The Role of X-band Radars in Rainfall Estimation for Complex Terrain

Applications

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### Project Overview

The San Francisco Bay Area is covered by two operational S-band NEXRAD: KMUX and KDMX. However, the KDMX radar beams are partially blocked at low elevation angles due to the mountainous terrain, whereas the KMUX radar is deployed at an elevation of over 1000 m, which can easily overshoot precipitation during the winter storm season in Northern California. As a result, these two radars are not sufficient to provide detailed precipitation information for quantitative hydrometeorological applications.

The National Oceanic and Atmospheric Administration’s (NOAA) Advanced Quantitative Precipitation Information (AQPI) project aims to improve monitoring and forecasting of precipitation, streamflow, and coastal flooding in the San Francisco Bay Area using a combination of observations and numerical models.

AQPI is deploying 5 new polarimetric radar units strategically located to provide high-resolution coverage over populated and flood-prone urban areas throughout the San Francisco Bay region and offshore.

### Radar Rainfall Algorithm

\[ R(K_{dp}) = aK^b \]

- \( K_{dp} \) in rain is more sensitive at X-band compared to lower frequencies such as S-band.
- \( R(K_{dp}) \) is less sensitive to raindrop size distribution (DSD) variation compared to those based on power terms such as \( Z \) and \( Z_{DR} \).
- \( K_{dp} \) is immune to radar calibration, attenuation, and partial beam blockage issues.
- Even in the light rain regions (i.e., \( Z < 30 \, \text{dBZ} \), or \( K_{dp} < 0.3 \, \text{deg/km} \), \( R(K_{dp}) \) performs very well.

### Case Study: 1 February 2019

![AQPI Radar Network](image1.png)

![Reflectivity Observations](image2.png)

![Rainfall Accumulations](image3.png)

### AQPI Radar Rainfall Product

**Summary**

- To date, AQPI has deployed two X-band radar systems; two more are scheduled for installation in the next few months.
- The radar information is being used by local water managers for situational awareness and to inform decision making.
- The AQPI X-band radar provides reasonable QPE without gauge-based correction compared to gauge measurements.
- The AQPI radar QPE has much higher spatiotemporal resolution so it observes much more variability within watersheds compared to NEXRAD QPE.
- Research is underway to assess the streamflow sensitivity to different precipitation inputs (see Poster H43I-2115).
- For more information about AQPI, visit [https://www.esrl.noaa.gov/psd/aqpi](https://www.esrl.noaa.gov/psd/aqpi)