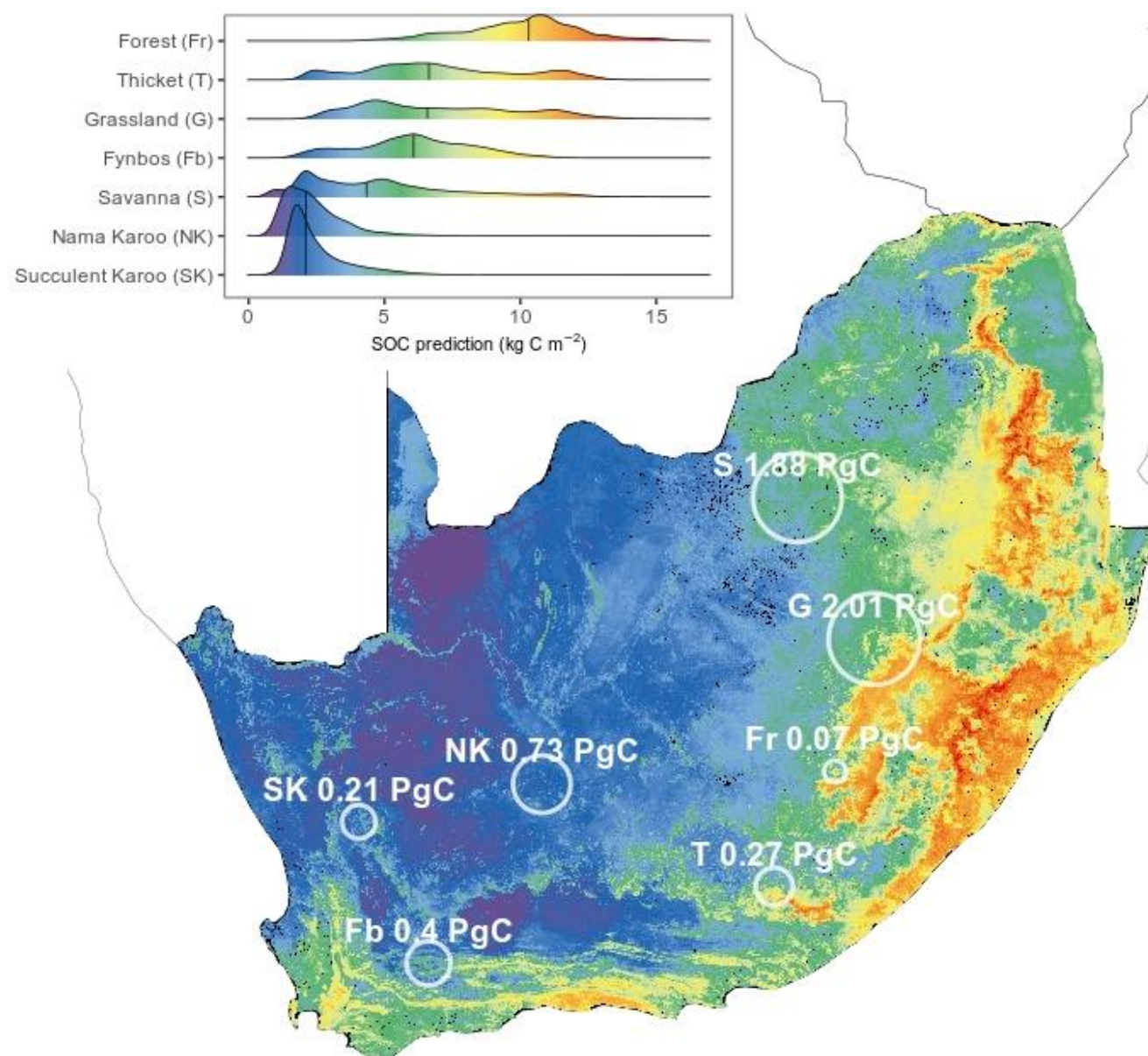


# SOC map for South Africa – spatial modelling and transfer value for forest soils in the Nordic – Baltic region

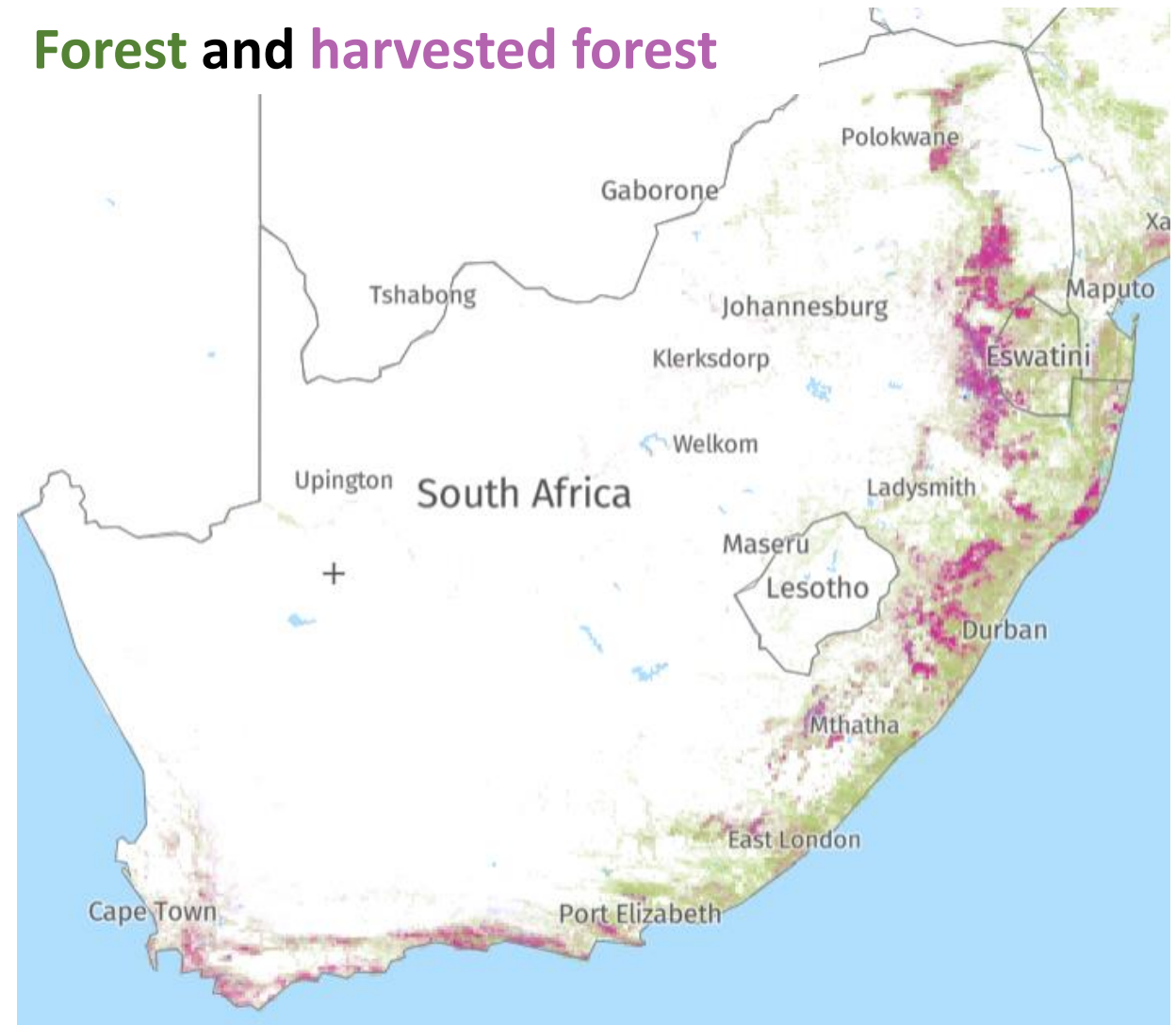
Zander Venter

Spatial ecologist at  
Norwegian Institute for Nature Research



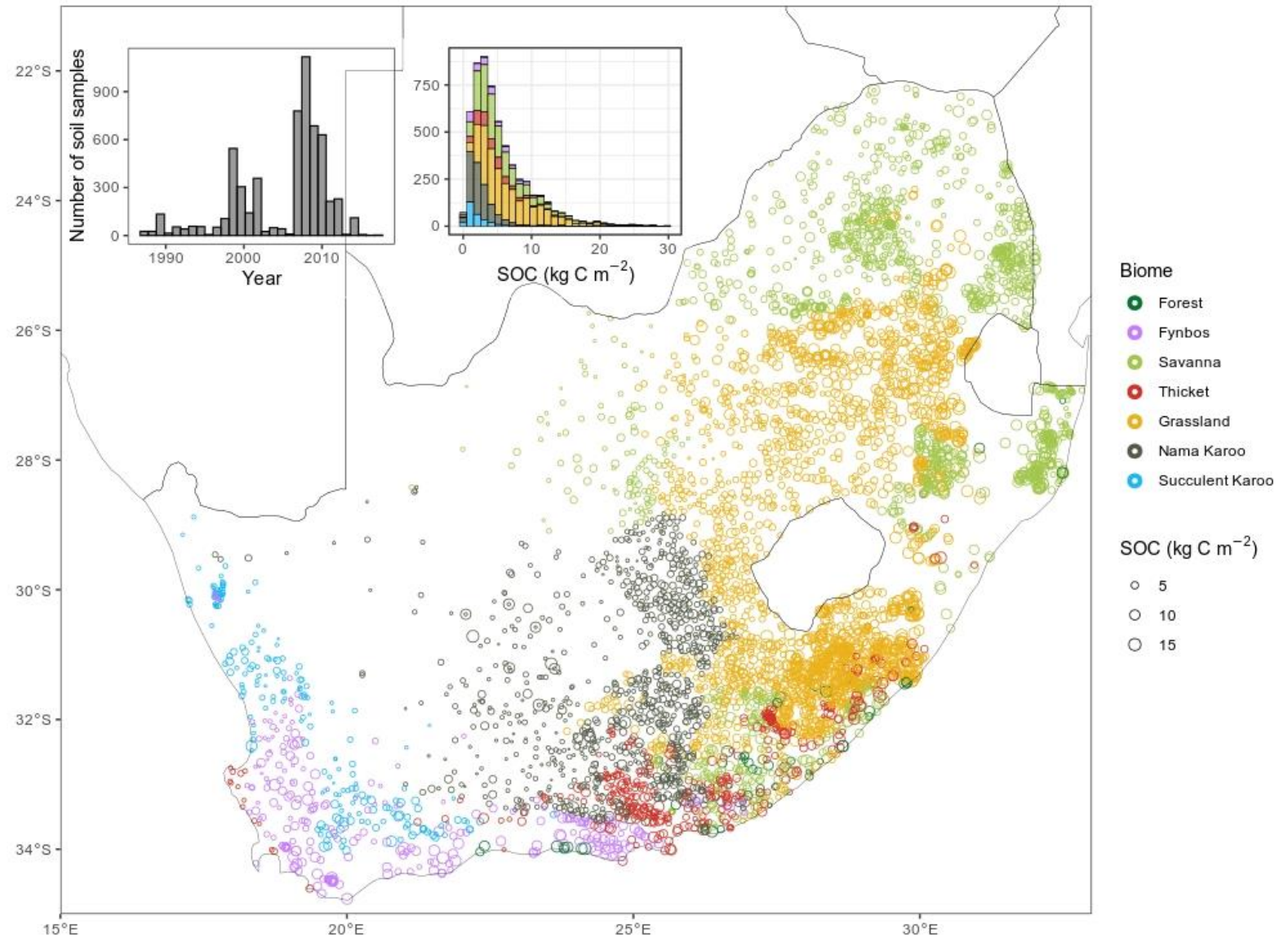
# Very different to Nordics

- Forest covers a very small proportion of South Africa and forestry is not a dominant industry sector
- Much more interest in SOC in cultivated lands and also in natural ecosystems
- Below-ground C is very important in grassy ecosystems
- SOC is much more dynamic due to sub-tropical climate and disturbance regimes
- Fire, herbivory are major drivers of SOC in addition to climatic and edaphic templates

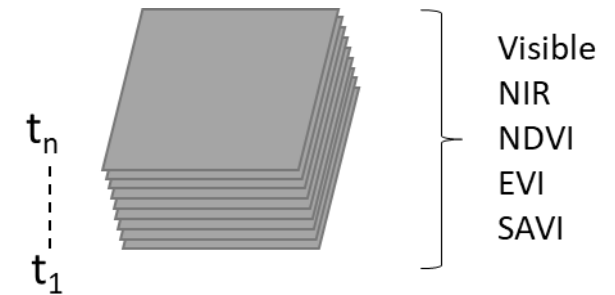
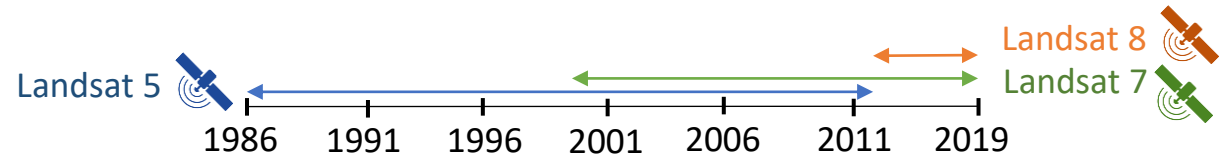
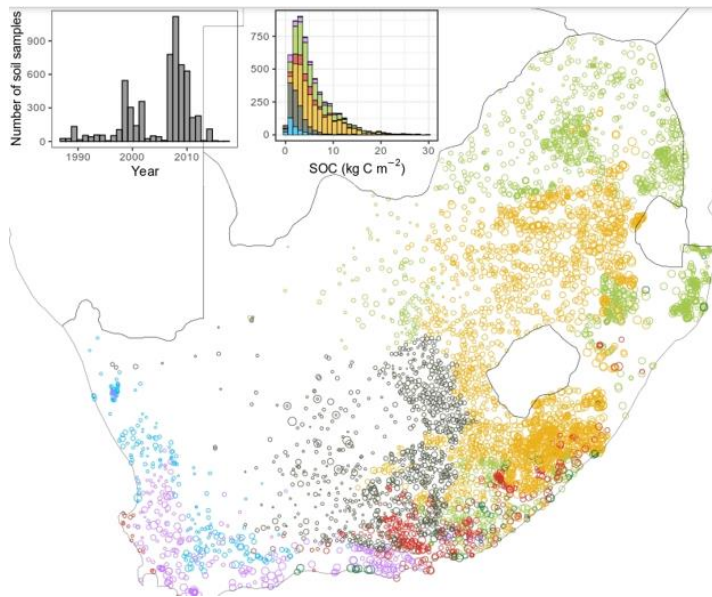


# Wealth of soil sampling data in SA

- Agricultural Research Council of South Africa
- International Soil Reference and Information Centre (ISRIC)
- Research-based private collections maintained by Heidi Hawkins and Anthony Mills



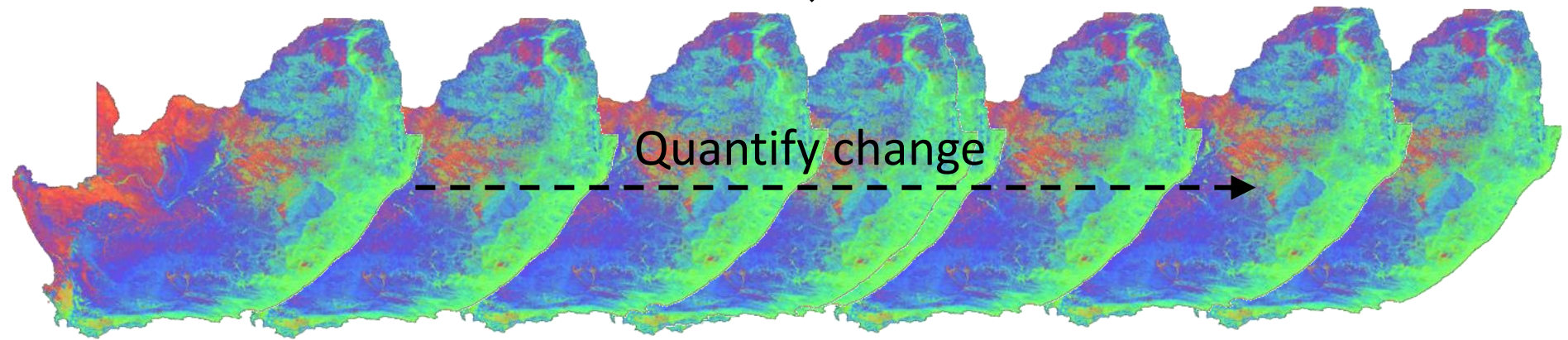
# Spatial-temporal SOC mapping - machine learning and remote sensing



Machine learning model

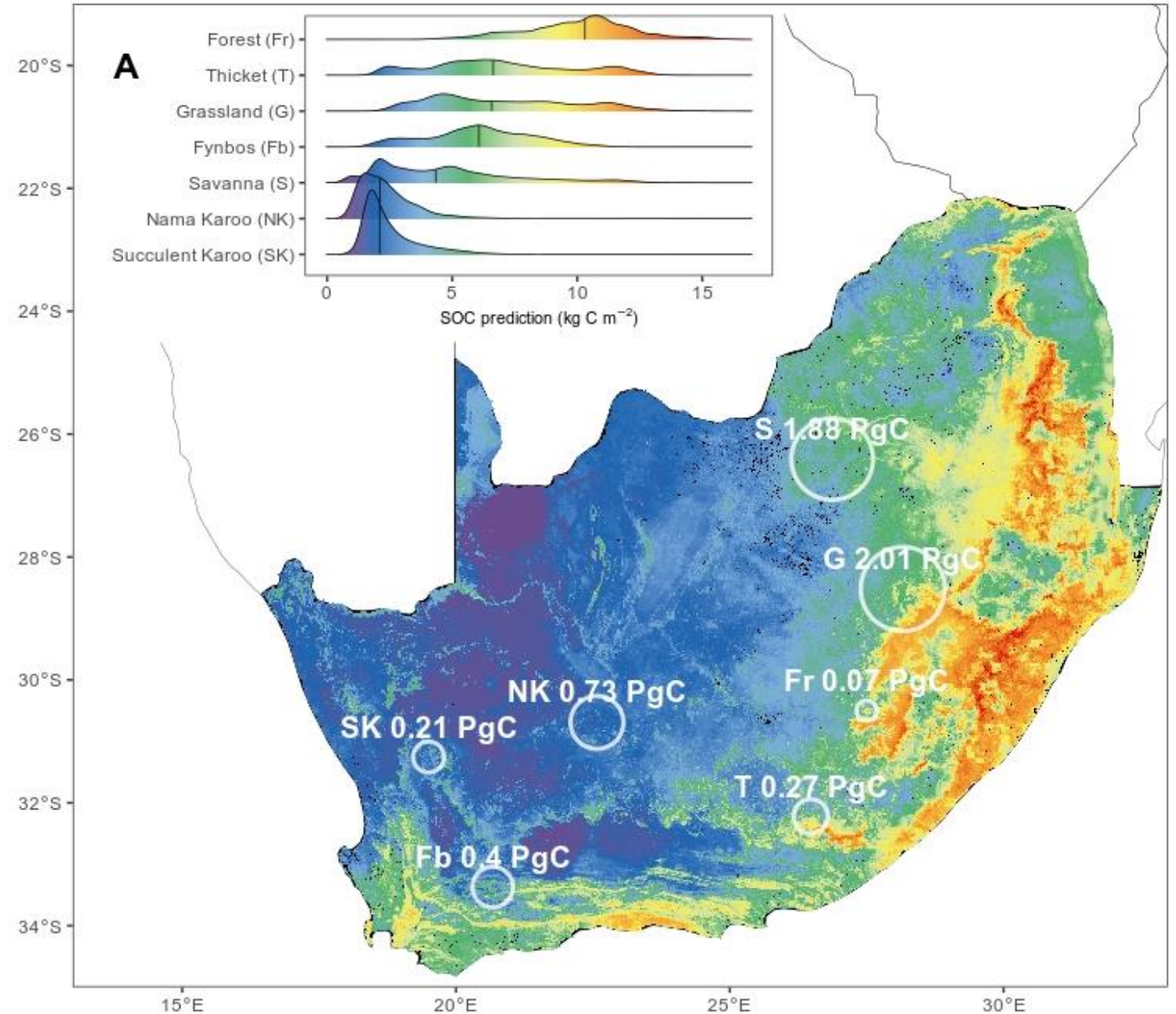
1986

2019



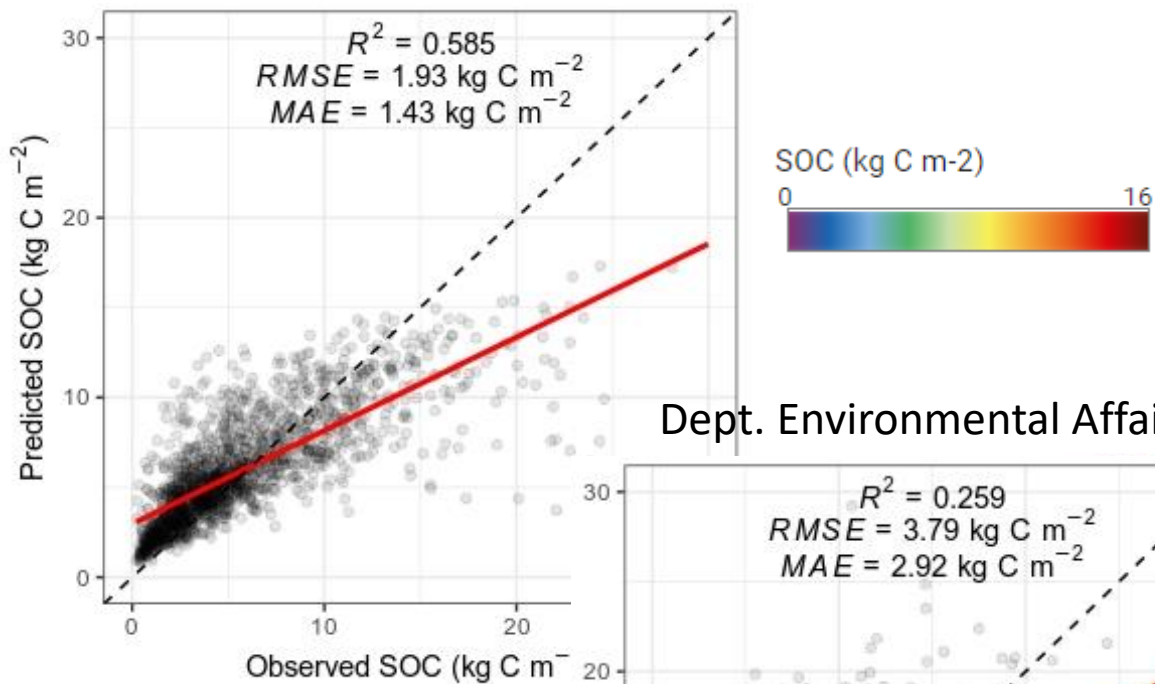
## Results: SOC average

- We estimate a total topsoil SOC stock of 5.6 PgC in natural areas
- Median SOC density of  $6 \text{ kg C m}^{-2}$  (IQR: interquartile range  $2.9 \text{ kg C m}^{-2}$ ) or  $60 \text{ t ha}^{-1}$ .
- Grasslands contribute the most to the total SOC stock
- Mean absolute error of  $1.43 \text{ kg C m}^{-2}$

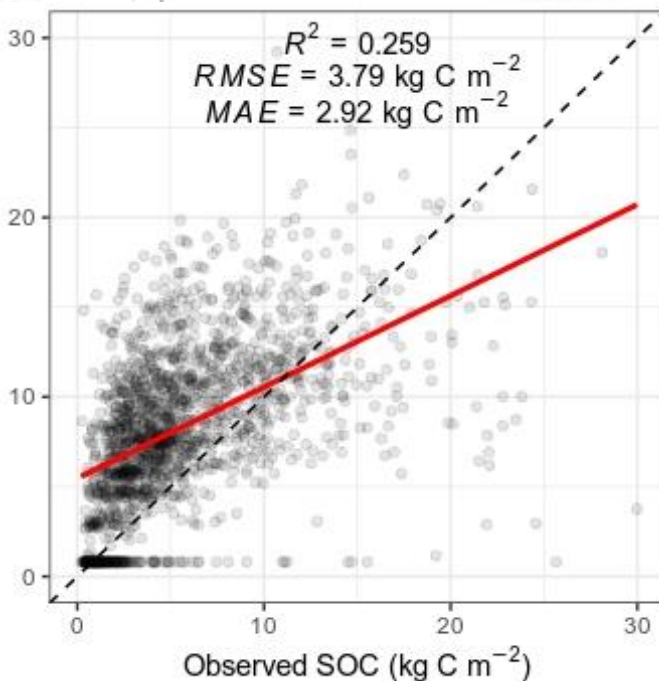


# Comparison to other maps

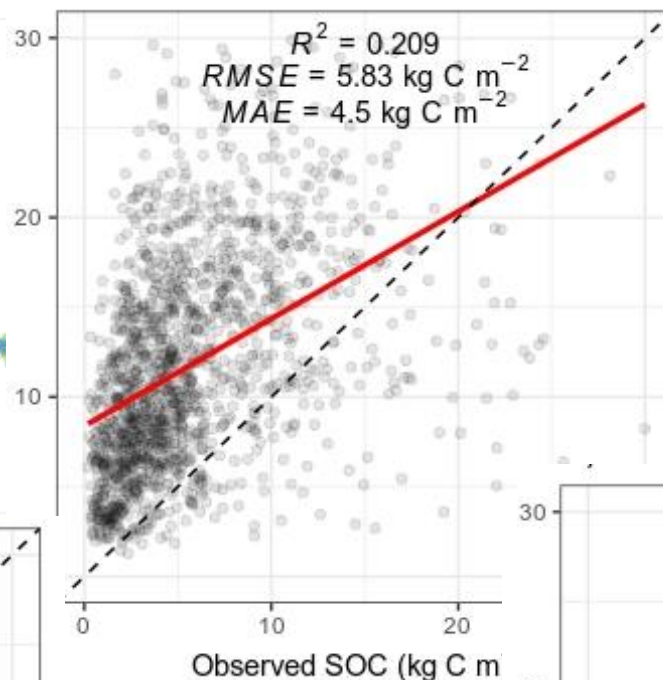
Venter et al. (present study)



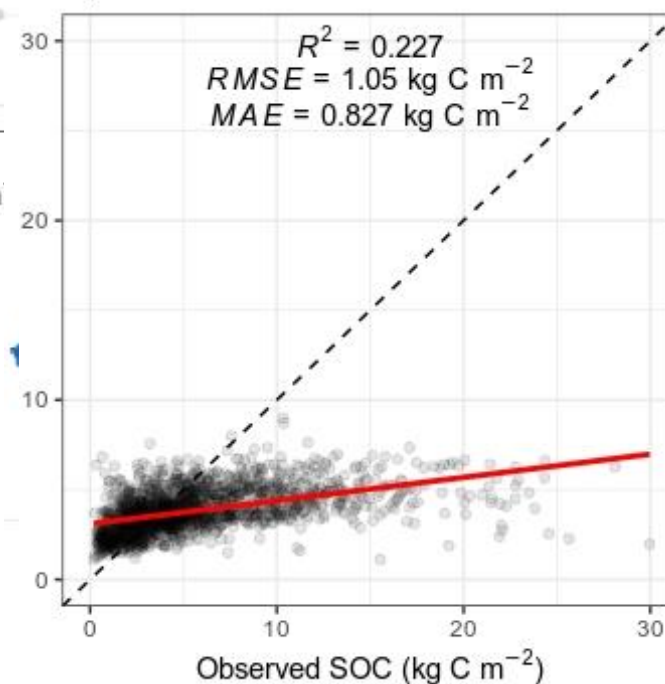
Dept. Environmental Affairs



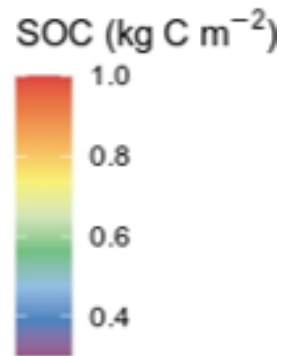
Schultze and Schutte 2020



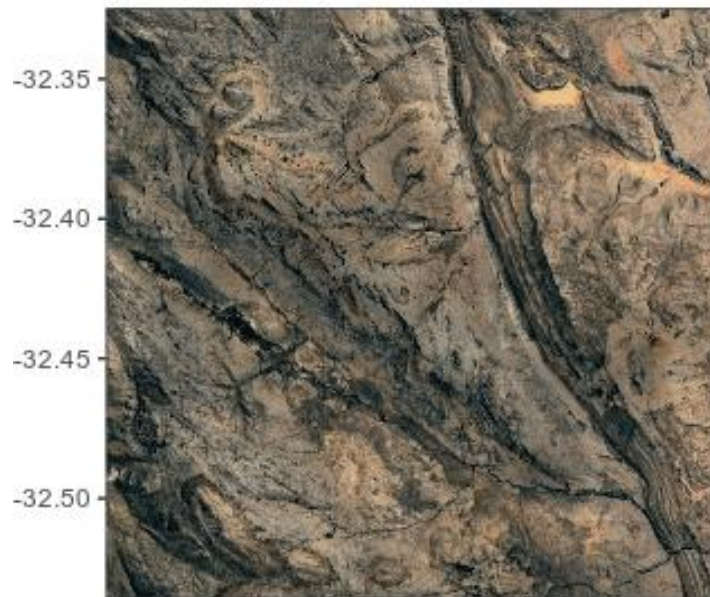
SoilGrids



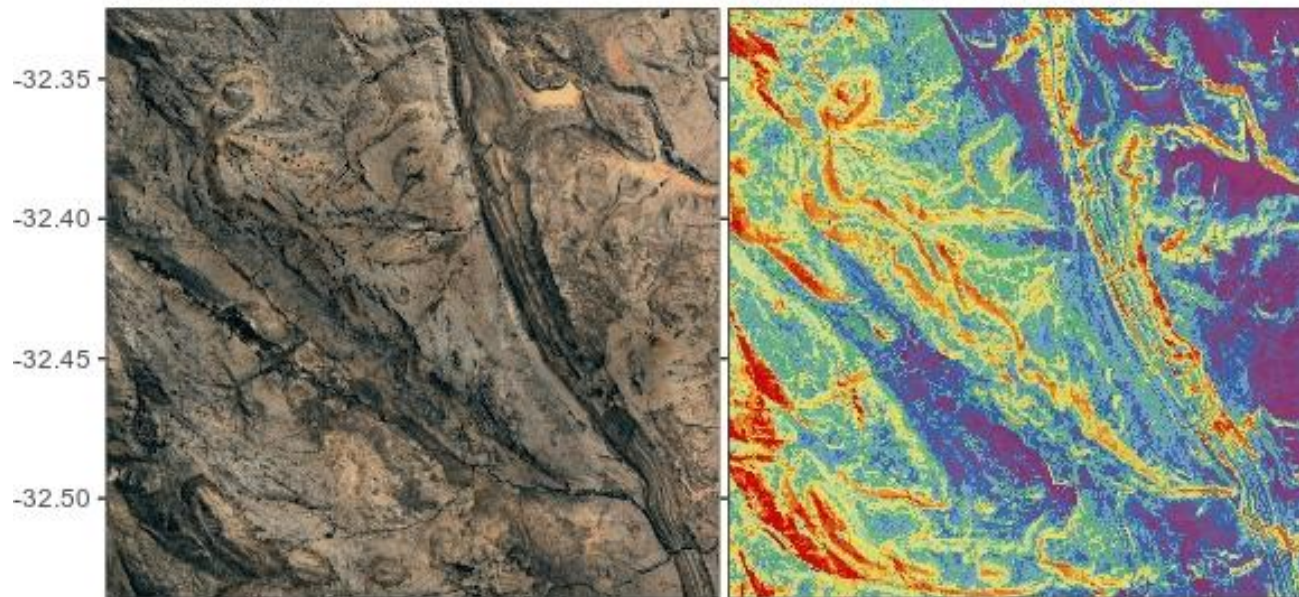
# Comparison to other maps



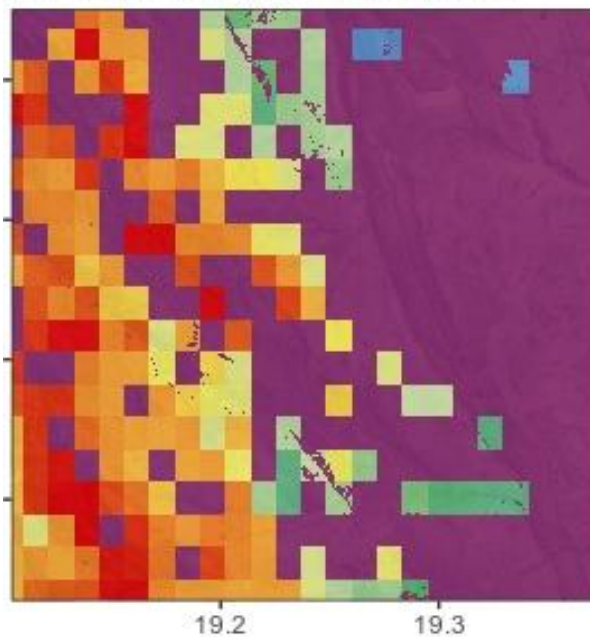
Satellite image



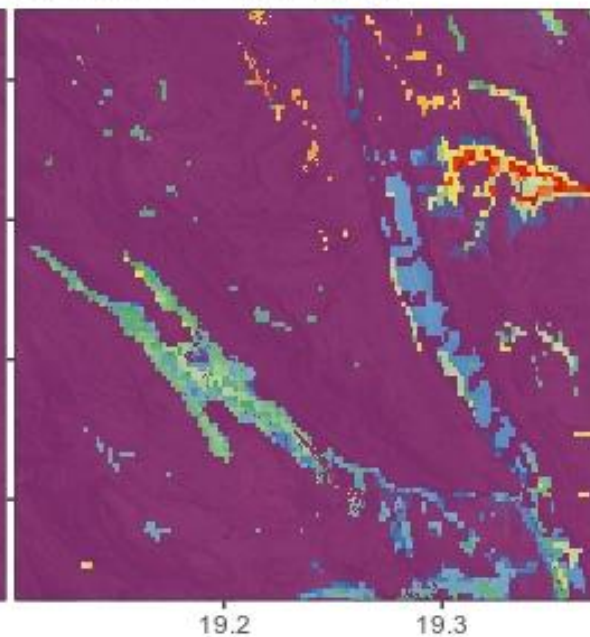
A) Venter et al. (present study)



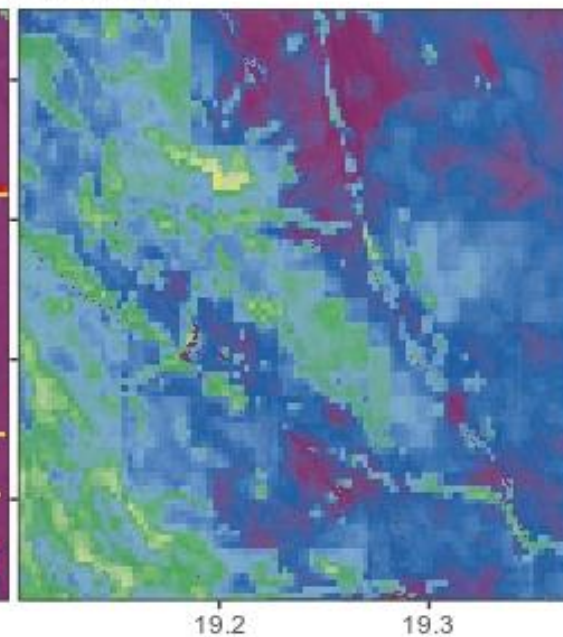
B) Department of Environmental Affairs



C) Schultze & Schutte (2020)

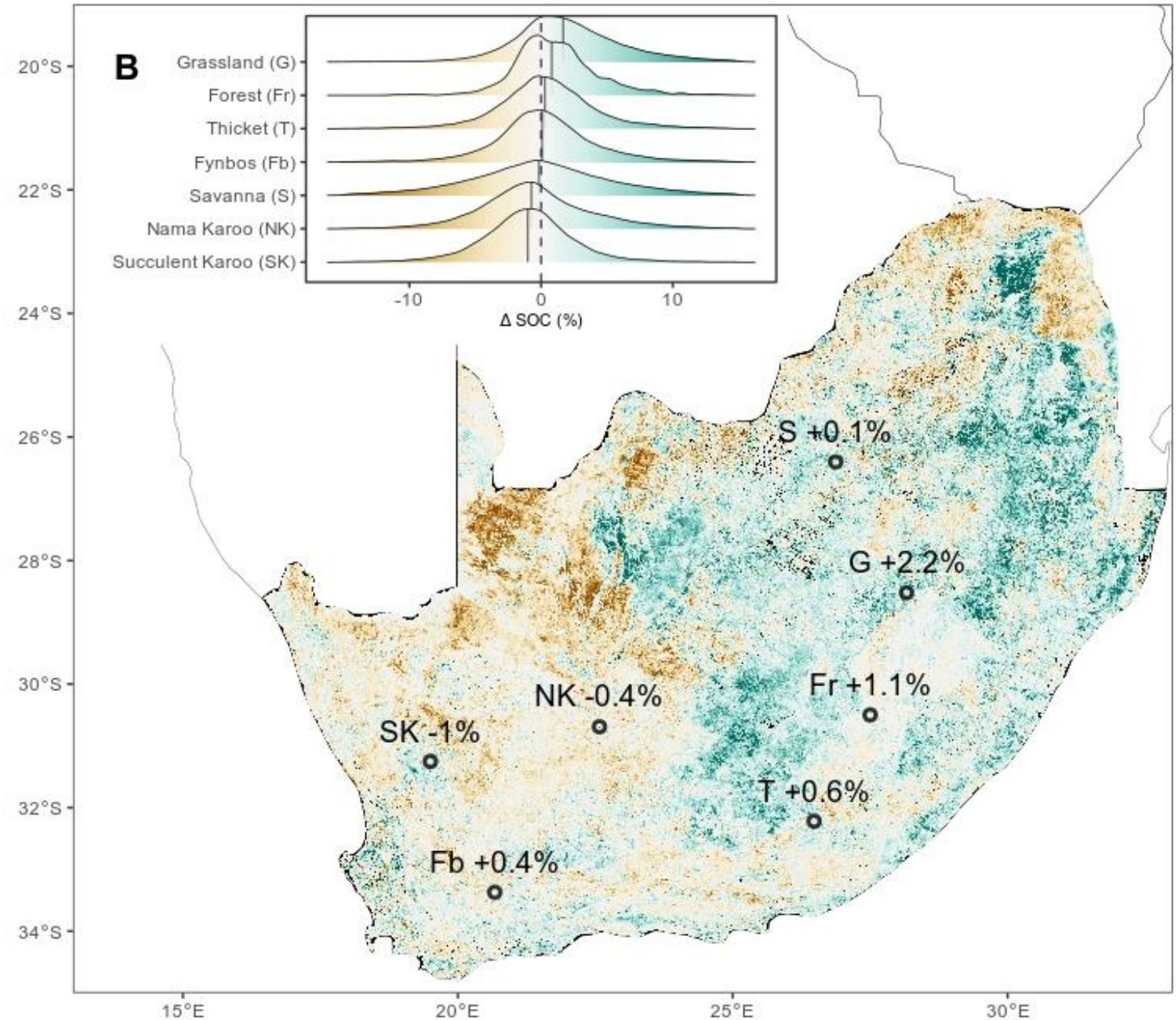


D) SoilGrids



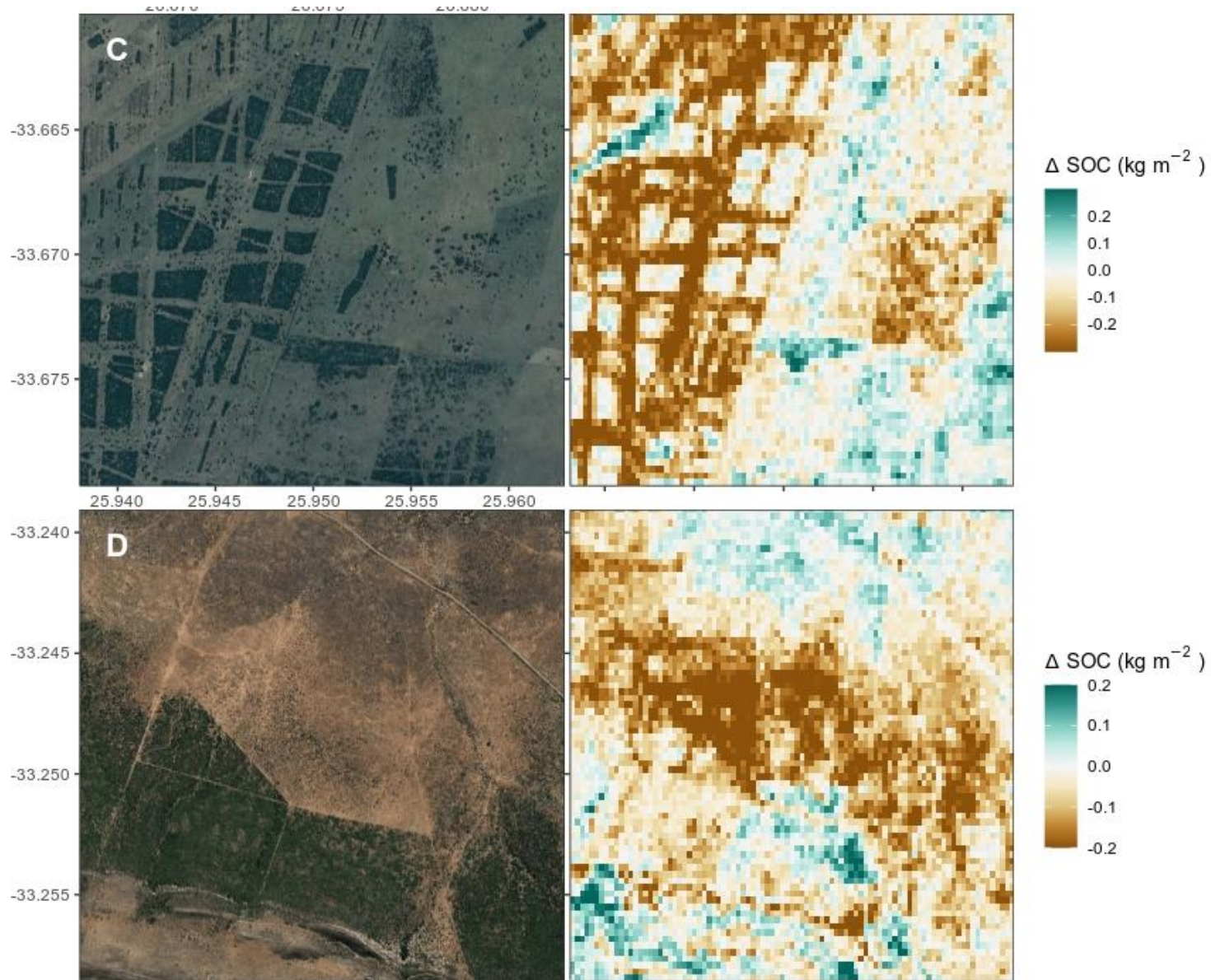
## Results: SOC trends

- Over 35 years, SOC underwent a net increase of 0.5 % (relative to long-term mean)
- Greatest net increases (2.2%) in Grassland
- Greatest decreases (-1%) in Succulent Karoo biomes





# SOC change at landscape scale



## Limitations:

- Unable to distinguish land-use vs climate changes
- Uncertainty not known – needs SOC time series data for validation

# Brainstorming transfer value for Nordic forests...

- Integrating soil sampling designs with remote sensing data
  - Scale differences between sample plot and satellite image
  - Relying on forest canopy as proxy for soil properties
- Leverage rich temporal component of satellite data
  - Estimate changes in SOC – NB! First we need plot-level “ground truth” measurement of change
  - Derive variables as input into process-based models
- Use satellite-based maps to better stratify sampling plots
- Use wall-to-wall satellite-based maps to explore questions of landscape context, connectivity as drivers of SOC

