Dynamic Weather Routes: Concept, Tool, and Trial at American Airlines

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Take Away Message

• DWR a ground-based continuous search engine, finds corrections to weather avoidance routes, in-flight aircraft, en route airspace

• Trial at American Airlines Operations Center, Fort Worth, Texas - DWR operates 24 hrs/day, 7 days/week since July 2012, ZFW flights only

• AA revenue flights get 10% more savings on big convective weather days when tool being used vs. big weather days when tool not used
What’s the Problem

- Convective weather leading cause of delay in US National Airspace System
- Weather avoidance routes planned 1-2 hours in advance, include large buffers to forecasted weather
- Weather changes, dispatchers & traffic managers busy, opportunities for more efficient routes are missed
- No automation to help determine when standardized weather avoidance routes have become stale
Outline

Concept and Tool
Trial at American Airlines
Analysis Results
Next Steps
Dynamic Weather Routes

Current active Center flight plan route

Return capture fix, inside limit region, or last fix before STAR

Dynamic Weather Route

Insert waypoints for minimum delay weather or weather and traffic resolution

Reference route, savings > 5 min wind corrected

Snap-to nearby named fix option
## DWR Flight List

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<tr>
<th>TP</th>
<th>ACID/TYPe</th>
<th>DEP/DST</th>
<th>SAV</th>
<th>FIX/AUX</th>
<th>TR</th>
<th>SC</th>
<th>TMI</th>
<th>STATUS</th>
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</table>

- Potential flying time savings (min)
- Capture fix / number aux waypoints
- Minutes to traffic conflict
- Sector congestion on DWR route
- Route Traffic Management Initiatives
Convective Weather Avoidance Model and 4D Trajectories Integrated

Corridor Integrated Weather System (CIWS)
Convective Weather Avoidance Model (CWAM)
Trial at American Airlines
Trial at American Airlines

American Airlines System Operations Center, Fort Worth, Texas

DWR Display
ATC Coordinator
Dispatcher
ACARS
Pilot
Controller
Clearance
Sector congestion on flight plan route

Accept, Reject, Cancel

Maneuver Start Point

Flying Time Savings (or Delay)

DWR route

Flight plan

Active SUAs

Active Route TMIs

Sector congestion on DWR route

DWR User Interface

Flight plan route

Maneuver Start Point

Accept, Reject, Cancel
Dynamic Weather Routes

DWR

Sample Fort Worth Center reroutes from 2012 Operational Trial with American Airlines
Analysis Results
Potential DWR Savings and Today’s Savings without DWR:

- **Center flight plan route**

Potential DWR Savings:
First time flight appears on DWR List (time = t1)

Today’s Savings without DWR:
Observed Center route amendments (time > t1):
Potential DWR Savings and Today’s Savings without DWR

All ZFW flights with DWR Advisories – 11/18/12 to 6/30/13

Potential DWR: 115,018 min, 11,746 flights, 9.8 min/ftl avg
Today’s Savings: 36,285 min, same flights, 3.1 min/ftl avg

Today’s operations result in 30% of potential DWR savings overall
Savings Attributed to DWR:

Observed Center route amendments (time > t1):

Assume observed amendments for AA flights following dispatcher accepted DWRs attributed to DWR
DWR Activity at American Airlines
July 31, 2012 to November 5, 2013

- Advised DWR Routes: 38882 min, 6112 flights
- Evaluated: 8145 min, 1361 flights
- Accepted: 4403 min, 808 flights
- Rejected: 751 min, 104 flights
- Cancelled: 1241 min, 260 flights

59% of routes evaluated rated Accept by AA users
1241 min estimated savings, 28% of Accepted savings, attributed to DWR

Flying Time Savings (min)

Primary reasons for
- DWRs not evaluated by AA: staffing
- AA Rejected DWRs: arrival streams, close weather, playbook/CDRs, congestion
- No clearance issued: arrival streams, inter-Center coordination
Sample: Tampa/Chicago

Flight Plan

Accepted DWR

Estimated Actual Savings: 24 minutes

FLYING TIME SAVINGS
AA ACCEPTED DWR: 23.6 min
ROUTE AMENDMENT: 23.8 min
TOTAL AMENDMENTS: 23.8 min

TRACK MILES SAVINGS
DWR (FP - DWR): 188 nmi
ACTUAL (FP - TRACK): 196 nmi
Do AA flights get more savings when using DWR vs. when not using DWR?
Tool Used and Tool Not Used Days

- Pick heavy convective weather days: 34 days
  Potential savings AA flights > 300 minutes
- Tool Used Days: 16 of 34 days
  AA evaluates > 20% potential savings
- Tool Not Used Days: 18 of 34 days
  AA evaluates < 20% potential savings
Tool Used vs. Tool Not Used

AA Flights with Advised DWRs

16 Tool Used Days vs. 18 Tool Not Used Days

- **Observed**
  - 1185 min (15%)
  - 289 flights

- **Advised**
  - 7912 min
  - 704 flights

10% more savings when DWR used = 586 min ($88K) over 16 days

- **Observed**
  - 1485 min (25%)
  - 278 flights

- **Advised**
  - 5863 min
  - 540 flights

- **Not Used**
  - 7912 min
  - 704 flights

- **Observed**
  - 1185 min (15%)
  - 289 flights
Tool Used vs. Tool Not Used

AA Flights with Advised DWRs & Observed Amendments

16 Tool Used Days vs. 18 Tool Not Used Days

- **Observed**
  - Tool Used: 1485 min (46%) on 278 flights
  - Tool Not Used: 1185 min (37%) on 289 flights

- **Advised**
  - Tool Used: 3248 min
  - Tool Not Used: 3218 min

- 9% more savings when tool used = 292 min ($44K) over 16 days
Next Steps

- Smart filtering for more DWRs acceptable as proposed
- Common route corrections for multiple flights
- Weather avoidance for merging arrivals and metering
Take Away Message

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