Technical Workshop: Remote Sensing for Water Quality Applications

Potential barriers and considerations for remote sensing data

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May 18, 2025

Anchorage, AK

Source: NASA

Potential Barriers & Considerations

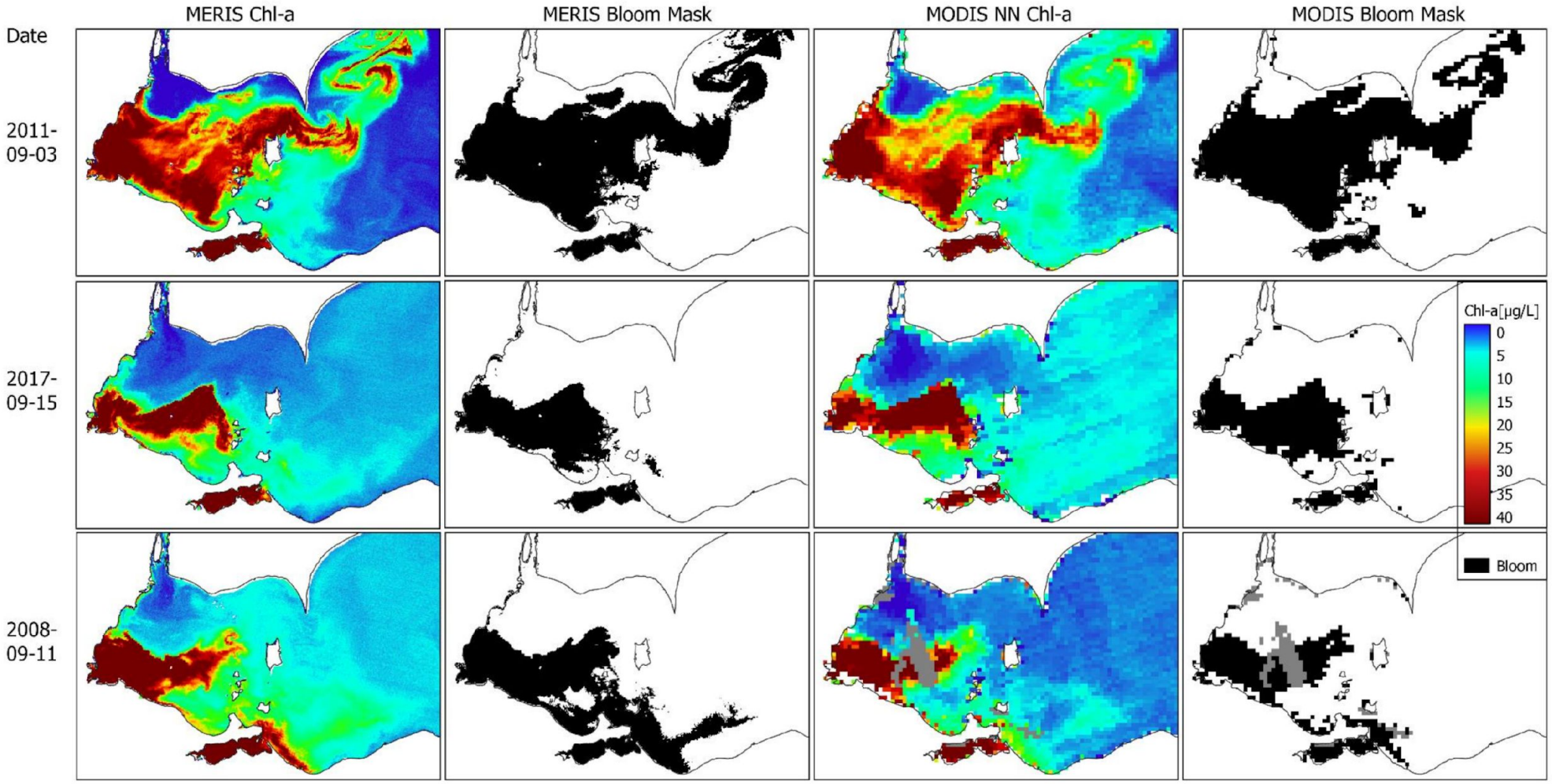
1. Spatial resolution
2. Spectral resolution
3. Temporal resolution
4. Atmosphere related issues
5. Data fusion

1. Spatial resolution of data products

Spatial resolution: the area on Earth's surface represented by each pixel

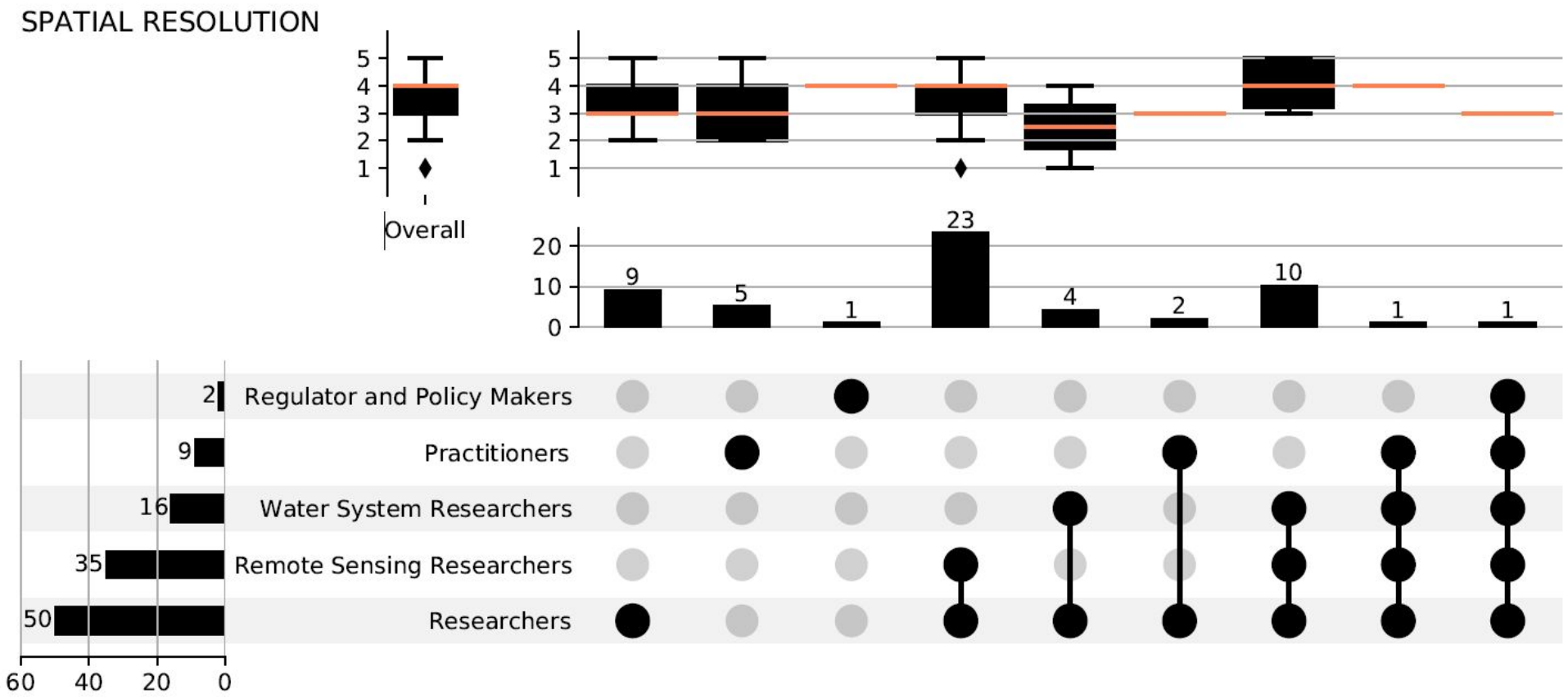
Source: NASA

1. Spatial resolution of data products



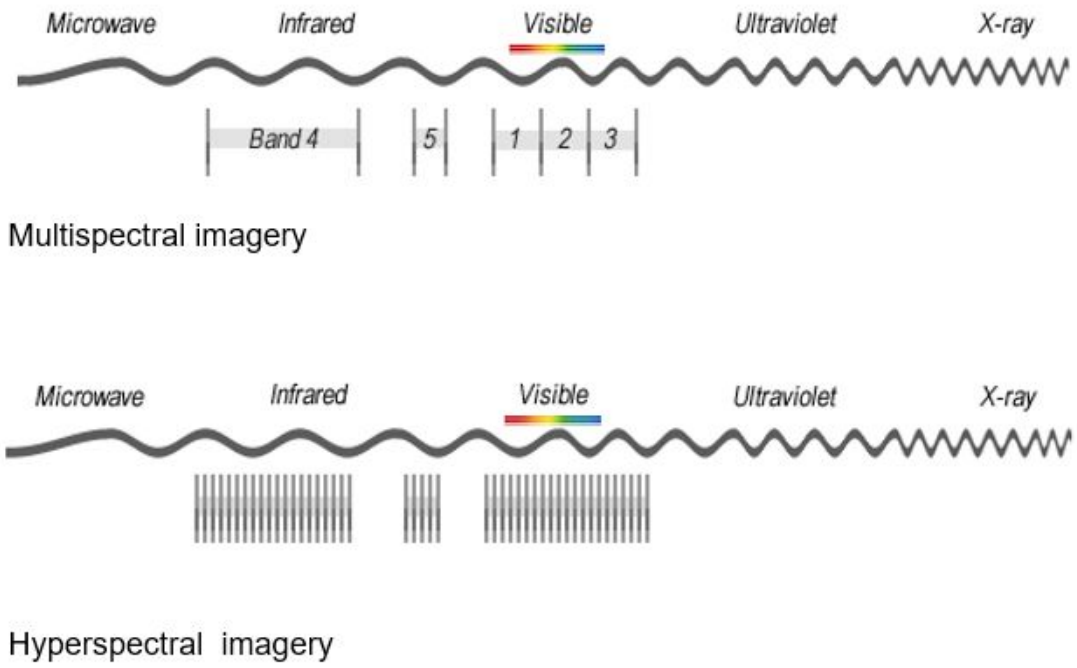
Zeng, C., & Binding, C. E. (2021). Consistent Multi-Mission Measures of Inland Water Algal Bloom Spatial Extent Using MERIS, MODIS and OLCI. *Remote Sensing*, *13*(17), 3349.

Spatial Resolution – Survey

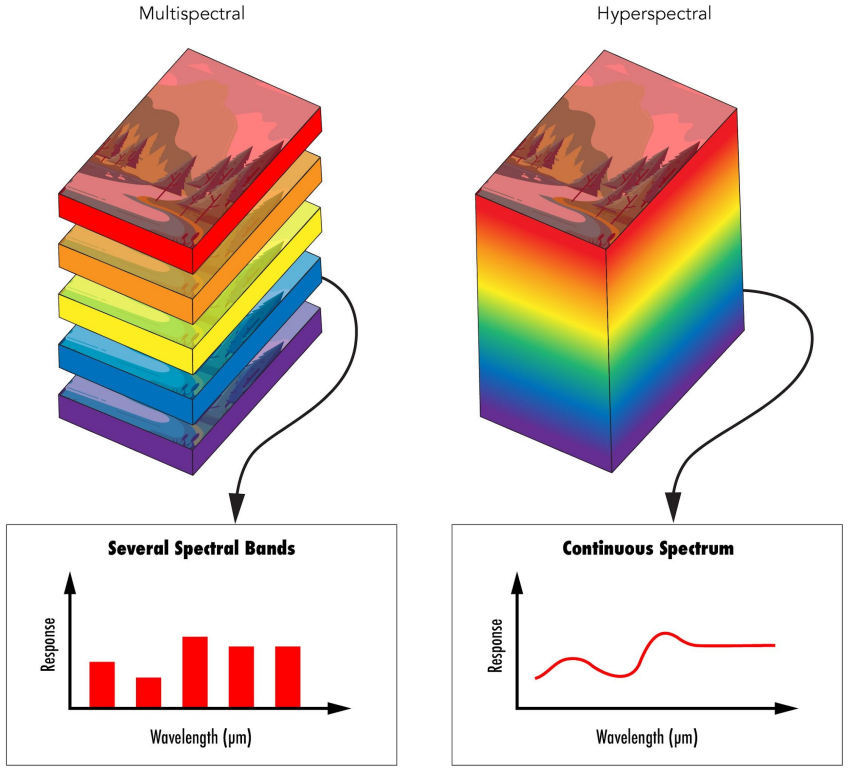


2. Spectral resolution of data products

Spectral resolution is the ability of a sensor to discern finer wavelengths – e.g., having more and narrower bands.

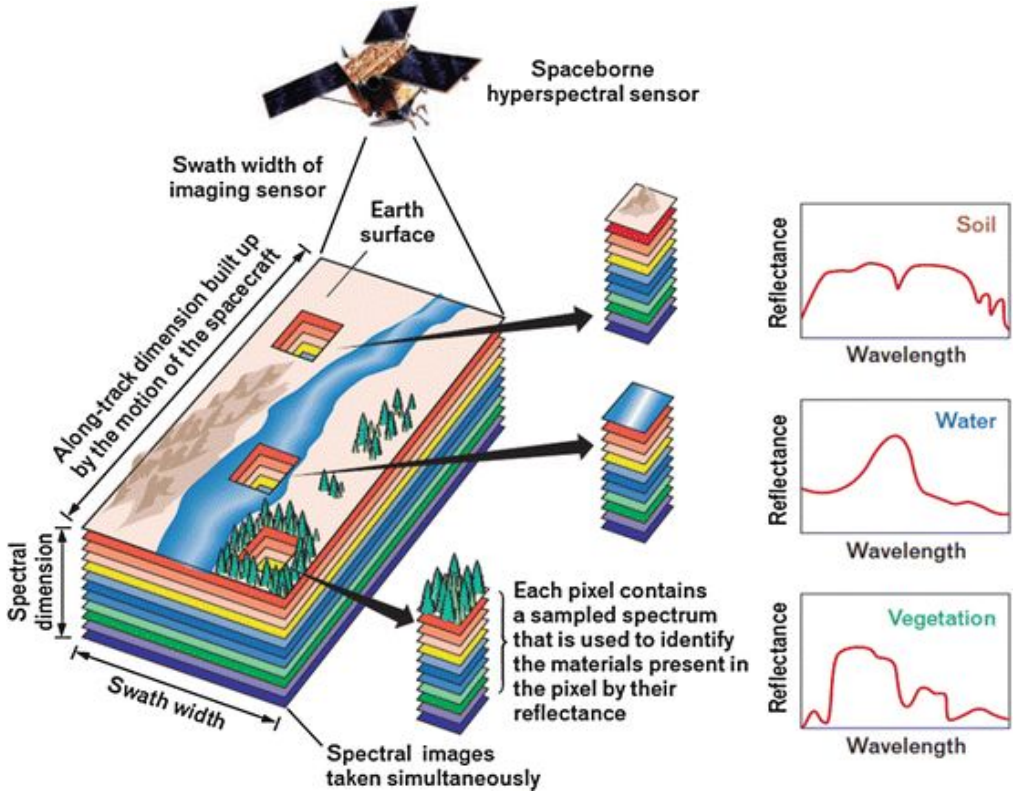


GIS Geography. *Multispectral vs Hyperspectral Imagery Explained - GIS Geography*. URL: https://gisgeography.com/multispectral-vs-hyperspectral-imagery-explained/.

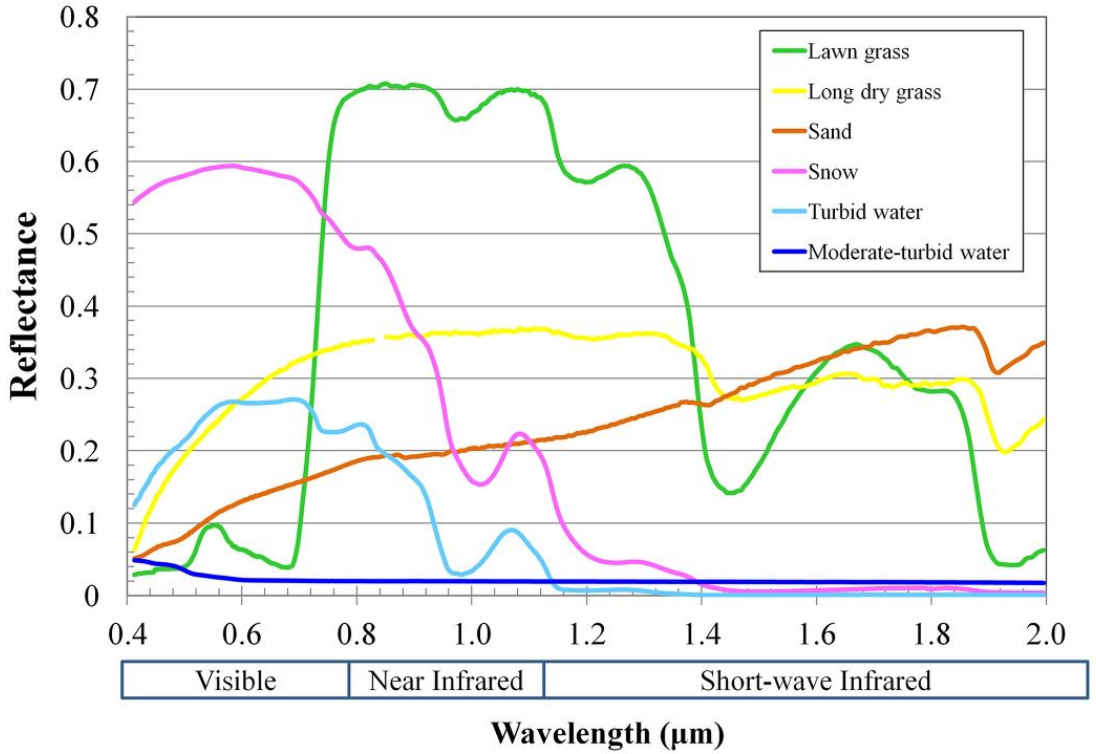


edmundoptics.com

2. Spectral resolution of data products

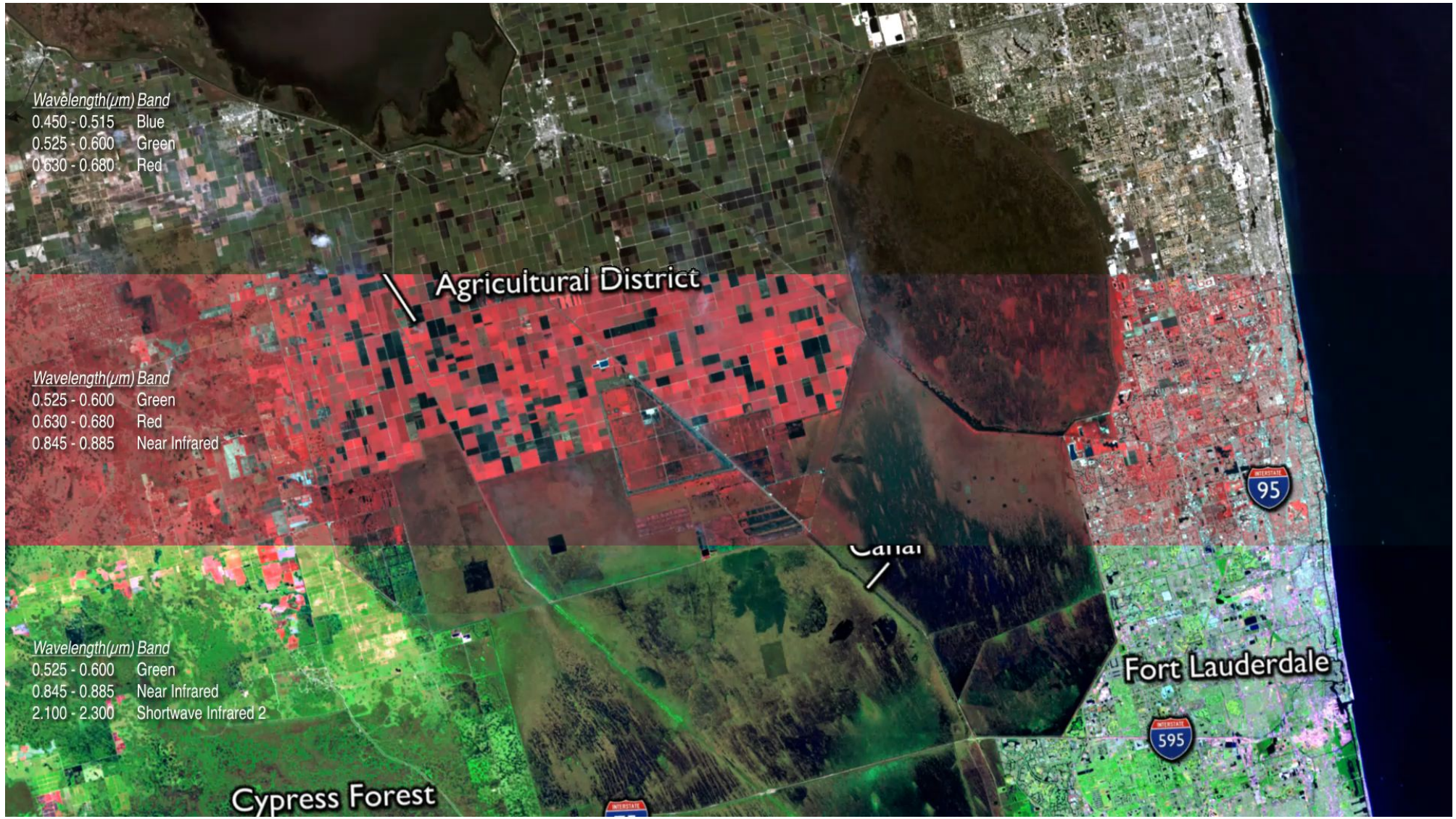


Li, J., Shen, H., Li, H., Jiang, M., & Yuan, Q. (2021). Radiometric quality improvement of hyperspectral remote sensing images: a technical tutorial on variational framework. *Journal of Applied Remote Sensing*, *15*(3), 031502.

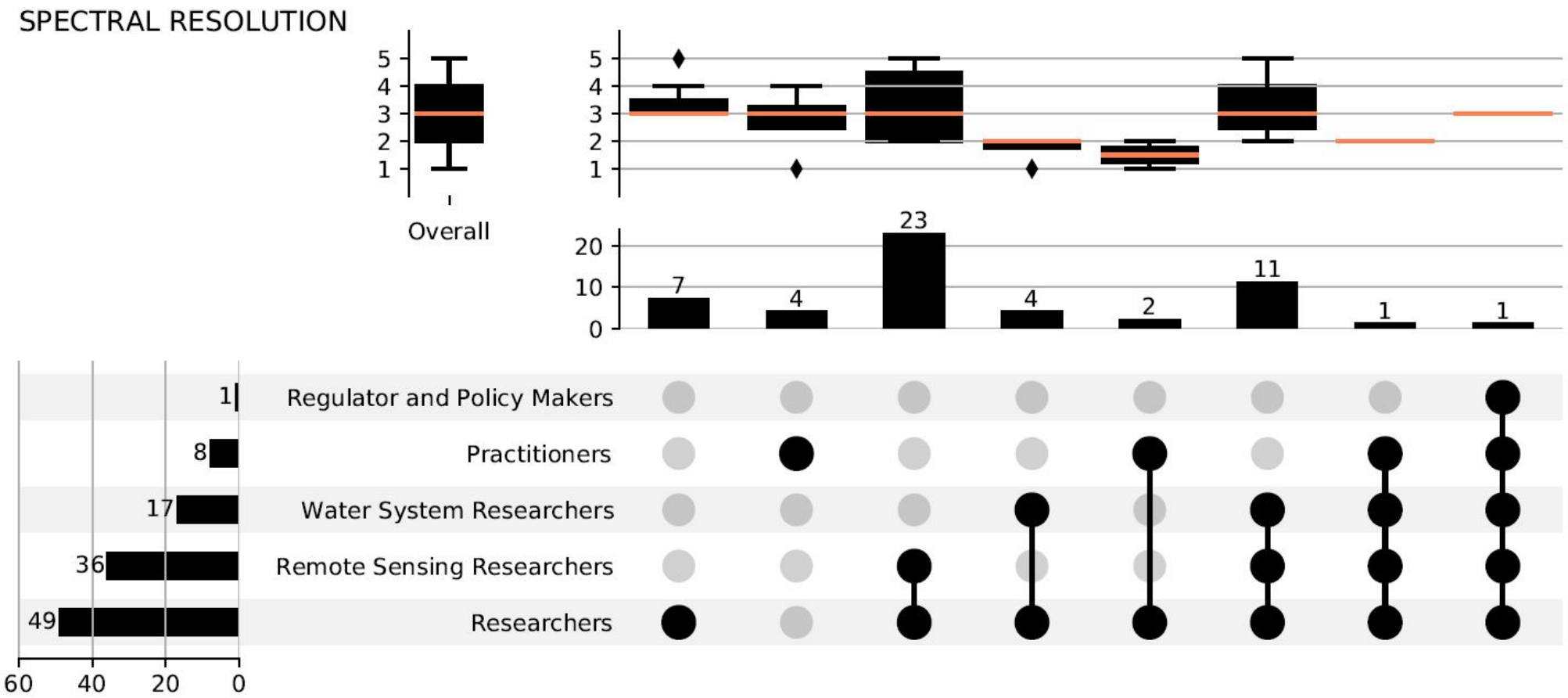


Spectral signatures of different Earth features within the visible light spectrum. Credit: Jeannie Allen.

2. Spectral resolution of data products



Spectral Resolution – Survey

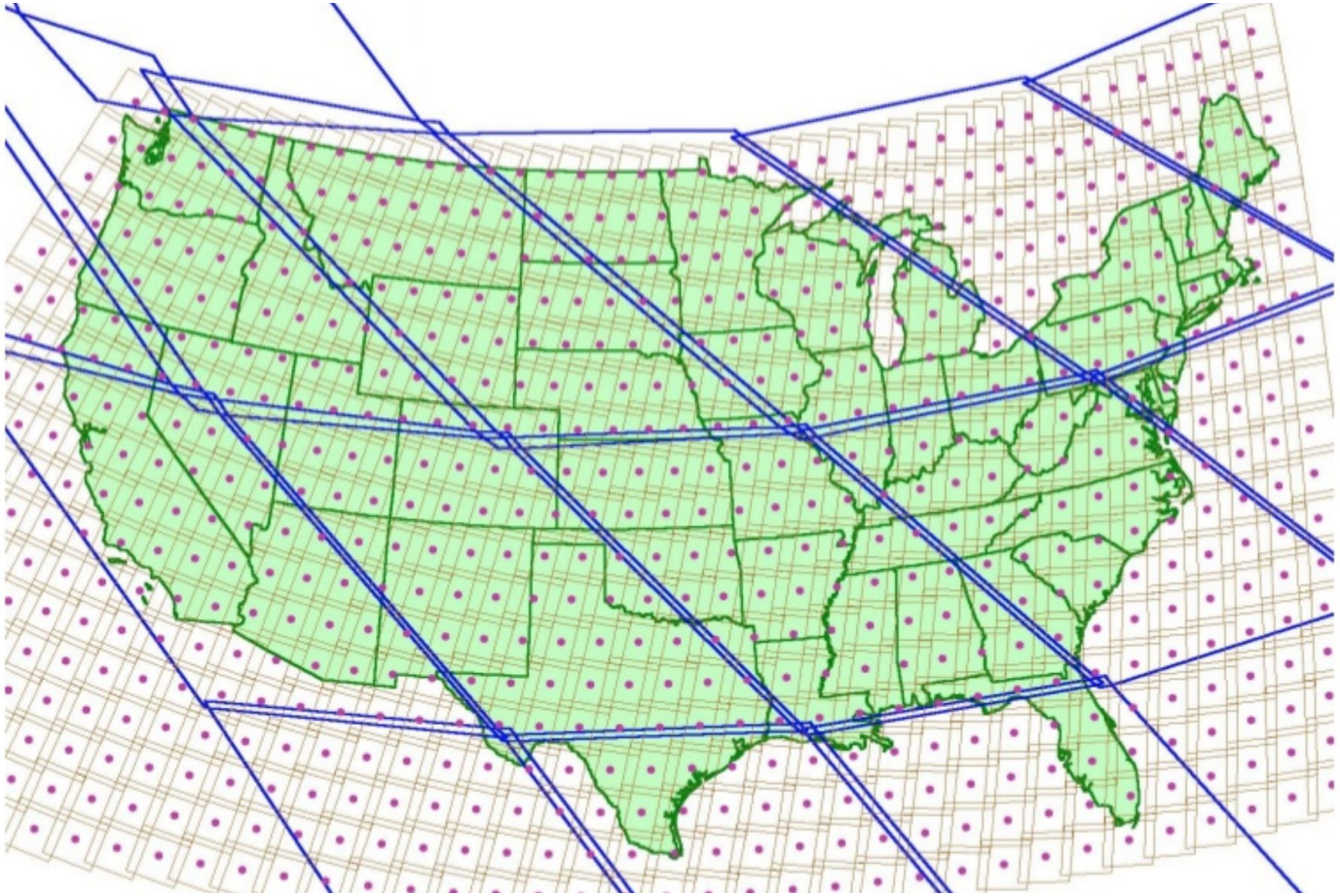


3. Temporal resolution of data products

Temporal resolution is the time it takes for a satellite to complete an orbit and revisit the same observation area.

Source: NASA

3. Temporal resolution of data products

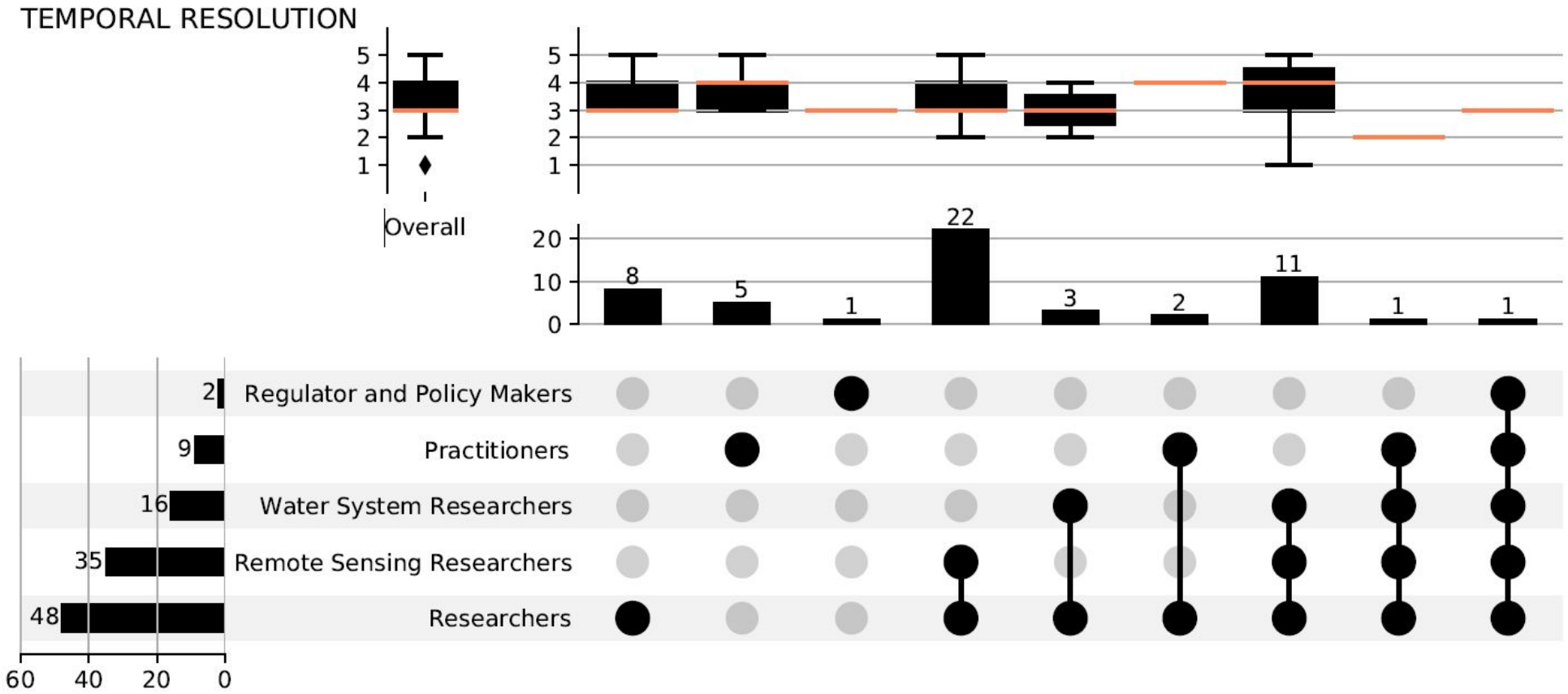


Credit: NASA Applied Remote Sensing Training (ARSET).

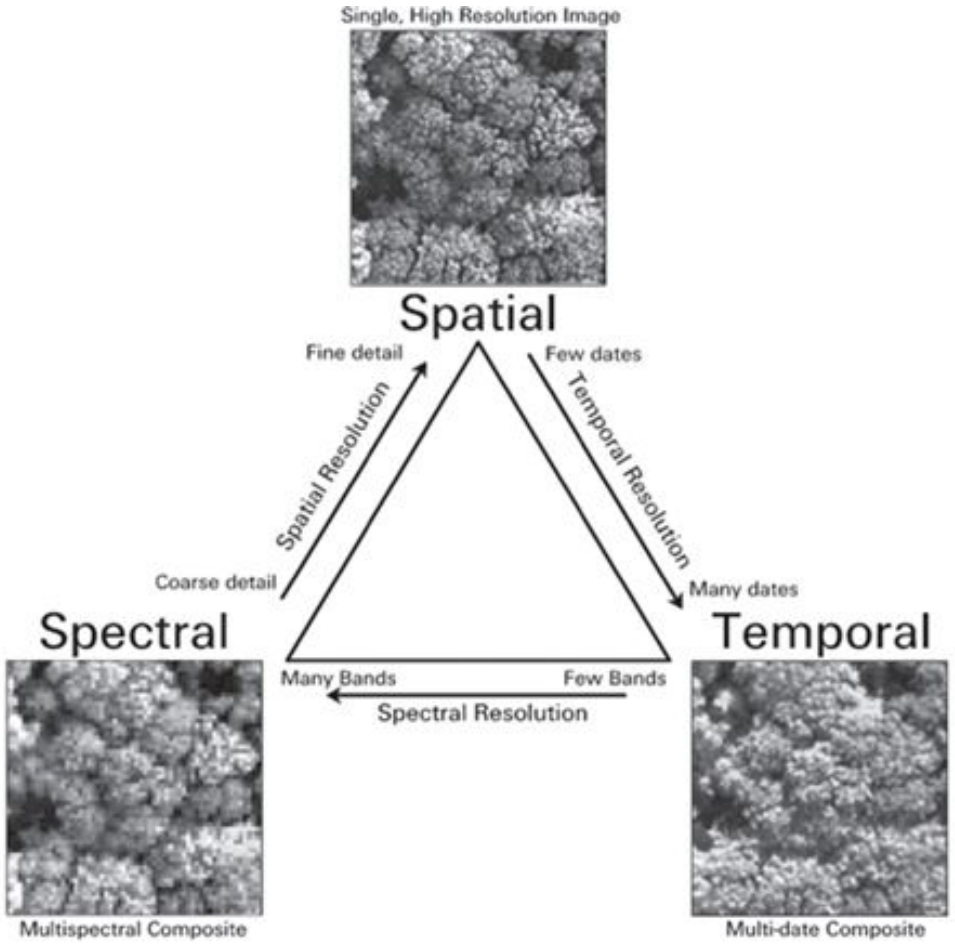
MODIS
1-2 days

OLI
16 days

Temporal Resolution – Survey



Spatial, spectral, temporal -- tradeoffs



High spatial resolution means a narrower swath and therefore longer time between observations

Timothy A Warner, M Duane Nellis, and Giles M Foody. Remote sensing scale and data selection issues. *The SAGE handbook of remote sensing*, 2:568, 2009.

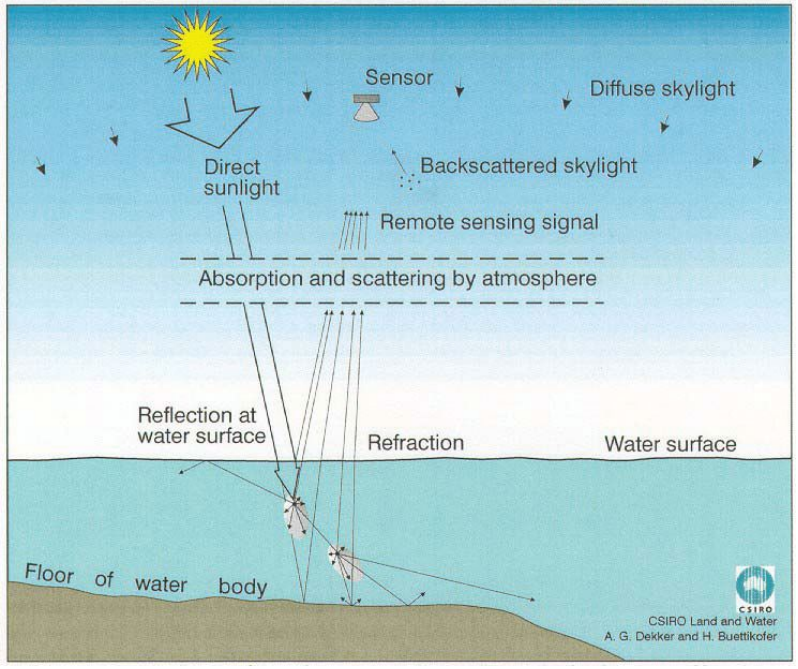
	Satellite Sensor	Launch Date	Spatial Resolution (m)	Spectral Resolution Band	Temporal Resolution (Day)
Multi-spectral	NIMBUS-7 CZCS	1978.10	825	6	6
	Landsat-5/7/8/9	1984–2020	30	5	16
	SeaWiFS	1997.8	1130	8	16
	NOAA-16 AVHRR	2000.10	1100–4000	6	9
	EO-1 ALI	2000.11	10	9	16
	WorldView-2/3	2009/2014	1.85/1.24	8	1.1
	MERIS	2002.3	300–1200	15	1
	MODIS	1999.12	250–500–1000	9	0.5
	Landsat-8 OLI	2013.2	30	7	16
Hyper-spectral	HY-1A COCTS	2002.5	1100	10	3
	PROBA CHRIS	2001.10	18–36	19	7
	Hyperion	2000.11	30	42	16
	HJ-1A HSI	2008.9	100	128	4
	HICO	2009.9	100	128	10
	VIIRS	2011.10	375–750	22	0.5
	OHS	2018.4	10	32	2
	GF5-AHSI	2018.5	30	330	3
	ZY1-02D	2019.9	30	166	3
sensors for UAV	ZK-VNR-FPG480	/	0.09	270	/
	GaiaSky-mini	/	0.04	176	/

Yang, H., Kong, J., Hu, H., Du, Y., Gao, M., & Chen, F. (2022). A Review of Remote Sensing for Water Quality Retrieval: Progress and Challenges. *Remote Sensing*, *14*(8), 1770.

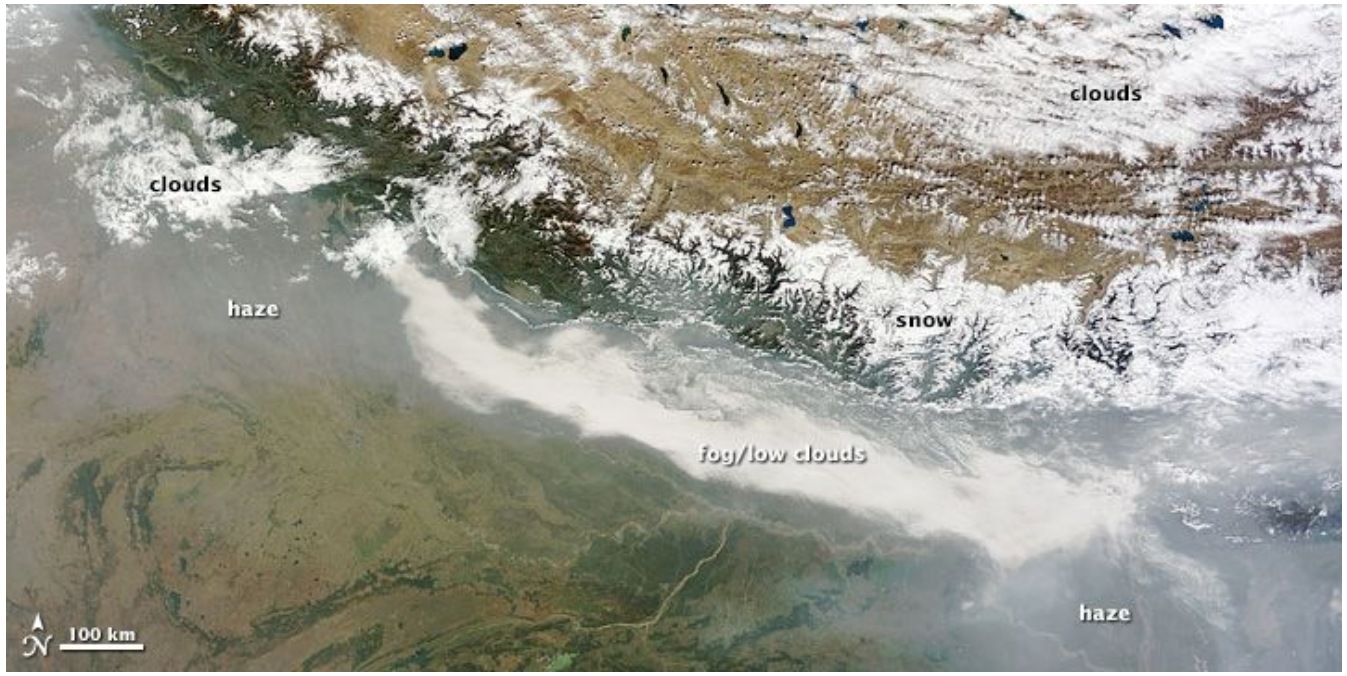
4. Atmosphere related issues

Atmospheric interference

- Scattering
- Absorption

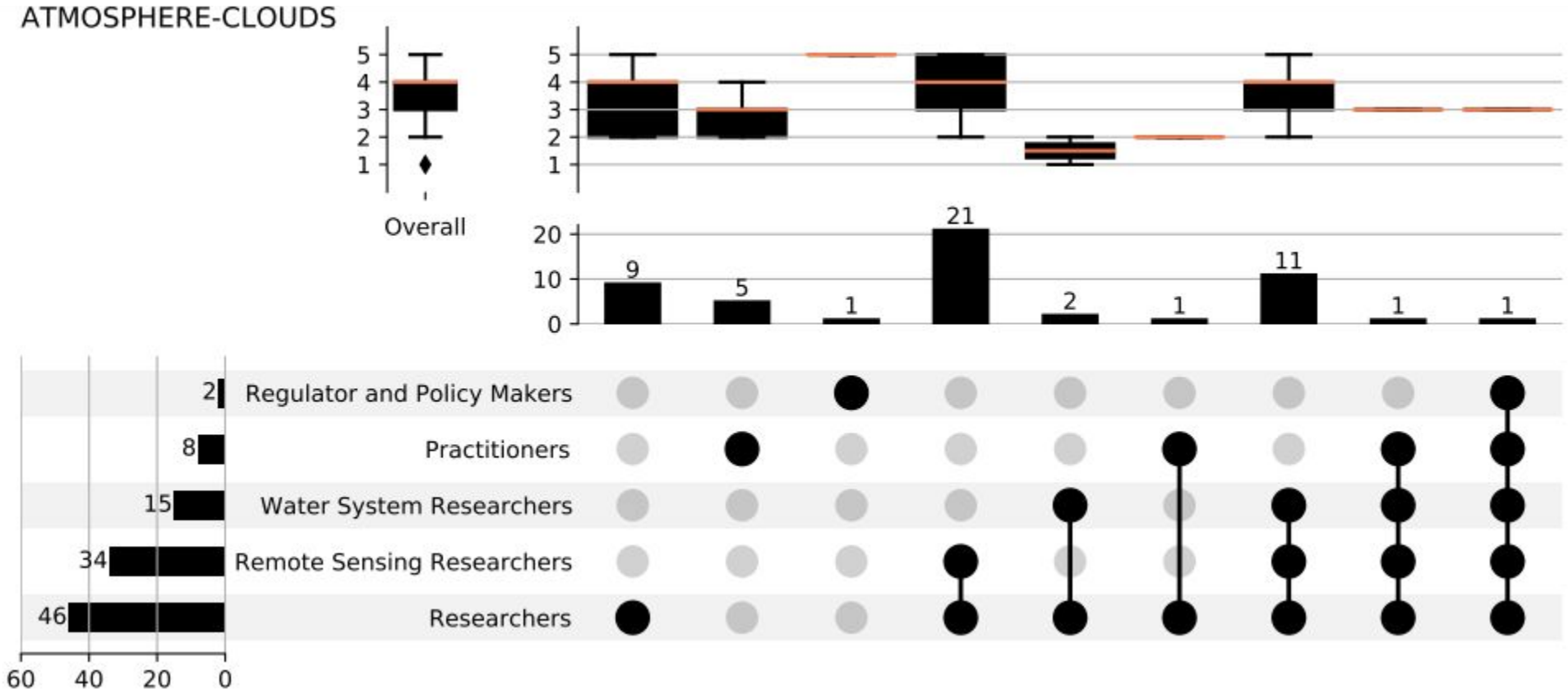


Dense cloud cover / pollution



https://earthobservatory.nasa.gov/features/ColorImage

Atmosphere/Clouds – Survey



5. Data fusion

Integrating multiple data sources for more consistent, accurate, and useful information

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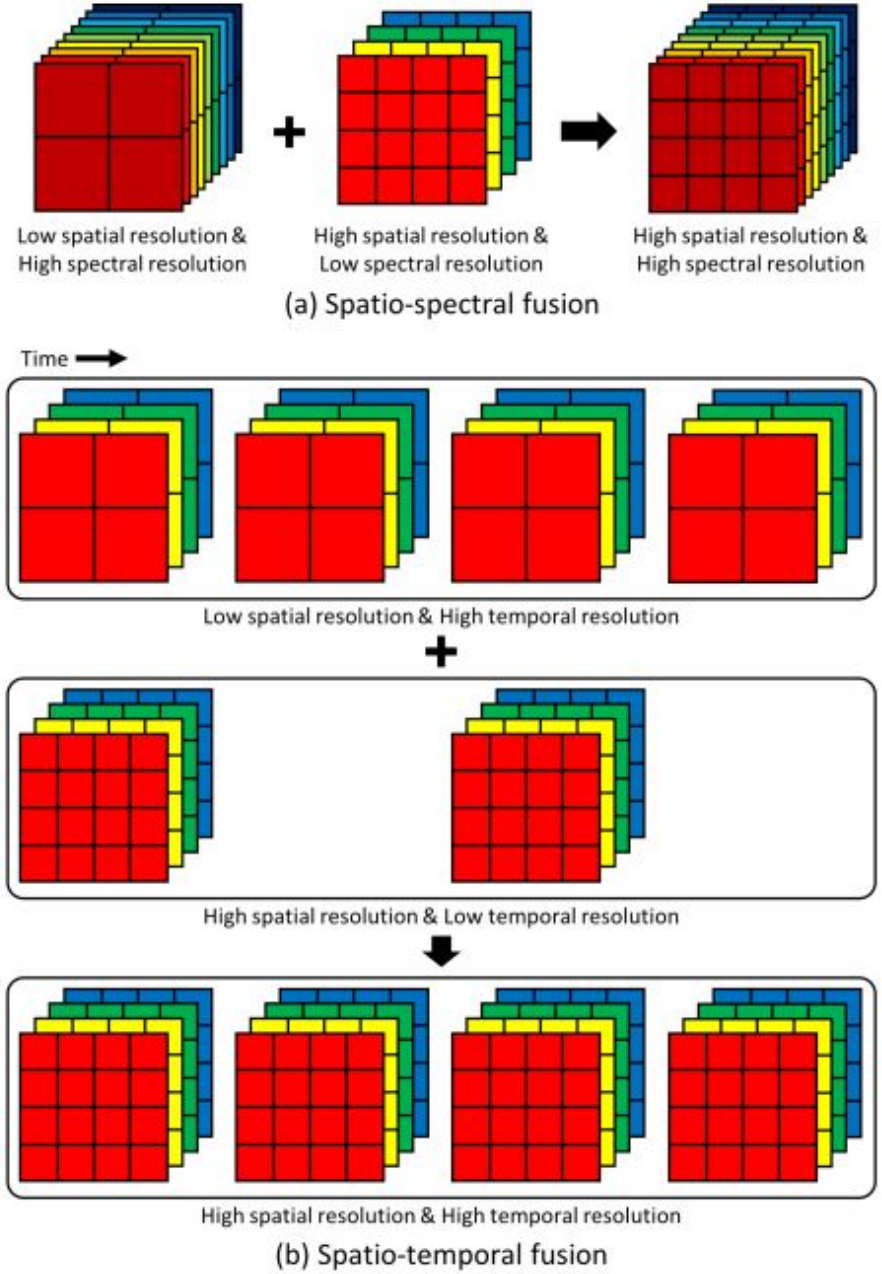
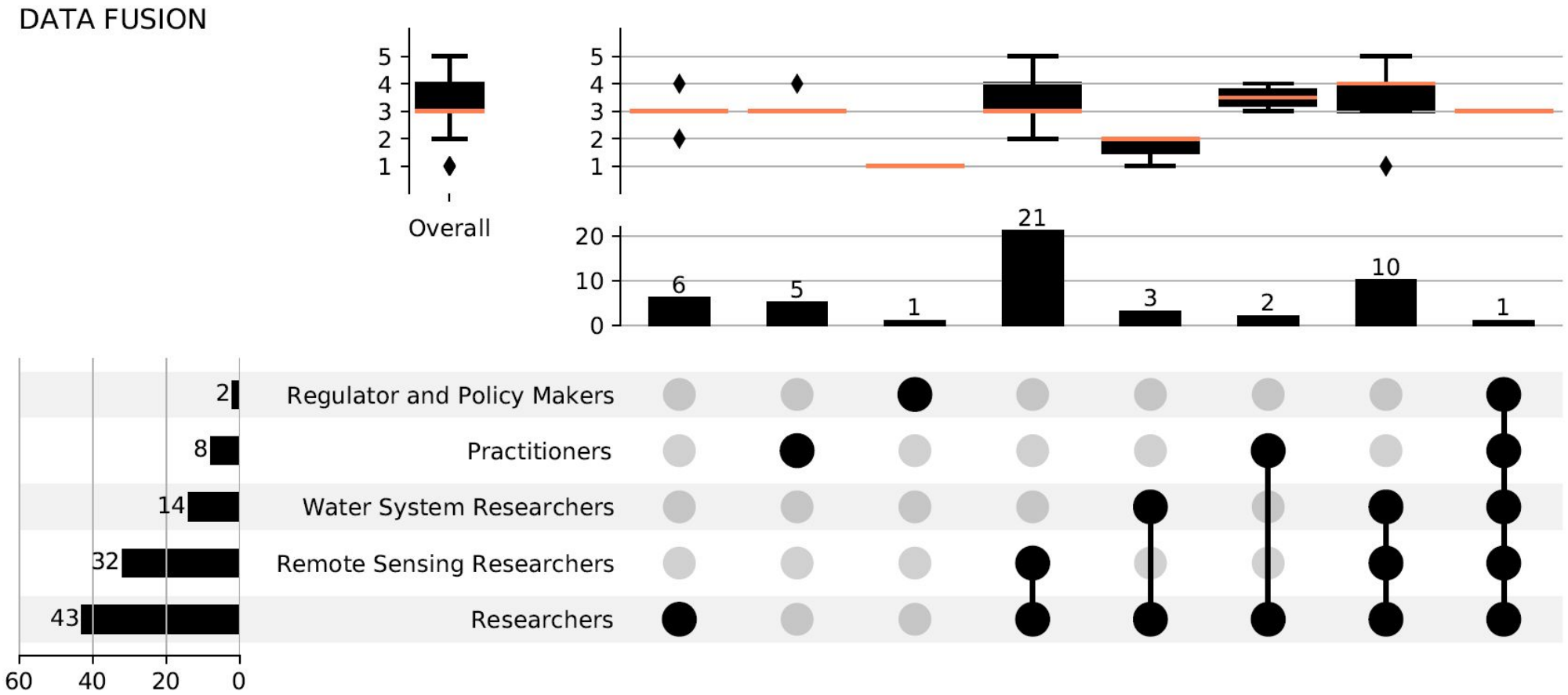


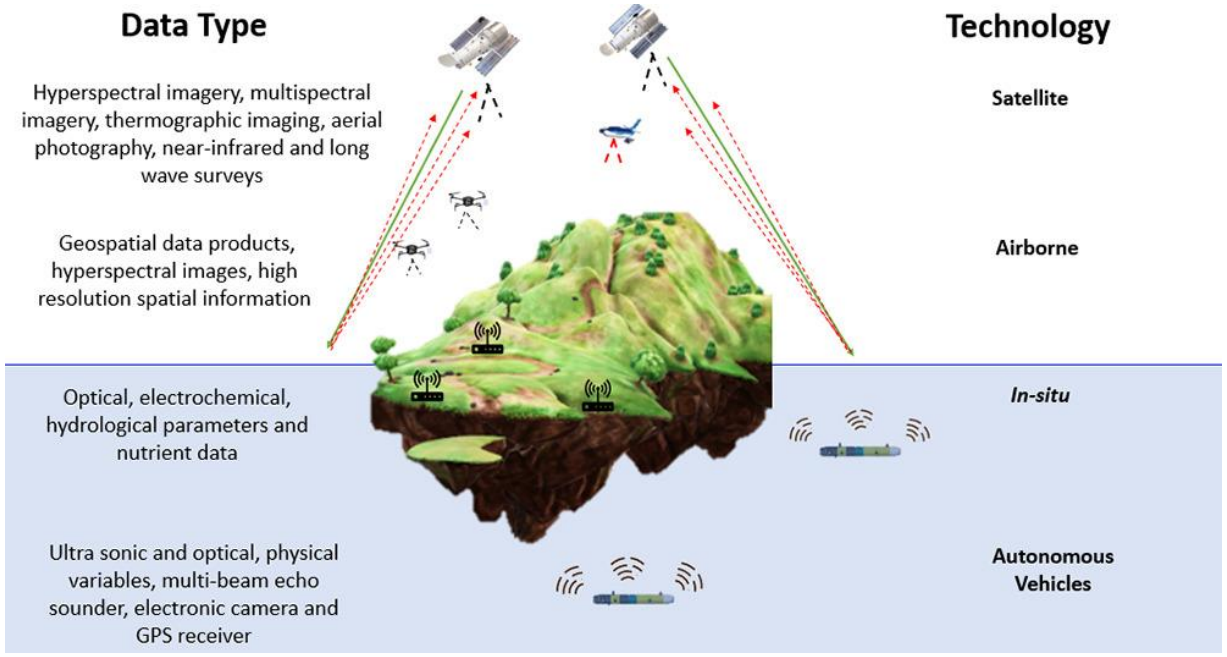
Ghamisi, P., Rasti, B., Yokoya, N., Wang, Q., Hofle, B., Bruzzone, L., ... & Benediktsson, J. A. (2019). Multisource and multitemporal data fusion in remote sens A comprehensive review of the state of the art. IEEE Geoscience and Remote Sensing Magazine, 7(1), 6-39.

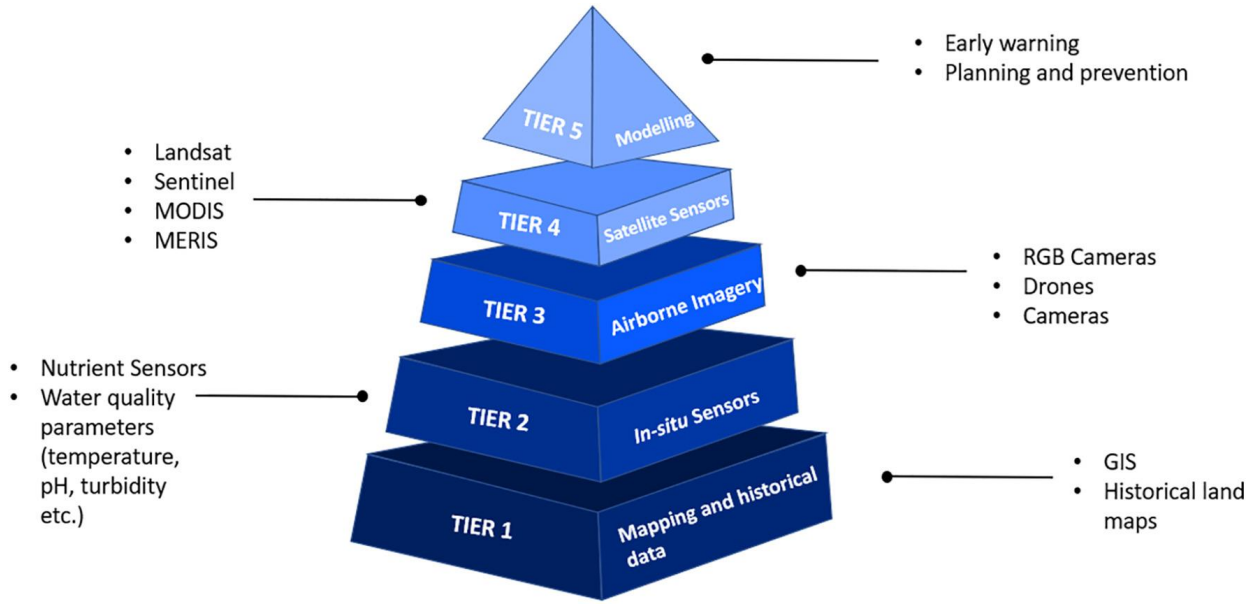
Data fusion – Survey



Group discussion

Data Integration





O'Grady, J., Zhang, D., O'Connor, N., & Regan, F. (2021). A comprehensive review of catchment water quality monitoring using a tiered framework of integrated sensing technologies. *Science of The Total Environment*, *765*, 142766.