

The Baseline Surface Precipitation Network: Benchmarking Satellite Precipitation Products Across Meteorological Regimes

Pierre Kirstetter¹⁻⁴, Daniel Watters¹, Aimee Matland-Dixon^{1,5},
Chris Kummerow⁶ & Giulia Panegrossi⁷

¹Advanced Radar Research Center, University of Oklahoma (OU); ²School of Meteorology, OU;

³School of Civil Engineering and Environmental Sciences, OU; ⁴NOAA National Severe Storms Laboratory;

⁵The Rainmaker Corporation; ⁶Colorado State University; ⁷ISAC-CNR

IPWG 15 | Krakow, Poland | July 7, 2026

Background



Goal: Advance global satellite-derived precipitation products.

- Validating and enhancing using surface precipitation data is vital
- Validation helps to direct improvements to spaceborne precipitation products

Long-standing challenge:

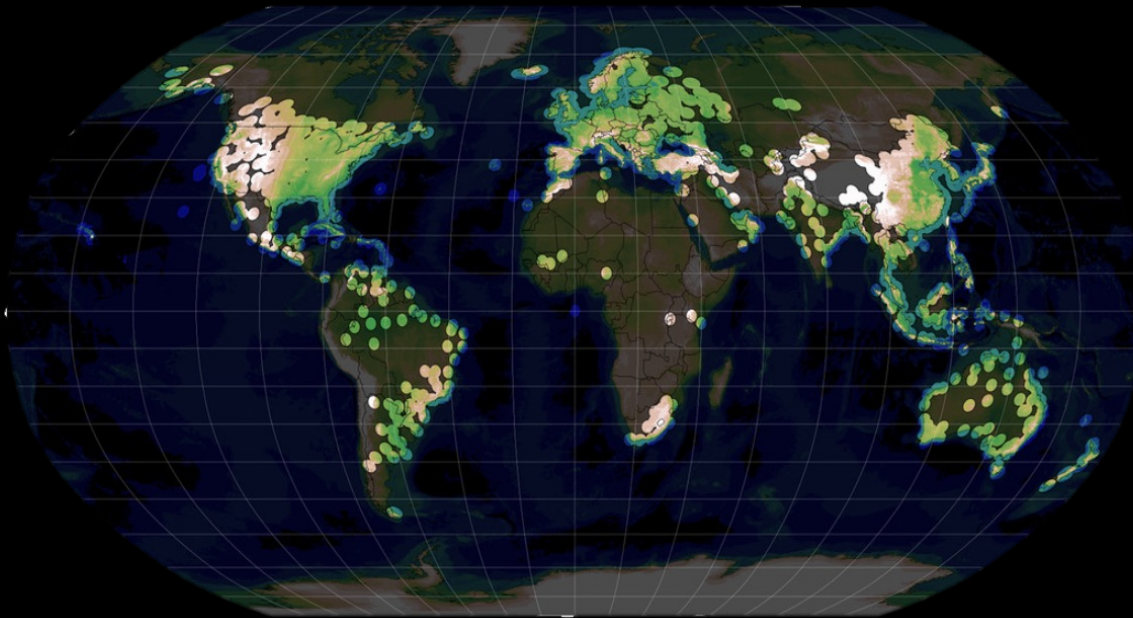
The validation outcomes have always depended on the ground reference (e.g., spatial/temporal resolution) and the domain of comparison (e.g., location, season).

Solution:

- Collect reference data from as many different climatological regimes as possible
- Ensure that reference data are reliable and homogeneously processed

Background – Need for Ground Radars + Gauges

Global Ground Radar Coverage



Credit: Saltikoff et al. (2019)

Satellite precipitation studies require that **validation becomes a function of meteorological regimes** instead of validation site:

1. Collect data from as many meteorological regimes as possible
2. Reference data processed homogeneously ensure that **processing differences are not convolved with meteorological regimes**

BSPN Expected Impacts

Baseline Surface Precipitation Network **Impacts:**

- **Satellite community:**
 - Help to account for regime dependencies in spaceborne retrieval algorithms
 - Help to estimate uncertainties in regions without validation data
- **Validation site operators:**
 - Greater insight into the relation of their site to other regimes
 - Ability to co-author more papers with global satellite validation community
 - Potential to identify calibration issues in ground radar networks using spaceborne radars

BSPN Status

Baseline Surface Precipitation Network **Status**:

1. Baseline Surface Precipitation Requirements:

- Formalize the procedure to become a BSPN contributor
- Define rigorous checklist that the satellite community can trust
- Balance: Keep BSPN as simple as possible while maintaining core quality

2. Enrolling validation site operators

How to Become a BSPN Contributor

BSPN Site Criteria:

- 1. Site radar-gauge expert:** Sustained involvement of an expert in surface precipitation observation and estimation with gauges and radars.
 - Provide documented precipitation estimates over a period of time - need not be continuous or real-time
 - Actively contribute to BSPN activities aimed at enhancing fundamental observation capabilities
- 2. Site collocation with gauge network:** Radar site should be co-located with gauge network and basic meteorological instrumentation.
 - Ancillary data should be shared with BSPN
- 3. Minimum one-year data period made available to satellite community.**

How to Become a BSPN Contributor

BSPN Site Facilitation:

- **WMO:**
 - BSPN participation is facilitated through the WMO representative of the participant's home country
 - Those interested should contact Daniel Watters, Chris Kummerow or Pierre Kirstetter
- **Voluntary participation:**
 - No funding is provided by BSPN or associated organizations for establishing or maintaining the measurement activity
- **Document site and request membership:**
 - Documentation should follow the requirements on the upcoming slides

BSPN Requirements

Tier 1: Basic Requirements with a Dual-Polarimetric Radar

1.1 Personnel

- Station Scientist who is expert in radar QPE at each site
- Participation in biennial IPWG Meetings

1.2 Radar Site/Location

- Site representative of large area and/or underrepresented regime in BSPN
- Radar visibility (i.e., beam blockage) must be documented

1.3 Radar Instrument

- Continuous measurement of dual-pol. variables via PPI, and regular calibration and maintenance, is mandatory

1.4 Gauge Instruments

- Regular maintenance and calibration, and documented locations
- Quality control of time series data

1.5 Radar Data Processing

- Precipitation rates and typology/phase are required
- Radar data quality controls should be applied, and estimates should be projected from the measurement altitude to the surface

BSPN Requirements

Tier 1: Basic Requirements with a Dual-Polarimetric Radar

1.6 Radar-Gauge Data Processing

- Bias adjustment of radar estimates with gauge observations is mandatory
- Radar-gauge merging with a documented technique is preferred

1.7 Precipitation Products

- Radar-only estimates every <10 minutes and hourly radar-gauge estimates
- Gridded data should be well documented

1.8 Data Continuity

- Data period should cover at least one year between 2014 and present (GPM lifetime)
 - No real-time or continuous delivery expectation – only careful inspection and QC prior to delivery
-

BSPN Requirements

Tier 2: Recommended Requirements with Radar Network Mosaics

2.1-2.7 Same as Tier 1

- See 1.1-1.7 on prior slides

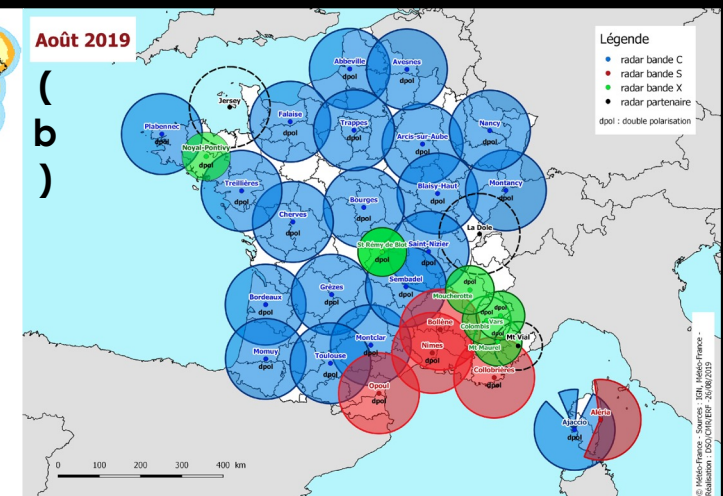
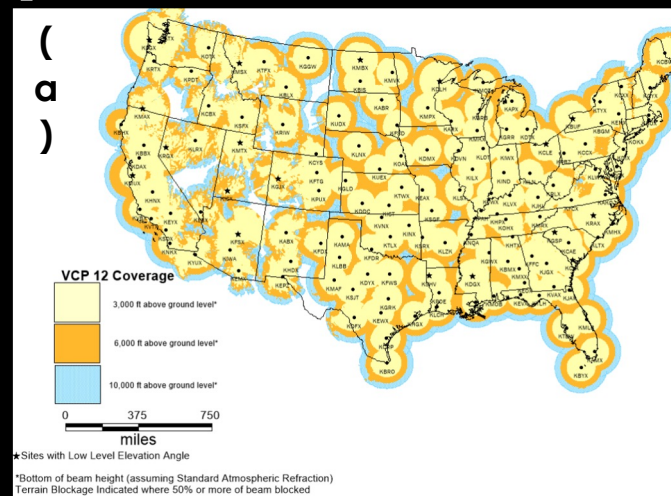
2.8 Radar Data Processing

- Weather radar data should be mosaicked following documented procedures
 - QPE quality index is welcome
-

BSPN Updates

Potential Contributors:

- **CONUS [GV-MRMS]** – Contact: Kirstetter
 - ~160 S-band radars
- **France [GV-PANTHERE]** – Contact: Kirstetter
 - 33 C-S-X-band radars

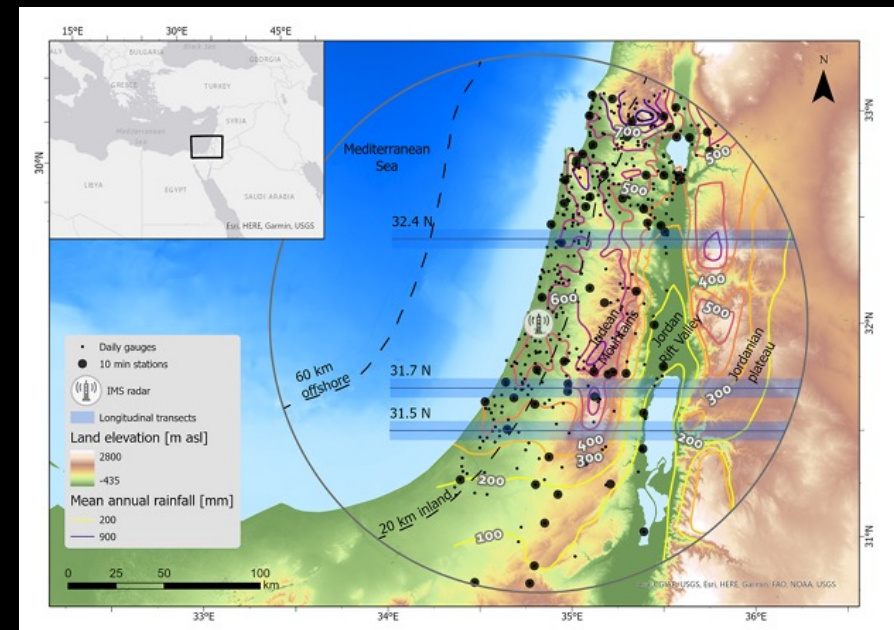


BSPN Updates

Potential Contributors:

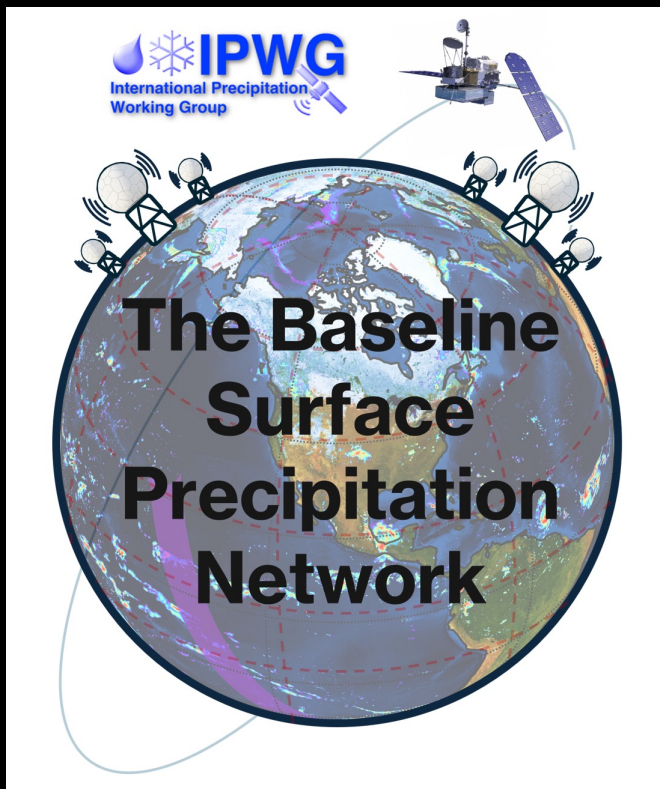
- **CONUS** [GV-MRMS] – Contact: Kirstetter
 - ~160 S-band radars
- **France** [GV-PANTHERE] – Contact: Kirstetter
 - 33 C-S-X-band radars
- **Israel** – Contact: Morin
 - 1 C-band radar
- **Japan** [JMA] – Contact: JAXA
 - 20 C-band radars
- **South Korea** – Contact: Lee
 - 11 S- & C-band radars

➔ Discussions and quality assessments are ongoing.



Israel Radar - Credit: Marra et al. (2022)

Overview of the Baseline Surface Precipitation Network (BSPN)



An International Precipitation Working Group (IPWG) Initiative

Need:

Consistently derived radar precipitation data to improve global satellite precipitation products and uncertainty estimates

Aim:

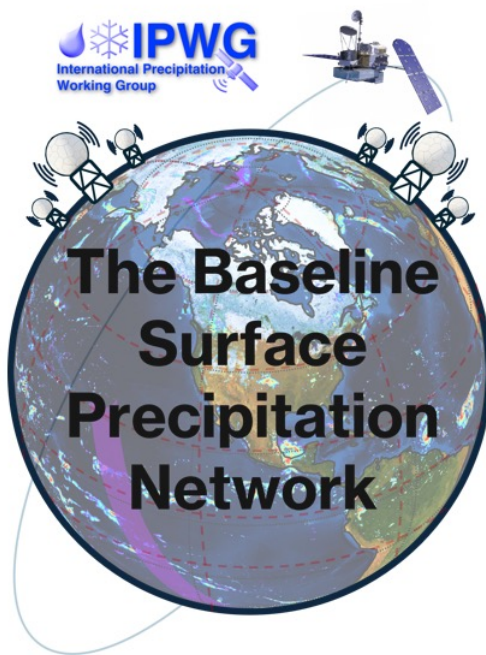
Collect ground-based radar data from as many meteorological regimes as possible

IPWG Request to Radar Operators:

Identify Baseline Surface Precipitation Network contributors

Thank you for listening

The Baseline Surface Precipitation Network



An International Precipitation Working Group (IPWG) Initiative

Need:

Consistently derived radar precipitation data to improve global satellite precipitation products and uncertainty estimates

Aim:

Collect ground-based radar data from as many meteorological regimes as possible

IPWG Request:

Identify Baseline Surface Precipitation Network (BSPN) contributors

Contact:

For interest in contributing data to the BSPN, please contact Daniel Watters (daniel.watters@ou.edu)