Radar Polarimetry to Characterize Overshooting Convection in the Western Ghats of India

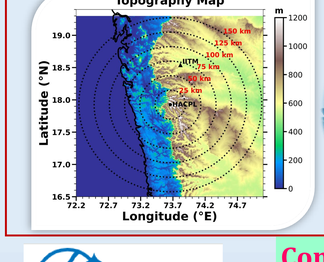
This presentation participates in OSPP
Outstanding Student & PhD candidate Presentation contest
EGU26-676
#EGU26

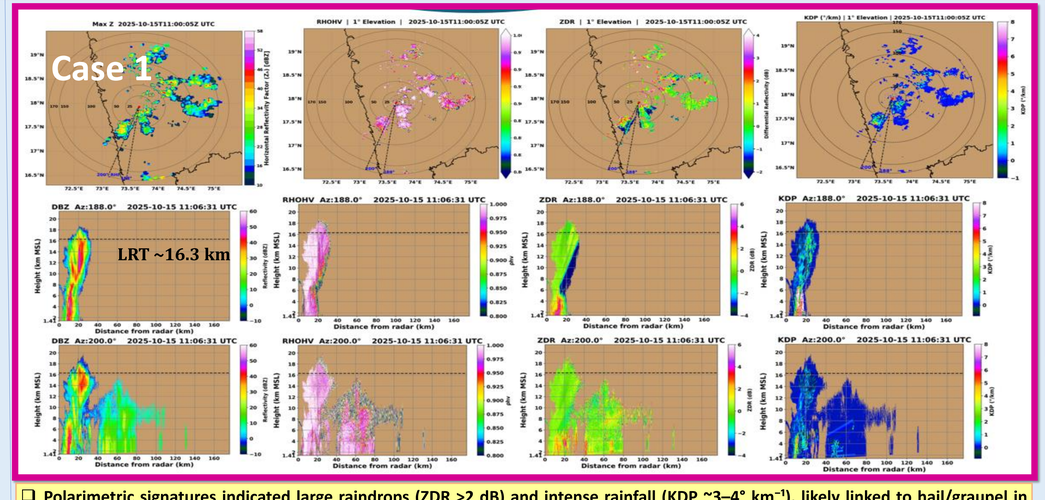
Harikrishna Devisetty[1,2], Murali Krishna UV[1], Bhishma Tyagi[3], Subrata K. Das[1], Kaustav C[1], Chandramuni S[1], Padma Kumari[1] harikrishna.d@tropmet.res.in

[1]Indian Institute of Tropical Meteorology (IITM), MoES, Pune-411008, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201002, India
[3]National Institute of Technology (NIT), Rourkela, 769008, India

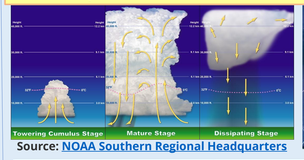
Overshooting Convective Storms (OCS)

- **Deep convective storms->severe lightning weather->heavy rainfall** and **penetrating the Tropopause-lower Stratosphere**, typically **16-20 km** in the tropical region **(Homeyer et al.,2015; Das et al.,2015; Uma et al., 2025)**
- **High-Altitude Cloud Physics Laboratory (HACPL): SSPA-based X-band Dual-Pol Doppler Weather Radar.**
- **OCS- observations XDWR: PPI & RHI (15, 23, 24 October 2025): Initial radar observations over WG region.**
- **PPI & RHI: Max-Z, ZDR, RHOHV & KDP are analyzed for OCS.**
- **ERA5 data: background atmospheric conditions (vertical velocities, specific humidity, and winds@850 hpa).**
- **Lapse Rate Tropopause ~16.3 km (7 years of Radiosonde observations over HACPL): Threshold kept for OCS in this study.**
- The study of OCS is very important: **To understand the storm evolution and associated electrical activity.**
- **Improve the prediction of such severe weather events, and understand their significant impact on atmospheric composition, STE processes, etc.**



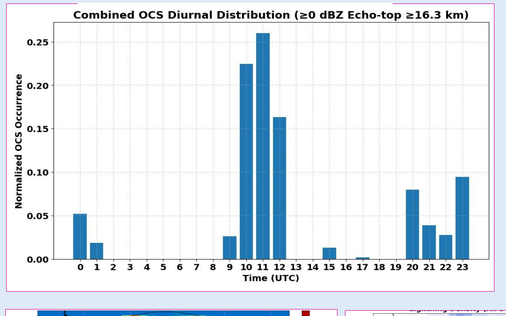


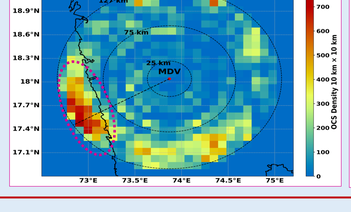
- Polarimetric signatures indicated large raindrops (ZDR >2 dB) and intense rainfall (KDP ~3–4° km^{-1}), likely linked to hail/graupel in the mixed-phase region.
- Deep convective updrafts generate ice-phase particles aloft (ρhv ≈ 1, low ZDR, weak KDP) above the melting layer.
- Below ML, (↓ρhv, bright band) intense warm-rain processes (high ZDR and enhanced KDP) driven by collision–coalescence, resulting in heavy rainfall and electrification.

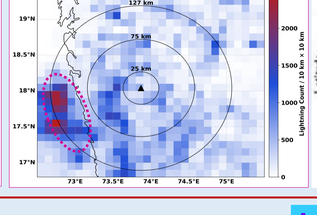


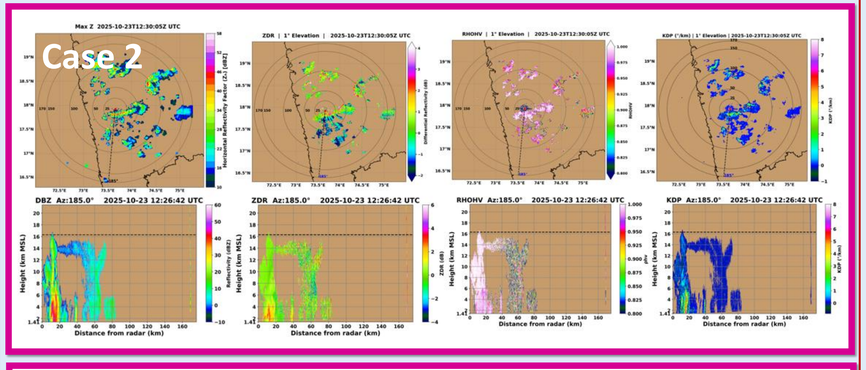
Source: NOAA Southern Regional Headquarters

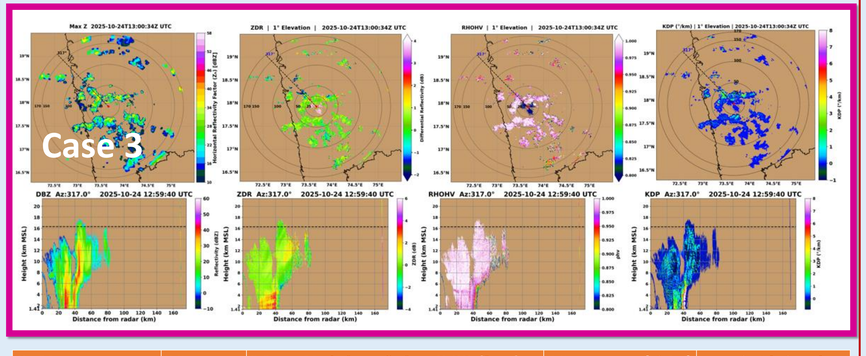
Parameter (XDWR)	Technical Specifications
Center Frequency	9.45 GHz (λ=3.17 cm)
Transmitter Type	SSPA
Peak Power	H&V: >250 W each channel
Pulse Width	Short: 1μs & 4μs; Long: 44μs & 90μs (Hybrid Pulse)
PRF	250Hz-3000Hz
Polarization	STAR and Alternate mode
Antenna Size	2.4 m
Antenna Gain	45 dBi
Beam Width	0.95°
Range	170 km radius
Range Resolution	75 m
Temporal Resolution	6-10 minutes
Sensitivity	13 dBZ @150 km



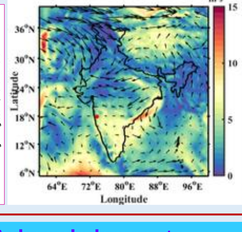


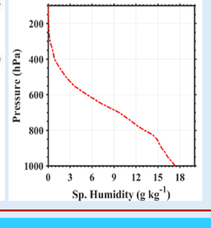


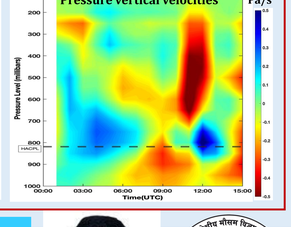




S. No.	Max Z (dBZ)	Max. Height of the OCS (km)	Max Z (dBZ) above 16 km	Total Lightning counts
15/10/2025	59.64	17.61 (188 Az) & 19.8 (200 Az)	42	18383
23/10/2025	63.34	16.52	15.45	11197
24/10/2025	52.15	17.83	24.22	12318







Conclusions

- 15 OCS cases were analyzed using radar observations, yielding 1,39,202 OCS grids and 3,36,959 lightning flashes (17.7% CG, 82.3% IC).
- Most lightning occurred in convective cells with reflectivity >45 dBZ. OCS reached heights up to 20.4 km, with Max Z exceeding 60 dBZ.
- ERA5 data showed strong updrafts (–0.6 to –0.8 Pa s^{-1}), high low-level moisture (14–18 g kg^{-1}), and convergence over the WG, supporting OCS development.

Acknowledgements

We sincerely express our gratitude to the Director, IITM Pune, and acknowledge the dedicated efforts of the ART–Radar and HACPL teams. We express our heartfelt thanks to the #EGU26 organizers for organizing this conference. ECMWRF for providing the reanalysis ERA5 data.

EGU26 GENERAL ASSEMBLY
Vienna, Austria & Online | 3–8 May 2026