Development of Global operational snow analysis at the US Air Force 557th Weather Wing

Yeosang Yoon (yeosang.yoon@nasa.gov) [1,2], Eric M. Kemp [1,3], Sujay V. Kumar [1], Jerry W. Wegiel [1,2], and Christa Peters-Lidard [1]

[1] NASA Goddard Space Flight Center, Greenbelt, MD; [2] Science Applications International Corporation, McLean, VA ; [3] SSAI, Lanham, MD

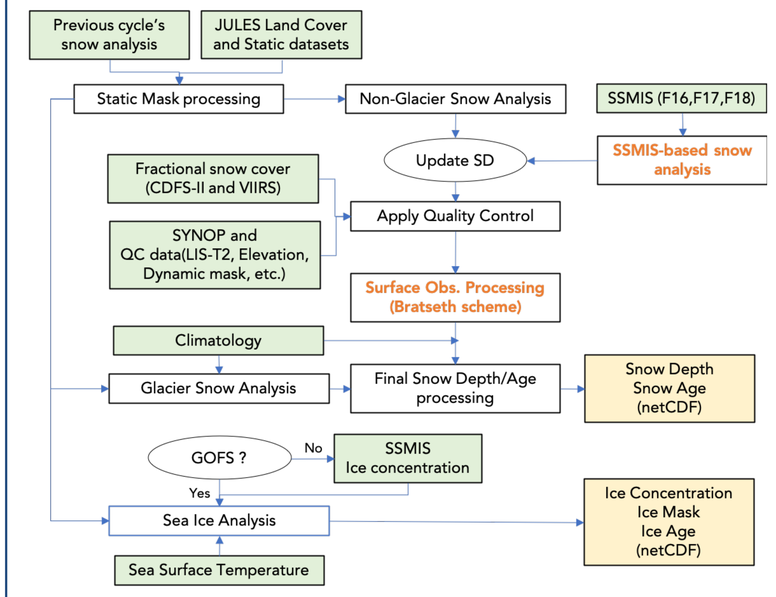
Research goals

- Present the development of a global operational snow analysis at 10-km resolution, called US Air Force Snow and Ice Analysis (USAF-SI)

Major enhance enhancements over the SNODEP

- The outdated SNODEP snow depth retrieval algorithm is replaced by the Foster et al. (1997; 2005) approach, which considers the effects of variations in forest cover.
- The simple blending algorithm (IDW) is replaced by the Bratseth scheme, a successive correction algorithm that converges to the solution provided by Optimal Interpolation (OI).
- Outdated quality control datasets are updated and quality control algorithms are reorganized to ensure the performance of the snow analysis.
- The spatial resolution of snow and ice estimates are increased from 25-km to 10-km.
- USAF-SI are fully integrated into the global operational land analysis configuration at the USAF 557th WW.

Schematic diagram for USAF-SI



- Green box: input dataset for next process
- Orange box: Final outputs
- White box: process (or module)

Evaluation setup for USAF-SI

- Generating global USAF-SI datasets (10-km spatial resolution)
- Resampling of the SNODEP (25 km -> 10 km)
- Evaluating USAF-SI and SNODEP products by comparing with in-situ (GHCN-D) and reanalysis dataset (SNODAS, US MET-SURF)
- Experimental periods: 2018/12/10 – 2019/04/30

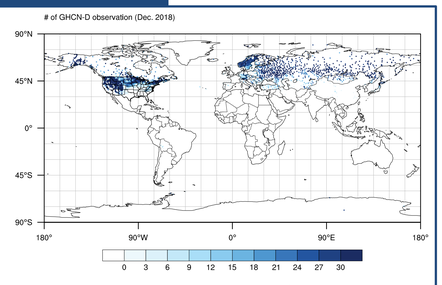


Fig 1. A map of the number of GHCN-D (Dec. 2018)

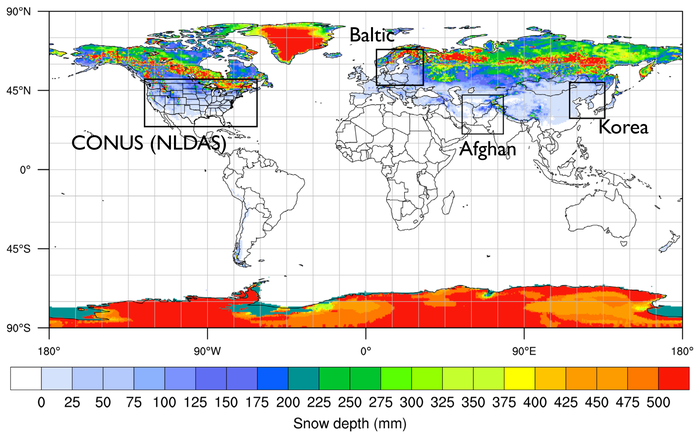


Fig 2. Spatial map of time-averaged USAF-SI snow depth (mm). Highlighted area (box) are used for evaluation.

Evaluation (vs GHCN-D)

CONUS (vs 6022 GHCN-D observations)

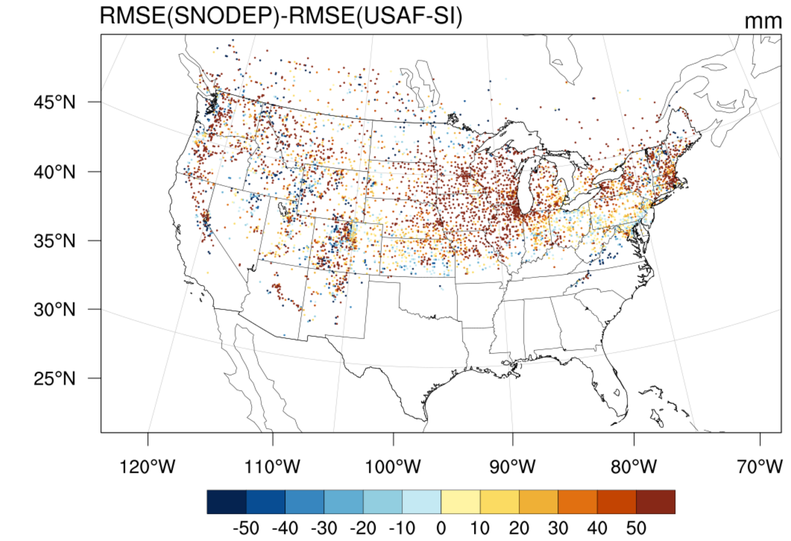


Fig 3. Difference RMSE between SNODEP and USAF-SI. Warm color indicate improvement and cool color indicate degradation. USAF-SI shows better performance than SNODEP over 75.2% locations.

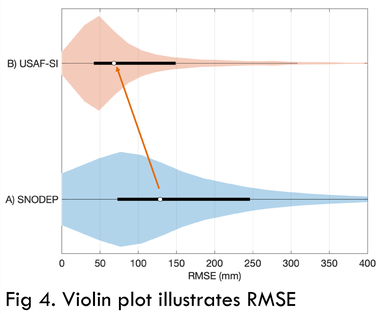


Fig 4. Violin plot illustrates RMSE distribution of A) SNODEP and B) USAF-SI and their probability density

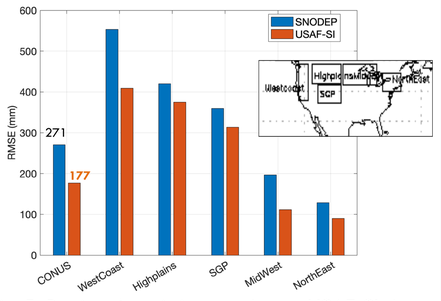


Fig 5. Regional statistics are shown. USAF-SI shows better performance, especially, West coast.

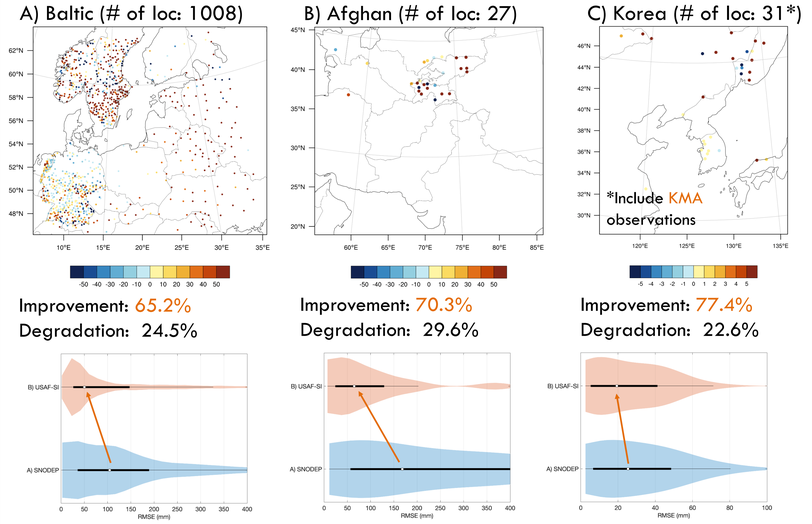


Fig 6. Same as Figure 3 and 4, but for A) Baltic, B) Afghan, and C) Korea. Overall, USAF-SI shows better performance than SNODEP.

Evaluation (vs SNODAS; CONUS only)

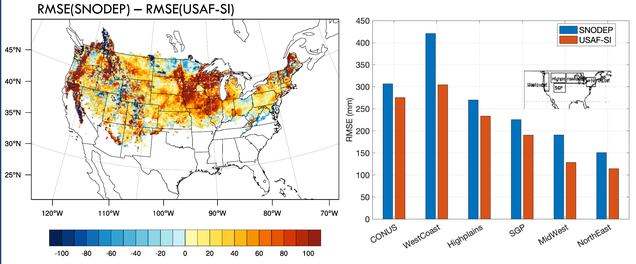


Fig 7. Same as Figure 3 and 5, but compared with SNODAS. USAF-SI shows a significant improvement over west coast and mid-west regions

Improvement: 76.6% Degradation: 23.4%

Evaluation (vs UK MET-SURF; CONUS only)

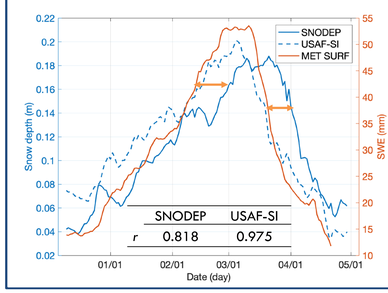


Fig 8. Time series of domain-averaged mean snow depth (or SWE). Both SNODEP and USAF-SI snow depths show similar patterns compared with MET-SURF SWE, but SNODEP has time lag during both snow accumulation and melt time.

Summary

- USAF-SI is a significant improvement on the current SNODEP analysis; includes improved retrieval algorithm; improved algorithm for blending gauge observations; increased spatial resolution from 25 km to 10 km
- Future enhancements
  - Data from additional sensors (AMSR-2)

Acknowledgements

Work funded by AFLCMC Contract, and by NASA/GSFC Hydrospheric and Biospheric Support (HBS) Services Contract NNG15HQ01C