

Supporting information for “Observations of Ruapehu Crater Lake (Te Wai ā-moe) and implications for lake dynamics and volcano monitoring”

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1. Written observations during fieldwork in this study

This section describes the written observations made during fieldwork from 31/01/2021 to 24/06/2021.

- 31 January – 5b/Medium grey (bluish) lake colour. West vent upwelling. Slicks in the north of the lake, likely sourced from a northern vent(s). Over 20 minutes the slick drifted all the way to the middle west of the lake edge. Very weakly steaming. Outlet is overflowing moderately with sulphur precipitates. Light blue meltwater input to the northeast corner has slightly increased since we've been here.
- 5 Feb – 1a/Light blue with a tinge of grey lake. East and west vent upwellings, east is on/off and west is constant. Abundant slicks blown across the lake. No steaming.
- 6 Feb – 1a/Light blue with a tinge of grey lake. Constant east and west vent upwellings. Some slicks that are blown across the lake.
- 7 Feb – 1a/Light blue with a tinge of grey lake. Large upwelling from north vent at the start of the day, is half out of sight from Dome. West vent upwelling constant all day, and east vent upwelling is transient. Abundant slicks on lake, often surrounding upwellings. Cloud coming in later in the day and mild steam developing.
- 9 March – 6c/Dark grey lake. Very large central vent upwelling that moved slightly further north and east throughout the day. Calmer water areas can be seen within the larger upwelling, possibly these calm areas are bubbles bursting at the surface while the rest of the upwelling is bubbles that have previously burst and the sediment is remaining in suspension. Small transient west vent upwelling observed. Slicks visible and moving around, and large sulphur pool in the far north of the lake that's only just visible, it is possibly sourcing the slicks on the lake. No steaming.
- 12 March – 5c/Dark grey (bluish) lake. Very large central vent upwelling surrounded by slicks, and a small transient west vent upwelling. Large calm area in the eastern area of the large central vent upwelling that is likely bubbles bursting at the surface. Slicks visible. No steaming. Lots of rain yesterday and the day before, was curious if that would change the lake colour to more bluish but it appears to have remained a similar grey colour to Tuesday 9 March. Upwellings are massive, either the vents are also very large beneath the lake, or the bubbles are being forced out of the vents at an angle, or during warm lake periods convection within the lake is moving the bubbles as they ascend to the surface.
- 13 March – 5c/Dark grey (bluish) lake. Constant small west vent upwelling, and slicks constantly sourced from centre-north vent, with brief small central vent upwelling at the start of the day that evolved into a large central vent upwelling later in the day. At 2:15 pm can see large weak upwellings from the central and centre-north vents that are linked up into one large upwelling. At 3:10 pm the sulphur is interspersed both within the larger upwelling and on the light blue edge of the lake. Can see weak steaming on the lake to the northeast near where the upwelling and meltwater input collide.
- 14 March – 5b/Medium grey (bluish) lake colour. Small consistent upwellings and slicks sourced from the west, centre-north, and east vents. Slicks from the north vent are being carried NNW, and slicks from the northeast vent are being carried NE, probably by wind. Small brief upwelling appearing from the central vent later in the day. No steam at start of day but developing into mild steaming later in the day. With sunglasses off I can see that the steam is in its typical hexagonal pattern. Sometimes the steam swirls around on itself in a big gyrating circle, sometimes it sticks to the hexagonal shape. At 3:35 pm, a lot of the sulphur slicks have been blown into the northwest corner of the lake and are now out of sight.

- 15 March – 6b/Medium grey lake colour. No upwellings or slicks observed. Vigorous steaming (understandable because of abundant cloud). Could only see the lake for 5 mins, left after 20 mins.
- 17 March – 4a/Light blue (greyish) lake. Just been to sample the lake with GNS Science, it was unreal. Upwellings from the central vent (more active at the start of the day), the west vent (transient all day), and the centre-north vent (more active later in the day). Abundant slicks on the lake at the start of the day. There is possibly another vent feeding slicks to the centre-north vent, and possibly another vent in the far southeast of the lake (but this is likely a reflection instead). Noticeable steaming started at the same time that clouds rolled in up the Whangaehu valley. The steam is starting in the southeast and being carried across the lake because Pyramid peak is stopping moist air from passing over the lake. Instead, the moisture is coming up the Whangaehu and over a saddle and down into the lake where it is steaming.
- 18 March – 5b/Medium grey (bluish) lake. Brief central vent and west vent upwellings observed later in the day. Abundant slicks, likely sourced from the centre-north vent. Vigorous steaming earlier in day, mild steaming later in day.
- 19 March – 5b/Medium grey (bluish) lake. Transient central vent and west vent upwellings. Slicks emitted from centre-north vent and transported north by wind or surface currents. Later in the day slicks are possibly being sourced from the north vent that is nearly out of view from Dome. At the end of the day slicks are dispersed across the whole lake. No steam earlier in day, mild/vigorous steaming developing later in the day likely due to cloud accumulation to the west and northwest of the mountain.
- 2 April – 6b/Medium grey lake. Central sediment-poor upwelling observed ephemerally throughout the day. The calm looking sediment-poor convection areas switch off even quicker than upwellings, can appear and disappear or change location in less than 30 secs. Mild/Vigorous steaming developing later in the day, however there is no large rain clouds anywhere near the mountain. There are stratus/cirrus clouds hundreds of metres to a couple kilometres above the lake right now. Only there for 2 hours because of high winds.
- 3 April – 6b/Medium grey lake. Central sediment-poor upwelling was observed ephemerally but will be hard to see on the thermal camera because of steam. Abundant slicks dispersed throughout the north of the lake with unknown source vents, including some black slicks. Slicks that were originally in the southwest of the lake have disappeared, likely blown by wind into the shore/rocks around there. Vigorous steaming. Can see where steam is whirlpooling by the lower temps on the thermal camera.
- 4 April – 6b/Medium grey lake. Central sediment-poor upwelling observed throughout the day. Slicks observed mainly in the north of the lake, that were likely sourced from the centre-north vent. Both upwellings and slicks were nicely picked up on the thermal camera. Mild steaming. No clouds anywhere near the whole day, so can still get mild and mild to vigorous steaming without any clouds nearby.
- 6 April – 6b/Medium grey lake. I think central sediment-poor upwelling was observed but because of the steam I was unsure, only time I was sure was at the end of the day after I turned the Nikon off and saw a circle surrounded by sulphur (took a photo on my Iphone). Slicks observed in the north of the lake, likely sourced from one of a vent in the north of the lake. Sulphur slicks appear and disappear in the far north of the lake, either because new sulphur is produced from an underlying vent, the same slick got blown out of sight and back into sight, or the slick was there the whole time and was concealed by steam (however I find this last interpretation unlikely as there was very little steam). Vigorous steaming which is very surprising as there is no cloud anywhere nearby, maybe the closest is 1 km away towards Raetihi, maybe the steam is due to an abrupt increase in lake temperature. At 2:37 pm the nearest clouds are at least 10-15 km away over the northern Kaimanawas so clouds are not a factor at all with the steaming but it's still vigorous.

- 7 April – 6b/Medium grey lake. Central sediment-poor upwelling observed consistently at the start of the day, could not see later in the day because of steam. Central vent upwelling picked up beautifully on thermal camera at the start of the day. Abundant slicks, likely sourced from a northern vent(s). Weak/Mild steaming at start of day, developing into very intense steaming at end of day that is almost definitely related to the cloud that's been steadily building up over the last 40 mins on the west of the mountain and is now pretty well developed, as it is forecast to rain this afternoon. There is no cloud at all on the eastern side of the mountain, so this shows that you just need considerable cloud on one side of the mountain to cause this amount of steam, and the high lake temp helps. Some steam plumes are rising above the height of me on dome. Notable blue snowmelt input is visible in the northwest corner. With polarised sunglasses you can see through the steam much better and see the sulphur slicks better, but convection is much harder to see.
- 8 April – 6b/Medium grey lake. No upwellings observed because steam prevented easy observations. One slick observed in the northwest corner of the lake as I was leaving, possibly more slicks on lake but hidden by steam. Vigorous/Very intense steaming at the start of the day, developing into very intense steaming, which isn't surprising as there is cloud on all sides of the mountain (I was walking through cloud on the way up), thankfully the top of the mountain is beautifully sunny at the moment.
- 24 June – 6c/Dark grey lake. No upwellings, potential moderate sediment-poor central upwelling at the start of the day but unsure. Slicks observed being emitted from the centre-north vent. No steam until cloud rolls in at end of the video. A dark grey (bluish) lake is observed in June while the lake temp is 22.5 degrees, so there is no clear relationship between lake colour and temperature (e.g. blue lakes at low temps and grey lakes at high temps).

2. Quantitative lake colour analysis using ImageJ

We attempted to quantitatively analyse the lake colour based on pixel colour values using ImageJ. However, as discussed in the manuscript, this was unsuccessful because (a) different camera angles produced different levels of glare and apparent colours, (b) the orientation of the sun and presence of clouds altered the apparent lake colour, and (c) consistent identifiable reference points were not available in each image, predominantly due to changing snow cover between summer and winter. Here, we describe the attempted quantitative analysis.

Methods:

- Pick one photo from each day of fieldwork that was representative of lake properties.
- Use the colour picker tool on ImageJ to select a point on the lake surface that best represented the overall lake colour (excluding upwellings and sulphur slicks but including snowmelt input).
- Repeat on three to four areas of the lake to check consistency.
- Compare RGB (red, green, blue) pixel values for the different observed lake colours.

Date and image number	ImageJ colour	ImageJ colour values (RGB)	Qualitative colour classification
5/02/2021, image 3100		123, 145, 159	1a/Light blue
6/02/2021, image 3630		130, 157, 174	1a/Light blue
7/02/2021, image 4024		136, 163, 182	1a/Light blue
9/03/2021, image 5500		100, 107, 155	6c/dark grey
12/03/2021, image 6132		136, 142, 142	5c/dark grey (bluish)
13/03/2021, image 6629		127, 140, 149	5c/dark grey (bluish)
14/03/2021, image 7420		121, 140, 155	5b/medium grey (bluish)
15/03/2021, image 8239		129, 136, 144	6b/medium grey
17/03/2021, image 8359		152, 170, 184	4b/medium blue (greyish)
18/03/2021, image 9200		142, 152, 161	5b/medium grey (bluish)
19/03/2021, image 9800		130, 143, 159	5b/medium grey (bluish)
2/04/2021, image 1180		140, 149, 164	6b/medium grey

3/04/2021, image 1420		123, 132, 141	6b/medium grey
4/04/2021, image 2100		128, 139, 159	6b/medium grey
6/04/2021, image 2610		118, 131, 150	6b/medium grey
7/04/2021, image 3131		131, 142, 160	6b/medium grey
8/04/2021, image 3519		124, 140, 163	6b/medium grey

Date	Upwelling or lake	lake colour	Red	Green	Blue
26/02/2020	lake	1a - light blue	171.379	199.505	200.417
26/02/2020	lake	1a - light blue	178.224	203.042	211.981
26/02/2020	lake	1a - light blue	153.111	172.591	169.444
26/02/2020	lake	1a - light blue	171.769	207.615	224.332
7/02/2021	whole lake excluding upwellings	1a - light blue	126.66	154.56	172.128
7/02/2021	whole lake excluding upwellings	1a - light blue	124.102	153.877	171.1
9/03/2021	whole lake	6c - dark grey	97.377	105.301	111.705
9/03/2021	lake	6c - dark grey	108.445	122.305	132.326
9/03/2021	lake	6c - dark grey	104.507	114.121	121.006
9/03/2021	lake	6c - dark grey	108.62	119.586	128.186
19/03/2021	whole lake	5b/medium grey (bluish). Later called blue-grey.	126.918	142.014	158.137
19/03/2021	whole lake	5b/medium grey (bluish). Later called blue-grey.	126.388	141.959	158.953
19/03/2021	whole lake	5b/medium grey (bluish). Later called blue-grey.	126.316	142.705	160.377
19/03/2021	whole lake	5b/medium grey (bluish). Later called blue-grey.	126.866	142.606	159.965
2/04/2021	whole lake	6b - medium grey	143.831	152.836	165.424

2/04/2021	whole lake	6b - medium grey	143.059	152.263	165.311
2/04/2021	whole lake	6b - medium grey	140.621	150.744	165.358
2/04/2021	whole lake	6b - medium grey	147.828	156.127	167.136

$\frac{R+G+B}{3}$	$0.299R + 0.587G + 0.114B$	$\frac{R}{(R+G+B/3)}$	$\frac{R}{(R+G+B)}$	$\frac{G}{(R+G+B/3)}$	$\frac{G}{(R+G+B)}$	$\frac{B}{(R+G+B/3)}$	$\frac{B}{(R+G+B)}$
190.527	191.238	0.899	0.896	1.047	1.043	1.052	1.048
197.636	196.622	0.902	0.906	1.027	1.033	1.073	1.078
165.109	166.461	0.927	0.920	1.045	1.037	1.026	1.018
201.271	198.839	0.853	0.864	1.032	1.044	1.115	1.128
151.106	148.176	0.838	0.855	1.023	1.043	1.139	1.162
149.709	146.872	0.829	0.845	1.028	1.048	1.143	1.165
104.822	103.673	0.929	0.939	1.005	1.016	1.066	1.077
121.045	119.292	0.896	0.909	1.010	1.025	1.093	1.109
113.22	111.994	0.923	0.933	1.008	1.019	1.069	1.080
118.837	117.25	0.914	0.926	1.006	1.020	1.079	1.093
142.362	139.357	0.892	0.911	0.998	1.019	1.111	1.135
142.395	139.257	0.888	0.908	0.997	1.019	1.116	1.141
143.085	139.833	0.883	0.903	0.997	1.021	1.121	1.147
143.103	139.889	0.887	0.907	0.997	1.019	1.118	1.144
154.181	151.502	0.933	0.949	0.991	1.009	1.073	1.092
153.695	150.923	0.931	0.948	0.991	1.009	1.076	1.095
152.333	149.308	0.923	0.942	0.990	1.010	1.086	1.107
157.111	154.868	0.941	0.955	0.994	1.008	1.064	1.079

Based off R+G+B

mean lake colour value on 26-02-2020 is 188.290

mean lake colour value on 7-02-2021 is 147.524

mean lake colour value on 9-03-2021 is 113.052

mean lake colour value on 19-03-2021 is 139.584

mean lake colour value on 2-04-2021 is 151.650

Based off $\frac{R+G+B}{3}$

mean lake colour value on 26-02-2020 is 188.636

mean lake colour value on 7-02-2021 is 150.408

mean lake colour value on 9-03-2021 is 114.481

mean lake colour value on 19-03-2021 is 142.736

mean lake colour value on 2-04-2021 is 154.33

Based off $B/(R+G+B)$

mean lake colour value on 26-02-2020 is .068
mean lake colour value on 7-02-2021 is 1.163
mean lake colour value on 9-03-2021 is 1.090
mean lake colour value on 19-03-2021 is 1.142
mean lake colour value on 2-04-2021 is 1.093

Based off $B/(R+G+B/3)$

mean lake colour value on 26-02-2020 is 1.066
mean lake colour value on 7-02-2021 is 1.141
mean lake colour value on 9-03-2021 is 1.077
mean lake colour value on 19-03-2021 is 1.116
mean lake colour value on 2-04-2021 is 1.074

Based off $B/R+G+B$

mean lake colour value on 26-02-2020 is 0.356
mean lake colour value on 7-02-2021 is 0.380
mean lake colour value on 9-03-2021 is 0.359
mean lake colour value on 19-03-2021 is 0.372
mean lake colour value on 2-04-2021 is 0.358

Based off $G/(R+G+B)$

mean lake colour value on 26-02-2020 is 1.039
mean lake colour value on 9-03-2021 is 1.020
mean lake colour value on 19-03-2021 is 1.020
mean lake colour value on 2-04-2021 is 1.009

Based off $G/(R+G+B/3)$

mean lake colour value on 26-02-2020 is 1.038
mean lake colour value on 7-02-2021 is 1.025
mean lake colour value on 9-03-2021 is 1.007
mean lake colour value on 19-03-2021 is 0.997
mean lake colour value on 2-04-2021 is 0.991

$R/(R+G+B)$

mean lake colour value on 26-02-2020 is 0.897
mean lake colour value on 7-02-2021 is 0.850
mean lake colour value on 9-03-2021 is 0.927
mean lake colour value on 19-03-2021 is 0.907
mean lake colour value on 2-04-2021 is 0.948

$R/(R+G+B/3)$

mean lake colour value on 26-02-2020 is 0.896
mean lake colour value on 7-02-2021 is 0.834

mean lake colour value on 9-03-2021 is 0.915
mean lake colour value on 19-03-2021 is 0.887
mean lake colour value on 2-04-2021 is 0.932

The best lake colour quantification scheme is $G/(R+G+B)$ as it ordered the lake colours best from blue to blue-grey to grey as quantified numbers, however it defined grey (image from 9-03-2021) and blue-grey (initially named 5b/medium grey (bluish) and observed on 19-03-2021) with the same colour value of 1.020, when images show they were clearly different colours. Therefore, Image J did not quantify lake colours accurately.

3. Locating upwellings and measuring their errors using Agisoft Metashape

Here, we describe the six-stage process that was used to locate upwellings with Agisoft Metashape (Figure S1).

1. Trace upwellings and the lake shore outline on an orthomosaic image created using images from a GNS Science monitoring flight as these images create a comprehensive model of the entire lake surface and shoreline.
2. Delete the orthomosaic image and keep the traced outlines.
3. Trace upwellings and the lake shore outline on an orthomosaic image created using an image taken from Dome during fieldwork in this study.
4. Delete the orthomosaic image and keep the traced outlines.
5. Overlay the traced outlines of the orthomosaic image created from a GNS Science monitoring flight with the traced outlines of the orthomosaic image captured from Dome.
6. Delete the traced outlines of the orthomosaic image captured from Dome.

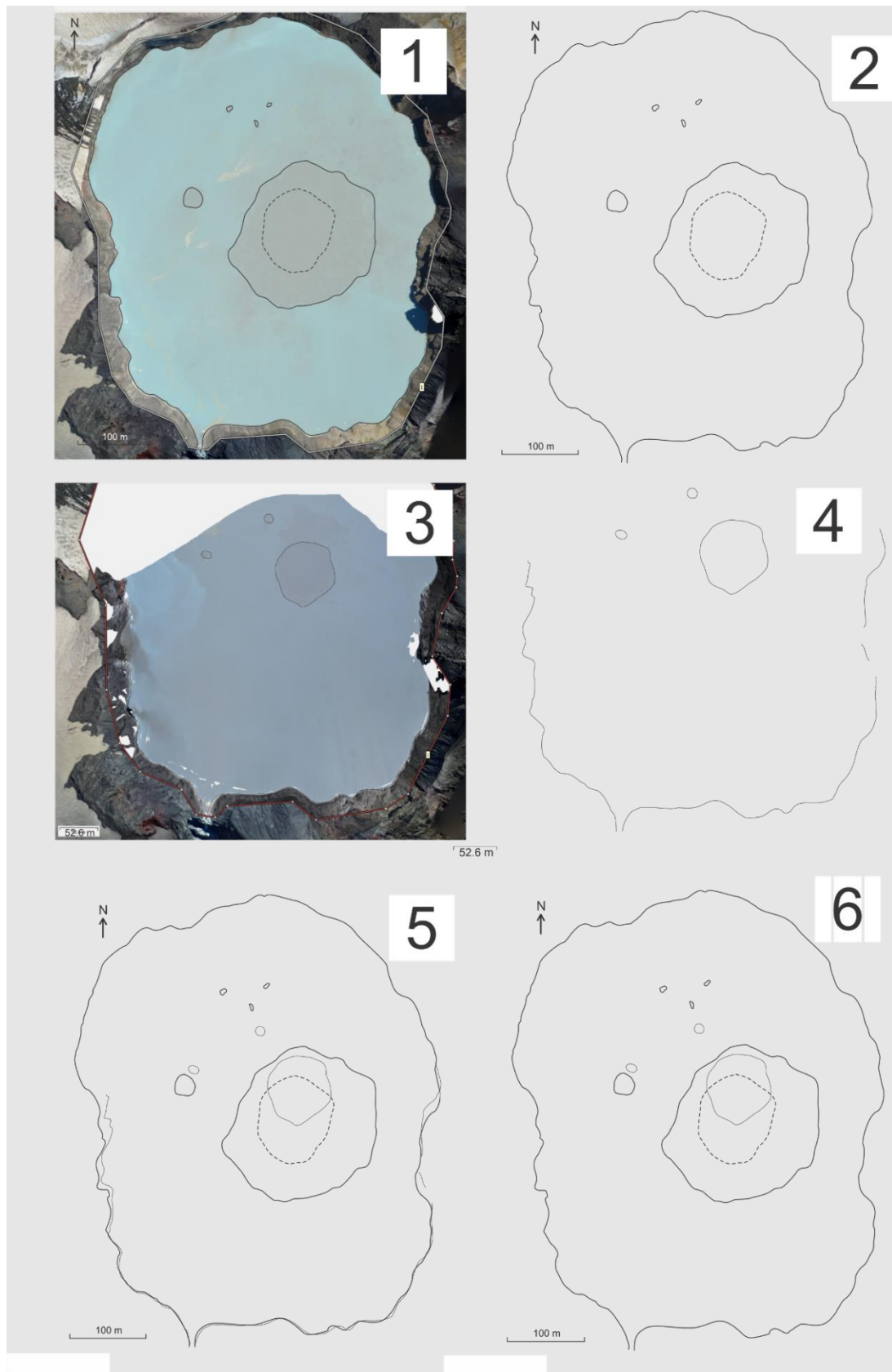


Figure S1: The six-step process that was used to locate upwellings.

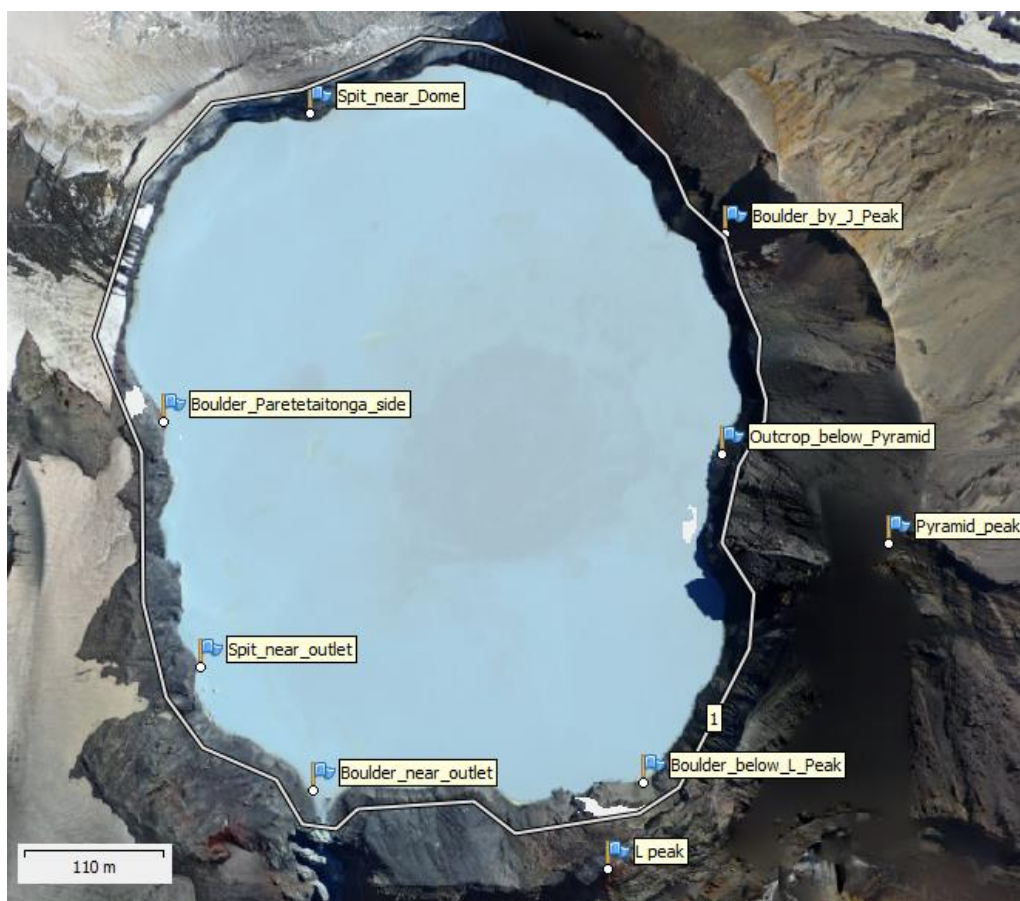


Figure S2: Recognisable features around Crater Lake (e.g. Boulder near outlet) during summer and autumn months when snow cover was absent. Precise co-ordinates of these features were taken from Google Earth, and co-ordinates of these same features were also taken from the georeferenced model. These co-ordinates were used to assess the potential error associated with identifying upwelling location on Crater Lake, via check point errors and control point scale bar errors.

Markers	Longitude	Latitude	Altitude (m)	Accuracy (m)	Error (m)
☐ point 1	175.564800	-39.277500	2584.000000	0.005000	3.804806
☐ point 3	175.566883	-39.282535	2530.000000	0.005000	11.670729
☐ point 4	175.563552	-39.283387	2531.936877	0.005000	6.095993

Figure S3: Check point errors quantifying the error associated with the Agisoft Metashape orthomosaic model of Crater Lake. The errors shown (far right) are the difference between the latitude and longitude co-ordinates of the recognisable feature taken from Google Earth, and the latitude and longitude co-ordinates of the same recognisable feature taken from the Agisoft Metashape orthomosaic model of Crater Lake.

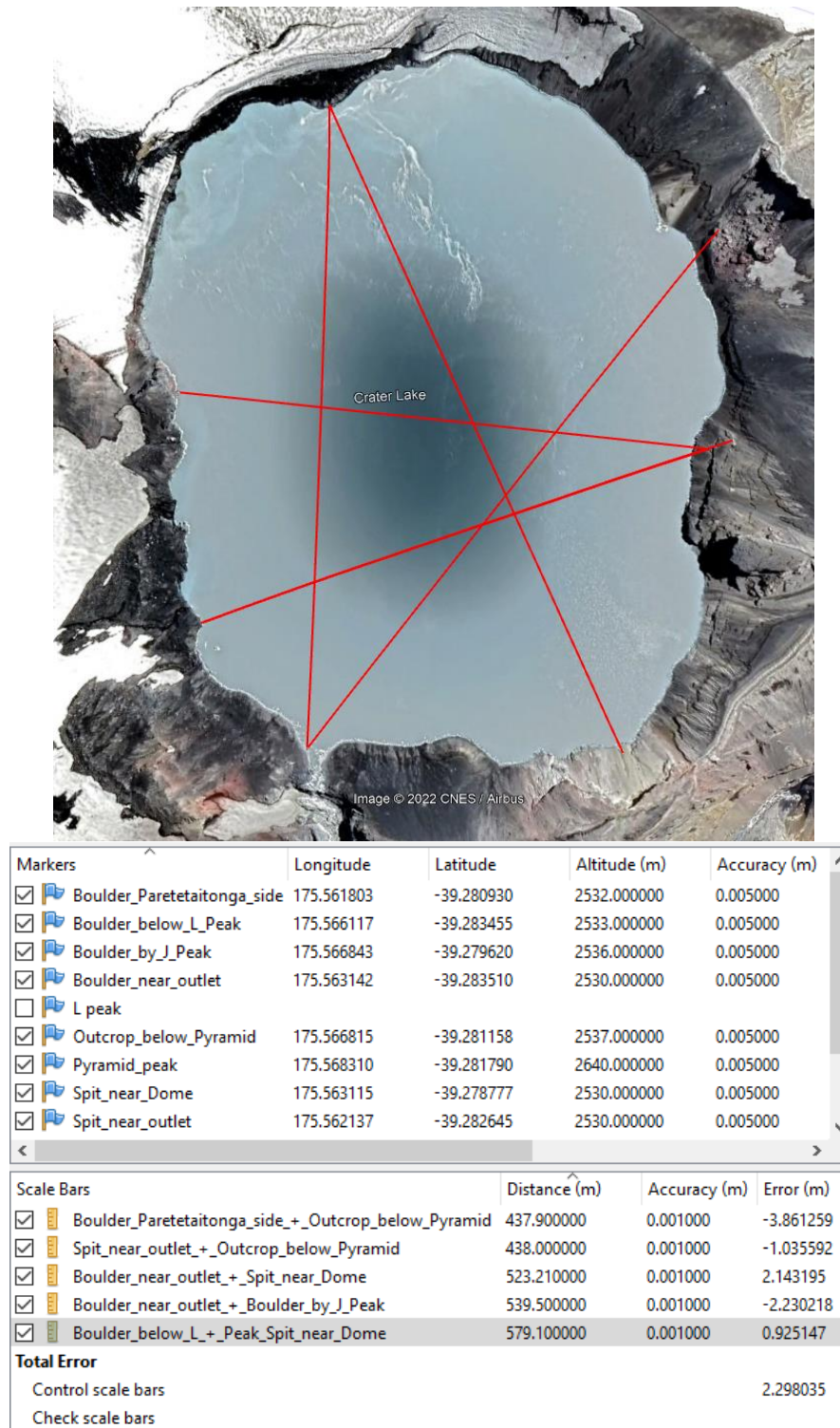
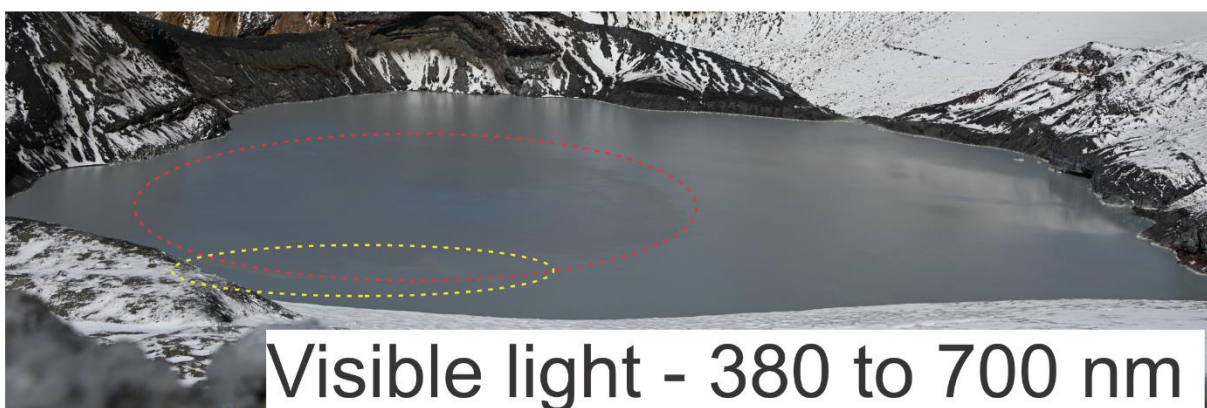


Figure S4: Control point scale bar errors quantifying the error associated with the Agisoft Metashape orthomosaic model of Crater Lake. Red lines indicate the distances between recognisable features (e.g. Boulder near outlet + Spit near Dome) around Crater Lake during summer and autumn months. The errors shown (far right) are the difference between the measured distance of two recognisable features taken from Google Earth, and the measured distance of the same two recognisable features taken from the Agisoft Metashape orthomosaic model of Crater Lake.

4. Multispectral imagery

The following six images are all captured simultaneously at 13:00 on 9 March 2021. They comprise the five wavelengths captured using the MicaSense RedEdge™ 3 Multispectral camera, and a visible light image captured with the Nikon z7 camera. The multispectral images explored in this study do not highlight any additional features of the lake suggesting, that when visibility is clear, visual cameras may provide sufficient information and the present level of analysis doesn't necessitate multispectral imagery for the lake.





5. Lake colour seasonality

Table S1: Lake colour by season.

Lake colour	Summer	Autumn	Winter	Spring	Total observations
Blue	22	19	3	10	54
Blue (%)	40.7%	35.2%	5.6%	18.5%	100%
Blue-green	15	18	5	8	46
Blue-green (%)	32.6%	39.1%	10.9%	17.4%	100%
Green	0	2	6	2	10
Green (%)	0%	20%	60%	20%	100%
Blue-grey	89	81	50	62	282
Blue-grey (%)	31.6%	28.7%	17.7%	22%	100%
Grey	48	66	39	53	206
Grey (%)	23.3%	32%	18.9%	25.7%	100%

6. Cross-correlations between lake observations

We compare between observations of lake colour, upwellings, sulphur, and steam as observed in high-quality images recorded between 28/08/1981 and 22/10/2021. The strongest cross-correlation is 0.28 between upwellings and sulphur followed by a negative correlation of -0.18 between sulphur and steam. All other correlations are less than ± 0.13 . The lack of strong correlations demonstrates that none of the lake observations can be used as proxies for each other and highlights the complex dynamics of the lake.

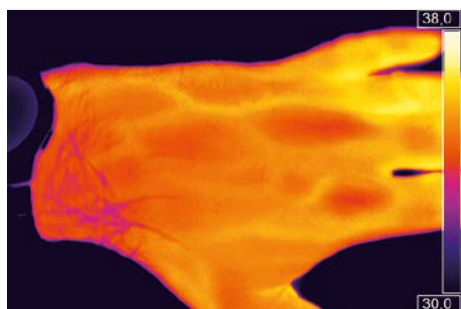
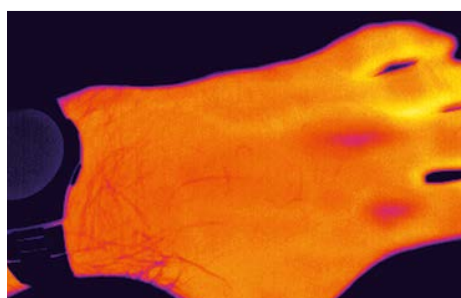
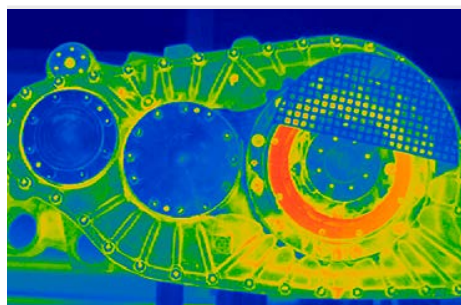
Table S2: Cross correlation values between different lake phenomena as observed in high quality images between 28/08/1981 and 22/10/2021.

	Lake colour	Upwellings	Sulphur	Steam
Lake colour	1	0.07	-0.01	-0.13
Upwellings	0.07	1	0.28	-0.11
Sulphur	-0.01	0.28	1	-0.18
Steam	-0.13	-0.11	-0.18	1

7. Full Camera Specifications

Nikon z7 visible light camera specifications are provided at the URL link below:
<https://www.nikonusa.com/p/z-7-refurbished/1591B/overview#tech-specs>

IR camera for the detection of slightest temperature differences



For further information as well as the product configurator, please visit:
www.optris.com/thermal-imager-pi400

Features:

- Smallest camera in its class 46 x 56 x 76 - 100 mm (1.8 x 2.2 x 3.0 - 3.9 in)
- Interchangeable lenses and industrial accessories
- Superb thermal sensitivity of 40 mK
- Licence-free analysis software and full SDK included

Technical specifications

Optical resolution	382 x 288 pixels
Detector	FPA, uncooled (25 µm x 25 µm)
Spectral range	8 – 14 µm
Temperature ranges	–20 ... 100 °C (–4 ... 212 °F) 0 ... 250 °C (32 ... 482 °F) (20) 150 ... 900 °C ([68] 302 ... 1652 °F) ¹⁾ optional range 200 ... 1500 °C (392 ... 2732 °F) ²⁾
Frame rate	80 Hz switchable to 27 Hz
Optics (FOV)	13° x 10° / f = 41 mm (f = 1.6 in) or 29° x 22° / f = 18.7 mm (f = 0.7 in) or 53° x 40° / f = 10.5 mm (f = 0.4 in) or 80° x 56° / f = 7.7 mm (f = 0.3 in)
Thermal sensitivity (NETD)	40 mK with 29° x 22° FOV / F = 0.8 40 mK with 53° x 40° FOV / F = 0.8 40 mK with 80° x 56° FOV / F = 0.8 0.06 K with 13° x 10° FOV / F = 1.0
Accuracy	±2 °C or ±2 % (±3.6 °F or ±2 %), whichever is greater
PC interface	USB 2.0 / optional USB to GigE (PoE) interface
Process interface (PIF), standard	0 – 10 V input, digital input (max. 24 V), 0 – 10 V output
Process interface (PIF), industrial	2x 0 – 10 V input, digital input (max. 24 V), 3x 0 – 10 V output, 3x relay (0–30 V/ 400 mA), fail-safe relay
Cable length (USB)	1 (standard) / 5 m / 10 m / 20 m (3.3 / 16.4 / 32.8 / 65.6 ft) 5 and 10 m (16.4 and 32.8 ft) also as HT cable (180 or 250 °C [356 or 482 °F])
Ambient temperature	0 °C ... 70 °C (32 °F ... 158 °F)
Storage temperature	–40 ... 85 °C (–40 ... 185 °F)
Relative humidity	20–80 %, non-condensing
Enclosure (size / rating)	46 x 56 x 76 - 100 mm (1.8 x 2.2 x 3.0 - 3.9 in) (depending on lens + focus position) / IP 67 (NEMA 4)
Weight	320 g (11.3 oz), incl. lens
Shock / Vibration ³⁾	IEC 60068-2
Tripod mount	¼-20 UNC
Power supply	via USB
Scope of supply	• USB camera with 1 lens • Table tripod • Software package optris® PIX Connect • Rugged outdoor case • USB cable (1 m [3.3 ft]) • Standard PIF with cable (1 m [3.3 ft]) and terminal block

¹⁾ Accuracy effective starting at 150 °C

²⁾ Not available for 80° optics

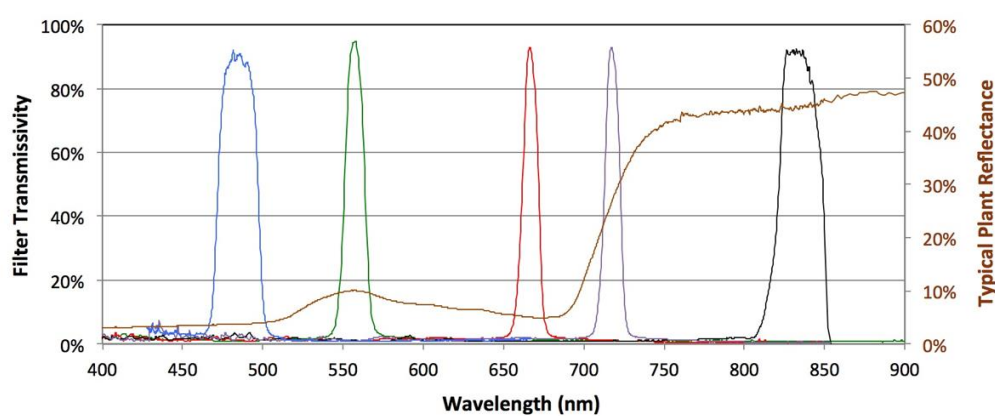
³⁾ For more details see operator's manual

10. Specifications

Basic Specifications

Weight	150 g
Dimensions	12.1 cm x 6.6 cm x 4.6 cm (4.8" x 2.6" x 1.8")
Power	5.0 V DC, 4 W nominal
Spectral Bands	Narrowband: Blue, Green, Red, Red Edge, Near IR
Ground Sample Distance	8.2 cm/pixel (per band) at 120 m (400 ft.) AGL
Capture Speed	1 capture per second (all bands), 12-bit RAW

Spectral Bands



Band Number	Band Name	Center Wavelength (nm)	Bandwidth FWHM (nm)
1	Blue	475	20
2	Green	560	20
3	Red	668	10
4	Near IR	840	40
5	Red Edge	717	10