INDUSTRY DAY
PRE-SOLICITATION CONFERENCE

Aeronautics and Exploration Mission Modeling and Simulation (AEMMS)

NASA Ames Research Center
MOFFETT FIELD, CA 94035-0001

November 5, 2014

Agenda

- 9:30am - 10:00am Registration
- 10:00am – 10:30am Procurement Process Overview
  - Naomi Castillo-Velasquez, Contracting Officer
  - Marie Z. Morales, Contract Specialist
- 10:30am – 11:30am Statement of Work Overview
  - Francisco J. Torres, Contracting Officer's Rep.
  - Ted A. Manning, Aerospace Engineer, NASA
  - Mark A. Potsdam, Senior Research Scientist, Army

Purpose

This Industry Day/Pre-Proposal Conference is intended to:

- Familiarize participants with the AEMMS Statement of Work (SOW) requirements;
- Provide the current status of the AEMMS acquisition;
- Permit potential Offerors an opportunity to network and discuss teaming or subcontracting arrangements;
- Allow potential Offerors an opportunity to submit questions regarding the recently posted Draft Request for Proposal; and
- Allow industry representatives an opportunity to ask questions pertaining to the AEMMS requirements.

General Guidance

- These slides shall not be interpreted as a comprehensive description of the Government's requirements. Please refer to the Draft Statement of Work and Draft Request for Proposal.
- Nothing discussed at this pre-proposal conference shall be construed as a revision to the Draft Request for Proposal.
- If there are any inconsistencies between this presentation and the Final Request for Proposal, the Final Request for Proposal will govern.

Blackout

- Communications blackout period will be invoked when the Final RFP issued.
- All communications with industry concerning this acquisition will then be with the Contracting Officer only.
- The “blackout” period for communication with industry will continue until contract award.

Electronic Posting

All documents pertaining to the AEMMS Procurement, including this presentation, the attendance list, and all questions, can be found at the following links by searching the solicitation number ***NNA14502291R*** or the procurement title, ***Aeronautics and Exploration Mission Modeling and Simulation (AEMMS)***:

NASA Acquisition Internet Service (NAIS) Business Opportunities:

https://prod.nais.nasa.gov/cgibin/eps/bizops.cgi?gr=D&pin=21&=

AND

Federal Business Opportunities (FBO):

https://www.fbo.gov/index?s=opportunity&mode=list&tab=list&tabmode=list&=

FOIA Requests

- The current contract is NNA10DF26C, which has a performance period of August 1, 2010 through July 31, 2015.
- NASA ARC FOIA Electronic Reading Room: http://www.nasa.gov/centers/ames/business/foia/elec.html
- Freedom of Information Act (FOIA) Requests may be submitted electronically to Lubna M. Shirazi at foia@arc.nasa.gov
- No proprietary information will be disclosed.

Questions

- Oral questions will be permitted at the end of the presentation.
- There are Question Forms at the sign-in table that may be used to write your questions.
- All questions, both oral and written, will be posted with official answers on the NAIS and FBO websites periodically in a timely manner.
- All questions related to this pre-proposal conference or the Draft Request for Proposal must be submitted to naomi.castillo-velasquez@nasa.gov no later than November 20, 2014.

Planned Award Information

- Intent is to award a single Cost-Plus-Fixed-Fee (CPFF) Contract

- Potential 5-year contract period of performance:
  - Two-year Base Period
  - Three one-year Option Periods

Acquisition Schedule (Tentative)

• *Synopsis Issued*	*April 8, 2014*
• *Draft RFP Issued*	*October 27, 2014*
• Industry Day/Pre-Proposal Conference	November 5, 2014
• One-on-one Meetings	November 5-6, 2014
• Questions/Comments Due	November 20, 2014
• Issue Final RFP	December 5, 2014
• Receipt of Proposals	February 3, 2015
• Contract Award	May 8, 2015

Please Note:

- There will be an update to the Draft RFP soon.
- These dates are subject to change. Updated milestones will be provided if necessary.

General Procurement Information

NASA may award a contract based solely on the initial offers received, without discussion of such offers. The initial proposals to the Government should contain the most favorable terms from a price and technical standpoint.

The terms of the Solicitation and Statement of Work will remain UNCHANGED, once posted as a final RFP, unless the Solicitation is amended in writing.

If Offeror's intent is to take exceptions to terms and conditions after proposal receipt, the proposal may be found ineligible for award and excluded from competition.

Proposal Preparation

- Proposals shall be prepared in accordance with the Final RFP and subsequent written Amendments, if any.

- Ensure that all Amendments are acknowledged with the proposal submission.

Proposal Preparation (Cont'd)

- Section L.6 - PROPOSAL PREPARATON—GENERAL INSTRUCTIONS - Outlines the information required to be included in the proposal:

  Cover Letter
  Volume I, Mission Suitability Proposal;
  Volume II, Past Performance Proposal;
  Volume III, Cost Proposal.

- Section L.7 - PROPOSAL PAGE LIMITATIONS - Outlines the page limits associated with various proposal sections and will be strictly enforced.

Source Evaluation Process

As stated in Draft RFP Section M, there will be three (3) Evaluation Factors:

FACTOR 1 – MISSION SUITABILITY

FACTOR 2 – PAST PERFORMANCE

FACTOR 3 – COST/PRICE

- The Mission Suitability Factor is evaluated at the subfactor level and is the only factor scored.
- The Past Performance Factor is evaluated and given a Confidence Rating
- The Cost/Price Factor is evaluated, but not scored

Source Evaluation Process (cont'd)

Relative Importance of Evaluation Factors

Of the evaluation factors identified above, Mission Suitability is moderately more important than Past Performance, and Past Performance is moderately more important than Cost. Mission Suitability and Past Performance when combined are significantly more important than Cost.

Evaluation Factors

Mission Suitability (Factor)

- The Mission Suitability Factor has a potential of 1000 points.
- The Mission Suitability Factor consists of two Subfactors that are numerically scored:

Subfactor 1 - Management Approach – 550 Points

Subfactor 2 - Technical Approach – 450 Points

Ames Research Center

Evaluation Factors (cont'd)

Past Performance (Factor)

- NASA will evaluate each Offeror's current/recent record of performing services or delivering products that are similar in size, content, and complexity to the requirements of this solicitation using the Level of Confidence ratings.

- Includes Significant Subcontractors (defined in Section L)

Evaluation Factors (cont'd)

Cost/Price (Factor)

- The overall cost for selection purposes will be the sum of the cost proposed for Contract Management (CLINs 01A, 02A, 03A, and 04A) and IDIQ (CLINs 01B, 02B, 03B, and 04B).
- Phase-In (CLIN 01) will not be included in the evaluated total cost for selection purposes, but it will be evaluated for reasonableness and realism.
- Evaluation of options shall not obligate the Government to exercise such options.

Statement of Work Overview

NASA Ames Research Center

Missions Supported by AEMMS

ATTREX
NASA
Airborne Tropical Tropopause Experiment
Dryden Flight Research Center Gram USA

U.S. ARMY
AMRDEC

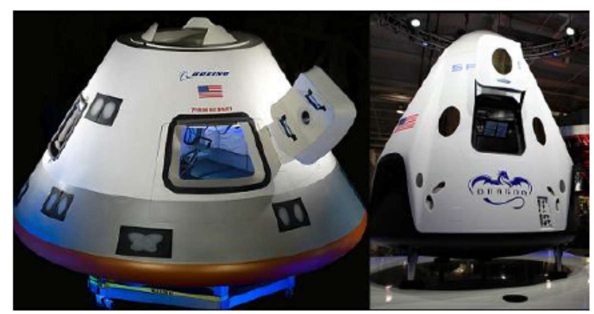
DOD HPC MODERNIZATION PROGRAM
CREATE


Environmental Responsible Aviation (ERA)

SPACE PORTAL
for enterprise and commerce


orion

COMMERCIAL CREW PROGRAM



NASA Ames Research Center

- **Office of the Director (Code D)**
  Director: S. Pete Worden
  - **Aeronautics Directorate (Code A)**
    Director: Thomas A. Edwards
    - **Systems Analysis Office (Code AA)**
      Chief: Mary E. Livingston
    - **Aeromechanics Office (Code AV)**
      Chief: William G Warmbrodt
  - **Exploration Technology Directorate (Code T)**
    Director: Eugene L. Tu
    - **NASA Advanced Supercomputing Division (Code TN)**
      Chief: Piyush Mehrotra
      - **Applied Modeling and Simulation Branch (Code TNA)**
        Chief: Cetin C. Kiris
      - **Fundamental Modeling and Simulation Branch (Code TNF)**
        Chief: Terry L. Holst
  - **Science Directorate (Code S)**
    Director: Michael D. Bicay
    - **Earth Science Div. (Code SG)**
      Chief: R. Stephen Hipskind
      - **Atmospheric Science Branch (Code SGG)**
        Chief: Warren J. Gore
    - **Space Biosciences Division (Code SC)**
      Chief: Sid Sun
      - **Bioengineering Branch (Code SCB)**
        Chief: Mark H. Kliss
  - **Partnerships Directorate (Code B)**
    Director: Gary L. Martin
    - **Space Portal (Code BP)**
      Chief: Daniel J. Rasky
- **Army Flight Dynamics Directorate (Code Y)**
  Director: Barry R. Lankinsmith
  - **Associate Director of Science & Tech.**
    Thomas H. Maier
    - **Computational Aero-mechanical TA**
      Roger C. Strawn
  - **Aviation Advanced Design Office:**
    Gerardo F. Nunez

Statement of Work

There are 8 sections within the Statement of Work

- Section 1: INTRODUCTION
- Section 2: SCOPE OF WORK
- Section 3: APPLICABLE DOCUMENTS
- Section 4: REQUIREMENTS (Contract and Technical)
- Section 5: DELIVERABLES AND REPORTS
- Section 6: EMERGENCY PREPAREDNESS AND RESPONSE
- Section 7: SECURITY REQUIREMENTS
- Section 8: PHASE-IN AND PHASE-OUT

Scope of Work

- The known minimum support needed in the next five years of contract performance will encompass the requirements for Contract Management (SOW Section 4.1).
- The IDIQ work will address currently unknown, but expected, requirements. The IDIQ task orders will be issued to address research and development projects that span across several integrally-related technical areas. The IDIQ encompasses requirements within eight key technical areas (Section 4.2 of SOW):
  - Systems Analysis Office (SOW Section 4.2.1)
  - NAS Division Requirements (SOW Section 4.2.2)
  - Computational Fluid Dynamics Applications for Rotary-Wing Vehicles (SOW Section 4.2.3)
  - Rotorcraft Aeromechanics Research and Development (SOW Section 4.2.4)
  - Airborne Tropical Tropopause Experiment (ATTREX) Mission Modeling and Simulation (SOW Section 4.2.5)
  - Physics-Based Modeling and Simulation of Potential Spacecraft and Mission Scenarios for Innovative Space Commercialization (SOW Section 4.2.6)
  - Concept Design and Assessment Focus Area Contractor Support (SOW Section 4.2.7)
  - Advanced Life Support Water Recycling Technology Modeling (SOW Section 4.2.8)
- Place of Performance:
  - The majority of the work will be performed on-site at NASA Ames, but the multidisciplinary nature of the work will require occasional support to be provided at other NASA Centers, or other installations if needed, in order to complete the mission.

Statement of Work (cont'd)

SECTION 4.1 CONTRACT MANAGEMENT REQUIREMENTS

- SECTION 4.1.1 Resource Tracking
- SECTION 4.1.2 Contract Compliance
- SECTION 4.1.3 Workforce Management and Allocation
- SECTION 4.1.4 Workforce Training
- SECTION 4.1.5 Risk Management
- SECTION 4.1.6 Health, Safety and Environmental
- SECTION 4.1.7 Quality Management and Assurance
- SECTION 4.1.8 Government Property Management
- SECTION 4.1.9 Travel Management
- SECTION 4.1.10 Resource Acquisition
- SECTION 4.1.11 Staffing Level Management
- SECTION 4.1.12 Employee Background Checks and Clearances

Statement of Work (cont'd)

IDIQ Section: SECTION 4.2 TECHNICAL REQUIREMENTS

- SECTION 4.2.1 Systems Analysis Office
- SECTION 4.2.2 NAS Division Requirements
- SECTION 4.2.3 Computational Fluid Dynamics Applications for Rotary-Wing Vehicles
- SECTION 4.2.4 Rotorcraft Aeromechanics Research and Development
- SECTION 4.2.5 Airborne Tropical Tropopause Experiment (ATTREX) Mission Modeling and Simulation
- SECTION 4.2.6 Physics-Based Modeling and Simulation of Potential Spacecraft and Mission Scenarios for Innovative Space Commercialization
- SECTION 4.2.7 Concept Design and Assessment Focus Area Contractor Support
- SECTION 4.2.8 Advanced Life Support Water Recycling Technology Modeling

SOW Technical Requirements Mapping
NASA Ames Research Center

Aeronautics and Exploration Mission Modeling and Simulation (AEMMS)

Aeronautics Directorate (Codes AA, AV)	Exploration Directorate (Codes TNA, TNF)	Science Directorate (Code SGG, SCB)	Partnerships Directorate (Code BP)	Army Aeroflightdynamics Directorate (Code Y)
Section 4.2.1 Systems Analysis Office 4.2.1.1 Integrated Environ. 4.2.1.2 Vehicle Design **Section 4.2.4 Rotorcraft Aeromech. Office** 4.2.4.2 Rotary Wing Methods 4.2.4.3 Technology Transfer 4.2.4.4 Testing	**Section 4.2.2 NAS Division Tasks** 4.2.2.2 CART3D Mesh Opt. 4.2.2.3 LAVA 4.2.2.4 LCTR2 4.2.2.5 Risk 4.2.2.6 CART3D Aerostructural	**Section 4.2.5 Atmospheric Science Branch** 4.2.5.2-6 ATTREX **Section 4.2.8 Bioengineering Branch** 4.2.8.2 Water Recycling Technology Development 4.2.8.3 Bio-Membrane 4.2.8.4 Green Building Modeling	**Section 4.2.6 Space Portal Office** 4.2.6.2 Space Commercialization Activities	**Section 4.2.3 Aeromechanics Div. Rotary Wing CFD** 4.2.3.2 Helios Applications 4.2.3.3 Dynamics and Trim 4.2.3.4 Helios Maintenance 4.2.3.5 Helios Developm't **Section 4.2.7 Advanced Design Office** 4.2.7.2-4 Subj. Matter Expert

SOW SECTION 4.2.1 Systems Analysis Office

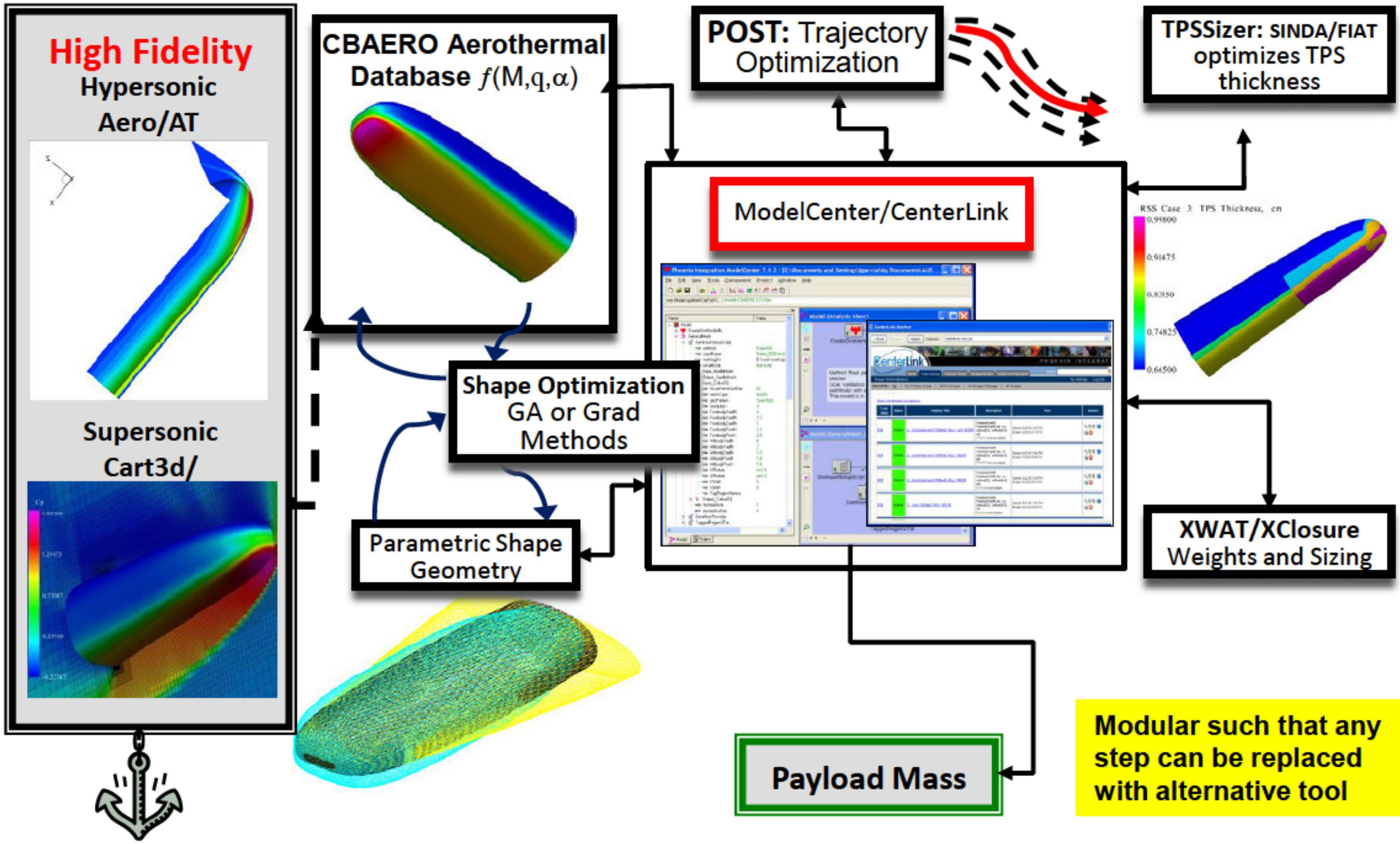
- Focuses on the development, test, application and evolution of computational modeling and simulation tools and technologies for system and vehicle conceptual analysis and design.
- Develops tools and integrated processes to enable new analysis methods in support of technology portfolio, vehicle, and mission analysis.
- Develops technologies and tools using high end computing for mission simulation and vehicle design, which are applied to advanced aerospace vehicle and system concepts.

- 4.2.1.1 Integrated Analysis Environment
  - Develop new tool and apply to improve vehicle design across various disciplines
  - Develop integration methods for multi-fidelity processes across various computer environments
  - Develop tool application processes across various configurations and flight conditions
  - Develop risk models and risk analysis tools
  - Provide specialized computer system administration

- 4.2.1.2 Aerospace Vehicle and System Design and Analysis
  - Perform vehicle/systems analysis and integration for aeronautics and space vehicles
  - Develop revolutionary concepts for aeronautics in pursuit of NASA goals
  - Develop CFD capabilities and databases for aeronautics and space vehicles
  - Develop and apply modeling and analysis capabilities across disciplines for advanced aeronautics vehicles

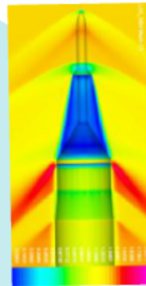
Systems Analysis Office
"COBRA" Design Environment

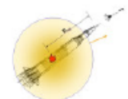
COBRA is a process by which vehicle shapes are co-optimized along with associated trajectories, TPS and subsystems in order to simultaneously satisfy desirable hypersonic aerothermodynamic and supersonic aerodynamic characteristics needed for entry into any planetary atmosphere.



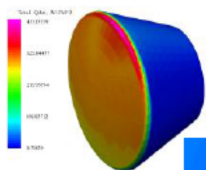
Aerospace Vehicle and System Design and Analysis

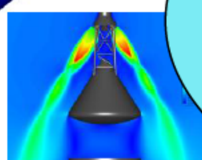
Multi-Purpose Crew Vehicle
- Aerodynamic Analysis
- Aerothermodynamic Analysis
- Heatshield Design Support
  - Requirements Definition
  - TPS Sizing
  - Flight Risk Analysis
  - Project Risk Management
  - Structural Analysis
- Launch Abort System Analysis



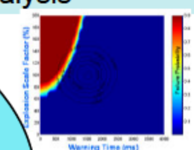


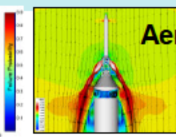
Launch Systems
- Launch Abort Risk Analysis
  - Simulation of critical failure modes to update PRA
  - Analysis of risk mitigation/reduction approaches
  - Models case burst, blast, re-contact, post-abort stability, landing risks
- Structural Analysis
- Fairing Aerodynamics/TPS
- Venting Analysis



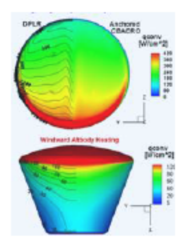


ARC Systems Design and Analysis
Develops and applies models and tools for aerospace vehicle design and analysis: aerodynamics; shape optimization; technology and flight risk analysis; aerothermodynamics; TPS sizing. Applications include Multi-Purpose Crew Vehicle, Space Launch System, Hypersonic and Supersonic Decelerators, Mars Entry Concepts, Environmentally Responsible Aviation, Airspace Operations.



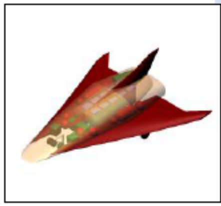


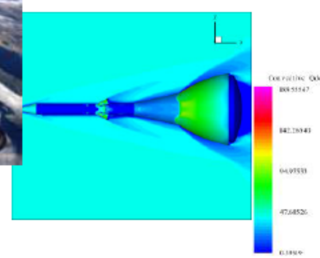
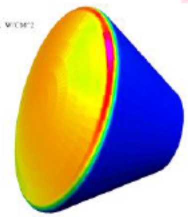
Flight Vehicle Technology
- Integrated Modeling and Simulation Development and Application
  - Tool and Model Development:
    - Aero/Aerothermal
    - TPS Sizing
    - Geometry
    - Data Ontology
    - Entry, Descent, Landing (EDL) analysis model
    - Launch Analysis
    - Structural Analysis
    - FSI

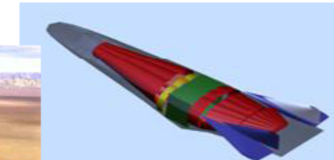
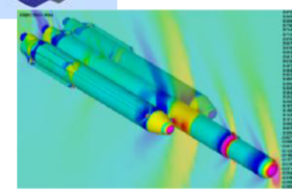


Aeronautics
- Vehicle Analysis
  - WT Test Planning and Analysis
  - Concept CFD Analysis
  - Aeroacoustics Analysis
- Airspace Operations
  - Vehicle and Trajectory Modeling
  - Systems Analysis

Space Vehicle Design and Analysis: Sampler



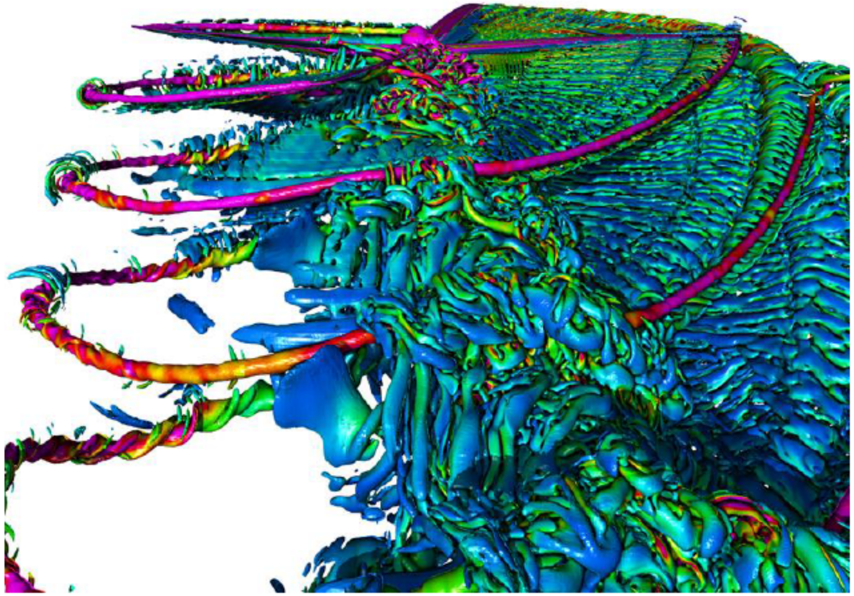



- *X-33 Phase I and II*
  - Aerothermal Database generation
  - TPS selection & Sizing
  - RLV Aerothermal & TPS sizing
- *Mars Airplane*
  - Conceptual Vehicle Design
- *Mars Sample Return*
  - Re-entry risk assessment
- *X-34*
  - Preliminary Aerothermal Definition
  - Initial TPS definition & Sizing/Weight
  - Subsystem evaluations
- *NASP*
  - Independent Configuration Assessment
  - Alternate Concept Evaluations
  - Program Cost estimation
- *SHARP CTV*
  - Configuration definition
  - Hypersonic Aero/Aerothermal
  - Trajectory modeling
- *Space Launch Initiative/Orbital Space Plane*
  - OSP Integrated Stack Aerodynamics
  - Aerothermal Environments Definition
  - TPS Sizing
  - Trajectory Analysis
  - Aerodynamic Optimization
- *Access-to-Space*
  - TSTO Conceptual Design
  - SSTO Rocket & A/B-Rocket Hybrid Assessment
- *Bantam*
  - Configuration evaluation
  - Hypersonic Aerodynamics
  - Aerothermal Environment definition
  - Nosecap & Wing L/E definition
  - Re-entry trajectory definition
  - Hypersonic trim and CG travel
  - Initial TPS selection & sizing
- *Crew Exploration Vehicle*
  - Aerothermal Environments definition
  - TPS Sizing and Layout
  - Heatshield Structural Analysis
  - CM Aerodynamics
  - Launch Abort System Aerodynamics
- *Crew Launch Vehicle*
  - Ascent and abort modeling
  - Structural analysis
  - Risk Analysis

NASA Supercomputing Division (NAS)

- Branches:
  - Applied Modeling and Simulation (TNA)
  - Fundamental Modeling and Simulation (TNF)
- Develops CFD/IT/Physical modeling and Computational Chemistry technologies to support
  - Human Exploration & Space Operations
  - Aeronautics
  - Science Missions
- Emphasis on
  - Tool development
  - Analysis of mission enabling technologies
  - Engineering applications
- Applications are varied and evolving with the new NASA Exploration and Science missions.
- Constant need to develop new computational tools and risk assessment



Pleiades Supercomputer

- Manufacturer: SGI
- 162 racks (11,232 nodes)
- 4.49 Pflop/s peak cluster
- Total cores: 198,432 (32,768 additional GPU cores)
- Total memory: 616 TB

SOW SECTION 4.2.2 NAS Division Requirements [1]

- 4.2.2.1 General — Task
  - Involves the development, validation, and application of CFD and engineering risk tools involving the
    - Space Launch System (SLS),
    - Commercial Crew Program and
    - Collaboration with Commercial Crew Program partners
  - Pursues fundamental research in support of these programs/missions as well as those in the Aerodynamic Research Mission Directorate
  - Areas of current and future activity include, but are not limited to:
    - Computational Fluid Dynamic (CFD) algorithm and tool development
    - Space Vehicle Launch and Ascent Analysis
    - Development and application of analysis tools in support of advanced rotorcraft design
    - Development of automated CFD parameter-study tools
    - Planetary and Earth Science CFD modeling
    - Modeling and Simulation of green technology applications
    - Computational chemistry modeling
    - Engineering Risk Assessment

SOW SECTION 4.2.2 NAS Division Requirements [2]

- 4.2.2.2 Adjoint-Based Mesh Optimization Frameworks for CART3D
  - Focus on ARMD Fundamental Aeronautics High Speed and Fixed Wing subprojects
  - Employ the Cart3D adjoint module for use in shape optimization with Cart3D
  - Use error information from solution of discrete adjoint to guide mesh adaptation
  - Investigate control of discretization error in gradient-based aerodynamic shape optimization
  - Formulate a functional appropriate for automatic error control

SOW SECTION 4.2.2 NAS Division Requirements [3]

- 4.2.2.3 Modeling and Simulation Support for Launch and Ascent Vehicle Analysis (LAVA) including Ground Operations
  - Conduct CFD Simulations for
    - Space Launch Systems (SLS)
    - Commercial Crew configurations
    - SWORDS
    - Fundamental Aerodynamics (FA) High Speed (HS) and Fixed Wing (FW) Projects
    - Environmentally Responsible Aviation (ERA) Subsonic Fixed Wing and High Speed Projects
    - SOFIA
  - Generate grid scripts to create viscous overset grid systems
  - Setup, execute, and analyze large aerodynamic databases for rocket ascent, loads, and separation
  - Evaluate methodologies for predicting ignition overpressure (IOP), noise generation, and acoustic propagation during lift-off of space launch vehicles.
  - Analyze assumptions for RANS/DES turbulence modeling
  - Expand prediction capabilities of LAVA solvers and pre-/post-processing tools

SOW SECTION 4.2.2 NAS Division Requirements [4]

- 4.2.2.4 Design Analysis for Large Civil Tiltrotor 2nd Generation (LCTR2)
  - Perform 3-D flow analysis / design for Large Civil Tilt Rotor 2 (LCTR2) blade in hover and forward flight
  - Employ rotorcraft mode of OVERFLOW2 and coupling code (CAMRAD II) for design of LCTR2 blades
  - Analyze feasibility of using 3D Navier-Stokes simulations in gradient optimization design

SOW SECTION 4.2.2 NAS Division Requirements [5]

- 4.2.2.5 Commercial Crew Transport Risk Studies
  - Support/perform crew safety assessments for
    - Commercial Crew Program (CCP)
    - Space Launch System (SLS)
    - SWORDS
    - Aquila II
  - Develop/apply GoldSim model and Ames Reliability Tool for assessment of several launch vehicles
  - Develop a generic case study, based on available commercial launch vehicles

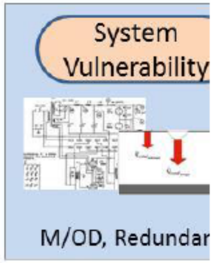
SOW SECTION 4.2.2 NAS Division Requirements [6]

- 4.2.2.6 Coupled Aero-structural Simulation with Cart3D
  - Supports ARMD Fundamental Aeronautics High Speed and Fixed Wing subprojects.
  - Develop structural-deformation loosely-coupled aero-structural solutions using Cart3D for multidisciplinary optimization (MDO).
  - Incorporate static structural deformation due to simulation-based estimates of flight loads
  - Produce a preliminary aero-structural module for use with Cart3D

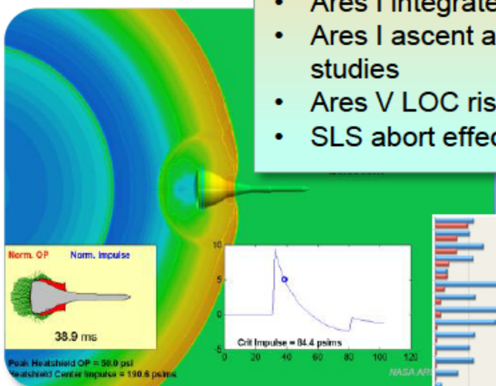
What is Engineering Risk Assessement?

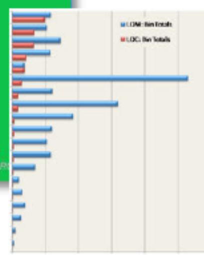
Engineering Risk Assessment extends traditional Probabilistic Safety/Risk Assessment (PRA/PSA) approaches to incorporate:

- **Physics-based analysis of key risk factors**
  - External hazards
  - Failure environments
- **Dynamic nature of failures**
  - Time dependence
  - State dependence
  - Interactive effects

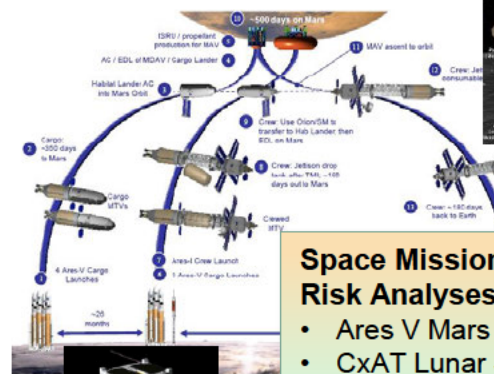


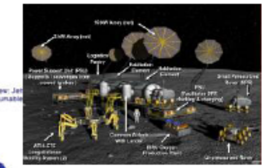
Engineering Risk Assessment Projects

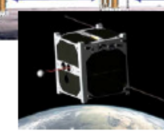




Ascent Abort LOM/LOC Risks for NASA Launch Vehicles
- Ares I integrated LOM/LOC
- Ares I ascent abort trigger studies
- Ares V LOC risk assessment
- SLS abort effectiveness

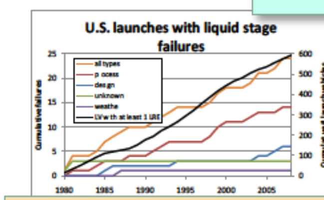


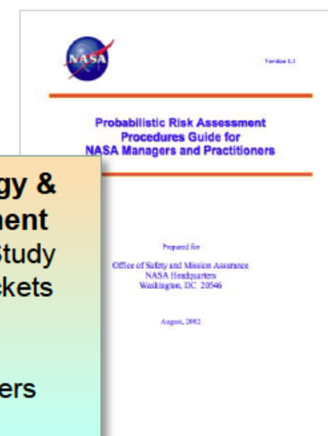




Space Mission & Campaign Risk Analyses
- Ares V Mars campaign
- CxAT Lunar Surface Systems
- HEFT II campaign to a NEO
- Aquila II
- SWORDS

Commercial Crew
- SNC Dream Chaser mission risk modeling
- SpaceX DragonRider ascent risk sensitivity studies
- CCP program requirements and policy support





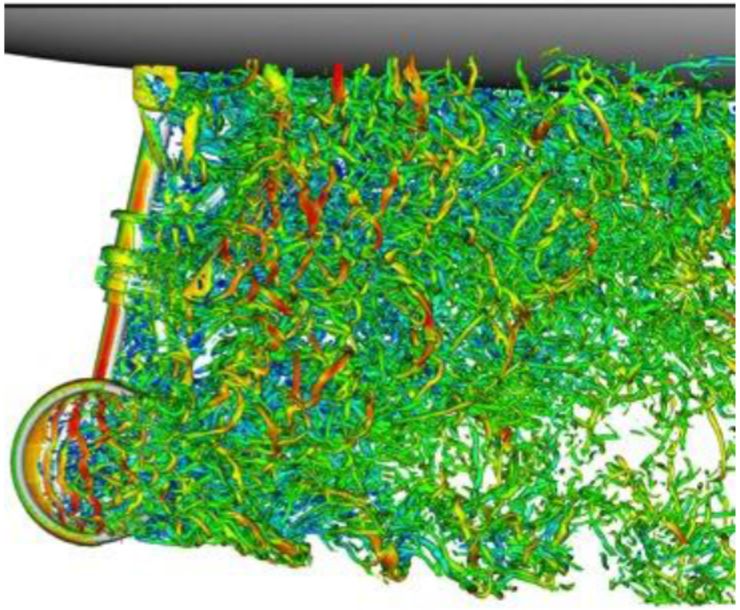
Agency Risk Methodology & Requirements Development
- Liquid/Solid Propellant Study for NASA's Study of Rockets
- CCP requirements development
- OSMA PRA guide chapters and training modules.

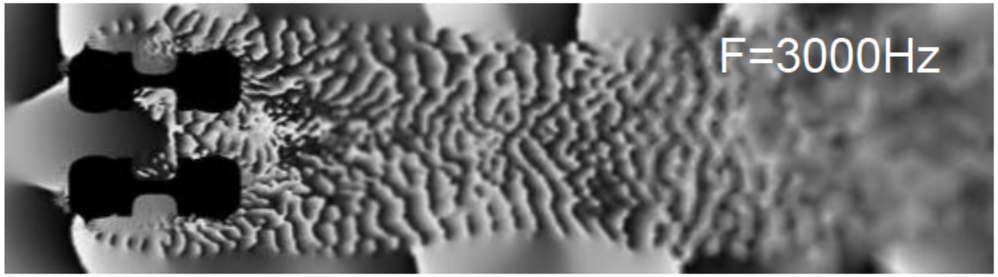
Environmentally Responsible Aviation

Landing Gear Noise Prediction

- 3rd AIAA workshop on Benchmark problems for airframe noise computations in preparation of aero-acoustic analysis of hybrid wing body
- Large-eddy simulation using immersed boundary method with fourth-order time and fifth-order space discretization
- Excellent agreement between CFD and experimental data

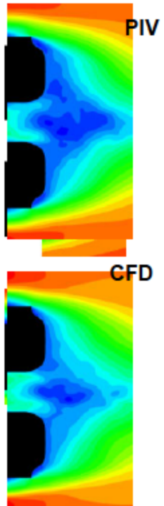
Acoustic Noise Source Characterization employing LES

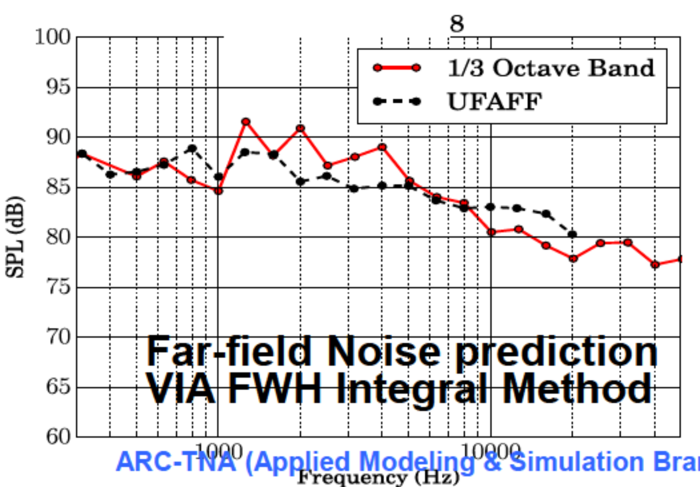




Phase Plots To Identify Noise Propagation

CFD vs PIV Measurements





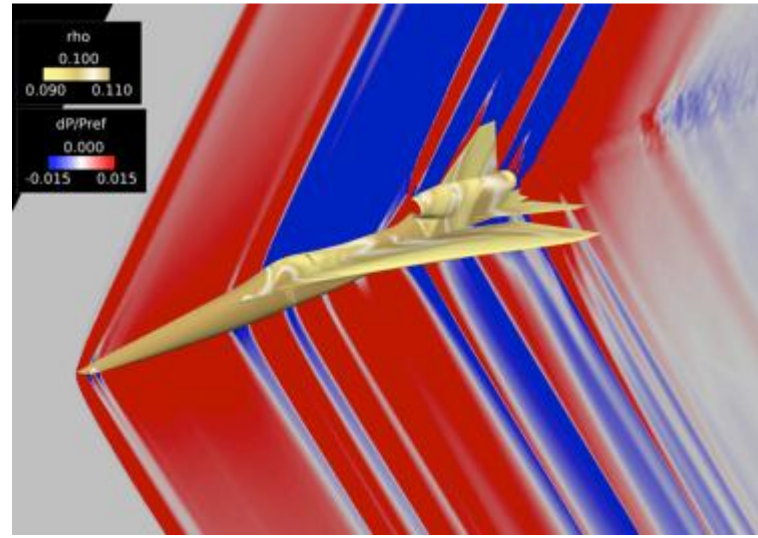
Far-field Noise prediction VIA FWH Integral Method

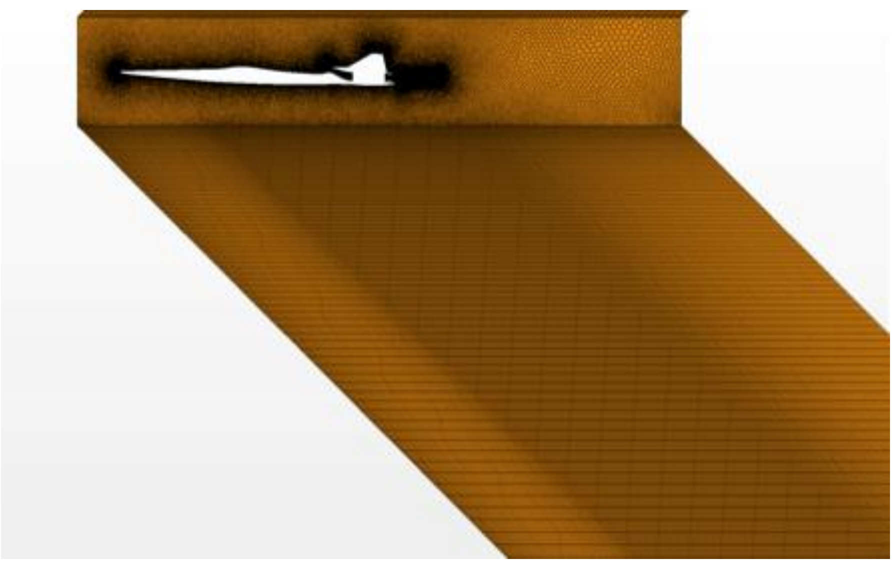
ARC-TNA (Applied Modeling & Simulation Branch)

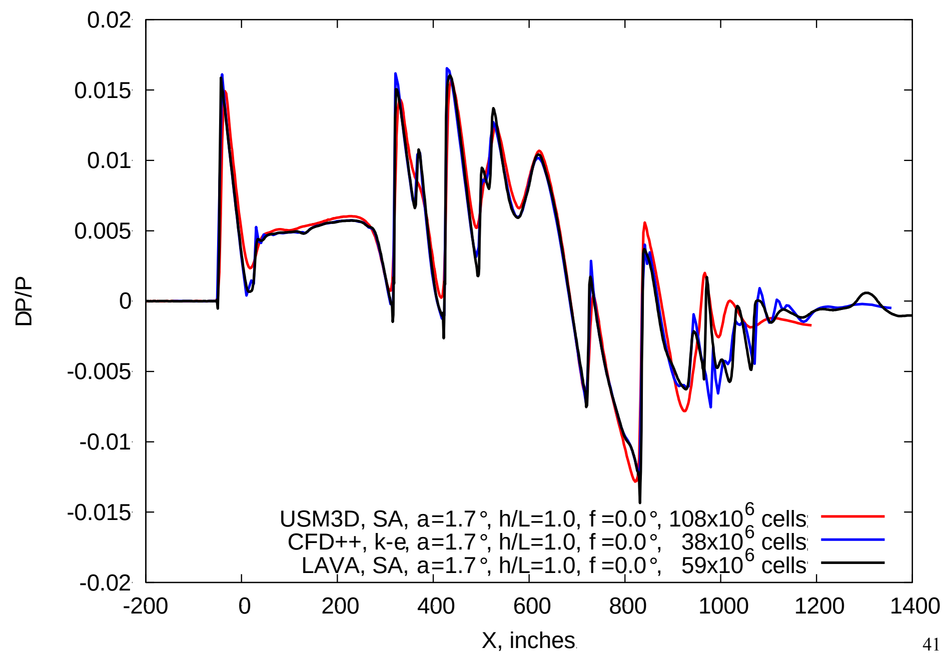
FA-High Speed Project

CFD Support for the Low Boom Flight Demonstrator

- Performed RANS analysis using an unstructured mesh with LAVA code
  - Arbitrary polyhedral cells, aligned with the Mach angle
- Accurately modeled the viscous physics, engine inlet and outlet as well as boundary layer bleed surfaces
- Predicted accurate sonic boom pressure signatures in the near and mid-field.
- Fast turn-around time from CAD to results







ARC-TNA (Applied Modeling & Simulation Branch)

SOW SECTION 4.2.3 Computational Fluid Dynamics Applications for Rotary-Wing Vehicles

- 4.2.3.1 General
  - The Army Aviation Development Directorate develops and applies tools for the computational simulation of rotorcraft, including codes to model rotor aerodynamics and methods for the coupling of computational fluid dynamics with computational structural dynamics.
- 4.2.3.2 Helios Aeromechanics Analysis Software
- 4.2.3.3 Rotor Dynamics and Trim Models
- 4.2.3.4 Helios Code Maintenance
- 4.2.3.3 New Capabilities for Helios Software

RDECOM

High-Performance Computing for Rotorcraft Modeling and Simulation

Mark Potsdam

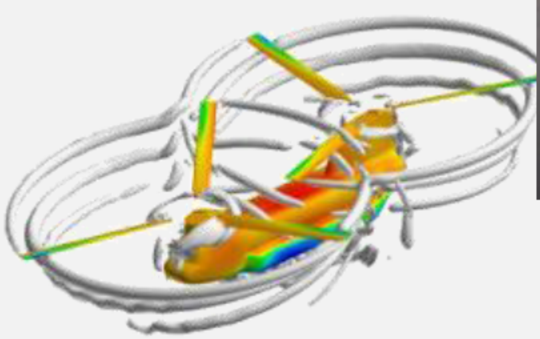
US Army Aviation Development Directorate (AFDD)
Ames Research Center, Moffett Field, CA

US Army Aviation Development Directorate

Located at Redstone Arsenal, Fort Eustis, NASA Ames, and NASA Langley Research Centers

Wind Tunnel Testing

Human Systems and Flight Control



Computational Modeling

Preliminary Design

From Computations to Flight !

Flight Testing

CFD to Support DoD Aircraft Acquisition Programs

- **High-fidelity modeling and simulation to reduce risk, reduce cost, and enhance safety for new DoD acquisitions**

CREATE
Computational Research & Engineering Acquisition Tools & Environments

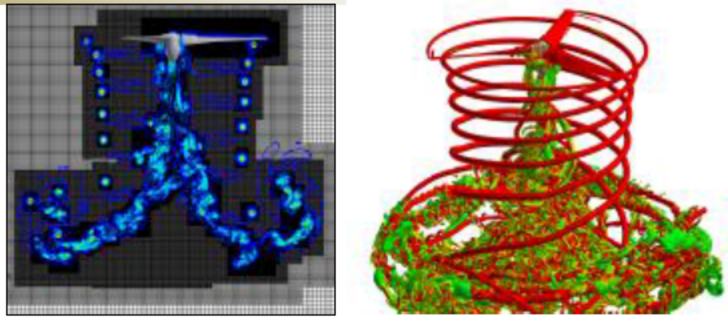
AMRDEC

Helios

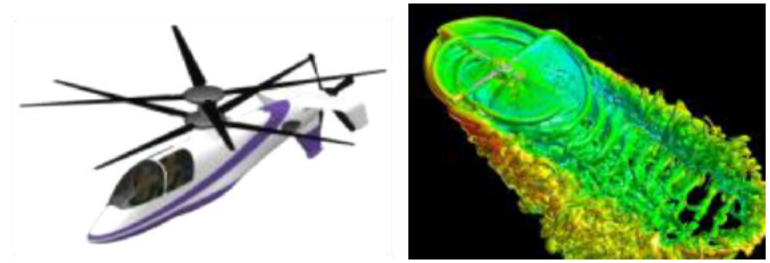
Joint Multi-Role Rotorcraft

- **Initially targeted technologies to address:**
  - ***Automation***
  - ***Rotor wake resolution***
  - ***Complex geometry***
  - ***Aero-structural coupling***

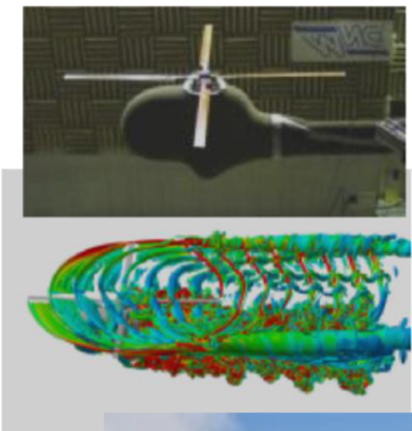
Helios Computational Simulations



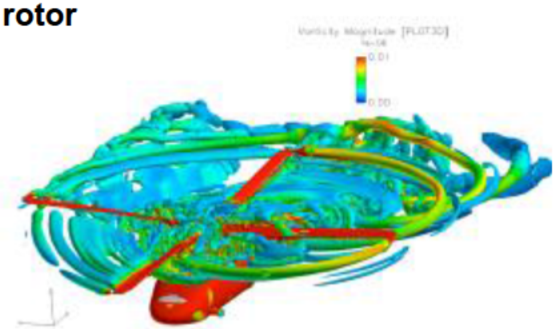
V-22 model rotor



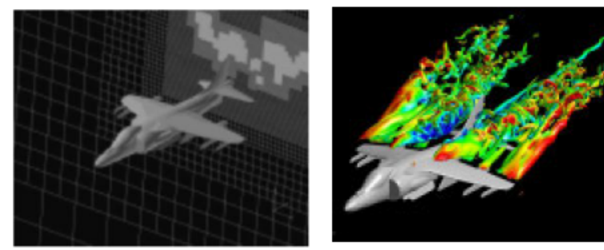
Sikorsky X-2



HART-II rotor and test stand

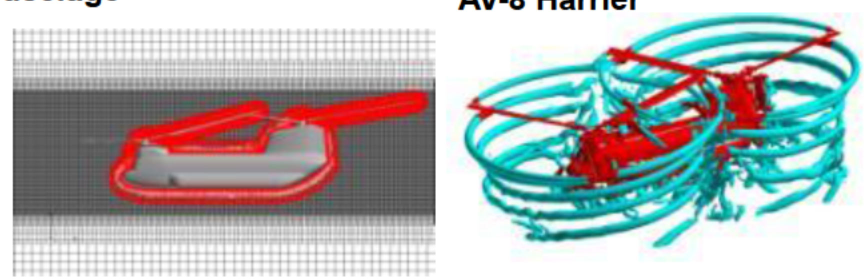


UH-60 rotor and fuselage



AV-8 Harrier

Apache composite main rotor

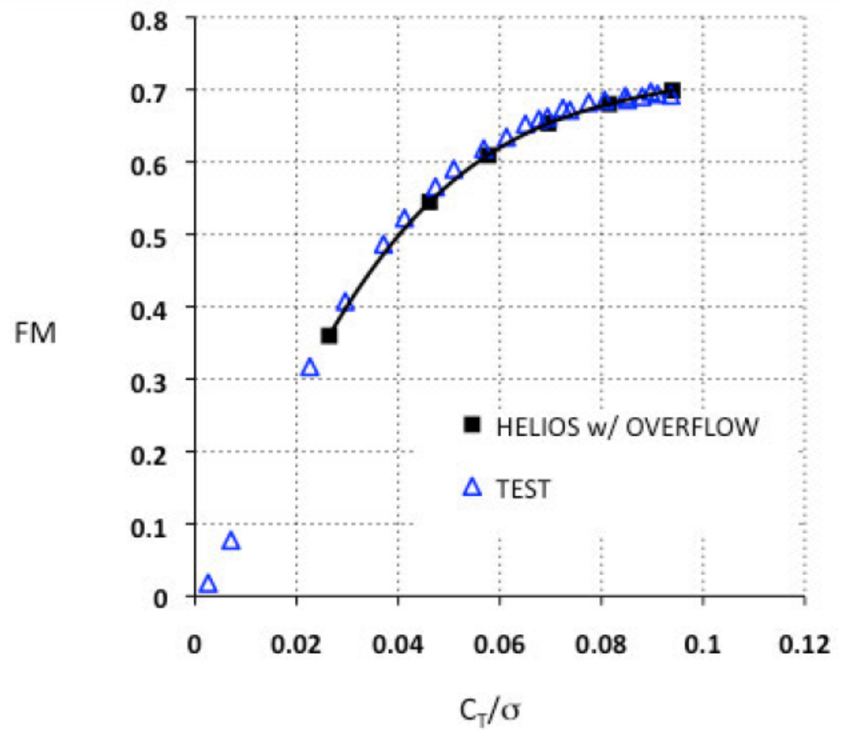


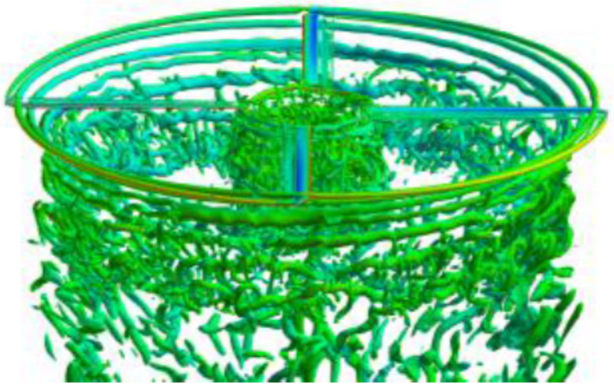
CH-47 Chinook rotor and fuselage

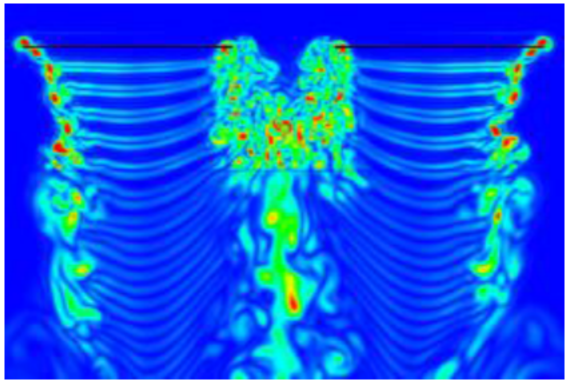
High-fidelity computational aeromechanics for general multi-rotor and rotor/fuselage combinations

Helios Validation for Hover Performance Prediction

- January 2013 AIAA Hover Prediction Workshop focused on S-76 hover performance
- Helios showed excellent results for S-76 hover performance prediction compared with other CFD solvers from national and international participants





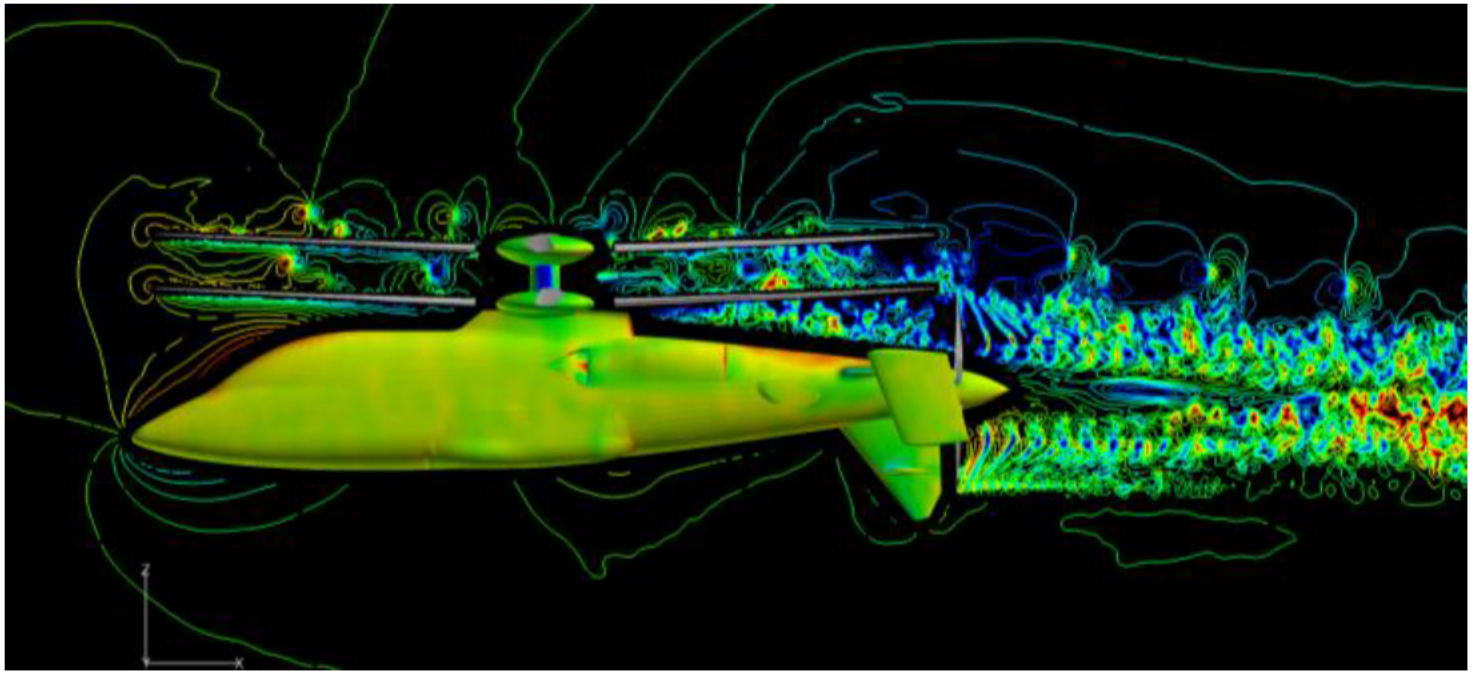


Test and Helios predictions agree to within 1 count in FM. (Reported experimental uncertainty in FM ~0.6 counts)

Mark Potsdam, Rohit Jain (Army ADD)

Sikorsky X-2 Helios Simulations

Alan Egolf, Ed Reed (Sikorsky)



- Helios simulations provide high-fidelity modeling of the coaxial rotor system, the fuselage, and the propulsor

Army Computational Aeromechanics Summary

- **Helios multi-flow solver and multi-mesh paradigm facilitates analysis of complex geometry and rotor wake resolution**

- **Helios software is currently being used for for high-fidelity rotary-wing aeromechanics modeling**
  - Helios analyses targeted for Army JMR rotorcraft procurement
  - Interactional rotor-airframe aerodynamics
  - Strongly-coupled rotor dynamics

- **Army support requirements for AEMMS**
  - New software development for computational fluid dynamics and computational structural dynamics
  - Careful validation of computational modeling and simulation capabilities
  - Applications of computational aeromechanics models to solve rotorcraft engineering problems

SOW SECTION 4.2.4 Rotorcraft Aeromechanics Research and Development

- 4.2.4.1 General
  - The NASA Aeromechanics Office is responsible for aeromechanics research activities that directly support the civil competitiveness of the U.S. helicopter industry.
  - The work will support the Aeronautics Research Mission Directorate (ARMD) and the Fundamental Aeronautics Program, through the Rotary Wing Project.
  - This work will address all aspects of the rotorcraft which directly influence the vehicle's aerodynamic performance, structural, and dynamic response, loads, external acoustics, flight dynamics and control, handling qualities, vibration, and aeroelastic stability.
  - The work to be performed is both theoretical and experimental in nature, including the development of new technologies and new vertical lift aircraft concepts.

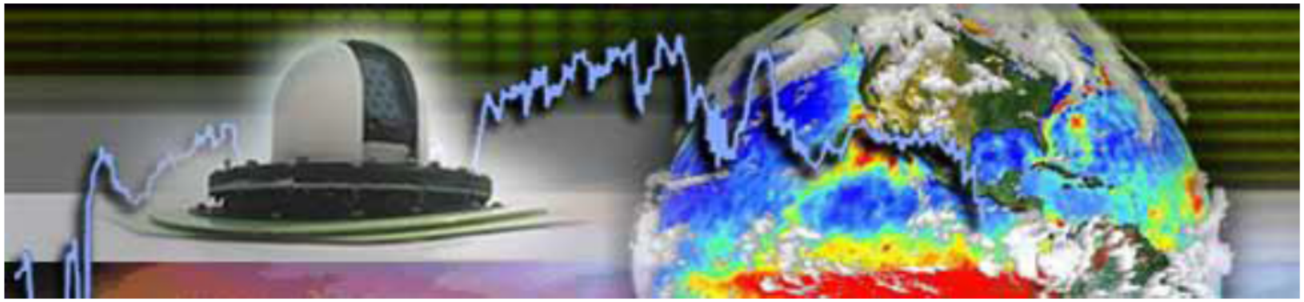
SOW SECTION 4.2.4 Rotorcraft Aeromechanics Research and Development

- 4.2.4.2 Computational and Experimental methods for Rotary Wings
  - Develop and apply advanced computational methodology in CFD, multi-disciplinary analyses, advanced flight dynamics and controls, and experimental methodologies for rotary wing preliminary design processes.
- 4.2.4.3 Rotorcraft Technology Transfer
  - Perform technology exploration, transfer, and transition in high risk, pre-competitive rotorcraft technology research areas.
- 4.2.4.4 Rotary Wing Testing
  - Perform rotary wing component testing, developing high quality data acquisition and measurement systems as required.

Aeromechanics Office

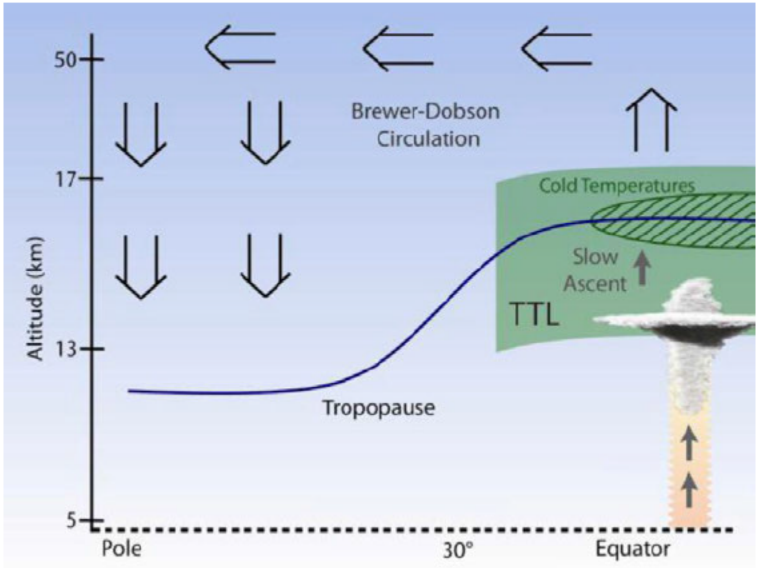
- Unique Full-Scale Wind Tunnel Facility for Rotorcraft Aeromechanics Test

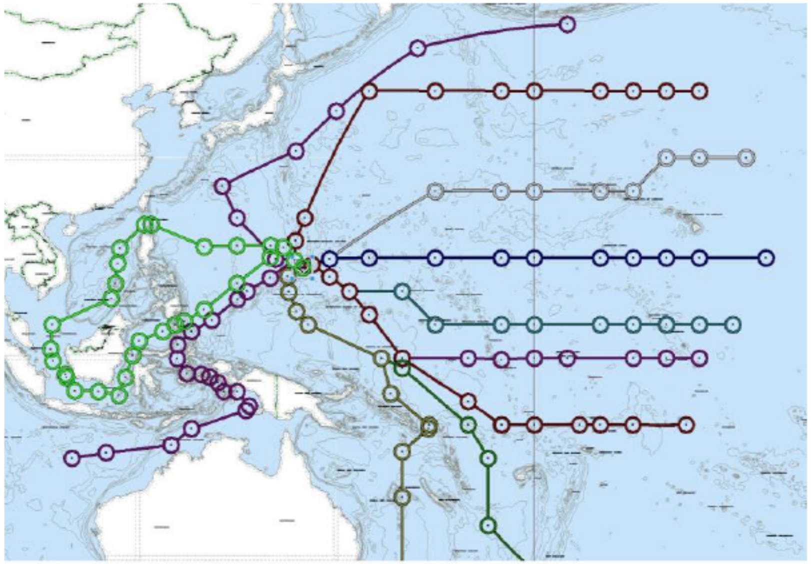
Earth Science Division
Atmospheric Science Branch



- Conducts scientific research on
  - Environmental / climatic issues in stratospheric chemistry and ozone depletion
  - Climatic changes due to clouds, aerosols, and greenhouse gases, stratosphere-troposphere exchange
  - Perturbations in the chemical composition of the troposphere
- Develops / deploys state-of-the-art instruments to
  - Ground sites
  - Aircraft, balloons, unmanned aerial systems (UAS), and ships
- Develops unique models of clouds, chemistry, dynamics, and radiative transfer processes to understand and elucidate controlling mechanisms.
- Performs laboratory experiments to advance and understand the detailed dynamic chemical interactions in the stratosphere.

Airborne Tropical Tropopause Experiment (ATTREX)





Ames Research Center

SOW SECTION 4.2.5 Airborne Tropical Tropopause (ATTREX) Mission Modeling & Simulation

- 4.2.5.1 General
  - Development, test, application, and evolution of tools and integrated modeling and simulation capabilities for conceptual aircraft analysis and design processes
  - Use of existing Schoeberl-Dessler codes for the extension of current models and prediction of aircraft capabilities under different mission conditions and scenarios.
  - Analysis of ATTREX field data, including participation in ATTREX publications.

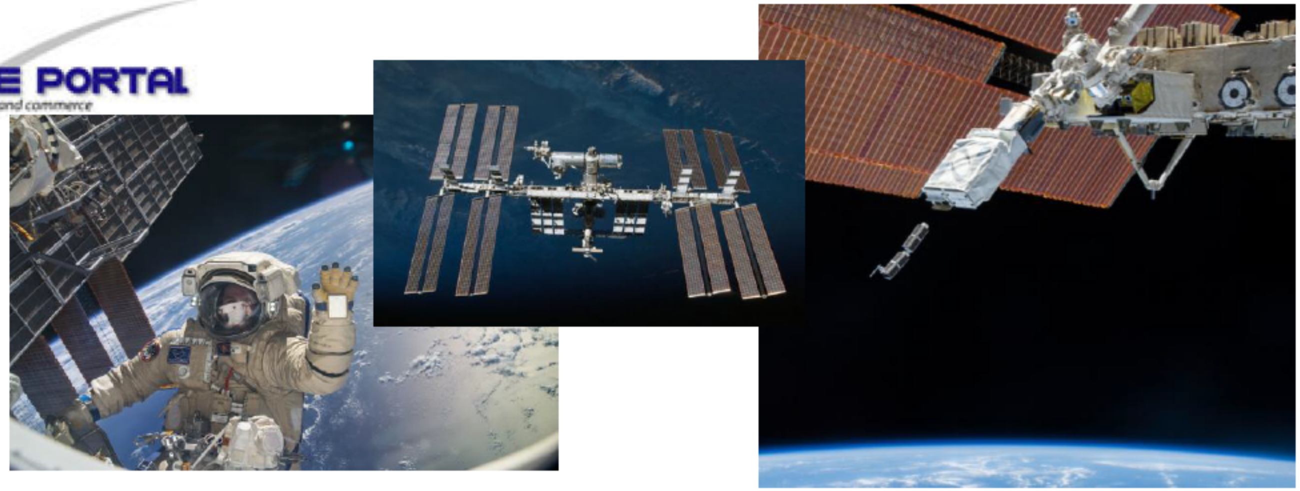
- 4.2.5.(2,4,5) Schoeberl-Dessler Code maintenance and validation
  - Update/modify Schoeberl-Dessler code to accommodate flight planning, analysis, forecasting
  - Validate code results with mission trajectory outputs and make recommendations
  - Provide data analysis report of software validation results and make recommendations

- 4.2.5.3 Dryden Mission Operations
  - Maintain liaison with Dryden Mission Operations for raw data and verification of scenarios

- 4.2.5.(6,7) ATTREX Field Data Analysis and Publications
  - Apply S-D code model capabilities to analyze ATTREX field data and publish results

The NASA Space Portal and Emerging Space Offices

SPACE PORTAL
for enterprise and commerce



- Supports private-sector individuals and organizations that invest in space
- Forefront of commercial space development and NASA innovation over the last decade
  - Structured a program to deliver cargo to the International Space Station (COTS)
  - Established program to fly NASA payloads on commercial reusable suborbital vehicles
  - NASA Planetary Sustainability Initiative
    - Developed for living on the Moon and Mars to help solve the sustainability challenges here on Earth.

SOW SECTION 4.2.6 Physics-Based Modeling and Simulation of Potential Spacecraft Mission Scenarios for Innovative Space Commercialization

- 4.2.6.1 General
  - Characterize and compare potential space commercialization opportunities.
  - Identify areas within a mission design scenario where physics-based analysis provides a significant benefit
  - Focus area: International Space Station
    - Platform for innovative commercialization
    - Sustainable human presence in space

- 4.2.6.2 Space Commercialization Activities
  - Develop alternative scenarios and methodologies to construct the concept of "return on alternatives" to guide investment decisions with quantitative analysis.

- 4.2.6.3 ISS Sustainable Technologies
  - Define and identify sustainable technologies on ISS and new areas where the impact of the microgravity environment has not been previously considered.

4.2.7.1 General

- Synthesizes and analyzes rotorcraft concepts against user requirements
- Develops tools and methods to improve the conceptual design process
- Conducts trades to assess the impact of technology insertion into conceptual rotorcraft designs

SOW SECTION 4.2.7 Concept Design and Assessment Focus Area Contractor Support

- 4.2.7.2 ADO Subject Matter Expert (SME)
  - Participate in the FVL S&T planning activity and serve as a subject matter expert for the ADO on integrated product teams.
  - Assist in the long term planning and coordination of ADO tool development efforts.
  - Support development of tactical and strategic approaches for products of the ADO to specifically satisfy the needs of the Army's user community

- 4.2.7.3 Concept Vehicle Design Characteristics
  - Assist in definition of concept vehicle characteristics that will show the impact of design requirements and system level.
  - Systematically solicit and collect technical information from the S&T, programmatic, and user communities that will have an impact on requirements and missions used to inform conceptual designs.
  - Help to identify technologies that will be included in vehicle designs.

- 4.2.7.4 SME Consultation
  - Provide consultation in the prioritization of system level synthesis activities, including developing system trades, negotiating technical products with the IPT component focus areas, and coordination of ADO design iterations.

Space Biosciences Division
Bioengineering Branch

- Conducts research and development of advanced life support systems
- Developing next generation technologies to enable humans to live beyond low Earth orbit for extended periods of time
- Researching and developing
  - Atmosphere revitalization and trace contaminant control
  - Water recovery
  - Waste management
  - In situ resource utilization
  - Improved production of cellulosic and algal biofuels feedstocks
  - Engineered nanoscale self-assembling enzyme complexes
  - Systems engineering tools for technology gap identification, trade studies, and down selection.

SOW SECTION 4.2.8 Advanced Life Support Water Recycling Technology Modeling

- 4.2.8.1 General
  - Development of models of the performance of various forward osmosis life support technologies such as the Forward Osmosis Secondary Treatment (FOST) system
  - Modeling of genetic engineering information for the Synthetic Biology Bio-Membrane project
  - Development of genetic maps and models to predict the function of genetically engineered organisms
  - Development, testing, application, and evolution of tools and integrated modeling and simulation capabilities for chemical and biological processes
  - Research, development, and validation of new technologies and models
- 4.2.8.2 Water Recycling Technology Development
  - Develop models of life support technologies
  - Construct test apparatus for and test life support technologies and validate models
- 4.2.8.3 Bio-Membrane
  - Develop genetic engineering models
  - Construct test apparatus for and test Bio-Membrane and validate models
- 4.2.8.4 Green Building Modeling and Remote Data Access
  - Develop interface to predictive modeling package and verify remote data access and operational parameters for NASA Ames Green building.

SOW SECTION 4.2.8 Advanced Life Support Water Recycling Technology Modeling

FOST (Forward Osmosis Secondary Treatment)

- Reduces water usage for long duration space missions by removing dissolved solids using saltwater as drawing solution, then using reverse osmosis to remove the salt
- Installed in the Sustainability Base at Ames Research Center (larger version)
- Recycles greywater for a building of 250 people, and reduces total tap water usage by 40%
- Allows long duration testing and failure prediction

FOST

Ames Sustainability Base

Statement of Work: Miscellaneous Sections

- 5.0 Deliverables and Reports
- 6.0 Emergency Preparedness and Response
- 7.0 Security Requirements
- 8.0 Phase-In and Phase-Out

QUESTIONS?

- Oral questions will be permitted now.
- If you prefer, please use Question Forms provided at the sign-in table to write your questions.
- All questions, both oral and written, will be posted with official answers on the NAIS and FBO websites periodically in a timely manner.
- All questions related to this pre-proposal conference or the Draft Request for Proposal must be submitted to naomi.castillo-velasquez@nasa.gov no later than November 20, 2014.