Remote survey of large gravel riverbeds using digital photogrammetry and image analysis

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The problem: How to survey large gravel riverbeds

- Conventionally using cross-sections:
  - Coarse spatial and temporal resolution
  - Unreliable estimates of morphological change
- Remote survey (measurement using non-contact methods) allows ‘snapshot’ of the riverbed:
  - Temporal resolution set by image interval
  - Spatial resolution set by image scale

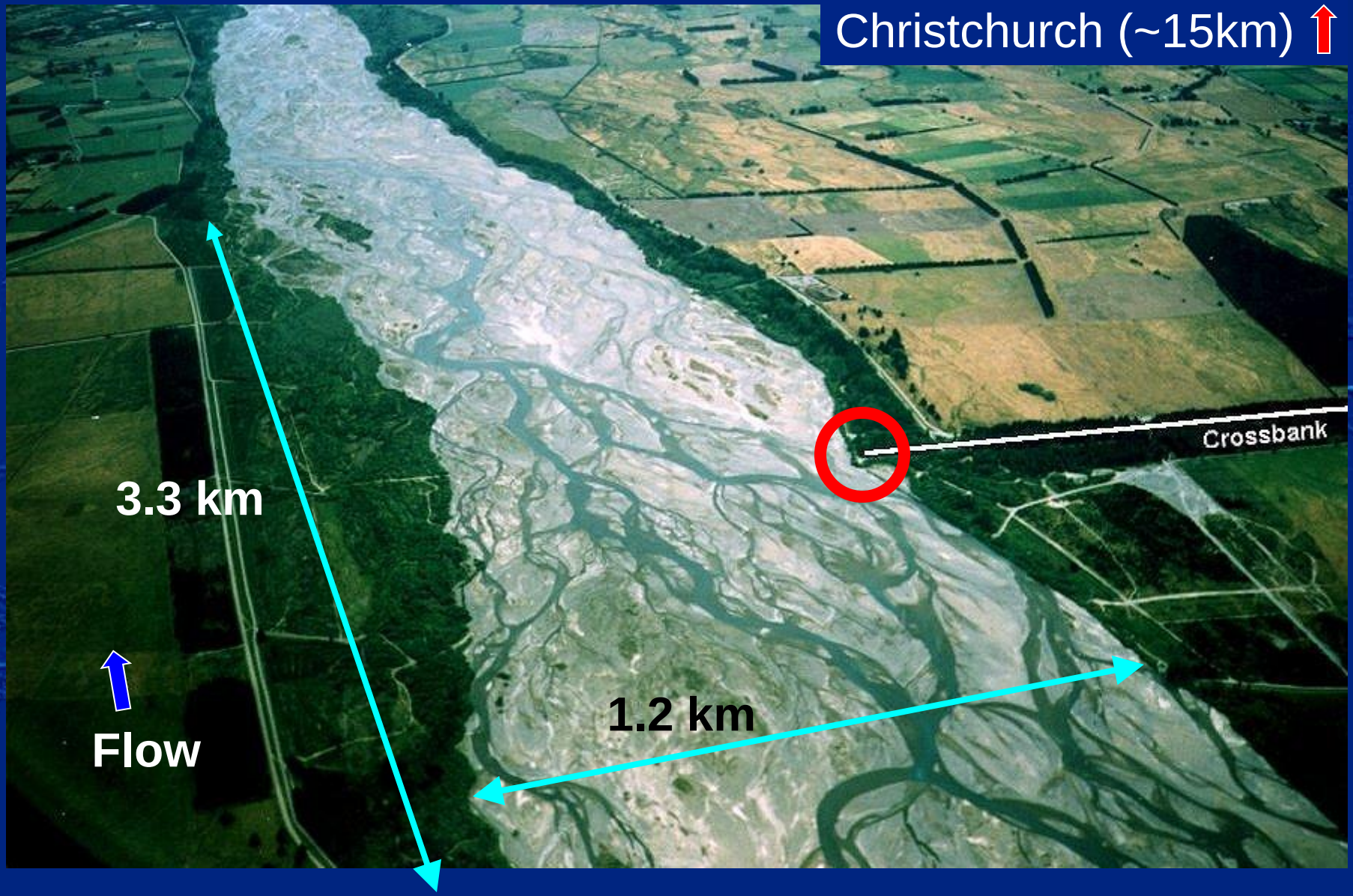
The research project

- To use digital photogrammetry and image analysis to obtain riverbed surfaces of the Waimakariri river for 3 epochs:
  - February 1999
  - March 1999
  - February 2000

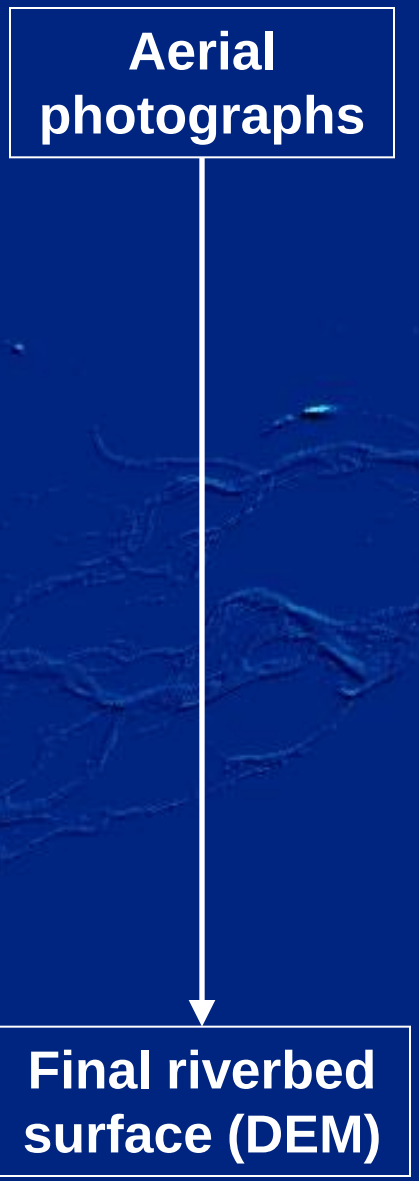
Large (bankfull) flood event
Annual change

  - *May 2000 (Laser altimetry)* - *See poster paper by Hicks et al.*

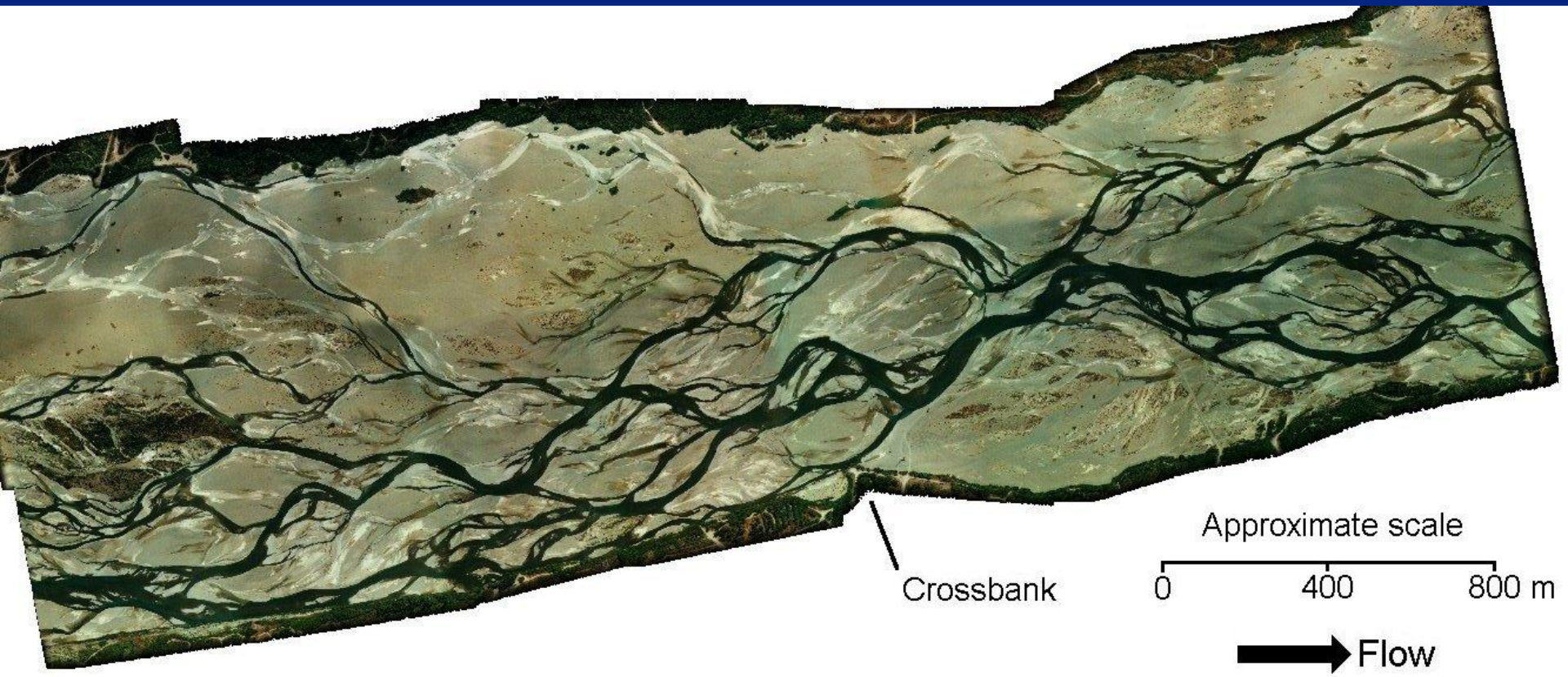
The field site: The Waimakariri River



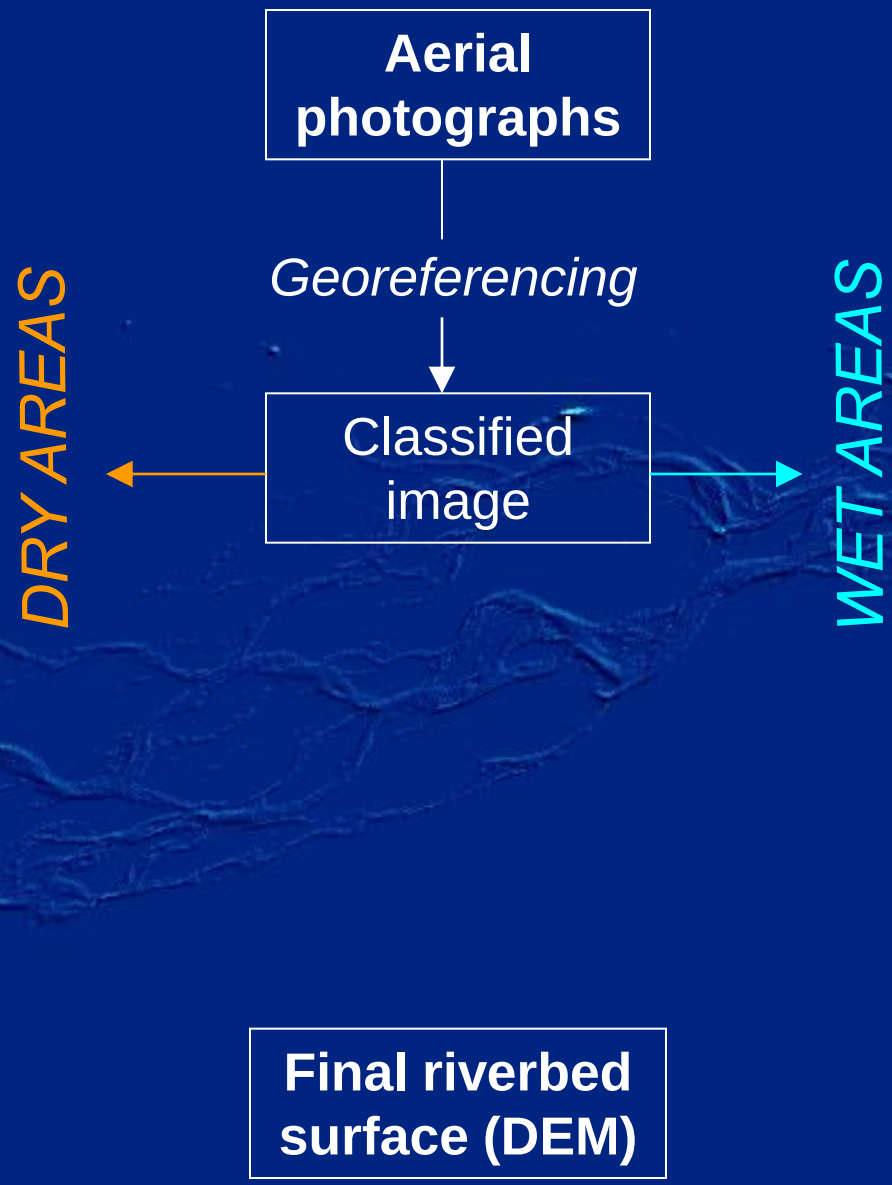
Remote survey method - Aim



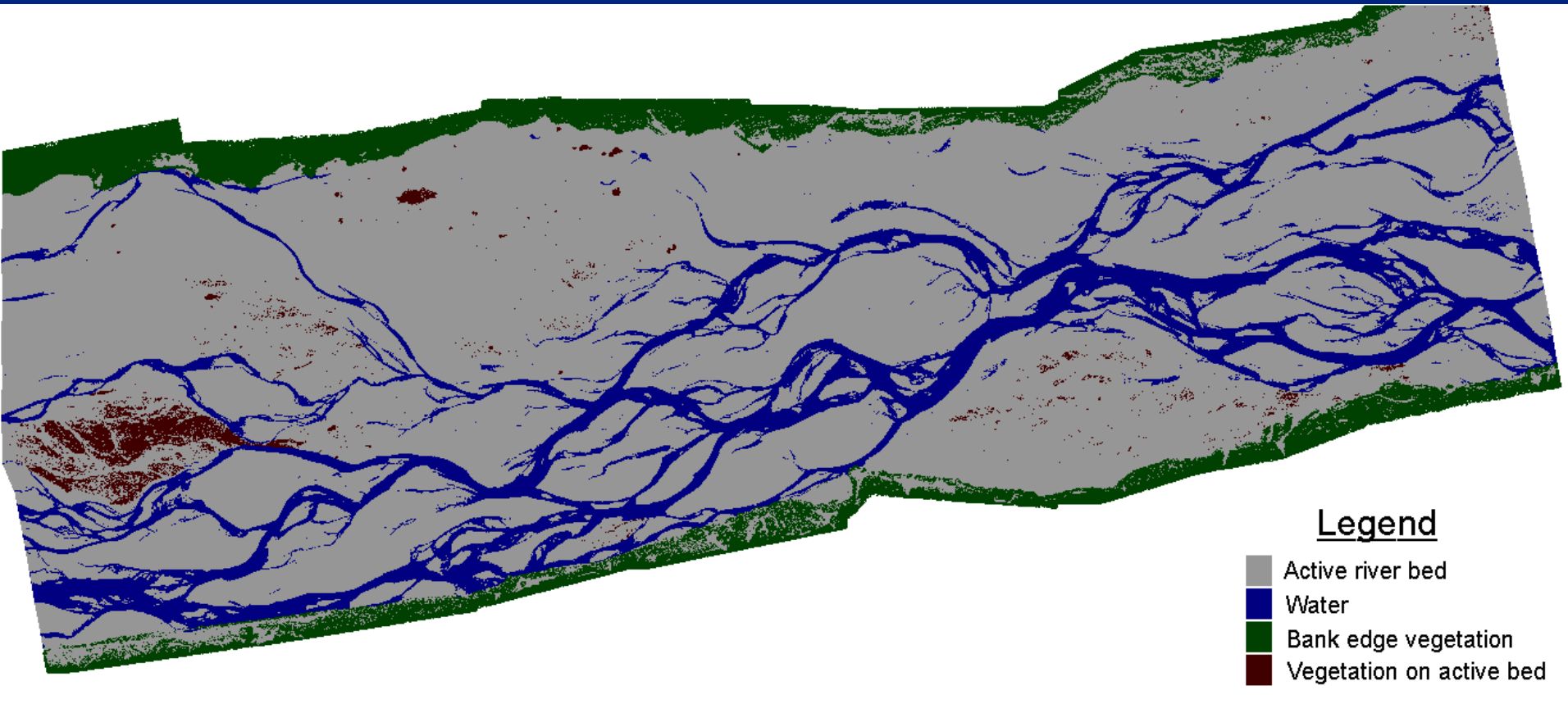
Aerial photographs - Feb 1999



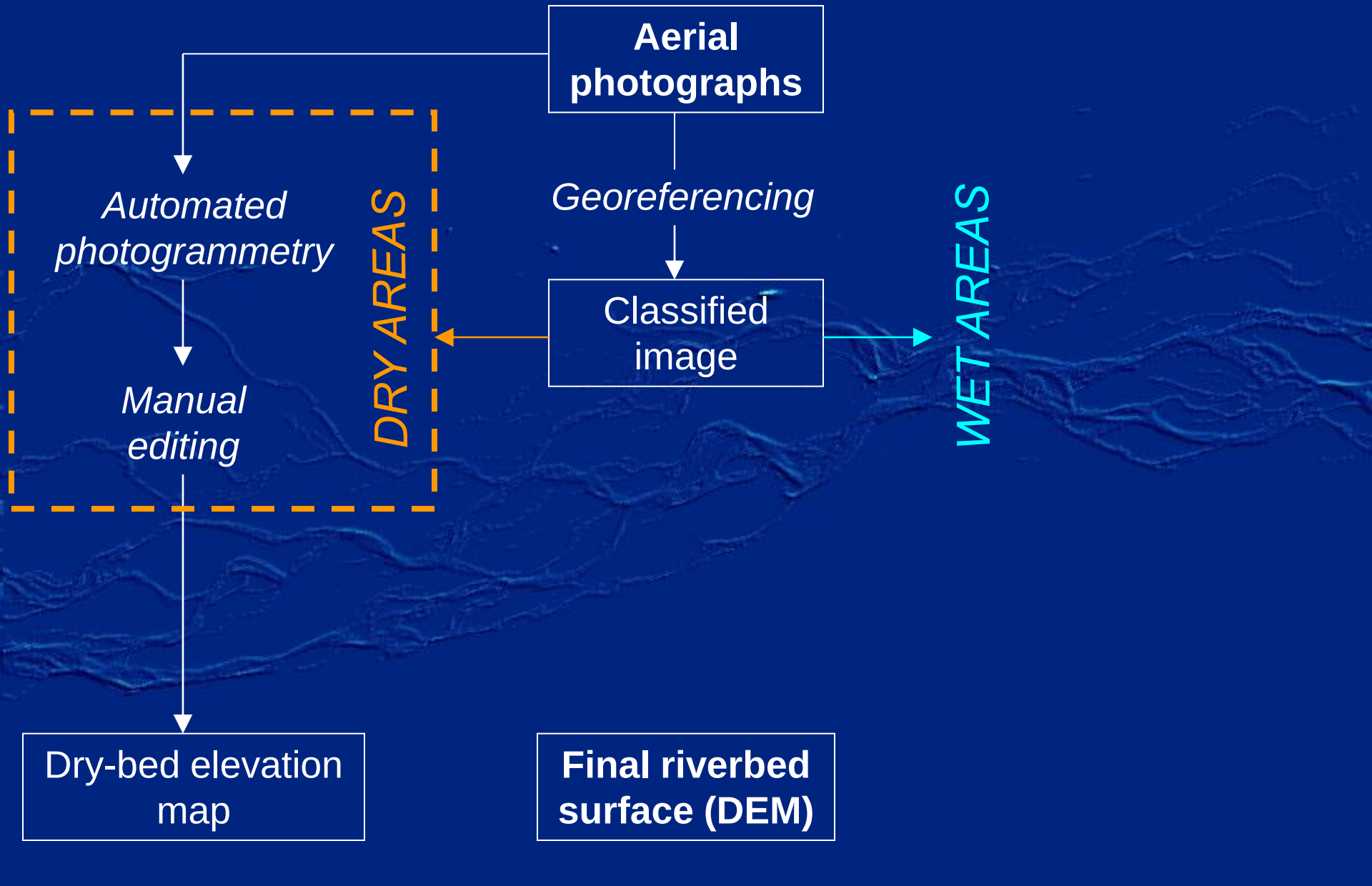
Remote survey method - Step 1



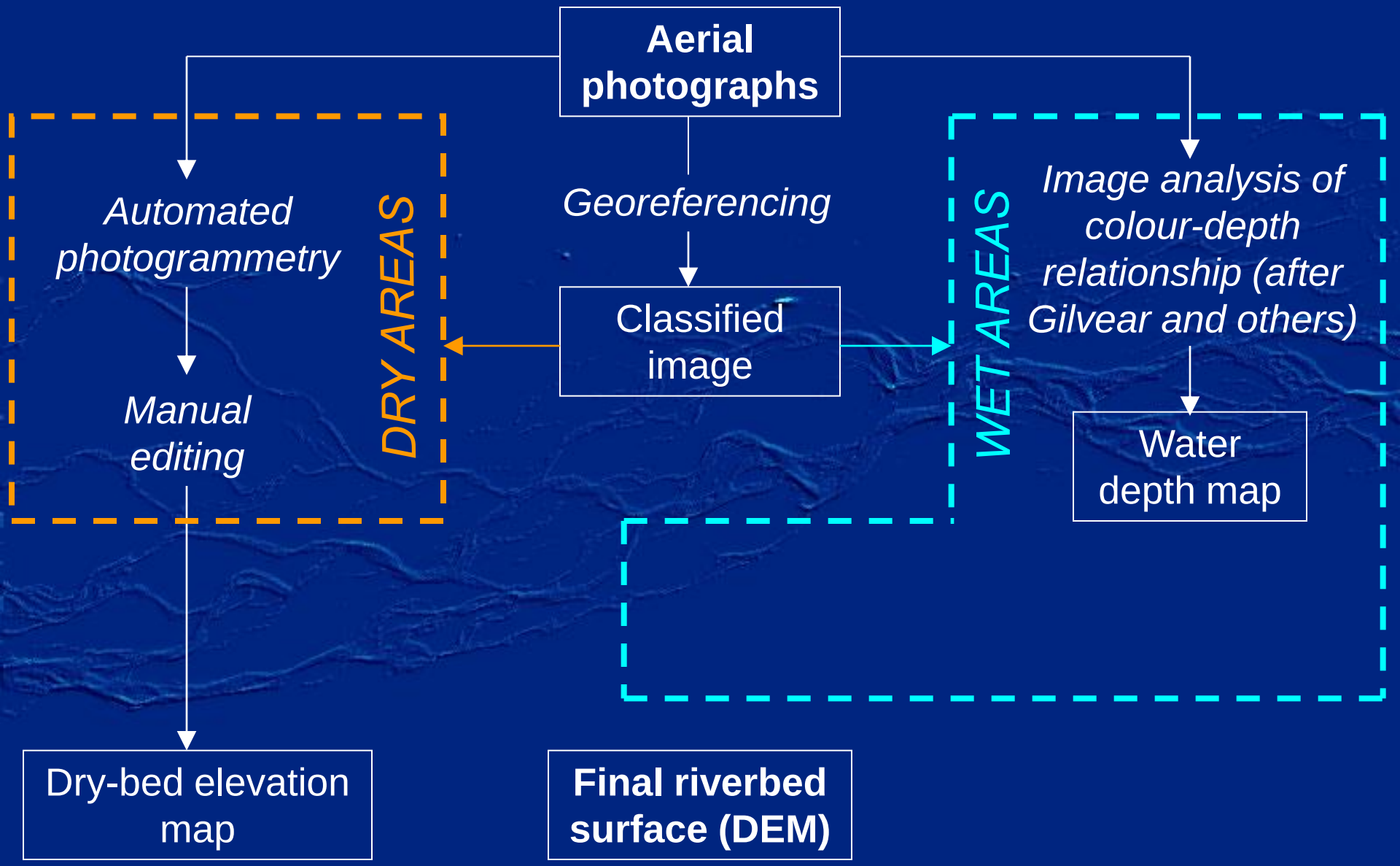
Classified image - Feb 1999



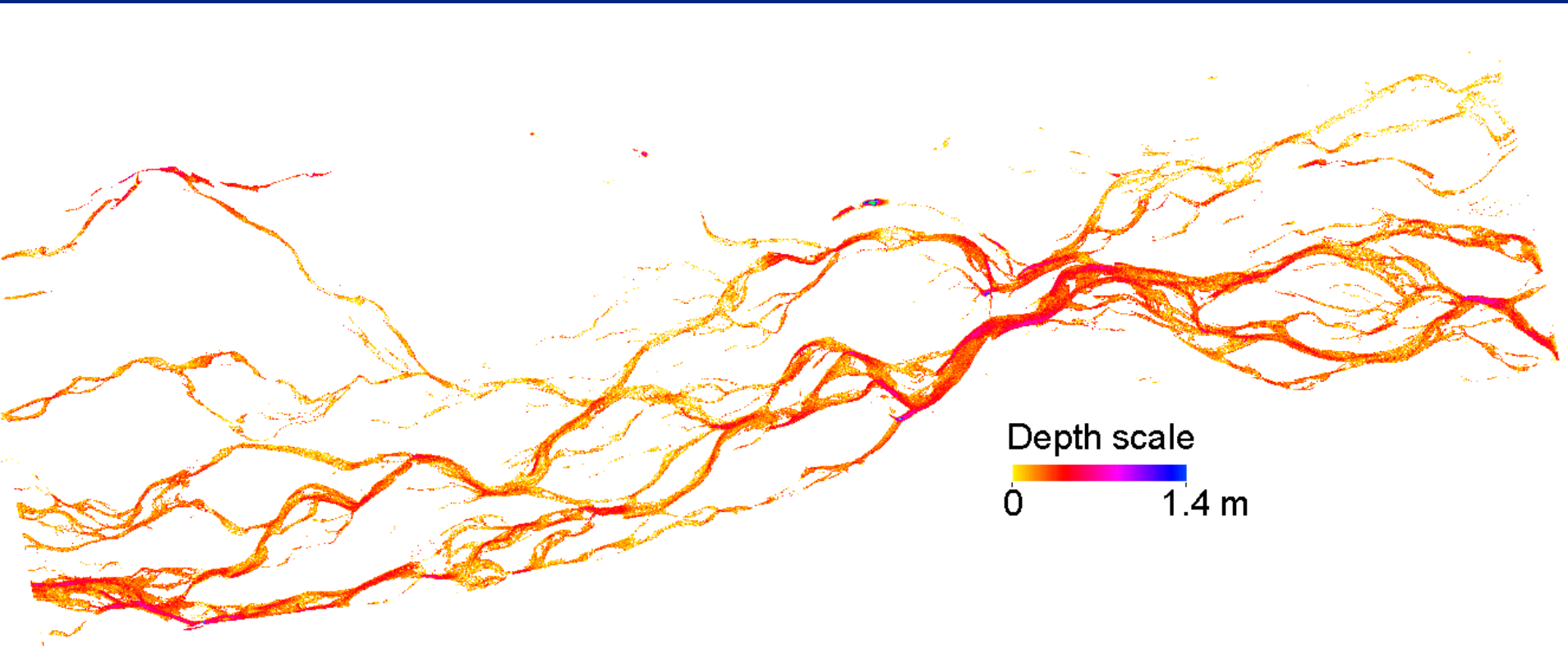
Remote survey method - Step 2



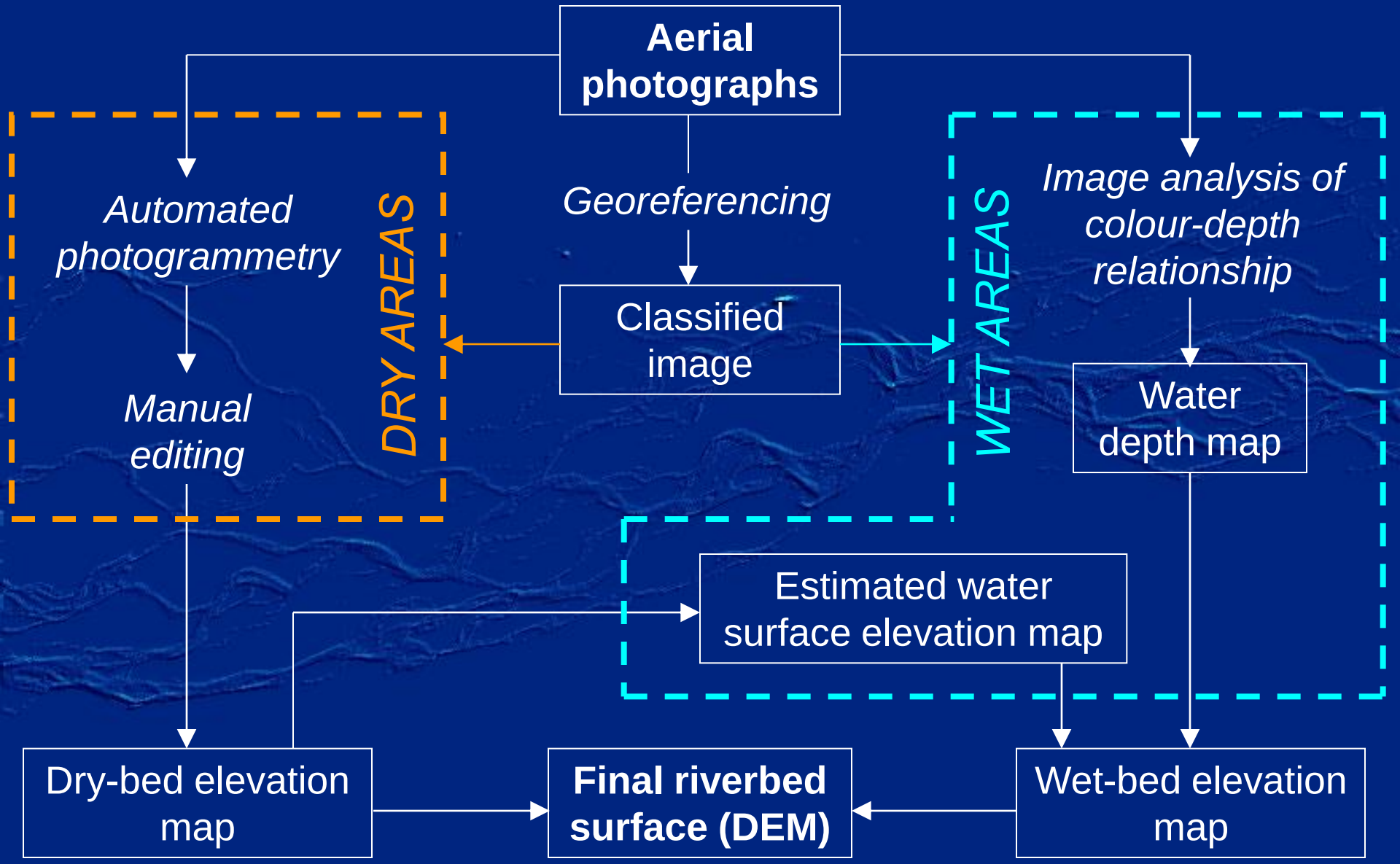
Remote survey method - Step 3



Water depth map - Feb 1999



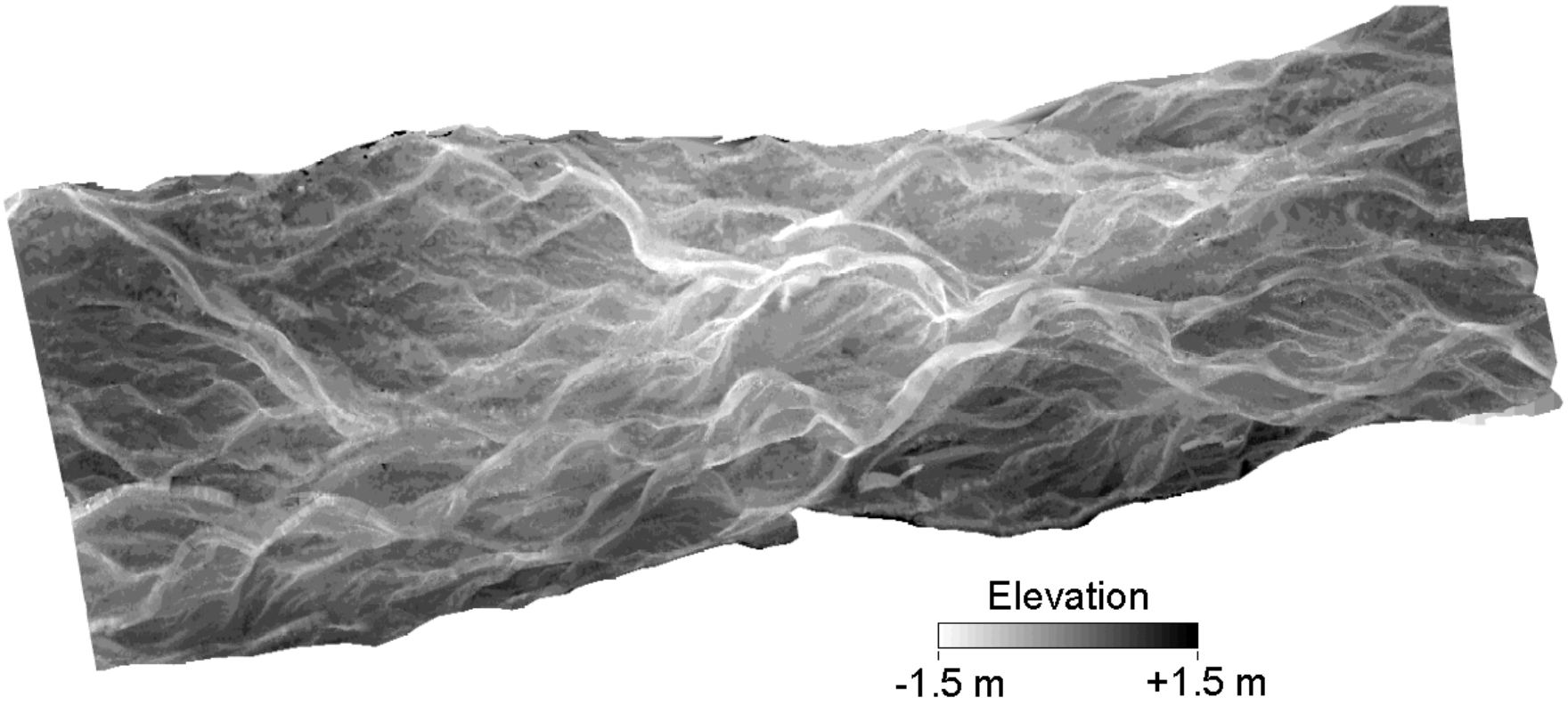
Remote survey method - Step 4



Progress to date

Epoch	Photogrammetry	Manual editing	Depth estimates	Final surface
Feb'99				
Mar'99				**Oct 2000**
Feb'00				**Dec 2000**

Final riverbed surface - Feb 1999



Results of quality assessment

Assessed in terms of mean error (ME) and standard deviation of error (SDE) from data collected by Environment Canterbury & NIWA

Riverbed zone	Number of points compared	ME (cm)	SDE (cm)
Dry	3703	+16	25
Wet	11232	+34	28

- Wet points have greater systematic error
  - probably due to underestimation of water depths
- Dry points also have bias
  - this only becomes a problem if error is spatially variable

Conclusions

- Digital photogrammetry and image analysis represent an effective way of surveying large gravel riverbeds
- …but there are unresolved issues
  - Systematic bias
  - ‘Banding effect’ found
  - See paper by Lane
- …and other (better?) technologies now exist
  - Laser altimetry - See poster paper by Hicks *et al*.

Future work & Further details

- Substantive analysis of surfaces:
  - ‘At epoch’:
    - 2D & 3D topography
    - Water routing
    - Scaling analyses
  - ‘Between epoch’:
    - Planform changes
    - Patterns of erosion and deposition
    - Morphological estimation of bedload transport rate
- Further details about the photogrammetric method can be found in the poster paper by Westaway *et al*.

DEM of difference:

Feb 1999 (photogrammetry) to May 2000 (laser altimetry)