

## **Launch Weather Decision Support System (LWDSS)**

### **Phase II Final Report**

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## **Quantitative description of work performed during Phase II**

The project developed and demonstrated operation of a Launch Weather Decision Support System (LWDSS) at Cape Canaveral during a 15-month period including all seasons of the year. The LWDSS delivers accurate, temperature, humidity and pressure soundings directly overhead to 20-km height. Prototype LWDSS software developed by the CAPS-RDX team combines microwave radiometer profiler thermodynamic measurements with collocated NOAA Op40<sup>1</sup> grid-point forecast profiles using a linear blend method based on the relative reliability of each. The LWDSS software also provides model wind profiles to 20-km height, and integrated liquid water observations.

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<sup>1</sup> <https://rucsoundings.noaa.gov>

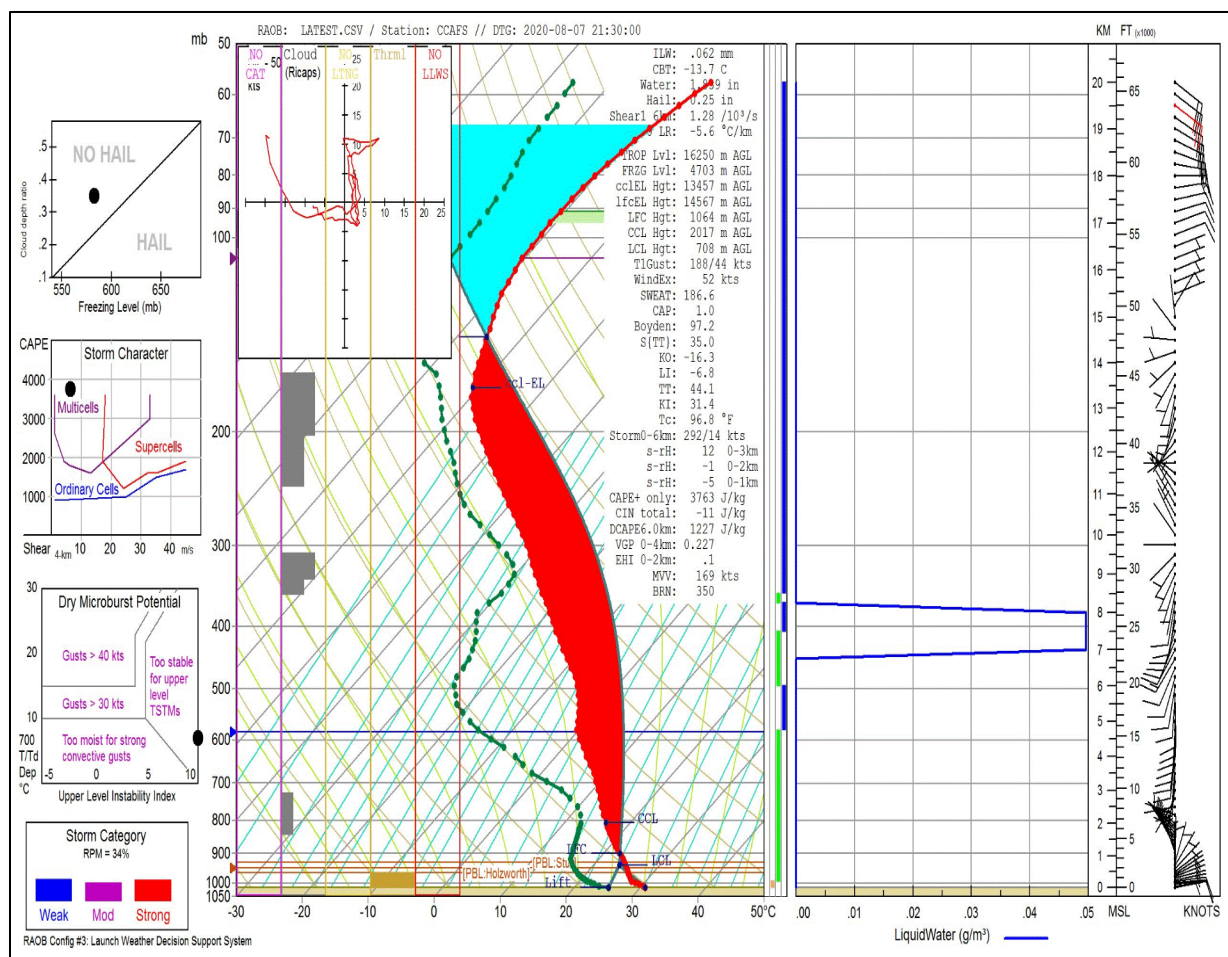


Figure 1. Example LWDSS profiles at 2130Z 7 August 2020.

LWDSS temperature and humidity profiles, derived forecast indices and tools, and model wind profiles are made available online in real time<sup>2</sup> as shown in Figure 1. LWDSS and rawinsonde thermodynamic and wind profiles and derived forecast indices are compared in Figure 2.

Statistics from comparisons of forecast indices derived from LWDSS to those from coincident nearby 15Z rawinsondes are included in the Appendix (pages 6-9).

<sup>2</sup> <http://weatherview.radiometrics.com/ccafs.htm>

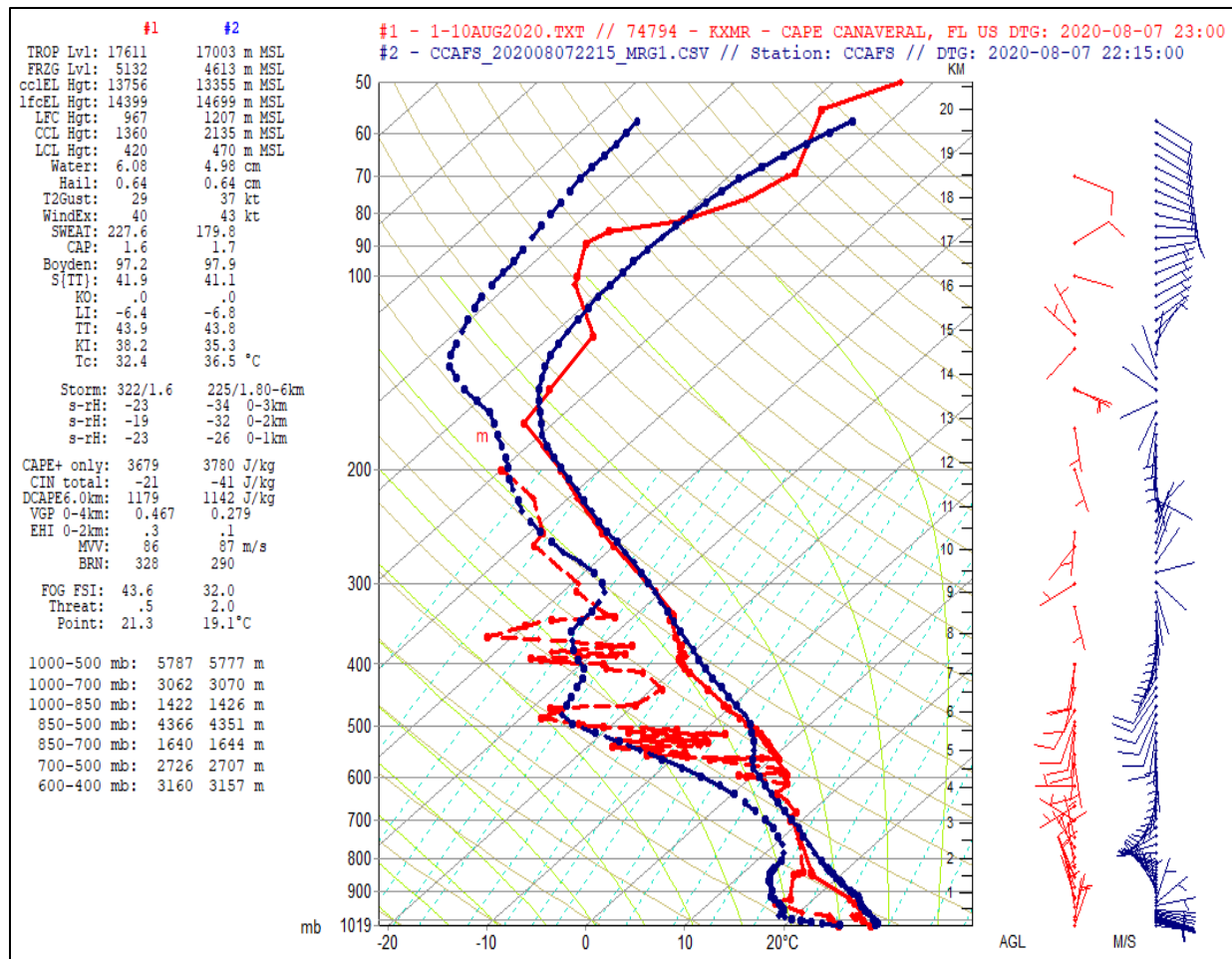
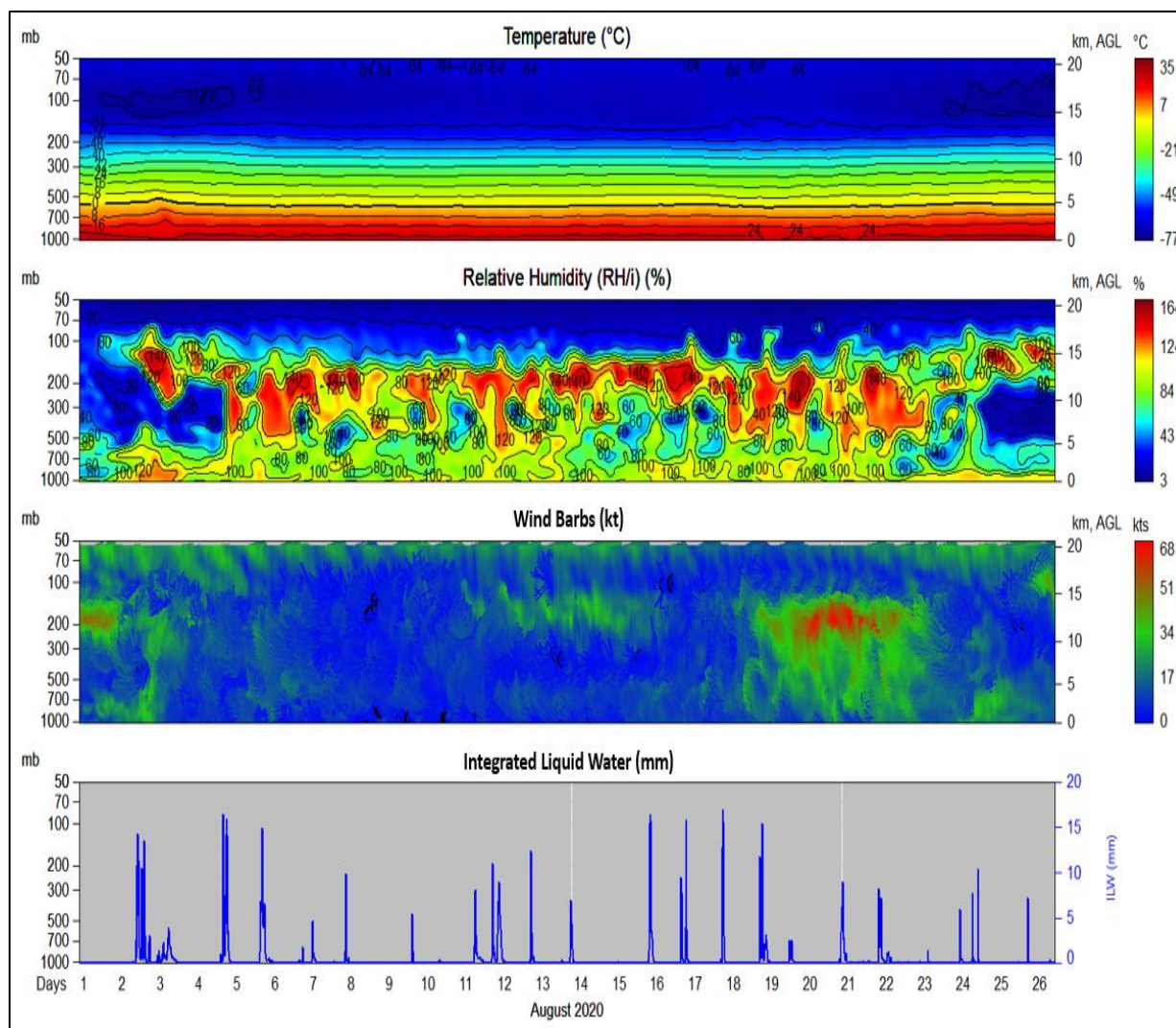


Figure 2. Example rawinsonde (red) and LWDSS (blue) profiles and forecast indices at 23Z August 7, 2020.

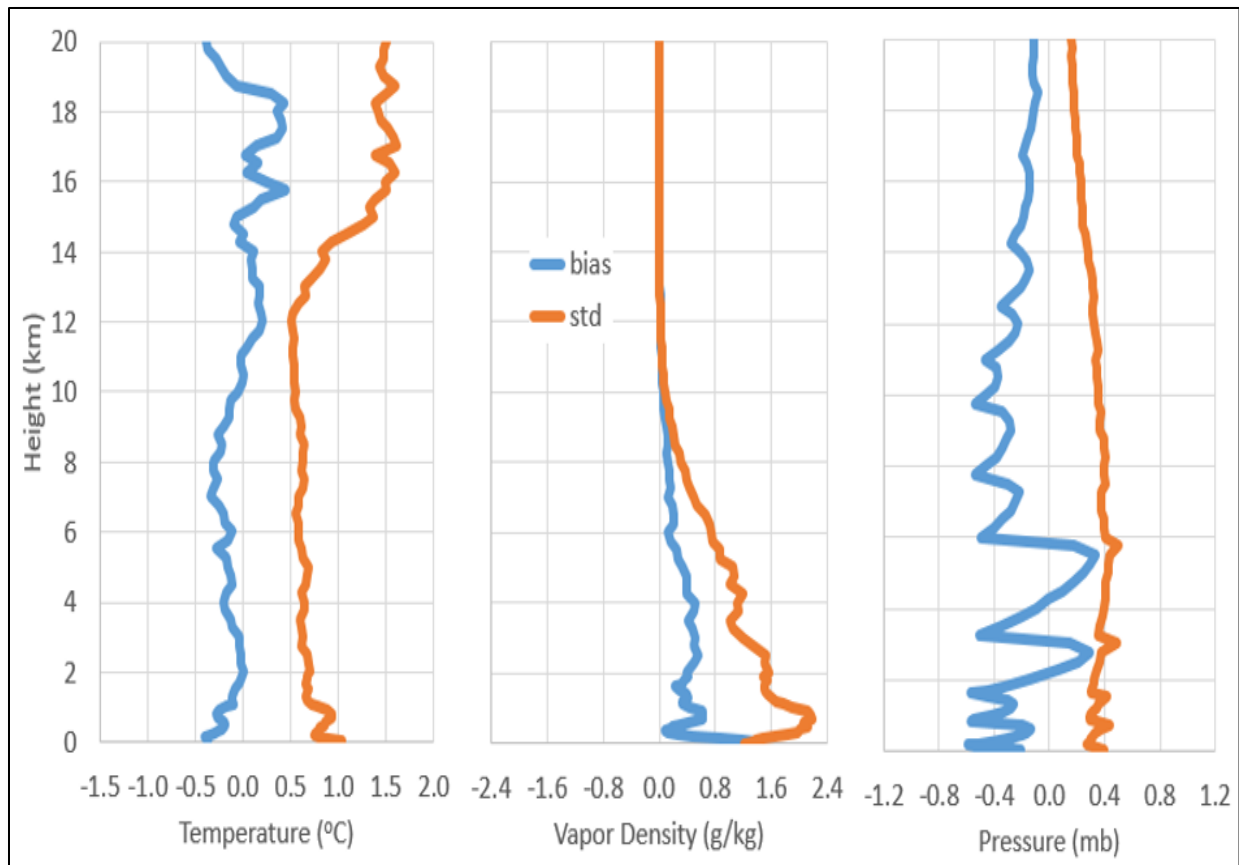
Sample LWDSS temperature, humidity and wind profiles are shown in Figure 3 along with zenith Integrated Liquid Water observations relevant to launch safety and efficiency. LWDSS profiles closely approximate rawinsonde profiles, as shown in statistical comparisons of LWDSS-rawinsonde datasets (Figure 4) and in a single case example (Figure 2).





*Figure 3. Example time series of LWDSS thermodynamics, winds and integrated liquid water during August, 2020.*

LWDSS data were obtained for the time periods including April-November 2019 and January-August 2020. Accuracy of the LWDSS temperature, humidity and pressure soundings was evaluated via statistical comparison with two or more rawinsondes per day. Example statistics for August 2020 are shown in Figure 4. In general, comparison of LWDSS and rawinsonde soundings including the entire observation time period demonstrate statistical accuracy within 2°C in temperature, 2.4 gm<sup>-3</sup> in vapor density, and 1.2 mb in pressure.



*Figure 4. LWDSS minus rawinsonde profile statistics during 1-26 August 2020.*

## Final Summary and Conclusions

NASA solicited for development and demonstration of capability to provide accurate thermodynamic profiles at hourly intervals directly overhead to at least 10-km height. The LWDSS project developed and demonstrated thermodynamic profiling to 20-km height at 15-min intervals at Cape Canaveral during all seasons with accuracy similar to radiosondes.

LWDSS profiles were displayed online in traditional meteorological format along with a full suite of forecast indices and tools. NASA, USAF and commercial Launch weather officers regularly viewed the LWDSS displays which they reported as relevant to safety and efficiency of ground operations. LWDSS technology is now available for public and private launch ranges. Discussions with public and private launch organizations regarding LWDSS are ongoing.

## Appendix

NASA and USAF Launch Weather Officers asked for comparisons of specified Forecast Indices derived from 15Z Cape Canaveral rawinsonde (KXMR) and LWDSS soundings. Comparisons are shown below for 1 May through 24 August 2020.

