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# The (South) African Soil Microbiology project

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[www.up.ac.za/CMEG](http://www.up.ac.za/CMEG)



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# **Centre for Microbial Ecology and Genomics**

## **University of Pretoria**

**3 Academic staff**  
**(Cowan, Makhalanyane, Coutinho)**

**1 Administrator**

**1.5 Technicians**

**14 Postdocs**

**23 PhDs**

**15 MSc**

# Soil Microbiology 101

- The soil microbiome
  - $10^4$  bacterial,  $10^2$  fungal,  $10^2$  archaeal,  $10^5$  virus and phage,  $10^3$  microinvertebrate **species**
  - Contribute to ecosystem services (C and N cycling)
  - Direct role in plant performance and productivity
  - Contribution to soil stability
- Microbiome structure influenced by soil type, soil physico-chemistry, vegetation, macroclimate, land-use

“There is no comprehensive survey of the national soil microbiome in South Africa, or across Africa (or anywhere else in the world)”!

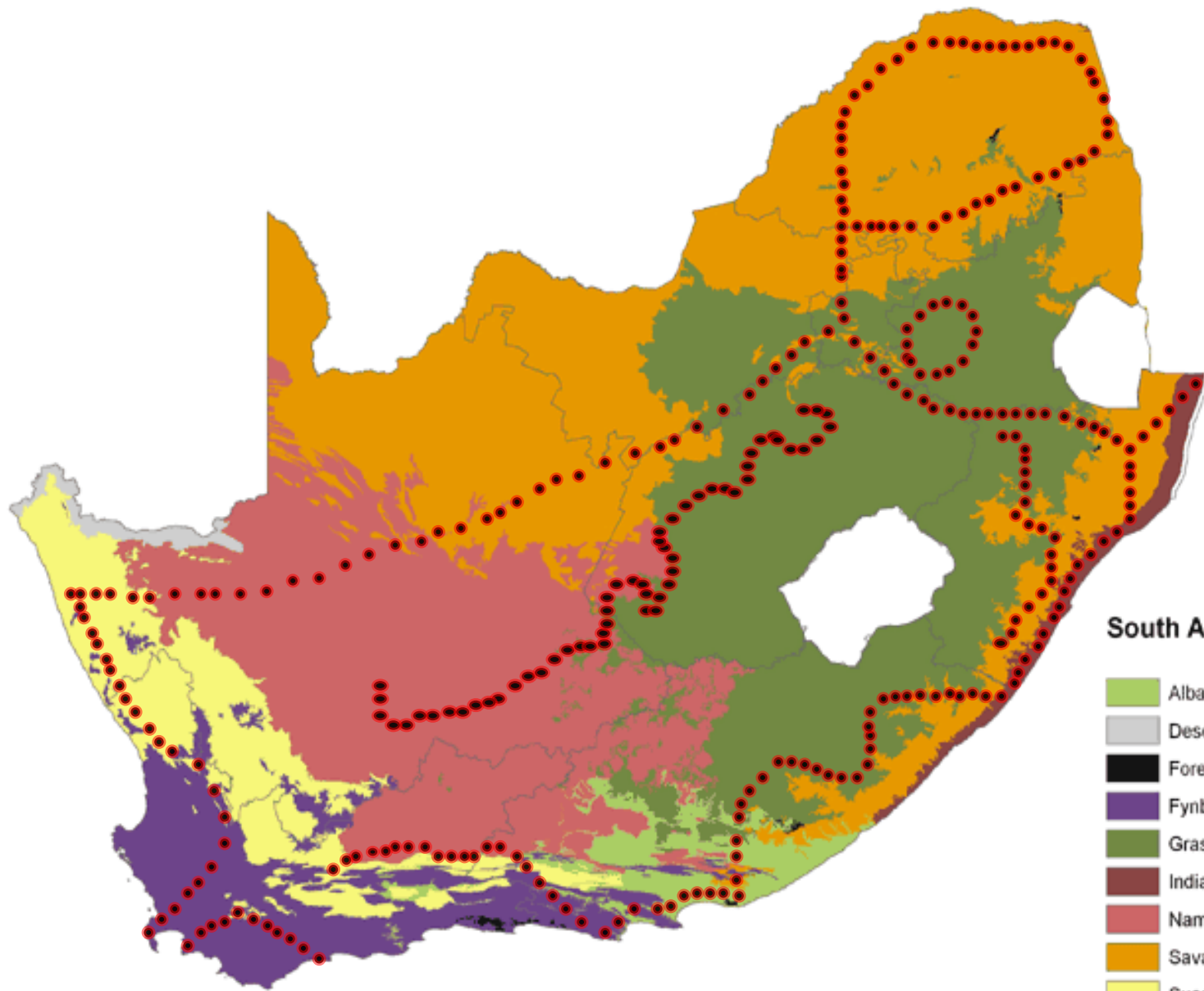


# The Project

- A 'low resolution' microbial community survey of soils across sub-Saharan Africa
  - ❖ Acquisition of soil samples from participating nations
  - ❖ Phylogenetic fingerprinting of bacterial communities using NG sequencing of 16S amplicon sets
  - ❖ Physicochemical analysis of soil samples
  - ❖ Interpretation of community composition in terms of soil physicochemical properties and macro-environmental parameters

# The basic numbers

- 10 nations: South Africa, Namibia, Botswana, Zimbabwe, Mozambique, Zambia, Kenya, Ethiopia, Cote D'Ivoire, Benin
- Plus a limited number of random samples from Angola, Tunisia
- Total budget: \$435,000
- 1000 samples
- Samples per nation defined by land area
- Sampling intervals: 50 km



### South Africa's nine biomes

- Albany Thicket Biome
- Desert Biome
- Forests
- Fynbos Biome
- Grassland Biome
- Indian Ocean Coastal Belt
- Nama-Karoo Biome
- Savanna Biome
- Succulent Karoo Biome

# Site data capture

- Sample number/code
- Time and date
- GPS location (decimal degrees)
- Altitude
- Aspect/Slope
- Local vegetation type
- Local ground characteristics
- Other notable characteristics
- Representative photographs of site and location



# Analysis: Phylogenetics

- Metagenomic DNA extraction
- DNA concentration and quality
- 16S rRNA gene amplification
- Next Generation Sequencing (Illumina MiSeq)
- Bioinformatics: Phylogenetic assignments
- Correlation analysis with macro- and microenvironmental parameters

# Data Interpretation

- Phylogenetic assignments (at various taxonomic levels)
- Estimates of  $\alpha$  and  $\beta$  diversity, diversity indices
- Correlation analyses with physicochemical properties, regional and national locations, climate zones, biome types, land and agricultural use, etc.
- Identification of differentially abundant taxa (biomarkers)
- Identification of core taxa
- Putative interaction between taxa: Network analysis

# Outputs and Evidence

- The 'first ever' survey of African soil microbiomes
- Correlation of microbiome fingerprints with region, biome, soil type, macroclimate, land-use
- Primary phylogenetic dataset for future re-analysis, comparison etc.
- The role of microbes in ecosystem services, ecosystem sustainability and resilience to climate change
- The soil microbiomic genetic resource

# Future Evidence-Based Outcomes

- New 'soil health' metrics for guiding fertilization practice
- Recommendations for soil emendation (with specific microbial preparations)
- Recommendations for crop selection (from pathogen presence/absence)

**Thank you.**

