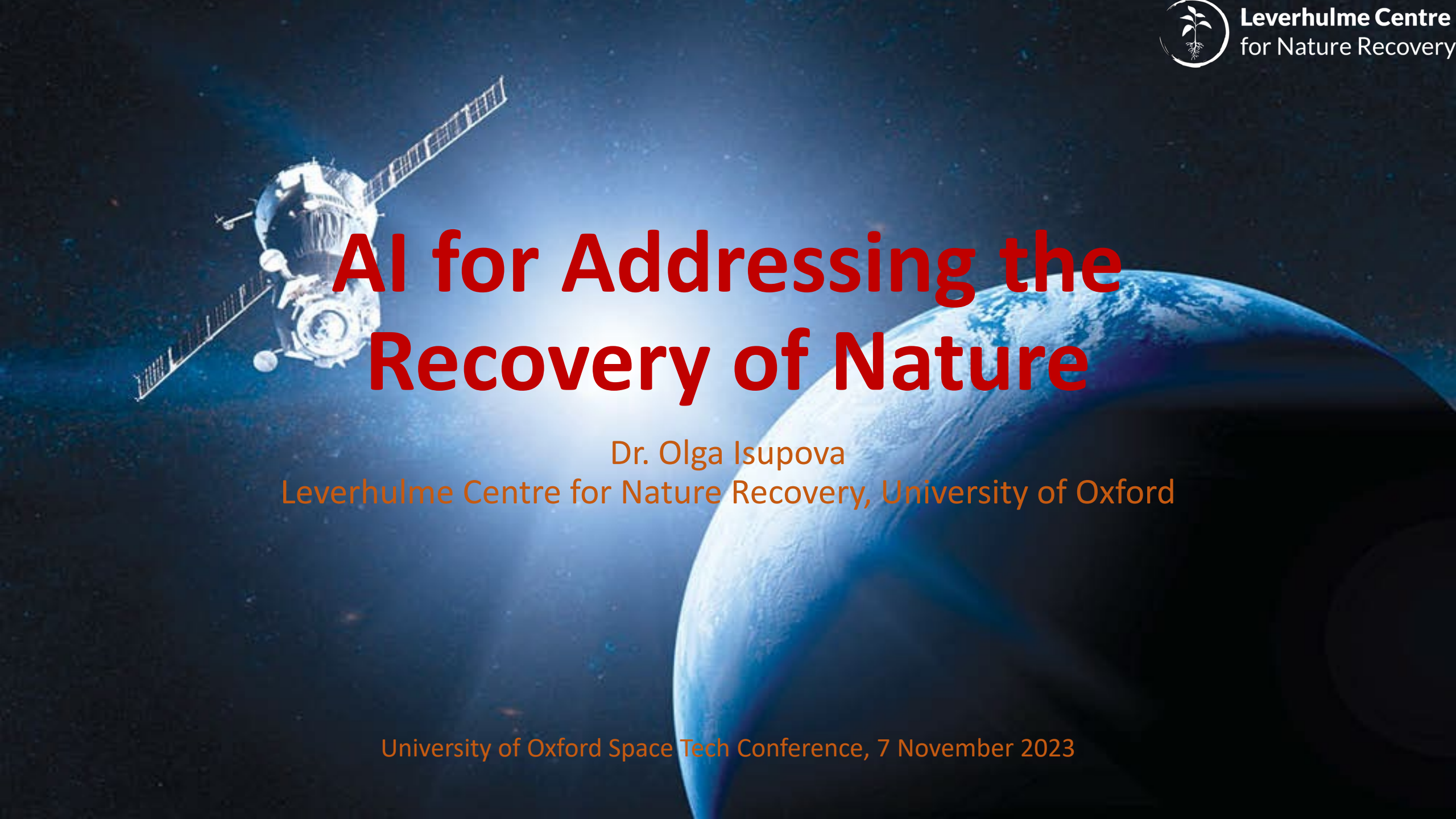

AI for Addressing the Recovery of Nature

Dr. Olga Isupova
Leverhulme Centre for Nature Recovery, University of Oxford

University of Oxford Space Tech Conference, 7 November 2023

Leverhulme Centre for Nature Recovery

Earth observations

Forestry

- Forest health monitoring
- Estimating extreme weather damage
- Mapping deforestation

Agriculture

- Crop monitoring and management
- Irrigation requirements
- Field boundary management

Risk management

- Land use monitoring
- Change detection
- Infrastructure planning

Disaster management

- Mapping disaster damage
- Disaster prediction

Natural resource management

- Resource mapping
- Environmental monitorir
- Infrastructure management

Maritime

- Mapping disaster damage
- Disaster prediction

AI can enable Earth observation more

Planet collects ~10TB satellite imagery per day

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Elephant detection from space

Duporge, I., Isupova, O., Reece, S., Macdonald, D.W. and Wang, T., 2021. Using very-high-resolution satellite imagery and deep learning to detect and count African elephants in heterogeneous landscapes.

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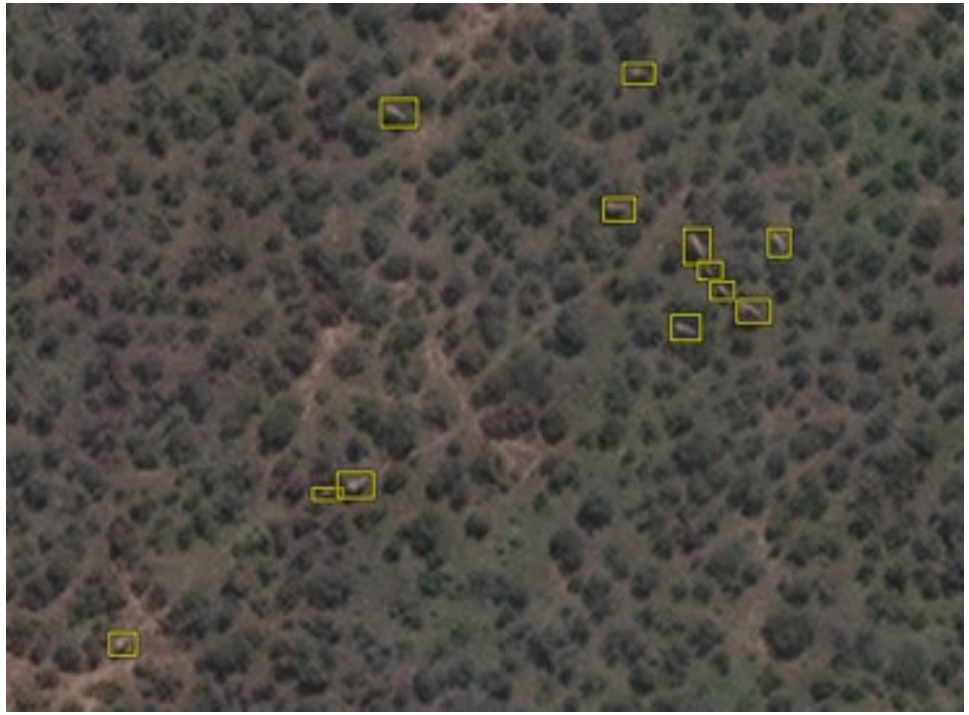
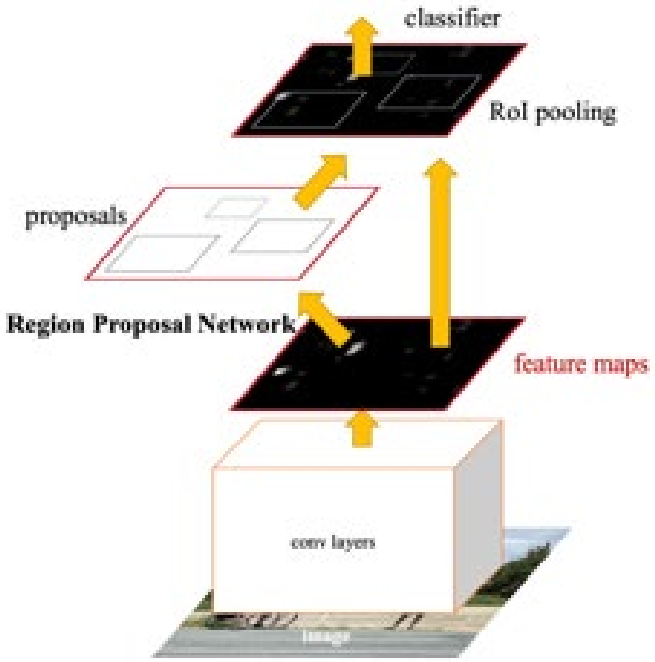
Elephant detection from space



Manually labelled elephants



Deep learning model

- Fully-grown bull elephant shows up in less than 15 pixels

Ren, S., He, K., Girshick, R. and Sun, J., 2015. Faster r-cnn: Towards real-time object detection with region proposal networks.

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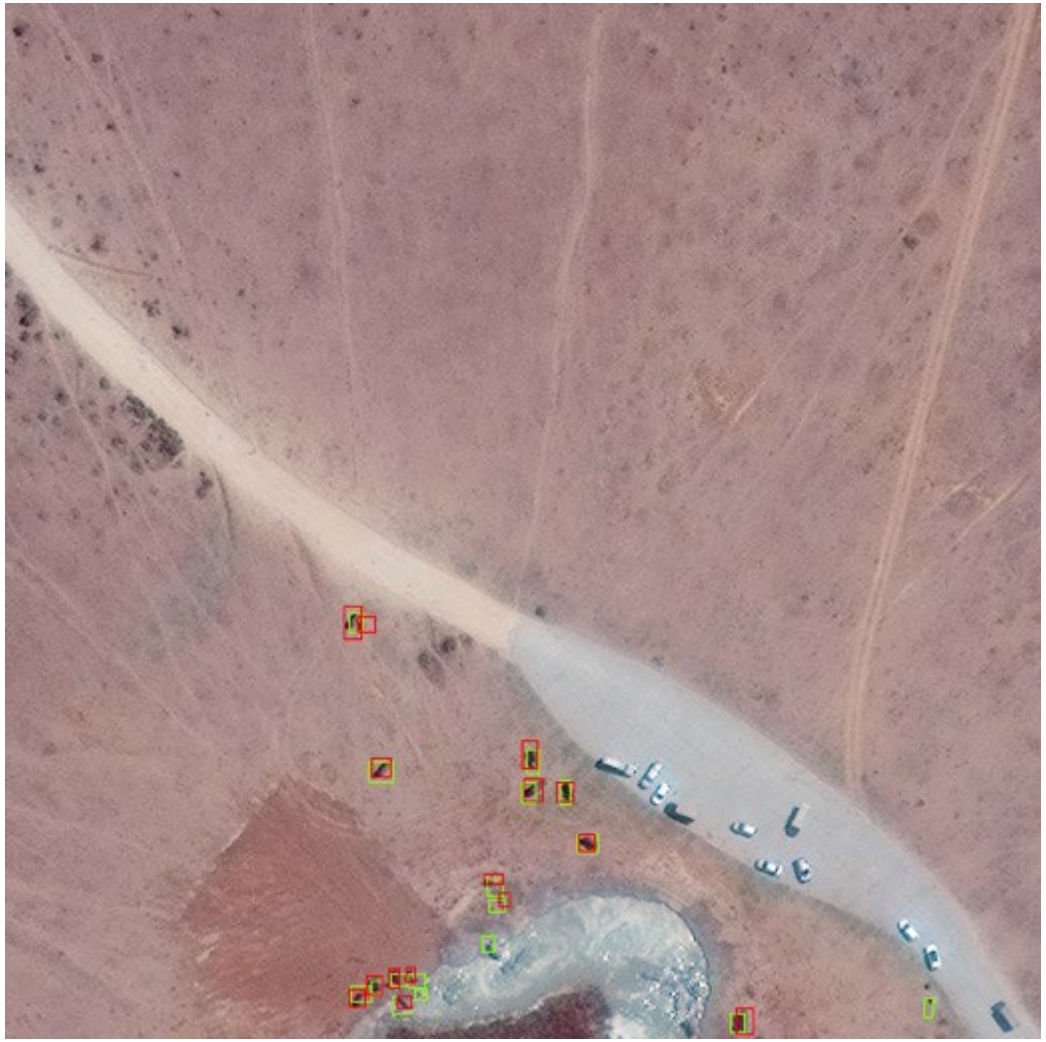
Elephant detection from space



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Elephant detection from space

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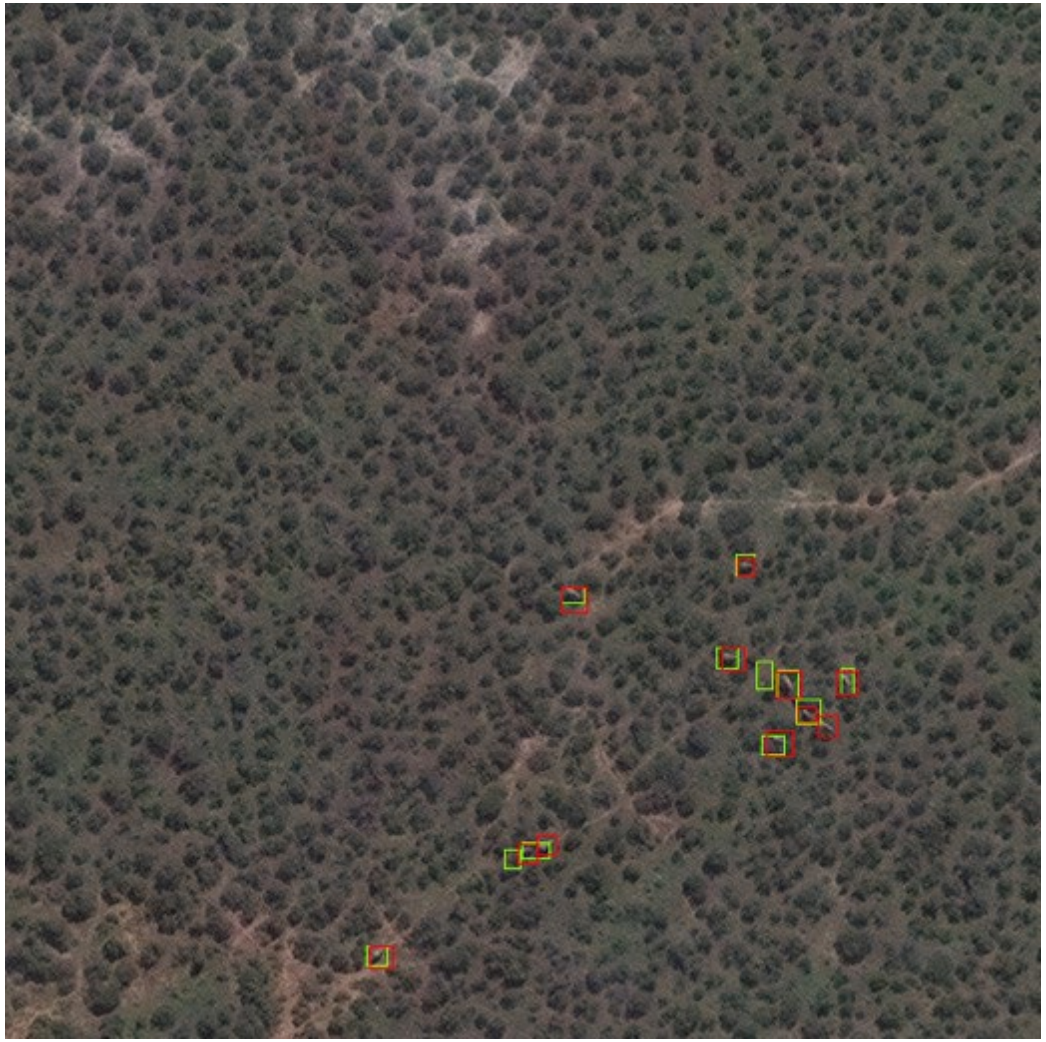
Elephant detection from space



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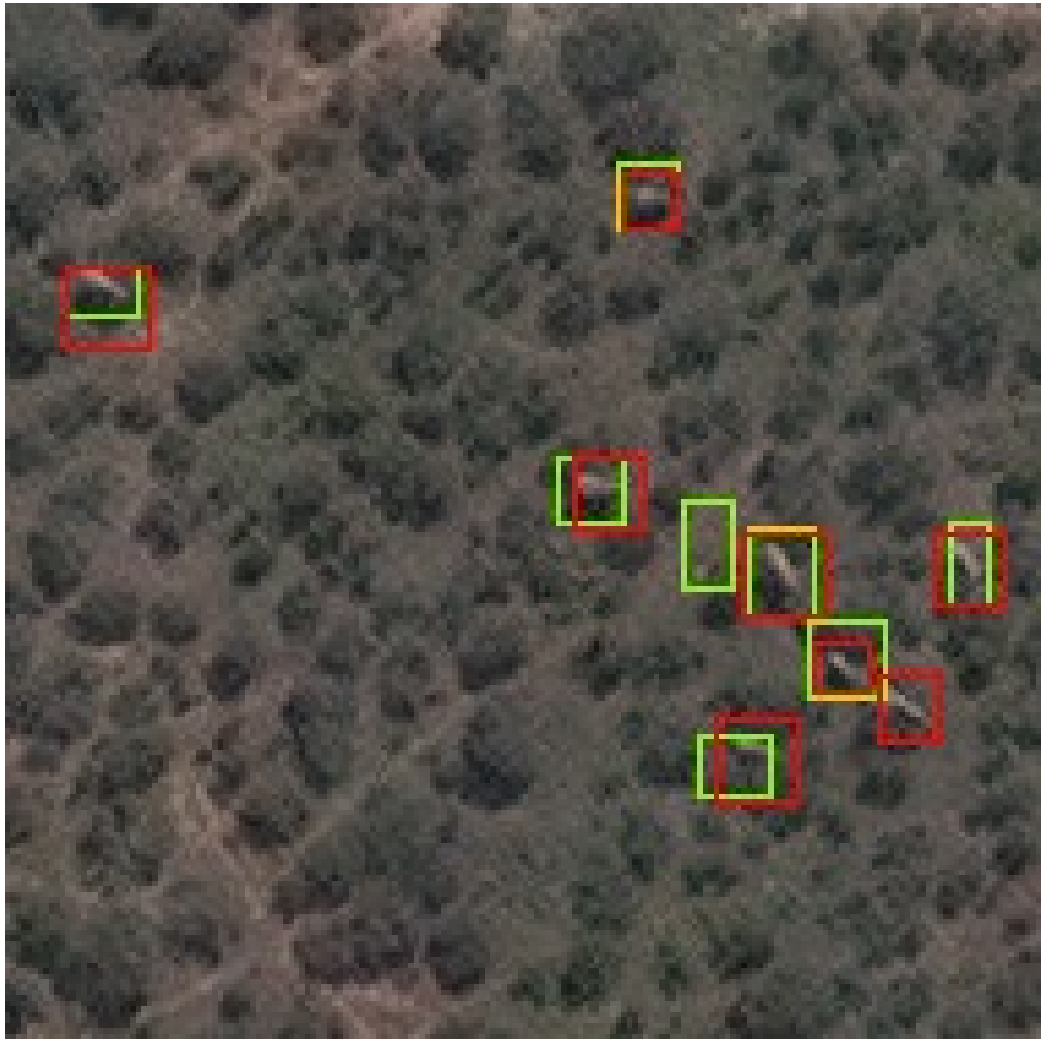
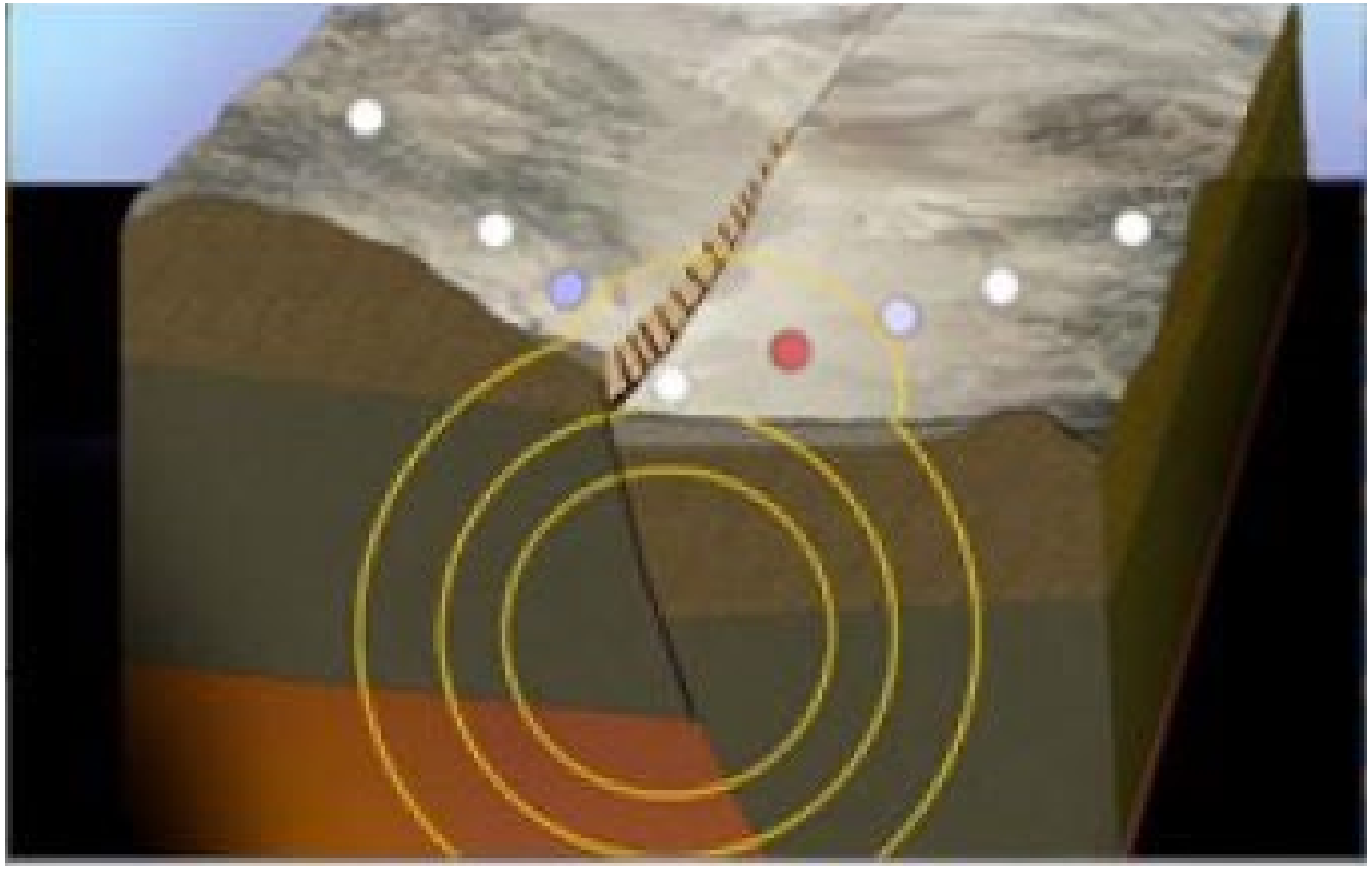
Elephant detection from space



Seismic fault detection from space



Kuzin, D., Isupova, O., Elliot, A., Walker, R., Reece, R., and England, P.

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Seismic fault detection from space

Features

- Landsat-8 channels
- Elevation
- Slope
- Terrain Ruggedness Index

Labels

- USGS Fault data
- Manual selection of representative faults of different types
- Faults are rasterized into 4 pixel (120m) width lines

Example elevation maps / corresponding labels

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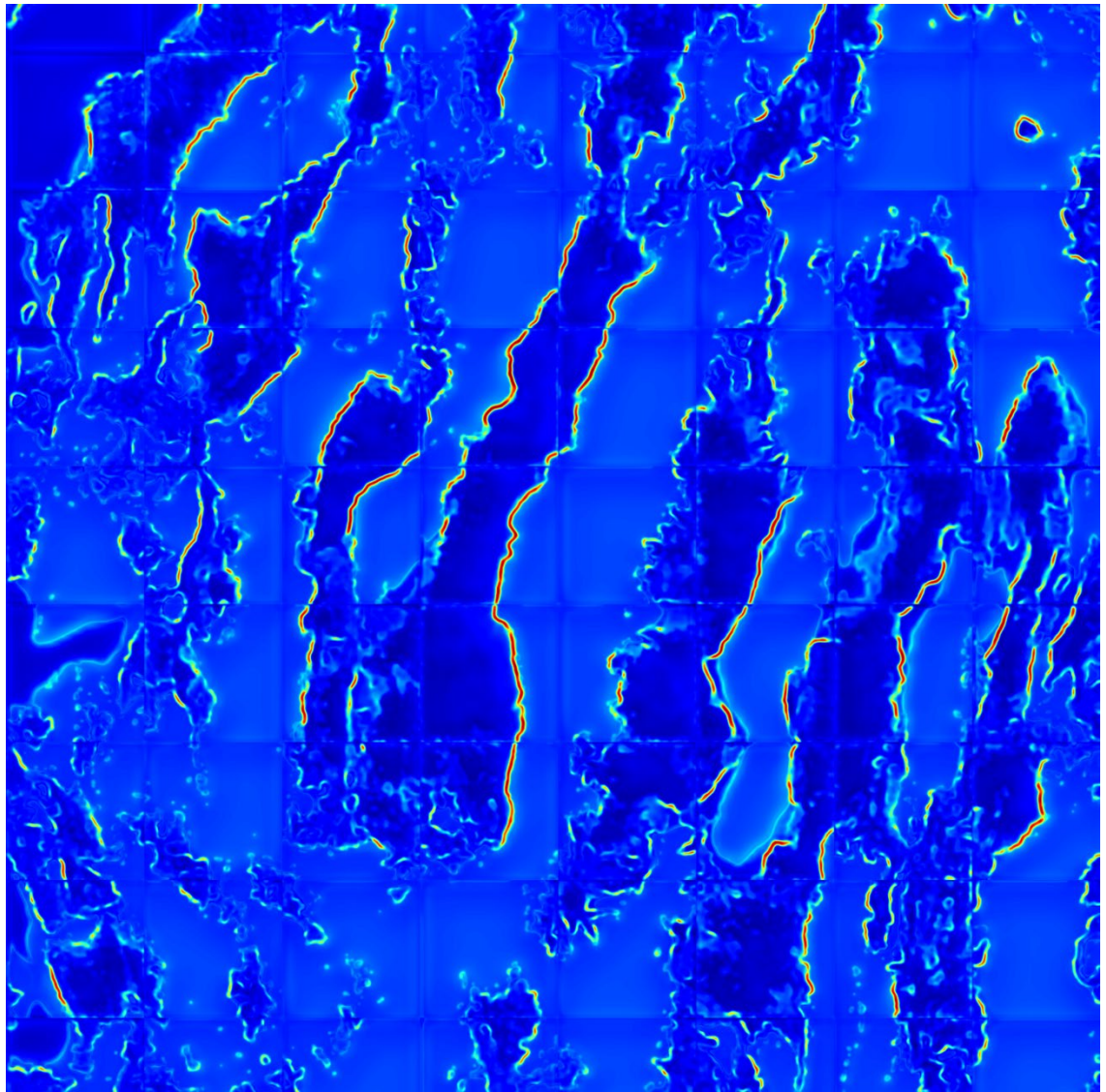
Seismic fault detection from space



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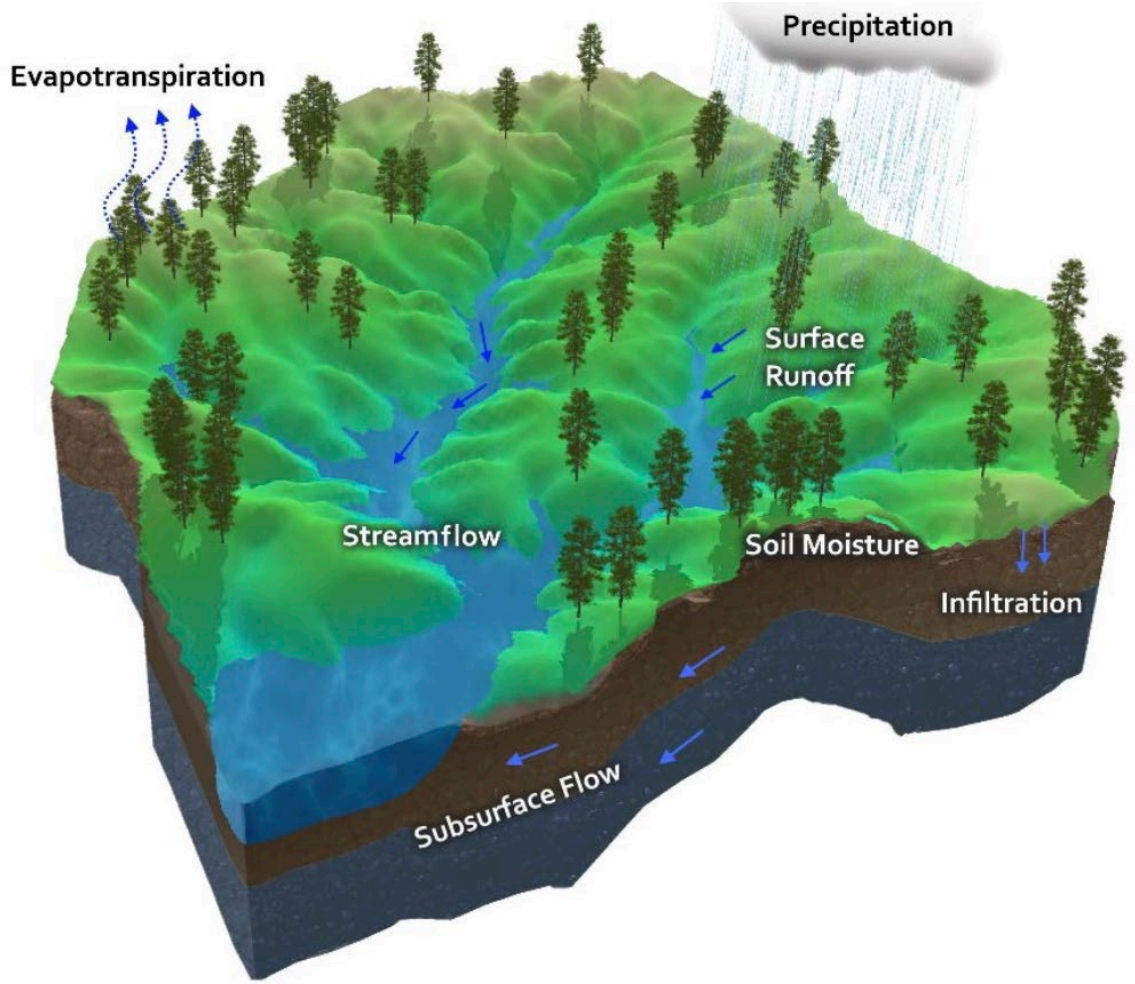
Discovering hydrological concepts from space



Lees, T., Reece, S., Kratzert, F., Klotz, D., Gauch, M., De Bruijn, J., Kumar Sahu, R., Greve, P., Slater, L. and Dadson, S., 2021. Hydrological concept formation inside long short-term memory (LSTM) networks

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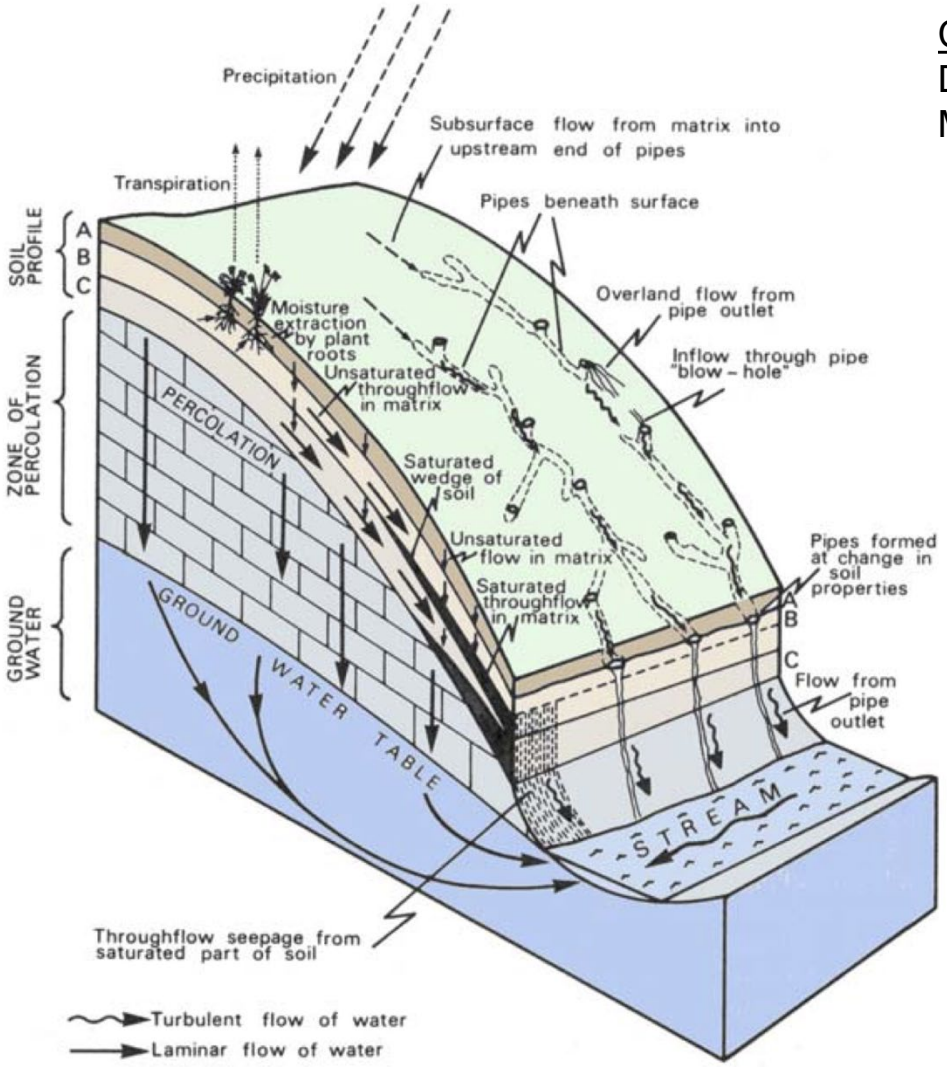
Discovering hydrological concepts from space

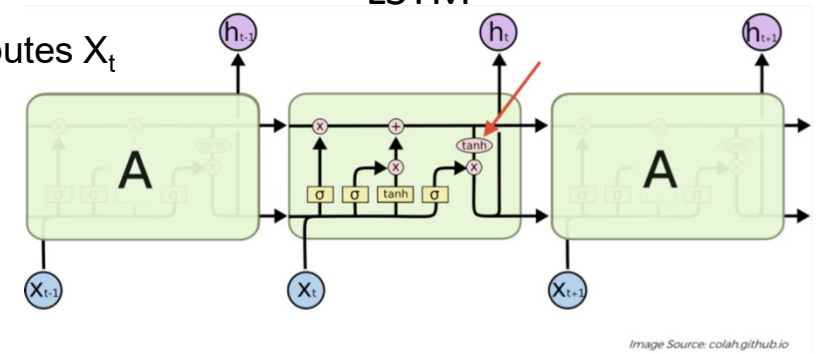


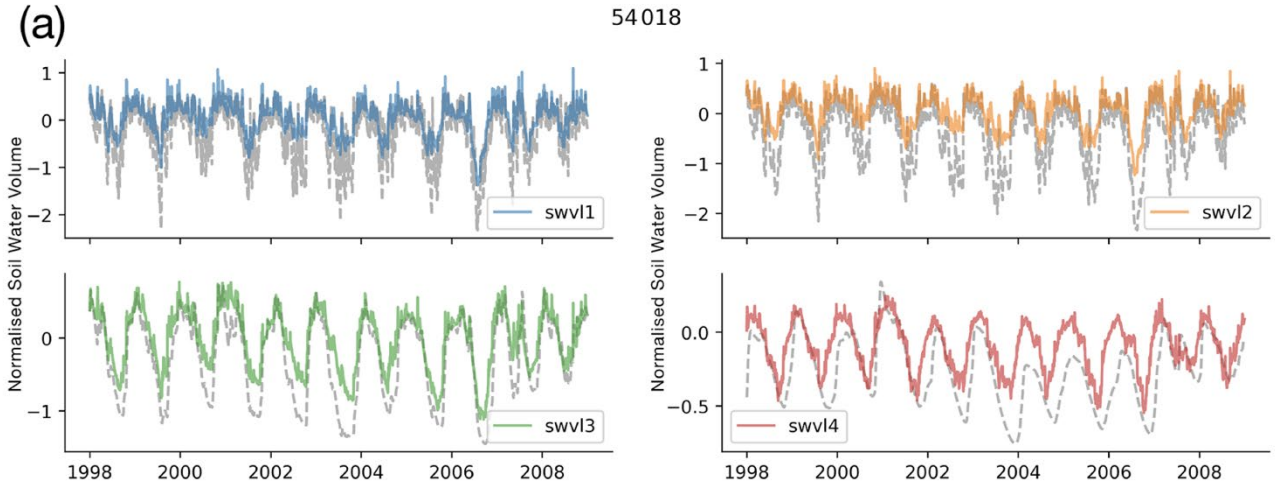
Camel—GB

Discharge h_t

Meteorological and catchment attributes X_t

LSTM





Estimated soil water volume; Target value in grey (ERA5-Land dataset)

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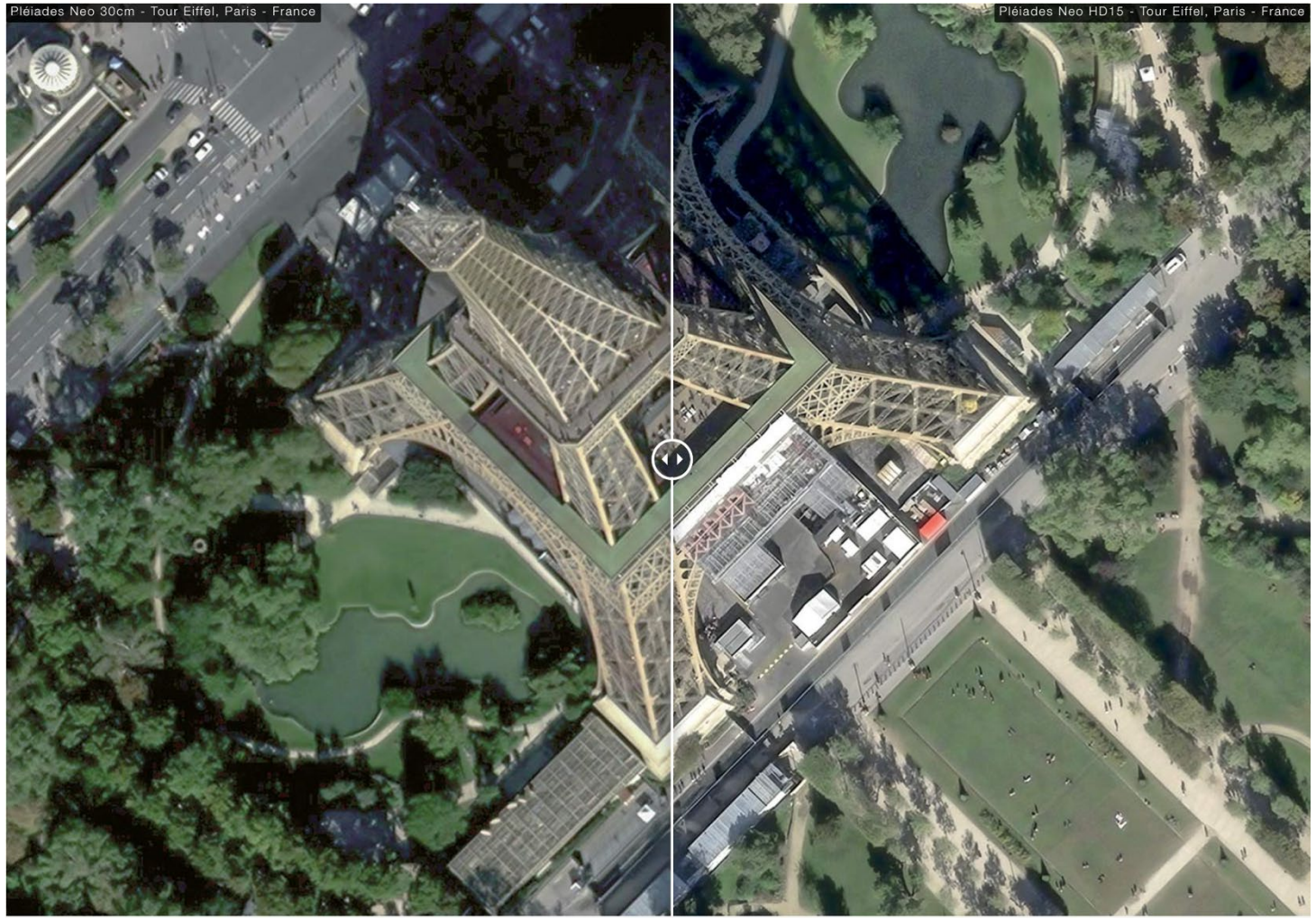
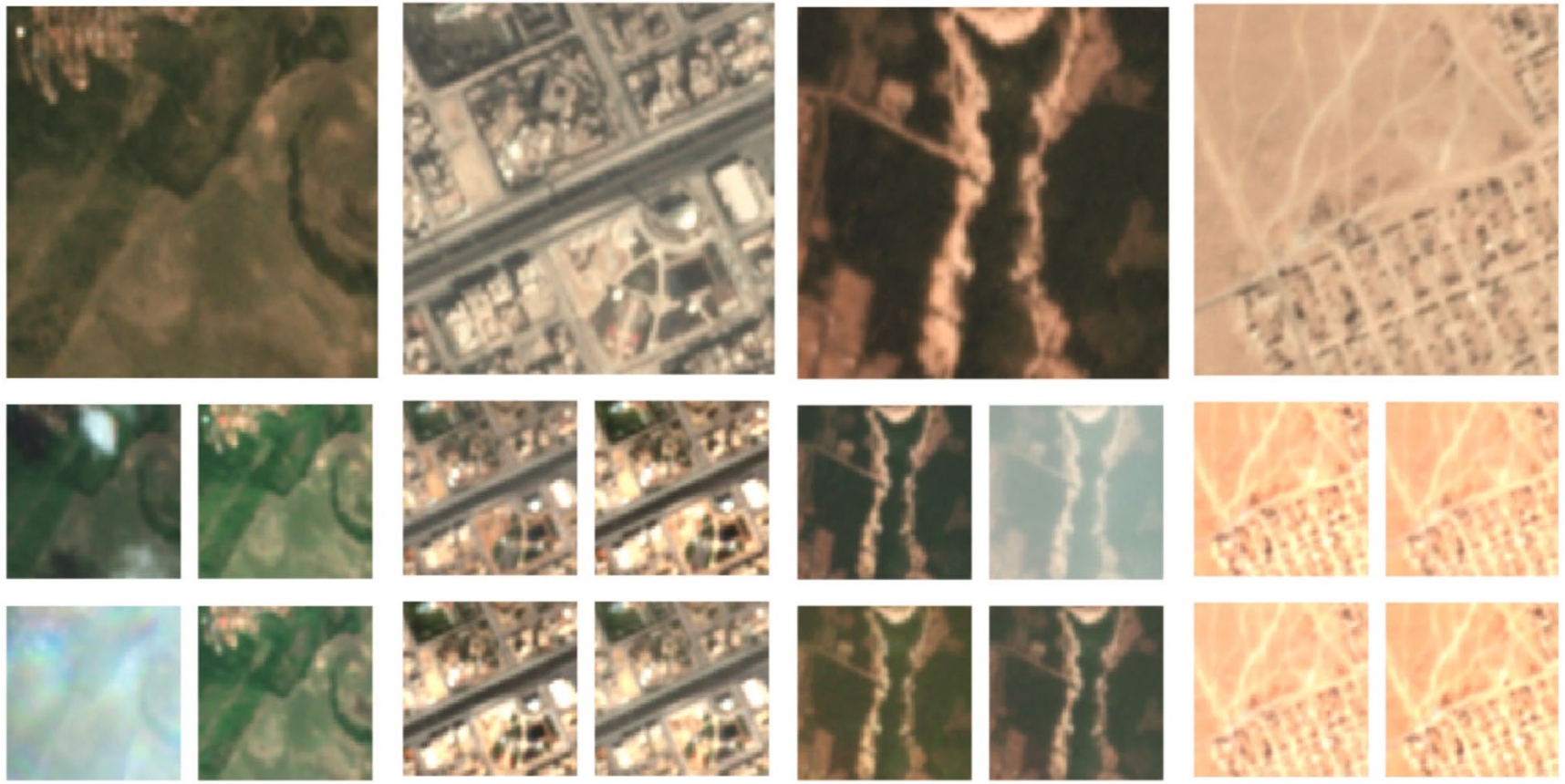
Superresolution of satellite imagery



Razzak, M.T., Mateo-García, G., Lecuyer, G., Gómez-Chova, L., Gal, Y. and Kalaitzis, F., 2023. Multi-spectral multi-image super-resolution of Sentinel-2 with radiometric consistency losses and its effect on building delineation.

Superresolution of satellite imagery



10 m RGB bands of Sentinel-2 images → 4.77 m RGB PlanetScope images

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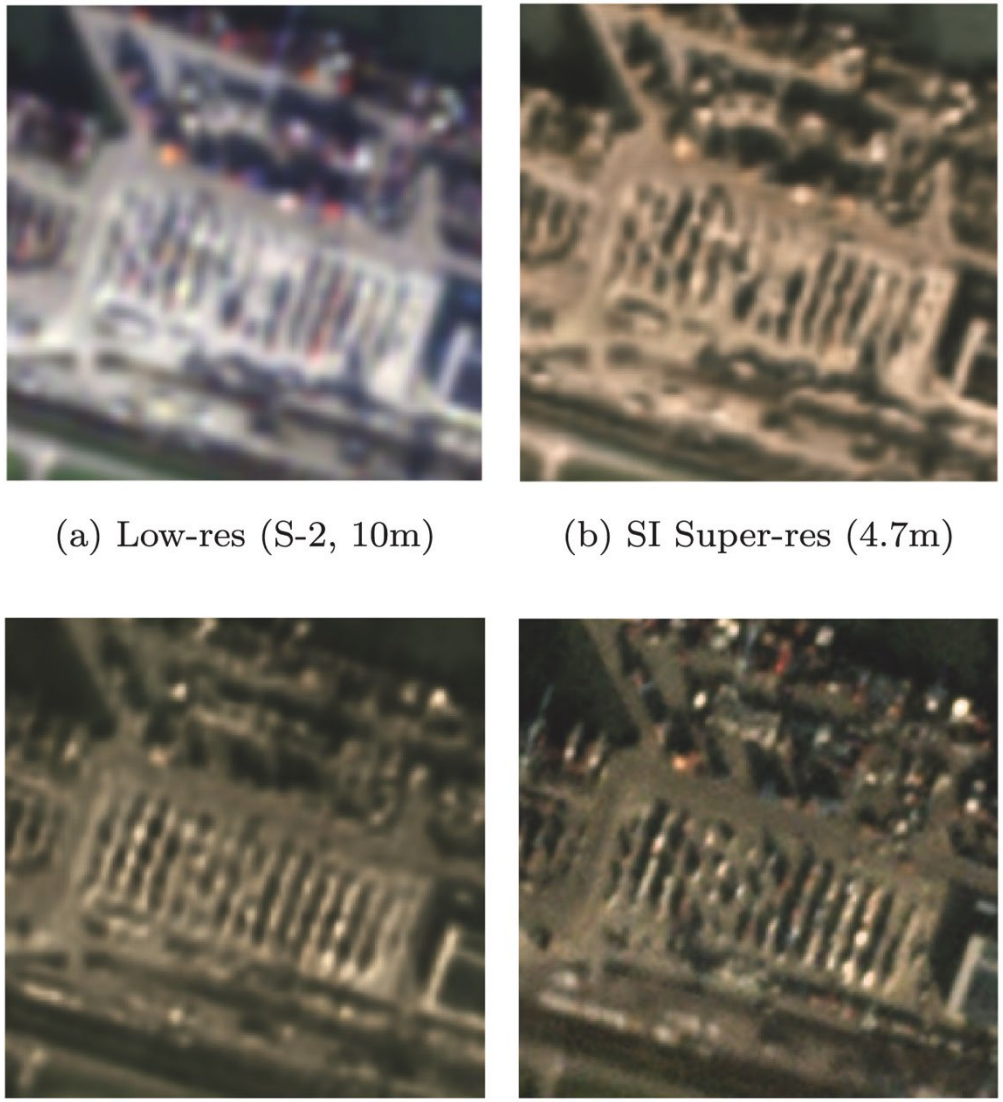
Superresolution of satellite imagery



(a) Low-res (S-2, 10m)

(b) SI Super-res (4.7m)

(c) MI Super-res (4.7m)

(d) High-res (Planet, 4.7m)

Summary

- AI can unlock many more applications for Earth observations that were previously impossible
- Only a few of already existing examples:
  - Satellite imagery as an additional tool for conservation monitoring
  - Global mapping of seismic faults to mitigate earthquake damage
  - Prediction and understanding of hydrological events
  - Superresolution of satellite imagery that in turn enhance performance on downstream tasks