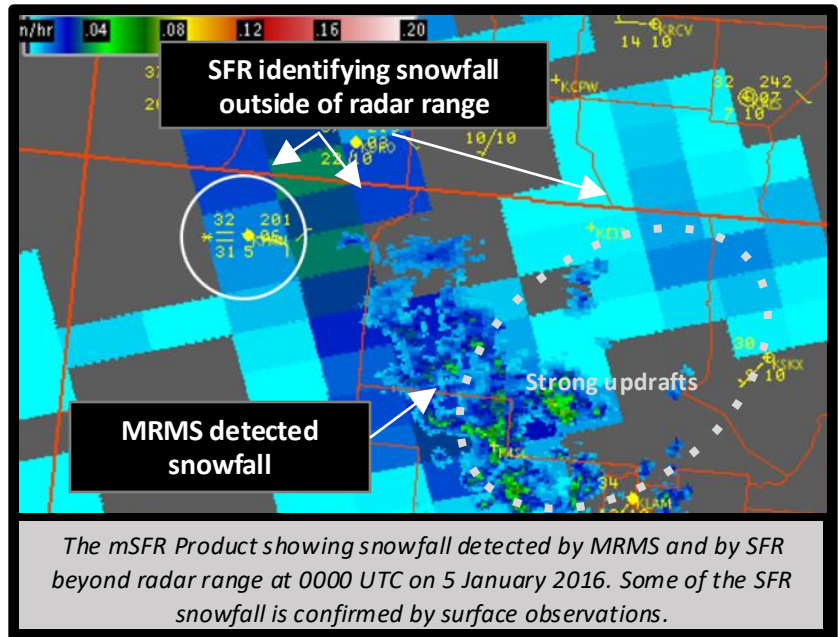


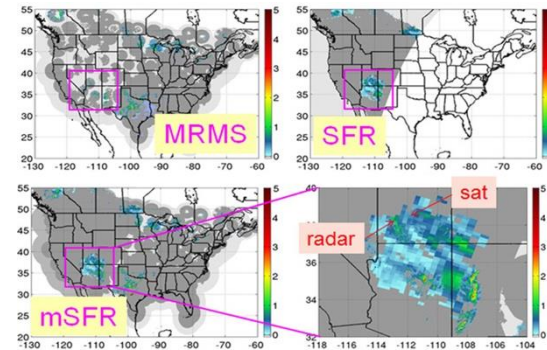
Why is the Radar-Satellite Blended or merged Snowfall Rate (mSFR) Product Important?

The mSFR product is liquid equivalent, instantaneous snowfall rate derived from merging the NSSL MRMS instantaneous precipitation rate (snowfall only) and the NESDIS satellite snowfall rate (SFR). It features broader spatial coverage than MRMS and higher temporal resolution than SFR. mSFR quantifies snowstorms, including their extent and the locations of the most intense snowfall, and tracks snowstorm evolution with its looping capability.



mSFR Product Creation and Attributes

- Snowfall detection (SD): use a GFS-based machine learning model for SD; extract MRMS snowfall based on SD
- Merge MRMS and SFR
- SFR and MRMS are time lagged by 30 minutes because satellite senses snowfall higher aloft than radar



- Attributes:**
- Available every 10 min
 - Latency ~ 6 min
 - Resolution: MRMS 1 km, SFR 7-16 km at nadir; distinguish the two by pixel size
 - ~14 overpasses per day

Impact on Operations

Primary Application

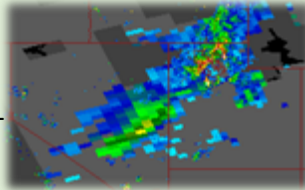
Situational awareness:

Provides real time, observation-based snowfall rate estimates from both radar and satellite for weather forecasting.

Enhanced coverage: SFR fills in snowfall activity in radar gaps so mSFR features enhanced spatial coverage compared to MRMS or SFR alone.

Quality controlled: MRMS is quality controlled prior to merging with SFR (beam height < 1.5 km and ML snowfall detection) for improved product quality.

Looping capability: With 10-minute temporal resolution, mSFR can be looped to track storm movement and evolution.



Limitations

mSFR availability: Due to MRMS limitations, mSFR only has coverage over CONUS and the near coast.

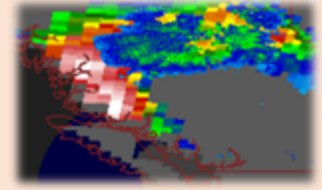
MRMS and SFR mismatch:

The optimal time shift between MRMS and SFR can be different than the standard 30-minute offset being used.

Sublimation: Some snowfall, especially light snowfall, detected by SFR may not reach the surface due to sublimation.

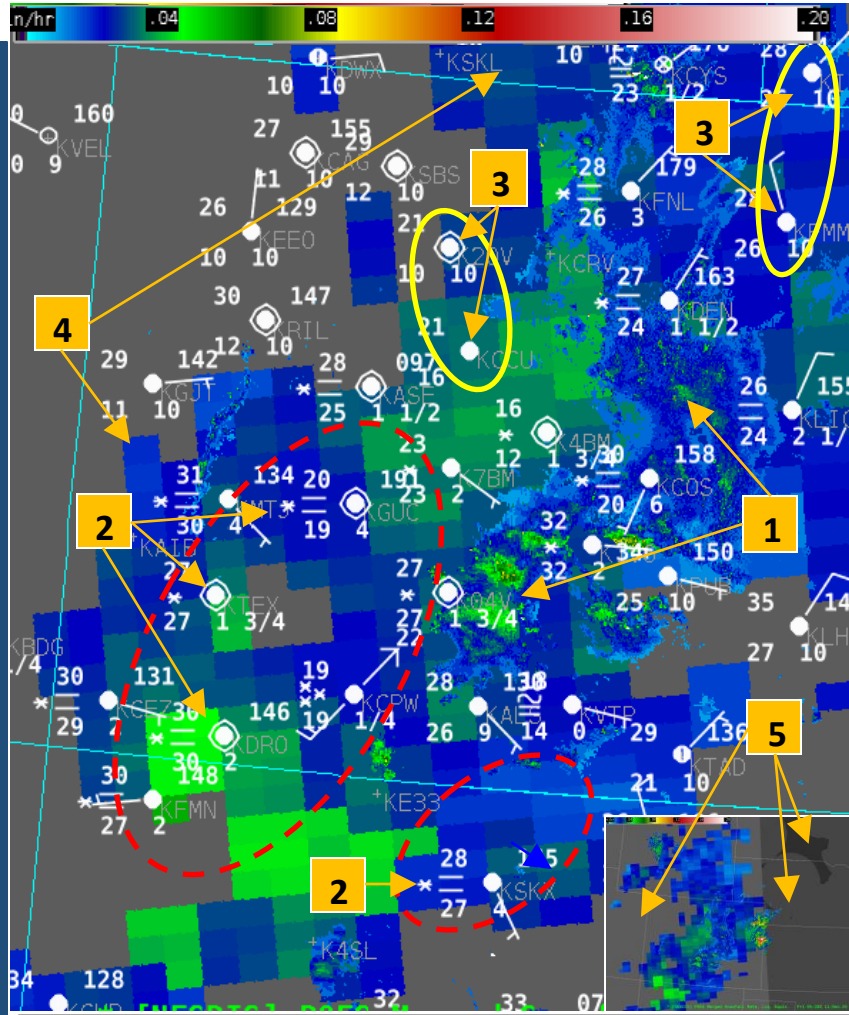
Radar dropoff: Inconsistency may occur in MRMS-SFR transition zone where radar underestimates but still passes QC.

Limited light snow: The minimum detection for mSFR is 7.9×10^{-4} in/hr (liquid).



mSFR Interpretation

- 1** mSFR merges radar-based MRMS (finer resolution) and satellite-based SFR (coarser resolution) with MRMS estimates generally taking precedence over SFR if beam height is less than 1.5 km.
- 2** mSFR shows snowfall occurring outside of the range of the ground-based radar network, and thus fills gaps in the MRMS coverage, as shown in these examples from Colorado and northern New Mexico (red dashed ovals).
- 3** Surface observations do not indicate the presence of snow and corroborate the SFR observations (yellow ovals) because the snowfall detected by SFR may have yet to fall to the surface or may be experiencing sublimation. Forecasters should be aware of lower-level dry layers.
- 4** MRMS has fixed pixel size but SFR has smaller footprint closer to nadir for most sensors. Pixels are a little smaller in the western part of this example image.
- 5** Satellite overpass is colored light gray, MRMS-only area is in dark grey, and radar gaps are colored black (inset image in bottom right).



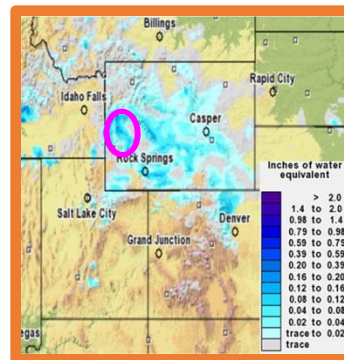
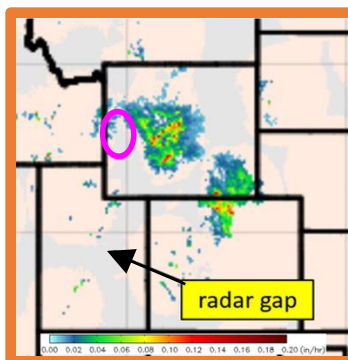
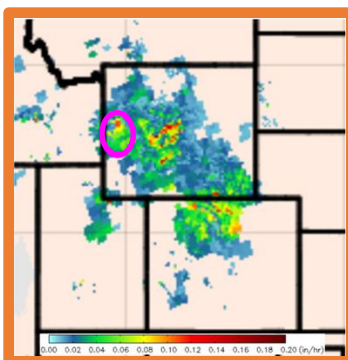
Radar-Satellite Blended Snowfall Rate (mSFR) product at 05:20 UTC, 11 December 2020.

mSFR Output

- Liquid equivalent (in/hr)
- 10:1 snowfall to liquid ratio
- 18:1 snowfall to liquid ratio
- 35:1 snowfall to liquid ratio

Comparison to other products:

Example from 16 April 2020 showing mSFR (left), MRMS (middle), and NOHRSC hourly snowfall analysis (right). Note the snowfall present in mSFR and NOHRSC (magenta oval) but missed by MRMS because the area falls in radar gap (grey color)



Resources

- NASA SPoRT Imagery**
[NASA SPoRT mSFR Page](#)
[NASA SPoRT SFR page](#)
 - UMD CISSS Imagery & Archive**
[CISSS mSFR Page](#)
[CISSS SFR Page](#)
 - OSPO Snowfall Rate Imagery**
[Snowfall Rate Imagery](#)
- Hyperlinks not available when viewing material in AIR Tool