

# ***NSERC***

**National Suborbital Education and Research Center**

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A Cooperative Agreement between the  
**University of North Dakota** and the  
National Aeronautics and Space  
Administration

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# Presentation Outline

- **DC-8 Program Information**
  - DC-8 Capabilities
  - Program Staff
  - NSERC Staff Services
  - FY06 Science missions completed
  - FY07 Science Missions proposed
  - Platform Avionics and Upgrades
  - Data System Upgrade Activities
  - Potential Facility Instrumentation Upgrades
  - DC-8 platform availability

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# Basic DC-8-72 Series Aircraft Specifications

## AIRCRAFT DESCRIPTION

**Crew:** Pilot, Co-Pilot, Flight Engineer, Navigator  
**Cabin:** Up to 40 passengers depending on payload  
**Size:**

**Length:** 157 ft  
**Wingspan:** 148 ft  
**Height:** 48 ft

**Engines:** Four CFM56-2-C1 High Bypass Turbofan Jet Engines  
**Base:** NSERC GFAFB Grand Forks, North Dakota

## PERFORMANCE:

**Altitude Envelope:** 500 - 41,000 feet  
**Range:** 5,400 Nautical miles  
**Endurance:** Up to 12 hours  
**Speed:** 425-490 knots True Air Speed (cruise)  
**Payload:** 30,000 lb

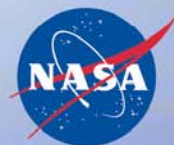
**Electrical Power Available:** ~42 kVA 115 V@60 Hz; 50 kVA 115 V@400Hz

**The combination of altitude, range, endurance, payload and instrument accommodations make the DC-8 a unique research platform**

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## INSTRUMENT ACCOMMODATIONS available on the DC-8

- Zenith and 2-large Nadir Viewports
- 4-upper and 2-lower 62 Degree Viewports with movable shields
- 10 modified experimenter window ports that support larger loads
- 40 standard window ports
- Optical windows of various sizes and materials with mounting flanges
- Air and Aerosol Sampling Probes
- Wing Pylons to accommodate up to 4 wingtip probes
- External Antenna Attachment Mounts
- Standard Equipment 19-inch Racks in 3 different heights
- Laser Chiller Unit accommodation in cargo pits
- ACES cargo pit cooling system
- 2-way aircraft intercom system at all investigator stations
- Aircraft power 5 converter stations for a total of ~42 kVA 115 V 60 Hz
  - Main Cabin 22 Stations 60 Hz and 400 Hz
  - Fwd Cargo PIT 4 Stations 60 Hz and 400 Hz
  - Aft Cargo PIT 4 Stations 60 Hz and 400 Hz



# DC-8 Program Staff

- **NSERC Scientific, Engineering, and Office Staff**

- Program Director
- Configuration and Integration Engineer
- Network Administrator
- Logistics Manager
- Web Development
- Media Development
- Business Manager

- **NSERC Aircraft Flight Crew and Support Staff**

- NASA Chief Pilot
- Highly experienced contract co-pilots, flight engineers, and navigators
- Aircraft Manager
- Avionics and Electronics Lead
- Crew Chief
- Inspector/Quality Assurance Lead
- Engine maintenance specialist
- A+P mechanics
- *\*Plans to add a avionics tech and maintenance manager*

- **NSERC Staff Expertise:**

The flight crew all have in excess of 3000 hours of DC-8 flight time.

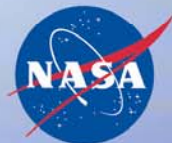
The support staff has more than 70 years aircraft maintenance experience with 37 years on the DC-8

The DC-8 Aircraft Manager has been with the DC-8 aircraft since delivery to NASA in 1986



## DC-8 Program Staff (cont)

- **UND Aerospace provides staffing for the following functions:**
  - Director of Flight Operations
  - Director of Maintenance
  - Quality Assurance Manager
  - Assistant Director Aviation Safety & Security
  - Inventory Control
  - Flight Dispatch Manager
  - Aircraft Information Management System
- **NASA Dryden currently provides staffing for the following positions:**
  - NASA DC-8 Chief Pilot
  - DC-8 Air Force Navigators
- **NASA Wallops currently provides staffing for the following functions:**
  - Airborne Science Catalog Manager
  - NASA COTR for UND Cooperative Agreement
  - DC-8 Mission Manager/On site surveillance
  - Air Worthiness Review Board
  - Maintenance Oversight
  - Aircraft Safety Oversight





# NSERC STAFF SERVICES

- **Program Management**
  - Feasibility analysis
  - Panel review participation
  - MPC budget preparation and analysis
- **Engineering and Instrument Integration**
  - Compilation of PI instrument requirements
  - Design of payload floorplan
  - Design and analysis of instrument interface requirements including equipment mounting racks, brackets, and probes
  - Preparation of engineering package for Airworthiness Review Approval
  - Fabrication of instrument components and mounting hardware
  - Pre-installation testing of components
  - Installation of all probes, windows, racks and brackets
  - Installation of power, signal, and data wiring
- **Risk and Hazard Management**
  - Risk and hazard analysis of all payload components
  - Design of a Ground Safety Plan
  - Preparation of hazard mitigation package for Airworthiness Review Approval
  - Hangar, hazard, and DC-8 operations safety briefings for all experimenters
- **Flight Planning**
  - Pilot and navigator participation in science and flight planning meetings
- **Logistics and Other Services**
  - Experimenter security and badging for hangar access
  - Logistics assistance for experimenter travel and shipping for integration site
  - Internet, phone, printing, and copying services during instrument integration



# DC-8 Program FY 06 Completed Missions

- **Stardust** 16.5 Flight Hours
- **INTEX-B** 143 Flight Hours
- **NAMMA** 119 Flight Hours

**FY06 278.5 Total Flight Hours**

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# STARDUST

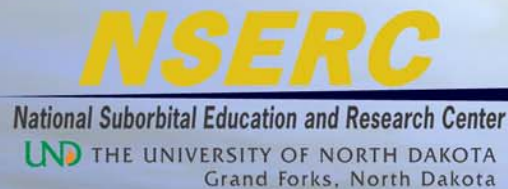
## Goals

- Test thermal protection for space capsule re-entry
- Probe delivery of organics by re-entry of natural objects
- PI Instruments: 11 spectrometers and high resolution cameras
- Dates: January 4-16, 2006
- Flight hours: 16.5
- Results: Outstanding success

Stardust capsule entering the atmosphere



Stardust instrument payload



# INTEX-B

## INTERCONTINENTAL CHEMICAL TRANSPORT EXPERIMENT Phase B

### Goals

- Study the transport and transformation of pollution from Mexico City to the US
  - Collaboration with NSF scientists on the MIRAGE mission
  - Study the transport and transformation of pollution plumes from Asia to the US
  - Instrument Intercomparison flights with the NSF C-130 research aircraft
- 
- PI Instruments: 26 instruments from 3 NASA centers, NCAR, and 8 university research groups
  - Dates: January 17-May 22, 2006
  - Flight hours: 143
  - Results: All 3 deployments very successful

NASA DC-8 and NSF C-130 during an intercomparison flight





# NAMMA

## NASA AFRICAN MONSOON MULTIDISCIPLINARY ANALYSES Mission

### Goals

- Characterize the evolution and structure of African Easterly Waves and Mesoscale Convection Systems
  - Characterize the impacts of AEWs and MCS on the water and energy budgets
  - Study the influence of Saharan dust events on the processes
  - Instrument Intercomparison flights with the UK BAE-146 for dust
- PI Instruments: 15
  - Dates: July 5-August 22, 2006
  - Flight hours: 118
  - Results: Deployment very successful

DC-8 taking off in Cape Verde



UK BAE-146 during intercomparison



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# DC-8 on science missions



In flight over the Atlantic



Takeoff in Hawaii



Landing in Kiruna, Sweden



On the ground at Hong Kong



# DC-8 FY 07 Upcoming Missions

- **TC-4 Costa Rica**

- 128 Flight Hours requested
- Instrument Integration starts in late May
- Deployment mid-July to mid-August 2007

- **Flight Request for Aurgids Meteor Showers**

- 7 Flight Hours requested
- Aircraft costs estimate requested by PI
- Identical payload to Stardust
- Upload by August 25, 2007
- Mission September 1, 2007
- Funding is not secured by PI Peter Jenniskens

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# AIRCRAFT AVIONICS

- **Current Systems**
  - Flight Management System version 1-B
  - RVSM (Reduced Vertical System Minimums) Compliant
  - TCAS (Traffic Collision Avoidance System) Installed
  - 3 VHF Radios- 8.33 Channel Spacing Equipped
  - 2 UHF Radios
  - 2 HF Radios
  - Stormscope Equipped
  - GPS Equipped
  - DME and Tacan Equipped
  - Dual INS Equipped
- **Upgrades that will be completed by April 2007**
  - New Flight Management System from 1-B to 1-F
  - New Terrain Awareness Warning System to meet FAA requirements
  - New Digital Aircraft Flight Recorder to meet FAA requirements
  - New Navigation Units with FM Immunity to meet European Standards
  - New Digital COMM / NAV Control Panels
  - New IRIDIUM air/ground communications for Flight Crew

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# Instrument Accommodation Upgrades

- Wing tip probe upgrades
  - Purge gas lines added to all four pods
  - New 12 gauge shielded wiring run to all four pods to accommodate new higher current probe requirements
  - Quadrex ethernet wiring run from the cabin to wingtip pods to accommodate high speed data transfer

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# New DC-8 Data Acquisition and Display System

- This is a joint effort with Dryden Global Test Range staff
  - New system includes:
    - REVEAL data acquisition system
    - IRIDIUM based satcom system
    - X-chat capability with ground
    - New gigabit ethernet based data display system
    - Backward compatibility with RS-232 data stream
    - High resolution LCD displays
    - Dedicated Mission scientist station
      - Multiple high resolution LCD screens
    - Digital video system
      - High resolution PoE video cameras
      - Server recording of AVI files
      - Ethernet availability of AVI files

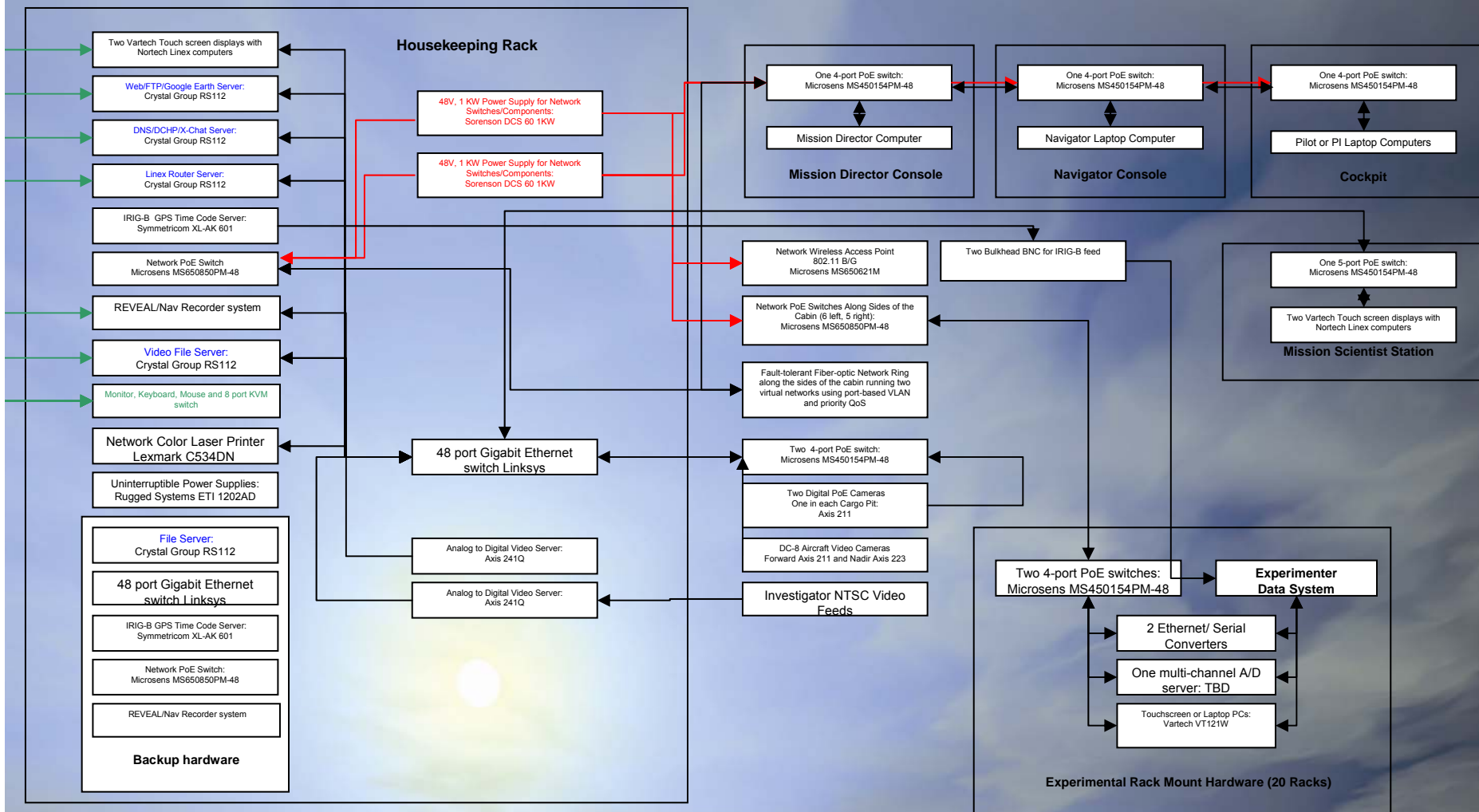
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# New DC-8 Data System Upgrade Schematic



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# Advantages of the Next Generation DC-8 Data Display System

## Data distribution

- High resolution of web based touchscreen LCD monitors in cabin

- Multiple high resolution touchscreen monitors in Housekeeping rack

- Rack space minimized for monitors and network equipment

- Data distribution entirely on fiber network behind aircraft overheads

- Cockpit and navigator's station will be web based display capable

- Digital video acquisition and recording

- Ability to easily search digital video files for events at specific time

- Ability to monitor cargo pit activities from mission console

- Video files available immediately on server or on DVD after any flight

## Space and personnel requirements for web based system

- Housekeeping rack contains the data acquisition hardware so no

  - DC-8 rack is required for data services in the main cabin

- Onboard operator will not be required in the future

## Mission Scientist facility

- Multiple high resolution displays

- X-chat capability with ground based scientists

- Mission Scientists have dedicated station to minimize interruption



# New Facility Instrumentation Enhancement Candidates

- **IRIDIUM communications in cabin for scientific staff**
- **Rosemount Icing Detector (Goodrich Aircraft Systems)**
- **Horizontally stabilized zenith and nadir platforms for radiometric instrumentation**
- **UV Ozone Detector (Thermoelectron Model 49i)**
- **Carbon Monoxide Detector (commercial unit with limited sensitivity)**
- **Aircraft-Integrated Meteorological Measurement System (Aventech Research) with Air Data Probe, IMU, and Altitude Heading and Reference System**
- **Solicitation of suggestions from Airborne Science Community**



# DC-8 Availability in Future

- **FY07**

**TC-4 Costa Rica**

128 Flight Hours requested  
Instrument Integration starts in late May  
Deployment mid-July to mid-August 2007

**Flight Request for Aurgids Meteor Showers**

7 Flight Hours and requested  
Aircraft costs estimate requested by PI  
Identical payload to Stardust  
Upload by August 25, 2007 Mission September 1, 2007  
Funding is not secured by PI Peter Jenniskens

- **FY08**

**Planning for ARCTAS IPY (2 deployment mission)**

Mid-February to late July 2008

- **Beyond**

**Inquiry from NSF for DC3 mission joint with NSF G V aircraft  
Possibly with NASA TCP participation**

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