Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Protect
Grow
Innovate

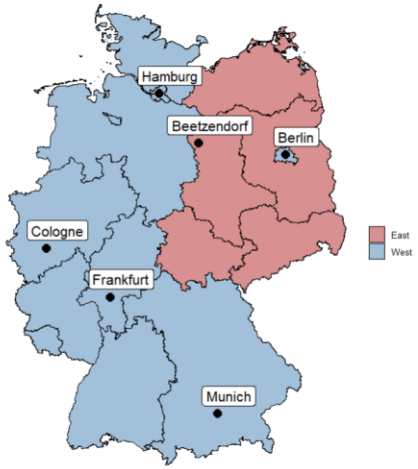
Enhancing Soil Mapping and Suitability Assessment with DPIRD's WA Soil Data

Tidyverse and Snakemake integration

Jakob Petereit
jakob.petereit@dpird.wa.gov.au
Dennis van Gool
Dennis.Vangool@dpird.wa.gov.au

About me

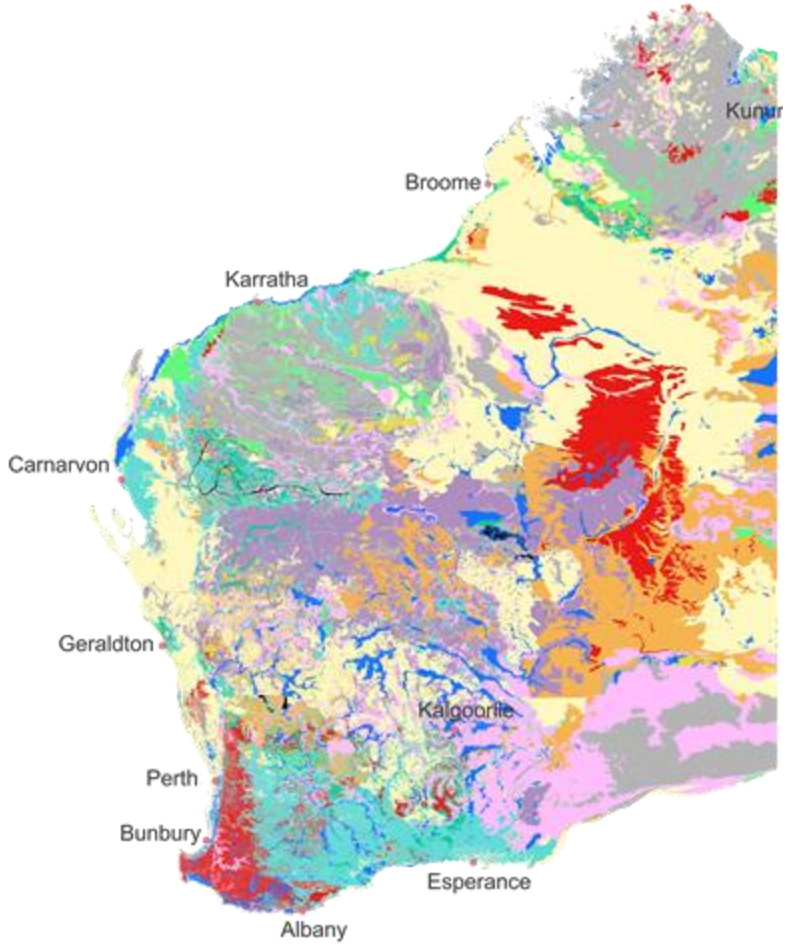
- Jakob Petereit
- Lived and studied in Germany

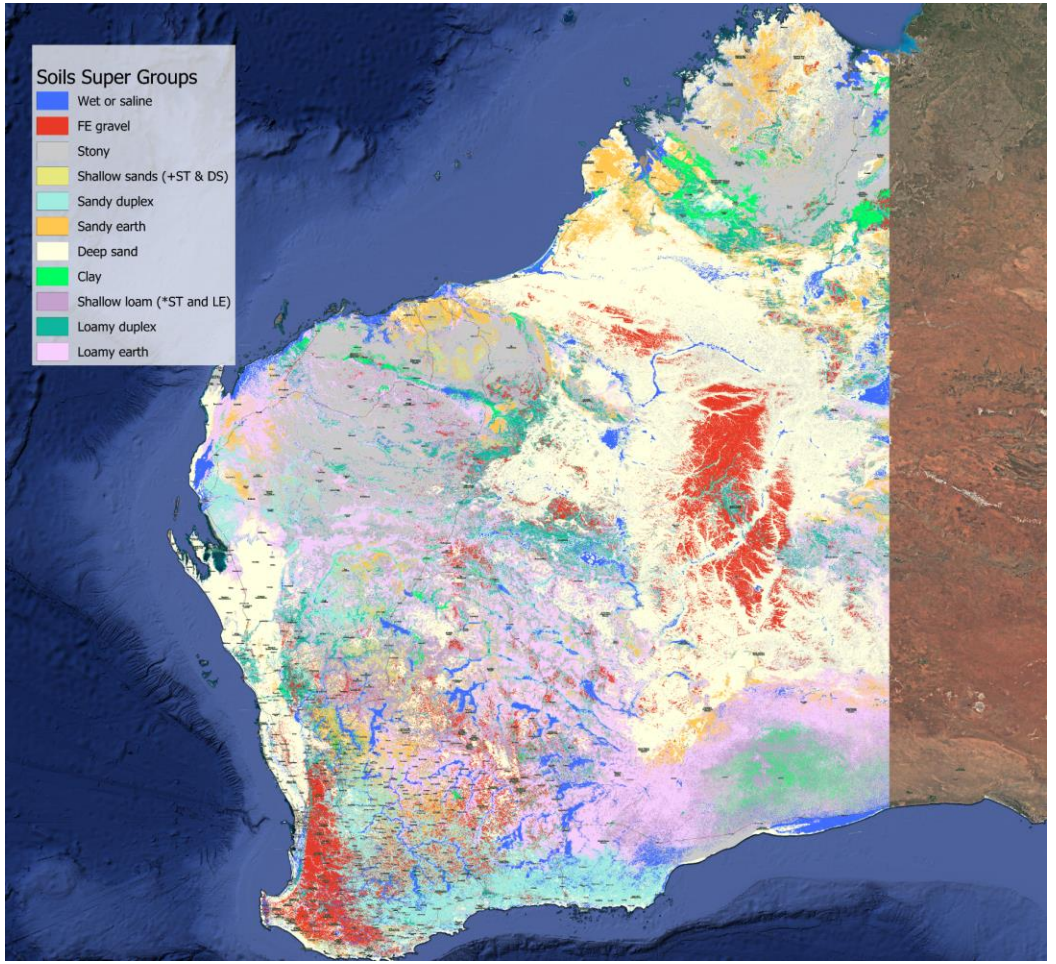


- PhD in Perth (Computational Biochemistry)
  - Genome assembly
  - RNAseq

- Moved to DPIRD and geospatial data science in February 2024
  - Groundcover Portal
  - HPC liaison
  - Digital Soil Mapping (DSM)

DSM: From Polygons to Raster, with focus on the Rangelands





Polygon Map

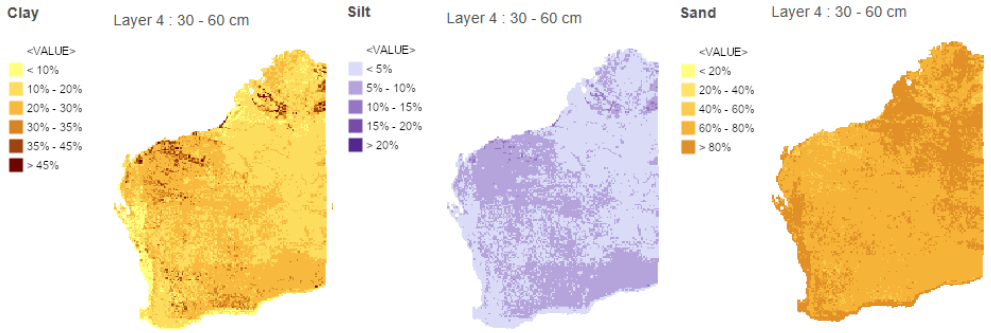
- Attribute per polygon

Raster Map

- Attribute per pixel

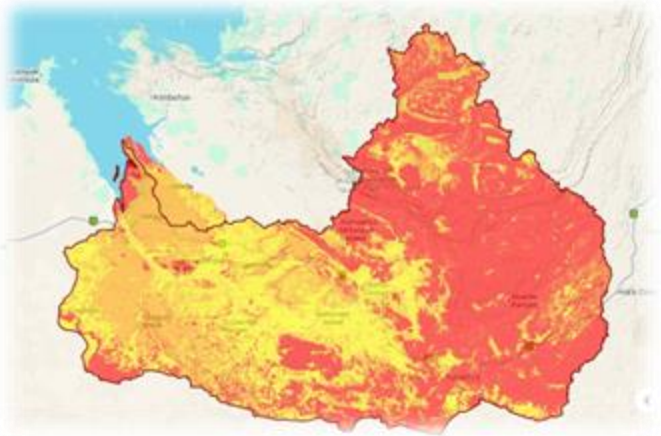
Extensive DSM Efforts in Australia – Other National Soil Products

- Soil and Landscape Grid of Australia



Source:https://esoil.io/TERNLandscapes/Public/Pages/SLGA/ViewData-QuickView.html

- Northern Australia Water Resource Assessment



Northern Australia Water Resource Assessment Explorer

Northern Australia Water Resource Assessment - CSIRO

GitHub

DSM project are shared

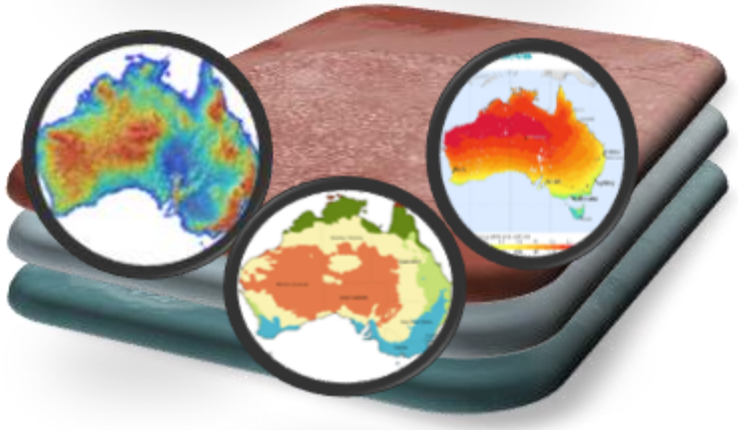
DPIRD Soils database

- ~80,000 training points from surveys dating back to 1937
- CSIRO did early surveying work until the 1960s, DPIRD has surveyed for nearly 50 years
- Valuable but imperfect dataset – modelling aids quality control
- Data shared nationally ANSIS Portal (see https://portal.ansis.net)

Link soil properties to covariates and then do the same backwards to predict soil properties

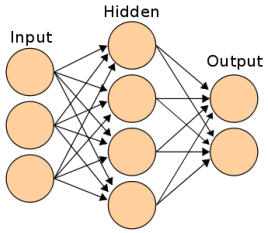
Soil Observations

Covariates

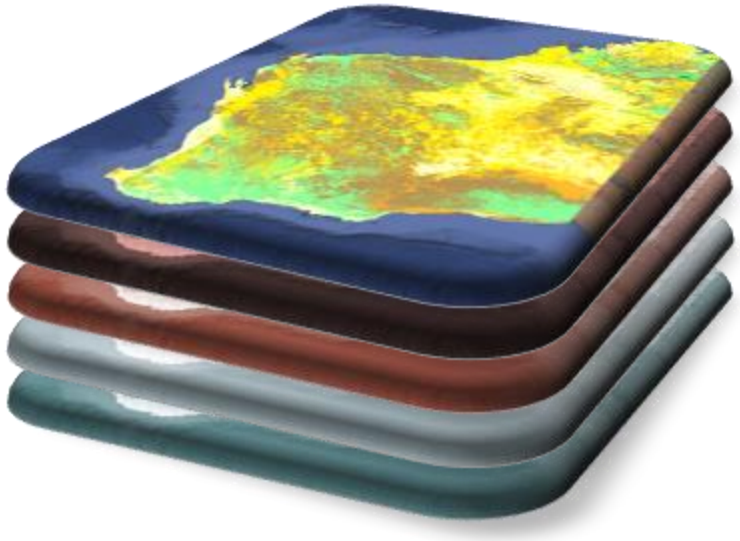


e.g. environmental maps,
radiation maps, elevation maps

Model



Soil Predictions



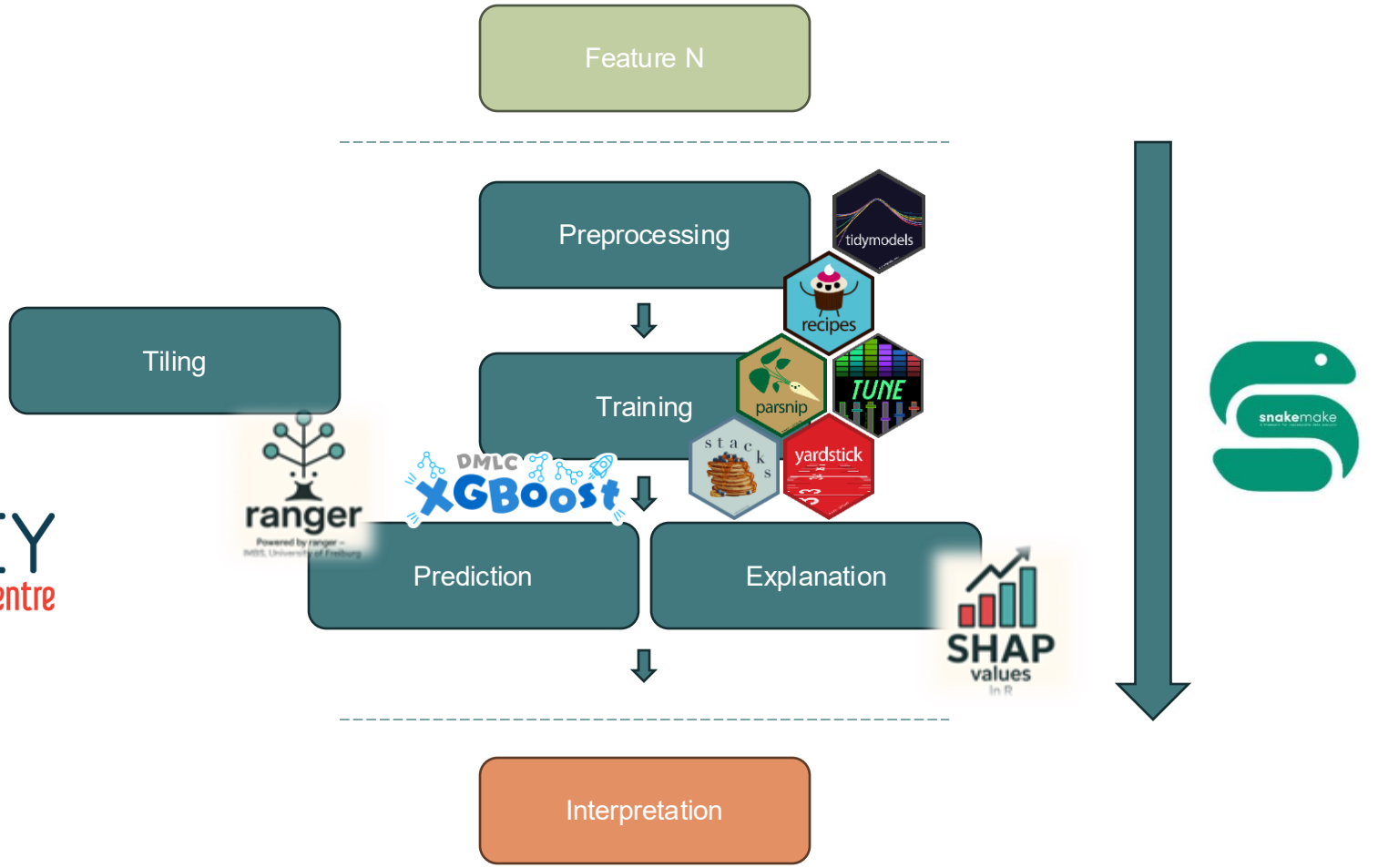
Soil Property Maps:
Maps of soil texture, pH, etc.

Soil Class Maps:
Classification of soil types
(e.g., WA Soil Supergroups).

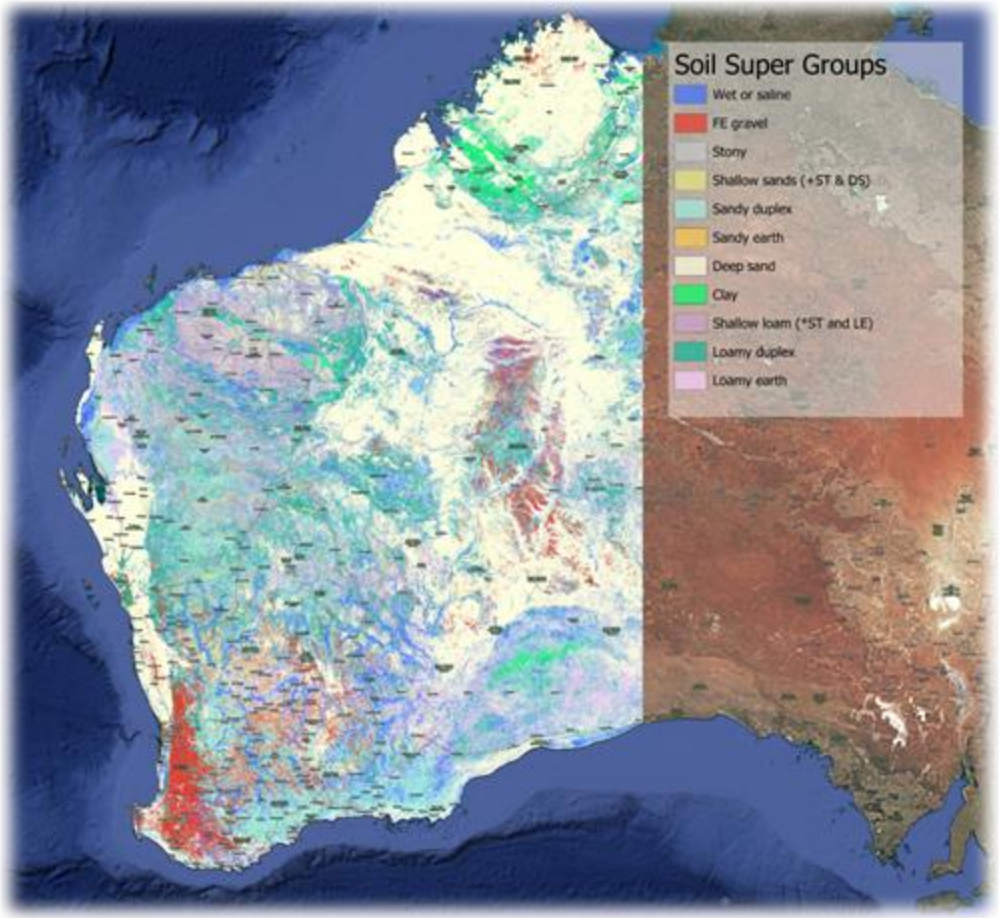
Suitability Maps:
e.g. Erosion hazard rating

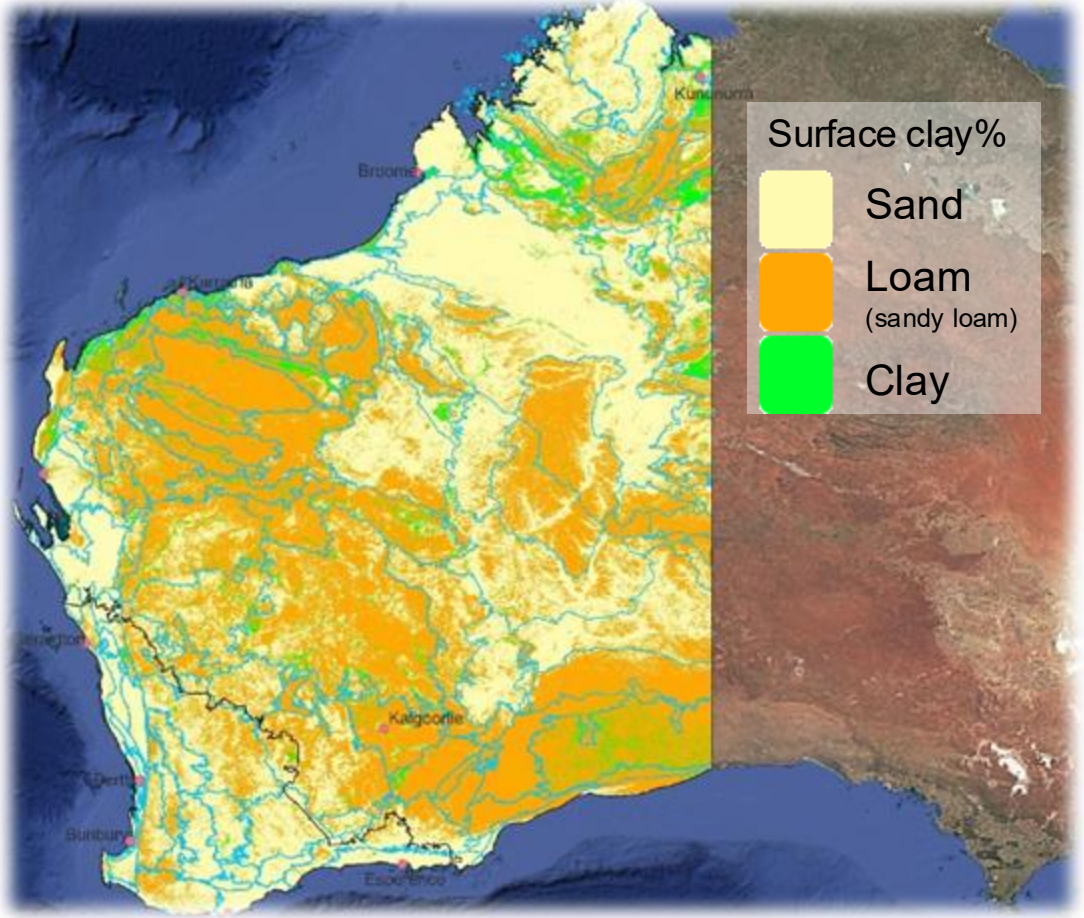
Pipeline overview

PAWSEY supercomputing centre



Example Output





Example Case:
Wind Erosion Hazard in the northern Ag region

Example Area

Example Case area

- North of Geraldton
- South of Kalbarri National Park

Example Area in detail

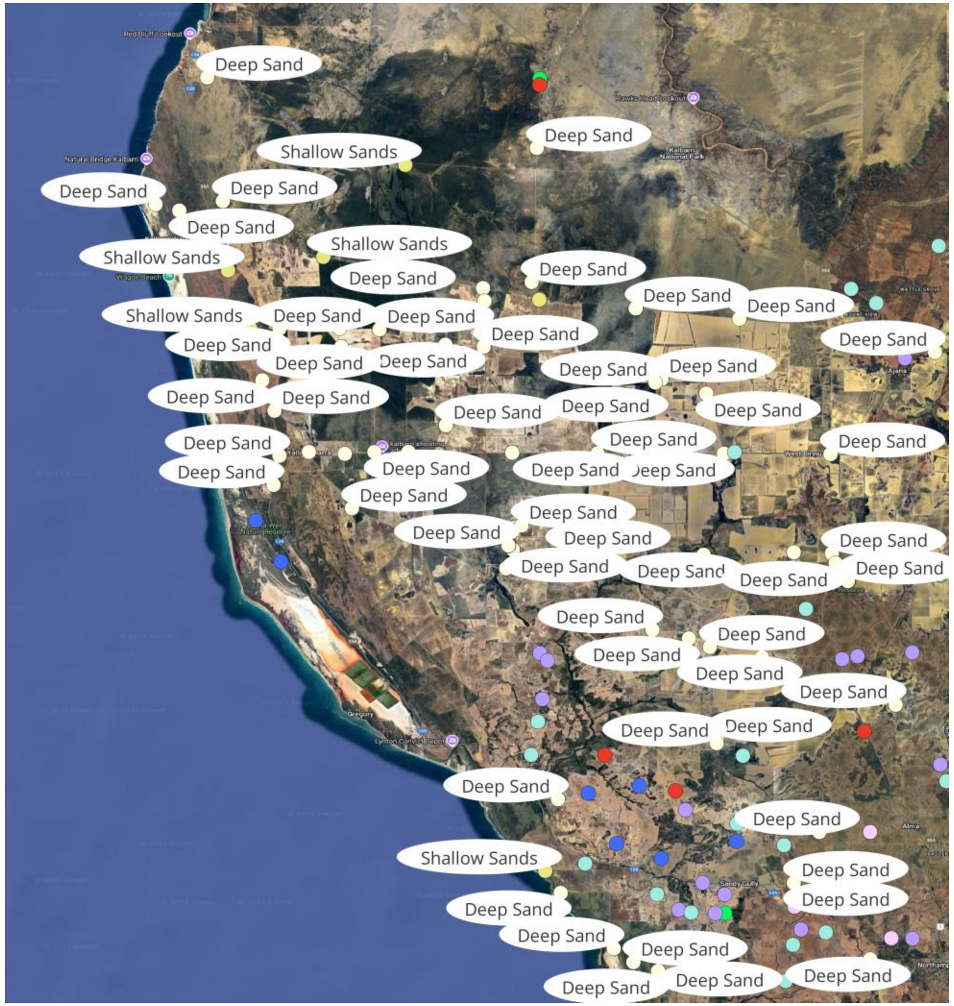
- 🏖️ Coastal region
- 🌳 Includes forest
- 🚜 Some areas used for farming
- 🌬️ Exposed to high winds

Example Area surveys

🛠️ Soil Survey Process

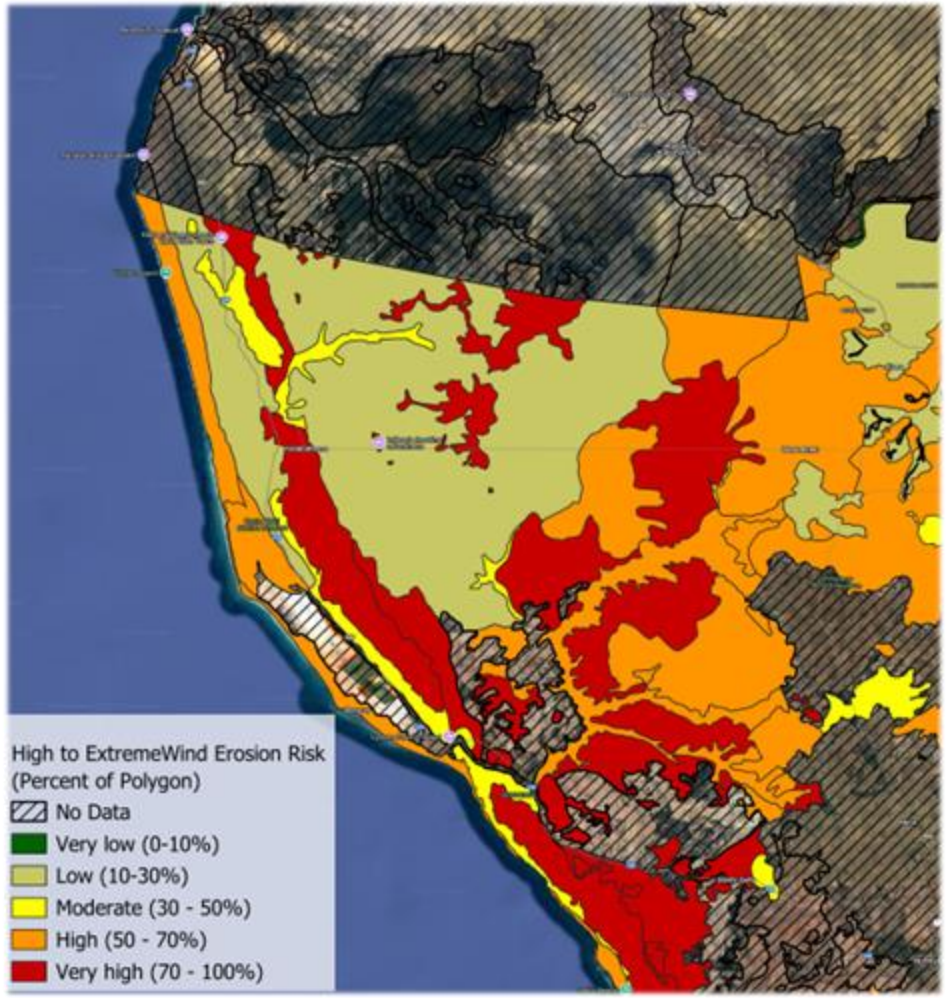
- 🔨 **Collect** soil samples and record landscape features
- 🔬 **Analyse** samples to determine soil characteristics
- 🧠 **Interpret** data to classify soil types and risks

Example Area mostly sandy



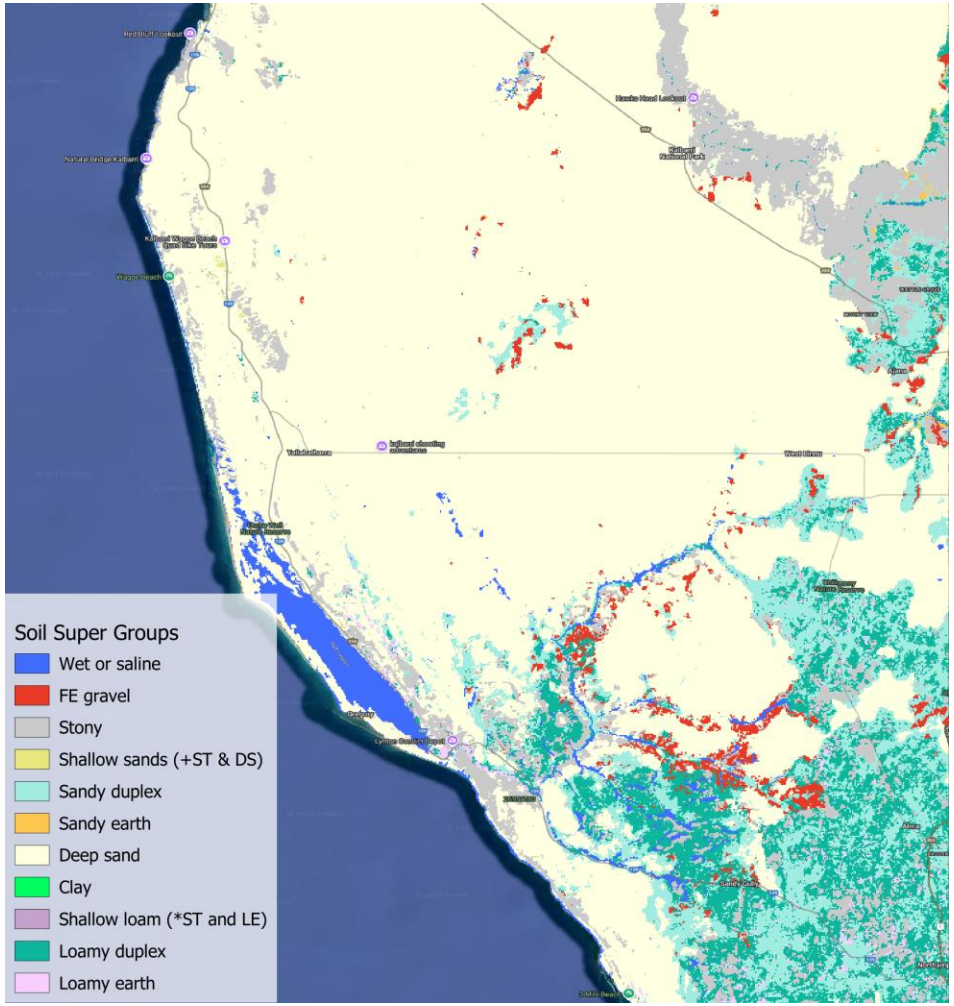
- 🤔 Sample area is dominated by sandy soils.
- 🧠 Sandy soils tend to be more vulnerable to wind erosion.

DPIRD Polygon Wind Erosion Risk



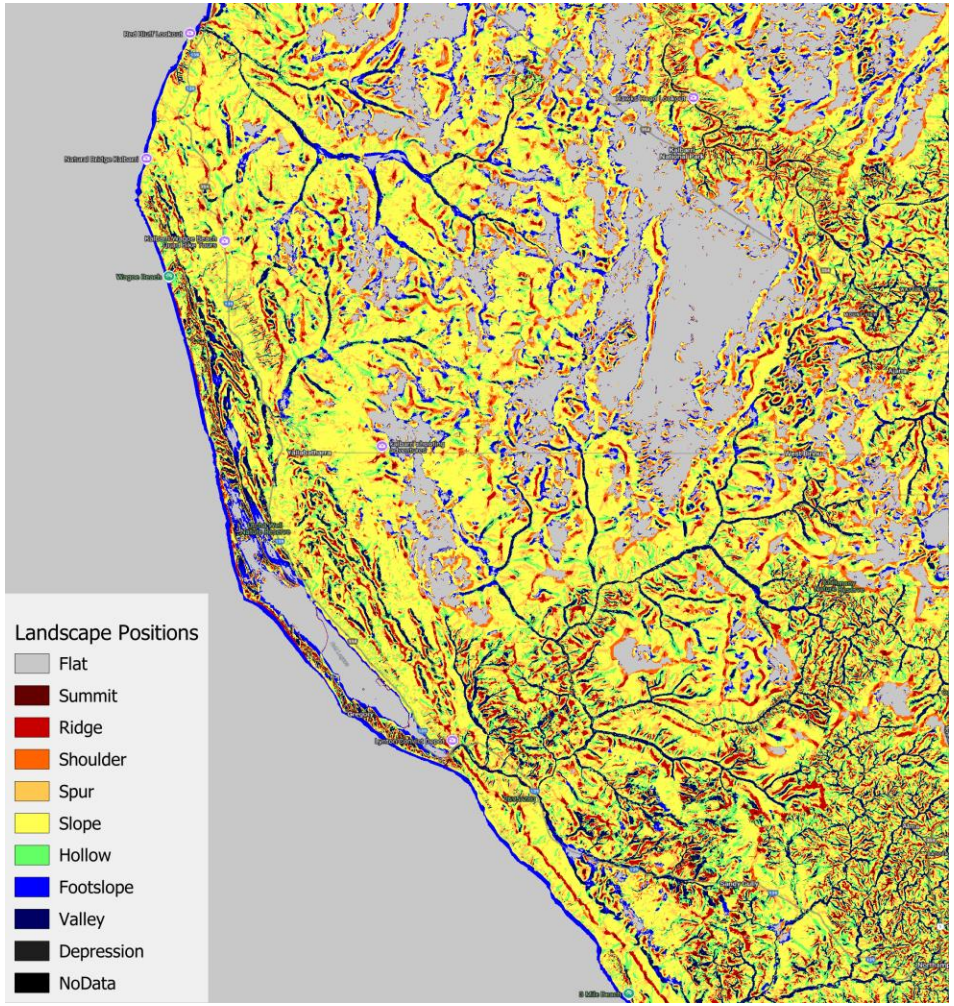
- Polygons are based on soil surveys (loose surface, deep sand) and landscape positions (e.g. summit, valley).
- Colours show % area at High to Extreme wind erosion risk.

Soil group raster prediction



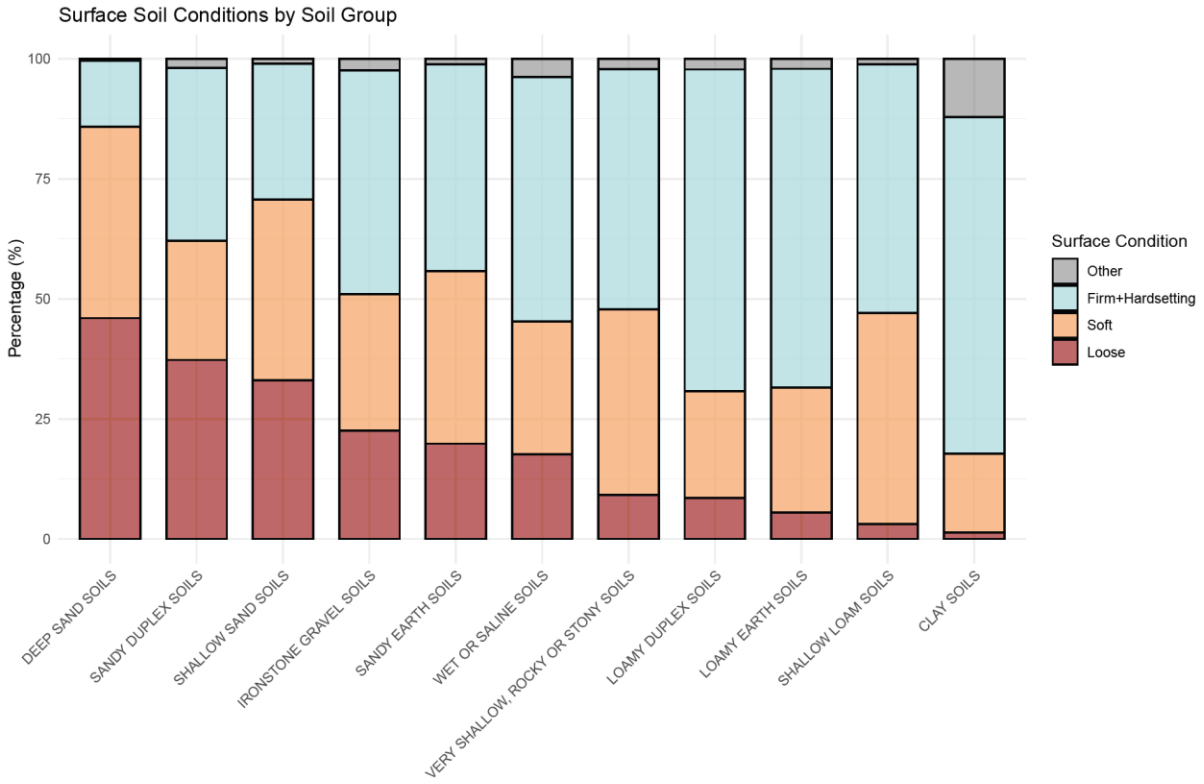
- **Deep Sand**: Dominant in coastal zones. Highly permeable and prone to wind erosion.
- **Sandy & Loamy Duplex**: Found near river systems and low-lying areas. Sandy Topsoil is erosion prone.
- **Ferric (FE) Gravel and Stony**: Scattered across upland zones. Less erosion concerns.
- **Wet or Saline Soils**: less concern for wind erosion

Landscape position prediction



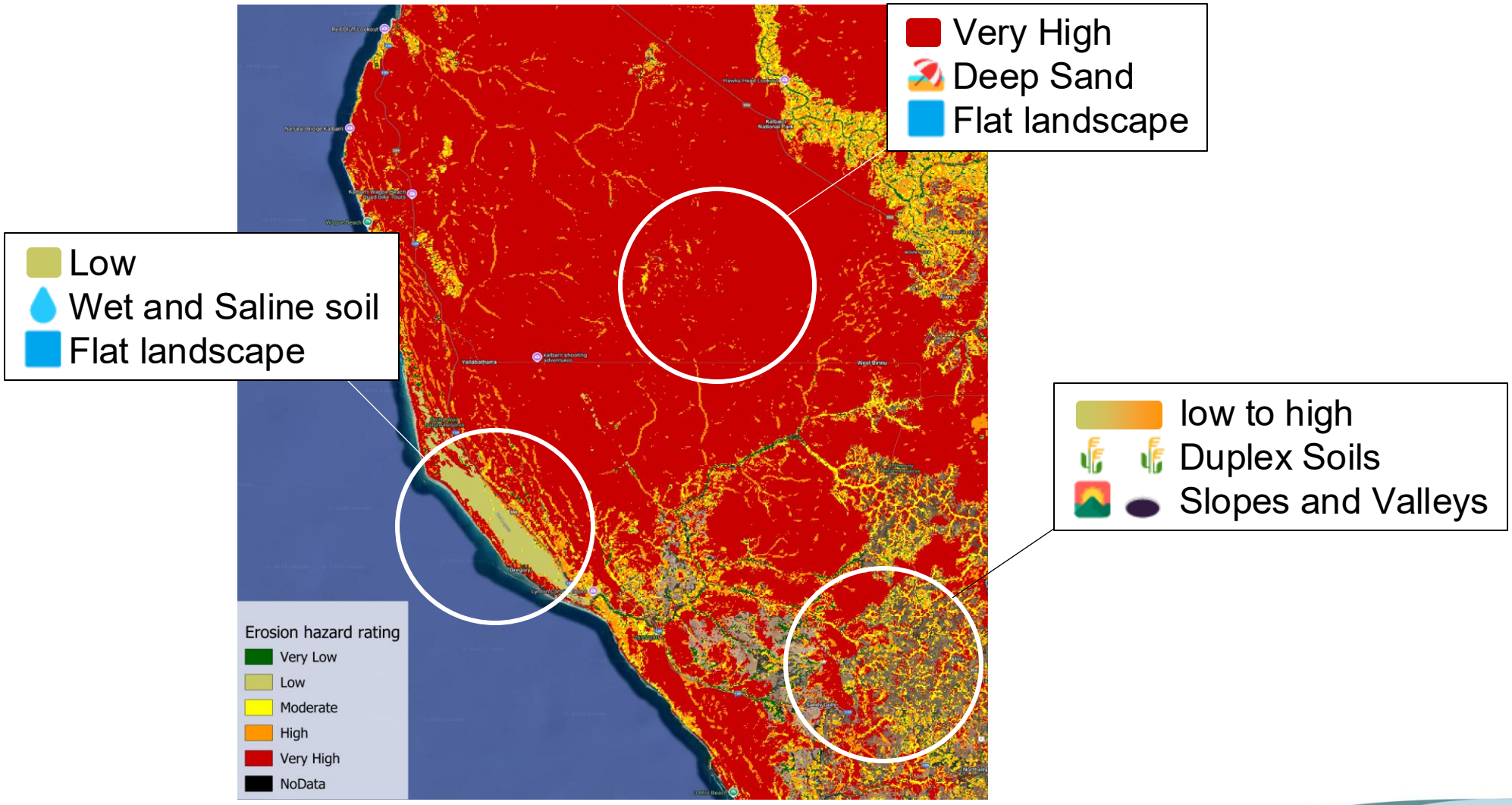
- **Summits & Ridges**: Most exposed positions—**high wind erosion risk**
- **Slopes & Shoulders**: Moderately exposed
- **Hollows, Valleys & Depressions**: Sheltered—**lower wind erosion risk**
- **Flats & Footslopes**: Variable risk

Combining information to model erosion

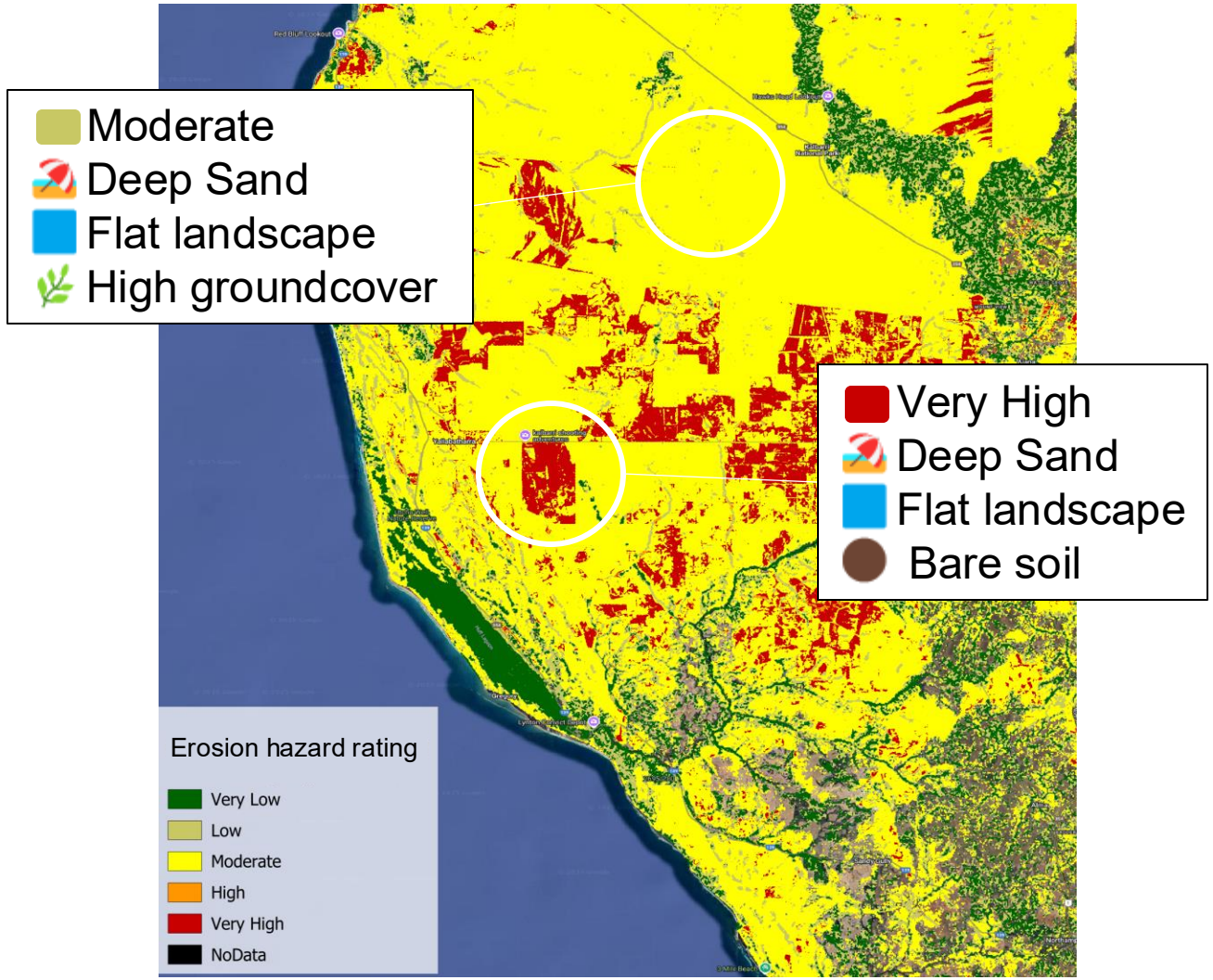


Soil Type ➡️ / Landscape ⬇️	Sands	Duplex	Clay/Loam
Summit Ridge	High	Moderate	Moderate
Shoulder Spur	High	Moderate	Low
Slope Flat	Moderate	Low	Very Low
Footslope Hollow	Low	Very Low	Very Low
Valley Depression	Very Low	Very Low	Very Low

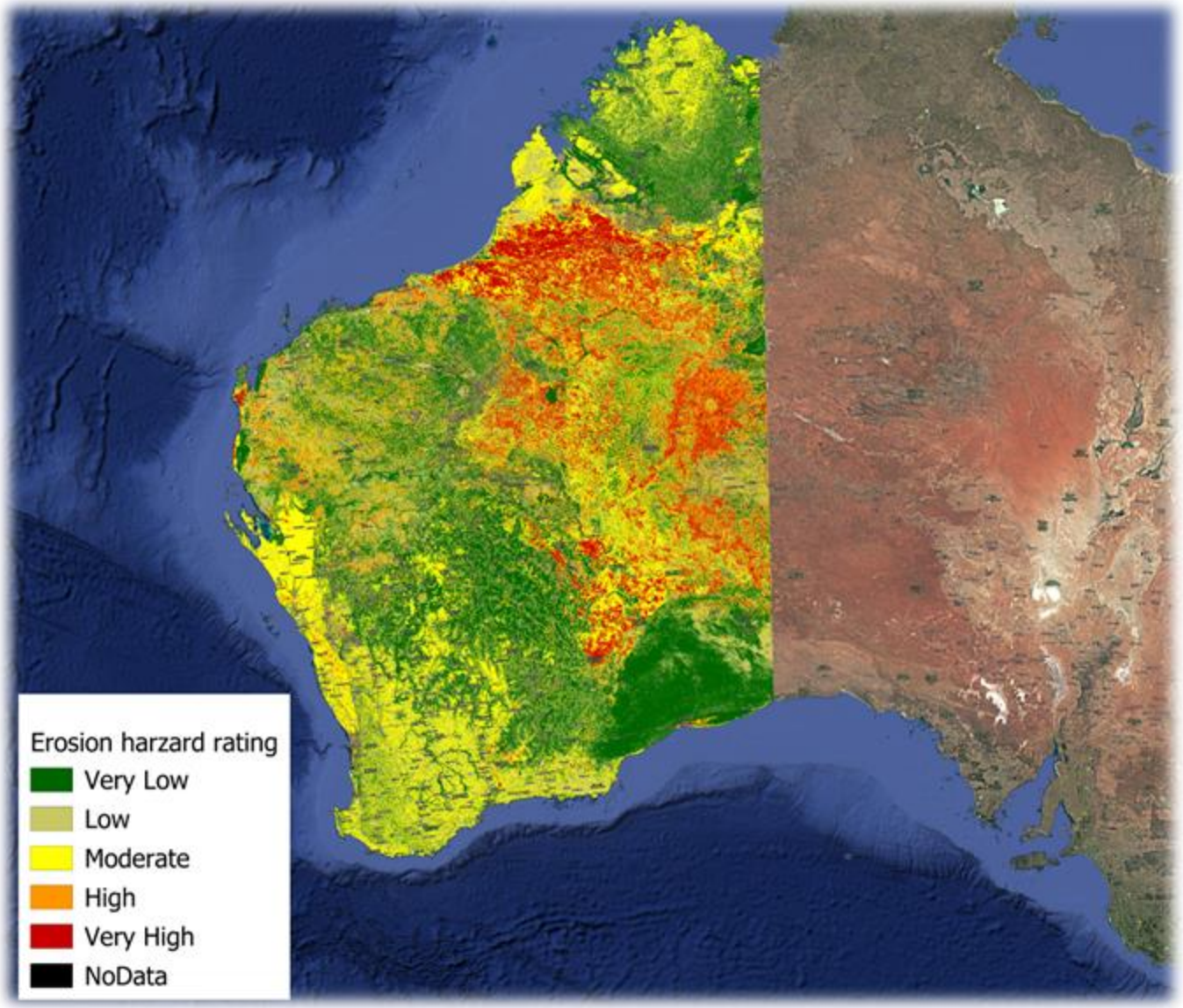
Erosion hazard rating



Erosion hazard rating is influenced by more than Soil and landscape



Raster map can do this for the whole state



- Raster map predictions are done statewide
- Prediction accuracy is dependent on training data density
- Erosion thresholds are not final

Next Steps

- Test & fix bugs – something will break
- Prune training data (~80,000 pts) – improve quality
- Contribute to national DSM development
- Share maps for feedback and validation

Thank you

dpird.wa.gov.au

Important disclaimer

The Chief Executive Officer of the Department of Primary Industries and Regional Development and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.