

# Remapping gridded data using Artificial Intelligence: real world challenges

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# Overview

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- Introduction
- Map overlay problem
  - Current solution methods
  - Proposed solution method
- Real world challenges
  - Technical / algorithmical
  - Data related
- Conclusion

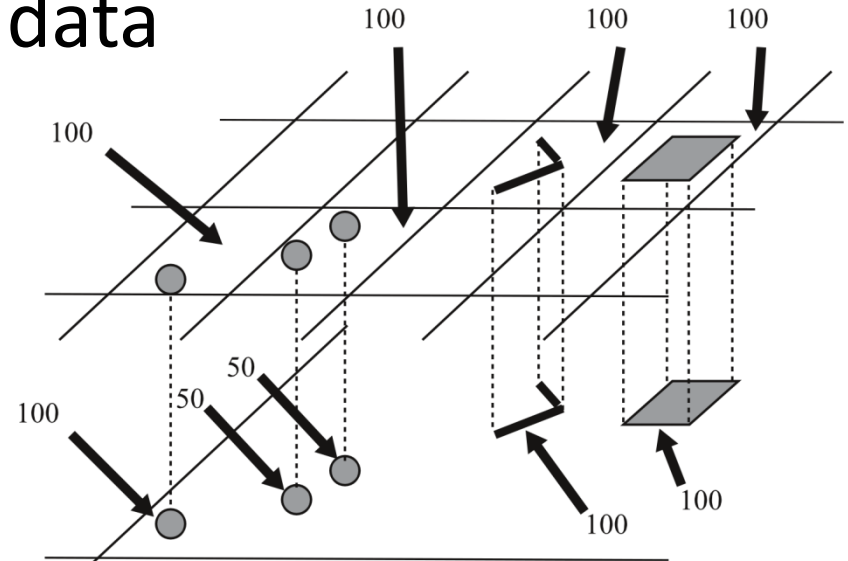
# Introduction

- Geographically related data

- Emission data, ....
- Represented in grids
- Numeric value per cell

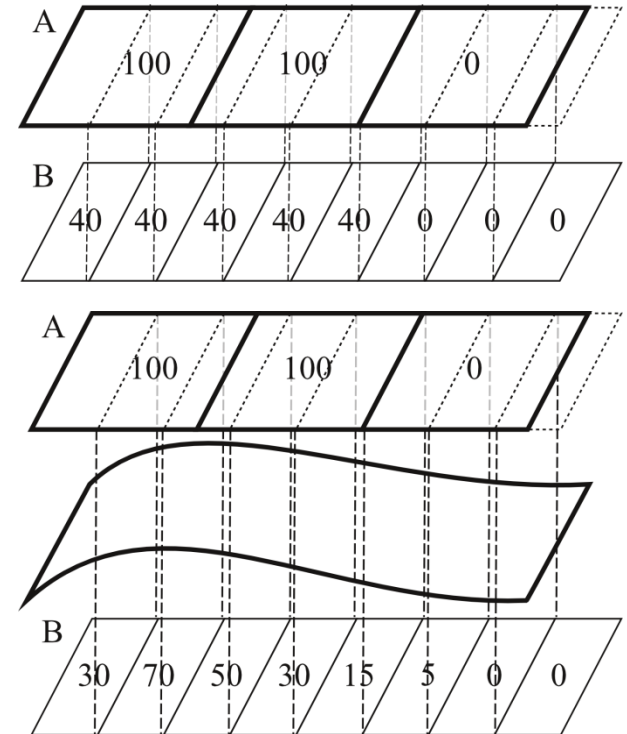
- Grids

- Discretisation of 2D space
  - Approximation
  - No knowledge of the distribution within a grid cell



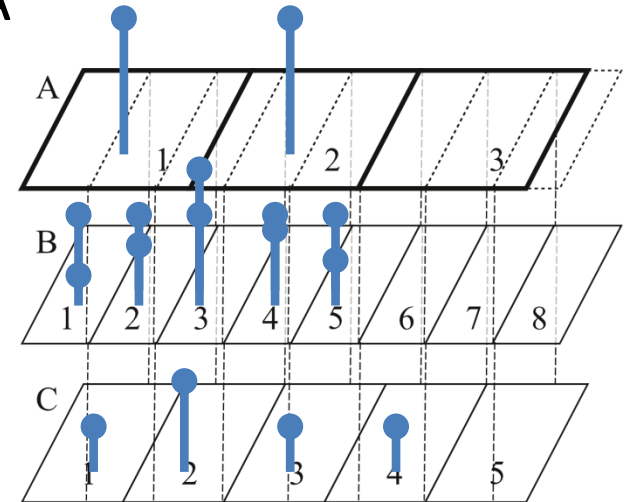
# Current approaches

- Assumption on the distribution
  - Areal weighting
    - Overlapping area = portion of data
  - Spatial smoothing
    - Smooth surface fitted  
resampled
  - Spatial regression
    - Relation between grids assumed
- Grid remapping increases the uncertainty of the data



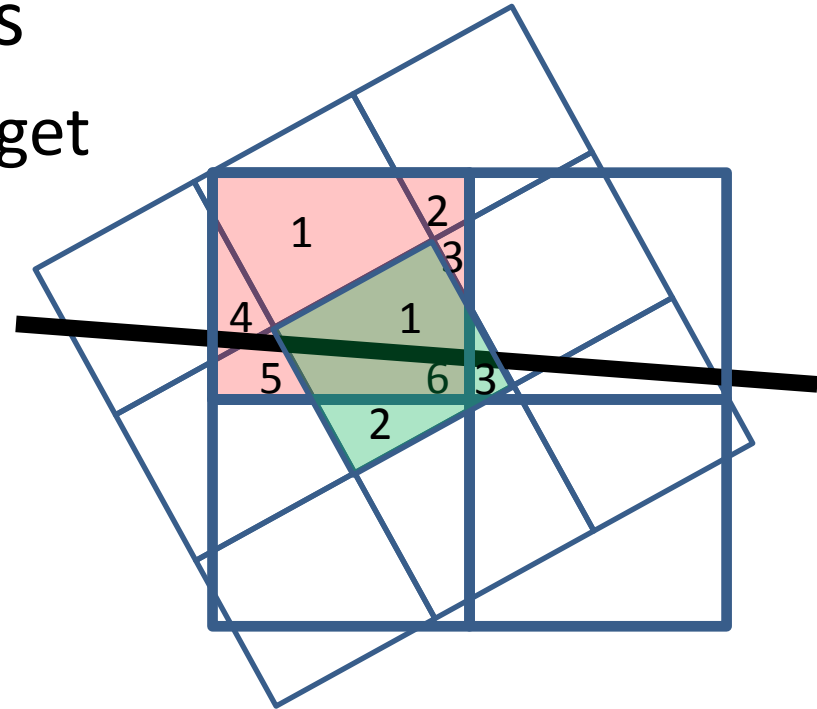
# Rulebase approach

- Intuitive; requires additional knowledge
  - Use additional knowledge to redistribute data
    - High value in C => high value in A
  - Intuitive approach
    - IF  $A_1 = A_2$  AND  $C_2 > C_1, C_3, C_4$
    - THEN  $B_3 > B_2, B_4 > B_1, B_5$
  - Problems
    - Results not necessarily unique
    - Should comply with input data



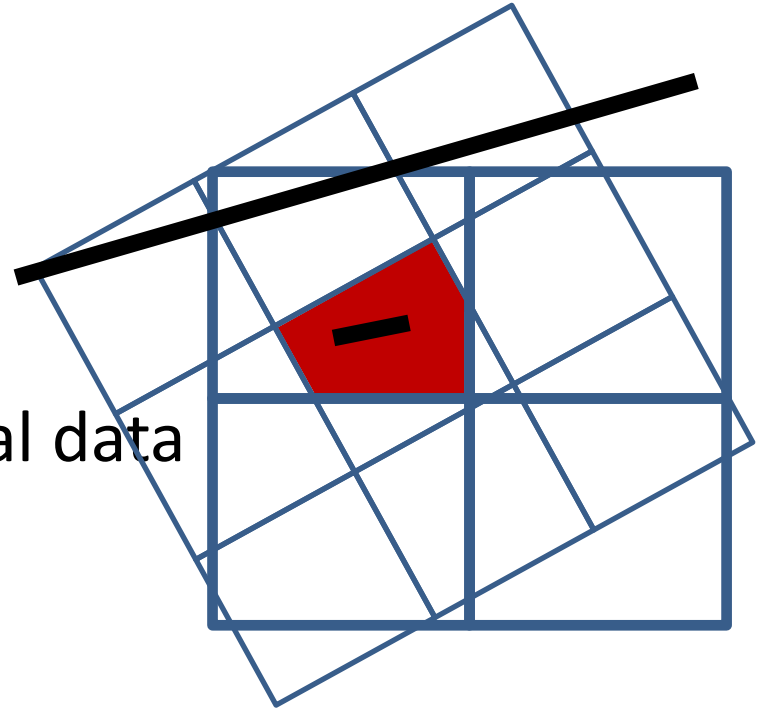
# Rulebase approach

- Ill-aligned grids: segments
  - Intersection of input & target
  - Problem translates to
    - redistribution per cell
    - recombination of segments
- Preprocessing step
  - Determine segments
    - non-standard irregular grid

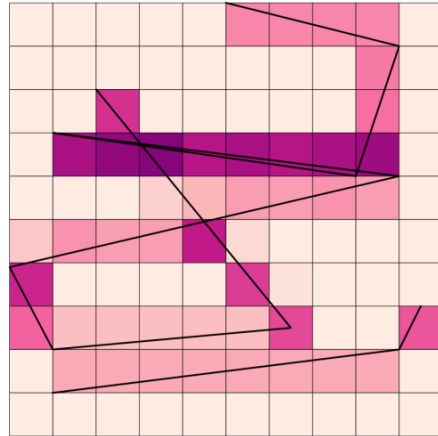


# Rulebase parameters

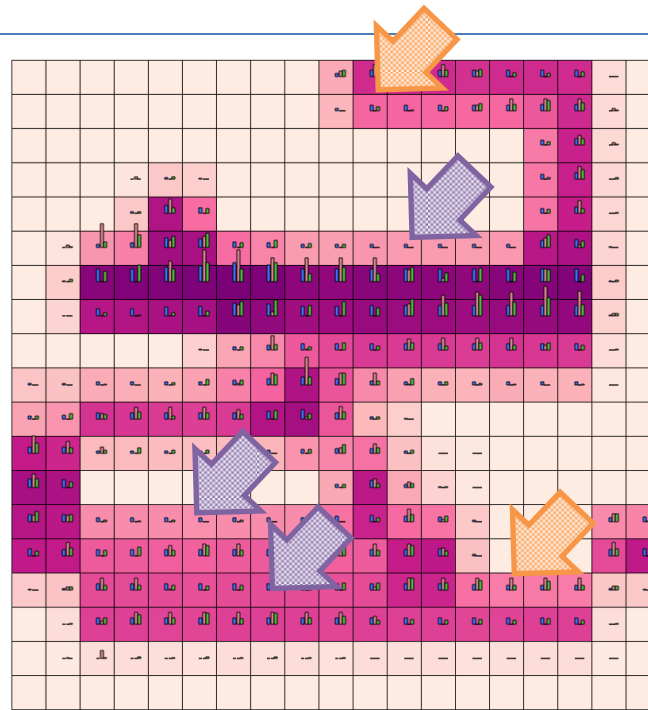
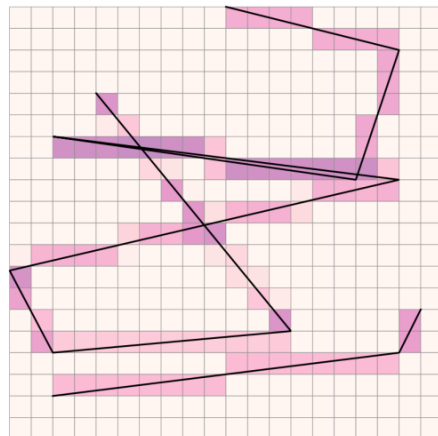
- Rules: if x is A then y is B
  - $A \in \{ \text{low, medium, high} \}$
  - $B \in \{ \text{low, medium, high} \}$
- Parameters x
  - e.g. overlap with additional data
    - Value = weighted value
    - Limits? Fuzzy sets?
      - Min = 0
      - Max = value of data



# Example

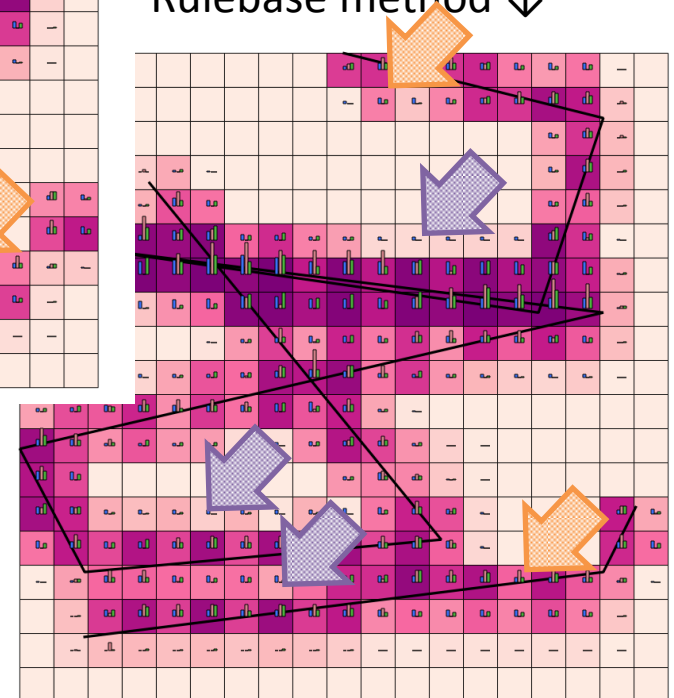


Input ↑ auxiliary ↓



← Areal weighting

Rulebase method ↓

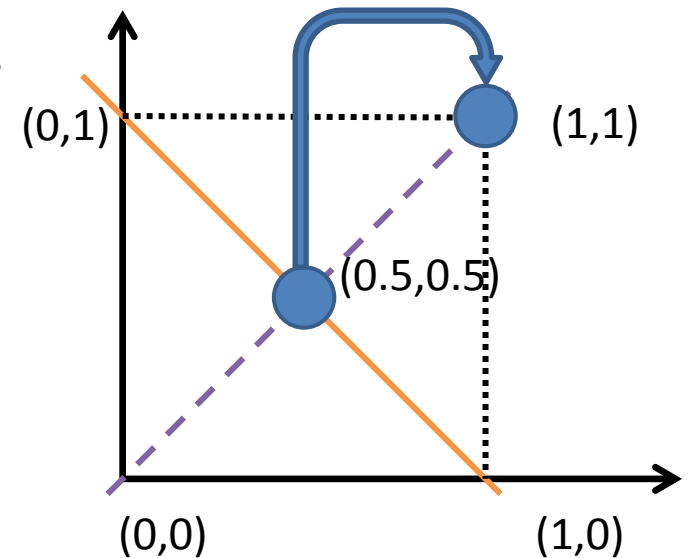
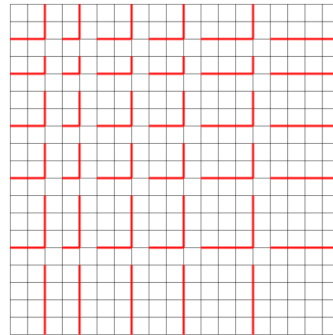




# Real-world challenges

## – Rounding errors

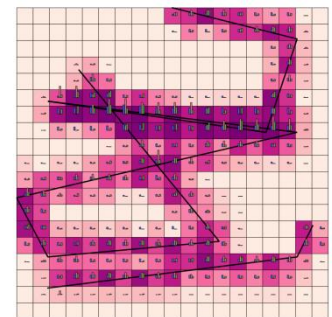
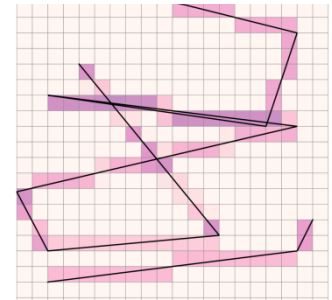
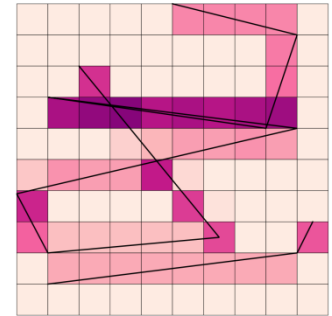
- Numerical representation (IEEE754 double: 8 bytes)
  - 15-17 significant decimals
- Limits representing coordinates
  - Problem: inconsistent topology



- Solution: detect and control in implementation

# Real world challenges

- Parameter definitions
  - Value, low limit, high limit
    - Meaningfull, relevant
    - Different for most gridcells
- Relative grid positions
  - Different relative grids require other parameters
    - Current parameter for overlap with auxiliary is not suitable for disaggregation
    - Detect best parameters for situation
- Additional data is necessary

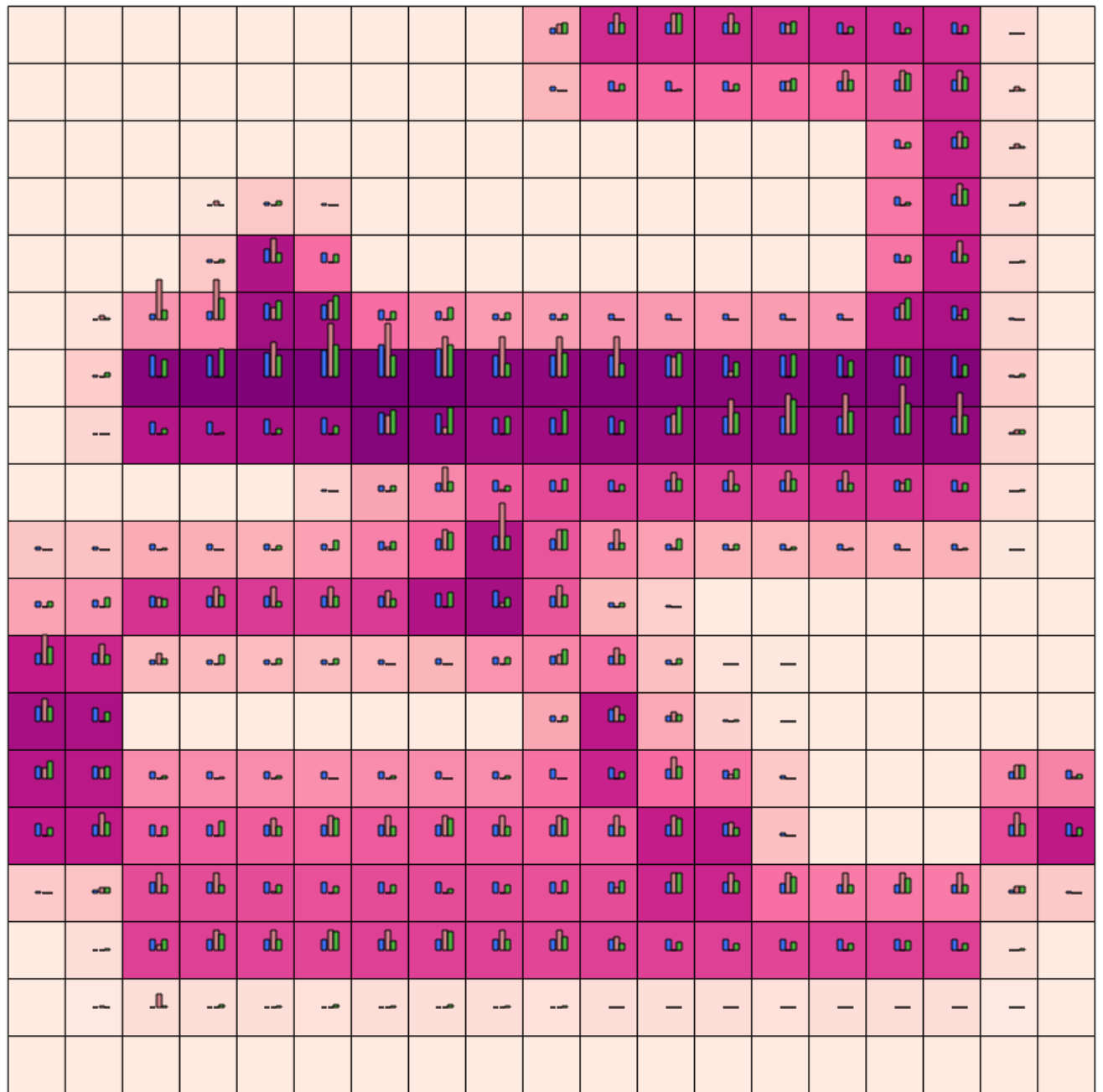
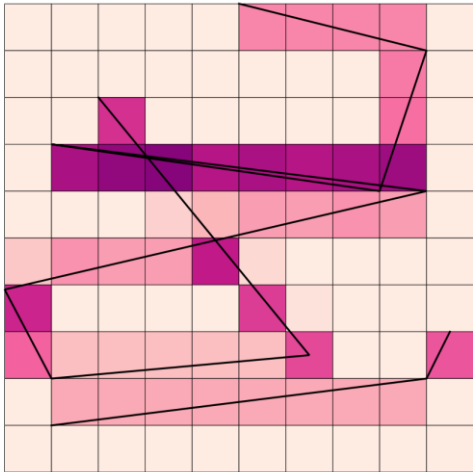


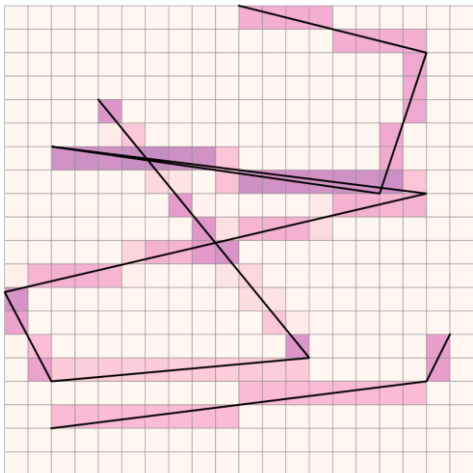
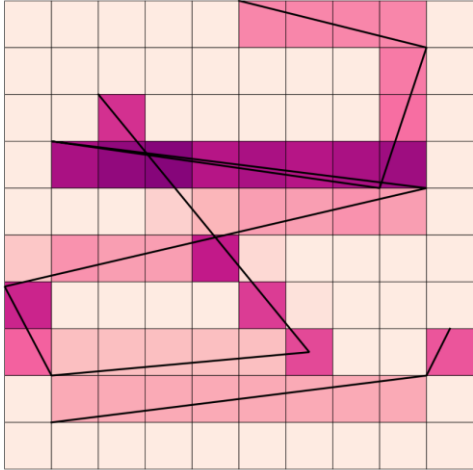
# Conclusion

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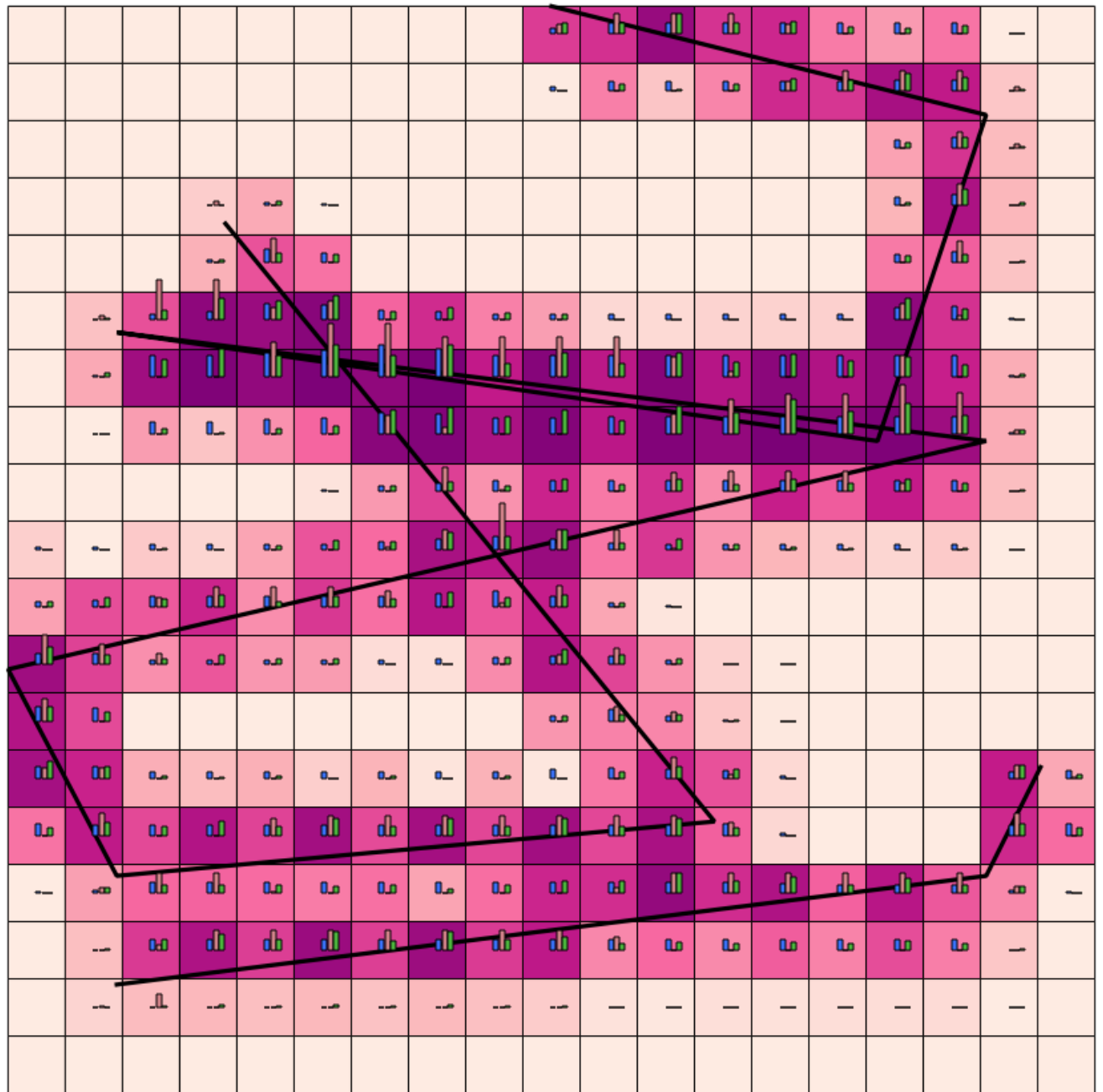
- Novel methodology for grid remapping
  - Shows interesting theoretical behaviour
  - Application in the real world poses challenges
    - New research targets
    - Initial tests on real data are ongoing and show promising results

# Areal weighting





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