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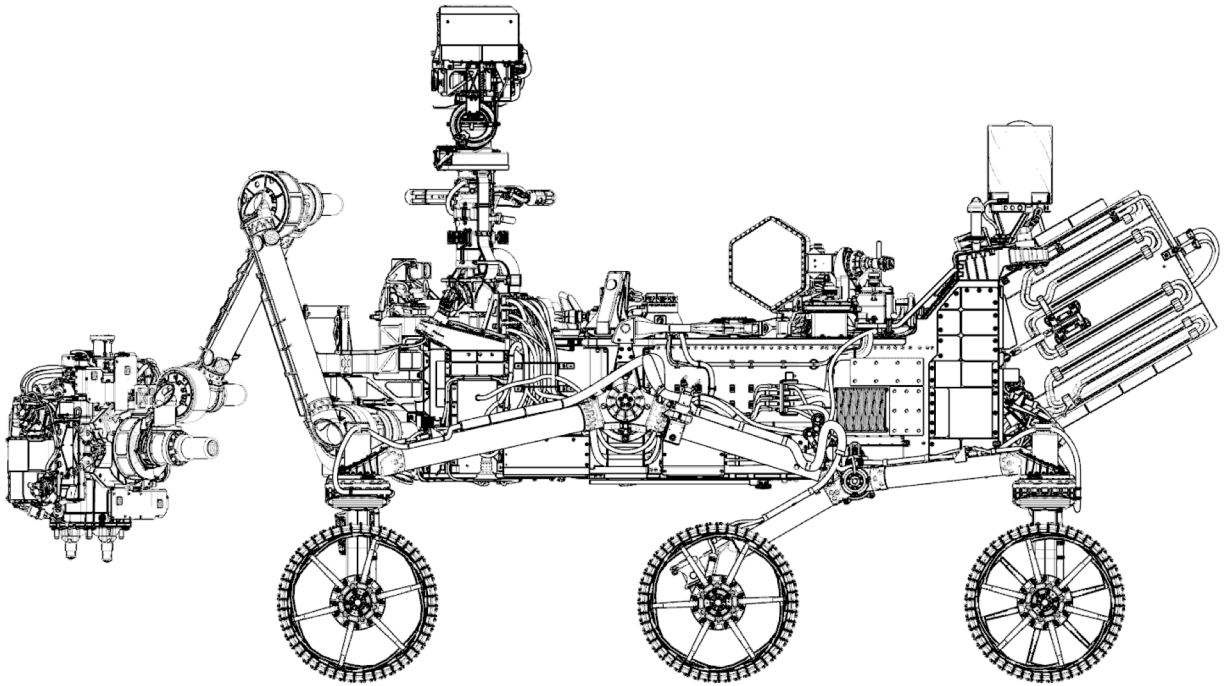
Jet Propulsion Laboratory
California Institute of Technology

Landing Site Safety Assessment

Fourth Mars 2020 Landing Site Workshop

Allen Chen, et al.
Mars 2020 EDL Team

October 16, 2018



MARS 2020
PROJECT

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Executive Summary

- Landing site safety assessment has been completed at all four sites
- External review of the safety assessment has been conducted
  - EDL standing review board concurs that the assessment is complete, valid, and likely to be stable
  - Safety assessment is more than sufficient to support site selection
- All sites have low EDL risk
  - Sites have differing levels of terrain risk, but the differences are very small
  - System margins are sufficient at all sites and don't vary significantly between sites
- EDL team is comfortable flying to any site

Review Recap: Landing Site Safety Assessment

October 2-3, 2018

Success Criteria

- The landing site safety assessment is sufficiently mature to support site selection
- The landing site safety assessment is sufficiently accurate to support site selection and relevant uncertainties are understood
- Future work is not likely to endanger the risk assessment presented

Board Members in Attendance	Affiliation
Gentry Lee, Chair	JPL
Doug Adams	APL
Bobby Braun	Colorado
Ben Cichy	GSFC
Rob Manning	JPL
Tim Priser	LMA
Mike Ryschkewitsch	APL
Miguel San Martin	JPL
Steve Sell	JPL
David Skulsky	JPL
Adam Steltzner	JPL

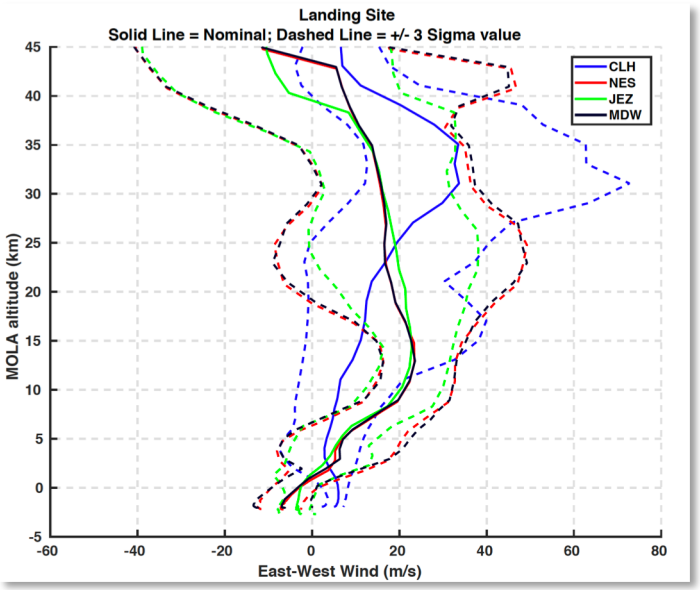
Board Comments Summary

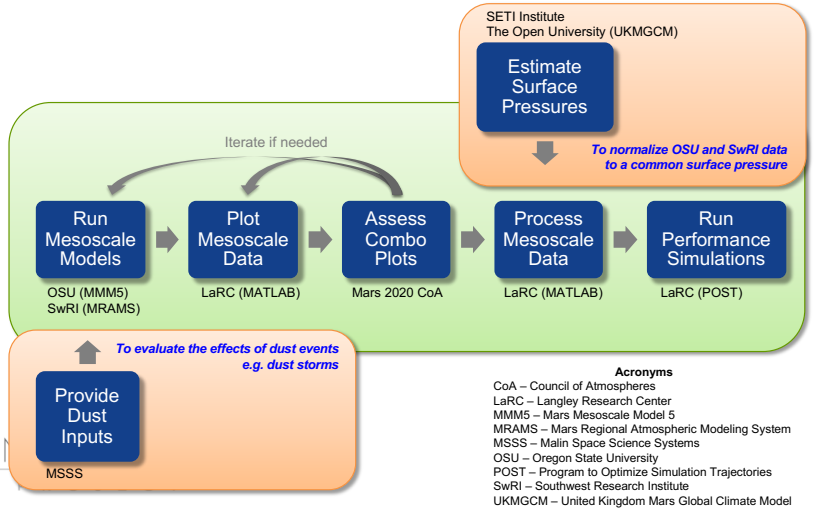
(Full Board Report Not Yet Available)

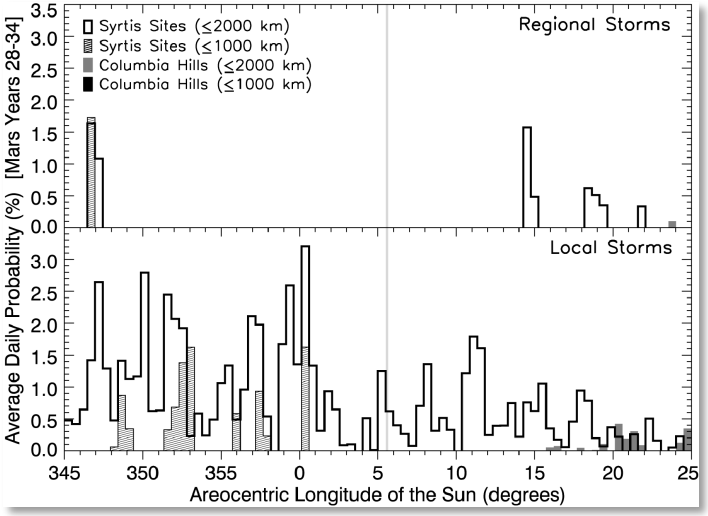
- "All success criteria met with flying colors"
- "All the work that needs to be done to provide the necessary inputs [to the landing site selection process] is complete"
- "All the sites have high enough probability of measured success [for selection]"
- All sites have high and in-family probabilities of success
  - There are still some small differences in relative risk
- More than enough information is available to support final site selection
  - Results expected to be stable
  - Analysis improvements likely to only shrink the small risk differences between sites
- Parachute inflation risk reduction activity was fantastic; board agrees that risk has been reduced to acceptable levels for flight

Atmosphere Characterization

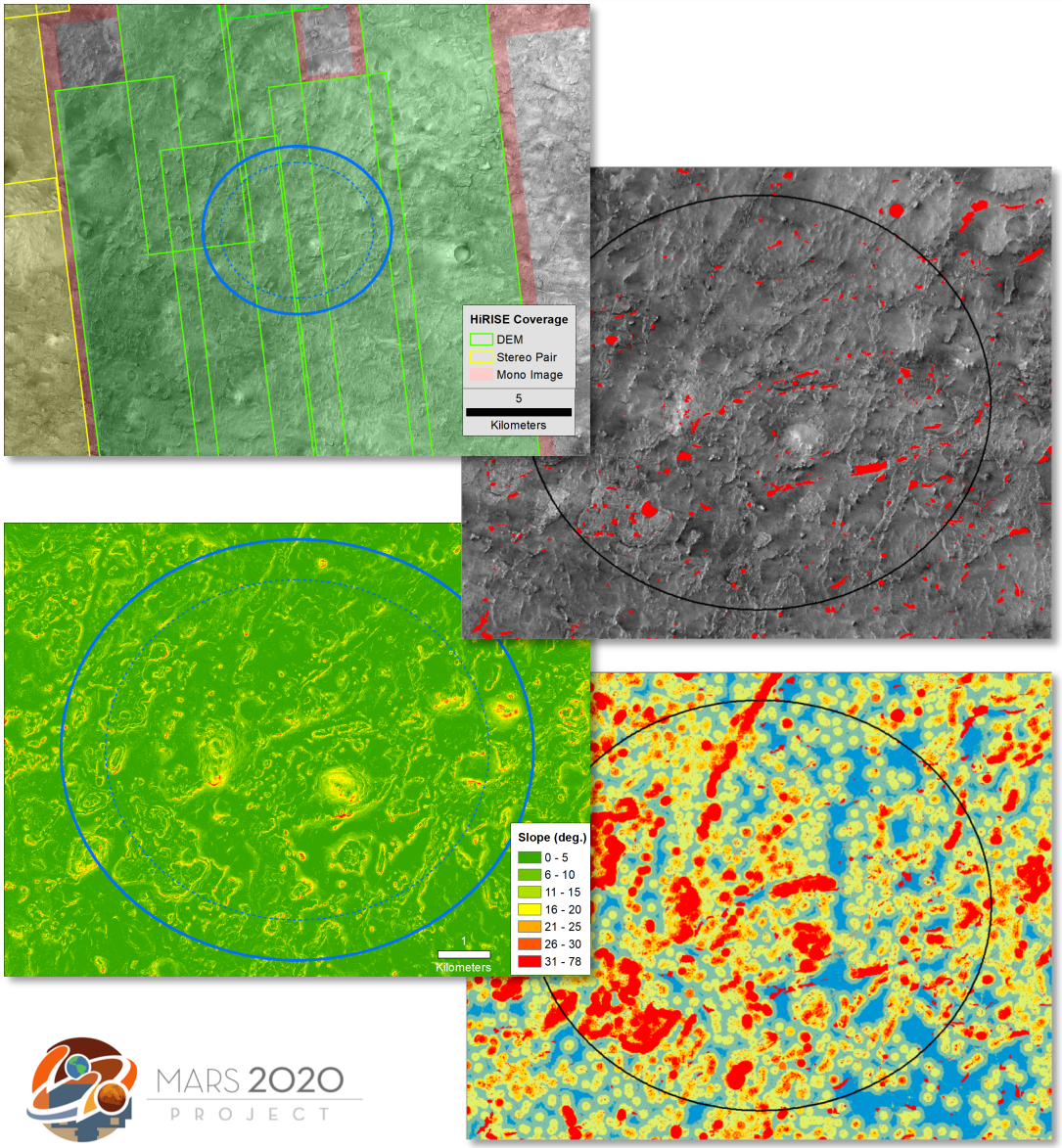
- 2020 is a great opportunity to land on Mars
- The atmosphere characterization approach is largely the same as it was for MSL, with incremental improvements
- Landing sites have been modeled with sufficient fidelity to support site selection; minimal work to go for flight
- Dust activity is low in the 2020 opportunity at our landing sites
- Council of Atmospheres has high confidence in the assessment provided







Terrain Characterization

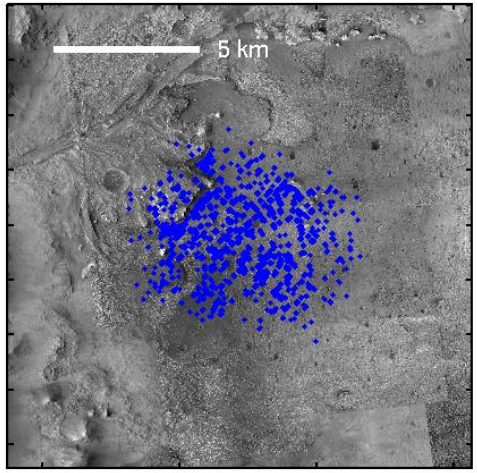


- Excellent coverage of landing sites from orbital imagery
- Key terrain hazards identified at all landing sites
  - Rocks
  - Slopes
  - Inescapable hazards
- TRN drives near complete characterization of landing ellipse
- Hazard assessment is mature
- Better characterization of landing sites than past missions even at landing

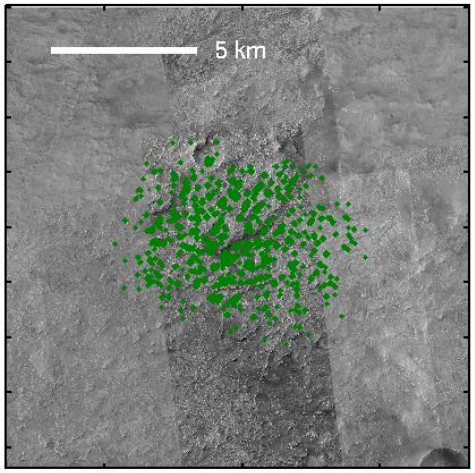
EDL System Performance and Margins

- Detailed performance assessments have been completed at all four landing sites
- Performance is very similar between landing sites and is in family with MSL
- Ample system margins available at all sites
- System sensitivities are well understood
- Touchdown terrain risk is the dominant risk type, but is minimized by TRN

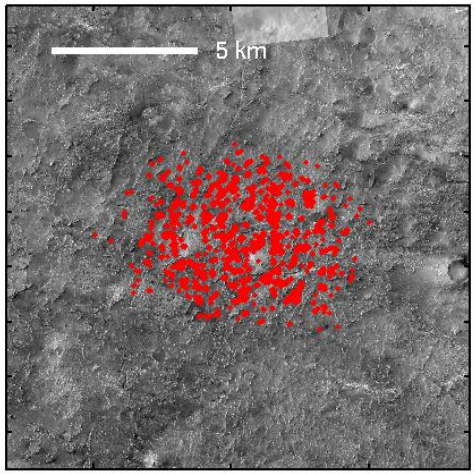
Jezero



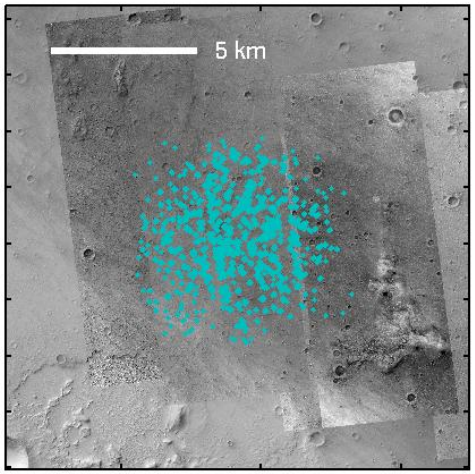
Midway



North East Syrtis



Columbia Hills



EDL performance is excellent at all four sites

Conclusions

- The landing site safety assessment presented is sufficiently mature, accurate, and stable for site selection
- Landing site safety is dominated by terrain hazards and ranges between ~98.5% - 99.5% probability of success for the final sites
  - Future analysis improvements likely to only shrink the small risk differences between sites
- Accuracy of safety assessment estimated to be of order +/- 0.5% based on engineering judgement
- Although there are differences between the sites, the probabilities of success are all in family with each other given our TRN capability
- **EDL is ready to support selection of any of the sites**