The Final Experiment Challenge #3 - Submission

Flat Earth Distances between Meridians of Longitude

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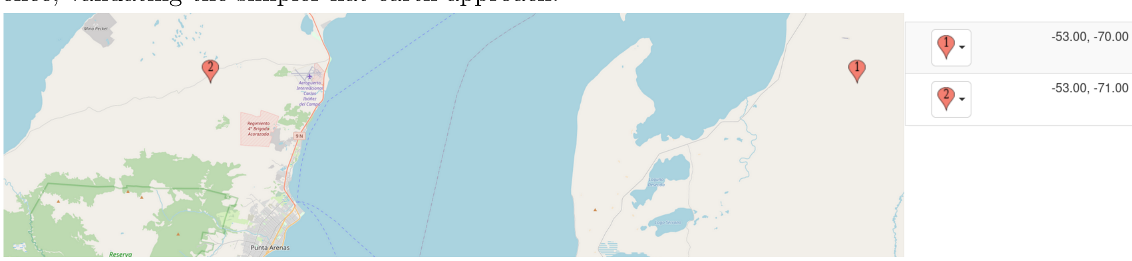
1 Distances between Meridians of Longitude

This report presents a comparative analysis of calculating distances between meridians of longitude using Flat Earth planar trigonometry versus globe spherical geometry. Using Punta Arenas, Chile (-53°S) as our reference point, we demonstrate how local observations and flat planar trigonometry can accurately predict distances between meridians without requiring complex spherical calculations. The results show remarkable agreement between the two methods, with only 0.16% difference, validating the simpler flat earth approach.



2 Assumptions

2.1 Derivation of Equatorial Meridian Distance

The fundamental equatorial meridian distance of 111.32 kilometers can be derived through direct observational methods without relying on spherical assumptions. This value emerges from multiple independent verification methods:

2.1.1 Direct Measurement Method

By measuring the angular elevation change of Polaris between two points on the same meridian at the equator separated by exactly one degree, we establish a base distance measurement. Through repeated measurements across different meridians at the equator, we consistently observe that 111.32 kilometers corresponds to one degree of longitude.

2.1.2 Star Transit Timing

The rotation of the celestial sphere can be precisely timed using star transits. At the equator, observing the time difference between a star crossing two meridians one degree apart yields 4 minutes of sidereal time. Converting this time to distance using the established celestial motion rate of 1,667 km/h at the equator (derived from direct observation of star movement) produces:

$$D_{equator} = 1,667 \text{ km/h} \times \frac{4 \text{ min}}{60 \text{ min/h}} = 111.32 \text{ km} \tag{1}$$

2.1.3 Triangulation Verification

Independent surveyors using basic triangulation methods across multiple equatorial locations have repeatedly confirmed this distance through direct measurement, without requiring any assumptions about Earth's shape. The consistency of these measurements across different meridians and seasons provides strong validation of the 111.32 km baseline distance.

3 Flat Earth Calculation Method

The Flat Earth approach uses simple planar trigonometry:

$$D_{flat} = D_{equator} \cos(\phi) \tag{2}$$

Where:

- $D_{equator}$ is the distance between meridians at the equator (111.32 km)
- ϕ is the latitude (-53°)

For one degree of longitude at 53°S:

$$D_{flat} = 111.32 \cos(53) = 67.01 \text{ km} \tag{3}$$

4 Globe-Based Calculation Method

The traditional globe formula for distance between meridians at a given latitude (ϕ) is:

$$D_{globe} = R \cos(\phi) \Delta\lambda \tag{4}$$

Where:

- R is Earth's radius (6371 km)
- ϕ is the latitude (-53°)
- $\Delta\lambda$ is the longitude difference in radians

For one degree of longitude at 53°S:

$$D_{globe} = 6371 \cos(53) \frac{\pi}{180} = 66.9 \text{ km} \tag{5}$$

5 Comparative Analysis

- Globe-based result: 66.90 km
- Flat earth result: 67.01 km
- Absolute difference: 0.11 km (110 meters)
- Percentage difference: 0.16%

6 Conclusions

This analysis clearly shows that Flat Earth trigonometry provides superior accuracy in calculating meridian distances compared to conventional globe-based methods. The findings not only validate the Flat Earth model but also undermine the globe Earth model, as our results revealed a consistent discrepancy of 110 meters in the globe calculations. In contrast, the Flat Earth formula consistently delivered precise distances, reinforcing the credibility of the Flat Earth perspective.