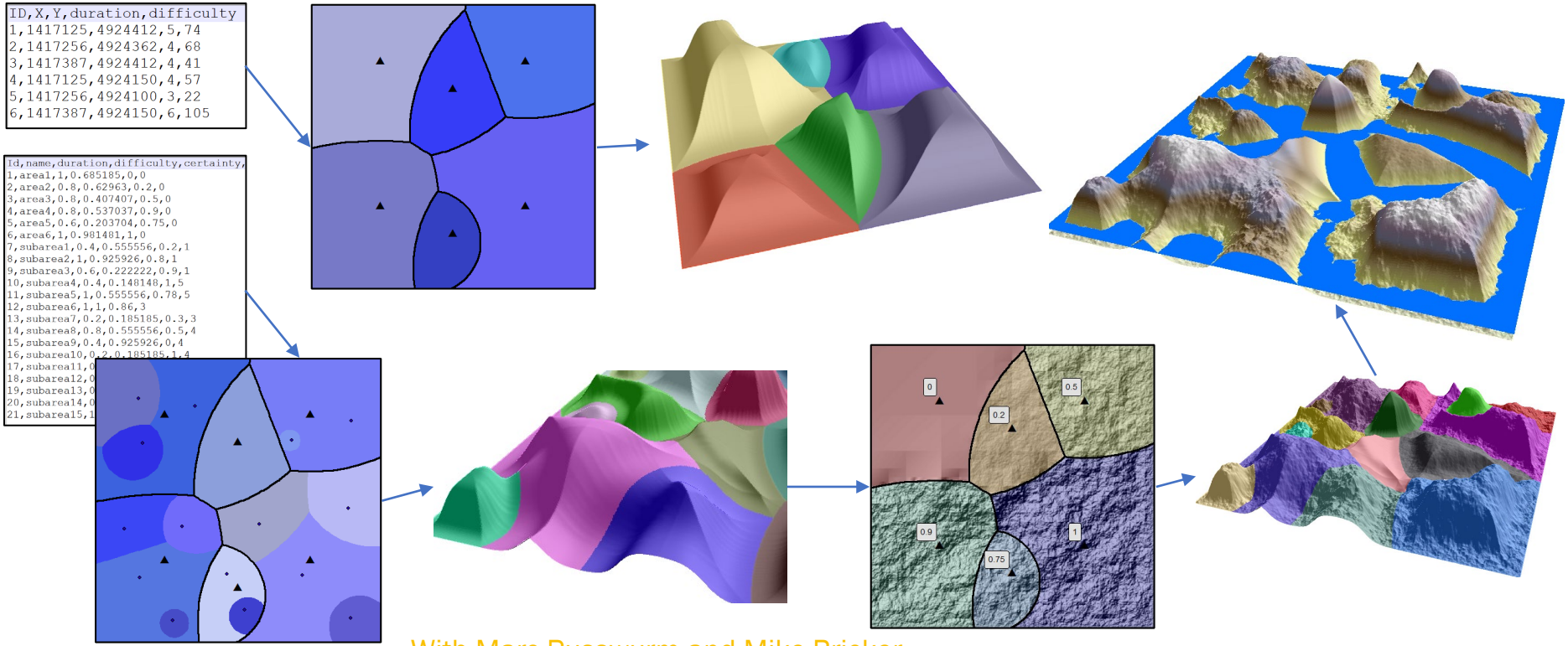
UNIVERSITY of OTĀGO
Te Whare Wānanga o Otāgo
NEW ZEALAND
SAPERE AUDE

Towards a Plausible Geomorphological Spatialisation of Graph Data

Antoni Moore | 4th November 2022 | AutoCarto 2022

Example spatialisation:

Non-spatial data: time is area; difficulty is height; certainty is roughness



With Marc Russwurm and Mike Bricker

Overview

- An exercise in using naïve geomorphological process and landform knowledge to synthesise non-spatial phenomena
  - Application and data context (the Dunedin music scene 1977-1993)
  - Exploration of two geomorphologically plausible algorithms to construct the spatialisation
    - Orogenesis (mountain building)
    - Young volcano
  - Concluding thoughts

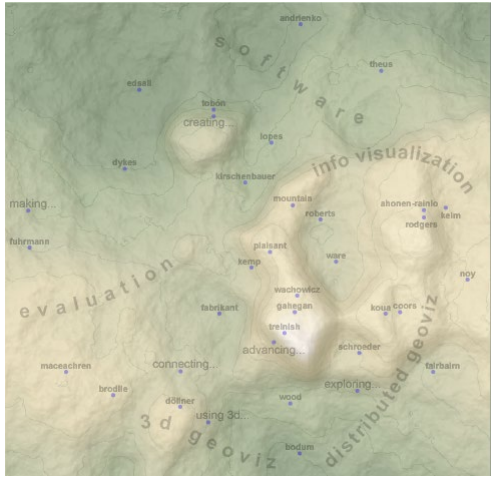
Traverse from the abstract towards the map (and landscape)

- "…a data transformation…based on spatial metaphors… generating cognitively adequate graphic representations."

  Fabrikant and Skupin

- Content of news stories and book chapters are communicated through our naïve familiarity with landscapes and maps

continuous density surface (from points)

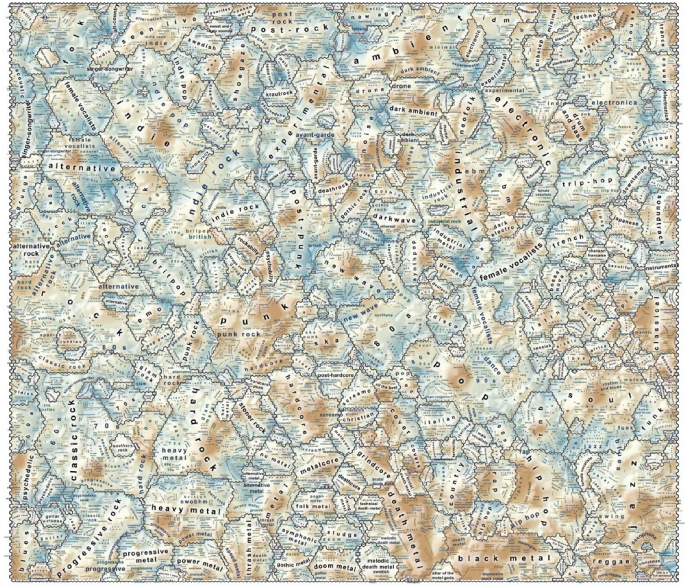


Spatialisation

- Applications of spatialization
  - Often large corpuses of documents
- Benefits of spatialization
  - Mining hidden space, time and attribute relationships
- How spatialization works
  - Usually employs map or landscape visual metaphors
  - Needs to be cognitively plausible
    - For landscapes and topographic maps that means geomorphologically (and/or geologically) plausible

Transformation techniques

- Self-Organising Map (SOM) then Cartogram
- SOM then Kernel Density Estimation
- Clustered Graph then Tree Mapping
- Force-Directed Graph then Multiplicatively-Weighted Voronoi



Biberstine et al 2012

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ID,X,Y,duration,difficulty
1,1417125,4924412,5,74
2,1417256,4924362,4,68
3,1417387,4924412,4,41
4,1417125,4924150,4,57
5,1417256,4924100,3,22
6,1417387,4924150,6,105
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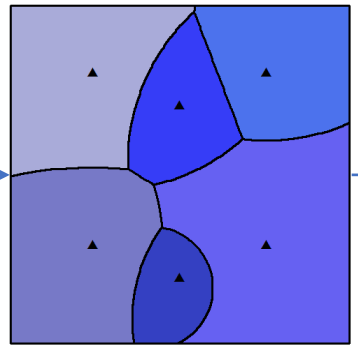
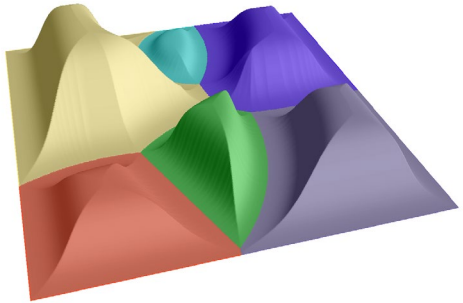


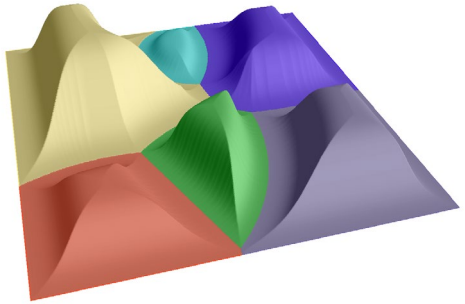


"Points"

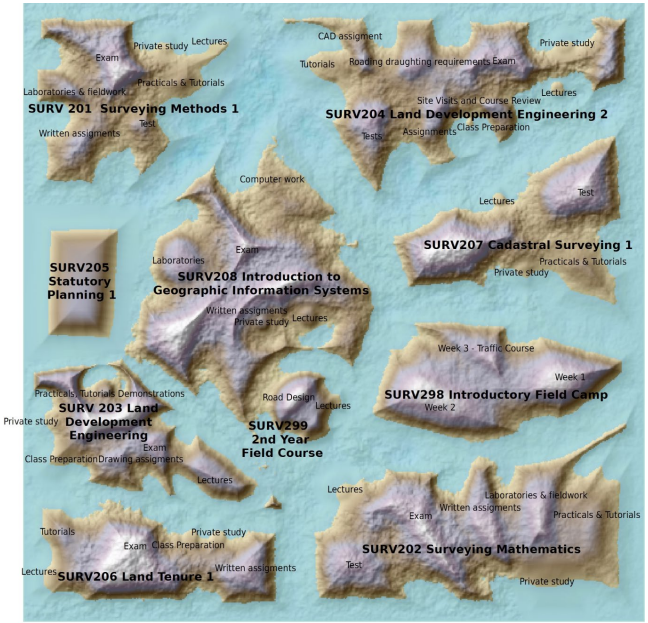
(arbitrary "location")

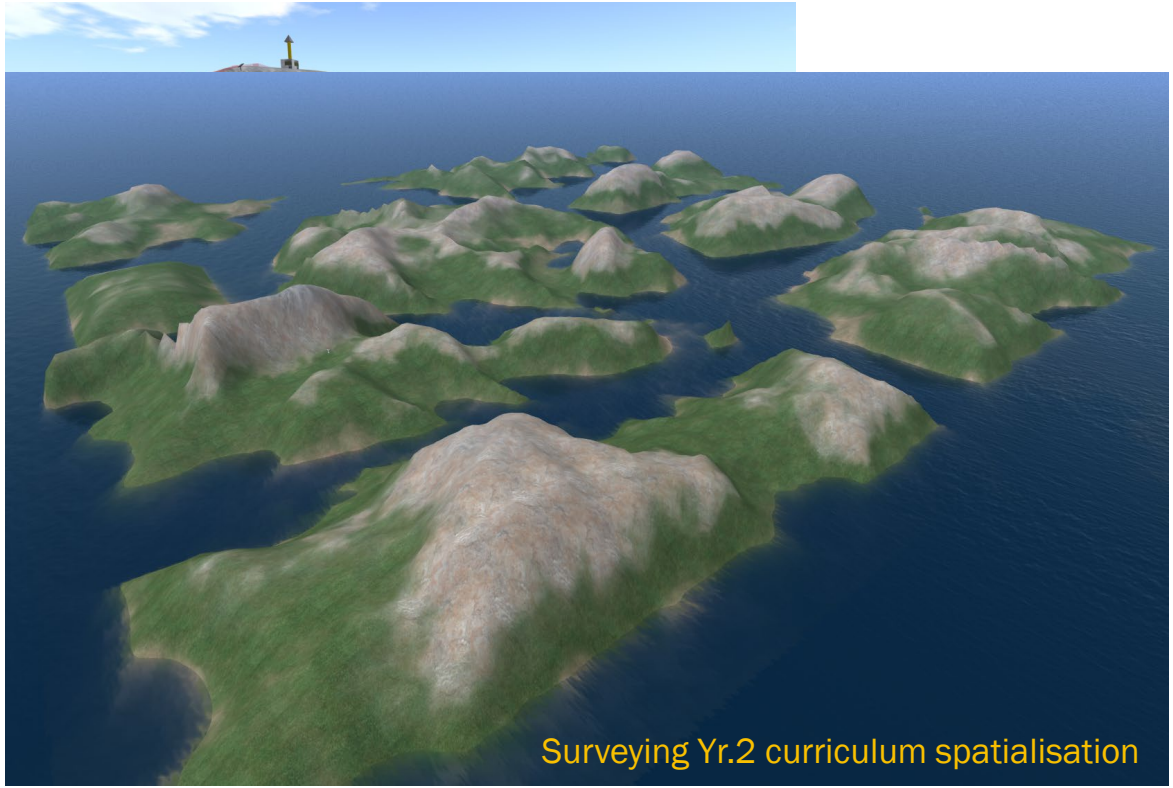
MW Voronoi

Sigmoidal profile

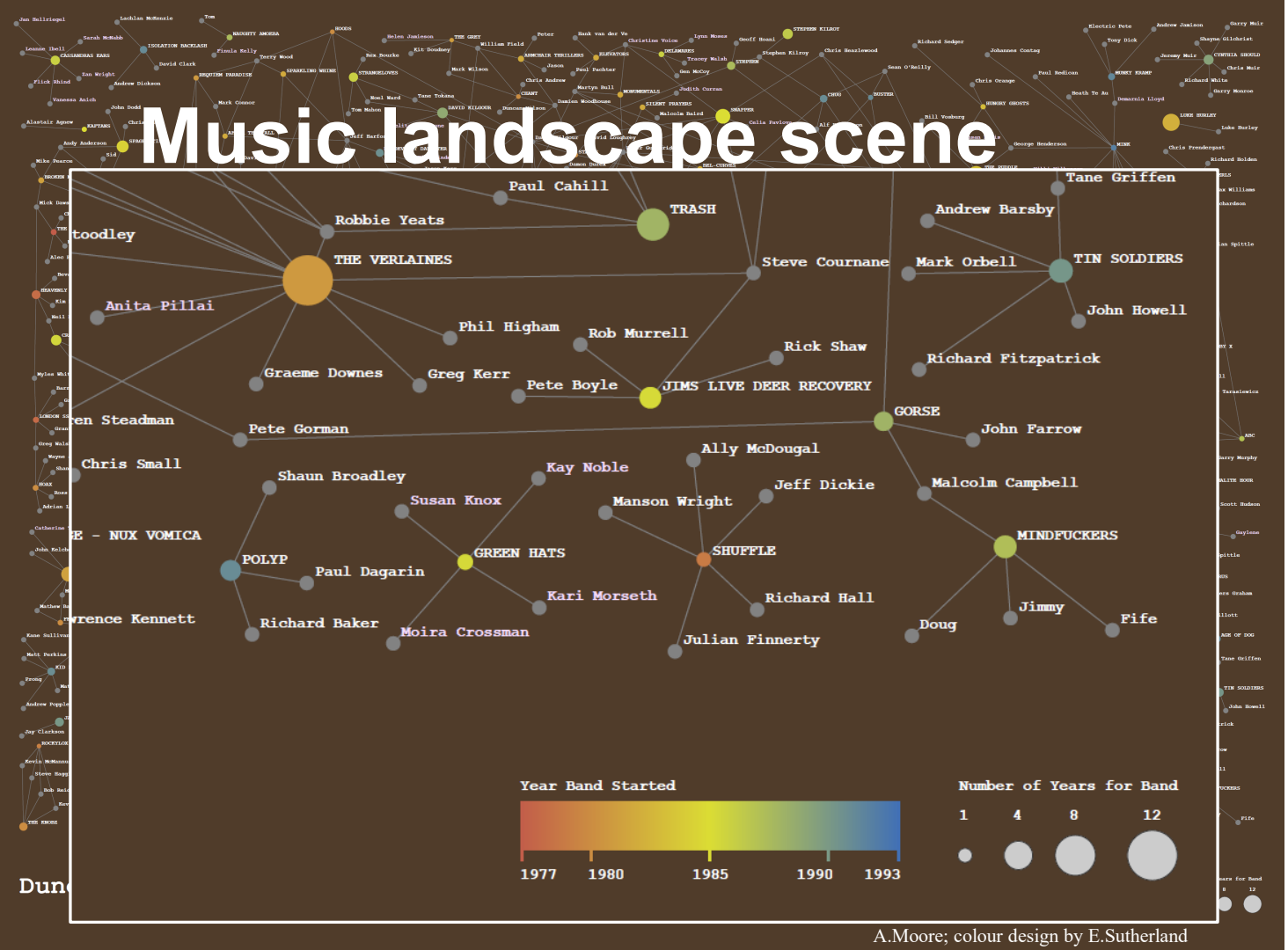


Curriculum spatialisation

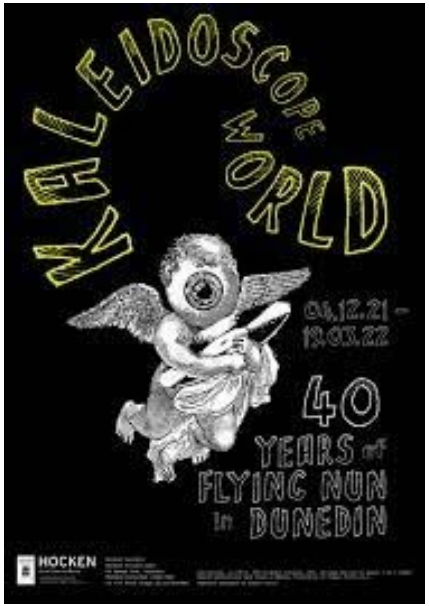




Music landscape scene



A.Moore; colour design by E.Sutherland



NZMS 1 (1979)

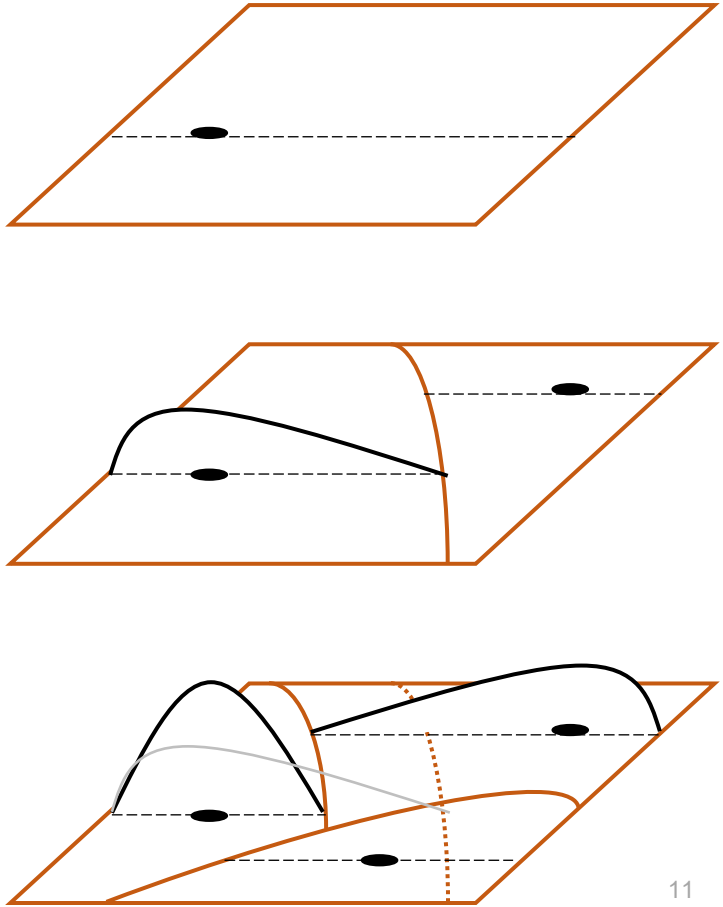
From mapspast.org.nz

Geomorphically-plausible spatialisation

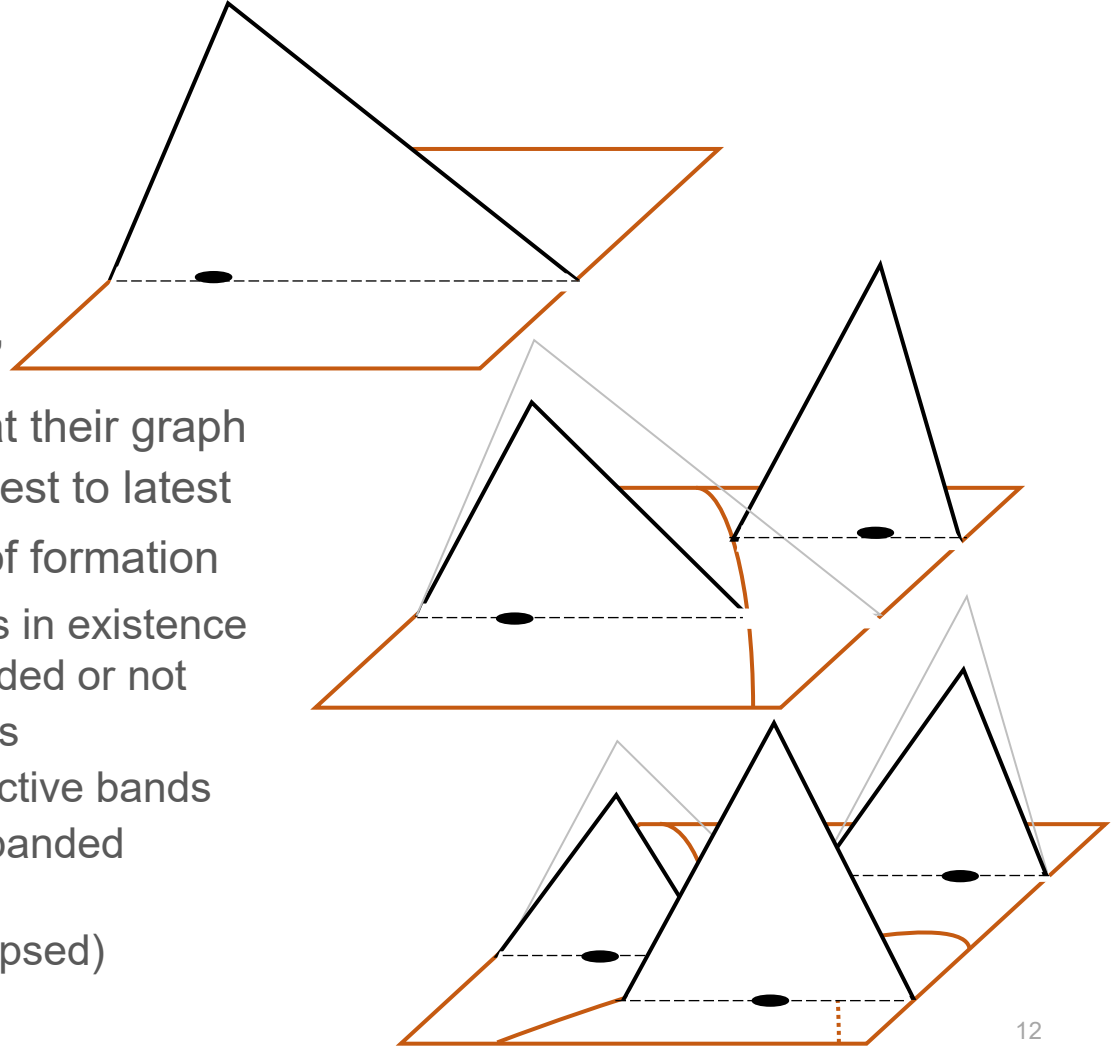
Mountain Building

“earlier is higher; duration is wider”

- Add bands as points at their graph location, one-by-one from earliest to latest
- For each added band at time of formation
  - MWV is calculated for all bands in existence before the current time, disbanded or not
  - Apply uplift and erosion (uplift > erosion) to all those bands
  - Apply spread to all active bands
  - Move bands from active to disbanded according to their end time
  - (uplift, erosion and spread ∝ time elapsed)



Young Volcano



“earlier is lower; duration is wider”

- Add bands as unit volcanoes at their graph location, one-by-one from earliest to latest
- For each added band at time of formation
  - MWV is calculated for all bands in existence before the current time, disbanded or not
  - Apply erosion to all those bands
  - Apply spread (eruption) to all active bands
  - Move bands from active to disbanded according to their end time
  - (erosion and spread ∝ time elapsed)

Summary

- Spatialisation is a powerful way of expressing non-spatial phenomena
  - A spatialisation based on geomorphological landform and process knowledge held at a naïve level
  - Feedback from the music application to the action of the visual metaphor via a shared creativity
- Naïve geomorphological solutions are needed to broaden understanding
  - A couple of examples have been presented but a naïve ontology of geomorphology ultimately needs to be defined
  - Also, does the linking network between band peaks and musician ‘settlements’ work according to a separate visual metaphor?
- Promise of revealing insights into application data BUT there needs to be a phase of testing
  - Including usability assessment of the shared geomorphological knowledge base between developer and user

Thanks – any questions?

Thanks also to: Alexander Kent, Kenneth Field, Linda Beale, Marc Russwurm, Mike Bricker, Ella Sutherland, Amanda Mills, Katherine Milburn, Neil Lowe