

StatEO

5-7 May 2026 | ESA-ESRIN | Frascati (Rome), Italy

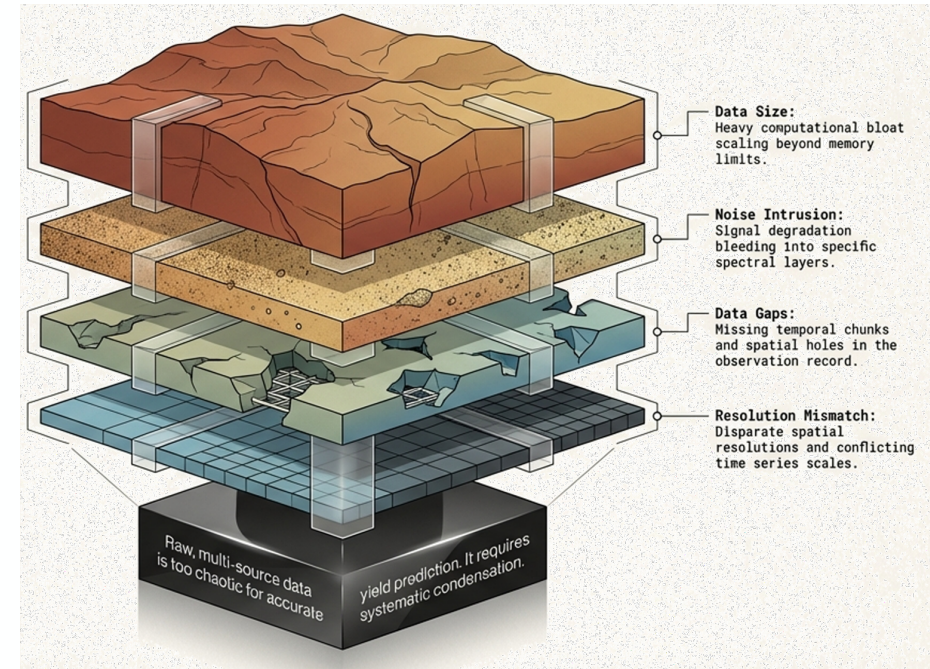


GAIG-Embeddings: Agroecosystem Intelligence: Insights from Canadian Prairies



Nketia, K., Ha, T., Morteza, K., Lotfi, A., Shirtliffe, S.
Nutrien Digital Agriculture Centre, Canada

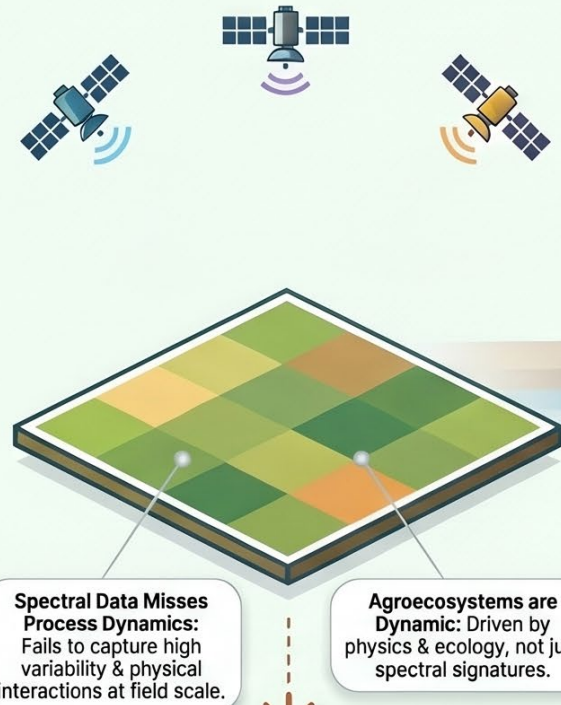
- Explosion of multi-source geospatial data
- Sparse, uneven, and costly **labels**
- Need for a **unified, transferable** representation
- Primarily learn from what satellites see, but not necessarily how **agroecosystems appear and function.**



- Agroecosystems are **process-driven**, not just spectral
- High variability **at field-scale** (Soil + Plant + Atmosphere + Water continuum)
- For regression models to explain **within-field variability** and process-based behaviour
- Move from purely data-driven representations to **process-aware representations**

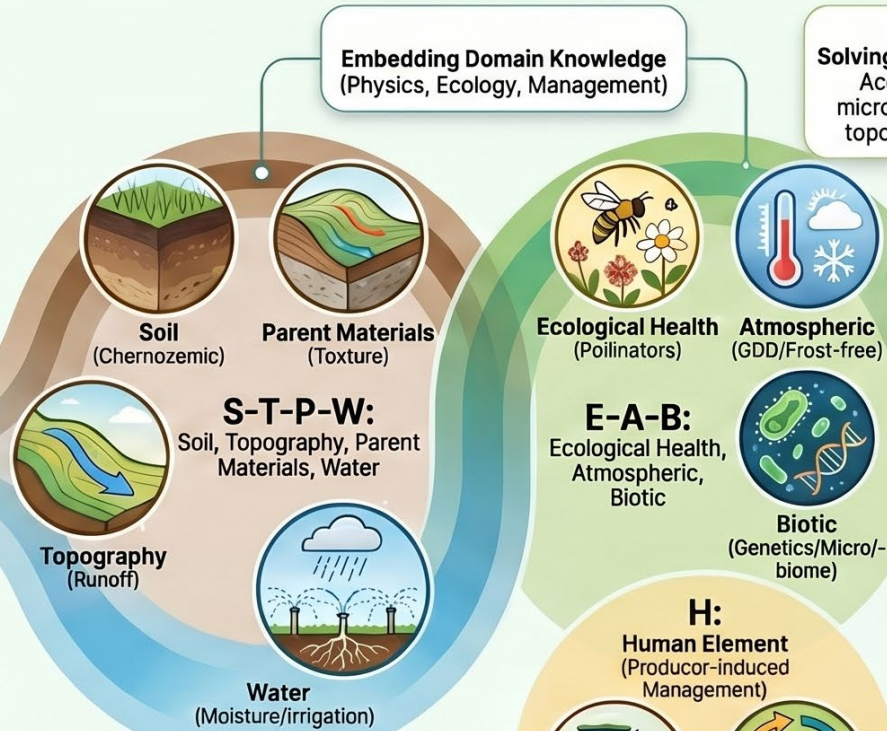
THE LIMITATIONS OF "DATA-ONLY" MODELING

EO-Only Embeddings & The SPAW Gap



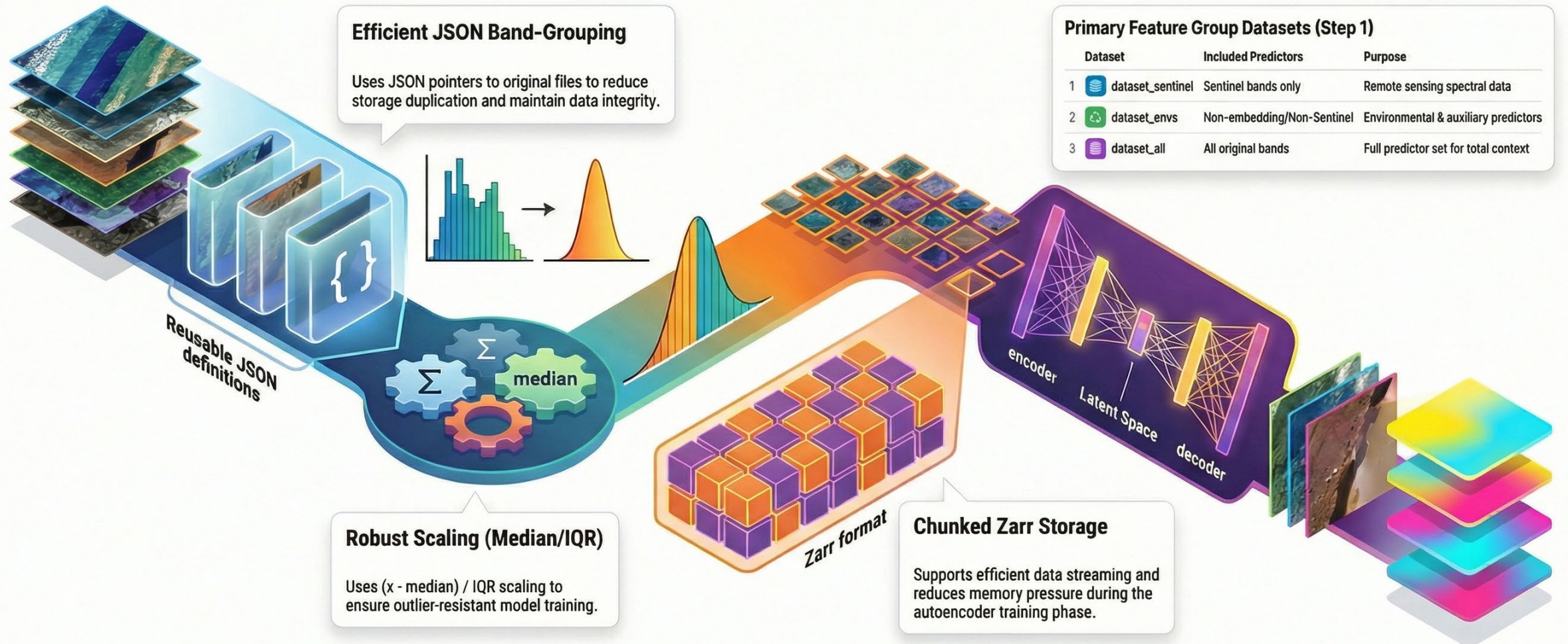
THE SPAW DYNAMICS GAP: Models fall without embedding Soil-Plant-Atmosphere-Water (SPAW) interactions.

THE STEP-AWBH PROCESS INTEGRATION



Moisture Dynamics: precipitation, irrigation, snowmelt and residue management

EXAMPLE: The Human Element (H). Producer decisions like crop rotations & zero-tillage override or enhance natural processes.



NDAC, Canada

Yield Prediction Use Case



NDAC, Canada ⁶

- Limited model generalization
- Scarce response
- Processing infrastructure



Yield Prediction Use Case



NDAC, Canada ⁸

Yield Prediction Use Case

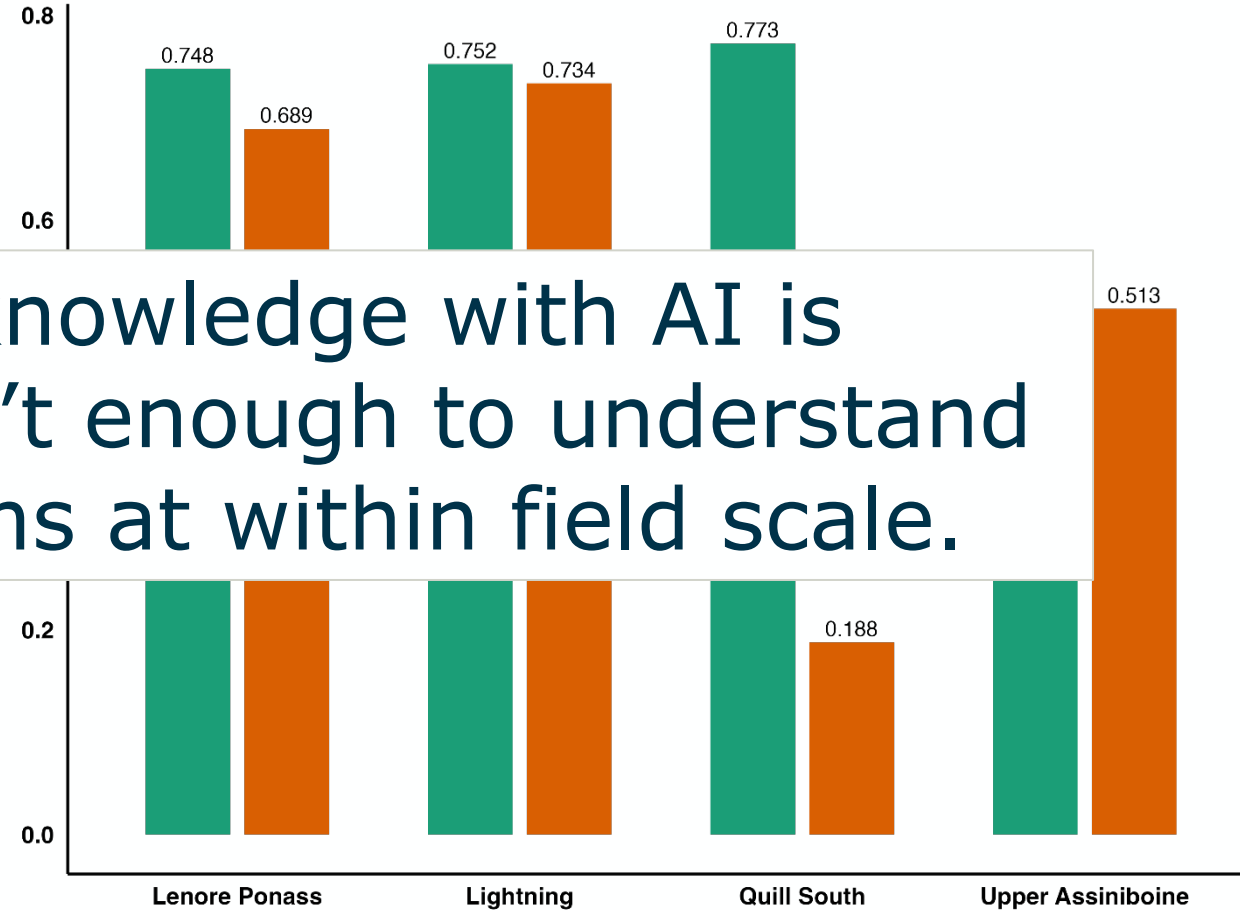


NDAC, Canada ⁹

Yield Prediction Use Case

Model Performance Across Landscapes

Model Type ■ Embedding ■ Traditional



Combining domain knowledge with AI is essential—data alone isn't enough to understand complex agroecosystems at within field scale.

