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The benefits of long-term orbital capabilities

CLOC-SAT Community Kickoff

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February 15, 2022

How do sustained orbital architectures enable new science and exploration activities?

What do we mean by long term? Sustained?

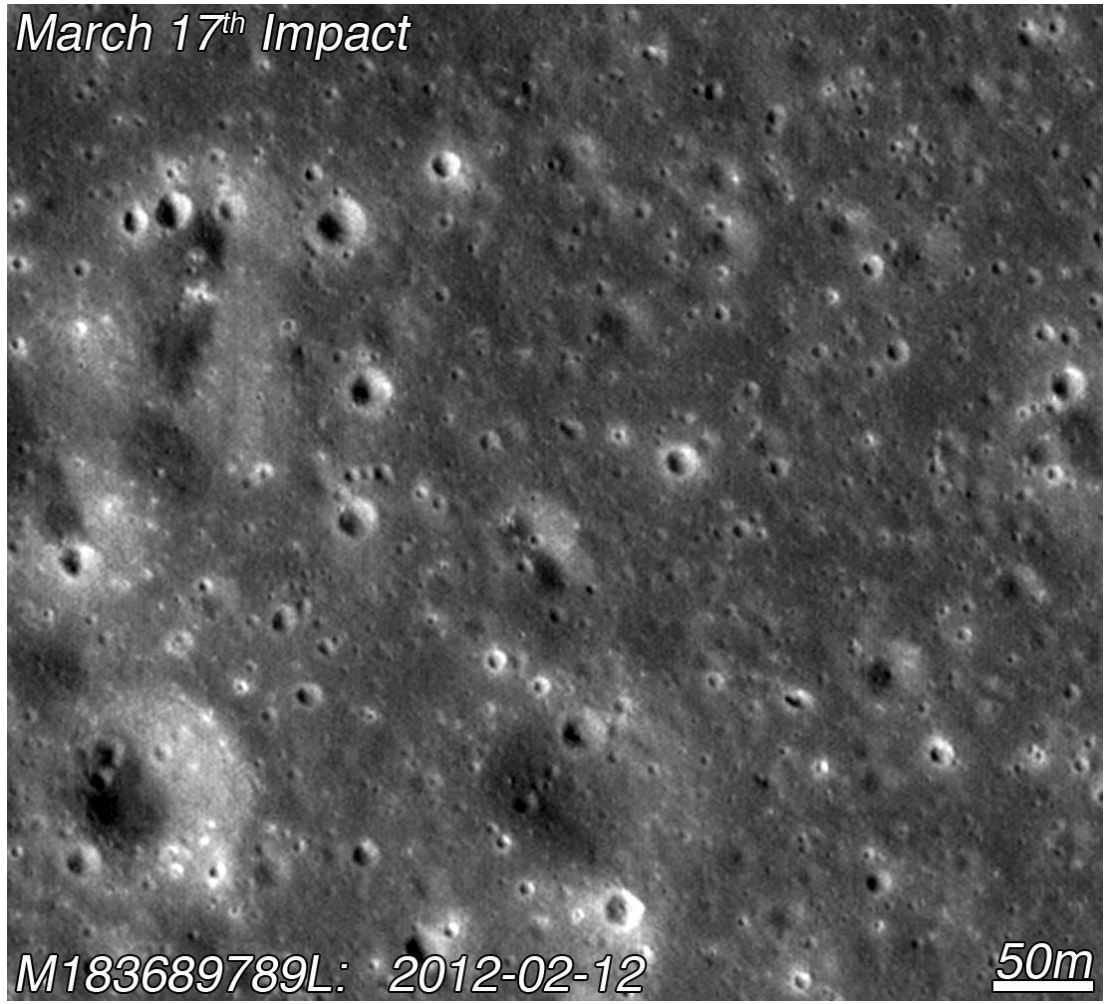
Measurements with a long time-horizon

- Radiation
- Exosphere
- Integrating measurements (e.g., instruments like LAMP, neutrons)
- Volatile migration
- Understanding how hardware is affected by dust and/or other environmental hazards through via photometry
- Impact rate

Understanding the impact flux

Recent rate and impact flash monitoring

http://lroc.sese.asu.edu/posts/943



(18 m, 20.7135N, 335.6698E)

Brightest ever flash recorded by MIDAS (March 17, 2013)

Science done by monitoring surface activities

- Volatiles – location and migration
- The lunar exosphere can be affected by landed missions, having a sustained orbiter capable of monitoring this is important to understand how atmospheres rise and fall and how rarified atmospheres behave
- Identifying new and interesting science sites
- Monitoring ISRU and excavation

It’s all about communication

- New lunar paradigm is different than anything we’re used to in SMD missions
  - Economic model is different
  - Scale becomes an issue
- Multiple assets on the surface communicating with each other and back to Earth require robust communication infrastructure
  - Spectrum management becomes a significant issue
  - SMD missions fall under NASA/government contract, this is not the case for commercial missions
- For mobile assets, bandwidth quickly becomes a limiting factor in operations
  - DTE is a bottleneck!

- Ensures farside access

- Maybe this is a nice place for international cooperation, or industry leading the way?

Knowing where we are and where we're going

We don't have GPS at the Moon

- Landed and mobile assets need to know where they are, and where they're going
- Precise landing location knowledge enables relative navigation
- "SLA(M)-like" navigation on the surface wants meter-level image and topography

- Surface beacons are valuable for regional surface navigation, but what happens when you're beyond LOS?
- For a lunar "GPS" we need multiple satellites, or to make significant capability trades
- Dedicated constellations can provide capabilities similar to GPS
  - Do we need permanent constellation? Small-sats in specialized orbits for select periods of time?
- Signals from Earth are generally too faint to be of use
- A single satellite at L1/L2 can't give us what we need for navigation

Other important things

- Security considerations
- Impact flux is cool science but also hazard monitoring
- Landing site evaluation could benefit from higher resolution orbital measurements, especially including stereo imagery
- Topographic maps at higher resolution enable precision landing and mobility in new places, this requires new orbital missions
- ISRU resource prospecting and map generation can be done in situ or with new, more highly-honed and capable instruments

A few closing thoughts

- A lot of science and exploration is enabled by orbital missions
- Exploration requires communications and navigation technology, which is greatly enhanced with orbital infrastructure
- What sorts of science questions require long-time baseline observations?
- How do we define “long-term”?
- Do we need continuous assets or just continuous coverage/access?

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