Comparison of Water Content Measurement System (WCM-3000), King Probe, and Cloud Droplet Probe in Liquid Water Clouds using IMPACTS 2022 Campaign Data

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Summary

During the 2022 Investigation of Microphysics and Precipitation in Atlantic Coast Threatening Snowstorms (IMPACTS) field campaign, the WCM-3000 was deployed on the NASA P-3 Research Aircraft for the first time. Hot wire probes measure liquid water content (LWC) by maintaining the heated sensing element at a specific temperature. The amount of energy required to keep the sensing element at the specific temperature is directly related to how much mass of liquid water is in the cloud being sampled. **By comparing the WCM, King, and CDP, the uncertainty of LWC measurements during the IMPACTS 2022 Campaign can be determined.**

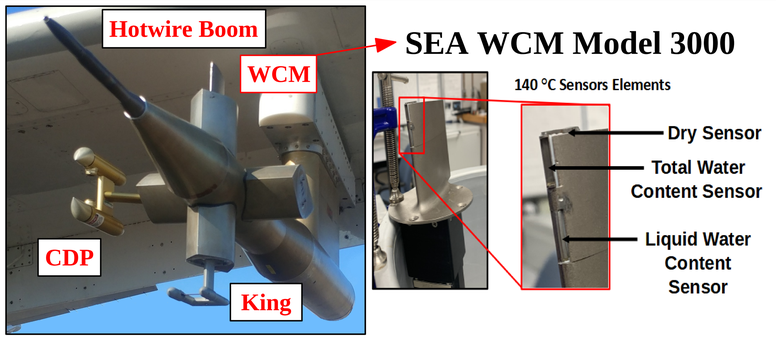
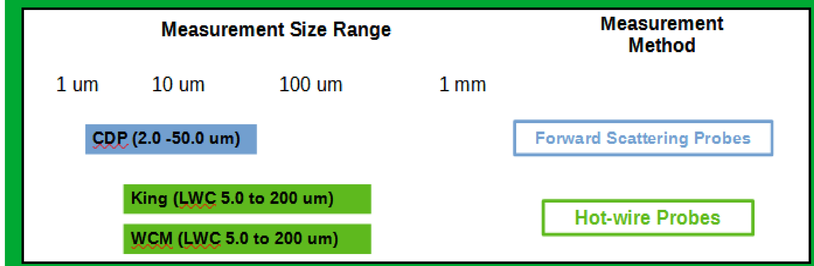
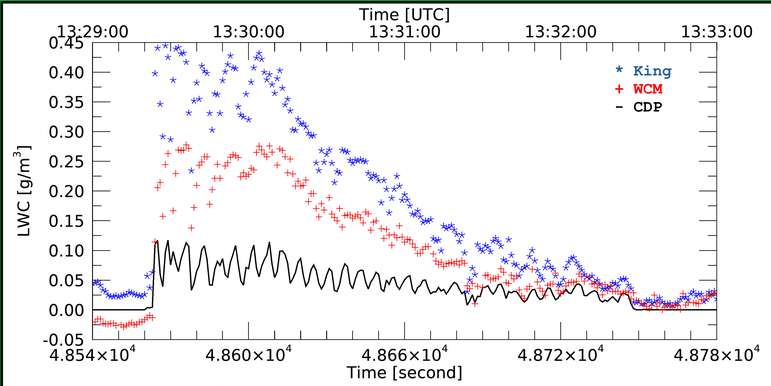
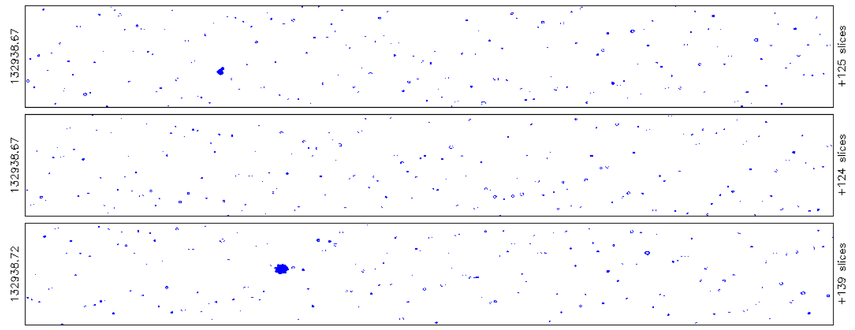


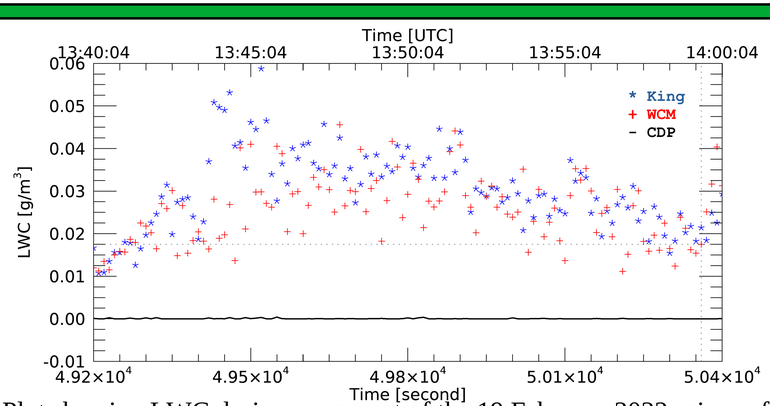
Image showing instruments on the NASA P-3 Research Aircraft for the IMPACTS 2022 field project. The Hotwire Boom has the Cloud Droplet Probe (CDP), King Probe, and Water Content Measurement (WCM) Probe.

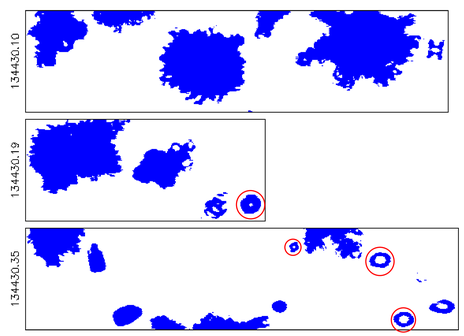






Plot showing LWC during a segment of the 19 February 2022 science flight, and corresponding images from the vertical channel of the 2D-S. The total of the y-axis for each image buffer is 1,280 µm. Note that the images show mostly small (< 50 µm) liquid water droplets, with a few lager droplets. The King, WCM, and CDP all detect liquid droplets; however, due to different upper size limits, the instruments have different LWC amounts.





Plot showing LWC during a segment of the 19 February 2022 science flight, and corresponding images from the vertical channel of the 2D-S. The total of the y-axis for each image buffer is 1,280 µm. Note that the images show no small (< 50 µm) liquid water droplets, some larger (~ 150 µm) droplets (red circles), and large ice particle. Hence, the CDP measure no LWC, while the King and WCM measure a small amount of LWC.

Future Work

- Refine the WCM and King calibrations using 2022 IMPACTS clear air test flight data.
- Analyze liquid water cases where all cloud droplets are less the 50 µm.
- Analyze ice only and mixed phase clouds cases, with comparison to WHISPER.

Acknowledgments

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