

Probabilistic TFM Demand Visualization

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FAA/MOIE

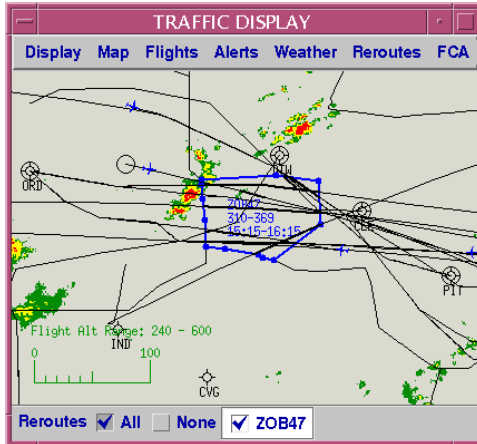
The logo for the MITRE Technology Program, featuring a stylized graphic of stacked blocks in yellow, orange, and blue to the left of the text.

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Problem

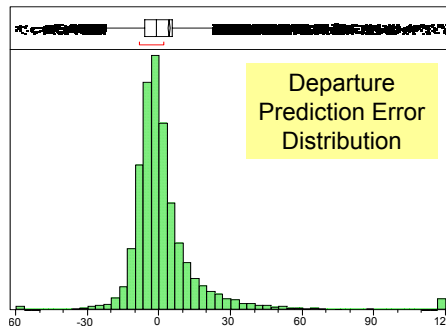
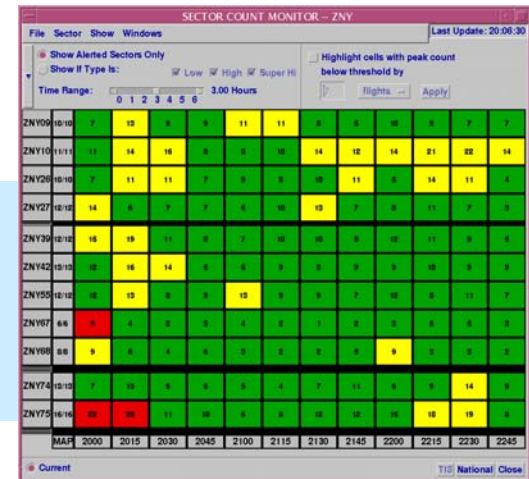
- **Traffic Flow Management (TFM) decisions are based on imperfect predictions of airspace demand, but prediction uncertainty is not a large factor in current decision-making.**
 - Predictions are presented as “truth,” but traffic managers *intuitively know* predictions are often “not very good.”
- **Results can include unnecessary actions, conservative decisions, excess delays...**
- **Can understanding prediction uncertainties improve operational decision-making?**

Background



En route sector congestion results from unusually high traffic demand or when airspace is limited due to hazardous weather.

Traffic managers use predicted sector demand, in the form of peak aircraft count, to find and solve congestion problems via rerouting, flow rate restrictions, or ground delays.



However, predictions are subject to several types of uncertainty, which increase in magnitude as the prediction look-ahead time increases.

Objective

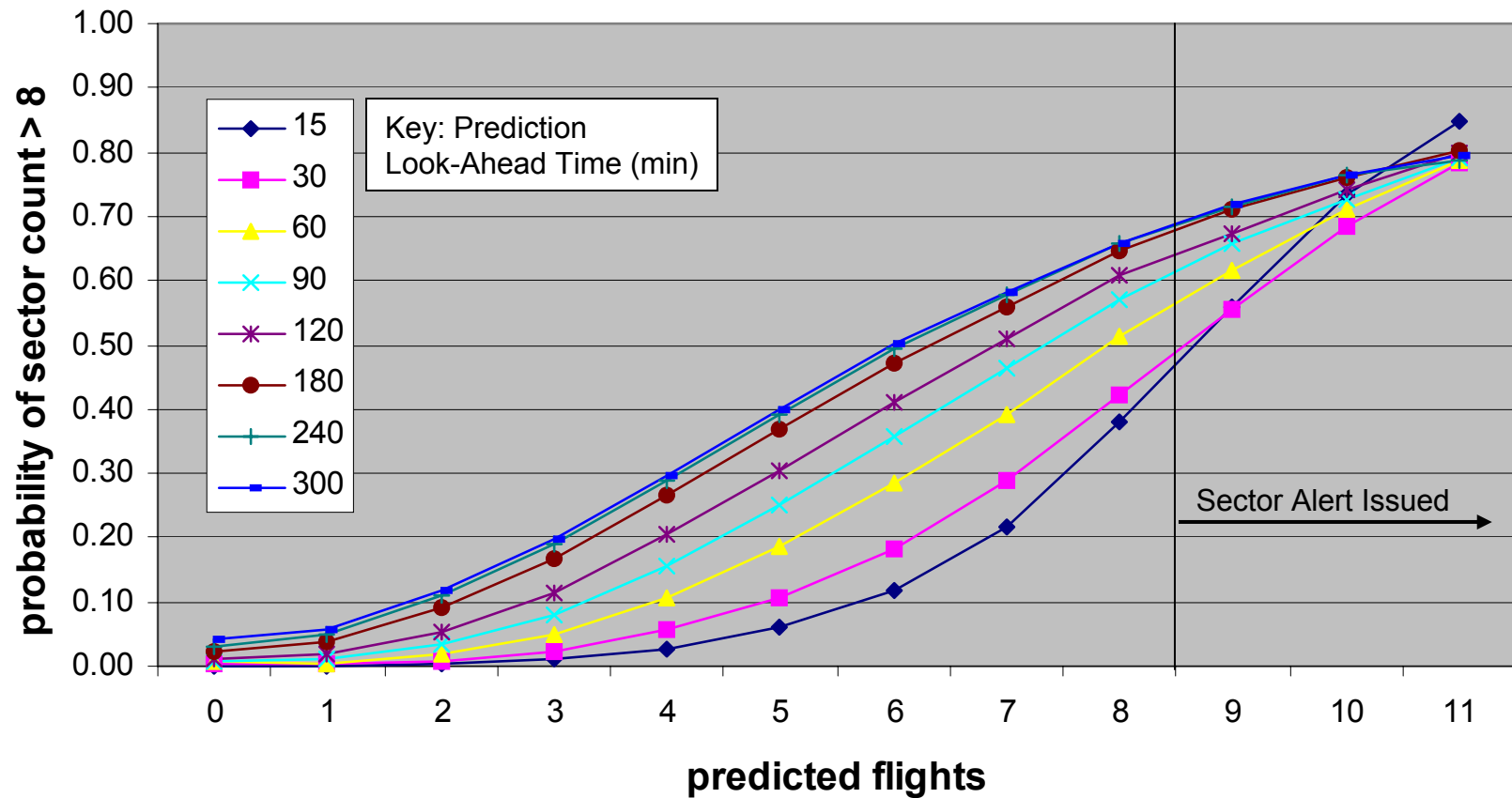
- **Improve operational TFM decision-making through application of probabilistic methods**
 - **Quantify prediction uncertainties in today's TFM environment**
 - **Present uncertainties in operationally useful ways**
 - **Analyze impact of uncertainty on decision-making**

Activities

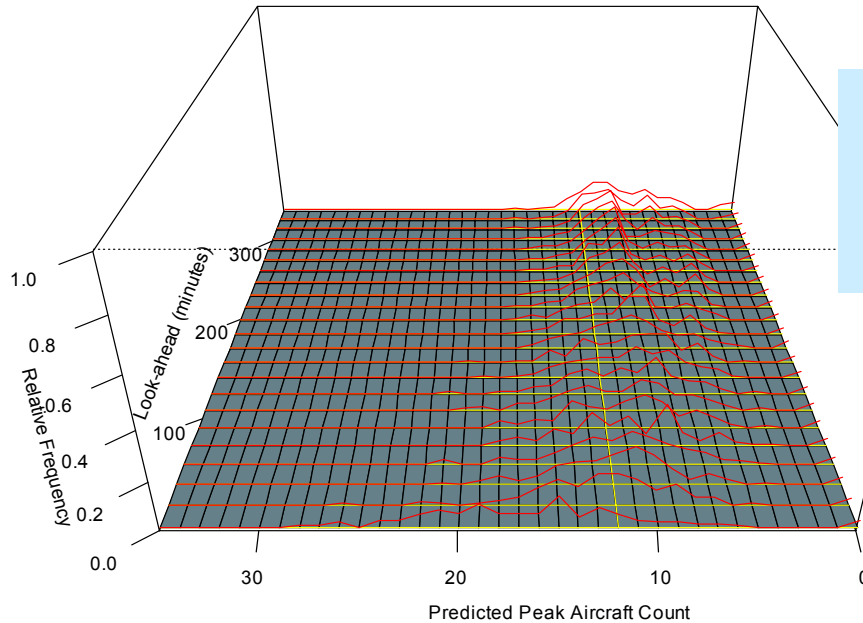
- **Develop mathematical and empirical models to quantify uncertainty in demand predictions**
- **Explore techniques to present uncertain information**
- **Develop decision heuristics to improve management of airspace demand in the presence of uncertainty**
- **Investigate human factors issues through structured exercises with former FAA traffic managers and controllers**

Highlight

Mixed sectors: probability of exceeding 8 flights, conditioned on prediction value and look-ahead time



Demonstration



Visualization of Demand Prediction Uncertainty

Decision Analysis for Demand Management Using Uncertain Predictions

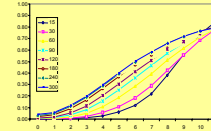
ZNY55	12/12	11-13	12-16	8-9
ZNY67	6/6	8-9	4-5	2-2
ZNY68	8/8	9-10	3-6	4-8
ZNY74	13/13	7-11	12-13	4-7
ZNY75	16/16	19-22	16-20	11-11
MAP	2000	2015	2030	

Impacts

- **The work addresses a key TFM decision-support need recognized by the FAA, industry, and other research organizations as vital.**
- **Results can improve application of TFM decision support tools across the board, from basic sector load alerting to integrated strategy assessment.**
- **Measurements of current-day uncertainty could be applied to improve TFM decision-making, even without deploying new automation.**

Future Plans

Core Research: Quantify, visualize, understand uncertainty in airspace demand predictions and the impact on human TFM decision-making



Operational Applications

Improved situation awareness for traffic managers



Improved decision heuristics for airspace demand management

Improved prediction performance for TFM decision-support systems

