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# Power-over-Tether UAS Leveraged for Nearly Indefinite Meteorological Data Acquisition In the Platte River Basin

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## Introduction

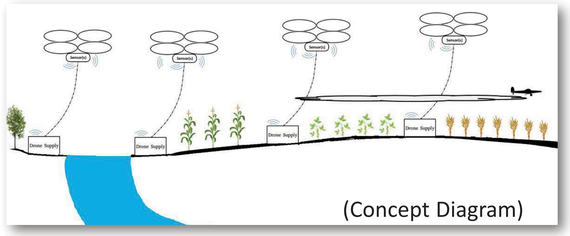
-Robotic systems and sensors have been successfully integrated into the agricultural sector completing tasks/providing data in many forms.

-Tasks and data such as harvesting and acquisitioning soil moisture, among many others.

-UAS specifically have been used to provide phenotype information via on-board imaging, or precise applications of herbicide/pesticide, etc.

-There are significant limitations for UAS such as load and duration of flight (typical quadcopter round trip is ~15-30min).

-The ability to power a UAS over a tether has been shown to be a viable way of substantially increasing flight times.



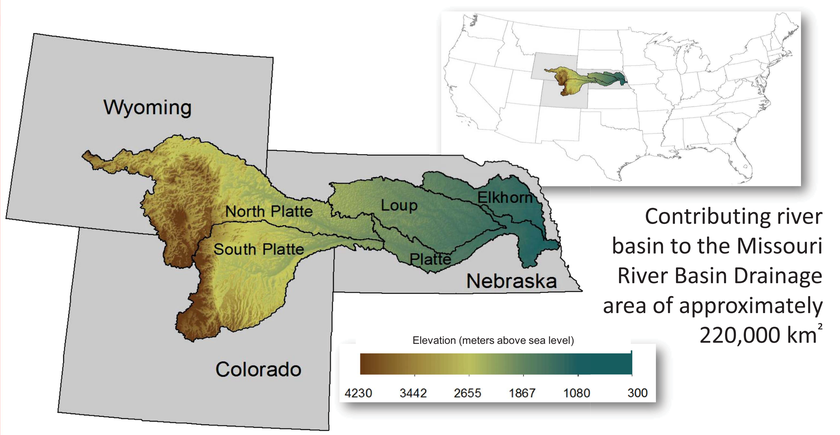

## Motivation & Direction

**Research Question**: Can we develop a novel UAS that can increase flight times and continuously acquisition atmospheric temperature data for the agricultural sector in the Platte River Basin?

**Hypothesis**: We can accomplish this if we engineer a novel UAS for being powered over a tether, and leveraging the physical tether by placing sensors periodically along the tether providing a gradient.

**Objective(s)**: Calculate adequate system parameters, engineer a prototype, generate computer simulations, run field experiments, and analyze the results.

## Platte River Basin

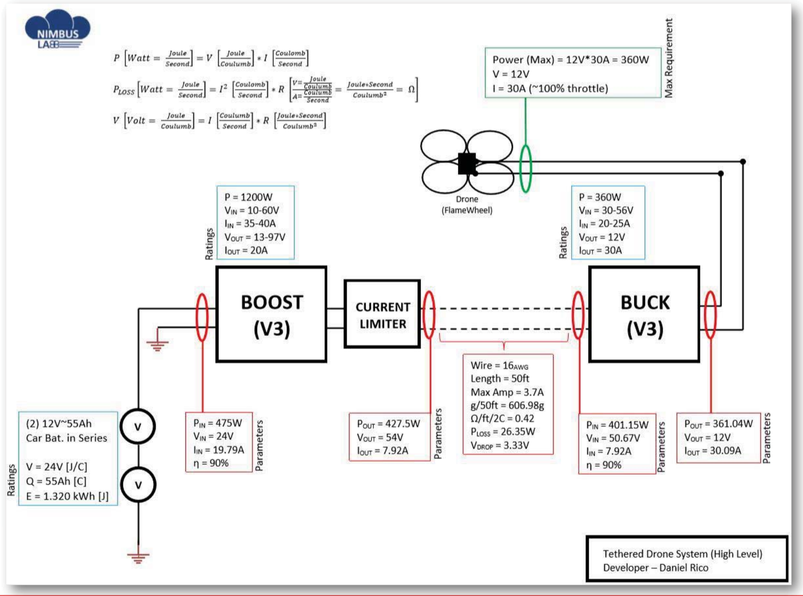



Contributing river basin to the Missouri River Basin Drainage area of approximately 220,000 km$^2$

## System (High Level)

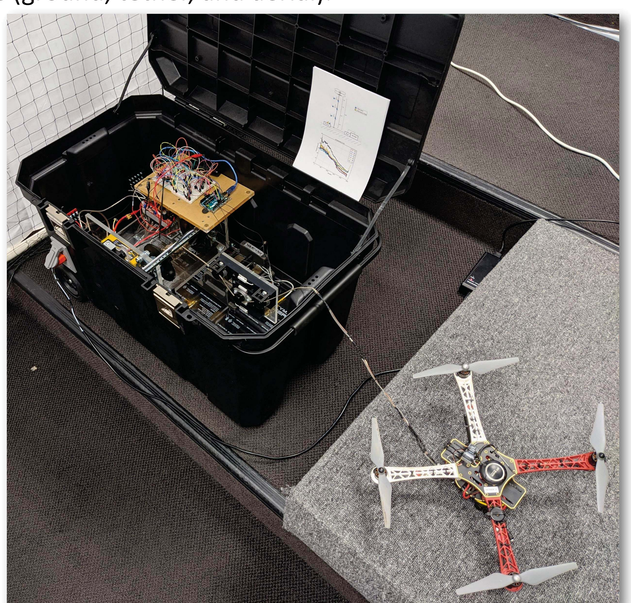
-Due to the power intensive nature of drones, the upper power bound must be understood and physically satisfied (~360 Watts).

-The following high level diagram depicts calculated values across the system when the theoretical max power is required.

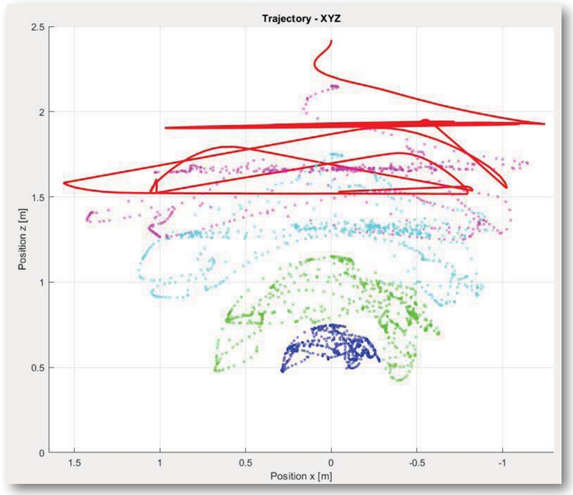



## Prototype

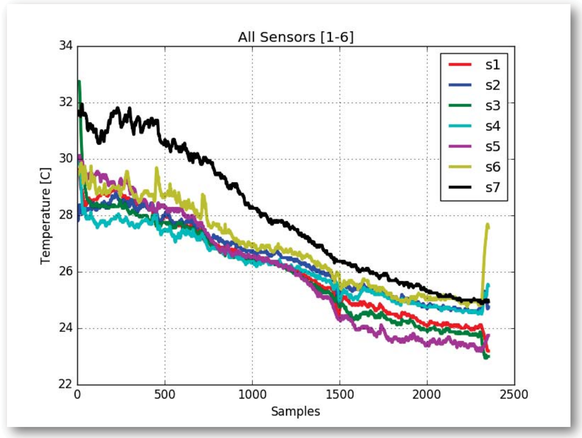
-In order to demonstrate proof of concept and design viability a prototype system was developed. The prototype consists of 3 sub systems (ground, tether, and aerial).



## Simulations & Field Results




-Using MATLAB-Simulink we developed a power-over-tether simulation that output spatial data of a UAS flight trajectory (red), and sensors along the tether (magenta, light blue, green, blue).




-The prototype was able to fly for 6 hours continuously at ~50ft AGL.
-At sunset the sensors acquisitioned temp. data for 1 hour (plotted).

## Conclusion & Future Work

-The system was successfully prototyped and field tested showing promise as a viable field instrument to help the agricultural sector.

-We will work on system refinement, sensor data validation, and increasing from 1 to N units to explore networking possibilities.

## Acknowledgments

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