DEVELOPMENT AND IMPLEMENTATION OF AN ATTENUATION CORRECTION ALGORITHM FOR CASA OFF THE GRID X-BAND RADAR NETWORK

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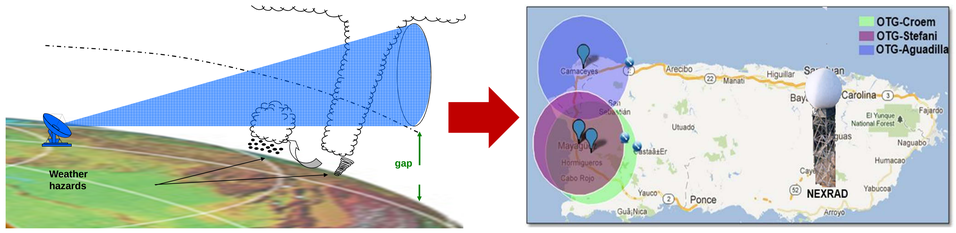
casa

ABSTRACT

The Collaborative Adaptive Sensing of the Atmosphere (CASA) Engineering Research Center (ERC) at UPRM developed an Off-The-Grid (OTG) X-band single polarized radar network deployed in the Puerto Rico west coast. With this kind of radar it is possible to observe some meteorological events that might not be detected by NEXRAD radar due to earth curvature. The main goal of this research is to break with the paradigm and limitations of using X-band OTG radars as a reliable forecast system, where the principal issue is the attenuation due to rain along the path. To overcome this problem the attenuated signal could be rectified through a correction algorithm based on reflectivity and also an ideal polarization (vertical or horizontal) will be identified to certain effects of rain attenuation. To correct for attenuation a hybrid between Hitschfeld – Bordan (HB) method and a Surface Reference Technique (SRT) would be used where the reference signal is the NEXRAD radar data because is considered negligible to attenuation.

INTRODUCTION

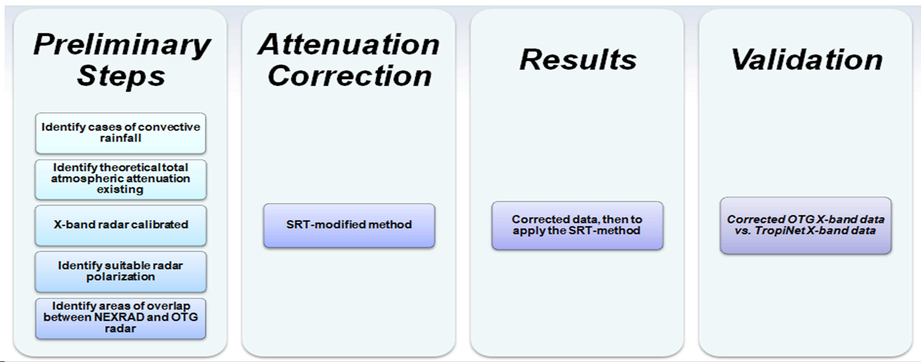


- The WSR 88-D S-band NEXRAD is not capable of observing the lower troposphere volume.
- NSF ERC-CASA UPRM deployed and Off-The-Grid (OTG) X-band Network in the Puerto Rico west cost.

OTG X-band radars are limited in their applicability for rainfall measurements due to attenuation caused by:

- Atmospheric constituents such as gases (water vapor and oxygen).
- Clouds and rain.

METHODOLOGY

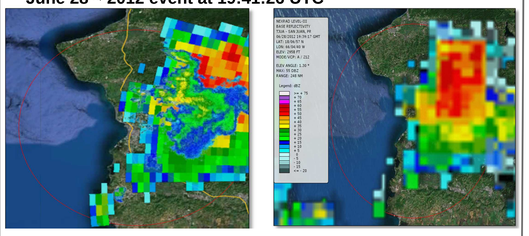


RESULTS

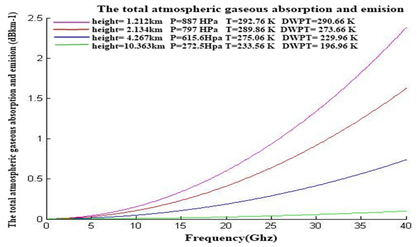
Preliminary Steps

- Identify case of convective rainfall:

June 28th, 2012 event at 19:41:26 UTC

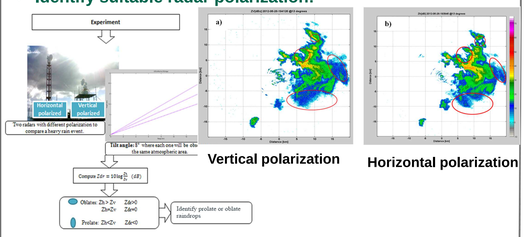


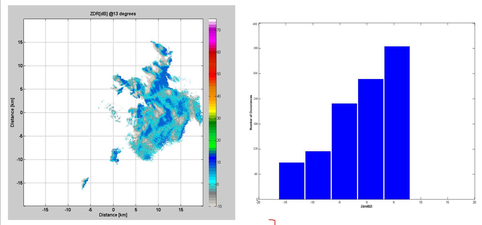
- Identify theoretical total atmospheric attenuation existing



For this purpose, the absorption model summarized by (Ulaby et al., 1981) and the improved atmospheric absorption model developed by (Cruz- Pol, 1998) at the 3.19 cm of the OTG X-band radar were used.

- Identify suitable radar polarization:





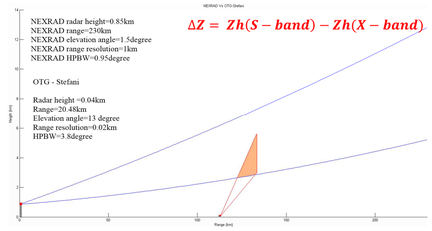
Z_{DR} is positive for oblate raindrops

Z_{DR} negative for prolate raindrops

Z_{DR} approximately 0 for spherical shape raindrops

There are greater numbers of prolate rain drops

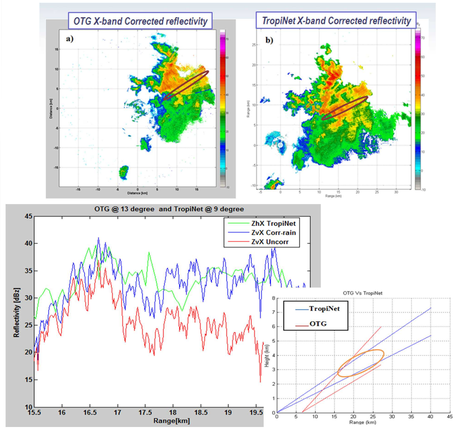
- Identify areas of overlap between NEXRAD and OTG radar



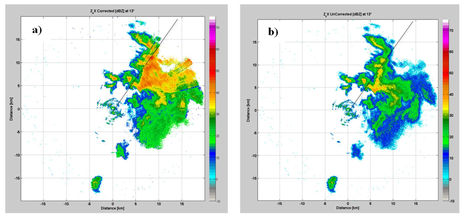
$$\Delta Z = Zh(S-band) - Zh(X-band)$$

- Attenuation Correction

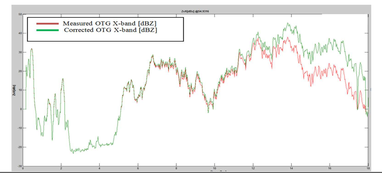
Validation



- Attenuation Correction for Rain Results



OTG X-band corrected reflectivity OTG X-band measured reflectivity



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CONCLUSIONS

- The reflectivity obtained from Off-The-Grid (OTG) X-band single polarized radars was corrected.
- The SRT-modified is properly estimating the true reflectivity.
- Before applying the attenuation correction method:
  - The radar was calibrated.
  - The attenuation caused by atmospheric factors was proven to be negligible.
  - Vertical polarization is the ideal type of polarization to avoid attenuation.

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