

EU request to provide a further technical service to aid in the interpretation of ICES advice on locations and likely locations of VMEs in EU waters of the NE Atlantic, and the fishing footprint of 2009–2011 (sr.2018.10)

Service summary

As follow-up technical work to aid in the interpretation of ICES 2018 ([sr.2018.10](#)) advice on locations and likely locations of VMEs in EU waters of the NE Atlantic, and the fishing footprint of 2009–2011, the European Commission (DG MARE) requested ICES to provide further information on seven aspects.

- 1) Since the release of the advice, there has been a (late) submission of Spanish VMS and logbook data from 2009 to 2017. ICES is currently performing the appropriate quality checks on these data and it may be that further work may be required by Spain. ICES is confident that ICES will, in 2019, be able to better describe the overall bottom fishing footprint of 2009–2011 in EU waters of the NE Atlantic.
- 2) Data for Spanish and Portuguese vessels with VMS <15m for 2009–2011 is presented.
- 3) Options to split into a northern and southern regions based on VMS/logbook and VME data coverage are not provided due to lack of quality assurance of the submitted data.
- 4) In addition to the static PDF maps in the ICES Advice (ICES 2018), interactive maps showing the same information are provided with a number of selectable layers to aid in the interpretation of the ICES Advice and implementation process of the deep-sea access regulation.
- 5) A table is presented showing percentage of total c-squares that lie within each of the nine likely VME options (3 quality x 3 confidence levels).
- 6) Two different bathymetry datasets (GEBCO and DTM) are used to describe the 800 m depth contour. In both cases, the resolution is much finer than the c-square resolution of the fisheries footprint dataset and can therefore confidently be used to define the fisheries footprint at the 800 m depth contour.
- 7) Four options are provided to describe the bottom fisheries footprint of the 2018 ICES advice as a uniform area (i.e. avoid “holes” and “islands”). Holes occur where no VMS signal have been received and thus fishing is assumed not to take place. Islands occur when individual or small clusters of c-squares occur where VMS pings have been received intermittently.

Request

On 28 June 2018, ICES provided advice to DG MARE on locations and likely locations of VMEs in EU waters of the NE Atlantic, and the fishing footprint of 2009–2011. DG MARE requests further technical follow-up work, based on the ICES advice, to assist the implementation process of the deep-sea access regulation (EU) 2016/2336. ICES is requested provide the following as a technical service:

1. *Report on the status of the ongoing quality control and re-submission process of Spanish VMS and logbook data to ICES. Spain did not submit VMS and logbook data by the required date in response to the 2018 ICES data call ([link](#)). ICES received a submission of VMS and logbook data from Spain 17 August 2018.*
2. *Report on the information available for vessels <15 m from submitted relevant [Portuguese and Spanish] VMS and logbook data, particularly for the years 2009–2011 and identify if a further data call might improve the ability to map the activity of these fleets.*
3. *Provide 2–3 options for a split of a northern region of EU Atlantic waters that has good VMS/logbook and VME coverage, from a southern region, in which data may be missing and thus is not representative.*
4. *In support of the PDF maps in the ICES advice, ICES is requested to produce an interactive map as electronic outputs with the following selectable layers:*
 - a) *VME habitats*
 - b) *Likely VME with 9 options– 3 quality x 3 confidence*
 - c) *Depth > 800m*
 - d) *800m contour*
 - e) *EEZ*
 - f) *ICES areas*
 - g) *Bottom fishing footprint, 200–400m, 400–800m, and >800m.*

5. Prepare a table showing the percentage of total c-squares that lie within each of the nine likely VME options (3 quality x 3 confidence levels).
6. Provide 2-3 options to describe the 800m contour, within a buffer of confidence.
7. Provide 2-3 options to describe the bottom fisheries footprint (i.e. as a larger polygons, circle, other).

Elaboration on the service

1. Status of the ongoing quality control and re-submission process of Spanish VMS and logbook data to ICES.

ICES received a submission of VMS and logbook data from Spain on 17 August 2018 in response to the ICES VMS/logbook data call covering the years 2009–2017 issued in January 2018 that had a deadline for response by 31 March 2018. The ICES secretariat, together with the chairs of ICES Working Group on Spatial Fisheries Data (WGSFD), quality-checked the submitted data to ensure that data submitted complied with data call specifications. A preliminary analysis of the data submitted by Spain led to the identification of a number of issues that required resubmission of revised data. The ICES secretariat received a revised data submission on 8 November 2018 and is currently quality-checking the new dataset.

Assuming this quality-checking is successful, ICES is confident that ICES will, in 2019, be able to better describe the overall bottom fishing footprint of 2009–2011 in EU waters of the NE Atlantic. ICES would require a specific request if such descriptions are to be given.

2. Information available for vessels <15 m from submitted Portuguese and Spanish VMS and logbook data, particularly for the years 2009-2011 and identify if a further data call might improve the ability to map the activity of these fleets.

The number of c-squares with fishing activity (number of records) for Spanish and Portuguese vessels below 15m for the reference period 2009–2011 is not complete (table 2 and figure 1). No VMS and logbook data have been submitted for <15 m Spanish vessels for 2010. The vessel monitoring system (VMS) is compulsory for EU vessels above 15 m and for vessels above 12 m as from 1 January 2012. Hence, a further data call will not improve the knowledge of the activity of fleets below 15m.

Table 2. Summary of number of c-squares with fishing activity (number of records) of Spanish and Portuguese VMS and logbook data for 2009–2011 for vessels >15m and <15m.

| Vessel length | Number of records per year | | | | | |
|---------------|----------------------------|---|--------|----------|-------|--------|
| | Spain | | | Portugal | | |
| < 15 m | 177 | 0 | 31 | 0 | 77 | 52 |
| > = 15m | 576782 | 0 | 635957 | 13214 | 12518 | 635957 |

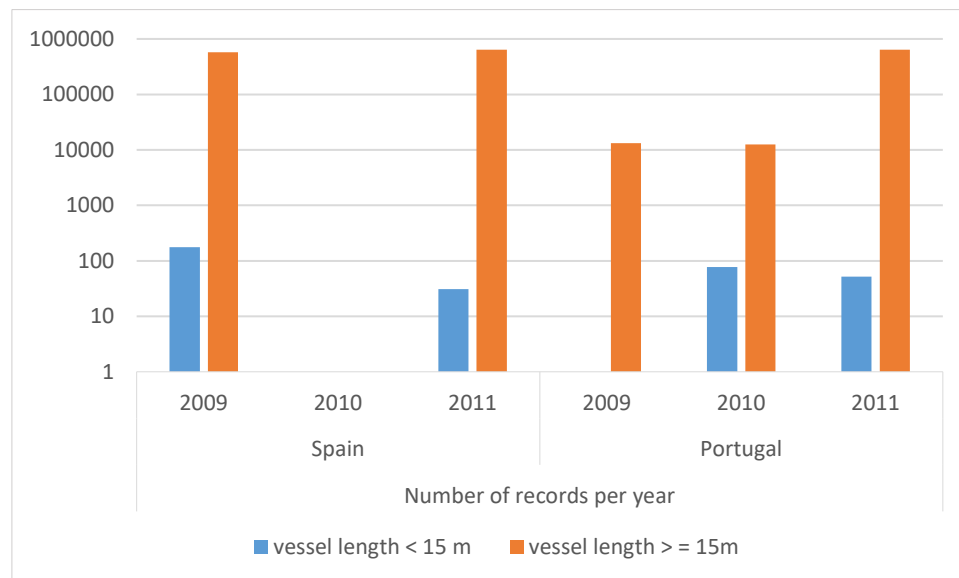


Figure 1. The number of c-squares with fishing activity (number of records) for Spanish and Portuguese vessels carrying VMS that are either >15m or <15m during each the three years of reference period 2009–2011.

3. Options for a split of a northern region of EU Atlantic waters that has good VMS/logbook and VME coverage, from a southern region, in which data may be missing and thus is not representative.

ICES Secretariat is currently not in a position to provide maps to illustrate options for this split. The relevant VMS and logbook data are being quality checked at the moment. A quality assured precise analysis requires additional time, and greater confidence in the data received.

4. Interactive map as electronic outputs In support of the PDF maps in the ICES advice with the following selectable layers: a) VME habitats, b) Likely VME with 9 options- 3 quality x 3 confidence, c) Depth > 800m, d) 800m contour, e) EEZ, f) ICES areas and g) Bottom fishing footprint, 200-400m, 400-800m, and >800m.

In addition to the static PDF maps in the ICES Advice (ICES 2018), ICES has developed interactive maps showing the same information with the selectable layers as requested (Flanders Marine Institute, 2018). These maps are a working tool for the European Commission and are not publicly available at the moment.

5. The percentage of total c-squares that lie within each of the nine likely VME options (3 quality x 3 confidence levels).

The ICES VME database contains >40 000 VME records (a combination of VME indicator and VME habitat records, ICES 2018a). C-squares ($0.05^\circ \times 0.05^\circ$) containing VME records can be classified according to different quality and confidence levels (Table 1).

Table 1. Percentage (%) of all c-squares (1403) allocated a VME index that lie within each of the nine likely VME options (3 quality x 3 confidence levels).

| | High Confidence | Medium Confidence | Low Confidence |
|----------------|-----------------|-------------------|----------------|
| High quality | 0.2% | 14.2% | 8.2% |
| Medium Quality | 0.1% | 12.7% | 19.7% |
| Low Quality | 0.6% | 30.2% | 14% |

6. Options to describe the 800m contour, within a buffer of confidence.

Two options can be provided to describe the 800 m depth contour from two different datasets depending on the resolution required.

Option 1) For the ICES advice in June 2018, the 800 m depth contour was based on the General Bathymetric Charts of the Ocean (GEBCO) dataset from 2014. This is a continuous terrain model at 30 arc second resolution (approximately 900m resolution at 50N). The GEBCO dataset has been created by assigning depth values to raster grid cells based on actual and predicted depths. Its resolution is much finer than the c-square resolution of the fisheries footprint dataset (0.05 x 0.05 degrees, approximately 5.5 km x 2.7 km at 60N) and it can therefore be used to 'cut' the fisheries footprint at the 800 m depth contour. To do this, a contour line is created from the GEBCO dataset by selecting only those raster cells that have a value of 800 m or less (see blue line, figure 2).

Option 2) A higher resolution depth dataset is also available via the EMODnet bathymetry Digital Terrain Model (DTM) at 3.75 arc second resolution (c115m resolution at 50N) from 2018. This has been created using bathymetric survey datasets, composite DTMs and Satellite Derived Bathymetry (SDB) data products. Gaps with no data coverage are completed by integrating the GEBCO Digital Bathymetry dataset. The accuracy and precision of the gridded data will vary over different sea basins depending on the data available for the model. However, this offers the highest resolution dataset available to define the 800 m depth contour. Again, a contour line would be created from the EMODnet dataset by selecting only those raster cells that have a value of 800 m or less (see red line, figure 2).

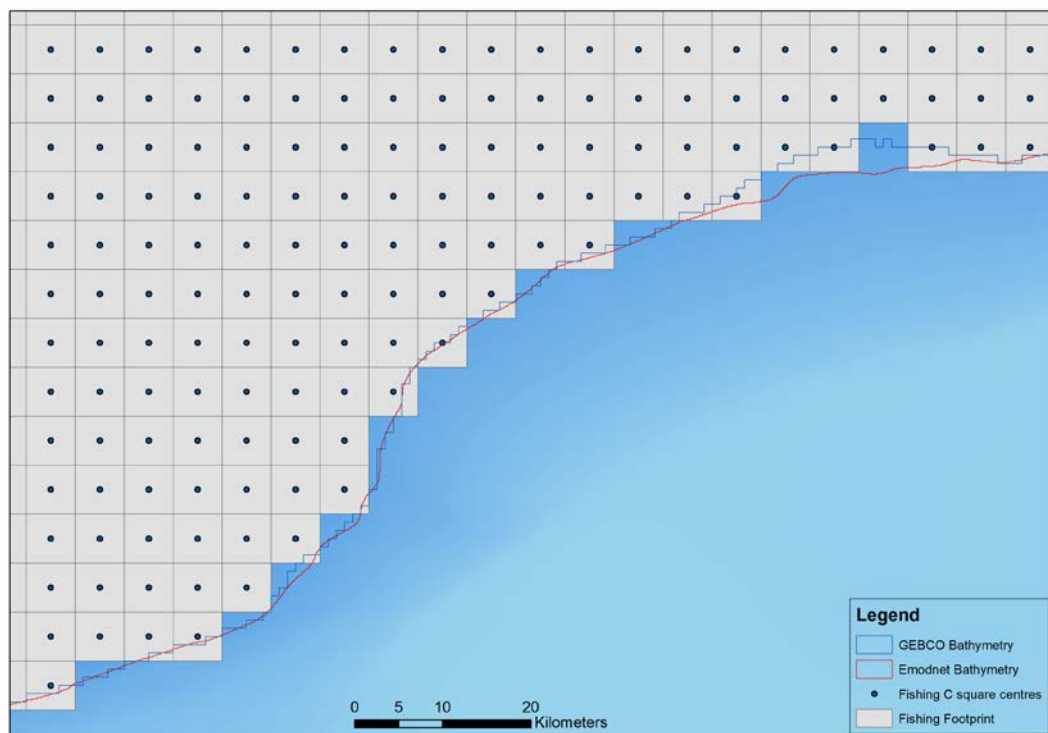


Figure 2. Illustration of the difference in resolution between the c-square fishing footprint (grey grid squares), GEBCO 0.008 x 0.008 degree depth data (blue line) and EMODnet 0.001 x 0.001 degree depth data (red line).

The bathymetry lines in figure 2 also show that the GEBCO and EMODnet depth datasets have some variation in the precise positioning of where the 800 m depth contour lies. This may simply be due to differences in quality of actual and predicted data used to create both of the datasets, or may be a result of more up to date data being used to create the 2018 EMODnet dataset vs the older 2014 GEBCO dataset. After the dataset is chosen, the contour can be smoothed to a curved line. This could be done with different levels of tolerance in a similar way that to the option 3 for the fisheries footprint (See figure 6). Higher tolerance means that the smoothed line will be more smooth but less accurate. However, the resolution of both of the bathymetry datasets are much higher than the one of the c-squares and as a result the potential loss of information during the smoothing process is negligible.

7. Options to describe the bottom fisheries footprint.

Due to the nature of the spatial fisheries data being mapped at a c-square resolution (0.05 x 0.05 degrees), there are difficulties describing the bottom fisheries footprint for different depth bands. For example, to select c-squares where bottom fishing is occurring > 800 m, a bathymetric dataset such as GEBCO or EMODnet can be used to identify the 800 m depth contour. However, inevitably some c-square grid cells are cut by the contour line and parts of the grid square that is cut may thus be mis-classified (see Figure 2). Furthermore, 'holes' in the footprint occur where VMS pings have not been received and thus fishing is assumed not to take place, and individual or small clusters of c-squares ('islands') occur where VMS pings have been received intermittently (see example areas circled in white, Figure 3). It is possible that some of these 'islands' relate to vessel transiting rather than fishing, and some of these holes may relate to areas closed to fishing already.

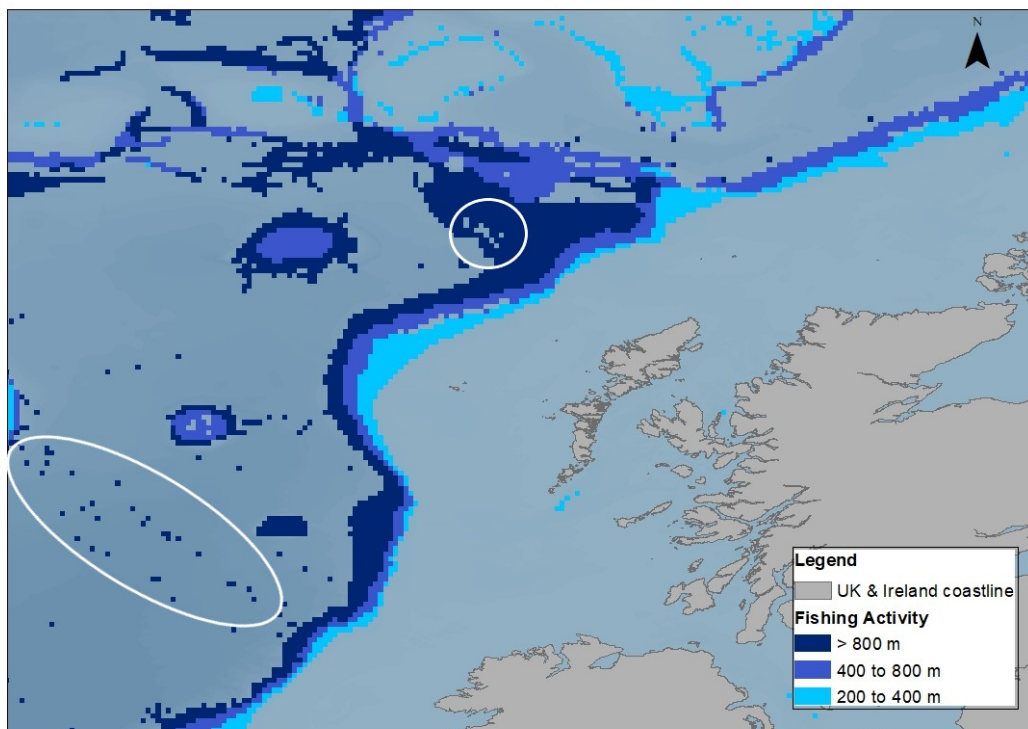


Figure 3 Fisheries footprint for waters north of west of the UK and of Ireland, showing fishing activity at 200–400; 400–800, and >800 m depths. Areas circled in white illustrate where 'holes' in the footprint occur due to no VMS ping data, and 'islands' of grid cells due to intermittent VMS pings.

Four options are provided to describe the bottom fisheries footprint, using the > 800 m depth band as an example.

Option 1) This option was provided during the ICES advice in June 2018. The fisheries footprint > 800 m is extracted using an 800 m depth contour created from the GEBCO or EMODnet bathymetry. C-squares that occur in areas ≥ 800 m depth are displayed as the fishing activity footprint (Figure 4).

- **Benefits:** This is the most simplistic option. All c-squares that occur at or deeper than the 800 m depth contour are included.
- **Limitations:** The VMS c-squares that overlap with the 800 m depth contour will be maintained in full, so some c-squares may be overlapping into areas slightly shallower than 800 m. 'Holes' and 'islands' will remain.

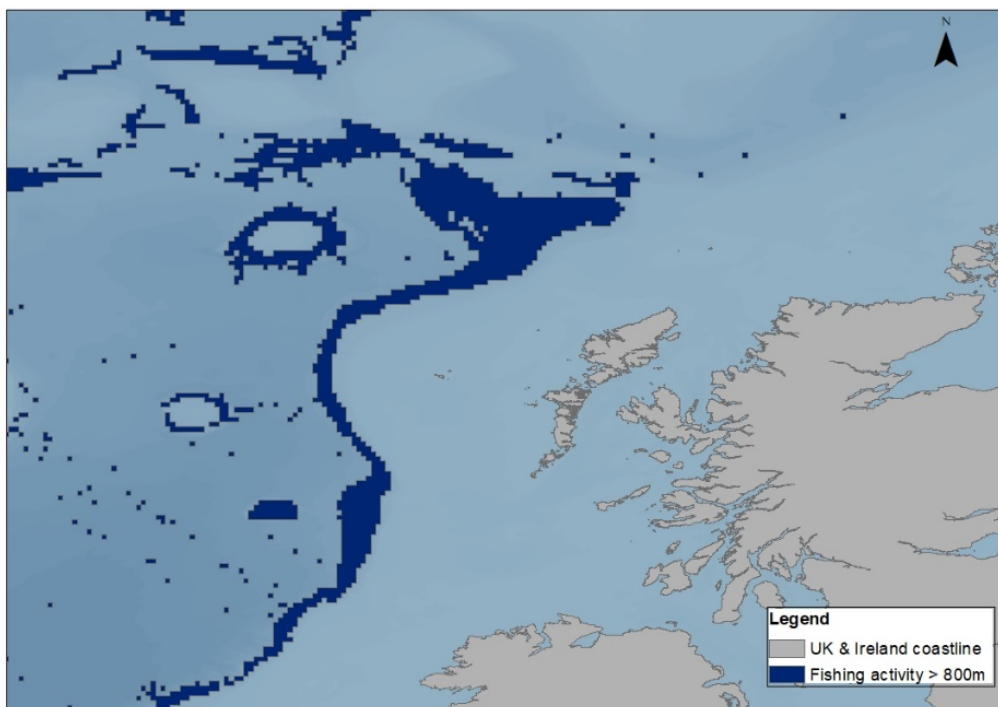


Figure 4 Option 1 showing the bottom fishing footprint for the North-West Approaches of the UK at ≥ 800 m depths based on c-squares occurring at or deeper than the 800 m depth contour.

Option 2) This option is similar to option 1, with the fisheries footprint > 800 m extracted using an 800 m depth contour created from the GEBCO or EMODnet bathymetry. To ensure c-squares do not overlap into areas slightly shallower than 800 m, the c-square can further be 'cut' using the 800 m contour line (Figure 5).

- **Benefits:** All c-squares that occur at or deeper than the 800 m depth contour are included, and no c-squares overlap into shallower areas.
- **Limitations:** The 'cut' of the data is reliant on confidence in the GEBCO or EMODnet datasets. Slight differences in the location of the 800 m contour line between these two datasets does occur, as described in the answer to Question 6 above. The contour will not be a completely 'smooth line' due to the underlying depth data being based on a gridded raster. 'Holes' and 'islands' will remain.

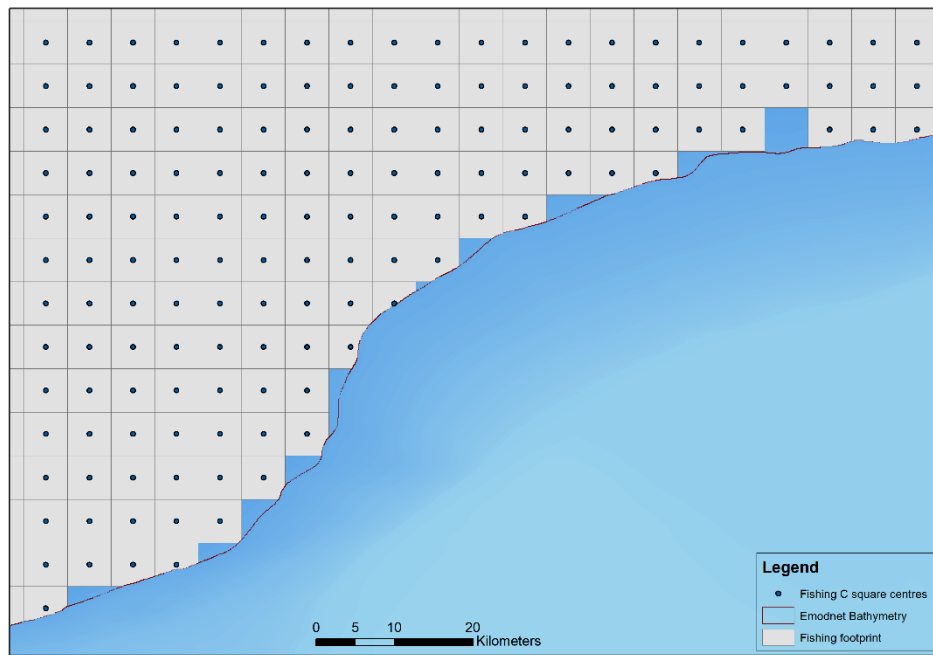


Figure 5 Option 2 showing how the fisheries footprint (grey grid cells) could be 'cut' using an 800 m depth contour created from the EMODnet bathymetry data.

Option 3) To further refine the fisheries footprint at the 800 m depth contour, c-square grid cells selected as occurring at or deeper than 800 m (following option 1) can be 'smoothed' using a smoothing tolerance function, the level of which can be adjusted as required (Figure 6).

- **Benefits:** This creates a more streamlined version of the fisheries footprint with no grid cell edges.
- **Limitations:** The smoothing is linked to the vertices of the underlying fishing footprint c-square data rather than an 800 m depth contour, which means the smoothed line could still occur shallower than 800 m if a grid cell overlaps that boundary. The location of the smoothed line will also vary depending on the tolerance level chosen (see Figure 5). Lower tolerance levels will produce more detailed results, but the processing time is higher and this will result in more coordinates for the layer due to the number of vertices created during the smoothing process. 'Holes' and 'islands' will remain.

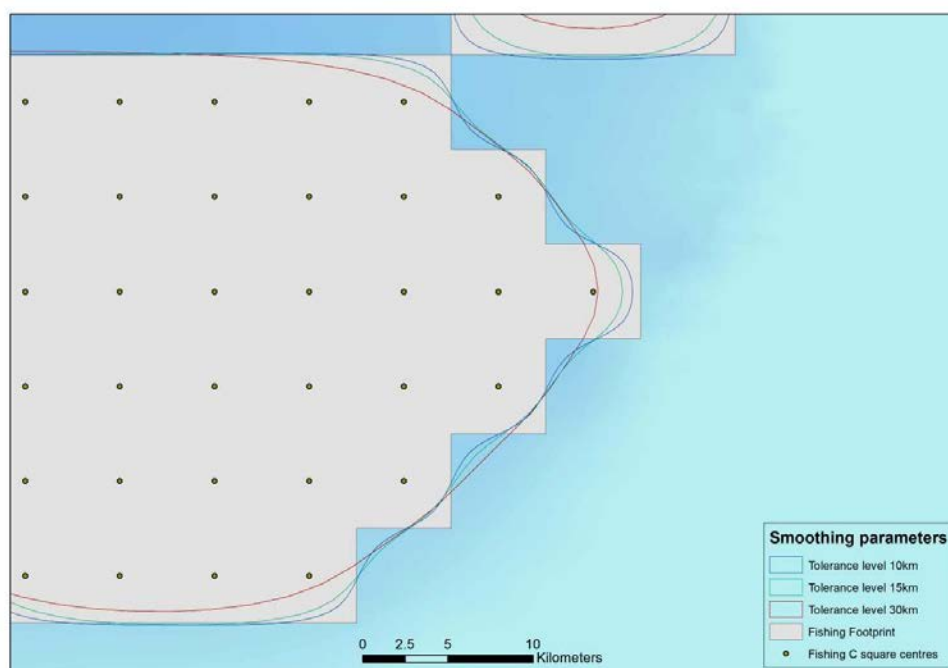


Figure 6 The 800 m fishing footprint with 'smoothed' edges shown at 3 different tolerance levels: 10km, 15km and 30km.

Option 4) It is possible to streamline the fisheries footprint, using a 'hotspot analysis'¹ which calculates areas of high, low or no significance in terms of fishing effort (numbers of VMS pings at fishing speeds per c-square) from the VMS data. This analysis considers each c-square's effort value within the context of neighbouring c-squares, and identifies areas where high or low fishing effort is clustered spatially and thus 'significant' at different confidence intervals. 'Hot spots' are a result of clusters of high fishing effort, and 'cold spots', low fishing effort. Cells recorded as 'not significant' indicate areas where effort is not clustered spatially, and thus unlikely to be a significant hot or cold spot (Figure 7).

- **Benefits:** This option would reduce the number of individual or small clusters ('islands') of grid cells in the fisheries footprint layer and highlights areas which are potentially not fished at a consistent level of effort, as many of these areas are found to be 'not significant' in the analysis, as shown in Figure 7. Figure 8 illustrates which areas of the fisheries footprint could be removed based on this approach (see example areas circled in black).
- **Limitations:** The analysis works on spatial clusters of data, and therefore the removal of cells considered 'not significant' does not necessarily mean the effort value for those cells is insignificant, simply that spatial clustering of high or low effort does not occur there, although it is possible to adjust this to give more weight to effort rather than the spatial dependency. This analysis does not remove 'holes' in the fishing footprint, as these areas have no VMS pings and thus no fishing effort data. Furthermore, the final footprint would remain at c-square resolution, unless it was 'cut' using option 2 or 3 above.

¹ Further information on this analytical method can be found at <http://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-hot-spot-analysis-getis-ord-gi-spatial-stati.htm>

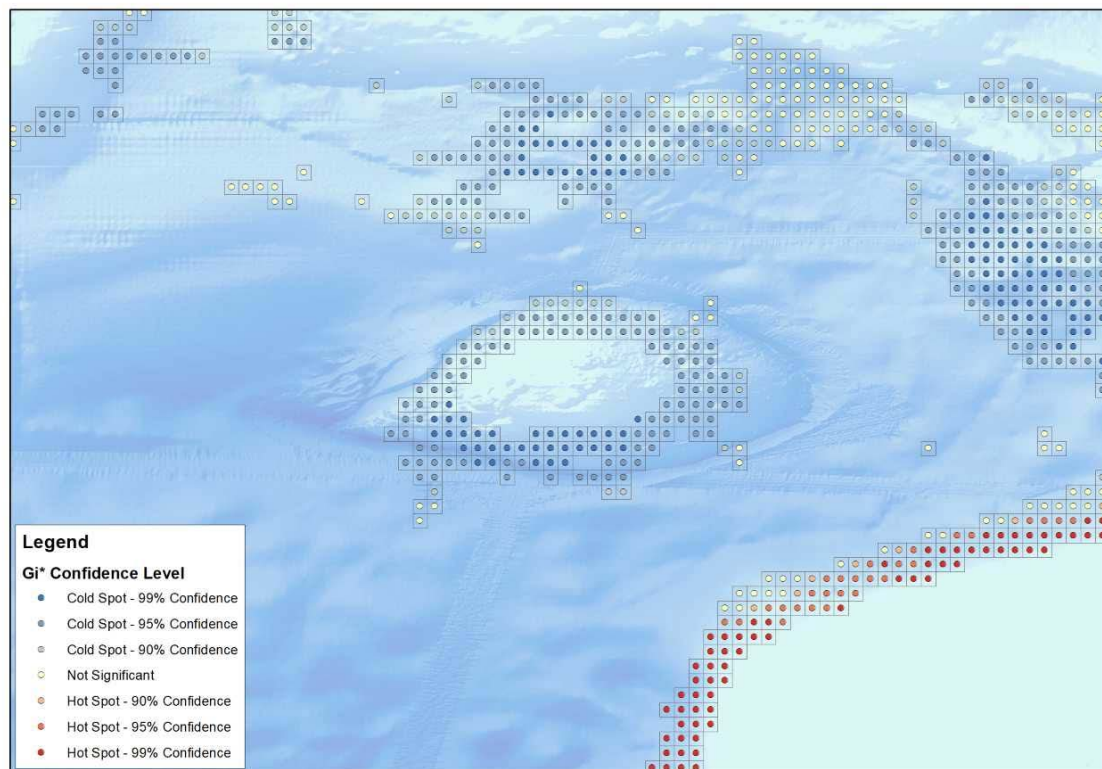


Figure 7 Hotspot analysis showing the fishing footprint (grey c-square grid cells) and the associated cold, not significant, and hot spots at 3 confidence intervals, based on fishing effort. Points represent the centroid of each grid square.

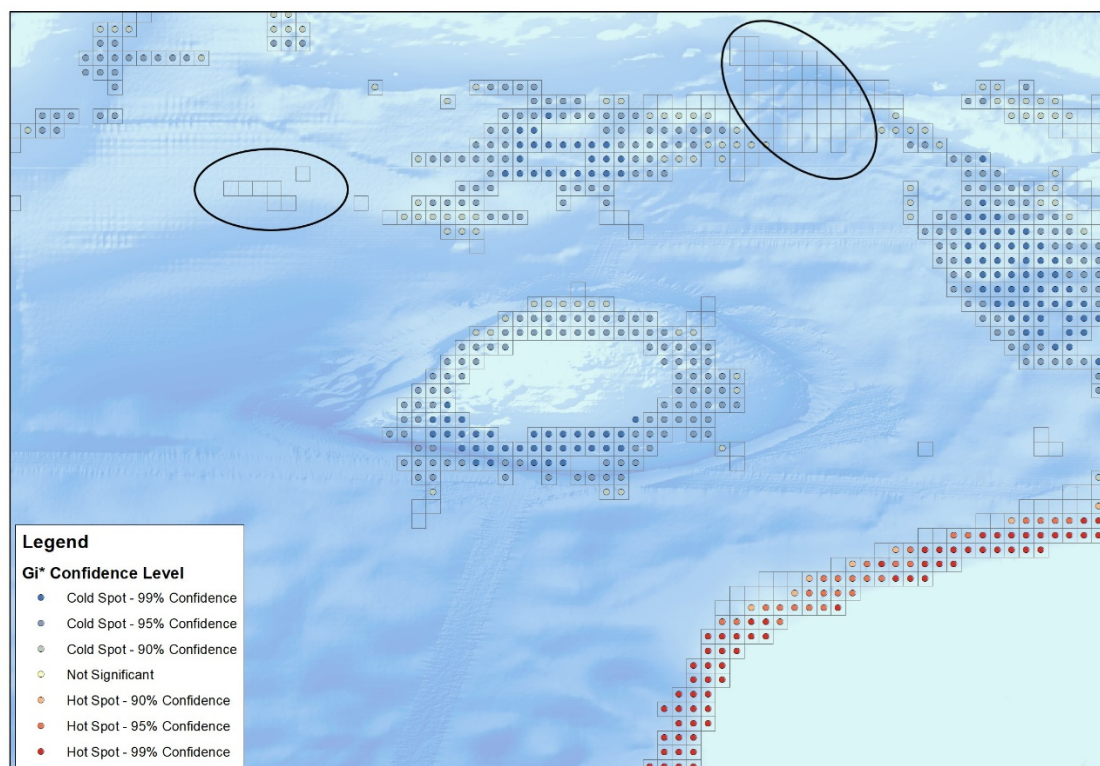


Figure 8 Hotspot analysis showing the fishing footprint (grey c-square grid cells) for cold and hot spots only. Empty grid cells (examples circled in black) represent areas where the fishing footprint could be minimised due to being considered 'not significant' in the analysis.

Basis of the service

Background

This technical service complements previous advice to the European Commission to establish a fishing footprint for deep-sea fisheries and helps fulfil a requirement under the European Union's deep-sea access regulation (EU 2016/2336) for deep sea fisheries (Article 7). Fishing with bottom trawls is prohibited at depths deeper than 800 m (Article 8), so these areas within the fishing footprint are also identified. Article 9 of the same Regulation requires the establishment of a list of areas where VMEs occur or are likely to occur. In the earlier advice, ICES provides maps of VMEs that occur in European Union waters of the North Sea and the Atlantic. ICES is aware of some VMEs missing from these maps but does not have access at present to the information on these sites.

Terms of use

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Sources and references

European Parliament and Council, 2016. Regulation (EU) 2016/2336 of the European Parliament and of the Council of 14 December 2016 establishing specific conditions for fishing for deep-sea stocks in the north-east Atlantic and provisions for fishing in international waters of the north-east Atlantic and repealing Council Regulation (EC) No 2347/2002. 19 pp.

FAO. 2009. International guidelines for the management of deep-sea fisheries in the high seas. Food and Agriculture Organization of the United Nations, Rome. 73 pp.

Flanders Marine Institute (2018). Maritime Boundaries Geodatabase, version 10. Available online at <http://www.marineregions.org/>.

ICES. 2017. EU request on indicators of the pressure and impact of bottom-contacting fishing gear on the seabed, and of trade-offs in the catch and the value of landings. In Report of the ICES Advisory Committee, 2017. ICES Advice 2017, Section sr.2017.13.

ICES. 2018a. Report of the ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC), 5–9 March 2018, Dartmouth, Nova Scotia, Canada. ICES CM 2018/ACOM:26. 126 pp.

ICES. 2018. Advice on locations and likely locations of VMEs in EU waters of the NE Atlantic, and the fishing footprint of 2009–2011
http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/Special_requests/eu.2018.10.pdf.

ICES. 2018a. Documentation of the processing, review and production of data products for ACOM's Vulnerable Marine Ecosystems Advice Drafting Group (ADGVME), 14 June 2018, Copenhagen, Denmark. DOI: <https://doi.org/10.17895/ices.pub.4430>.