Opening Remarks, Dr. Scott Pace

"It's easy to produce budget and policy in isolation; more difficult to produce them both in synchronicity." NASA's exploration budget has absorbed cost increases, which has led to an inability to fully fund the Constellation program. The implications of the President's 2010 budget, as it stands, has long-term workforce impacts, and while there are increases in the aeronautics and earth science budgets these increases won't compensate NASA spaceflight center workforces for losses in other areas.

Resources to implement the Vision for Space Exploration have eroded over time. Five years ago, the assumption was for a 2.4% growth rate in the budget each year. Additionally, NASA experienced a $12B cumulative loss due to deficit reductions, increased shuttle readiness, extra costs to retire the shuttle, and the Hubble servicing mission. As always, if performance and risk requirements stay the same, and no extra funding is provided then schedules slip to the right. The Constellation schedule is further threatened by a $3B out-year NASA budget gap for Exploration.

The impacts of the FY2010 Budget Proposal in the short run are positive given the $1.8B increase, but the long-run shortfall for the out-years still a significant issue. The Augustine Commission will be important since there is at least $3B at stake that might be restored to the Agency's budget. However, if the FY 2010 budget proposal represents a new baseline then long-term impacts are inevitable. NASA will face difficult programmatic decisions as a result of a reduced exploration budget but inflation will have a dramatic impact as well. Although inflation calculations are subject to debate it must be considered in long term planning. If the assumption is the NASA budget stays flat in the out-years then inflation reduces real purchasing power, with a possible shortfall of up to $11B over five years. Long term budget planning influences strategic choices.

Mary Kicza (Keynote Speaker)

"In civil space NASA is the research arm; for space-based land remote sensing the USGS is the lead agency and for weather, climate, ocean and space environment NOAA is the lead agency." NOAA is comprised of 12,600 staff (equivalent to about 2/3 of the NASA workforce) and NOAA's capital assets include 16 spacecraft, 12 aircraft and 18 ships.

The NOAA budget outlook is somewhat more optimistic than other agencies, with growth seen over last 5 years and the Agency received about $74M in stimulus funds. The FY2010 request by the administration of $4.5B, a 2.5% increase above the Omnibus Appropriations Act of 2009, this represents a $272M increase for geo weather satellite, allowing for an early 2015 launch, $12M increase in data preparation project for NPOESS data, and a $20M increase Jason 3 program, a follow-on to Jason 2. The budget did have some planned decreases of about $112M as certain polar and geo spacecraft are retired.

"A primary mission of NOAA is maintaining the continuity of measurements derived from polar and geo spacecraft." To accomplish this mission NOAA has a number of satellites that have recently been added to active constellations or will be launched within the coming year. The GOES series is progressing well and timelines for the GOES N, O, P series are: GOES-N on orbit and functioning, GOES-O is set for a June 26 launch; GOES-P is planning for a June 2010 launch. GOES-R under development but the contract for the ground segment has been awarded to Harris Corp.; space segment contract was awarded to Lockheed-Martin although under protest by Boeing. There is concern that the protest may adversely impact a planned launch in early 2015. POES-N' (NOAA-19) was launched in February 2009.

Kicza discussed the on-going NOAA/NASA partnership, notably in: Altimetry - $20M requested to fund the US portion of the JASON-3 mission (follow-on to Topex-Poseidon → JASON-1→ JASON-2…). Other partnerships include: Solar Wind – ACE satellite at L1 is approaching end-of-life and NOAA would like to build a follow-on spacecraft, hence examining a number of options (1) working with OSTP to possibly refurbish DSCVR spacecraft, (2) service level agreements with commercial providers that would provide solar wind data, (3) develop a new spacecraft, partnership with NASA to measure ocean surface vector winds utilizing the NASA QuickScat spacecraft since this is critical information which affects maritime shipping and the ability to track tropical storms; NOAA follow-on to COSMIC program which may be a 4-way partnership between NOAA, NSF, the government of Taiwan, and NASA for 6-12 spacecraft similar to the COSMIC constellation.

Kicza also noted that climate services continues to be one of NOAA highest priorities and NOAA advocates the need for a National Climate Service, since no single agency can address this issue alone. Dr. Jane Lubchenco NOAA administrator testified on such, and several bills are in Congress emphasizing NOAA's priorities in climate monitoring and climate data integrity. NOAA's FY 2010 budget included $12M in their specifically for climate sensors and data processing. Dr. Tom Karl is actively canvassing the public sector on climate data needs. NOAA is working with GEOS to ensure open access data policies, continuity of data products and working within CEOS, a group of 27 agencies around the world, to provide a constellation of capabilities in climate monitoring. NOAA has a commercial remote sensing advisory committee to help the U.S. respond to an increasingly competitive international market.

<u>Q&A</u>

Q: How does NOAA address the infosec threat and space situational awareness in systems acquisition and operations?

Kicza: NOAA has a very structured accreditation process - every 3 years penetration testing, and other tests are conducted. NOAA is coordinating with DoD to better understand the hazard of space debris, NOAA assets are restricted in maneuverability and so there is not much we can do. This is especially an issue for polar orbits.

Q: Remote sensing national policy has not been fully engaged to protect the frequency bands for passive and active remote sensors. Can a dialogue be started?
Kicza: Agree we need international dialogue to prevent encroachment on frequency bands associated with remote sensing. At the same time we must balance the issue against the needs of other commercial capabilities.

Panel One: Civil Space Programs

Paul Shawcross, Chief, Science and Programs Branch, OMB
Damon Wells, Senior Policy Analyst, OSTP
Dr. Michael Hawes, NASA Associate Administrator for Program Analysis & Evaluation
Dr. Kevin Eveker, Analyst, National Security Division, Congressional Budget Office
Marcia Smith, President, Space and Technology Policy Group, LLC

Damon Wells:

The United States faces a range of complex challenges, yet the Administration wants to fund Science and Technology (S&T) due its unique role, and space is a driver in S&T. President Obama wants a strong NASA and specifically to ensure space science and aeronautics are on a stable footing. The Administration appears to have strong support for NASA and NOAA since funding levels requested are above previous years.

However, NASA does face a number of challenges. NASA is expected to deliver on a very wide portfolio such as space science, global climate, earth science, the great observatories (e.g., James Webb space telescope) and missions to the outer planets, aeronautics and aeronautics green air initiative. Space operations has a number of challenges in the next year and a half: they must complete the ISS and properly utilize it, fly the final shuttle mission taking AMS to the station, and the properly manage the challenges of shuttle closeout, which include workforce and asset transition. The task before the Augustine Commission is to evaluate the safety and sustainability of the human spaceflight program, assess the feasibility of extending the ISS; it will be a significant challenge for the commission to have a final report by Aug. 2009. The NASA nominees, Charles Bolden and Lori Garver, for Administrator and Deputy Administrator possess a wealth of civil space experience.

Concerning NOAA, the administration appears to support a range of polar and geo weather satellites (e.g. Jason 3). This support reflects the Administration's broader S&T goals.

Paul Shawcross:

Remarks geared to consider the federal fiscal backdrop: once the economy recovers, lawmakers hope to reign in spending to reduce the deficit. The goal is to reduce the deficit to $500 M by 2014. However, some spending is mandatory, and Social Security, Medicare, and DoD spending are bound to rise and as a result some discretionary spending – like NASA – will be under immense pressure.

NASA budget drivers: FY2010 $18.7B, up $900M from last year's FY09 appropriations, the 5-year run-out is flat thereafter resulting in a very front-end loaded budget.

Dr. Michael Hawes:

According to Dr. Hawes, NASA was expecting a confused budget year. Overall, NASA has typically done badly (budget-wise) the first year with a new Administrator – so this year has actually been quite positive. The Troubled Asset Recover Act was a wildcard providing the Agency with an extra $1B. This year's budget integration task was enormous; part of the budget exercise included a historical survey to understand if FY2010 represents a significant departure from previous NASA budgets.

The FY2010 budget is unique in the sense that it helps NASA to focus on earth science, finish ISS, fund the decadal missions, and fund space science. Additionally there was support for education, internships, fellowships, etc. included. The aeronautics program received an increase as a result of the recent increase of Congressional interest. This funding increase makes the Environmentally Responsible Aeronautics program feasible.

NASA remains cautiously optimistic that the 8 remaining shuttle flights can be completed by 2010, which is consistent with the FY2010 budget as is. However, if the manifest extends beyond 2010 then a budget re-look would be needed. For the first time space operations requested transitions funds; usually NASA has to fund these types of things out of hide; case in point there are over a million line items of assets related to the shuttle. If the policy of providing funds up front instead of forcing NASA to fund out of hide continues then commercial firms can count on more stable environment in the out years.

Exploration is the elephant in the room, as any discussion of human exploration must consider ISS extension and shuttle closeout. The Augustine panel members are in the process of submitting their outlines of issues they will address.

The supporting functions of the agency continue to receive little attention. Interoperability with international partners should have more emphasis; the cross agency budget has unique programs that are often underfunded (e.g. space debris office) and potentially puts some of these crucial Agency missions at risk.

Dr. Kevin Eveker: *(Dr. Eveker's charts are available for download)*

Provided highlights and perspectives from the April 2009 CBO report on budget implications of NASA Space Exploration Report. The report is available at http://www.cbo.gov/ftpdocs/100xx/doc10051/toc.shtml.

This CBO report was prepared and published prior to FY2010 budget submission and stimulus funding process, however the study observed the following based on NASA provided data:

- Funding requirements for exploration systems grows
- Funding for space ops decreases
- Funding for science/aeronautics flat
- Funding for cross agency (support, education, inspector general, etc) remains flat

With these facts, what are implications for Constellation program?

- Scenario 1: funding remains flat
- Scenario 2: if the shuttle and ISS program is extended
- Scenario 3: achieve constellation schedule by allowing space science to slip
- Scenario 4: reduce funding for science and aeronautics to fund Constellation

In each scenario Ares-1 IOC occurs no earlier than March 2015 and ISS support must be terminated by December 2015. However, the FY2010 budget request and stimulus funds greatly (though temporarily) avoided these scenarios.

Marcia Smith: *(Ms. Smith's slides are available for download)*

Aligning priorities and budgets is a task of assessing what to do with the money. All agencies have this challenge, but NASA is under the microscope (i.e. the press) more often than most. The United States spends a significant amount of taxpayer dollars space. All space players (NASA, NOAA, DoD) must address the numerous schedule and cost overruns in space programs? How do we go about this? Should the budgets be bigger, or do we need to spend more wisely?

A 2003 report assessed that NASA is being asked to accomplish too much with too little. It appears as if little has changed, NASA budget outlook still looks stressed for the out years after the FY2010 windfall.

What steps can we take to alleviate the fiscal issues of the space program?

- Step 1: Space program needs to be re-aligned to match resources. You can't plan a program based on hopes of annual Congressional appropriations. We need to get control of our current programs.

"The current space program is designed to maximize the number of programs that are started and minimize the number of programs that are completed" [quote Tom Young]

- Step 2: Determine Priorities - is the current mix appropriate? The NRC decadal surveys determine 10- year priorities based on community based consensus for science missions, but the human spaceflight program does not have a similar process.

The Augustine panel is a blue ribbon panel operating within a short time frame (realistically speaking - without not enough time to complete a thorough assessment.) Additionally, not everyone agrees on timing or mandate of the commission. Congress and the Obama administration disagree on interpretation of Augustine Panel mandate. The 2005 and 2008 NASA Authorization Acts endorsed (both Republican and Democratic Congresses) the Vision so why are there placeholder funds in FY2010 budget for space exploration?

Other things to consider include:

- Why the 2020 date for original Vision for Space Exploration "boots on the moon," the date seems arbitrary.
- Does the humans to Mars program resonate with the people who will still be around when we get there? (i.e. the upcoming generation)
- How can NASA avoid promising more than can be delivered?
- What's to be done with the ISS, shouldn't we use it? After all the total investment ranges between $64B-$100B. The centrifuge for ISS was a key loss of science utilization; per the Space Studies Board the science utility of ISS is much less as a result.

Some options for consideration:

- Emphasize an approach that includes self-assembly of habitats and labs for human destinations; minimizes mass that must be transported along with the crews and they are ready for use once humans arrive.
- Stick to programmatic priorities unless they cross a "trip-wire"
- On national security space side, cancel TSAT
- Also on the national security side, leadership is critical; who's in charge?

<u>Panel One Q&A:</u>

Q: Smaller elephant in the room is the green house gas data is needed to support a cap and trade system inherent in the Waxman bill, if the budget is flat over next couple of years, where do we get the money?

Pace: Perhaps a more fundamental issue for a climate treaty is verification. A treaty requires Senate approval and three questions will be asked: 1) what does verification mean? 2) what space and ground architecture is required for verification? 3) how might decadal science priorities get re-shuffled to support funding?

Damon: OCM mission loss was unfortunate.

Q: Are we most effectively organized to accomplish the challenges? The agencies with space components to their missions were created 50 years ago.

A: Almost certainly not optimal, but the tradeoffs of re-organization would have to be weighed. DHS is example with huge overhead costs. Basically you need a real problem before you decide to reorganize NASA and DoD space.

Pace: Perhaps the more appropriate question should be about what the organizations do. DoD space has many challenges since it doesn't have "in-house" work. NASA has had "in-house" work that helps it manage projects somewhat more effectively. What about the industrial base, particularly for human spaceflight?

A: Government needs a certain amount of expertise to effectively manage high-risk, technology programs. It's a pendulum. There is a sense that in-house program management and acquisition staff must be improved. Not a one-size fits all.

Hawes: Ares 1 design has been a great experience for NASA Marshall staff. Boeing and ATK critiquing Marshall designs have been a learning experience for the civil force. The country could benefit from better coordination between DoD and civil space in terms of workforce management.

Q: What can leaders say to encourage collaboration?

A: National Space Council would help. It can bring government and commercial players together.

Q: Is it time for a multi-lateral human spaceflight program?

A: The Augustine panel will have figures of merit on international cooperation. We will have four ISS partners speak to the panel specific to the ISS program. Expect a broader discussion, but who knows if that leads to an international effort. We cannot afford it all, but the issue is more than just about the money.

Smith: The Vision for Space Exploration was largely international, but the transportation segment was United States only. Recall the Global Exploration Strategy is already in play and the U.S. is active in that context.

Wells: Hopes the issue is raised. International space activities tend to improve international relations.

Panel Two: View from the Congress – Civil Space

Chris Homan, Office of Senator Richard Durbin (D-IL)

Richard Obermann, House Subcommittee on Space and Aeronautics

Jeffrey Bingham, Senate Committee on Commerce, Science and Transportation

Jeff Bingham:

For the past 20 years the budget has driven the policy; it should be the other way around. The Augustine panel should not be limited; Congress believes all options should be examined. However, they are confident the panel will rise above any boundaries set by the administration. Bingham believes we should ask ourselves what

does the nation need, and not what can we afford in the budget, i.e. question "go as you pay."

The Senate Subcommittee is concerned that as the nation goes forward with human space flight, there is an inevitable detrimental impact to other parts of NASA budget. Amidst the flat budgets of previous years, NASA had to find $2.7B out of hide to return shuttle to flight post-Columbia. Right now the space operations numbers for FY2010 appear to be placeholders until Augustine panel is complete.

Consideration must be given to what it means for ISS operate as a national lab beyond NASA exploration goals. At one point 900 research proposals were vetted and slated for the ISS. That number is down to 100 research proposals. Science on the ISS is greatly reduced since equipment is simply not there. There is no down mass capability from orbit, which means you must do data evaluation and certain other activities in orbit, which increase costs. Bingham knows he speaks for the minority (Republicans), but believes these questions are fair and balanced (i.e. common sense issues to be addressed).

Richard Obermann:

The Good News: When comparing FY10 and FY09 budgets the Obama requests for NASA along with the stimulus funding addresses most of the near term issues. Investing in science and technology is important and he would like to see NASA get more.

Not so good news or uncertainty: Assessing the Administration's vision? (Though admittedly Obama has had limited time in office).

- What is the priority of civil space?
- What is the direction of human spaceflight?
- To what extent does civil space supports foreign policy goals
- Interagency coordination policy - Authorization should be agnostic on how to get interagency issues resolved. Perhaps a National Space Council would help.
- Define the role for commercial space
- Sustainability of key space initiatives

Following issues remain the dominant concerns for NASA: Out year funding for space exploration, research and institutional needs are not really addressed in the budget, the aging NASA workforce

From a budgetary perspective, if the post 2015 profile is not a placeholder, then very difficult decisions must be made. Experience shows consensus on what should be taken off of NASA's plate is hard to achieve, as there are too many cooks in the kitchen. The FY08 Authorization Act's goals were to force NASA (and the country) to determine what are the policies and programs that are needed. The House subcommittee is generally encouraged, but questions if the numbers are place holders or if the FY2010

budget is a map for a new Obama exploration vision. The subcommittee will exercise its oversight charter authority following the Augustine Panel report and will be monitoring the panel over the next months.

Chris Homan:

Take a step back and look at history, the shuttle and ISS were oversold, as a result Congress still has skepticism and mistrust as a result of these programs. Administrator Mike Griffin took courageous positions on shuttle and ISS. The great irony is the previous Administration didn't ask for adequate funding for its own vision. We will soon depended on Russia for transport to a station we built for them.

The FY2010 budget resolution is good start, but what happens in the out years? Cost overruns will undoubtedly occur. NASA jobs are American jobs. It's important to retain this expertise. So it's wise to invest in NASA and science and technology in general even during an economic downturn.

Panel Two Q&A:
Q: Can anyone on the panel address what multiplier effect can be expected from the current space program?

A: Difficult to assess, but nevertheless we need to fund a space program to maintain the industrial base in aerospace.

Bingham: How do we ensure long-term economic stability? One way is through funding R&D. Some information shows during the justification phase of the ISS, information showed that $9 was returned for every $1 invested. Recent proprietary data tentatively shows ISS-based science returns may be $1:$1000 cost benefit return. If the ISS is fully utilized, it will more than pay for itself, but how many government programs do you know of that return even $1 for each dollar invested?

Obermann: It's really hard to find good credible numbers. Congress tends to treat it as a qualitative return. They believe it's a good return, but it is a leap of faith.

Homan: There are non-financial benefits; Sen. Durbin mentions smart power or soft power via technological superiority.

Q: If NASA was to budget at 70% cost confidence level, then a corollary would be to start fewer programs. How would Congress tradeoff the increased confidence with fewer programs?

Obermann: FY2010 budget deliberations are a hint since some programs starts are being scrutinized with emphasis on cost management. Just because you

start fewer missions does not mean automatic improvements in cost management.

Bingham: Pressure of ongoing missions competing with demands for new missions (climate monitoring) create a challenge. We need to focus on sustaining fewer programs. He notes that ISS survived 22 attempts to kill the project.

Q: What should we expect of the NASA Administrator confirmation, when and if there will be a smooth process?

A: No hints of any real problems. Vetting has been thorough so no problems are anticipated. However, a hearing will not be scheduled until formal nomination, ethics, and other admin details are resolved. There are schedule conflicts, with only one hearing option in June, and two in July. Some room for semi-informal vetting but eventually must have formal hearing.

Chris Scolese (Keynote Address) Administration Priorities in Space

Slides are available for download.

General remarks about the NASA budget:

- Agency budget gets flat about the end 2010/start of 2011
- Facilitates new "Venture" class science missions
- Continues next generation observatories
- Starts Environmentally Responsible Aviation Project
- Optimistic about completing last 8 shuttle flights by Sept 2010
- Highest priority is to safely ramp down shuttle program
- Launch of Japanese Kibo module will complete ISS; the next ISS mission will have 12-13 people in space at one time, a new record.

Stimulating commercial Space Industry: NASA is relying on COTS-D and the possibility of commercial crew [COTS-E].

Exploration Systems Progress Highlights:

- $400M in stimulus funding; $200M in 2010 and [$200M in 2011]
- No significant changes in Constellation schedule - IOC still 2015, Constellation J2X test stand for high-alt testing nearing completion, lightning and other pad 39B modifications are ready by end of summer for Ares 1X
- Hangar for Orion integration well underway
- Testing of J2X engines continues; more reliable stir friction welding to be utilized [a technique also used by SpaceX]
- Testing of capsule re-entry parachutes continues
- Ares1x integration of solid rocket booster stack well under way
- Orion Pad 1 abort test this fall: learning again how to recover capsules in ocean sea state of up to 5 with help of the Navy

- Lunar Precursors: LCROSS launch in 2 weeks (target June 17), LRO long duration mapping for landing sites using optical and laser altimeter, suite of instruments for mineral characterization
- LCROSS on Atlas V - LCROSS will monitor 2nd stage impact plume, then LCROSS will also impact for second plume characterization for mineralogical characterization.

Science Directorate Highlights:

- FY2010 budget accelerates earth science program
- Venture class missions similar to Explorer missions in space science
- Budget extends the Cassini mission
- Evaluating how to recover from the launch failure of OCO; as a policy NASA does not maintain spacecraft spares for research missions
- Hubble Space Telescope Servicing Mission (HSTS-4) went flawlessly; expect imagery in late summer for the public
- Hershel and Planck; initial indications mission going well
- Earth science in addition to NOES, GOES i.e. the EOS missions some 14 spacecraft
- Majority of space science missions focuses on Mars, astrophysics missions several are in extended mission profiles, and heliophysics missions, half in prime mission, half in extended profile

Aeronautics Directorate Highlights: This portion of the budget saw the most significant increase in the last 10 years; major segments include:

- Airspace traffic management research
- Fundamental Aeronautics
- Aviation safety
- Aeronautics test program
- New budget line item: integrated systems (i.e. environmental responsible aeronautics) program. Realized we needed an integrated approach for example of new paradigms, this program will research and advocate: continuous ascent or descent instead of "stair-step" departures/approaches could save 20/30% fuel.

Conclusion: FY2009/10 budgets greatly enhance NASA 'ability to carry out goals requested of the Agency. However, U.S. Human Spaceflight Review will affect the out years.

<u>Q&A</u>

Q: A national climate service is needed to align policy and budgets. Should NASA establish itself as the national climate lead agency?

A: It's reasonable. However administration is already out front since NASA is a standing member of the Council for Environmental Quality and in that role NASA represents the interests of NOAA, Interior, DOD, etc.