Summary and Conclusions

The study highlights the importance of hyperspectral data in estimating tree species diversity, utilizing an extensive field-sampled dataset integrated with hyperspectral airborne data obtained during the collaborative ISRO-NASA AVIRIS-NG India campaign. This integration aimed to unveil the intricate relationships between tree species diversity observed in the field and spectral diversity metrics across three PAs in India.

Analysis of field data substantiates the conclusion that tree species diversity increases from drier PAs (SWS & VNP) to wetter PA (MTR). A similar trend was observed for the PA-specific and evergreen species. Although tree species were more or less evenly distributed in the three PAs, their composition changed substantially, supported by the presence of numerous PA-specific species, singleton species, and the Bray-Curtis dissimilarity between plots. Despite the overall similarity in diversity between SWS and VNP, their community structures and floristic compositions were distinct. Non-parametric species richness estimators highlighted the suitability of the Bootstrap estimator in estimating richness in such diverse PAs.

The spectral analysis emphasized that abundant species across the three PAs were spectrally distinct in the selected four wavelength regions (VIS, NIR, and two regions in SWIR) of AVIRIS-NG data. This underscored the importance of selecting appropriate band combinations for effective mapping of tree species in diverse tropical forests.

The application of machine learning algorithms, Random Forest (RF) and Support Vector Machine (SVM), demonstrated their efficacy in mapping abundant tree species of the three PAs. High resolution AVIRIS-NG datasets worked effectively in developing abundant species maps. RF performed better over SVM in terms of overall accuracy at MTR, while both classifiers exhibited similar performance at the other two

PAs. The findings emphasized the significance of employing high-resolution datasets, brightness normalization, and dimensionality reduction method (MNF) to enhance classification accuracy, with RF providing sharper images than SVM. The developed abundant species maps would be beneficial for forest managers in monitoring and management of abundant tree species of these PAs.

Spectral diversity metrics emerged as efficient tools for inferring species diversity within and across the three PAs. The study showcased the effectiveness of high-resolution datasets in developing abundant species maps and discerning intra- and inter-species variability as CHVs within and across three PAs in the tropics.

Importantly, the study's conclusions are substantiated by major findings from the analysis, providing valuable insights for the management of forest covers of ecologically sensitive PAs. The integration of remote sensing and field data, especially from regions underrepresented in global databases, holds immense potential by giving inputs to global models. Overall, by providing detailed insights into the biodiversity patterns and spectral characteristics of tropical forests, as well as demonstrating effective methodologies for species mapping, the outcomes of this study offer significant inputs for enhancing the accuracy and applicability of global models related to biodiversity distribution, conservation planning, and ecosystem management.

In conclusion, this research provides crucial inputs for conservation efforts and highlights the potential of an integrated approach of contemporary tools and field data for the better understanding of vegetation characteristics of tropical forests.