Scanning Plastic Soup From The Skies

Robin de Vries // Blue Drones, 24 October 2019, Port of Antwerp

THE OCEAN CLEANUP

What I will be telling you

- Multirotor UAV can scan 1 km x 1 km area for plastic debris concentration in 30 minutes
- Offshore environment = hostile environment
- Risky to operate, but providing unique and valuable data
- UAVs provide observation when all other methods fail

The Ocean Cleanup

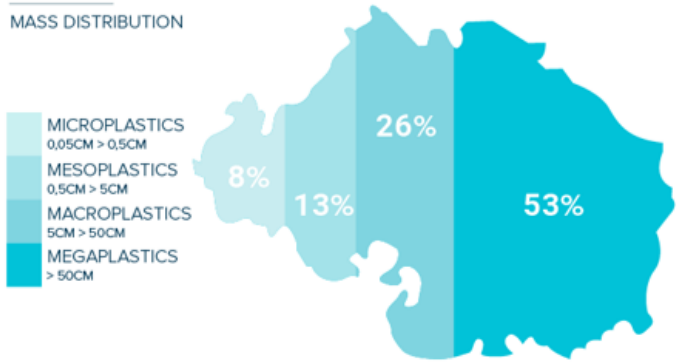
MASS

MICROPLASTIC	LARGER THEN 5MM
8%	92%

COUNTS

MICROPLASTIC	LARGER THEN 5MM
94%	6%

MASS DISTRIBUTION

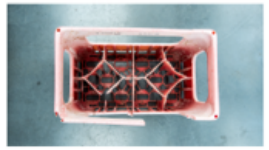


99%
OF EVERYTHING
IS PLASTIC

46%
OF THE TOTAL MASS IS MADE OF DISCARDED **FISHING GEAR**

THE TOTAL MASS OF PLASTIC IS
4X TO 16X HIGHER
THAN PREVIOUS STUDIES HAVE SHOWN

1977



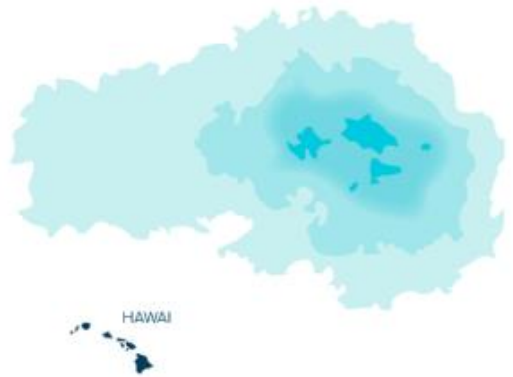
PRODUCTION DATE OF THIS **PLASTIC CRATE** FOUND FLOATING IN THE GPGP BY THE OCEAN CLEANUP RESEARCHERS

REFERENCE
Lebreton et al. (2018). Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. Scientific Reports..

THE **GREAT PACIFIC GARBAGE PATCH** IN NUMBERS

CONCENTRATION

The GPGP holds ocean plastic concentrations ranging **from 10s to 100s kg** per km²



MEASURES

1,6 MILLION KM²

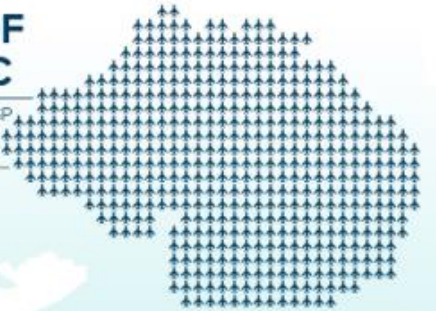
2X THE SIZE OF **TEXAS**

3X THE SIZE OF **FRANCE**

MASS & COUNT

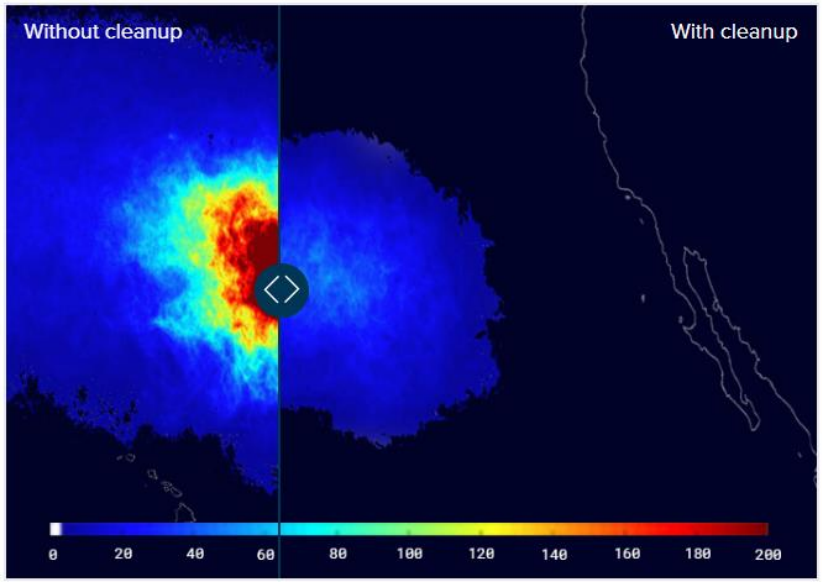
1,8 TRILLION PIECES
EQUIVALENT TO **250 PIECES** OF DEBRIS FOR **EVERY HUMAN IN THE WORLD**

80.000 TONS OF PLASTIC
FLOAT IN THE GPGP
EQUIVALENT TO **500 JUMBO JETS**

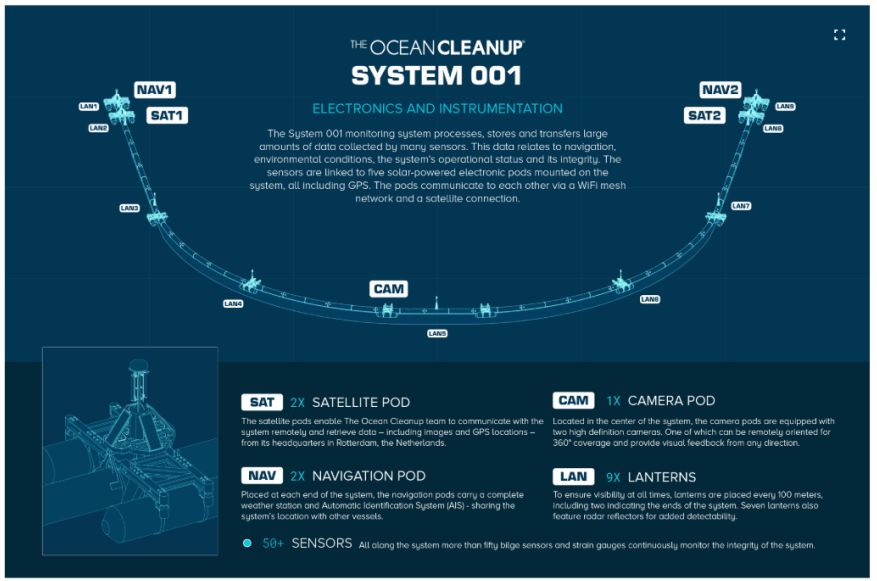


100.000 tons if we consider the outerpatch defamed by a concentration of 0.1kg per km²

About The Ocean Cleanup … In general



Great Pacific Garbage Patch in 2030 with and without cleanup. [scale units : kg/km2]



Layout of The Ocean Cleanup System 001 Electronics and Instrumentation

FOUNDED 2013

Dutch inventor Boyan Slat founded The Ocean Cleanup at the age of 18 in his hometown of Delft, the Netherlands.

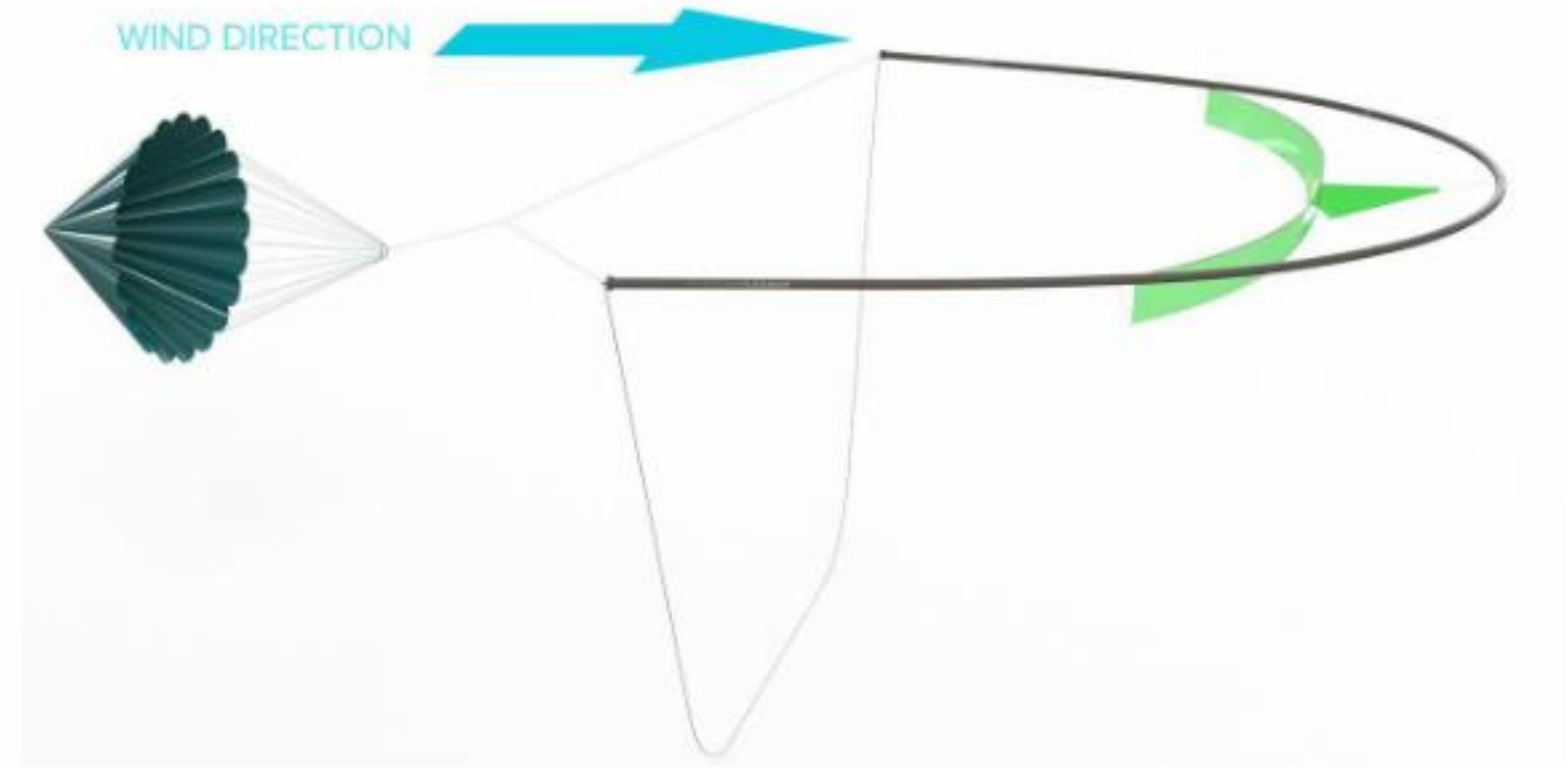
STAFF 80+

The Ocean Cleanup's team consists of more than 80 engineers, researchers, scientists and computational modelers working daily to rid the world's oceans of plastic.

HQ ROTTERDAM

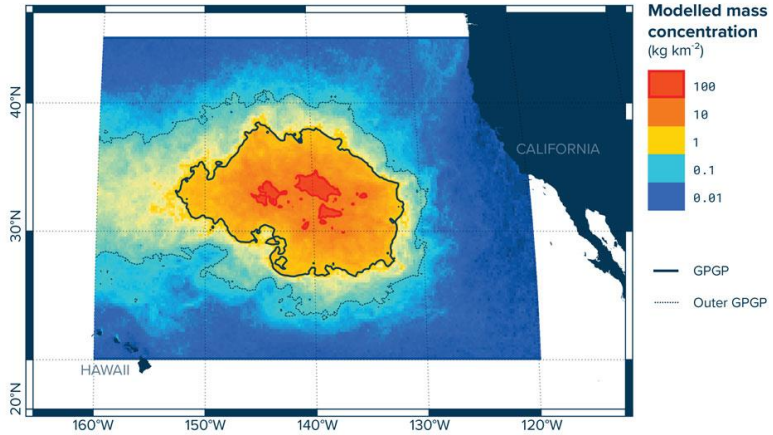
Our headquarters are located in Rotterdam, the Netherlands. We are a registered charity as a 'Stichting' in the Netherlands, and a 501(c)(3) in the US.

The Ocean Cleanup – 2019 proof of concept



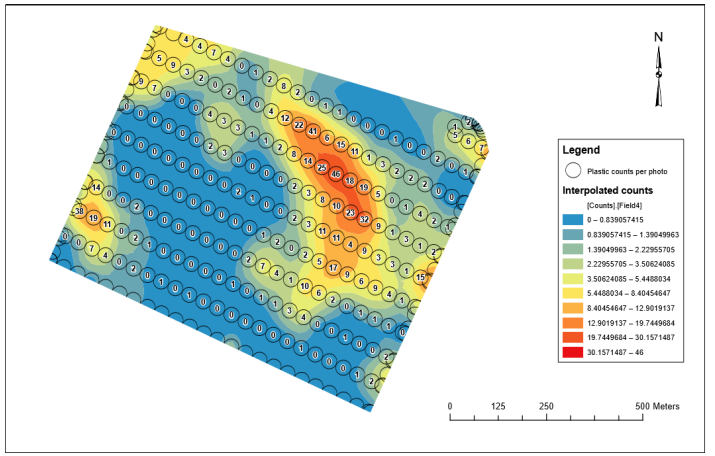
Why we map debris - Research

- Models

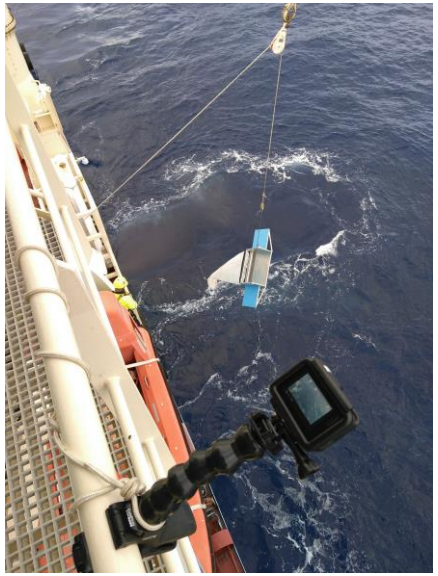


A visual showing where plastic waste leaks into the environment

- Observations



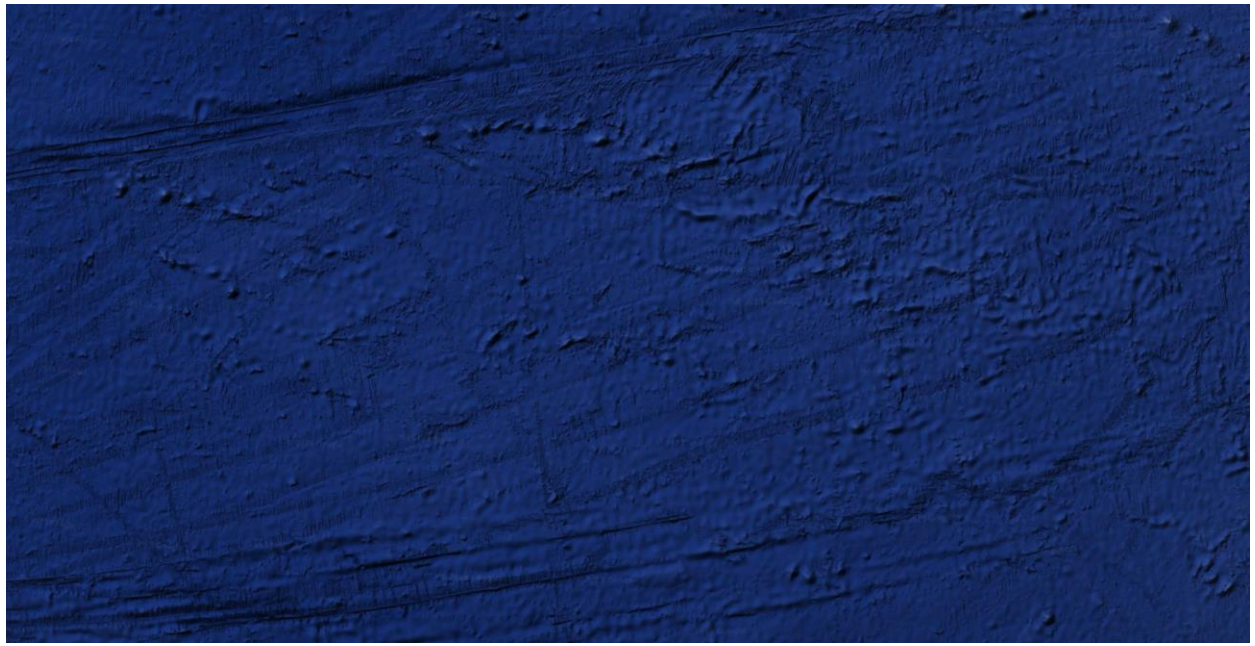
Collection of field data: microplastics



Collection of field data: macroplastics

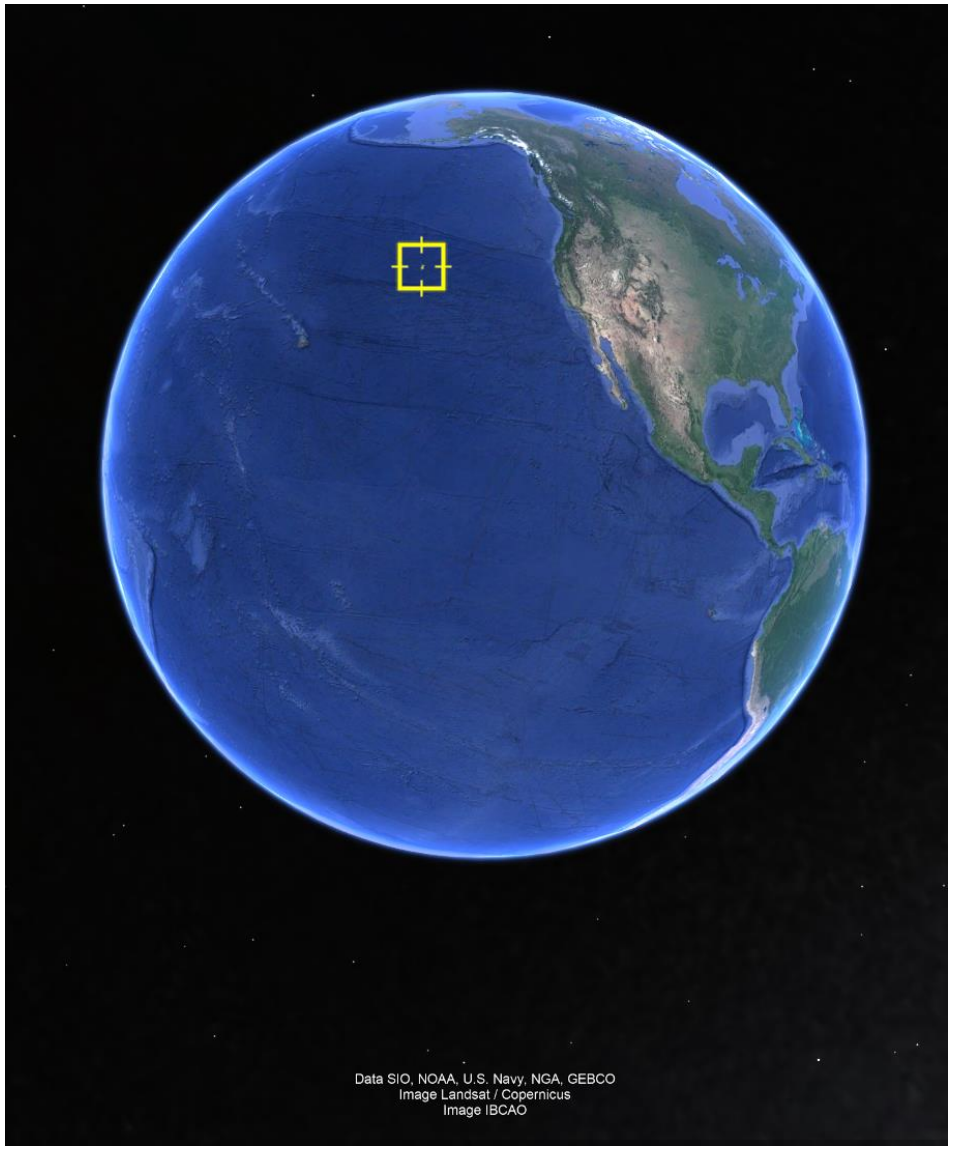
Airspace: easy

- No access restriction
- BVOL flights
- Signal power only limitation



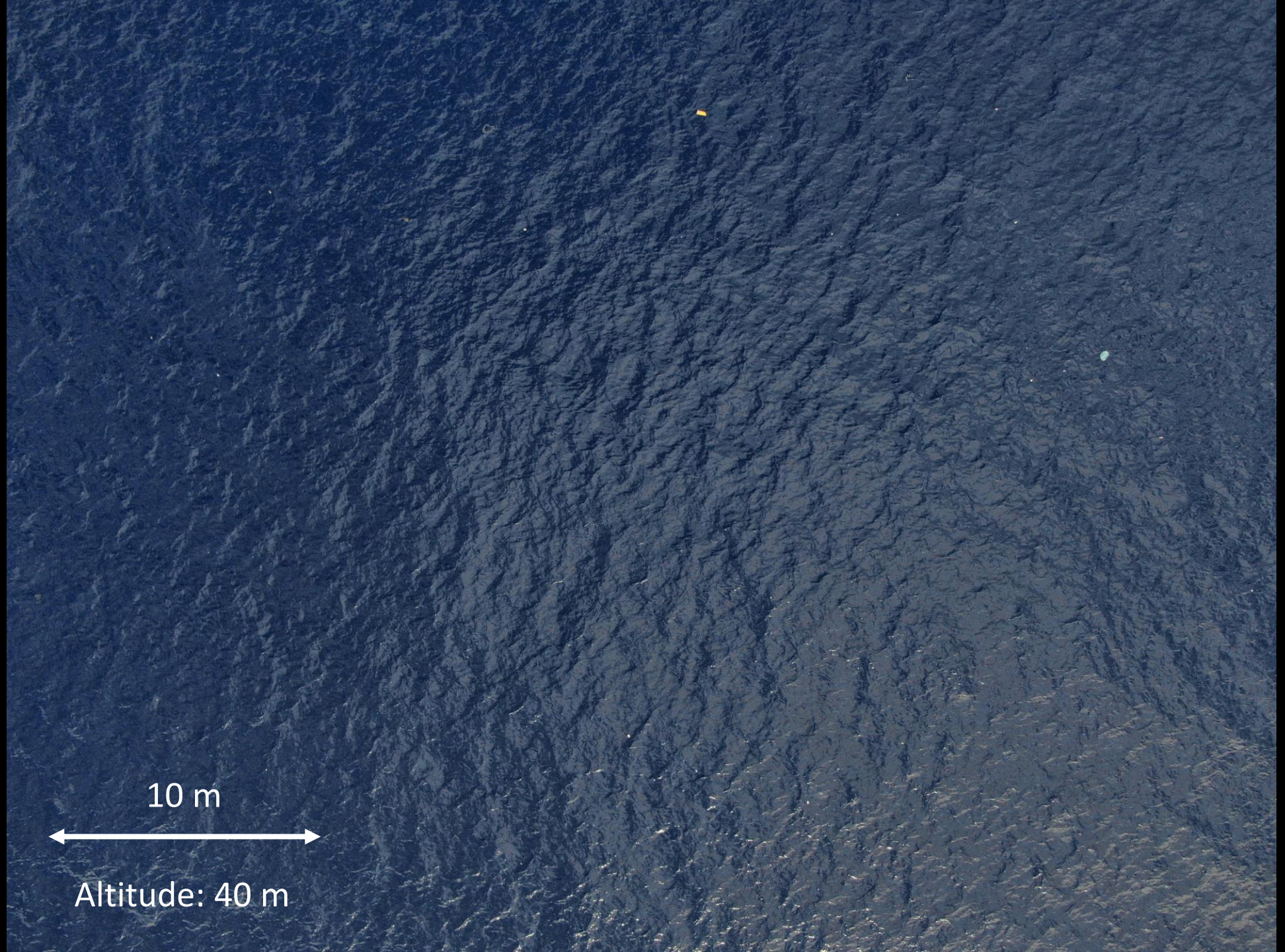
Operational environment

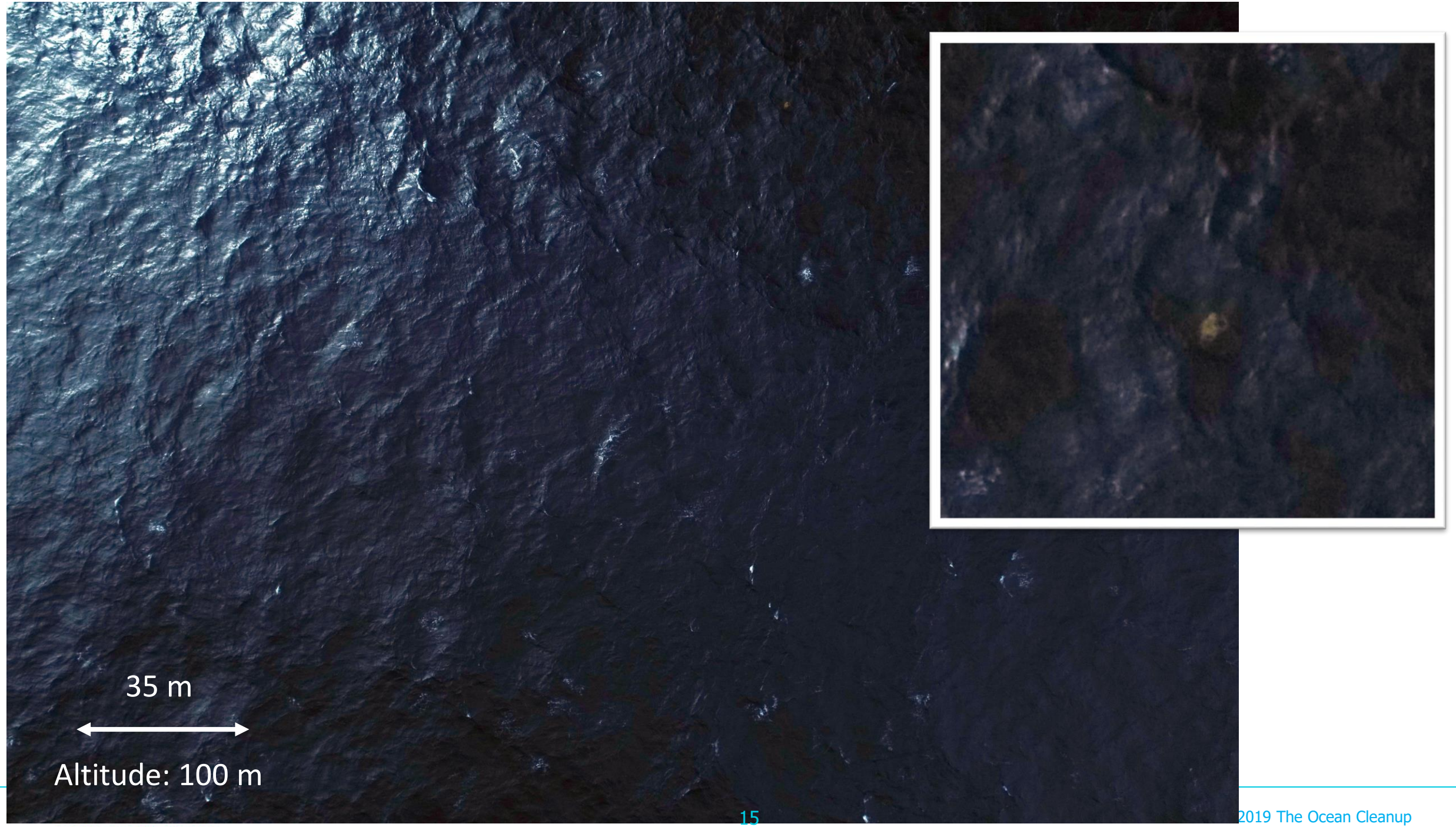
- ~2000km from nearest port
- Limited / poor internet connection and no background maps
- Remote, no backup support: plan for redundancy
- Weather conditions can change quickly, poor predictions
- Offshore reality and technology development: not the easiest combination
- No advanced medical aid

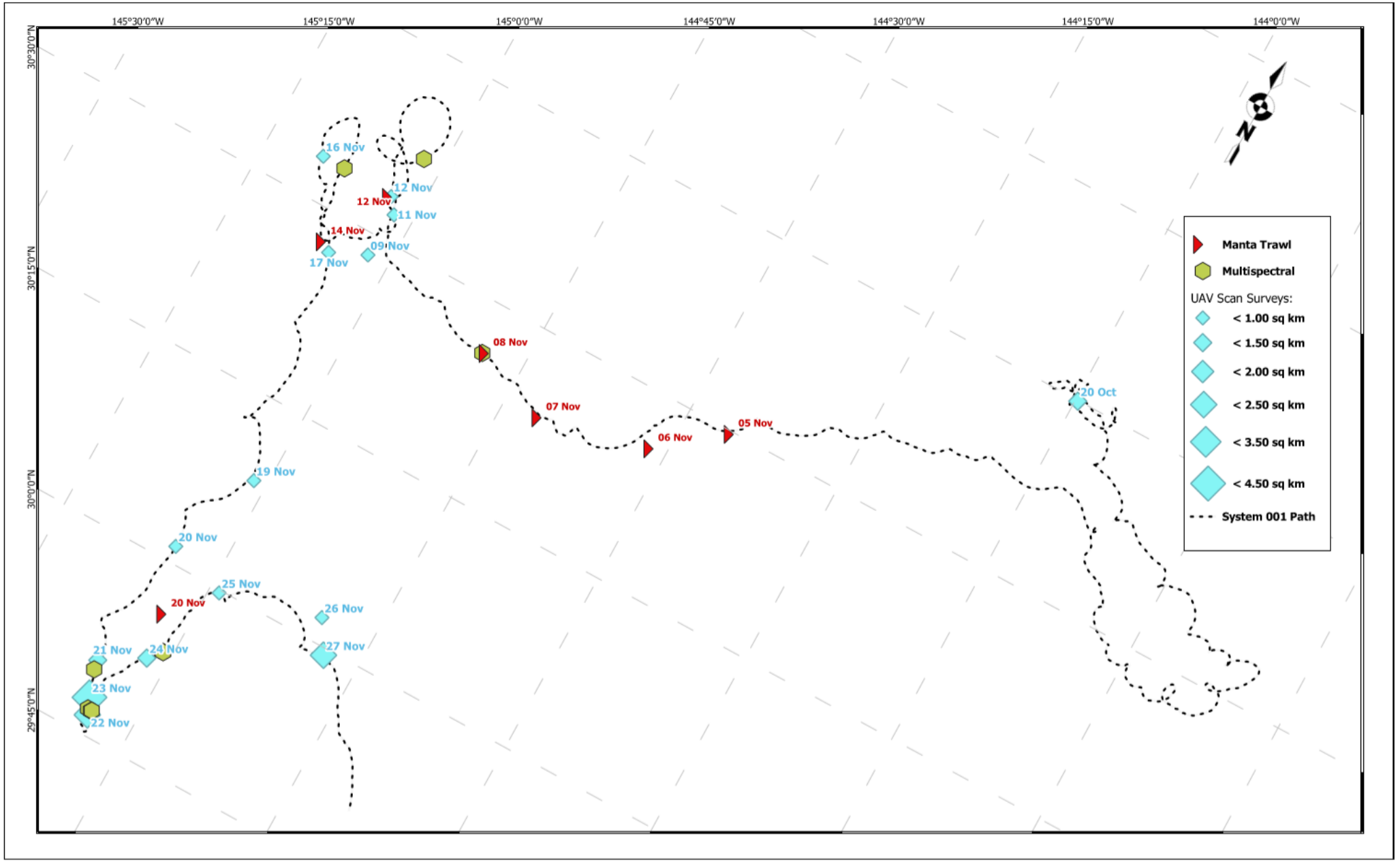


Principles of selection

- Light enough
- Compact
- Stable
- Adequate flight time
- Plug-’n-play
- Standardized
- Payload flexible 1 -2 kg


10 m
Altitude: 40 m





THE OCEAN CLEANUP

Date: 18 Jan 2018
Author: R. de Vries

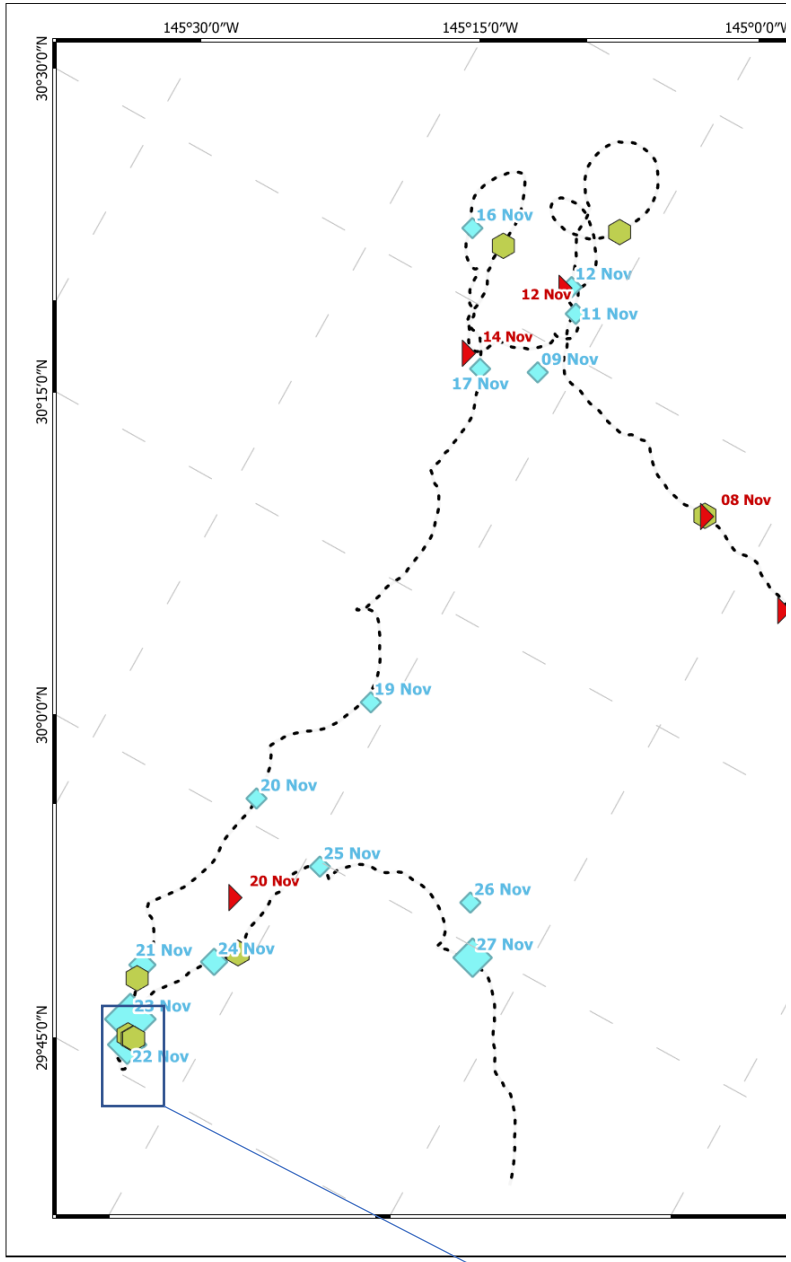
Overview of UAV surveys at the Great Pacific Garbage Patch, following System 001 during Mission 1 and 2 (20 Oct 2018 - 29 Nov 2018)

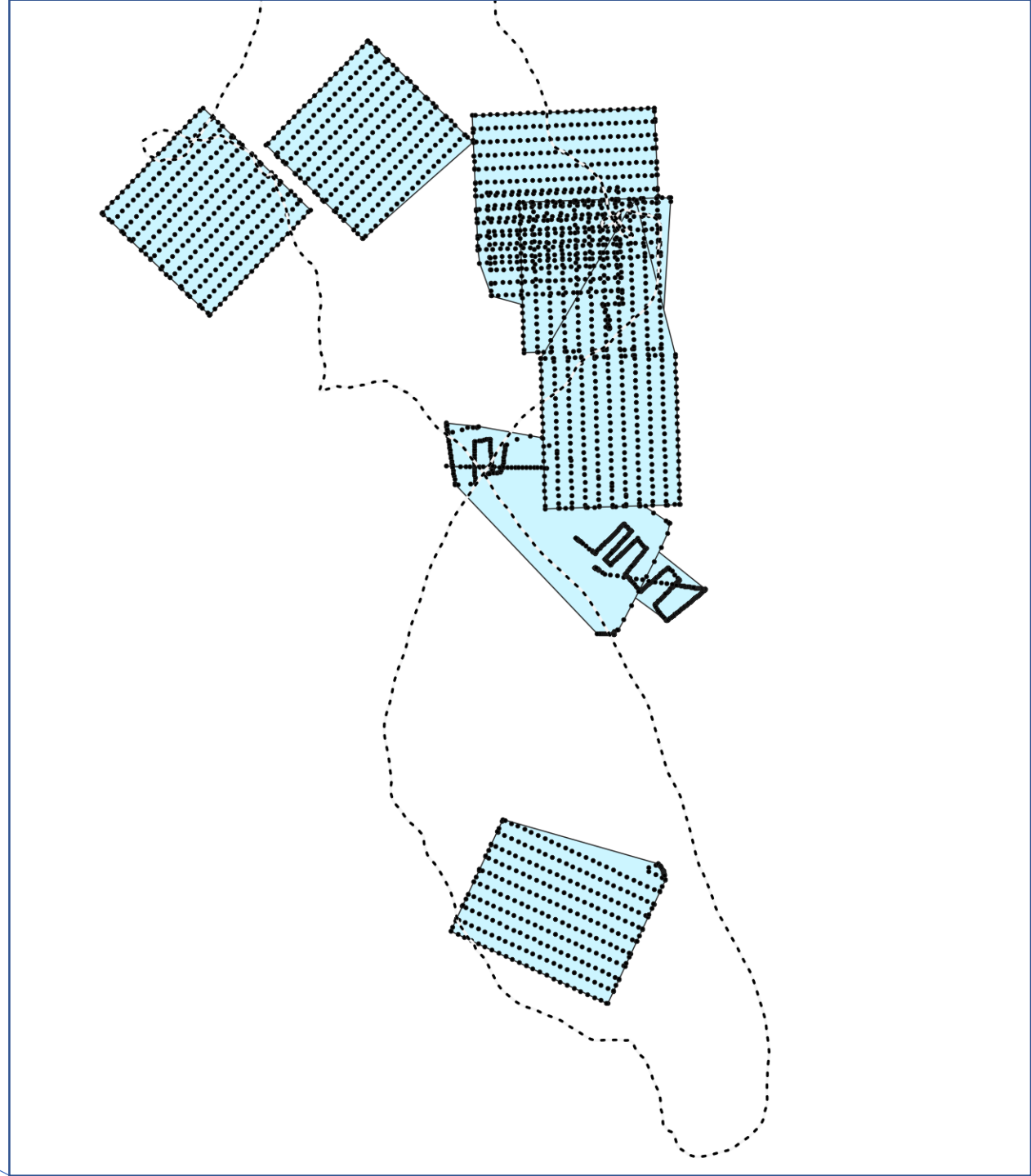
0 10 20 30 km
0 10 20 NM

CRS: WGS 84 / UTM Zone 6N

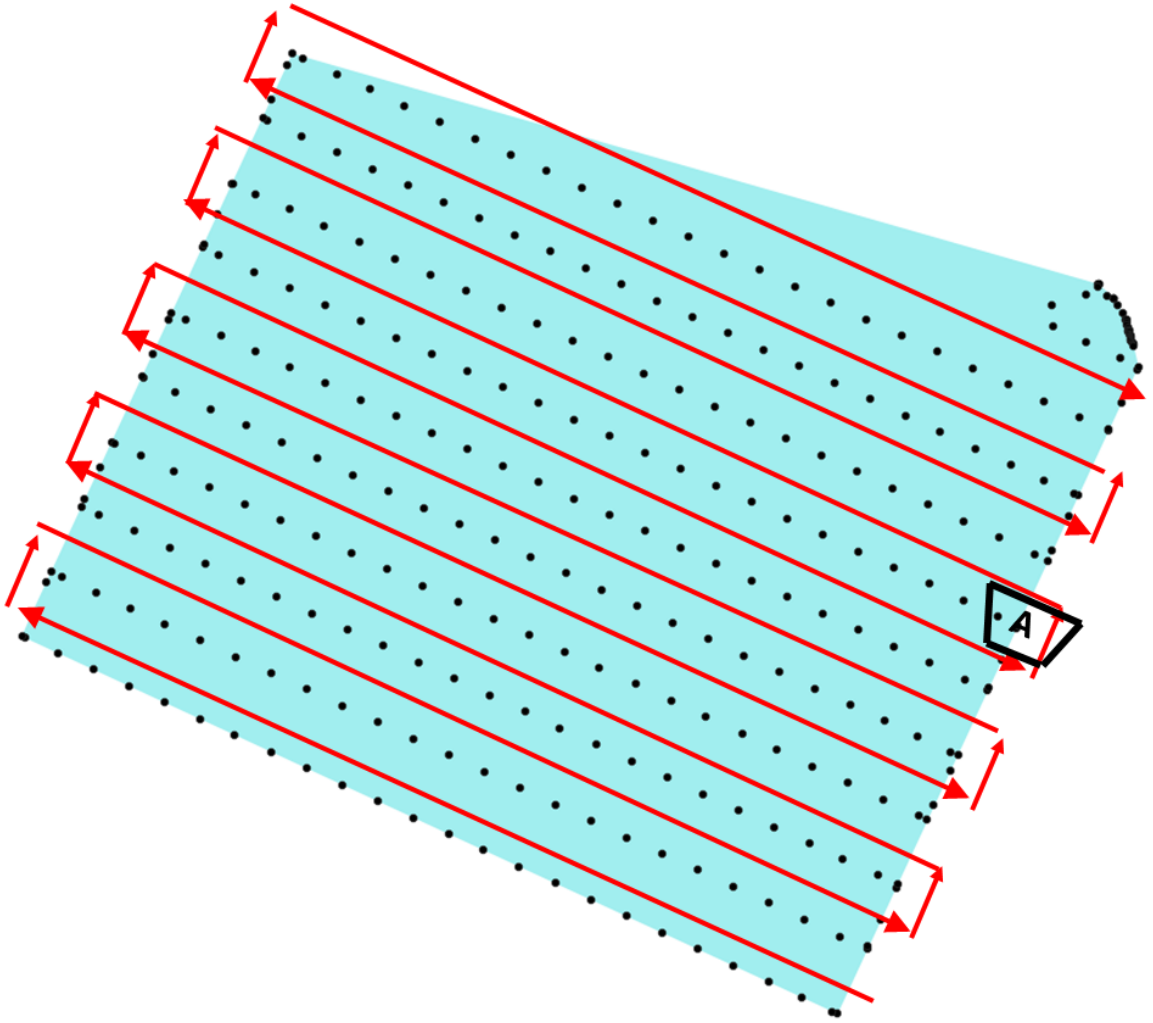
Scale (A3): 1:500000

All research surveys around Wilson



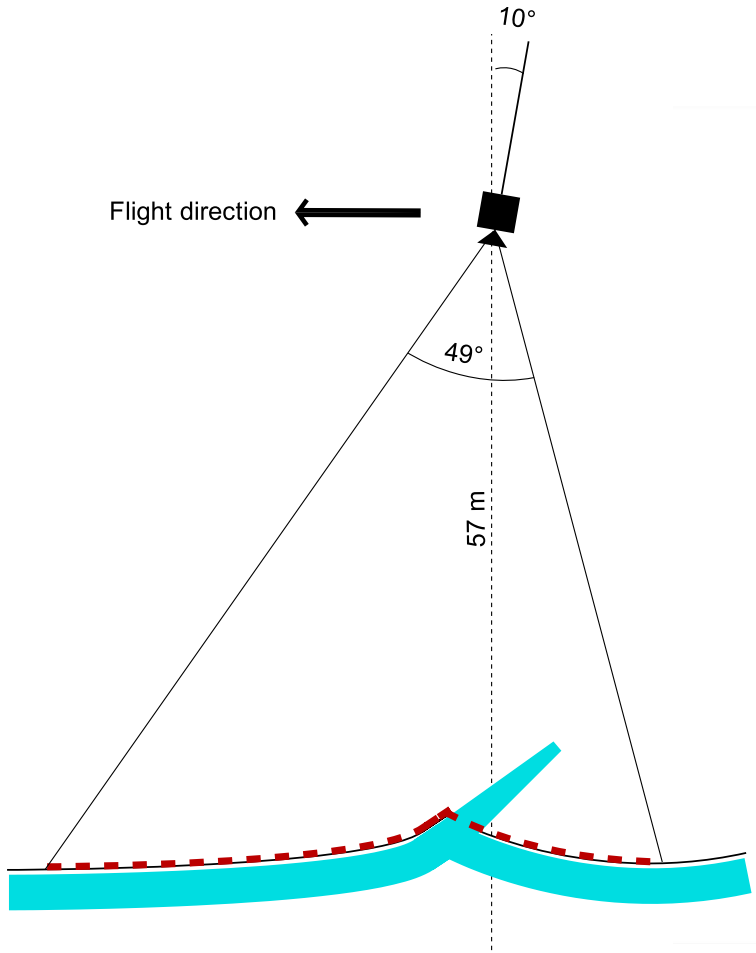


Macrodebris density: an example

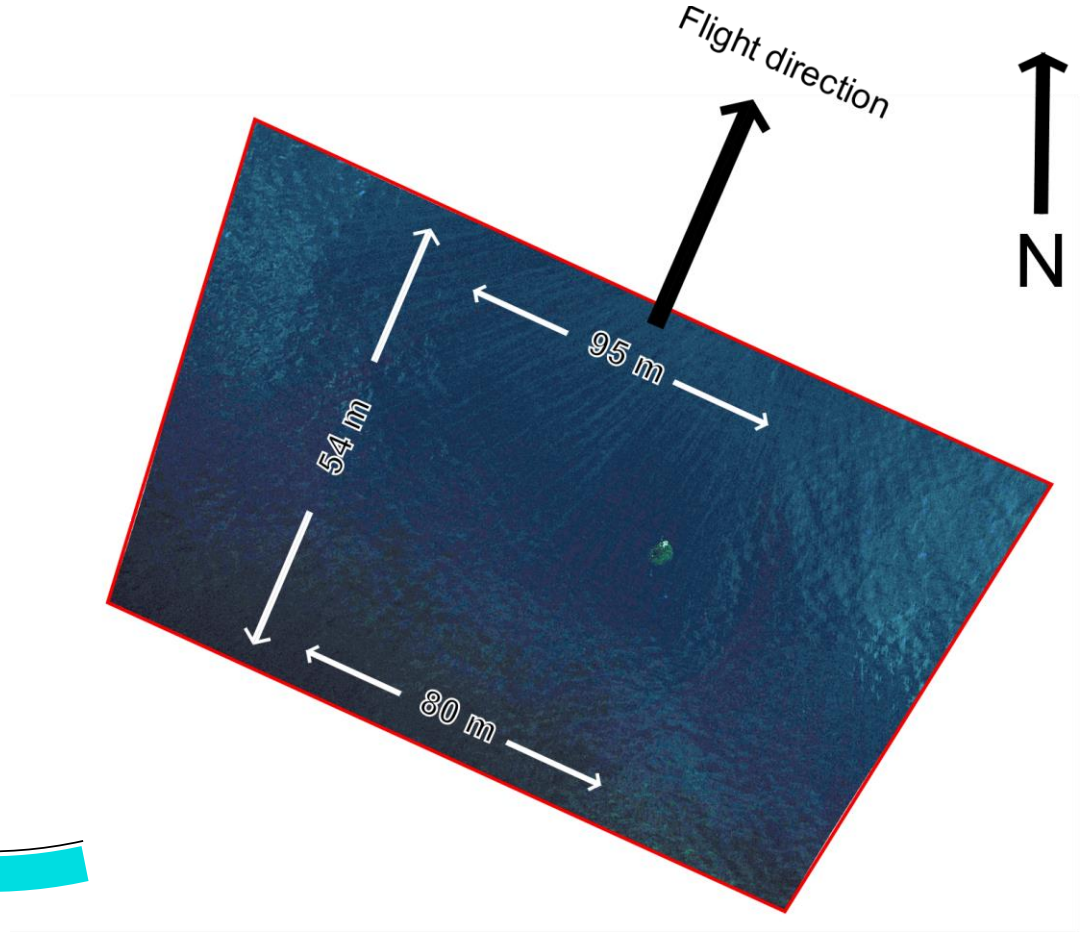


Macrodebris density: an example

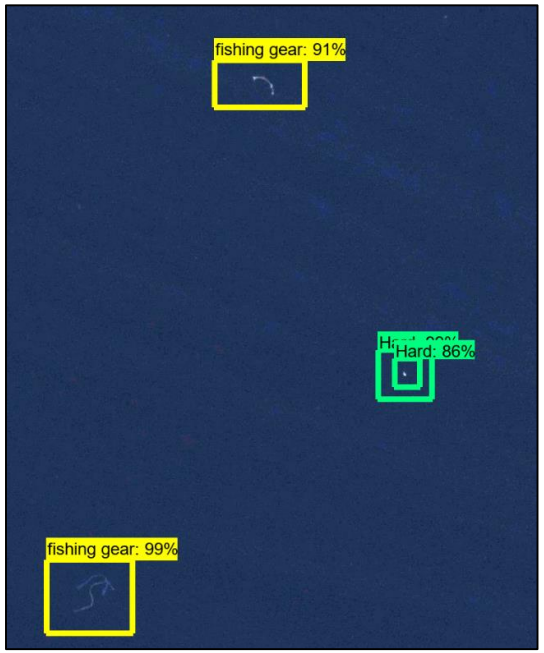
Side View (A)



Top view (A)

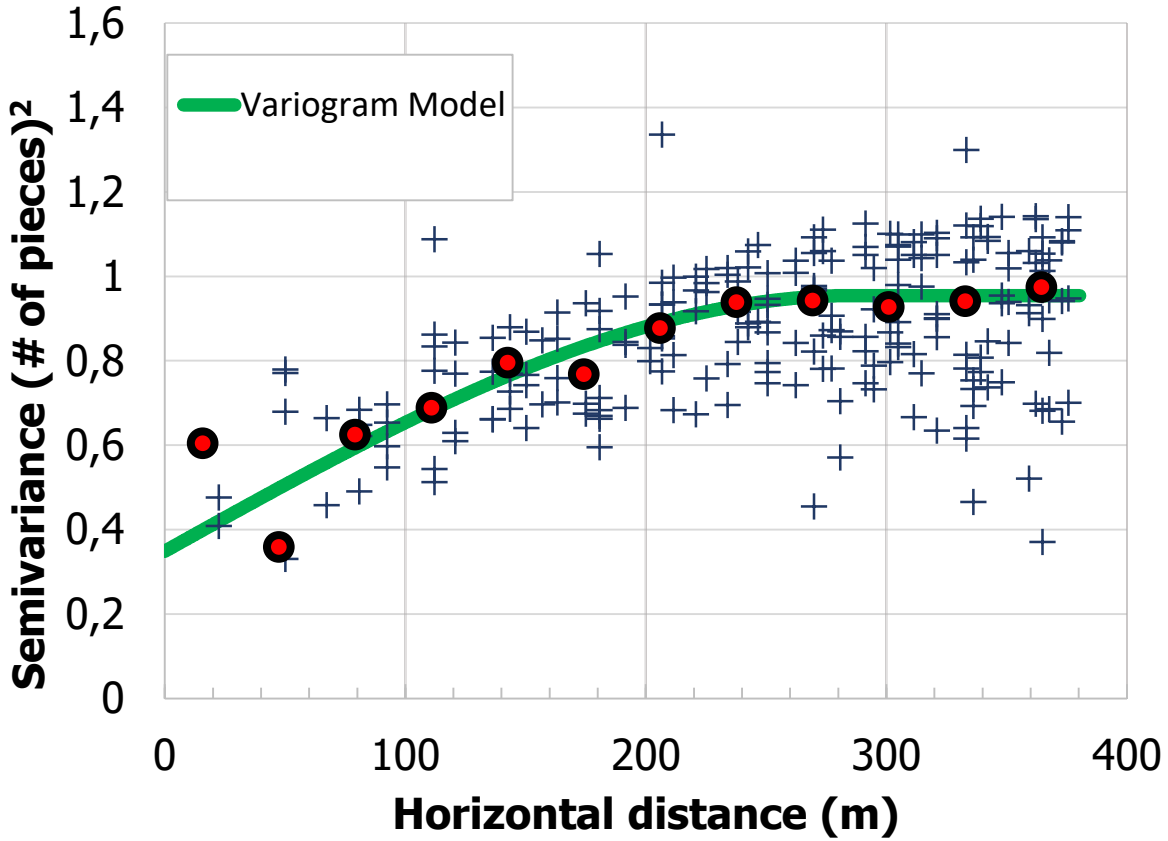


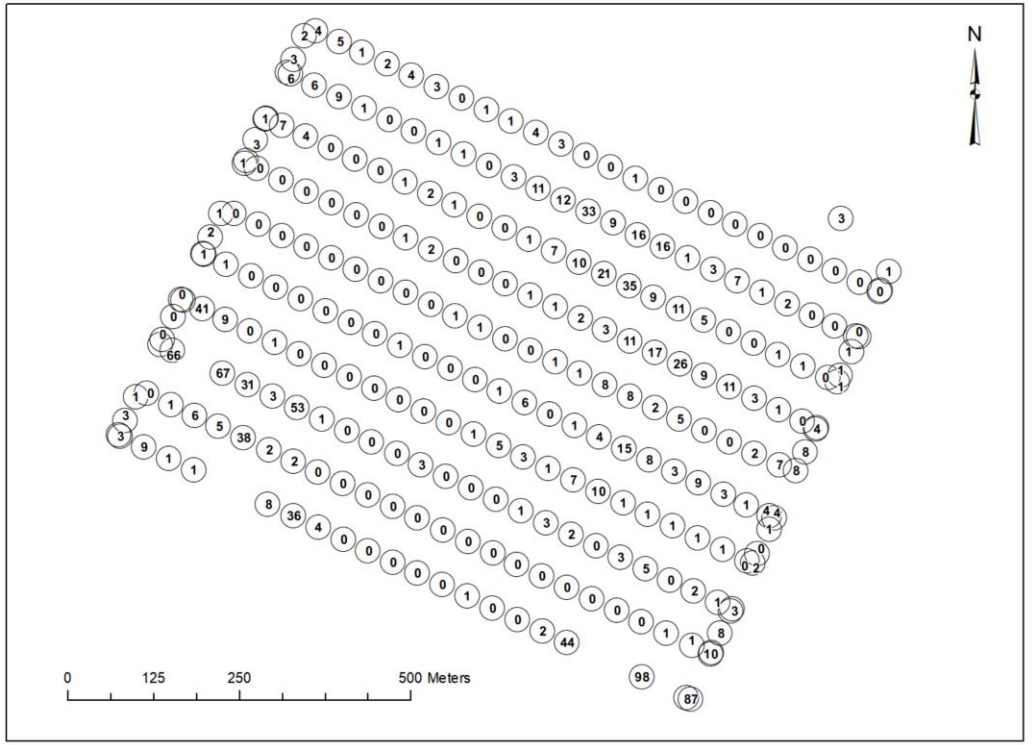
Macrodebris density: an example

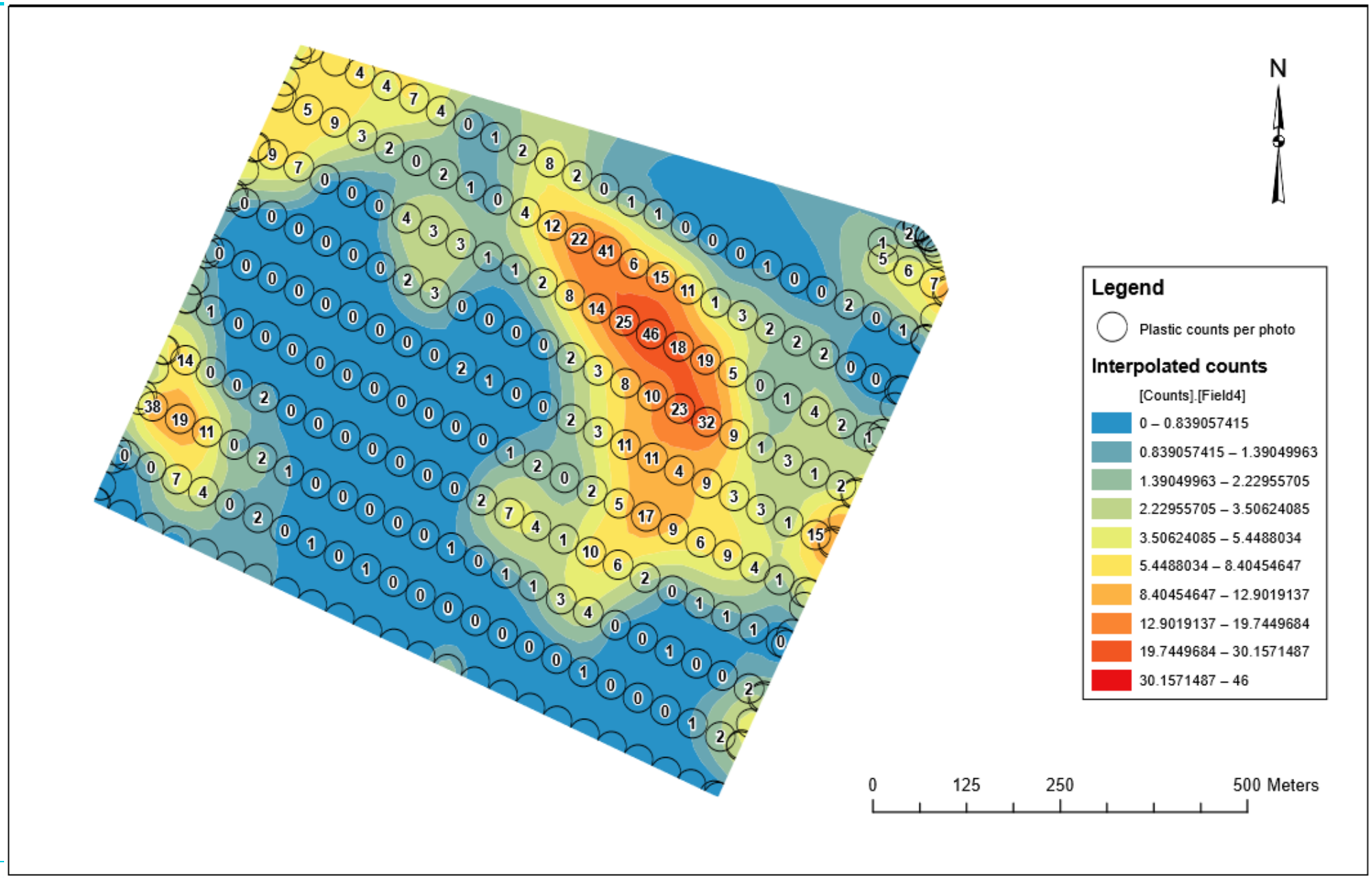


Filename	Time (UTC)	Lon (WGS84)	Lat (WGS84)	Altitude (m)	Count
DJI_0001.JPG	0:36:43	-145.0663269	29.76128717	60.395	87
DJI_0002.JPG	0:36:47	-145.066386	29.76130683	60.595	76
DJI_0004.JPG	0:36:55	-145.067053	29.76158964	60.695	98
DJI_0007.JPG	0:37:07	-145.0681703	29.76205792	60.695	44
DJI_0008.JPG	0:37:11	-145.0685403	29.76221389	60.695	2
…	…	…	…	…	…

Macrodebris density: an example







UAVs at open sea: wish list for the future:

- More advanced sensors: LIDAR, Hyperspectral
- VTOL flights
- Automatic take-off, mission control and landing
- Small, robust, lightweight and high visibility
- Navigation aids / mission planning with grids & graticules
- Remote charging
- Water- and weatherproofing
- Automatic data transfers

Summary

- Multirotor UAV can scan 1 km x 1 km area for plastic debris concentration in 30 minutes
- Offshore environment = hostile environment
- Risky to operate, but providing unique and valuable data
- UAVs provide observation when all other methods fail