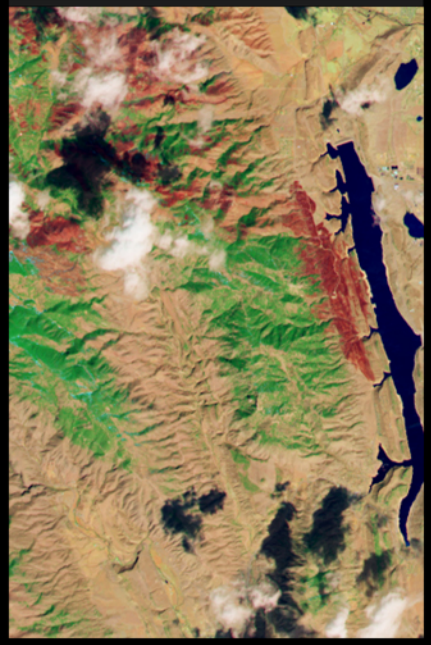
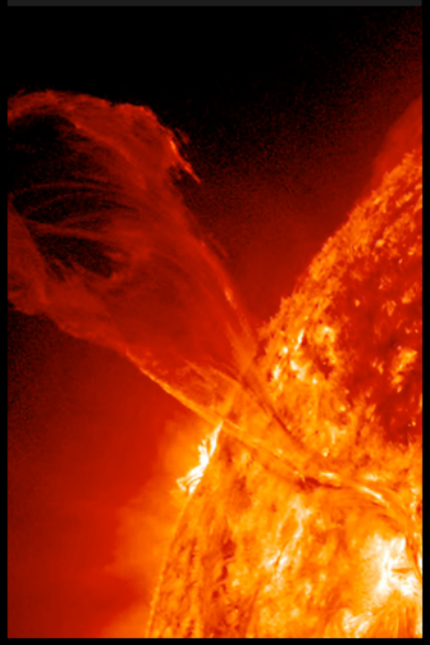
National Aeronautics and Space Administration



EARTH SCIENCE



HELIOPHYSICS

PLANETARY SCIENCE

ASTROPHYSICS

NAC SCIENCE COMMITTEE REPORT

WES HUNTRESS, CHAIR

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Dave McComas, Southwest Research Institute, Heliophysics member
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Charlie Kennel, Chair of Space Studies Board (*ex officio* member)

Finding

NASA Asteroid Capture and Exploration Mission

The agency's Asteroid Initiative is an innovative approach to a human spaceflight mission to an asteroid. It would develop capabilities required for human exploration to the Moon and beyond.

SMD can support this human spaceflight mission in several ways. First, by finding and characterizing asteroids in the size, mass, rotation rate, orbital characteristics and velocity range required for transfer to lunar orbit. This effort should search all space as well as near-earth space to increase the rate of discovery of smaller asteroids. Second, by providing expertise and advice on the space weather environment that astronauts may encounter beyond low Earth orbit. While not a science-driven mission, there may be an opportunity for doing some science.

There are challenging technical requirements as well as schedule and cost issues that require further investigation. SMD should provide support to HEOMD and STMD in the 2013 summer feasibility study.

Agenda

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

Diminished Temperature and Vegetation Seasonality Over Northern High Latitudes

NASA-funded researchers used MODIS and AVHRR data to investigate changes in the *seasonality of temperature and vegetation* growth in the HNL between 1982 and 2010.

Seasonality is defined as the difference between peak (summer) and minimum (winter), and increases with latitude (**Figure 1**).

The High Northern Latitudes (HNL) are experiencing rapid temperature warming due to climate change – but changes in temperature are not uniformly distributed across time. ***Winters are warming faster than summers.***

The data reveal on overall trend of "greening" in the Arctic and Boreal regions since 1982, although a small percentage of areas have decreased mean NDVI, (**Figure 2**).

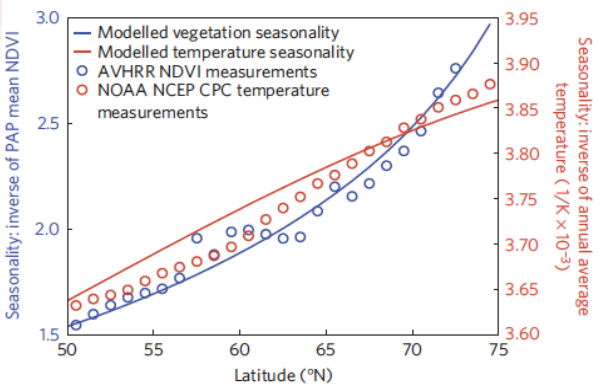


Figure 1 (above): **Comparison of modeled growing-season (photosynthetically active period – PAP) vegetation (mean NDVI) and temperature seasonality with observations by latitude.**

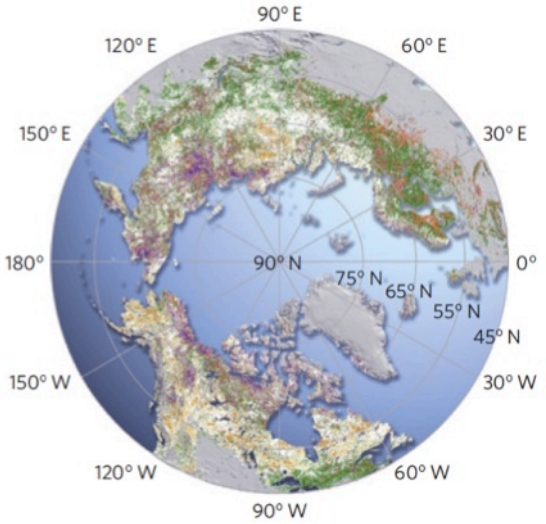
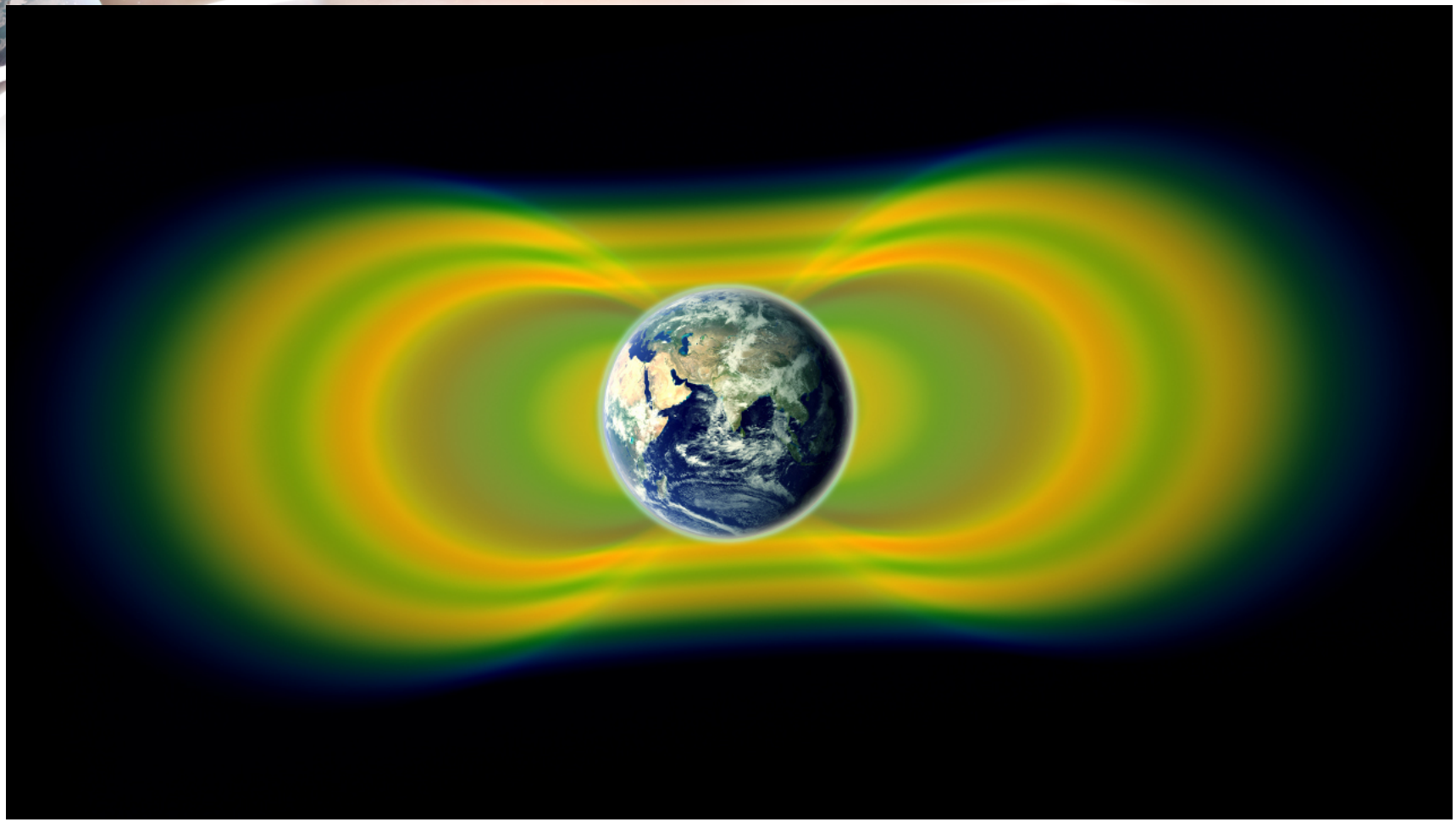


Figure 2 (right): **Map of percentage change in vegetation growth (mean NDVI) during the summer for the Arctic and boreal regions since nineteen eighty two.**

Science Highlight – Van Allen Probes

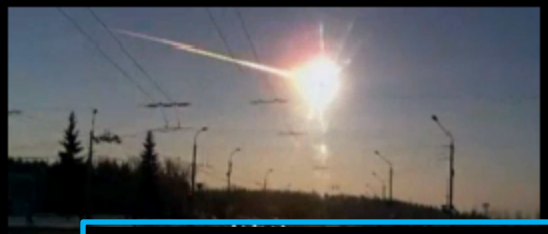


Van Allen Probes mission discovered a previously unknown third radiation belt around Earth shortly after launch on August 30, 2012. The third belt was observed for about four weeks before being annihilated by an interplanetary shock.

Small Bodies In the News

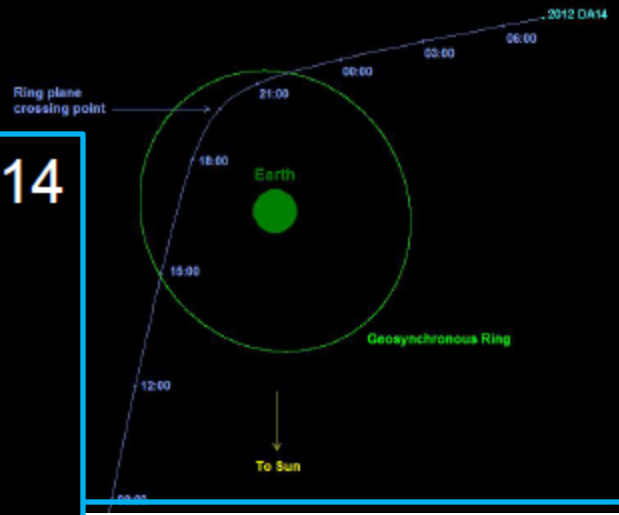
Meteorite Explosion over Chelyabinsk

February 15, 2013
Altitude: ~23 km
Diameter: 17-20 m
Velocity: ~19 km/s
Explosive energy: ~440 kT
Injuries: 1500+



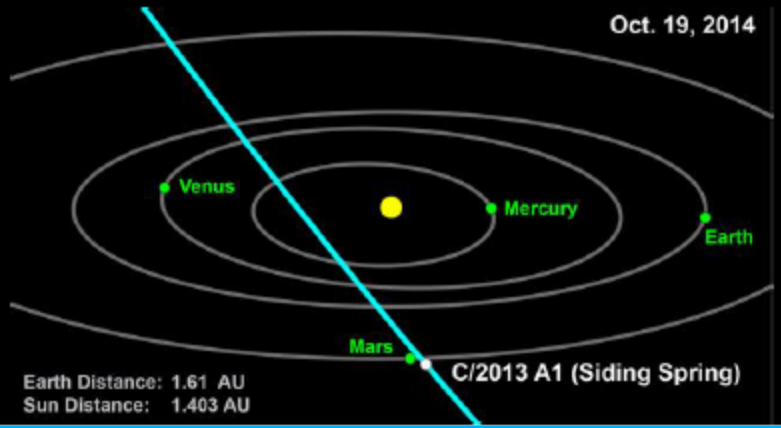
Asteroid Flies Within Geosynchronous Satellites RIng

February 15, 2013
Dimensions: 20x40 m

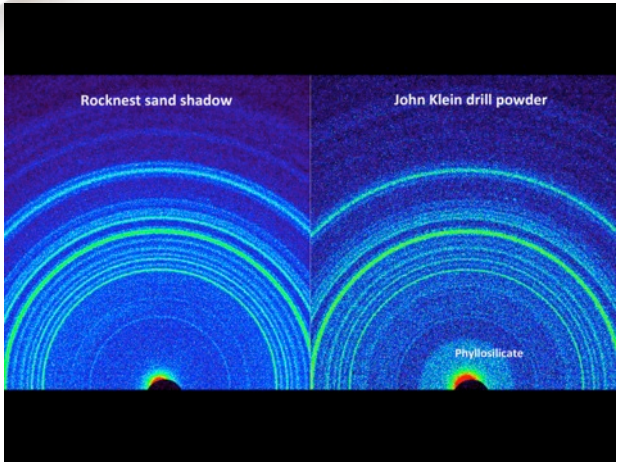


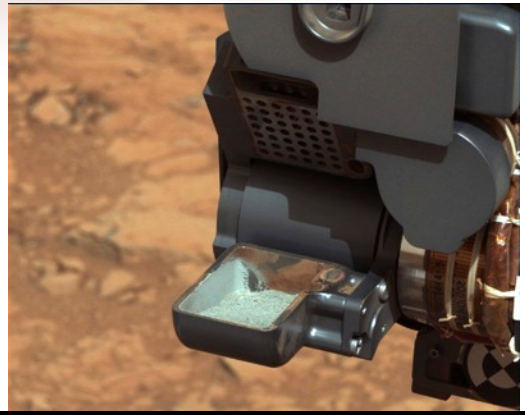
Comet May Impact Mars in October 2014

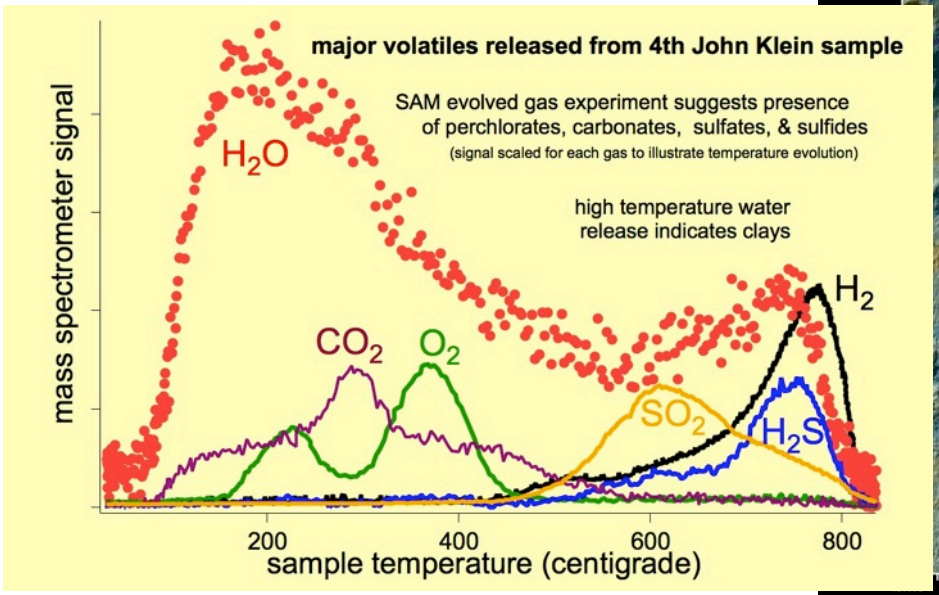
Discovered January 3, 2013 at Siding Spring
Diameter: 3-50 km
Impact velocity: 56 km/s
Impact probabiliy: ~1/10000

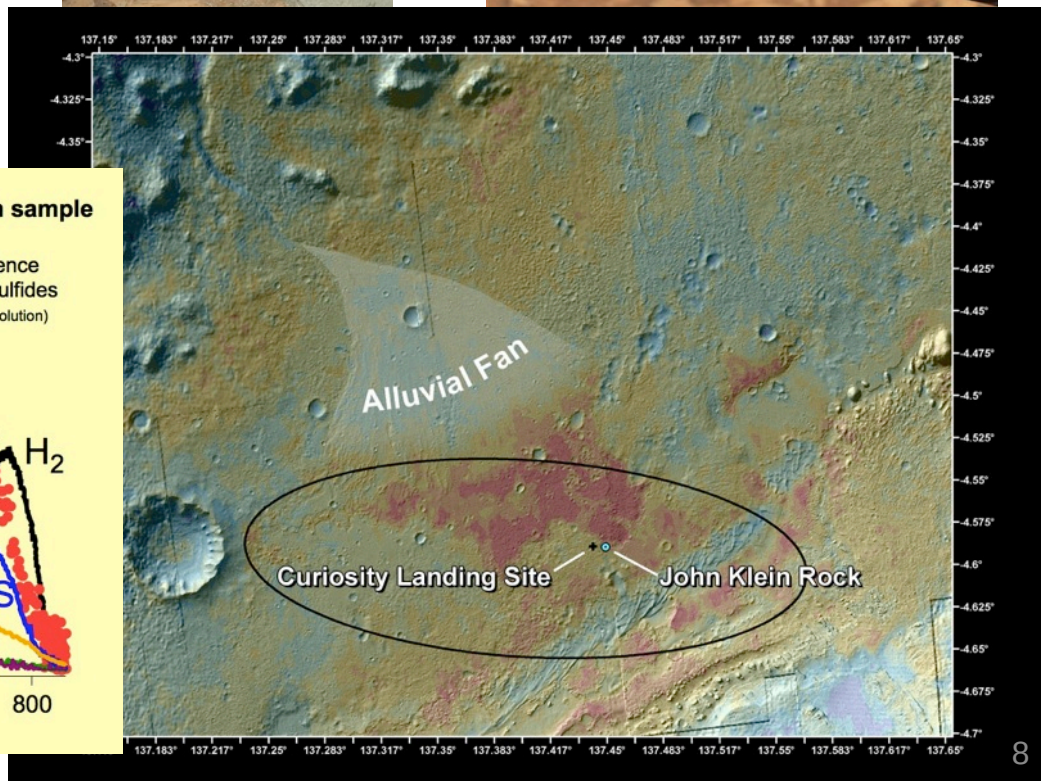


Curiosity to Earth – Mars WAS habitable!



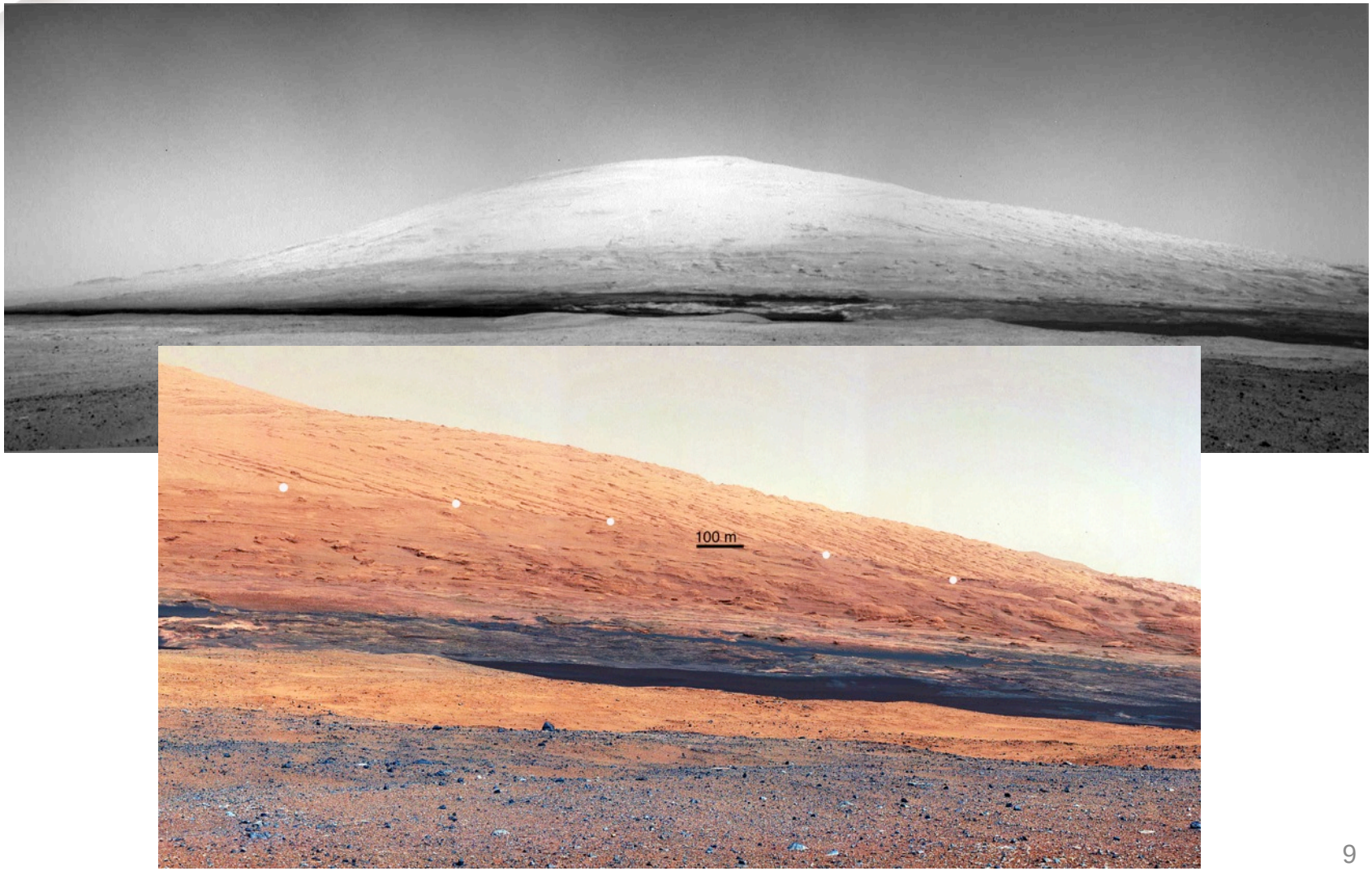


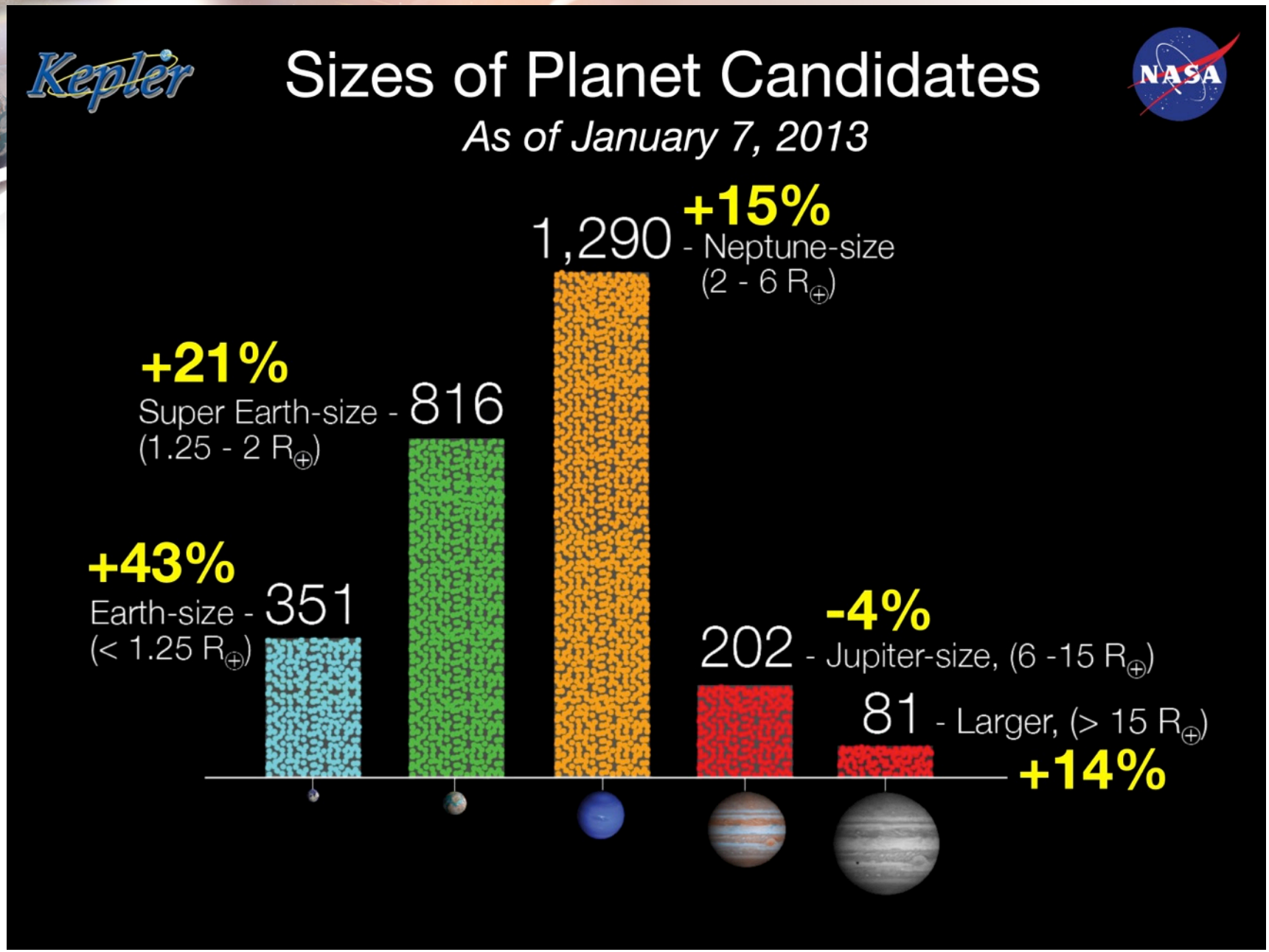




Next Destination – Mt. Sharp

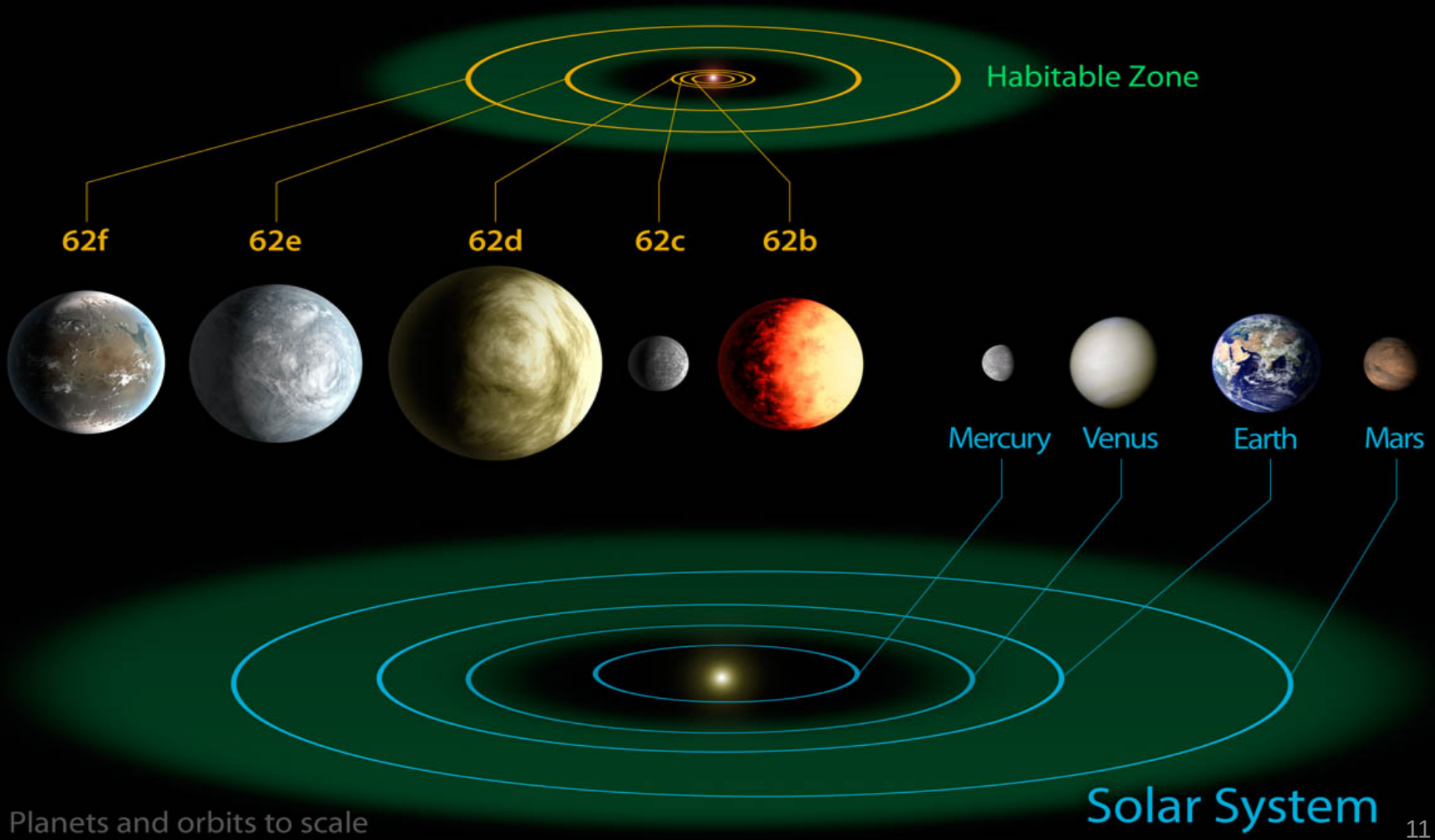
Layer cake of ancient deposits – and more clays!



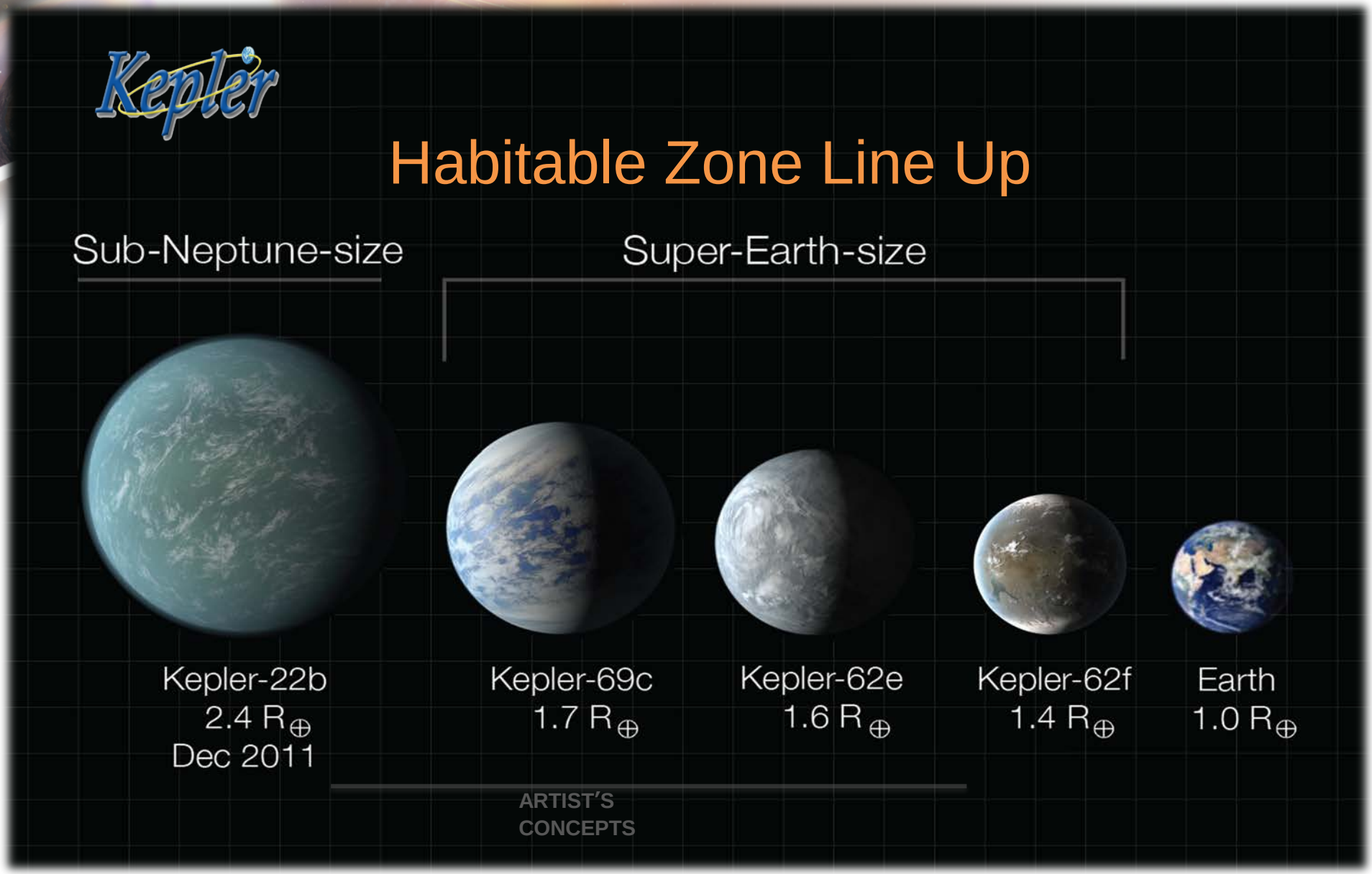

Kepler
Sizes of Planet Candidates
As of January 7, 2013
NASA
+43%
Earth-size - 351
(< 1.25 R⊕)
+21%
Super Earth-size - 816
(1.25 - 2 R⊕)
1,290 - Neptune-size
(2 - 6 R⊕)
+15%
202 - Jupiter-size, (6 -15 R⊕)
-4%
81 - Larger, (> 15 R⊕)
+14%

Kepler

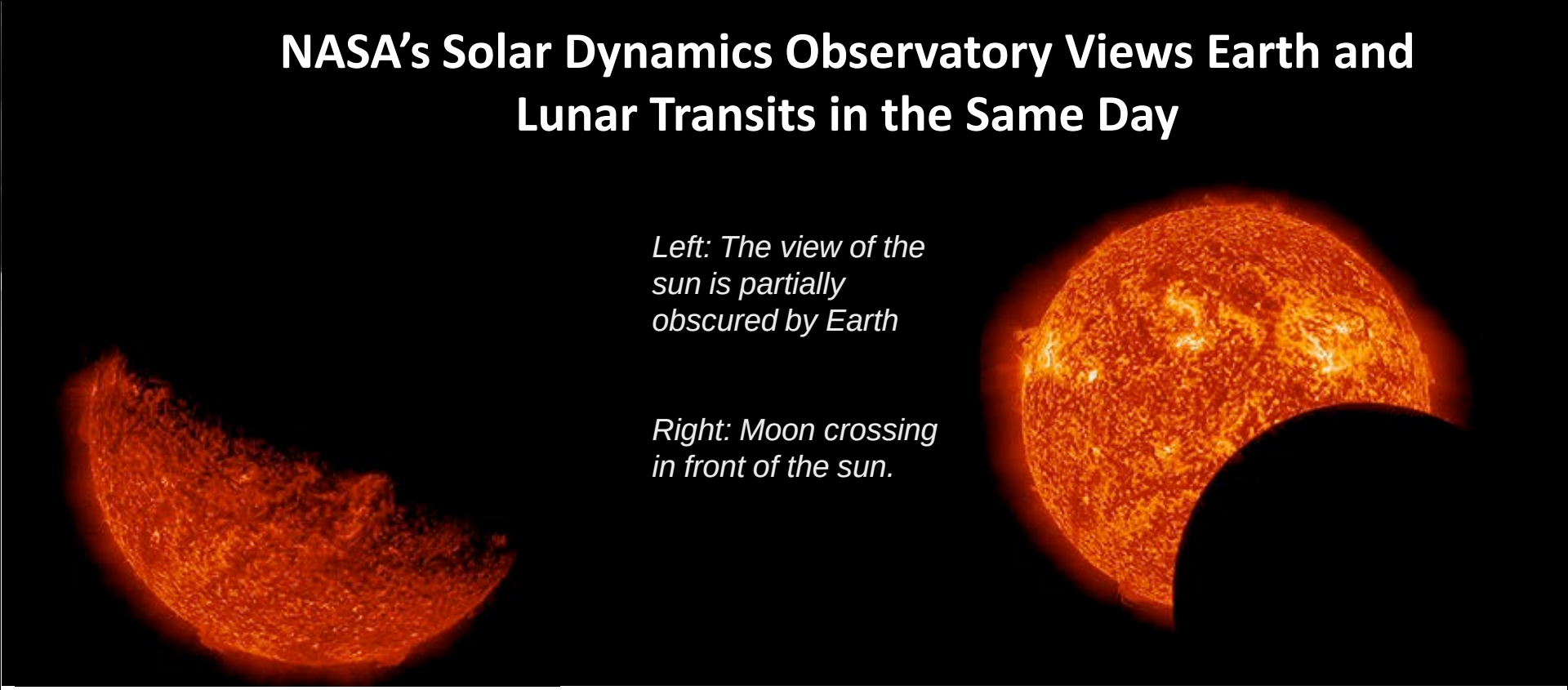
Kepler-62 System



Habitable Zone Line Up



NASA's Solar Dynamics Observatory Views Earth and Lunar Transits in the Same Day



Left: The view of the sun is partially obscured by Earth

Right: Moon crossing in front of the sun.

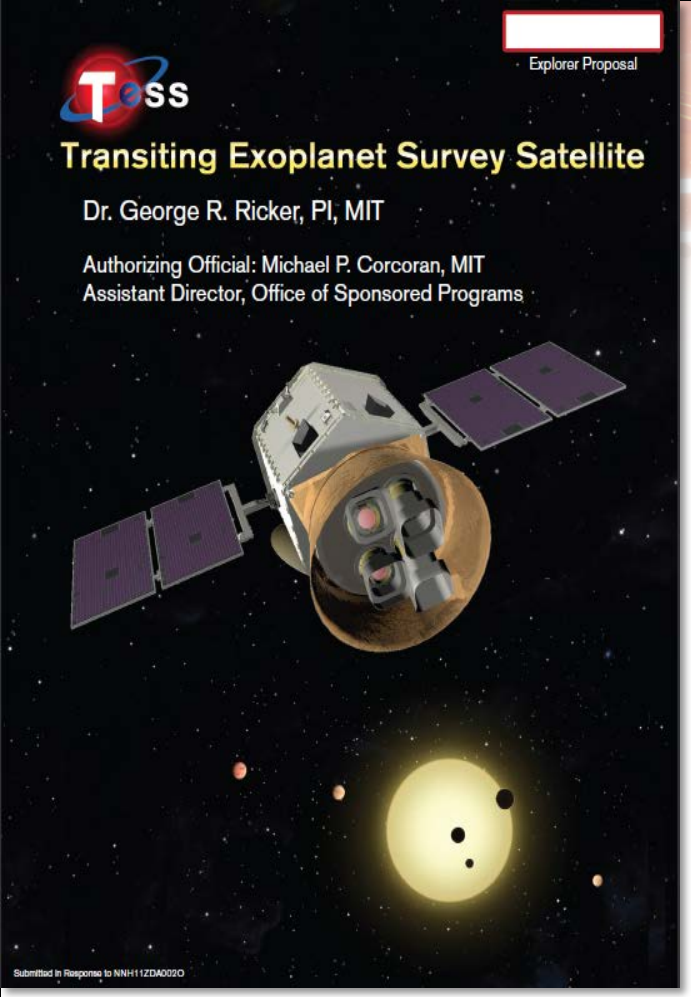
On March 2, 2013, SDO entered its semiannual eclipse season, a period of three weeks when Earth blocks its view of the sun for a period of time each day.

On March 11, however, SDO observed two transits.

- Earth blocked SDO's view of the sun from about 2:15 to 3:45 a.m. EDT.
- Later in the same day, from around 7:30 to 8:45 a.m. EDT, the moon moved in front of the sun for a partial eclipse.

Agenda

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

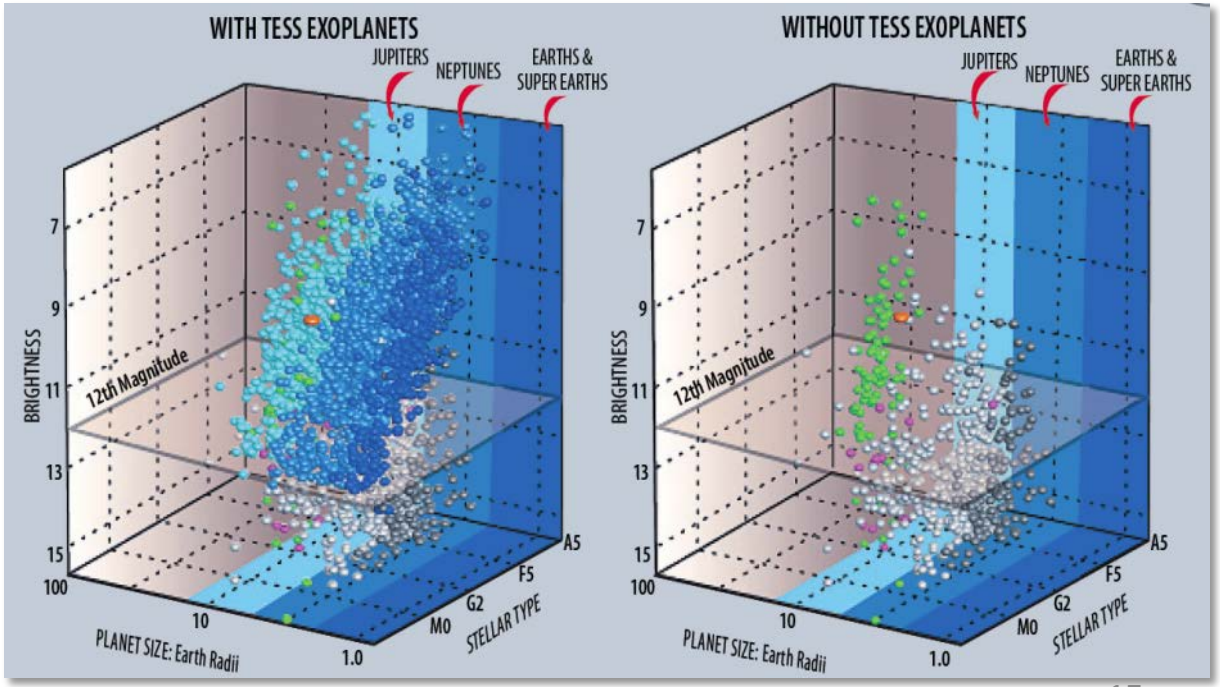


Transiting Exoplanet Survey Satellite

All-Sky, Two-Year Photometric Exoplanet Mapping Mission

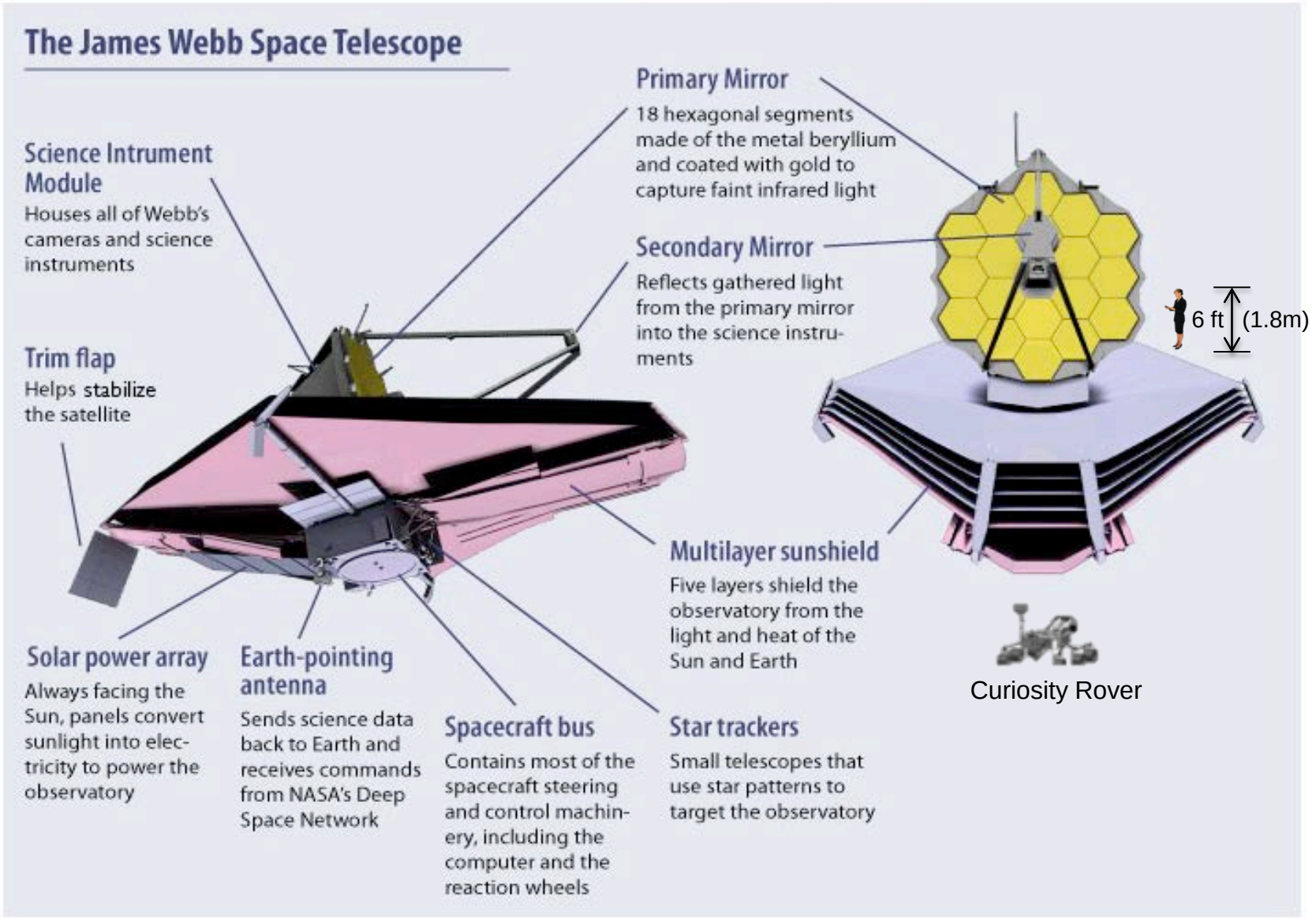
Discover new worlds transiting the nearest and brightest stars

- **All-sky survey** of transiting extrasolar planets
- **Monitor >500,000 main-sequence stars**, focus on dwarfs of types F5 to M5.
- **Discover more than 2,000 new planets**, approximately 300 of which are expected to fall in Earth ($R_p \leq 1.25\ R_E$) and super-Earth ($R_p \leq 2.0\ R_E$) categories.
- **Provide the target list for JWST** future follow-up observations and future exoplanet characterization missions



Instrument: Four WFOV CCD cameras with overlapping FOV of 23x90deg mounted in a common lens hood. Passively-cooled 600-1000nm 4096x4096 pixel FPA

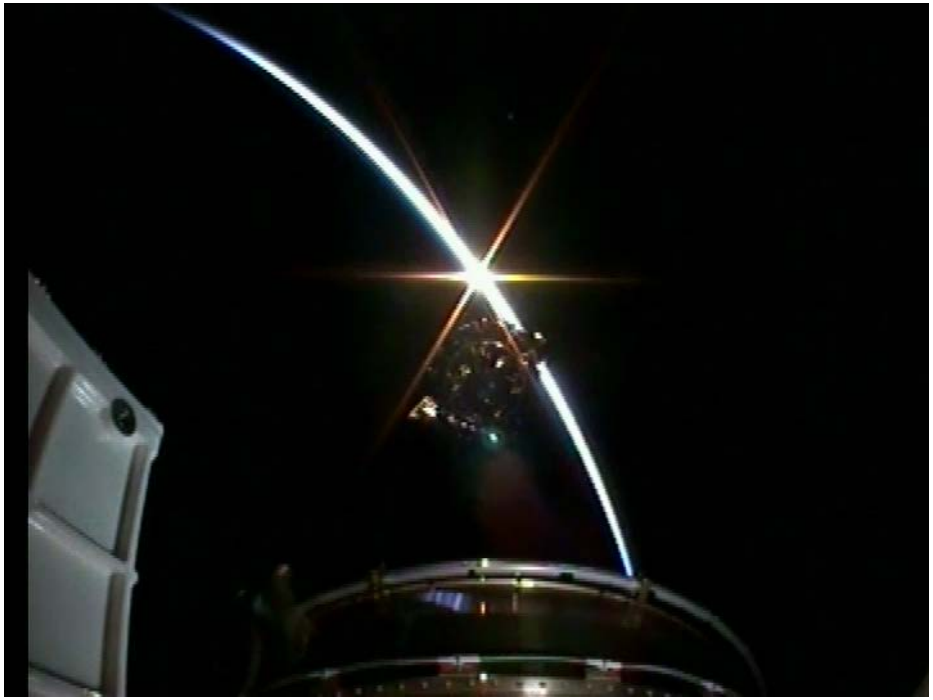
JWST


The James Webb Space Telescope
Primary Mirror
18 hexagonal segments made of the metal beryllium and coated with gold to capture faint infrared light
Science Intrument Module
Houses all of Webb's cameras and science instruments
Secondary Mirror
Reflects gathered light from the primary mirror into the science instruments
Trim flap
Helps stabilize the satellite
6 ft (1.8m)
Curiosity Rover
Multilayer sunshield
Five layers shield the observatory from the light and heat of the Sun and Earth
Solar power array
Always facing the Sun, panels convert sunlight into electricity to power the observatory
Earth-pointing antenna
Sends science data back to Earth and receives commands from NASA's Deep Space Network
Spacecraft bus
Contains most of the spacecraft steering and control machinery, including the computer and the reaction wheels
Star trackers
Small telescopes that use star patterns to target the observatory

LDCM – on orbit and working well

Monday, February 11, 2013 @ 10:02 a.m. (PST)

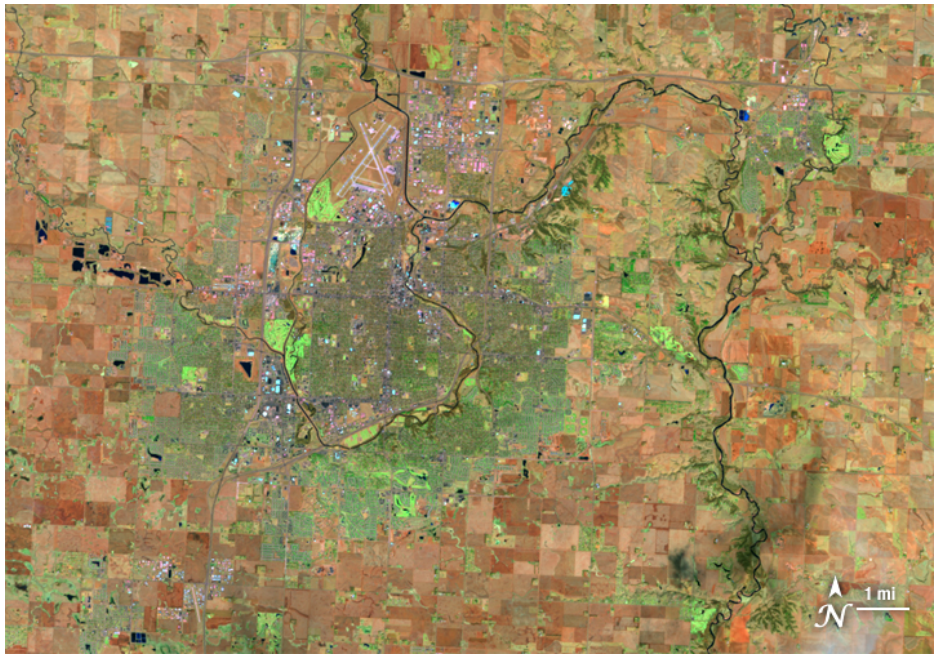
The LDCM Observatory was lifted to orbit by a United Launch Alliance Atlas V rocket launching from Vandenberg Air Force Base, Calif. The launch capped a flawless countdown.



The Observatory separated from the Centaur upper stage approximately 79 minutes after launch.

LDCM / Landsat 7 Underflight Validation

Sioux Falls – 30 March 2013



LDCM

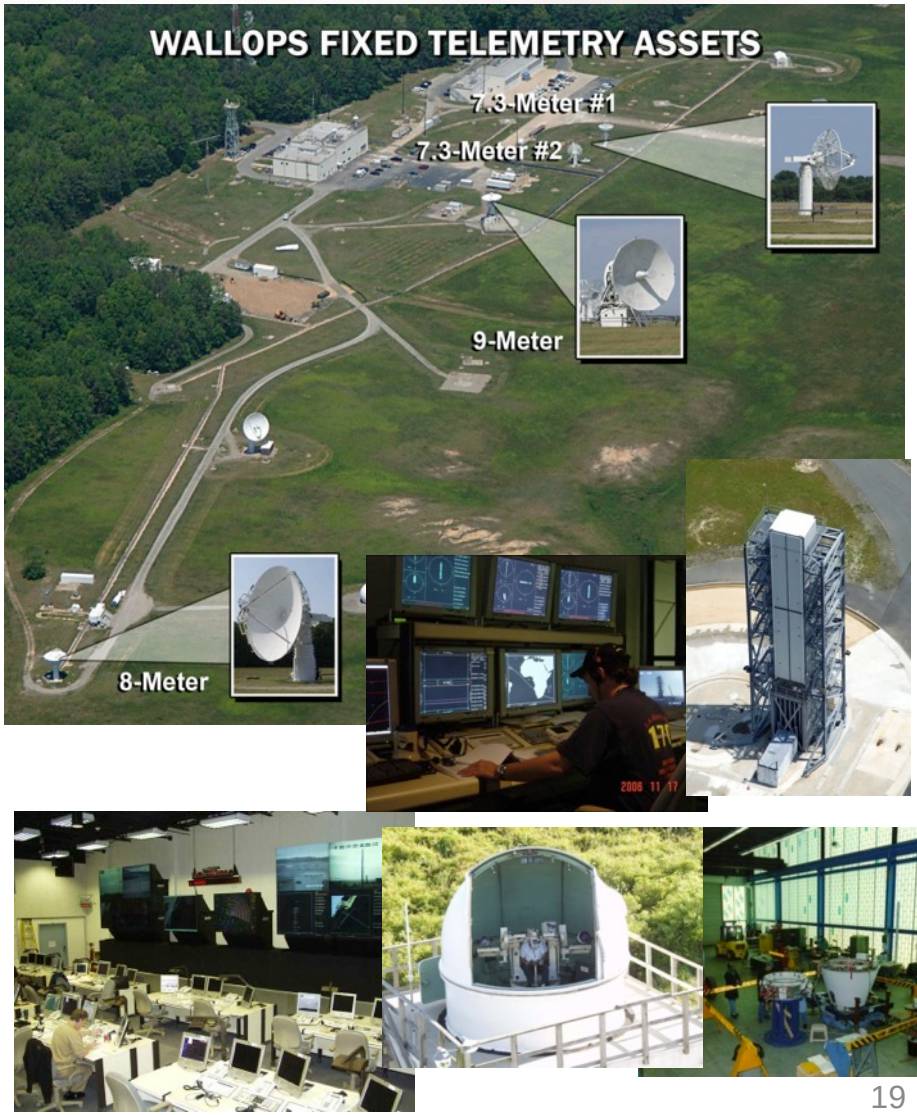
Landsat 7

LADEE launch from WFF – August 2013

1st Deep Space/Lunar mission from WFF

1st Minotaur (Peace Keeper family) launch from WFF

LADEE Pathfinder activities - View towards the south after gantry roll-away on newly enlarged Pad 0B w/ Min V mockup.



FY 2014 NASA Budget Request

	FY 2012 Actual	FY 2013 Annualized CR	FY2014	Notional FY2015	Notional FY2016	Notional FY2017	Notional FY2018
NASA FY 2014	**$17,770.0**	**$17,893.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**
Science	**$5,073.7**	**$5,115.9**	**$5,017.8**	**$5,017.8**	**$5,017.8**	**$5,017.8**	**$5,017.8**
Earth Science	$1,760.5	-	$1,846.1	$1,854.6	$1,848.9	$1,836.9	$1,838.1
Planetary Science	$1,501.4	-	$1,217.5	$1,214.8	$1,225.3	$1,254.5	$1,253.0
Astrophysics	$648.4	-	$642.3	$670.0	$686.8	$692.7	$727.1
James Webb Space Telescope	$518.6	-	$658.2	$645.4	$620.0	$569.4	$534.9
Heliophysics	$644.8	-	$653.7	$633.1	$636.8	$664.3	$664.6
Aeronautics Research	**$569.4**	**$572.9**	**$565.7**	**$565.7**	**$565.7**	**$565.7**	**$565.7**
Space Technology	**$573.7**	**$578.5**	**$742.6**	**$742.6**	**$742.6**	**$742.6**	**$742.6**
Exploration	**$3,707.3**	**$3,790.1**	**$3,915.5**	**$3,952.0**	**$3,970.7**	**$3,799.0**	**$3,589.3**
Exploration Systems Development	$3,001.6	-	$2,730.0	$2,789.8	$2,801.5	$2,818.3	$2,819.5
Commercial Spaceflight	$406.0	-	$821.4	$821.4	$821.4	$590.0	$371.0
Exploration Research and Development	$299.7	-	$364.2	$340.8	$347.8	$390.7	$398.7
Space Operations	**$4,184.0**	**$4,247.8**	**$3,882.9**	**$4,014.9**	**$3,996.2**	**$4,167.9**	**$4,377.6**
Space Shuttle	$596.2	-	$0.0	$0.0	$0.0	$0.0	$0.0
International Space Station	$2,789.9	-	$3,049.1	$3,169.8	$3,182.4	$3,389.6	$3,598.3
Space and Flight Support (SFS)	$797.9	-	$833.8	$845.1	$813.8	$778.3	$779.3
Education	**$136.1**	**$136.9**	**$94.2**	**$94.2**	**$94.2**	**$94.2**	**$94.2**
Cross Agency Support	**$2,993.9**	**$3,012.2**	**$2,850.3**	**$2,850.3**	**$2,850.3**	**$2,850.3**	**$2,850.3**
Center Management and Operations	$2,204.1	-	$2,089.7	$2,089.7	$2,089.7	$2,089.7	$2,089.7
Agency Management and Operations	$789.8	-	$760.6	$760.6	$760.6	$760.6	$760.6
Construction & Envrmtl Compl Restoration	**$494.5**	**$401.9**	**$609.4**	**$440.9**	**$440.9**	**$440.9**	**$440.9**
Inspector General	**$38.3**	**$38.2**	**$37.0**	**$37.0**	**$37.0**	**$37.0**	**$37.0**
NASA FY 2014	**$17,770.0**	**$17,893.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**	**$17,715.4**

Notes:
-- FY 2012 is consistent with submitted operating plans however, for comparability purposes, values for Space Technology reflect the funding for Space Technology related activities executed in Exploration, Space Operations, and Cross Agency Support.
-- FY 2012 Estimates include rescission of prior year unobligated balances, pursuant to section 528(f) of P.L. 112-55, Division B, Commerce, Justice, Science, and Related Agencies Appropriations Act, 2012
-- The FY 2013 appropriation for NASA was not enacted at the time that the FY 2014 Request was prepared; therefore, NASA is operating under a Continuing Resolution (CR) (P.L. 112-175). Amounts in the "FY 2013 annualized CR" column reflect the annualized level provided by the CR. Rescission of remaining unobligated balances of American Recovery and Reinvestment Act funds in the Office of Inspector General account pursuant to section 1306 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (P.L. 111-203)
-- Funds associated with out-year estimates for programmatic construction remain in programmatic accounts.

Agenda

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

Recommendation

Short Title: Recovering the Planetary Exploration Program

Recommendation:
The Council recommends that NASA seek restoration of funds in its FY15 budget proposal to recoup the damage to the Nation's robotic planetary exploration program in the FY14 budget proposal and to meet Congressional guidance in the FY13 passed budget.

Major Reasons for the Recommendation:
Congressional action on the NASA FY13 budget restored $223M of the $309M cut in the Administration's proposed FY13 Planetary Science Division budget and provided direction on the use of these funds in planetary science. The intent of Congressional action has not been included in formulating the FY14 budget and the Planetary Science Division budget again faces a large $284M cut relative to FY12.

Recommendation (Cont'd)

Consequences of No Action on the Recommendation:
The FY14 funding profile for the Nation's robotic planetary exploration program will result in early termination of operating missions, a serious decline in new mission launches over the decade, and will sacrifice our leadership to other space-faring nations as they pursue capabilities and goals abandoned by the United States.

Finding

Transfer of Education and Public Outreach Funding

The NASA SMD Education and Public Outreach (EPO) Program has arguably caused the most inspirational and successful infusion of science into the public consciousness, from content for K-12 curriculum to public awareness of the Sun, Earth, solar system, and universe. Images from NASA's great observatories and results from other science missions appear in every current science textbook. Moreover, effective engagement of the scientific community has brought many Earth and space scientists directly into public outreach, and has sharpened the accuracy and quality of materials seen by the public.

The Science Committee therefore finds it shocking that this incredibly successful and low-cost EPO enterprise (1% of science missions budgets) will now be managed centrally by other entities, largely outside NASA. The Nation risks losing a critical tool for inspiring the future STEM workforce, as well as the extraordinary expertise NASA scientists bring to public education, and for informed public assessment of the NASA enterprise.

Finding

Earth and Space Science R&A Grants Program Under Stress

The proposals selection rate for high quality proposals has fallen to levels sufficiently low to cause an unstable feedback loop where the Earth and space science community writes a much larger number of proposals, resulting in a significant non-productive burden on the community and NASA staff.

Finding

Pu238 Production

Pu238 is vital to the future of NASA's planetary science program. There is a long, complex history of negotiations concerning its production. Rather than simply purchasing Pu238, the NASA Planetary Science Division has now been tasked with managing and funding DOE facilities involved in the production of this material. NASA is a customer for Pu238, however, it has no expertise in the management or engineering of its production. The Science Committee finds this an inappropriate, ineffective and highly risky method for inter-governmental mutual support.