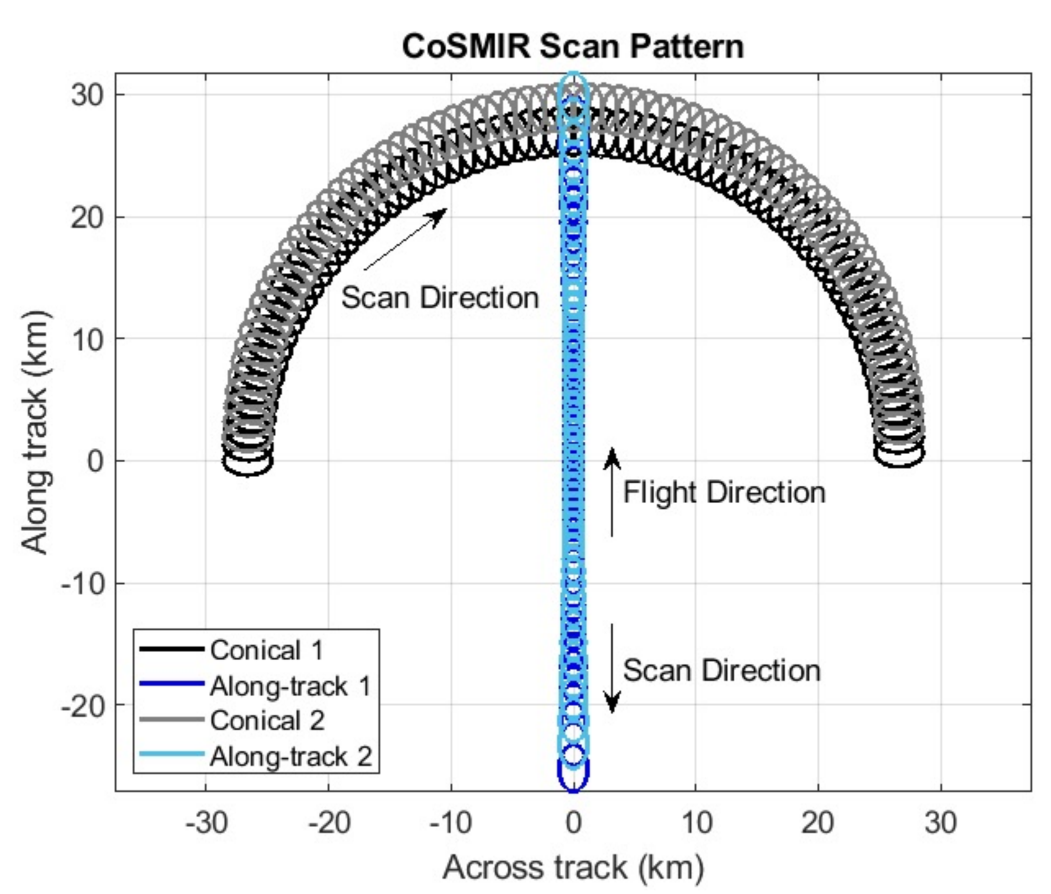
Dual-Polarized Brightness Temperatures Observed by CoSMIR during the First IMPACTS Deployment

Ian S. Adams[1], Rachael Kroodsma[2,1], Matthew Fritts[1], Yuli Liu[3], and S. Joseph Munchak[1*]
[1]NASA Goddard Space Flight Center, [2]Earth System Science Interdisciplinary Center, University of Maryland, [3]University of Utah
*now with tomorrow.io

OVERVIEW

The airborne Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) observes brightness temperatures (T_b) at 50.3, 52.6, 89, and 165.5 GHz, with dual-polarization capabilities at 89 and 165.5 GHz. Unique to CoSMIR is a configurable scanning geometry that has allowed CoSMIR to mimic the scanning geometries of both conical and cross-track scanning radiometers that are commonly flown in space, such as the GPM Microwave Imager (GMI) and the Advanced Technology Microwave Sounder (ATMS), respectively. Importantly, the CoSMIR implementation results in a fixed polarization orientation for the cross-track scans. These geometries are often combined in a hybrid mode, alternating between conical and cross-track scans.

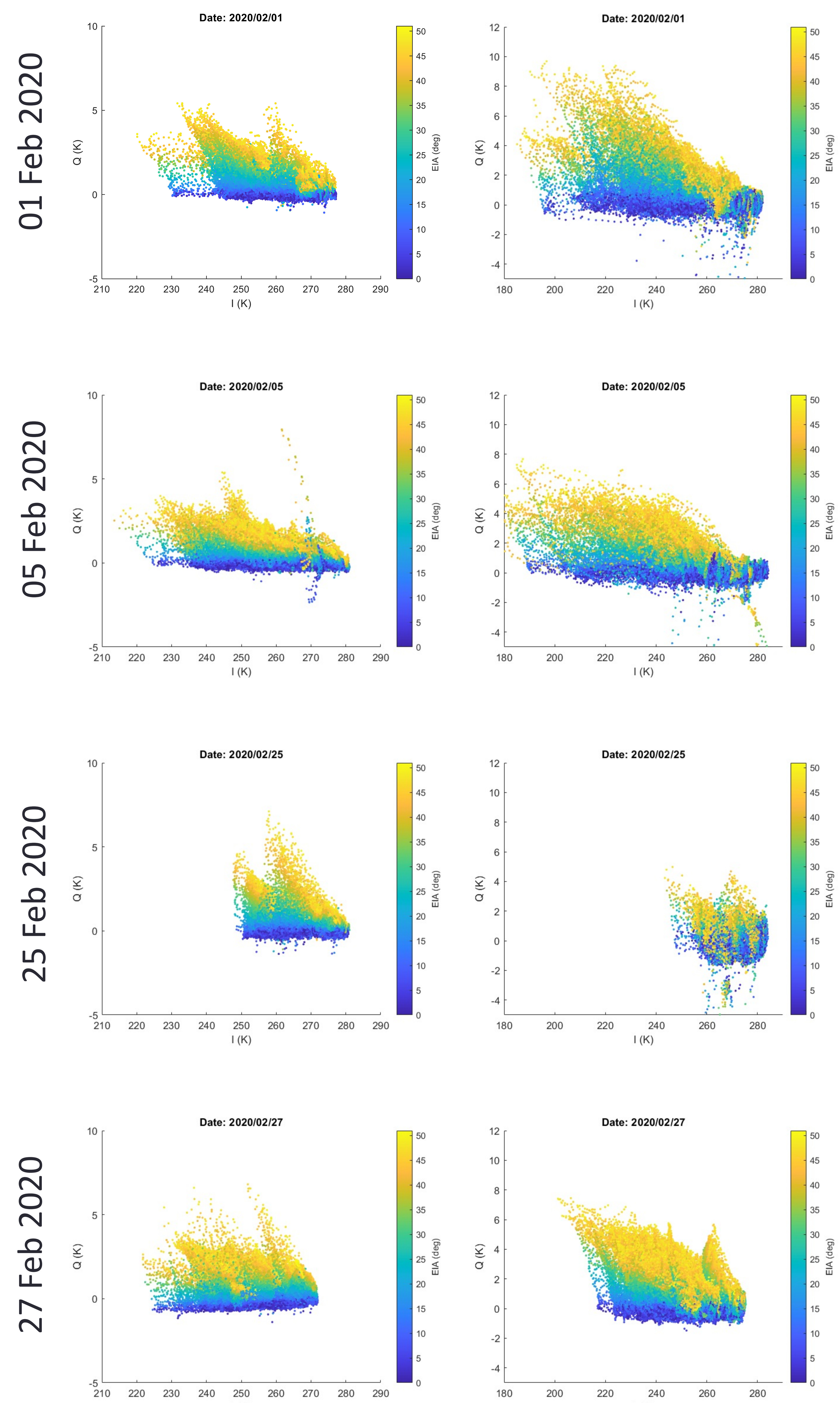
Given the flexible scanning capabilities of the sensor, the CoSMIR team, with concurrence of the IMPACTS Science Team, configured a new hybrid mode that combines conical scanning with a novel along-track scanning mode with fixed polarization orientation.



The along-track data from four flights during the IMPACTS 2019–2020 deployment is presented in the left two columns. Polarization difference, $Q=0.5(T_{b,v}-T_{b,h})$, is induced by horizontally-oriented hydrometeors, with larger PD values corresponding to stronger alignment and lower optical depth, while intensity, $I=0.5(T_{b,v}+T_{b,h})$, is anti-correlated with storm height and intensity. The along-track scans align with radar observations, allowing comparison of multi-angle radiometer measurements with radar reflectivity factor (see contoured frequency by altitude diagrams, or CFADs, in the right two columns). The T_b depressions (I) are related to strong echoes aloft, as expected. The Q values appear to be less associated with structure but may be related to enhanced dendritic growth and aggregation. Future work will test this hypothesis.

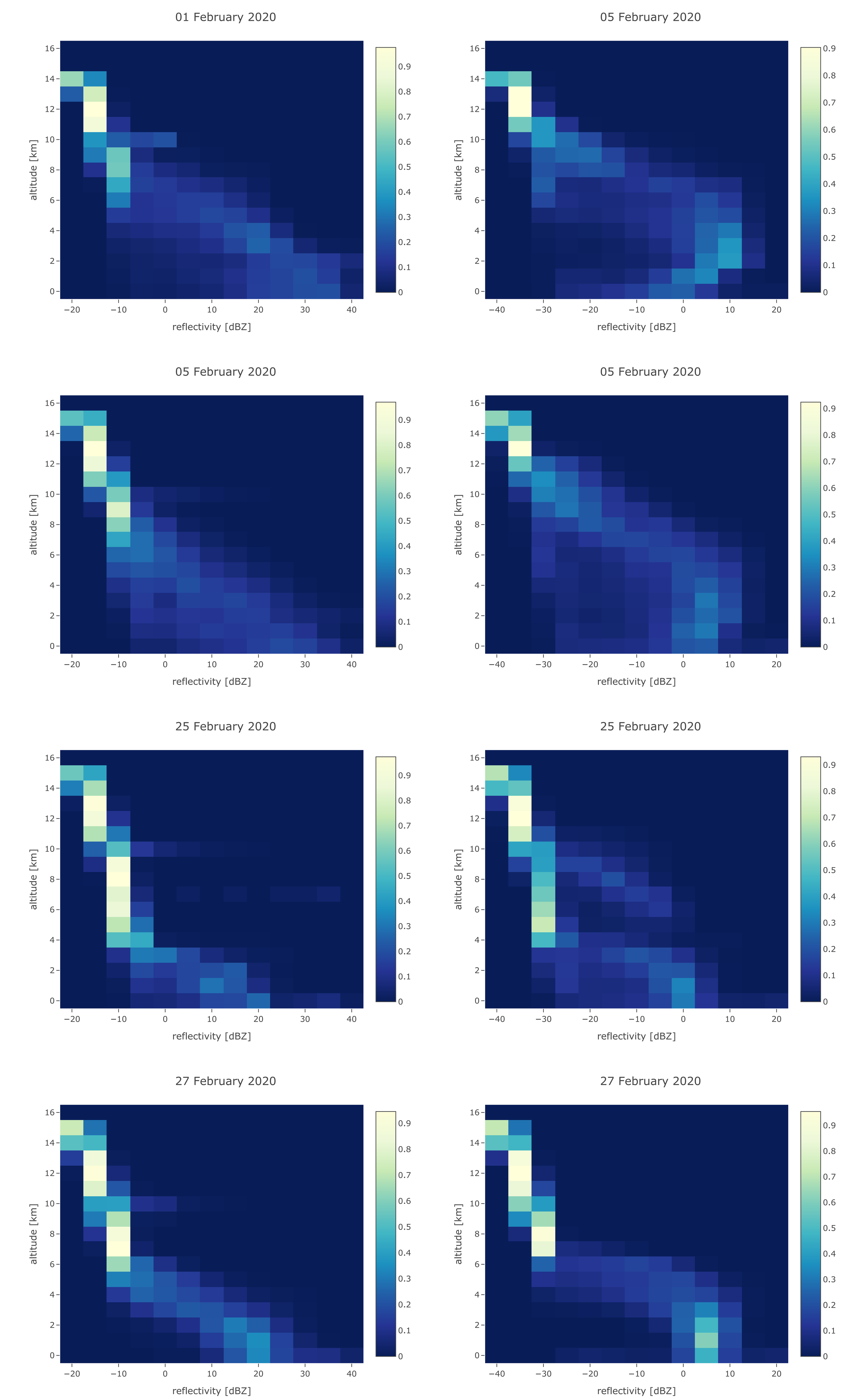
COSMIR Q-I PLOTS

CoSMIR 89 GHz | CoSMIR 166 GHz



EXRAD/CRS CFADS

EXRAD (9.6 GHz) | CRS (94 GHz)



ER-2 X-band Radar (EXRAD) & Cloud Radar System (CRS) data courtesy of G. Heymsfield, M. Walker McLinden, and L. Li