LEO Precip Products That Aid Forecaster's in Monitoring/Tracking Heavy Precipitation
&
Their Needs in the Future

Aaron Jacobs, Senior Service Hydrologist/Meteorologist

National Weather Service Forecast Office, Juneau Alaska

Talk Outline

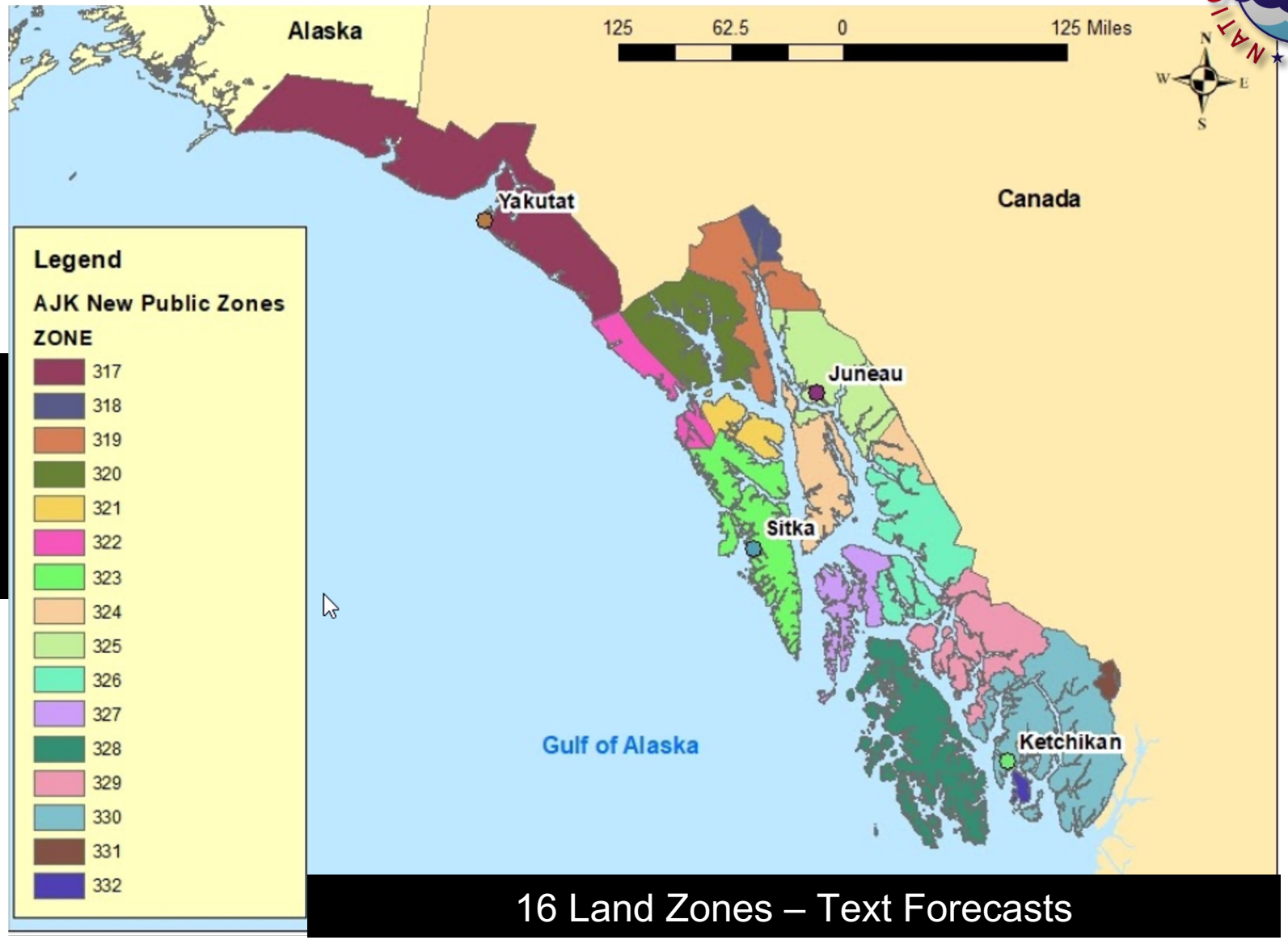
- NWS WFO Scale (Juneau Alaska)
  - Area of responsibility
  - Radar Coverage
  - Southeast Alaska precipitation
  - Impacts that need flood or winter weather products (Watch,Warning,Advisory) and IDSS from WFO

- Polar MV products available to Juneau's forecasters
  - CIMMS MIMIC TPW, MiRS TPW, CIRA ALPW
  - MiRS, GPM, CMOPRH2, GCOM

- Users needs in the future from LEO MV precip products.

WFO Juneau Forecast Area

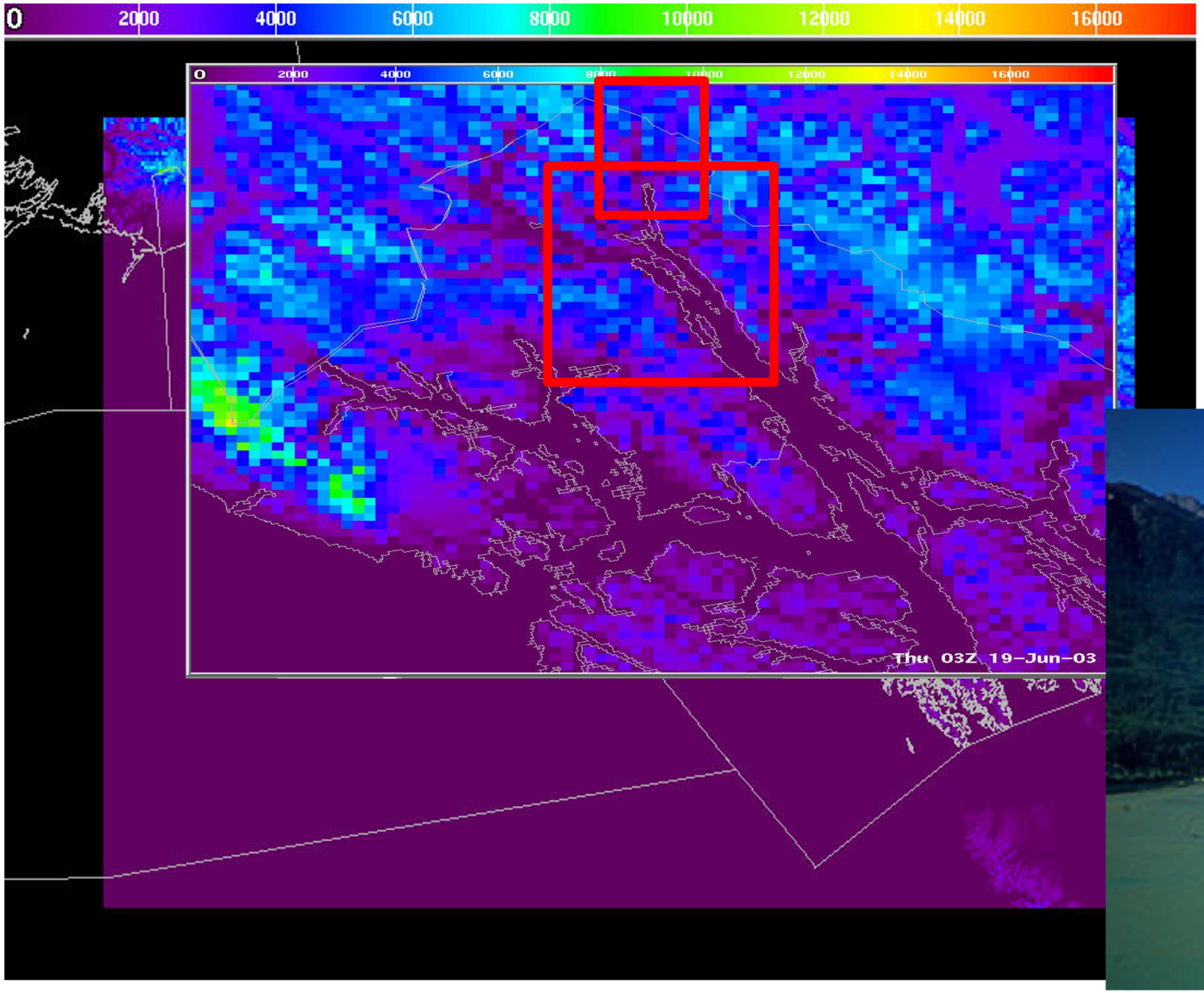
Area of Responsibility:
155,000 sq mi
(3rd Largest in NWS)



16 Land Zones – Text Forecasts

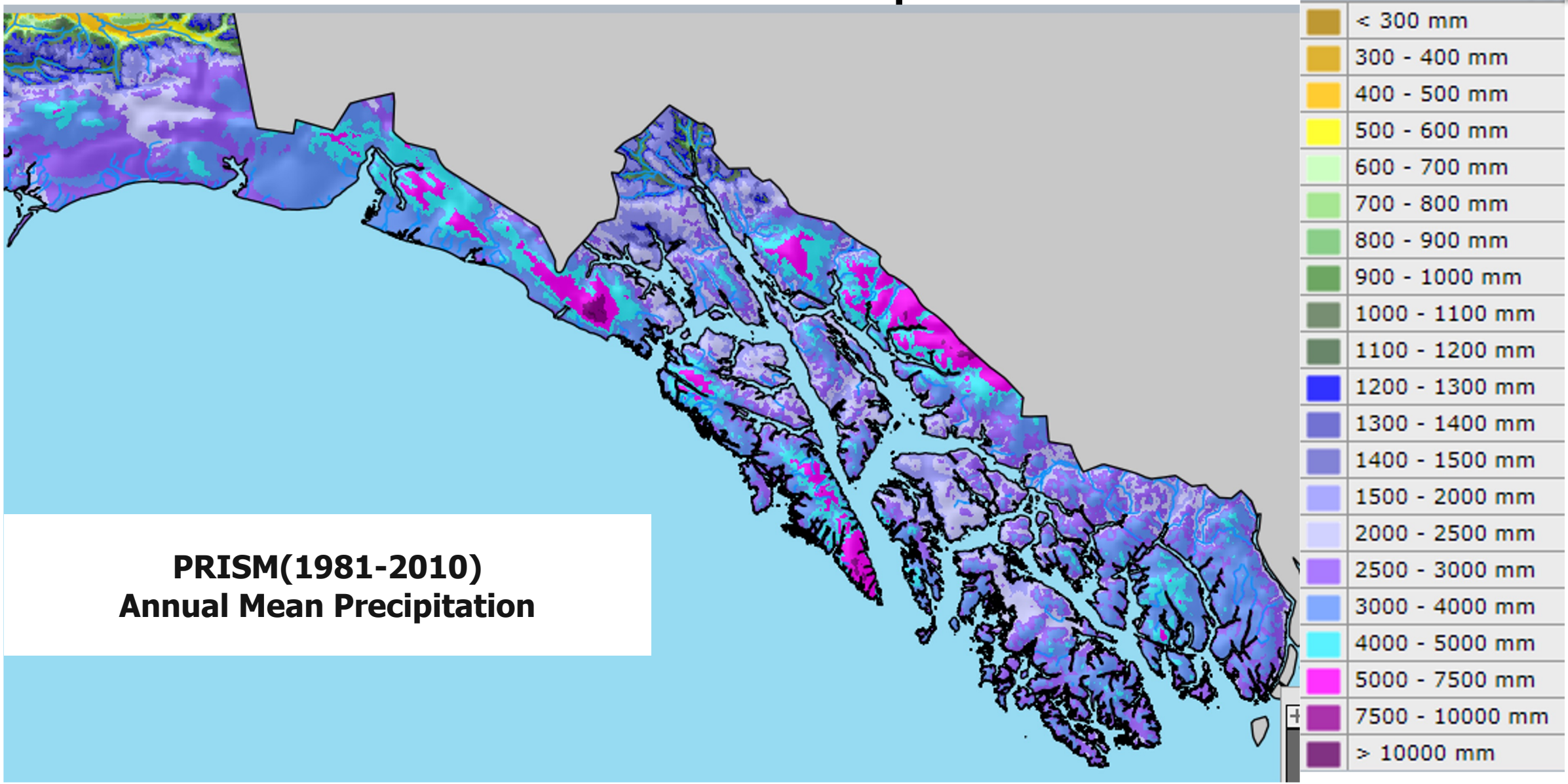
75 % of Forecast Area is covered by Water

WFO Juneau Forecast Area Terrain



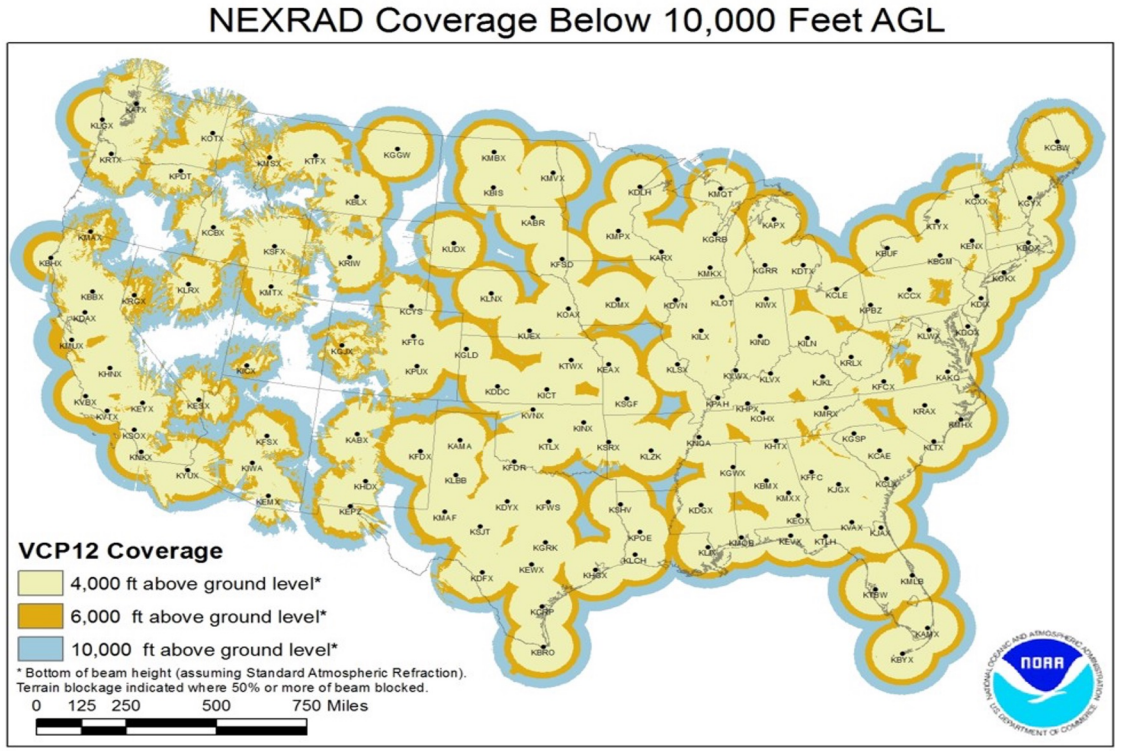
- Very steep terrain next to ocean. Area average=sea level to 3,000ft in 3 miles and in some cases sea level to 15,000ft in 8 miles

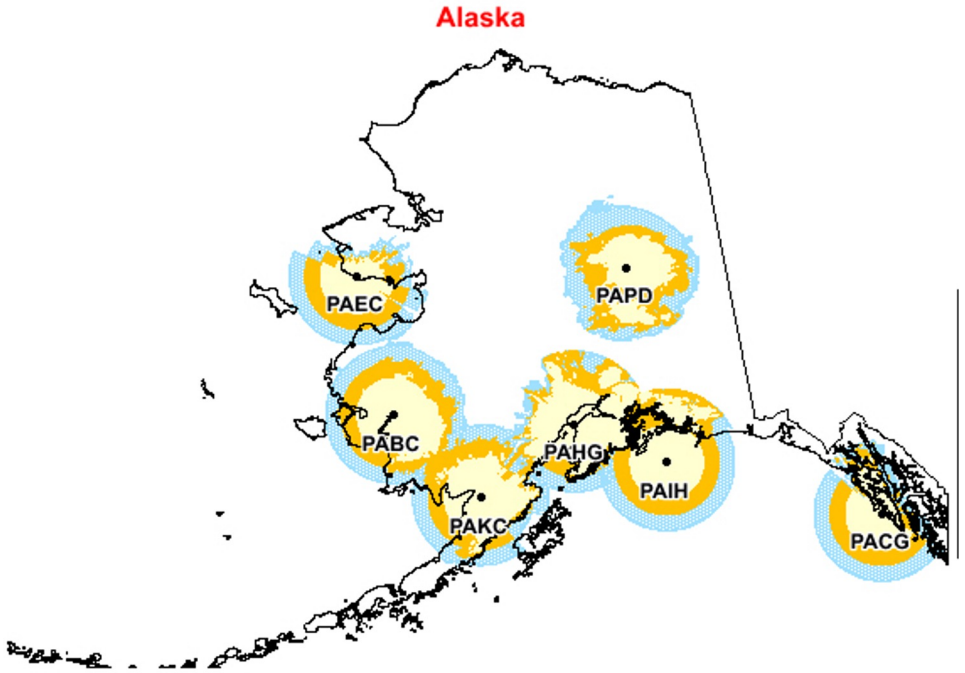
WFO Juneau Forecast Area
Land of Preciptation



Radar Coverage in Alaska is Limited

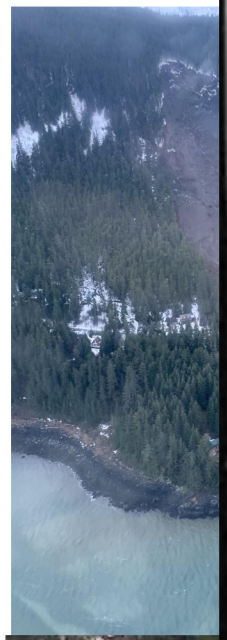
- NWS Rain/Flood monitoring:
  - assumes WSR-88D at WFO
  - AWIPS FFMP tool designed for radar.
- Effective radar coverage in Alaska greatly reduced:
  - Only 7 radars (over 140 in CONUS).
  - Most Alaskan radars and some western CONUS have beam blockage.
  - Accumulated QPE range 124 nm.





Flooding & Debris Flow – Northern SE Alaska

lities)
an Creek

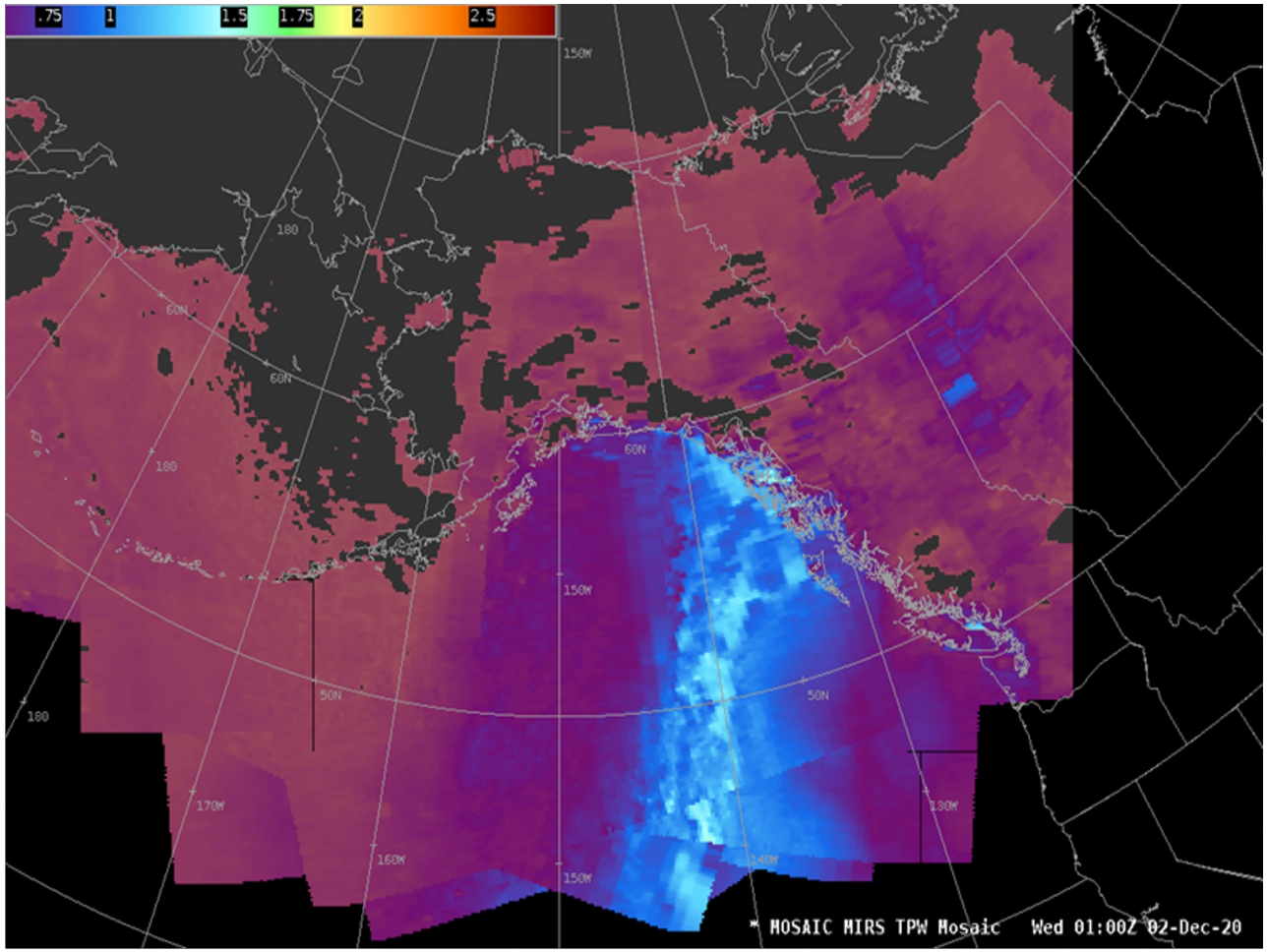


Alaska State Library - Historical Collections

Polar Satellite Precipitable Water Products

MiRS TPW

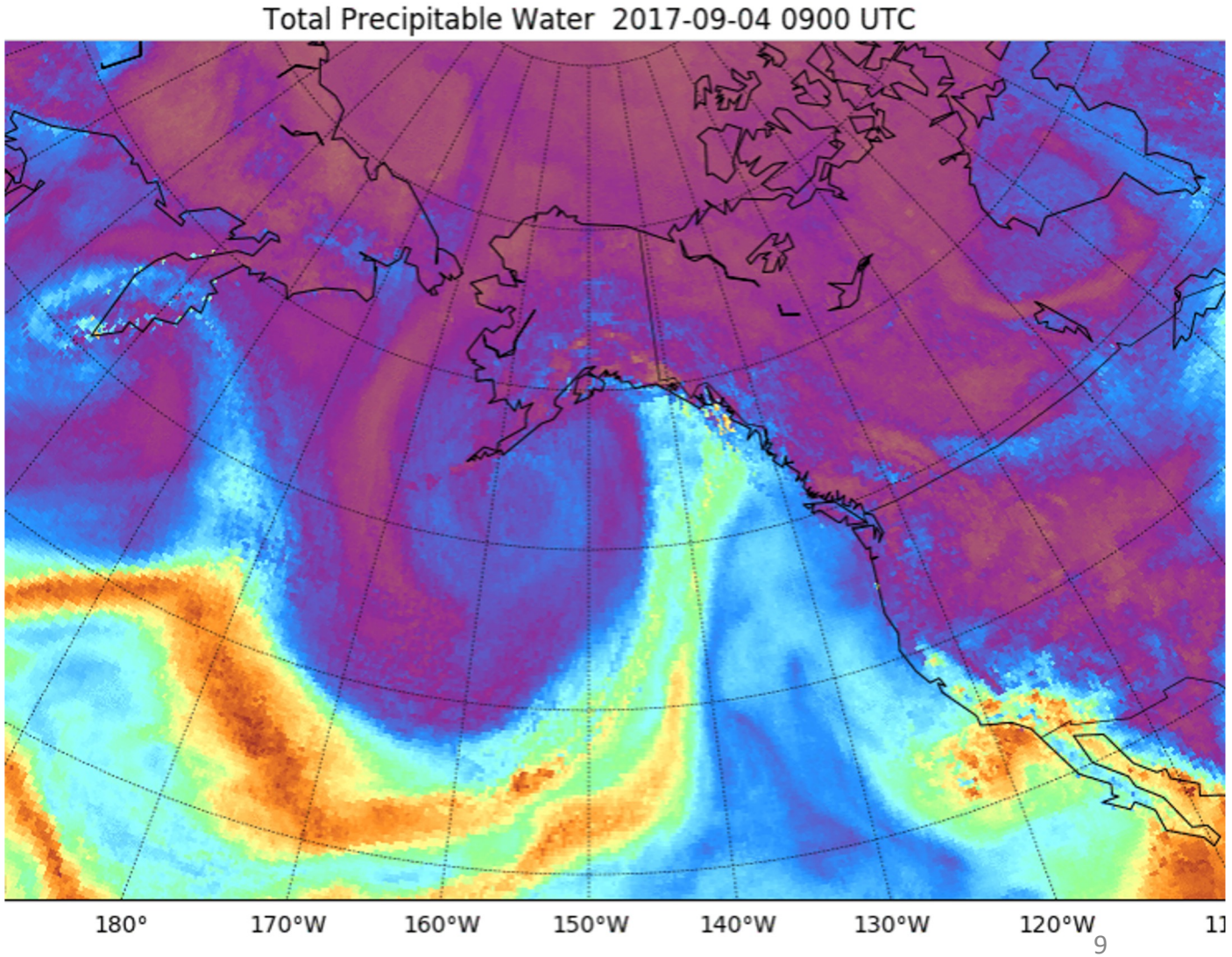
- CSPP MiRS package for DB
- Multiple satellites: 5 received by GINA (NOAA-21 soon)
- Frequency: 12-20 passes/day S to N
- Low latency: Avg ~28 min
- Resolution: 15-25 km (sensor dependent)
- Considerations:
  - Best with mosaic composite to track moisture plumes
  - Greater uncertainty:
    - over land
    - Snow/ice
    - heavy precip



Polar Satellite Precipitable Water Products

MIMIC TPW (CIMSS)

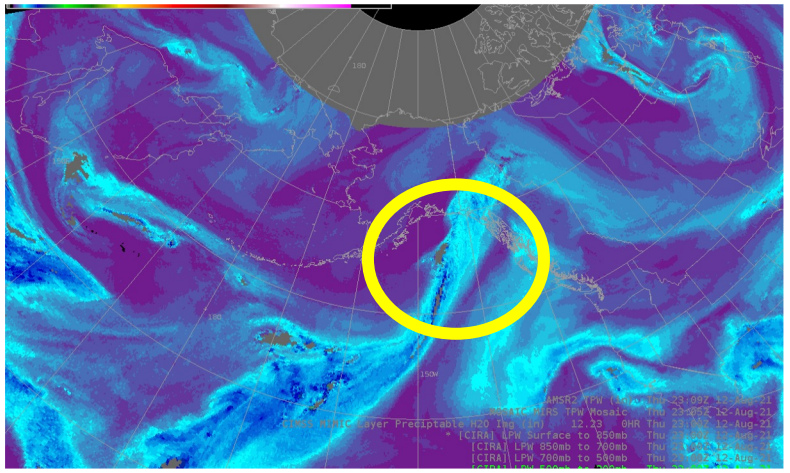
- Morphing technique to blend multiple satellite sources.
- Smooth propagation and evolution of features
- Frequency: hourly
- Coverage: global
- Considerations:
  - Recent passes may not be included.
  - Greater uncertainty:
    - over land
    - Snow/ice
    - heavy precip.



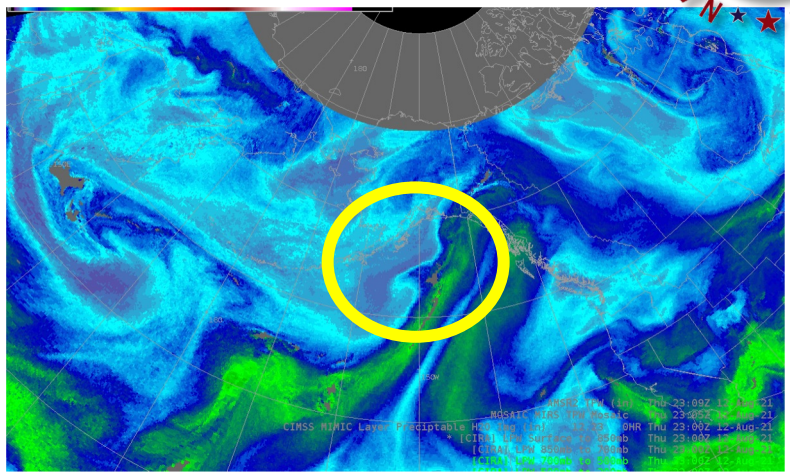
Advected Layer PW (CIRA)

- Best for evaluating depth and extent of moisture source
- Advection method blends and moves features.
- Multiple satellites
- Frequency: hourly
- Latency: ~35-45 min
- Considerations:
  - Recent passes may not be included.
  - Greater uncertainty: over land, snow/ice, heavy precip.

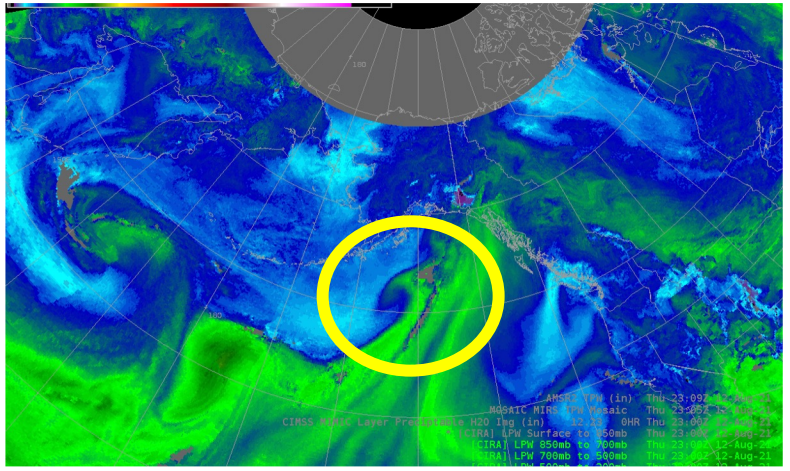
2300 UTC 12 Aug 2021



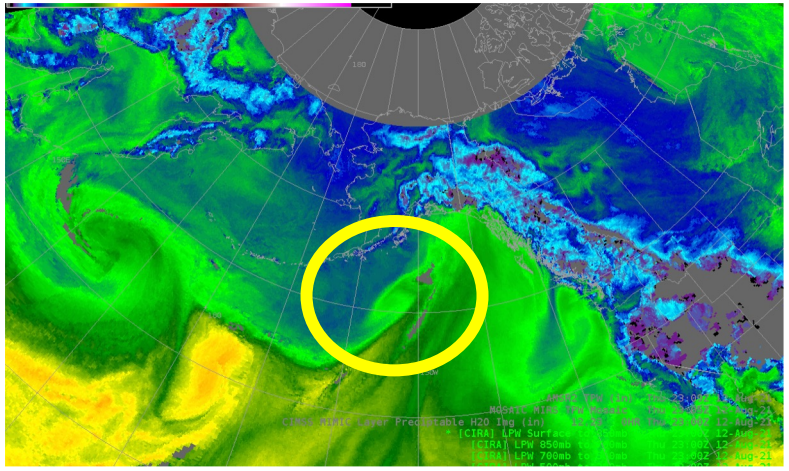
500-300 mb



700-500 mb



850-700 mb

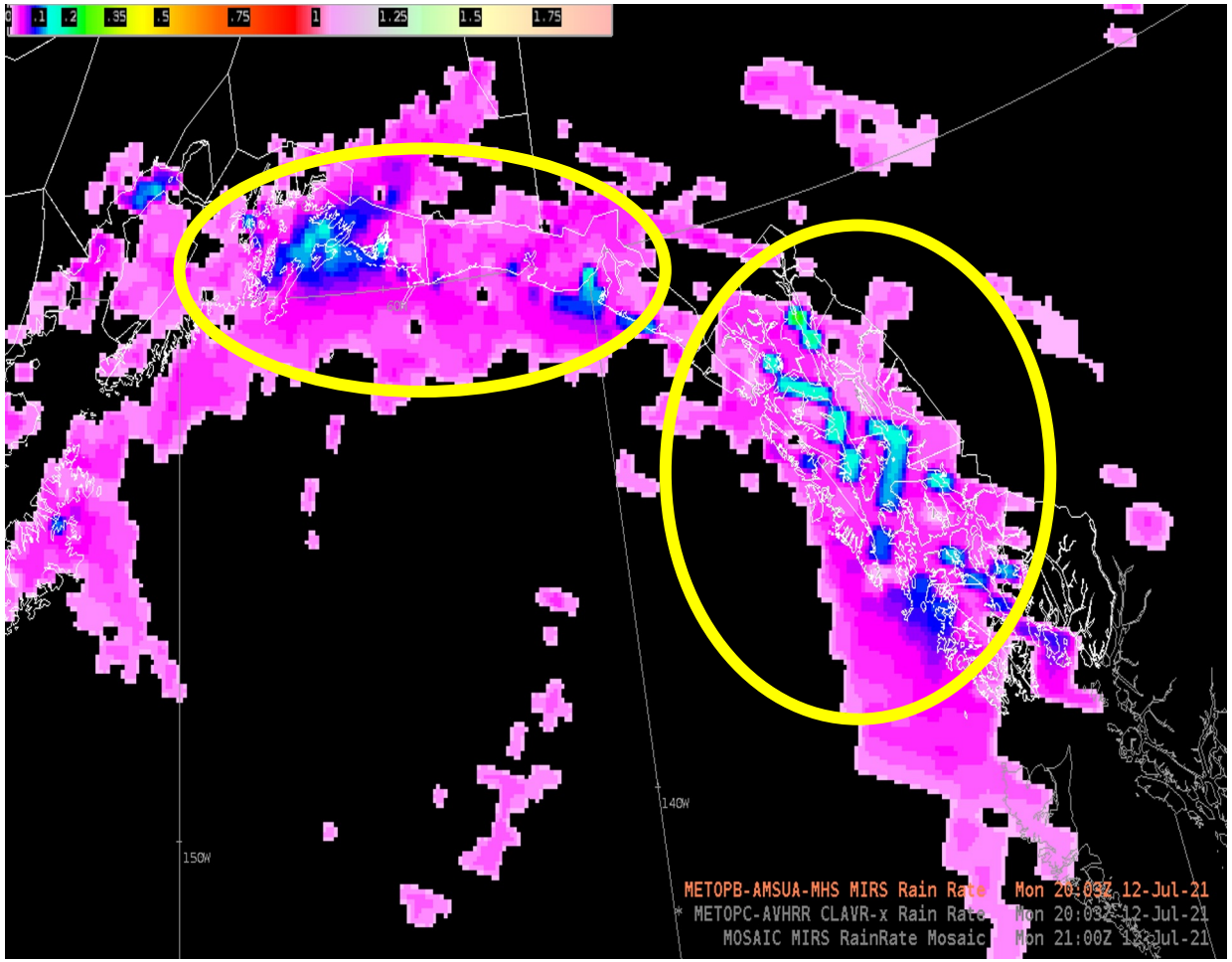


Sfc-850 mb

Polar Satellite Precipitation Products

MiRS Rain Rate (GINA)

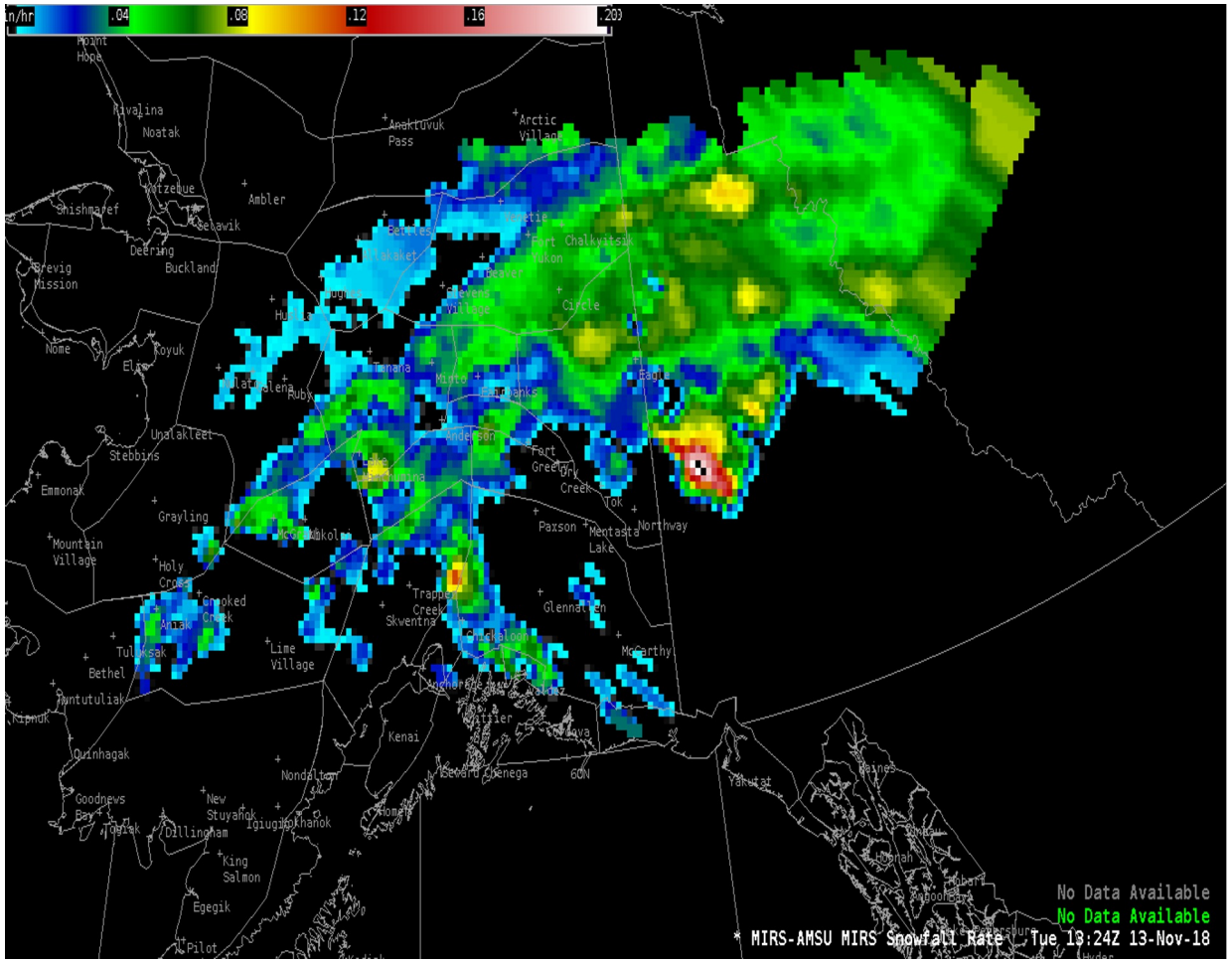
- CSPP MiRS package for DB
- Multiple satellites: 5 received by GINA (NOAA-21 soon maybe fall)
- Frequency: 12-20 passes/day S to N
- Low latency: Avg ~28 min
- Resolution: 15-25 km (sensor dep)
- Works with mosaic script
- Considerations:
  - More uncertainty over land
  - Water values more representative
  - Use as a general condition rather than specific point values
  - No retrievals over snow/ice



Polar Satellite Precipitation Products

MiRS Snowfall Rate (GINA)

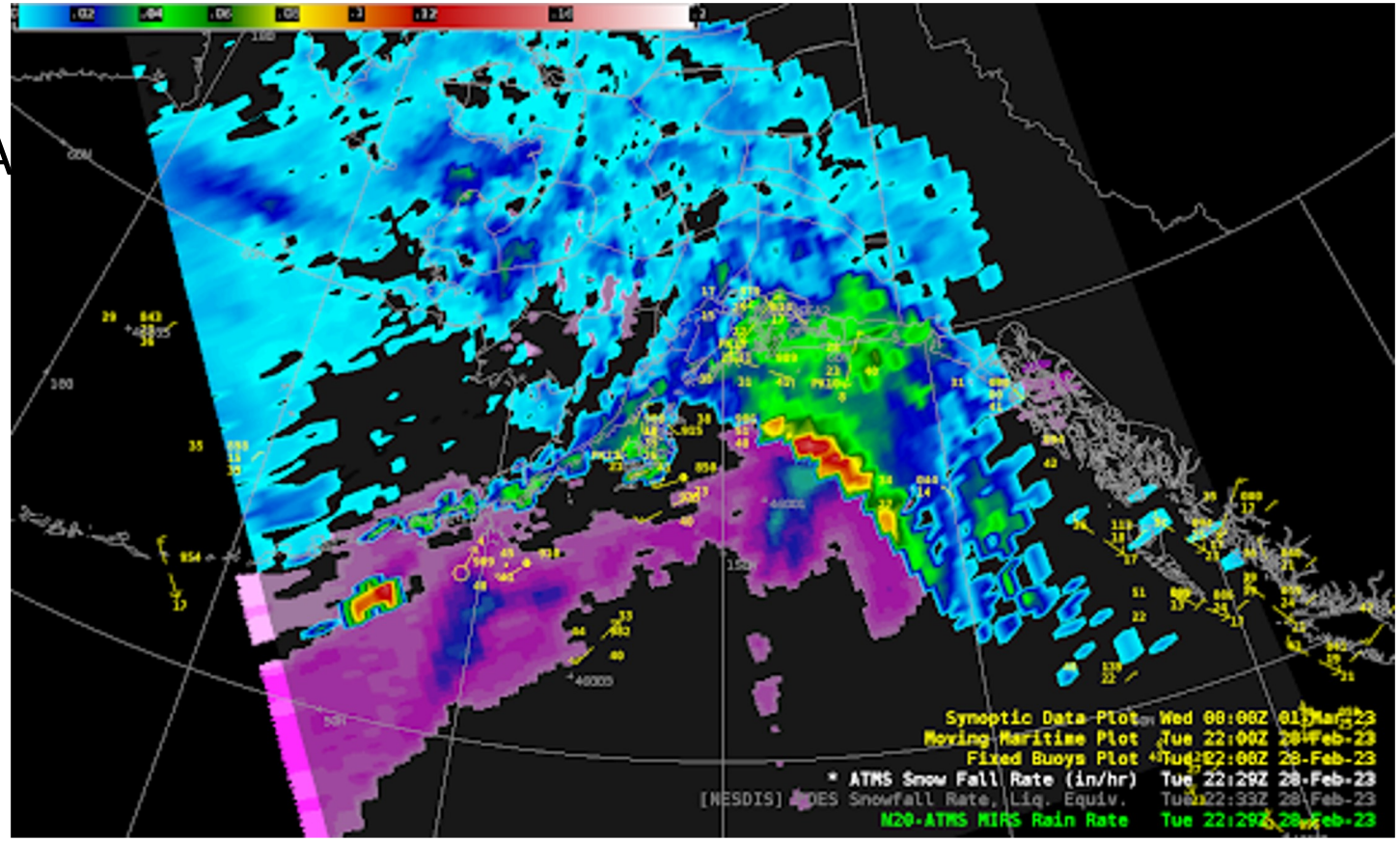
- CSPP MiRS package for DB
- Multiple satellites: 5 received by GINA
- Frequency: 12-20 passes/day S to N
- Low latency: Avg ~28 min
- Resolution: 15-25 km (sensor dep)
- Works with mosaic script
- Considerations:
  - Not affected by snow on ground
  - No retrievals temps < 7 deg F
  - Max liquid equivalent is 0.2"/hr
  - No retrievals over water



Polar Satellite Precipitation Products

Improved MiRS Snowfall Rate AKSFR (GINA)

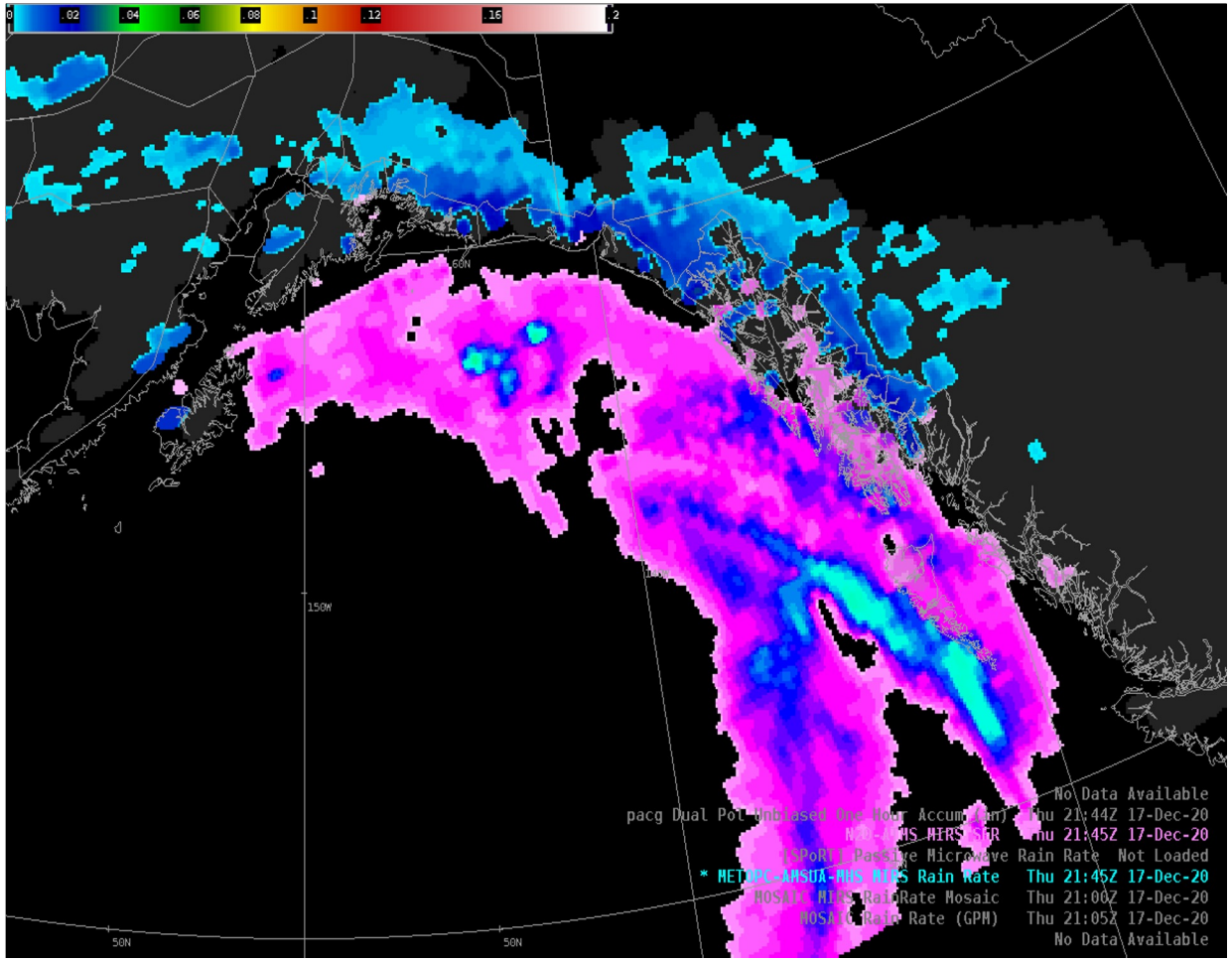
- CSPP MiRS package for DB
- Multiple satellites: 5 received by GINA
- Frequency: 12-20 passes/day S to N
- Low latency: Avg ~28 min(could be faster)
- Resolution: 15-25 km (sensor dep)
- Improvements
  - Works over water
  - Improved detection from ML
  - Less over estimation
- Considerations:
  - May miss snow along coastlines
  - Works best for deep snowfall systems



Winter Precipitation Considerations

Snow/Ice on ground is challenging:

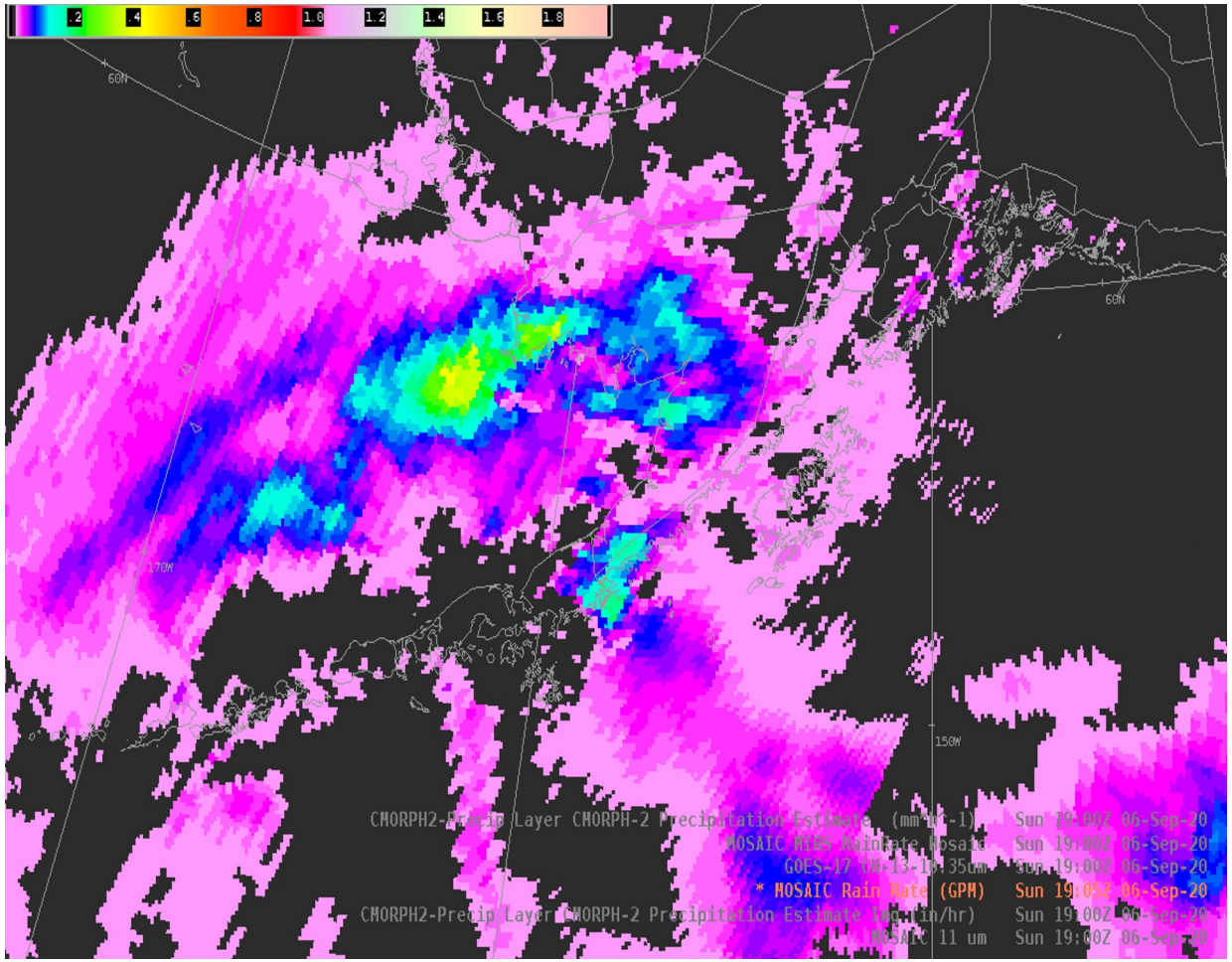
- No MiRS Rain Rate over snow/ice.
- SFR not affected by snow cover.
- RainRate + SFR more complete <u>except for rain on snow.</u>



Polar Satellite Precipitation Products

GPM Rain Rate (SPoRT)

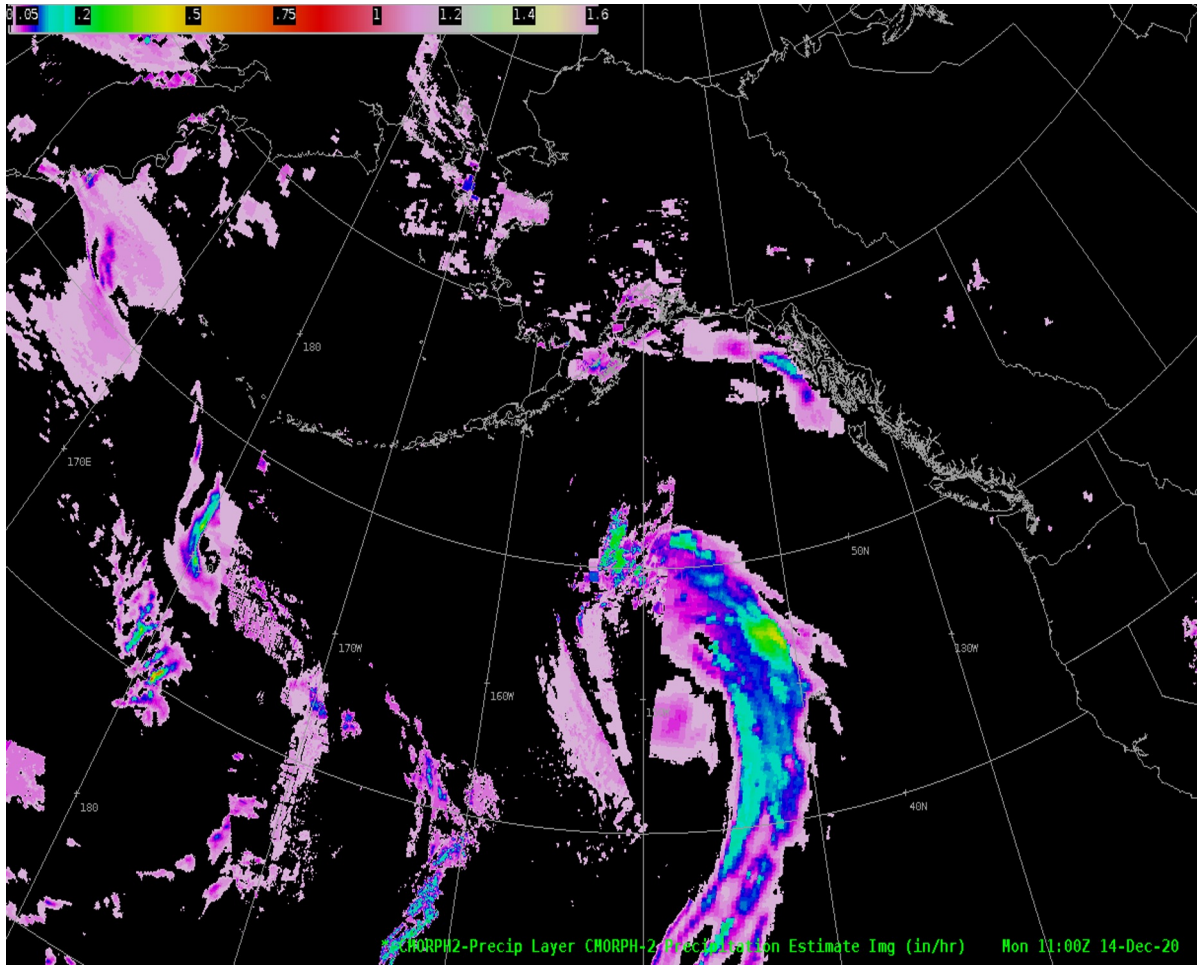
- Goddard Profiling Precipitation Retrieval (GPROF)
- Many satellites in constellation (9 over AK)
- Frequency: 20-30 passes/day S to N
- TDRS downlink: Avg latency ~130 min. (valid time different than DB)
- Resolution: ~ 15-25 km (sensor dep)
- Works with mosaic script
- Considerations:
  - Represents a general condition
  - Some values in snowfall (unvalidated)
  - More uncertainty over land
  - No retrievals over snow/ice?



Blended Satellite Precipitation Products

CMORPH2 Rain Rate (CPC)

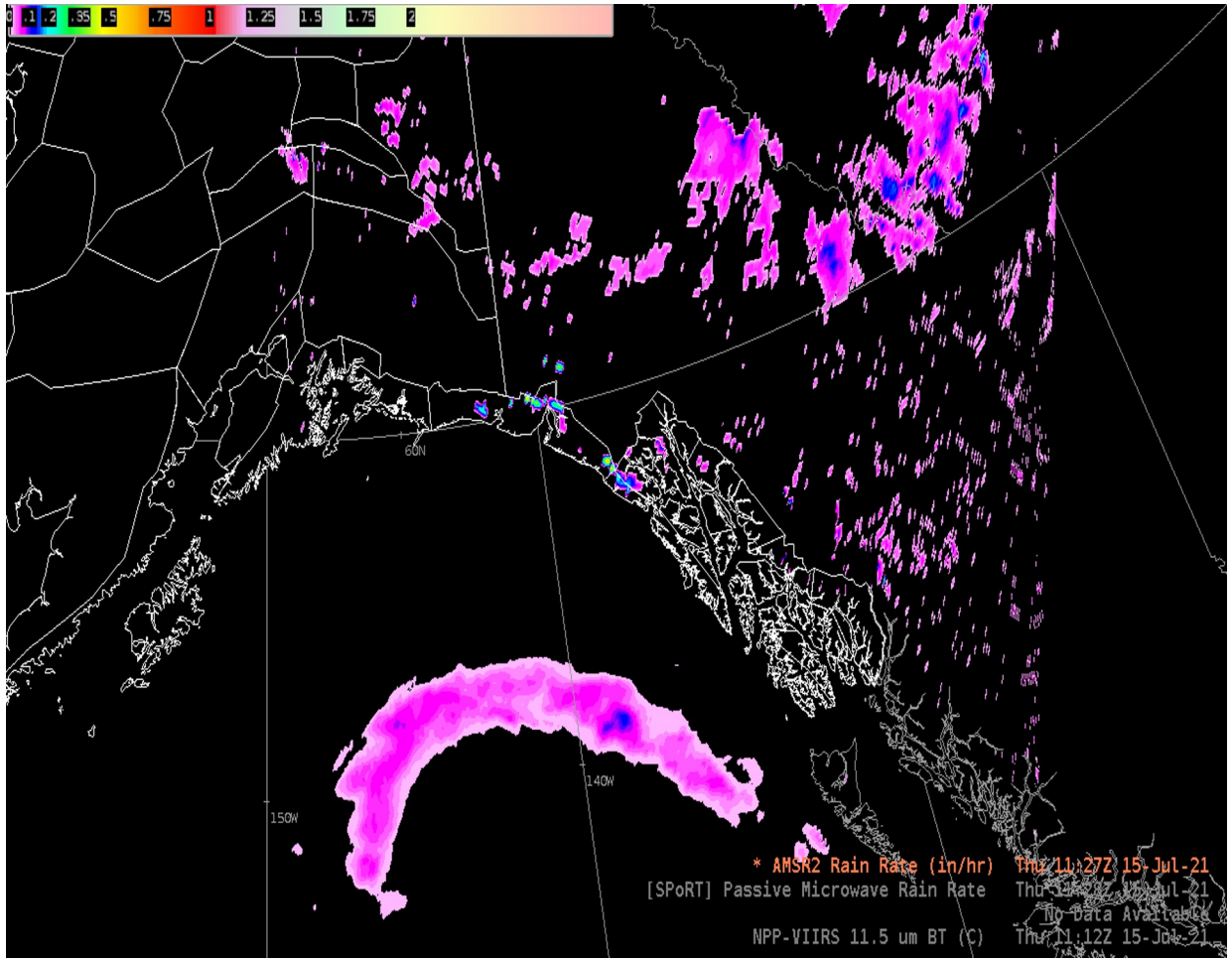
- Blend of satellite sources (GPM, MiRS, GEO Rain Rates)
- GEO wind vectors used for morphing technique to generate products every 30 min.
- Coverage: global every 30 min.
- Latency: 225-255 min (goal is 60 min)
- Regular time steps can convert to QPE
- Considerations:
  - Incorporates MiRS SFR liquid equiv.
  - Blending/morphing causes spatial discontinuities
  - GEO cloud top temps cause rain rates temporal discontinuities
  - More uncertainty over land
  - Limited estimates over snow/ice



Polar Satellite Precipitation Products

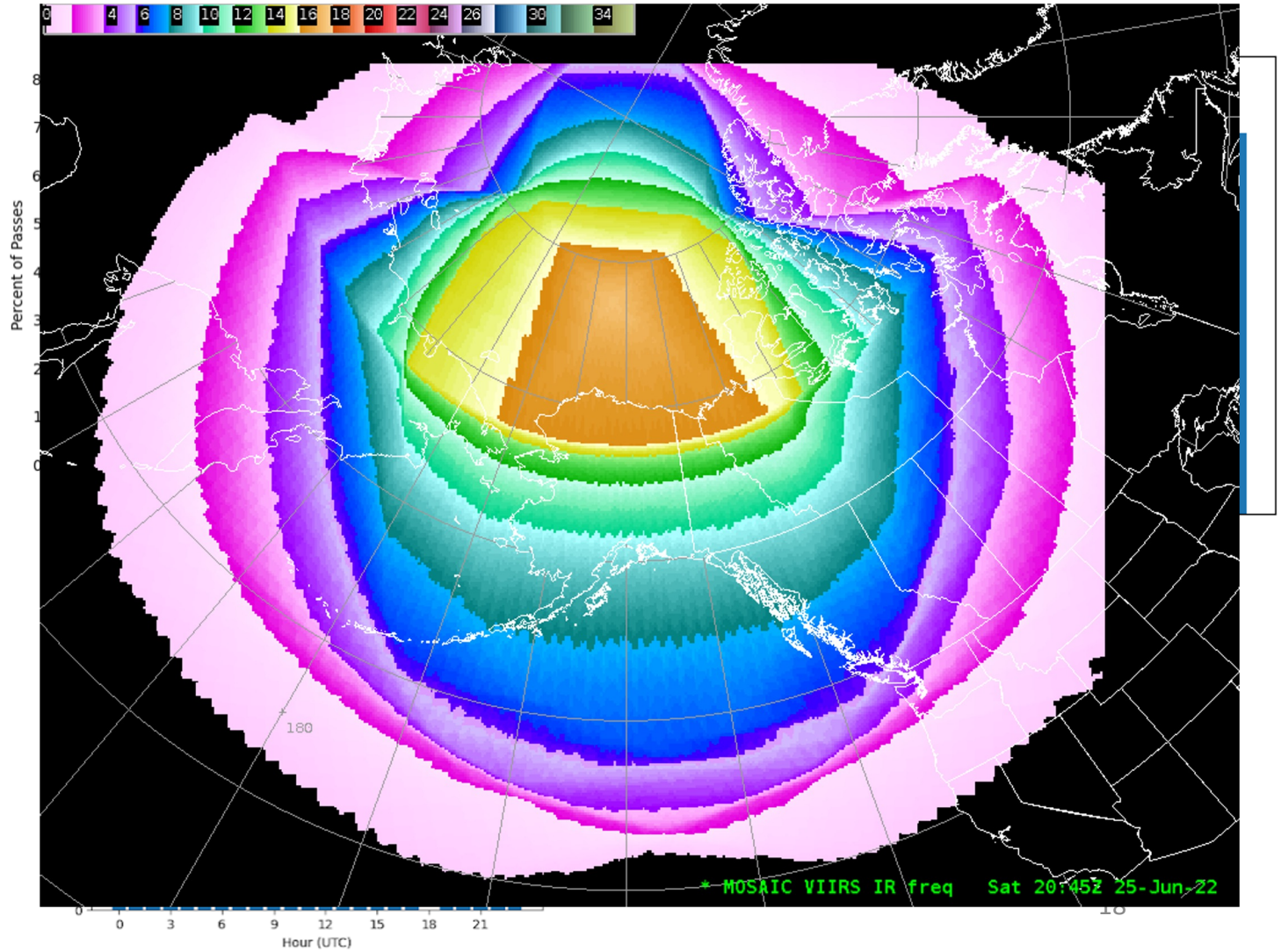
AMSR2 Rain Rate (GINA)

- CSPP GAASP package for DB
- Only 1 satellite
- Frequency: 2-4 passes/day S to N
- Low latency: Avg ~20 min
- Resolution 5-10 km.
- Considerations:
  - no retrievals near coast
  - No retrievals in snow or over snow/ice
  - More uncertainty over land



Users Needs In The Future From LEO MV Precip Products

- Fill in data gaps to improve coverage:
  - More LEO satellites with MV sensors for precipitation and ocean winds
  - Coordinate with partners domestic and international on orbital pass times to limit large gaps in MV data
  - Reduction in data gaps to forecasters in AK will improve situational awareness to provide IDSS in a surface data deprive region



Users Needs In The Future From LEO MV Precip Products

- Improve algorithms for:
  - Orographic effects on precipitation in complex terrain
  - Warm cloud shallow rain processes
  - Detection of liquid precipitation over snow
  - Utilize current AI/ML to improve MV precip products

- Continue to reduce latency of all LEO product through DB

- Continue to work with the field/end user to improve performance of products and strengthen relationships between NESDIS STAR developers and NWS forecasters

Questions??