Wind Miles Model

Case Study

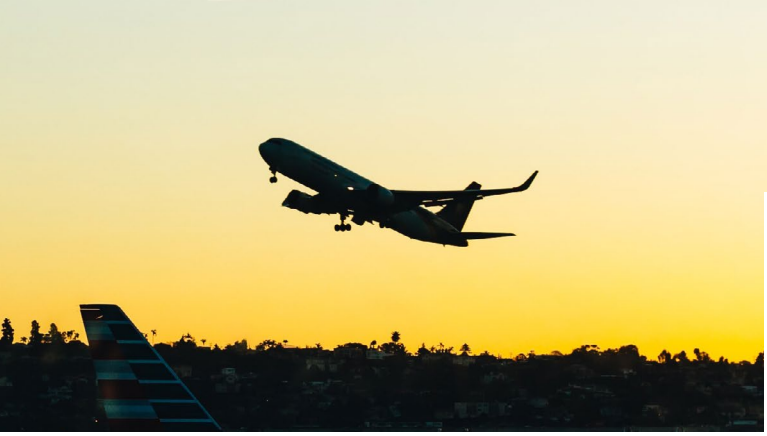
MOSAIC ATM™

Wind Miles Model

Combatting Flight Delays with Machine Learning

A study completed by the National Center of Excellence for Aviation Operations Research (NEXTOR) found that the impact of flight delays costs airlines over $8 billion on an annual basis. Information systems are needed to support the airlines and the entire air transportation system in reducing these delays. The cost of these delays creates a valuable market for such information systems, data services, and other improvements.

Numerous opportunities exist to improve the National Airspace System (NAS) efficiency by providing information to flight operators and aviation industry stakeholders. Mosaic ATM leverages extensive expertise in artificial intelligence, machine learning, software development, and NAS expertise to build data solutions that are accessible, actionable, and impactful.



Mosaic sought to provide an open and accessible model to predict the impacts of wind on air miles flown under an SBIR contract with NASA. Ultimately, this effort has developed a model that the broader aviation community can use as a publicly available data service. What good is solving a significant problem if you cannot get it into the hands of operators? The corporate mission statement of Mosaic ATM is "To Increase the Capacity and Improve the Efficiency of Global Air Transportation Systems." We hire data scientists, system engineers, software architects, and aviation experts dedicated to solving complex challenges NAS-wide.

Wind Impacts

One of the most significant factors affecting an aircraft's movements during flight is wind. Aircraft rarely travel in the same direction as the wind, leaving operators to compensate for both direction and speed. The speed and direction of the wind can significantly alter an airplane's in-flight progress. Mosaic ATM, a leading aviation analytics company, was contracted by NASA to build a 'Wind-Miles' model as a feature of the Tactical Departure Scheduling and Traffic Flow Management system.

Designing a better Model with Machine Learning

Background

The Wind-Miles concept provides a corrected number of miles that a flight will have to fly considering the impact of wind compared to the number of miles that would be flown through still air. I.e., if a flight's true airspeed is 100 knots, with a headwind component of 10 knots, the flight would essentially fly 10 miles through the air (wind-miles) to cover a flight segment that is 9 miles of ground distance.

This concept is used on a segment-by-segment basis to provide a wind correction factor for current flight trajectories to provide wind-adjusted trajectory forecasts to users. To garner more usage from aviation industry stakeholders and operators, Mosaic has made this service accessible to the public, facilitating similar NASA-level research. Providing this information to the public allows for a safer, more efficient National Airspace System.

Model Approach

The model performs a no-wind trajectory generation for the route of flight and altitudes to determine the approximate time the flight will reach each segment. The wind miles computes for each segment according to:

*Wind-miles = true airspeed * ground distance / (true airspeed + wind component),*

where the wind component is positive for a tail-wind contribution of the wind. The total wind miles are summed over all segments of the trajectory.

Self-Scoring of Wind Miles Prediction

In addition to the wind-miles calculation itself, the WMM has a self-scoring approach to report its accuracy. The self-scoring process for the WMM uses a rolling window of time over which real-time actual wind miles calculations provided by participating airlines are compared against the WMM calculation. A machine learning approach is used to infer neighboring wind estimates from actual data to enhance the self-assessment of accuracy. Historical accuracy analysis of the WMM is used to compare the model against previous performance and to establish thresholds of self-scoring accuracy for real-time reporting purposes.

The WMM self-scoring capability will provide an output message on the data service regularly to report the self-scored accuracy metric.

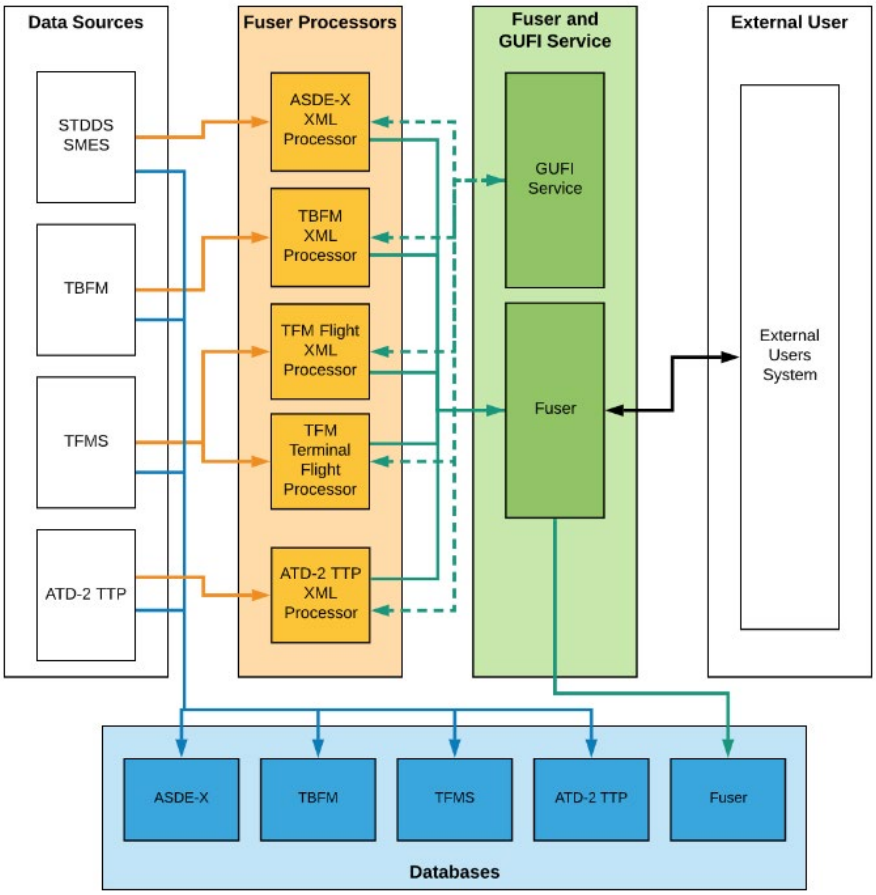
Test Deployment

Mosaic was able to work with operational airline partners to conduct deployment, testing, and evaluation of the prototype WMM. Mosaic baked feedback directly into the WMM from participants to ensure a usable model. This process was critical to launching a publicly available service[1].

Data Fuser

As part of Mosaic's experiences working under the TDS/TFM & ATD-2 contract, our system engineers and developers created a cloud-based Data Fuser to ingest and aggregate disparate aviation data sources to be consumed for analytics. The Data Fuser underpins all our predictive services, including the Wind Miles Model. Access to aviation data is critical to understanding how the NAS is performing or has performed.

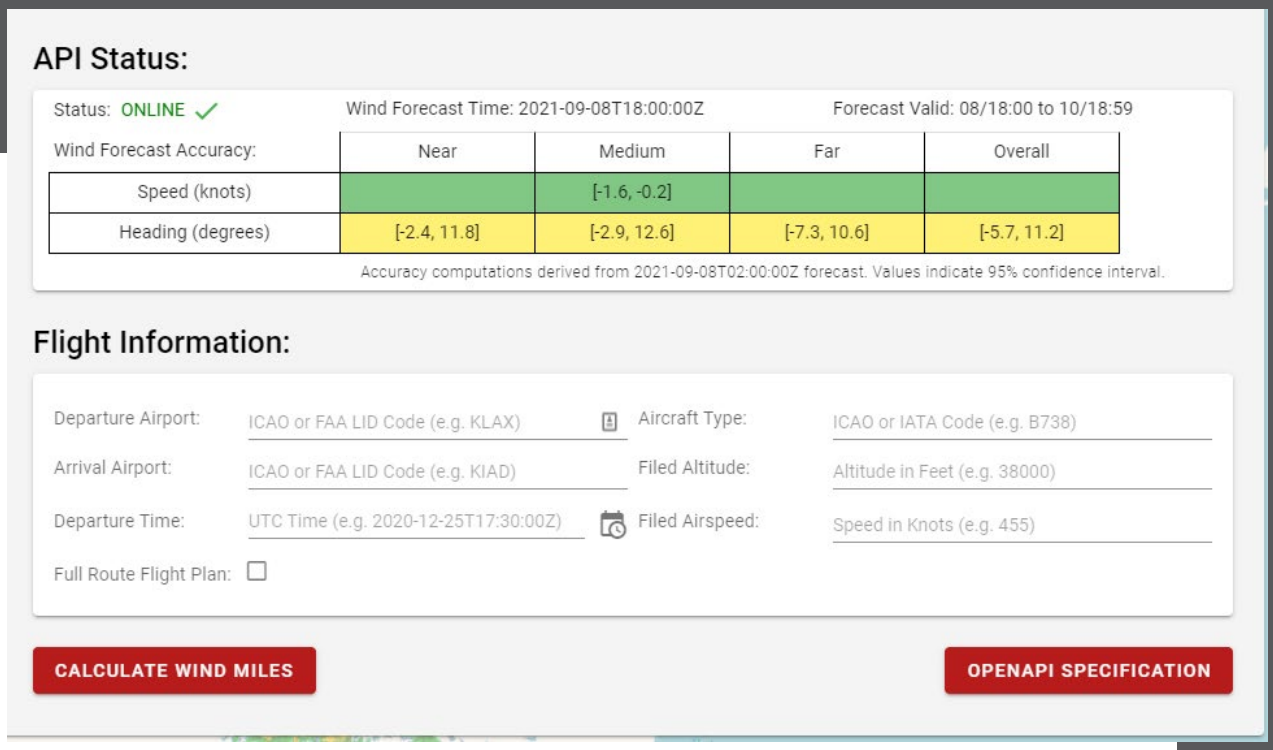
Mosaic saw that several organizations struggle to keep up with data as they try connecting, consuming, cleaning, parsing, and translating aviation data feeds into information that can be used to inform data-driven, operational decisions. To catch up with this runaway data and translate it into usable information, a framework was needed that could connect to multiple data feeds, mediate between disparate sources of data, make sense of the data, and provide the correct data at the right time.



Conclusion

The corporate mission statement of Mosaic ATM is "To Increase the Capacity and Improve the Efficiency of Global Air Transportation Systems." Seeking opportunities to improve airspace and air transportation operations is one of our core corporate strategies. Mosaic has established itself as a significant contributor in the pursuit of ATM data analysis and modeling research that expands beyond traditional approaches with machine learning and artificial intelligence.

After a rigorous machine learning development effort, we generated a model that can benefit anyone looking to calculate wind effects on flight miles. Mosaic made this available to the broader public and is excited to continue building new features. Please keep your eye out as we will continue to add more ML-driven aviation services to our catalog.



Wind Miles Web App

If your needs outpace the publicly available Wind Miles Model, [please drop us a line here](#)[2], and reference the Wind Miles Model.

Endnotes

1. https://services.mosaicatm.com/flight/windmile-sweb

2. https://mosaicatm.com/contact-us/