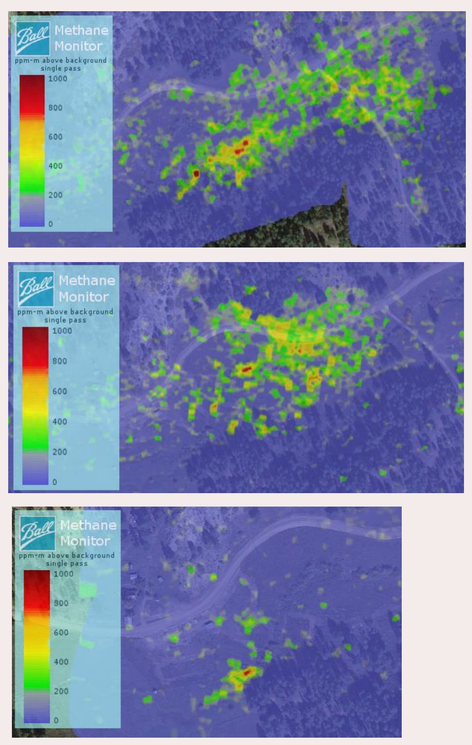
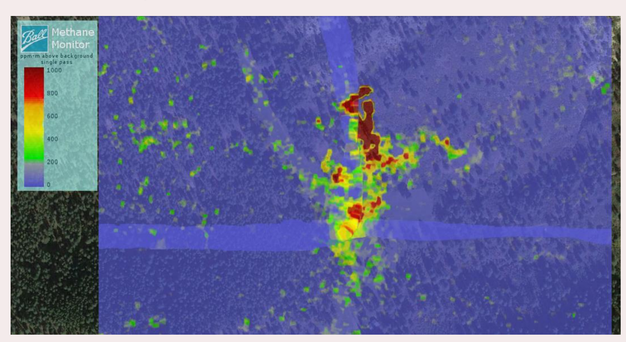


Fig 1. (Above): View of the Fruitland Outcrop borders (white) with the mapped area (red). The zoomed in subset image is the mapped result from Feb. 26th. The two red circles highlight the largest found seeps. The region is approximately 13 km long, 1.2 km wide and is 20 km east-northeast of Durango, CO.

Fig 2, 3, 4. (Left): Time varying views of the South Fork Texas Creek mitigation site. The top two were taken on Feb 26th. The bottom image was taken on Feb 27th. Each pass showed varying concentration and distribution.

Fig 5: (Below): Large, unexpected methane plume from a natural seep. This was the greatest concentration of methane found within the mapped region. A literature search has not found previous documentation of this site. Coordinates 107.642014W, 37.312666N.



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