Processing Steps:

*Background*

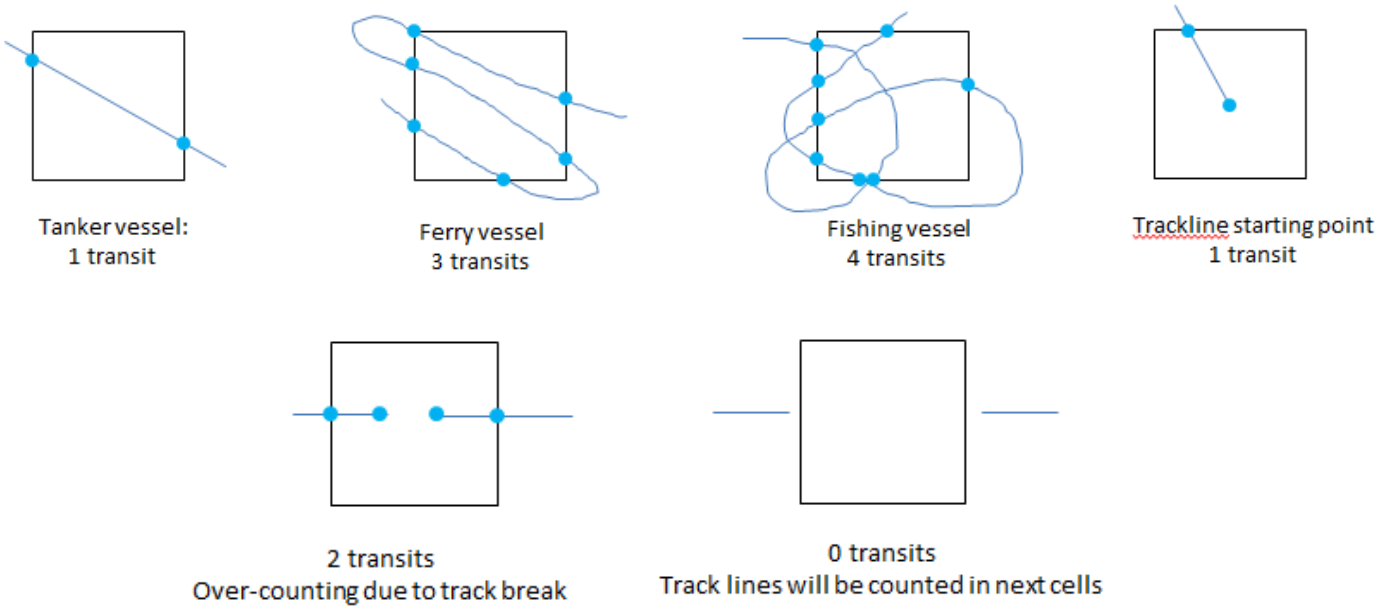
NROC hosts AIS vessel traffic data in the Northeast Portal for 2011 and 2012, and is shortly going to release the 2013 AIS data. The products are density grids with a 100 meter resolution which indicate how densely trafficked an area is. The values do not show the count of how many vessels occurred within a cell or how many times a vessel transited a cell. While density is a valuable representation of vessel traffic patterns, NROC has investigated the possibility of creating products that show counts of vessel transits per cell.

*Method and Logic*

Based on familiarity with AIS data, RPS ASA contracting staff identified possible patterns that might occur for how trackline features might overlap or interact with grid features. This list includes some examples of tracklines that might:

1. Transit straight through a cell (i.e. tanker)
2. Crisscross back and forth across a cell multiple times (i.e. ferry)
3. Move irregularly across a cell with random exiting/entering (i.e. fishing boat)
4. Show incomplete coverage, such that part of the trackline is missing from the data

The next step was to identify how to capture each interaction of a trackline and a grid cell. This required obtaining data for wherever a trackline touched a grid cell or had an end point.




The simple example of a tanker vessel shows one boat transiting straight though a cell. There are 2 trackline-to-grid intersections, one for entry and one for exit, resulting in a transit count of 1.

The ferry example shows how a single trackline may cross a cell numerous times. There are 6 trackline-to-grid intersections, resulting in a transit count of 3.

The fishing example shows a single trackline moving about a cell randomly without apparent pattern. There are 8 trackline-to-grid intersections, resulting in a transit count of 4.

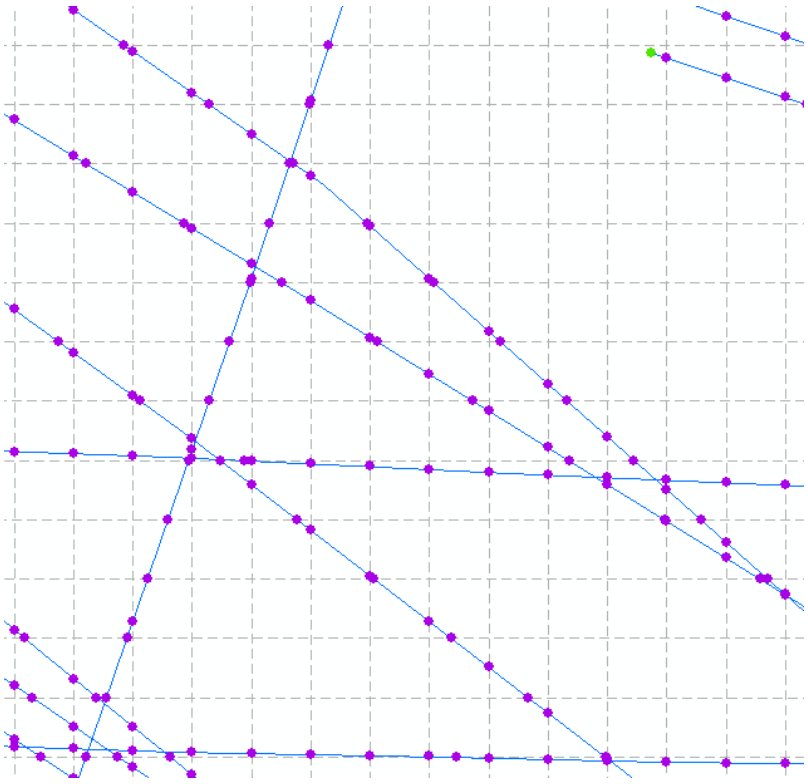
The example where a trackline starts within a cell shows 1 trackline-to-grid intersection and 1 end point. There are 2 points total, indicating a transit count of 1.

The next two examples show where data may be missing. If there is a gap in a trackline within a cell, then the method will count 2 trackline-to-grid intersections and 2 end points. There are 4 points total, resulting in a transit count of 2 (over-counting). Alternatively, the trackline may break outside the grid cell, in which case the transit count would be 0. The first condition is not prevalent within the data, especially given the fine cell size. The second condition does occur, however filling those gaps are beyond the scope of this method or project.

*Data Processing*

To obtain the number of vessel transit counts per cell, ArcGIS Pro was required and the pairwise intersection tool was downloaded for use.

A polyline grid for the area of interest was created in ArcMap with 100 meter grid cells. This grid was intersected with the 2013 AIS tracklines to produce points for every trackline-to-grid intersection (236,574,527 points). Additionally, start and end points were created for each trackline (1,162,732 points) and of these, 41 were removed since they were duplicates of the pairwise intersection output.



**Example of the polyline grid (grey/dashed line) and tracklines (blue). The points represent the trackline-to-grid intersections (purple) and start-end points (green).**

In order to obtain the count of points that fell on the border or within each cell, ArcGIS's point density tool was used with a 100 meter cell size, a neighborhood specified as a 100 x 100 meter rectangle, and output units in square meters. The output density grid was then multiplied by 100 x 100 (10,000) to obtain the point count metric. Since there were two points representing every trackline, the number of points was divided by two to obtain counts of vessel transits.

| | Process Steps Description |
|---|---|
| 1 | Create a line grid with 100 meter grid cells using the CREATE FISHNET tool for the Northeast and Mid-Atlantic regions.<br>Projection is WGS 1984 Web Mercator Auxiliary Sphere. |
| 2 | Clip NOAA's AtlanticVesselTracks_2013 trackline product to the fishnet grid |
| 3 | In ArcGIS Pro, run PAIRWISE INTERSECT tool for the clipped tracklines and fishnet grid to create a point feature class for each trackline-to-grid intersection |
| 4 | Convert the start and end of each trackline to points using the Feature Vertices to Points tool (ArcGIS Advanced license), specifying BOTH_ENDS of the line |
| 5 | Examine whether any start-end points are duplicates of pairwise points; 41 start-end points removed. |
| 6 | Run POINT DENSITY tool separately on 1) the pairwise points and 2) the start-end points. Population=None \| Cell Size = 100 \| Neighborhood = 100x100 meter rectangle \| Units = SQUARE_METERS. Under Environments, set original fishnet grid as the processing extent and raster mask |
| 7 | Run RASTER CALCULATOR separately on 1) the pairwise density and 2) start-end density to multiply each grid by 10,000 |
| 8 | RASTER CALCULATOR to add the multiplied pairwise and start-end grids together into a combined grid |
| 9 | RASTER CALCULATOR to divide the combined grid by 2 |
| 10 | SET NULL to convert all 0 values to NoData |
| 11 | Run RASTER CALCULATOR to force all values to integer format based on rounding up/down. Int(grid + 0.4) |
| 12 | SET NULL to convert all 0 values to NoData, since the previous step produced some legacy zero values |