A Geospatial Analysis of Animal Movement: Why Did the Elephant Cross the Zambezi?

Present by Molly Azami on behalf of the Victoria Falls Elephant Project

Contents

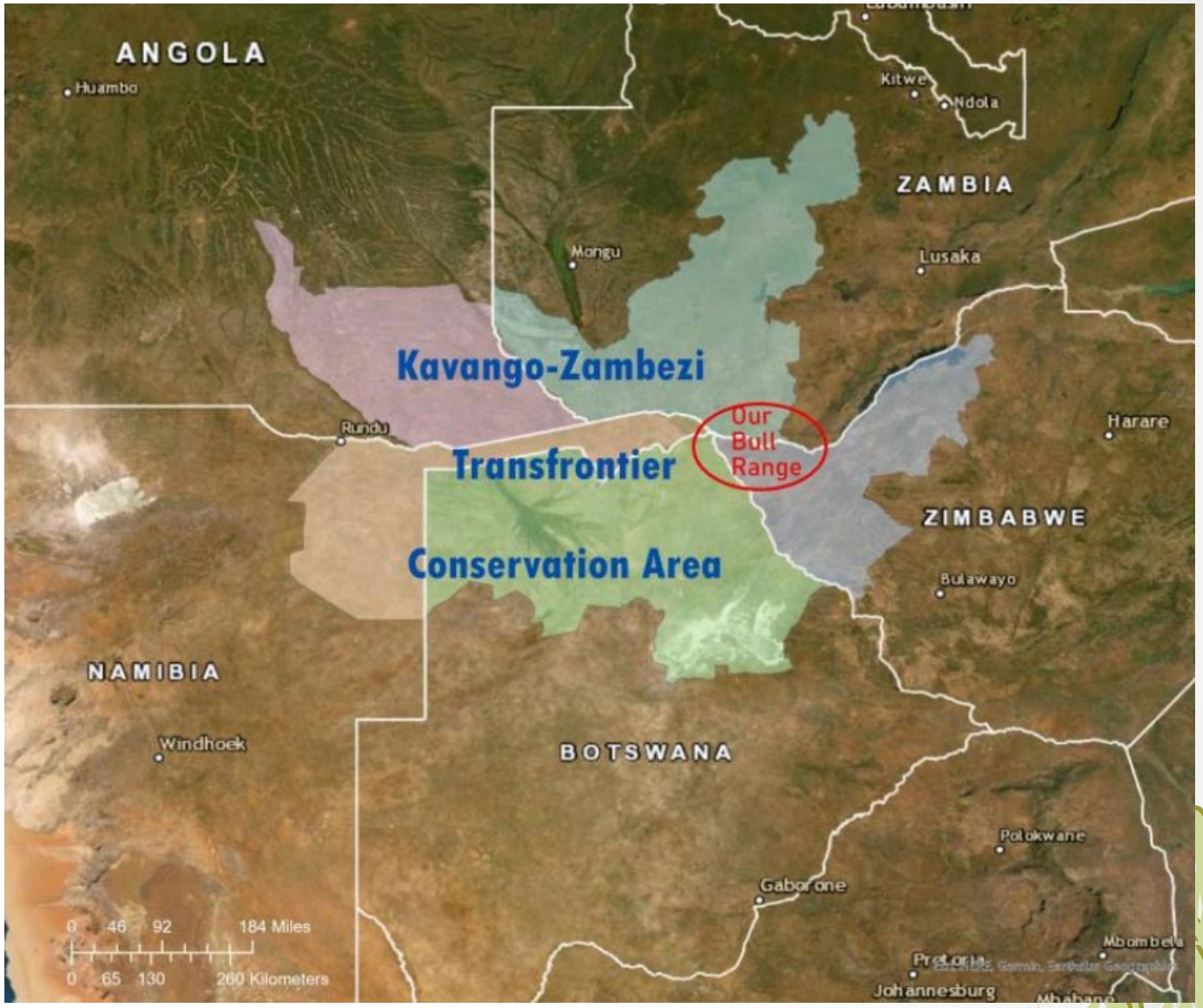
The Victoria Falls Elephant Project

works with:

- Connected Conservation (CC)
- The Victoria Falls Wildlife Trust (VFWT)
- Zimbabwe Parks and Wildlife Management Authority
- Zambezi Elephant Welfare Conservation Trust

Project Area of Interest

The project is within the Kavango-Zambezi Transfrontier Conservation Area (KAZA), in the part around the town of Victoria Falls, Zimbabwe



Project Concerns

Rogue bull behavior concerns:

- Crops raiding
- Property damage
- Intimidating or causing harm to humans

Elephant welfare concerns

- Eating garbage
- Bathing and drinking at the water treatment facilities
- becoming victims of poachers.

Bull in town, Victoria Falls, Zimbabwe

Bottlecaps, other metal and plastic found in the stomach of a deceased elephant

Plastic bags in dung pile

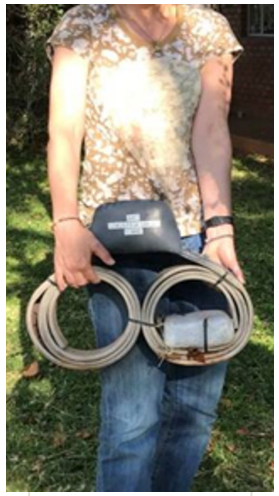
Location of bulls in the garbage dump and water treatment plant Victoria Falls, Zimbabwe

The Project

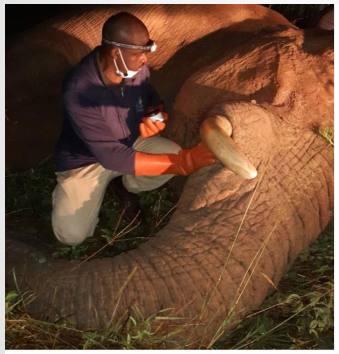
team works to mitigate conflict between the human population and elephants while promoting coexistence by:

- Monitoring bull elephants who are not associated with a family group through:
  - Field observation
  - GPS collaring
  - A citizen reporting program
- Coordinating with local farmers and government officials
- Conducting education and awareness programs
- Actively being involved in mitigation efforts:
  - Consultants to planners to advise how new developments can keep local of elephant populations in mind
  - For bulls causing damager, disruptive darting and chili pepper treatment.

Areal survey plane



GPS Collar



Smearing chilli wax on the airport problem elephant.

Chilli wax

Burning chilli bricks and chilli pods to deter elephants

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- Analysis of GPS Collar Data
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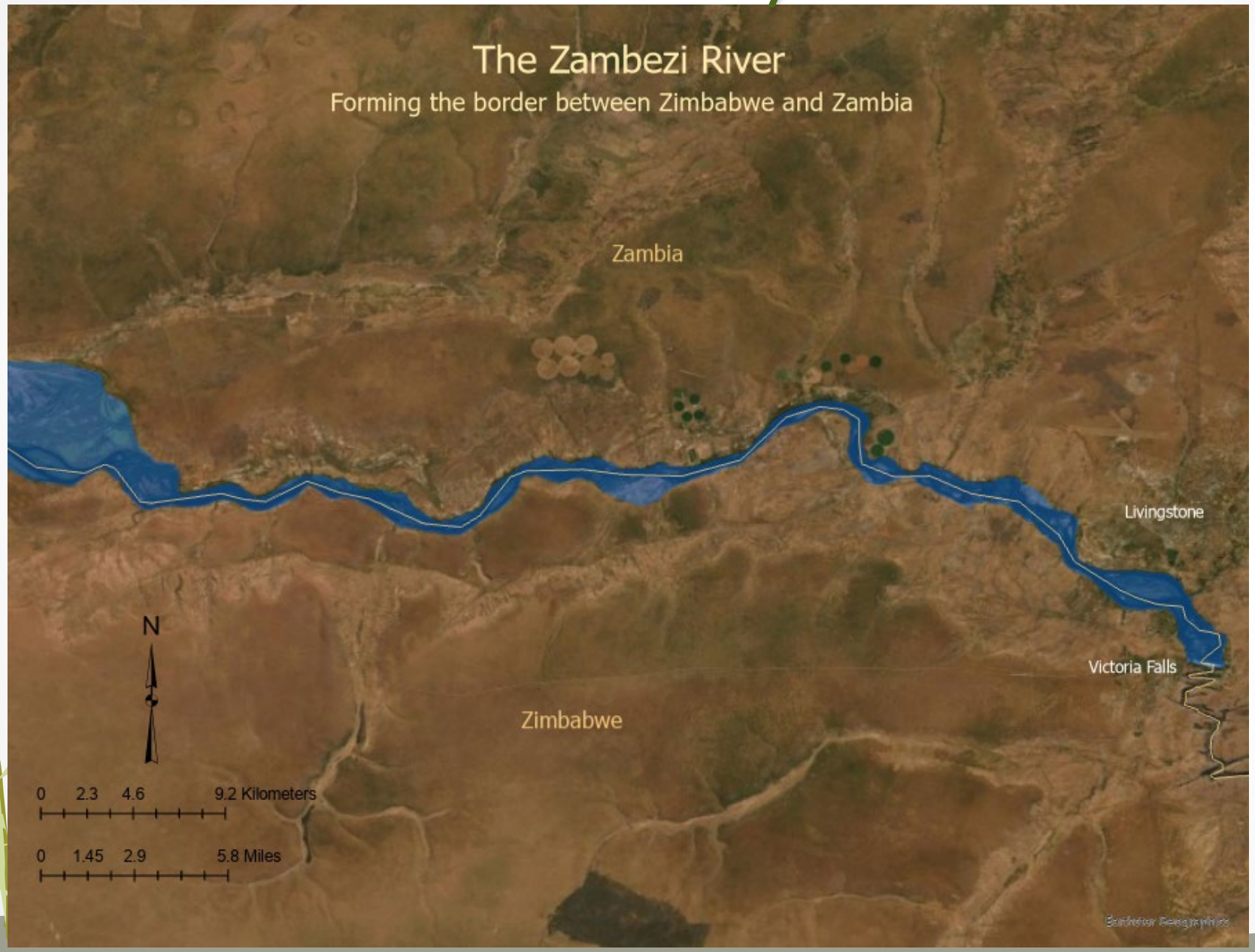
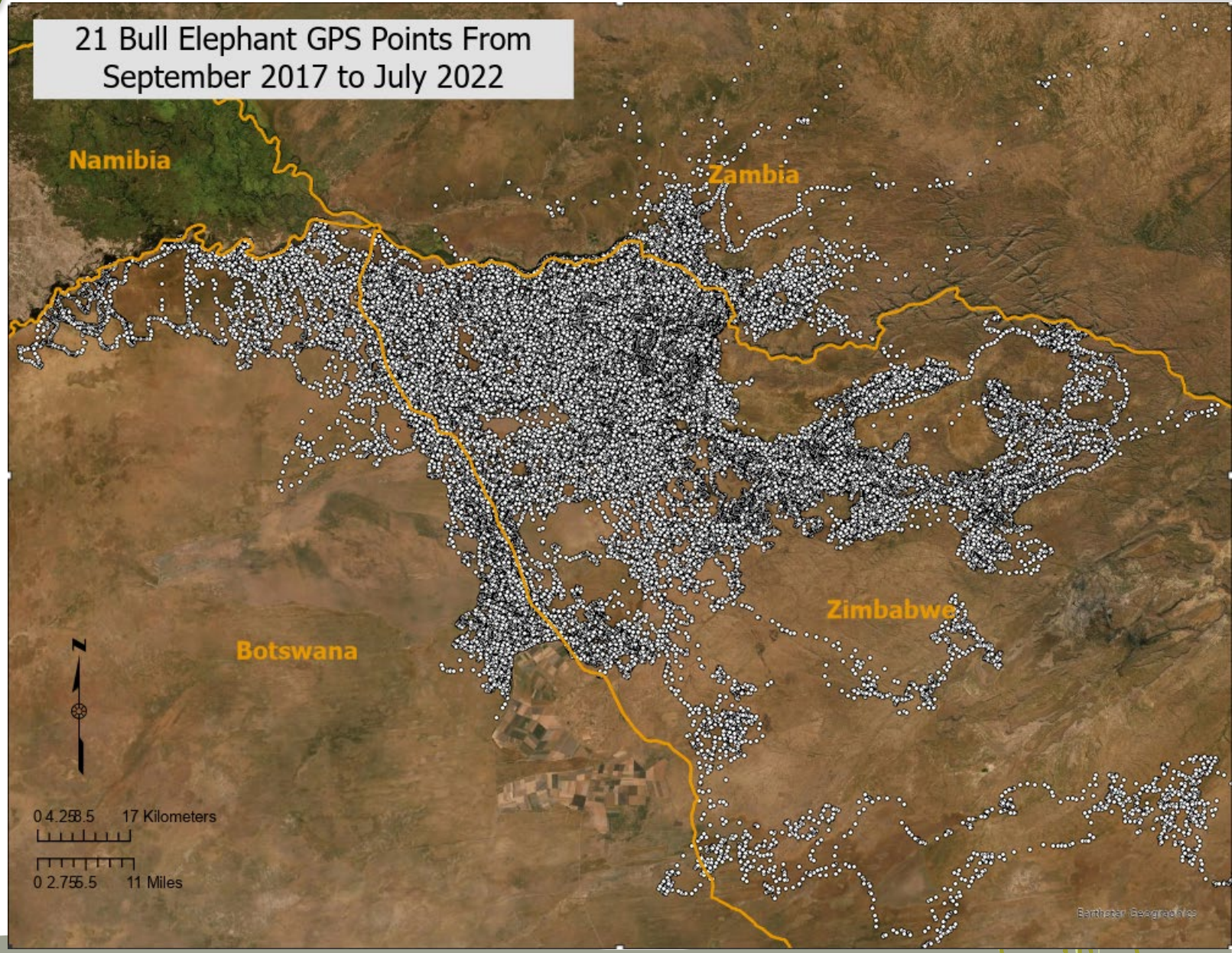
Transboundary Issues



Transboundary

- The elephants' range is primarily in Zimbabwe.
- The elephants that are collard had been identified as problem elephants.
- These problem elephants regularly cross international borders.



“As noted by Linsey (2017) 76% of Africa’s elephants are in populations which cross at least one international boundary. This has wide ranging implications for elephant co-management. In the KAZA there are five countries attempting to co-manage elephants’ population and the historical non harmonized policies may get even more complicated when we add the increase in human population and urbanization.” (Karidozo 2021)

Bull 19 crossing the Zambezi

Image by Julie Phippen

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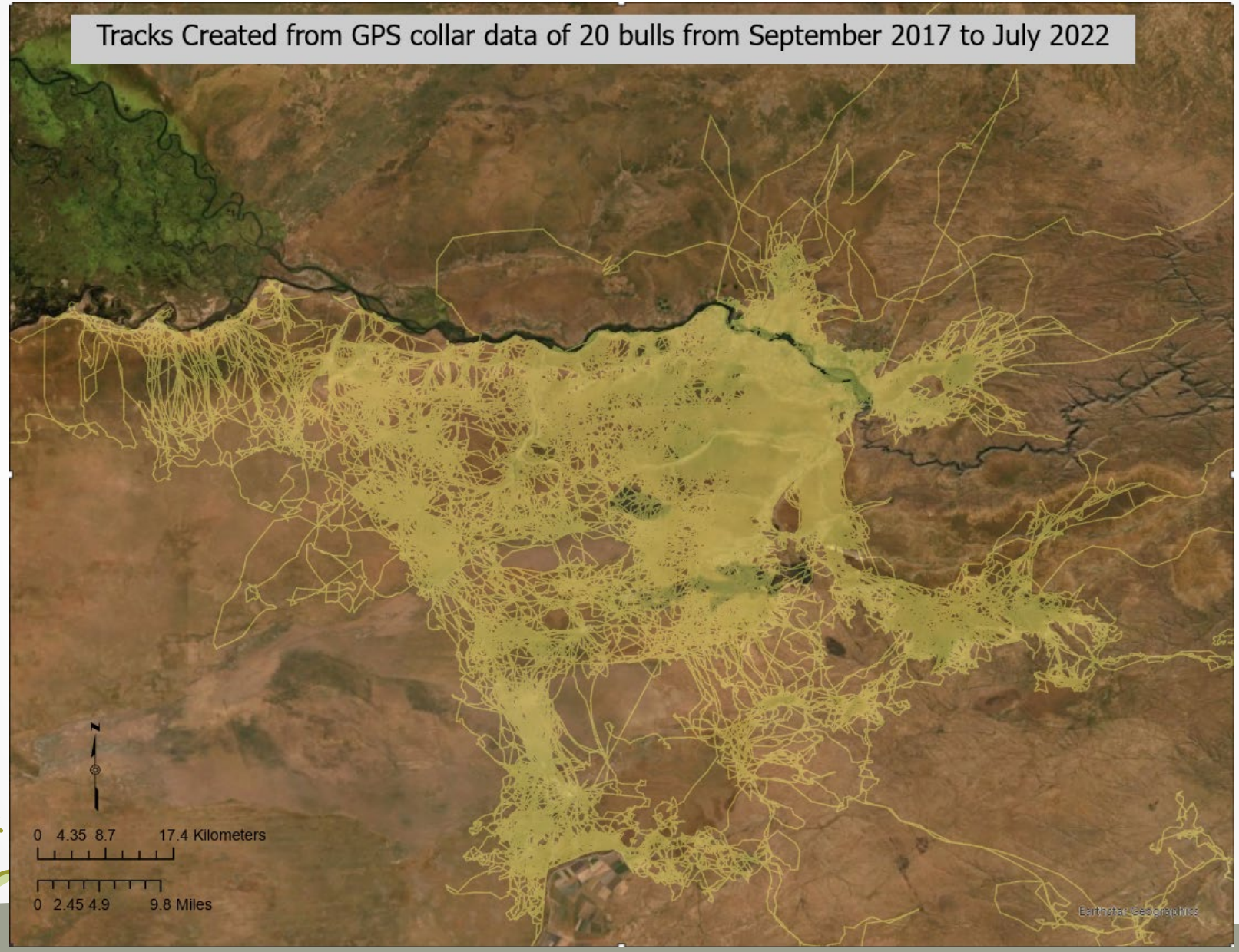
Analysis of Collar Data

Early Data Issues

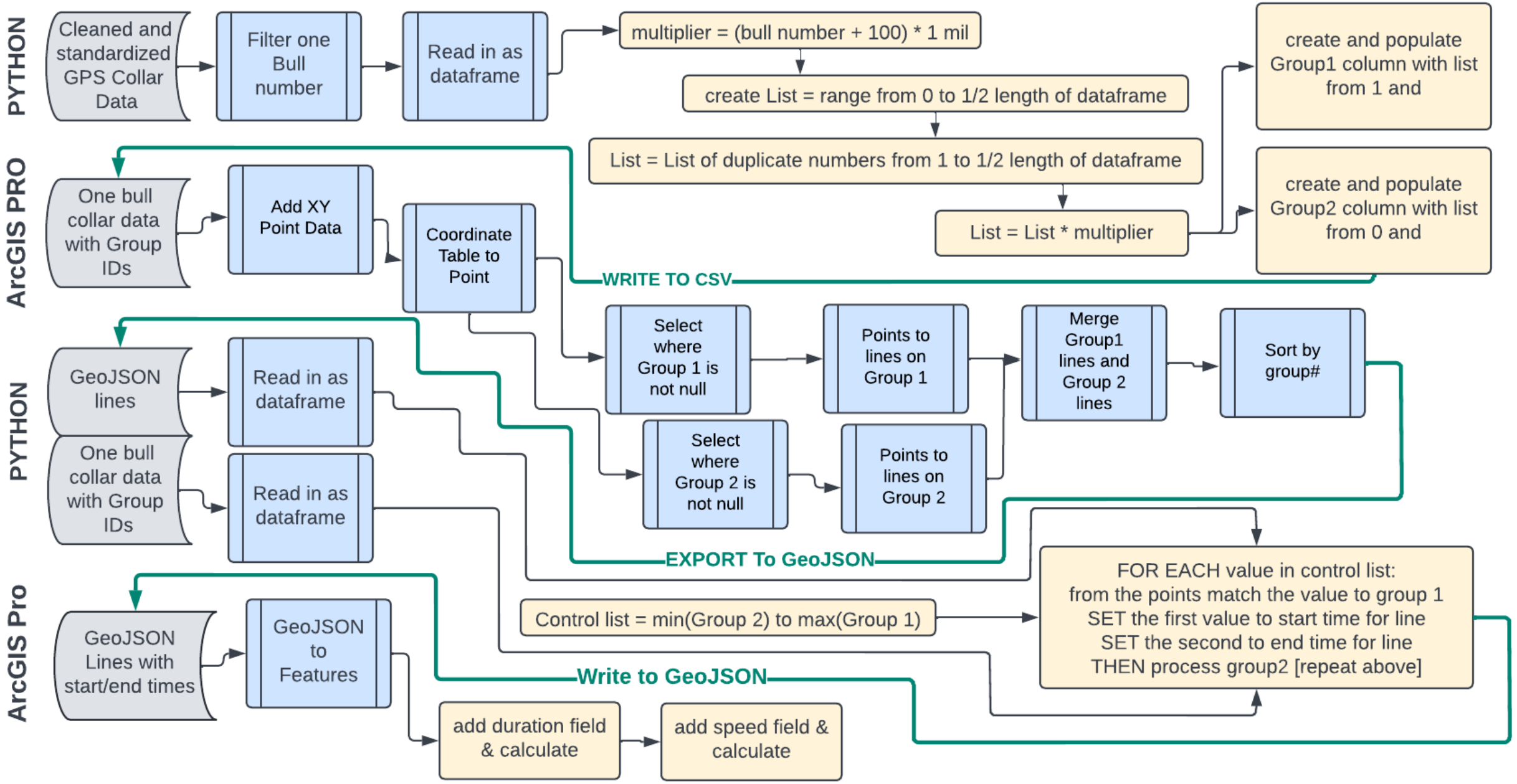
- Date/time format sometimes inconsistent between files
- Tens of thousands of duplicate records
- Inconsistence numbers of columns
- Some data came with column labels, some did not
- Several months of missing data between 2017 and present for some bulls
- Inconsistent time intervals

Analysis of Collar Data

One of the first process I ran was turning GPS points into tracks that maintain attributes.



GPS Points to Lines



Analysis

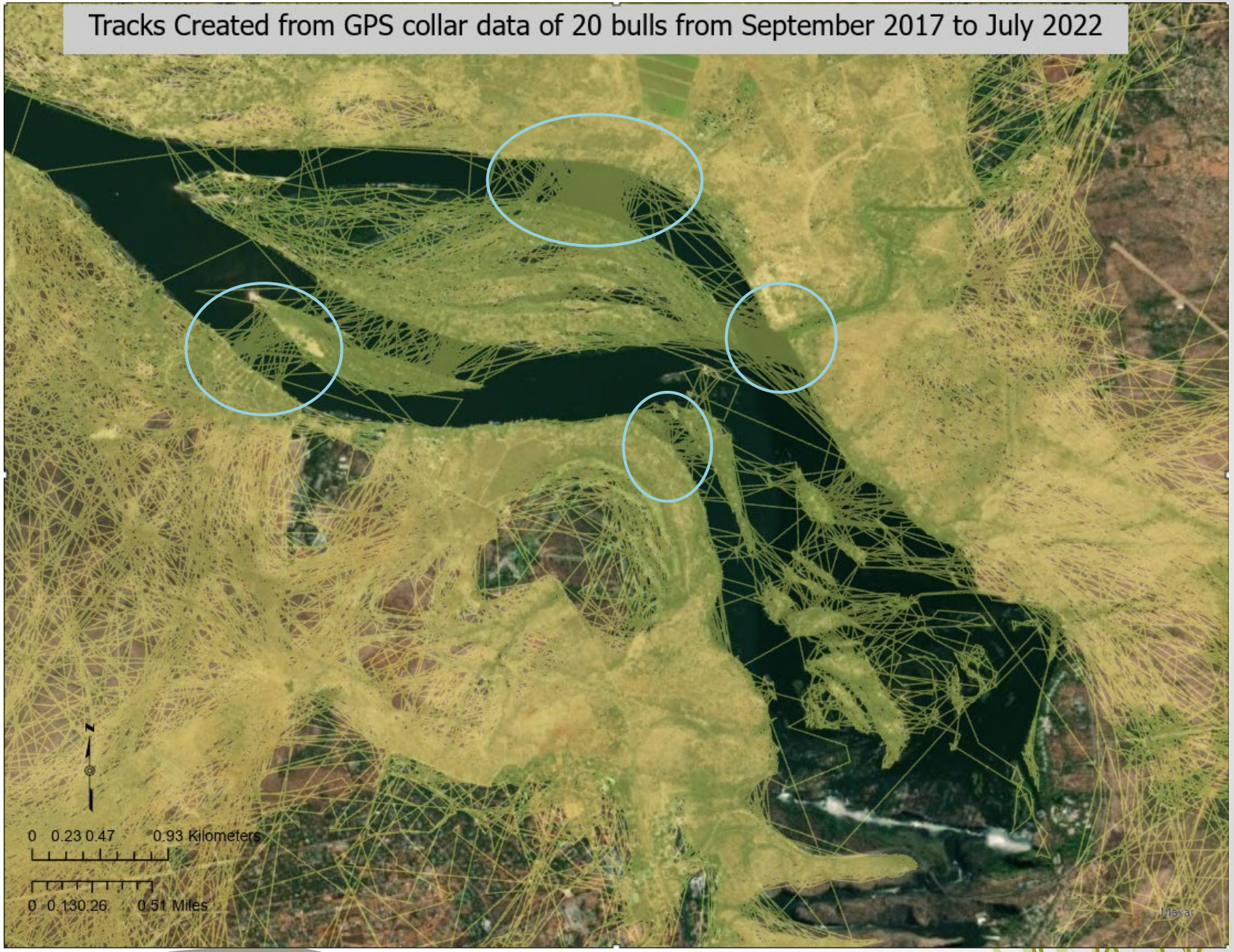
Talking a closer look at one area of the river we can see patterns emerge

The waypoints were mostly captured in 15-minute intervals, but through cleaning of bad data, the length of the line can represent much longer times.

A straight line represents the slowest path between two points

In another study I look the speed of the straight-line path.

All points in Livingstone's Water Treatment



Analyzing Why They Cross

The study aims to analyze many aspects of the physical environment to determine:

1. What draws the elephants to the Zambia side?
2. Why do they use specific crossing areas?

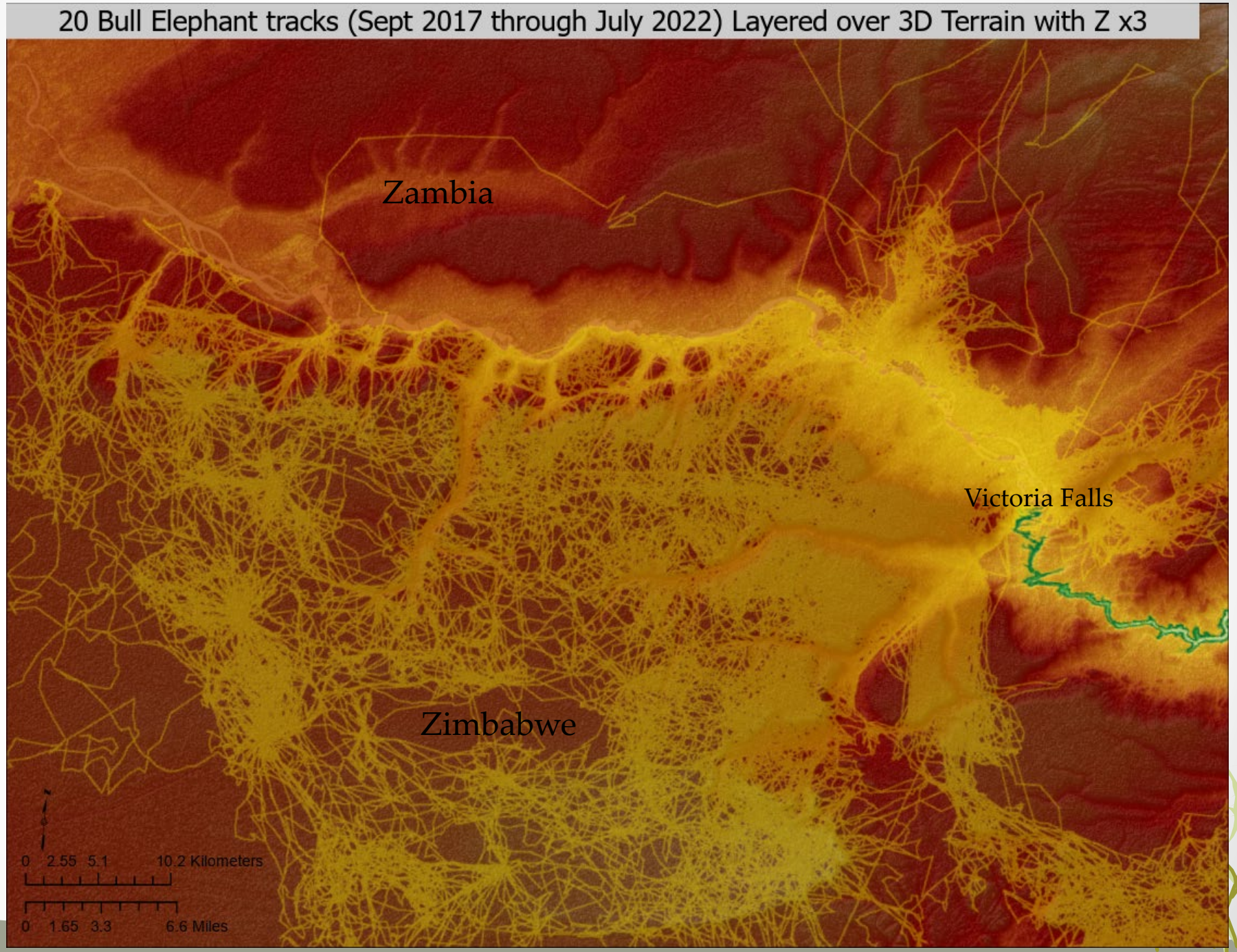
Aspects that have been observed in the field:

- Seasonal travel
- The soils on the Zambia side are richer so the grasses stay longer through the dry season
- There are more fruit trees on the Zambia side
- Rainfall is greater on the Zambia side – reason for leaving in the wet season

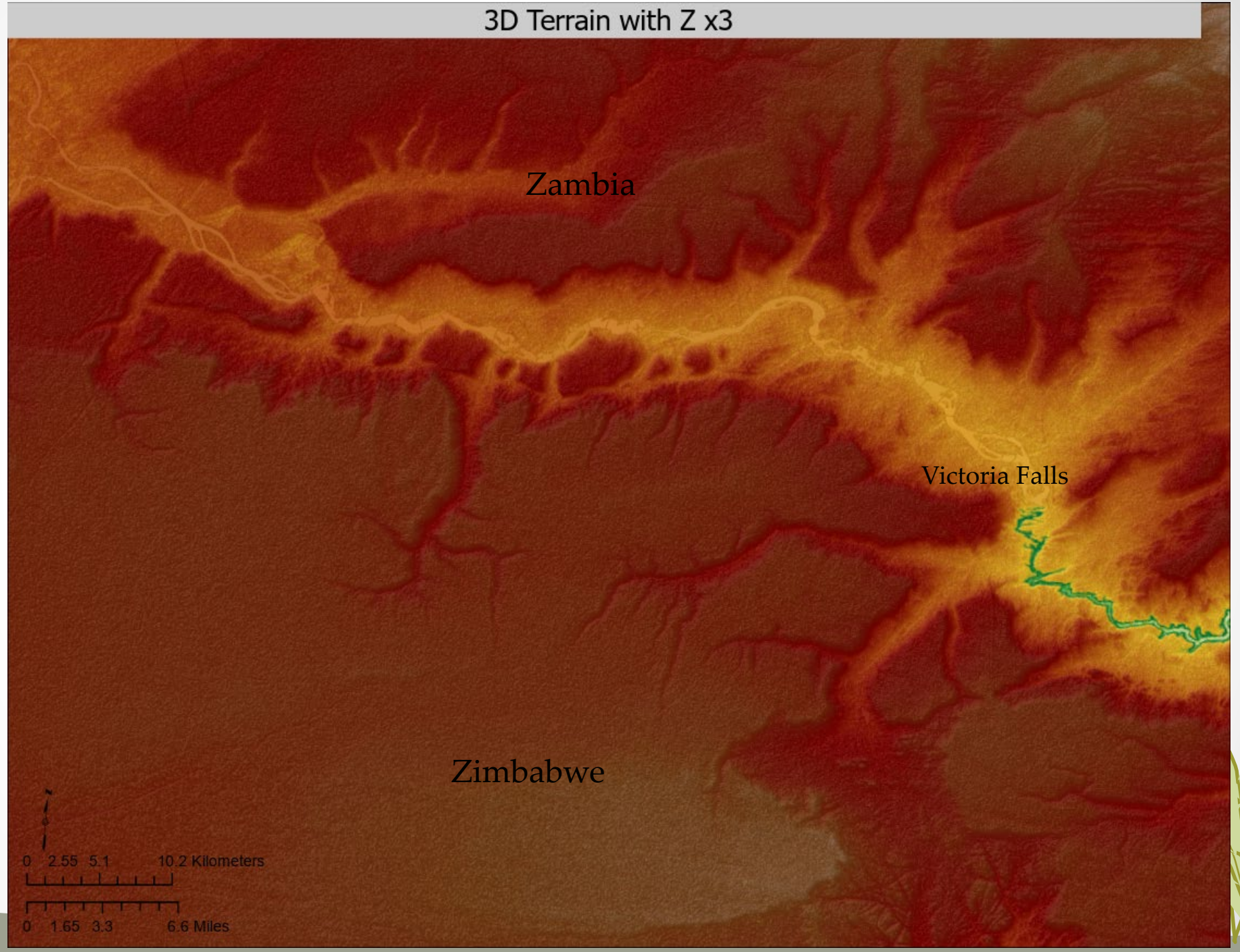
Observations from looking at the data in a GIS

- Slope of the terrain is a factor

Analysis


20 Bull Elephant tracks (Sept 2017 through July 2022) Layered over 3D Terrain with Z x3
Zambia
Victoria Falls
Zimbabwe
0 2.55 5.1 10.2 Kilometers
0 1.65 3.3 6.6 Miles

Analysis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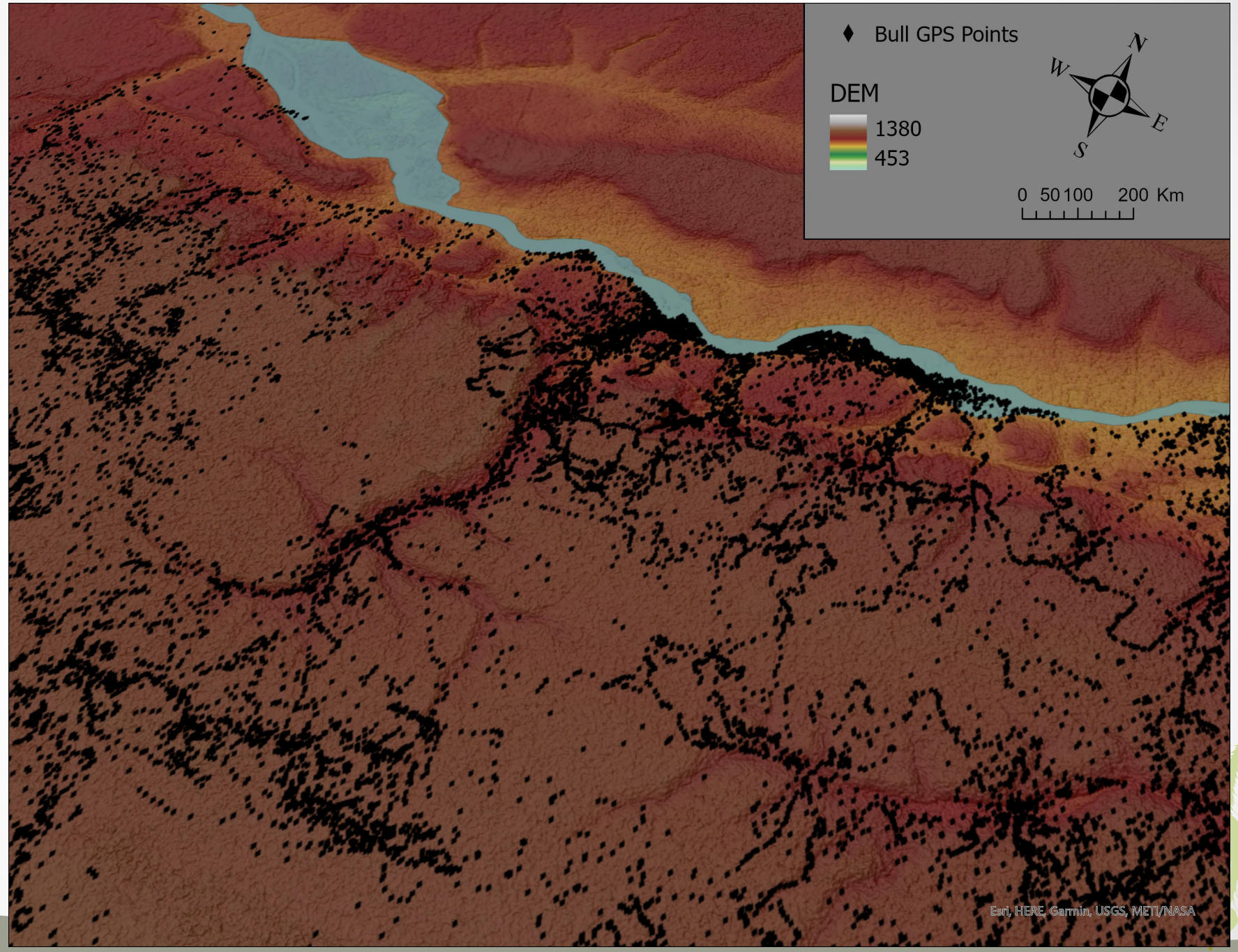
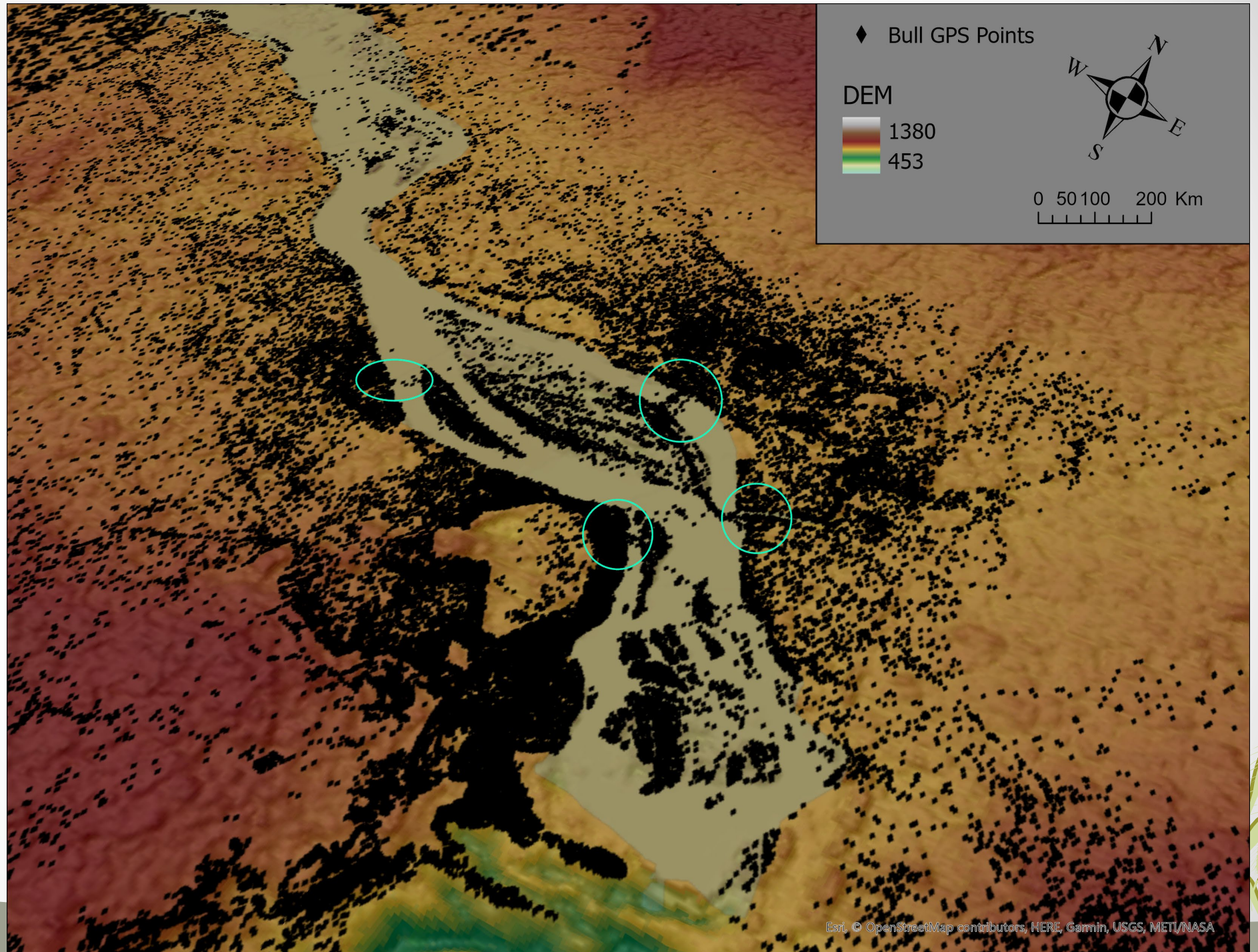

Bull GPS Points
DEM
1380
453
N
W
E
S
0 50 100 200 Km
Esri, HERE, Garmin, USGS, METI/NASA

Analysis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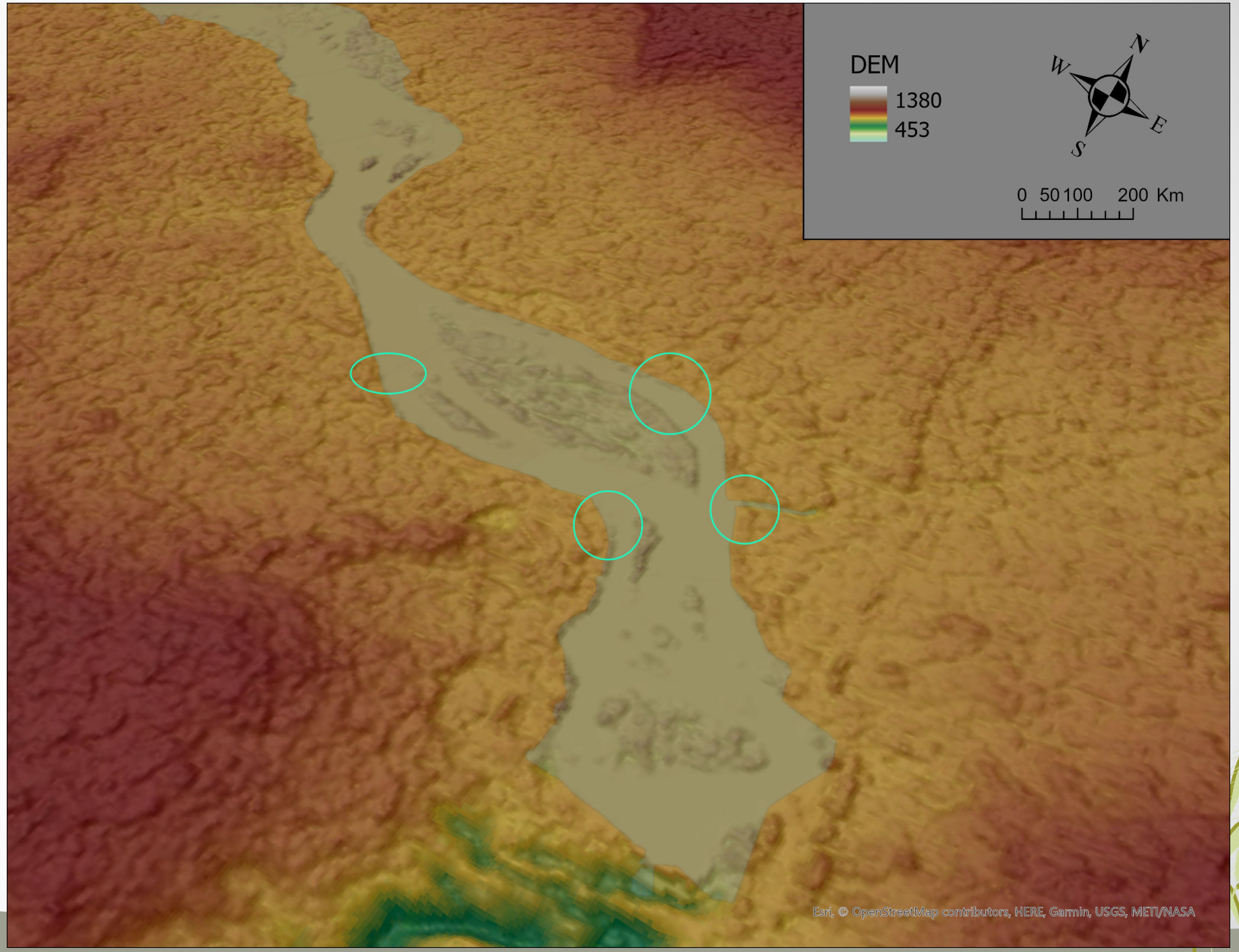
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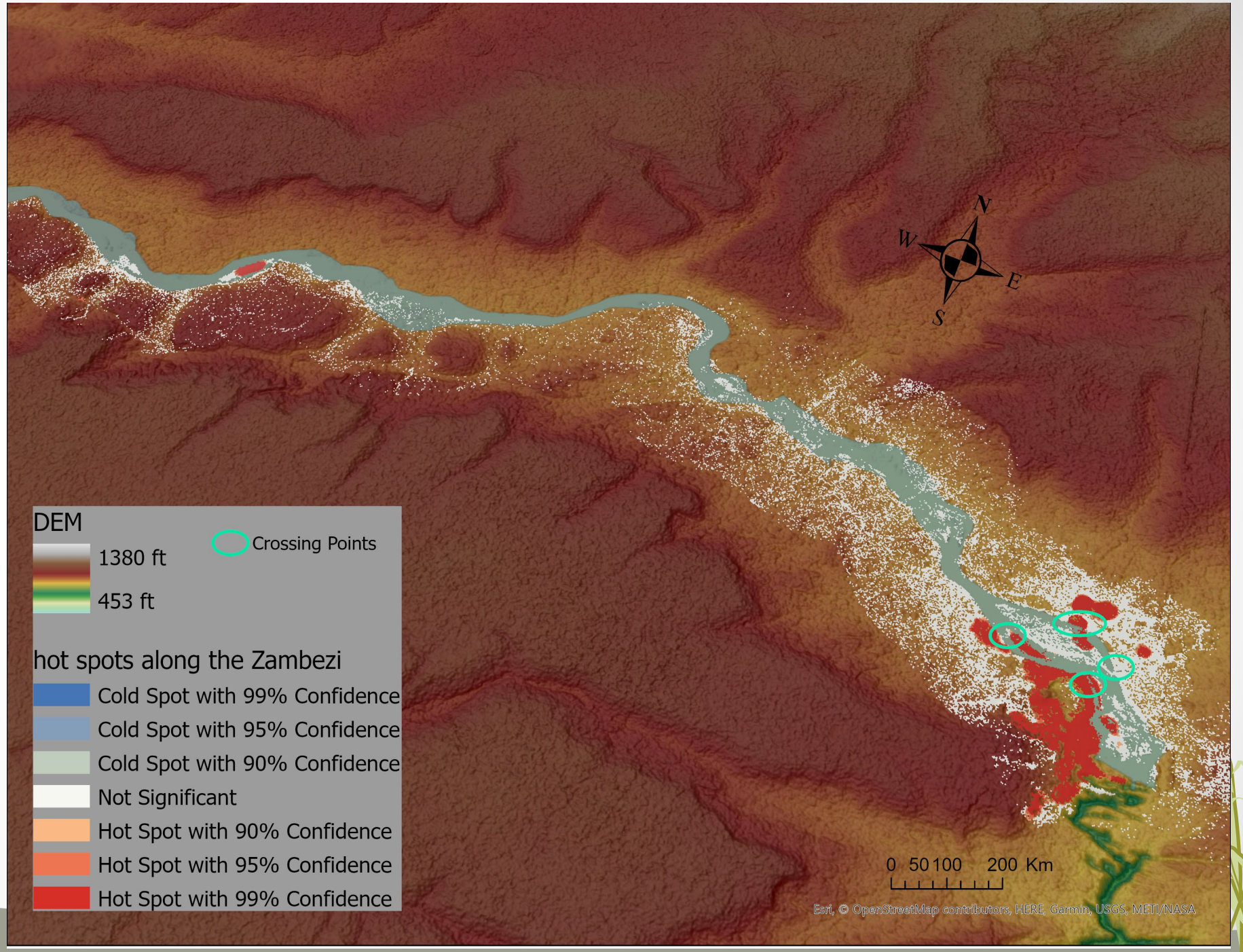
Analysis

Hot Spot analysis of 20 bull elephant GPS points clipped to within a 150 km of the Zambezi



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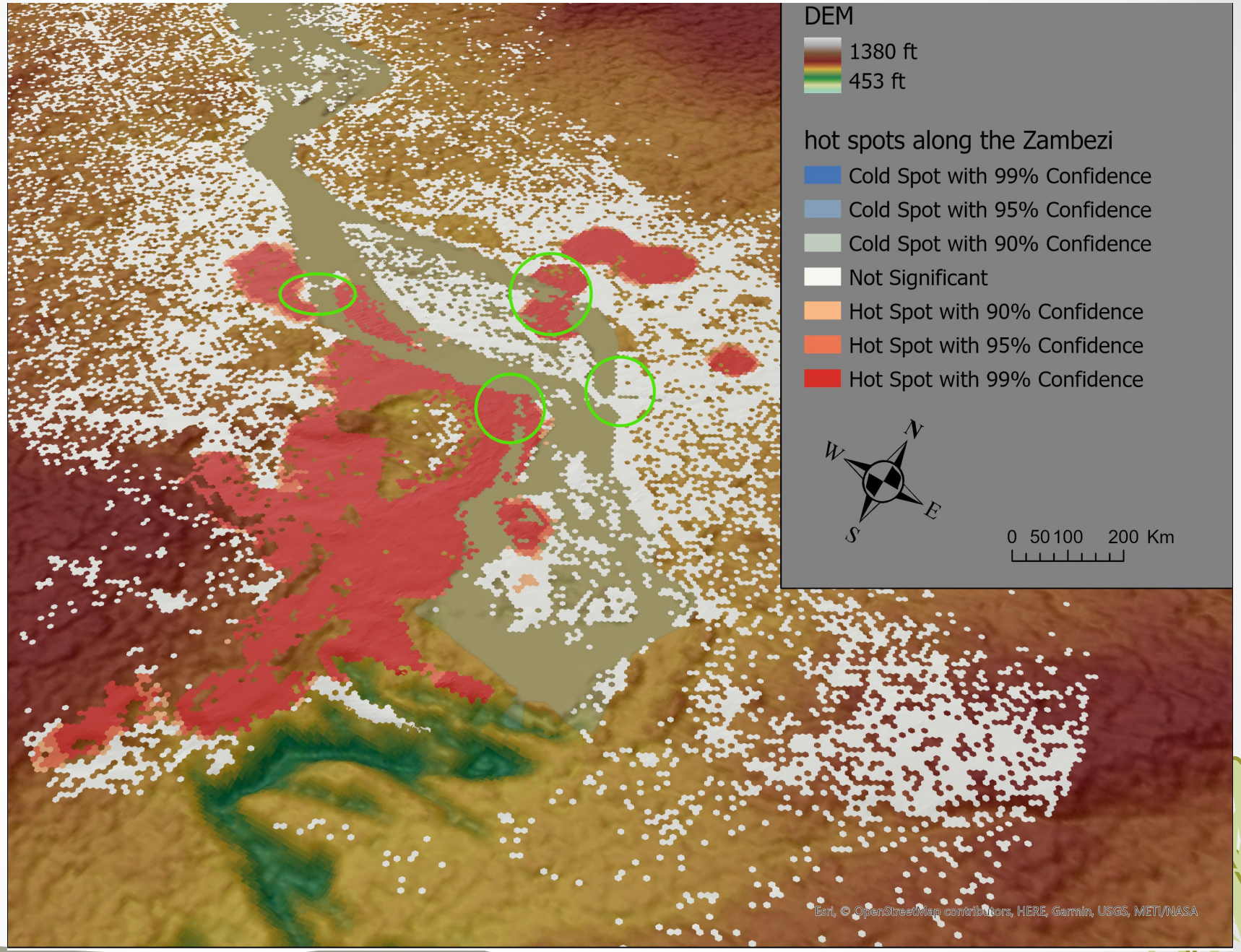

Analysis

Results/Conclusion of terrain study

- Extracted Point values from the DEM for all 20 elephant points (442, 963 total)
- Using 5 categories of Slope from the UN Food and Agriculture Organization:
  - Gentle: < 5 %
  - Slight Rise: 5 to 10%
  - Moderate Rise: 10 to 25%
  - Steep: > 25%

Analysis

Results/Conclusion of terrain study

Slope Category	Count of GPS Points	Percent of Total
Flat to Gentle: < 5 %	315,126	71.18%
Slight Rise: 5 to 10%	114,945	25.96 %
Moderate Rise: 10 to 25%	12,514	2.82 %
Steep: > 25%	108	0.02 %

Only 3% of all bull points were found on slopes higher than 10%

Analysis

Results/Conclusion of terrain study

Through studying bull elephant tracks in and around the Zambezi river in relation to slope and elevation it was observed that:

- The slope of the land is an important factor in elephants path choice
- They seem to utilize ravines and gullies

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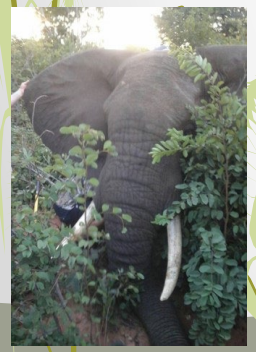
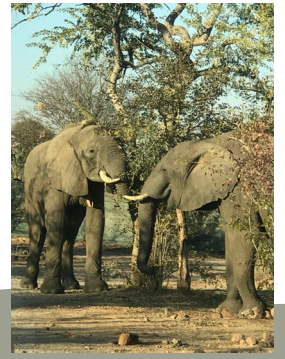
Continuing the Work

It has been observed that bull elephants move more at night, and it is believed the reason is because it is cooler. This could also be the reason for favoring ravines and gullies.

1. Take a closer look at diurnal patterns in conjunction with seasonal behaviors
2. Common path analysis in the ravine areas and areas of cooled temperatures
3. Strengthen local observations of soils fertility and more attractive vegetation with high detailed LULC and soil maps of the area
4. Expand the study beyond the Zambezi river border area for terrain analysis, and particularly look at the Botswana border as well.





Contents

Acknowledgements

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  - Malvern Karidozo, Connected Conservation
  - Dr. Marguerite Madden, Center for Geospatial Research, UGA
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References

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QUESTIONS ?