



Update on Comparison of Denver-2003 Lidar Measurements with Fast-Time Model Predictions

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19 October 2012

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Acknowledgement

- **This work is supported by the NextGen Concepts and Technology Development (CTD) Project of the National Aeronautics and Space Administration's Airspace Systems Program (ASP)**
- **Neil O'Connor (Air Traffic Management Team Lead)**
- **Brad Perry (Wake Vortex Technical Lead)**

Update on Fast-Time Model Comparison with Denver 2003 Data



- **Update for study originally presented at Wakenet-Memphis 2012: “Application of Fast-Time Models to the 2003 Denver Data Set”**
- **Changes include:**
 - EDR computed from Pulsed Lidar
 - Circulation computed using Wakemod-2.1 Lidar algorithm
- **Comparisons include:**
 - Three fast-time models
 - Measured wake position and circulation estimated using
 - CTI-Lockheed’s Legacy algorithm
 - Wakemod 2.1 algorithm (circulation only)

- **APA Fast-Time Suite used with TDAWP 2.1, APA 3.2 and APA 3.4**
- **Evaluation uses data from Denver, 19 September 2003**
- **Fast-time Model Input:**
 - **Aircraft Parameters (type, speed, weight, position)**
 - **Temperature profile (measured – MTP5)**
 - **Crosswind profile (measured – Pulsed Lidar)**
 - **Turbulence profile (measured – Pulsed Lidar)**
- **Lidar circulation processed from raw “prd” files**

RMSE Evaluation (Larges & Heavies)



Denver: September 19, 2003 (82 Cases)

Model	Circulation (normalized by Γ_0)		Lateral Transport (normalized by b_0)	Altitude Lateral Transport (normalized by b_0)
	Legacy	Wakemod 2.1	Legacy	Legacy
TDP 2.1	0.302	0.222	0.621	0.885
APA 3.2	0.458	0.228	0.623	0.948
APA 3.4	0.345	0.194	0.615	0.938

Input

EDR (Lidar)
Temperature (MTP5)
Crosswind (Lidar)

RMSE = Root Mean Square Error
Pulsed Lidar Data was used for Model Evaluation
 b_0 = initial vortex separation

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Crosswind (Lidar)

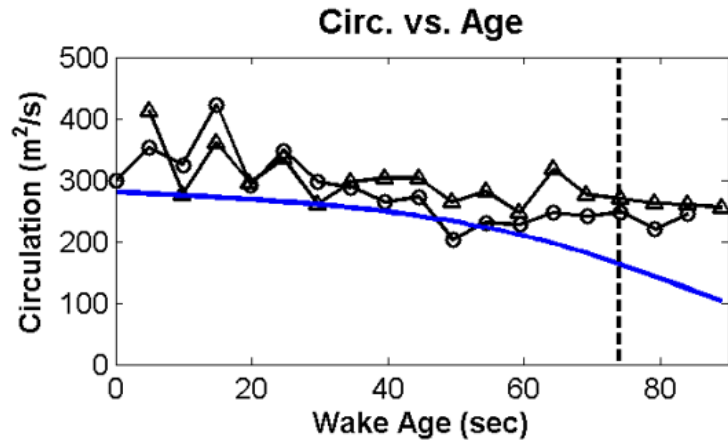
Error 30-50% smaller
than Legacy

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Example: circulation comparison –Legacy vs Wakemod 2.1 vs TDAWP

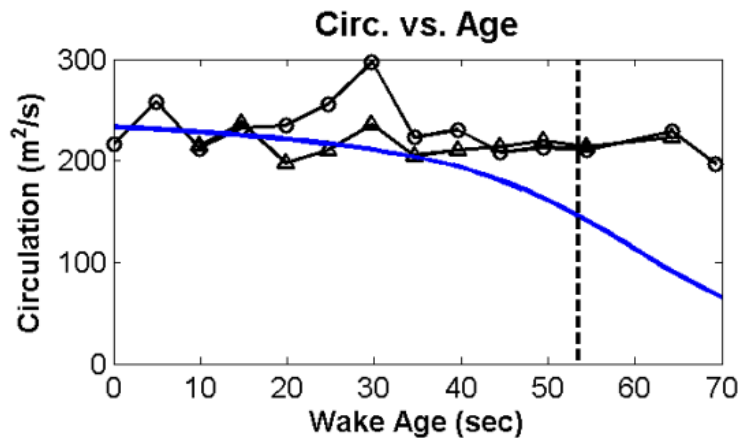
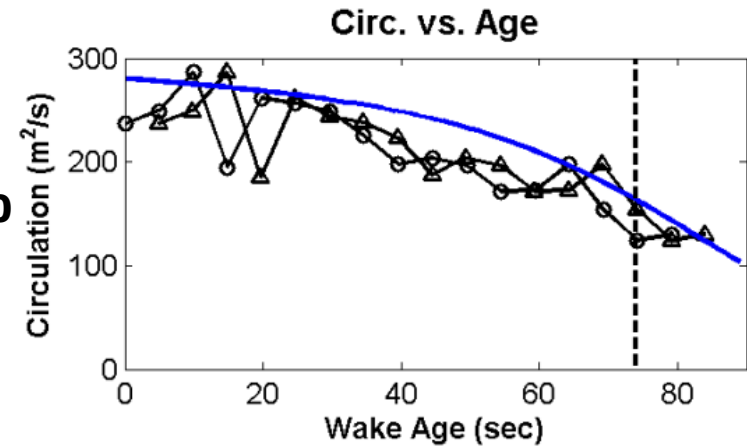


Legacy Lidar Algorithm

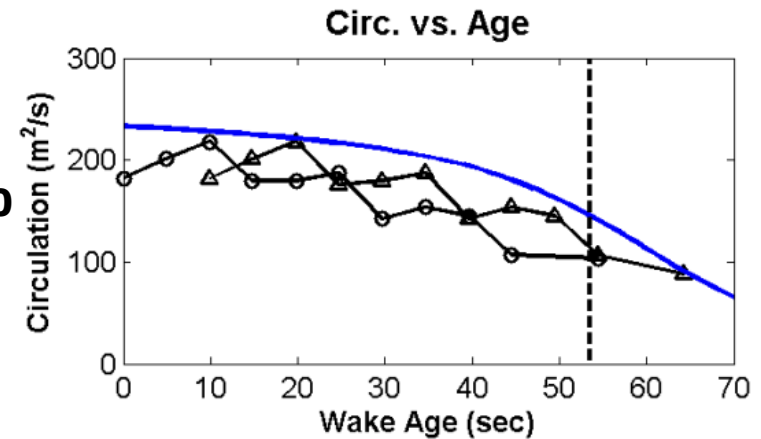


B757-200

Wakemod 2.1 Lidar Algorithm



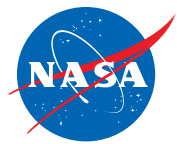
B737-300



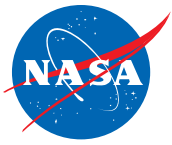
Solid Blue Line - TDAWP 2.1 Prediction
Symbols – CTI Pulsed Lidar Measurement

- **Modified algorithm believed to be better than the Legacy algorithm for estimating circulation with Lidar**
- **Legacy algorithm often produces elevated circulations, especially at late times**
- **Circulation using the modified Lidar algorithm consistent with circulation predicted by our fast time models**
- **The Wakemod 2.1 algorithm reduces differences with fast-time models by 30-50%**

Questions ?



Backup Slides



Wake Vortex Fast-Time Models

Deterministic Fast-Time Models

- Predict vortex position and circulation histories

- Examples:

- AVOSS Prediction Algorithm (APA)
- TASS Derived Algorithms for Wake Prediction (TDAWP)
- APA Suite

- Input

- Generating aircraft parameters
- Vertical profiles of crosswind, temperature, and turbulence

- Output can be scored against Lidar measurements

- Much of the uncertainty appears to be due to quality of input data and accuracy of wake measurements

