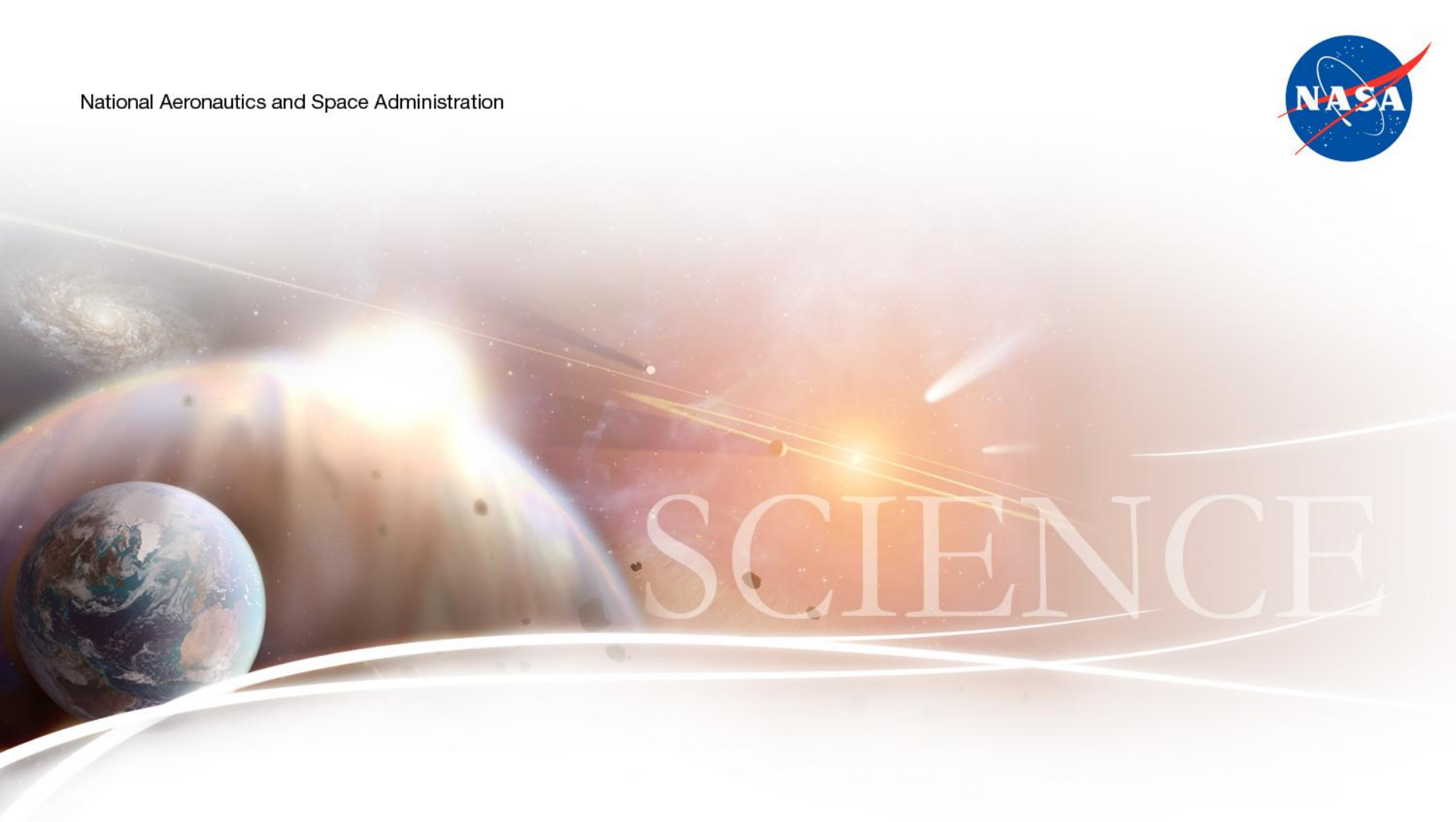
National Aeronautics and Space Administration



Science Committee Report

Dr. Byron Tapley, Vice Chair

Science Committee Members

Wes Huntress, Chair
Alan Boss, Carnegie Institution, Chair of Astrophysics
Ron Greeley, Arizona State University, Chair of Planetary Science
Noel Hinners, Independent Consultant
Scott Hubbard, Stanford University
Eugenia Kalnay, University of Maryland
Gene Levy, Rice University, Chair of Planetary Protection
Dave McComas, Southwest Research Institute
Byron Tapley, Vice Chair, University of Texas-Austin, Chair of Earth Science
Roy Torbert, University of New Hampshire, Chair of Heliophysics
Michael Turner, University of Chicago
Charlie Kennel, Chair of Space Studies Board (*ex officio* member)

T. Jens Feeley, NASA Executive Secretary

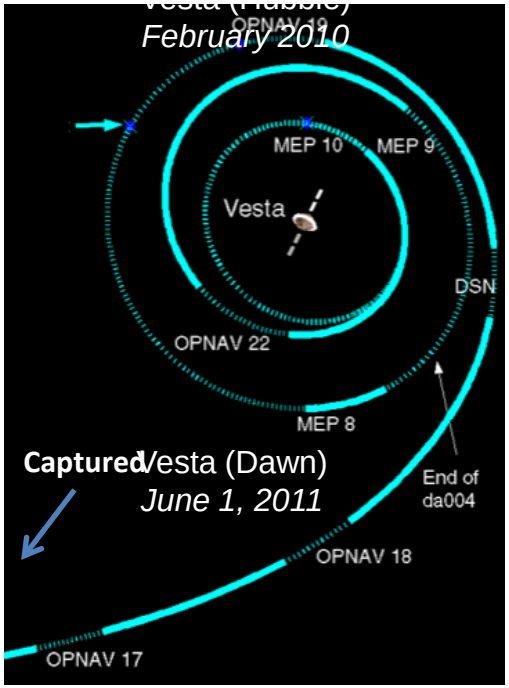
Agenda

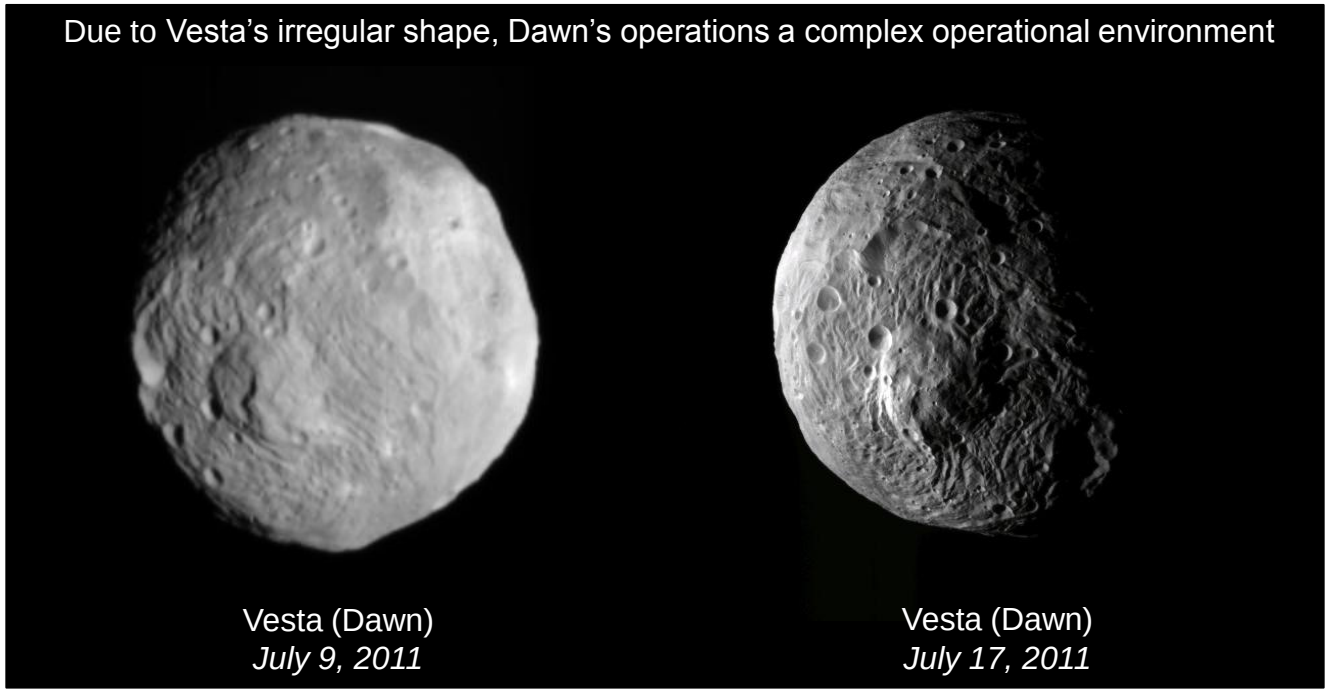
- **Science Results**
- Programmatic Status
- Findings & Recommendations

Dawn Enters Into Orbit Around Vesta

Dawn is a mission of planetary exploration firsts:

- First time spacecraft has entered into orbit around main asteroid belt object
- First time an ion engine has been used on a NASA planetary mission
- First time a spacecraft has visited an asteroid thought to be the source of many meteorites





Dawn, after a 1.7 billion mile journey, was captured into orbit around Vesta on July 15 (PDT), starting a yearlong science campaign to map one of the solar system's largest main asteroid belt protoplanets. Mission engineers estimate the orbit capture took place at approximately 10 p.m. PDT Friday, July 15 (1 a.m. EDT Saturday, July 16).

Opportunity Approaching at Endeavour Crater - Sol 2603

Opportunity can already see the rim of Endeavour Crater

Eagle crater

Endurance crater

Victoria crater

Santa Maria crater

2603

< 3.5 km

2000m

Endeavour crater

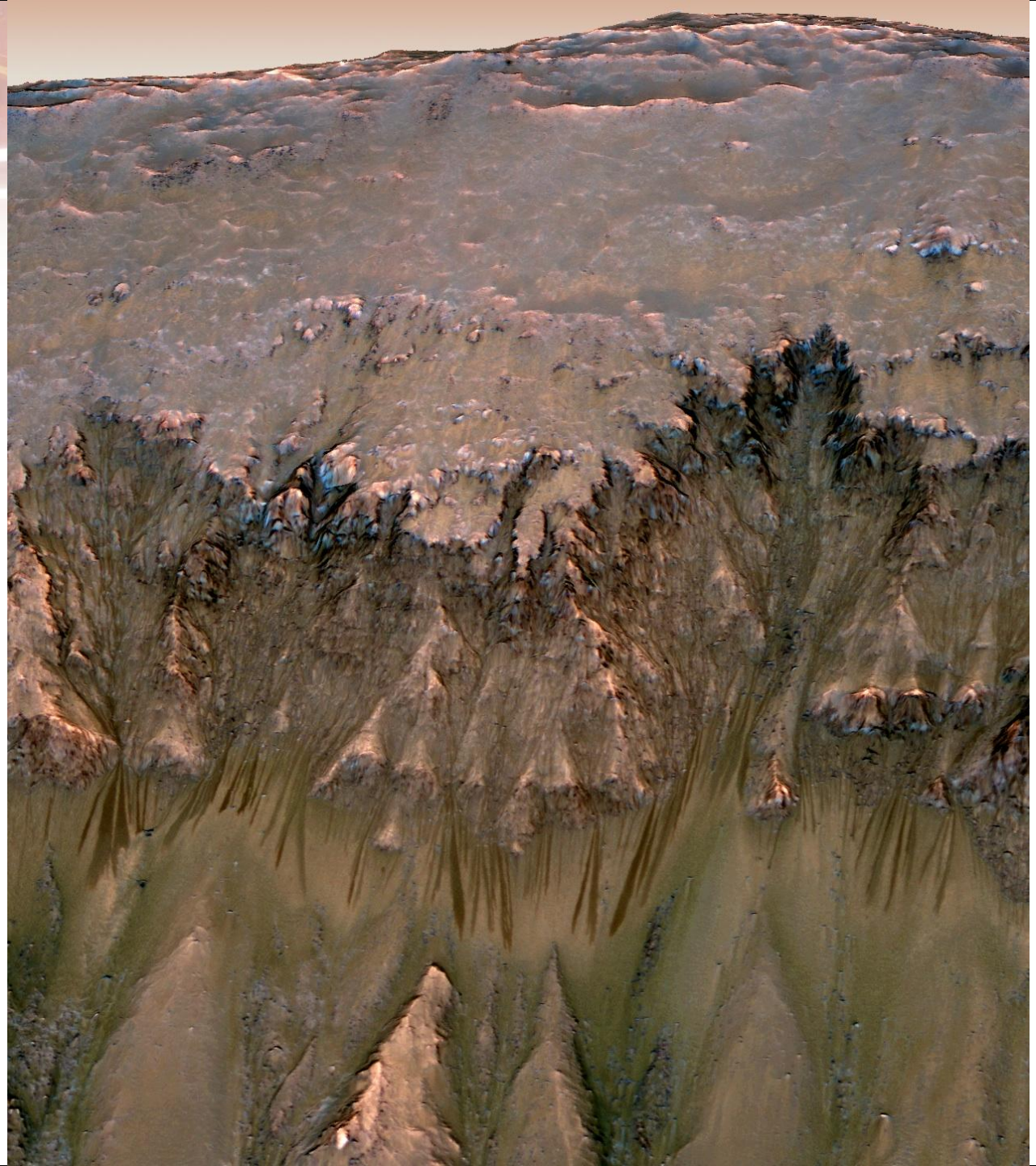
Endeavour crater

2000m

Opportunity drives ~400 m/week
Less than 2 km to go until it reaches the Endeavour Crater

LCrumpler 5/16/11

Embargoed until released at 2pm EDT on 4 August 2011

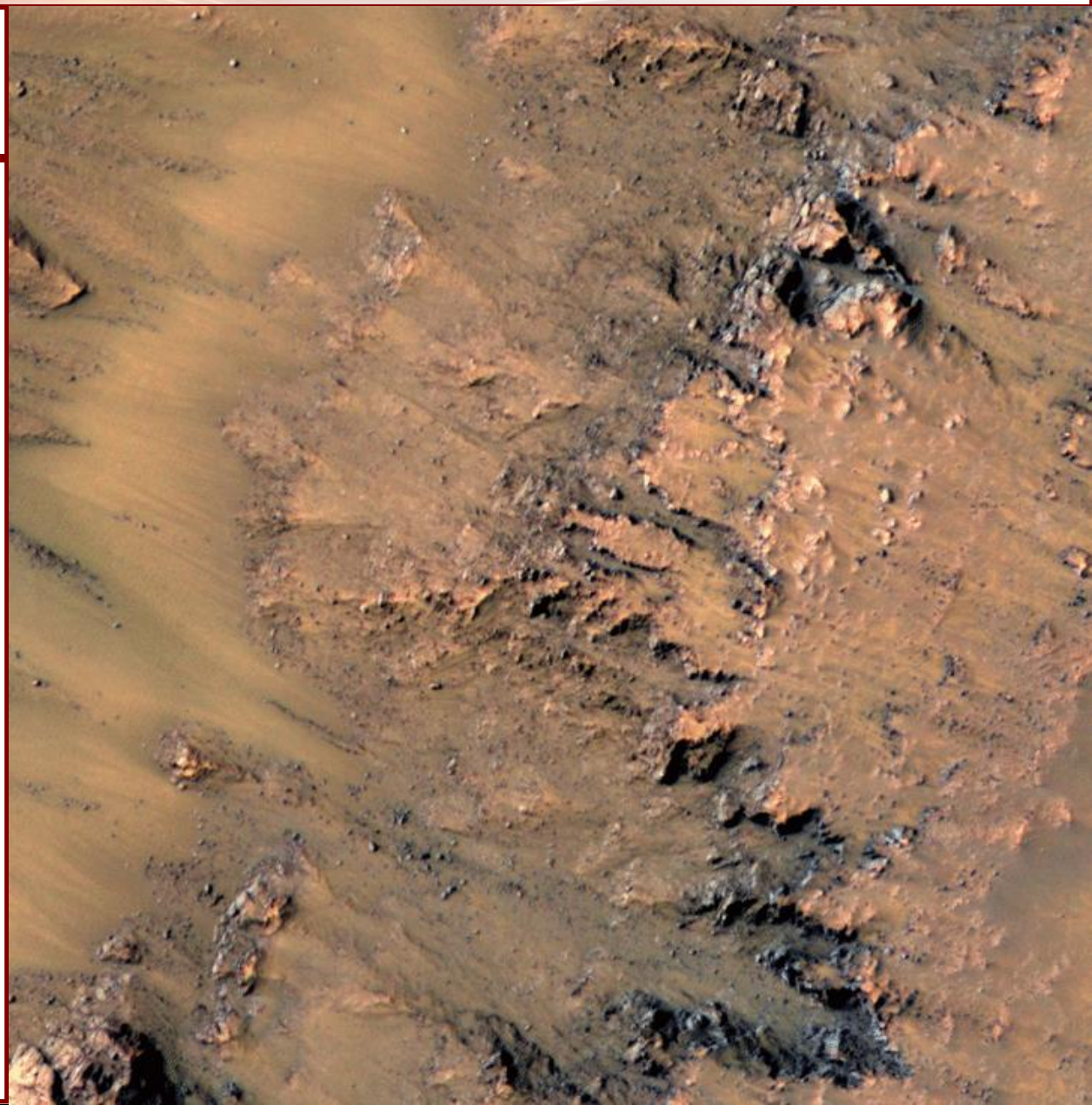


Seasonal Flows on Warm Martian Slopes

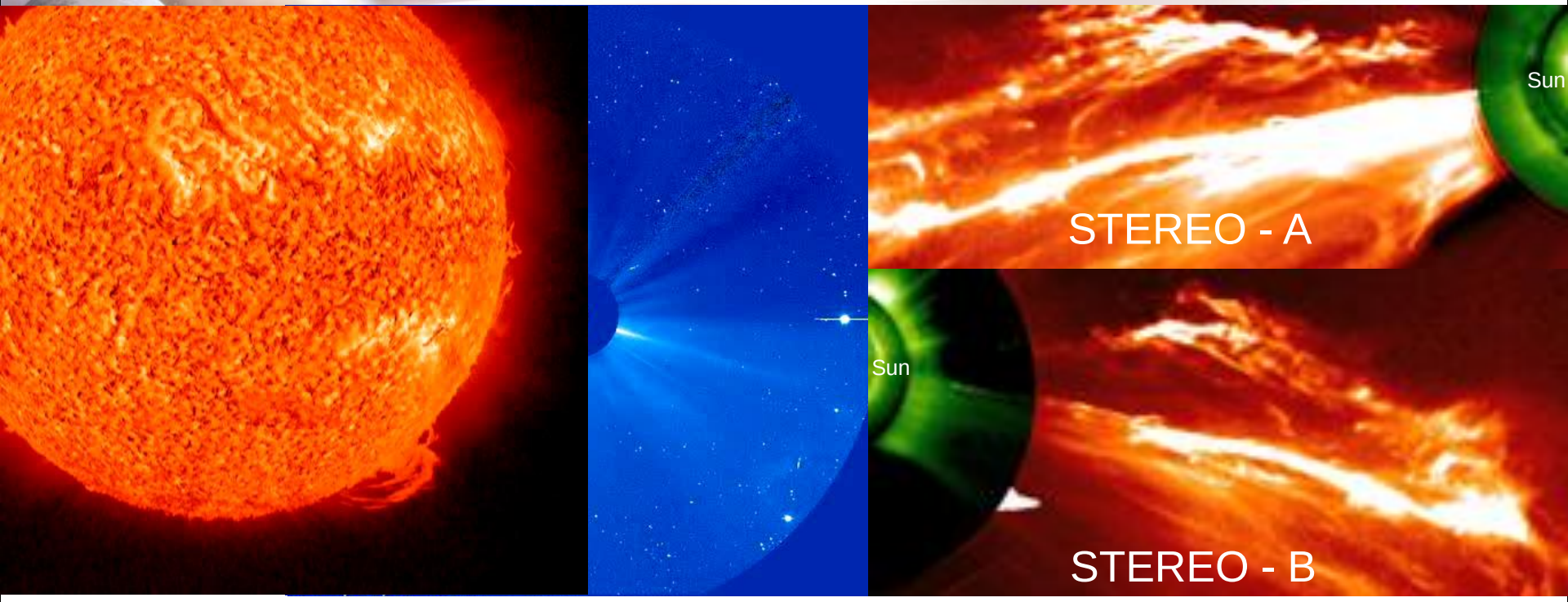
(A. McEwen et al., Science, 5 Aug 2011)

Embargoed until released at 2pm EDT on 4 August 2011

- Recurring Slope Lineae (RSL) are narrow (0.5-5 m), dark markings on steep slopes (>25°)
- Form and incrementally grow in late spring to summer, then fade or disappear in fall.
- Reform at nearly same locations in multiple Mars years.
- Extend downslope from bedrock outcrops or rocky areas; often associated with small channels.
- Concentrated in southern hemisphere (32°S to 48°S), favoring equator-facing slopes.
- Form and grow at temperatures at which brines would be liquid.
- Exact mechanism not understood, but activity of brines is current best model.

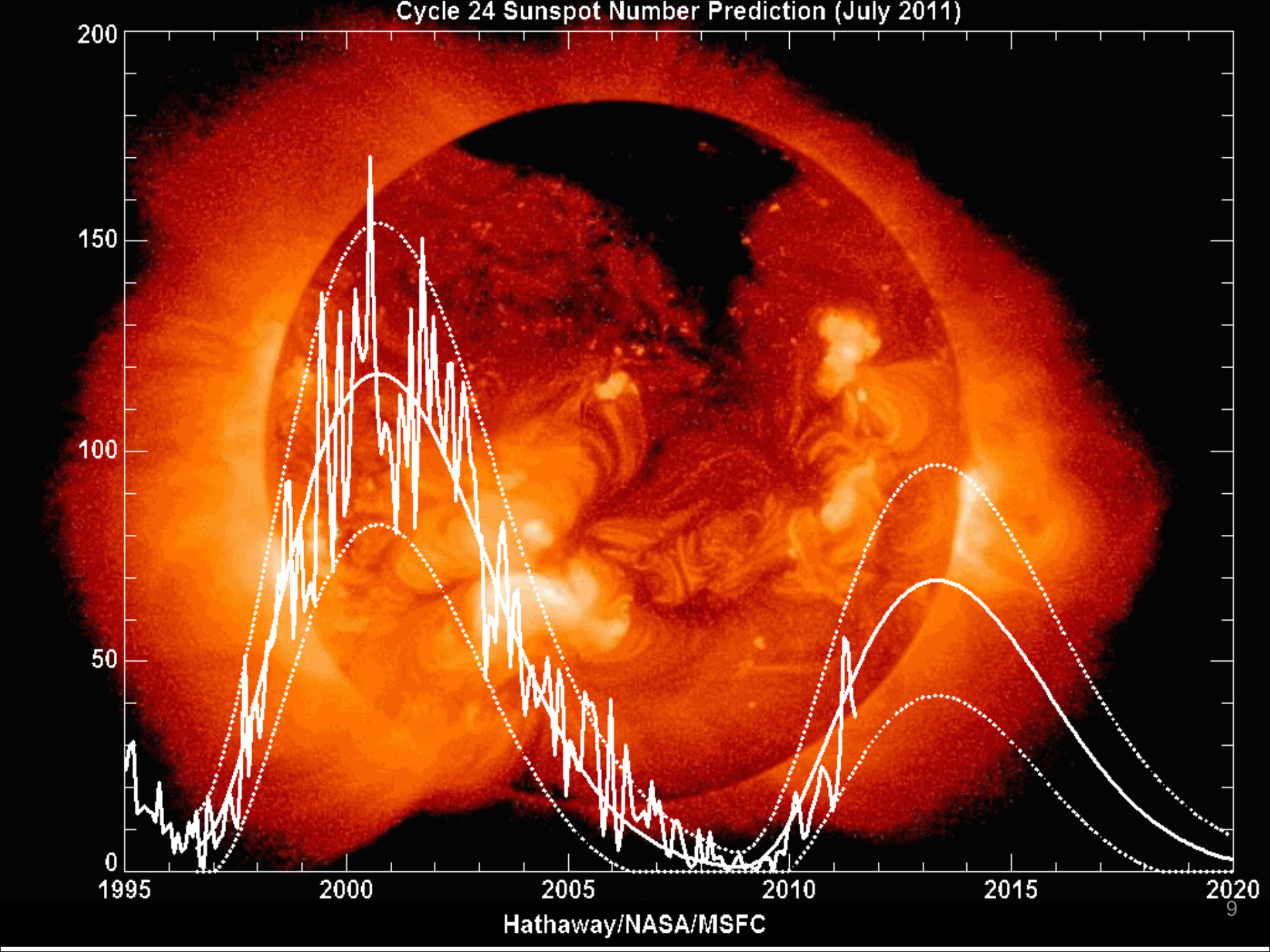


Heliophysics Spacecraft Observe Giant Solar Eruption

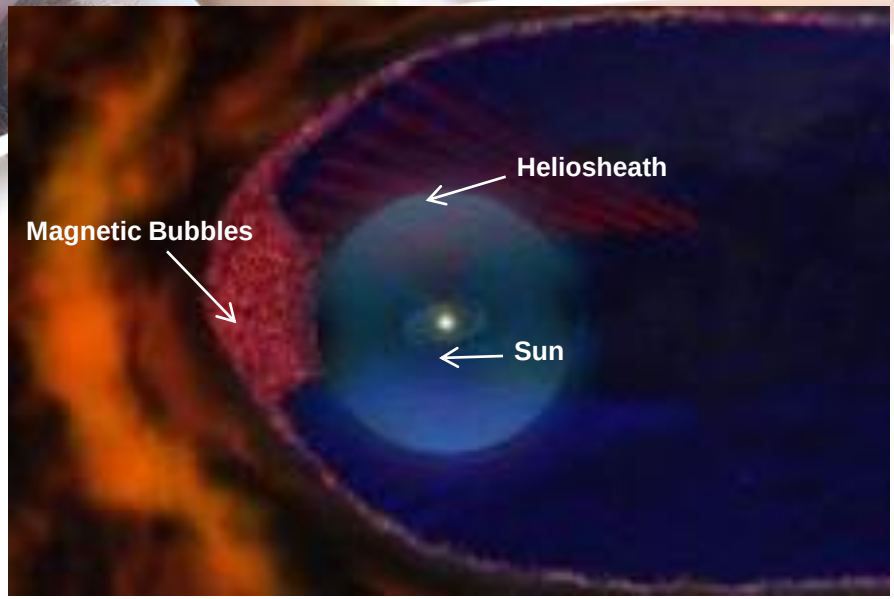


• The sun unleashed a solar flare and a spectacular coronal mass ejection (CME) on June 7, 2011. The eruption originated from the almost spotless active region 11226 and was associated with a moderate M2-class X-ray flare. The CME, moving at approximately 1400 km/s was not Earth-directed. **This event is not only one of the most spectacular ever recorded, but also one of the best observed, with complementary data from several spacecraft and different vantage points.**

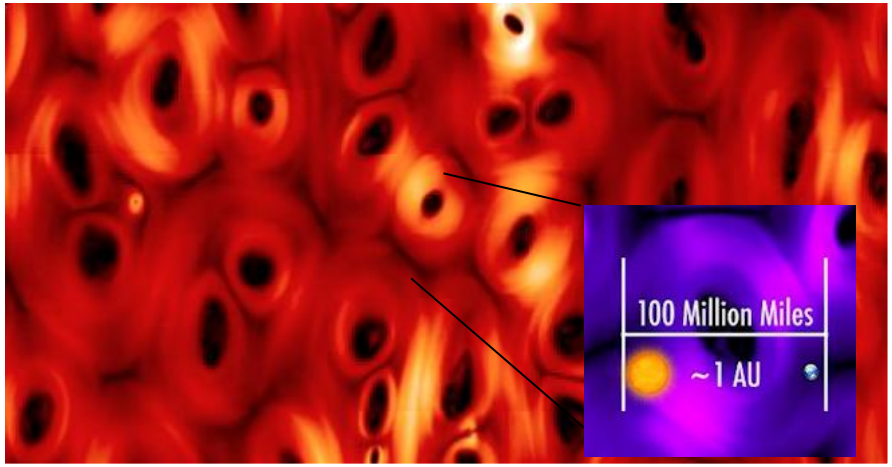
• The Solar Dynamics Observatory (SDO) observed the flare's peak at 1:41a.m. EDT (above left). When viewed in the Solar and Heliospheric Observatory's (SOHO) coronagraphs (above center), the event shows bright plasma and high-energy particles streaming from the sun. In addition, the Solar Terrestrial Relations Observatory (STEREO) Ahead (right top) and Behind (right bottom) coronagraphs viewed the CME expanding on both sides of the sun.


Cycle 24 Sunspot Number Prediction (July 2011)
200
150
100
50
0
1995
2000
2005
2010
2015
2020
Hathaway/NASA/MSFC

Voyager Spacecraft Suggest Magnetic Bubbles Reside at the Edge of the Solar System



Above: Artist concept of the new view of the heliosphere based on Voyager data. The heliosheath is filled with "magnetic bubbles." Credit NASA.



Below: Close-up of the bubbles, created by magnetic reconnection, at the edge of the solar system. Credit NASA

• Observations from NASA's Voyager spacecraft suggest the edge of our solar system may not be smooth, but filled with a turbulent sea of magnetic bubbles. While using new computer models to analyze Voyager data, scientists found the sun's distant magnetic field is made up of bubbles approximately 100 million miles wide.

• The bubbles are created when magnetic field lines reorganize and reconnect. The new models suggest the field lines are broken up into self-contained structures that are disconnected from the solar magnetic field. The findings were described in the June 9 edition of *the Astrophysical Journal.*

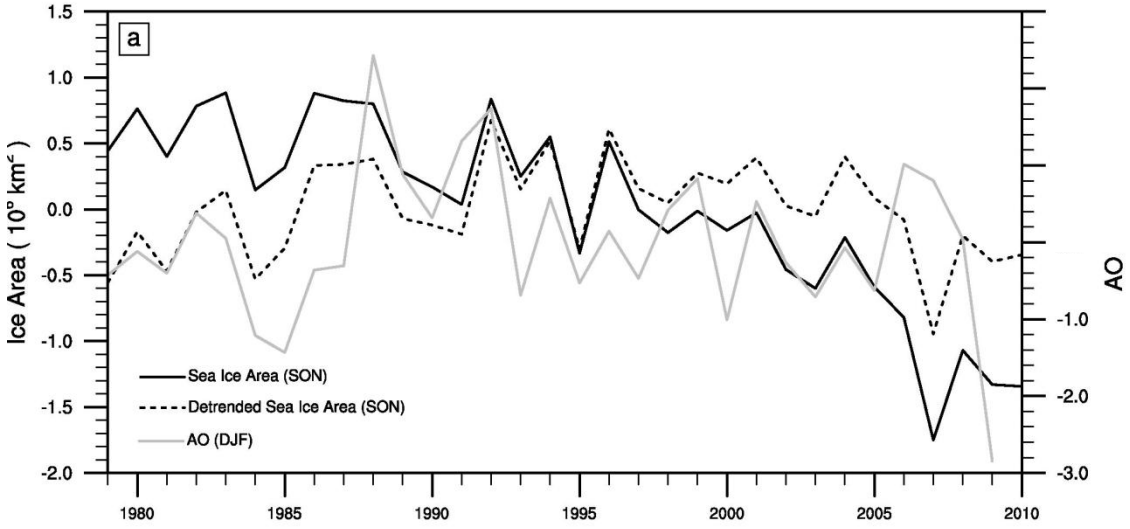
• The Voyager spacecraft, approximately 10 billion miles away from Earth, are traveling in a boundary region. In that area, the solar wind and magnetic field are affected by material expelled from other stars.

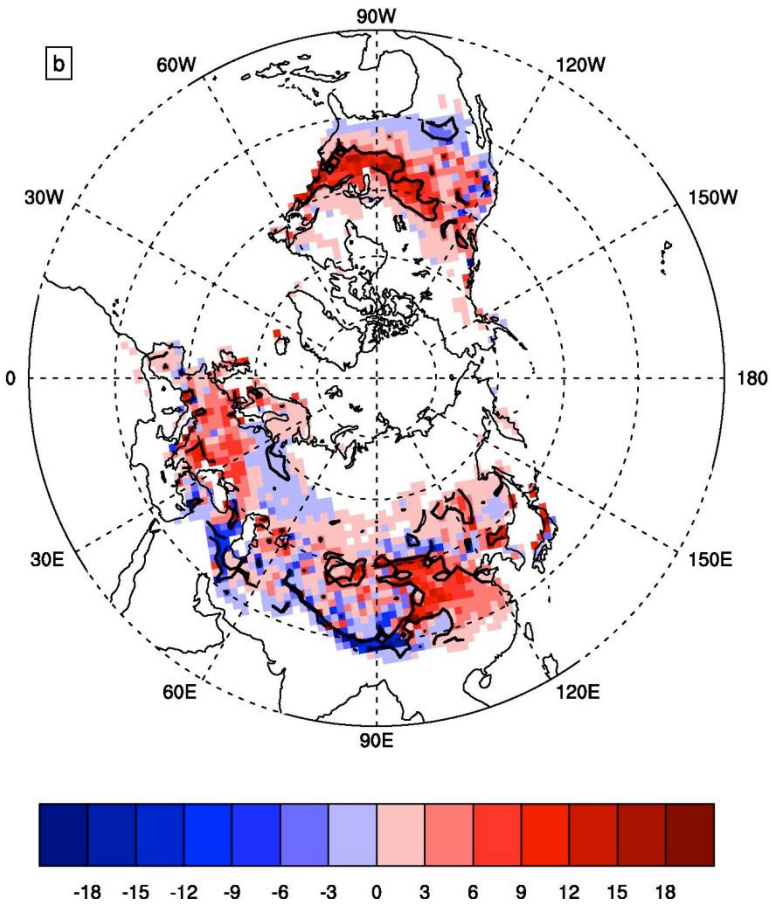
• Understanding the structure of the sun's magnetic field will allow scientists to explain how galactic cosmic rays enter our solar system and help define how our star interacts with the rest of the galaxy. So far, much of the evidence for the existence of the bubbles originates from an instrument aboard the spacecraft that measures energetic particles. Investigators are studying more information and hoping to find signatures of the bubbles in the Voyager magnetic field data.

Impact of Declining Arctic Sea Ice on Winter Snowfall

Jiping Liu and Judith Curry, Georgia Institute of Technology

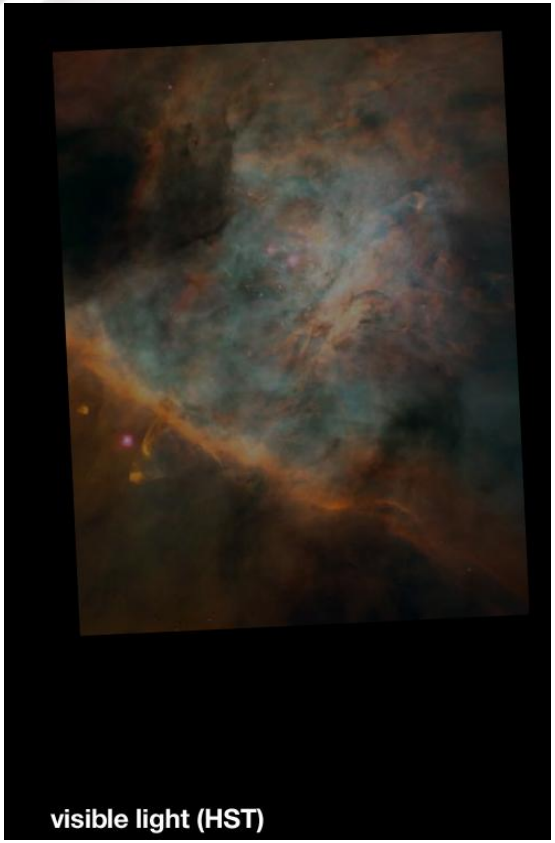
Analysis of satellite data sets of sea ice and snow cover in combination with atmospheric circulation data demonstrates that the anomalous increase in NH winter snow extent is linked to changes in the winter NH atmospheric circulation that are in turn linked to decreased autumnal extent of Arctic sea ice. This circulation change results in more frequent episodes of blocking patterns that leads to increased cold surges over large parts of northern continents. The increase in atmospheric water vapor content in the Arctic region during late autumn and winter in response to the reduction of sea ice provides enhanced local moisture sources, supporting increased heavy snowfall in Europe and northeastern and mid-west U.S.

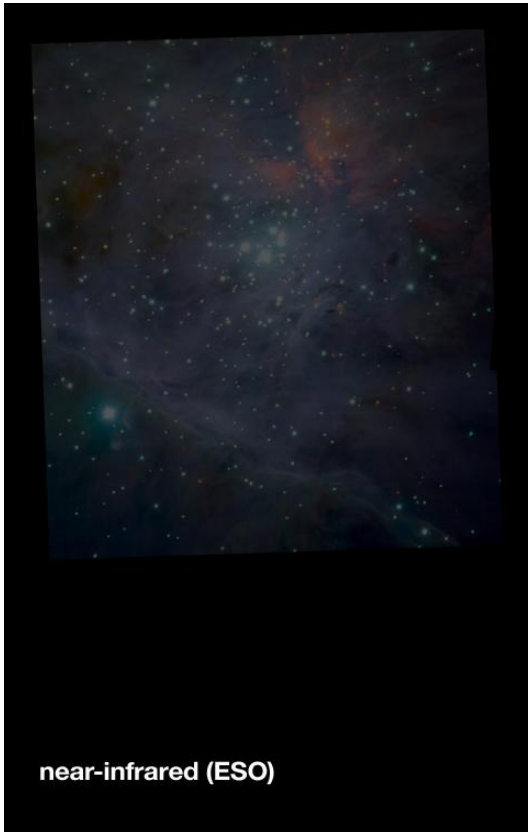


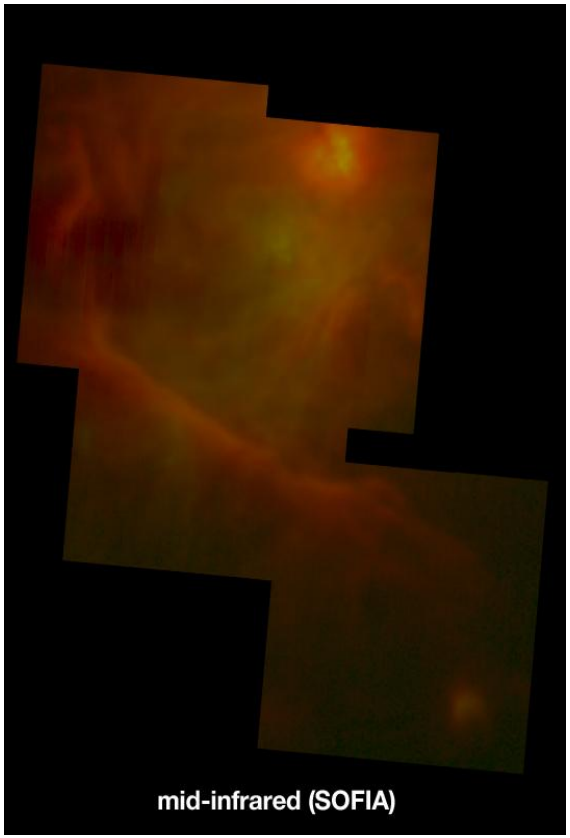


linear regression of winter snow cover anomalies (%) on the detrended autumn Arctic sea ice area anomaly

SOFIA Recent Highlights





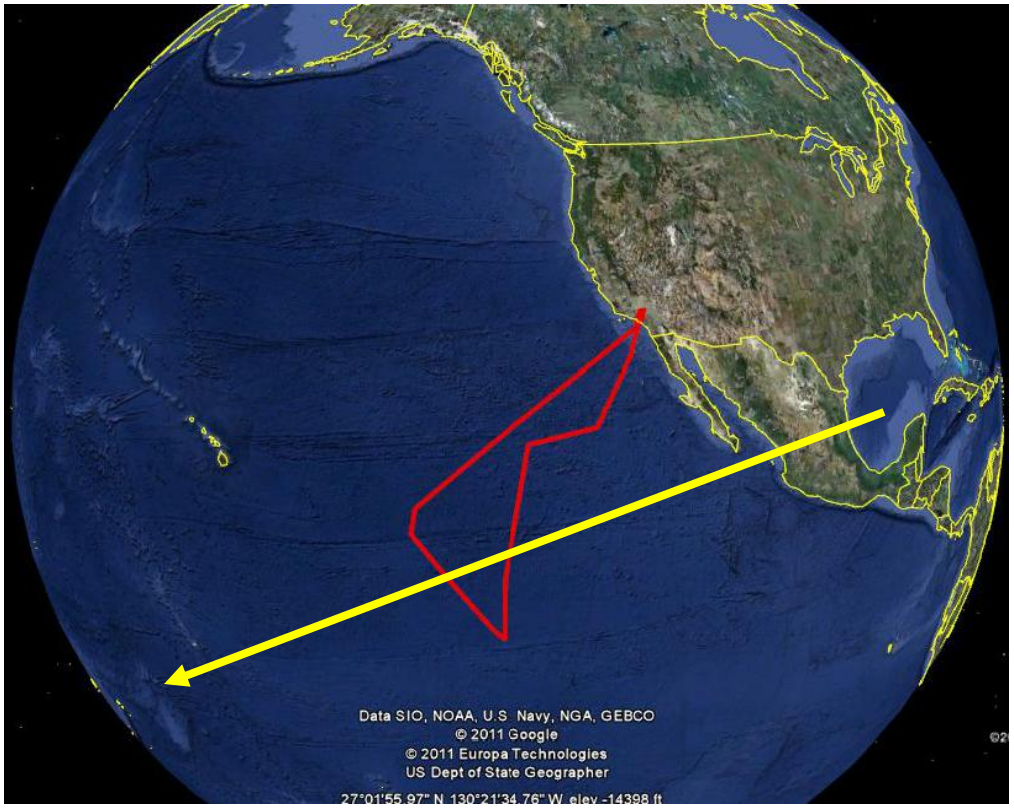


FORCAST Observations of the Orion Nebula

Occultation by Pluto - June 23, 2011

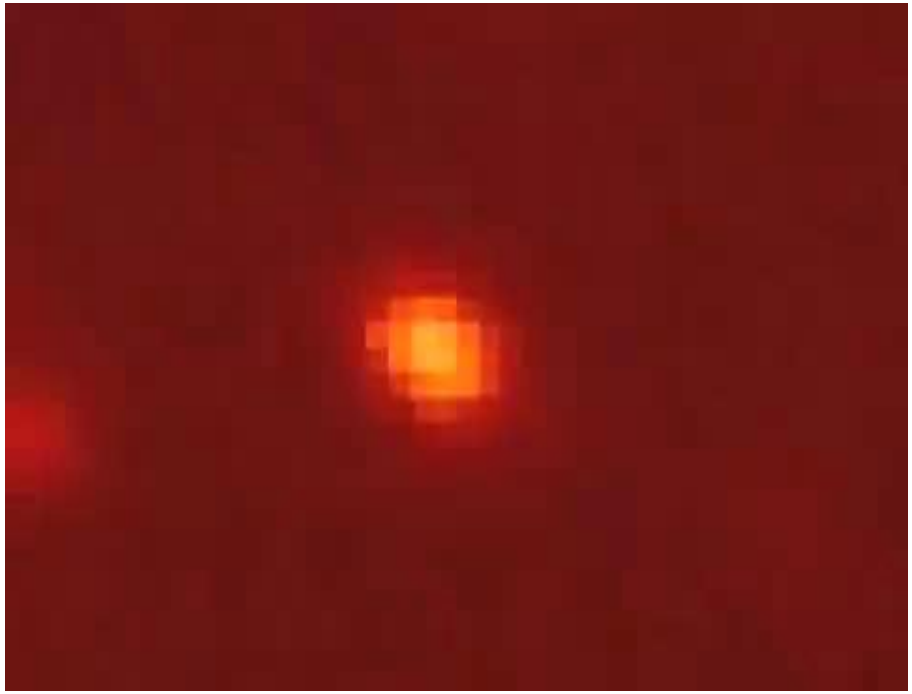
- Observation of Pluto passing in front of a bright star is used to provide highly detailed information about the atmosphere

- Mobility of SOFIA is key to successful observations



Pluto Occultation Results

- Goal of flight was to get as close as possible to center line of occultation
  - If close enough to center line, we can see brightening at mid-event due to atmospheric refraction in Pluto
- Required refinement of prediction as close to time of event as possible
  - Observations at US Naval Observatory, Flagstaff AZ
  - Reductions at MIT
  - Rerouting of SOFIA during flight
- Successful detection indicated SOFIA hit the mark within 100 km.



Ted Dunham, Lowell Observatory, HIPO instrument

Agenda

- Science Results
- **Programmatic Status**
- Findings & Recommendations

Earth Science Operating Missions – Senior Review

NASA Earth Science Senior Review 2011

Submitted to:

Dr. Michael Freilich
Director, Earth Science Division Science Mission Directorate

Submitted by:

George Hurtt (Chair), Ana Barros, Richard Bevilacqua, Mark Bourassa, Jennifer Comstock, Peter Cornillon, Andrew Dessler, Gary Egbert, Hans-Peter Marshall, Richard Miller, Liz Ritchie, Phil Townsend, Susan Ustin

June 30, 2011

Senior Review during 2011
- **Science**
- **National Needs**
- **Technical/Cost**
- **Recommendations 6/11**

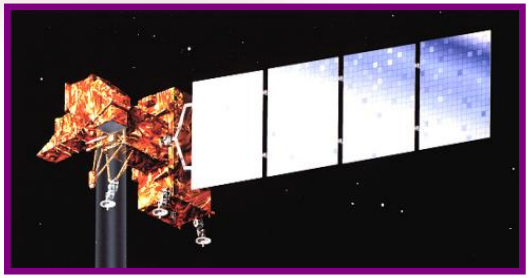
Mission	Utility Score	Technical Risk	Cost Risk	Conclusion	
				FY12-13	FY14-15
Aqua	Very High	Medium	Medium	Baseline*	Baseline
Aura	High	Medium-High	Low	Reduce	Reduce
CALIPSO	High	Medium-Low	Low	Baseline	Baseline
CloudSat	High	Medium*	Low	Baseline*	Baseline*
EO-1	High	High*	High	Baseline	Baseline
GRACE	High	Medium-High	Medium	Augment*	Augment*
Jason-1	High	Medium-High	High	Baseline	Augment
OSTM	Very High	Low	Low	Baseline	Baseline
QuikSCAT	High	High*	Medium	Baseline	Augment
SORCE	High	Medium-High	Medium	Augment*	Augment*
Terra	Very High	Medium	Low	Baseline	Baseline
TRMM	High	High*	Low	Baseline	Baseline

Following the Glory failure (loss of TIM) and successful cross-cailbration/ characterization, Acrimsat was also recommended for continuation

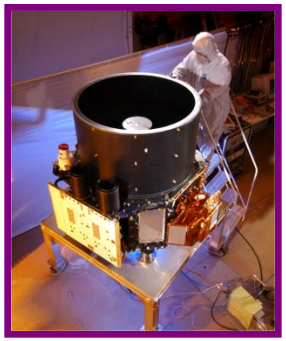
Missions in Formulation and Implementation

AQUARIUS
6/10/2011
w/CONAE; SSS

NPP
10/25/2011
w/NOAA
EOS cont., Op Met.



LDCM
12/2012
w/USGS; TIRS



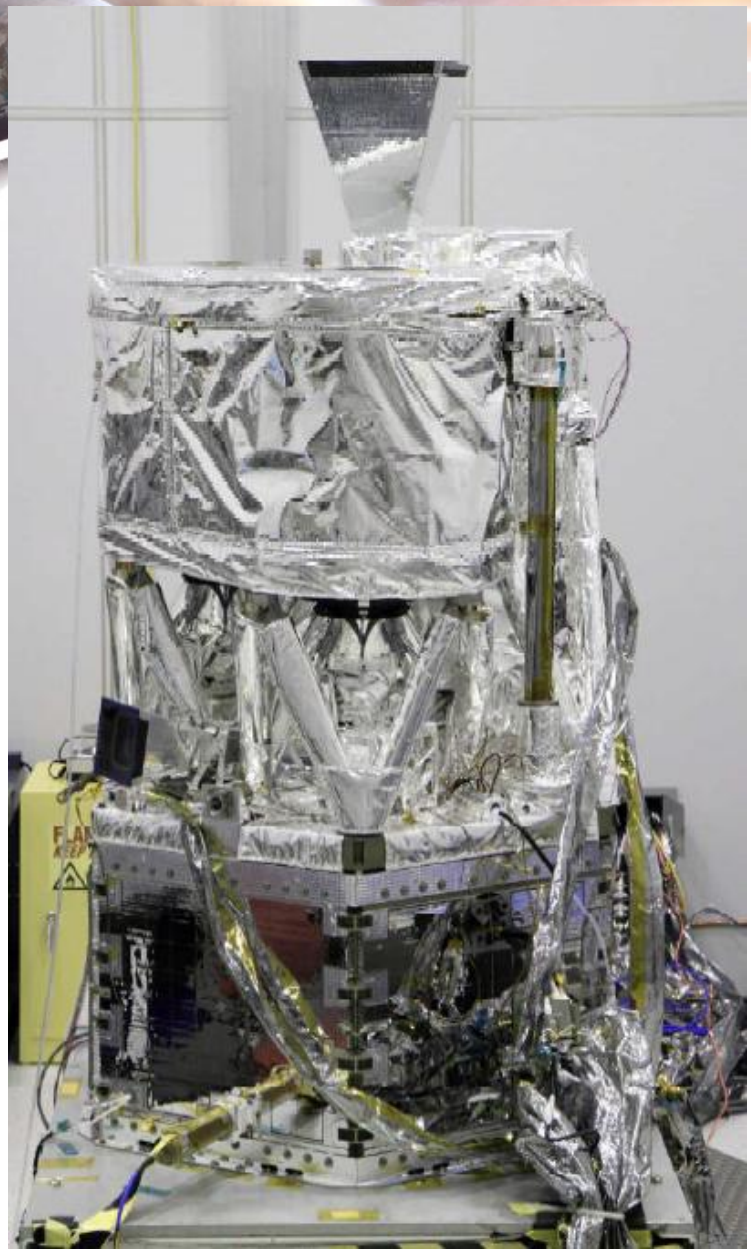
ICESat-II
Likely 2016
Ice Dynamics

SMAP
Late CY2014
w/CSA
Soil Moist., Frz/Thaw

GPM
7/2013
w/ JAXA; Precip

OCO-2
2013
Global CO_2

NuSTAR Status



Comprehensive Performance Testing successfully concluded.

Thermal Vacuum Chamber testing July 13-30.

Two of the eight X-ray detectors were found to have nonfunctioning pixel elements. Repair of the two detectors is planned for completion in early August, with installation planned for late September or early October.

Observatory in final Integration and testing at OSC, Virginia.

Observatory shipment to Vandenberg AFB for physical integration to the Pegasus launch vehicle currently planned for December 2011.

NuSTAR Observatory launch from Kwajalein Island planned for February 3, 2012.

Juno

Juno Near-term Schedule

July 27
Press Conference at KSC

July 29
LV FRR

Next Activities:

August 3
Launch Readiness Review

August 5 – 26
Launch Window

August 5 – 12
Science Team Meeting

Popular Science Magazine

PHOTO GALLERIES FACEBOOK DIGG STUMBLEUPON REDDIT PRINT

Big Science: The Universe's Ten Most Epic Projects

By Gregory Mone, Brooke Borel, Katherine Bagley and Jennifer Abbasi Posted 7.16.11 at 8:06 pm 9 Comments

IMAGE 5 OF 10

6: Juno, a Jupiter Orbiter on a Suicide Mission

NASA/JPL-Caltech/Lockheed Martin

Annual budget: $30,000,000
Construction cost: $928,000,000
Staff: Hundreds
Physical size: 66 feet in diameter, 15 feet tall
Scientific utility: 7
WIIFY: 1
Wow factor: 10

Just before Juno enters Jupiter's orbit in 2016, the spacecraft, pulled by the gas giant's tremendous gravity, will reach speeds of 134,000 miles an hour, making it one of the fastest human-made objects ever built. Once in orbit, the craft will make 33 passes around the planet and then dive directly into it. On its suicide run, it will plow through Jupiter's hydrogen atmosphere until it burns up like a meteor.

Scientific Utility

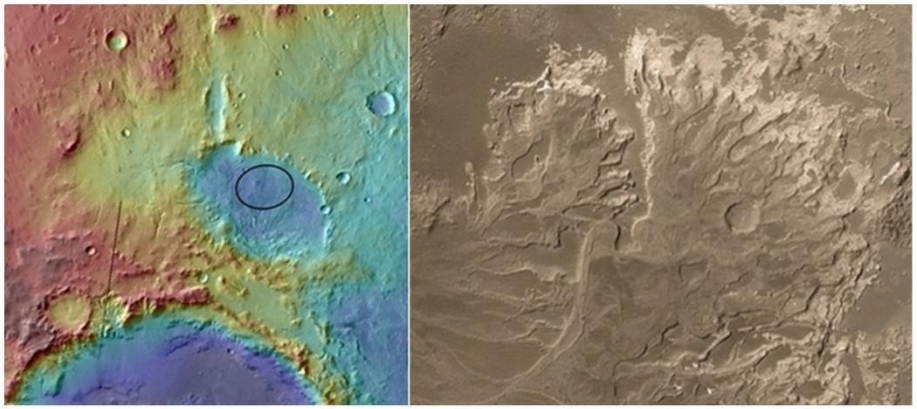
While Juno circles Jupiter, a suite of nine instruments will study the planet's many layers. Jupiter was the first planet in the solar system to form, and because it is so large, its gravity has retained original material found in the early solar system, primarily hydrogen and helium. This characteristic makes the planet a valuable window into the solar system's origins. Measurements of Jupiter's magnetic field could finally resolve the debate over whether the planet has a rocky core. Juno's magnetometers will characterize the depth and motions of the metallic hydrogen ocean found in the interior, which generates the strongest magnetic field in our solar system aside from that found around the sun. Finally, a microwave radiometer will measure the amount of water in Jupiter's deep atmosphere, a key to understanding how the planet was originally formed.

What's In It For You

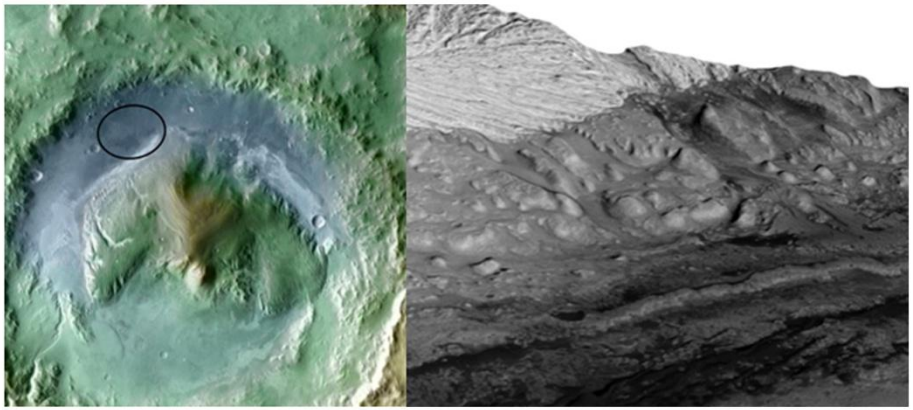
Study of Jupiter's complex weather patterns could help us predict our own, but for the most part this is pure scientific research.

Juno is Ready for Launch

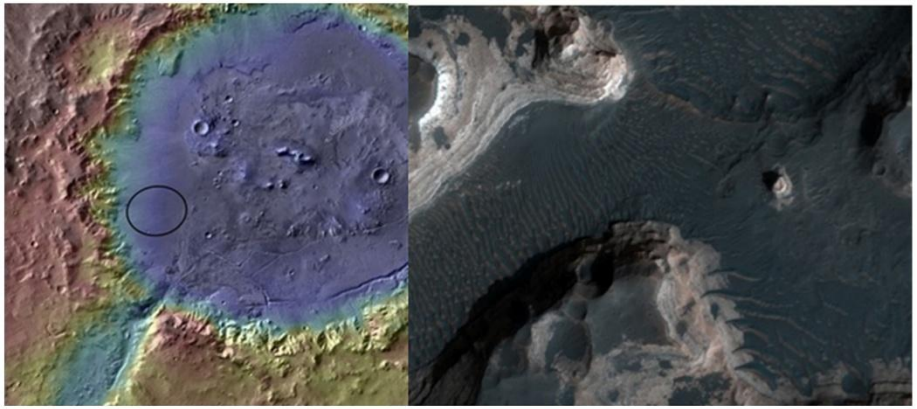
Gale Crater Selected for MSL Landing Site



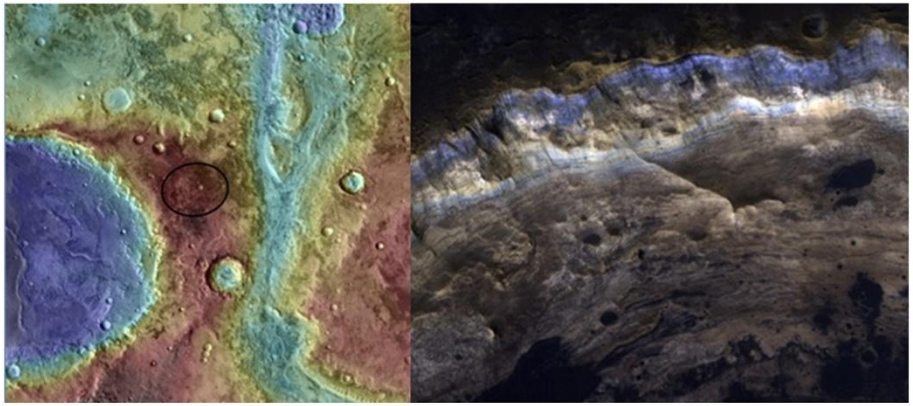
Eberswalde Crater: The Best Delta on Mars?



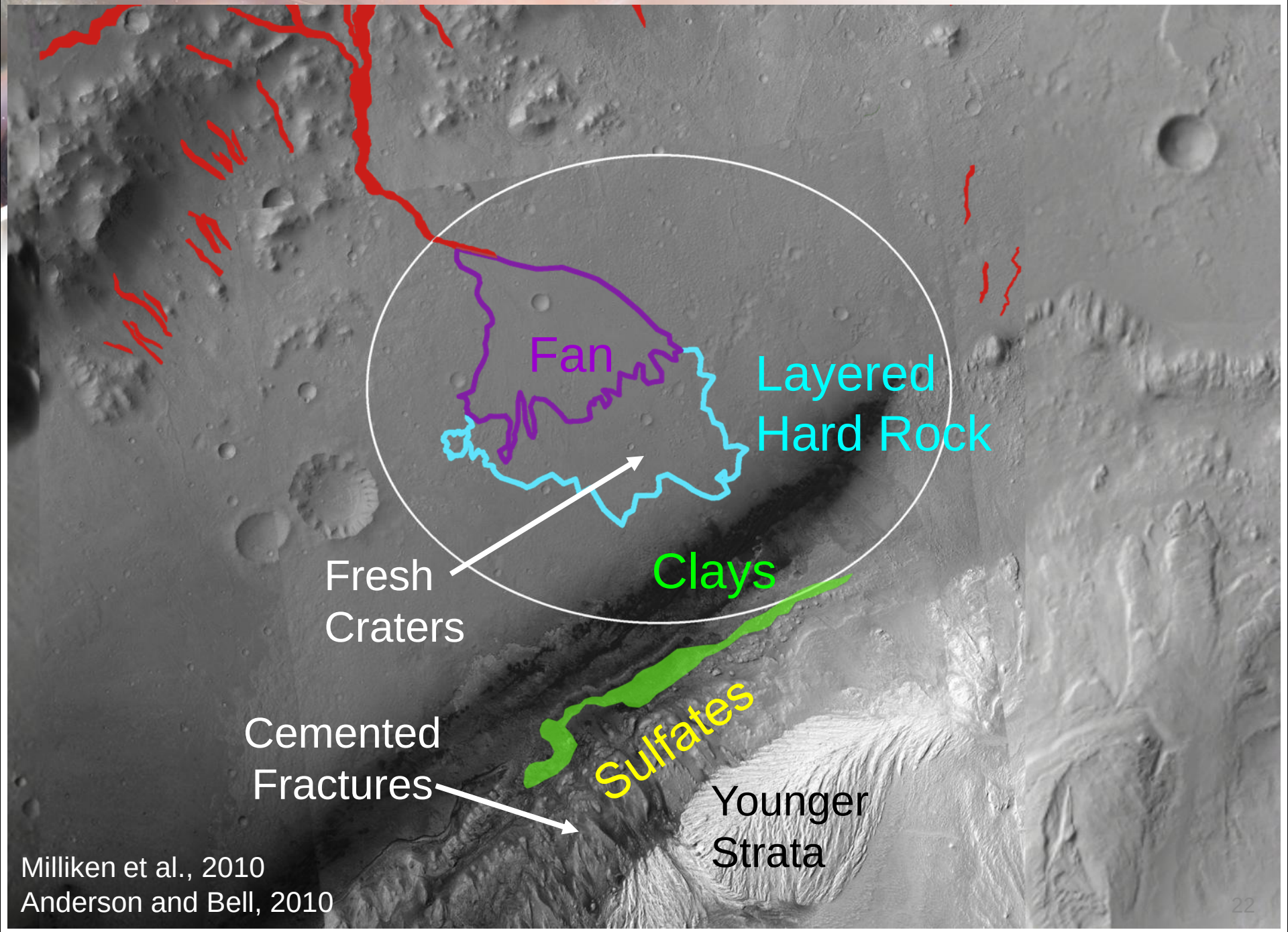
Gale Crater: Thickest Rock Section on Mars?



Holden Crater: Most Diverse Alluvial/Lake?



Mawrth Vallis: Oldest Rock Section on Mars?



Milliken et al., 2010
Anderson and Bell, 2010

Planetary Protection Subcommittee (PPS)

The PPS has recently taken up:

- Questions surrounding final selection of MSL landing target
- NASA support of the Russian Space Agency's Phobos Grunt Mission
- NASA involvement in launches by non-governmental organizations

Looking ahead, the committee is focusing on:

- Planetary protection issues raised by future missions planned in the context of the decadal survey
- Technology development for planetary protection
- Adequacy of support for planetary protection activities

James Webb Space Telescope (JWST)

- Astrophysics Subcommittee (APS) continues to closely monitor progress and issues associated with the James Webb Space Telescope (JWST)
- APS requested a lengthy briefing on the JWST re-plan status at its next face-to-face meeting in Fall 2011
- The future of JWST, the top-ranked mission in the 2001 Decadal Survey, clearly is an important agenda item for the APS and Science Committee to consider
- Detailed background data has been requested in advance of Fall meeting
  - Documentation about recent (within the past 3years) studies of de-scope/re-scope options for JWST
  - Documentation about studies of alternative means of achieving the scientific goals of JWST
  - History of JWST project status reports (Green/Yellow/Red) for the last 3years
  - Estimates of what percentage by cost (not mass) of JWST's parts have already been fabricated, or are in the process of being fabricated

NRC Decadal Surveys Shape Future Plans

- *Earth Science* – "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond " (NRC, 2007) influenced the FY2011 budget

- *Astrophysics* – "New Worlds, New Horizons in Astronomy and Astrophysics" (NRC, 2010) is reflected in the FY2012 budget request

- *Planetary Science* – "Visions and Voyages for Planetary Science in the Decade 2013-2022" (NRC, 2011) is being used to shape the FY2013 budget request

- *Heliophysics* – New decadal survey expected in Spring 2012; will be used to shape the FY2014 budget request

Government Performance and Results Act (GPRA) Assessments

- Science Subcommittees conduct independent assessments of progress toward annual performance goals
  - Assess performance by NASA as Green, Yellow or Red
    - Green – expectations were fully met in context of resources invested;
    - Yellow – notable or significant shortfall accompanied by good scientific results in some areas;
    - Red – major disappointments or shortfalls in scientific outcomes, uncompensated by other, positive results.
- Astrophysics: All performance goals rated Green (7/14)
- Heliophysics: All performance goals rated Green (6/22)
- Planetary Science: All performance goals rated Green (6/22)
- Earth Science: GPRA Assessment telecon scheduled for 8/31

Agenda

- Science Results
- Programmatic Status
- **Findings & Recommendations**

Recommendation

Short Title: Capturing Decadal Survey Lessons Learned

Recommendation: NASA should request a formal examination by the National Research Council (NRC) of the lessons learned, from the perspective of the National Academies, from recent NASA-related decadal surveys. Planning for this examination should be initiated after the release of the Heliophysics Decadal Survey in early 2012, and the examination should make recommendations about the next cycle of decadal surveys, which will begin circa 2015.

Major Reasons for the Recommendation:
Lessons learned, from NASA's perspective, are being captured. But the lessons learned, from the perspective of the National Academies, are also vital to maintaining the importance and continued value of the decadal surveys.

Consequences of No Action on the Recommendation:
The collection and examination of lessons learned will become more difficult with the passage of time, and the failure to capture these lessons could adversely affect the importance and continued value of future decadal surveys.

Recommendation

Short Title: Science Budget Options

Recommendation:
The Science Committee supports the intention of SMD to task the relevant NAC Subcommittees with evaluating possible division-level budget options, once the FY12 budget process results in an SMD appropriation or year-long Continuing Resolution. The Science Committee and its Subcommittees have a key role to play in this difficult process, especially in the event that major changes result from the budgetary process. The Science Committee stands ready to meet and to provide SMD the desired advice.

Major Reasons for the Recommendation:
The NAC Committees and Subcommittees are the only vehicle for timely advice concerning budget options that require major changes in programs.

Consequences of No Action on the Recommendation:
SMD is left without a timely source of advice for how to deal with the science and programmatic trades necessitated by major funding changes.

Recommendation

Short Title: NASA Press and Outreach Programs

Recommendation:
NASA's ongoing program of scientific challenges and exciting science missions, (those launched in the coming year, in development, and planned over the rest of the decade) will provide outstanding results and new discoveries. The NAC encourages NASA's press and outreach programs to strengthen their focus on science missions and stands ready to help formulate, facilitate, and champion these activities.

Major Reasons for the Recommendation:
NASA's science programs provide numerous opportunities for carrying the excitement of the U.S. space program to the public throughout the next decade and beyond.

Consequences of No Action on the Recommendation:
Missed opportunities to inspire the next generation of space explorers and inform the public about the results of NASA's science programs.

Recommendation

Short Title: Planetary Science Subcommittee Analysis Groups

Recommendation: NASA should revise the Terms of Reference (TOR) for the Lunar Exploration Analysis Group (LEAG), Mars Exploration Analysis Group (MEPAG), and the Small Bodies Assessment Group (SBAG) to reflect the recommendations contained in the Task Group of the NAC Science Committee (TagAG) final report. Specifically:

1) Add explicit tasking authority for the Exploration Systems Mission Directorate (ESMD) and relevant Committees of the NAC;

2) Add language concerning the appointment of the Chair (and in the case of LEAG, Co-Chairs) that has appointment made by the Associate Administrator (AA) for Science after consultation with the AA for Exploration Systems;

3) Update language to capture revisions in the topic areas covered by the respective Analysis Groups;

Recommendation (cont'd)

4) Acknowledge the uniqueness of LEAG by:

a) Establishing a LEAG Co-Chair for Science (appointed by AA for Science after consultation with AA for Exploration), who would replace the current LEAG Chair as a member of the NAC Science Committee's Planetary Science Subcommittee;

b) Establishing a LEAG Co-Chair for Exploration (appointed by the AA for Exploration Systems after consultation with AA for Science) who would be added to the membership of the NAC Exploration Committee; and,

c) Incorporating language that the LEAG Executive Secretary should be appointed by AA for Science after consultation with AA for Exploration Systems;

5) Refine the wording concerning the role of the Designated Federal Official (DFO)/Executive Secretary to ensure consistency with the Federal Advisory Committee Act (FACA) Final Rule and NASA Policy, while recognizing the value of a close working relationship between the Executive Secretary and the Chair.

Recommendation (cont'd)

Major Reasons for the Recommendation:
These recommended changes would update the three relevant Planetary Science Subcommittee Analysis Groups so that they can more directly provide analysis not only to the Science Mission Directorate (SMD) but, also, to the Exploration Systems Mission Directorate (ESMD) for integration of science into its exploration mission objectives.

Consequences of No Action on the Recommendation:
ESMD is left without a clear and direct mechanism for tasking the three relevant Planetary Science Subcommittee Analysis Groups that cover targets of interest to ESMD, namely, LEAG (Moon), MEPAG (Mars), and SBAG (asteroids).

National Aeronautics and Space Administration

www.nasa.gov