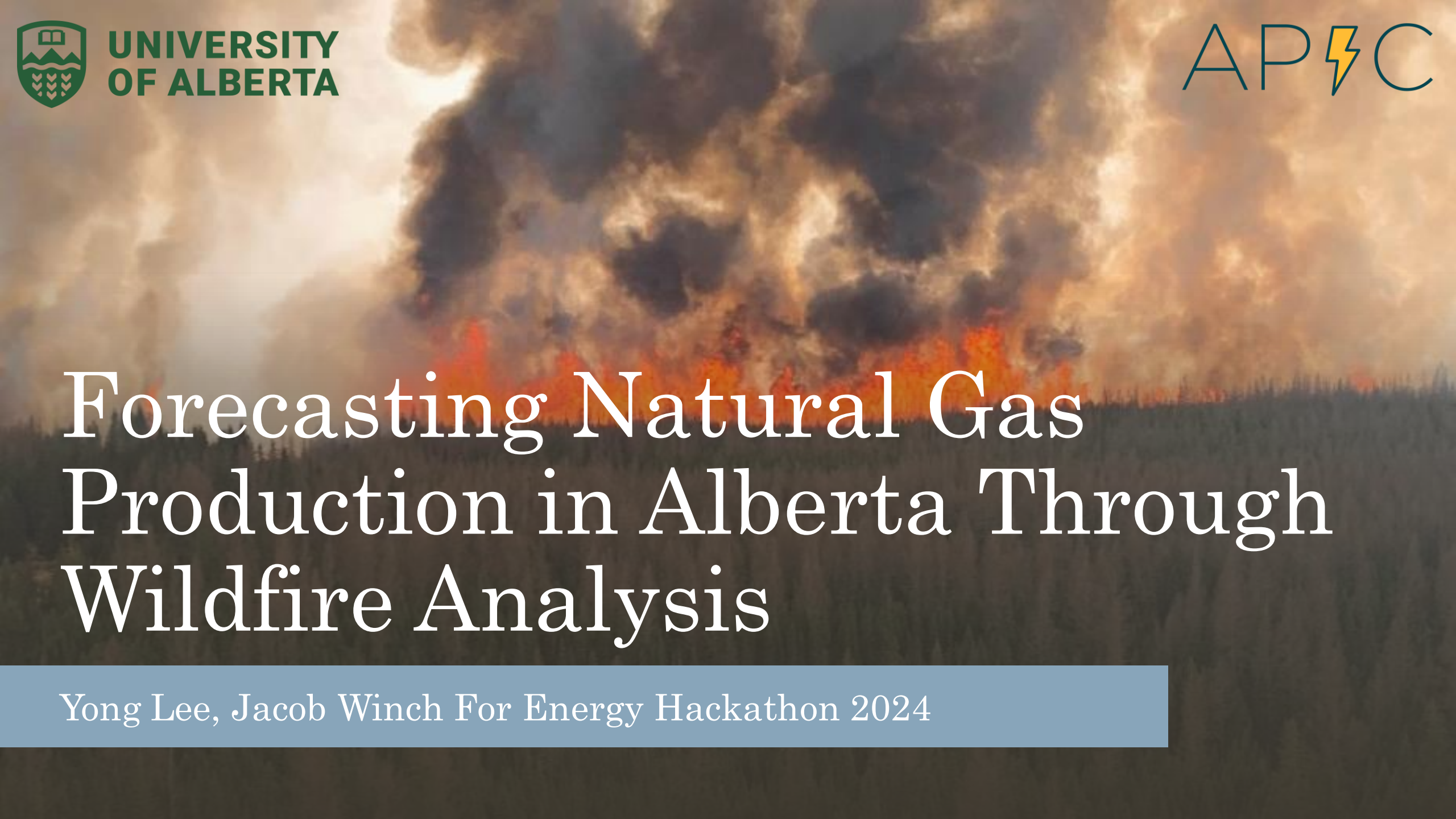

UNIVERSITY OF ALBERTA

APIC

Forecasting Natural Gas Production in Alberta Through Wildfire Analysis

Yong Lee, Jacob Winch For Energy Hackathon 2024

Motivation

Natural Gas Generates 72.6% of Electricity in Alberta (2022)*

News

Alberta wildfires hit Canada-l gas flow

Wildfires in Alberta Canada-US gas flo

Ashima Sharma May 19, 2023

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NATURAL GAS — 07 Jun 2023 | 17:44 UTC

Canadian gas productio
Alberta wildfires heat u

HIGHLIGHTS

Output falls 400 MMcf/d from late May peak

Pipeline exports to the US rebound to 5 Bcf/d in June

Hot, dry weather forecast for southern Alberta

Environment

Alberta wildfires hit gas flow out of Canada to US, spiking prices

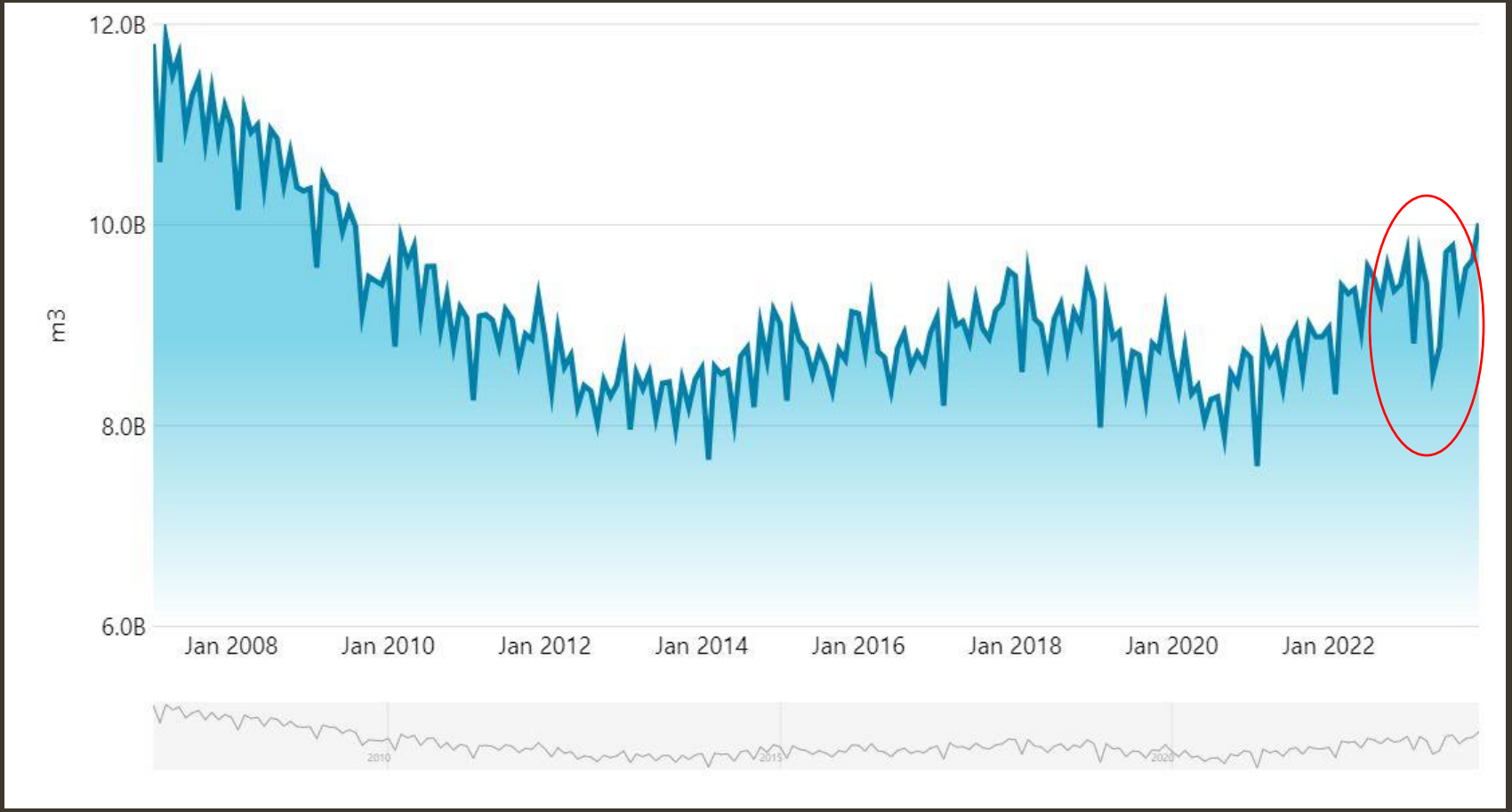
Reuters

May 18, 2023 5:10 PM MDT · Updated 9 months ago

[1/4] Smoke rises above the southeast perimeter of the Paskwa fire (HWF030) as it burns near Fox Lake, Alberta, Canada, May 16. Alberta Wildfire/via REUTERS *Purchase Licensing Rights*

*Annual Electricity Data by AUC - https://www.auc.ab.ca/annual-electricity-data/

Alberta Natural Gas Production



In May 2023, marketable natural gas production was 8.5B cubic metres, down 9.66% from April 2023*. During May 2023, Alberta's wildfires were the worst the province has ever seen in the spring, with a record breaking 1,017,00 hectares burnt from the start of the fire season to May 23rd, 2023**.

*Natural Gas Production. Alberta Economic Dashboard. https://economicdashboard.alberta.ca/dashboard/natural-gas-production/

**2023 wildfires in Alberta worst record for Spring. CityNews Edmonton. https://edmonton.citynews.ca/2023/05/23/worst-spring-wildfire-season/#:~:text=Last%20Updated%20May%2023%2C%202023,fires%20have%20burnt%201%2C017%2C000%20hectares.

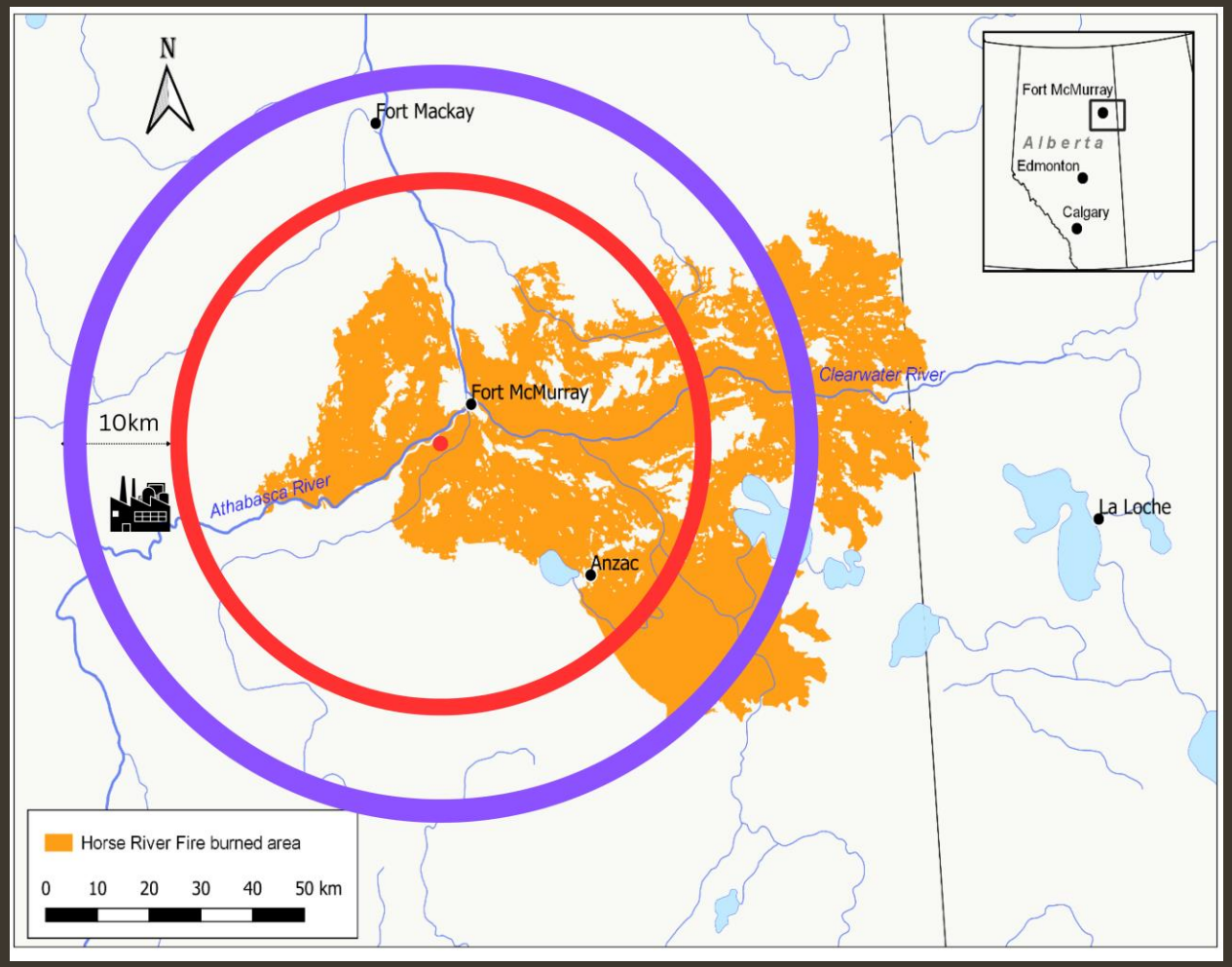
Data Ingestion, Cleaning, Compiling

- Wildfire data: 2006.Apr to 2021.Dec
  - https://www.alberta.ca/wildfire-maps-and-data
- Natural Gas Historical Production in Alberta: 2007.Jan to 2023.Dec
  - https://economicdashboard.alberta.ca/dashboard/natural-gas-production
- ST50: Gas Processing Plants in Alberta
  - https://www.aer.ca/providing-information/data-and-reports/statistical-reports/st50
- Nova Gas Transmission Ltd. (NGTL) Pipeline
  - https://open.canada.ca/data/en/dataset/dc343c43-a592-4a27-8ee7-c77df56afb34

Feature Engineering

Gas Plant Locations in Alberta

BOE Reports. https://boereport.com/2023/04/26/xi-technologies-alberta-gas-processing-a-summary/



Incentives and Barriers to Homeowners' Uptake of Firesmart. https://www.mdpi.com/2571-6255/5/3/80

Example: 2016 Horse River Wildfire

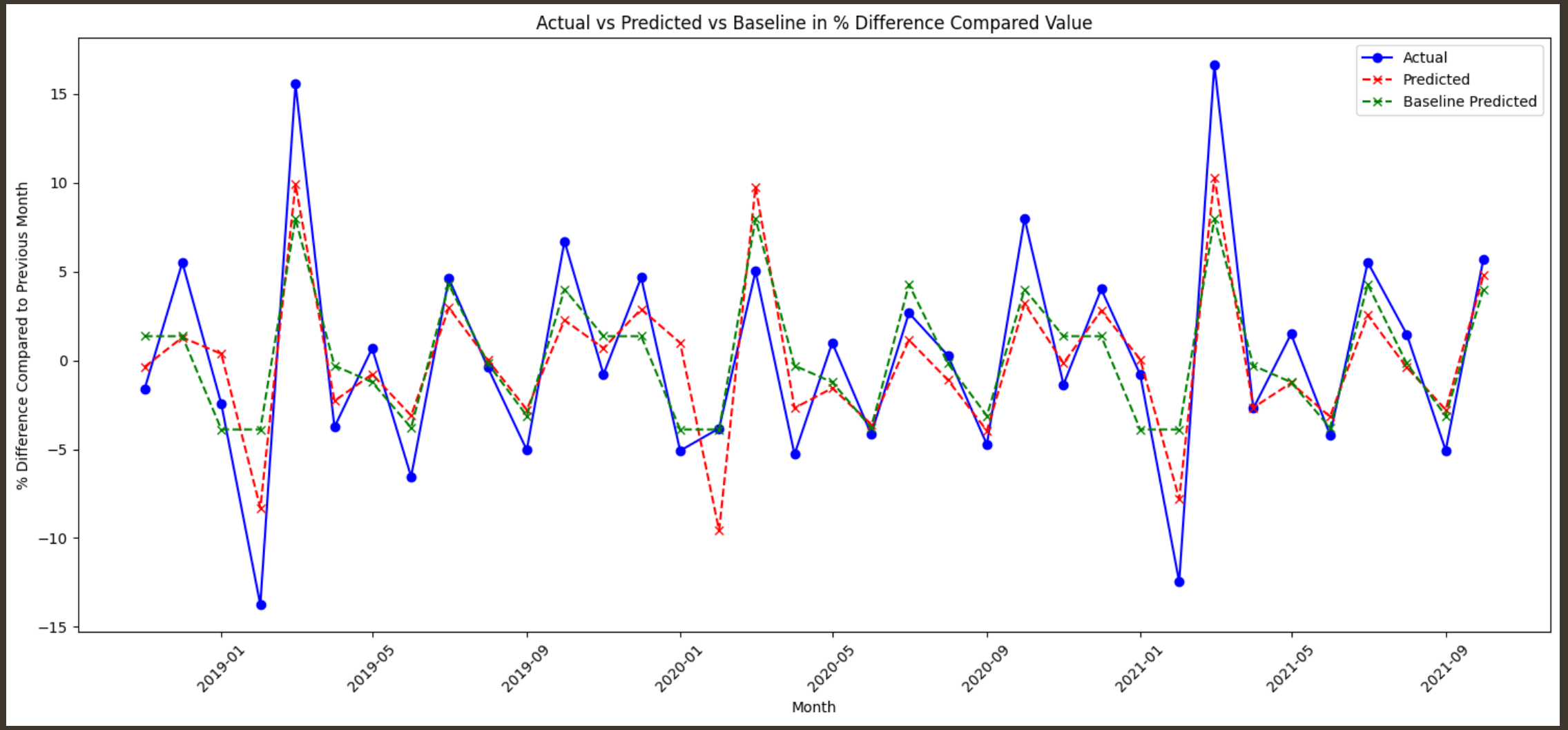
Fire Impact on Facilities & Infrastructures

- Haversine Formula Use:
  - Calculated "as-the-crow-flies" distance between two points, factoring in Earth's curvature, using coordinates in radians.
- Distance in Meters:
  - Applied Earth's radius (~6371 km) within the Haversine formula to output distance in meters.
- Fire Impact Assessment:
  - Assessed if facilities are within a fire's impact zone by comparing the calculated distance to the fire's radius, assumed as a circle for simplicity.
  - Adds safety margins: 10 km for gas plants and 5 km for pipelines, based on industry safety standards, to account for indirect fire impacts.

Model Features

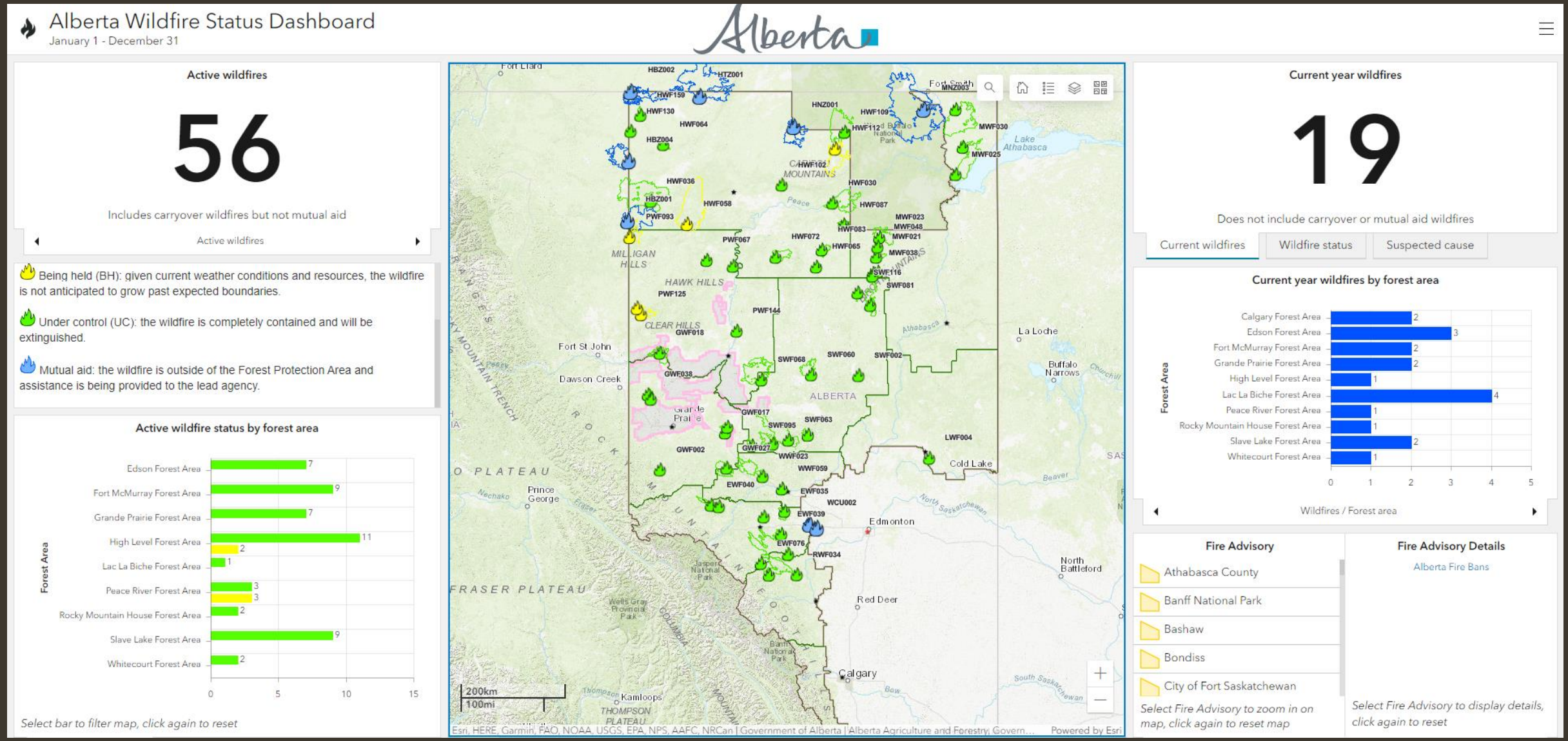
- Fire Size Class: ['A', 'B', 'C'. 'D', 'E']. A class = 0 to 0.1 ha B class > 0.1 ha to 4.0 ha C class > 4.0 ha to 40.0 ha D class > 40.0 ha to 200 ha E class > 200 ha
- Year: Fire year
- Month: Fire Month
- Gas Plant Frac (1000 m3/d): Gas Plant Fractionation: The process of boiling off the different hydrocarbons.
- Gas Plant Sweet (1000 m3/d): The Process of removing hydrogen sulfides.
- Gas Plant Flaring (1000 m3/d): Burning of natural gas
- Gas Plant Acid Gas Flaring %
- Gas Plant Acid Gas Inj (1000 m3/d): Gas Plant Acid Gas Injection
- Gas Plant Mainline Strdle (1000 m3/d): Gas Plant Mainline Straddle. Recover NGL components
- Gas Plant Sulphur Recovery (1000 m3/d)
- Pipeline Average Capacity (1000 m3/d):

Results



Random Forest Regressor(Best Performing) MSE: 10.1542, R-squared: 0.7417
Baseline (Seasonal Pattern) MSE: 13.6521, R-squared: 0.6527

Alberta Wildfire Status Dashboard on ArcGIS



https://www.arcgis.com/apps/dashboards/3ffcc2d0ef3e4e0999b0cf8b636defa3

Real-time Wildfire Data available on CIFFC

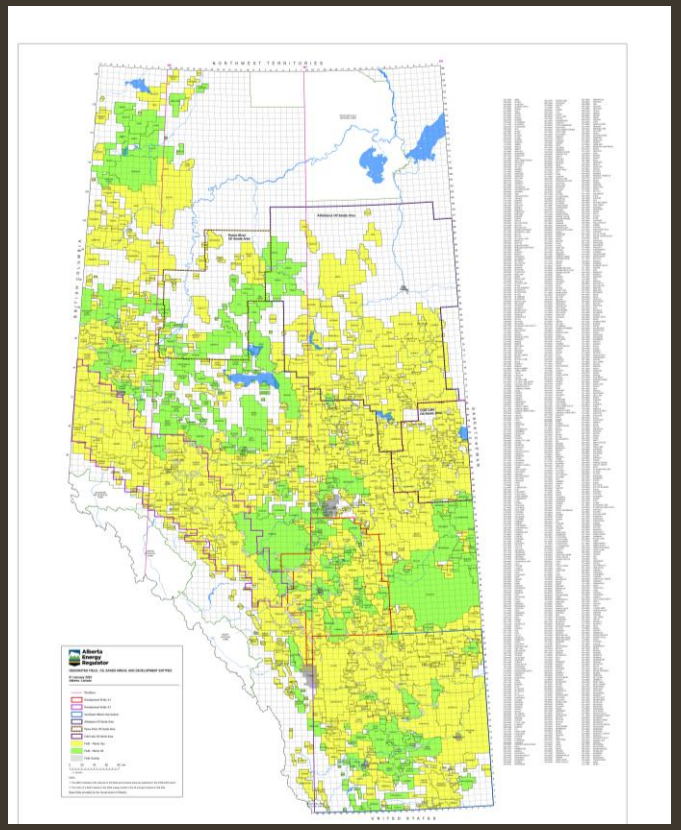
https://geoserver.ciffc.net/en/national-fires?filter_agency_code=All&stage_of_control=All&response_type=All&page=1&order=wildfire_agency_fire_id&sort=desc

- The Canadian Interagency Forest Fire Centre (CIFFC) is a not-for-profit corporation owned and operated by the federal, provincial and territorial wildland fire management agencies

Our model predicts a ***9.49% decrease*** in Natural Gas Production for February 2024 in Alberta.

Difficulties Faced & Limitations

Isolating individual wells impacted by wildfires



Map-90: Designated Oil and Gas Fields, and Oil Sands Deposits. https://www1.aer.ca/productcatalogue/187.html

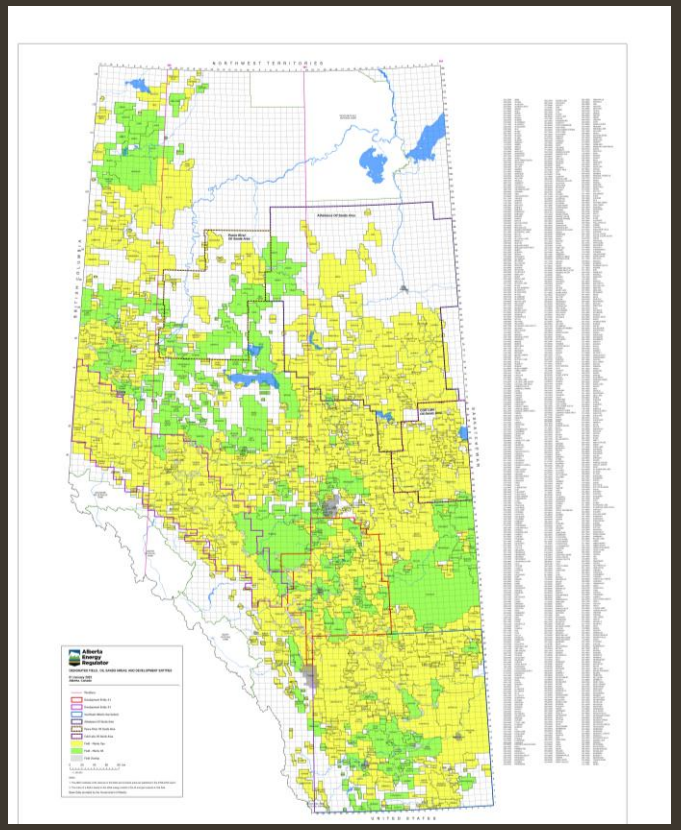
In addition to gas processing plants and pipelines we also tried to incorporate individual gas wells. However, we struggled with isolating the location of each well.

Attributing Causality

Due to a multitude of factors influencing natural gas production it is difficult to determine if an increase in wildfires in Alberta truly causes fluctuation in natural gas production. However, we can confidently say that at least some of the change is due to wildfires.

Difficulties Faced & Limitations

Isolating individual wells impacted by wildfires



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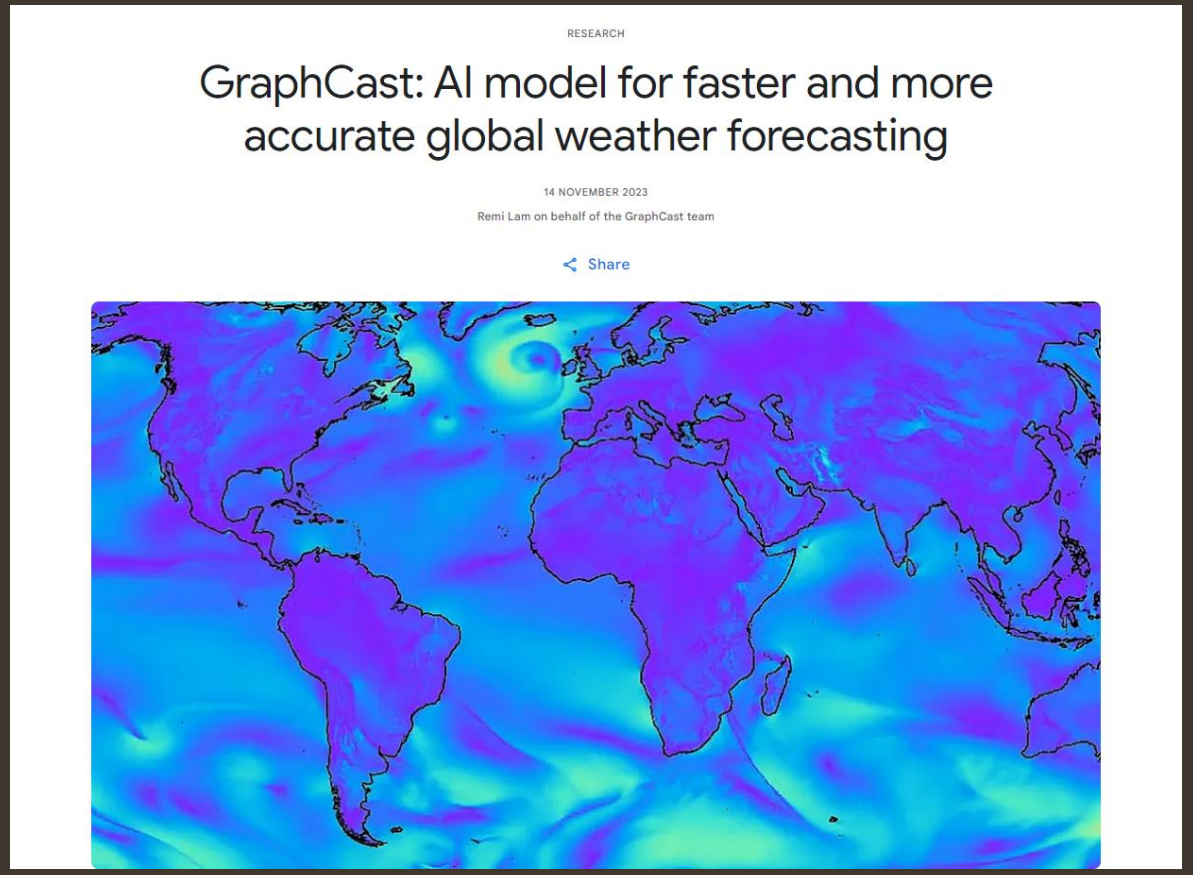
What's Next?

Incorporating state of the art wildfire prediction models to forecast impacts to Alberta's natural gas production.

AI for Wildfire Prediction. AltaML. https://www.govlab.ai/wildfire-prediction



Google Deepmind. https://deepmind.google/discover/blog/graphcast-ai-model-for-faster-and-more-accurate-global-weather-forecasting/