

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

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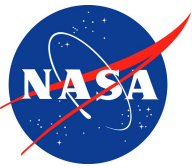
NASA Ames Research Center

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Lincoln Laboratory Air Traffic Control Workshop 2013

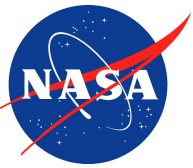
FAA Washington, DC

19 November 2013



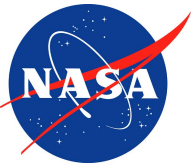
Take Away Message

- 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



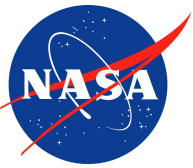
Outline

Concept and Tool

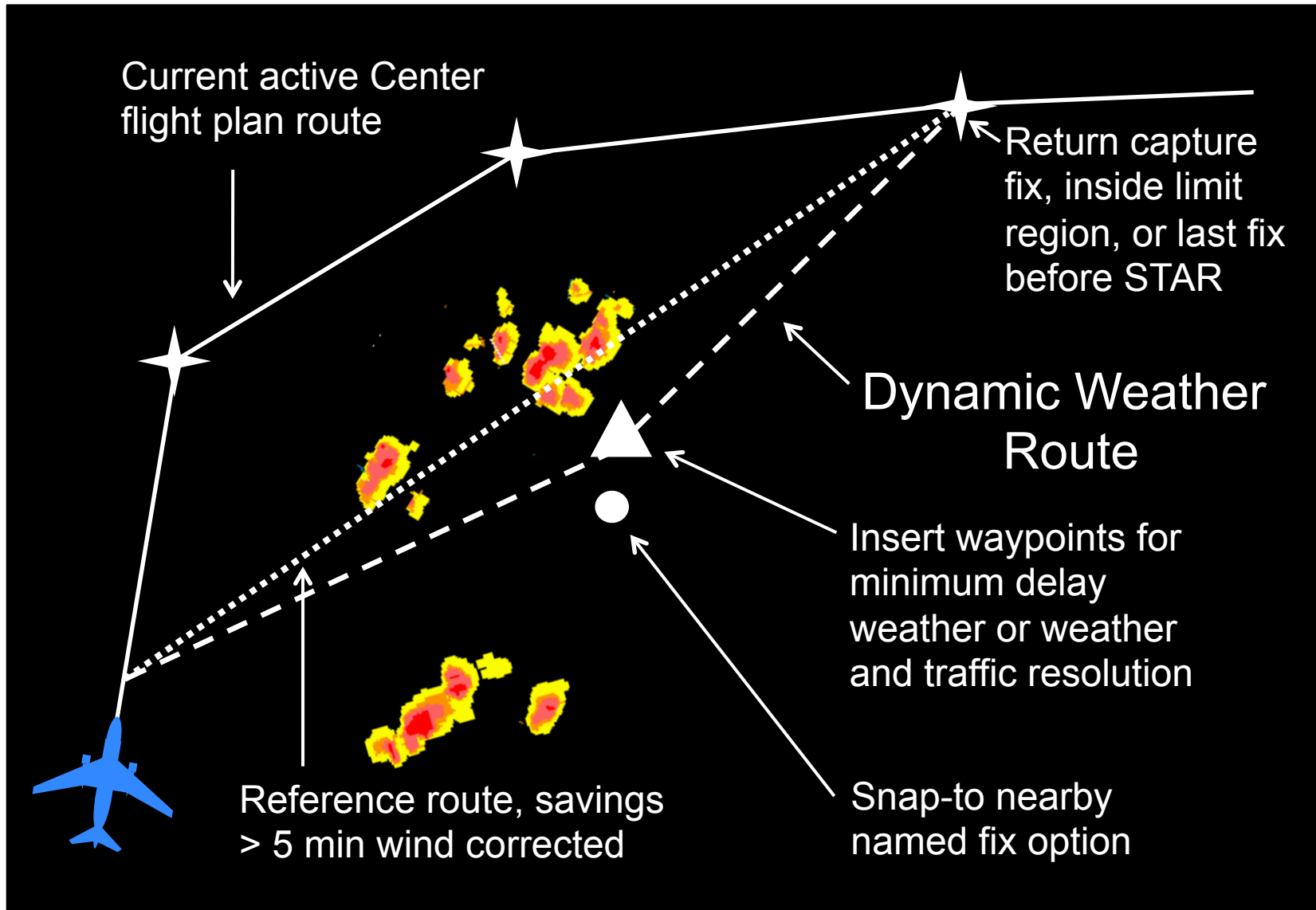
Trial at American Airlines

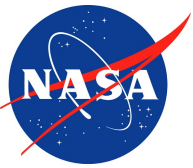
Analysis Results

Next Steps



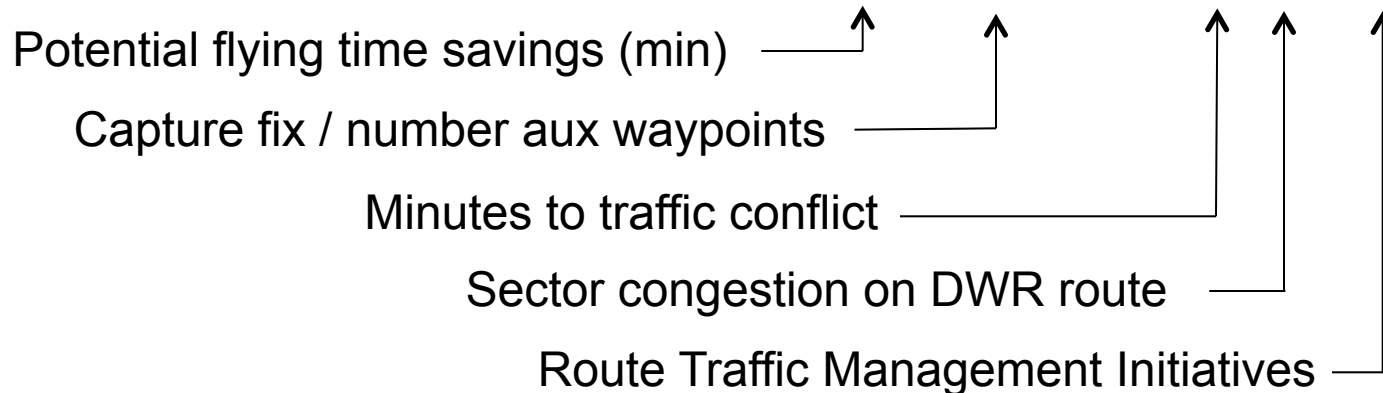
Dynamic Weather Routes

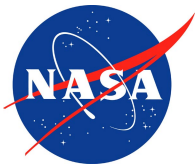




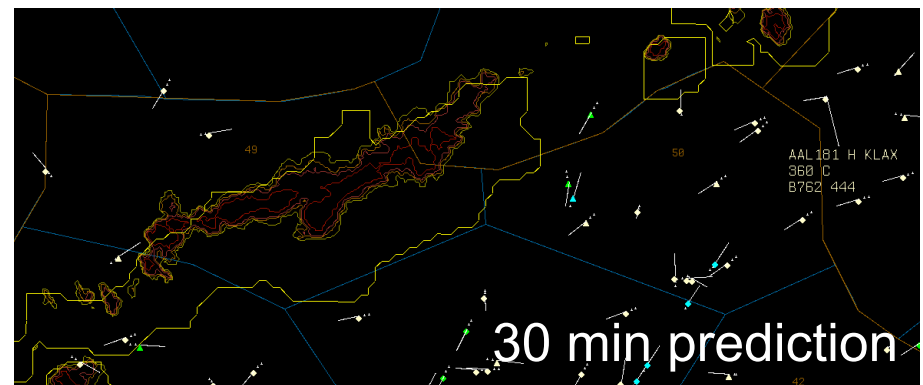
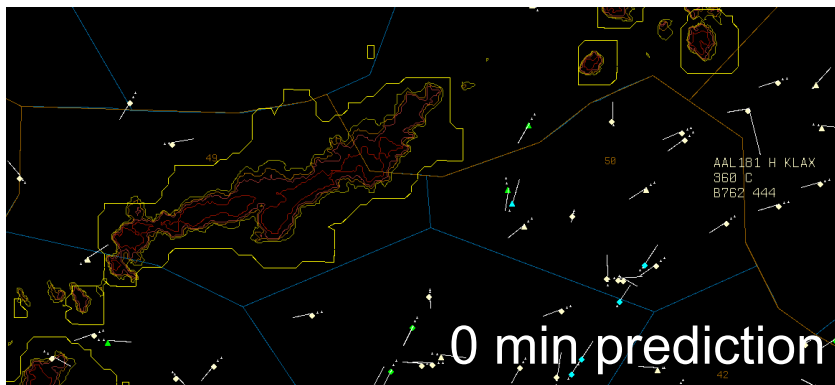
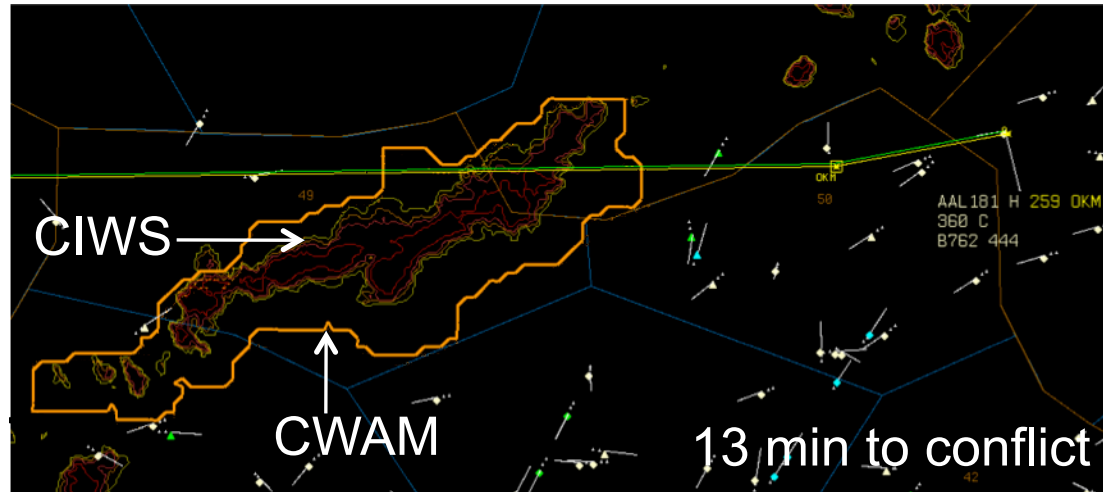
DWR Flight List

TP	ACID/TYPE	DEP/DST	SAV	FIX/AUX	TR	SC	TMI	STATUS
<input type="checkbox"/>	DAL2188/B752	KATL/KSEA	29.4	JNC/1	OK	SC	N	
<input type="checkbox"/>	AAL2295/MD82	KDFW/KSLC	15.0	JNC/1	OK	OK	R	
<input type="checkbox"/>	UAL745/B752	KLGA/KDEN	10.7	TODDE/1	9	OK	N	
<input type="checkbox"/>	UAL652/B752	KDEN/KIAD	9.0	SJI/1	OK	SC	R	
<input type="checkbox"/>	AAL473/MD82	KDFW/MMGL	7.2	JCT	OK	SC	R	
<input type="checkbox"/>	NKS719/A319	KDFW/KDEN	6.7	FTI	OK	OK	R	
<input type="checkbox"/>	EGF3601/CRJ7	KELP/KORD	6.3	STL	OK	OK	N	
<input type="checkbox"/>	SWA2714/B737	KLAX/KSTL	5.8	SGF/1	OK	SC	N	

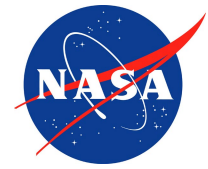




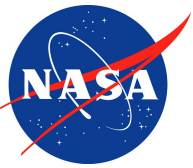
Convective Weather Avoidance Model and 4D Trajectories Integrated



Corridor Integrated Weather System (CIWS)
Convective Weather Avoidance Model (CWAM)



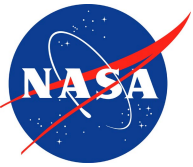
Trial at American Airlines



Trial at American Airlines

American Airlines System Operations Center, Fort Worth, Texas





DWR User Interface

01:40:27

Dynamic Weather Routes Alert Criteria: 5 min

TP	ACID/TYPE	DEP/DST	SAV	FIX/AUX	TR	SC	TMI
<input type="checkbox"/>	AAL599/B752	KMIA/KORD	45.8	IRK/1	OK	OK	R
<input type="checkbox"/>	AAL1406/MD83	KRSM/KORD	39.2	IRK	OK	OK	R
<input checked="" type="checkbox"/>	AAL1651/B738	KTPA/KORD	30.9	IRK/1	OK	SC	R
<input type="checkbox"/>	AAL1509/B752	KMIA/KORD	21.0	IRK	OK	OK	R

Flight plan

DWR route

Maneuver Start Point

Flying Time Savings (or Delay)

Active Flight Plan

Sector congestion on flight plan route

Status: Flying Type: B738 Speed: 445 FL: 340 Cruise FL: 340 Heading: 285
Nominal 01:46 hrs 924 nms 9471 lb [KTPA./DECOD293009..MMB..SLN..IRK.BENK]...

Trial Flight Plan

Sector congestion on DWR route

Active SUAs

Active Route TMIs

Status: Flying Type: B738 Speed: 445 FL: 340 Cruise FL: 340 Heading: 285
Nominal 01:15 hrs 664 nms 6595 lb [KTPA./335347N/0952937W..341433N/0]...

TMI Information (for AAL1651)

Advisory	Orig	Effective Time	Route
7	ZTL ZJX ZMA	08,0134 SOUTH_2_ORD (ETD)	[ATL HVQ APE ZANLA WATSN1]

Maneuver Start Point

Delay (min.) 5 0 15

Time: 01:45:25 FL: 340

Accept, Reject, Cancel

Accept Reject

Trial Planner - AAL Dispatch Display

Altitude	STATUS: Trial Planning	AAL1651	B738/Q	340	KTPA./..DECOD293009..MMB..SLN..IRK.BENKY1.KORD
MMB -11		AAL1651	B738/Q	340	KTPA./..DECOD293009..MMB..SLN..IRK.BENKY1.KORD
SLN 12		AAL1651	B738/Q	340	KTPA./..DECOD293011..AQR153010..TUL..IRK..BENKY1.KORD
IRK 31/006					
ORD 32					

Send TMI Approve Unable Cancel Request

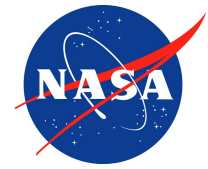
2013-11-01 Friday 13:39:04



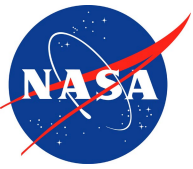
Dynamic Weather Routes

DWR

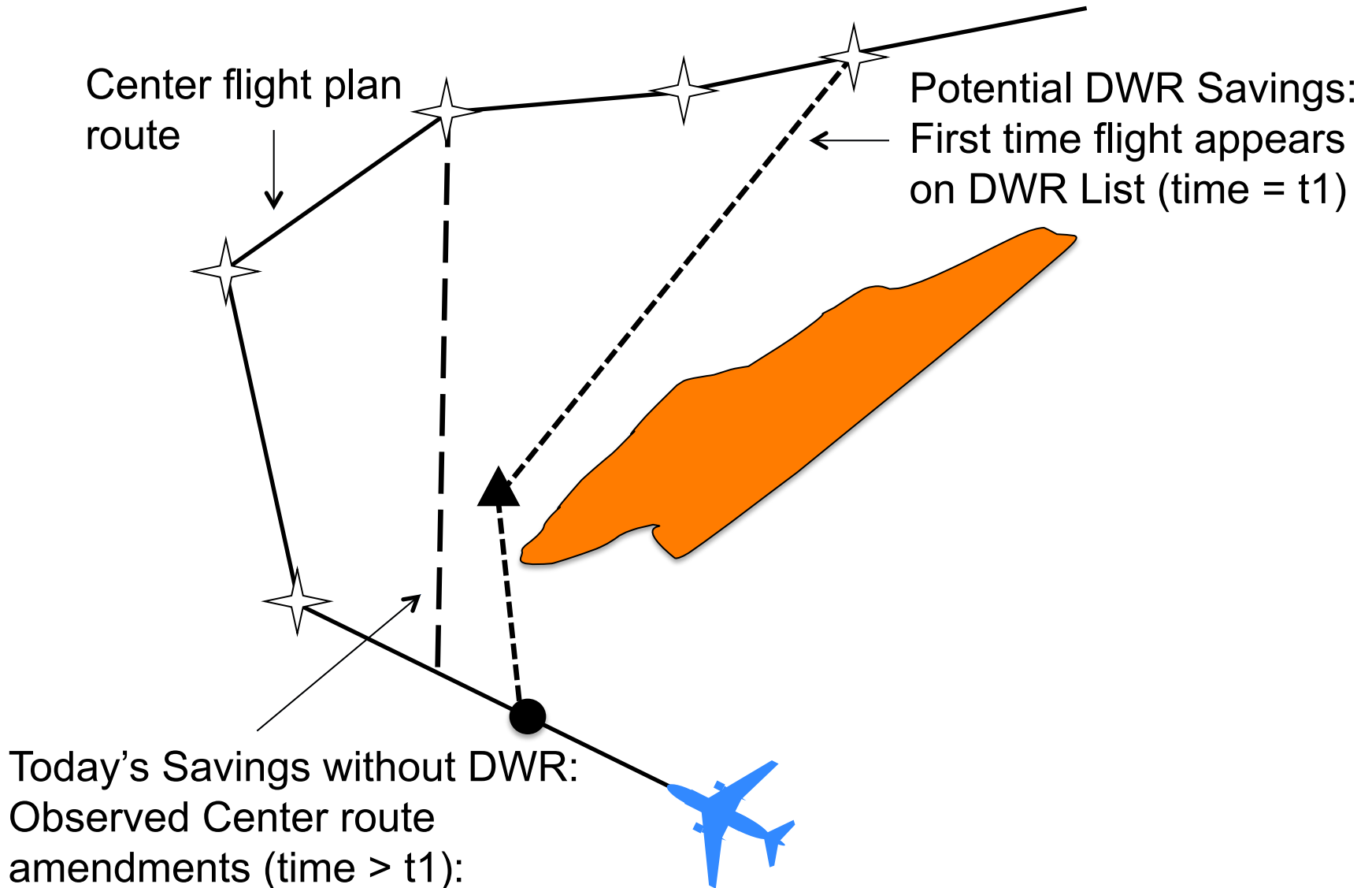
**Sample Fort Worth Center reroutes from
2012 Operational Trial with American Airlines**

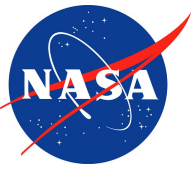


Analysis Results



Potential DWR Savings and Today's Savings without DWR

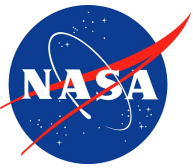




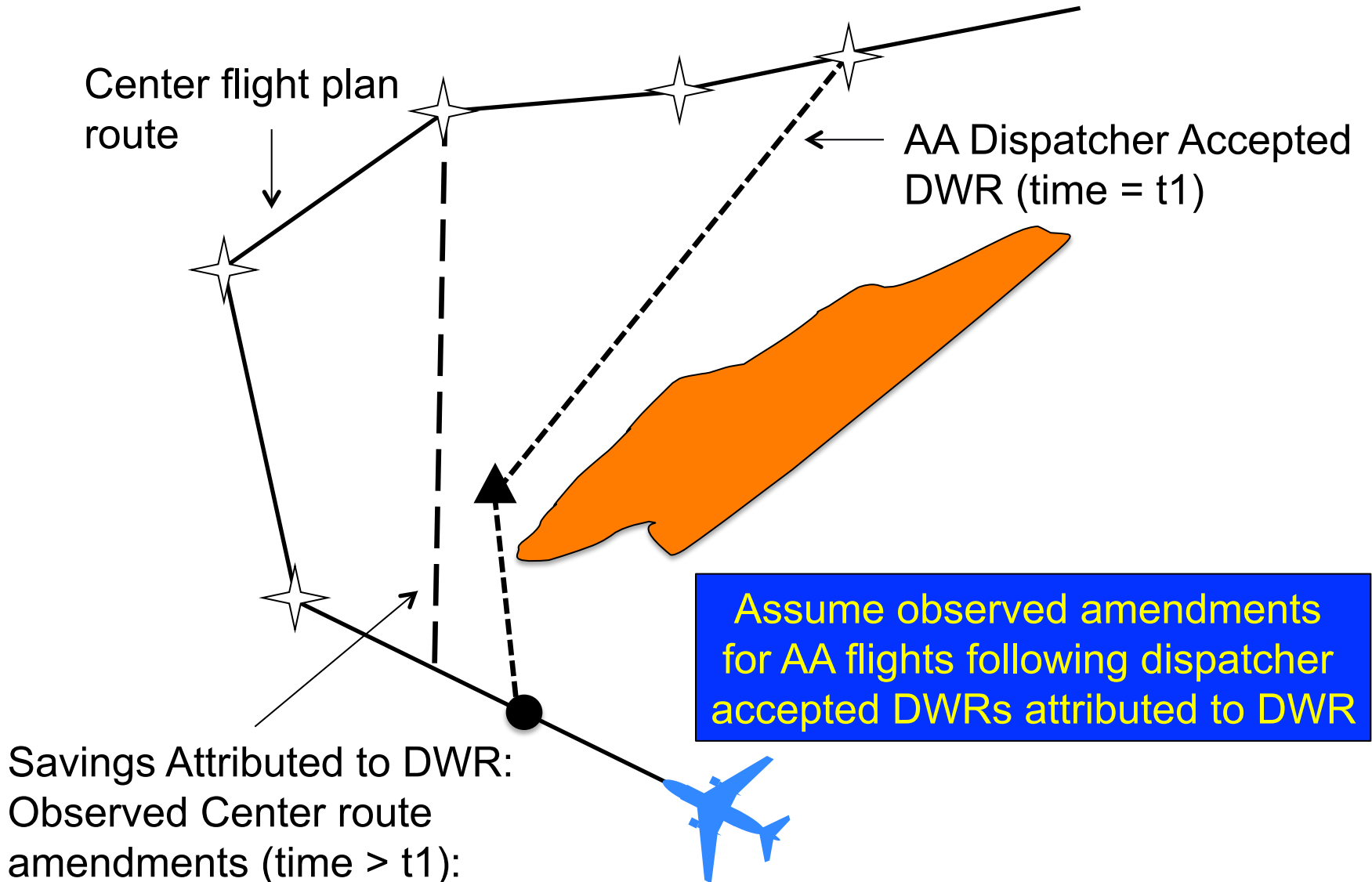
Potential DWR Savings and Today's Savings without DWR

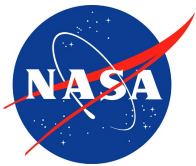
All ZFW flights with DWR Advisories – 11/18/12 to 6/30/13





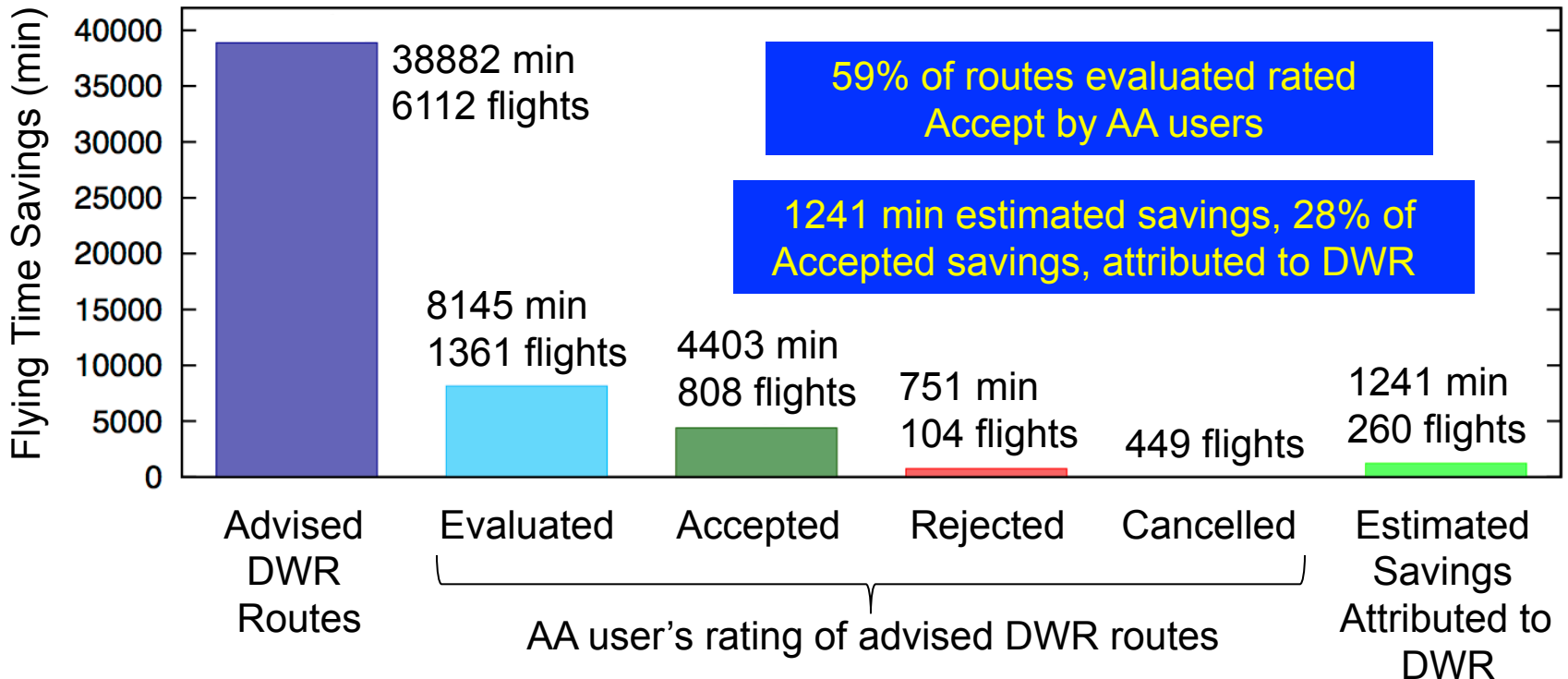
Savings Attributed to DWR





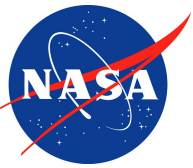
DWR Activity at American Airlines

July 31, 2012 to November 5, 2013



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



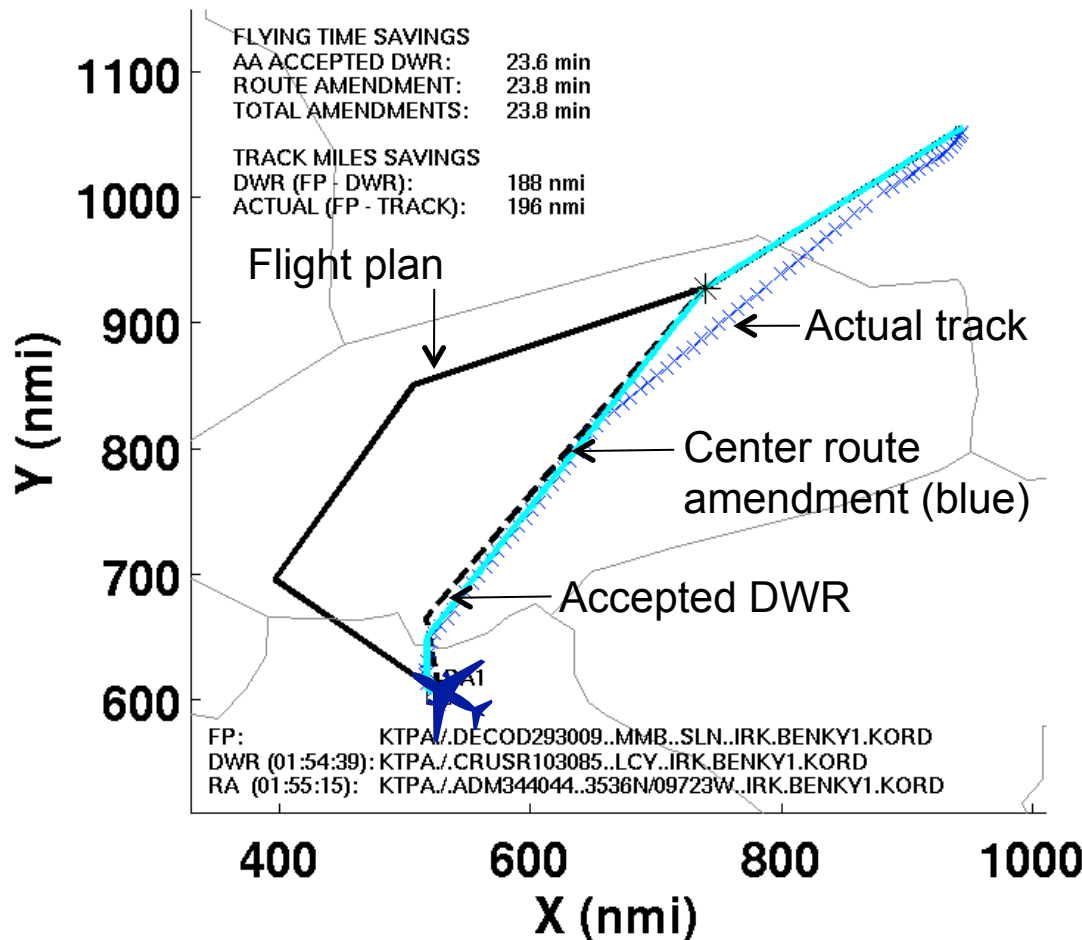
Sample: Tampa/Chicago

pgui [oper.soc]

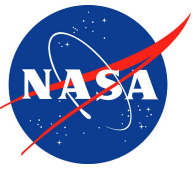
Dynamic Weather Routes - AAL

TP	ACID/TYP	DEP/DST	DRCT	DWR	FIX/VIA	TR	SC	WX
☐	AAL /MDS2	KDFW/KORD	25.0	25.0	IRK/1	14	OK	OK
■	AAL /B738	KTPA/KORD	25.3	23.6	IRK/1		OK	OK

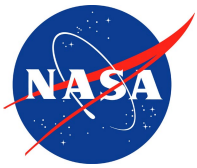
01:54:39



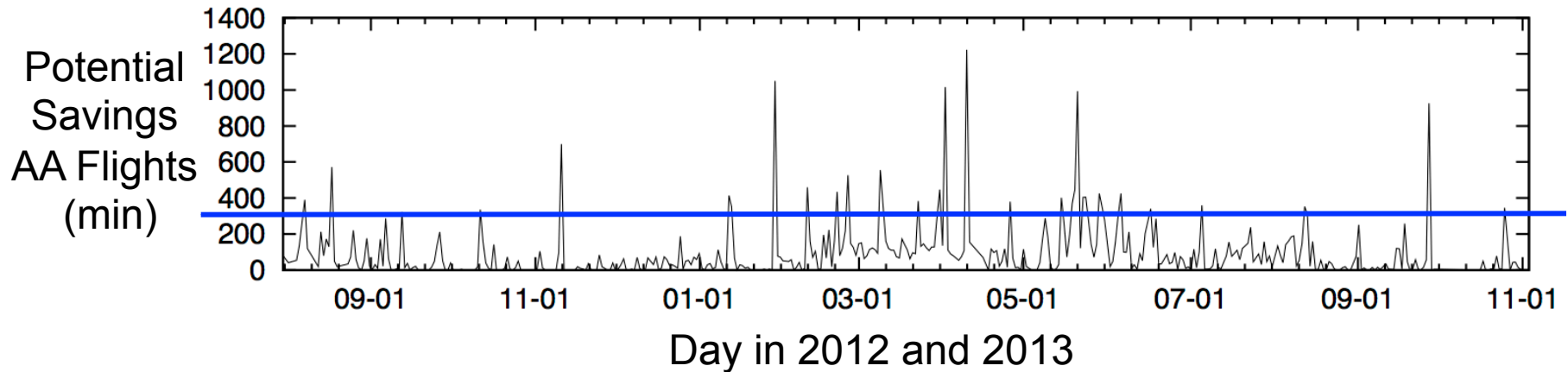
Estimated Actual Savings: 24 minutes



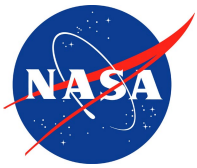
Do AA flights get more savings
when using DWR vs. when not
using DWR?



Tool Used and Tool Not Used Days



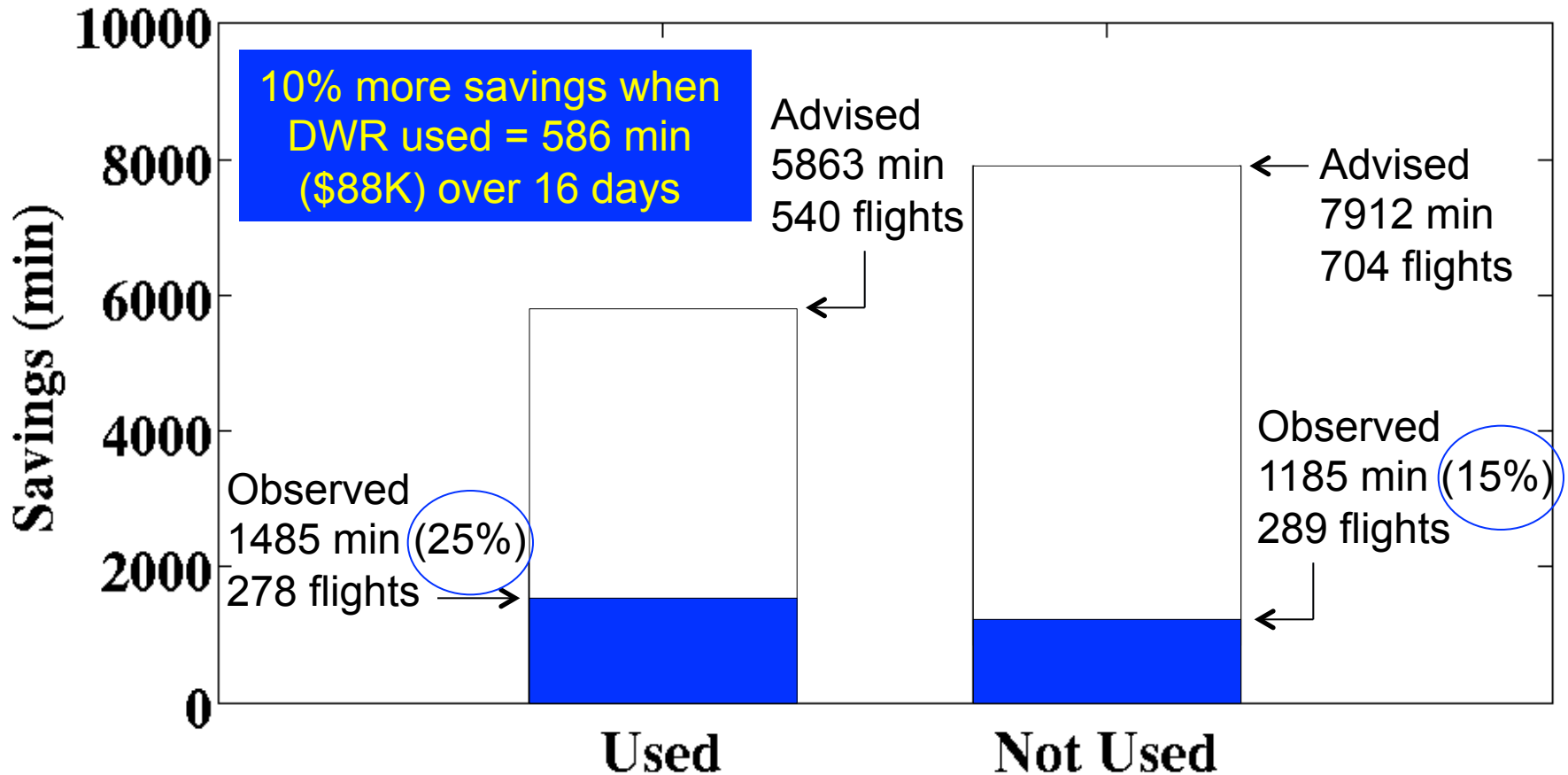
- Pick heavy convective weather days: 34 days
Potential savings AA flights > 300 minutes
- Tool Used Days: 16 of 34 days
AA evaluates > 20% potential savings
- Tool Not Used Days: 18 of 34 days
AA evaluates < 20% potential savings

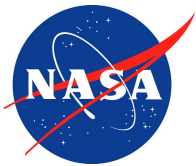


Tool Used vs. Tool Not Used

AA Flights with Advised DWRs

16 Tool Used Days vs. 18 Tool Not Used Days

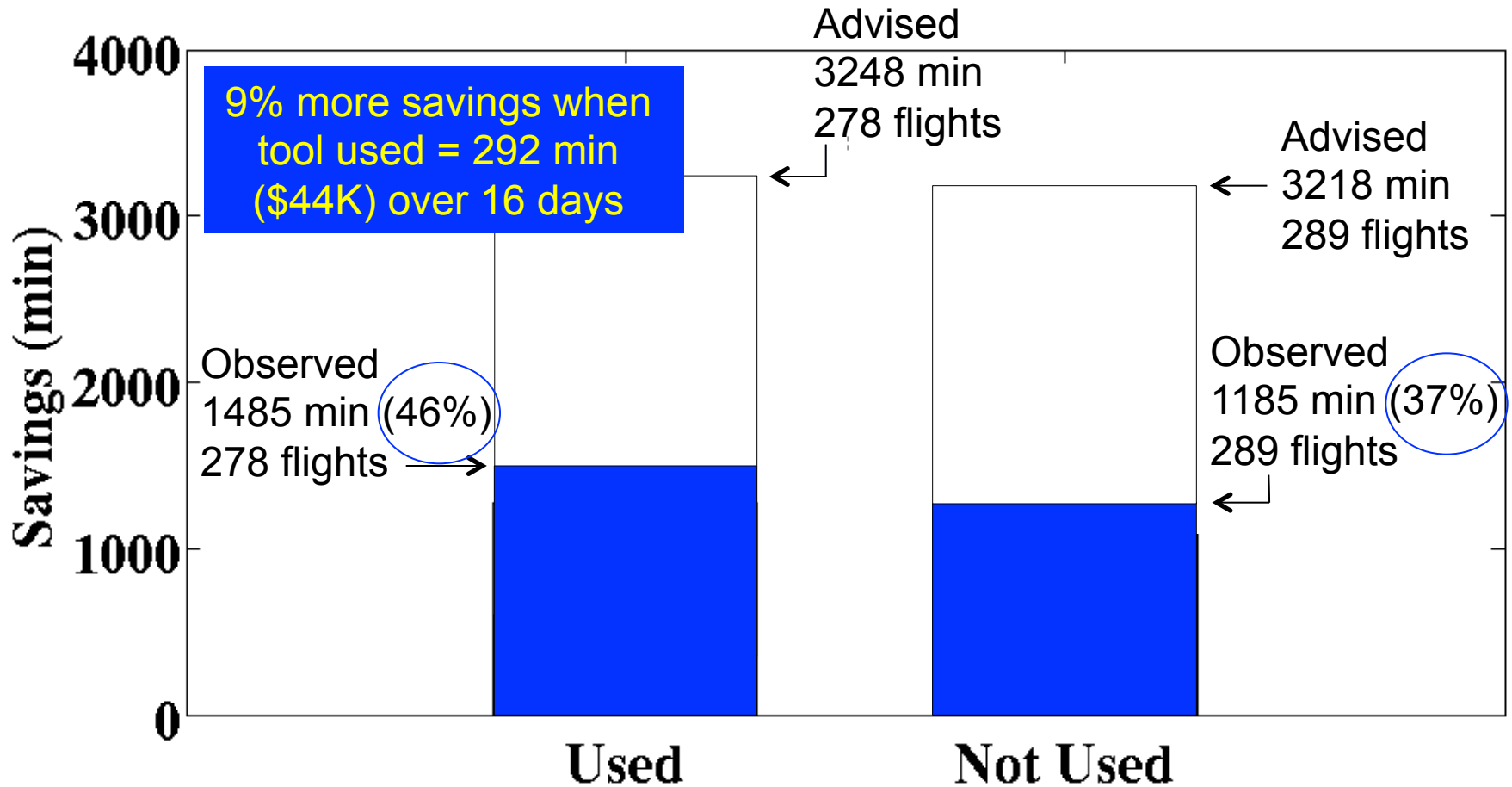


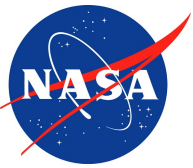


Tool Used vs. Tool Not Used

AA Flights with Advised DWRs & Observed Amendments

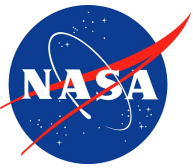
16 Tool Used Days vs. 18 Tool Not Used Days





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

- 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