Stichting De Hollandse Cirkel voor de Geschiedenis der Geodesie

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FIG e-Working Week 2021 – paper 11089

Medieval Portolan Charts

A geodetic and historical mystery

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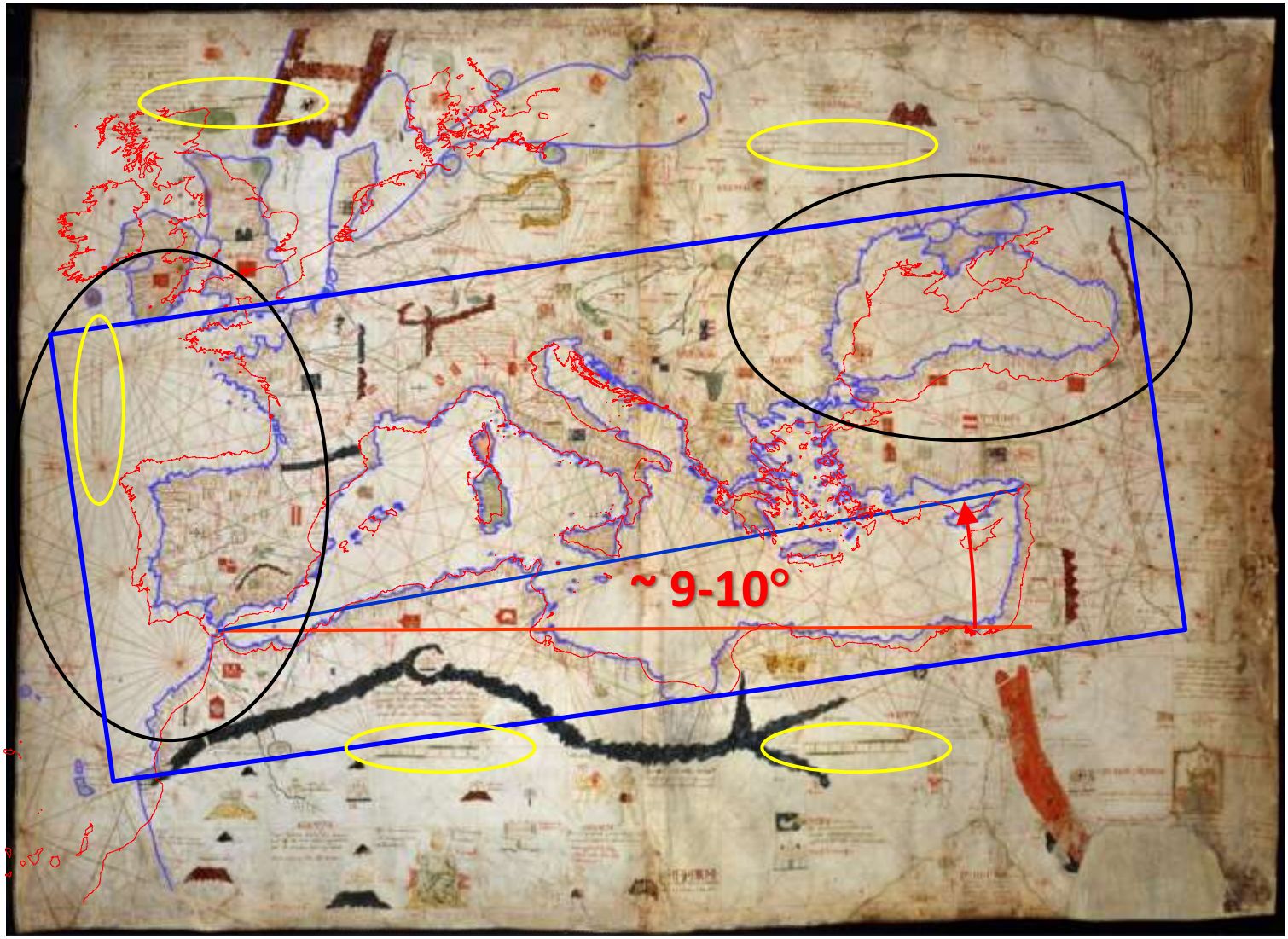
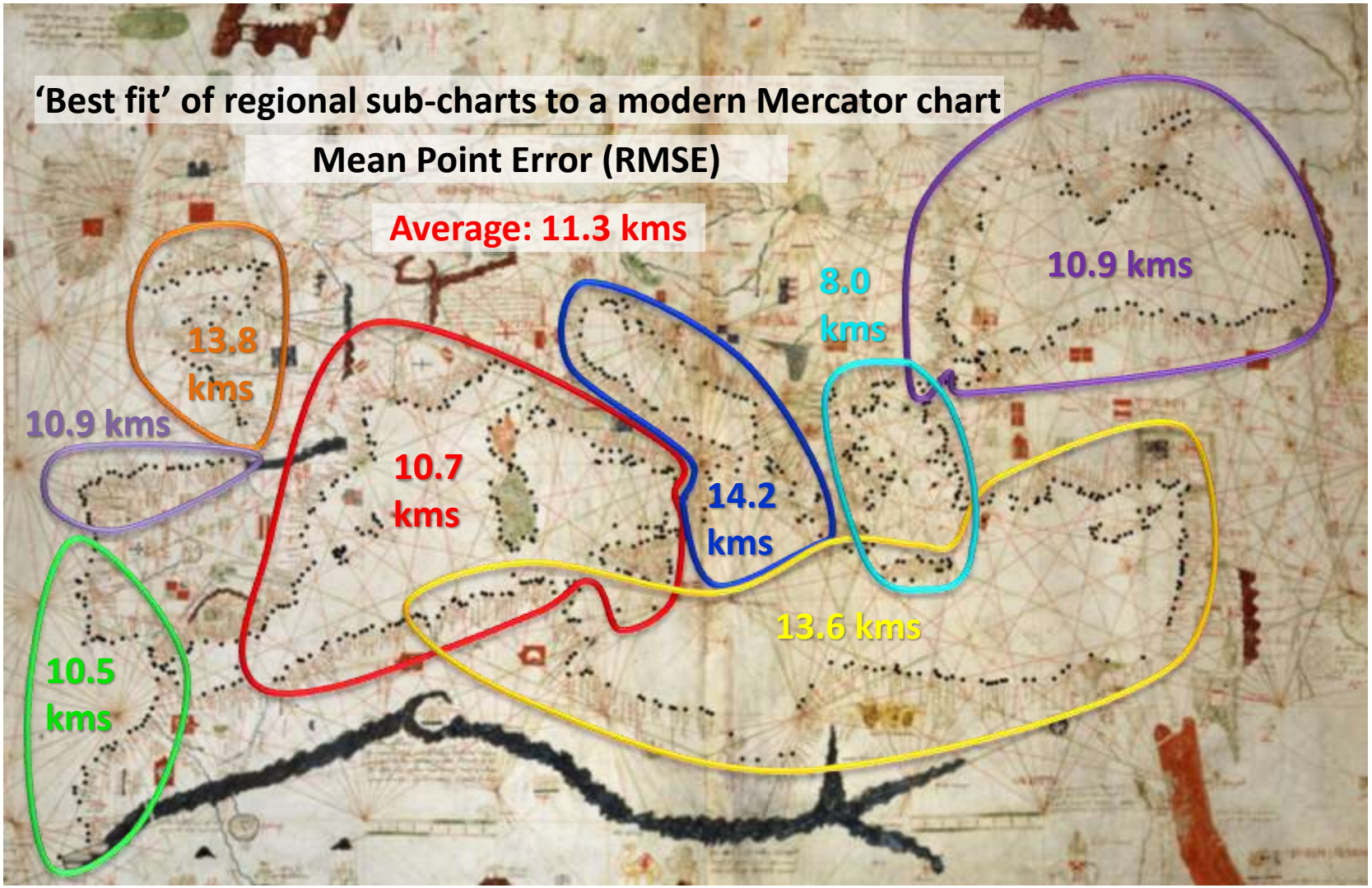
Portolan chart from 1339

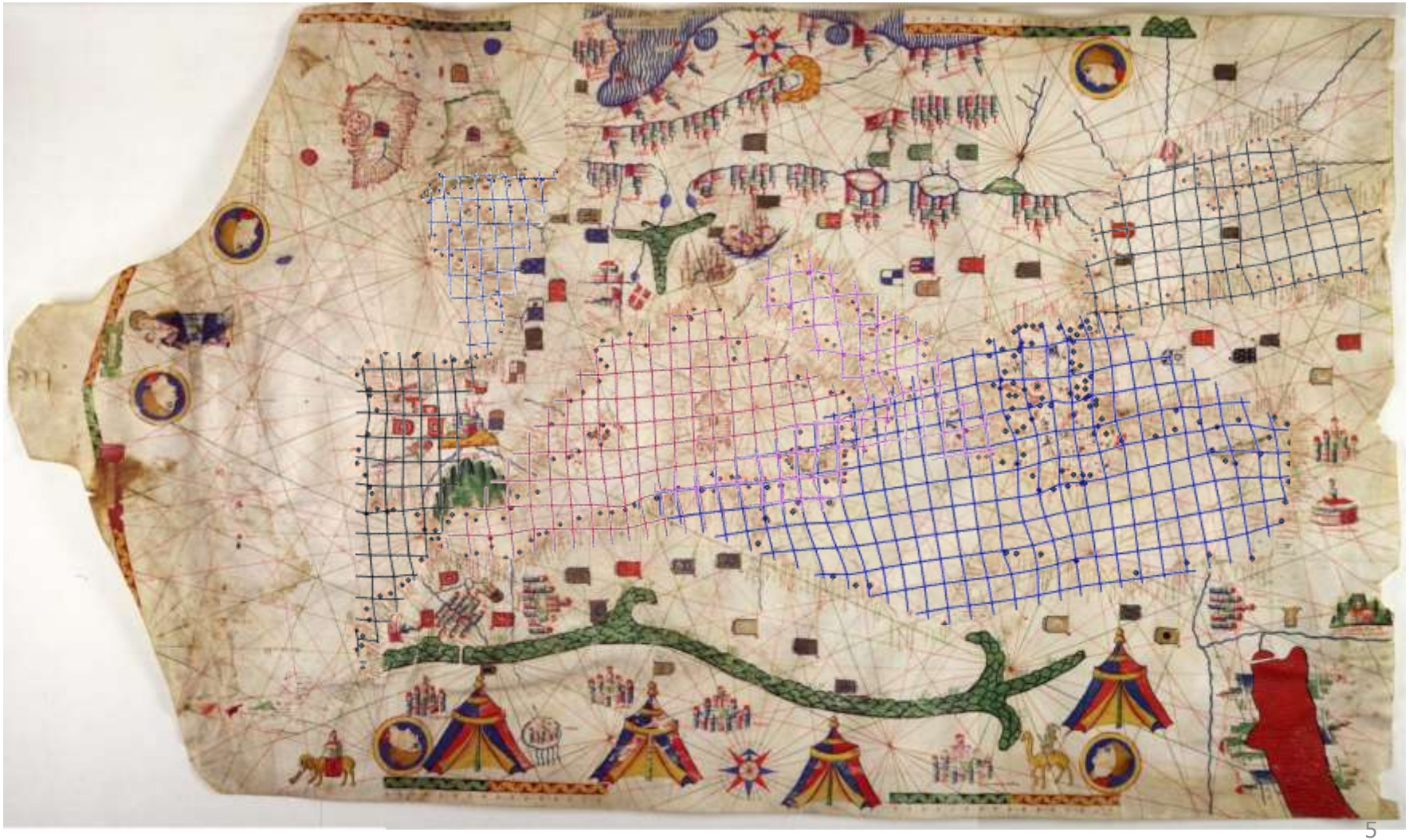


Portolan chart accuracy

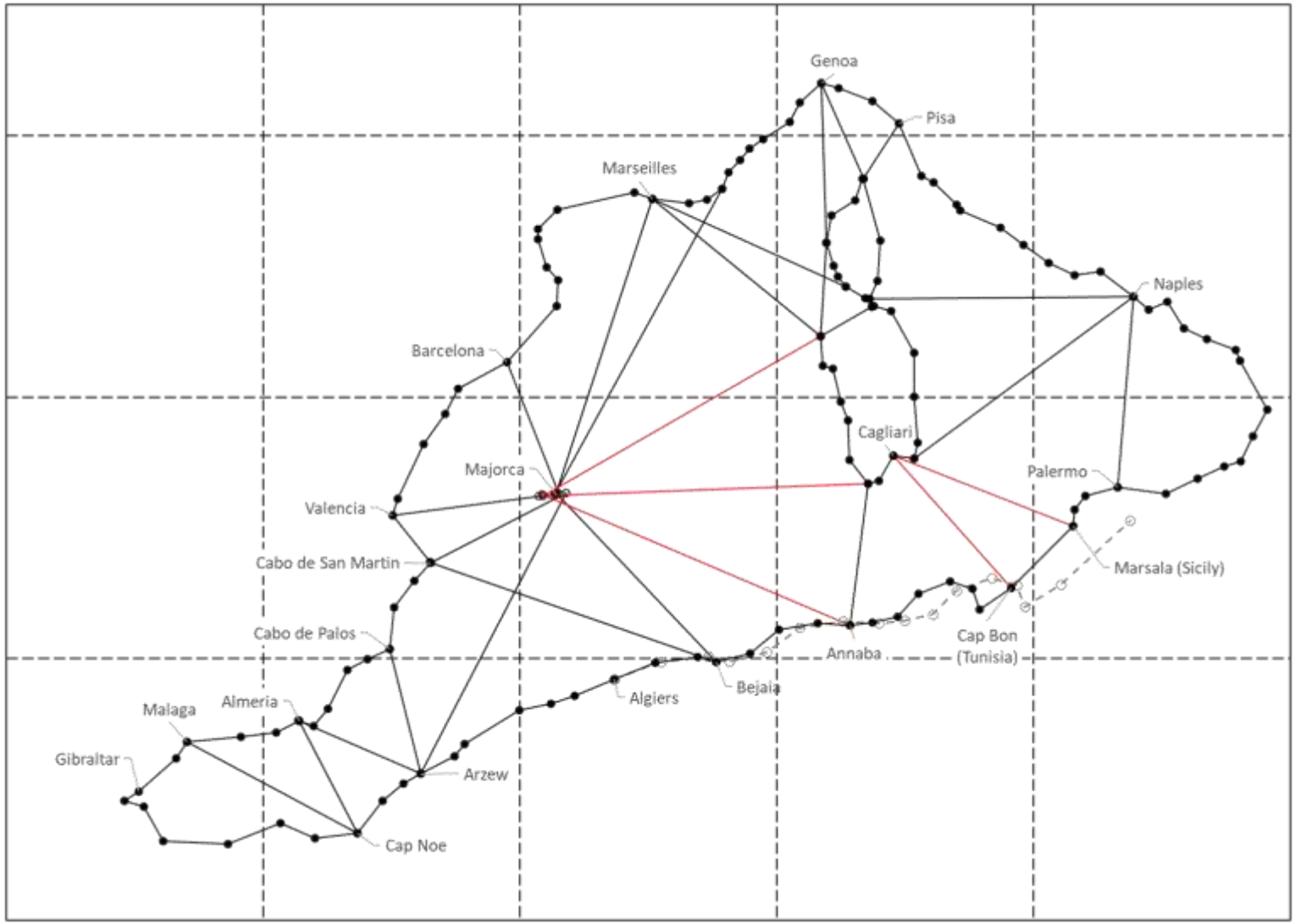


Piecewise rectified chart

Portolan chart from 1466



Medieval mapping simulated



Network Quality Control

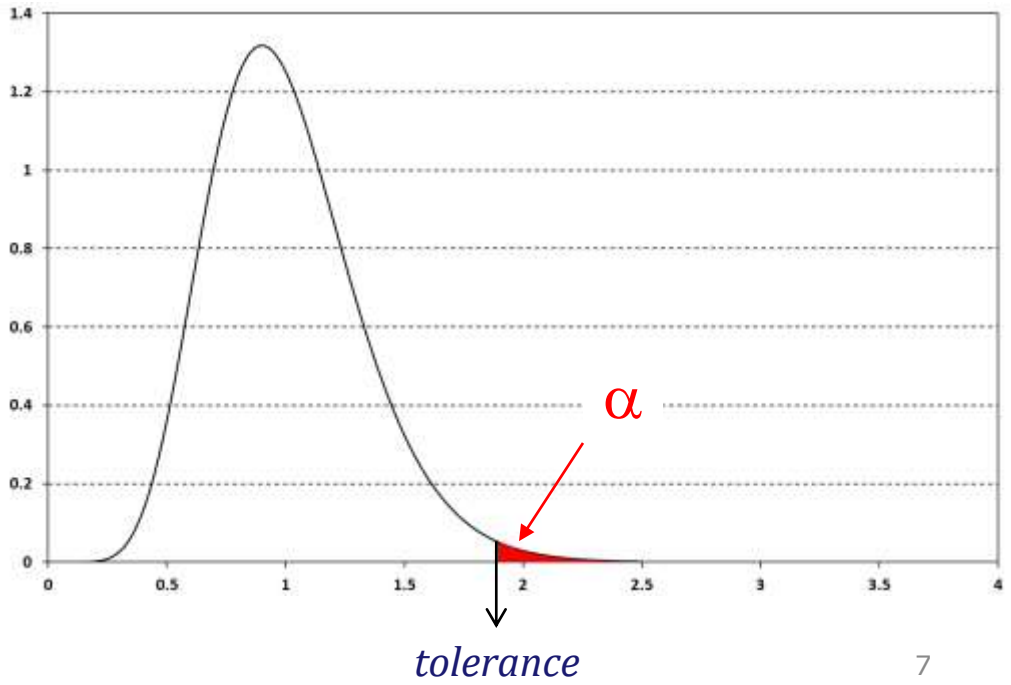
- Mean Squared Error (MSE)
  - = sum of squared, weighted residuals, divided by redundancy number (b)
  - = To be divided by its expectation σ_0^2
- Fisher-distributed

If $MSE/\ \sigma_0^2 \geq tolerance$:

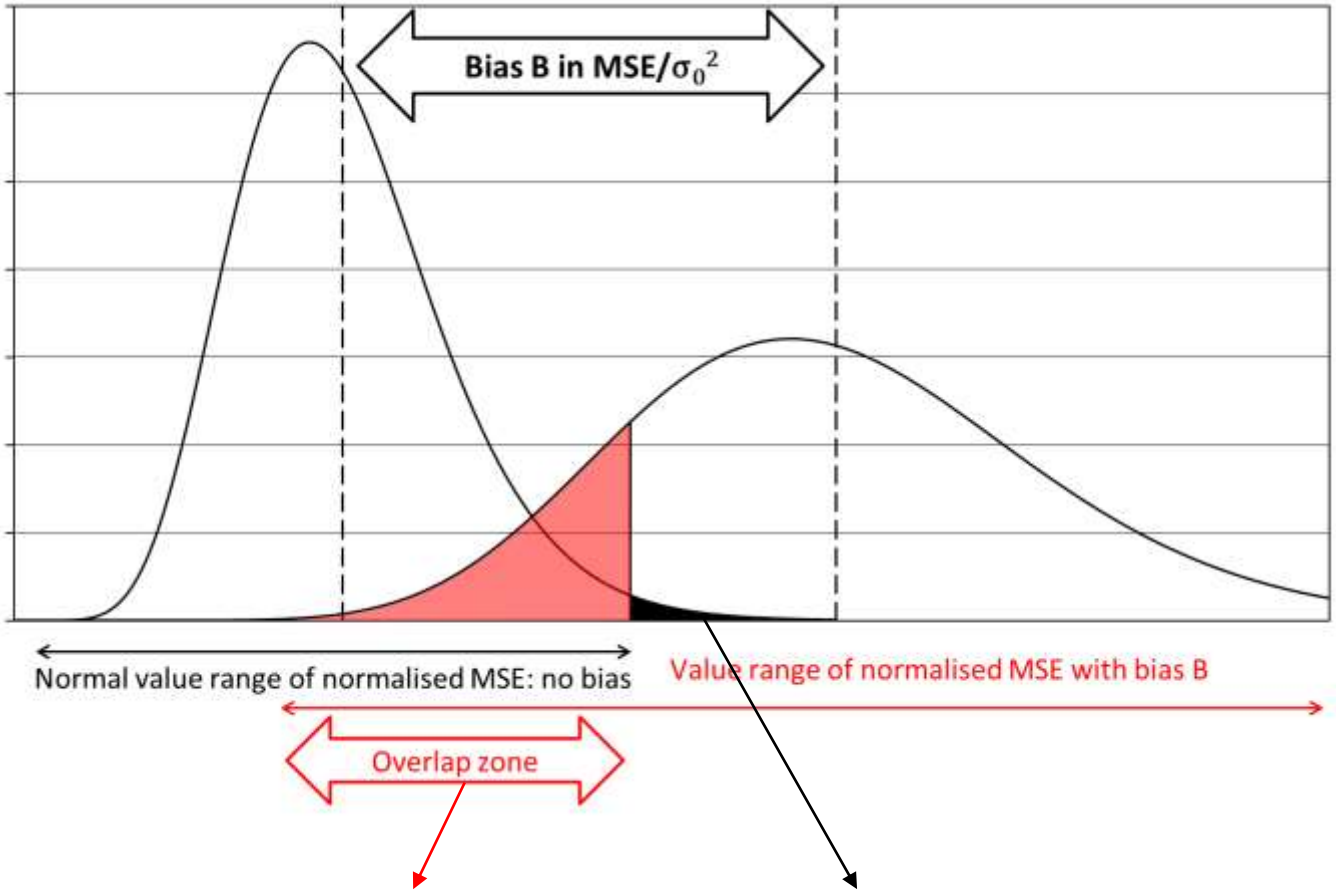
⇨ errors in network

α = significance level

(α = 1%, 0.5% or 0.01%)



Neyman-Pearson lemma



Magnitude of error(s) normally unknown:

Compute B that is discoverable with probability β

Also used in automatic face recognition software

Type 2 error (probability = $1-\beta$)
(You think 'No error(s)',
.... but there are)

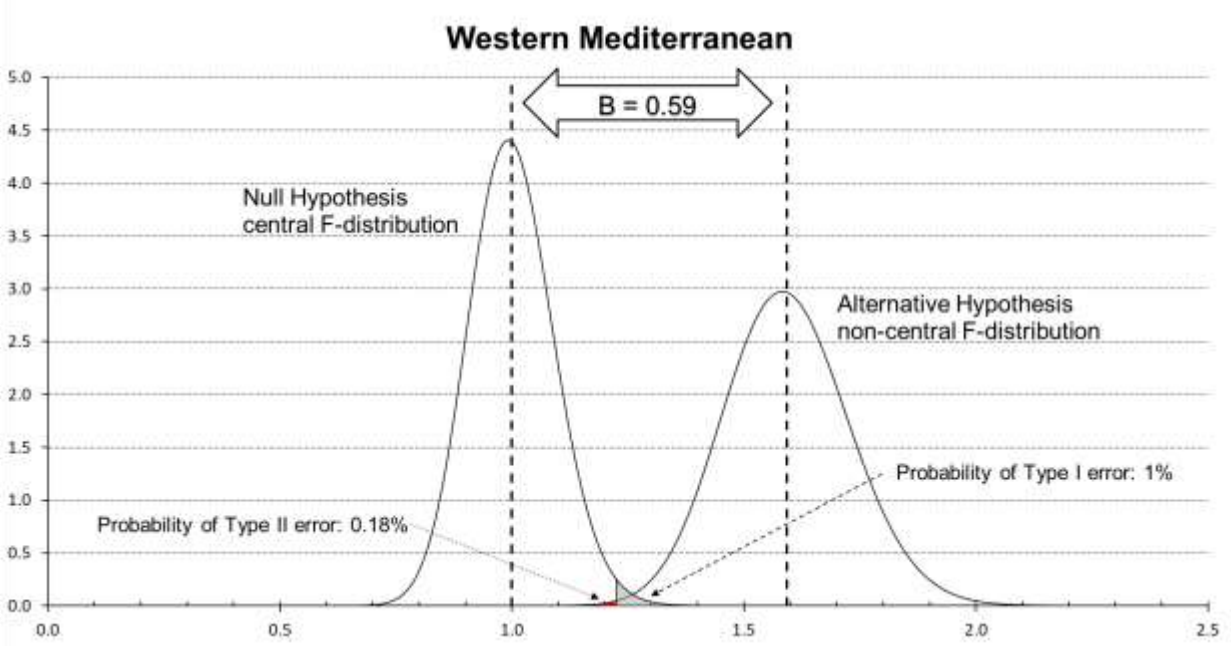
Type 1 error (probability = α)
No error(s),
.... but you think there are!

Inverted Neyman-Pearson

- 'Medieval network': bias (B) may be computed:
  - Distance error (ignored earth curvature error)
  - Magnetic declination from paleomagnetic model
  - Plausible plane charting schema
  - Fit the 'medieval network' to Mercator and compute the MSE
  - No random errors ⇨ $MSE / \sigma_0^2 = B$
- Inversion of the Neyman Pearson principle:
  - Probabilityof map projection being co-incidental may be computed

Co-incidental map projection?

- ‘Real’ values of B and their associated probabilities:
  - Western Mediterranean: $\mathbb{P} = 0.0018$
  - Eastern Mediterranean: $\mathbb{P} = 3*10^{-7}$
  - Black Sea: $\mathbb{P} = 0.31$



Conclusions

- The **map projection** (Mercator or Mercator-like) cannot be a co-incidental feature; ⇨ **intentional**
- **Mosaics**
  - Made in medieval times,
  - … matching overlapping coastal sections of existing regional charts
- **Original regional charts:**
  - Sophisticated charts on Mercator(-like) projection
  - Must be pre-medieval
- **Geodesy is older than you think !!**