Cross-validation of CSU-CHIVO with GPM-DPR and ARM-CSAPR2 during RELAMPAGO

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RELAMPAGO (Remote sensing of Electrification, Lightning, And Mesoscale/microscale Processes with Adaptive Ground Observations) was an international field campaign that took place in Argentina near Sierras de Cordoba. It had an Intense Observing Period (IOP) from November 1st to December 15th of 2018 and an extended period that went until January 31st of 2019. In this paper we study Colorado State University C-band Hydrological Instrument for Volumetric Observation (CSU-CHIVO) and cross-compare it with GPM-DPR during the field campaign. CHIVO is also compared with C-band Scan Precipitation Radar 2 (CSAPR2) that is part of ARM and also was deployed during RELAMPAGO. Both radars were in the field for IOPs and the extended period.

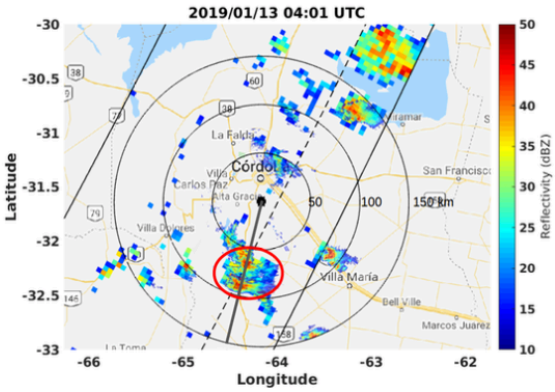
RELAMPAGO domain is known for having severe weather and convective systems with cloud top that during the campaign reached more than 20 km height. On January 13th, GPM captured a group of convective cells in Cordoba region. For this case, CHIVO RHI in 192° azimuth overlaps significantly well with bin 13 of DPR Normal Swath which allow to do a vertical analysis of this convective system. Fig. 1.A. shows GPM-DRP and CHIVO reflectivity overlapped in the same map. A vertical cut of the storm is shown fig. 1.B using GPM-DPR corrected reflectivity for both bands. Differential Frequency Ratio (DFR) is computed from Ku and Ka DPR and is shown in Fig 1.B bottom. CHIVO RHI moments are shown in Fig. 1.C, DROPS 2.0 is used to correct attenuation in reflectivity and differential reflectivity and to get Hydrometeor Classification. Note the core of the cell (~65 km for CHIVO RHI and latitude -32.2 for GMP vertical cut) exhibits interesting features. Reflectivity is significantly high below 8 km for both platforms and the column has a remarkable high DFR that coincides with high KDP and ZDR. HydroClass resolves for this column heavy rain below 5 km. GPM made another pass on December 6th but this time with stratiform. Common Volume methodology is performed to find the geometry that matches DPR and CHIVO. Bias and Pearson Correlation Coefficient are computed to compare both platforms.

To compare CHIVO and CSAPR2, stratiform cases are selected. Attenuation correction of reflectivity and differential reflectivity are performanced for both radars. CHIVO and CSAPR2 are 80 km apart to each other. The region in between them is used to analyze reflectivity and differential reflectivity distribution. One of the cases that is used for this analysis is January 26th at 5:30 UTC since it exhibits a homogeneous melting layer.

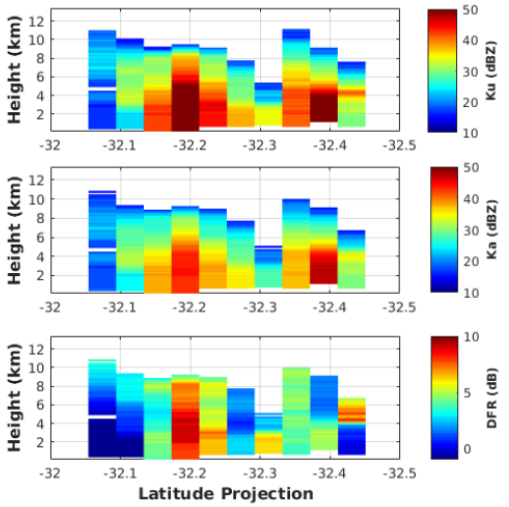
In conclusion, CHIVO compares well with GPM with a high correlation within 88% and bias within 1 dB. Vertical analysis for convective and stratiform storms coincides for both platform in the sense that both show similar structure and microphysics. In the same way, CHIVO agrees with CSAPR2 with similar distributions of reflectivity and differential reflectivity during stratiform cases. These results show that CHIVO data is reliable and consistent with other measurements during RELAMPAGO.

Keywords: RELAMPAGO, CHIVO, GPM, DPM, ARM, CSAPR2

(A) GPM-DPR and CSU CHIVO, Solid line means CHIVO RHI in (C), dashed line is DPR vertical cut in (B)



(B) Vertical cut of DPR along dashed line



(C) CSU-CHIVO RHI | Azimuth: 192° | 2019/01/13 04:06 UTC

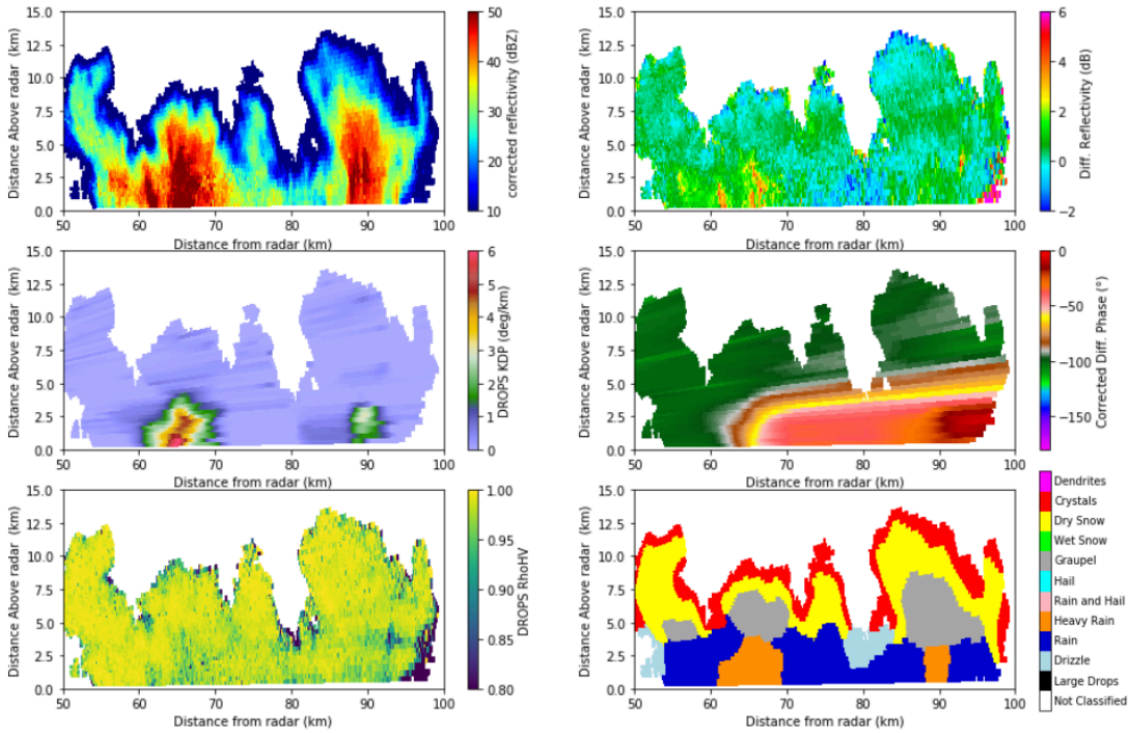


Figure 1. GPM-DPR and CSU-CHIVO vertical analysis, case: 2018/01/13