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**Space Administration** 

# Sensing Heavy Precipitation with Polarimetric Radio Occultations aboard the PAZ satellite: A new view of precipitation and water vapor

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## **Polarimetric Radio Occultations (PRO)**

- New measurement technique being tested for the first time aboard the Spanish PAZ satellite.
- Launched on February 22, 2018. More than one year collecting data.
- Like standard Radio Occultations, it also provides vertical profiles of pressure, temperature and water vapor.
- Sensitivity to the whole vertical precipitating structure, including frozen particles and ice in addition to rain.
- Observable: Differential phase shift between H and V components of the received GNSS signal (ΔΦ<sub>H-V</sub>).
- Asymmetric horizontally oriented falling hydrometeors induce a larger phase shift to the H component (basics of Polarimetric Weather Radar)
- First space based observing technique able to provide joint thermodynamic and precipitation information, simultaneously.
- Useful for the study of the thermodynamic processes underlying heavy precipitation, globally (ocean/land, regardless of cloud coverage).



## **On Orbit Calibration and Validation**

- Calibration and validation using GPM constellation products (IMERG) show sensitivity to precipitation intensity
- Vertical structure of  $\Delta \phi$  exhibits good agreement with precipitation climatologies
- Lower layers ( $\Delta \phi_{h < 5km}$ ): Heavy precipitation is distributed following well known patterns
- Higher layers ( $\Delta \phi_{h>10km}$ ): Good correlation with deep convection



All the PRO observations are linked to a precipitation measurement (R) from the IMERG product. R and  $\Delta \phi$  are compared for all available observations.  $\Delta \phi$  is evaluated between 0 and 10 km. The heavier the precipitation, the larger the  $\Delta \phi$ .

# Jun - Jul - Aug $(\Delta \varphi) = 0.5 \text{ km}$ $(\Delta \varphi) = 0.$

## **Sensitivity of PRO Observations to Frozen Particles**

- GPM and CloudSat observations are used to simulate the effect of rain and frozen particles to Δφ.
- Simulations using only rain cannot explain PAZ observations. Frozen particles need to be included.



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between the different height levels indicated in the

legend (different colors)



