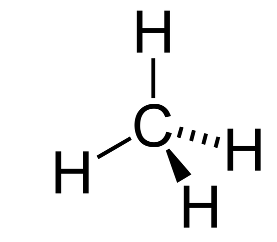
Identifying Sources of Methane Leaks in the Bountiful/North Salt Lake Area



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I. Introduction

Methane (CH4) is a highly potent greenhouse gas that is emitted into the atmosphere from natural and anthropogenic sources. Methane is said to have 80 times the warming potential of Carbon Dioxide (CO2) which is another greenhouse gas of concern. During a MethaneAir pass over of the North Salt Lake Area on August 11th, 2021, a notable methane plume was observed prompting the question of where the source of the plume originated. Since the beginning of the industrial revolution, methane emissions have been rising as the demand for oil and natural gas continues to surge. In the Uinta Basin, drilling for oil and natural gas began in the early 1900s and continues to be a prominent industry in Northeastern Utah today. However, the transportation (through pipelines) and processing of these fuels often comes with leakage of methane.

This research seeks to identify the source of the methane plume observed during the pass over using a combination of meteorological simulations generated from the Weather Research and Forecast model (WRF) and nearby wind measurements obtained from MesoWest. Identifying sources of methane leaks not only helps oil and gas companies economically but also aids in estimating the degree in which methane leakage contributes to global methane concentration increases.

II. Methods

- Wind measurements from 23 monitoring stations surrounding the study area obtained
- Wind speed and direction measurements collected for August 11, 2021 (pass over day)
- WRF Model simulations ran for August 11th
- Wind barb plots of model and observational measurements created
- Time series charts created to assess the accuracy of the model
- STILT model ran to obtain a trajectory footprint of methane for August 11th

Image 1 – MethaneAir Flyover Image of North Salt Lake and Bountiful Area

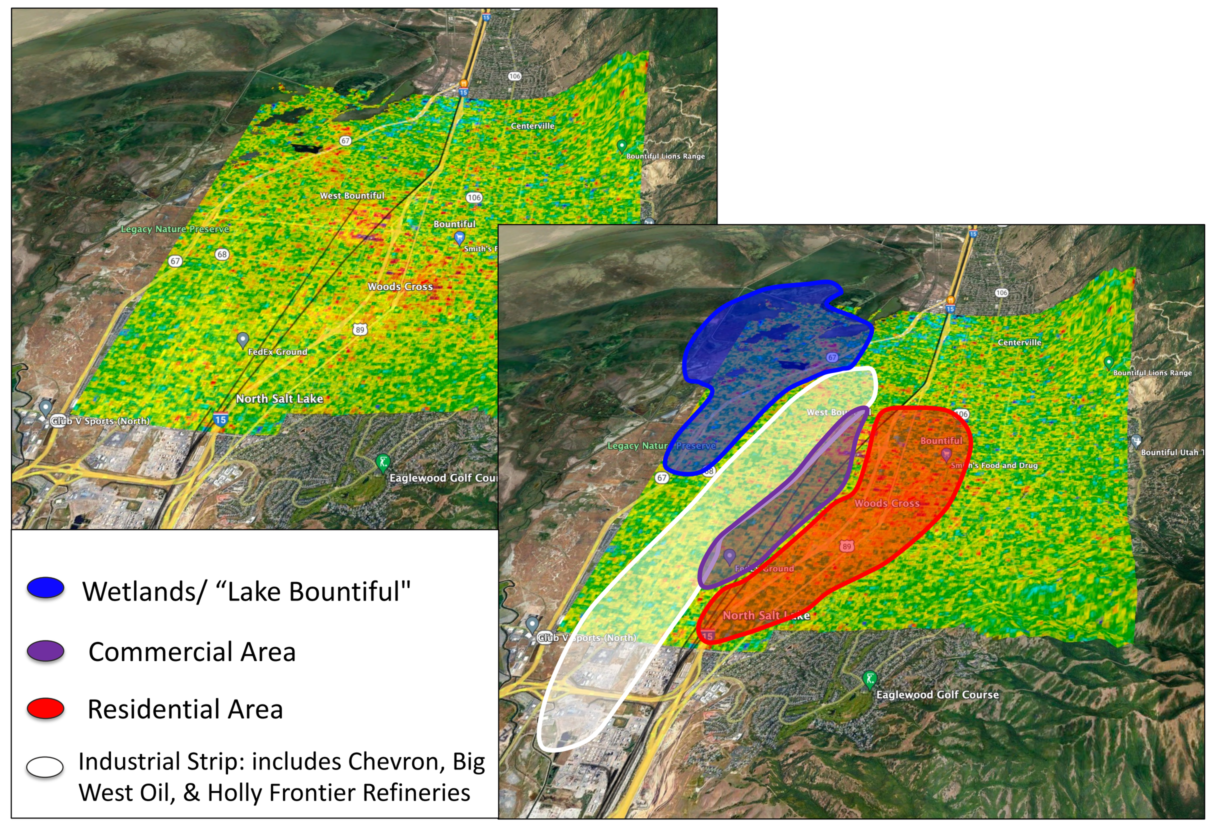
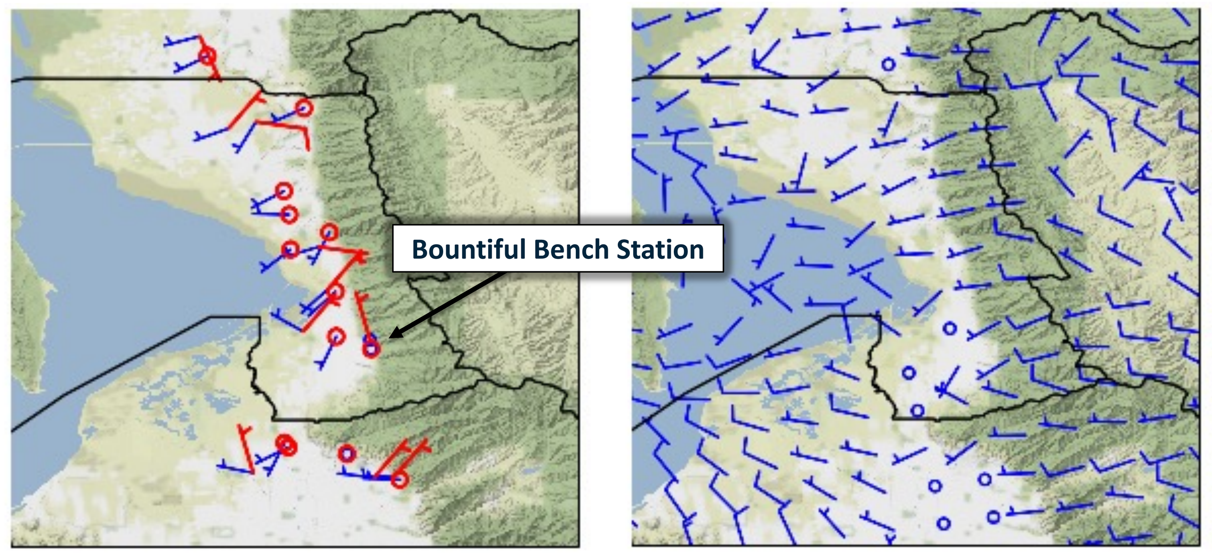
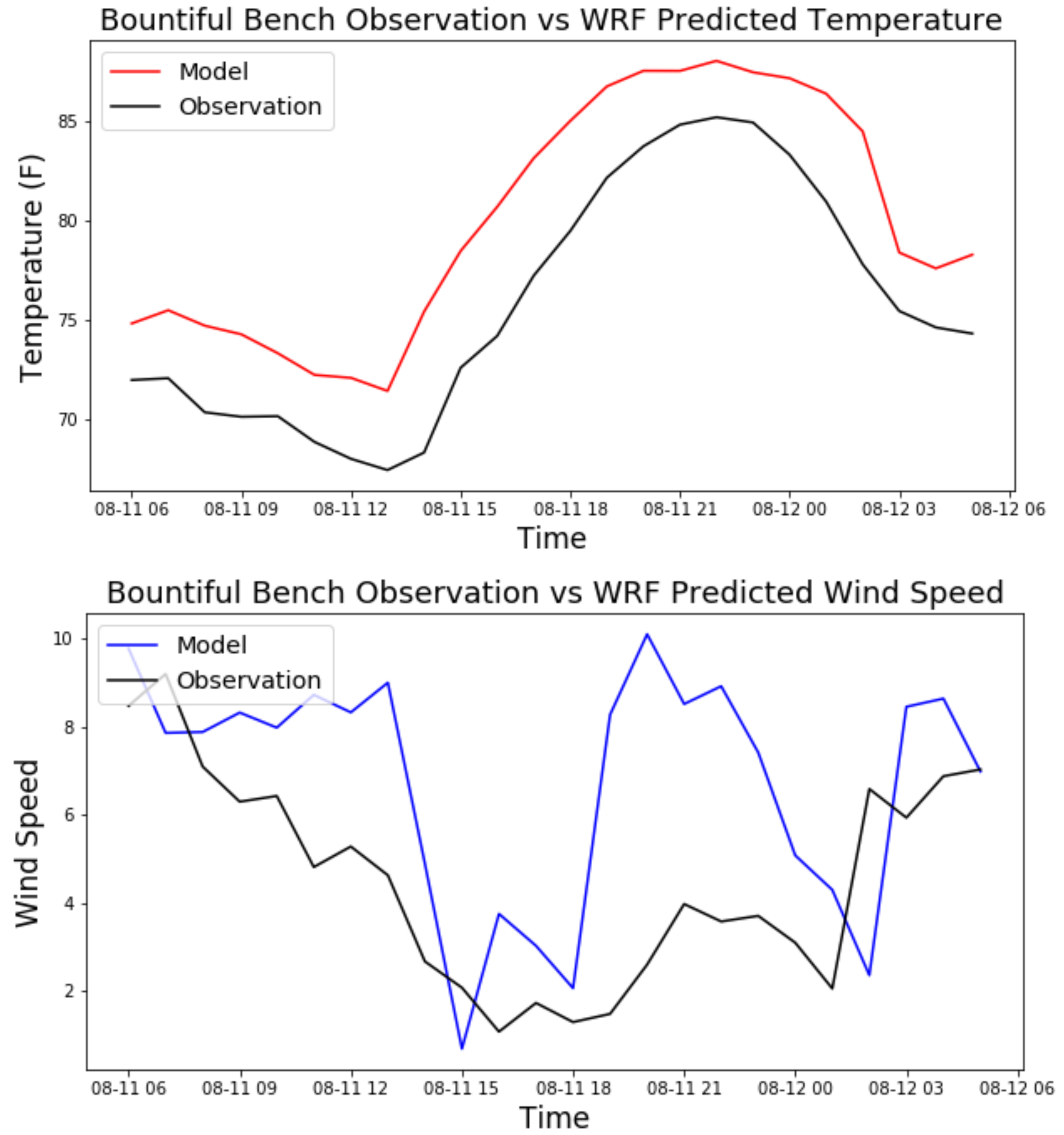


Figure 1 – WRF Model and Station Wind Barb Plot Comparison



Left image shows model-generated wind barbs overlaid with wind barbs generated from local station measurements. Right image shows only model-generated wind barbs.

Figure 2 – WRF Model and Station Measurement Comparison



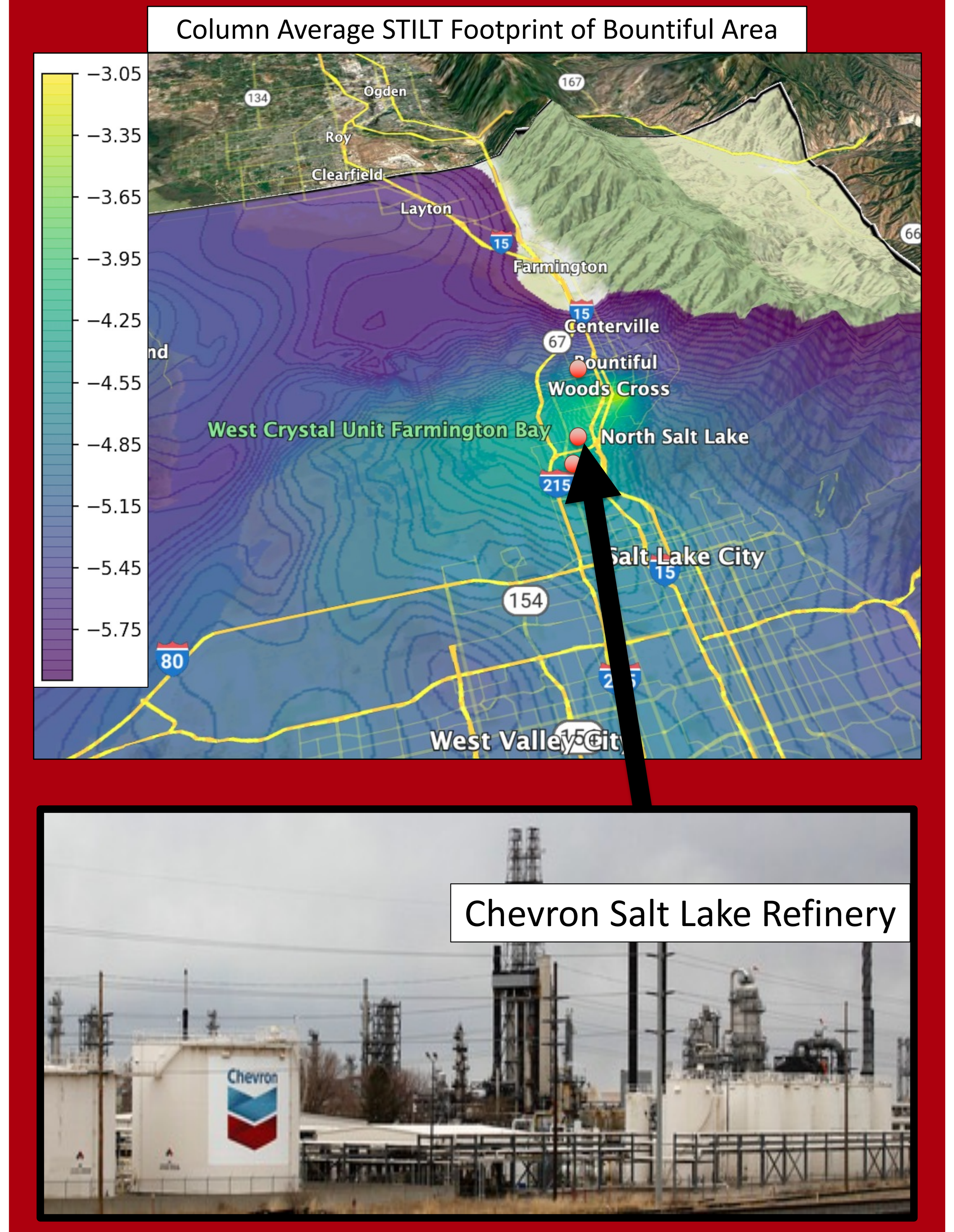
The top chart shows a time series of local station temperature measurements for 24 hours compared to WRF model predictions. Bottom chart shows a surface wind speed evaluation between WRF and observed winds.

III. Results

Winds were found to be light and variable (<10 knots) on August 11th, which indicated that the methane plume likely originated from a hyper-local source. Due to the light winds and general direction of the winds, it is unlikely that the methane plume originated from wetland areas located west of the North Salt Lake area. This analysis is further supported by the STILT trajectory analysis, which indicated that air was moving from southwest to northeast.

Figure 3 – STILT Trajectory (Lin et al. 2003) Model of Methane

This image shows a column-averaged footprint (surface - 2000mAGL) for a methane spike located in Bountiful, Utah, on August 11th.



IV. Conclusions

After considering the WRF predicted winds and local wind measurements, the meteorological analysis suggested that winds were stagnant on the pass over day increasing the probability of the methane source being in close proximity to the plume. Given that the plume is likely localized, we hypothesize that the plume originated from a nearby oil or gas refinery.

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References:
Lin, J. C., Gerbig, C., Wofsy, S. C., Andrews, A. E., Daube, B. C., Davis, K. J., and Grainger, C. A. (2003), A near-field tool for simulating the upstream influence of atmospheric observations: The Stochastic Time-Inverted Lagrangian Transport (STILT) model, J. Geophys. Res., 108, 4493, doi:10.1029/2002JD003161, D16.

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