

# Challenges of Micro-Weather Forecasting for UAS Skyways

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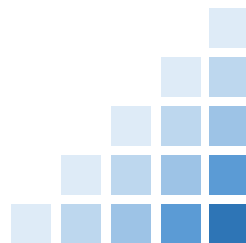
29 April 2019

With key contributions from:

Sean Bailey and Suzanne Weaver Smith (UKY)

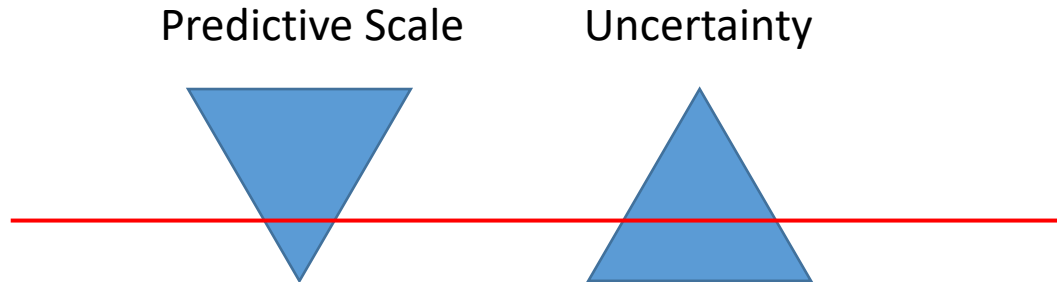
Pedro Jimenez, Anders Jensen Tracy Hertneky (RAL)

Gijs De boer (University of Colorado)



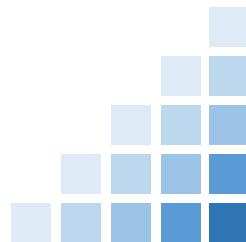
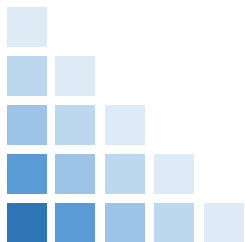
# Challenge

- Small UAS very susceptible to finescale weather variability
- Smaller scale phenomena are inherently more uncertain to predict.

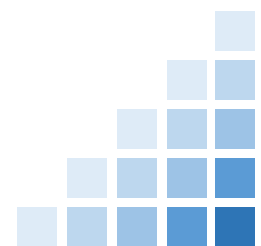
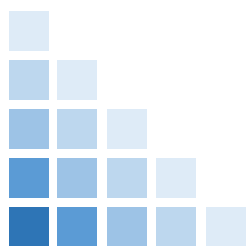
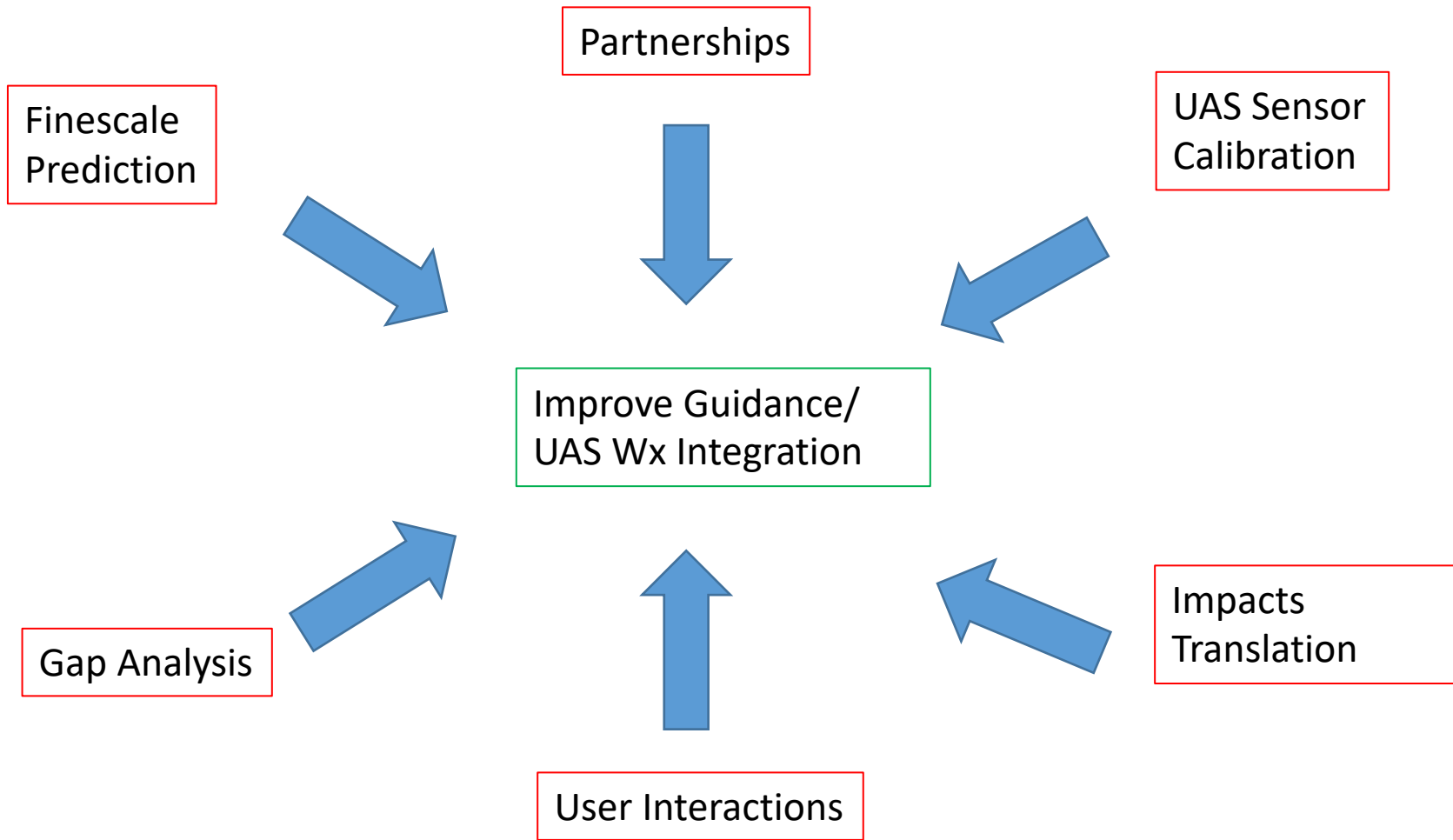


## What are the requirements for a particular UAS operation?

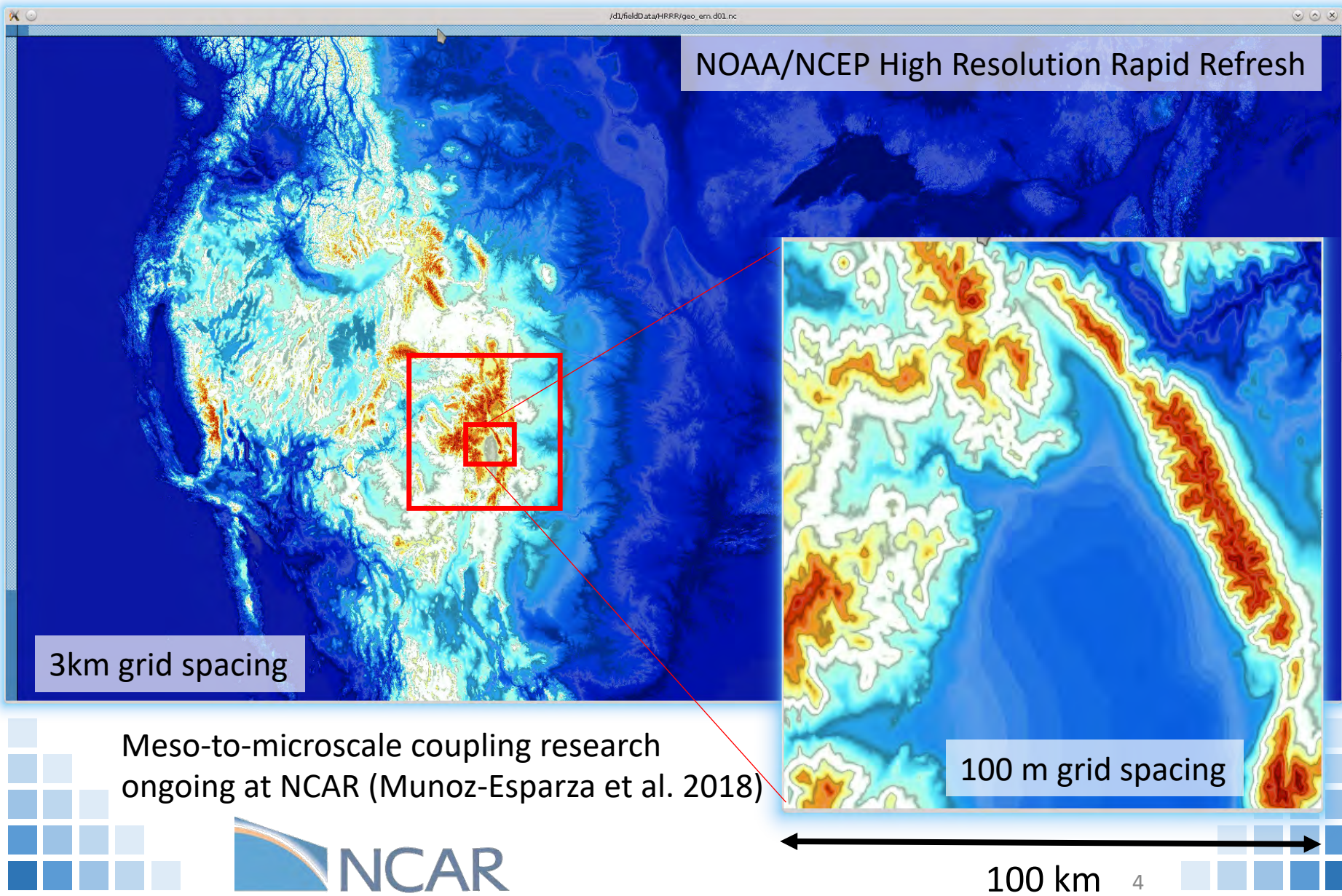
How do we translate uncertain wx info into decisions?



# NCAR UAS/UAM Wx Program

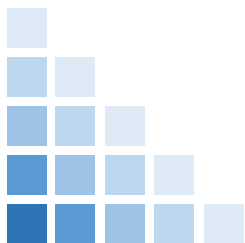
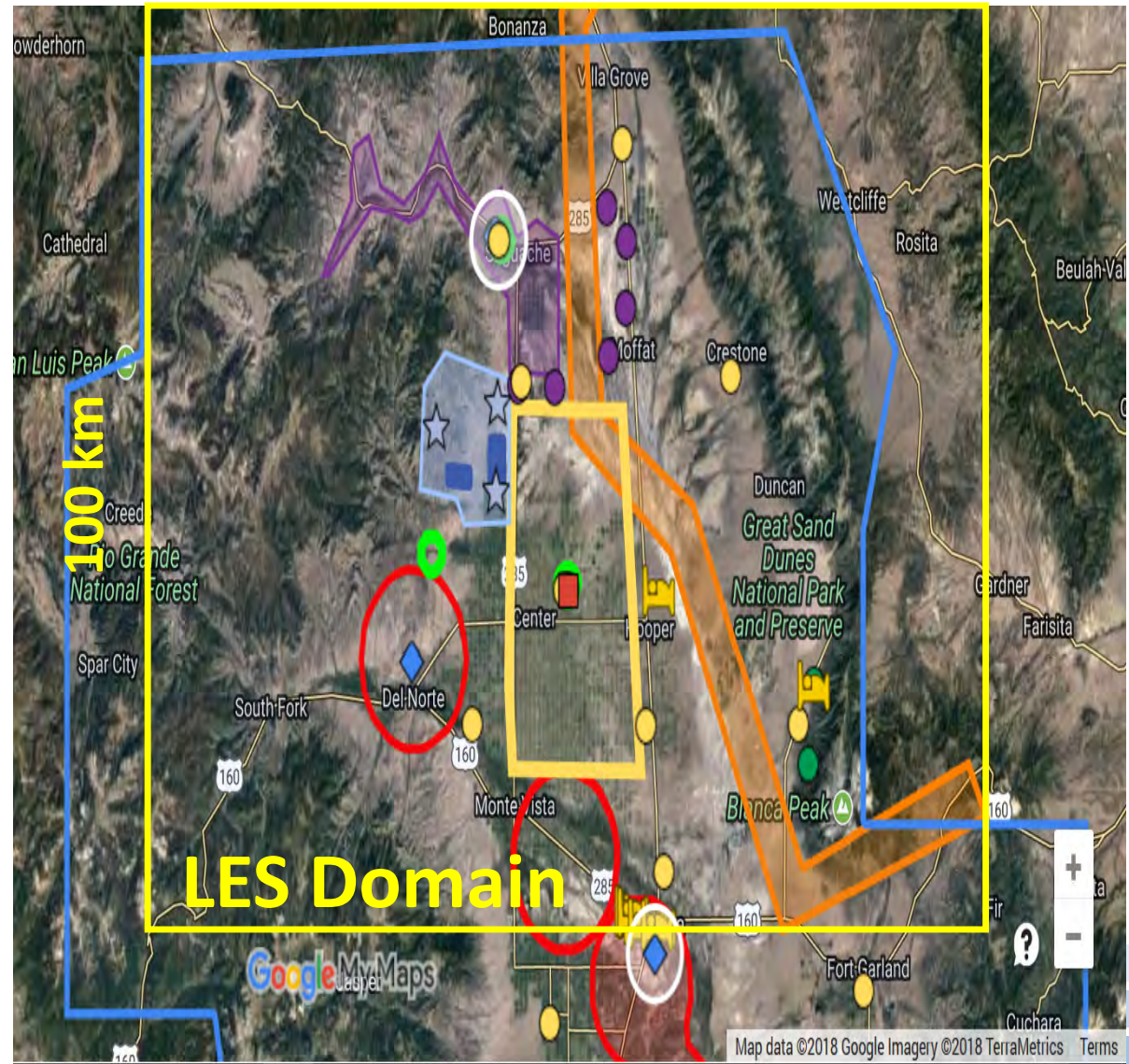


# Realtime Finescale Prediction for LAPSE-RATE



# LAPSE-RATE Field Experiment

- Period: 15-21 July 2018
- Location: San Luis Valley, South-central Colorado
- WRF-based system - run twice per day
- Used in next day mission planning
- 100 m grid spacing – can resolve gusts and thermals

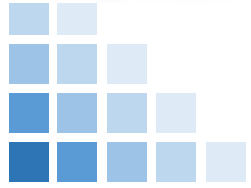
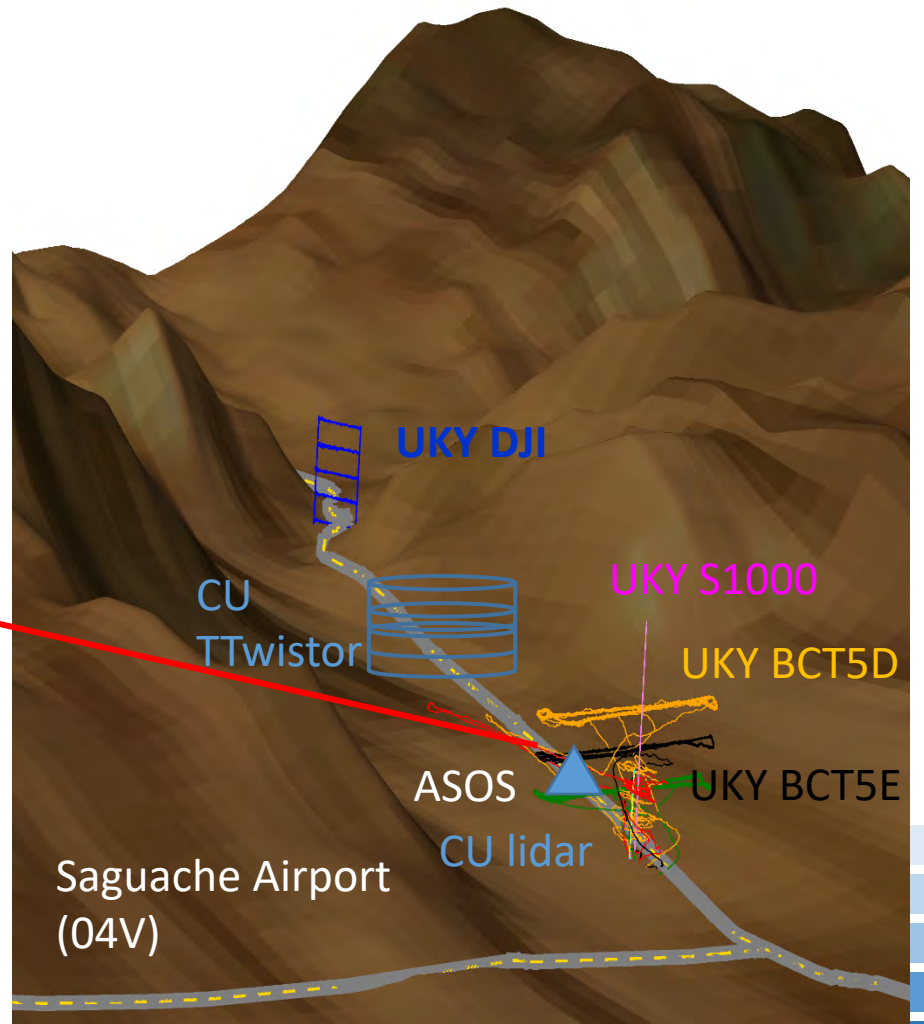
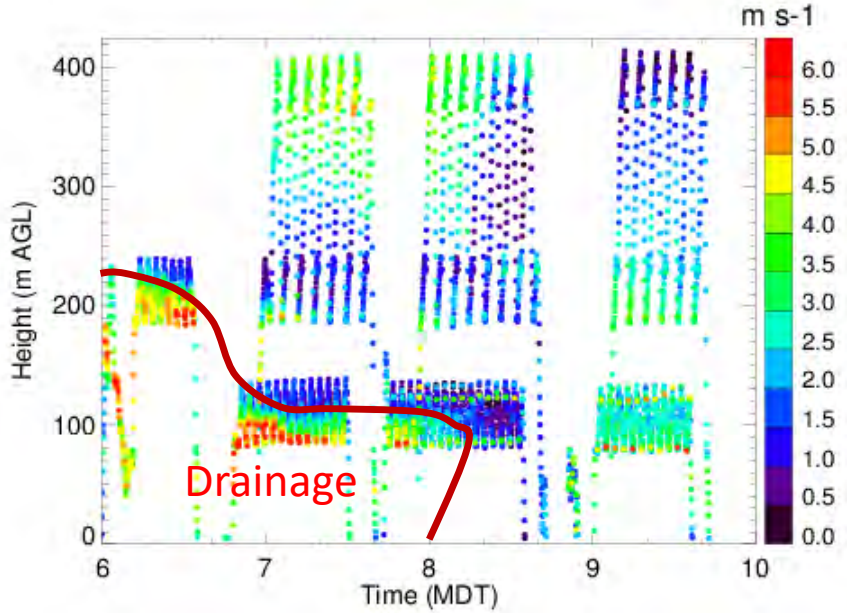


# Drainage Flow Case Study

- 75 UKY flights
  - 2 quadcopters
  - 3 fixed-wing platform
- 2 long duration orbits – CU TTwistor

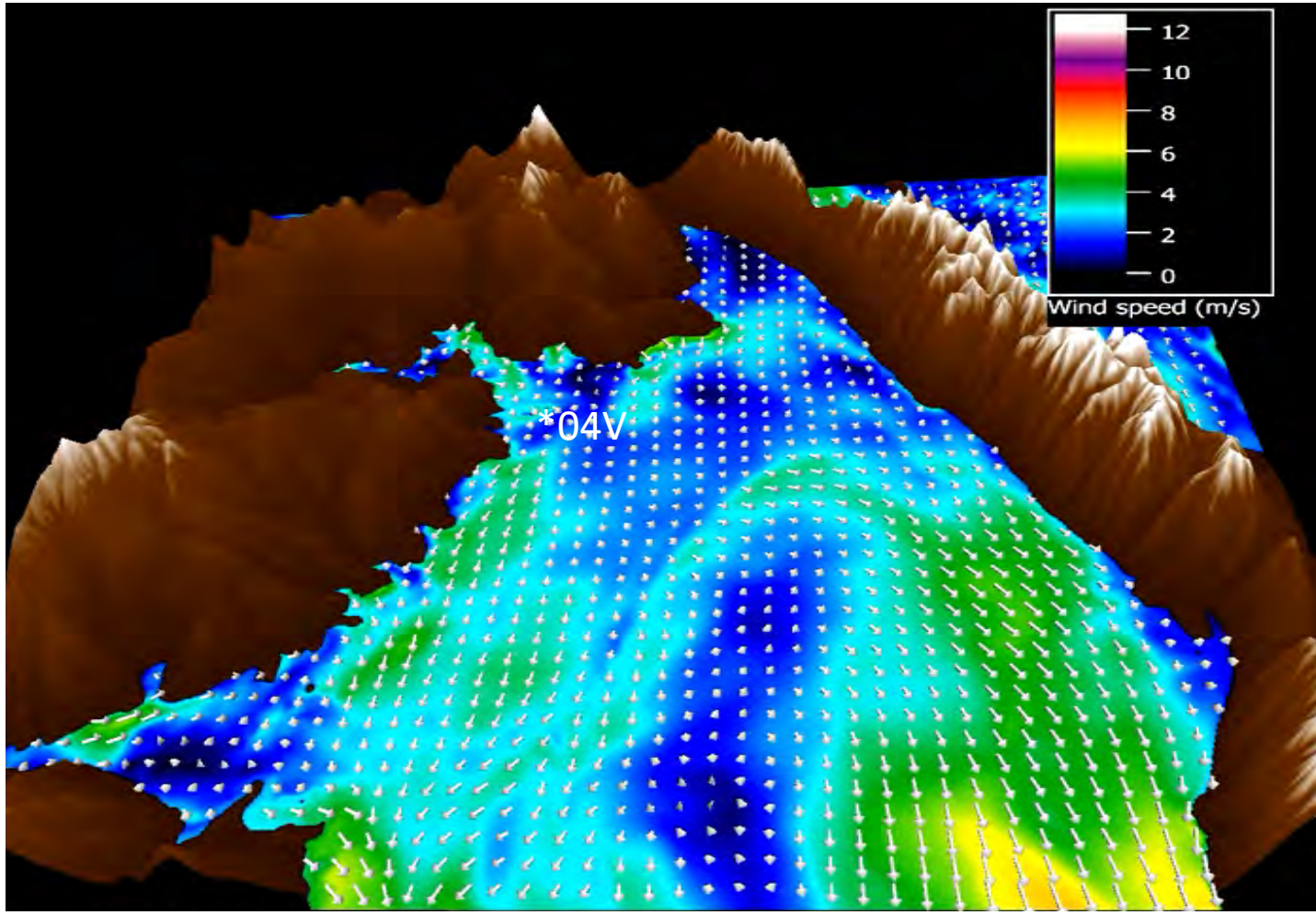
Asset Deployment in Saguache Canyon  
19 July 2018

BlueCat Fixed Wing UAS

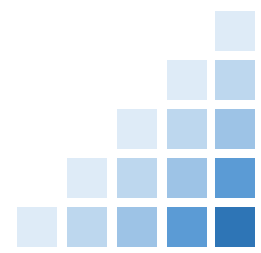
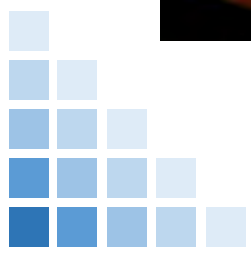


# Evolution of Drainage Winds in San Luis Valley

12 hour run valid: 06:00 – 18:00 UTC (00:00 – 12:00 LT)      ~300 ft AGL

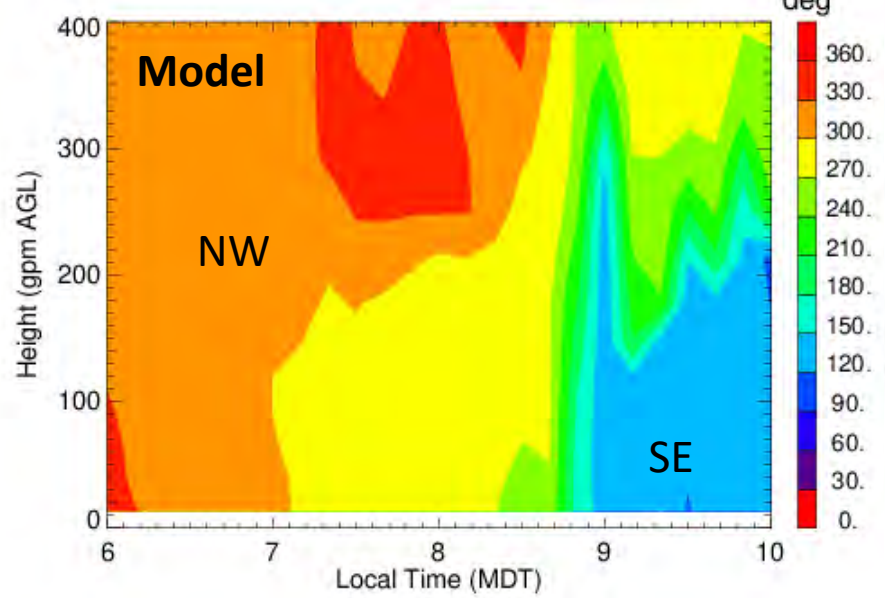


04V = ASOS at Saguache Airport

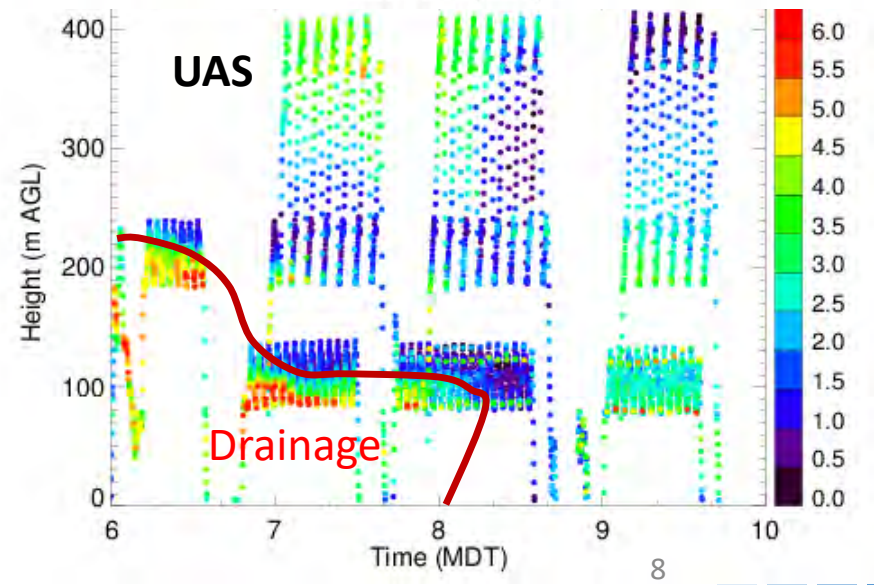
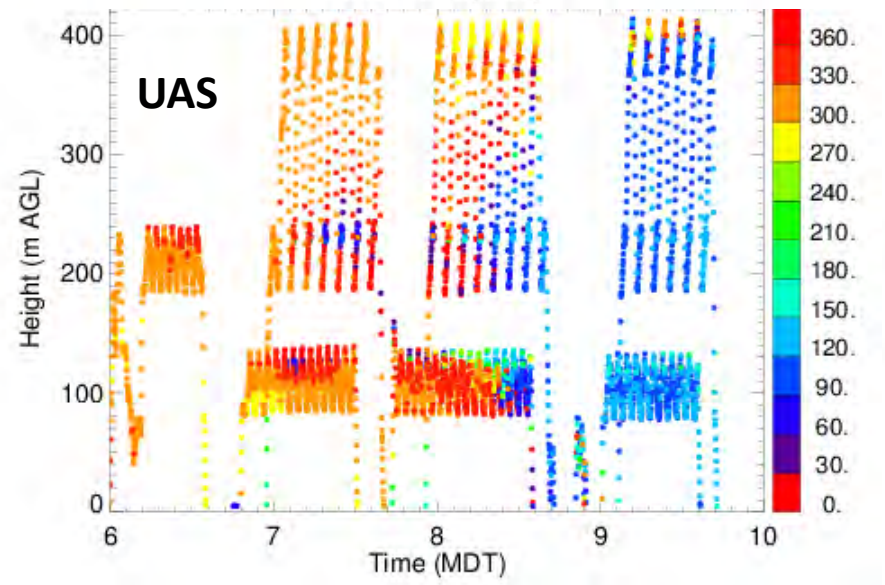
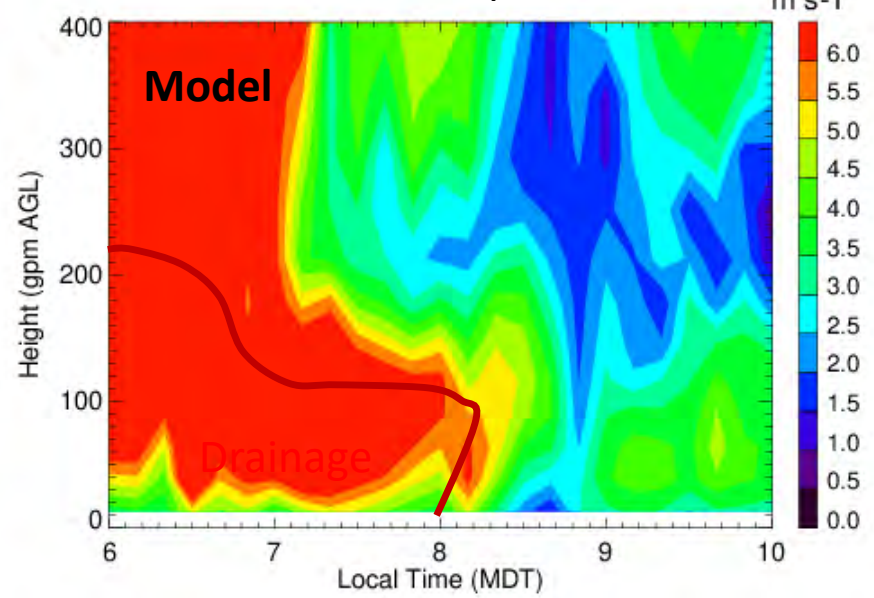


# Evaluation of Modeled Wind Variability with UAS

### Wind Direction



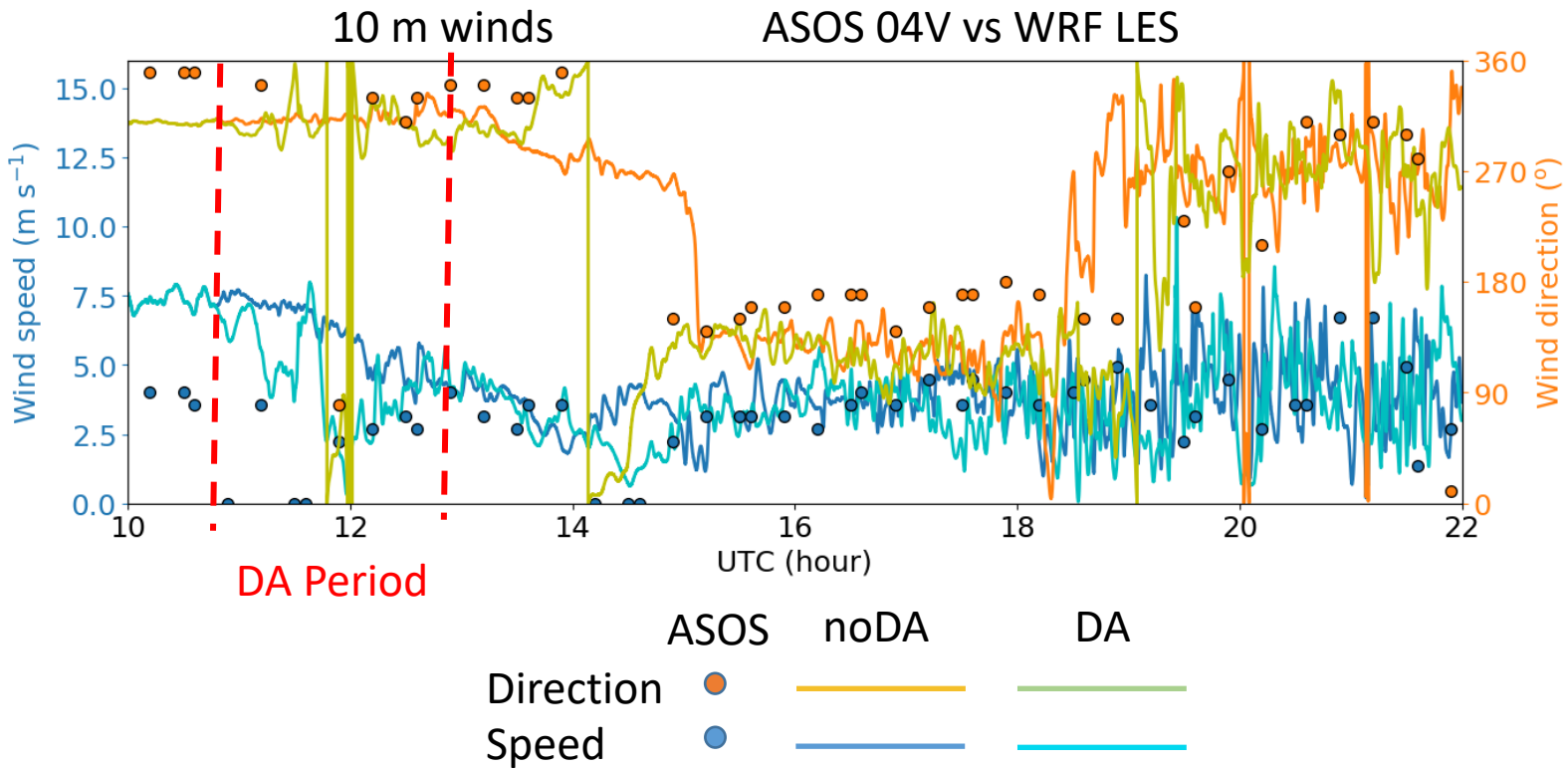
### Wind Speed





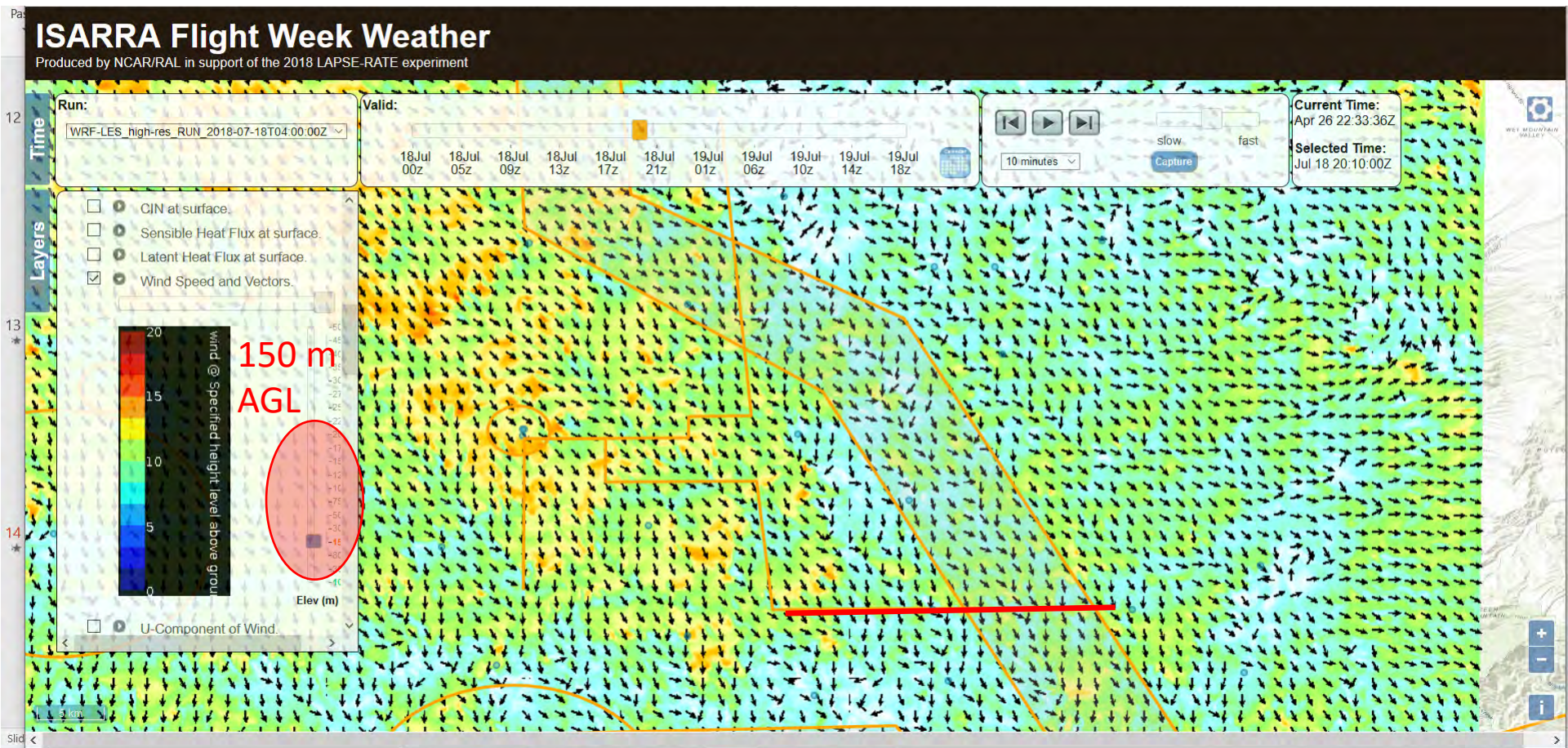
# UAS Data Assimilation

## Impact on Low-level Winds



UAS DA results in 25%-50% reduction in mean error

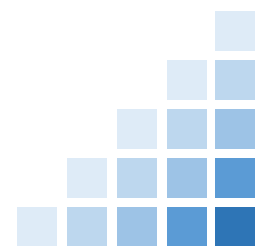
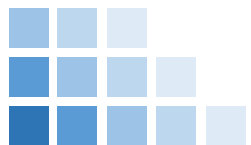
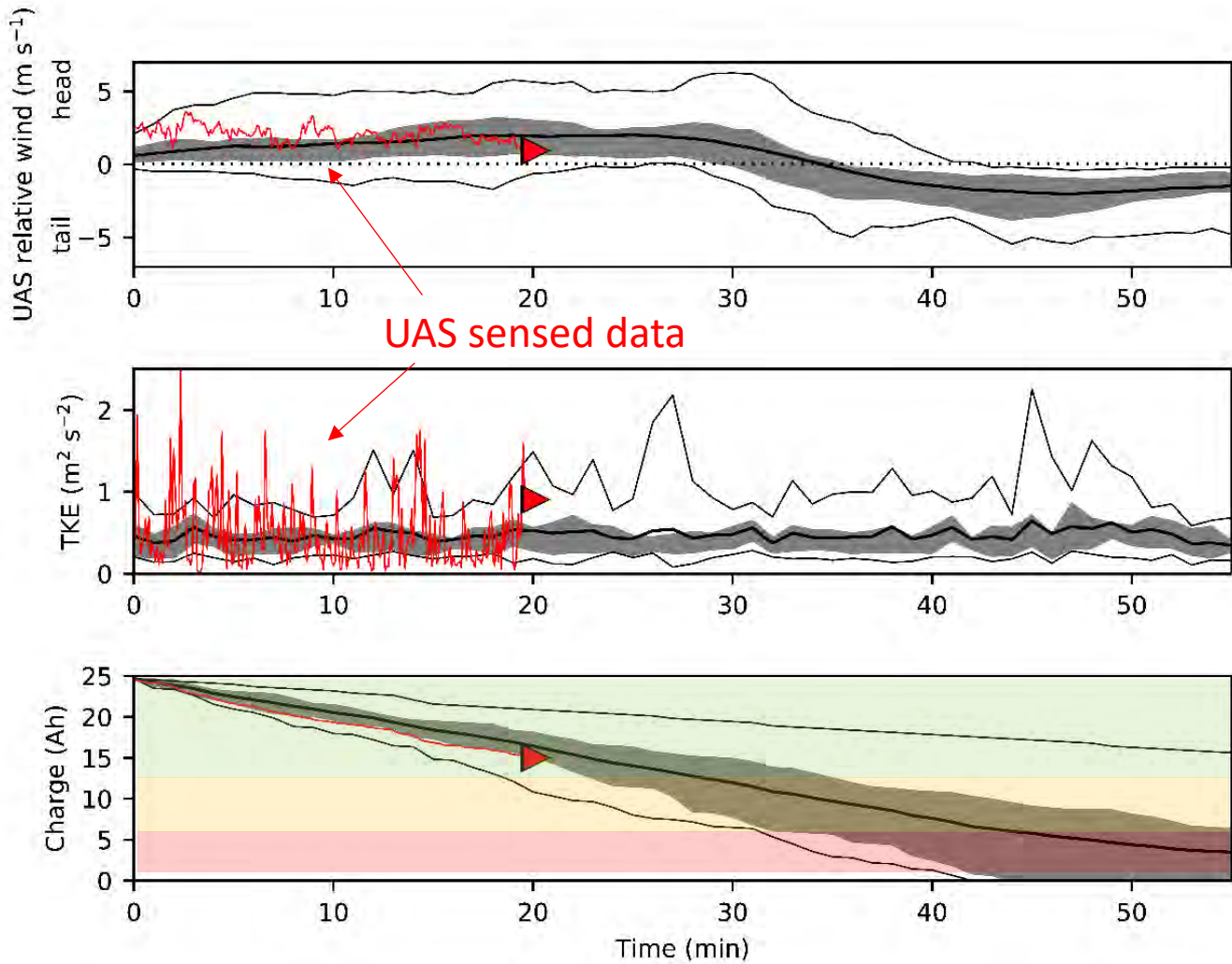
# Interactive Tools



- Used for daily weather briefings for LAPSE RATE : 14-21 July 2018

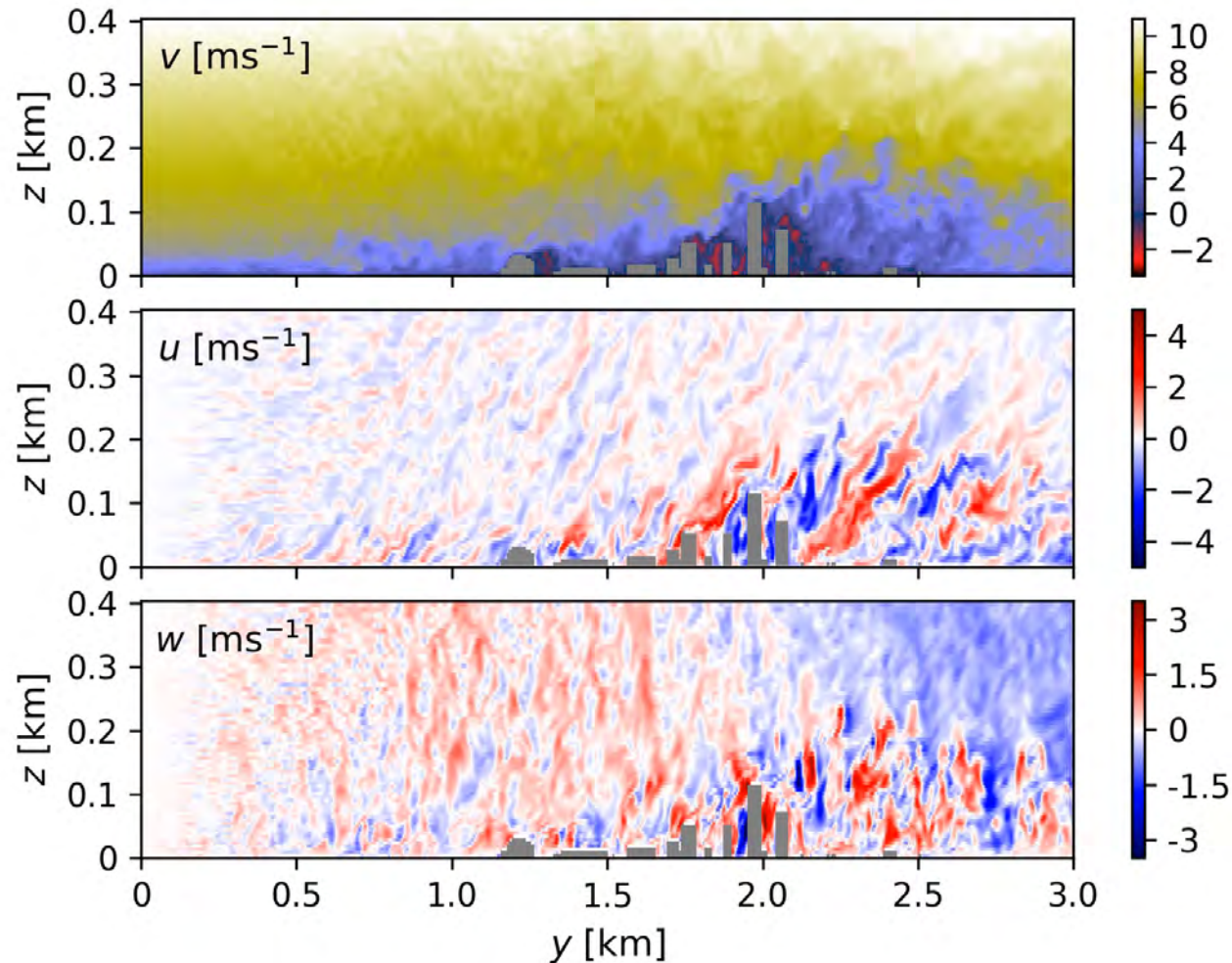
# Future of UAS Weather Guidance

Predicted Winds, Turbulence, Battery Charge along Flight Path with Uncertainty



# Future of UAS Weather Guidance

Simulation for Oklahoma City 10 m grid spacing using FastEddy™



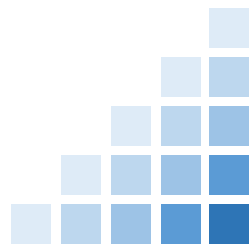
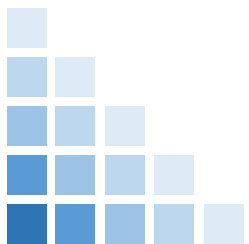
Sauer and Domingo-Esparza

# Questions?

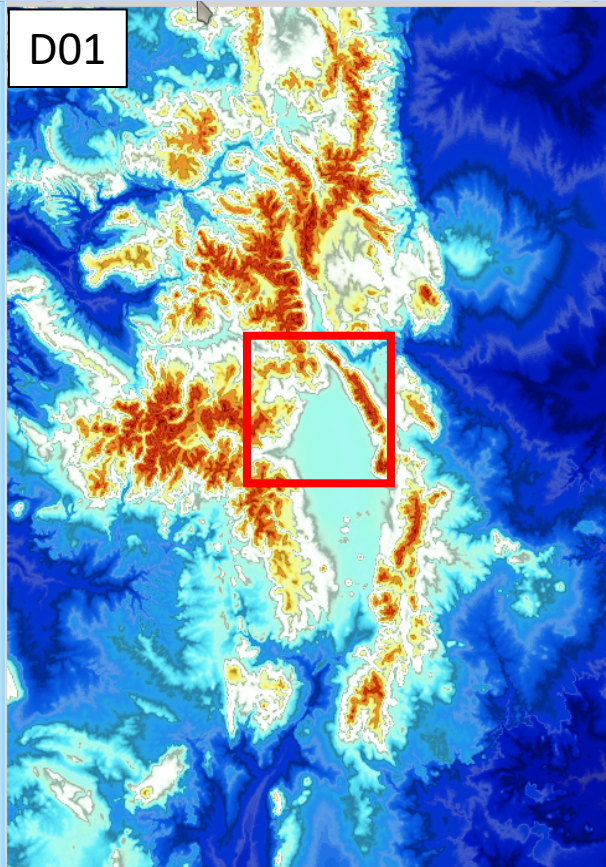


# Backup Slides

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# Model Configuration



## Domain 1

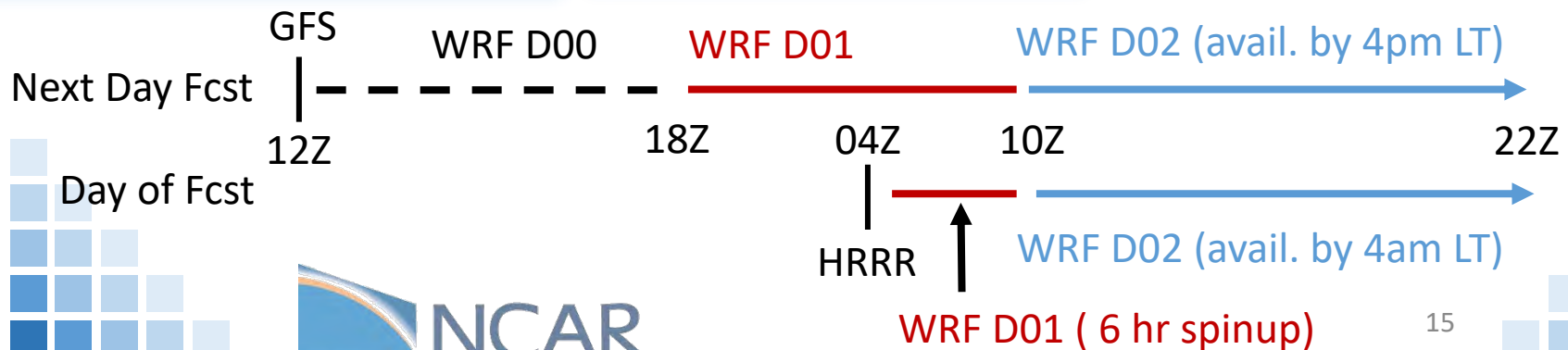
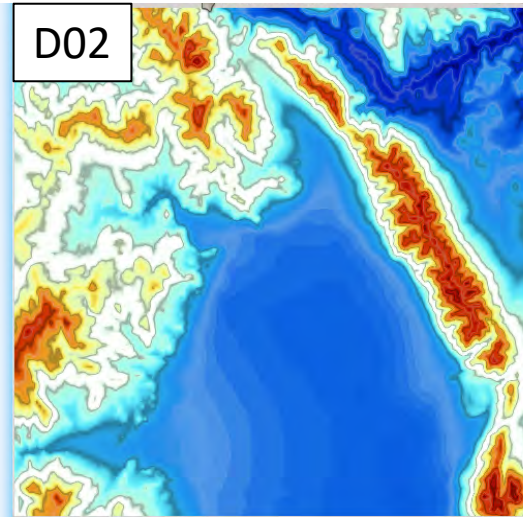
- 1 km resolution
- 487 x 637 x 45 gps

## Domain 2

- 100 m resolution
- 1008 x 972 x 45 gps

## Model Physics

- WSM Microphysics
- MYNN2 PBL – D01 Only, D02 = WRF\_LES
- NOAH LSM
- Builds on Munoz-Esparza et al 2017, 2018



# Evaluation of Finescale Model Winds

