Building a Decision Tree for Complete and Coherent Coastal ENC coverage

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National Oceanic and Atmospheric Administration | Office of Coast Survey

Goals

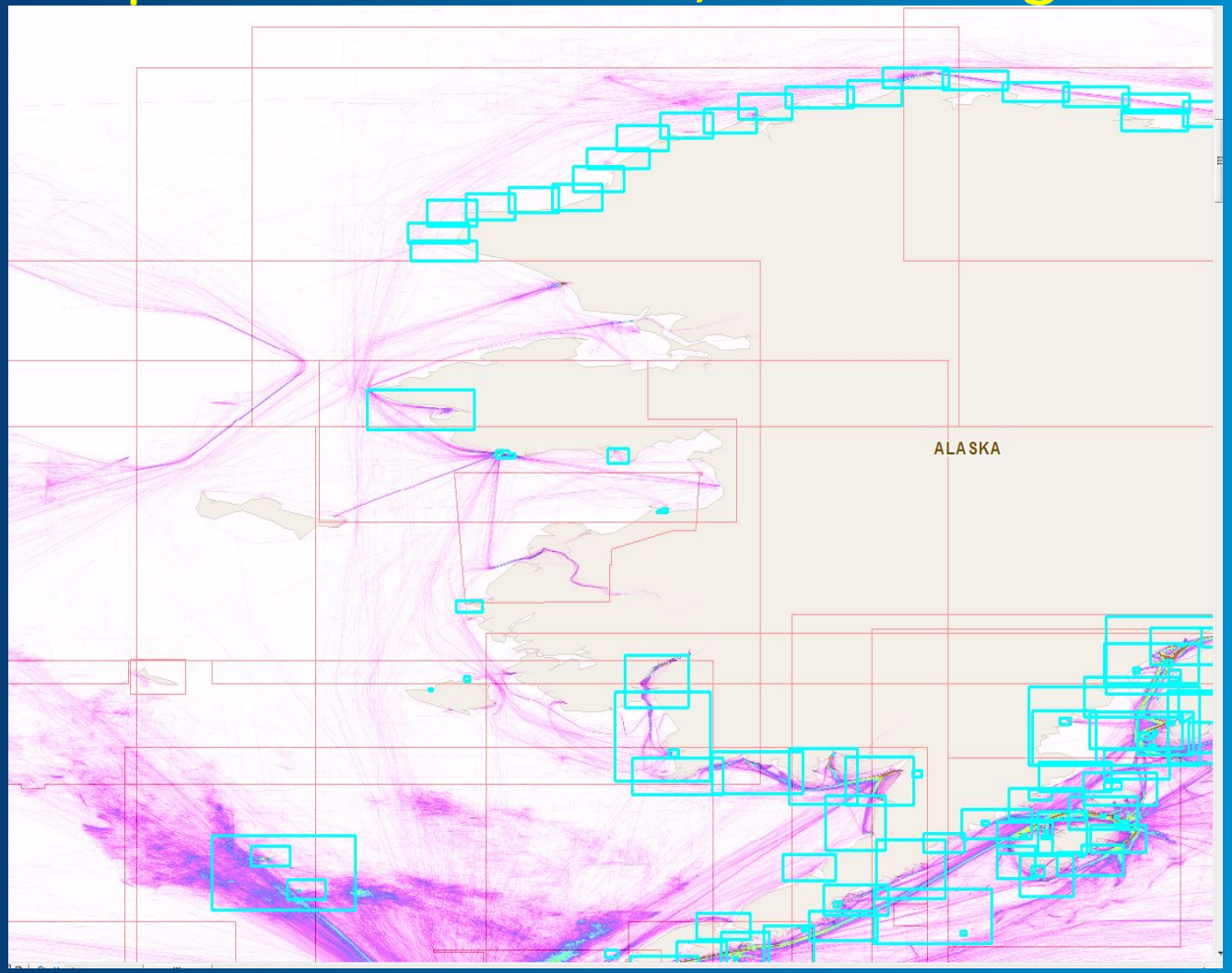
- Creating a charting scheme based on traffic, environment and shoreline. In order to hone the largest practical scale for best coverage.

Study Site

- Arctic Alaska as a case study.
- Area covered from the Canadian border (North Slope) to Bristol bay.

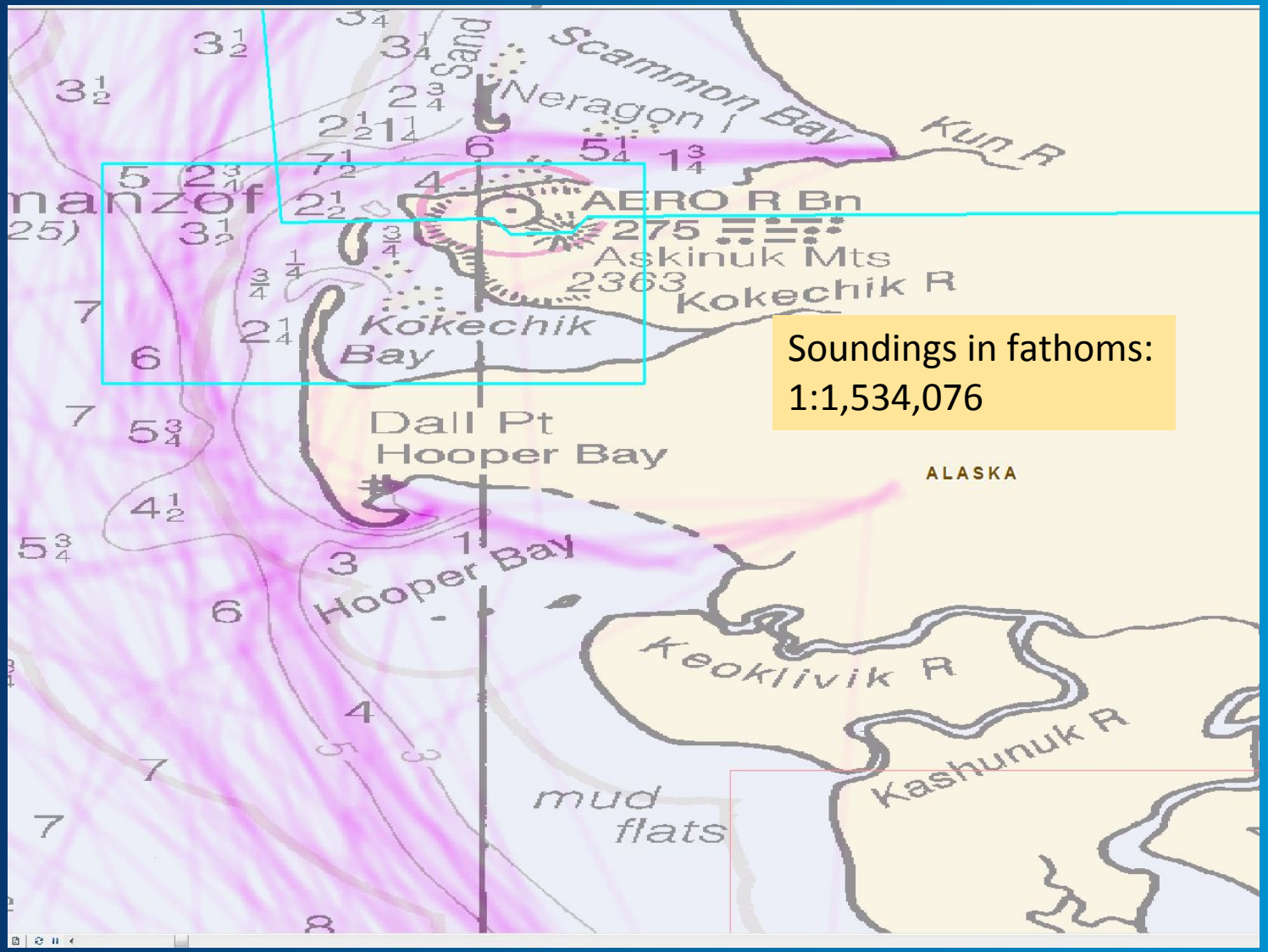
Alaska

Paper Charts - 1:300,000 or larger



Current Challenges

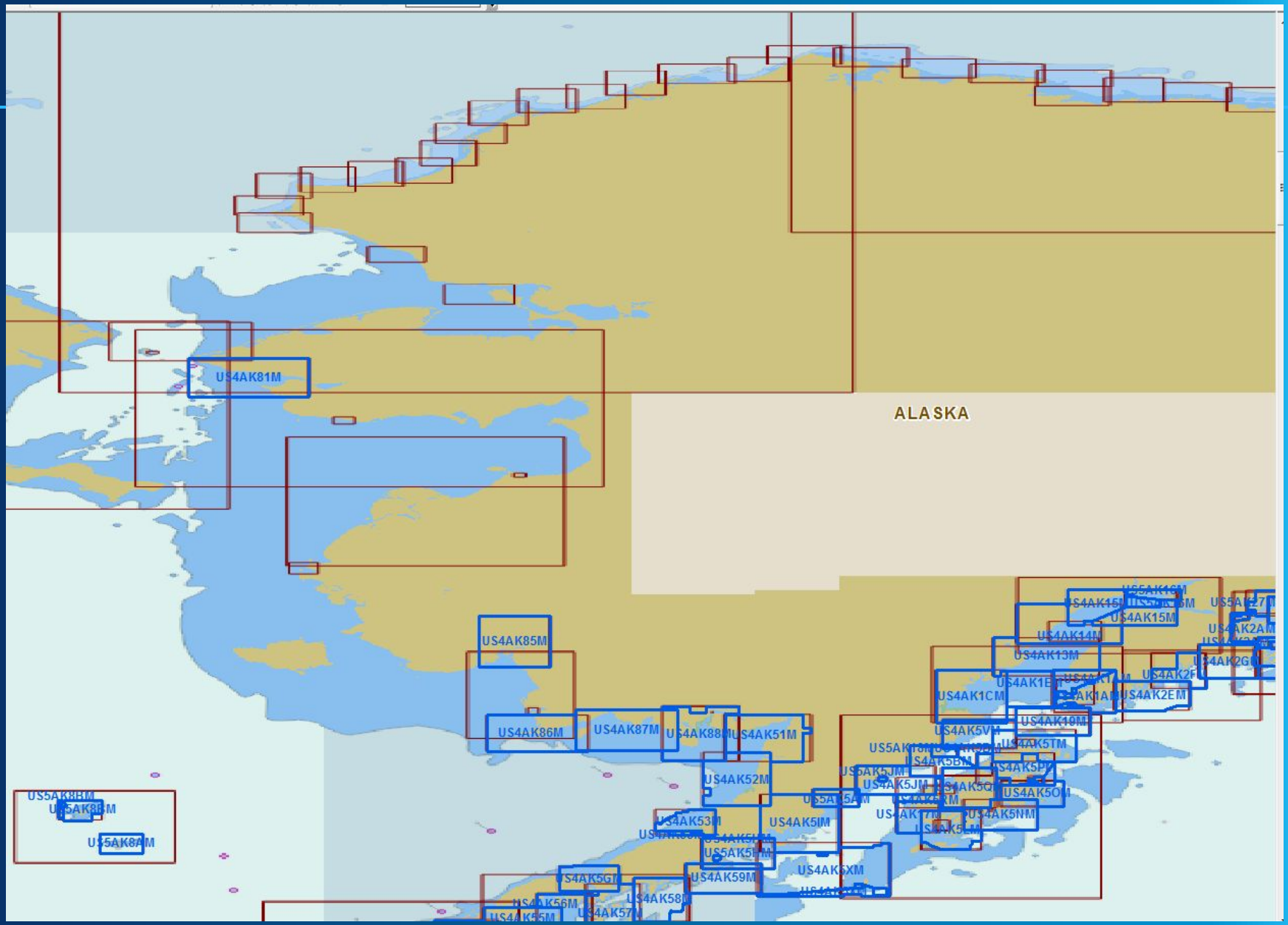
- The current charting infrastructure is the result of mostly inconsistent human factors (politics or legacy data) which resulted in some areas being inappropriately charted.


Scammon Bay
Kun R
Neragon I
AERO R Bn
275
Askinuk Mts
2363
Kokechik R
Kokechik Bay
Dall Pt
Hooper Bay
ALASKA
Hooper Bay
Keoklivik R
Kashunuk R
mud flats
Soundings in fathoms:
1:1,534,076

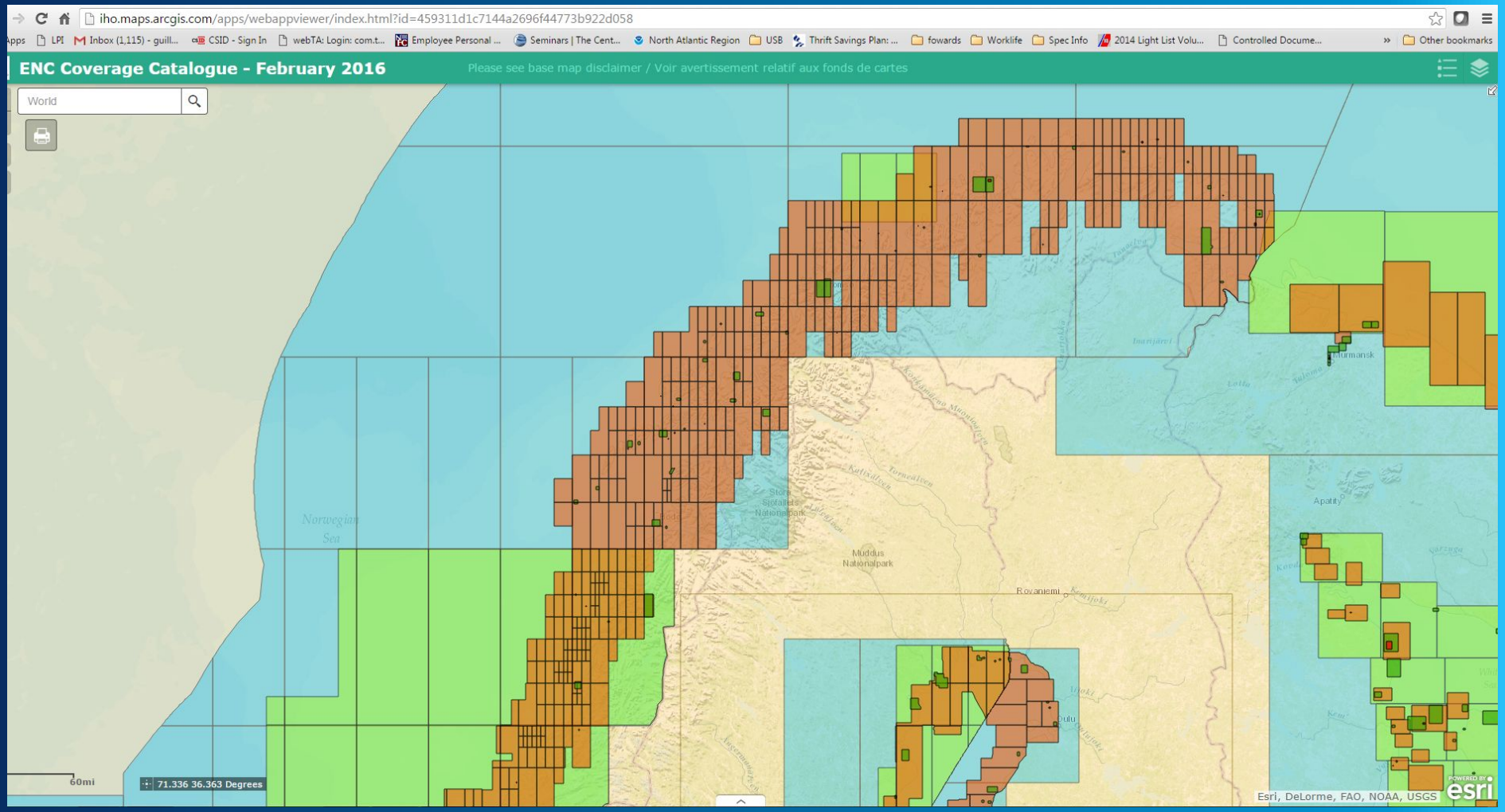
Objectives

Goal: to create an algorithm to determine best appropriate chart extent and scale, based on available data.

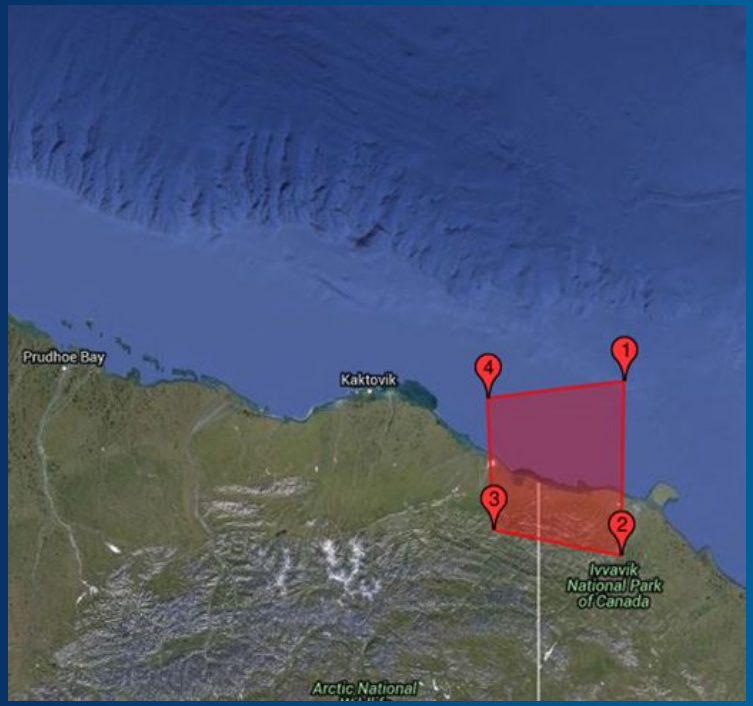
- Determining the scale and layout in order to make the chart products safe and useful for navigation.

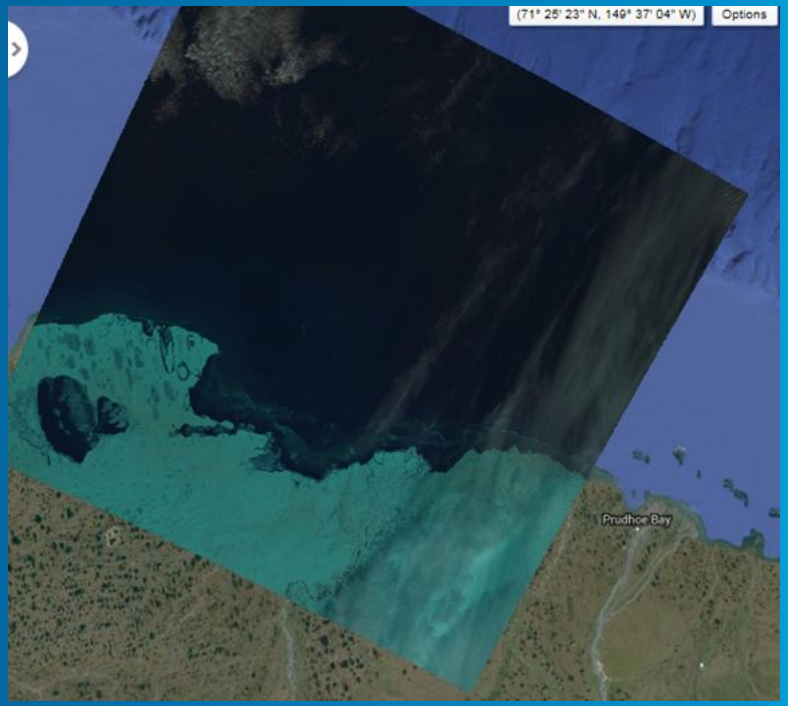

ALASKA
US4AK81M
US4AK85M
US4AK86M
US4AK87M
US4AK88M
US4AK51M
US4AK52M
US4AK53M
US4AK5IM
US4AK59M
US4AK5XM
US4AK56M
US4AK57M
US4AK58M
US4AK15M
US4AK14M
US4AK13M
US4AK1CM
US4AK2EM
US4AK10M
US4AK5TM
US4AK5OM
US4AK5NM
US5AK8AM

Norway as an alternative approach



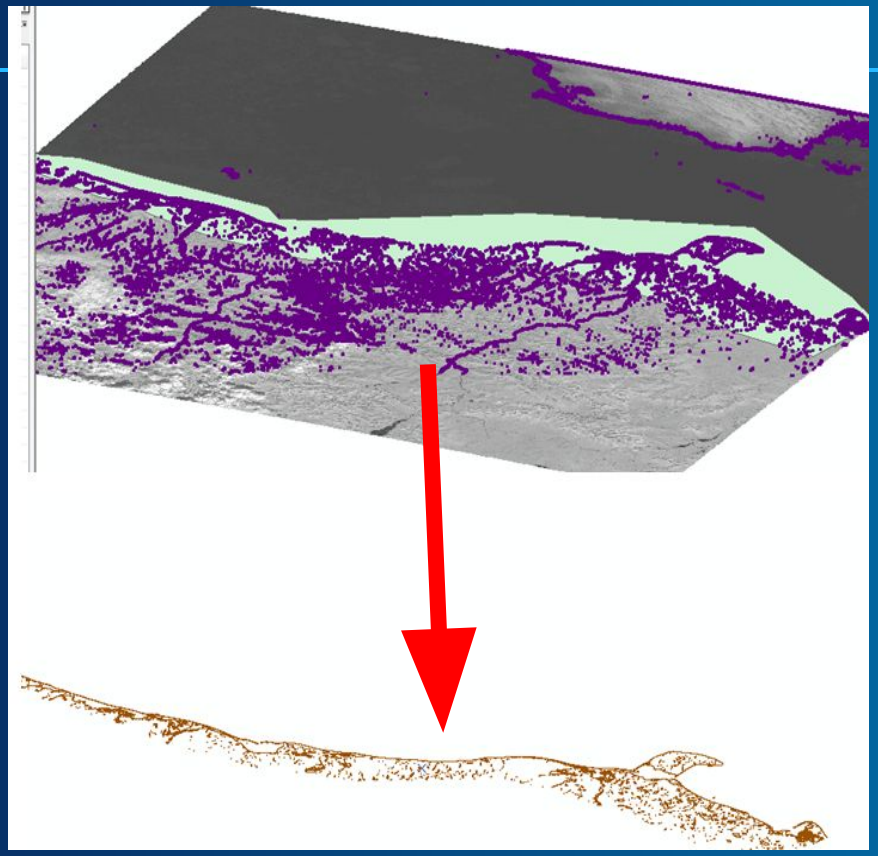
Creating a shoreline

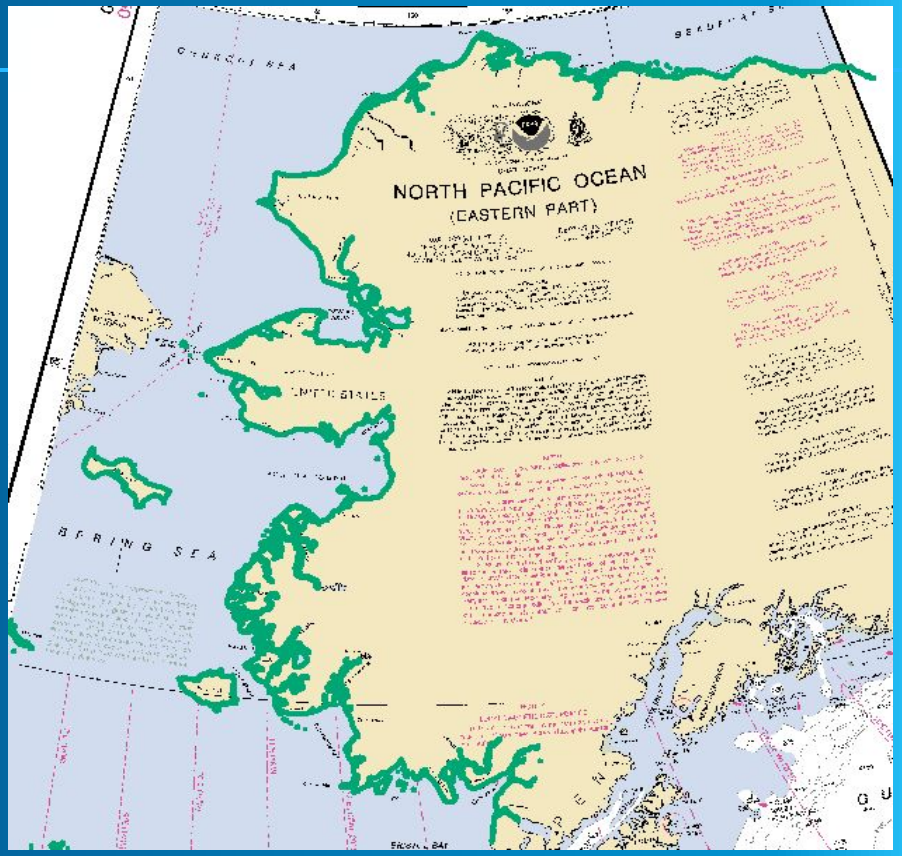




http://earthexplorer.usgs.gov/

short wave infrared band land/water interface classification





- Cleaning the shapefiles of extraneous polygons.
- Merging all the pieces of shoreline together.

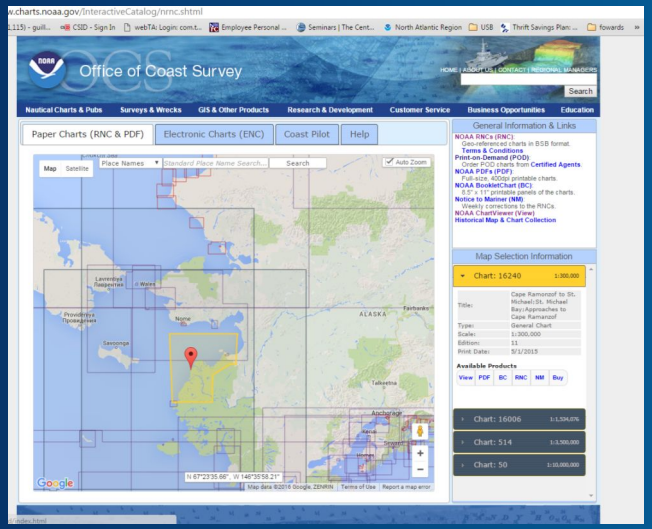
Bathymetric Surface Creation

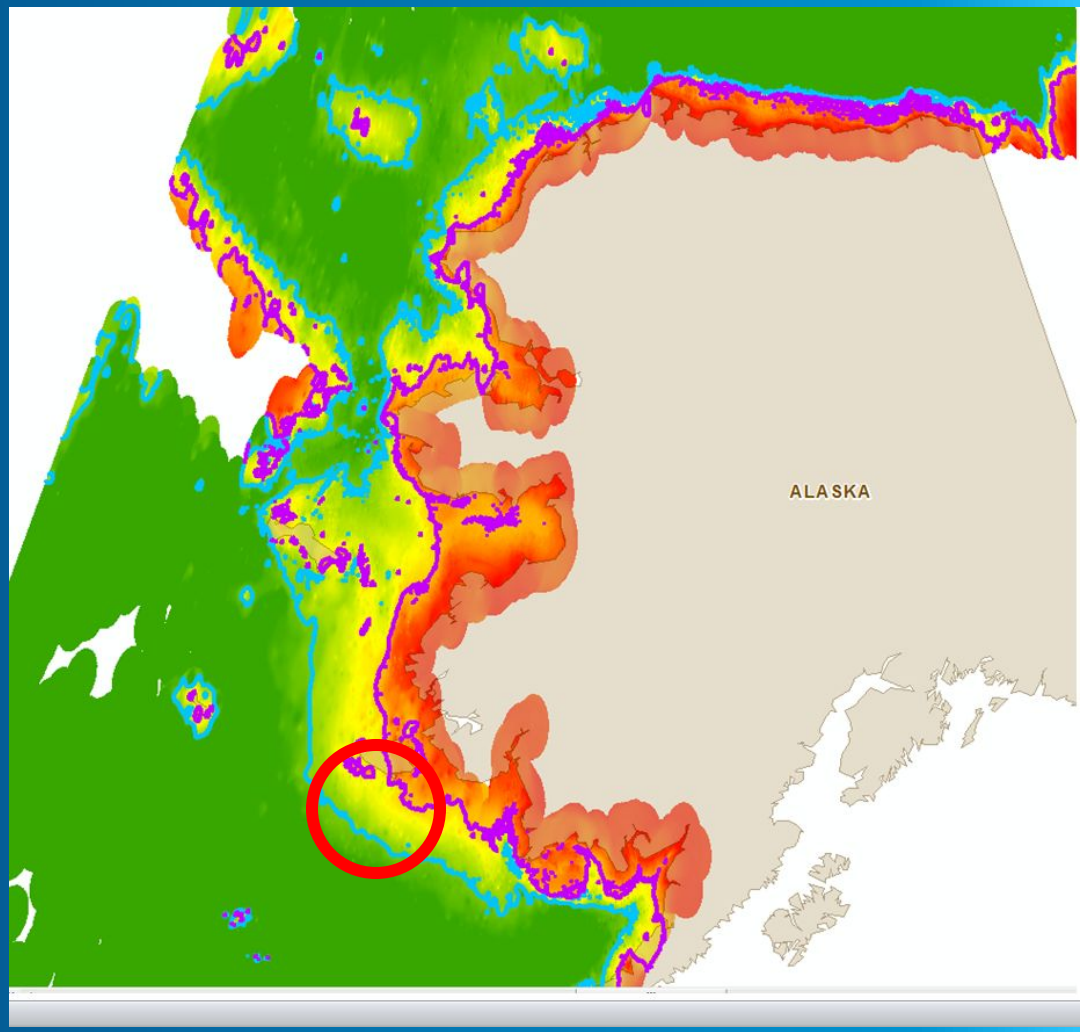
Soundings from NOAA ENCs

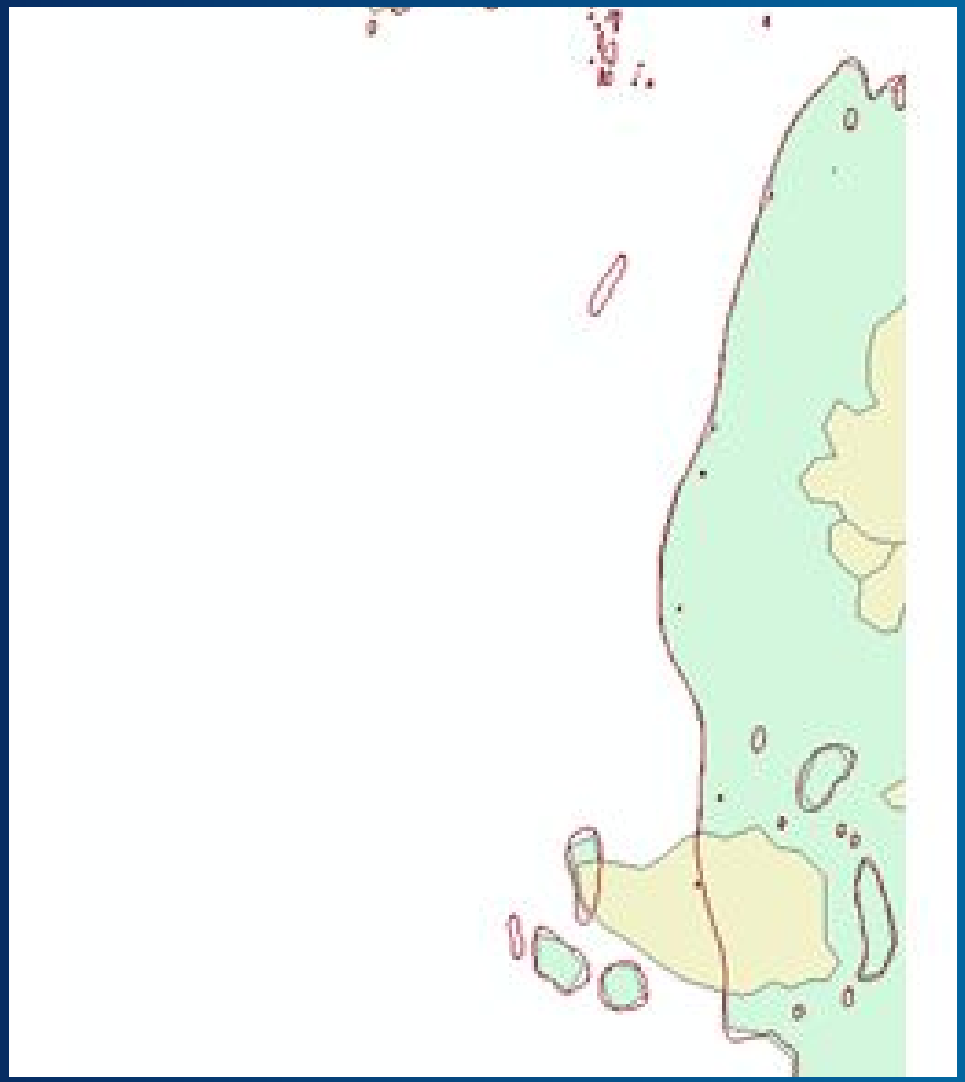
Using DEPTH_M points

Interpolation method:

-IDW (problem with 20m contour)

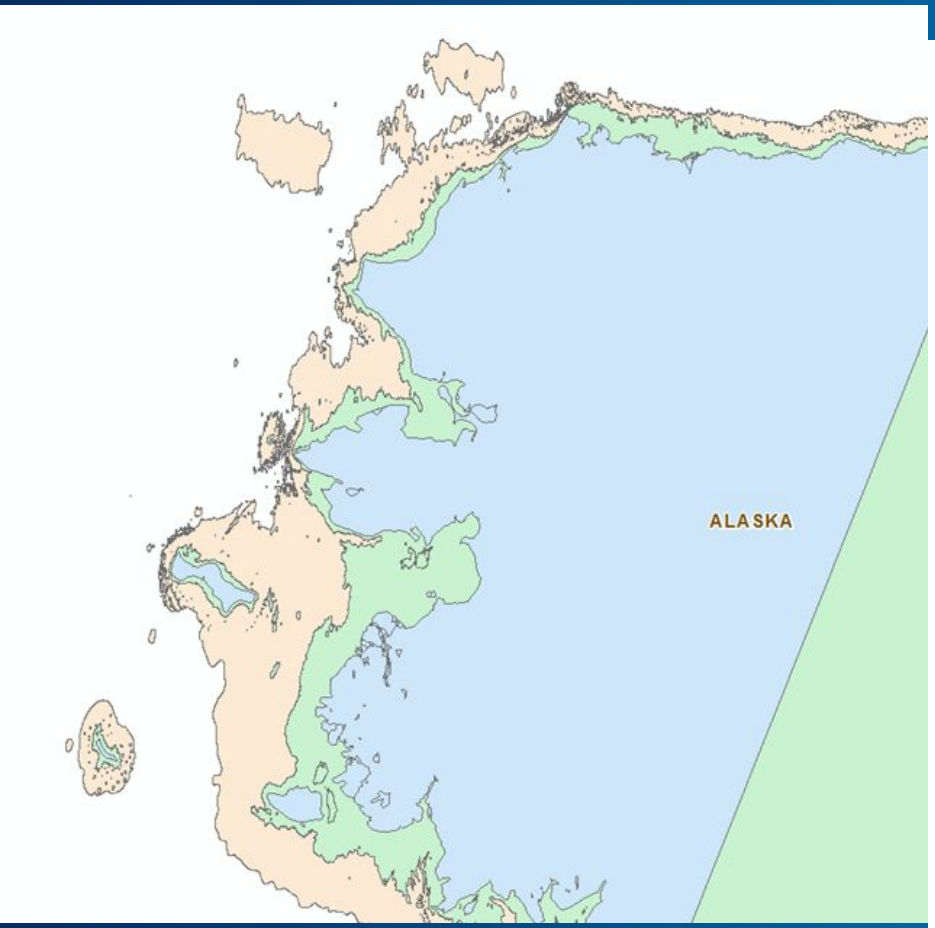


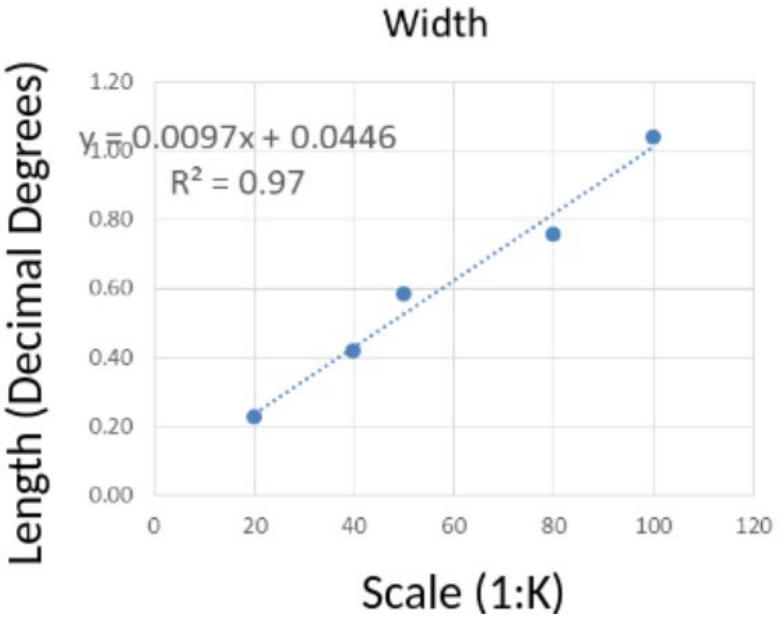


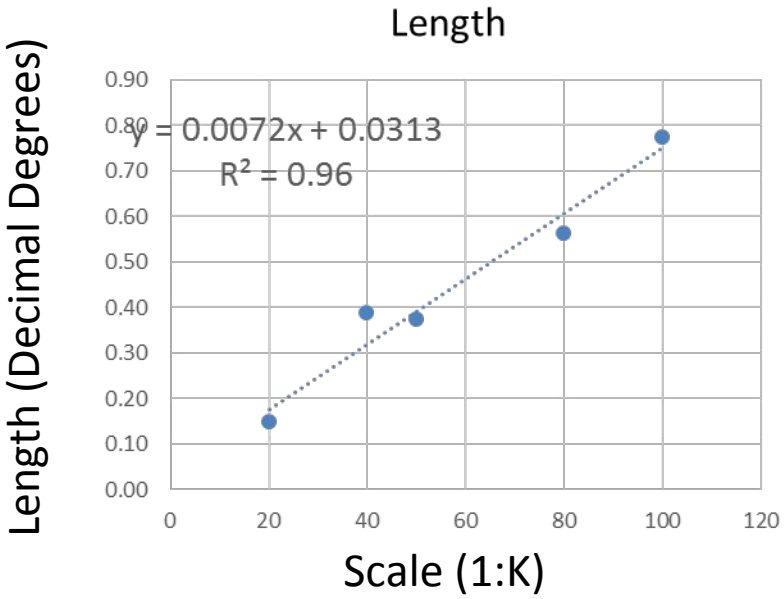


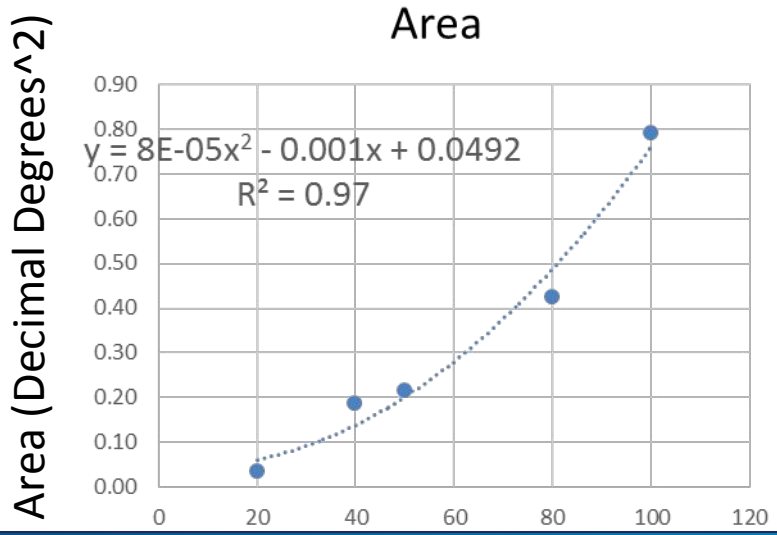
To make the derived depth contours more true-to-life, the SWIR extracted shoreline polyline verticies were converted to point, and added to the bathymetry as a depth value = zero

Some Polygon subtractions to create the coverage area:




Width
Length (Decimal Degrees)
y = 0.0097x + 0.0446
R² = 0.97
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
20
40
60
80
100
120
Scale (1:K)


Length
Length (Decimal Degrees)
y = 0.0072x + 0.0313
R² = 0.96
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
20
40
60
80
100
120
Scale (1:K)

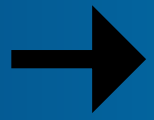

Area
Area (Decimal Degrees^2)
y = 8E-05x² - 0.001x + 0.0492
R² = 0.97
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
20
40
60
80
100
120
Scale (1:K)

Scale according to the US East Coast Charts

Suggested values:

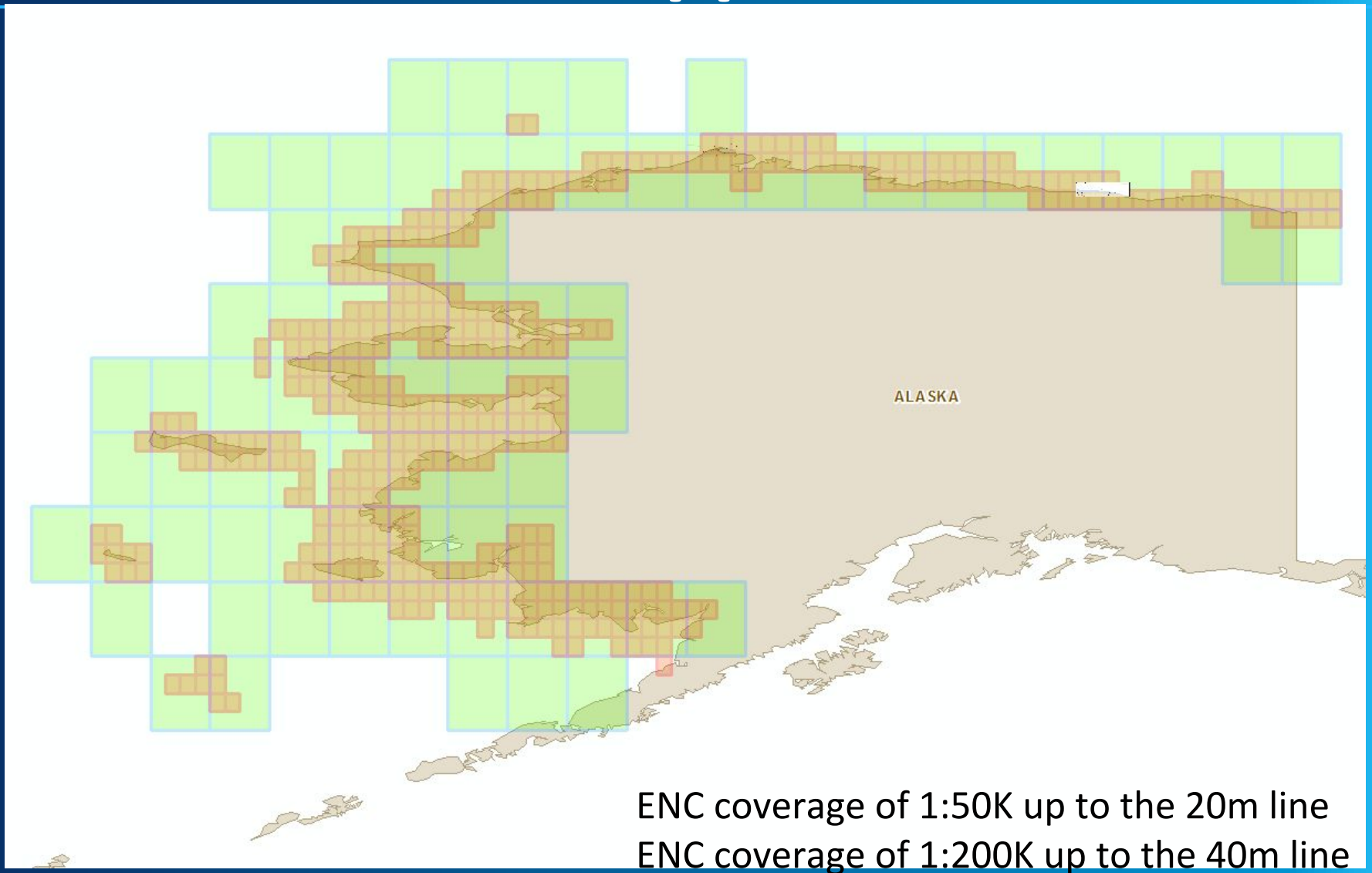
(Based on the characteristics of the Alaska Shoreline we can switch between the width and length)
Long. Diff. 140 W- 178W

Scale (K)	Dim.1 dd	Dim.2 dd
50	0.5	0.4
100	1.0	0.8
150	1.5	1.2
200	2.0	1.6
250	2.5	2.0
300	3.0	2.4



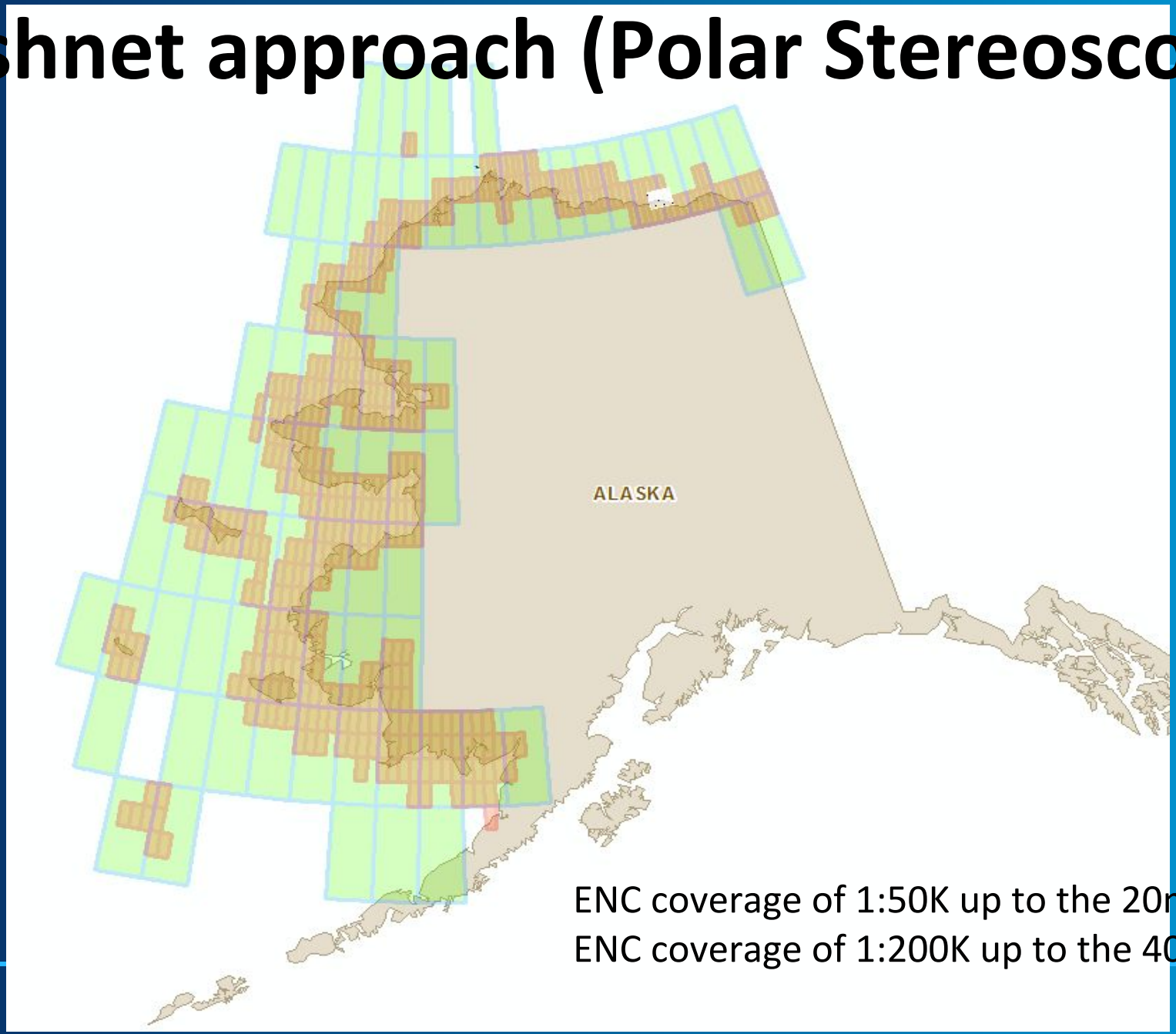
Scale (K)	# Cells (H)	# Cells (W)
50	76.0	95.0
100	38.0	47.5
150	25.3	31.7
200	19.0	23.8
250	15.2	19.0
300	12.7	15.8

Fishnet approach



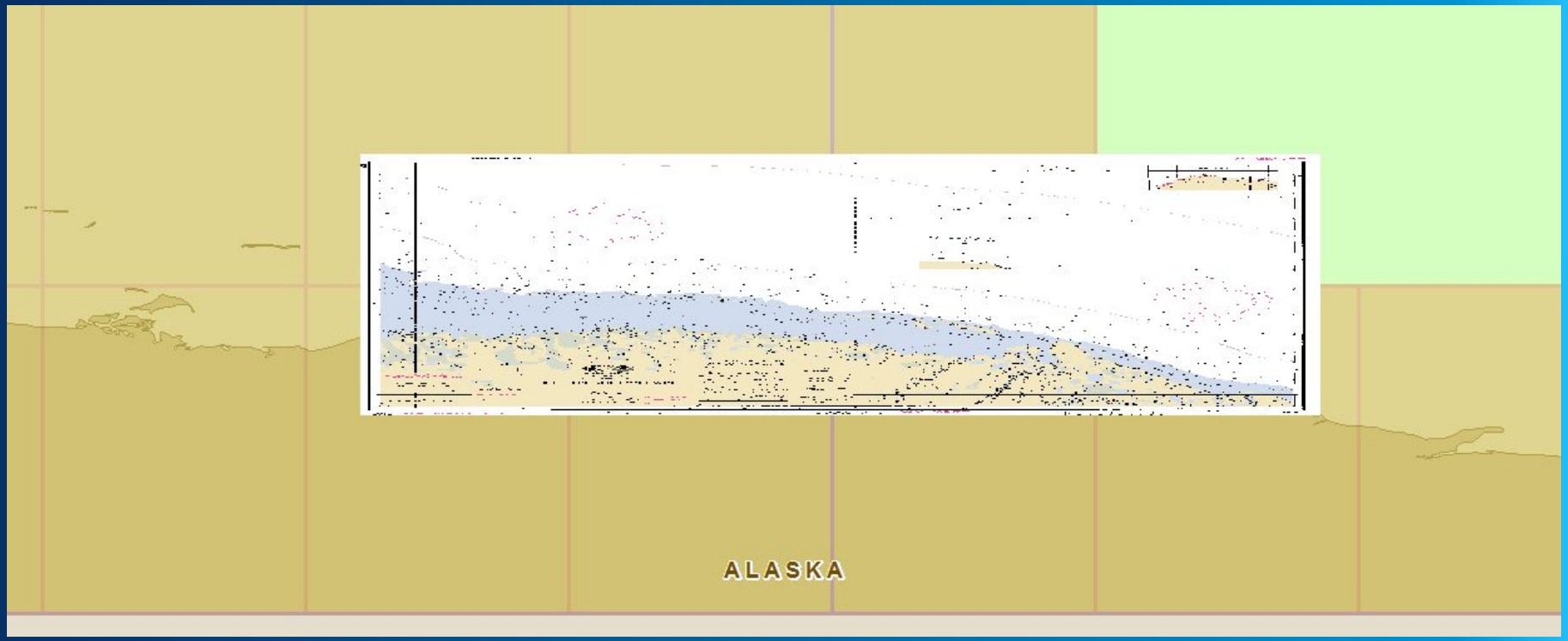
ENC coverage of 1:50K up to the 20m line
ENC coverage of 1:200K up to the 40m line

Fishnet approach (Polar Stereoscopic)



ENC coverage of 1:50K up to the 20m line
ENC coverage of 1:200K up to the 40m line

Issues on the North Slope



1 longitude degree

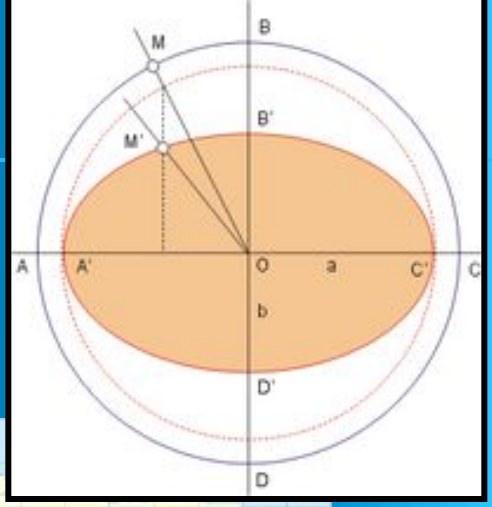
= 111 km (at the equator)

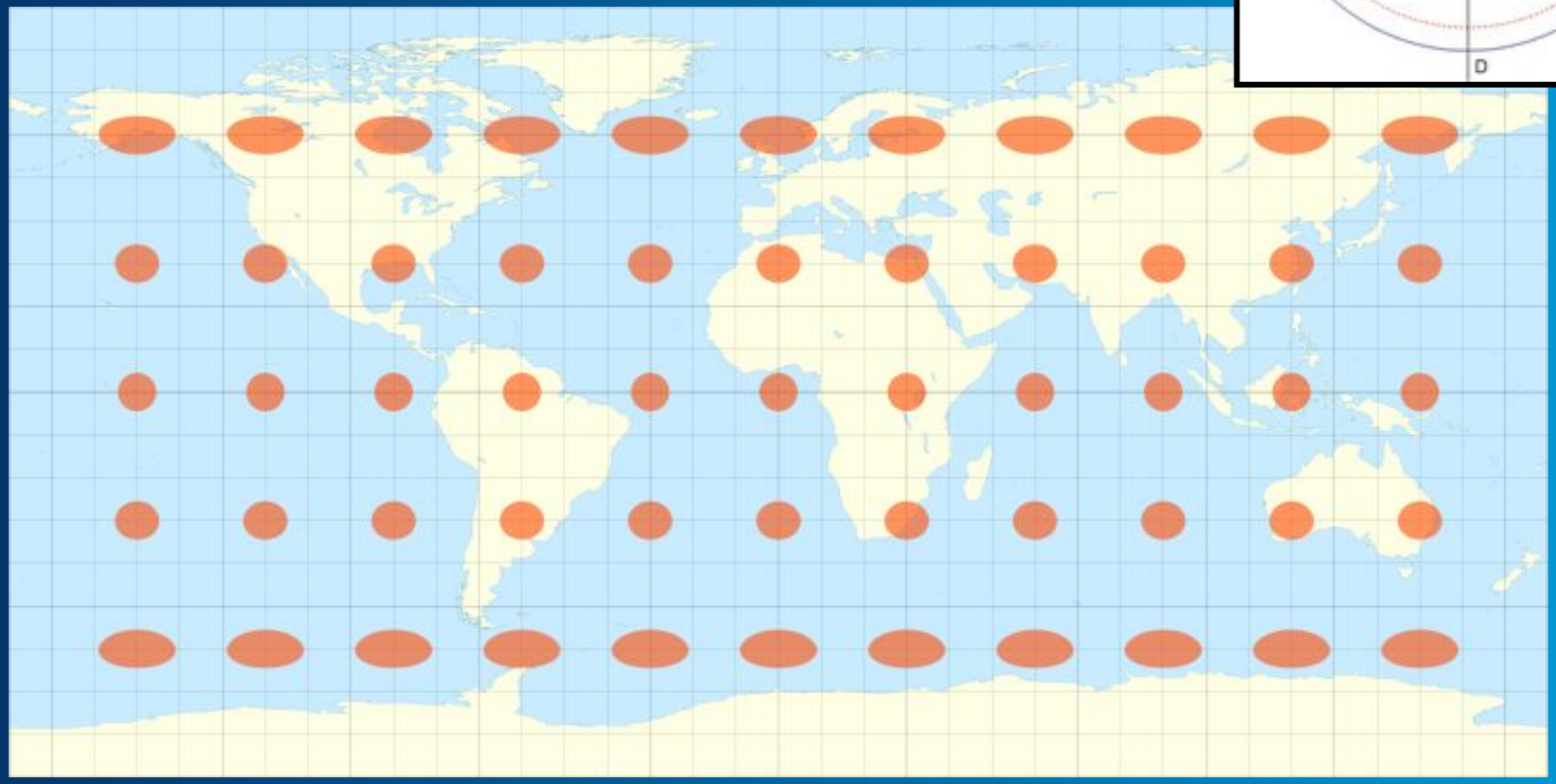
= 80 km (at 45°)

= 38 km (at 72°)

Tissot's Indicatives

Equirectangular projection



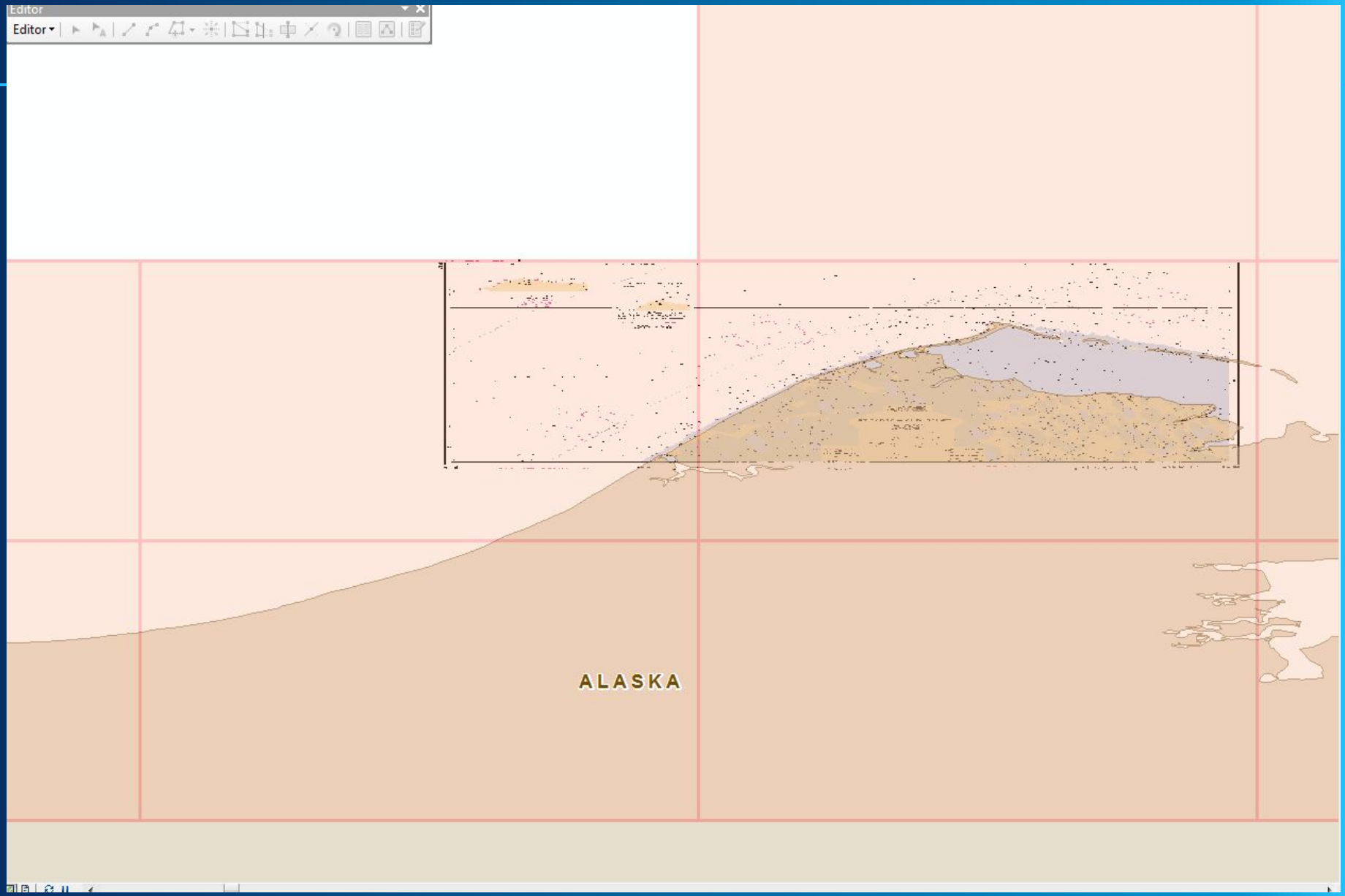


http://www2.hawaii.edu/~matt/104/Exercises/projections.html

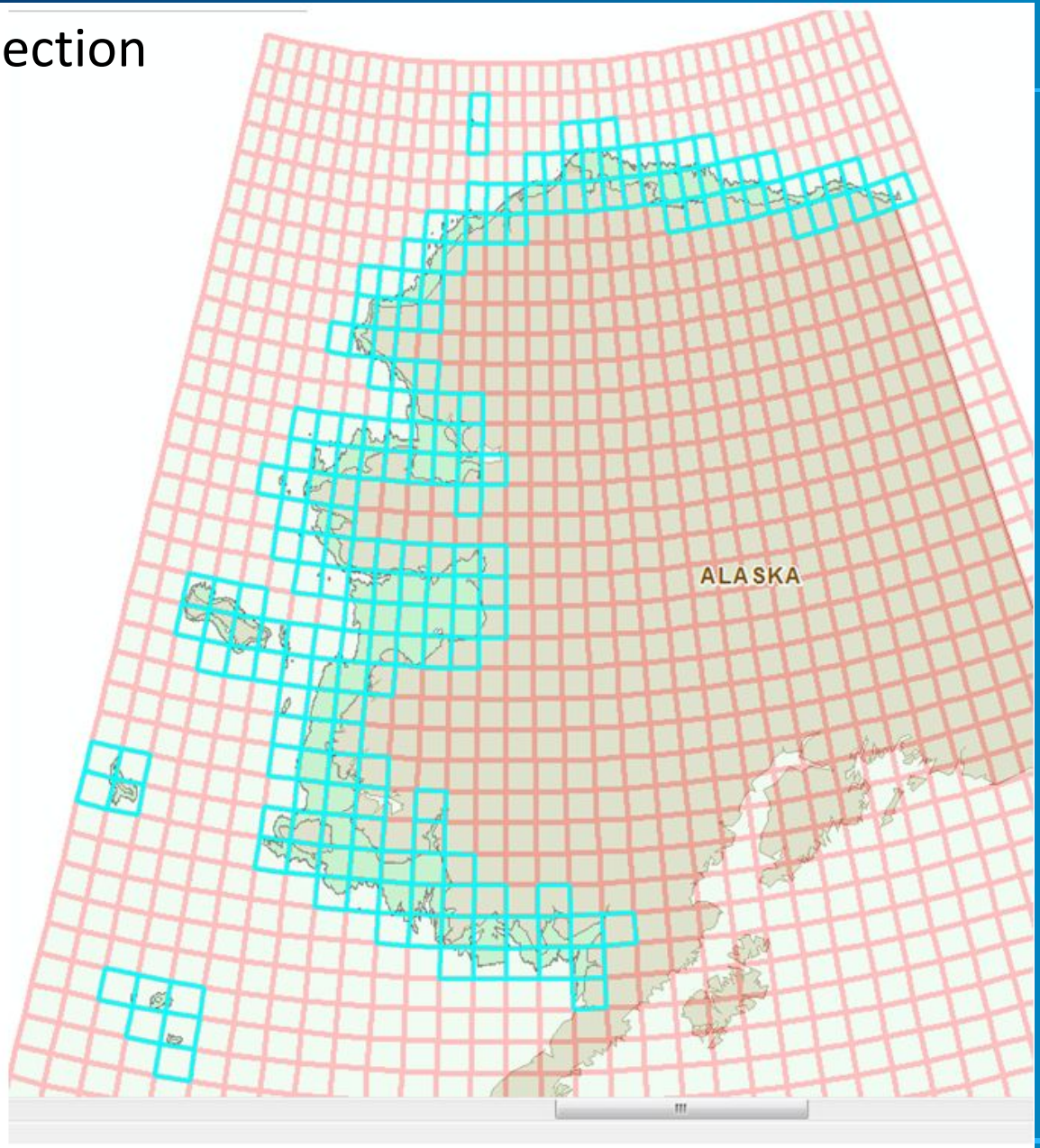
Adjusted values for the North Slope

Suggested values:

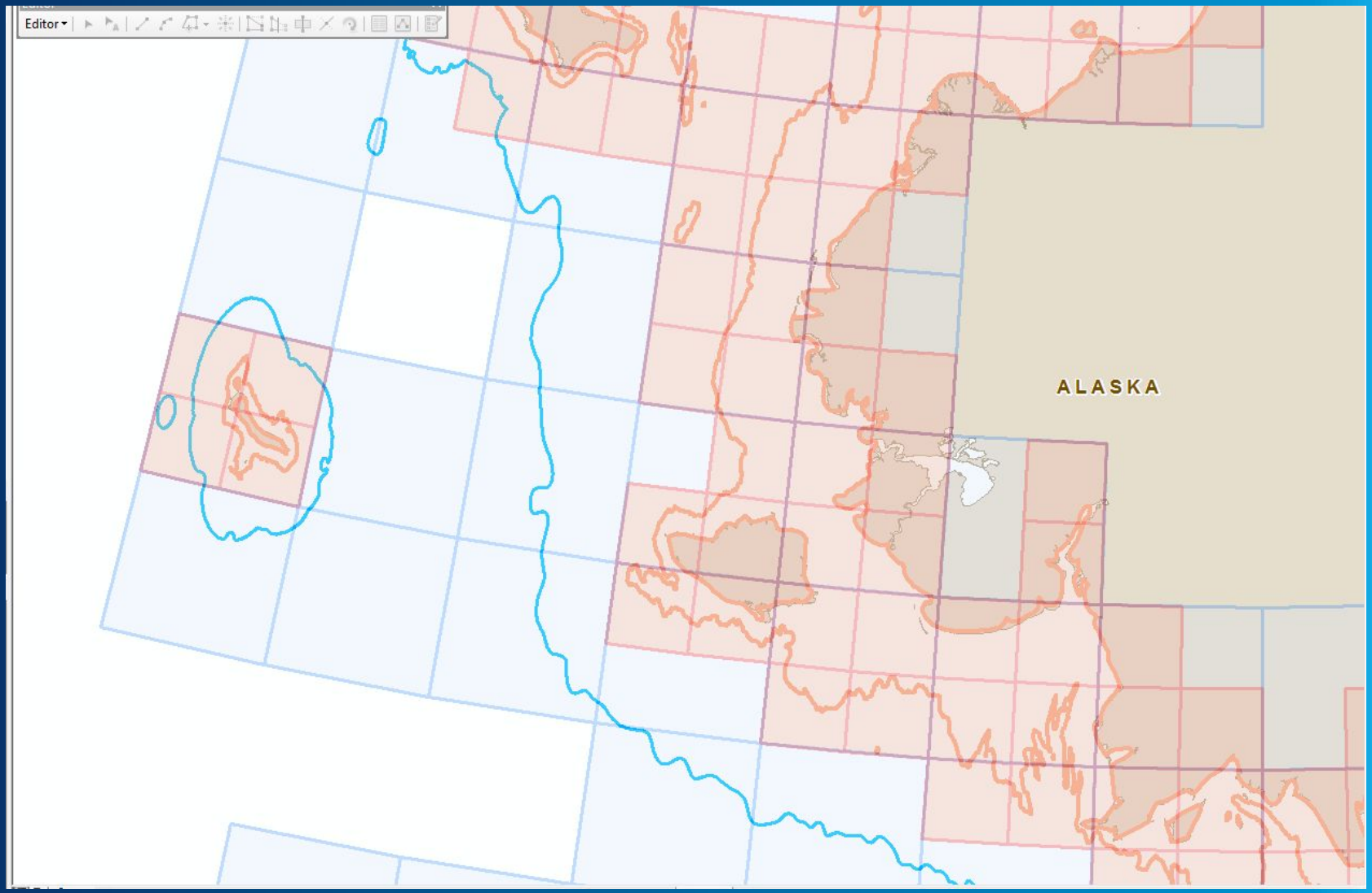
Scale (K)	Height dd	Width dd
50	1.0	0.5
100	2.0	1.0
150	3.0	1.5
200	4.0	2.0
250	5.0	2.5
300	6.0	3.0


Editor
Editor
ALASKA

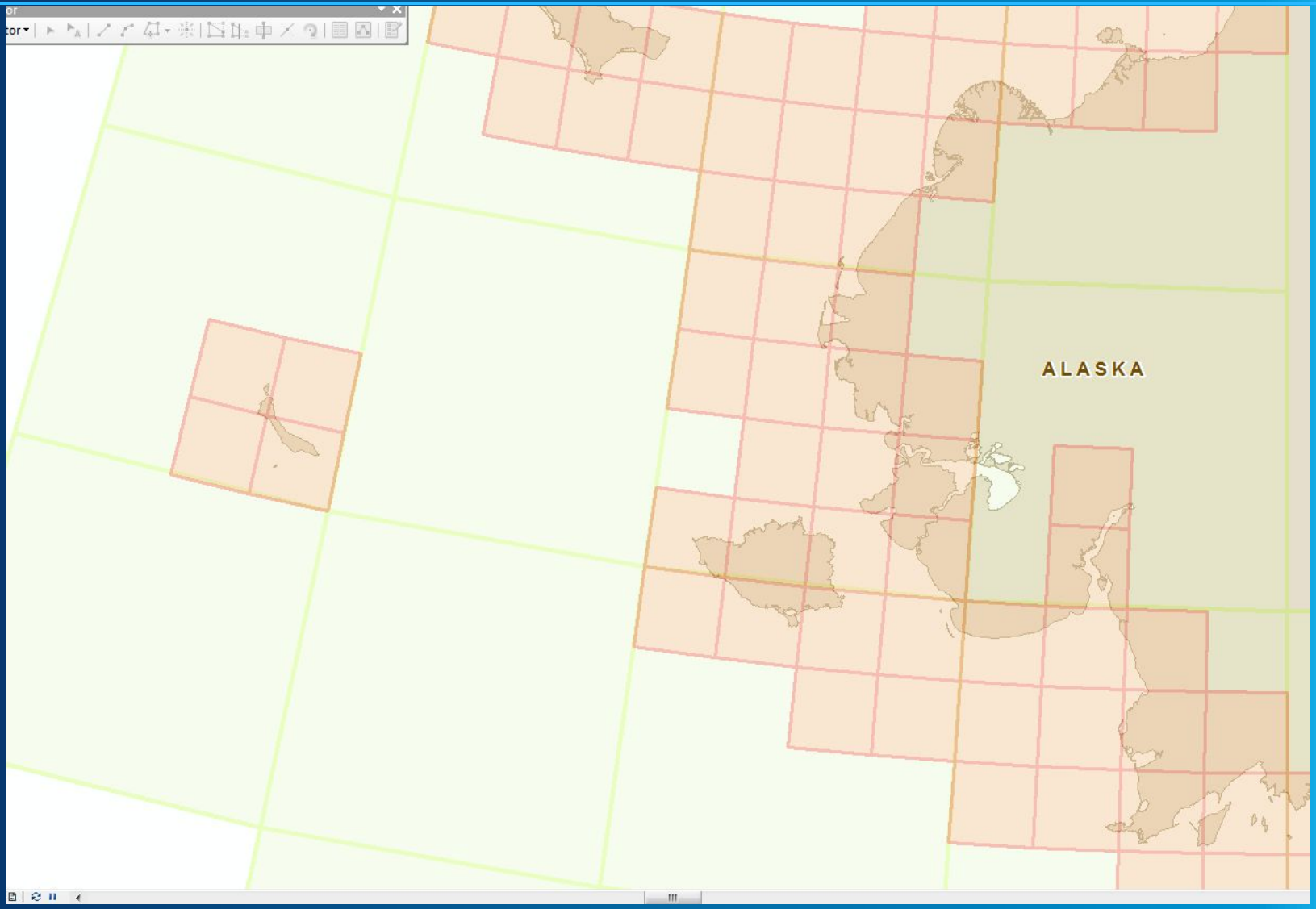
Polar projection



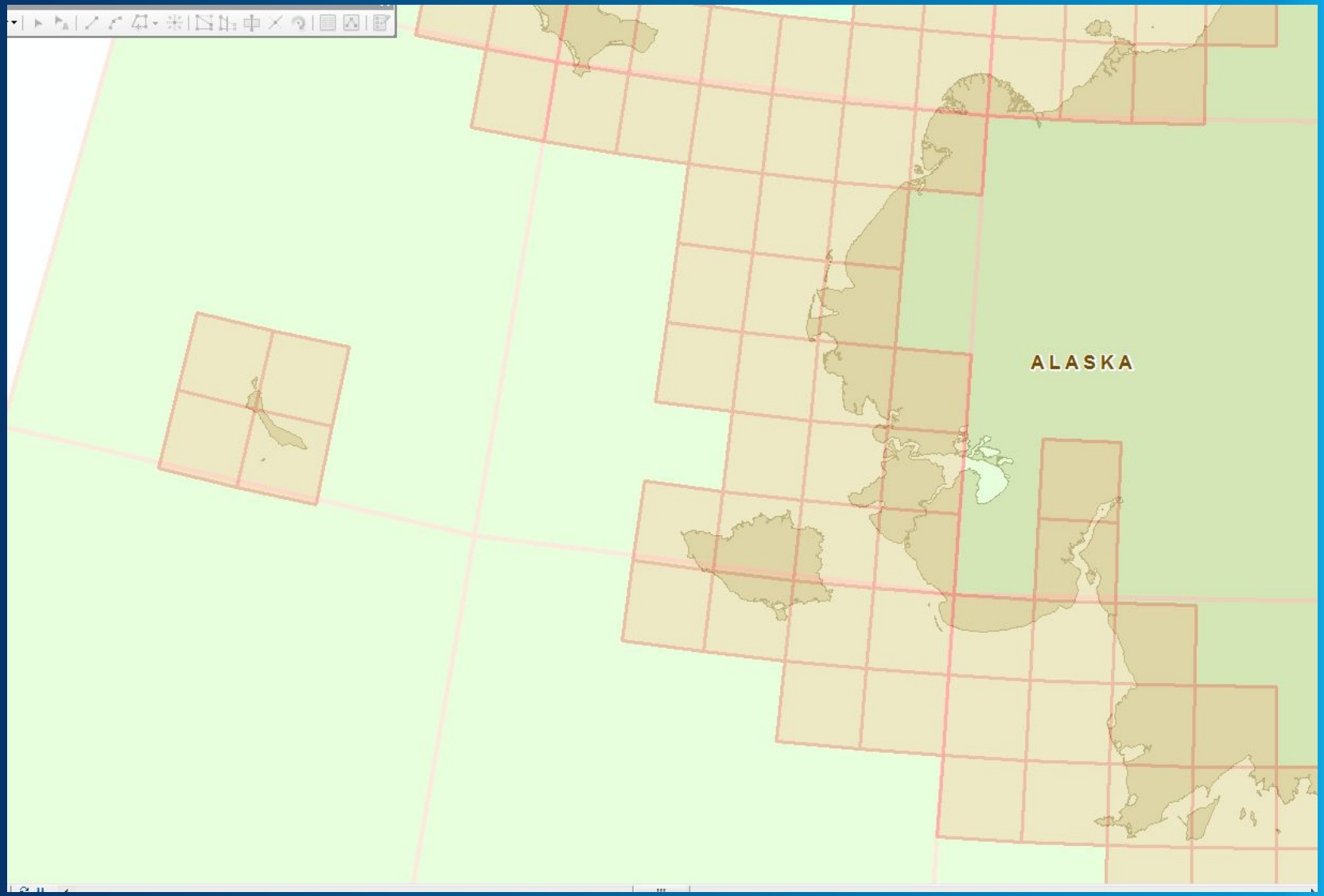
Results 50k and 100k

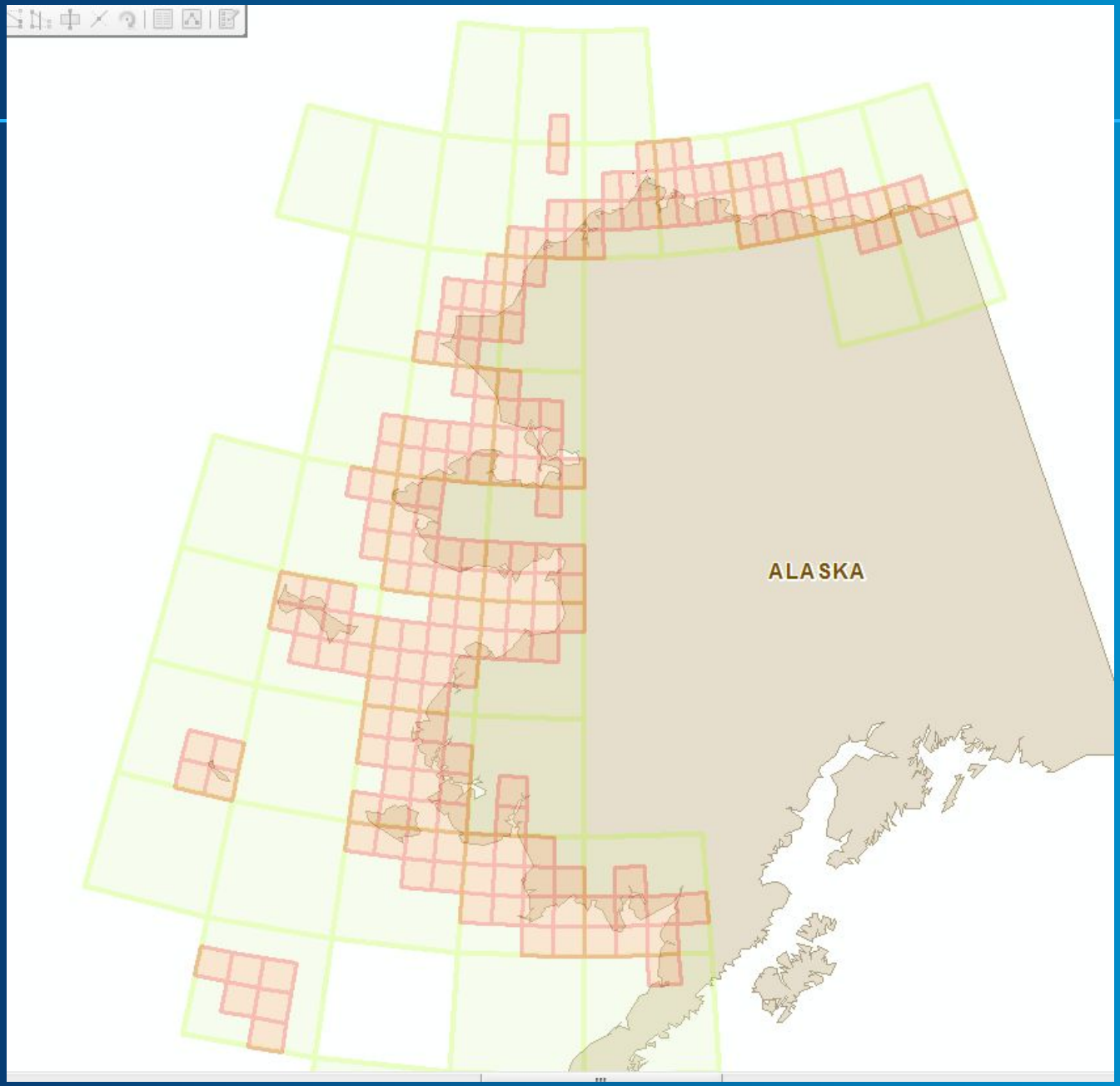


50k and 200k

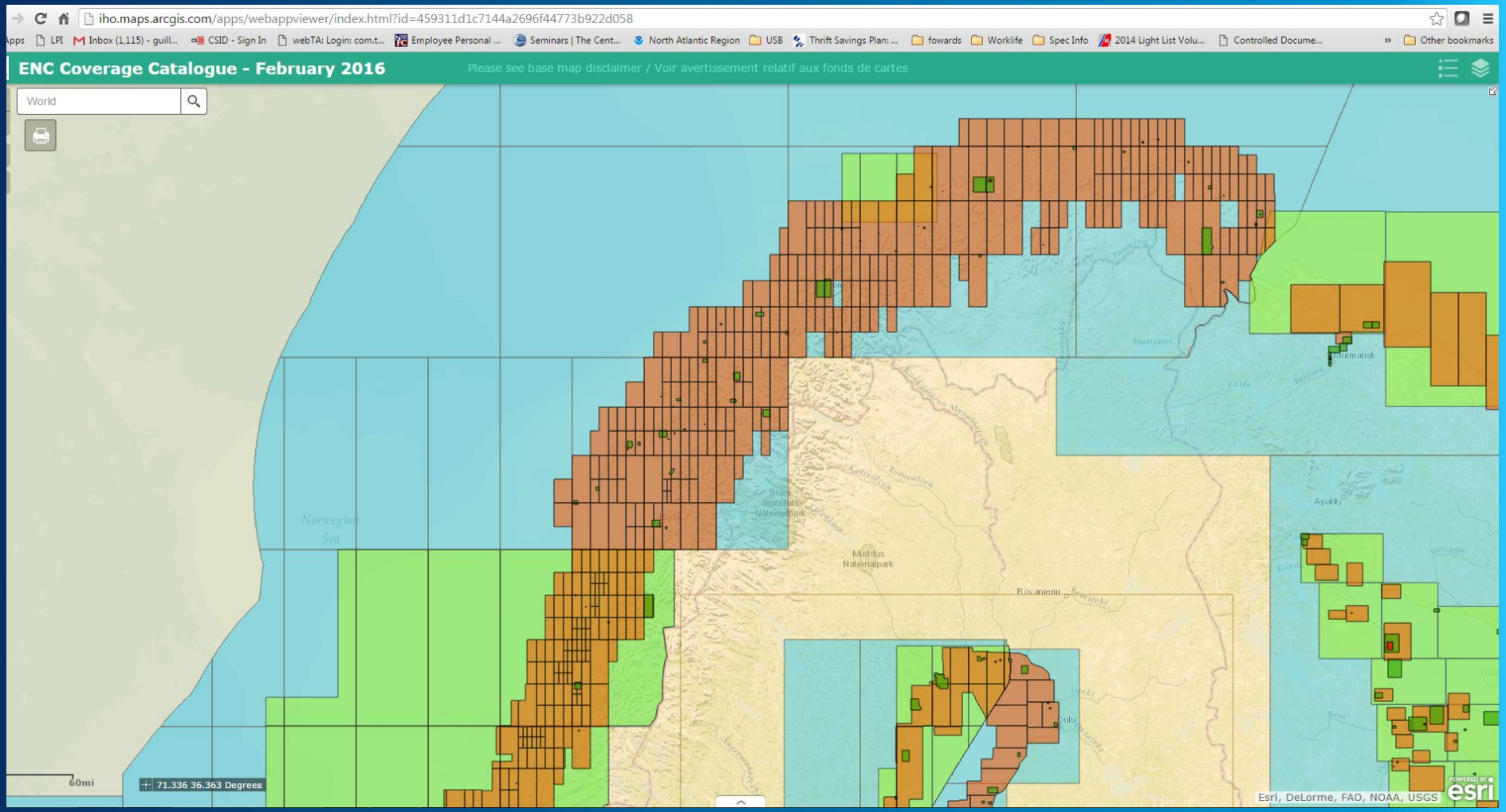


50k and 300k




ALASKA

Norway as an example

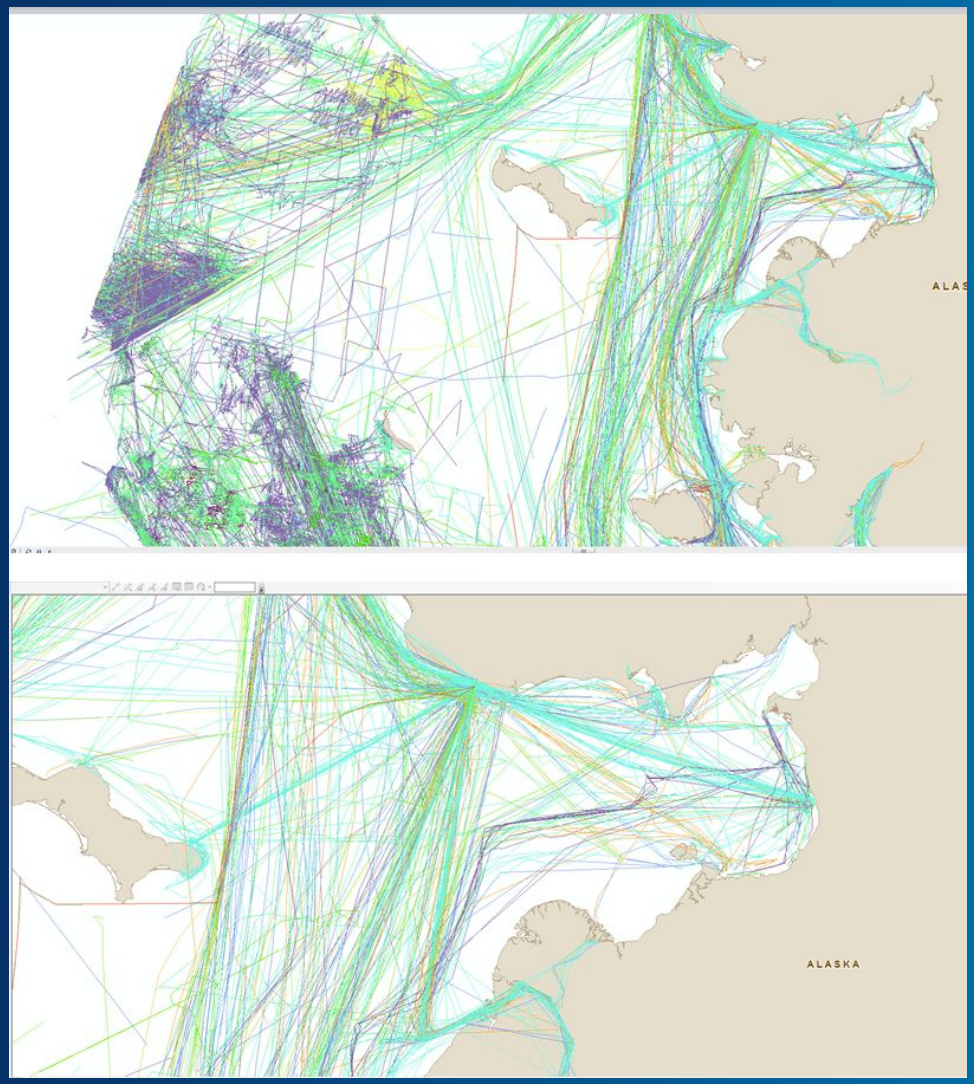


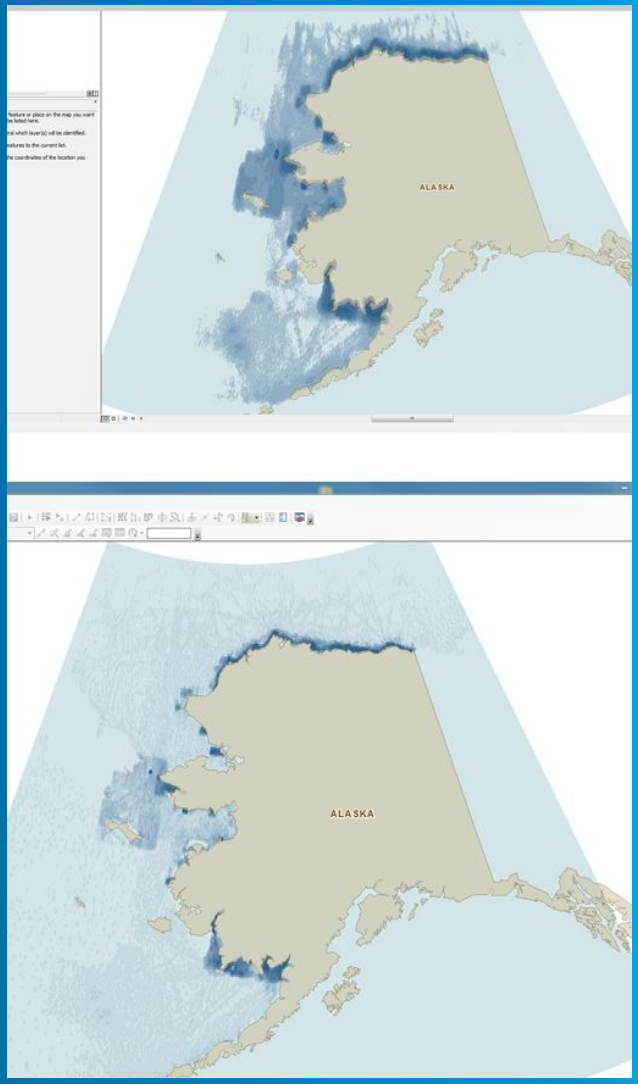
Discussion

ENC Navigational Purpose

Navigational Purpose	Code	NOAA Scale Ranges	IHO Recommended Scale Ranges
Berthing	6	< 1:5,000	<1:4,000
Harbour	5	1:5,001 – 1:50,000	1:4,001 – 1:21,999
Approach	4	1:50,001 – 1:150,000	1:22,000 – 1:89,999
Coastal	3	1:150,001 – 1:600,000	1:90,000 – 1:349,999
General	2	1:600,001 – 1:1,500,000	1:350,000 – 1:1,499,999
Overview	1	>1:1,500,001	>1:1,500,000

Other considerations for ENC scale decisions





Discussion

ENC Navigational Purpose

Navigational Purpose	Code	NOAA Scale Ranges	CHS Scale Ranges	IHO Recommended Scale Ranges
Berthing	6	< 1:5,000	< 1:2,000	<1:4,000
Harbour	5	1:5,001 – 1:50,000	1:2,001 -1:20,000	1:4,001 – 1:21,999
Approach	4	1:50,001 – 1:150,000	1:20,001-1:50,000	1:22,000 – 1:89,999
Coastal	3	1:150,001 – 1:600,000	1:50,001 – 1:150,000	1:90,000 – 1:349,999
General	2	1:600,001 – 1:1,500,000	1:150,001- 1:500,000	1:350,000 – 1:1,499,999
Overview	1	>1:1,500,001	> 1:500,001	>1:1,500,000

Conclusions

- Easy to use tool (ESRI environment)
- Transferable to other geographic Regions
- A decision regarding the bands is needed and should be made before going forward.
- Preparation to IHO S-101