US AMSR-U Science Team Update

Christian Kummerow
Colorado State University

JAXA Joint PI Meeting
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History of US AMSR Science Teams

- US AMSR-E Team: The original Aqua Science Team. PI was Roy Spencer with help from Elena Lobl at UAH. Funding ended around 2013.

- US AMSR2 Team: The continuation of the AMSR-E team. Roy Spencer, PI. The team adapted algorithms to use L1B radiances from JAXA, and created a new “Ocean Suite” to replace the RSS algorithm that was tied to the L2A radiances. Funding ended in 2018.

- US AMSR-Unified Team: A much smaller effort to create a Unified, long-term product from AMSR-E, AMSR2 and future AMSRs using JAXA L1R data. Products are still generated at UAH under Sherry Harrison (Sherry.Harrison@uah.edu) and soon Leigh Sinclair. Science team is led by Chris Kummerow (CSU) and Linette Boisvert (GSFC).

- Science focus of AMSR-Unified Team is long term and product consistency.

AMSR Data Products

- Level-2 and Level-3 Products
  - Atmosphere over oceans, precipitation, soil moisture, sea ice, snow water equivalent
  - **AMSR-U (Unified):** products generated from JAXA L1R brightness temperatures, using common algorithms for both AMSR-E and AMSR2 instruments
    - *AMSR-U2, AMSR-UE used to refer to data from specific instruments*
  - **AMSR-E:** legacy product suite derived from RSS L2A brightness temperatures

Input / Instrument	Level-2A Brightness Temps from RSS	Level-1R Brightness Temps from JAXA
AMSR-E, NASA Aqua	Legacy AMSR-E products	AMSR-UE product line
AMSR2, JAXA GCOM-W1	-	AMSR-U2 product line

AMSR SIPS Data Flows

KSAT Svalbard Ground Station

JAXA GCOM-W1 Data Providing Service

AMSR2 L1R

AMSR-E L1R

AMSR SIPS

AMSR L2B & L3 Product Generation (science, metadata, qa, ph, subsets, browse)

full res imagery

data & metadata

metrics

Worldview

GIBS

NSIDC DAAC

EMS

science algorithms

science QA

Land Algorithm Teams Snow Rain Ocean Sea Ice

NOAA NCEI

OISST

GSFC GMAO

GEOS-5 FP-IT

Product	Algorithm PI
Precipitation	Kummerow, CSU Ferraro, UMD
Atmosphere over Ocean	Kummerow, CSU
Soil Moisture	Bindlish, GSFC
Sea Ice	Boisvert, GSFC
Snow Water Equivalent	Tedesco, Columbia U

AMSR-U2 Standard Products
Status and Plans

AMSR2 Standard Product	Processing Status and Plans
L2B Soil Moisture	Routine product generation since Oct 2016.
L3 Snow Water Equivalent: Daily, 5-Day, Monthly	Routine product generation since **February 2019**.
L3 Sea Ice: 6.25 km, 12.5 km, 25 km	Routine product generation since **April 2018**.
L2B Precipitation	Routine product generation since **March 2020**.
L2B Atmosphere over Ocean	Version 01 is ready to be moved into production.
L3 Atmosphere over Ocean (Daily, Weekly, Monthly)	

AMSR-UE Standard Products: Plans

Generated from JAXA AMSR-E Level-1 Resampled (L1R) brightness temperatures (Tb) using the latest algorithms from the US AMSR•U Science Team

- JAXA created an AMSR-E Level-1R product (version 4, using the same algorithm and format as AMSR2) in order to support a unified data record from AMSR-E and AMSR2.
- SIPS has retrieved the full mission of AMSR-E L1R data from JAXA; available to Science Team for their evaluation
- Science team to adjust their latest algorithms for use with AMSR-E L1R
- ***Goal: Full AMSR-E mission reprocessing to generate AMSR-UE data record – consistent AMSR-U data record from 2002 forward***

Status of AMSR-UE algorithms and products

Algorithm Package	AMSR-UE Status
L2 Ocean	We have this algorithm in house
L2 Rain	We have this algorithm in house
L2 Land (soil moisture)	We have this algorithm in house
L3 Sea Ice - Daily (6, 12, 25 km)	We have this algorithm in house
L3 Ocean - Daily, Weekly, Monthly	We have this algorithm in house
L3 Land (soil moisture) - Daily	Waiting for L3 AMSR-UE Land algorithm
L3 Snow - Daily, 5-Day, Monthly	Waiting for L3 AMSR-UE Snow algorithm

AMSR2 LANCE NRT Status and Plans

LANCE AMSR2 Product	Near Real Time Processing Status
L2B Rain	**NRT products available since March 2020, updated to version R02 October 2021** (replaced preliminary NRT combined RainOcean product that was available since March 2015)
L2B Ocean	**NRT products available since June 2020** (replaced preliminary NRT combined RainOcean product that was available since March 2015)
L3 Snow	**NRT products available since April 2019, updated to version R02 May 2021** (replaced preliminary NRT product that was available since August 2015)
L3 Sea Ice	**NRT products available since September 2018, updated to version R04 July 2020** (replaced preliminary NRT product that was available since December 2015)
L2B Soil Moisture	**NRT products available since September 2017, updated to version R02 April 2018** (replaced preliminary NRT product that was available since June 2016)

AMSR Stewardship / Preservation

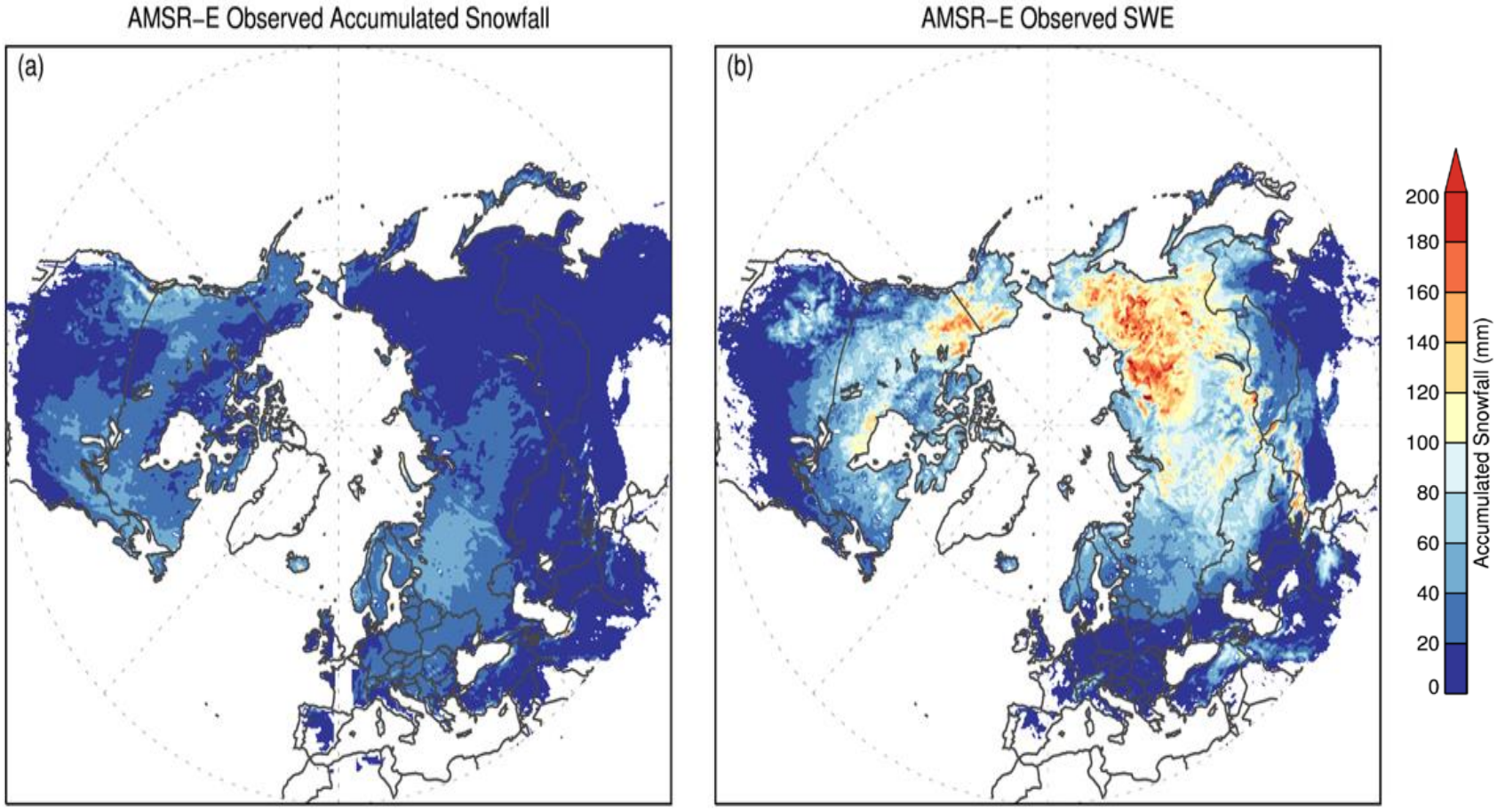
- AMSR Data Management Plan and Data User Guide completed
  - Final Data Mgmt Plan delivered to ESDIS on **April 21, 2020**
  - Completing details on AMSR-U products as these algorithms are integrated
- AMSR ATBDs
  - Updated ATBDs Available at NSIDC
    - AMSR-U: https://nsidc.org/data/amsre_amsr2/technical-references
    - Legacy AMSR-E: https://nsidc.org/data/amsre/technical-reference
- AMSR Preservation Information
  - Collection of preservation information continues at NSIDC DAAC

Science work for AMSR-U

As we move from product archives to process understanding, we begin to ask if products are consistent with one another.

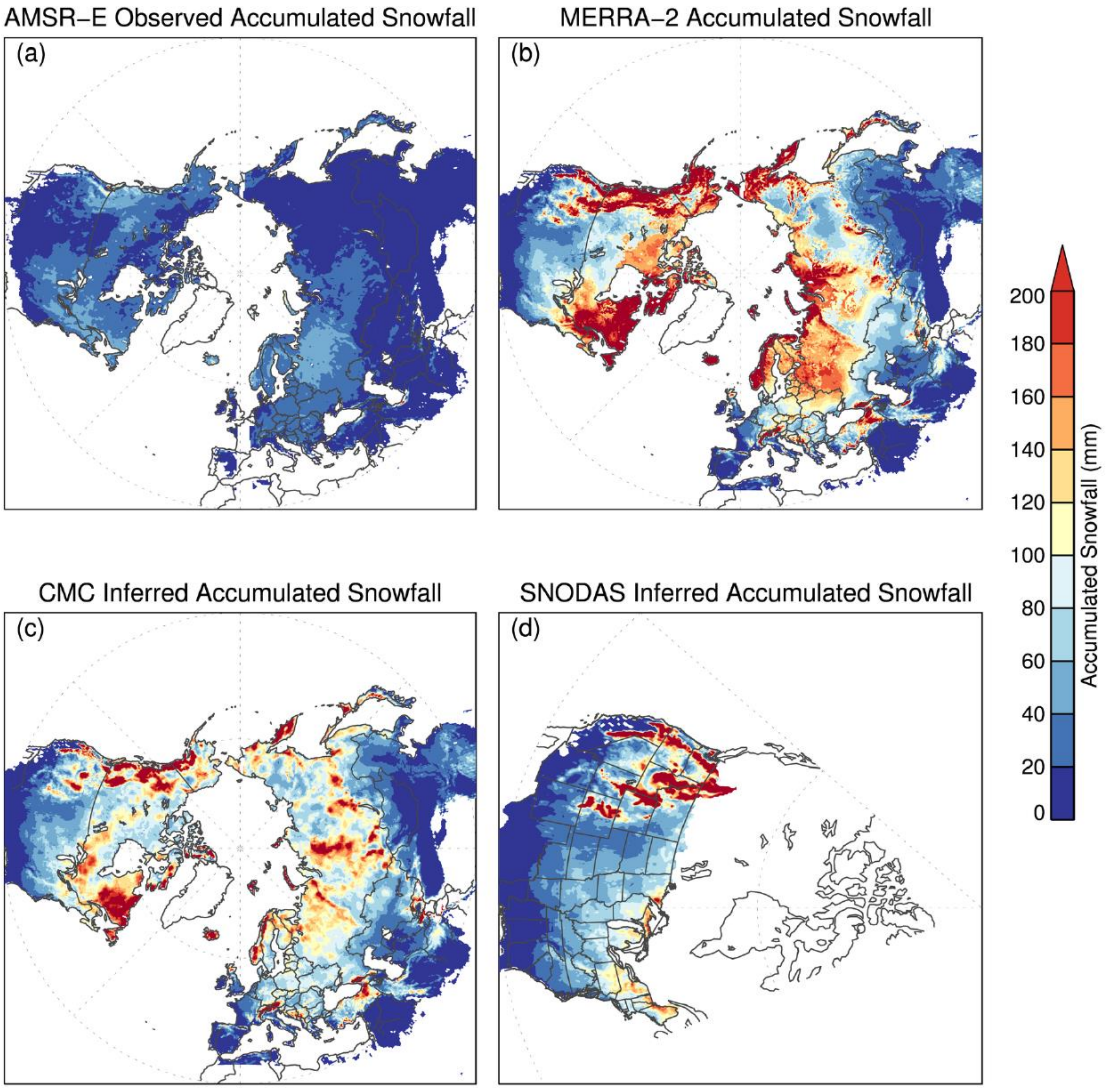
First results are not so encouraging ☹

AMSR Snow

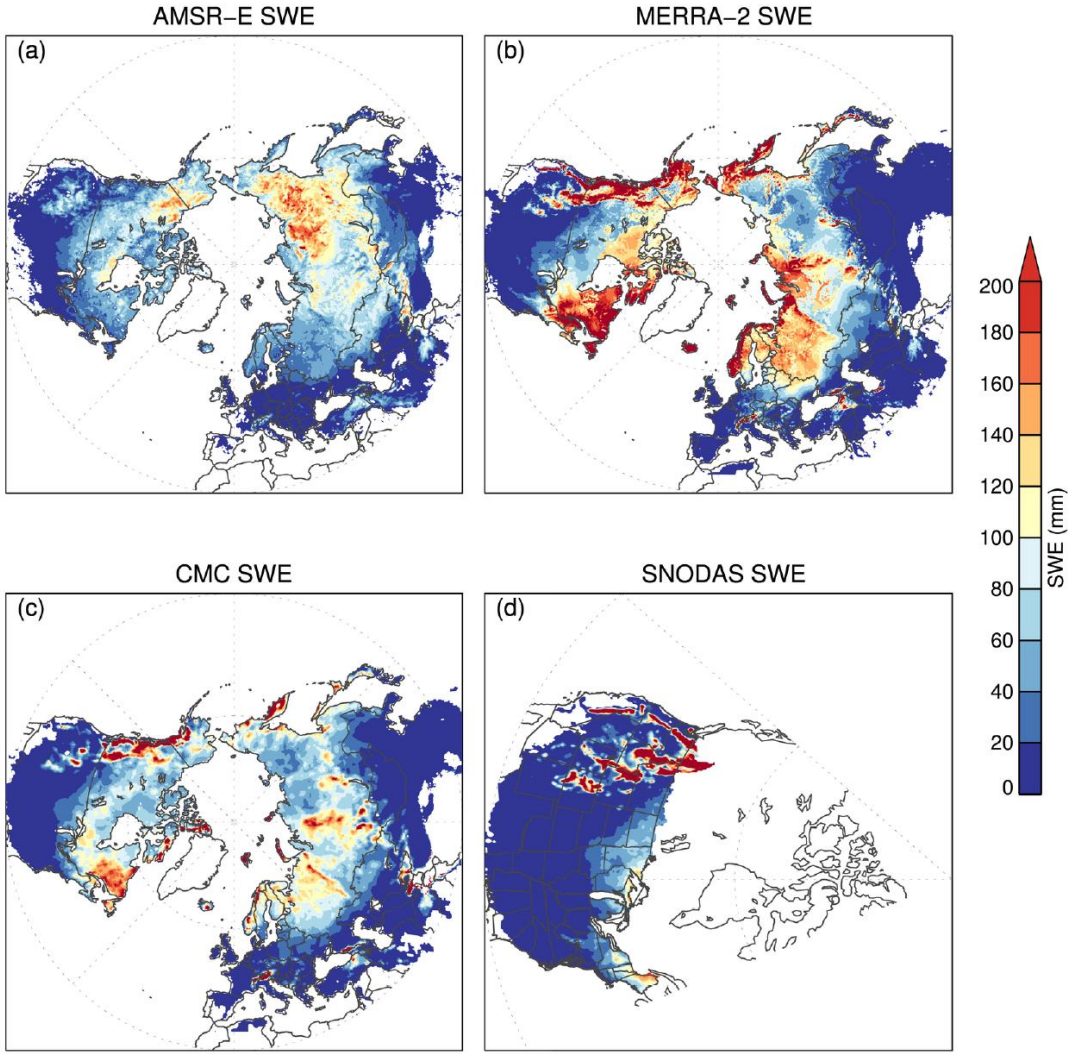


Snowfall – melt – sublimation

Avg. Snowfall
2003-2011

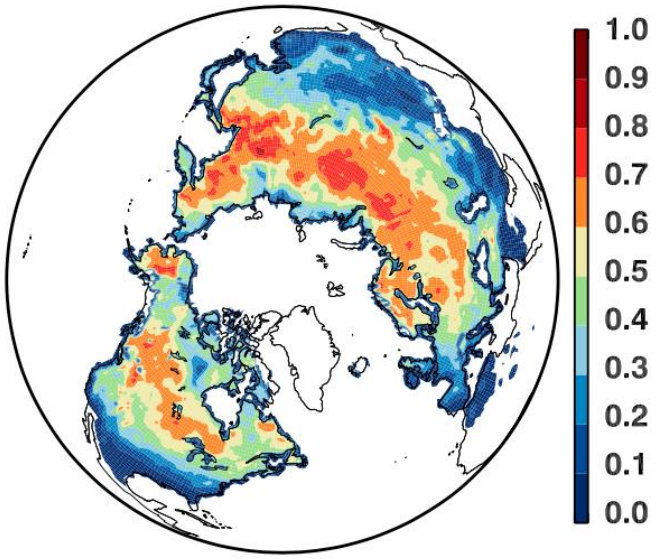


Avg. Snow Water Equivalent
2003-2011

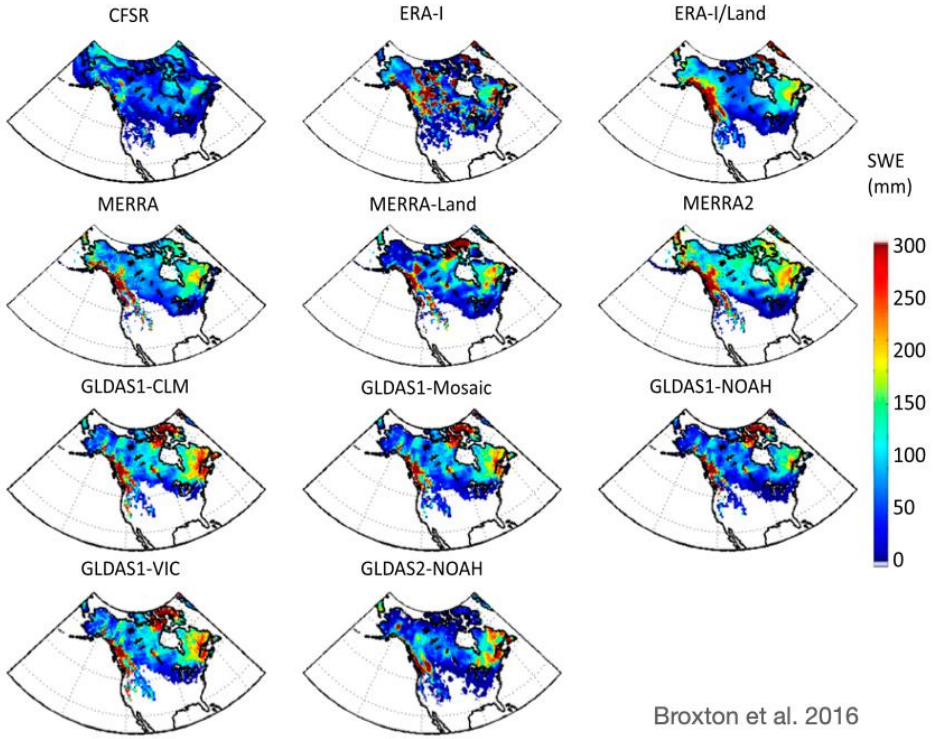


Snow – Inconsistency Among Models

Model outputs vary spatiotemporally.



Mudyrk et al. 2015



Broxton et al. 2016

Research Strategy 1

Improve SWE through better snowfall and snow evolution model

Improve microwave snowfall algorithm using Convolution Neural Network algorithm (high-frequency channels not sensitive to surface). Requires reliable training data.

- Ground-based radar misses higher snowfall in Mountains. Z-S is questionable
- GPM misses light/moderate snowfall due to lack of radar sensitivity
- Use high resolution **Model** (HRRR) or Ground based **Radar** (MRMS) scaled locally to monthly accumulation from in-situ downscaled using temporal disappearance of snow to distribute spatially.

Currently testing and validating against daily snowfall analysis during selected Field Experiments. Likely will make use of ancillary data to predict orographic enhancements.

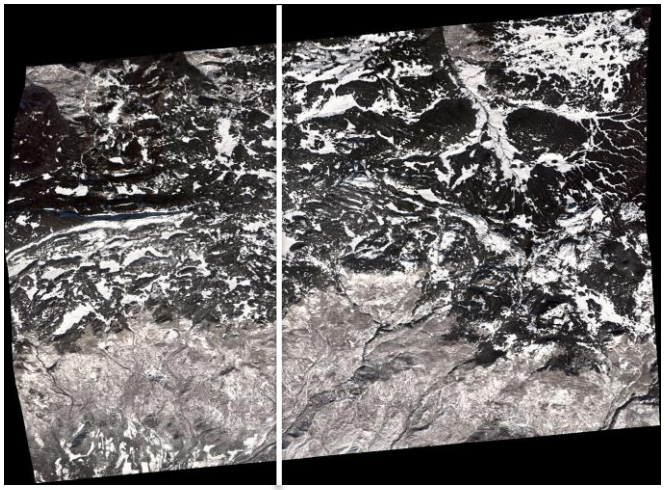
Many hydrologists believe that good snowfall + snow evolution model may be better than SWE measurements. Particularly in mountains.

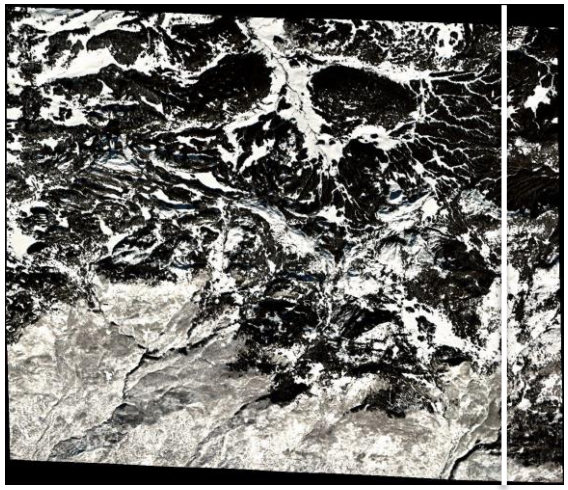
Research Strategy 2

Improve SWE through better snowfall and snow emissivity

Improve microwave snowfall algorithm by retrieving emissivity during clear overpasses and evolving emissivity to future overpasses. This allows Convolution Neural Network algorithm to use all channels and retrieve SWE and snowfall simultaneously. Also requires reliable training data.

- Need to better understand the evolution of emissivity and relation to new snowfall and SWE evolution
- Using direct emissivity retrieval in clear skies with High Resolution Visible Imagery (MAXAR) over Central Colorado to better understand local relationship between SWE and emissivity





Future Work

- AMSR•U team will continue to process JAXA L1R data for long-term climate record.
- UAH will produce selected real-time products for its LANCE system
- Science team will continue to assess product consistency as a way to stimulate improvements in key areas of deficiency.
- US AMSR-U Team exploring potential for continuing activities with AMSR3. Focus would be on better integration of products as well as producing longer time series.