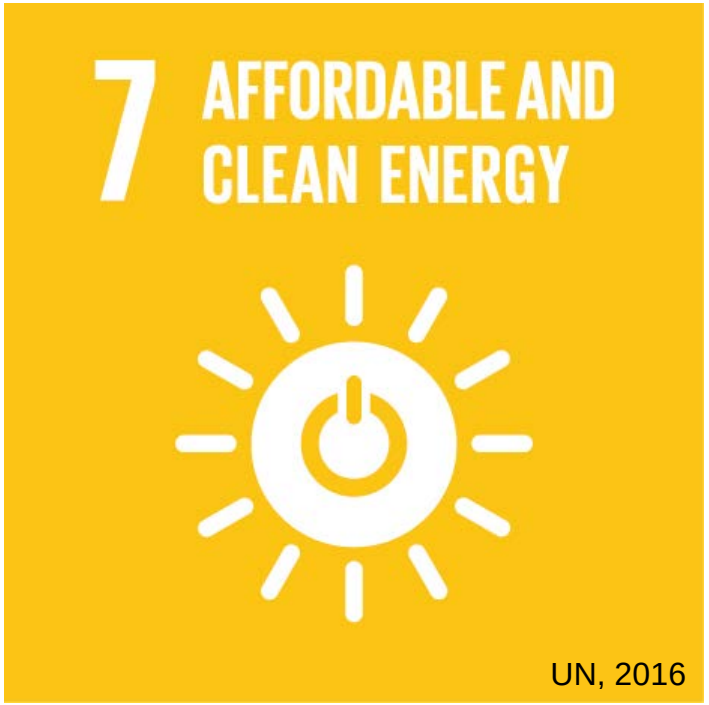
Determination of electrification expansion in rural areas using routing algorithms in R

Outline

- Introduction
  - Electrification
  - Aim of Research
  - Area of Research
- Workflow
  - Cost Raster
  - Routing Algorithms
  - Minimum Spanning Tree of Least Cost Paths
- Conclusions
  - Further Research

Rural Electrification

Bringing (generate, transmit, distribute and use) electrical power to rural and remote areas



UN, 2016

- 20 % of world´s population still lack access to modern electricity
- Energy is the dominant contributor to climate change (around 60 % of total global GHG emissions)

UN, 2016

Provide a decision support tool

- Nigerian Energy Support Programme (NESP)
- Open source – transferable model
- Realistic and detailed expansion paths and its costs
- Current research on electrification expansion paths and costs based on linear distances *
- R because other GIS get overstrained

* OHIARE, 2015

Nigeria

- Population: 175 million
- National electrification rate: 45 %

  Average of sub-Saharan countries: 32 %

- Population without electricity: 95 million

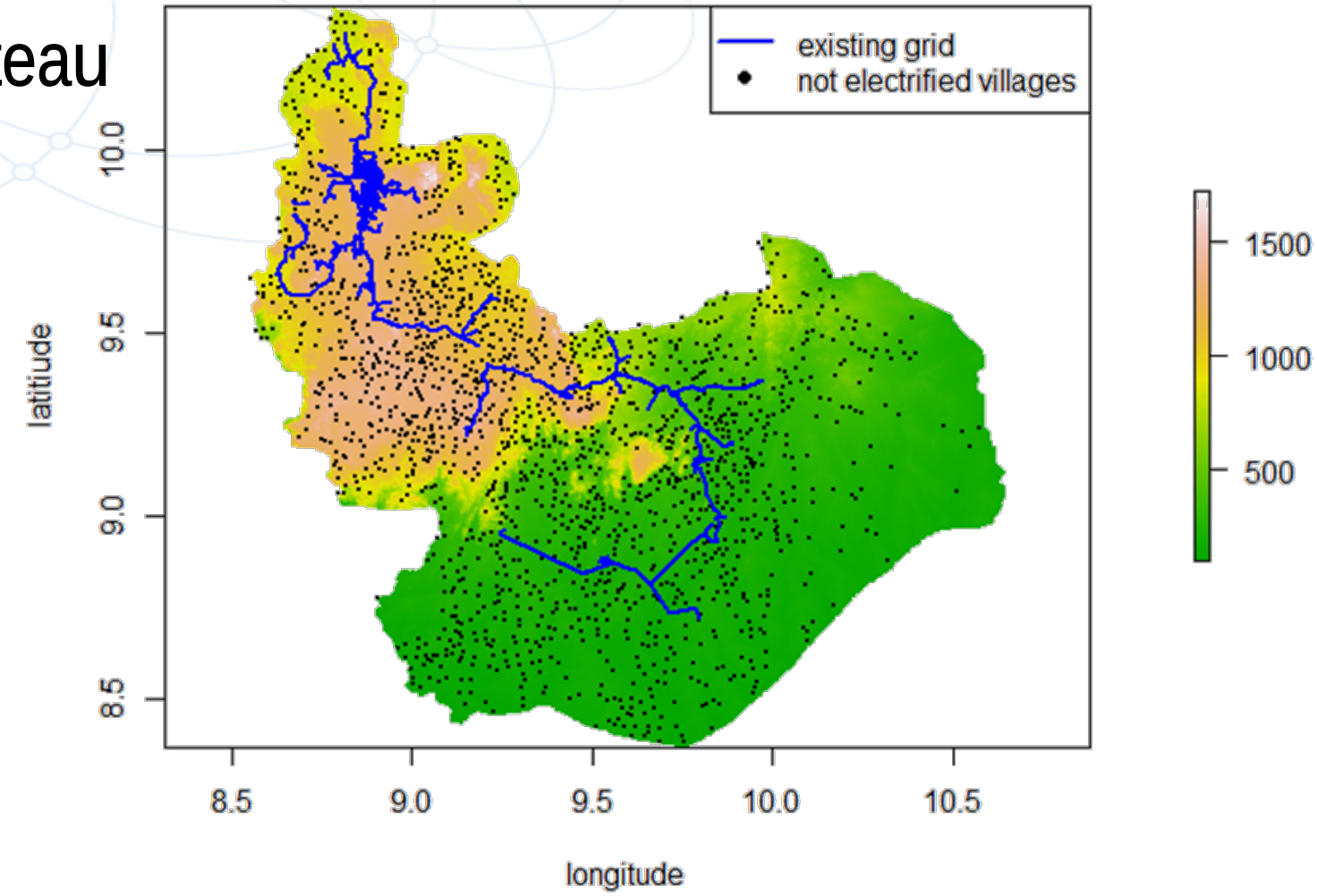
  Highest worldwide

- Rural electrification rate: 36 %

IEA, 2015

Introduction - Area of Research

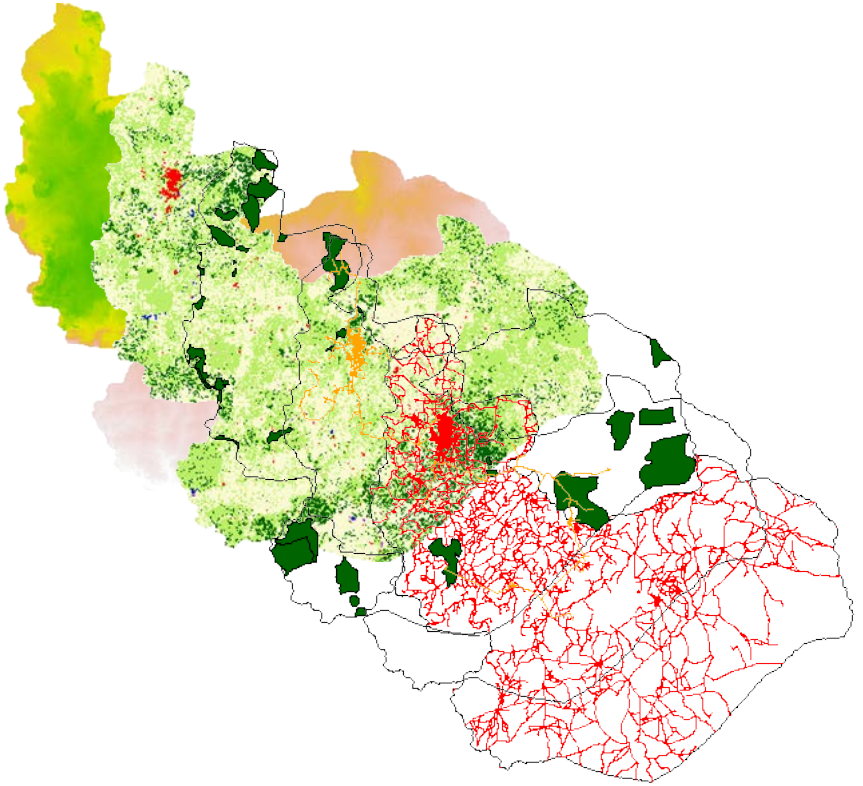
Plateau



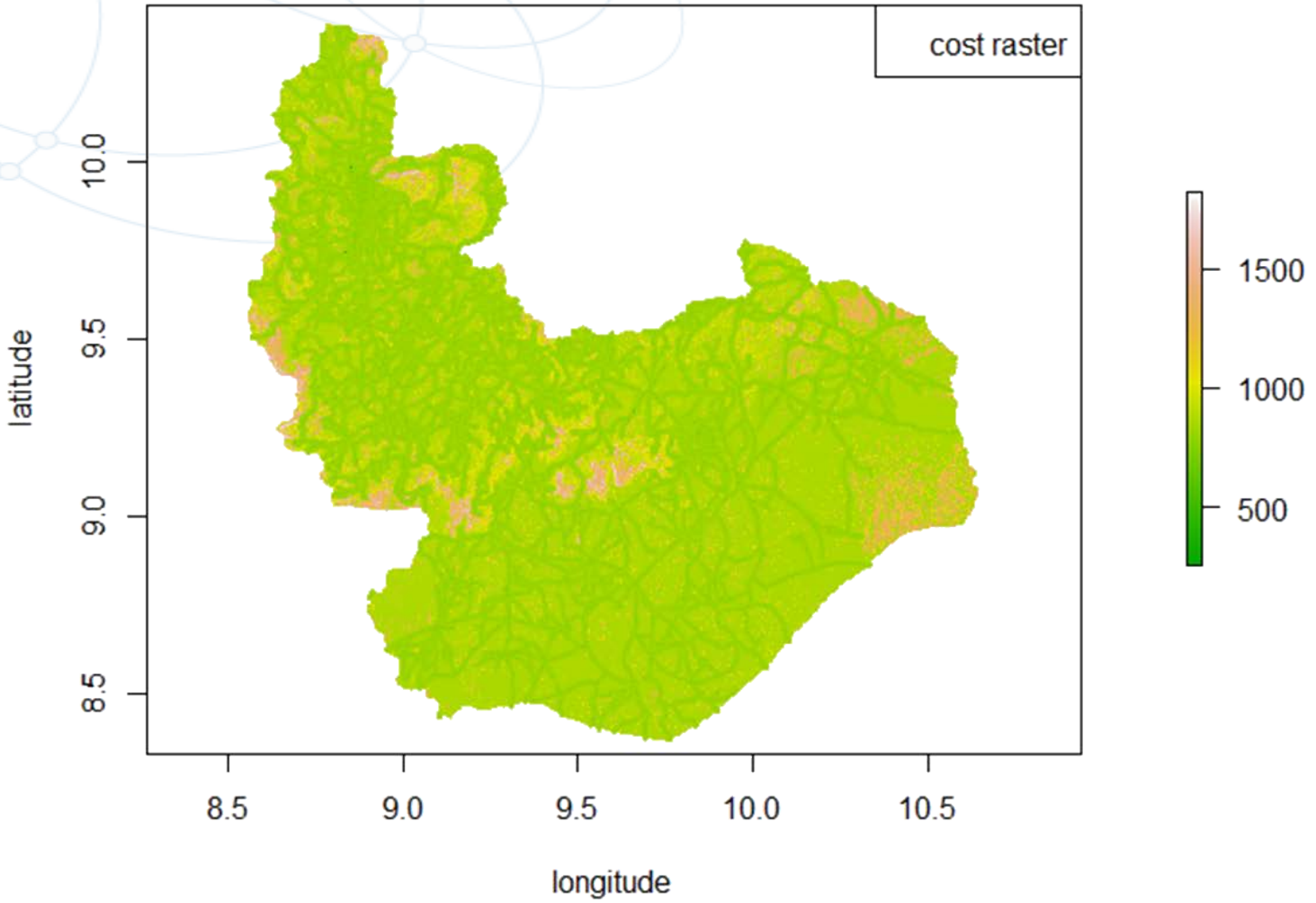
REINER LEMOINE INSTITUT

Input data for cost raster

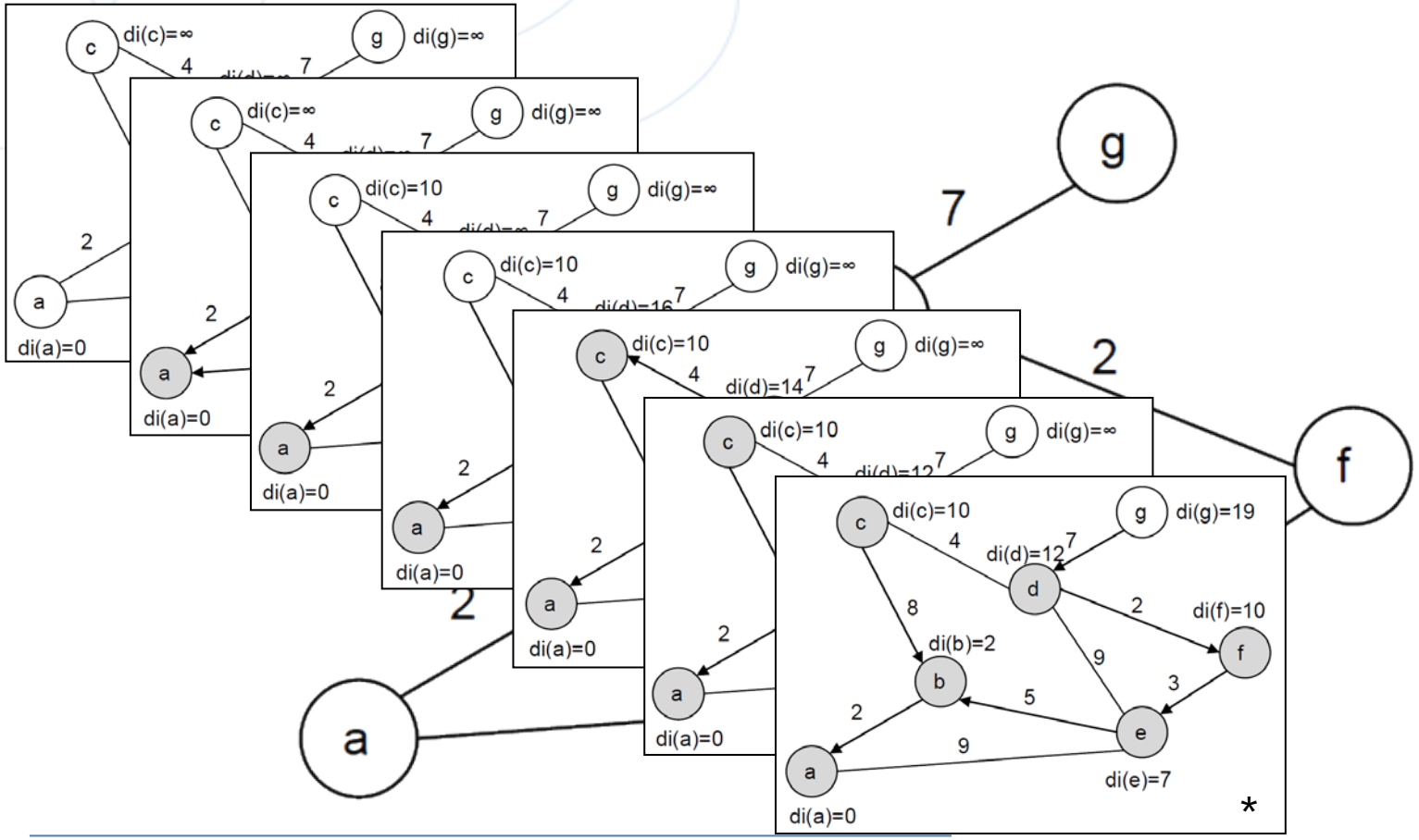
- SRTM 90
- GLC 30
- Exclusion areas
- Existing grid
- Roads



Workflow – Cost Raster



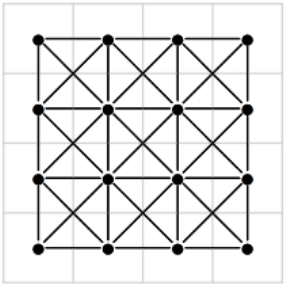
Dijkstra Algorithm



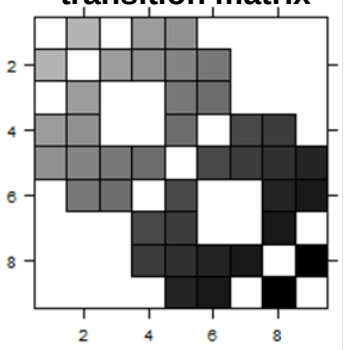
GRUEGER, 2011

Minimum Spanning Tree of Least Cost Paths

raster to graph



transition matrix

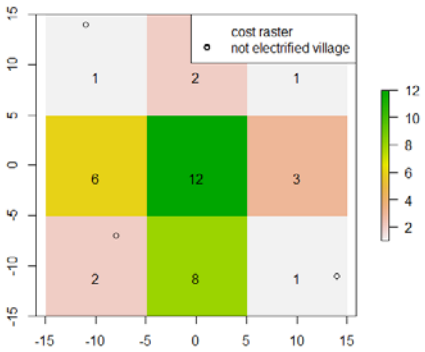


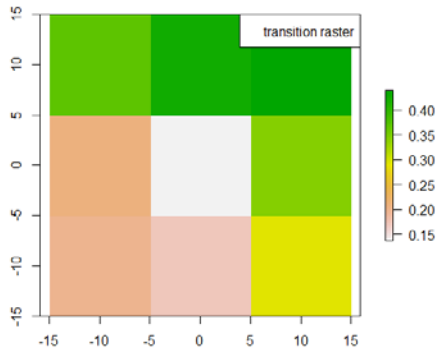
CD

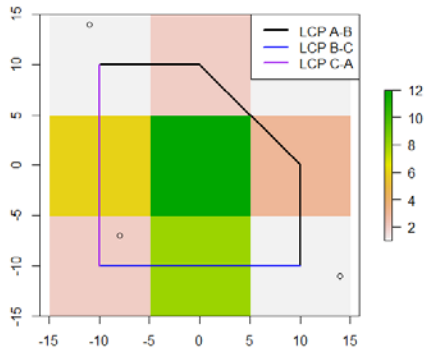
	A	B
B	6.0	
C	7.5	9.5

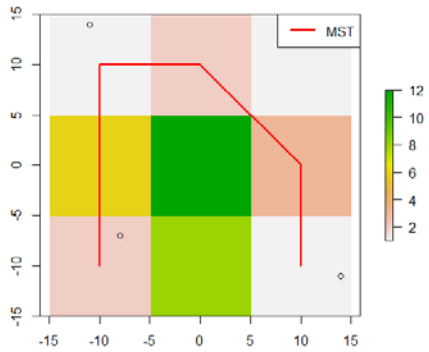
MST

	A	B	C
A	0	1	1
B	1	0	0
C	1	0	0



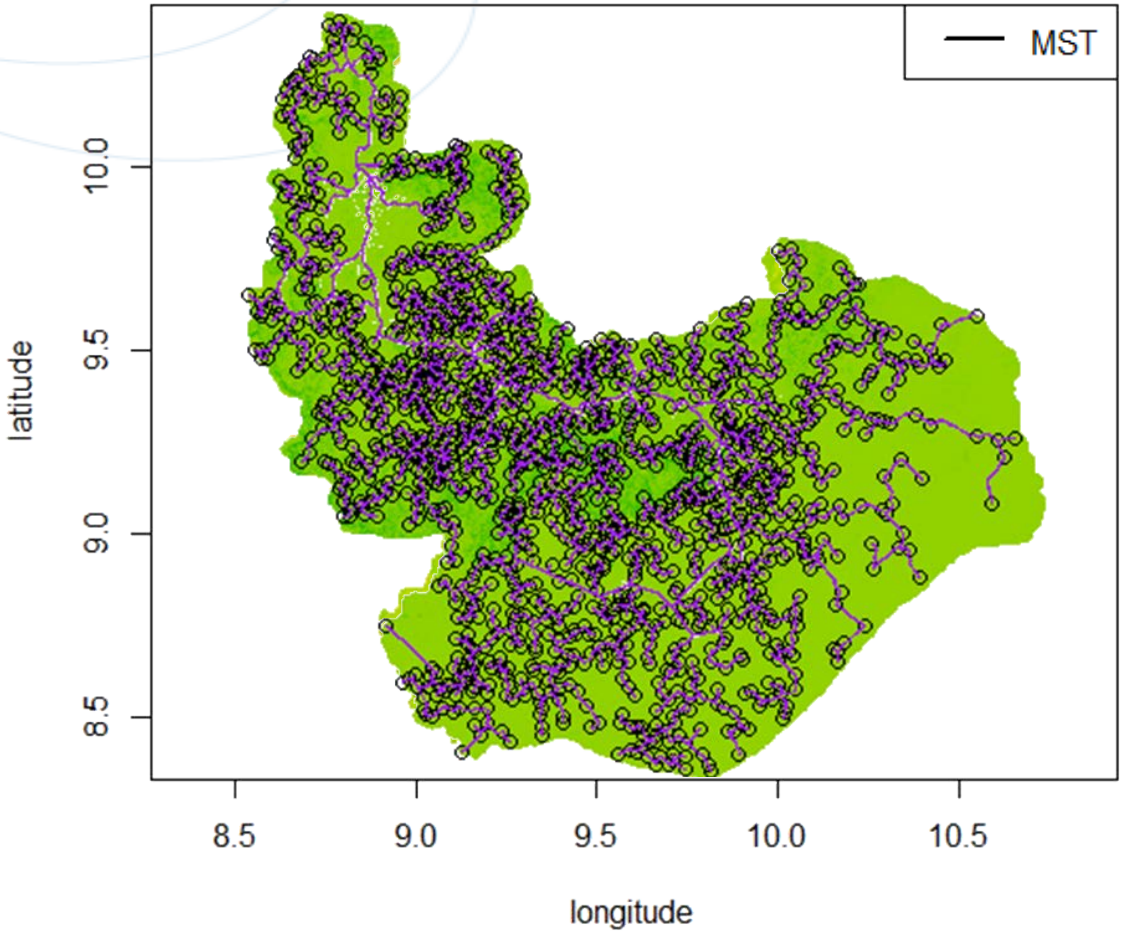






Annex VI

Minimum Spanning Tree of Least Cost Paths



Results

- Creation of cost raster based on multiple criteria
- Detection of detailed power network expansion
- Fast processing
- Open source - transferable model
- Solid basis for further research

Future Research

- Determine resolution
- Determine realistic parameters for cost values
  - Identify close to reality expansion cost
  - Set suitable value for characteristics of each cost layer
- Create a hierarchical MST, based on the optimal MST
- Receive costs for each expansion section
- Compare electrification options

Thank you for your attention!

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