Forcing an Arctic Sea Ice Model with NARR Surface Winds
How to Stitch Datasets

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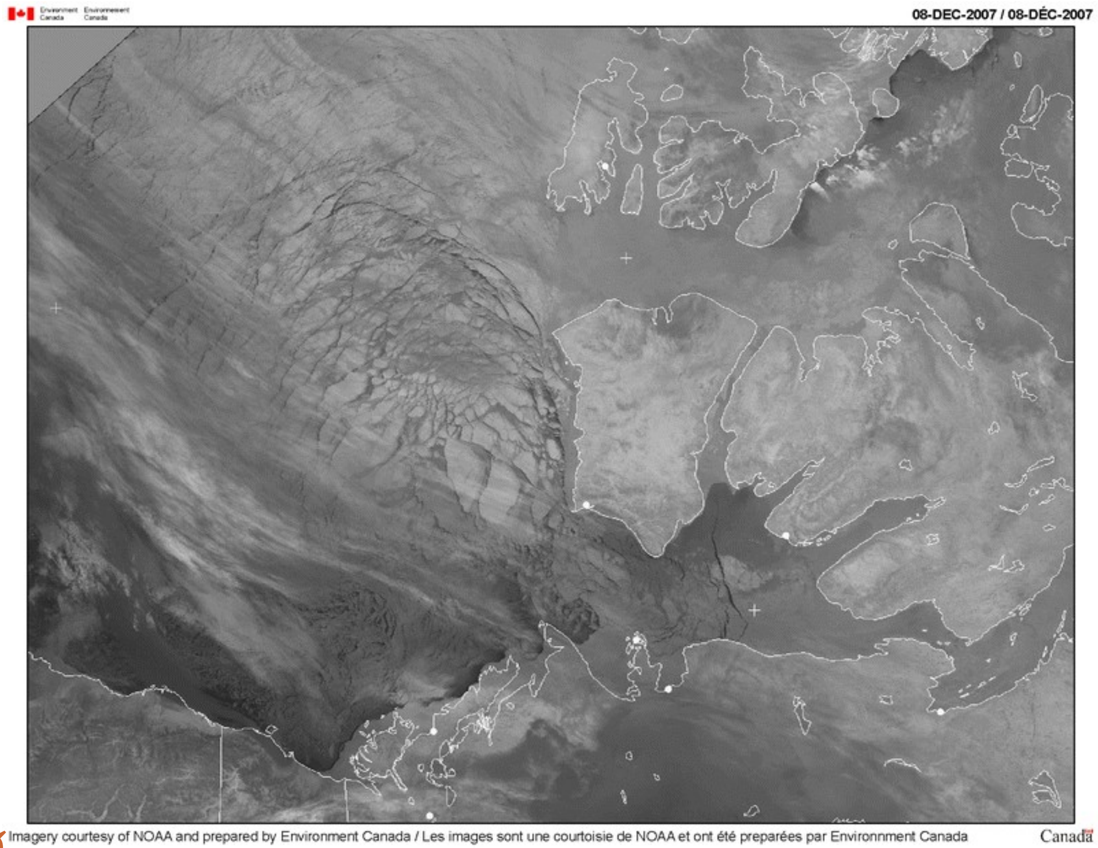
Sea Ice Models Increase in Resolution

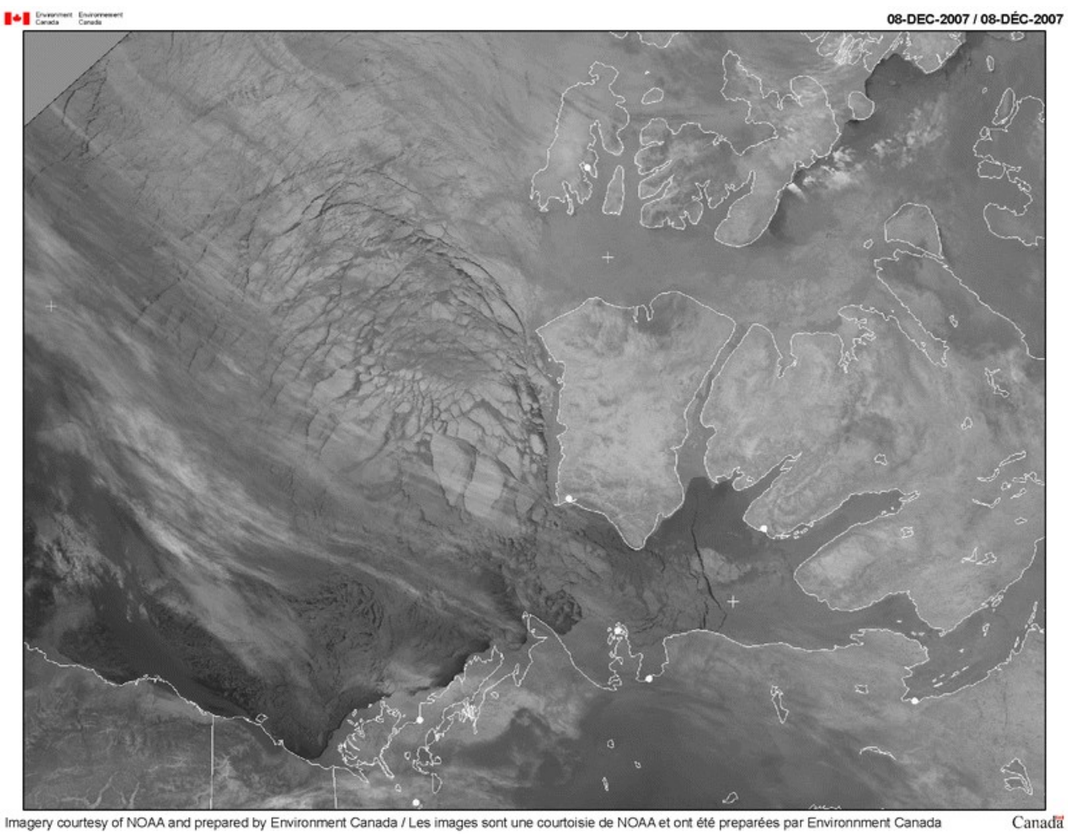
1979 – 125 km
1985 – 222 km
1992 – 160 km
1995 – 160 km
1997 – 40 km
2002 – 55 km
2003 – 9 km

…

but the wind forcing fields are still at ~ 1° resolution.

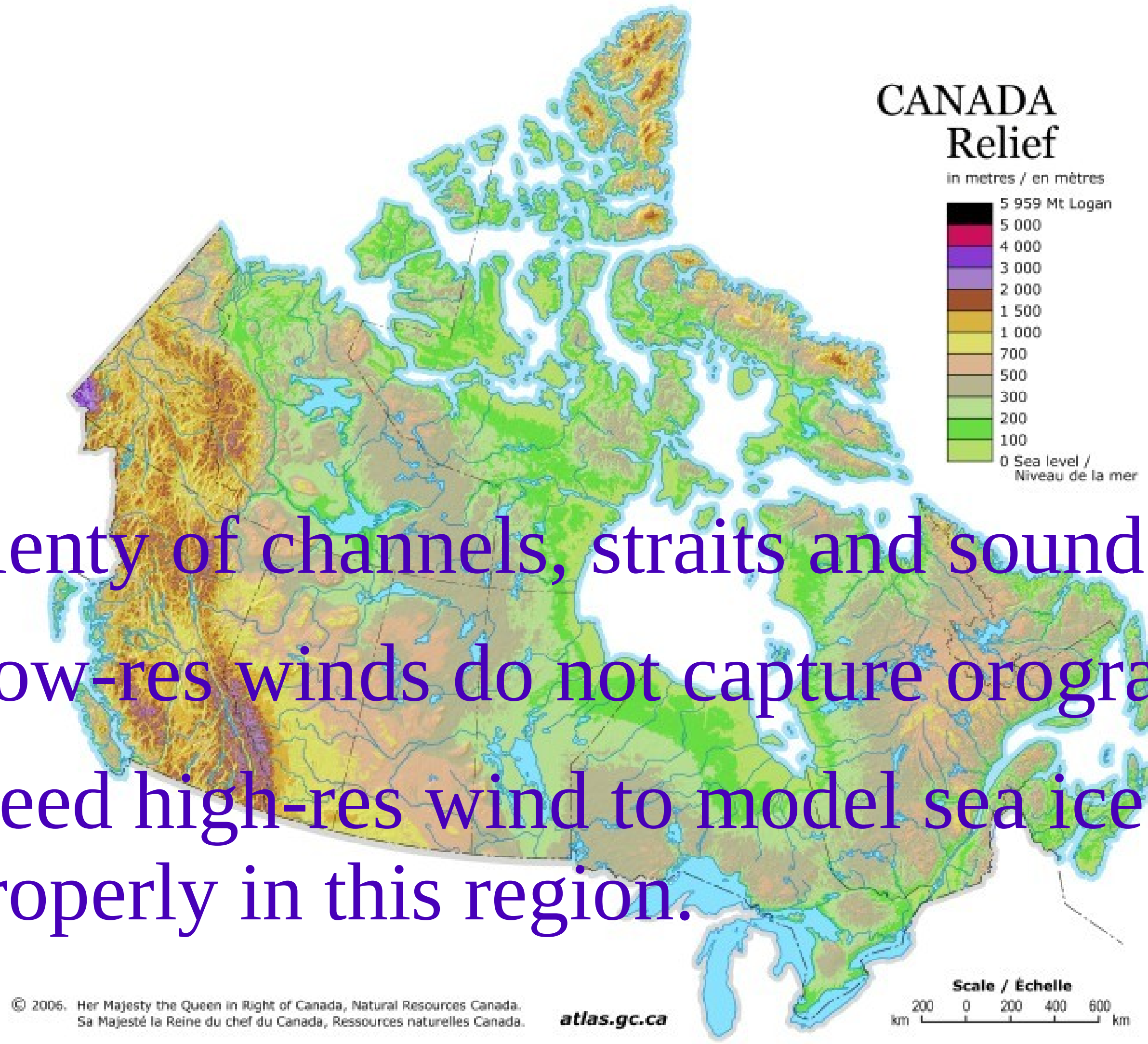


Why are modeled ice fields so smooth?



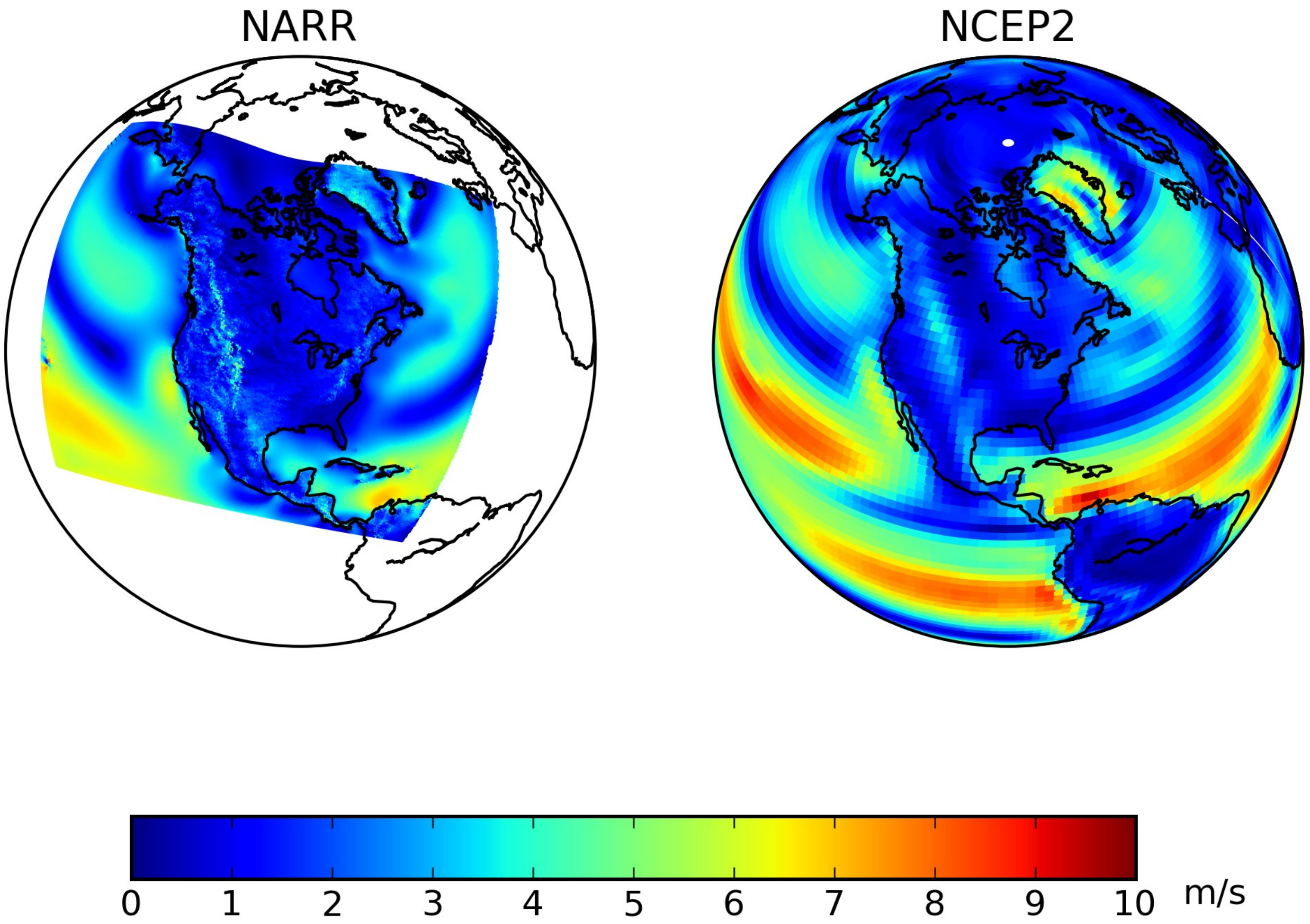
- Coarse grid ?
- Diffusive advection scheme ?
- Continuity assumption ?
- Yield curve ?
- Wind field too smooth ?

The Canadian Arctic Archipelago



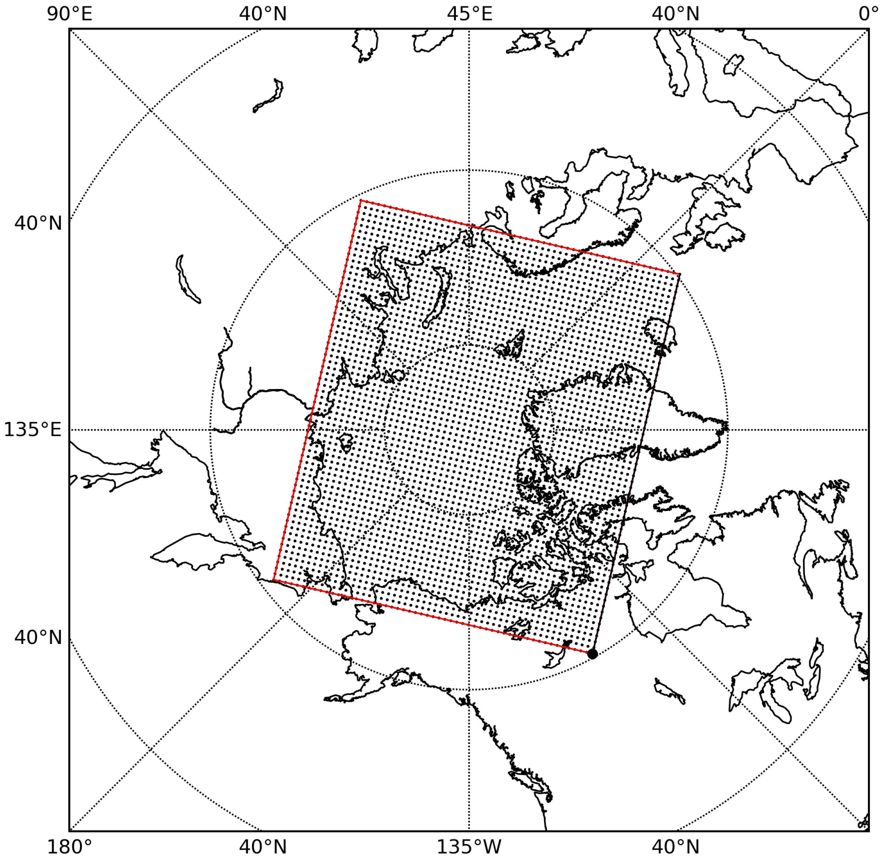
- Plenty of channels, straits and sounds.
- Low-res winds do not capture orographic effects.
- Need high-res wind to model sea ice motion properly in this region.

North American Regional Reanalysis (NARR)



Stitching NARR and NCEP winds

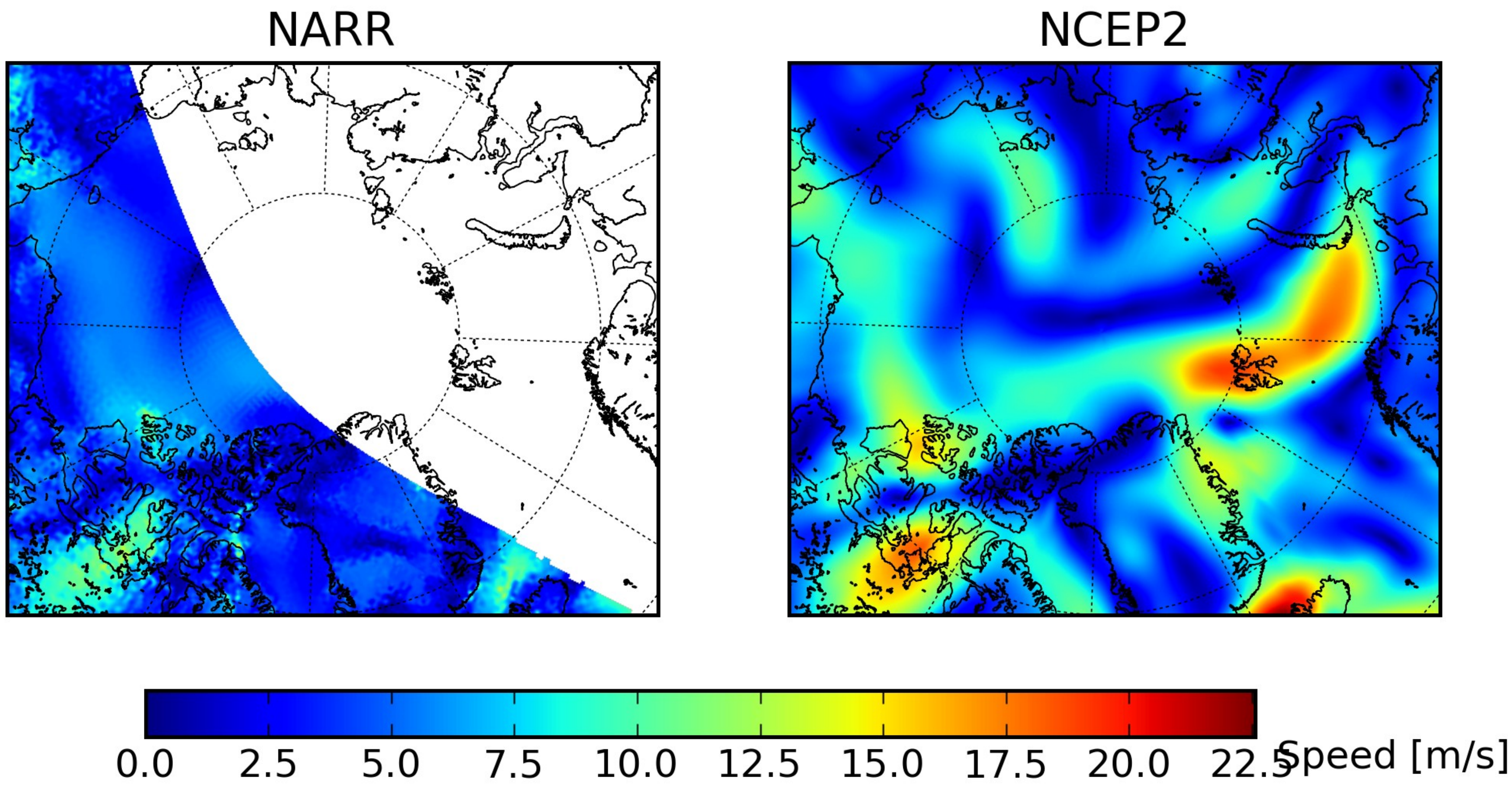
- Merge and interpolate
  Combine data points unto an unstructured grid and interpolate (*eg*. kriging) on the model grid.
- Interpolate and merge
  Interpolate the two data sets on the model grid, then merge them using a weighted average.



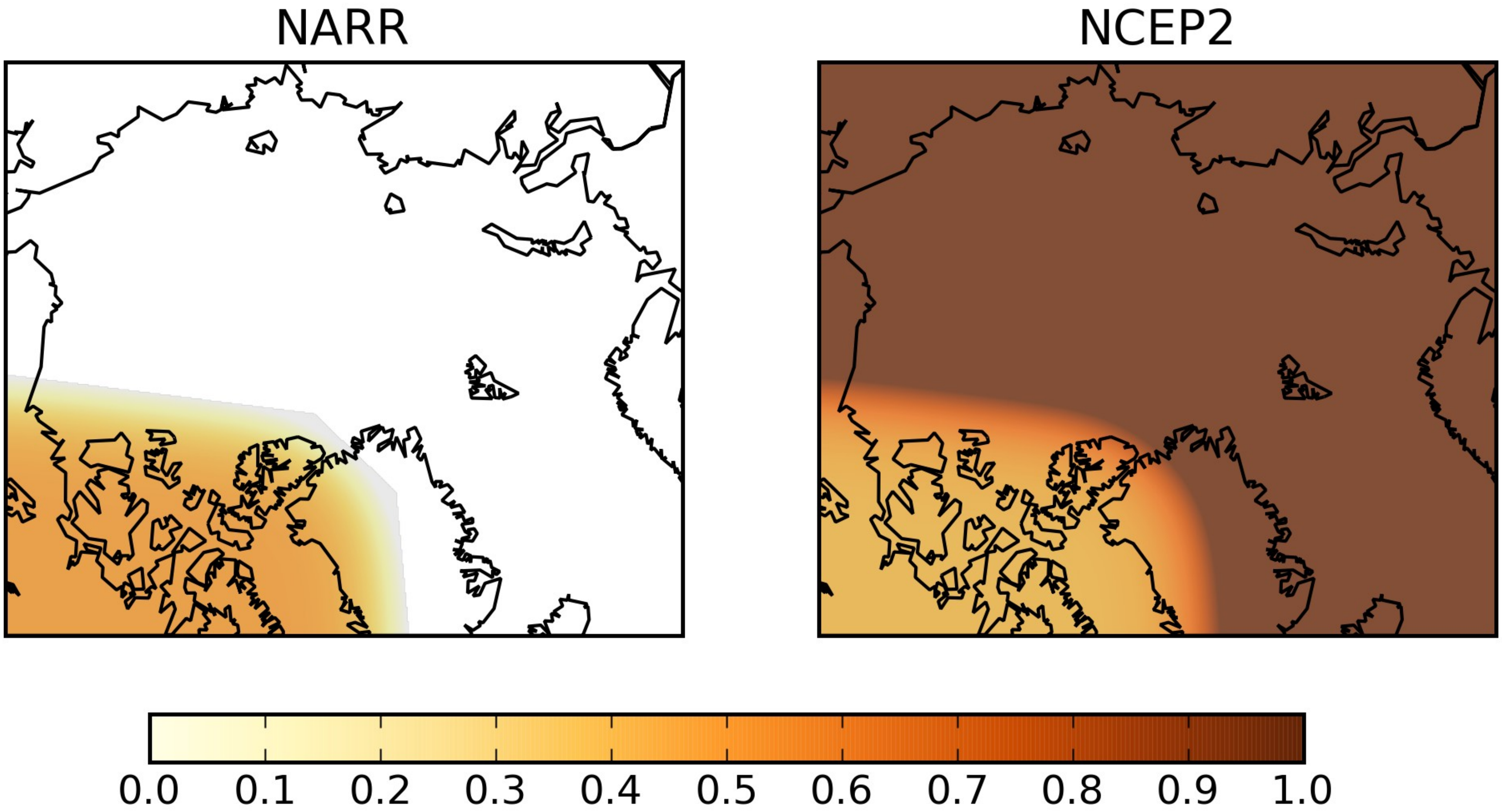
Interpolate and Merge

1. Interpolate NARR and NCEP on the model grid using Akima's revised bicubic interpolator.
2. Apply a weighted mask to each dataset.
3. Merge the *u* and *v* winds using a weighted average.

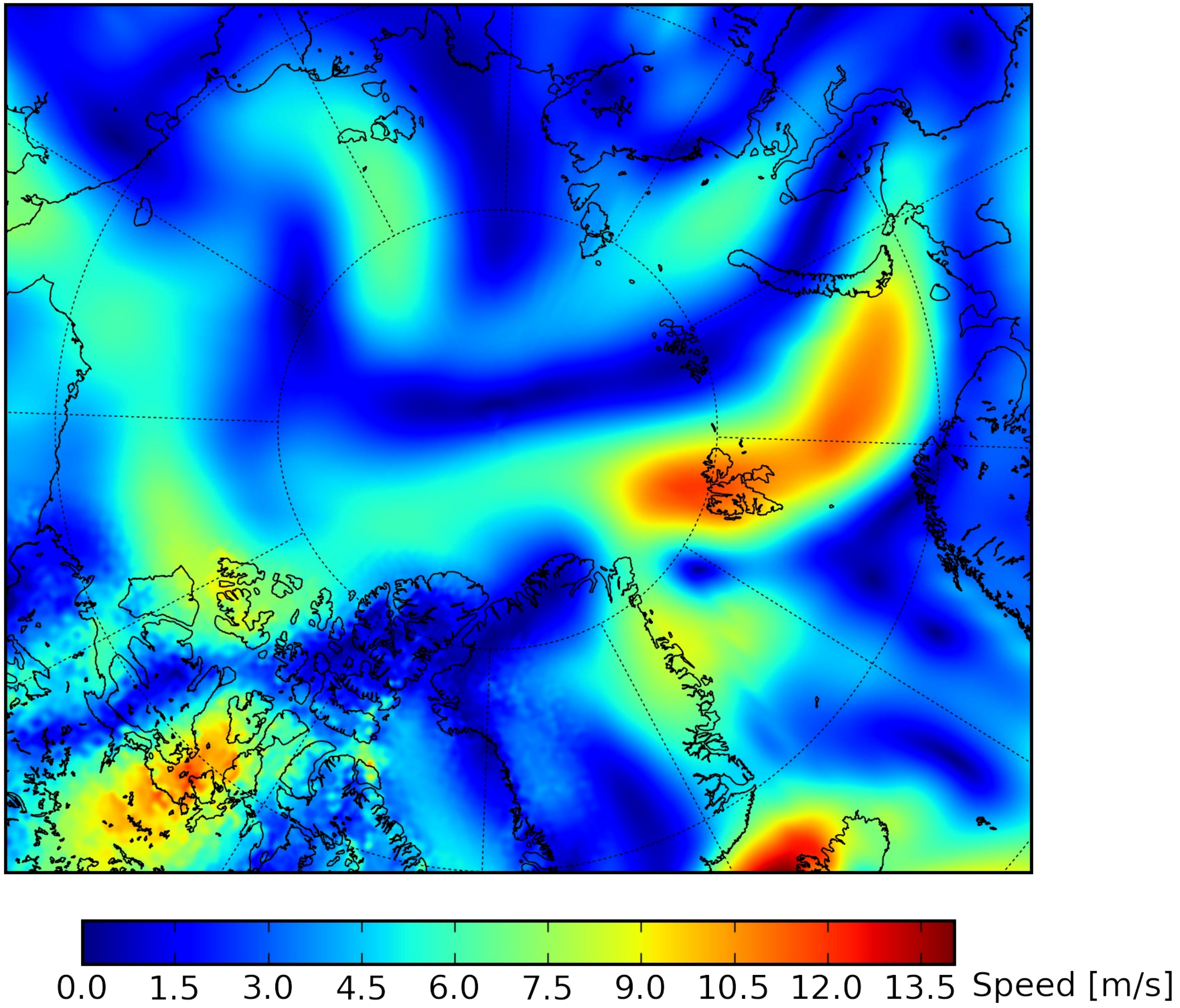
Step 1: Interpolate on the model grid



Step 2: Apply a weighted mask



Step 3: Weighted average of both

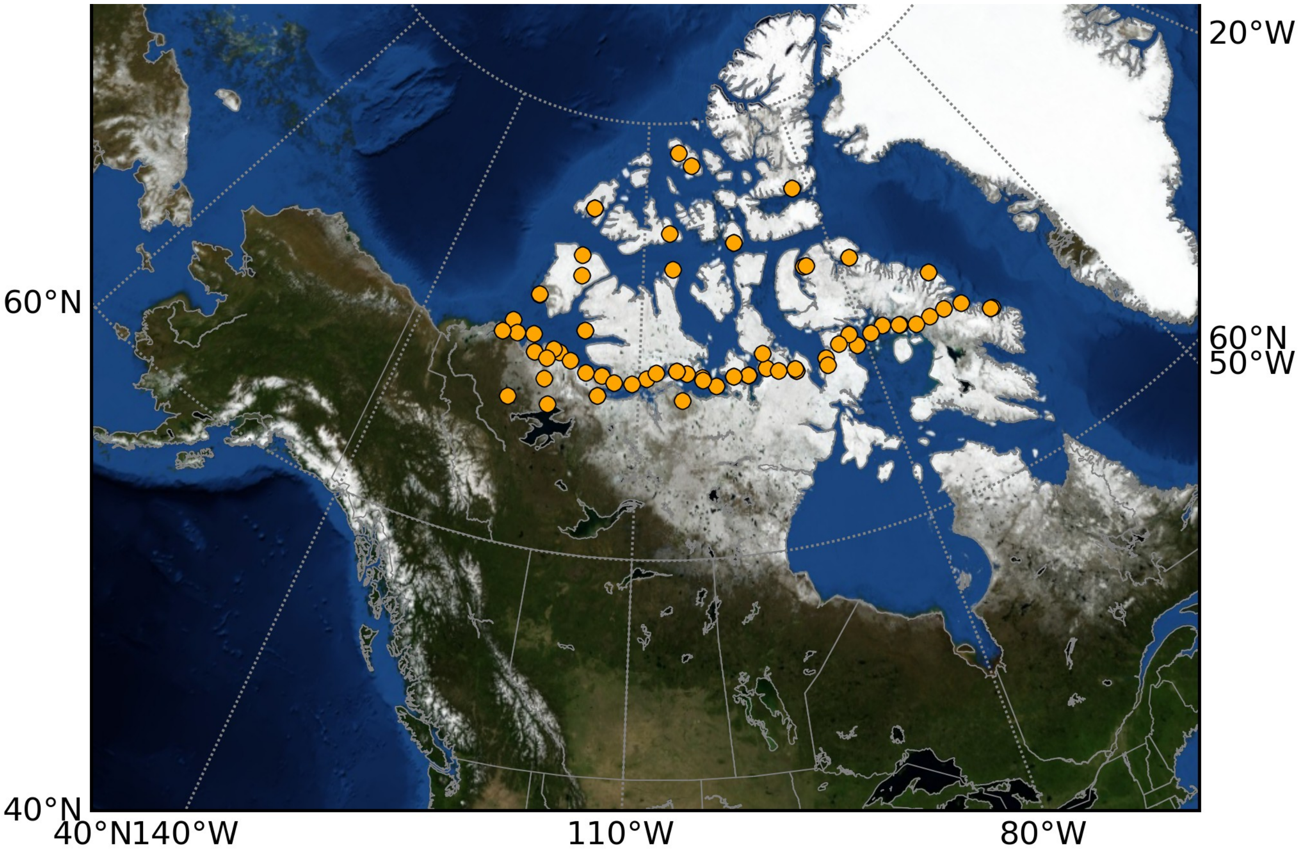


The Scale Problem

- Mean wind speeds are not compatible.
- One or the other data set must be scaled to avoid large discrepancies at the seam.
- NARR wind speed < NCEP2 wind speed
- Which one fits better with observations ?

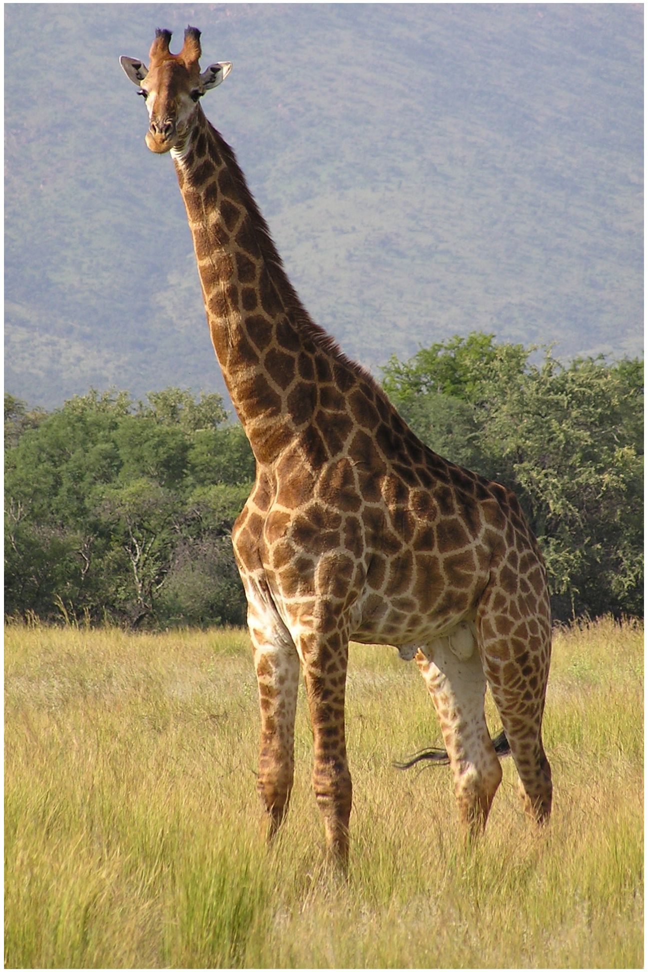
Wind Speed Intercomparison

- Compare NARR and NCEP2 10m winds with meteorological stations data.



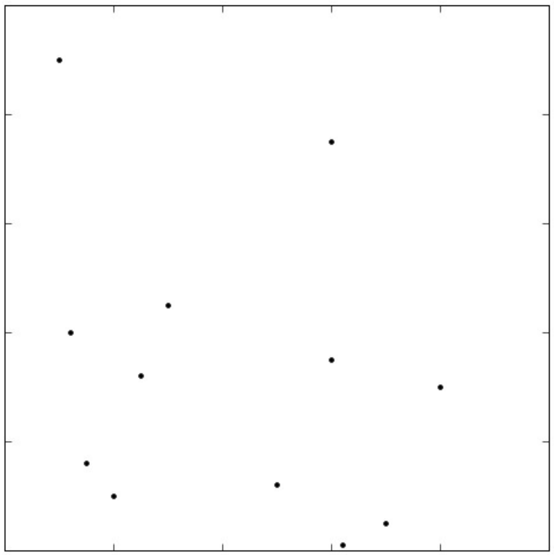
Interpolating... again.

- Interpolate NARR and NCEP2 winds at the stations location.
- Delaunay Nearest Neighbor interpolation – Voronoi tessellation.



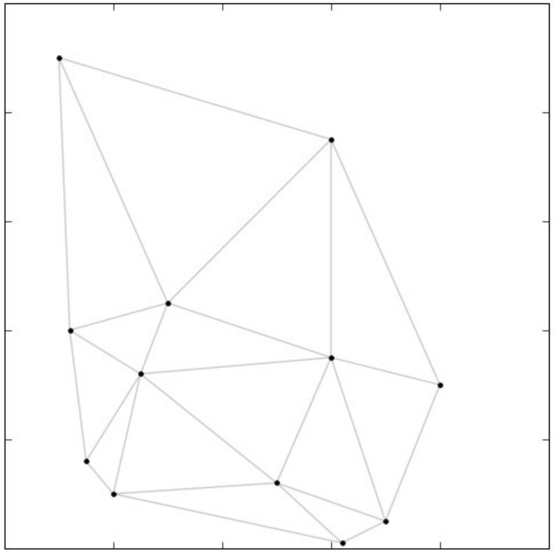
Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)



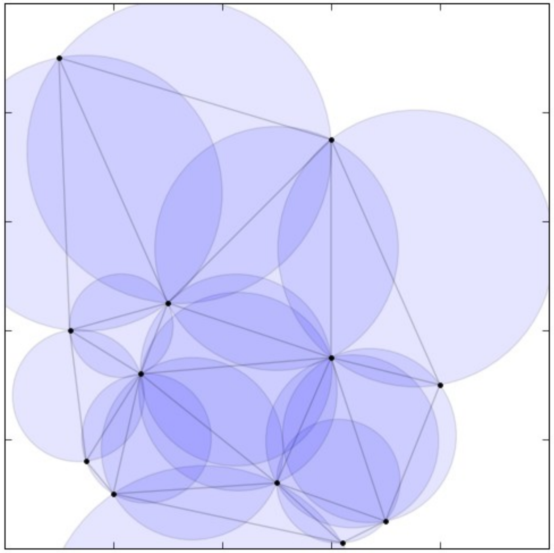
Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)
2. Delaunay tesselation



Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)
2. Delaunay tesselation
3. Circumcenters



Delaunay Nearest Neighbor Interpolator

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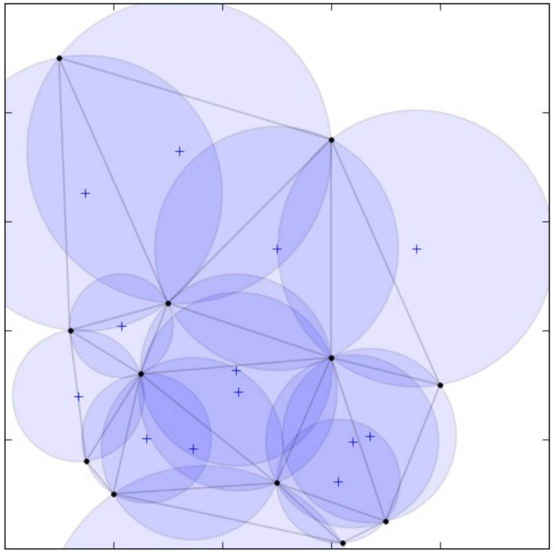
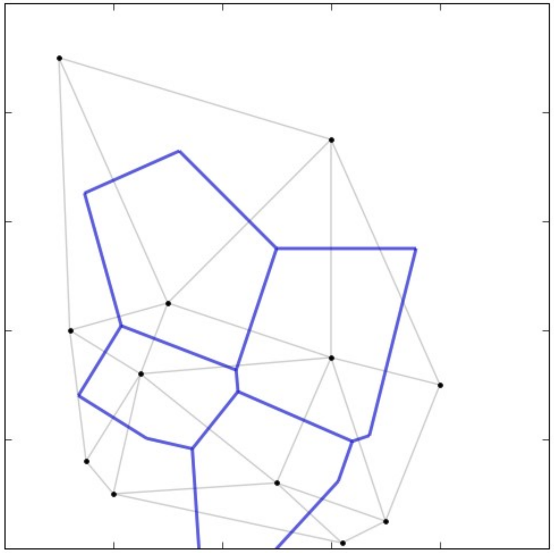


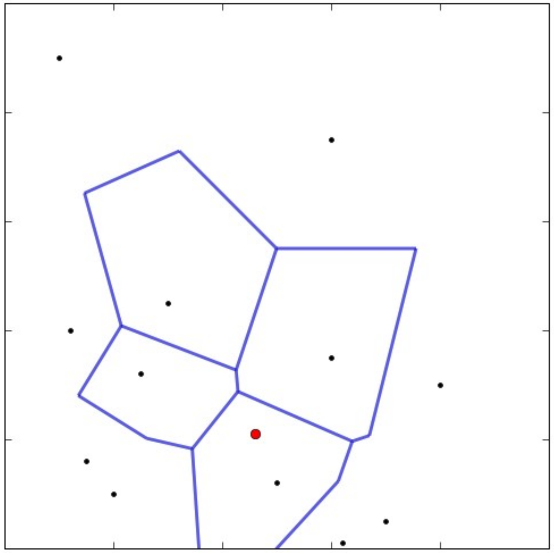
Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)
2. Delaunay tesselation
3. Circumcenters
4. Voronoi tesselation



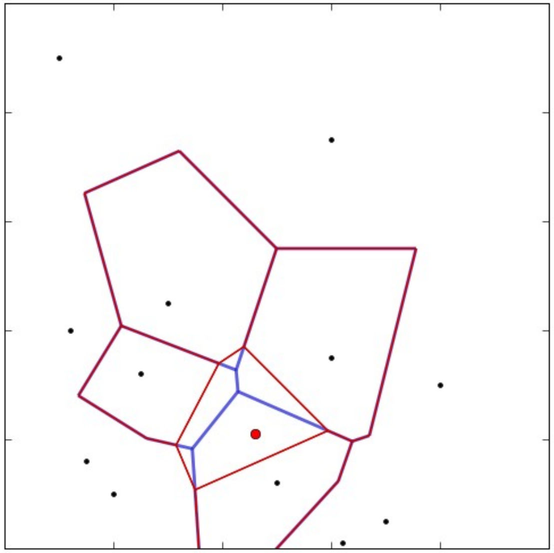
Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)
2. Delaunay tesselation
3. Circumcenters
4. Voronoi tesselation
5. Interpolation point

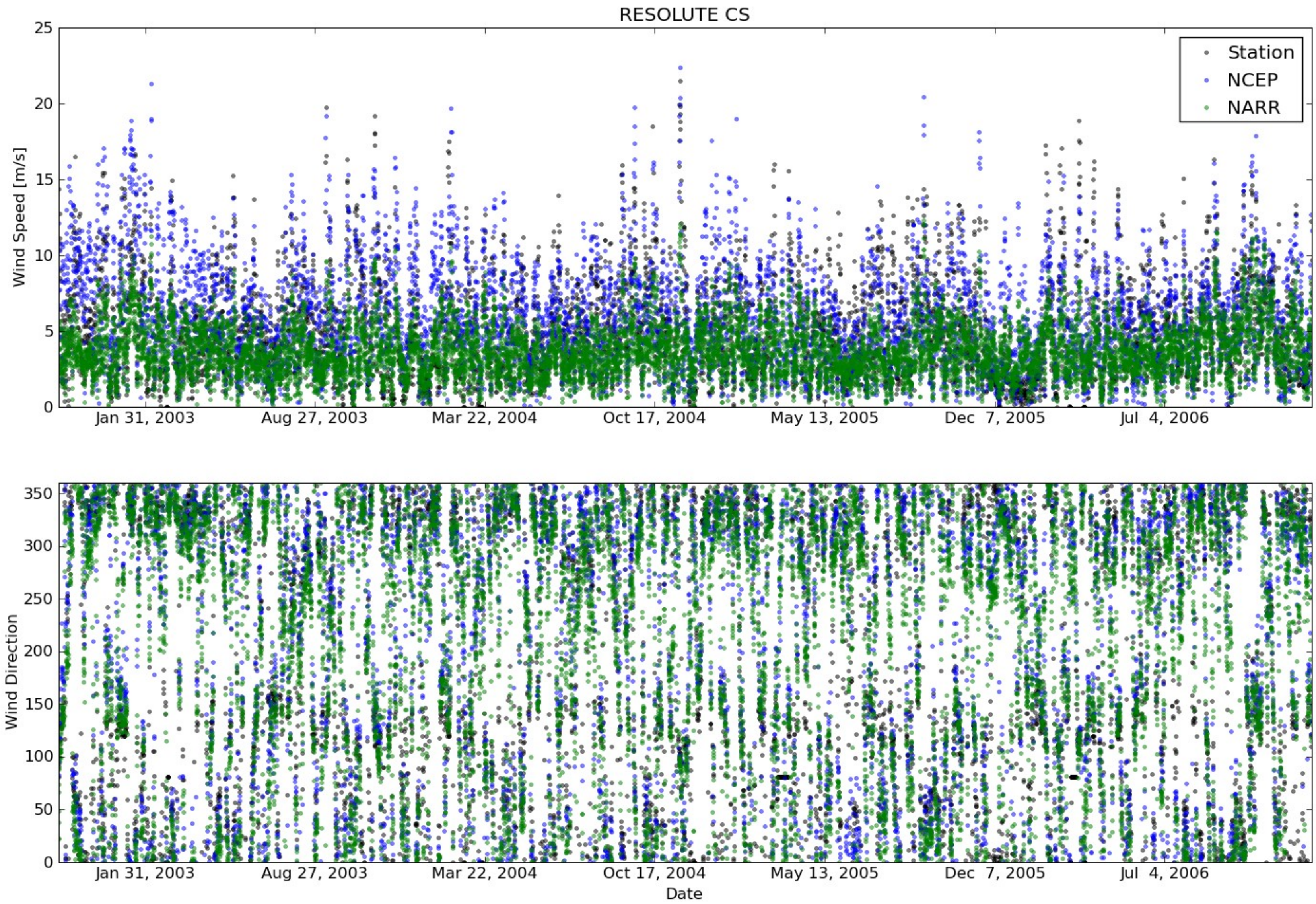


Delaunay Nearest Neighbor Interpolator

1. z = f(x,y)
2. Delaunay tesselation
3. Circumcenters
4. Voronoi tesselation
5. Interpolation point
6. Weigh neighbor points according to the *stolen area*



Wind Time Series



Time Series Statistics

Resolute

	Mean	Std	Autocorrelation
NARR	3.74	1.76	0.94
NCEP2	5.94	3.38	0.87
Station	5.05	3.24	0.81

Kugluktuk

	Mean	Std	Autocorrelation
NARR	3.23	1.62	0.91
NCEP2	5.17	2.95	0.82
Station	4.38	2.67	0.73

Global Results

	Mean (m/s)	Std (m/s)	Autocorrelation
• Station	4.8	3.1	0.51
• NCEP2	5.6	3.2	0.85
• NARR	3.5	1.8	0.92

Conclusion

- NCEP2 winds seem fast for grid averaged winds.
- NARR shows little variability and high auto-correlation.

What's next ?

- Discuss those differences with data sets authors.
- Study differences in modeled sea ice fluxes and shear.

Line Integral Convolution