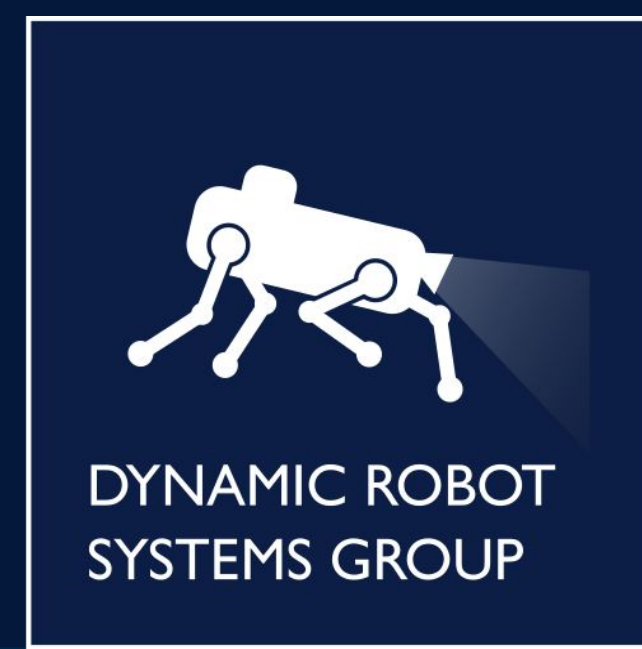
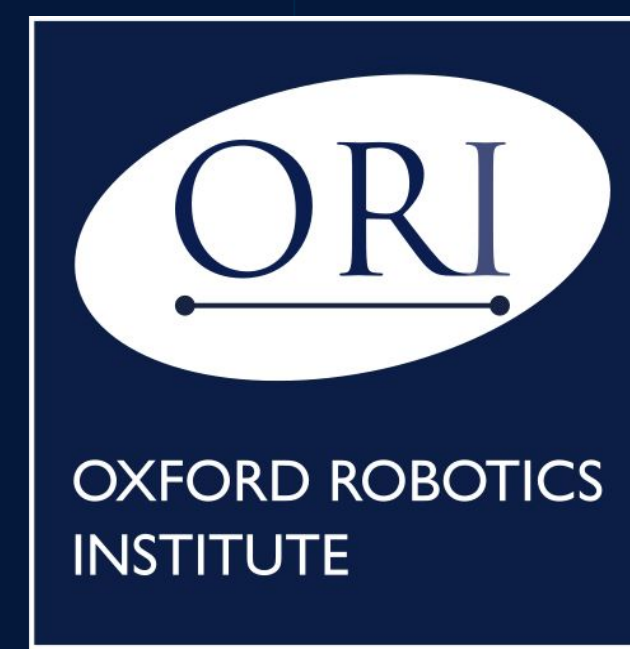


Sapling-NeRF: Geo-Localised Sapling Reconstruction in Forests for Ecological Monitoring

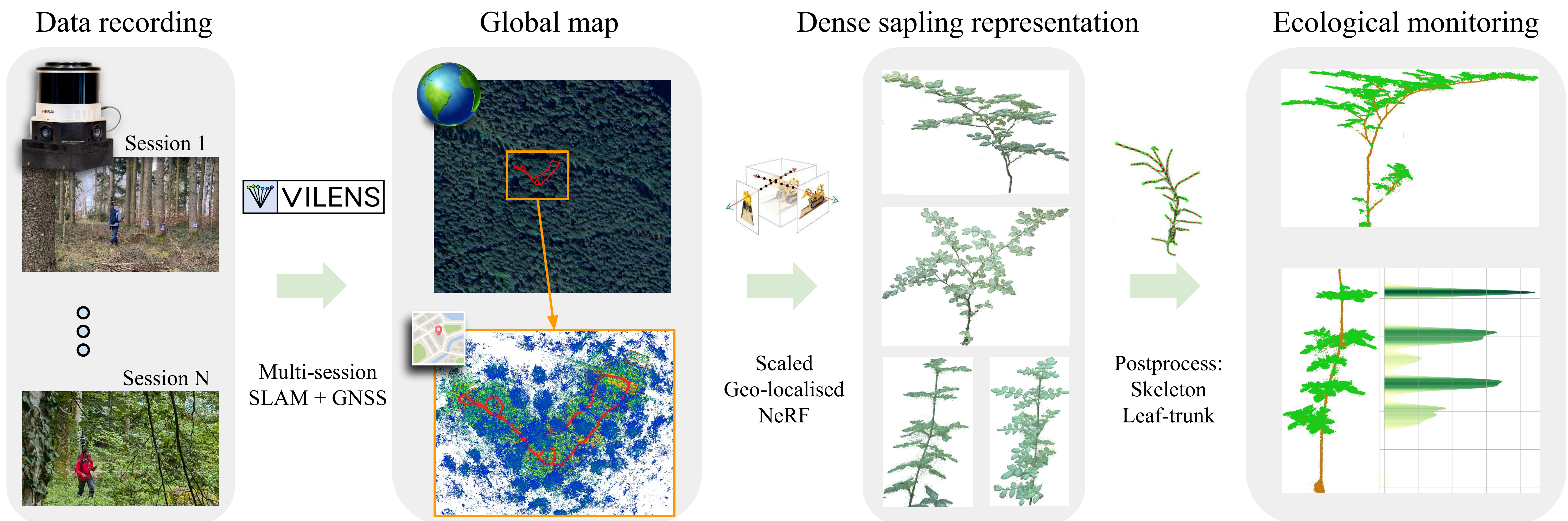
Miguel Ángel Muñoz-Bañón, Nived Chebrolu, Sruthi M Krishna Moorthy, Yifu Tao, Fernando Torres, Roberto Salguero-Gómez, Maurice Fallon

<https://dynamic.robots.ox.ac.uk/projects/sapling-nerf/>
miguelangel.munoz@ua.es



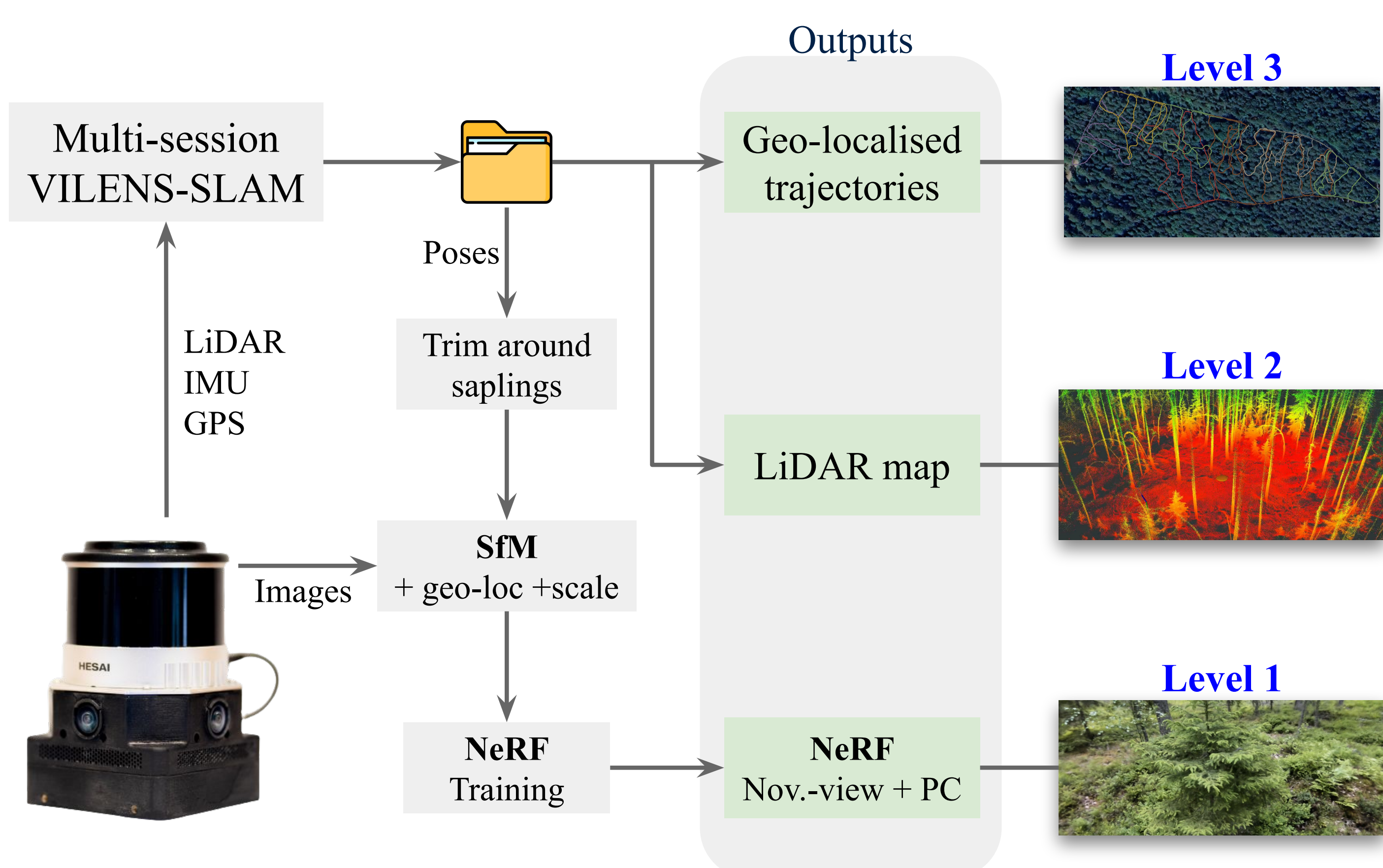
- In the **context of forest reconstruction** for ecological monitoring:
 - LiDAR-based approaches (MLS/TLS) **cannot capture details** in small structures such as saplings.
 - **NeRF/3DGS is a promising strategy** for capture details, but lacks scale and global localisation.
 - We propose to localise **individual object-centric sapling NeRF** reconstructions in LiDAR-SLAM-based maps with hectare-scale, multi-session, and GNSS alignment:

- **Global Map:** The core LiDAR SLAM system supports hectare-scale multi-session map merging as well as GNSS alignment.
- **Dense Sapling Representation:** We extract a sub-trajectory from a mapping session which encircles an individual sapling of interest and run SfM while using the SLAM-derived trajectory to determine consistent metric scale and global localisation. The images and poses are used to train NeRF models.
- **Ecological Monitoring:** The NeRF-derived point cloud is sufficiently accurate to detect the tree skeleton and to measure leaf-wood separation and the leaf distribution over time.



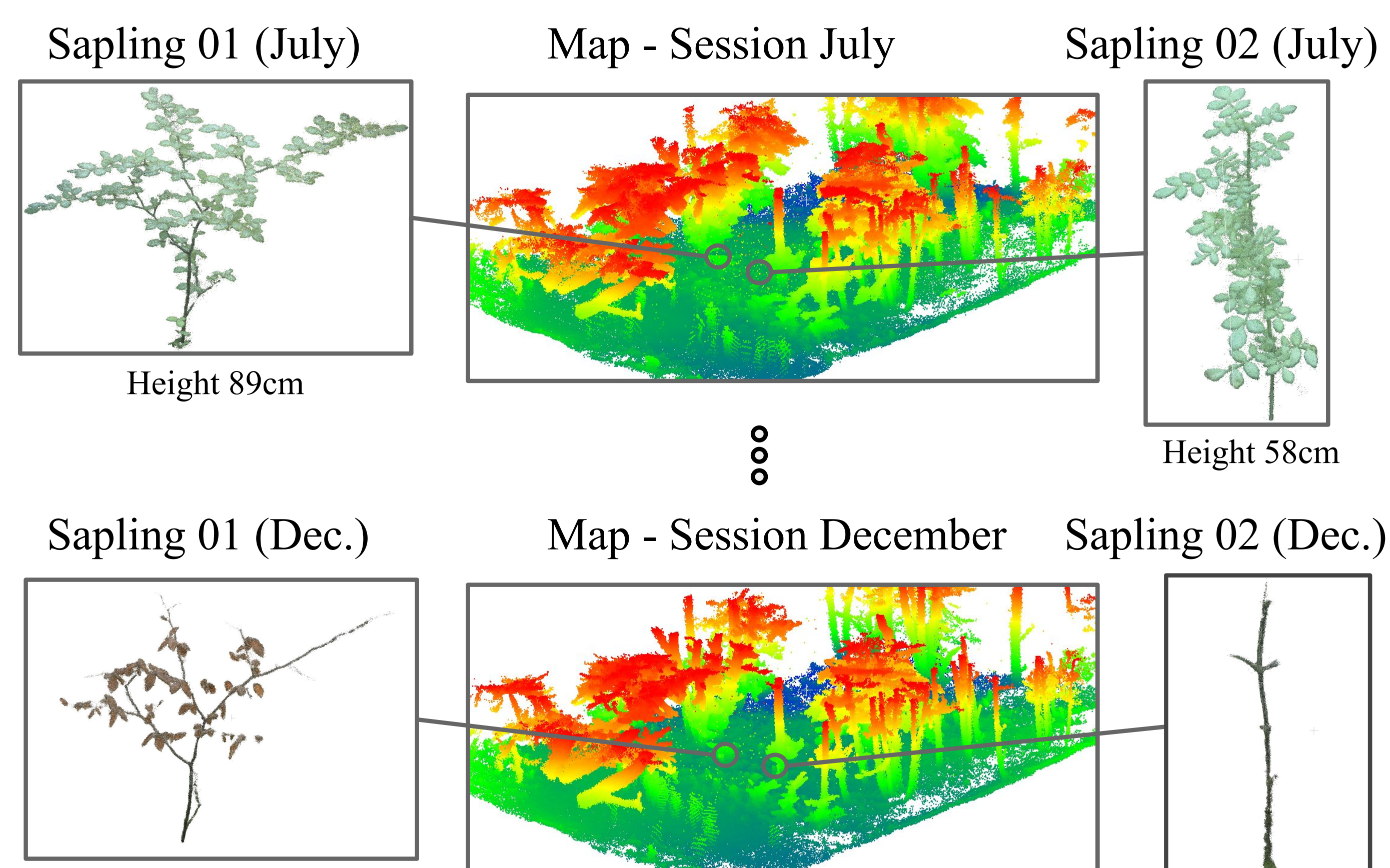
Sapling representation in 3 levels

- Our approach represents each sapling **over 3 LEVELS**.
- From hectare scale plot to millimetre density NeRF point clouds.

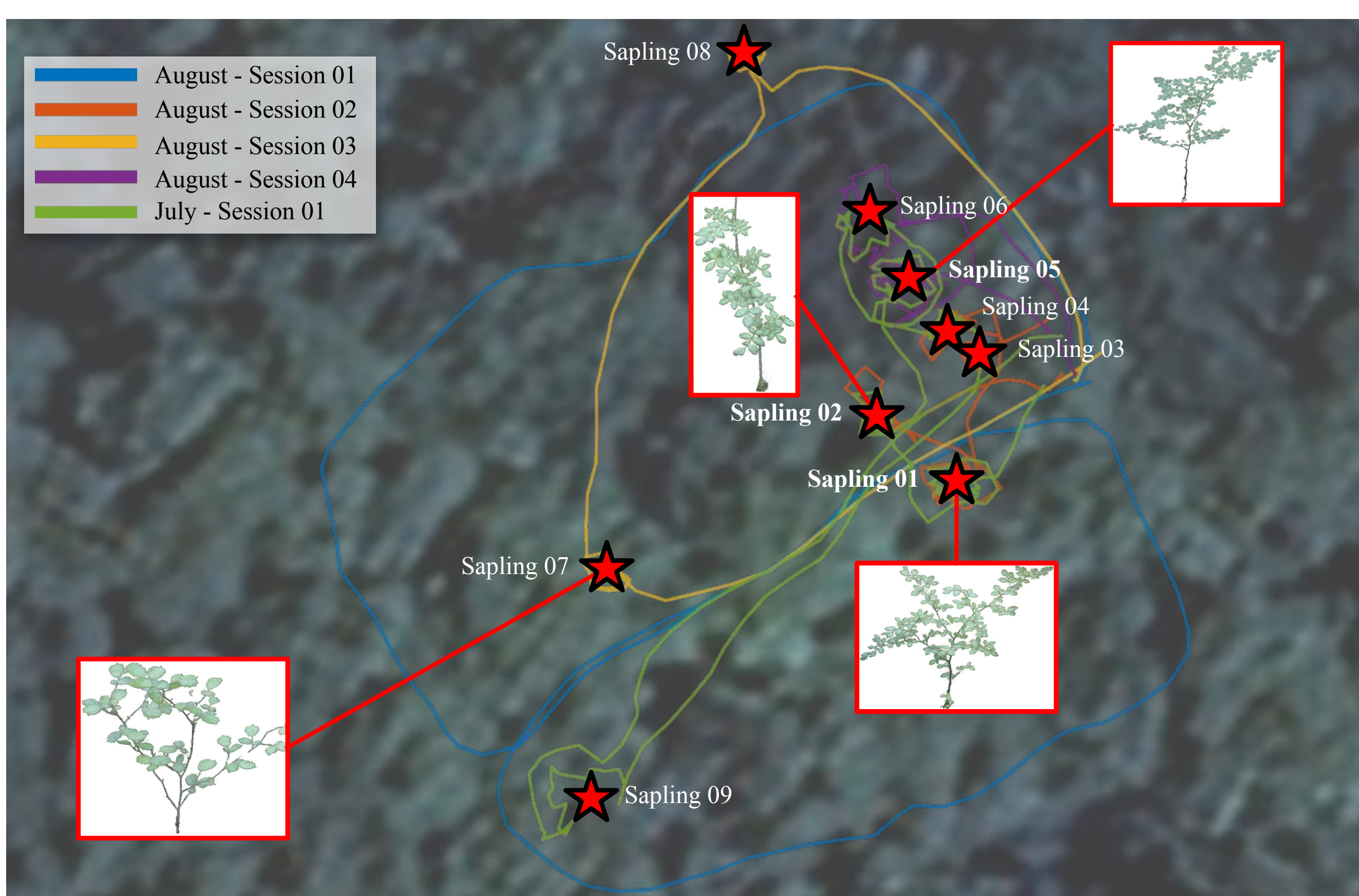


Longitudinal Monitoring

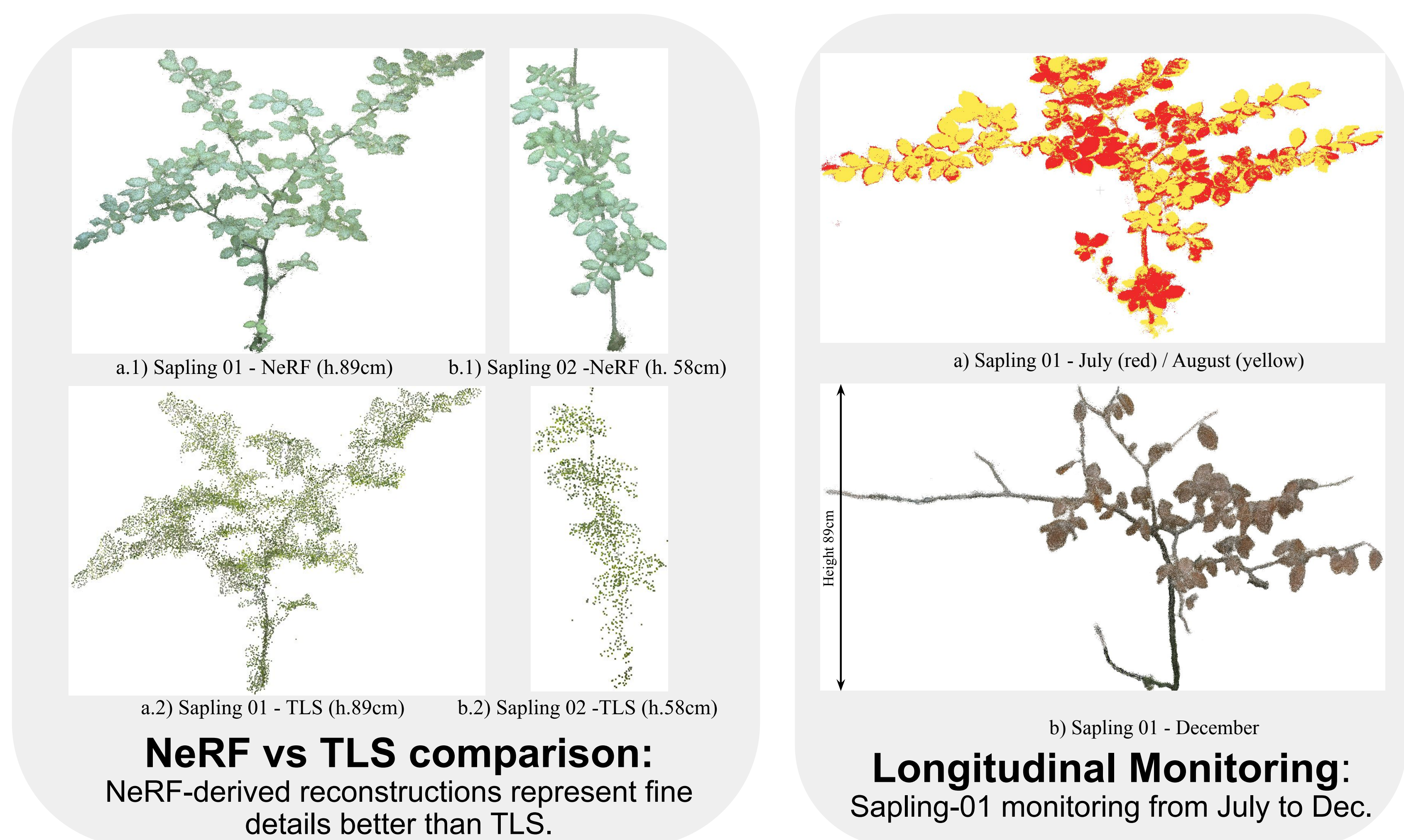
- Our system allows **over-time monitoring**.
- We conducted experiments from July to December.



Results *in situ* in Wytham Woods (Oxford)



Sapling Geo-Localisation: The sapling reconstructions are geo-localised, as the multi-session SLAM results are aligned using GNSS.



NeRF vs TLS comparison:
NeRF-derived reconstructions represent fine details better than TLS.

Longitudinal Monitoring:
Sapling-01 monitoring from July to Dec.