On the use of climate models in paleoclimate data assimilation

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1. Research goal

• _Data assimilation_ approach combines paleoclimate proxy data and numerical models
• Accurate paleoclimate forcing for ice sheet models → improved understanding of ice-sheet response to climate

2. My role: spatial statistics

• To assess the reliability of numerical climate models and proxy records
• Correlation (r) vs. distance
• For example, _can tropical proxy records tell us anything about past climate over the Greenland Ice Sheet?_

3. E-folding distance

• The distance (or time) over which an exponentially decreasing quantity decays to 1/e of its previous value
• Importance: quantifies spatial relationships, for comparison among different data sets

4. "Drill" an ice core in Greenland, test correlation with global data

5. Preliminary Results (using temperature data sets)
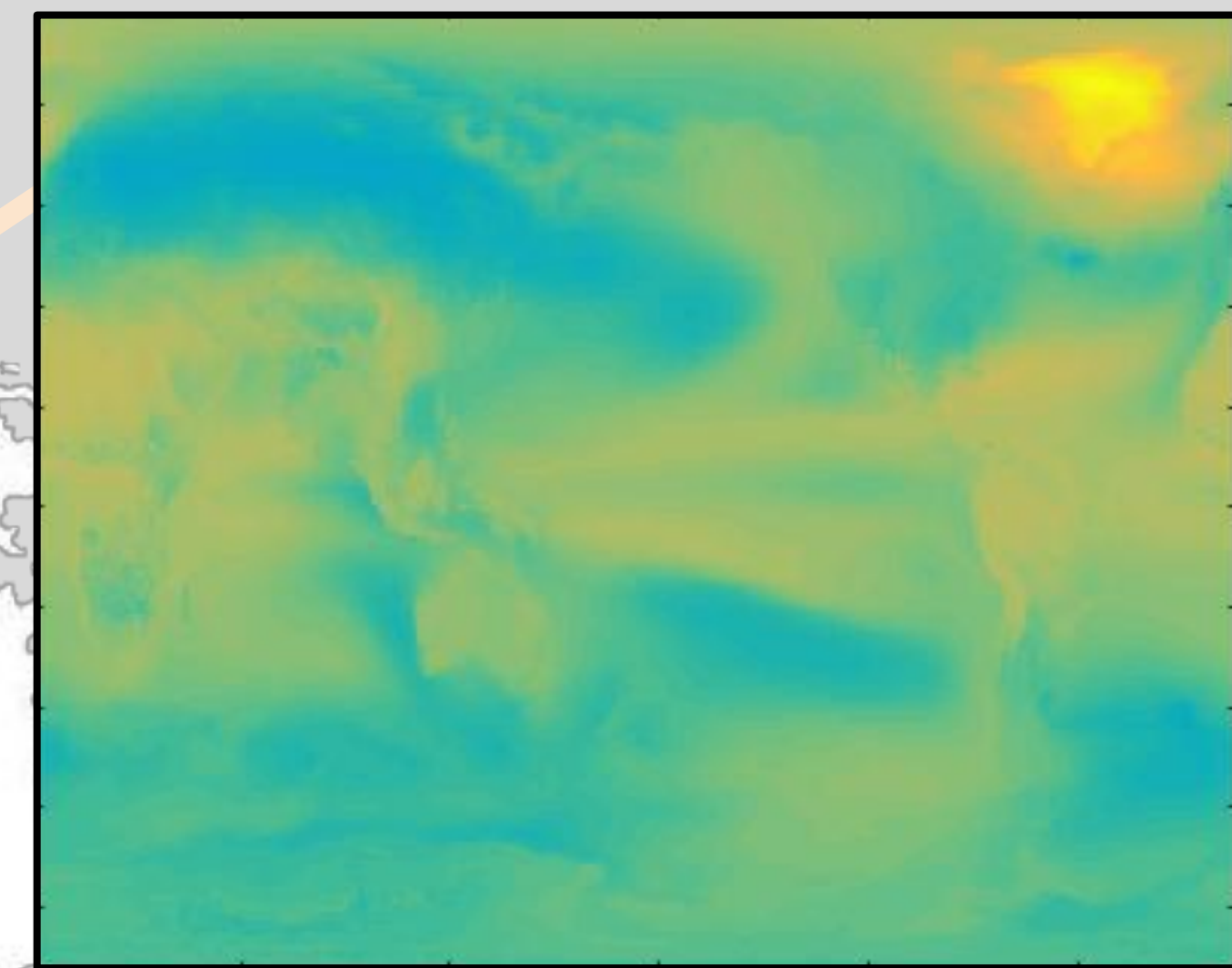
Annual Resolution

Decadal Resolution

Figure 1: using _climate model temperature data_ over the last 1,000 years, this map shows annual correlation vs. distance from a location in central Greenland.
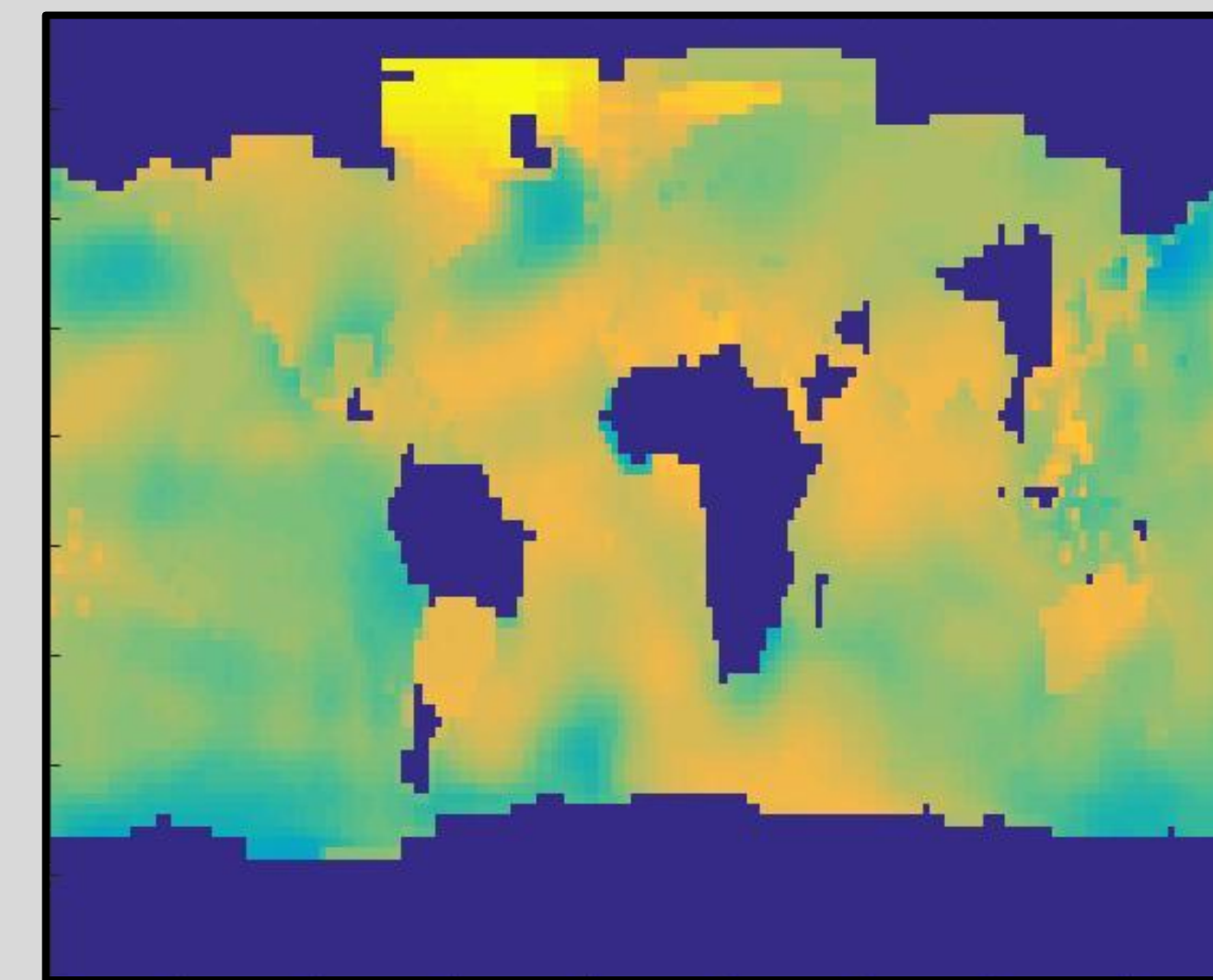
Figure 2: using _measured temperature data since 1800_, this map shows annual correlation vs. distance from a location in central Greenland.
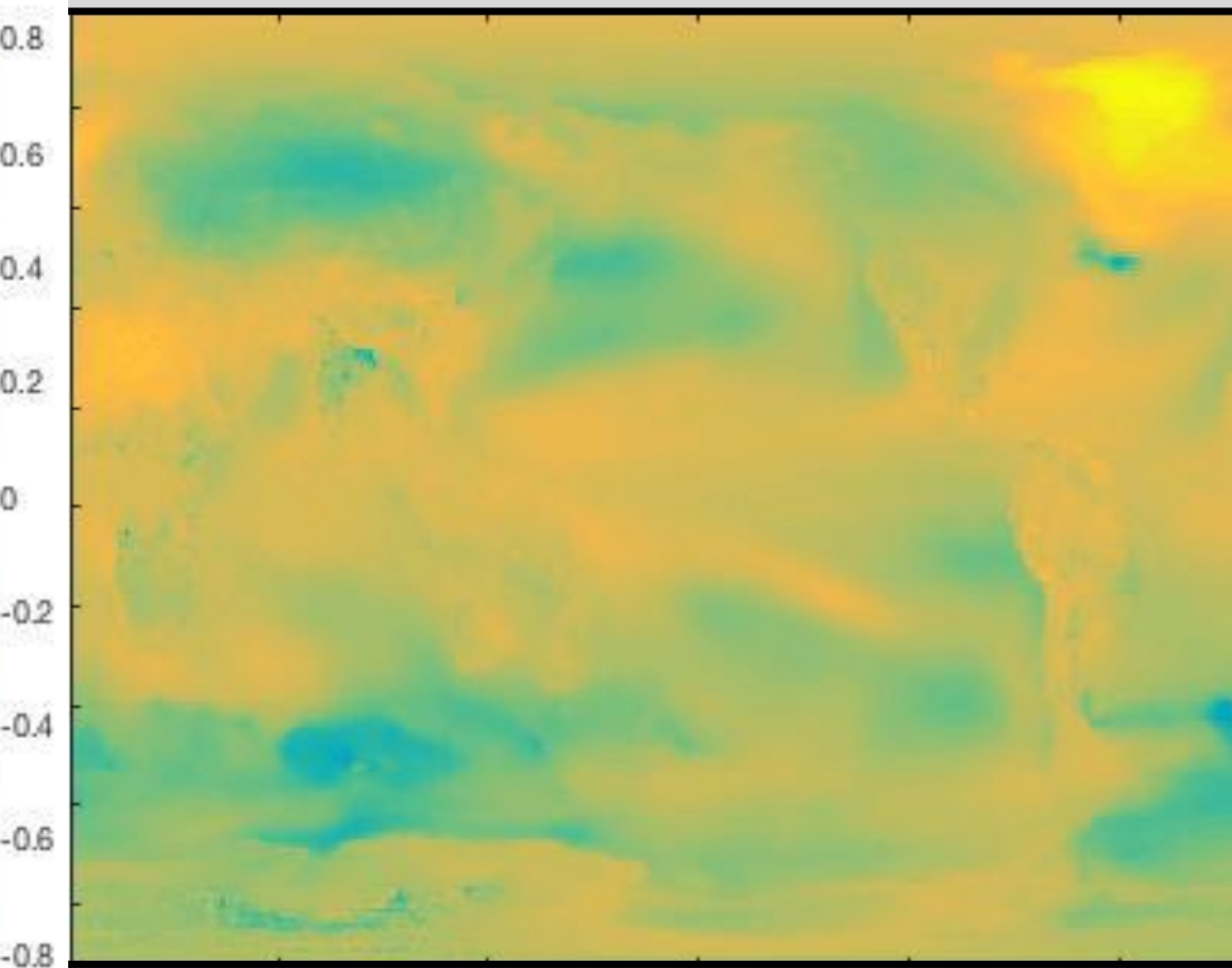
Figure 3: using c_limate model temperature data_ over the last 1,000 years, this map shows decadal correlation vs. distance from a location in central Greenland.
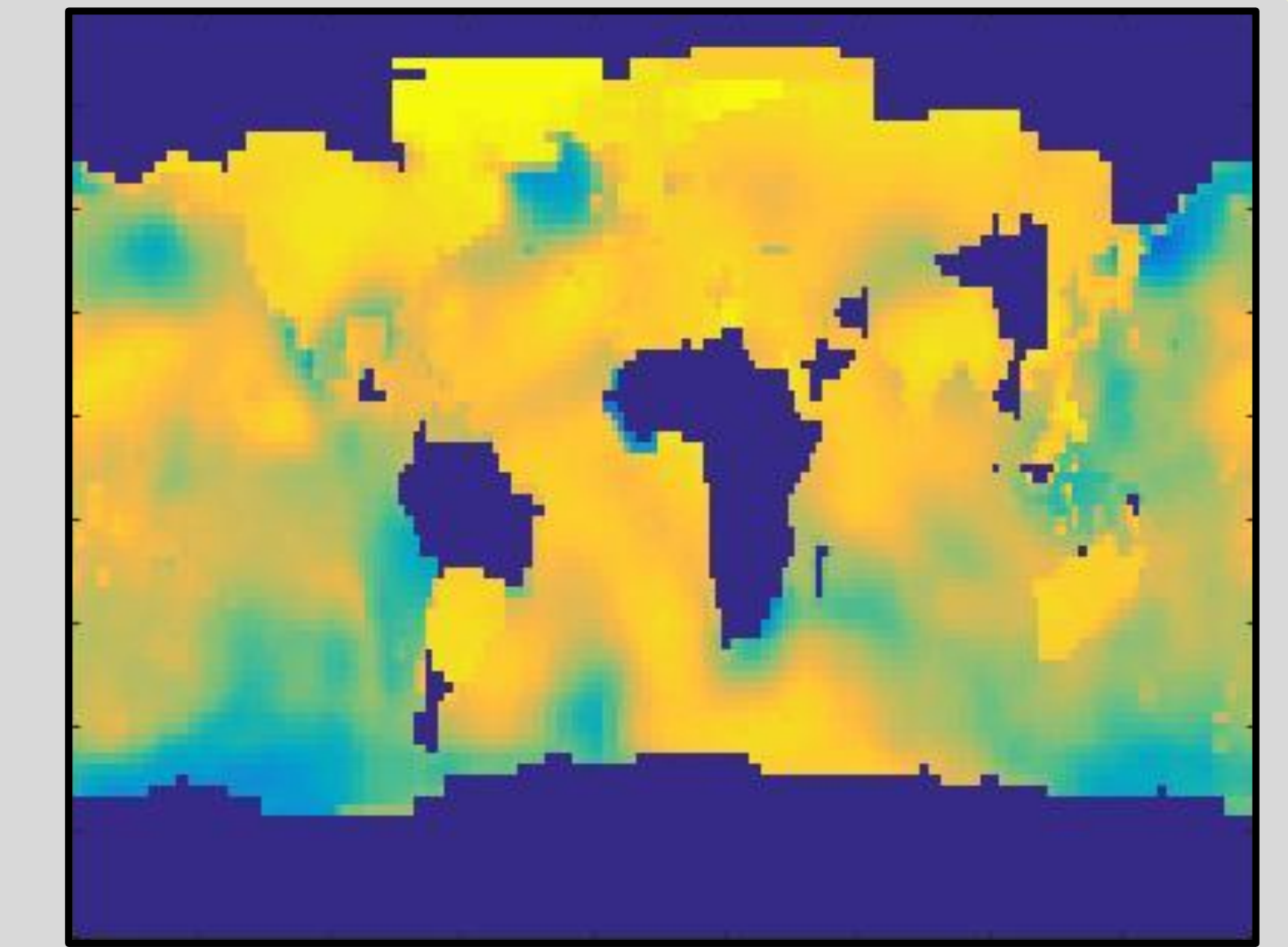
Figure 4: using _measured temperature data since 1800_, this map shows decadal correlation vs. distance from a location in central Greenland.
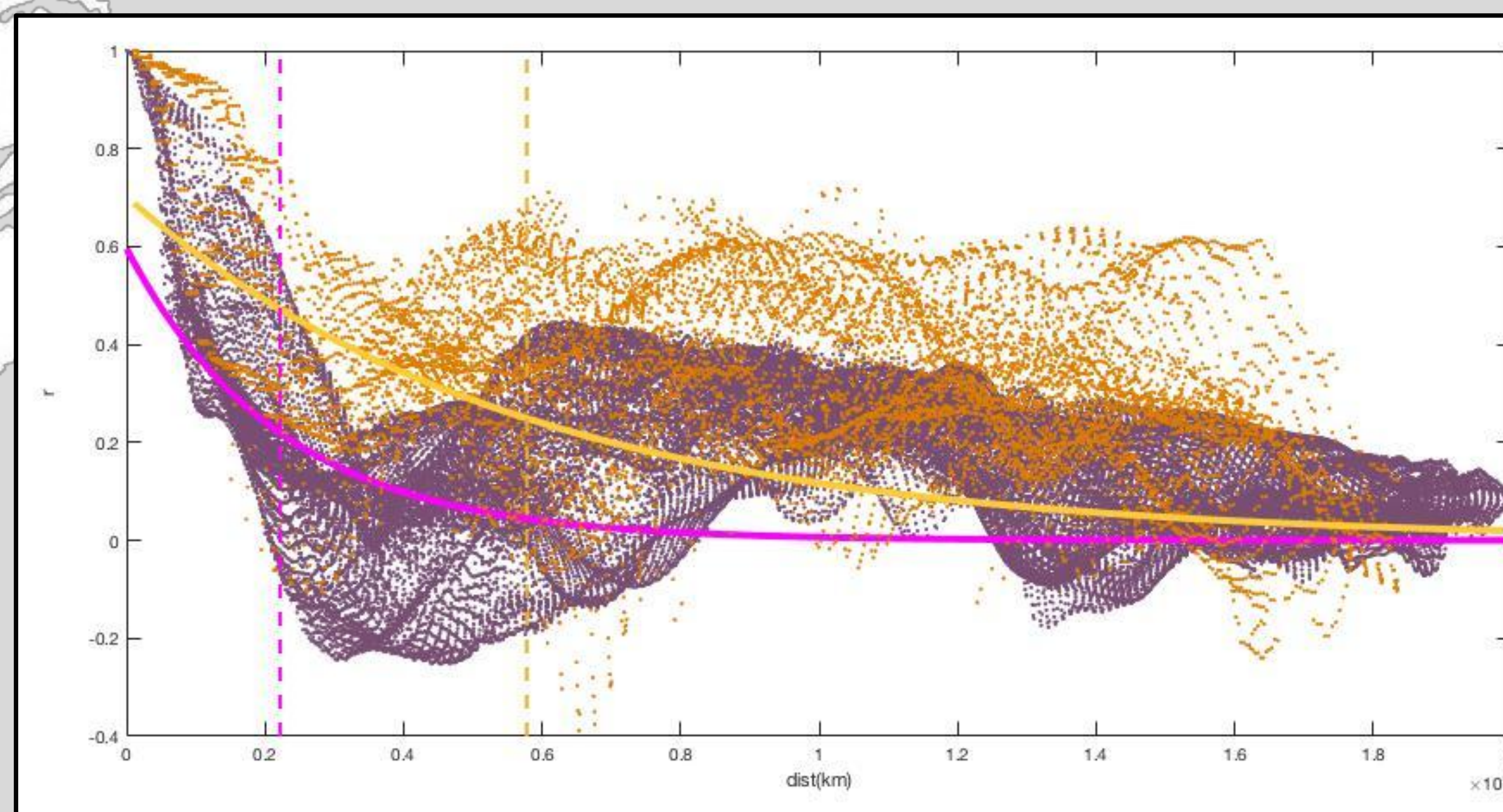
Figure 5: the plotted values represent the annual correlation (r) for all locations around the globe to the chosen site in central Greenland ("drilled" ice core) for figure 1 (shown in purple) and for figure 2 (shown in orange). The corresponding exponential functions are first-order representations to quantify the data trends using all positive r values and all distances within 5,000 km of the chosen site. The dashed lines represent the corresponding e-folding distances for each data set.
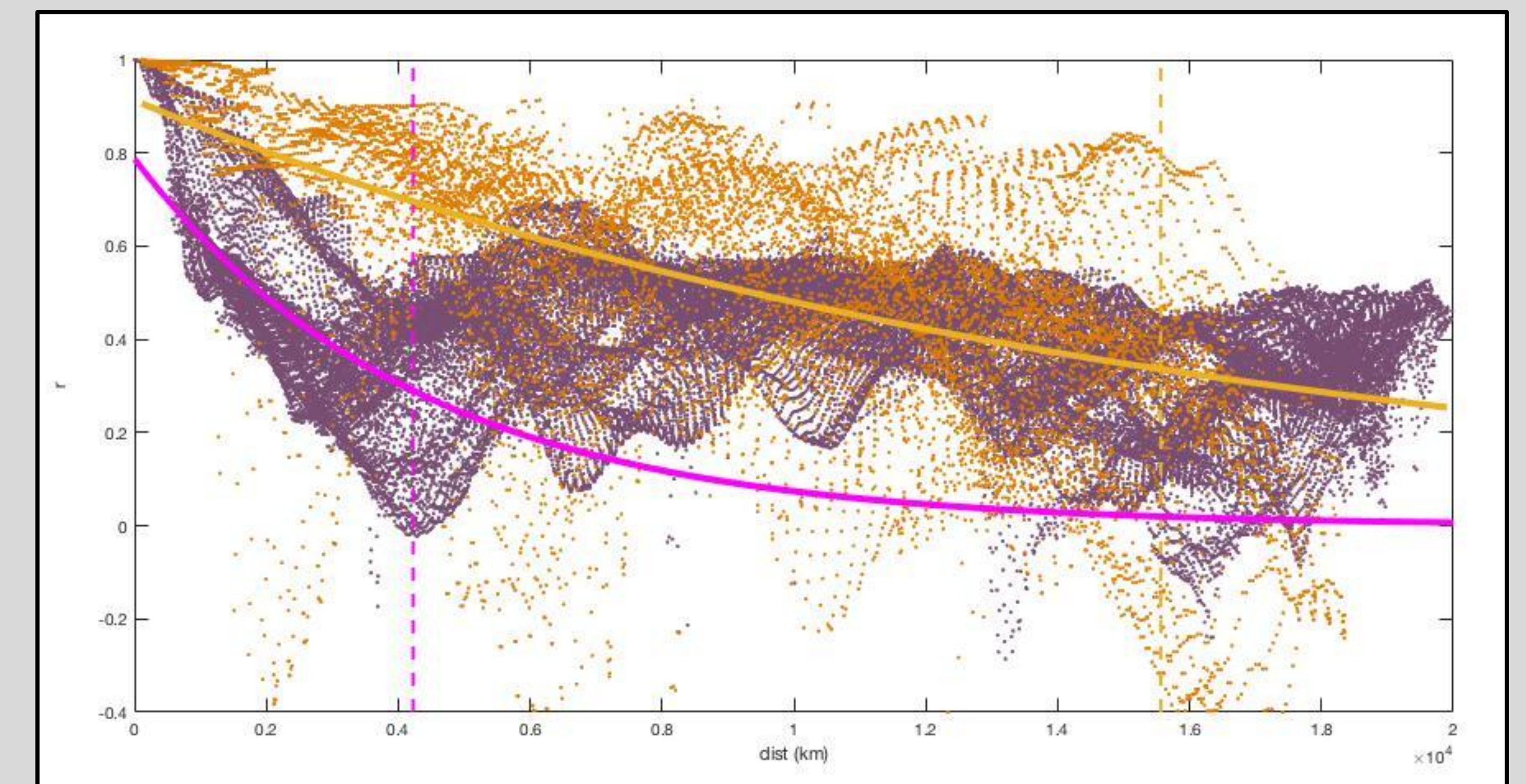
Figure 6: the plotted values represent the decadal correlation (r) for all locations around the globe to the chosen site in central Greenland ("drilled" ice core) for figure 3 (shown in purple) and for figure 4 (shown in orange). The corresponding exponential functions are first-order representations to quantify the data trends using all positive r values and all distances within 5,000 km of the chosen site. The dashed lines represent the corresponding e-folding distances for each data set.

6. Takeaways

• e-folding distances similar to Rossby radius: length-scale over which atmospheric systems are influential
• e-folding distance for climate model is smaller than for modern observations: _are climate models properly capturing true spatial characteristics?_

7. Moving Forward

PAGES2k 2.0.0 (692 records from 648 sites)
Archive types

bivalve (1)
borehole (3)
coral (96)
documents (15)
glacier ice (49)
hybrid (1)
lake sediment (42)
marine sediment (58)
sclerosponge (8)
speleothem (4)
tree (415)