

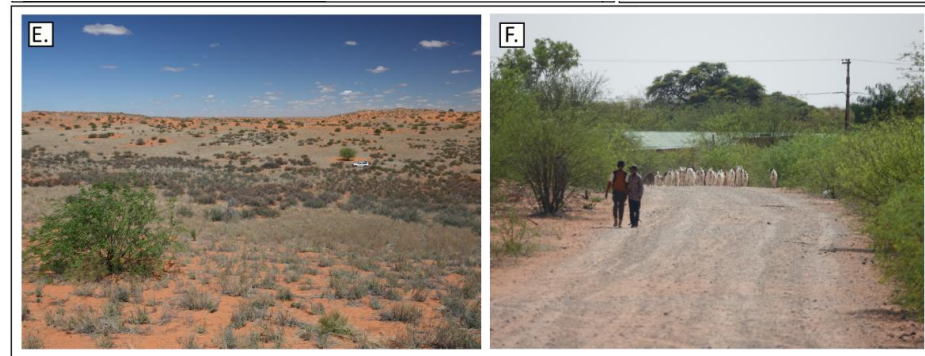
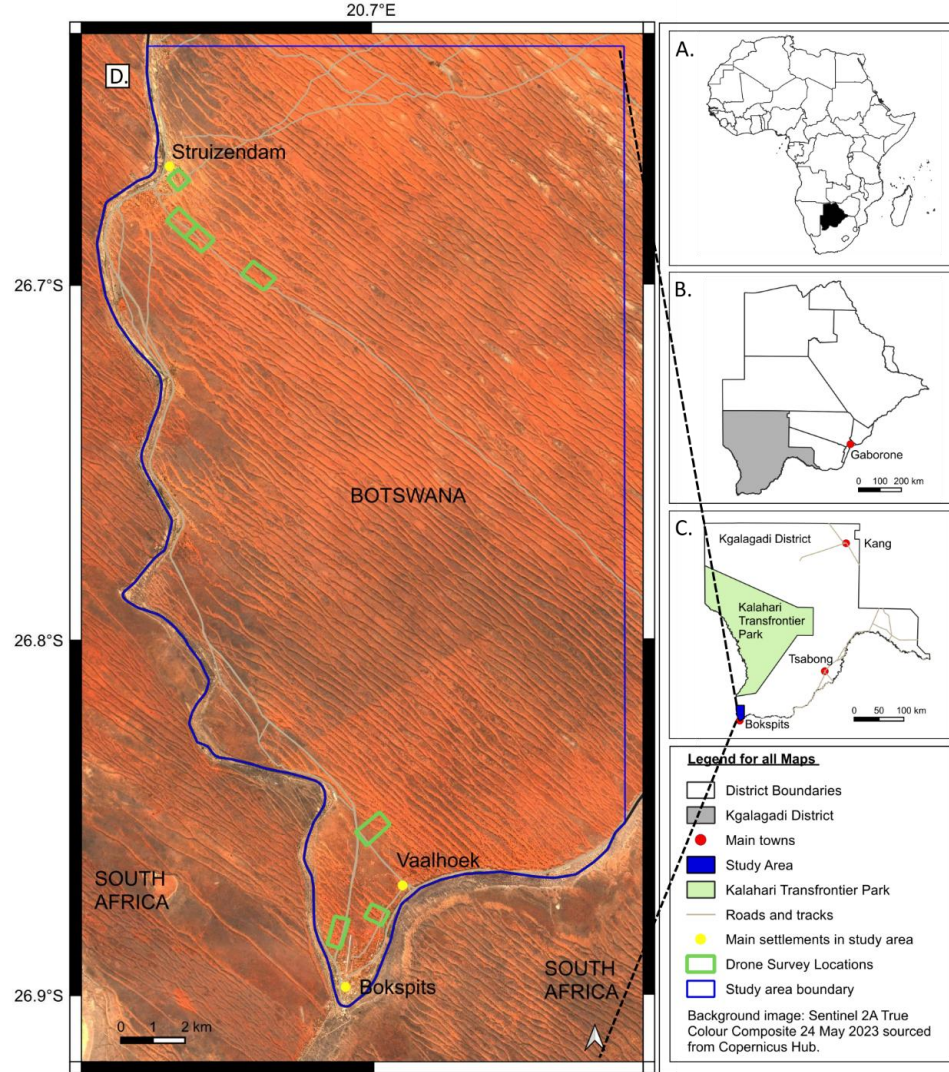
Multi-scale machine learning to improve detection of invasive *Neltuma* by integrating UAV and satellite Earth observation data

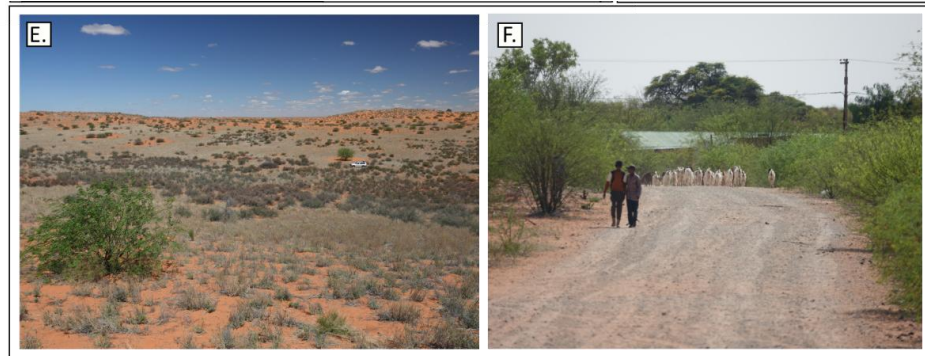
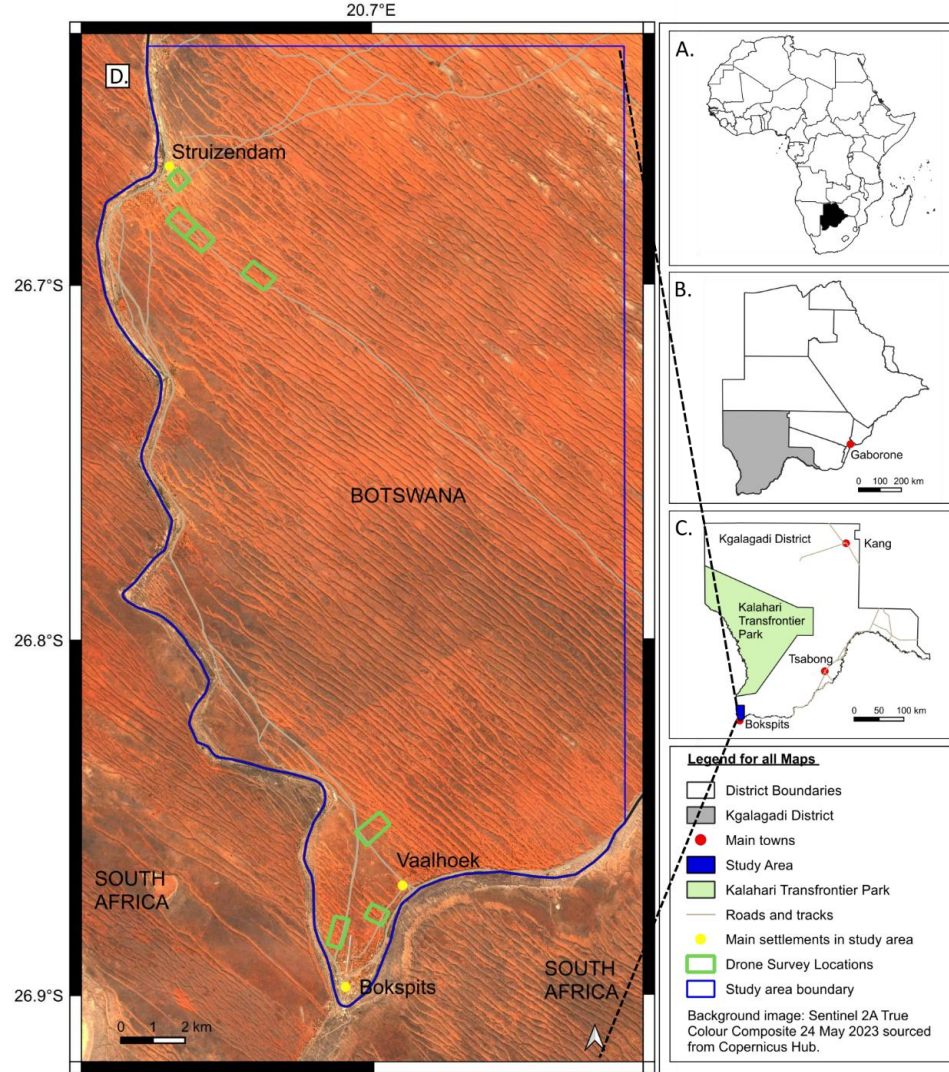
Glenn Slade, Hugh Graham, Jeremy Perkins, Lawrence Akanyang, Karen Anderson, **Andrew Cunliffe**



Oppenheimer Programme in African Landscape Systems (OPALS)









Neltuma



Neltuma

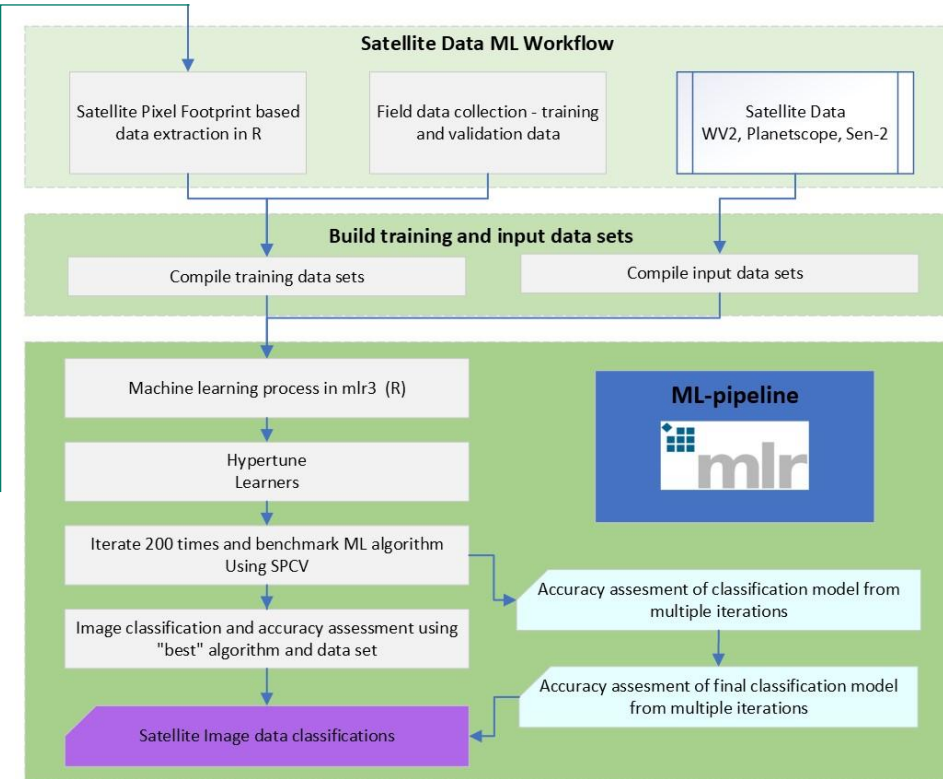
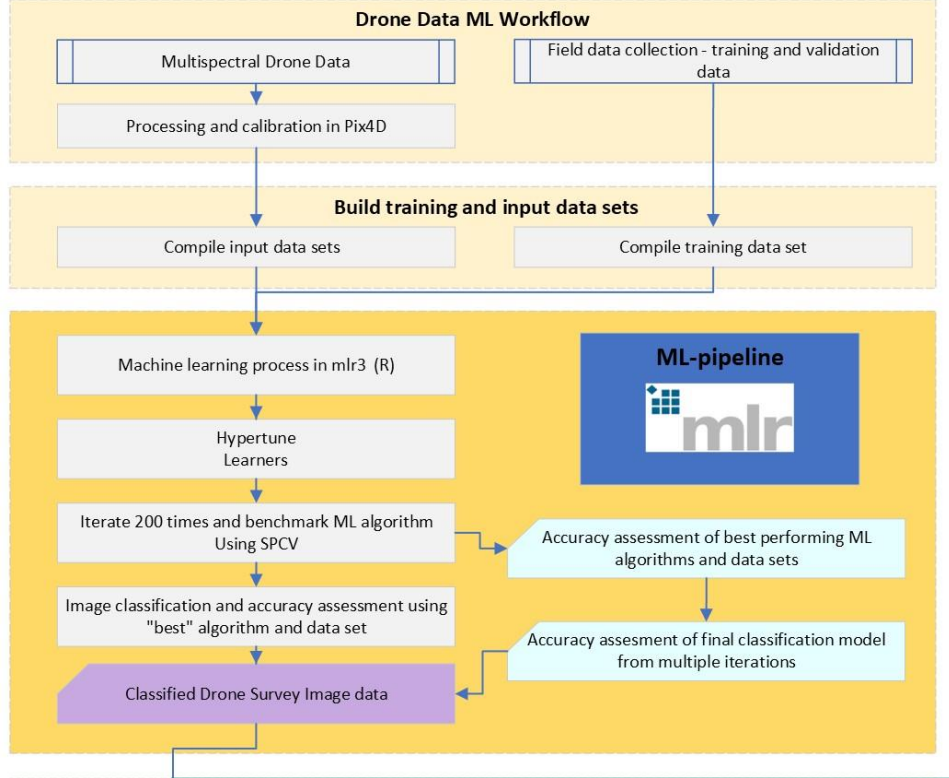




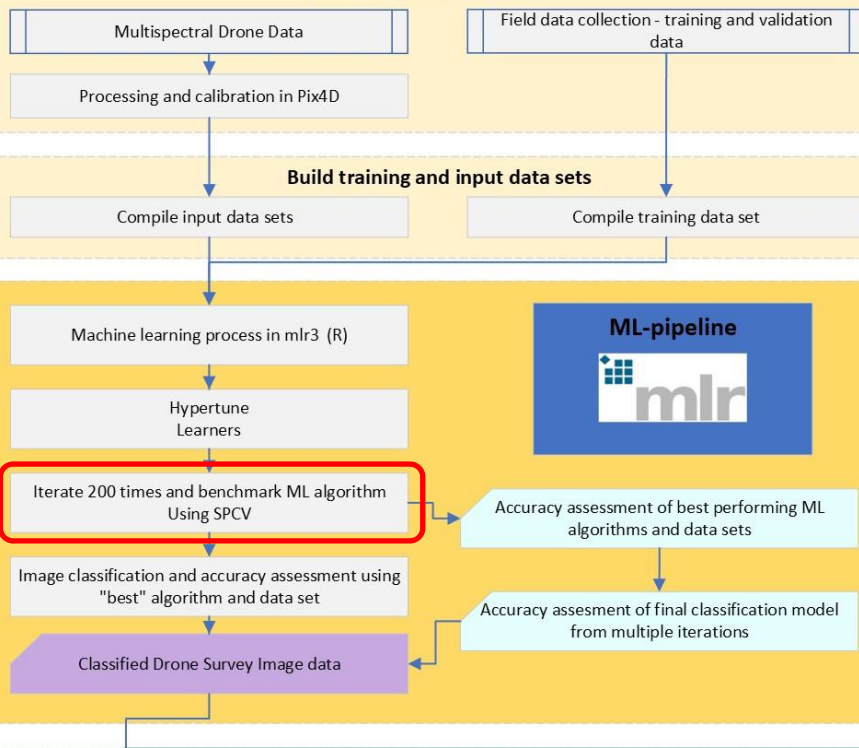
Neltuma



Hierarchical machine-learning workflows integrate drone and satellite observations for multi-scale classification of sparse *Neltuma* invasion.

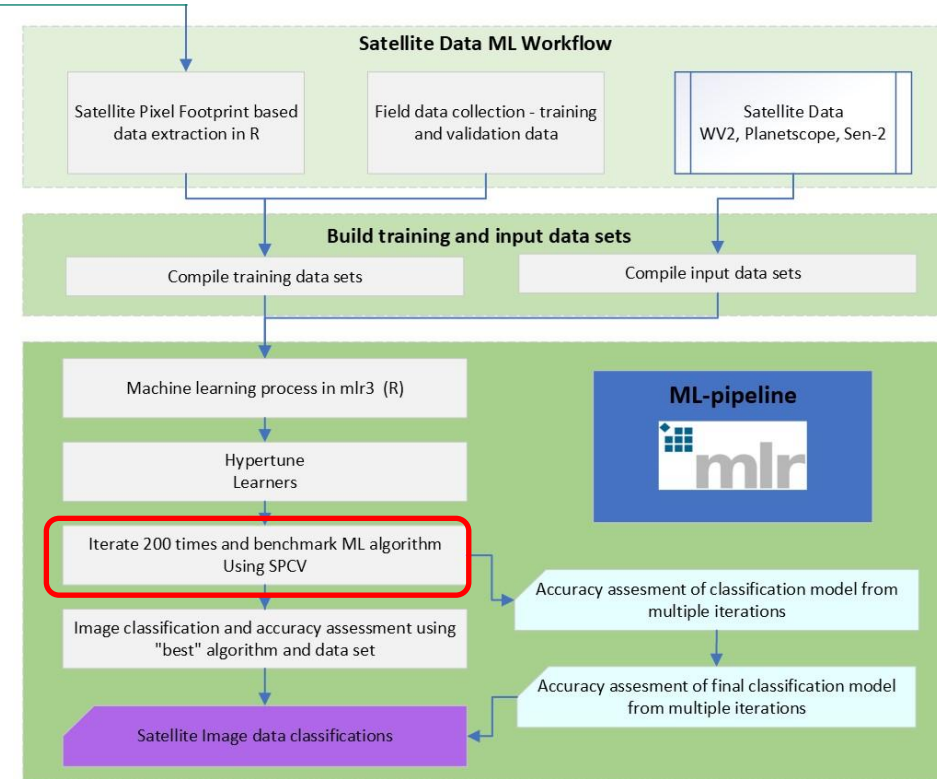


Drone Data ML Workflow

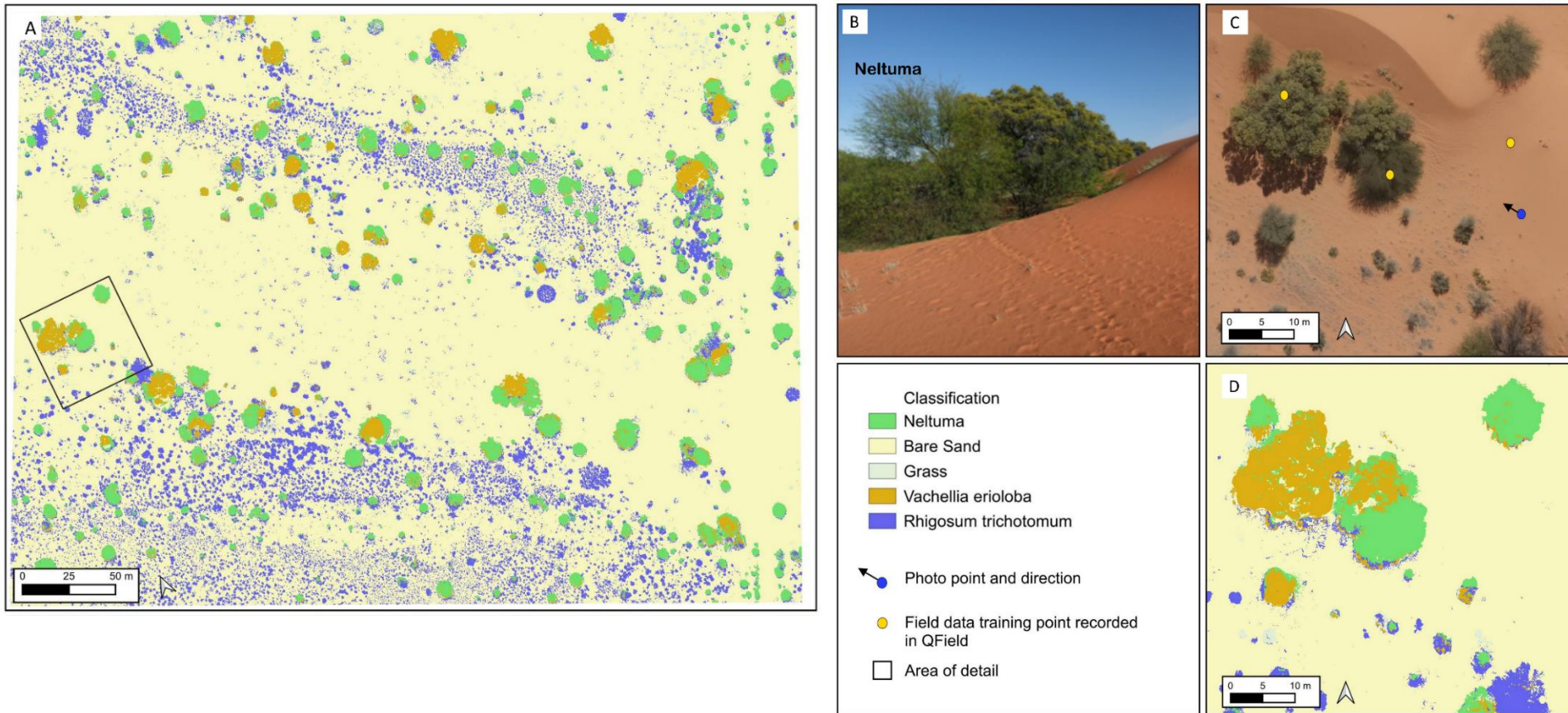


Hierarchical machine-learning workflows integrate drone and satellite observations for multi-scale classification of sparse *Neltuma* invasion.

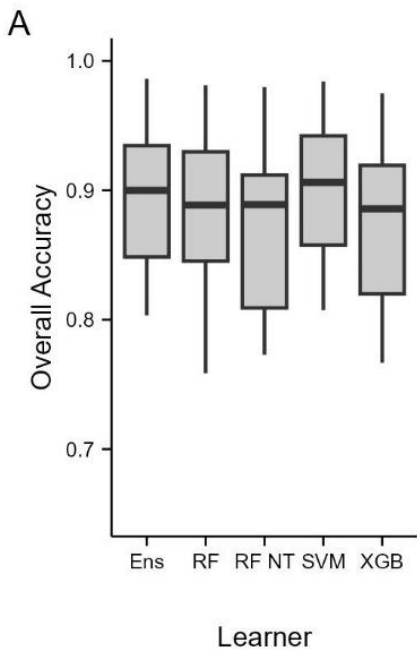
Satellite Data ML Workflow



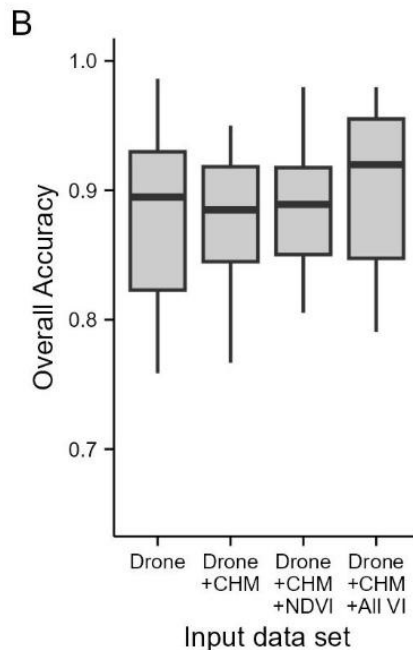
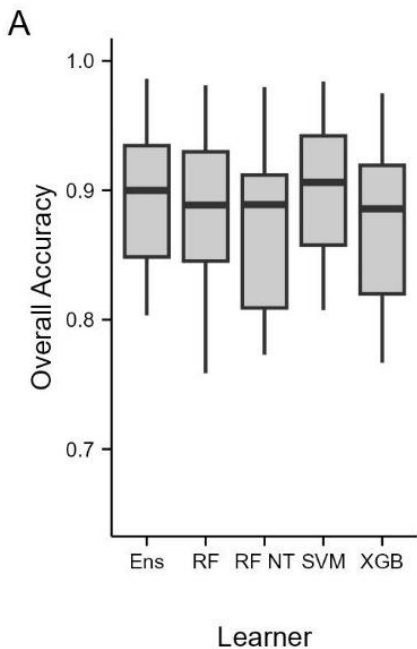
Drone multispectral classification resolves sparse *Neltuma* and species associations at plant scales in heterogeneous Kalahari vegetation.



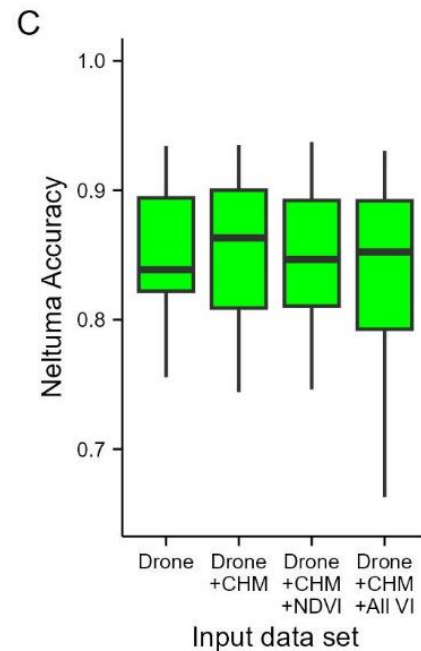
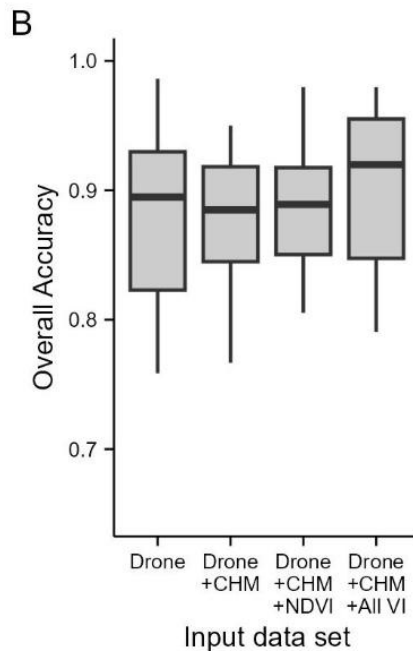
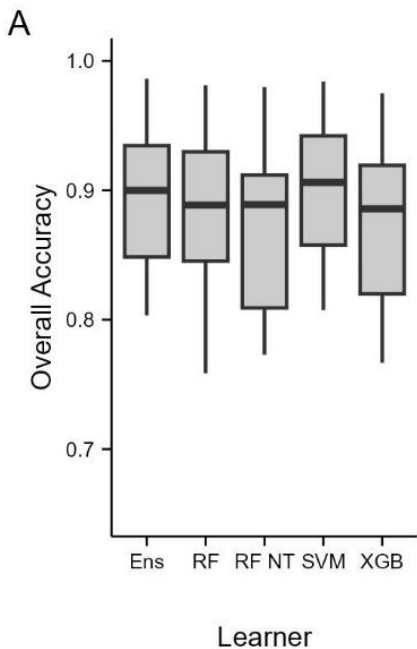
Drone multispectral classification achieved ~90% overall accuracy for vegetation mapping and reliable detection of sparse *Neltuma*



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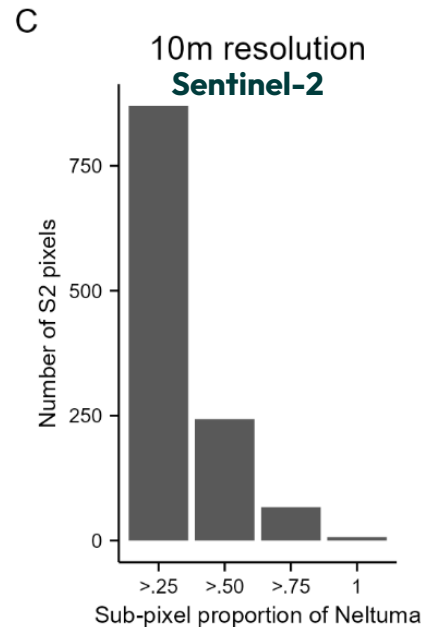
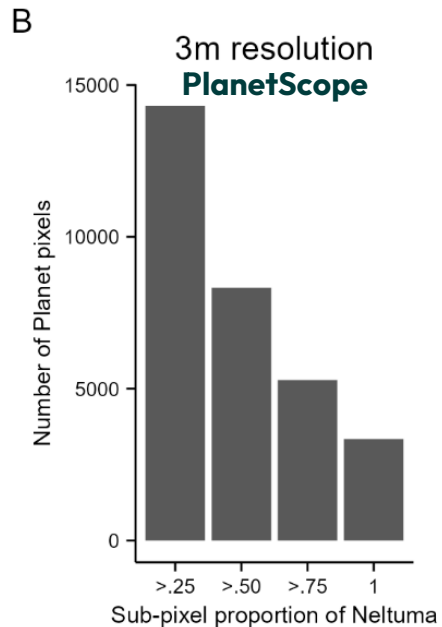
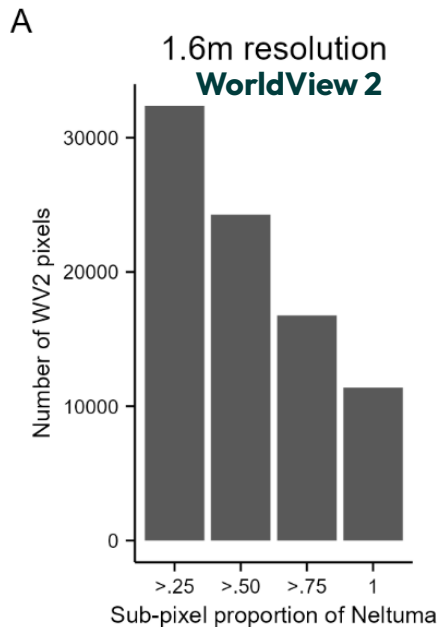


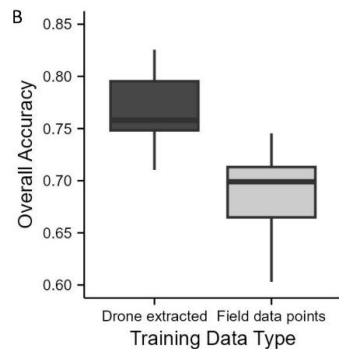
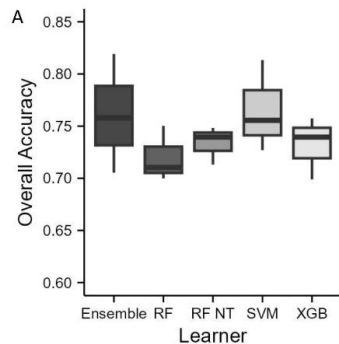
Drone multispectral classification achieved ~90% overall accuracy for vegetation mapping and reliable detection of sparse *Neltuma*



Scale matters:

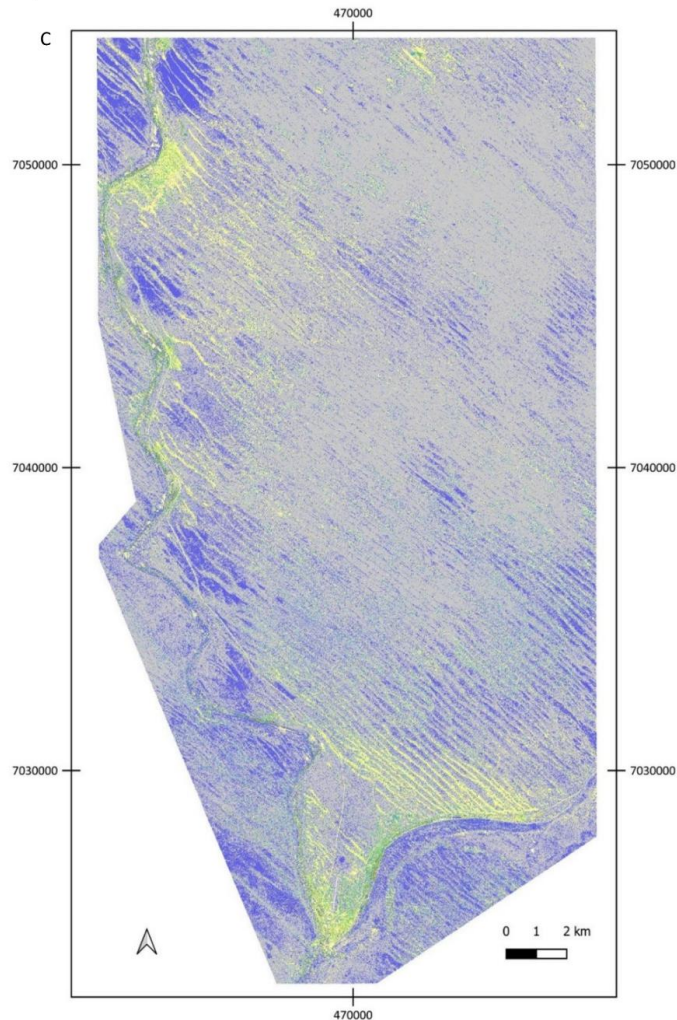
Coarser sensor grain sharply reduces the availability of high-*Neltuma*-cover pixels for training and detection



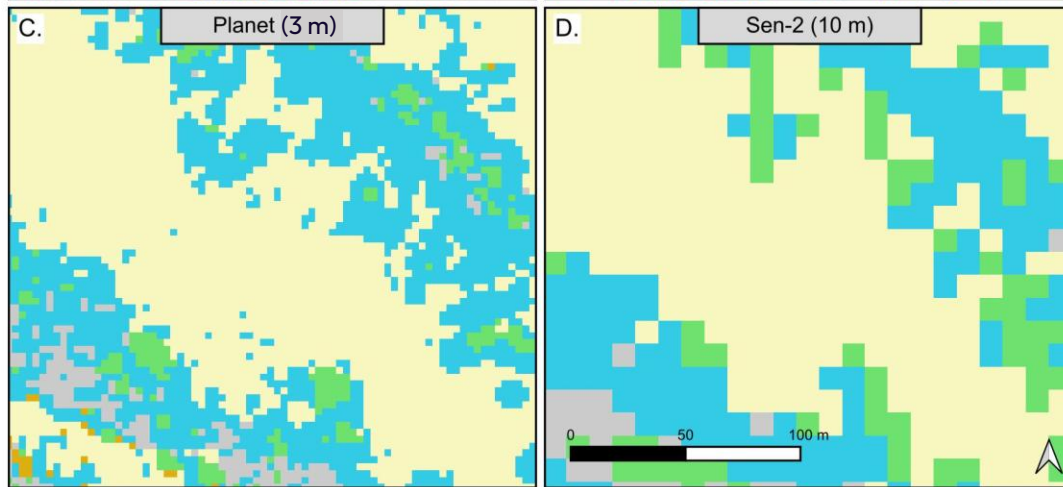
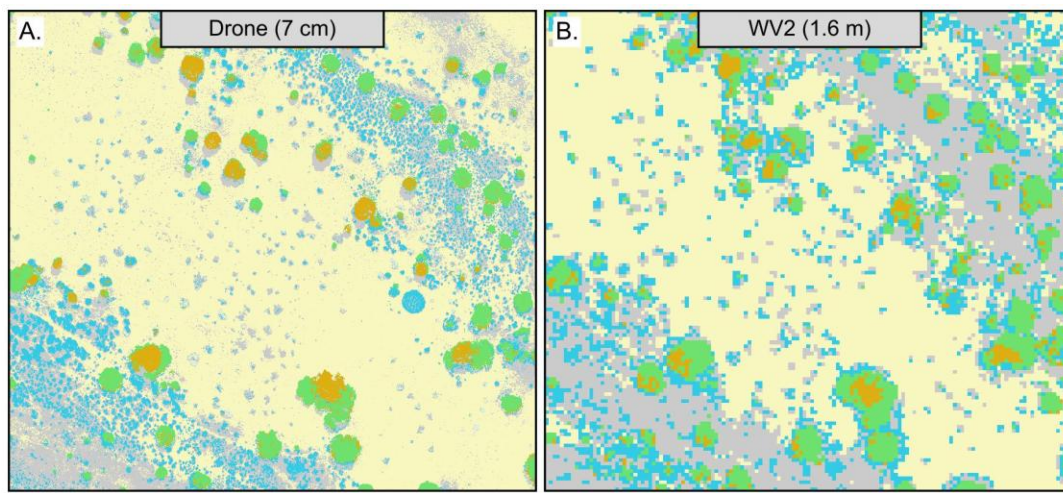


Land cover classification

- Neltuma
- Bare Sand
- Grass
- Vachelia erioloba
- Rhigosum trichotomum
- Mixed woody cover

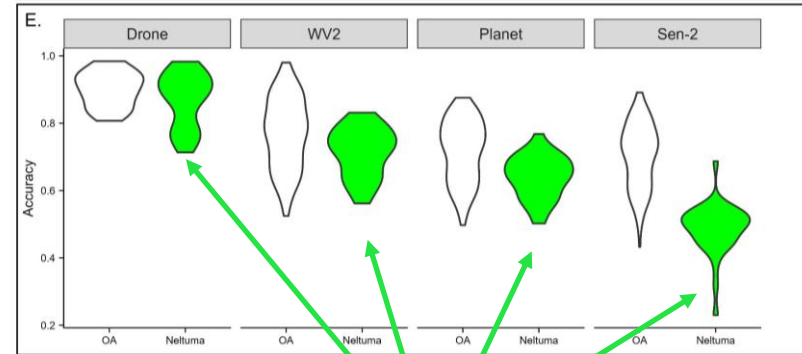


Cross-scale calibration with drone data increased satellite classification accuracy and improved landscape-scale mapping of sparse *Neltuma*

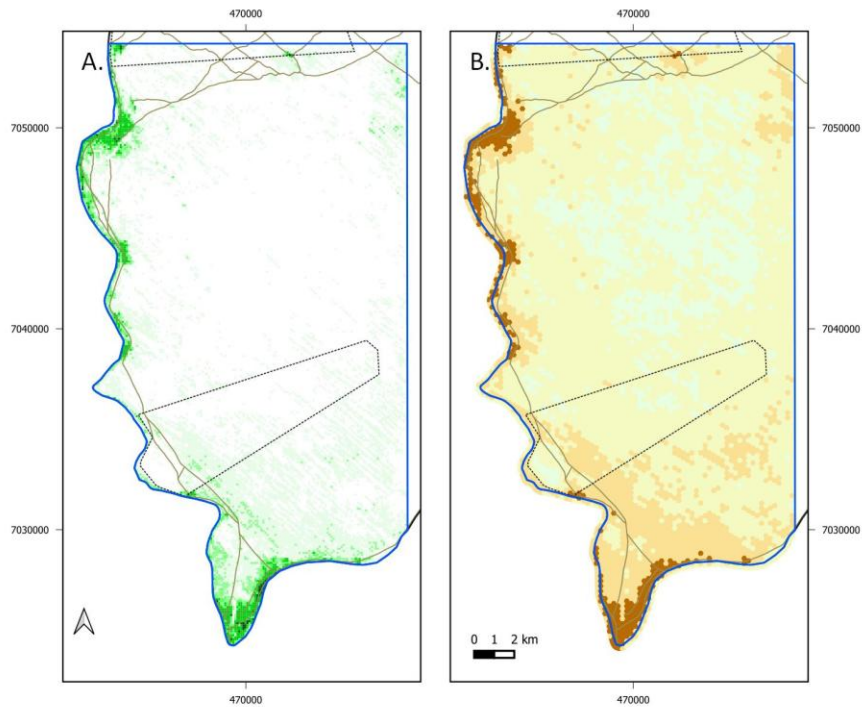


■ Neltuma
 ■ Bare Sand
 ■ Grass
 ■ Vachellia erioloba
 ■ Other woody species

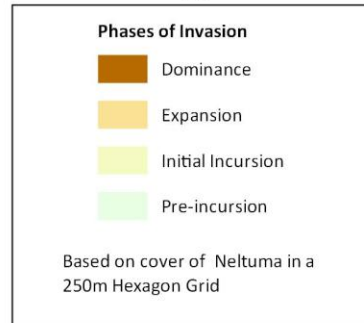
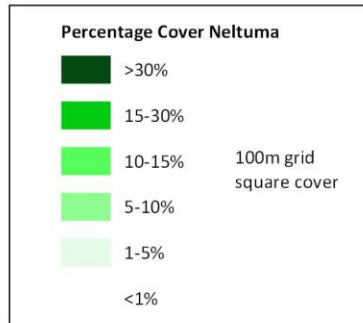
Detectability of sparse *Neltuma* declines sharply as sensor grain becomes coarser



Target of interest



Spatial patterns of *Neltuma* prevalence reveal widespread invasion and extensive areas vulnerable to further spread



Take homes:

- Multi-scale data fusion frameworks are underutilised to support management relevant insights.





Take homes:

- Multi-scale data fusion frameworks are underutilised to support management relevant insights.
- Invasive *Neltuma* is an underrecognized problem – linked in with other social issues



Take homes:

- Multi-scale data fusion frameworks are underutilised to support management relevant insights.
- Invasive *Neltuma* is an underrecognized problem – linked in with other social issues
- These data can be shared for anyone who would like to collaborate on improving on this technical pipeline