NASA Community Snow Meeting

August 14–15, 2024
Boulder, Colorado USA

NASA

University of Colorado Boulder

UAF UNIVERSITY OF ALASKA FAIRBANKS

BOISE STATE UNIVERSITY

Day 2, Session 2: Identify areas that the snow community should focus on in the next decade to make major advances in the future, both in snow and in the broader earth science communities.

10:50 AM-11:00 AM: Introduction of breakout session objectives/expectations
11:00 AM-12:00 PM: Breakout session
12:00 PM-01:00 PM: Breakout session groups present 1 summary slide, full group discussion
01:00 PM-02:00 PM: Lunch catered

Day 2 Breakout Session II Objectives, Format, and Intended Outcome

- **Objective:** Map out future directions for snow science, modeling and remote sensing. Identify areas that the snow community should focus on in the next decade to make major advances in the future, both in snow and in the broader earth science communities.
- **Format:** Breakout session by random assignment (8-10 individuals per group). In person, an early career leader is paired with senior leadership to facilitate each breakout group discussion. Remotely, one identified leader will facilitate each breakout group discussion. Each group will have access to a Google Drive folder with the breakout session guidelines, formatted summary slides (this file), and a blank Google document where group leaders can take notes.
- **Outcome:** By the end of the hour, the two group leaders will compile 1 presentation slide summarizing the state of the art for each technique. This slide will be presented immediately afterward to the larger group.

Group Numbers, Session Leaders

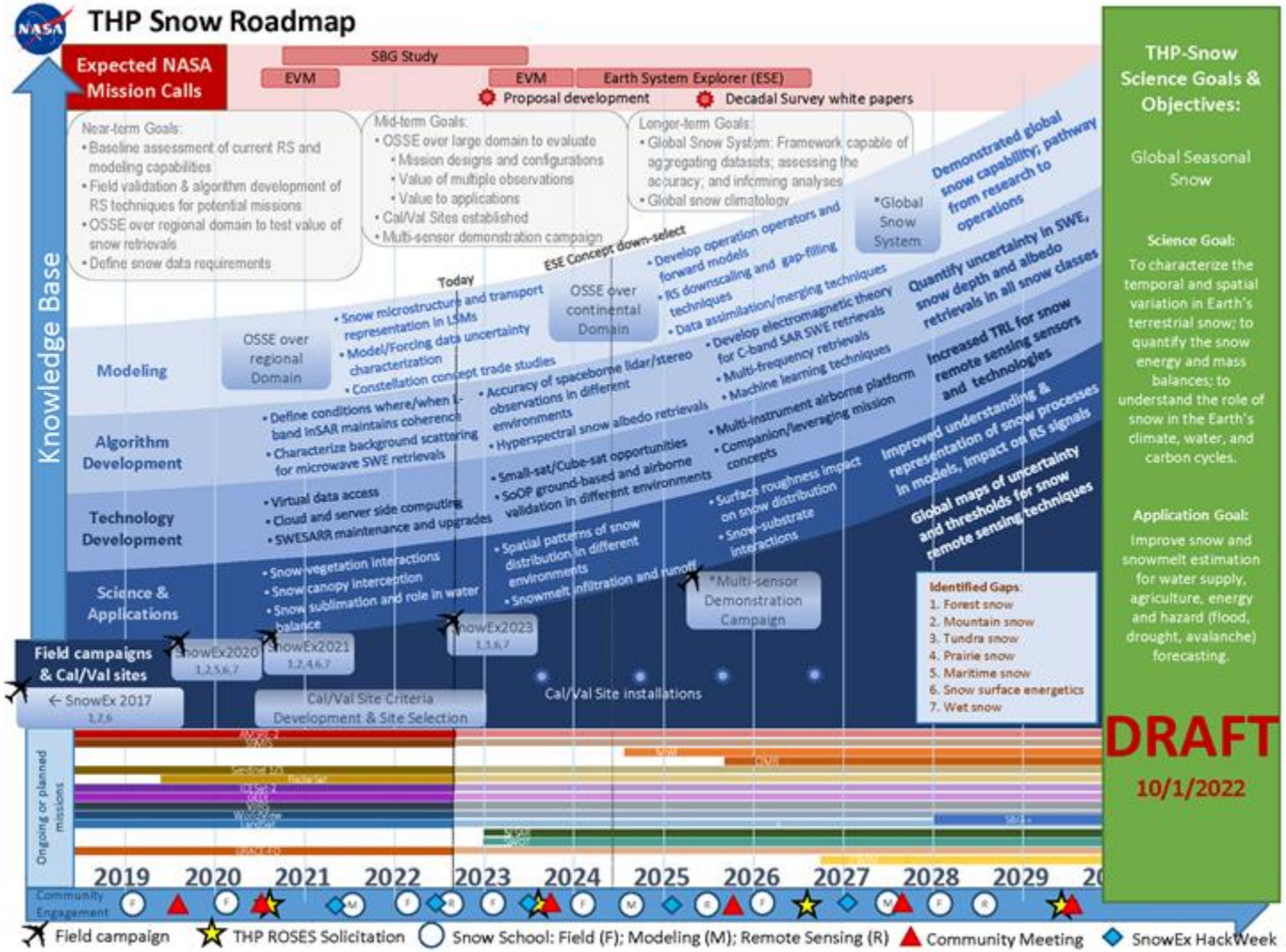
In-person	Virtual
1. Kehan Yang, Eric Sproles	1. Niklas Bohn
2. Bert Davis, Rashmi Shah	2. Dhanendra Singh
3. Mahsa Moradi, JT Reager	3. Vincent Vionnet
4. Julien Meloche, Leung Tsang	
5. James Garrison, Anna Grunes	
6. Swati Tak, Ross Palomaki	
7. Xiaolan Xu, Justin Pflug	
8. Mark Robertson, Rajeev Ranjan	
9. Shad O'Neel, Ally Fitts	
10. Adrienne Marshall, Uriel Aviles Ruiz	
11. Cenlin He, Ethan Gutmann	
12. Hannah Besso, Sam Tuttle	

Day 2 Breakout Session II Instructions:

- Breakout group specific documents for note-taking and summary slides: https://tinyurl.com/Day2-SessionI-II

- Breakout session leaders will facilitate a discussion around the following questions, notes can be taken at length in a Google Document specific to your breakout group topic (in “Day 2 Breakout Session I & II Notes” folder)

- “Day 2 Breakout Session II Summary Slides” has 1 labeled slide for each breakout session group to summarize discussion for full group discussion in the following hour


THP Snow Roadmap
Expected NASA Mission Calls
SBG Study
EVM
EVM
Earth System Explorer (ESE)
Proposal development
Decadal Survey white papers
Knowledge Base
Near-term Goals:
• Baseline assessment of current RS and modeling capabilities
• Field validation & algorithm development of RS techniques for potential missions
• OSSE over regional domain to test value of snow retrievals
• Define snow data requirements
Mid-term Goals:
• OSSE over large domain to evaluate
• Mission designs and configurations
• Value of multiple observations
• Value to applications
• Cal/Val Sites established
• Multi-sensor demonstration campaign
Longer-term Goals:
• Global Snow System: Framework capable of aggregating datasets; assessing the accuracy; and informing analyses
• Global snow climatology
*Global Snow System
Demonstrated global snow capability; pathway from research to operations
ESE Concept down-select
Today
Modeling
OSSE over regional Domain
• Snow microstructure and transport representation in LSMs
• Model/Forcing data uncertainty characterization
• Constellation concept trade studies
OSSE over continental Domain
• Develop operation operators and forward models
• RS downscaling and gap-filling techniques
• Data assimilation/merging techniques
Quantify uncertainty in SWE, snow depth and albedo retrievals in all snow classes
Algorithm Development
• Define conditions where/when L-band InSAR maintains coherence
• Characterize background scattering for microwave SWE retrievals
• Accuracy of spaceborne lidar/stereo observations in different environments
• Hyperspectral snow albedo retrievals
• Develop electromagnetic theory for C-band SAR SWE retrievals
• Multi-frequency retrievals
• Machine learning techniques
Increased TRL for snow remote sensing sensors and technologies
Technology Development
• Virtual data access
• Cloud and server side computing
• SWESARR maintenance and upgrades
• Small-sat/Cube-sat opportunities
• SoOP ground-based and airborne validation in different environments
• Multi-instrument airborne platform
• Companion/leveraging mission concepts
Improved understanding & representation of snow processes in models, impact on RS signals
Science & Applications
• Snow vegetation interactions
• Snow canopy interception
• Snow sublimation and role in water balance
• Spatial patterns of snow distribution in different environments
• Snowmelt infiltration and runoff
• Surface roughness impact on snow distribution
• Snow-substrate interactions
Global maps of uncertainty and thresholds for snow remote sensing techniques
*Multi-sensor Demonstration Campaign
Identified Gaps:
1. Forest snow
2. Mountain snow
3. Tundra snow
4. Prairie snow
5. Maritime snow
6. Snow surface energetics
7. Wet snow
Field campaigns & Cal/Val sites
← SnowEx 2017
1,7,6
SnowEx2020
1,2,5,6,7
SnowEx2021
1,2,4,6,7
SnowEx2023
1,3,6,7
Cal/Val Site Criteria Development & Site Selection
Cal/Val Site installations
Ongoing or planned missions
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
Community Engagement
Field campaign
THP ROSES Solicitation
Snow School: Field (F); Modeling (M); Remote Sensing (R)
Community Meeting
SnowEx HackWeek
THP-Snow Science Goals & Objectives:
Global Seasonal Snow
Science Goal:
To characterize the temporal and spatial variation in Earth's terrestrial snow; to quantify the snow energy and mass balances; to understand the role of snow in the Earth's climate, water, and carbon cycles.
Application Goal:
Improve snow and snowmelt estimation for water supply, agriculture, energy and hazard (flood, drought, avalanche) forecasting.
DRAFT
10/1/2022

Day 2 Breakout Session II Questions:

1. What efforts are needed in the near term to mature technologies?
    a. Field campaign, airborne campaigns, instrument development, etc?
    b. Model advances, OSSEs,
    c. Data merging, cloud computing, etc
    d. What questions did SnowEx not address? What forward-thinking ways should we approach the next major campaign?
2. How can we better engage the applications & operational communities in future missions or campaigns?
3. How do we foster a community that is welcoming of new members?
4. Who are the partner user communities? Can we leverage advances or lessons learned in other communities for snow?
5. What white papers should go toward the next Decadal Survey?