The accuracy of wind information, especially forecasted wind errors, has been repeatedly identified as one of the largest contributors to aircraft runway incursions (Comiso, 2002). Wind errors impact the FAA’s ground control, monitoring, and flight clearance operations as well as the aircraft’s performance and safety. 4D TBO is an ATM concept where planned trajectories in both space and time are used along with data from multiple sources, known as trajectories. The concept of 4D TBO is highly relevant for airport runway incursions reduction. Forecasted wind information relative to truth winds, actually flown through, can significantly degrade the performance of ATM operations. The use of improved (high-confidence, high-resolution, and timely) wind information will be key to mitigating trajectory errors, ensuring better and more consistent operational performance, and helping improve precision, consistency, and use of ATM and flight-deck automation tools. In addition, it will help to increase airspace and airport capacity, improve efficiency, and enhance safety in the National Airspace System.

**Problem Statement**

**Required Time of Arrival**

- **Use of wind information** requires applications of uncertainty buffers and trajectory control to ensure safe operation and avoid conflicts between aircraft.
- **Forecasted wind information** is essential to achieve high-precision TM and accurate aircraft arrival management.
- **Wind forecast errors** significantly reduce safety and accuracy of planned trajectories.
- **Wind forecast errors** are a major factor contributing to airport runway incursions.

**Interval Management**

- **Interval management** is a key component of air traffic control to ensure safe and efficient airspace operations.
- **Wind forecast errors** can significantly impact interval management, as inaccuracies in wind forecasts can lead to missed trajectory clearances and potential runway incursions.

**Wake Turbulence Mitigation**

- **Wake turbulence** is a significant safety concern for aircraft, especially at high speeds and altitudes.
- **Current wake turbulence monitoring and mitigation systems** are insufficient to handle the growing demand for air traffic.
- **Improved wake turbulence monitoring and mitigation systems** are needed to enhance safety and efficiency in the National Airspace System.

**Wake Turbulence Mitigation**

- **Wind steering** is a technique used to guide aircraft around areas of high turbulence.
- **Wake turbulence monitoring systems** use a variety of techniques to detect and mitigate turbulent areas.
- **Improved wind steering techniques** can significantly reduce the risk of wake turbulence incidents.

**Research**

- **Findings and recommendations** for wake mitigation operations were based on the large quantity of previous research conducted by the FAA Weather Turbulence Research Office and international organizations.

**Waste Turbulence Mitigation**

- **The goal of wake turbulence mitigation is to safely and efficiently manage wake traffic and reduce the risks associated with wake turbulence.**
- **Current wake turbulence monitoring and mitigation systems** are insufficient to handle the growing demand for air traffic.
- **Improved wake turbulence monitoring and mitigation systems** are needed to enhance safety and efficiency in the National Airspace System.

**Waste Turbulence Mitigation**

- **The key to improving wake turbulence monitoring and mitigation systems is to develop advanced wind forecasting and turbulence characterization tools.**
- **Improved wind forecasting and turbulence characterization tools** are needed to accurately predict wake turbulence and mitigate risks.
- **Integrated wake turbulence monitoring and mitigation systems** can significantly reduce the risk of wake turbulence incidents.

**Conclusion**

- **Improved wind forecasting and turbulence characterization tools** are needed to enhance safety and efficiency in the National Airspace System.
- **Integrated wake turbulence monitoring and mitigation systems** can significantly reduce the risk of wake turbulence incidents.
- **Improved wind forecasting and turbulence characterization tools** are needed to enhance safety and efficiency in the National Airspace System.