Advances on river sediment properties and water quality

Rob Davies-Colley* – NIWA-Hamilton
Arman Haddadchi* – NIWA-Christchurch
Andrew Hughes– NIWA-Hamilton

STEC wrap-up meeting
Palmerston North,
13 September 2023.

Acknowledgements to –
Murray Hicks
Andrew Swales
Iain MacDonald
Fleur Matheson & Inigo Zabarte-Maetzu
NIWA WQ laboratory (esp. Ron Ovenden)

Climate, Freshwater & Ocean Science

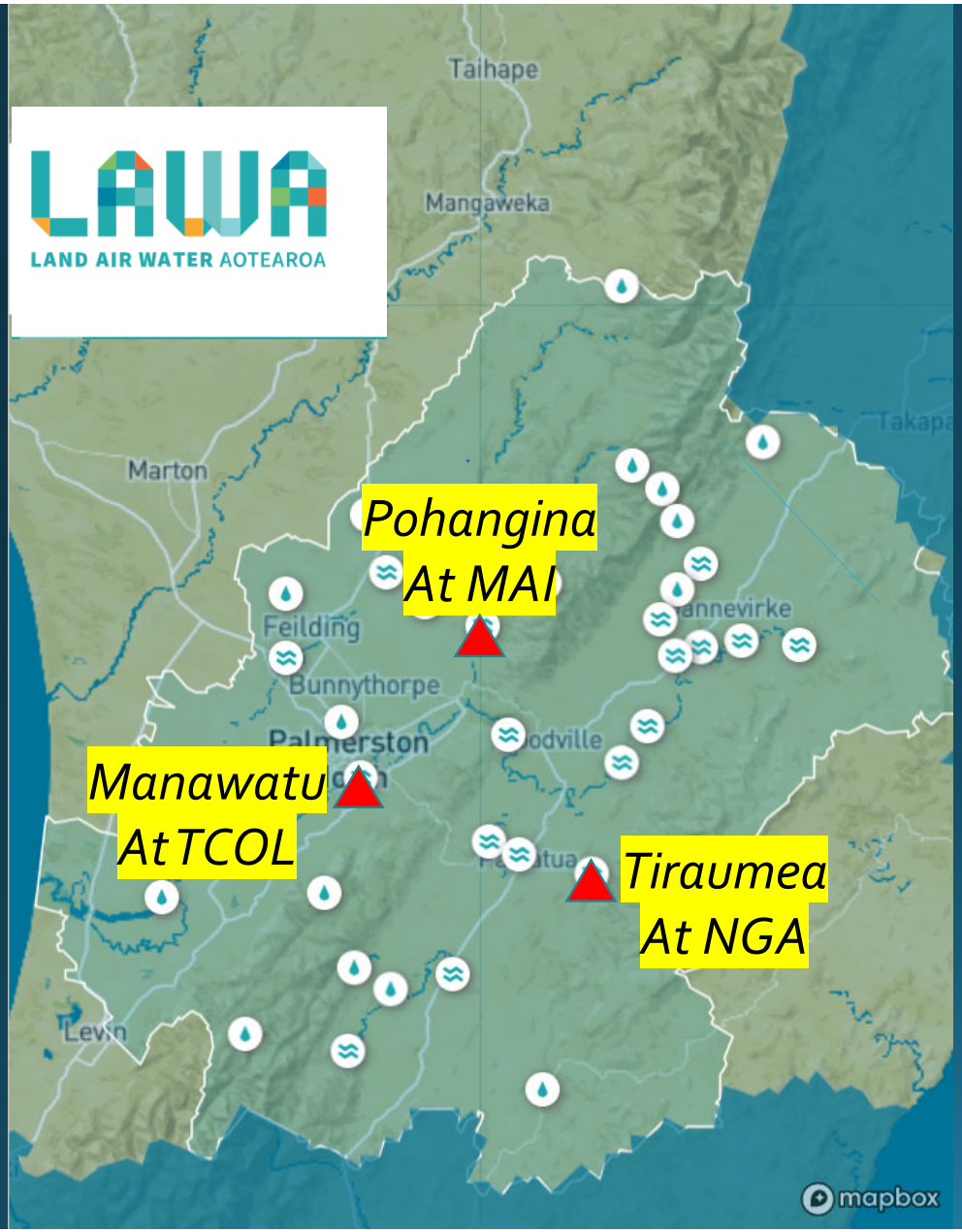
NIWA
Taihoro Nukurangi

Outline…

- Manawatu River sediment sampling
- Turbidity measurement
- Effects of fine sediment on rivers (NPS-FM)
- Downstream (coastal) FX of fine sediment
- *Lead-in to…* modelling of river sediment dynamics

Manawatu Flood 2004 (Fitzherbert Bridge) – TAMIRO

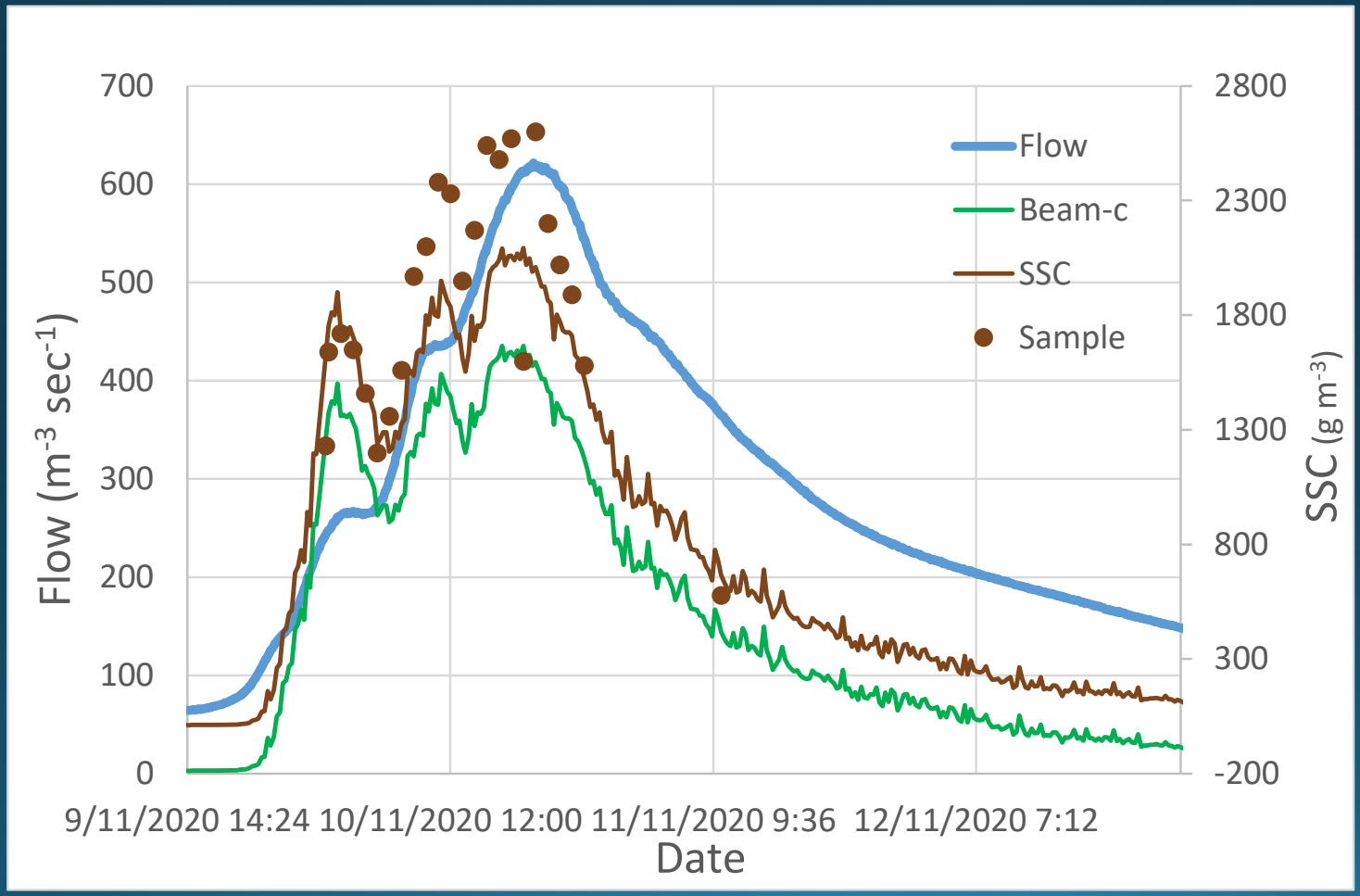
Sediment properties and water quality – Manawatu River (main STEC testbed)



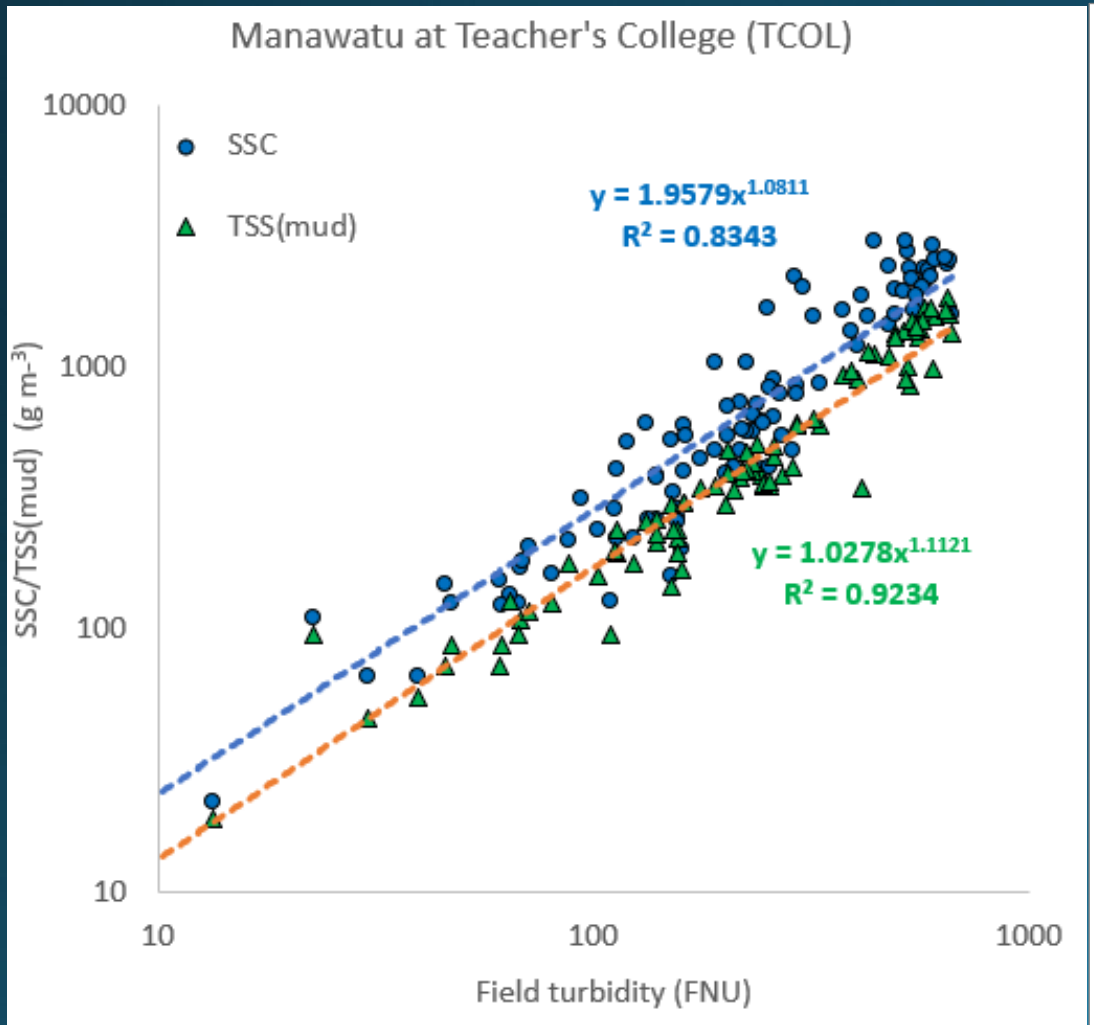
EXO2 sonde

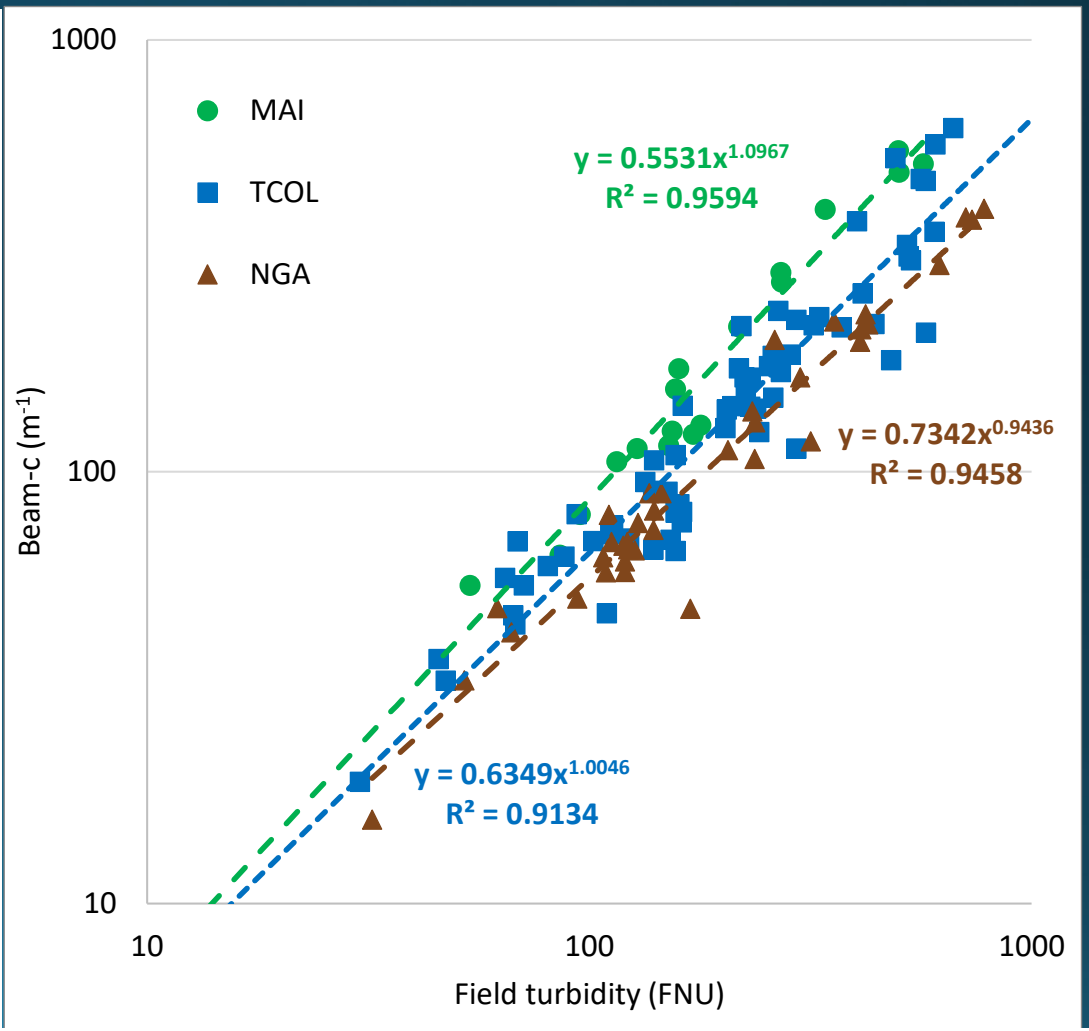
Hach auto-sampler

Measurements over flood events (Manawatu at TCOL November 10, 2020

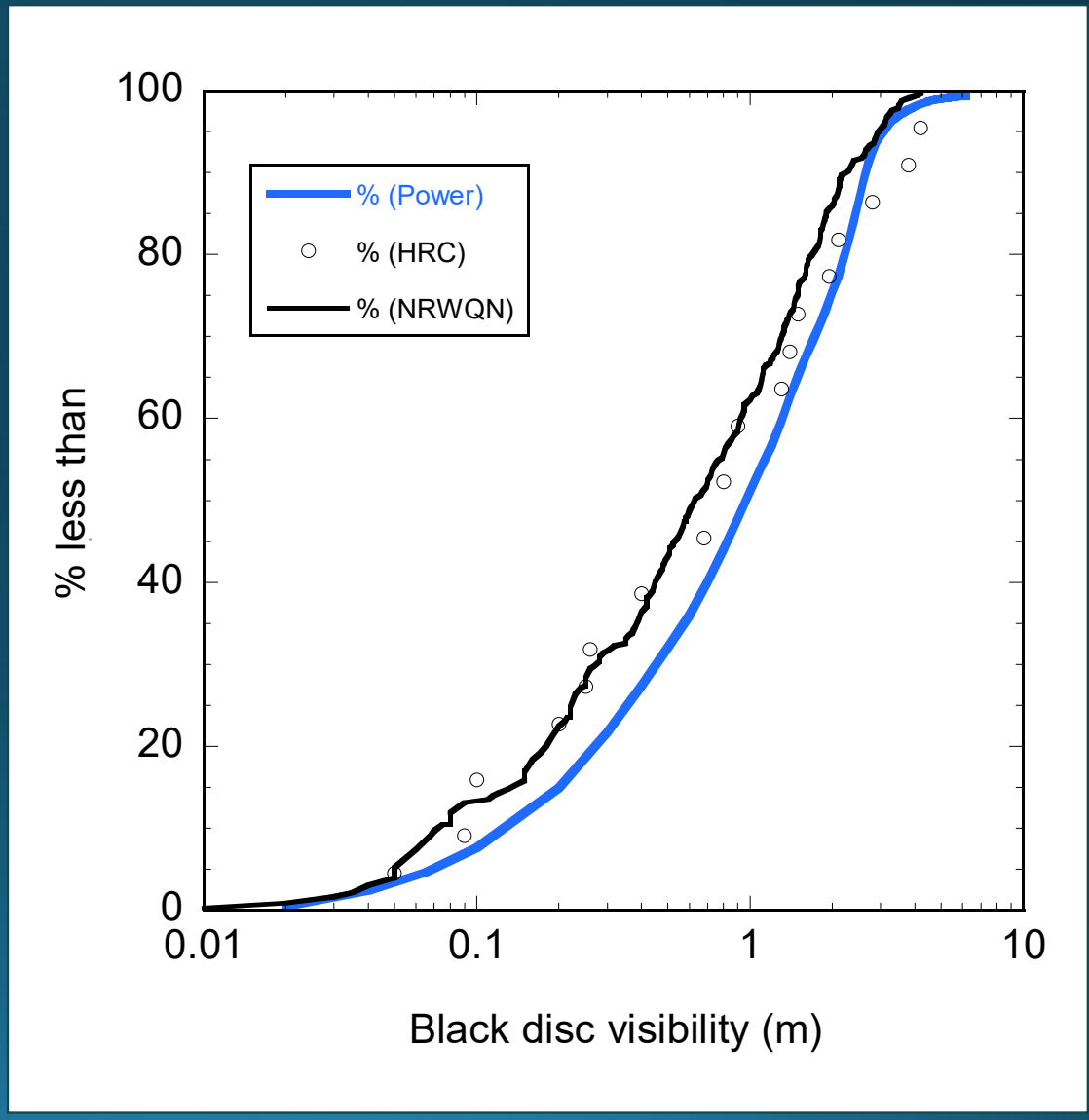


Results: SSC (and TSS) and beam-c vs field turbidity

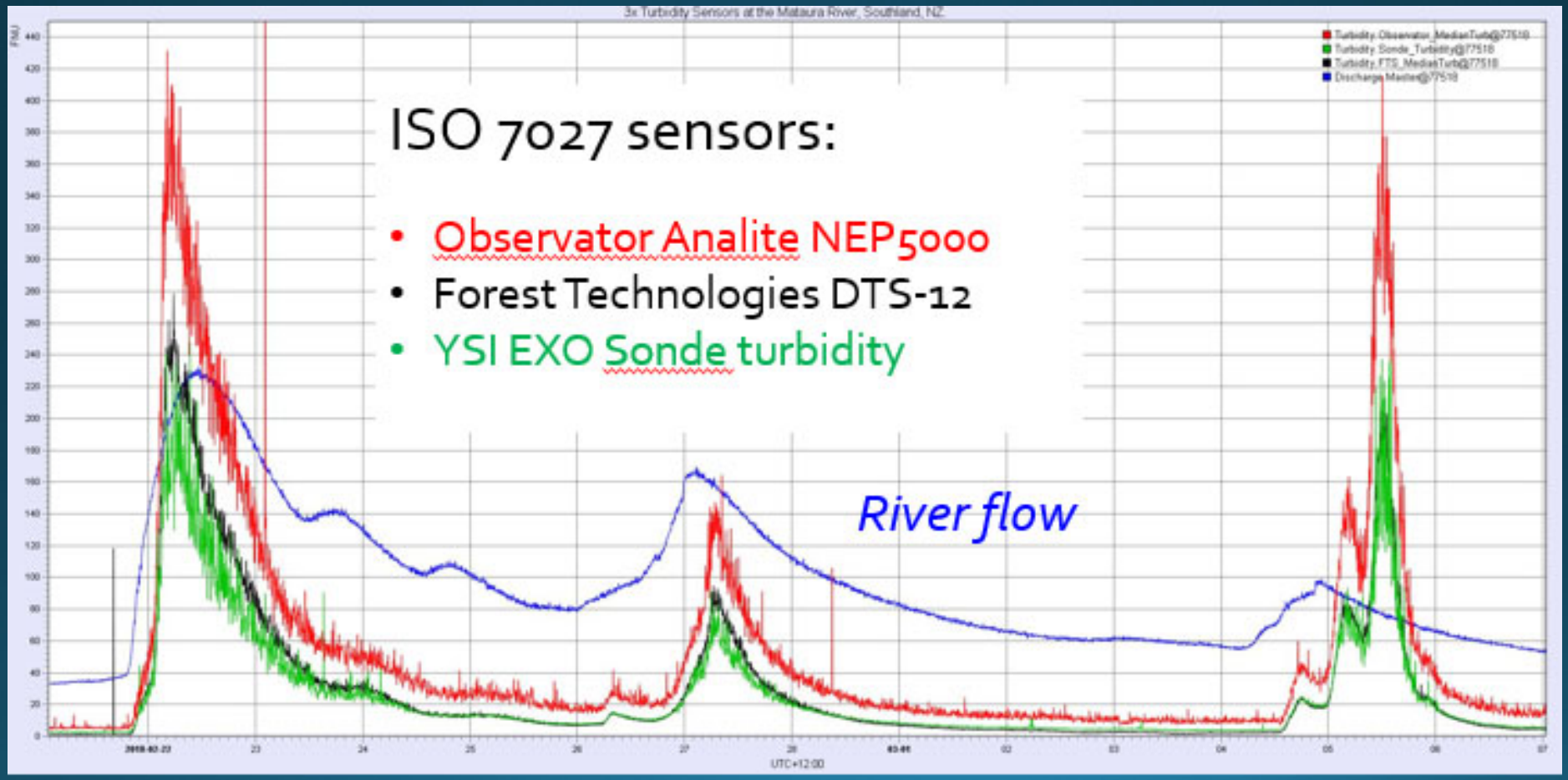




Visual clarity – *Manawatu at TCOL*



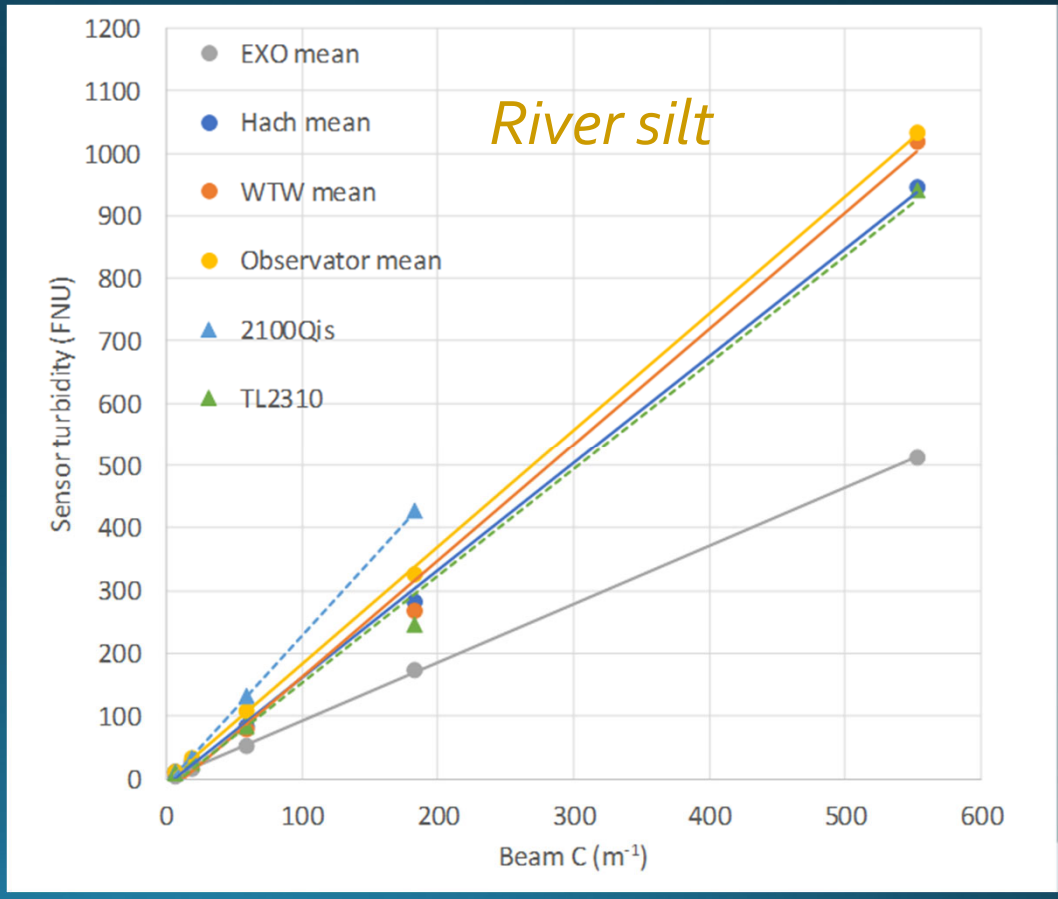
NIWA field turbidity records – *Mataura River*



Turbidity sensor comparisons – Envirolink-funded

River silt

Kaolinite



Ramifications – Far-reaching

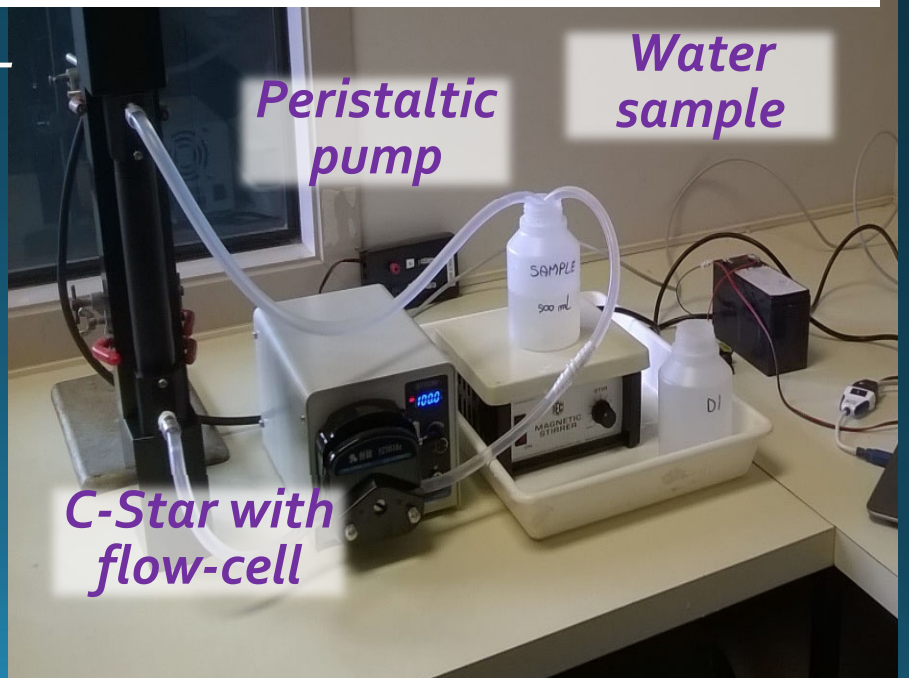
- Avoid reporting in FNU, NTUs (
  - no need for formazin!
- High-frequency turbidimeters are useful, *BUT*
  - calibrate to beam-c (or VC)
- Don't use turbidity in
  - studies of sediment effects on biota
  - environmental standards

Hydrological Processes

RESEARCH ARTICLE | Full Access

Weak numerical comparability of ISO-7027-compliant nephelometers. Ramifications for turbidity measurement applications

Rob Davies-Colley, Andrew O. Hughes, Alex G. Vincent, Stephan Heubeck

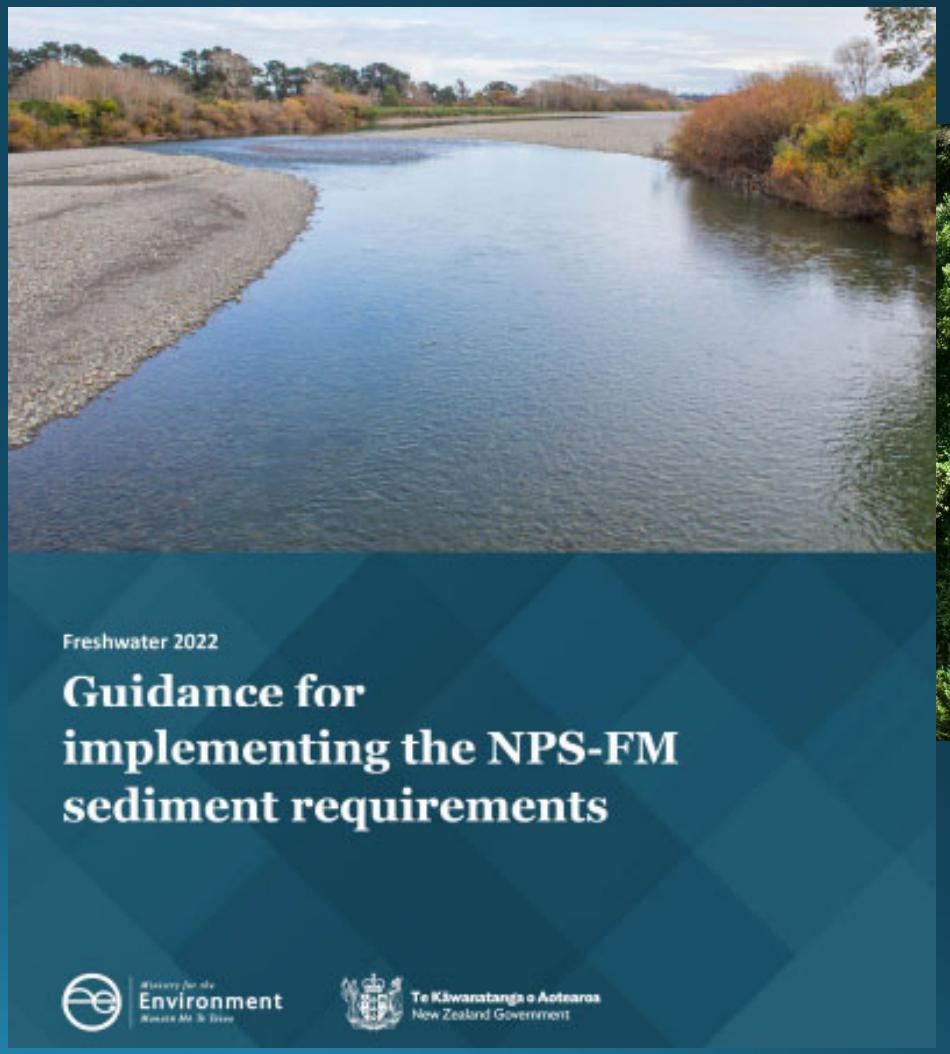


Measuring beam-c

Effects of fine sediment – national standards (for rivers)

- Work for MfE (2015-2020)
  - fine sediment attributes in the NPS-FM (2020)
- Standards (thresholds) for
  - **black disc visual clarity** (Table 8), and
  - **deposited fine sediment** (Table 16)
- *No standards for turbidity!*
- Guidance for implementing the NPS-FM fine sediment standards

https://environment.govt.nz/publications/guidance-for-implementing-the-npsfm-sediment-requirements/



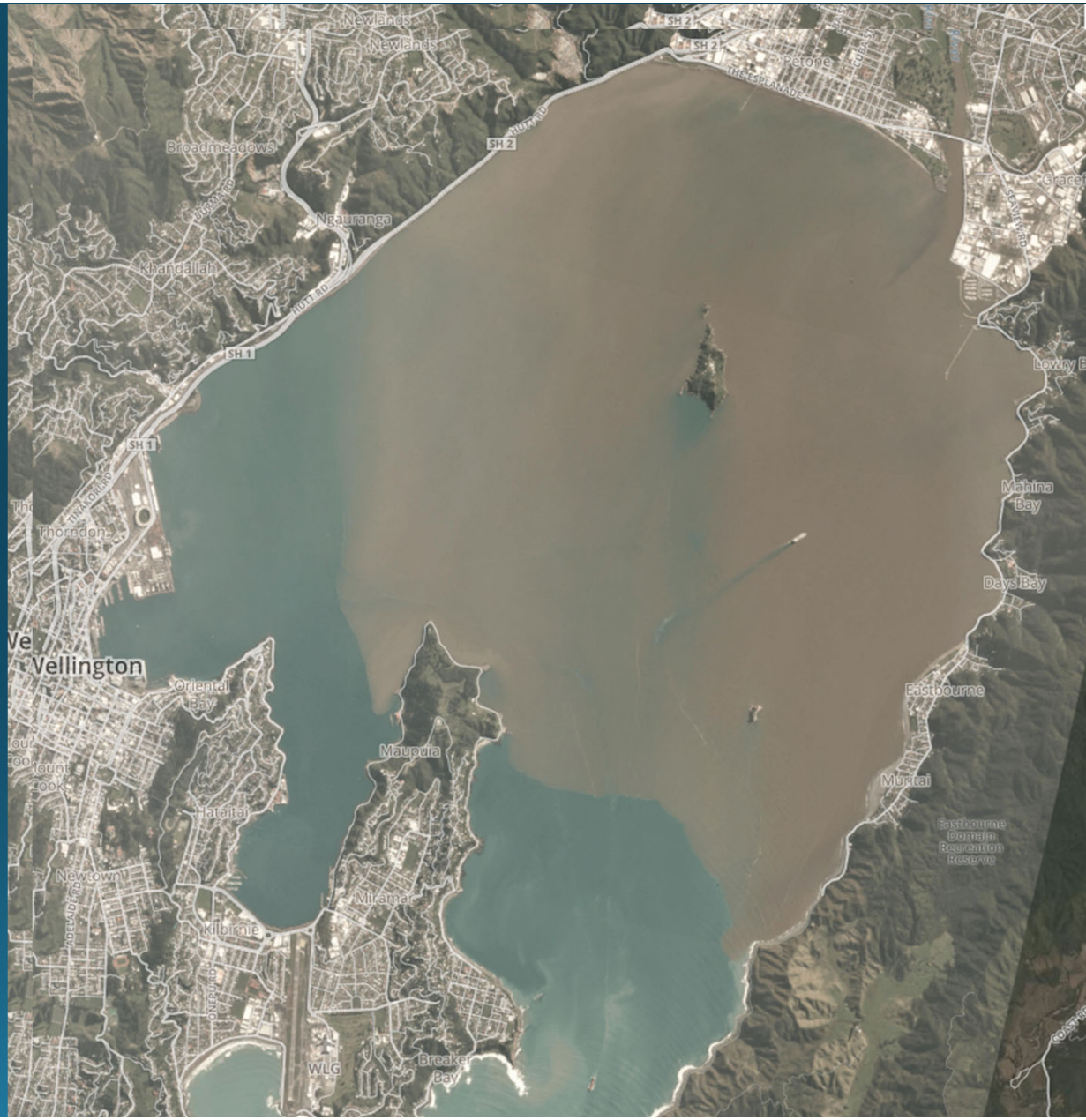
Muddy plumes – Downstream (coastal) effects of fine sediment

- River storm plumes
- Flocculation – Iain Mac
- Remote sensing
- HD modelling
- FX on Seagrasses (keystone sp)

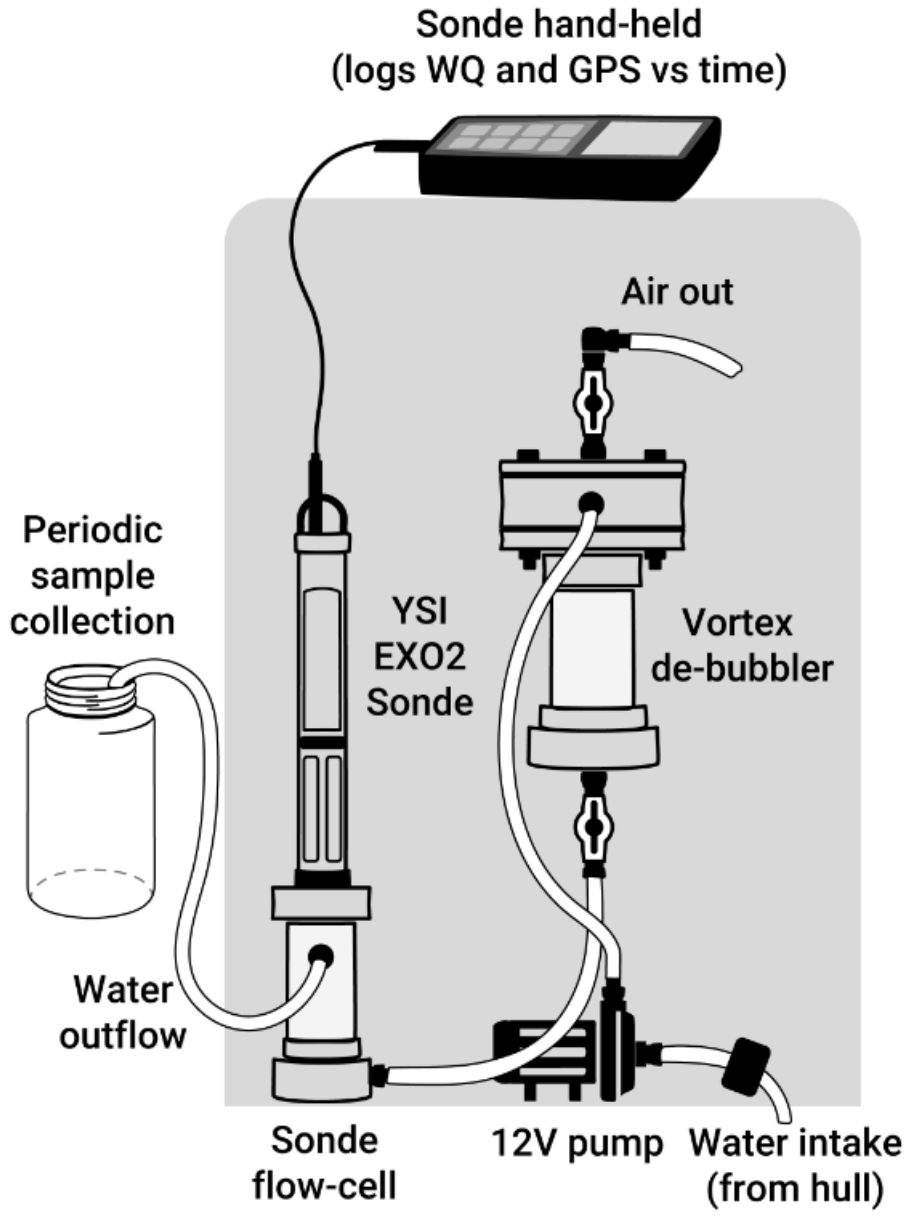
11 April 2018

(Rare cloud-free image!)

https://www.planet.com/

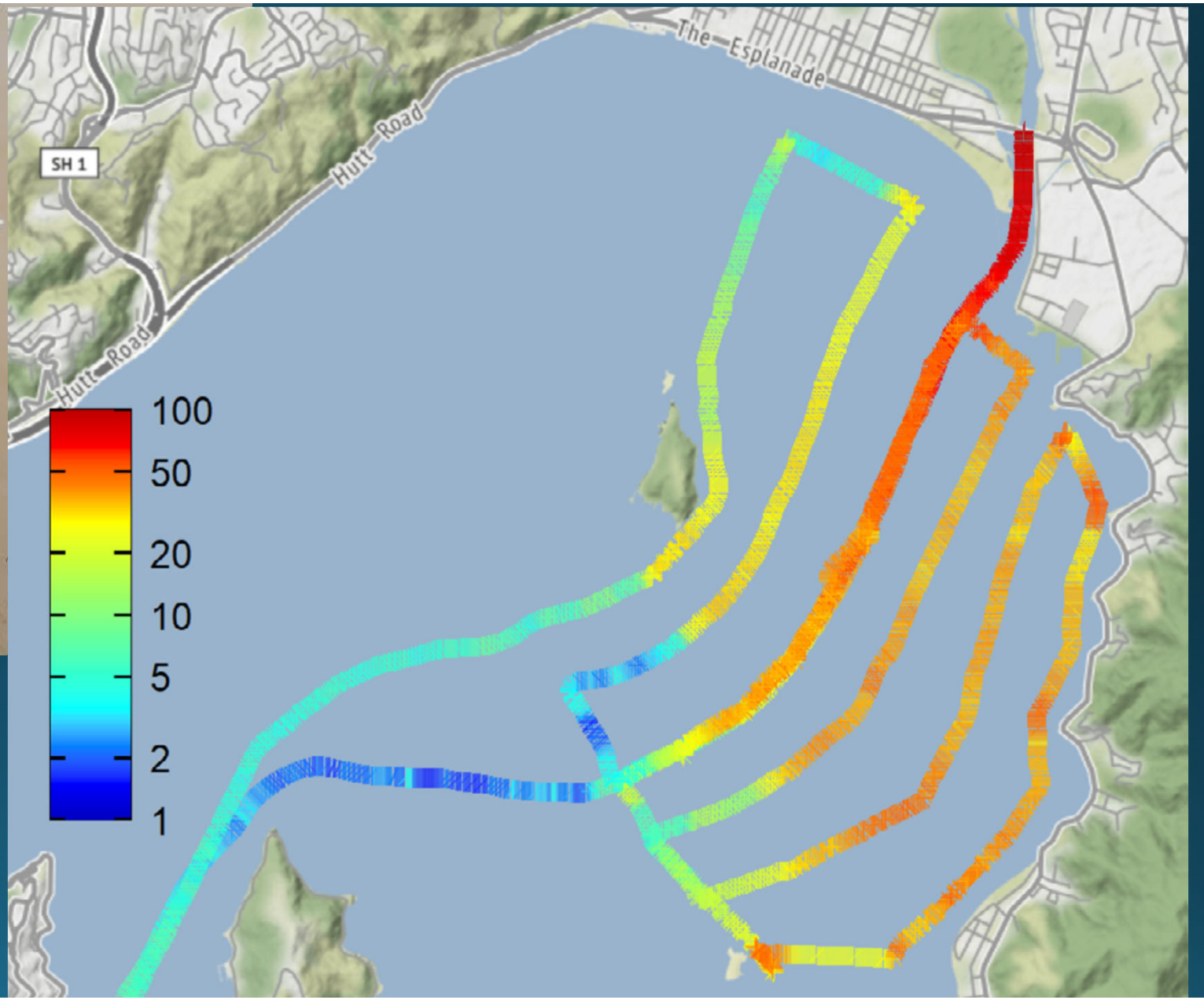


Sampling coastal plumes
PUFTS – rapid



River mouth –
4 cm vis!

Turbidity (FNU) along boat track



Sediment FX on seagrass

Contents lists available at ScienceDirect

Marine Environmental Research

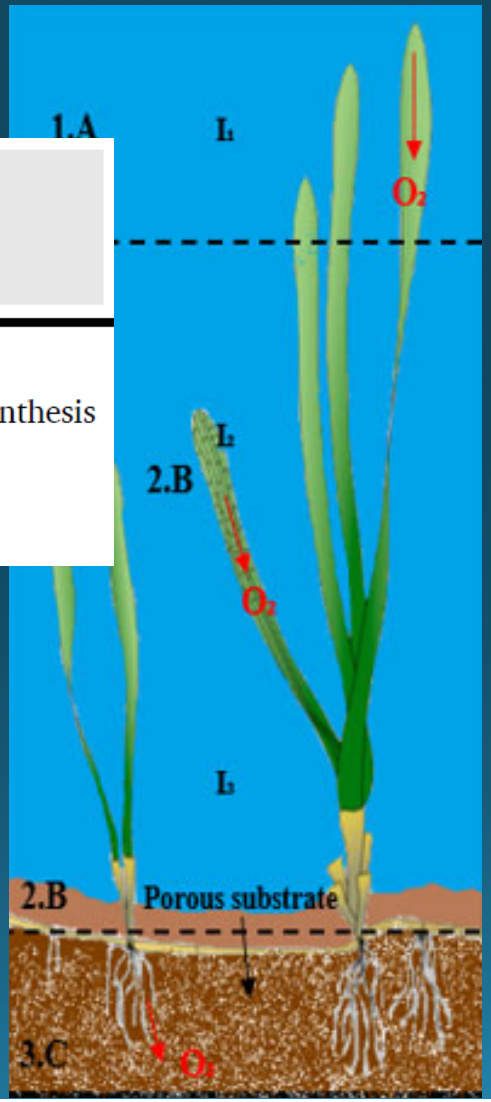
journal homepage: www.elsevier.com/locate/marenvrev

Review

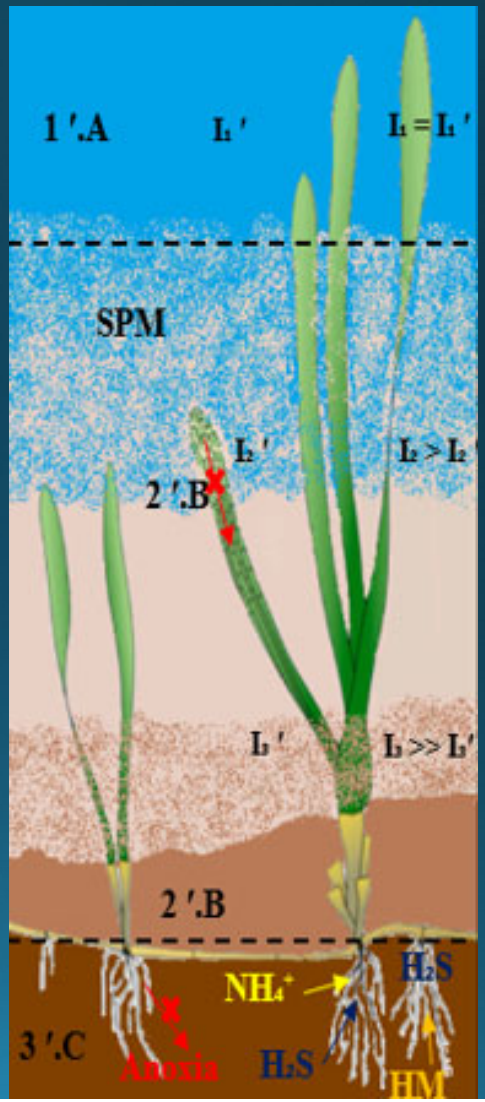
Fine sediment effects on seagrasses: A global review, quantitative synthesis and multi-stressor model

Iñigo Zabarte-Maeztu [a,b,*], Fleur E. Matheson [a], Merilyn Manley-Harris [b], Robert J. Davies-Colley [a], Ian Hawes [c]

Healthy seagrass



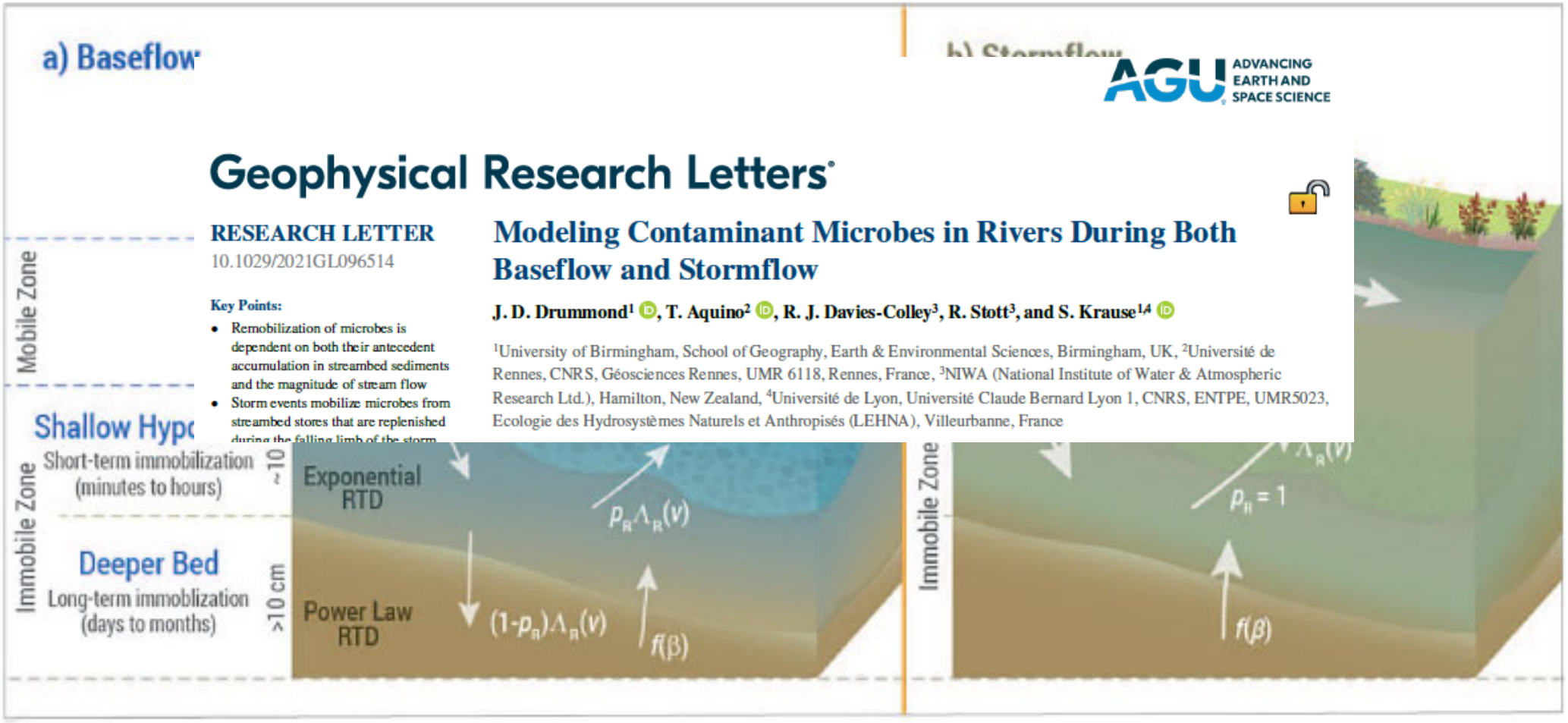
Mud damages…



Suspended fines – *Light attenuation*

Settled fines – *Smothering & anoxia*

Stochastic modelling of very fine particle dynamics in rivers?



Geophysical Research Letters

RESEARCH LETTER
10.1029/2021GL096514

Modeling Contaminant Microbes in Rivers During Both Baseflow and Stormflow

J. D. Drummond[1], T. Aquino[2], R. J. Davies-Colley[3], R. Stott[3], and S. Krause[1,4]

[1]University of Birmingham, School of Geography, Earth & Environmental Sciences, Birmingham, UK, [2]Université de Rennes, CNRS, Géosciences Rennes, UMR 6118, Rennes, France, [3]NIWA (National Institute of Water & Atmospheric Research Ltd.), Hamilton, New Zealand, [4]Université de Lyon, Université Claude Bernard Lyon 1, CNRS, ENTPE, UMR5023, Ecologie des Hydrosystèmes Naturels et Anthropisés (LEHNA), Villeurbanne, France

Key Points:

- Remobilization of microbes is dependent on both their antecedent accumulation in streambed sediments and the magnitude of stream flow
- Storm events mobilize microbes from streambed stores that are replenished

Take-homes

- Sediment properties – as important as sediment mass

  (Light attenuation by SS – as important as sedimentation)
- NPS-FM (2020) – requires management of *visual clarity* (awa fines deposition)
- Muddy plume effects on coastal waters can be severe

- Review of sediment FX on seagrass – justifies erosion control to avoid far-field damages
- Turbidity – a useful high-freq. proxy…

  *(BUT c*alibrate to beam-c ; dispense with formazine)