



Radar Observations and How We Use Them

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What is Radar?

☞ Radio Detection and Ranging



Radar Cross Section

- ☞ Why radar?
 - ❑ *Day/night, any weather*
 - ❑ *Detection/imaging resolution*

- ☞ What does radar measure?
 - ❑ *“Brightness” of the target*
 - ❑ *Roundtrip delay time*
 - ❑ *Doppler frequency **

- ☞ Radar Cross Section (RCS) is a measure of “brightness” and depends on the frequency of the emitted radio waves.
- ☞ Roundtrip delay – time between transmission of a radio wave and reception of the backscattered echo
- ☞ Resolution – distance between detected targets
- ☞ Doppler frequency – change in frequency of the echo wrt transmitted frequency, only radars designed to do this are capable of measuring Doppler



Types of radar

☞ Land/ship based
(detection)



☞ Airborne
(imaging/detection)



☞ Spaceborne
(imaging/detection)



Types of radar

- ☞ Why airborne?
 - ❑ *Can be fixed!*
 - ❑ *Less expensive*
 - ❑ *Faster to deploy*

- ☞ Why spaceborne?
 - ❑ *Coverage*
 - ❑ *Repeatability of measurements*



- ☞ What do we detect?
 - ☐ *Aircraft*
 - ☐ *Ships/boats*
 - ☐ *Vehicles*
 - ☐ *Missiles*

- ☞ Why do we detect
 - ☐ *How far – range to target*
 - ☐ *How fast – speed of a target*
 - ☐ *Which way – trajectory*
 - ☐ *How many*



Imaging

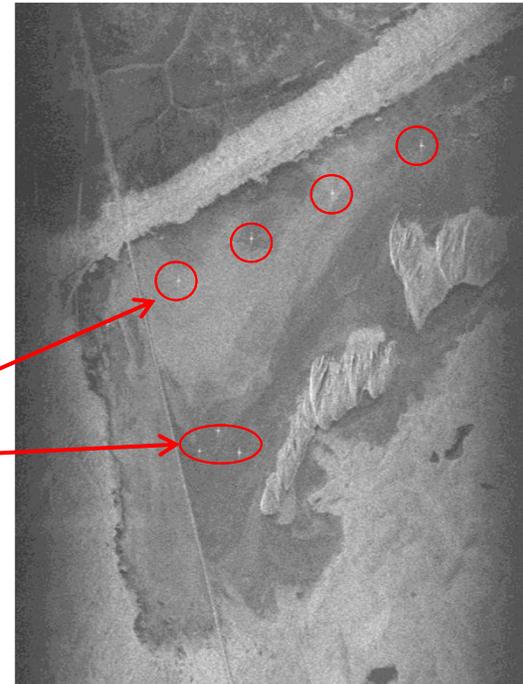
☞ What do we image?

- ☐ *Weather*
- ☐ *Ocean properties*
- ☐ *Surface properties*

☞ Why do we image?

- ☐ *How far – range to target*
- ☐ *What do we see – composition of the scene*
- ☐ *Tracking - changes between repeated scenes*

Radar bright targets
Corner - reflectors



Airborne Radars at JPL (present)

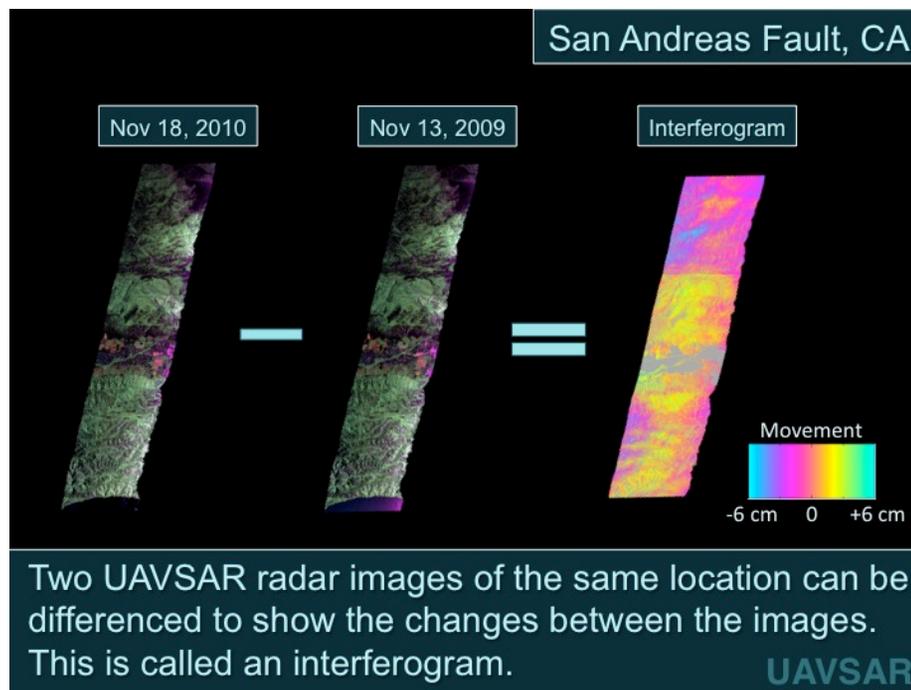
- UAVSAR is an L-band polarimetric Synthetic Aperture Radar specifically designed to acquire repeat-pass measurements, creating interferograms.



The radar pod is mounted beneath the Gulfstream-III

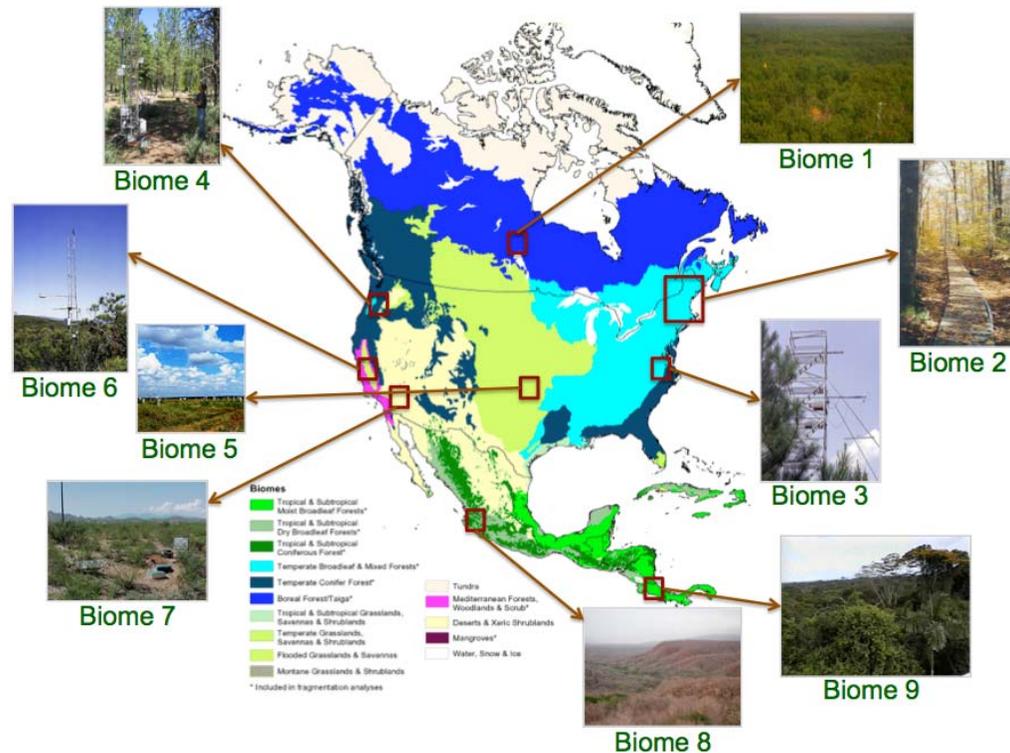


UAVSAR



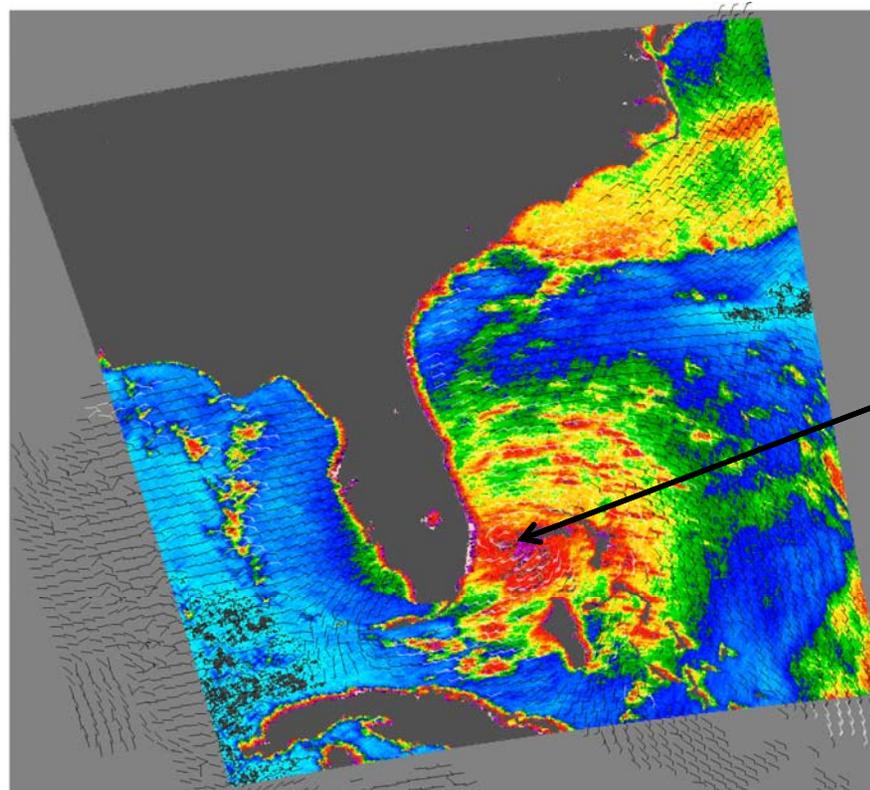
Airborne Radars at JPL (present)

- AirMOSS – Airborne Microwave Observatory of Subcanopy and Surface
- AirMOSS radar is a polarimetric P-band SAR based on the UAVSAR and its predecessor's designs. It flies on the same aircraft in a pod.
- Its data is used for observation of root-zone soil moisture and net ecosystem exchange (how much carbon is entering and leaving the ecosystem).



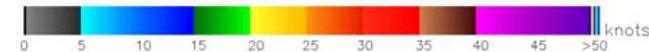
Spaceborne radars at JPL (past)

- ☞ QuikSCAT – Quick Scatterometer launched in June 1999 and is still in operation today. The radar on QuikSCAT is a Ku-band scatterometer.
- ☞ The primary science objective of QuikSCAT is to make all-weather global observations of ocean near-surface winds.



Hurricane eye

Hurricane Katrina Aug 2005
<http://winds.jpl.nasa.gov/index.cfm>

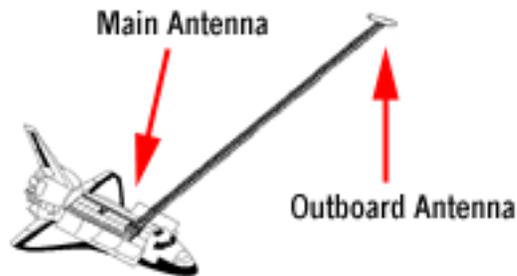


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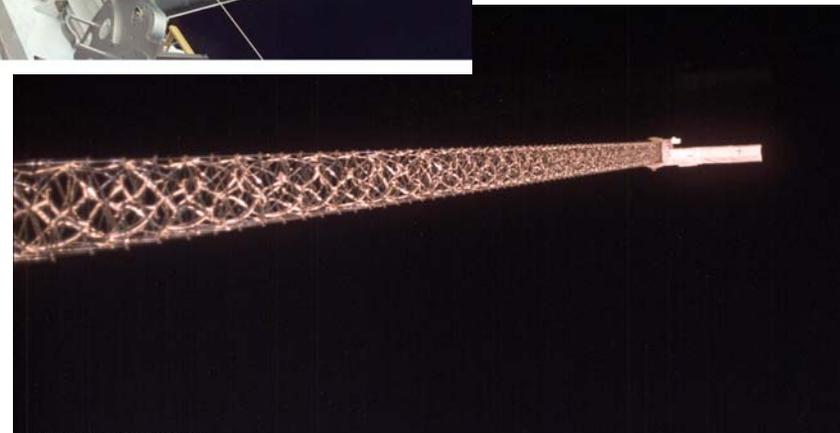


Spaceborne radars at JPL (past)

- SRTM – Shuttle Radar Topography Mission
- SRTM obtained topographic data on an almost global scale and produced the most complete high-resolution digital topographic database of Earth which is still used today
- Hosted on space shuttle Endeavour and flew a mission in early 2000 for 11 days.

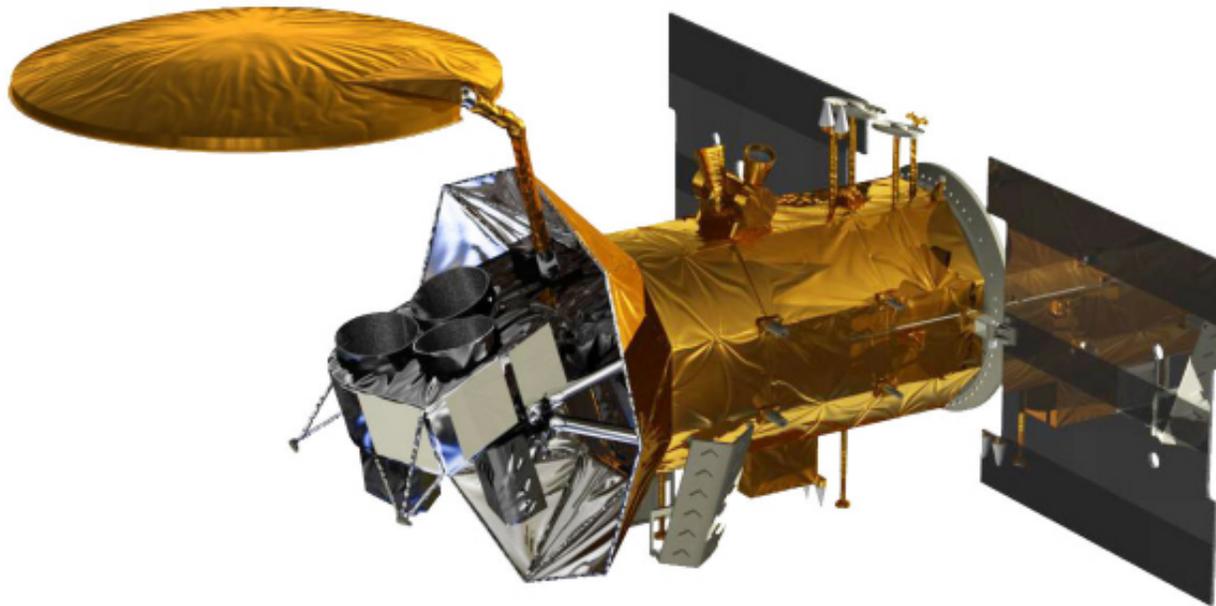


Reflected radar signals collected at two antennas, providing two sets of radar signals separated by a distance.



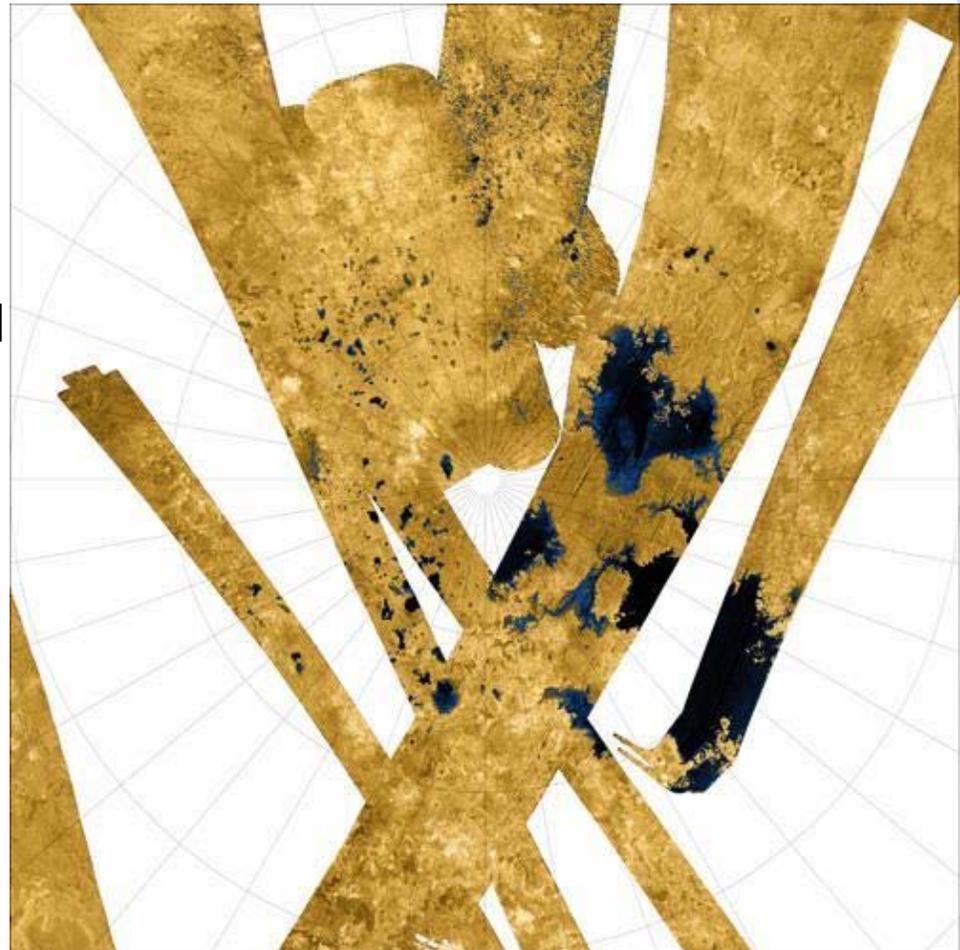
JPL Earth-Orbiting Spaceborne Radars at JPL (present)

- Aquarius instrument will collect sea surface salinity data over global oceans. The Aquarius suite of instruments carries a scatterometer developed at JPL and a radiometer developed by NASA Goddard.
- The radar is an L-band scatterometer



Planetary Spaceborne radars at JPL

- Cassini's instruments were deployed to study Titan, the largest moon of Saturn.
- It launched in 1997 and it is currently in its second extended mission.
- Approximately 60% of the north polar region has been mapped by radar. About 14% of the whole region is covered by what are interpreted to be liquid hydrocarbon lakes.

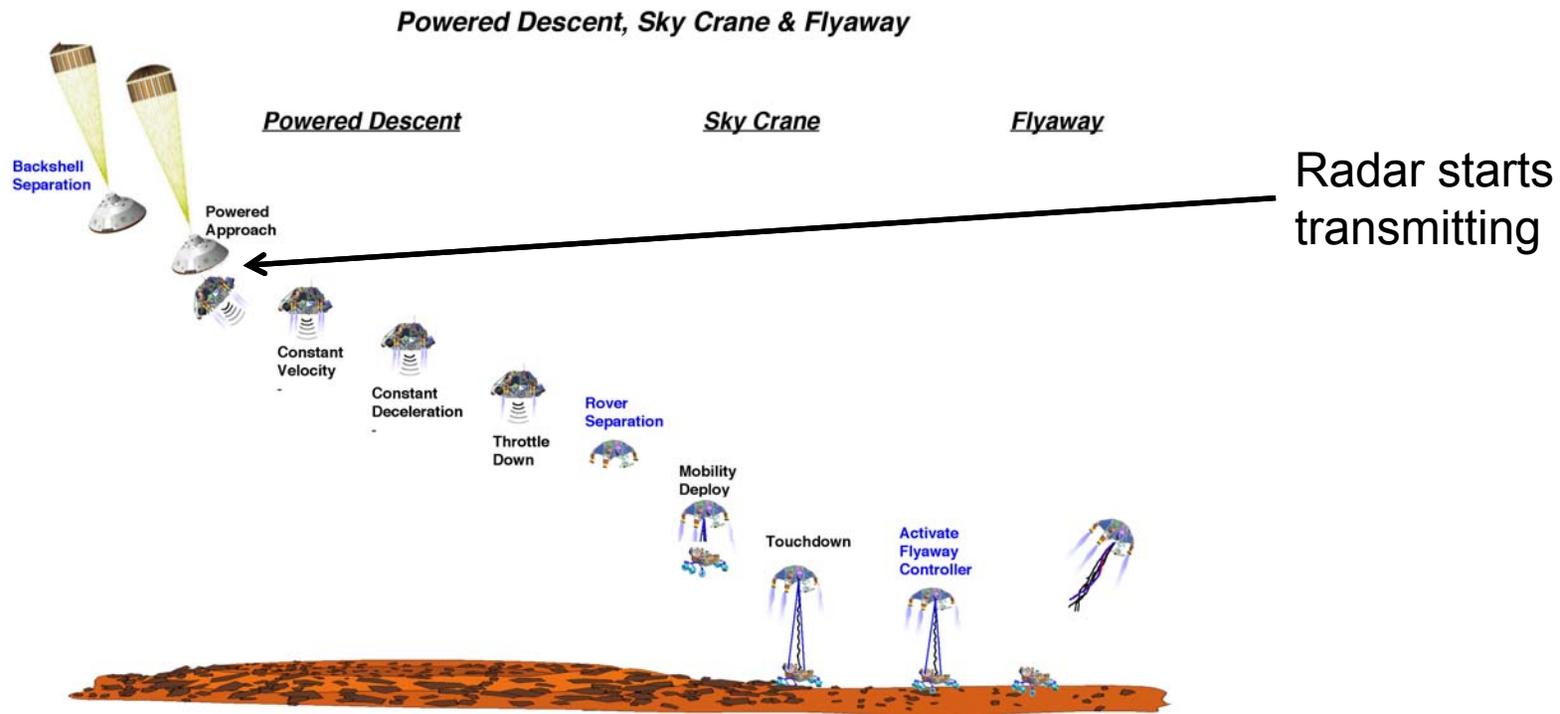


<http://saturn.jpl.nasa.gov/>



Planetary Spaceborne radars at JPL

- MSL – Mars Science Laboratory “Curiosity”
- MSL is a part of NASA’s Mars Exploration Program. Its major science goal is to determine habitability of Mars by examining whether it ever had an environment that could support life.
- MSL’s radar was used for landing of the rover and was named Terminal Descent Sensor (TDS).



Planetary Spaceborne radars at JPL

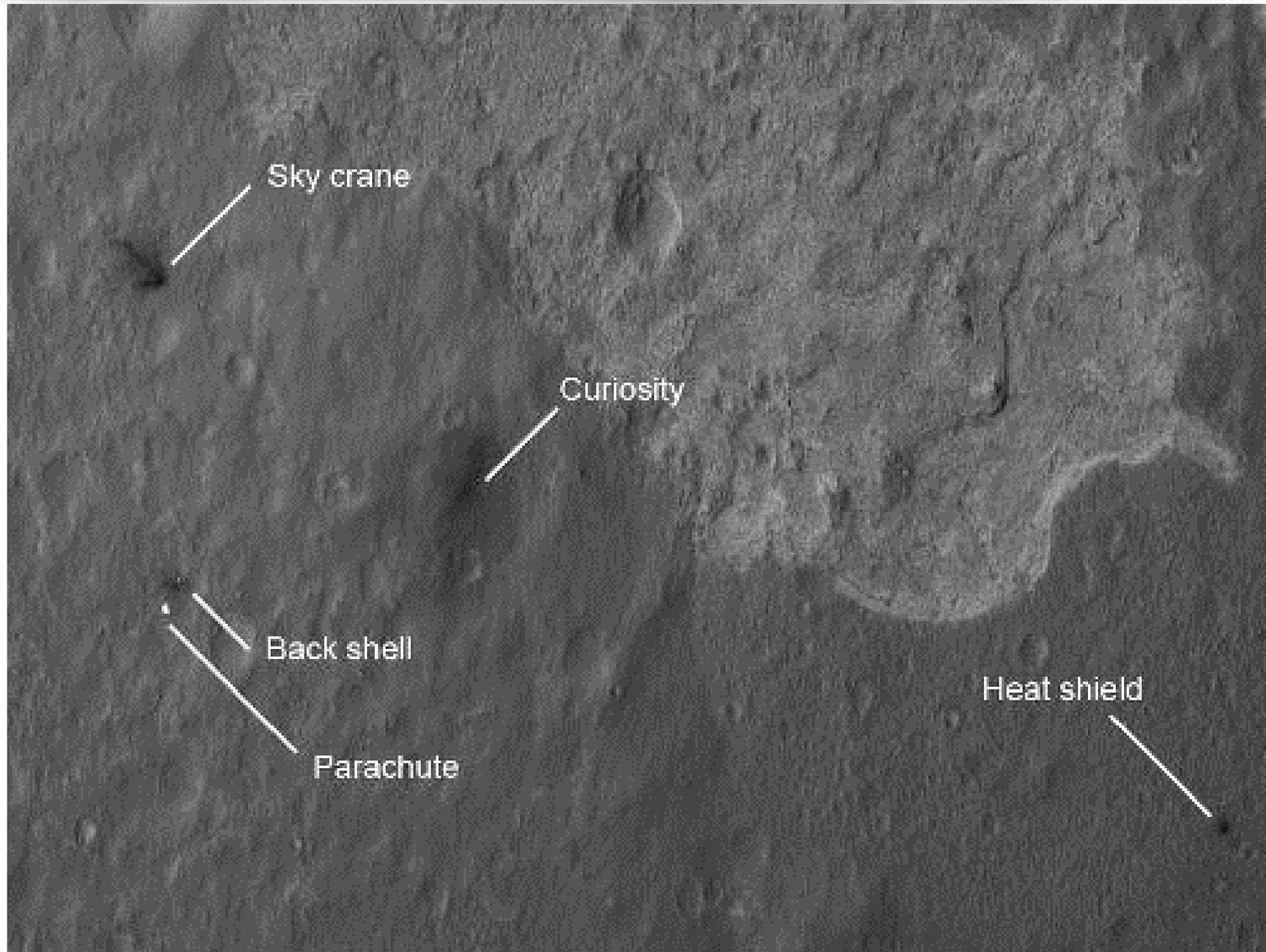


Image captured by HiRISE camera, one of the instruments aboard Mars Reconnaissance Orbiter (MRO)



Thank you for your attention!

QUESTIONS??

