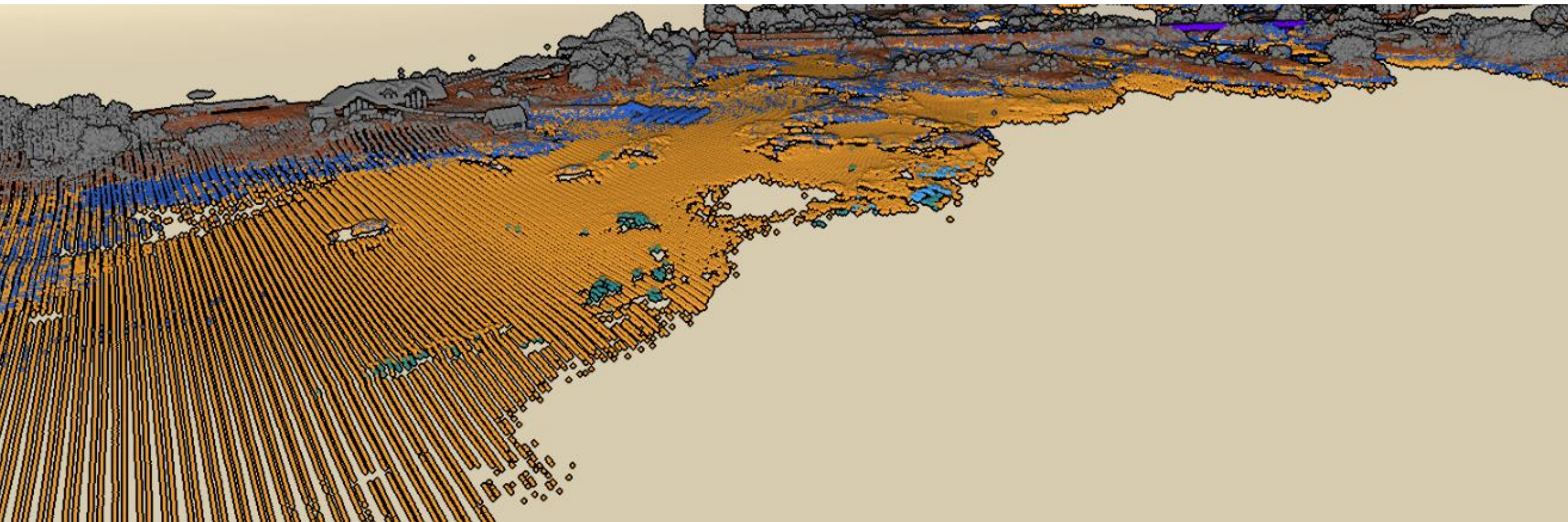




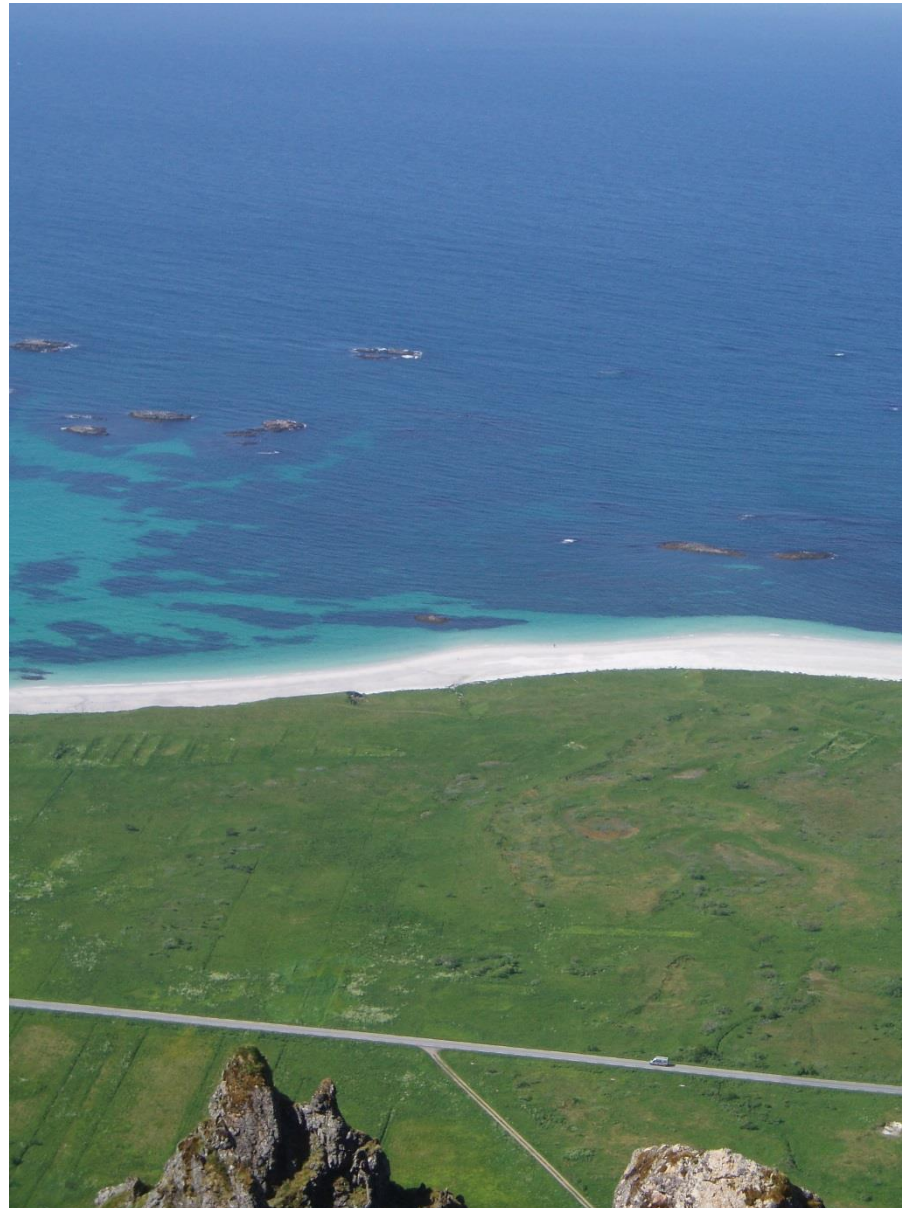
Kartverket

Large scale Bathymetric LiDAR for shallow water

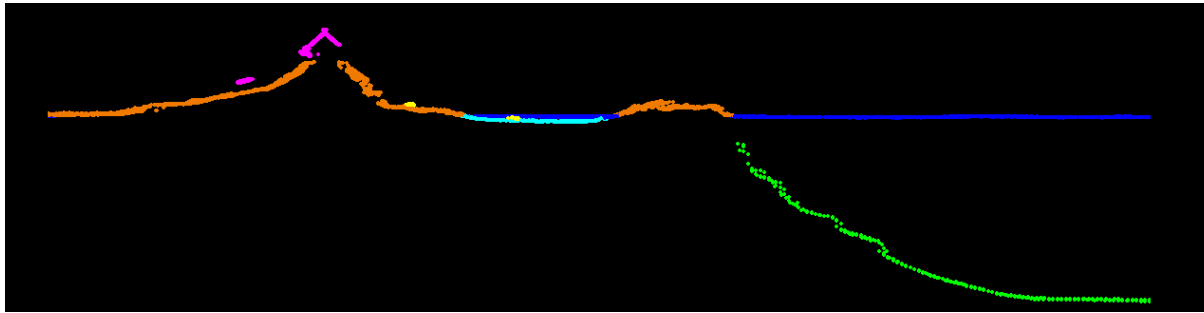
*Jon Moe
The Norwegian Mapping Authority*



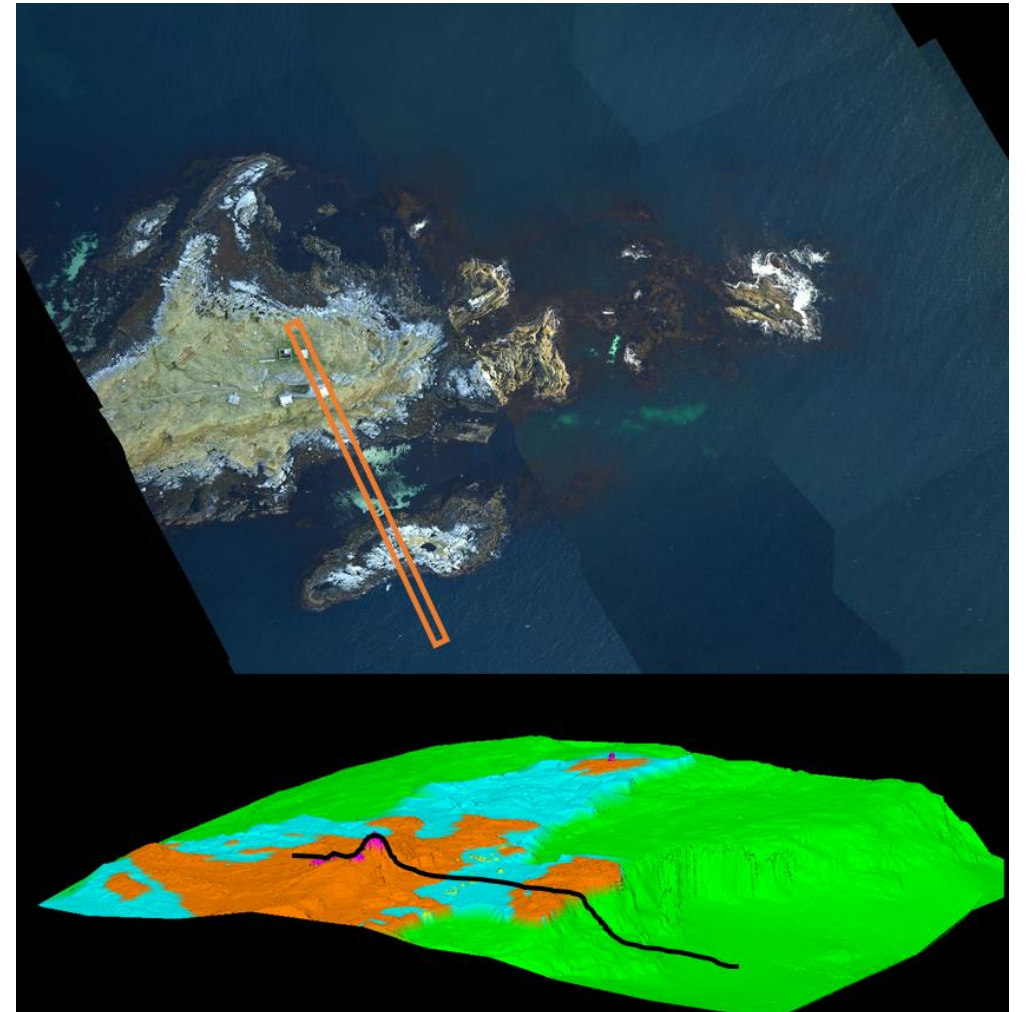
- Goal
- Background
- Challenges
- Result



Seamless elevation model

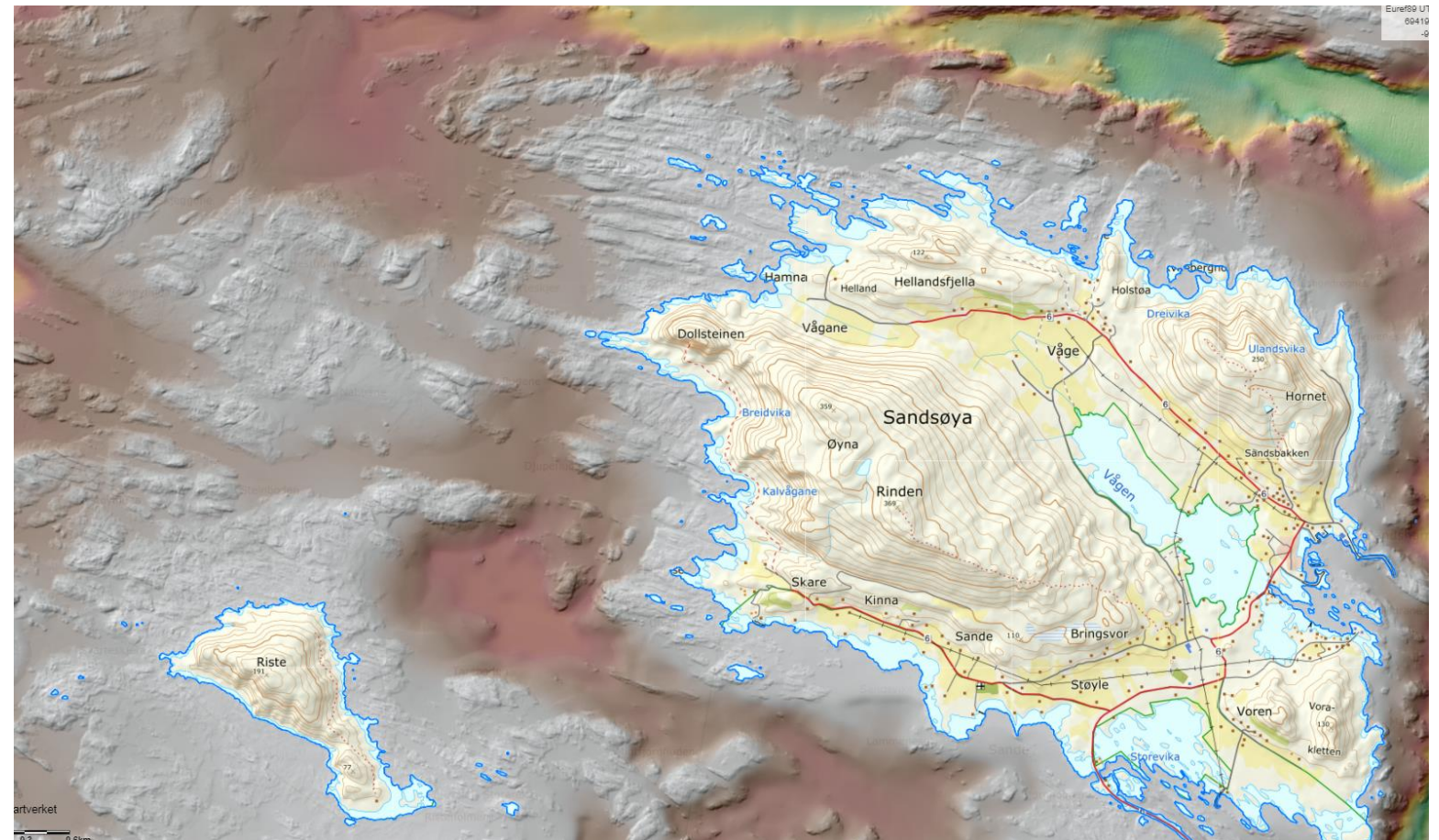


- Multibeam
- Lidar



Multibeam at sea

- Acquired for navigation purposes

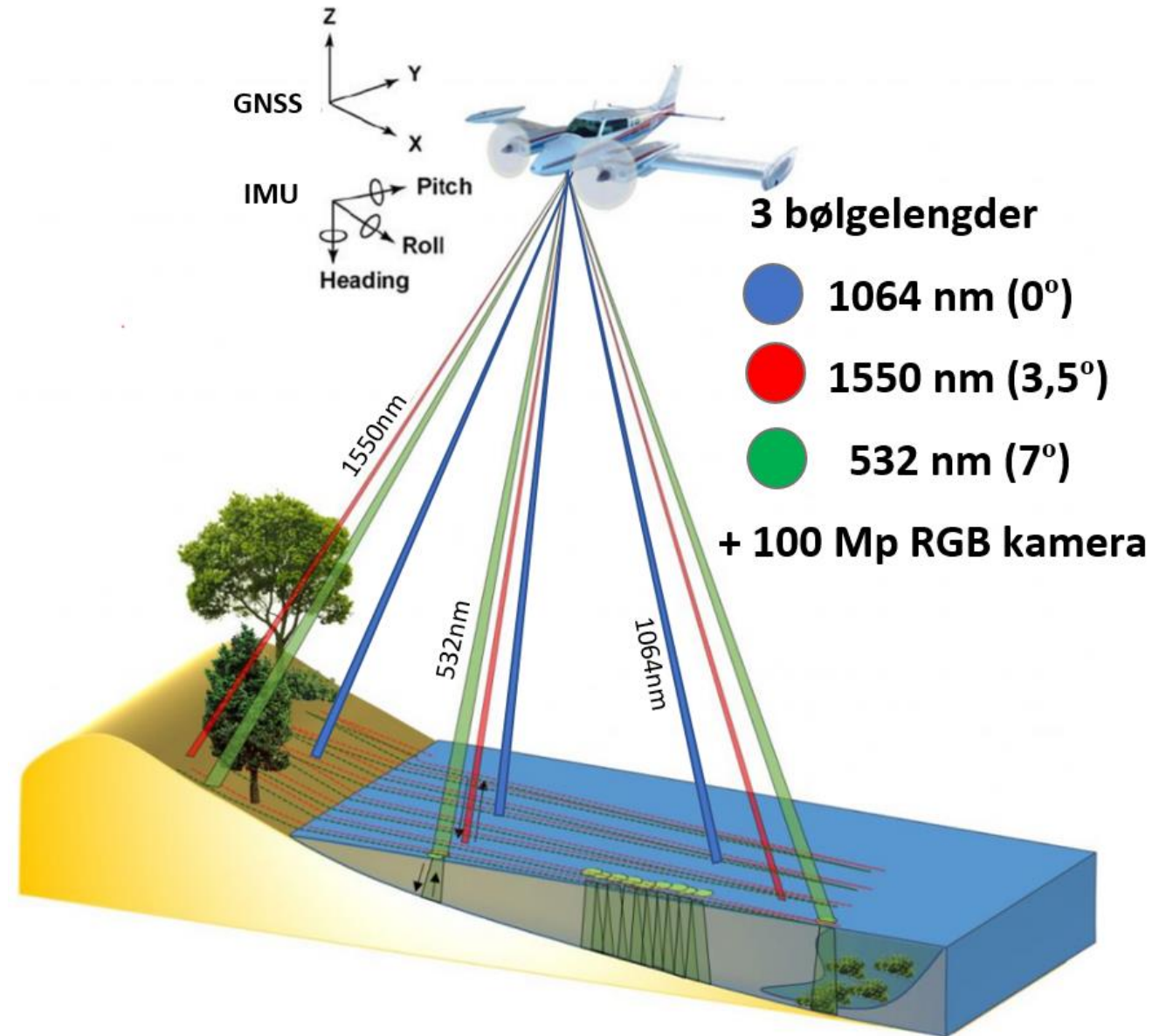


Lovely crinkly edges



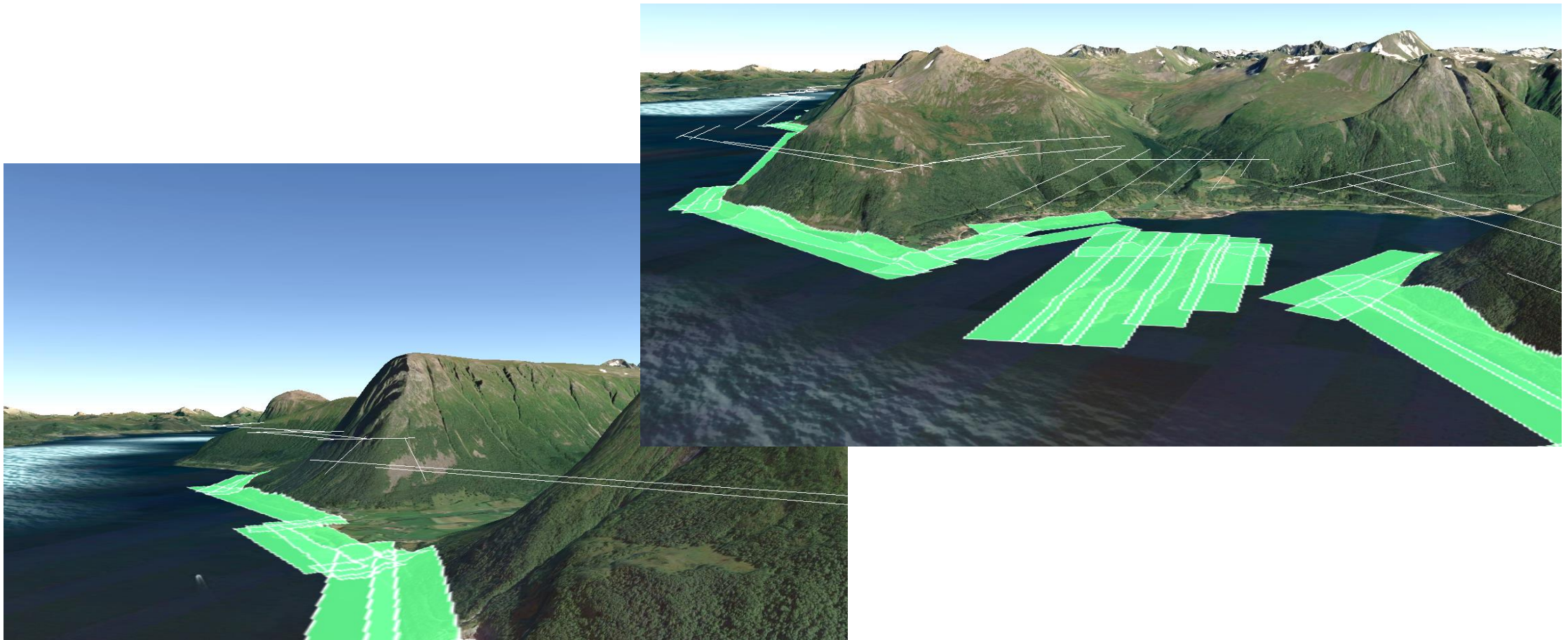


Optech Titan





Challenging flightpaths



Weather

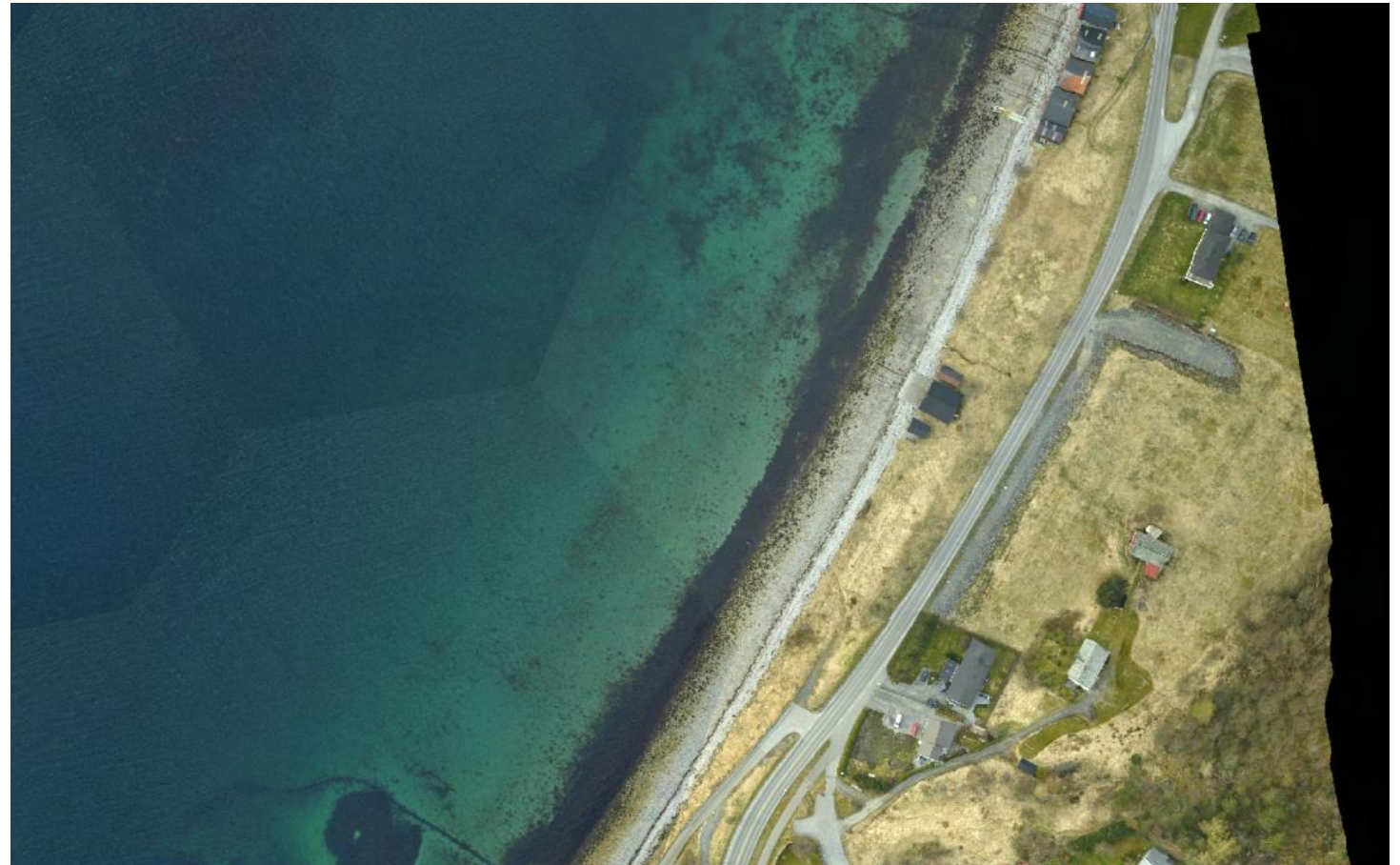
- Visibility
- Turbulence
- Wind
- Watersurface
- Waterclarity
- Tide

Long term forecast

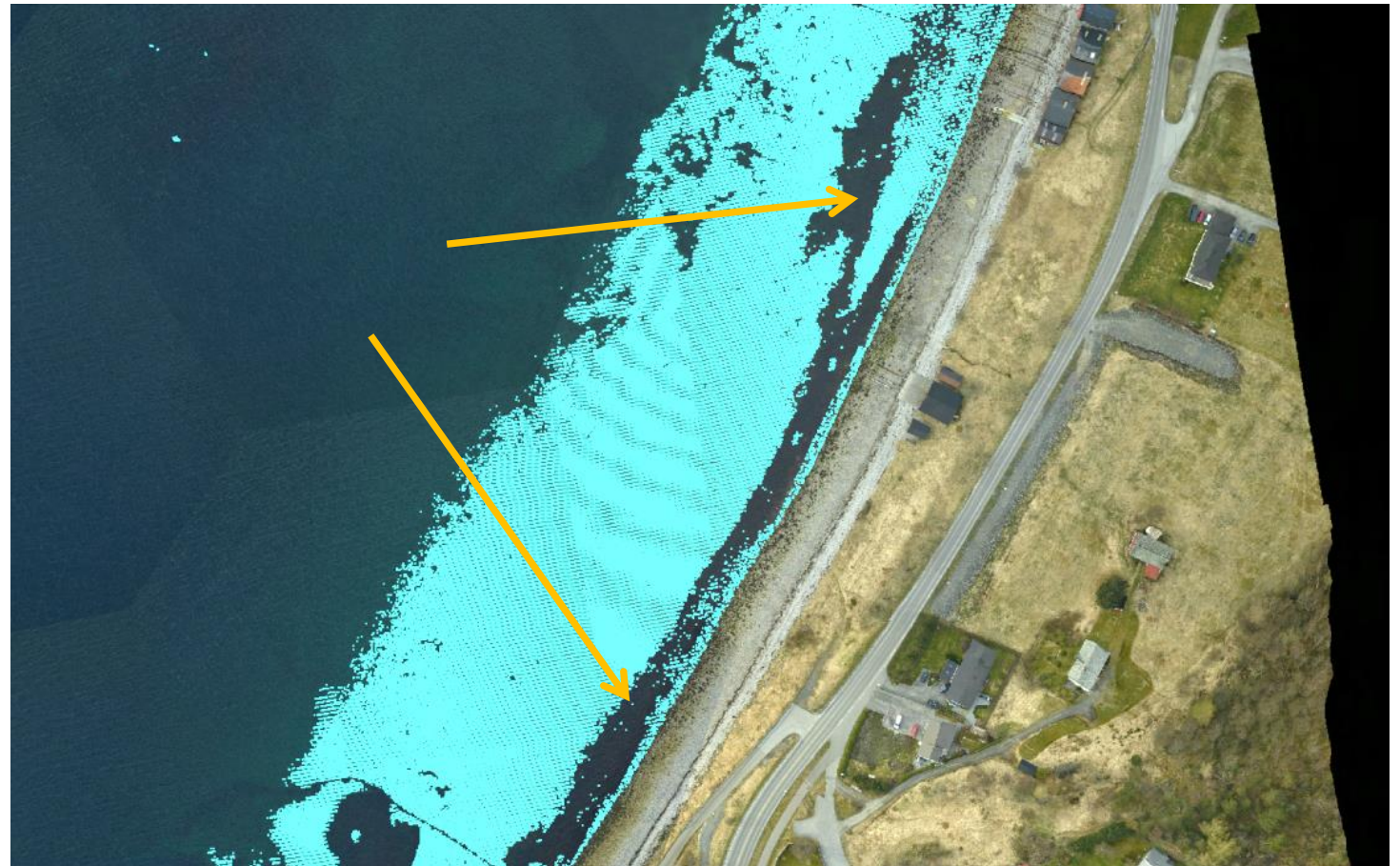
Tuesday 13 June 12-18	Wednesday 14 June 12-18	Thursday 15 June 14-20	Friday 16 June 14-20	Saturday 17 June 14-20	Sunday 18 June 14-20	Monday 19 June 14-20	Tuesday 20 June 14-20
11°	15°	19°	17°	15°	14°	15°	16°
0 mm	0 mm	3.3 mm	2.4 mm	3.0 mm	2.1 mm	0 mm	0 mm

UTC Tide table for Ultsteinvik,
Sat 10th through Wed 14th June 2017.
OK to fly within the following hours:
UTC: 10-June-2017 01:15 -> 10-June-2017 07:45
UTC: 10-June-2017 13:30 -> 10-June-2017 20:00
UTC: 11-June-2017 01:45 -> 11-June-2017 08:20
UTC: 11-June-2017 14:15 -> 11-June-2017 20:10
UTC: 12-June-2017 02:45 -> 12-June-2017 08:30
UTC: 12-June-2017 15:15 -> 12-June-2017 20:30
UTC: 13-June-2017 03:15 -> 13-June-2017 09:30
UTC: 13-June-2017 15:30 -> 13-June-2017 21:30

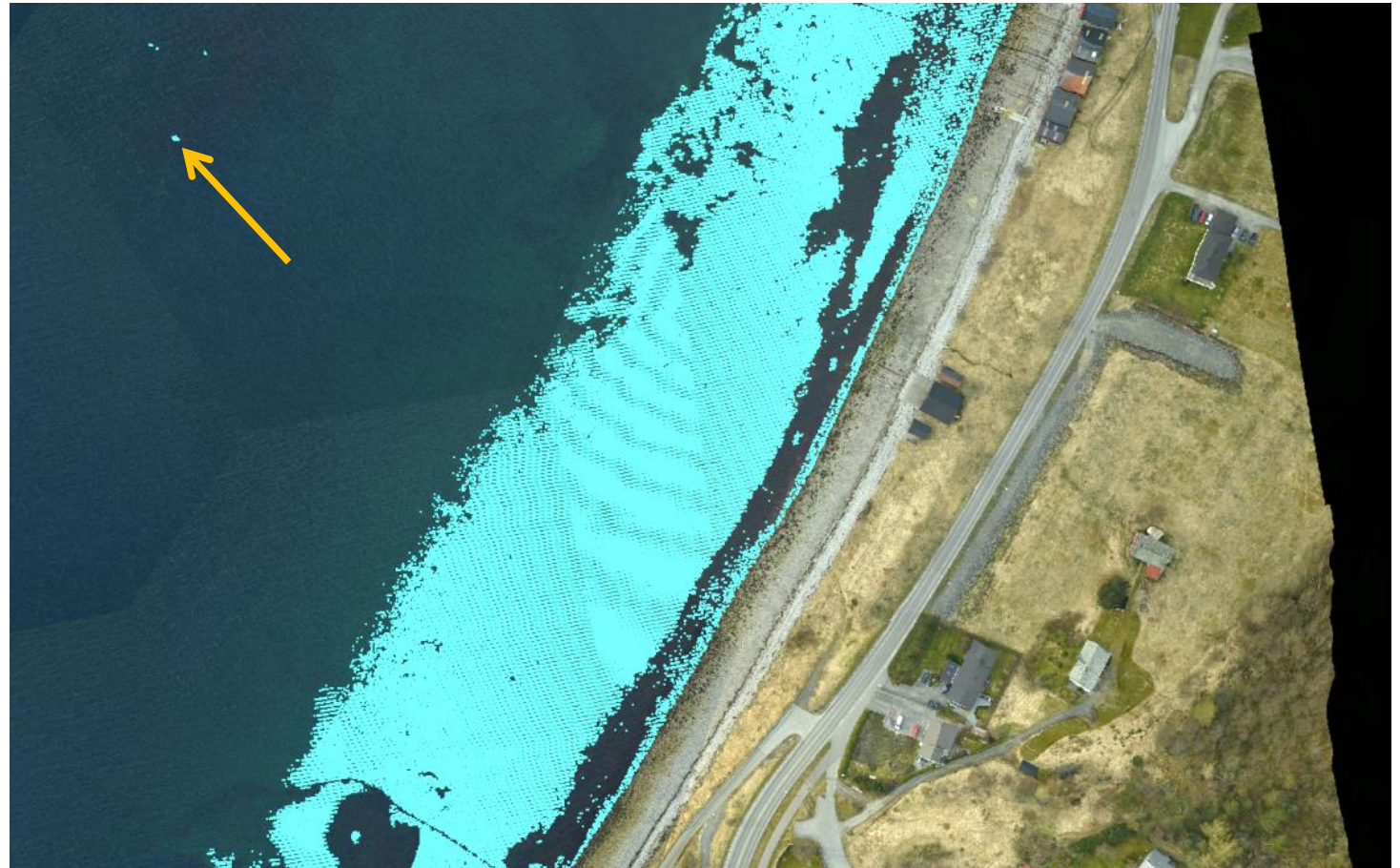
Sandbottom give good returns



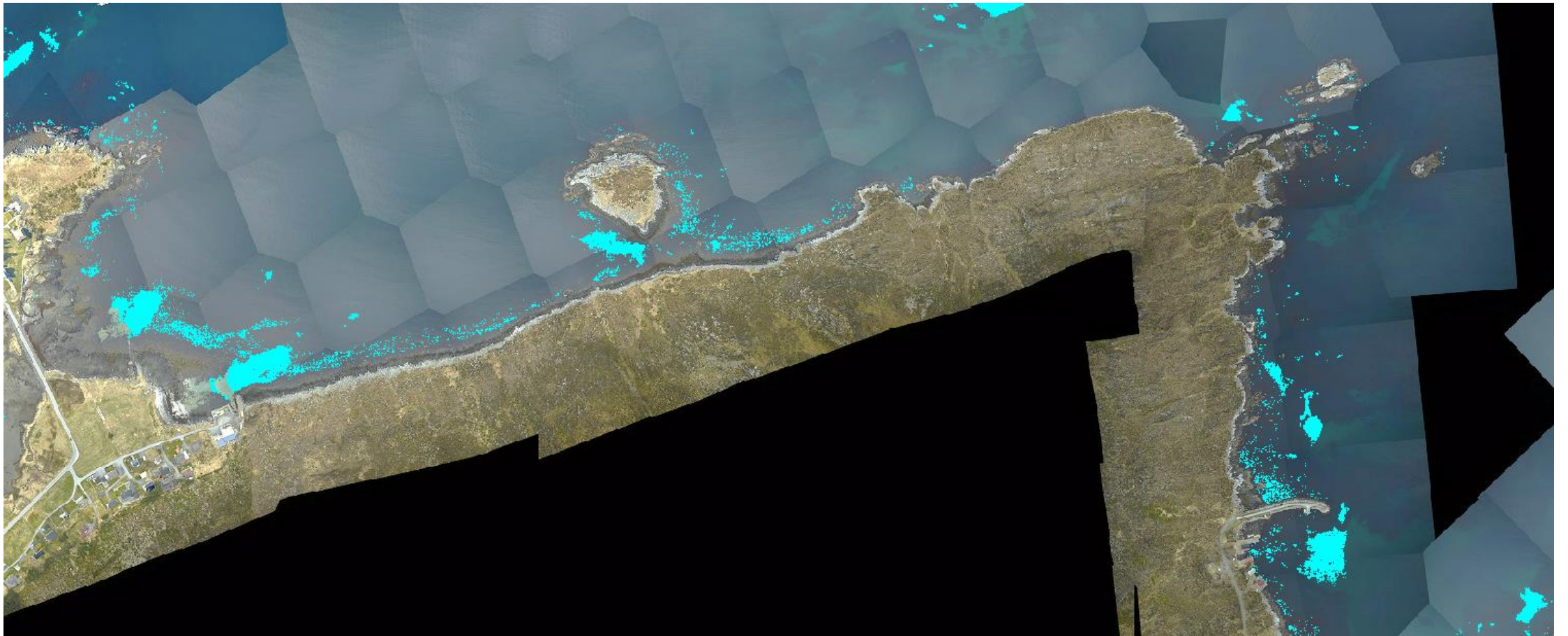
... but little return in vegetation



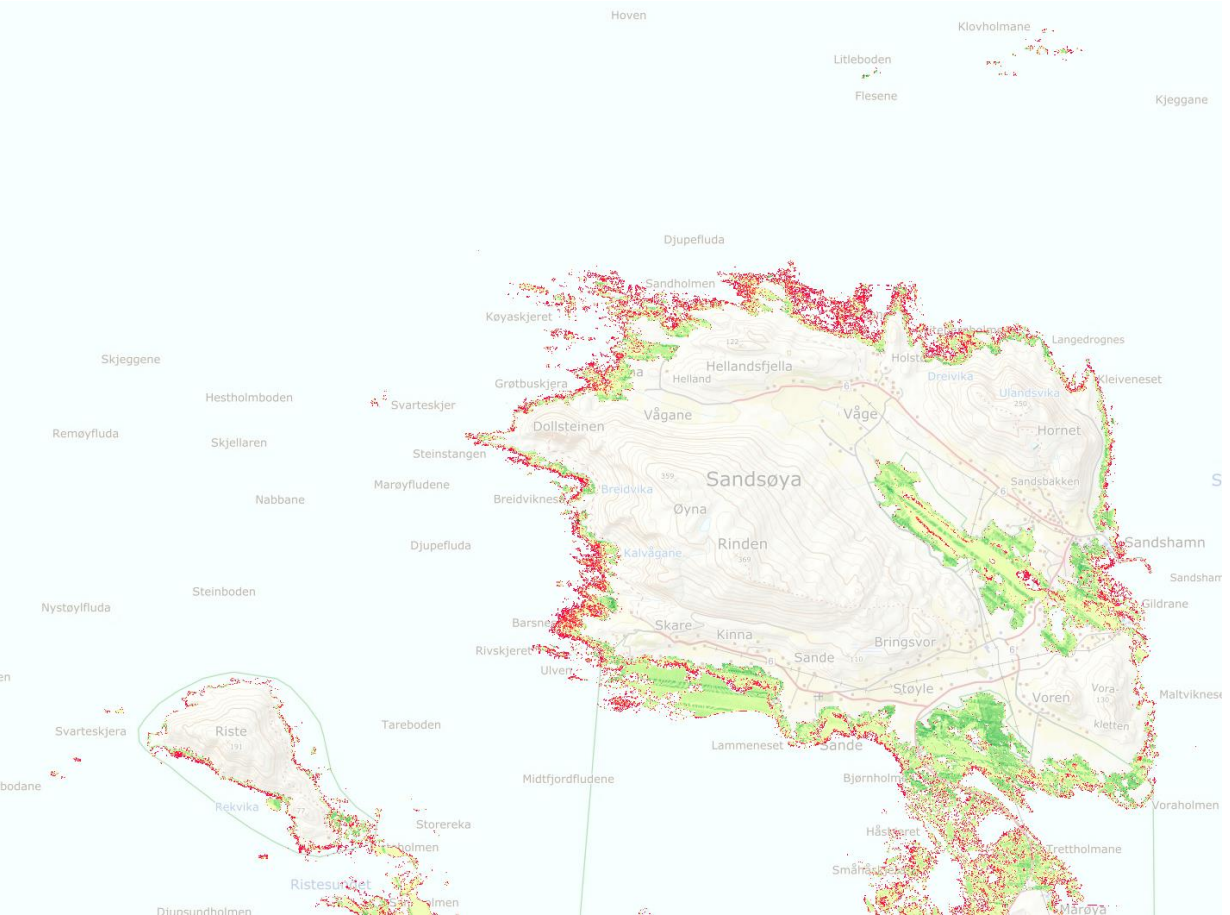
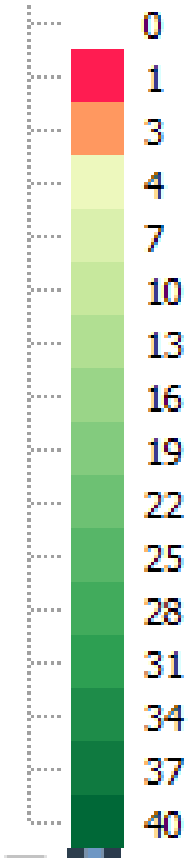
**... patches of data down
to 10-12m**



Coverage varies...



Points /m2

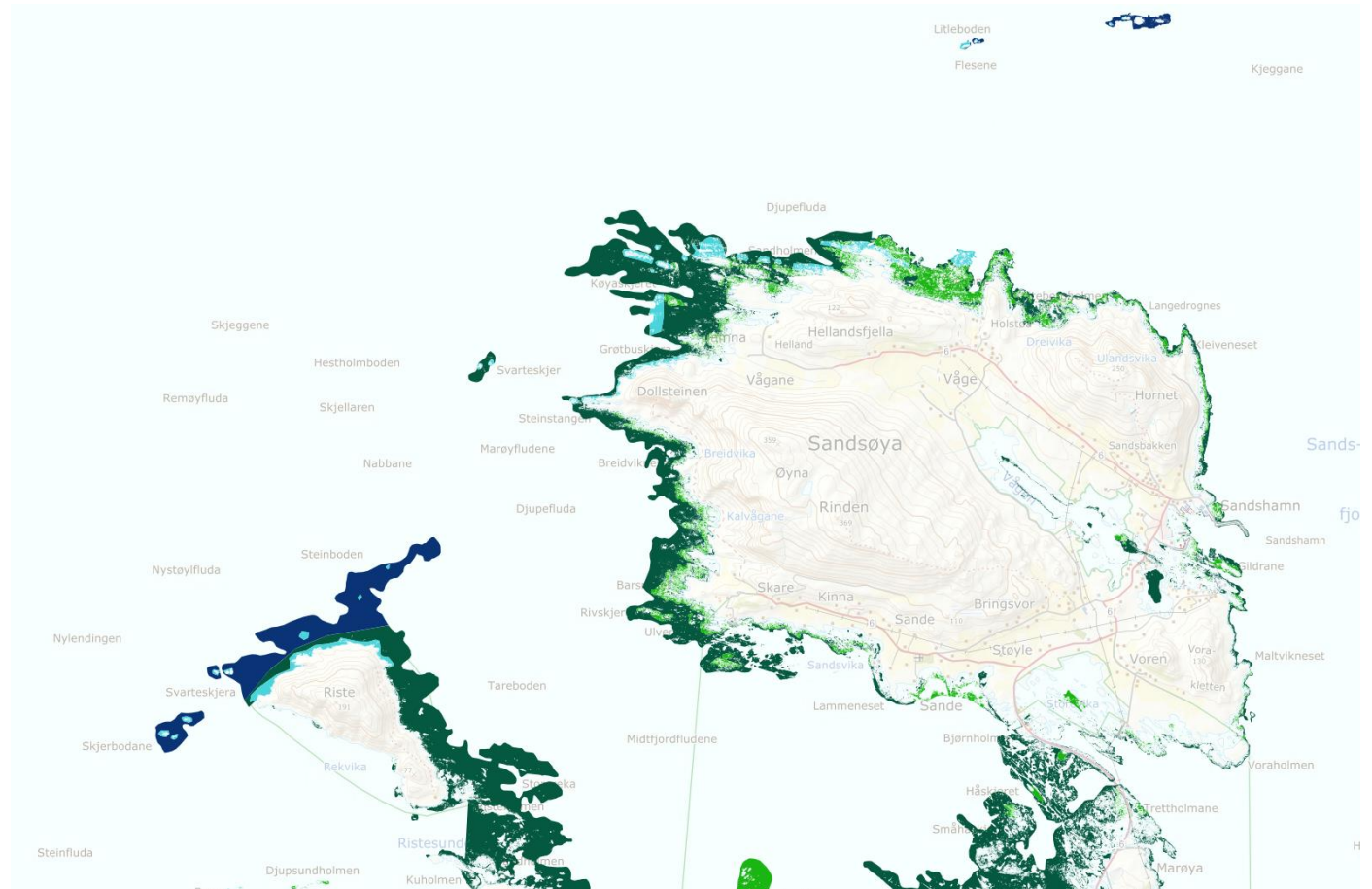


Added classes

- 25 - Rocks
- 26 - Seabed
- 27 - Water surface bathy
- 29 - Marine vegetation
- 30 - IHO objects
- 31 - No bottom

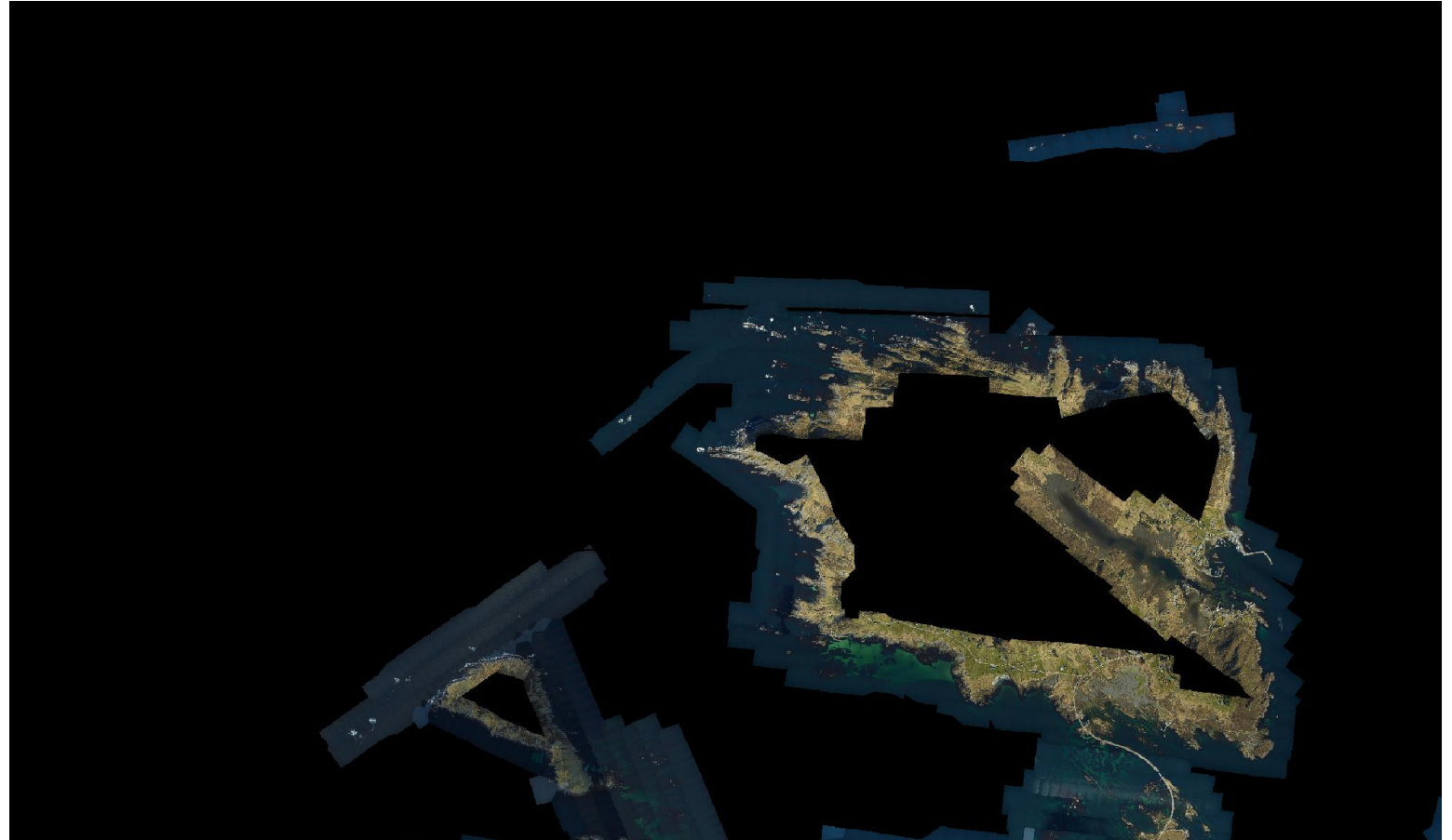
No data

- Dark bottom
- Vegetation
- Depth
- Manmade object
- Turbulent water

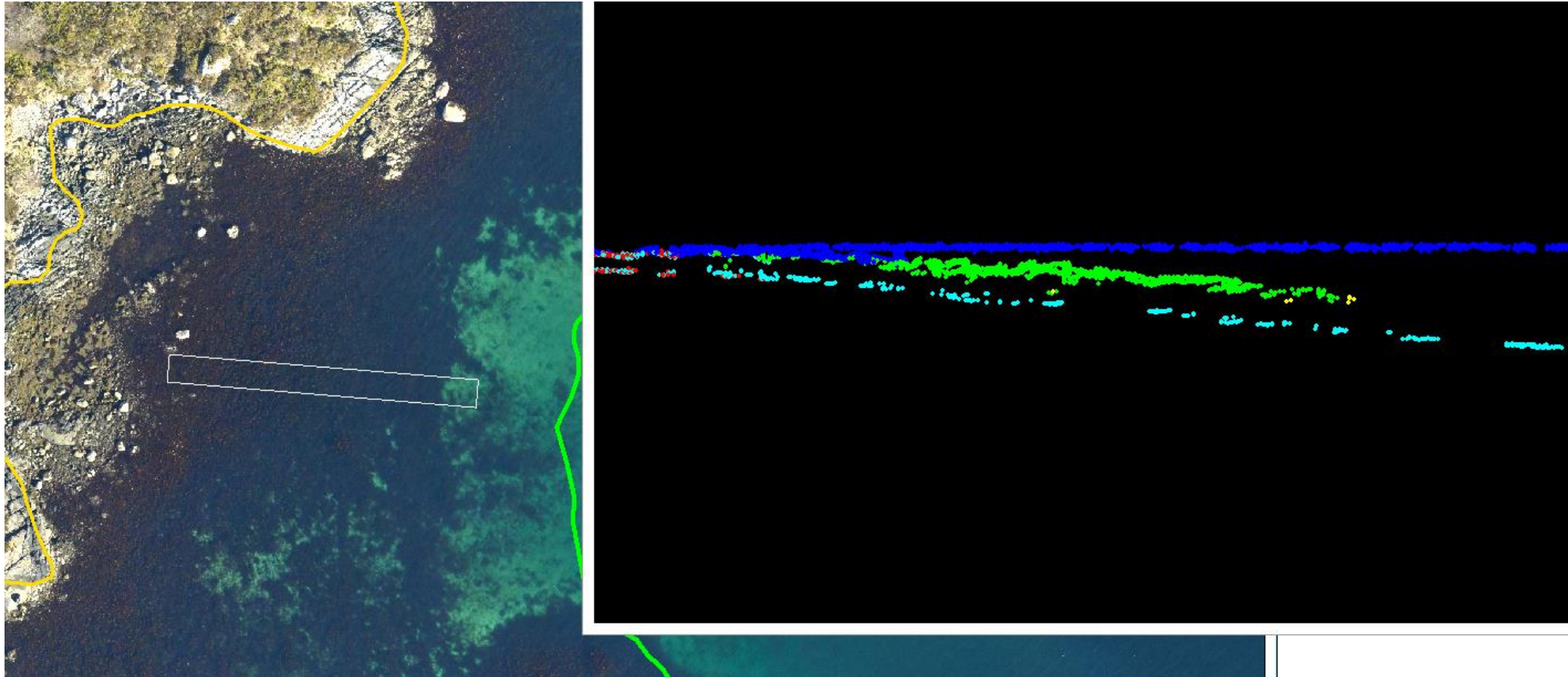


Color mosaic

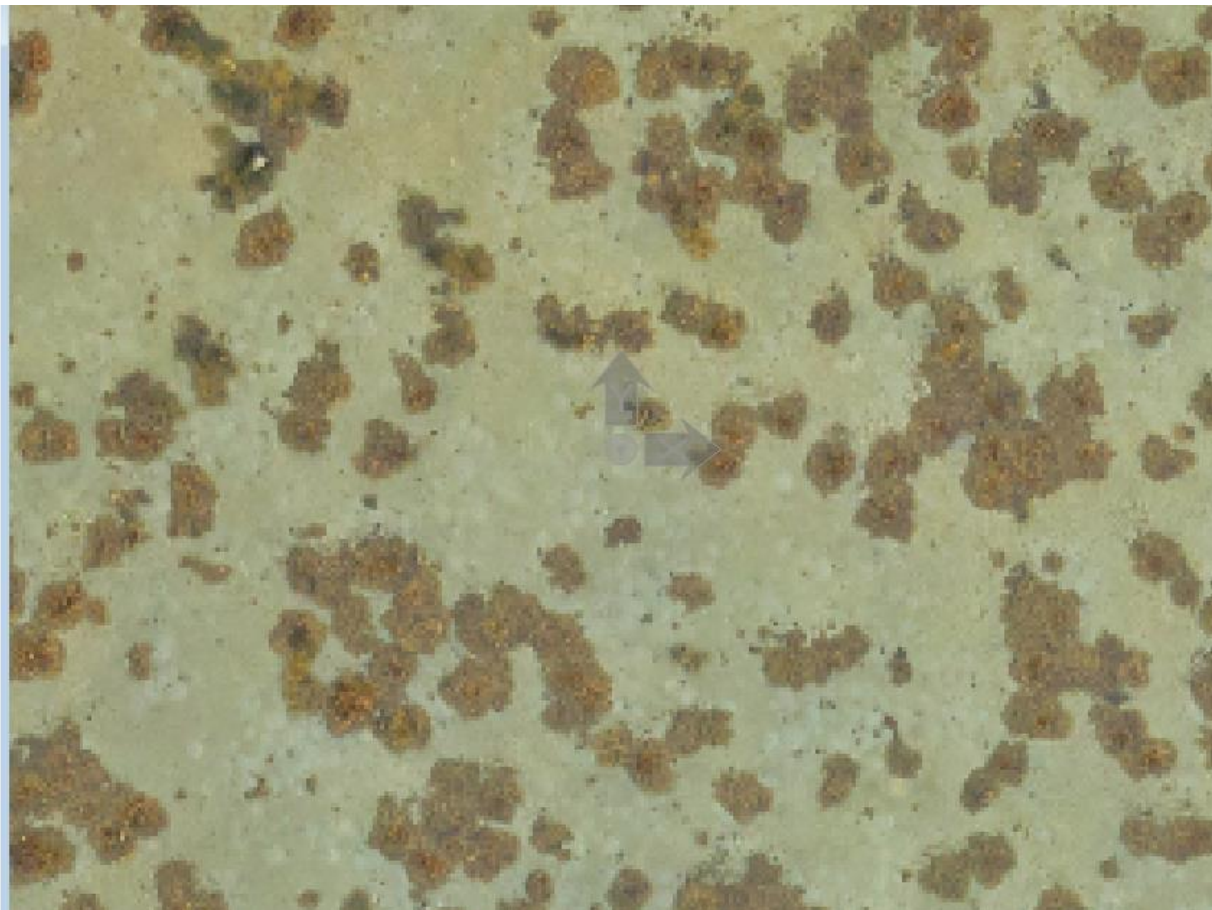
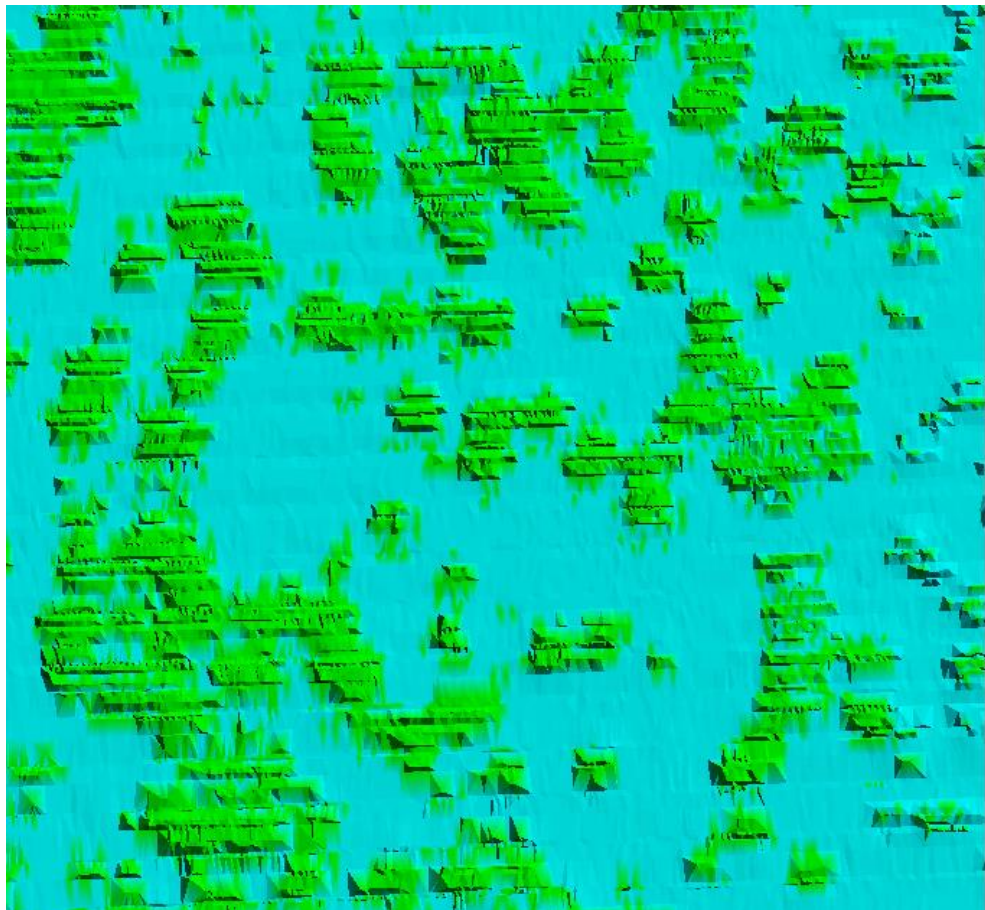
- Help during classification
- Documentation of conditions



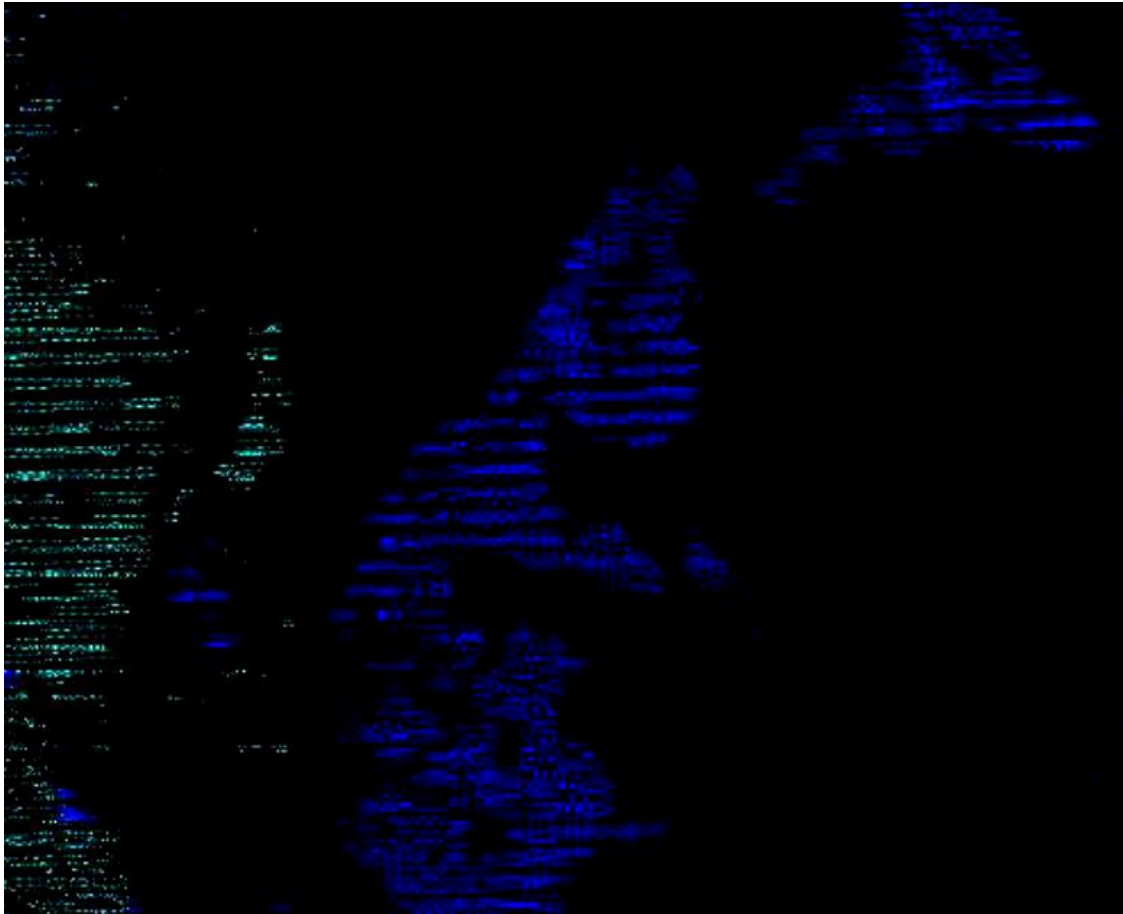
Main challenge: vegetation



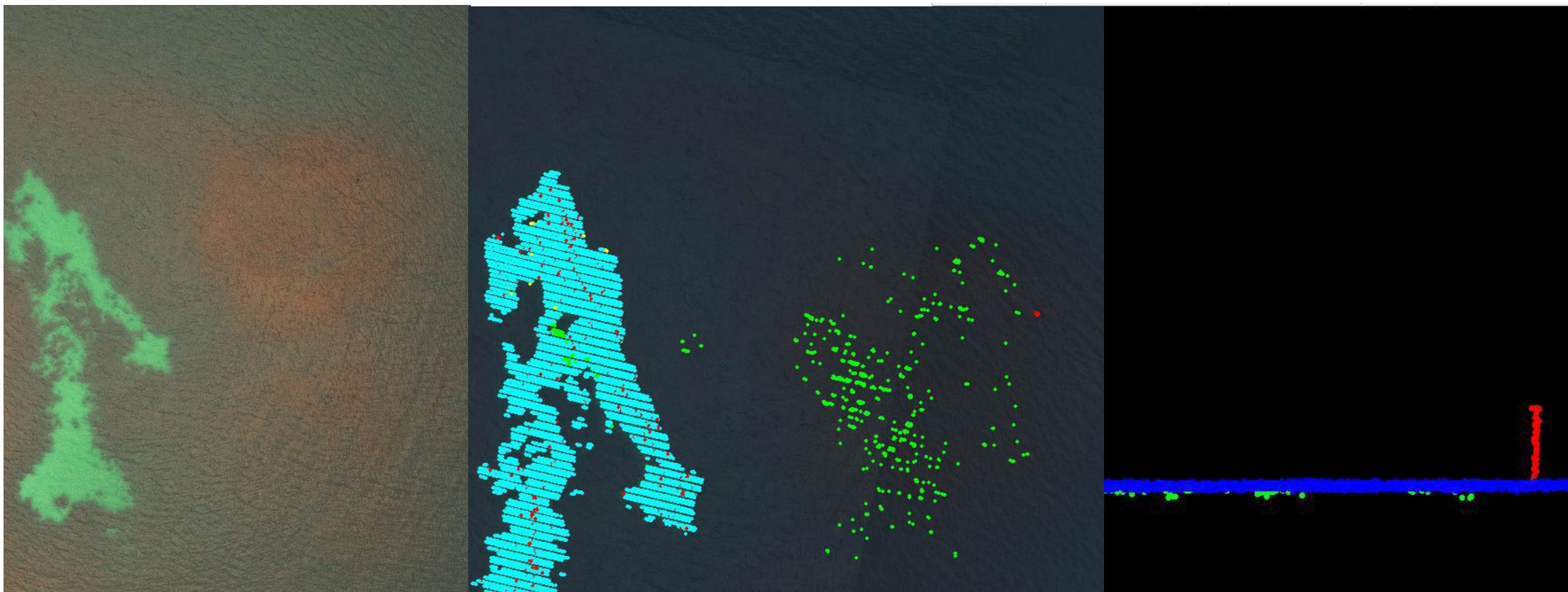
Rocks or vegetation?



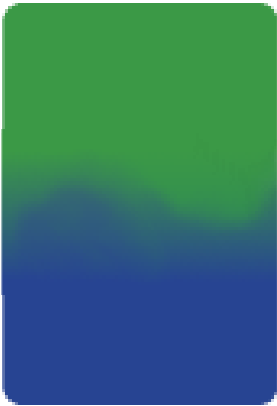
Floating vegetation



Images as support for classification



Are we there yet?



No...



- 49% coverage down to 3m below
- 44% coverage down to 5m below
- Reason is mainly vegetation