# Understanding Operational Risk: Analysis on LEL & $H_2S$ Exposure Incidents

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Ovintiv™

# Self-Introduction

**Background**

- BSBA in Information Systems from CU Denver

**Position**

- EH&S Data and Analytics Intern

**Plans after college**

- Enter the workforce
- MS in Analytics from GA Tech

**Favorite Activities:**

- Traveling, backpacking in the outdoors, hiking, trying new dishes, weightlifting, biking, spending time with friends and family

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# Presentation Overview

- Project Background
- Profiling Tasks
- Hot-Spot Analysis
- Solutions, Impact, & Next Steps

# Project Background

Project Scope, Blackline Safety Monitors, & Data Collection Process

# Blackline Project Overview

## Big Picture

- A collaborative effort
- Explore solutions for reducing risks and improve working conditions

## Team Specific Goals

- Assess if certain tasks have higher exposure levels
- Pinpoint sites with elevated exposure levels


## Core Values

**Safety**: Improve health of the field operators through risk mitigation

**Sustainability**: Commitment in sustaining safe work environments

**Integrity**: Ensuring the data that collected is transparent and reliable

Sources: OSHA, CDC, and Safety-Line Lone Worker

# Blackline Safety Monitors

### Blackline Safety™ G7x

- Detects $H_2S$, gasses at their LEL, $O_2$, and CO
- Focus is on $H_2S$ and LEL

### $H_2S$ (Hydrogen Sulfide)

- Range: 0 ppm to 100 ppm
- Alarm goes off at 10 ppm

### LEL (Lower Explosive Limits)

- Range: 0% to 100%
- Alarm goes off at 10%


Sources: OSHA, CDC, and Safety-Line Lone Worker

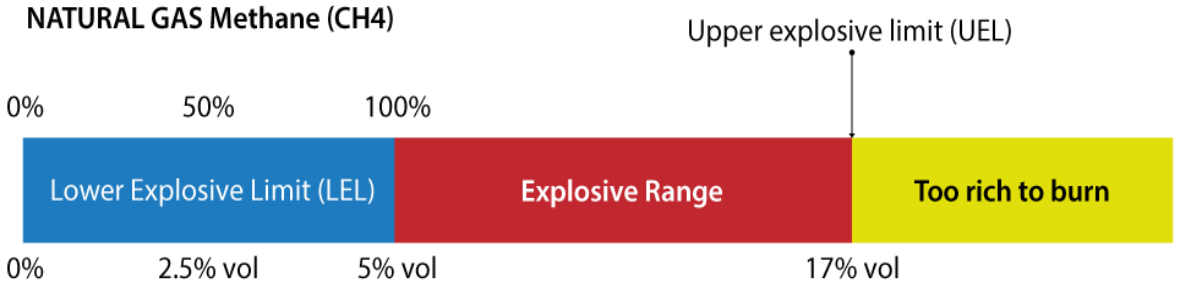
# LEL & $H_2S$

## Lower Explosive Limit (LEL)

- Lowest concentration of a gas in the air that cause an explosion (if ignition source is nearby)

**An example: Methane**

- **LEL for Methane is 5% by vol or 100% LEL**
- **60% - 99% (3% - 4.95% Methane):** Considered dangerous and highly flammable




## Hydrogen Sulfide $H_2S$

- Smells like rotten eggs at lower concentration but becomes undetectable at higher concentration (DEADLY!)

**Health effects ($H_2S$ Poisoning):**

- 10-99 ppm: Eye + respiratory irritation
- ≥100 (Over-limit!): Immediate danger to health and life
  - 500-700 ppm: Blackout + respiratory failure
  - 1,000-2,000 ppm: Death can occur

**Ceiling limits**

- **ACGIH (STEL): 5 ppm for a 15-min window**
  - Short term exposure limit protects workers from the acute effects of $H_2S$
- **NIOSH (REL): 10 ppm**
  - Should not be exceed during any part of the workday

Sources: Wermac, EGasDepot, OSHA, CDC, and NIOSH

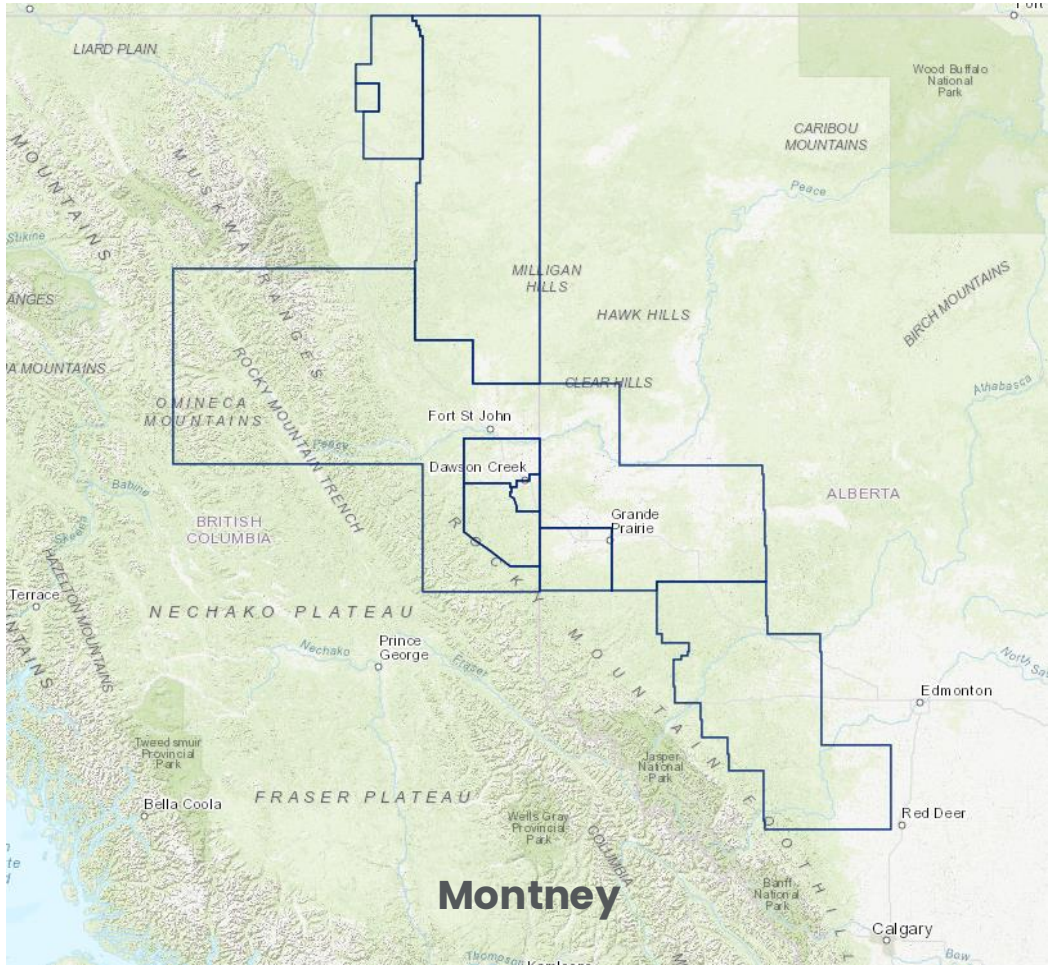
# More on the Data

## Data Composition

- $H_2S$ data contains events without SCBA (self-contained breathing apparatus) use
- Ignore events marked as ‘sensor error’
- Testing pool is in Montney

## Events

- Each event occurs randomly and independently
- Events grouped to the nearest site using a distance formula (Haversine)
- Duration varies from event to event



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# Data Collection Process

**1. Detection & Logging**

- Monitors detect high $H_2S$/LEL levels and log entries in the MSSQL database
- **Limitation**: No info on which task the operator performed

**2. Email Alert Management**

- Power Automate handles email alerts
- Alerts are sent to ops EOD

**3. Power App Interaction**

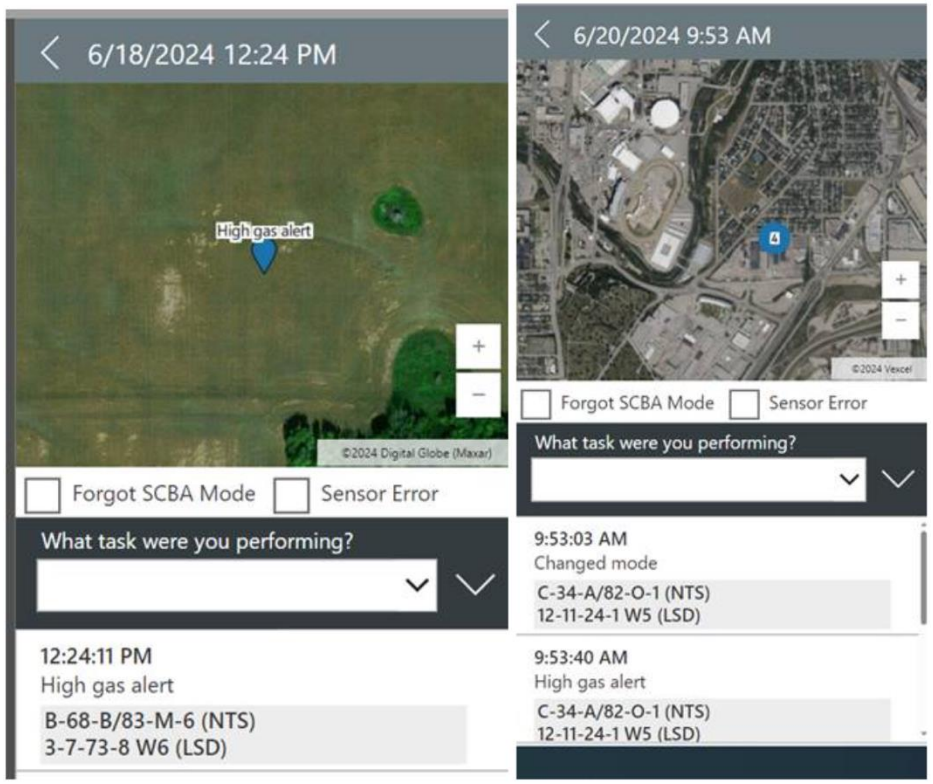
- Prompt ops to open the Power App and provide task info

**4. Updating Task Information**

- Task info is updated using the description ops give


Sources: Power Automate, Power App, and MS SQL Server

# Email Format and Power App




**You currently have the following event(s) that require tagging:**

| Event Date | Total LEL Events | Total $H_2S$ Events | Total Events |
|---|---|---|---|
| 2024-06-18 | 1 | 0 | 1 |
| 2024-06-20 | 2 | 0 | 2 |
| 2024-06-29 | 1 | 1 | 1 |

**Please update those event(s) here: Power App**

Sources: Power Automate, Power App, and MS SQL Server

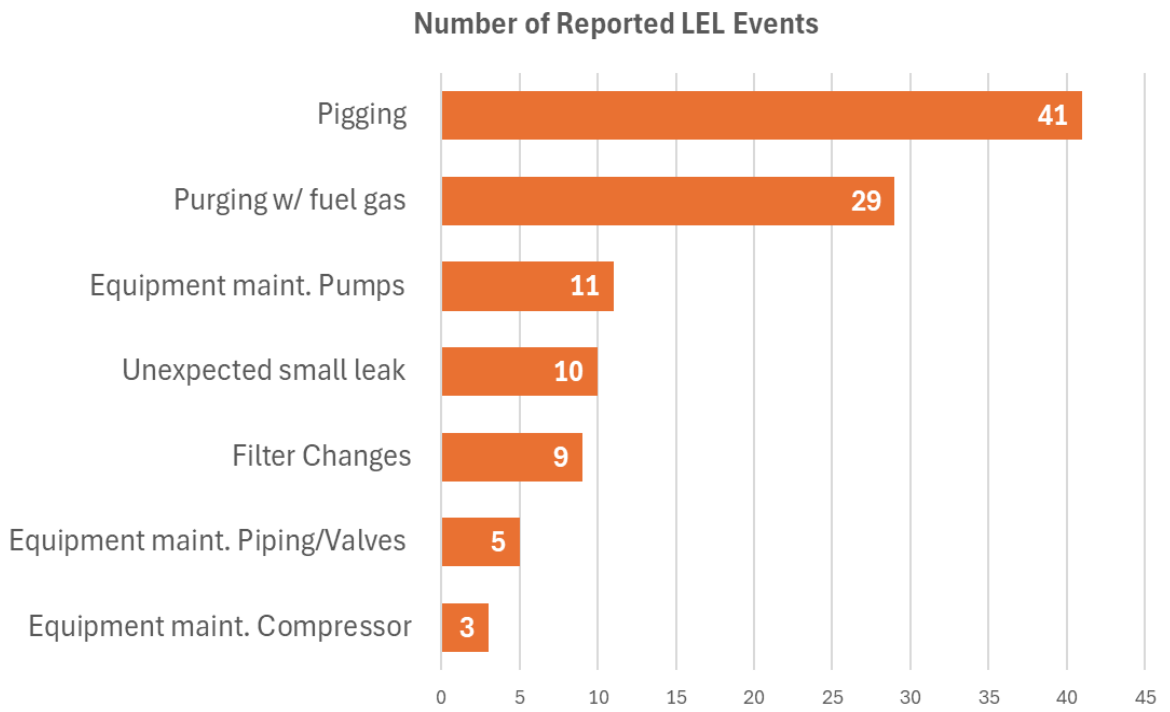
# Profiling Tasks

Profiling Tasks using Task Labeled Data

# Task Profiles

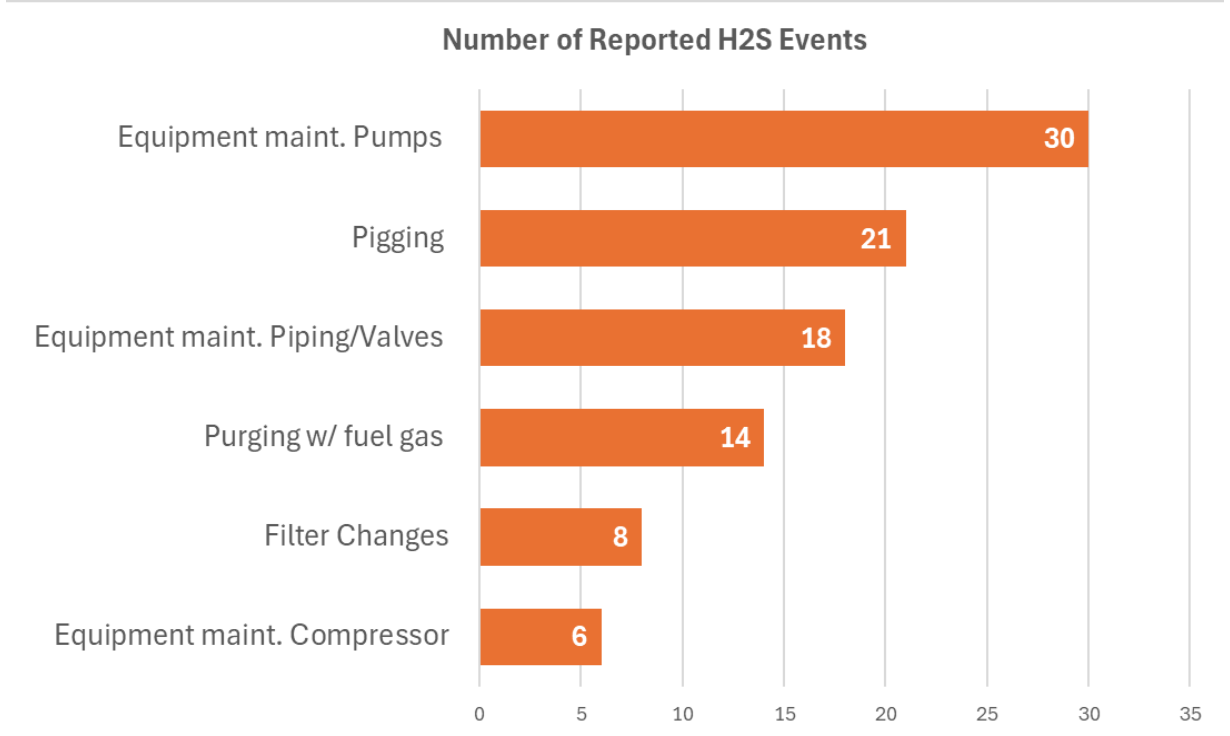
**Number of Reported LEL Events**

- Purging and pigging have the highest number of reported events
- More likely to trigger LEL events that have higher LEL percentages on average




**Number of Reported $H_2S$ Events**

- Pumps maintenance and pigging have the highest number of events
- More likely to trigger $H_2S$ events that have higher $H_2S$ ppm on average




Created Using

Pandas and Matplotlib in Python

# Hot Spot Analysis

Permutation Testing
for Getis-Ord Gi*
using Locational Data

# Hot-Spot Analysis: LEL Data

**Hot-Spots Analysis**

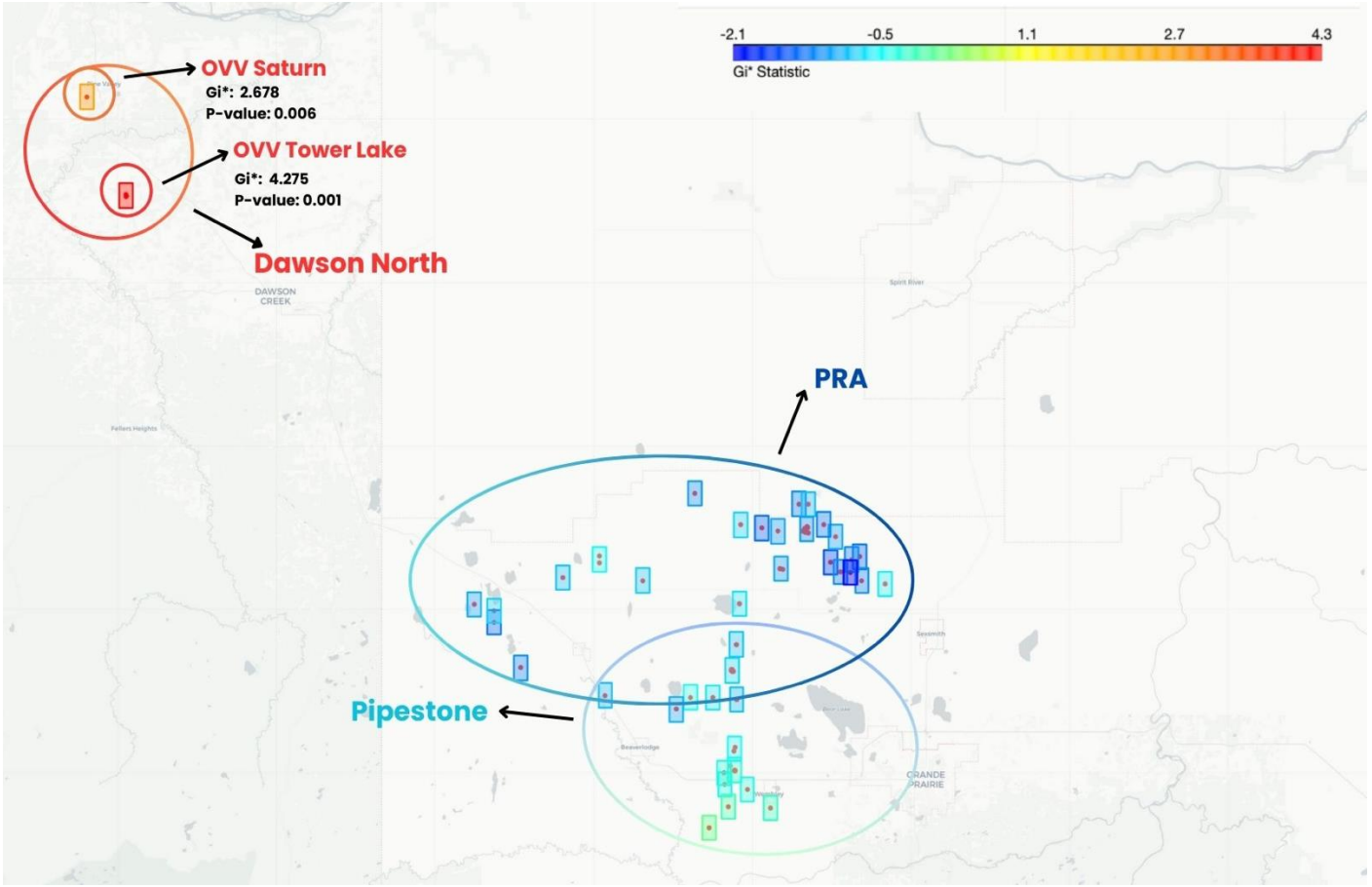
- Two hot-spots in Dawson North
  - Average LEL's are higher than average for all locations (17.2%)
- Mostly purging/pigging events
- Tower Lake has two 'filter changes' events
  - These events are above the average LEL for similar events

**Tower Lake**

- **Average for all events at Tower Lake: 67.9%**
- 119.1% above the overall average,, close to the LEL threshold

**Saturn**

- **Average for all events at Saturn: 49.0%**
- 96.0% higher than the overall average




Modeled Using ESDA, PySal, Folium, NumPy and Statsmodels in Python

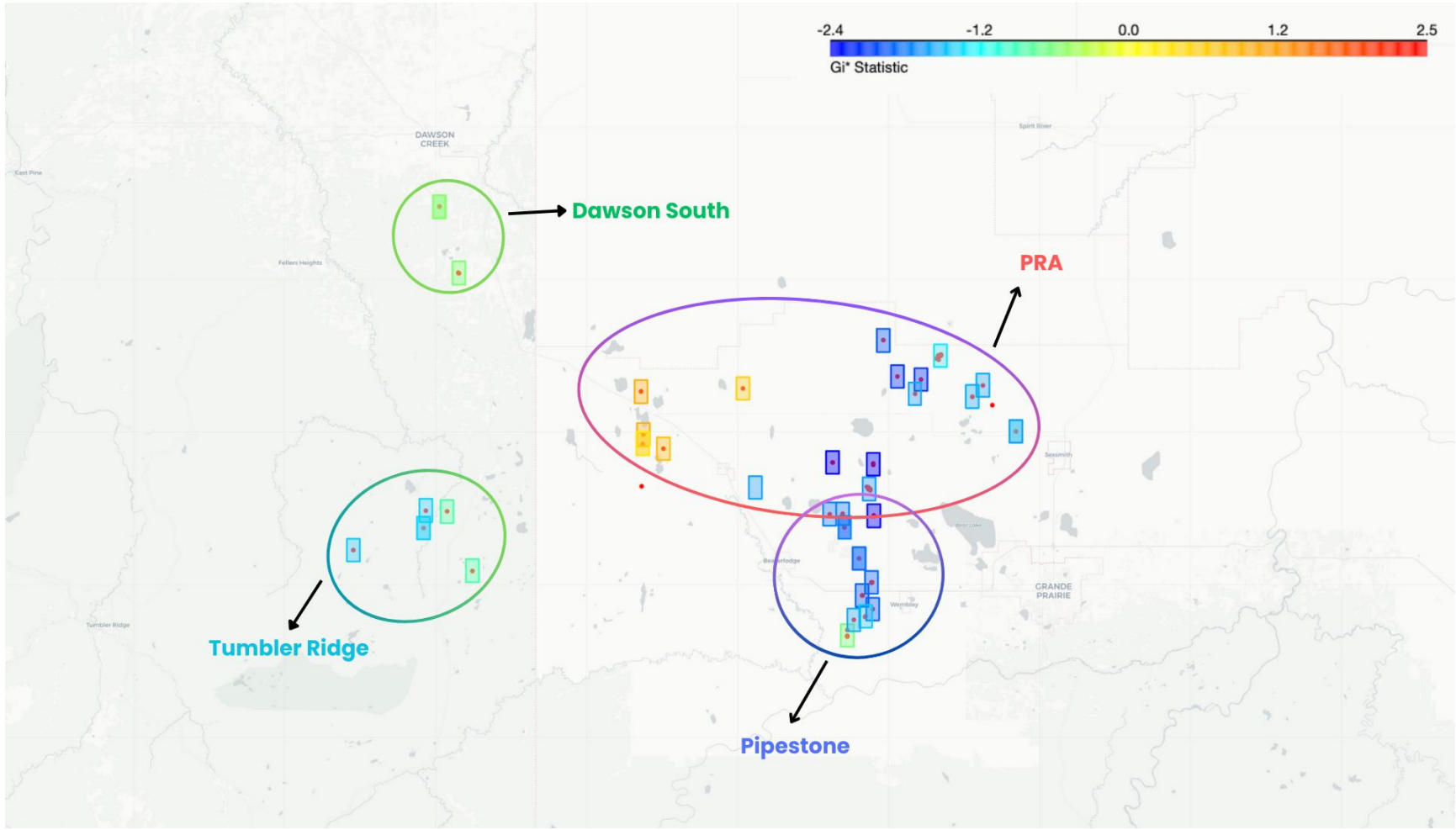
# Hot-Spot Analysis: $H_2S$ Data

**Hot-Spots**

- Compressor stations in west PRA were flagged
- Involved pumps/pipes maintenance, or pigging

**Profile of West PRA**

- Average $H_2S$ range 18.4-26.00 ppm
- **18% to 45% higher than the average $H_2S$ level** for all locations combined (16.5 ppm)
- Need for closer monitoring




Modeled Using ESDA, PySal, Folium, NumPy and Statsmodels in Python

# Solutions & Impact

# Risk Reduction Solutions

**Targeted Approach**

- Focus on tasks with more practical solutions
  - Example: Replacing outdated filter pots
  - Not all processes use these filter pots
- **Matteo Gagliardi**: Ops must delve into the pot to do filter changes, exposing themselves to trapped gases
  - A widespread issue at Sexsmith.

**Potential Improvement**

- **Shawn Simmonds**: New filter design allows ops to open the lid in a safer manner (quick-release snap)
- An opportunity to reduce number of LEL events at Tower Lake

**Beyond the Numbers**

- Decision-making includes perspectives from ops
- Ensure ops are safe and feel safe

# Project Impact

**Employee Safety**
- Improved working conditions can lead to greater job satisfaction

**Company Reputation**
- Commitment to safety can boost reputation of company
- Key stakeholders: employees and investors

**Communication**
- Daily emails have been increasing communications
- Fosters a proactive and collaborative safety culture

# Next Steps

# Next Steps of the Project

**Location Granularity**

- Focus on individual equipment and tools for precise data
- Allows thorough inspections and potential upgrades

**Advanced Analytics**

- **Regression Algorithms**: Predict risk scores for specific tasks
- **Classification Algorithms**: Identify the most probable risk types
- Apply sentiment analysis techniques on comments made by ops

# Thank You!

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field operators!