35. GeoAI and Foundation Models Embeddings: new data for new challenges

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In recent years, Earth Observation (EO) has seen growing adoption of Geospatial Artificial Intelligence (GeoAI). The scale of geospatial data has pushed the scientific community toward Deep Learning (DL) and Geospatial Foundation Models (GFMs) trained on large, heterogeneous EO datasets to learn general patterns transferable across tasks. Beyond using pre-trained GFMs directly, an emerging perspective is the use of precomputed embeddings generated by these models as input features for lighter, task-specific DL networks, exploiting powerful GFM feature extractors without the cost of training or fine-tuning the full model. Despite this potential, the usability of embeddings for EO applications remains unclear: how much information they encode and how reliably downstream models can learn from them are open questions, particularly for tasks beyond classification and segmentation, such as height estimation. Research initiatives and international challenges are increasingly exploring this topic. In particular, the ESA Φ-lab challenge “Reaching New Heights with GeoFM” focuses on embeddings from popular GFMs, including TerraMind, AlphaEarth, TESSERA, and THOR, aiming to foster new approaches to their exploitation. This contribution investigates the use of precomputed GFM embeddings to train task-specific DL networks, presenting preliminary results developed by a team within the ESA Φ-lab challenge. The work uses embedding products as input features for models targeting fractional cover and height estimation. The challenge provides a useful test bed for investigating how precomputed GFM embeddings can be adapted to pixel-level prediction and regression, as well as a benchmark for comparison with the results obtained by other competing teams.