BR*aid*2017

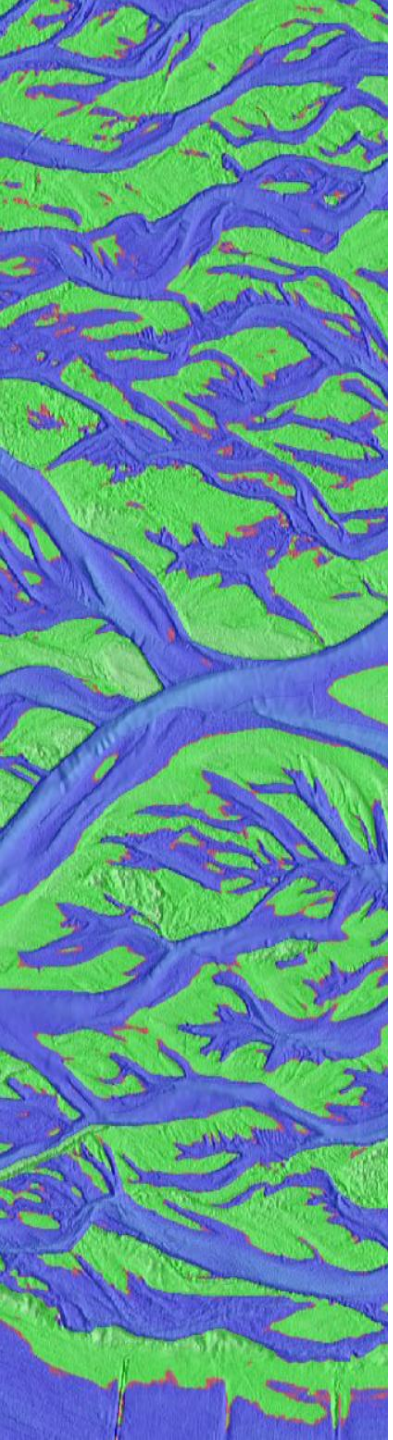
The effects of vegetation on braided rivers

Jo Hoyle[1]
Murray Hicks[1]
Guglielmo "Gu" Stecca[1, 2]
Davide Fedrizzi[2]
Michal Tal[3]

[1] NIWA, Christchurch, New Zealand
[2] University of Trento, Italy
[3] CEREGE – University of Aix-Marseille, France

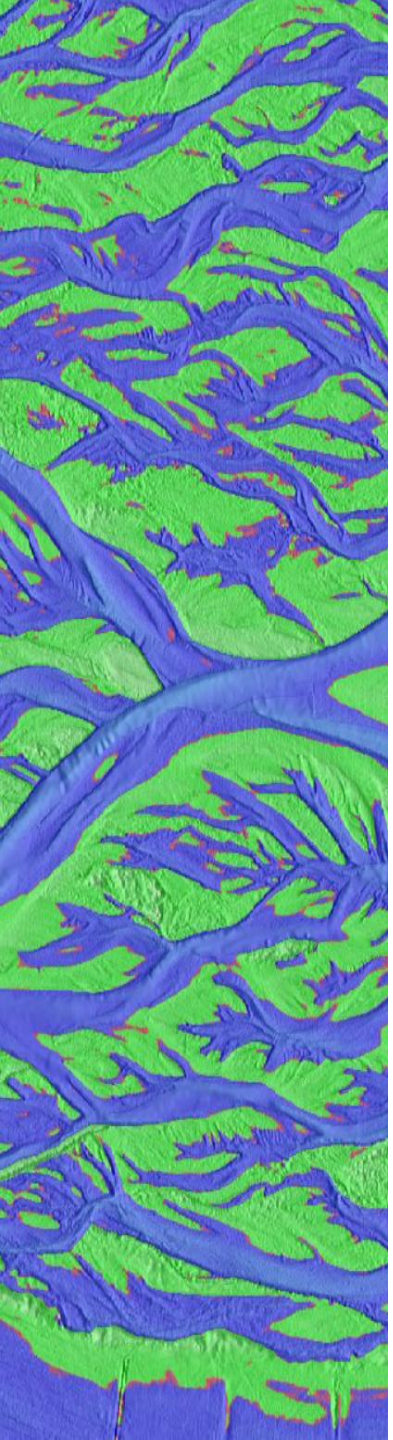
NIWA
Taihoro Nukurangi

Photo – Rakaia River
Satellite Imaging Corporation



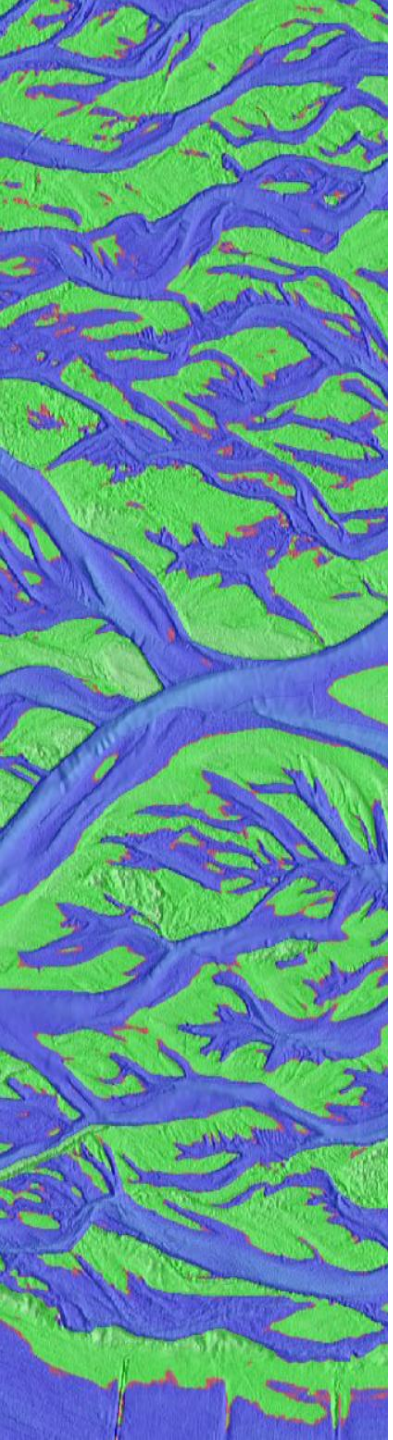
Outline

- Geomorphic background
  - Causes & characteristics of braiding
  - Controls on braiding
- The geomorphic effects of vegetation
- Examples of riparian vegetation effects
  - Waitaki case study – floods versus vegetation
  - Physical model of vegetation in braided rivers
  - 2D Numerical model of vegetation in braided rivers
- Summary



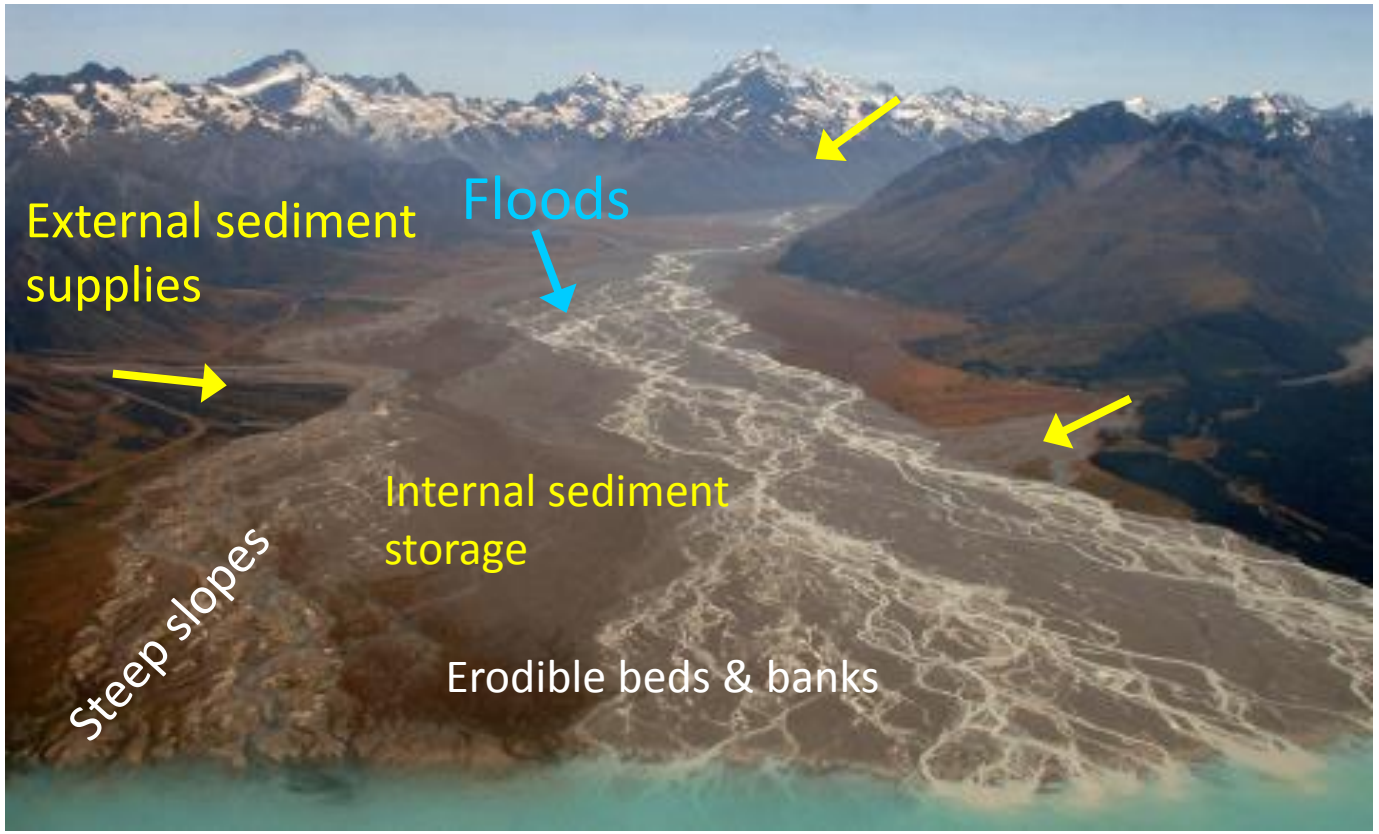
Causes & characteristics of braiding

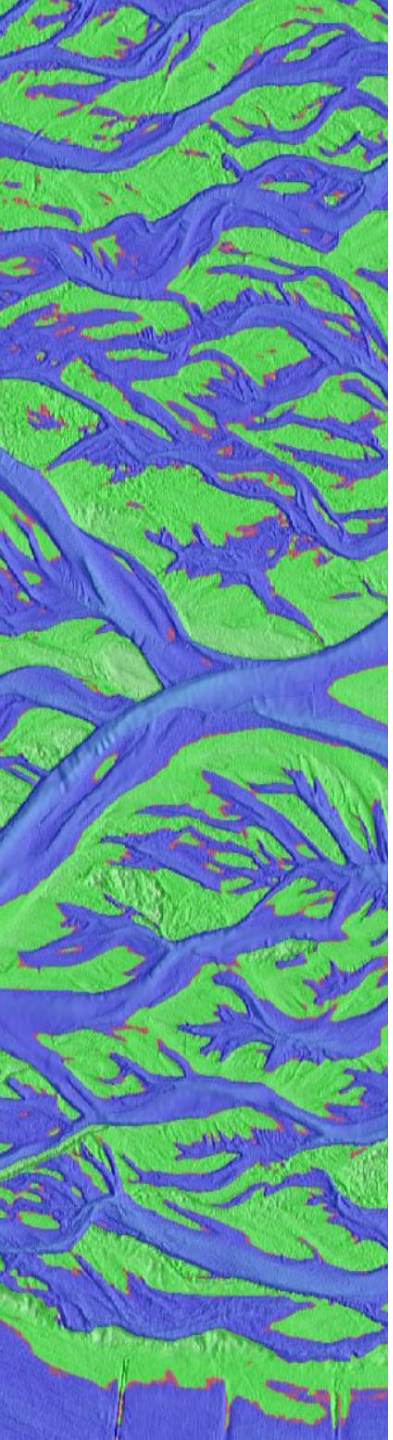
- Flows picking up sediment and dropping it in a chaotic process
- Erosion processes
  - bank erosion
  - Scour in flow-convergence zones
- Depositional processes
  - Side, centre bar deposition
- Migrating bedforms
  - Gravel lobes
  - Gravel sheets
- Avulsions
- Recession features

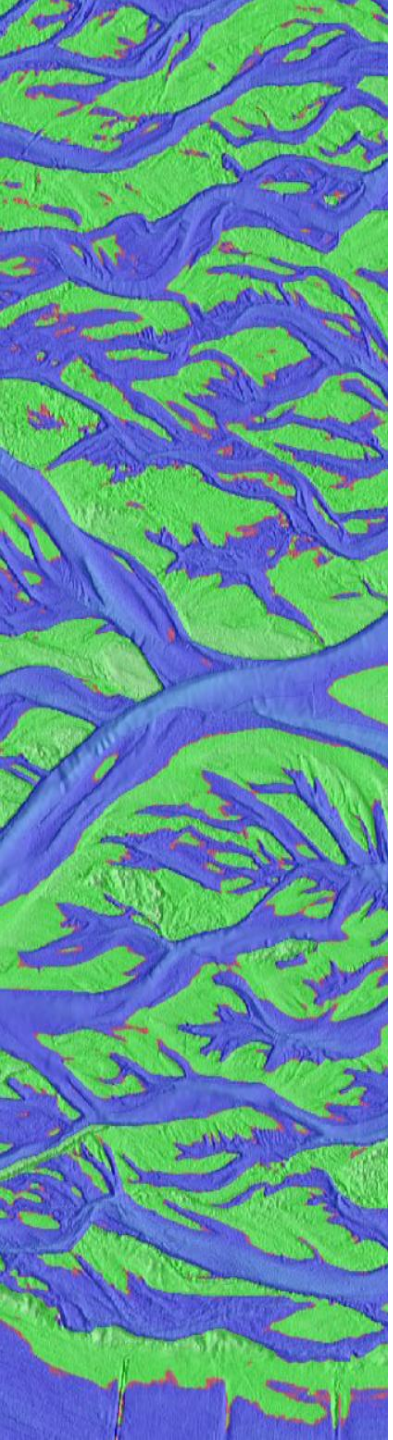


Controls on river braiding

- Adequate supply of sandy/gravely bed-material
- Floods (& channel) slopes competent to move bed-material & erode banks
- Space to occupy
- Erodible bed and banks

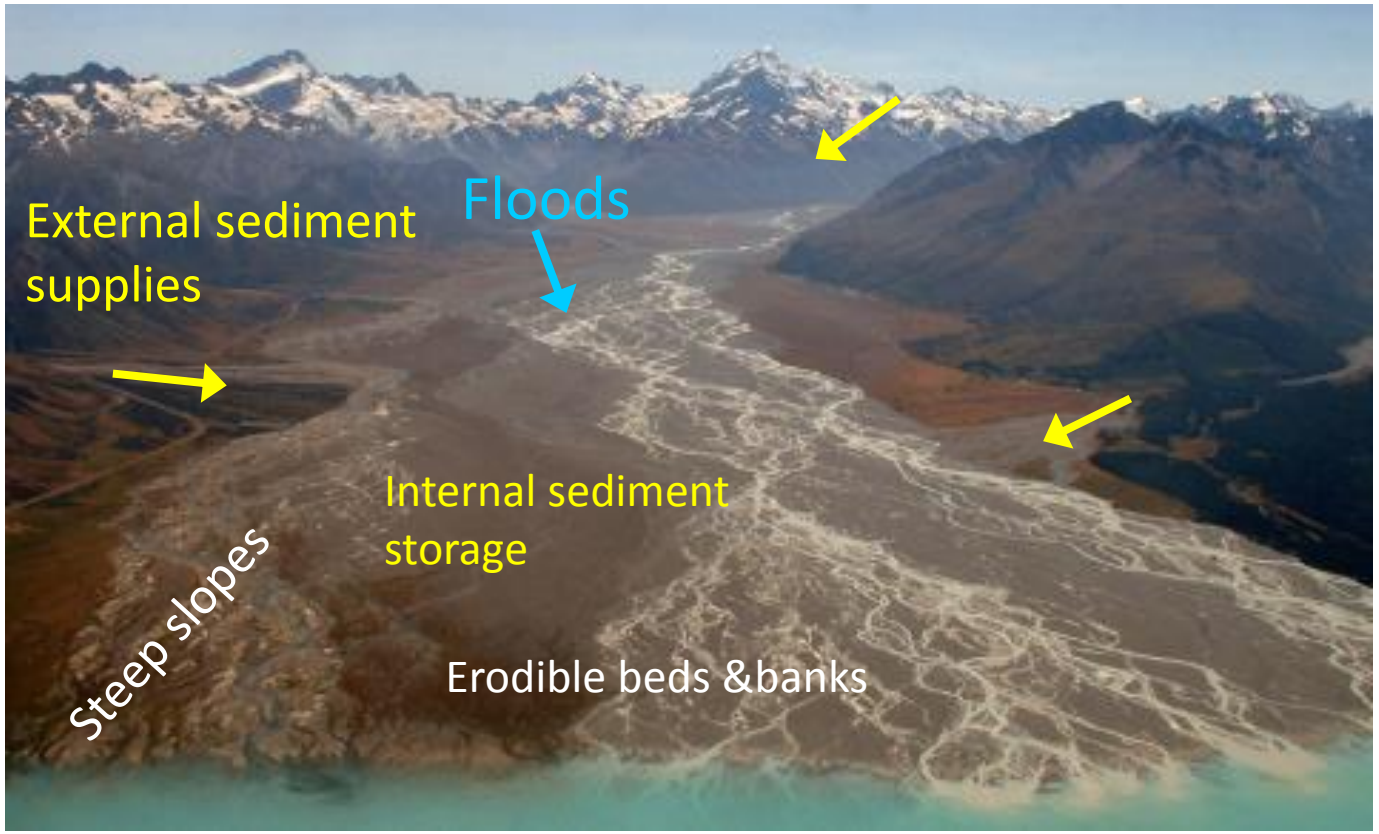


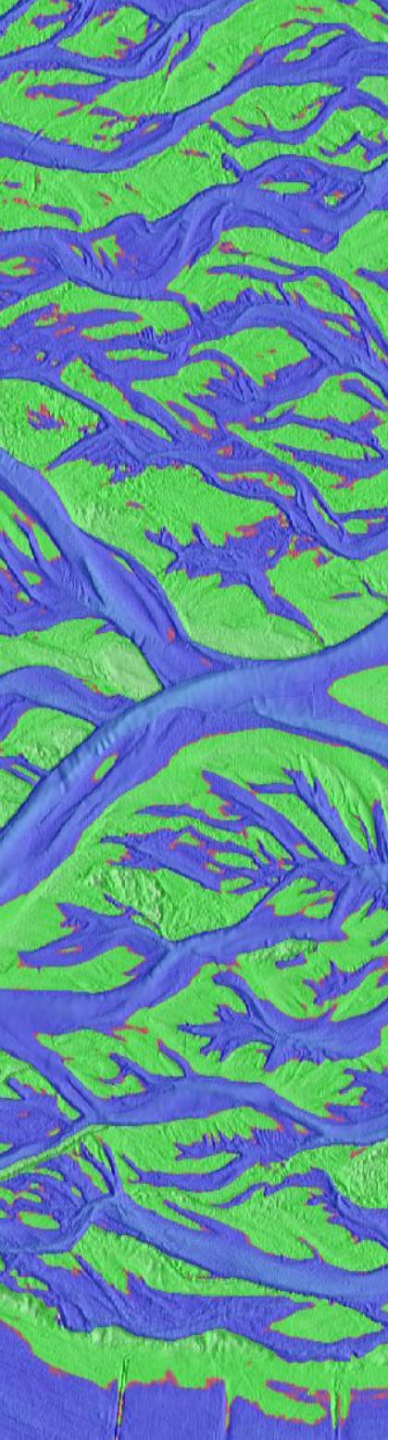




Controls on river braiding

- Adequate supply of sandy/gravely bed-material
- Floods (& channel) slopes competent to move bed-material & erode banks
- Space to occupy
- Erodible bed and banks
- Floods occur frequently relative to riparian vegetation growth rate

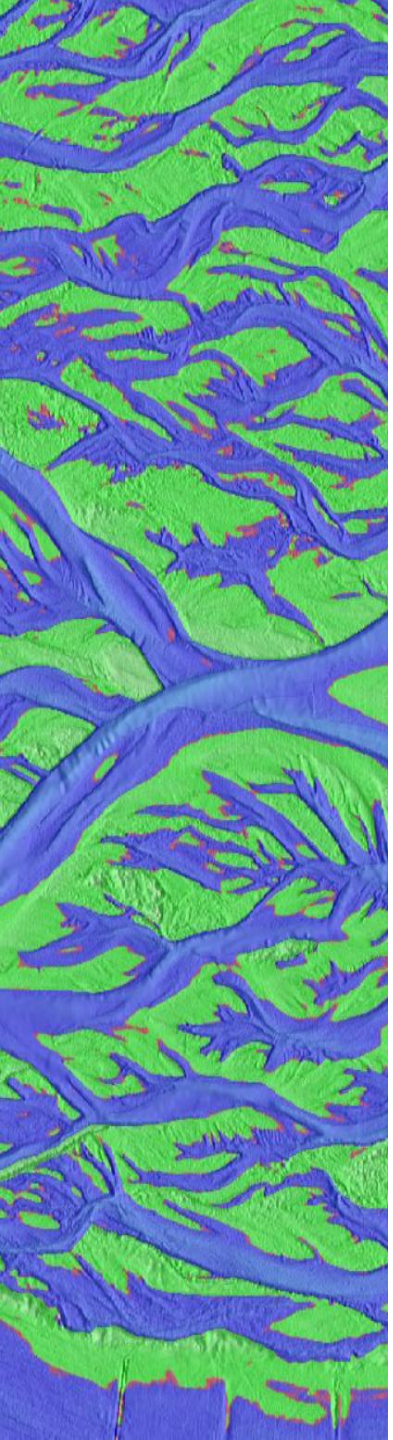


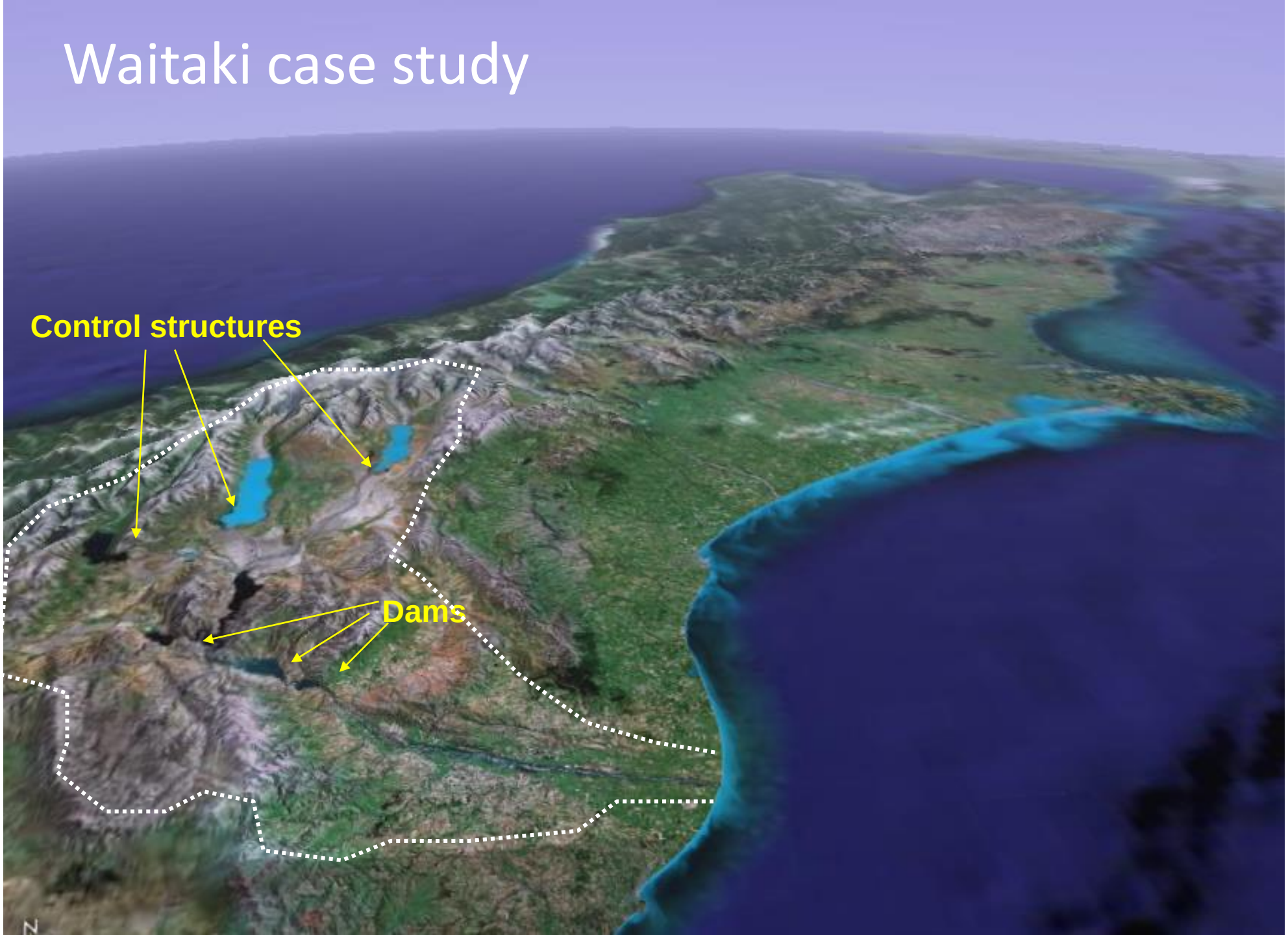


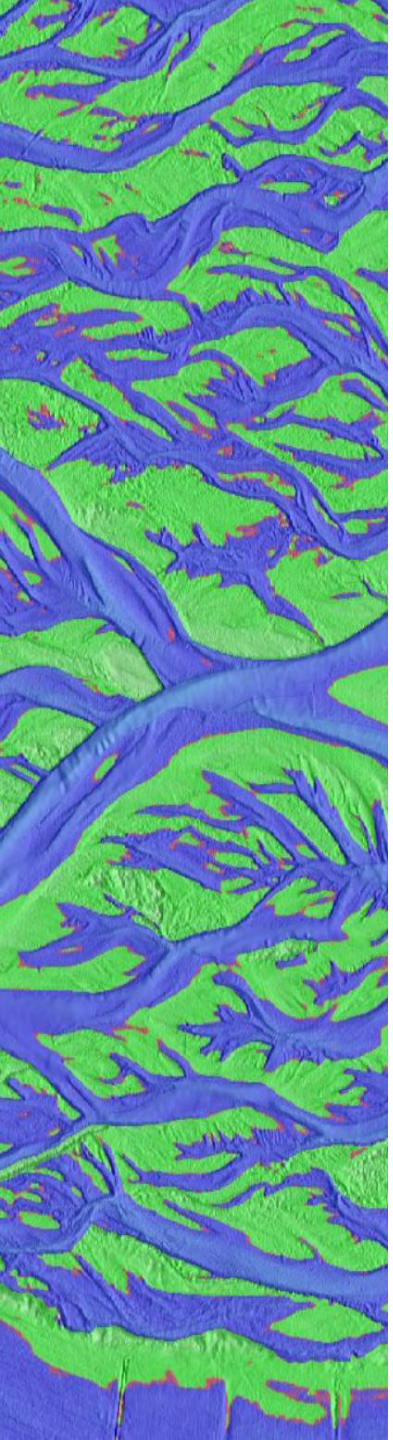
The geomorphic effects of riparian vegetation

- hinders bank erosion
- changes local bank-topography
- reduces bed-material supply
- encourages island growth & stability
- corrals flow
- hinders braiding
  - fewer braids
  - stabilises channels
  - deeper channels

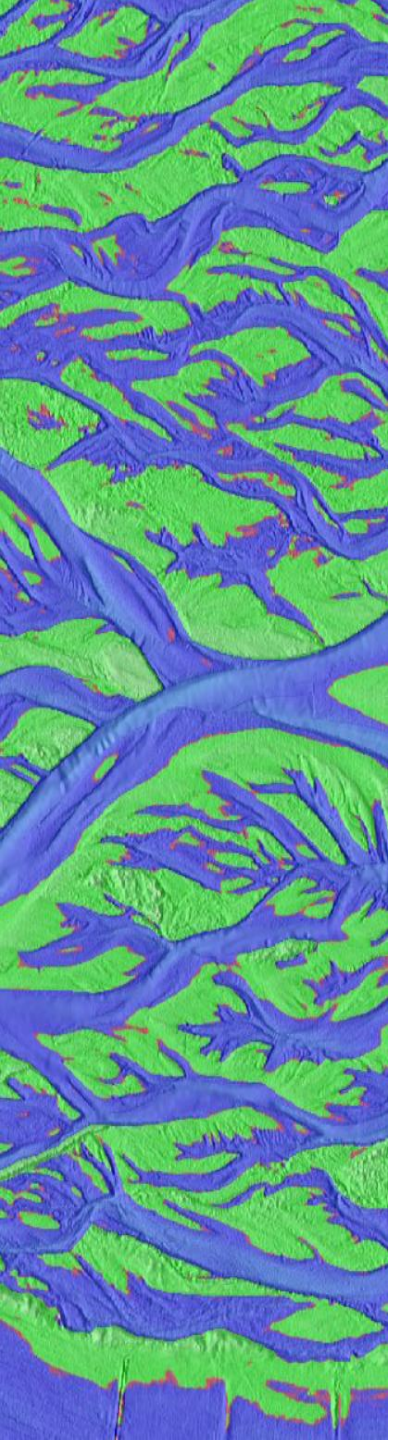
Waitaki case study



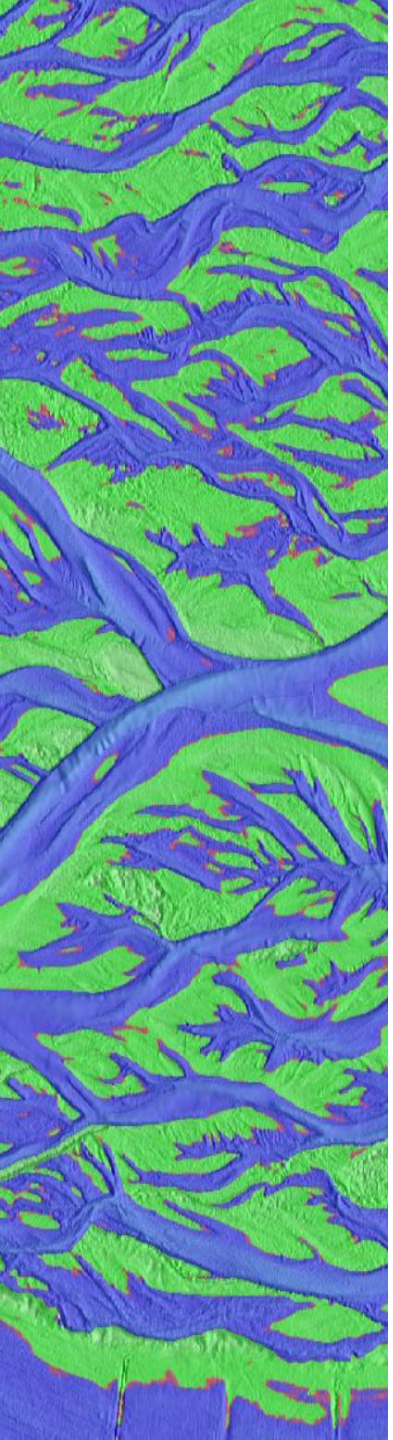




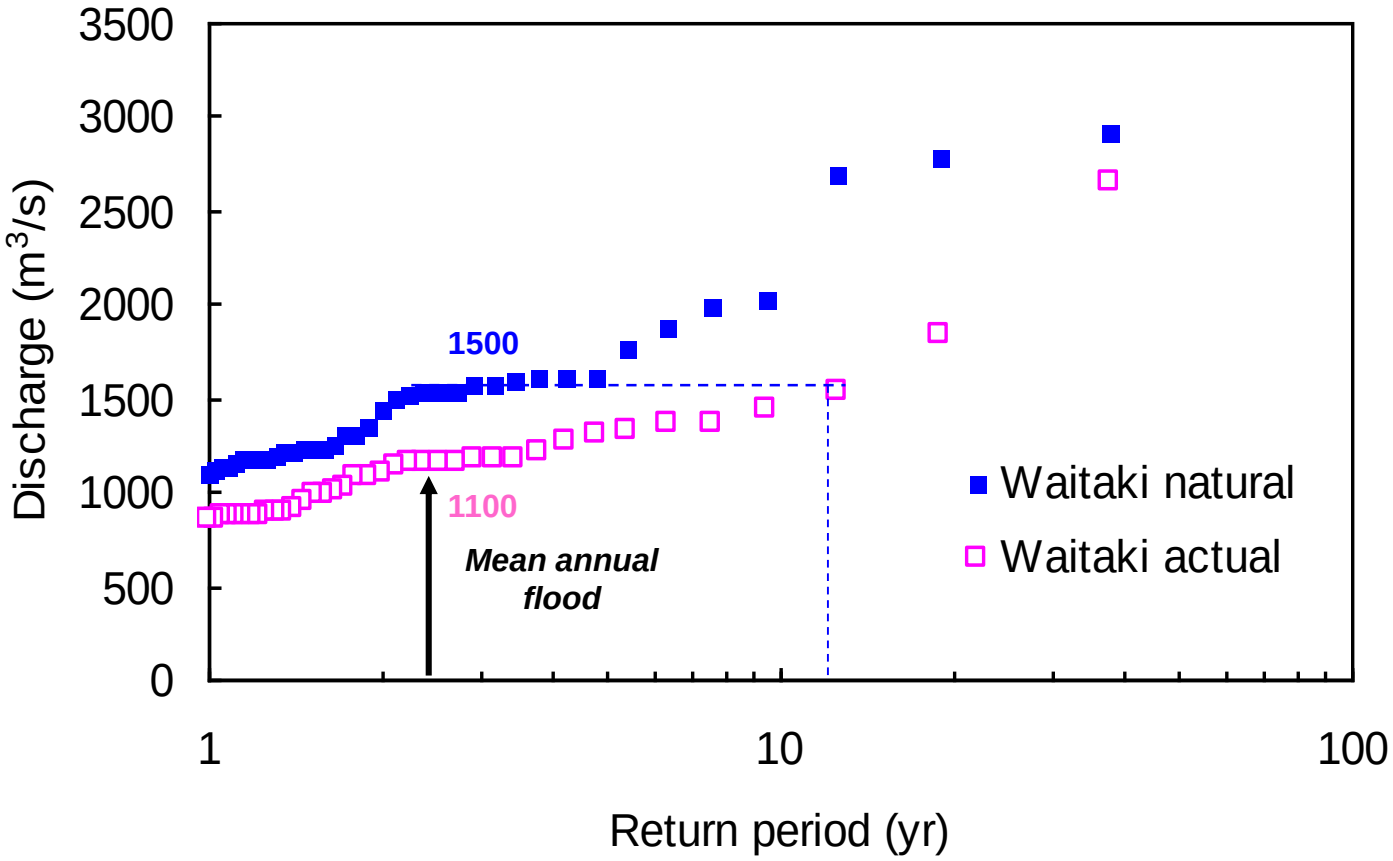
Upper Waitaki

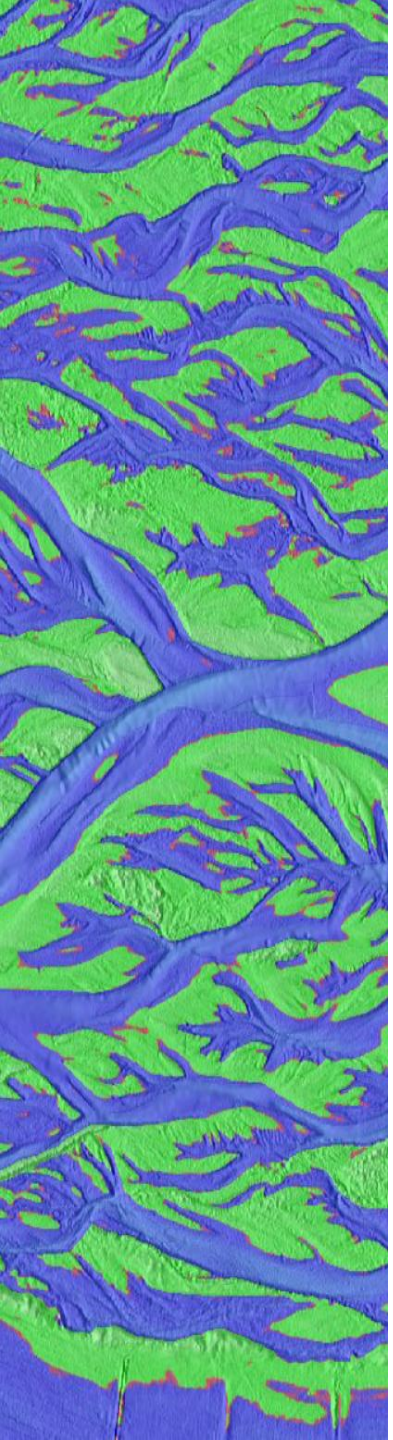


Lower Waitaki

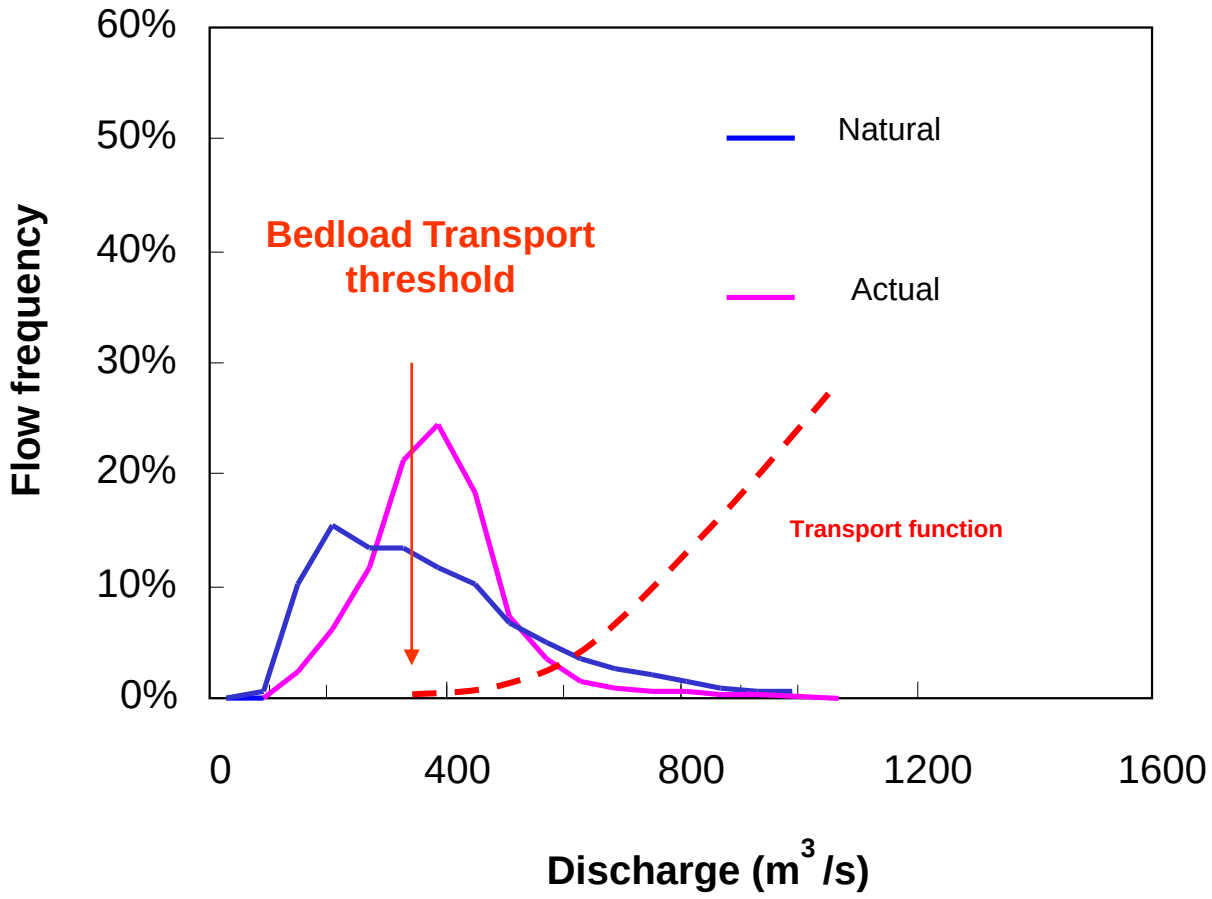


Changes in Waitaki flow regime - floods

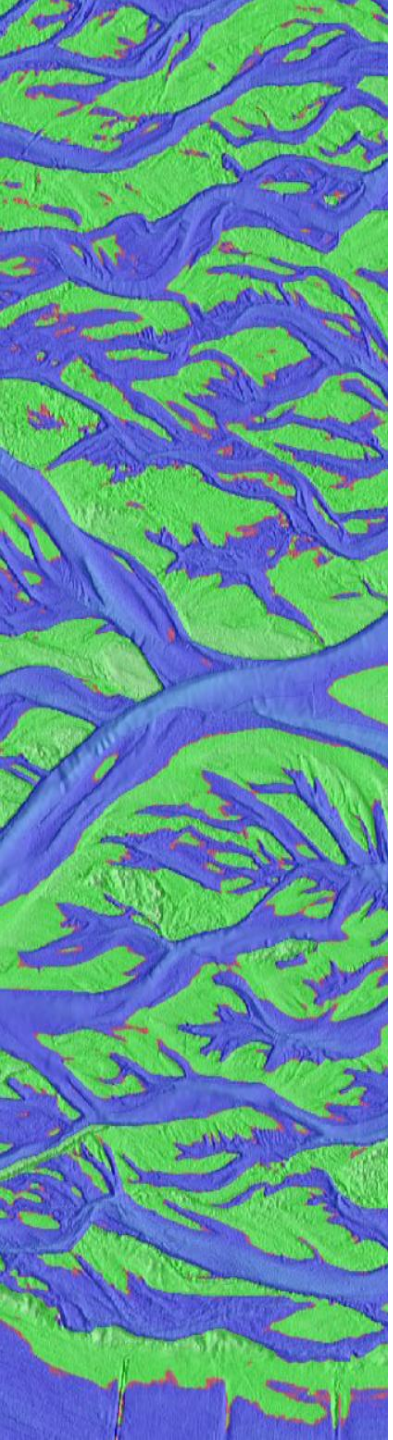


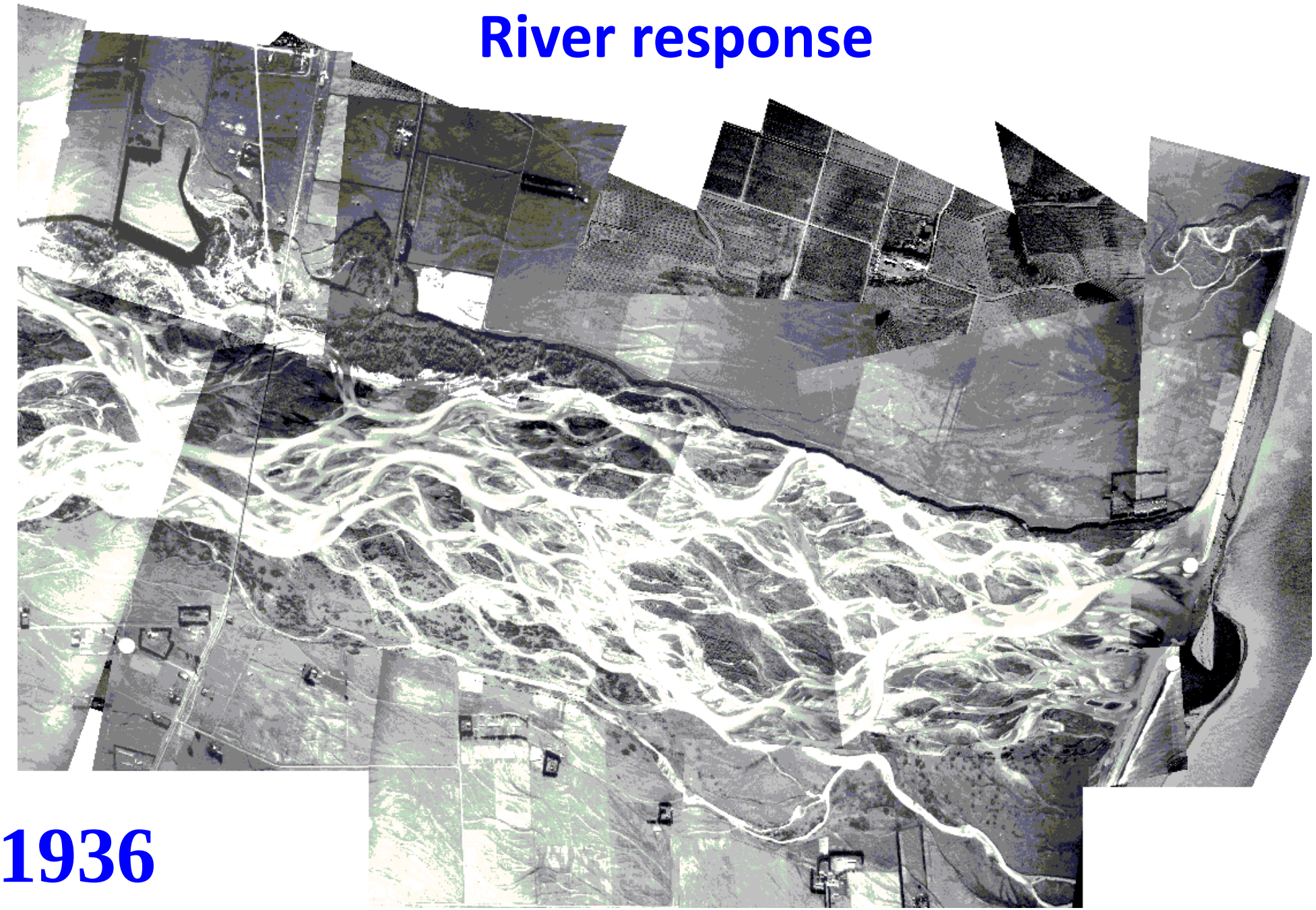


Changes in Waitaki flow regime - flow frequency



River response





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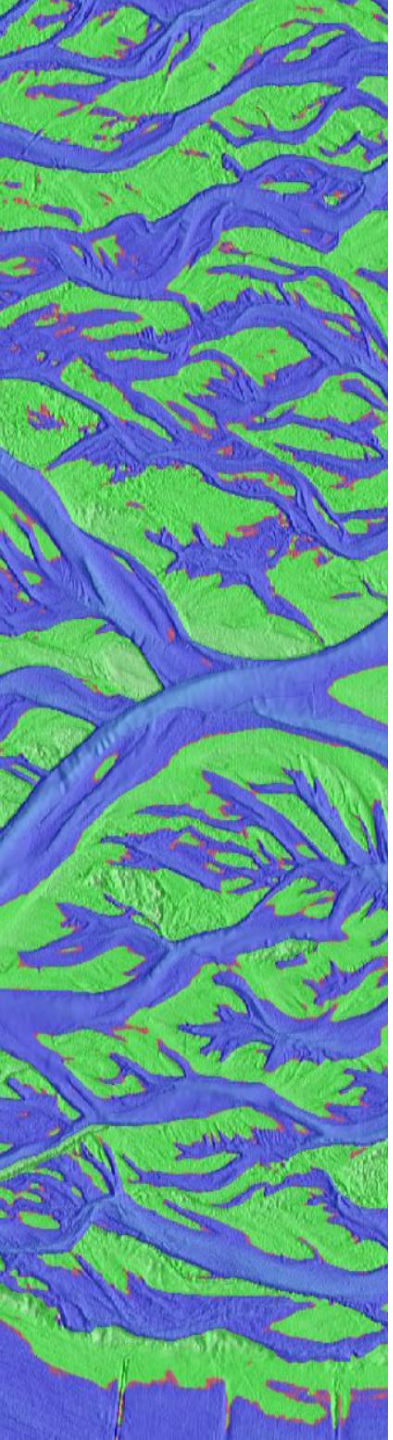

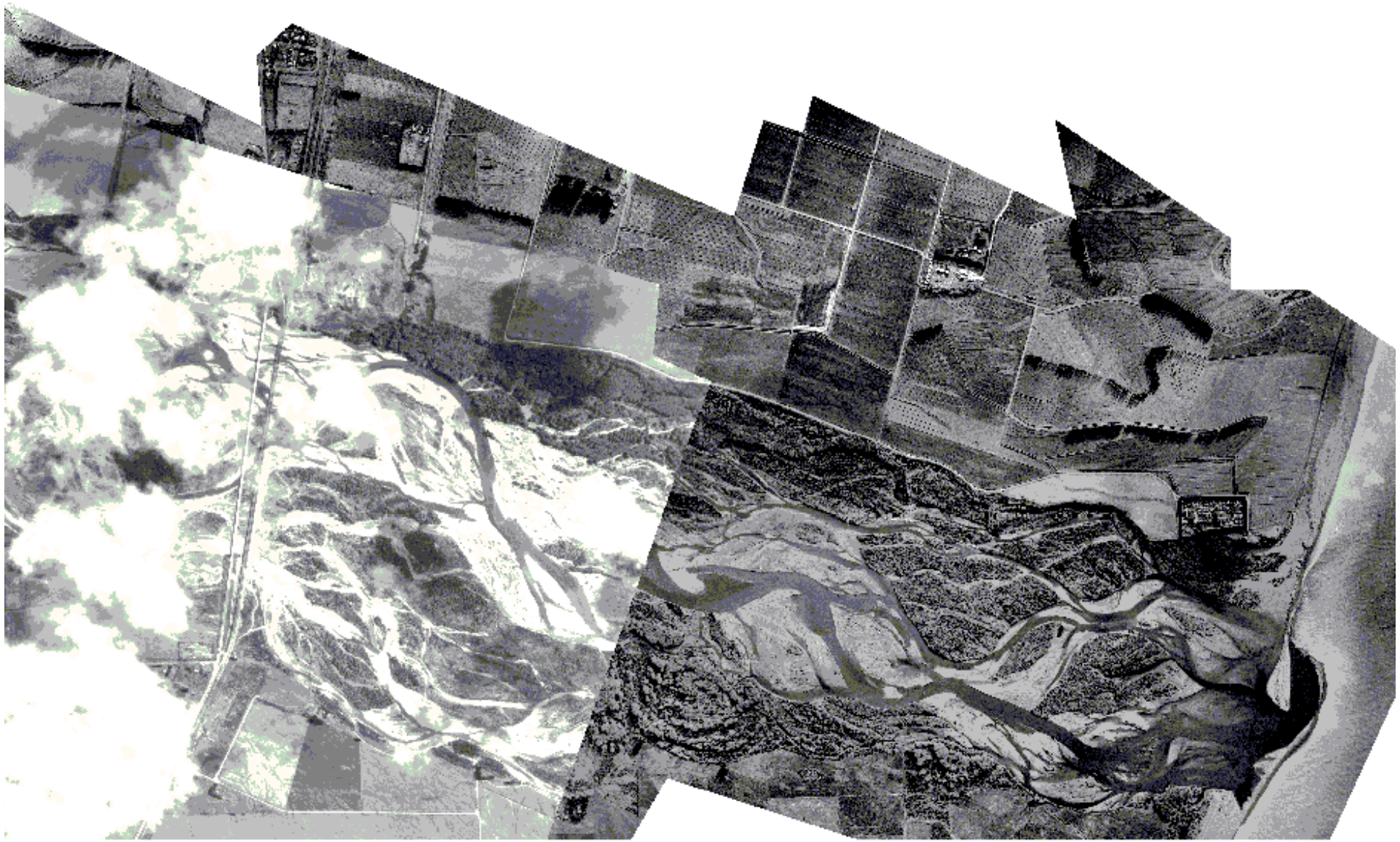

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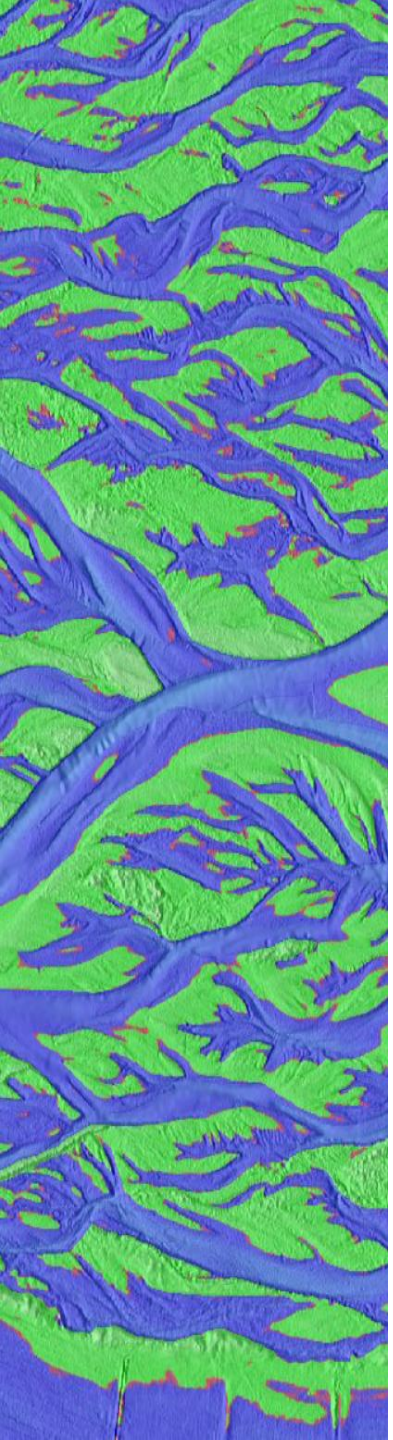
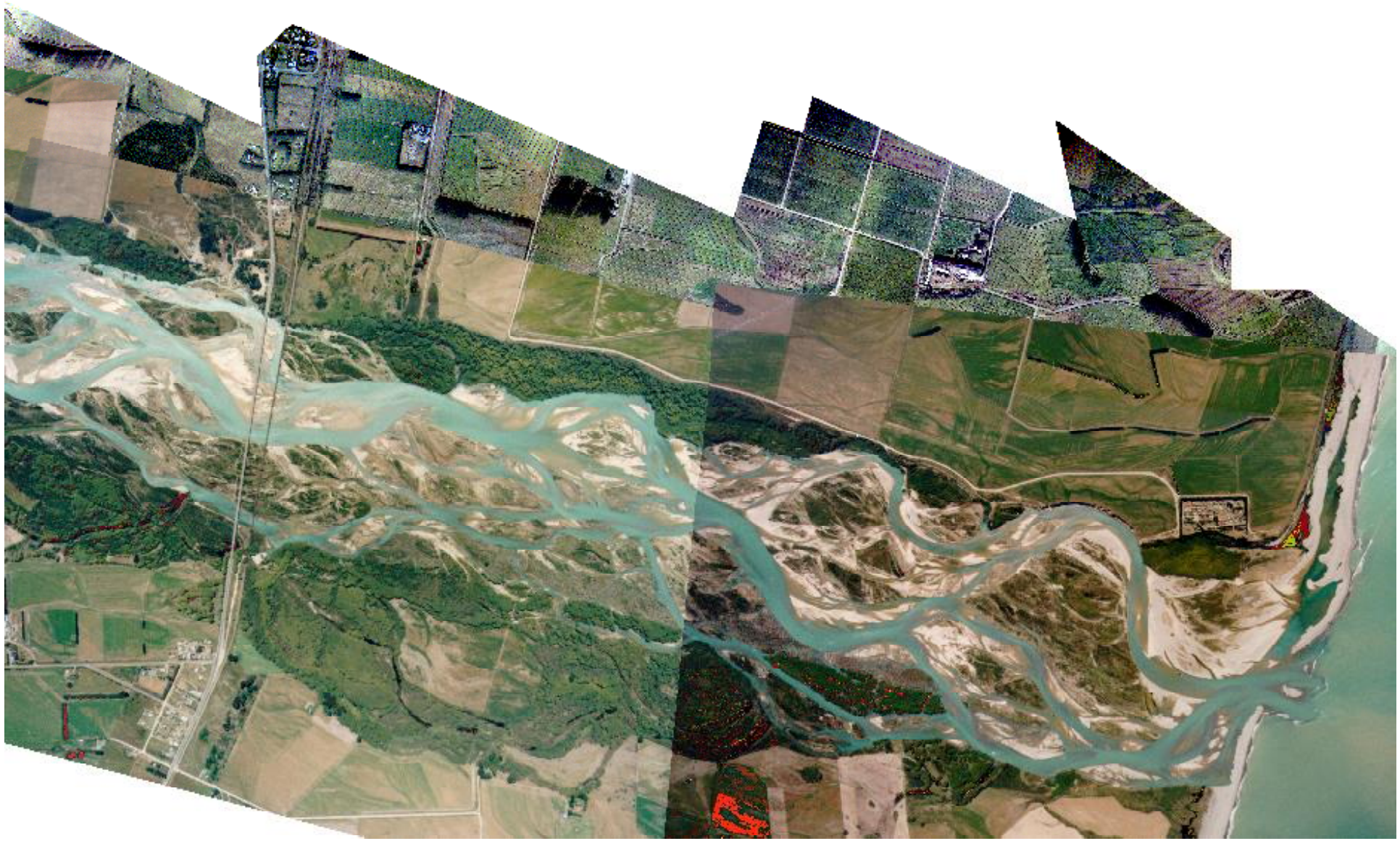
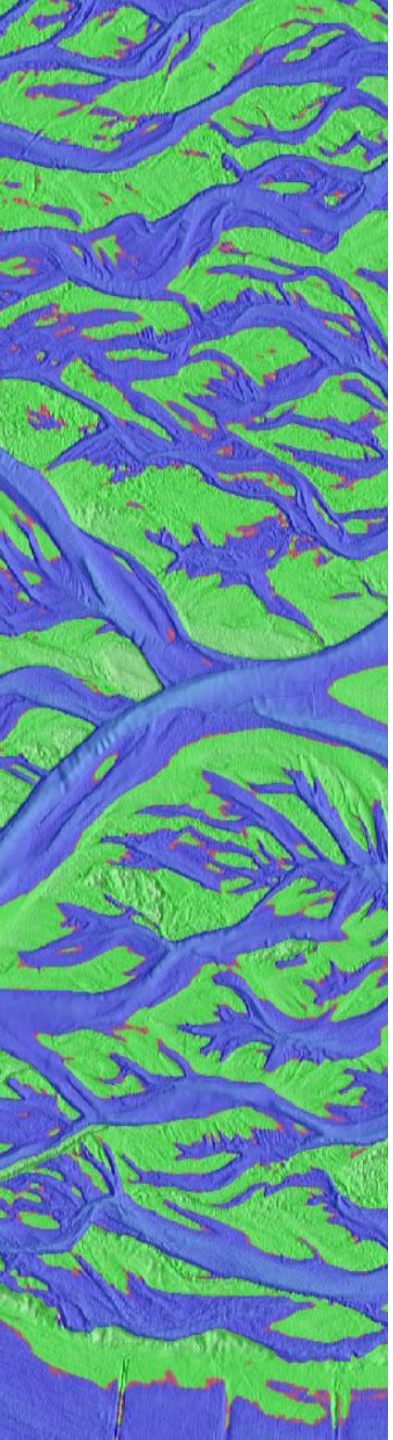
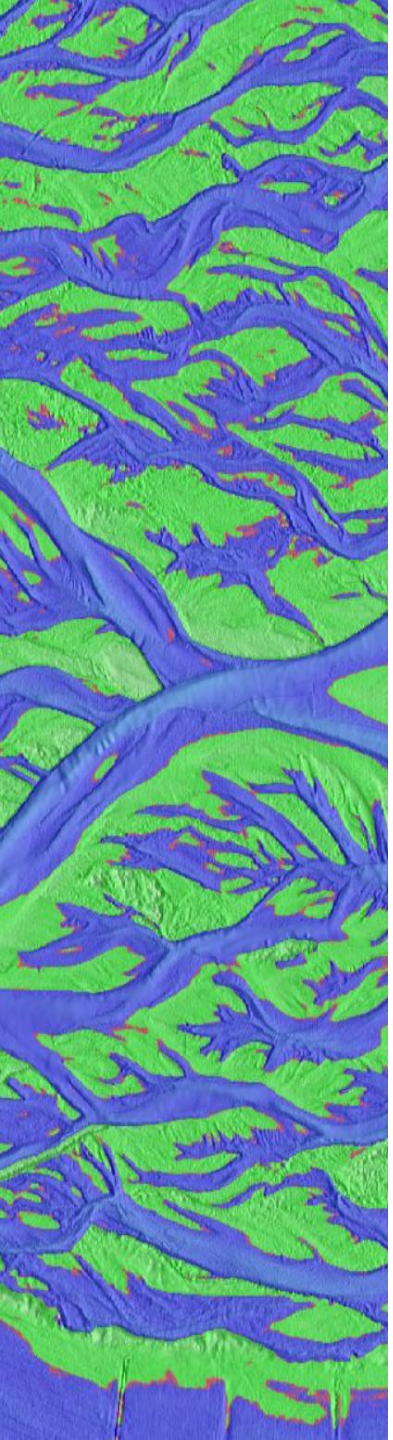




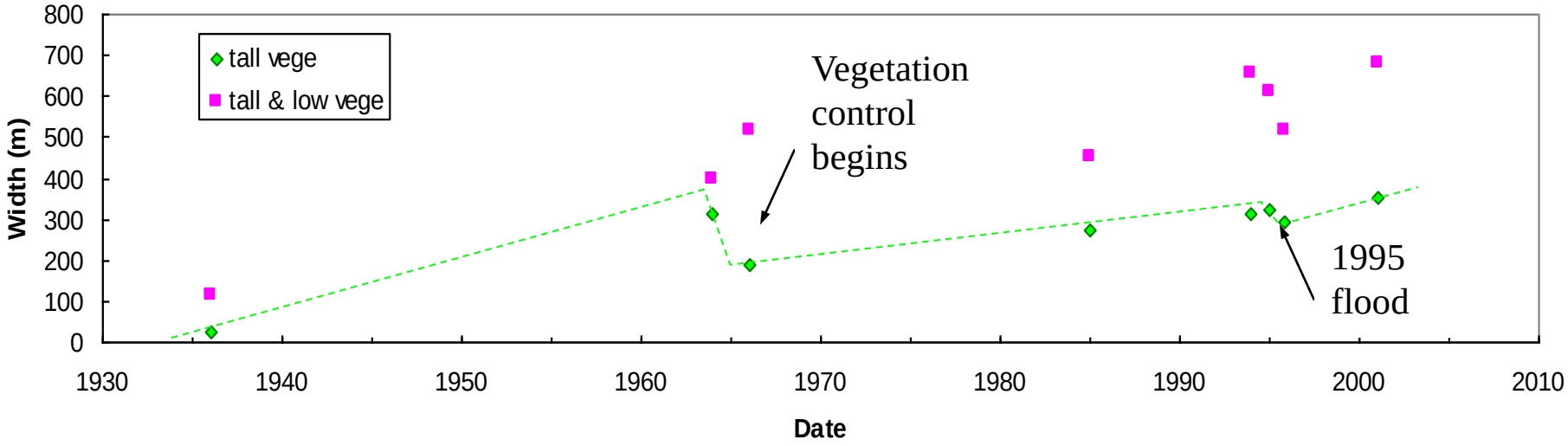
1994

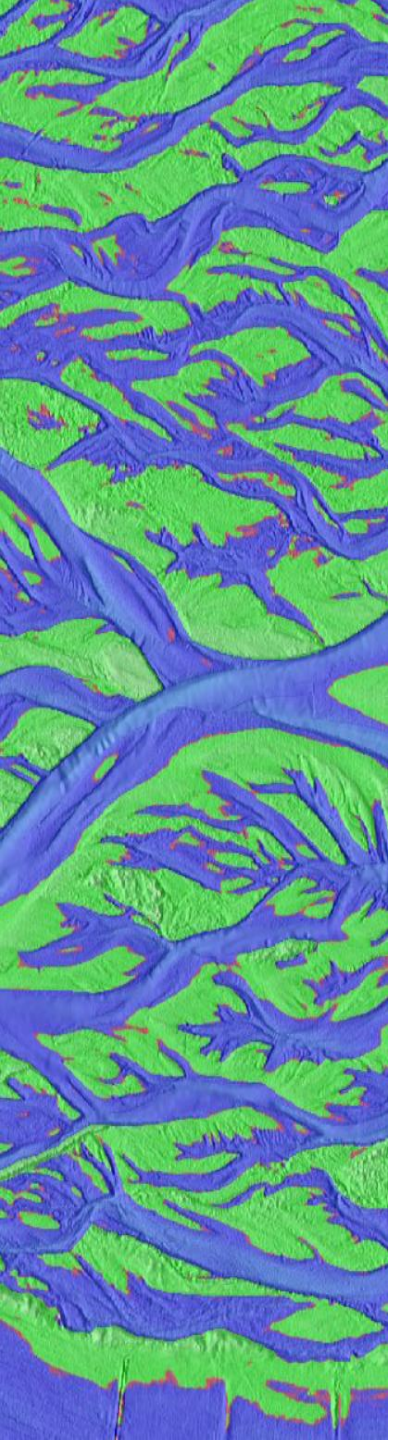


2001



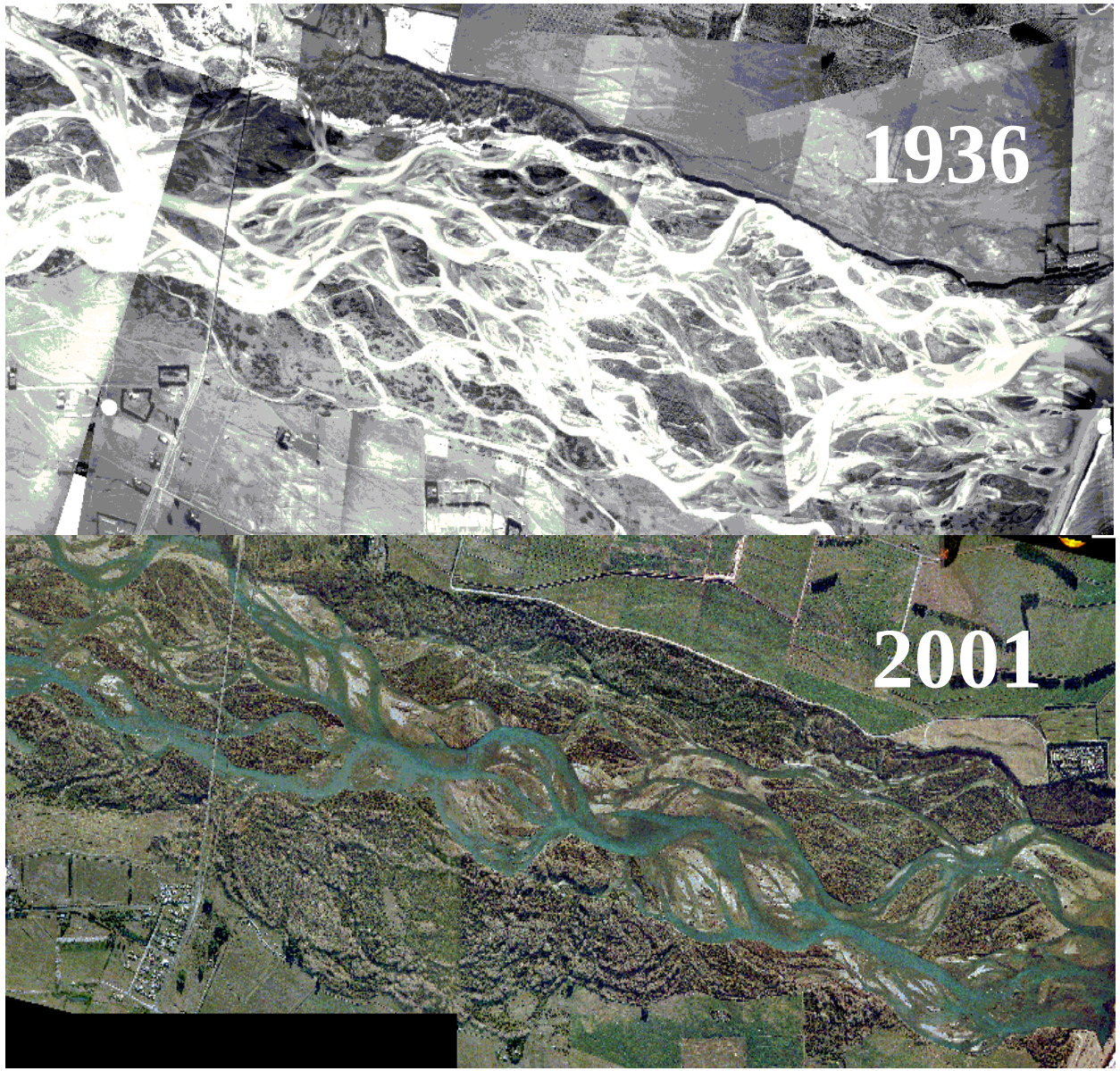
Vegetation trends in the Waitaki

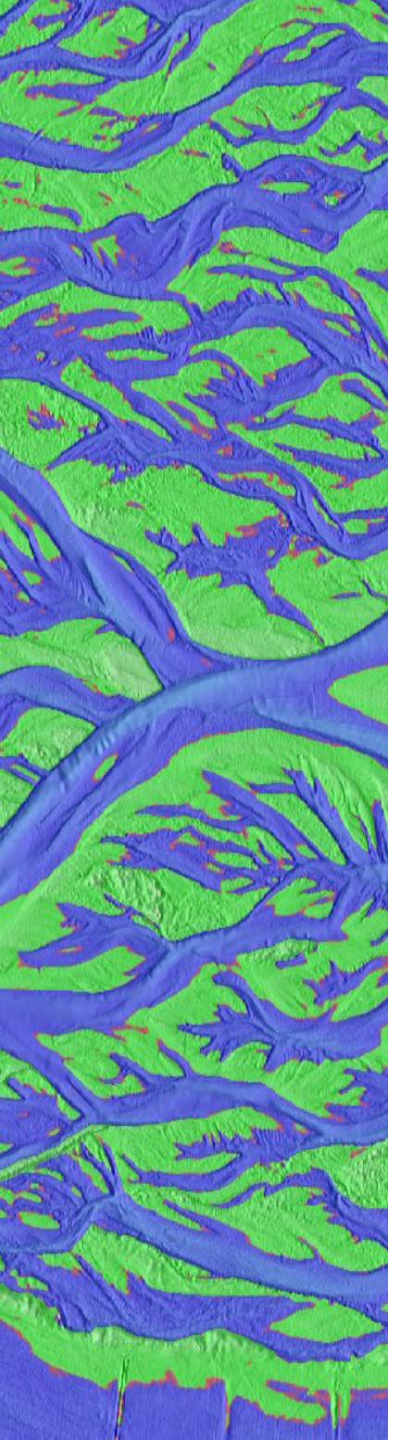




Summary of changes in the Waitaki

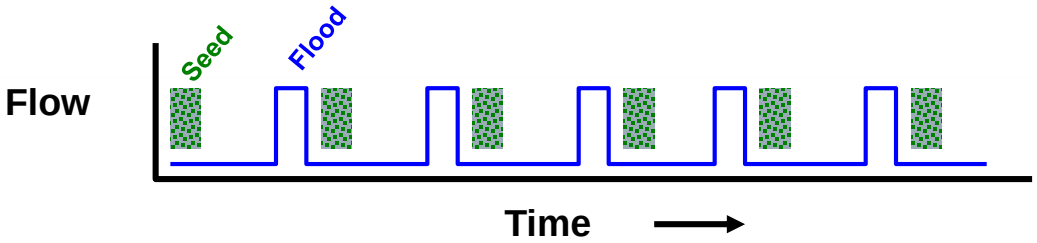
- Less frequent floods
- Less frequent bedload transport
- Vegetation encroachment
- Reduced braiding intensity
- Narrowed fairway
- Vegetation management is an ongoing challenge

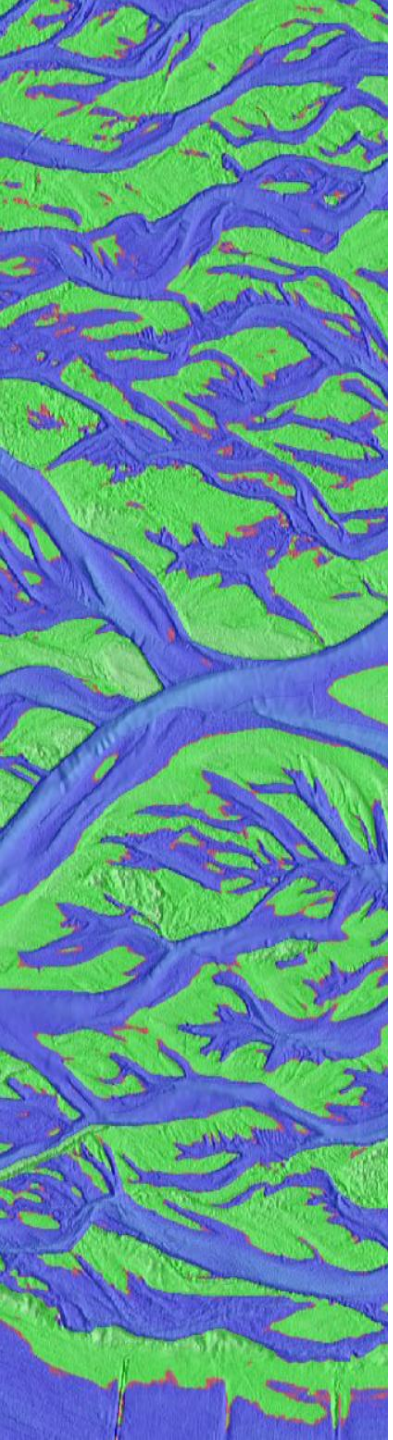




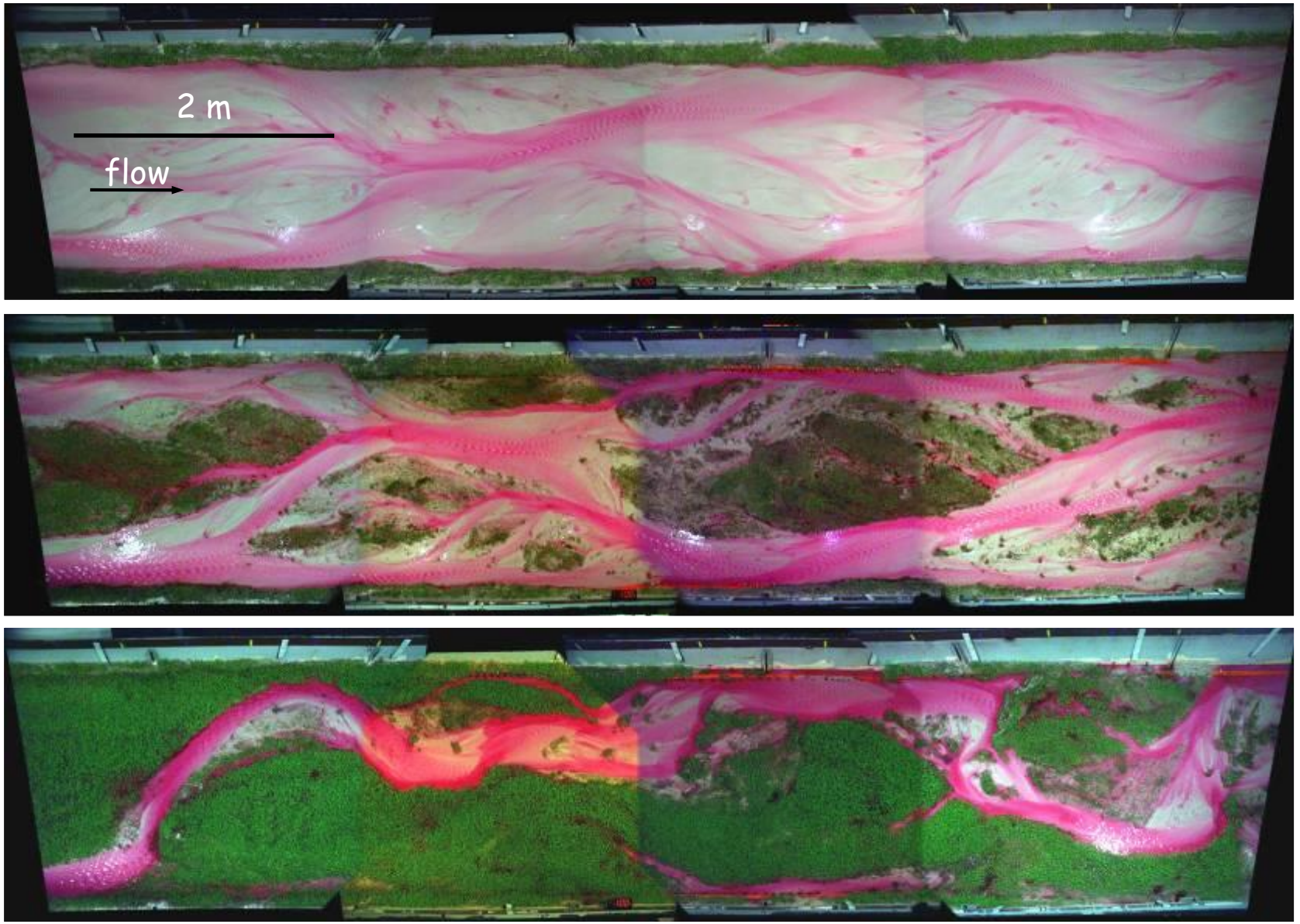
Physical modelling

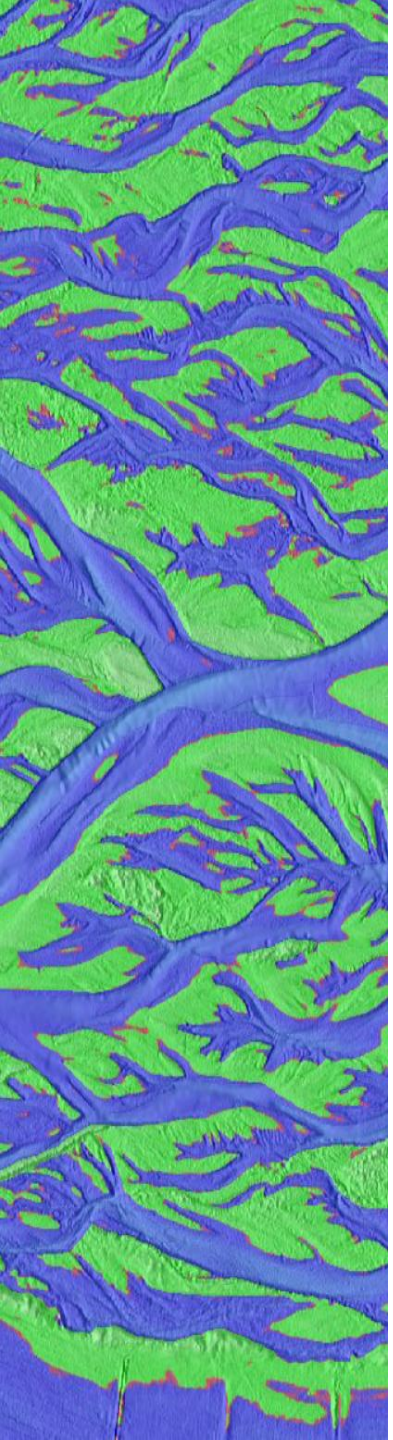
Michal Tal's PhD study at St Anthony Falls Hydraulics Laboratory



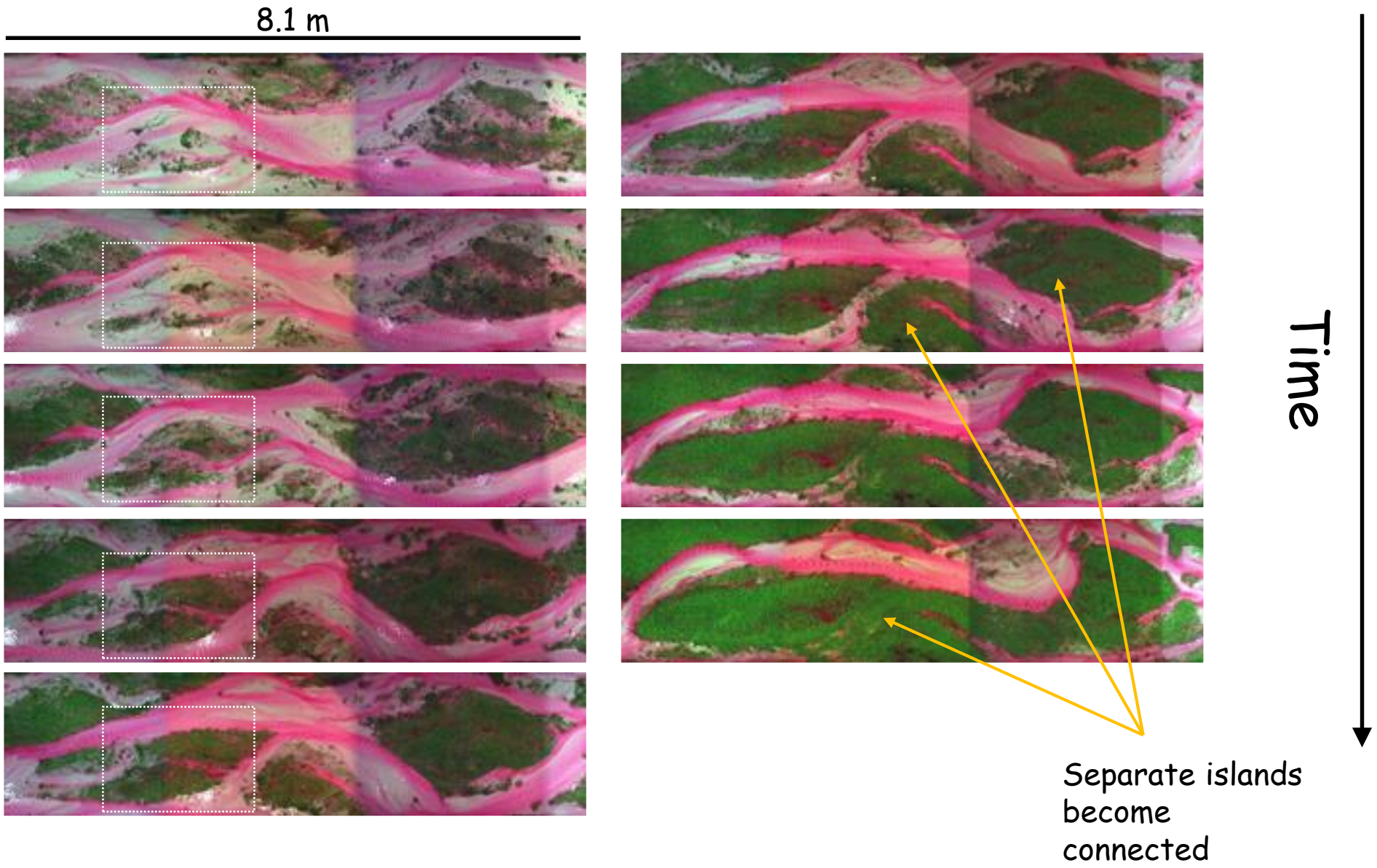


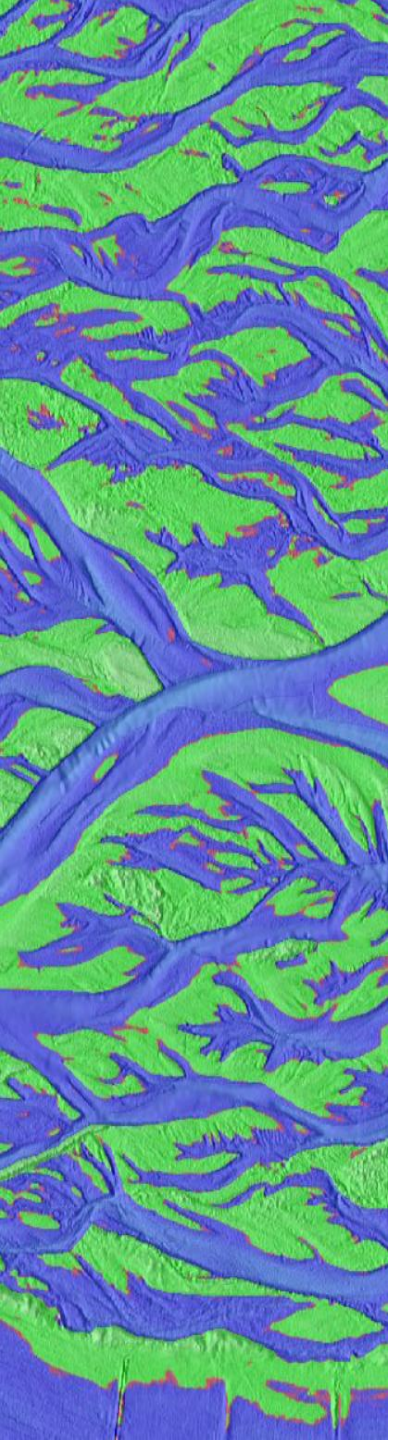
Braiding destroyed



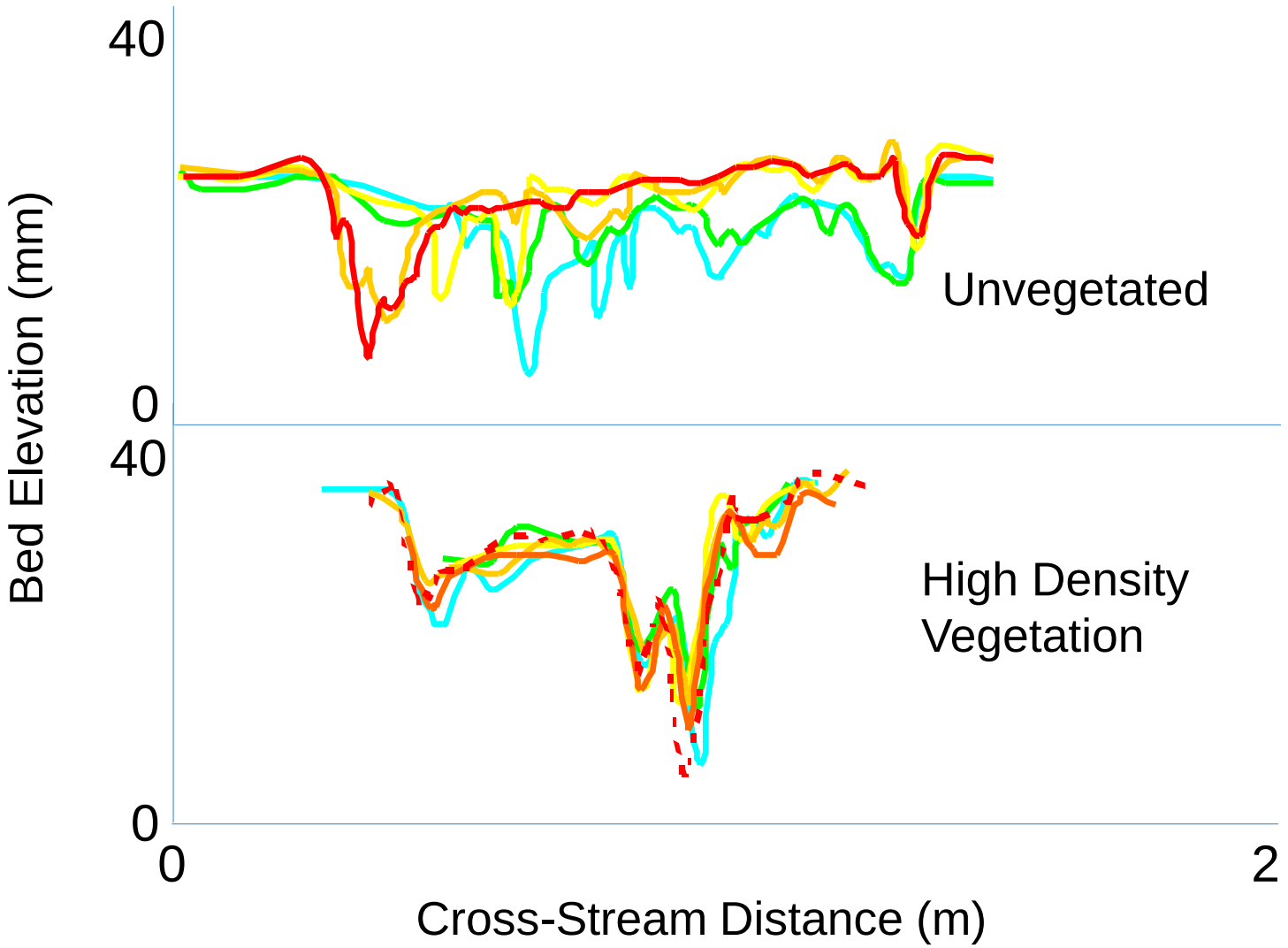


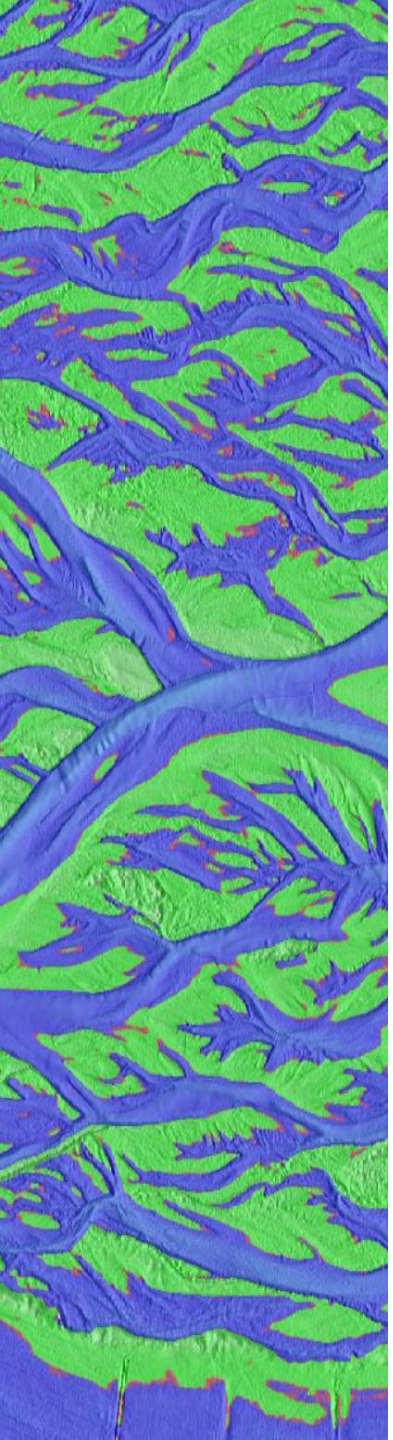
Accretion & amalgamation of patches & islands





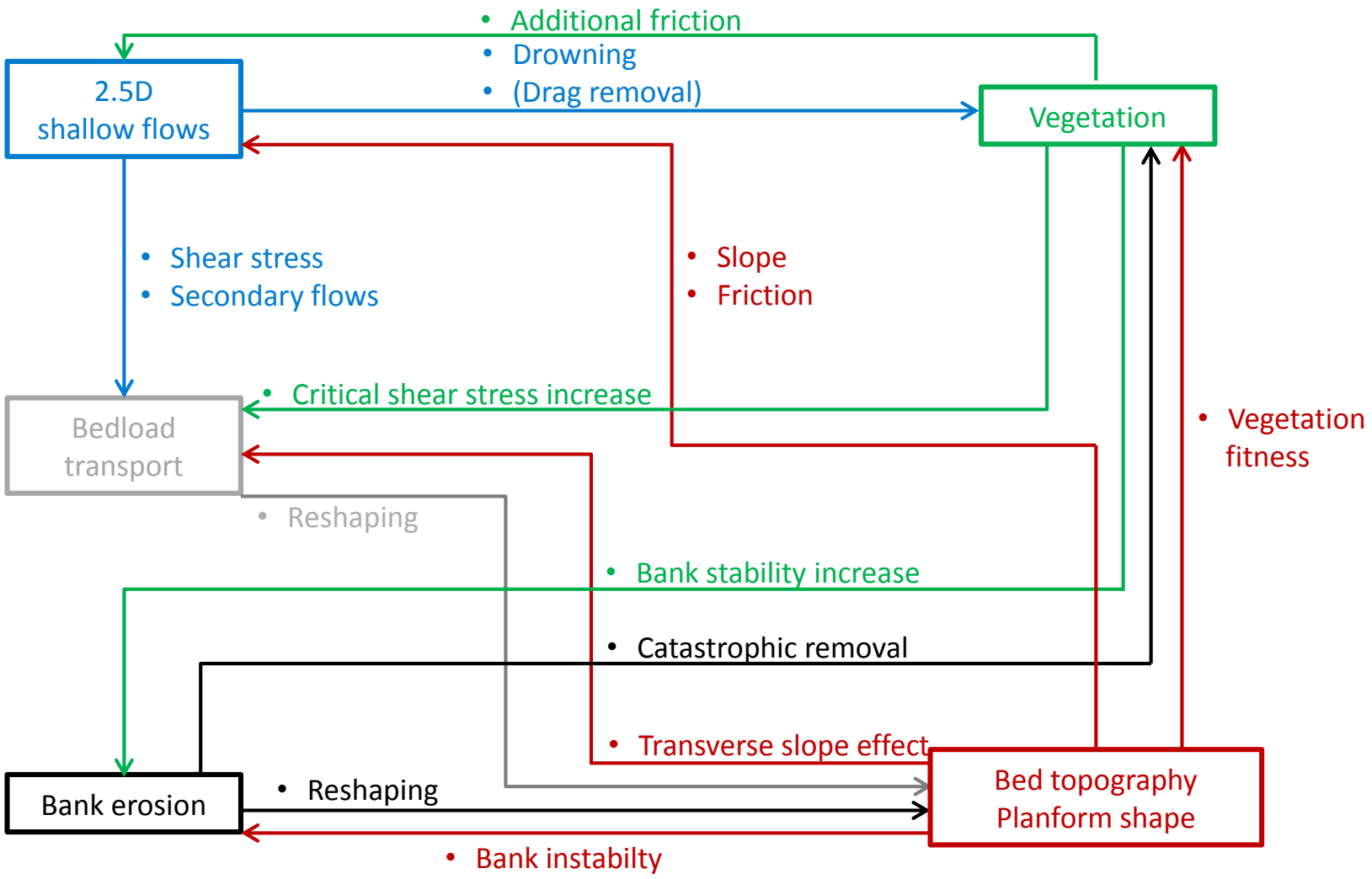
Lateral mobility of channels decreased

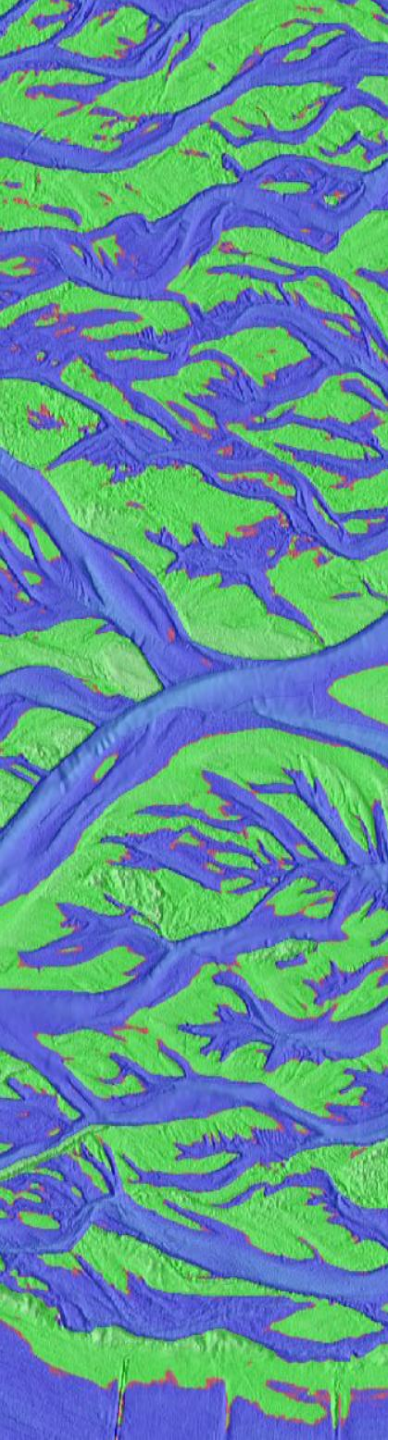




2-D Numerical modelling

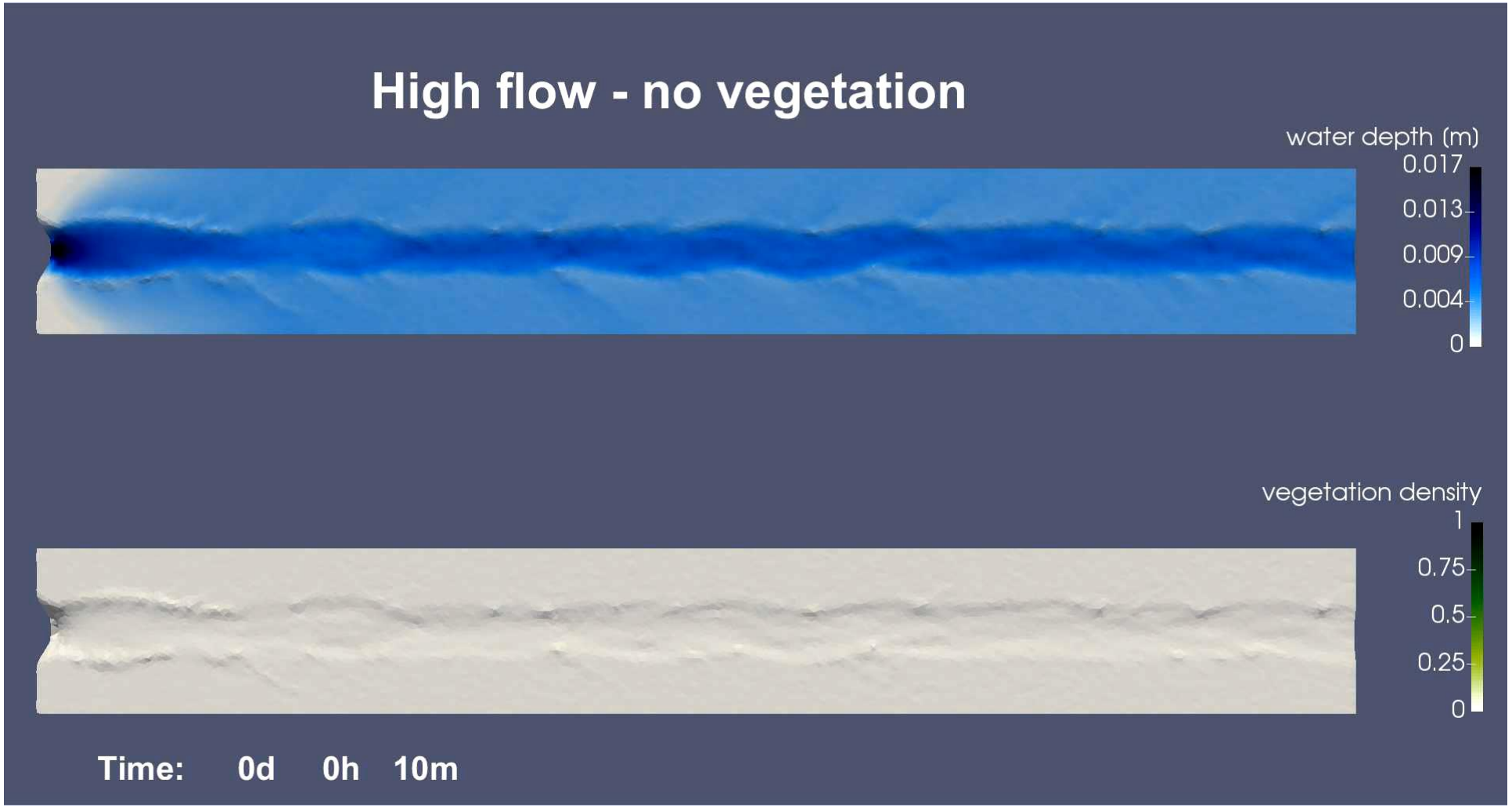
GIAMT2D_veg (Gu Stecca's research)

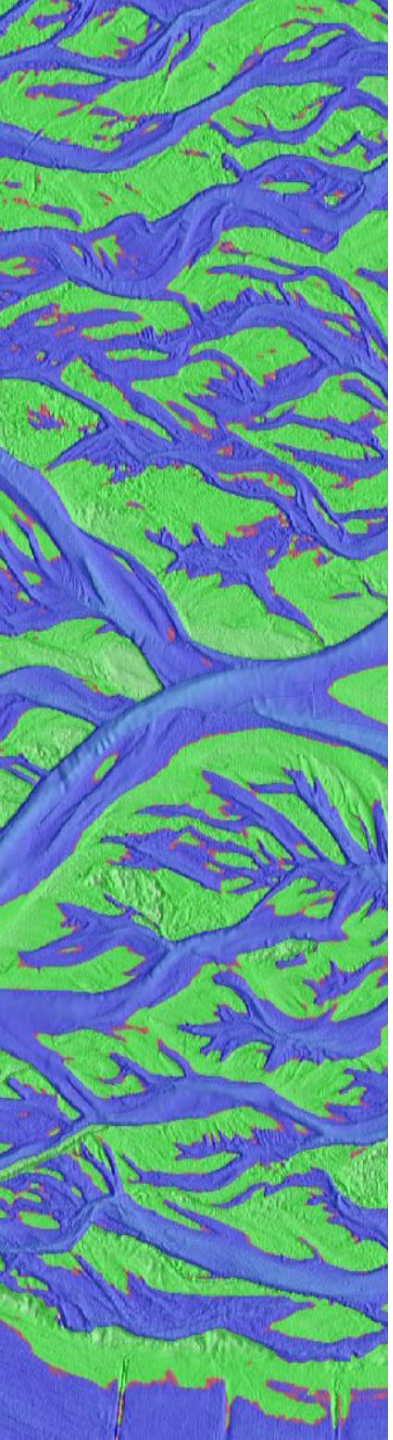




2-D Numerical modelling

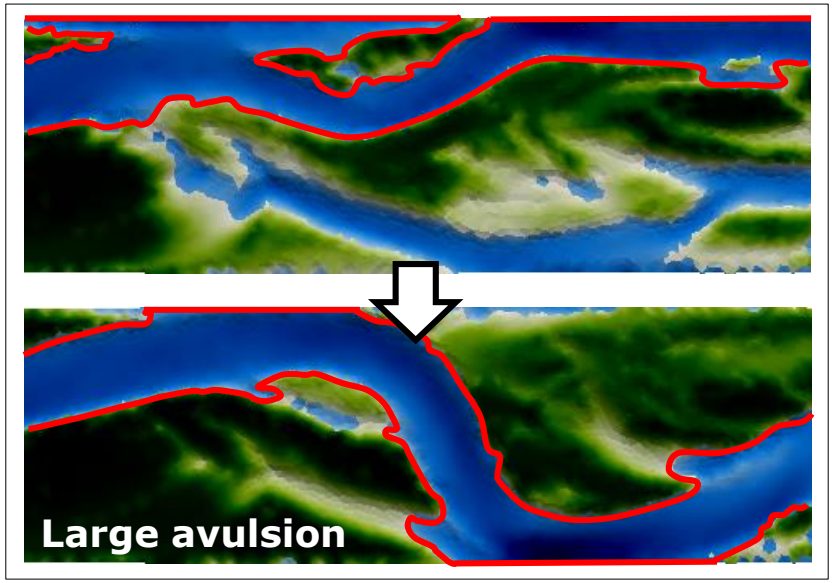
Gu Stecca and Davide Fedrizzi's research

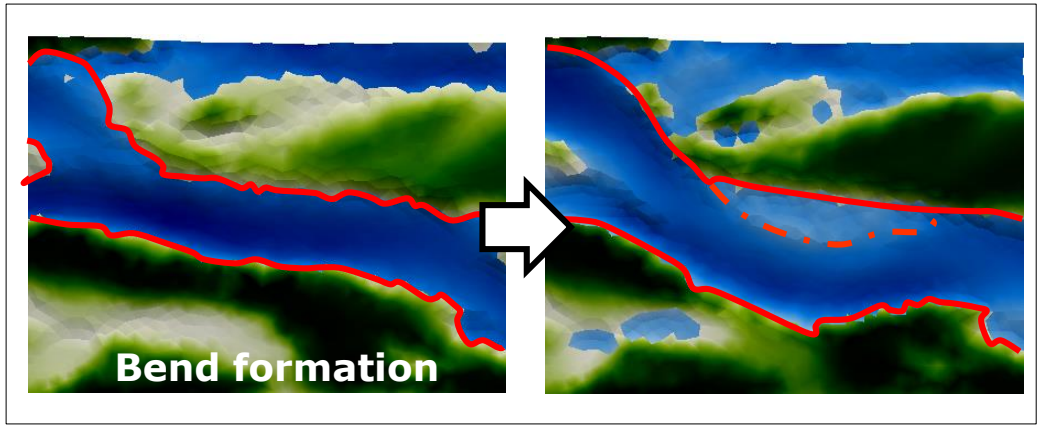


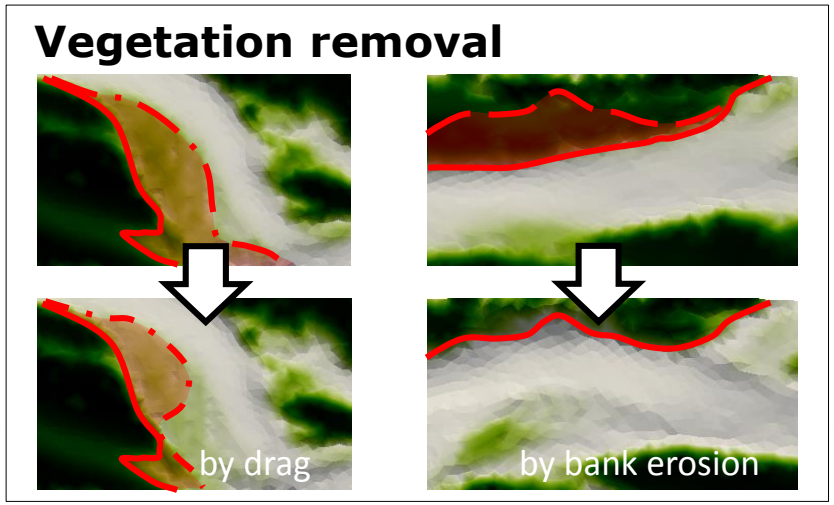


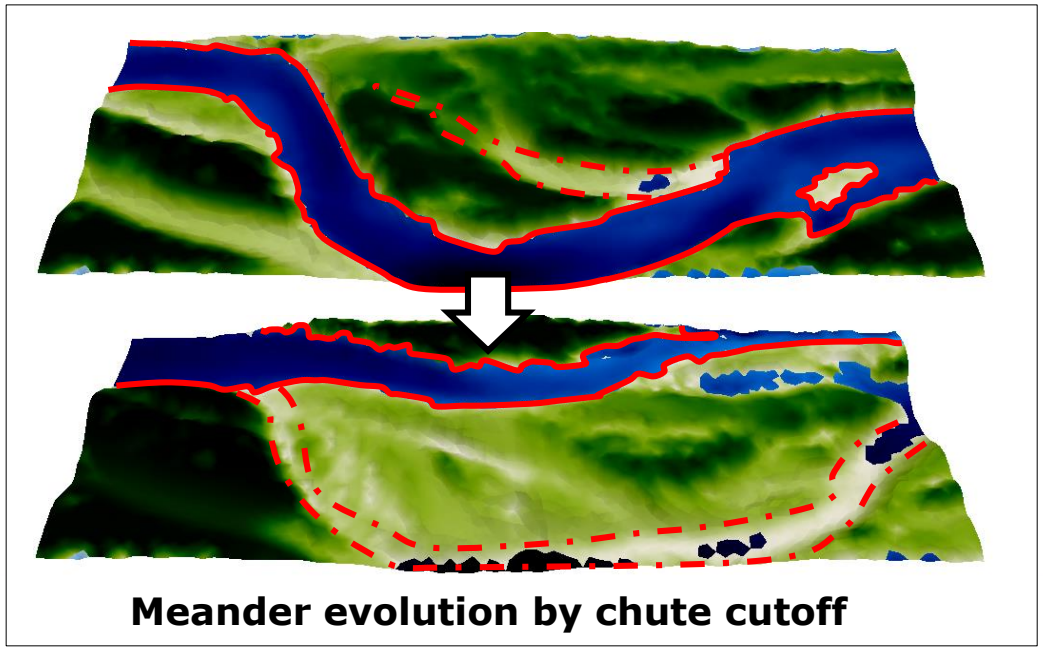
2-D Numerical modelling

What processes can we simulate?

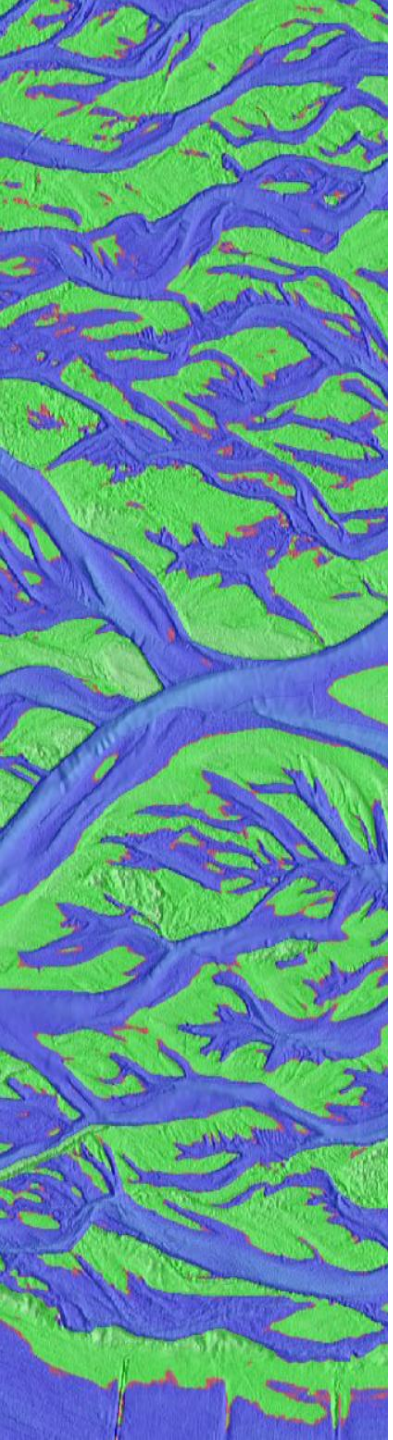








Limitations – theoretical channel, all vegetation cover is the same



2-D Numerical modelling

Next Steps

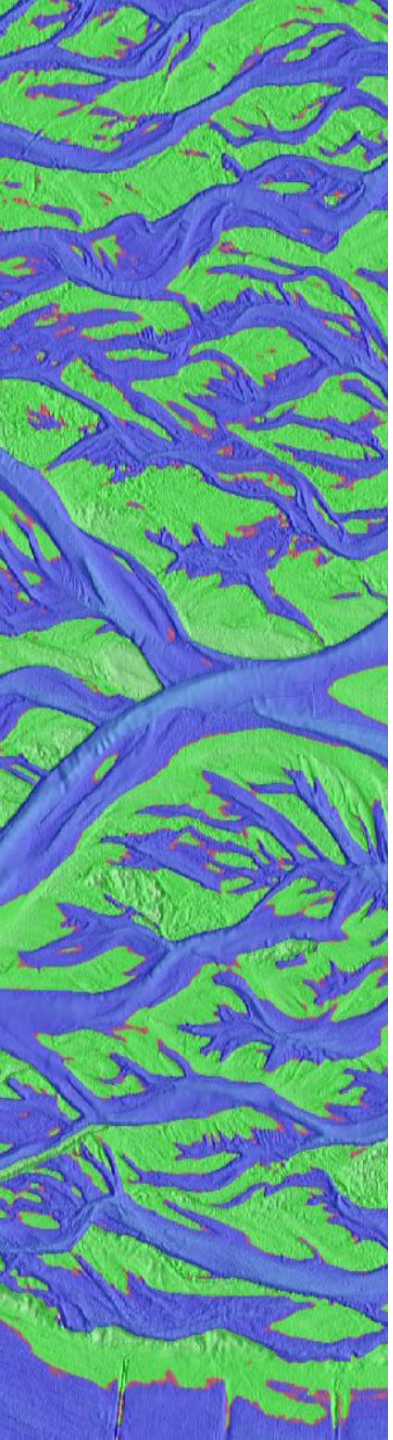
- Gather data on rates of growth and thresholds of removal for a range of braided river vegetation/weeds

  e.g. Willow AND Russell lupin, tree lupin, gorse, broom, false tamarisk…

- Develop a 2D morphological model on a <u>real</u> system

  i.e. further develop GIAMT2D_veg

- Model the feedbacks between vegetation and geomorphology and assess the implications of:
  - changes in flow regime
  - changes in mix of species present
  - frequency/location of vegetation clearance (i.e what is optimal?)



Summary

- Braided rivers are an arena where woody weeds and floods fight it out
- Naturally-braided rivers flood frequently enough to contain woody vegetation by ‘rapid’ bed turnover
- Schemes/situations that reduce average flood frequency (and intermittency) give vegetation greater advantage
- 2D numerical modeling of braided rivers is getting very sophisticated
- These models help us assess the feedbacks between vegetation and geomorphology and predict the implications of changes in flow regime