

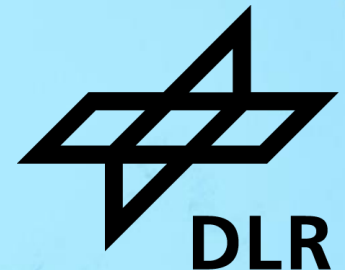
# ProGIRH-DLR

REMOTE SENSING OF WATER QUALITY IN THE MANTARO RIVER BASIN THROUGH SPACEBORNE AND GROUND-BASED ACQUISITION OF MULTI- AND HYPERSPECTRAL DATA

DETECCIÓN REMOTA DE LA CALIDAD DEL AGUA EN LA UNIDAD HIDROGRÁFICA DEL RÍO MANTARO A TRAVÉS DE LA ADQUISICIÓN ESPACIAL Y TERRESTRE DE DATOS MULTI- E HIPERESPECTRALES

Taller: Uso del Observatorio del Agua de la Cuenca Mantaro

AAA Mantaro - Huancayo, Perú – 05 de Octubre, 2023



# The principle of aquatic remote sensing

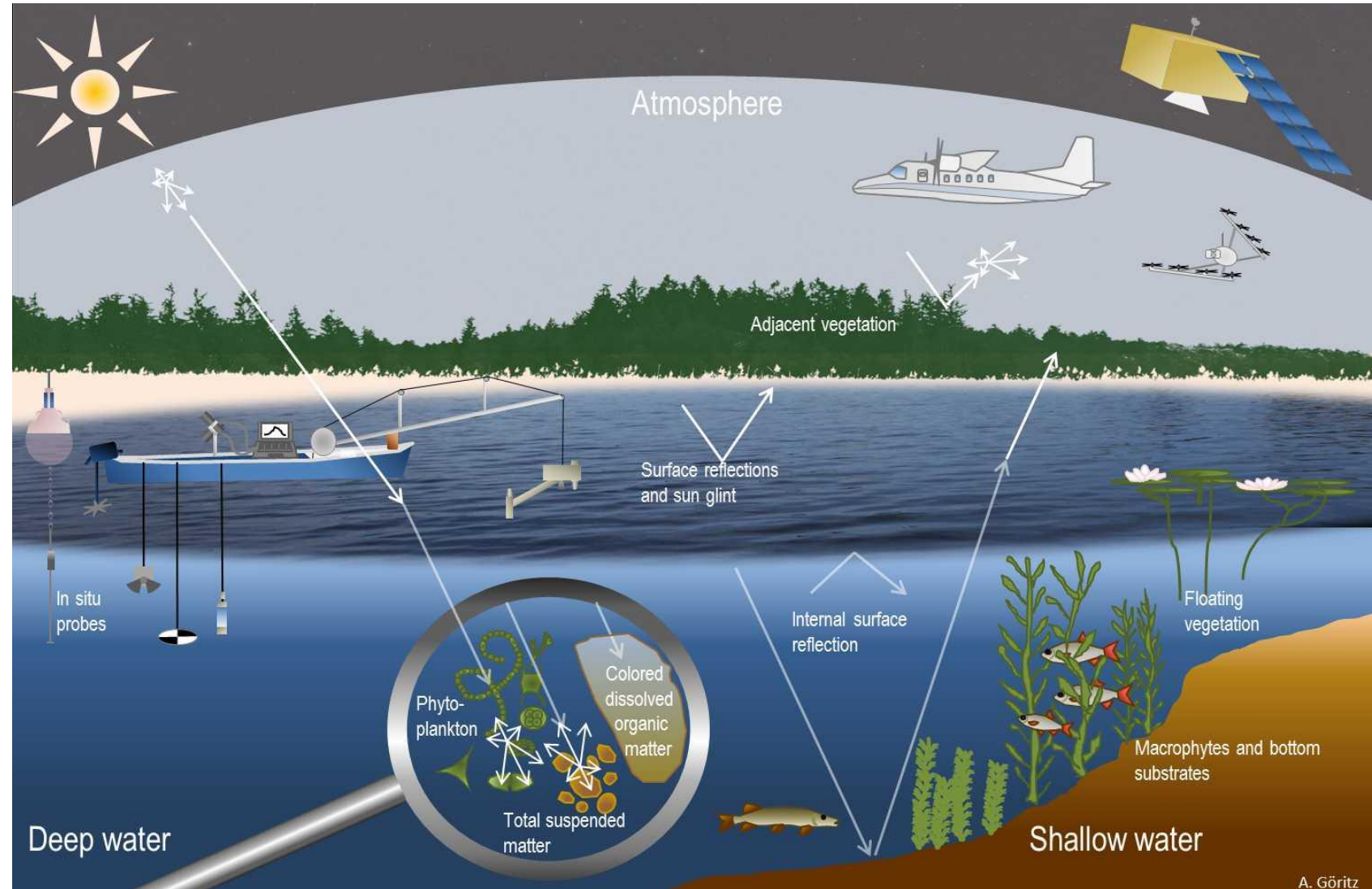


Courtesy: C. Giardino (CNR)

# The principle of aquatic remote sensing

Which major groups of constituents are typically discriminated in aquatic remote sensing?

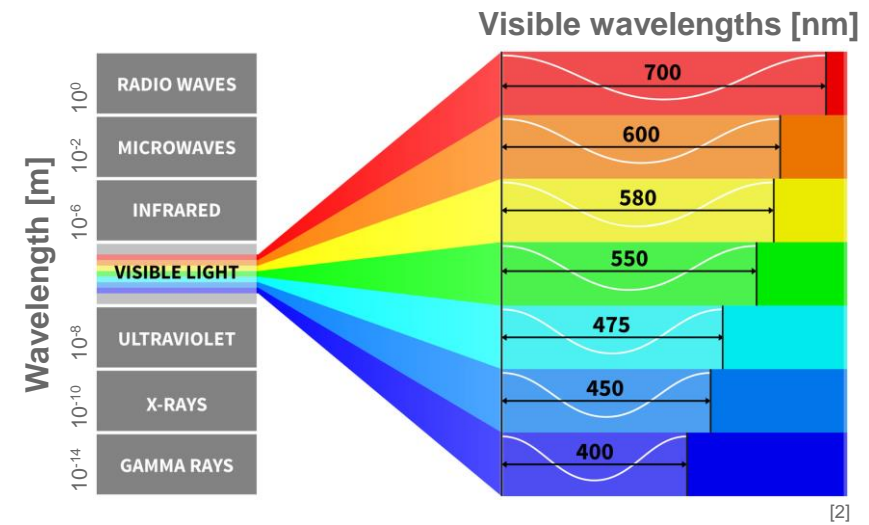
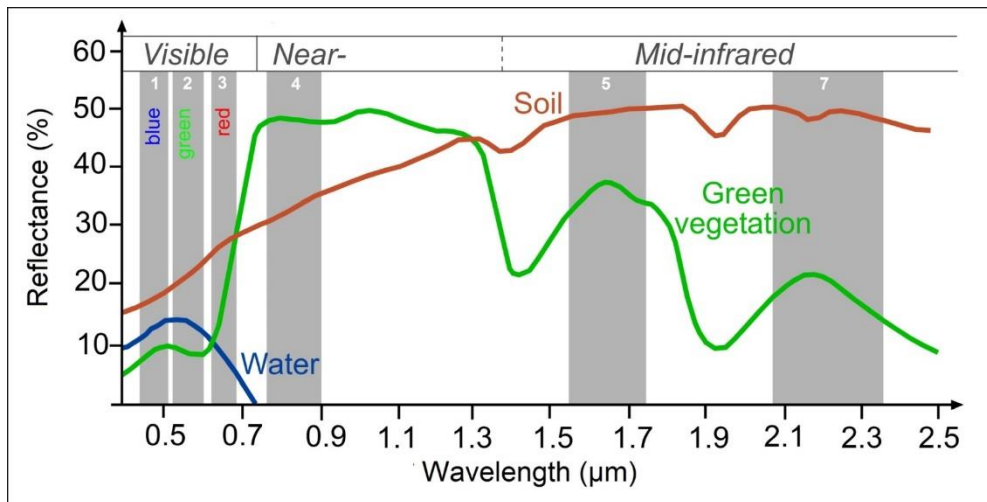
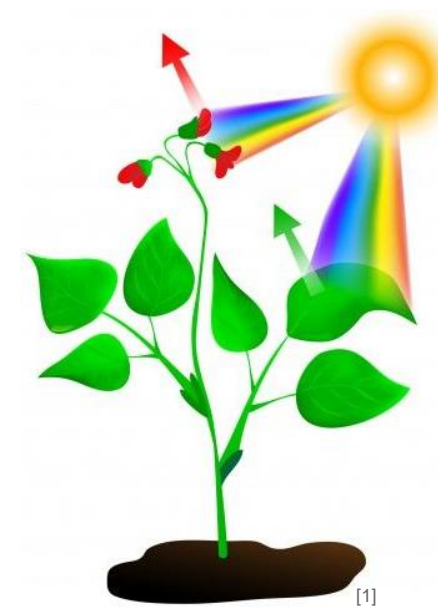
- Phytoplankton (Chl-a)
  - Colored dissolved organic matter (CDOM)
  - Total suspended matter (TSM)
- + Bathymetry (shallow waters)



# Reflectance spectrum

What does the human eye see?

- Every material reflects / absorbs electromagnetic radiation differently
- Visible spectrum represents only a short wavelength range
- Reflected light defines a material specific spectral signature = spectrum  
→ Reflectance spectrum contains information about material properties!  
(not restricted to VIS)

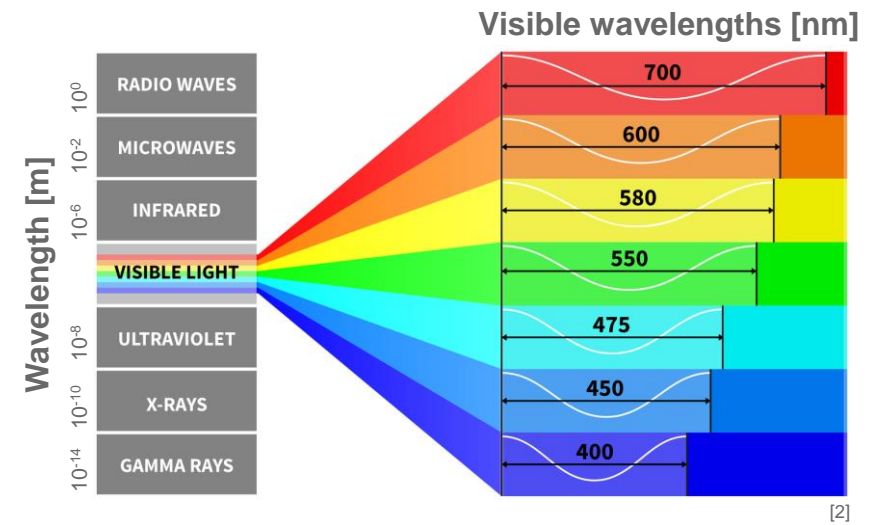
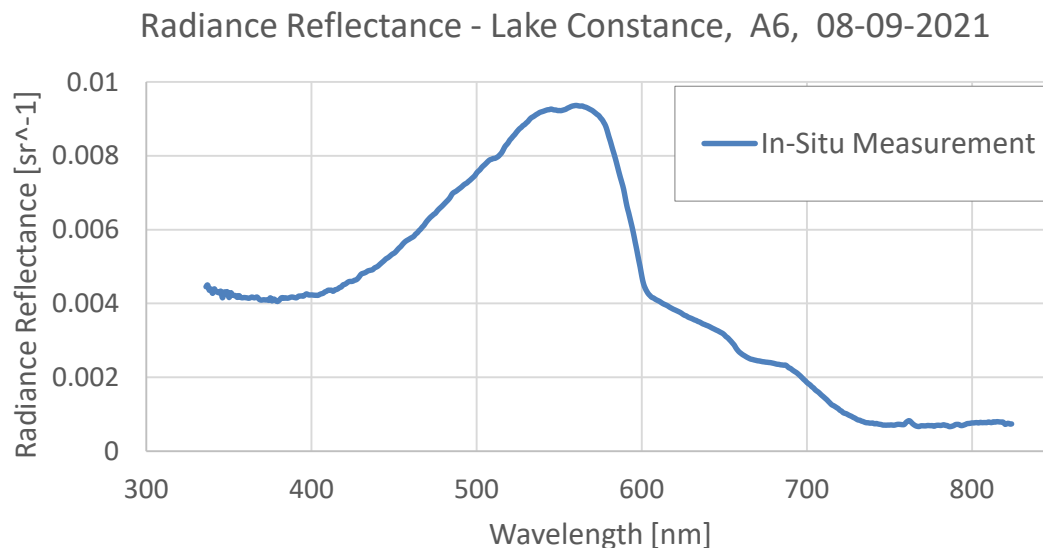
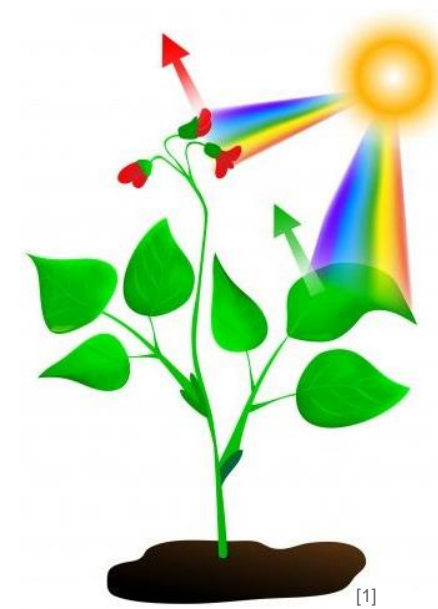


[1] justledus.com  
[2] boeye.com

# Reflectance spectrum

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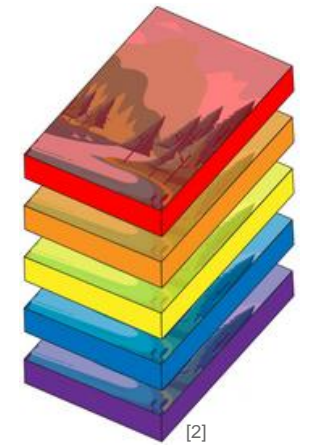
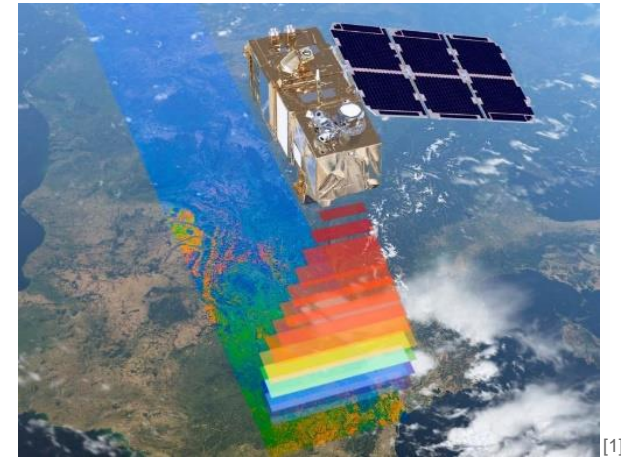
[1] justledus.com  
[2] boeye.com

# Reflectance spectrum

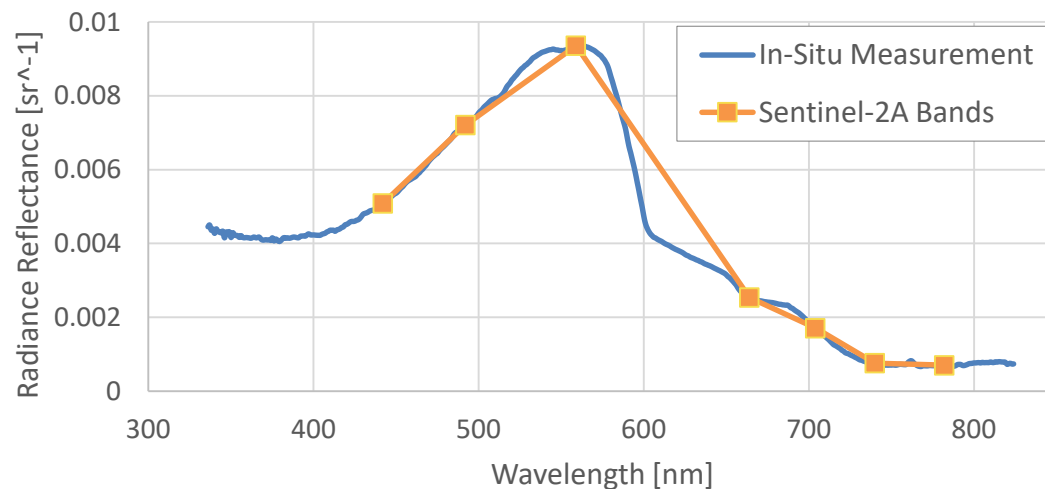
## What does an optical satellite sensor see?

- Reflected light coming from large areas on the planet's surface and propagating through the atmosphere
- Each image pixel contains one reflectance spectrum
- Number of bands and spectral properties defined by sensor

→ Multi- and hyperspectral sensors



Radiance Reflectance - Lake Constance, A6, 08-09-2021



[1] [www.dlr.de/content/de/artikel/news/2015/20150623\\_landbeobachtung-4-0-sentinel-2a-gestartet\\_14001.html](http://www.dlr.de/content/de/artikel/news/2015/20150623_landbeobachtung-4-0-sentinel-2a-gestartet_14001.html)

[2] [www.edmundoptics.eu/knowledge-center/application-notes/imaging/hyperspectral-and-multispectral-imaging](http://www.edmundoptics.eu/knowledge-center/application-notes/imaging/hyperspectral-and-multispectral-imaging)

# Derive concentration of water constituents from satellite images



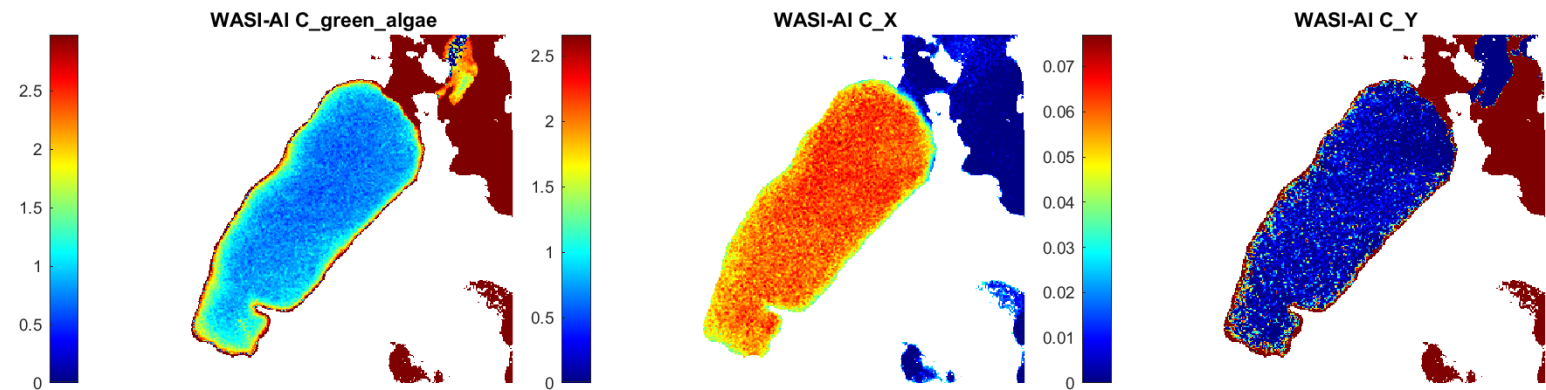
From this ...



Laguna Lasuntay - PlanetScope, 16.08.2022



... to this!

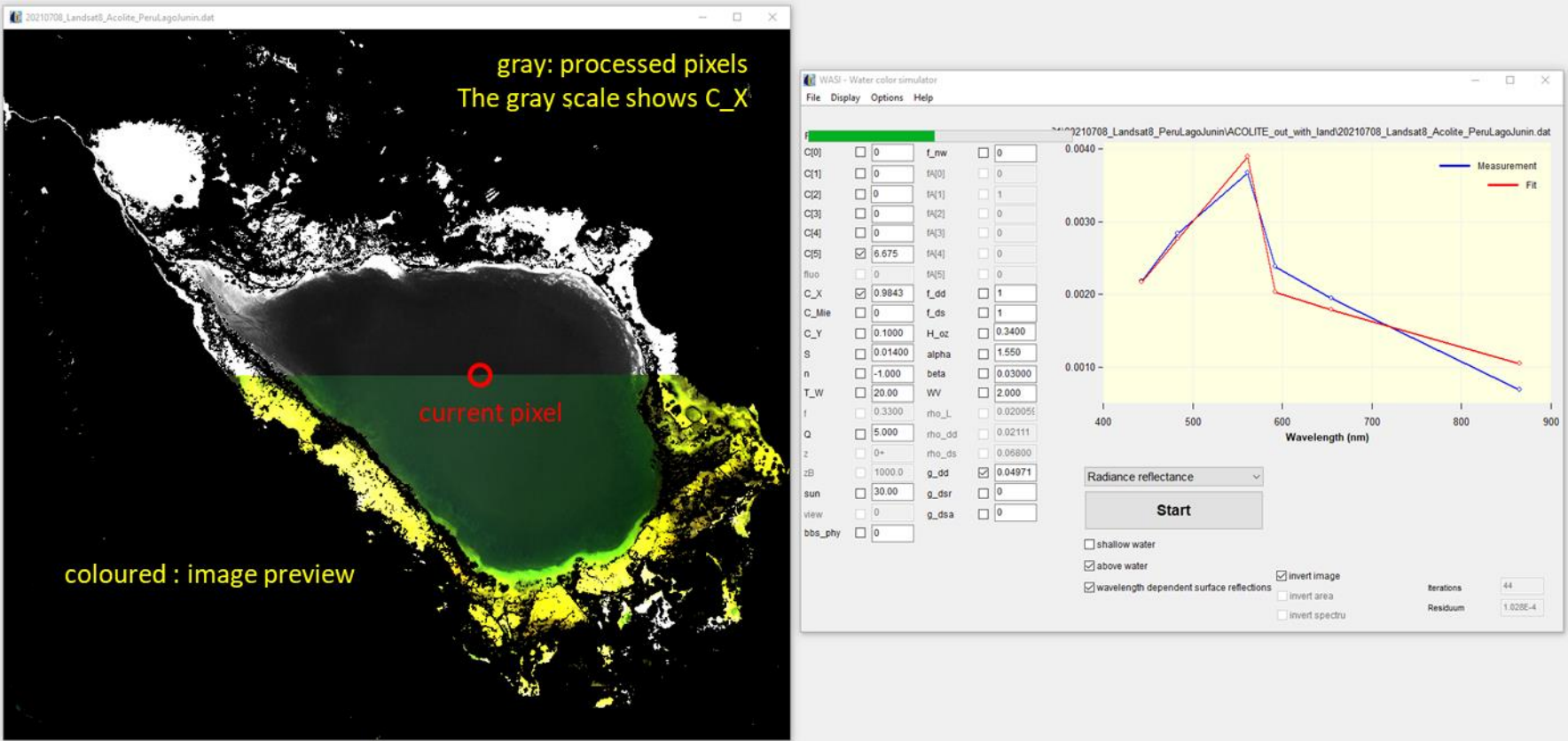


Peter Gege, WASI-AI

# Derive concentration of water constituents from satellite images



Screenshot of WASI during data processing

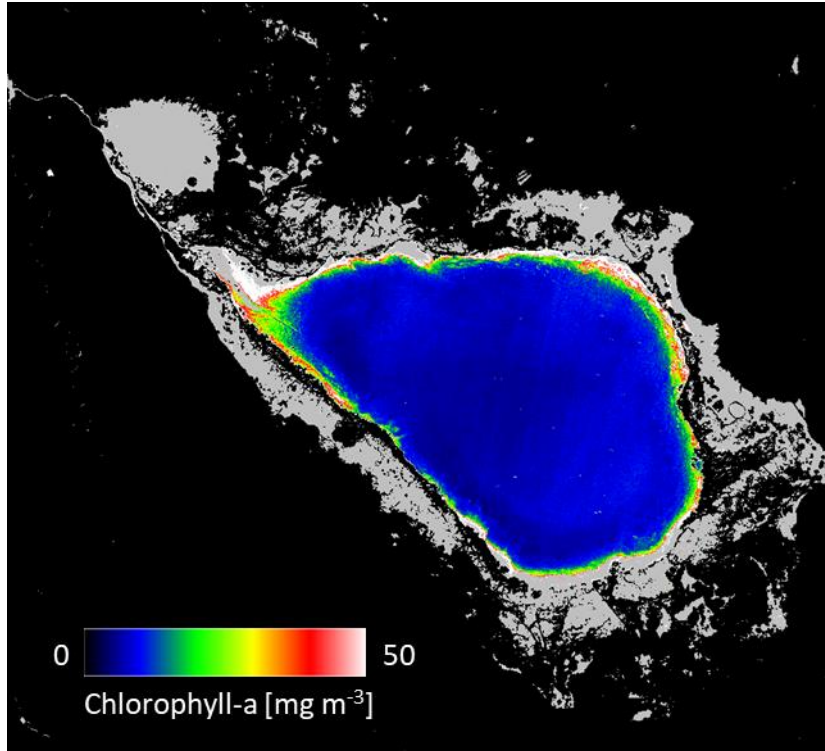


Lago Junín - Landsat 8, July 8th, 2021

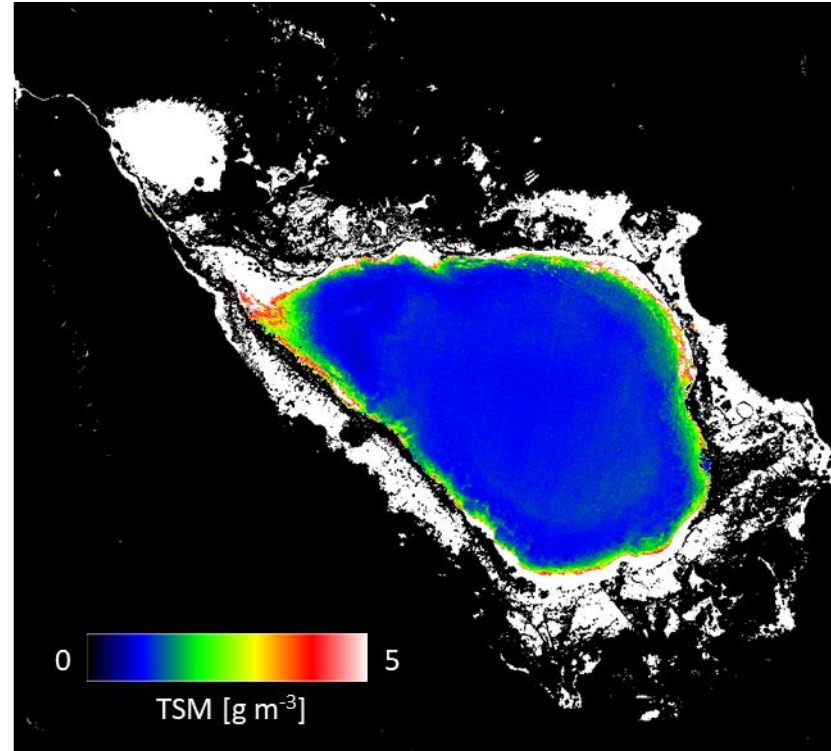


# Derive concentration of water constituents from satellite images

Screenshot of WASI generated results



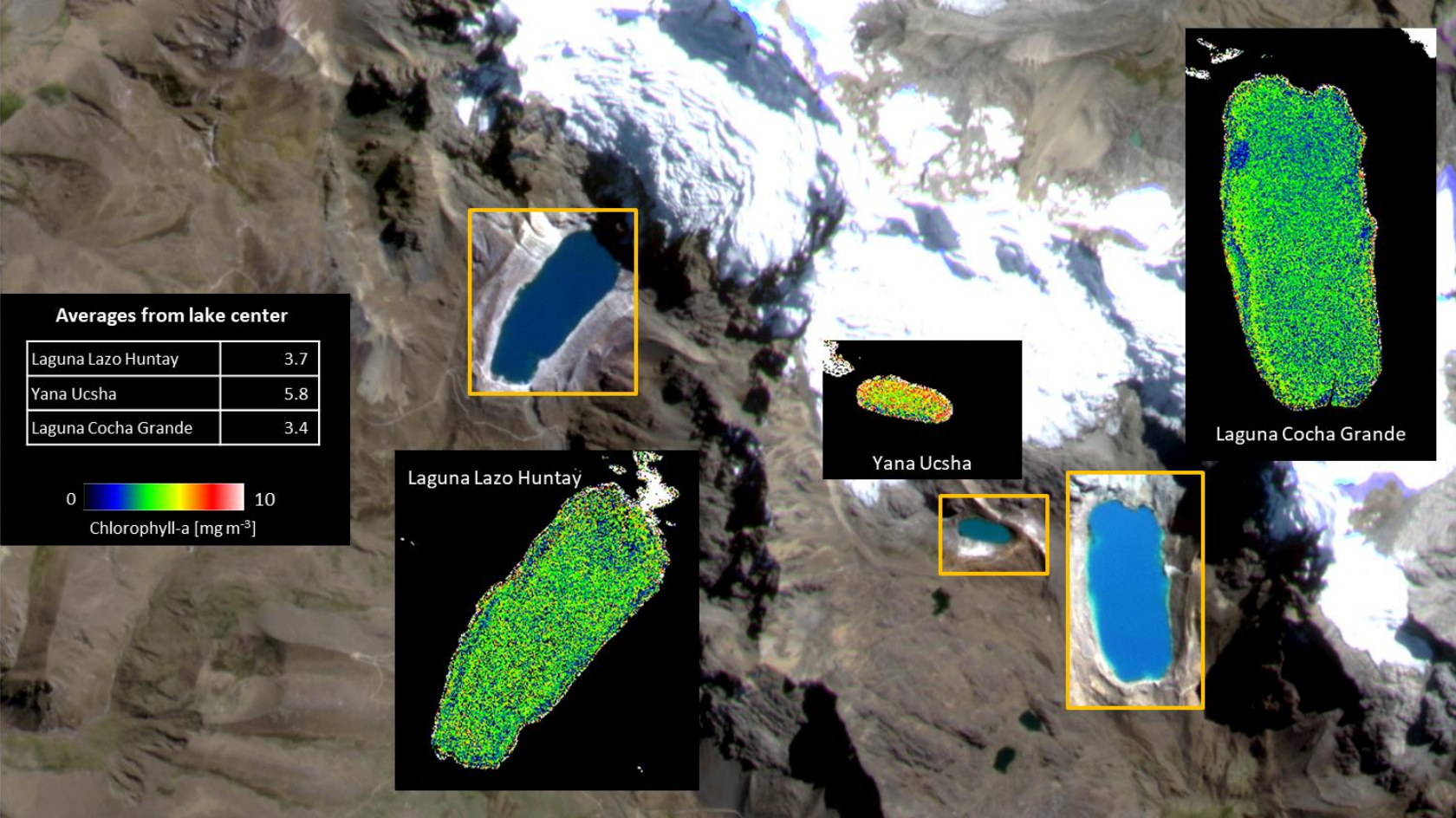
Lago Junín - Landsat 8, July 8th, 2021



# Derive concentration of water constituents from satellite images

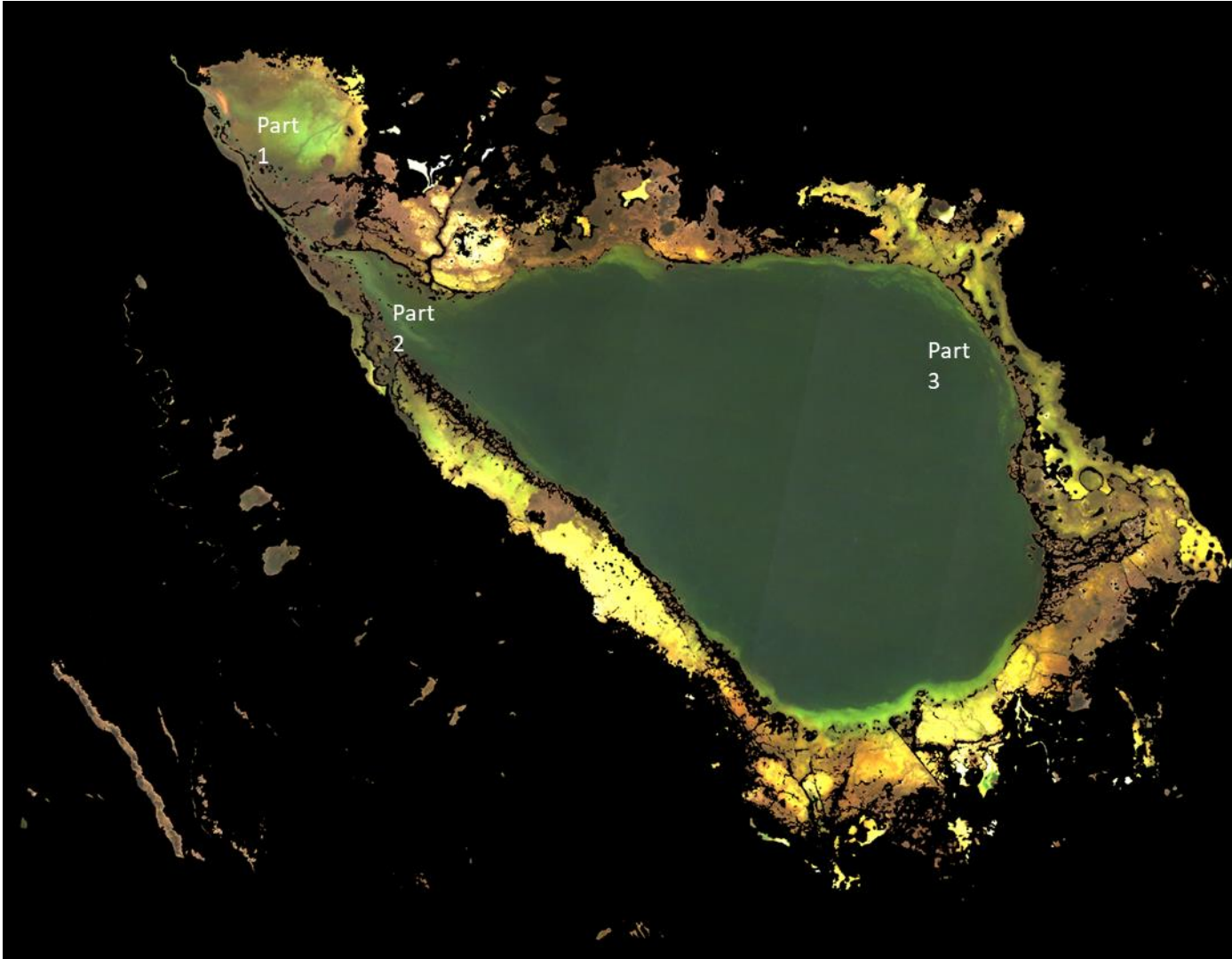


Screenshot of WASI generated results



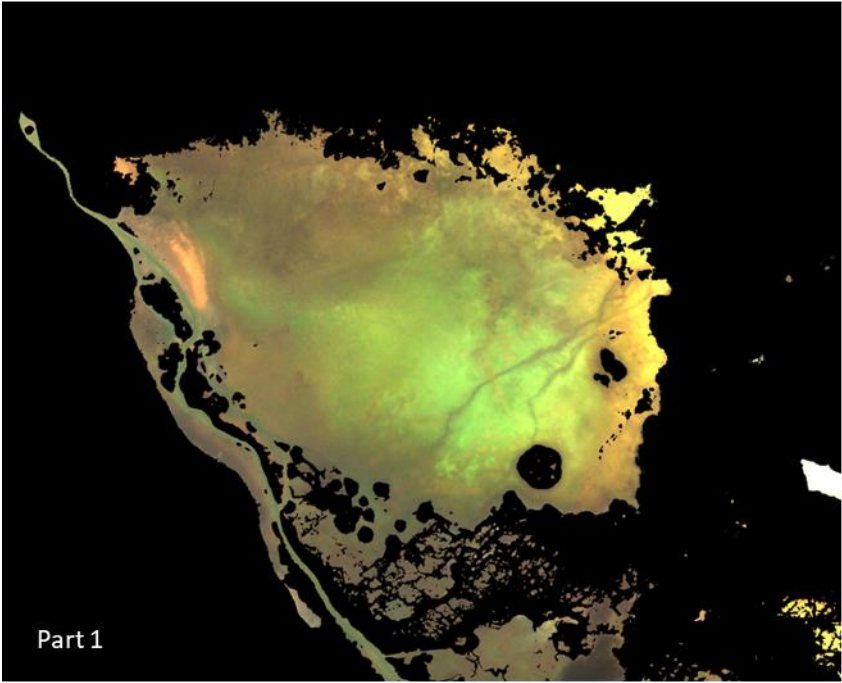
Laguna Lazo Huntay - Planet Scope, July 7th, 2021

# Derive bathymetry from satellite images

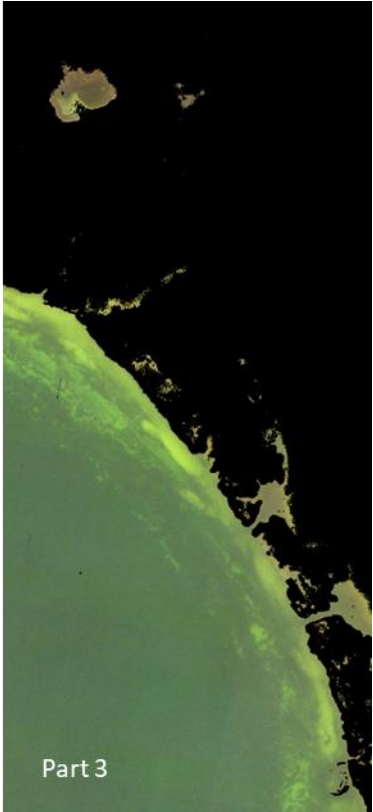
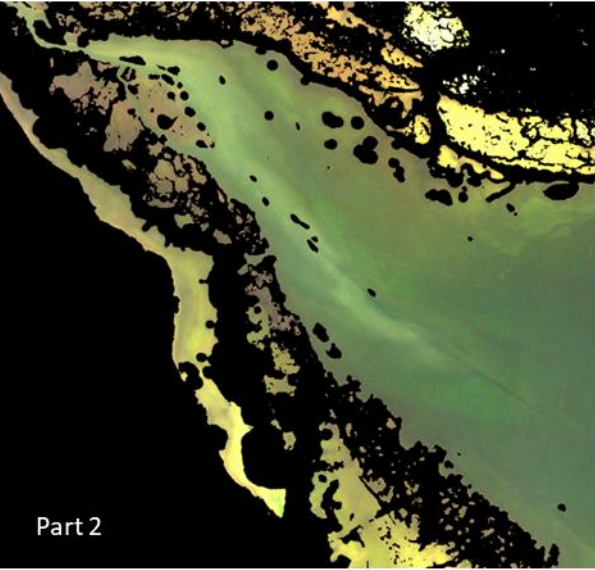


Lago Junin - Planet Scope, July 10th, 2021

# Derive bathymetry from satellite images

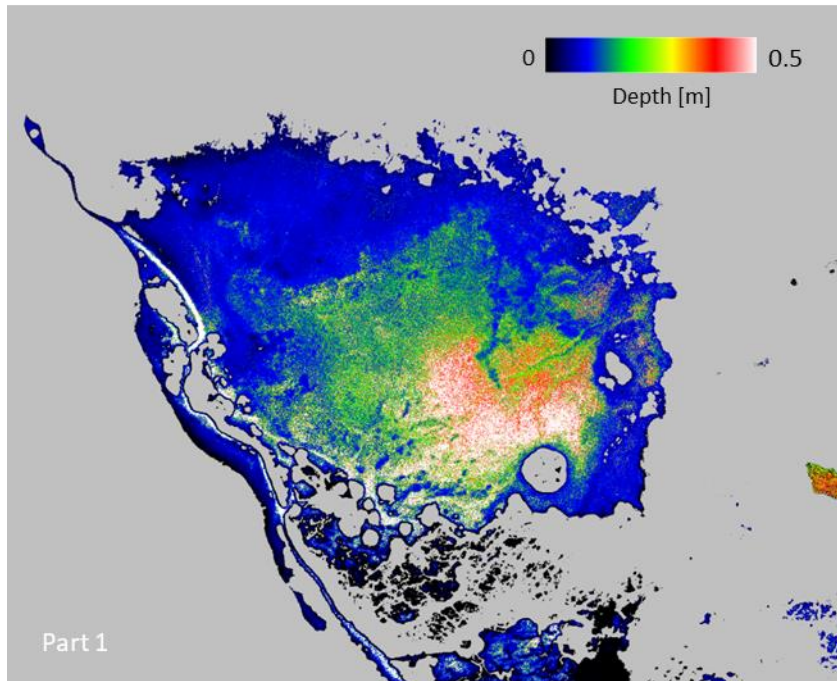


Lago Junin - Planet Scope, July 10th, 2021

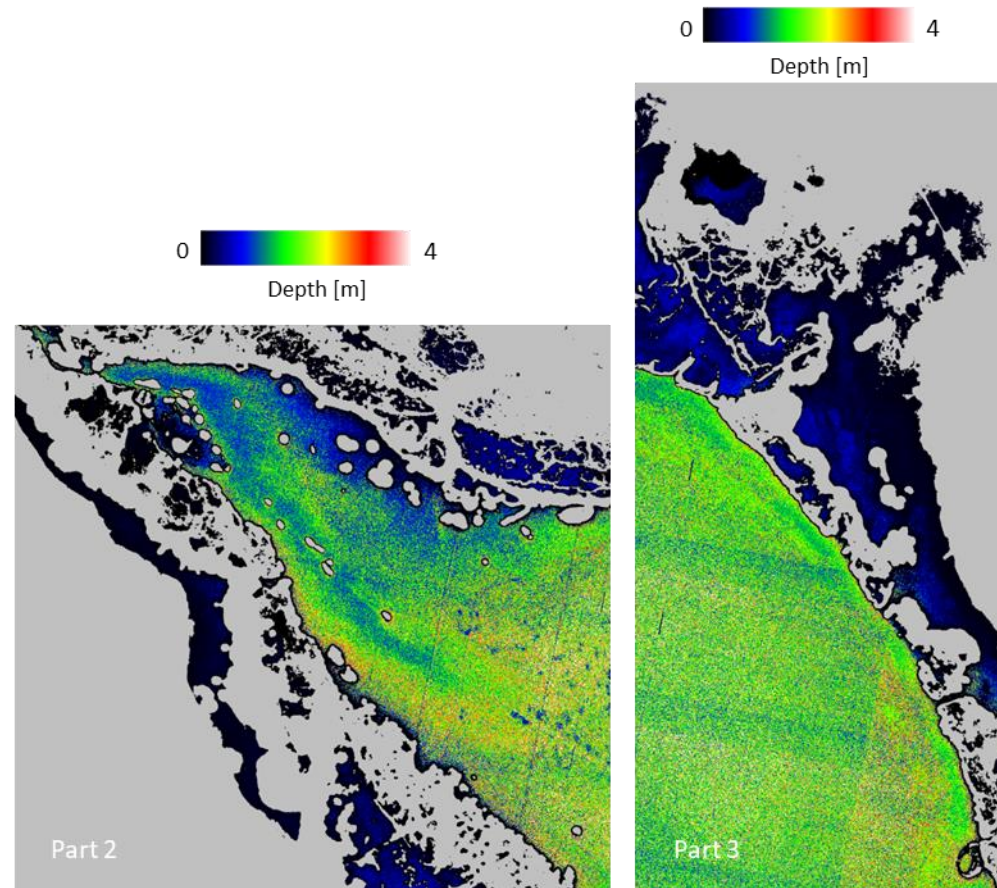


# Derive bathymetry from satellite images

Screenshot of WASI generated results



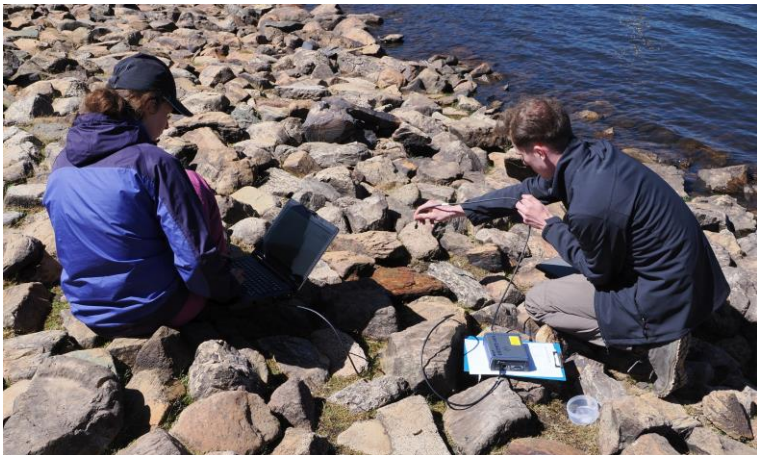
Lago Junin - Planet Scope, July 10th, 2021



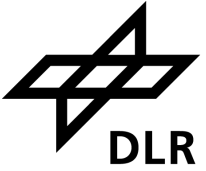
# Field Campaign 2023



Spectral and bathymetric measurements in Laguna Lazo Huntay, Laguna Huacracochoa and Lago Junín

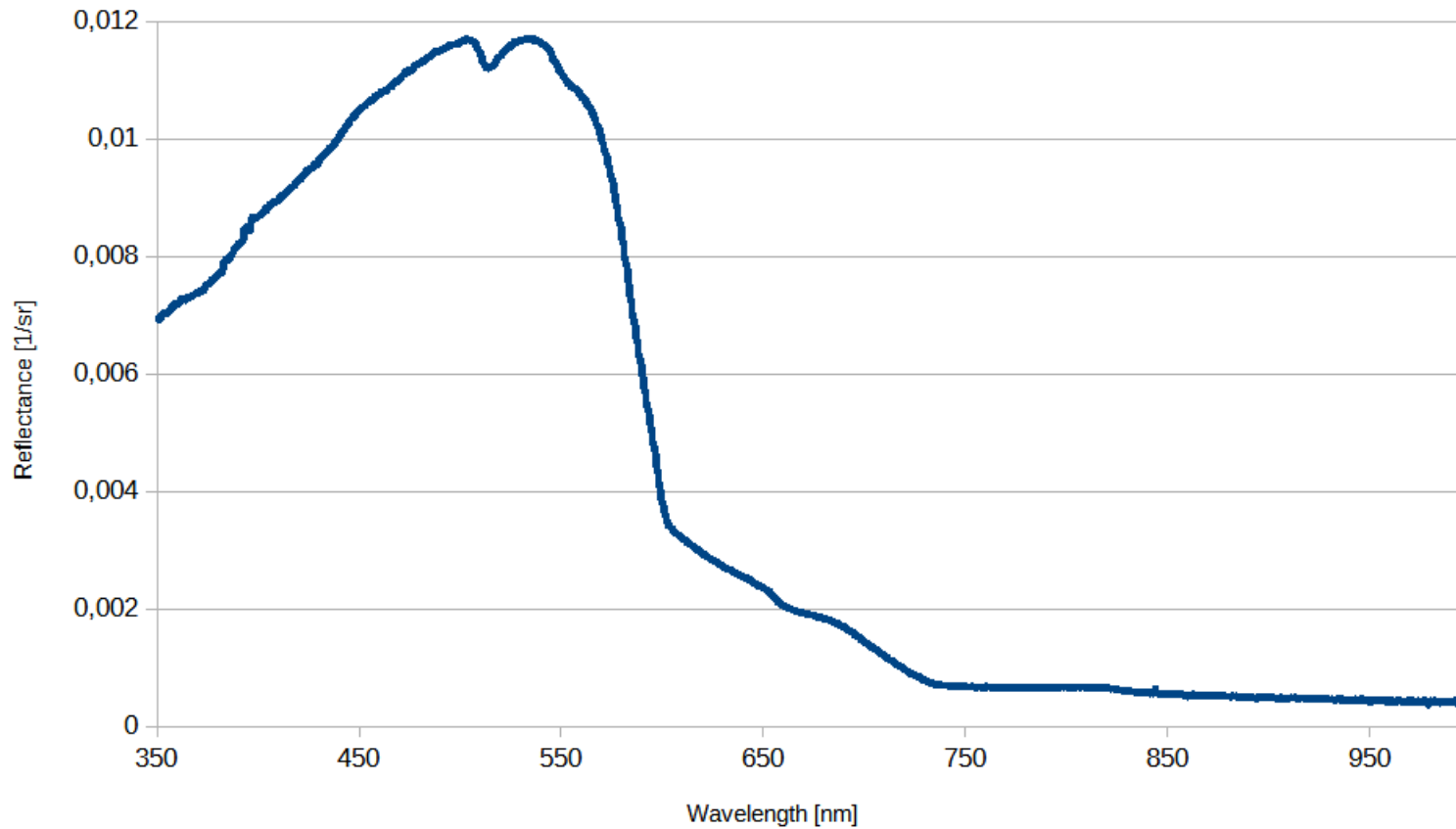


# Field Campaign 2023 – Preliminary results



First reflectance spectrum – Lazo Huntay

Lazo Huntay, 19.06.2023 - LH\_02



GRACIAS PROFESOR INGARUCA  
Y SU EQUIPO DE LA UNCP!

→ Further analysis of all data and derivation of water constituents with WASI

# Field Campaign 2023 – Preliminary results



Concentration of water constituents obtained from in-situ spectral measurements

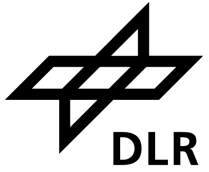
	Lazo Huntay											
	Datum	Station	Lat	Long	See	C[0]	C[4]	C[5]	Chl-a	C_Mie	C_Y	S
	19.06.2023	LH_01	-11.9199833	-75.0594017	Lazohuntay		0.31	0.90	1.21	0.98	0.071	0.0150
	19.06.2023	LH_02	-11.923705	-75.0593517	Lazohuntay		1.48	0.36	1.84	1.80	0.035	0.0172
	19.06.2023	LH_03	-11.9249767	-75.061445	Lazohuntay		1.11	0.38	1.48	1.18	0.045	0.0158
	19.06.2023	LH_04	-11.926445	-75.062225	Lazohuntay		1.86	0.79	2.65	1.52	0.106	0.0159
						Mean	1.19	0.60	1.80	1.37	0.064	0.0160
						StdDev	0.66	0.28	0.63	0.36	0.032	0.0009
	Huacracocha											
	Datum	Station	Lat	Long	See	C[0]	C[4]	C[5]	Chl-a	C_X	C_Y	S
	20.06.2023	HC_07	-12.045255	-75.1035217	Huacracocha	5.9	6.8	2.2	14.9	4.0	1.12	0.0119
	20.06.2023	HC_08	-12.0436917	-75.103585	Huacracocha	6.1	7.5	2.7	16.3	4.2	1.20	0.0120
	20.06.2023	HC_09	-12.0430667	-75.10341	Huacracocha	7.0	6.7	3.8	17.5	5.2	1.38	0.0108
						Mean	6.3	7.0	2.9	16.2	4.5	1.23
						StdDev	0.6	0.4	0.8	1.3	0.6	0.13
												0.0006
	Junin											
	Datum	Station	Lat	Long	See	C[0]	C[4]	C[5]	Chl-a	C_X	C_Y	S
	26.06.2023	JU_01	-10.9719666	-76.2167567	Junin	13.65			13.65	8.10	0.77	0.0101
	26.06.2023	JU_02	-10.9797335	-76.2028169	Junin	4.89			4.89	5.42	1.03	0.0131
	26.06.2023	JU_03_a	-10.9860854	-76.1914316	Junin	7.27			7.27	5.05	1.37	0.0148
	26.06.2023	JU_04_a	-10.995825	-76.1974934	Junin	6.27			6.27	3.09	0.89	0.0109
						Mean			8.02	5.41	1.02	0.0122
						StdDev			3.88	2.06	0.26	0.0021
	27.06.2023	JU_12	-11.0124468	-76.170329	Junin		0.78		0.78	1.32	0.63	0.0150
	27.06.2023	JU_13	-11.0078631	-76.1678701	Junin		0.65		0.65	1.17	0.51	0.0136
	27.06.2023	JU_14	-10.9991737	-76.1641708	Junin		1.34		1.34	0.86	0.38	0.0145
	27.06.2023	JU_15	-10.9876253	-76.1592588	Junin		1.40		1.40	0.90	0.39	0.0150
	27.06.2023	JU_16	-10.981823	-76.157148	Junin		1.38		1.38	1.02	0.56	0.0179
						Mean	1.11		1.11	1.05	0.49	0.0152
						StdDev	0.36		0.36	0.19	0.11	0.0016
	28.06.2023	JU_20	-10.9944852	-76.110731	Junin	2.06			2.06	1.06	0.52	0.0129
	28.06.2023	JU_21	-10.9987028	-76.1117801	Junin	2.84			2.84	1.52	0.46	0.0118
	28.06.2023	JU_22	-11.0038128	-76.1135167	Junin	2.90			2.90	1.42	0.55	0.0123
	28.06.2023	JU_23	-11.0088476	-76.1157008	Junin	2.89			2.89	1.48	0.52	0.0120
	28.06.2023	JU_24	-11.0134419	-76.117228	Junin	2.91			2.91	1.32	0.54	0.0126
	28.06.2023	JU_25	-11.017455	-76.1183704	Junin	2.95			2.95	1.47	0.55	0.0127
	28.06.2023	JU_26	-11.0216644	-76.1198735	Junin	3.23			3.23	1.47	0.53	0.0126
	28.06.2023	JU_27	-11.0261536	-76.1216241	Junin	3.24			3.24	1.39	0.53	0.0126
	28.06.2023	JU_28	-11.03069	-76.1234511	Junin	3.18			3.18	1.46	0.52	0.0122
	28.06.2023	JU_29	-11.0350073	-76.1250834	Junin	2.77			2.77	1.40	0.50	0.0125
	28.06.2023	U_210/JU_30	-11.0304775	-76.1384871	Junin	1.83			1.83	1.26	0.47	0.0135
						Mean	2.80		2.80	1.38	0.52	0.0125
						StdDev	0.46		0.46	0.13	0.03	0.0005

Preliminary results

→ Further analysis and validation of water constituents derived from simultaneous satellite images



# Field Campaign 2023 – Preliminary results



Remote controlled or autonomous boat for bathymetry measurement: “La Plancha”



# Field Campaign 2023 – Preliminary results



First validated bathymetry map of Lazo Huntay



→ Derivation of bathymetry from satellite images in shallow areas.

# Group Validation

- Principal research topic: remote sensing of inland waters
- Validation of satellite data and model results for water quality parameters
- Development of radiative transfer models for water (WASI)
- Conduction of field campaigns
- Development of instrumentation for field measurements



Peter Gege



Ian Somlai



Stefan Plattner



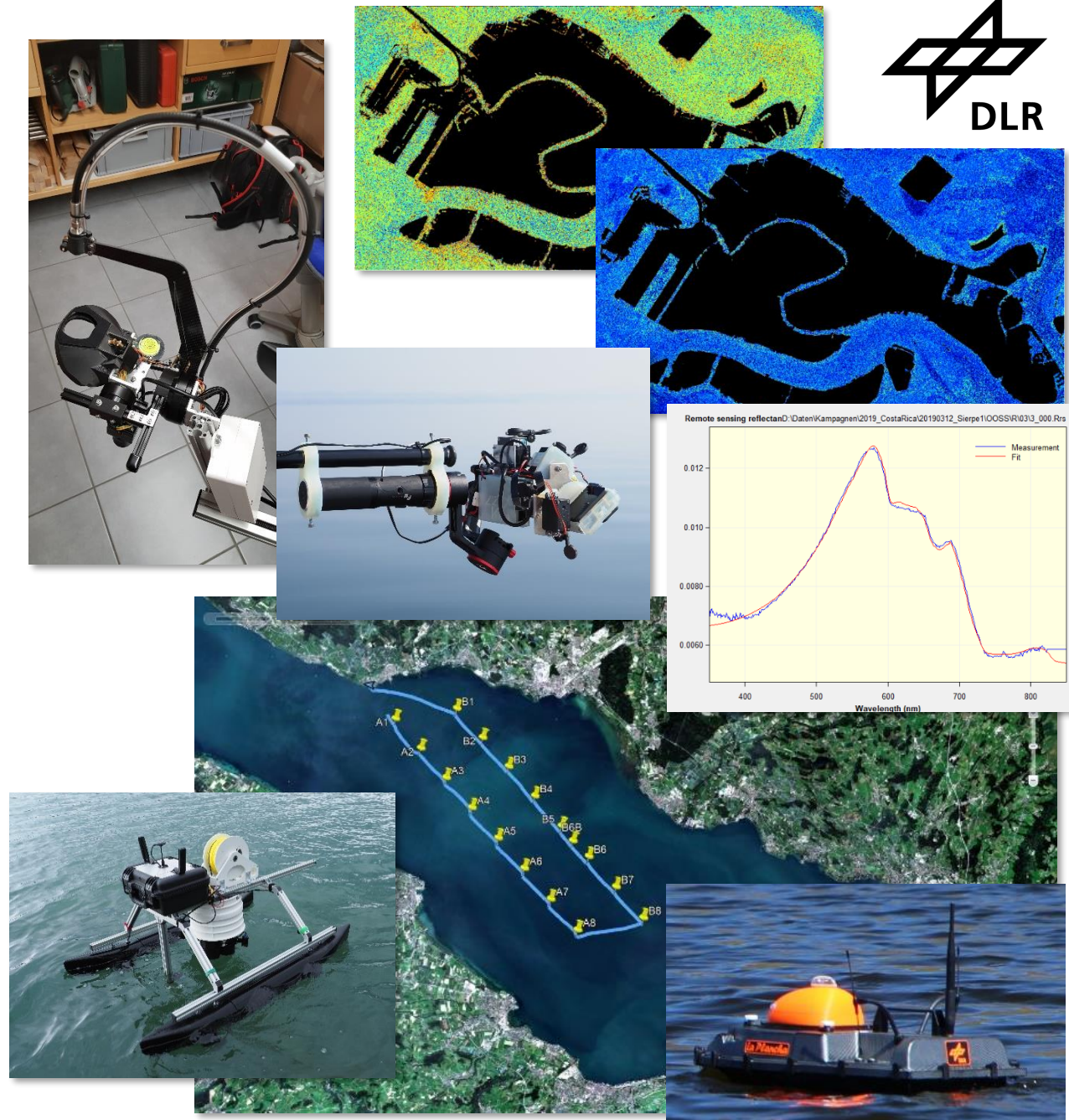
Thomas Schwarzmaier



Sonja Schmid



Patrick Klotz



# Thank you! - ¡Muchas gracias! - Vielen Dank!

DLR-Team "Validation": Peter Gege, Stefan Plattner, Sonja Schmid, Patrick Klotz, Thomas Schwarzmaier, Ian Somlai

