Canadian Year-Round Shipping Traffic Atlas for 2013: Volume 2, Centre: Great Lakes and Upper St. Lawrence

Yvan Simard, Nathalie Roy, Samuel Giard, and Mehmet Yayla

Fisheries and Oceans Canada
Science Branch
Maurice Lamontagne Institute
850 route de la Mer, P.O. Box 1000
Mont-Joli, Québec
Canada G5H 3Z4

2014

Canadian Technical Report of Fisheries and Aquatic Sciences 3091(Vol.2)E

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in the data base *Aquatic Sciences and Fisheries Abstracts*.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. II n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications à part entière. Le titre exact figure au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la base de données *Résumés des sciences aquatiques et halieutiques*.

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Canadian Technical Report of
Fisheries and Aquatic Sciences 3091(Vol.2)E

2014

Canadian Year-Round Shipping Traffic Atlas for 2013: Volume 2, Centre: Great Lakes and Upper St. Lawrence

by

Yvan Simard[1], Nathalie Roy[1], Samuel Giard[2], and Mehmet Yayla[1]

[1]Fisheries and Oceans Canada
Sciences Branch
Maurice Lamontagne Institute
850 route de la Mer, P.O. Box 1000
Mont-Joli, Québec
Canada G5H 3Z4

[2]36253 Chateaubriand
Montréal, Québec
Canada H2S-2N5

Cat. No. Fs 97-6/3091(Vol.2)E-PDF ISBN 978-1-100-23768-8 ISSN 1488-5379

Correct citation for this publication:

Simard, Y., Roy, N., Giard, S., and Yayla, M. 2014. Canadian year-round shipping traffic atlas for 2013: Volume 2, Centre: Great Lakes and upper St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3091(Vol.2)E: xviii + 186 pp.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Simard, Y., Roy, N., Giard, S., and Yayla, M. 2014. Canadian year-round shipping traffic atlas for 2013: Volume 2, Centre: Great Lakes and upper St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3091(Vol.2)E: xviii + 186 pp.

The Automatic Identification System (AIS) ship-tracking data collected by Fisheries and Oceans Canada's (DFO) Canadian Coast Guard (CCG) in southern Canadian waters were used to map traffic density throughout 2013. The region considered in this report is the Great Lakes and upper St. Lawrence fresh waters, west of the eastern end of Ile d'Orléans near Québec City in the St. Lawrence estuary. The AIS traffic maps are provided for the whole year and by month. For each time period, maps of daily traffic density are provided for all vessel traffic and selectively for seven vessel types, five vessel length classes, and five sailing speed classes. The data were binned using a common metric of ship-h per 1 × 1 km grid cell per day for all maps. The cumulative histogram of traffic density, total area with traffic, and the sum of daily traffic density are provided for each map. The atlas contains a total of 299 traffic maps.

RÉSUMÉ

Simard, Y., Roy, N., Giard, S., and Yayla, M. 2014. Canadian year-round shipping traffic atlas for 2013: Volume 2, Centre: Great Lakes and upper St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3091(Vol.2)E: xviii + 186 pp.

Les données du système AIS (*Automatic Identification System*) de suivi de la navigation maritime récoltées par la Garde Côtière canadienne du ministère des Pêches et des Océans (MPO) dans les eaux méridionales canadiennes sont utilisées pour cartographier l'intensité du trafic au cours de 2013. La région considérée dans ce rapport est celle des Grands Lacs et des eaux douces à l'ouest de de la pointe est de l'Ile d'Orléans, près de Québec dans l'estuaire du Saint-Laurent. Les cartes du trafic AIS sont fournies pour l'année entière ainsi que par mois. Pour chaque période, les cartes sont fournies pour le trafic total ainsi que séparément pour sept types de navires, cinq classes de longueur de navire et cinq classes de vitesse de transit. Une métrique commune, navire-h par cellule de 1 × 1 km par jour, est utilisée pour toutes les cartes. L'histogramme cumulé de la densité du trafic, l'aire totale avec trafic et la somme du trafic quotidien sont fournis pour chaque carte. L'atlas renferme un total de 299 cartes de trafic.

1. INTRODUCTION

Shipping is one of several human uses of deep oceans, continental shelves, and inland waters to transport goods that are essential to the world economy. The world merchandise trade increases about two times faster than the world gross domestic product (GDP) (UNCTAD 2013). With three bordering oceans, large marginal seas and straits, and an extended network of inland waters, Canada has extensive domestic and international cargo shipping. The worldwide growth rate of this industry changed from high in the 2000's to stagnant or negative after the 2008 global economic crisis (UNCTAD 2013). The amount of transported cargo and the number of ships peaked in 2008 following a seven-fold increase since 2000. In January 2013, the transported cargo and number of ships had respectively decreased to 40% and 33% of their 2008 peaks (UNCTAD 2013; their Table 2.10, p. 62-63.). The average ship size has generally increased. This is particularly evident for general cargo ships and container vessels; the size of these latter has almost doubled since 2000. More than half of the global fleet is composed of new ships (< 10-years old).

Shipping can have various effects on several structural components and functions of aquatic ecosystems via diverse transmission pathways, including the discharge of contaminants, radiated underwater noise, introduction of aquatic invasive species, and ship strike risk (Simard et al. 2006, Clark et al. 2009, Simard et al. 2010, Bailey et al. 2012, DiBacco et al. 2012, Gervaise et al. 2012, van der Hoop et al. 2012, Greig and Abraham 2014). The probability and magnitude of such effects are often largely determined by the amount of temporal and spatial overlap of traffic density and vulnerable ecosystem components, the fleet composition, and the type of activity. Therefore, assessing the risk of shipping effects on ecosystems and their living components generally requires the temporal and spatial structure of the traffic and its composition. The possibility of assembling such information for marine spatial planning using ship position data from the satellite-based long range identification and tracking (LRIT) system with geographic information system (GIS) techniques has been assessed for Atlantic Canada (Koropatnick et al. 2012). Coarse track count maps of LRIT-participating ships in 2010–11 were computed for distances greater than 1000 km from coastline and clearly illustrated the large-scale network of main shipping routes and the much lower traffic above 50°N. The low resolution of LRIT data and the limited information on ship identity did not allow a detailed analysis of traffic density per ship type, length class, or other characteristics. In contrast, automatic identification system (AIS) data provide more complete ship identity and high-resolution position data for a larger fraction of ships, which allows the building of detailed traffic maps per ship category in Canadian waters. This has never been done for shipping in Canadian waters.

The present atlas is a contribution to filling this gap for southeastern Canada by providing maps of AIS-tracked ship traffic during 2013. It documents the present state of the AIS traffic density over time and space, including by ship type, length class, and speed categories. Similar shipping traffic atlases have been published for two other southern Canadian regions: East (from the St. Lawrence Estuary marine water limit) and West Coast. They are presented in two other issues of the same report series (Simard et al. 2014a, b).

2. MATERIALS AND METHODS

This atlas is based on AIS information on shipping in Canadian waters and surroundings, south of ~55° N, from 1 January to 31 December 2013. Except for fishing vessels, AIS is compulsory by law for all ships of 500 gross tonnage (GT) or more, ships of 300 GT or more engaged on an international voyage, and ships of 150 GT or more engaged on an international voyage and carrying more than 12 passengers[1]. Other ships and boats can be equipped with AIS systems on a voluntary basis; these may include fishing vessels and fishing beacons. Other vessels not equipped with an AIS system are not mapped. The source of the raw shipping data and its processing are detailed below.

2.1. AIS data bank

The analyzed data are the AIS streams collected by the DFO–Coast Guard's coastal network of AIS antennas deployed to track and monitor shipping in southern Canadian waters (Fig. 1). This ship monitoring network provides a real-time, continuous stream of AIS ship positions from all southern Canadian waters (< 55° N) that is consolidated on a single server. This flow of binary data was recorded for the whole year in 2013 via a connection to the server. This data stream represents about 600 MB of data per day.

The DFO–Coast Guard's coastal AIS covers all areas of interest for the atlas, except for parts too far from the coastal AIS antennas, notably far offshore in the Great Lakes. Although ship positions beyond 200 km of the coastline were sometimes collected, the usual maximum AIS communication ranges with coastal antenna are generally smaller (typically < 100 km). Successful AIS communication between ships and coastal antennas also depends on other factors affecting radio frequency (RF) communication range, such as proper installation and working of the systems, antenna height and lines of sight, transmission power, and weather conditions. A 100% RF communication range limited to ~ 100 km is more common. An examination of the AIS antenna distribution (Fig. 1) and the computed traffic density maps indicate that all Canadian waters up to ~ 100 km from the coastline seem to be well covered by the coastal AIS network. Within that range, ship trajectories were continuous and did not end in zones of null traffic. A part of northern Lake Superior is farther than 100 km from any antenna and is an area where AIS signal reception may become weak (Fig. 1). Interruptions shorter than 3 h were filled in by interpolations (see below). Longer interruptions were not interpolated.

Communication with the server was interrupted on occasion. Interruptions usually lasted only a few minutes and were much shorter than 3 h most of the time. These data gaps were bridged by interpolation (see below). Longer interruptions occurred on 28 days over the year; the daily traffic statistics for these days were computed with the available data that remained. Data were missing for four complete days in October. The monthly and annual averages and percentiles were computed based on the number of days for which data existed.

---

[1] http://laws-lois.justice.gc.ca/eng/regulations/sor-2005-134/page-11.html (accessed on 2014-02-16)

2.2. Data processing

The raw binary AIS data strings were read using a customized software program (in Python language) to extract the data fields shown in Table 1 and convert them into ASCII format. These data are provided chronologically for all ships independent of their location in Canadian waters. The reading and conversion program sorted them by ship and stored them in one *.csv ASCII file per day.

The retained AIS data for the atlas were first checked for errors or incomplete information, such as spurious latitude, longitude, time errors, and interruptions in data streams or absent or erroneous ship-length data. Position and time errors or gaps were corrected by interpolating from adjacent positions in the time-series. A table of the 12,645 different *mmsi* (maritime mobile service identity) numbers retrieved by the DFO–CG AIS network for all regions in 2013 with their corresponding characteristics was built. In cases of multiple entries for single *mmsi* numbers, only the entry containing the most complete information was retained.

Table 1. Data fields of ASCII-txt files extracted from the recorded raw AIS data and used in the computation of the maps.

Data field	**Examples**	**Used**
Vessel type	Search and rescue vessel	
	Tanker; no additional information	
	Passenger; all ship of this type	
	Cargo; all ship of this type	
	Pleasure	
	Other type; all ship of this type	
	Not available	
	Tug	√
Time (UTC)	2013-01-14 05:33:41	√
Vessel mmsi no. (Maritime mobile service identity)	316278000	
Navigation status (0= underway using engine, 1= at anchor, 2 …. etc.)	0	
ROT (Rate of turn) (° / min)	0.0	
SOG (speed over ground) (knots)	8.7	
Latitude (°)	46.6270166667	√
Longitude (°)	-53.0057966667	√
COG (course over ground) (°)	211.0	
True heading (°)	207	
Length (m)	193	√
Breadth (m)	27	
Draught (m)	8.1	

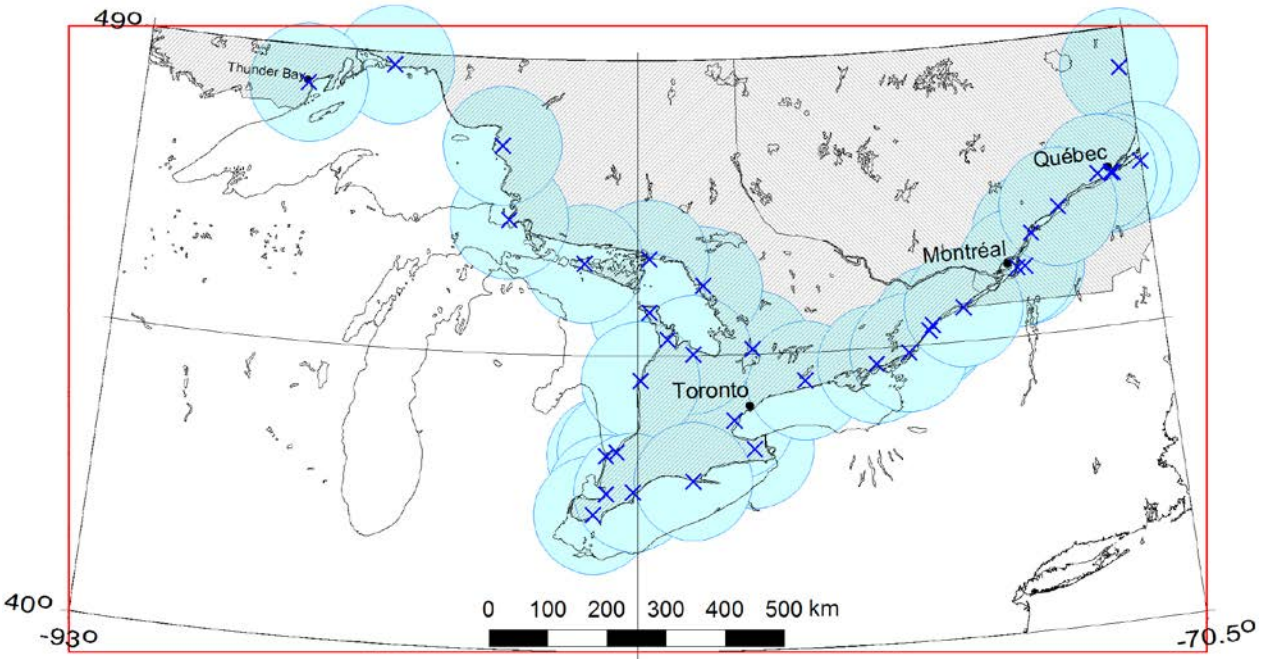

Figure 1. Map of the study area in Québec and Ontario showing the outer contour of the 1 km^2 mesh Cartesian grid (red rectangle) used for reporting the AIS shipping traffic density as delimited in Table 2 and the DFO–Coast Guard AIS antenna network, with radii of 100 km (blue circles).
The map coordinates are projected using the parameters of the Lambert conformal conic equal area projection of Table 3. Canadian area is hatched.

Table 2. Latitude and longitude limits of the study area used to compute the Cartesian grid.

Grid corner bin center	**Latitude N**	**Longitude W**
Bottom left	39.380°	92.886°
Top left	48.795°	94.950°
Bottom right	39.380°	70.614°
Top right	48.795°	68.550°

Table 3. Parameters of the Lambert conformal conic equal-area projection used for the conversion of the positions in latitude and longitude into the Cartesian grid. These parameters conform to WGS 84 datum.

Parameter	**Value**
Standard parallel 1	45.0° N
Standard parallel 2	50.0° N
Origin latitude	48.0° N
Origin longitude	81.75° W
Semimajor earth axis (km)	6378.137
Semiminor earth axis (km)	6356.75231424518
Earth flattening ratio	1/298.257223563

A large proportion (42%) of the *mmsi* numbers (for the whole year of 2013 and in all regions) had missing, wrong, or zero-length data. The missing lengths were partially filled by browsing Internet sites that provide ship characteristics for *mmsi* numbers, which allowed us to retrieve 1,203 ship lengths. Lengths were still zero for 4,075 *mmsi* (32% of all *mmsi*). Approximately ~25% the 12,645 *mmsi* numbers did not contribute to the shipping traffic maps because their sailing speed was less than 1 knot, which was below the threshold for inclusion in the analysis (see below).

The AIS-SOG field was discarded because this field was sometimes missing (SOG code =1023) for some ships and was often contaminated by erroneous values. The SOG used in the atlas was therefore computed from the correct positions using a multi-step filter that removed speeds exceeding 40 knots and smoothed the fast fluctuations with a moving average on 900 s. Cross-checks with valid AIS-SOG series showed that our estimated SOG was unbiased, properly tracked the vessel speed, and was robust to non-plausible large speed fluctuations.

In AIS communication protocols, positions are not broadcasted at a constant or the same rate for all ships. The data transmission pace varies depending on the AIS class (A or B), the ship speed, and the availability of the VHF transmission band. In addition, there were periods of variable durations along a ship track from which no positions were available. Therefore mapping ship traffic with AIS data is not a direct plot of broadcasted AIS positions. The time–position data must first be interpolated on a common time grid before proceeding to the mapping. Hence, before estimating the time spent by ships in a given area, all positions were interpolated to a same time step of 10 s. Position gaps along ship tracks were filled by interpolation, up to a maximum of 3 h, to account for gaps in reception either resulting from ships that were out of range of AIS coastal antenna or data stream interruptions from the server. Gaps longer than 3 h for the same ship were considered as two different tracks. (See Discussion for unwanted effects introduced by this interpolation).

The 1 × 1 km mesh grid used for reporting the traffic (Fig. 1) was obtained by projecting the latitude and longitude limits of the study area (Table 2) onto a Cartesian grid using a Lambert conformal conic equal-area projection using the parameters given in Table 3.

The metric used to map the AIS traffic density is *daily ship-h per 1 × 1 km grid cell*. One ship spending 0.5 h in a 1 km^2 grid cell in a given day would give 0.5 daily ship-h of traffic. Two ships spending 0.25 h in 1 km^2 grid cell would also give 0.5 daily ship-h of traffic. This metric is computed using only the ships that are underway (i.e., SOG > 1 knot [1.85 km h^{-1}]). This criterion eliminates data from anchored or docked ships as well as AIS data coming from fixed antennae or beacons, notably fishing AIS beacons, which are included in the analyzed raw AIS data bank.

The atlas maps present yearly and monthly statistics of the traffic metrics by ship category as indicated in Figure 2. For each period (i.e., the whole year and the 12 months individually), 23 traffic maps are computed for the following:

(a) the total traffic from all vessels (the mean and the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles of the distribution of the daily traffic density per 1 km^2 grid cell);
(b) the mean traffic corresponding to seven vessel types (cargo carriers, tankers, passengers, tugs, fishing, pleasure, and others ships [including ships of unidentified types]);

(c) the mean traffic corresponding to five different ship length classes (< 10 m, 10–50 m, 50–150 m, 150–250 m, and > 250 m);
(d) the total traffic separated into five ship–SOG classes (2–5 knots, 5–10 knots, 10–15 knots, 15–20 knots, and > 20 knots).

The equations are:

$$Mean\ traffic_{Cl(x,y)} = \frac{1}{n}\sum_{k=1}^{n} Daily\ traffic_{Cl(x,y)}$$

where *Cl* is the vessel category considered, (*x*,*y*) are the coordinates of the 1 km^2 grid cell, and *n* is the number of days corresponding to the period (year or month).

$$Traffic\ percentile_{T\alpha\ ALL(x,y)} = Percentile_{T\alpha\ Cl}(Daily\ traffic_{ALL(x,y)})$$

where α is the considered percentile of the daily traffic distribution for the period T (year, month). These percentiles are computed for all vessel traffic only (Fig. 2).

Overall, a total of 299 maps are presented. A common exponential six-colour palette was used for displaying the traffic density for the whole atlas (Table 4). White corresponds to null traffic. The allocation of traffic density to colours follows a geometric series with a doubling ratio. This allows highlighting the densest traffic areas while keeping the differences in low traffic densities visible.

For each map, the cumulative histogram of the mapped non-null traffic density per 1 km^2 grid cell is provided in a superimposed bar chart, where each bar corresponds to the traffic density intervals of the map palette (Table 4). The total number of 1 km^2 grid cells containing non-null traffic is also provided below the palette as well as the sum of the daily traffic. These statistics can be used to compare regional traffic among maps. The total traffic density per 1 km^2 grid cell for the map period is the product of the mapped daily traffic values per 1 km^2 grid cell times the number of days. The total traffic is the sum of the daily traffic times the number of days.

Table 4. Colour palette used to display the AIS shipping traffic in the atlas maps.

Traffic (ship-h per 1 km^2 grid cell)	**Color**	**Cumulative histogram traffic density class**
No traffic	white	nil
> 0 to 0.0025	dark blue	1
> 0.0025 to 0.005	cyan	2
> 0.005 to 0.01	green	3
> 0.01 to 0.02	yellow	4
> 0.02 to 0.04	orange	5
> 0.04	red	6

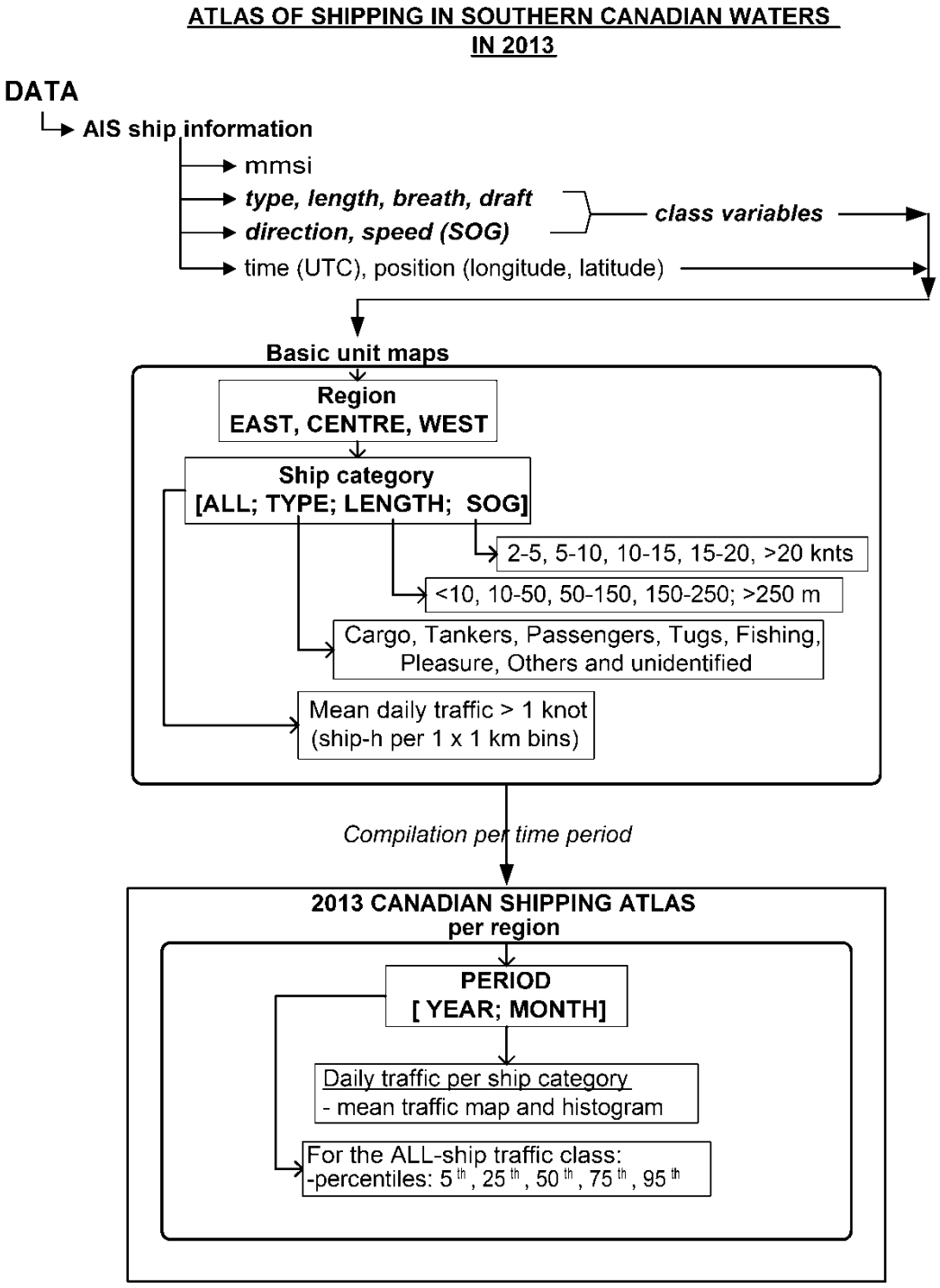

Figure 2. Flow diagram of the AIS data processing for computing the various shipping traffic maps of the atlas.

3. RESULTS

The atlas maps are arranged by year and by month and are presented in sections 7 and 8 of this report. In each section, the maps of all ship traffic statistics are presented first, then the maps of the mean traffic per ship length and ship SOG categories. How to properly interpret the traffic percentile maps is indicated in the figure legends and the Discussion. These total traffic percentile maps are effective for rapidly locating the high traffic density areas. For example, the 5^{th} or 25^{th} traffic percentile maps reveal areas where the traffic is most intense, having been respectively visited at least 95% or 75% of the days in the considered period. Inversely, the null traffic areas on the 95^{th} traffic percentile map indicate low density areas where there was no traffic at least 95% of the days.

4. DISCUSSION

Traffic studies for this part of Canadian waters have been conducted for tracking ballast water operations in the context of the introduction of invasive species (Colautti et al. 2003, Rup et al. 2010). However, the ensemble of maps presented in this report constitutes the first atlas of shipping traffic for this part of Canadian waters. The atlas provides high-resolution traffic density maps for a large fraction of the shipping traffic using a precise traffic-density metric and detailed layers for supporting several marine spatial planning tasks. It offers a reasonable representation of the present traffic throughout the annual cycle for different ship types, length classes, and sailing speeds within at least a 100 km radius of the coastline. However, the user must recognize the limitations of this atlas, especially that only AIS-equipped vessels are considered. Although AIS traffic includes almost all merchant shipping, a fraction of the total traffic is still missing. For instance, although a part of the pleasure fleet is equipped with AIS, an unknown and spatially variable proportion is not. Given the various contributors to AIS data, knowing the relative contribution of the different ship types appears critical in interpreting total traffic maps.

Another limitation is that the information that was used to separate ships by type and length class is sometimes erroneous or simply lacking, especially for small vessels. Although we invested much time in correcting and completing the received AIS information by consulting ship lists on the Internet, we know that errors are still present and that information is still missing for several ships. As a consequence, the maps of the ship category “other ships and ships of unidentified type” includes traffic that should have contributed to other maps. Similarly, the traffic maps by ship length may contain ships that are not in the right length class and do not include the proportion of ships with unknown lengths. Therefore the reader must use the atlas for the regional picture it presents on shipping traffic and not put too much emphasis on particular outliers.

The 3 h linear interpolation approach we adopted to correct for the data interruptions successfully filled the ship-track gaps that would otherwise have been numerous. However, this approach sometimes had the unwanted drawback of positioning ships on land when they were changing course to sail around islands or curved coastlines. One way of mitigating this effect is to superimpose the land over the traffic to mask the tracks located on land. This had the unwanted

consequence of masking all near-shore grid cells partially covered by land. We therefore chose to leave these false traffic track lines visible, after erasing by hand the most striking ones.

An implicit assumption of the atlas is that the fraction of the total fleet equipped with AIS did not change over the annual cycle. This is likely, but we cannot confirm it is true. It is also possible that the AIS reception antenna network did not entirely and uniformly cover the whole study area and that some traffic was missed in a few locations, continuously or intermittently for some periods. Such reception gaps would, however, mostly occur > ~100 km offshore. The interpolation approach we used in making the maps has also likely filled most of the embedded reception gaps and bridged time gaps.

For each map, the total sum of the 1 km^2 grid cells where some traffic was encountered is provided. However, it is wrong to interpret this as the area covered by shipping for the considered period, since the physical footprints of ships are much less than 1 km^2 and ship density varies by grid cell. This value is given to assist in comparing the relative importance of given types of traffic throughout the annual atlas. It can be used in combination with the corresponding total daily traffic.

The maps of the daily traffic density percentiles reveal different properties of the total shipping traffic than the maps of the single central statistic (i.e., mean) used elsewhere in the atlas. Their interest for marine spatial planning is to provide, for each 1 km^2 bin, how the daily traffic was distributed at a given location within the month or the whole year. For example, if the traffic was constant throughout the period, all traffic percentiles for this location would have a traffic density equal to the mean because of the uniform probability distribution of the traffic. If the traffic was nil half of the days, then the traffic density percentiles < 50% would have a traffic density of zero. The mean would show some traffic at the location, but the absence of traffic for half of the days would go unnoticed. Likewise, if the traffic was very intense on a few days (of the month or year) and nil the other days, then all traffic percentiles but the highest (e.g., 95%) would have a zero traffic density. This would clearly show the highly sporadic nature of the traffic at this location. On the contrary, when the low traffic density percentiles (e.g., 5% or 25%) are not zero at a given location, this location is likely part of a regularly used sea route. Another interest of the traffic density percentile maps is to provide values of the traffic density associated with sea routes and busy traffic hot spots (e.g., daily traffic density in the 75^{th} or 95^{th} percentiles). When considered over the whole map, the series of traffic density percentiles illustrate how the traffic is spatially distributed over the month or year and its density better than mean traffic density, which blurs the information by averaging over the whole month.

5. ACKNOWLEDGMENTS

This work was supported by Fisheries and Oceans Canada. We are grateful to Michel Desparois and Jean-François Coutu for access to the AIS DFO–Coast Guard data. We thank Cédric Gervaise and Bazile Kinda of the Chair Chorus of the Grenoble Institute of Technology for the initial AIS decoding Python code, Jean-Philippe Lapierre for his help in the acquisition and storing of the AIS data stream from the server, and Gilles Fortin for his help with GIS and

geographic data. Thanks to Laure Devine for her editorial work and contribution to improve the readability of the report, and to Martine Giangioppi, Léa Olsen, and Sarah Bailey for reviewing the manuscript.

6. REFERENCES

Bailey, S.A., Chan, F., Ellis, S.M., Bronnenhuber, J.E., Bradie, J.N., and Simard, N. 2012. Risk assessment for ship-mediated introductions of aquatic nonindigenous species to the Great Lakes and freshwater St. Lawrence River. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/104.

Clark, C., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S., Frankel, A.S., and Ponirakis, D. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Mar. Ecol. Prog. Ser. 395: 201-222.

Colautti, R.I., Niimi, A.J., van Overdijk, C.D.A., Mills, E.L., Holeck, K., and MacIsaac, H.J. 2003. Spatial and temporal analysis of transoceanic shipping vectors to the Great Lakes. *In* Invasive species vectors and management strategies. *Edited by* G.M. Ruiz and J.T. Carlton. Island Press, Washington DC. pp. 227-246.

DiBacco, C., Humphrey, D.B., Nasmith, L.E., and Levings, C.D. 2012. Ballast water transport of non-indigenous zooplankton to Canadian ports. ICES J. Mar. Sci. 69(3): 483-491.

Gervaise, C., Simard, Y., Roy, N., Kinda, B., and Menard, N. 2012. Shipping noise in whale habitat: characteristics, sources, budget, and impact on belugas in Saguenay - St. Lawrence Marine Park hub. J. Acoust.Soc. Am. 132: 76-89.

Greig, L., and Abraham, D. 2014. National shipping pathways of effects models. DFO Can. Sci. Adv. Sec. Res. Doc. in press.

Koropatnick, T., Johnston, S.K., Coffen-Smout, S., Macnab, P., and Szeto, A. 2012. Development and applications of vessel traffic maps based on long range identification tracking (LRIT) data in Atlantic Canada. Can. Tech. Rep. Fish. Aquat. Sci. 2966.

Rup, M.P., Bailey, S.A., Wiley, C.J., Minton, M.S., Miller, A.W., Ruiz, G.M., and MacIsaac, H.J. 2010. Domestic ballast operations on the Great Lakes: potential importance of Lakers as a vector for introduction and spread of nonindigenous species. Can. J. Fish. Aquat. Sci. 67: 256-268.

Simard, Y., Roy, N., and Gervaise, C. 2006. Shipping noise and whales: World tallest ocean liner vs largest animal on earth. *In* Proceedings of OCEANS'06 MTS/IEEE, Boston, 18-21 Sept. 2006, IEEE, Piscataway, NJ, pp. 1-6. DOI: 10.1109/OCEANS.2006.307053

Simard, Y., Lepage, R., and Gervaise, C. 2010. Anthropogenic sound exposure of marine mammals from seaways: Estimates for lower St. Lawrence Seaway, eastern Canada. Appl. Acoust. 71: 1093-1098.

Simard, Y., Roy, N., Giard, S., and Yayla, M. 2014a. Canadian year-round shipping traffic atlas for 2013: Volume 1, East Coast marine waters. Can. Tech. Rep. Fish. Aquat. Sci. 3091(Vol.1)E.

Simard, Y., Roy, N., Giard, S., and Yayla, M. 2014b. Canadian year-round shipping traffic atlas for 2013: Volume 3, West Coast. Can. Tech. Rep. Fish. Aquat. Sci. 3091(Vol.3)E.

UNCTAD. 2013. Review of maritime transport no. E.12.II.D.17. United Nations, Geneva. http://unctad.org/en/PublicationsLibrary/rmt2013_en.pdf.

van der Hoop, J.M., Vanderlaan, A.S.M., and Taggart, C.T. 2012. Absolute probability estimates of lethal vessel strikes to North Atlantic right whales in Roseway Basin, Scotian Shelf. Ecol. Appl. 22(7): 2021-2033.

7. YEARLY TRAFFIC MAPS

All AIS traffic

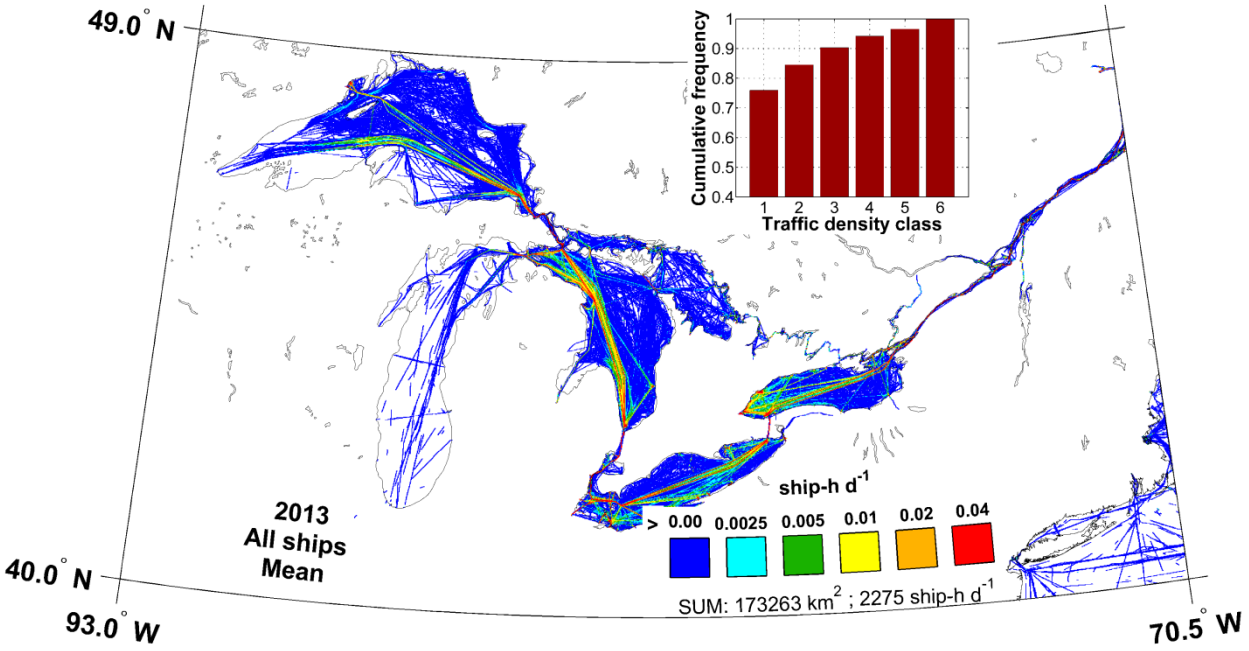

Figure 3. Map of AIS mean traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

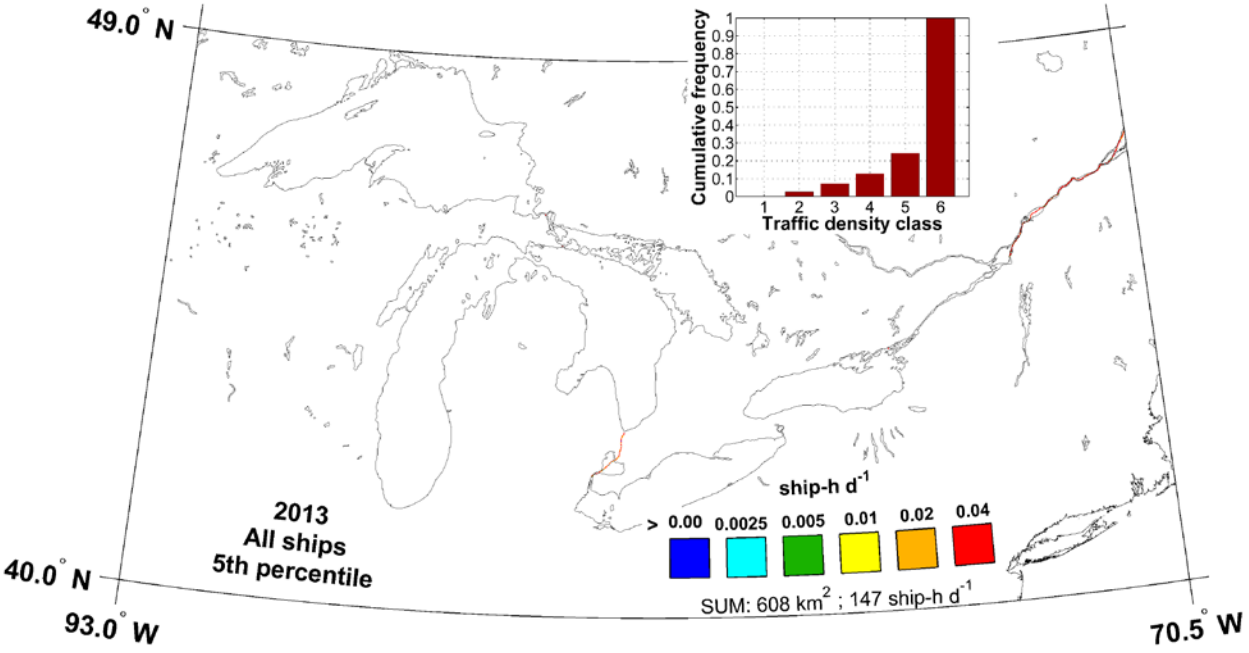

Figure 4. Map of the 5th percentile of the daily AIS traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

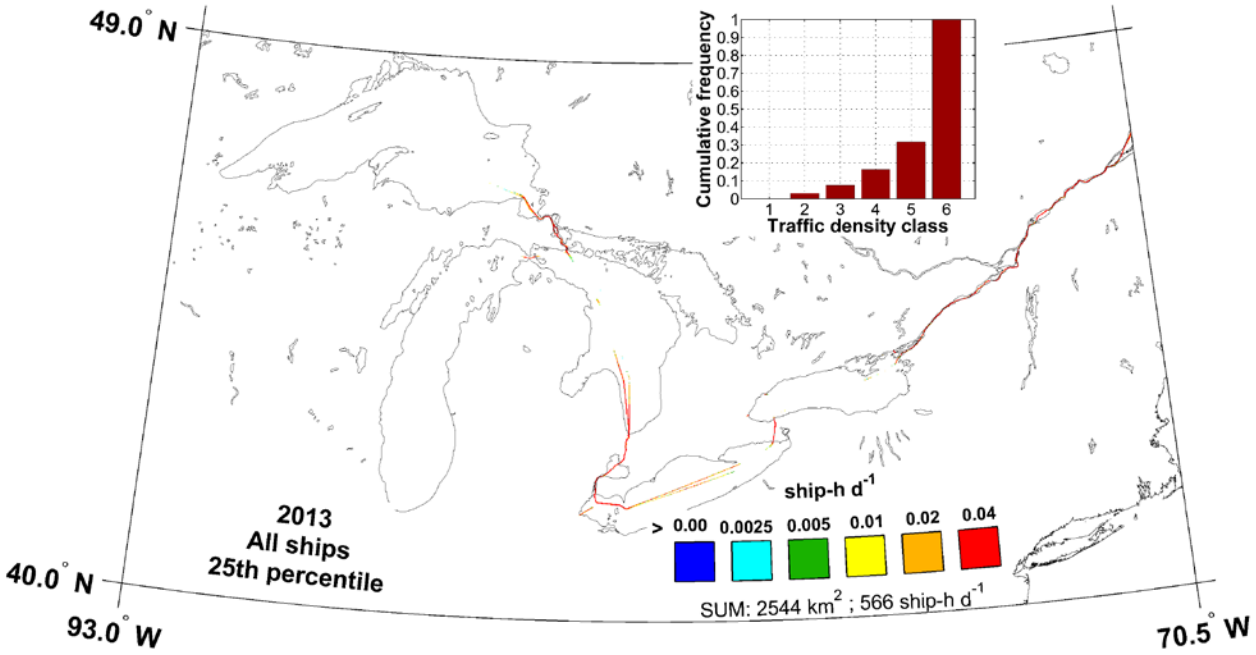

Figure 5. Map of the 25th percentile of the daily AIS traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

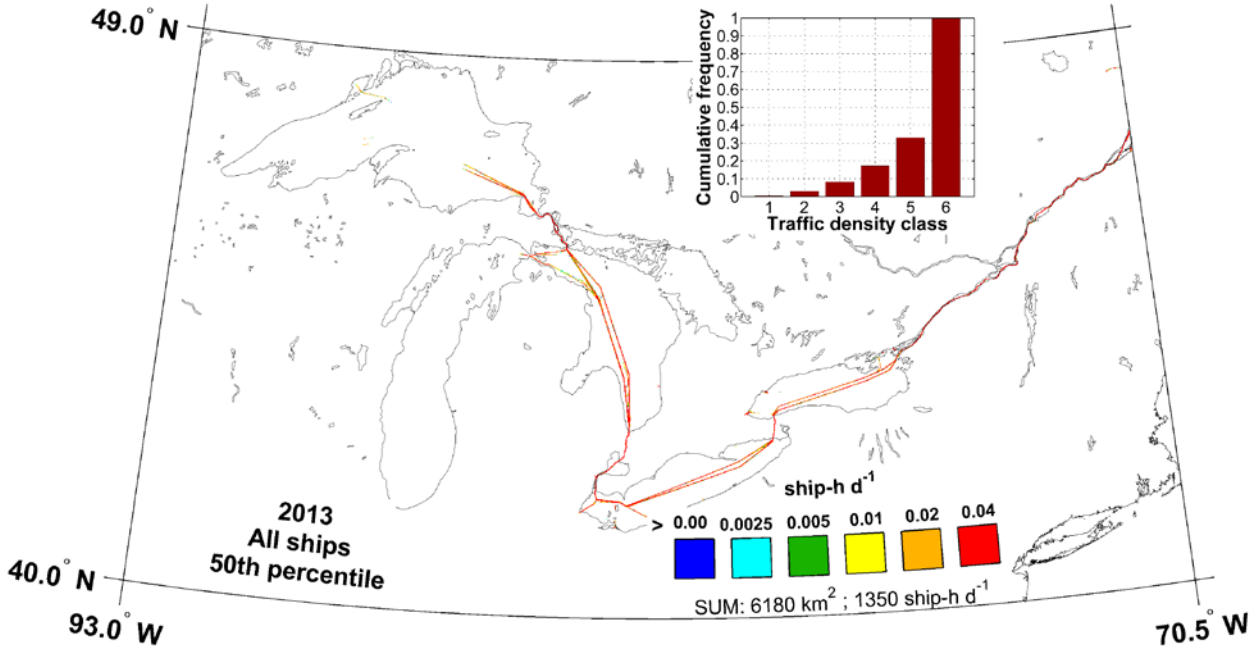

Figure 6. Map of the 50th percentile of the daily AIS traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

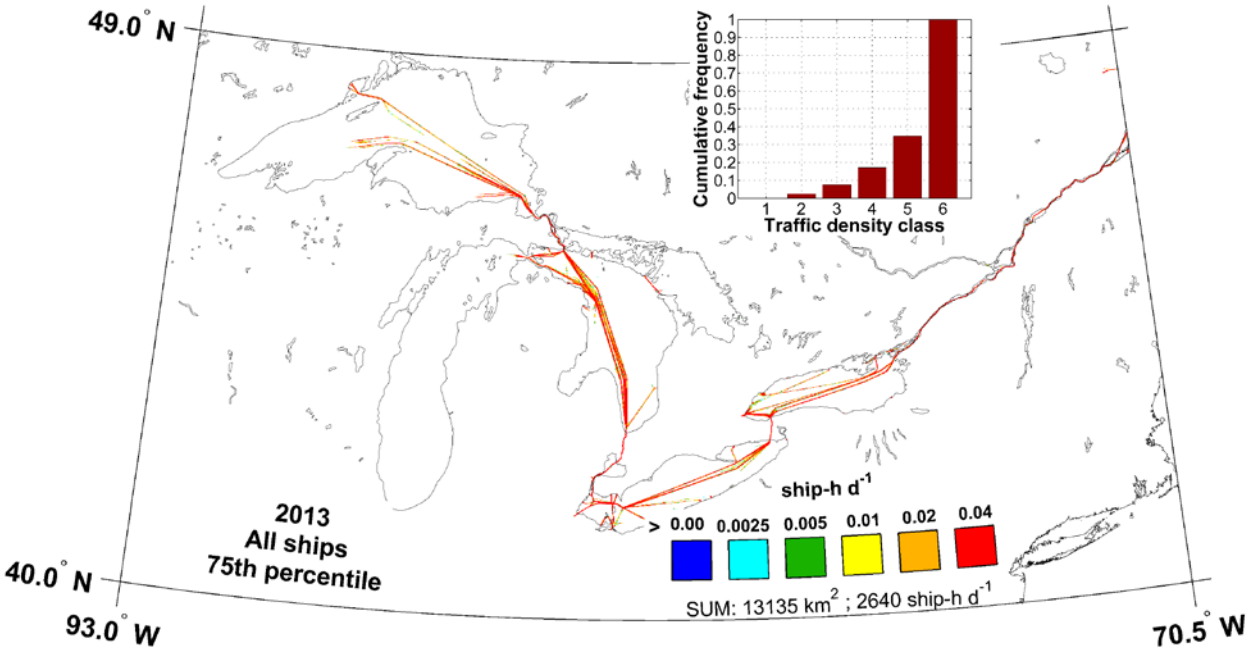

Figure 7. Map of the 75th percentile of the daily AIS traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

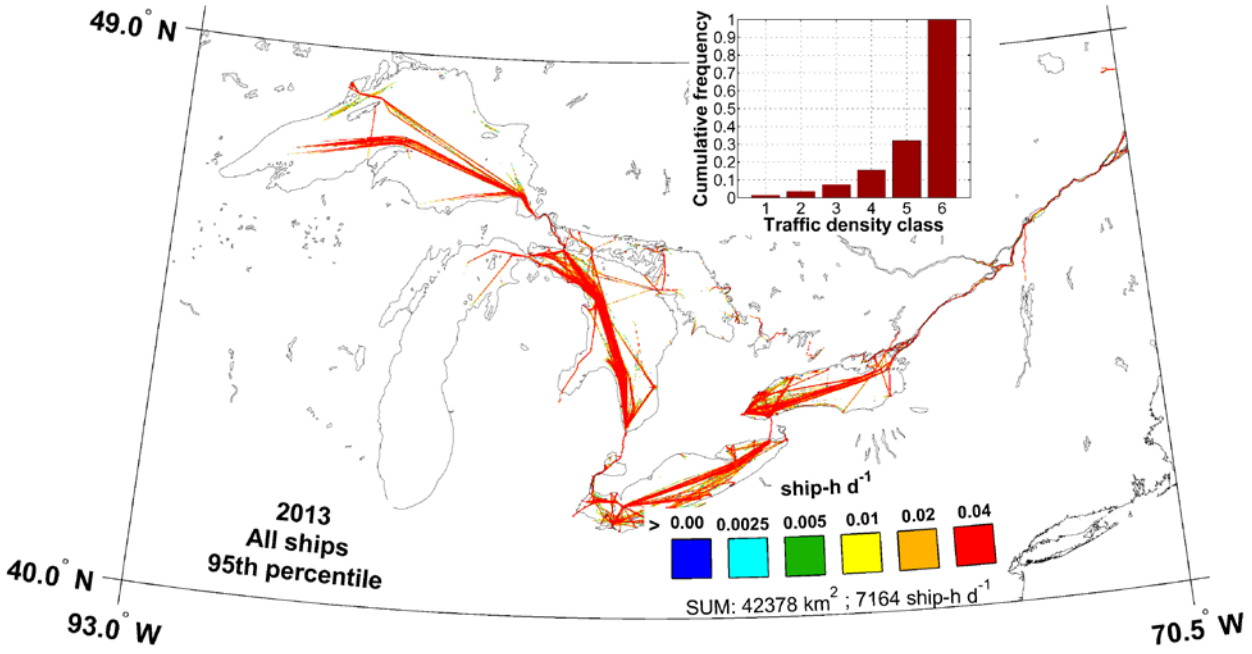

Figure 8. Map of the 95th percentile of the daily AIS traffic density of all ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

AIS traffic by ship types

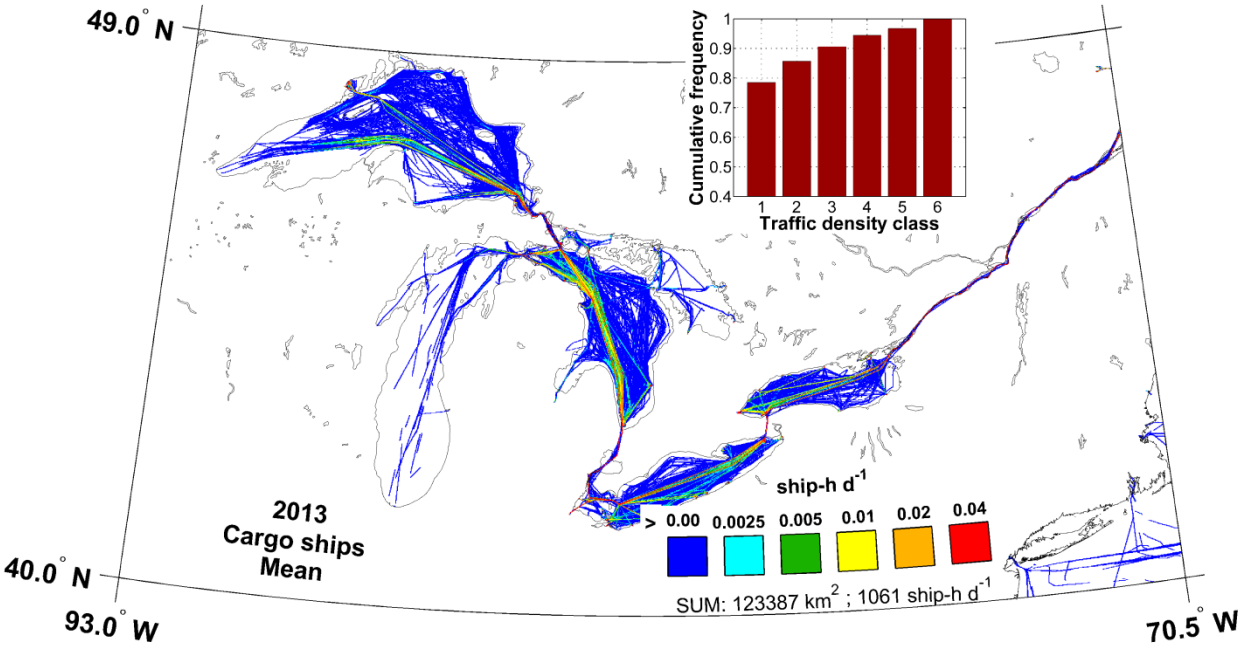

Figure 9. Map of AIS mean traffic density of cargo-type ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

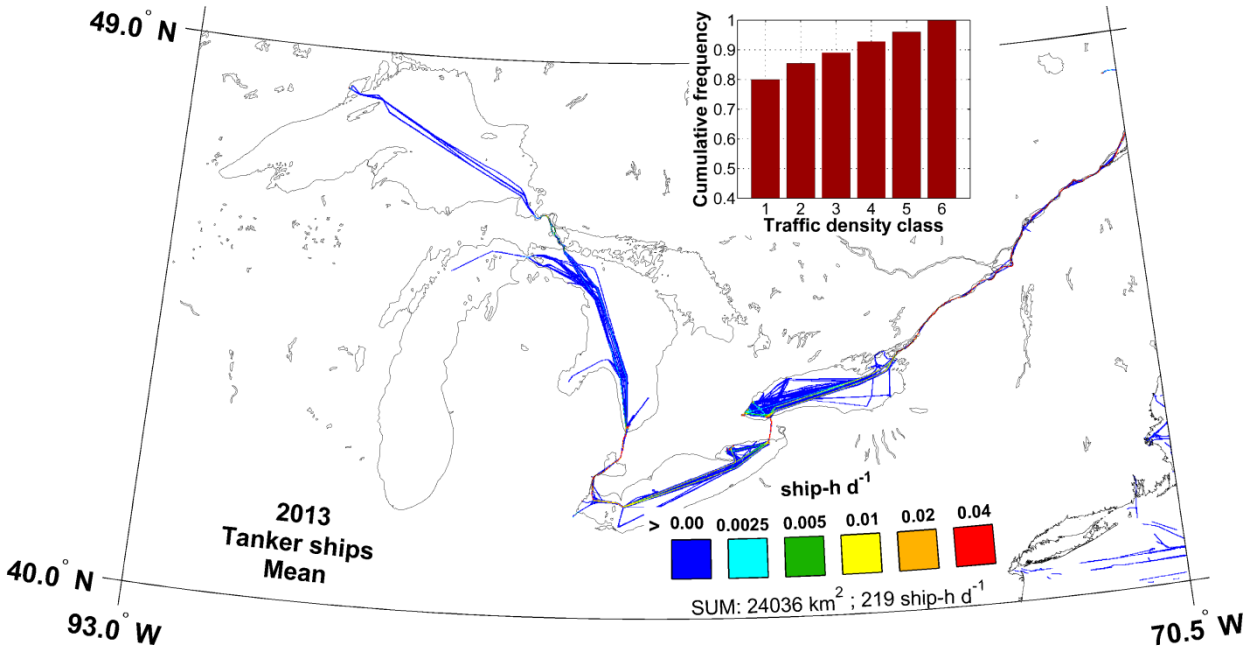

Figure 10. Map of AIS mean traffic density of tanker-type ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

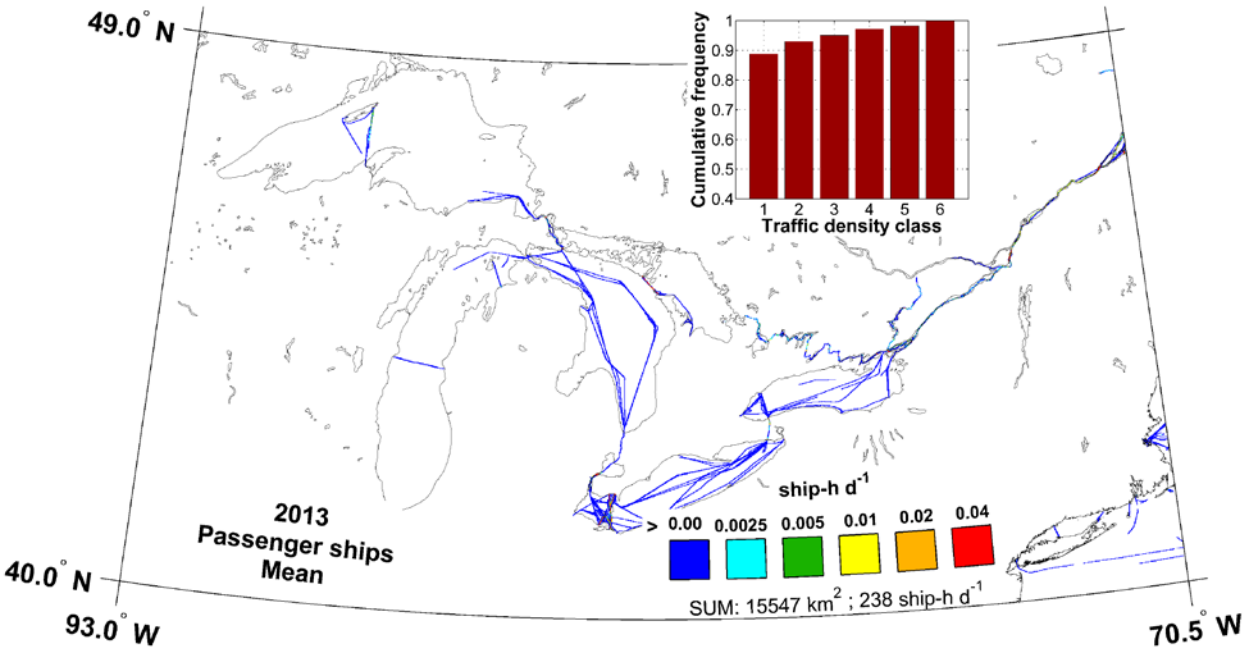

Figure 11. Map of AIS mean traffic density of passenger-type ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

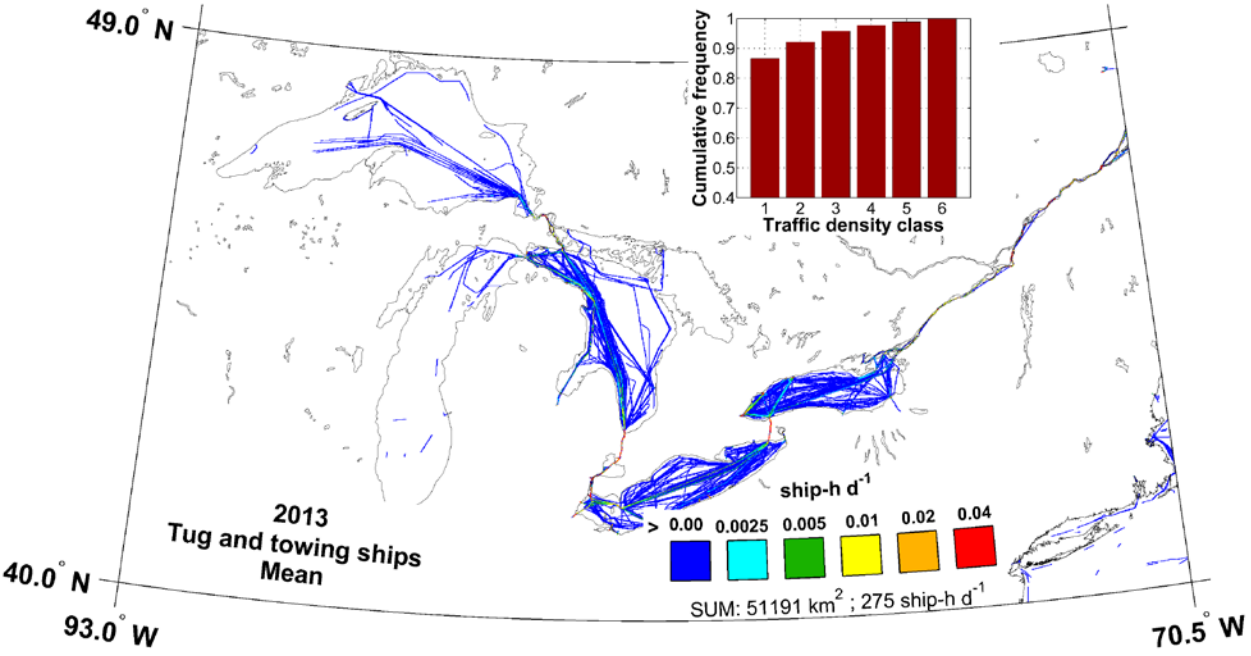

Figure 12. Map of AIS mean traffic density of tug and towing-type ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

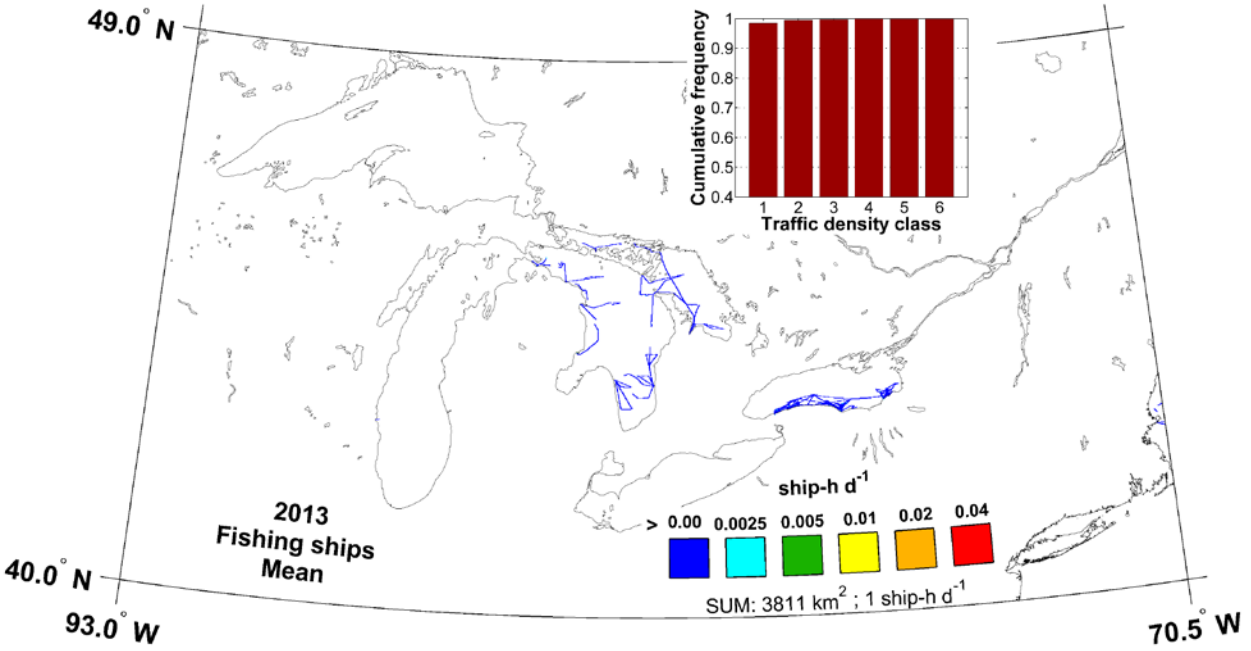

Figure 13. Map of AIS mean traffic density of fishing-type ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

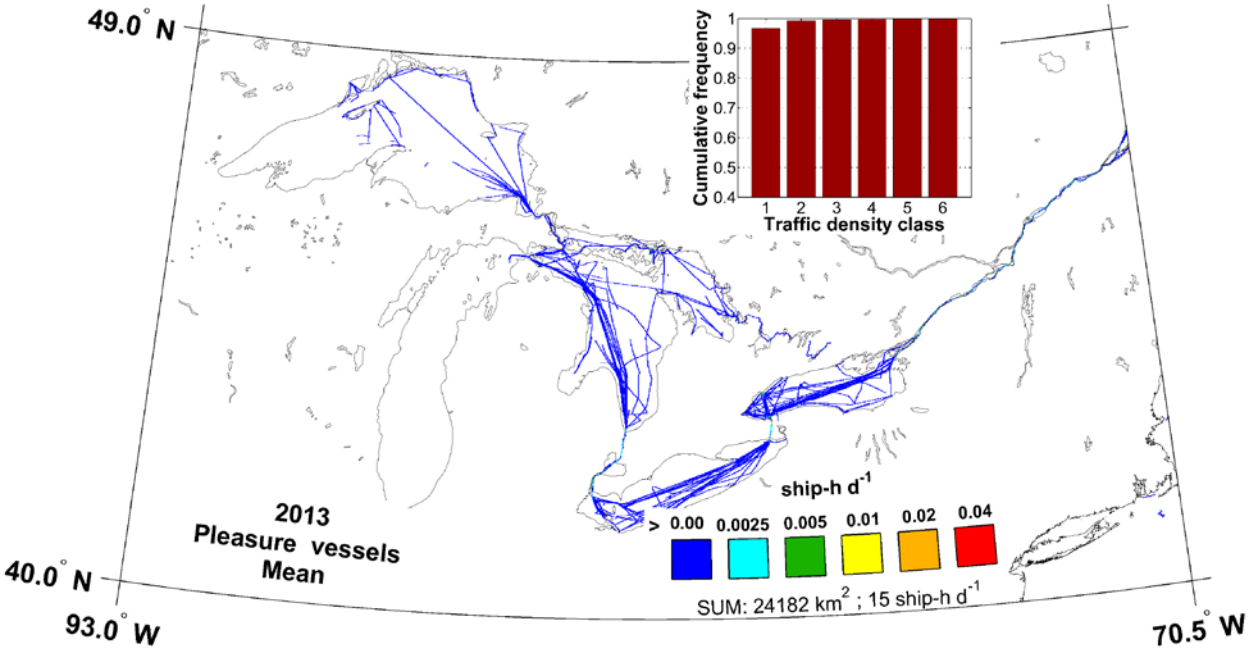

Figure 14. Map of AIS mean traffic density of pleasure-type vessels in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

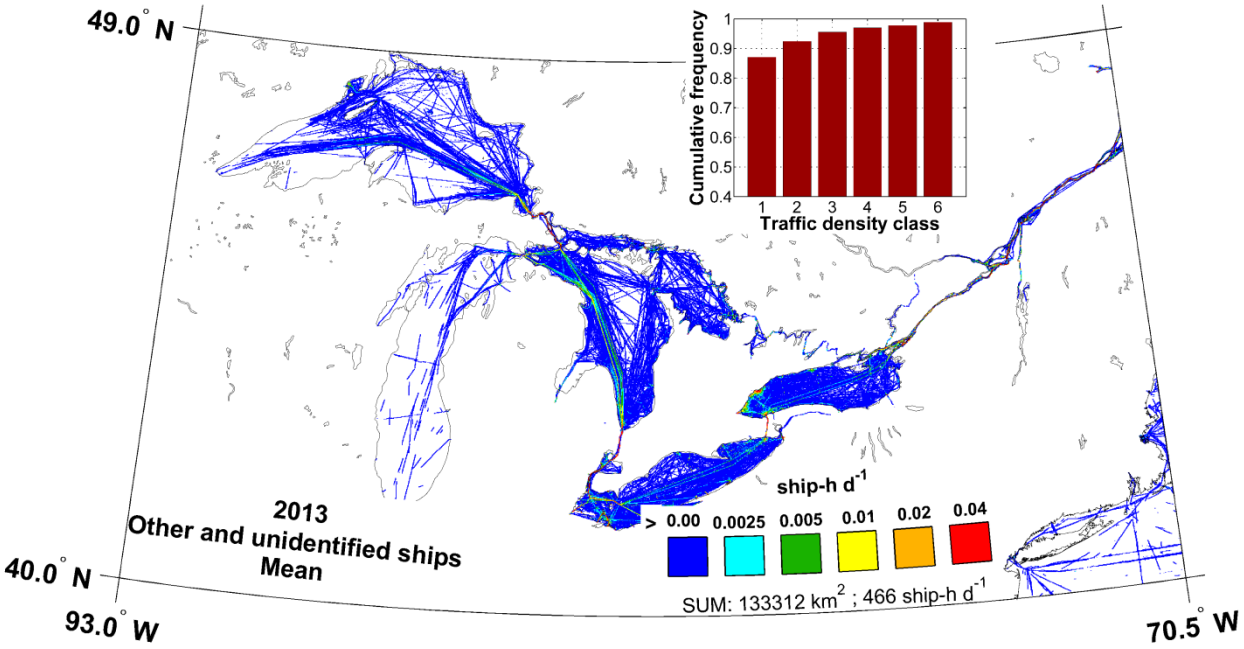

Figure 15. Map of AIS mean traffic density of other types of ships and ships of unidentified type in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

AIS traffic by ship length classes

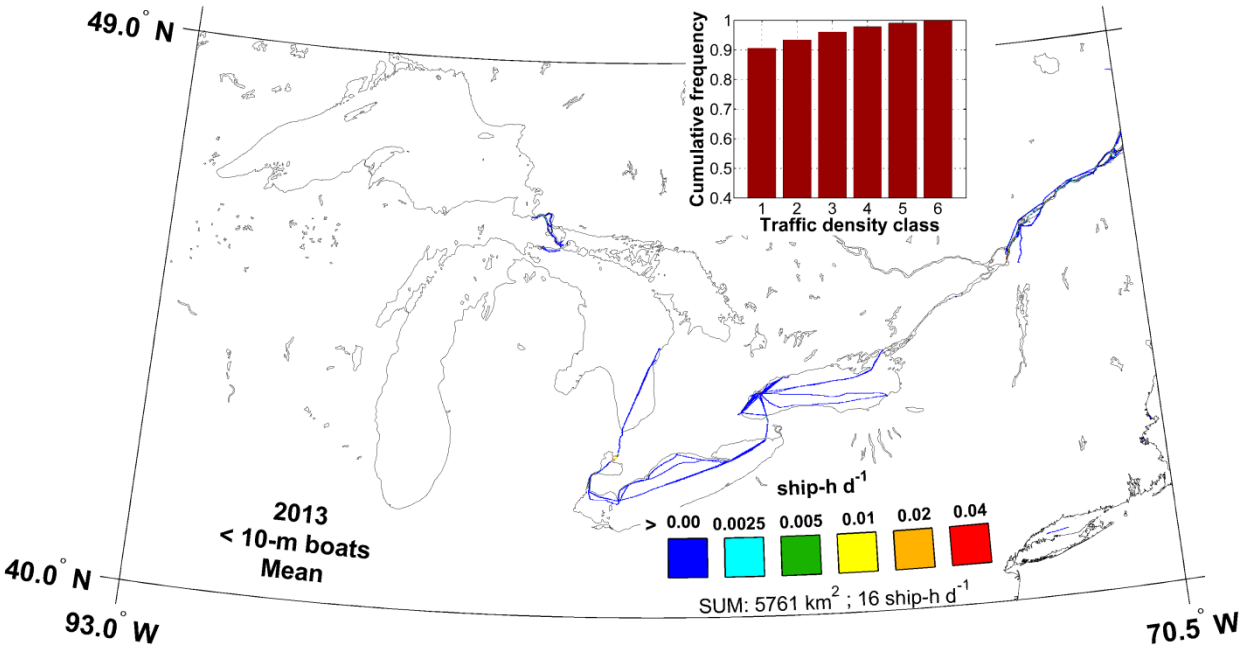

Figure 16. Map of AIS mean traffic density of ships with lengths < 10 m in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

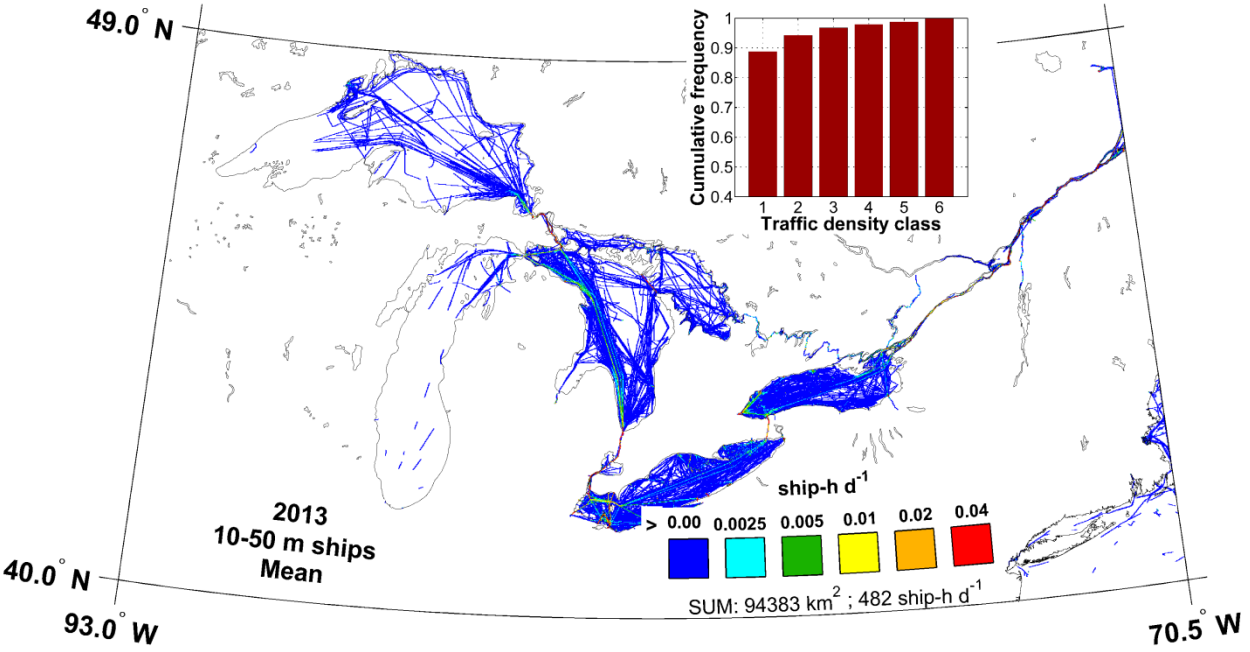

Figure 17. Map of AIS mean traffic density of 10 to 50 m ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

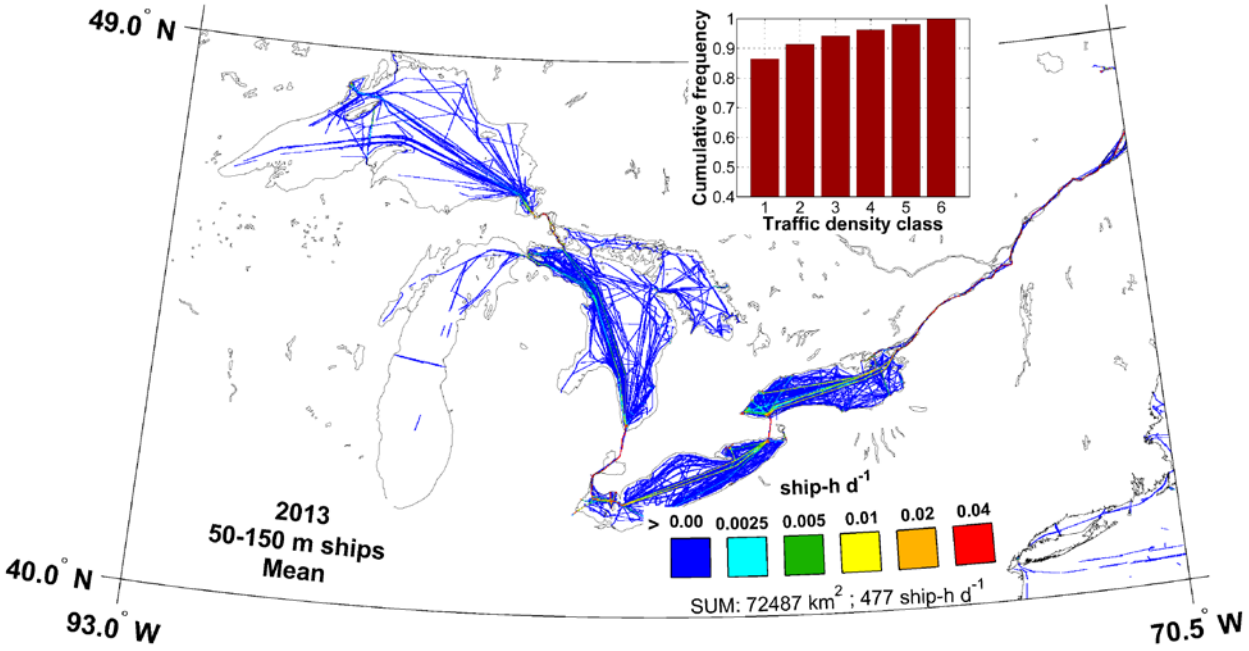

Figure 18. Map of AIS mean traffic density of 50 to 150 m ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

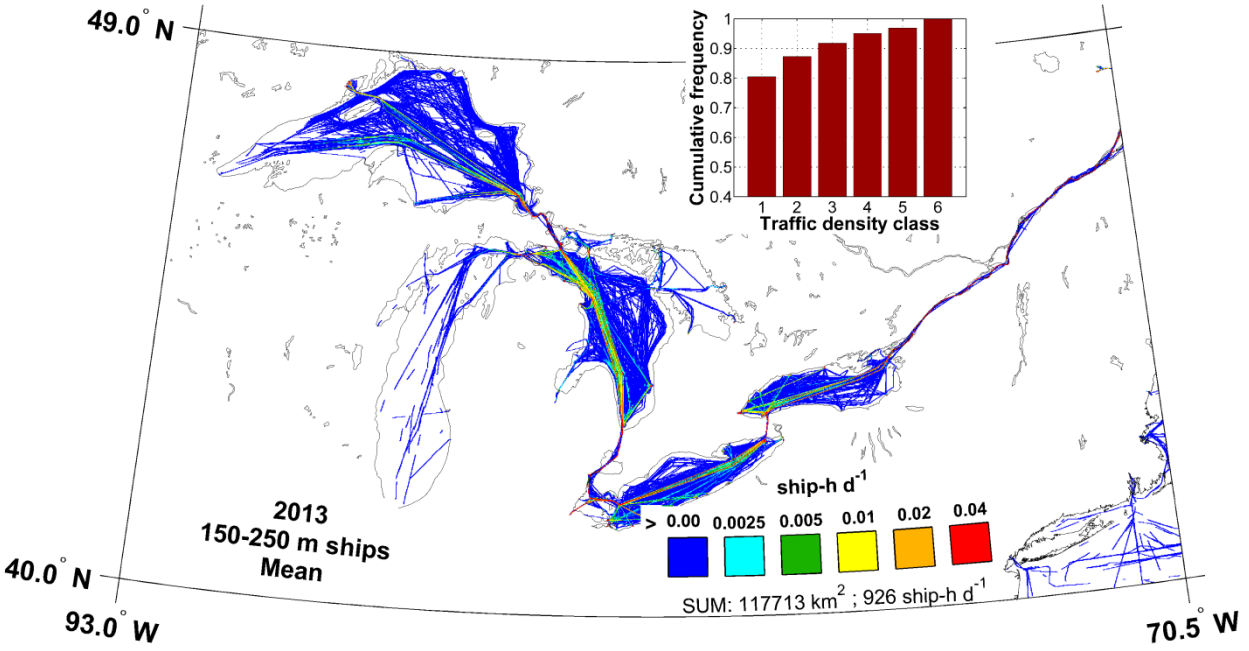

Figure 19. Map of AIS mean traffic density of 150 to 250 m ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

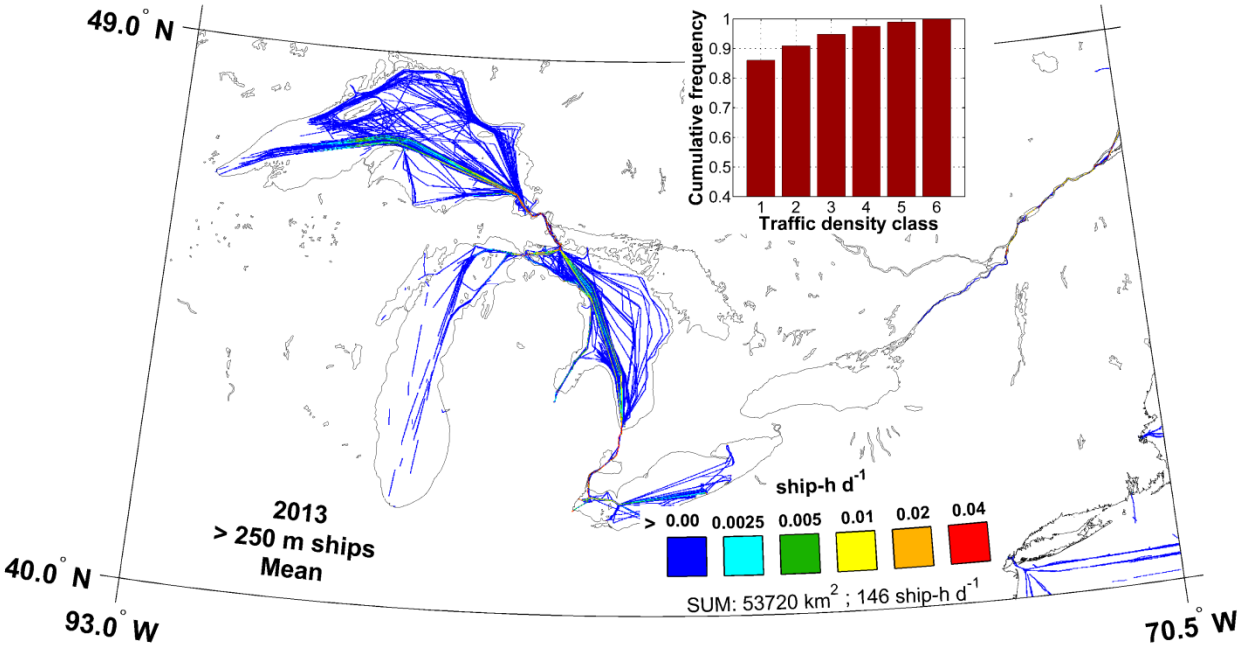

Figure 20. Map of AIS mean traffic density of > 250 m ships in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

AIS traffic by speed categories

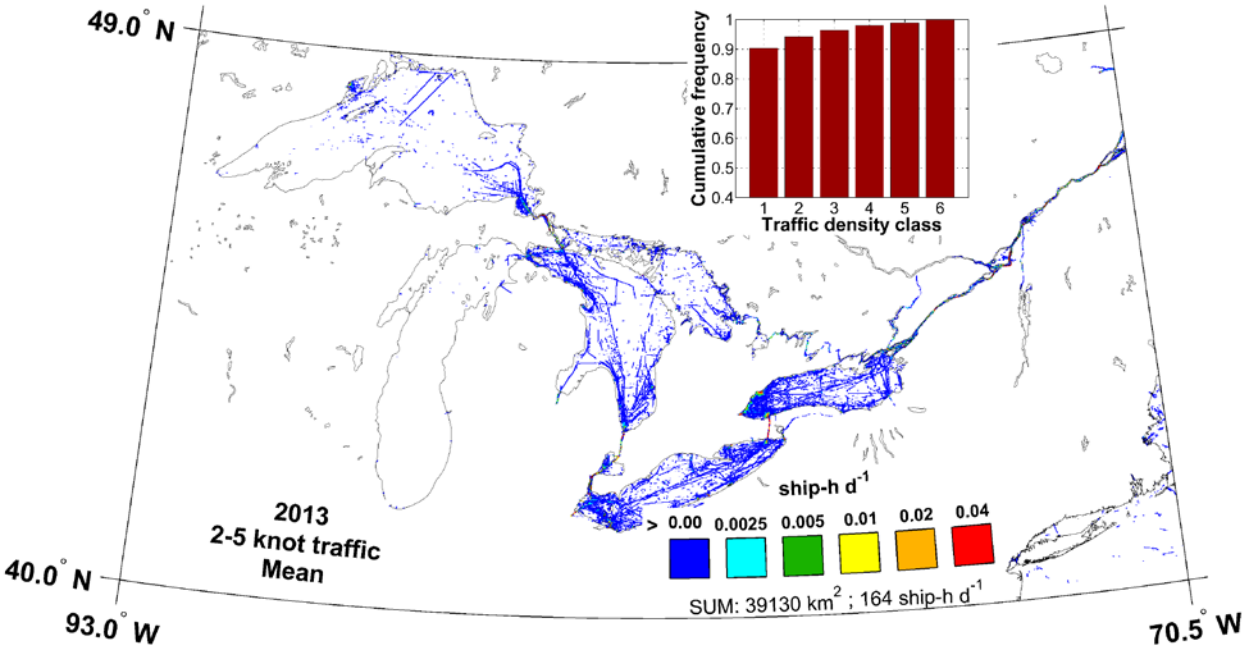

Figure 21. Map of 2–5 knot AIS mean traffic density in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

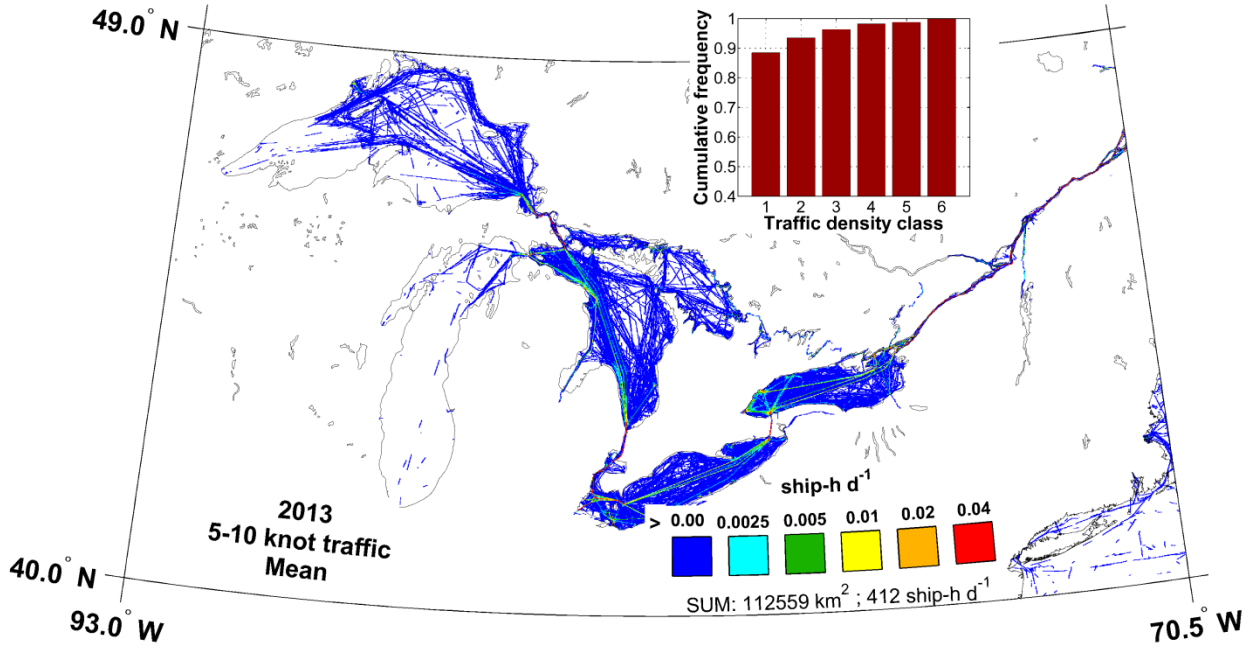

Figure 22. Map of 5–10 knot AIS mean traffic density in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

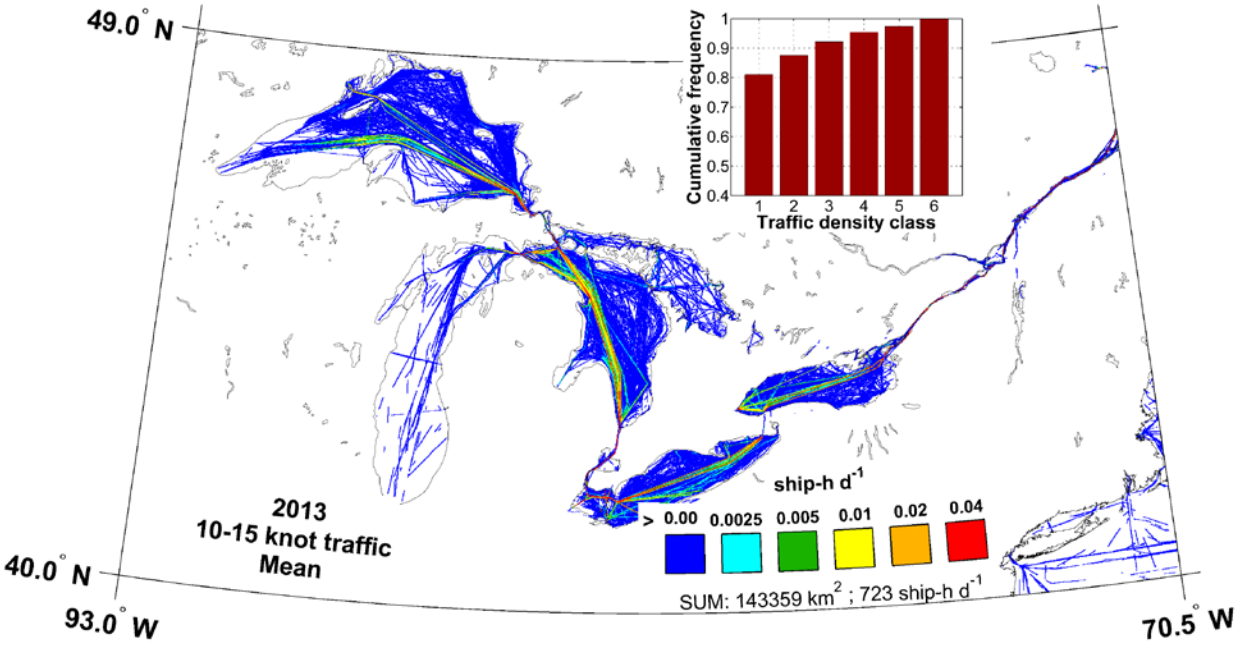

Figure 23. Map of 10–15 knot AIS mean traffic density in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

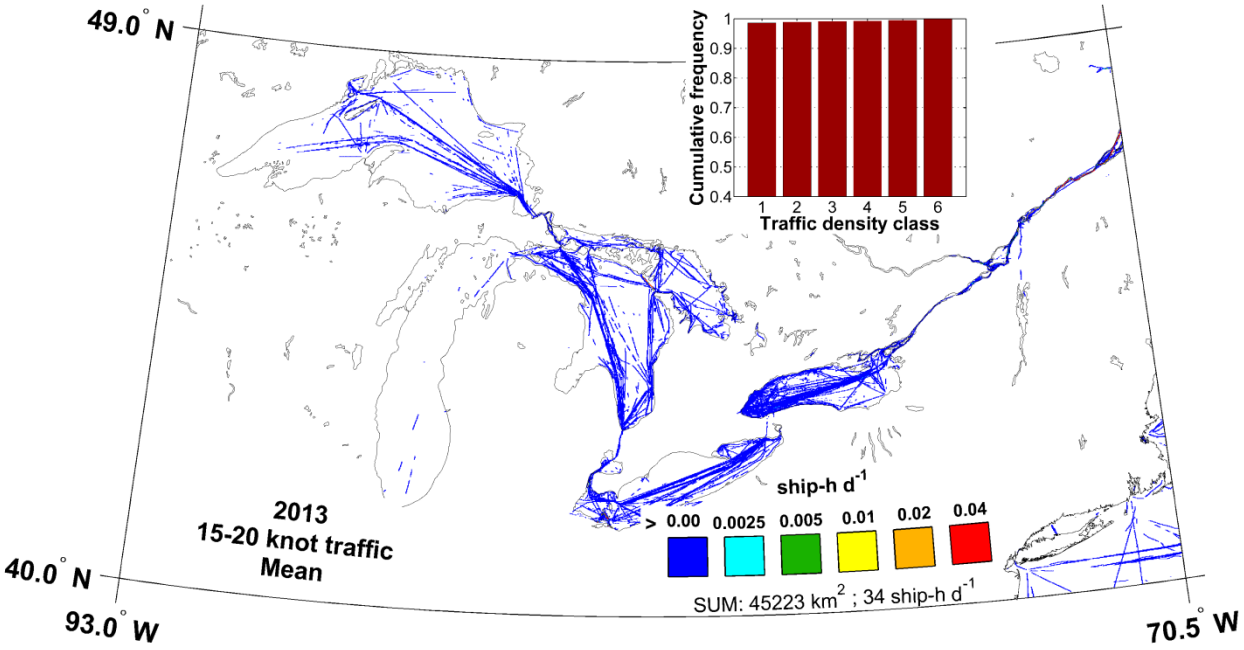

Figure 24. Map of 15–20 knot AIS mean traffic density in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

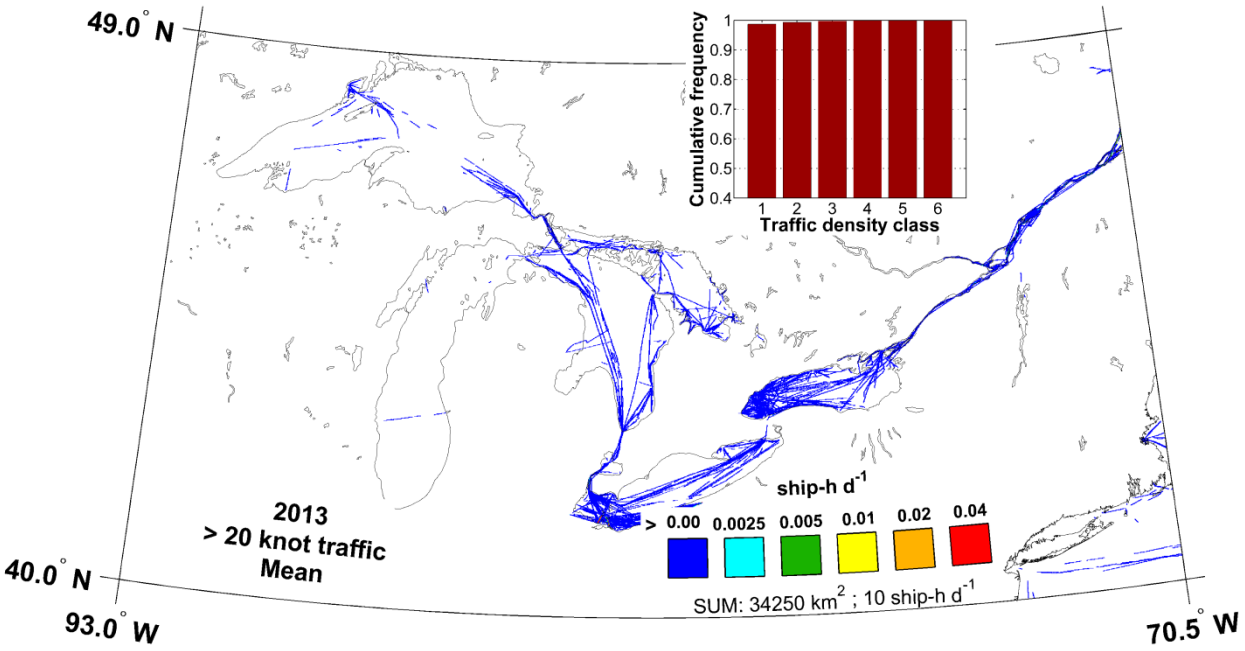

Figure 25. Map of >20 knot AIS mean traffic density in 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8. MONTHLY TRAFFIC MAPS

8.1. January 2013

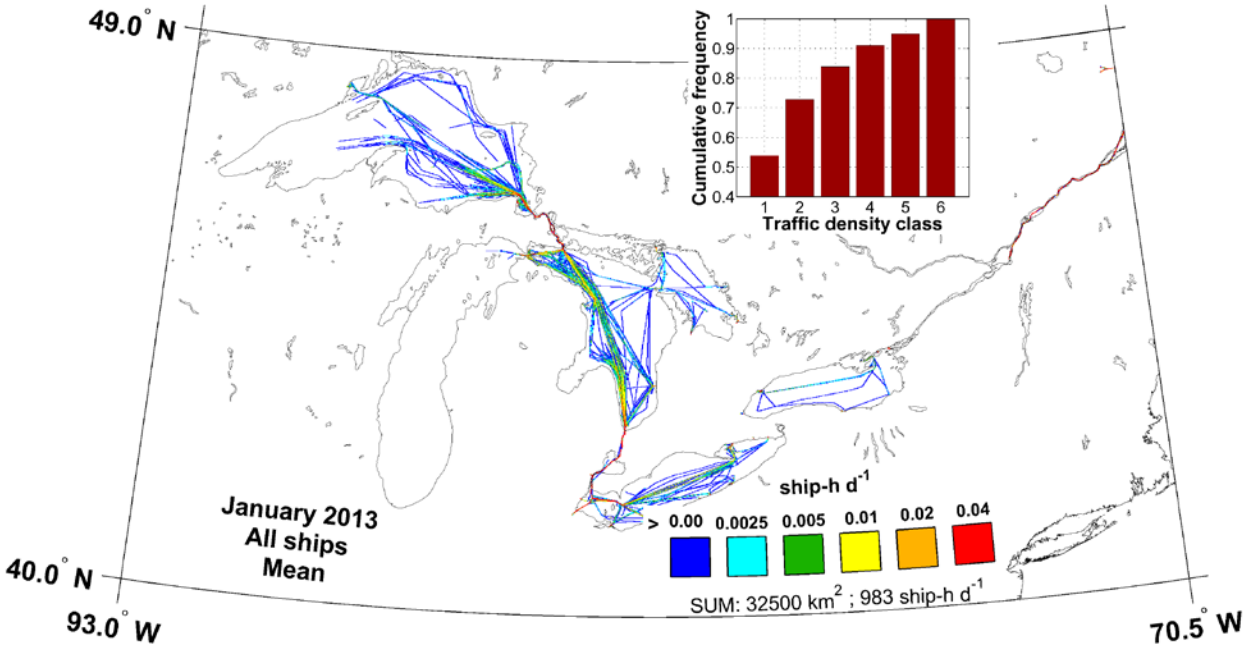

Figure 26. Map of AIS mean traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

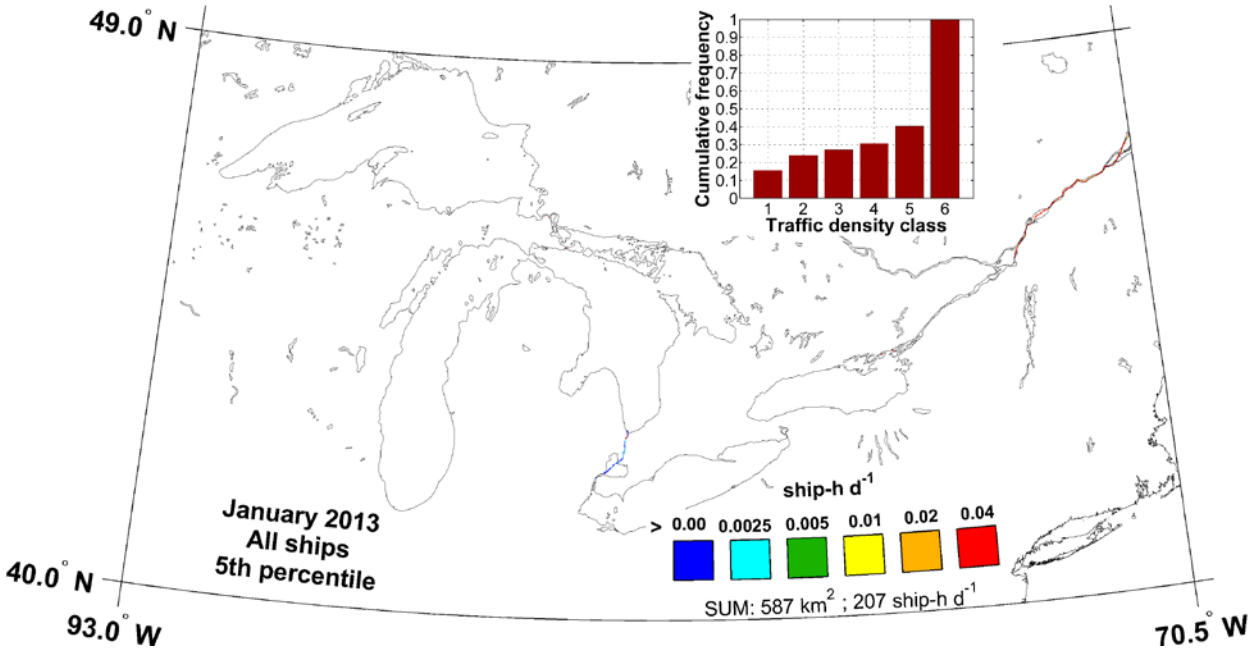

Figure 27. Map of the 5th percentile of the daily AIS traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

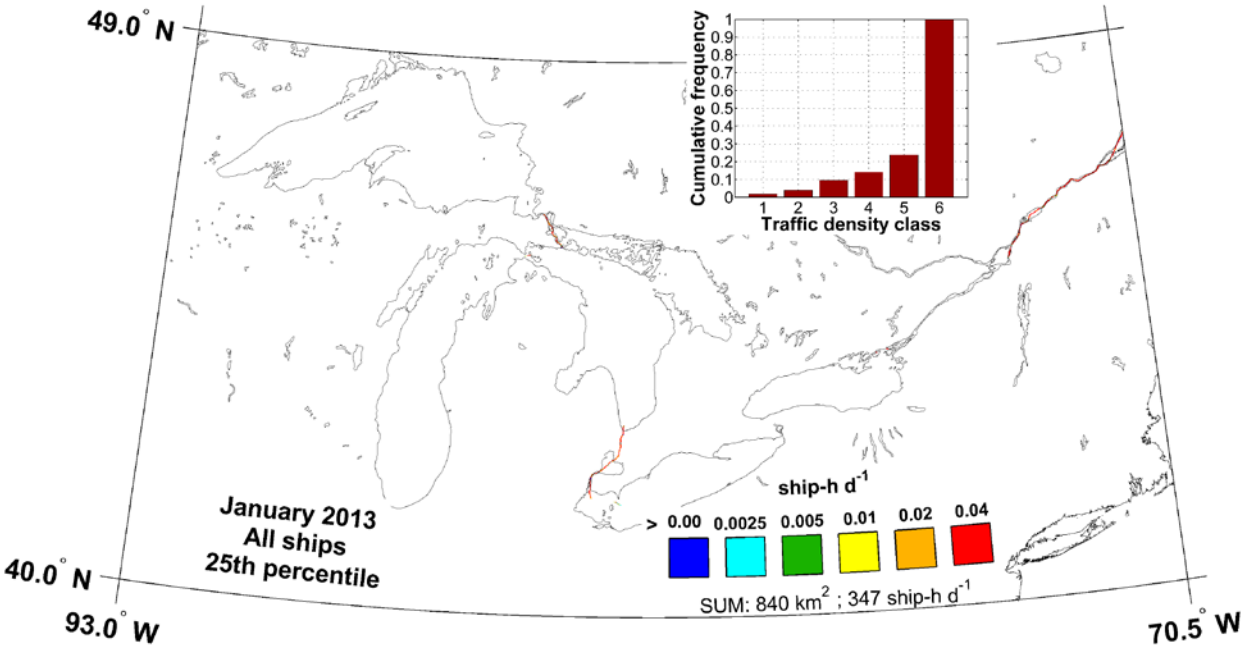

Figure 28. Map of the 25th percentile of the daily AIS traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

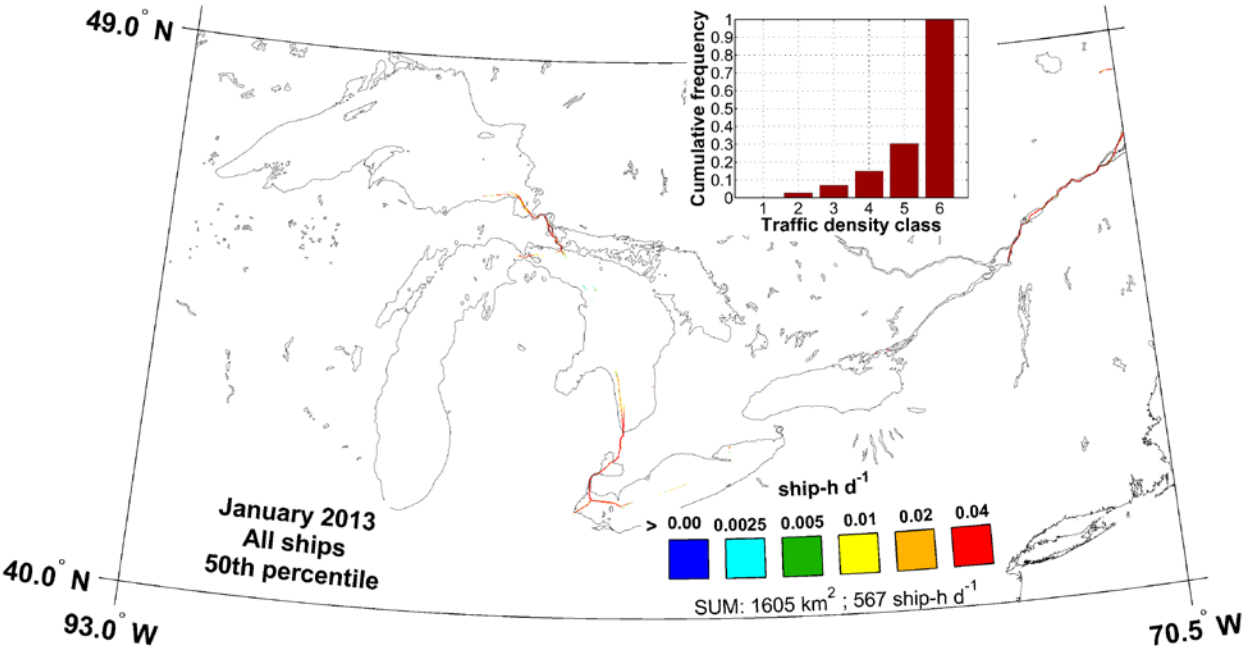

Figure 29. Map of the 50th percentile of the daily AIS traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

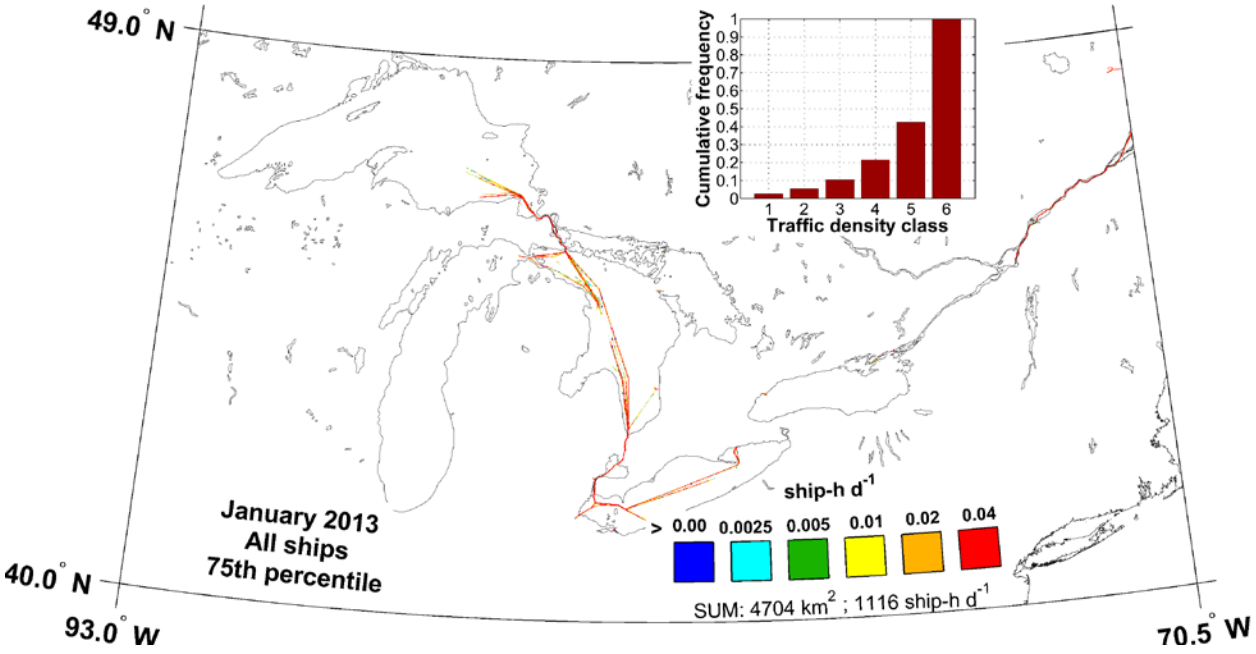

Figure 30. Map of the 75th percentile of the daily AIS traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

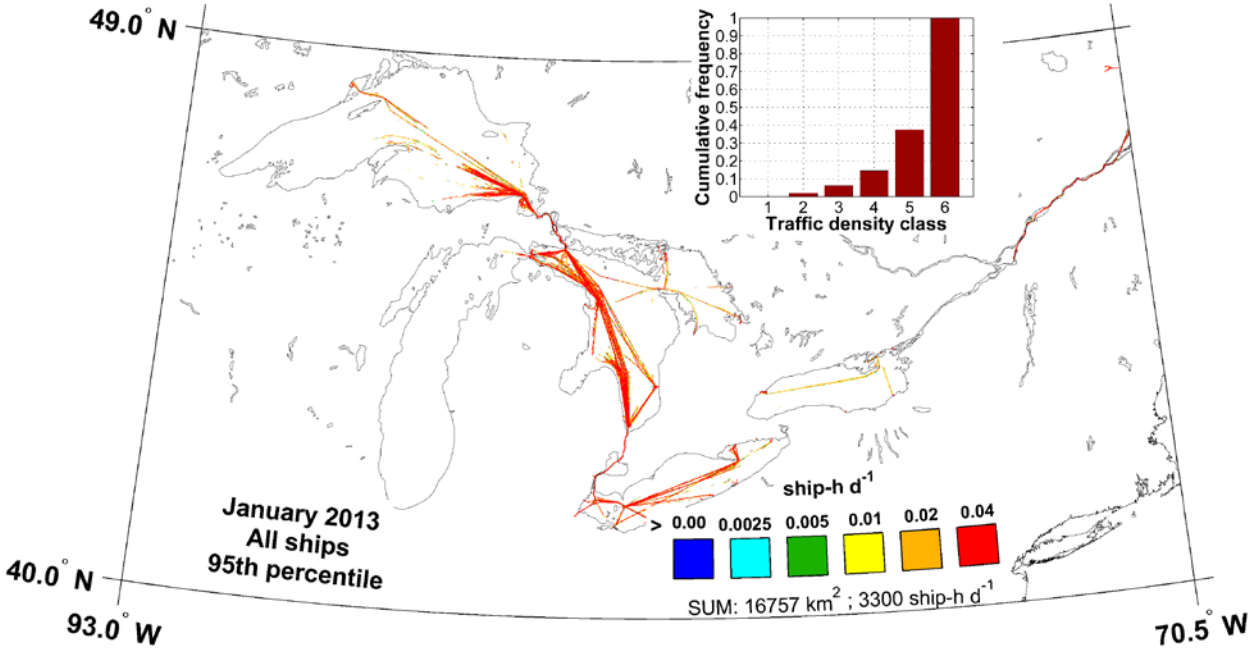

Figure 31. Map of the 95th percentile of the daily AIS traffic density of all ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

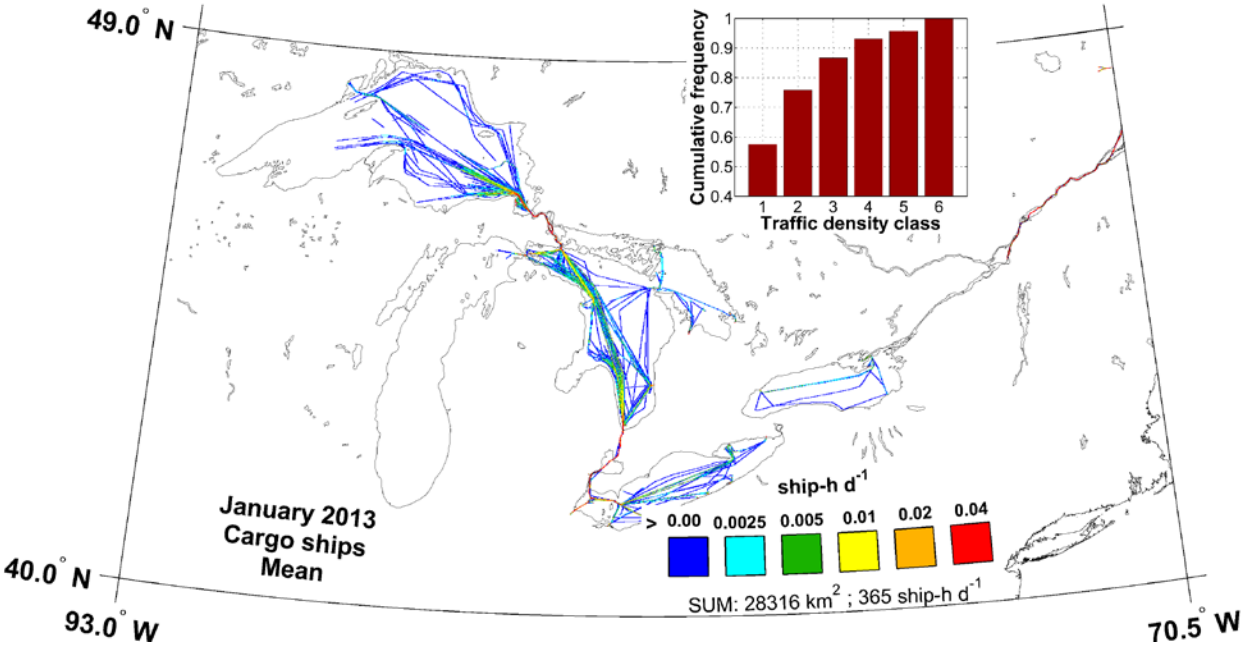

Figure 32. Map of AIS mean traffic density of cargo-type ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

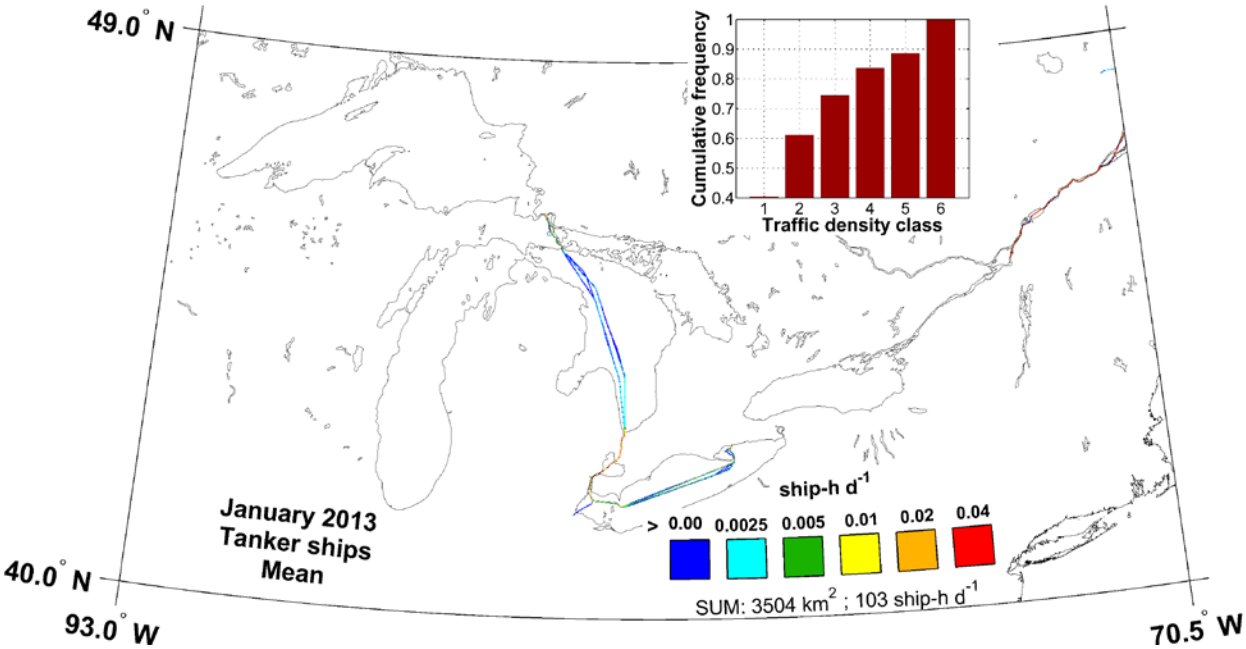

Figure 33. Map of AIS mean traffic density of tanker-type ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

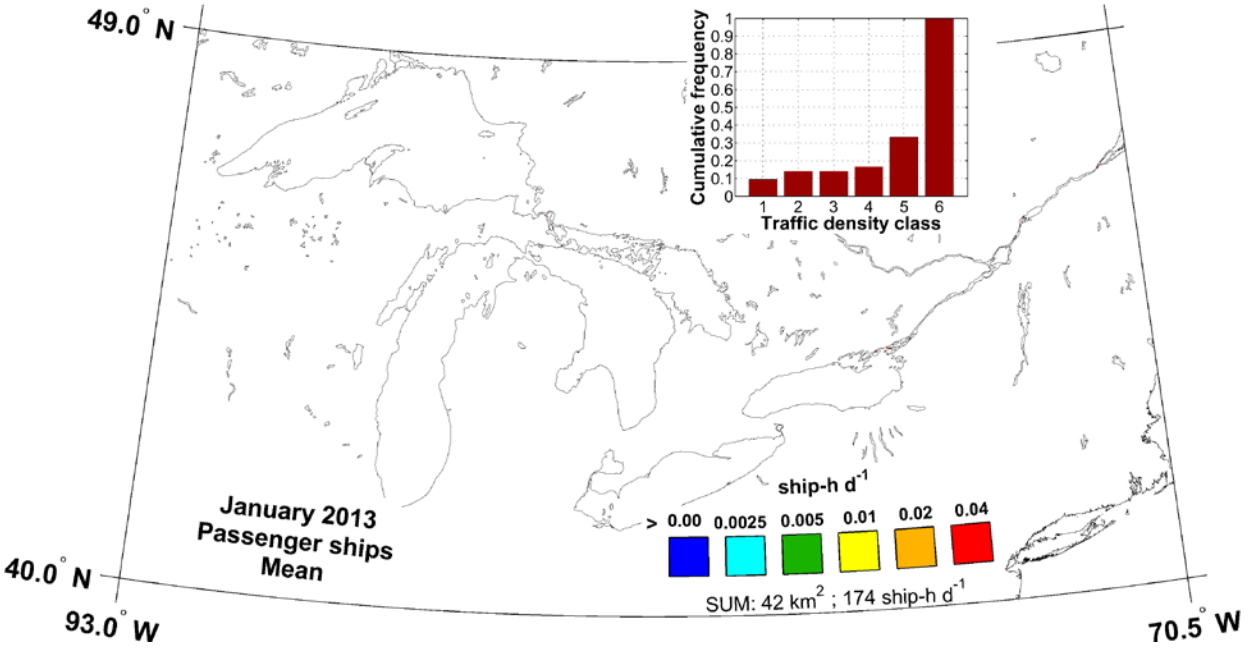

Figure 34. Map of AIS mean traffic density of passenger-type ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

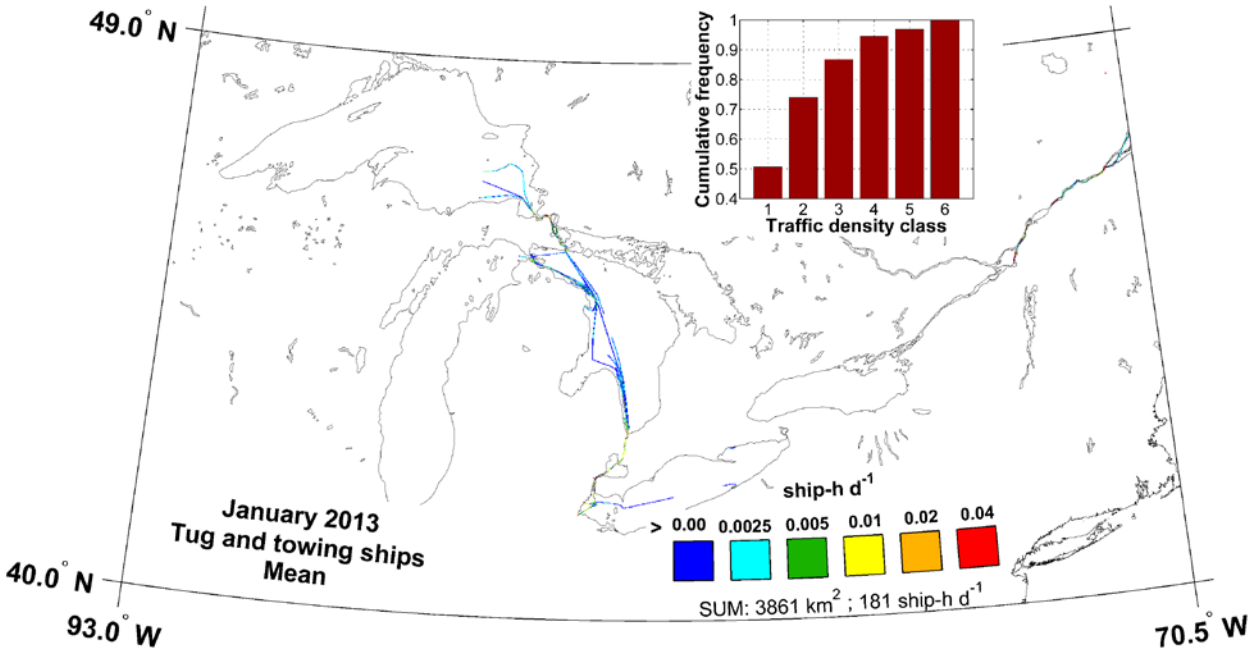

Figure 35. Map of AIS mean traffic density of tug and towing-type ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

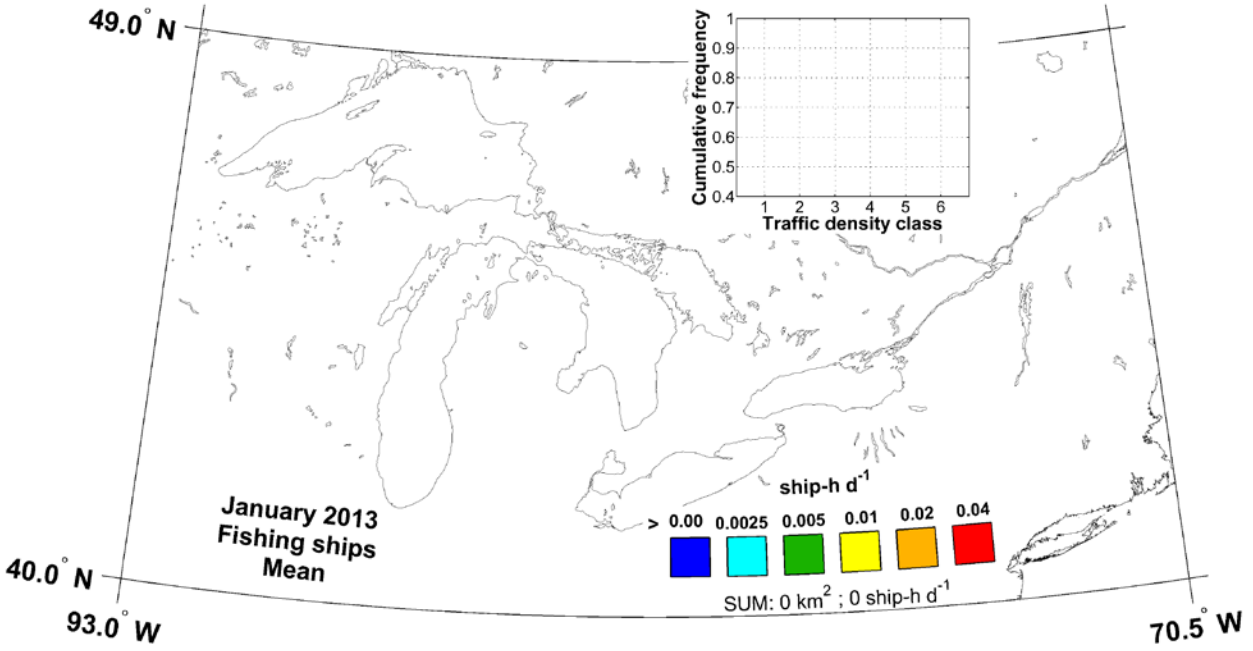

Figure 36. Map of AIS mean traffic density of fishing-type ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

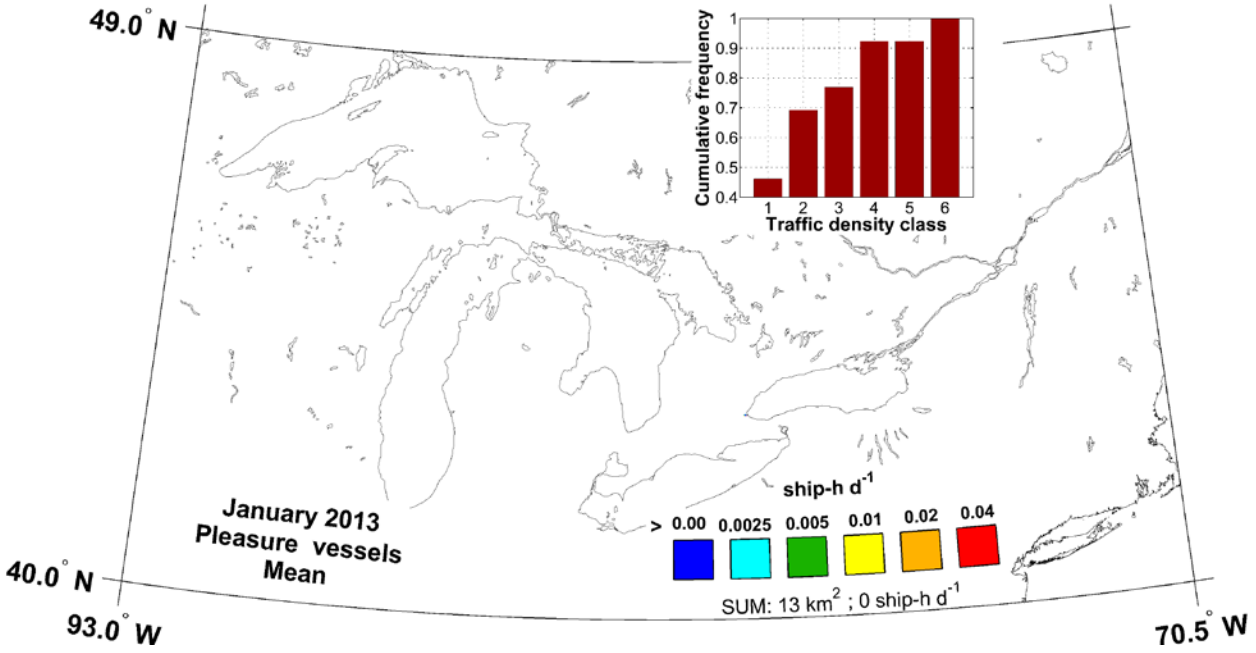

Figure 37. Map of AIS mean traffic density of pleasure-type vessels in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

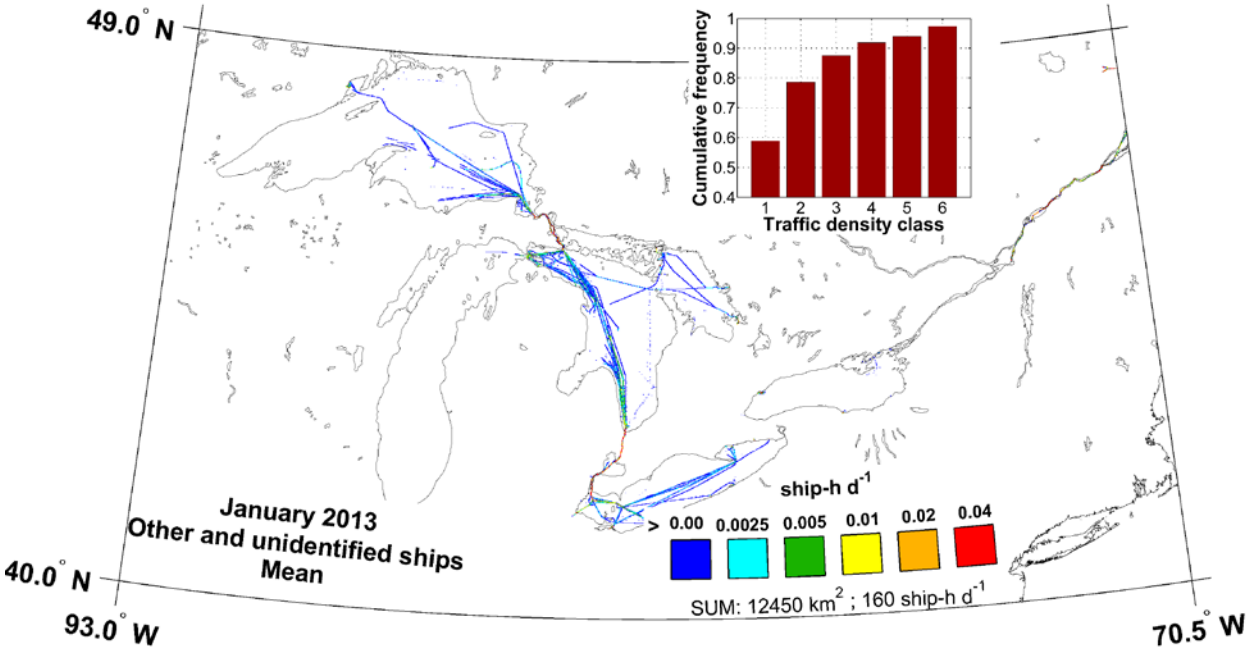

Figure 38. Map of AIS mean traffic density of other types of ships and ships of unidentified type in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

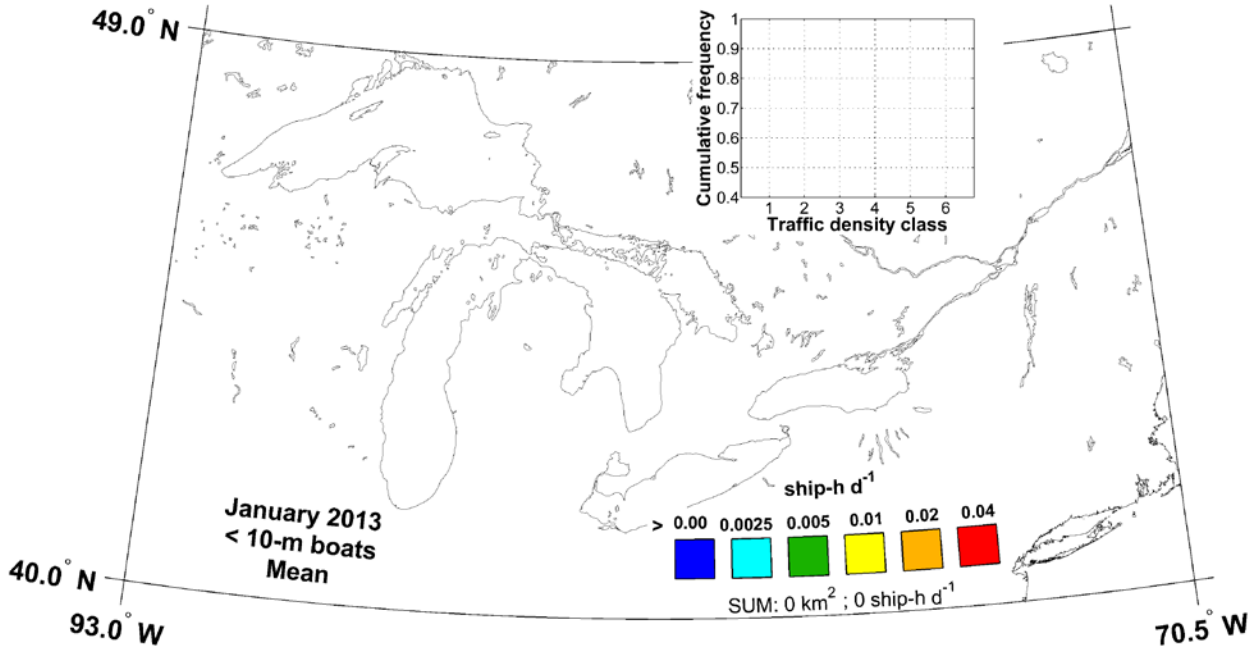

Figure 39. Map of AIS mean traffic density of ships with lengths < 10 m in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

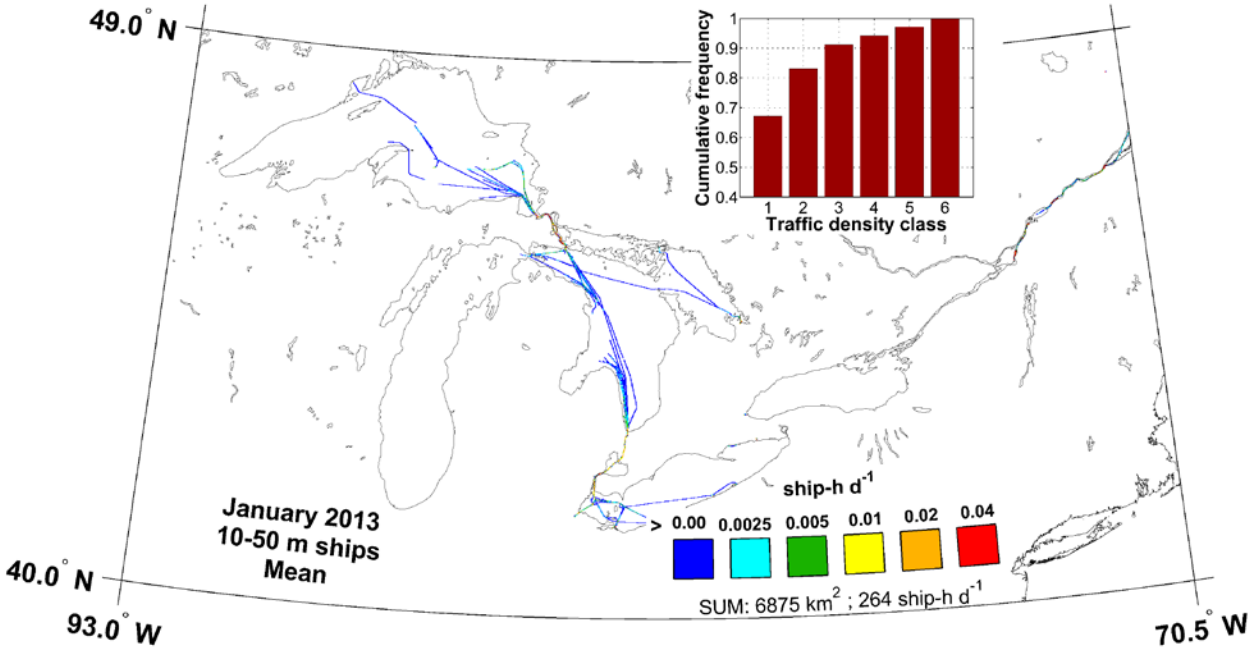

Figure 40. Map of AIS mean traffic density of 10 to 50 m ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

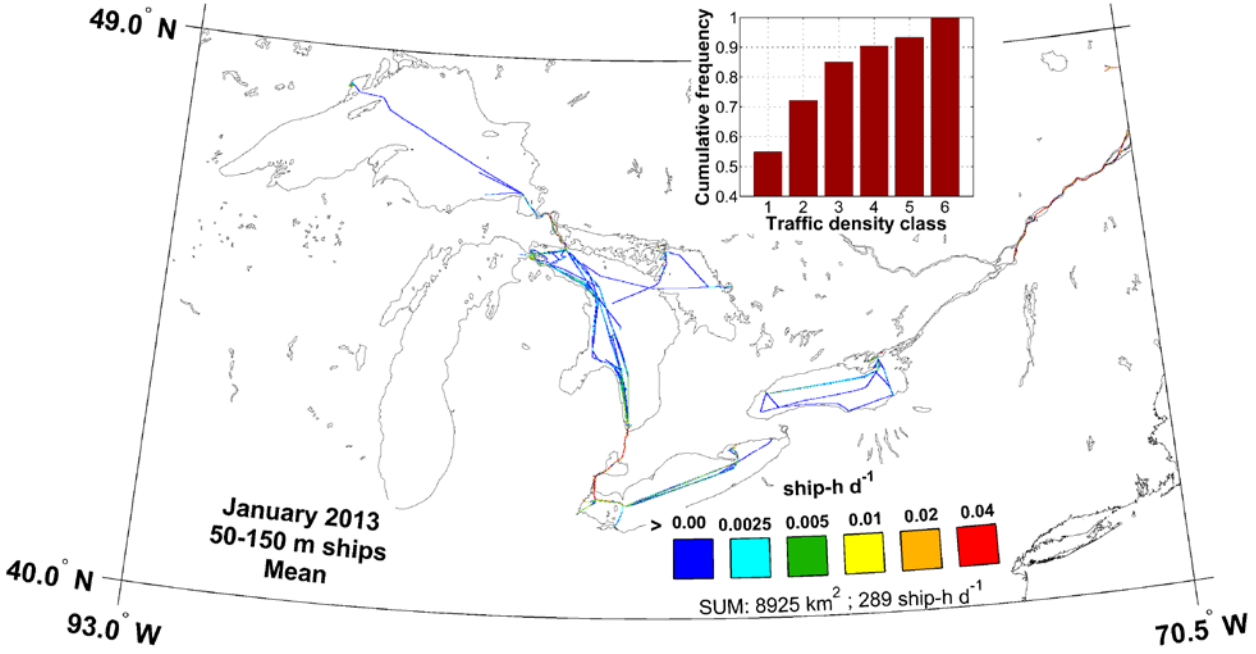

Figure 41. Map of AIS mean traffic density of 50 to 150 m ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

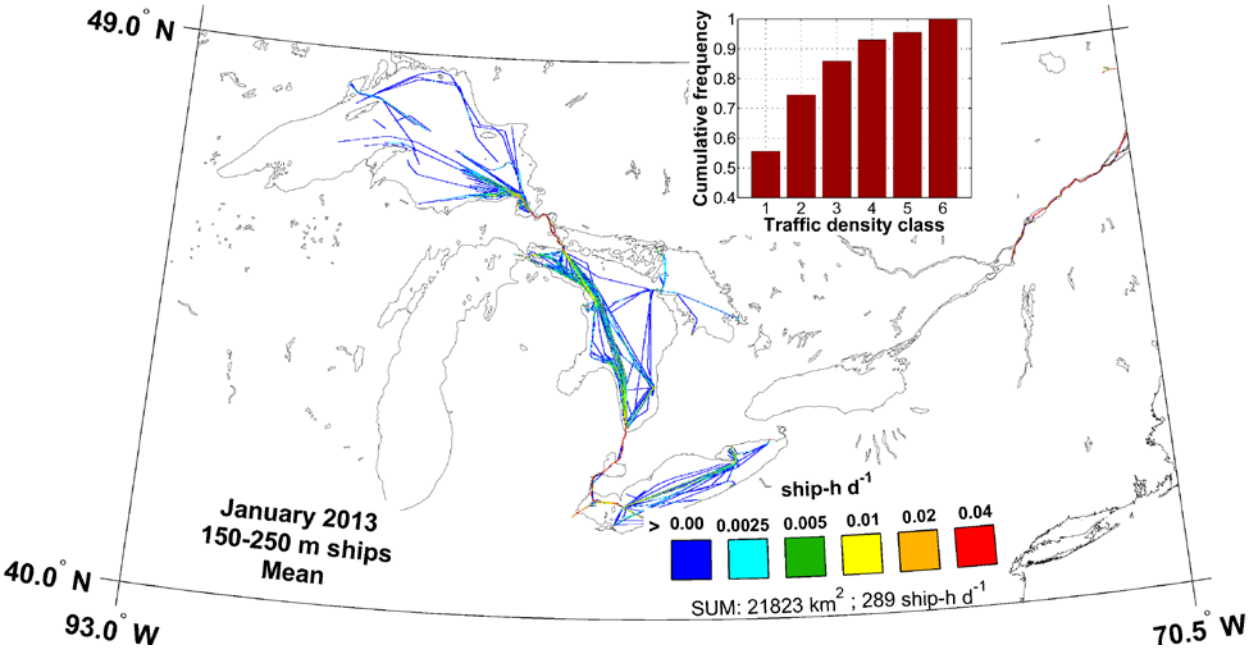

Figure 42. Map of AIS mean traffic density of 150 to 250 m ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

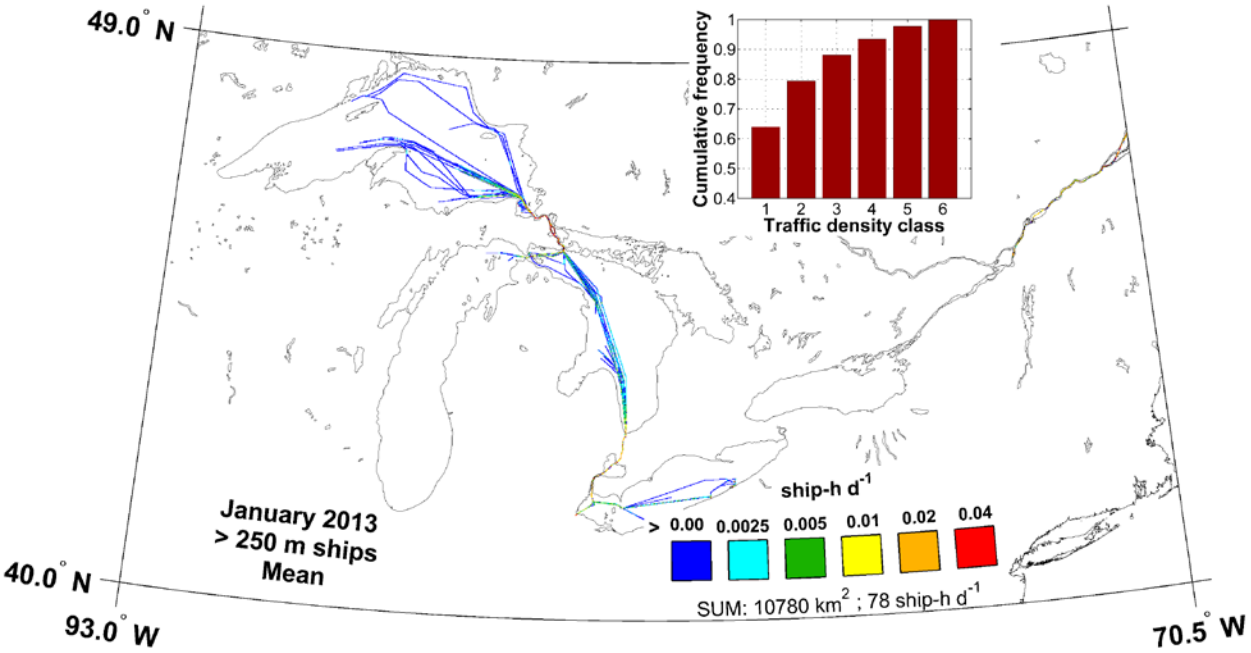

Figure 43. Map of AIS mean traffic density of > 250 m ships in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

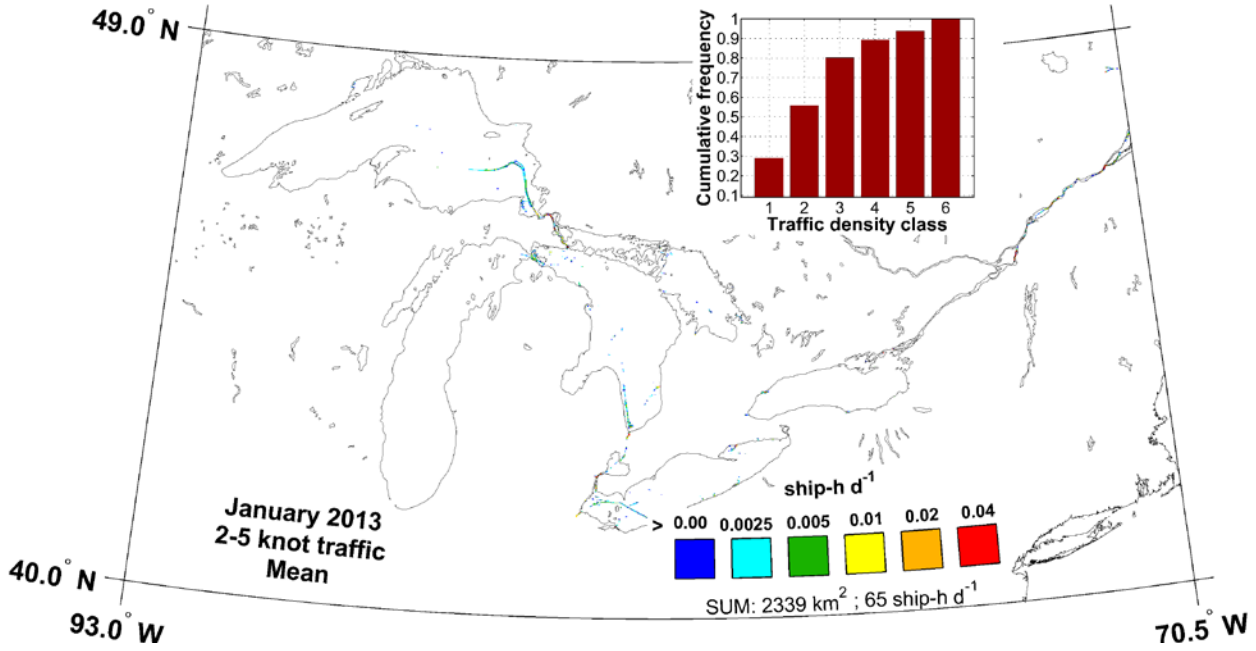

Figure 44. Map of 2–5 knot AIS mean traffic density in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

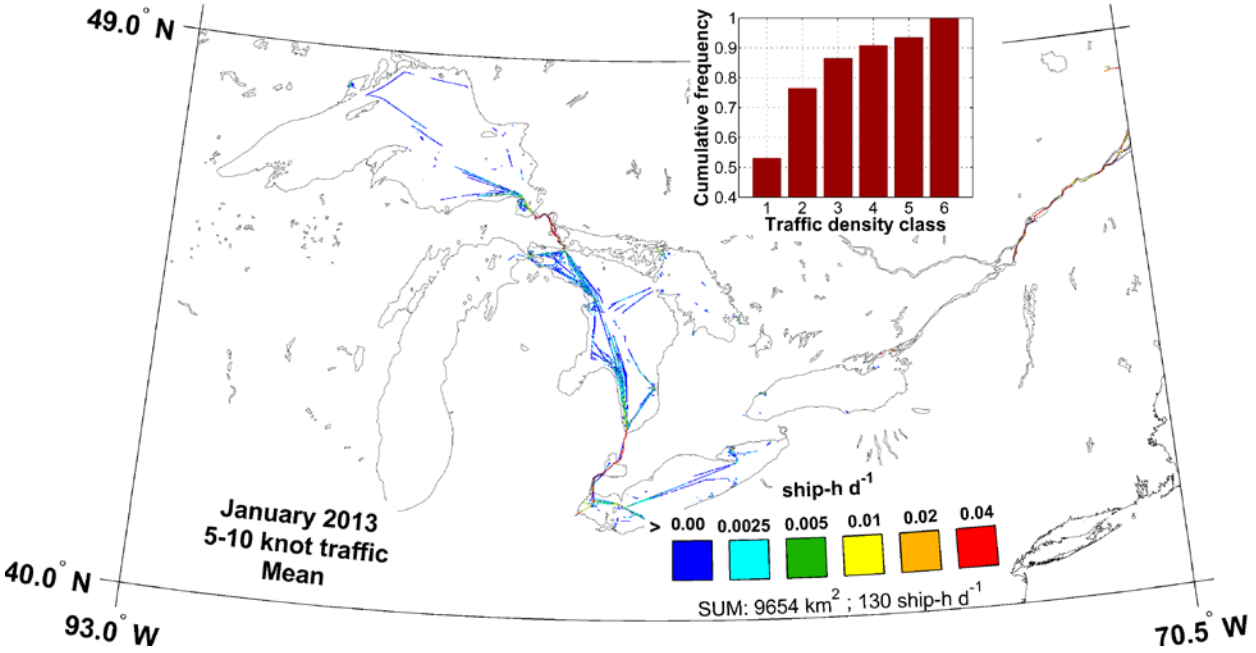

Figure 45. Map of 5–10 knot AIS mean traffic density in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

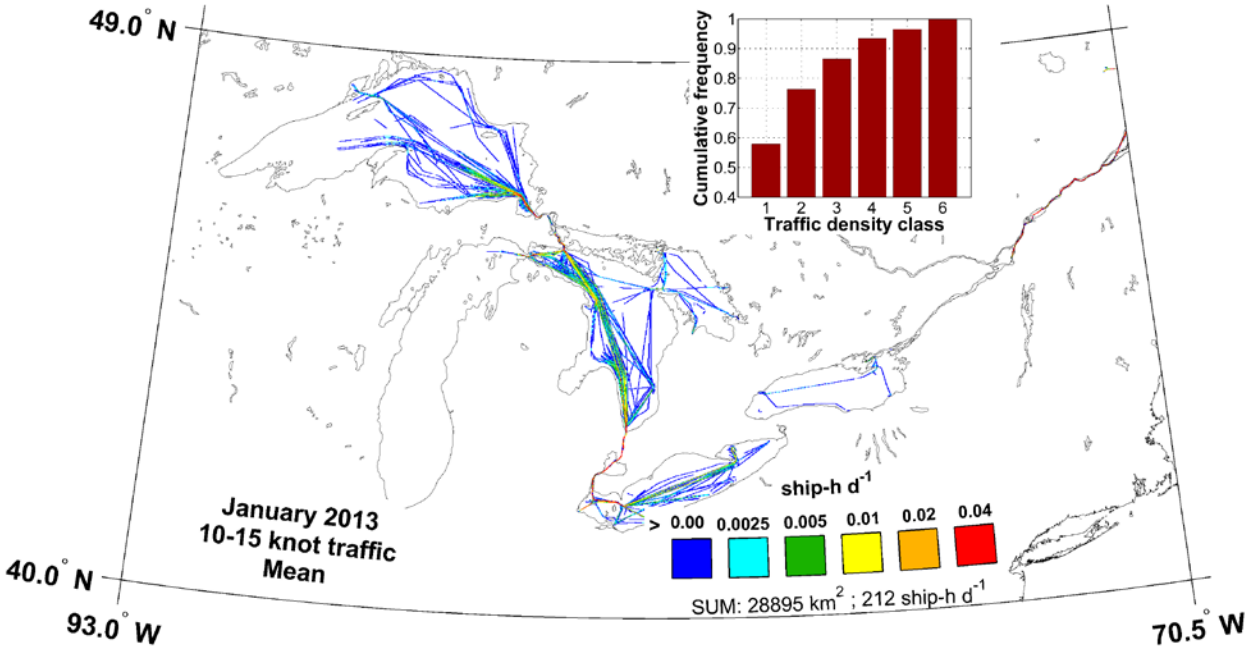

Figure 46. Map of 10–15 knot AIS mean traffic density in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

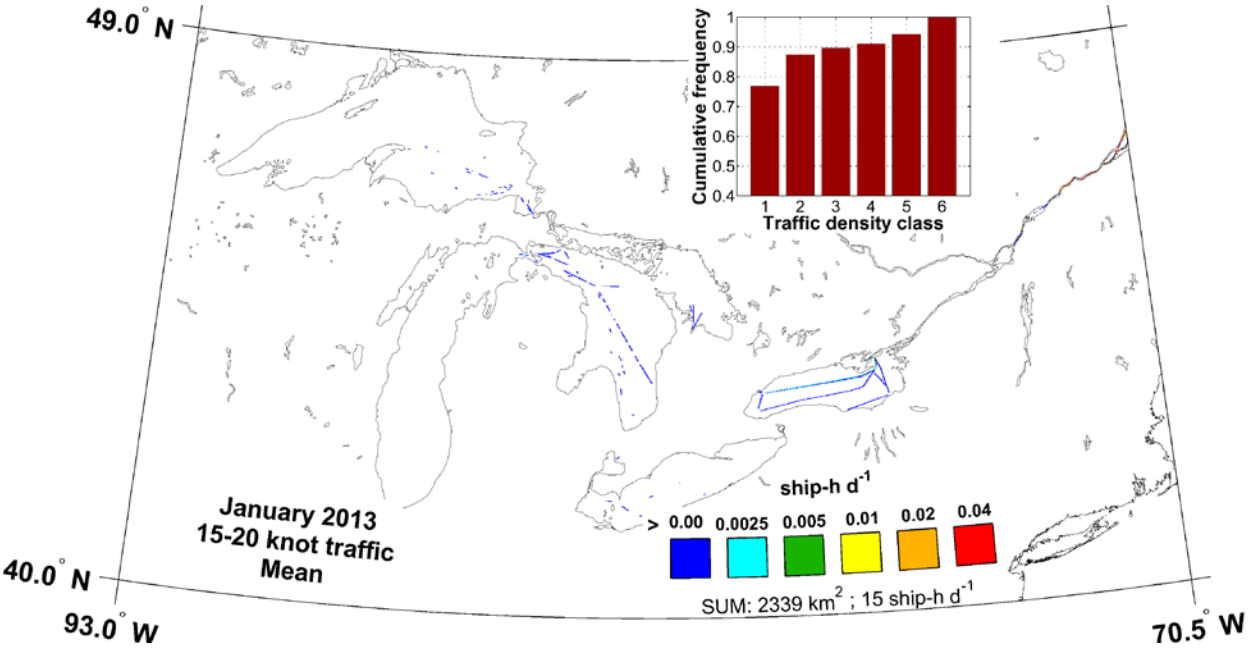

Figure 47. Map of 15–20 knot AIS mean traffic density in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

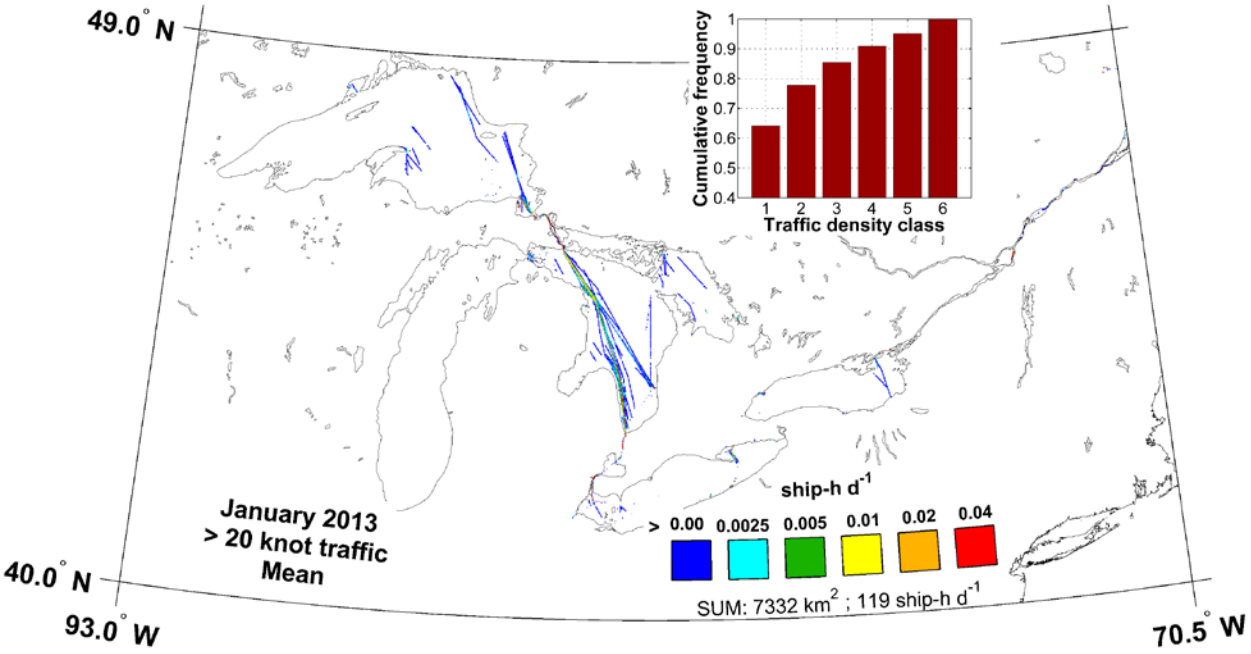

Figure 48. Map of >20 knot AIS mean traffic density in January 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.2. February 2013

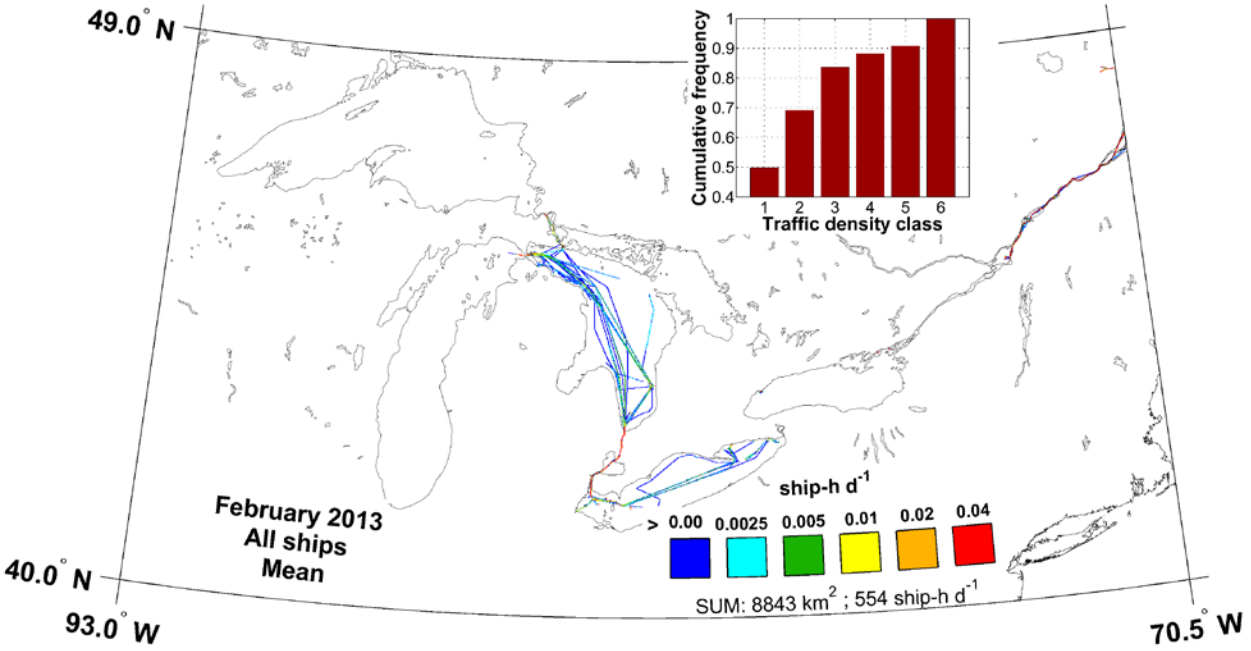

Figure 49. Map of AIS mean traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

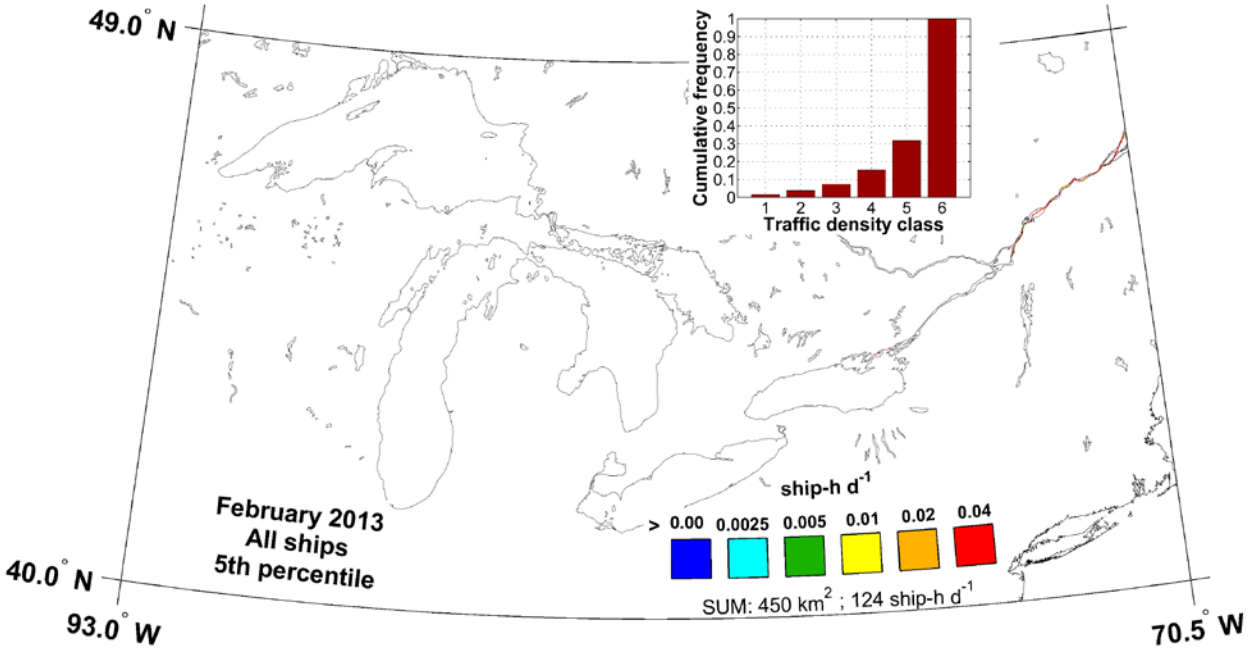

Figure 50. Map of the 5th percentile of the daily AIS traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

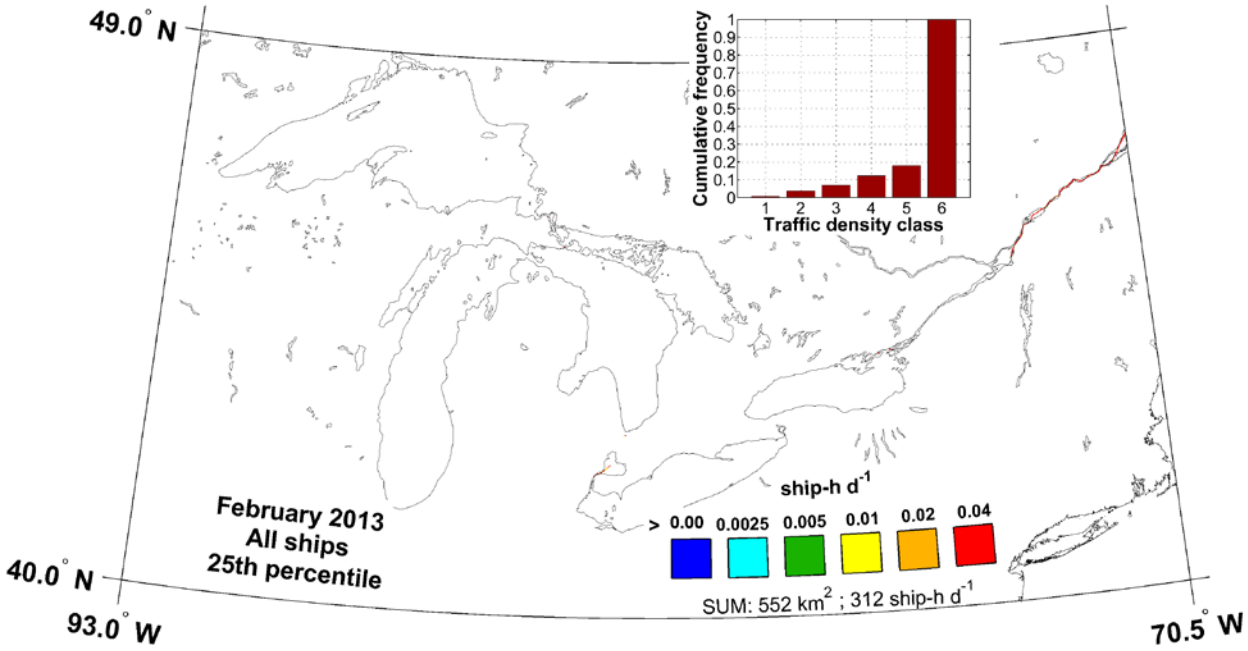

Figure 51. Map of the 25th percentile of the daily AIS traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

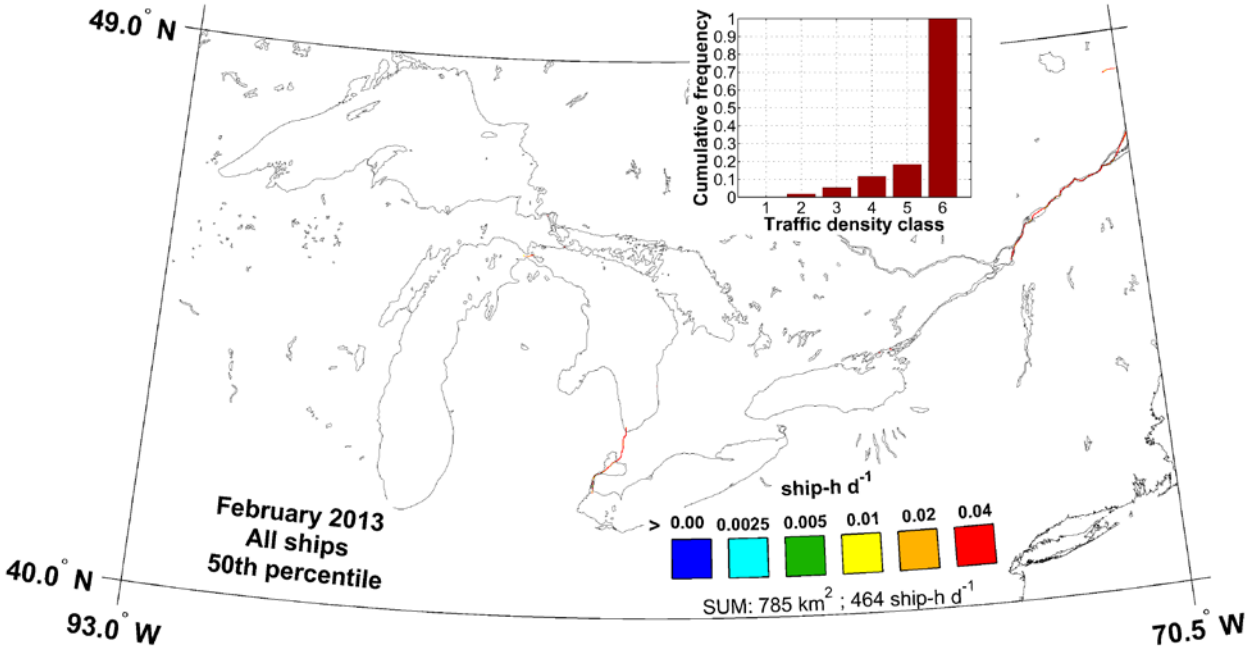

Figure 52. Map of the 50th percentile of the daily AIS traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

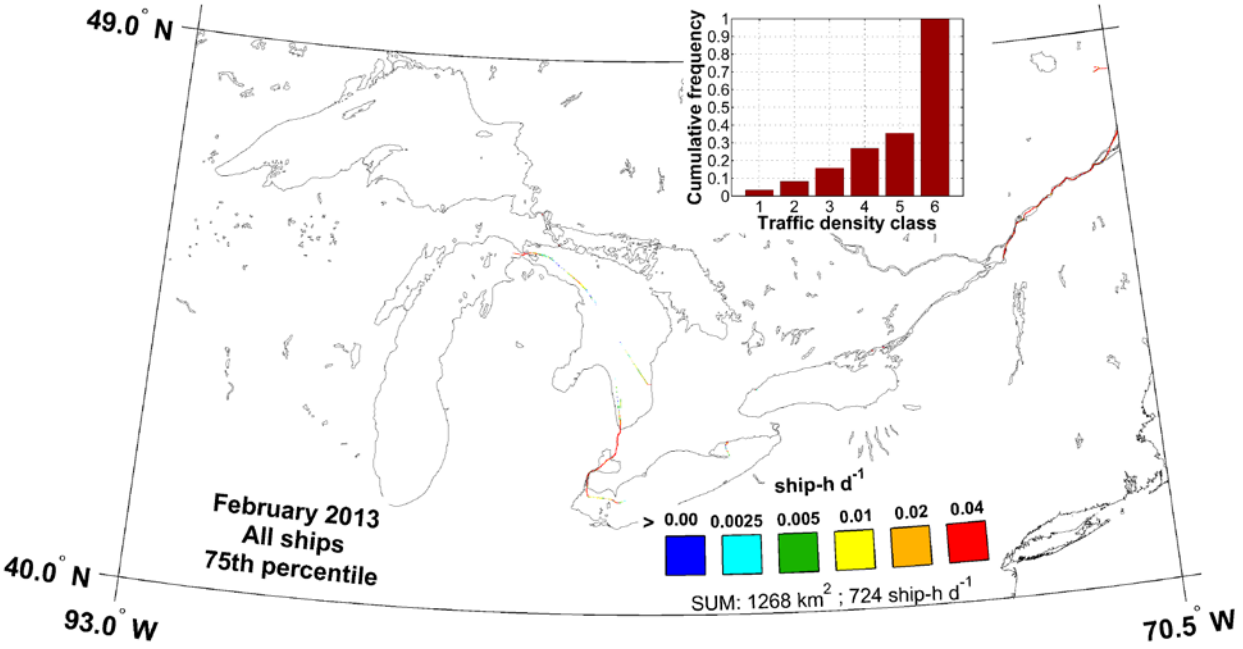

Figure 53. Map of the 75th percentile of the daily AIS traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

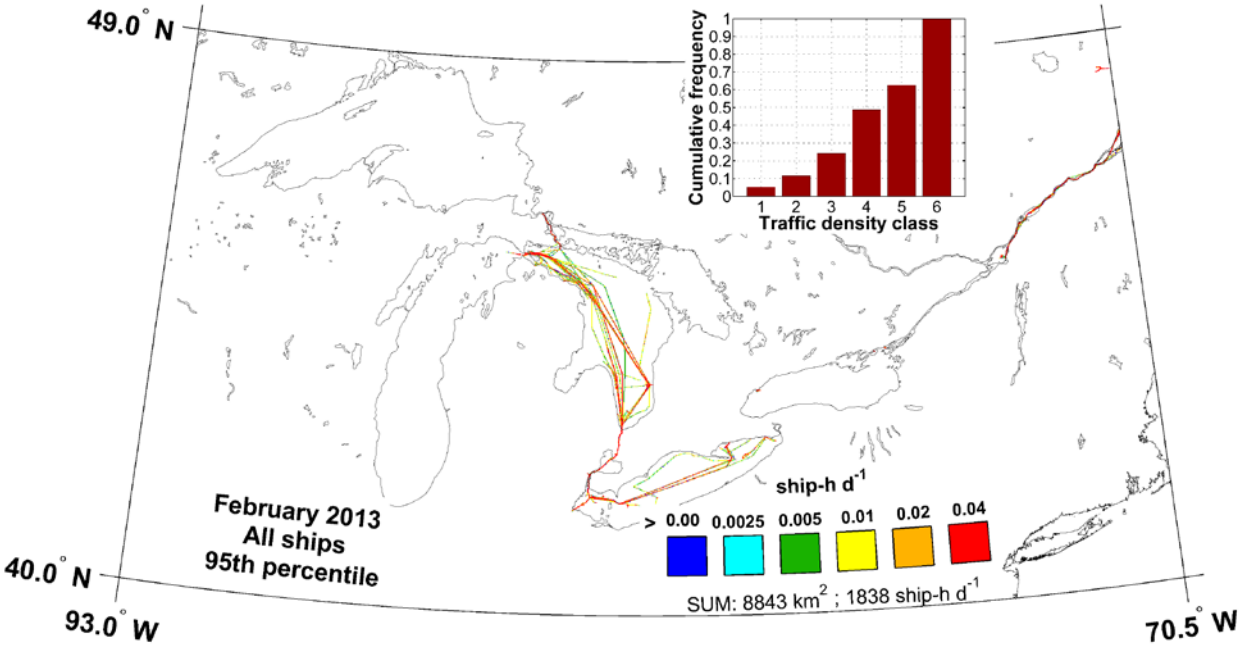

Figure 54. Map of the 95th percentile of the daily AIS traffic density of all ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

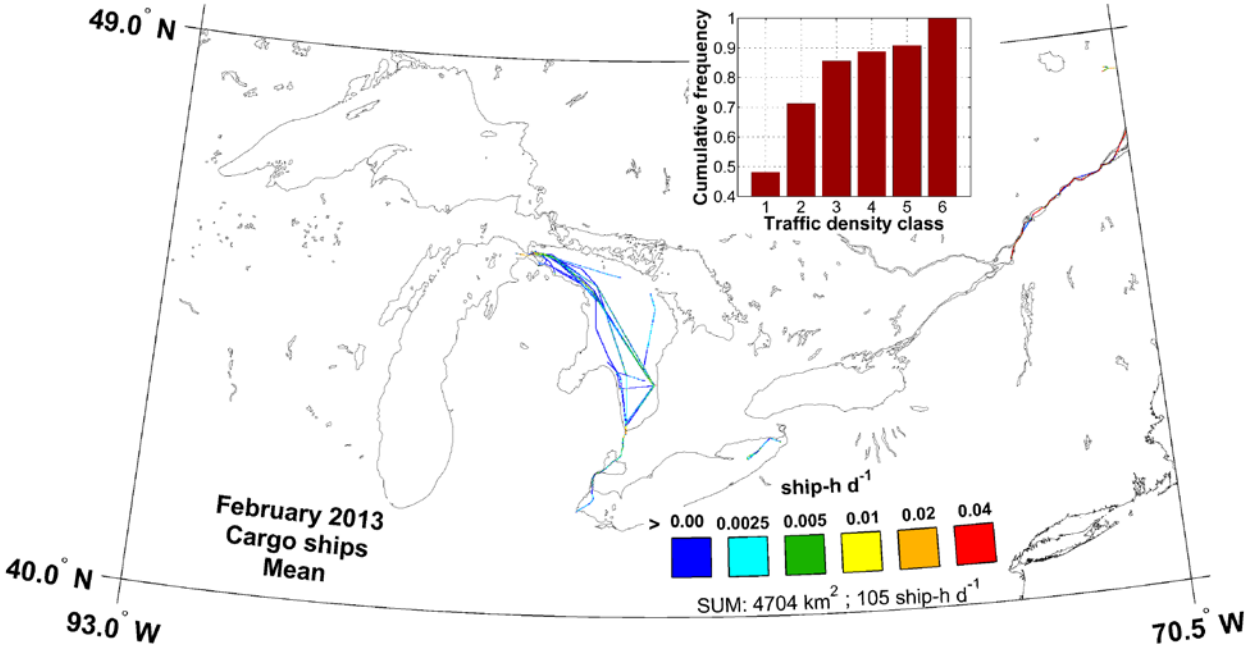

Figure 55. Map of AIS mean traffic density of cargo-type ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

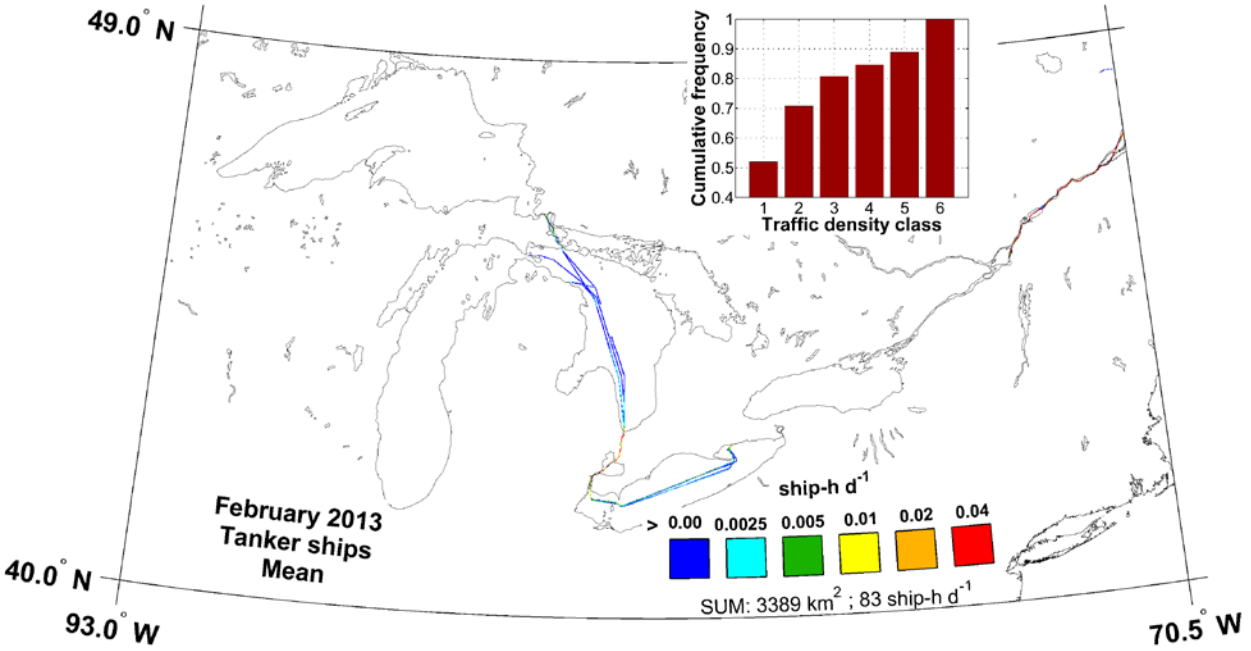

Figure 56. Map of AIS mean traffic density of tanker-type ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

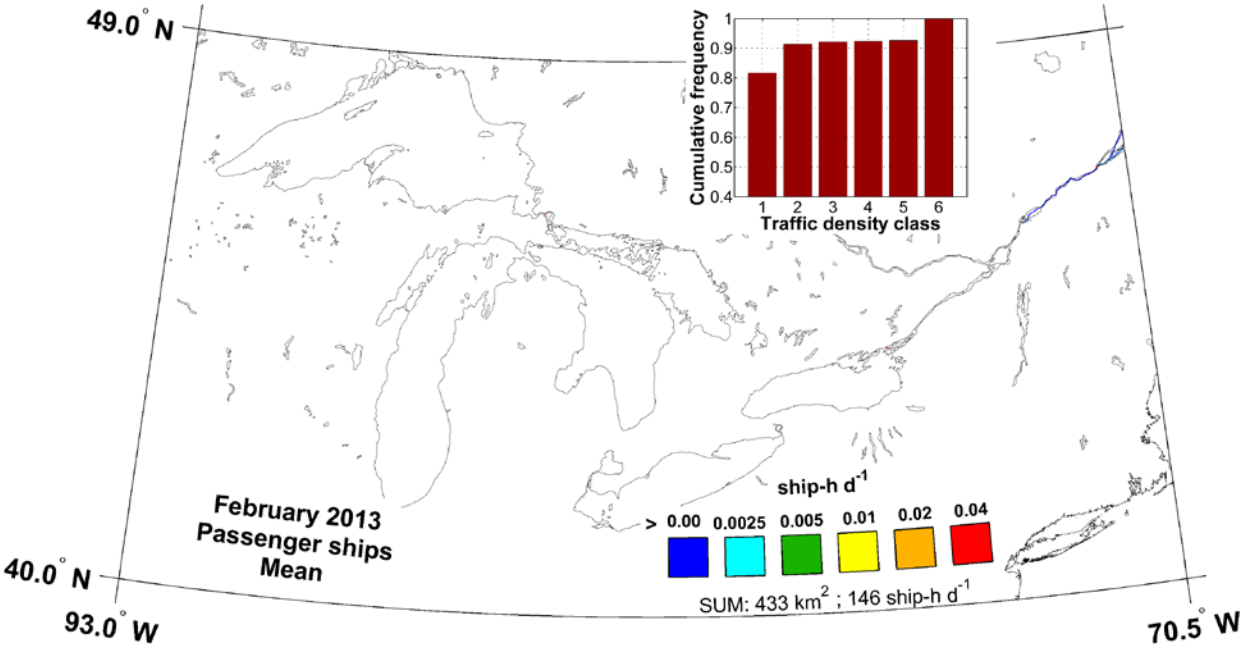

Figure 57. Map of AIS mean traffic density of passenger-type ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

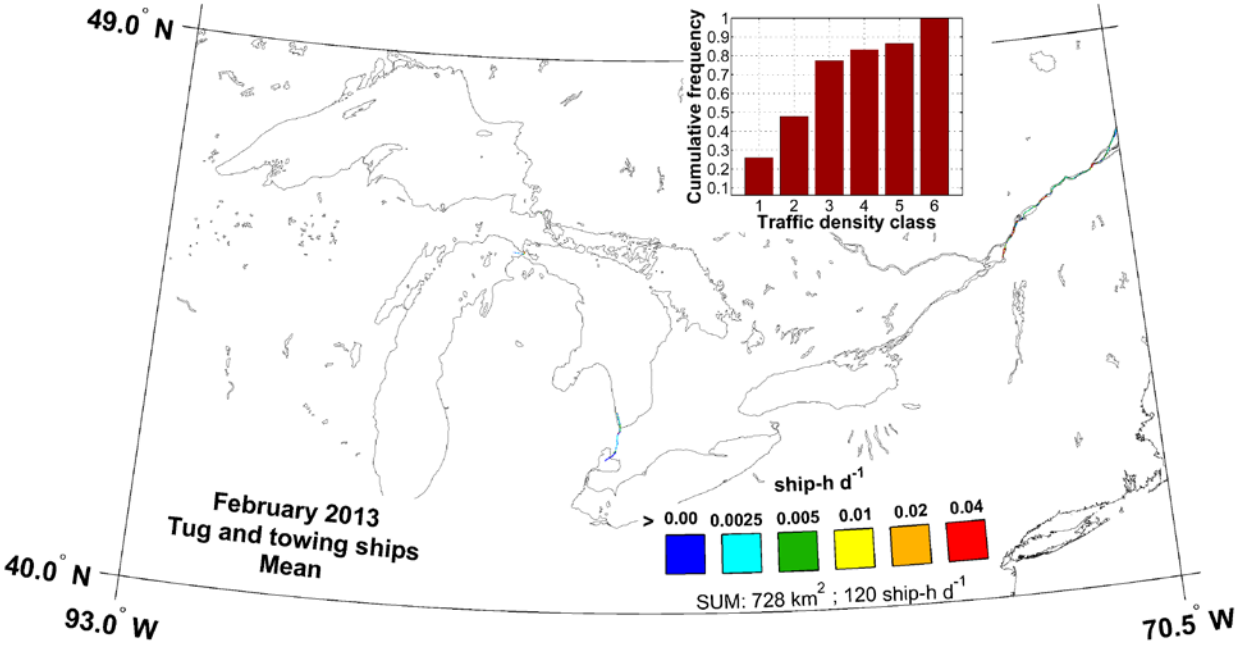

Figure 58. Map of AIS mean traffic density of tug and towing-type ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

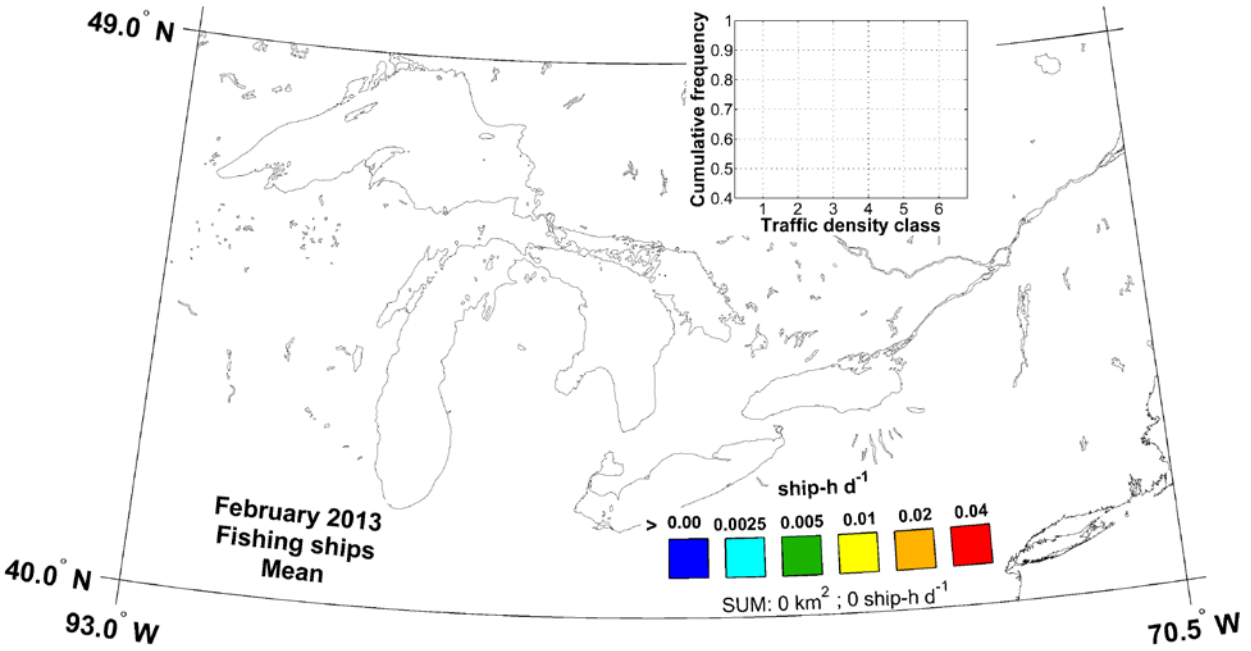

Figure 59. Map of AIS mean traffic density of fishing-type ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

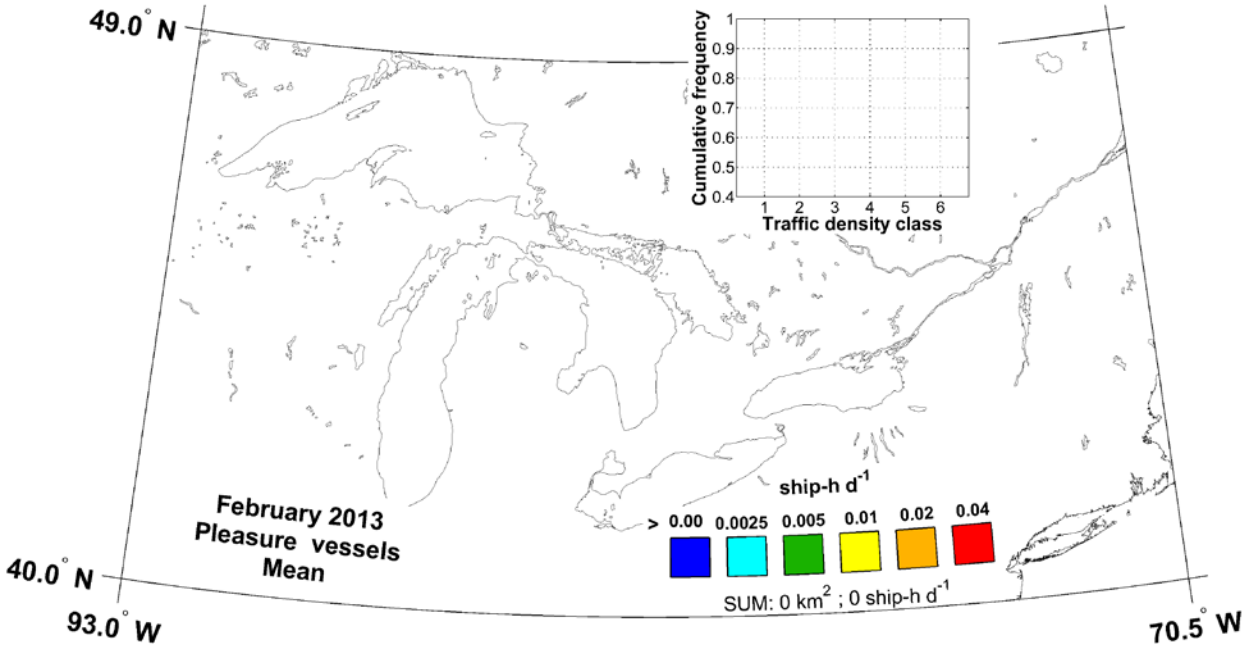

Figure 60. Map of AIS mean traffic density of pleasure-type vessels in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

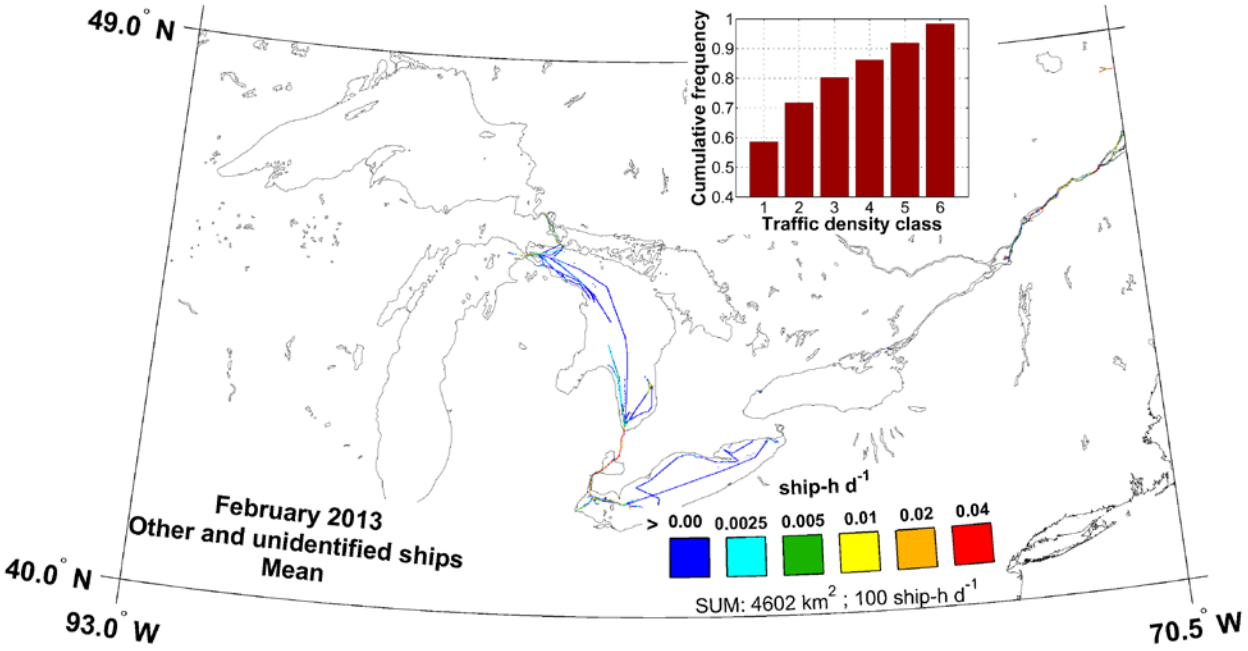

Figure 61. Map of AIS mean traffic density of other types of ships and ships of unidentified type in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

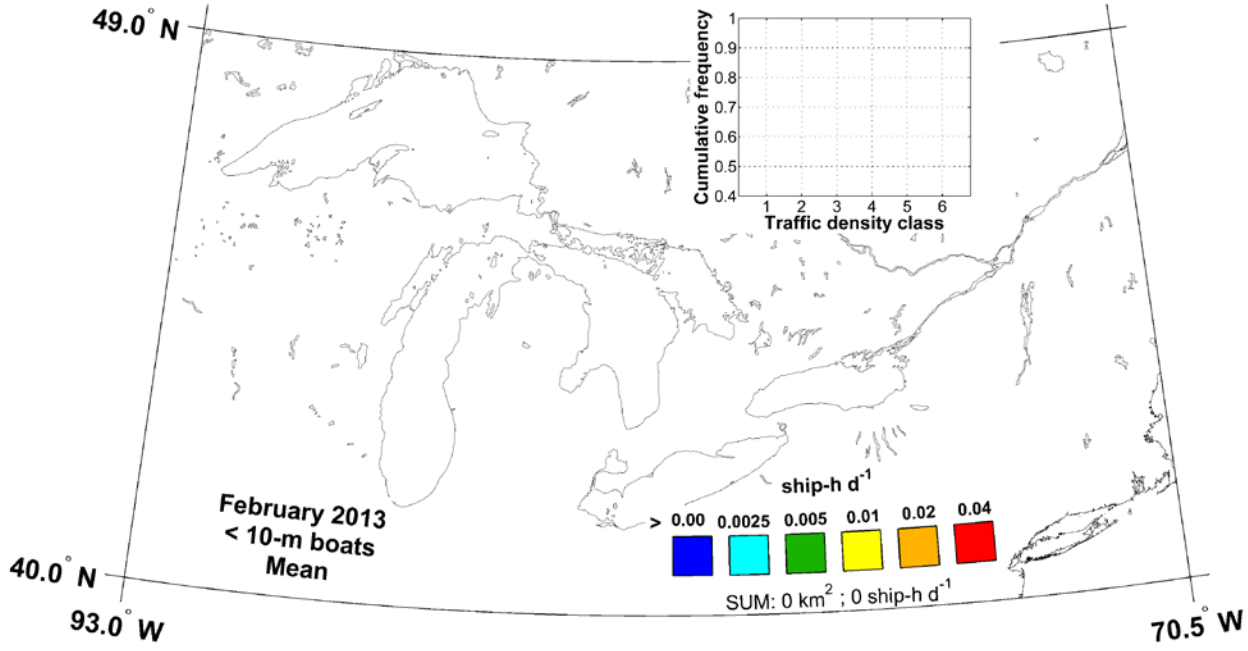

Figure 62. Map of AIS mean traffic density of ships with lengths < 10 m in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

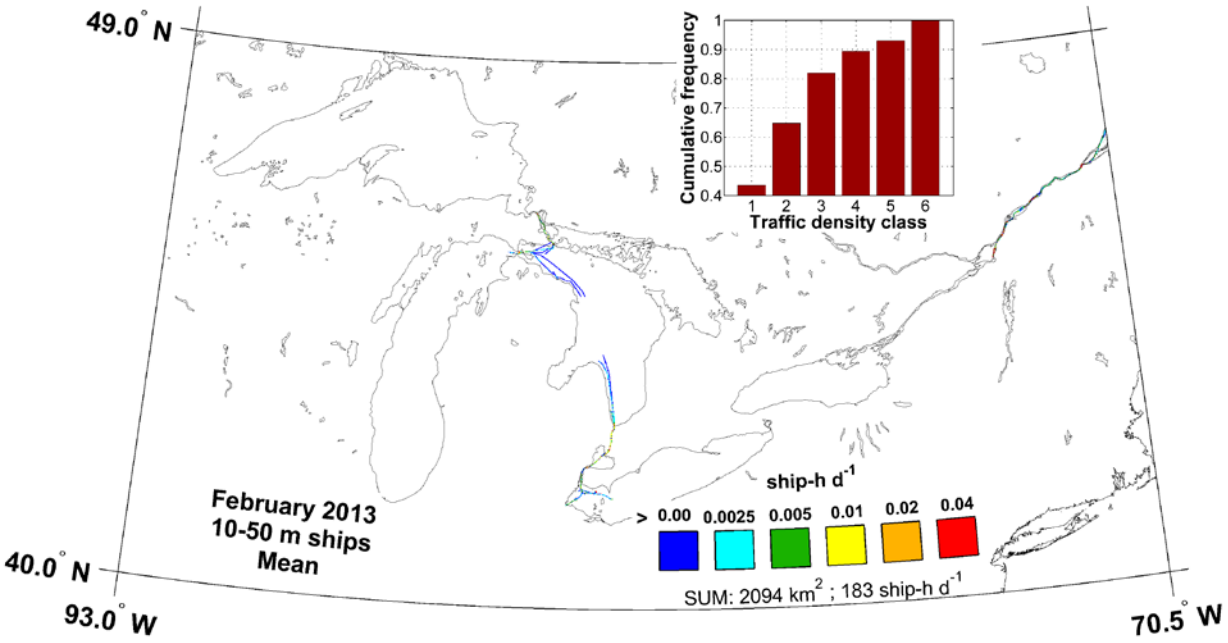

Figure 63. Map of AIS mean traffic density of 10 to 50 m ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

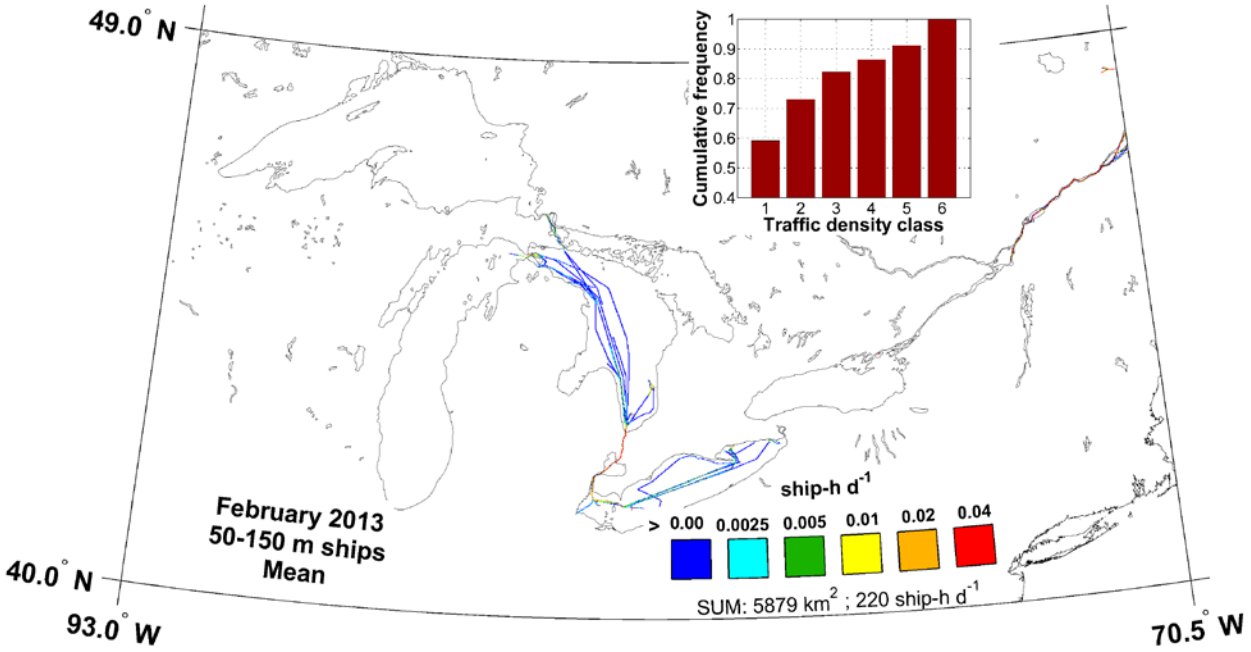

Figure 64. Map of AIS mean traffic density of 50 to 150 m ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

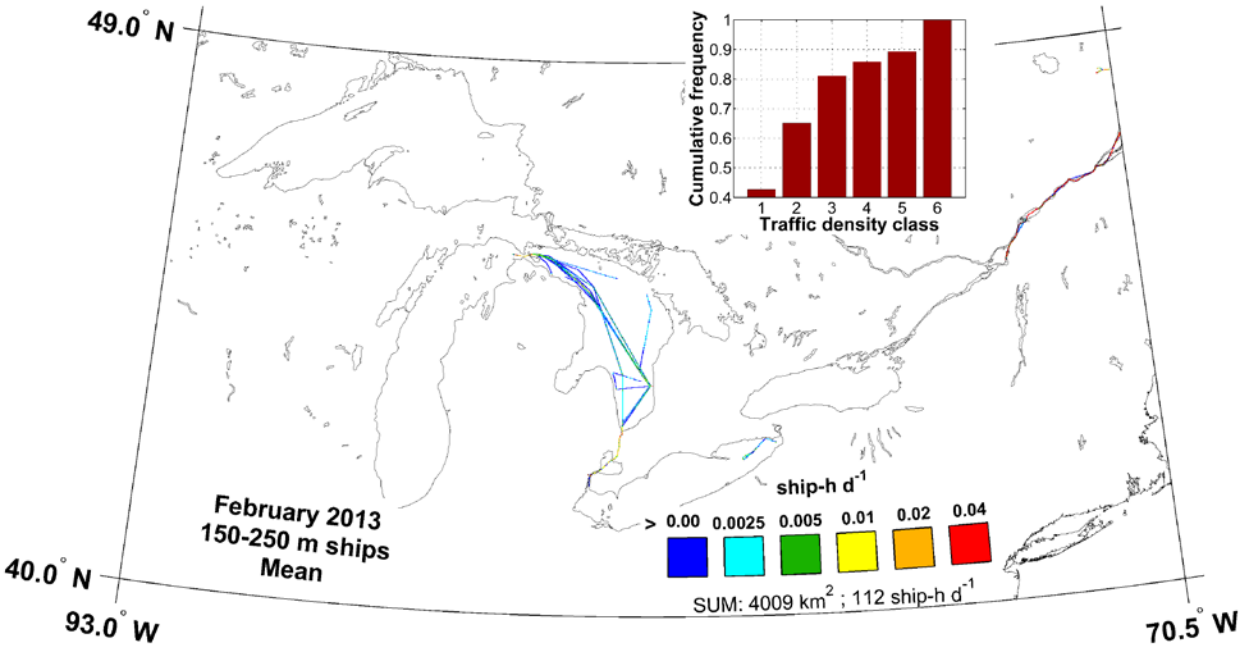

Figure 65. Map of AIS mean traffic density of 150 to 250 m ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

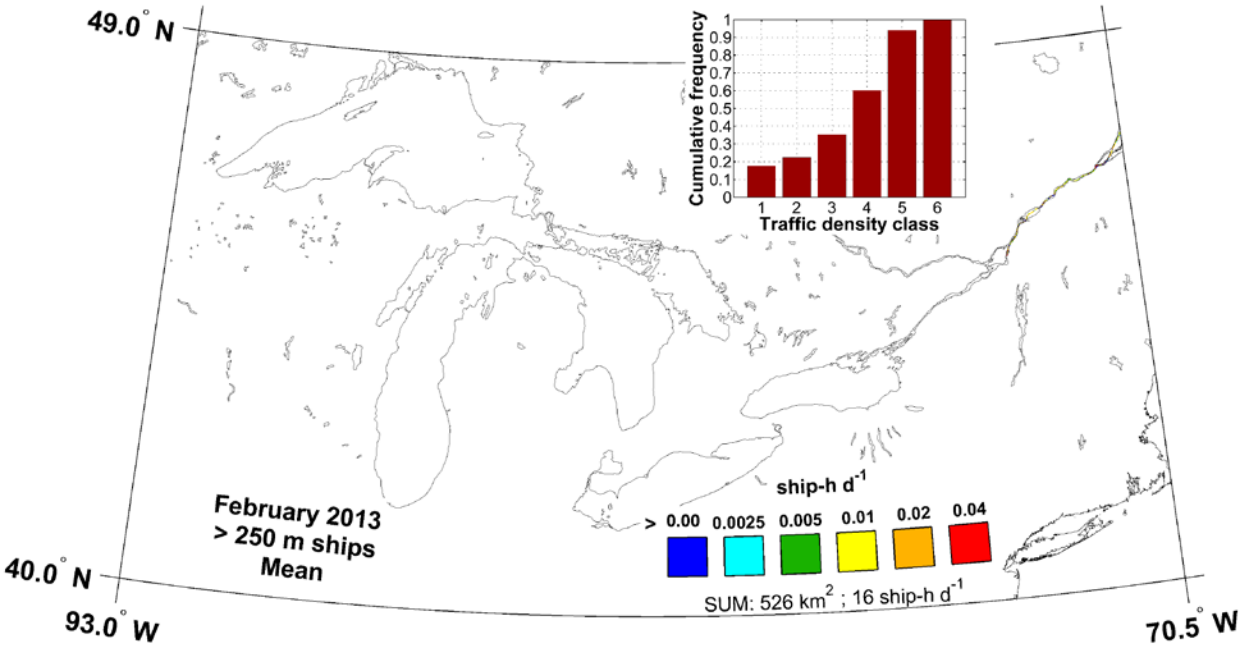

Figure 66. Map of AIS mean traffic density of > 250 m ships in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

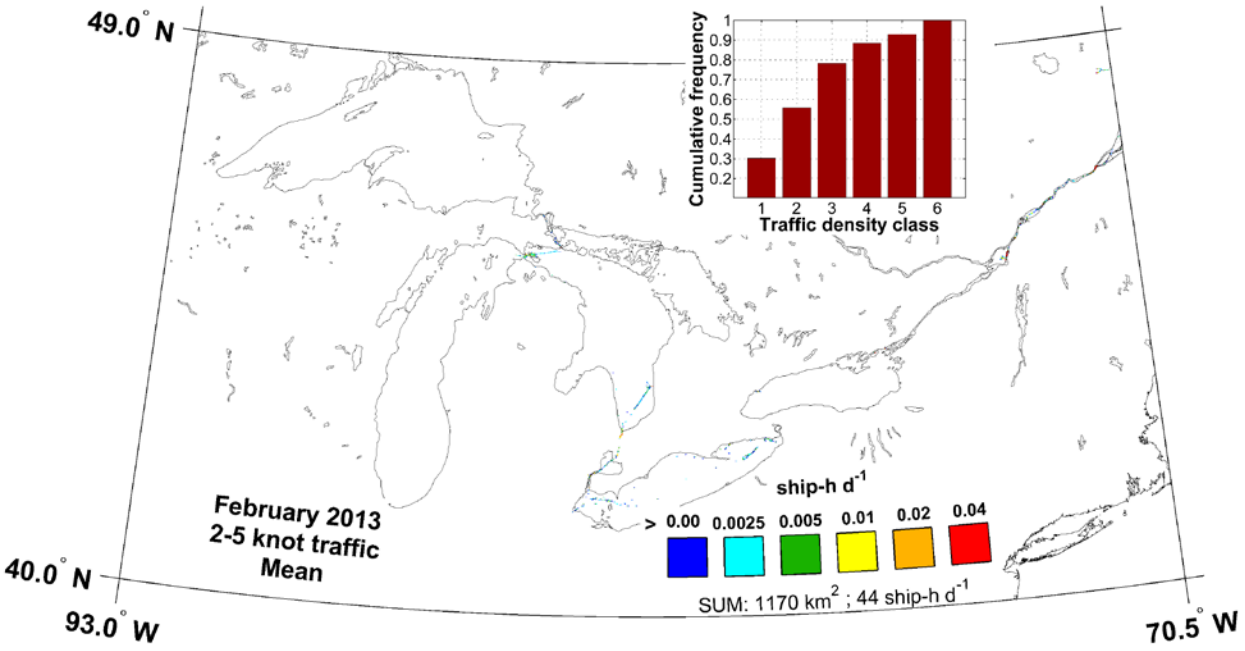

Figure 67. Map of 2–5 knot AIS mean traffic density in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

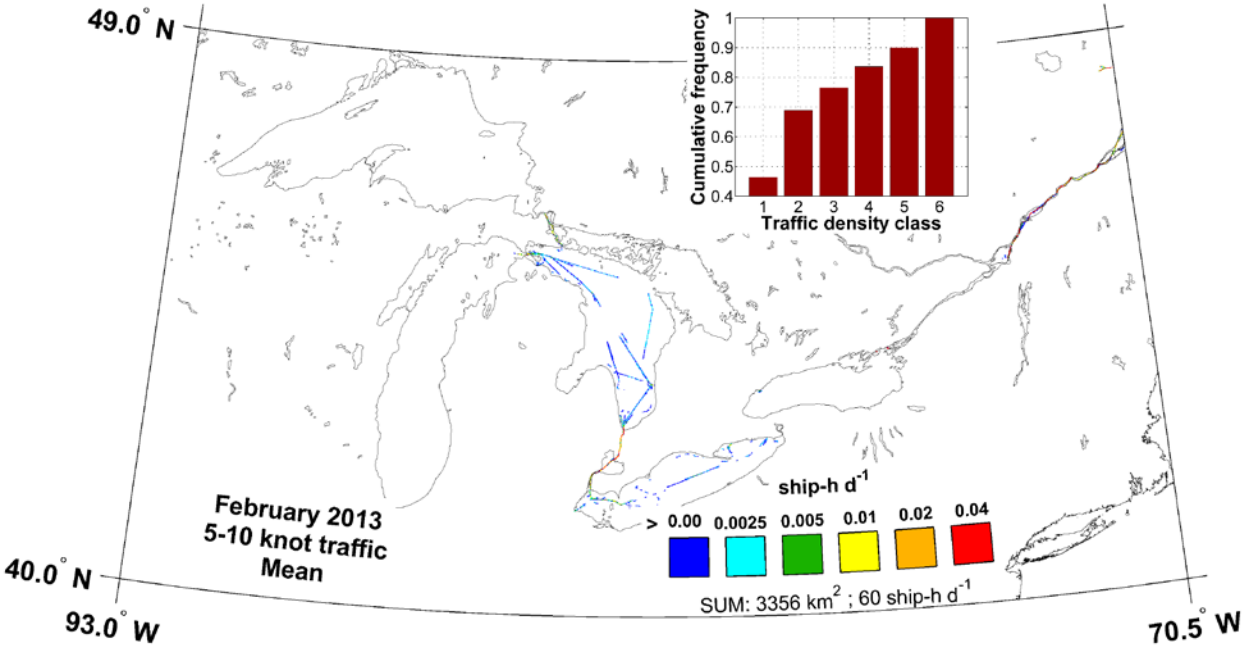

Figure 68. Map of 5–10 knot AIS mean traffic density in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

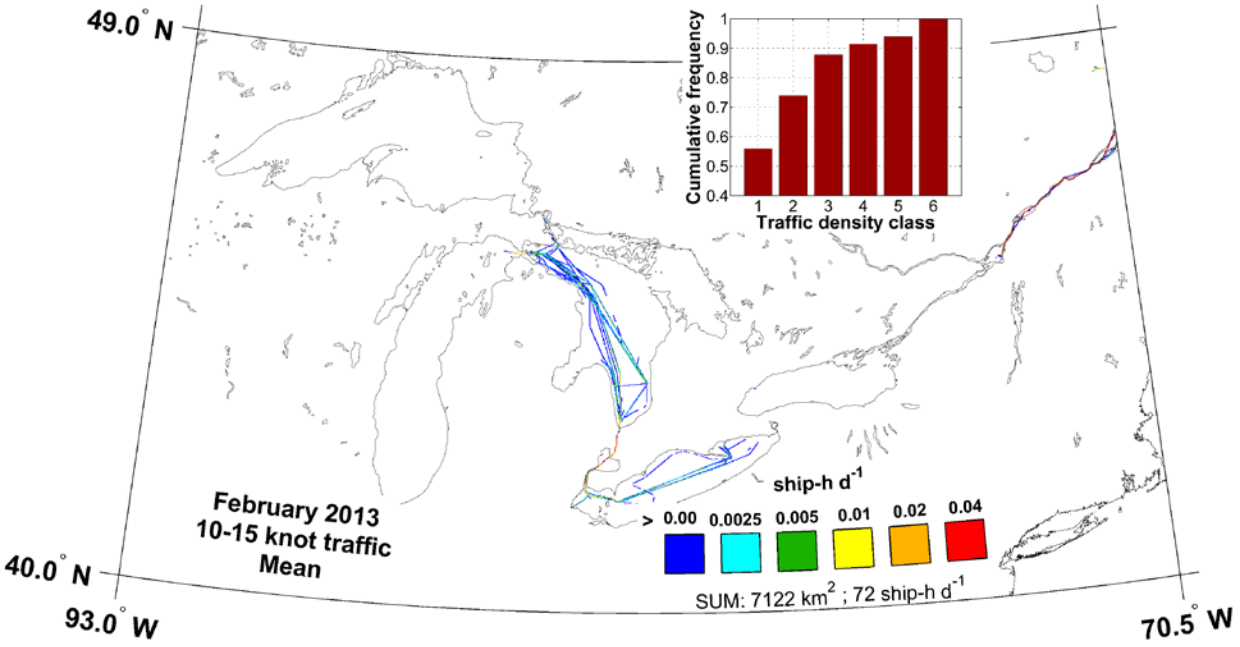

Figure 69. Map of 10–15 knot AIS mean traffic density in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

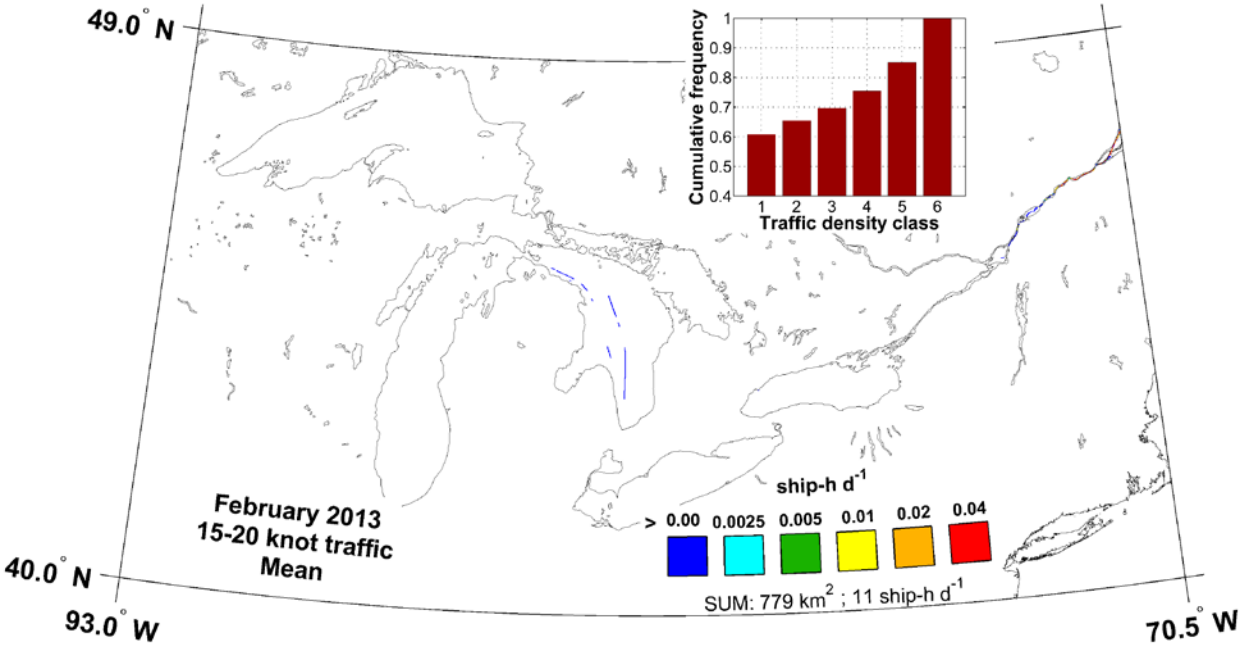

Figure 70. Map of 15–20 knot AIS mean traffic density in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

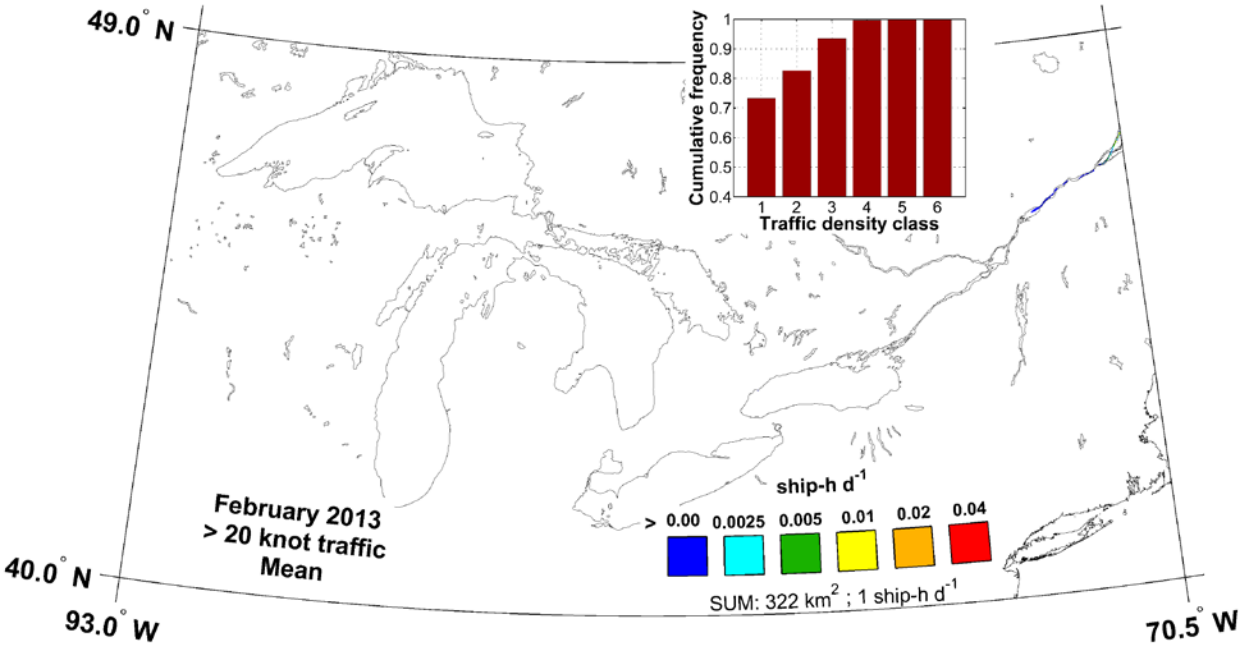

Figure 71. Map of >20 knot AIS mean traffic density in February 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.3. March 2013

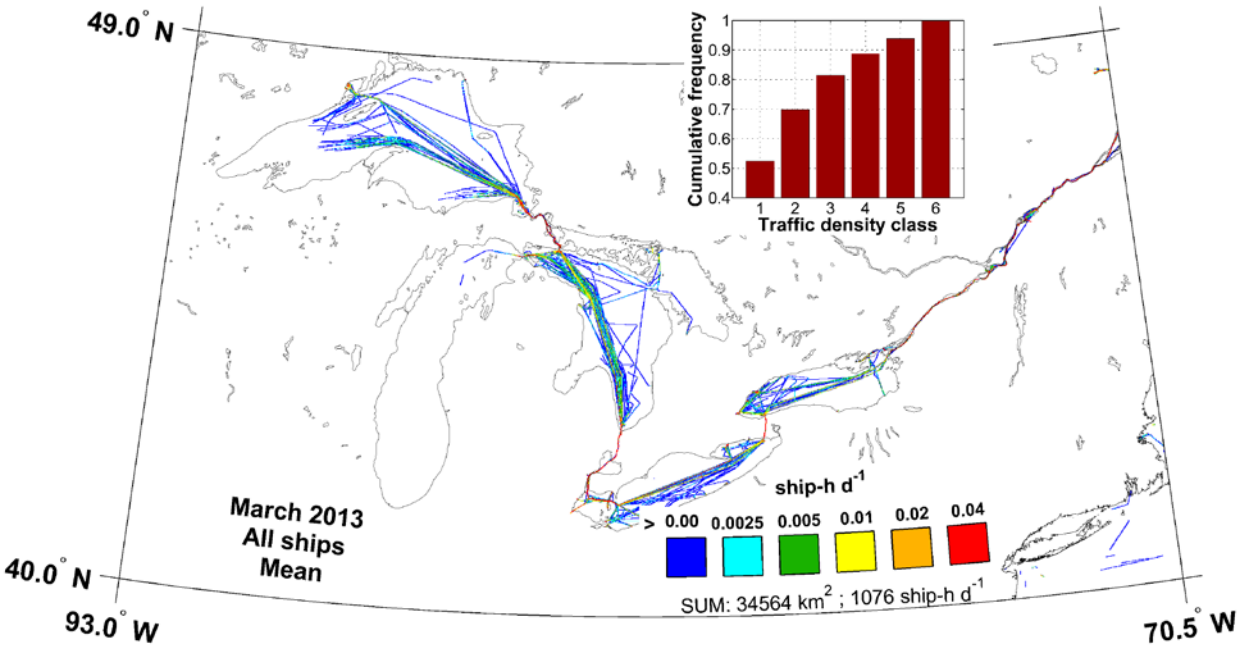

Figure 72. Map of AIS mean traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

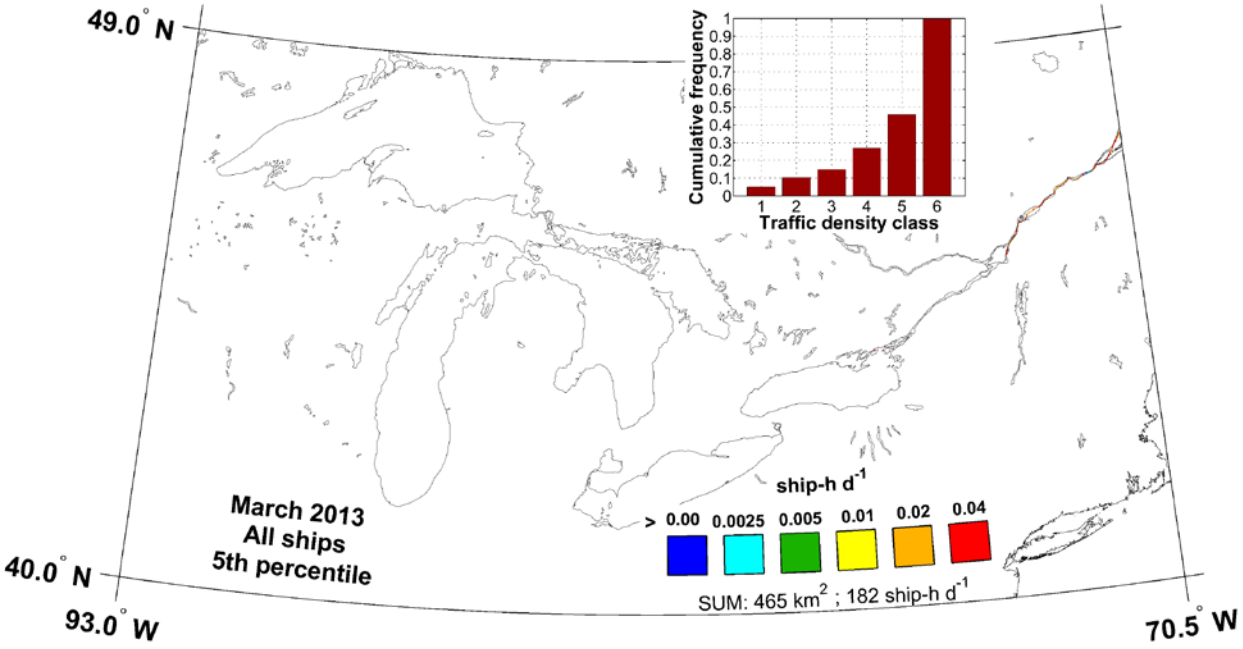

Figure 73. Map of the 5th percentile of the daily AIS traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

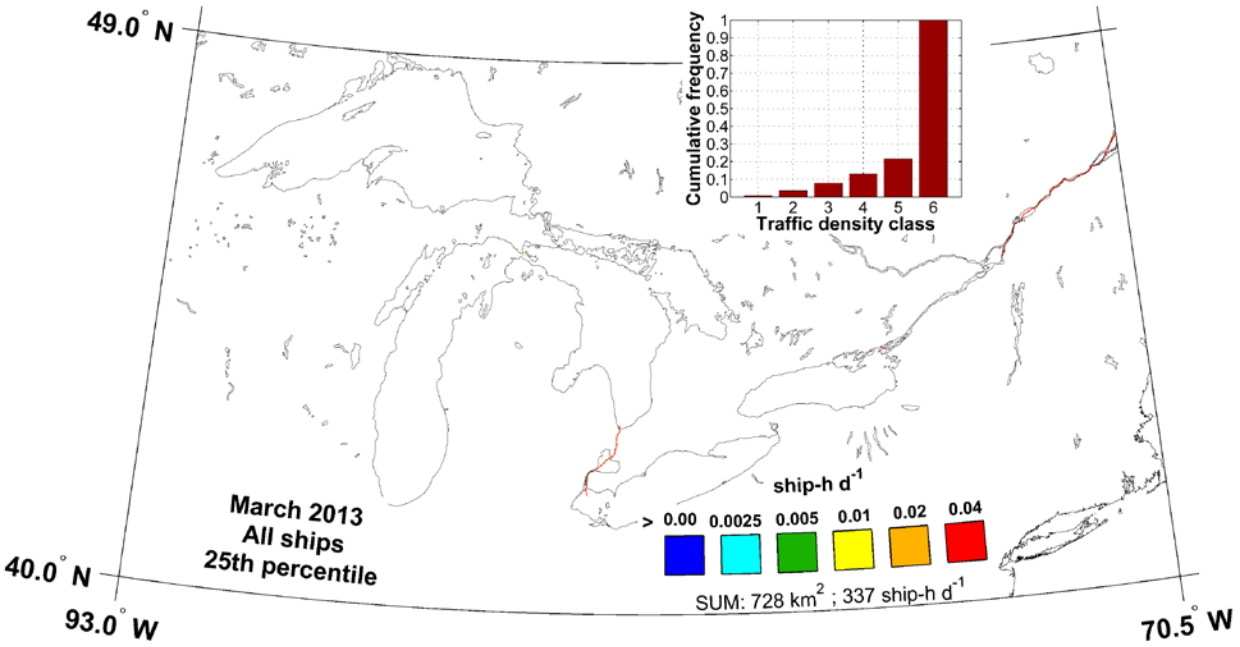

Figure 74. Map of the 25th percentile of the daily AIS traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

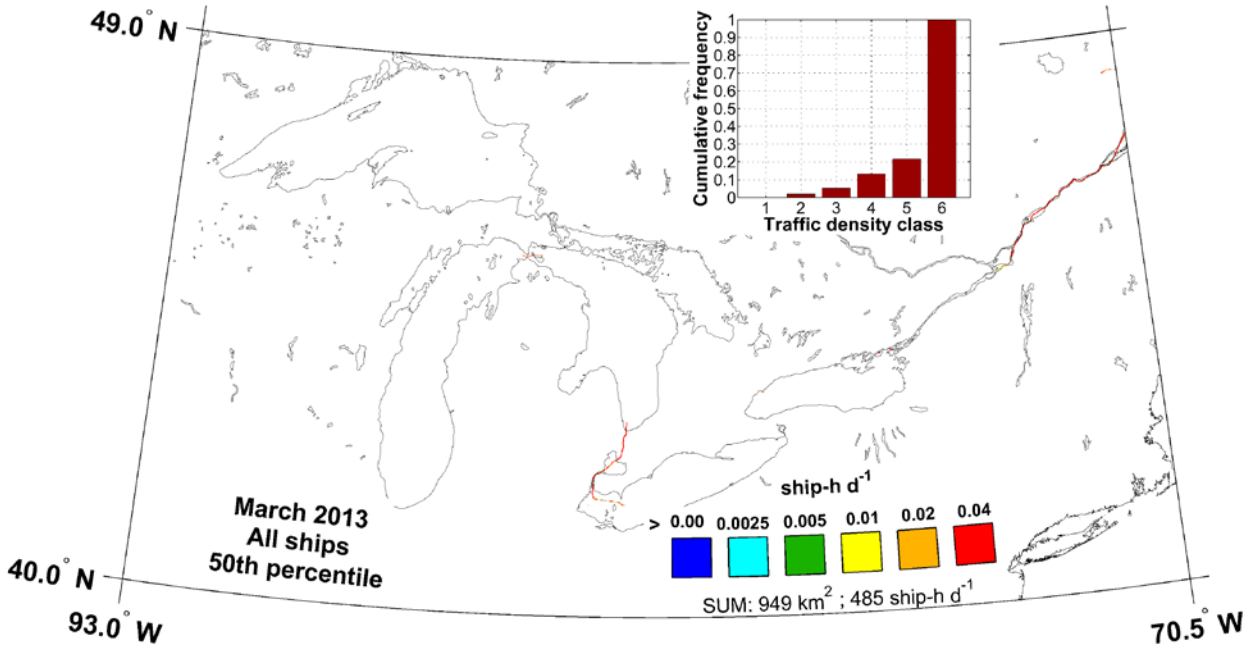

Figure 75. Map of the 50th percentile of the daily AIS traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

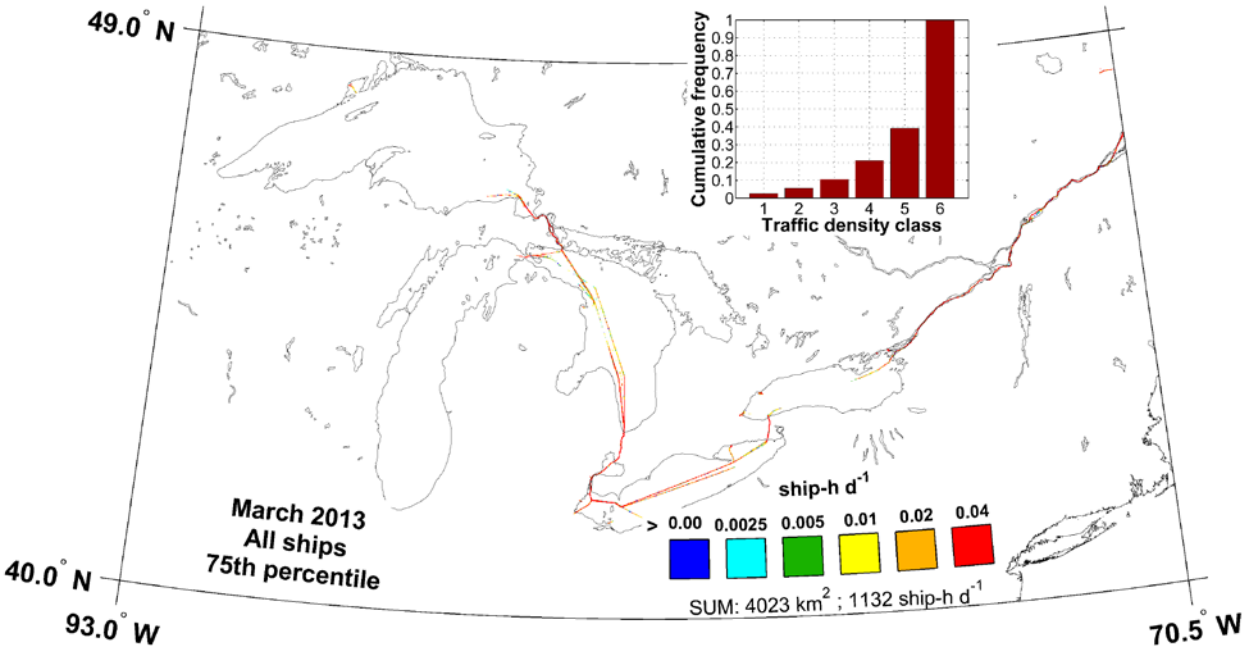

Figure 76. Map of the 75th percentile of the daily AIS traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

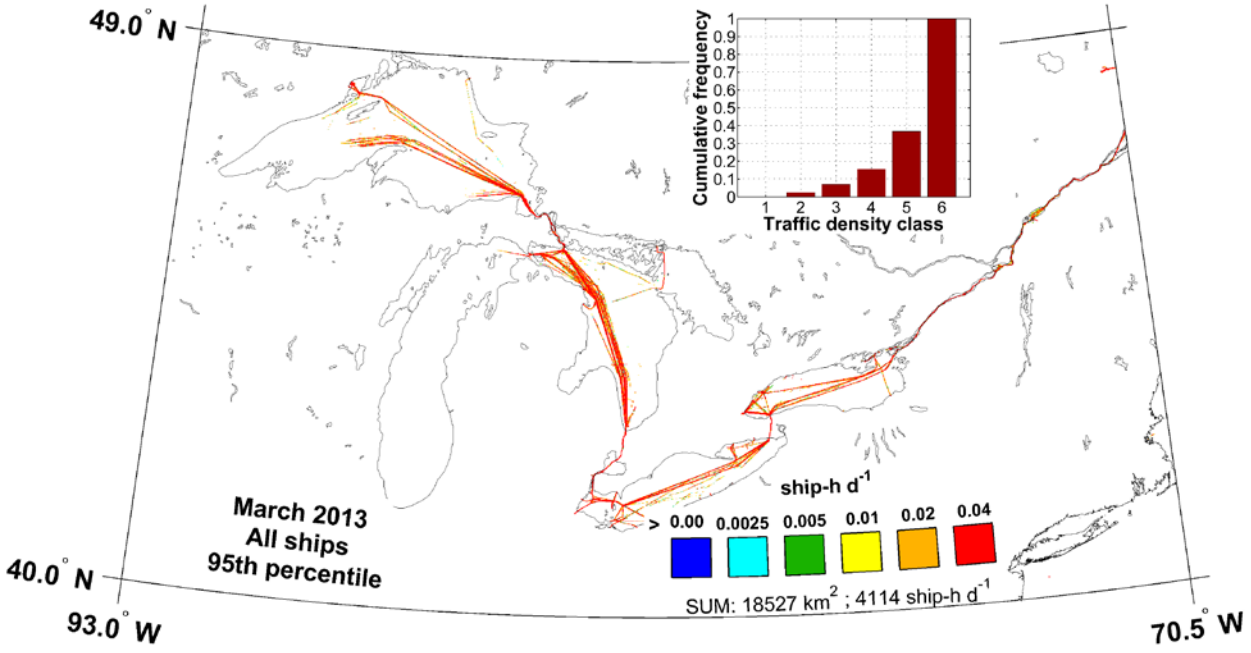

Figure 77. Map of the 95th percentile of the daily AIS traffic density of all ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

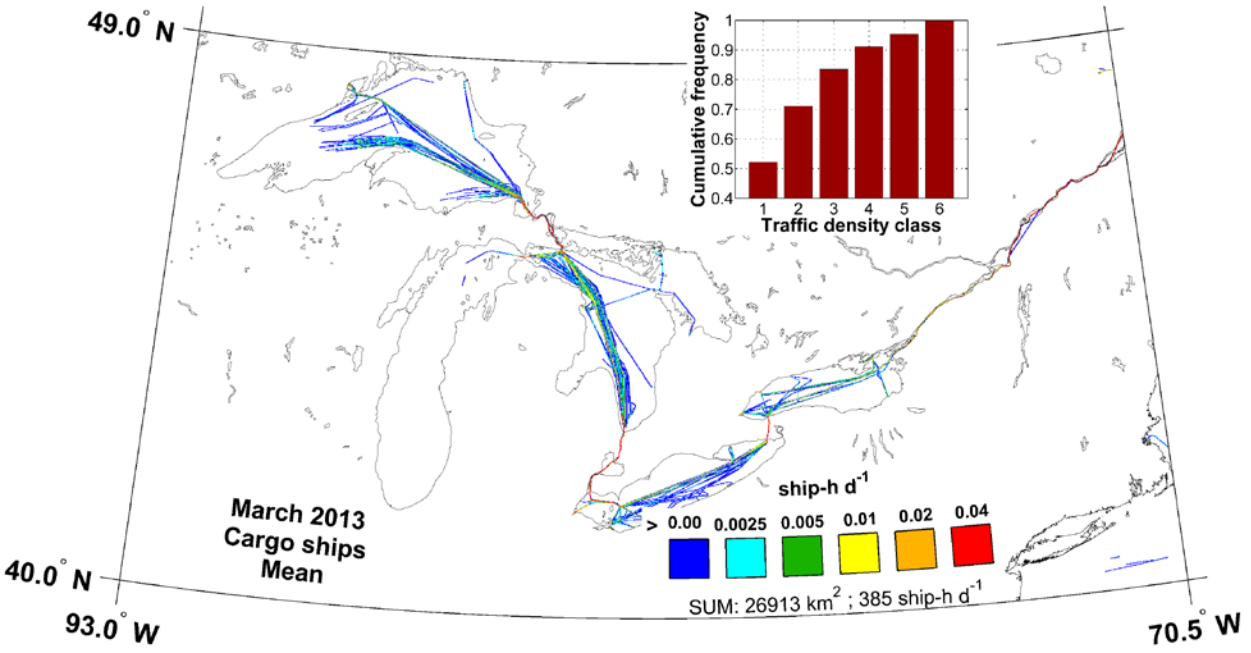

Figure 78. Map of AIS mean traffic density of cargo-type ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

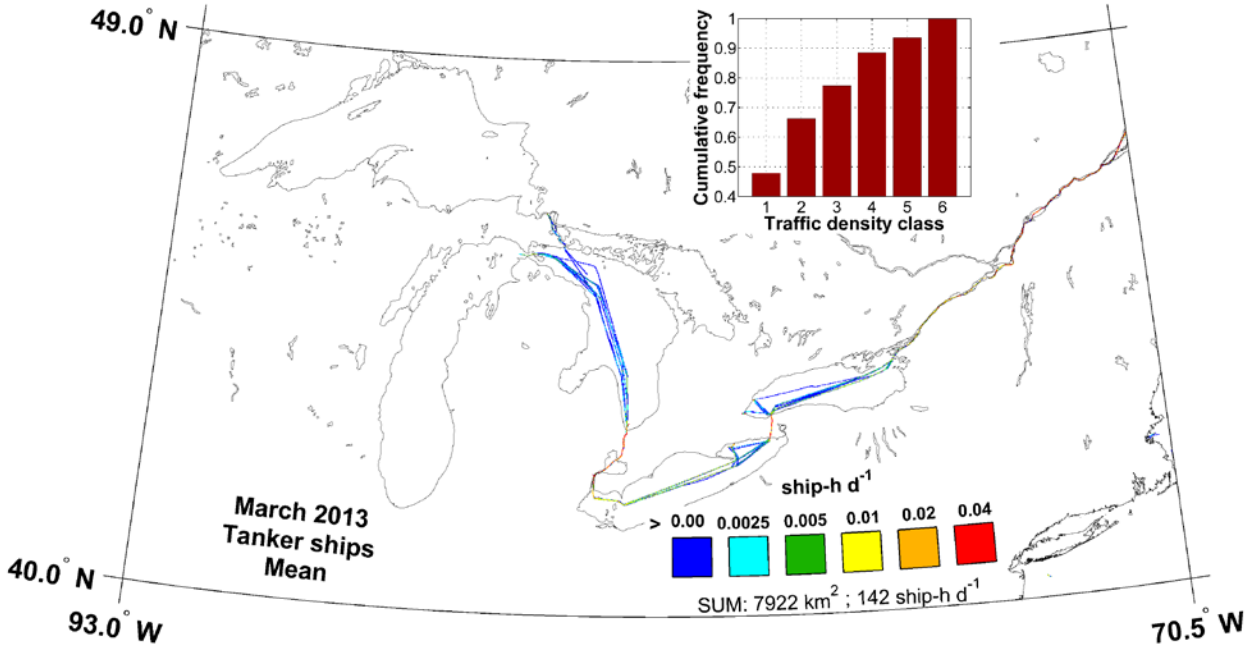

Figure 79. Map of AIS mean traffic density of tanker-type ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

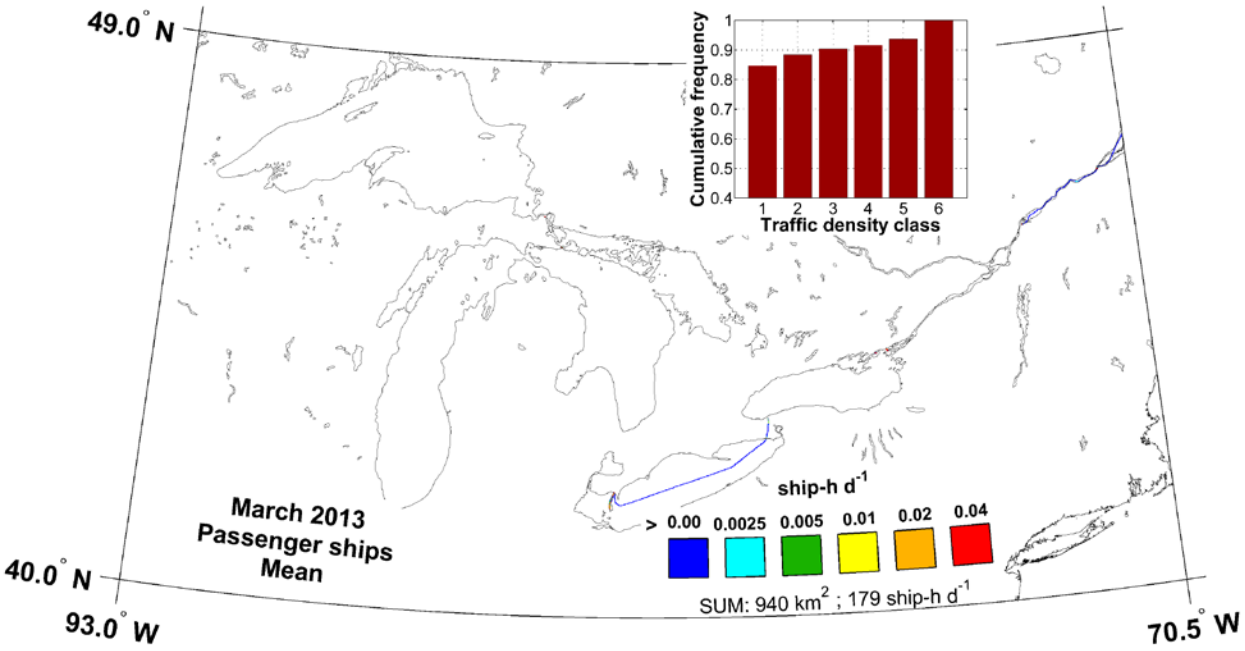

Figure 80. Map of AIS mean traffic density of passenger-type ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

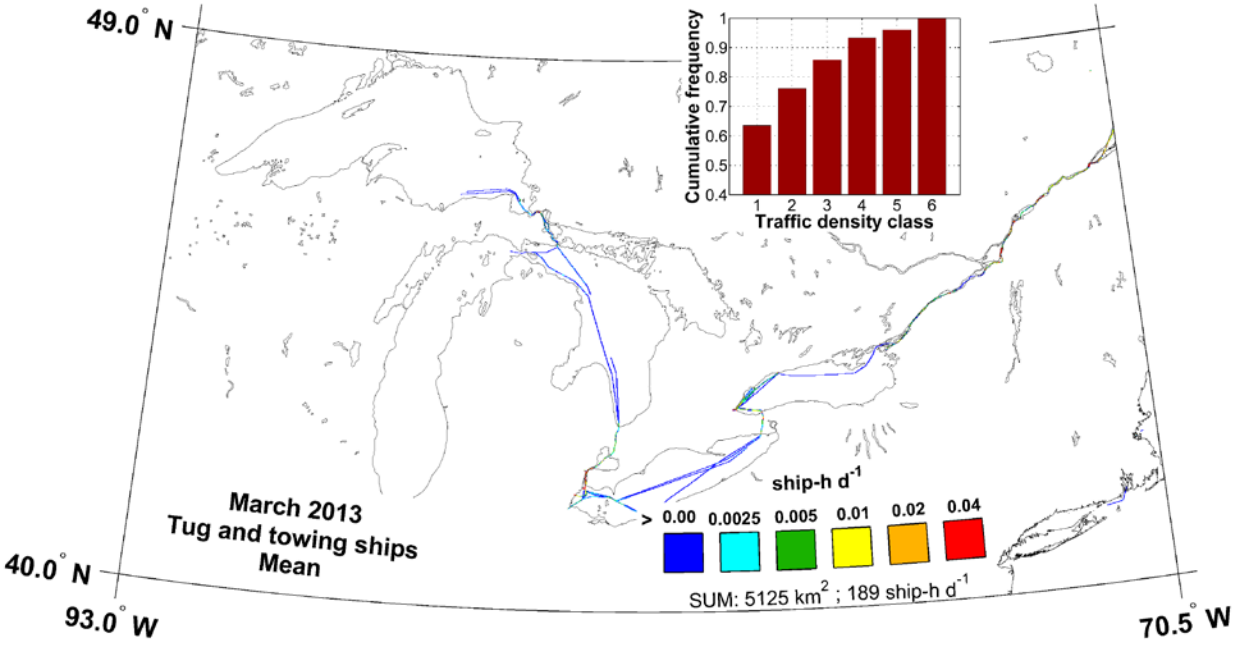

Figure 81. Map of AIS mean traffic density of tug and towing-type ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

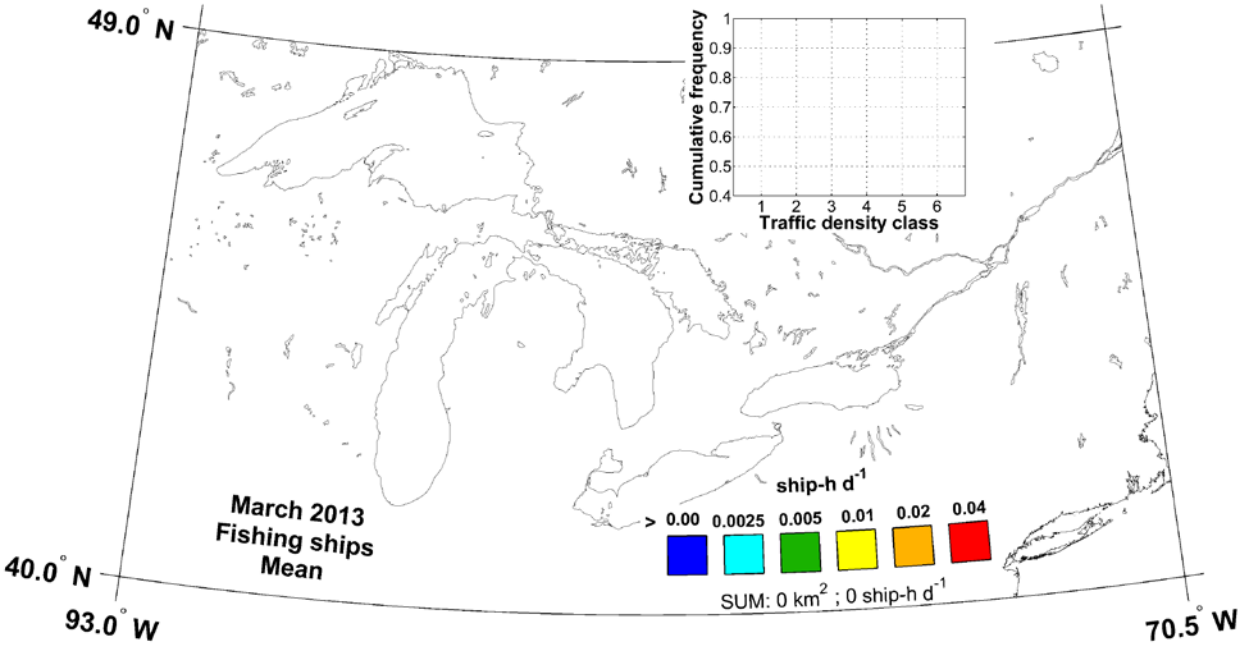

Figure 82. Map of AIS mean traffic density of fishing-type ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

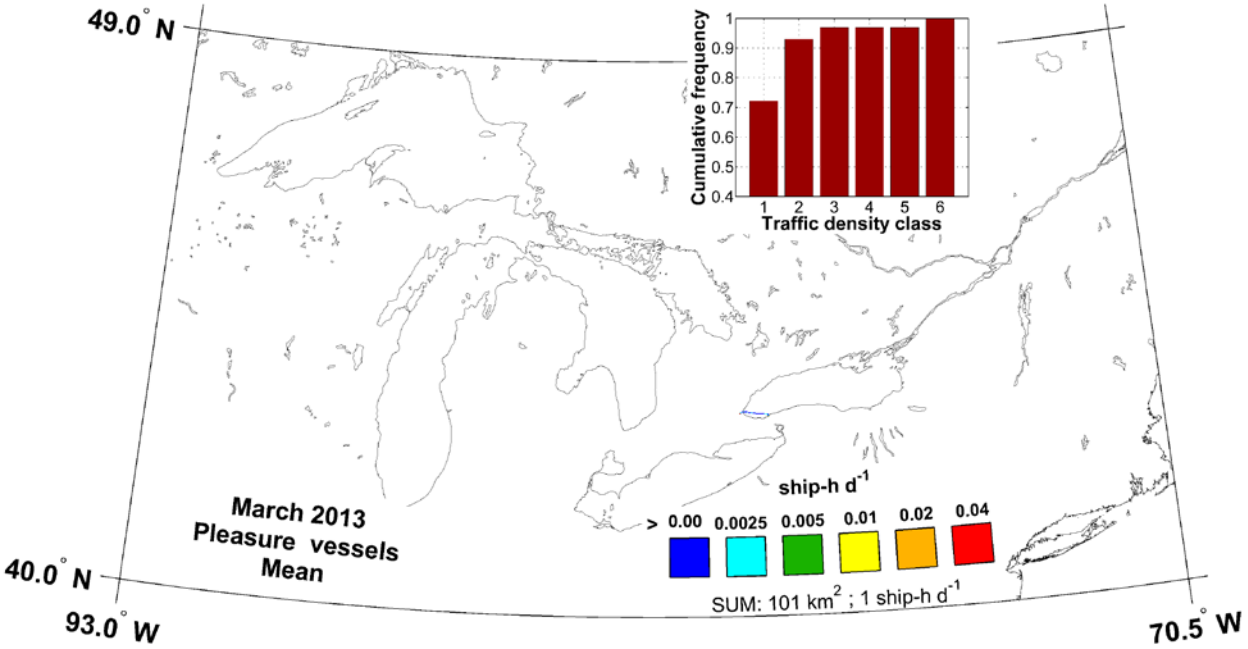

Figure 83. Map of AIS mean traffic density of pleasure-type vessels in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

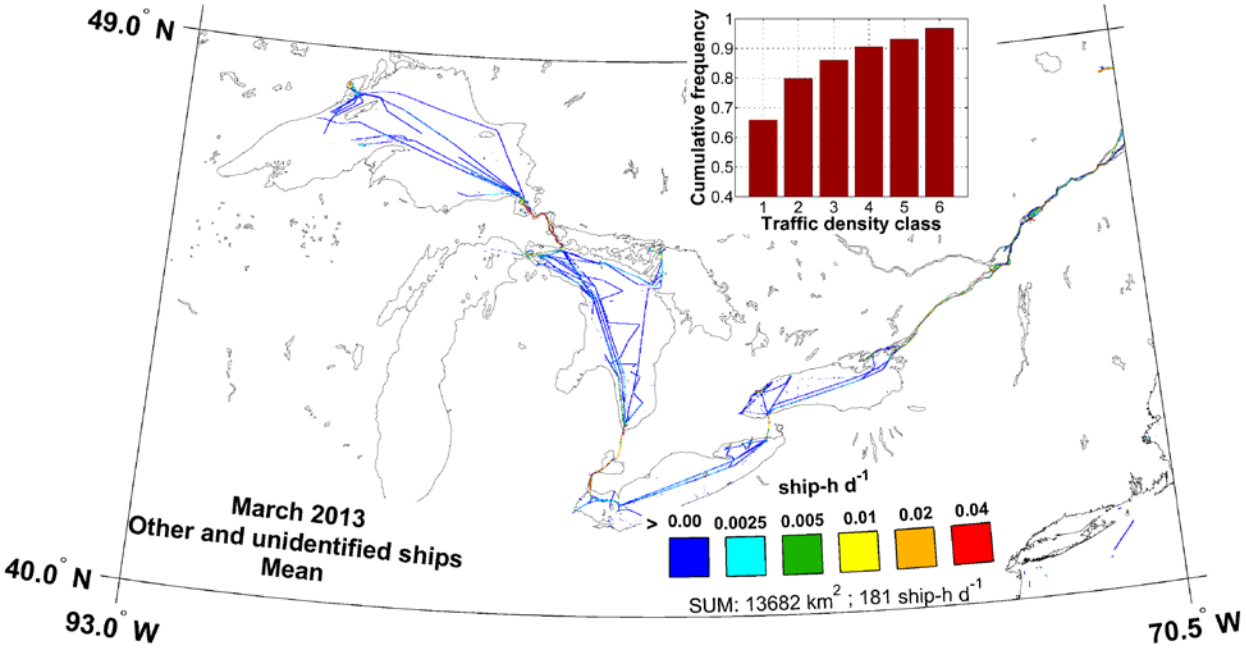

Figure 84. Map of AIS mean traffic density of other types of ships and ships of unidentified type in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

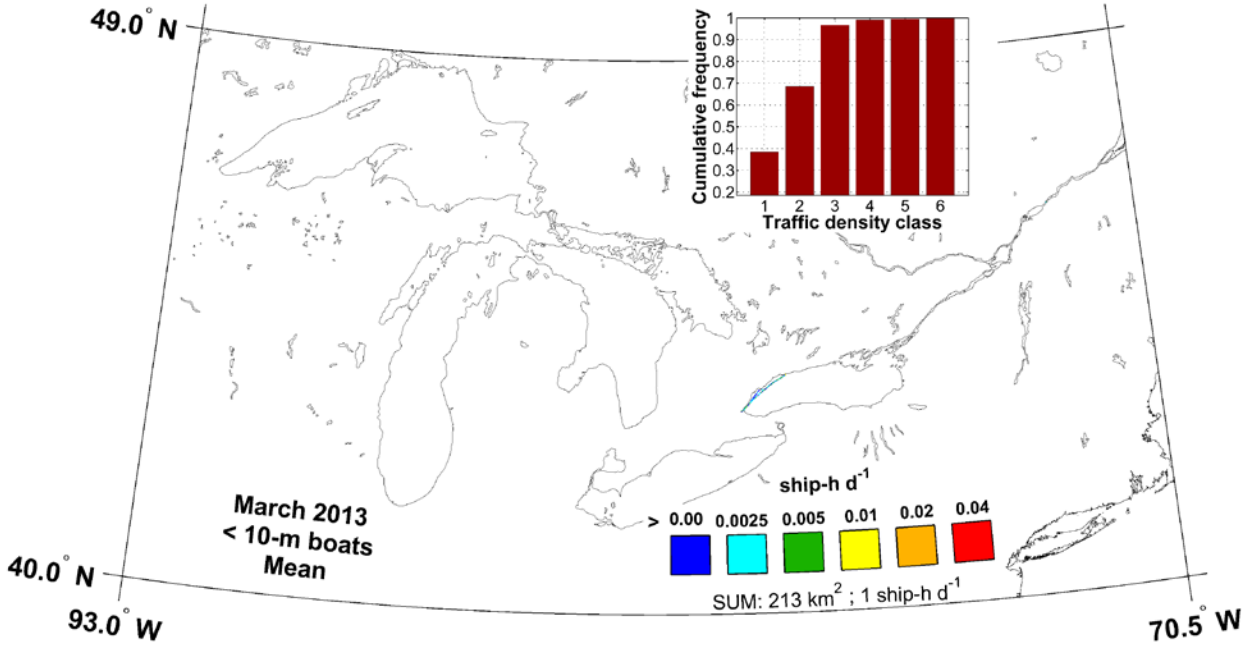

Figure 85. Map of AIS mean traffic density of ships with lengths < 10 m in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

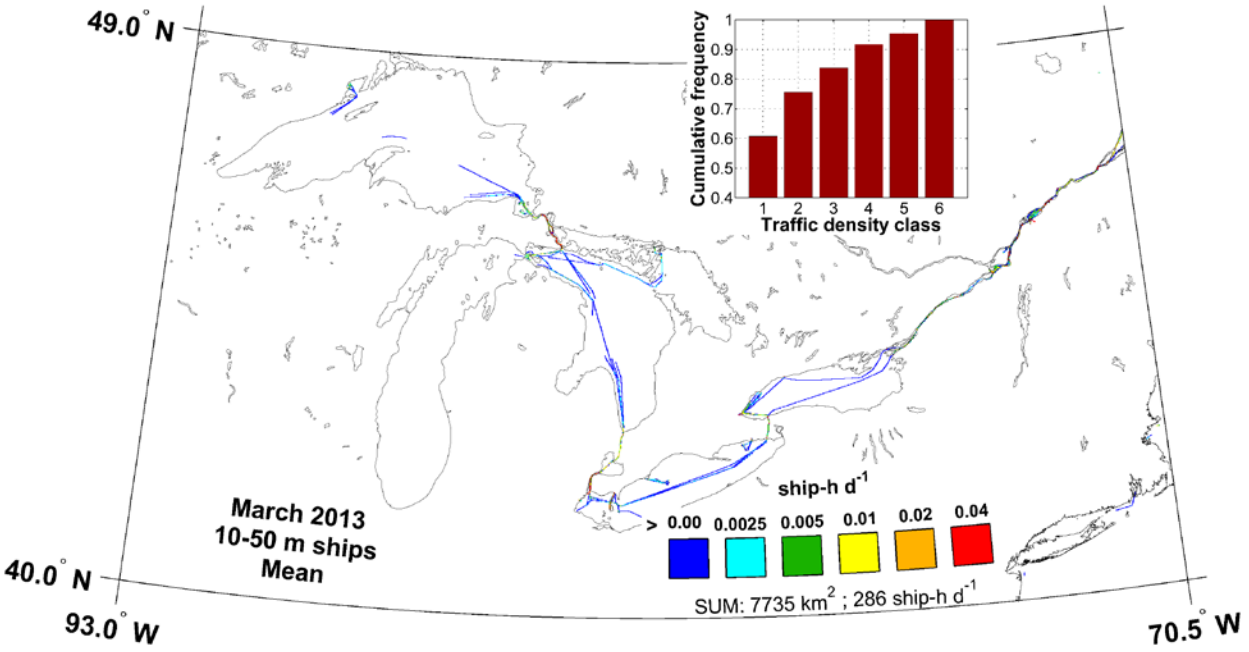

Figure 86. Map of AIS mean traffic density of 10 to 50 m ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

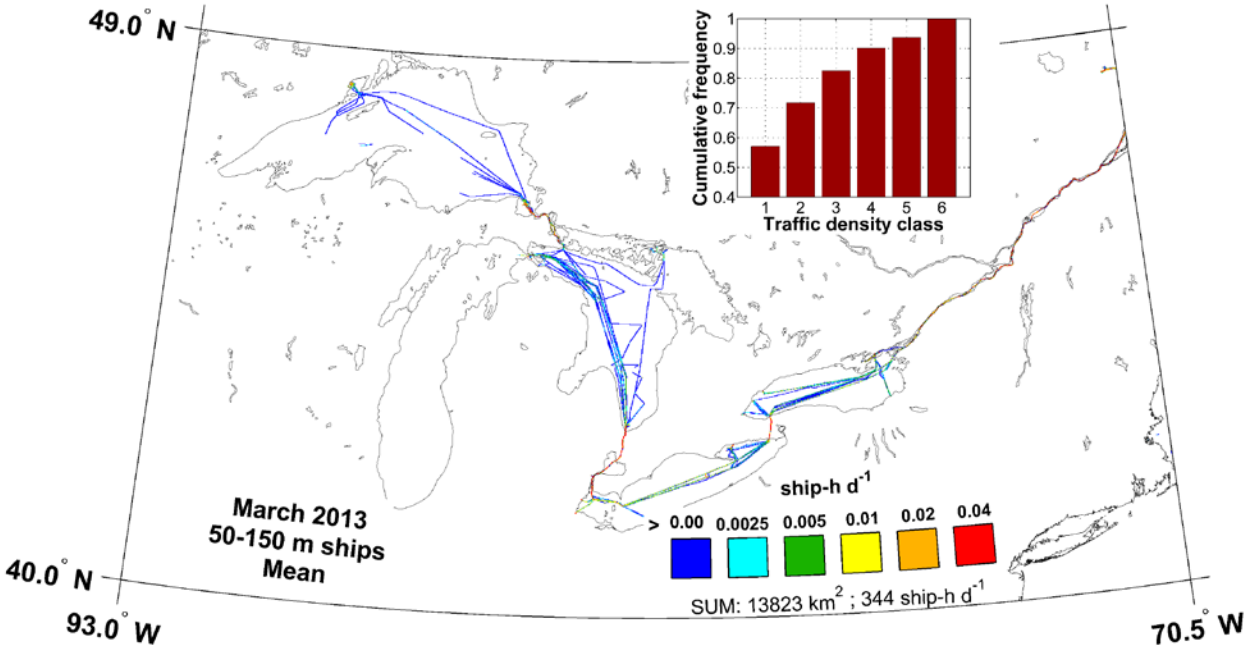

Figure 87. Map of AIS mean traffic density of 50 to 150 m ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

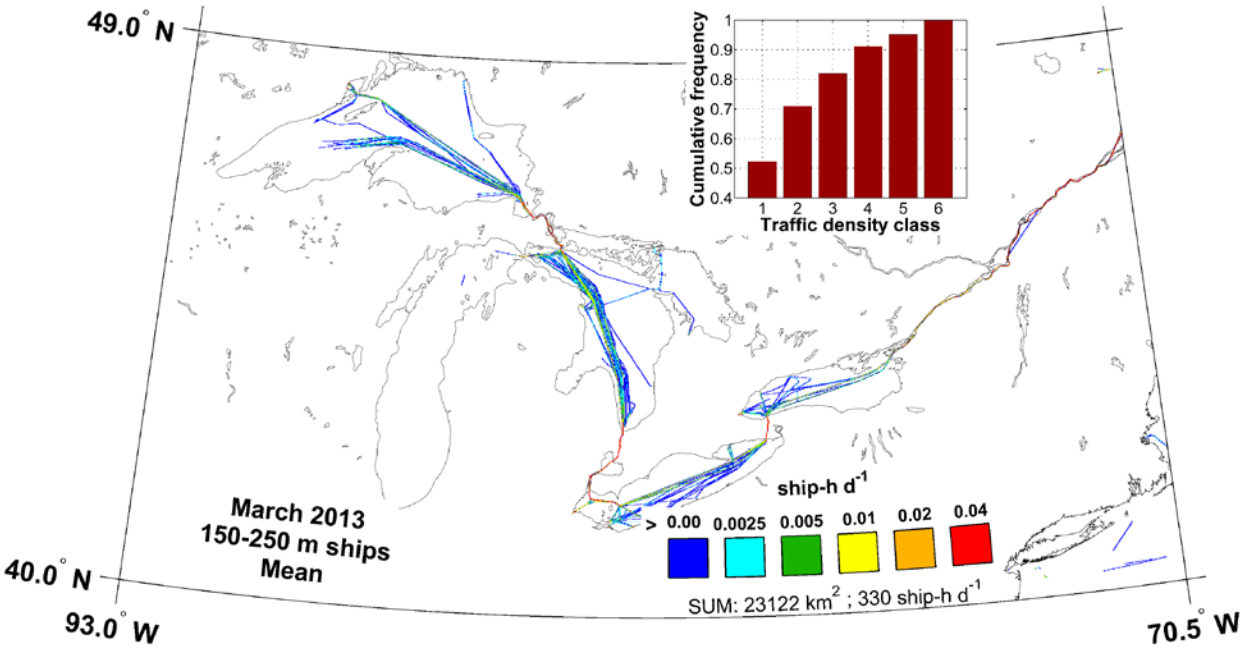

Figure 88. Map of AIS mean traffic density of 150 to 250 m ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

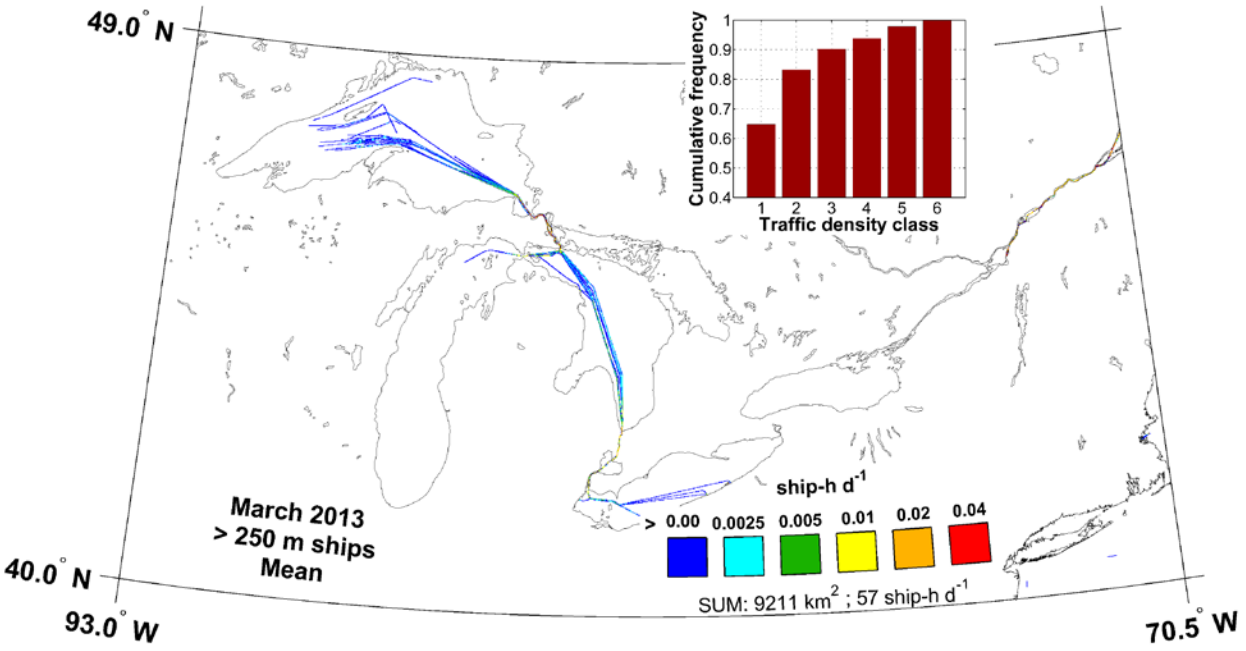

Figure 89. Map of AIS mean traffic density of > 250 m ships in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

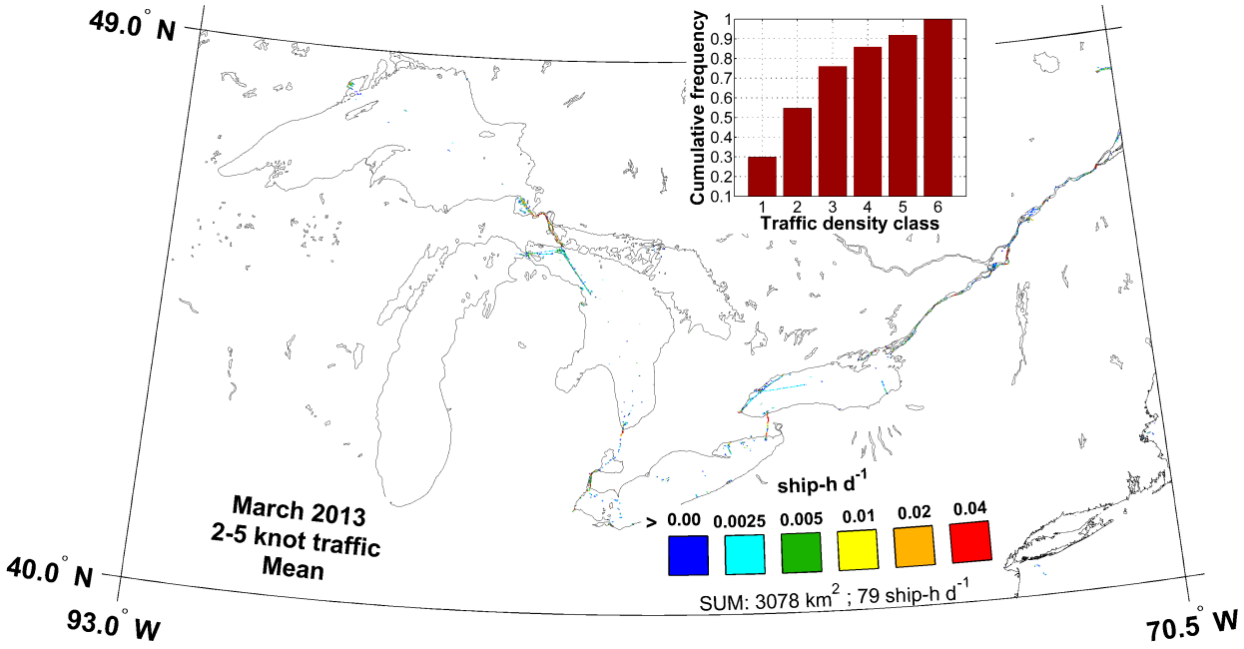

Figure 90. Map of 2–5 knot AIS mean traffic density in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

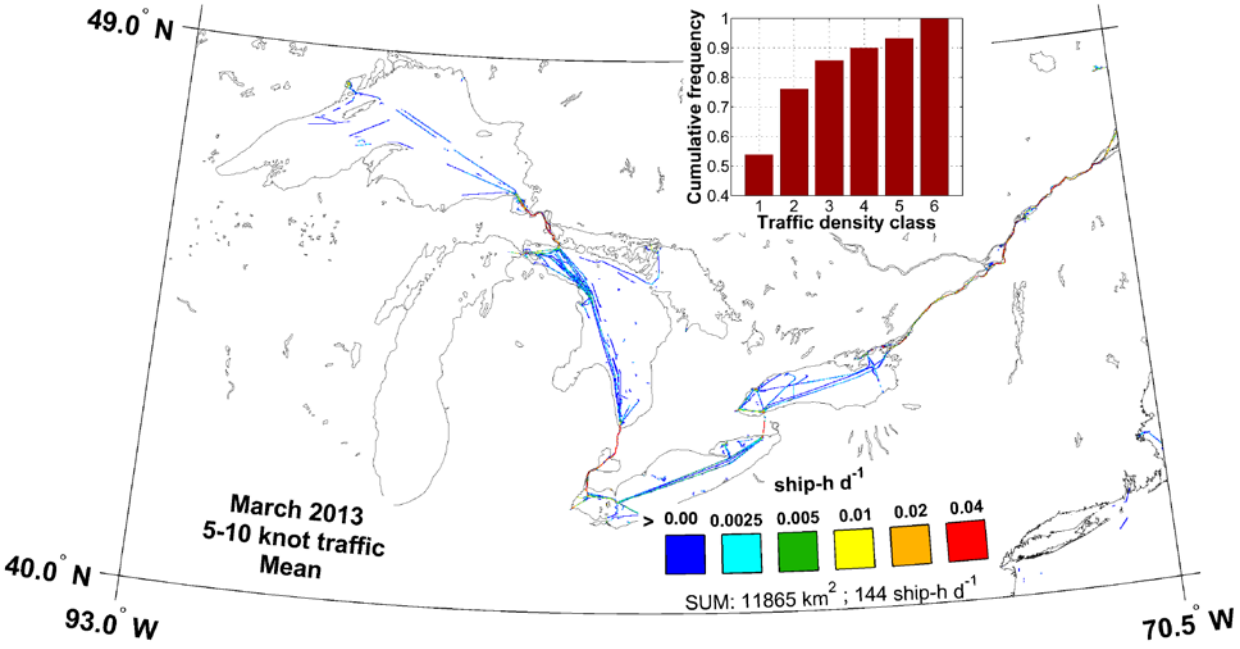

Figure 91. Map of 5–10 knot AIS mean traffic density in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

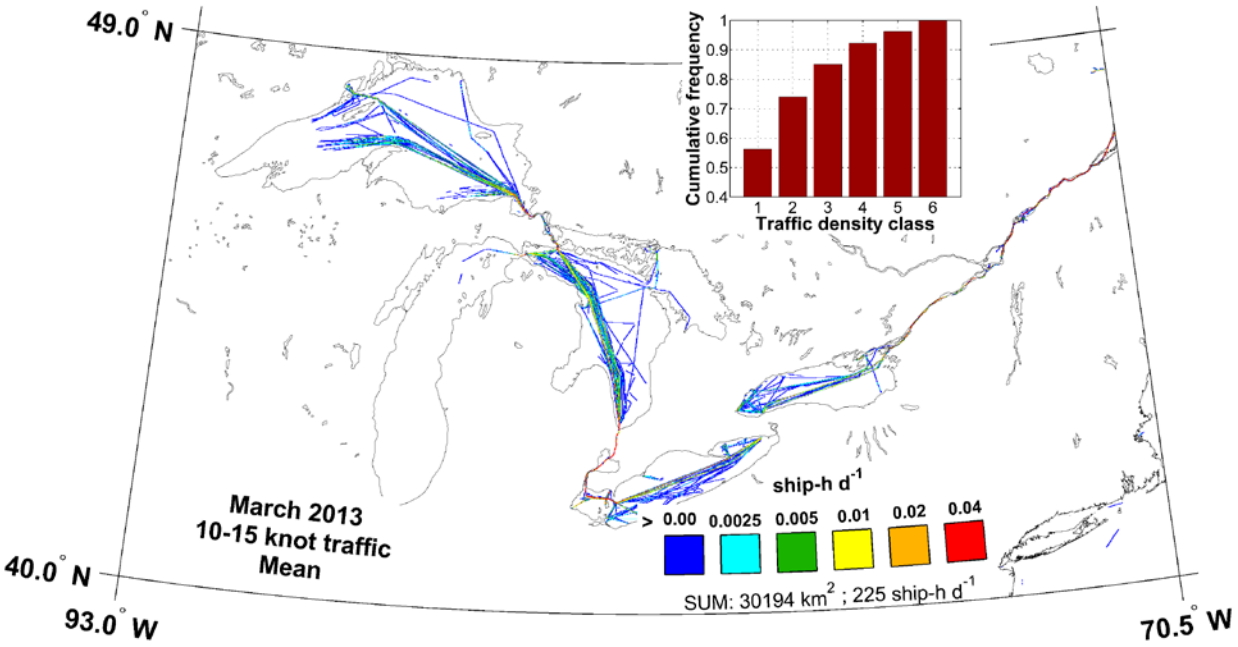

Figure 92. Map of 10–15 knot AIS mean traffic density in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

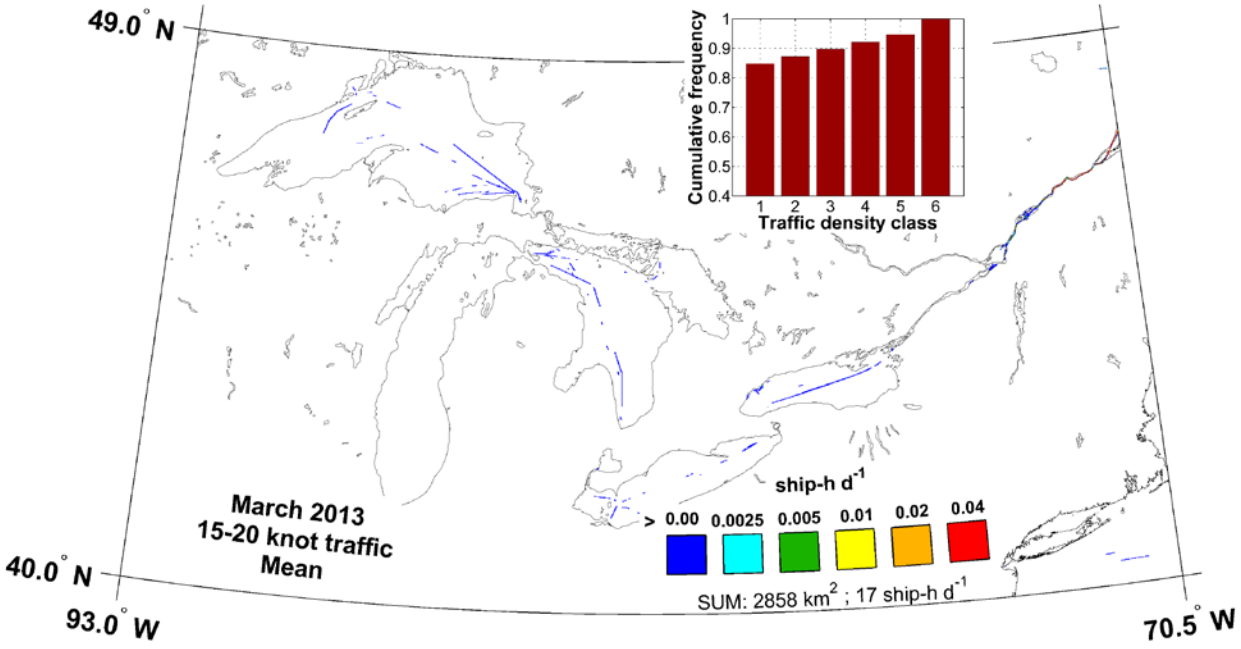

Figure 93. Map of 15–20 knot AIS mean traffic density in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

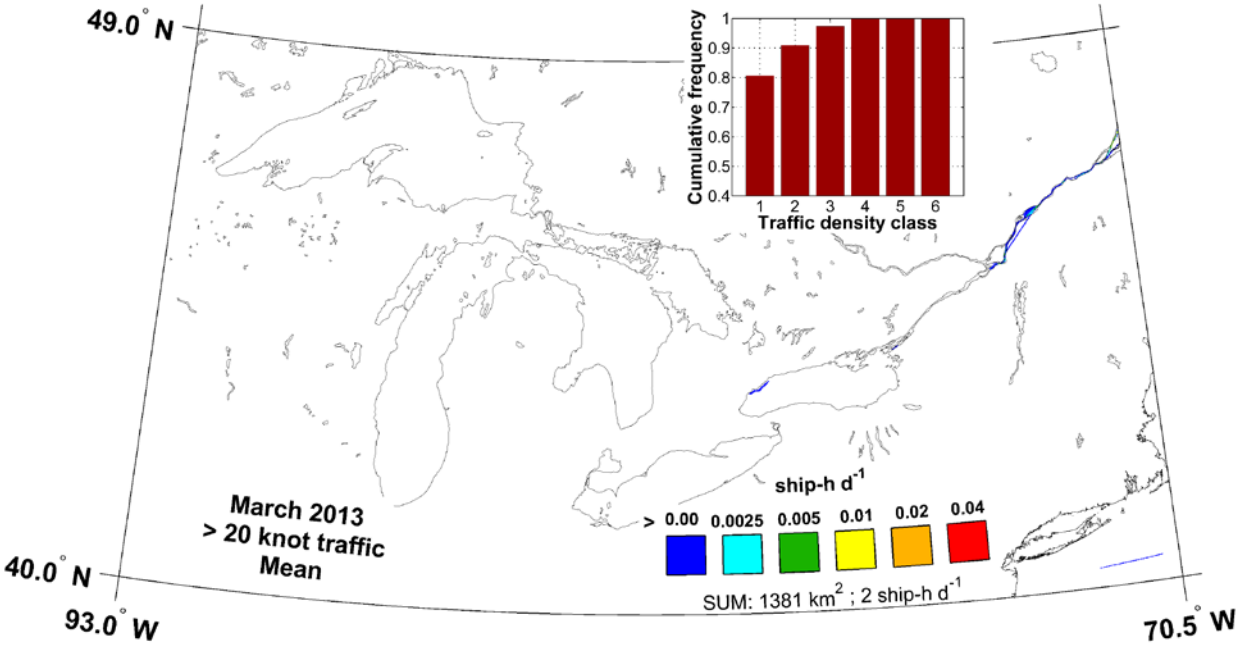

Figure 94. Map of >20 knot AIS mean traffic density in March 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.4. April 2013

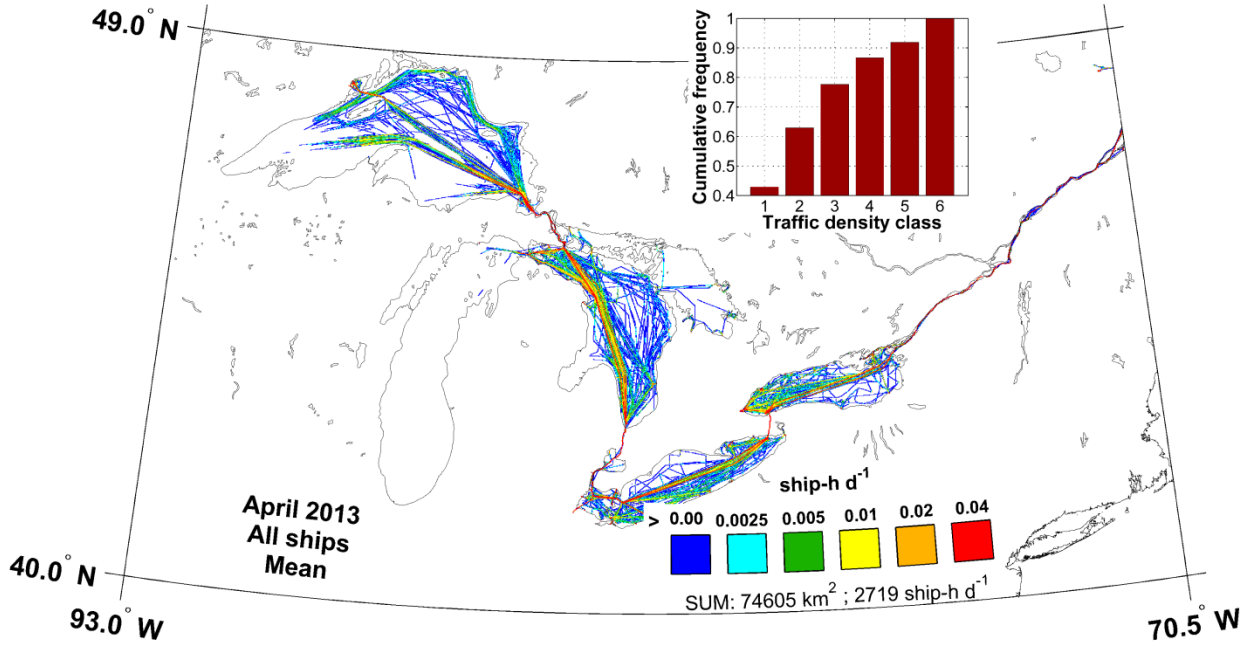

Figure 95. Map of AIS mean traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

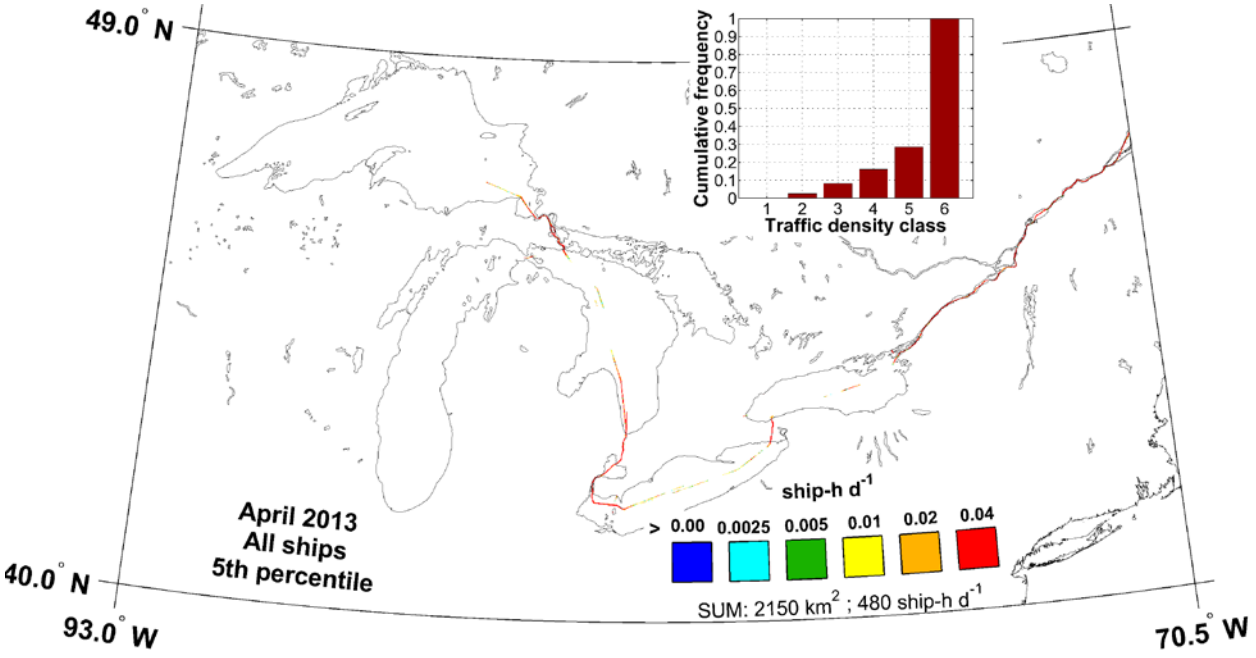

Figure 96. Map of the 5th percentile of the daily AIS traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

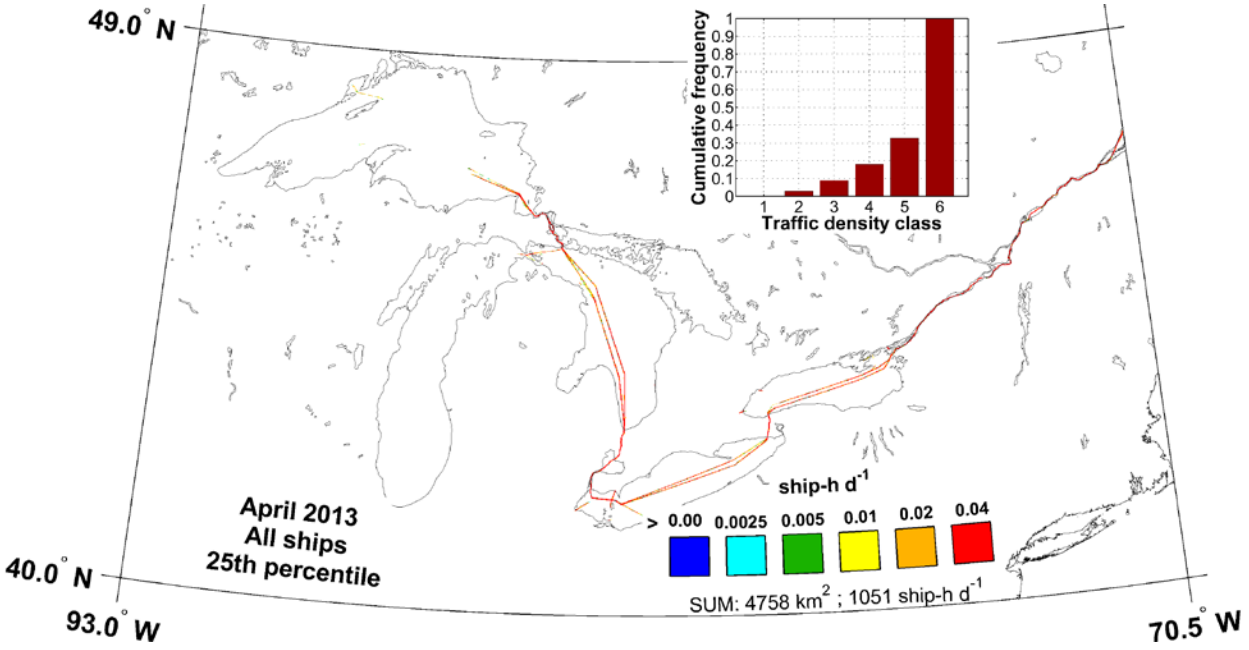

Figure 97. Map of the 25th percentile of the daily AIS traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

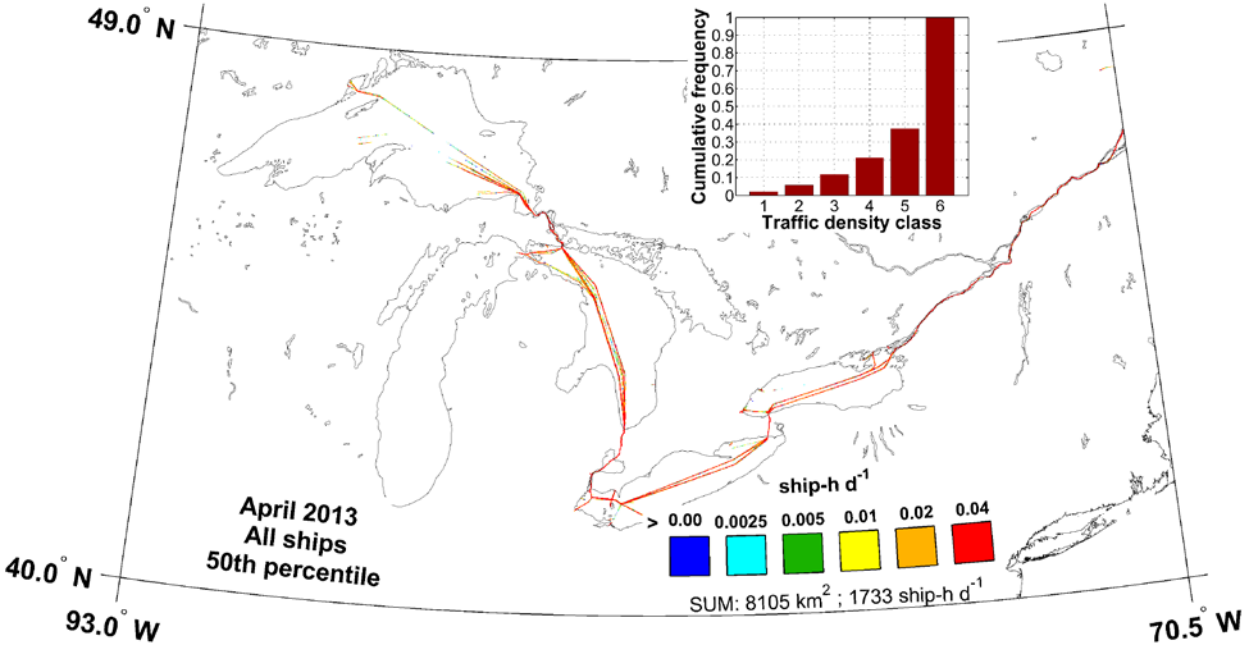

Figure 98. Map of the 50th percentile of the daily AIS traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

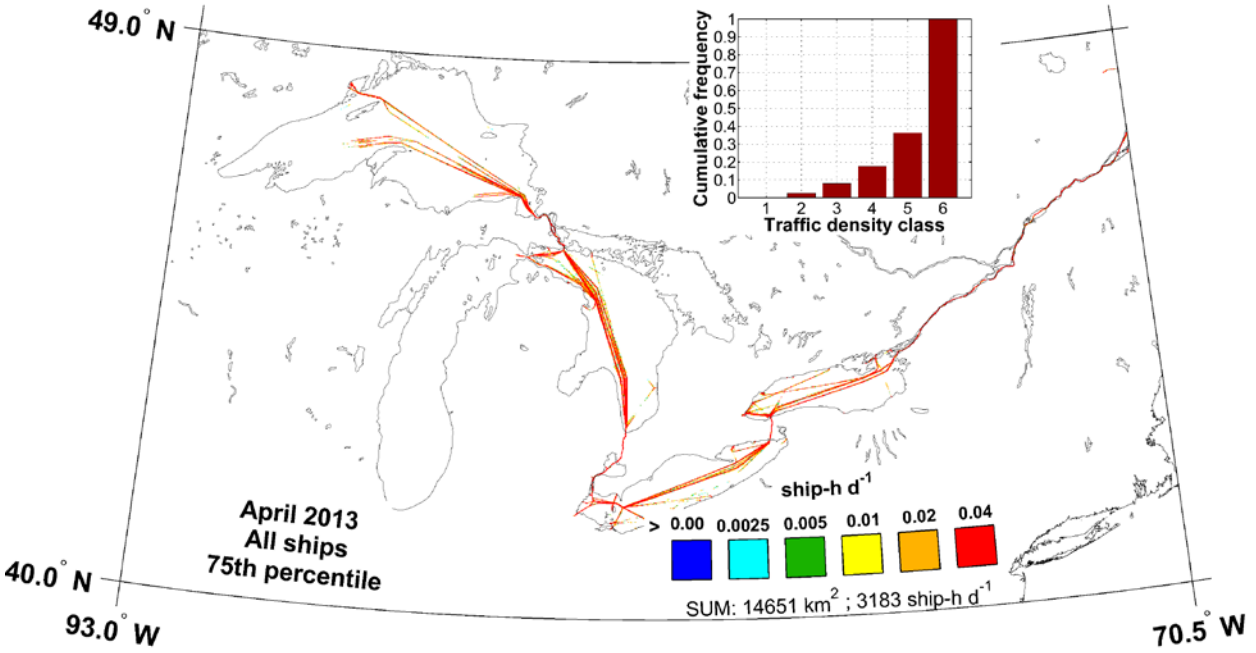

Figure 99. Map of the 75th percentile of the daily AIS traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

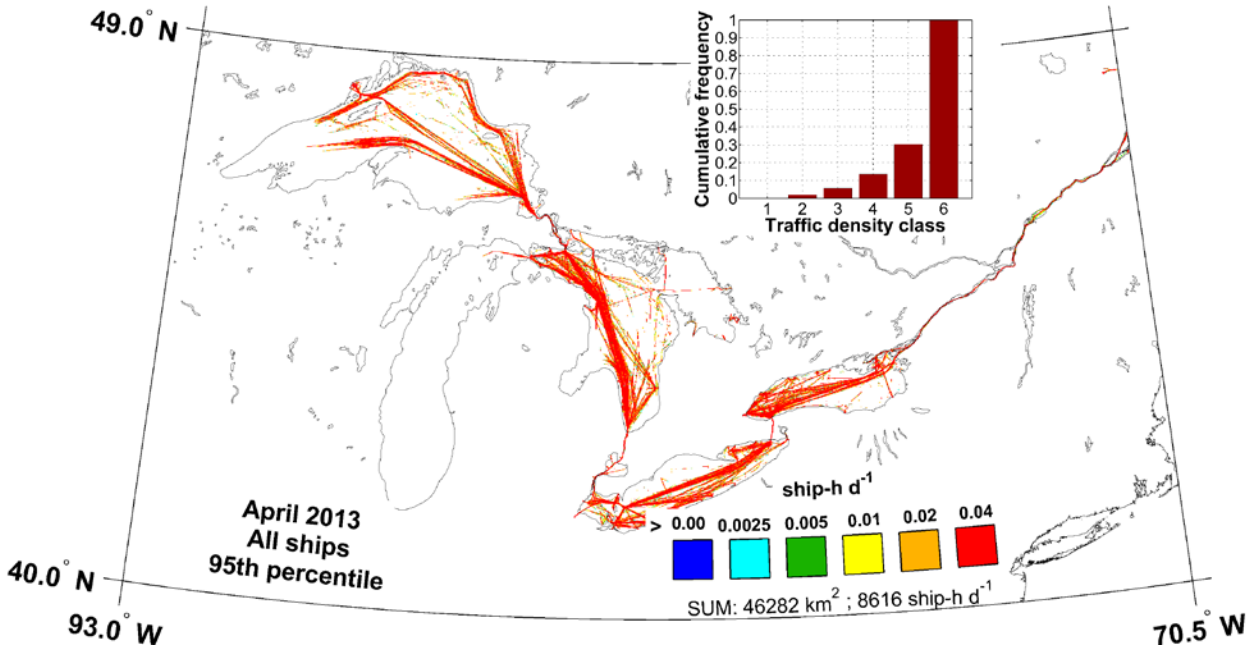

Figure 100. Map of the 95th percentile of the daily AIS traffic density of all ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

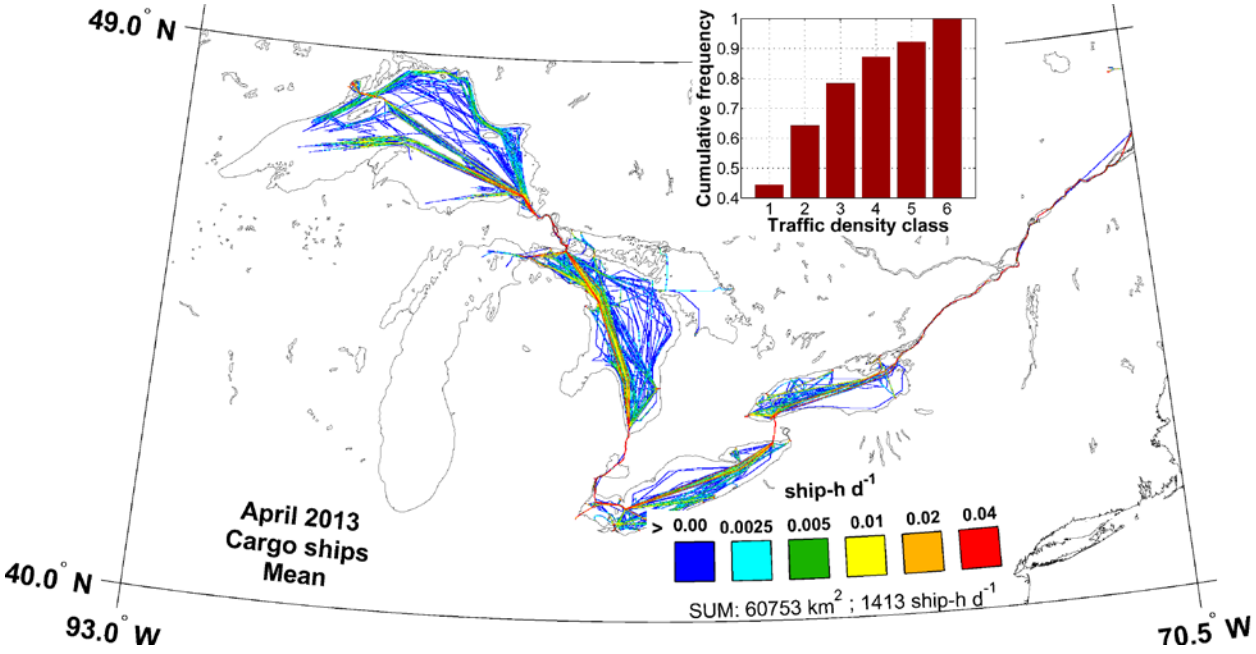

Figure 101. Map of AIS mean traffic density of cargo-type ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

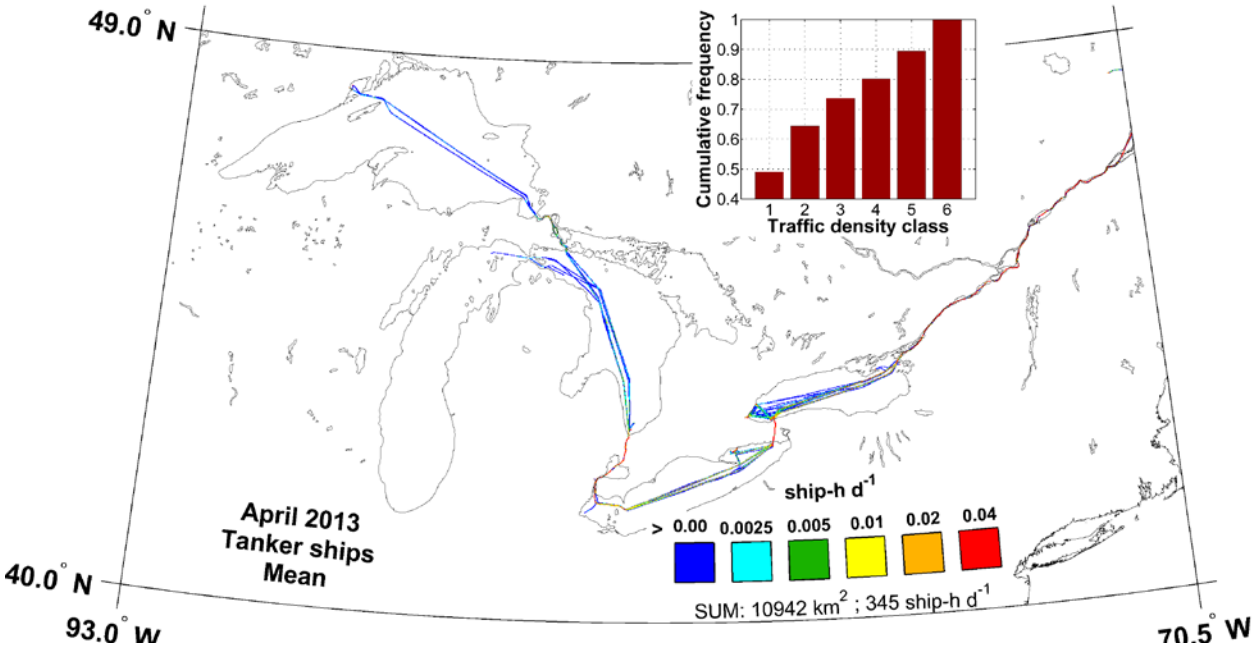

Figure 102. Map of AIS mean traffic density of tanker-type ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

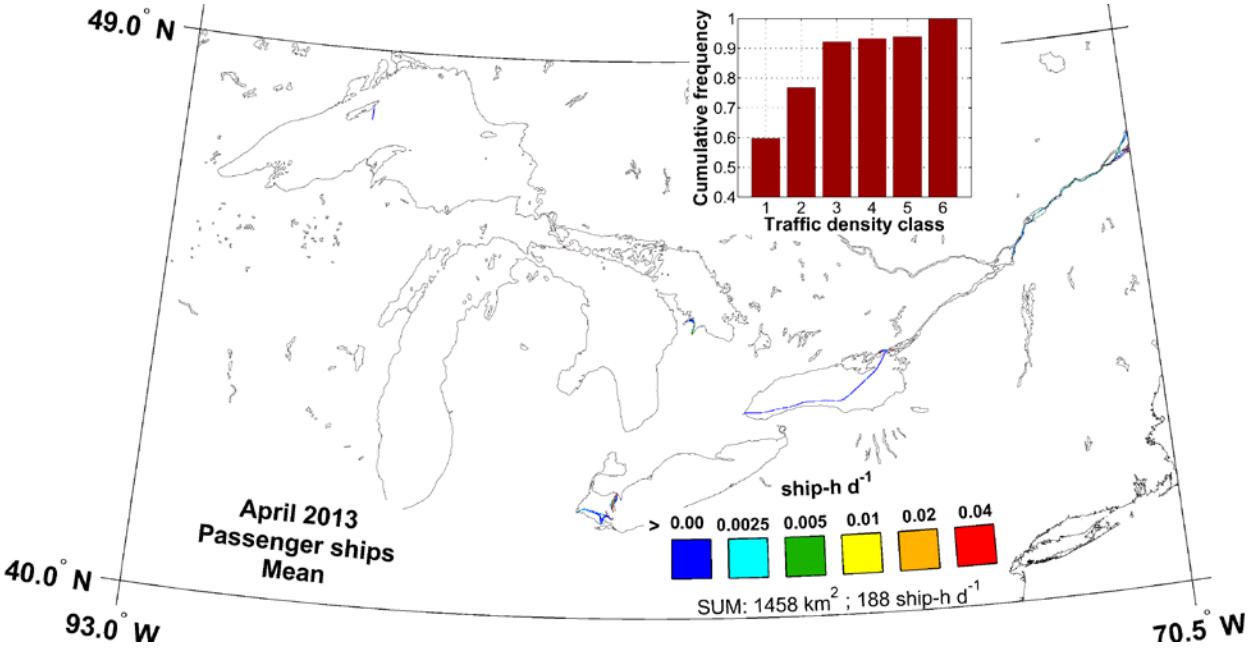

Figure 103. Map of AIS mean traffic density of passenger-type ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

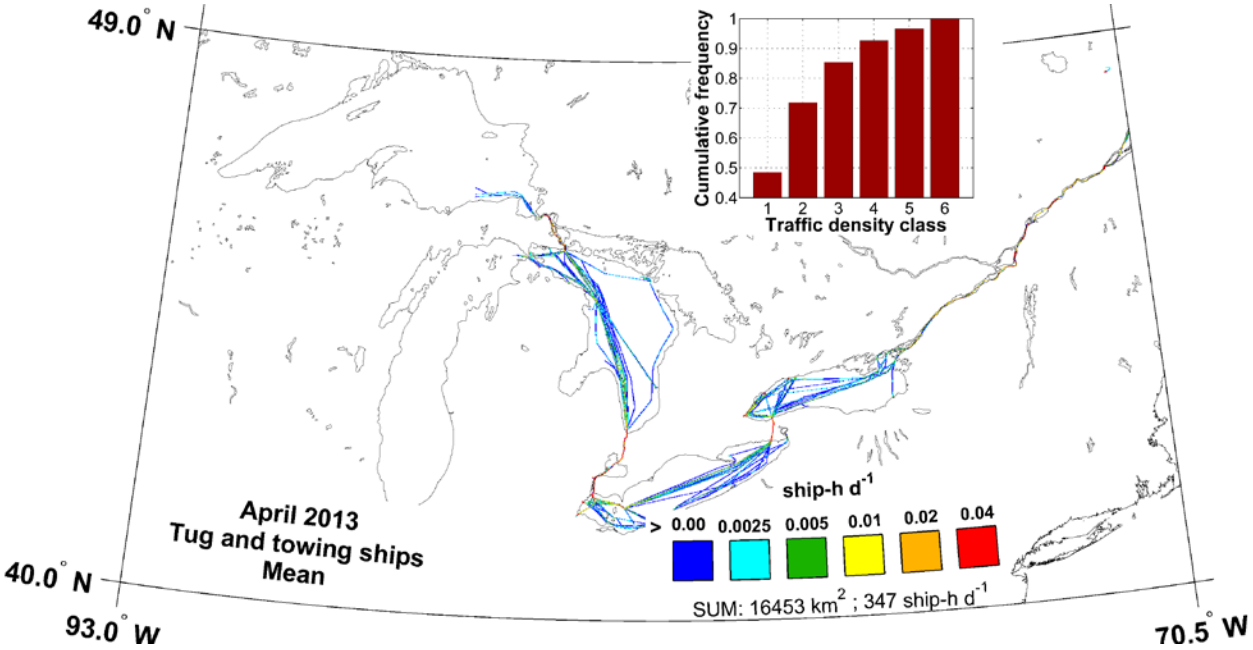

Figure 104. Map of AIS mean traffic density of tug and towing-type ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

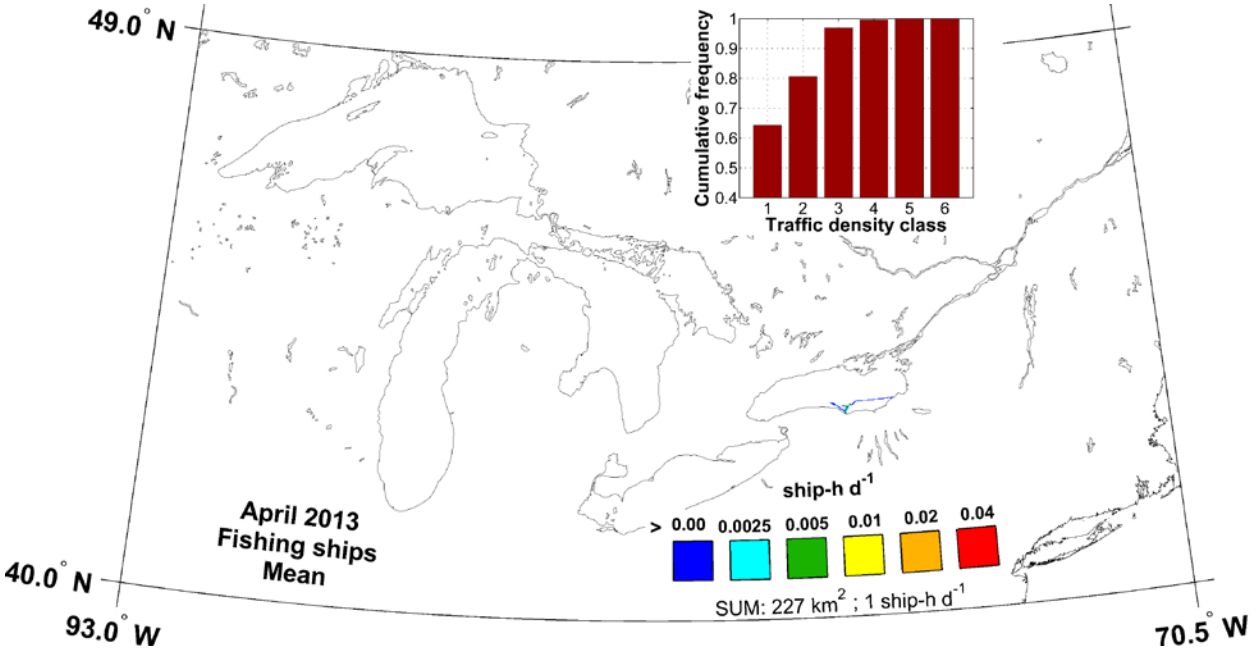

Figure 105. Map of AIS mean traffic density of fishing-type ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

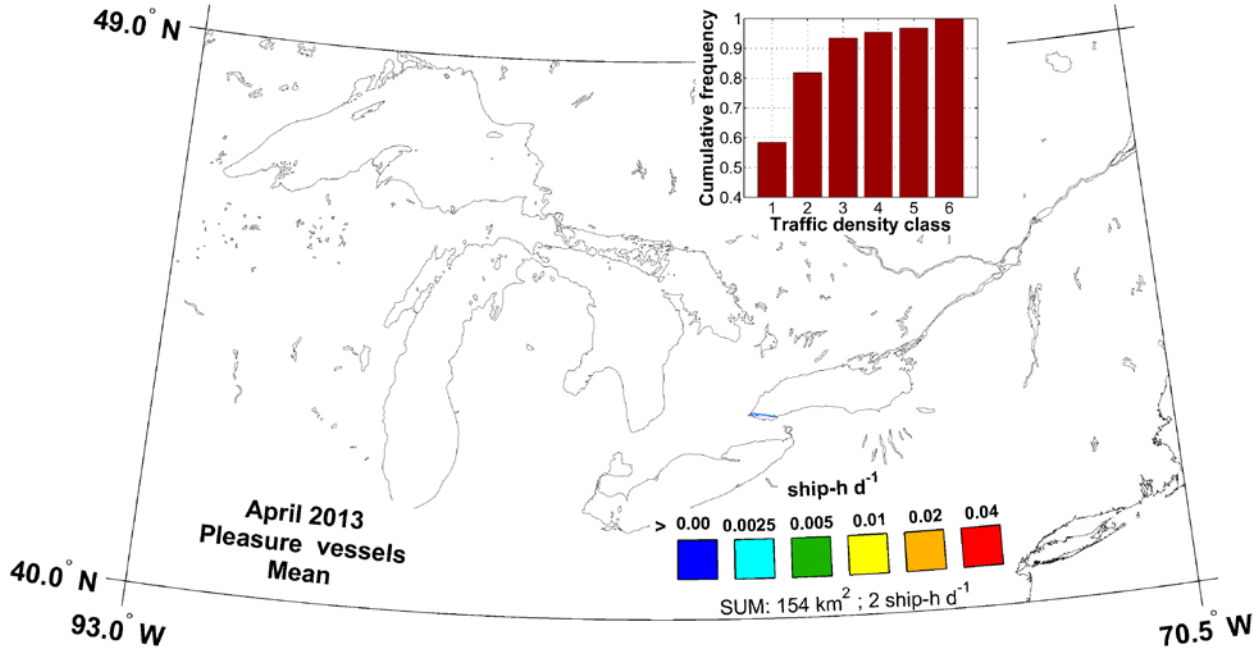

Figure 106. Map of AIS mean traffic density of pleasure-type vessels in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

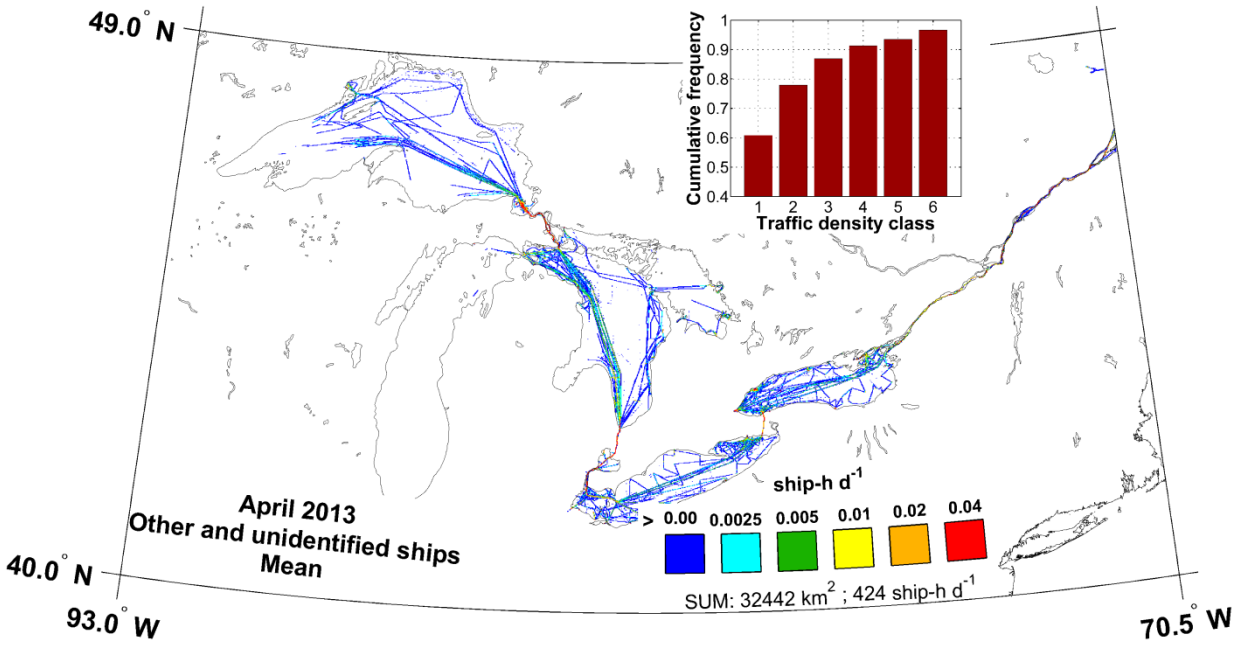

Figure 107. Map of AIS mean traffic density of other types of ships and ships of unidentified type in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

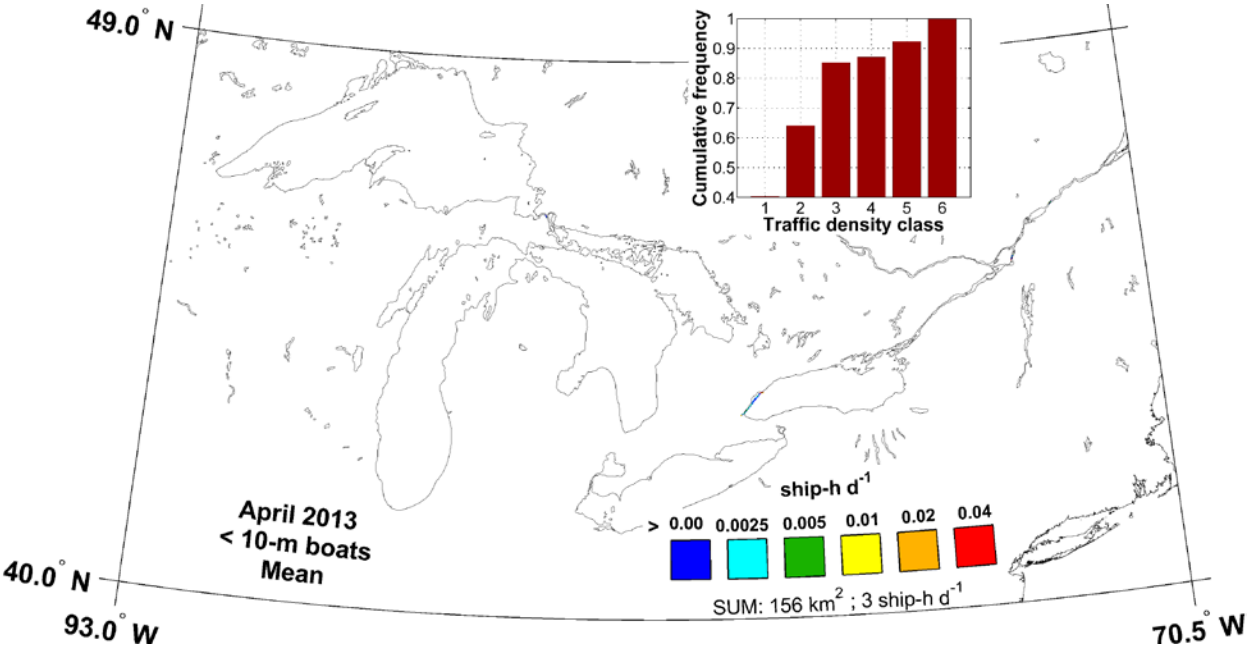

Figure 108. Map of AIS mean traffic density of ships with lengths < 10 m in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

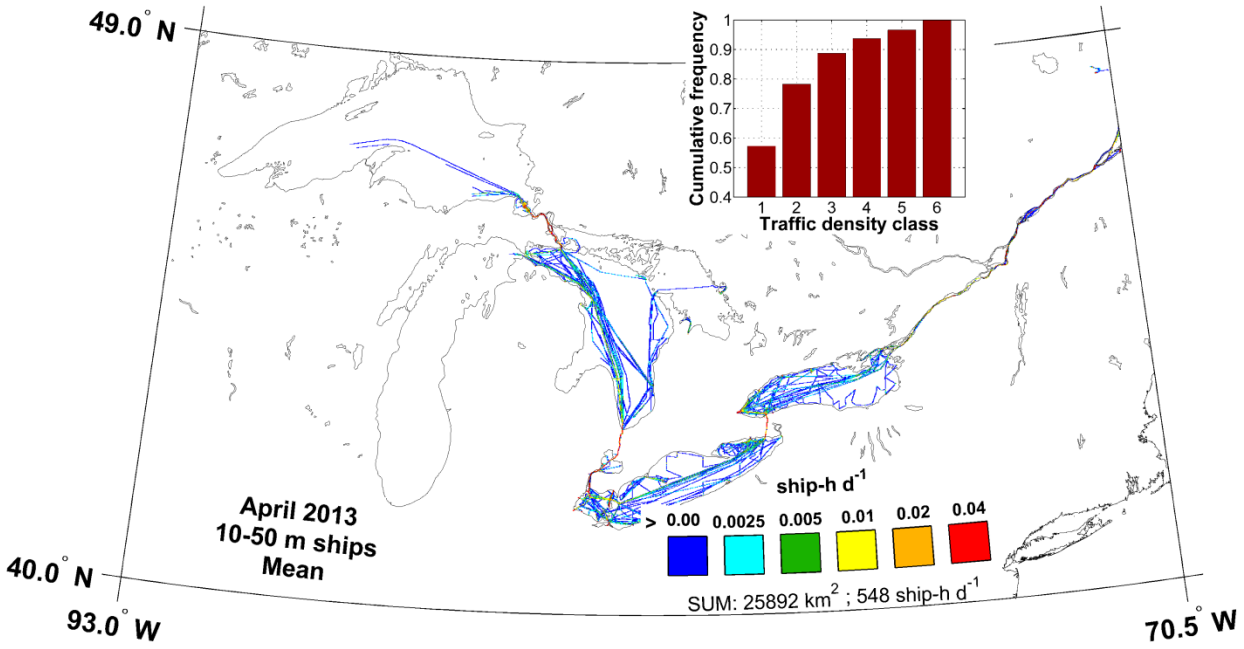

Figure 109. Map of AIS mean traffic density of 10 to 50 m ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

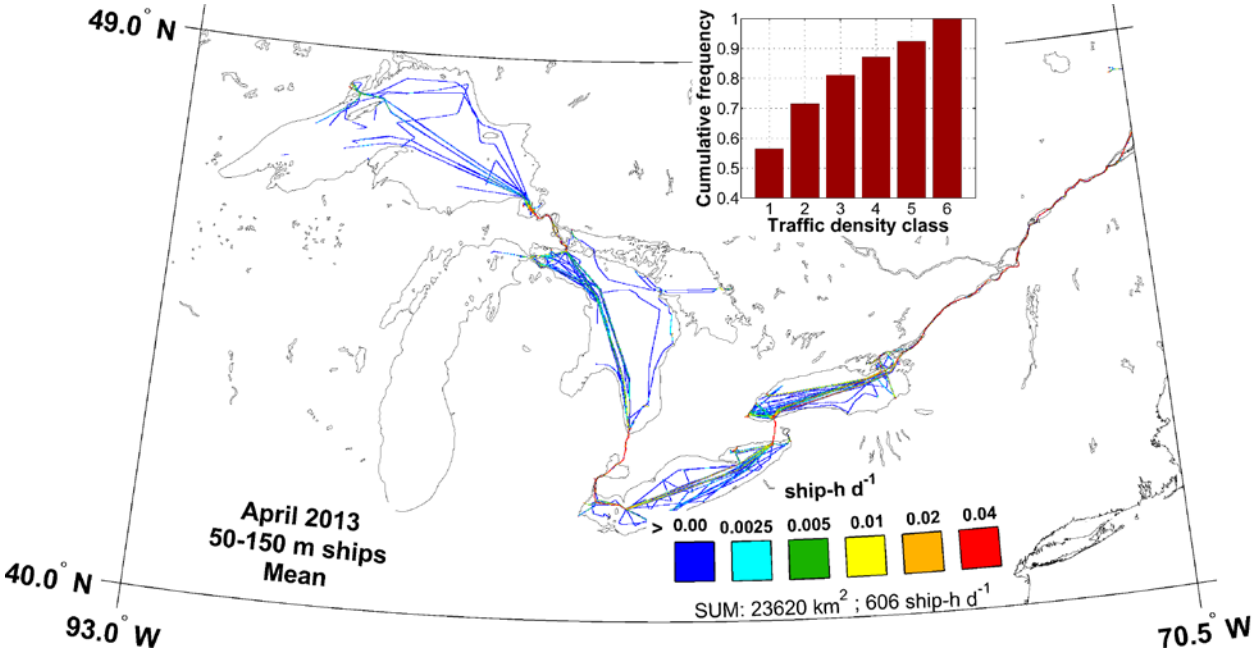

Figure 110. Map of AIS mean traffic density of 50 to 150 m ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

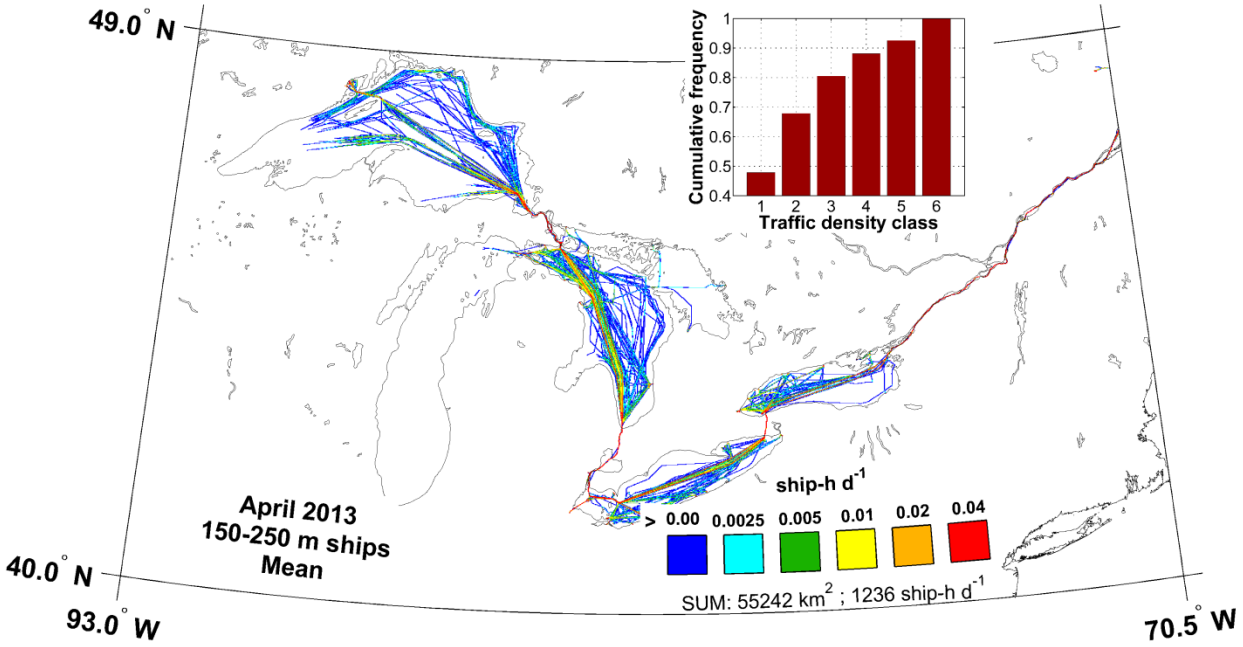

Figure 111. Map of AIS mean traffic density of 150 to 250 m ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

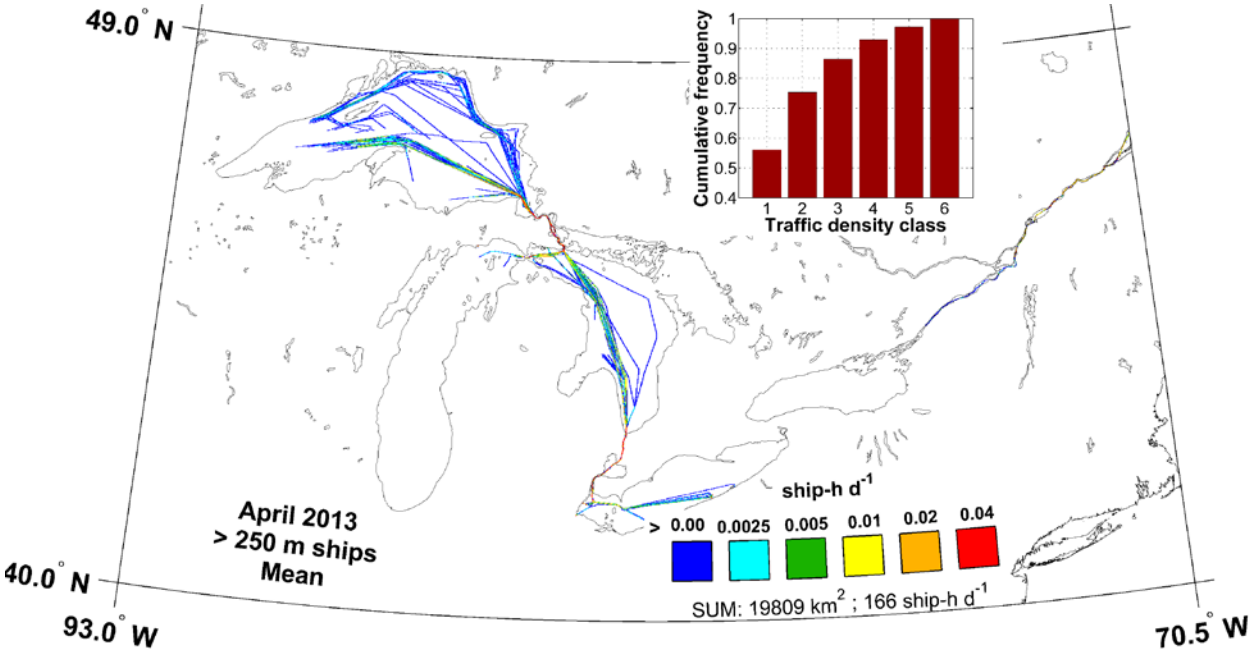

Figure 112. Map of AIS mean traffic density of > 250 m ships in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

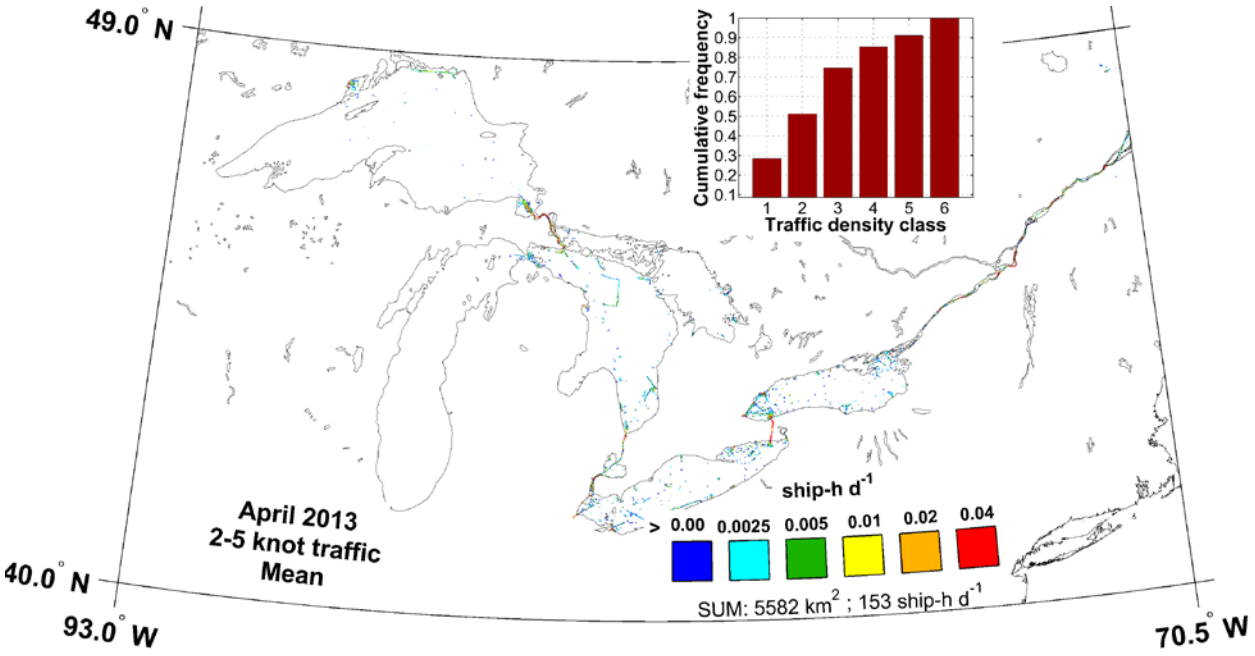

Figure 113. Map of 2–5 knot AIS mean traffic density in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

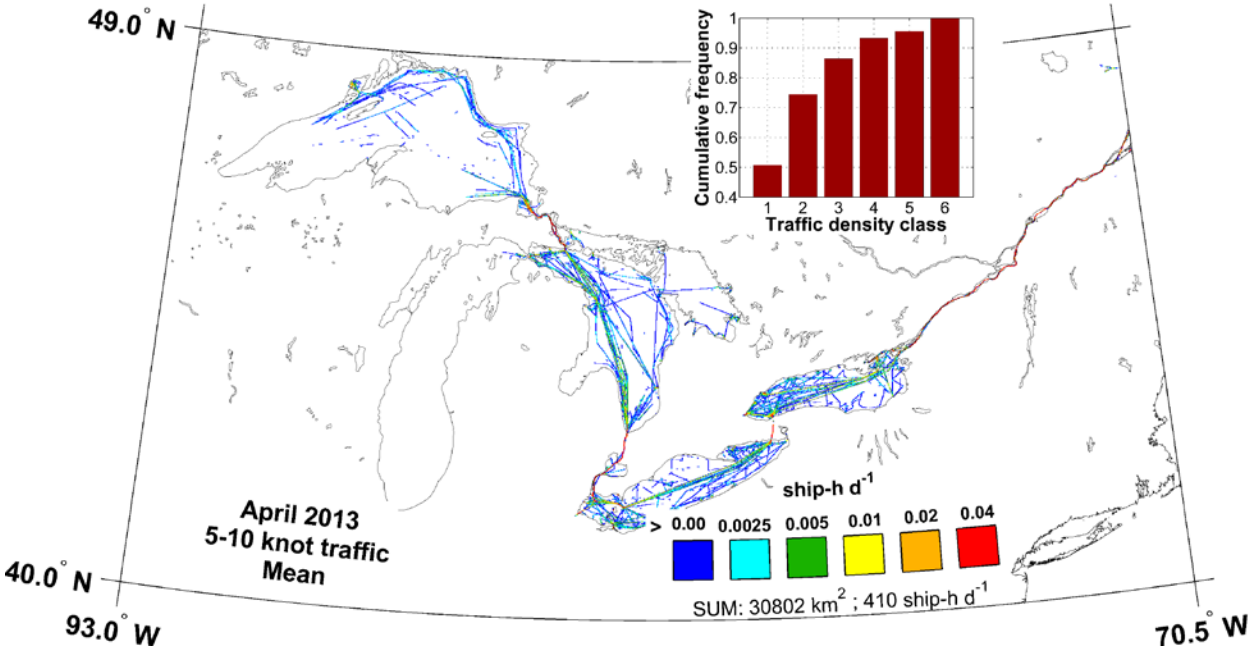

Figure 114. Map of 5–10 knot AIS mean traffic density in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

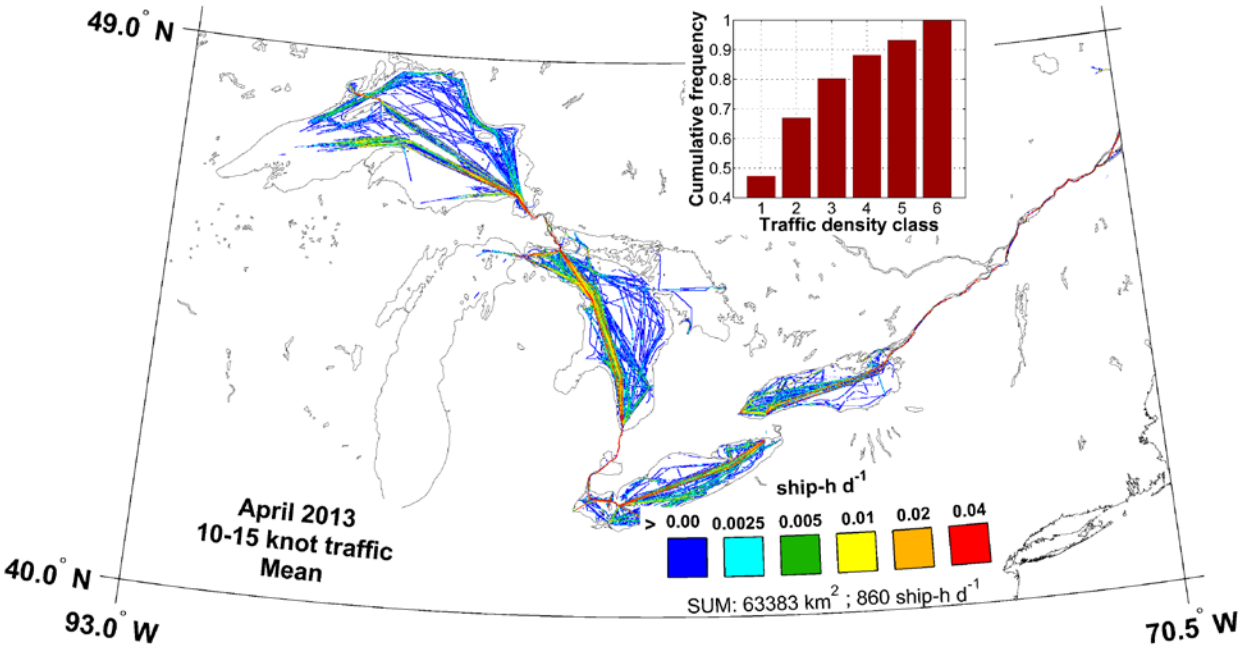

Figure 115. Map of 10–15 knot AIS mean traffic density in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

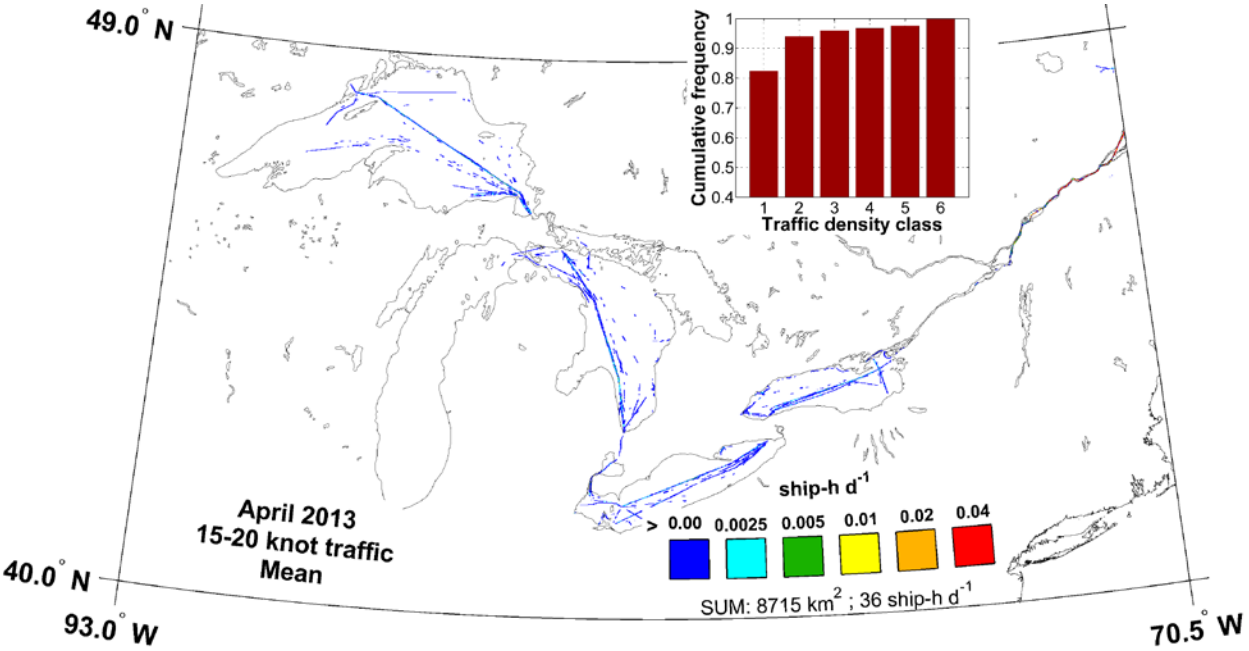

Figure 116. Map of 15–20 knot AIS mean traffic density in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

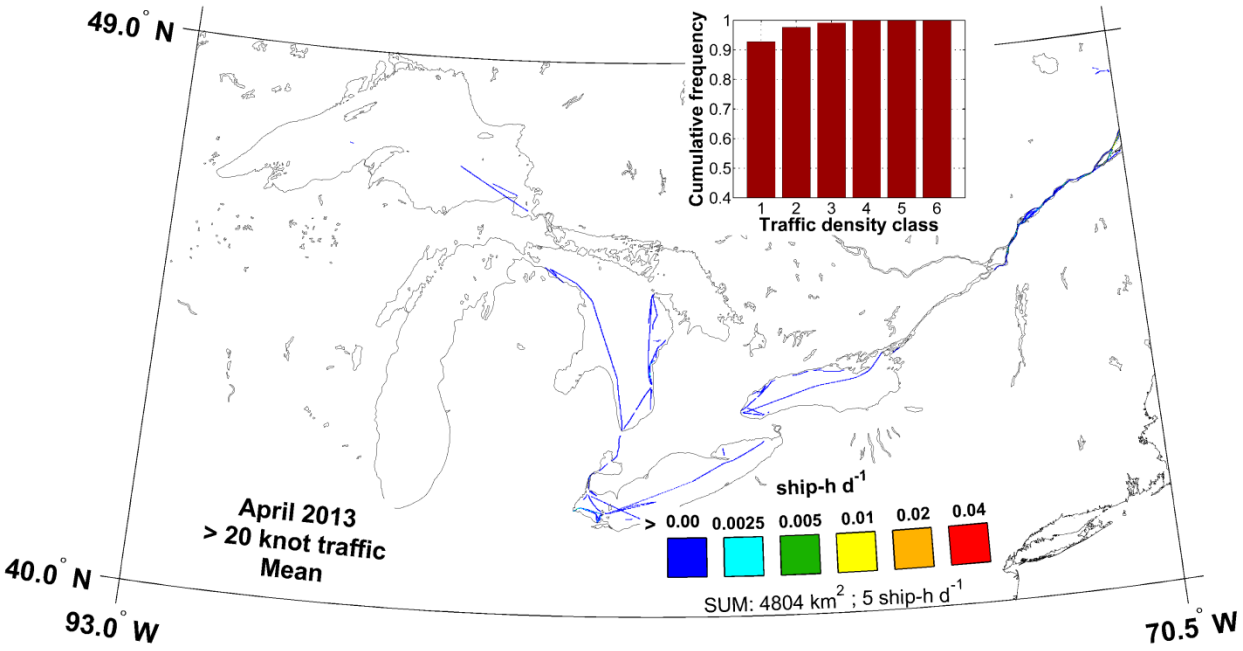

Figure 117. Map of >20 knot AIS mean traffic density in April 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.5. May 2013

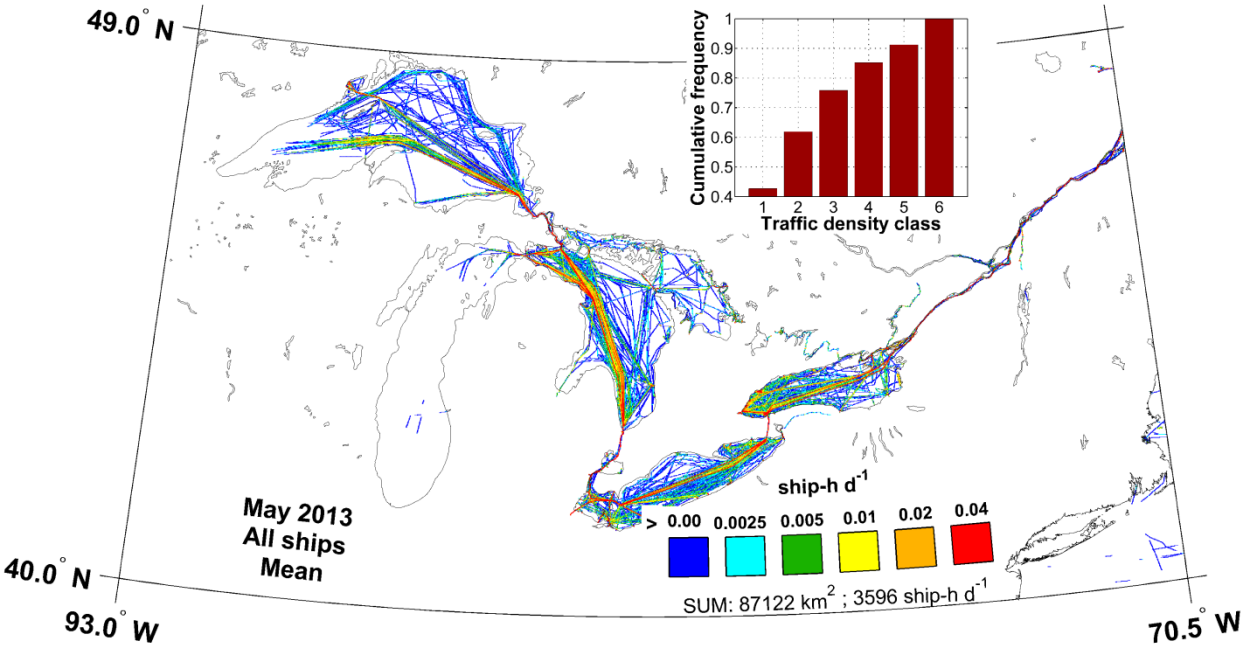

Figure 118. Map of AIS mean traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

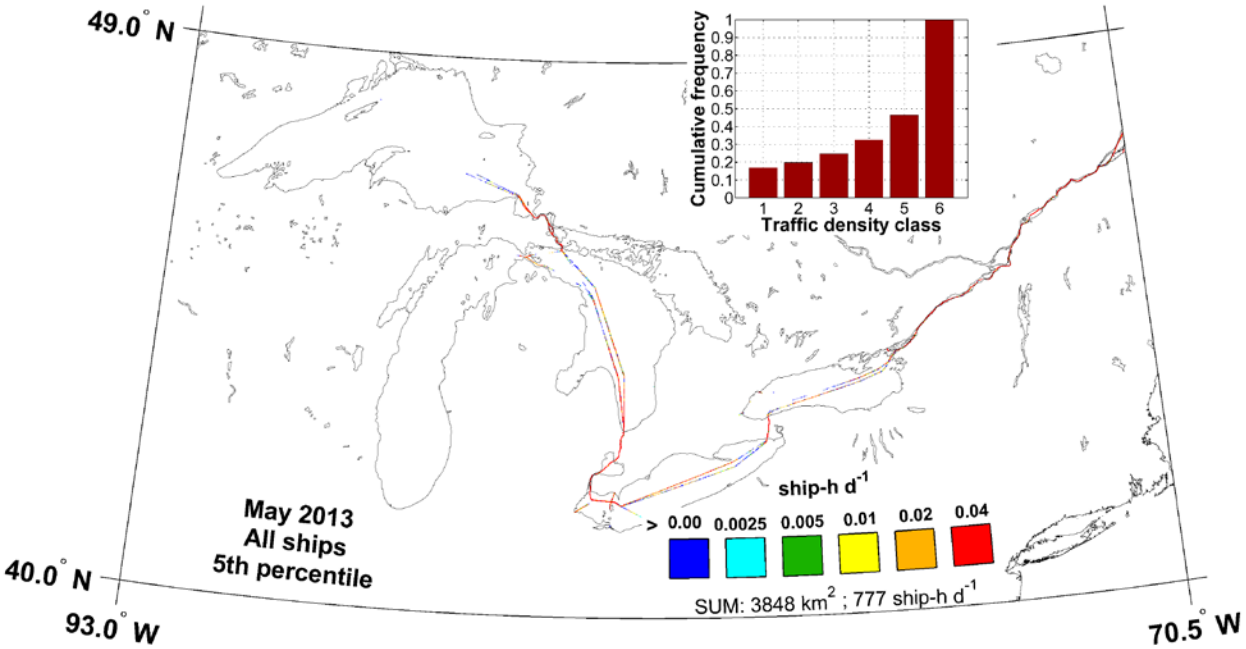

Figure 119. Map of the 5th percentile of the daily AIS traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

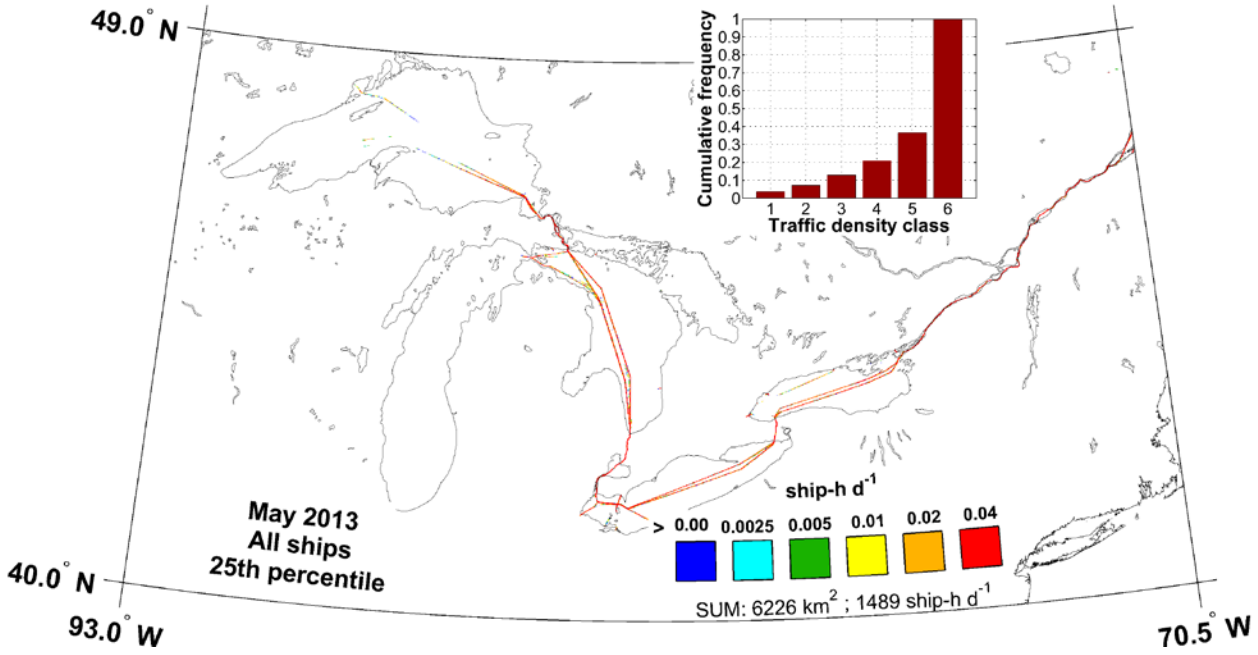

Figure 120. Map of the 25th percentile of the daily AIS traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

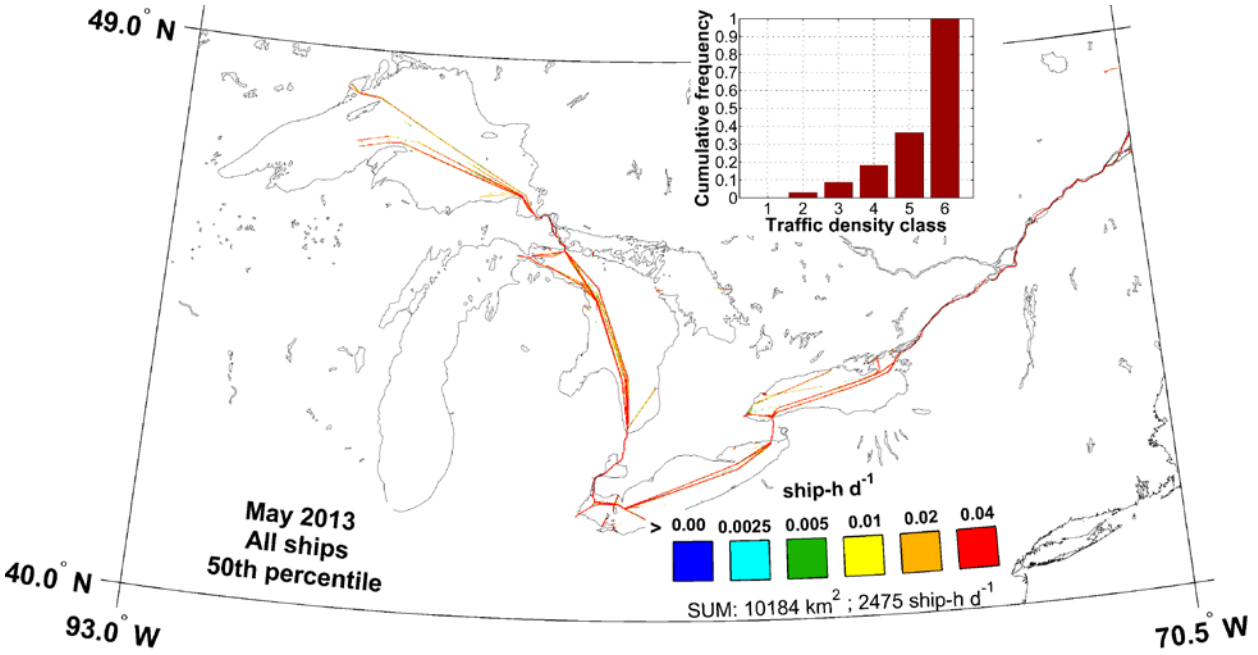

Figure 121. Map of the 50th percentile of the daily AIS traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

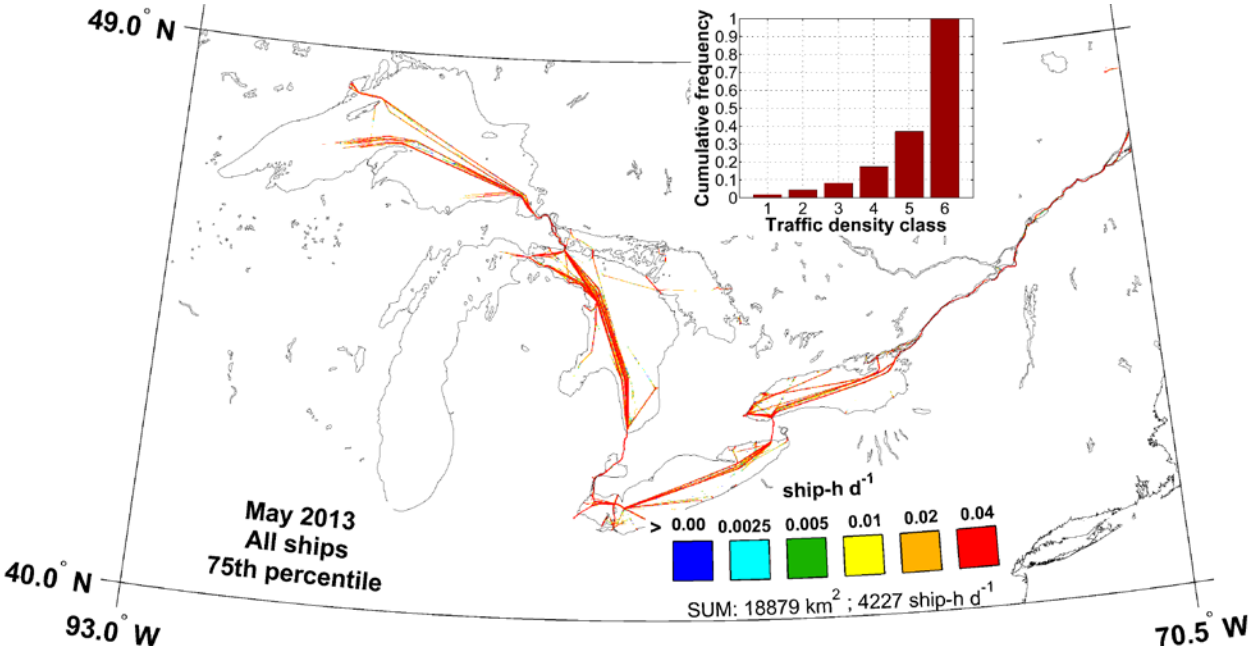

Figure 122. Map of the 75th percentile of the daily AIS traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

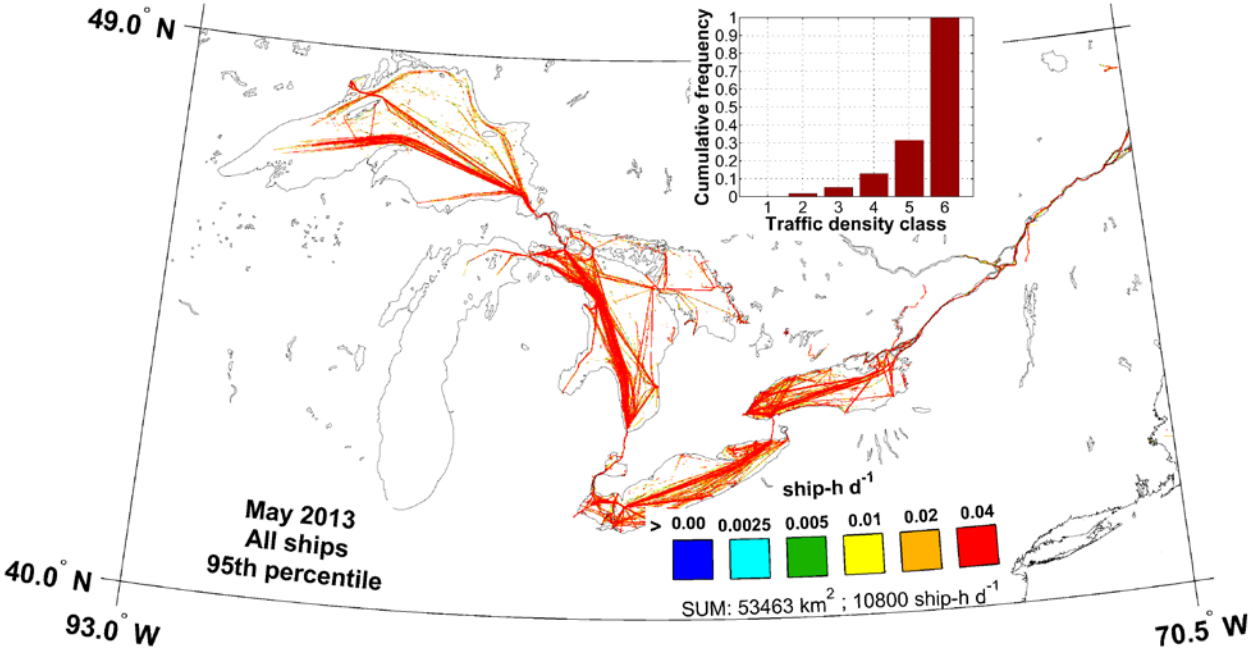

Figure 123. Map of the 95th percentile of the daily AIS traffic density of all ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

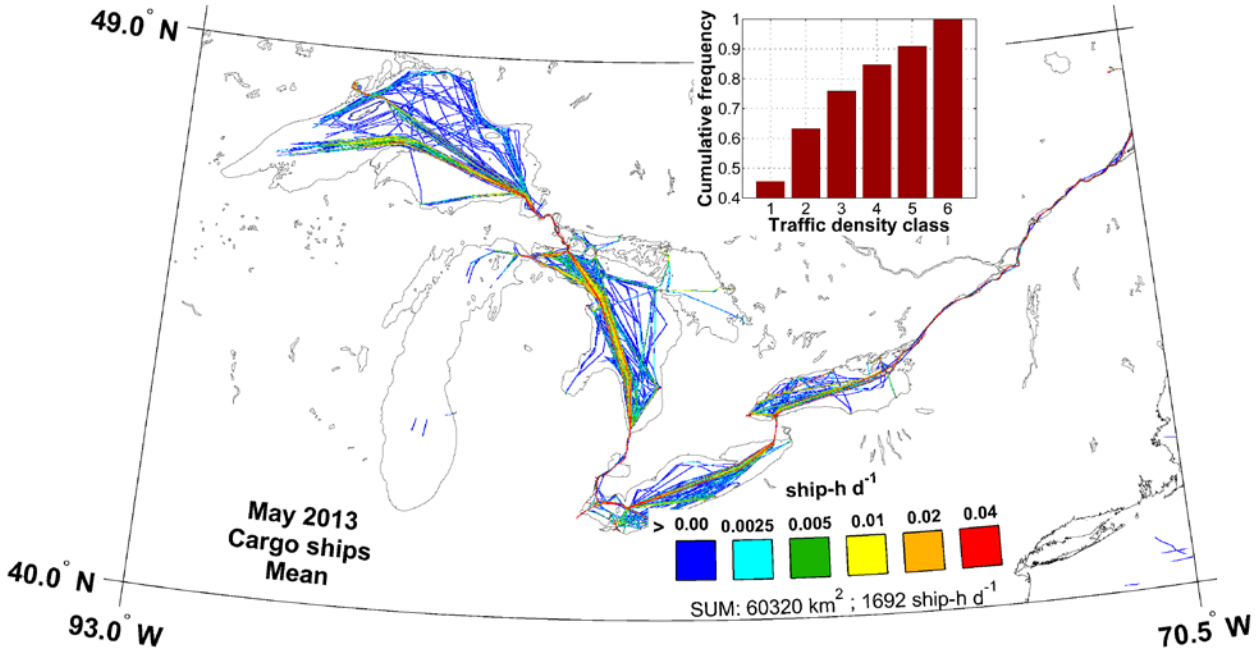

Figure 124. Map of AIS mean traffic density of cargo-type ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

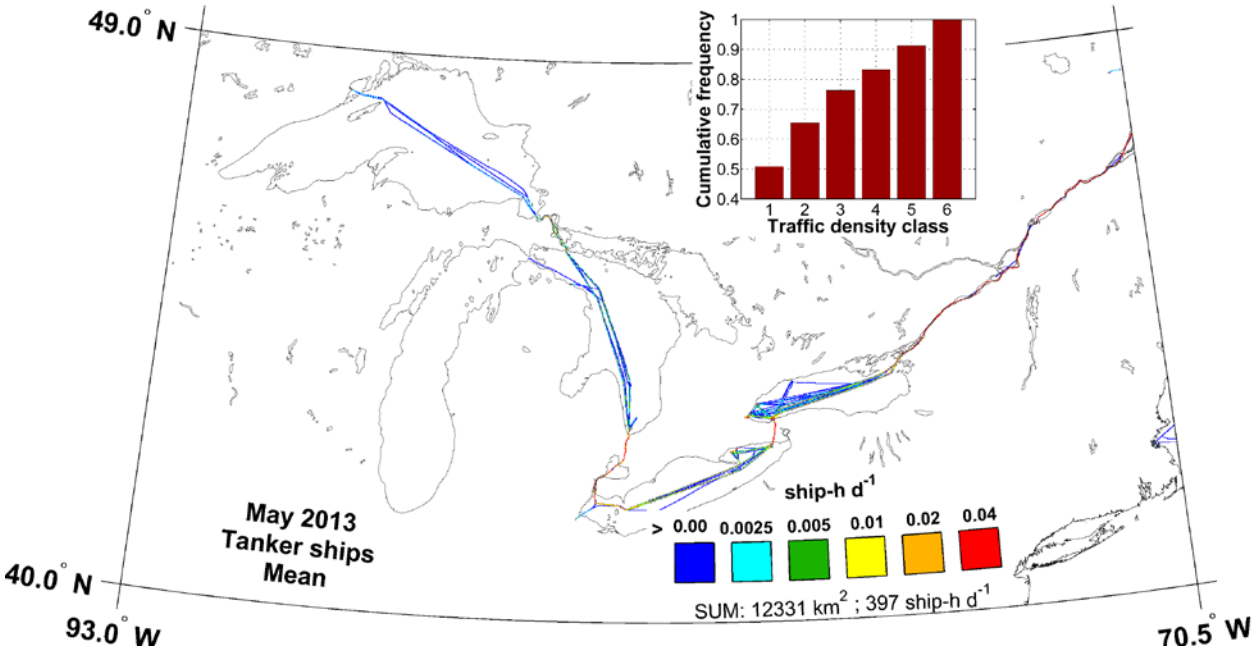

Figure 125. Map of AIS mean traffic density of tanker-type ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

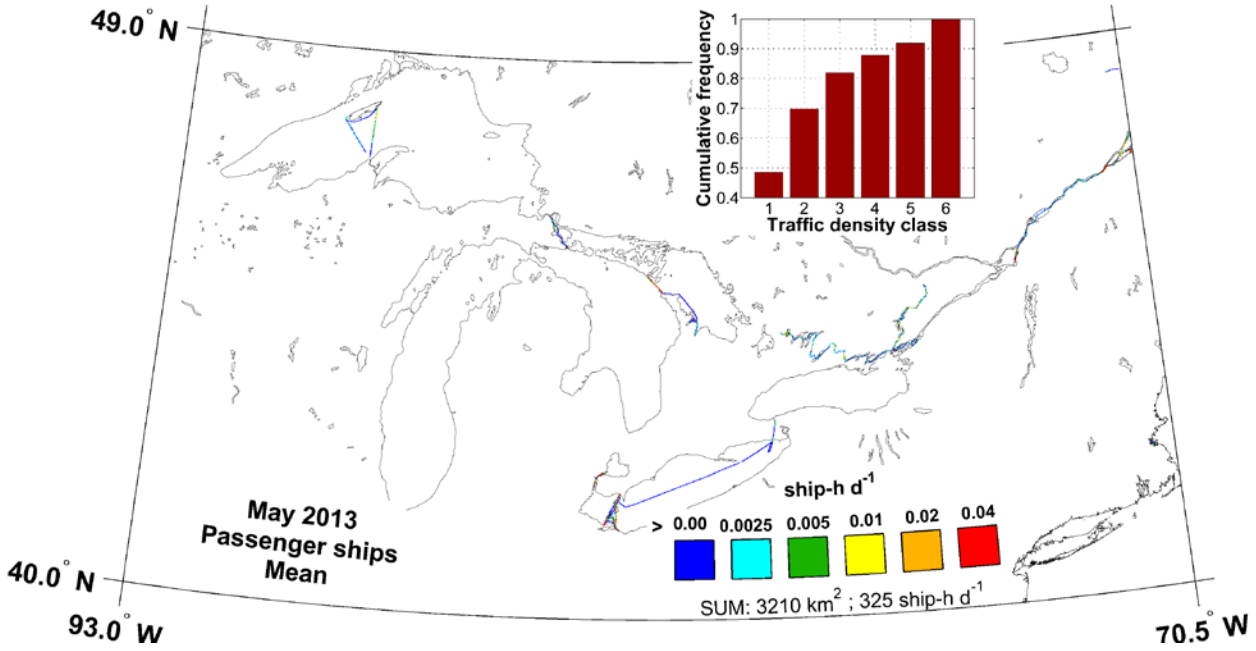

Figure 126. Map of AIS mean traffic density of passenger-type ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

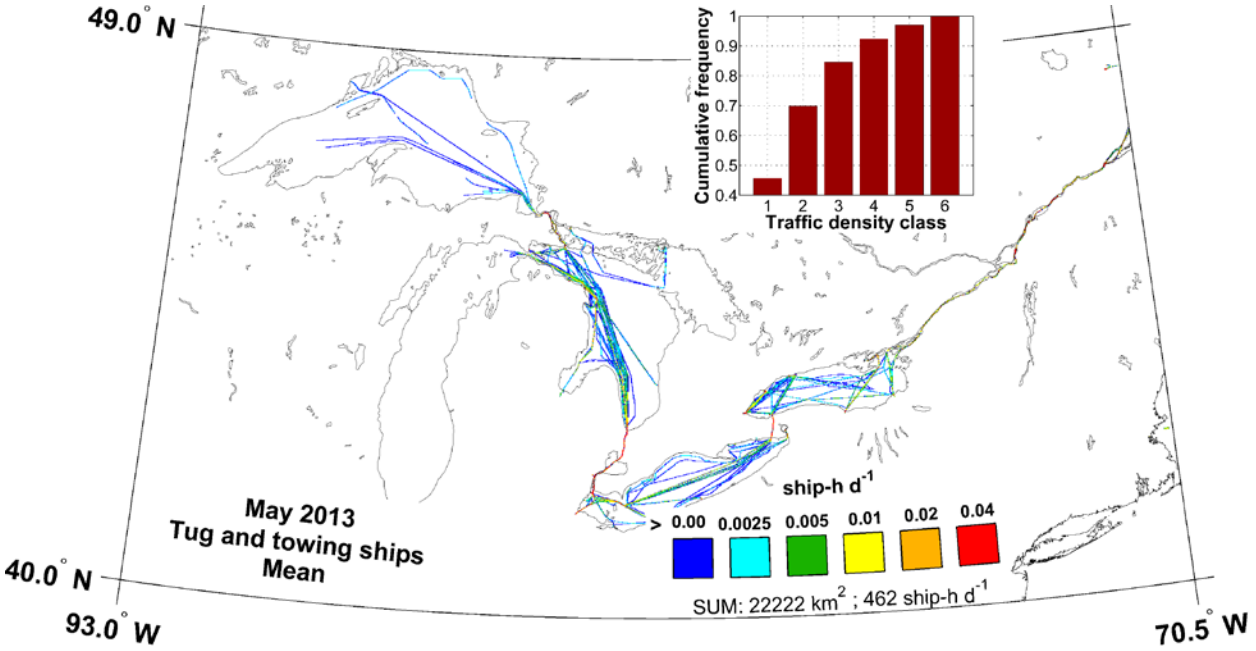

Figure 127. Map of AIS mean traffic density of tug and towing-type ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

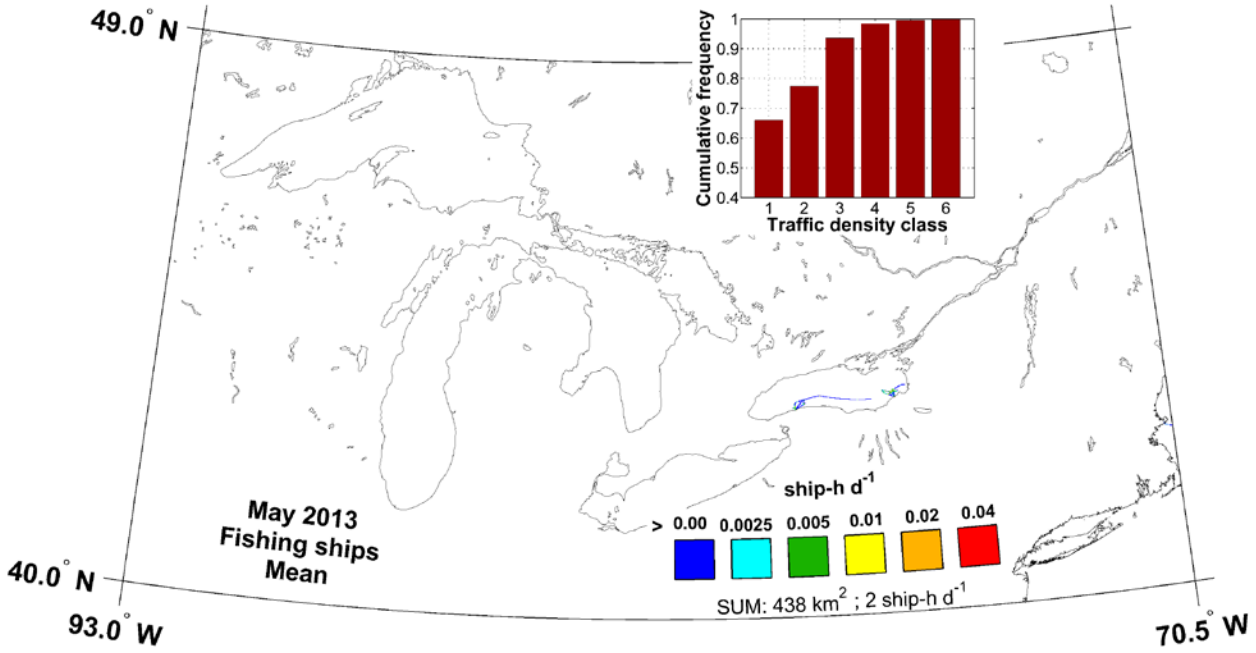

Figure 128. Map of AIS mean traffic density of fishing-type ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

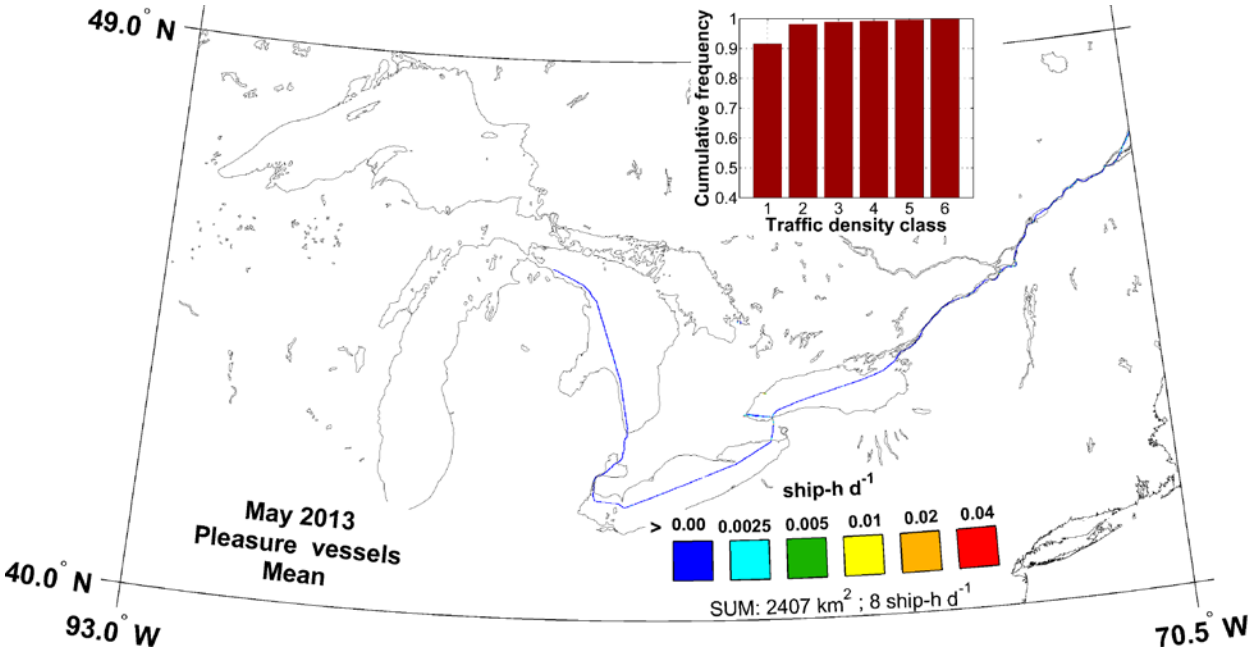

Figure 129. Map of AIS mean traffic density of pleasure-type vessels in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

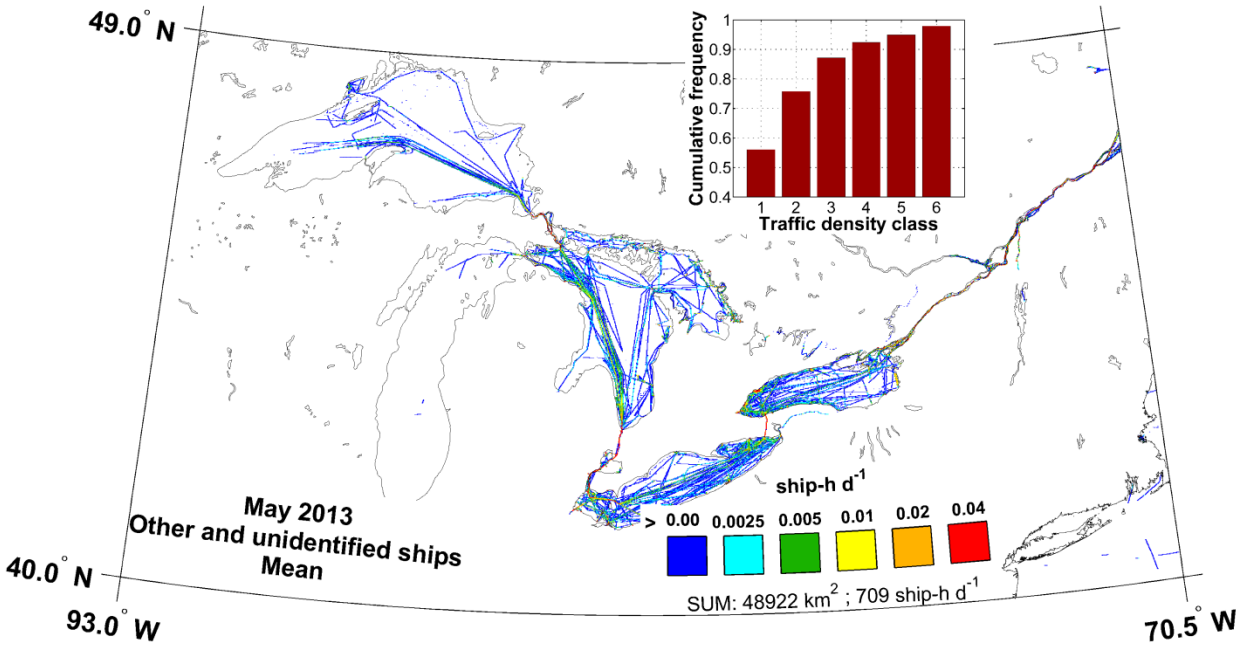

Figure 130. Map of AIS mean traffic density of other types of ships and ships of unidentified type in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

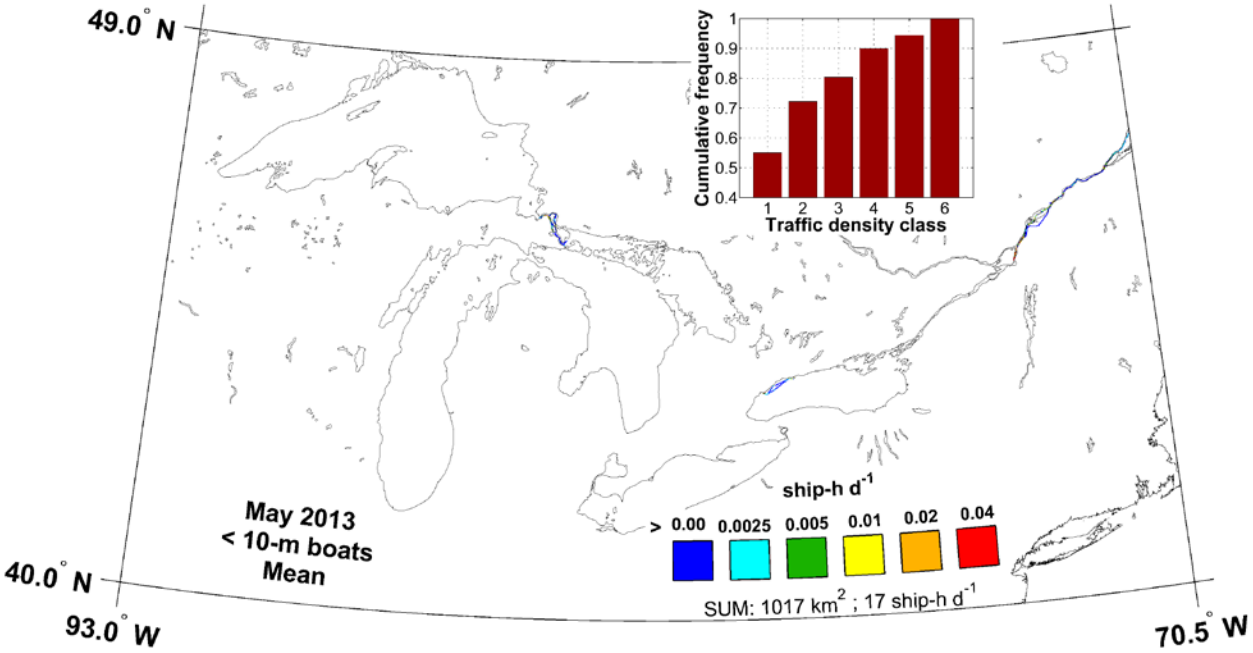

Figure 131. Map of AIS mean traffic density of ships with lengths < 10 m in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

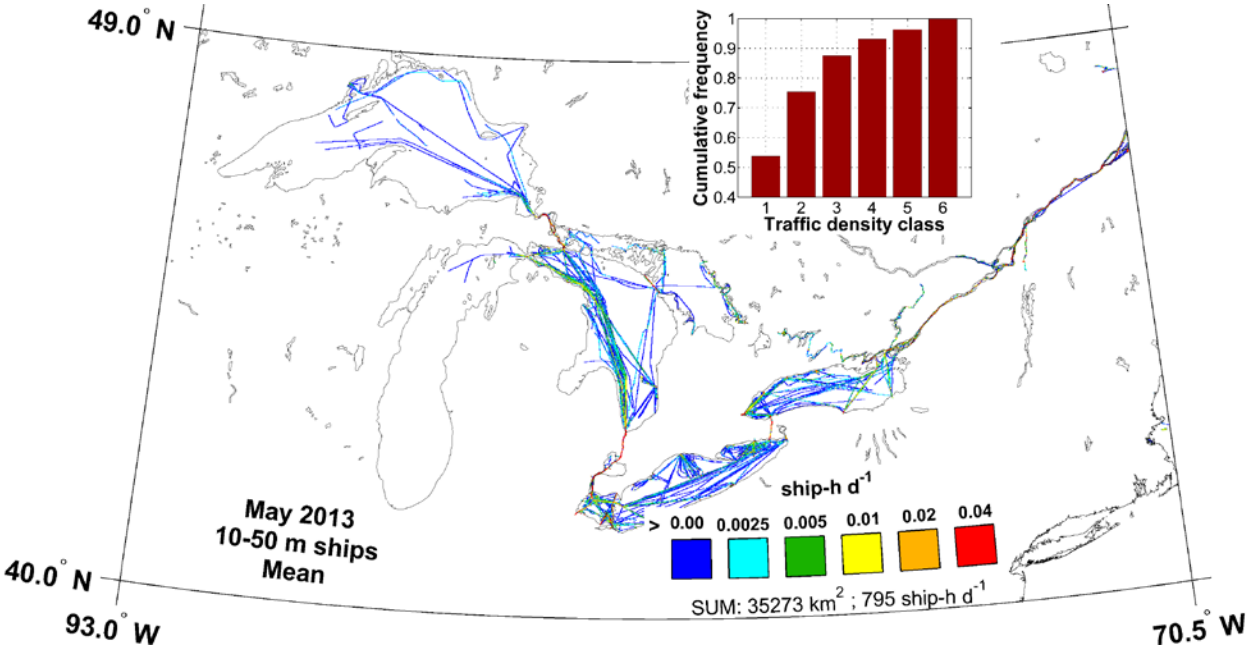

Figure 132. Map of AIS mean traffic density of 10 to 50 m ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

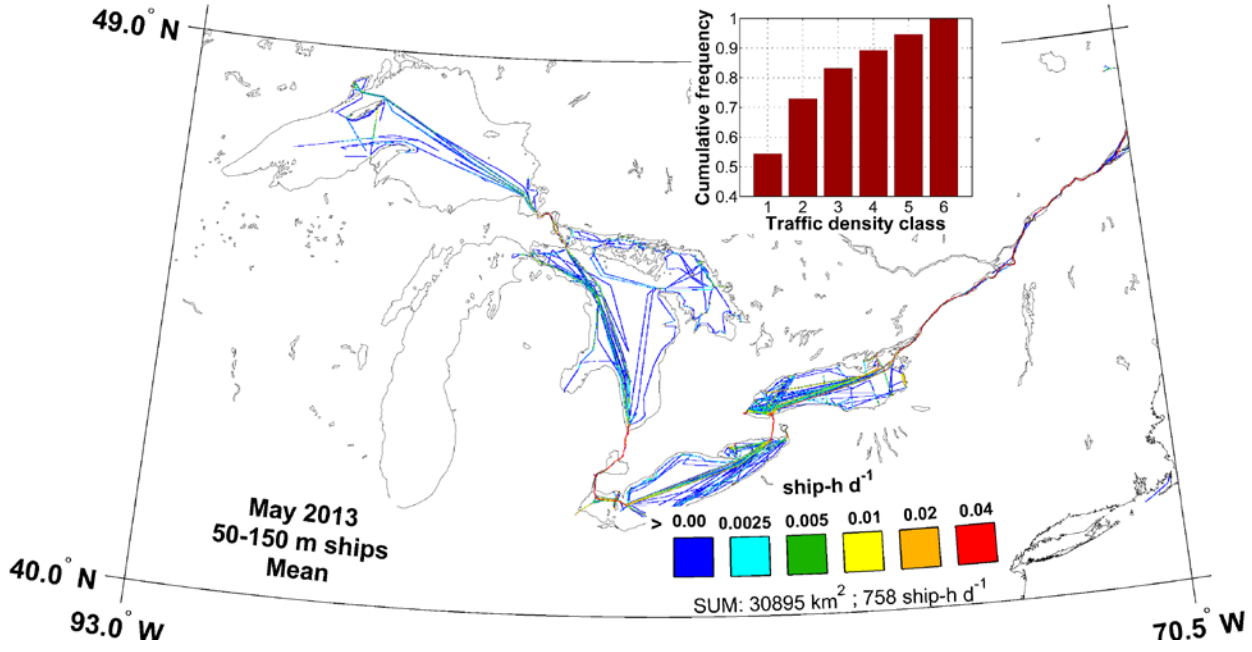

Figure 133. Map of AIS mean traffic density of 50 to 150 m ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

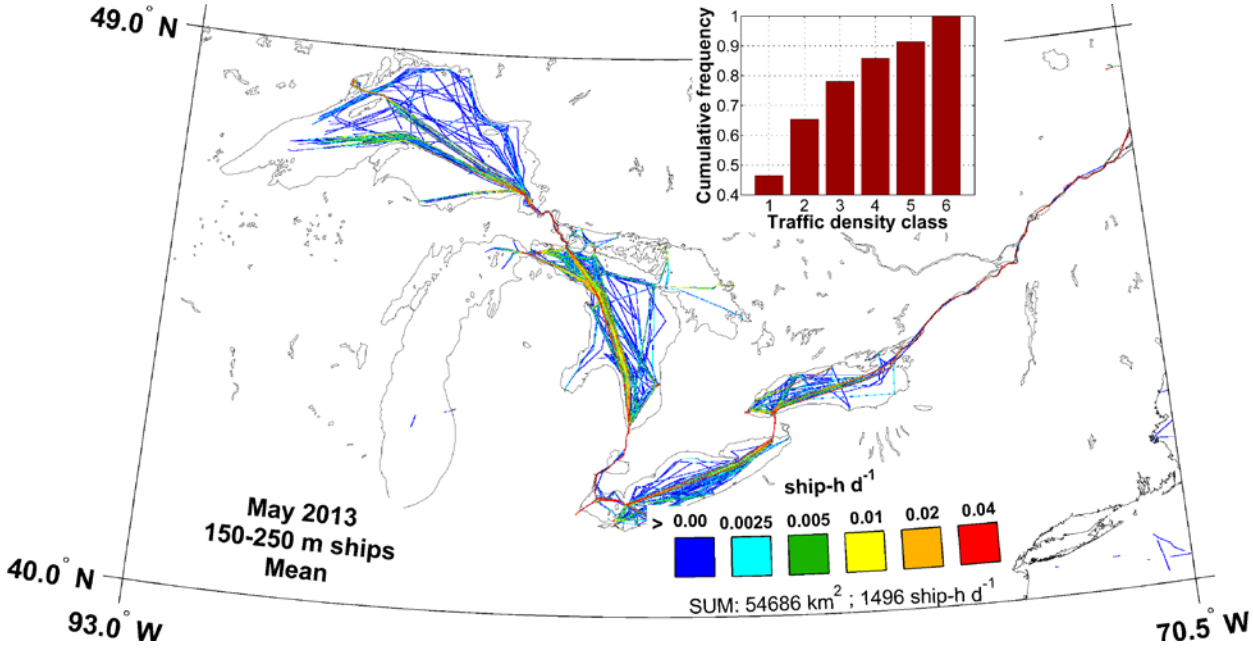

Figure 134. Map of AIS mean traffic density of 150 to 250 m ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

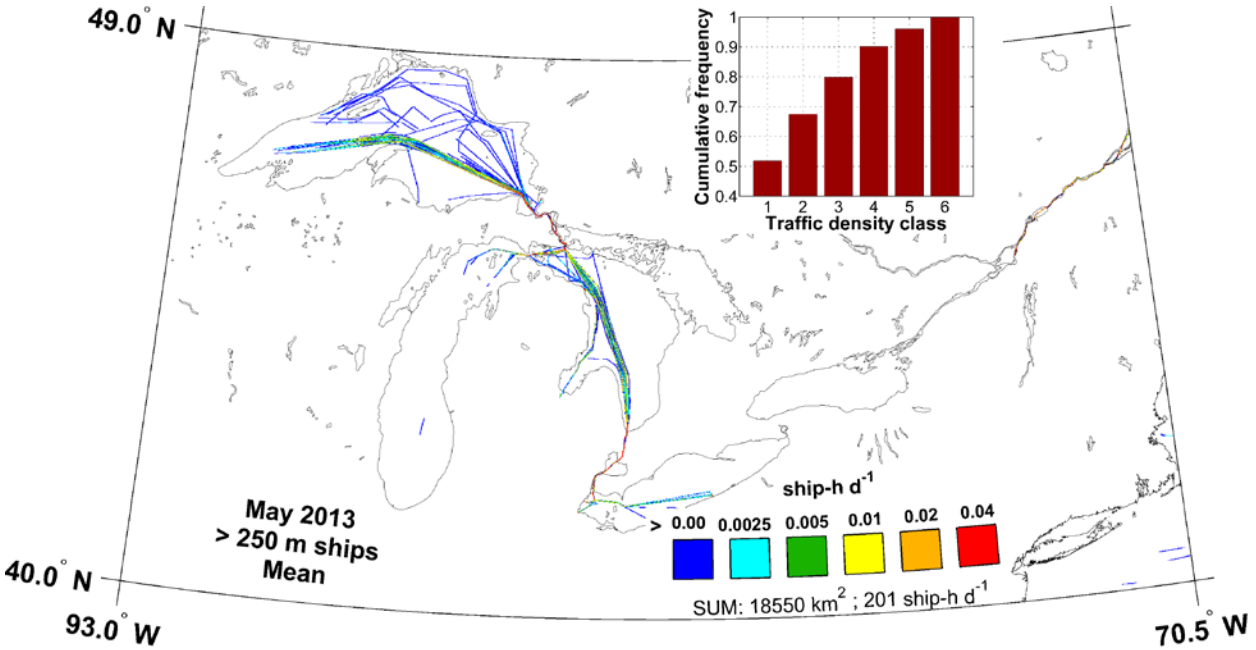

Figure 135. Map of AIS mean traffic density of > 250 m ships in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

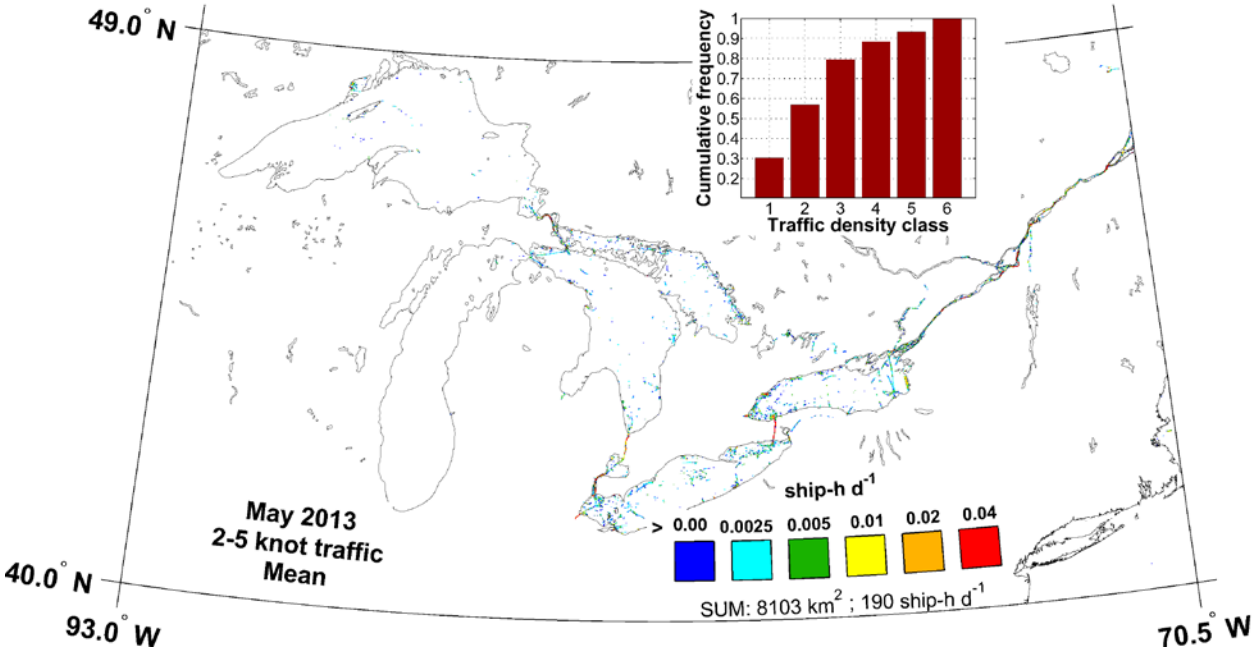

Figure 136. Map of 2–5 knot AIS mean traffic density in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

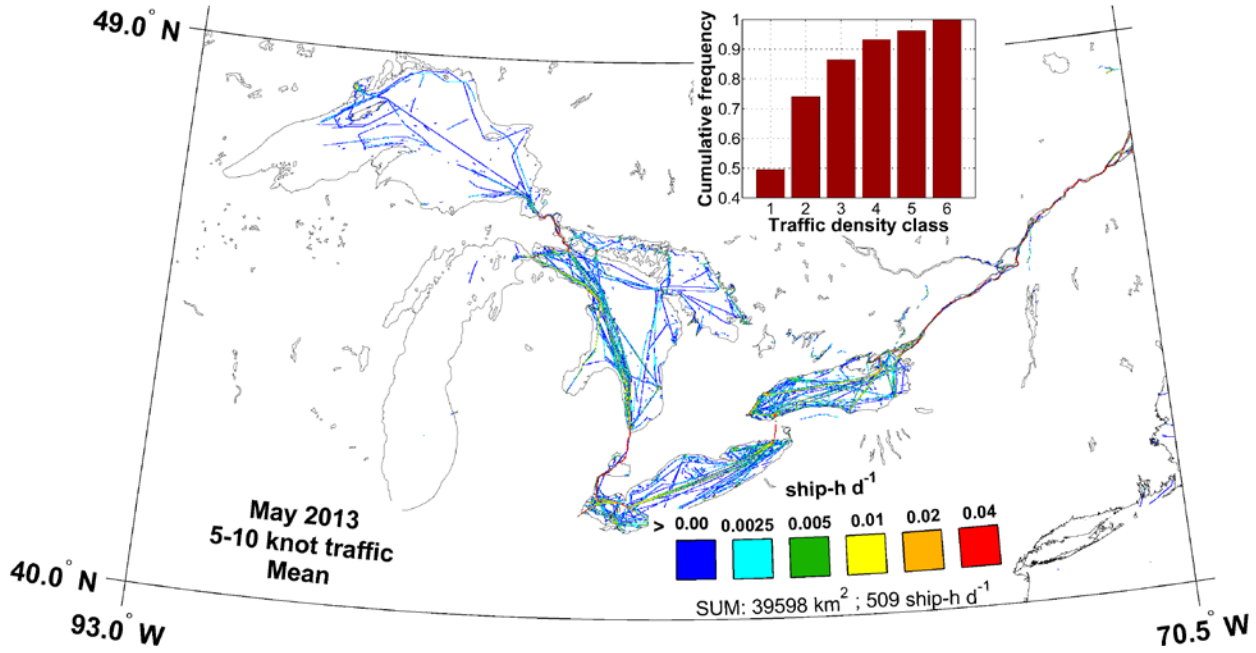

Figure 137. Map of 5–10 knot AIS mean traffic density in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

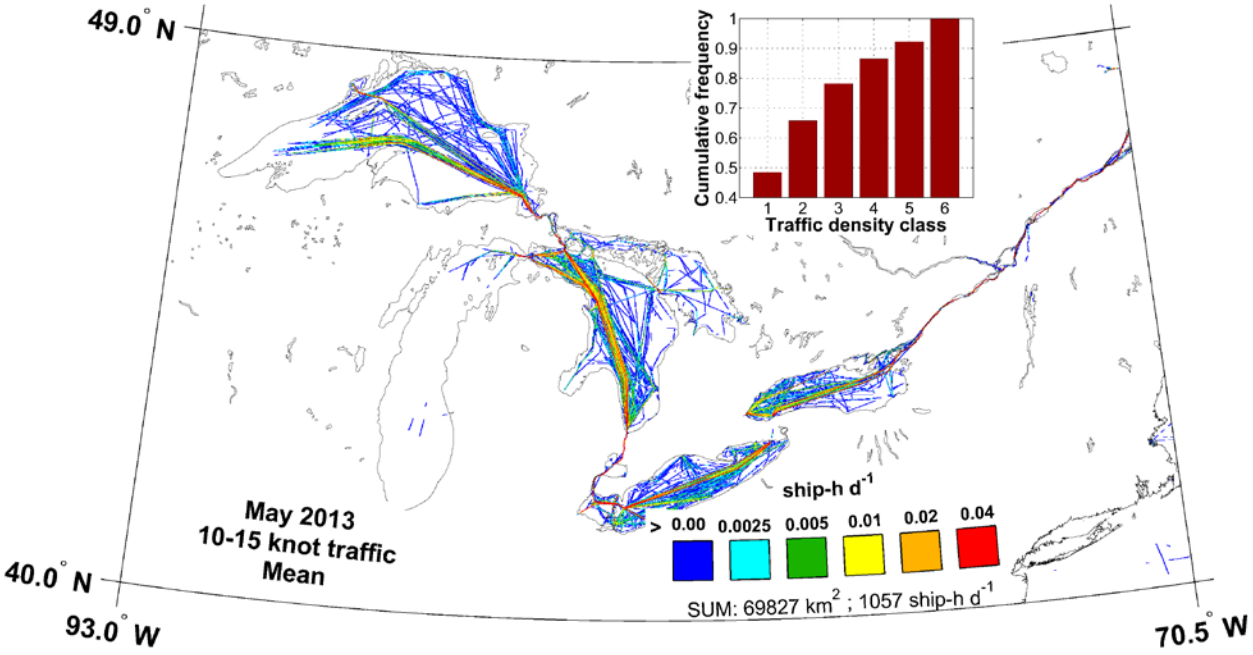

Figure 138. Map of 10–15 knot AIS mean traffic density in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

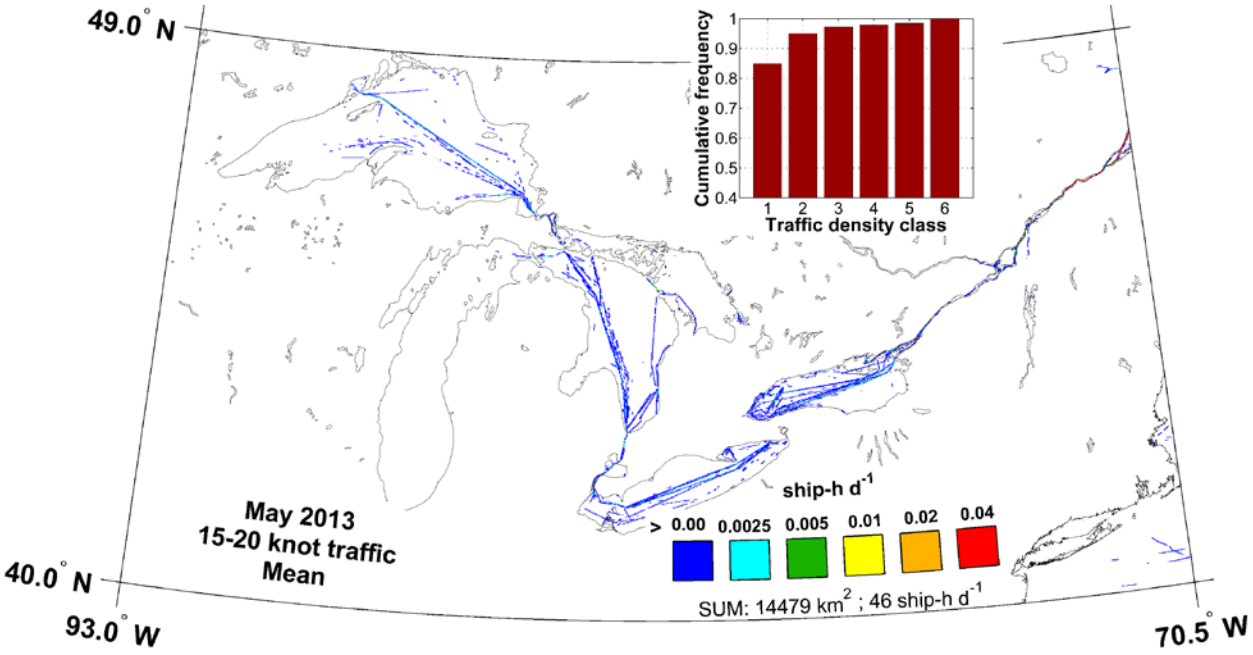

Figure 139. Map of 15–20 knot AIS mean traffic density in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

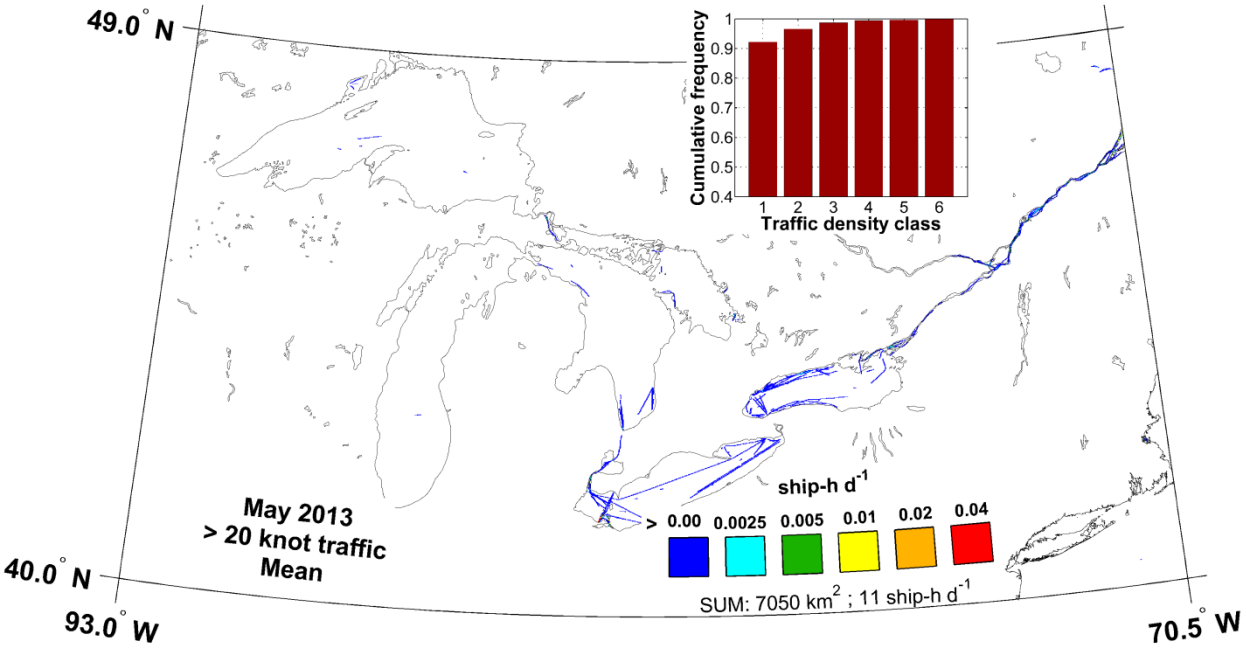

Figure 140. Map of >20 knot AIS mean traffic density in May 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.6. June 2013

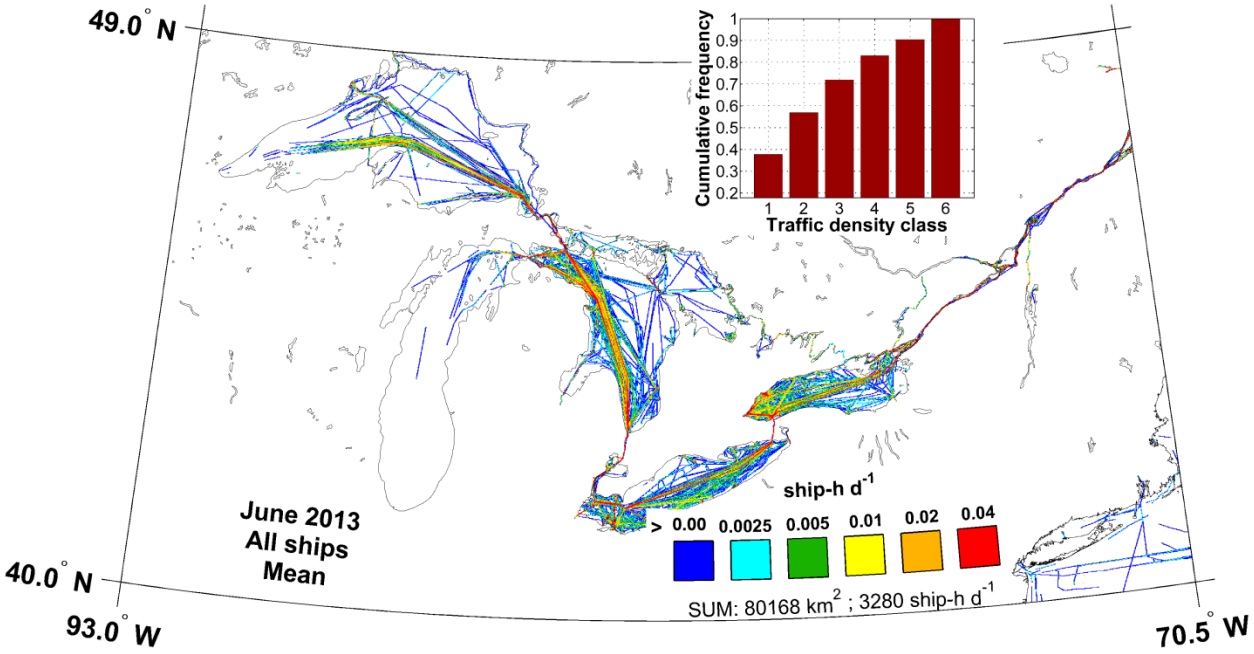

Figure 141. Map of AIS mean traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

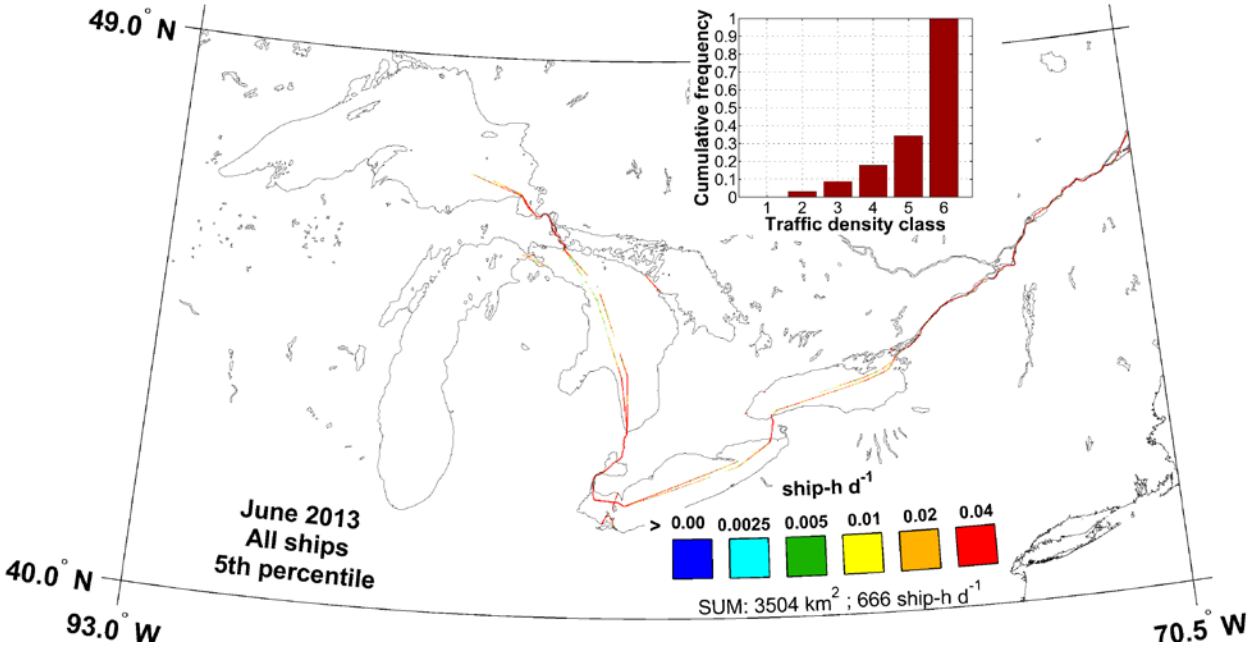

Figure 142. Map of the 5th percentile of the daily AIS traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

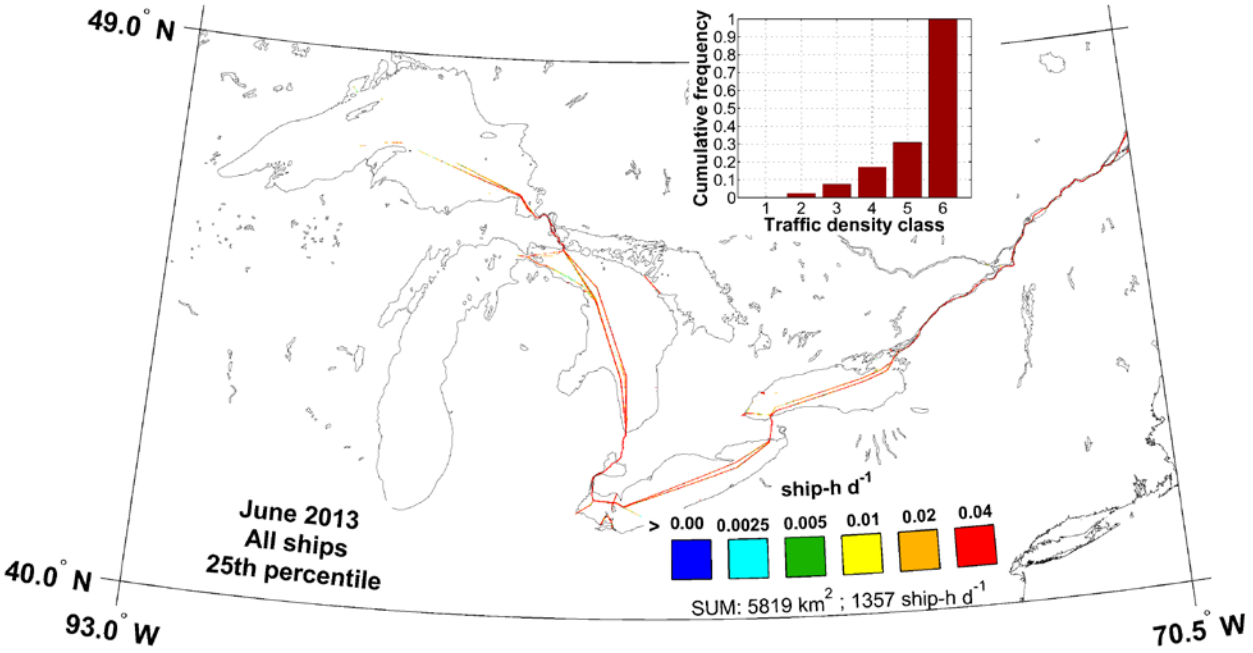

Figure 143. Map of the 25th percentile of the daily AIS traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

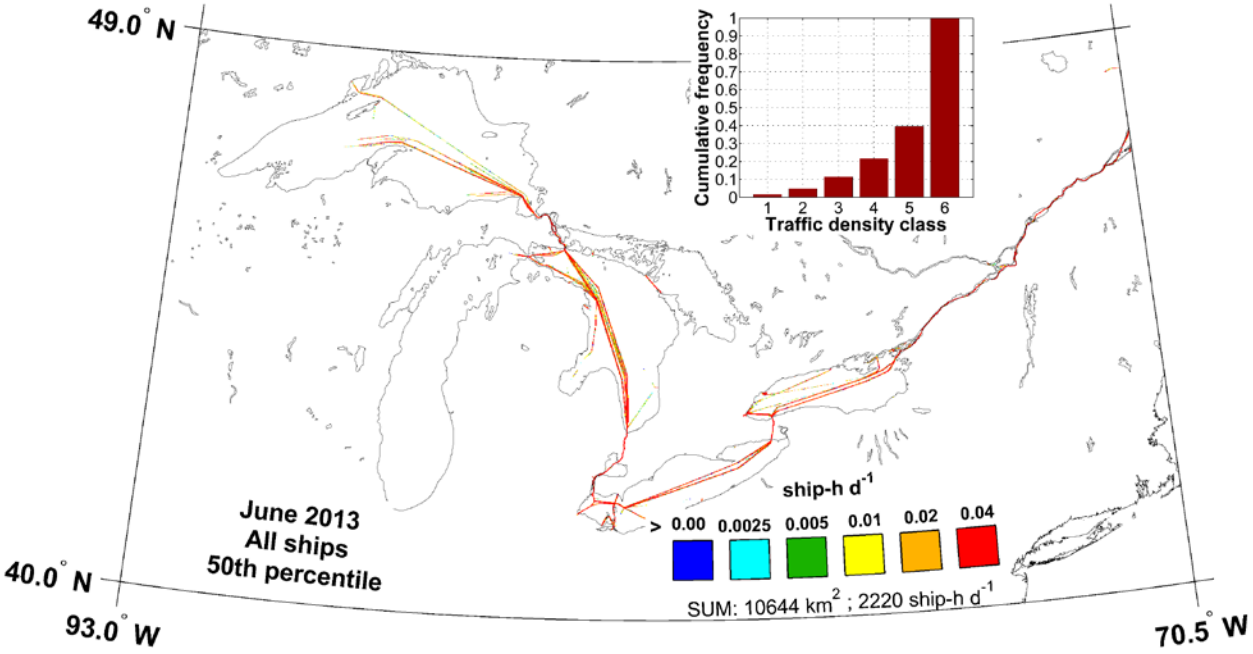

Figure 144. Map of the 50th percentile of the daily AIS traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

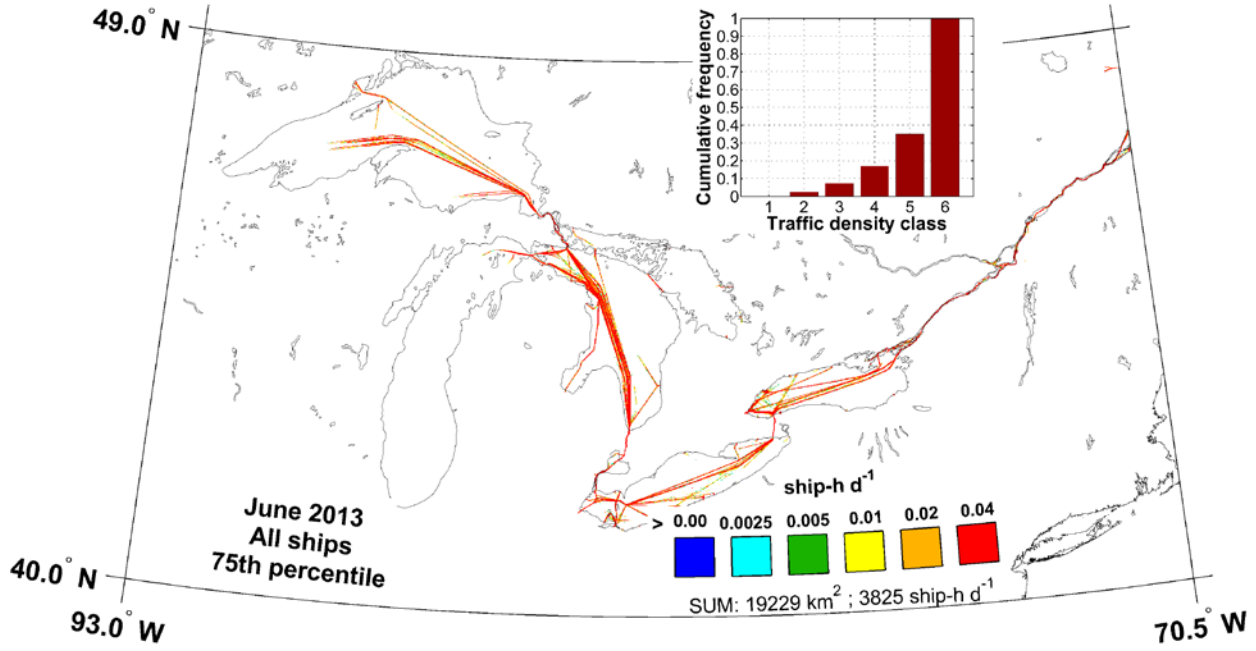

Figure 145. Map of the 75th percentile of the daily AIS traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

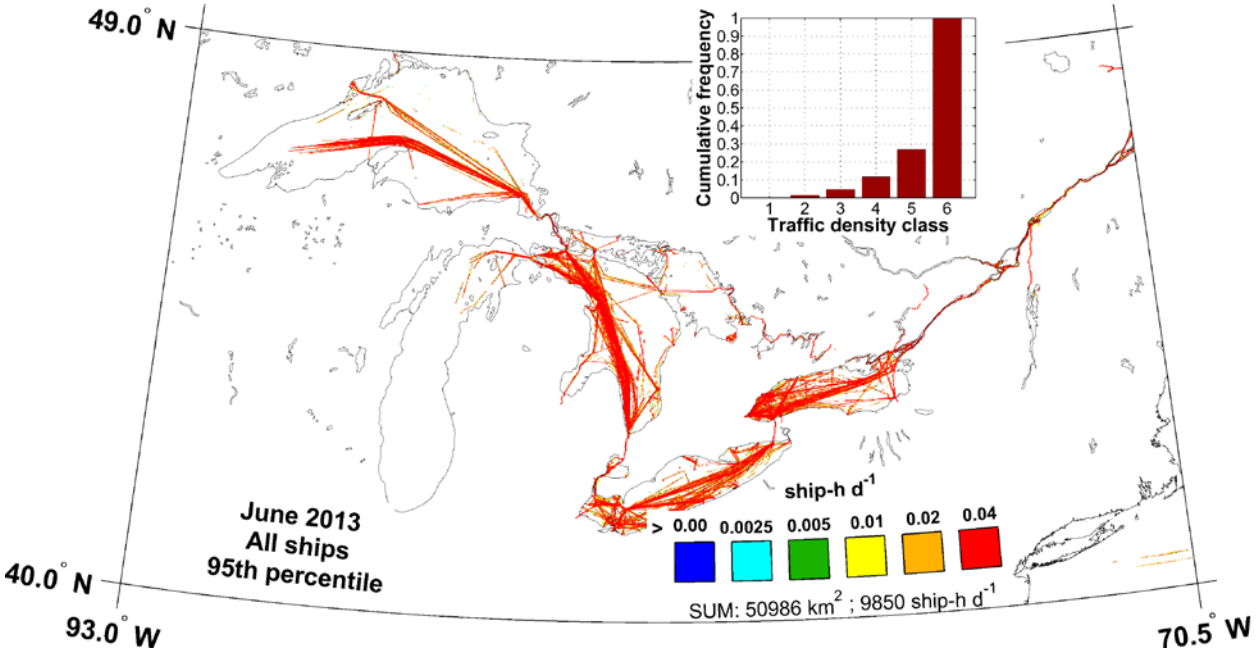

Figure 146. Map of the 95th percentile of the daily AIS traffic density of all ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

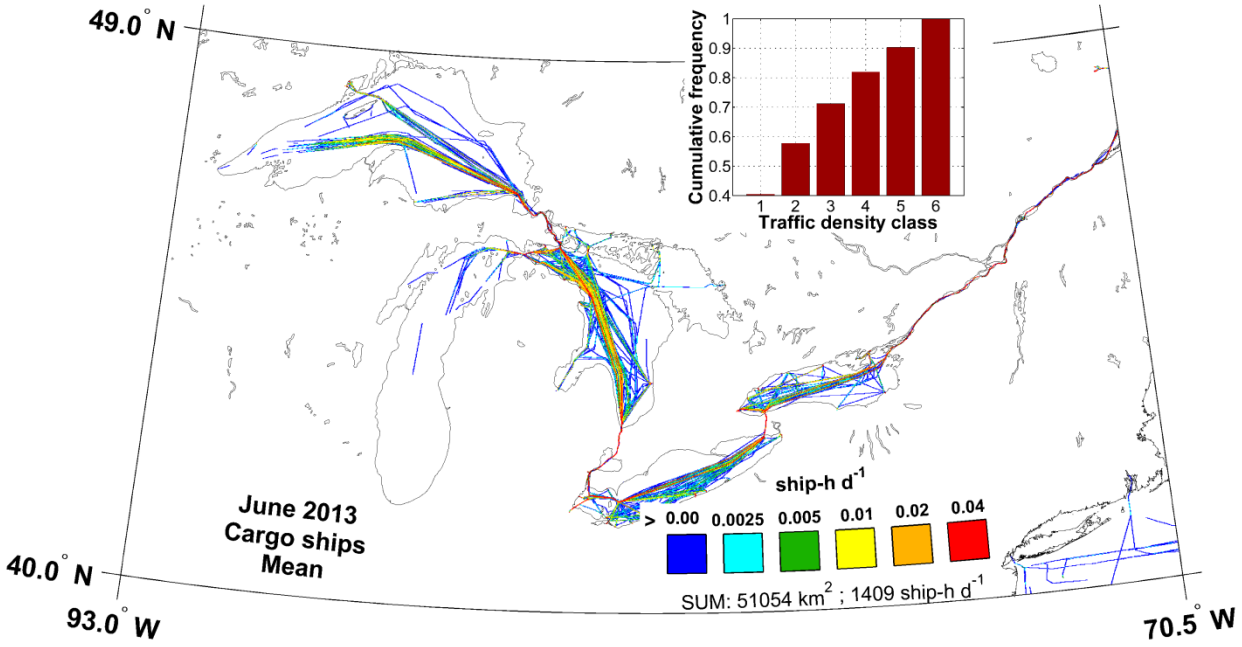

Figure 147. Map of AIS mean traffic density of cargo-type ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

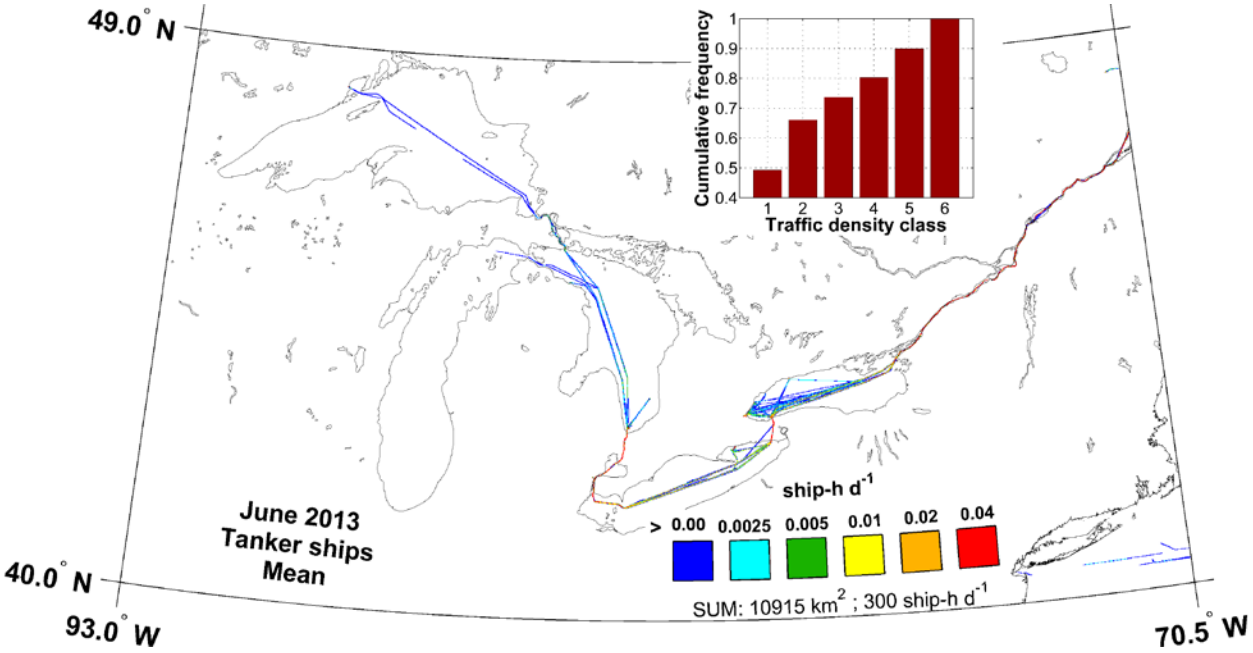

Figure 148. Map of AIS mean traffic density of tanker-type ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

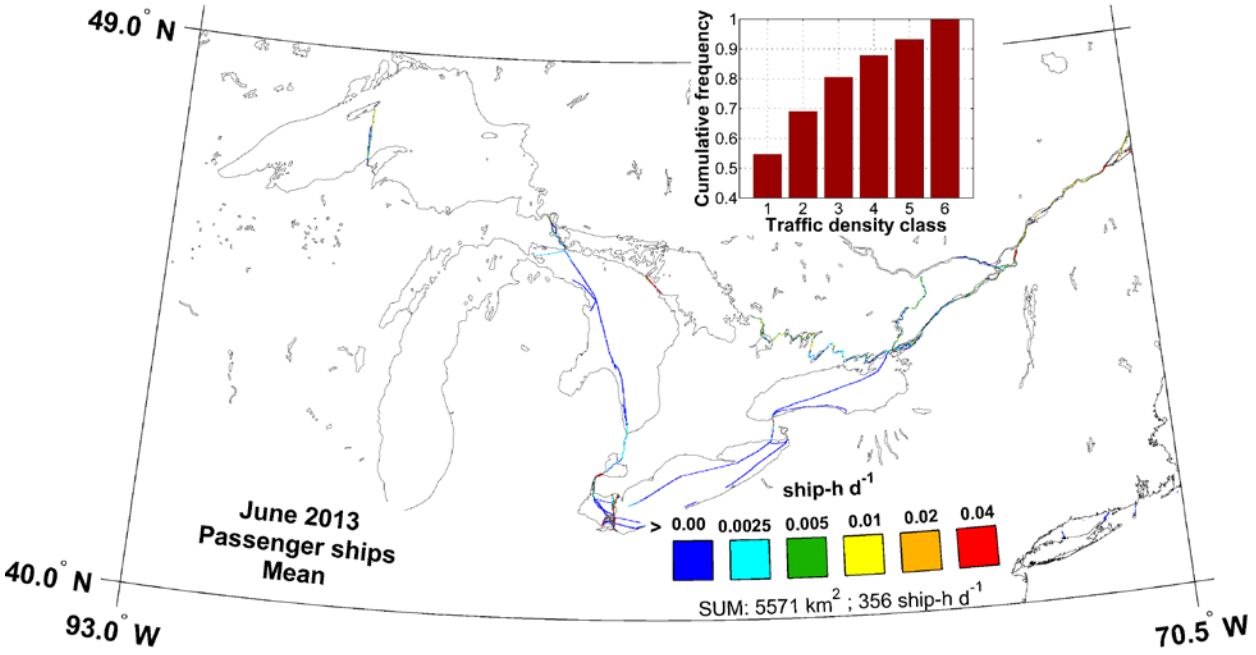

Figure 149. Map of AIS mean traffic density of passenger-type ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

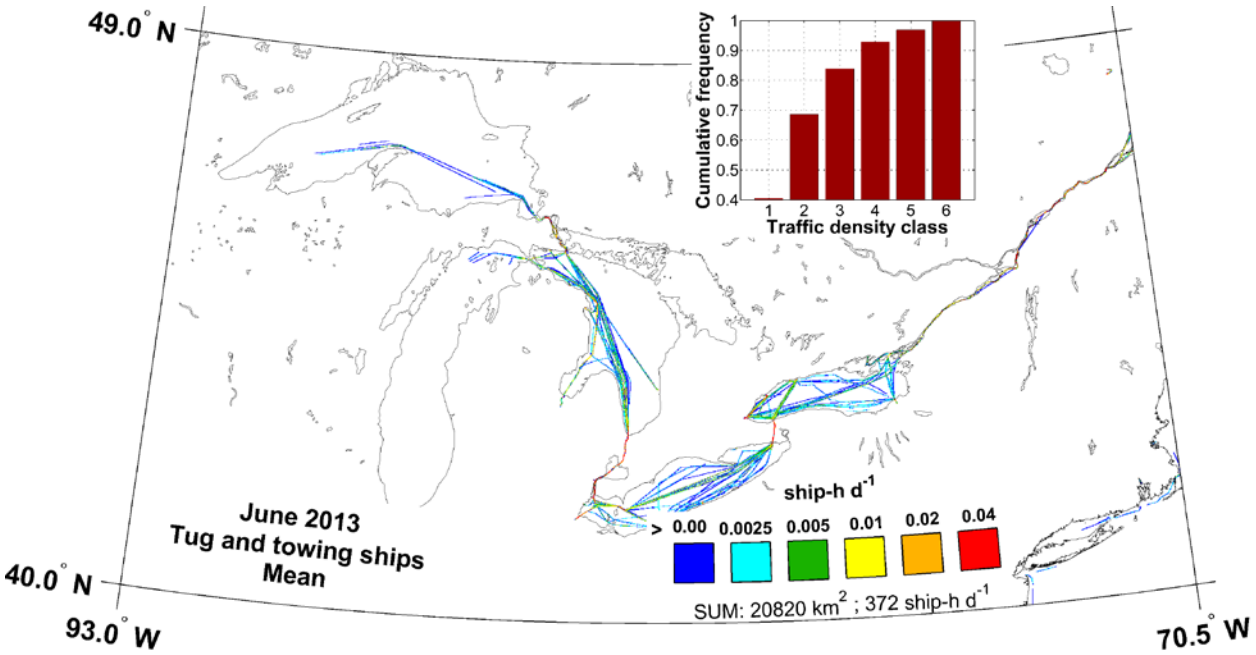

Figure 150. Map of AIS mean traffic density of tug and towing-type ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

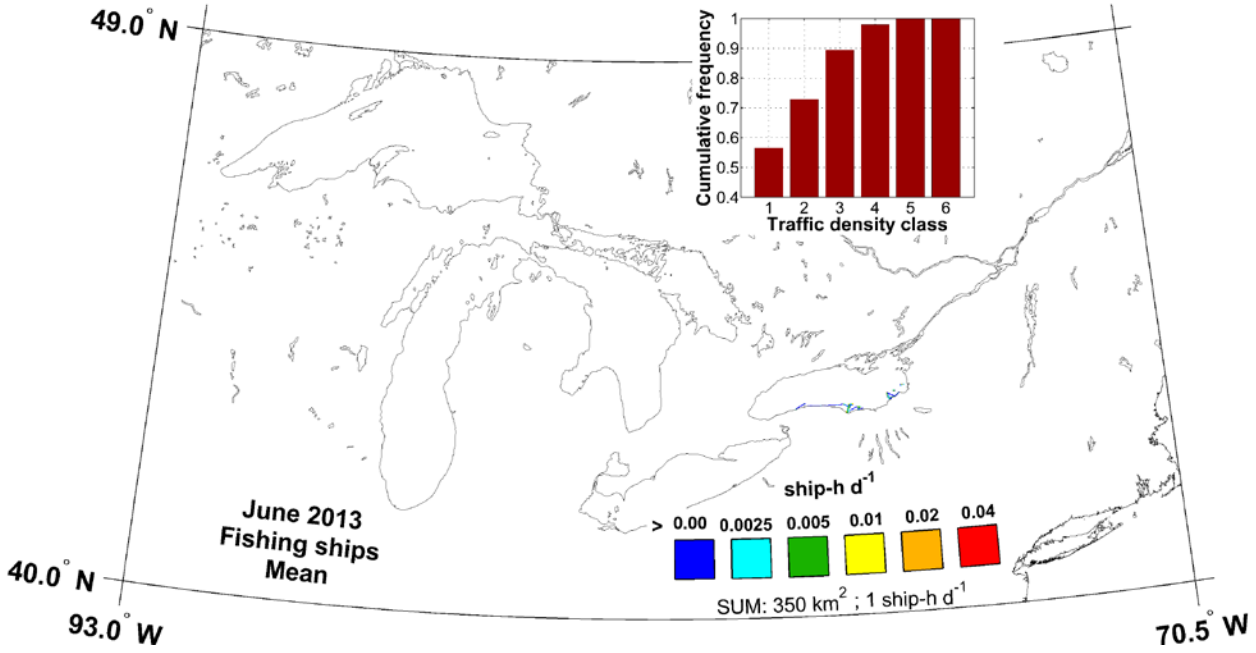

Figure 151. Map of AIS mean traffic density of fishing-type ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

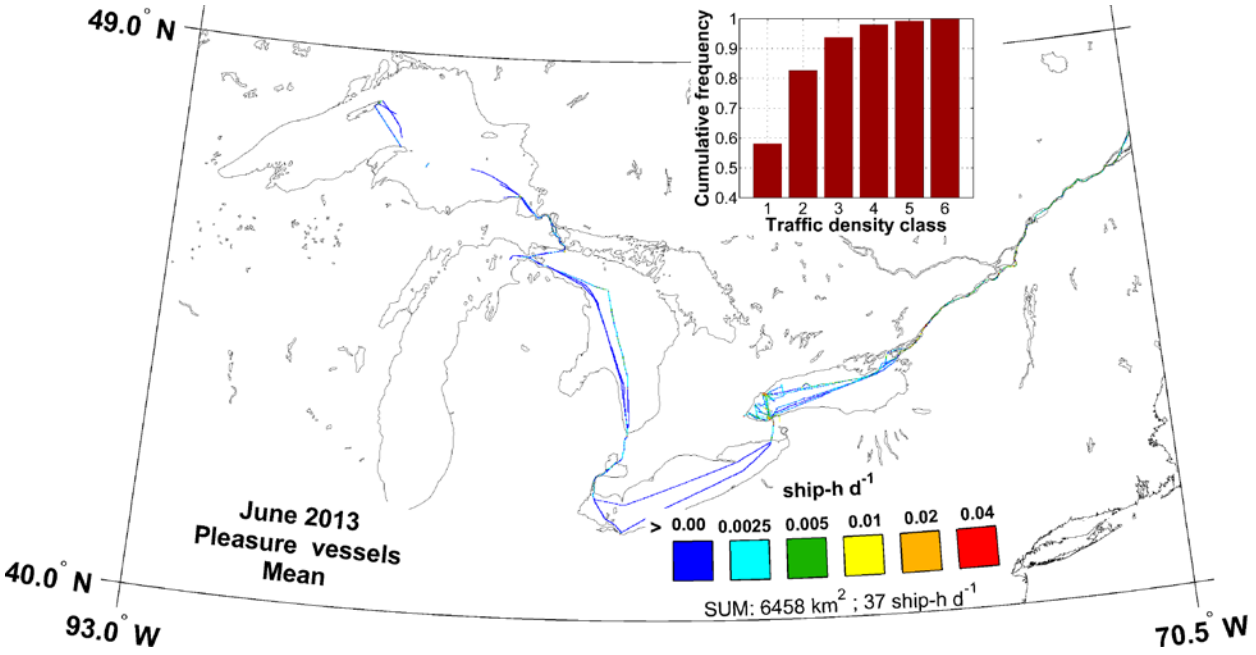

Figure 152. Map of AIS mean traffic density of pleasure-type vessels in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

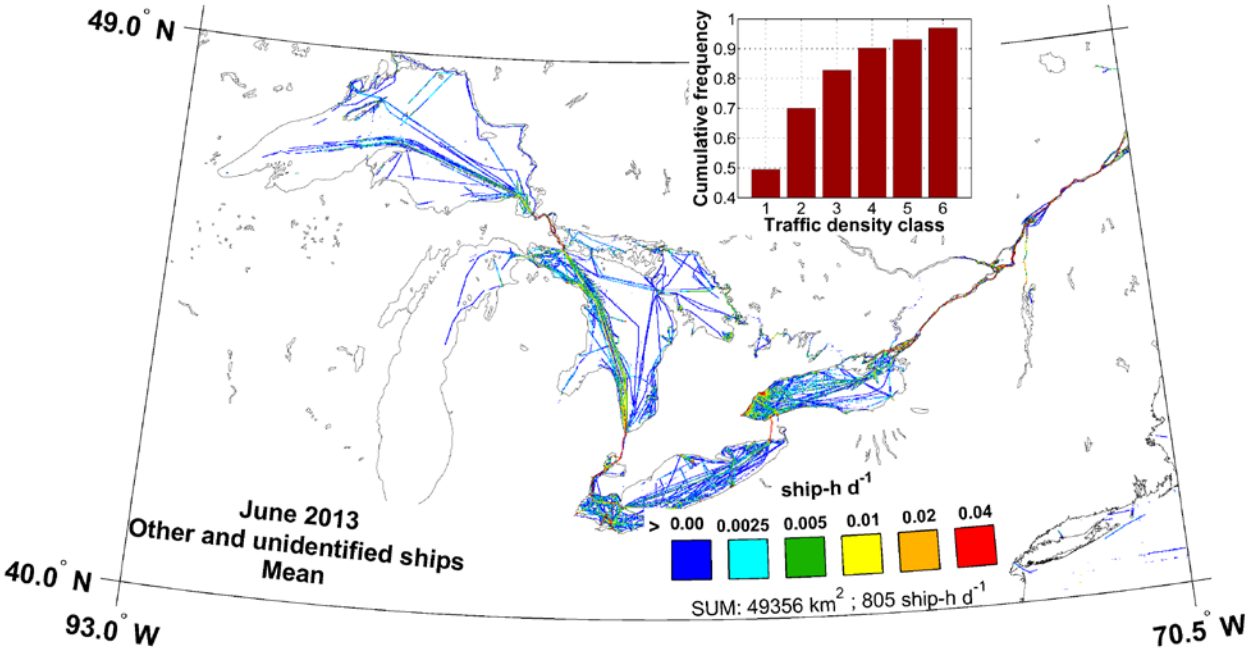

Figure 153. Map of AIS mean traffic density of other types of ships and ships of unidentified type in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

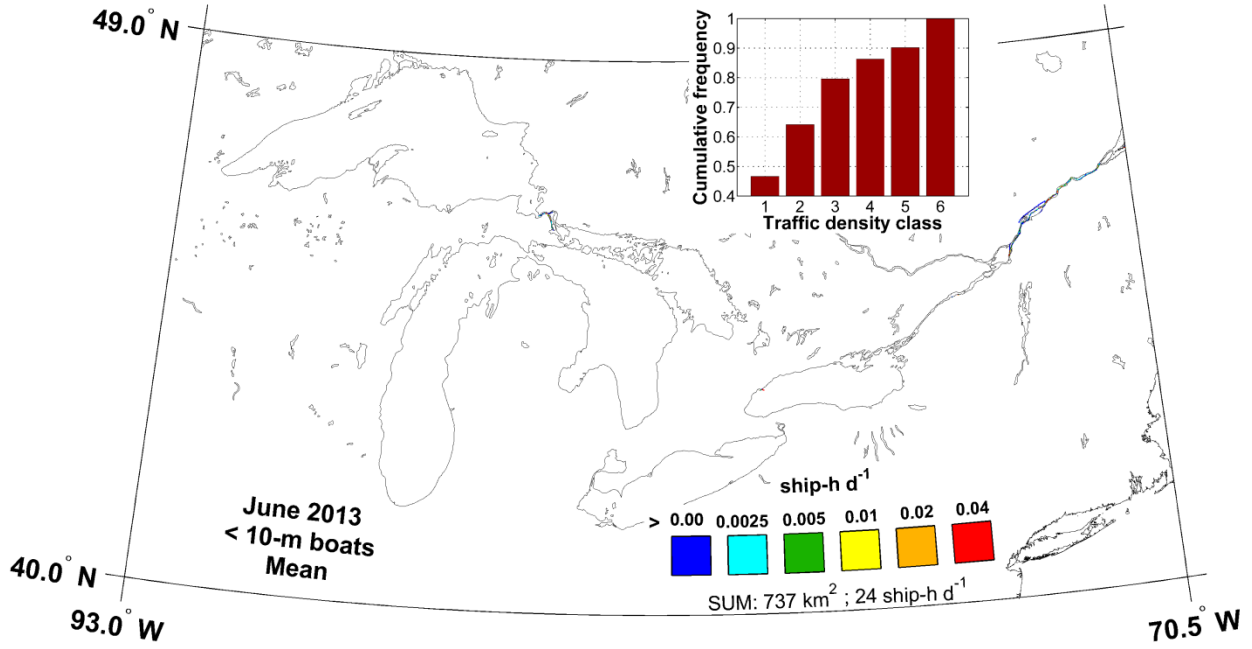

Figure 154. Map of AIS mean traffic density of ships with lengths < 10 m in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

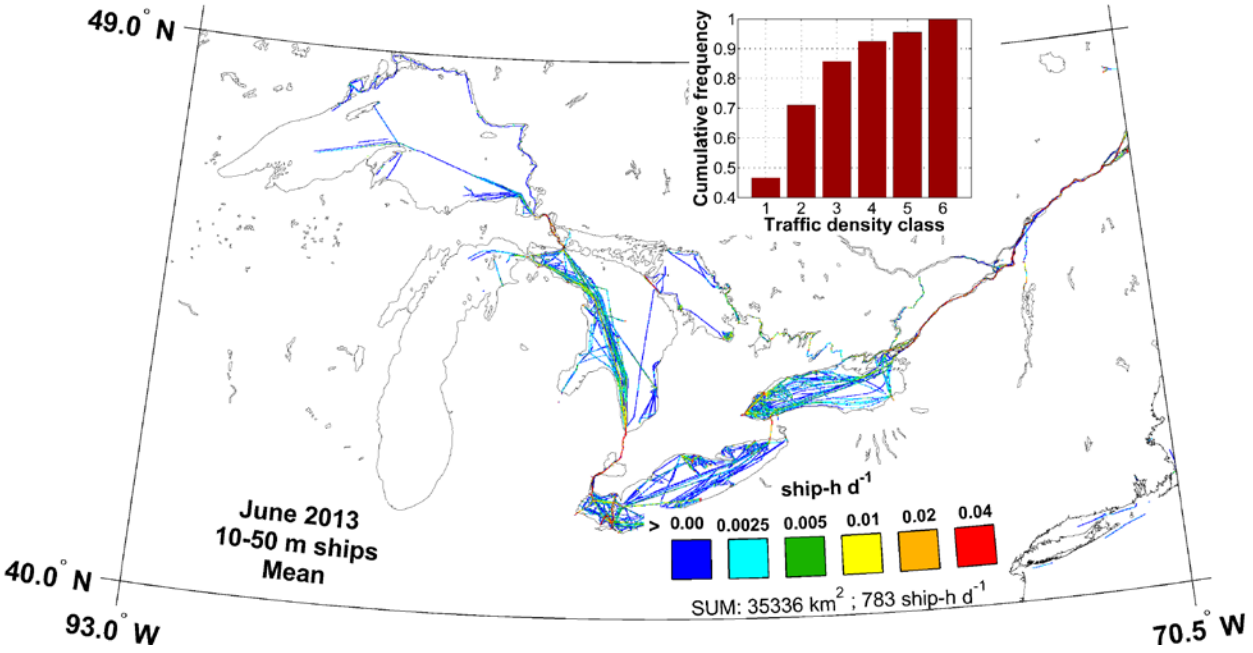

Figure 155. Map of AIS mean traffic density of 10 to 50 m ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

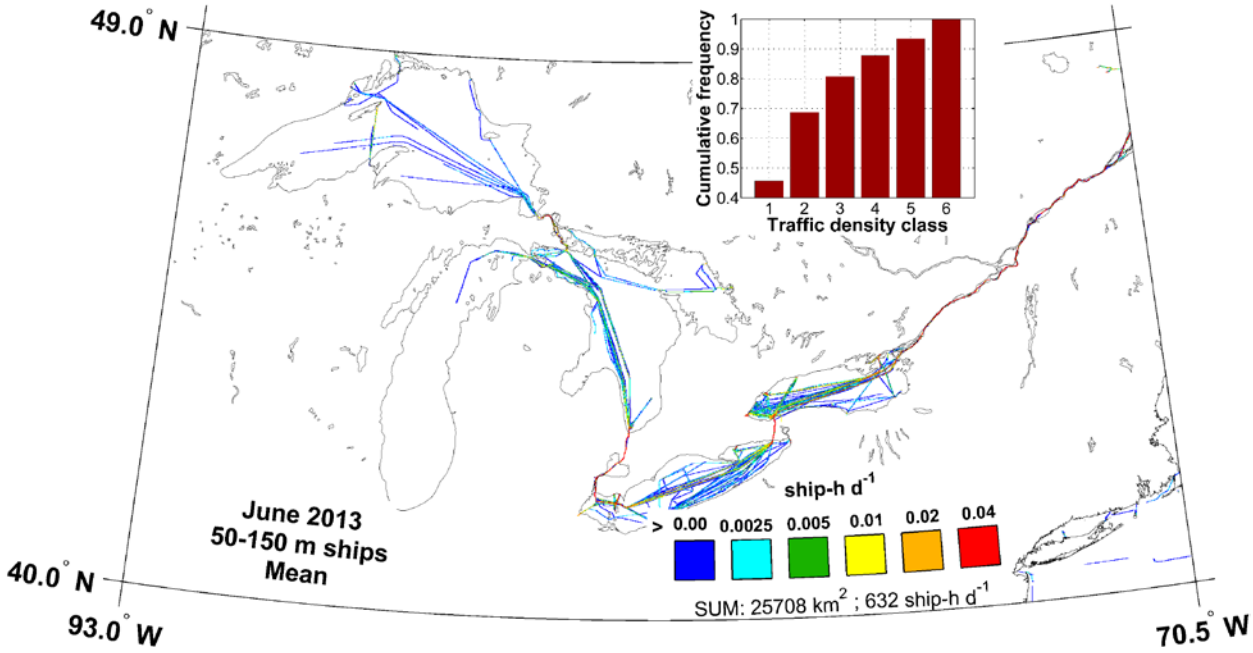

Figure 156. Map of AIS mean traffic density of 50 to 150 m ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

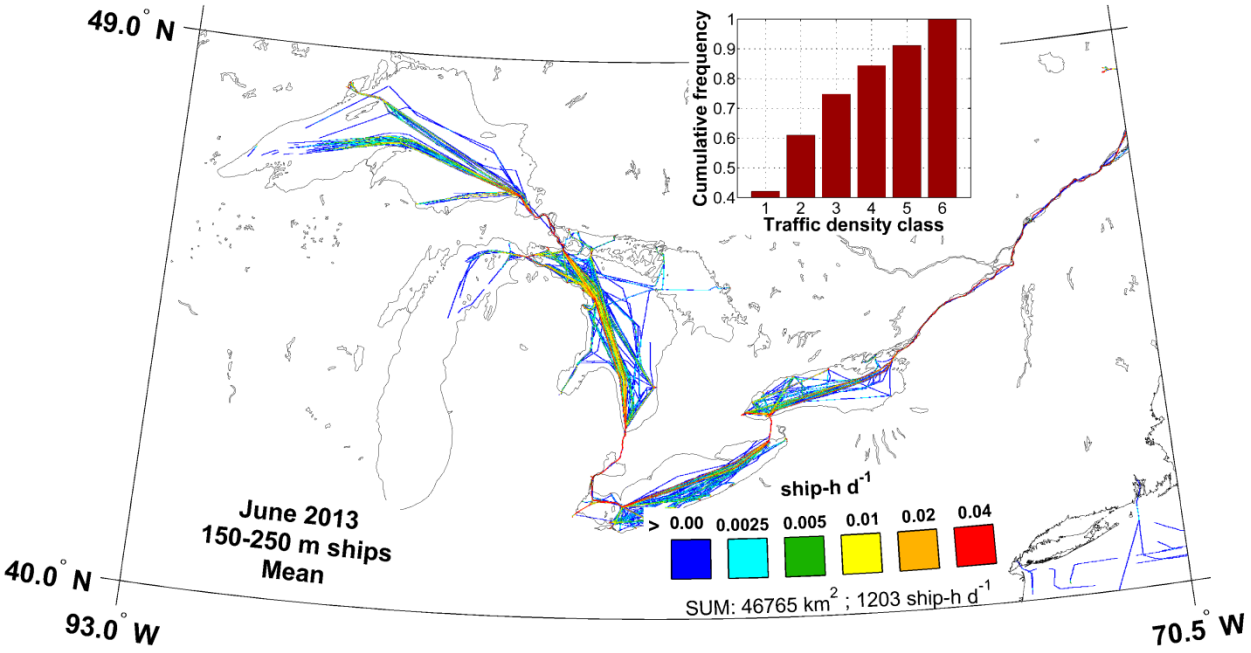

Figure 157. Map of AIS mean traffic density of 150 to 250 m ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

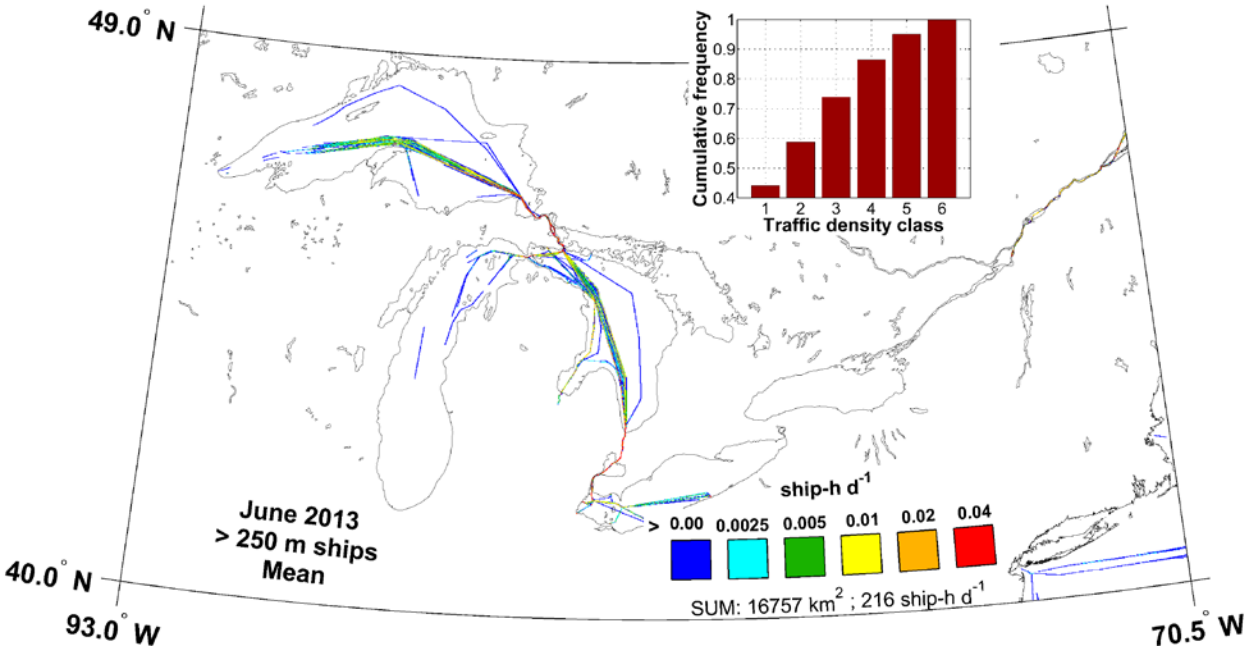

Figure 158. Map of AIS mean traffic density of > 250 m ships in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

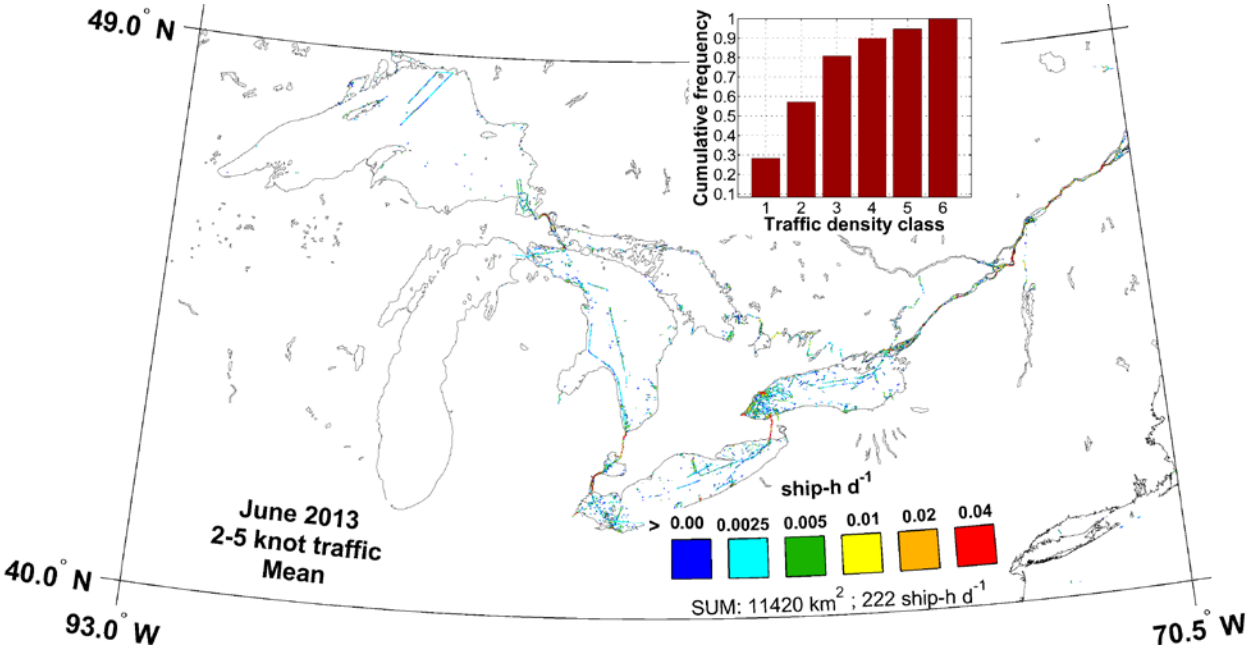

Figure 159. Map of 2–5 knot AIS mean traffic density in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

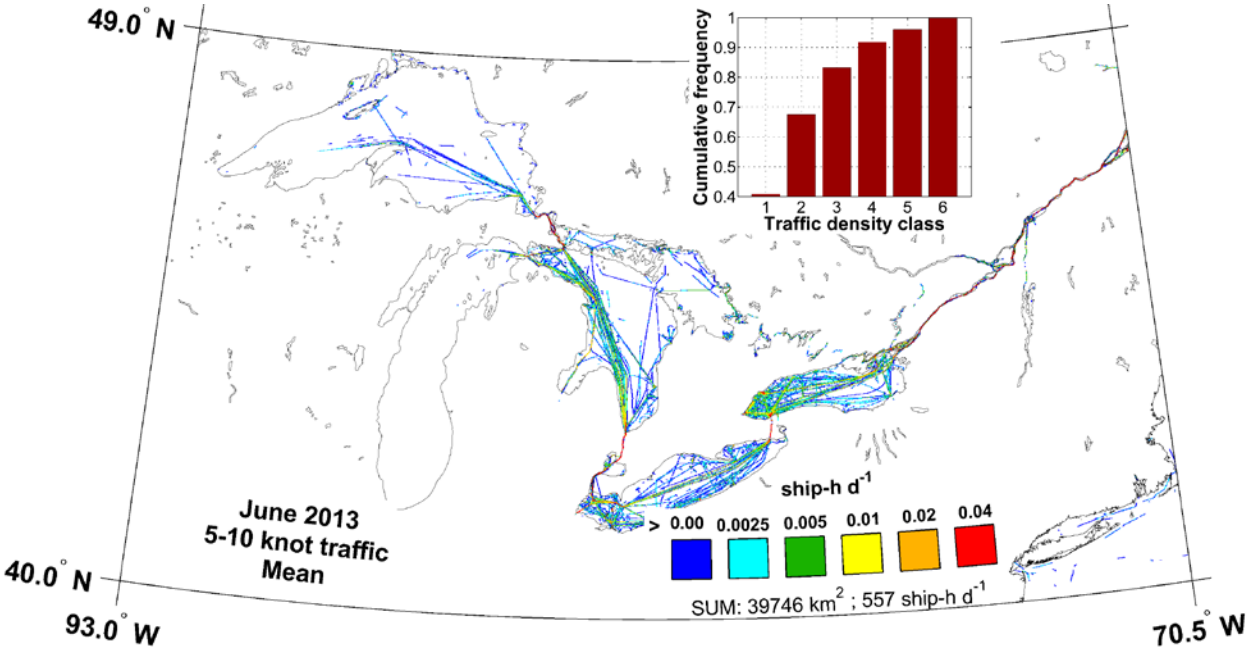

Figure 160. Map of 5–10 knot AIS mean traffic density in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

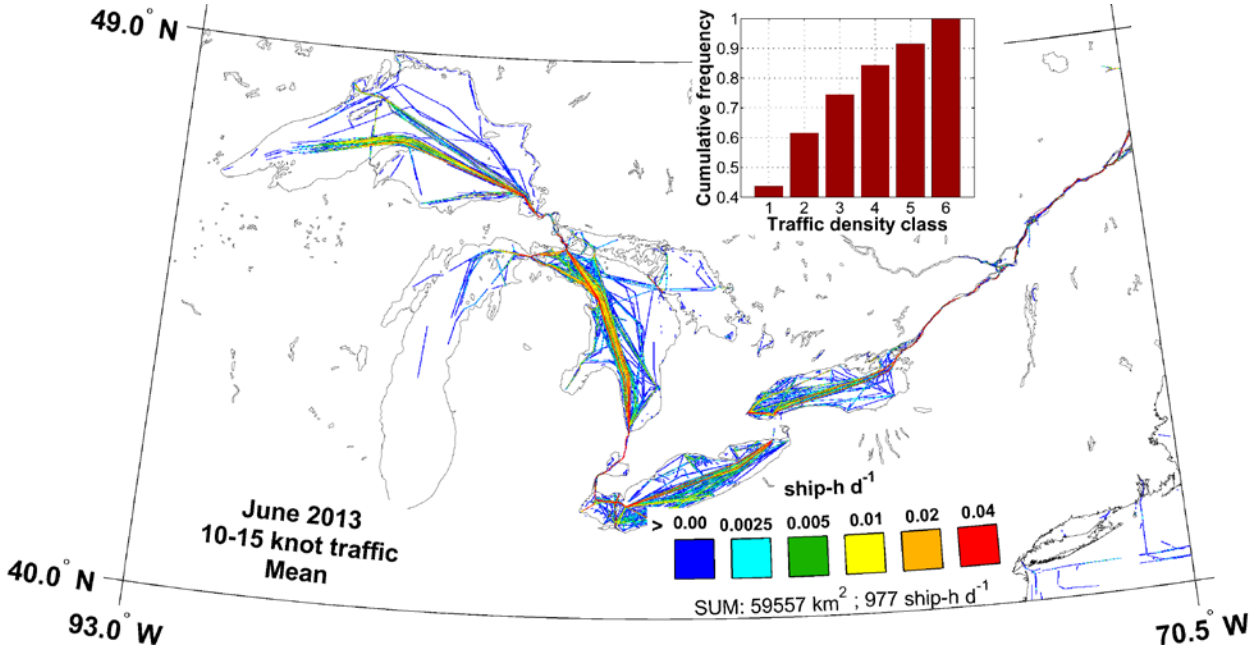

Figure 161. Map of 10–15 knot AIS mean traffic density in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

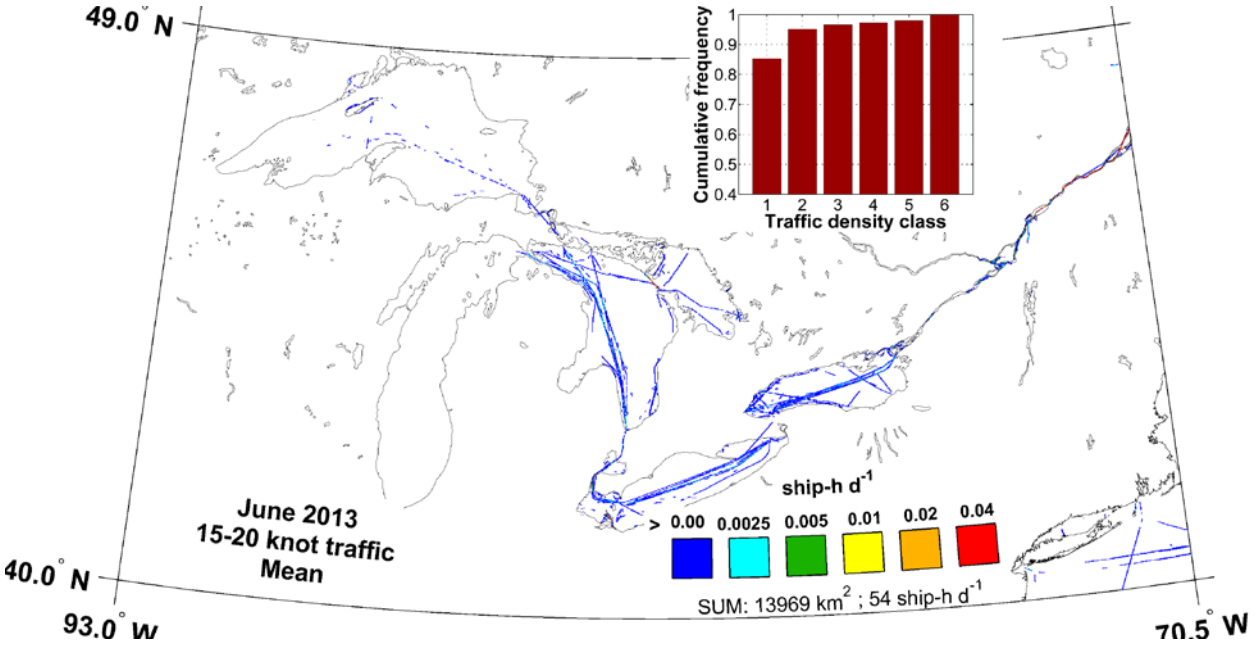

Figure 162. Map of 15–20 knot AIS mean traffic density in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

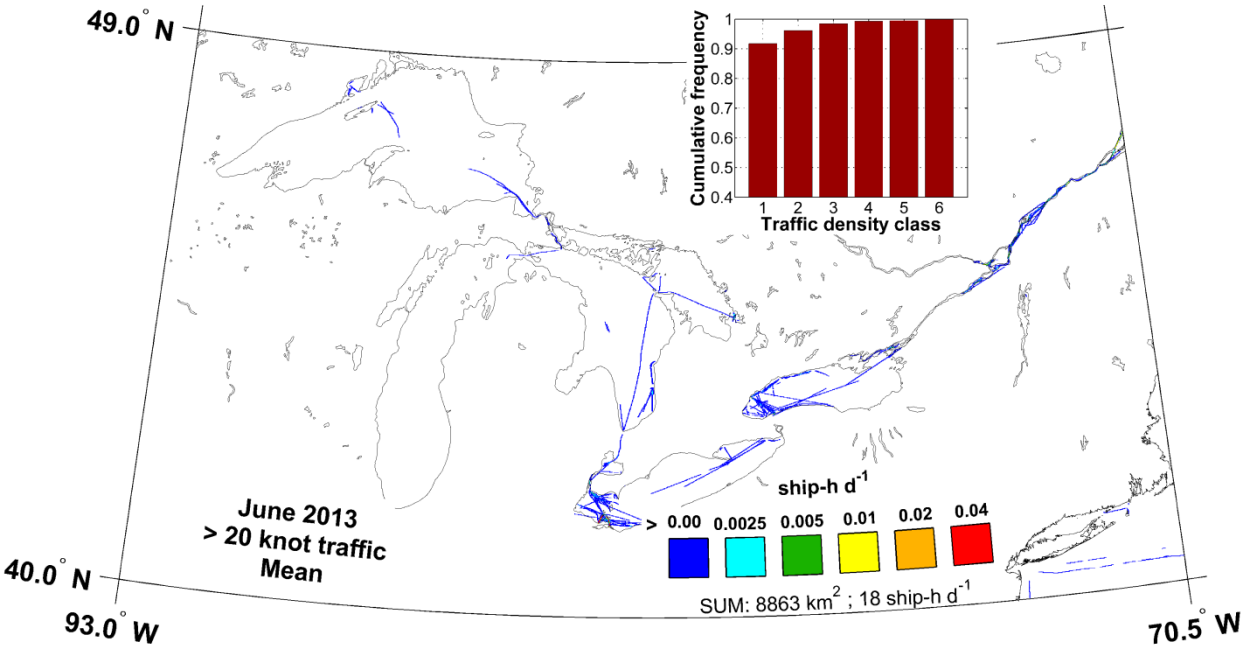

Figure 163. Map of >20 knot AIS mean traffic density in June 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.7. July 2013

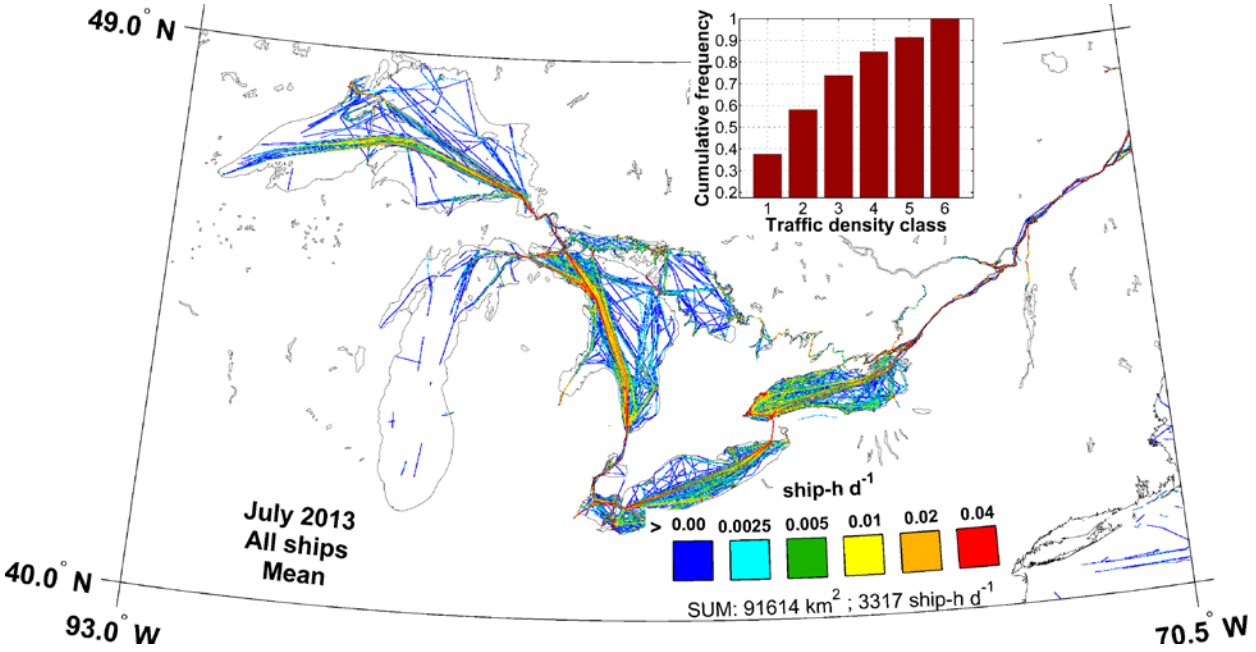

Figure 164. Map of AIS mean traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

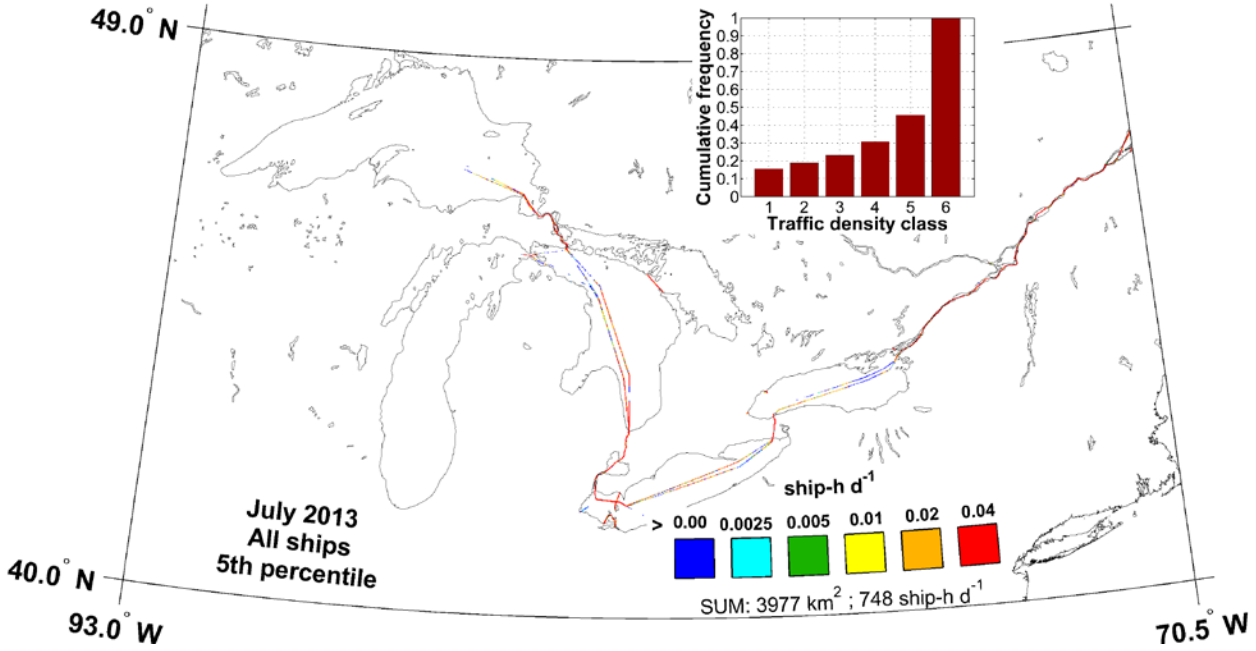

Figure 165. Map of the 5th percentile of the daily AIS traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

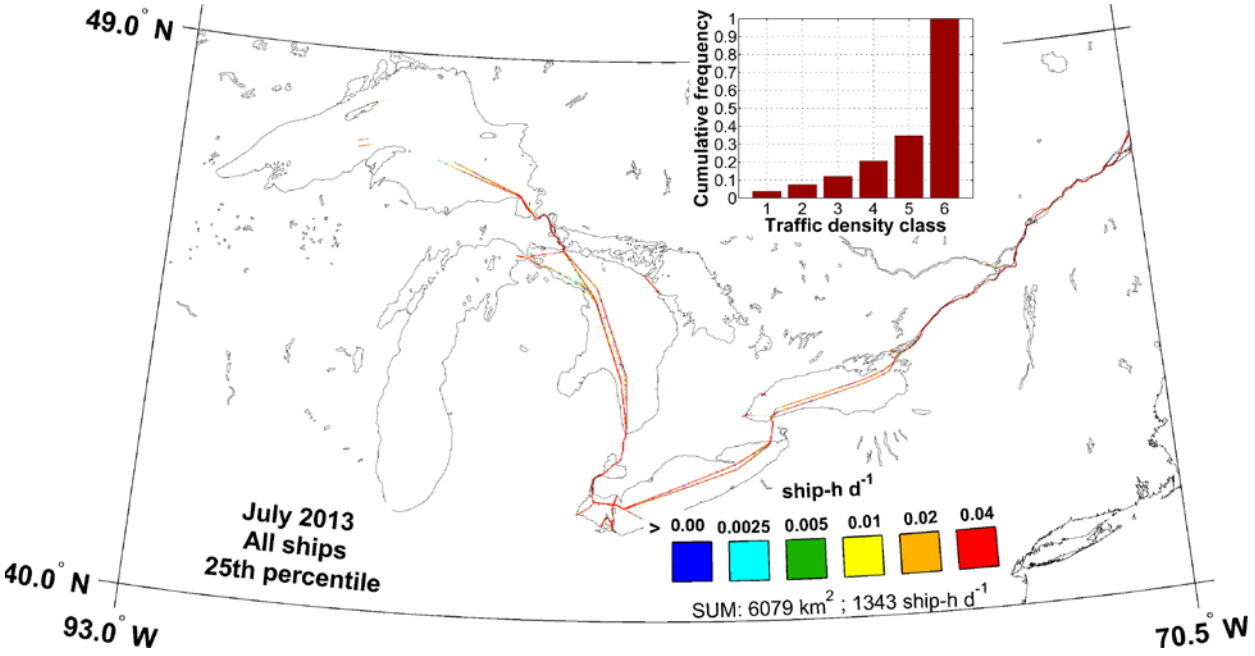

Figure 166. Map of the 25th percentile of the daily AIS traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

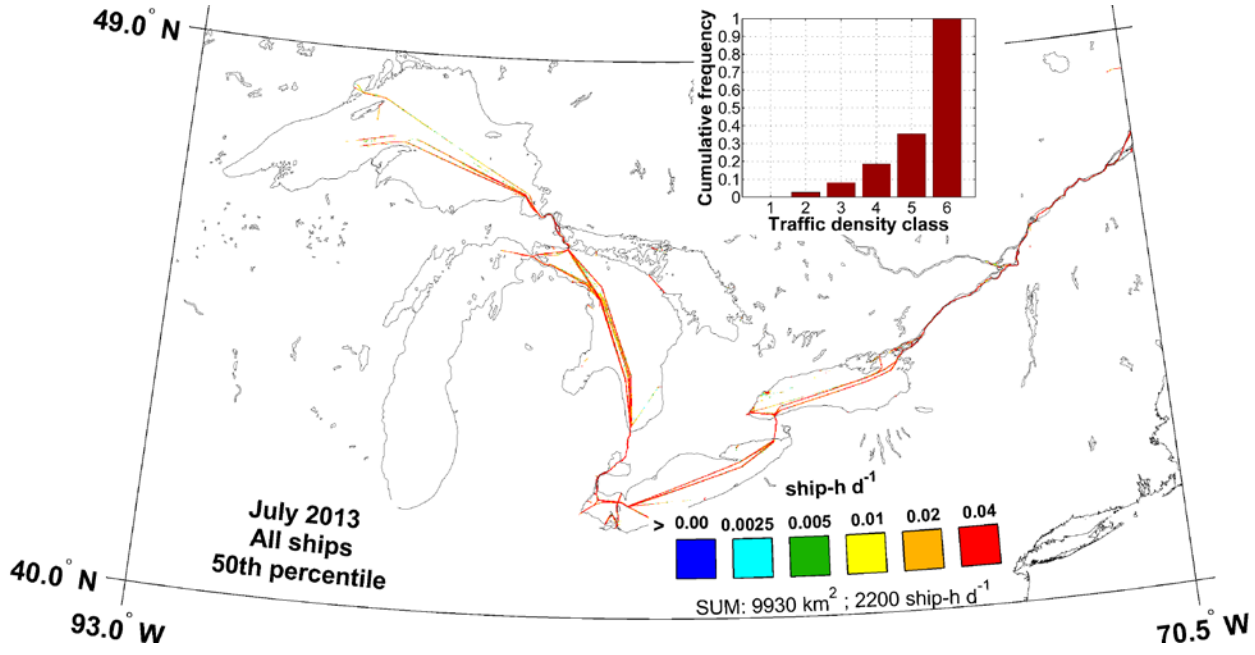

Figure 167. Map of the 50th percentile of the daily AIS traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

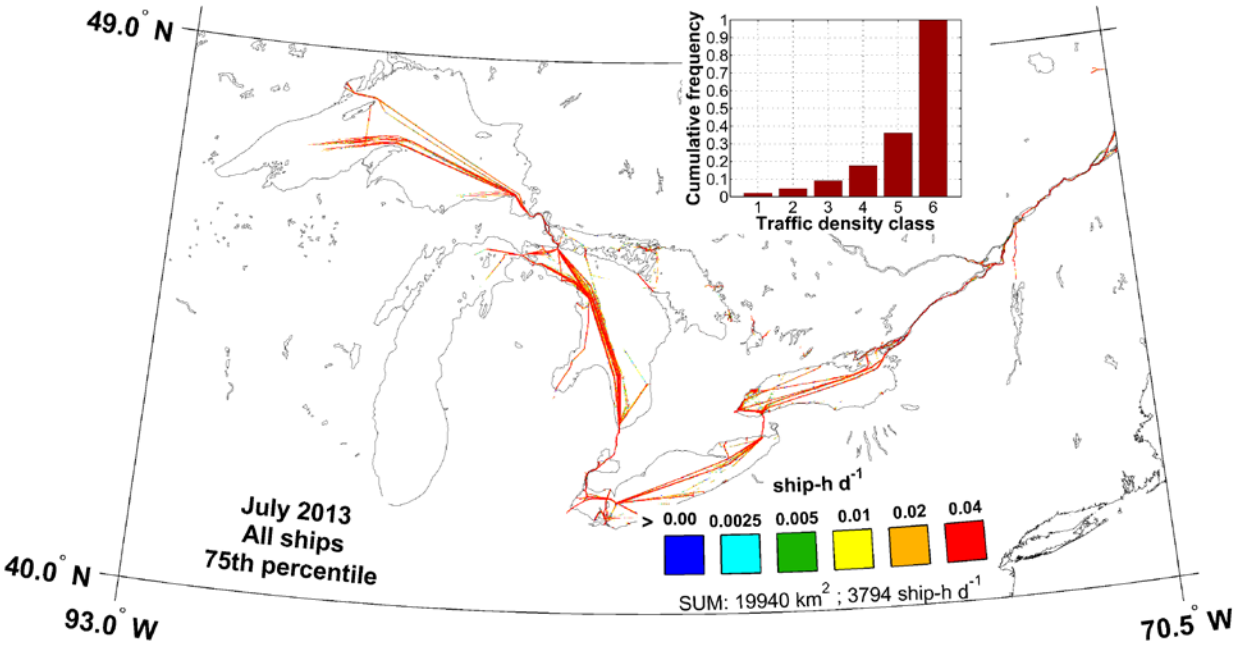

Figure 168. Map of the 75th percentile of the daily AIS traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

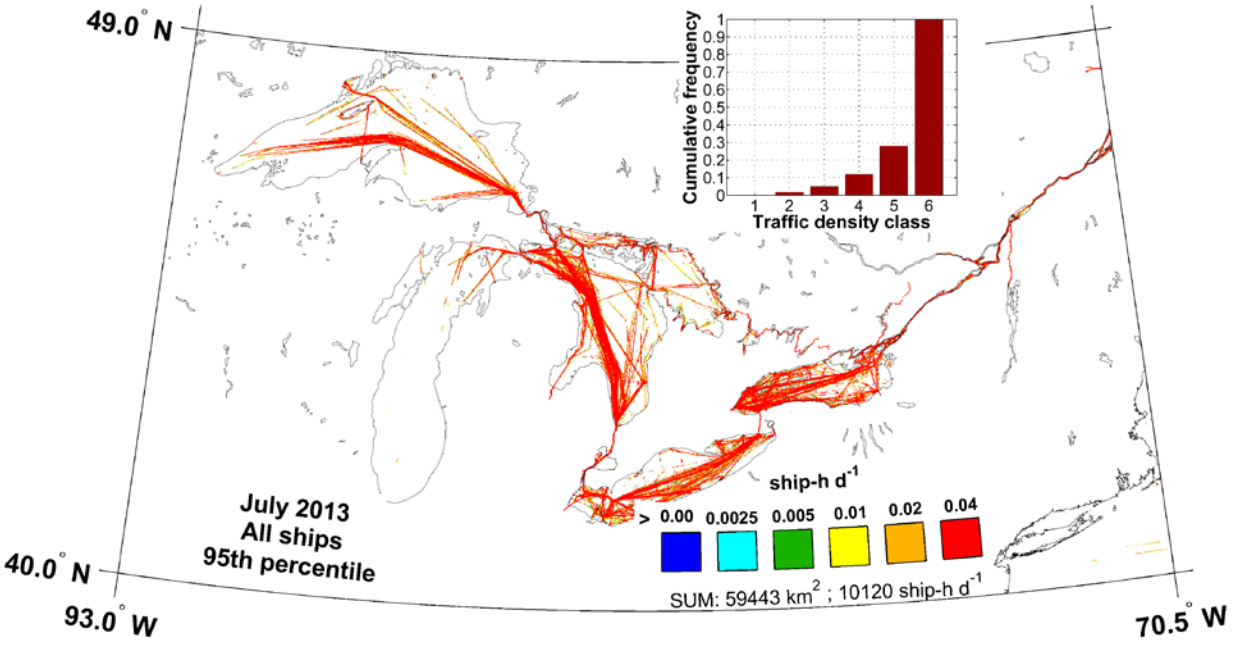

Figure 169. Map of the 95th percentile of the daily AIS traffic density of all ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

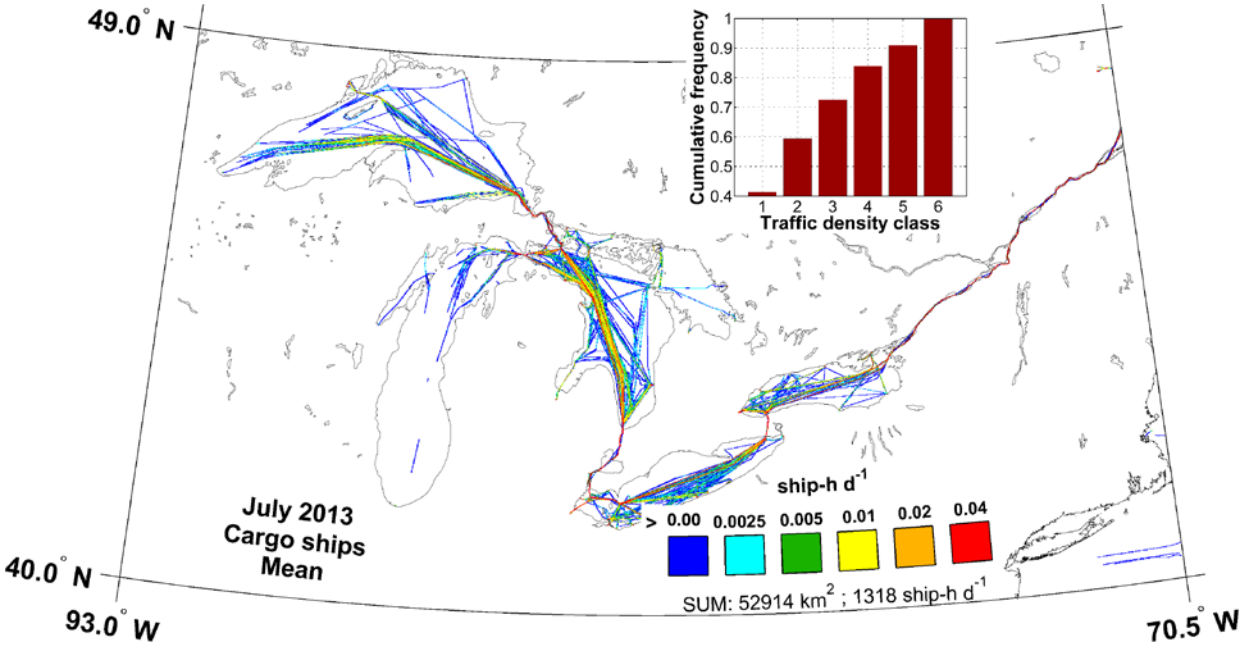

Figure 170. Map of AIS mean traffic density of cargo-type ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

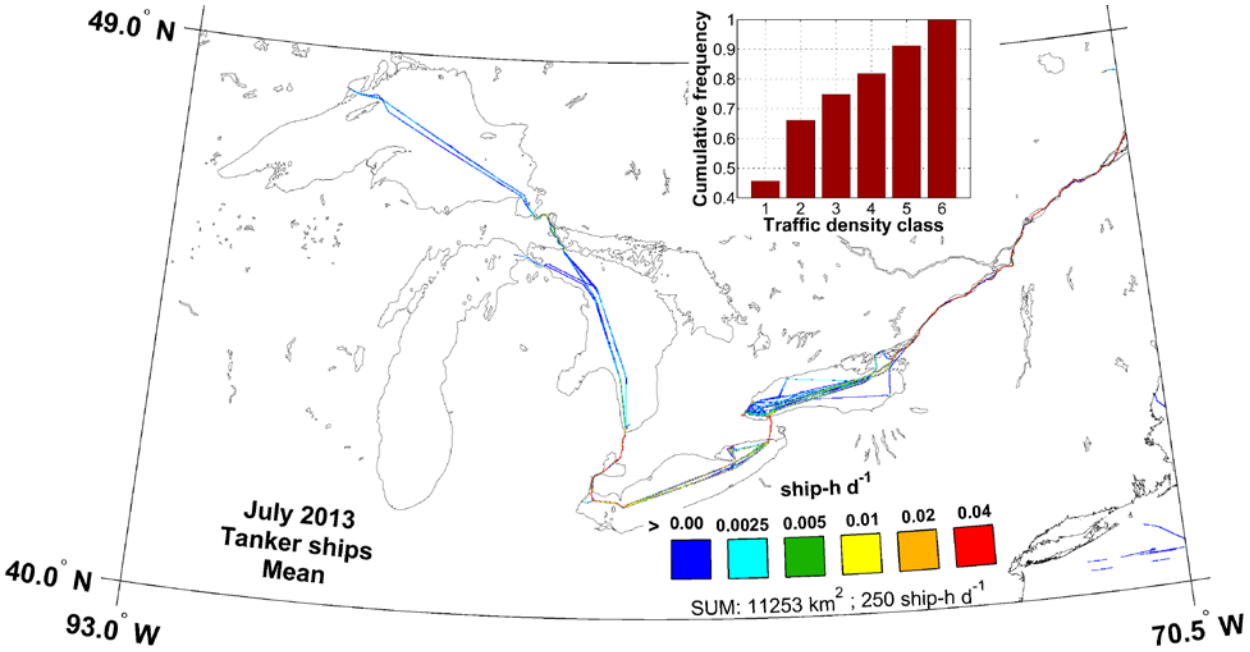

Figure 171. Map of AIS mean traffic density of tanker-type ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

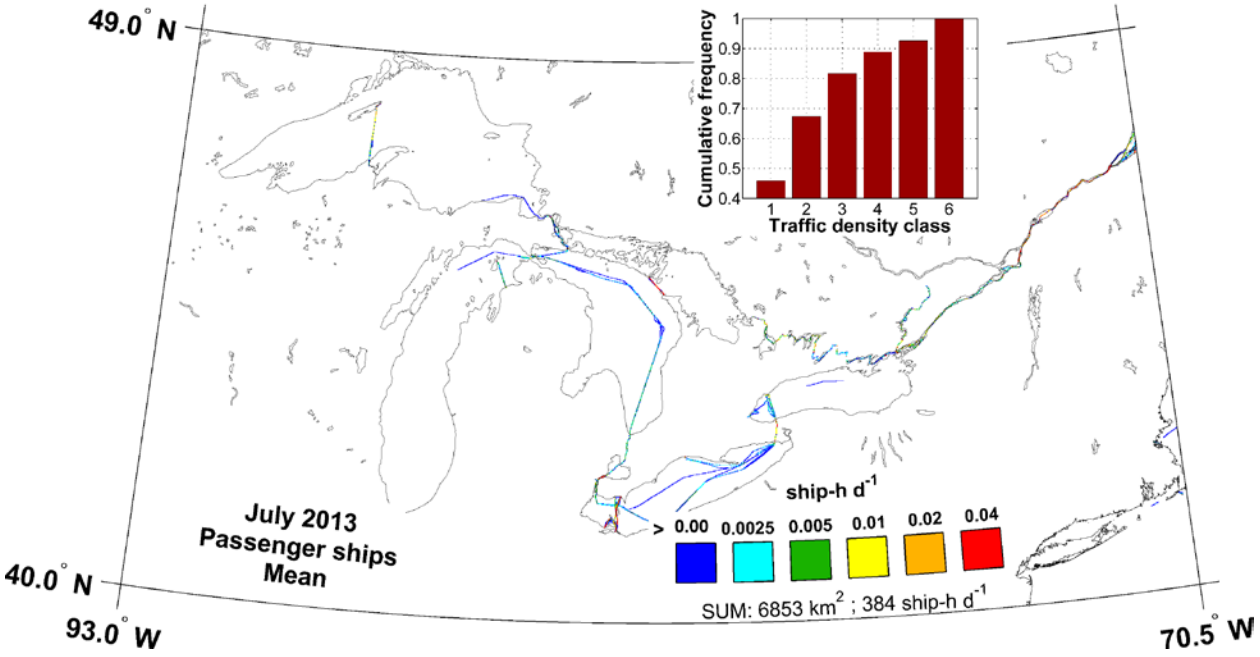

Figure 172. Map of AIS mean traffic density of passenger-type ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

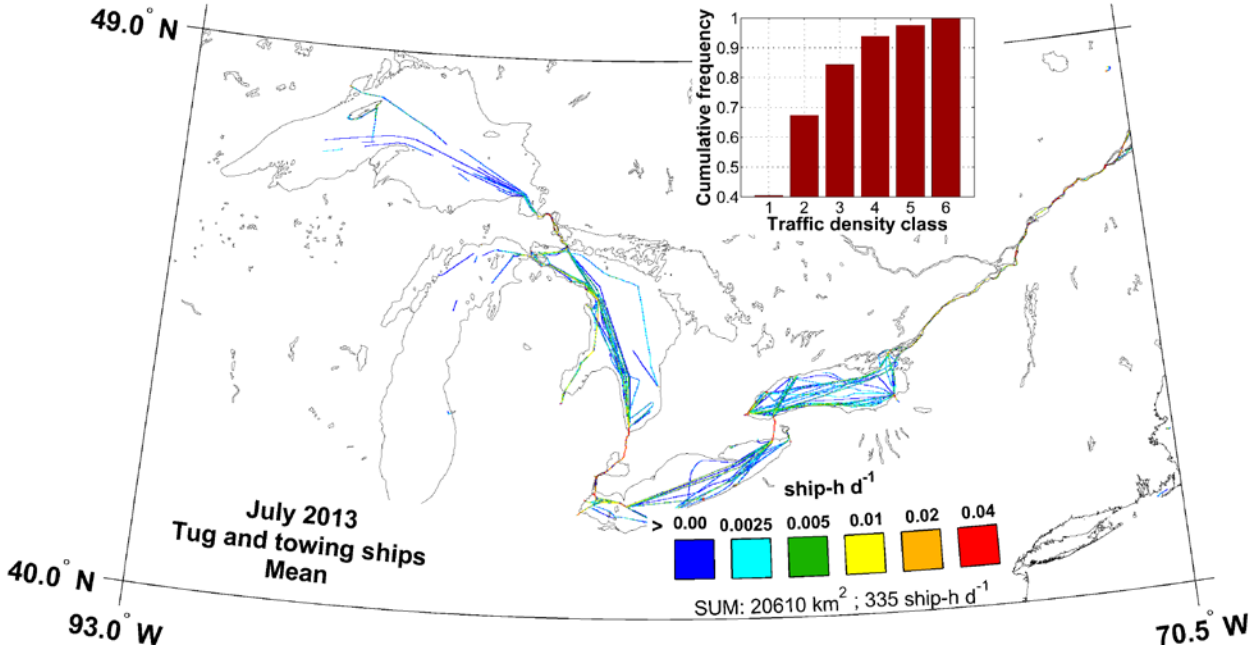

Figure 173. Map of AIS mean traffic density of tug and towing-type ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

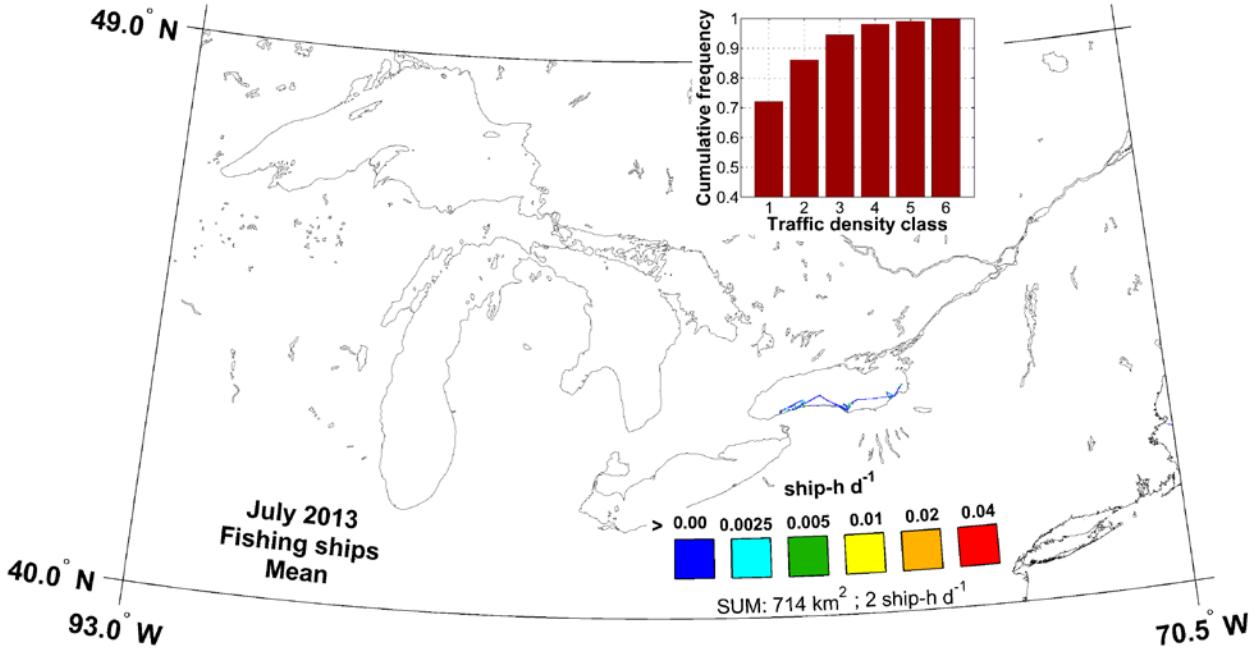

Figure 174. Map of AIS mean traffic density of fishing-type ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

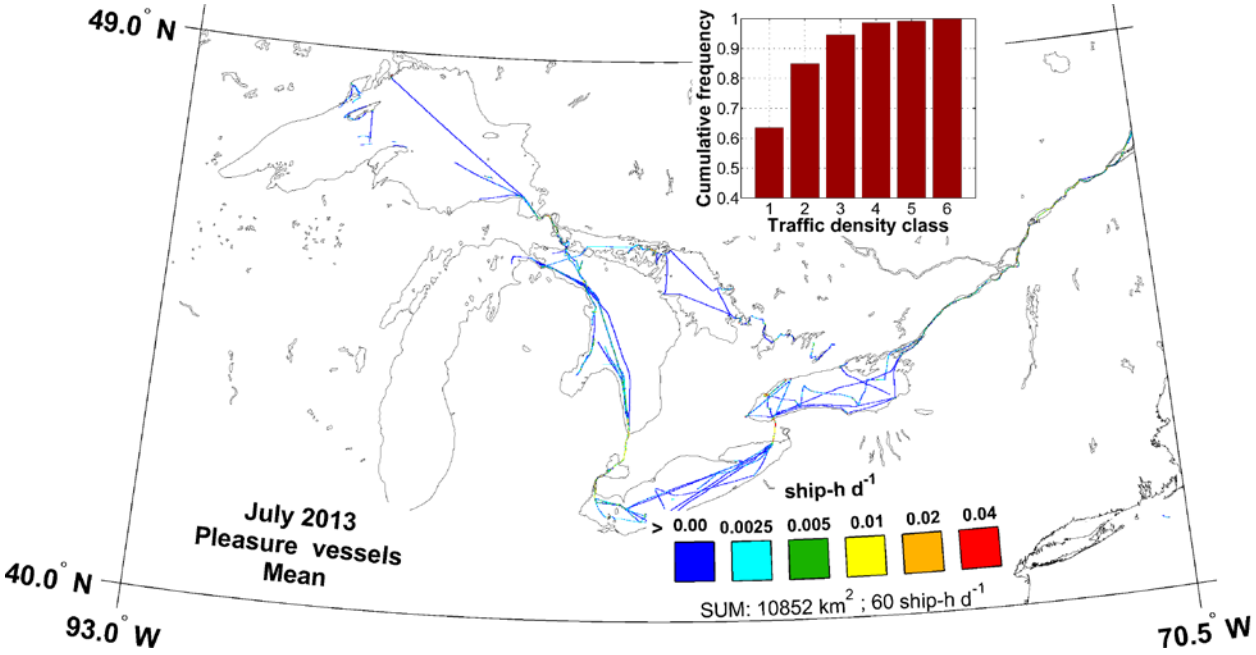

Figure 175. Map of AIS mean traffic density of pleasure-type vessels in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

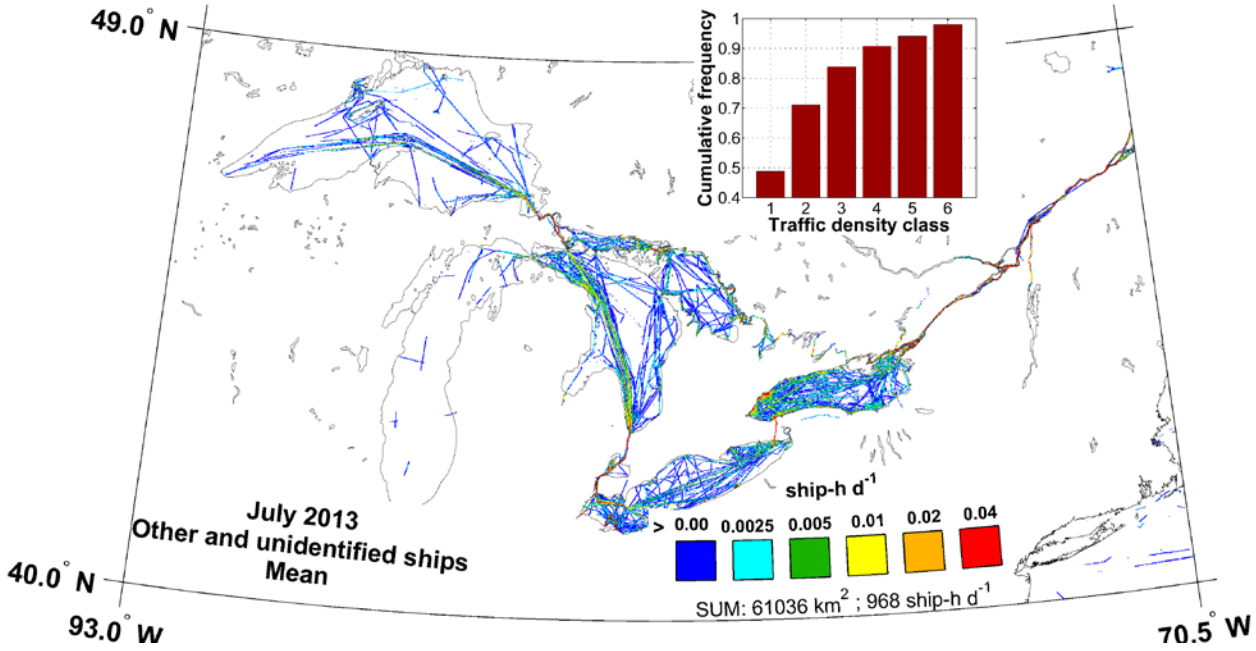

Figure 176. Map of AIS mean traffic density of other types of ships and ships of unidentified type in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

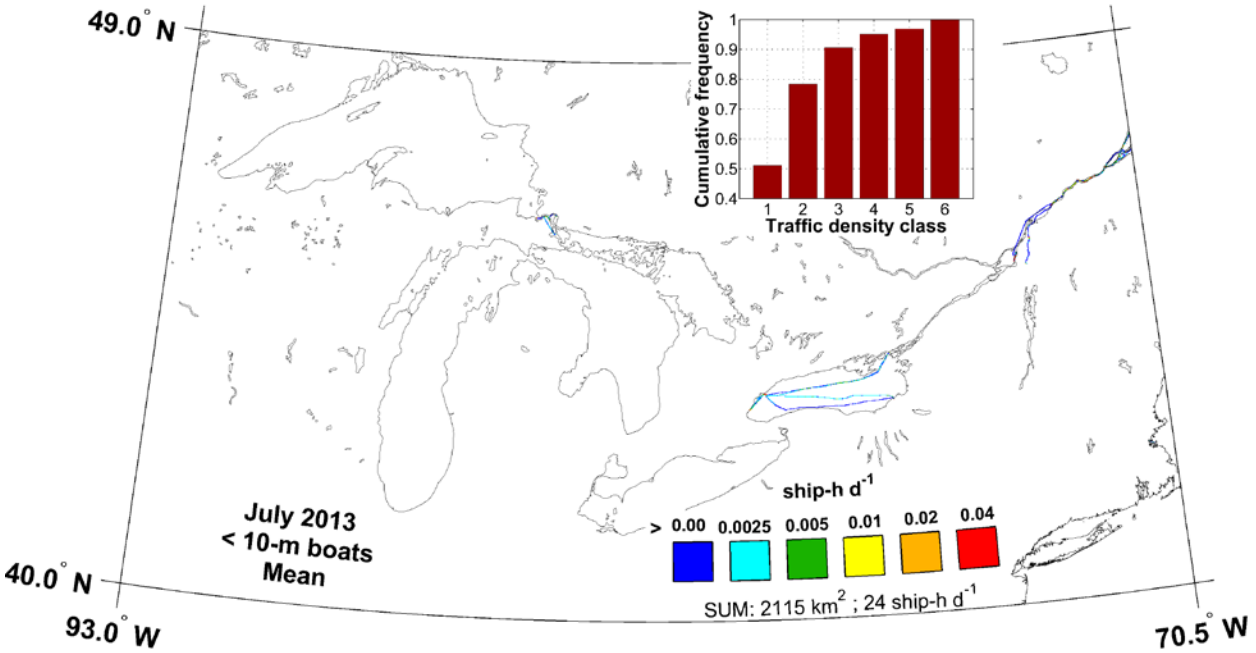

Figure 177. Map of AIS mean traffic density of ships with lengths < 10 m in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

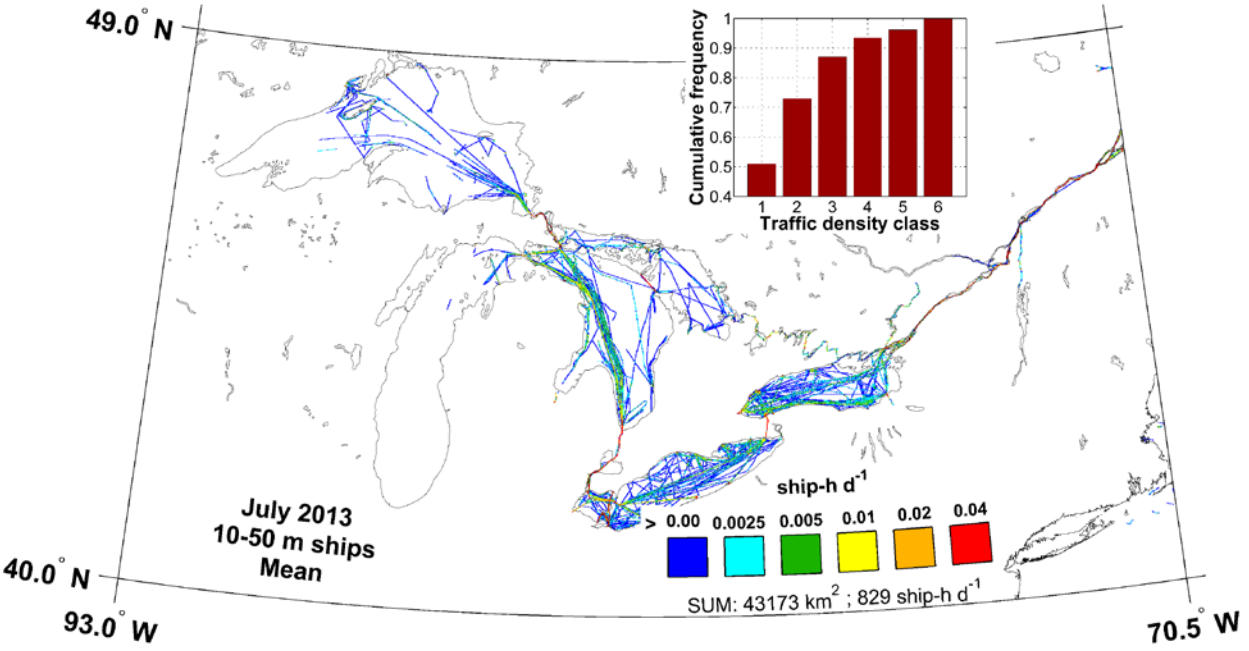

Figure 178. Map of AIS mean traffic density of 10 to 50 m ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

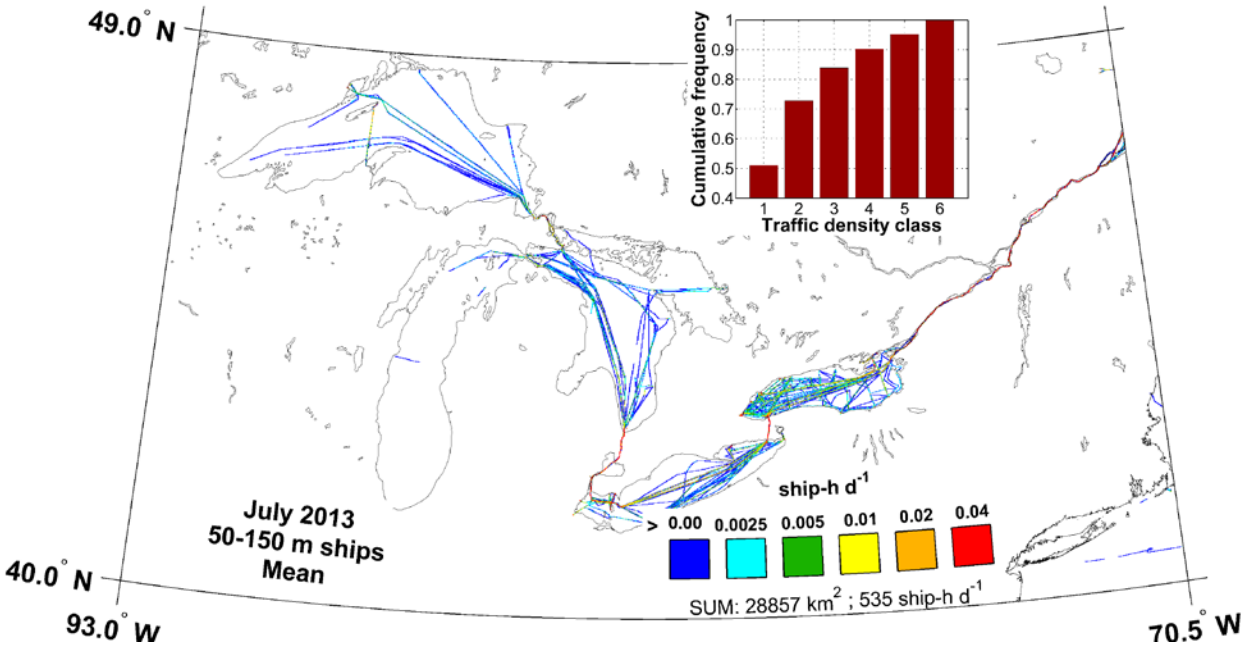

Figure 179. Map of AIS mean traffic density of 50 to 150 m ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

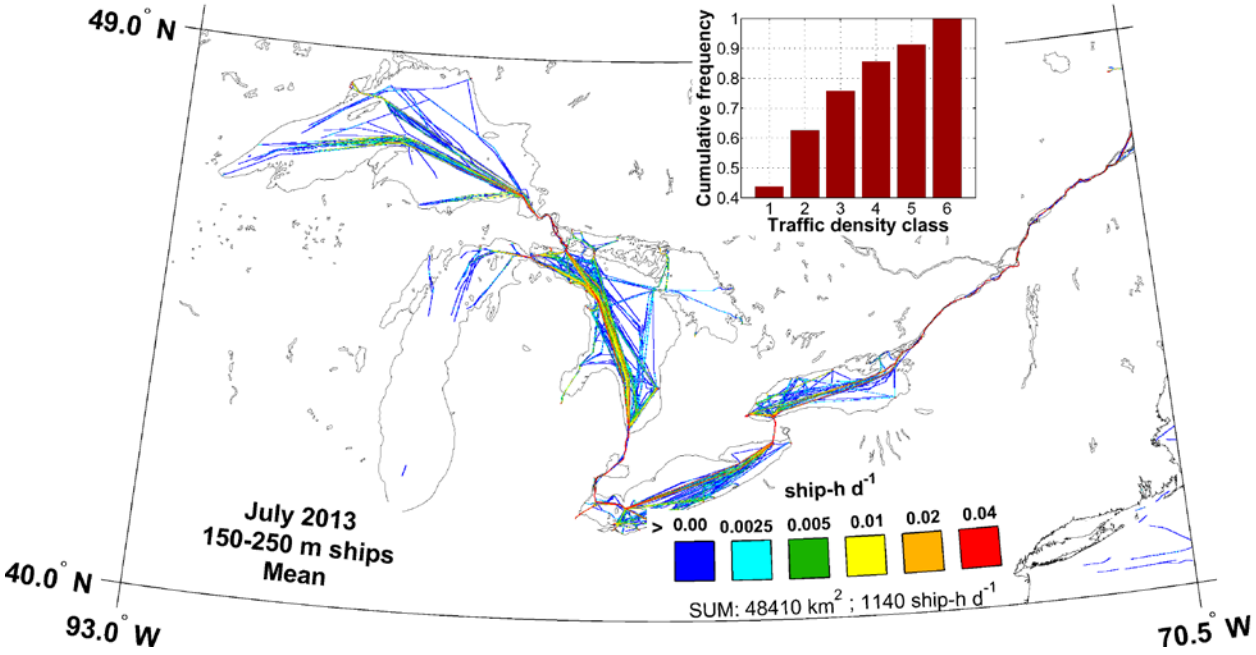

Figure 180. Map of AIS mean traffic density of 150 to 250 m ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

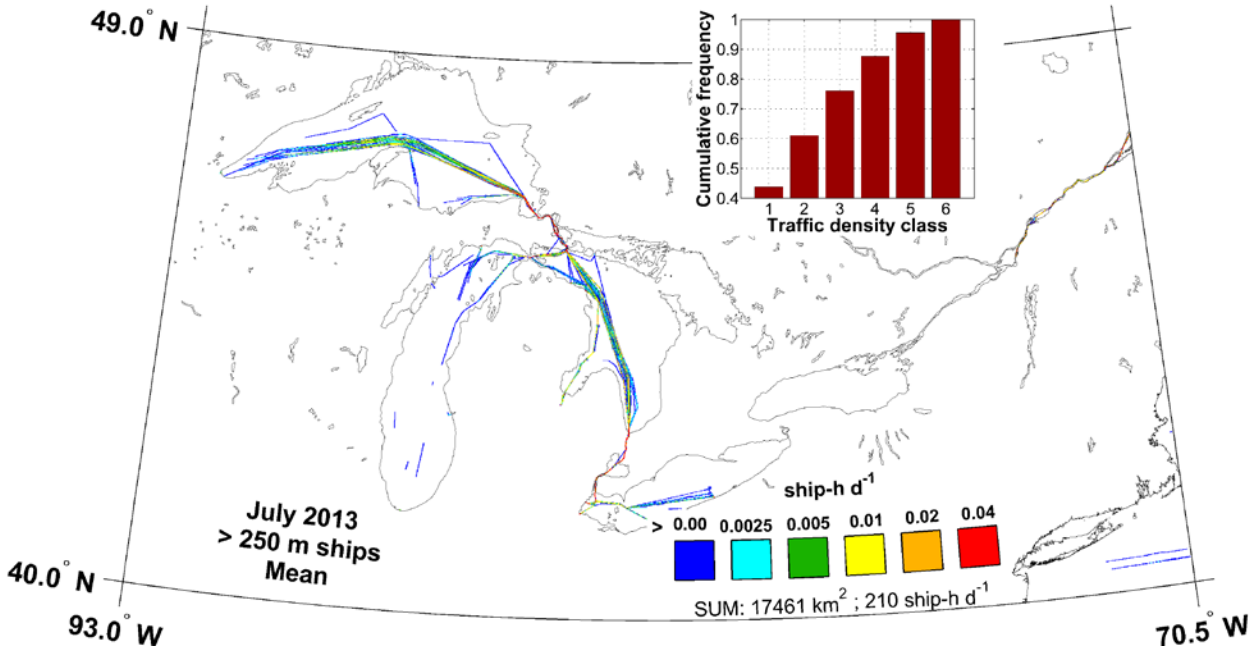

Figure 181. Map of AIS mean traffic density of > 250 m ships in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

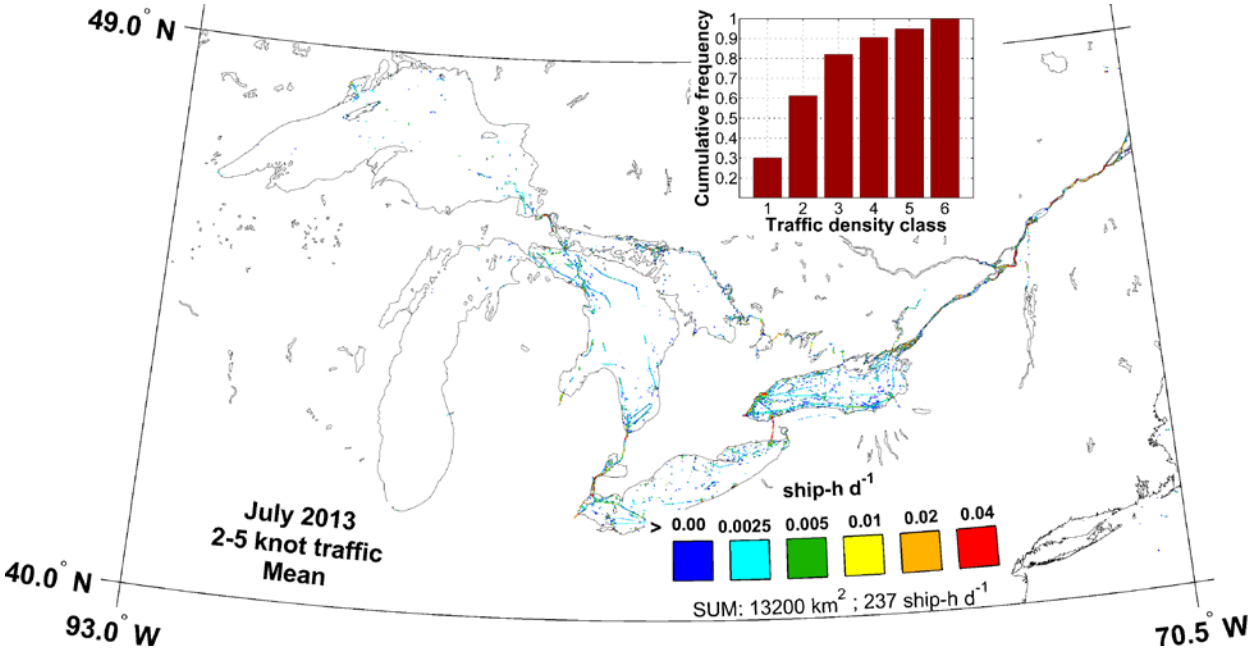

Figure 182. Map of 2–5 knot AIS mean traffic density in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

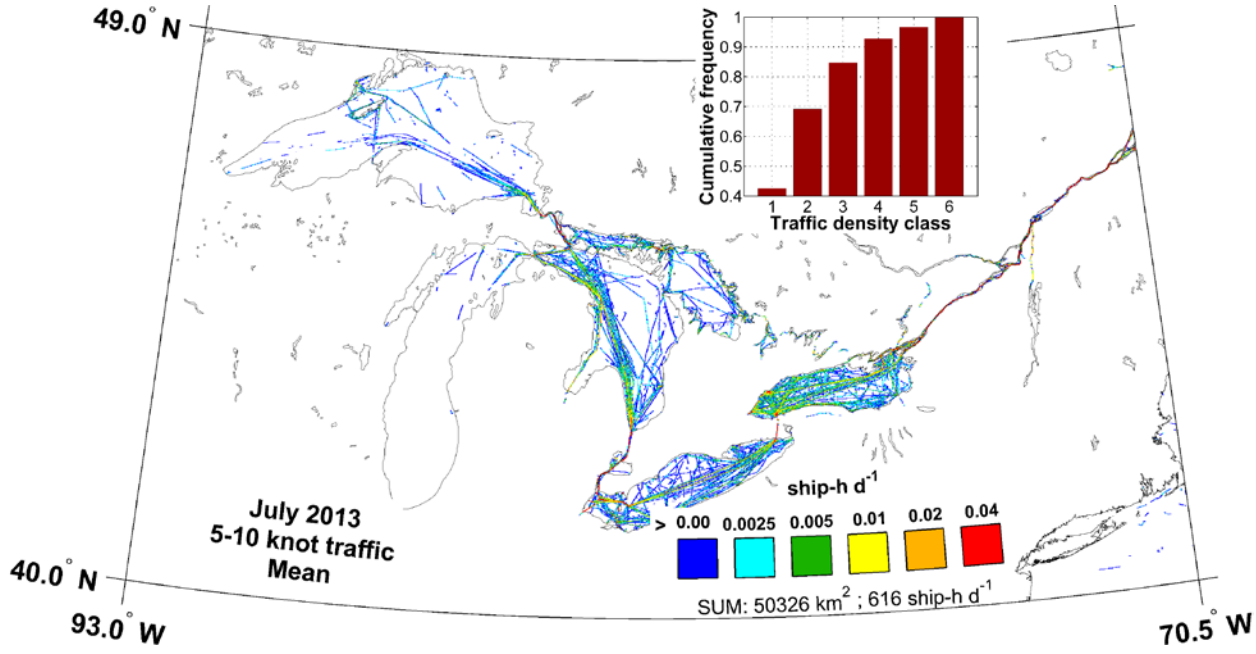

Figure 183. Map of 5–10 knot AIS mean traffic density in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

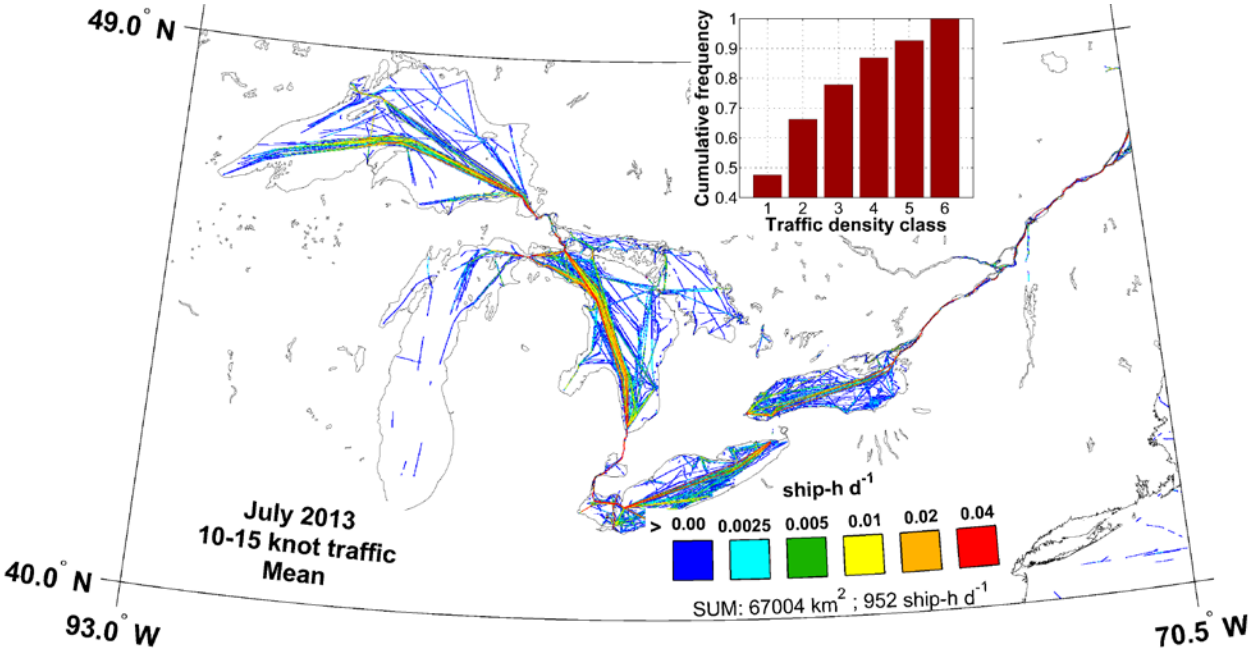

Figure 184. Map of 10–15 knot AIS mean traffic density in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

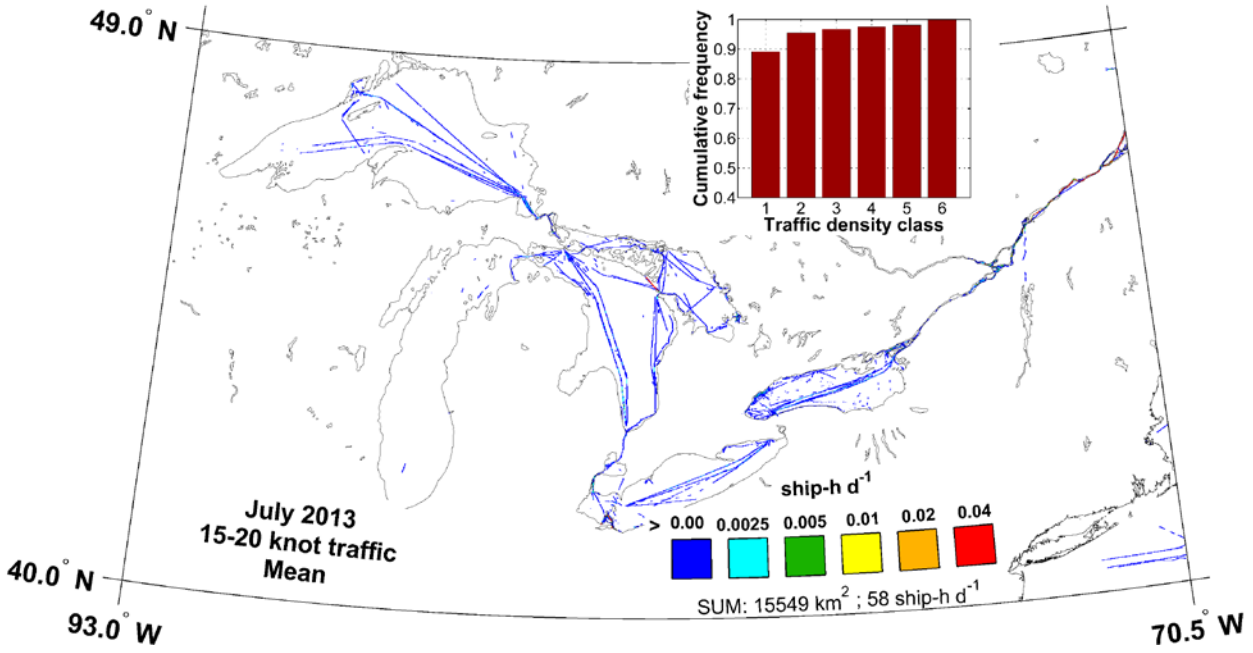

Figure 185. Map of 15–20 knot AIS mean traffic density in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

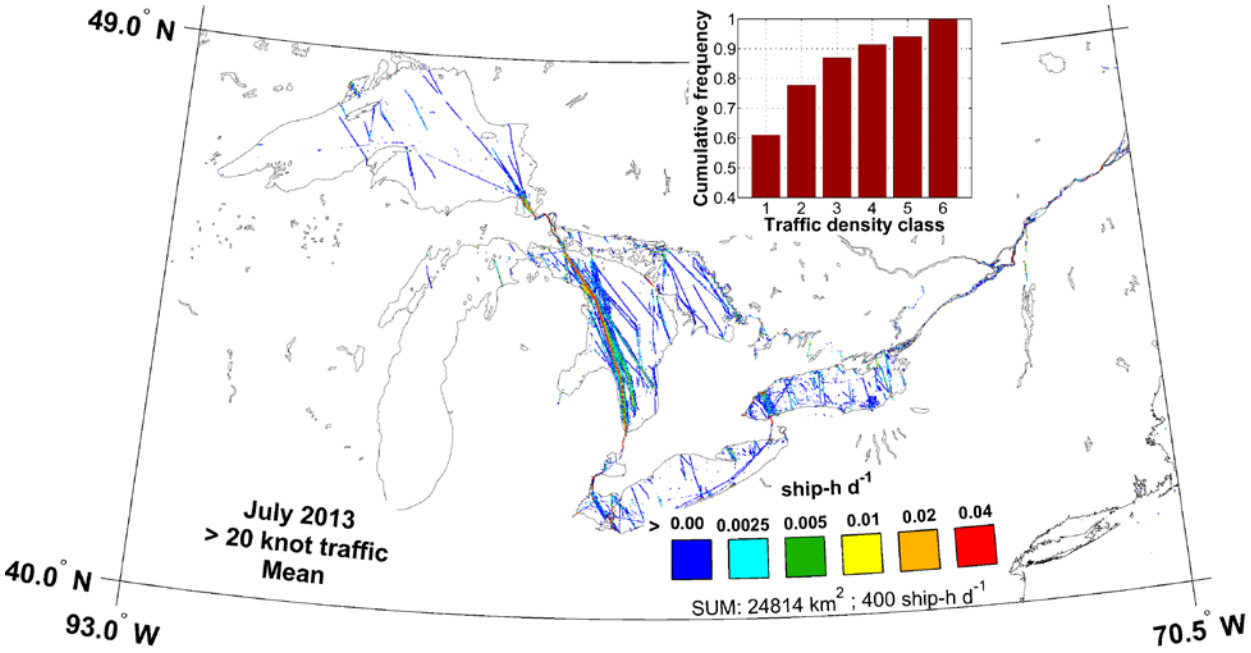

Figure 186. Map of >20 knot AIS mean traffic density in July 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.8. August 2013

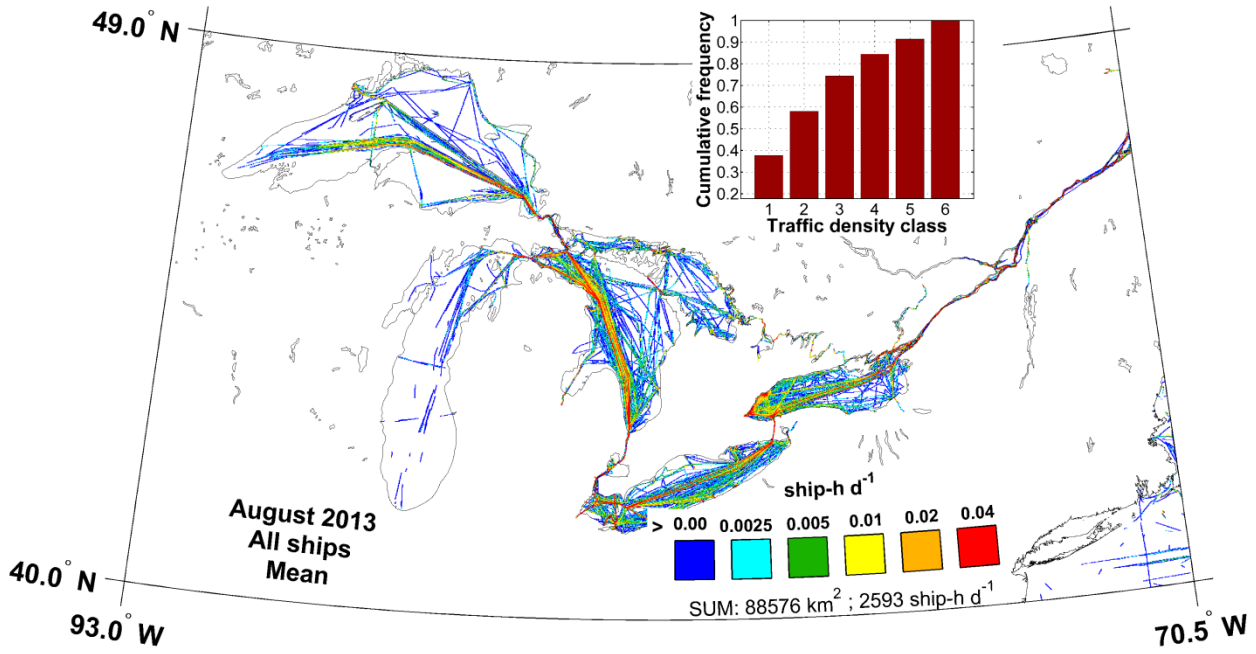

Figure 187. Map of AIS mean traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

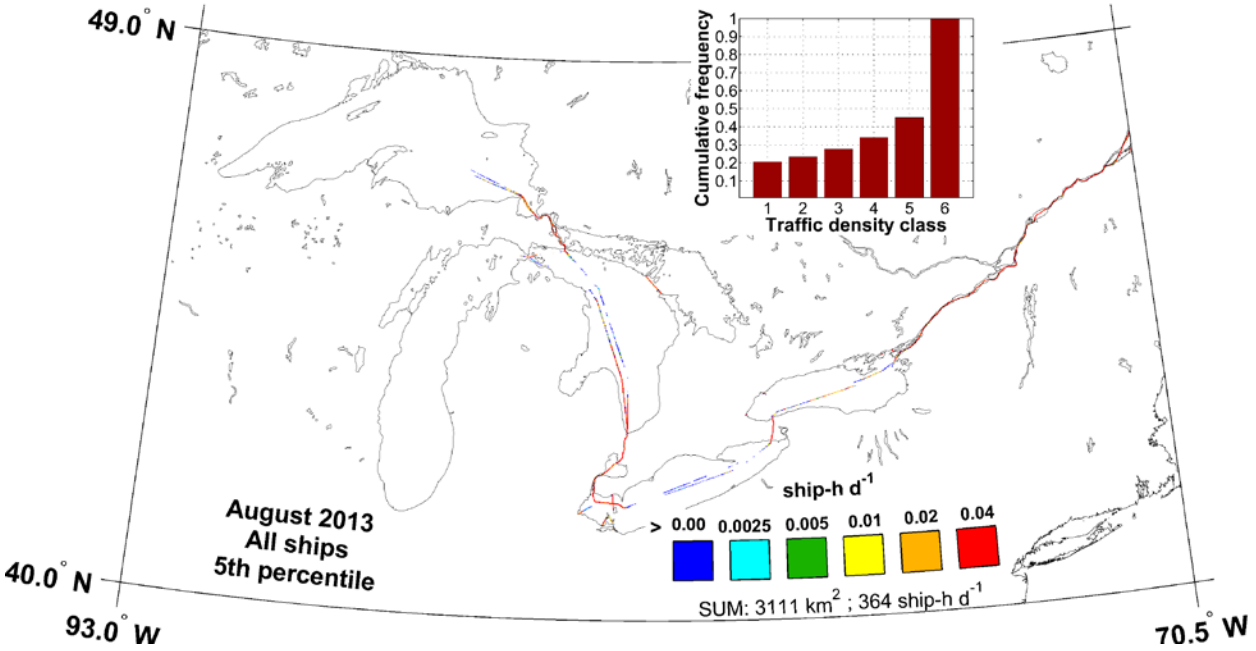

Figure 188. Map of the 5th percentile of the daily AIS traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

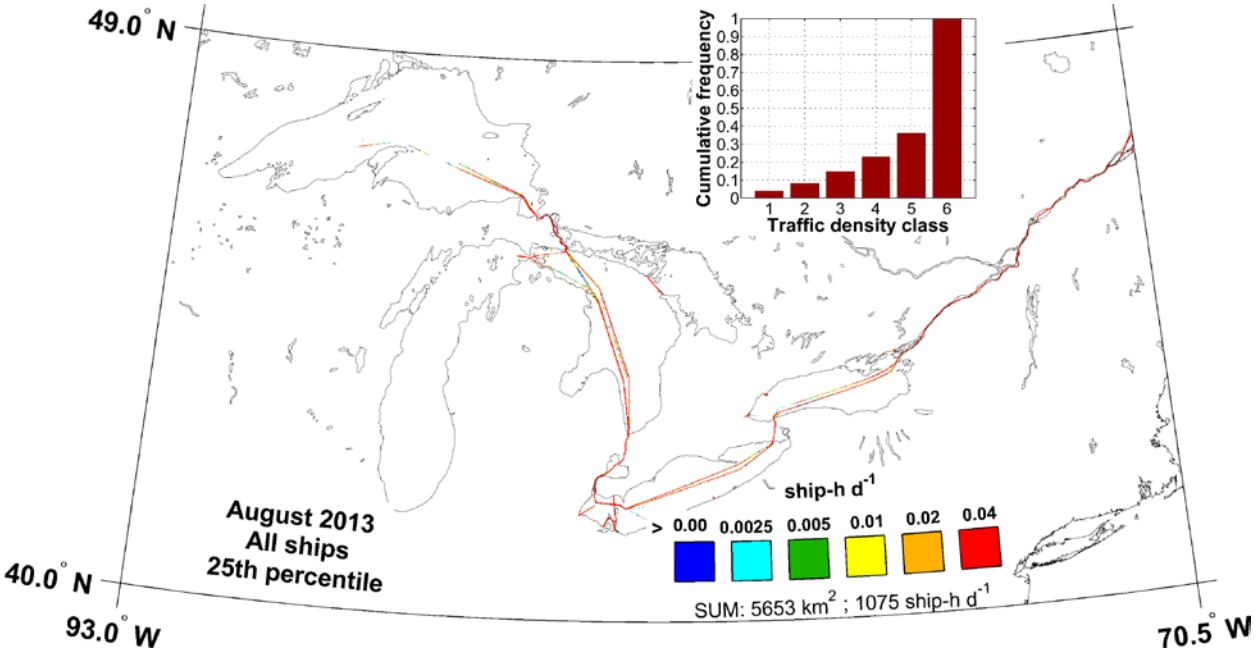

Figure 189. Map of the 25th percentile of the daily AIS traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

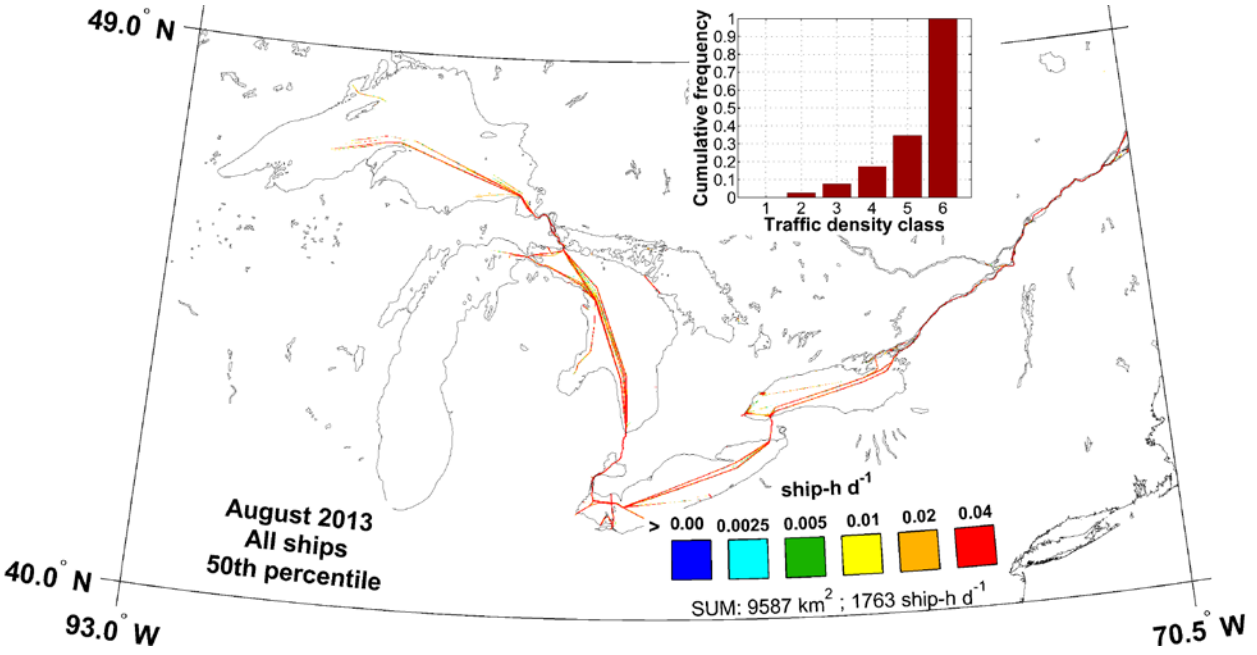

Figure 190. Map of the 50th percentile of the daily AIS traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

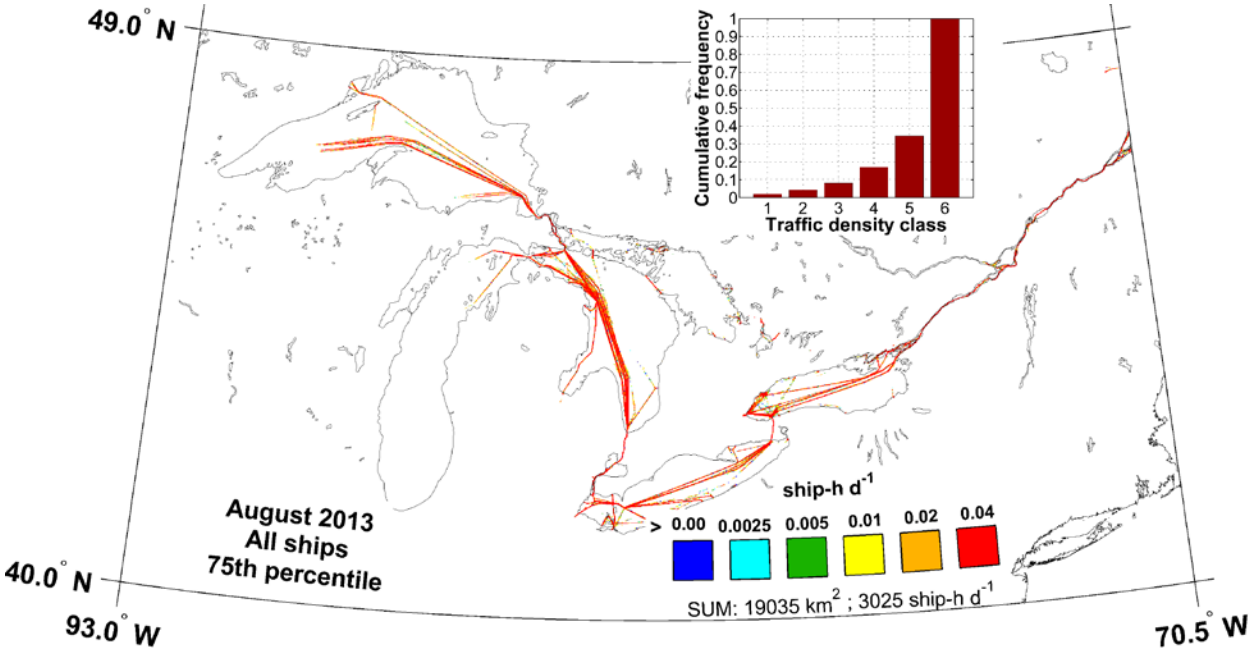

Figure 191. Map of the 75th percentile of the daily AIS traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

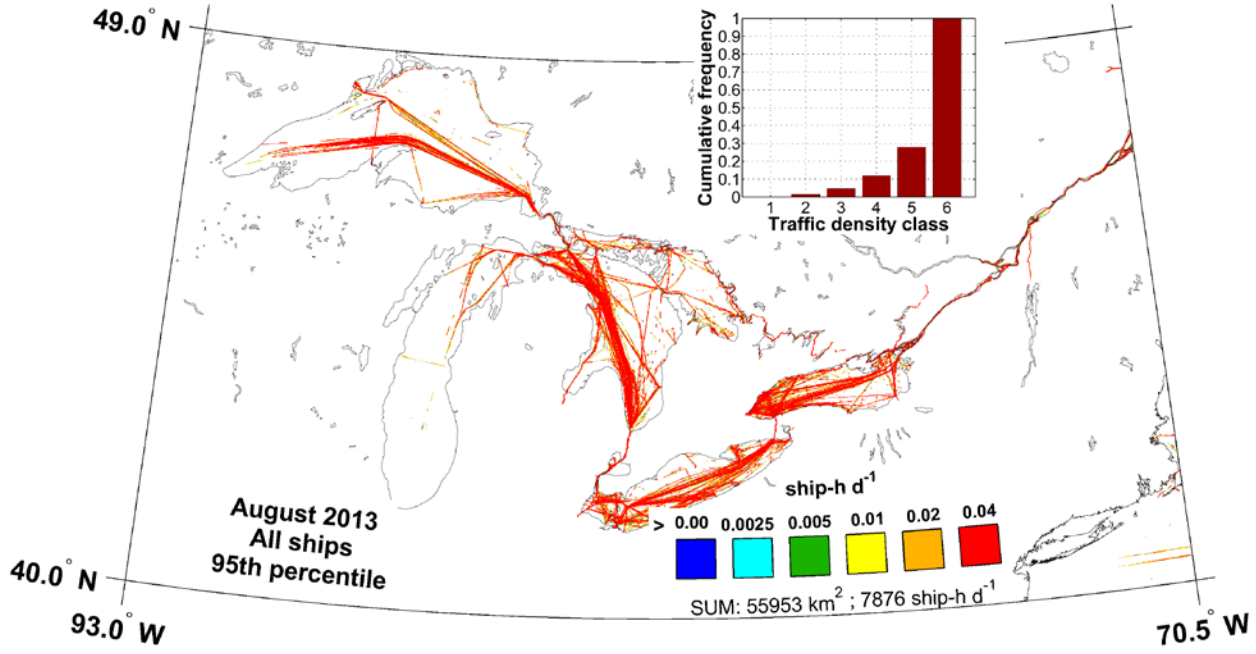

Figure 192. Map of the 95th percentile of the daily AIS traffic density of all ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

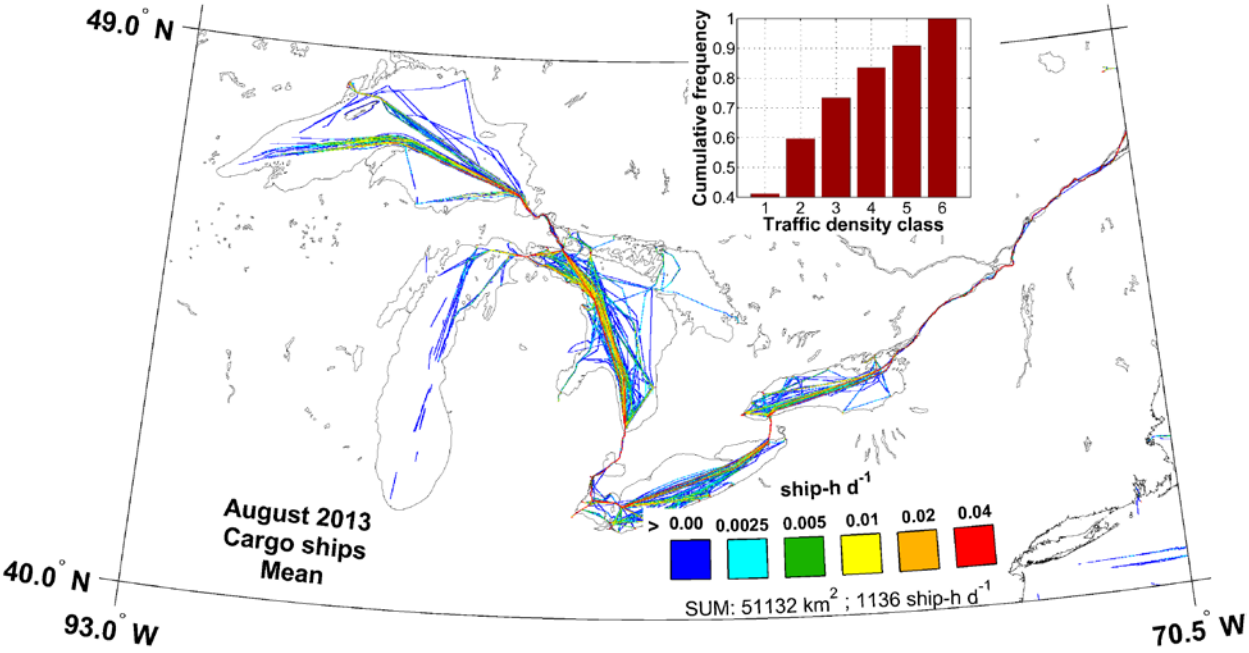

Figure 193. Map of AIS mean traffic density of cargo-type ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

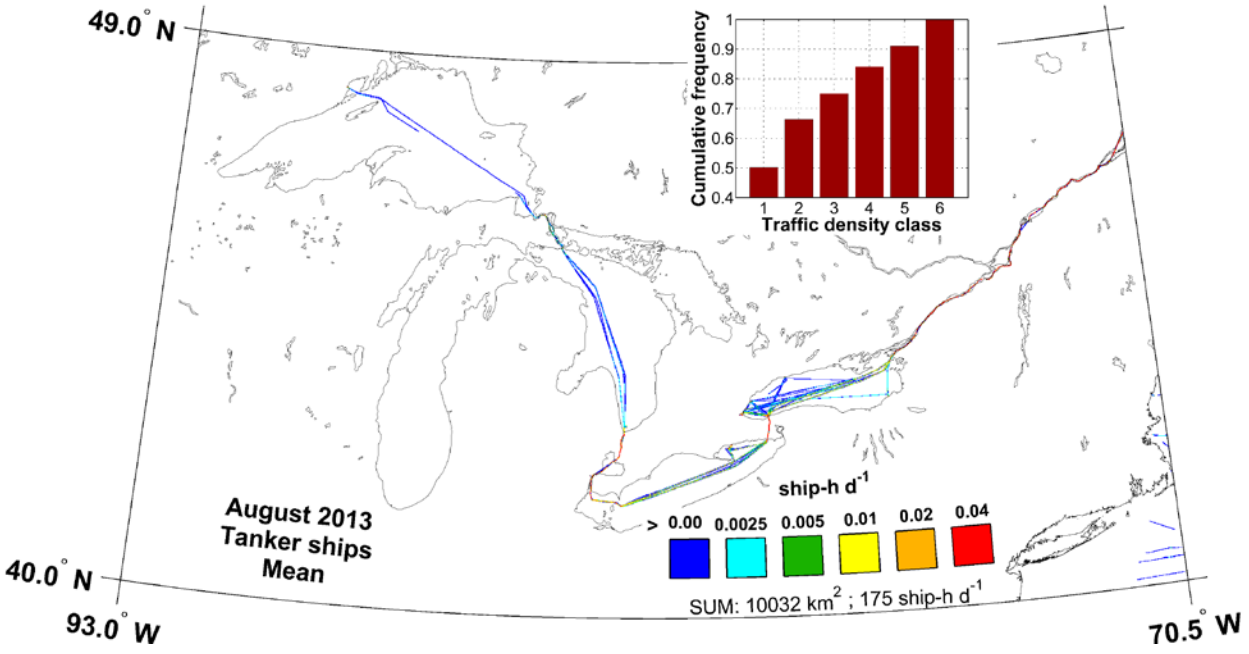

Figure 194. Map of AIS mean traffic density of tanker-type ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

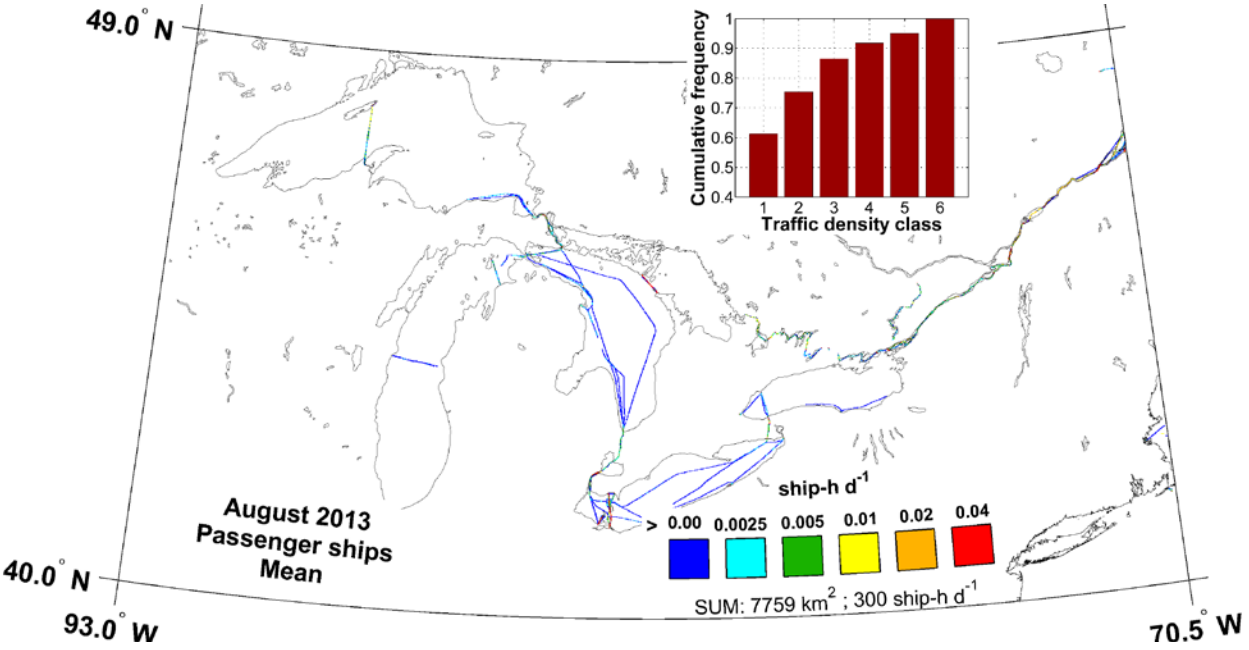

Figure 195. Map of AIS mean traffic density of passenger-type ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

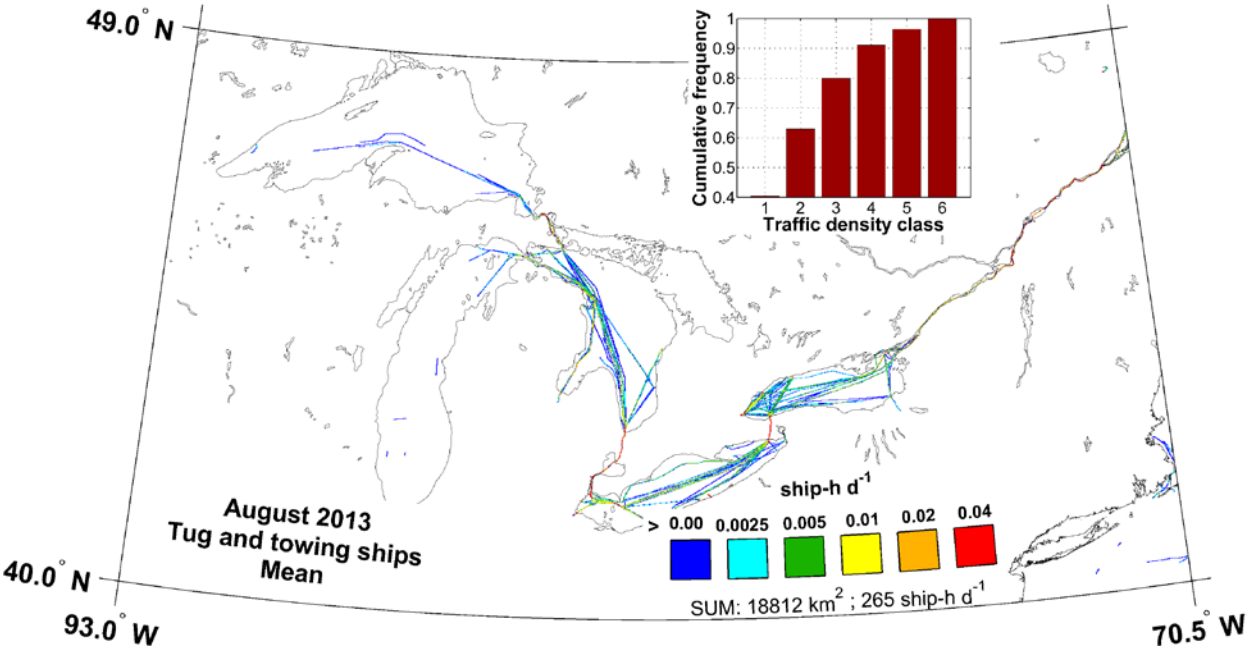

Figure 196. Map of AIS mean traffic density of tug and towing-type ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

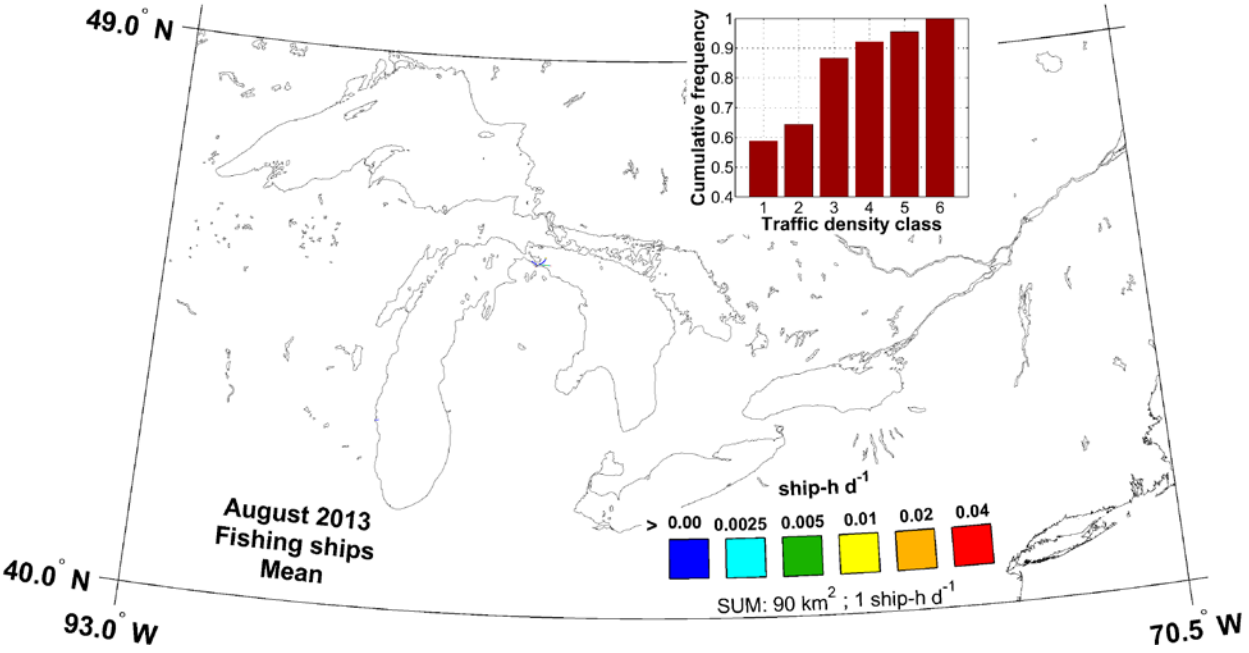

Figure 197. Map of AIS mean traffic density of fishing-type ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

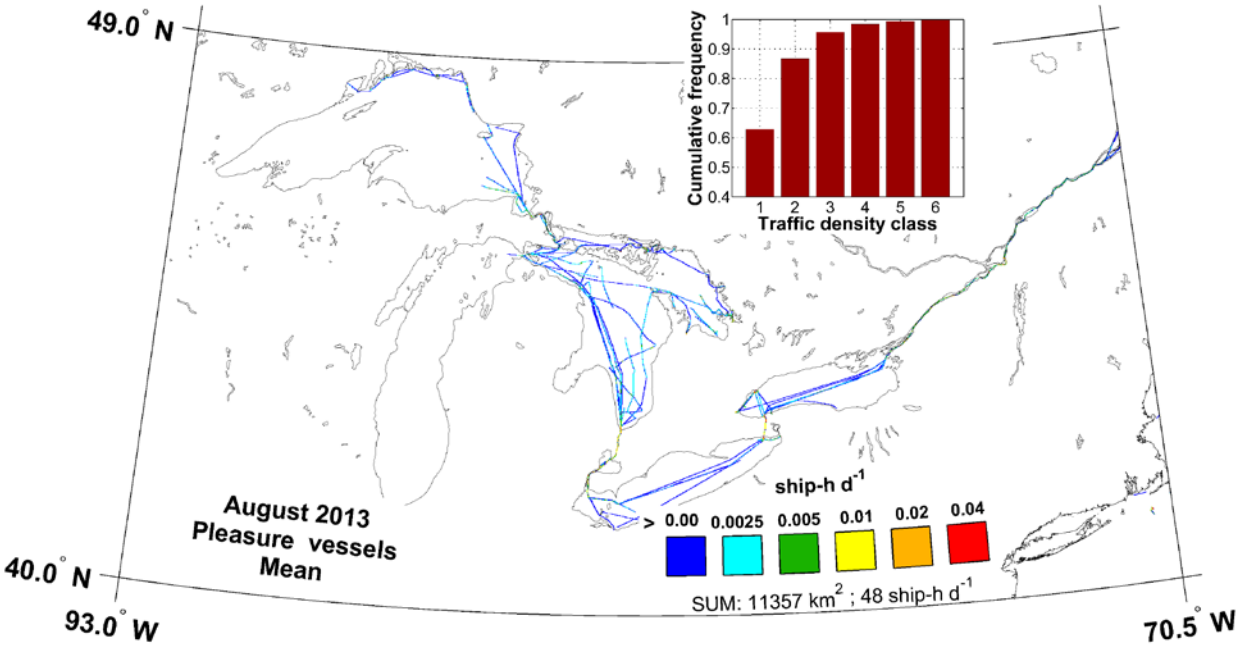

Figure 198. Map of AIS mean traffic density of pleasure-type vessels in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

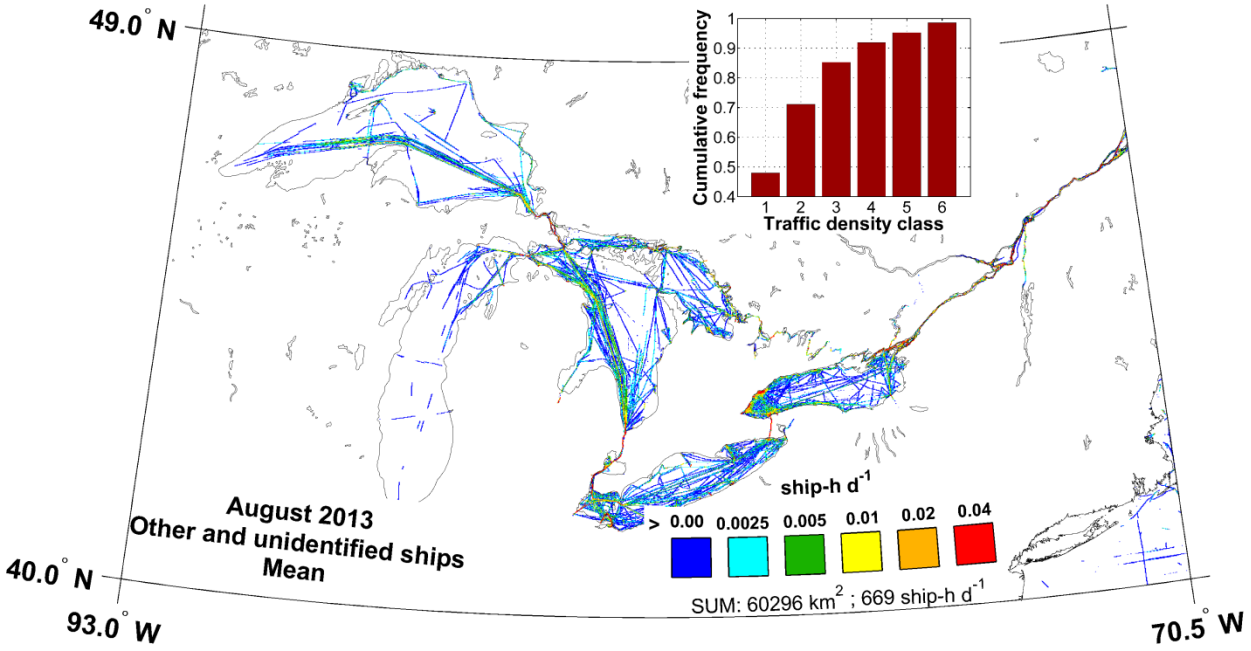

Figure 199. Map of AIS mean traffic density of other types of ships and ships of unidentified type in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

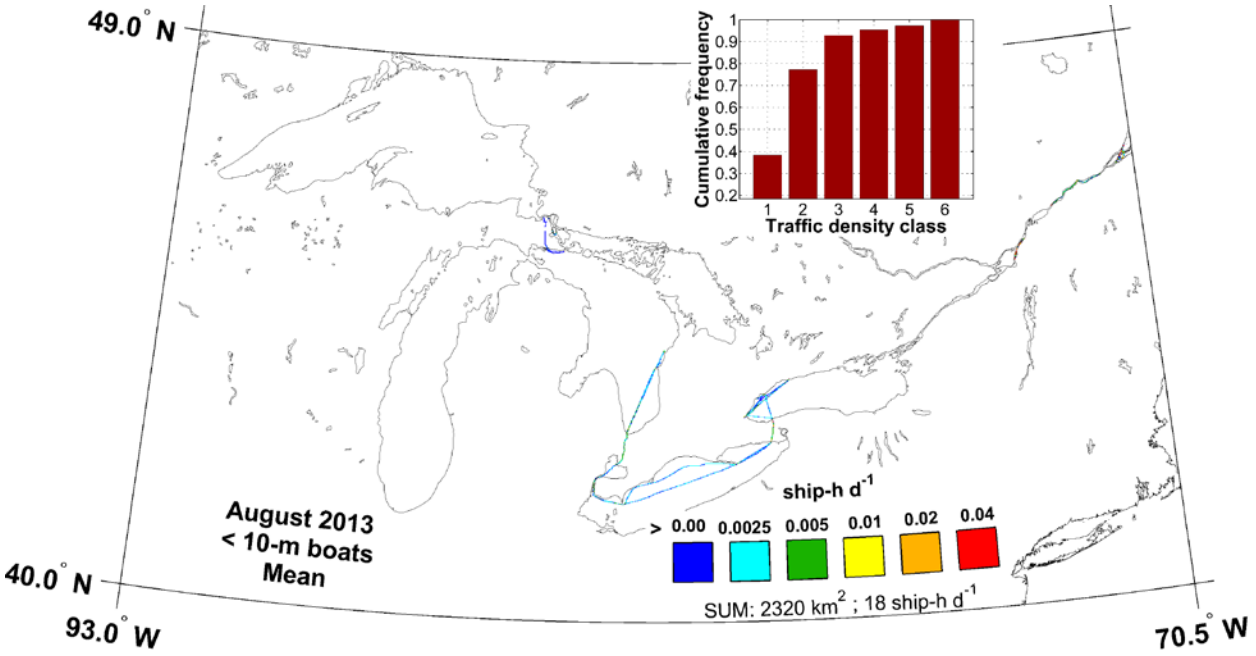

Figure 200. Map of AIS mean traffic density of ships with lengths < 10 m in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

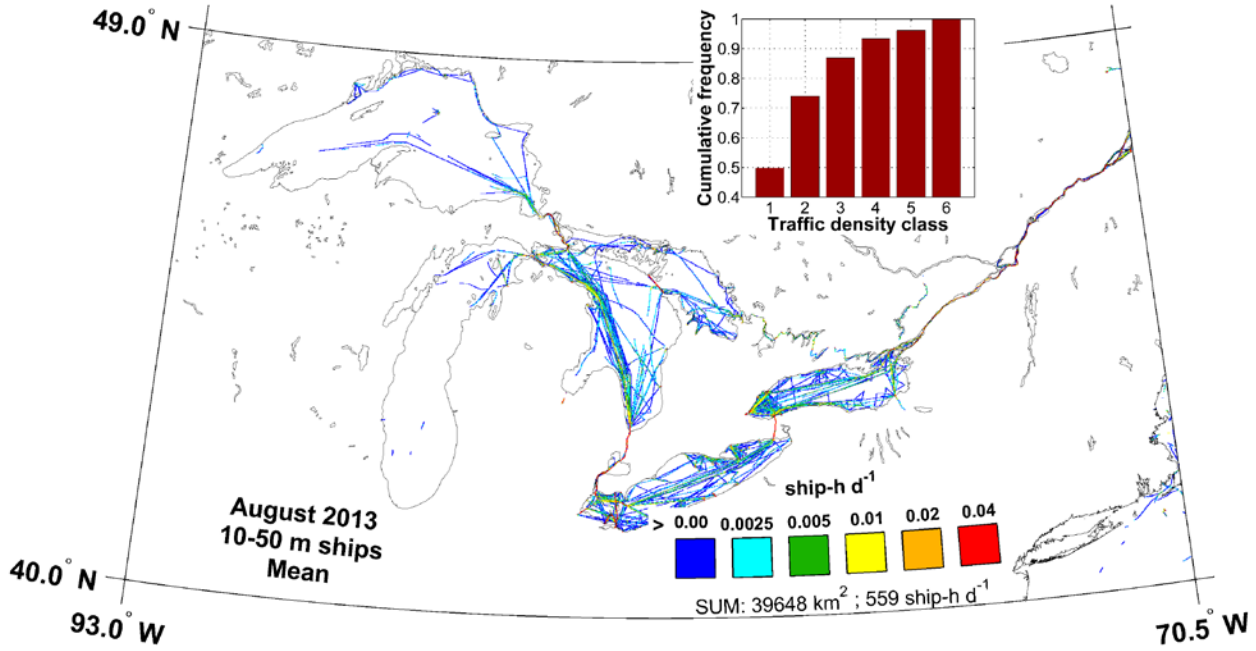

Figure 201. Map of AIS mean traffic density of 10 to 50 m ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

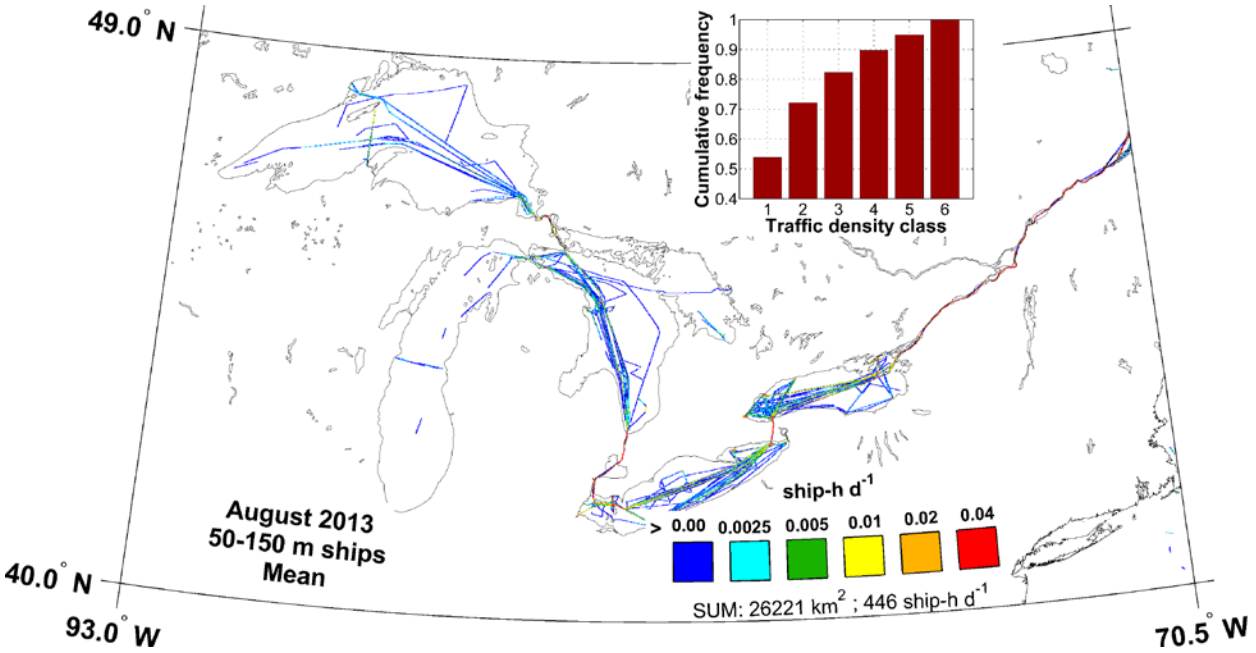

Figure 202. Map of AIS mean traffic density of 50 to 150 m ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

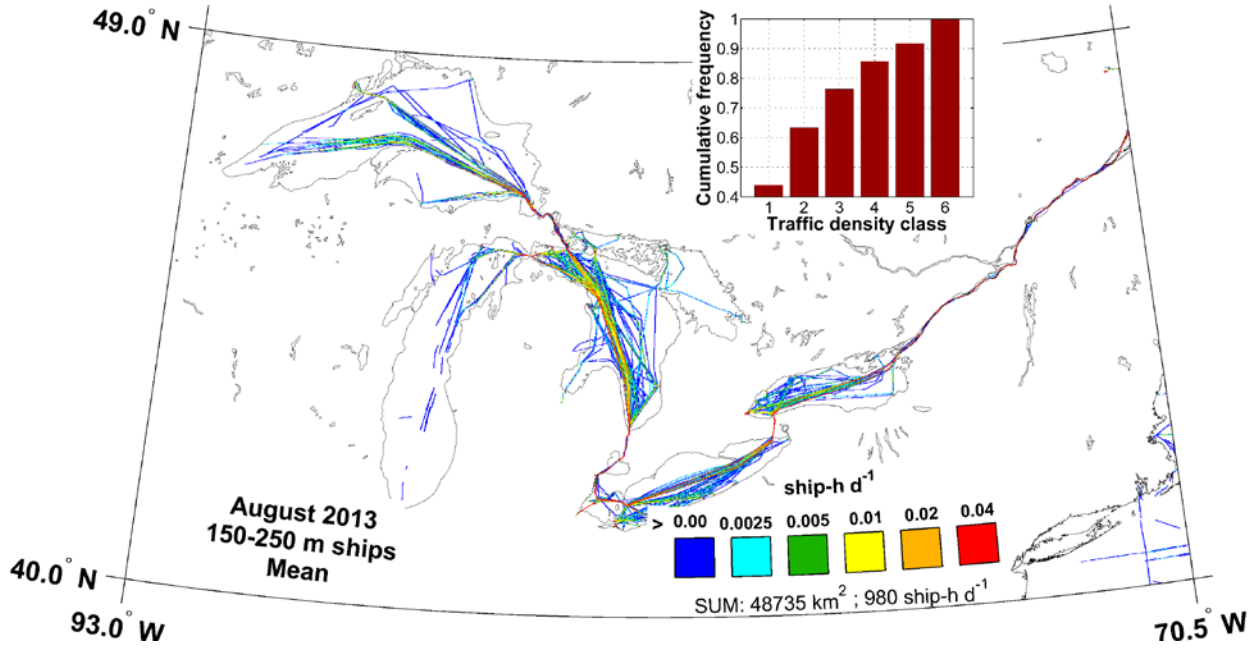

Figure 203. Map of AIS mean traffic density of 150 to 250 m ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

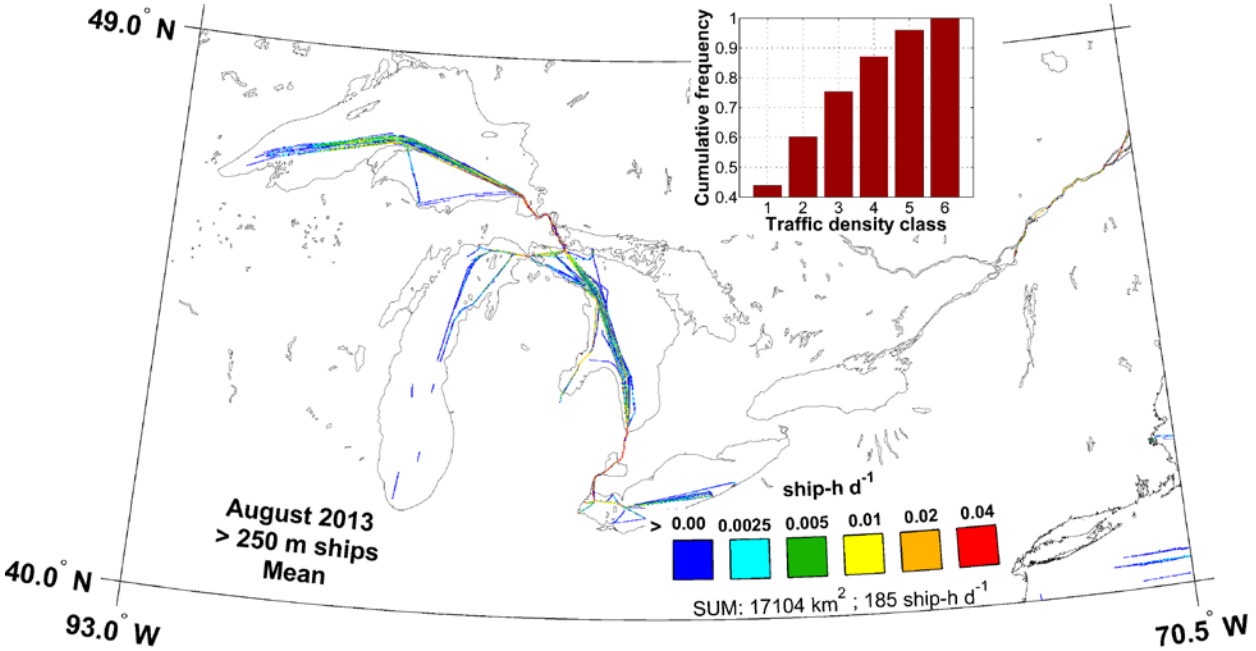

Figure 204. Map of AIS mean traffic density of > 250 m ships in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

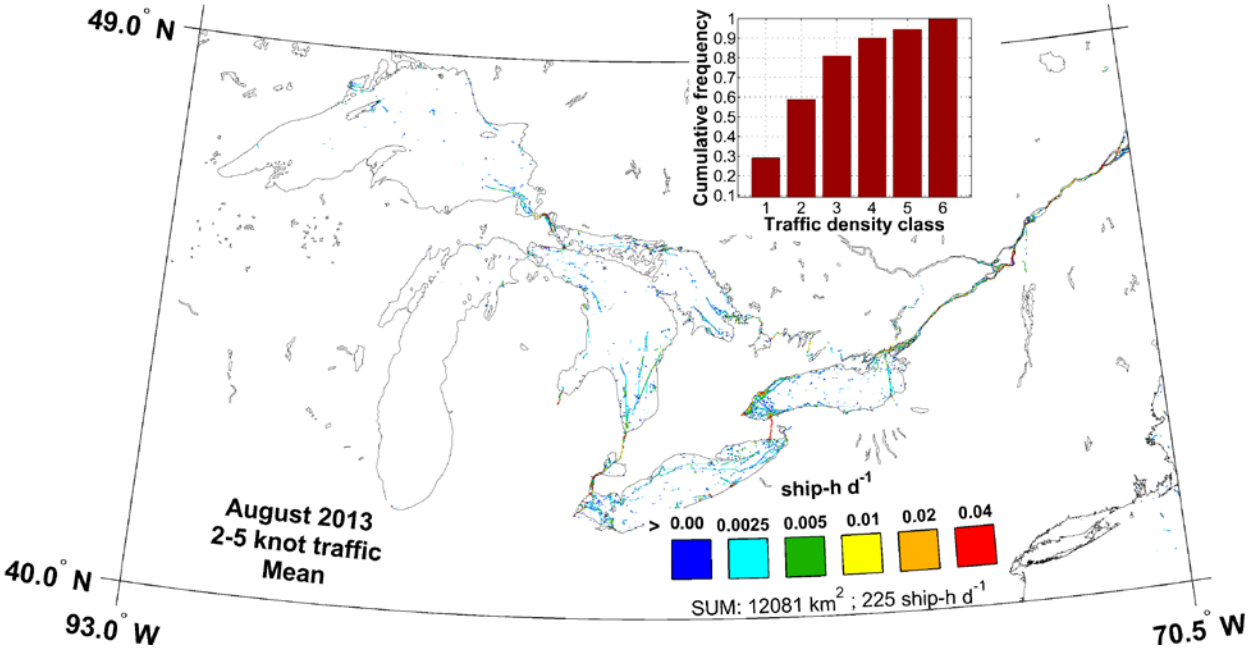

Figure 205. Map of 2–5 knot AIS mean traffic density in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

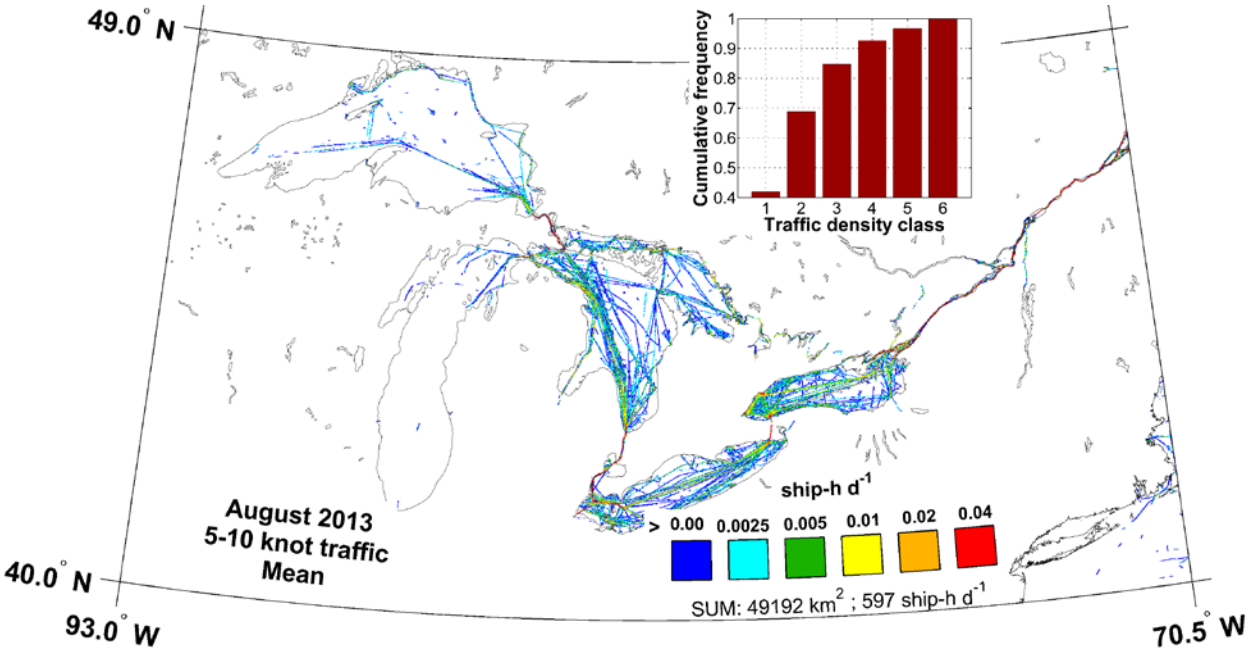

Figure 206. Map of 5–10 knot AIS mean traffic density in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

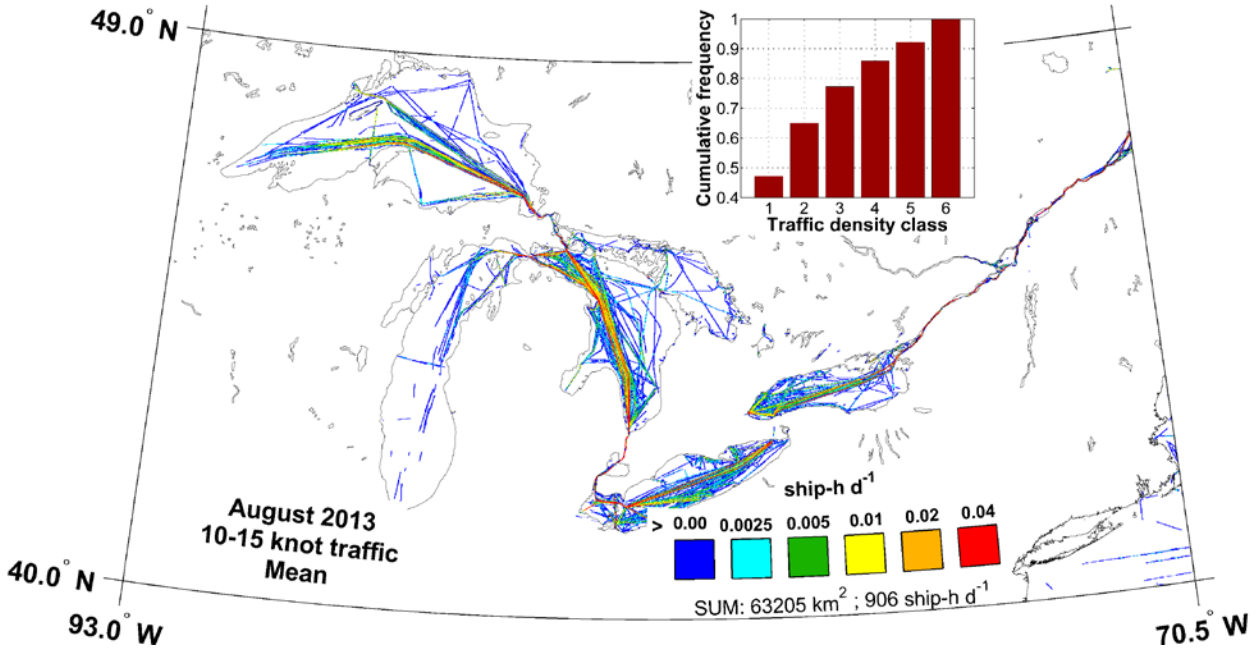

Figure 207. Map of 10–15 knot AIS mean traffic density in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

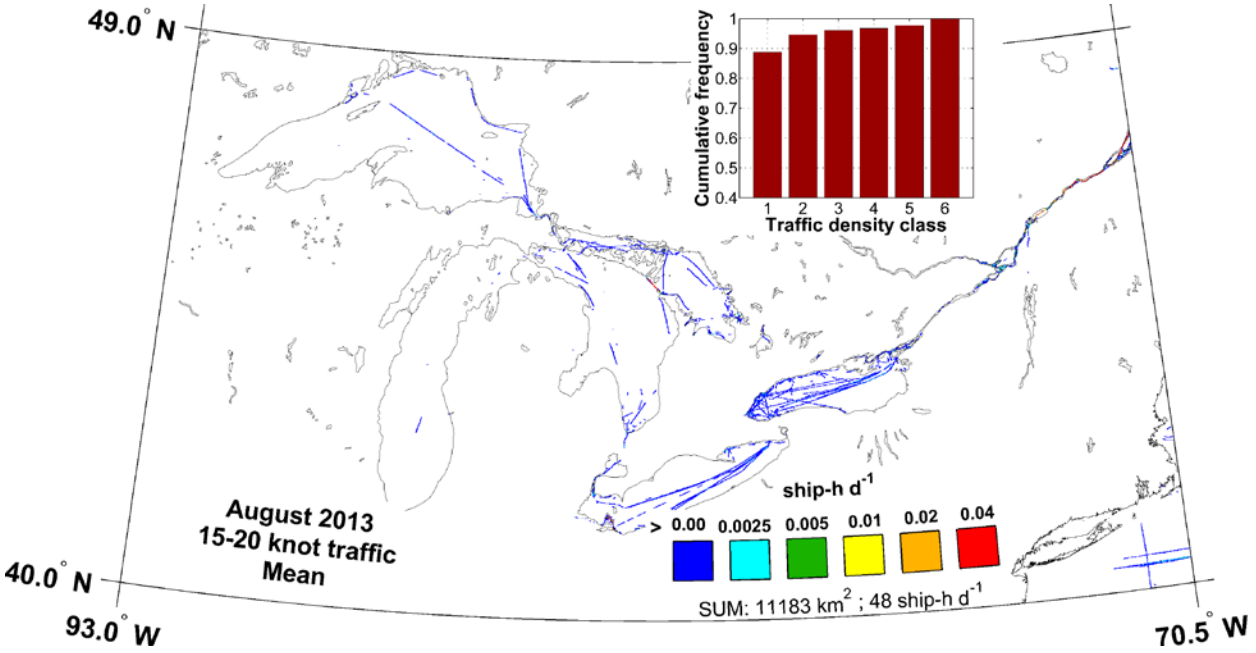

Figure 208. Map of 15–20 knot AIS mean traffic density in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

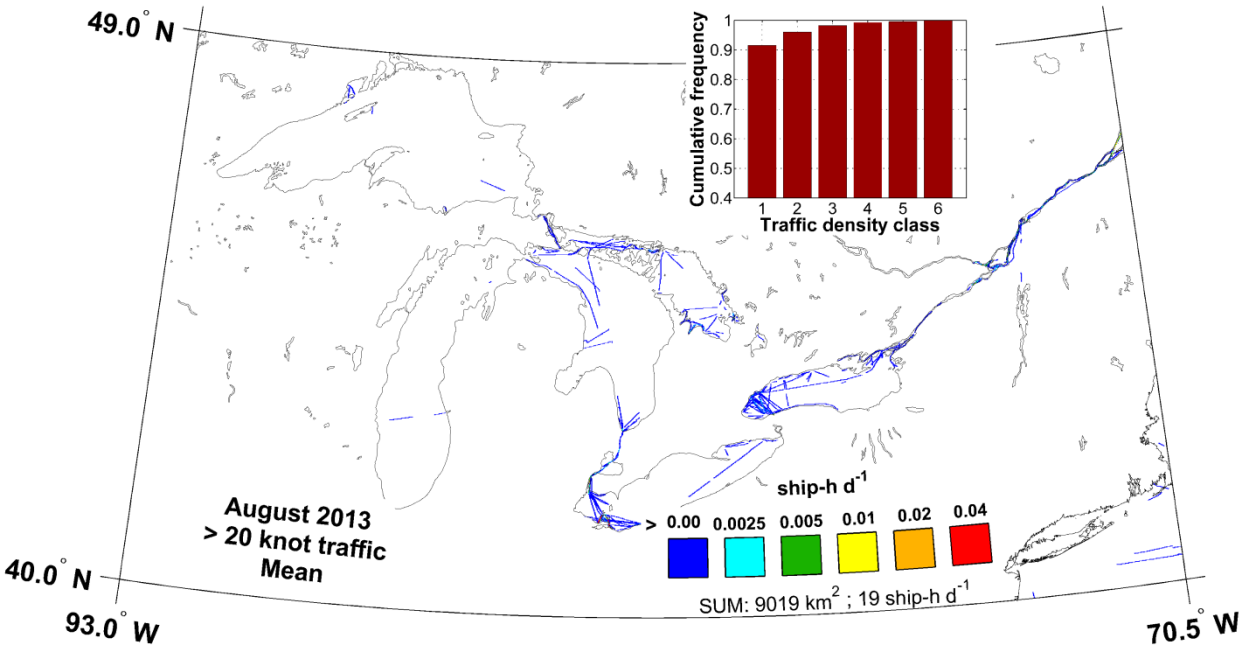

Figure 209. Map of >20 knot AIS mean traffic density in August 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.9. September 2013

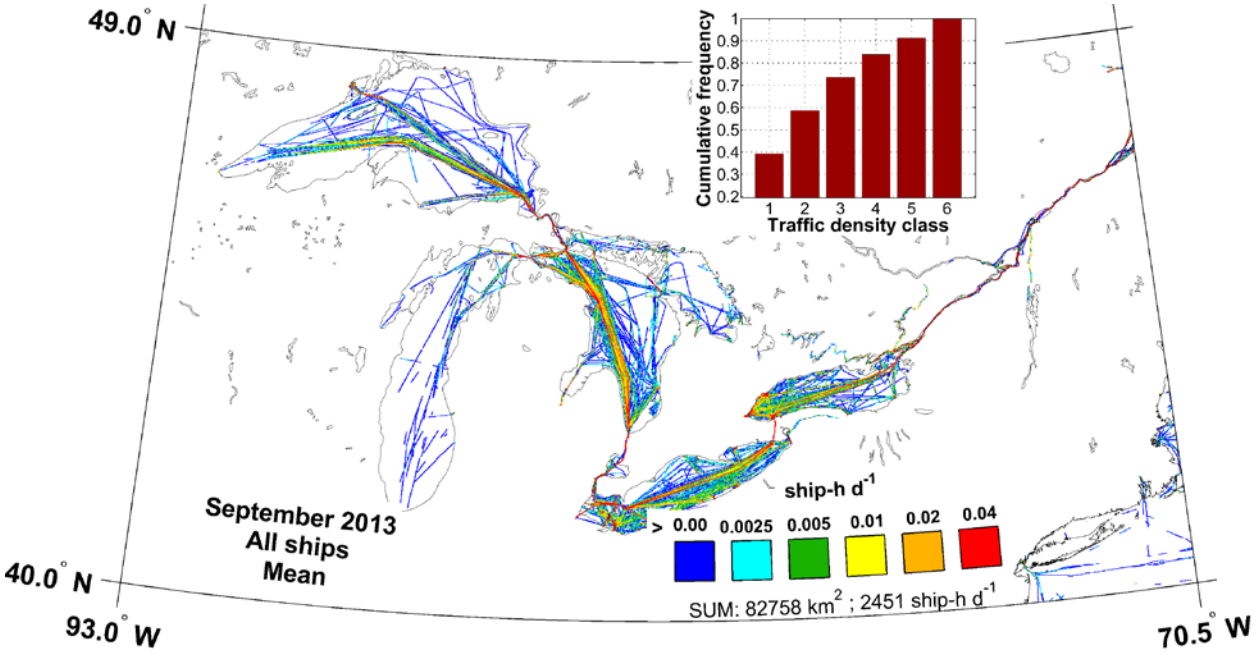

Figure 210. Map of AIS mean traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

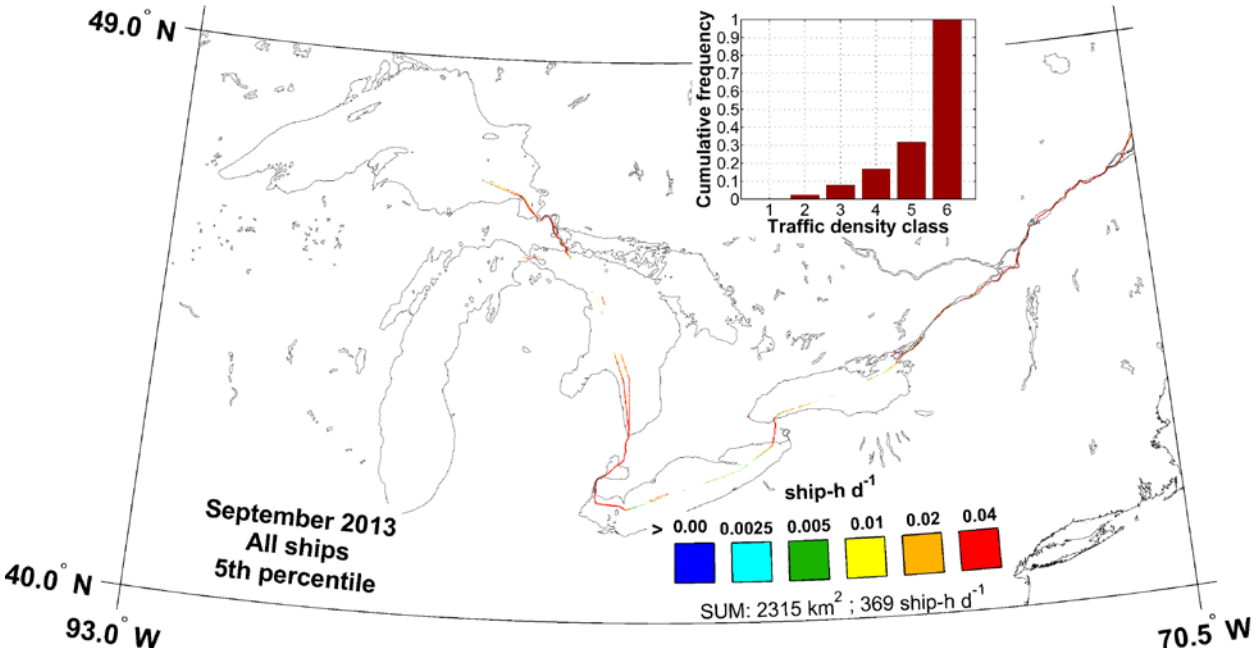

Figure 211. Map of the 5th percentile of the daily AIS traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

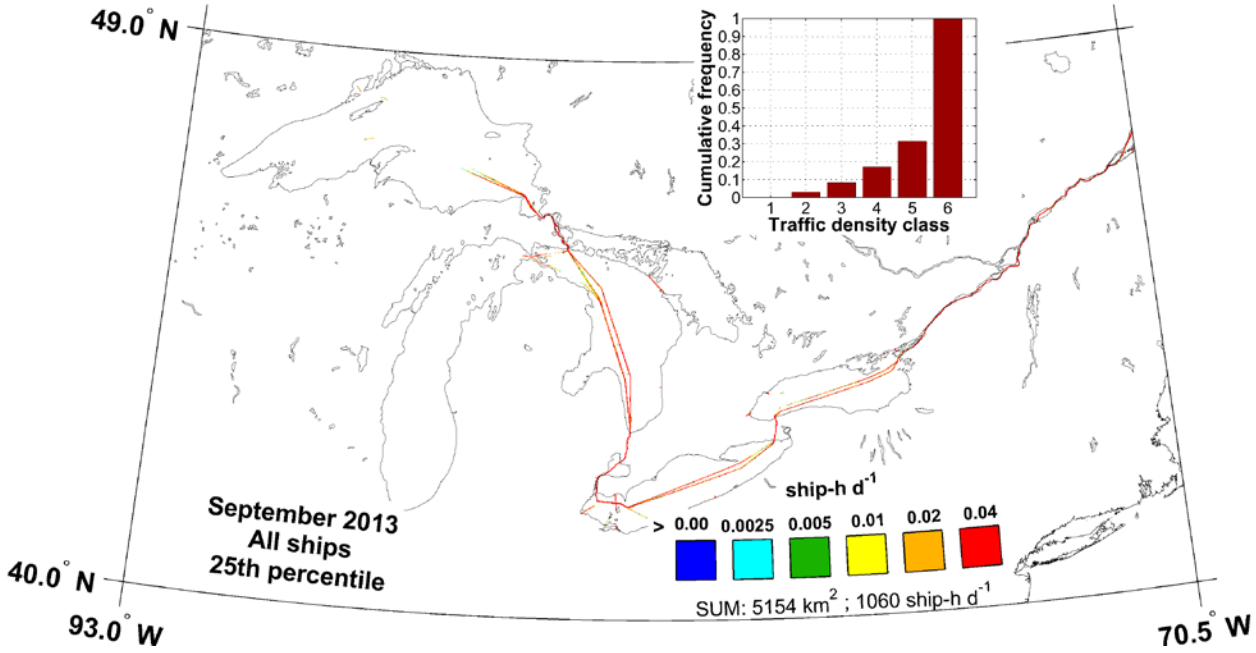

Figure 212. Map of the 25th percentile of the daily AIS traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

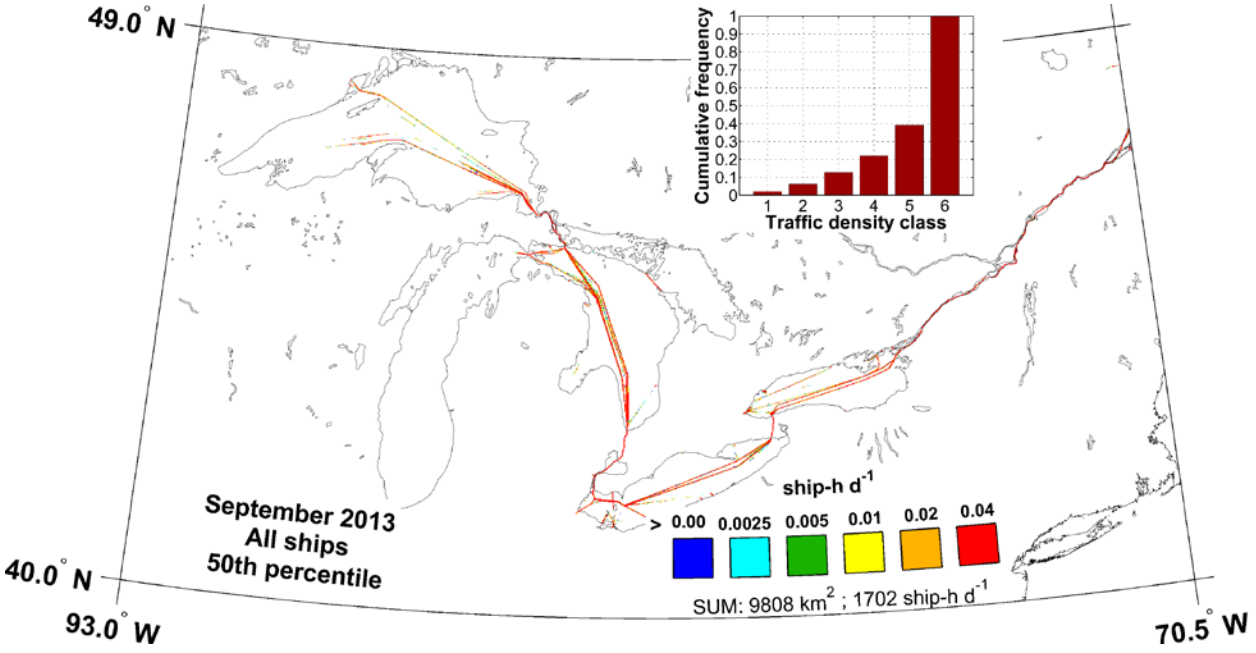

Figure 213. Map of the 50th percentile of the daily AIS traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

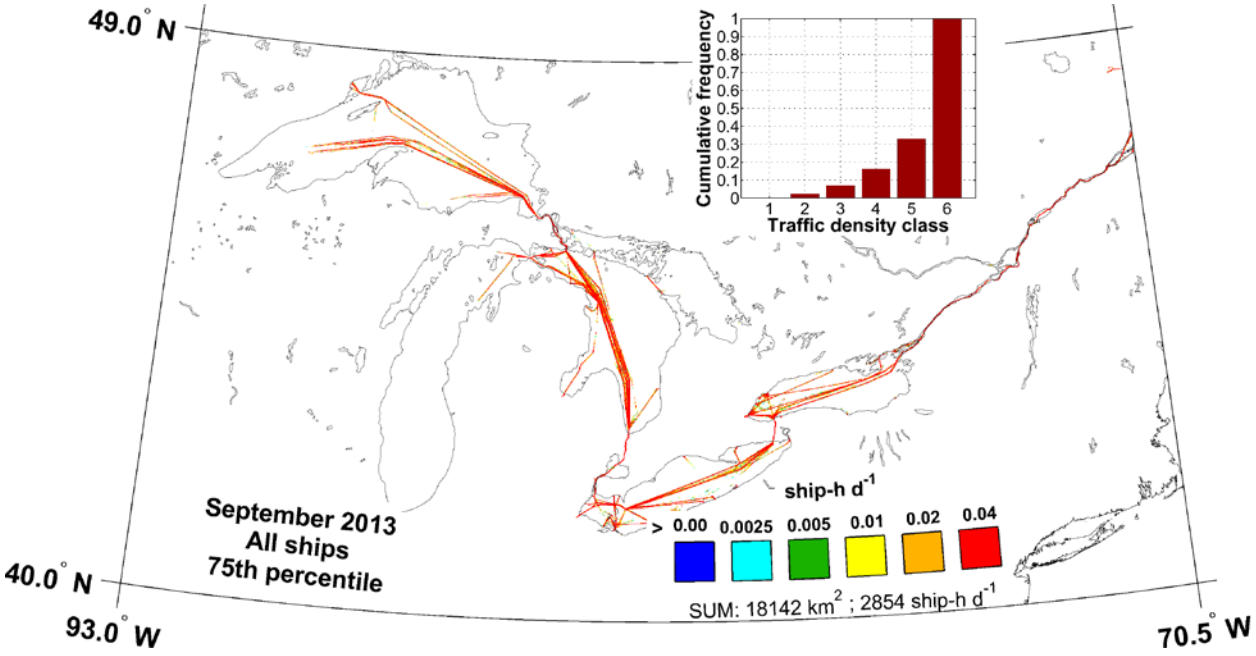

Figure 214. Map of the 75th percentile of the daily AIS traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

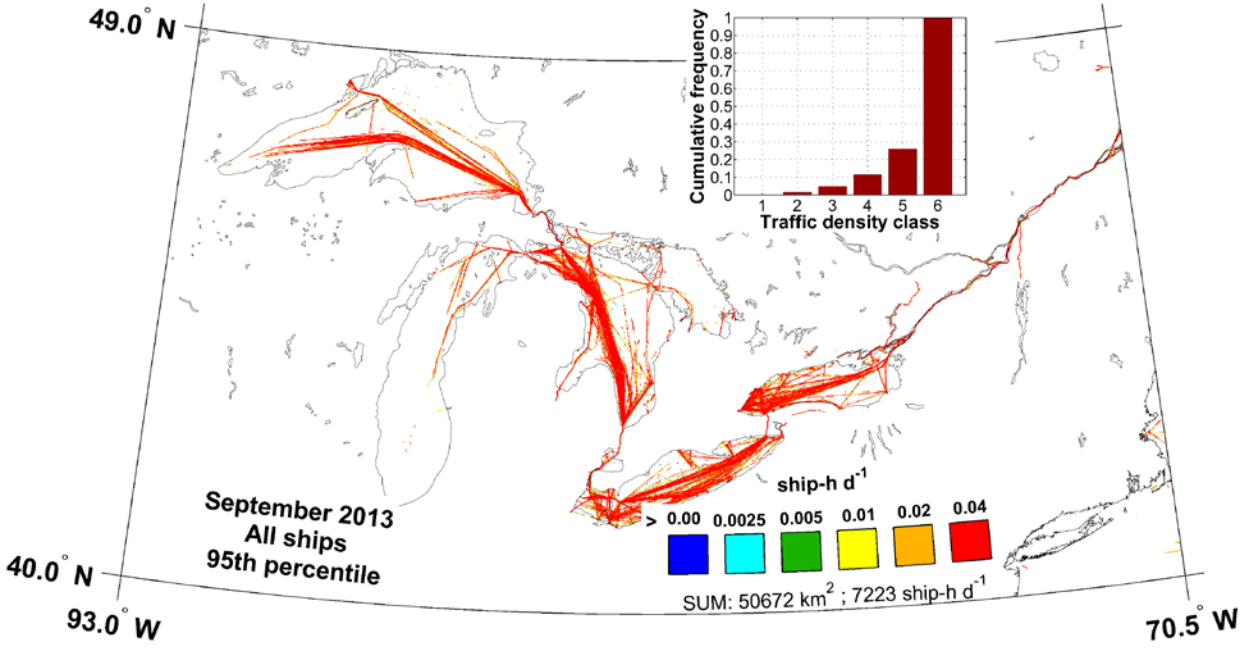

Figure 215. Map of the 95th percentile of the daily AIS traffic density of all ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

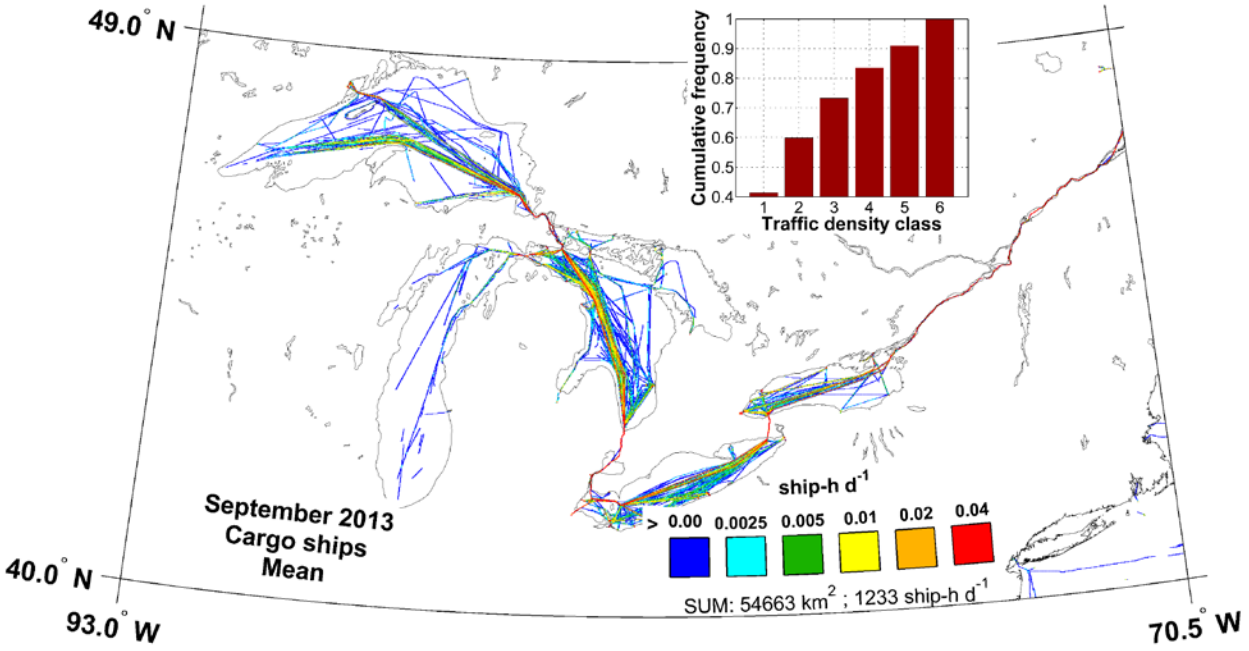

Figure 216. Map of AIS mean traffic density of cargo-type ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

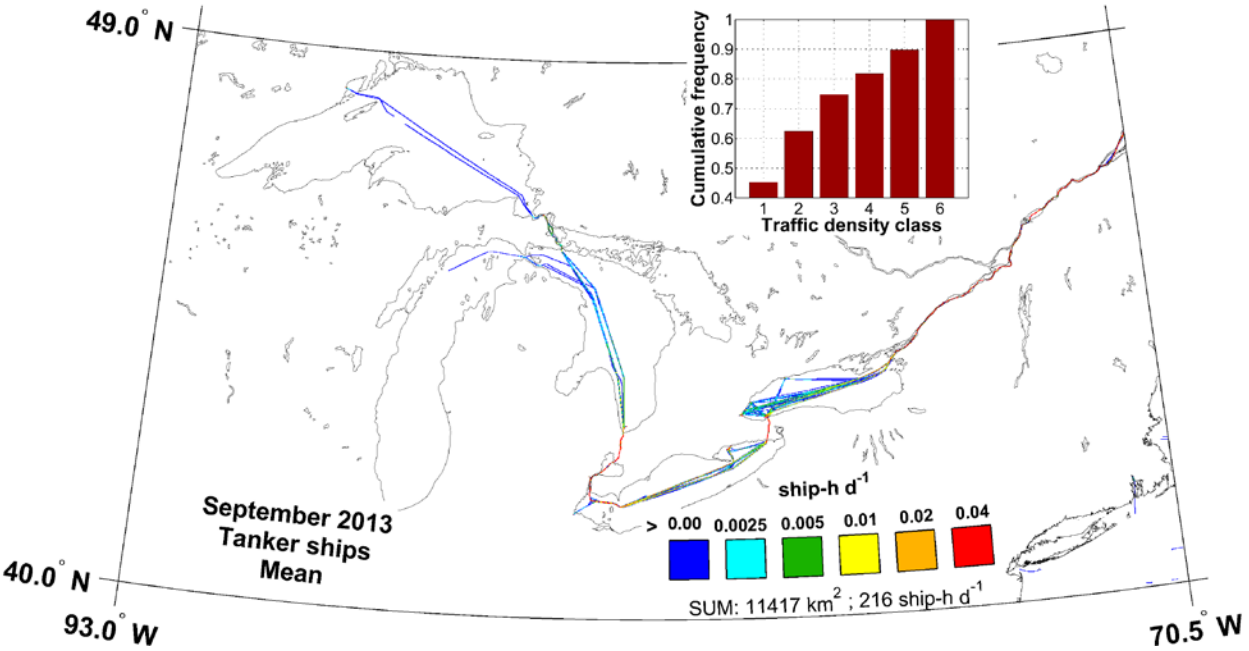

Figure 217. Map of AIS mean traffic density of tanker-type ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

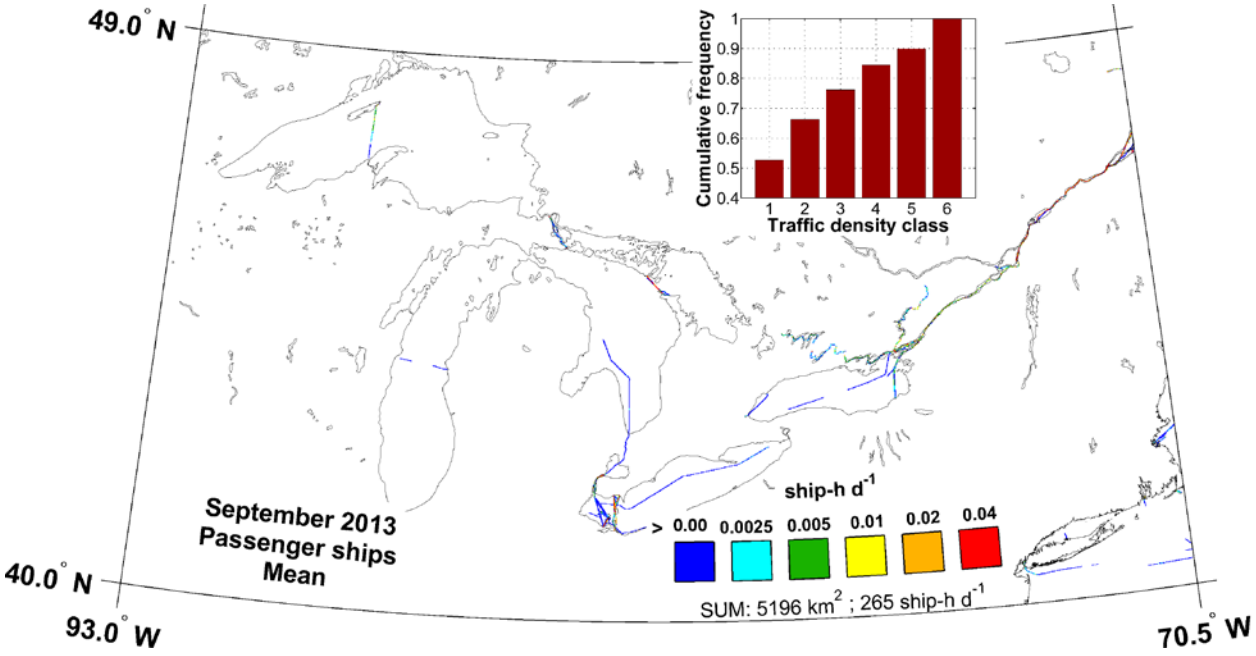

Figure 218. Map of AIS mean traffic density of passenger-type ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

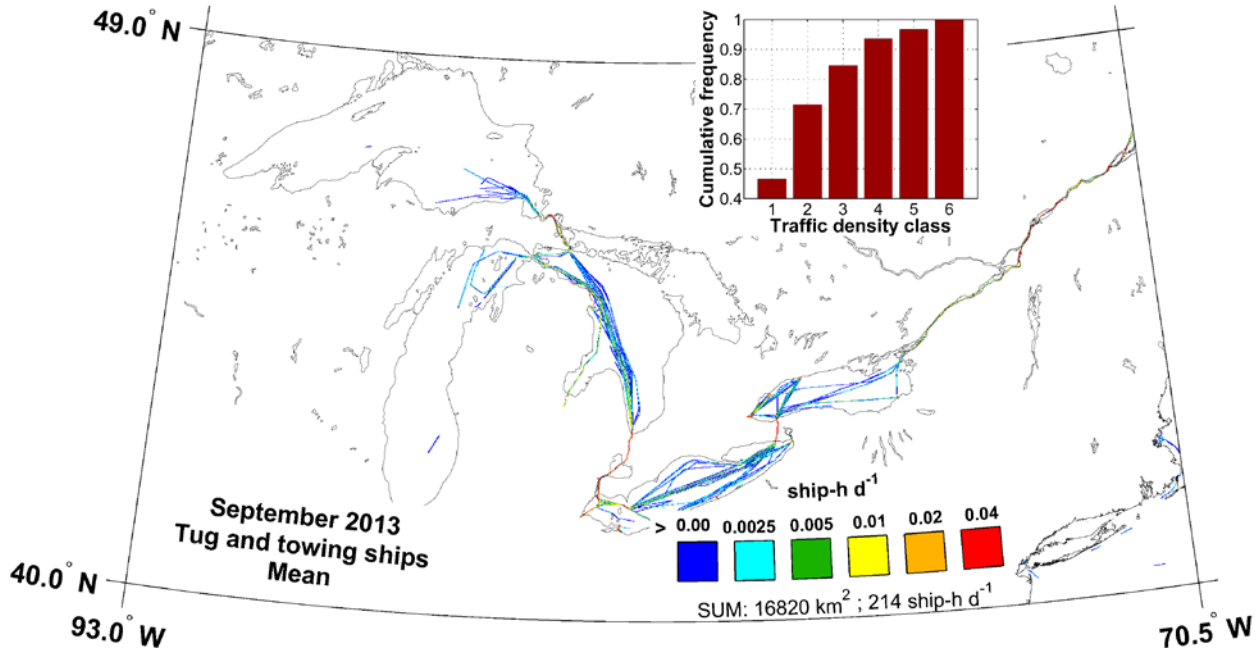

Figure 219. Map of AIS mean traffic density of tug and towing-type ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

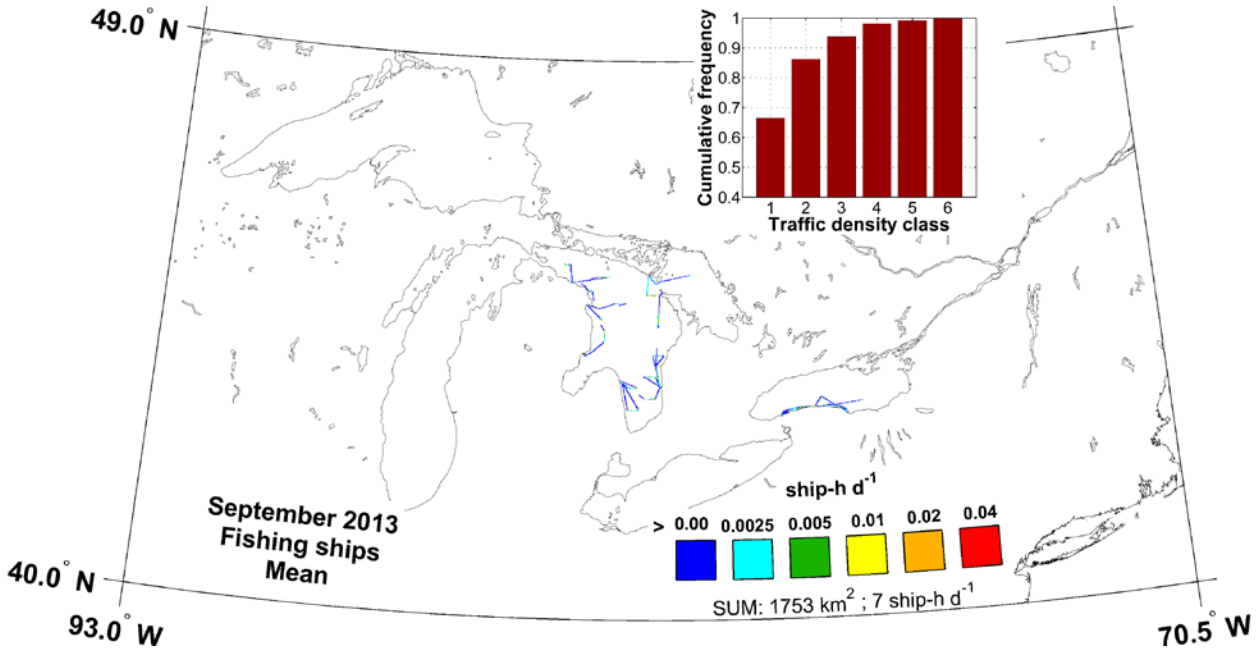

Figure 220. Map of AIS mean traffic density of fishing-type ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

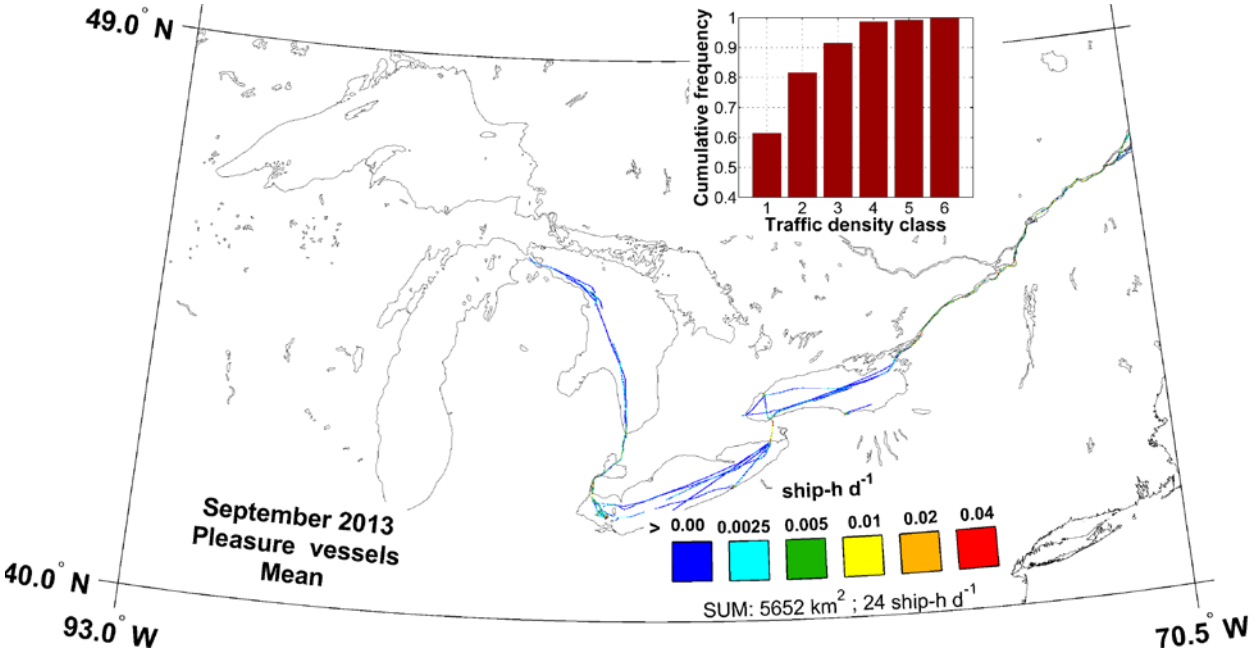

Figure 221. Map of AIS mean traffic density of pleasure-type vessels in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

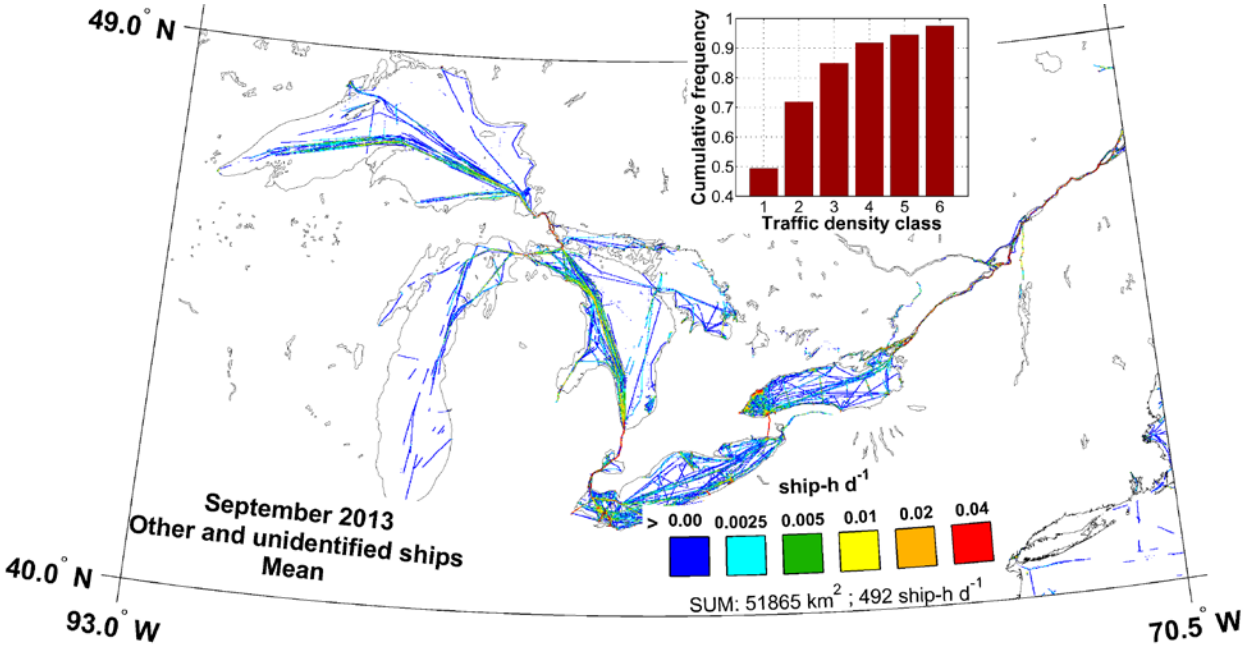

Figure 222. Map of AIS mean traffic density of other types of ships and ships of unidentified type in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

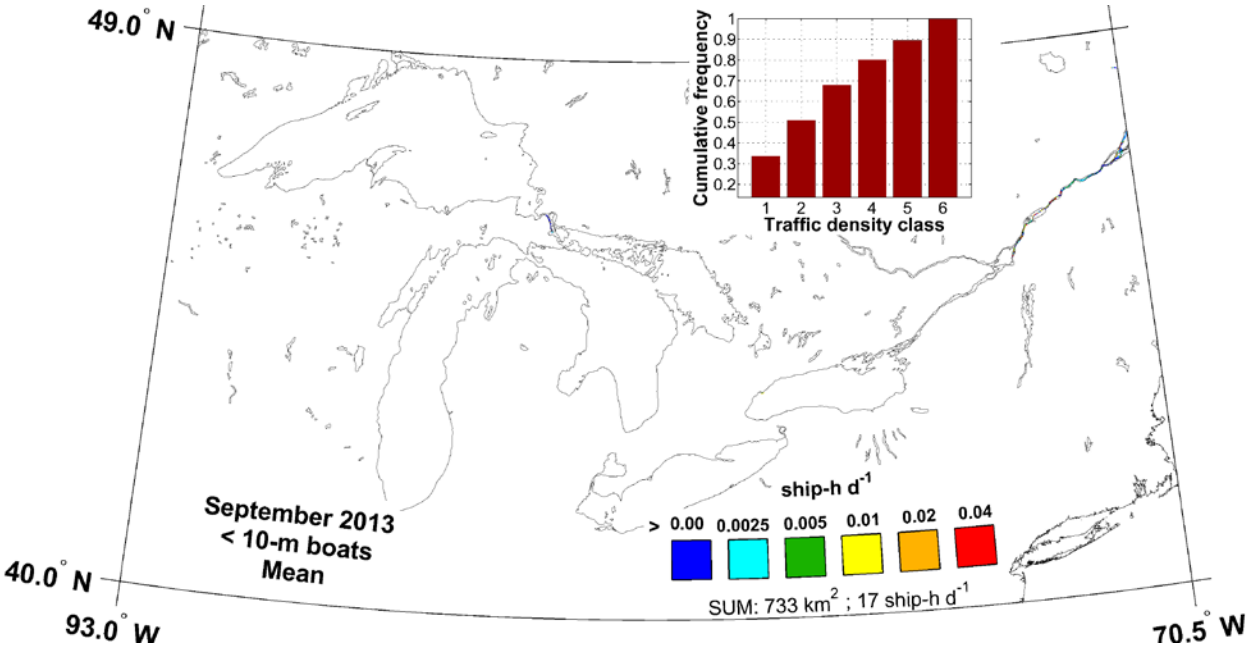

Figure 223. Map of AIS mean traffic density of ships with lengths < 10 m in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

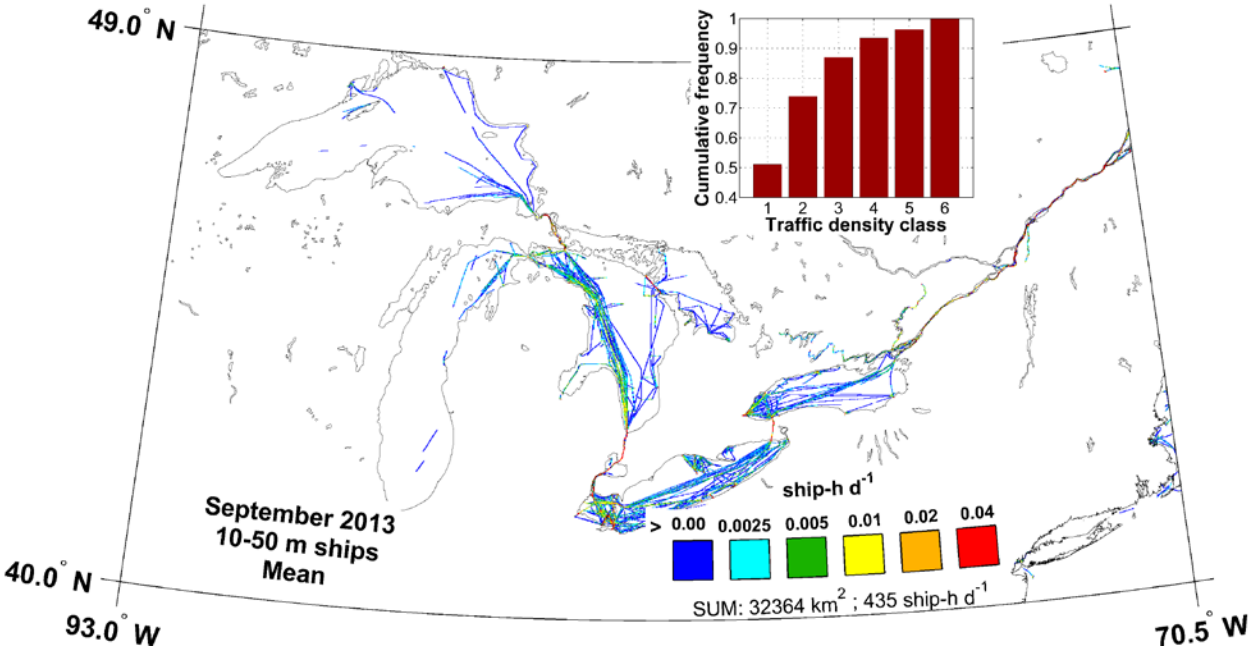

Figure 224. Map of AIS mean traffic density of 10 to 50 m ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

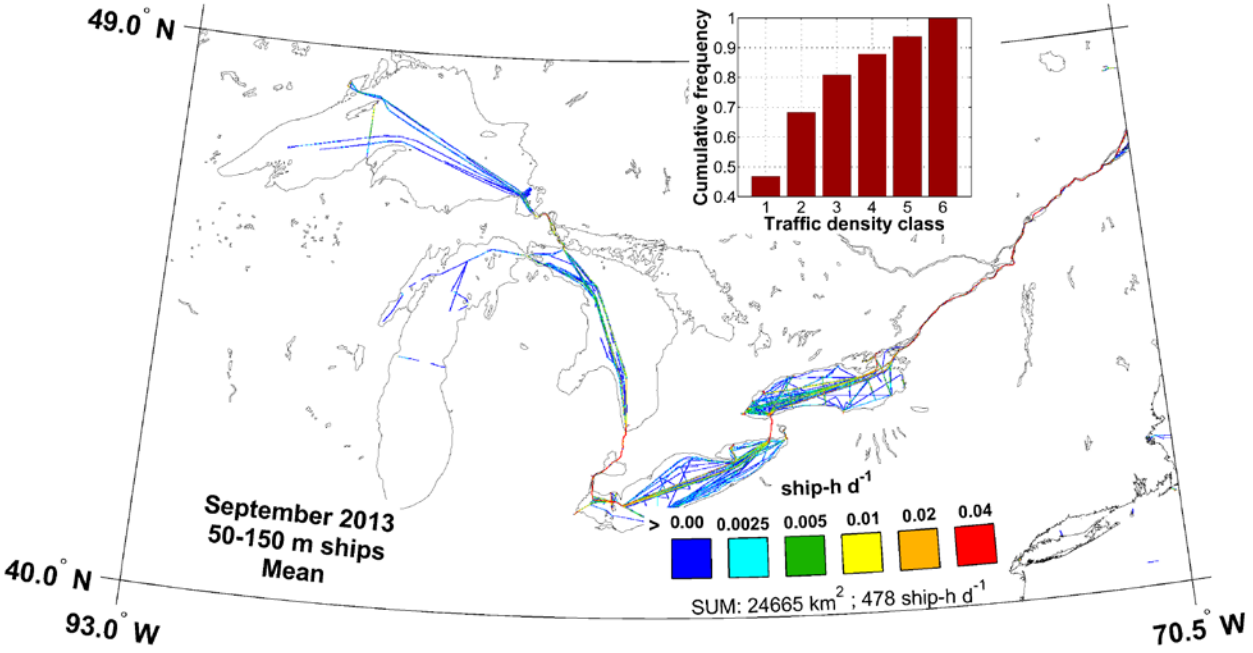

Figure 225. Map of AIS mean traffic density of 50 to 150 m ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

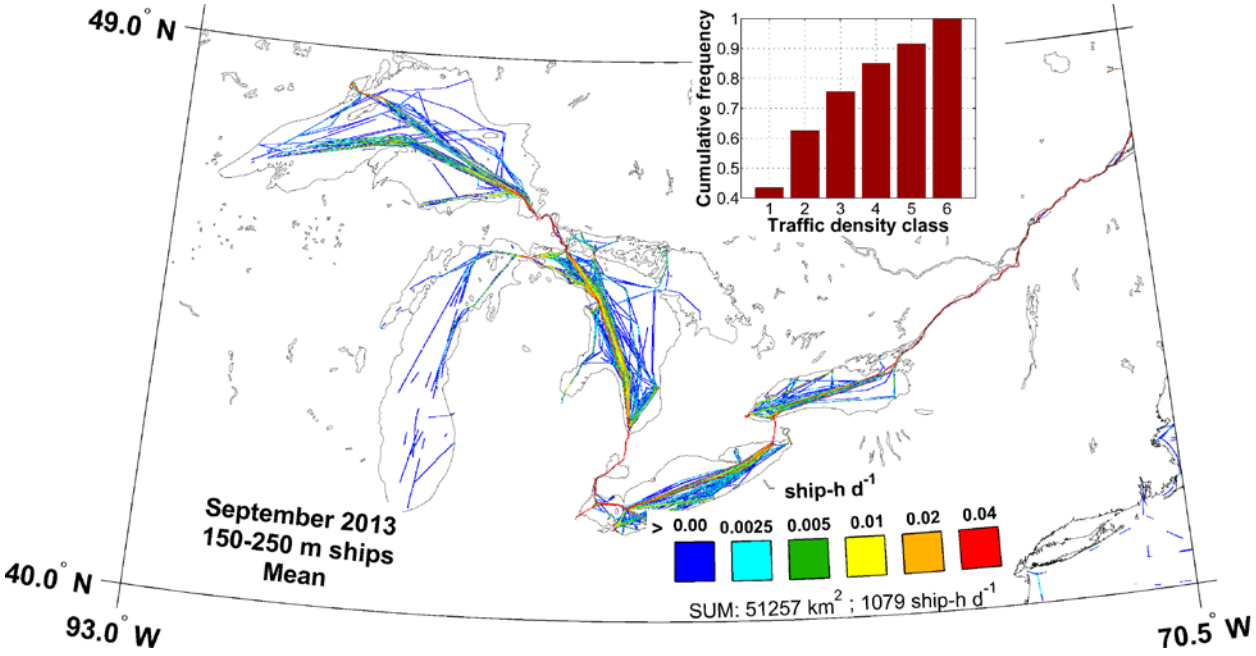

Figure 226. Map of AIS mean traffic density of 150 to 250 m ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

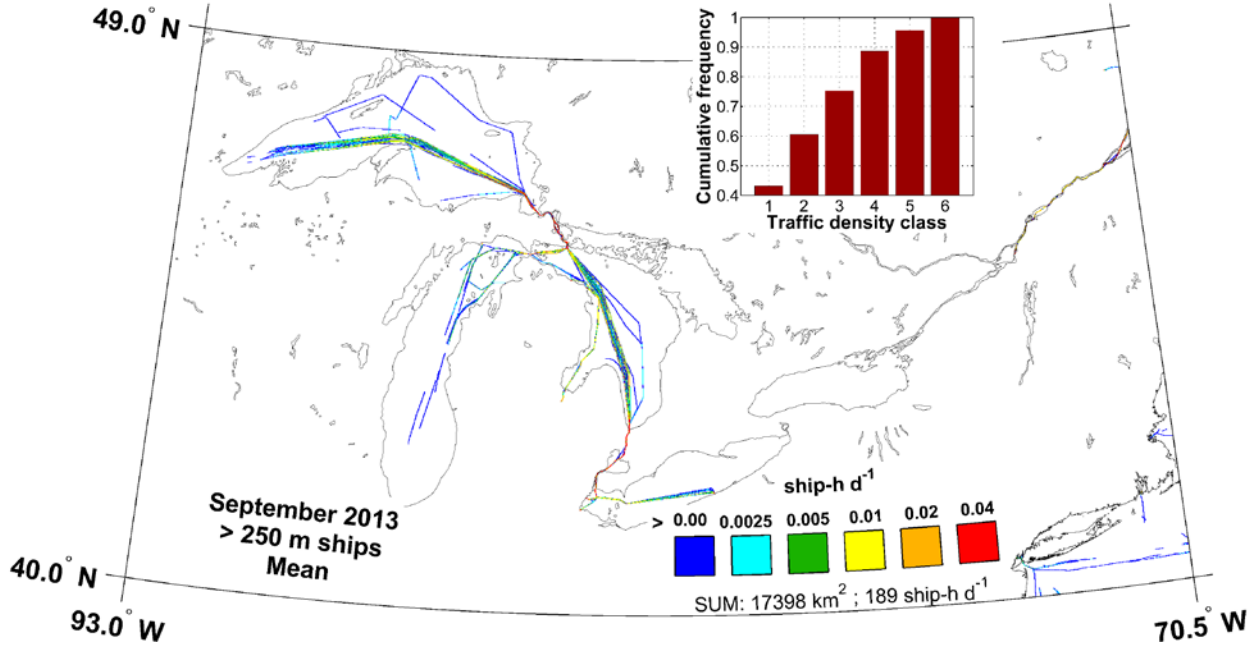

Figure 227. Map of AIS mean traffic density of > 250 m ships in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

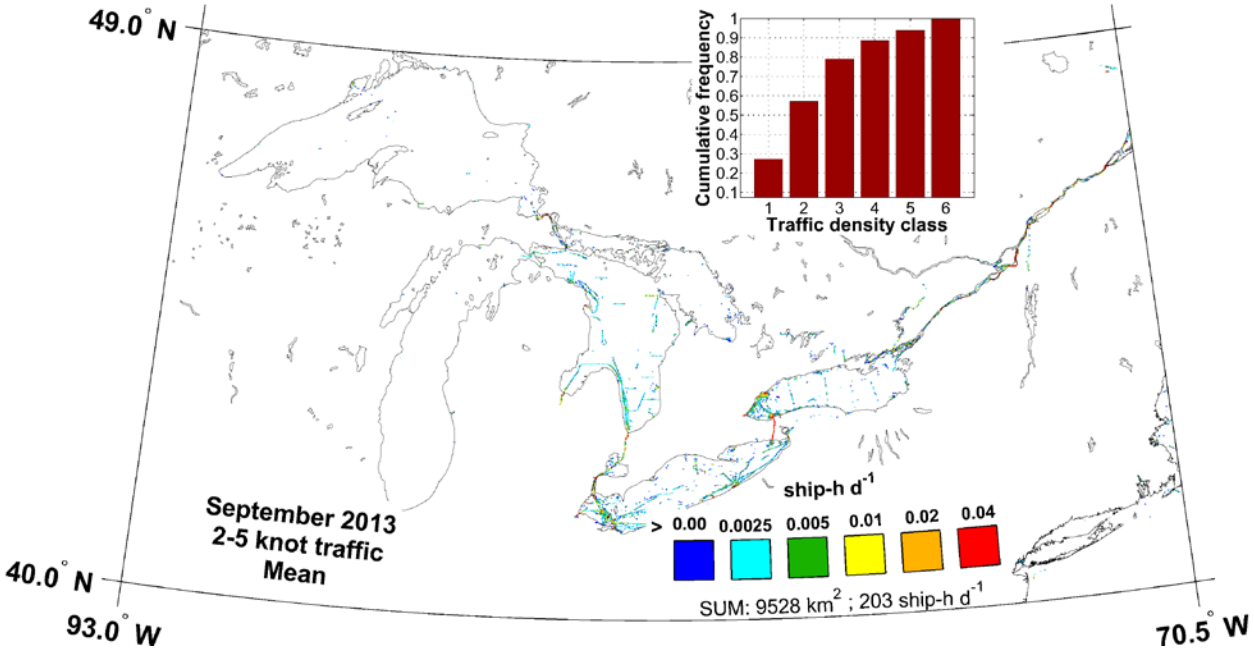

Figure 228. Map of 2–5 knot AIS mean traffic density in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

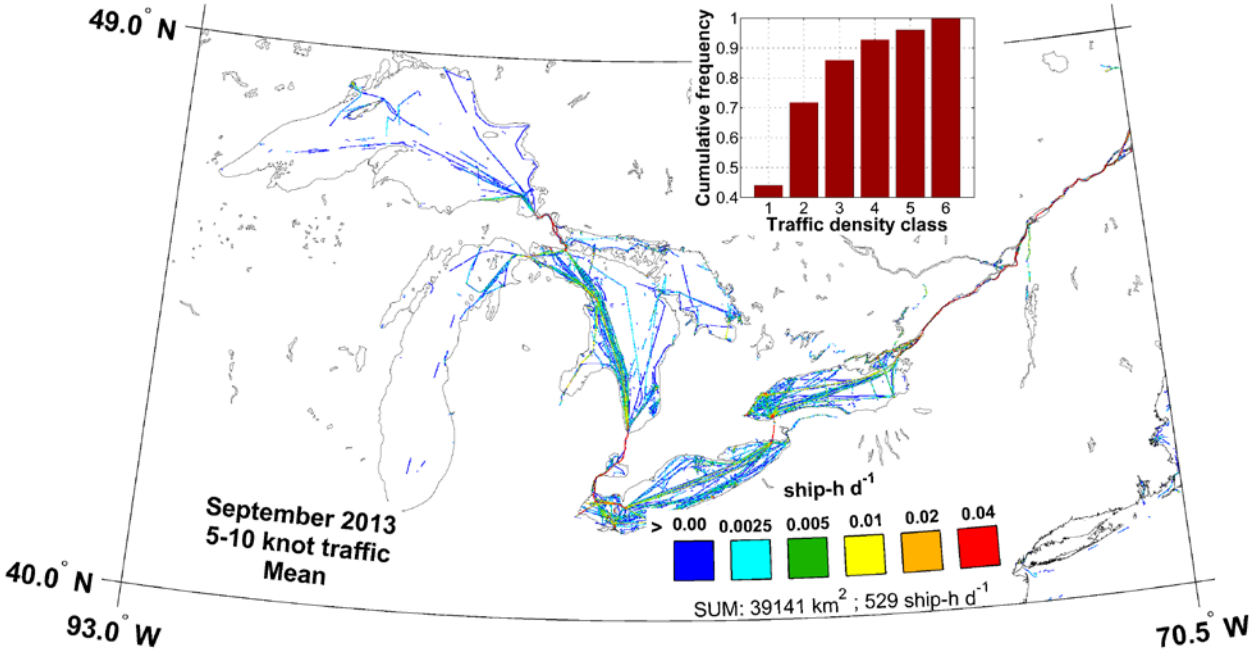

Figure 229. Map of 5–10 knot AIS mean traffic density in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

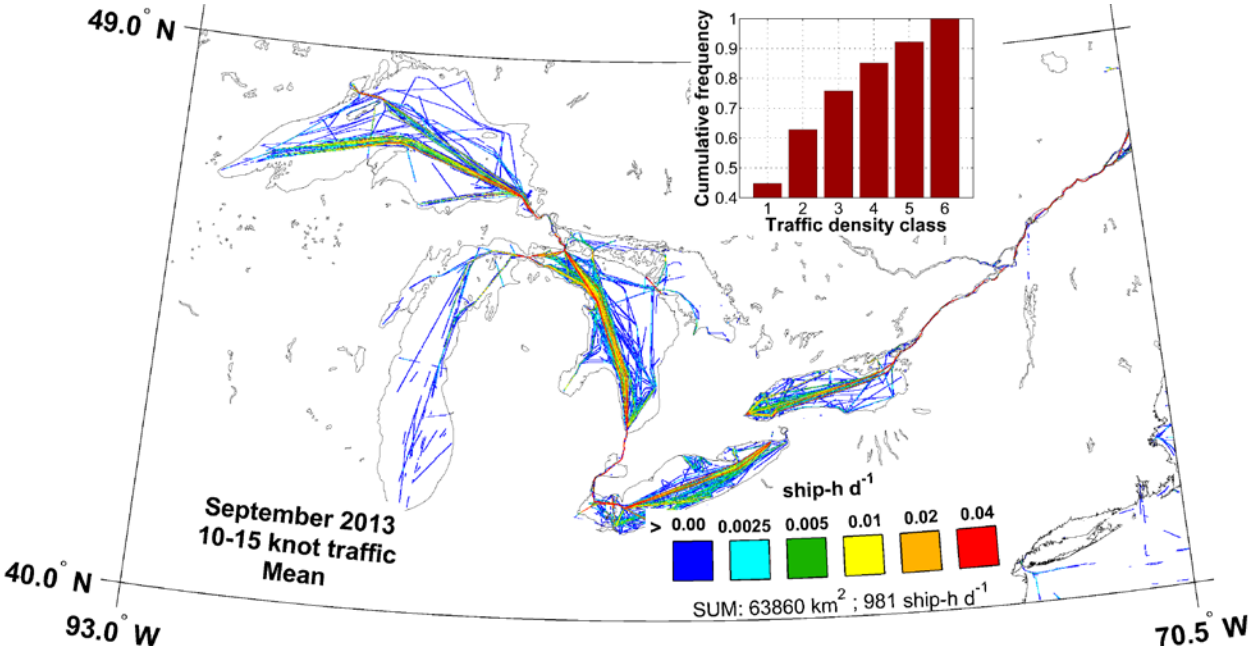

Figure 230. Map of 10–15 knot AIS mean traffic density in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

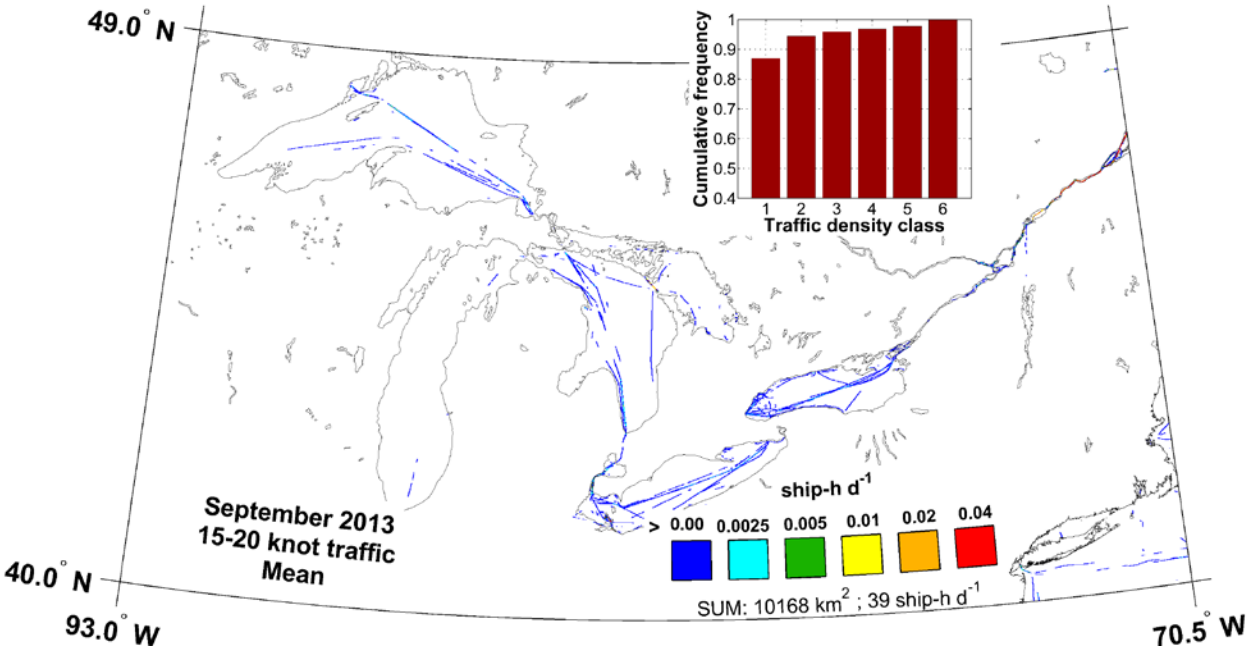

Figure 231. Map of 15–20 knot AIS mean traffic density in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

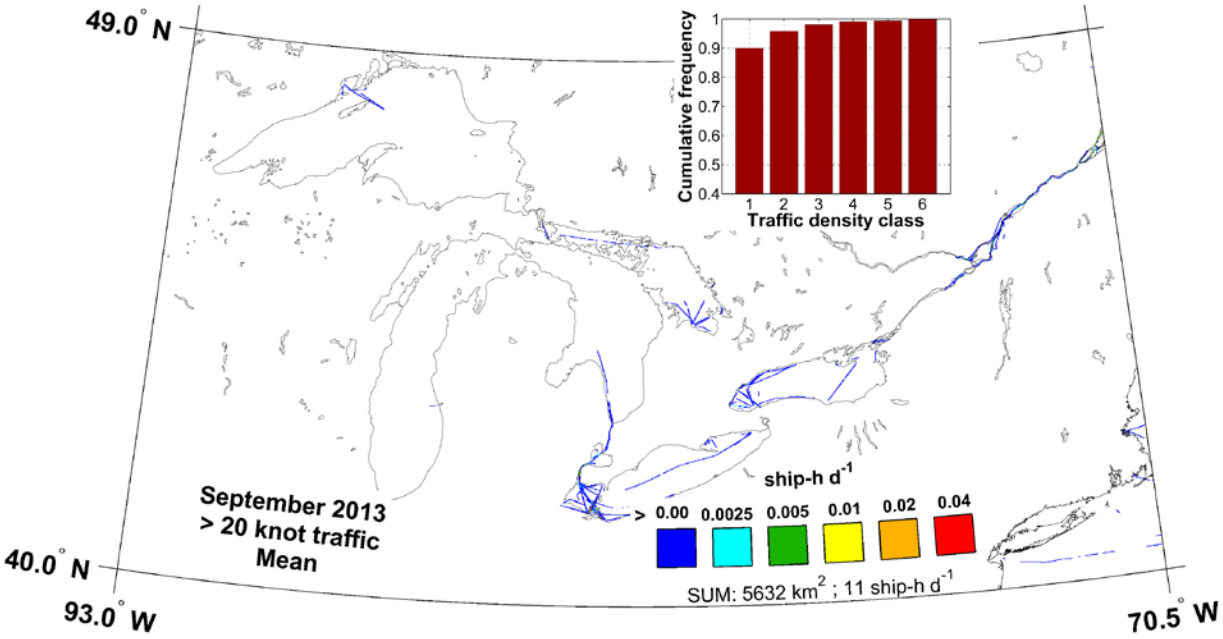

Figure 232. Map of >20 knot AIS mean traffic density in September 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.10. October 2013

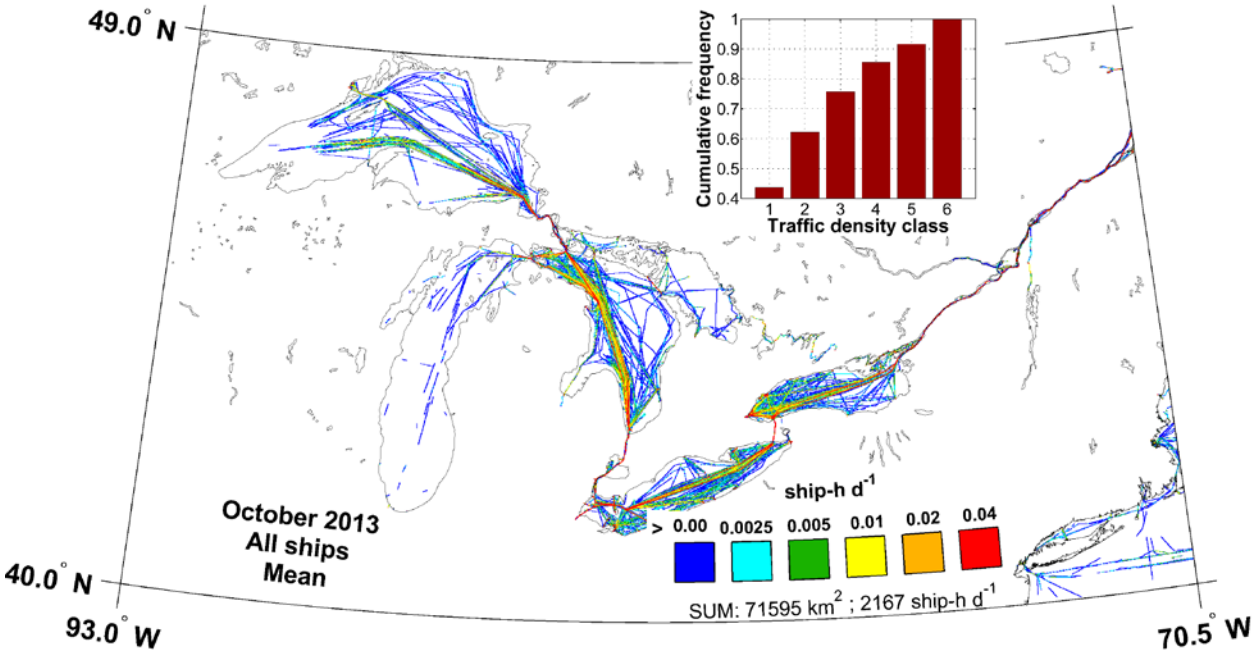

Figure 233. Map of AIS mean traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

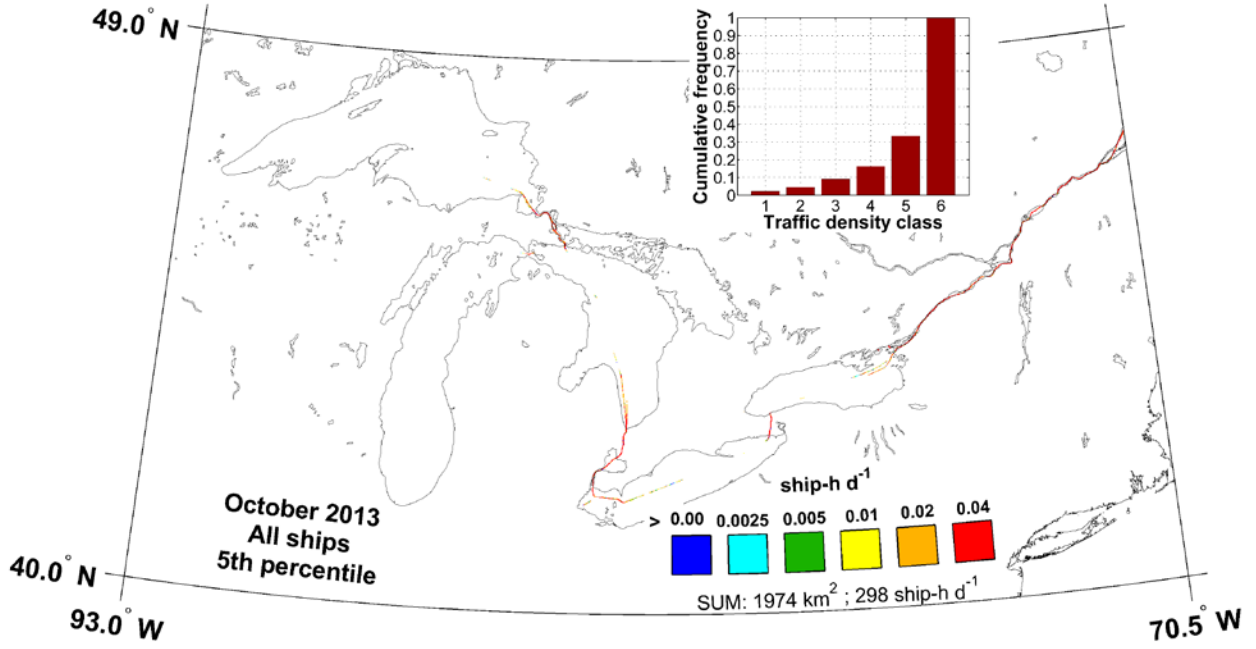

Figure 234. Map of the 5th percentile of the daily AIS traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

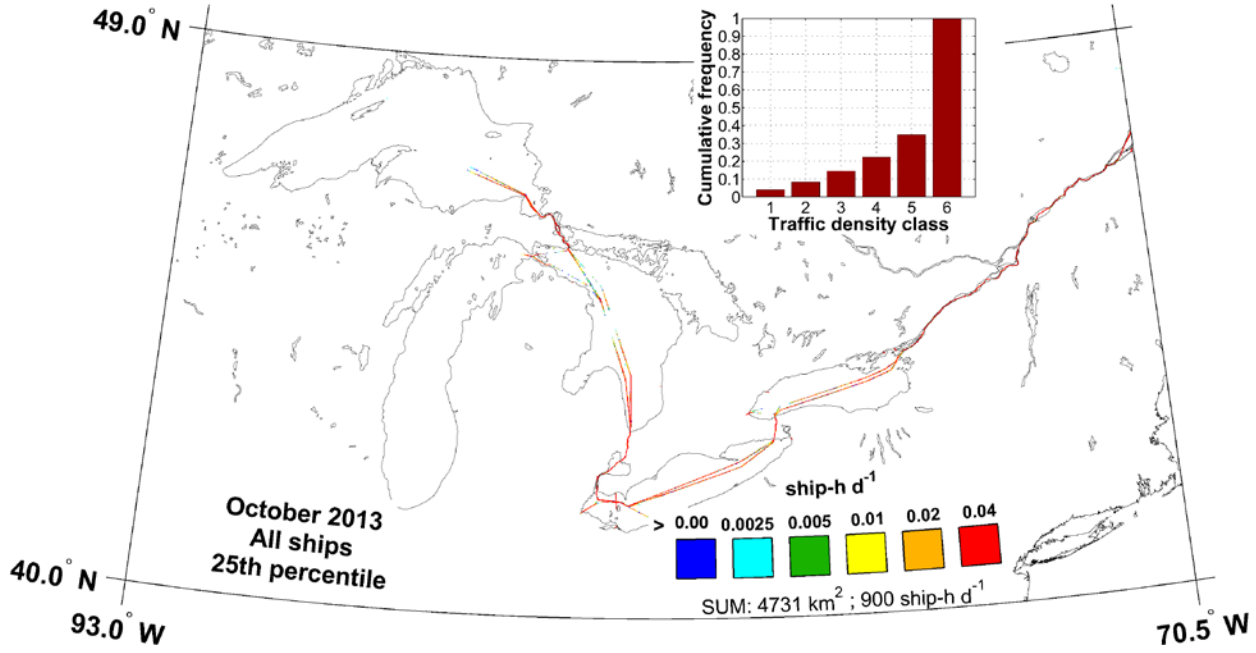

Figure 235. Map of the 25th percentile of the daily AIS traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

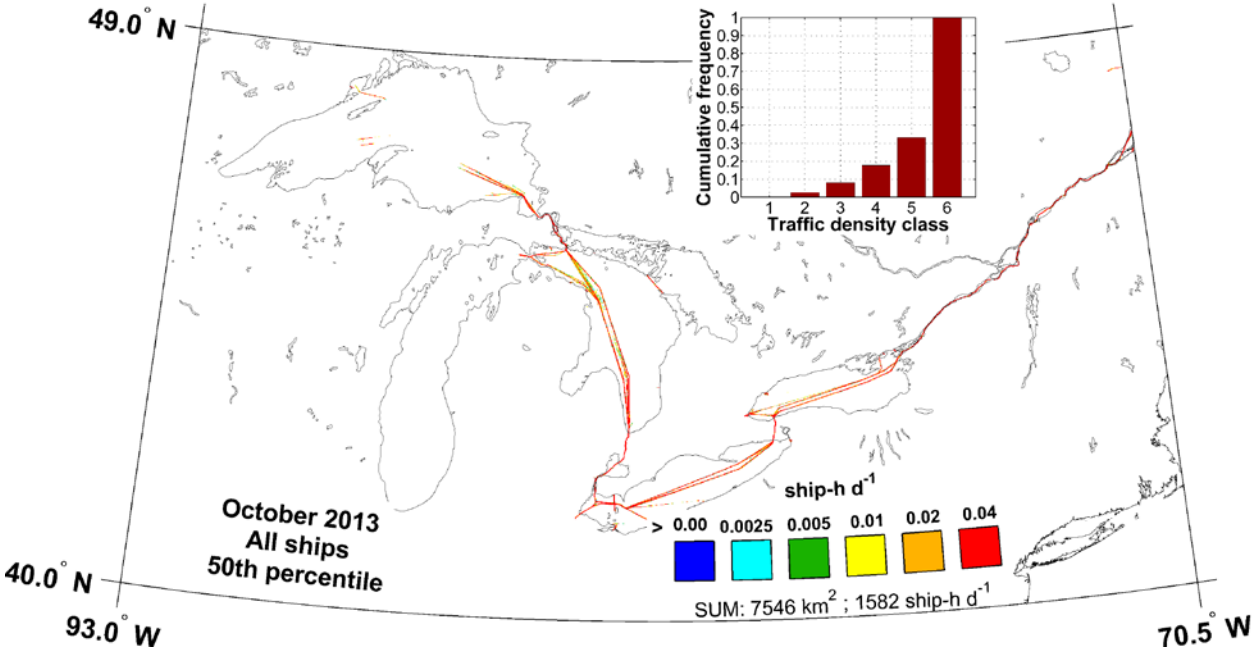

Figure 236. Map of the 50th percentile of the daily AIS traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

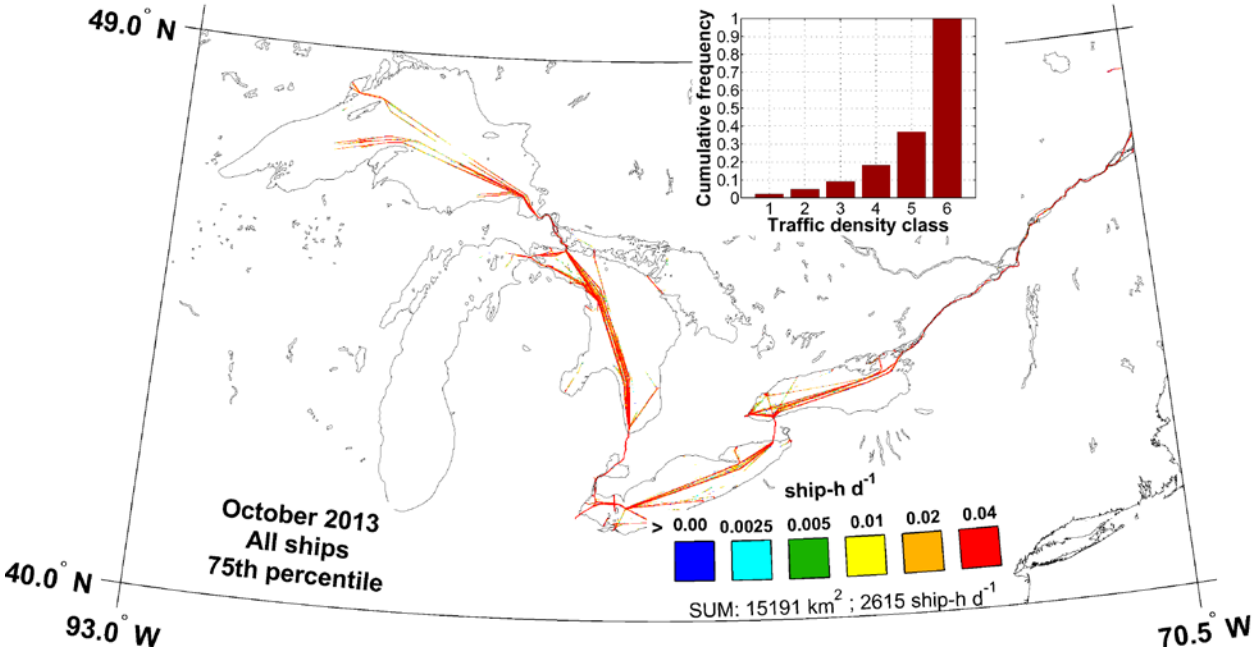

Figure 237. Map of the 75th percentile of the daily AIS traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

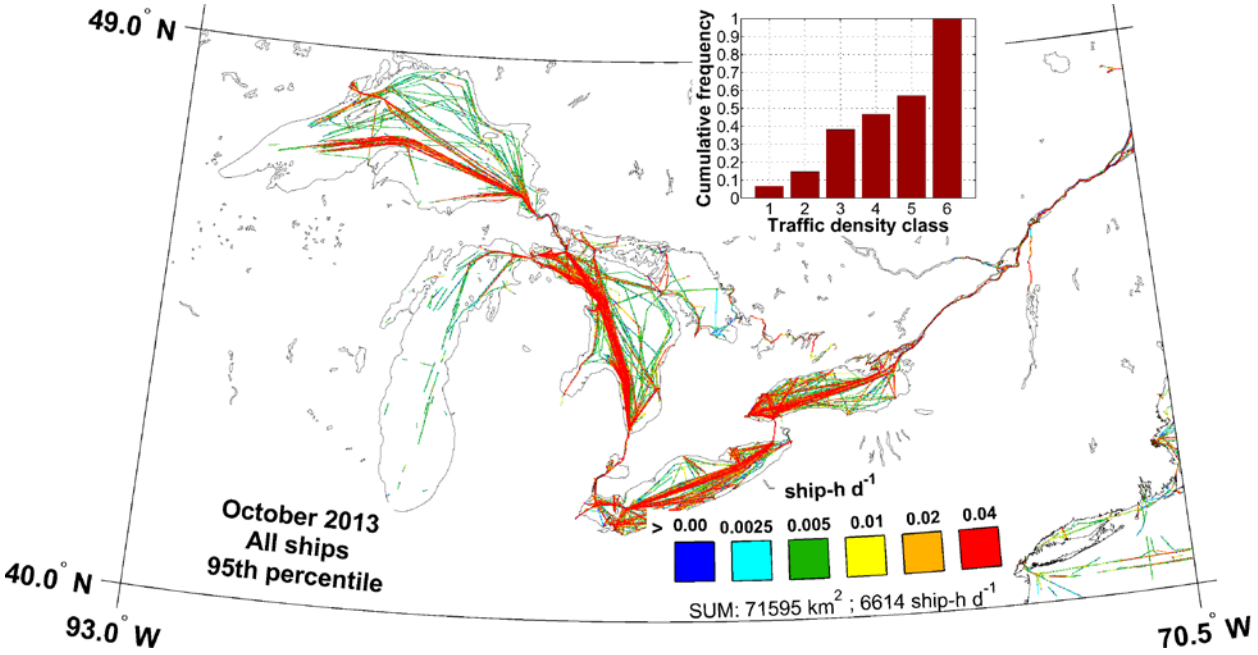

Figure 238. Map of the 95th percentile of the daily AIS traffic density of all ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

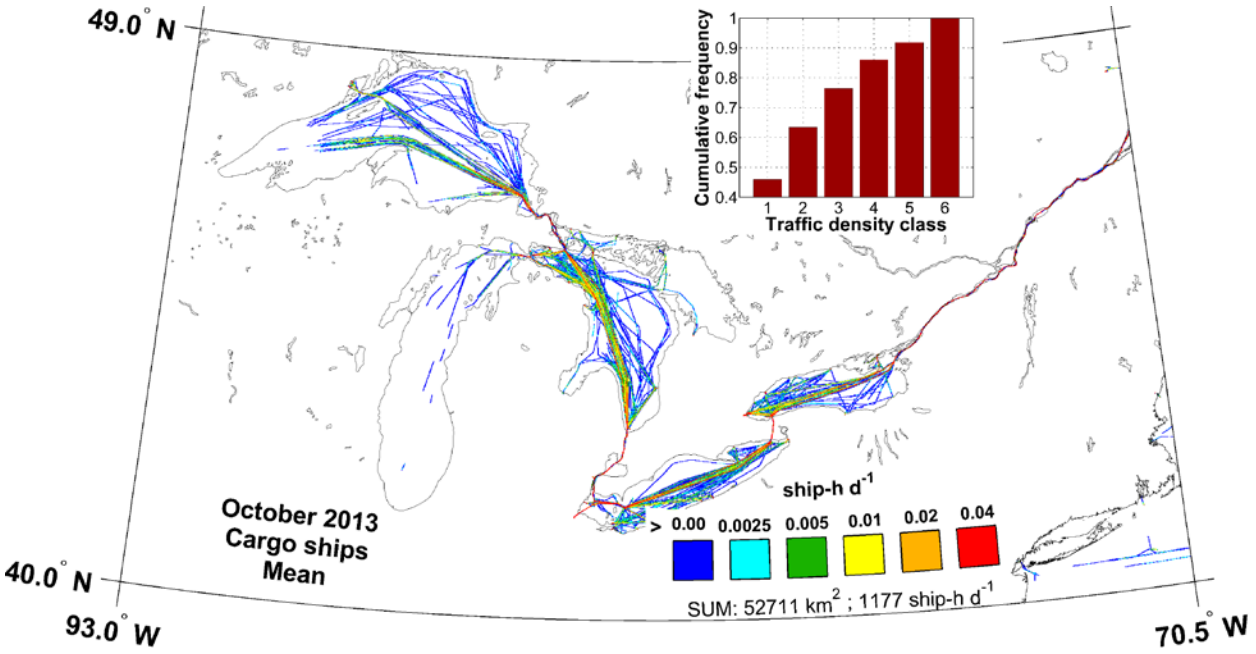

Figure 239. Map of AIS mean traffic density of cargo-type ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

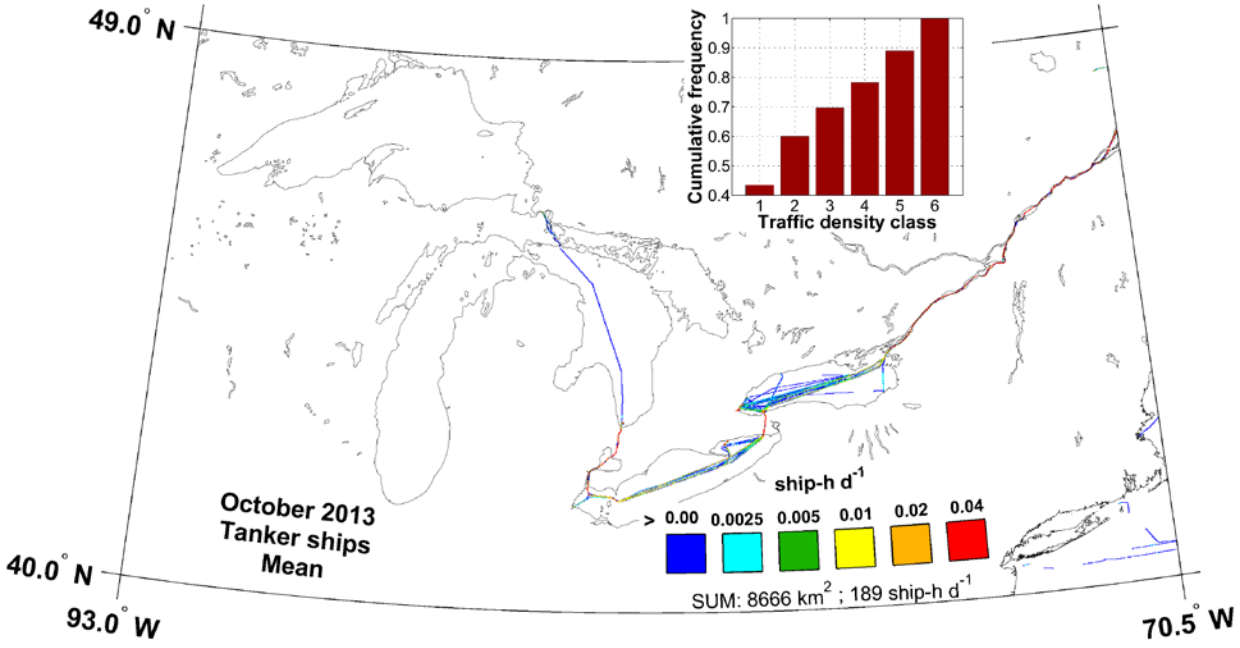

Figure 240. Map of AIS mean traffic density of tanker-type ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

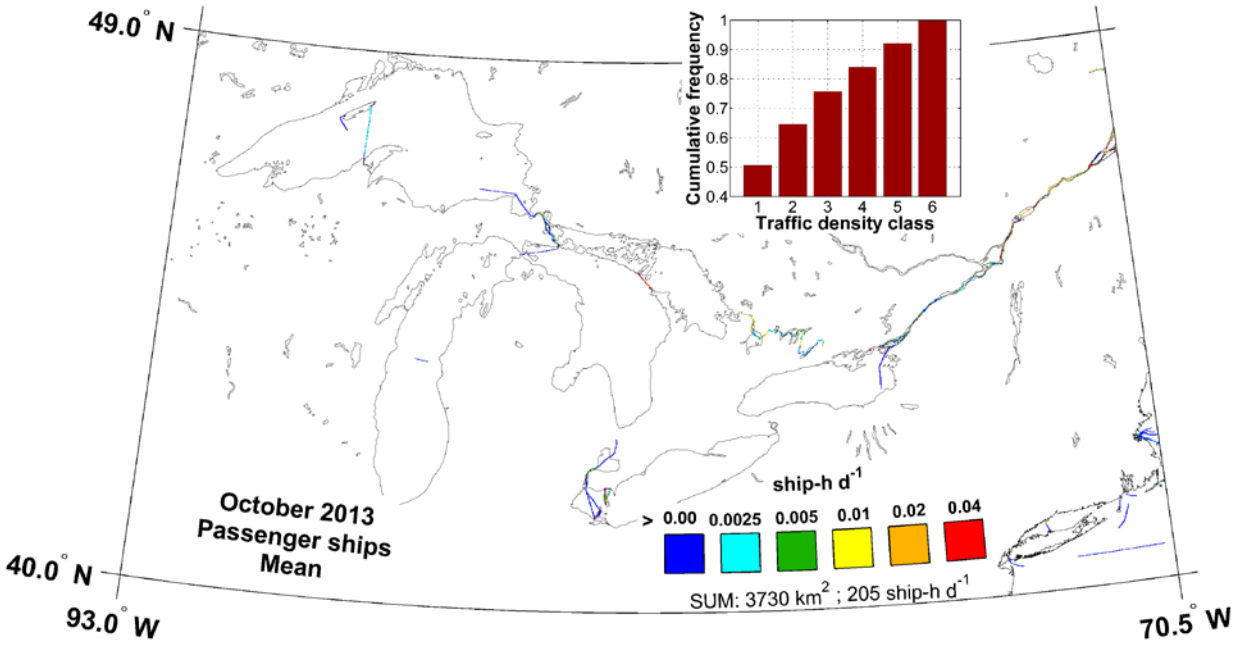

Figure 241. Map of AIS mean traffic density of passenger-type ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

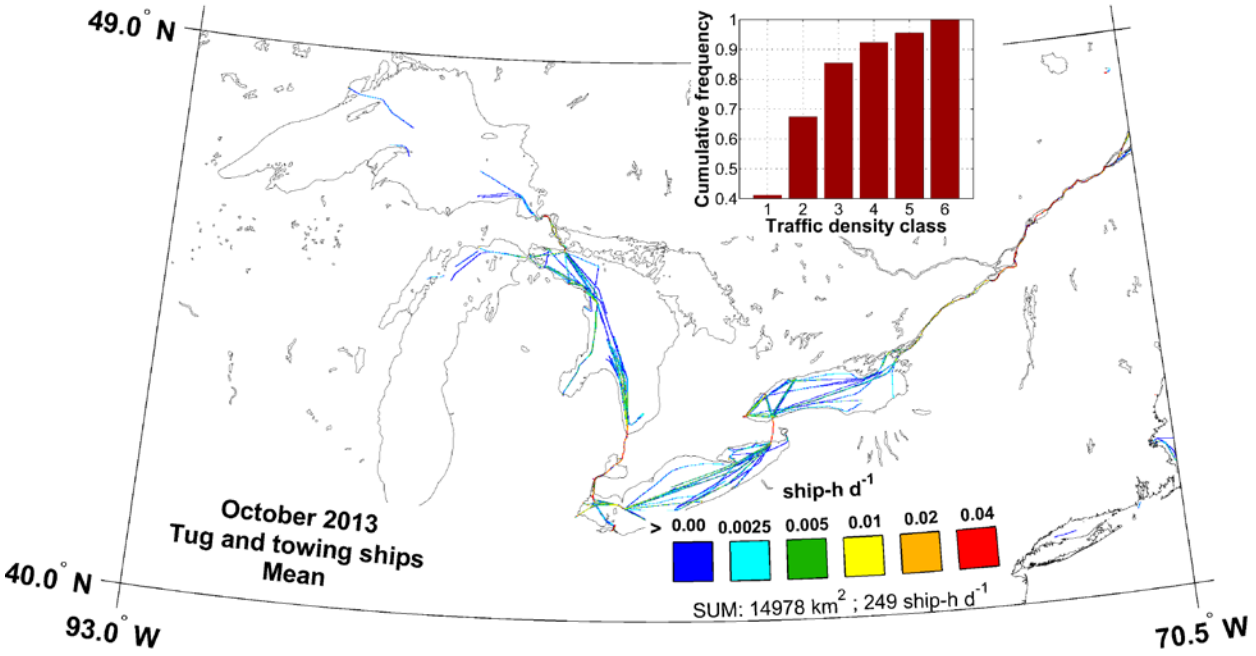

Figure 242. Map of AIS mean traffic density of tug and towing-type ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

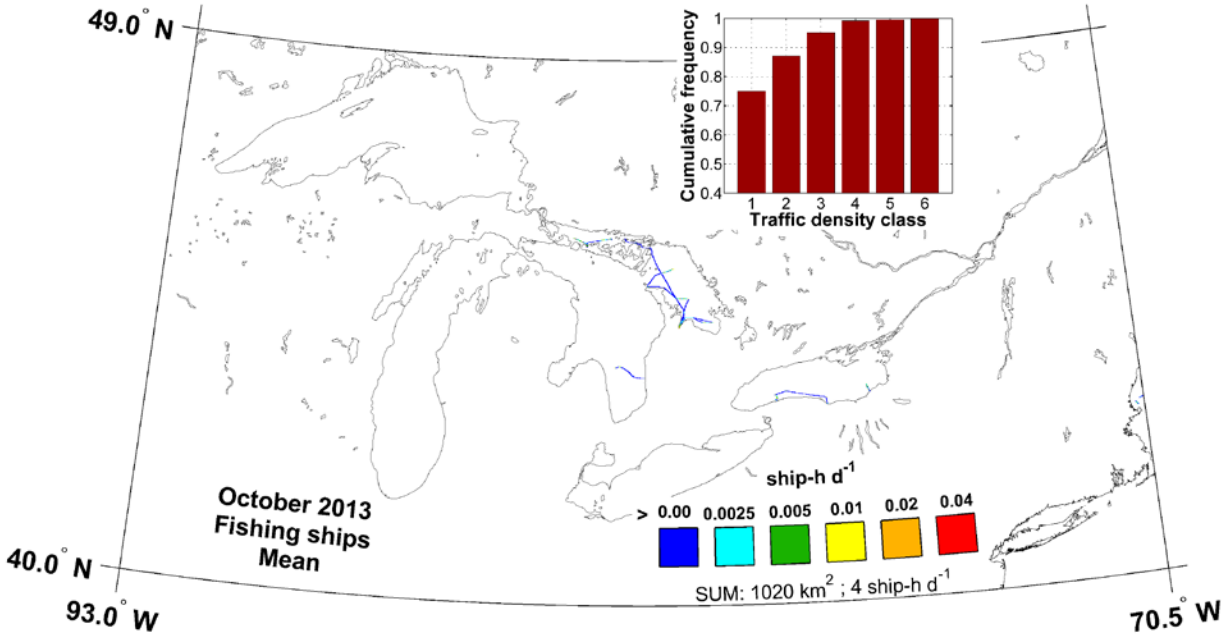

Figure 243. Map of AIS mean traffic density of fishing-type ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

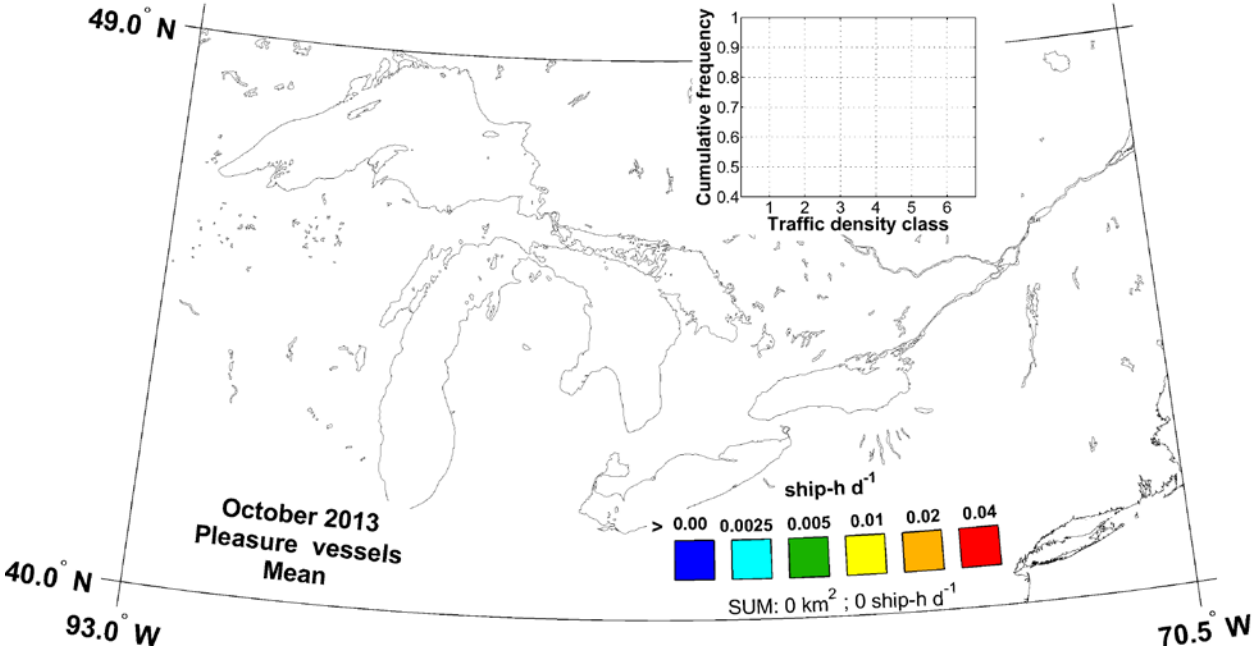

Figure 244. Map of AIS mean traffic density of pleasure-type vessels in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

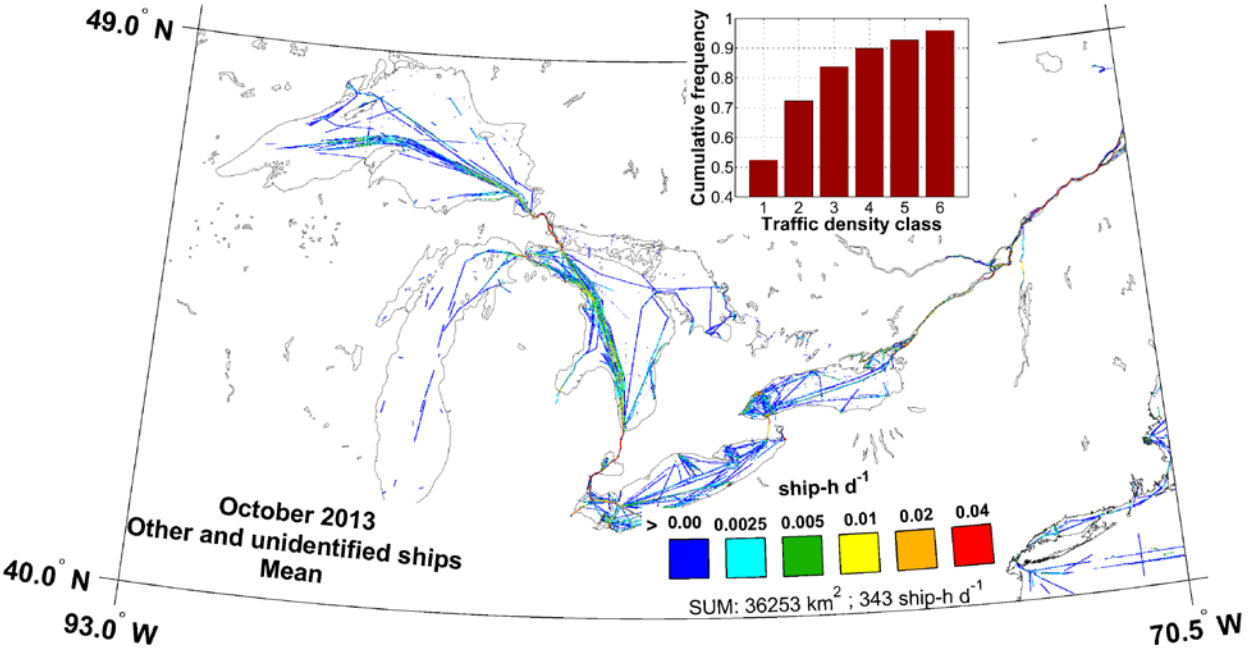

Figure 245. Map of AIS mean traffic density of other types of ships and ships of unidentified type in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

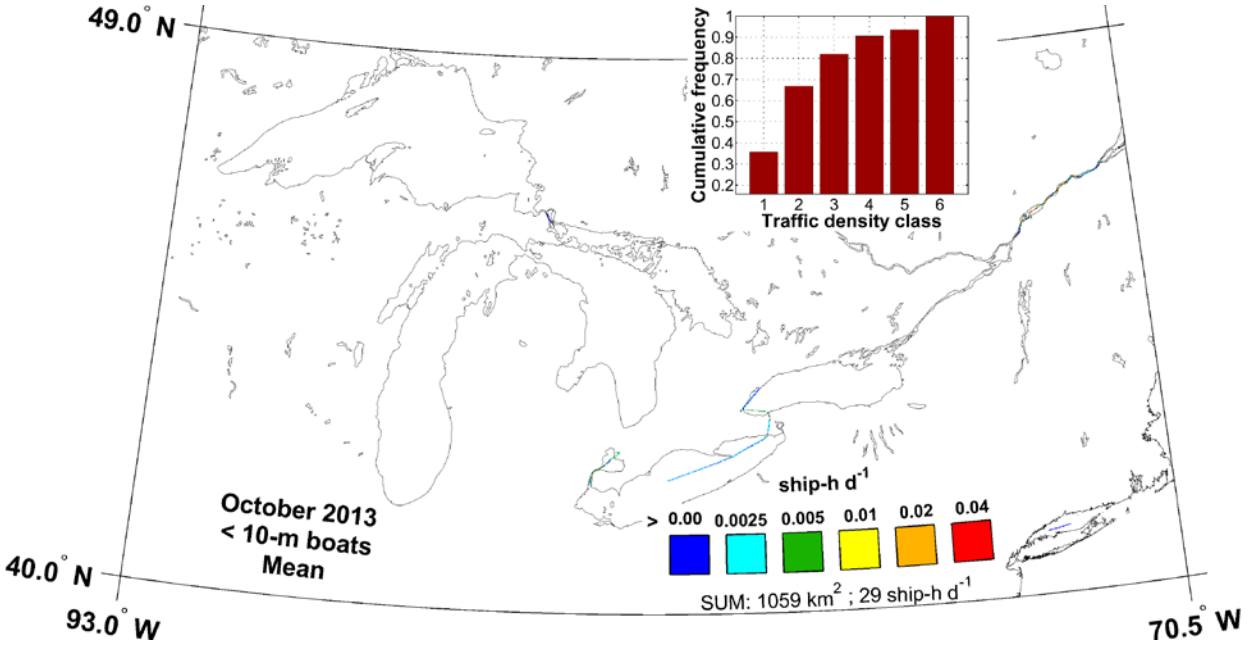

Figure 246. Map of AIS mean traffic density of ships with lengths < 10 m in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

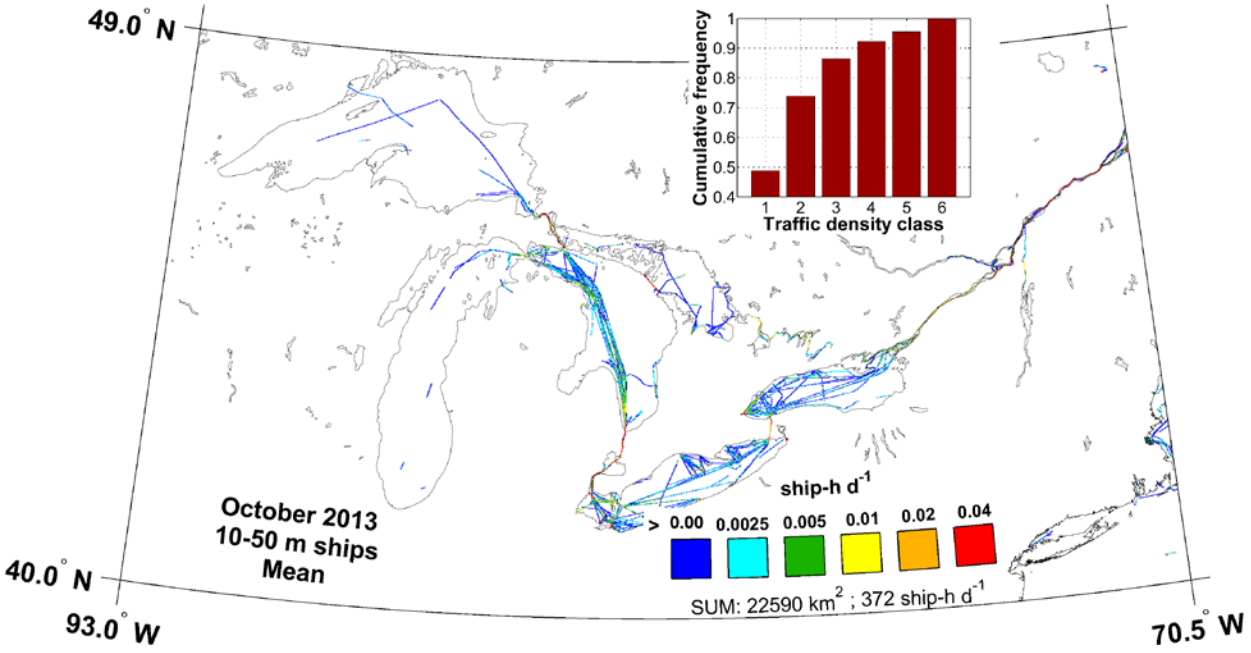

Figure 247. Map of AIS mean traffic density of 10 to 50 m ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

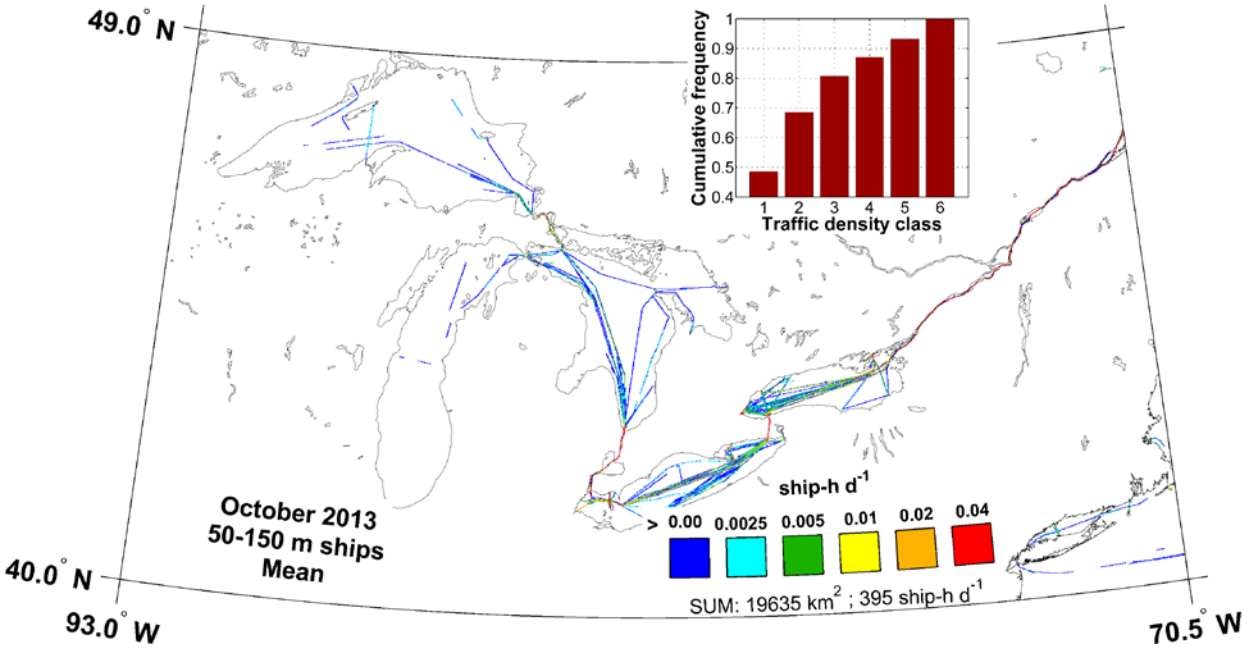

Figure 248. Map of AIS mean traffic density of 50 to 150 m ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

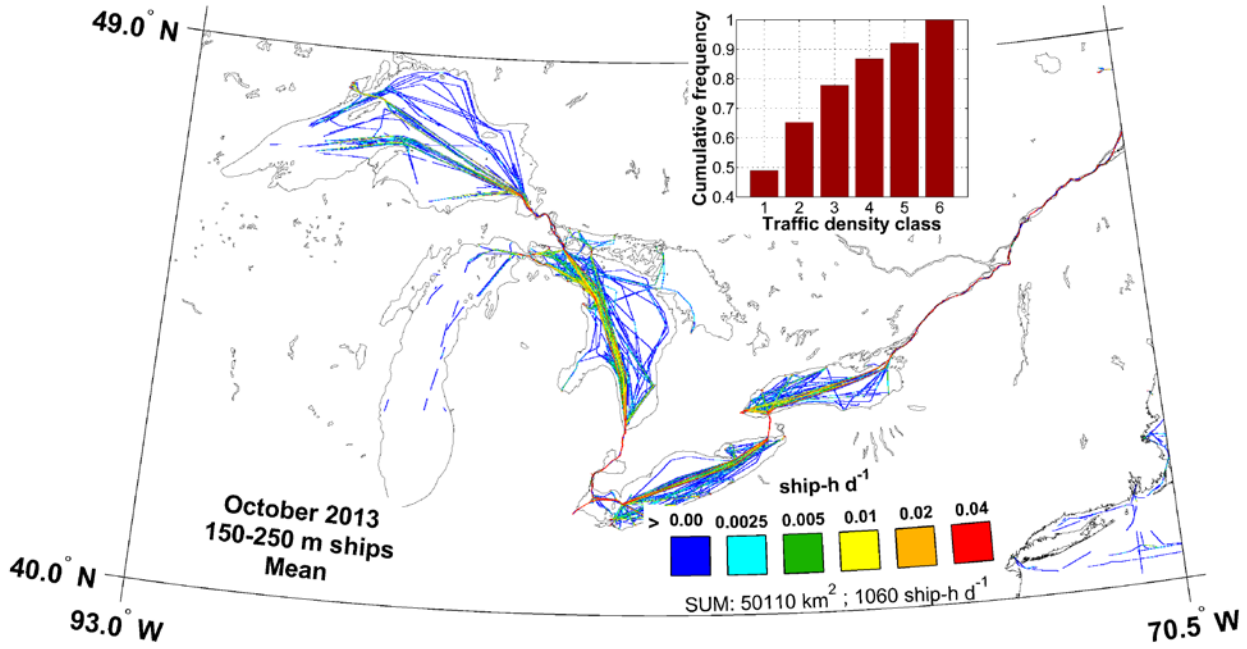

Figure 249. Map of AIS mean traffic density of 150 to 250 m ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

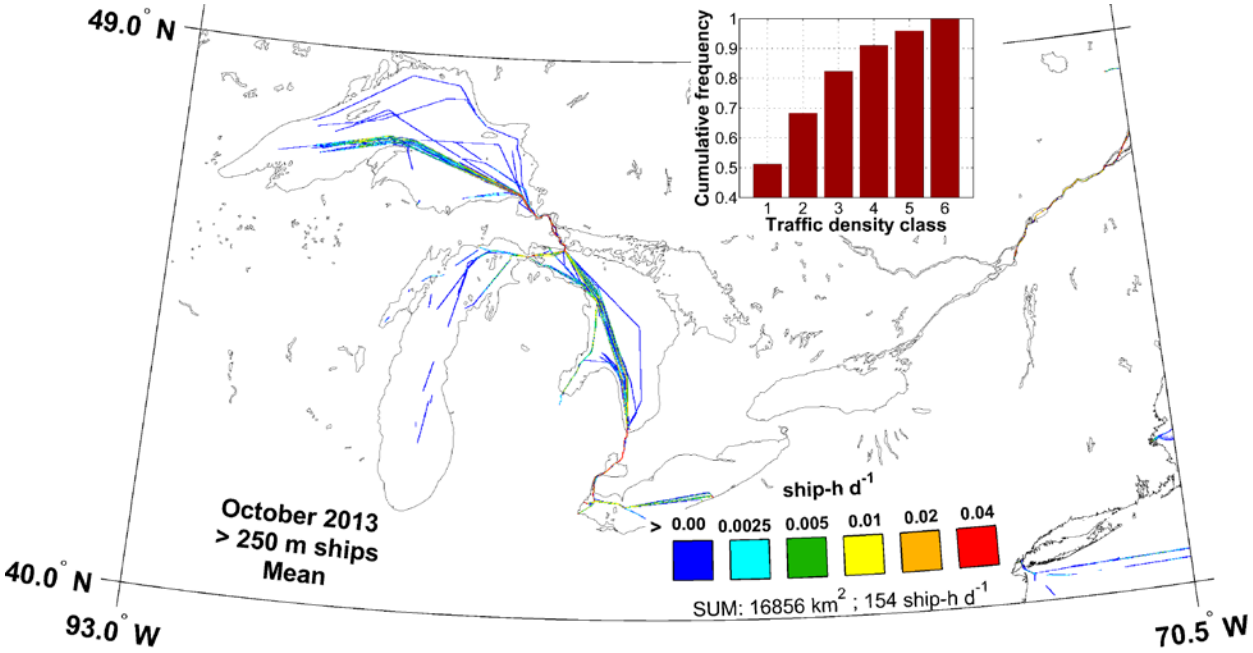

Figure 250. Map of AIS mean traffic density of > 250 m ships in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

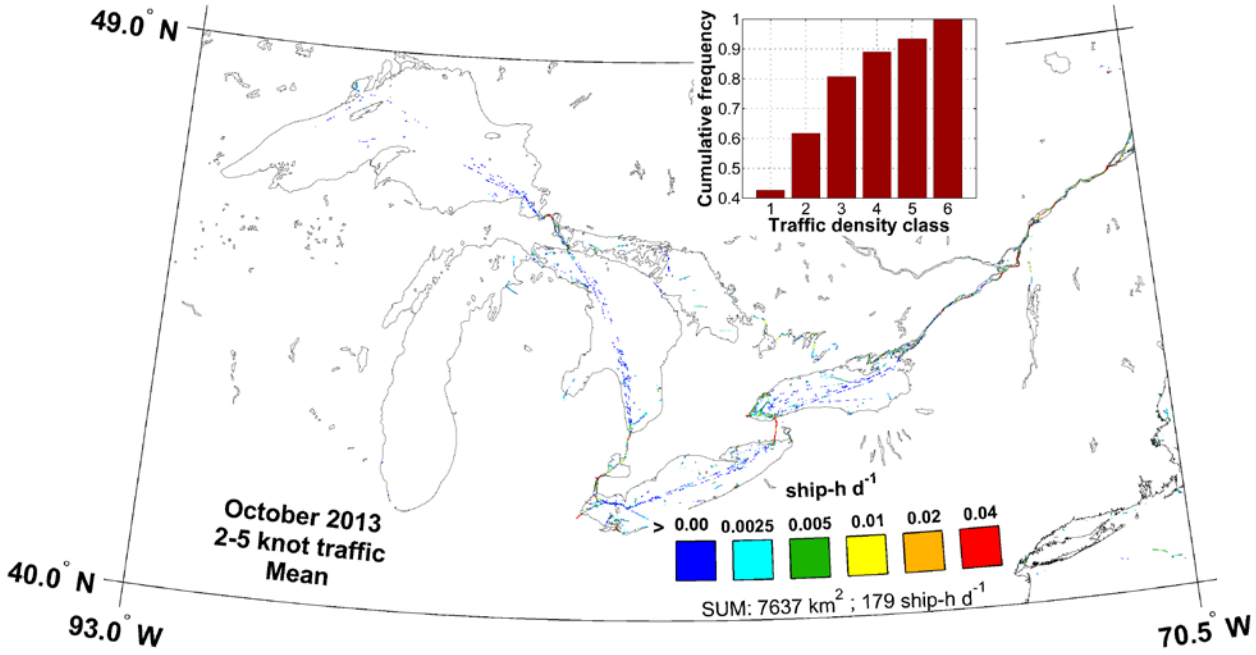

Figure 251. Map of 2–5 knot AIS mean traffic density in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

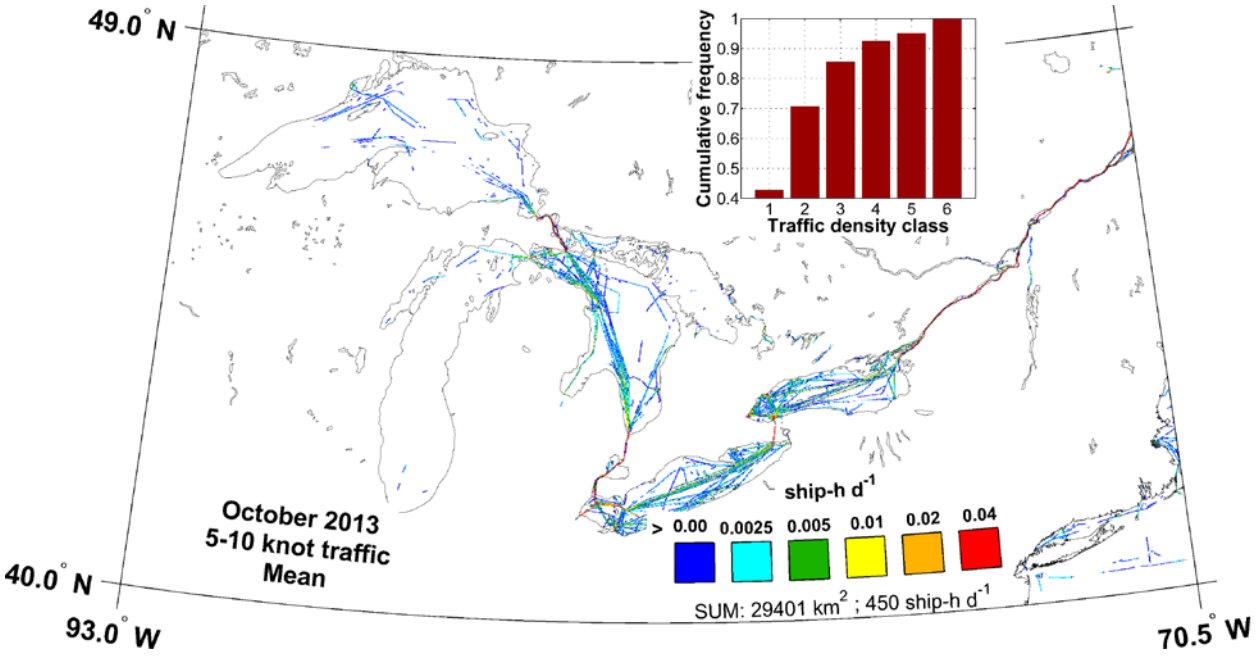

Figure 252. Map of 5–10 knot AIS mean traffic density in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

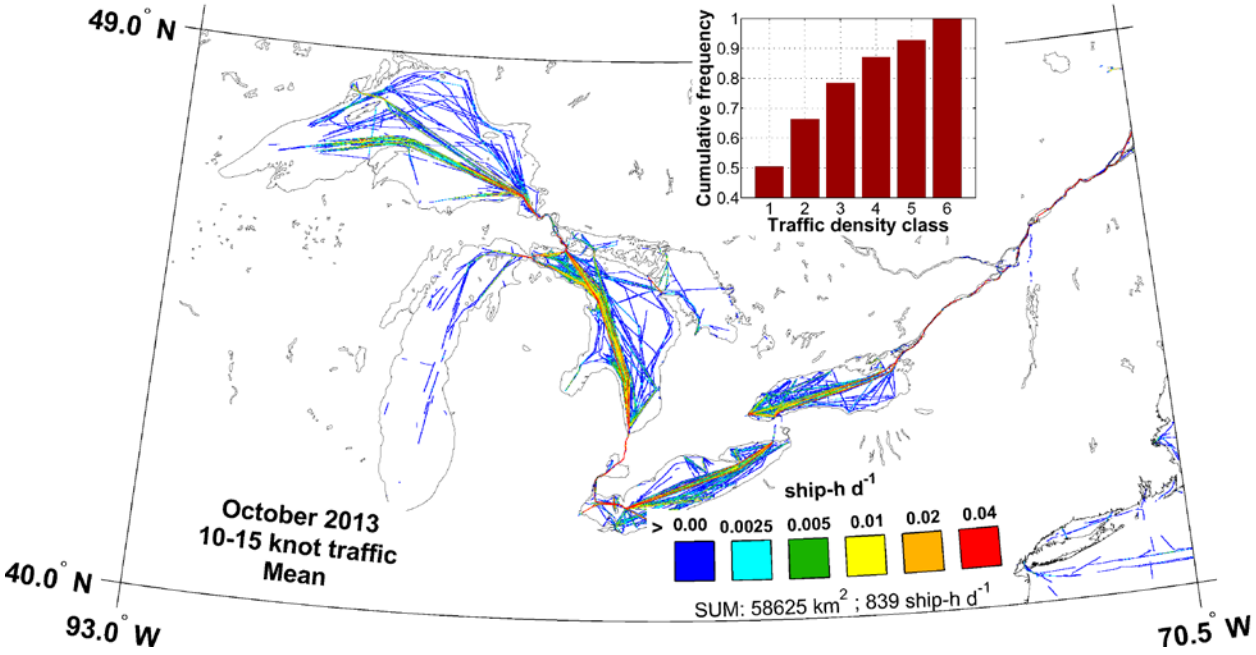

Figure 253. Map of 10–15 knot AIS mean traffic density in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

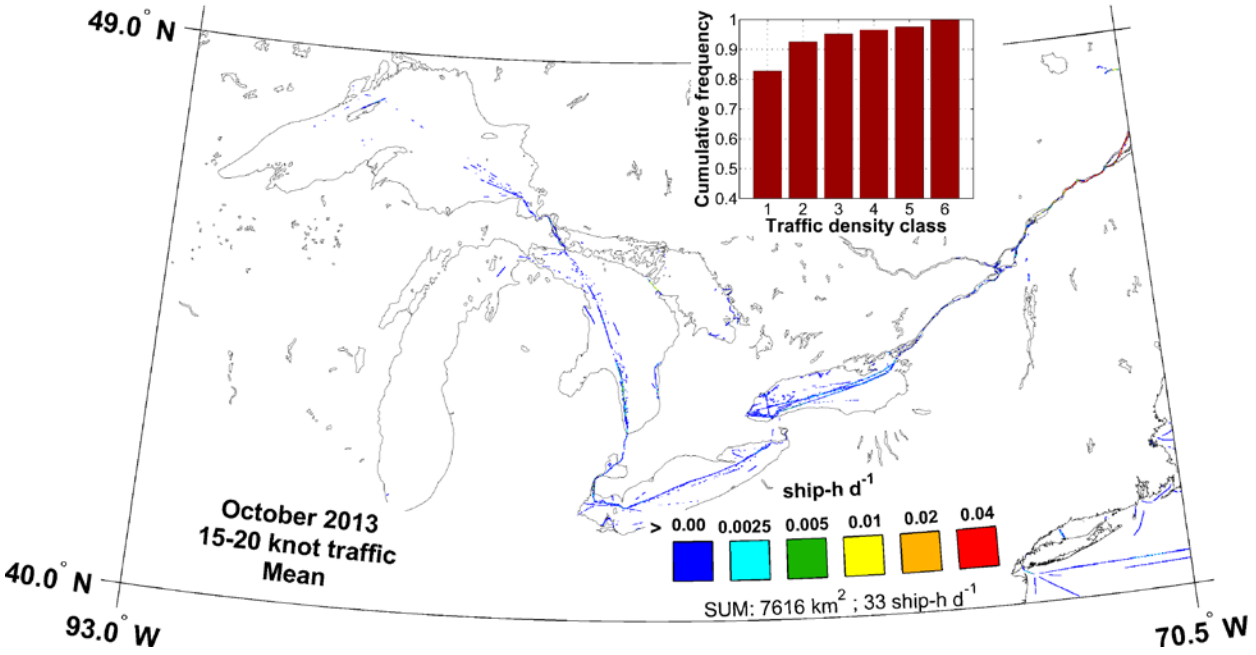

Figure 254. Map of 15–20 knot AIS mean traffic density in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

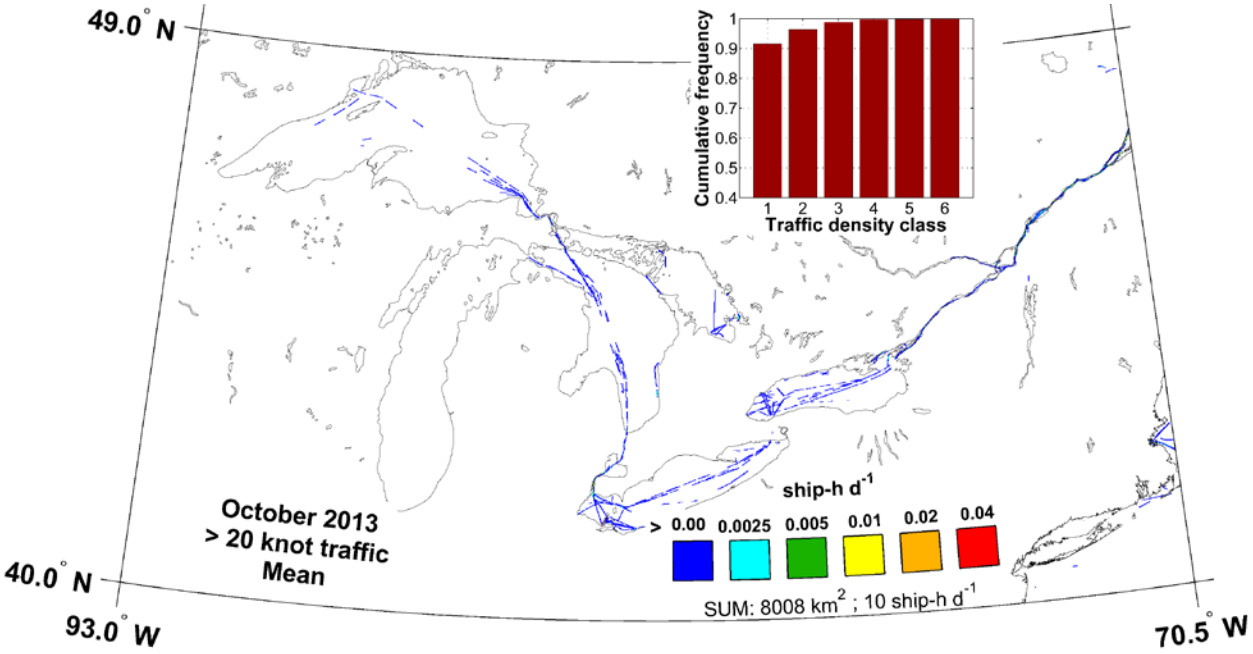

Figure 255. Map of >20 knot AIS mean traffic density in October 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.11. November 2013

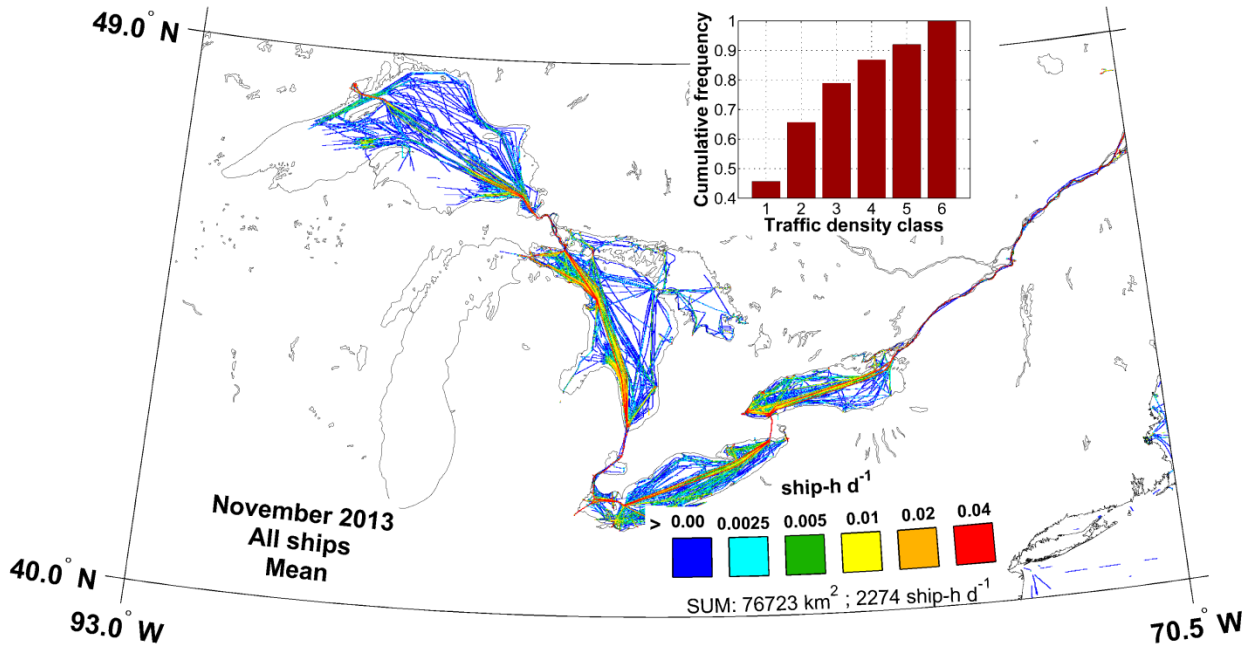

Figure 256. Map of AIS mean traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

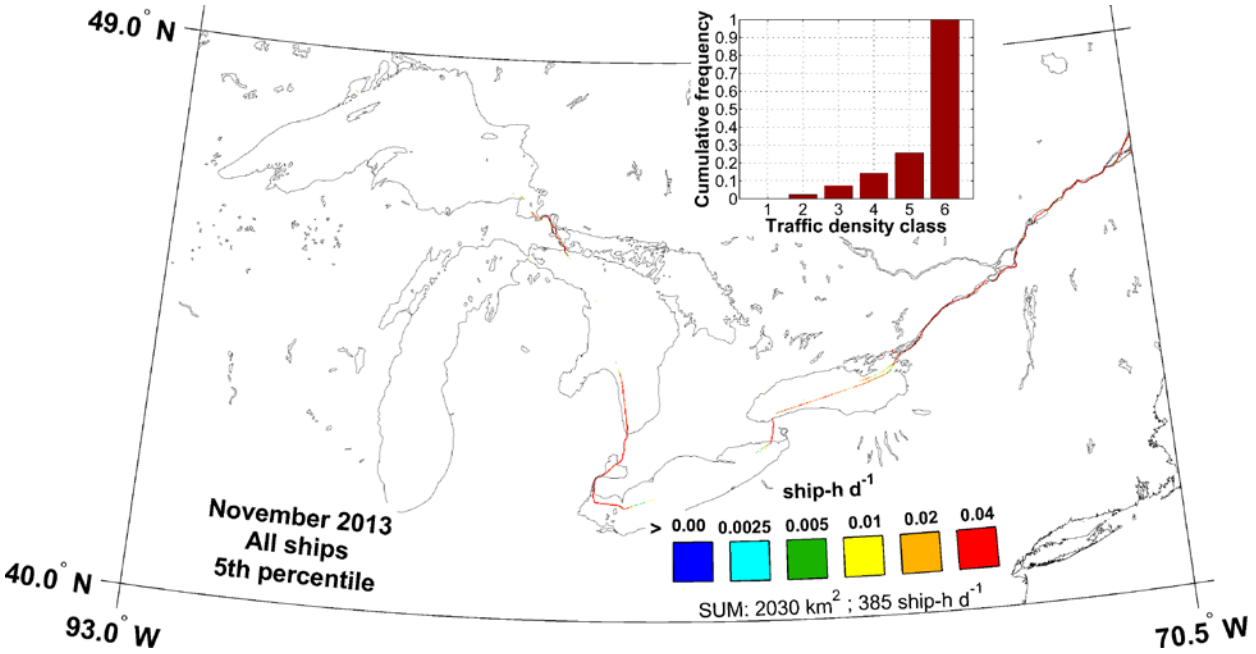

Figure 257. Map of the 5th percentile of the daily AIS traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

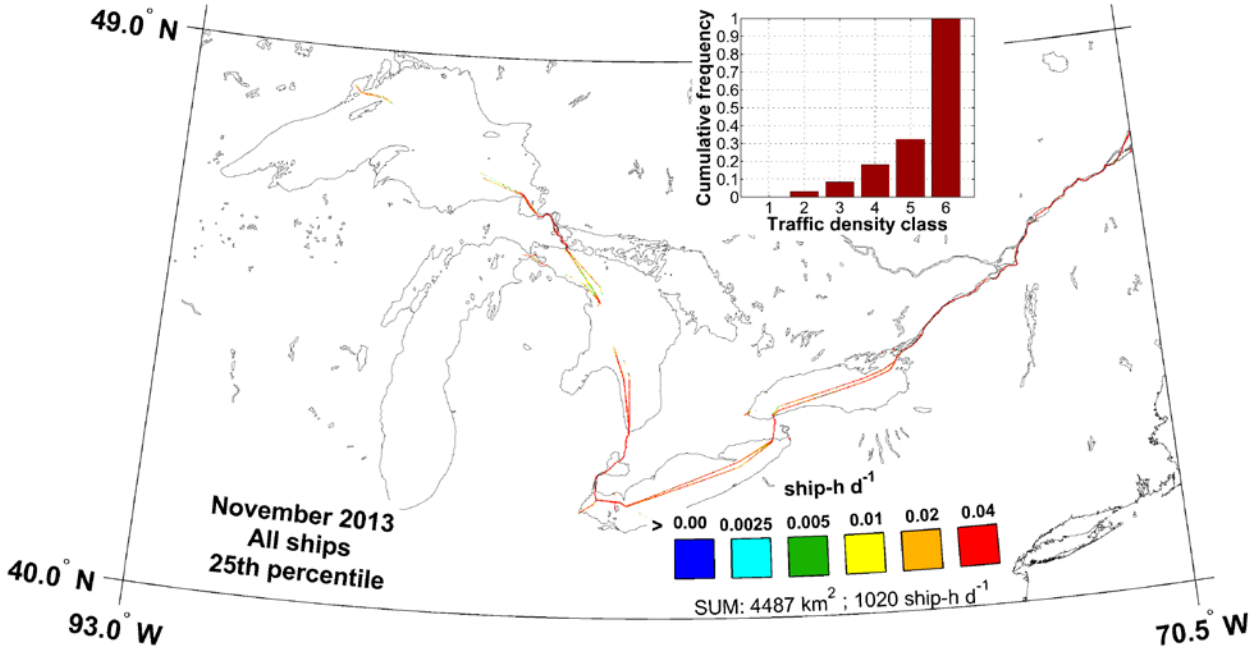

Figure 258. Map of the 25th percentile of the daily AIS traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

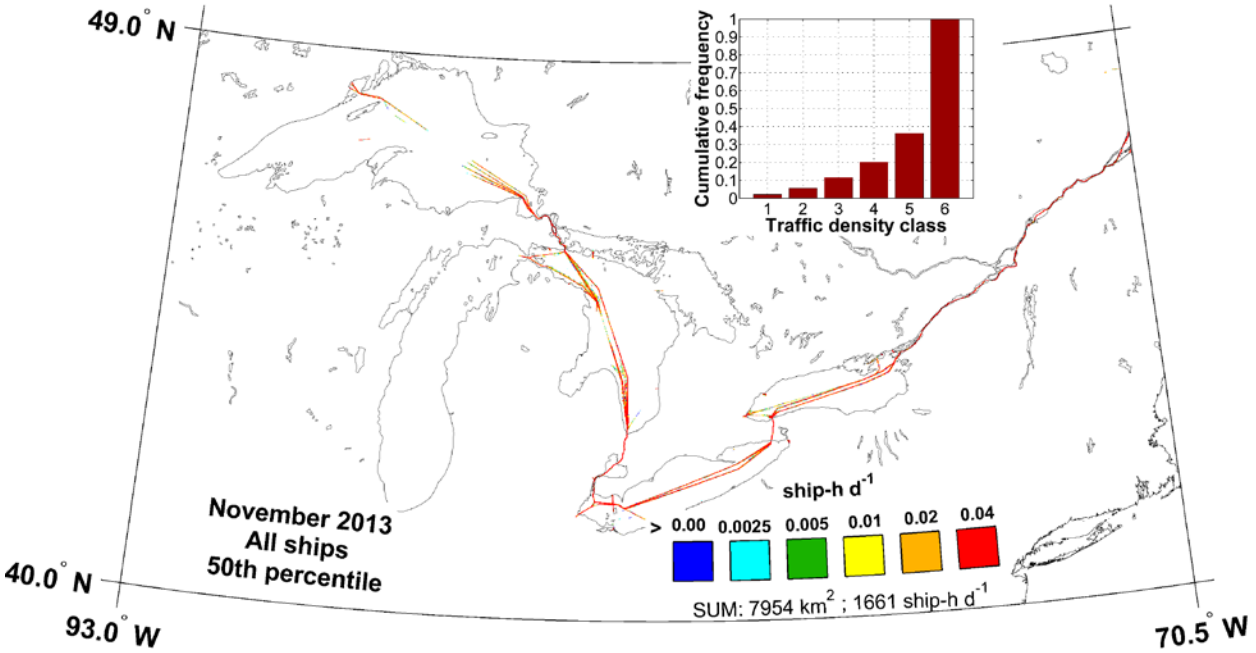

Figure 259. Map of the 50th percentile of the daily AIS traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

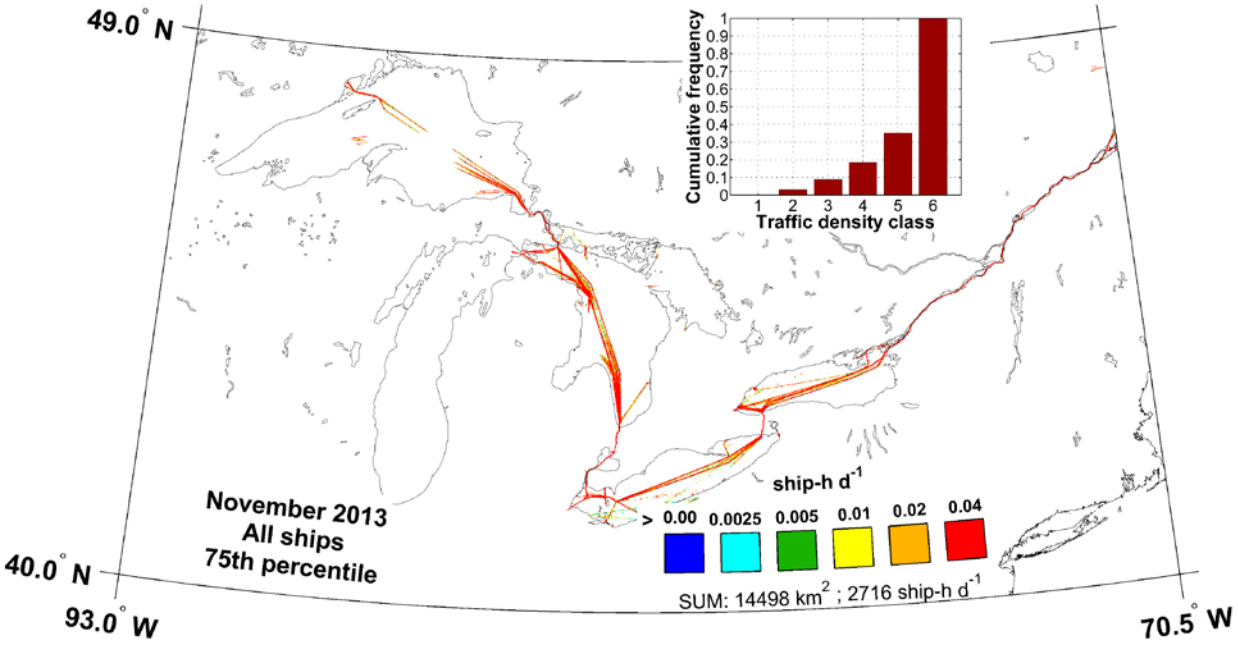

Figure 260. Map of the 75th percentile of the daily AIS traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

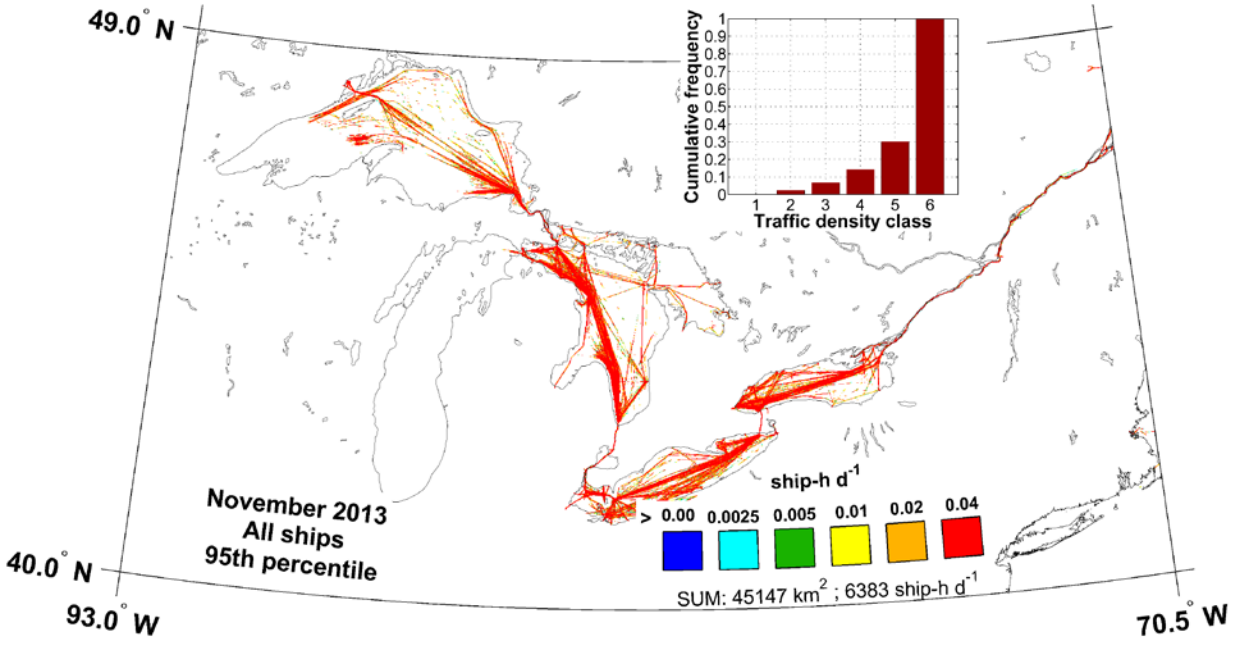

Figure 261. Map of the 95th percentile of the daily AIS traffic density of all ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

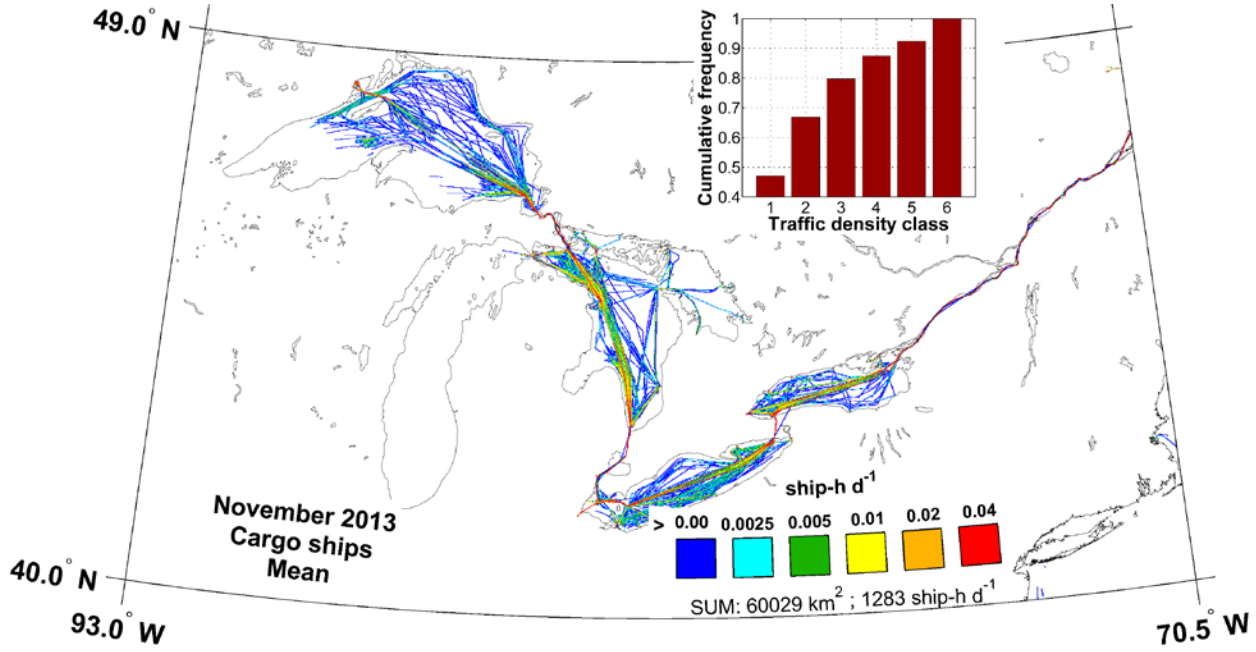

Figure 262. Map of AIS mean traffic density of cargo-type ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

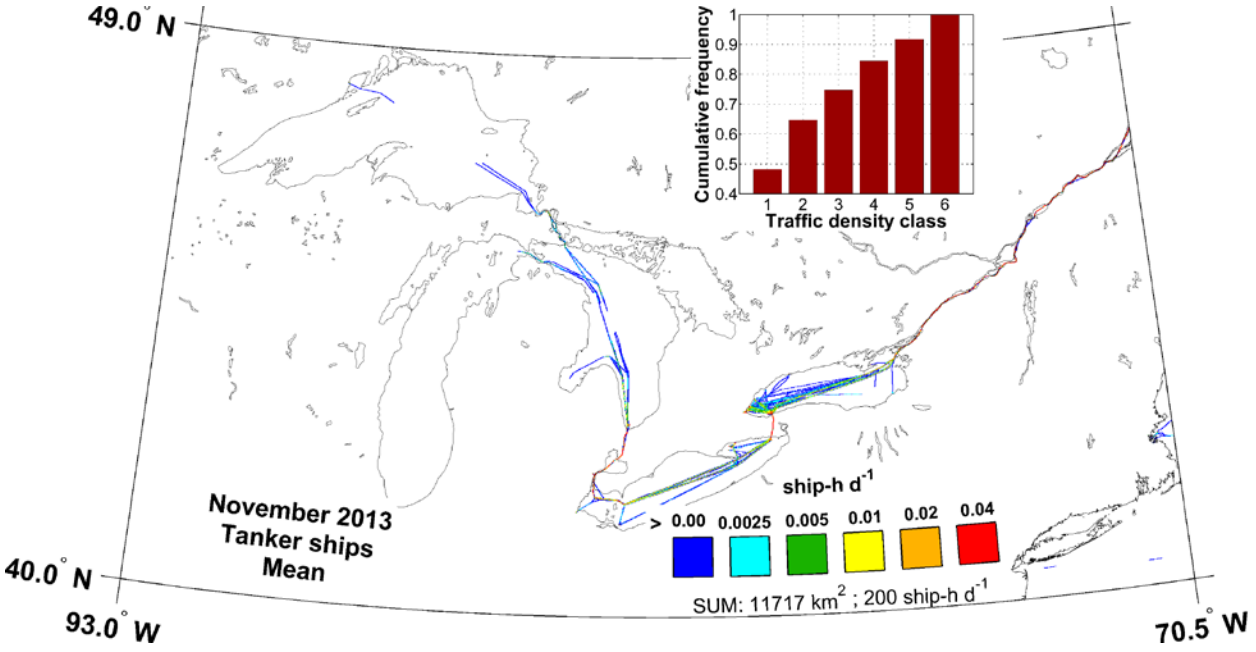

Figure 263. Map of AIS mean traffic density of tanker-type ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

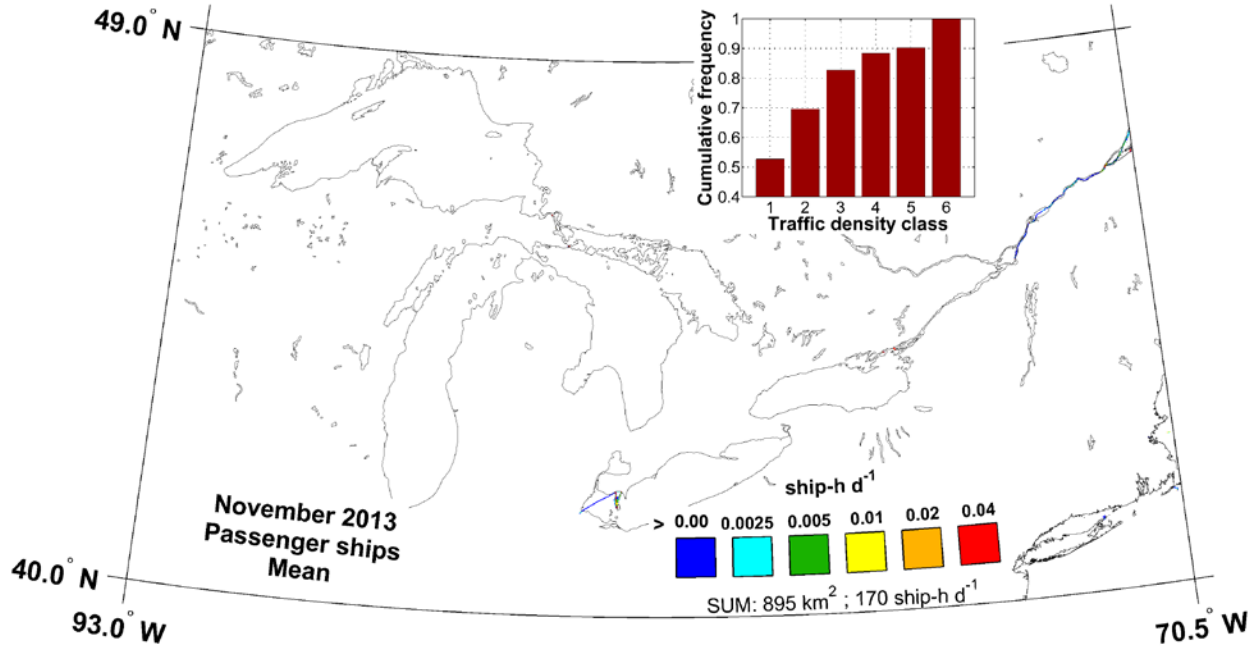

Figure 264. Map of AIS mean traffic density of passenger-type ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

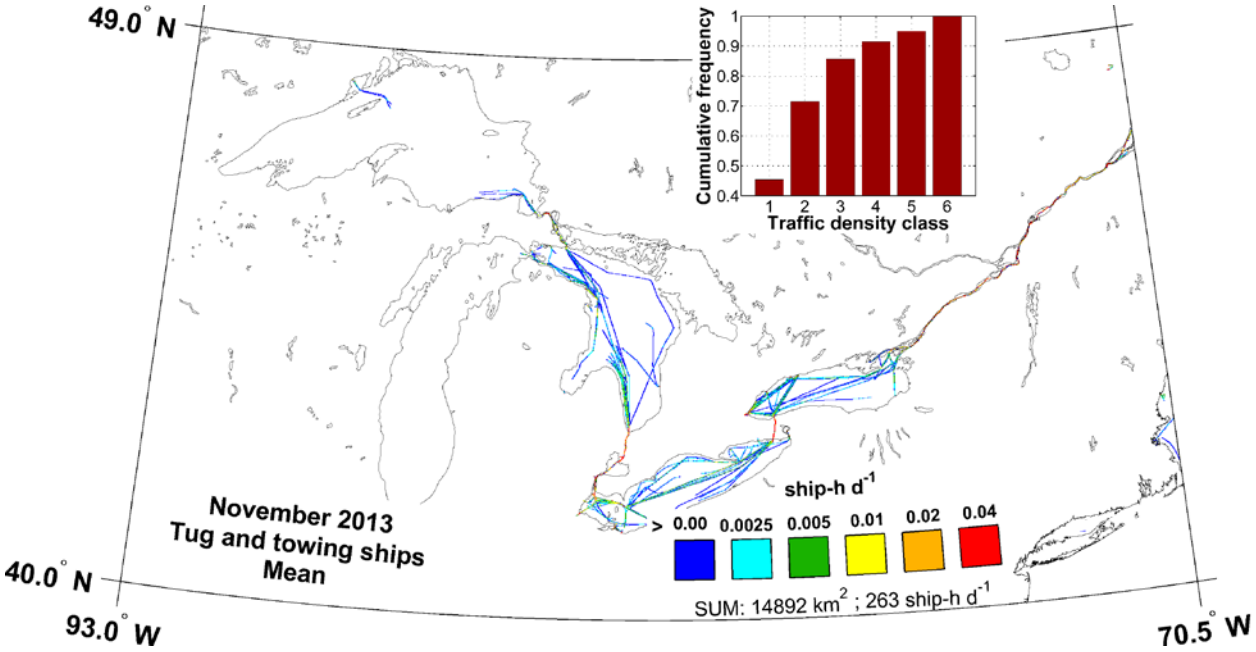

Figure 265. Map of AIS mean traffic density of tug and towing-type ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

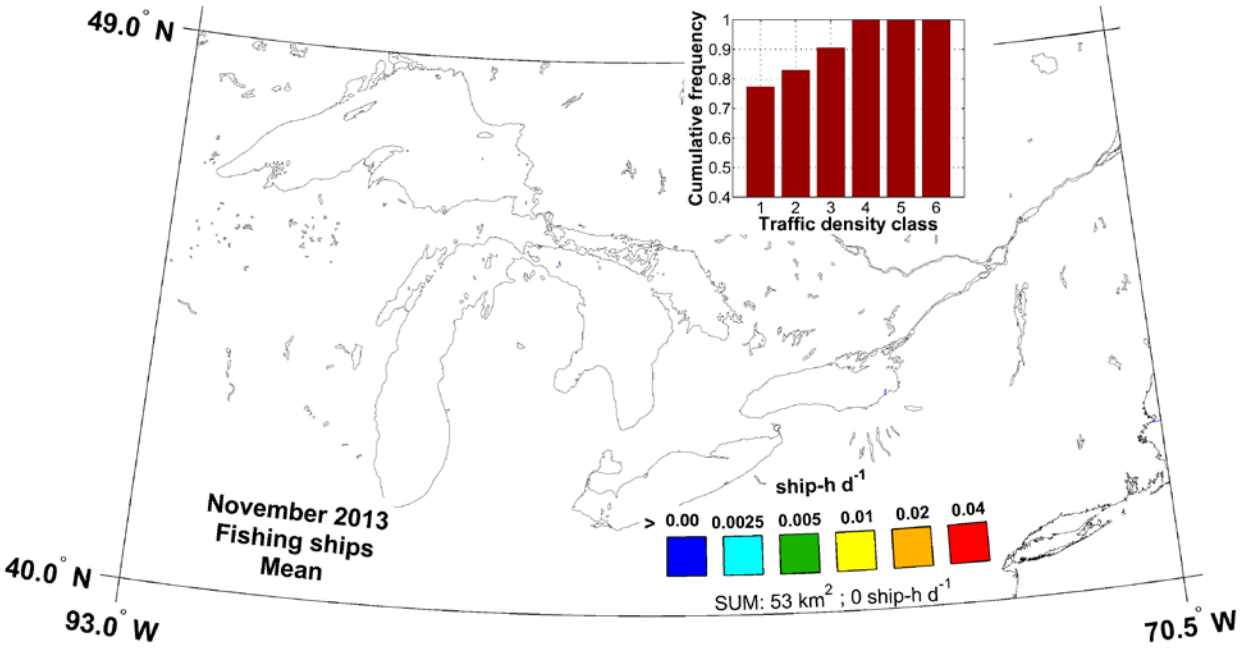

Figure 266. Map of AIS mean traffic density of fishing-type ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

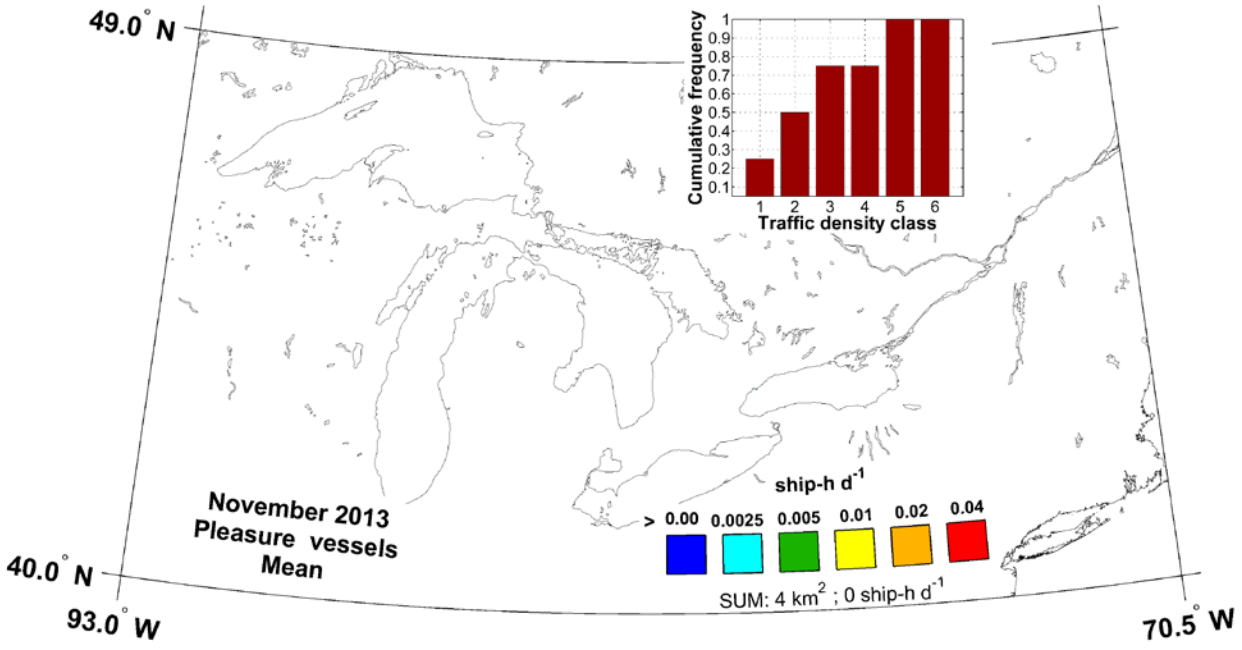

Figure 267. Map of AIS mean traffic density of pleasure-type vessels in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

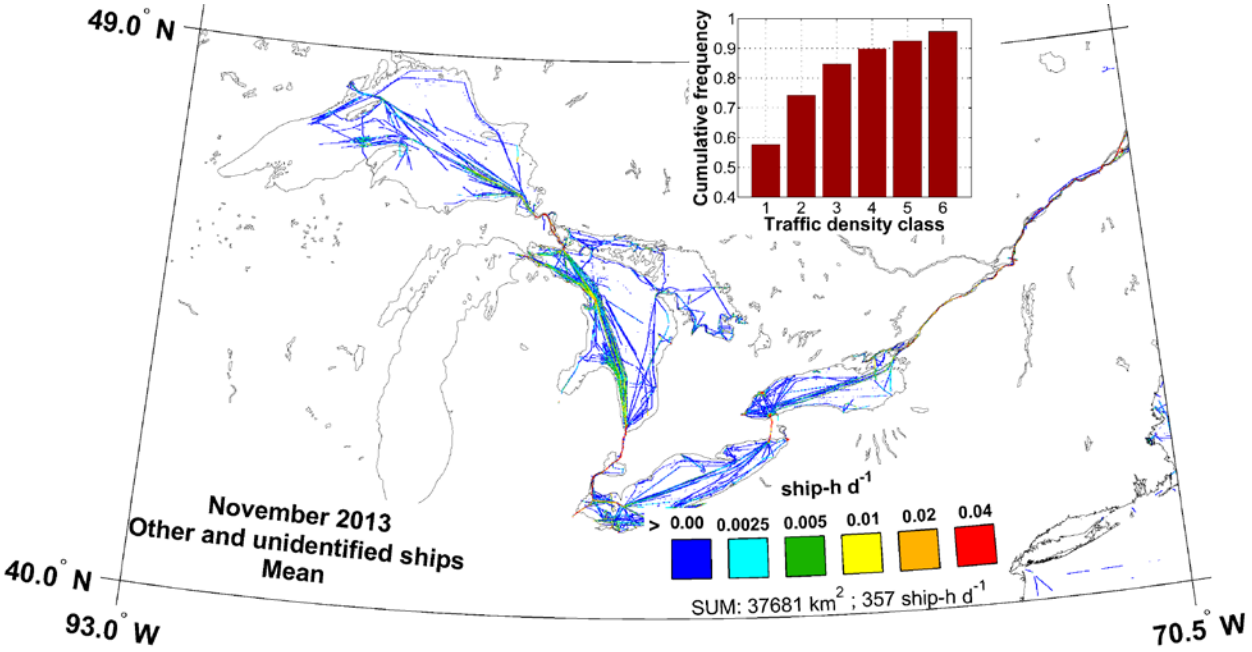

Figure 268. Map of AIS mean traffic density of other types of ships and ships of unidentified type in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

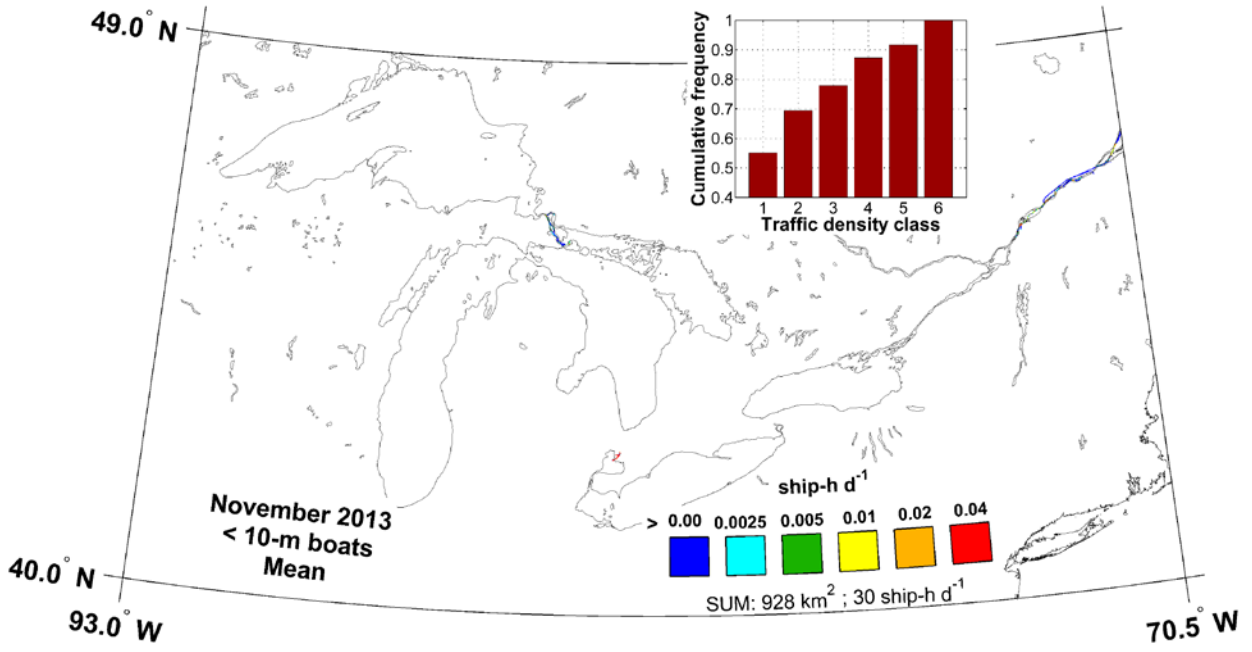

Figure 269. Map of AIS mean traffic density of ships with lengths < 10 m in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

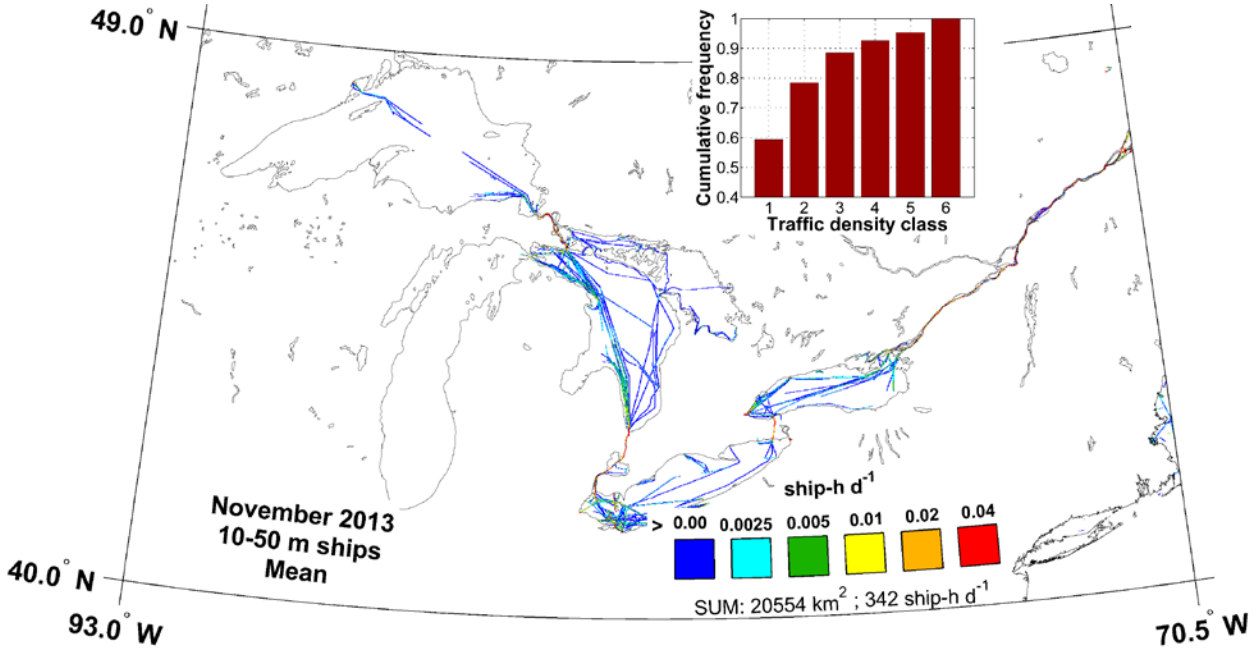

Figure 270. Map of AIS mean traffic density of 10 to 50 m ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

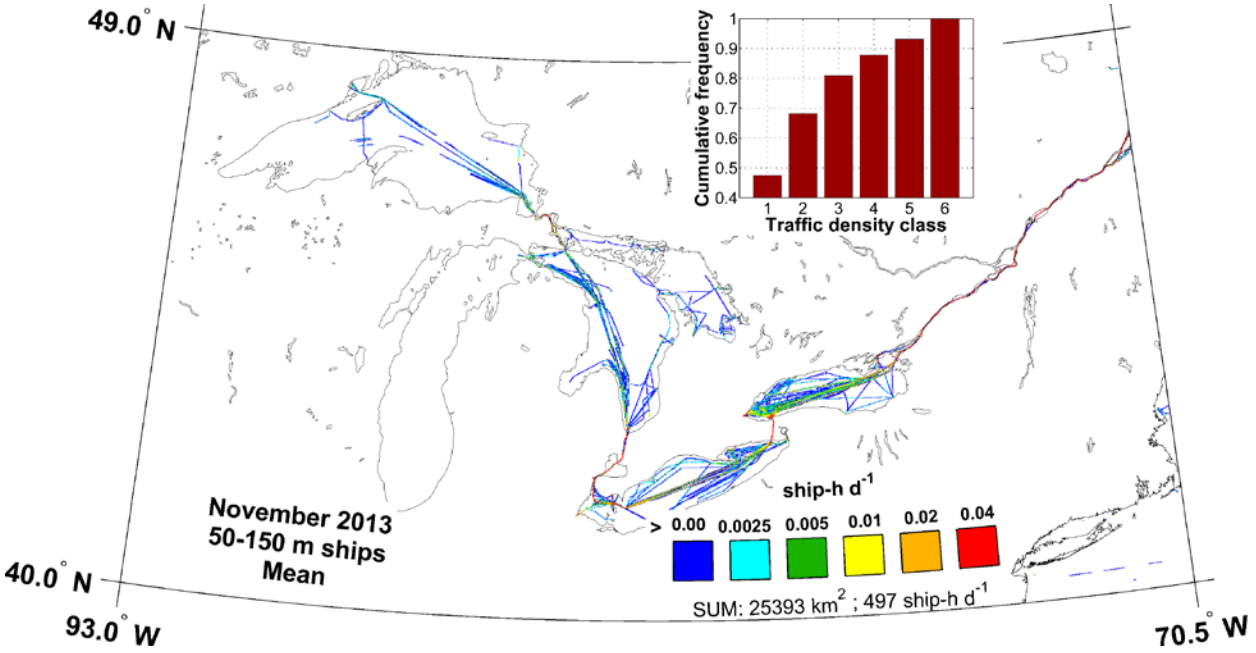

Figure 271. Map of AIS mean traffic density of 50 to 150 m ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

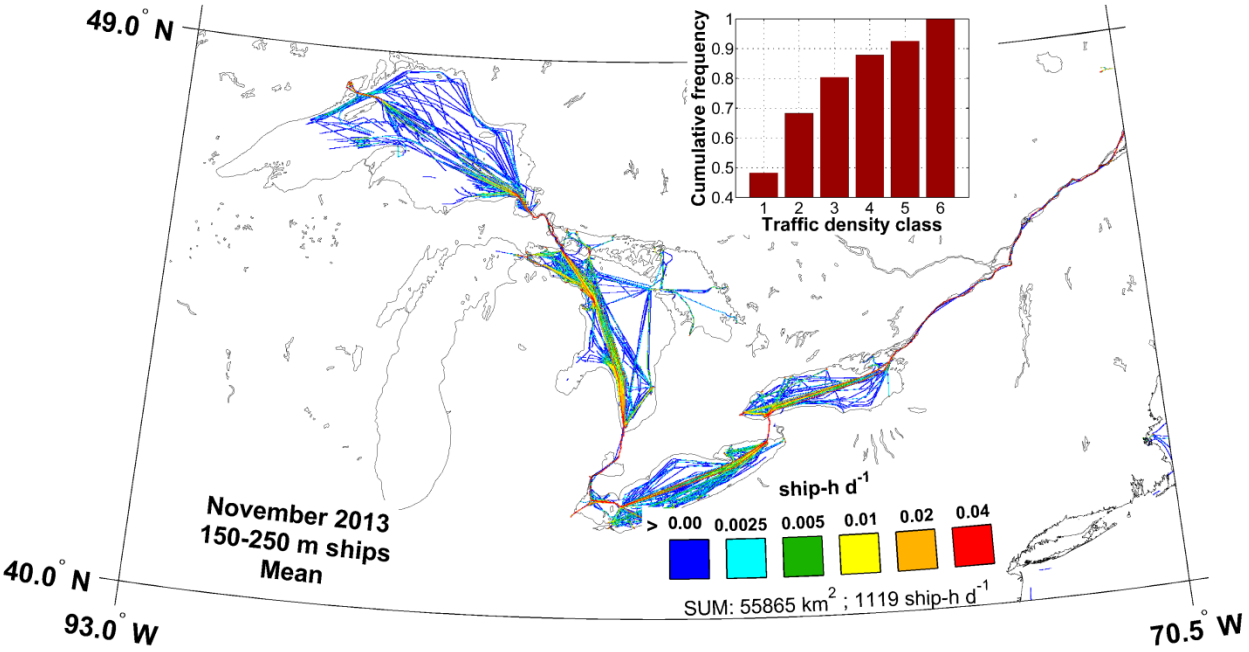

Figure 272. Map of AIS mean traffic density of 150 to 250 m ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

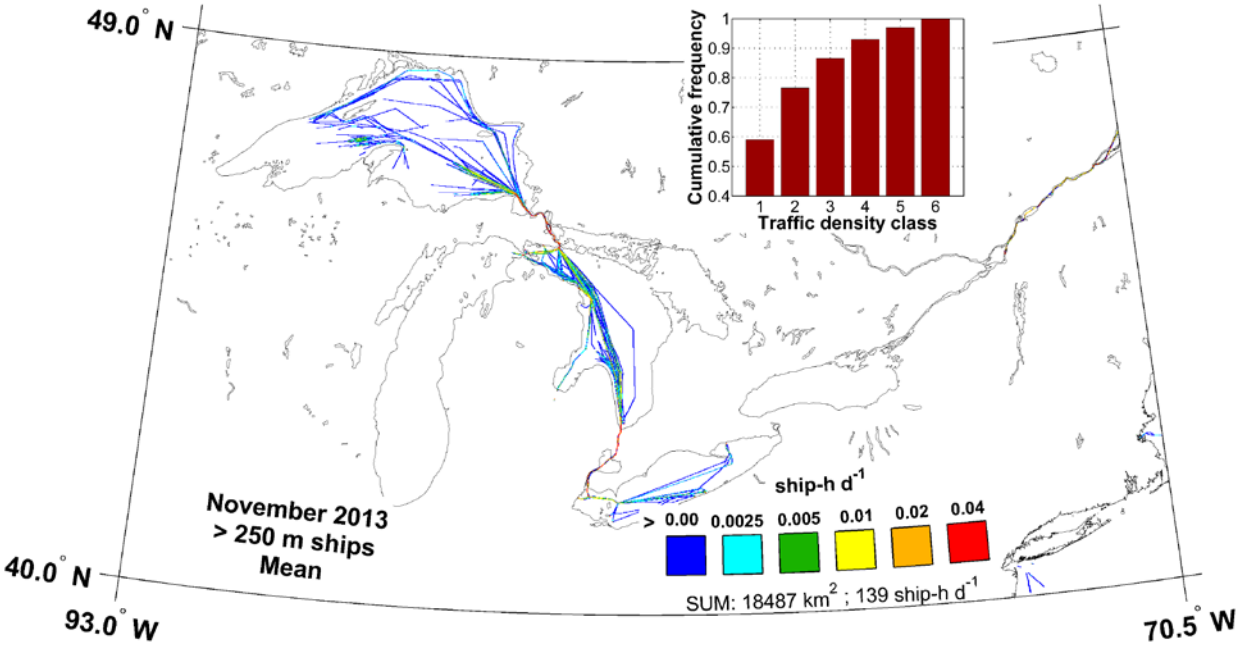

Figure 273. Map of AIS mean traffic density of > 250 m ships in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

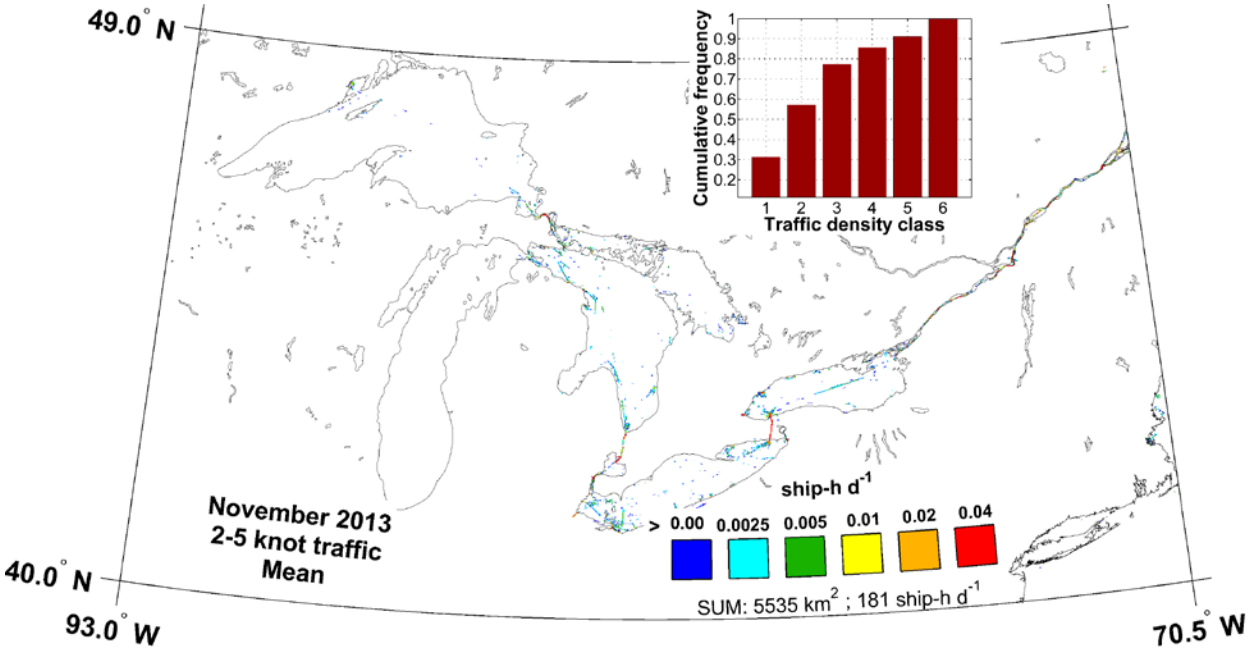

Figure 274. Map of 2–5 knot AIS mean traffic density in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

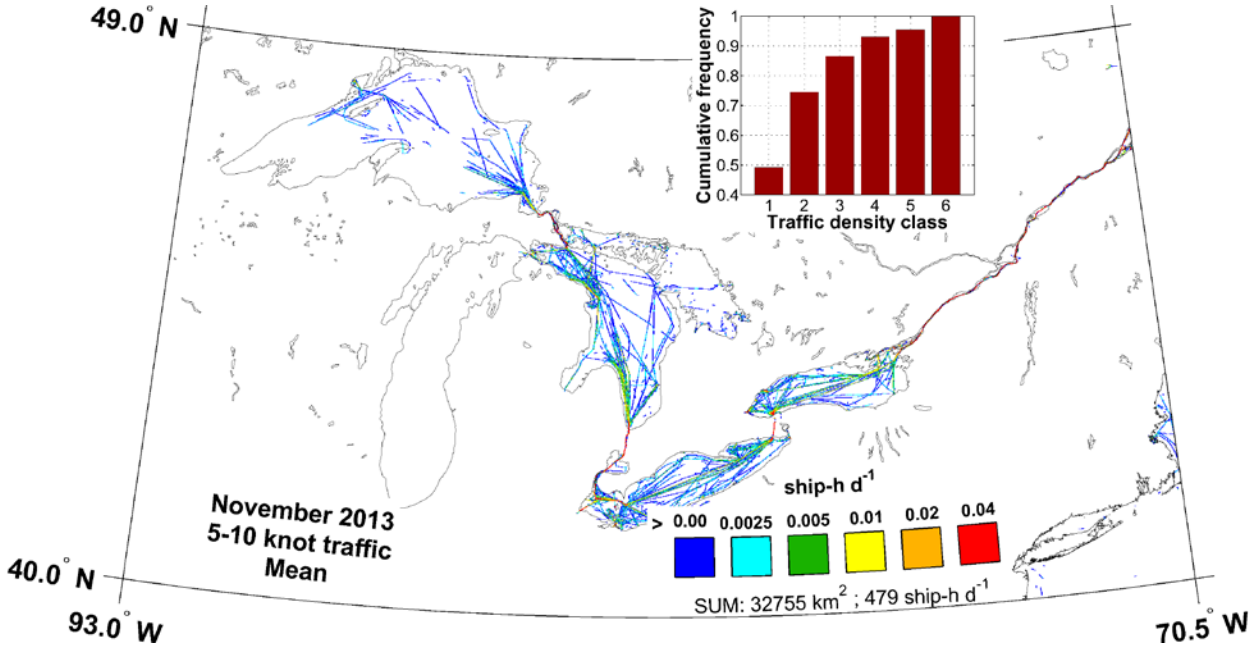

Figure 275. Map of 5–10 knot AIS mean traffic density in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

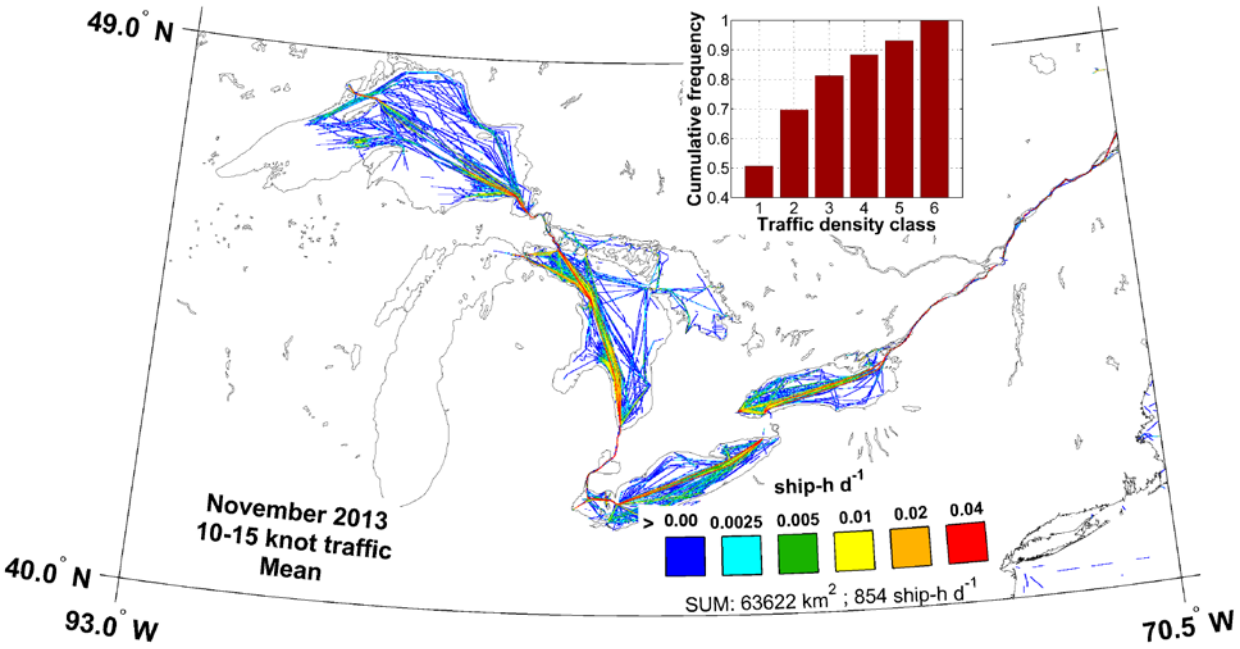

Figure 276. Map of 10–15 knot AIS mean traffic density in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

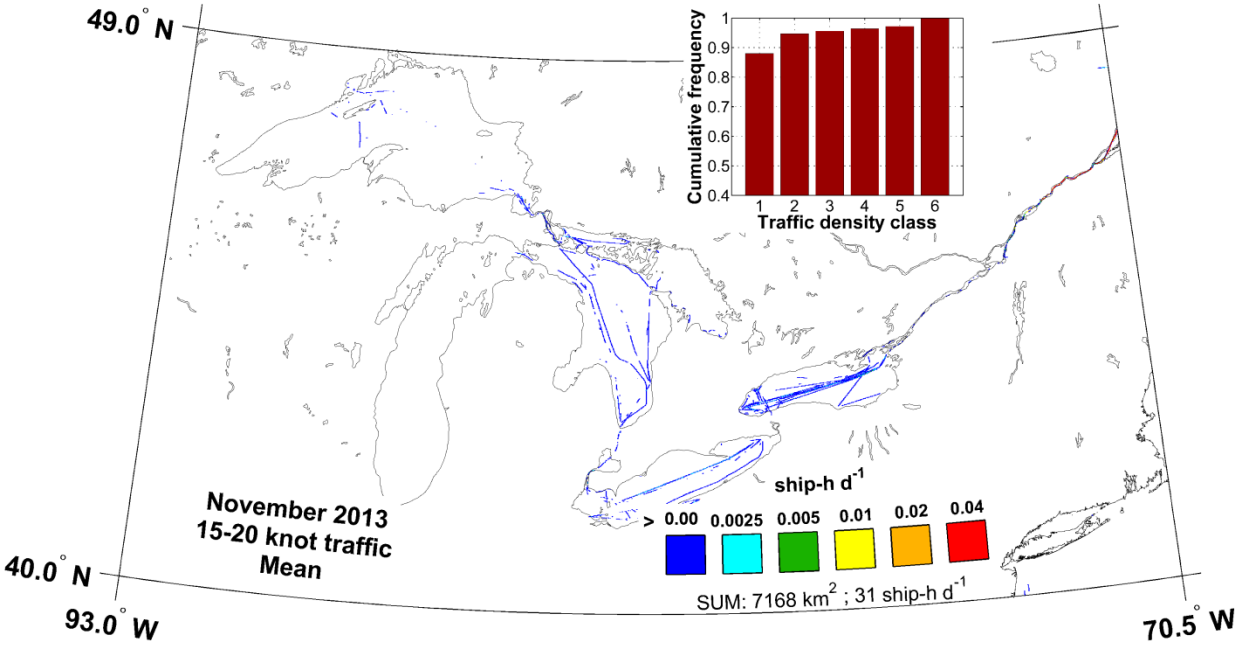

Figure 277. Map of 15–20 knot AIS mean traffic density in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

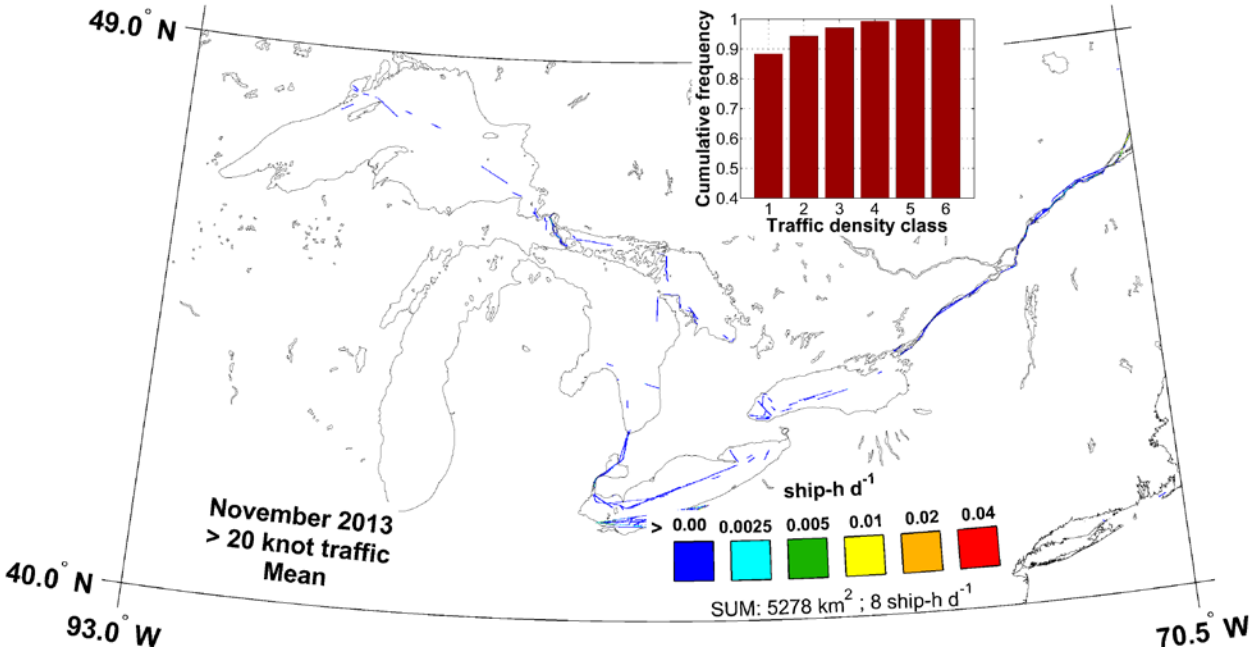

Figure 278. Map of >20 knot AIS mean traffic density in November 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

8.12. December 2013

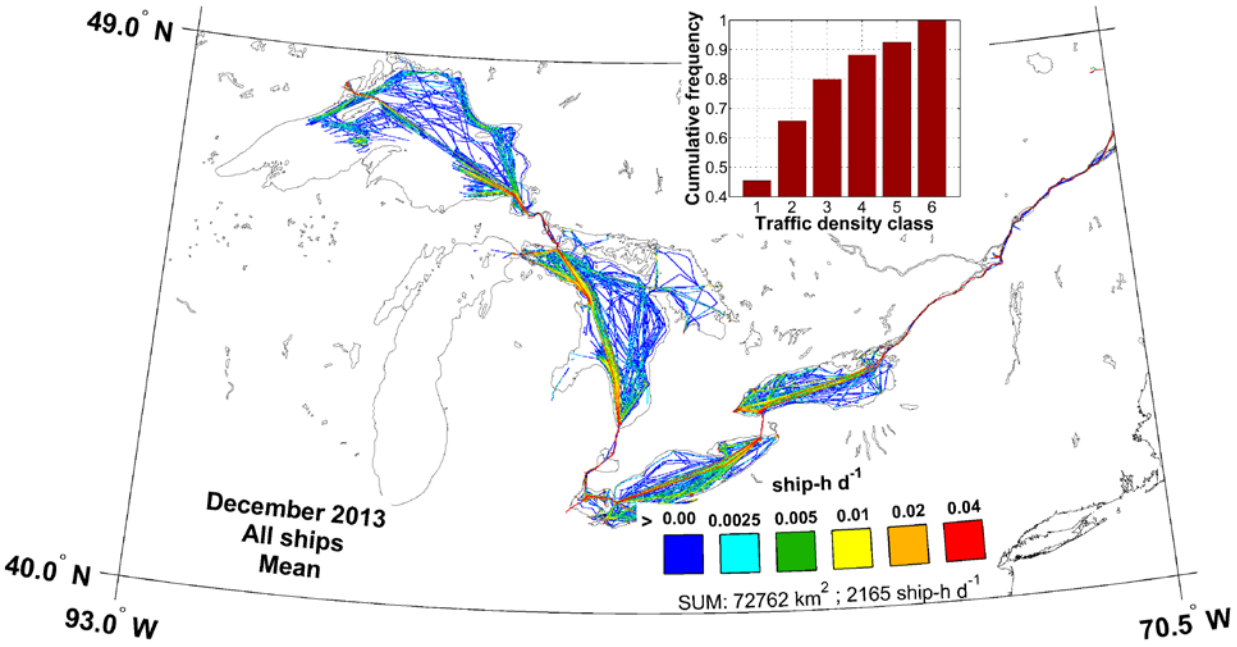

Figure 279. Map of AIS mean traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

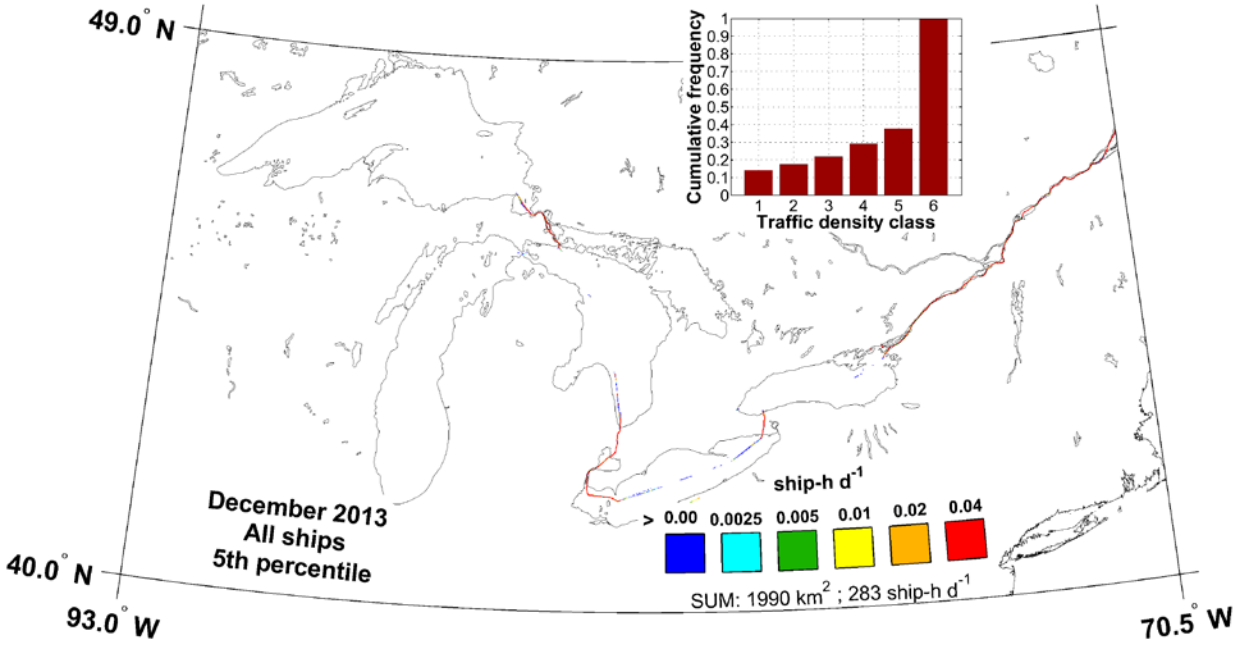

Figure 280. Map of the 5th percentile of the daily AIS traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 95% of the time, the traffic at a given location is higher than the displayed value; 5% of the time it is lower.

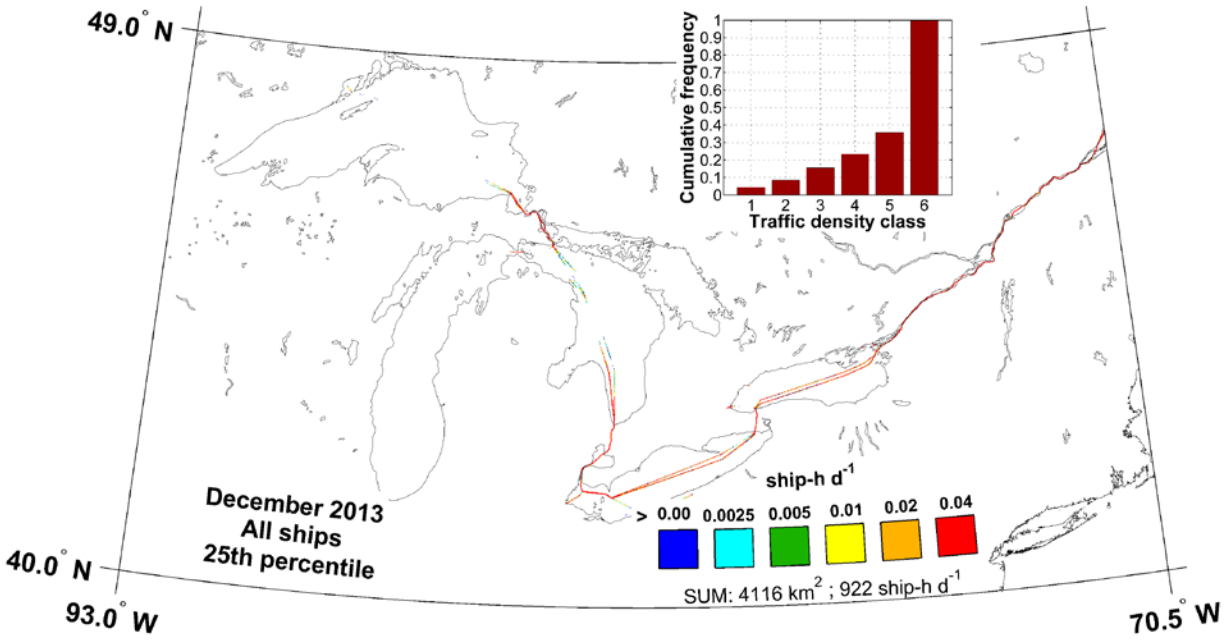

Figure 281. Map of the 25th percentile of the daily AIS traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 75% of the time, the traffic at a given location is higher than the displayed value; 25% of the time it is lower.

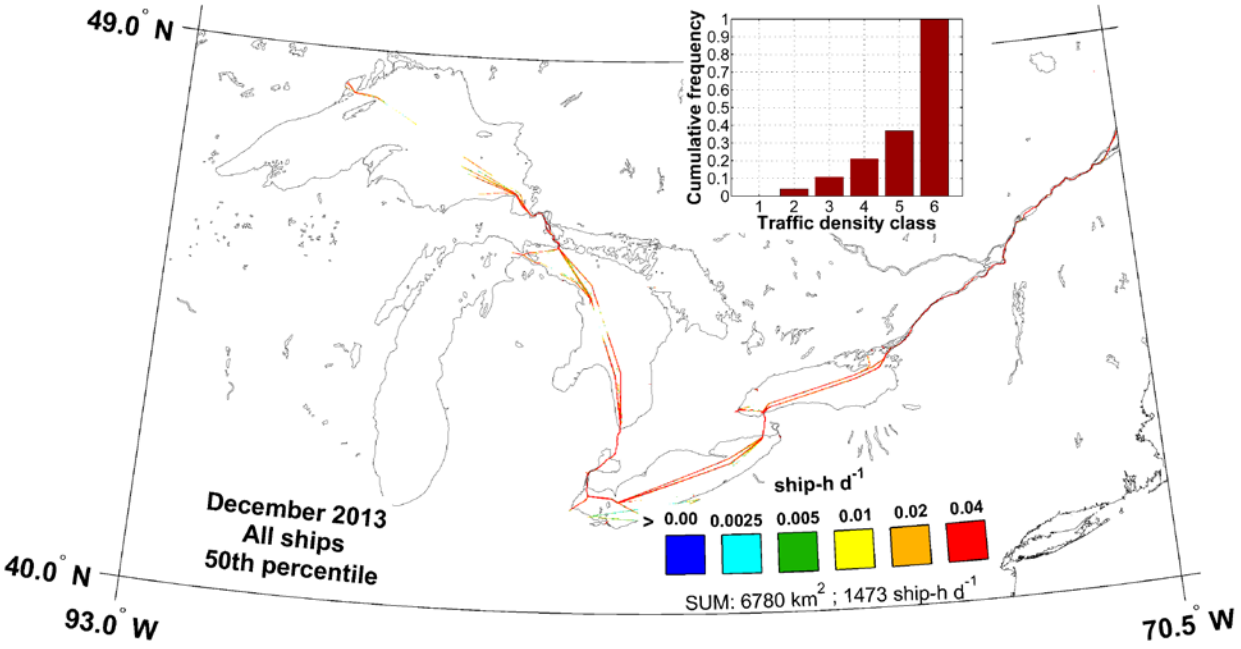

Figure 282. Map of the 50th percentile of the daily AIS traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 50% of the time, the traffic at a given location is higher than the displayed value; 50% of the time it is lower.

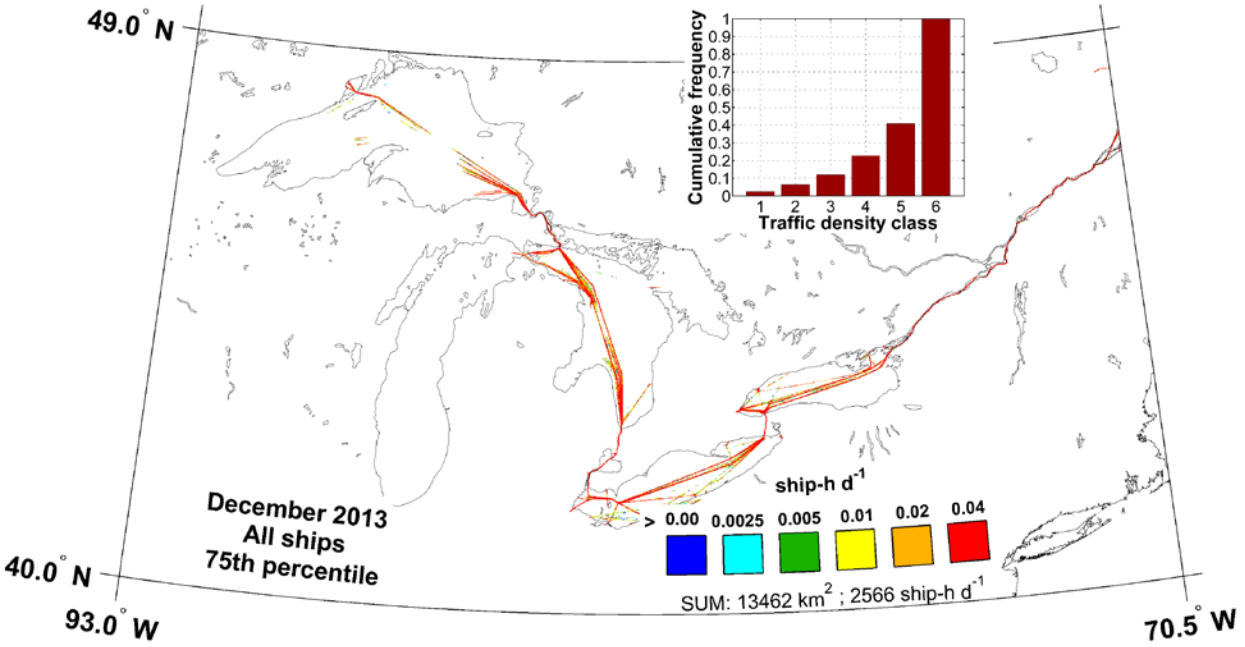

Figure 283. Map of the 75th percentile of the daily AIS traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 25% of the time, the traffic at a given location is higher than the displayed value; 75% of the time it is lower.

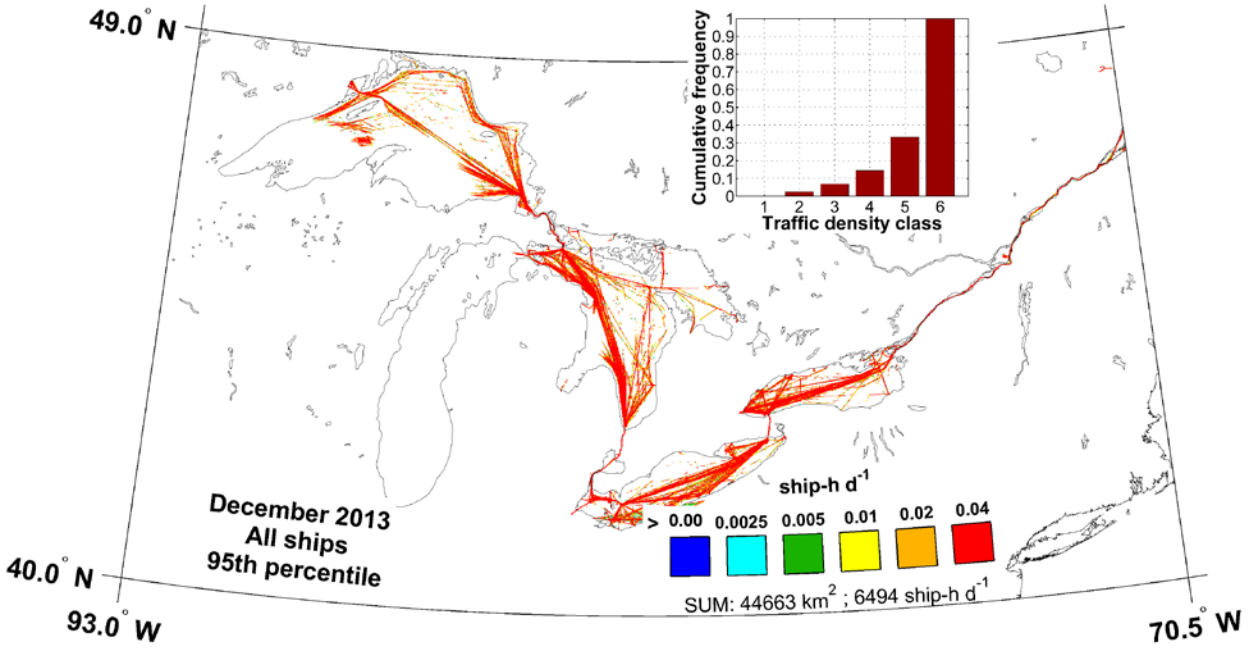

Figure 284. Map of the 95th percentile of the daily AIS traffic density of all ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}). Interpretation: 5% of the time, the traffic at a given location is higher than the displayed value; 95% of the time it is lower.

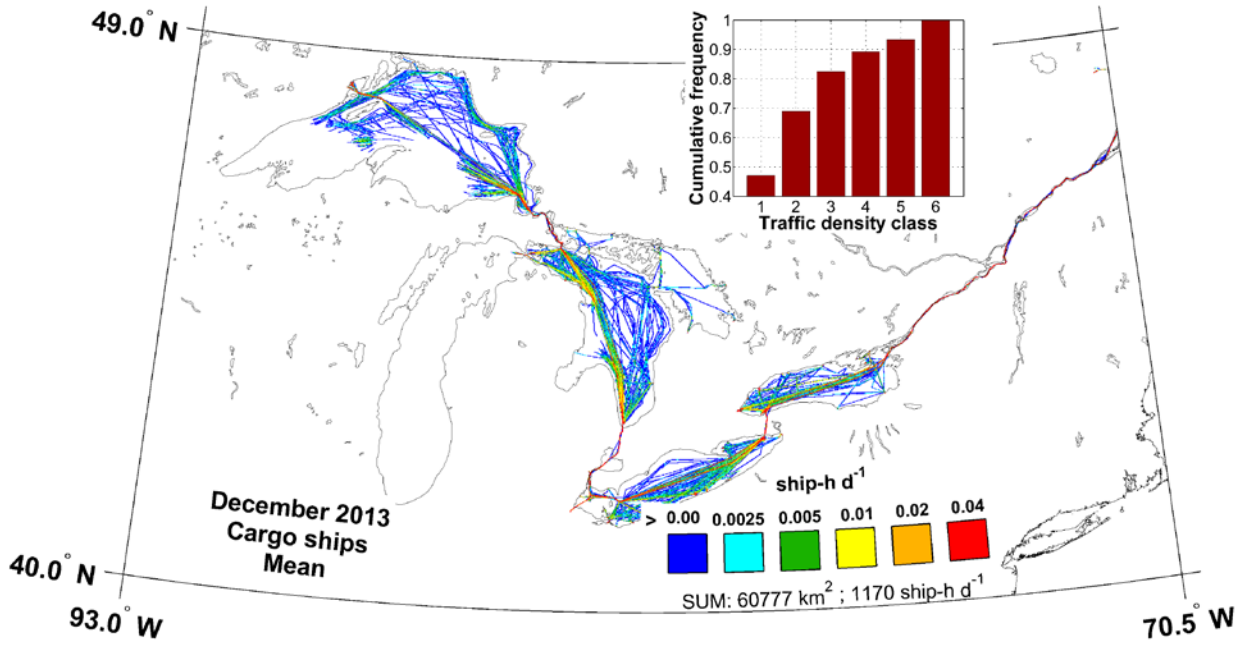

Figure 285. Map of AIS mean traffic density of cargo-type ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

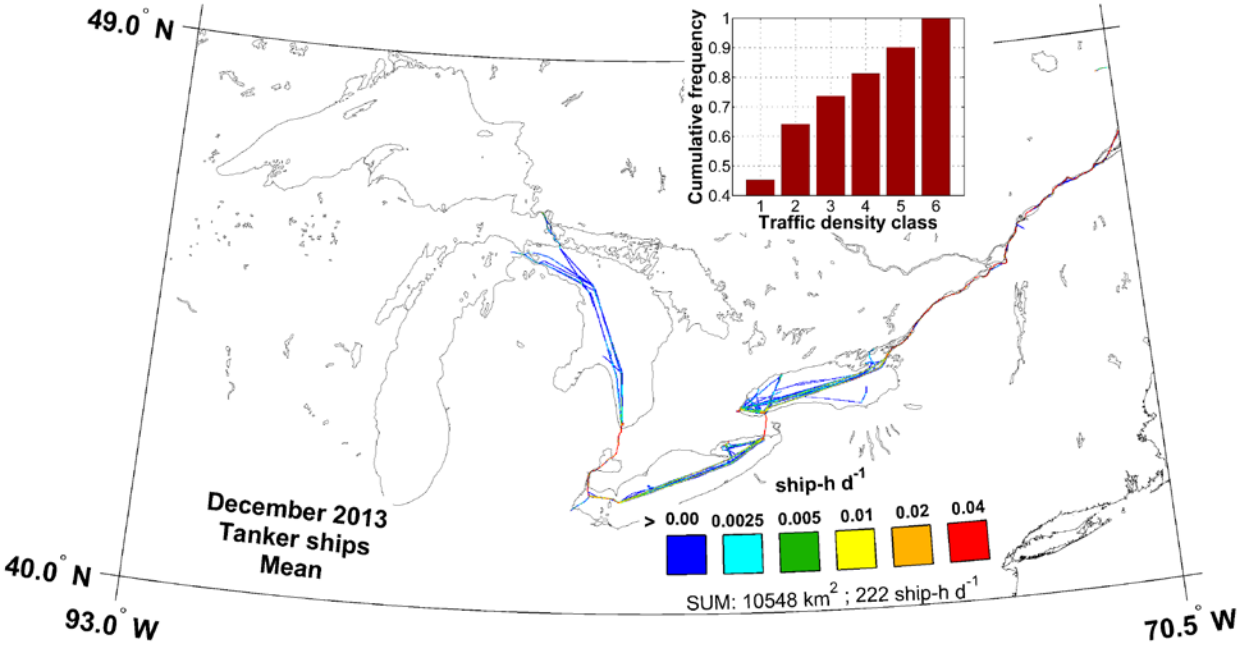

Figure 286. Map of AIS mean traffic density of tanker-type ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

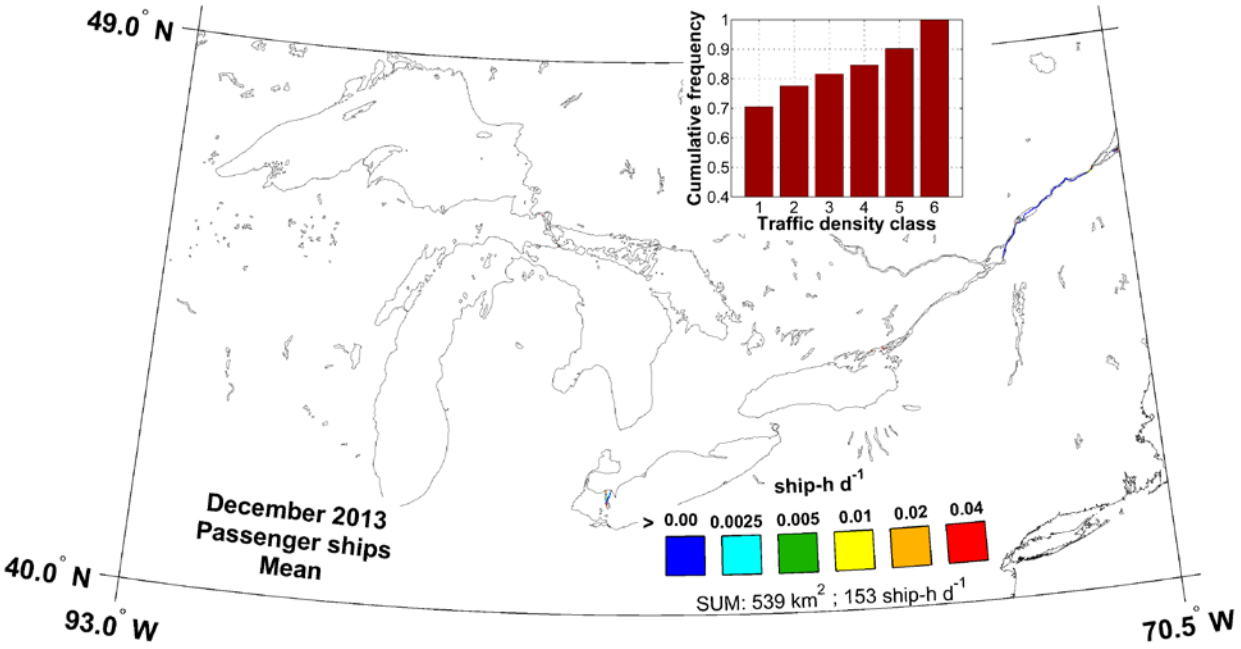

Figure 287. Map of AIS mean traffic density of passenger-type ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

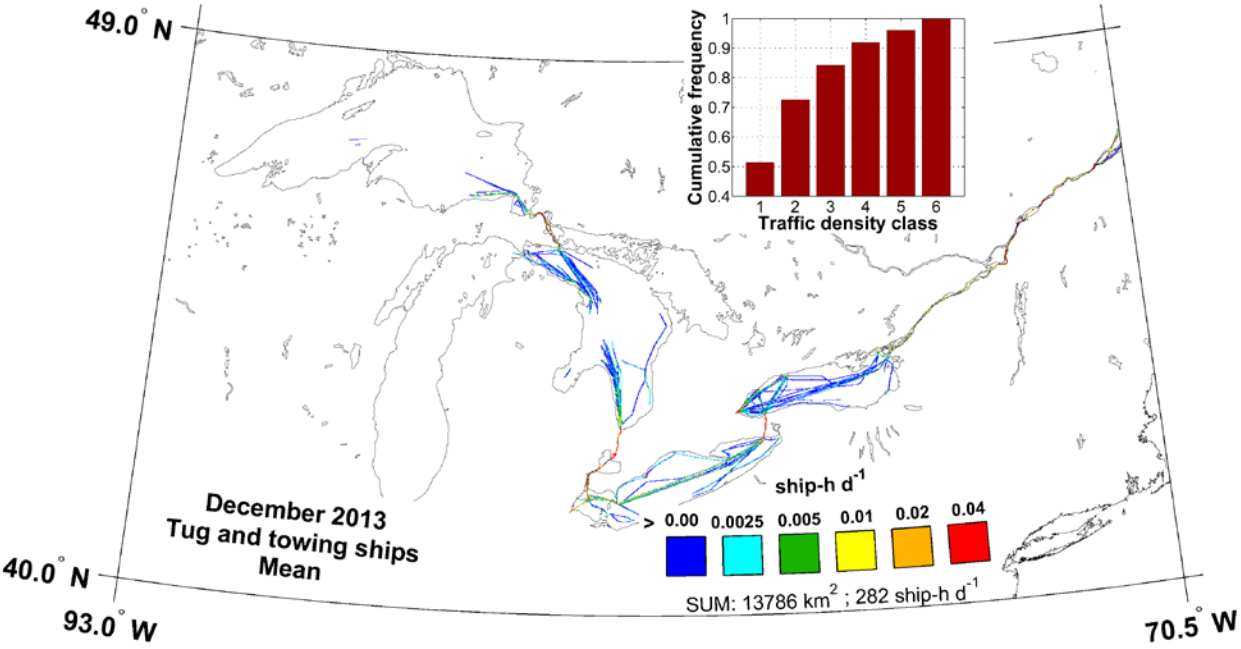

Figure 288. Map of AIS mean traffic density of tug and towing-type ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

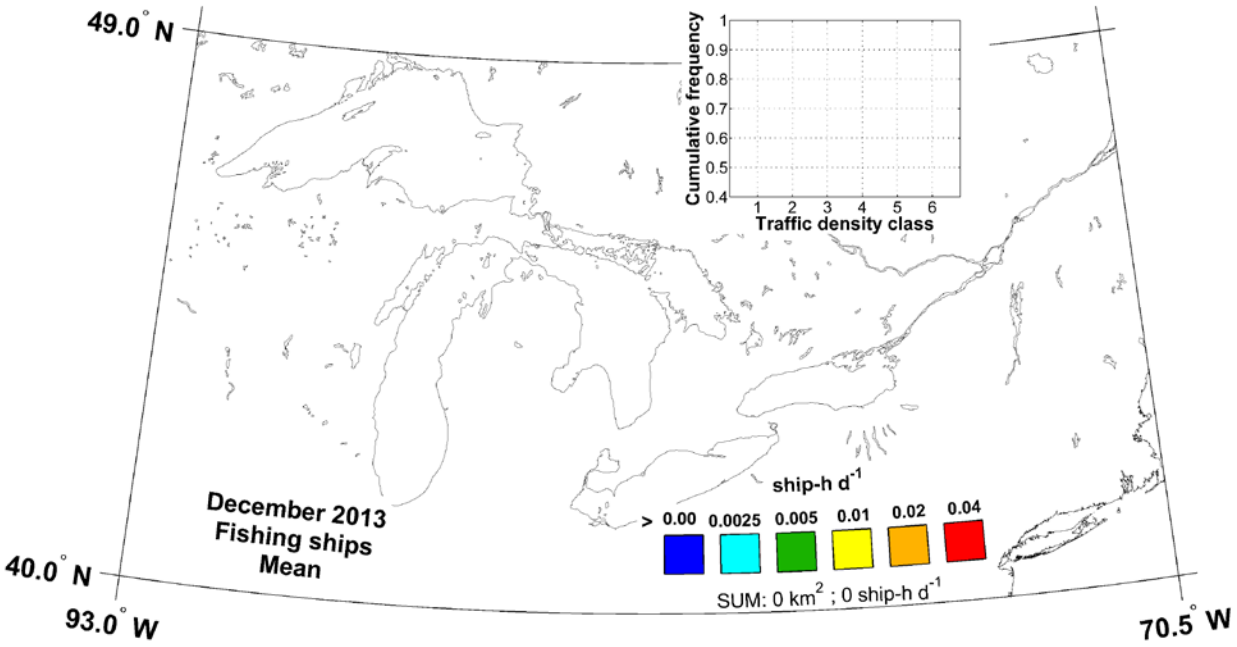

Figure 289. Map of AIS mean traffic density of fishing-type ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

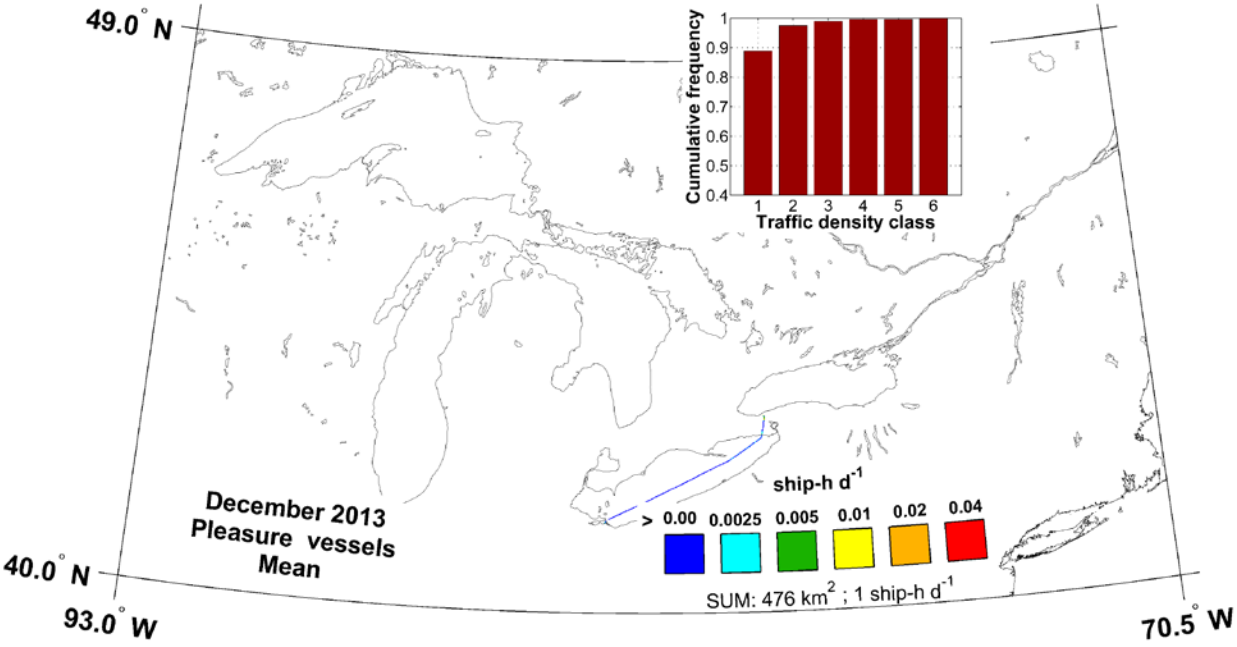

Figure 290. Map of AIS mean traffic density of pleasure-type vessels in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

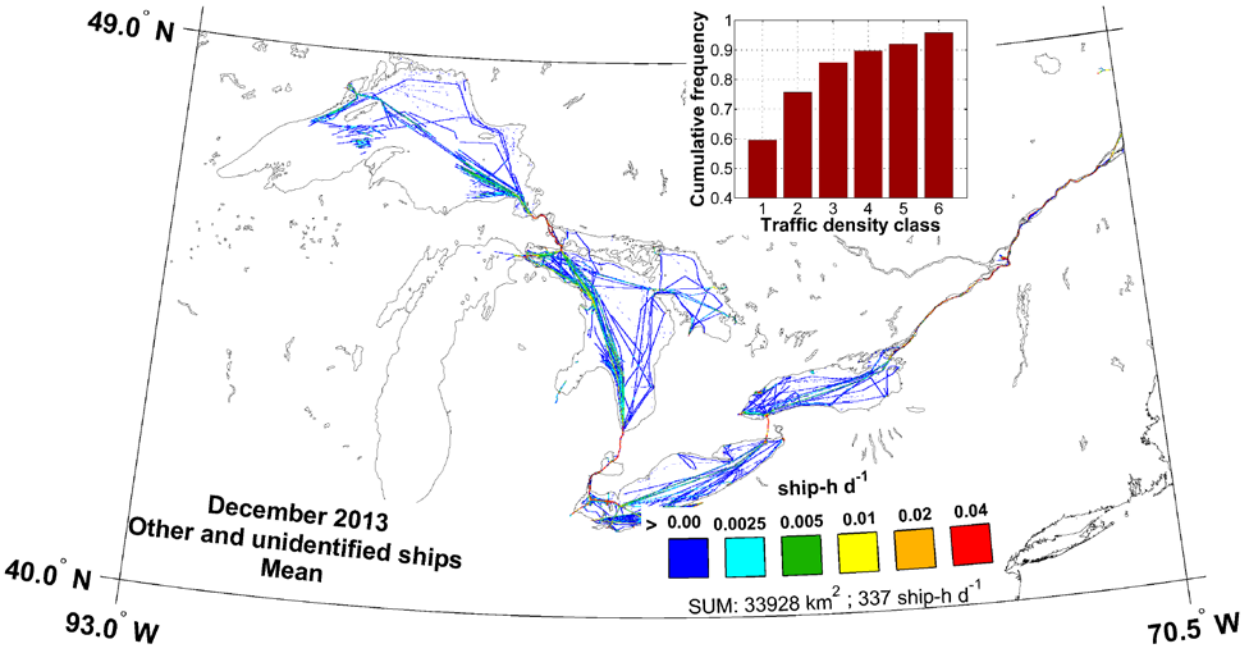

Figure 291. Map of AIS mean traffic density of other types of ships and ships of unidentified type in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

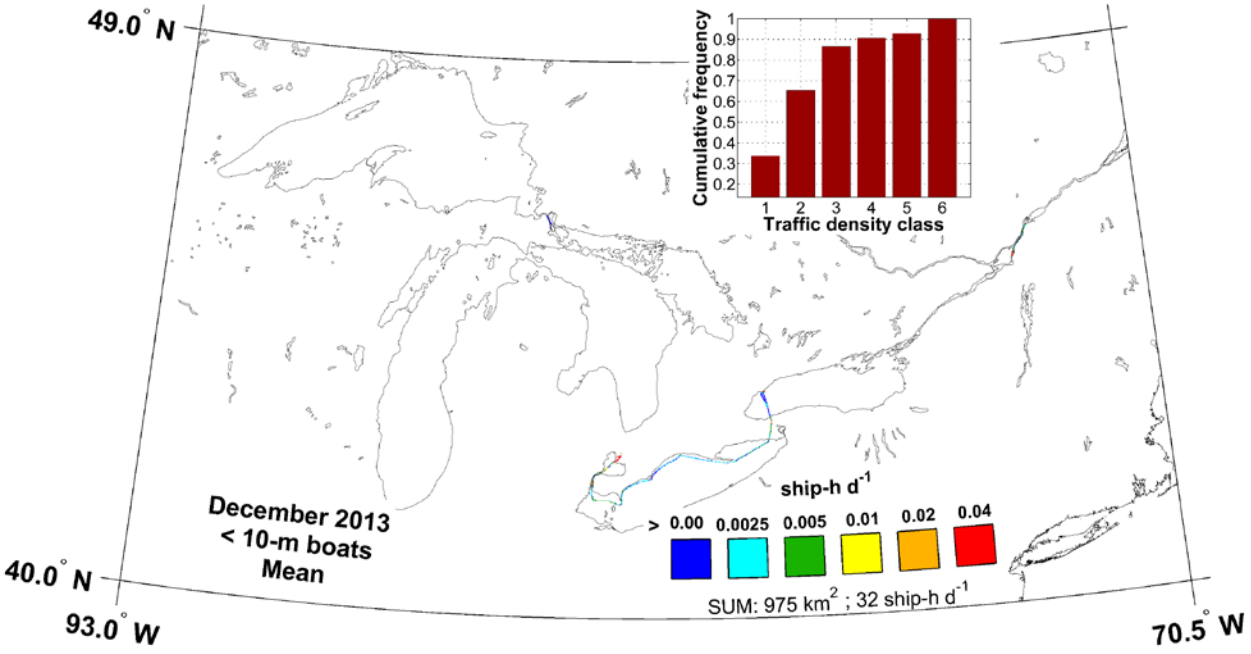

Figure 292. Map of AIS mean traffic density of ships with lengths < 10 m in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

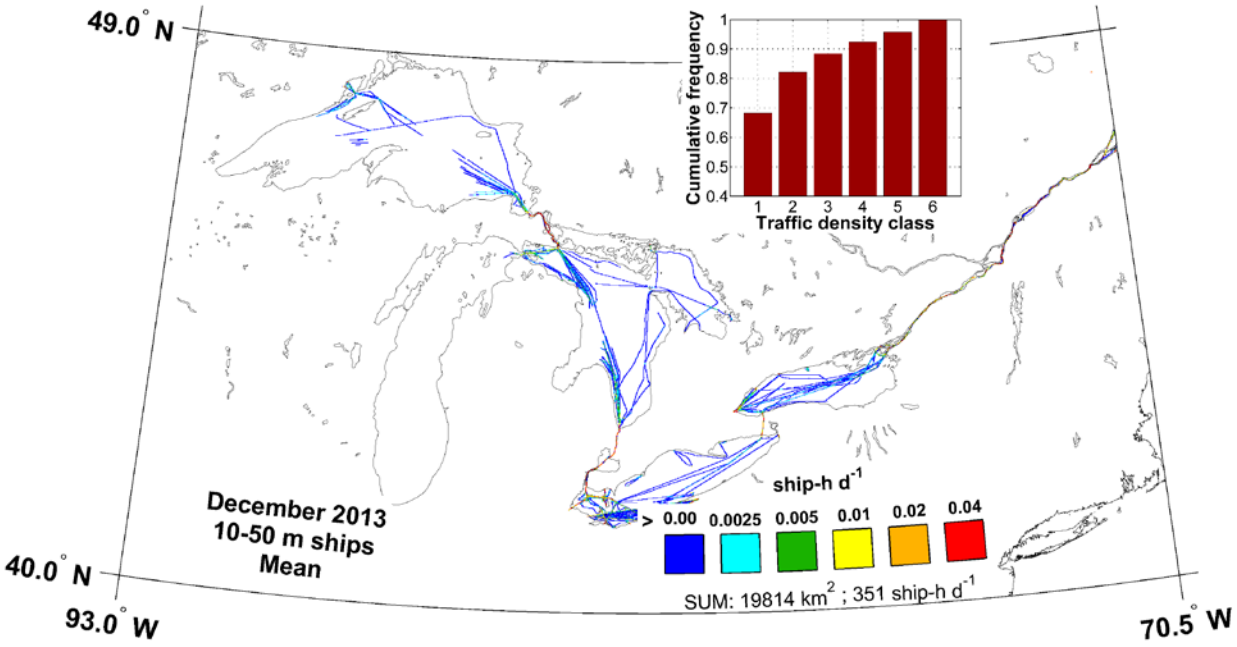

Figure 293. Map of AIS mean traffic density of 10 to 50 m ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

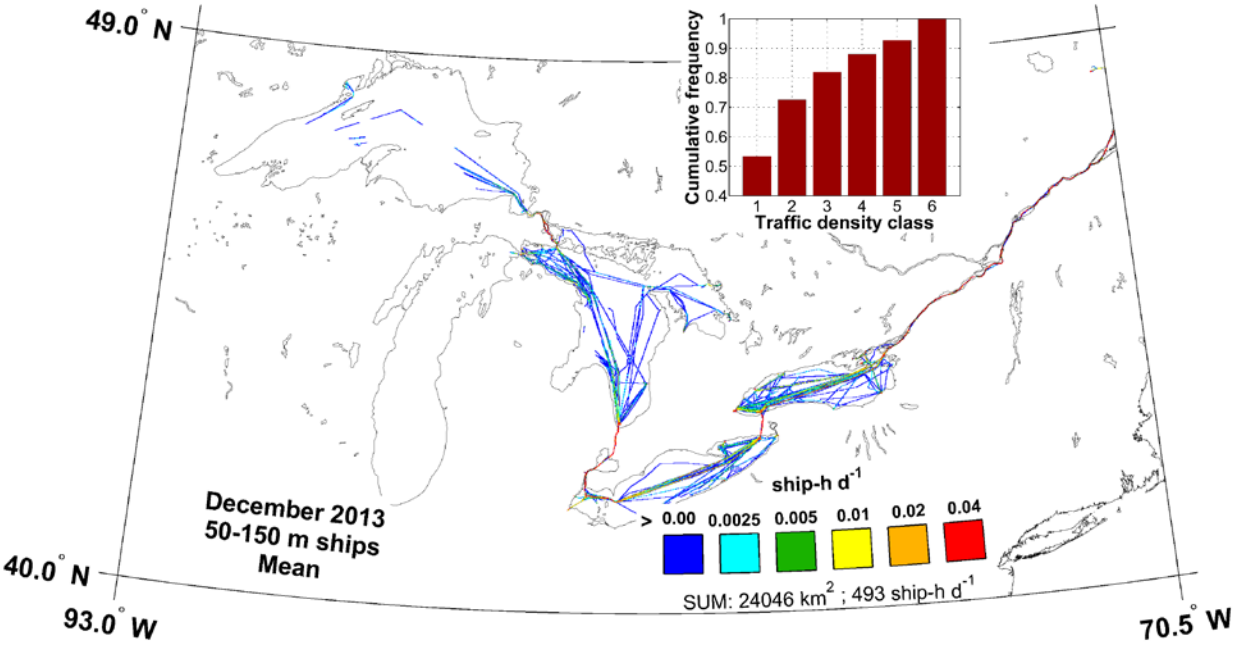

Figure 294. Map of AIS mean traffic density of 50 to 150 m ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

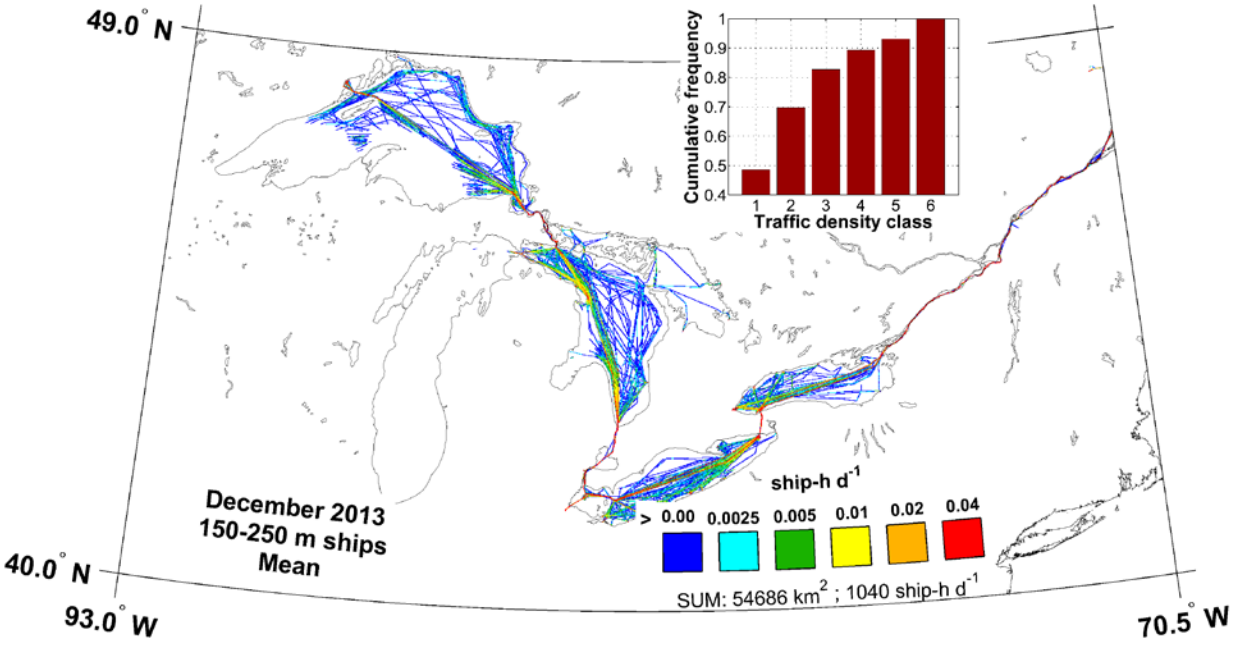

Figure 295. Map of AIS mean traffic density of 150 to 250 m ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

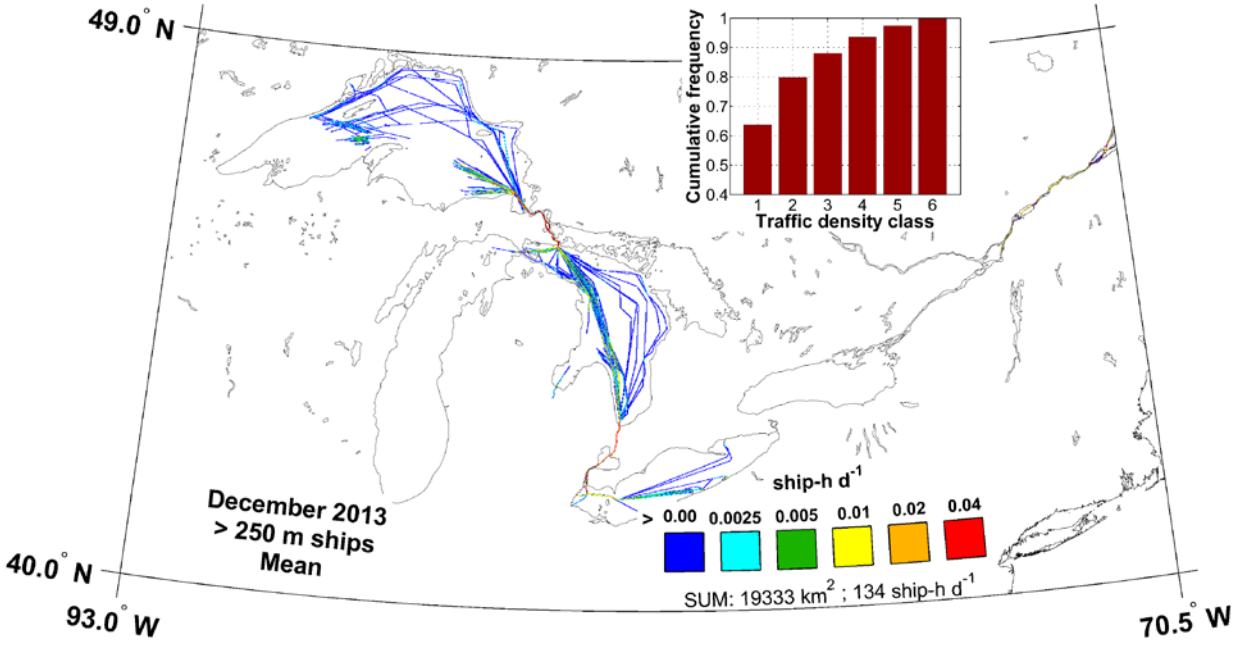

Figure 296. Map of AIS mean traffic density of > 250 m ships in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

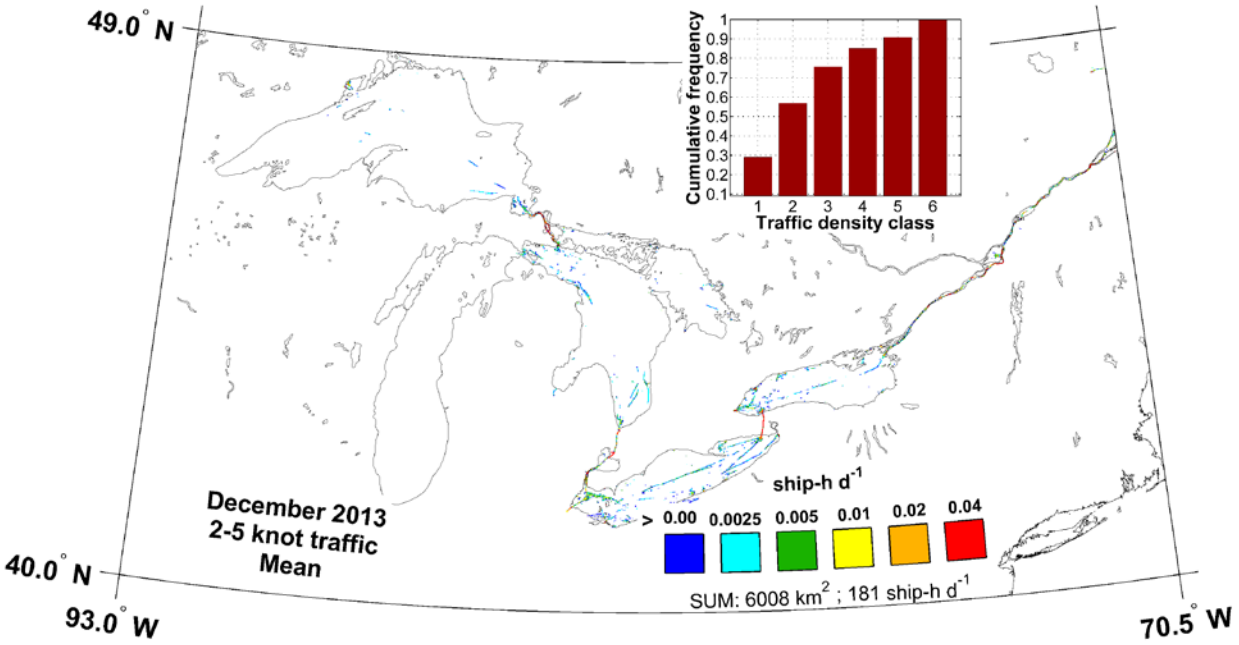

Figure 297. Map of 2–5 knot AIS mean traffic density in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

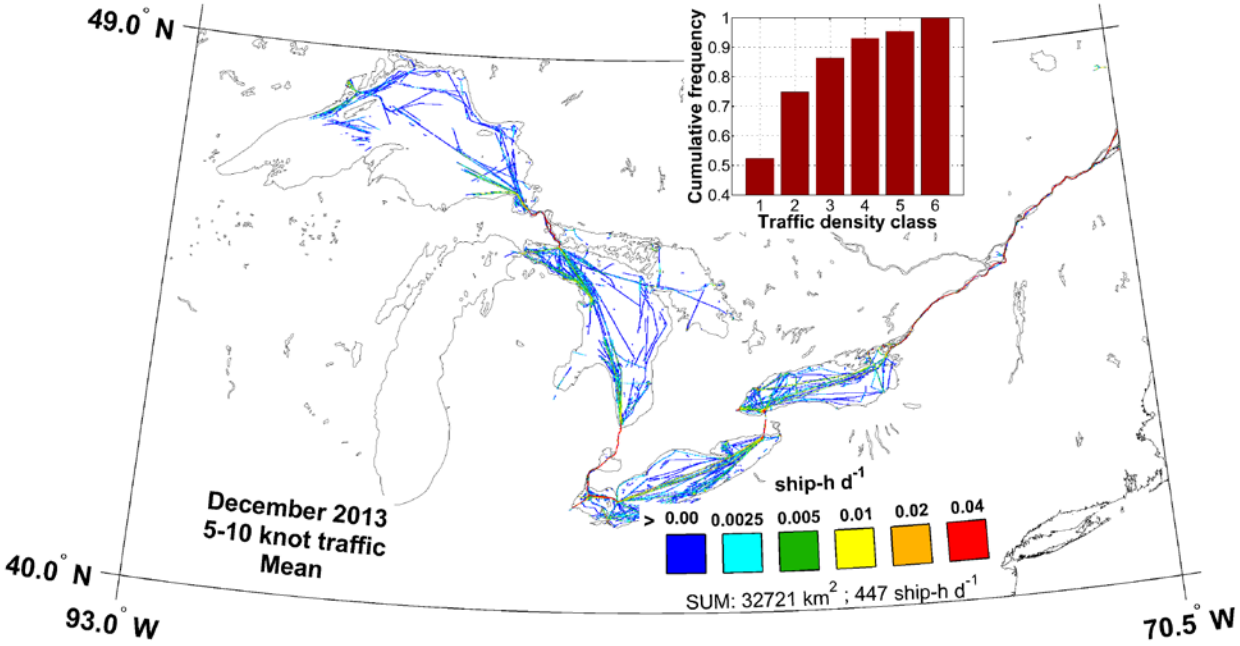

Figure 298. Map of 5–10 knot AIS mean traffic density in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

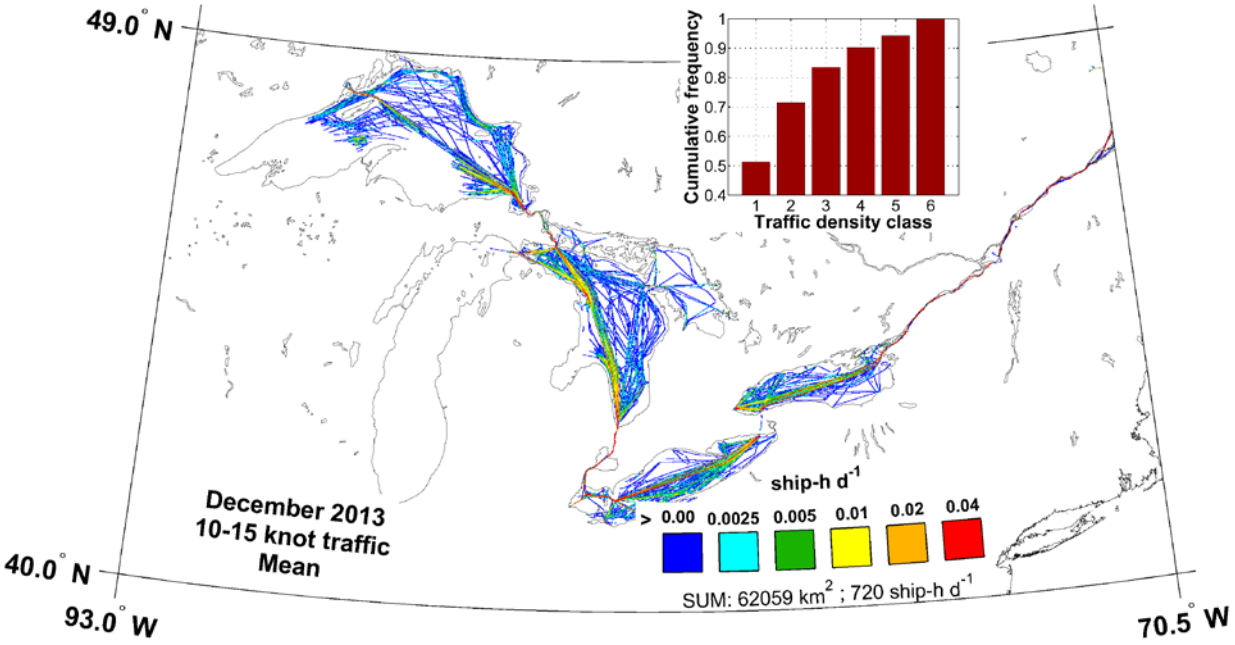

Figure 299. Map of 10–15 knot AIS mean traffic density in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

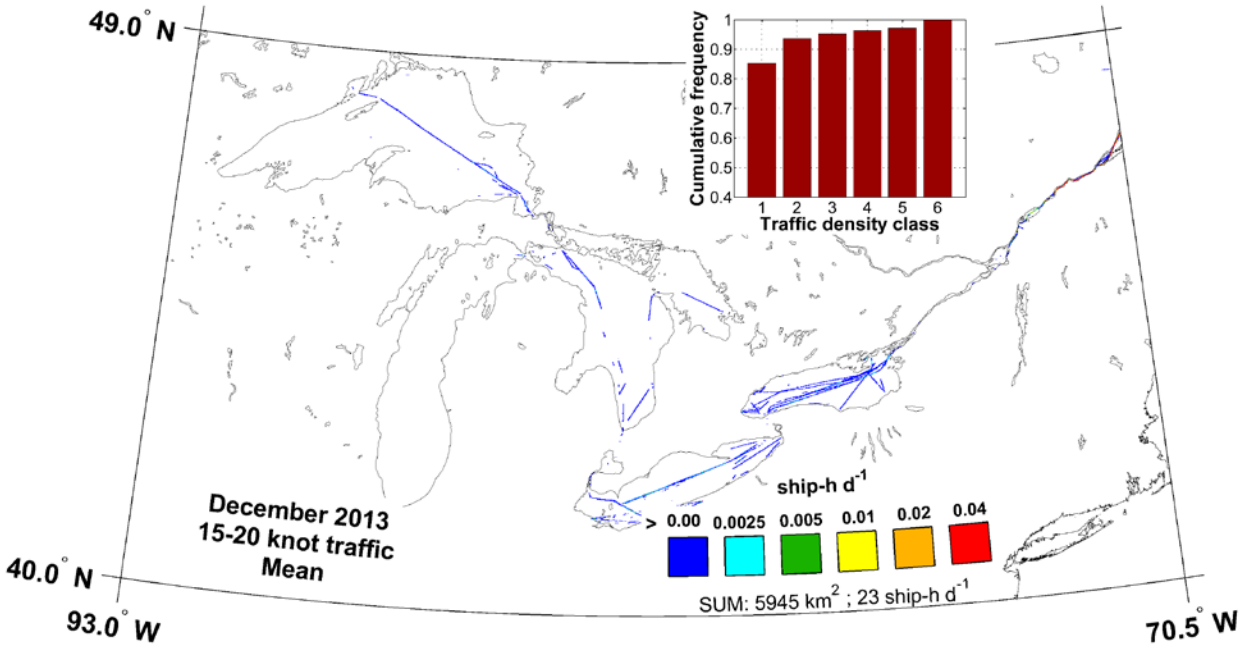

Figure 300. Map of 15–20 knot AIS mean traffic density in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).

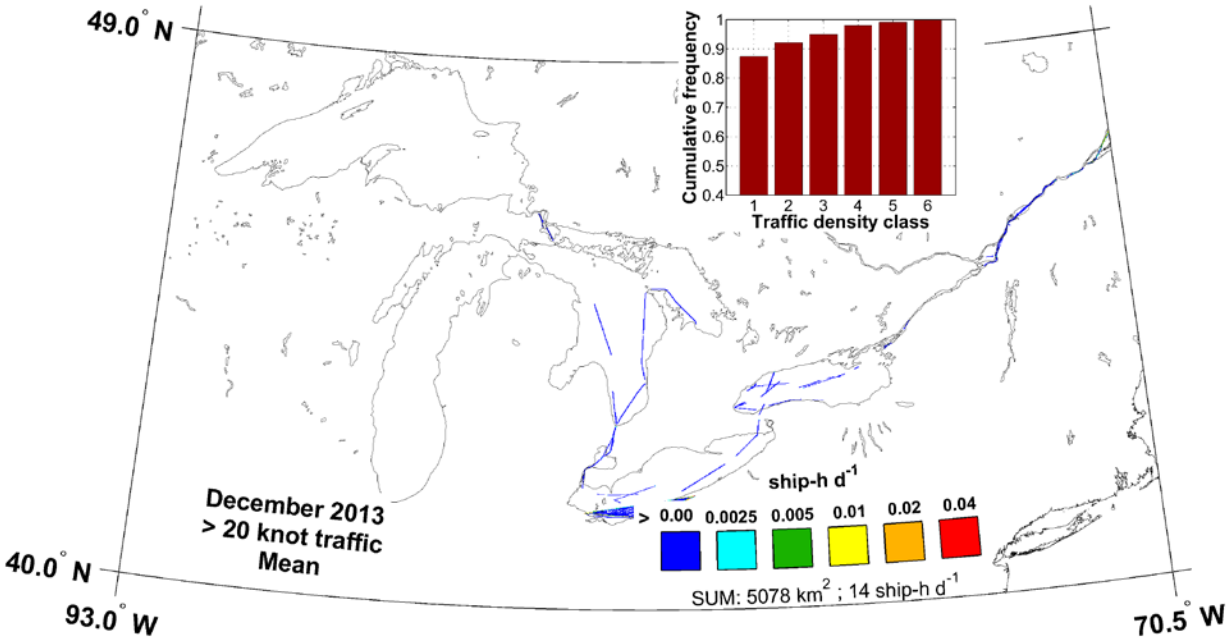

Figure 301. Map of >20 knot AIS mean traffic density in December 2013 with corresponding cumulative histogram and sums (daily ship-h km^{-2}).