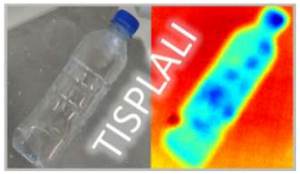
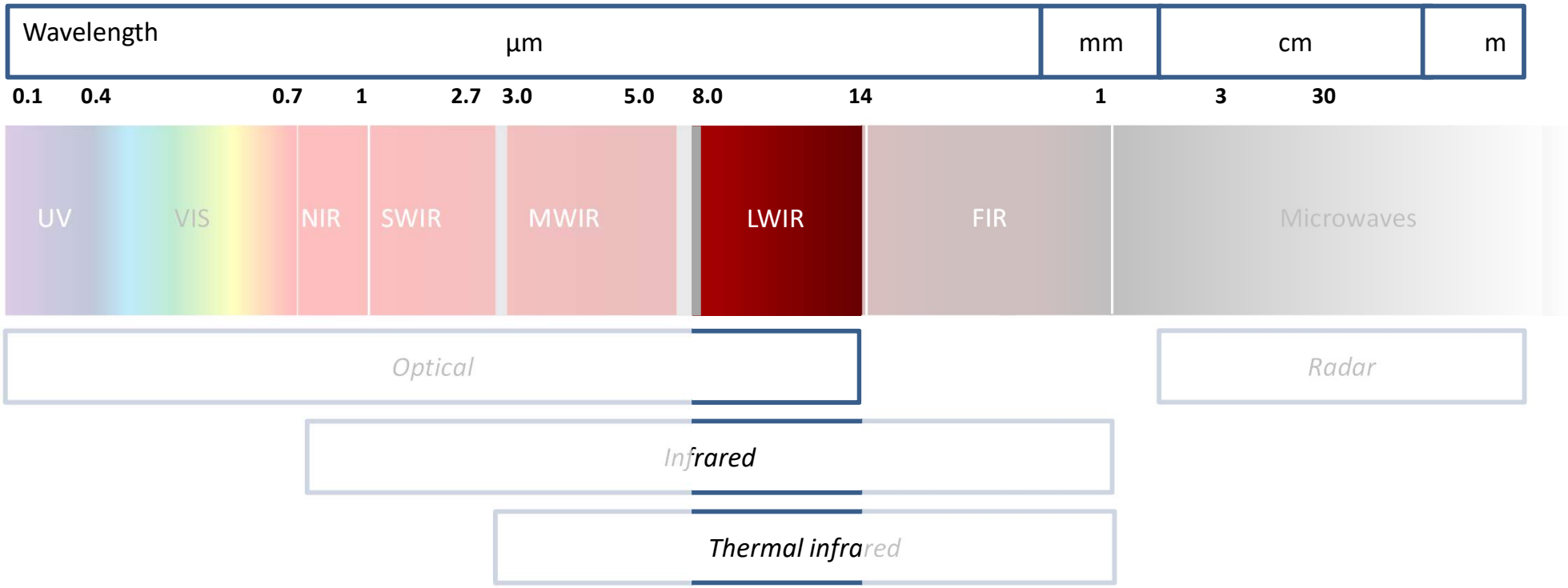


Thermal infrared sensing to monitor floating plastic litter.

Lonneke Goddijn-Murphy, Jason McIlvenny, Benjamin J. Williamson, Paolo Corradi

WITH THE SUPPORT OF

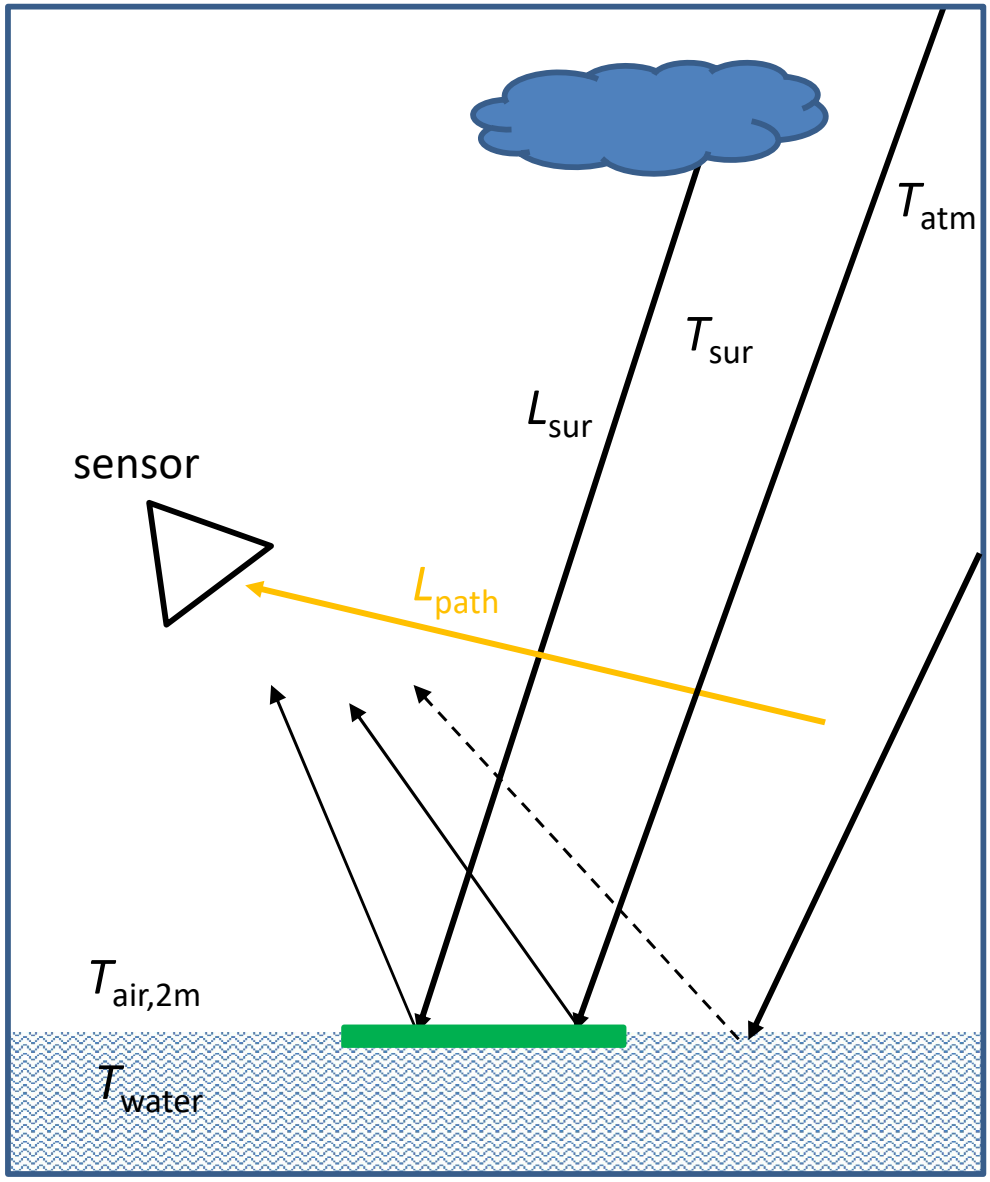
Thermal Infrared Radiometry



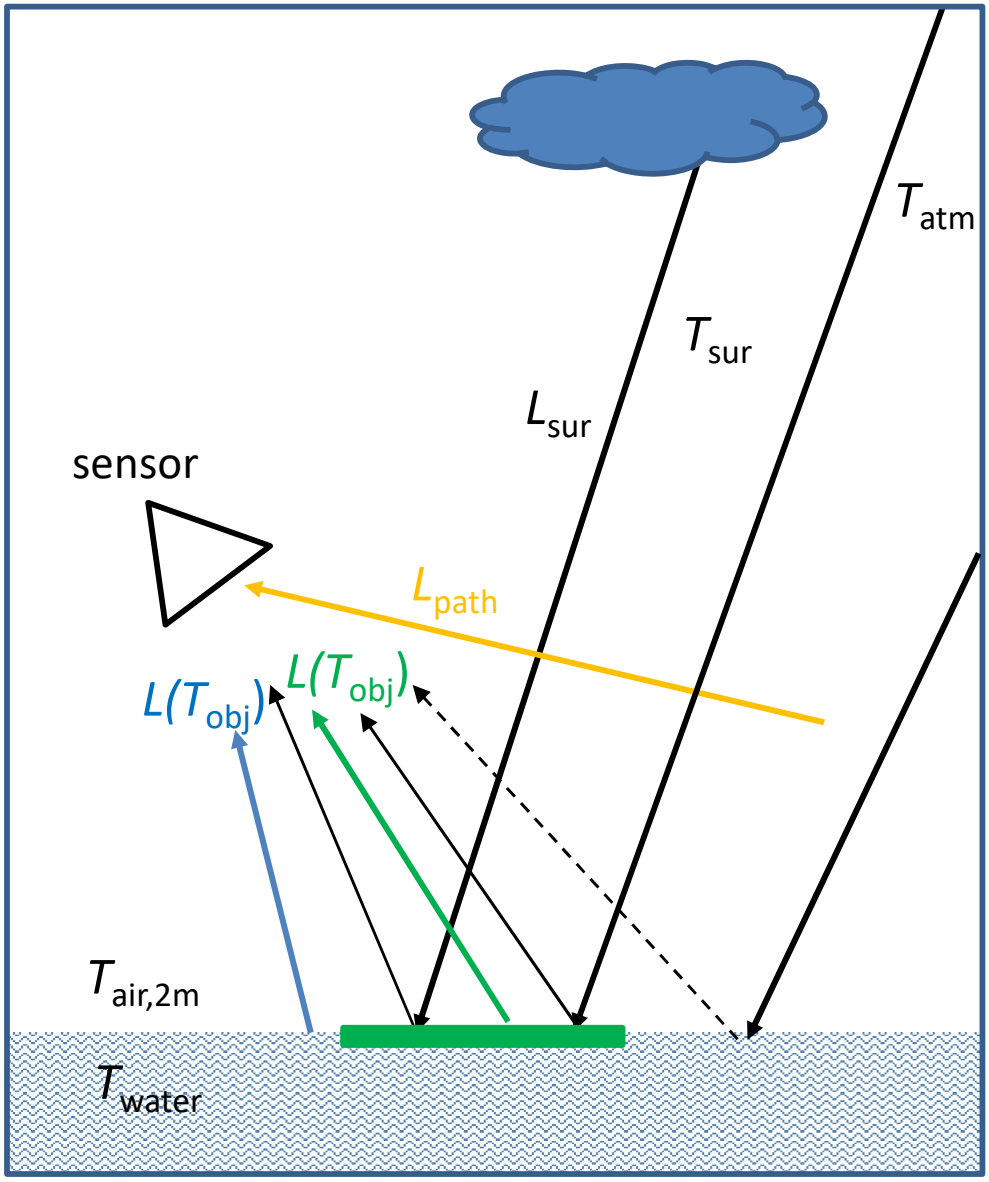
7.5 to 13.5 µm

FLIR Vue Pro R 640

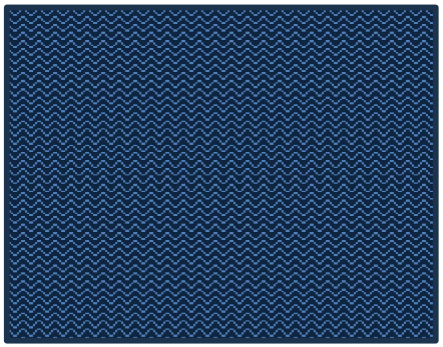
Thermal Infrared Radiometry



Thermal Infrared Radiometry

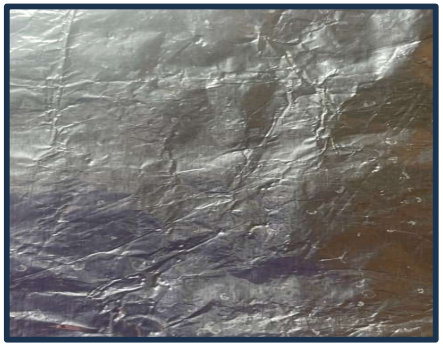


Thermal Infrared Radiometry



Water — *emissivity* ≈ 1; *reflectivity* ≈ 0

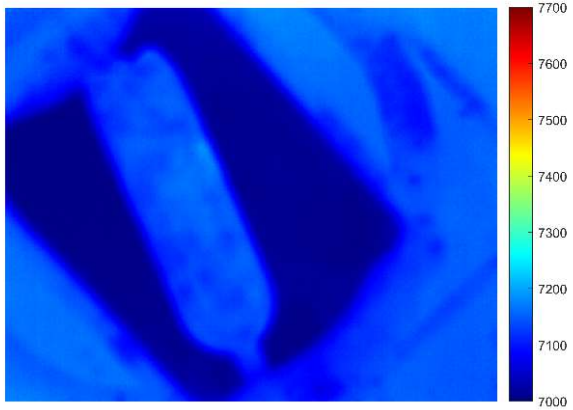
Plastics — 0 < *emissivity* < 1; 0 < *reflectivity* < 1



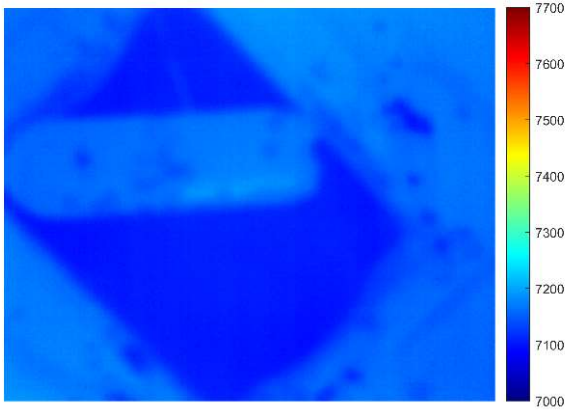
Aluminium foil — *emissivity* ≈ 0; *reflectivity* ≈ 1

Thermal Infrared Imaging

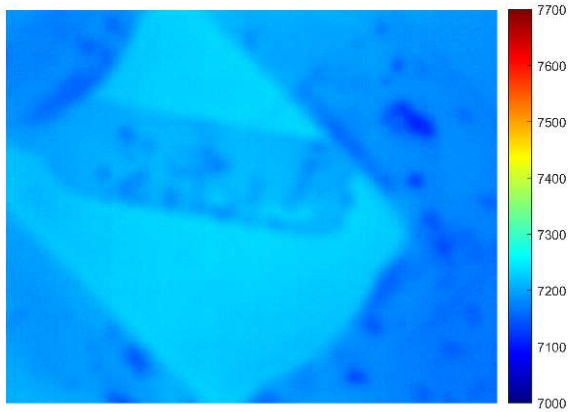
T_{room} = 13 °C



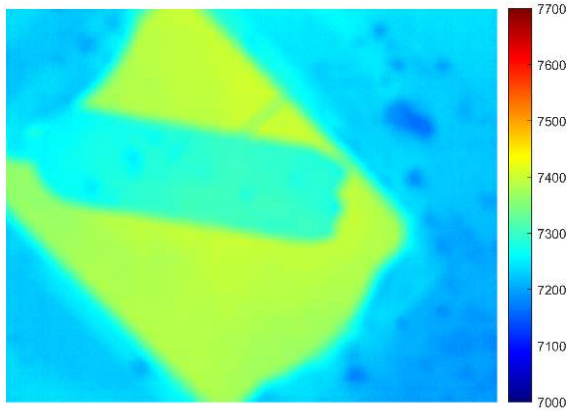
T_{water} = 6 °C



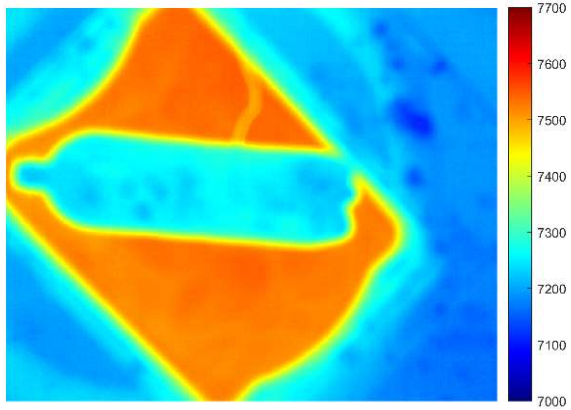
T_{water} = 10 °C



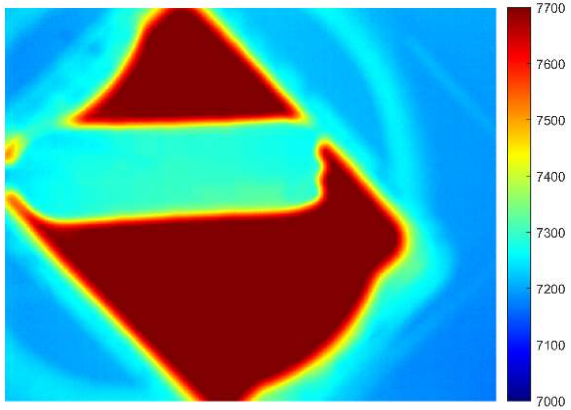
T_{water} = 14 °C



T_{water} = 19 °C

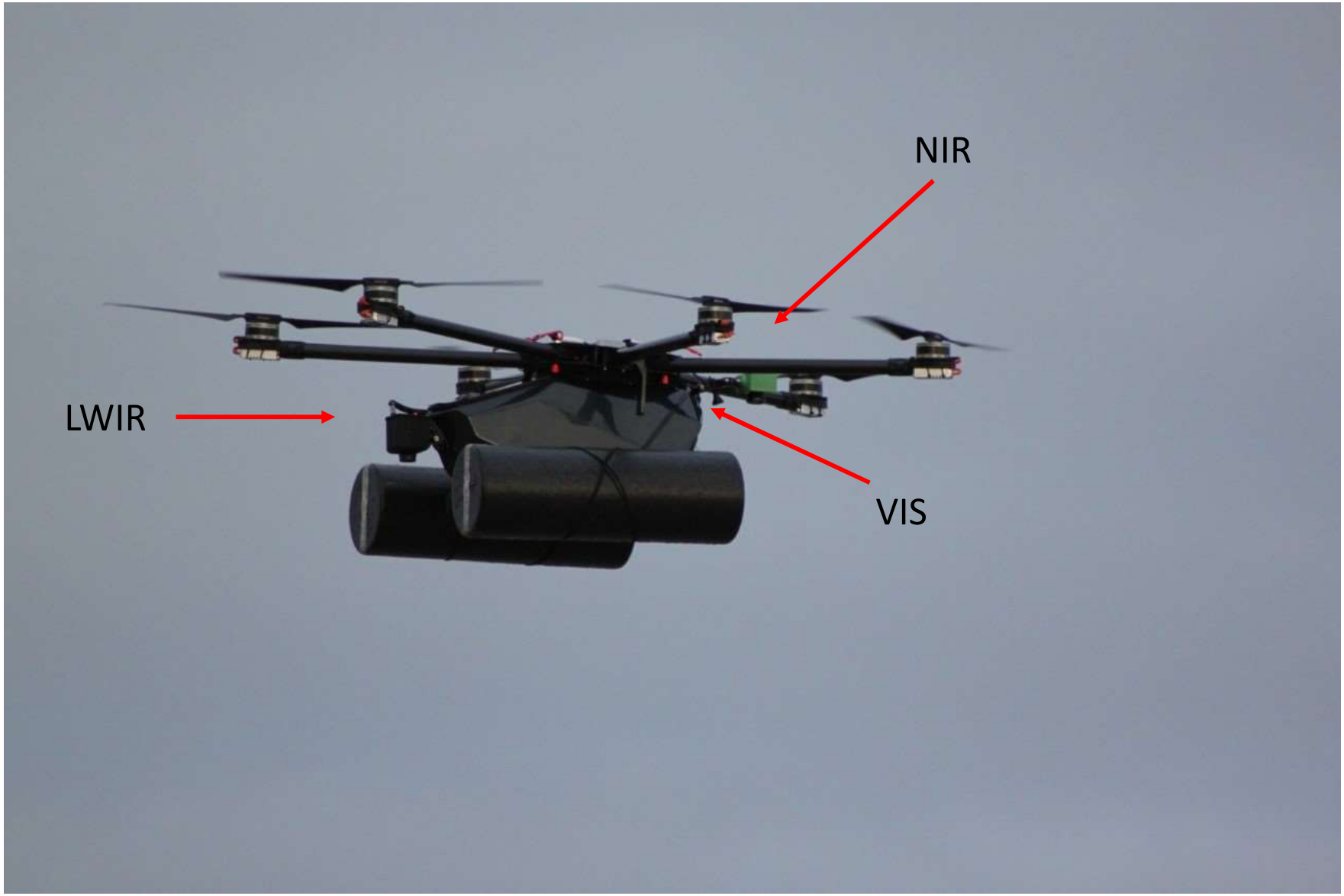


T_{water} = 28 °C



T_{water} = 36 °C

Drone surveys



Drone surveys

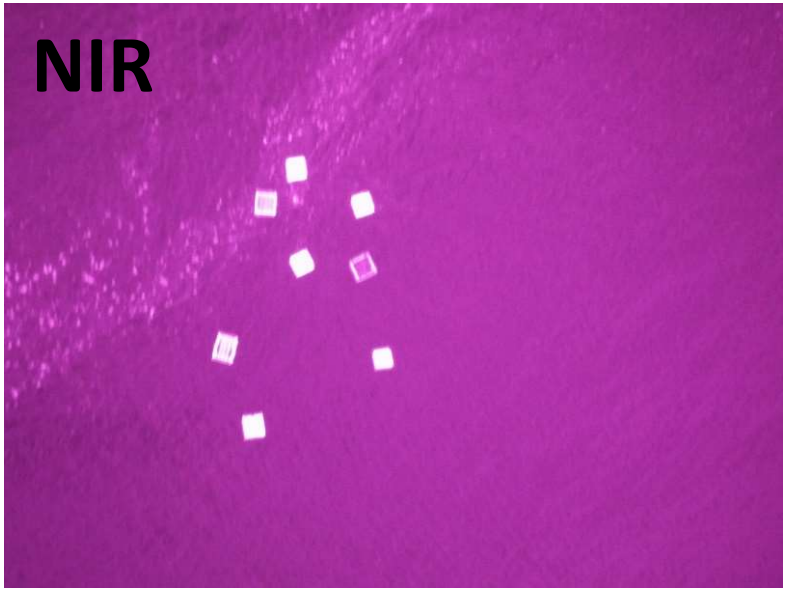

Google Earth
1,000 km
Camera: 9,876 km 46°06'35"N 7°57'34"E
Data SIO, NOAA, U.S. Navy, NGA, GEBCO Landsat / Copernicus IBCAO U.S. Geological Survey INEGI

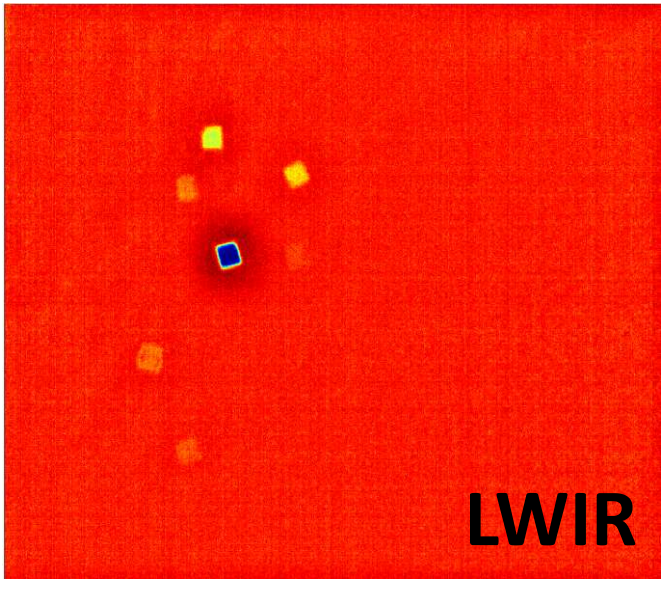

UNIS

Drone surveys

Day-time, 1 April (7:40 am)

<u>Temperatures</u>
Water, 6.1 °C
Air 2 m, 6.0 °C
Air 111 m, 1.9 °C

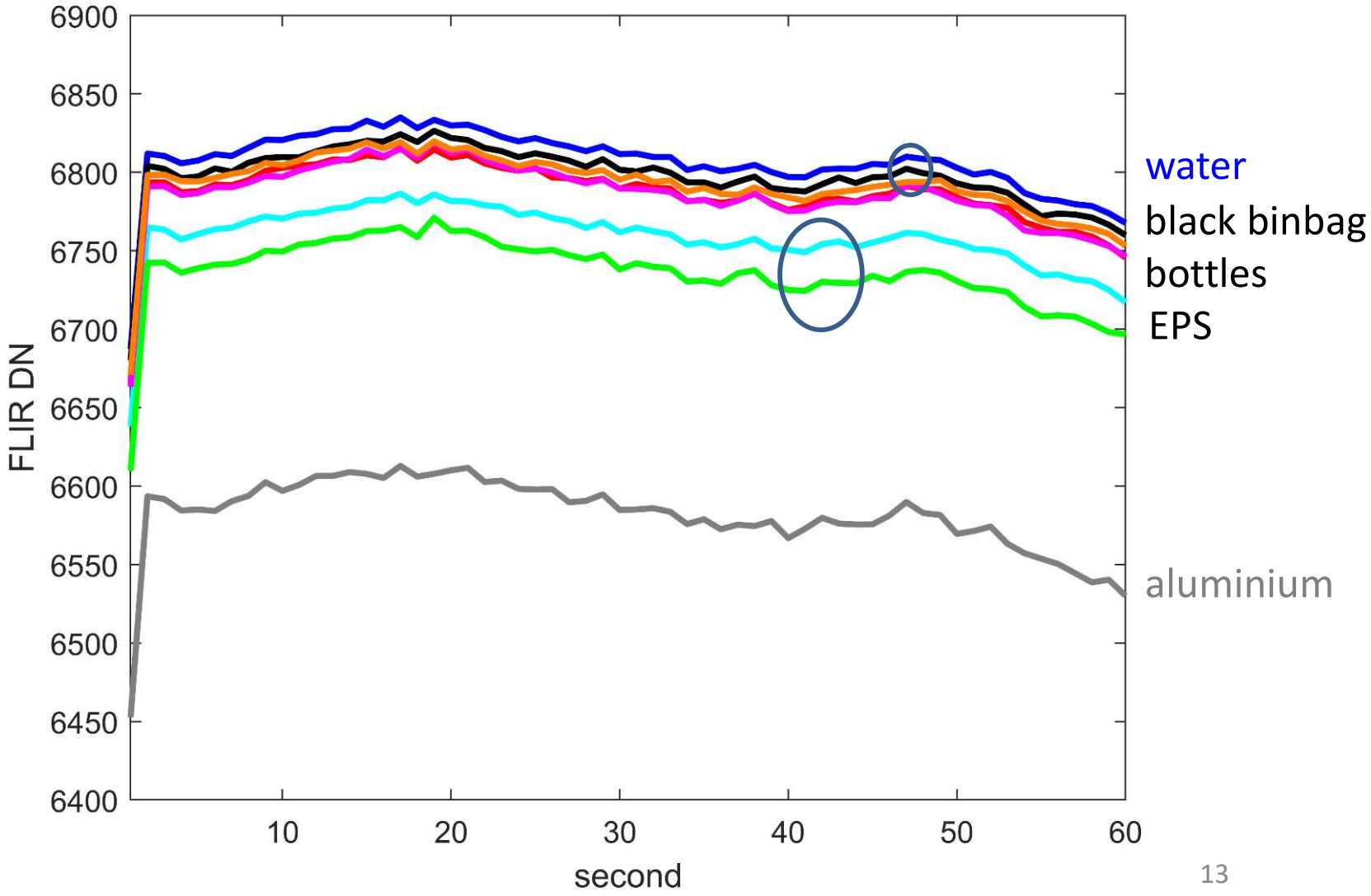




Drone surveys

Day-time, 1 April (7:40 am)

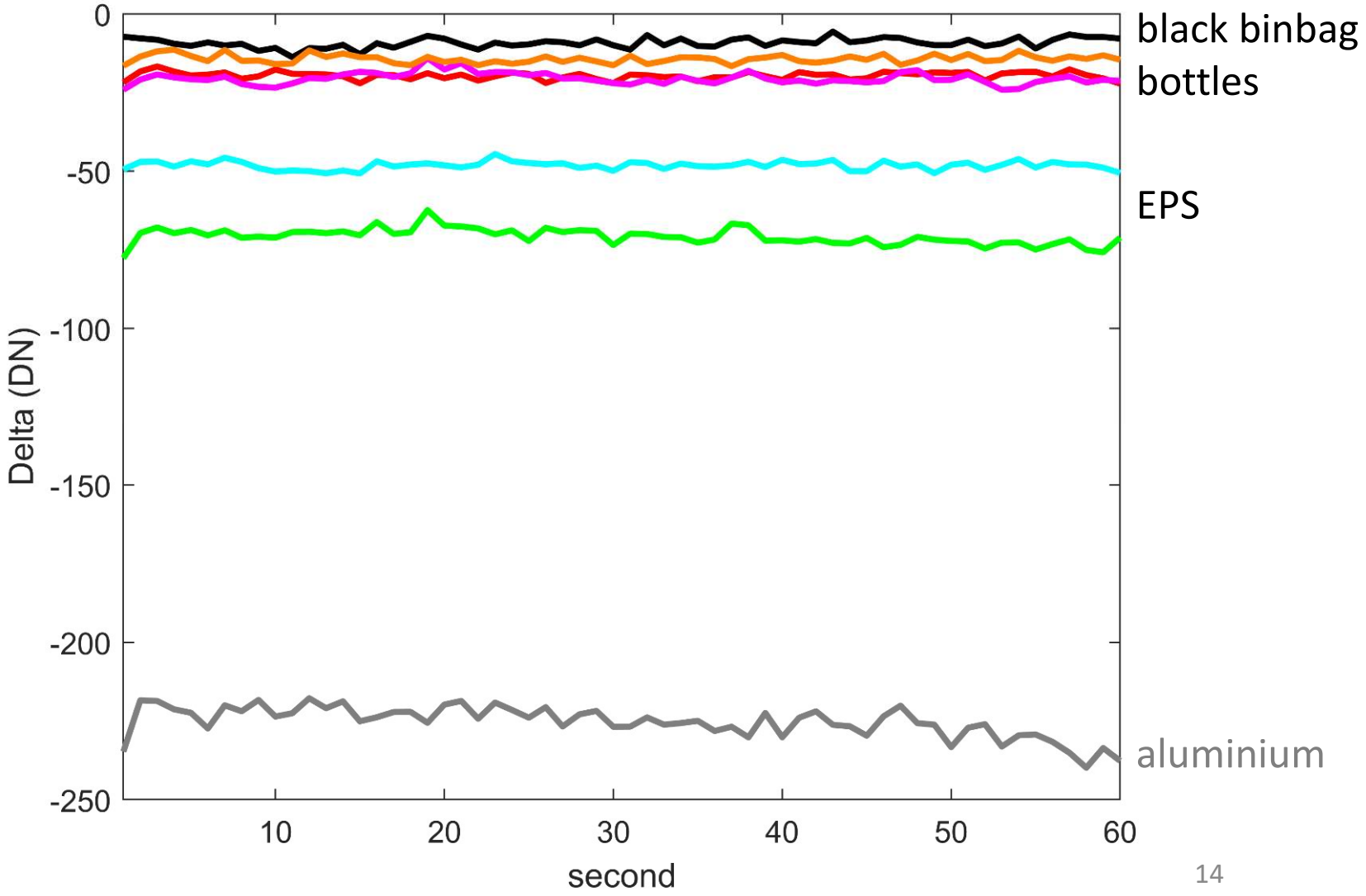
1-minute, FLIR DN



Drone surveys

Day-time, 1 April (7:40 am)

1-minute, Delta = DN(target)- DN(water)

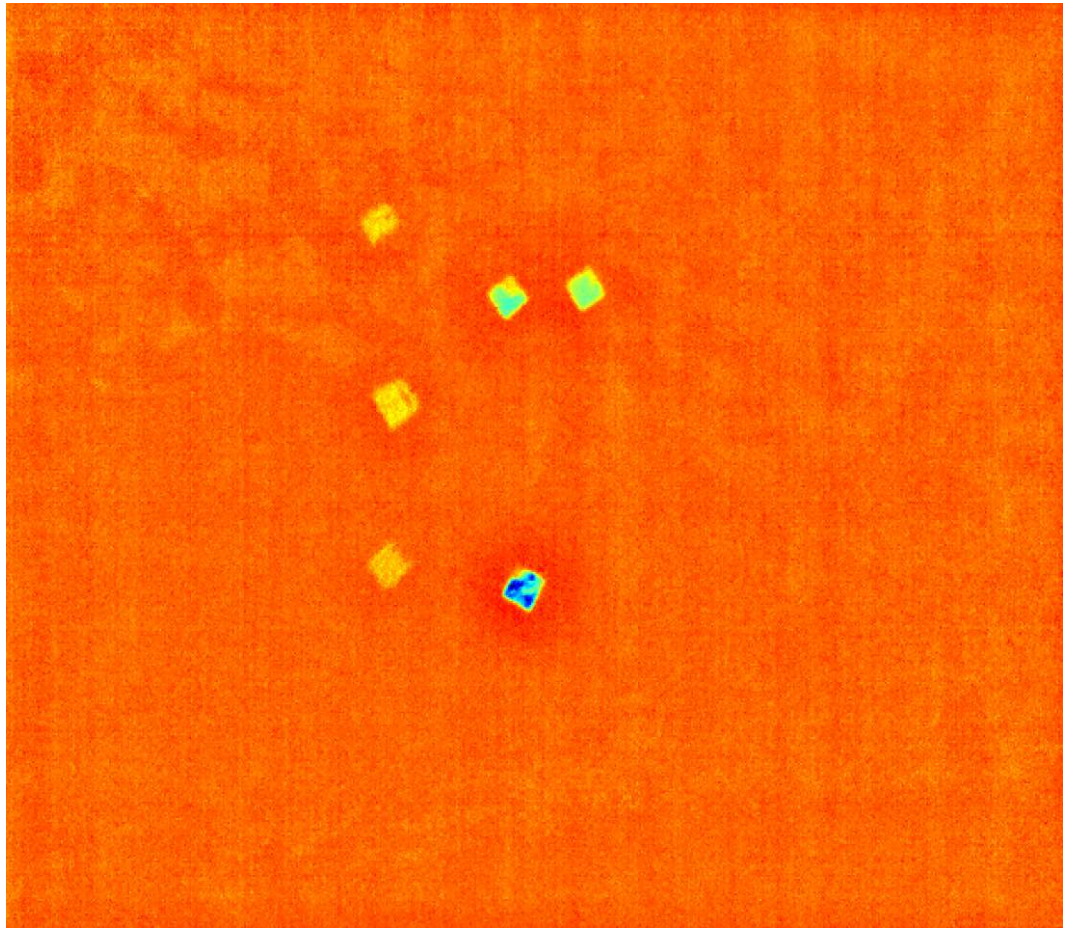


Drone surveys
Night-time

Drone surveys

Night-time, 23 April (4:14 am)

<u>Temperatures</u>
Water, 7.6 °C
Air 2 m, 6.6 °C
Air 111 m, 5 °C



LWIR

Drone surveys

Day-time, 3 August (12:01 pm)

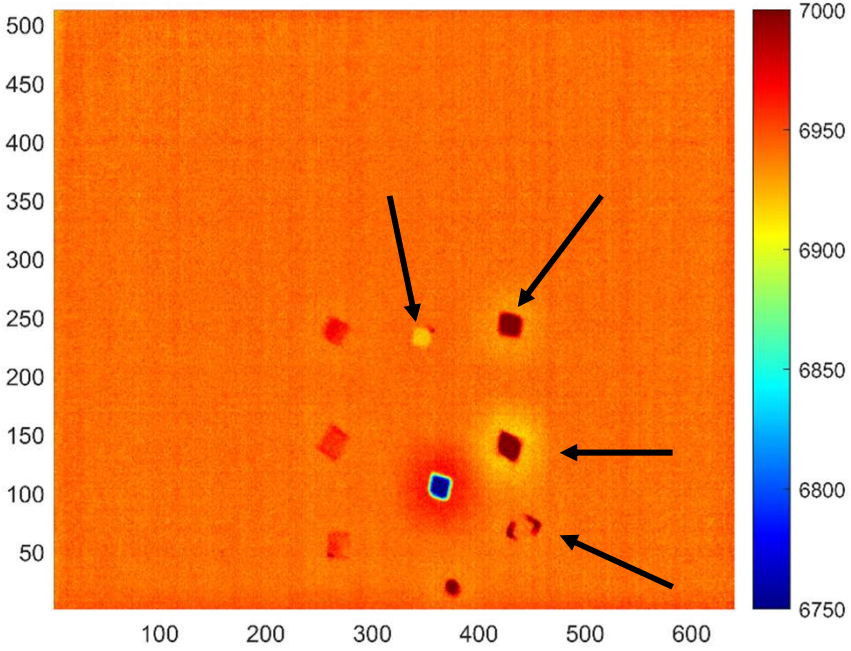
<u>Temperatures</u>

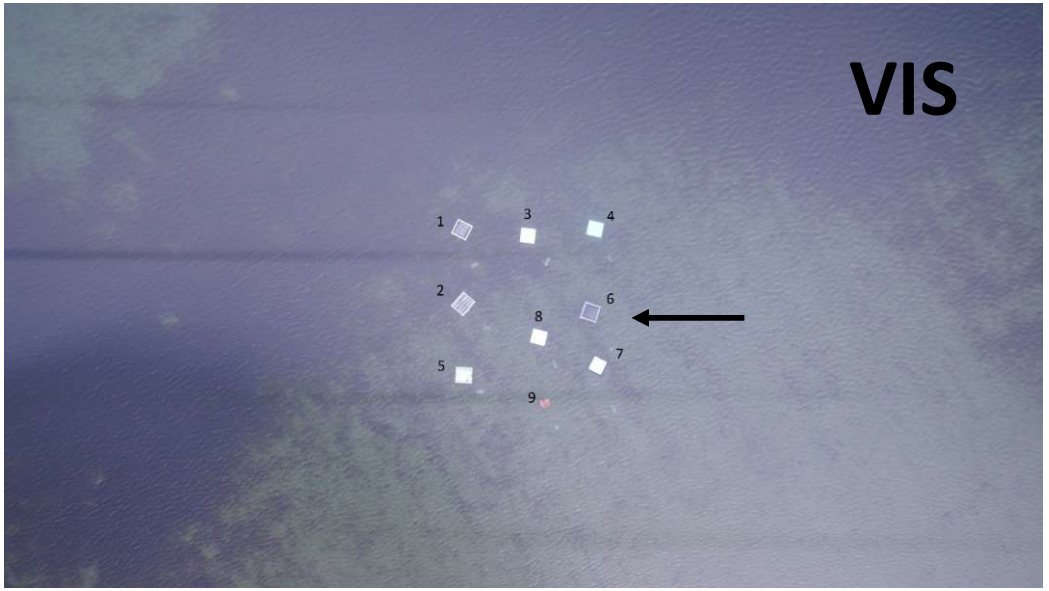
Water, 14.1 °C

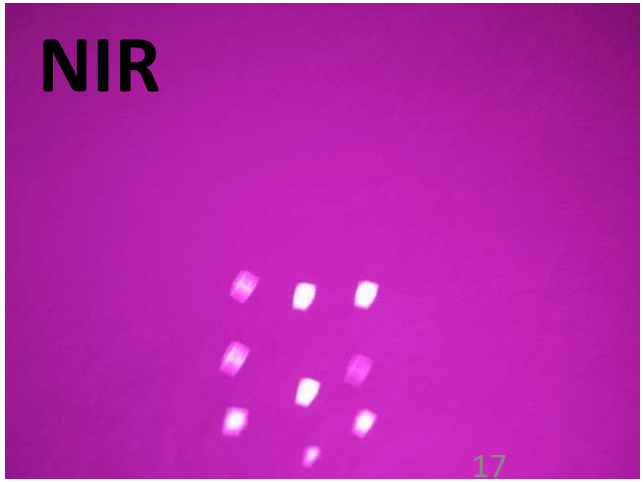
Air 2 m, 19.1 °C

Air 111 m, 14.6 °C

LWIR



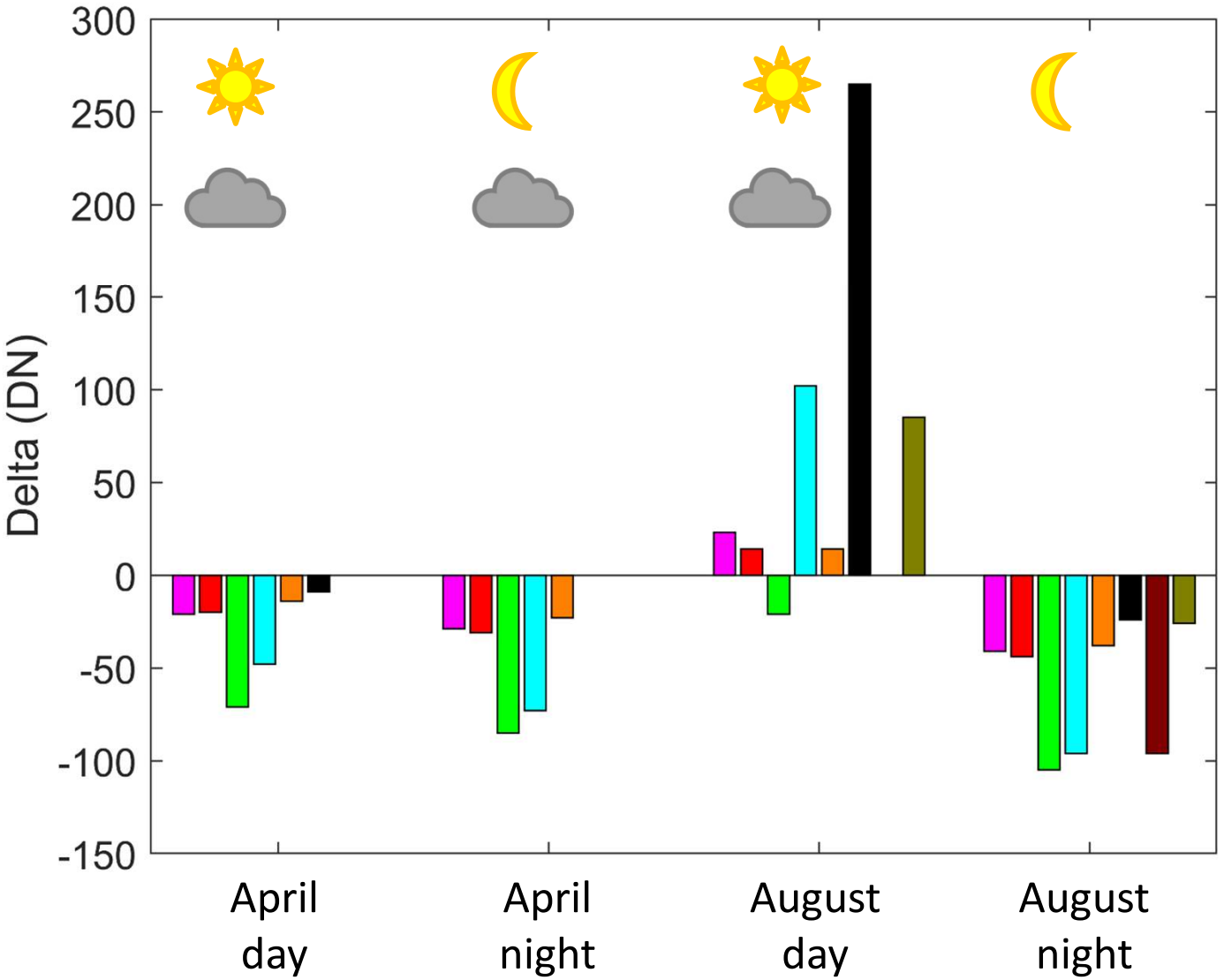




Drone surveys

April and August surveys

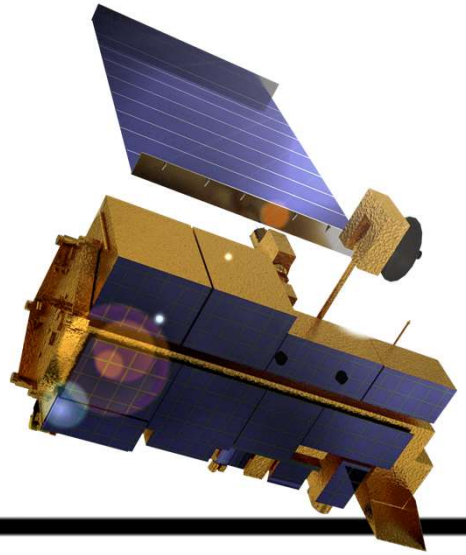
Delta = DN(target)-DN(water)



How can TIR sensing complement other remote sensing measurements?

We found that thermal infrared sensing

- Did not need external light source like the sun
- Did not see sea foam
- Did not see the sea floor in shallow and clear water
- Could see floating black and clear plastic
- Did see aluminium different



Satellite sensors

			revisit	*Best spatial resolution in band (m)*					
Sensor	*Mission*	*Type*	*time*	*VIS*	*NIR*	*SWIR*	*MWIR*	*LWIR*	*Status*
ASTER	Terra	MS	16 d	15	15	30		90	current
LSTR	Sentinel-LSTM	MS	4 d	37				37	future
PHyTIR	ECOSTRESS	MS	3 d					60	current
TIRS(-2)	Landsat 8(9)	MS	16 d					100	current

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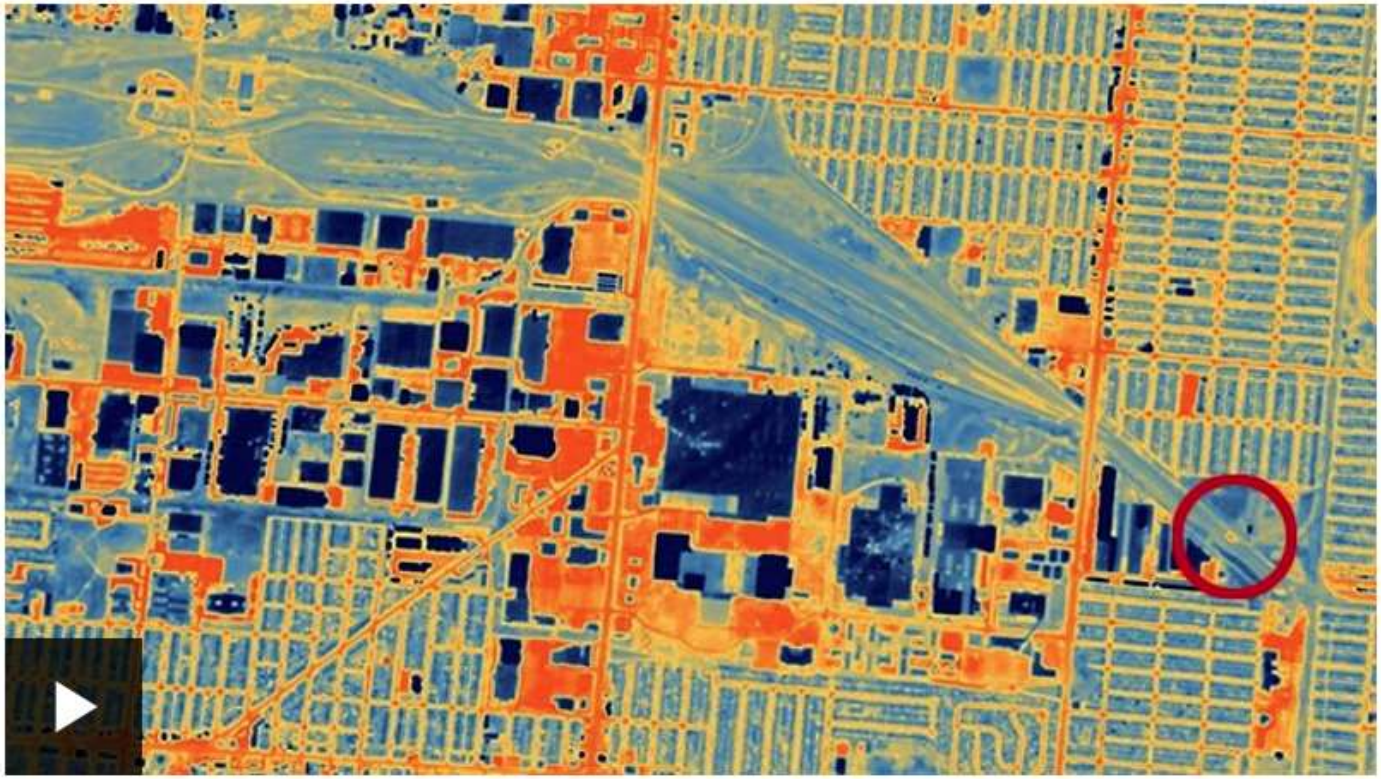
Science & Environment

HotSat-1: UK spacecraft maps heat variations across Earth

3 days ago

Climate change



eri environmental research institute

Commercial satellite

SatVu plans to launch seven additional spacecraft

6 October 2023

MWIR

Spatial resolution, 3.5 m

Frequency, several times a day