

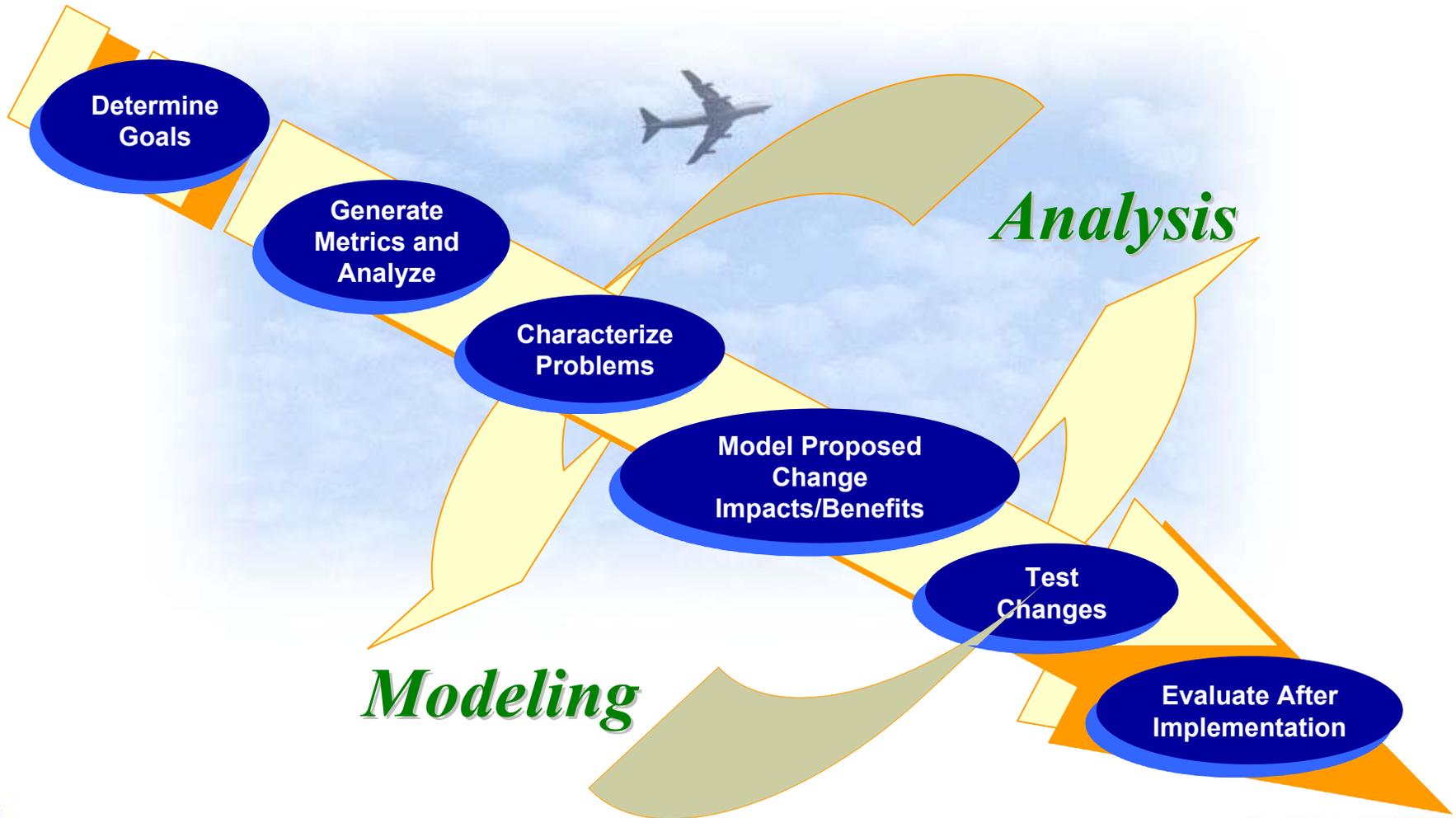
A decorative graphic on the left side of the slide shows a portion of a globe with a grid of latitude and longitude lines. A white flight path with a small airplane icon at the end curves across the top of the globe. The background is a light blue sky with soft white clouds.

CAASD En Route/TFM/Airspace Modeling and Analysis

Dr. Bradley Hargroves

12 March 2003

Modeling and System Performance Analysis are Intertwined



CAASD Metric Development Activities are Driven by En Route and TFM Goals

Determine
Goals

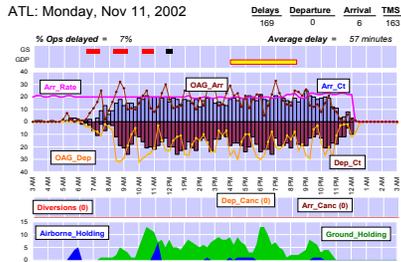
- ***Balance among:***
 - Reducing difference between route flown versus filed route or routing defined by Strategic Plan of Operations/severe weather advisories/pref route
 - Maintaining high airspace utilization relative to demand and capacity
 - Reducing unnecessary restrictions by:
 - Reducing instances that capacity limited airports are over restricted
 - Reducing restrictions on flows to/from airports that are not capacity limited
 - Reducing volume restrictions on flows to sectors or routes that are not capacity limited
 - Reducing passback restrictions
 - Reducing difference between altitude desired versus altitude flown
 - Reducing Ground Stop/Ground Delay Program delay minutes for en route issues

Balance determined by impact on system measures:

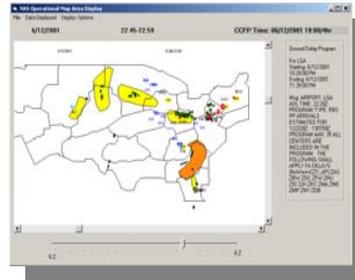
Delays, cancellations, diversions, equity, user benefits, etc.

Improving Metrics, Data Sources, and Knowledge Base

Generate Metrics and Analyze



Integrated Airport Data

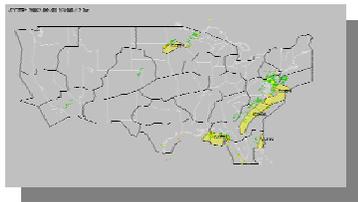


Integrated NAS Operational Data

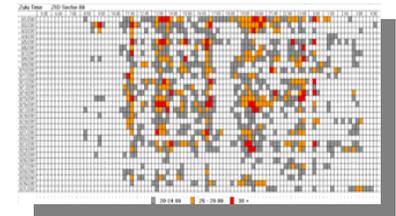


TFM Advisories

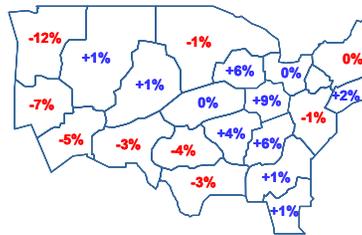
Data Produced and Archived Daily for Analysis, Model Input, and Validation



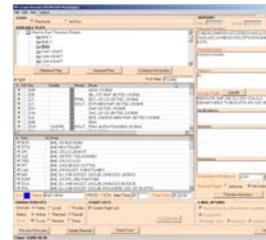
Wx Archiving and Visualizaton



Sector Loading



OPSNET and ASPM Improvements



Reroutes

Airport Specific Analysis Page (ASAP)

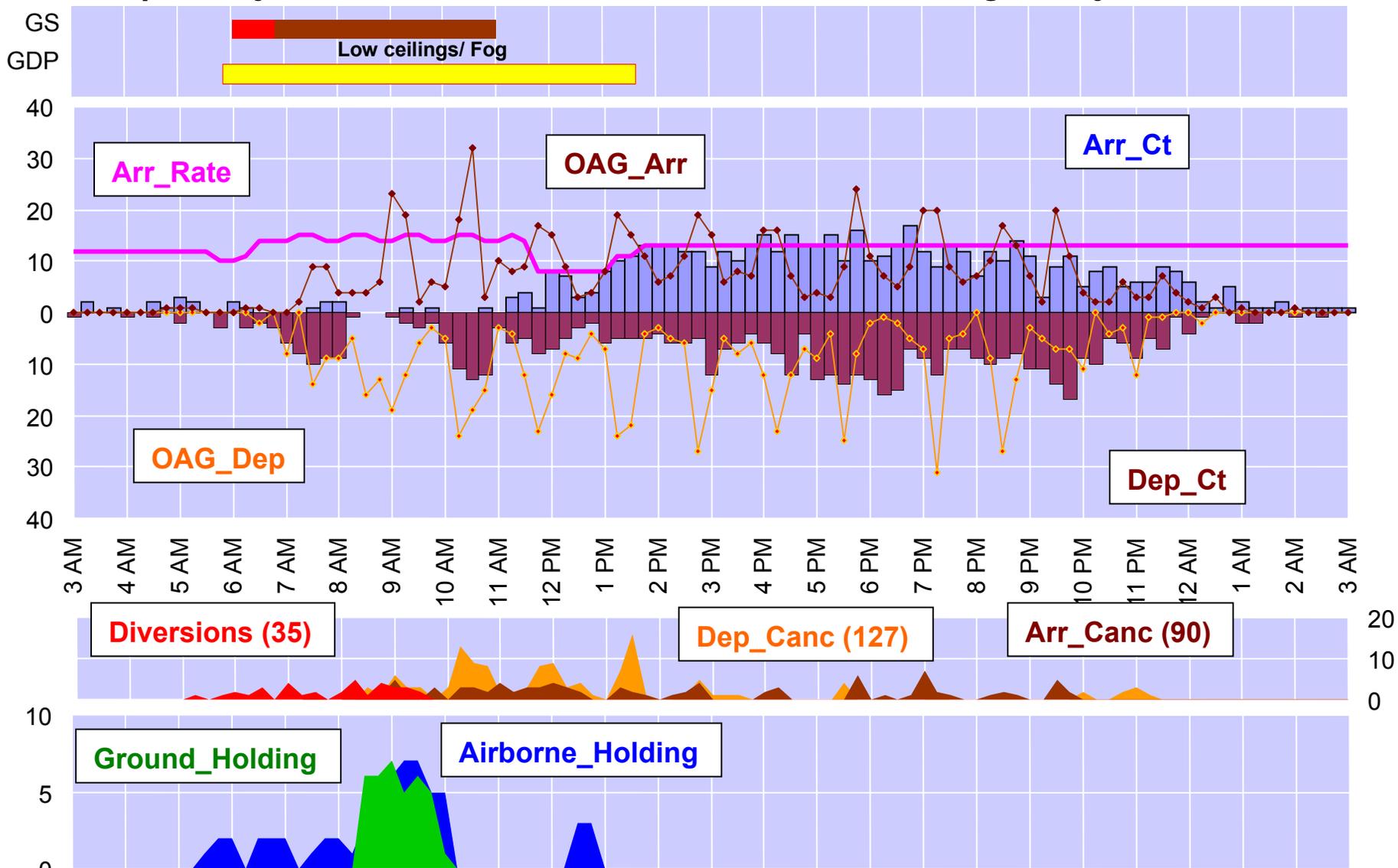
PHX: Thursday, Jan 09, 2003

Delays Departure Arrival TMS

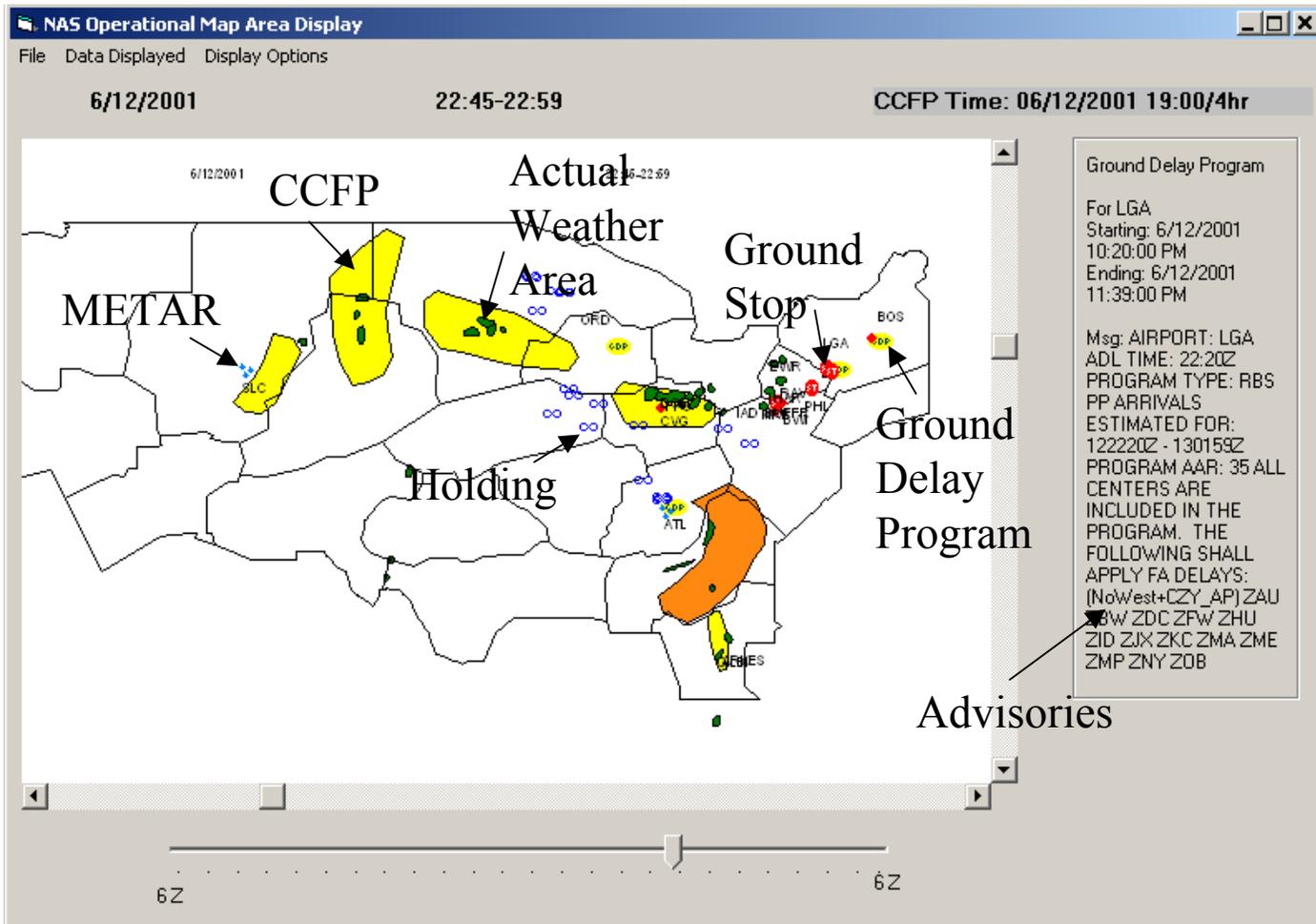
192 37 7 148

% Ops delayed = 15%

Average delay = 139 minutes

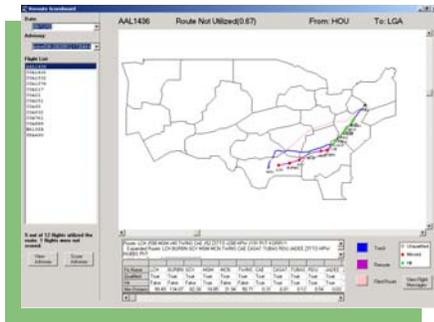


Animated Integrated Data Analysis: NAS Operational Map Display (NOMAD)



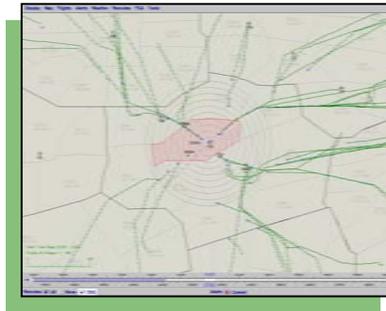
Problem Characterization Using Multiple Models and Techniques

Route Usage Tools, CAPER, SDAT, POET



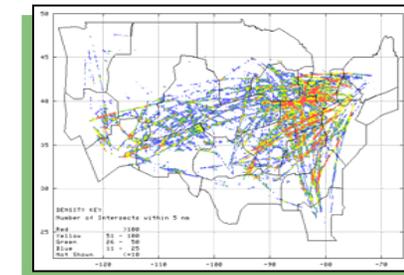
Routing

CAPER, HAME Tools, POET



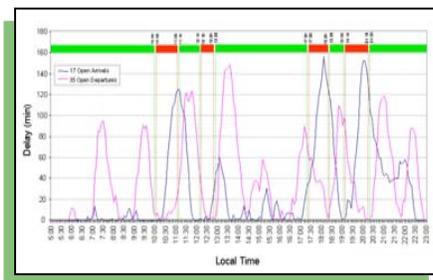
Demand/Capacity

IDAT, SDAT, CAPER



Intersections/Conflicts

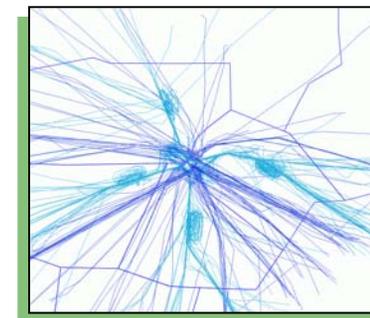
OPSNET, ASPM, ASQP



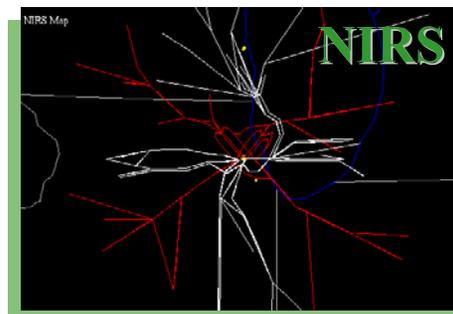
Delays

Results are cross checked using multiple models and techniques

MapInfo, ArcView, SDAT



Holding and Diversions



Noise

Route Utilization: Visualization

Aircraft Id **Utilization Score** **Departure Airport** **Arrival Airport**

Date: 08/12/02
 Advisory: Advn038-20020812-172044-6

Flight List:
 AAL1436
 COA1432
 COA1532
 COA1576
 COA217
 COA22
 COA251
 COA50
 COA532
 COA761
 COA889
 N615SR
 USA450

5 out of 12 flights utilized the route. 1 flights were not scored.

View Advisory Score Advisory

AAL1436 Route Not Utilized(0.67) From: HOU To: LGA

Route: LCH J590 MGM J40 TWINS CAE J52 ZITTO J208 HPW J191 PXT KORRY1
 Expanded Route: LCH BURBN GCV MGM MCN TWINS CAE CASAT TUBAS RDU JADEE ZITTO HPW HUBBS PXT KORRY1

Fix Name	LCH	BURBN	GCV	MGM	MCN	TWINS	CAE	CASAT	TUBAS	RDU	JADEE
Qualified	True	True	True	True	True	True	True	True	True	True	True
Hit	False	False	False	True	False	False	True	True	True	True	True
Min Distance	99.49	134.07	82.28	18.85	31.94	50.71	0.31	0.01	0.12	0.54	0.00

Track Unqualified
 Reroute Missed
 Filed Route Hit

View Flight Messages

Eligible Flights

Scoring Summary

Filed Route

Actual Track

Advisory Reroute

Missed Fix

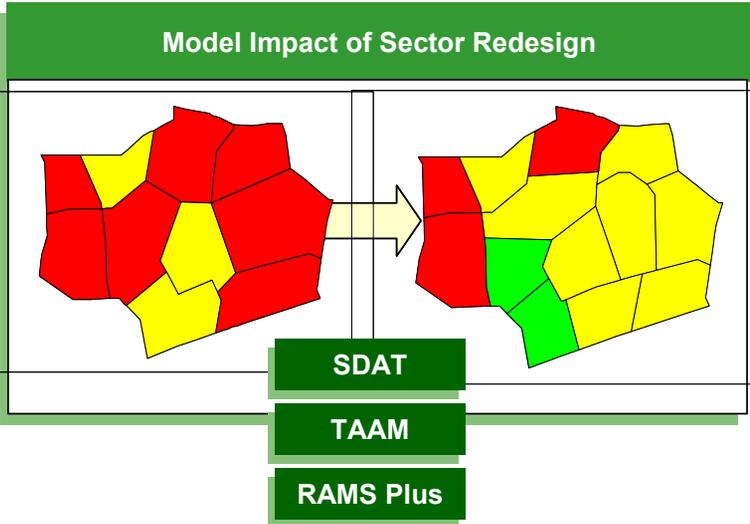
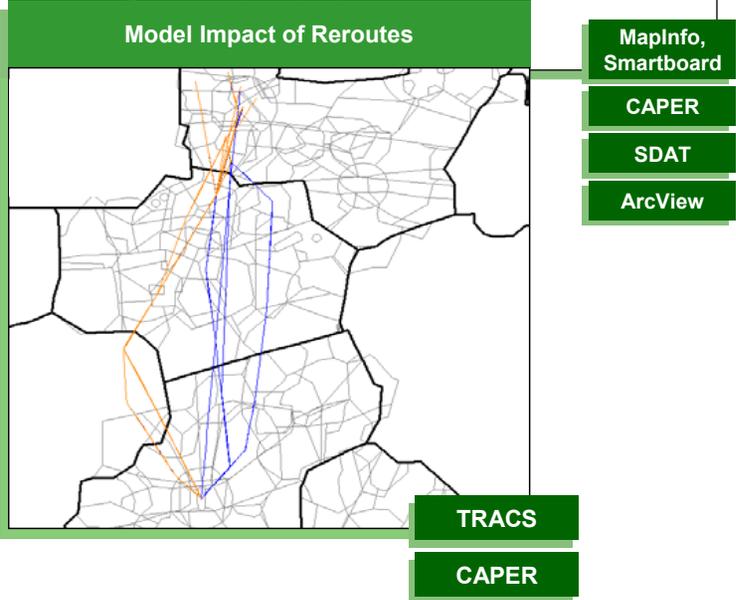
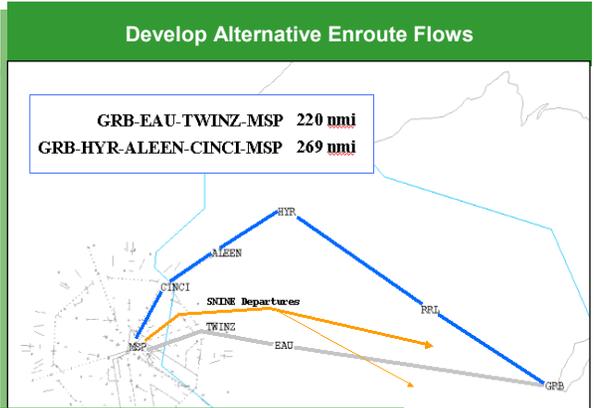
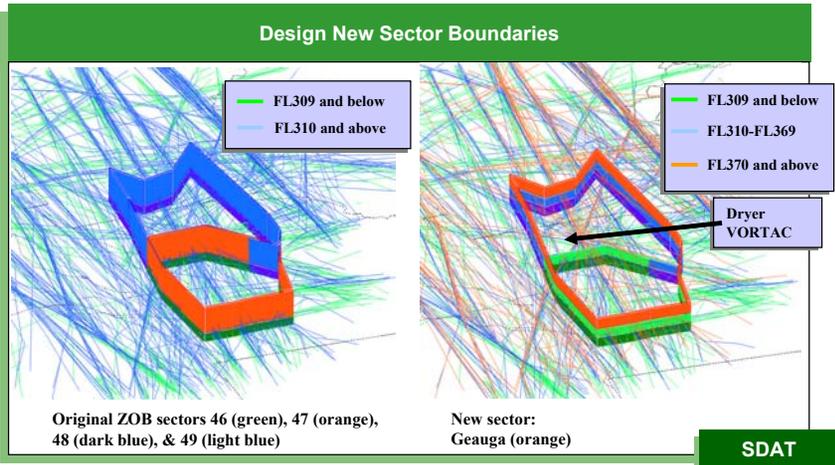
Hit Fix

Fix Scoring Matrix

Route Info Messages

Solution Development

Model Proposed
Change
Impacts/Benefits



Analysis and Modeling for Procedure and Requirement Development

Test Changes

View Simulated Traffic

SDAT Viewer
TAAM Viewer

TARGETS
GRADE
RAPTOR

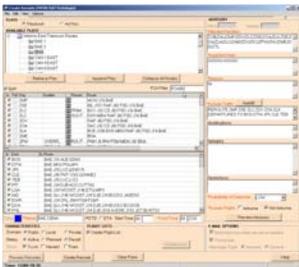
Interact With Simulated Traffic

ATC HIL Simulators
Flight Simulators
AT Coach
URET

Prototype Evaluations in Field



URET



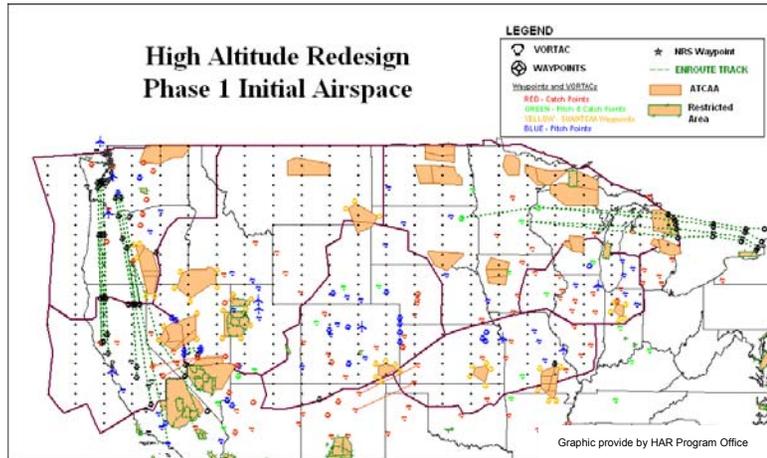
RAT



CRCT

High Altitude Redesign Modeling Example

Test Changes



**Advanced
Controller
Validation**

Controller Metrics:

- Number of conflicts
- Aircraft counts over specific points
- Counts of participating and non-participating aircraft
- Throughput for specific sectors
- Aircraft distribution (# of a/c at each altitude)

**Reroute
Modeling**

User Metrics:

- En route time and distance

Human In the Loop Validation: Multi-Center Airspace Redesign

Test
Changes

- Scenarios from seven en route centers
- Used to evaluate workability of new design concepts



Effective human-in-the-loop simulation



Simulated pilots

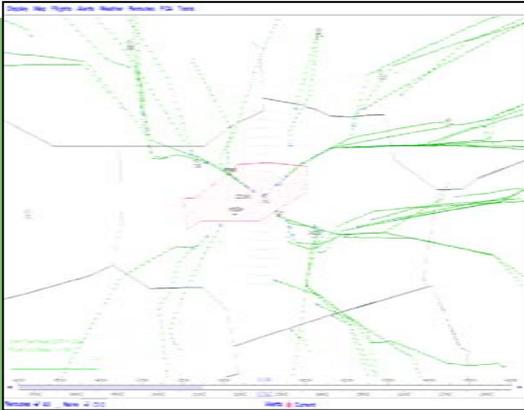


Specialized facilities for briefings, observation, and structured evaluation

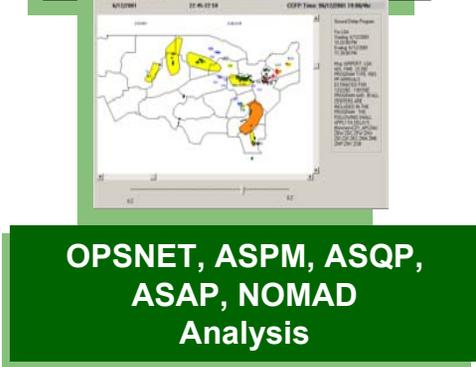
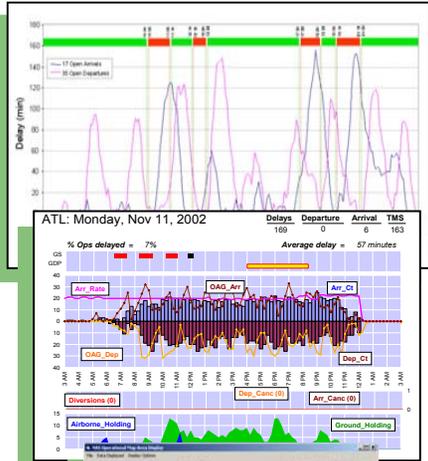
Post Implementation Benefits Analysis

Evaluate After Implementation

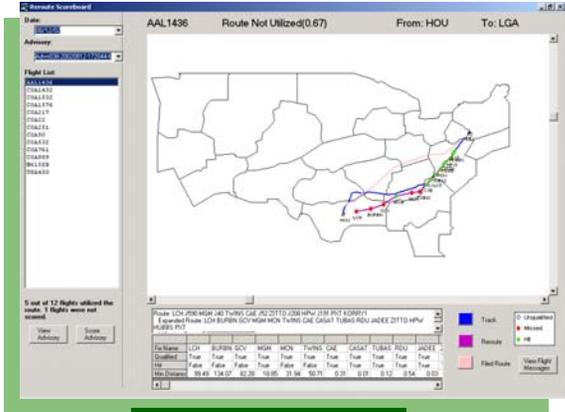
Evaluate Impacts



CAPER
POET
SDAT



OPSNET, ASPM, ASQP,
ASAP, NOMAD
Analysis



Route Usage
Tool
ArcView
MapInfo