

# NASA

WEATHER ACCIDENT PREVENTION  
PROJECT REVIEW 2004

*“Celebrating Today’s Success... Looking to  
Tomorrow’s Challenges”*

JUNE 2-4, 2004

MGM GRAND HOTEL • LAS VEGAS, NEVADA

- Communicate progress to NASA's stakeholders, partners and customers
- Solicit feedback on NASA's aviation weather safety activities and plans
  - Submit written questions by Noon Thursday
- Further encourage and strengthen NASA's collaboration with the aviation community
- Support internal communication and integration of NASA weather accident prevention activities
- Provide input to assist NASA's planning of future research and technology for Follow-On Project (FY06-FY10)

## This Morning

- Plenary Session:
  - Select industry briefings highlighting NASA's contribution to product implementation

## This Afternoon and Tomorrow Morning

- Serial Technical Sessions:
  - Aviation Weather Information
  - Weather Information Communications
  - Turbulence Prediction & Warning Systems

## Tomorrow Afternoon

- Awards Luncheon
  
- Parallel Break-out Workshop Sessions
  - Aviation Weather Information
  - Weather Information Communications
  - Turbulence Prediction & Warning Systems

## Friday

- Workshop Brief-outs
- Follow-on Aviation Weather Safety Research Session



## NASA's Vision

- To improve life here
- To extend life to there
- To find life beyond

## NASA's Mission

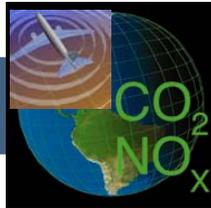
- To understand and protect our home planet
- To explore the universe and search for life
- To inspire the next generation of explorers  
...as only NASA can



### Objectives



**Protect Air Travelers and the Public**



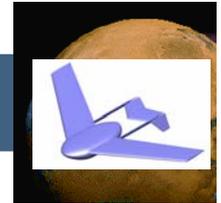
**Protect the Environment**



**Increase Mobility**



**Protect the Nation**

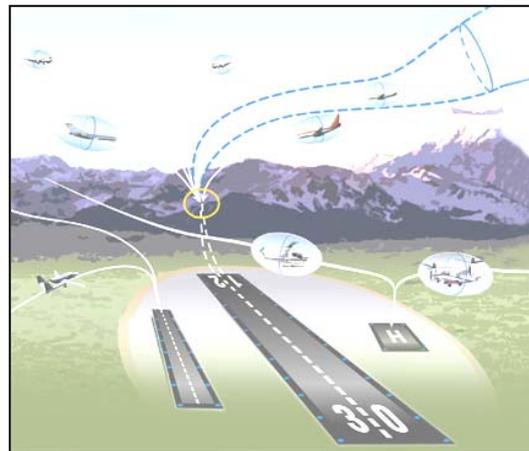


**Explore New Aeronautical Missions**

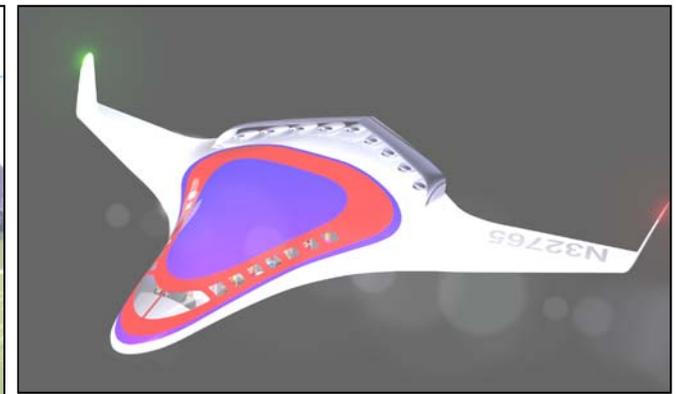
### Programs



**Aviation Safety & Security**



**Airspace Systems**



**Vehicle Systems**

### Vehicle Safety Technologies

#### Synthetic Vision

Provides commercial & general aviation pilots with clear-day operations all of the time



#### Accident Mitigation

Increases survivability when accidents occur

#### Single Aircraft Accident Prevention

Develops health management & robust control technologies to enable aircraft that are "self healing" & "refuse to crash"



### Weather Safety Technologies



#### Weather Accident Prevention

Brings intelligent weather decision-making to every cockpit



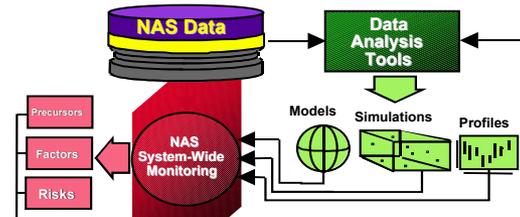
#### Icing Research

Icing detection and protection systems, training aids, tools for design and certification of aircraft systems

### System Safety Technologies

#### Aviation System Monitoring & Modeling

Monitors and assesses data from every flight for known & unknown issues



#### System-Wide Accident Prevention

Improves human/machine integration in design, operations, & maintenance





# Program Organization (FY00-05)



Aviation Safety & Security Program

2004 Weather Accident Prevention Review

## Aviation Safety & Security Program Office\*

George Finelli, Director  
 John White, Deputy Director  
 Gin Marks, Senior Prog Analyst  
 Connie Buffin, Secretary  
 Tina Beard, Dep Prog Mgr (Acting, ARC) Ron Çolantonio, Dep Prog Mgr (Acting, GRC)

**Technical Integration**  
 Frank Jones  
 (LaRC)

**Program Integration**  
 Michael Basehore (FAA)

**1.3**  
**Vehicle Safety Technology**

**1.4**  
**Weather Safety Technology**

**1.5**  
**Systems Safety Technology**

**2.3**  
**Single Aircraft Accident Prevention**  
 Carrie Walker  
 (LaRC)

**2.6**  
**Synthetic Vision**  
 Daniel Baize  
 (LaRC)

**2.5**  
**Accident Mitigation**  
 Robert McKnight  
 (GRC)

**2.4**  
**Weather Accident Prevention**  
 K. Martzaklis  
 (GRC)

**2.7**  
**Aircraft Icing**  
 Mary Wadel  
 (GRC)

**2.1**  
**Aviation System Monitoring & Modeling**  
 Irving Statler  
 (ARC)

**2.2**  
**System-Wide Accident Prevention**  
 Sandy Hart  
 (ARC)

**Aviation Weather Information (AWIN)**  
 Paul Stough (LaRC)

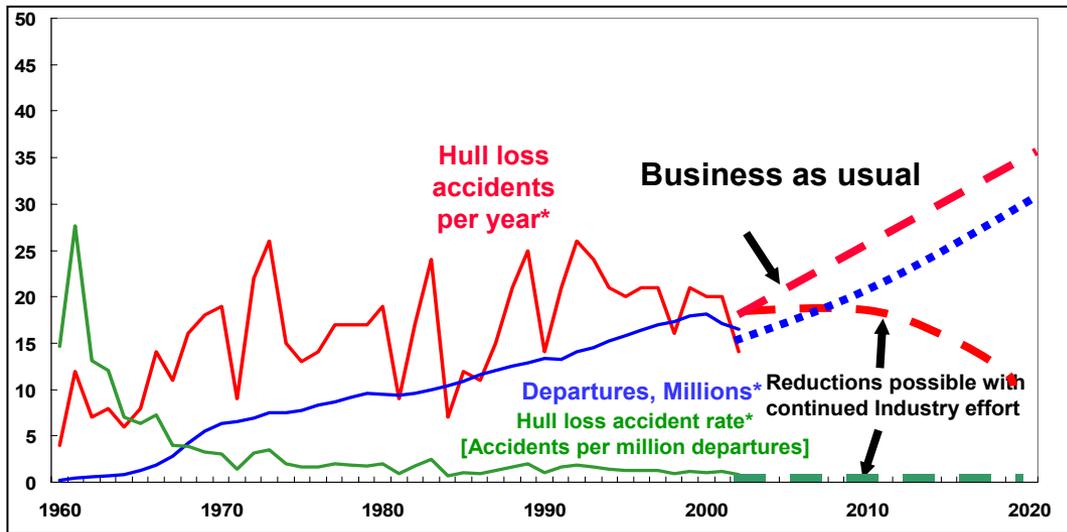
**Weather Information Communications (WINCOMM)**  
 Mike Jarrell (GRC)

**Turbulence Prediction & Warning Systems (TPAWS)**  
 Jim Watson, (LaRC)  
 Rod Bogue, Dep (DFRC)

\*Note: Security Projects Not Shown (FY04-08)

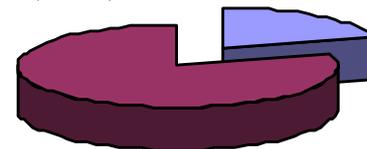
WxAP Martzaklis

**NASA Aviation Safety Goal:** Develop and demonstrate technologies that contribute to a reduction in the aviation fatal accident rate by a factor of 5 by year 2007.



\*Accident and Departure data through 31 December 2002

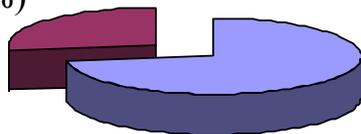
Non-Turbulence-related Injuries (67%)      Turbulence Injuries (33%)  
*Ranked #1 for Injuries*



**Commercial Transport Serious Injuries 1990-1996**  
 Fatal/Non-fatal Accidents  
 Source: NTSB Data

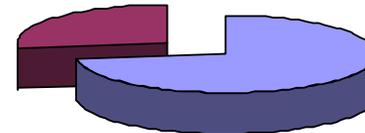
41% during cruise  
 27% due to visual flight operation in instrument flight conditions

Weather-related (27%)      Non-weather-related (73%)



**GA Aviation Accidents 1982-1993**  
 (22,053 total accidents)  
 Source: AOPA Air Safety Foundation

Weather-related (33%)      Non-weather-related (67%)



**Commercial Carrier Accidents 1983-1995**  
 Source: NTSB  
 WxAP Martzaklis

**Goal:** Develop enabling technologies to reduce weather-related accident causal factors by 50% and turbulence-related injuries by 50% by the year 2007.

**Objectives:**

1. Improve pilots' ability to obtain, understand and use weather information for safer decision-making.
2. Develop means to expand automated airborne in-situ weather reporting for altitudes below 25,000 ft. for improved forecasts.
3. Develop en-route turbulence hazard prediction and warning technologies for reducing injuries to passengers and crew.
4. Develop air/ground communications concepts and technologies for improved weather information dissemination.
5. Develop methods to use advanced satellite weather-observation capabilities to improve aviation weather products.

- Datalink Cockpit Weather Information Systems

- General Aviation systems
- Commercial Air Transport systems

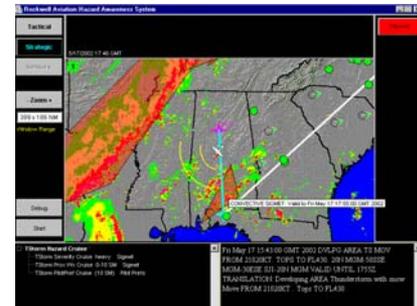


- Cockpit Weather Technologies:

- Interface Technologies & Display Guidelines:
  - Presentation, decision aiding, flight planning tools

- Information Acquisition & Conditioning Technologies:

- Information fusion, enhanced on-board radar, Advanced Satellite Aviation-weather Products (ASAP)



- Airborne Weather Sensor Technologies

- Tropospheric Airborne Meteorological Data Reporting (TAMDAR)



WxAP Martzaklis

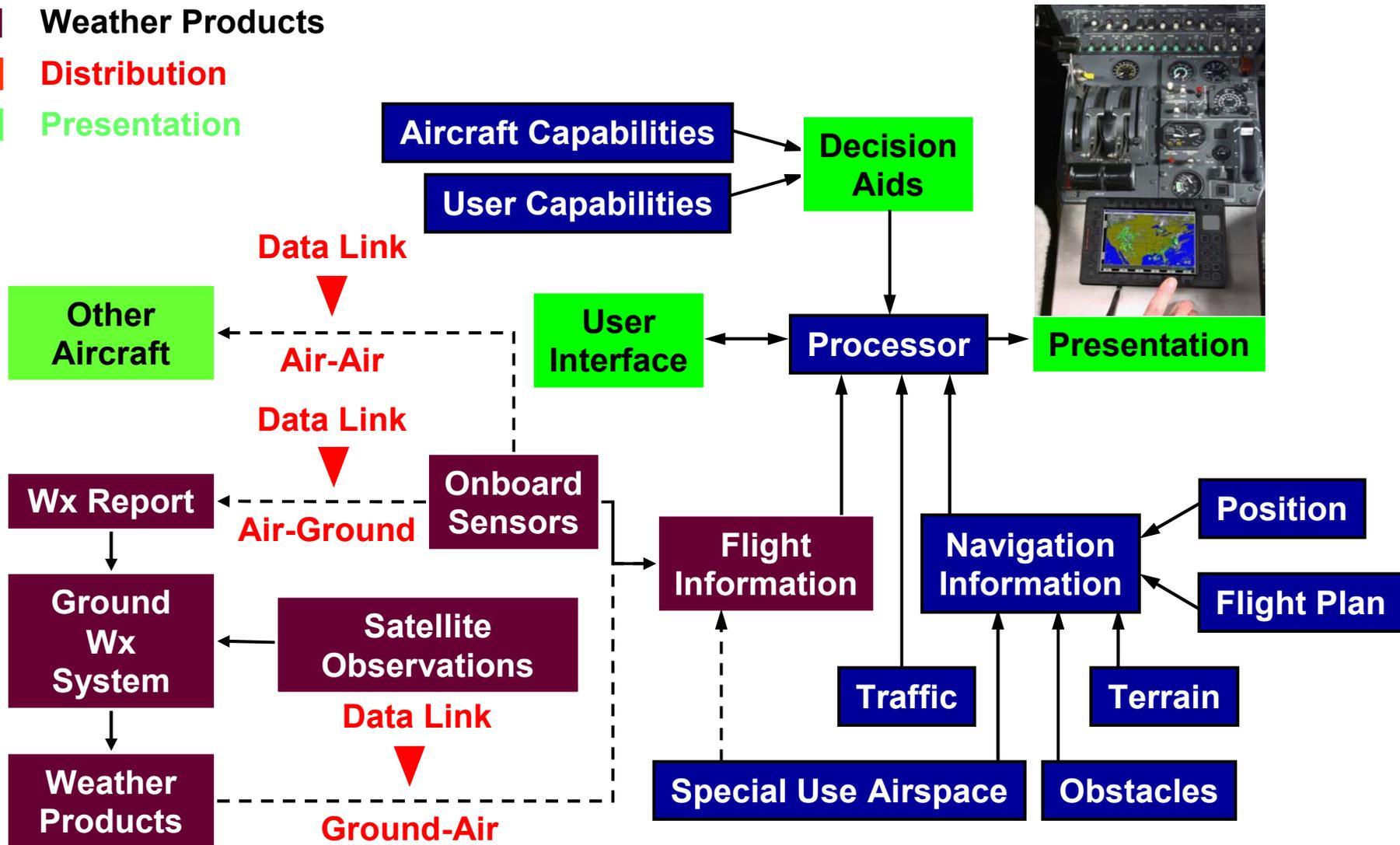
- Weather Communications Technologies:
  - National Weather Dissemination Capability for
    - Air Transport
    - General Aviation / Regional Carriers
  - Global Weather Dissemination Capability



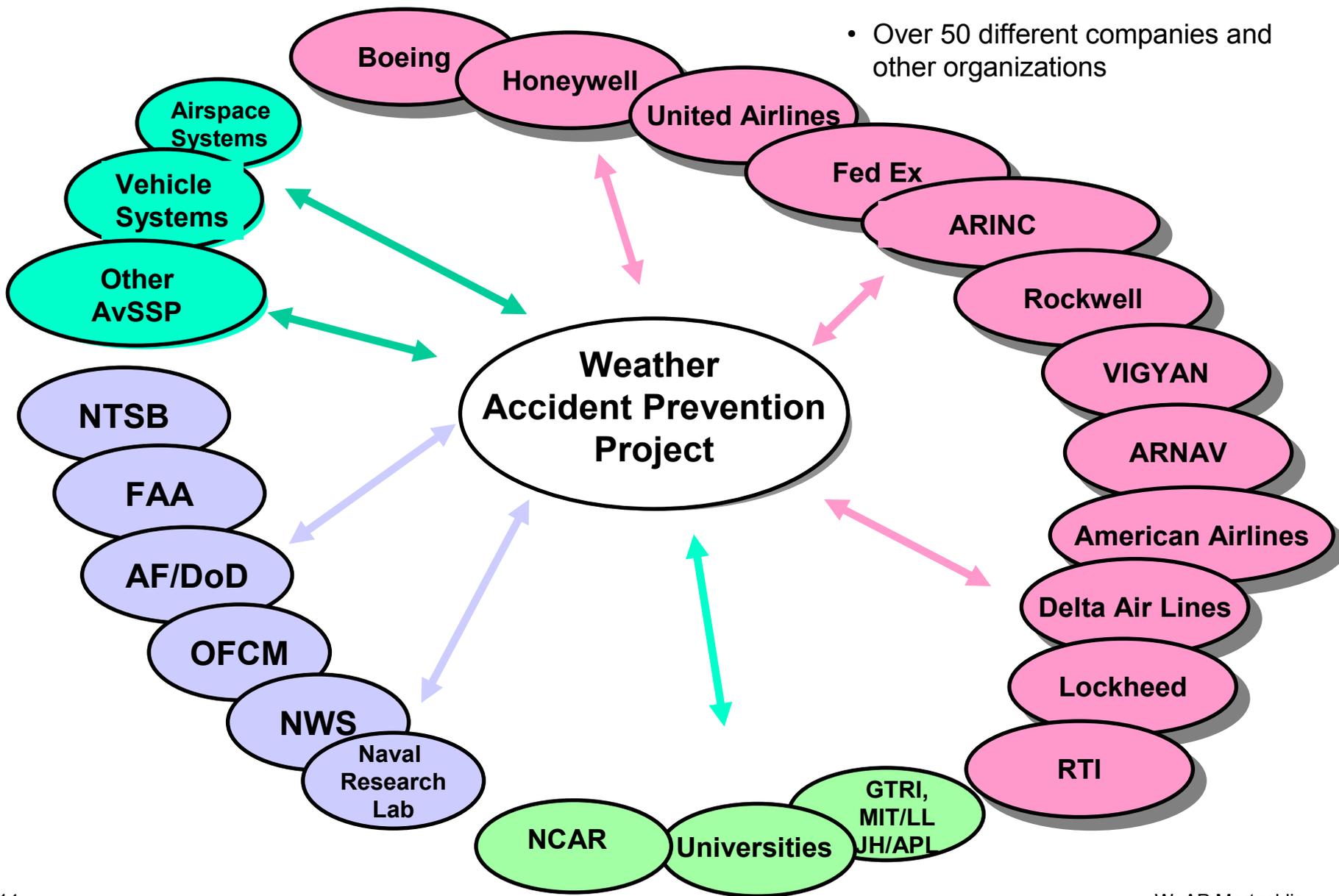
- Turbulence Technologies:
  - Turbulence Modeling & Simulation
  - Airborne Turbulence Sensors
  - Turbulence In-Situ Systems
  - Turbulence Prediction Algorithms & Hazard Metrics
  - Flight Deck Integration
  - Enhanced Autopilot Concepts for Turbulence Ride Smoothing
  - Certification Methods & Tools



- Weather Products
- Distribution
- Presentation



- Over 50 different companies and other organizations



- NASA-FAA Integrated Safety Research Plans
  - NASA-FAA MoA on Weather Safety research in place
    - Numerous jointly funded Inter-Agency Agreement tasks
  - FAA Safer Skies: JSAT/JSIT teams
  - NASA-FAA Joint Working Group on AvSafety: Integrated roadmaps on atmospheric hazards
  
- NASA-NWS Research Plans
  - NASA-FAA Space Act Agreement on Wx Accident Prevention
  
- Tri-agency (NASA/FAA/NOAA) Collaboration Teams
  - Airborne Weather Reporting (TAMDAR) Team
  - Forward-Looking Turbulence Detection Team
  - Weather Communications Working Group
  - Turbulence Reporting ConUse & Research Teams
  - AWIN Human Factors Team
  
- Multiple NASA-Industry Cooperative Research Agreements
  - ARNAV, Honeywell, Boeing, Rockwell and others



# Key Accomplishments To-Date (FY00-03)



*Aviation Safety & Security Program*

*2004 Weather Accident Prevention Review*

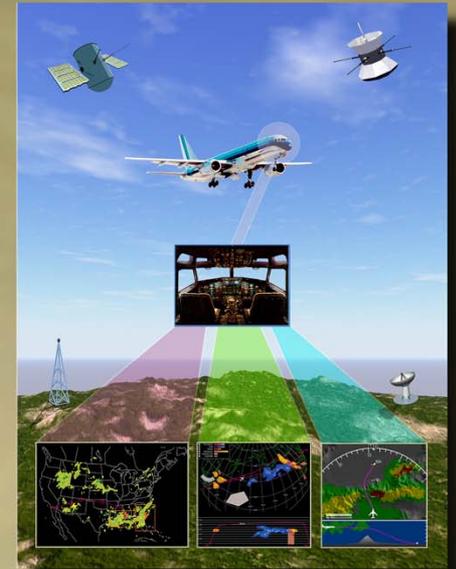
- ✓ First generation cockpit weather systems and datalinks commercialized!
- ✓ Validated radar-based turbulence warning technology via NASA flights
- ✓ Validated prototype airborne weather sensor (TAMDAR)
- ✓ First generation turbulence LIDAR characterized
- ✓ Completed benefit studies of satellite-enhanced aviation weather products

T 2  
G 0  
I 0  
R 2

## Aviation Safety Aviation Weather Information and Communications Research Team

**Team Members:** NASA Langley Research Center, NASA Glenn Research Center, Honeywell International, Incorporated, ViGYAN, Incorporated, Federal Aviation Administration, Rockwell Collins, United Airlines

The Aviation Weather Information & Communications Research Team developed weather presentation and communications technologies resulting in cockpit weather information systems being introduced into the marketplace. Glenn and Langley researchers worked with the Federal Aviation Administration (FAA), industry and academia to achieve better crew situational awareness. It is anticipated that these systems will result in a 50% reduction in aircraft accidents attributable to a lack of weather awareness. In addition, more than 60% of air traffic delays are attributed to weather, and the technologies developed will significantly improve operational efficiency by allowing strategic avoidance of weather.

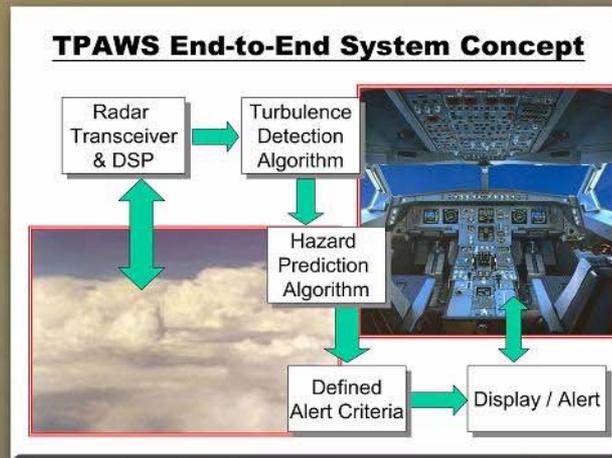


Santa Clara, CA

# Aviation Safety Turbulence Prediction and Warning Systems (TPAWS) Team

Team Members: NASA Langley Research Center, NASA Glenn Research Center, NASA Dryden Flight Research Center, Federal Aviation Administration, AeroTech Research (USA), Research Triangle Institute, National Center for Atmospheric Research, North Carolina State University, Aviation Cabin Safety Specialists Incorporated

NASA and its partners are developing advanced airborne systems to predict and provide cockpit alerting for inflight turbulence--the leading cause of injuries in airline incidents. These innovative technologies greatly enhance the capabilities of existing windshear radars and have been successfully flight-tested aboard the NASA 757 research aircraft. Results indicate important advancements to predicting turbulence ahead of aircraft that adversely affect scheduled commercial operations. This early warning will allow pilots enough time to advise flight attendants and passengers to buckle up resulting in significantly reduced turbulence-related injuries.



TGAIR 2003  
Williamsburg, VA



Goal One

## Pilot Weather Advisor

### INNOVATION

ViGYAN, Inc. developed the Pilot Weather Advisor system using state of the art satellite communications technology to substantially increase the amount of weather information available to pilots in flight

### ACCOMPLISHMENTS

- ◆ Broadcast system is up and running 24/7 – graphical and text weather information updated every 5 minutes and covers the entire continental U.S. and border regions
- ◆ Received FAA certification (hardware and software)
- ◆ The availability of strategic weather information while in flight will increase safety of General Aviation

### COMMERCIALIZATION

- ◆ Phase III effort led to a spin-off company, WeatherStream, which has since been acquired by WSI, Inc. (Service renamed WSI InFlight in Summer 2002)
- ◆ WSI InFlight Aircraft Weather Information Service ([www.wsi.com/solutions/aviation/inflight/](http://www.wsi.com/solutions/aviation/inflight/))
- ◆ Service is affordable, even to hobbyist pilots (\$49.95/mo.)
- ◆ Avionics start at \$3,495
- ◆ Compatible with a large number of portable and in-dash displays
- ◆ Orders started shipping January 2003



**WSI InFlight Display, Receiver and Antenna**

### NASA SBIR and AvSSP Contribution

- ◆ Phases I and II funded by NASA LaRC (NAS1-19250 and NAS1-19595): completed development and patent of the original system concept (Patent #5265024)
- ◆ Phase III funded by NASA GRC Weather Accident Prevention Project (Contract # C-70699-N): Completed development and demonstration of the satellite data link system for the dissemination of weather information enabling commercial viability.
- ◆ Prototype receiver was evaluated by GRC test pilots

For more information:  
 Project Manager-: Gus Martzaklis  
 NASA GRC Technical Contact – Glenn Lindamood  
 NASA LaRC Technical Contact – Bruce Fisher  
 Company Contact – Richard White

- Reduced research funding due to increased infrastructure costs and aviation security re-vectoring (FY03-05)
  - Re-baselining project plan to reflect
  - FY03-05 descope of technical objectives being factored into Aviation Safety Follow-on planning process
  
- Langley flight operations safety stand-down (FY03)
  - Mitigating via expanded use of simulators, other NASA and non-NASA aircraft platforms (Delta airlines, U. North Dakota, Mesaba..)
  
- Perception of duplication in Airborne Turbulence Reporting research area between FAA and NASA
  - Have established Tri-Agency (FAA, NASA, NOAA) Steering Committee, CONUSE and Research-to-Ops Teams to investigate and resolve issue

- Complete next-generation presentation and decision-aiding research and validate via transport and G/A flight experiments
  - Perform air transport simulation experiment in FY04, integrating turbulence warning display concepts, and migrate to B-757 for flight evaluation with commercial pilots (FY05)
  - Validate G/A research via NASA C-206 flights (FY05)
- TAMDAR:
  - Conduct fleet evaluation of TAMDAR sensors with Mesaba
  - Integrate sensor and datalink system for TAMDAR system validation on-board NASA C-206 (FY05)
- Validate selected target weather communications architectures via flight experiments (UAT, 1090, VDL Mode 3, Satcom)
- Perform in-service evaluation of turbulence radar system with Delta
- Flight evaluate turbulence hazard reporting system via NASA and Delta experiments
- Perform field evaluation of ASAP in-flight icing algorithms