Evaluation of WRF LES using UAS observations and Doppler lidar in a high sub-alpine desert valley

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[8]CLOUD-MAP

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Motivation

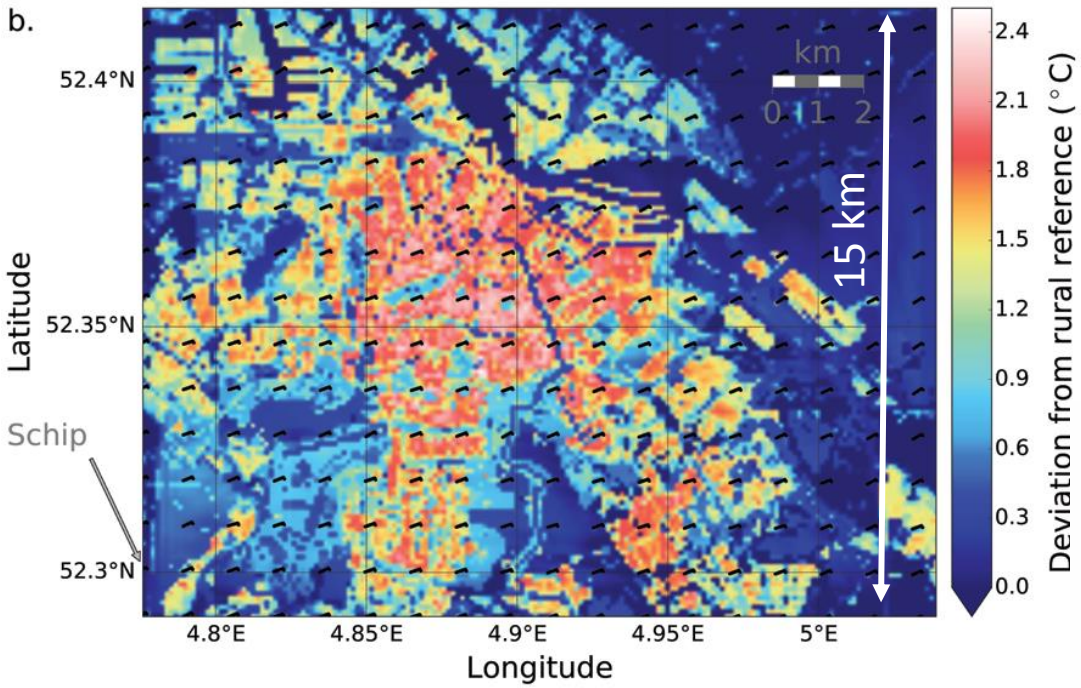
- Increasing need for microscale weather info

What are the requirements for micro weather information?

Planning time scales: 0-12hr
Resolution: < 1 km
Parameters: sensible weather in BL
Domain: O(100 km)
Uncertainty Information

Realtime Finescale Prediction Systems

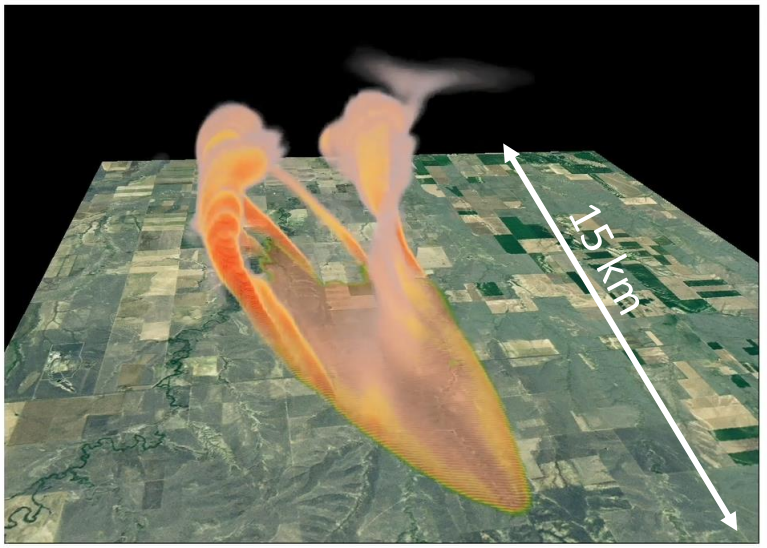
WRF coupled with Urban LSM – 4 day nighttime T anomaly – for Amsterdam heat wave



Rhonda et al. 2015

~100 m grid spacing

WRF coupled with fire model - Colorado

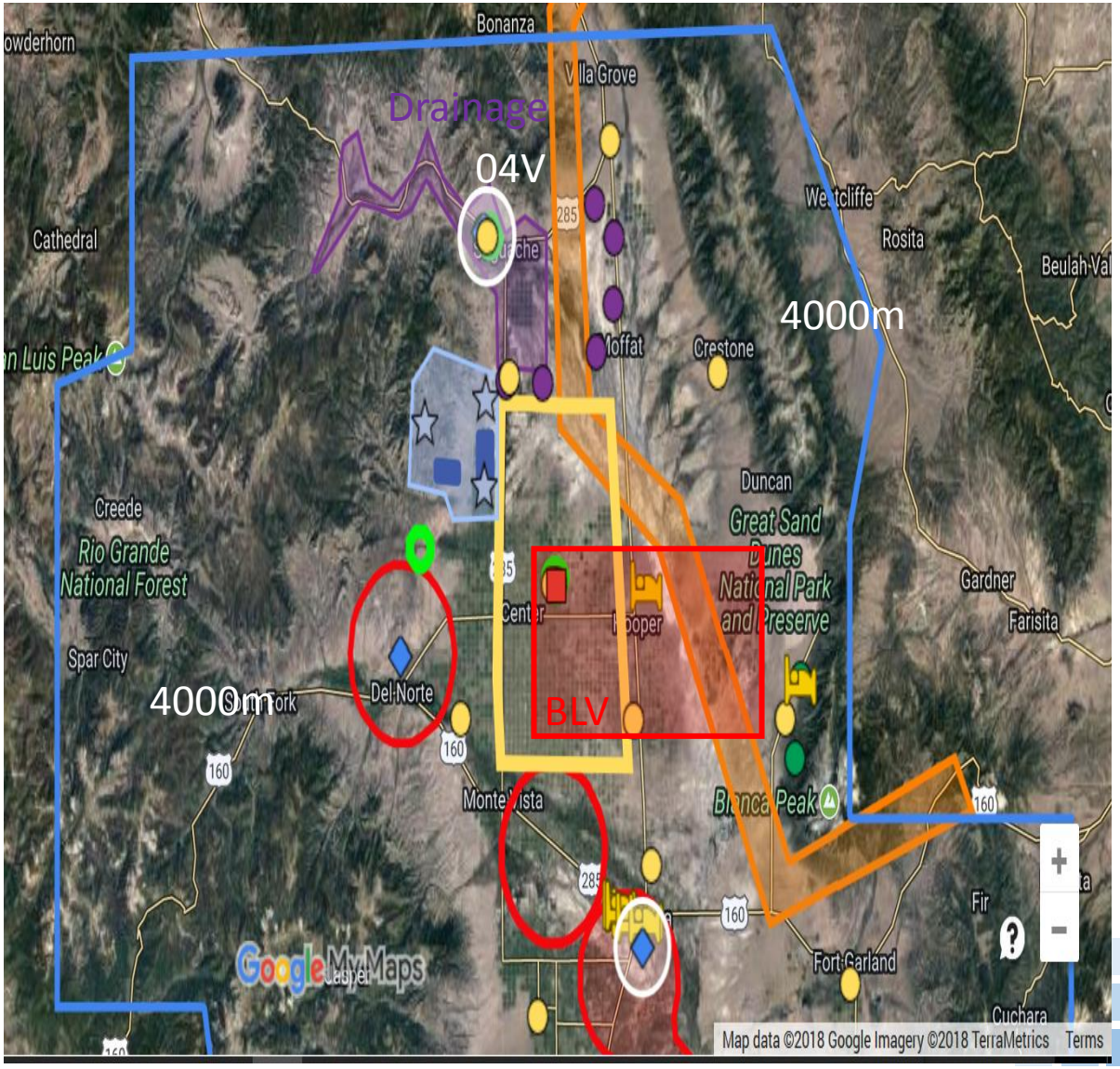


Munoz-Esparza et al. 2018

LAPSE-RATE Field Experiment

- Period: 15-21 July 2018
- Location: San Luis Valley, South-central Colorado
- Boundary layer variability
- Drainage flows
- Valley CI

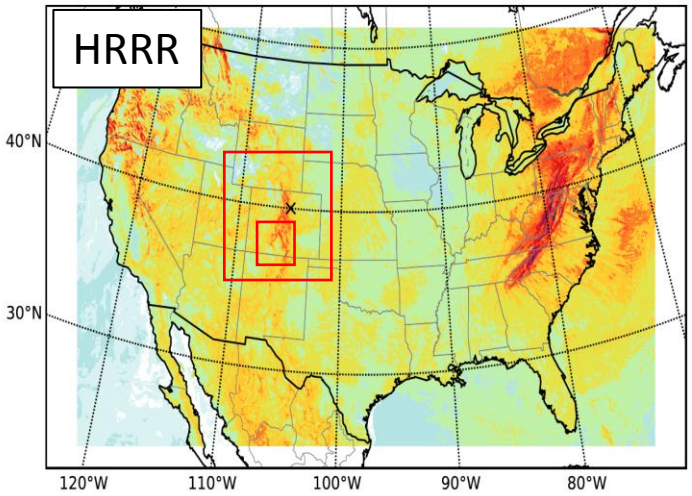
- Flight Information
  - ➢ 1287 flights
  - ➢ 262 flight hours
  - ➢ 50 UAS platforms

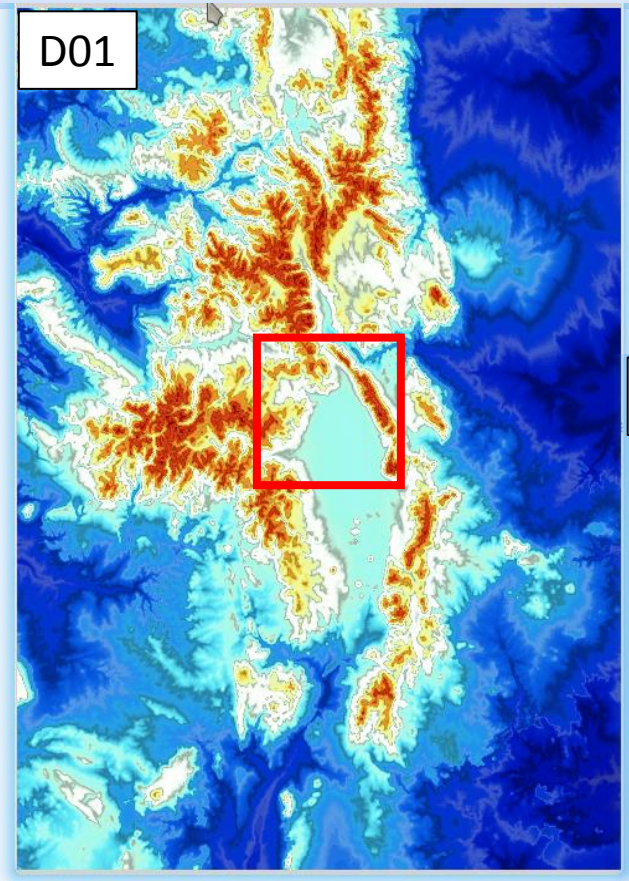


Model Configuration

Model Physics

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



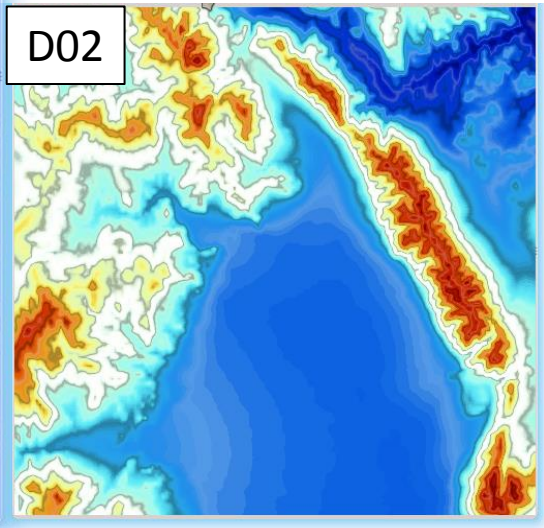


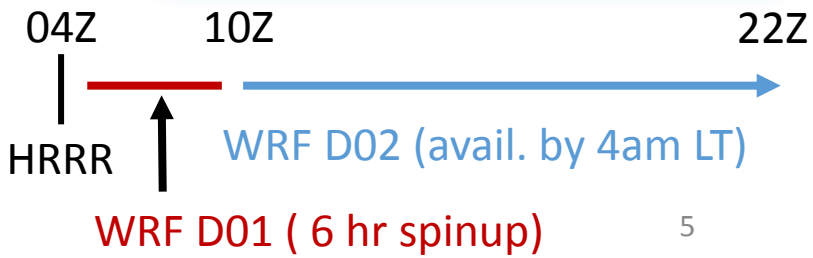
Domain 1

- 1 km resolution
- 487 x 637 x 45 gps

Domain 2

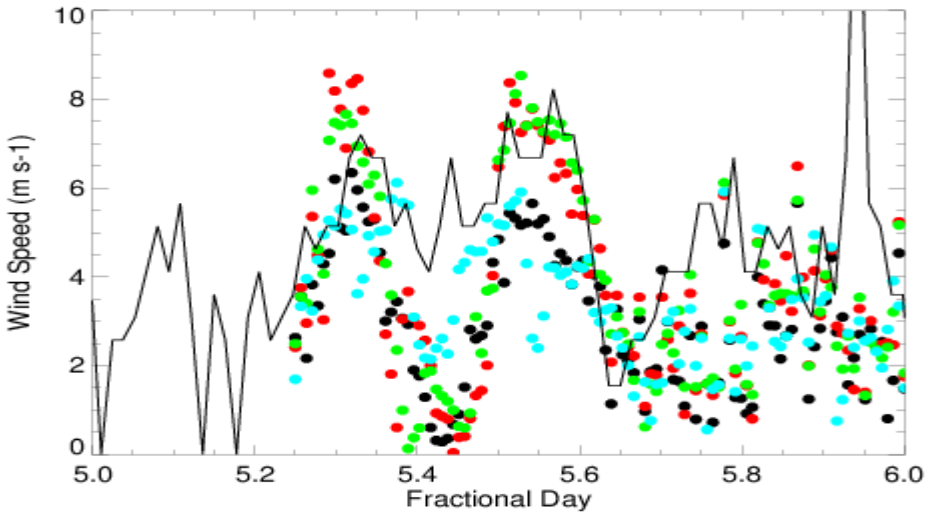
- 100 m resolution
- 1008 x 972 x 45 gps





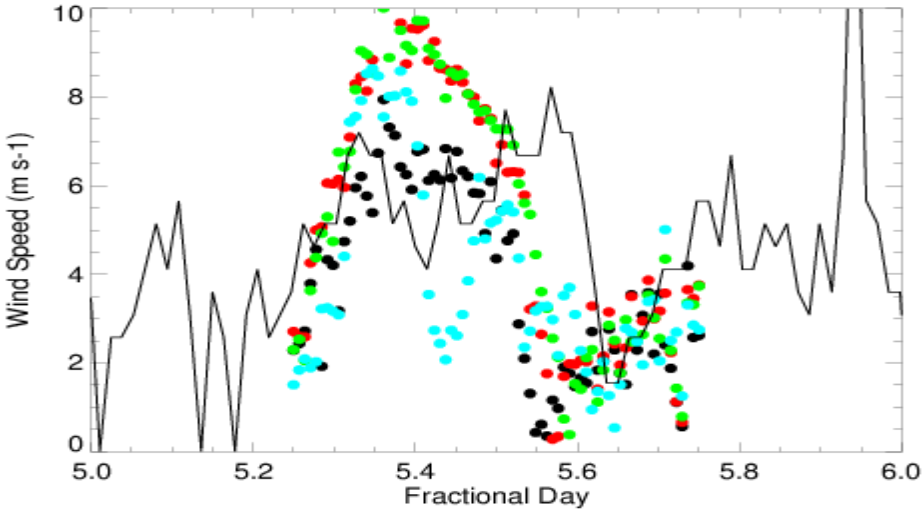
Model Sensitivities

D1 Spinup Period: 0h



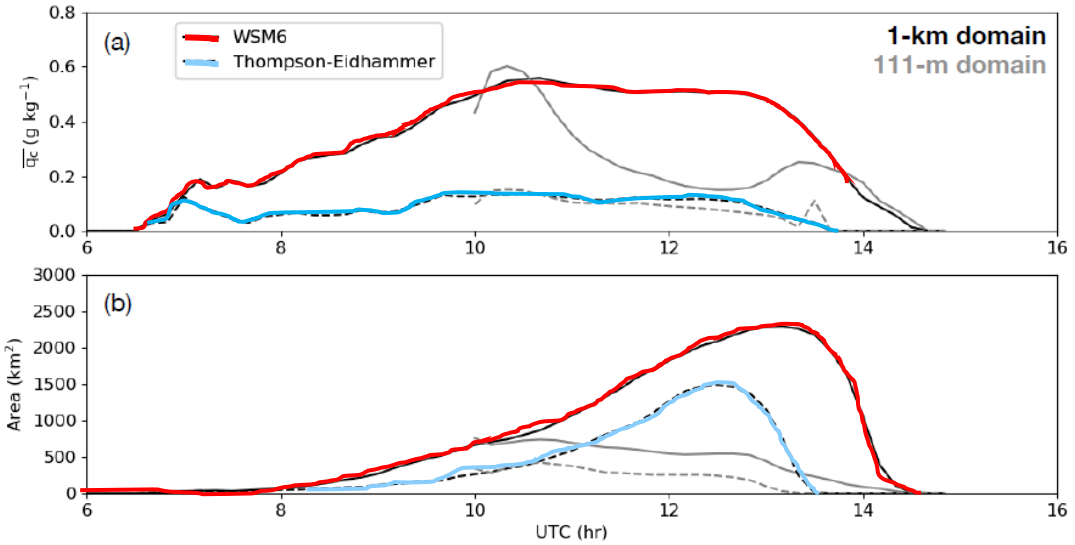
(UTC)

Test: 6h



WRF LES Wspd: 10 60 120 240 m

Physical Parameterizations: Sensitivity of fog layer to microphysics



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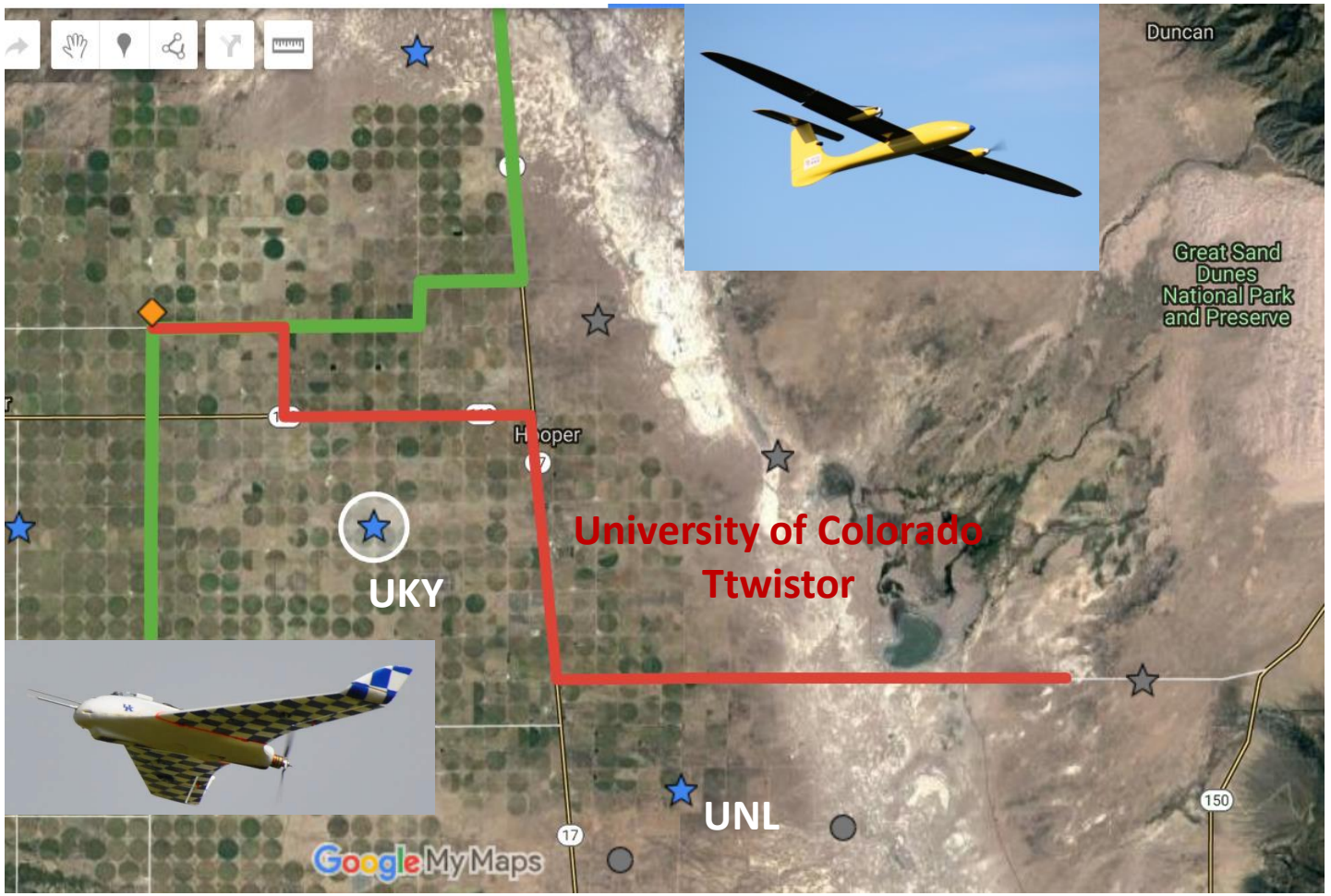
Boundary Layer Variability

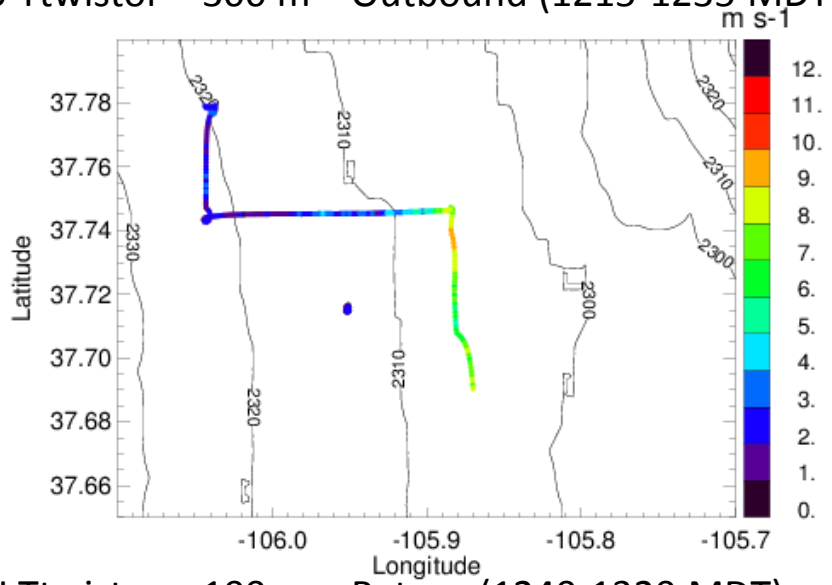
CU Ttwistor



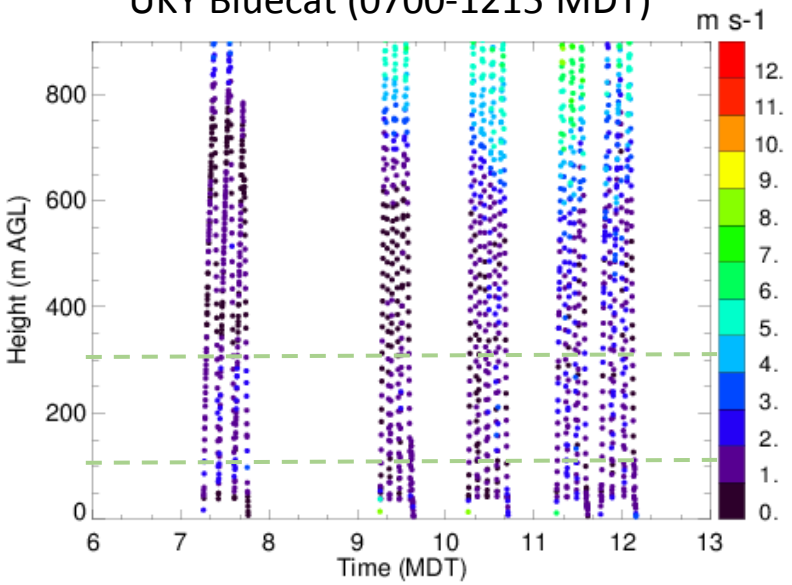
UKY
Bluecat

Boundary Layer Variability

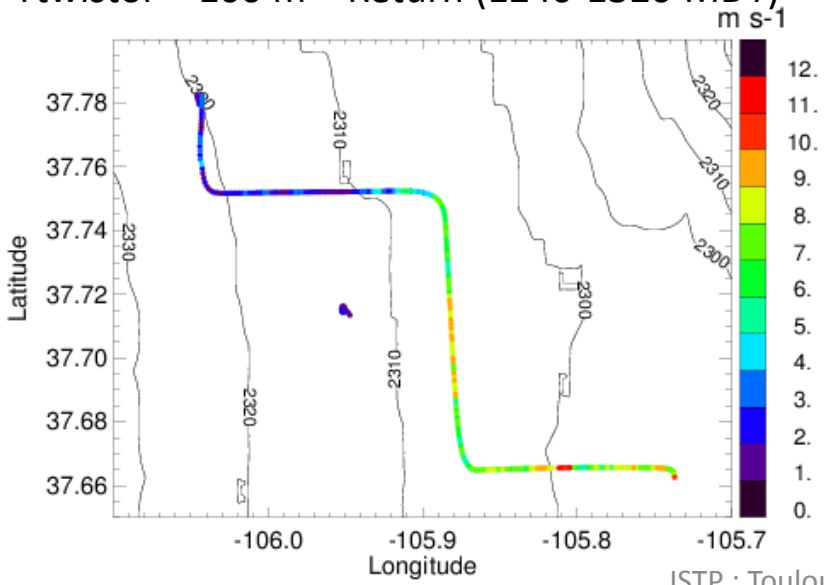
CU Ttwistor – 300 m – Outbound (1215-1235 MDT)



UKY Bluecat (0700-1215 MDT)

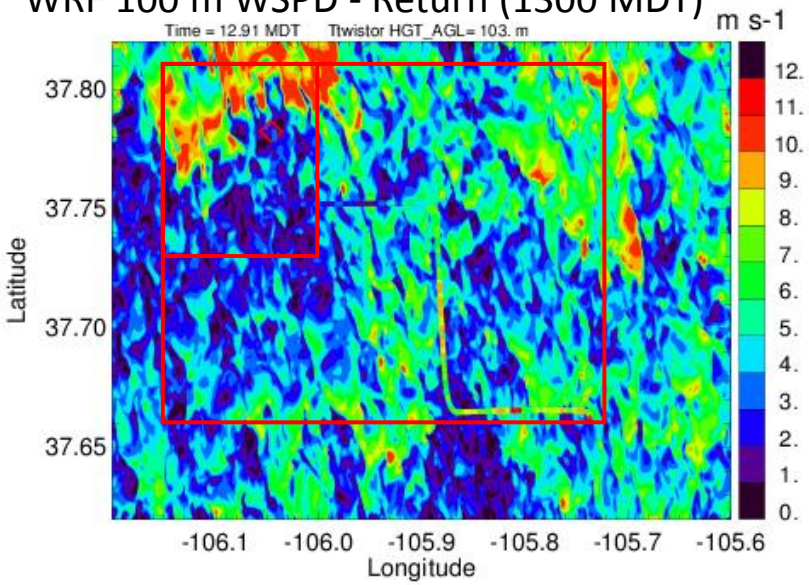


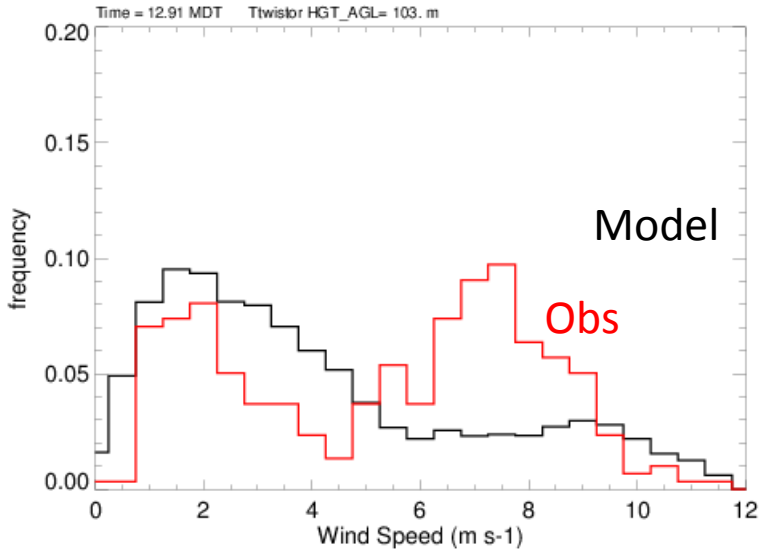
CU Ttwistor – 100 m – Return (1240-1320 MDT)



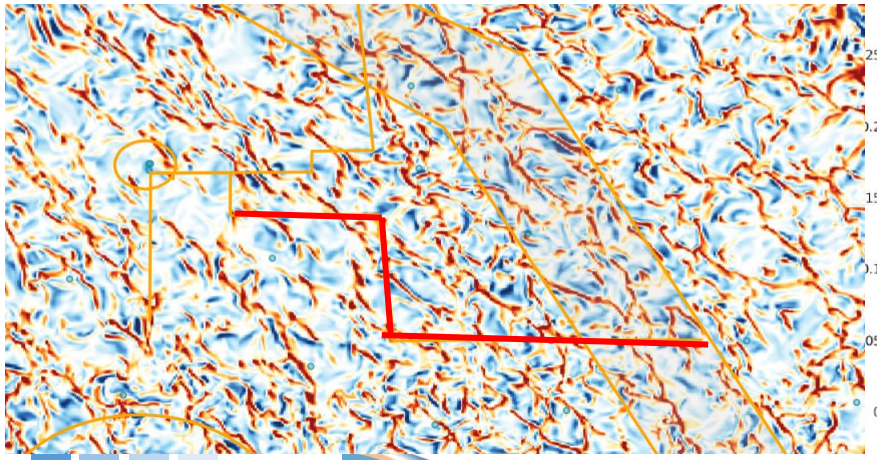
Boundary Layer Variability

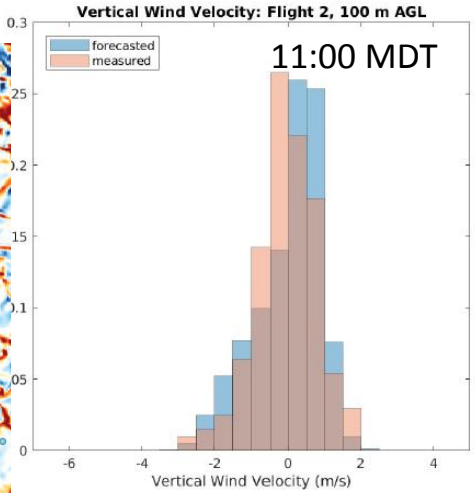
WRF 100 m WSPD - Return (1300 MDT)

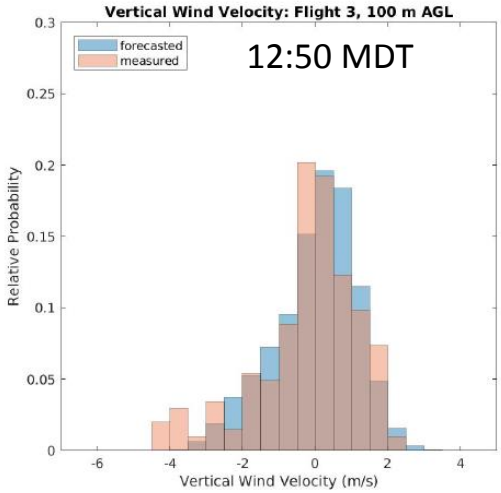




WRF 100 m Vertical velocity

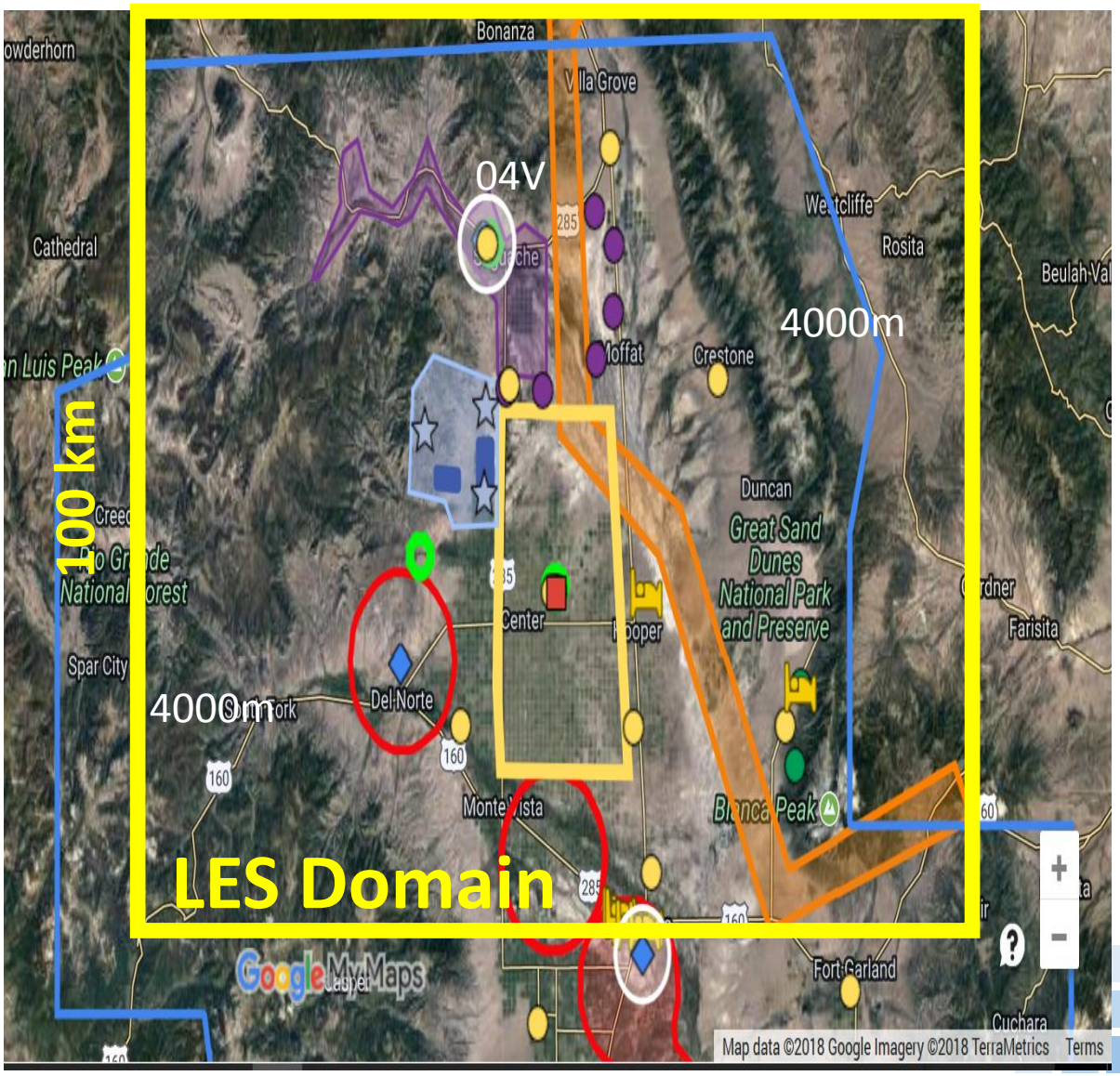






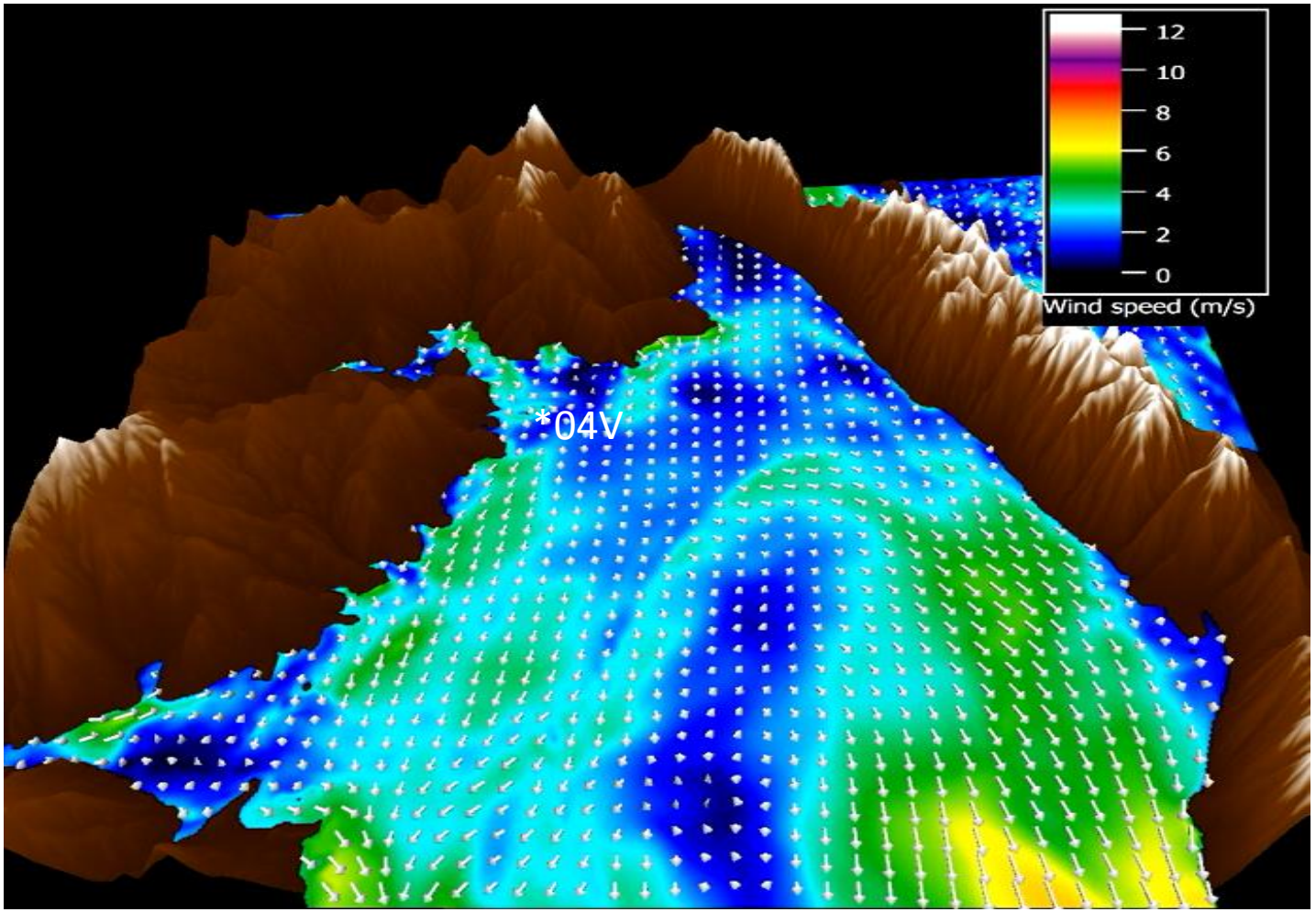
LAPSE-RATE Field Experiment

- Period: 15-21 July 2018
- Location: San Luis Valley, South-central Colorado
  - ➢ Boundary layer variability
  - ➢ Drainage winds
  - ➢ Valley CI



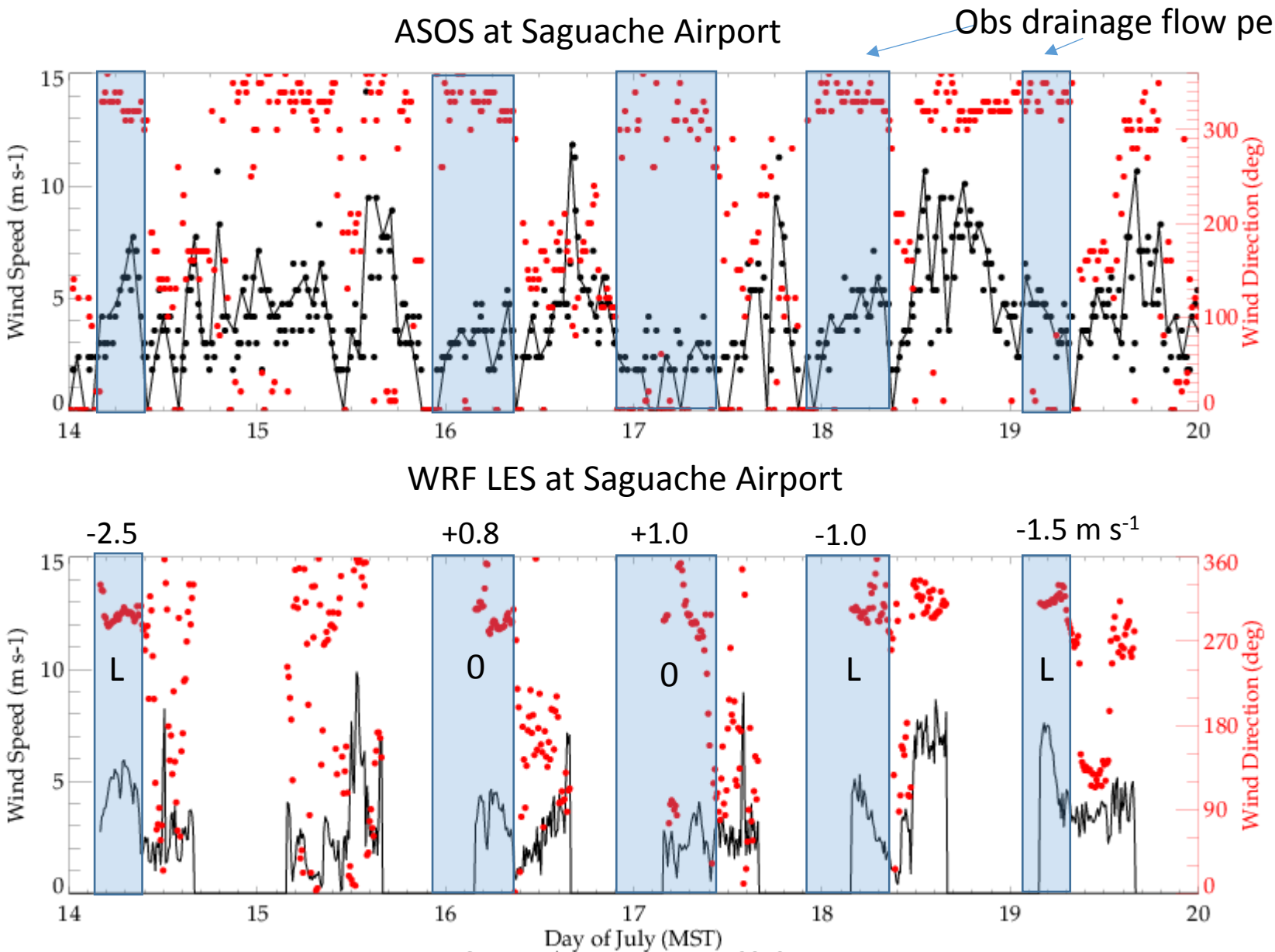
Evolution of Drainage Winds in San Luis Valley

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



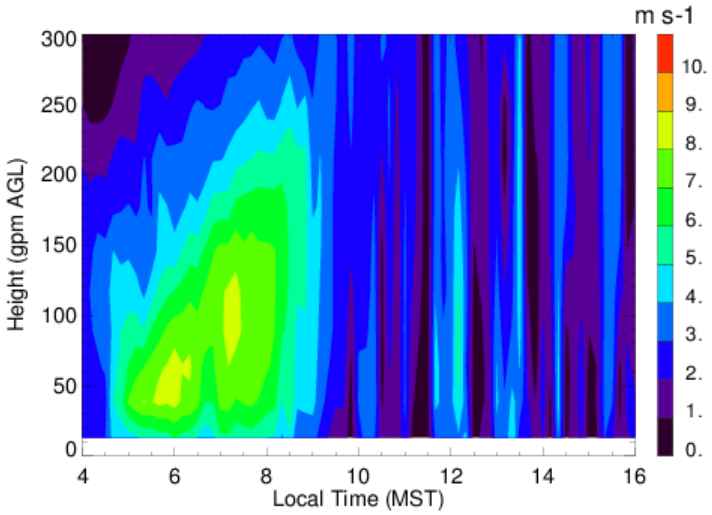
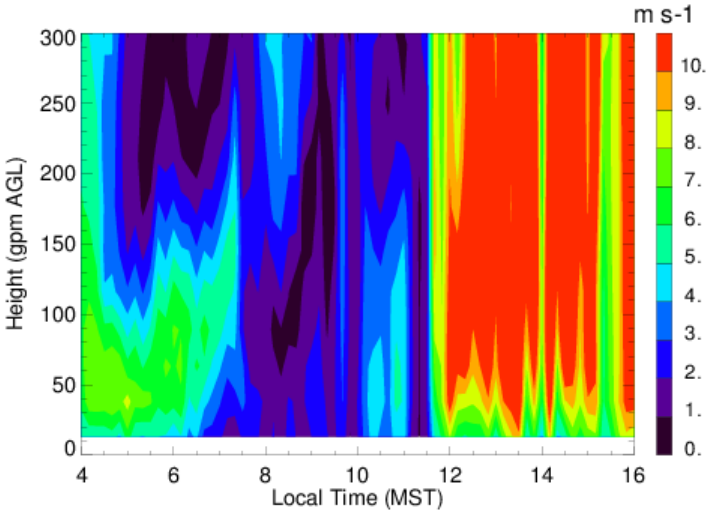
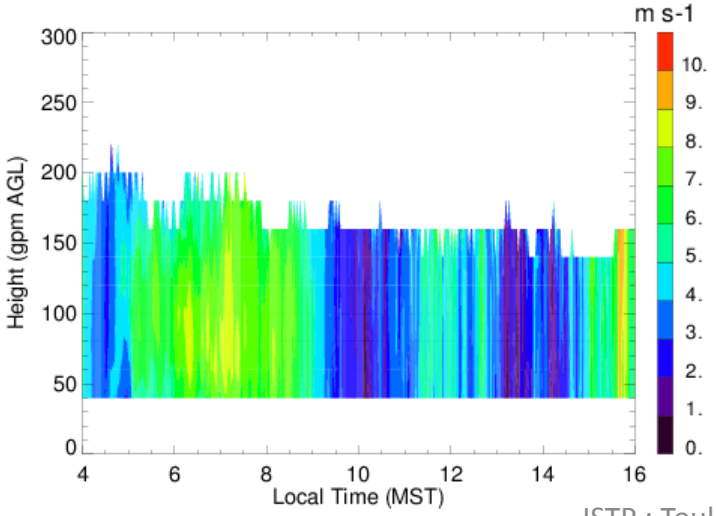
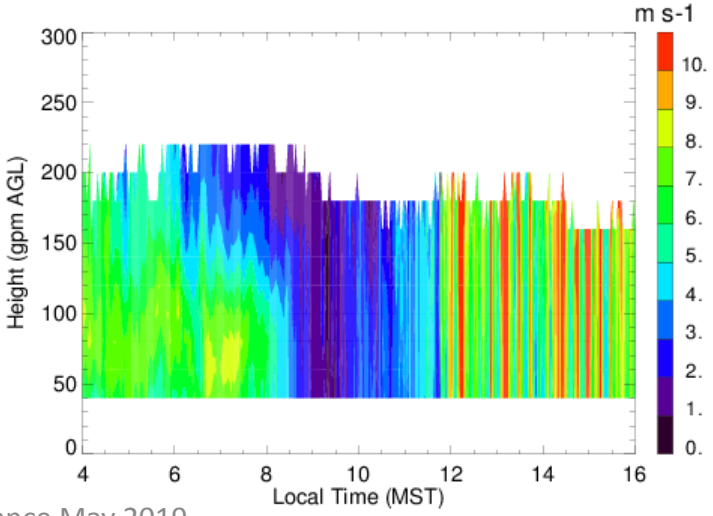
04V = ASOS at Saguache Airport

Evaluation of Finescale Model Winds



WRF LES vs Lidar

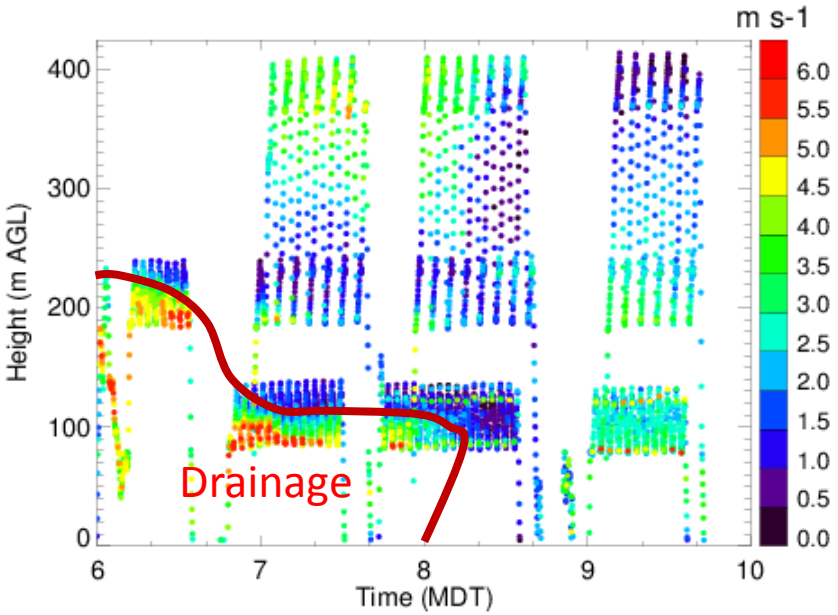
Comparisons of Wind Speed Profiles at Saguache Airport (SLV)

	2018-07-14	2018-07-18
WRF LES		
CU Lidar		

Drainage Flow Case Study

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

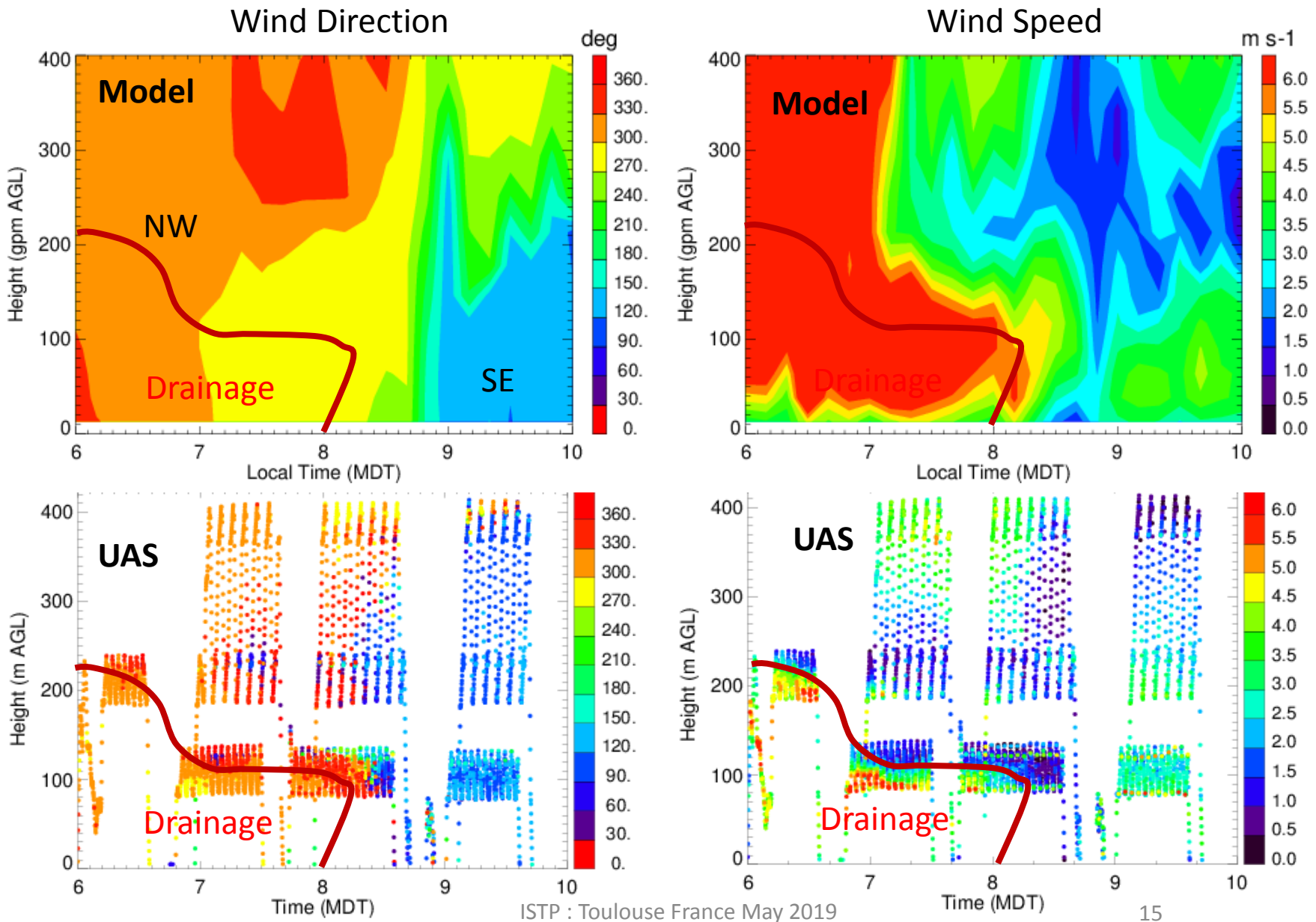
BlueCat Fixed Wing UAS



Asset Deployment in Saguache Canyon

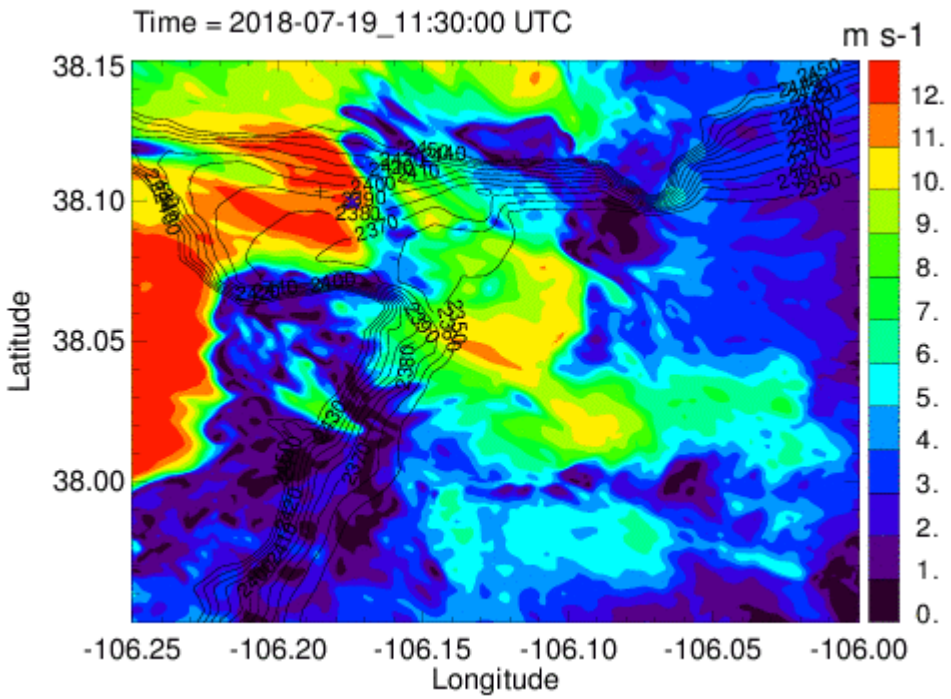
19 July 2018

Evaluation of Modeled Wind Variability with UAS

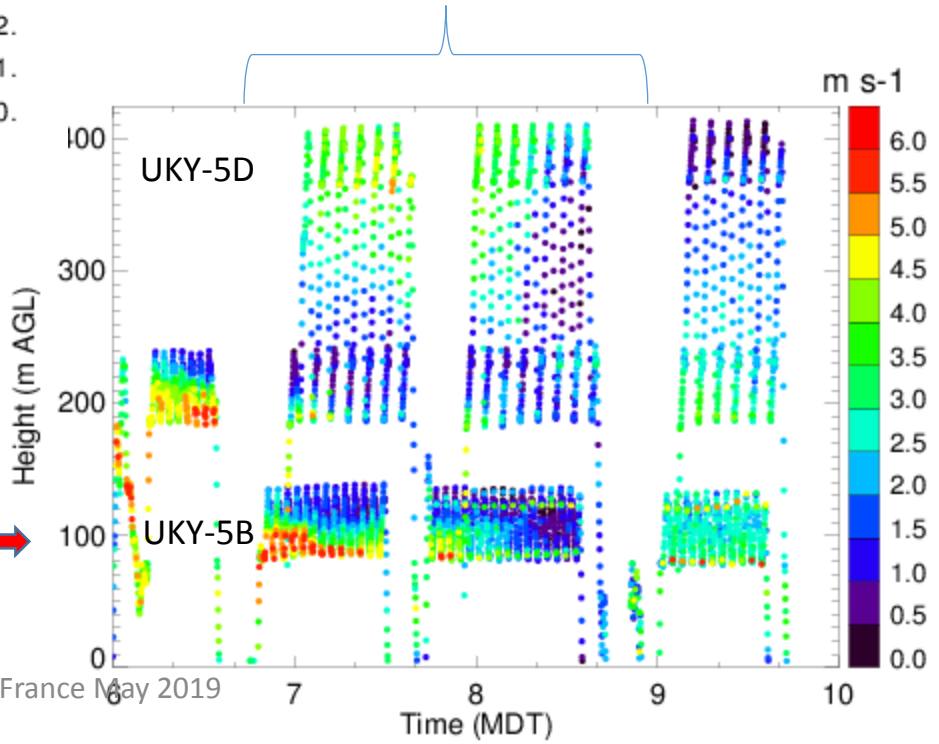


Temporal Variations in Wind Speed

100 m AGL



Movie time period



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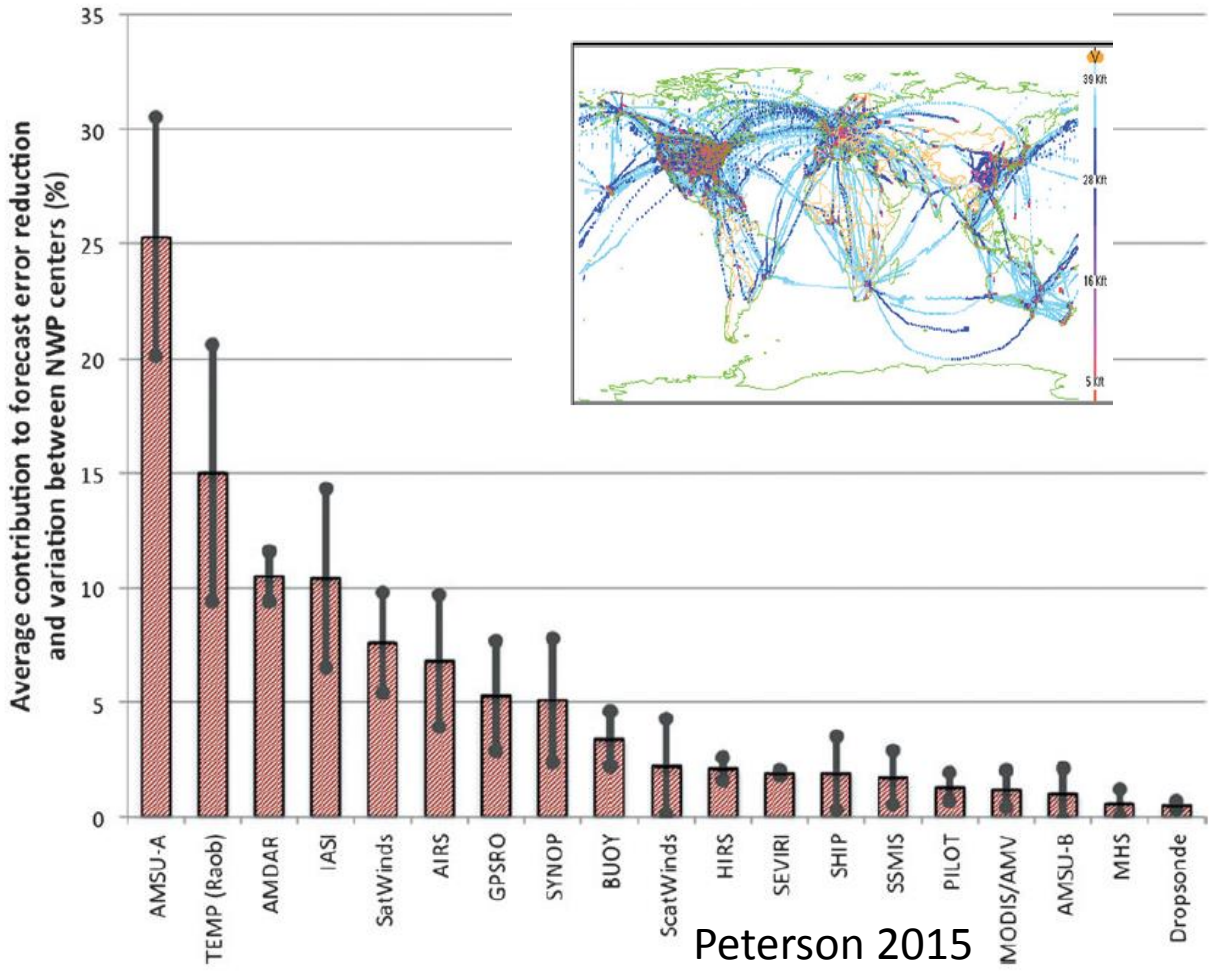
Impact of AMDAR Data on Fcst Error Reduction

Error Reduction per Observational Dataset (24 hour forecast)

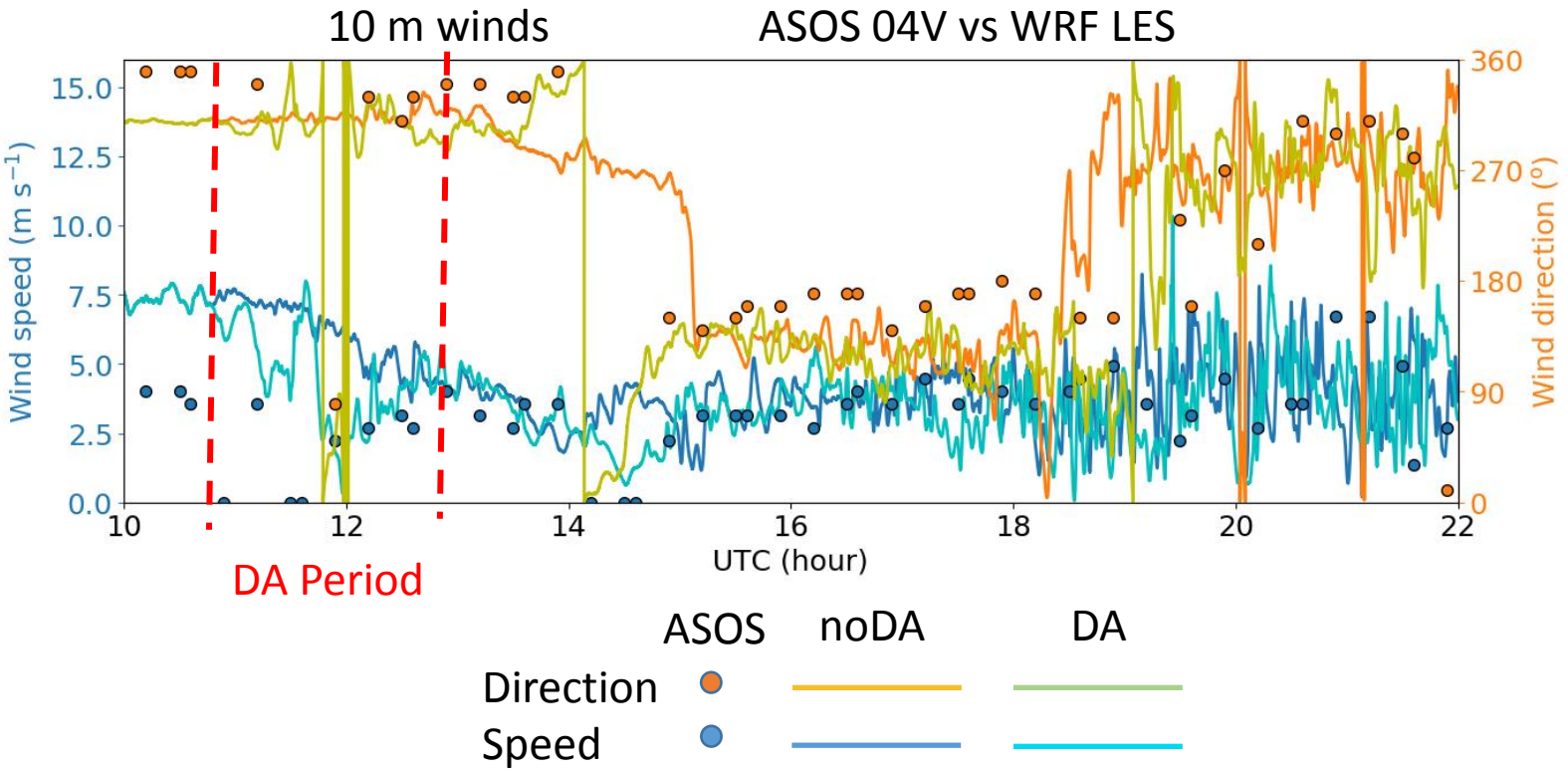
(5 model mean and STD



Peterson 2015

UAS Data Assimilation

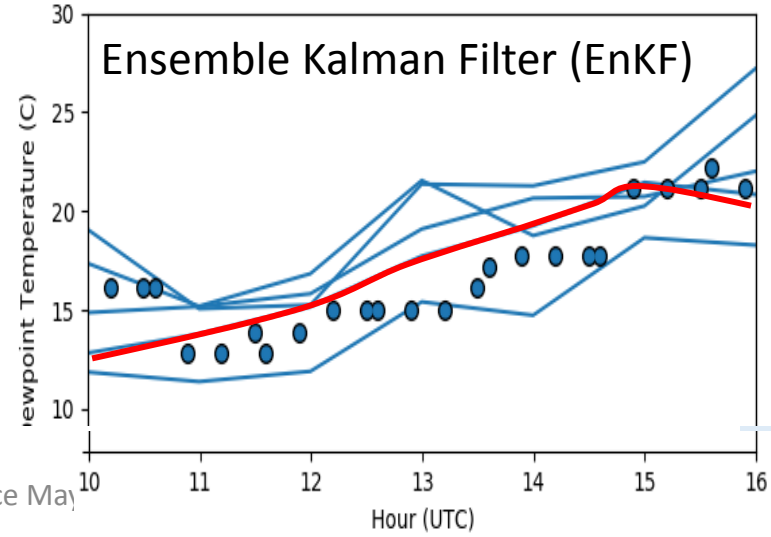
Impact on Low-level Winds



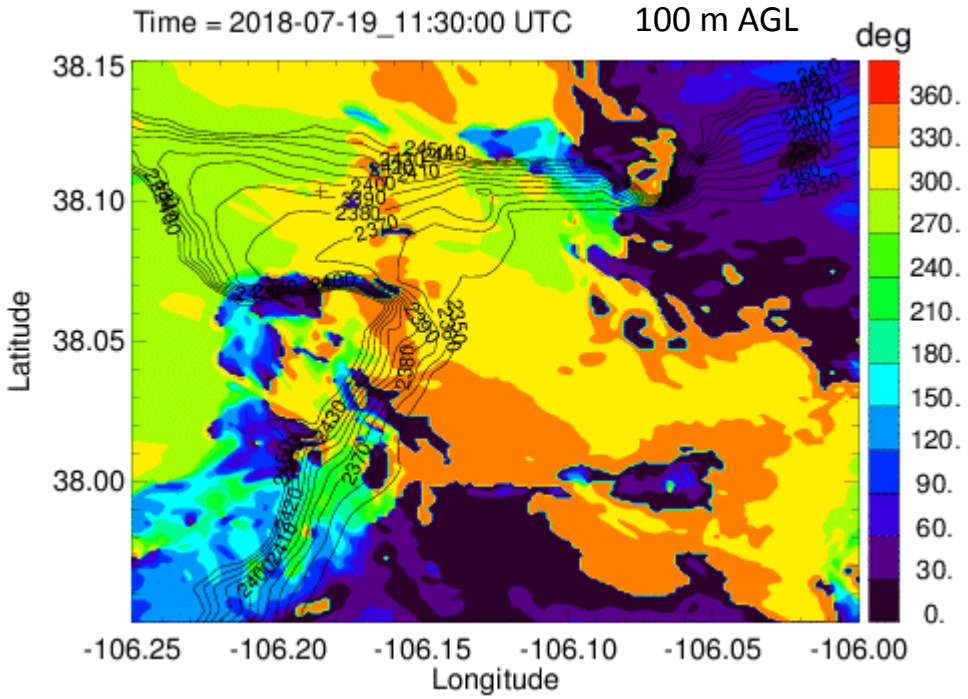
UAS DA results in 25%-50% reduction in mean error

Summary Points

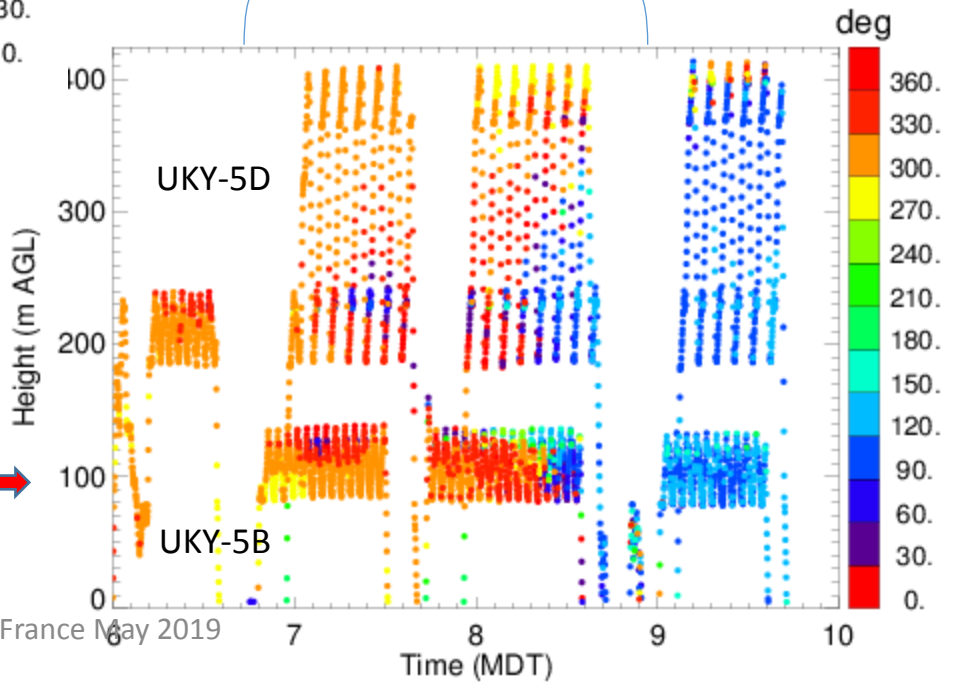
- Meso-to-microscale coupling is critical for properly representing finescale evolution of boundary layer structures.
- Care must be taken to optimize configuration of M2M system.
- Assimilation of local scale observations will be needed to better constrain mesoscale forcing and to quantify uncertainties.



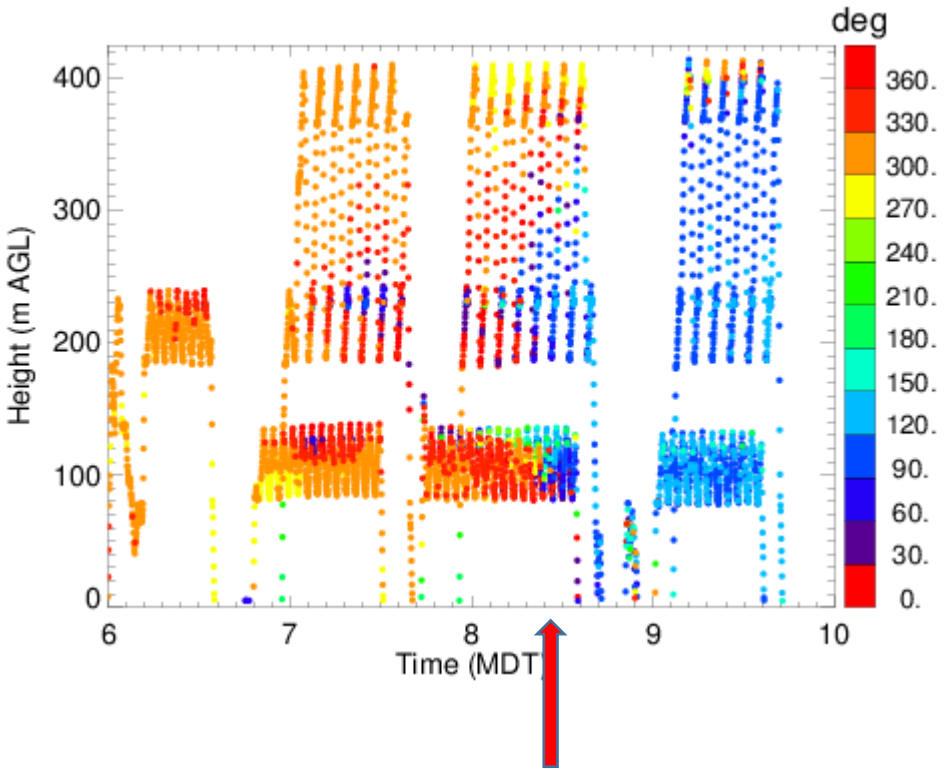
Temporal Variations in Wind Direction



Movie time period



Drainage flow Erosion



WRF LES Wdir 0830 MDT