

## **ARM Radiosondes for Joint Polar Satellite System (JPSS) Validation Field Campaign Report**

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## **Acronyms and Abbreviations**

|          |   |
|----------|---|
| ARM      | Atmospheric Radiation Measurement                                       |
| COSMIC   | Constellation Observing System for Meteorology, Ionosphere, and Climate |
| DOE      | U.S. Department of Energy   |
| ENA      | Eastern North Atlantic  |
| EUMETSAT | European Organization for the Exploitation of Meteorological Satellites |
| GCOS     | Ground Computer Operating System  |
| GOES     | Geostationary Operational Environmental Satellite                       |
| GRUAN    | GCOS Reference Upper-Air Network  |
| JPSS     | Joint Polar Satellite System  |
| NASA     | National Aeronautics and Space Administration                           |
| NOAA     | National Oceanic and Atmospheric Administration                         |
| NPROVS+  | NOAA Products Validation System   |
| NSA      | North Slope of Alaska   |
| NWP      | numerical weather prediction  |
| RIVAL    | Radiosonde Intercomparison and Validation                               |
| SGP      | Southern Great Plains   |
| SNPP     | Suomi National Polar-Orbiting Partnership                               |
| TWP      | Tropical Western Pacific  |
| UW-M     | University of Wisconsin-Madison   |

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## 1.0 Summary

The Joint Polar Satellite System (JPSS) Radiosonde Field Campaign has been a coordinated multi-year effort involving the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility, the University of Wisconsin at Madison (UW-M), and the JPSS project to validate the National Oceanic and Atmospheric Administration (NOAA) JPSS operational satellite sounding products. In this arrangement, funding for radiosondes has been provided by the JPSS project to ARM. These radiosondes have been launched coincident with JPSS satellite overpasses at ARM field sites, with UW-M personnel coordinating the radiosonde launch schedules. This work has been a fundamental, integral, and cost-effective part of both the Suomi National Polar-Orbiting Partnership (SNPP) and NOAA20 satellite validation efforts and has provided critical accuracy assessments of the temperature and water vapor soundings. It is anticipated that these effort will continue throughout the lifetime of NOAA20.

JPSS validation efforts began in July 2012, with radiosonde launches targeting overpasses of the recently launched SNPP satellite from the ARM sites at the North Slope Alaska (NSA), Southern Great Plains (SGP), and Tropical West Pacific (TWP) at Manus Island, Papua New Guinea. Launches at TWP ceased in May 2014, with the closure of the site, and launches began at the Eastern North Atlantic (ENA) site in February 2015. Radiosonde launches targeting SNPP continued through January 2018 and a total of 204/443/482/190 SNPP overpasses were targeted at the ENA/NSA/SGP/TWP sites respectively. More information about the SNPP radiosonde launches is provided in Table 1.

| <b>SNPP Radiosonde Launches: Total (Twin) Launches</b> |                |                  |                  |                |
|--|----------------|------------------|------------------|----------------|
|  | <b>ENA</b>     | <b>NSA</b>       | <b>SGP</b>       | <b>TWP</b>     |
| <b>Phase-1</b><br>Jul12 – Jun13                        | ---            | 96 (94)          | 101 (96)         | 105 (0)        |
| <b>Phase-2</b><br>Jun13-Sep14                          | ---            | 134 (70)         | 145 (108)        | 85 (0)         |
| <b>Phase-3</b><br>Feb15-Sep15                          | 38 (0)         | 46 (23)          | 53 (29)          | ---            |
| <b>Phase-4</b><br>Oct15-Sep16                          | 80 (0)         | 90 (32)          | 90 (71)          | ---            |
| <b>Phase-5</b><br>Oct16-May17                          | 78 (0)         | 68 (28)          | 85 (66)          | ---            |
| <b>Phase-6</b><br>Oct17-Jan18                          | 8 (0)          | 9 (9)            | 8 (7)            | ---            |
| <b>Total</b>   | <b>204 (0)</b> | <b>443 (256)</b> | <b>482 (377)</b> | <b>190 (0)</b> |

**Table 1.** JPSS radiosonde launch efforts targeting SNPP overpasses for each ARM site and funding phase. The number of overpasses targeted is shown along with the number of twin launches parenthetically. A twin launch is a two-balloon launch, 45 min and 5 min prior to overpass.

Beginning in February 2018, JPSS validation efforts switched to the recently launched NOAA20 satellite and radiosonde launches targeting NOAA20 began from the ENA, NSA, and SGP sites. In addition, a portion of the NOAA20 radiosonde launches was performed in collaboration with the Radiosonde Intercomparison and VALidation (RIVAL) field campaign. The goal of RIVAL is to assess the impact of

the transition to the Vaisala RS41 model radiosonde from the RS92. To accomplish this, both radiosonde models are launched on the same balloon at a NOAA20 overpasses time. A total of 43/28/78 NOAA20 overpasses have been targeted at the ENA/NSA/SGP sites respectively and 37/11/55 of these launches were RIVAL launches. See Table 2 for more information. Both the JPSS and RIVAL launches targeting NOAA20 overpasses are currently ongoing.

| <b>NOAA20 Radiosonde Launches: Total (Twin) Launches</b> |                |                |                |
|--|----------------|----------------|----------------|
|  | <b>ENA</b>     | <b>NSA</b>     | <b>SGP</b>     |
| <b>Phase-6</b><br>Feb18-Sep18                            | 22 (16)        | 17 (2)         | 46 (26)        |
| <b>Phase-7</b><br>Oct18-May19                            | 21 (21)        | 11 (9)         | 32 (29)        |
| <b>Total</b>   | <b>43 (37)</b> | <b>28 (11)</b> | <b>78 (55)</b> |

**Table 2.** JPSS radiosonde launch efforts targeting NOAA20 overpasses for each ARM site and funding phase. The number of overpasses targeted is shown along with the number of RIVAL launches parenthetically. RIVAL launches include Vaisala RS41 and RS92 radiosondes on the same balloon.

## 2.0 Results

The radiosonde launches, which have occurred as part of the JPSS Validation field campaign, have been integral to both the SNPP (1, 2) and NOAA20 satellite validation efforts. The radiosondes have been added to the NOAA Products Validation System (NPROVS+) system, which collocates the radiosondes with satellite products (NOAA, National Aeronautics and Space Administration [NASA], European Organization for the Exploitation of Meteorological Satellites [EUMETSAT], Geostationary Operational Environmental Satellite [GOES], Constellation Observing System for Meteorology, Ionosphere, and Climate [COSMIC]) and numerical weather prediction (NWP) forecasts for use in product assessment and algorithm development. Additionally, these radiosondes have been processed using the Ground Computer Operating System (GCOS) Reference Upper-Air Network (GRUAN) processing algorithm extending the relevancy of this campaign and data to a wider international community. While phase-8 funding from the JPSS project to ARM has been delayed, it is anticipated to arrive soon (June 2019). The hope is to extend this field campaign to obtain a statistically significant number of coincident radiosondes with NOAA20. This is of critical importance in order to assess any day/night or seasonal variations in the NOAA20 retrievals. Future efforts will include: publication of the NOAA20 retrieval validation work and collaboration with the RIVAL team in assessing the Vaisala RS41/RS92 differences. This collaboration will not only aid in the validation of the temperature and water vapor retrievals for NOAA20, but will also ensure the continuity of the ARM radiosonde data sets.



### 3.0 Publications

Feltz, ML, L Borg, RO Knuteson, D Tobin, H Revercomb, and A Gambacorta, 2017. “Assessment of NOAA NUCAPS upper air temperature profiles using COSMIC GPS radio occultation and ARM radiosondes.” *Journal of Geophysical Research–Atmospheres* 122(17): 9130–9153,

[doi:10.1002/2017JD026504](https://doi.org/10.1002/2017JD026504)

Nalli, NR, A Gambacorta, Q Liu, C Barnet, C Tan, F Iturbide-Sanchez, T Reale, B Sun, M Wilson, L Borg, and V Morris. 2018. “Validation of Atmospheric Profile Retrievals From the SNPP NOAA-Unique Combined Atmospheric Processing System. Part 1: Temperature and Moisture.” *IEEE Transactions on Geoscience and Remote Sensing* 56(1): 180–190, [doi:10.1109/TGRS.2017.2744558](https://doi.org/10.1109/TGRS.2017.2744558)



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