Results from the Ice and Climate Evolution Science Analysis Group (ICE-SAG)


ICE-SAG Membership

Table 1. 22 members from 13 institutions covering a broad range of relevant expertise.

ICE-SAG Contributors

Table 2. ICE-SAG sought inputs from internal and external participants in a related SAG and recent workshops (green background) and from 11 external relevant subject-matter experts.

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Mission Concepts

Table 2. ICE-SAG discussed mission concepts addressing key questions over a range of mission sizes. Here, we present concepts that could fit within NASA’s New Frontiers class and considerations for larger and smaller missions. JPL’s Team X assisted with improved cost assessments for several aspects of these missions.

Ordering does not imply any prioritization of the mission concepts.

New Frontiers Class Concepts

NF1: Investigate polar layered structure and formation.
- Examine interaction of the current climate with the surface and layering within the upper meter
- Lander with atmospheric and material properties instruments, drill or bistic GPR for subsurface investigation

NF2: Assess deposition & sublimation of seasonal polar frost layer
- Monitor transport of volatiles and dust and the seasonal evolution of surface ice
- Lander with atmospheric and surface properties instruments for assessing conditions throughout the polar night

NF3: Measure key atmospheric parameters from surface to 80 km
- Monitor temperature, pressure, wind, water vapor, and aerosol abundance over annual & diurnal cycles
- Orbiter with solar-electric propulsion, optionally paired with landed met stations

NF4: Catalog and characterize the north polar layered deposits
- Traverse and sample outcropping layers & their conditions within a polar trough
- Rover with material properties instruments and a met station

NF5: Investigate mid-latitude ice vertical structure & exchange
- Assess boundary-layer meteorology, subsurface ice reservoirs, and volatile exchange between ice, regolith, and atmosphere
- Lander with atmospheric and material properties instruments, a 1-m drill, and radar or electromagnetic sounding

NF6: Map global near-surface ice, stratigraphy, changes
- Determine stratigraphy to depths of 1-100 m at ~1-m vertical resolution, map surface composition and topography at ~20-m lateral and ~1-m vertical resolutions, quantify surface changes
- Orbiter with InSAR, radar sounder, spectral and thermal imagers

Other Concepts

Flagship missions can be realized by supplementing or merging the New Frontiers concepts. Discovery or smaller missions can be realized by scaling down the New Frontiers concepts.

ICE-SAG considered separate small missions with specific goals:

- Landers for Investigating Gullies and Recurring Slope Lineae
- Lander to Assess North Polar Residual Cap and Atmosphere

More Information

The ICE-SAG report is in review, with completion slated for April 2019. The final report will be posted on the MEPAG website.

ICE-SAG’s presentation for MEPAG Virtual Meeting 4 on Feb. 25, 2019, is available at: http://mepag.jpl.nasa.gov

Acknowledgements

ICE-SAG thanks our subject-matter experts, JPL’s Team X, other external contributors, and our reviewers, and we are grateful to PSIS, Kimberly Post (PSIS), and Barbara Saltsberg (JPL) for hosting and supporting our January 2019 meeting in Tucson.