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Report of the Study Group on VMS data, its storage, access and tools for analysis (SGVMS)

8-9 September 2010

Hamburg, Germany

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Executive summary

The Study Group on VMS data, its storage, access and tools for analysis (SGVMS) took place in Hamburg, 8–9 September 2010. Heino Fock and Vanessa Stelzenmüller chaired the meeting with 16 participants from 8 nations.

SGVMS was initiated by WGDIM recognizing that in the context of rapidly evolving methodologies of VMS data analysis and emerging requirements with regard to advice for European policies and the ICES Science Plan, a structured approach to holding and accessing VMS data are essential.

SGVMS had to consider implications for an ICES strategic position on VMS data, to review data availability, data access and storage, data formats and data products, tools for analysis and quality assurance issues.

Data availability and access was documented for eight Europeans nations. Due to the fact that confidentiality issues and other legal constraints have to be accounted for, direct access and delivery of unprocessed data to ICES in most cases is likely impossible. Instead, delivery of anonymized aggregated data with VMS linked to logbook information could provide an alternative with data of acceptable scientific value with regard to spatio-temporal and métier resolution (approach 4). This approach requires considerable national effort to aggregate and analyse the data before being delivered to a centralized database. Methods to link VMS data and logbook data and data exchange formats were reviewed.

A catalogue of quality assurance measures was developed to document the quality of the VMS data, the analysis and its analysed products.

SGVMS recommended that:

- A centralized database should be established in the ICES Data Centre in order to deliver standardized data products to Working Groups and clients.
- A working group should be established to regularly work on VMS methodologies and standards, and to provide data to the ICES Data Centre.
- A consultation process among WG chairs and ACOM and SCICOM should be undertaken by a competent authority to find out needs on VMS data in the ICES community to better determine the involvement of ICES in the medium and long-term.

1 Opening of the meeting

1.1 Terms of Reference

The Study Group on VMS data, its storage, access and tools for analysis (SGVMS), chaired by Heino Fock, Germany, and Vanessa Stelzenmüller, Germany, met in Hamburg, Germany, 8–9 September 2010 to:

a) Provide expert advice regarding VMS data, with particular reference to:
   ii) ICES strategic position regarding VMS data, the level of involvement required in the short, medium and long-term;
   iii) Storage and management of the data;
   iv) Access to raw data and data products;
   v) Data products;
   vi) Tools and methods for analysis;
   vii) Quality assurance, quality control and quality flags.

SGVMS will report by 4 October 2010 (via SSGSUE) for the attention of SCICOM, ACOM, SSGHIE, WGDIM, and PGCCDBS.

1.2 Objectives and working rationale

Based on the Terms of Reference, the aim of SGVMS was defined as to provide advice to ICES on how VMS data could be treated within the ICES data strategy, to work on definitions for standardized data products that can be delivered to and be stored within ICES, and to describe tools needed to develop these data products. Because standards for holding and processing VMS data are not only required for ICES advice, the SGVMS recommendations on standardization should also aim at addressing needs to develop indicators for Commission Decision 2008/949/EC, but not at developing the indicators themselves.

Commission Decision 2008/949/EC requires to analyse VMS data resolved to fisheries métier level 6. This means that logbook information is essential to VMS analysis. A EC call for tender *MARE/2008/10; Lot 2 - Development of tools for logbook and VMS data analysis* was launched to develop such tools and SGVMS work will collect and review results from this project as far as being available.

This means that the SGVMS TORs were interpreted and amended in a way as such that VMS and logbook data are to be treated simultaneously in a joint analysis.

SG working rationale

Referring to TORs II-VI, 3 working groups were established assigned to TORs II-III. IV-V and VI, respectively, with a strong focus on technical and practical issues. There was considerable overlap between these TORs and the SG reconvened on Wednesday afternoon for a first evaluation of links and reassignment of tasks between subgroups.

TOR I was answered with a retrospective view back from the output of TORs II-VI towards TOR I, i.e. the recommendation to ICES on its strategic position is based on the practical and technical sections analysed beforehand.

1.3 Participants

Anders Ostreim	Norway
Carlos Pinto	Denmark
Cecilie Kvamme	Norway
Doug Beare	the Netherlands
Fabricio Manco	UK
Hans Gerritsen	Ireland
Heino Fock	Germany
Josefine Egekvist	Denmark
Laurans Martial	France
Neil Campbell	Scotland
Niels Hintzen	the Netherlands
Sofie Nimmegeers	Belgium
Sofie Vandendriesche	Belgium
Torsten Schulze	Germany
Uwe Böttcher	Germany
Vanessa Stelzenmüller	Germany

There is a detailed list of affiliations in Annex 1.

1.4 Background information

SGVMS was established as a subgroup to the ICES WG on Data and Information Management (WGDIM). In 2009, WGDIM TORs were:

a) The current and pending legal status of VMS data in the ICES area, including any issues that may hinder data use for scientific purposes and considering the status of VMS data in relation to the present and revised EU Data Collection Regulations

b) Estimates of data quantities that can be expected from Vessel Monitoring Systems, including a consideration of VMS data temporal resolution in relation to its potential scientific uses, and any proposed or required changes in temporal resolution

c) Investigation of organizations within the ICES area that currently archive or intend to archive VMS data and which allow access for scientific purposes

d) A summary of what scientific tools are being developed by existing research programmes, including EU Framework projects, to analyse and interpret VMS data

e) Proposals for how ICES scientists and Expert Groups should gain access to VMS data in future and what data interface, interrogation, display, analysis and interpretation tools ICES should obtain or develop.

Prior to the 2010 SGVMS meeting, WGDIM TORs for 2010 were *inter alia* to provide advice on the need and usage of VMS.

WGDIM 2010 undertook a survey to investigate national VMS data policies. Based on results from this survey, WGDIM stated that "… although the Study Group aims are solely directed to holding and processing the **VMS data that may be supplied to ICES**, and to provide a strategic overview of their use, the various responses to the [survey] questions, …, suggest that items [of storage and access] may raise legal issues that are outside the competence of scientists to deal with"(ICES 2010).

2 Data formats and availability

2.1 VMS data strategy

VMS data will be essential to meet the requirements from the ICES Science Plan 2009–2013, especially for the subtopic 'Impacts of fishing on marine ecosystems' under the thematic area 'Understanding of interactions of human activities with ecosystems'.

To date, there is no official ICES strategic position on VMS. The WGDIM Working Document on an ICES data strategy 2010 onwards (ICES 2010) develops the goal to manage and disseminate marine data for the ICES Area in support of the Science and Advisory programmes. "Taking into account that marine policy is looking increasingly to performance indicators for marine management, and that performance measures and indicators for fisheries are defined in 2008/949/EC, corresponding data are an essential element of the future ICES data policy. ICES must develop a strategy for managing its data, and whether it should become a regional data centre and how it will be resourced." WGDIM stated that a documented plan is required accepted by customers and stakeholders.

European policies stipulate (COM(2010)461 final) that fisheries data according to the Data Collection Framework (i.e. including VMS) shall be collected by a joint data centre then distributed among users such as ICES, STECF and the General Fisheries Commission of the Mediterranean (GFCM).

Thus, it is unclear whether ICES will act as primary user generating and processing a database directly from national inputs, or if ICES will act as secondary user retrieving standardized products from a joint data centre.

SGVMS 2010 recommends that an ICES working group should establish the transfer of national VMS data directly to the ICES data centre[1], and that data from this database should be used to fulfil ICES management and advice needs. It is not likely, that a European joint data centre instead will be able to deliver VMS data needed for current ICES advice with immediate effect.

The discrepancy between the position of the European Commission (COM(2010)461 final) of holding the data in a joint data centre and the ICES need for instantaneous use of VMS data to meet the requirements of the ICES Science Plan 2009–2013 could not be resolved within SGVMS 2010.

[1] Alternatively, instead of establishing a new working group, the existing assessment working groups could collate VMS effort information for their relevant fisheries (H. Gerritsen, personal statement).

2.2 Storage and management of the data

2.2.1 Regulations on data exchange formats

The EU Data Collection Framework (DCF), EC Regulation 199/2008, requires Member States to collect certain data under 'multi-annual national programmes', prescribes the process for collection, management and use of that data and provides for data collected in the framework of the Common Fisheries Policy (CFP), including VMS data, to be used for the purposes of such 'national programmes'. It requires Member States to provide anonymized data to 'end-users' to support scientific analysis as a basis for advice to fisheries management; in the interest of public debate and stakeholder participation in policy development, and for scientific publication (Article 18). 'End-users' are defined as bodies with a research or management interest in the scientific analysis of data in the fisheries sector. This regulation does not provide a guaranteed right of access to VMS data, which is generally considered personal information, obtained via surveillance. However, the right to withhold the data are limited, the most relevant reason being the risk of natural or legal persons being identified (Article 20). The DCF is concerned with improving the quality of information and scientific advice available for implementation of the CFP, therefore is entirely CFP-related. This obligation does not directly apply to data sharing for marine planning purposes, unless such marine planning is integral to the CFP as an environmental consideration or requirement.

Administrations of EU member states powers to share VMS data for non-CFP purposes is constrained by a combination of human rights law; data protection law; the law of confidence, and EU law - in particular the EU confidentiality obligation under Article 113 of EC Regulation 1224/2009 (the "Control Regulation"). When sharing VMS data outwith the sphere of the CFP, compliance with the EU confidentiality obligation cannot be guaranteed, however, it is arguable that sharing anonymized VMS data for marine planning purposes is not contrary to human rights law, data protection law or the EU confidentiality obligation if certain safeguards are put in place to protect the commercial value of VMS data and preserve confidentiality. Such safeguards could require a clearly defined and legitimate purpose to be defined before data would be shared, either aligning with the CFP's objectives or "conservation and protection of the wider marine environment" as described in the Control Regulation, a demonstration that disclosure is necessary to fulfil that purpose and proportionate (i.e. no alternative means could achieve the same aim); the data are anonymized and aggregated to prevent the identification of any natural/legal person, and access is restricted to individuals or bodies whose functions require them to have access and that adequate safeguards are in place to prevent further unauthorized disclosure.

In the EC No 1077/2008 on electronic recording and reporting of fishing activities and on means of remote sensing, it is stated that "In each Member State, a single authority shall be responsible for transmitting, receiving, managing and processing all data covered by this Regulation." It is unclear how processing for scientific purposes relates to this.

Regulation EC No 1077/2008 also states that: "A flag Member State shall ensure that a coastal Member State has online access in real time to electronic logbook and landing declaration data of vessels flying its flag when conducting fishing operations in the waters under the sovereignty or jurisdiction or entering a port of the coastal Member State."

In the EC No 2244/2003 laying down detailed provisions regarding satellite-based Vessel Monitoring Systems, no reference is made to access to the data for third parties (except for specific requests of the Commission). The regulation does state that the all VMS-related data should be treated in a confidential manner.

2.2.2 Available data exchange formats

TACSAT2/EFLALO2 format

In the Lot2 project common data formats have been made to store raw VMS and logbook data that the analysis tools developed in the project can use. Under the EU projects TECTAC and CAFÉ common data exchange format for logbook (EFLALO) and VMS data (TACSAT) were developed. These formats have been modified for the Lot2 project in order to include the relevant information, and information irrelevant for the Lot2 project has been removed from the formats.

VMS data (TACSAT2 format)

The VMS data are stored in the TACSAT2 format, and includes the following variables: vessel ID, latitude, longitude, date, time, instant speed delivered and instant heading delivered. The status/memtype codes have not been included, but can be added if required.

Logbook data (EFLALO2 format)

The logbook data are stored in the EFLALO2 format. There are three levels of information in the EFLALO2 format:

- Vessel
- Fishing trip
- Log event

On the vessel level, the information related to the vessel is stored: Vessel ID, fleet, home country, vessel length, vessel power (kw) and tonnage.

On the fishing trip level, the information related to the fishing trip is stored: fishing trip reference number, departure country, departure harbour, departure date, departure time, landing country, landing harbour, arrival date and arrival time.

On the log event level, the information related to the log event is stored: catch date, log event start time, log event end time, sequence number, gear, mesh size, ICES rectangle, fishing activity (métier), landing weight and landing value of all the species.

The data are saved in a csv format (comma separated file). When information is missing, an empty zero-length string is added between the commas.

Detailed descriptions of the TACSAT and EFLAFLO2 are given in Annex 6.

North Atlantic Format (NAF)

When vessels are fishing in the zones of other coastal states or international waters they are required to send various reports making the authorities in the coastal state able to manage and control the activity. The types of reports that are required, their content and the definition of the various variables in each report has been decided bilaterally (between flag state and coastal state) or multilaterally (RFMO's). In the NEAFC scheme of control and enforcement one standard for types of reports, coding of reports and methods for how these reports should be exchanged between parties

has been established. The types of reports and the definition of the codes used in the various reports are based on the North Atlantic Format (www.Naf-format.org).

2.2.3 Review of methods for linking logbooks and VMS data and required variables for these methods

The VMS data contain information about positions and time of the position. In order to know the gear, métier or catches, the VMS data have to be linked to logbook data. In the DCF EC 949/2008 it is described in Appendix XIII that the VMS position should be linked to the level 6 for the métier classification.

Simple method 1 (variables required for linking: vessel ID and date)

The simplest method for linking VMS data with logbook data are to merge by vessel identifier and fishing date (e.g. Gerritsen and Lordan, 2010). If multiple gears or mesh sizes are used by a vessel on a single day, the dominant gear/mesh is selected. Effort is assigned to each VMS position as the average daily interval between pings and fishing pings are selected using a simple speed rule. When catch data are assigned to VMS positions, the catch data are assumed to be distributed evenly among all VMS positions that correspond to fishing activity. Data from discard observer trips were used to validate speed criteria and to test the assumption of evenly distributed daily catches.

Quality assurance: The quality of the link between VMS and logbook data were quantified by estimating the proportion of effort (hours fished) of VMS data that could be linked with logbooks and vice versa the effort of logbook data (of vessels >15m) that could be linked with the VMS.

Reasons why VMS and logbook data cannot be linked: VMS data are only available for vessels>15m; errors in the logbook data (wrong date, vessel identifier, missing data); errors in the VMS data (missing data, errors in matching vessel IDs, fishing activity not correctly identified)

Simple Method 2: (additional variables required: trip departure + return, port locations) The VMS points corresponding to a logbook trip can then be filtered by only taking the VMS points with times between the start and end times of the trip reported in the logbook. VMS locations near ports (e.g. 3nm radius) may be removed to avoid assigning slow moving vessels in port to fishing activity.

Method developed for Lot2 project described by Bastardie *et al.*, 2010 (additional variables required: ICES rectangle)

The first step of the merging routine consists of assigning a common identifier joining each VMS trip to a logbook trip by searching for the nearest trip among all logbook trips based on the temporal midpoint of trips. This circumvents problems where the start and end time of VMS and logbook trips do not match exactly and ensure that each logbook trip will be merged with a given VMS trip even if the reporting of the start and end date by fishers is uncertain. It is observed in the data that this reporting date may fluctuate with +/- 1 day around the VMS trip dates possibly because of error in reporting. Additionally, the possible few remaining logbook trips are also linked with the nearest VMS trips. This latter event may occur from unknown failure in the VMS device while fishers are still fishing. In the processing, links are then forced to nearest VMS trips to prevent loss of any reported landings.

The second step of the process evaluates the consistency between both types of data sources. Sequentially, a quality flag is issued for each recorded position depending on the various degrees of matching, from finer to coarser, if both data have in common:

(i) the trip identifier, the same area (ICES rectangle), and the catch date (ii) only the trip identifier and the area, or (iii) only the trip identifier. The initial datasets (both VMS and logbooks) are split into sub-blocks according to this flag. Each pair of sub-blocks is then joined separately and all merged sub-blocks are bound in one dataset afterwards.

In a final step, declared landings (in weight and value) at the ICES rectangle scale from logbooks were further allocated at a lower spatial and time-scale level with regard to the VMS information. This was done by allocating a proportion of the landings to each detected fishing position depending on the level of matching between VMS and logbook data as described in step 2. In the case of full matching, landings allocated to a given position were proportional to the number of detected fishing positions lying inside each declared logbook area for a given date, assuming that the total landings declared in this area at this date are divided equally among all of these positions. In the particular case of the use of several gear types within the same rectangle and also for the same catch date, an equal share of landings between gear types was also assumed for this day. In case of partial matching, the following procedure was used. First, when the match was correct by area but not by catch date, the landings were equally dispatched between all the fishing positions of this trip detected in this particular ICES rectangle. Second, when the match failed on both catch date and area, the landings concerned were equally allocated to all the detected fishing positions of the trip for which no previous match has been detected. Finally, residual landings (kept in the final output) occurred when the match failed both for the catch date and area, and no fishing position remained.

Other methods

With no logbook data but only aggregate international catch data being available, Pedersen *et al.* (2009) combined all landings data by gear type and ICES statistical rectangle and weighted these landings by the spatial distribution of the VMS effort data. This method is contingent on accurate reporting of landings to the correct rectangle. Skippers are not required to record all statistical rectangles in which they fished but may only record the rectangle in which most of the catches were made (EEC, 1983)

Others have assigned the landings from each trip to the VMS fishing locations for the matching trip (Afonso-Dias *et al.*, 2002; Palmer and Wigley, 2007). When daily logbook data are available, it is likely to be more accurate to use daily data, rather than trip data. However it needs to be recognized that the landings data by trip are used as 'official' landings figures while the daily retained catch is an estimate for which a certain amount of error is allowed to exist with the actual weights.

2.2.4 Information on foreign vessels inside an EEZ

The EU fleet register (http://ec.europa.eu/fisheries/fleet/index.cfm) provides data on the main gear type used for each EU vessel – this may be used to identify the gear of foreign vessels inside a country's EEZ for which this country does not have logbook data. The accuracy of the register is unknown but many vessels are known to change gears on a regular basis so there is uncertainty associated with this information, and métier level 6 type analyses is not possible with only gear type data (see Pedersen *et al.* 2009).

A better alternative would be for nations to share daily gear information (or full logbook data). EU states are required to make these data available for vessels inside the

EEZ of other member states under EC No 1077/2008 but the data do not appear to be requested on a regular basis.

2.3 Access to raw data and data products

2.3.1 Survey of availability and sharing of VMS data

Participants from each member state were asked to fill in a survey on availability and sharing of VMS data, the full responses are given in Annex 5.

Summary and conclusions from the survey

- The fisheries labs generally do not collect and own the VMS data. When the data are obtained they are often processed in some sort of way. It is important for the fisheries labs to be able to access the data in its raw format before any processing takes place.
- It is unlikely that raw data will be made available to ICES or any other third party; sharing of aggregated data will probably be possible as long as confidentiality is not breached.
- VMS and Logbook data are collected for enforcement. However it is possible for science to have an input into the type of data that are collected. For example an increase in the ping rate would be very useful. (From a practical point of view: it may not be necessary to transmit the data more often, instead a series of positions could be stored and sent in a single transmission).

2.3.2 Electronic logbooks / (electronic reporting system)

Norway

Norway introduced a first version of a voluntary electronic reporting system (ERS) in 2005. The intention with this first version was to make the skipper on-board the vessels able to send the required reports such as catch on entry (COE), weekly catch (CAT) and various other reports to the coastal state authorities electronically. These reports were formatted according to and using codes given in the North Atlantic Format (NAF; www.naf-format.org). In 2007 a voluntary pilot project started on daily catch reporting involving approximately 25 trawlers. A specific type of report (LOG) was designed for this purpose which allows for reporting details about each fishing operation electronically.

A new regulation on electronic reporting was introduced in December 2009 replacing various earlier regulations on vms, reporting requirements, logbook etc. In the development and work on this new regulation discussions were held with parties involved in management and enforcement and with the industry.

According to this regulation all vessels 21 m overall length and above are required to send various reports electronically as from 1. October 2010, and vessels down to 15 will be included from 1.January 2011. When using active gears such as trawl, seine etc detailed data of each fishing operation should be recorded and transmitted daily to the Directorate of Fisheries. Vessels using other types of gear such as nets, line etc should report aggregated data of the catch each day. Only ERS software approved by the Directorate of Fisheries can be used by the vessels in this reporting.

In parallel discussions have been held between the EU and Norway to secure that the reports sent from the vessel to the national FMC is forwarded to and accepted by the authorities when fishing in each other's waters. An agreement was signed in Febru-

ary 2010. The NAF codes are used in the exchange of required reports which is performed according to an agreed xml/ web service.

As from mid July 2010 Norwegian fishing vessels 21 meter and above were required to report electronically when fishing in EU waters, whereas other Norwegian vessels were allowed to start using the approved ERS software in other waters on a voluntary basis provided that they report according to the new regulation. If vessels start using the approved software they are not required to register information in the paper logbook when fishing in Norwegian or EU waters. Electronic reporting will be mandatory from 1.January 2011 for EU vessels when fishing in Norwegian waters.

Norwegian authorities have started discussions with authorities in other neighbouring countries to secure that the Norwegian fishing vessels are allowed to use ERS in all waters in future.

Denmark

From 1 January 2010 all EU vessels larger than 24 meters have to be able to transmit an electronic logbook. From 1 July 2011 all vessels between 15 and 24 meters also have to use the electronic logbooks. In Denmark the electronic logbooks should hold the same information as the paper logbook according to the logbook regulation (EC 2807/83). It is possible to add extra information about time and coordinates for start or end of a fishing operation, but not mandatory.

3 Data products

SGVMS considered and developed a hierarchy of deliverables to a centralized database suitable for different purposes each (unprocessed records, records aggregated to grid cells, records interpolated etc., Figure 1).

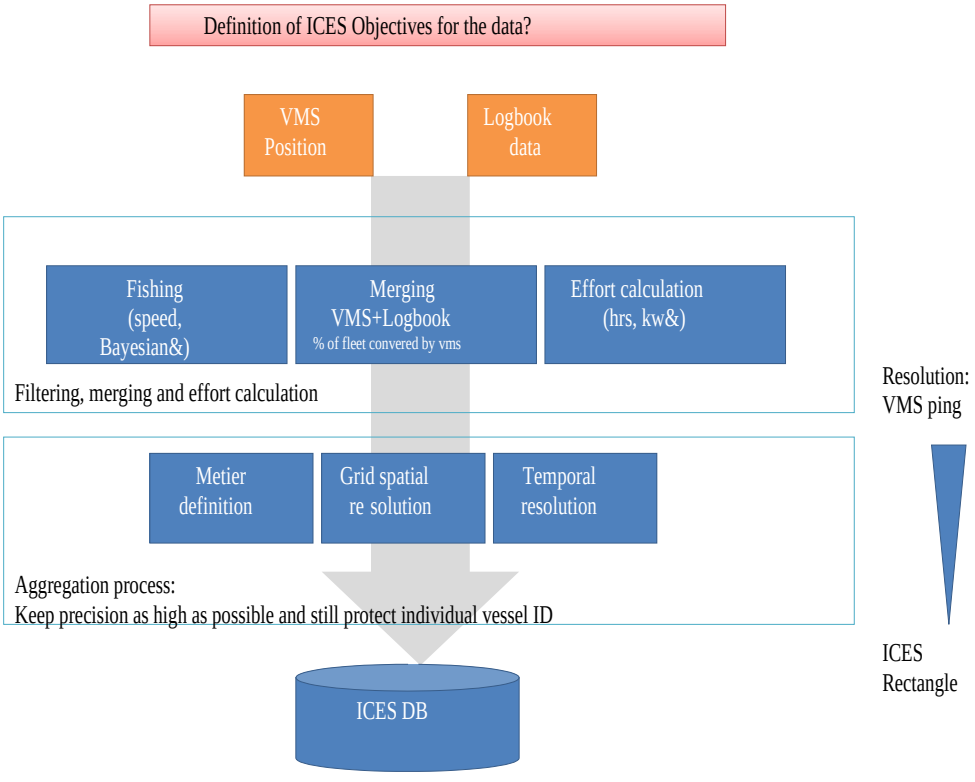

Figure 1. Schematic representing the processes that might be involved in sending VMS data to a centralized European database that might be hosted by, for example, ICES.

3.1 Approach 1: Raw vms and logbook data to ICES

We first discussed the prospect of sending 'raw' VMS and logbook data to ICES. By this we mean data at the individual ping level. Some in the group felt that it would be the 'easiest' and most practical way in which to get the data. Others in the group thought that, although desirable, this would be unlikely to happen in practice because EU Member States have strict controls regulating the distribution of these data. Raw logbook data would be necessary to identify the métier being used and, again, data at this resolution are unlikely to be sent to ICES. The group recognized that it would, however, be desirable because if aggregation thresholds change in future, then this can be easily accommodated. The advantages of this approach would be that a) future métier definitions can be met; b) areas of nonfishing can be indicated accurately, c) abundance of species can be determined at fine spatial resolution (LPU).

This approach implies that a) individual fishing vessel positions can be identified; b) individual fishing vessel catch and revenues can be identified.

- Pre-processing quantity: very low
- Scientific value: high
- Confidentiality issues: very high

3.2 Approach 2: 'Truncated' raw VMS data without reference to logbook data to ICES

If approach 1 fails to satisfy confidentiality issues there are possibilities to disguise data.

VMS data could be 'disguised' by truncating various information, e.g. a) spatial aggregation (truncation of the last digits of lat/long (gridding), b) temporal aggregation (month, quarter); or c) truncating vessel ids. Confidentiality issues could be ameliorated depending on the 'truncation' resolution.

The advantages of this approach would be that a) areas of high vessel presence/fishing effort would still potentially be identifiable and b) areas of non-fishing can be indicated accurately. The disadvantage is the lack of information on the individual fisheries, vessel characteristics (métier, power category etc.).

- Pre-processing quantity: low
- Scientific value: medium
- Confidentiality issues: low to high

3.3 Approach 3: 'Truncated' raw VMS data informed with reference to logbook data

VMS data could be 'disguised' by truncating various information, e.g. a) spatial aggregation (truncation of the last digits of lat/long (gridding), b) temporal aggregation (month, quarter); or c) truncating vessel IDs. Confidentiality issues could be ameliorated depending on the 'truncation' resolution.

The advantages of this approach would be that a) areas of high vessel presence/fishing effort would still potentially be identifiable and b) areas of non-fishing can be indicated accurately. Further the characteristics (métier, power category etc.) of fishing fleets can be identified.

- Pre-processing quantity: medium

- Scientific value: medium
- Confidentiality issues: medium to high

3.4 Approach 4: Aggregated data to ICES

Given the current legal situation, the most likely possibility, then would be to send ICES some form of 'aggregated' VMS data, e.g. kWhours or number of pings per grid square per month per métier with corresponding time intervals. Prior to this happening we would need to address such issues as: What method is used to define fishing (the problem of estimating effort for passive gears is not fully solved); What method is used to define steaming or whether or not it is important; What size of grid to use; What would be the duration of the time-steps required (month, quarter); How métiers could be identified (e.g. level 5, level 6); How these procedures would be standardized among Member States; How the 'quality' of data would be assured. How to deal with 'specialist' métiers with only a few vessels enabling them to be easily identified (perhaps when aggregated with those métiers from other countries this problem might 'disappear'); How to deal with uncertainty.

(Problems of course will arise when métier or aggregation definitions change.)

- Pre-processing quantity: very high
- Scientific value: medium to high
- Confidentiality issues: low to medium

3.5 Review of tools and products from MARE/2008/10 lot 2

The VMS Tools (Lot 2) project has been underway now for nearly one year (see http://code.google.com/p/vmstools/). The project has constructed an R Library with a set of generic tools that can be used to analyse VMS and logbook data. They have two standardized data formats, EFLALO2 (EU logbook data) and TACSAT2 (the VMS positions) which build on work done and 'agreements' in other EU funded projects such as CAFÉ, AFRAME, and TICTAC. Once the data are in R in the correct format a series of scripts enables, identification of métiers, estimation of fishing activity, linking between logbook and VMS data, interpolating vessel tracks, and methods for putting the data (e.g. number of pings, kwhours) onto grids of any resolution required. The group believed that this R – library could be distributed to contracting parties who would then get their logbook and VMS data into the required formats, import it into R and use the relevant functions to output the data in an aggregated format suitable for import into ICES database. Ultimately, the VMS Tools project (Lot 2) will produce effort and landings data estimates from VMS data in an aggregated format that will go into FishFrame http://www.fishframe.org/ hosted by the Danish Fisheries Institute (see Tables 1 and 2 for an overview of the 'draft' FishFrame format). So the R-library would potentially enable each contracting party to send data in a useful format to a centralized system. Using such data, ICES could then add up the data from different Member States and produce maps etc. The exact form of the data would have to be set up in consultation with ICES, contracting parties and the requirements of each ICES Working Group.

Table 1. Exchange format (draft) for commercial effort based on merging of VMS data and log-book data (VF) that will be produced by the VMS-tools library.

ORDER	NAME	TYPE	REQ.	BASIC CHECKS	COMMENTS
1	Record type *	String	M		Fixed value VE
2	Vessel Flag Country *	String	M	Code list	ISO 3166-1 alpha-3 codes. The flag country of the vessel.
3	Year *	Integer	M	Code list	1900 to 3000
4	Quarter *	Integer	M	Code list	1 to 4.
5	Month *	Integer	M	Code list	1 to 12
6	C-square*	String	M	Code list	3x3 minutes, C-square reference XXXX:XXX:XXX:X
7	Fishing activity category National *	String	O	Code list	Fishing activity category – National coding system. Bound to the Nantes matrix level 4 as children i.e. an alternative level 5+6.
8	Fishing activity category European lvl 6 *	String	M	Code list	Fishing activity category – Level 6 in the Nantes matrix (SGRN 06–03)
9	Fishing hours	Decimal numeral	M/O	1 to 9999999999	Fishing hours calculated from VMS data
10	kW*fishing hours	decimal numeral	M/O	1 to 9999999999	
11	Tot weight	Decimal numeral	M/O	1 to 9999999999	Total landings of all species caught. In kg
12	Tot value	Decimal numeral	M/O	1 to 9999999999	Total value of all species caught. In Euro

Table 2. Exchange format (draft) for commercial landings based on merging of VMS data and logbook data (VF) that will be produced by the VMS-tools library.

ORDER	NAME	TYPE	REQ.	BASIC CHECKS	COMMENTS
1	Record type *	String	M		Fixed value VSL.
2	Vessel Flag Country *	String	M	Code list	ISO 3166–1 alpha-3 codes. The flag country of the vessel.
3	Year *	Integer	M	Code list	1900 to 3000
4	Quarter *	Integer	M	Code list	1 to 4.
5	Month *	Integer	M	Code list	1 to 12
6	C-square*	String	M	Code list	3x3 minutes, C-square reference XXXX:XXX:XXX:X
7	Species *	String	M	Closed list of species 1)	Scientific name in Latin (genus species).
8	Weight	Integer	M	1 to 9999999999	Whole weight in gram. Decimals not allowed.
9	Value	Integer	O	1 to 9999999999	In Euro. Decimals not allowed.

*** = The field is a key field.**

3.6 Linking data products to indicators as defined through 2008/949/EC.

The following indicators are defined through 2008/949/EC:

1) Distribution of fishing activities.

2) Aggregation of fishing activities.

3) Areas not impacted by bottom gears.

In 2008/949/EC these indicators are actually rather poorly defined and it is difficult to discover what level of detail or not is actually required. The Commission guidelines give no real information about how VMS and logbook data might be processed prior to construction of these 'indicators'.

The vms-tools R library described above is capable of producing such 'indicators'. The real difficulties, however, are related to questions of data aggregation. Unless you have highly detailed spatial information, for example, you will not be able to identify areas not impacted by bottom gears.

4 Quality Assurance and Quality Control

4.1 General remarks on the assessment of quality of aggregated data

Quality assurance (QA) refers to the entire process of auditing a procedure to analyse and process data with the aim to deliver a 'fit for purpose' product 'free of mistakes'. QA does not eliminate uncertainty, but within QA a measure of uncertainty should be delivered. Quality control is a means (QC) to analyse specific components of the process and QF are indicators for data or products after passing QC.

The quality assurance needs to be considered at the level of raw, aggregated, processed, and analysed data. Quality assurance at the level of raw and aggregated data relates to a suit of quality control measures to be applied to derive certain standard or quality of the data subjected to further processing. At the level of processed and analysed data quality assurance rather relates to uncertainty that is introduced in the subsequent data processing steps. Thus to achieve a certain data standard a set of quality control actions or measures are listed together with suggested measures of uncertainty in Table 1. Therefore these categories should be distinguished for each of the data handling steps. The data handling steps can be subjected to four general categories: 1) raw data; 2) aggregating (merging) VMS and logbook data; 3) general processing of aggregated data; and 4) further "fit for purpose" processing (see SGVMS 2010 Figure 2).

4.2 Raw data (VMS and logbook)

At the raw data level the set of actions should be applied to achieve defined quality standards. For the VMS data those actions relate to the correction or removal of data due to i) false geographic positions, ii) missing speed information, iii) pseudo duplications, and iv) heading outside the compass range. Quality standards for logbook data address for instance i) errors in the ICES rectangle assignments, ii) multiple gear usage, iii) outliers in the catch data, or iv) non-unique trip numbers.

4.3 Aggregation of VMS and logbook data

At this level of data handling process both aspects of quality assurance need to be considered. Quality standard actions relate to i) VMS data that are not matched with logbook data for vessels with a length > 15m, ii) logbook data that are not matched with VMS data for vessels > 15 m. Uncertainty on the other hand is introduced in the

further processing and subsequent analysis by missing out logbook data not matched to VMS data for vessels with a length < 15m and broken VMS transmitters.

4.4 General processing of aggregated data

At this level of data handling only uncertainty can be introduced in the further analysis due to the rules and assumptions applied. For data with gaps in speed information speed is calculated; thus the difference between the instantaneous and the calculated speed introduces uncertainty. A common next step is the filtering of the data for fishing and steaming which requires the application of an activity rule often based on speed. Here the uncertainty is caused by the method used in combination with the quality of the speed information available. Changes in fishing behaviour require respective adaption in the analysis tools. It is impossible to anticipate these changes a priori. For example, the increase in fuel prices led to reduced steaming speed for many vessels, so that speed based rules to define fishing and steaming activity were be confounded. It appeared during the Plaice Box evaluation (Beare *et al*., 2010), that steaming behaviour of large beam trawlers changed over a period of 4 years, and with the 'wrong' speed rules being applied, fishing was indicated where vessels were actually steaming at low speed. Further the vessel positions close to the ports are removed by applying a spatial rule such as a defined radius around the center location of a port. The uncertainty especially arises from the assumptions made on what would be an appropriate radius which likely differs between the ports.

4.5 "Fit for purpose" processing

In the following sources of uncertainty are listed that are most likely common to any analysis concerning the spatial and temporal distribution pattern of fishing activity based on aggregated VMS data. The definition of the métier used is one source of uncertainty as this determines how the data are grouped for further analysis. Many applications use aggregated VMS data to assess the impact on ecosystem components such as marine habitats (e.g. Stelzenmüller *et al*., 2008). This requires the reconstruction of fishing activity in terms of their footprint and intensity. Thus to derive an estimate of the footprint of e.g. mobile bottom fishing gears the reconstruction of fishing tracks are essential. An array of methods are available to reconstruct the fishing tracks ranging from the straight line approach to more complex methods such as cubic splines (see Lee *et al*., 2009). Thus the uncertainty is related to the estimated spatial extent of pattern of the fishing activity (see e.g. Hinzen *et al*., 2010). A common approach is the aggregation of fishing activity (points or fishing tracks) for unit areas such as ICES rectangles or other grid sizes. The spatial resolution used is a further important source of uncertainty. Alike the spatial resolution the temporal resolution can introduce uncertainty especially in the interpretation of the persistence of activity patterns (see Stelzenmüller *et al*., 2008).

Table 3. Quality assurance measures and activities for VMS data analysis.

Level	Issue	Action/Measure
Quality standards - VMS	Points on land	Remove complete record
	Unrealistic speed	Check for speed <0 or >20 knots and replace speed with "unknown"
	Pseudo duplicates	Check for time intervals < 5 min at trip level and remove* duplicate records and replace speed and heading to "unknown"

Level	Issue	Action/Measure
	Headings outside compass range	Check for heading <0 or > 360 and replace heading with "unknown"
Quality standards - Logbooks	Outlying catch records	Check for outliers in catch records and replace with "unknown"
	Non-unique trip number	Check for the unique combination of vessel, trip number, departure and arrival date and replace trip number with a new trip number
	Arrival time before departure time	Compare arrival and departure times at trip level and remove records with mismatches (not of concern if the data are used not at the trip level)
Quality standards – merged VMS and logbook data	VMS data without logbook data	Remove complete record Check for VMS data that are not merged to logbook data and remove those from the database for métier level 6 analysis (for other métier levels an assignment may be possible by using the fleet register)
	Logbook data without VMS data (vessels > 15m)	Check for logbook data that are not merged to VMS data and remove those records from the database
	Incorrect ICES rectangle assignment	Check for geographical mismatch between VMS and logbook data and replace the logbook ICES rectangle by ICES rectangle calculated from the the VMS data
Uncertainty – merged VMS and logbook data	Removed records because of quality standards	Calculate ratio between number of records in raw data and merged data (%)
	Logbook without VMS (vessel < 15 m)	Check for logbook data from vessels < 15m and calculate the ratio between number of records in logbook data with and without VMS (%) by gear
	VMS transponder not operating	Check for time intervals at trip level for logbook data not merged to VMS data. Replace outlying interval rates with the median interval length at trip level (see Mills *et al.*, 2007) and report on the number of replacements.
	Multiple gear usage declaration	Report on the number of vessels fishing with multiple gears at trip level.
Processing – merged VMS and logbook data	Instantaneous vs. calculated speed	Calculate the difference between instantaneous and calculated speed and plot the difference against speed to assess spatial accuracy.
	Activity rule applied	Apply a sensitivity analysis on the activity rule applied to describe the uncertainty (Hintzen *et al.*, 2010)
	Outside/Inside harbour	Apply a spatial rule (range) to remove data allocated inside harbour. Report on number of points removed by gear and the ratio between the spatial rule applied and the closest centre of fishing activity.
Analysing – merged VMS and logbook data	Metier definitions	For analysis at métier level 6 the uncertainty is introduced to false or missing allocation of métiers in logbooks which cannot be corrected. For analysis at métier level < 6 the uncertainty is introduced by assuming usage of gears. Report on percentage of records with métier level information 1 to 6.

LEVEL	ISSUE	ACTION/MEASURE
	Spatial resolution	The spatial resolution at which data are gridded should be balanced with the spatial dimension of the study area of interest. Show the relationship between aggregated data and grid size and determine the grid size at which the change of spatial accuracy (error) of reconstruction fishing activity stabilizes (see Campell *et al*., 2010)
	Temporal resolution	Calculate a respective measure of temporal variability (see Fock, 2008; Stelzenmüller *et al*., 2008).
	Reconstruction of fishing tracks	The reconstruction of fishing tracks results in different pattern of fishing activity which introduces uncertainty in the interpretation of the results. Therefore this variability needs to be quantified. Calculate the difference in length of reconstructed fishing tracks or areas and the baseline fishing track or area.

***The removal of data points should be reported.**

5 References

Afonso-Dias, M., Simões, J.M., Pinto, C., and Sousa, P. 2002. Use of Satellite GPS data to map effort and landings of the Portuguese crustacean fleet (GeoCrust), Universidade do Algarve, Faro, Portugal.

Beare, D., Rijnsdorp, A., Kooten, T.V., Fock, H.O., Schröder, A., Kloppmann, M., Witbaard, R., Meesters, E., Schulze, T., Blaesbjerg, M., Damm, U., and Quirijns, F. 2010. Study for the Revision of the Plaice Box - Draft Final Report, Rep. No. C002/10. IMARES.

Campbell, N., Catarino, R., Holmes, S., Neat, F., The temporal and spatial resolution of Vessel Monitoring System (VMS) data necessary to distinguish and measure static and mobile gear fishing effort, Poster

Deng, R., Dichmont, C.M., Milton, D., Haywood, M., Vance, D., Hall, N., and Die, D. 2005. Can vessel monitoring system data also be used to study trawling intensity and population depletion? The example of Australia's northern prawn fishery. Can. J. Fish. Aquat. Sci., 62(3): 611–622.

EEC. 1983. Commission Regulation (EEC) No 2807/83 of 22 September 1983 laying down detailed rules for recording information on Member States' catches of fish. Official Journal of the European Union, L 276: 1–18.

Fock, H.O., Fisheries in the context of marine spatial planning: Defining principal areas for fisheries in the German EEZ, Marine Policy 32 (2008) 728–739.

Gerritsen, H., and Lordan, C. 2010. Integrating vessel monitoring systems (VMS) data with daily catch data from logbooks to explore the spatial distribution of catch and effort at high resolution. ICES J. Mar. Sci. (2010) doi: 10.1093/icesjms/fsq137

Hintzen, N.T., Piet, G., Brunel, T., Improved estimation of trawling tracks using cubic Hermite spline interpolation of position registration data, Fisheries Research 101 (2010) 108–115.

ICES. 2010. Report of the Working Group on Data and Information Management (WGDIM), Rep. ICES CM 2010/SCICOM:05, Copenhagen.

Palmer, M.C., and Wigley, S.E. 2007. Validating the stock apportionment of commercial fisheries landings using positional data from Vessel Monitoring Systems (VMS). Northeast Fisheries Science Center Reference Document 07–22, NOAA.

Pedersen, S.A., Fock, H.O., and Sell, A.F. 2009. Mapping fisheries in the German exclusive economic zone with special reference to offshore Natura 2000 sites. Marine Policy, 33(4): 571–590.

Stelzenmüller, V., Rogers, S. I., and Mills, C. M. 2008. Spatio-temporal patterns of fishing pressure on UK marine landscapes, and their implications for spatial planning and management. – ICES Journal of Marine Science, 65: 1081–1091.

Walter, J.F.I., Moenig, J.M., and Gedamke, T. 2007. Correcting for effective area fished in fishery-dependent depletion estimates of abundance and capture efficiency. ICES J. Mar. Sci., 64: 1760–1771.

Annex 1: List of participants

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Annex 2: Agenda

Wednesday 8 September 2010

13.00	Introduction, Adoption of Agenda	[Chairs]
	Presentation from ICES Data Centre	[Carlos Pinto]
	Presentation from MARE2008/10	[Beare *et al*.]
	Plenary discussion	
14.30	Separation into subgroups and discussion of subgroup work	
16.00	Coffee-break	
	Re-convening and Plenary discussion	
	Working on subgroup packages (different rooms)	

Thursday 9 September 2010

9.00	Summary of Day 1 and short plenary
	Working on subgroup packages
12.00	Lunch
	Compilation of subgroup packages, discussion of TOR (i)
17.00	End of study group meeting.

Annex 3: SGVMS terms of reference for the next meeting

The Study Group on VMS data, its storage, access and tools for analysis [SGVMS] (Chair: H. Fock, V. Stelzenmüller, Germany) will meet in Hamburg, Germany from 7–9 September 2011 to:

a) Review and consider implications for VMS data management at ICES based on the ICES strategic position on VMS data and data needs as defined by ICES working groups, and determine resources required to accomplish the goals of the strategy;

b) Work on standardized data products for the ICES data centre;

c) Test and undertake quality assurance measures for standardized data products;

d) Review ongoing work for analysing VMS data and developing standardized data products.

If TOR a will become invalid dependent on a pending decision on the ICES strategic position on VMS data, the study group will meet by correspondence only.

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem effects of fisheries with reference to the ICES Science Plan 2009–2013 and the European Common Fisheries Policy (2008/949/EC).
Scientific justification and relation to Science Plan	Science Plan No: 4.2. Term of Reference a) VMS and logbook data are sensitive data and European states and their national agencies will presumably be reluctant to share raw data. The European Commission (COM(2010)461 final) has so far only suggested to build up a data centre to compile and distribute data among endusers. Thus, it is not yet clear how in practice VMS data will be stored and processed. In turn, ICES will need to analyse fisheries patterns to provide substantiated advice for CFP. However, by holding VMS data, even in some aggregated form, ICES and its expert groups will have the option to re-use the data time and again when the DCF states clearly that provision should be for a stated purpose. ICES in its Science Plan has decided to take a leading in research on fisheries impacts on ecosystem and research fields and purposes for where VMS data are essential, should be clearly stated. Term of Reference b) Several analysis tools are available, and it essential to not only work on case studies of a limited number of vessels, métiers or nationalities, but to start to build up a comprehensive database all fisheries for which VMS is available. Term of Reference c) SGVMS 2010 identified a series of Quality Assurance measures which will be tested and applied to the ICES dataset. Term of Reference d) Update information on available tools.
Resource requirements	Advice on the legal basis for sharing of VMS data in accordance with Data Collection Framework, VMS Control Order and European Human Rights legislation must be available. VMS and logdata are provided to study group members through their national agencies. For the storage of data in an ICES data centre/base, preparatory steps and maintenance need to undertaken by ICES. The additional resource required to undertake additional activities in the framework of this group is negligible.

Participants	The Group is normally attended by some 20–25 members and guests. If legal expertise is required, i.e. sufficient legal advice is not available beforehand, administrators from EC and others should also be invited.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committees.
Linkages to other committees or groups	There is a very close working relationship with all groups dealing with EAM, in particular WGECO.
Linkages to other organizations	The work of this group is closely aligned with similar work in OSPAR and HELCOM.

Annex 4: Recommendations

SGVMS 2010 recognizes that

the analysis of fisheries VMS data are indispensable for the fields of marine spatial planning, for meeting CFP requirements and conservation issues and to analyse the impacts of fisheries on the marine ecosystem.

SGVMS 2010 states that

ICES will need fisheries VMS data to accomplish future management needs according to provisions from the ICES Science Plan 2009–2013.

SGVMS 2010 recommends that

a centralized database should be established in the ICES Data Centre in order to deliver standardized data products to Working Groups and clients.

a working group should be established to regularly work on VMS methodologies and standards, and to provide data to the ICES Data Centre.

a consultation process among WG chairs and ACOM and SCICOM should be undertaken by a competent authority to find out needs on VMS data in the ICES community to better determine the involvement of ICES in the medium and long-term.

Annex 5: Survey of VMS data availability

Belgium

COUNTRY:	*BELGIUM*
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Raw data are owned by the Flemish government and the fisheries institute gets automatic updates every 3 months with a time-lag of 1 to 3 months.
Are the data processed in any way before they are made available?	unknown
For which years are data available?	2006–2009 (vessels>15m)
Are foreign VMS data available?	ILVO has access to the raw data from all Belgian vessels in the Belgian EEZ and other fishing grounds in the North Sea, Celtic Sea, Bay of Biscay and Irish Sea visited by the Belgian fleet. We don't have access to data of foreign vessels in the Belgian EEZ.
Are foreign logbook data available?	Catches and positions from foreign vessels landing in Belgium are reported to the authorities but they are not accessible for scientific purposes.
Ping rate	Generally every 2 hours
Data fields available	1) VesselID 2) Date-Time (UTC) 3) Position (decimal lat-long) 4) Instantaneous speed 5) Vessel course 6) No access to MemCode (ANBLK; ANOFF; ASPLM etc); perhaps this is possible
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	ILVO has access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction): positions and intensity of dredge dumping and sand and gravel extraction (black box data).
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached. This is evaluated on a case-by case basis
Protocols for sharing VMS data	

Which protocols are used for sharing raw data?*	Example datasets, (suitably anonymized) could be shared using the MARE/2008/10 (LOT2) - TACSAT2 format (see Annex 6). Other alternatives include the NEAFC scheme (http://www.neafc.org/page/neafcscheme)
*Which protocols are used for sharing aggregated** data?*	MARE/2008/10 (LOT2) – Fishframe format (see Tables 1 and 2). Species, gear and harbour coding should follow FAO format. Metier coding is defined by the DCF
** Raw VMS data are data on individual VMS positions* *** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*	

Denmark

COUNTRY:	*DENMARK*
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Raw data are collected by the Danish Fisheries Directorate. The data are available to DTU Aqua via a VPN connection.
Are the data processed in any way before they are made available?	Several variables are added to the raw data; see the point "Data fields available".
For which years are data available?	2002–2003 (vessels>24m) 2004–2010 (vessels>15m)
Are foreign VMS data available?	Foreign VMS data are available within the Danish EEZ. Danish VMS data are available for all areas.
Are foreign logbook data available?	Only for vessels landing in Denmark, not for vessels that enter the Danish EEZ but land outside Denmark.
Ping rate	Generally 1 hour interval.
Data fields available	7) Vessel country 8) European vessel ID 9) Danish vessel ID 10) Vessel name 11) Position date 12) Position time (UTC) 13) Previous position time (UTC) 14) Time difference between current position and previous position 15) Status: point AT SEA/IN HARBOUR 16) Course 17) Speed 18) Latitude (decimal degree) 19) Longitude (decimal degree) 20) ICES square 21) Status code (TPREP, POS etc.) 22) Area 23) Information if the point is inside special areas (e.g. Plaice box) 24) Distance between current position and previous position 25) Local time
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	DTU Aqua has currently no access to these data, perhaps it is available.

Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached.
Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	Raw data are stored in the common TACSAT2 format, but not shared/exchanged.
*Which protocols are used for sharing aggregated** data?*	Aggregated data are will be exchanged through the Lot2 FishFrame format
** Raw VMS data are data on individual VMS positions* *** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*	

Germany

COUNTRY:	GERMANY
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Data are retrieved from the *Bundeanstalt für Landwirtschat und Ernährung* (BLE), both logbooks and VMS. Analysis is undertaken at *Inst. of Sea Fisheries*, Hamburg, sf@vti.bund.de
Are the data processed in any way before they are made available?	Data are aggregated by métiers (métier resolution depends on request), processed (accounting for uncertainty) and gridded to rectangles of 1/100 size of ICES rectangles.
For which years are data available?	2001–2003 (vessels>24m) 2004 (vessels>18m) 2005–2009 (vessels>15m)
Are foreign VMS data available?	Foreign VMS data are available within the German EEZ. German VMS data are available for all areas.
Are foreign logbook data available?	Only for vessels landing in Germany, not for vessels that enter the German EEZ but land outside Germany.
Ping rate	Generally every 2 hours
Data fields available	26) VesselID (CFR; Community Fleet Registry number) 27) Date-Time (UTC) 28) Position (decimal lat-long) 29) Instantaneous speed 30) Vessel course 31) Access to MemCode (ANBLK; ANOFF; ASPLM etc)
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes, via the CFR (Community Fleet Registry number)
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	No direct access. Must be requested from other agencies
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Germany has a formal policy as such that VMS data can be forwarded to end-users in fully anonymized and métier aggregated form. End-users must apply for data use and purpose of use and objectives of the end-user must be specified prior to delivery to ensure compliance with legal obligations. Individual vessel tracks and individual activities cannot be discerned from the data. The terms of policy could be made available, but are not translated into English yet.

Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	None
*Which protocols are used for sharing aggregated** data?*	The protocol depends on the type of data requested (e.g. for projects like EMPAS, FIMPAS, Plaice Box evaluation), any standardized protocol could be applied as well.

** Raw VMS data are data on individual VMS positions*

*** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*

Ireland

COUNTRY:	*IRELAND*
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Raw data are collected by the Irish Navy and the MI gets access to VMS data following a specific request from the Department of Agriculture Fisheries & Food (DAFF).
Are the data processed in any way before they are made available?	It appears that some filtering of data takes place. Also, edits are made by the data owners, mainly corrections to the vessel identifiers. Duplicate data are common.
For which years are data available?	2001–2003 (vessels>24m) 2004 (vessels>18m) 2005–2009 (vessels>15m)
Are foreign VMS data available?	Foreign VMS data are available within the Irish EEZ. Irish VMS data are available for all areas.
Are foreign logbook data available?	Only for vessels landing in Ireland, not for vessels that enter the Irish EEZ but land outside Ireland.
Ping rate	Generally every 2 hours
Data fields available	32) VesselID (CFR; Community Fleet Registry number) 33) Date-Time (UTC) 34) Position (decimal lat-long) 35) Instantaneous speed 36) Vessel course 37) No access to MemCode (ANBLK; ANOFF; ASPLM etc); perhaps this is possible
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes, via the CFR (Community Fleet Registry number)
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	The Marine Institute has currently no access to these data, perhaps it is available
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached. This is evaluated on a case-by case basis

Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	NA
*Which protocols are used for sharing aggregated** data?*	Generally only image files or geoTiffs of gridded data

** Raw VMS data are data on individual VMS positions*

*** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*

The Netherlands

COUNTRY:	***NETHERLANDS***
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	The data are transmitted by the Dutch Ministry of LNV, monthly to the central ORACLE database held at IMARES.
Are the data processed in any way before they are made available?	Some merging with logbook data are done (gear codes etc.).
For which years are data available?	2000-present.
Are foreign VMS data available?	Foreign VMS data are available within the Dutch EEZ. Dutch VMS data are available for all areas.
Are foreign logbook data available?	No. The gear code comes from the Community Fleet Registry Number.
Ping rate	Generally every 2 hours
Data fields available	38) VesselID (RSS) 39) Nationality 40) Date-Time (UTC) 41) Position (decimal lat-long) 42) Instantaneous speed 43) Vessel course
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	No
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached.
Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	Not possible.
*Which protocols are used for sharing aggregated** data?*	During the Plaice Box project VMS estimates of hours fished were projected over a fine grid, by month, and métier and shared with Danish and German partners.

** Raw VMS data are data on individual VMS positions* *** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*

Norway

COUNTRY:	*NORWAY*
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Raw data are owned by the Directorate of Fisheries and the Institute of Marine Research (IMR) gets automatic updates every hour
Are the data processed in any way before they are made available?	Yes, some fields are removed, e.g. the MemCode
For which years are data available?	June 2000 - June 2010 (vessels > 21 m), July 2010 - (vessels > 15 m)
Are foreign VMS data available?	IMR has access to the raw data from all Norwegian vessels in the Norwegian EEZ and other fishing grounds visited by the Norwegian fleet. We do not have access to data of foreign vessels in the Norwegian EEZ.
Are foreign logbook data available?	Catches and positions from foreign vessels fishing in Norwegian waters are reported to the authorities but they are not accessible for scientific purposes (at the moment).
Ping rate	Generally every 1 hours
Data fields available	44) VesselID (Radio call signal) 45) Date-Time (UTC) 46) Position (decimal lat-long) 47) Instantaneous speed 48) Vessel course 49) No access to MemCode (ANBLK; ANOFF; ASPLM etc); perhaps this is possible
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	IMR has no access to data from vessels other than fishing vessels that impact on seabed.
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties, but are exchanged between authorities in the flag state and the coastal state when Norwegian vessels are fishing in other zones.
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached. This is evaluated on a case-by case basis.

Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	The information is exchanged between the parties involved by using NAF–codes.
*Which protocols are used for sharing aggregated** data?*	

** Raw VMS data are data on individual VMS positions*

*** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*

Scotland

COUNTRY:	UNITED KINGDOM (SCOTLAND)
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	Raw data are collected and held in a database by Marine Scotland – Compliance.
Are the data processed in any way before they are made available?	Marine Scotland – Science has access to read from this database in real time. Data appear to be unprocessed.
For which years are data available?	Q2, 2005 to date (vessels>15m)
Are foreign VMS data available?	Foreign VMS data are available for full trips where a vessel enters Scottish waters. VMS data are available for Scottish registered vessels all areas.
Are foreign logbook data available?	Only for vessels landing in Scotland.
Ping rate	Generally every 2 hours, hourly for vessels operating in the Norwegian sector.
Data fields available	50) VesselID 51) Date-Time (UTC) 52) Position (decimal lat-long) 53) Instantaneous speed 54) Vessel course 55) Other information available but unused
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes.
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	Vessels extracting aggregate from the seabed in UK waters are required to carry monitoring equipment and data can be obtained as a GIS layer from the Crown Estate. Information on drilling and seismic activity could be obtained from the UK DEAL website.
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties

*What is the policy for sharing aggregated** VMS data?*	Formerly, gridded VMS data products were shared outwith Marine Scotland to assist with spatial planning, fisheries accreditation, etc. Following the implementation of Council Regulation (EC) No 1224/2009, which provides for the exchange of VMS data in a very limited set of circumstances, namely maritime safety and security, border control, protection of the marine environment and general law enforcement, it was felt that this was at odds with both the requirement to provide "detailed" data to end-users contained within Council Regulation (EC) No 199/2008 where this was not explicitly in support of Common Fisheries Policy objectives. Until clarification of this situation occurs, MS-S policy is to restrict sharing VMS data outwith the organization to maps in pdf format.

Protocols for sharing VMS data

Which protocols are used for sharing raw data?*	NA
*Which protocols are used for sharing aggregated** data?*	See above. Fishframe protocols developed in the MARE lot 2 project can be used for sharing aggregated data for CFP related purposes.

** Raw VMS data are data on individual VMS positions*

*** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*

United Kingdom

COUNTRY:	*UNITED KINGDOM (ENGLAND AND WALES)*
Access to VMS data by fisheries institute	
How does the fisheries institute access VMS data?	VMS identity, position, speed, and heading data from UK vessels fishing in all areas and from UK and non-UK vessels fishing in UK waters are transmitted (by whom?) to the Marine and Fisheries Agency (MFA) of the UK Department of Environment, Food and Rural Affairs then to the Cefas for scientific purposes.
Are the data processed in any way before they are made available?	Inaccuracies in vessel ID, position, speed and heading are removed. Duplicate data are removed. And points which are within 3nm from a port are removed. The time interval between two successive points is calculated.
For which years are data available?	? 2006 (?) - 2009 (vessels>15m)
Are foreign VMS data available?	Foreign VMS data are available within the UK EEZ. UK VMS data are available for all areas.
Are foreign logbook data available?	No. The gear code comes from the Community Fleet Registry Number.
Ping rate	Generally every 2 hours
Data fields available	VesselID (RSS) Nationality Date-Time (UTC) Position (decimal lat-long) Instantaneous speed Vessel course
Can the vessel ID of the VMS be linked directly to the vessel ID of the logbooks?	Yes
Access to data from vessels other than fishing vessels that impact on seabed (e.g. gravel extraction)	Yes, we have Electronic Monitoring System (EMS) data from The Crown Estate (all Cefas or Rats or others?).
Policy for sharing VMS data	
What is the policy for sharing raw VMS data?*	Raw data are not shared with third parties
*What is the policy for sharing aggregated** VMS data?*	Aggregated (gridded) data may be shared as long as individual confidentiality will not be breached. Temporal restrictions?
Protocols for sharing VMS data	
Which protocols are used for sharing raw data?*	Example datasets, (suitably anonymised) could be shared using the MARE/2008/10 (LOT2) - TACSAT2 format (see Annex 6). Other alternatives include the NEAFC scheme (http://www.neafc.org/page/neafcscheme)
*Which protocols are used for sharing aggregated** data?*	MARE/2008/10 (LOT2) – Fishframe format (see Tables 1 and 2). Species, gear and harbour coding should follow FAO format. Metier coding is defined by the DCF
** Raw VMS data are data on individual VMS positions* *** Aggregated VMS data are aggregated to a spatial grid, generally after merging with logbooks data*	

Annex 6: Data exchange formats – TACSAT2 and EFLALO2

EFLALO2 format

Type	Variable	Code	Format/Unit
Vessel	Vessel ID	VE_REF	20 character string
	Fleet	VE_FLT	DCF regulation
	Home country	VE_COU	ISO 3166 – 1 alpha-3 codes.
	Vessel length	VE_LEN	Oal (m)
	Vessel power	VE_KW	kW
	Tonnage	VE_TON	GT *(optional)*
Fishing trip	Fishing trip reference number	FT_REF	20 character string
	Departure country	FT_DCOU	ISO 3166 – 1 alpha-3 codes.
	Departure harbour	FT_DHAR	International harbour codes. UN LOCODE
	Departure date	FT_DDAT	DD/MM/YYYY
	Departure time	FT_DTIME	HH:MM
	Landing country	FT_LCOU	ISO 3166 – 1 alpha-3 codes.
	Landing harbour	FT_LHAR	International harbour codes. UN LOCODE
	Arrival date	FT_LDAT	DD/MM/YYYY
	Arrival time	FT_LTIME	HH:MM
Log event	Log event ID	LE_ID	25 character string FT_REF_number (1,2,3,etc.)
	Catch date	LE_CDAT	DD/MM/YYYY
	Log event start time	LE_STIME	HH:MM *(Optional)*
	Log event end time	LE_ETIME	HH:MM *(Optional)*
	Log event start position latitude	LE_SLAT	Decimal degrees *(Optional)*
	Log event start position longitude	LE_SLON	Decimal degrees *(Optional)*
	Log event end position latitude	LE_ELAT	Decimal degrees *(Optional)*
	Log event end position longitude	LE_ELON	Decimal degrees *(Optional)*
	Gear	LE_GEAR	3 character string. DCF metiér level 4
	Mesh size	LE_MSZ	mm stretched mesh
	ICES rectangle	LE_RECT	37F5, NA=unallocated
	ICES division	LE_DIV	10 character string (see codes in annex 1)
	Fishing activity (métier)	LE_MET	Filled in as output from Lot2 tool
	Landing weight estimate of species SP1 (FAO species codes)	LE_KG_<SP1>	Kg
	Landing value of species SP1 (FAO species codes)	LE_EURO_<SP1>	EURO
	…	…	…
	Landing weight estimate of species SPn (FAO species codes)	LE_KG_<SPn>	Kg
	Landing value of species SPn (FAO species codes)	LE_EURO_<SPn>	EURO

TACSAT2 format (VMS data)

Type	Variable	Code	Unit
Vessel	Vessel ID	VE_REF	20 character string
Sighting operation	Latitude	SI_LATI	Decimal degrees
	Longitude	SI_LONG	Decimal degrees
	Date	SI_DATE	DD/MM/YYYY
	Time	SI_TIME	HH:MM
	Instant speed delivered	SI_SP	Knots
	Instant heading delivered	SI_HE	Degrees
	At Sea/In Harbour	SI_HARB	0: In harbour 1: At sea
	Fishing/Steeming	SI_STATE	0: Steaming 1: Fishing Filled in as output from Lot2 tool
	Fishing trip reference (FT_REF)	SI_FT	20 character string Filled in as output from Lot2 tool

Codification:

Country codes: ISO 3166 – 1 alpha-3 codes

Harbour codes: International harbour codes based on the UN LOCODE format. Harbour codes and harbour positions have been collected for the EU project ERS (Electronic Reporting System), and these codes are available on the page:

http://ec.europa.eu/fisheries/cfp/control_enforcement/ers_en.htm

Gear codes: The FAO gear codes are used:
ftp://ftp.fao.org/FI/DOCUMENT/cwp/handbook/annex/AnnexM1fishinggear.pdf

Species codes: FAO species codes are used: http://www.fao.org/fishery/collection/asfis/en

Fishing activity codes: The fishing activity codes used in FishFrame for Nantes matrix level 6.

Annex 7: ICES Division codes from FishFrame

Code	Description
2a	Norwegian Sea (Division IIa)
2b	Spitsbergen and Bear Island (Division IIb)
3a	Skagerrak and Kattegat (Division IIIa)
3b	Sound or the Transition Area (Divisions IIIb)
3c	Belt Sea or the Transition Area (Divisions IIIc)
3d	Baltic Sea (Division IIId)
4a	Northern North Sea (Division IVa)
4b	Central North Sea (Division IVb)
4c	Southern North Sea (Division IVc)
5a	Iceland Grounds (Division Va)
5b	Faroes Grounds (Division Vb)
6a	Northwest Coast of Scotland and North Ireland or as the West of Scotland (Division VIa)
6b	Rockall (Division VIb)
7a	Irish Sea (Division VIIa)
7b	West of Ireland (Division VIIb)
7c	Porcupine Bank (Division VIIc)
7d	Eastern English Channel (Division VIId)
7e	Western English Channel (Division VIIe)
7f	Bristol Channel (Division VIIf)
7g	Celtic Sea North (Division VIIg)
7h	Celtic Sea South (Division VIIh)
7j	Southwest of Ireland - East (Division VIIj)
7k	Southwest of Ireland - West (Division VIIk)
8a	Bay of Biscay - North (Division VIIIa)
8b	Bay of Biscay - Central (Division VIIIb)
8c	Bay of Biscay - South (Division VIIIc)
8d	Bay of Biscay - Offshore (Division VIIId)
8e	West of Bay of Biscay (Division VIIIe)
9a	Portuguese Waters - East (Division IXa)
9b	Portuguese Waters - West (Division IXb)
14b	Southeast Greenland (Division XIVb)

Annex 8: Figure 2