

IMPS, DWLs, DIALs and the NIA

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NASA LaRC National Institute of Aerospace

Stratospheric/Tropospheric Science Initiatives

Lead Institution: UVA (Emmitt)

Member Institutions

UVA, UMD, VPI, NCSU, NCAT, & GIT

National Institute of Aerospace

- NASA initiative to create a world-class aerospace and atmospheric institute
- Located at LaRC
- Academic partners: UVA, VPI, UMD, NCSU, NCAT and GIT
- 5-20 year plan @ ~\$10-12M/year
- MS and PhDs in science and engineering
- Distinguished professorships

Six Initial Research Scenarios

Scenario #1: Biologically Inspired, Nano-Structured,
adaptive-Controlled Materials and Morphed Concepts

Scenario #2: Global/Orbital Transport—Hypersonic Cruise
Airplane and Space Access Vehicle Concepts

Scenario #3: Sub-Orbital Atmospheric Observing Networks based
upon Integrated Model Platform Sensors (IMPS)

Scenario #4: Dual Relevance Technology Maturation for
Quiet Supersonic Aircraft

Scenario #5: Technology Integration of Personal Air Vehicles (PAVs)
into the National Airspace System (NAS) Utilizing
Small Aircraft Transportation System(SAT) Technologies

LaRC AtSC/NIA_AS Initiatives

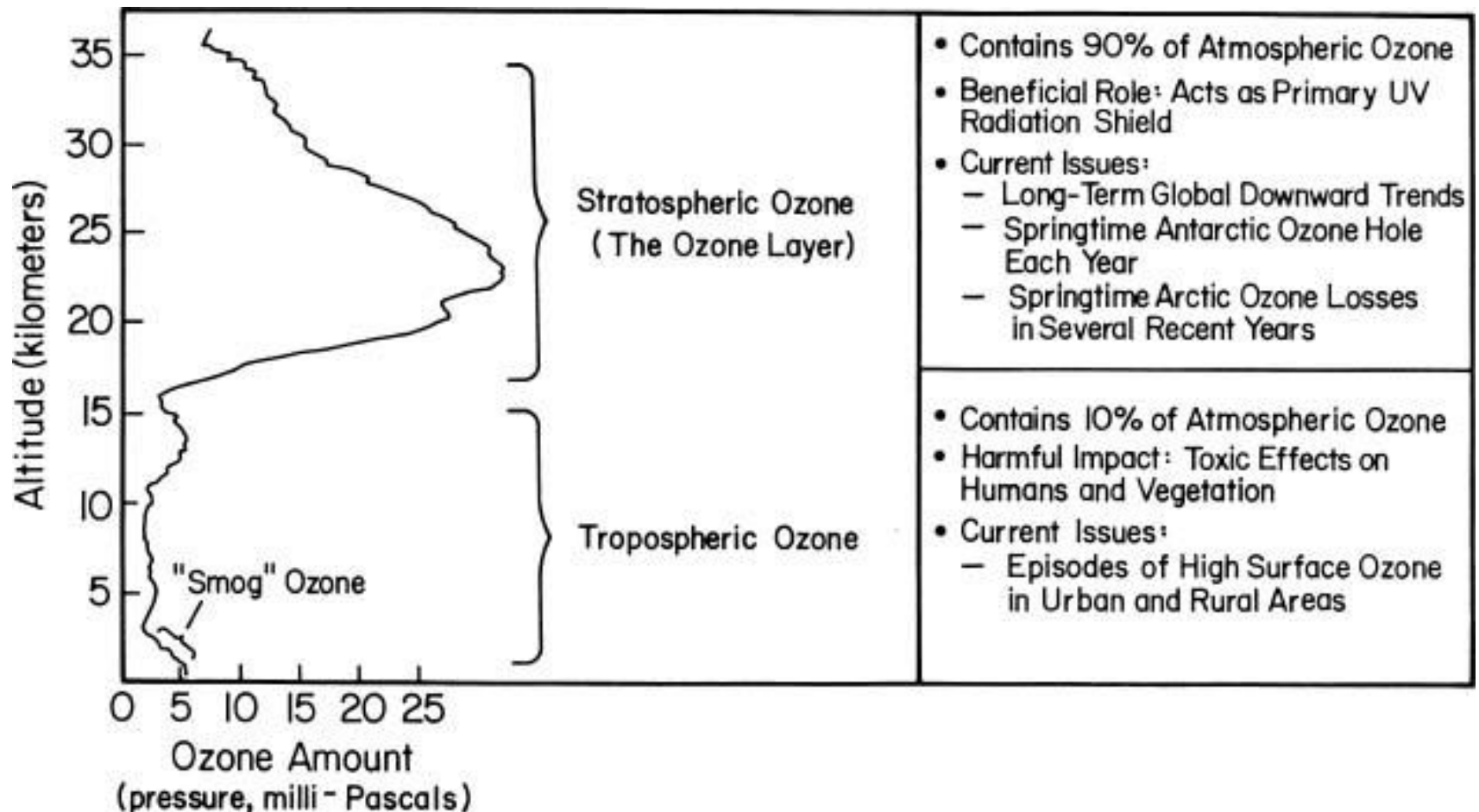
Code Y Strategic Plan directed (funded) activities within the NIA will be closely aligned with those ongoing within the AtSC. The NIA_AS efforts will be complimentary and not competitive. The NIA_AS projects will involve research in those areas best represented by the member institutions of the NIA as determined by some form of peer review and NIA_AS board oversight. Some research carried out within the NIA will be crosscutting Code Y and Code R programs. One example is S #3 submitted in the proposal.

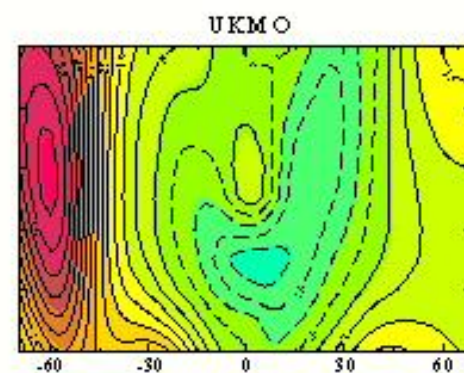
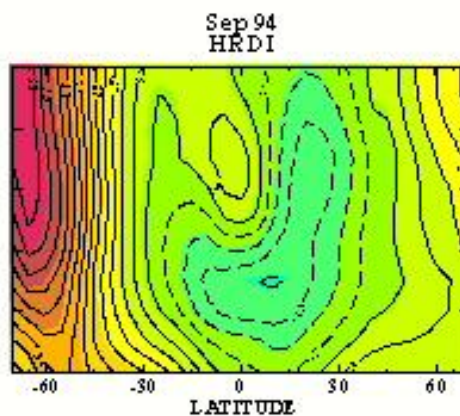
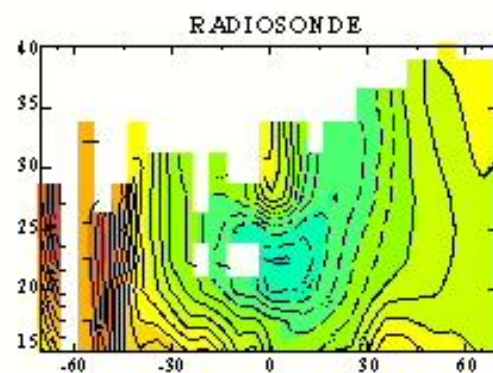
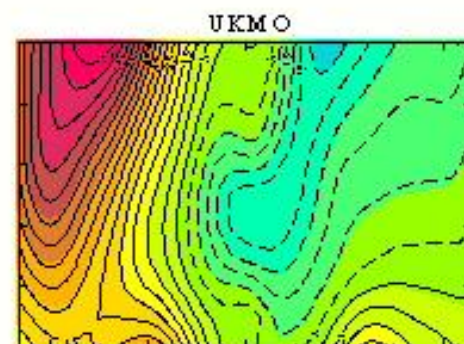
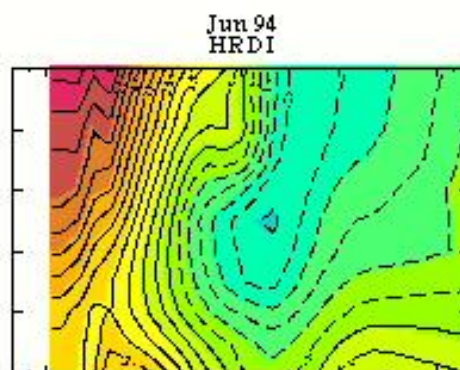
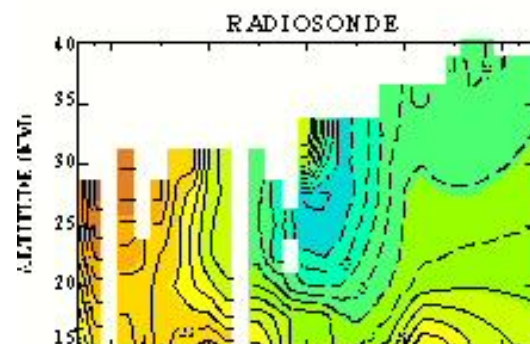
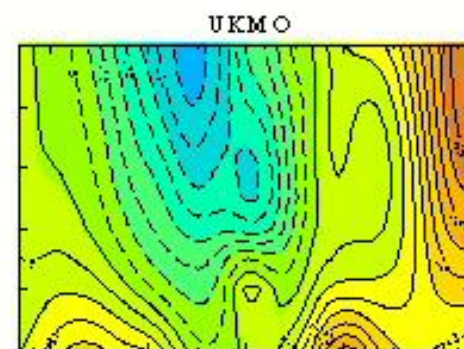
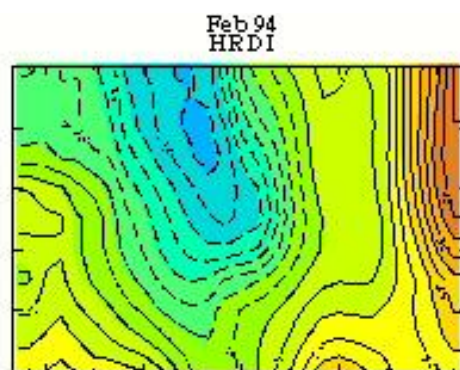
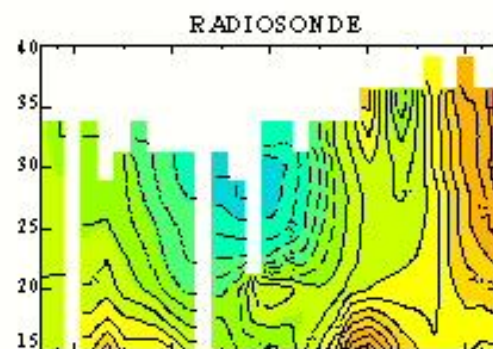
AtSC = Atmospheric Science Competency

NIA_AS = National Institute of Aerospace_Atmospheric Sciences

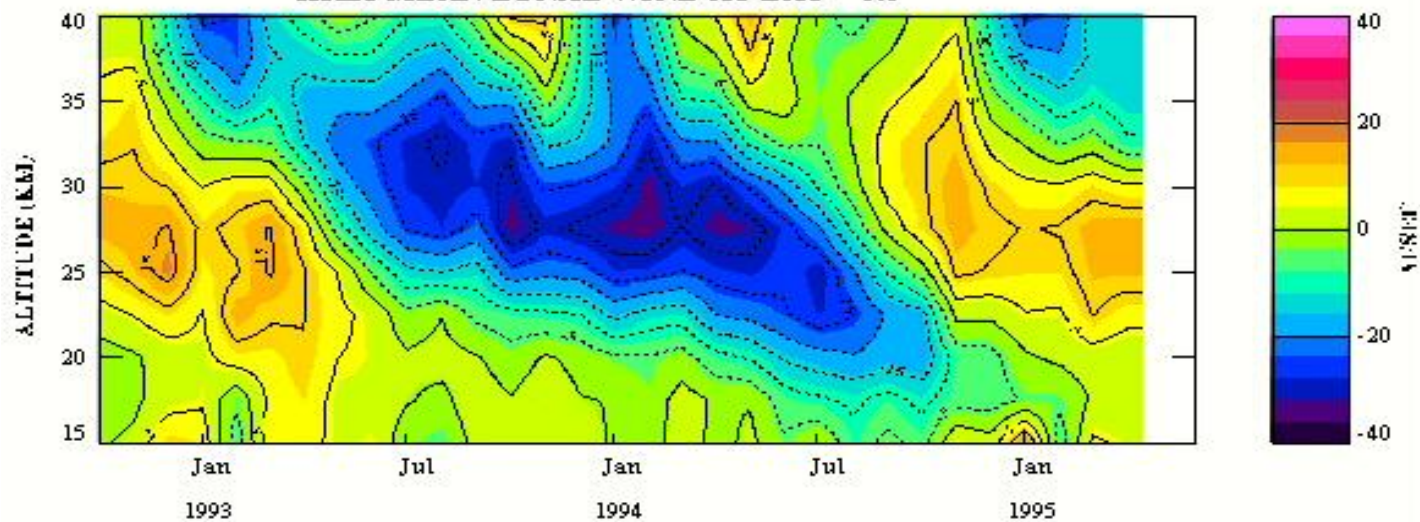
Science Issues

- Atmospheric Chemistry --Ozone depletion along with other atmospheric chemistry processes including water vapor
- Radiation --- climate change
- Aerosol physics -- radiation budget impacts
- Trans tropopause exchange--- tropospheric weather impacts; modeling and data assimilation

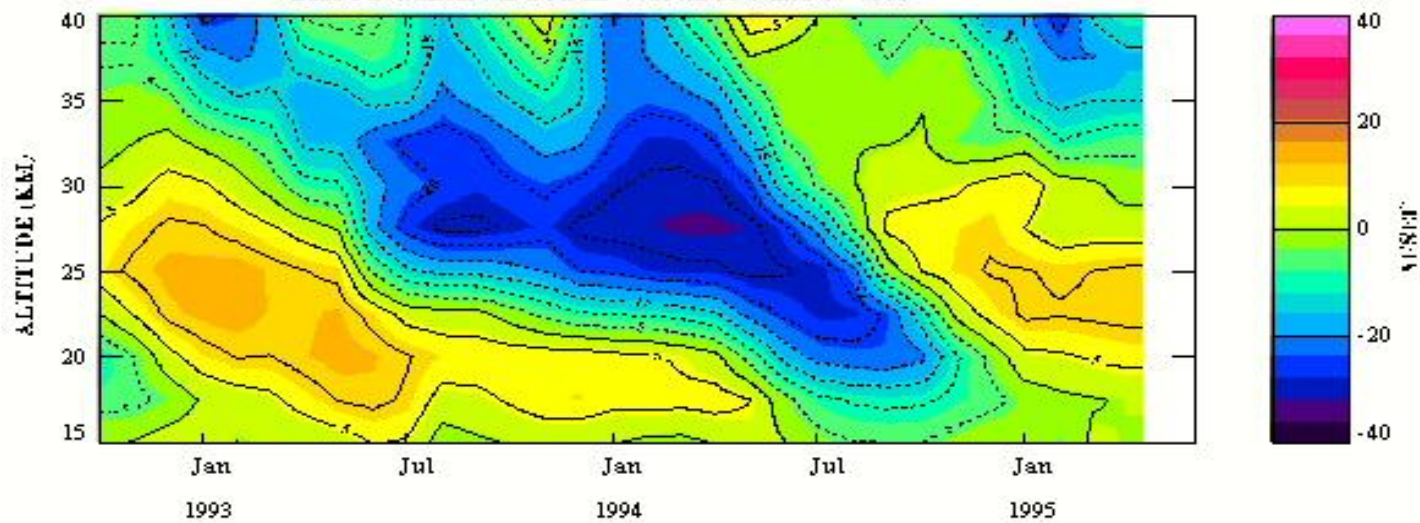




HRDI MEAN ZONAL WIND AT LAT= 0.0



UKMO MEAN ZONAL WIND AT LAT= 0.0



Weather predictions

Changes in the stratosphere, the atmospheric layer from six to 30 miles up, usually take a week or more to work their way down to where they affect weather, giving forecasters some lead-time. Once the changes affect the weather, they tend to last as long as two months.

Our understanding of the role of the stratosphere in weather and climate could be compared to our knowledge of El Niño 20 years ago. (Dunkerton, 2001)

Data for today's research

SAGE

Stratospheric Aerosol and Gas Experiment



Concentrations of chemically-active and man-made gases containing chlorine, bromine, and fluorine in the stratosphere have increased dramatically and cause destruction of ozone which is needed to shield the Earth from harmful ultra-violet radiation.

Understanding how changes to the atmosphere such as these may affect our climate is not clear. Accurate and precise measurements are needed to unravel complex and interactive relationships between chemical, radiative, and dynamical processes in the atmosphere, ocean, and on land.



Network for the Detection of Stratospheric Change (NDSC)

DIAL

Microwave Ozone

Ozone sondes

UV/VIS Spectrometer

FTIR

Aerosol sondes



NASA's Scientific Balloon

3600Kg; 46Km; 2 weeks

Scientific Balloons...

1. can be launched from locations worldwide to support scientific needs.
2. can be readied for flight in as *little as six months.*
3. offer a low-cost method of conducting science investigations.
4. provide a stable platform for longer flight duration.

Tomorrow

第2回成層圏プラットフォームワークショップ



Helios

<500Kg; 30Km; Months



Day after tomorrow

An NIA S/T I and aeronautics
integrated research initiative (S #3):

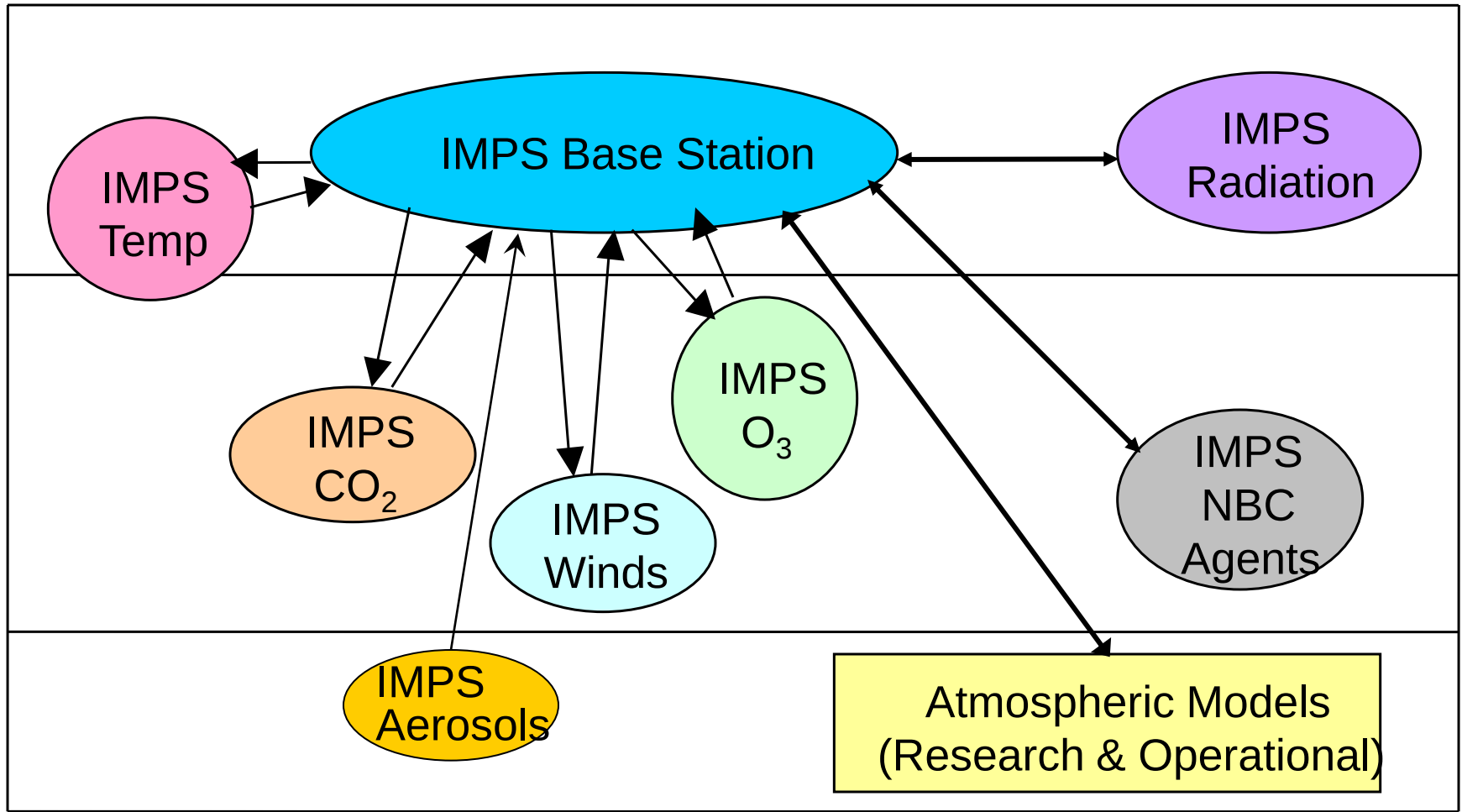
Atmospheric observing networks
based upon Integrated Model
Platform Sensors (IMPS)

G. D. Emmitt, Lead
University of Virginia

The Vision

- The Scenario #3 team envisions technology and research/operations algorithm development leading to fully Integrated Model Platform Sensors (IMPS) concepts that will enable both bi-directional (model/observing systems) adaptive targeting and autonomously-coordinated self-positioning of a constellation of sub-orbital observing systems.

The Vision



The Approach (FY03)

- Develop observational requirements that will be used by the scenario team to develop conceptual level technology requirements.
- Construct roadmaps for achieving the needed advances in material sciences, propulsion, flight control, sensors and bi-directional integration of models and observing systems.
- Identify new modeling paradigms to guide airborne observation systems and vice versa.

FY03 Research Objectives: S#3

- **Advanced understanding of key atmospheric processes**
 - Scenario #3 team meeting to draft science objectives and observational requirements
 - Identify and prioritize key observations (e.g., ozone, aerosols, NBC agents)
 - Hold broad community workshop
 - Issue documented observational requirements for stratospheric dynamics and chemistry
 - Define modeling requirements to guide airborne observations
- **Atmospheric and vehicle sensor systems**
 - Identify needed instruments and associated advances
 - Issue an RFP within the NIA for instrument design and prototyping
- **Enabling Technologies**
 - Revolutionary vehicles and systems
 - Identify key technologies needed to achieve the observation goals
 - Innovative flow management
 - Identify advances needed in propulsion
 - Advanced structures and materials
 - Identify necessary advances in structures and materials
 - Airborne systems for planetary-like atmospheres
 - Identify needed advances in flight control
 - Atmospheric and vehicle sensor systems
 - Identify needed instrument advances

Scenario #3 Research Team

Year 1 Task	Lead PI	Supporting co-PIs
1. Define science objectives and observation requirements	D Emmitt (UVA)	J Curry (GIT) JD Fuentes (UVA) M Garstang (UVA)* E Browell (LaRC)* Kavaya (LaRC)*
2. Establish airborne observation priorities	R Hudson (UMCP)	M Garstang (UVA)* E Park (NCAT) V Saxena (NCS)
3. Document observation requirements	D Cunnold (GIT)	J Sankar (NCAT) R Hudson (UMCP) E Browell (LaRC)* Kavaya (LaRC)*
4. Define data assimilation and numerical paradigms	V Saxena (NCS)	E Kalnay (UMCP) R Dickeson (GIT) JD Fuentes (UVA)*
5. Identify key technologies	AD Kelkar (NCAT)	D Emmitt (UVA) R Nagle (NCS) E Browell (LaRC)*

*: May not require funding for this task