NIWA
Taihoro Nukurangi

WMO HydroHub Innovation Call in the Pacific

Climate, Freshwater & Ocean Science

Non-contact measurement of river flows in the Pacific region

Surface velocimetry and stereoscopic camera stations

Hamish Biggs, Evan Baddock, Andrew Starr, Brendon Smith, Alec Dempster

enhancing the benefits of New Zealand's natural resources

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Project Overview

Objectives/deliverable:

(1) Provide advice and training on flow measurement with Surface Velocity Radar (SVR), smart phones, and trail cameras.

(2) Develop a novel stage triggered stereoscopic camera station for capturing flood flows.

(3) Deploy stereoscopic camera stations in Fiji with the Fiji Meteorological Service (FMS) and the Pacific Community (SPC).

Project duration:

1st September 2022 -> 30th September 2023

Project team:

NIWA – Hamish Biggs, Andrew Starr, Evan Baddock, Brendon Smith, Alec Dempster, Andrew Willsman, Shaun Williams

SPC – Tom Stewart, Jacqui Reid, John Carreon, Peter Sinclair

FMS – Viliame Vereivalu, Sepesa Gauna, Iowane Valuibulu

WAF – Jone Wainitasi

Surface Velocity Radar (SVR) Training

Surface Velocity Radar (SVR) Training & Cross Section Surveys

Surface Velocity Radar (SVR) Training

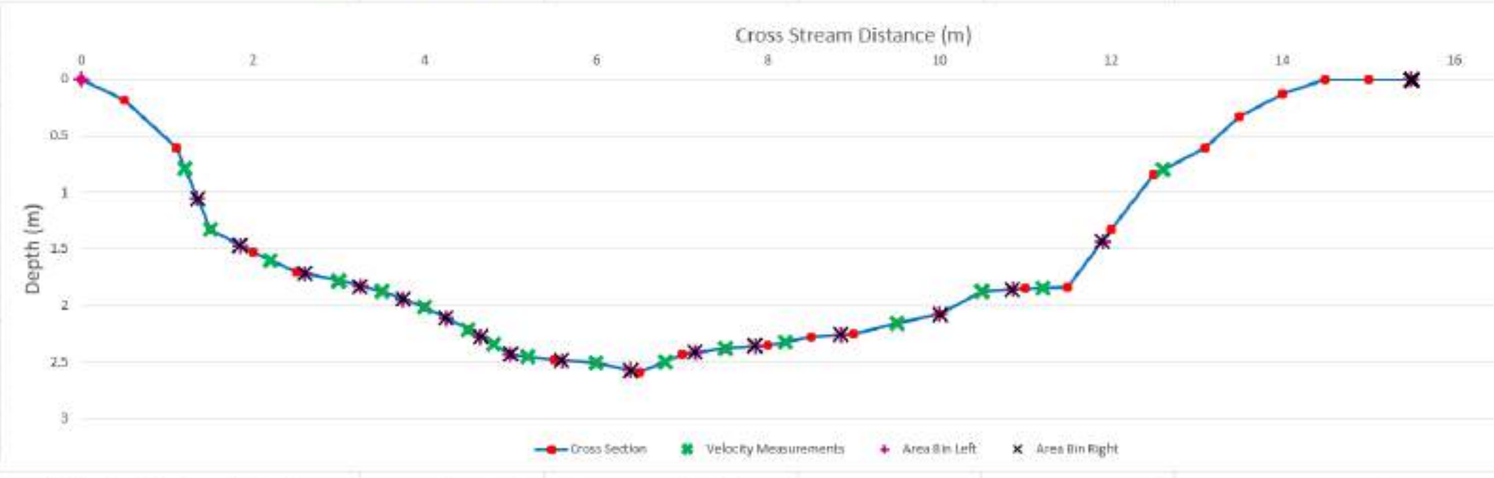
Surface Velocity Radar (SVR) Training – Discharge Calculator

Fiji › SVR Training Resources

Name

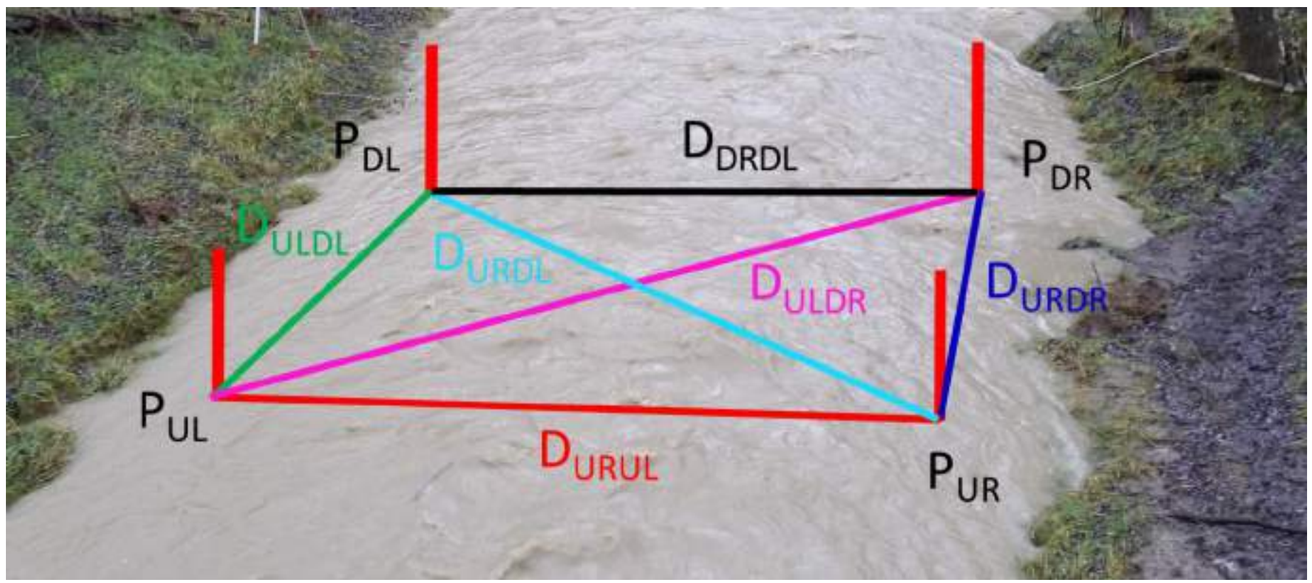
- Training Data - Hurunui River
- Baddock E - SVR Data Collection - Finished
- NIWA Surface Velocimetry Discharge Calculator - V1.4
- Radar Velocity Gun Gauging Field Form - V1.1
- SOP - Surface velocity radar gaugings - Fiji - V1.1
- Stalker_Pro_II_operator_manual

	A	B	C	D	E	F
1	**NIWA Surface Velocimetry Discharge Calculator**					
2						
3	**Options:**		**Notes:**			
4	Cross Section Water Level To Use	New WL	Type: "Original WL" or "New WL"			
5						
6	**Cross Stream Distance To Surface Velocity (m)**	**Surface Velocity (m/s)**	**Alpha (default = 0.857)**	**Area Bin (m^2)**	**Discharge Bin (m^3/s)**	**Notes:**
7	TRUE LEFT BANK	TRUE LEFT BANK			TRUE LEFT BANK	
8	1.2	0.1	0.857	0.48603125	0.041652878	
9	1.5	0.15	0.857	0.66896875	0.085995933	
10	2.2	0.22	0.857	1.2033	0.226870182	
11	3	0.32	0.857	1.15045	0.315499408	
12	3.5	0.45	0.857	0.941875	0.363234094	
13	4	0.58	0.857	1.009375	0.501719938	
14	4.5	0.65	0.857	0.87645	0.488226473	
15	4.8	0.68	0.857	0.82355	0.479931998	
16	5.2	0.62	0.857	1.4758	0.784151572	
17	6	0.58	0.857	2.016	1.00207296	
18	6.8	0.52	0.857	1.876575	0.836276883	
19	7.5	0.45	0.857	1.66845	0.643437742	
20	8.2	0.35	0.857	2.305	0.69138475	
21	9.5	0.25	0.857	2.500675	0.535769619	
22	10.5	0.15	0.857	1.644325	0.211377979	
23	11.2	0.05	0.857	1.855075	0.079489964	
24	12.6	0.03	0.857	1.4461	0.037179231	
25		0	0.857	0	0	
26		0	0.857	0	0	
47		0	0.857	0	0	
48	TRUE RIGHT BANK	TRUE RIGHT BANK			TRUE RIGHT BANK	
49						
50	**Total Discharge (m^3/s):**	**7.324271602**				
51						
52	**Notes on calculations:**					
53	Surface velocity measurement locations can be irregularly spaced.					
54	The edges of surface velocity bins (i.e. dA) are equidistant between surface velocity measurement locations. Except for first and last bins, which extend to the left bank and right bank of the cross section.					
55	Trapezoidal integration is used to find the area of each surface velocity bin. This integration follows the cross section profile between the left and right edges of the bins.					
56	This method of finding the area of each surface velocity bin along the cross section profile is much more accurate than simply using the bin edge points.					
57	Password to unlock the workbook is: UNLOCK					
58	Please copy and rename the workbook before unlocking it and editing.					
59						

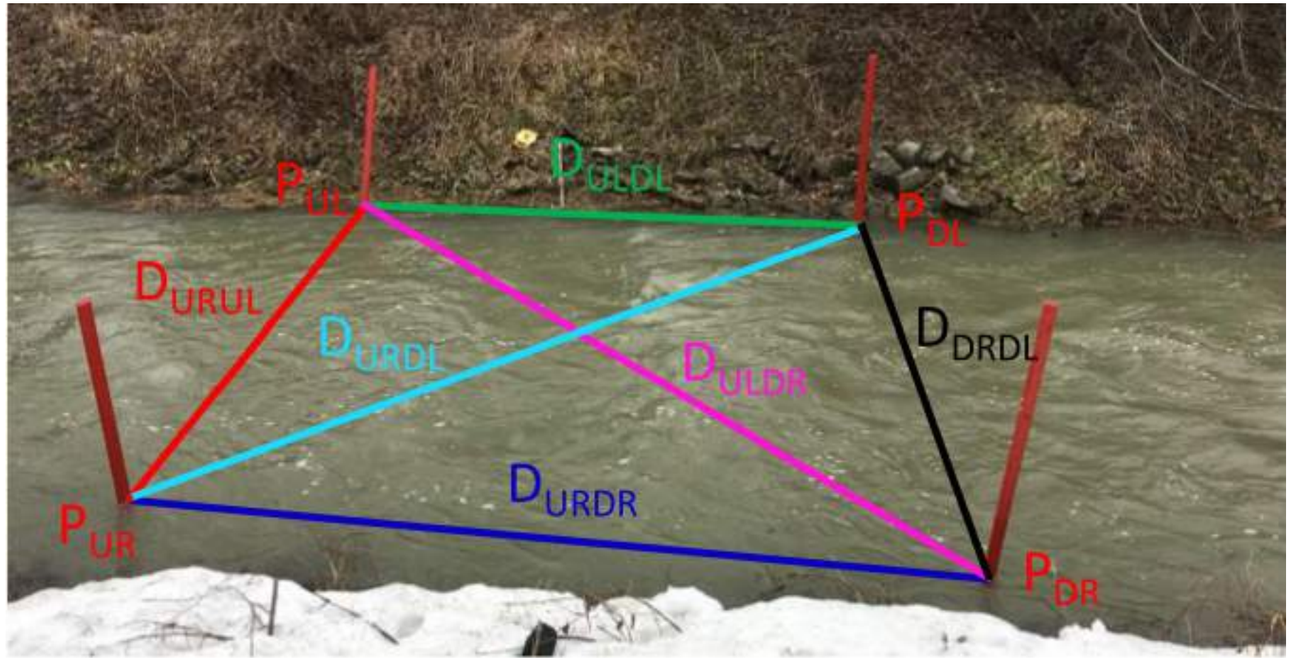


Velocity and Discharge | Original Cross Section - 1st WL | Updated Cross Section - New WL

Surface Image Velocimetry Training - 4 GCPs at water level



Training Image - Stanton River New Zealand



Training Image - Courtesy of Frank Engel [USGS]

Surface Image Velocimetry Training - 4 GCPs at water level

Single Camera Surface Image Velocimetry Training

Single Camera Surface Image Velocimetry Training

Fiji › Surface Image Velocimetry Training Resources

Name

- Fudaa-LSPIV - 1.9.2 - Installation Files
- Training Data - Hurunui River
- Training Data - Stanton River
- Alex Hauet - EDF France - Training Demo - Data processing Fudaa LSPIV
- Alex Hauet - Fudaa-LSPIV tutorial 1 - Import images
- Alex Hauet - Fudaa-LSPIV tutorial 2 - Stabilize images
- Biggs 2022 - Drone Flow User Guide - Released V1.1
- Biggs et al 2021 - A field guide for selecting alpha - Envirolink Advice Rep...
- Biggs H - Fudaa-LSPIV Video 1 - Import - Stablisation - Orthorectification
- Biggs H - Fudaa-LSPIV Video 2 - Grid generation
- Biggs H - Fudaa-LSPIV Video 3 - Setting LSPIV parameters.mp4
- Biggs H - Surface Image Velocimetry Measurement Sites and Stereoscopic...
- Biggs H - SVR and cross section data processing - FINISHED
- Fudaa LSPIV 4x GCPs At Water Level
- Jerome Le Coz and Alex Hauet - Fudaa-LSPIV Presentation
- Mark Randall - Hydro-STIV Demo Using Drones and Fixed Camera videos
- NIWA Surface Velocimetry Discharge Calculator - V1.4
- Randall 2021 - Australian National Guidelines for hydrometric monitoring ...
- User Manual - Fudaa-LSPIV 1.9.2
- User Manual - Hydro-STIV

Stereoscopic camera stations – Innovation part of project

Design:

- Triggered by water level (or timelapse).
- Top end of rating curve from a single flood event.
- Rivers and streams in remote locations.
- Sites with forest and tree cover.
- 4k and wide field of view.
- Camera 1 for imagery (i.e. 20 second videos).
- Camera 2 for 3D reconstruction (stereo image pair).
- Objective: No GCPs and surveying needed.

Hardware:

- Housing: BIT-HS4211 from BIT-CCTV Ltd.
- CPU: Intel NUC i7, 16 GB RAM, 1 TB SSD.
- Cameras: 2x Basler Ace acA4024-29uc.
- Lenses: 2x C23-0824-5M-P f8mm.
- PCB: Mode selection, real time clock, reading water level recorder & camera triggering.
- Power supply: Murata UQQ-15/7-Q12PB-C.
- Battery: 12.8V 12Ah LiFePO4.

Stereoscopic Camera Station Controller (Slide 2)

MODE:

- ST (Stage Triggered).
  - Record video when water level changes by certain amount (i.e. sensor_delta in ‘config.txt’).
- TL + ST (Time Lapse + Stage Triggered).
  - This mode does both TL and ST.
  - This also functions as an ‘instant record button’.
    - Turn to this mode, then press SELECT/TRIGGER to manually record a video.

NOTES:

- NOTE 1: To change modes turn the rotary switch then press SELECT/TRIGGER.
- NOTE 2: Green Status LED will indicate when the camera is on/active.

Rakiraki Catchment – Water Level Recorders

Stereoscopic Camera Station Training

Stereoscopic Camera Station Installations - Vatukacevaceva

Stereoscopic Camera Station Installations - Vatukacevaceva

Stereoscopic Camera Station Installations - Vatukacevaceva

Stereoscopic Camera Station Installations - Vatukacevaceva

Stereoscopic Camera Station Installations - Vatukacevaceva

Stereoscopic Camera Station Installations - Narara

Stereoscopic Camera Station Installations - Narara

Stereoscopic Camera Station Installations – Completed!

Next steps?

Short term:

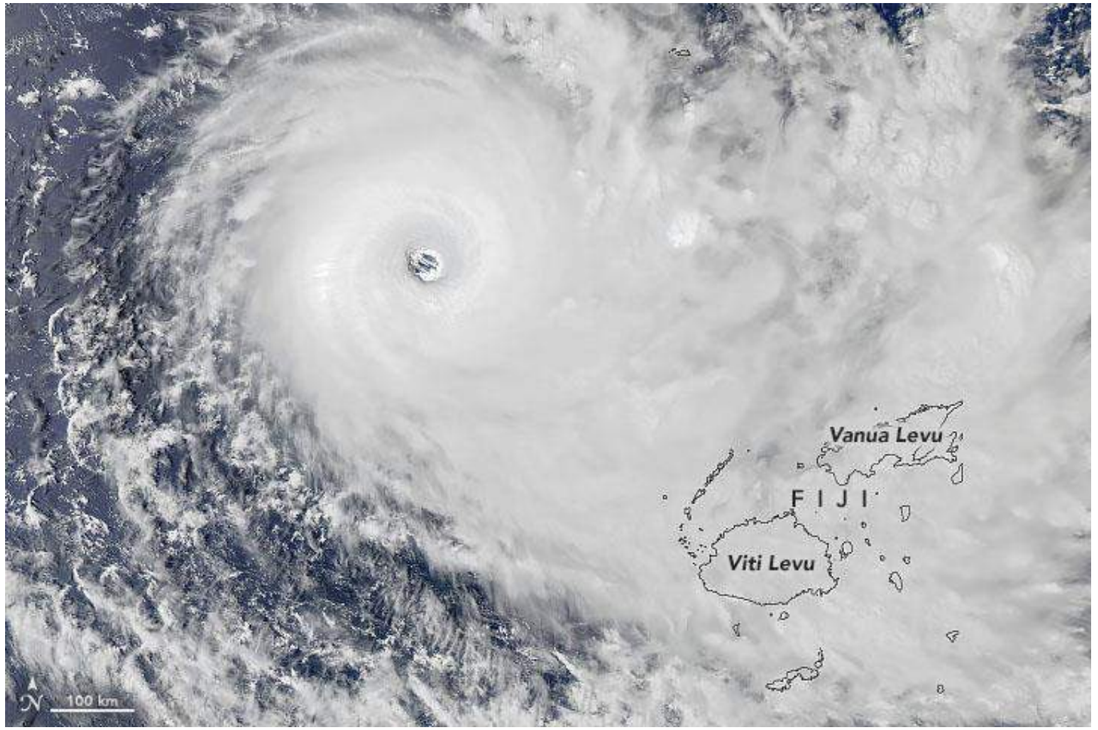
- Finish advice documents and final report [*Project Completed*].

Medium term:

- Provide support with stereoscopic camera station operation.
    - FMS/SPC to swap stereoscopic camera station batteries before storm events and increase capture frequency.
- Provide support with data processing.

Longer term:

- Capture of storm events used to build stage-discharge relationships for high flows.
    - Currently no data, access to sites cutoff during floods.
- Stereoscopic camera stations to be moved to different sites once stage-discharge relationship established.
    - 9x foundations provided and more can be produced.
- Effectiveness of stereoscopic camera stations and surface velocimetry methods assessed for Fiji.
    - Potentially wider roll out of stereoscopic camera stations around the Pacific and internationally.



Many thanks to our awesome team:

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Tom Stewart, Jacqui Reid, John Carreon, Peter Sinclair (SPC)

Viliame Vereivalu, Sepesa Gauna, Iowane Valuibulu (FMS)

Jone Wainitasi (WAF)

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