

Europa Lander Concept Site Selection: Approach on Collaborative Mission Planning and Certification

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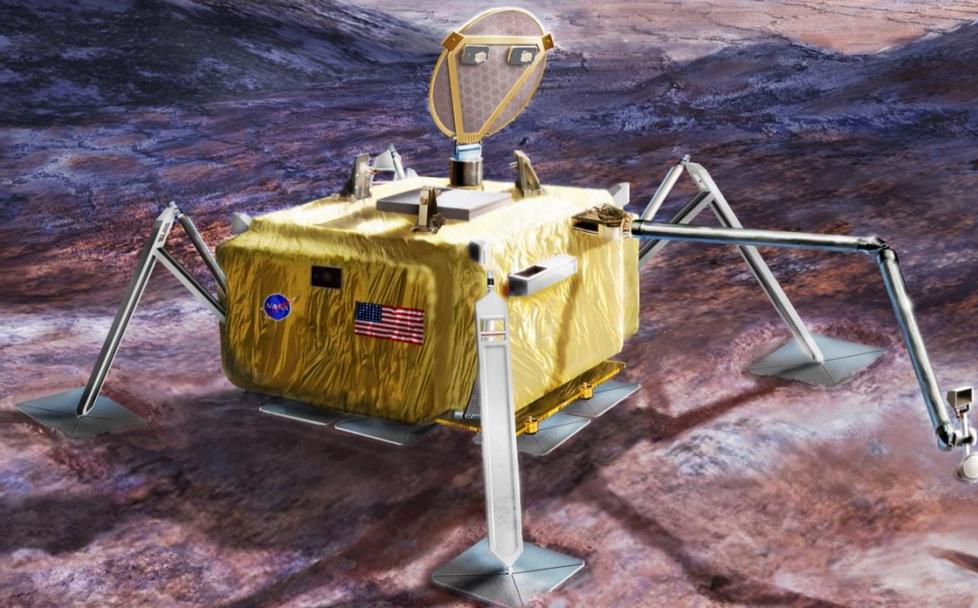
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Challenge

Challenge:

- Design a mission concept that would successfully land on Europa with timely high resolution data

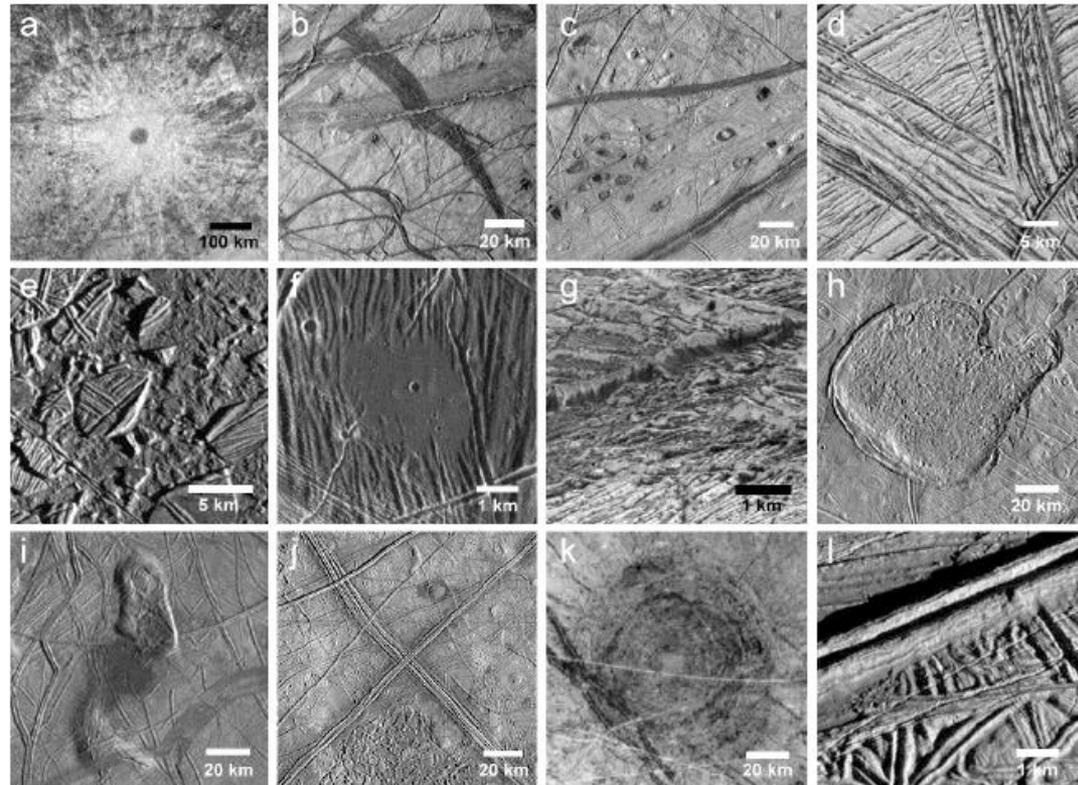
Current: a single image at 6 m/pixel (GAL)

Most of the images of Europa are at 500-2000 m/pixel resolution

Need: 0.5 m/pixel, stereo images

Clipper Reconnaissance would provide

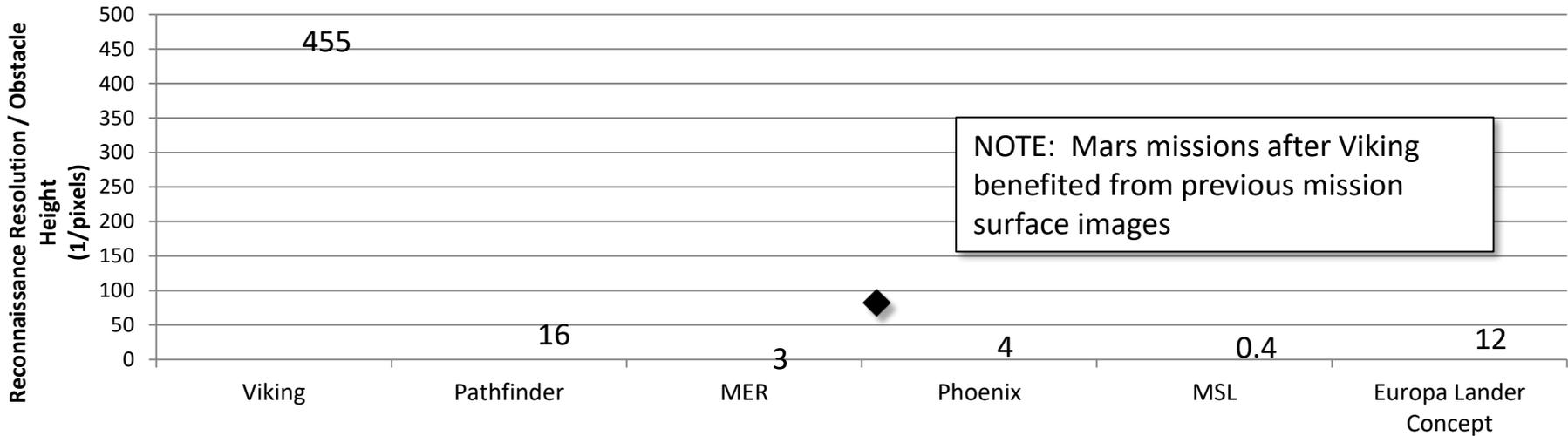
Galileo Images Show Europa Having Rugged, Unusual Terrain



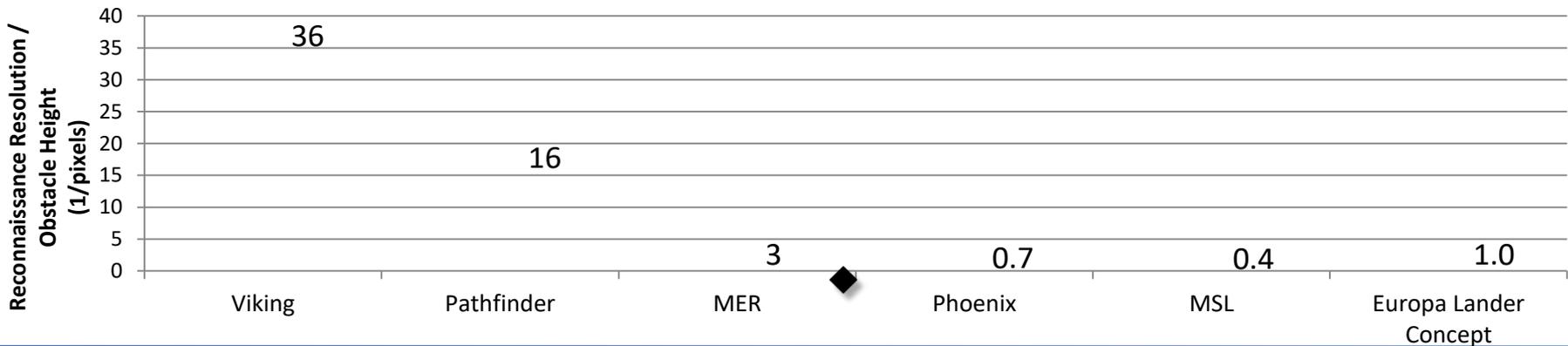


Historical Comparison of Lander Mission Design vs Available Reconnaissance

Reconnaissance Resolution / Obstacle Height at Time of Lander Design



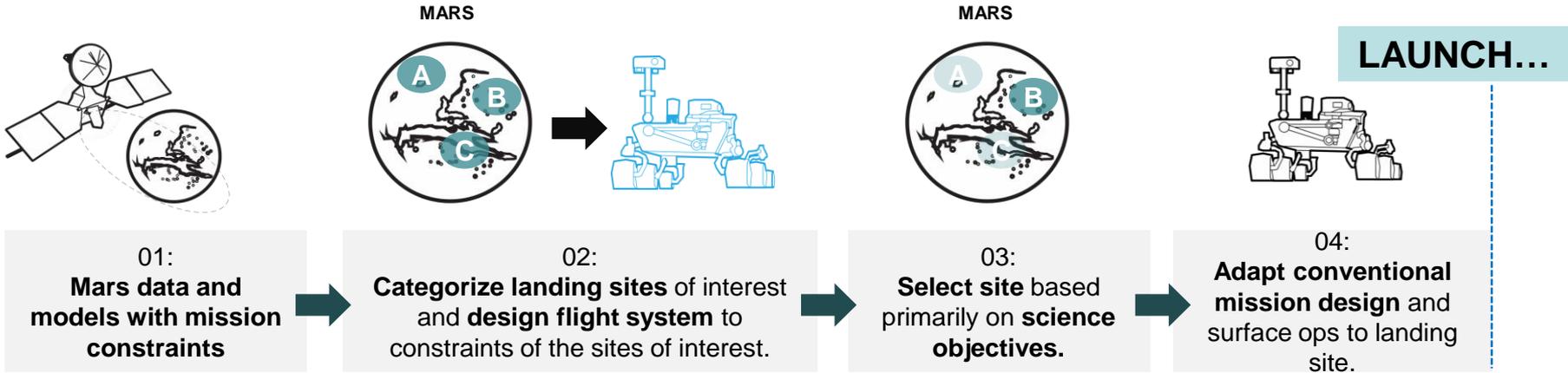
Reconnaissance Resolution / Obstacle Height at Time of Landing



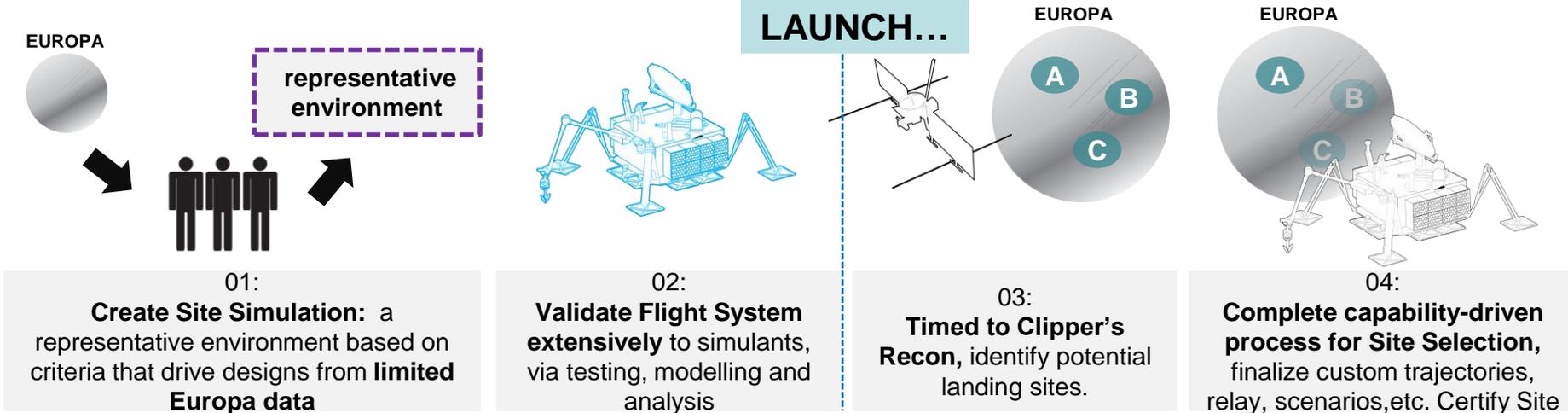


A Different Site Selection Process: Mars vs. Europa

MARS



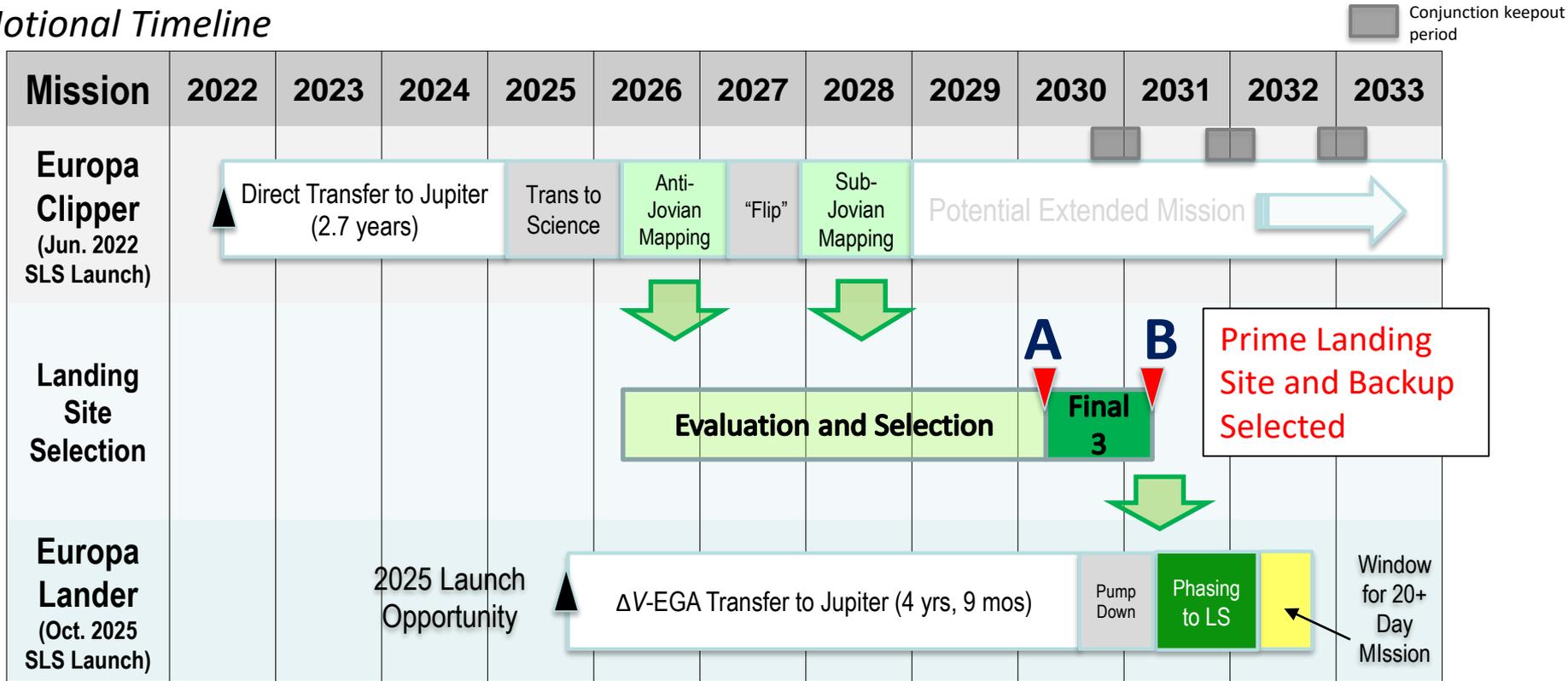
EUROPA





Landing Site Selection Timeline Would Complement Clipper Recon

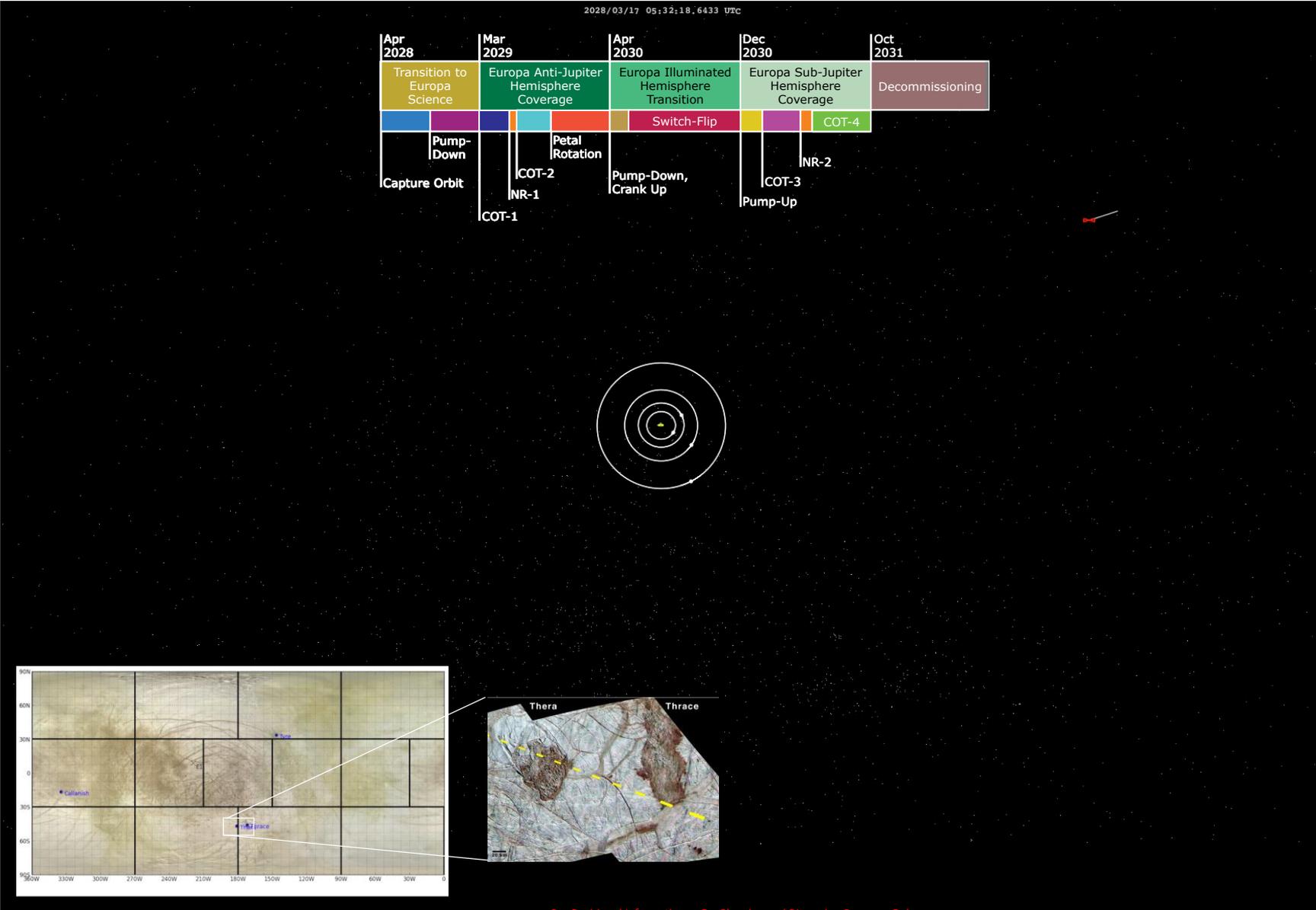
Notional Timeline



Gate A: Initial selection of 3 pairs of prime and backup sites. No more inputs on new sites.

Gate B: Final selection of prime and backup landing site pair. Site Certification complete.

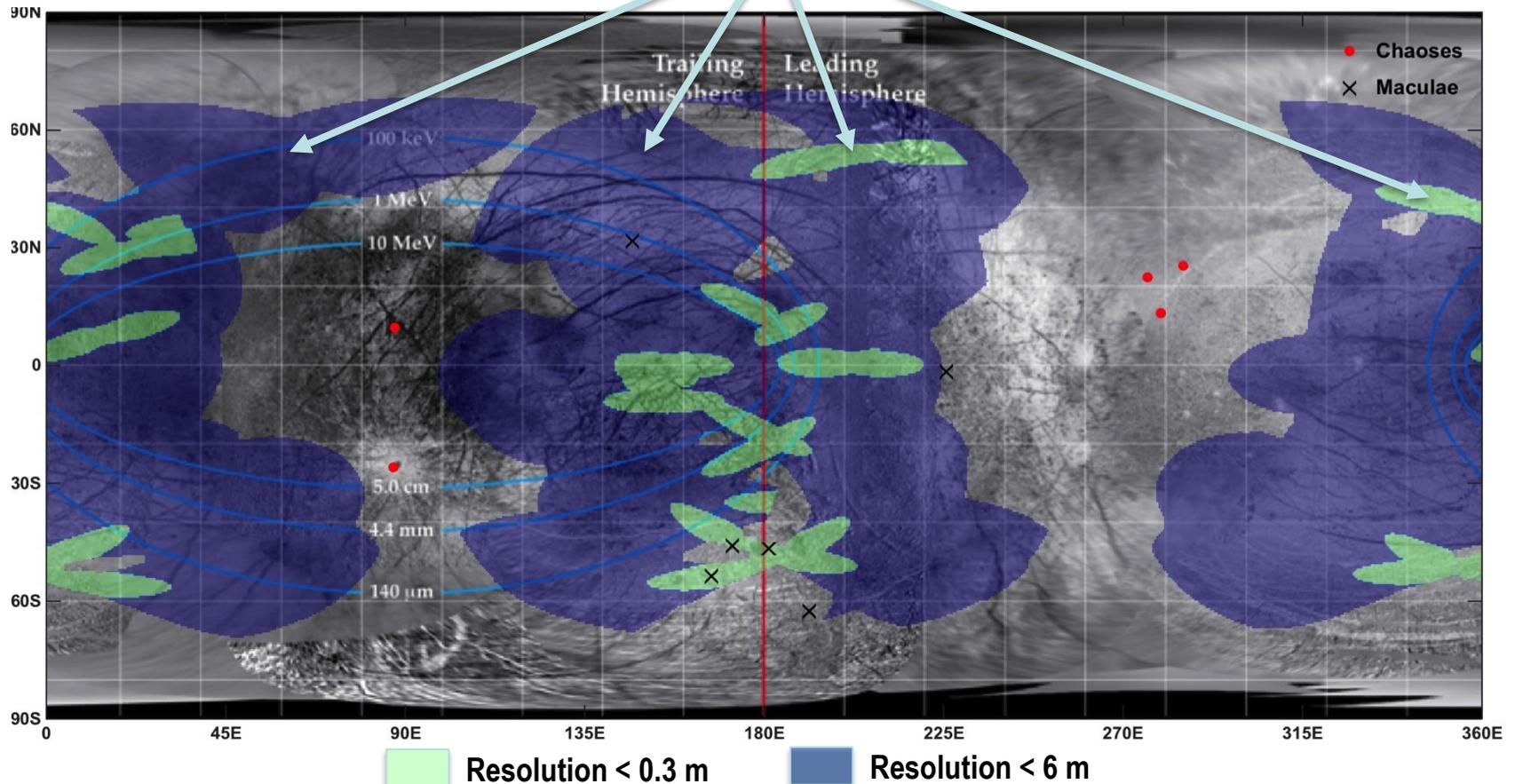
Example of Clipper Reconnaissance Coverage





Example Europa Clipper Reconnaissance Mapping

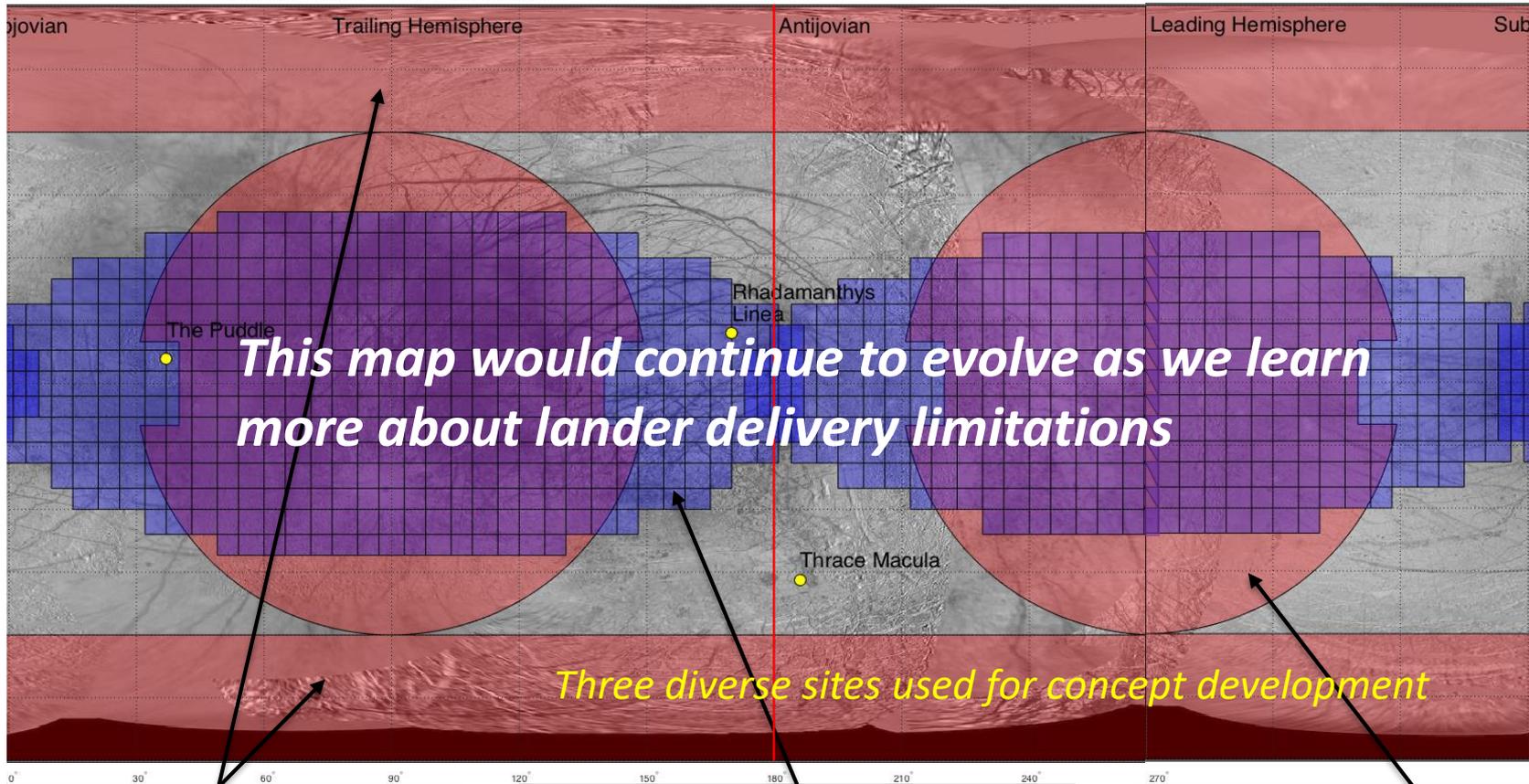
Blue/Green shaded areas represent potential Clipper data with sufficient coverage and resolution for landing site characterization





Complete capability-driven process for Site Selection: Constraints on Europa Site Accessibility

Union of all Constraint Maps



This map would continue to evolve as we learn more about lander delivery limitations

Three diverse sites used for concept development

Latitudes in excess of $\pm 60^\circ$ are currently considered inaccessible due to TRN image sun incident angle

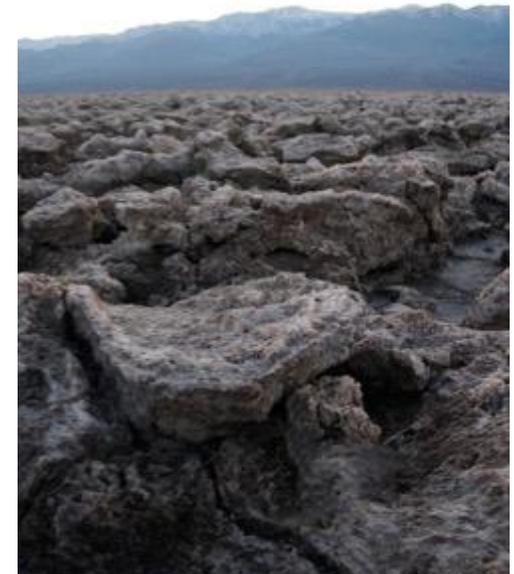
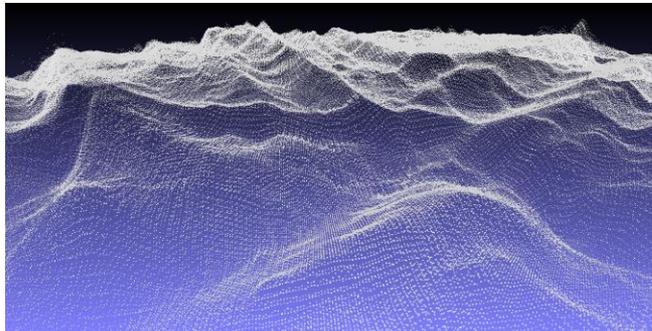
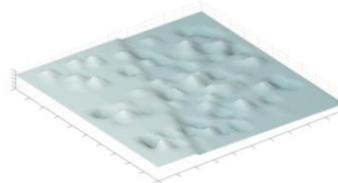
Blue regions are higher surface radiation zones and would require at least 10-cm sampling depth

Circular Longitudinal regions indicate no Clipper reconnaissance capability and are not considered accessible



Site Simulation Plan Summary

- Establish a limited set of canonical Europa surface models for engineering development for near term prototyping
 - About half dozen topologies for landing
 - About half dozen simulants for sampling
- Establish the infrastructure for a multi-pronged approach for flight development
 - Digital terrain Simulation
 - Europa DEM upscaling
 - Earth Analogues
 - A broad range of surface simulants





Concluding Remarks

- Path to Landing
 - Site Simulation > Feeds into Design
 - Site Reconnaissance > Reduces Science and Engineering Risks
 - Site Selection > Down select to best science site
 - Site Certification > Quantifies Safe Landing Risk
- Concurrent lander concept development with NASA's planned Europa Clipper mission provides for earlier surface science and better optimized reconnaissance for landing