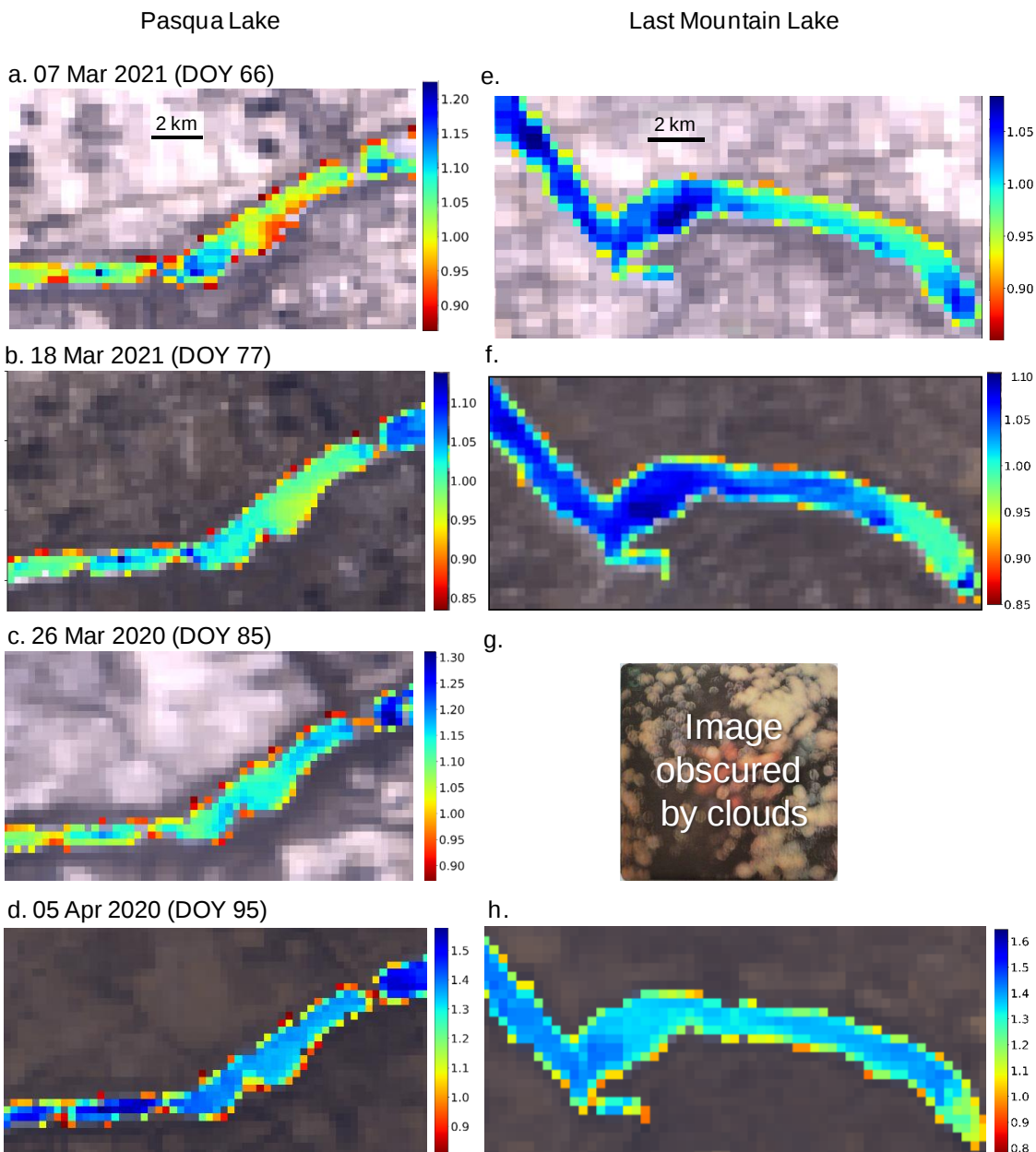
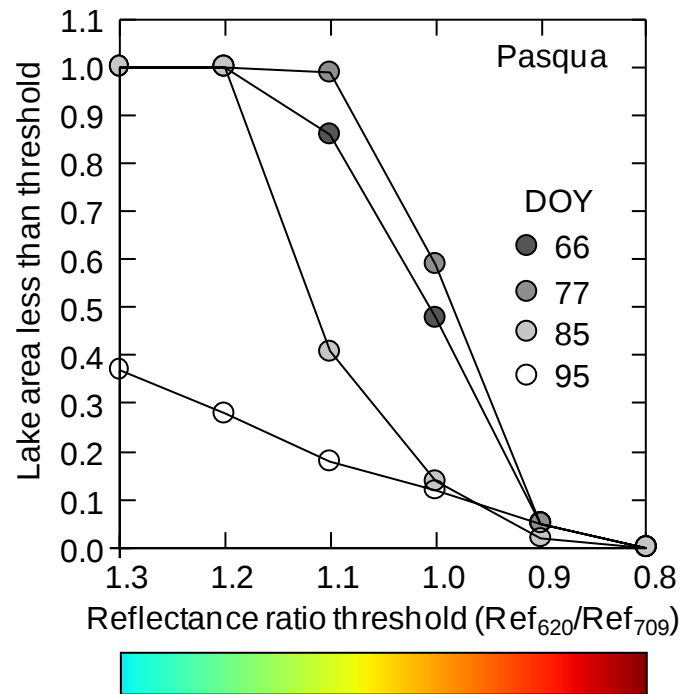


Supplement Fig. S1. Heat maps of reflectance ratio $\text{Ref}_{620 \text{ nm}}/\text{Ref}_{709 \text{ nm}}$ for late winter 2021 (07 March – 05 April) as detected by Sentinel-3A/B OLCI sensor, corrected for cloud cover and adjacency effect. See Methods for details. Hot (red) colors indicate maximal relative absorbance at 620 nm and potentially high concentrations of C-phycocyanin, whereas cool (blue) colors show minimal absorbance at 620 nm and limited blue discoloration. Left column images of hypereutrophic Pasqua Lake, right column images of the south end of eutrophic Last Mountain Lake (except panel g). Scale bar represents 2 km. Color bar on each figure represents $\text{Ref}_{620 \text{ nm}}/\text{Ref}_{709 \text{ nm}}$.

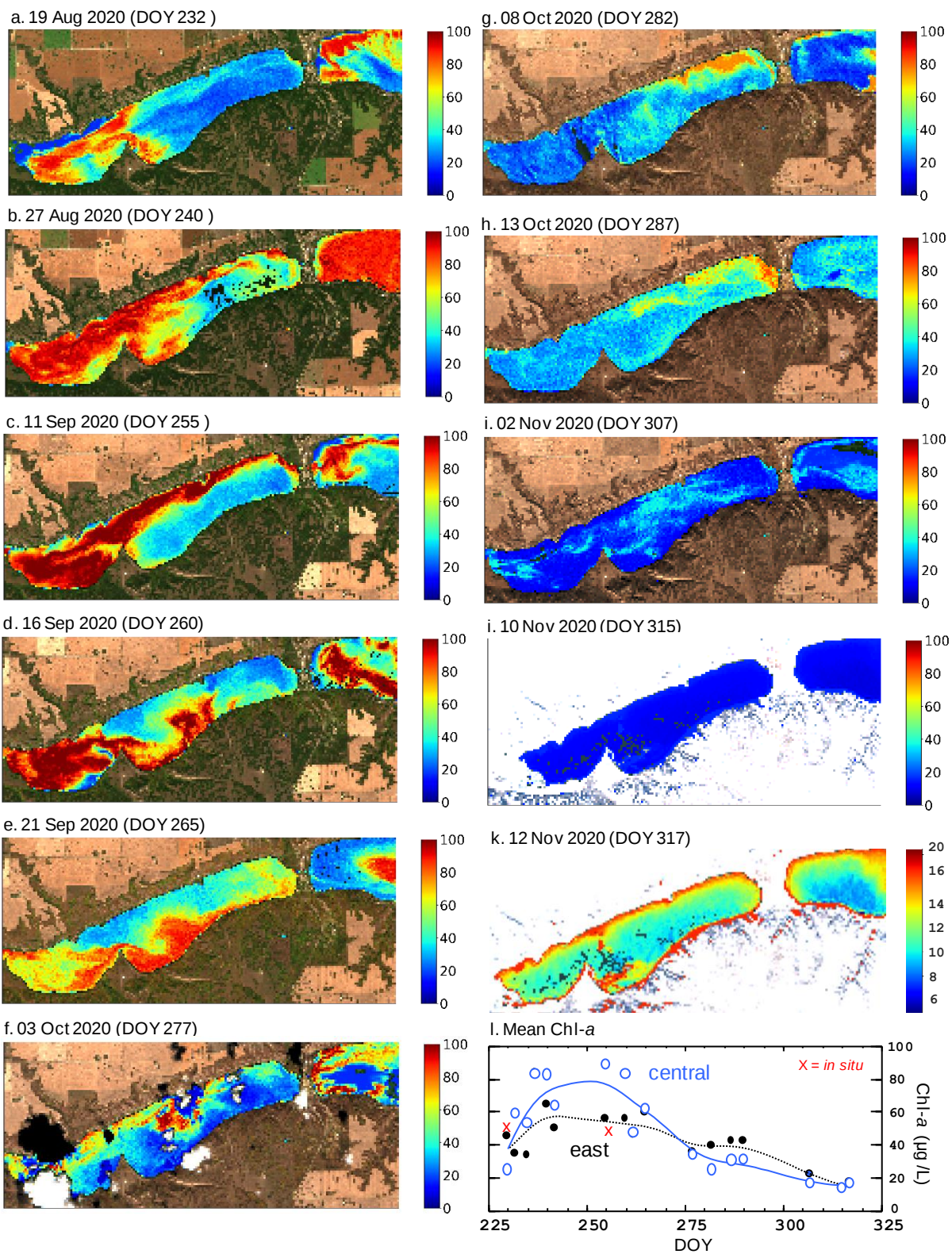


Supplement Fig. S2. Fraction of the surface area of Pasqua Lake (central and eastern basins only) with reflectance ratio ($\text{Ref}_{620 \text{ nm}}/\text{Ref}_{709 \text{ nm}}$) less than critical value on X axis. Effects of fresh snow identified from RGB images are seen as sharp declines in the proportion of lake area with a high reflectance ratio as day of year (DOY) increases (see also Supplement Fig. S1). Values for $\text{Ref}_{620 \text{ nm}}/\text{Ref}_{709 \text{ nm}} = 0.9$ were stable at $4.25 \pm 1.5\%$ of Pasqua Lake area and were used to map potential locations of blue ice and water. Maximum potential extent of blue ice ($0.68 \pm 0.24 \text{ km}^2$) was subtracted from total area analyzed (16.02 km^2) and both entire and blue-free values were used to estimate the radius of the lake, if it were round. Differences between the two radius estimates was 48.5 m, suggesting that blue ice was located mainly close to the shore (see Supplement Fig. S1).

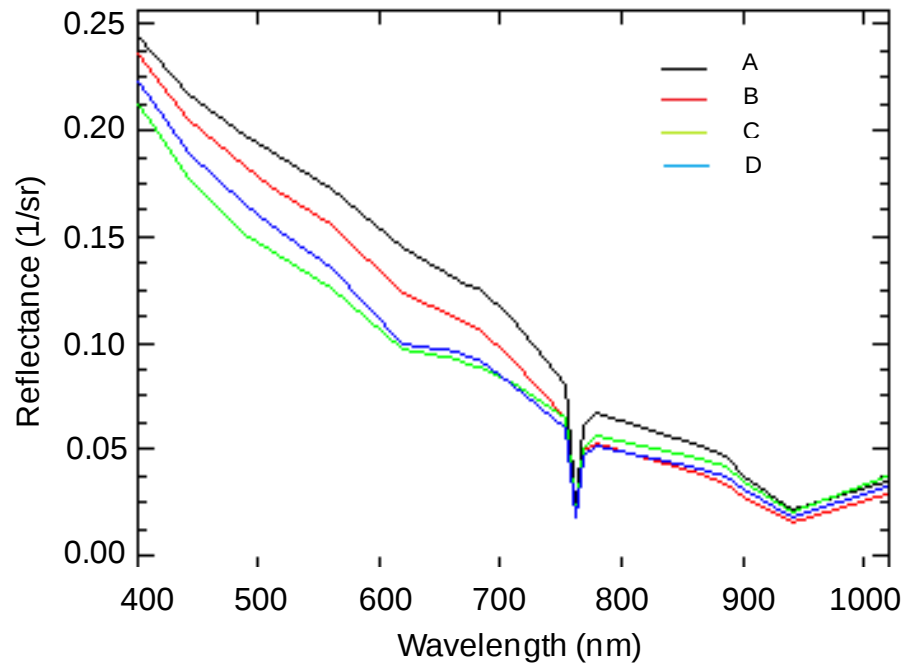


Supplement Fig. S3. Heat map of surface water Chl-*a* concentrations ($\mu\text{g/L}$) in Pasqua Lake as detected by Sentinel-2A/2B MSI sensors deployed 19 August to 12 November 2020. Hot (red) colors indicate elevated concentrations of Chl-*a*, whereas cool (blue) colors indicated low chlorophyll content. Note change in color scale after 10 November 2020. Panel 1 represents the mean Chl-*a* concentration recorded by satellite for central (blue) and eastern (black) basins, as well as by in situ measures from the eastern basin (red) measured by the Saskatchewan Water Security Agency.

(Image on next page)



Supplement Fig. S4. Spectral response of sampling points (A, B, C, D in Fig. 3) acquired from an OLCI image on 05 April 2021. Reflectance (1/sr) is presented as a function of wavelength (nm).



Supplement Table S1. Phytoplankton composition at 1-m depth in Pasqua Lake on 11 August 2020

and 22 September 2020, as well as at outlet of Pasqua and Echo lakes on 19 October 2020. Relative (%) proportion of total biomass (far right) used for Fig. 3d.

Pasqua Lake, 11 August 2020 (DOY 224)	Density	Biomass	Length	Width	Cell	%
	(Cells / L)	(mg m⁻³)	(µm)	(µm)	volume (µm³)	biomass
<i>Aphanizomenon flos-aquae</i> Ralfs and Born.	36400	109.78	240.00	4.00	3015.90	3.0866
<i>Limnothrix redekei</i> (Van Goor) Meffert	21552	9.82	145.00	2.00	455.50	0.2760
<i>Microcystis aeruginosa</i> (Kutzing) Kutzing	5200	26.00	0.00	0.00	5000.00	0.7310
<i>Woronichinia compacta</i> (Lemmermann) Komarek and Hindak	7200	21.60	0.00	0.00	3000.00	0.6073
<i>Planktothrix agardhii</i> (Gom.) Anagnostidis and Komarek	3200	18.54	461.00	4.00	5793.10	0.5212
<i>Anabaena crassa</i> (Lemm.) Kom-Legn. & Crongerg	11600	275.51	436.00	10.20	23751.20	7.7464
<i>Anabaena flos-aquae</i> (Lyngb.) Breb. & Bornet	36000	205.74	275.00	6.30	5714.90	5.7845
Heterocycts (<i>Anabaena crassa</i>)	25200	14.84	10.40	10.40	589.00	0.4173
Heterocycts (<i>Anabaena flos-aquae</i>)	93600	12.85	6.40	6.40	137.30	0.3613
Heterocycts (<i>Aphanizomenon flos-aquae</i>)	12600	0.84	7.20	4.20	66.50	0.0236
<i>Anabaena</i> akinetes	5200	8.87	29.00	10.60	1706.10	0.2494
<i>Aphanizomenon</i> akinetes	2000	2.72	26.00	10.00	1361.40	0.0766
<i>Chlamydomonas</i> spp.	35920	1.23	6.00	3.30	34.20	0.0345
<i>Pediastrum duplex</i> Meyen	1200	3.78	0.00	0.00	3150.00	0.1063
<i>Oocystis lacustris</i> Chodat	344832	9.76	6.00	3.00	28.30	0.2744
<i>Cosmarium</i> sp.	5400	25.45	30.00	30.00	4712.40	0.7155
<i>Ankyra judayi</i> (G.M. Smith) Fott	7184	0.38	14.00	3.10	52.80	0.0107
<i>Selenastrum copricornutum</i> Printz	129312	1.34	6.90	1.70	10.40	0.0378

<i>Euglena acus</i> Ehrenberg	600	3.02	96.00	10.00	5026.50	0.0848
Small chrysophyceae	1005760	12.87	2.90	2.90	12.80	0.3620
Large chrysophyceae	93392	16.77	7.00	7.00	179.60	0.4716
<i>Chrysococcus</i> sp.	308912	20.20	5.00	5.00	65.40	0.5680
<i>Salpingoeca frequentissima</i> (Zach.) Lemmermann	186784	9.40	6.00	4.00	50.30	0.2642
<i>Cyclotella ocellata</i> Pant.	64656	9.57	4.55	9.10	148.00	0.2690
<i>Fragilaria crotonensis</i> Kitton	92400	31.74	82.00	4.00	343.50	0.8924
<i>Stephanodiscus niagarae</i> Ehrenberg	2400	117.83	31.50	63.00	49096.60	3.3130
<i>Rhodomonas minuta</i> Skuja	359200	25.40	10.00	4.50	70.70	0.7140
<i>Cryptomonas erosa</i> Ehrenberg	19000	33.80	26.00	14.00	1778.80	0.9503
<i>Cryptomonas rostratiformis</i> Skuja	600	1.40	34.00	14.00	2326.20	0.0392
<i>Katablepharis ovalis</i> Skuja	201152	8.99	8.00	4.00	44.70	0.2528
<i>Peridinium goslaviense</i> Woloszyńska	1000	33.51	40.00	40.00	33510.30	0.9422
<i>Ceratium hirundinella</i> (Muller) Schrank	49400	2483.12	60.00	40.00	50265.50	69.8159
Sum		3556.66				99.9999

Pasqua Lake, 22 September 2020 (DOY 266)

<i>Aphanizomenon flos-aquae</i> Ralfs and Born.	1102000	3323.52	240.00	4.00	3015.90	52.1922
<i>Microcystis aeruginosa</i> (Kutzing) Kutzing	3000	15.00	0.00	0.00	5000.00	0.2356
(Lemmermann) Komarek and Hindak	26000	83.20	0.00	0.00	3200.00	1.3066
<i>Anabaena crassa</i> (Lemm.) Kom-Legn. & Cronberg	1000	22.65	400.00	10.40	22653.00	0.3557
Heterocycts (<i>Anabaena crassa</i>)	4000	2.36	10.40	10.40	589.00	0.0370
Heterocycts (<i>Aphanizomenon flos-aquae</i>)	146000	8.91	6.30	4.30	61.00	0.1399
<i>Aphanizomenon</i> akinetes	44000	37.29	34.00	6.90	847.60	0.5857
<i>Scenedesmus quadricauda</i> (Turp.) Brebisson	79366	2.79	6.30	4.00	35.20	0.0439
<i>Closterium kuetzingii</i> Brebisson	1000	0.54	86.00	4.00	540.40	0.0085
<i>Cosmarium</i> sp.	1000	11.17	40.00	40.00	11170.10	0.1754
<i>Staurodesmus paradoxum</i> Meyen	1000	1.61	22.00	19.00	1605.00	0.0252
<i>Ankyra judayi</i> (G.M. Smith) Fott	39683	2.40	16.00	3.10	60.40	0.0376
Small chrysophyceae	714294	5.14	2.40	2.40	7.20	0.0808
Large chrysophyceae	39683	7.13	7.00	7.00	179.60	0.1119

<i>Cyclotella ocellata</i> Pant.	39683	6.89	4.80	9.60	173.70	0.1082
<i>Fragilaria crotonensis</i> Kitton	450000	133.83	71.00	4.00	297.40	2.1017
<i>Aulacoseira italica</i> v <i>subarctica</i> (O. Muller) Simonsen	20000	137.93	280.00	5.60	6896.40	2.1660
<i>Aulocoseira ambigua</i> (Grunow) Simonsen	28000	628.28	310.00	9.60	22438.50	9.8664
<i>Rhodomonas minuta</i> Skuja	39683	2.68	10.00	4.40	67.60	0.0421
<i>Cryptomonas erosa</i> Ehrenberg	37000	65.82	26.00	14.00	1778.80	1.0336
<i>Cryptomonas rostratiformis</i> Skuja	2000	5.34	34.00	15.00	2670.40	0.0839
<i>Katablepharis ovalis</i> Skuja	79366	3.55	8.00	4.00	44.70	0.0557
<i>Peridinium goslaviense</i> Woloszyńska	3000	100.53	40.00	40.00	33510.30	1.5787
<i>Ceratium hirundinella</i> (Muller) Schrank	35000	1759.29	60.00	40.00	50265.50	27.6277
Sum		6367.85				99.9999

Outlet of Pasqua and Echo lakes, 19 October 2020 (DOY 297)

<i>Aphanizomenon flos-aquae</i> Ralfs and Born.	69465091	1745866.1	200.00	4.00	2513.30	95.8473
<i>Woronichinia compacta</i> (Lemmermann) Komarek and Hindak	1825418	1369.06	0.00	0.00	750.00	0.0752
Heterocycts (<i>Aphanizomenon flos-aquae</i>)	13333488	898.68	7.30	4.20	67.40	0.0493
<i>Aphanizomenon</i> akinetes	8531845	9232.31	30.00	8.30	1082.10	0.5068
<i>Stephanodiscus niagarae</i> Ehrenberg	912709	64141.26	35.50	71.00	70275.70	3.5213
Sum		1821507.5				100.0000