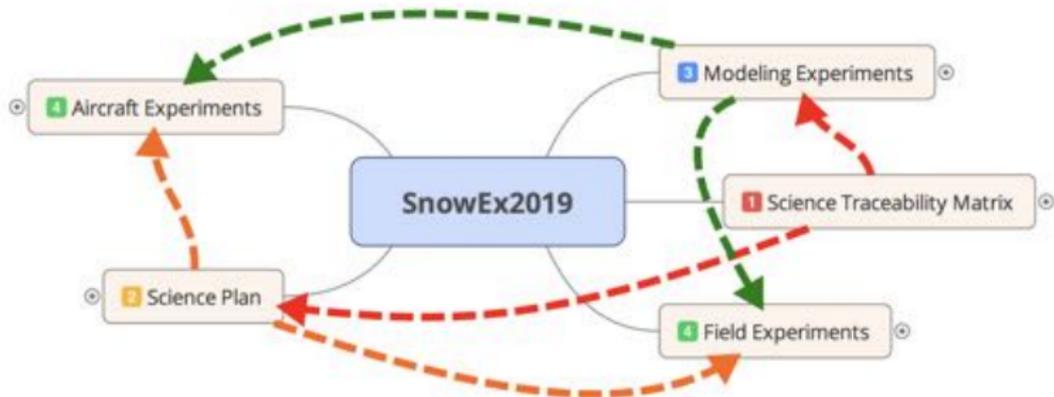




## NASA SnowEx 2019 Campaign: Jan 20 - June 1, 2019



**SnowEx19: A multi-sensor time-series experiment in multiple snow climates**

NASA SnowEx  
2017-2019

Field  
Experiments for  
Cal/Val of  
Airborne  
Campaigns

Timeline of  
Aircraft  
Experiments

Getting involved

## SnowEx 2019 Science Questions from Science Traceability Matrix:

### SnowEx 2019 Fundamental Questions (FQs) from STM & Science Plan:

- *FQ1: What are the physical controls & dynamics of accumulation and melt of snow (SWE) across topo gradients?*
- *FQ2: What are the patterns of snow accumulation and melt in boreal vs. **temperate forests**, and what are the resulting hydrologic partitioning of snowmelt?*

### SnowEx 2019 Mission Objectives (MOs) from STM & Science Plan:

- *MO1: Quantify snow mass & properties across topo and veg gradients in different snow climates, for accumulation & melt.*
- *MO3: What is the sensitivity & accuracy of different sensors in measuring snow mass and properties?*
- *MO4: What are the optimal spatial and temporal observation scales to capture variation in snow mass and properties?*

### **SnowEx 2017, Grand Mesa and Senator Beck Basin, Colorado:**

- Large continuous month-long effort
- Focus on training and community building
- Successful intensive ground-based effort, 100+ people
- Very small change in SWE during campaign

### **SnowEx 2019, Western U.S.:**

- More limited funding for airborne and field experiments
- Cover range of snow climates and conditions:  
*leverage planned campaigns & intensive snow research sites*
- Capture accumulation & melt, large  $\Delta$  SWE:  
*time series approach, using local experienced field observers*
- Focus on low-risk, high TRL instruments for the primary time series experiment

## SnowEx19 Alignment with THP16 Science Plan

NASA SnowEx  
2017-2019

Field  
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- SnowEx19 will address Mission Critical Science Plan priorities
- Modeling/DA priority requires coordination between Modeling, Airborne, and Field Experiments

Core airborne instruments will include:

- Ku-band SAR (intensive SWESARR campaign)
- L-band InSAR (time series UAVSAR campaign)
- Ka-band InSAR (time series subset with GLISTIN-A)
- LiDAR (time series ASO and CRREL Helipod, separately funded campaigns in CA, CO, ID)

## SnowEx 2019 Campaigns

### Goals for SnowEx 2019 Airborne Experiments

- Quantify accuracy and limitations of L-band InSAR retrievals of change in SWE, in preparation for NISAR
- Test and validate SWE retrieval from Ku-band radar
- Test Ka-band InSAR for snow depth retrieval, quantify bias due to penetration
- Quantify subpixel variability in thermal IR signatures, and their effect on coarse resolution spaceborne products
- Evaluate the use of airborne UWB radar for direct snow travel-time measurements, for validation and monitoring

### SnowEx 2019 Campaigns

- Time series of L-band InSAR and LiDAR:  
*leveraging separately funded LiDAR efforts in CA, CO, and ID*
- 9-day Intensive Observation Period @ Grand Mesa, CO:  
*Mutli-band radar, passive microwave, thermal IR, UWB radar, L-band InSAR, LiDAR*
- Ka-band InSAR, L-band InSAR, LiDAR @ San Joaquin, CA

## SnowEx19 Field Experiments

NASA SnowEx  
2017-2019

Field  
Experiments for  
Cal/Val of  
Airborne  
Campaigns

Timeline of  
Aircraft  
Experiments

Getting involved

- LiDAR/InSAR time series: Ten 1-day campaigns across 5 states
- Network of 13 intensive study sites, managed by local site leads and local experienced observers
- Active/passive microwave and thermal IR week-long experiment in mid-February at Grand Mesa
- Ka-band and LiDAR experiment in California
- Core teams established to develop execution plan for time series and Grand Mesa IOP
- Redundancy in options to mitigate risks due to weather and instrument issues



## Timeline of SnowEx19 Aircraft Experiments

- UAVSAR L-band InSAR: Jan 20, Feb 1, Feb 15, March 1, March 15, April 1, April 15, May 1, May 15, June 1
- ASO LiDAR / spectrometer, Lakes and San Joaquin Basins: approx Feb 1, March 1, April 1, May 1, + 2 TBD (*funded by CA*)
- ASO LiDAR / spectrometer, East River: approx Feb 15, March 15, April 15, May 15 (*partly funded by CO*)
- CRREL/NCALM Helipod LiDAR / Thermal IR: Boise River Basin, Reynolds Creek: approx Feb 1, Mar 1, Apr 1 (*funded by DoD*)
- Goddard SWESARR + UW Thermal IR: Grand Mesa, Feb 7-17
- Naval Research Lab SnowRadar, 2-18 GHz: Grand Mesa, Feb 7-17
- GLISTIN-A Ka-band InSAR: TBD, coincident with ASO in Lakes / San Joaquin Basins



## SnowEx 2019: Proposed Grand Mesa Field Campaign





# Grand Mesa IOP Airborne activities

- Twin Otter #1
  - SWESARR

	Band	#	Freq. (GHz)	BW (MHz)	PoL
Active	X	1	9.65	200	VV, VH
Passive	X	2	10.65	200	H
Active	Ku-Lo	3	13.60	200	VV, VH
Active	Ku-Hi	4	17.25	100	VV, VH
Passive	K	5	18.70	200	H
Passive	Ka	6	36.50	1000	H

- Thermal IR
- ARFC G3 – UAVSAR L-Band InSAR
- ASO, King Air
  - LiDAR
  - Hyperspectral Imager
- Twin Otter #2
  - NRL SnowRadar (2-18 GHz)





## Ground campaign schedule & activities

- SWESARR check out flight, early December
- Pre-campaign trips – check on met stations; install time-lapse cameras
- Grand Mesa IOP, targeting 7-17 Feb 2019
- Small group measuring throughout the week
- Focus on flat, open areas and with some vegetation gradient
- Primary observations
  - Spatial variability in snow depth and surface temperature
  - Vertical profiles of snow stratigraphy and microstructure



0 1 2 3 4 5 km



high priority

medium priority

Map of Grand Mesa showing prioritized GOES pixels for sampling to focus on flat areas without edge effects in pixels.  
(provided by Steven Pestana, UW)

## Want to volunteer / get involved in SnowEx 2019 and beyond?

- Join the International Snow Working Group for Remote sensing (ISWGR)
- Become a SnowEx 2019 Data Early Adopter - field obs will be available online shortly after campaigns
- Participate in monthly telecons during campaign to hear updates and provide feedback
- Modeling / Data assimilation activities in each ISA
- Remote sensing analysis in each ISA
- QC of field / met data
- attend ISWGR SnowSchool
- SnowEx Town Hall, Thursday 12:30, *Marriott Marquis - Independence F-H*

Please email [SnowEx19@gmail.com](mailto:SnowEx19@gmail.com) with questions, suggestions, or interest in any of the above.