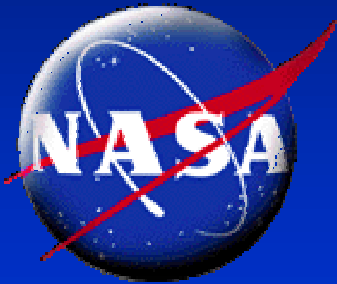


Capacity, Safety, and Weather



***Some technologies on the
VERY near horizon***

Transportation Research Board/FAA

Conference on

Aviation Gridlock - Part III: Weather and Weather Technology

May 16, 2001

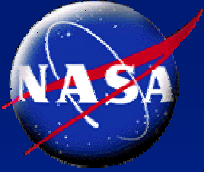
Michael S. Lewis

Director, Aviation Safety Program

NASA Langley Research Center

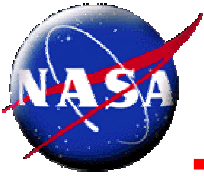
757-864-9100

m.s.lewis@larc.nasa.gov



The 6 Key Hurdles for Increased System Capacity

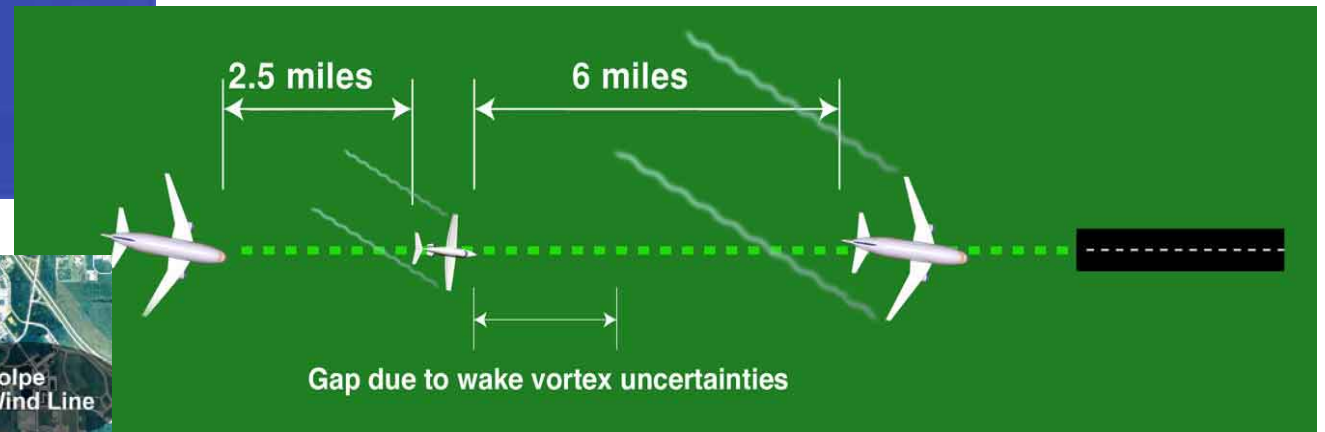
1. Reduce wake vortex separations
2. Increase efficiencies in terminal area weather operations
3. En route airspace management
4. Eliminate visibility/surveillance limitations
5. Use/build more runways
6. Reduce aircraft noise



Wake Vortex Spacing



- ATC spacing procedures are conservative due to vortex uncertainty
- Short term forecasts + Wake movement/dissipation models + confirming airport sensors = Aircraft Vortex Spacing System (AVOSS)



- June 2000 DFW AVOSS demonstration
- AVOSS provided an average 6 -12% throughput increase
- Application to parallel runways is straightforward



USA TODAY

NO. 1 IN THE USA . . . FIRST IN DAILY READERS

AUTHOR'S TALE TOLD FROM THE HAMPTONS

GAINES HITS HOME
IN 'PHILISTINES', 1D

TROUBLED TEENS CHART NEW COURSE FOR LIFE ON WATERS OFF BALTIMORE, 7D



By Robert Deusch, USA TODAY
Steven Gaines: Latest offering
sold out in the Hamptons, 1D

WEDNESDAY

Report: Pilots get worse weather data than public

By Fred Bayles
USA TODAY

Airline pilots aloft may know less about the weather than somebody sitting at home watching TV weather reports.

In a report issued Tuesday, the General Accounting Office said the Federal Aviation Administration still does a poor

job getting crucial weather data to pilots, information that could avoid everything from bumpy flights to crashes.

The report, based on recent criticisms, said technological advances have given forecasters a better understanding of changing weather conditions, but the information is still not readily available to pilots.

"One comment made at our panel was that you can sit in the cabin of a jet with a laptop computer and get better weather information than what the pilot up front has," says Robert White, the GAO's assistant director for aviation safety.

The report said meteorologists at regional air traffic centers seldom share information

with controllers nearby.

"Everyone is so focused on what they are doing that they don't have time to talk," says James Sweetman, one of the report's authors.

About 30% of air carrier accidents stem from weather problems. In general aviation, which includes small planes and corporate jets, more than

80% are caused by weather.

The FAA says it is making progress, installing 37 high tech Doppler radar units at major airports around the country.

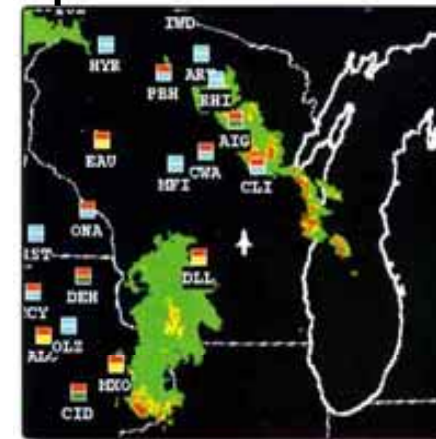
"We agree that improving the quality of weather information is critical," says FAA spokesman Hank Price.

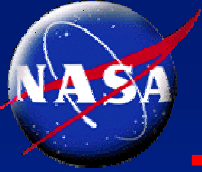
► **Deadly delays, 6A**

Text Printout of Convective SIGMET

MKCC WST 221355
CONVECTIVE SIGMET 49C
VALID UNTIL 1555Z
IL IN KY
FROM IND-30SSW LOZ-60ESE FAM-IND
AREA TS MOV FROM 30030KT. TOPS ABV FL450.
CONVECTIVE SIGMET 50C
VALID UNTIL 1555Z
IL MO
FROM 20N BRL-40N DEC-50NE FAM-30N VIH-20N BRL
AREA SEV TS MOV FROM 29035KT. TOPS ABV FL450.
HAIL TO 1 IN... WIND GUSTS TO 50 KT POSS.
OUTLOOK VALID 221555-221955
FROM ORD-EKN-CLT-DYR-SGF-MKC-DSM-CID-ORD
TS CONTG TO MOVE THRU MID MS VLY/LWR OHIO VLY. AMS ALG/S OF
QSTNRY SFC FNTL BNDRY THRU CNTRL PLAINS SE TO NC CST RMNS MOIST
AND UNSTABLE. S-SWLY FLOW AT LOW LVLS INTSECTG BDRY OVR MID MS
AND LWR OHIO VLYL HELPING TO MAINTAIN TS ACT. SOME WKNNG
PSBL... HOWEVER... EXP NEW DVLPMNT IN THE 15Z TO 18Z HRS.
RFM

Cockpit Weather Presentation



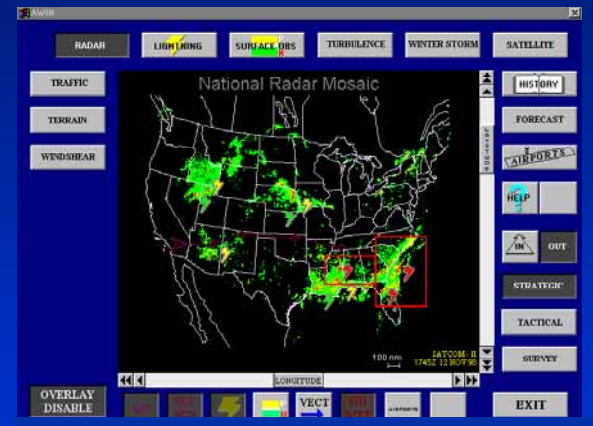


Graphical Weather Technologies for GA and Commercial Aircraft



Weather Information Network (Honeywell-WINN) Avionitek Display in NASA B-757

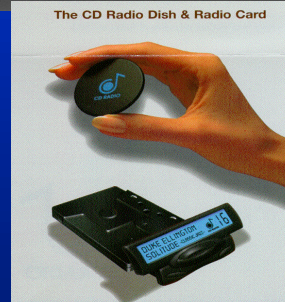
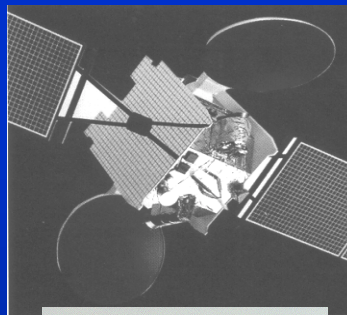
Multi-function Display Installation in General Aviation Cockpit



Implementation of Boeing AWIN cockpit weather display in FedEx MD-11, USAF C-135C, and NC-21



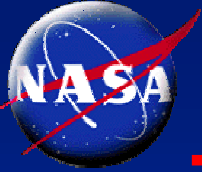
Tethered general aviation weather information system on NASA LaRC BE200 King Air



The Worldspace Afristar Satellite with close-up of a patch antenna



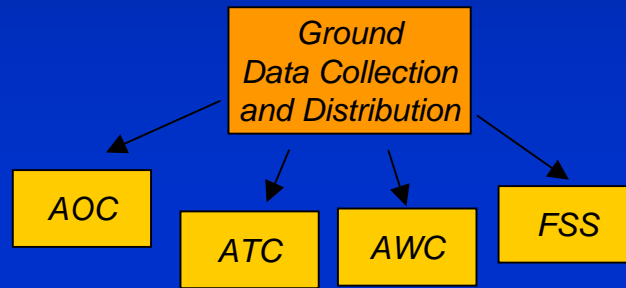
United Airlines in-service evaluations



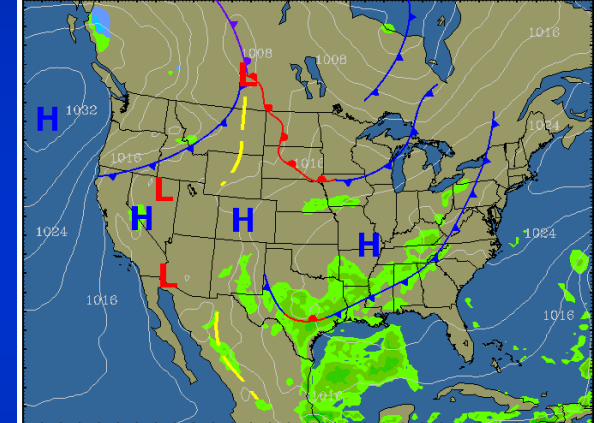
Improving Weather Forecasts



**Airborne
Atmospheric
Sensing and
Data Sharing**



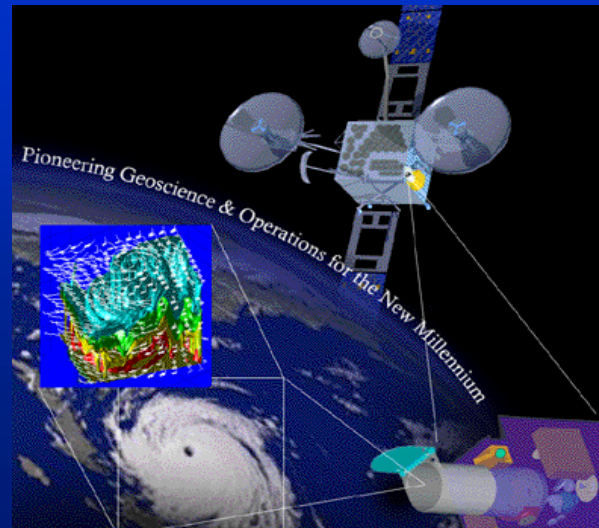
12 hr forecast valid 0000 UTC Wed 09 May 2001



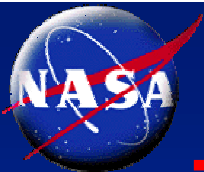
Rain Snow



**Atmospheric
Sensing from
Space**

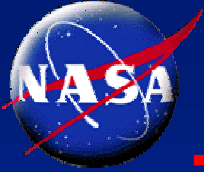


**Greatly
improved input
data for weather
forecasting
model**



Weather R&D Objectives

- Higher resolution/more frequent atmospheric measurements
- More reliable terminal area short term forecasts
- Airborne graphical weather displays and shared airborne/ground decisionmaking for increased safety and approach/departure flow efficiencies



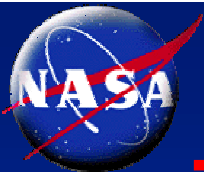
What the need for visibility makes us do

Costs

- ILS ground installations
- ILS/Autoland airborne systems
- Extensive training
- Airfield and approach lighting and real estate
- Aircraft lighting
- Special ops procedures
- Aircraft equipment (artificial horizon, TCAS, EGPWS, HUDS, Nav)
- 200+ foot ATC control towers
- Others . . .

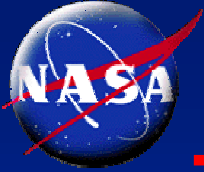
Consequences

- CFIT, obstacle collisions
- Loss of Control accidents (GA, some 121)
- Approach and Landing accidents (low, long, wrong runway...)
- Runway Incursions
- Limited single runway use
- Limited parallel runway use
- Limited airport configuration capacity (i.e., O' Hare/Midway)
- Limited airports (towered, with ILS)
- Others. . .



Benchmark Capacities

Airport	Optimum	Reduced
ATL Atlanta Hartsfield International	185-200	167-74
BOS Boston Logan International	118-126	78-88
BWI Baltimore-Washington National	111-120	72-75
CLT Charlotte Douglas International	130-140	108-116
CVG Cincinnati-Northern Kentucky	123-125	121-125
DCA Washington Reagan National	76-80	62-66
DEN Denver International	204-218	160-196
DFW Dallas-Fort Worth International	264-270	183-85
DTW Detroit Metro Wayne County	143-146	136-138
EWR Newark International	92-108	74-78
HNL Honolulu International	120-126	60-60
IAH Houston Bush Intercontinental	120-123	112-113
JFK New York Kennedy International	88-98	71-71
LAS Las Vegas McCarran International	84-85	52-57
LAX Los Angeles International	148-150	127-128
LGA New York LaGuardia	80-81	62-64
MCO Orlando International	144-145	104-112
MEM Memphis International	150-152	112-120
MIA Miami International	124-134	95-108
MSP Minneapolis-St. Paul International	115-120	112-112
ORD Chicago O'Hare International	200-202	157-160
PHL Philadelphia International	100-110	91-96
PHX Phoenix Sky Harbor International	101-110	60-65
PIT Greeter Pittsburg International	140-160	110-131
SAN San Diego Lindbergh Field	43-57	38-49
SEA Seattle-Tacoma International	90-91	78-81
SFO San Francisco International	95-99	67-72
SLC Salt Lake City International	130-132	95-105
STL Lambert St. Louis International	104-112	64-65
TPA Tampa International	110-119	80-87



The Four Fundamentals

**GPS
(WAAS/LAAS)**

+

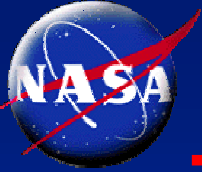
**Precise Traffic
Position
(i.e. ADS-B)**

+

**Digital Terrain/
Airport/Obstacle
Database**

+

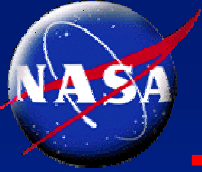
**Processing
and
Display**



Day VMC - all the time



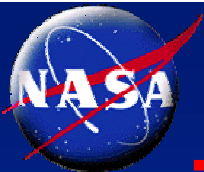
Ashville, NC



Day VMC - all the time



Eagle/Vail, CO

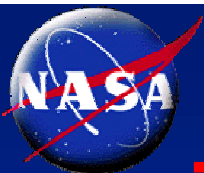


Taxi Map Displays

Simulations, flight tests, and operational evaluations all show:

- taxi time decreases
- elimination of Runway Incursion errors





What These Four Fundamentals Can Yield

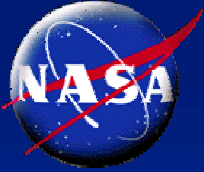
**GPS
(WAAS/LAAS)**

**Precise Traffic
Position
(i.e. ADS-B)**

**Digital Terrain/
Airport/Obstacle
Database**

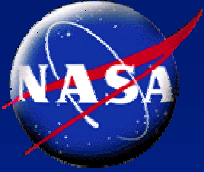
**Processing
and
Display**

- Increase useable airports
 - Increase useable runways
 - Increase arrivals at single runway
 - Increase departures
 - Eliminate CFIT accidents
 - Eliminate Runway Incursions
 - Eliminate visibility-induced GA loss of control
 - Eliminate low-visibility approach errors
- as well as . . .
- Allow visual presentation of NOTAM info
 - Allow pre-approach rehearsals to unfamiliar airports
 - Allow remote, virtual towers for any airport
 - Others . . .



The 6 Key Hurdles for Increased System Capacity

1. Reduce wake vortex separations
2. Increase efficiencies in terminal area weather operations
3. En route airspace management
4. Eliminate visibility/surveillance limitations
5. Use/build more runways
6. Reduce aircraft noise



NASA Research and Development Initiatives in Partnership with the FAA

- Aviation Safety Program
- Aviation System Capacity Program
- Small Aircraft Transportation
System Program
- Aircraft Noise Program