Radar Strategy for SPLASH and Synergy with SAIL

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Physical Sciences Laboratory

CIRA
Connecting Models and Observations

SPLASH Science *(Contributions from Scanning Radar Observations)*

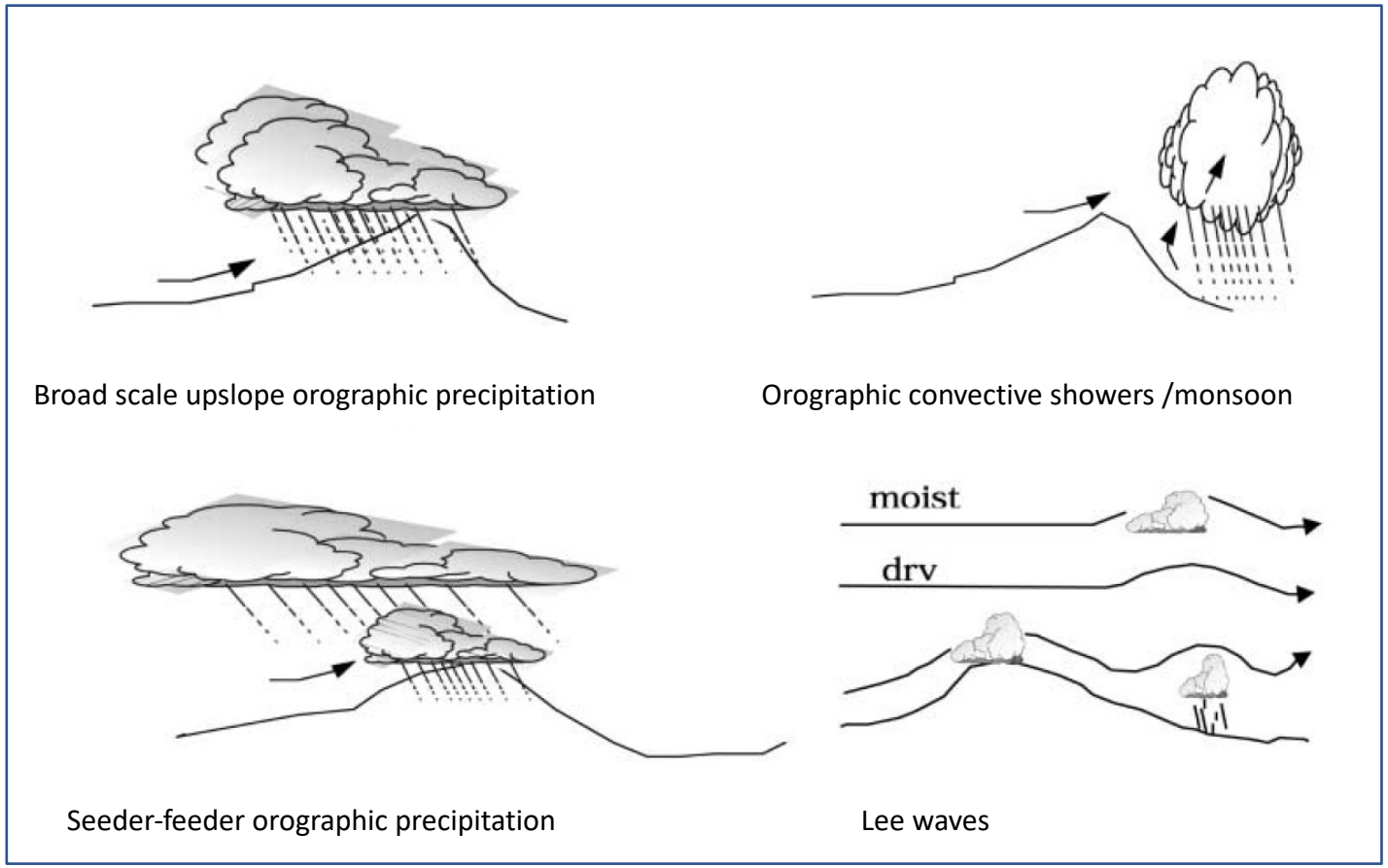
Clouds and Precipitation:
- Quantitative Precipitation Estimation (QPE)
- Snow level and drivers
- Precipitation Microphysics
- Convective Initiation
- Rain-on-snow events

Surface Properties:
- Snow cover
- Sublimation of surface snow
- Surface Albedo
- Soil Moisture
- Surface-atmosphere exchange and impact on hydrology

Mountain Weather:
- Orographic flows
- Diurnal circulations for renewable energy
- Boundary layer development

Improving Prediction:
- Seasonal evolution of snowpack in the NWM
- NWM forcing, including precipitation
- Seasonal streamflow biases
- Soil moisture variability
- Improving convective initiation with DA
- UFS-NWM coupling
- UFS/RRFS evaluation
- Gap-filling radars

What processes contribute to precipitation in the East River Valley and surrounding terrain?



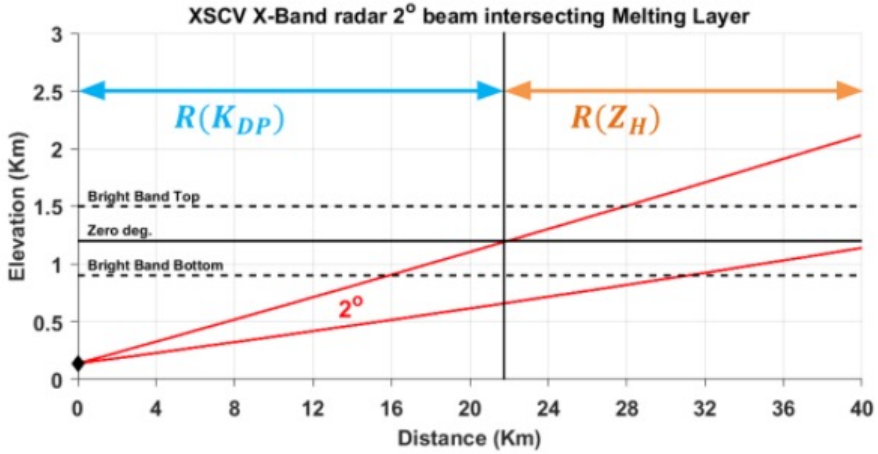
From Lee et al. 200

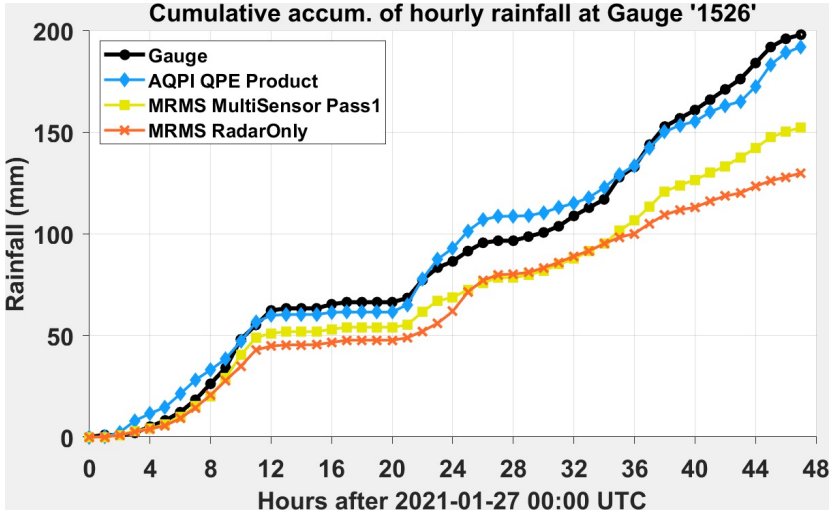
How much precipitation falls in the East River watershed?

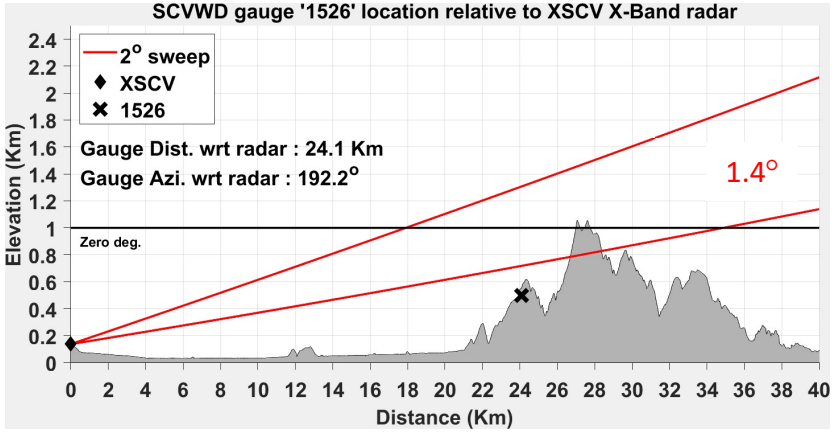
Blended QPE Approach for SPLASH: liquid

Radar Rainfall Estimation in Low Melting Layer

- **The X-Band only QPE is blending of R-KDP and R-Z (with VPR correction applied)**





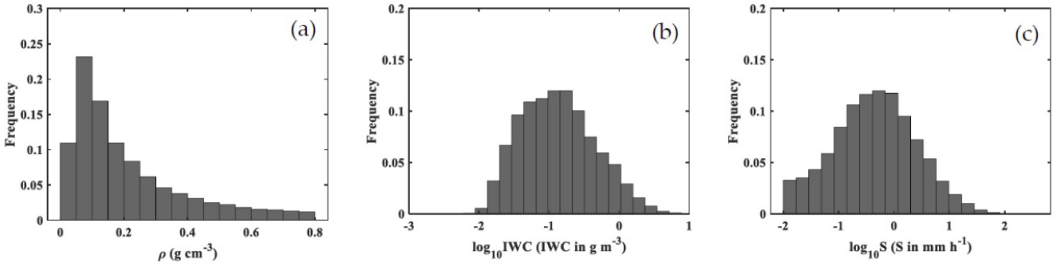


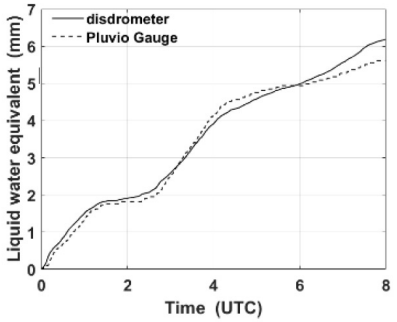
SPLASH Snow QPE Approach

- Liquid QPE in orographic terrain is hard
- Solid QPE in orographic terrain is way harder
  - variable density
- For SPLASH use disdrometer data to retrieve density

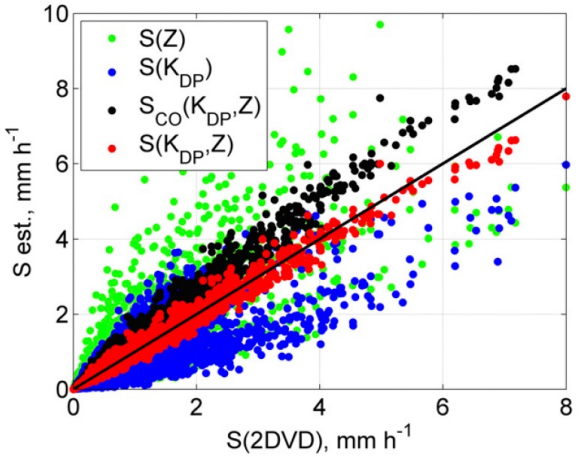
$$\rho_s = \frac{3\rho_0 v^2 C_D}{4gD}$$

  - Follow approach of Yu et al 2020
- QPE approach: $S(K_{dp},Z_H) = A*K_{dp}^{B}*Z_H^{C}$
- Explore other approaches as well



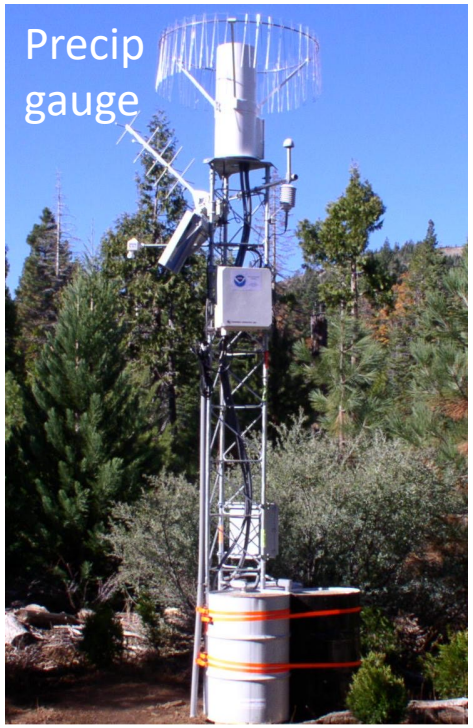


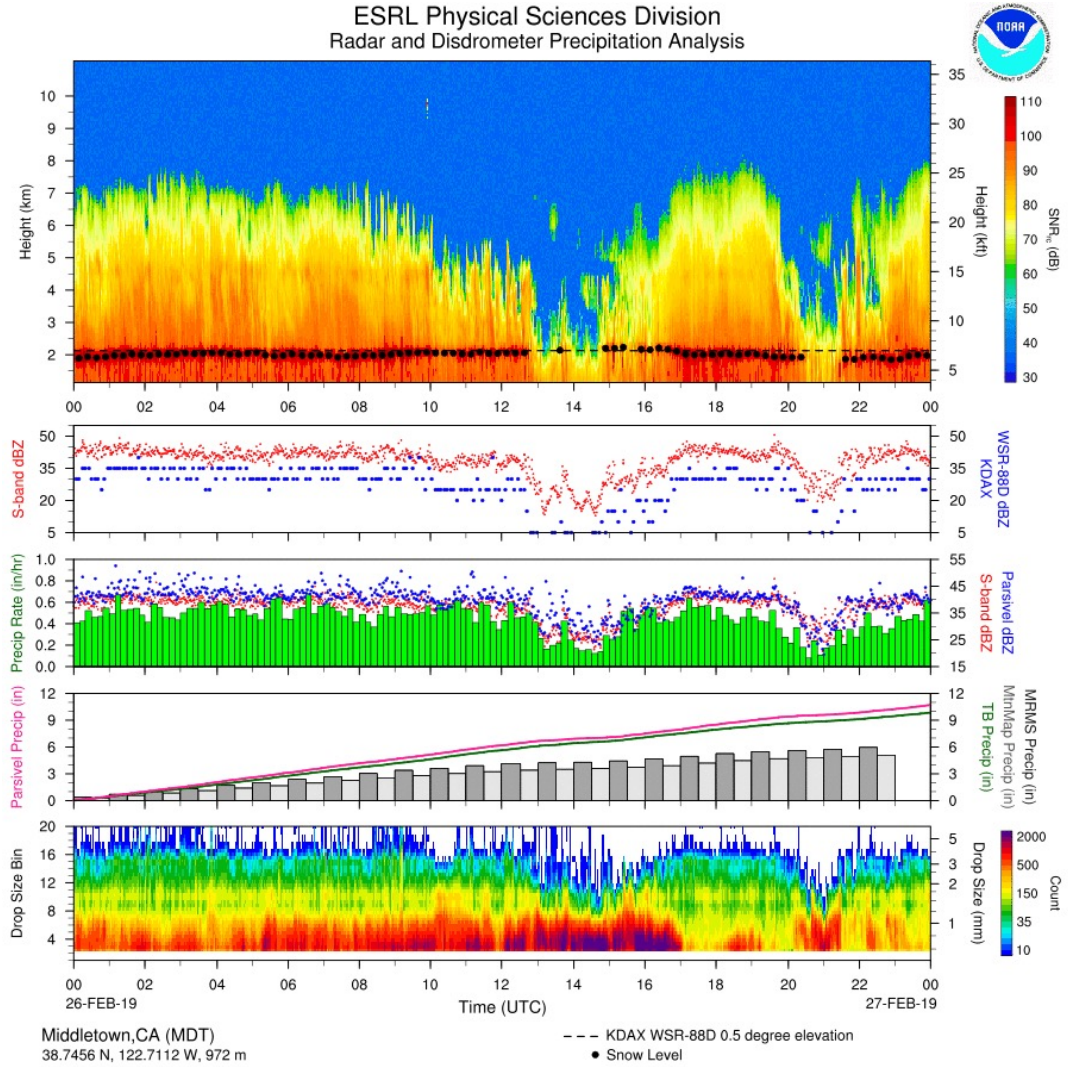
From Yu et al 2020

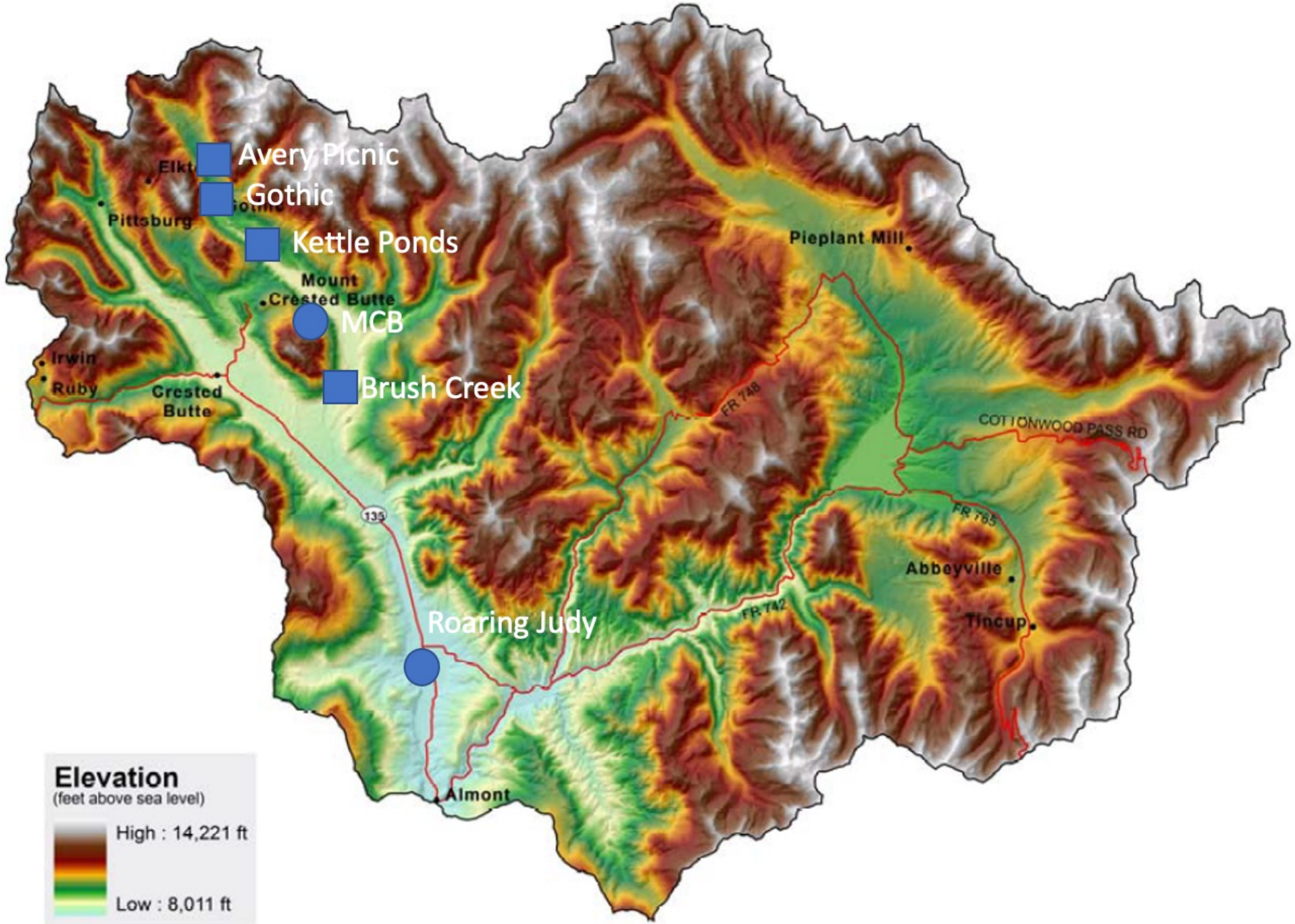


From Bukovcic et al. 2018

Critical Ancillary Measurements for QPE






Avery Picnic
Gothic
Kettle Ponds
MCB
Brush Creek
Roaring Judy
Pittsburg
Mount Crested Butte
Irwin
Ruby
Crested Butte
Pieplant Mill
COTTONWOOD PASS RD
FR 748
FR 765
FR 742
135
Abbeyville
Tincup
Almont
Elevation
(feet above sea level)
High : 14,221 ft
Low : 8,011 ft

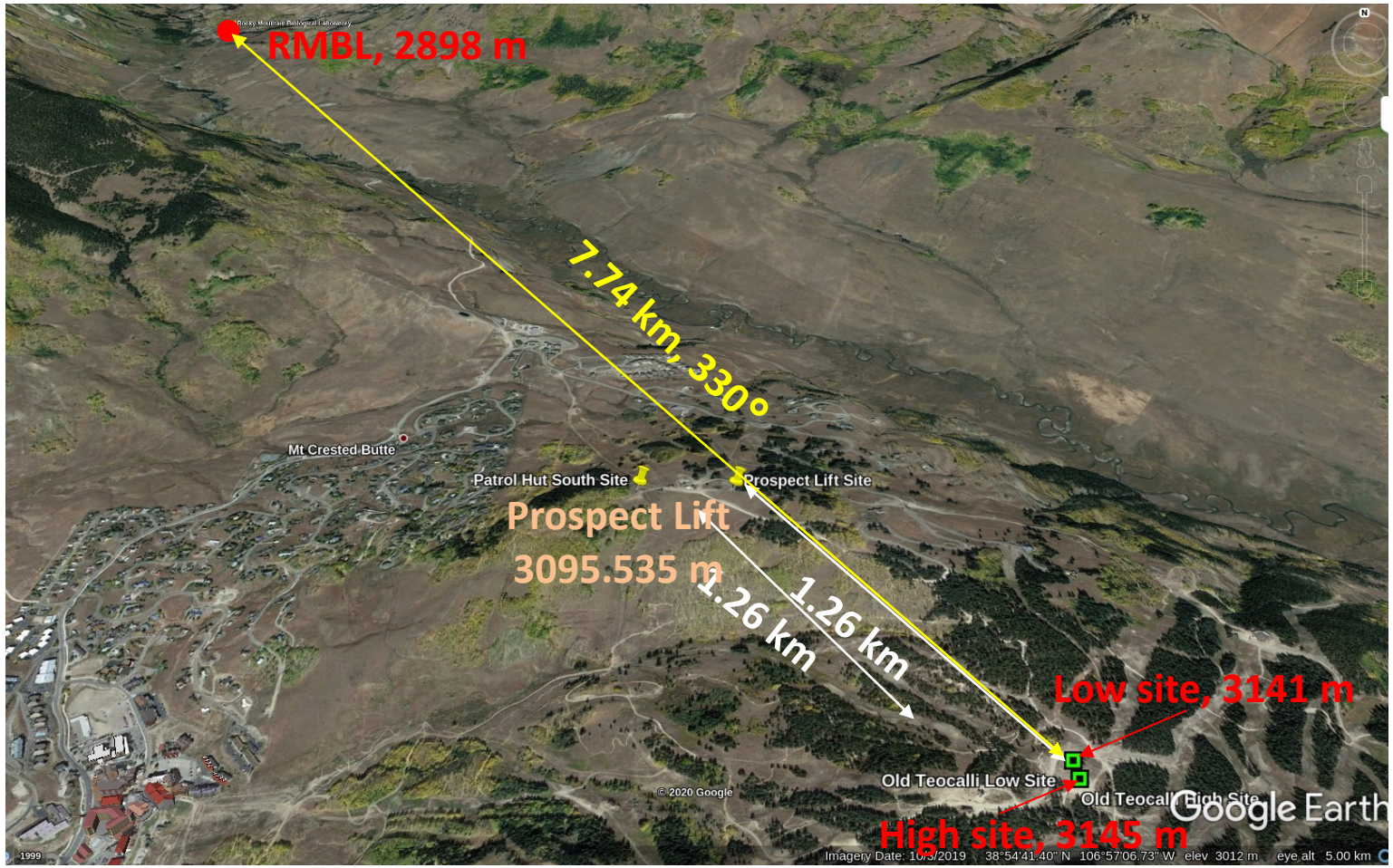
SPLASH/ SAIL radar deployment overview

General Information

- **Old Teocalli Low Site:**
  Latitude: 38.898367 °N.
  Longitude: 106.9432056 °W
  Altitude: 3141 m

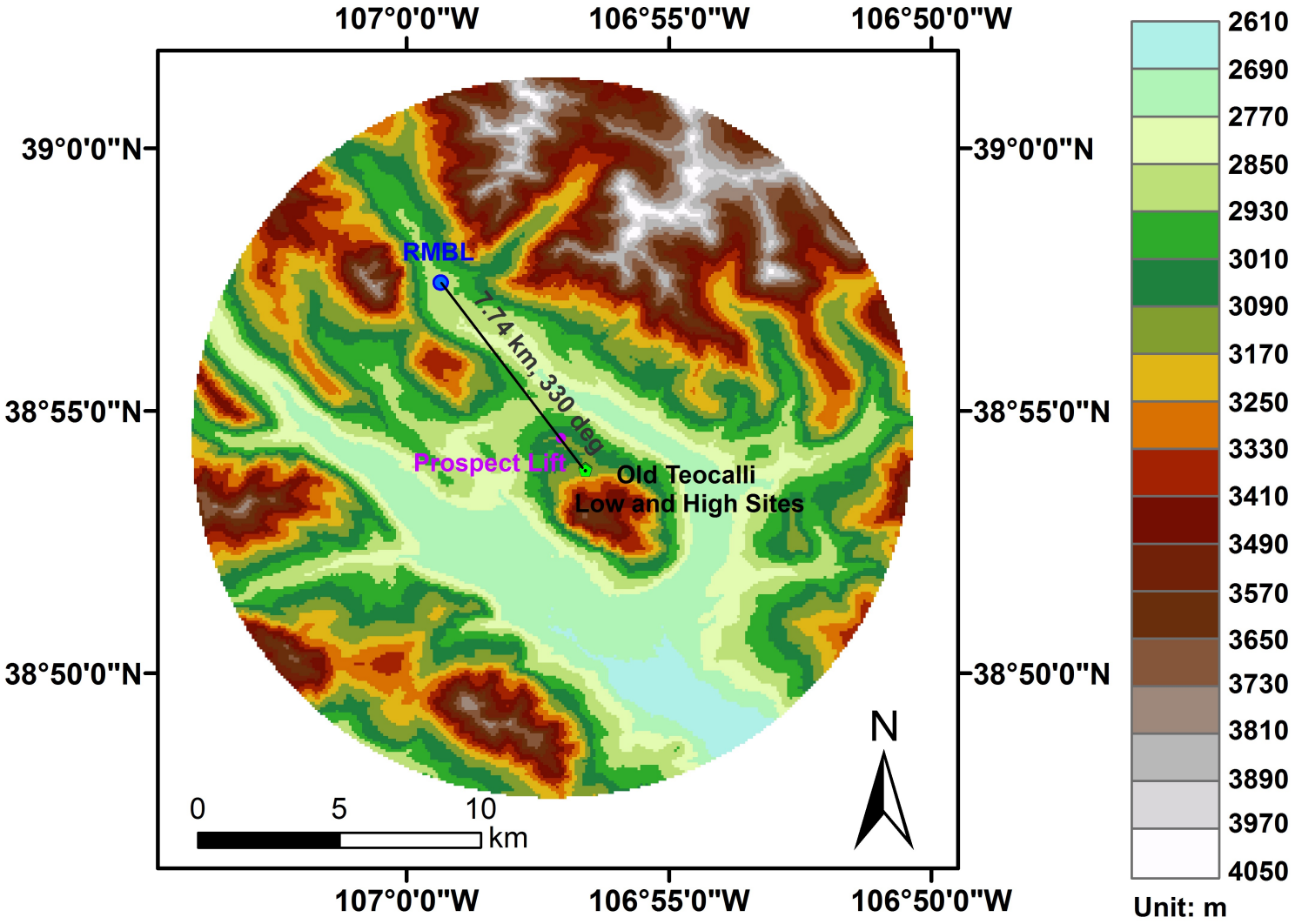
- **Old Teocalli High Site:**
  Latitude: 38.897934 °N.
  Longitude: 106.9432083 °W
  Altitude: 3145 m

- **RMBL:**
  Latitude: 38.9585639 °N.
  Longitude: 106.987761 °W
  Altitude: 2898 m



RMBL: Rocky Mountain Biological Lab (38°57’30.83”N, 106°59’15.94”W, 2898 m)

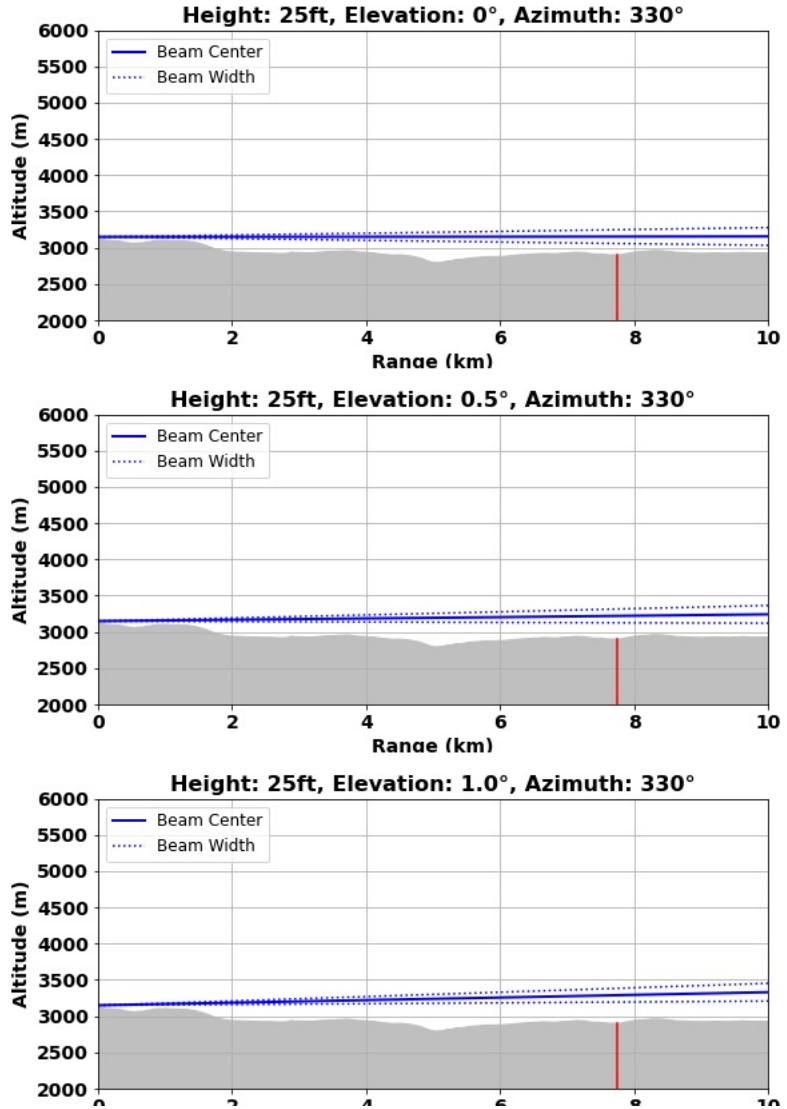
Common for all sites: 10 km radius



Old Teocalli Lift: Ray Profile

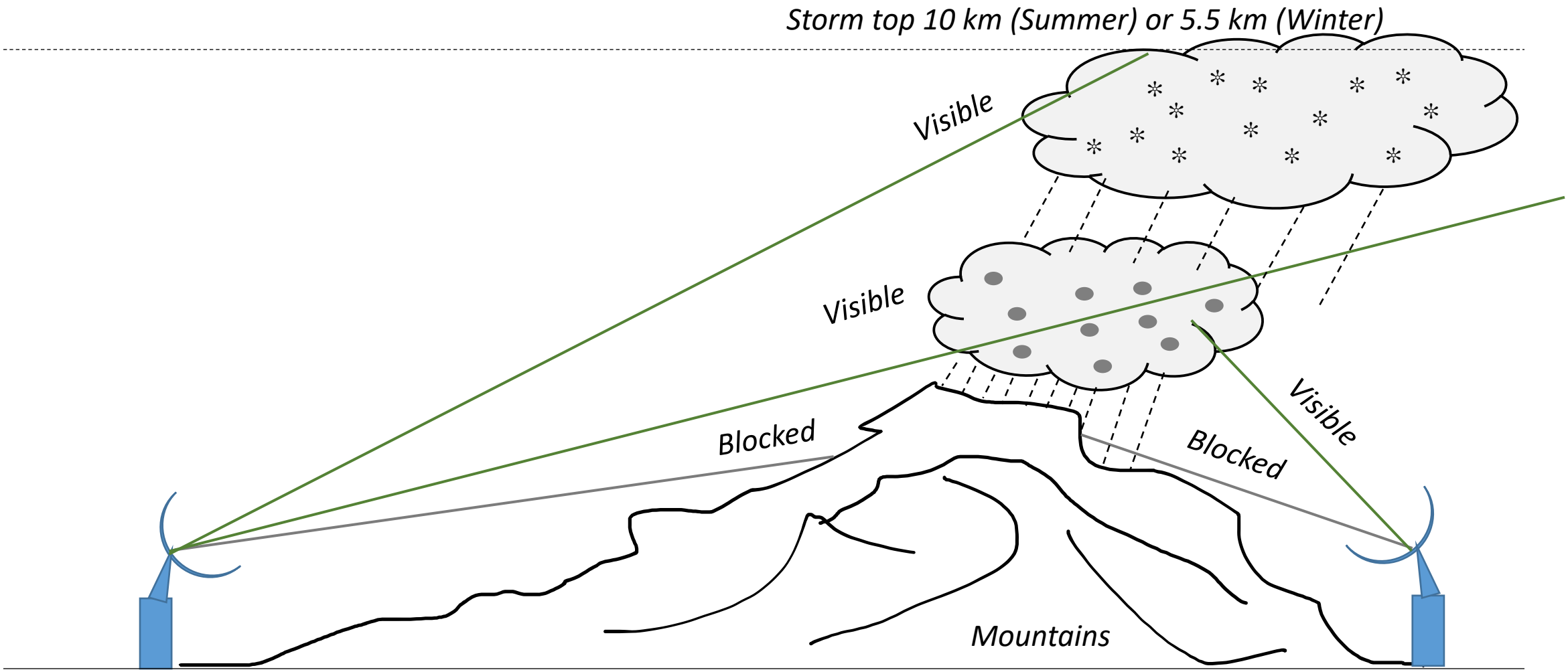
Radar Tower Height: 25 ft, Azimuth: 330°

(a) Low Site



Red line: RMBL: 7.74 km, 330°

Cartoon of two radar observations with terrain in between



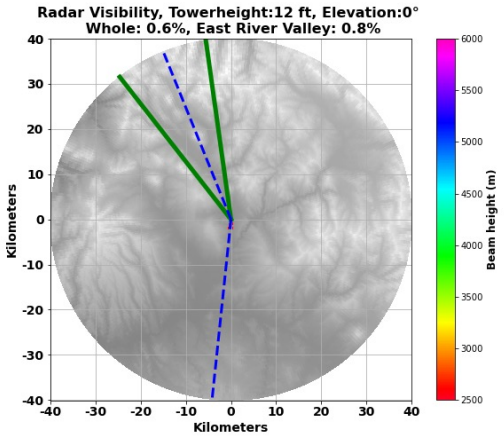
Radar height: 12 ft

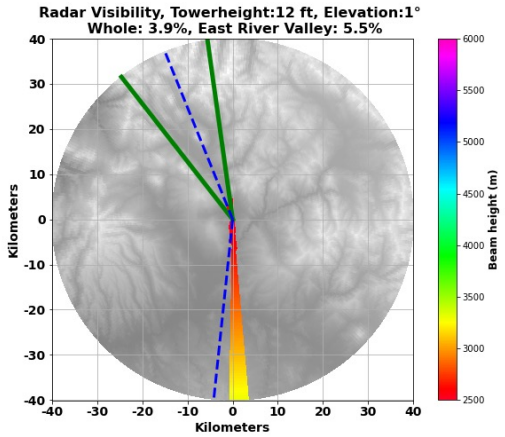
Elevation: 0°, 1.0°, 2.0°, 4.0°, 6.0°, 8.0°, 10.0°, 12.0°

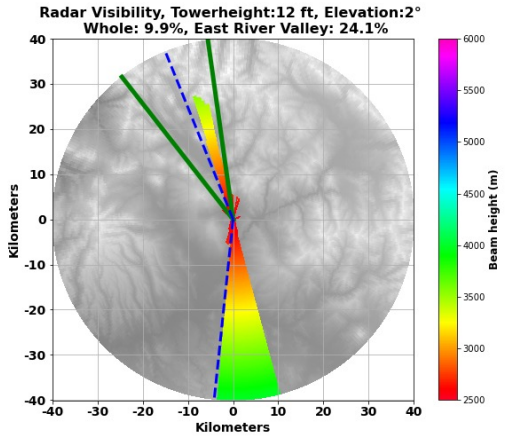
Azimuth: 338°

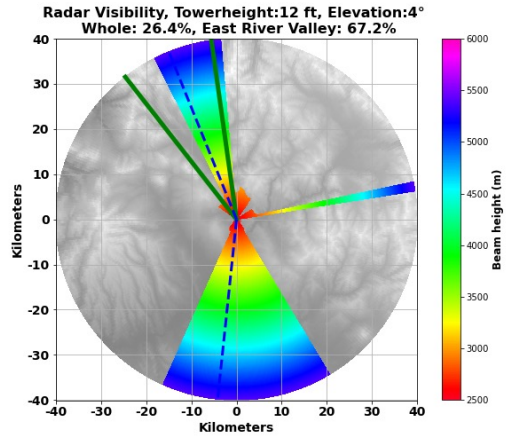
Radar Visibility with vegetation (40km radius)

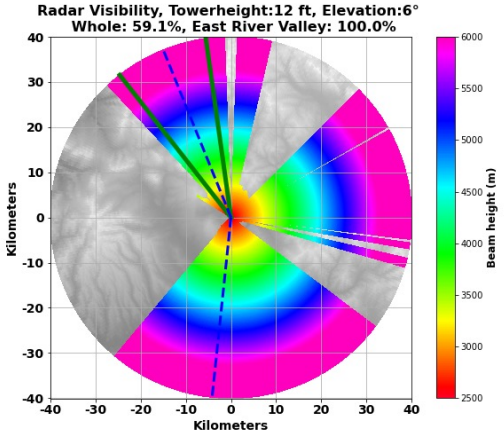
Radar Tower Height: 12 ft, Elevation: 0°, 1.0°, 2.0°, 4.0°, 6.0°, 8.0°, 10.0°, 12.0°

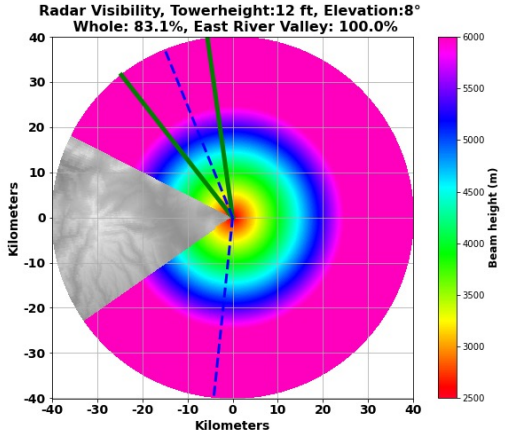


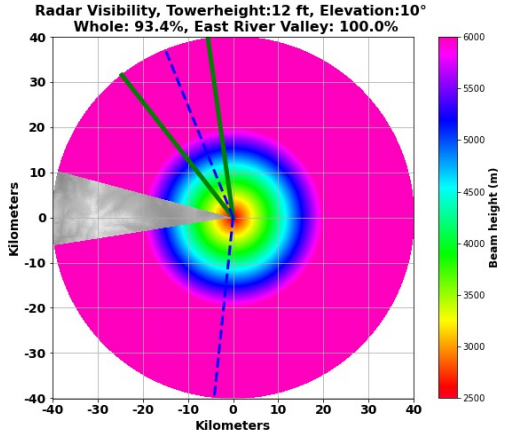


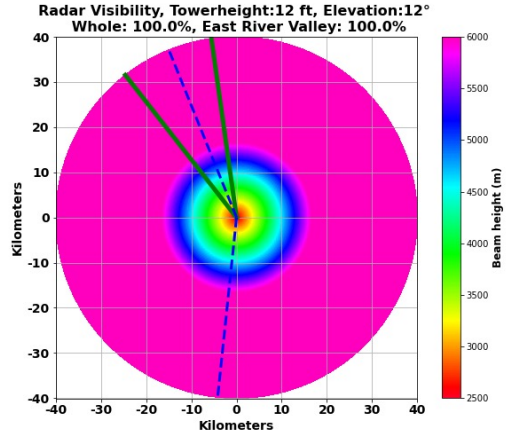






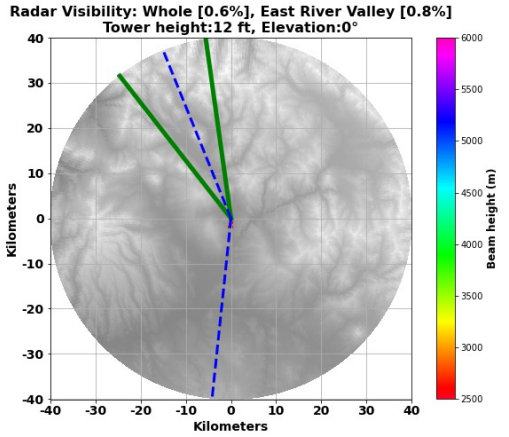


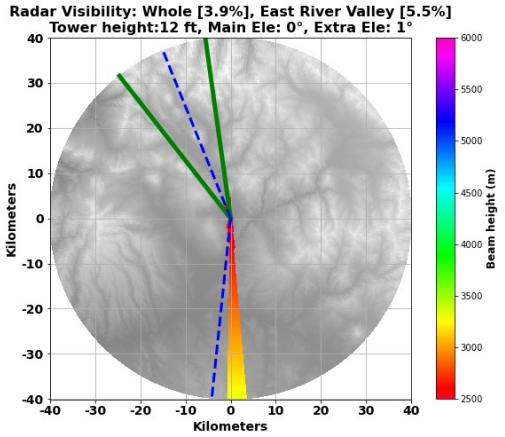


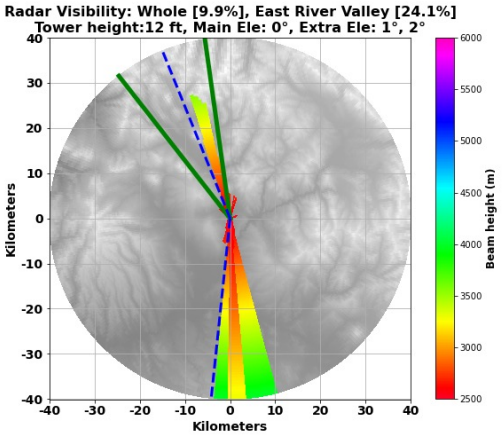


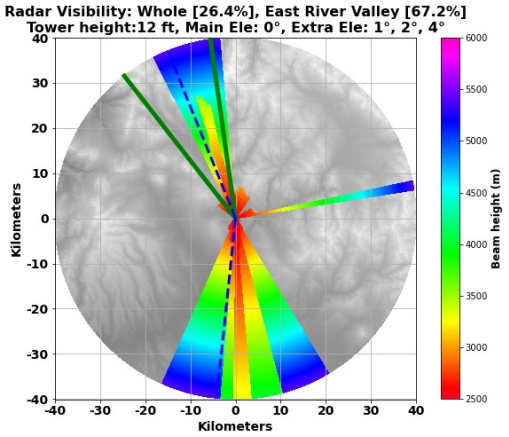
Radar Visibility with Tree height (40km radius), Summer Season

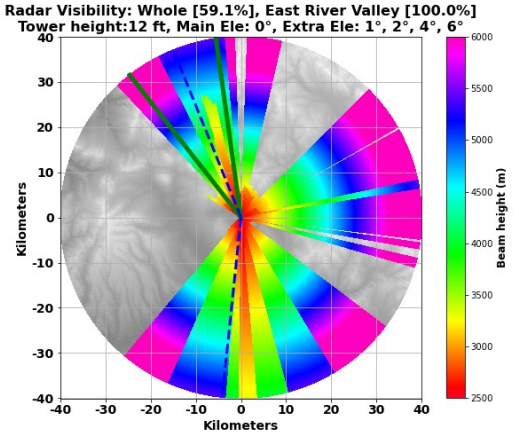
Radar Tower Height: 12 ft, Elevation: 0°, 1.0°, 2.0°, 4.0°, 6.0°, 8.0°, 10.0°, 12.0°

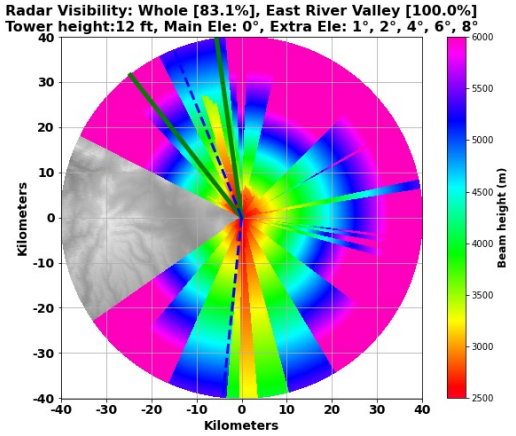


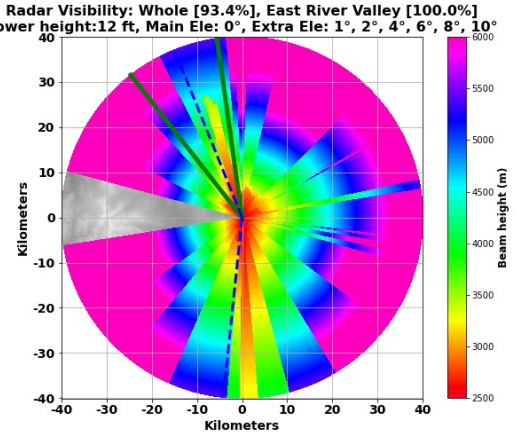


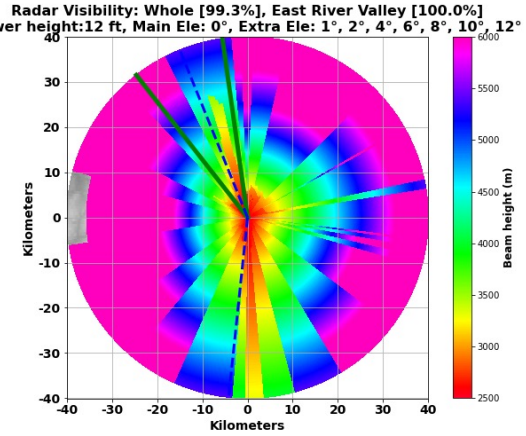






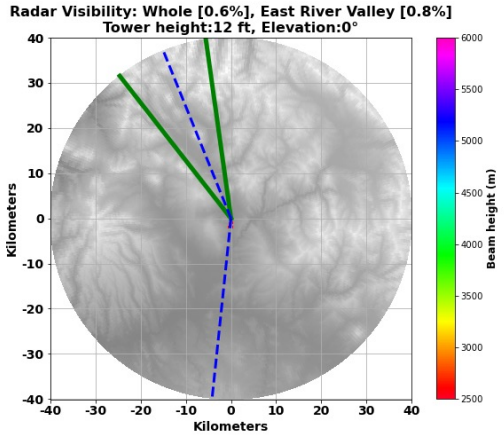


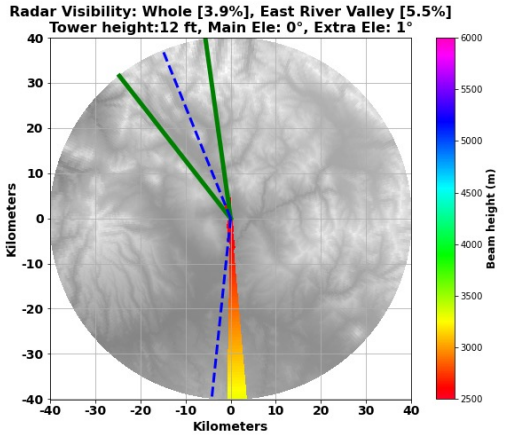


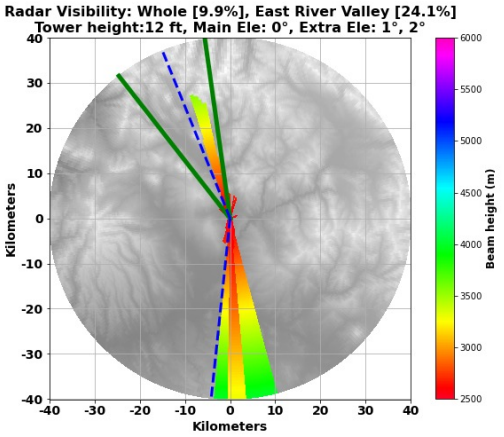


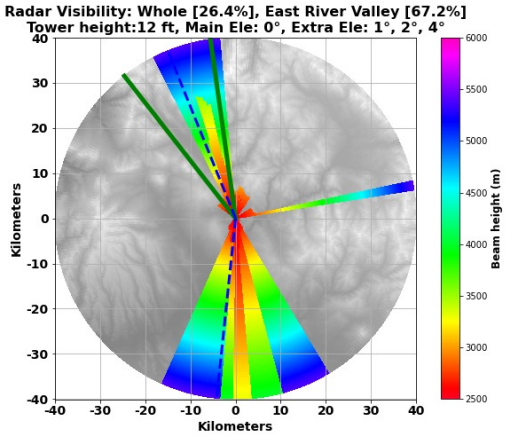
Radar Visibility with Tree height (40km radius), Winter Season

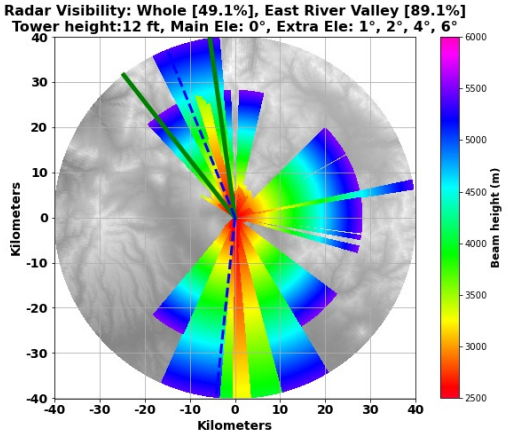
Radar Tower Height: 12 ft, Elevation: 0°, 1.0°, 2.0°, 4.0°, 6.0°, 8.0°, 10.0°, 12.0°

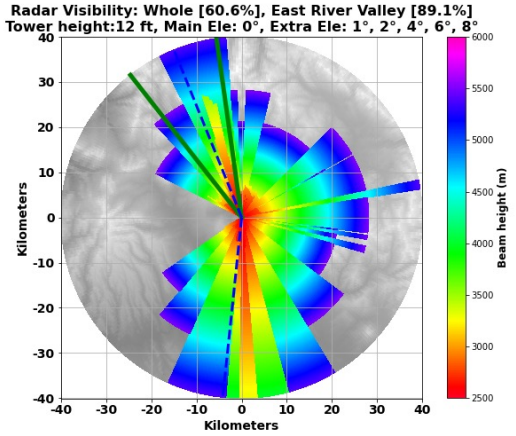


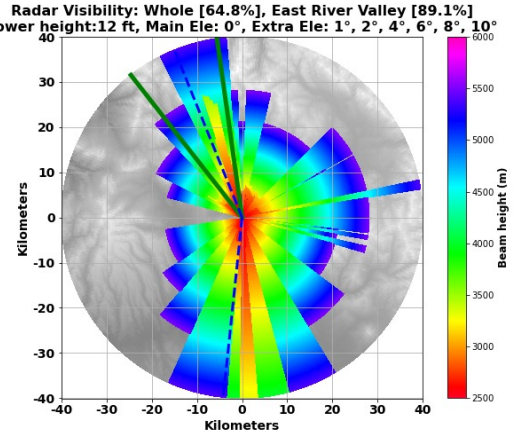


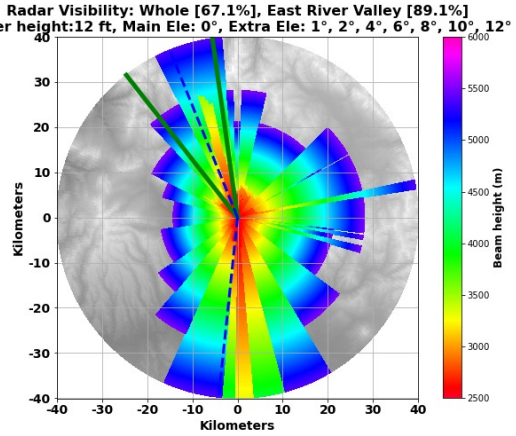




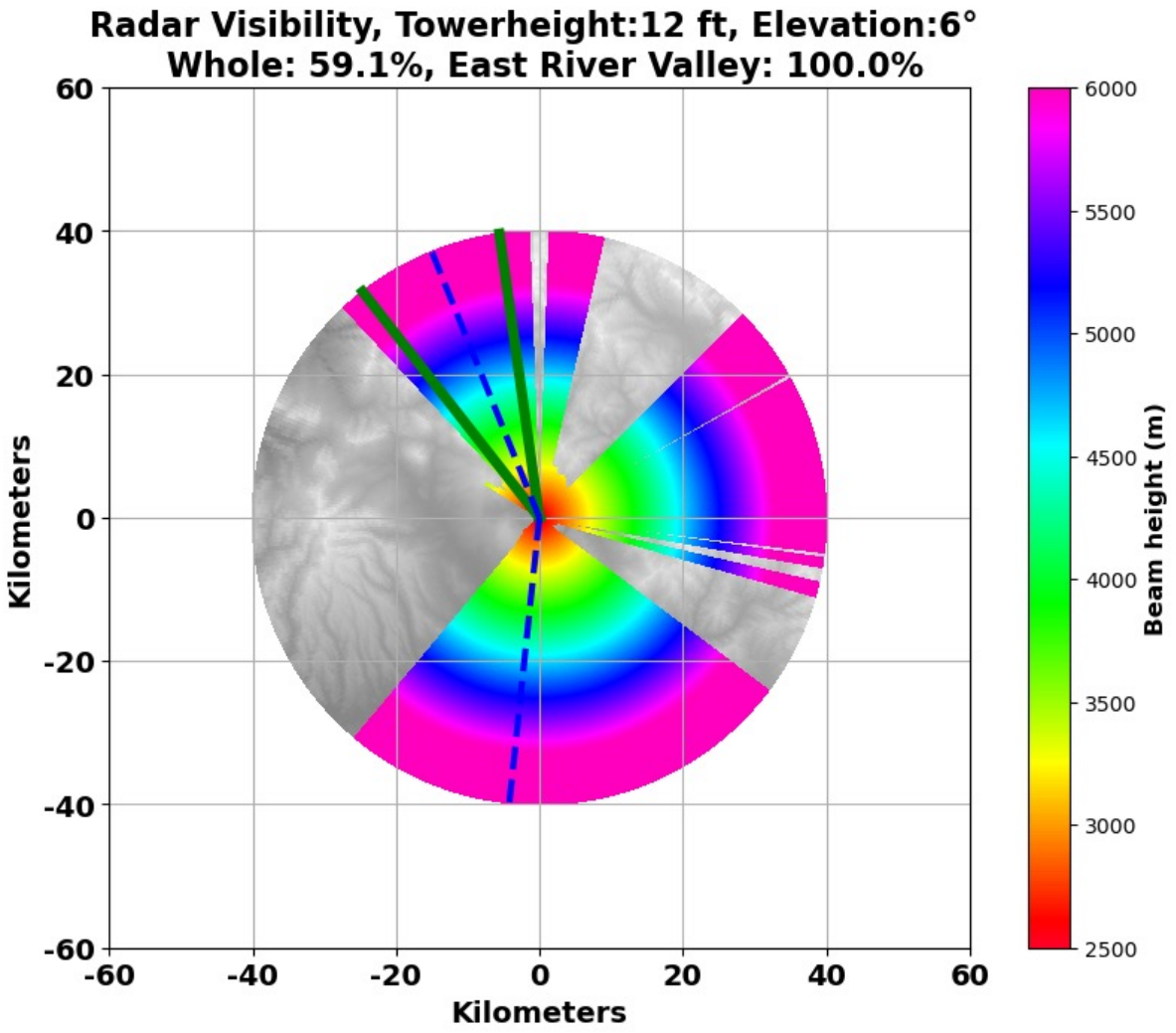




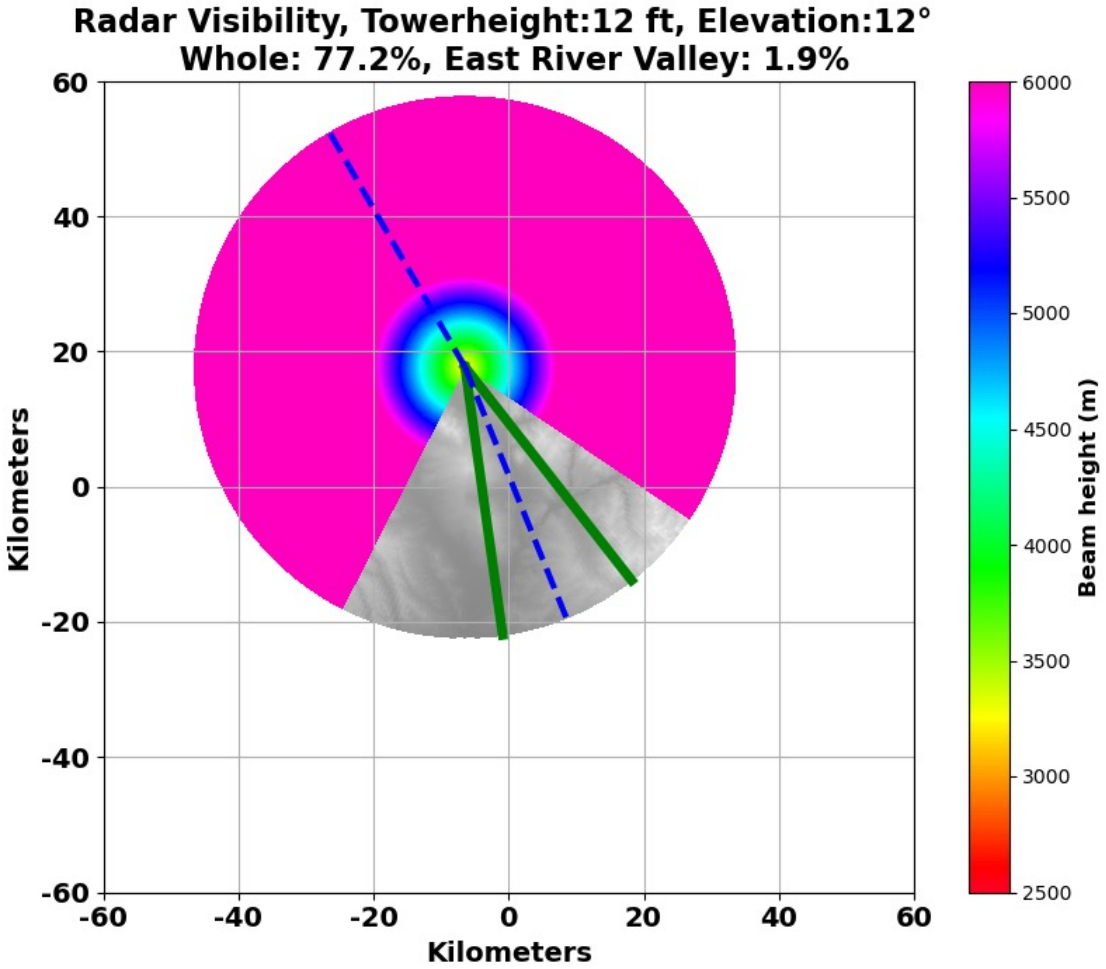


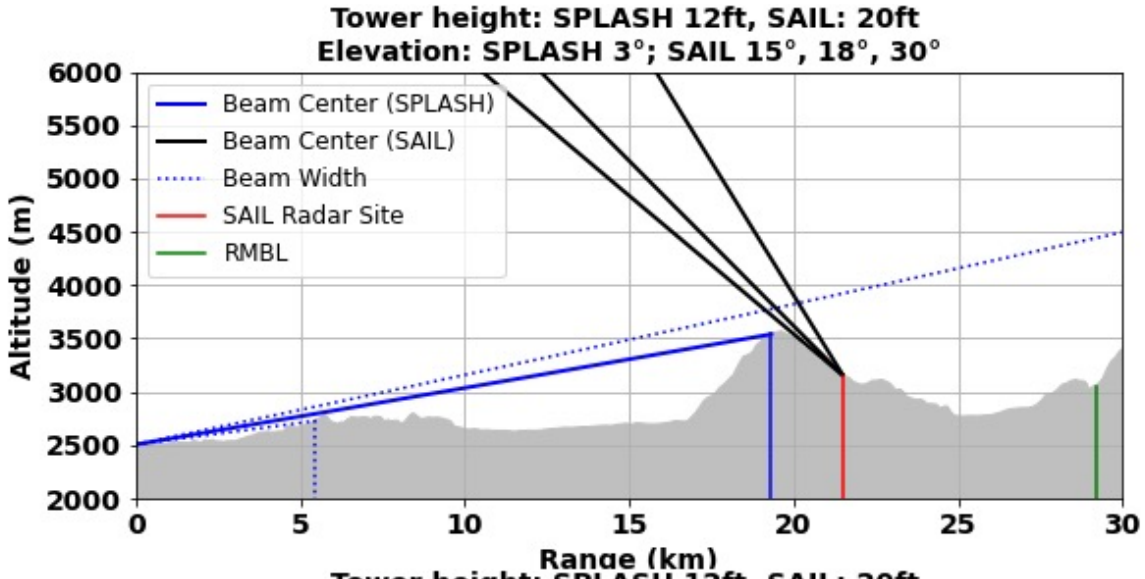
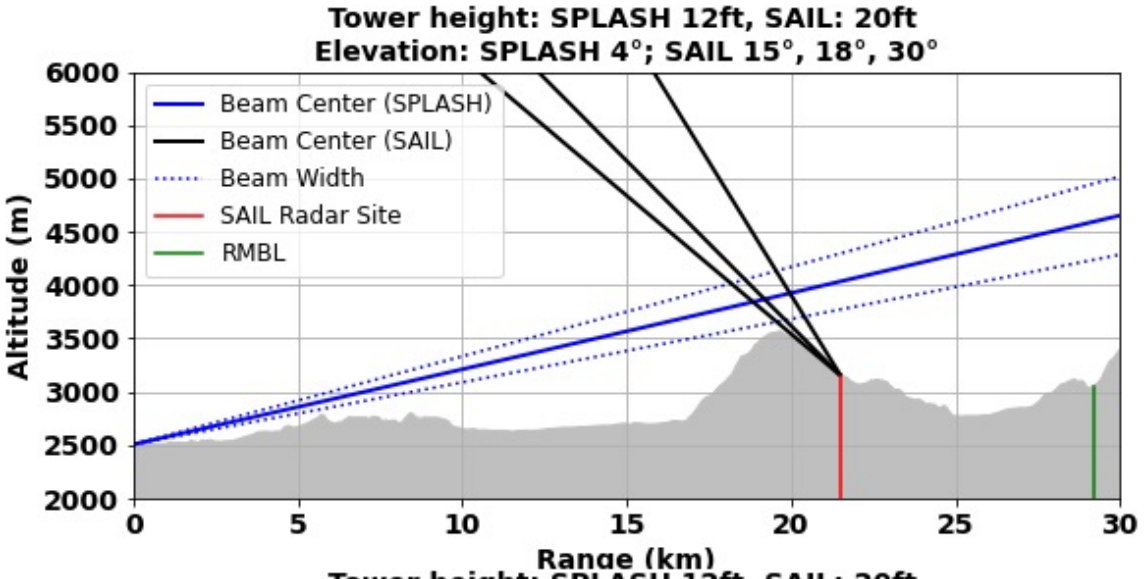
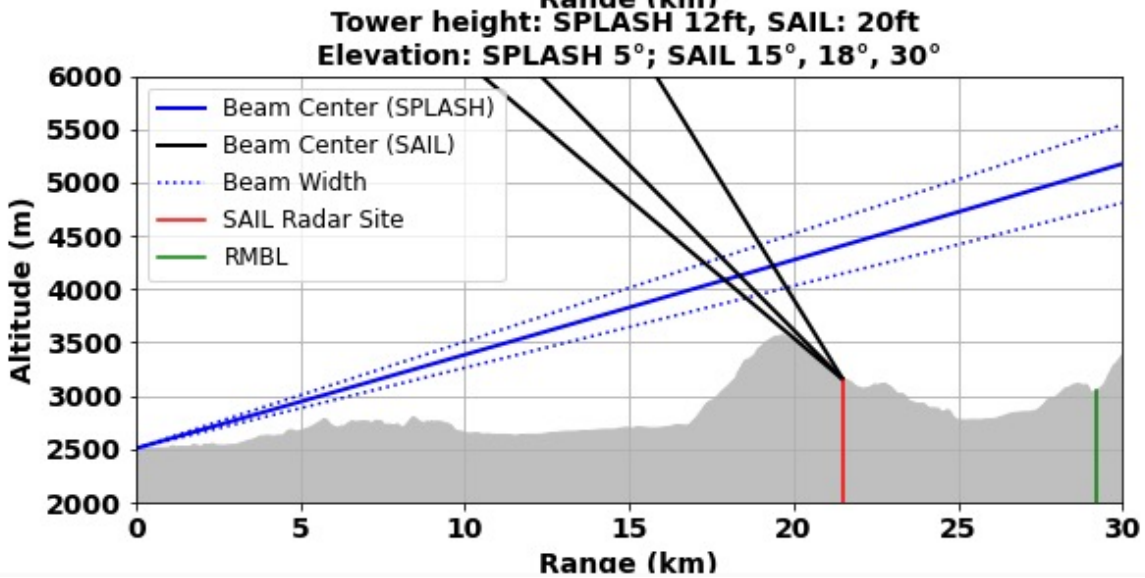
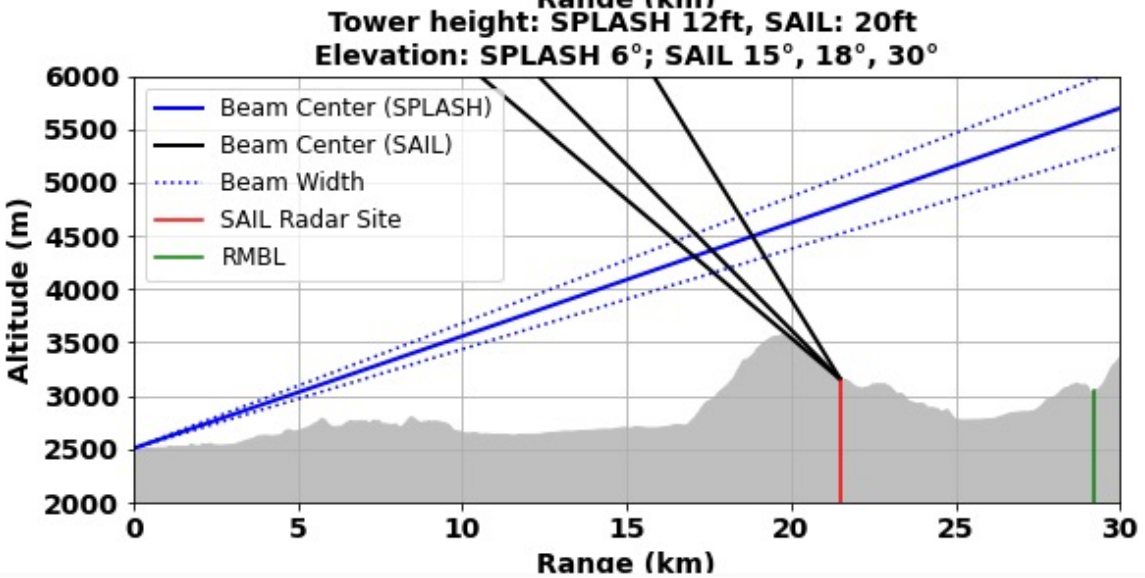


SPLASH Radar, 12 ft, Elevation: 6°



SAIL Radar, 12 ft, Elevation: 12°



Radar Tower Height: SPLASH radar (12 ft), SAIL radar (20 ft)

Elevation: SPLASH 3°, 4°, 5°, 6.0° , SAIL: 15°, 18°, 30°