



# Air Traffic Management Research at NASA

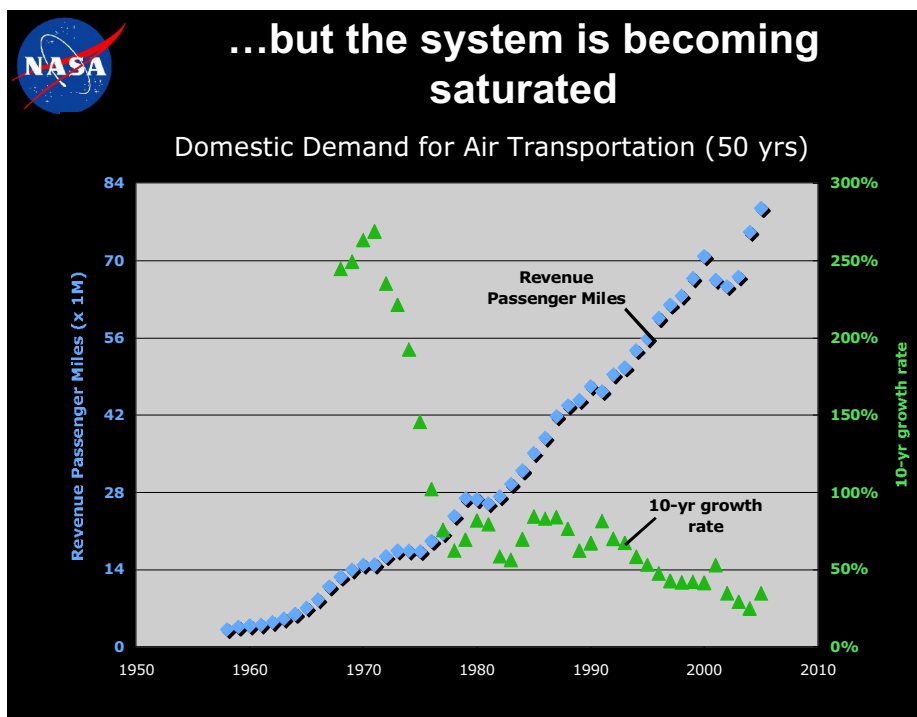
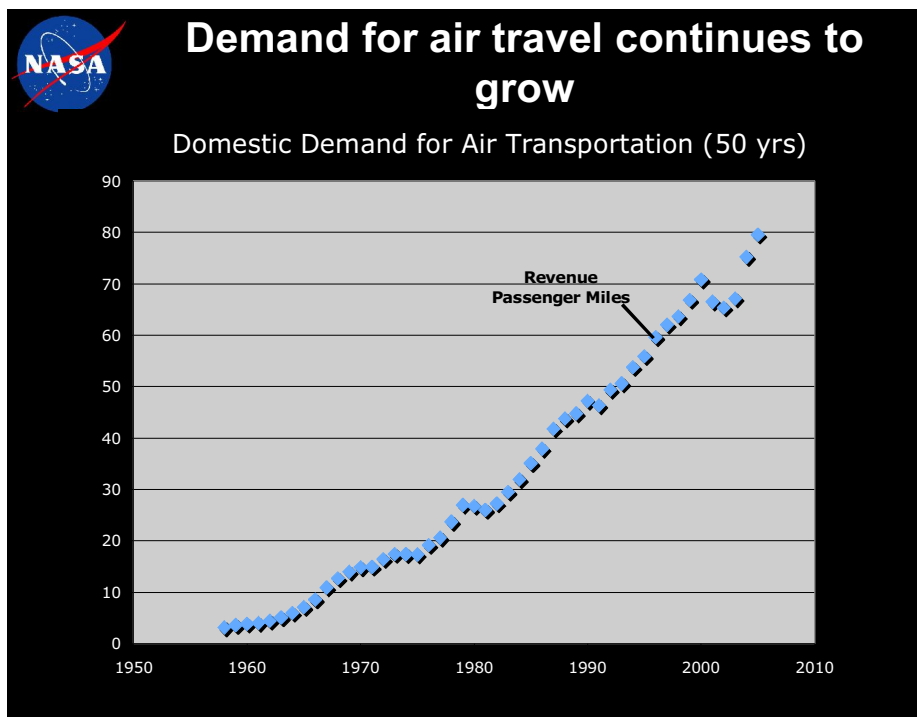
Todd Farley  
Chief, Flight Trajectory Dynamics & Controls Branch  
NASA Ames Research Center

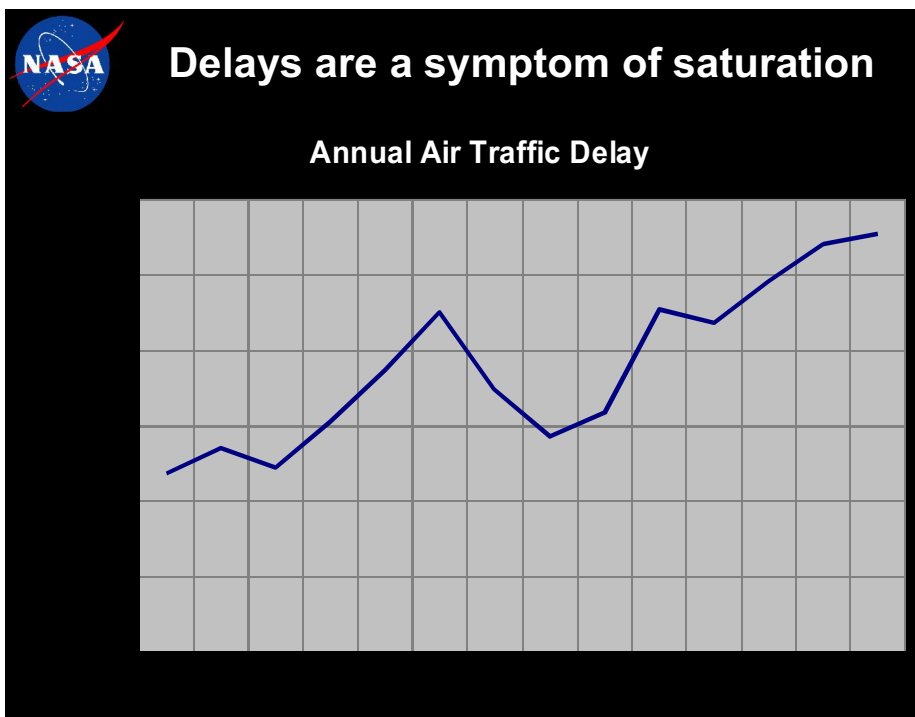


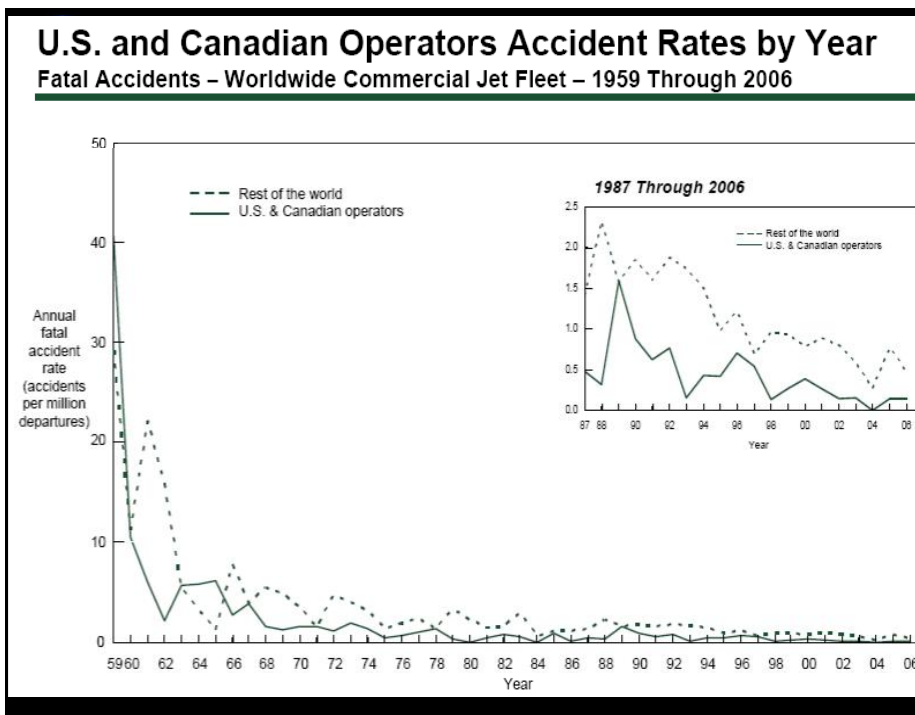
## Outline

- Need to modernize the air traffic system
- Informal history of air traffic modernization
- Air traffic control operations
- Technical challenges
- Concluding remarks











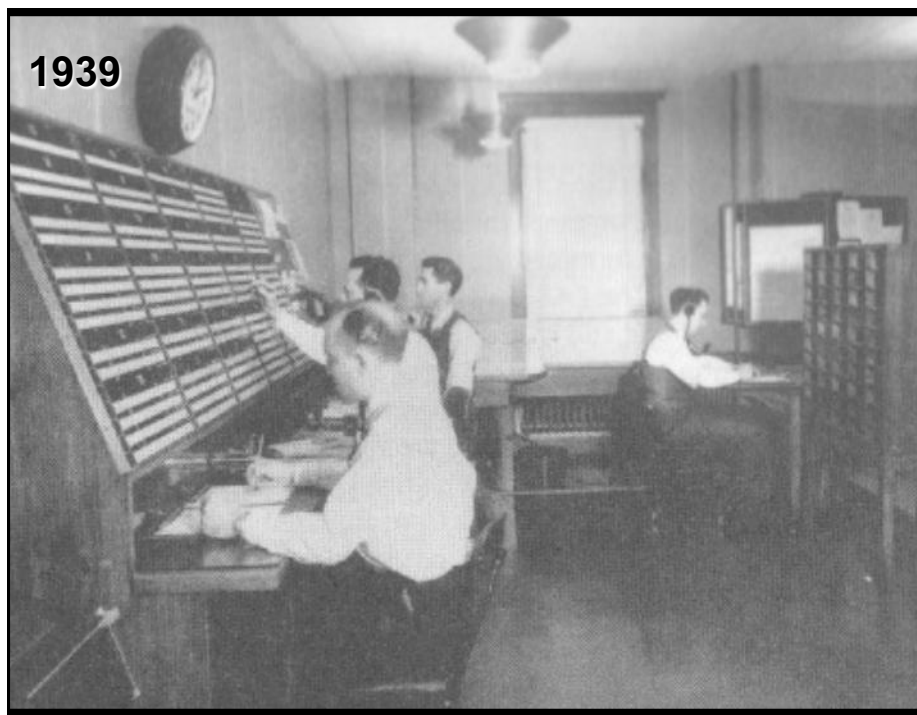
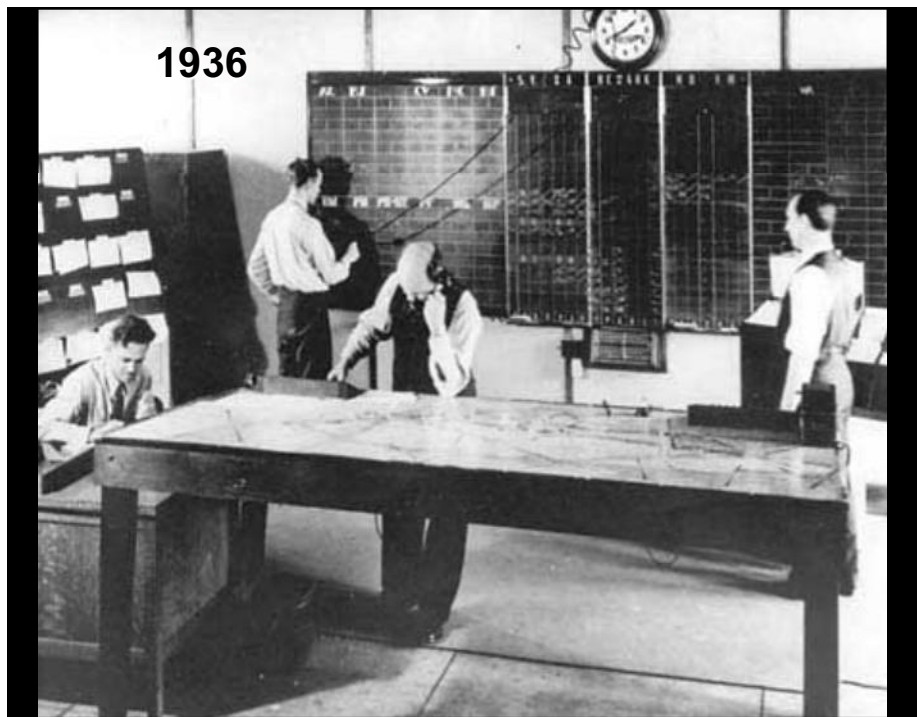
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Briefing at University of Cincinnati





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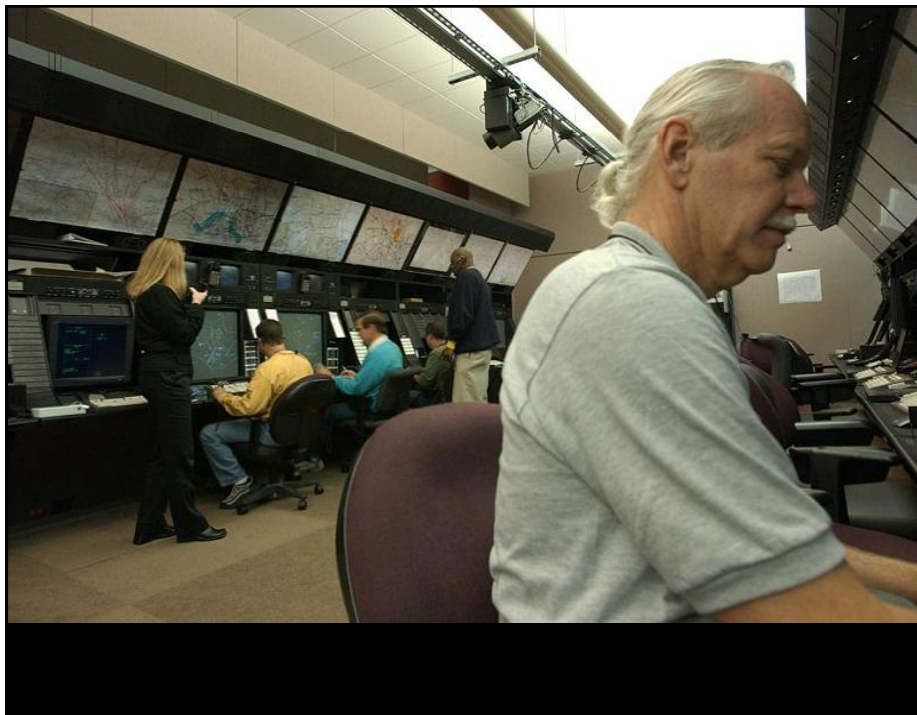



1981

### Advanced Automation System

- Big Bang approach underestimated complexity
- Excessive faith in new technologies
- Customizable interfaces led to state explosion for V&V
- Politics

Briefing at University of Cincinnati





## Outline

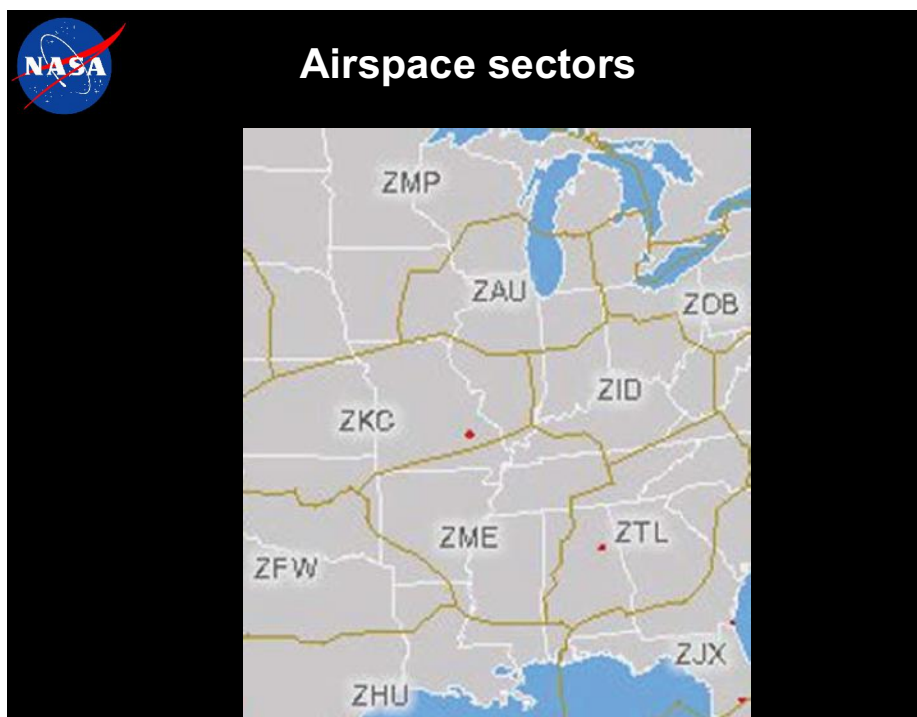
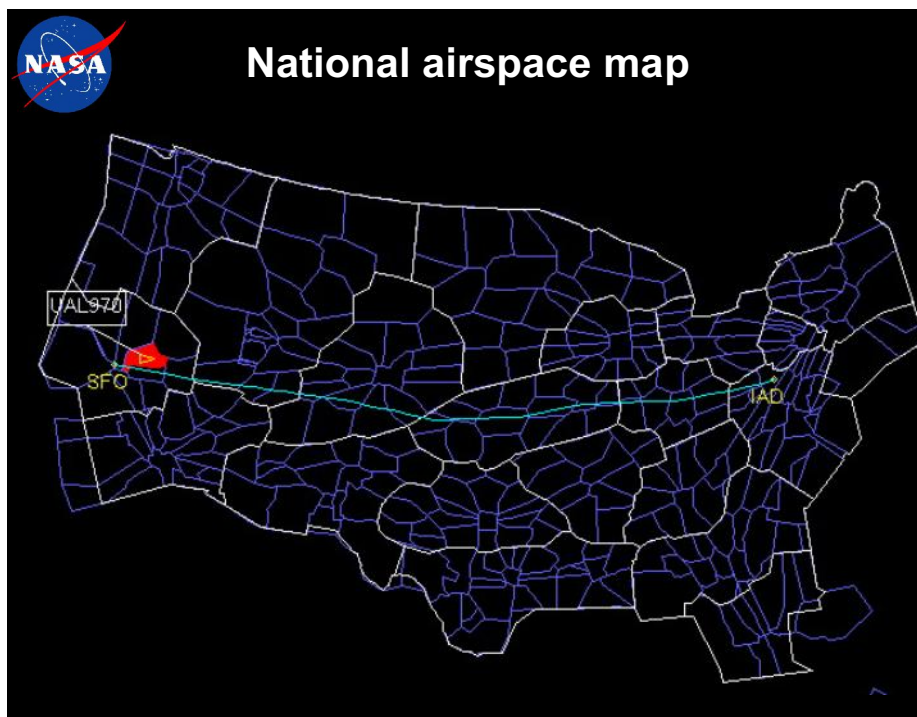
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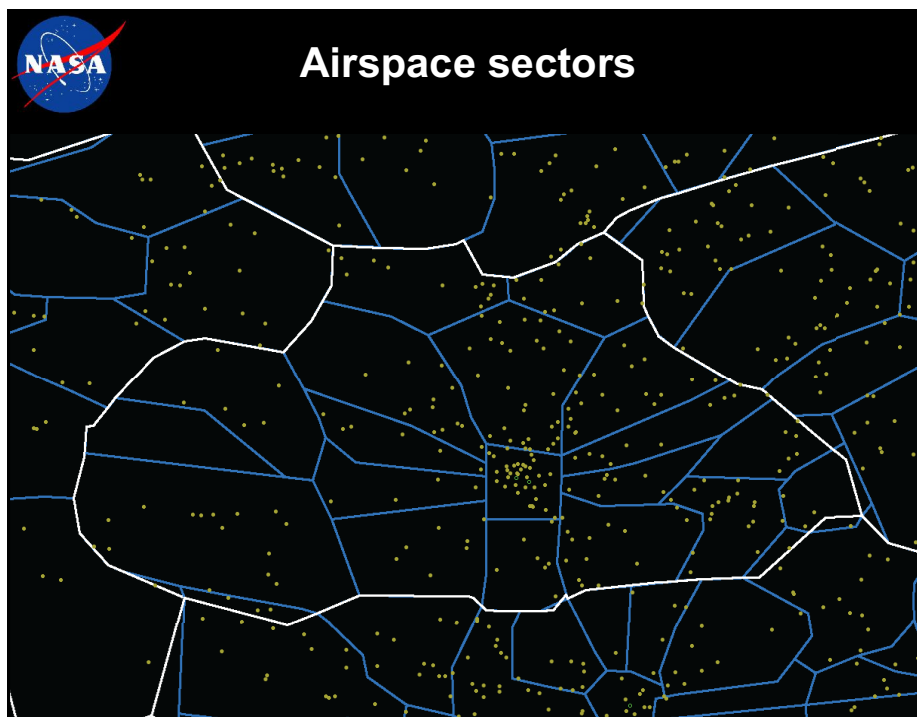



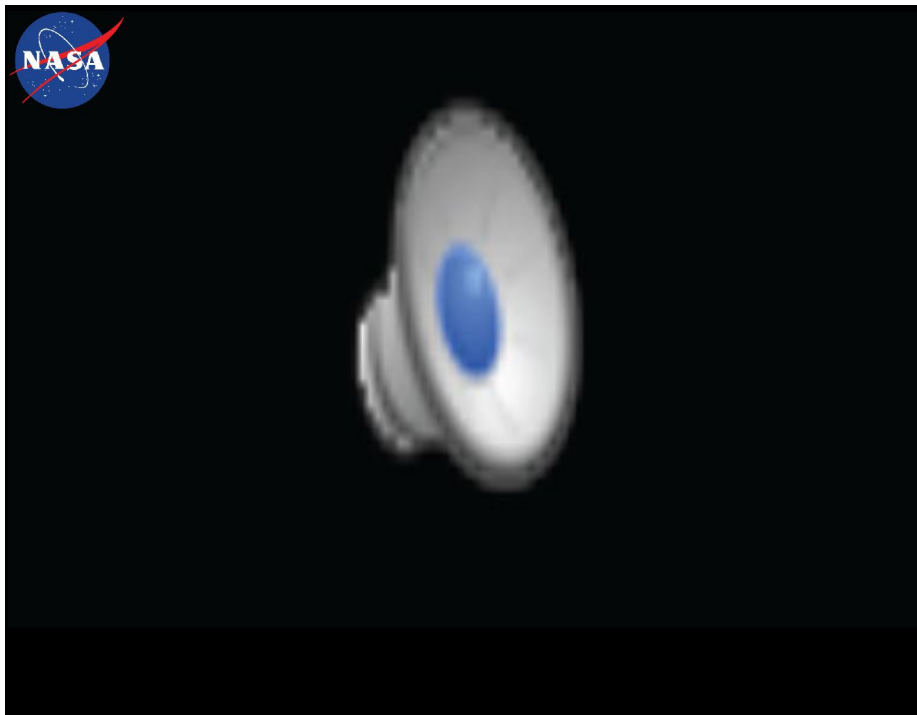
## Air Traffic Control Objectives



- Keep aircraft safely separated
- Minimize delay







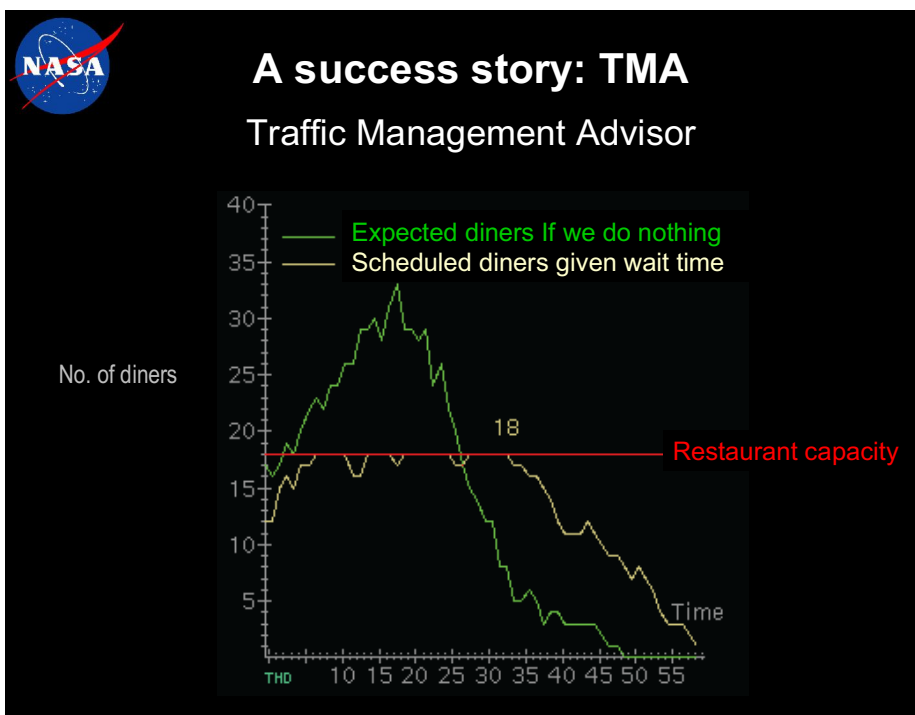
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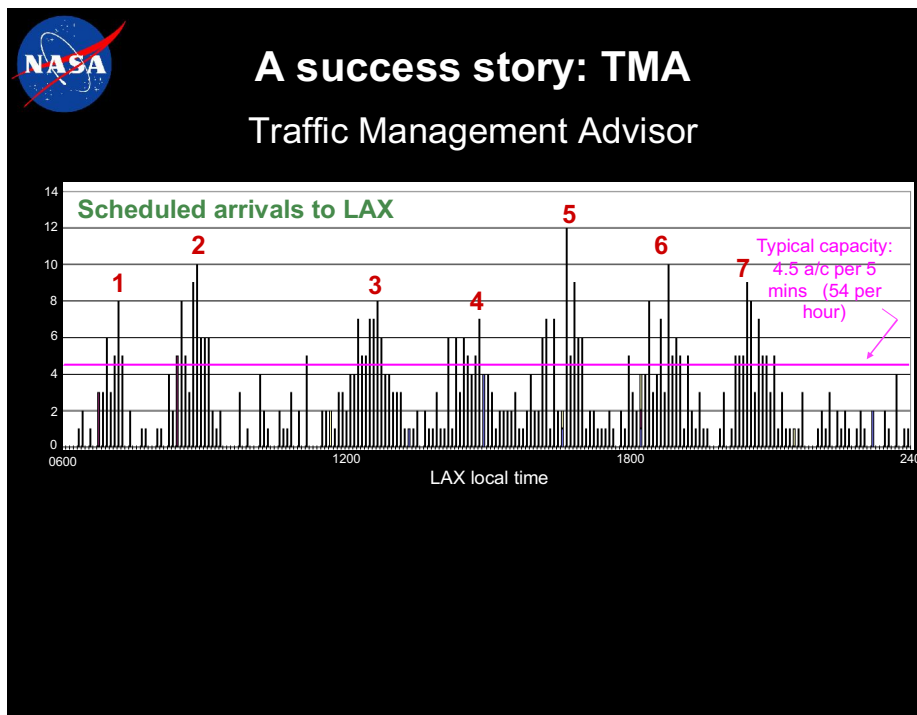
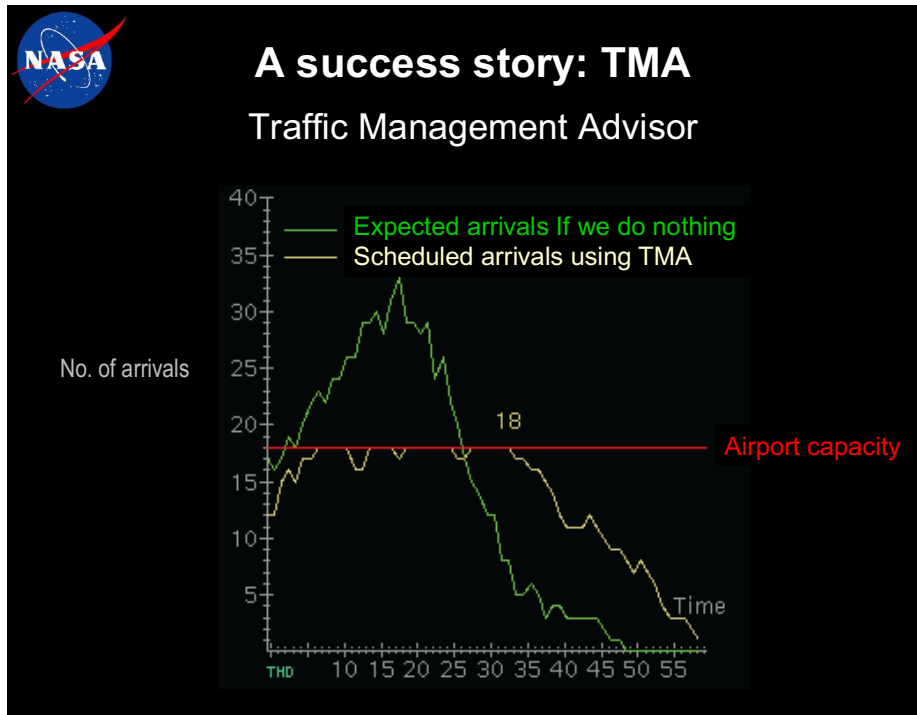
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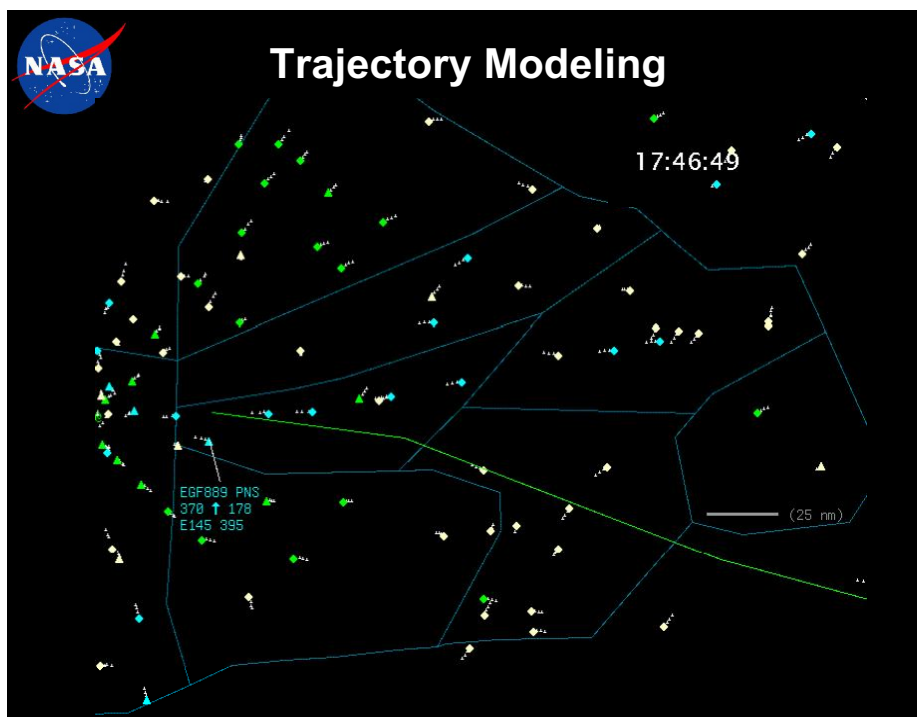
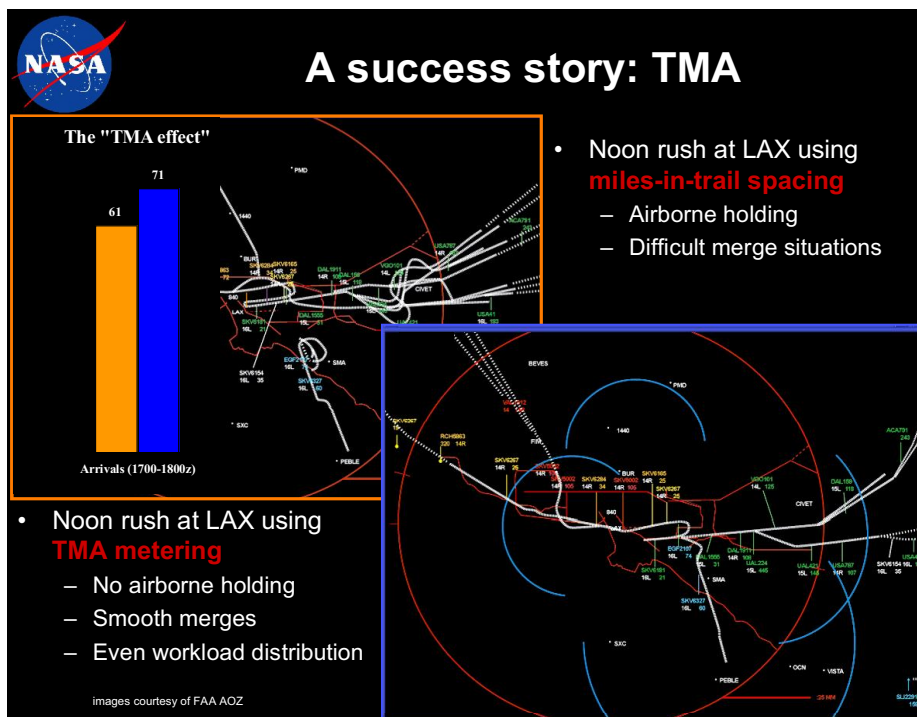


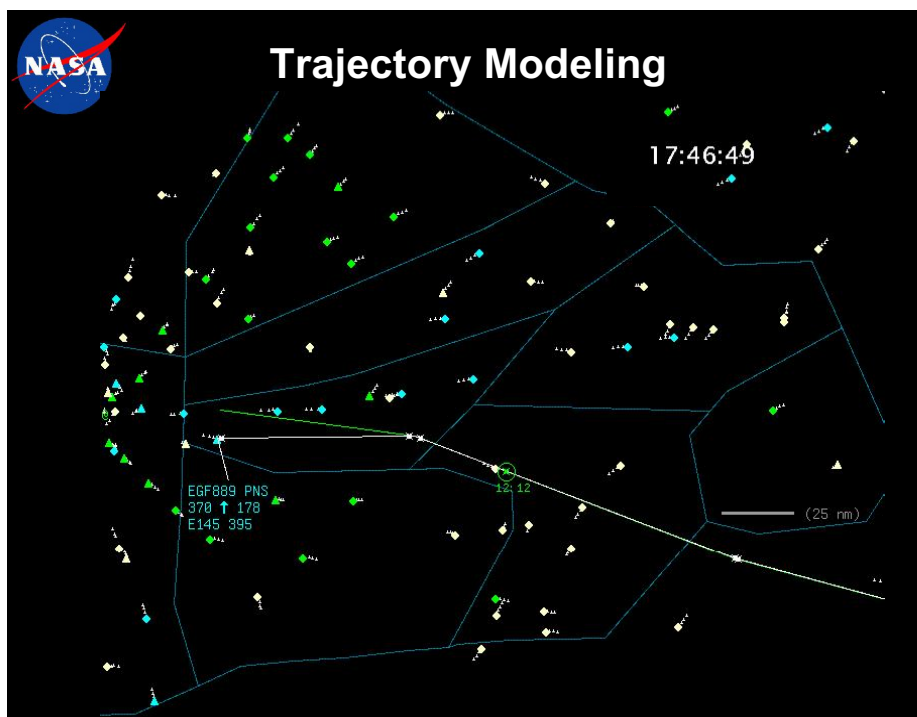
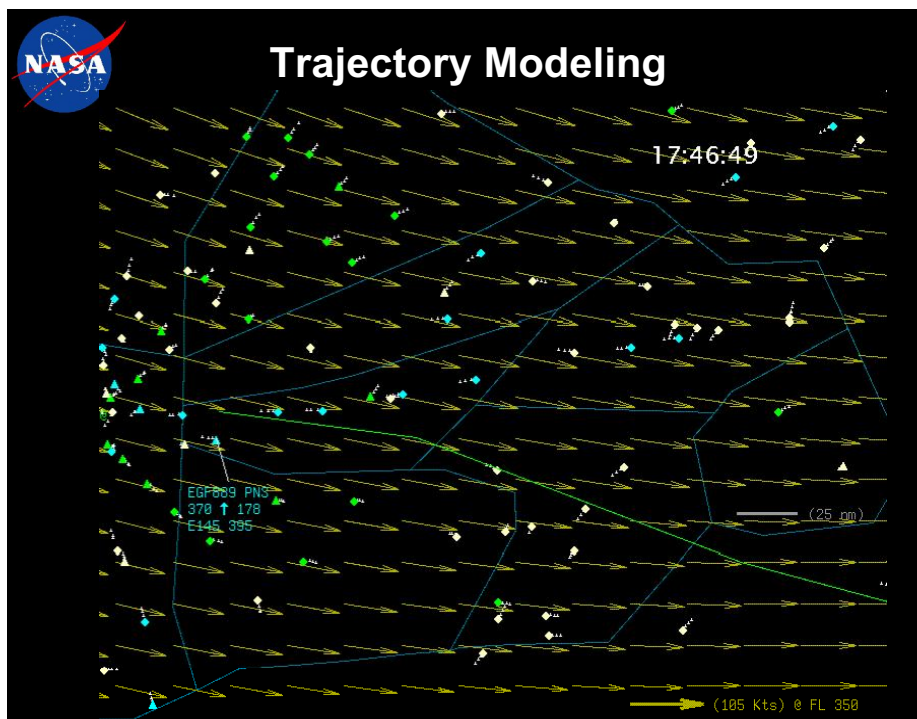
 **Air Traffic Management Research**

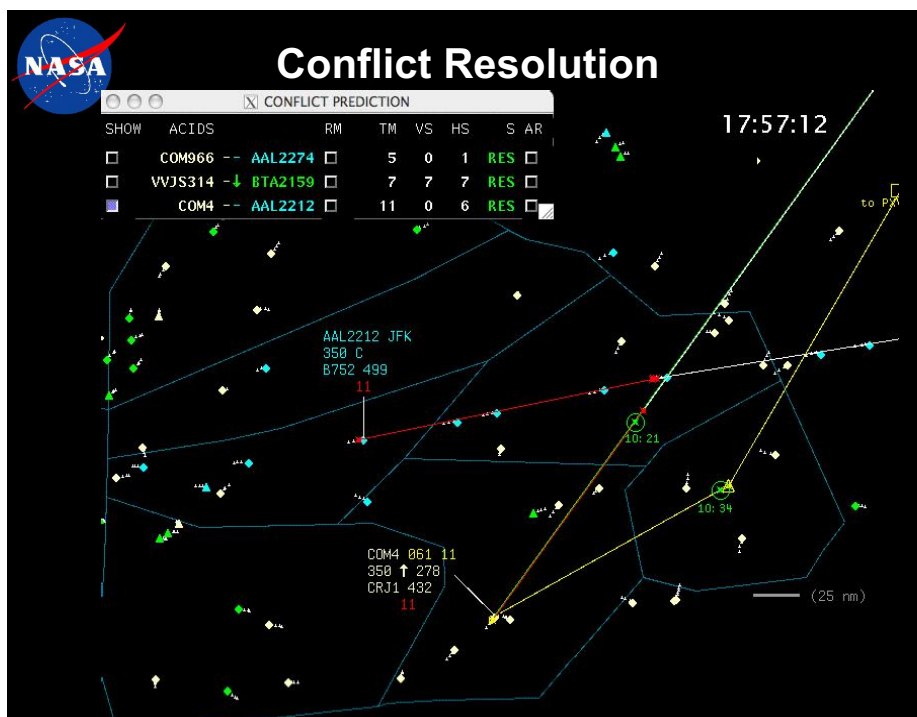
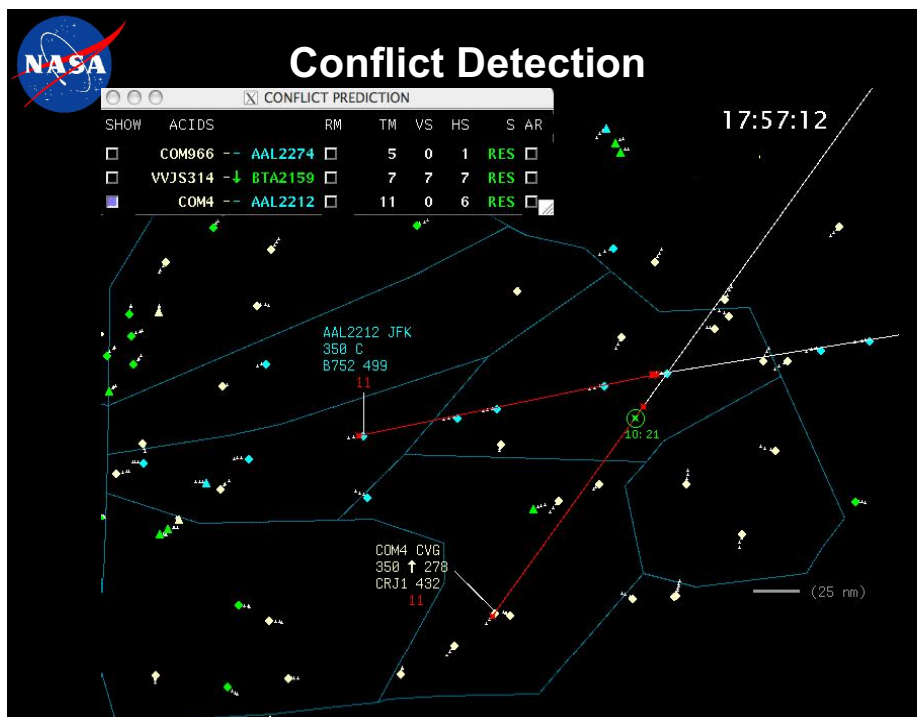
- What's so hard about it?
  - Rampant uncertainty
  - Safety-critical, real-time, human-centered
  - How to test and transition to new technology?

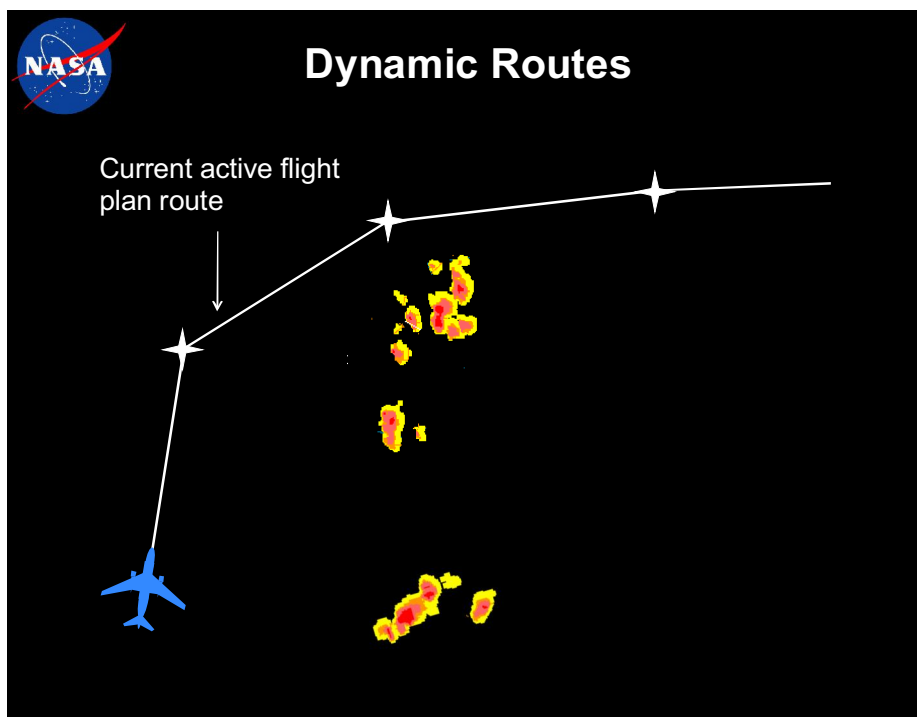


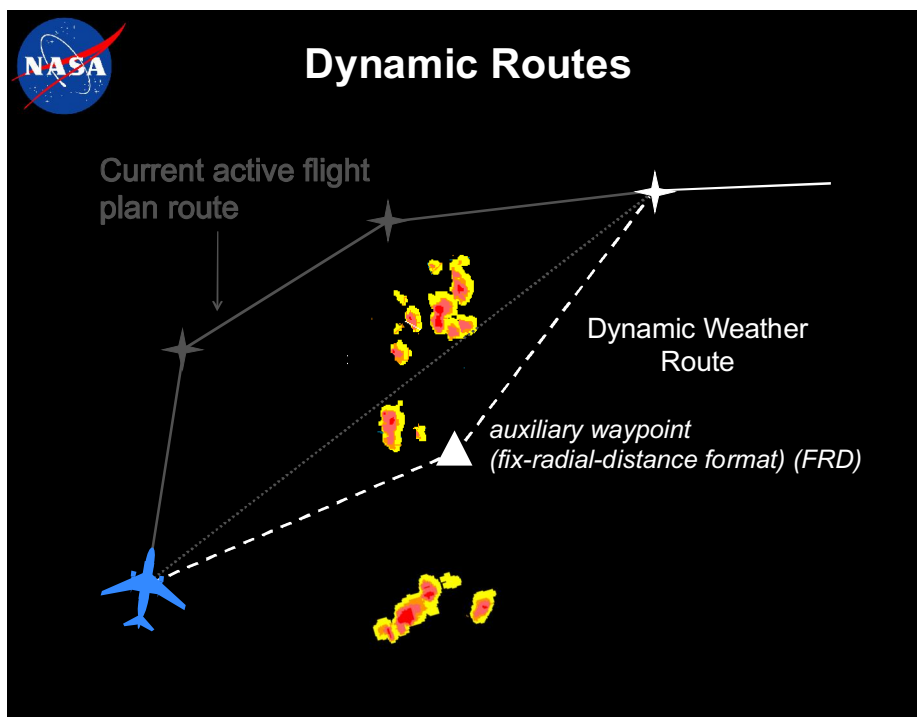
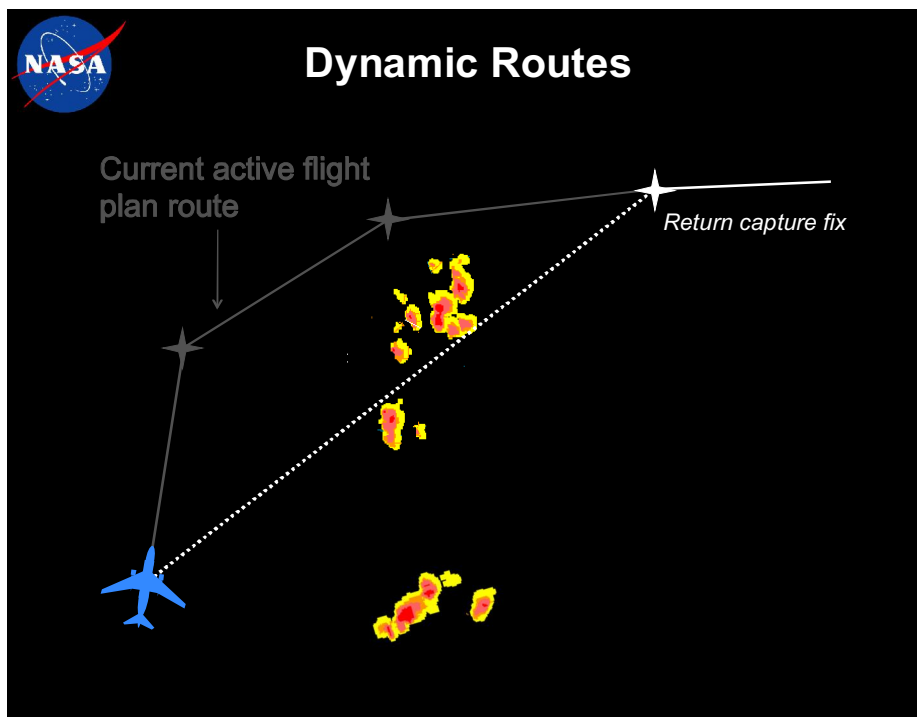






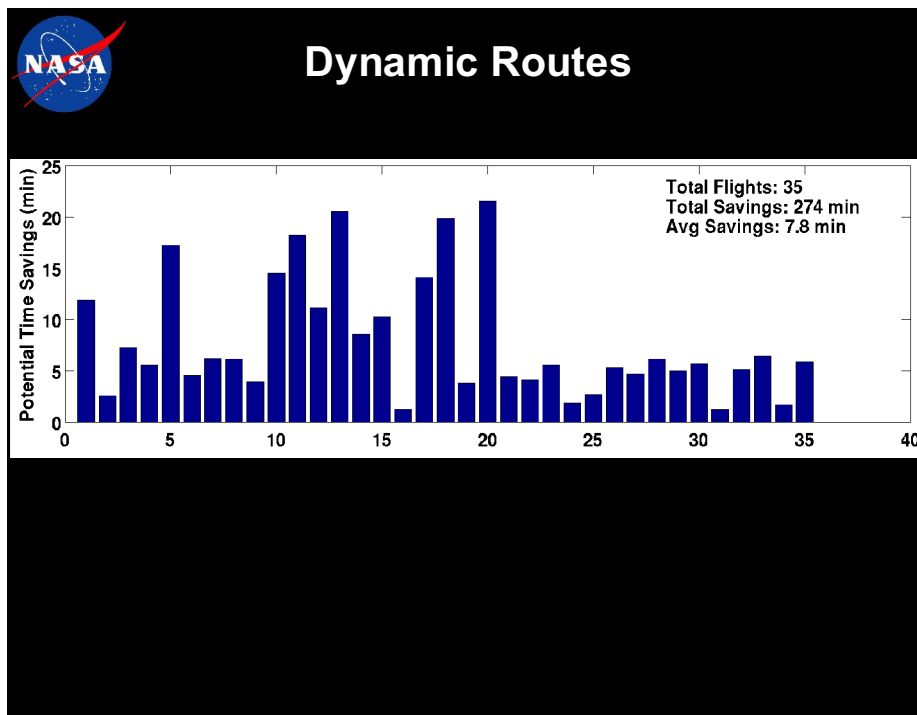
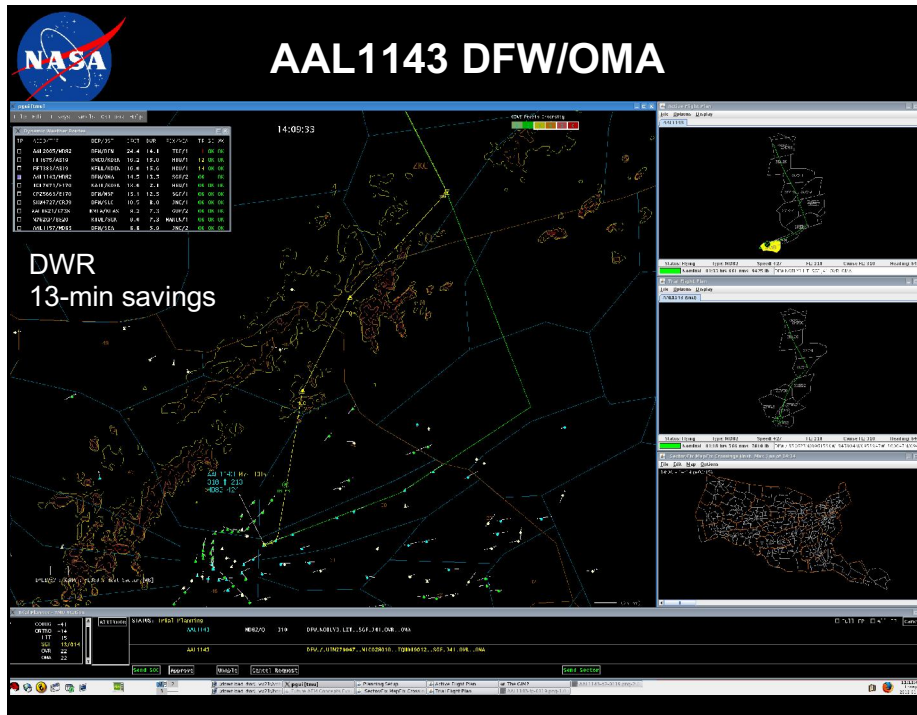


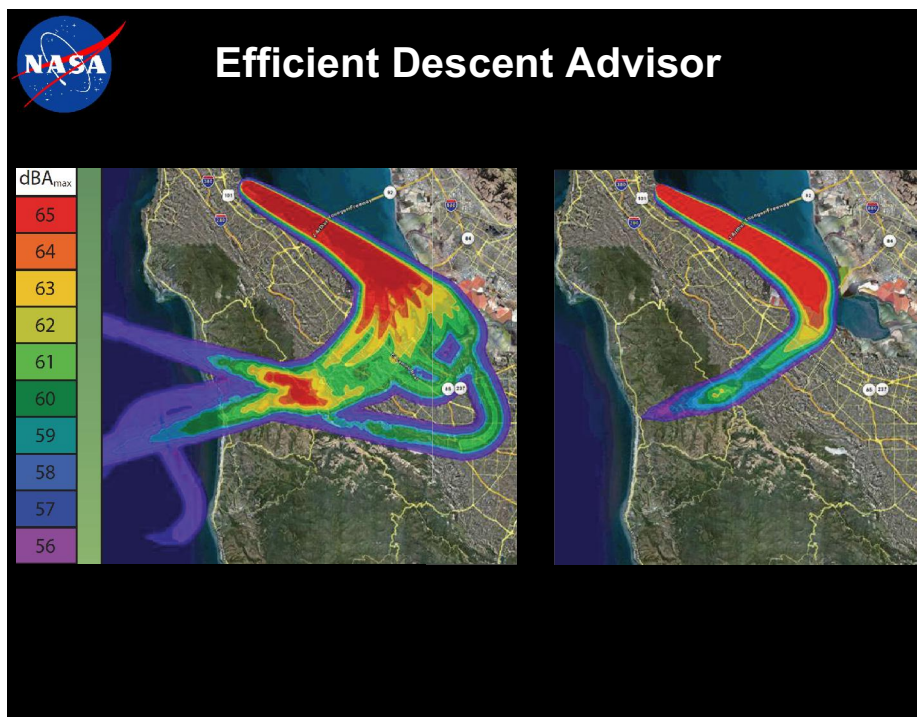












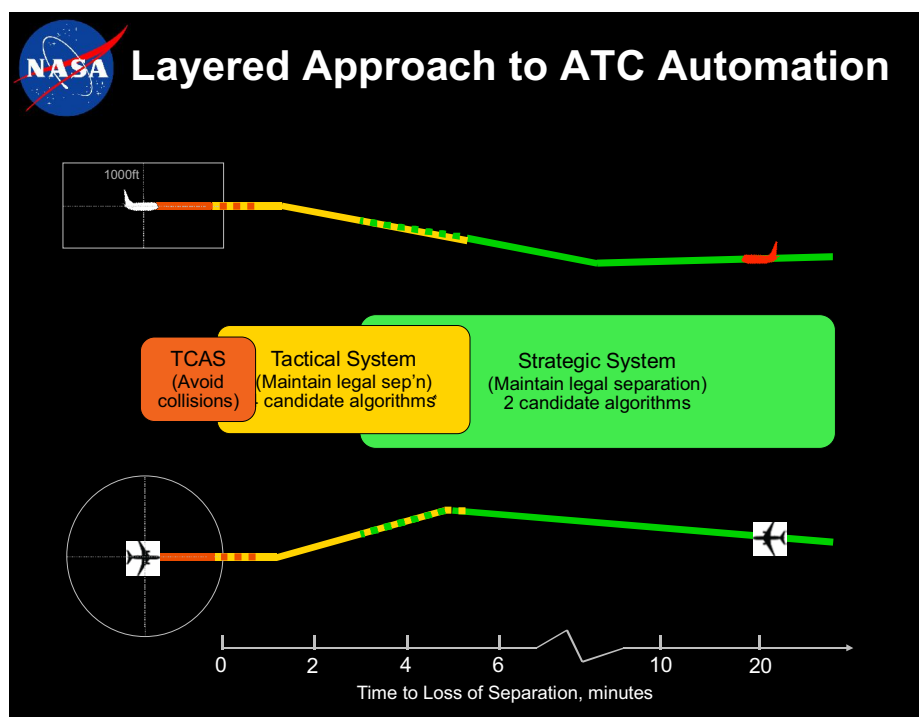
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- ### Concluding Remarks
- Urgent need to modernize
    - Today's system routinely operates at its limit
    - Impinging on US economic growth
  - Extraordinarily complex problem space
    - Rampant uncertainty
    - Human-centered
    - Don't mess up!
  - Make a difference

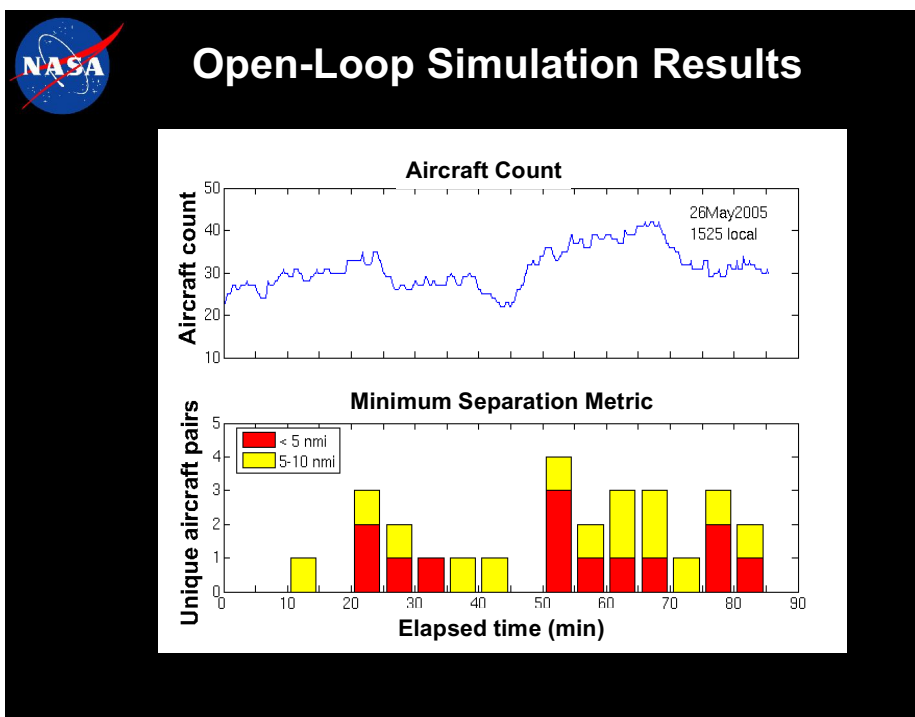
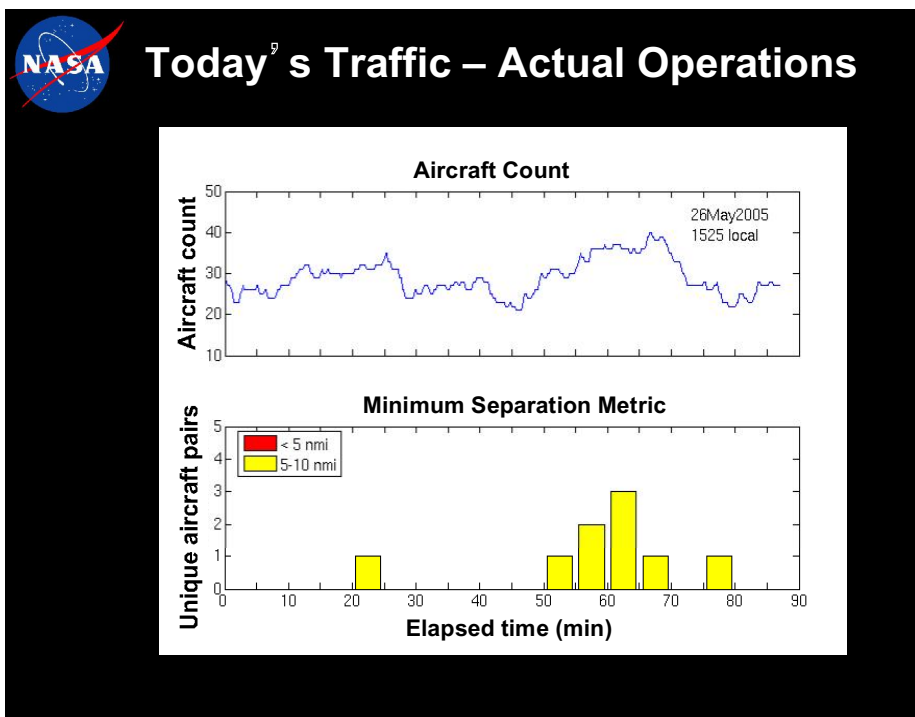


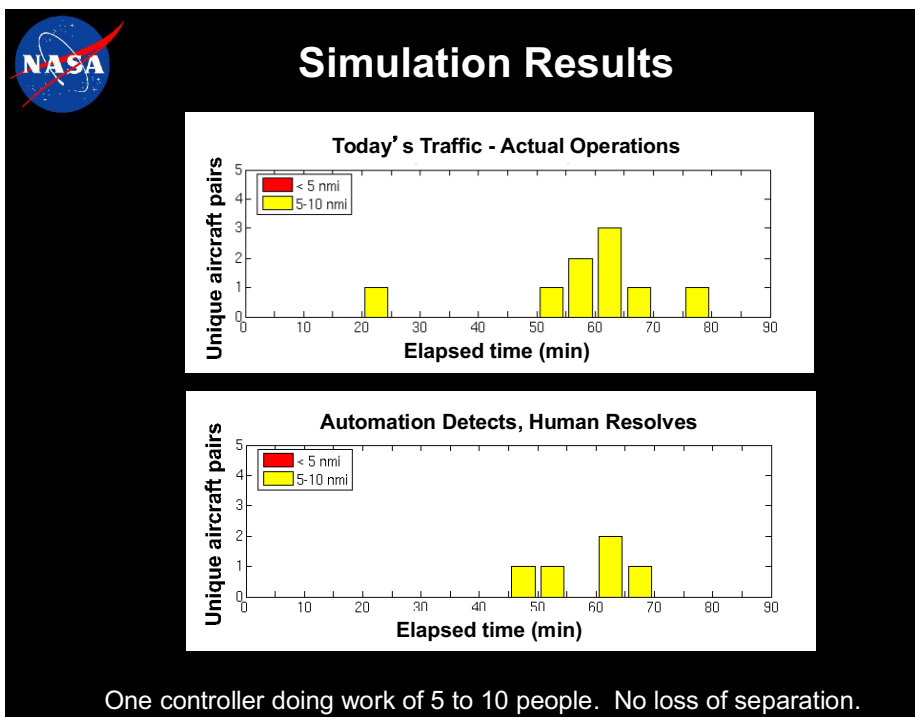
## Air Traffic Management Research at NASA

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**Auto Resolution Results Summary**

	1X	~2X	~3X
Traffic level, Cleveland Center	1X	~2X	~3X
Traffic count (24 hours)	7000	17800	26000
Conflicts detected and resolved	<b>532</b>	<b>1572</b>	<b>3099</b>
% flights in conflict	12	20	23
Mean delay (sec)	21	22	25

100% of en-route conflicts resolved.

Cost of resolution rises acceptably with traffic level.

