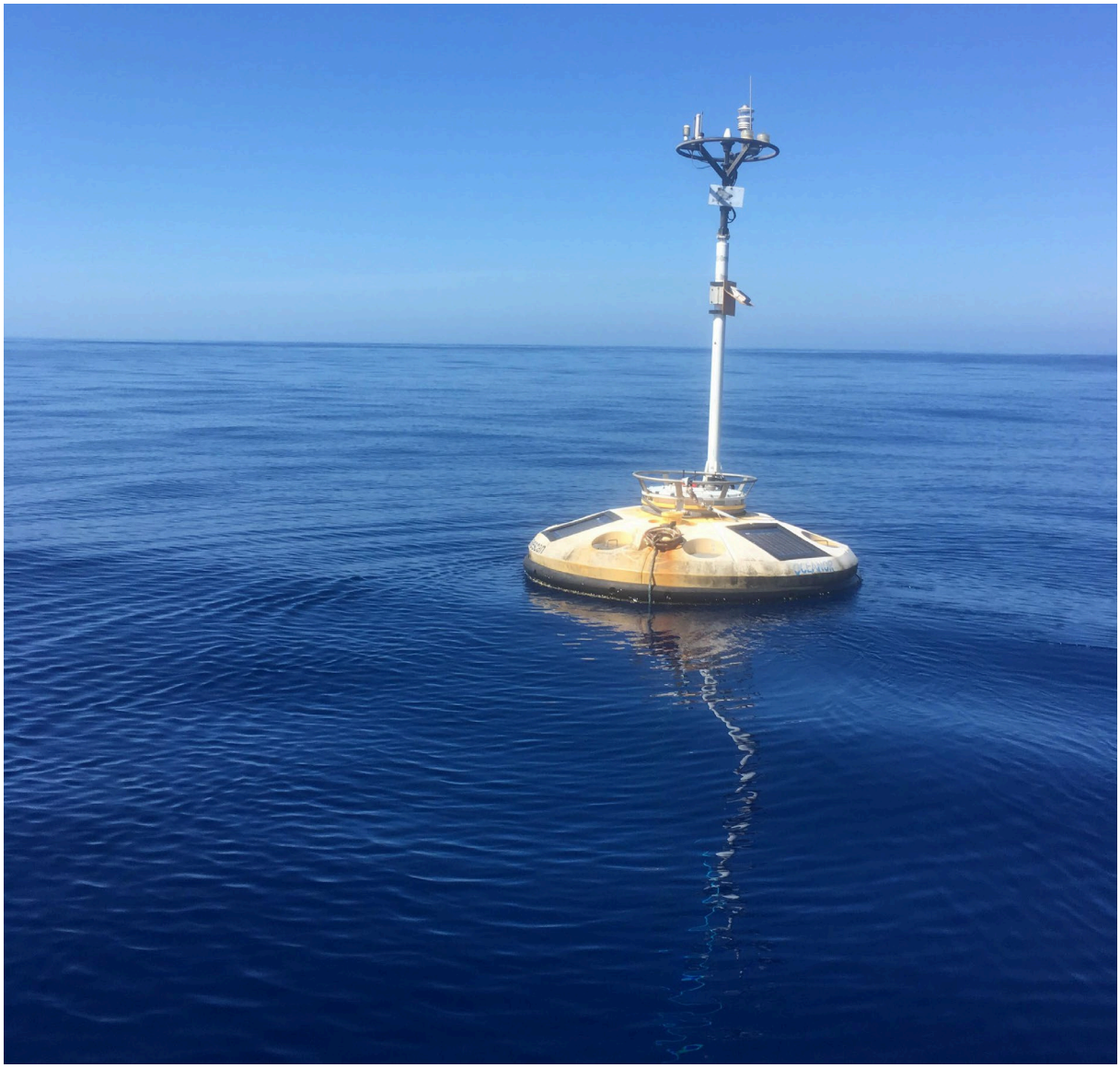
EUMETSAT CONTRACT EUM/CO/20/4600002509/FM

Copernicus Climatological Characterisation of Ocean Sites for OC-SVC



Hellenic Centre for Marine Research (HCMR)

Characterisation of the Greek Sites MSEA-N, MSEA-S, & Antikythera

Task 2 Report, Annex D3: Physical Safety of the Sites

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TASK 2 REPORT: CLIMATOLOGICAL CHARACTERISATION
ANNEX D3: PHYSICAL SAFETY OF THE SITES

Prepared by

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ANNEX D3: PHYSICAL SAFETY OF THE SITES

Applicable Documents

[AD-1] RSP Science Studies Web Template (EUM/RSP/DOC/18/1000216)
[AD-2] Mazeran et al., Requirements for Copernicus Ocean Colour Vicarious Calibration Infrastructure", EUMETSAT study report, https://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_SS_OCEAN_COLOUR_CALIB_REQ&RevisionSelectionMethod=LatestReleased&Rendition=Web
[AD-3] EUMETSAT Contract No. EUM/CO/20/4600002509/FM Copernicus Climatological Characterisation of Ocean Sites for OC-SVC, Hellenic Centre for Marine Research (HCMR) Characterisation of the Greek Sites MSEA-N, MSEA-S & Antikythera: Deliverable 3, Task 1 Report – Climatological and Observational Datasets
[AD-4] EUMETSAT Contract No. EUM/CO/20/4600002509/FM Copernicus Climatological Characterisation of Ocean Sites for OC-SVC, Hellenic Centre for Marine Research (HCMR) Characterisation of the Greek Sites MSEA and Antikythera: Minutes of the kick off meeting, 21/01/2021.
[SOW] EUMETSAT Statement of Work for Climatological Characterisation of Ocean Sites for OC-SVC (SOW; EUM/RSP/SOW/20/1170709).

Reference Documents

[RD-1] Zibordi, G. and Mélin, F. (2017). An evaluation of marine regions relevant for ocean color system vicarious calibration. Remote Sensing of Environment, 190:122–136.
[RD-2] Antoine, D., Vellucci, V., Banks, A.C., Bardey, P., Bretagnon, M., Bruniquel, V., Deru, A., Fanton d'Andon, O.H., Lerebourg, C., Mangin, A., Crozel, D., Victori, S., Kalampokis, A., Karageorgis, A.P., Petihakis, G., Psarra, S., Golbol, M., Leymarie, E., Bialek, A., Fox, N., Hunt, S., Kuusk, J., Laizans, K., and Kanakidou, M. (2020). ROSACE: A proposed European Design for the Copernicus Ocean Colour System Vicarious Calibration Infrastructure. Remote Sensing 12, 1535. https://doi.org/10.3390/rs12101535.
[RD-3] ROSACE Preliminary Design of the Copernicus Ocean Colour Vicarious Calibration Project: Infrastructure, Project Planning and Costing Preliminary Design Document, EUMETSAT study report, https://www.eumetsat.int/website/home/Data/ScienceActivities/ScienceStudies/CopernicusOceanColourVicariousCalibrationInfrastructure/PreliminaryDesignProjectPlanandCostingforCopernicusOceanColourVicariousCalibrationInfrastructure/index.html
[RD-4] FRM4SOC D-240, Proceedings of WKP-1 (PROC-1). Report of the International Workshop. 2017. https://frm4soc.org/wp-content/uploads/filebase/FRM4SOC-WKP1-D240-Workshop_Report_PROC-1_v1.1_signedESA.pdf
[RD-5] Zibordi, G., Mélin, F. and Talone, M. (2017). System Vicarious Calibration for Copernicus Ocean Colour Missions: Requirements and Recommendations for a European Site; Publications Office of the European Union: Brussels, Belgium. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC105497/kj-na-28433-en-n%20pdf.pdf

Acronyms

List of the acronyms used in this document:

AD: Applicable Document
AIS: Automated Identification System
EMODnet: European Marine Observation and Data Network
ESA: European Space Agency
EUMETSAT: European Organization for the Exploitation of Meteorological Satellites
GOOS: Global Ocean Observing System
GPS: Global Positioning System
GSM: Global System for Mobile Communications
HCMR: Hellenic Centre for Marine Research
HNHS: Hellenic Navy Hydrographic Service
LED: Light Emitting Diode
MOBY: Marine Optical BuoY

MPPT: Maximum Power Point Tracking
NASA: National Aeronautics and Space Administration
NOAA: National Oceanic and Atmospheric Administration
OC: Ocean Colour
OLED: Organic Light-Emitting Diode
PI: Principal Investigator
ROSACE: Radiometry for Ocean Colour SAtellites Calibration & Community Engagement
SOW: Statement of Work
SVC: System Vicarious Calibration

Introduction

Physical safety of an OC-SVC site is paramount. This is because of the Copernicus requirement for operational data delivery as well as because of the high costs and effort of maintaining the infrastructure. The description of work for this work package (AD-4) therefore asked for an annex to AD-3 which provides: a) Information from the local coastguard on presence and patterns of fishing, shipping and tourism in the vicinity of 10 km around the site locations, separately for each location: MSea-N, MSea-S and Antikythera; b) The frequency of vessels provided as a function of the calendar month for each site; and c) A proposal formulated on the possibilities to make the sites protected and safe.

Presence and patterns of fishing, shipping and tourism

During the main phase of this project detailed information was given on the density patterns of all shipping (including fishing and tourism) in the area of all 3 Crete sites (AD-3). All the information available from the Hellenic coastguard in the form of monthly statistics for all of the main ports in the vicinity of the sites was also given in AD-3 (Heraklion, Chania, Kissamos, Kythera and Antikythera). This information, presented in Tables OT1-OT5 in AD-3, is all that the Hellenic coastguard has or is allowed to release in terms of shipping information. Nevertheless, the density of shipping information that was mapped for all shipping in AD-3 using EMODnet data can be separated into categories of fishing and pleasure (touristic) boating activities and plotted with total shipping as a function of calendar month as requested. The following figures show the original maps and this separation for focused areas around each site.

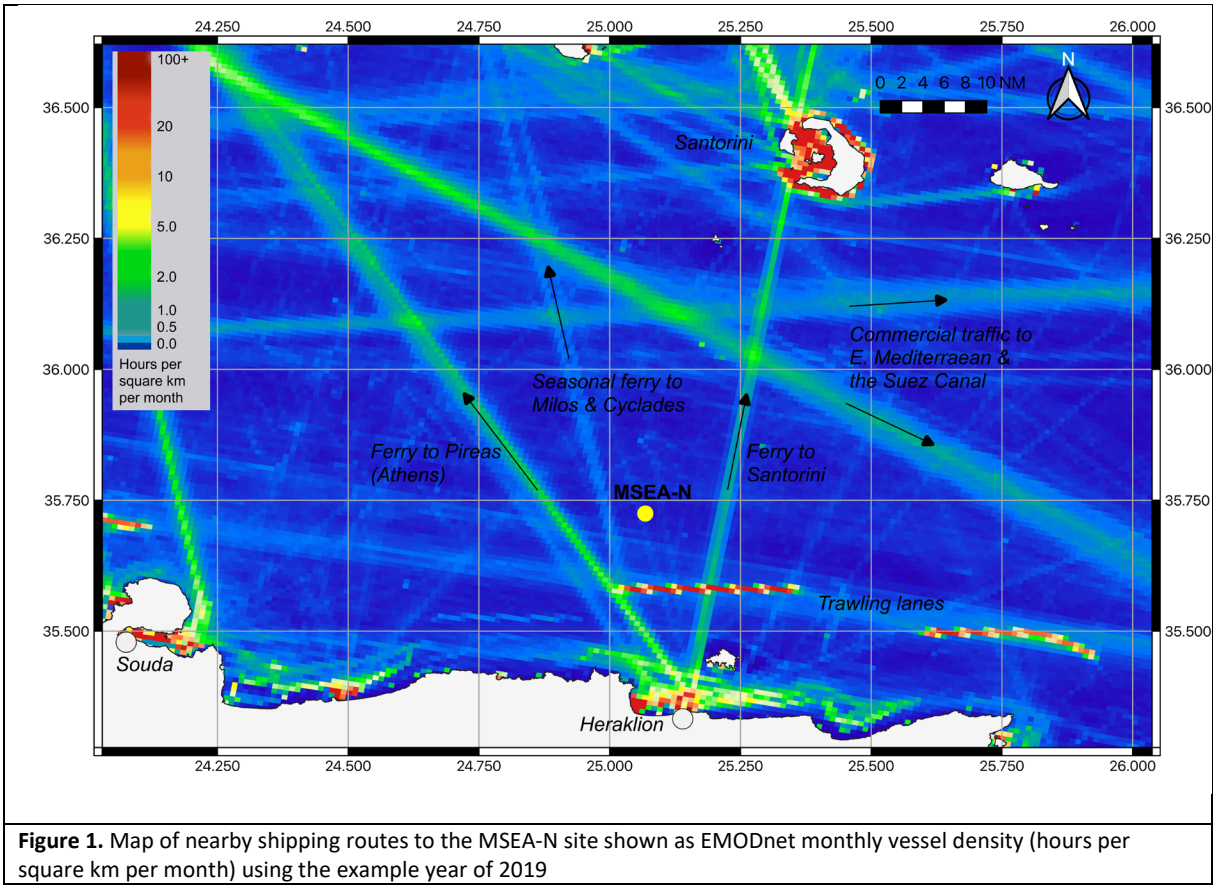


Figure 1. Map of nearby shipping routes to the MSEA-N site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019

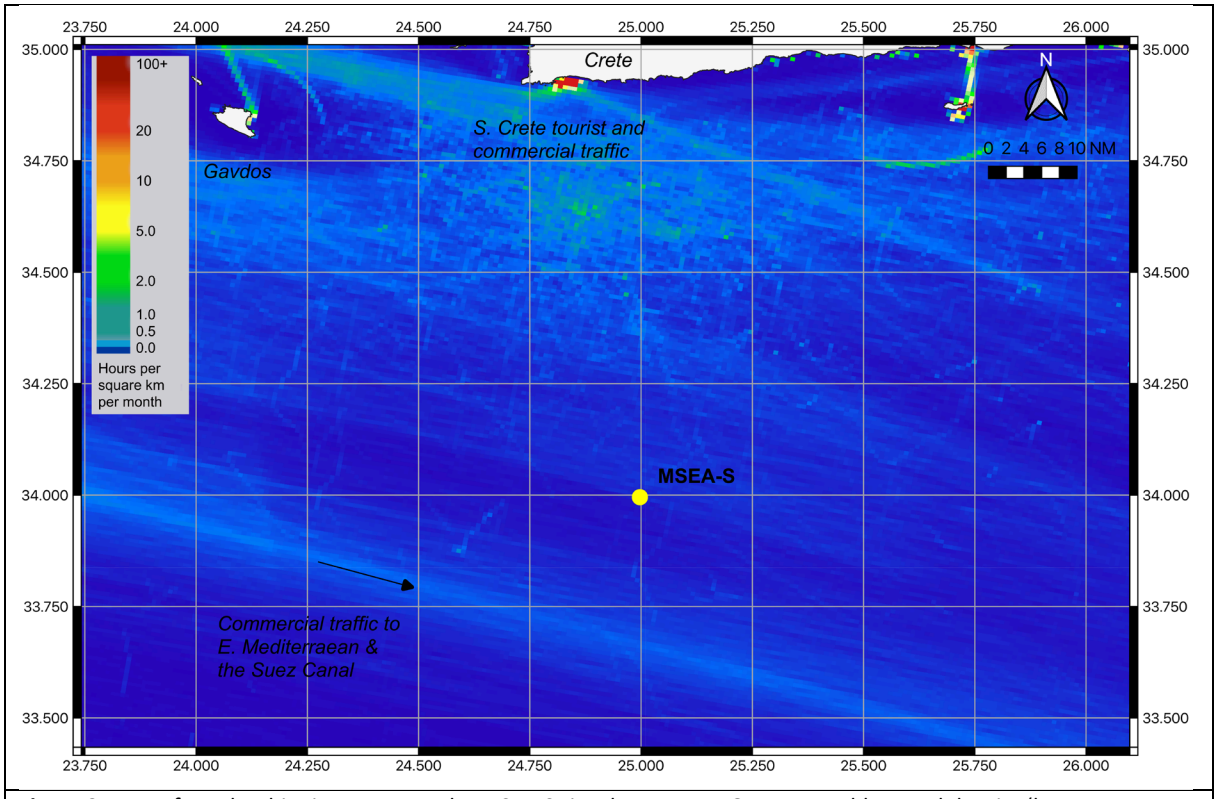


Figure 2. Map of nearby shipping routes to the MSEA-S site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019.

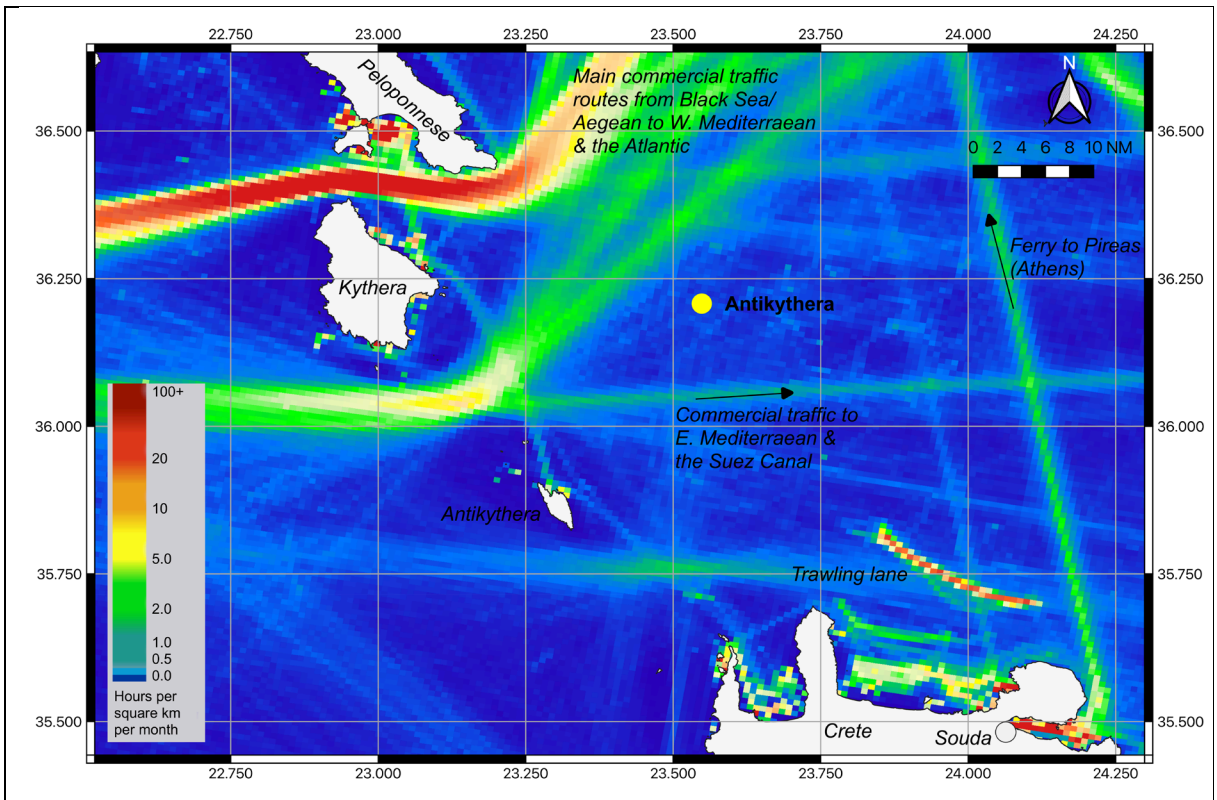
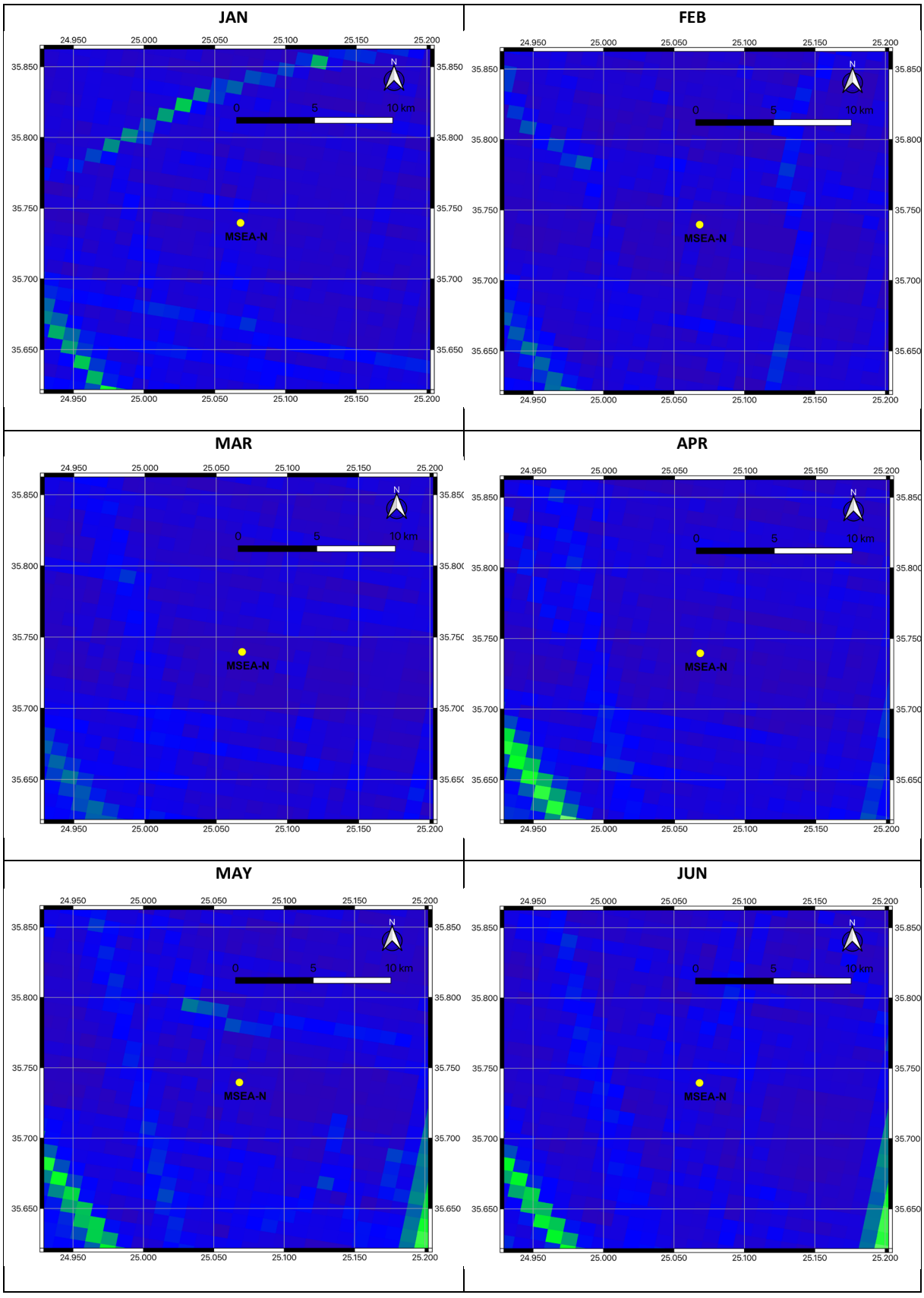


Figure 3. Map of nearby shipping routes to the Antikythera site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019.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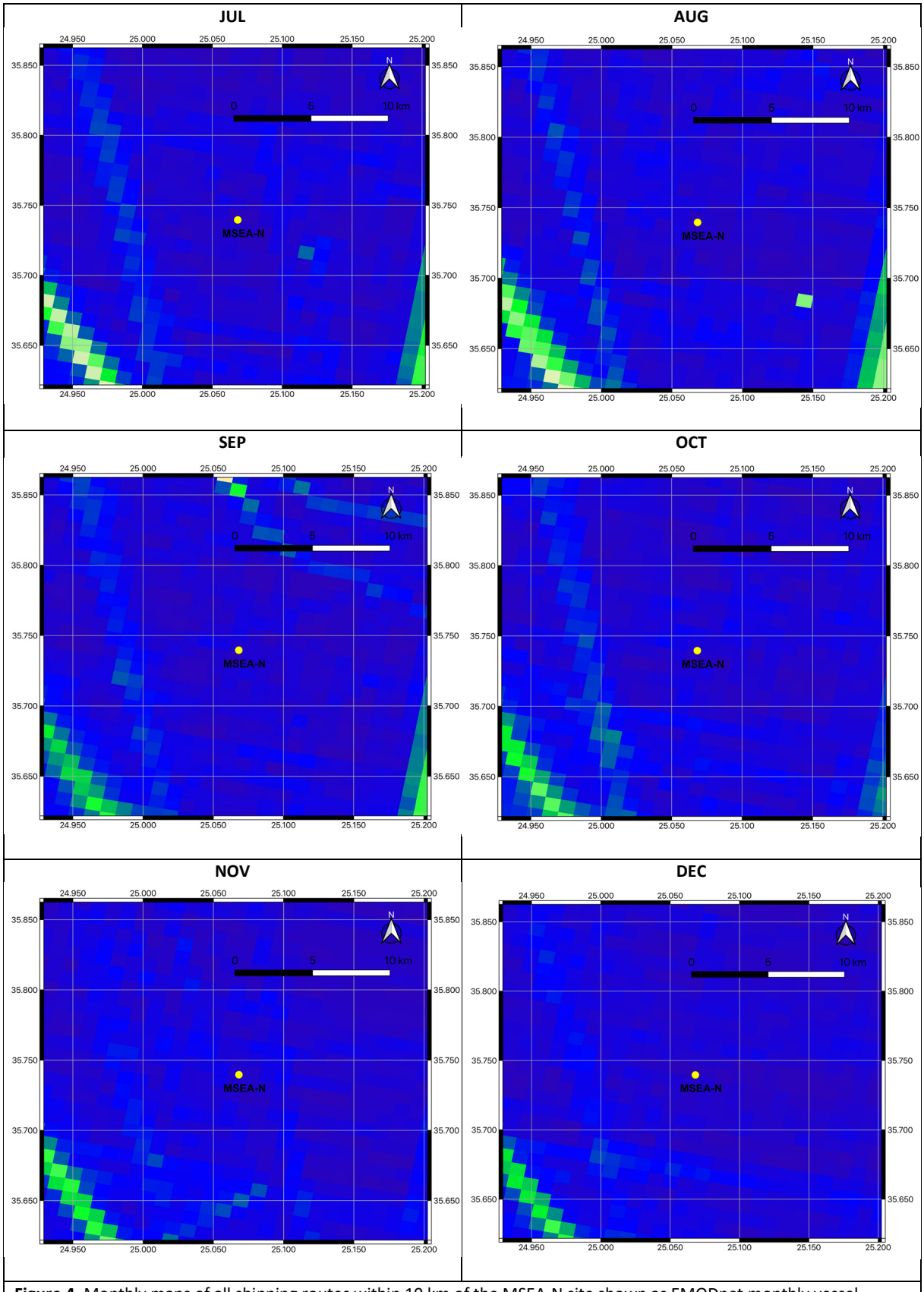
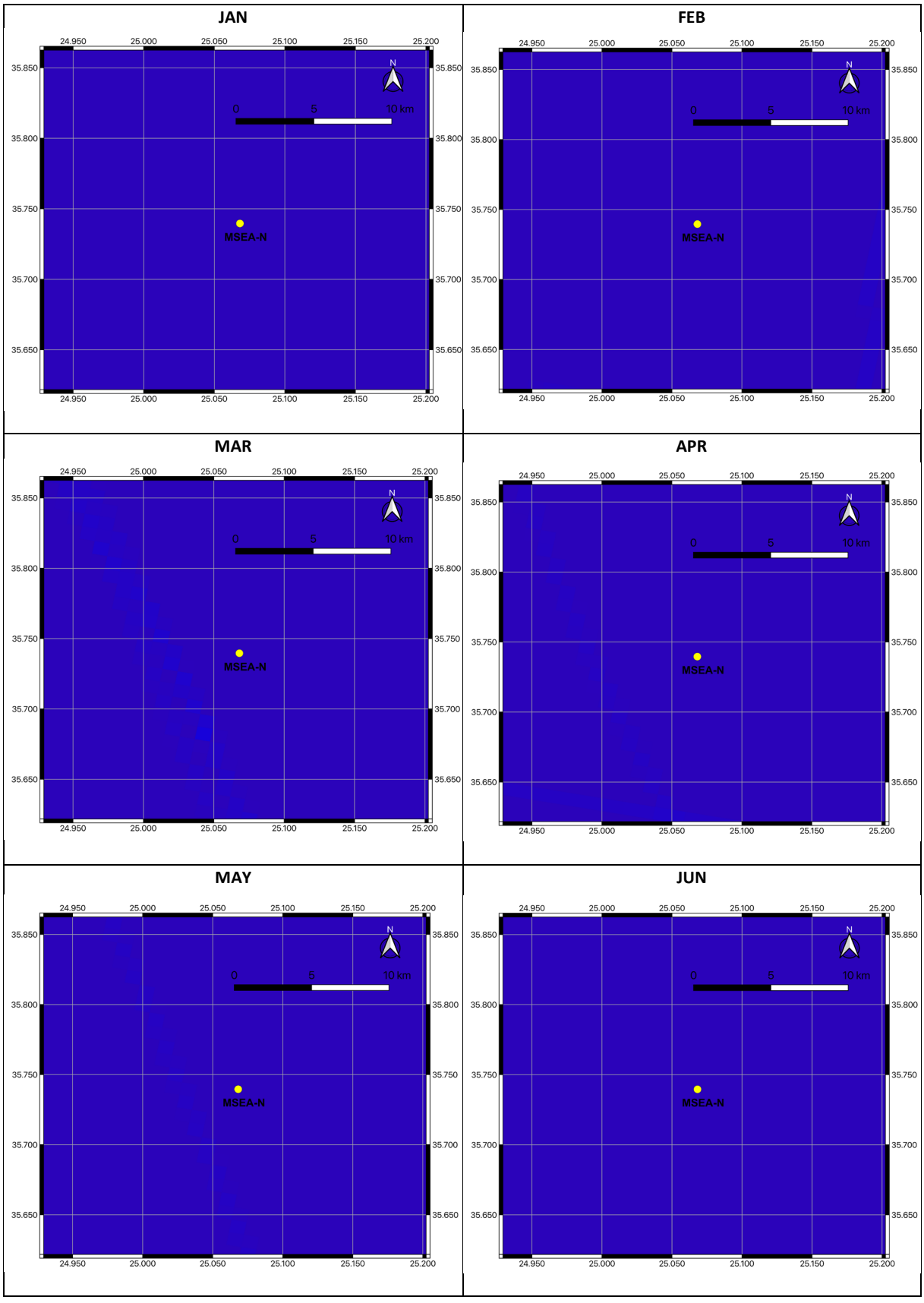


Figure 4. Monthly maps of all shipping routes within 10 km of the MSEA-N site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 1.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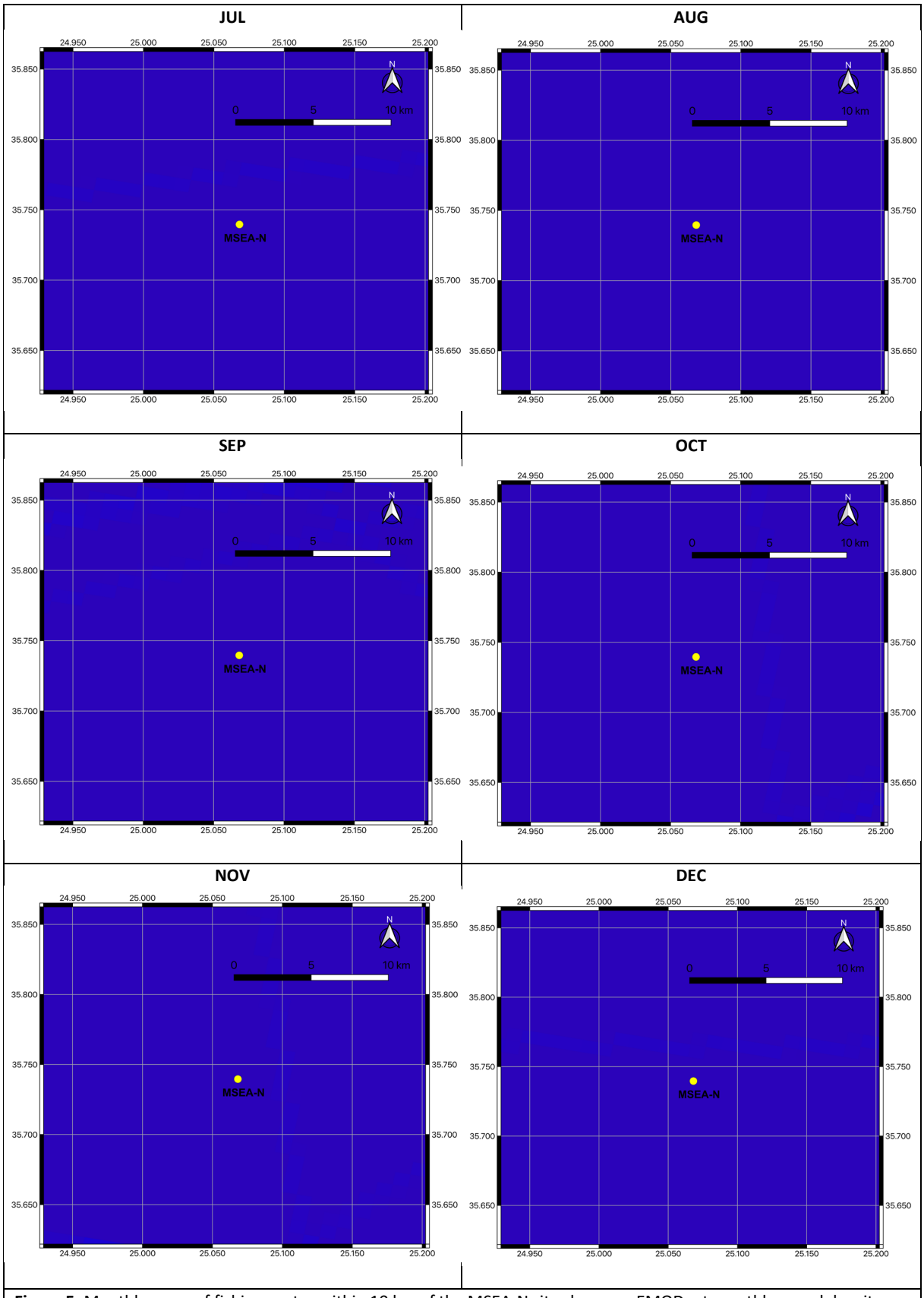
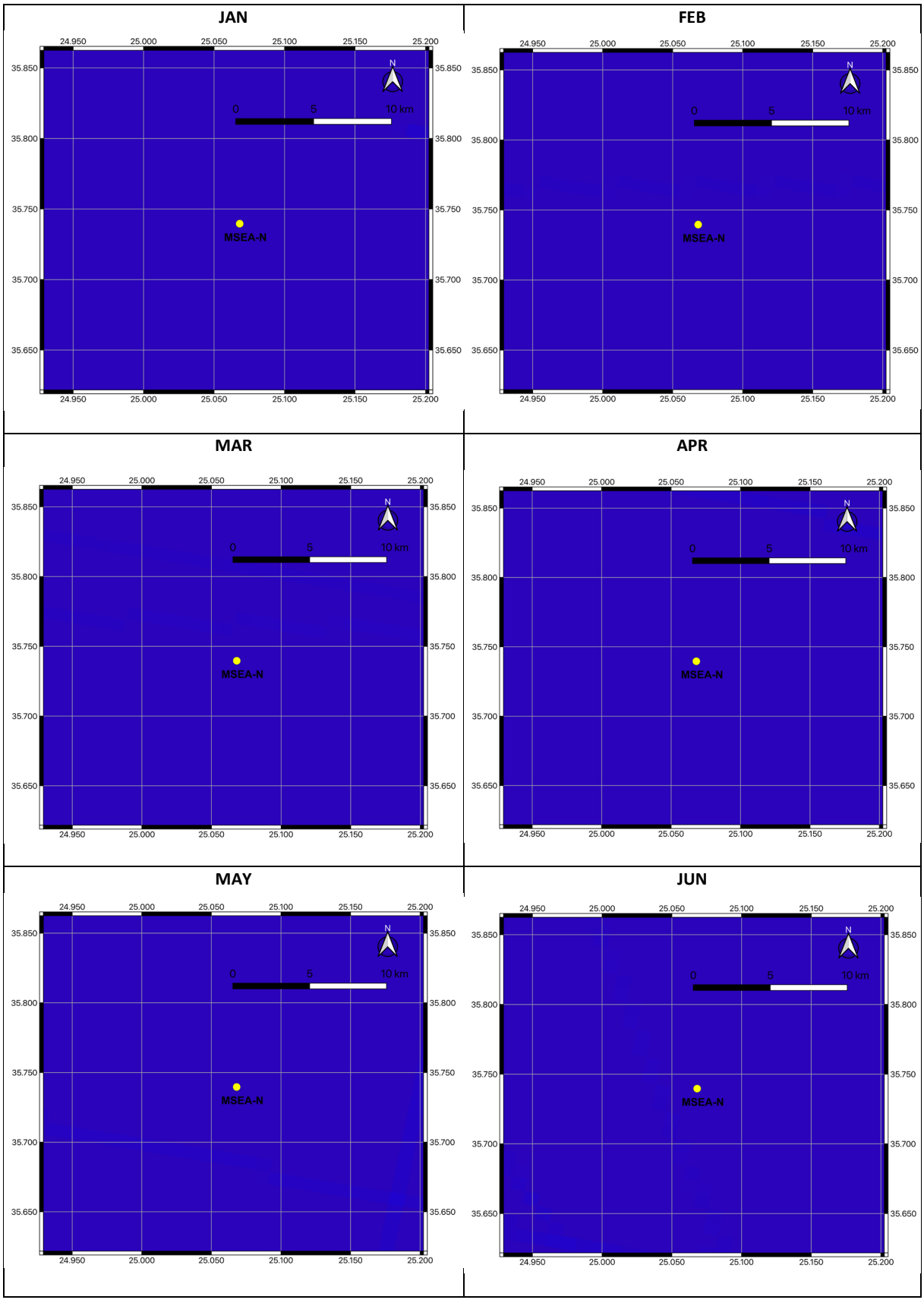


Figure 5. Monthly maps of fishing routes within 10 km of the MSEA-N site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 1.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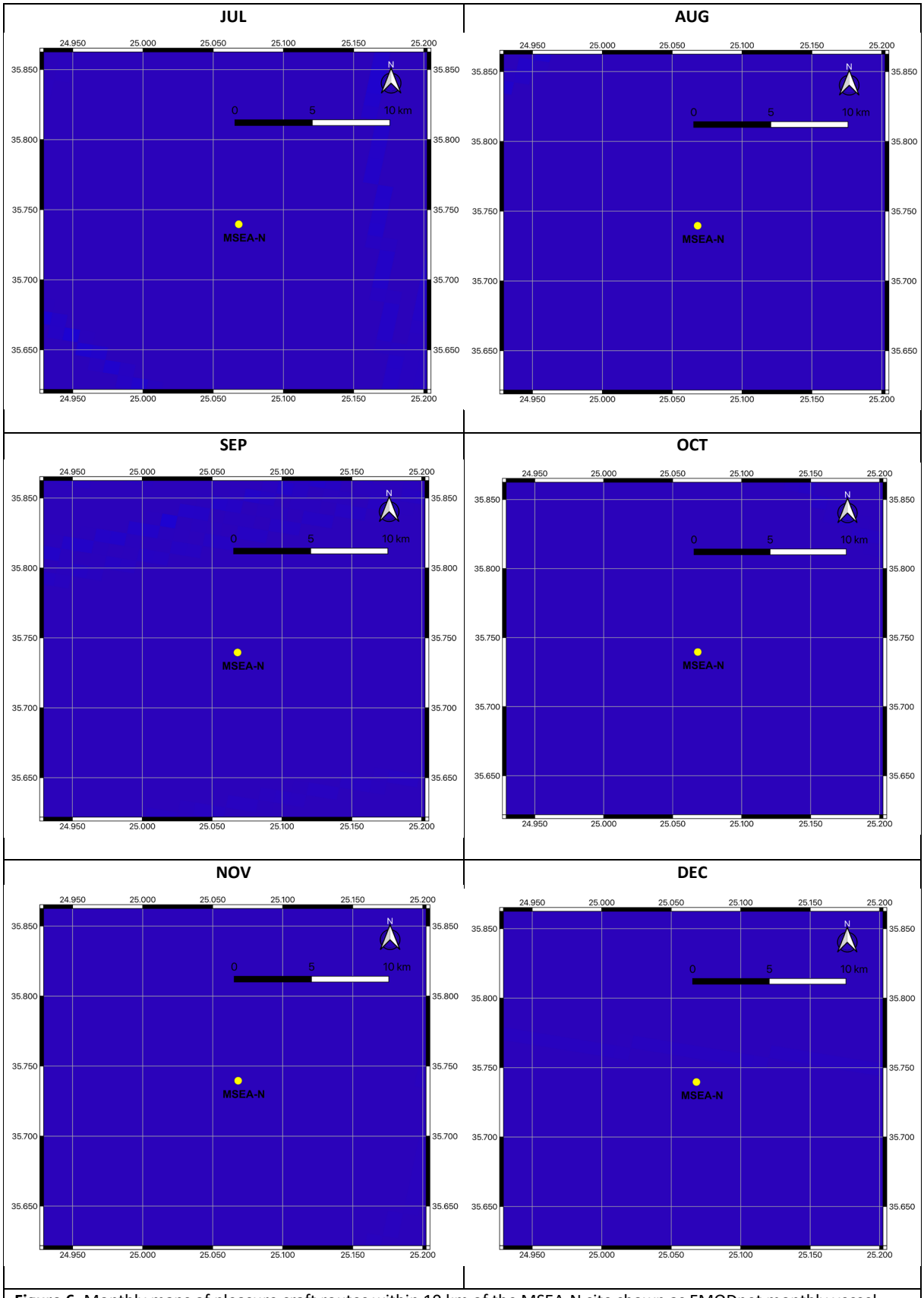
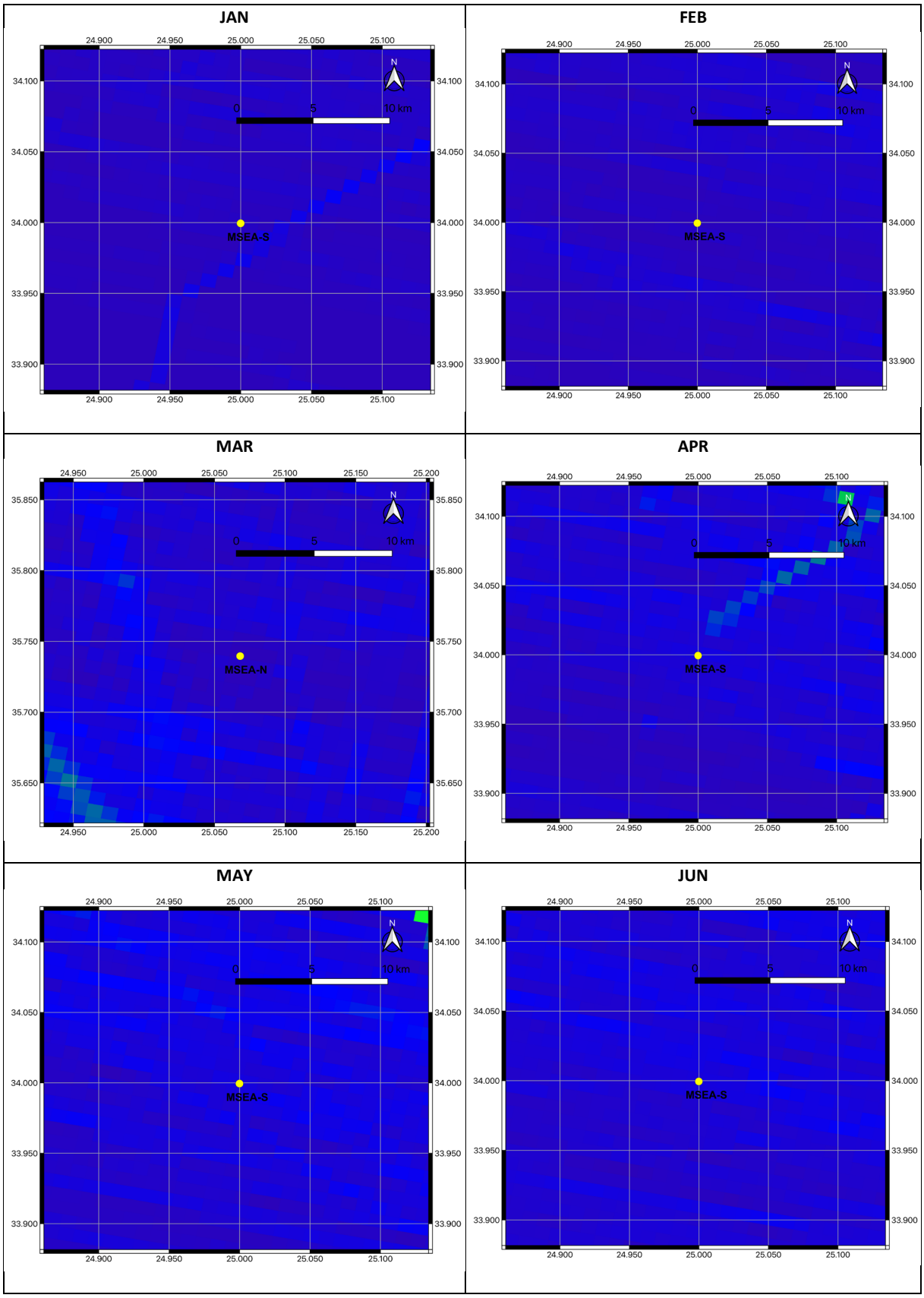


Figure 6. Monthly maps of pleasure craft routes within 10 km of the MSEA-N site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 1.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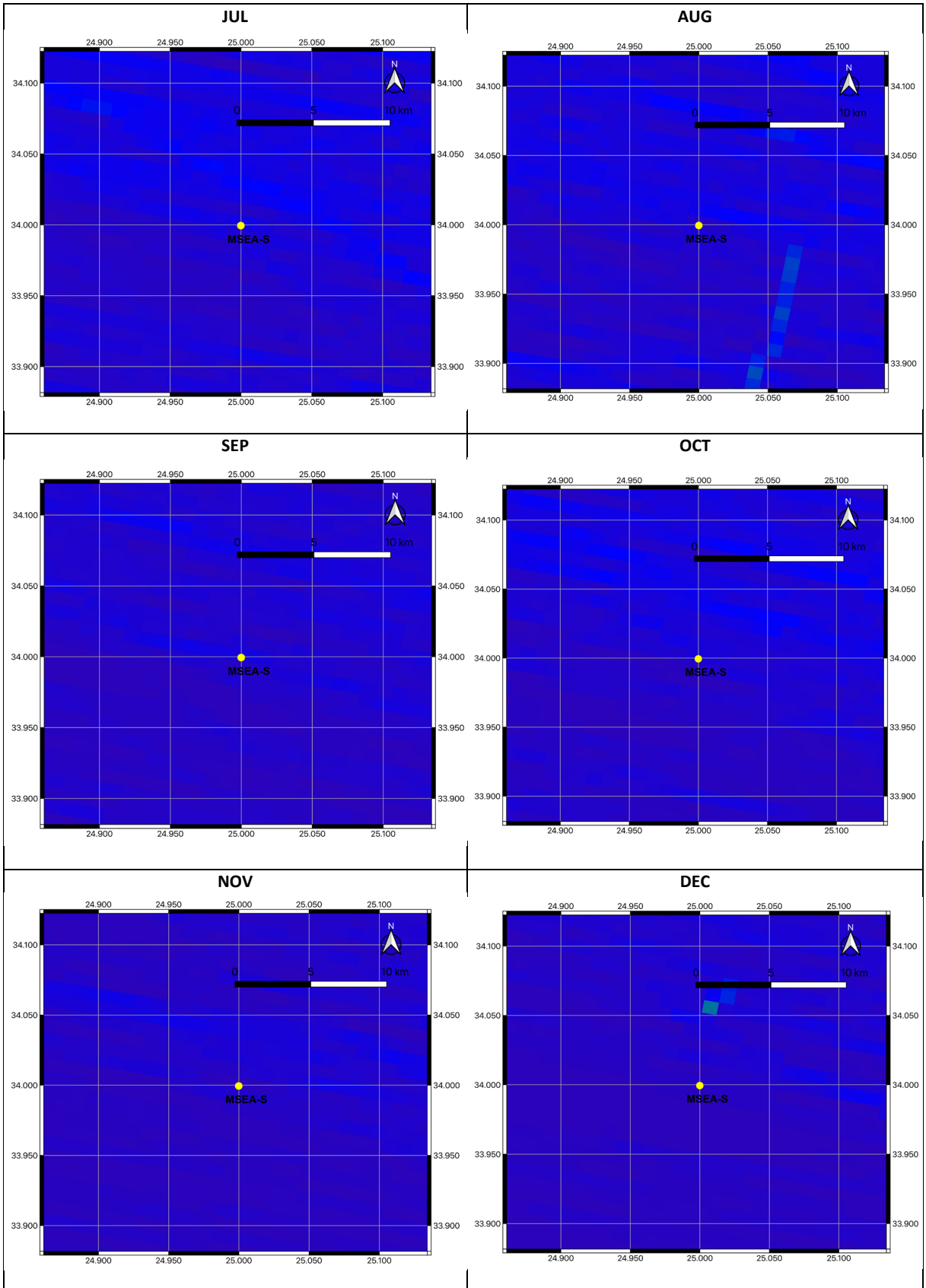
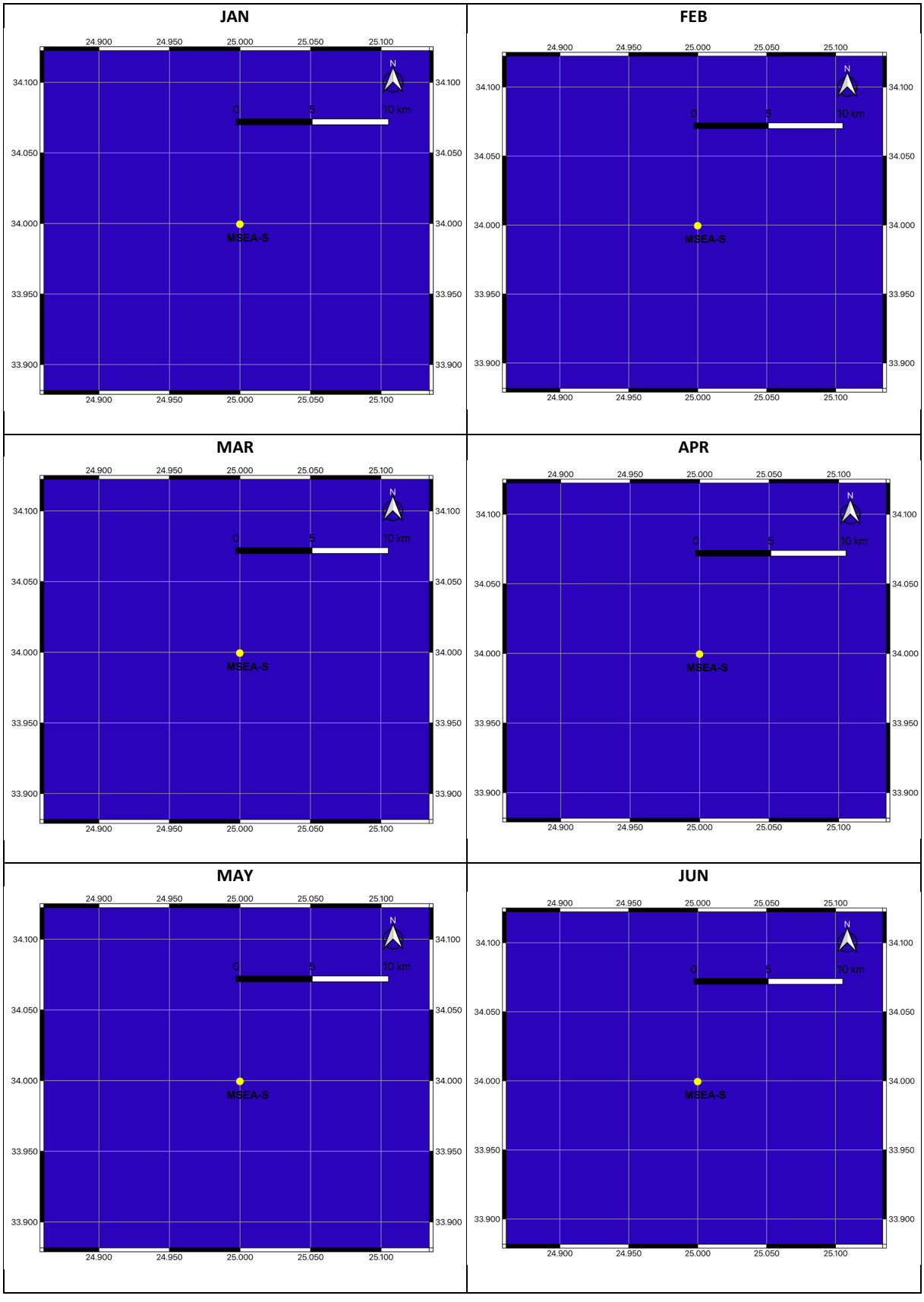


Figure 7. Monthly maps of all nearby shipping routes to the MSEA-S site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 2.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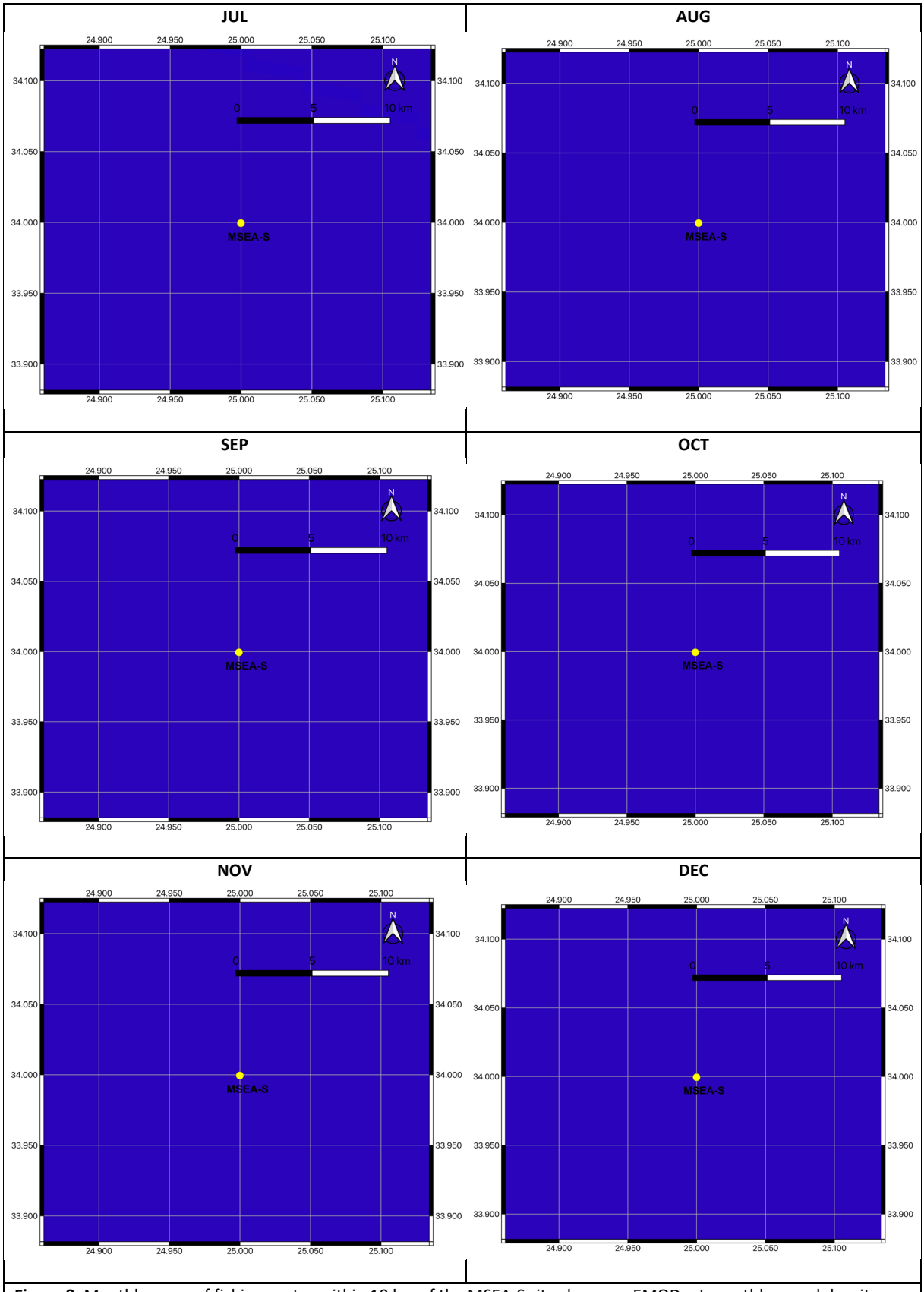
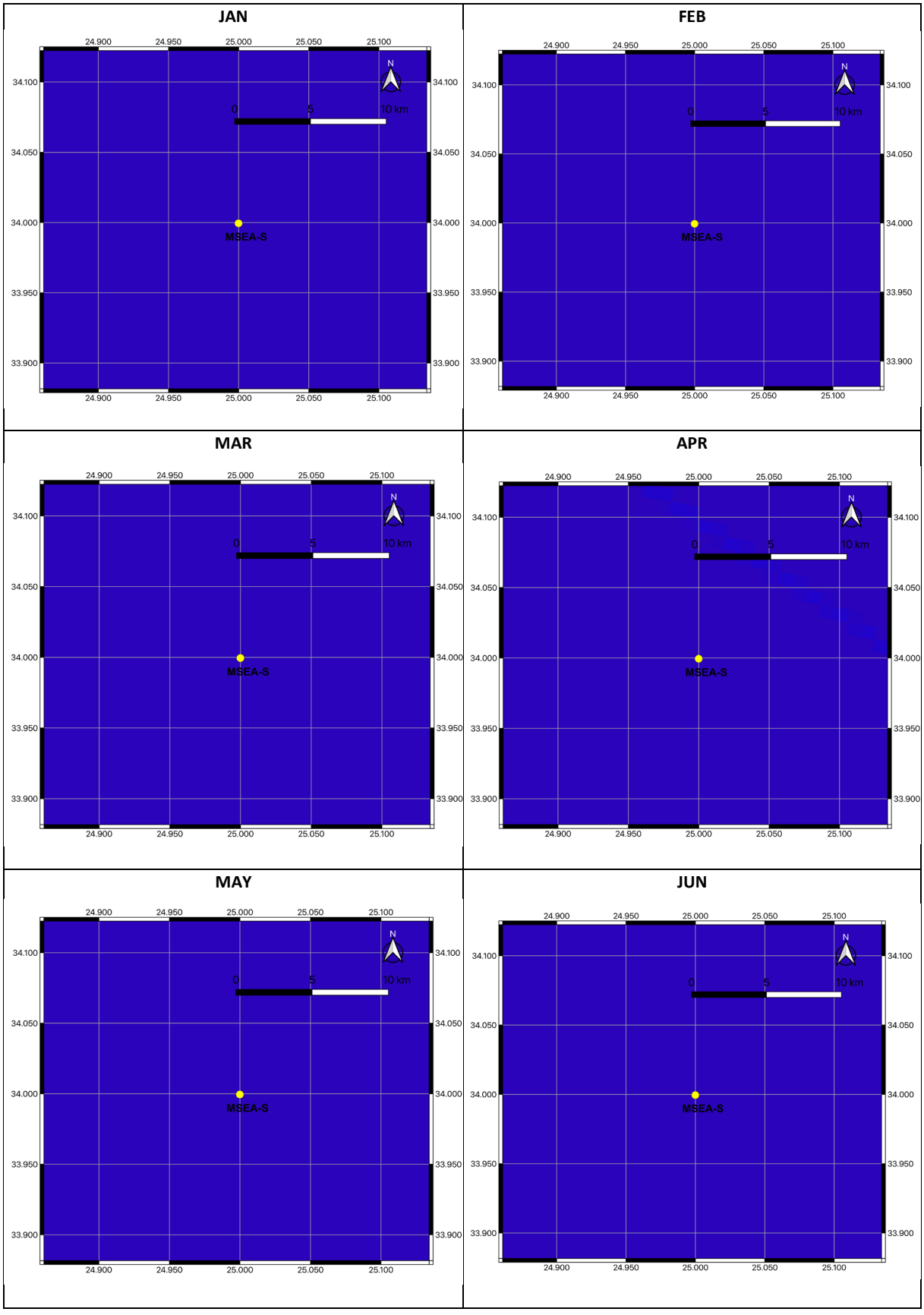


Figure 8. Monthly maps of fishing routes within 10 km of the MSEA-S site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 2.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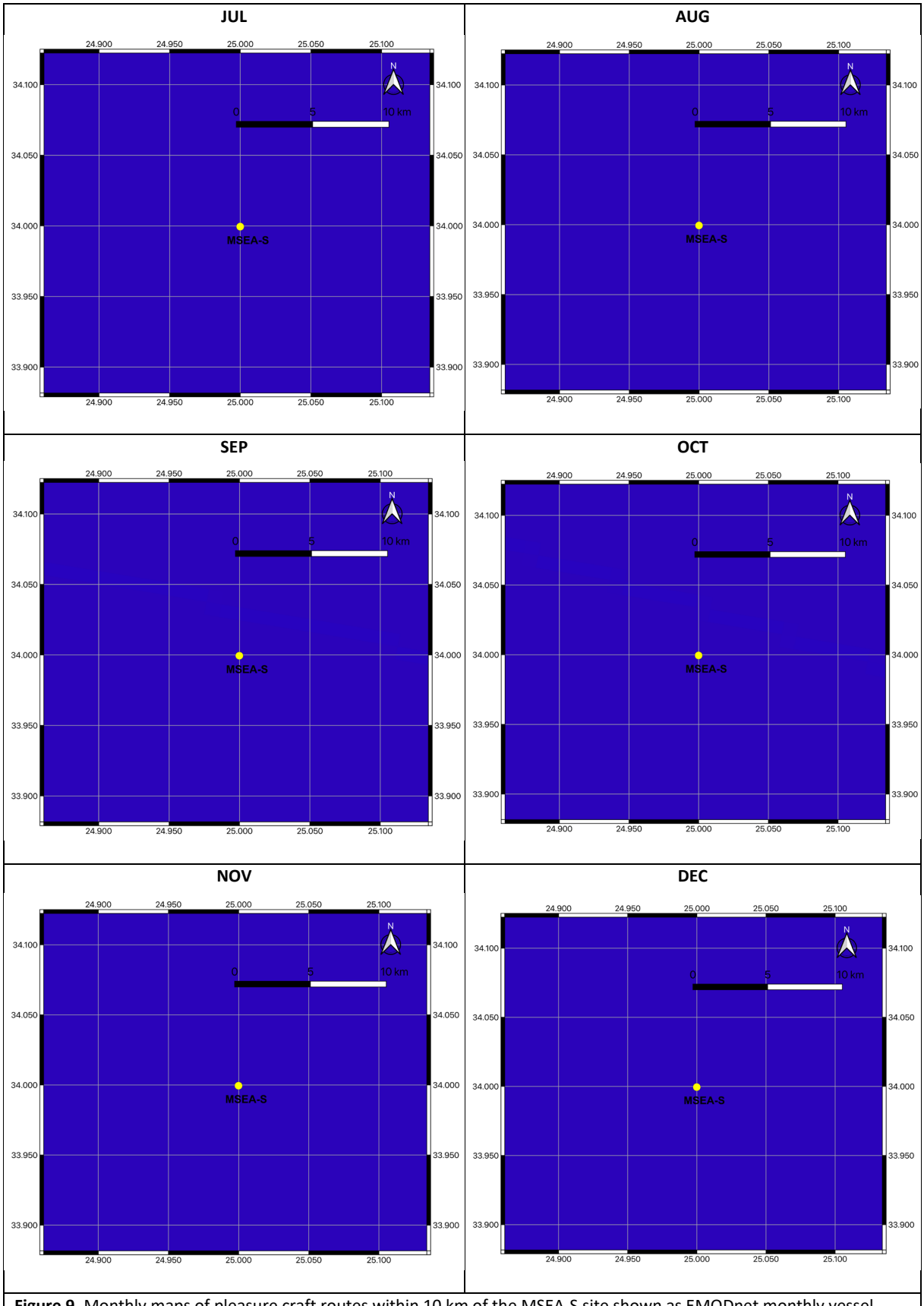
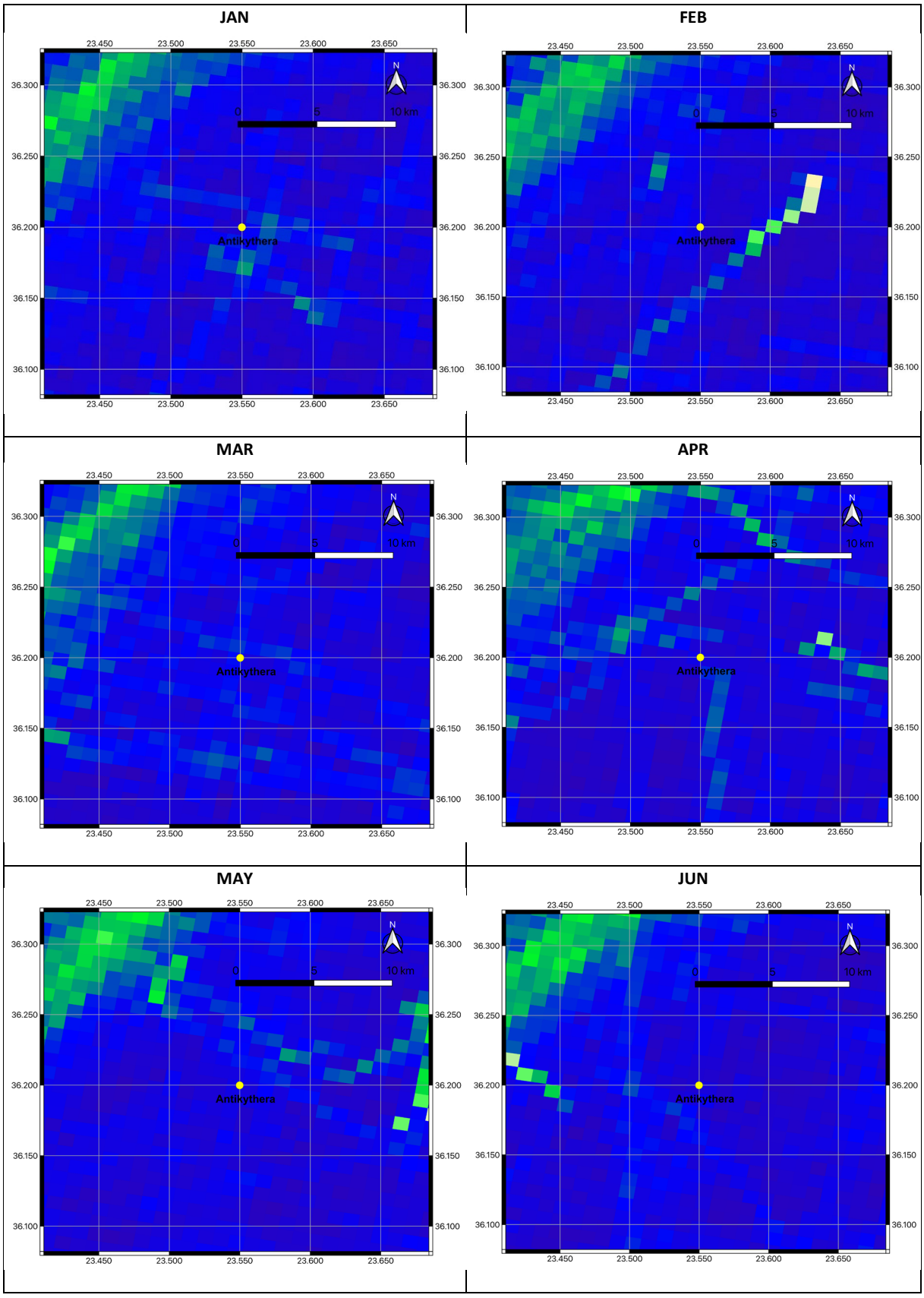


Figure 9. Monthly maps of pleasure craft routes within 10 km of the MSEA-S site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 2.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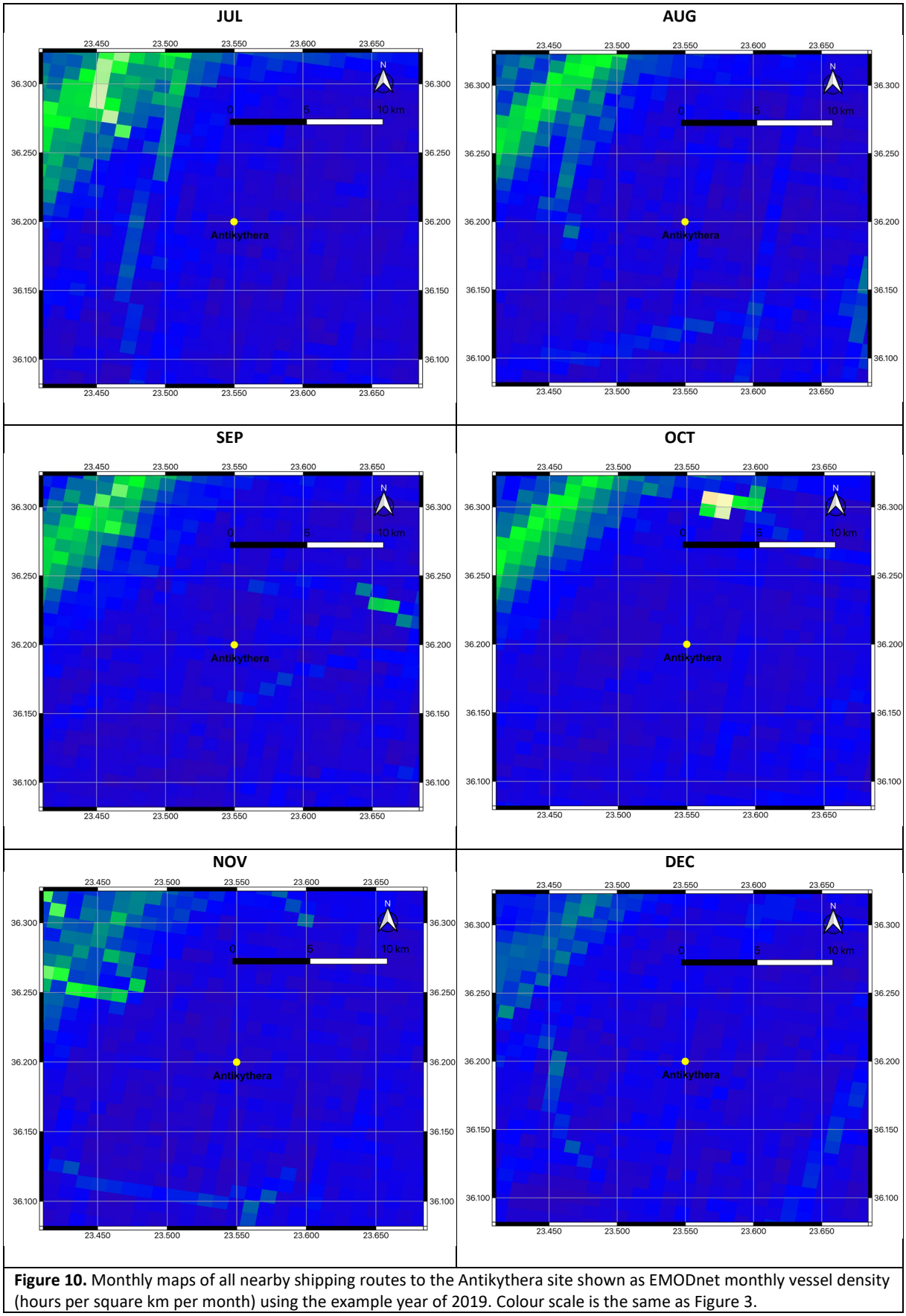
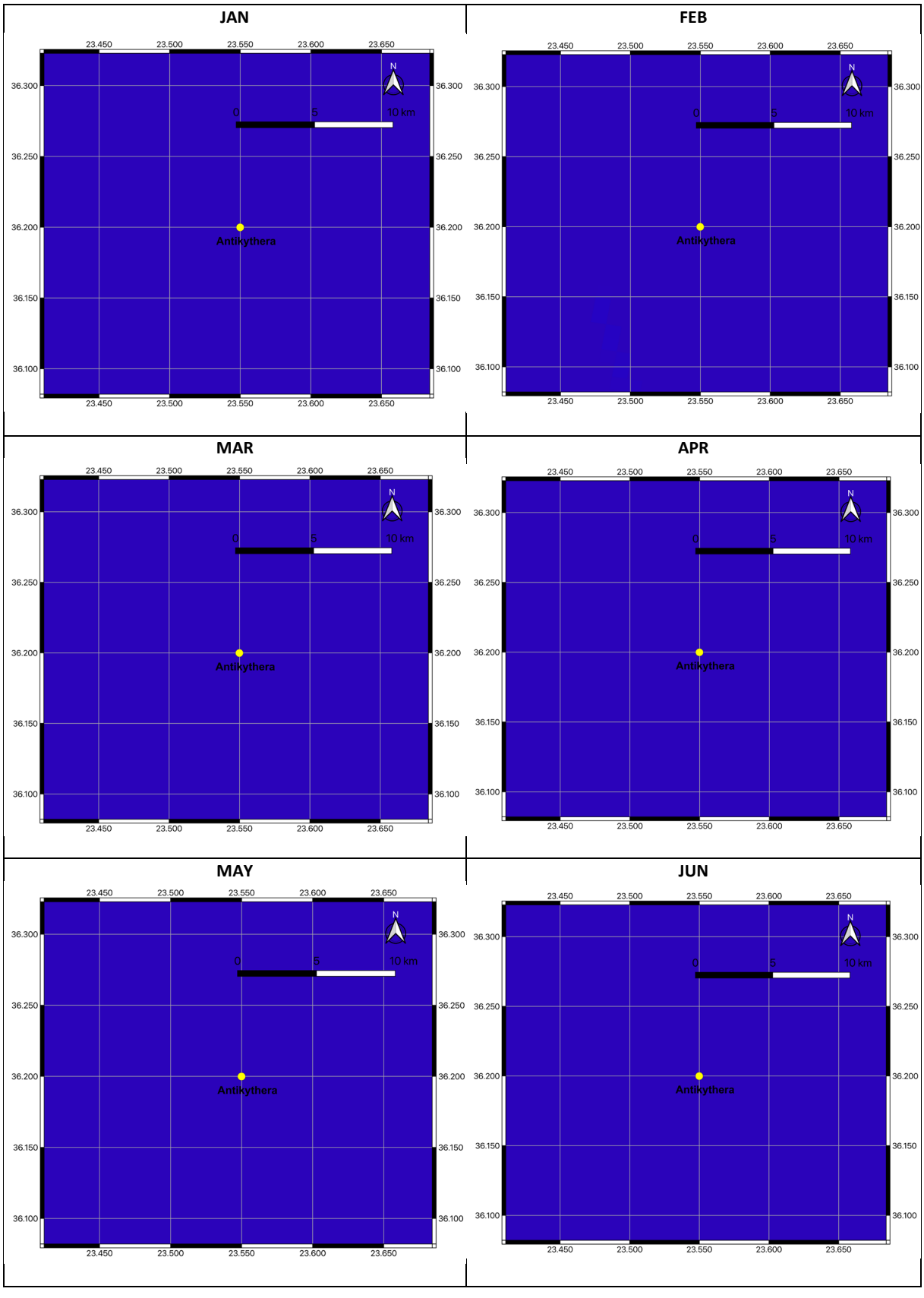


Figure 10. Monthly maps of all nearby shipping routes to the Antikythera site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 3.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Antikythera

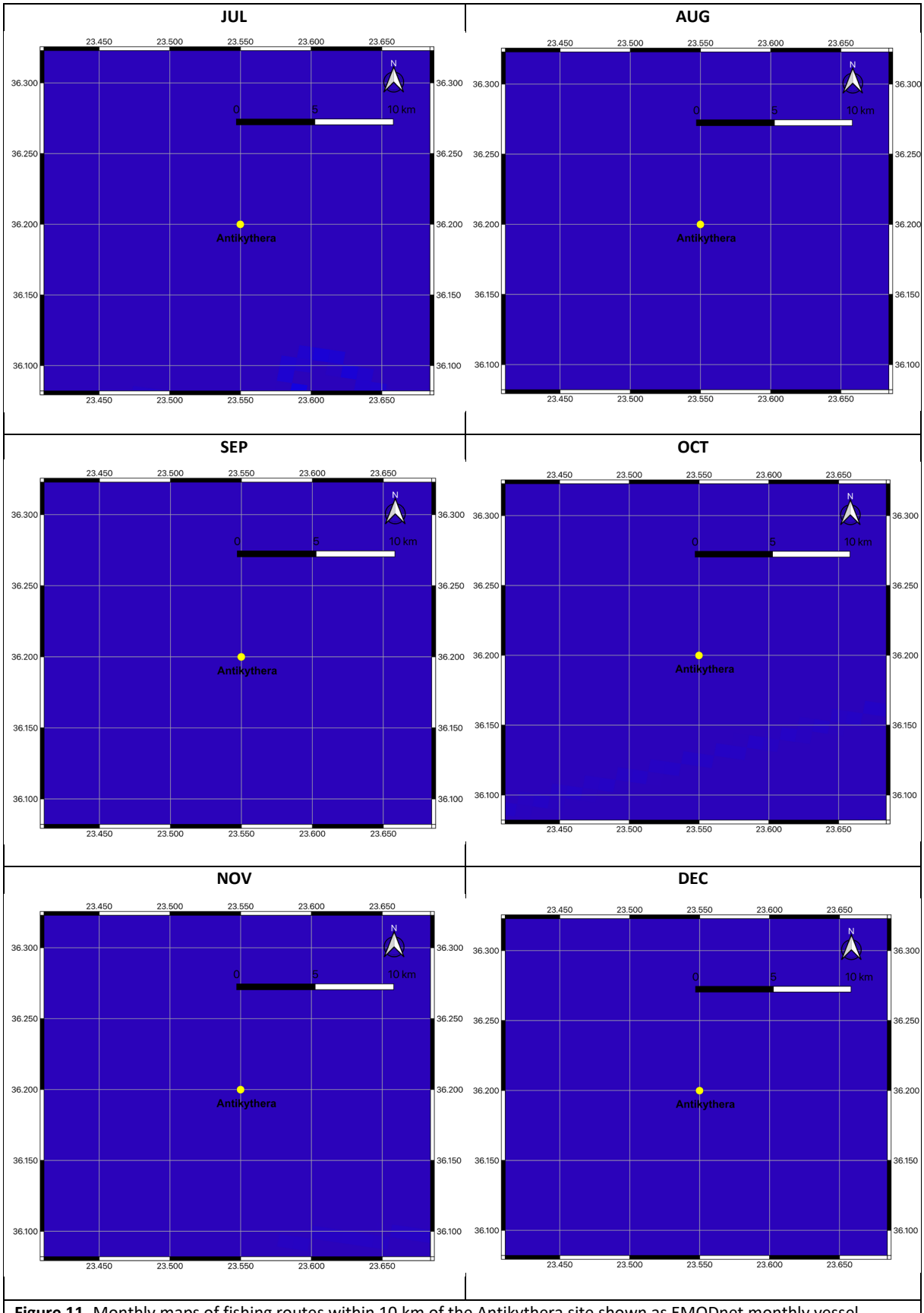
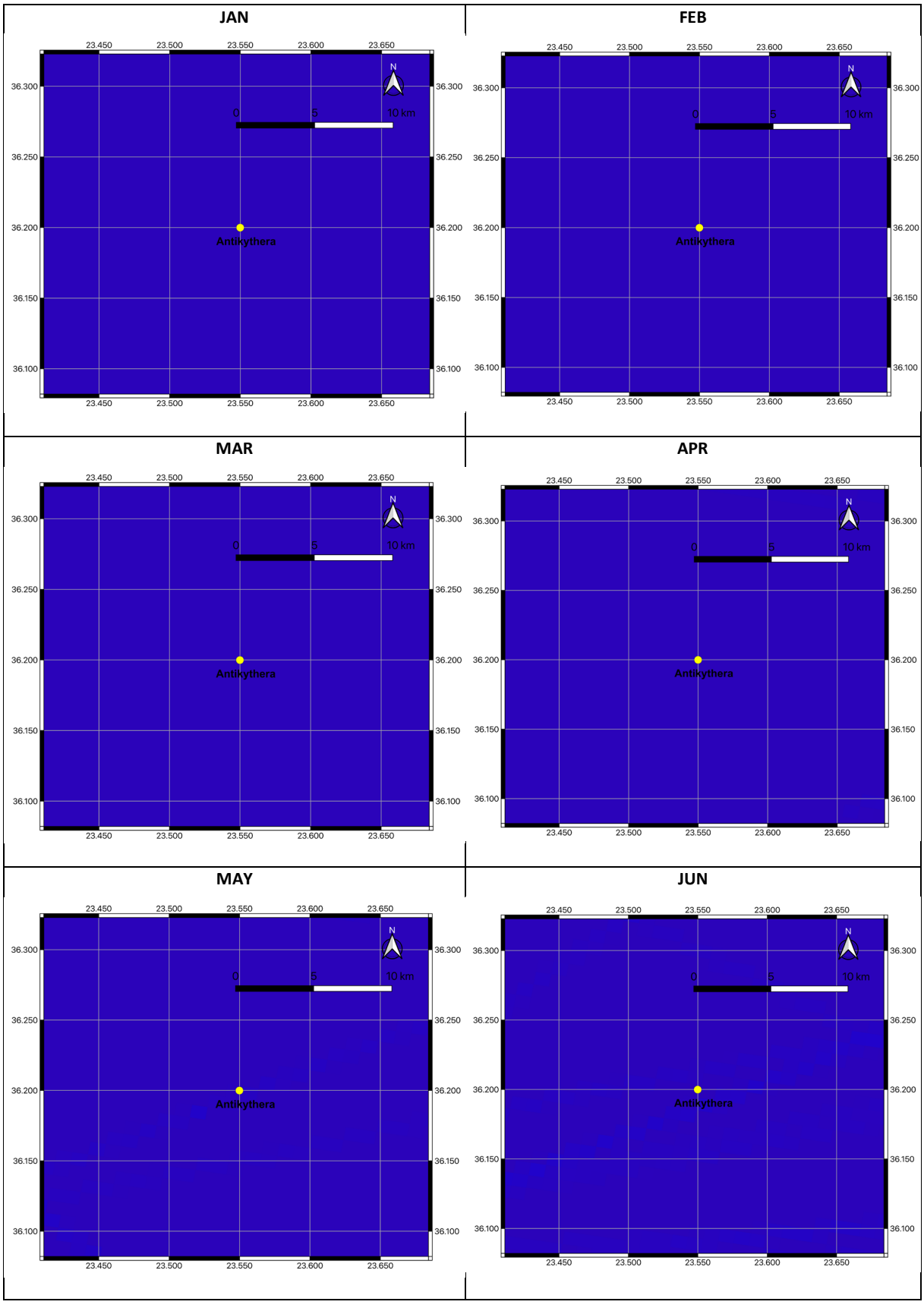


Figure 11. Monthly maps of fishing routes within 10 km of the Antikythera site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 3.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Antikythera

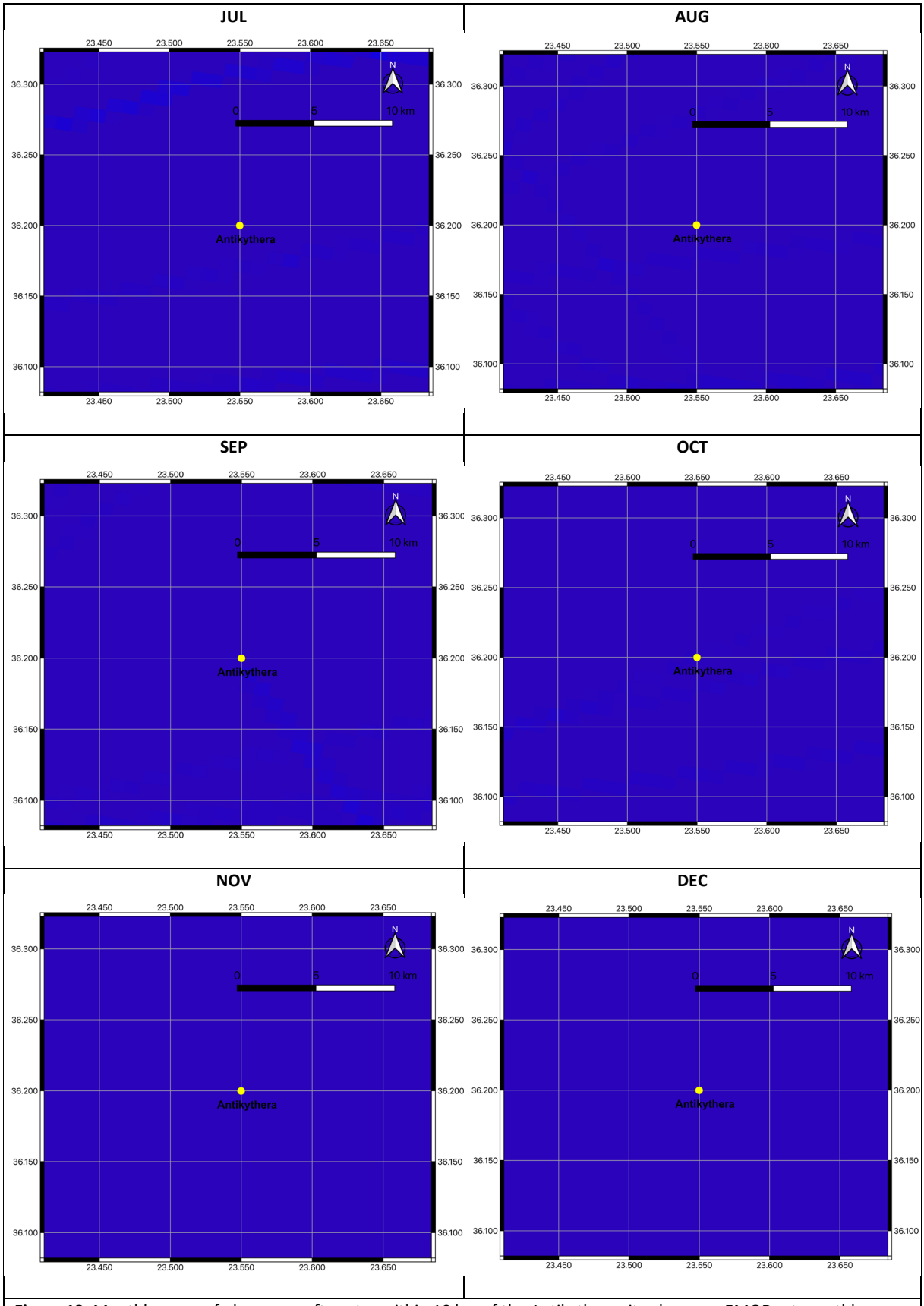

Figure 12. Monthly maps of pleasure craft routes within 10 km of the Antikythera site shown as EMODnet monthly vessel density (hours per square km per month) using the example year of 2019. Colour scale is the same as Figure 2.

The figures above clearly show that there is little to no threat from fishing and tourism activities at any of the three sites, with only occasional incursions into the areas during the year. These represent only a few minutes per square km per month and not in all months. However, with regards to tourism the maps of pleasure craft routes do not represent all touristic activity on the sea, with an increase in ferry traffic (standard and high speed) also occurring during the tourist period in Crete (April to October). This has been corroborated from meetings with the Hellenic coastguard who stated that as far as they know there is little to no fishing or tourist interest or marine traffic at any of the three sites.

This can be clearly seen on the MSEA-N maps of all shipping where the main ferry routes from Heraklion to Piraeus (Athens) and Santorini are more visible on the edges of the maps during this period. Nevertheless, the MSEA-N location, also highlighted by the yearly map (Figure 1), sits in a large quiet area between these ferry routes largely undisturbed by any type of marine traffic.

This is also the case for MSEA-S which is much more remote than the other sites. However, there is a small amount of overall shipping passing close by to the MSEA-S site, as with the MSEA-N site, but in contrast to ferries, this is due to the W-E / E-W passage of commercial tankers and container ships towards and from the Suez canal. Nevertheless, for both sites the level of total shipping traffic is very low and in the order of a few minutes per month within 10km of the actual site point.

The Antikythera site, on the other hand, in terms of total shipping, has slightly more traffic than the other two sites as it sits very close to the Western Aegean N-S / S-N commercial shipping lanes that connect the Mediterranean with the North Aegean and Black Sea. The level of total shipping traffic is in the order of 30 minutes to 2 hours per month close by to the Antikythera site which raises slightly the risk of collision from a tanker or container ship when compared with MSEA-S and MSEA-N where there appears to be minimal risk of such an occurrence. This has certainly been the experience of HCMR at the MSEA-N site where the E1-M3A buoy has existed for more than 20 years without a single shipping collision.

Proposal for a protected and safe site

From meetings and telephone conversations with the local Crete and national headquarters of the Hellenic Coastguard and with the Hellenic Navy Hydrographic Service (HNHS), HCMR has received assurances of the following:

i. When the infrastructure has been approved for one of the Crete sites, HNHS will include the buoy on all digital maps that are released to aid navigation in Greek waters and the Eastern Mediterranean.
ii. HNHS and the Hellenic coastguard will issue a “Stay Away” warning regarding the presence and location of the buoy to all shipping leaving from or arriving at the ports of Crete. There will also be a formal notification to all registered Hellenic maritime organisations including fishing and maritime commercial shipping organisations, as well as all Hellenic ferry companies and sailing organisations.
iii. The above services, which will help a great deal to keep the Copernicus buoy protected and safe, will be provided by the Greek State free of charge / without fees to HCMR as part of the Hellenic public service.

To increase the protection and safety of the buoy at sea some mandatory and recommended physical measures will also be taken. HCMR has decades of experience in this regard through keeping its POSEIDON system’s buoys (including E1-M3A at the MSEA-N location) safe and protected at sea with the same general measures to be implemented for Copernicus OC-SVC. These measures follow the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) regulations and recommendations. Support for these has been given through recent further discussion with the Hellenic Coastguard and some operational maritime companies and subsequently the following are the main measures that HCMR proposes for the on-buoy safety system for the Copernicus OC-SVC buoy:

- The Copernicus OC-SVC buoy must be painted yellow. This is the colour of the "General Purposes Buoy International Code". Additionally, a large yellow X should be attached on the top of the buoy or when this is not possible as high up on the buoy as practical.
- The Copernicus OC-SVC buoy must be equipped with a yellow light beacon, visible from a distance of at least 5 nautical miles. Preferably, this should be an 8 nautical mile + yellow marine light (see below). This light will include an AIS system, GSM and satellite communication for emergencies and a GPS receiver (possibly with geo-fence capabilities).
- A RADAR Reflector should be included as part of the buoy construction. This is not mentioned as mandatory by the maritime authorities but HCMR recommends this as it gives the buoy extra visibility to nearby ships if they have a radar system, which is the case for most commercial and larger vessels.

The painting of the buoy and the inclusion of a radar reflector are straightforward and do not need further detailing here. However, for the yellow light beacon we have investigated a number of different options and detail below our preliminary first choice for this safety equipment. As mentioned it has a GPS, GSM and satellite communication, and the Automated Identification System (AIS) integrated into the lantern that allows it to be visible to the majority of vessels and to communicate with HCMR essential status and location information in the event of an emergency (e.g. weather or shipping related).

Onboard High Intensity Yellow Light Beacon

Manufacturer:	Sealite
Model:	Solar Marine Lantern SL-C510
Function:	High intensity beacon / GPS / GSM and SATCOM / AIS
Enclosure:	Original

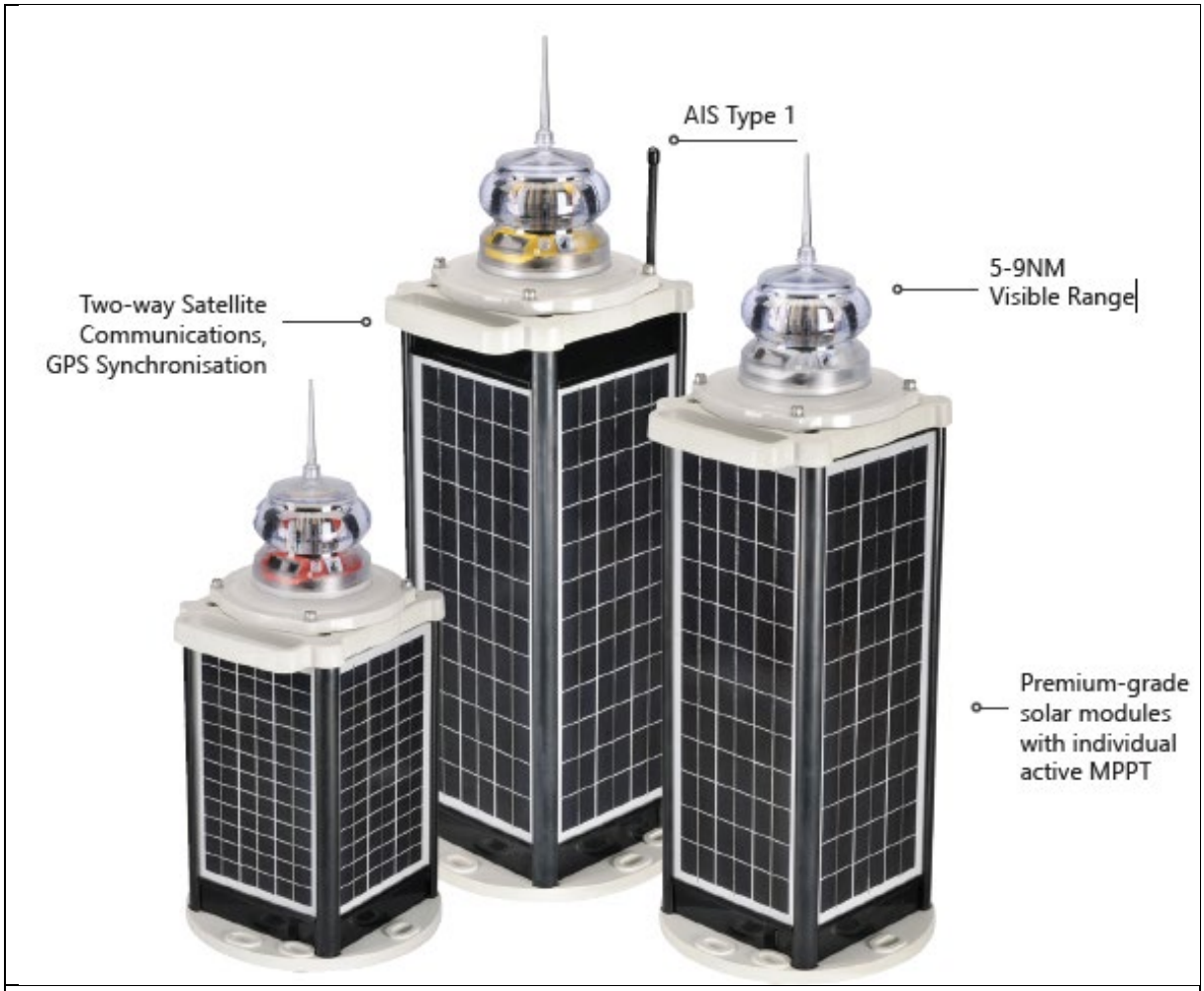

Figure 13. The Sealite SL-C510 Solar Marine Lantern

The SL-C510 lantern range utilise leading technology LEDs for a visible range of 5-9NM. It carries enhanced optics and lenses whose design ensures that vessel operators can clearly see the light from above when passing the buoy. It has beed designed with next generation solar technology including individual active MPPT (maximum power point tracking), maximizing the power extracted from the solar panels for improved performance and efficiency.

It has a conveniently located OLED (Organic Light-Emitting Diode) screen with touchpad that allows maintenance personnel to check the diagnostics of the lantern with the touch of a button. The SL-C510 range is also available with an optional integrated Iridium Satellite module enabling two-way monitoring and control using the Iridium Low Earth Orbit satellite network. The lantern also has the option for integrated, internal AIS Type 1.

Sealite SL-C510 Technical Specifications

Light Characteristics
Light Source LED
Available Colours Red, Green, White, Yellow, Blue
SL-C510-5D Typical Maximum Intensity (cd)† Red - 620, Green - 690, White - 1150, Yellow - 570, Blue - 310
SL-C510-10D Typical Maximum Intensity (cd)† Red - 460, Green - 440, White - 650, Yellow - 320, Blue - 200
Visible Range (NM) AT @ 0.74: 5-9NM
Horizontal Output (degrees) 360
Vertical Divergence (degrees) 5 or >10
Available Flash Characteristics Up to 310 IALA recommended (user adjustable)
Intensity Adjustments Multiple intensity settings
LED Life Expectancy (hours) >100,000
Electrical Characteristics
Current Draw (mA) Refer to Sealite Solar Calculator
Circuit Protection Integrated
Nominal Voltage (V) 12
Autonomy (nights) >110 (14 hour darkness, 12.5% duty cycle)
Solar Characteristics
Solar Module Type Monocrystalline
Output (watts) 20.0 (4 x 5 watt) 33.6 (4 x 8.4 watt) 33.6 (4 x 8.4 watt)
Charging Regulation MPPT
Power Supply
Battery Type Gel SLA
Battery Capacity (Ah) 12 24 24
Physical Characteristics
Body Material Aluminium chassis with UV-stabilised rubber corners & gaskets. Polymer composite-moulded top and base
Lens Material LEXAN Polycarbonate – UV-stabilised
Lens Diameter (mm/inches) 98 / 3 7/8
Lens Design LED Optic
Mounting 3 & 4 hole 200mm bolt pattern
Height (mm/inches) 492 / 19.37 648 / 25.50 660 / 25.98
Width (mm/inches) 234 / 9.05 234 / 9.05 234 / 9.05
Mass (kg/lbs) 9.2 / 20.3 15.2 / 33.5 16.0 / 35.3
Service Life 15 years ^
Environmental Standards
Shock MIL-STD-202G Test Condition H, Method 213B 30G vertical and 35G horizontal shock
Vibration MIL-STD-202G, Test Condition B, Method 204D 5G in all axes
Ice Loading Rated to withstand 22kg/m2
Salt Fog MIL-STD-810F Method 509.4
Rain Test MIL-STD-810F Method 506.4 procedure 1
Wind Exposure Rated to withstand 140 knots
Humidity MIL-STD-810F method 507.4 (0 – 100%, condensing)
Temperature Range -30 to 50 C
Compliance
CE EN61000-6-2:2005, IEC61000-4-2:2008, IEC61000-4-3:2010, IEC61000-6-1:2016
IALA Signal colours compliant to IALA E-200-1
Ingress Protection IP68
Intellectual Property
Trademarks SEALITE is a registered trademark of Sealite Pty Ltd
Warranty * 3 years
Options Available • IR Programmer
• External ON/OFF Switch
• External Battery Charging Port
• Satellite Communications
• 5o, 10o Lens
• AIS Type 1