



DRAW

Dynamic Routes for Arrivals in Weather

NASA-NATCA Technical Interchange Meeting

October 12, 2016

Chester Gong
NASA Ames Research Center



Today's Arrival Operations

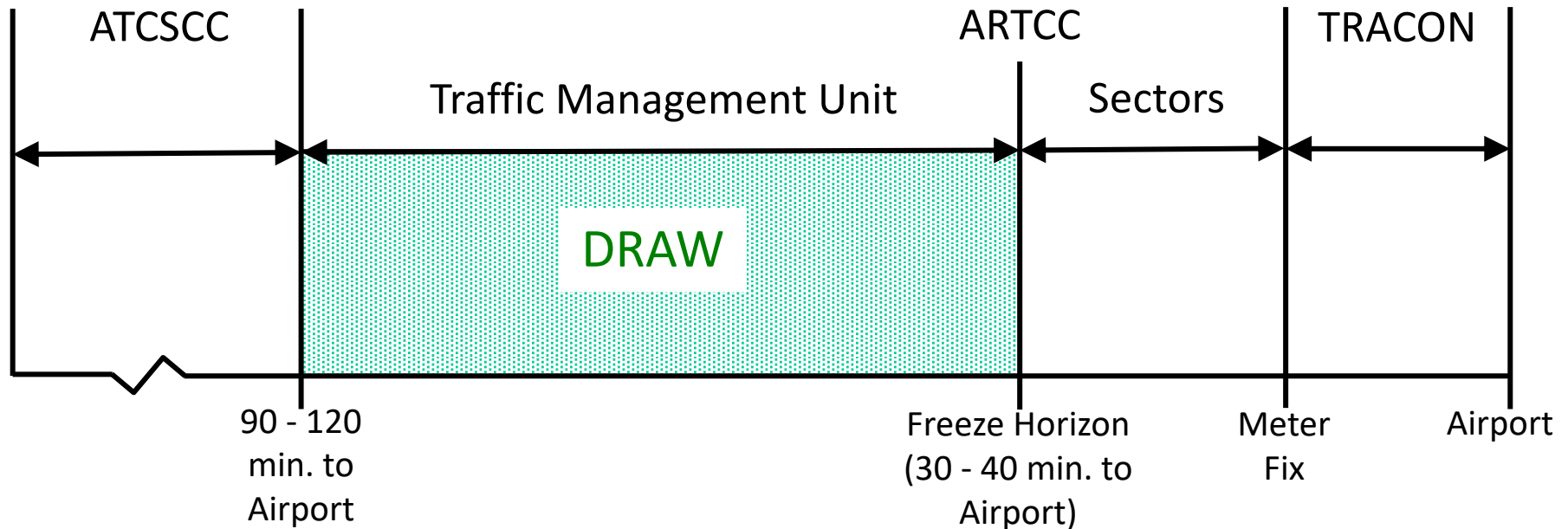
- Weather is one of the primary reasons for time-based metering to be discontinued
- Current operational system cannot adjust its scheduled times of arrival (STA) for aircraft that need to deviate around weather
- Traffic Managers and Controllers revert to less efficient methods of managing arrival traffic flow in weather
 - Implement conservative alternate routes hours in advance
 - Miles-in-trail (MIT)



What is DRAW?

Traffic management decision support tool that proposes reroutes to improve arrival traffic flow

- Sustain metering operations in the presence of weather
- Find efficient arrival routes
- Balance meter fix demand





DRAW System

Planview GUI

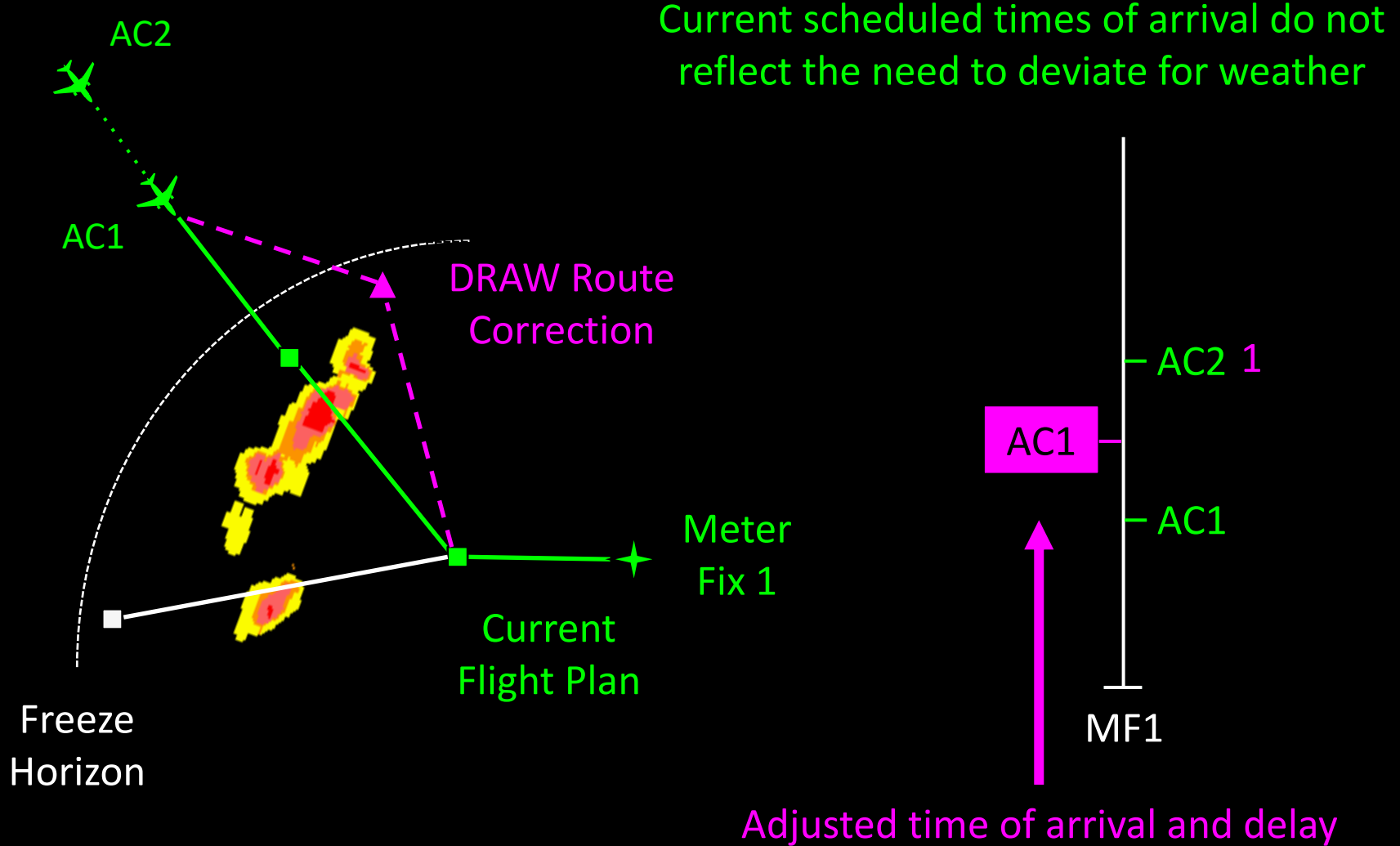
DRAW Advisory List

Timeline GUI

- Planned as future TBFM enhancement
- Integrated Route and Schedule Trial Planner
- Two-hour convective weather forecast updated every five minutes
- Hourly atmospheric updates (e.g., winds)
- ERAM traffic feed from home and adjacent Centers
- Reroute candidate automatically identified and posted on DRAW Advisory List

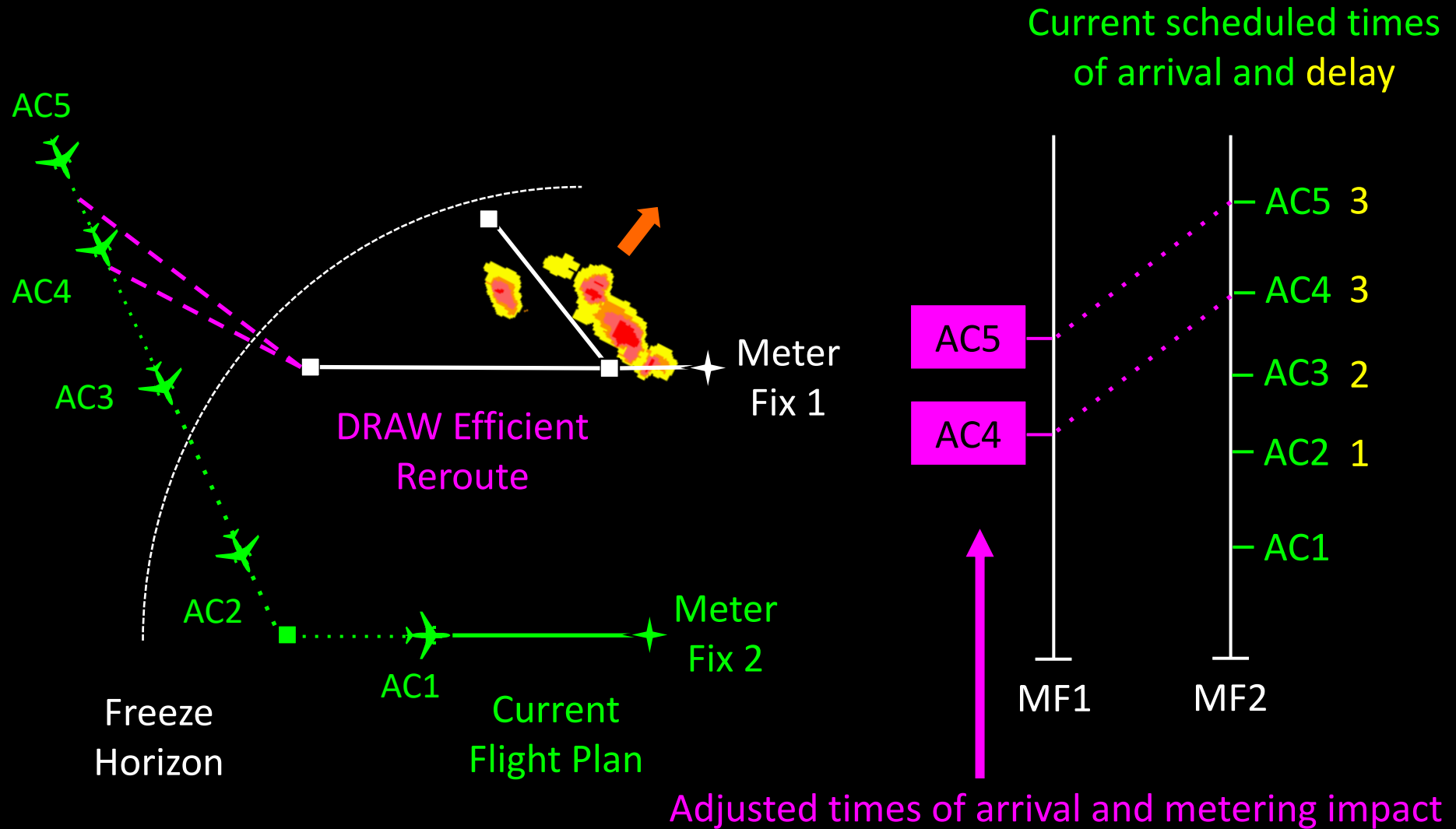


Route Correction to Avoid Weather and Maintain Accurate Schedule Time of Arrival



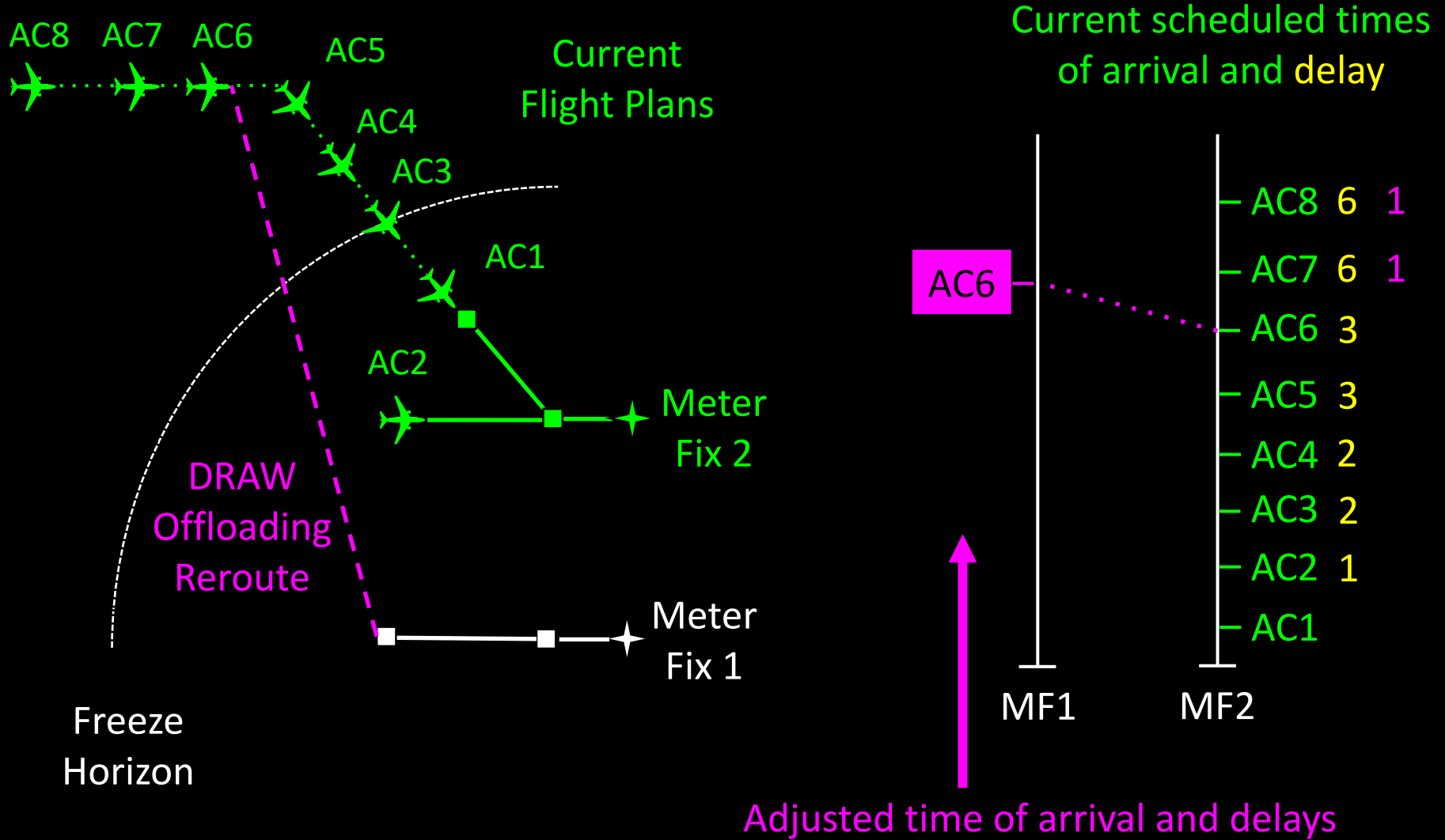


Time Saving Reroutes to Alternate Meter Fix





Meter Fix Demand Balancing (future capability)





DRAW Advisory List

Individual Advisory Group Advisory Current Arrival Route Time Savings Proposed Arrival Route

Grouped By Meter Fix

TL	TP	GP	ACID/TYPE	DEP/TRAN	STAR	DEST	SAV	TRANS	STAR/AUX	STATUS
<input checked="" type="checkbox"/>			DEBBB GREGS							
	<input type="checkbox"/>		SWA662/B738	KOAK/STNLI	JFRYE3	KDAL	0.1	GREGS	JFRYE3	OK
<input checked="" type="checkbox"/>			FEVER BOOVE KNEAD							
	<input type="checkbox"/>		VRD878/A320	KLAX/BGTOE	BACHR3	KDAL	-0.8	KNEAD	BACHR3/1	OK
	<input type="checkbox"/>		SWA290/B733	KMAF/BGTOE	BACHR3	KDAL	0.2	ANGST	BACHR3	OK
	<input type="checkbox"/>		AAL1184/MD82	KDEN/GEEKY	BOOVE3	KDFW	17.5	MDANO	VKTRY1	ALT
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2533/MD82	KFAT/GEEKY	BOOVE3	KDFW	-1.0	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2402/A321	KLAX/GEEKY	BOOVE3	KDFW	0.0	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL606/A321	KSAN/GEEKY	BOOVE3	KDFW	-0.9	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL1547/A321	KLAS/GEEKY	BOOVE3	KDFW	0.9	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2207/A321	KSFO/GEEKY	BOOVE3	KDFW	2.3	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2228/MD83	KSMF/GEEKY	BOOVE3	KDFW	1.6	BOOVE	BOOVE3	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2195/MD83	KTUS/GEEKY	BOOVE3	KDFW	-1.7	BOOVE	BOOVE3/1	OK
	<input type="checkbox"/>		ASQ2789/CRJ2	KMAF/GEEKY	BOOVE3	KDFW	-6.1	HNKER	VKTRY1	ALT
<input checked="" type="checkbox"/>			KARLA BRDJE SASIE FINGR							
<input checked="" type="checkbox"/>			HOWDY DODJE ORVLL YEAGR							

DRAW Status OK: Weather Deviation Route
ALT: Alternate STAR



Notional DRAW Reroute Process

Traffic Management Coordinator

DRAW System

DRAW Advisory List

Select single or multiple flights

Trial Plan Route and Schedule

Evaluate Reroute

Coordinate/Implement Reroute(s)

TBFM

Voice

Voice

Area Supervisor

ABRR

Sector Controller(s)

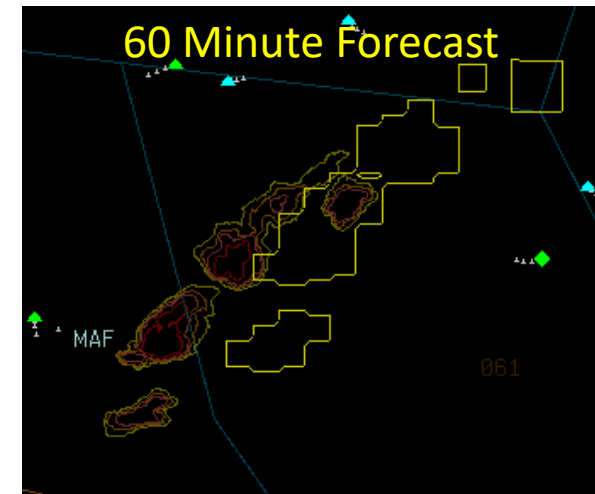
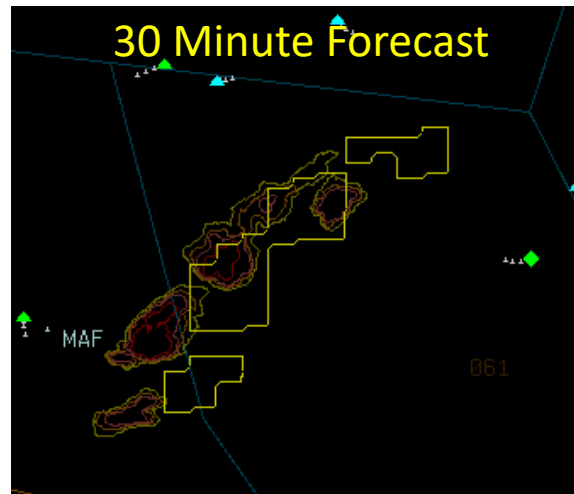
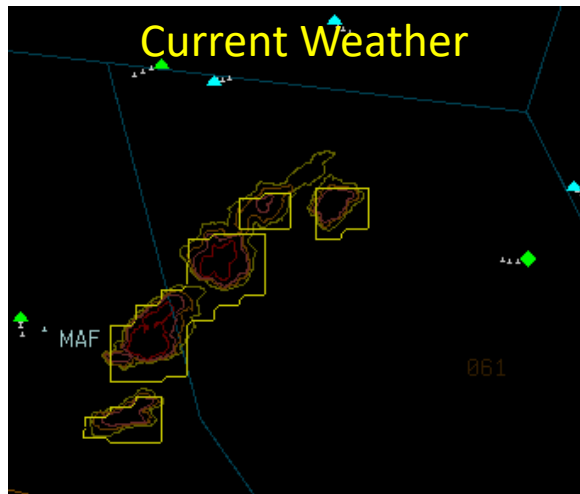
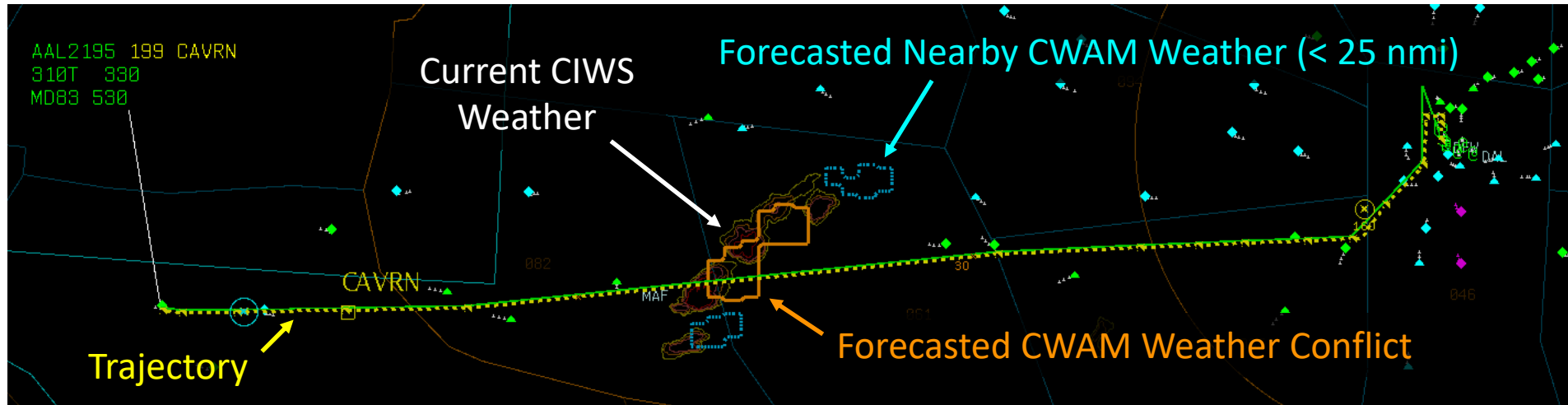
Datacom

Voice

Flight(s)



Trajectory Based Weather Modeling



CIWS*: Corridor Integrated Weather System (precipitation, echo tops)

CWAM*: Convective Weather Avoidance Model (pilot deviation model)

*- Products of MIT Lincoln Laboratory



DRAW Trial Planning: Trial Plan Activation

File Edit F-Keys Panels Options Help DWR Alert Criteria: 5 min

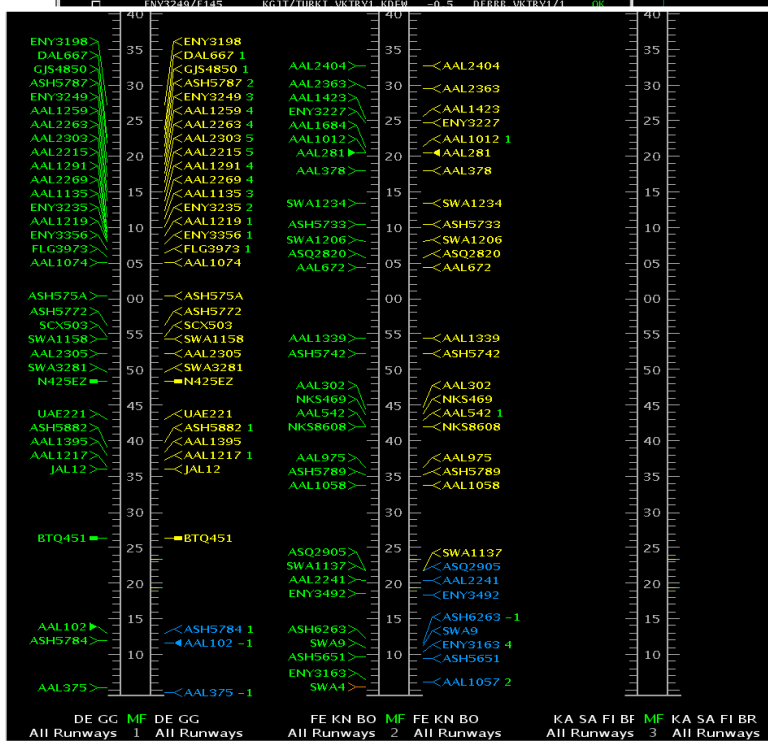
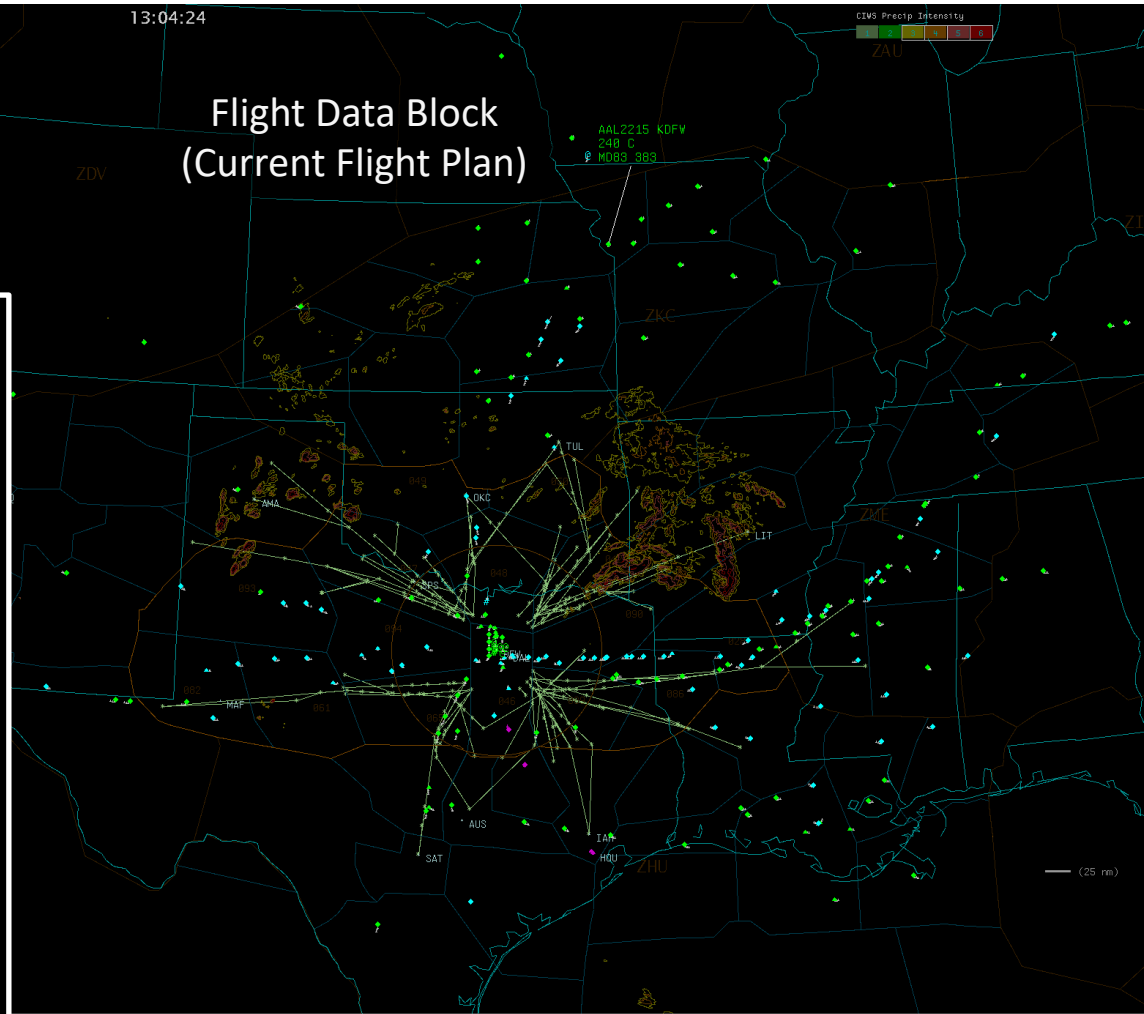
13:04:24

CVS Precip Intensity

DRAW Advisory List

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR.DEST	SAV	TRANS.STAR/AUX	STATUS
DEBB	1		GREGS 1				
			SWA3281/B738	KMDW/HYDPS..JFRV3..KDAL	7.5	ATRRF..CRTKT1	ALT
			JAL12/B788	RJAA/MDANO..JOVME..KDFW	-9.9	DEBYV..SOGR2	ALT
			DAL667/A320	KMSP/HOFFF..VKTRY1..KDFW	6		ALT
			AAL1135/M083	KDSM/HOFFF..VKTRY1..KDFW	6		ALT
			ENY3407/E145	KCMH/IBAKE..VKTRY1..KDFW	28.4	ASXEL..BRJ33	ALT
			GJS4850/B737	KORD/IBAKE..VKTRY1..KDFW	4	JONEZ..CAINE2	ALT
			ASH5787/CR39	KSDF/IBAKE..VKTRY1..KDFW	11.9	JONEZ..CAINE2	ALT
			AAL1259/M082	CVYZ/IBAKE..VKTRY1..KDFW	11.9	JONEZ..CAINE2	ALT
			AAL2263/M083	KCMH/IBAKE..VKTRY1..KDFW	13.1	JONEZ..CAINE2	ALT
			AAL2303/M082	KORD/IBAKE..VKTRY1..KDFW	5.9	JONEZ..CAINE2	ALT
			AAL2215/M083	KDTH/IBAKE..VKTRY1..KDFW	8.5	JONEZ..CAINE2	ALT
			ENY2235/E145	KBMT/IBAKE..VKTRY1..KDFW	8.7	JONEZ..CAINE2	ALT
			AAL1074/M083	KIND/IBAKE..VKTRY1..KDFW	11.9	JONEZ..CAINE2	ALT
			AAL1219/M083	KSCL/MDANO..VKTRY1..KDFW	-1.3	DEBB..VKTRY1/1	OK
			ENY3677/E145	KPIA/POTTY..VKTRY1..KDFW	27.7	JONEZ..CAINE2	ALT
			ENY3249/E145	KCLT/TURBT..VKTRY1..KDFW	20.5	DEBB..VKTRY1/1	OK

Flight Data Block
(Current Flight Plan)

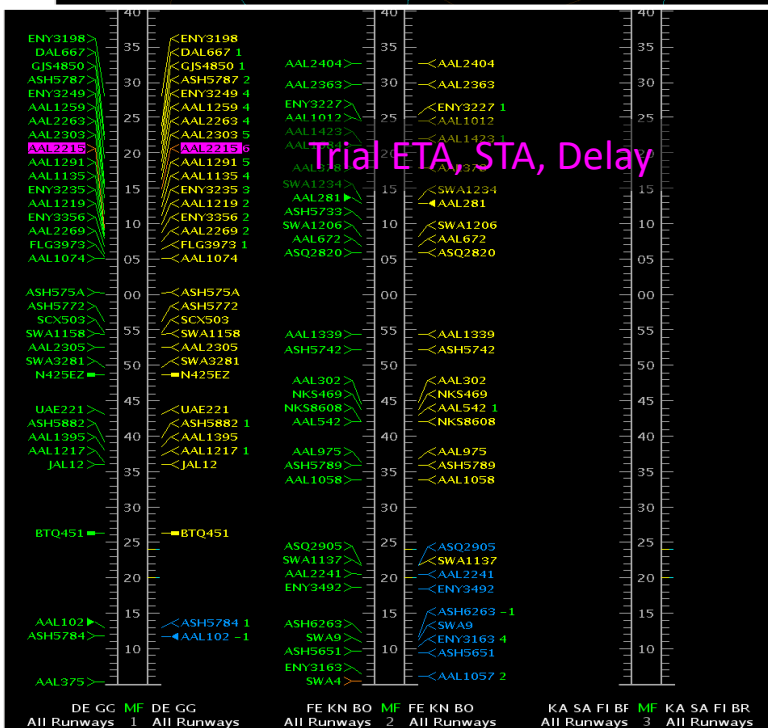
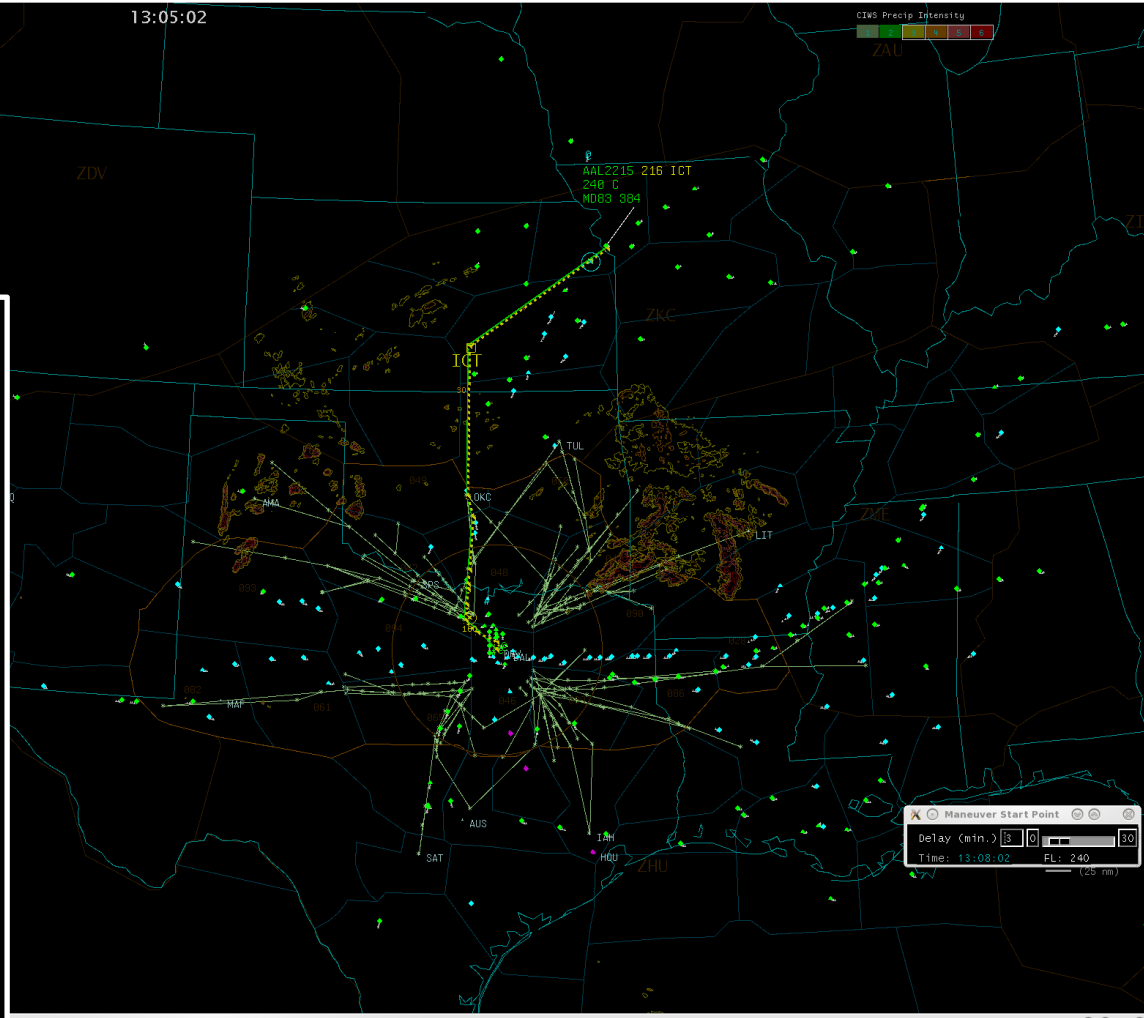


Trial Planner Window



DRAW Trial Planning: Current Flight Plan

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR_DEST	SAV	TRANS.STAR/AUX	STATUS
			DEBBB CREGS				
			SMA3281/B738	KMDW/HYDES..JERYE3..KDAL	7.0	ATRR..CRIKT1	ALT
			JAL12/B788	RJAA/MDANO..JOMV63..KDFW	0.0	ZUBOV..JOMV63	OK
			DAL667/A320	KMSP/HOFFF..VKTRY1..KDFW	6.5	JONEZ..CAINE2	ALT
			ENY3407/E145	KCMH/IBAKE..VKTRY1..KDFW	28.3	AXMEE..BRDJE3	ALT
			GJS4850/CRJ7	KORD/IBAKE..VKTRY1..KDFW	6.7	JONEZ..CAINE2	ALT
			AAL2263/M83	KORD/IBAKE..VKTRY1..KDFW	12.9	JONEZ..CAINE2	ALT
			AAL2303/M83	KORD/IBAKE..VKTRY1..KDFW	5.7	JONEZ..CAINE2	ALT
			AAL2215/M83	KDTH/IBAKE..VKTRY1..KDFW	8.1	JONEZ..CAINE2	ALT
			ENY3235/E145	KBMT/IBAKE..VKTRY1..KDFW	8.6	JONEZ..CAINE2	ALT
			ENY3677/E145	KPIA/POTTY..VKTRY1..KDFW	27.5	JONEZ..CAINE2	ALT
			ENY3249/E145	KGJT/TURKI..VKTRY1..KDFW	-1.9	TURKI..VKTRY1/1	OK
			AAL2269/M83	KCOS/TURKI..VKTRY1..KDFW	7.4	LAYMV..VKTRY1	OK
			FEVER BRDJE KNEAD				
			KARLA BRDJE SASIE FINGR				
			HOMDY DODJE ORVLL YEAGR				



ICR	TRW	IBAKE	FAMNT	WNSTR	BRUKI	PAUL23	SEEV93	SHAWM2	SOCKR2	TILLA3	UKM4	VKTRY1	Altitude	STATUS: Trial Planning
-0.0	4.6	5.3	5.8	6.0	6.0									AAL2215
M83/Z 240 KDTM./..MC1051010..MCI..ICT..IRW..IBAKE..VKTRY1..KDFW														
AAL2215 KDTM./..ICT048160..ICT048141..ICT..IRW..IBAKE..VKTRY1..KDFW														

Current Flight Plan Route
Trial Plan Route

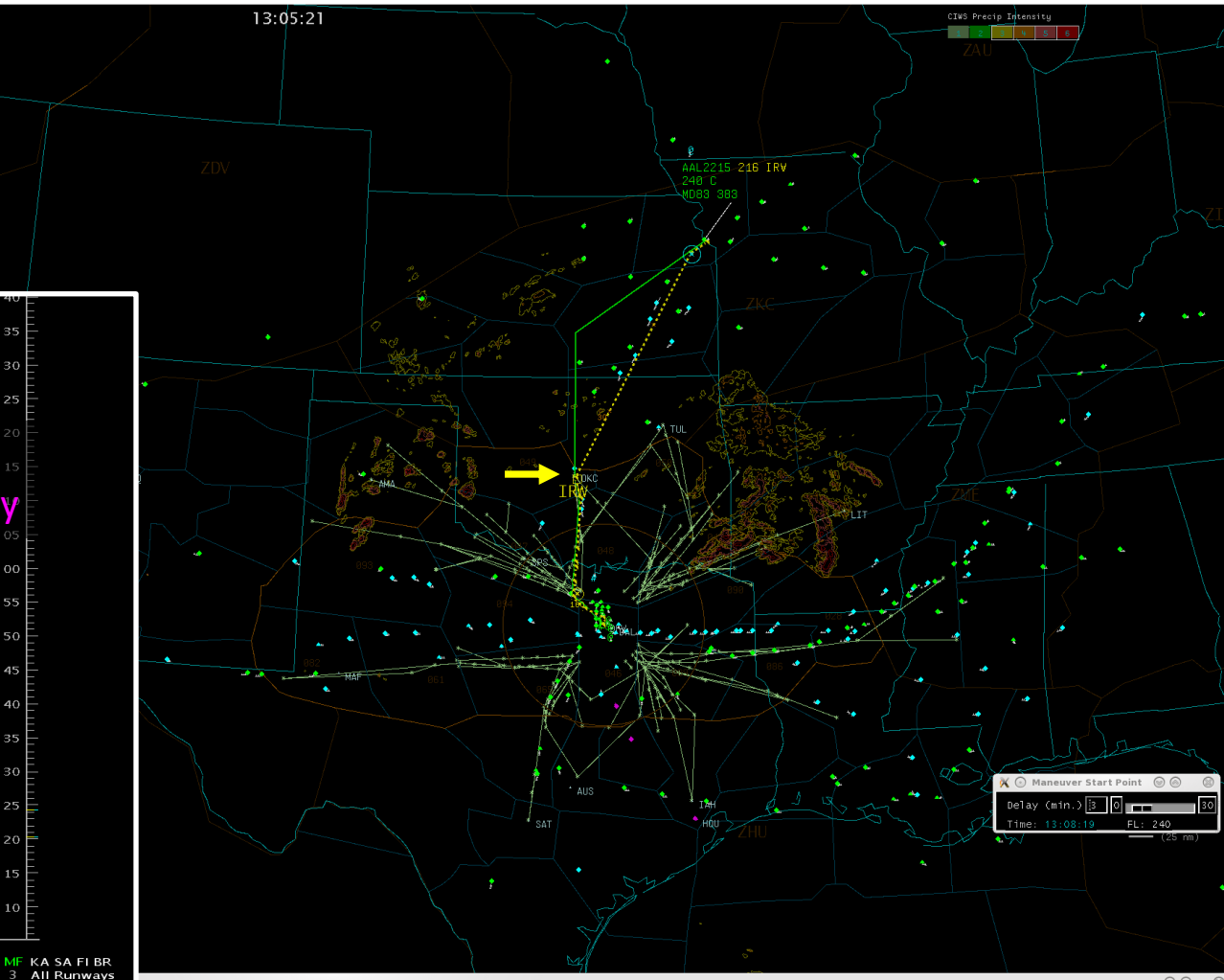
Delay (min.): 0 | 30
 Time: 13:08:02 | EL: 240
 (25 nm)

Send TRW | Approve | Unable | Cancel Request | Accept | Reject



DRAW Trial Planning: Capture Waypoint

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR.DEST	SAV	TRANS.STAR/AWX	STATUS	
DEBBB	I	GREGS	1					
				SMA3281/8738	KMDW/HYDES..JRYE3..KDAL	6.9	AIRRE..CRIKT1	ALT
				DAL667/4320	KMSP/HOFFF..VKTRY1..KDFW	6.5	JONEZ..CAINE2	ALT
				AAL1135/MD83	KDMS/HOFFF..VKTRY1..KDFW	5.9	JONEZ..CAINE2	ALT
				ENY3407/E145	KCMI/IBAKE..VKTRY1..KDFW	29.0	RRNET..BRDJE3	ALT
				GJS4850/CRJ7	KORD/IBAKE..VKTRY1..KDFW	6.6	JONEZ..CAINE2	ALT
				ASH5787/CRJ9	KSDF/IBAKE..VKTRY1..KDFW	14.7	JONEZ..CAINE2	ALT
				AAL1259/MD82	CVYZ/IBAKE..VKTRY1..KDFW	9.0	JONEZ..CAINE2	ALT
				AAL2263/MD83	KCMB/IBAKE..VKTRY1..KDFW	12.8	JONEZ..CAINE2	ALT
				AAL2303/MD82	KORD/IBAKE..VKTRY1..KDFW	5.6	JONEZ..CAINE2	ALT
				AAL2215/MD83	KDTH/IBAKE..VKTRY1..KDFW	7.9	JONEZ..CAINE2	ALT
				ENY3235/E145	KBMT/IBAKE..VKTRY1..KDFW	8.5	JONEZ..CAINE2	ALT
				AAL1074/MD83	KIND/IBAKE..VKTRY1..KDFW	11.4	JONEZ..CAINE2	ALT
				AAL1219/MD83	KSIC/MDANO..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/1	OK
				ENY3677/E145	KPIA/POTTY..VKTRY1..KDFW	27.3	JONEZ..CAINE2	ALT
				ENY3249/E145	KGJT/TURKI..VKTRY1..KDFW	-0.5	DEBBB..VKTRY1/1	OK
				AAL2269/MD83	KCOS/TURKI..VKTRY1..KDFW	7.5	DEBBB..VKTRY1	OK



ENY3198	ENY3198	AAL2404	AAL2404
DAL667	DAL667 1	AAL2369	AAL2369
GJS4850	GJS4850	ENY3227 2	ENY3227 1
ASH5787	ASH5787 2	AAL1012	AAL1012
ENY3249	ENY3249 5	AAL1423	AAL1423 1
AAL1259	AAL1259 4	AAL1684	AAL1423 1
AAL2269	AAL2269 4	AAL281	AAL281
AAL2303	AAL2303 5	AAL193	AAL193
AAL1291	AAL1291 6	SWA1234	SWA1234
AAL1135	AAL1135 5	ASH1234	ASH1234
ENY3235	ENY3235 4	ASH1234	ASH1234
AAL1219	AAL1219 9	ASH1234	ASH1234
ENY3356	ENY3356 3	ASQ2820	ASQ2820
AAL2269	AAL2269 3		
FLG3973	FLG3973 2		
AAL1074	AAL1074 1		
AAL2215	AAL2215		
ASH575A	ASH575A		
ASH5772	ASH5772		
SCX509	SCX509		
SWA1158	SWA1158		
AAL2305	AAL2305		
SWA3281	SWA3281		
N425E2	N425E2		
AAL1217	AAL1217		
UAE221	UAE221		
AAL1395	AAL1395		
ASH5882	ASH5882		
JAL12	JAL12		
BTQ451	BTQ451		
AAL102	ASH5784 1		
ASH5784	AAL102 -1		
AAL375			

Updated Trial ETA, STA, Delay

IC	IRW	IBAKE	FAMNT	WNSTR	RBUKI	PAWLZ3	SEEV83	SHAWM2	SOCKR2	TILL33	UKM4	VKTRY1	Altitude	STATUS	MANEUVER START POINT
0.0	4.5	5.3	5.8	5.9	5.9									Trial Planning	MANEUVER START POINT
														AAL2215	MANEUVER START POINT
														AAL2215	MANEUVER START POINT

Capture Waypoints



DRAW Trial Planning: Alternate STAR

File Edit F-keys Panels Options Help DWR Alert Criteria: 5 min 13:05:43

DRAW Advisories

TL	TP	GP	ACID/TYPE	DEP/TRAN.	STAR.	DEST	SAV	TRANS.	STAR/AUX	STATUS
DEBBB	I	GREGS	1							
				SMA3281	/B738	RMDW/JVDES..JFRYE3..KDAL	6.6	AIRRE..CRK1		ALT
				DAL667	/A320	RMSF/HOFFE..VKTRY1..KDFW	6.4	JONEZ..CAINE2		ALT
				AAL1135	/MD83	RDSM/HOFFE..VKTRY1..KDFW	5.8	JONEZ..CAINE2		ALT
				ENY3407	/E145	KCM1/IBAKE..VKTRY1..KDFW	28.9	RRNET..BRDJE3		ALT
				GJS4850	/CRJ7	KORD/IBAKE..VKTRY1..KDFW	6.5	JONEZ..CAINE2		ALT
				ASH5787	/CRJ9	KSDF/IBAKE..VKTRY1..KDFW	14.6	JONEZ..CAINE2		ALT
				AAL1259	/MD82	CVYZ/IBAKE..VKTRY1..KDFW	8.9	JONEZ..CAINE2		ALT
				AAL2263	/MD83	KCM1/IBAKE..VKTRY1..KDFW	12.7	JONEZ..CAINE2		ALT
				AAL2303	/MD82	KORD/IBAKE..VKTRY1..KDFW	5.5	JONEZ..CAINE2		ALT
				AAL2215	/MD83	KDTW/IBAKE..VKTRY1..KDFW	7.8	JONEZ..CAINE2		ALT
				ENY3235	/E145	KBML/IBAKE..VKTRY1..KDFW	8.4	JONEZ..CAINE2		ALT
				AAL1074	/MD83	KIND/IBAKE..VKTRY1..KDFW	11.3	JONEZ..CAINE2		ALT
				AAL1219	/MD83	KSLG/MBAND..VKTRY1..KDFW	-0.5	DEBBB..VKTRY1/I		OK
				ENY2677	/E145	KPIA/POTTY..VKTRY1..KDFW	27.1	JONEZ..CAINE2		ALT
				ENY3249	/E145	KG17/TURKI..VKTRY1..KDFW	-0.5	DEBBB..VKTRY1/I		OK
				AAL2269	/MD83	KCOS/TURKI..VKTRY1..KDFW	7.4	DEBBB..VKTRY1/I		OK

Map showing flight paths and STAR locations. AAL2215 is highlighted with a yellow arrow pointing to its STAR location.

Vertical timeline for AAL2215 showing various STARs and their altitudes.

STAR	Altitude (ft)
ENY3198	35
DAL667	30
GJS4850	25
ASH5787	20
AAL1259	15
ENY3249	10
AAL2263	5
AAL2303	0
AAL2215	0
AAL1291	0
ENY3235	0
AAL1219	0
AAL1135	0
ENY3356	0
AAL2269	0
AAL1074	0
FLG3973	0
ASH575A	0
ASH5772	0
SCN509	0
SWA1158	0
AAL2305	0
SWA3281	0
N425EZ	0
UAE221	0
ASH5882	0
AAL1395	0
AAL1217	0
JAL12	0
BTQ451	0
AAL102	0
ASH5784	0
ASH5784	0
ENY3163	0

DE GC MF DE GC FE KN BO MF FE KN BO KA SA FI BF MF KA SA FI BR

All Runways 1 All Runways 2 All Runways 3 All Runways

STAR	Altitude	STAR	Altitude
AXXEE	8.6	JNVI	8.6
MMBNN	8.6	JOVEM3	7.6
LRKNS	8.7	KLNDR2	7.6
SEEV3	8.7	PAWLZ3	-1.9
BRDJE	9.0	SEEV3	6.9
		TRHED	-0.2
		PRWMD	4.6

STATUS: Trial Planning

AAL2215 MDS3/Z 240 KDTW./..MC1051010..MC1..ICT..IRW..IBAKE..VKTRY1..KDFW

AAL2215 KDTW./..MC1232009..ICT048136..AXXEE..SEEV3..KDFW

Delay (min.) 0 30 Time: 13:08:42 FL: 240 (EOI)

Accept Reject

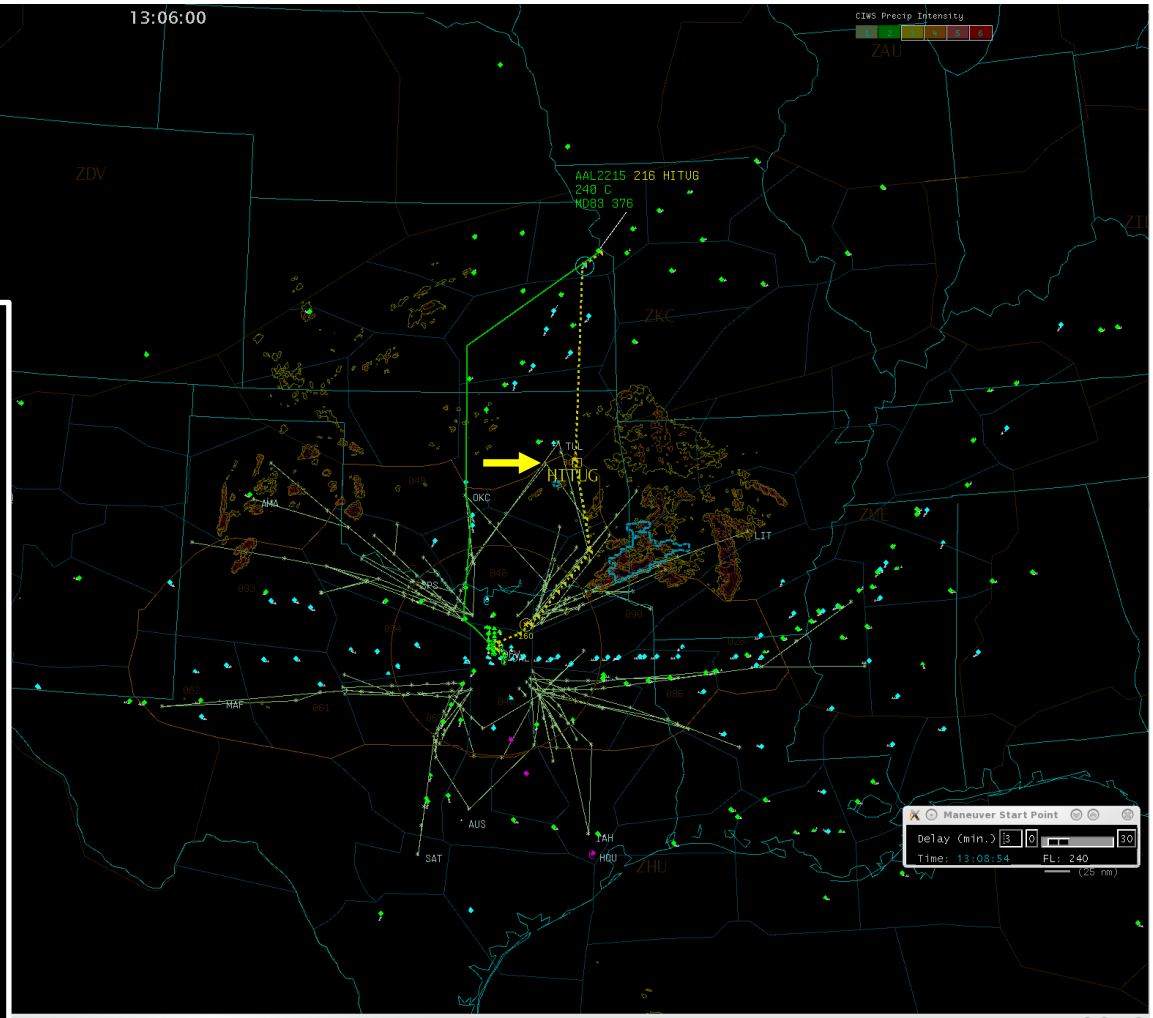
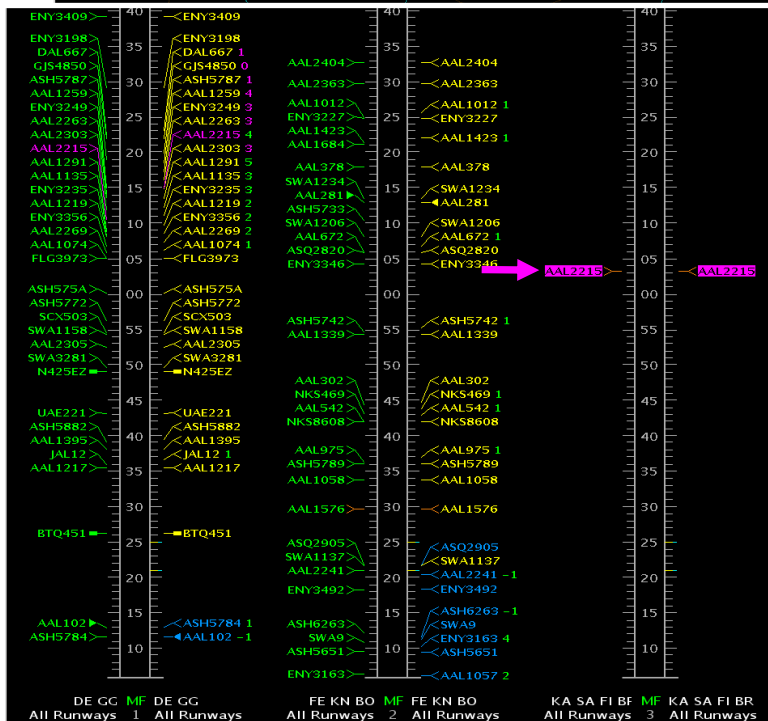
↑ STARS



DRAW Trial Planning: Transition Fix

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR_DEST	SAV	TRANS.STAR/AUX	STATUS
<input checked="" type="checkbox"/>	DEBBB		GREGS				
<input type="checkbox"/>		<input type="checkbox"/>	SMA3281/B738	KMDW/HYDES..JFRYE3..KDAL	6.5	AIRRE..CRIKT1	ALT
<input type="checkbox"/>		<input type="checkbox"/>	DAL667/A320	KMSP/HOFFE..VKTRY1..KDFW	6.4	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	ENY3407/E145	KCMH/IBAKE..VKTRY1..KDFW	28.9	RRNET..BRDJE3	ALT
<input type="checkbox"/>		<input type="checkbox"/>	GJS4850/C377	KORD/IBAKE..VKTRY1..KDFW	6.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	AAL2263/MD83	KCMH/IBAKE..VKTRY1..KDFW	12.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	AAL2303/MD82	KORD/IBAKE..VKTRY1..KDFW	5.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	AAL2215/MD83	KDTH/IBAKE..VKTRY1..KDFW	7.8	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	ENY3235/E145	KBM1/IBAKE..VKTRY1..KDFW	8.4	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	ENY3877/E145	KFTJ/POTTY..VKTRY1..KDFW	27.1	JONEZ..CAINE2	ALT
<input type="checkbox"/>		<input type="checkbox"/>	ENY3249/E145	KGTT/TURKI..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1	OK
<input type="checkbox"/>		<input type="checkbox"/>	AAL2269/MD83	KCOS/TURKI..VKTRY1..KDFW	7.4	DEBBB..VKTRY1	OK
<input type="checkbox"/>	FEVER		BOOVE				
<input type="checkbox"/>	KARLA		BRDJE				
<input type="checkbox"/>	HOWDY		DODJE				
<input type="checkbox"/>		<input type="checkbox"/>	KNEAD				
<input type="checkbox"/>		<input type="checkbox"/>	SASIE				
<input type="checkbox"/>		<input type="checkbox"/>	FINGR				
<input type="checkbox"/>		<input type="checkbox"/>	ORVLL				
<input type="checkbox"/>		<input type="checkbox"/>	YEAGR				

13:06:00



ACID	Altitude
HITUG 6.9	8.6
SSLID 7.1	7.6
PLEZE 7.1	-2.0
CHMLT 7.6	6.9
JUSST 7.8	4.6
SMICH 8.0	6.3

STATUS: Trial Planning

AAL2215 M83/Z 240 KDTW./..MC1051010..NCL1..ICT1..IRW1..IBAKE..VKTRY1..KDFW

AAL2215 KDTW./..HITUG005199..1CT048135..HITUG..SEEVRS..KDFW

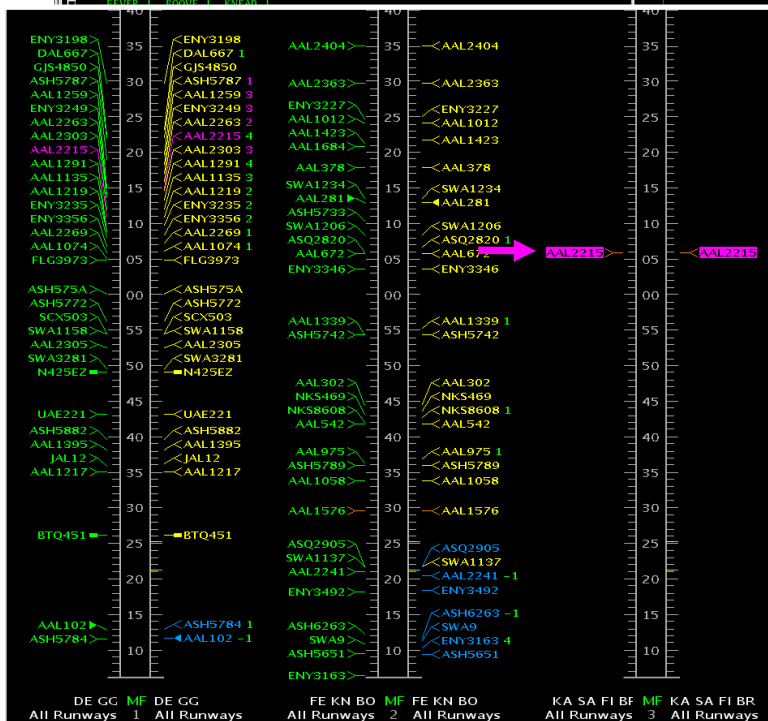
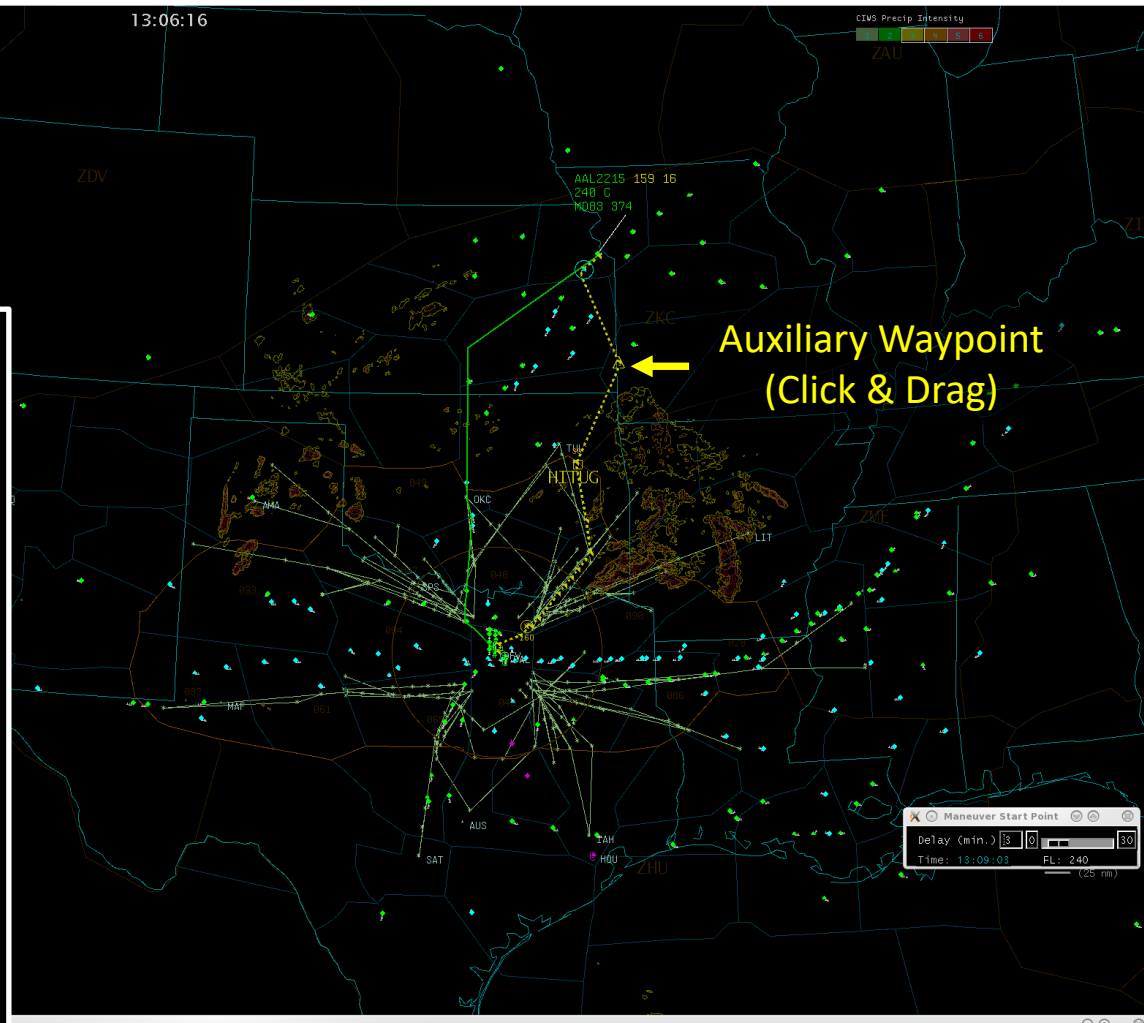
Buttons: Send TRN, Approve, Unable, Cancel Request, Accept, Reject

Transition Fixes



DRAW Trial Planning: Auxiliary Waypoint

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR_DEST	SAV	TRANS.STAR/AUX	STATUS																																																							
<input type="checkbox"/>			DEBBB GREGS																																																											
<input type="checkbox"/>			SWA3281/B738	KMDW/HYDES..JFRYE3..KDAL	6.4	AIRRE..CRKT1	ALT																																																							
<input type="checkbox"/>			DAL667/A320	RMSF/HOFFF..VKTRY1..KDFW	6.4	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			AAL1135/M83	RMSF/HOFFF..VKTRY1..KDFW	5.8	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			ENY3407/E145	KCMI/IBAKE..VKTRY1..KDFW	28.6	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			GJS4850/CRJ7	KORD/IBAKE..VKTRY1..KDFW	6.5	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			ASH5787/CRJ9	KSDF/IBAKE..VKTRY1..KDFW	14.3	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			AAL1259/M82	CVYZ/IBAKE..VKTRY1..KDFW	8.8	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			AAL2263/M83	KCMI/IBAKE..VKTRY1..KDFW	12.5	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			AAL2303/M82	KORD/IBAKE..VKTRY1..KDFW	5.5	JONEZ..CAINE2 </tr <tr><td><input type="checkbox"/></td><td></td><td></td><td>AAL2215/M83</td><td>KDTW/IBAKE..VKTRY1..KDFW</td><td>7.8</td><td>JONEZ..CAINE2</td><td>ALT</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>ENY3235/E145</td><td>KBMI/IBAKE..VKTRY1..KDFW</td><td>8.3</td><td>JONEZ..CAINE2</td><td>ALT</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>AAL1074/M83</td><td>KIND/IBAKE..VKTRY1..KDFW</td><td>11.0</td><td>JONEZ..CAINE2</td><td>ALT</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>ENY3677/E145</td><td>RP1A/POTTY..VKTRY1..KDFW</td><td>27.0</td><td>JONEZ..CAINE2</td><td>ALT</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>ENY3240/E145</td><td>KOJ7/TURKI..VKTRY1..KDFW</td><td>-0.4</td><td>DEBBB..VKTRY1/1</td><td>OK</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>AAL1219/M83</td><td>KSJC/TURKI..VKTRY1..KDFW</td><td>0.3</td><td>DEBBB..VKTRY1/1</td><td>OK</td></tr> <tr><td><input type="checkbox"/></td><td></td><td></td><td>AAL2269/M83</td><td>KCOS/TURKI..VKTRY1..KDFW</td><td>7.4</td><td>DEBBB..VKTRY1</td><td>OK</td></tr>	<input type="checkbox"/>			AAL2215/M83	KDTW/IBAKE..VKTRY1..KDFW	7.8	JONEZ..CAINE2	ALT	<input type="checkbox"/>			ENY3235/E145	KBMI/IBAKE..VKTRY1..KDFW	8.3	JONEZ..CAINE2	ALT	<input type="checkbox"/>			AAL1074/M83	KIND/IBAKE..VKTRY1..KDFW	11.0	JONEZ..CAINE2	ALT	<input type="checkbox"/>			ENY3677/E145	RP1A/POTTY..VKTRY1..KDFW	27.0	JONEZ..CAINE2	ALT	<input type="checkbox"/>			ENY3240/E145	KOJ7/TURKI..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/1	OK	<input type="checkbox"/>			AAL1219/M83	KSJC/TURKI..VKTRY1..KDFW	0.3	DEBBB..VKTRY1/1	OK	<input type="checkbox"/>			AAL2269/M83	KCOS/TURKI..VKTRY1..KDFW	7.4	DEBBB..VKTRY1	OK
<input type="checkbox"/>			AAL2215/M83	KDTW/IBAKE..VKTRY1..KDFW	7.8	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			ENY3235/E145	KBMI/IBAKE..VKTRY1..KDFW	8.3	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			AAL1074/M83	KIND/IBAKE..VKTRY1..KDFW	11.0	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			ENY3677/E145	RP1A/POTTY..VKTRY1..KDFW	27.0	JONEZ..CAINE2	ALT																																																							
<input type="checkbox"/>			ENY3240/E145	KOJ7/TURKI..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/1	OK																																																							
<input type="checkbox"/>			AAL1219/M83	KSJC/TURKI..VKTRY1..KDFW	0.3	DEBBB..VKTRY1/1	OK																																																							
<input type="checkbox"/>			AAL2269/M83	KCOS/TURKI..VKTRY1..KDFW	7.4	DEBBB..VKTRY1	OK																																																							



DE GC MF DE GC FE KN BO MF FE KN BO KA SA FI BF MF KA SA FI BR	STATUS: Trial Planning	M83/Z 240	KDTW./..MCI051010..MCI..ICT..IRW..IBAKE..VKTRY1..KDFW
All Runways 1 All Runways 2 All Runways 3 All Runways	AAL2215		KDTW./..HITUG004198..ICT048133..HITUG021105..HITUG.SEEVR3..KDFW

HITUG 4.9	JOVEM3	AKXEE 7.1	Altitude
SSLID 6.0	CHML1	CHML1 6.5	
PLIZE 6.2	KLNDR2	FEVWV -2.3	
CHML1 6.5	PAWLZ3	HITUG 4.9	
JUSST 6.6	SEEV3	JHED -0.8	
SWTCH 6.7	SHAM2	PROMD 3.8	
		BRNET 5.6	

Send TNU Approve Unable Cancel Request Accept Reject



DRAW Trial Planning: DRAW List Activation

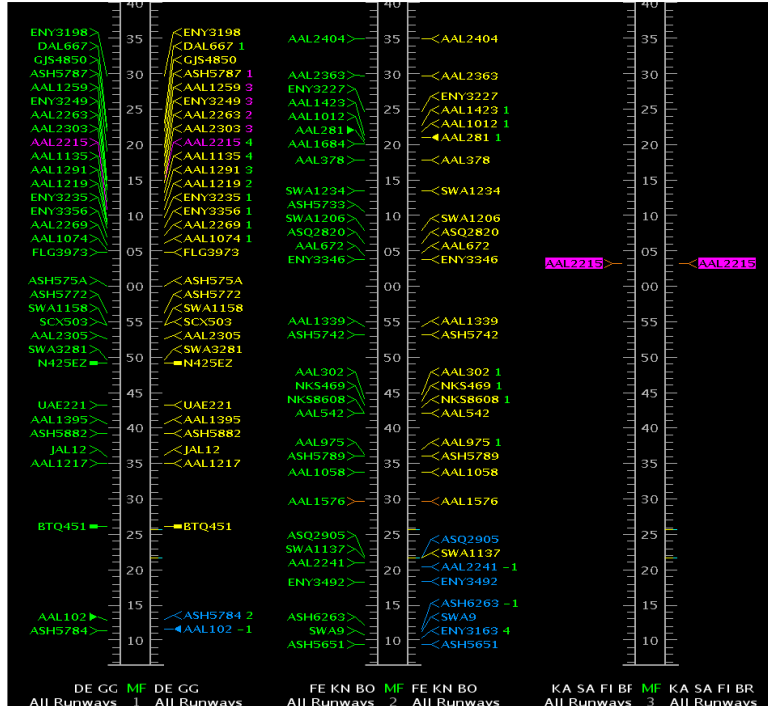
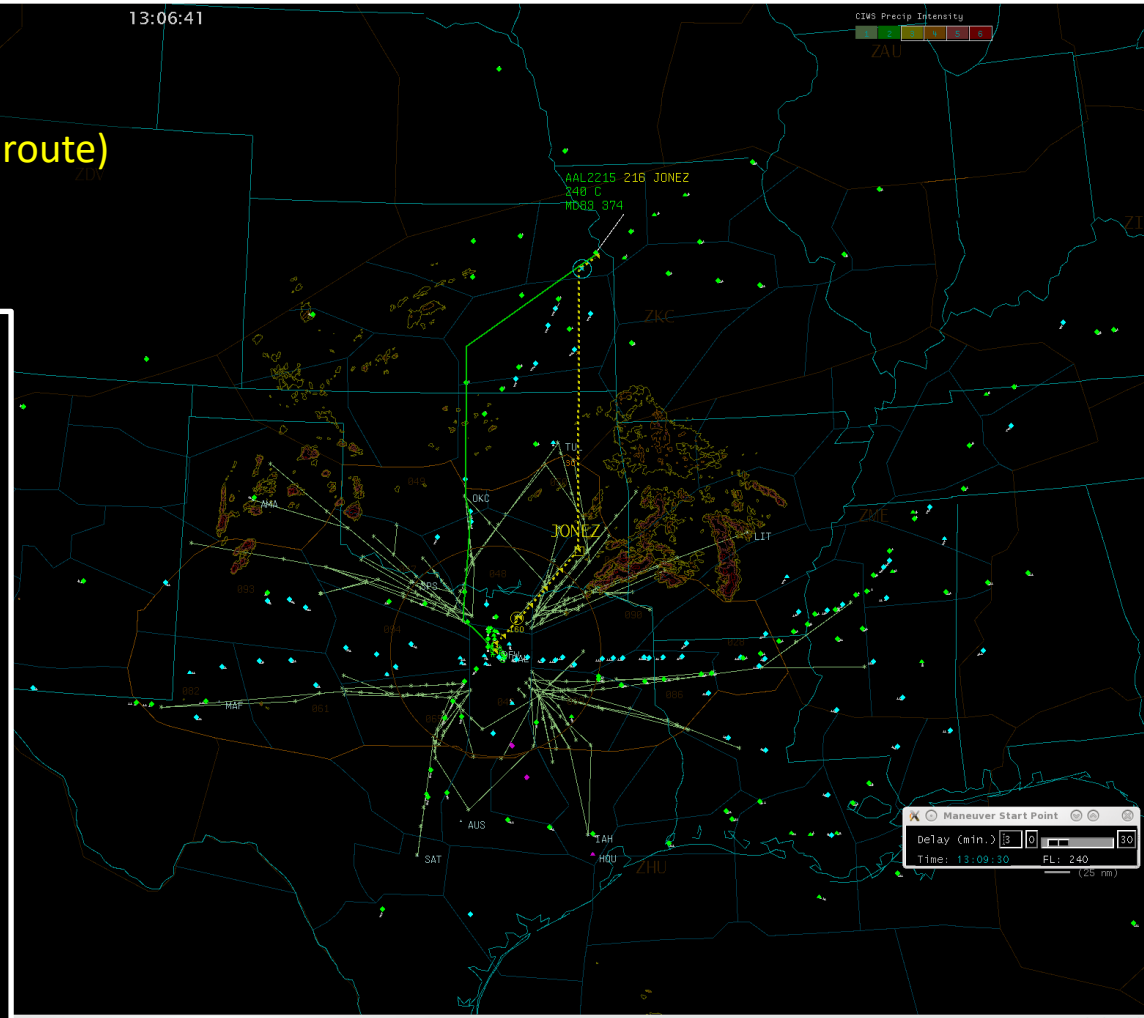
File Edit F-keys Panels Options Help DWR Alert Criteria: 5 min

13:06:41

DRAW Advisories

TL	GP	ACID/TYPE	DEP/TRAN.STAR_DEST	SAV	TRANS.STAR/AUX	STATUS
<input type="checkbox"/>		DEBBB GREGS				
<input type="checkbox"/>		SWA3281/B738	KMDW/HYDES..J.FRYE3..KDAL	6.2	AIRRE..CRIKT1	ALT
<input type="checkbox"/>		DAL667/A320	KMSP/HOFFF..VKTRY1..KDFW	6.4	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL1135/MD83	KDMS/HOFFF..VKTRY1..KDFW	5.8	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ENV3249/E145	KYPT/IBAKE..VKTRY1..KDFW	28.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		GJS4850/E145	KYPT/IBAKE..VKTRY1..KDFW	28.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ASH5787/E145	KYPT/IBAKE..VKTRY1..KDFW	28.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ASH5787/E145	KYPT/IBAKE..VKTRY1..KDFW	28.5	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL1259/MD82	CVYZ/IBAKE..VKTRY1..KDFW	8.8	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL2263/MD83	KCMH/IBAKE..VKTRY1..KDFW	12.4	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL2303/MD82	KORD/IBAKE..VKTRY1..KDFW	5.3	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL2215/MD83	KDTW/IBAKE..VKTRY1..KDFW	7.7	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ENV3235/E145	KBMT/IBAKE..VKTRY1..KDFW	8.3	JONEZ..CAINE2	ALT
<input type="checkbox"/>		AAL1074/MD83	KIND/IBAKE..VKTRY1..KDFW	11.0	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ENV3677/E145	KPIA/POTTY..VKTRY1..KDFW	26.8	JONEZ..CAINE2	ALT
<input type="checkbox"/>		ENV3249/E145	KGJT/TURKI..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/I	OK
<input type="checkbox"/>		AAL1219/MD83	KSLG/TURKI..VKTRY1..KDFW	0.3	DEBBB..VKTRY1/I	OK
<input type="checkbox"/>		AAL2269/MD83	KCOS/TURKI..VKTRY1..KDFW	7.3	DEBBB..VKTRY1	OK
<input type="checkbox"/>		FEVER ROOVR KNFA0				

DRAW List Activation (pre-defined route)



DE	CG	MF	DE	CG	MF	FE	KN	BO	MF	FE	KN	BO	MF	KA	SA	FI	BF	MF	KA	SA	FI	BR		
All	Runways	1	All	Runways	1	All	Runways	2	All	Runways	2	All	Runways	All	Runways	3	All	Runways	3	All	Runways	3	All	Runways

JONEZ	7.7	BRDJE3	Altitude	STATUS: Trial Planning
DRRTH	8.4	CABBY2		AAL2215 M83/Z 240 KDTW./..MC1051010..MCI..ICT..TRW..IBAKE..VKTRY1..KDFW
PRIZZ	8.8	CAINE2		
CAINE	9.2	COY8		
SASTE	9.4	DANGZ2		
		FINGRS		
		FORNV2		
				AAL2215 KDTW./..MC1232012..ICT048132..JONEZ..CAINE2..KDFW

Send TRN Approve Unavailable Cancel Request Accept Reject



DRAW Trial Planning: Multi-flight Trial Planning

File Edit F-Keys Panels Options Help DVR Alert Criteria: 5 min 13:07:06

DRAW Advisories

TL	TP	GP	ACID/TYP	DEP/TRAN.STAR.DEST	SAV	TRANS.STAR/AUX	STATUS
DEBBB	1	GREGS	1	KMDW/HYDES..JFREY3..KDAL	5.9	AIRRE..CRIKT1	ALT
DAL667/A320				KMSP/HOFFF..VKTRY1..KDFW	6.3	JONEZ..CAINE2	ALT
AAL1195/MDB3				KDSM/HOFFF..VKTRY1..KDFW	5.7	JONEZ..CAINE2	ALT
ENY3407/E145				KCMH/IBAKE..VKTRY1..KDFW	28.5	JONEZ..CAINE2	ALT
GJS4850/CRJ7				KORD/IBAKE..VKTRY1..KDFW	6.3	JONEZ..CAINE2	ALT
ASH5787/CRJ				KSDF/IBAKE..VKTRY1..KDFW	14.1	JONEZ..CAINE2	ALT
AAL1259/MDB				CYYZ/IBAKE..VKTRY1..KDFW	8.7	JONEZ..CAINE2	ALT
AAL2263/MDB				KCMH/IBAKE..VKTRY1..KDFW	12.2	JONEZ..CAINE2	ALT
AAL2303/MDB				KORD/IBAKE..VKTRY1..KDFW	5.3	JONEZ..CAINE2	ALT
AAL2215/MDB				KDTW/IBAKE..VKTRY1..KDFW	7.5	JONEZ..CAINE2	ALT
ENY3235/E14				KBMI/IBAKE..VKTRY1..KDFW	8.2	JONEZ..CAINE2	ALT
AAL1074/MDB				KIND/IBAKE..VKTRY1..KDFW	10.9	JONEZ..CAINE2	ALT
ENY3677/E145				KPIA/POTTY..VKTRY1..KDFW	26.7	JONEZ..CAINE2	ALT
ENY3249/E145				KGJT/TURK1..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/1	OK
AAL1219/MDB3				KSLG/TURK1..VKTRY1..KDFW	2.7	DEBBB..VKTRY1/1	OK
AAL2269/MDB3				KCOS/TURK1..VKTRY1..KDFW	7.2	DEBBB..VKTRY1	OK

Multi-Flight Trial Plan Status

TP	ACID/TYP	DEP/DST	SAV	FIX/AUX	TR SC	WX	TMI	RM
AAL2215/MDB3	KDTW/KDFW	7.5	JONEZ	OK	OK			
AAL1074/MDB3	KIND/KDFW	10.9	JONEZ	OK	OK			
ENY3235/E145	KBMI/KDFW	8.2	JONEZ	OK	OK			
AAL2303/MDB2	KORD/KDFW	5.3	JONEZ	OK	OK			
AAL2263/MDB3	KCMH/KDFW	12.2	JONEZ	OK	OK			
AAL1259/MDB2	CYYZ/KDFW	8.7	JONEZ	OK	OK			
ASH5787/CRJ9	KSDF/KDFW	14.1	JONEZ	OK	OK			

DE GC MF DE GC FE KN BO MF FE KN BO KA SA FI BF MF KA SA FI BR

All Runways 1 All Runways 2 All Runways 3 All Runways

JONEZ 7.5	BRDJE3	Altitude	STATUS: Trial Planning	
DRRTH 8.2	CABBY2		AAL2215	MDB3/Z 240 KDTW./..MC1051010..MCI..ICT..IRW..IBAKE..VKTRY1..KDFW
PRIZZ 8.7	COVS		AAL2215	KDTW./..MC1231016..ICT048129..JONEZ..CAINE2..KDFW
CAINE 9.3	DANC22			
SASIE	FINGRS			
	FORYN2			

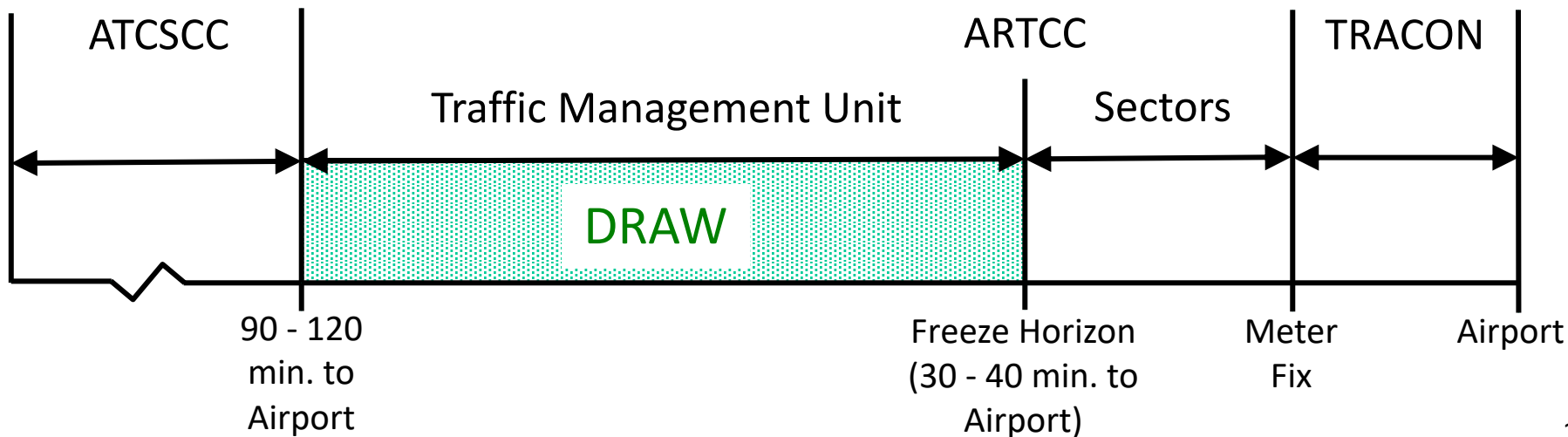
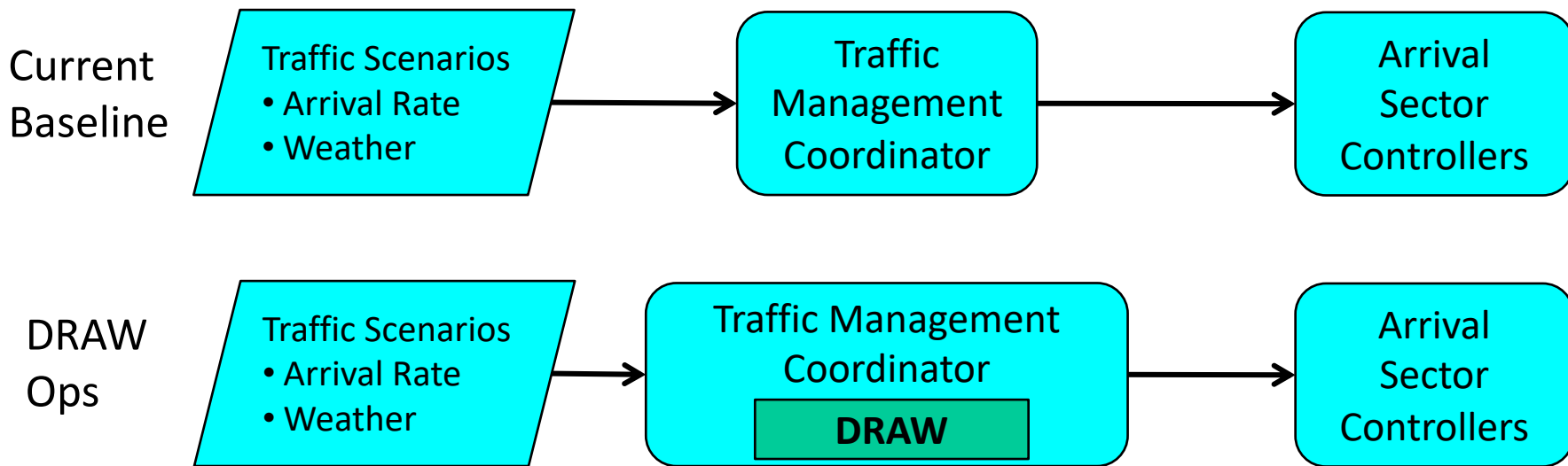
Send TNU Approve Unavailable Cancel Request Accept Reject



Scenario Walk-Throughs and ConOps Discussion

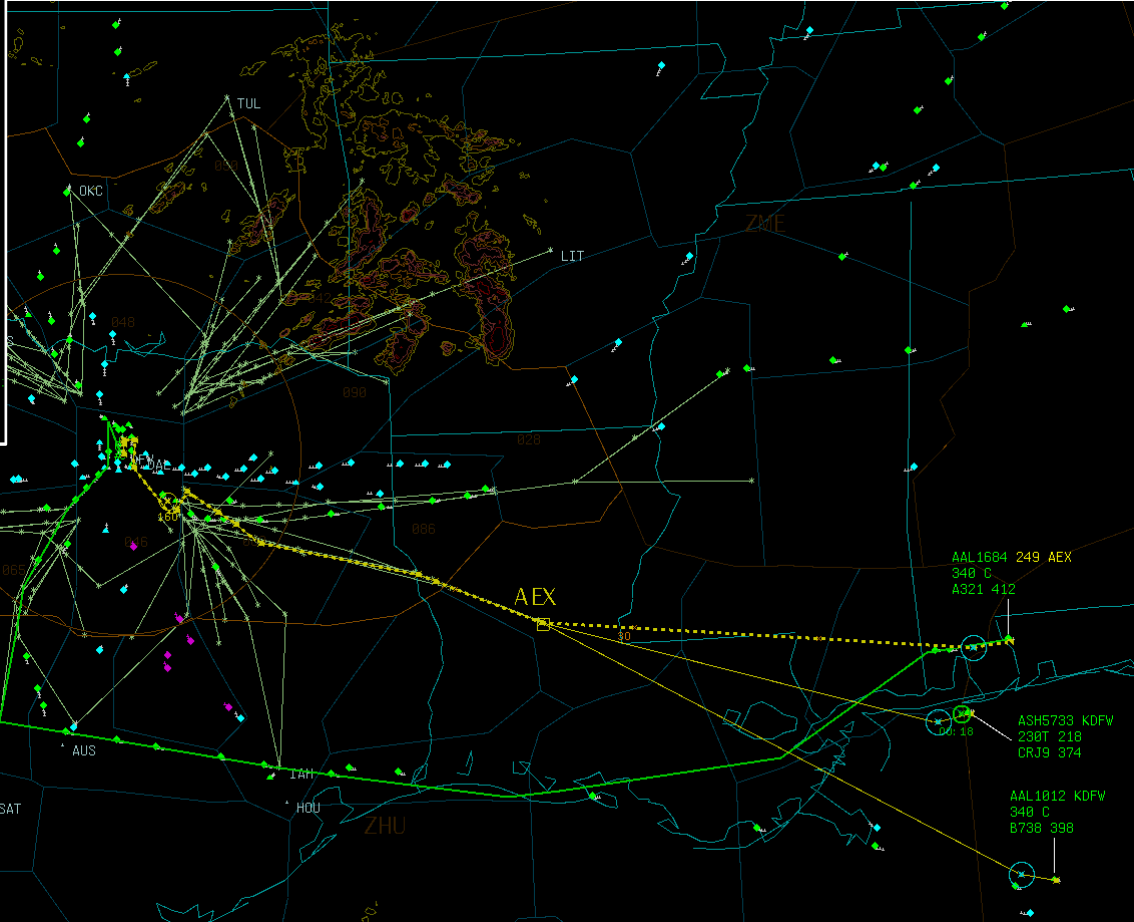
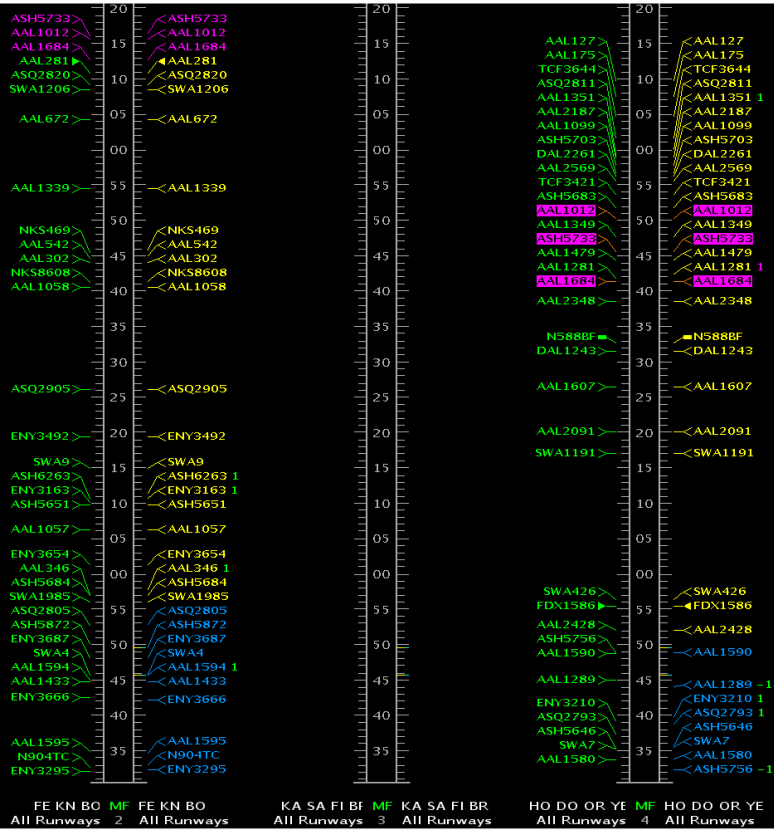


DRAW Simulation Design



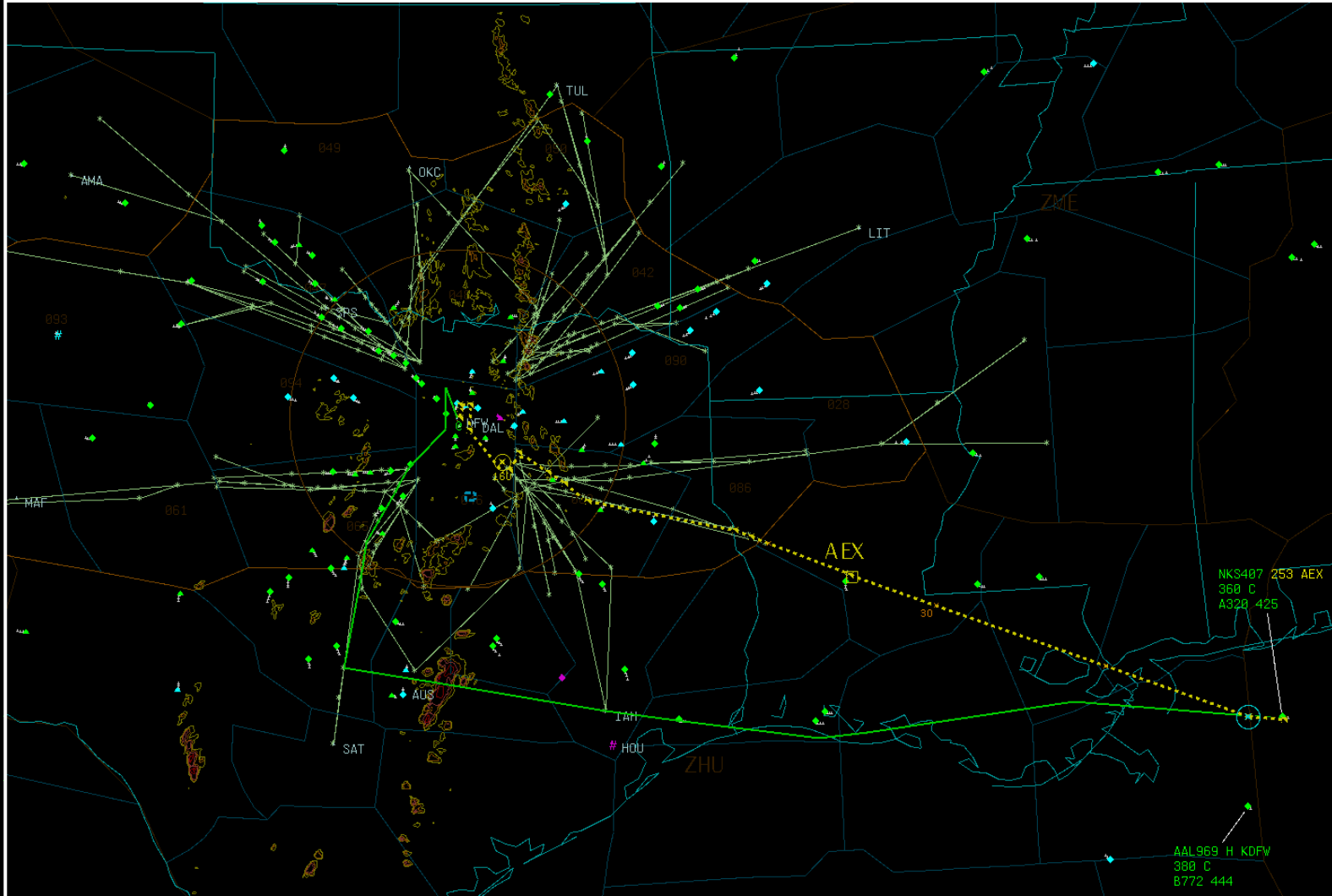
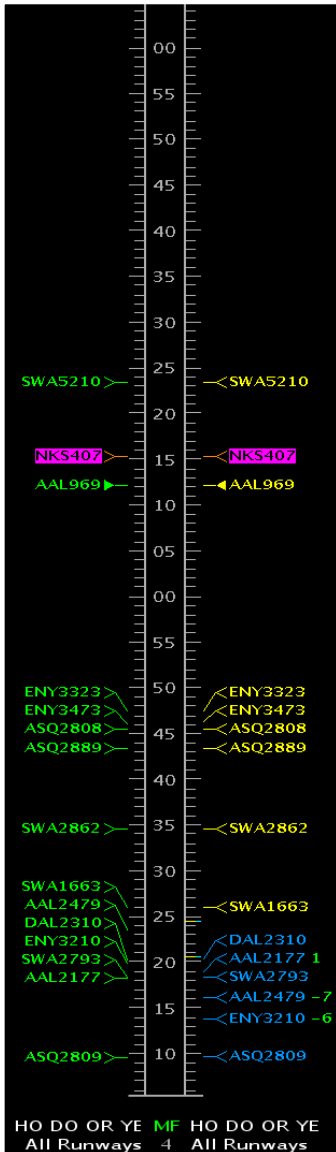


Weather Farther North Than Expected



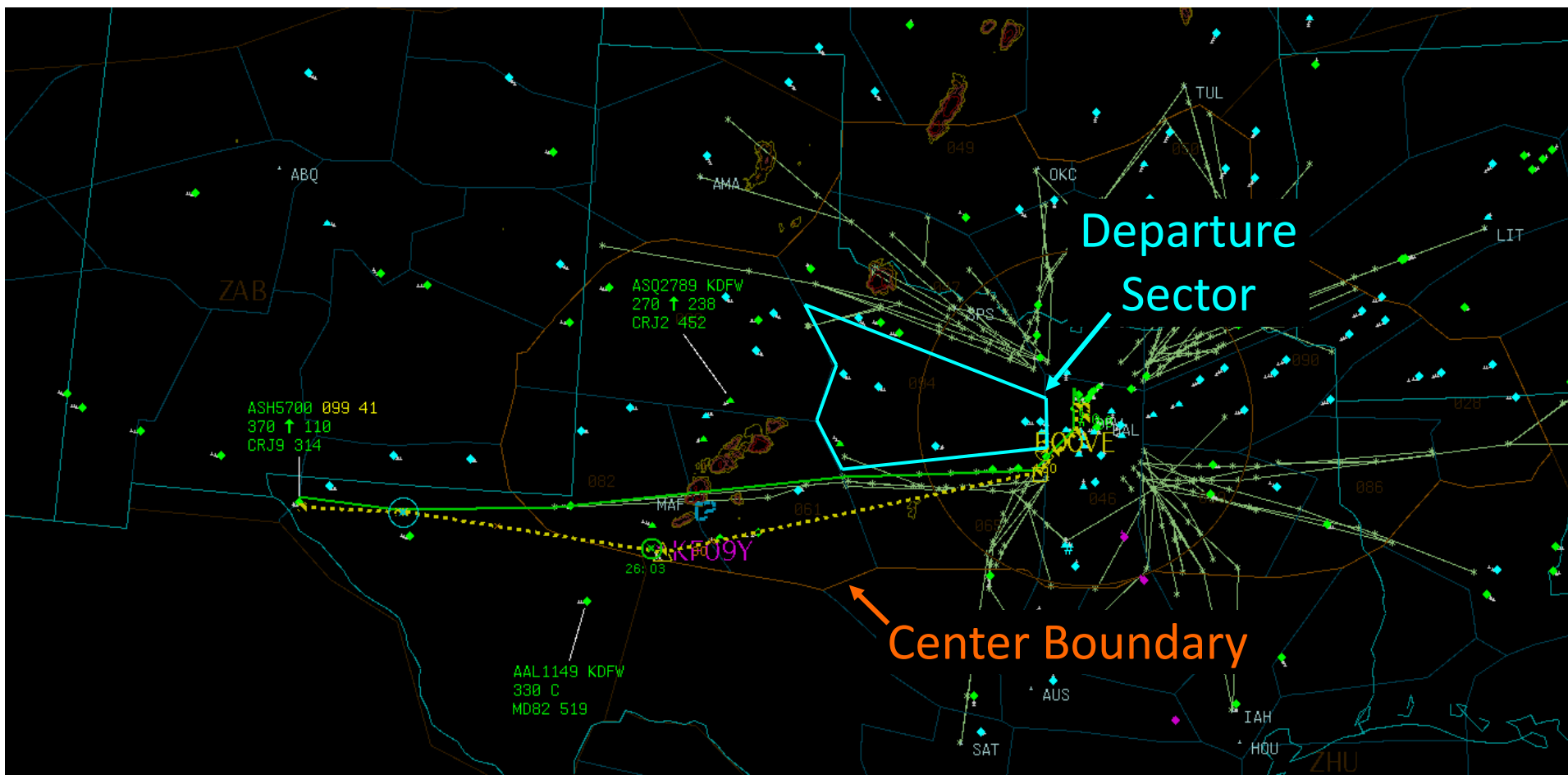


Scattered Weather



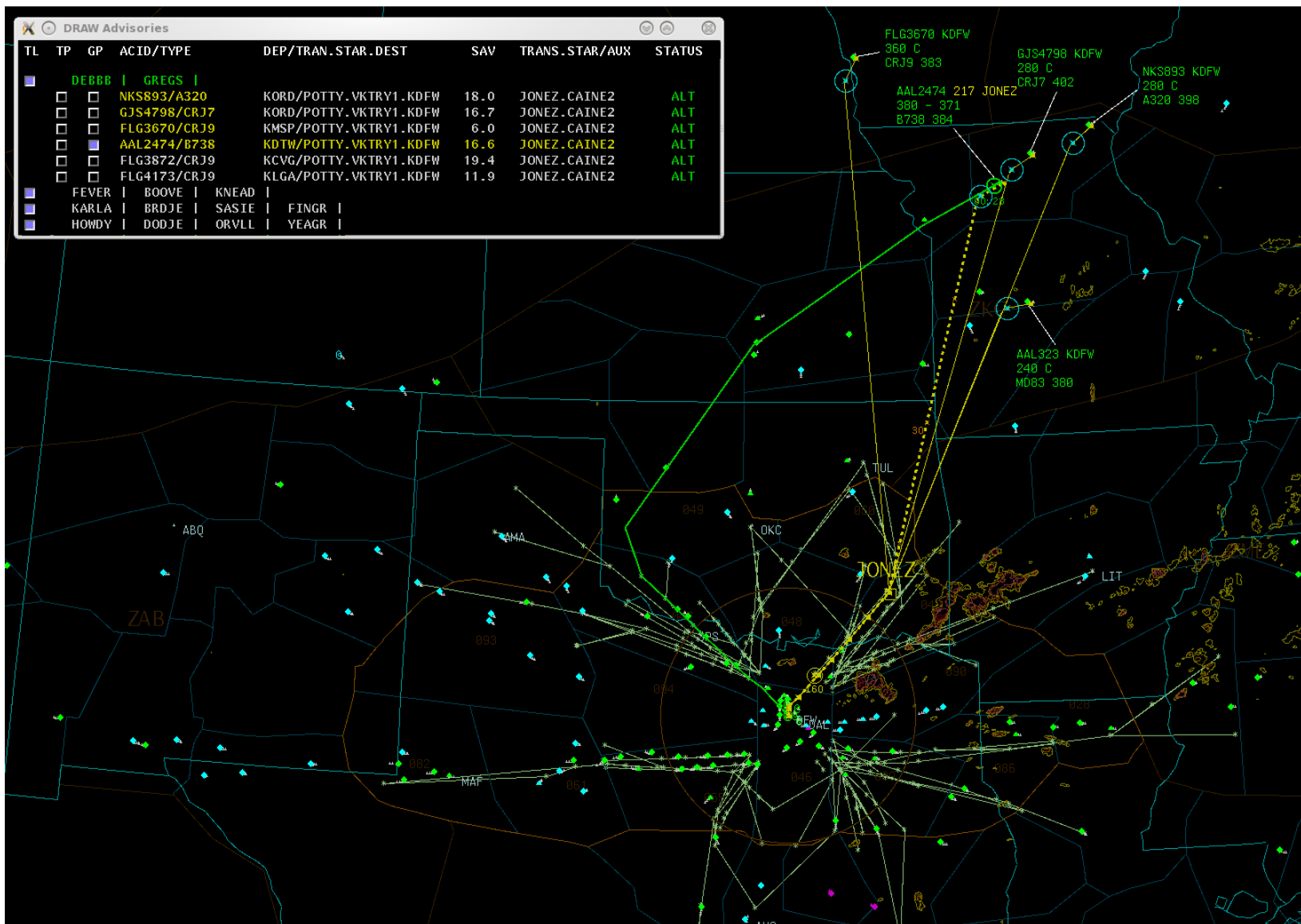


Weather in Arrival Sector





Returning to Normal: "Exit Strategy"





DRAW

Dynamic Routes for Arrival in Weather

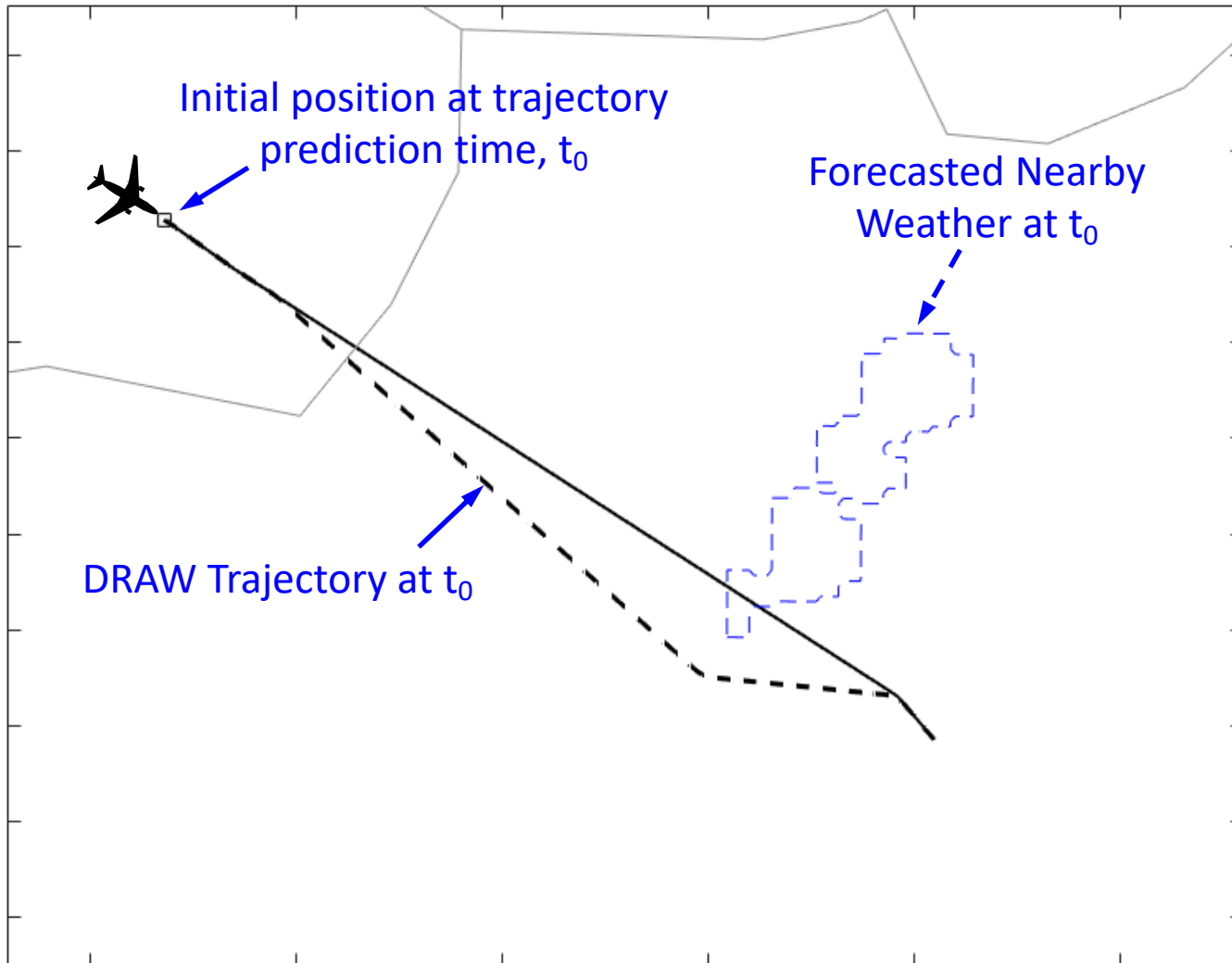
Chester.Gong@nasa.gov



Backups



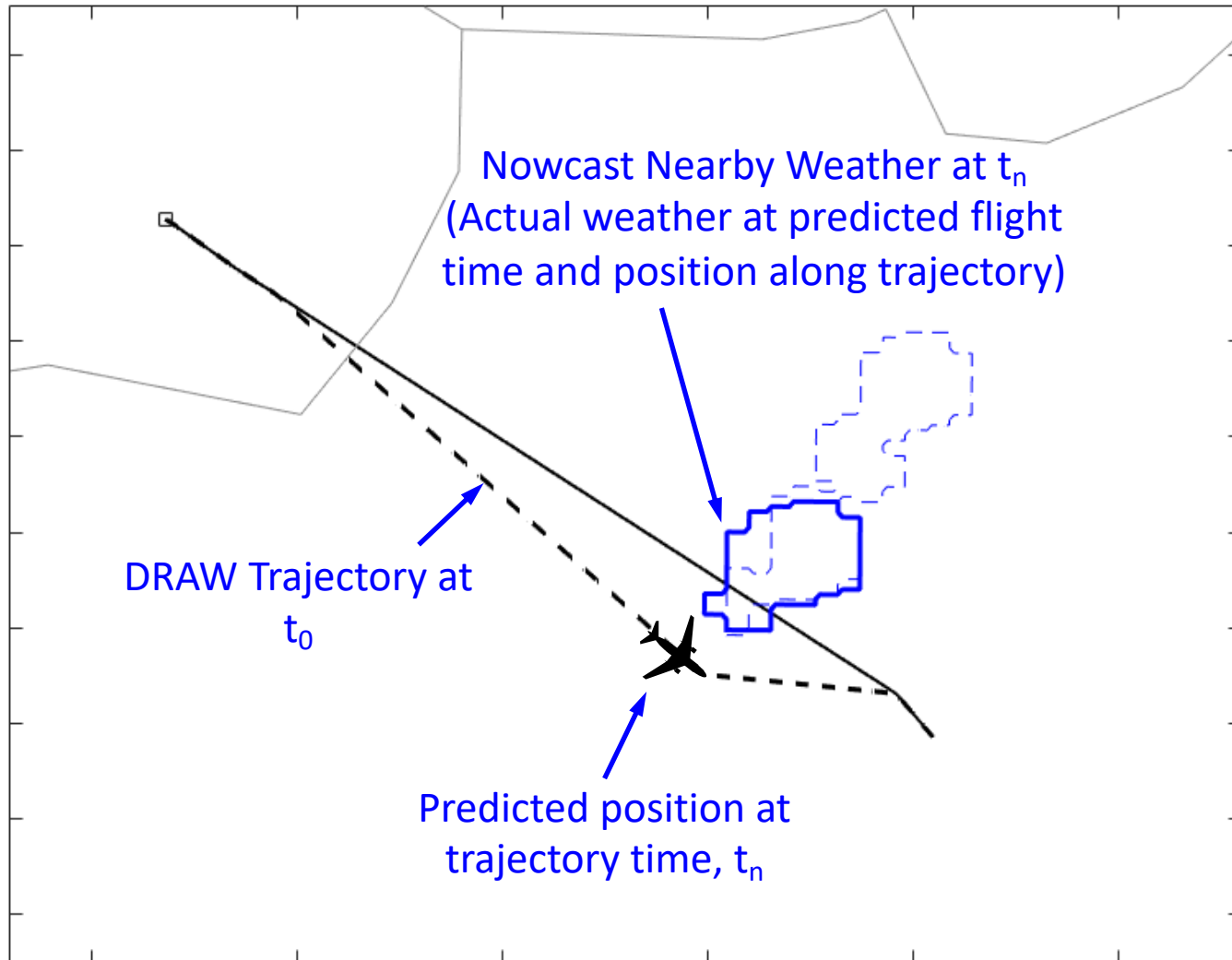
How well does DRAW Avoid Forecasted Weather? Forecasted Conditions





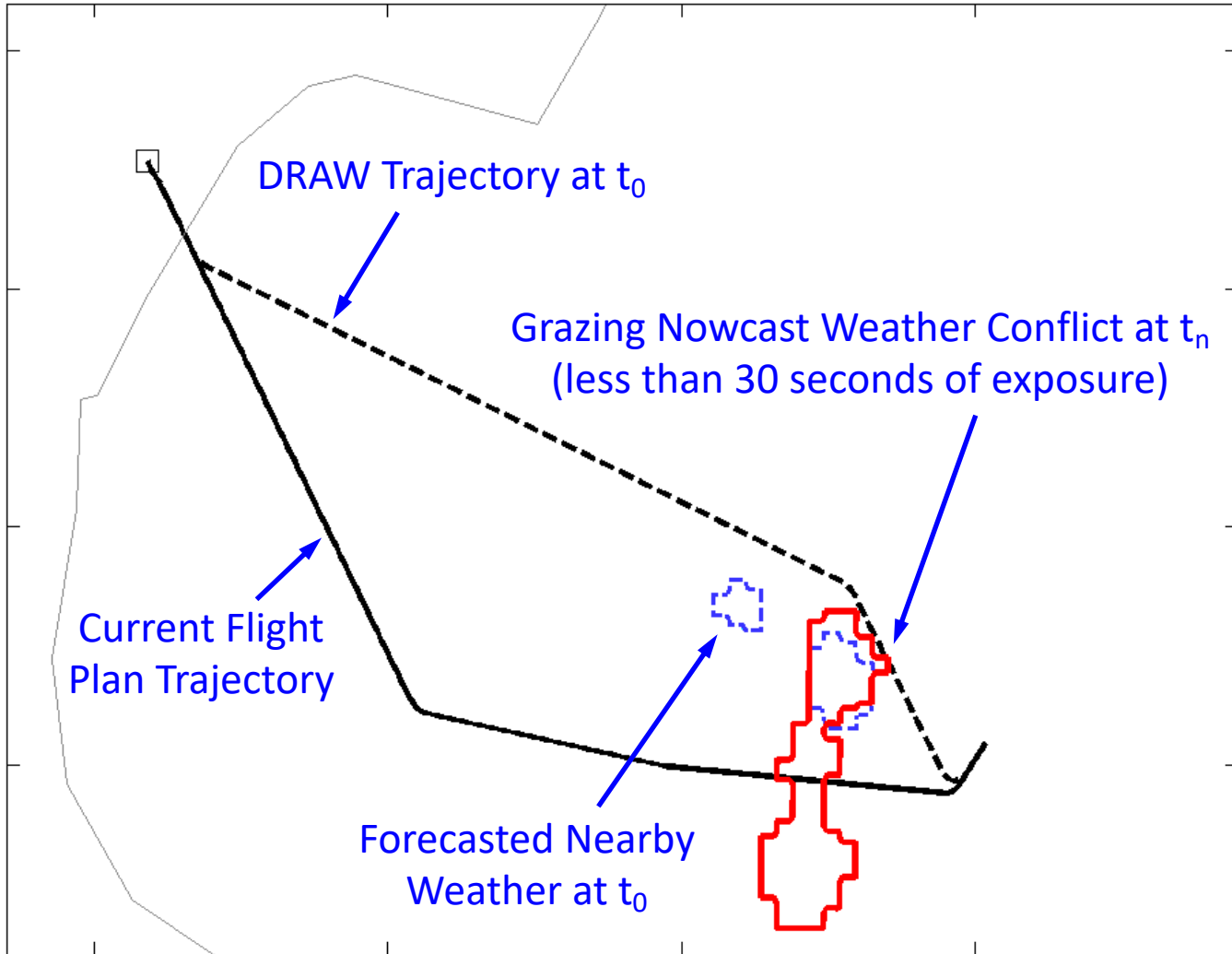
How well does DRAW Avoid Forecasted Weather?

Nowcast Weather Analysis



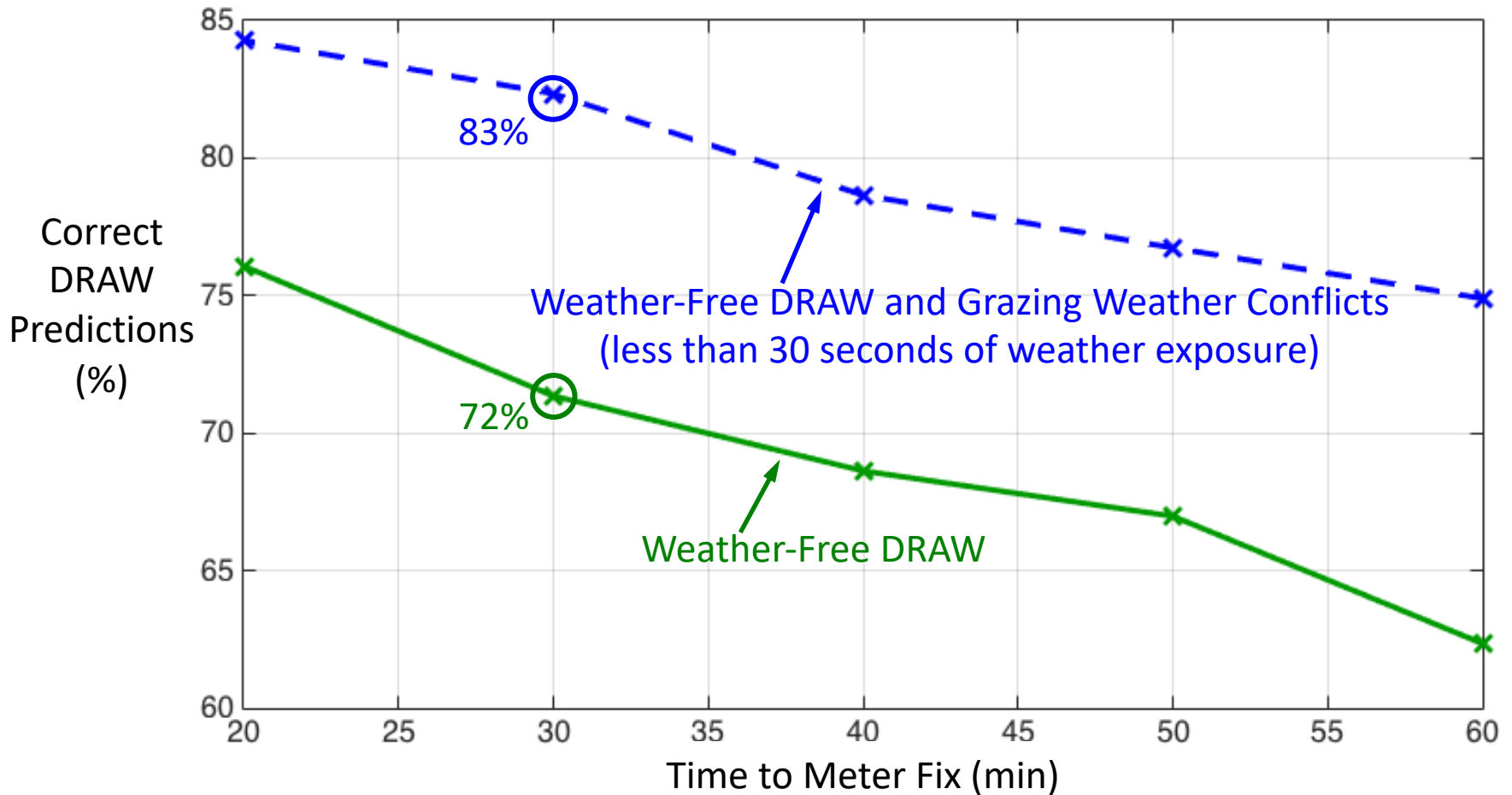


Example of Grazing Weather Conflict



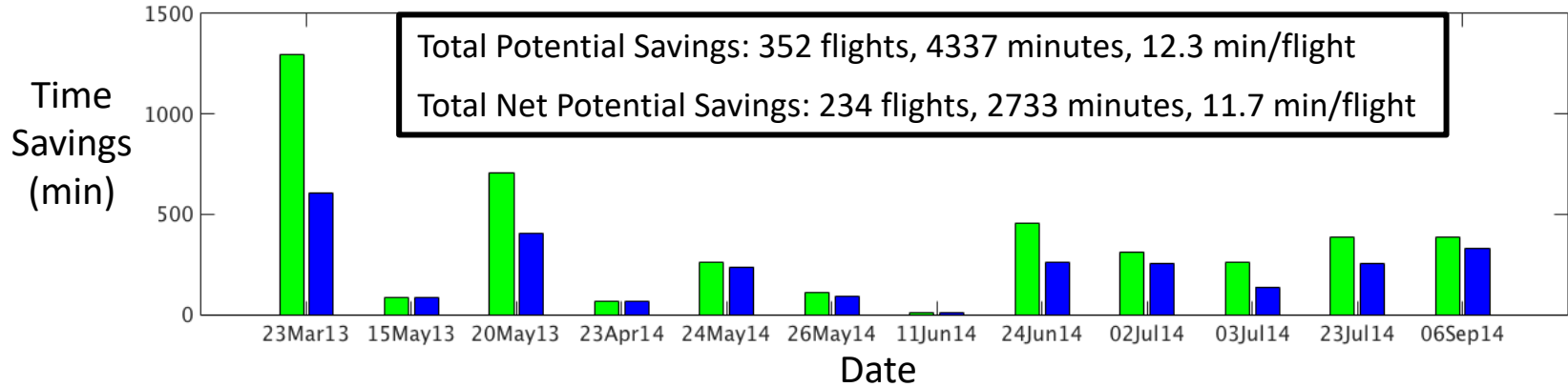
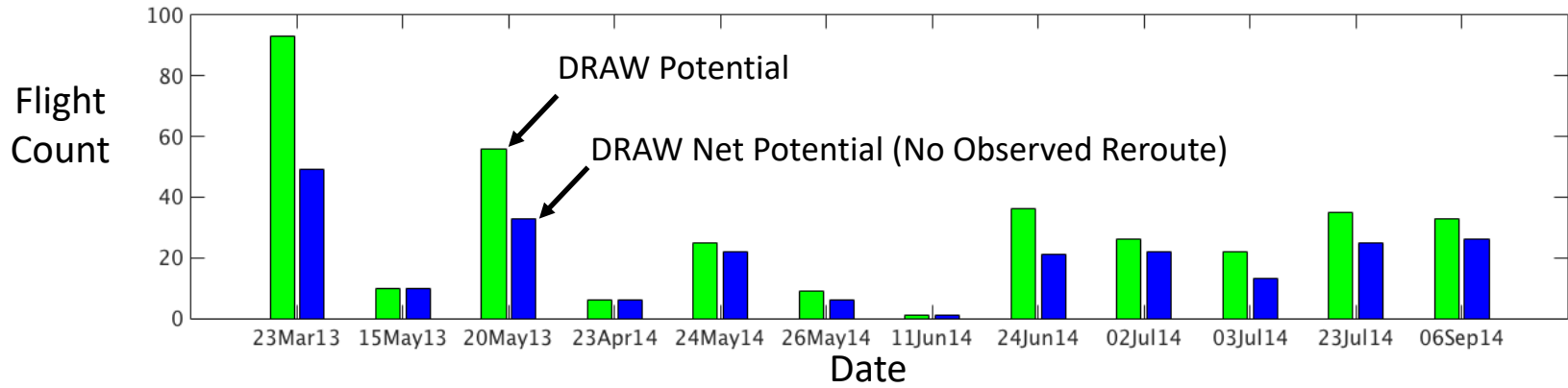


Nowcast Weather Analysis Results (Fort Worth Center, 12 Days, 93 Hours)





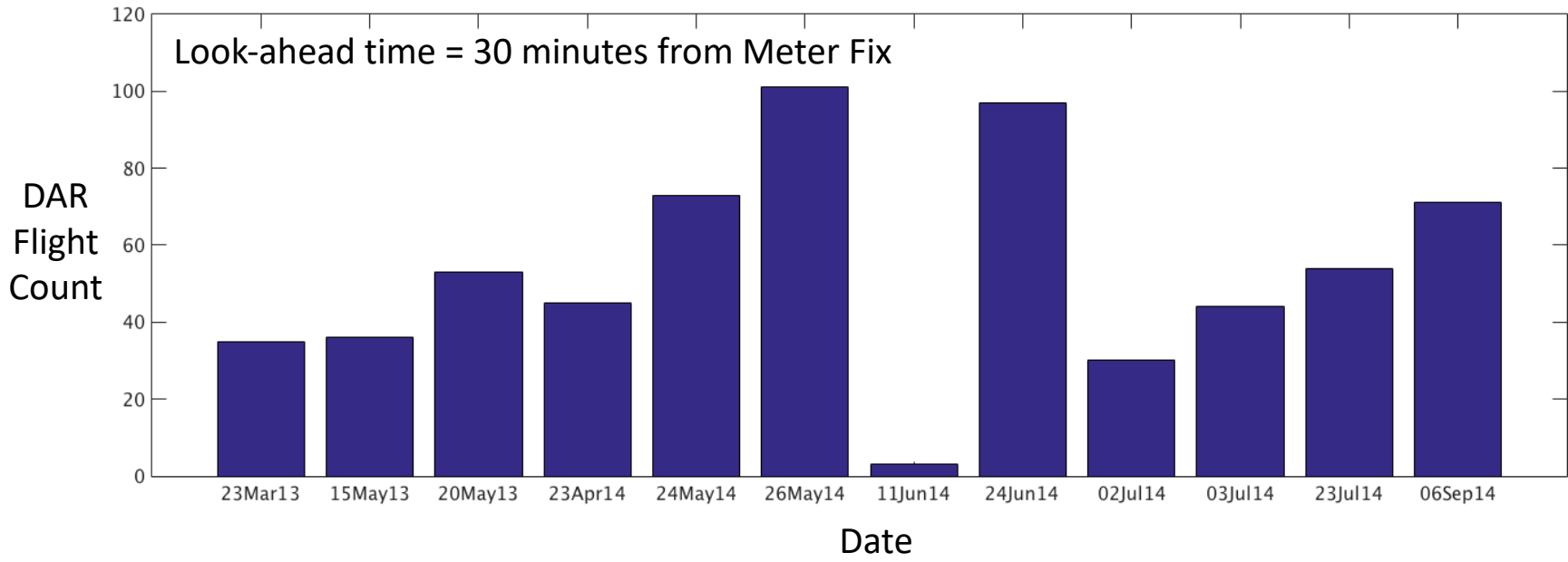
DRAW Time Savings Summary (Fort Worth Center, 12 Days, 93 Hours)



DRAW time saving reroutes worth 12 minutes per flight



DRAW Summary: Weather Adjusted Routes (Fort Worth Center, 12 Days, 93 Hours)



642 flights in need of weather adjusted times of arrival



Off Nominal: Airport Closed By Weather

