Validation of 12.5 km Resolution Coastal Winds

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Outline

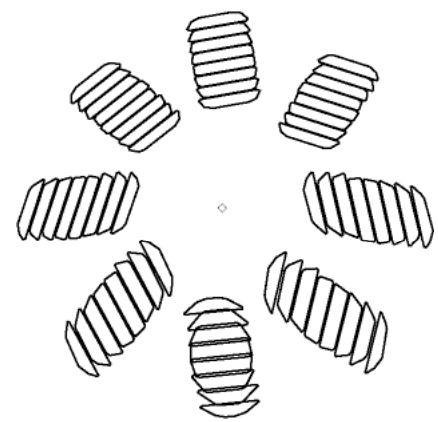
- Part 1: Determining empirical land mask
  - Characterizing σ_0 near coast
- Part 2: Wind retrieval using new mask
  - Methodology
  - Comparisons with NDBC buoy winds
- Future work

Overview of Land Masks

- Current QuikSCAT land mask is fixed
  - 35km for 25km resolution wind vectors
  - 20km for 12.5km resolution wind vectors
- Use backscatter measurements (σ_0) to determine "empirical" land mask
- **Key Assumption:** At a fixed viewing geometry and location, σ_0 will have a larger *variability* over ocean than over land
- Long QSCAT mission provides accurate statistics

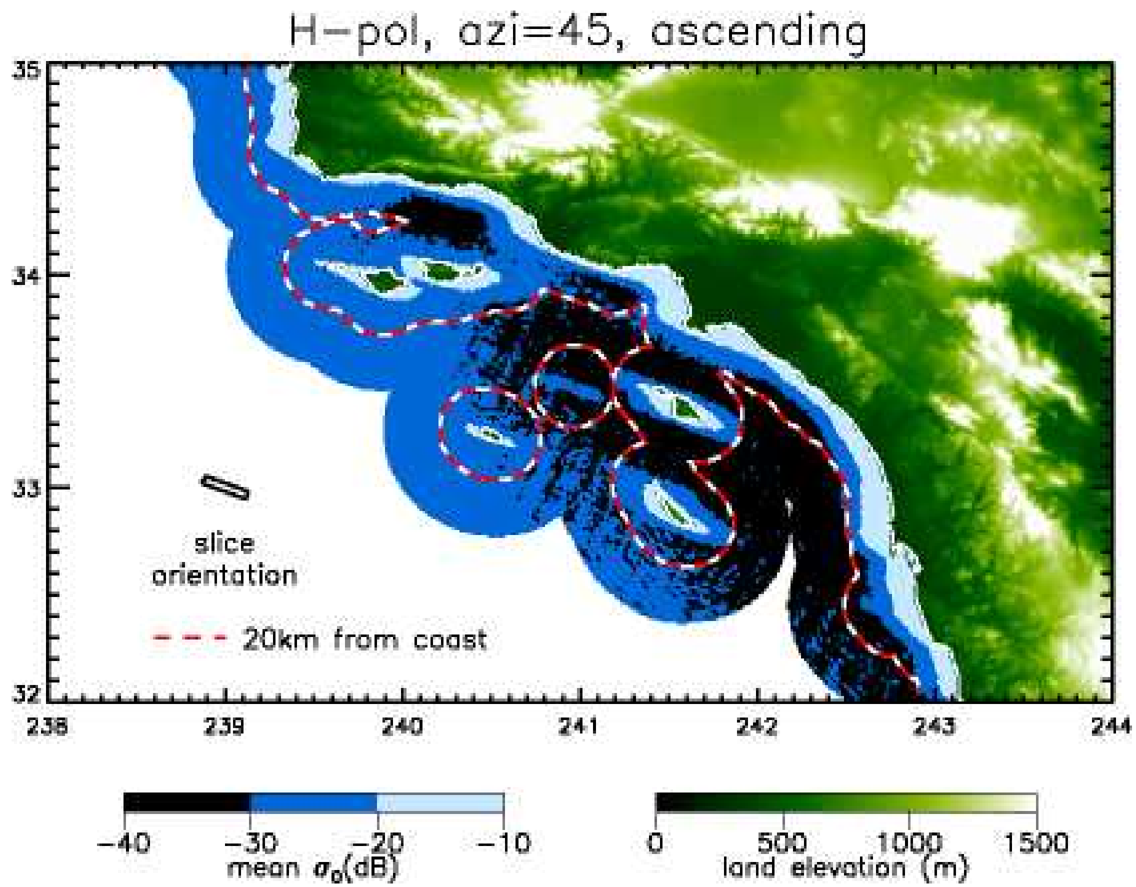
Characterizing σ_0 Near Coast

- Calculations of temporal mean and variability (*sdev)* of σ_0 *slices* in region within 50km of coast
  - Function of:
    - Measurement location
      - *Latitude and longitude of* σ_0 center
    - Viewing geometry
      - antenna azimuth angle, χ
      - incidence angle, θ
      - *ascending/descending*
  - Use 8 years of QuikSCAT σ_0 data, 2000-2007
  - *mean(lat,lon; θ,χ) and sdev(lat,lon; θ,χ);*
    - Gridded on a 1/120th degree grid
    - Each calculation includes all σ_0 within 3km of grid point
    - ~200-400 σ_0 slice values in each calculation



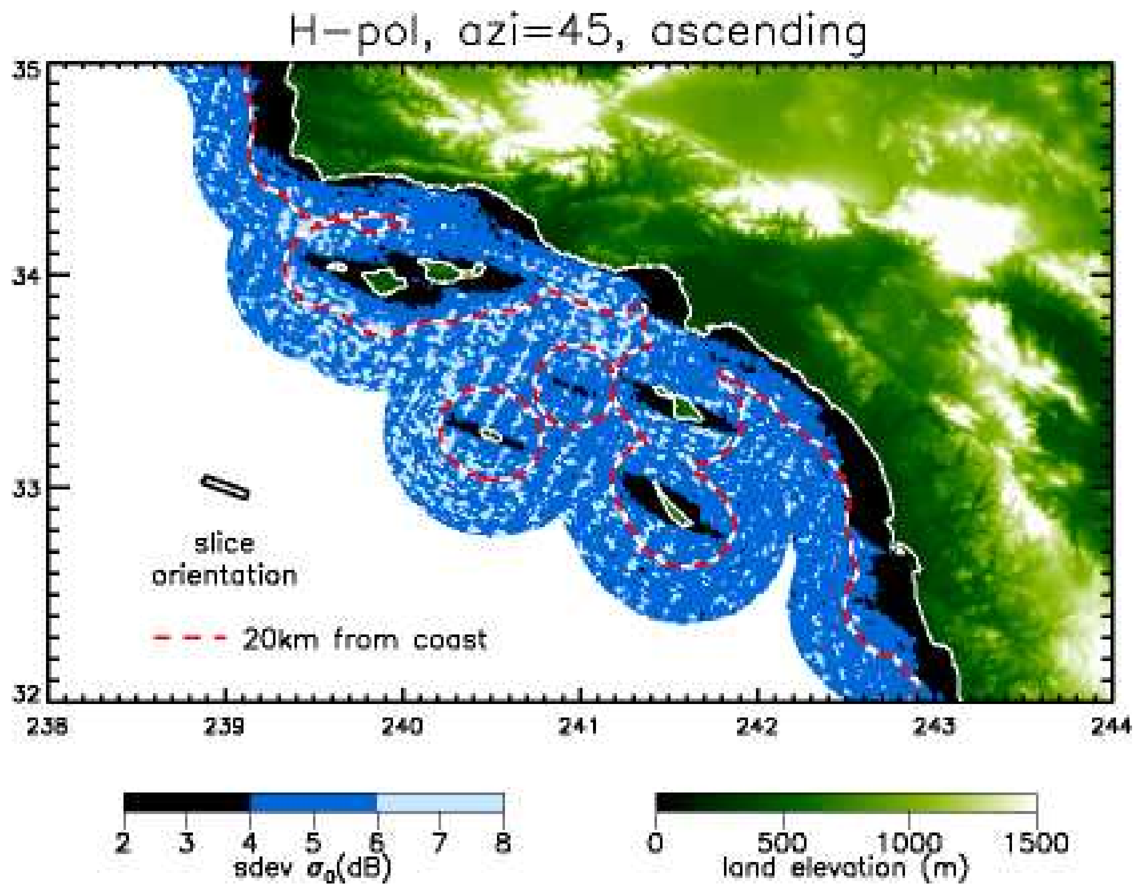
Examples of slices at different azimuth angles.

Mean of Coastal σ_o



- Topography is from GTOPO30 database

Variability of Coastal σ_o



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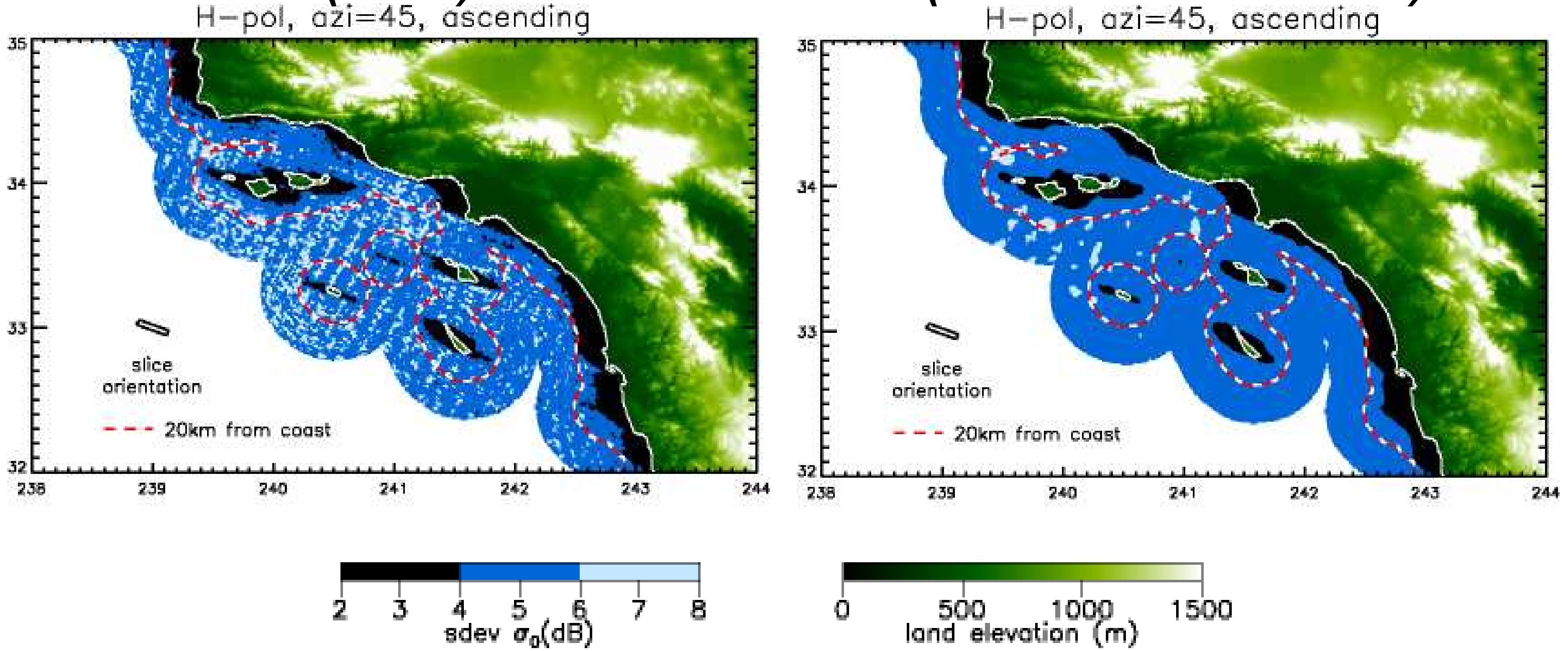
Construction of Land Mask

- Your eye can “see” contamination (aided by choice of color palette)
- Apply median filter to “de-speckle” images
  - Robust calculation
- Use a spatial extent of ~5km
  - If too small, resulting mask will be noisy
  - If too large, details will be lost

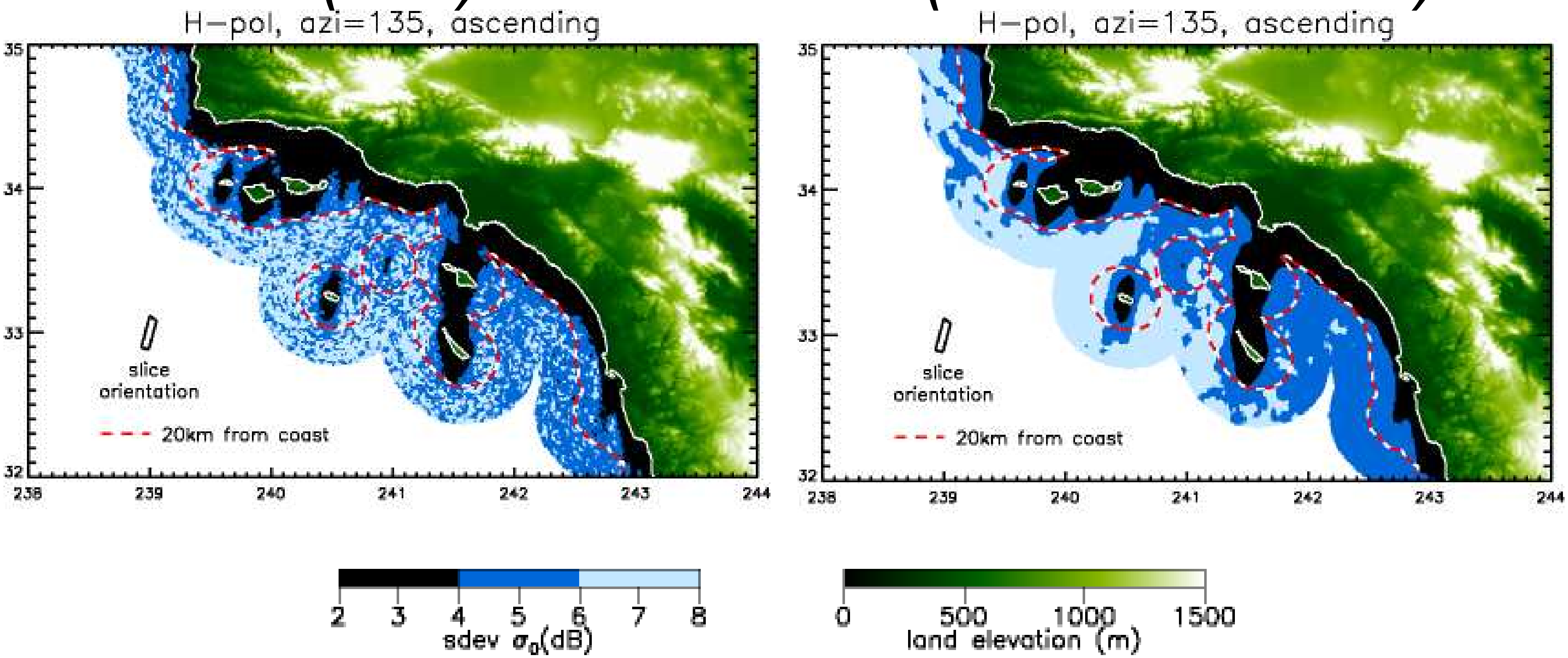
Variability of Coastal σ_o

(raw) *(median filtered)*



Variability of Coastal σ_o

(raw) *(median filtered)*



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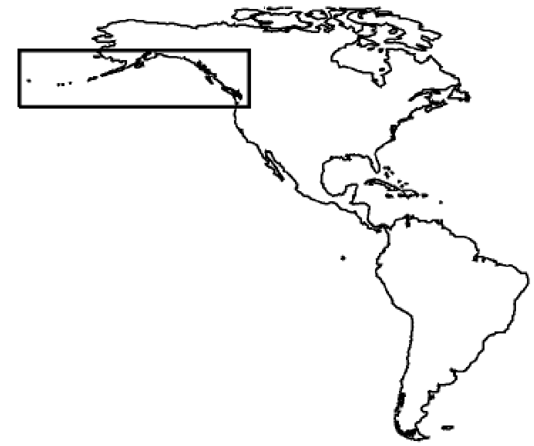
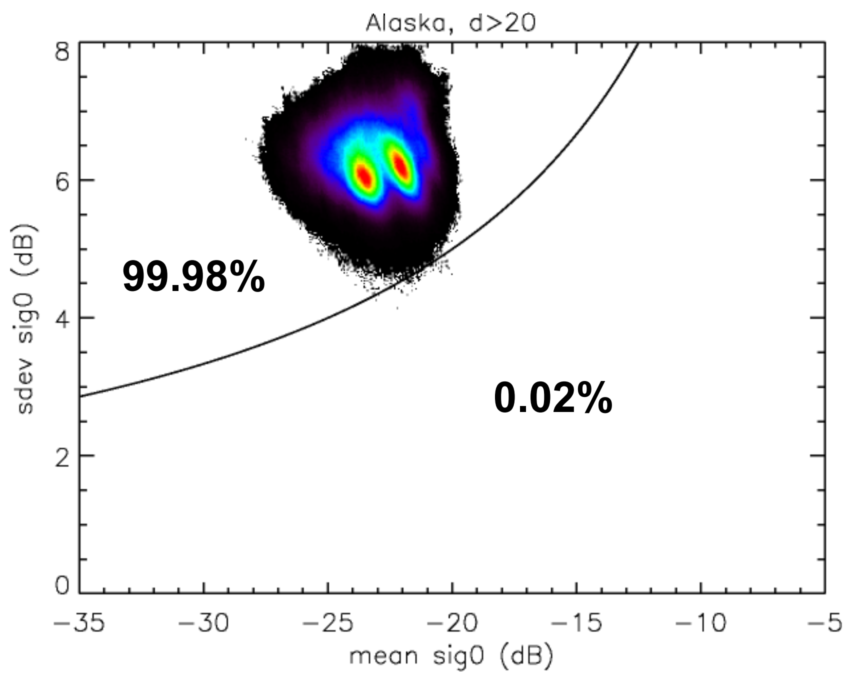
  - If too large, details will be lost
- **Determine criteria for "good" vs. "contaminated"** σ_0

Sdev vs. mean σ_o

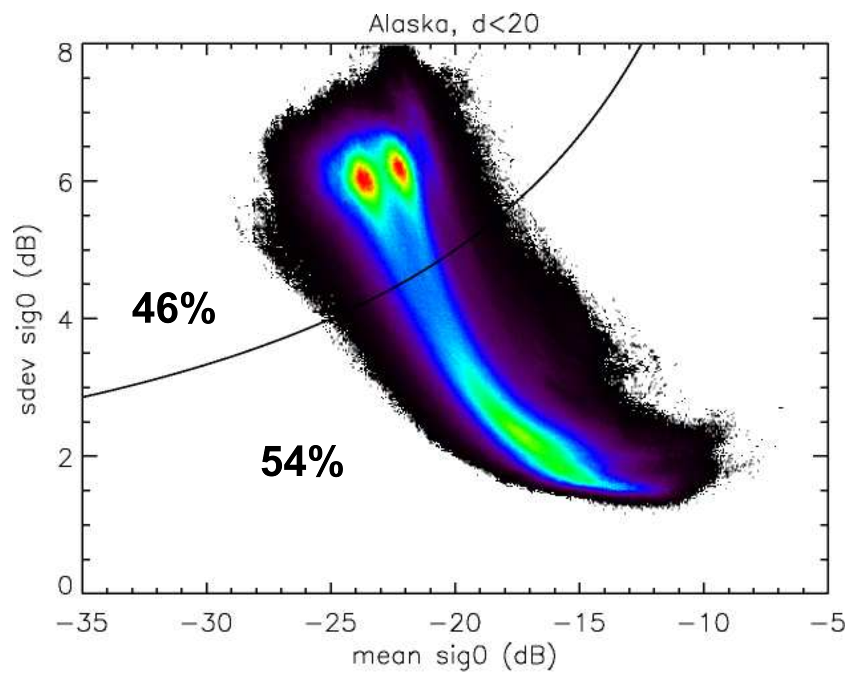


- -All grid points within 50km of land
- -Both H-pol and V-pol
- -All azimuth angles
- -“One size fits all?”

50 km > D > 20 km



D < 20 km



Sdev vs. mean σ_o

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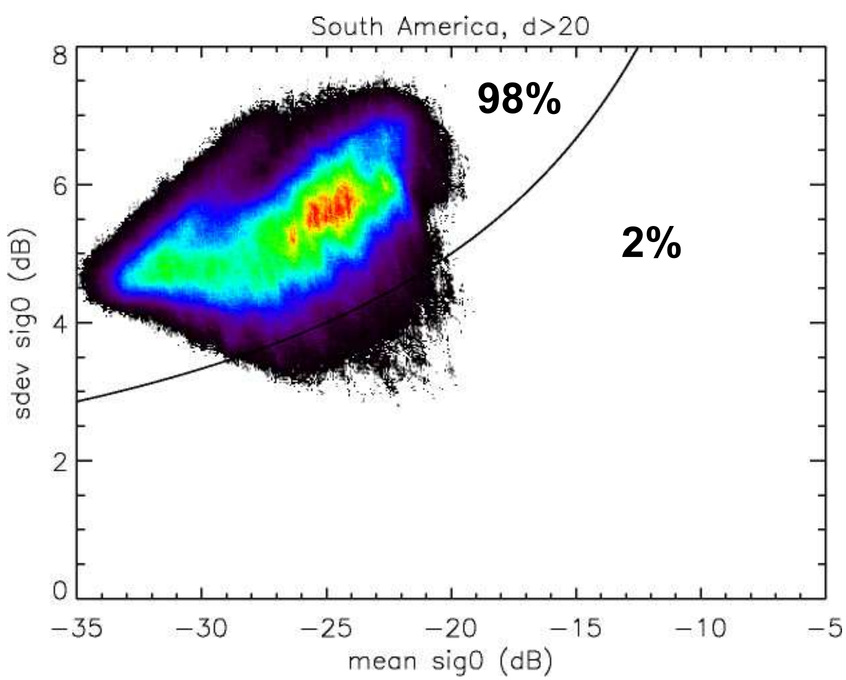
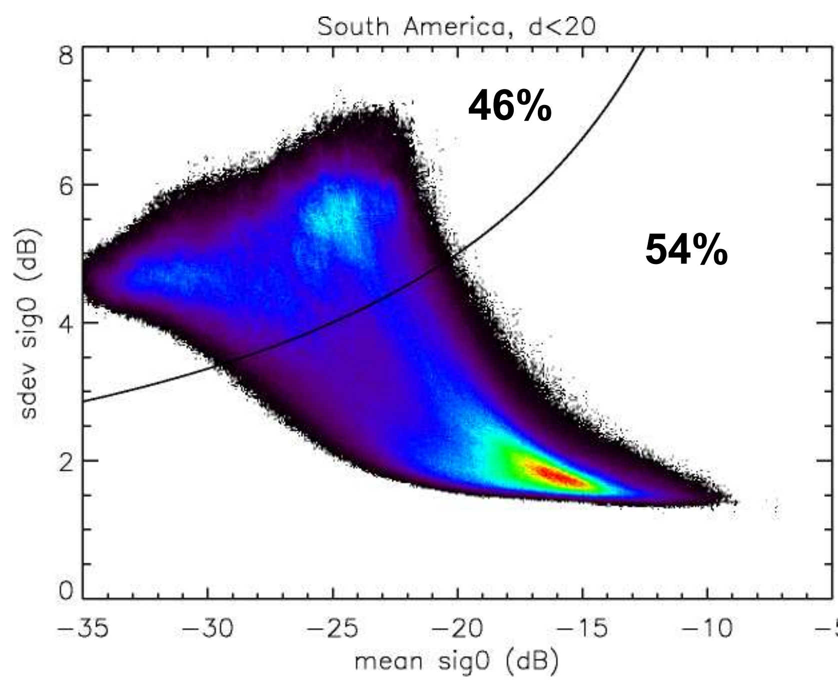
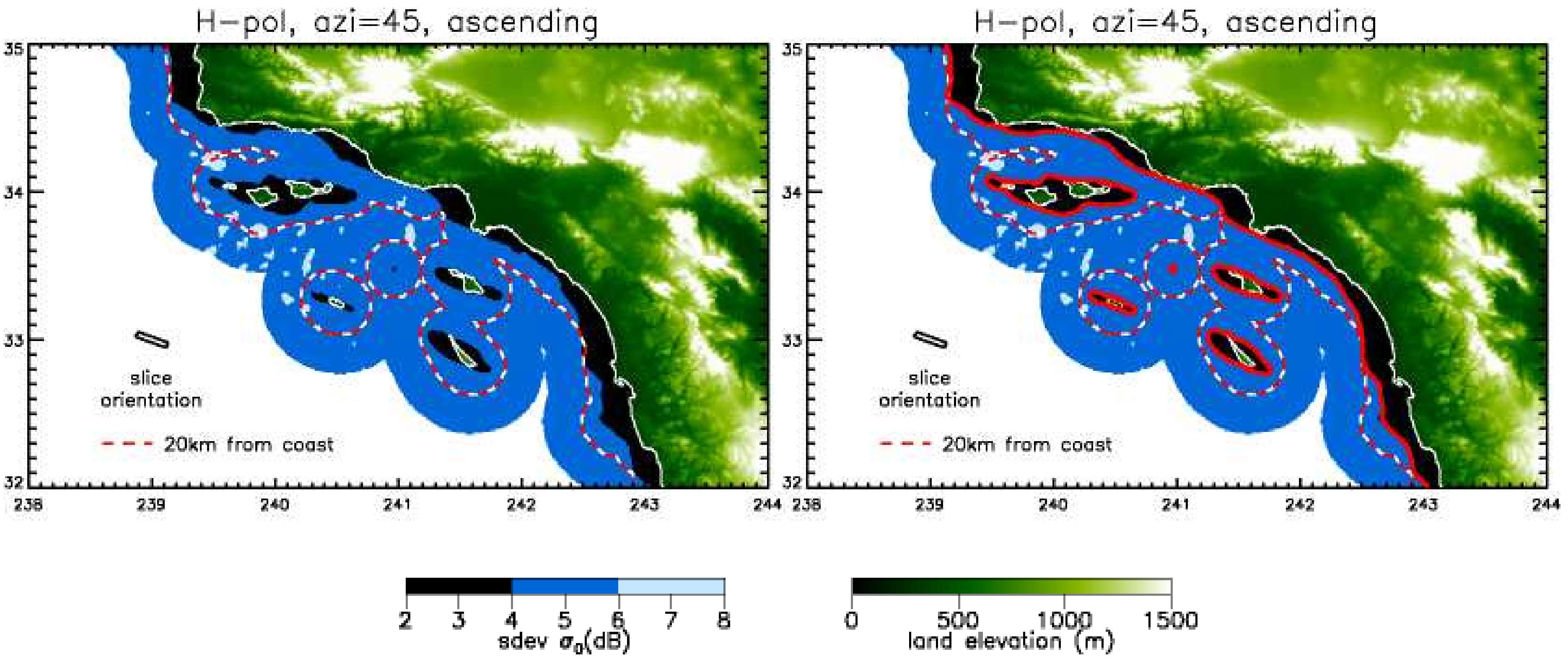


D < 20 km



Variability of Coastal σ_o

Red line: New empirical land mask



Variability of Coastal σ_o

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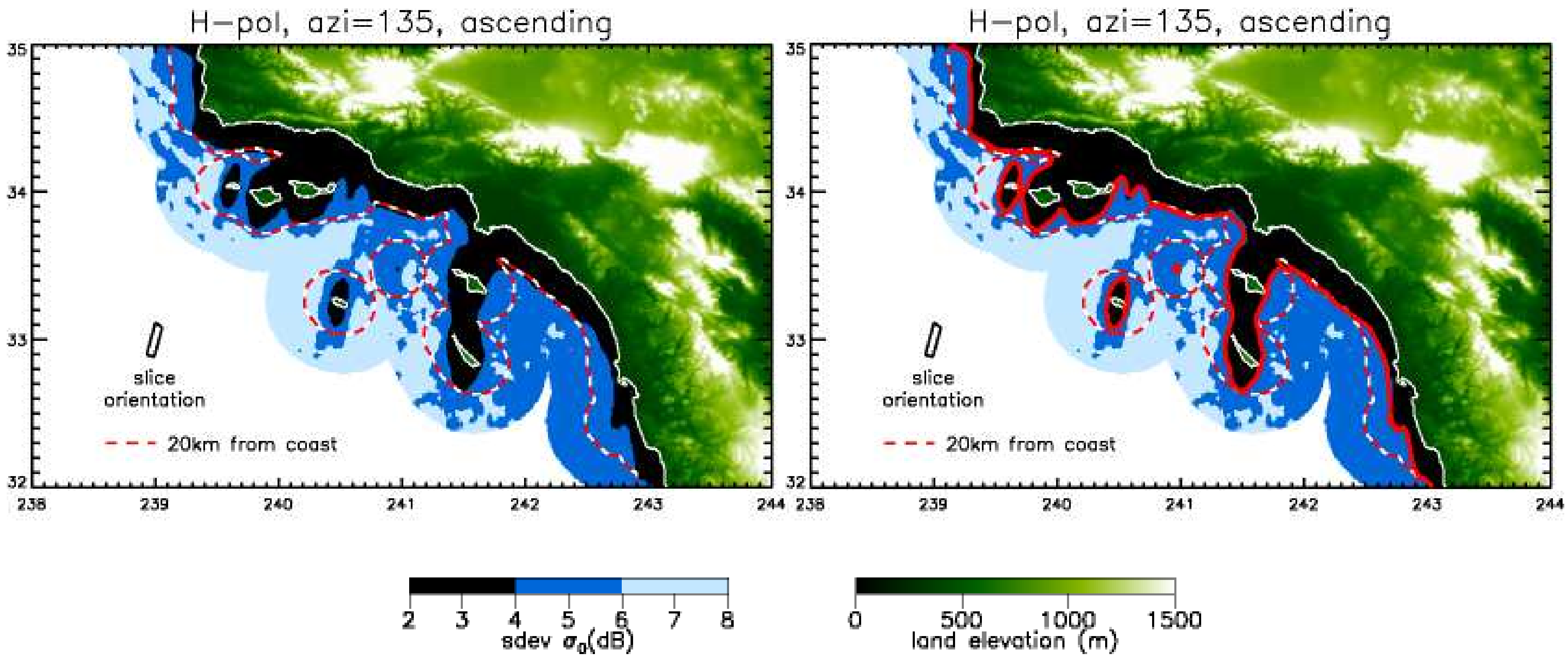


Conclusions: Part 1

- Current 20 km land mask is “about right” for global solution at all azimuth angles

- Characterizing σ_0 near coast
  - Variability is smaller near land
    - (Mean is larger in regions near land)
  - Depends upon slice orientation
  - Validates initial assumption

- Determine empirical land mask
  - Used conservative slice through 2-dimensional *sdev vs. mean* space to remove contamination

Wind Retrieval Details

- Convert land mask into table
- Do “coastal” wind retrievals
  - Only do retrievals within 50 km of coast (<<CPU time)
  - Flag σ_0 ***slices*** for contamination prior to compositing
  - Can use either MGDR-NRT ***or*** “science” code for retrievals
- Merge coastal retrievals with science
- Apply ambiguity removal
  - Treat new coastal winds (d<20 km) similar to “rain” to avoid propagation of possible spurious coastal wind vectors to open ocean

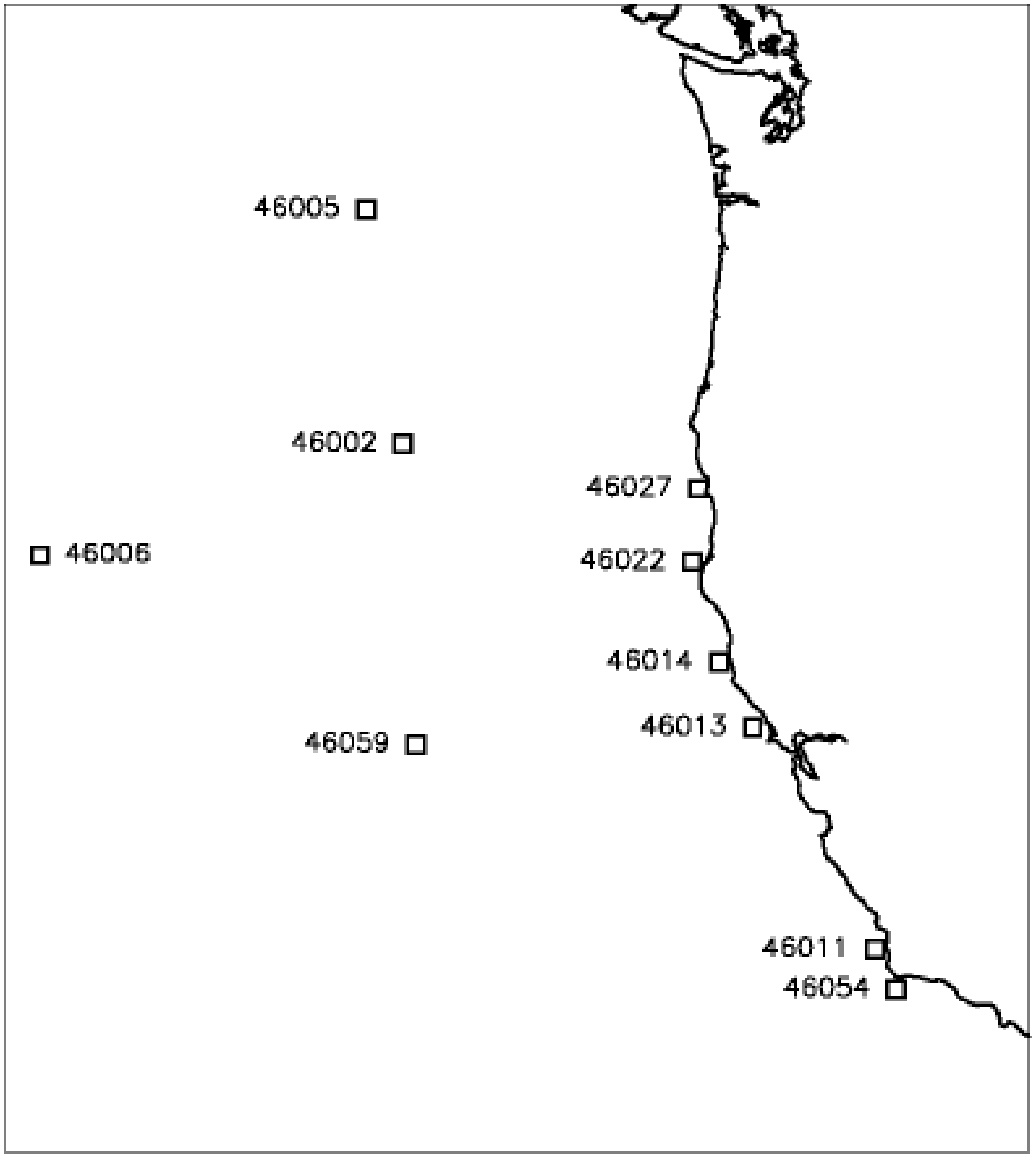
Validation Status

- Comparisons with NDBC buoys

- Collocate with QuikSCAT:
  - Within 30 minutes
  - d<12.5 km from buoys
  - Use selected ambiguity

- Use buoys ~20 km from land
  - Coastal retrievals do not fall within collocation radius (d<12.5 km) if buoy is too far from land

NDBC Buoy Locations



<u>Selected buoys</u>
-Four “open ocean” buoy
-Six “coastal” buoys

Collocations with these six coastal buoys include winds that are <20 km from land.

NDBC Buoy Info

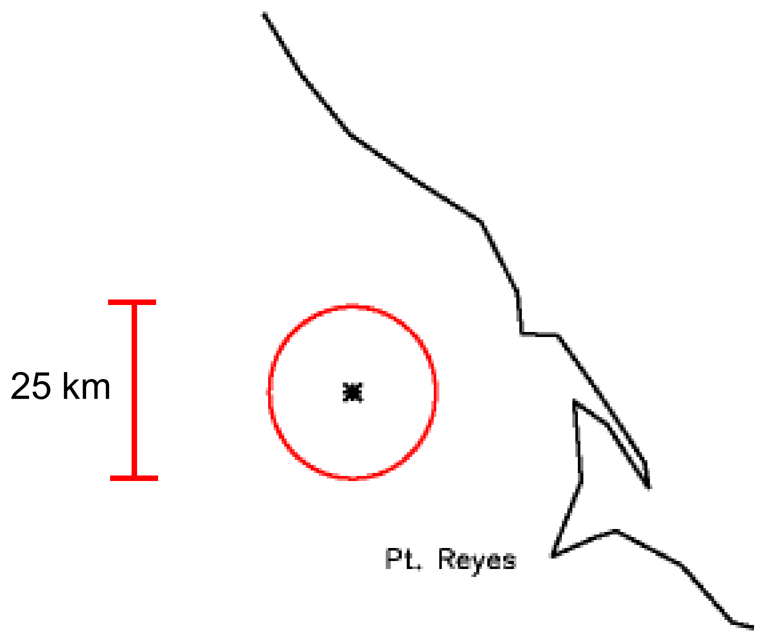
- **"Open Ocean" buoys**

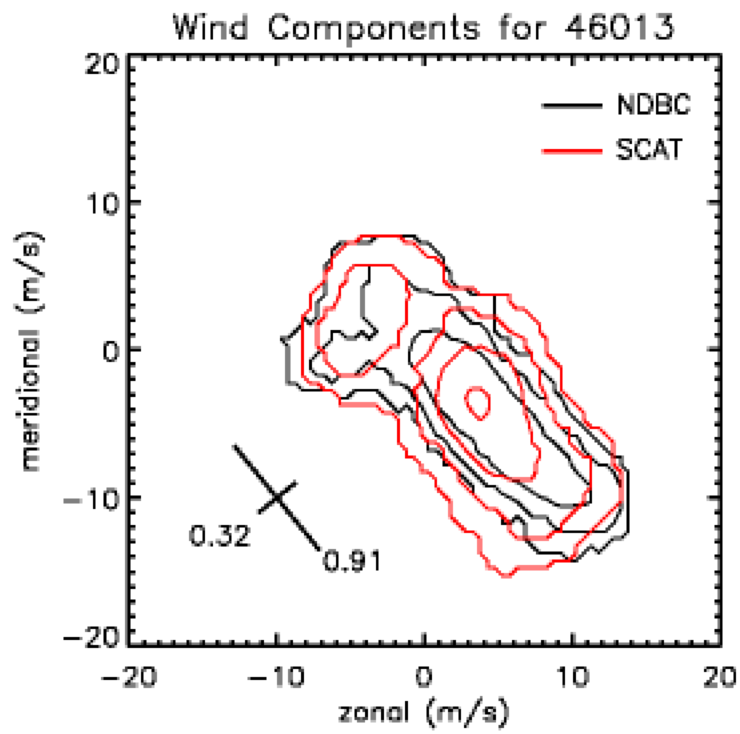
Buoy	lon	lat	npts	dist	VC	CC1	CC2	srms	drms
46002	229.74	42.53	8215	>99	1.69	0.93	0.76	0.9	23.8
46005	229.00	46.08	8081	>99	1.73	0.93	0.81	1.0	22.4
46006	222.51	40.84	5272	>99	1.76	0.92	0.84	1.1	22.2
46059	230.00	37.98	9650	>99	1.66	0.94	0.73	0.9	24.3

- **"Coastal" buoys**

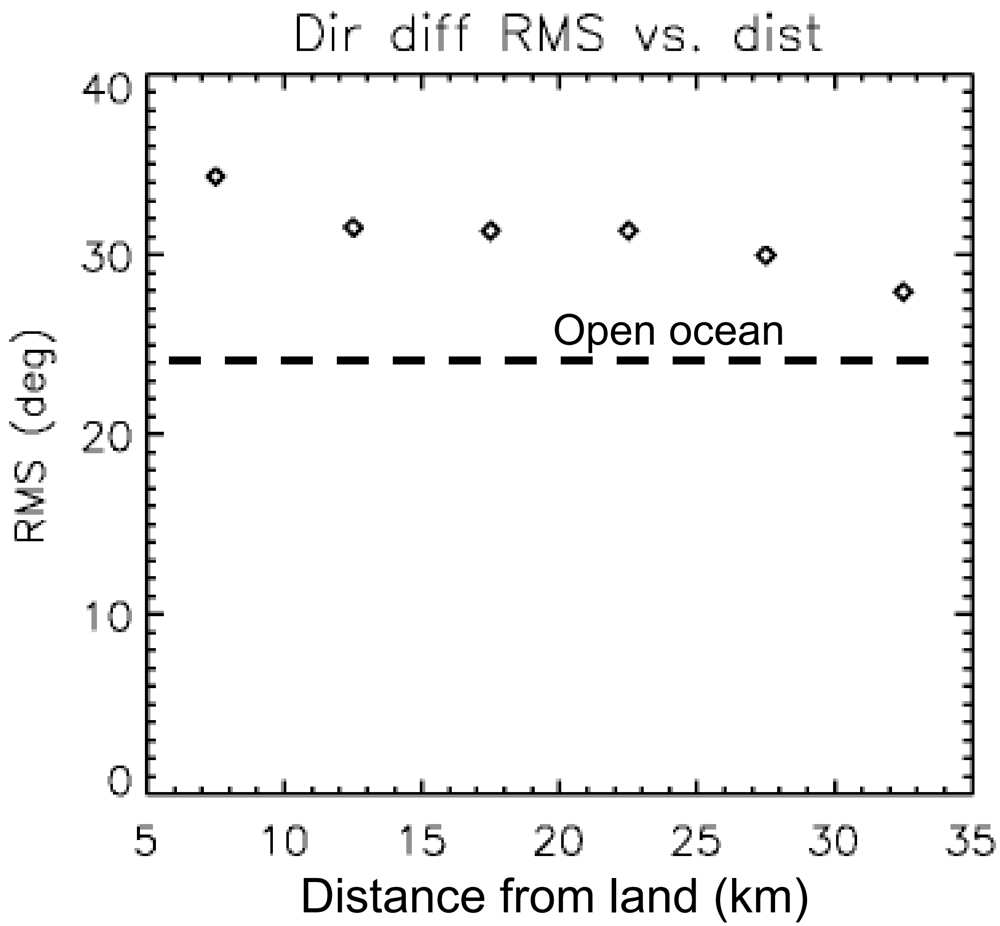
Buoy	lon	lat	npts	dist	VC	CC1	CC2	srms	drms
46011	239.13	34.88	4604	21	1.20	0.88	0.32	1.3	29.4
46013	236.70	38.23	6671	23	1.23	0.91	0.32	1.5	28.7
46014	236.03	39.22	4042	20	1.14	0.91	0.23	2.1	30.7
46022	235.49	40.74	4421	22	1.21	0.90	0.30	1.8	35.6
46027	235.62	41.85	2635	17	1.20	0.88	0.32	2.6	35.6
46054	239.55	34.27	4871	17	1.04	0.88	0.16	1.7	29.0

NDBC 46013

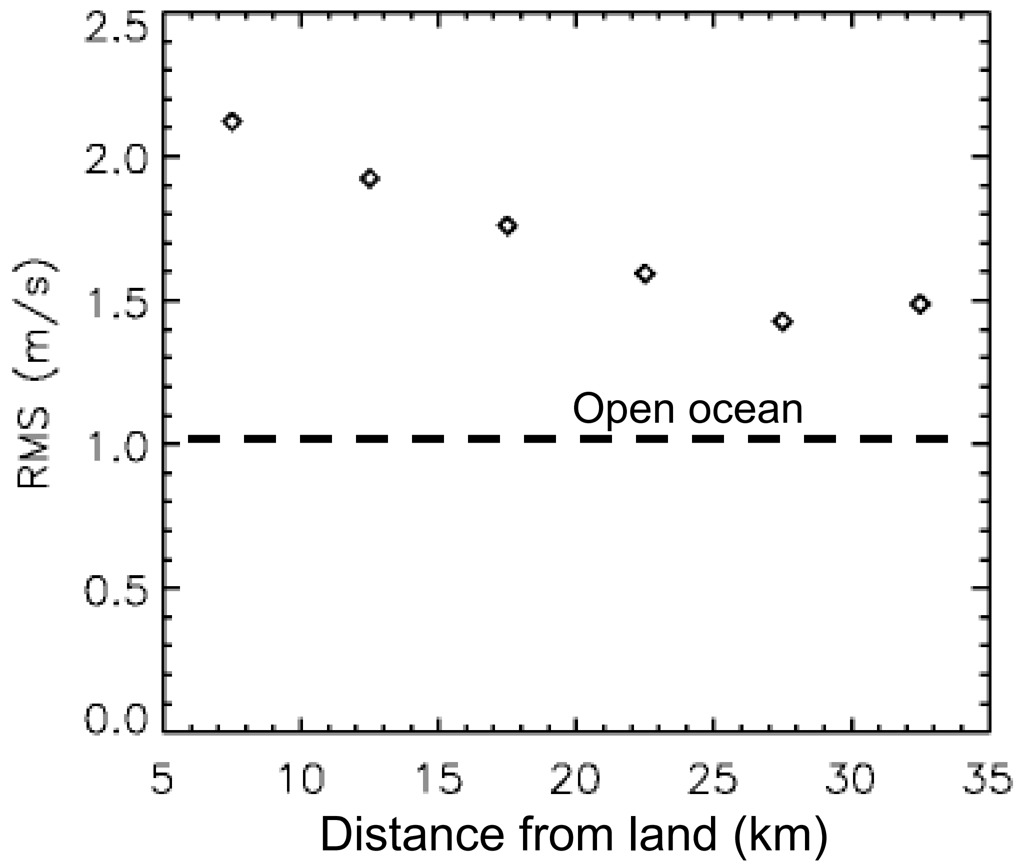

25 km
Pt. Reyes


Wind Components for 46013
NDBC
SCAT
meridional (m/s)
zonal (m/s)
0.32
0.91
20
10
0
−10
−20

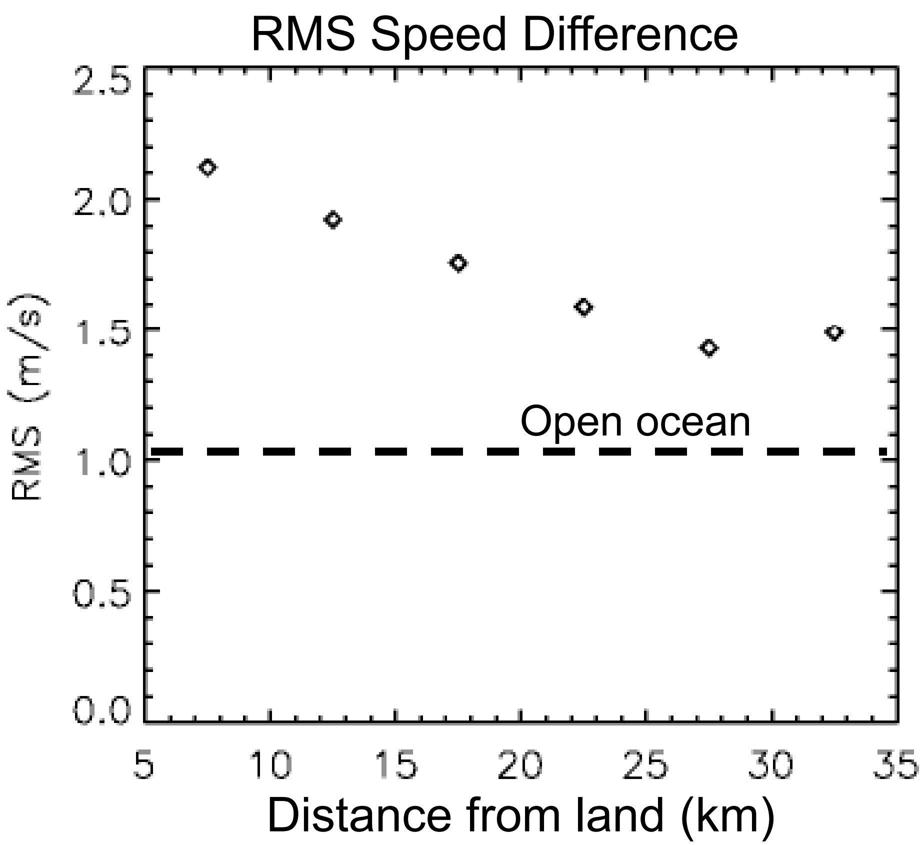
RMS Directional Difference

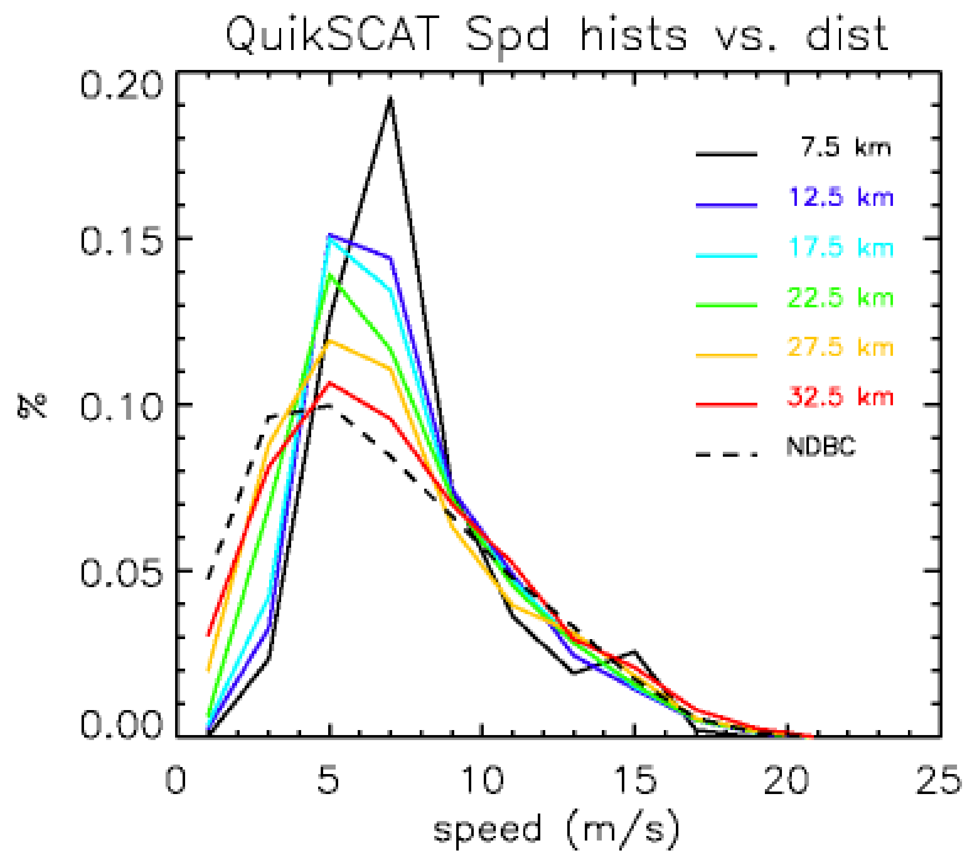


RMS Speed Difference vs. distance



QuikSCAT Speed Histograms vs. dist





Conclusions: Part 2

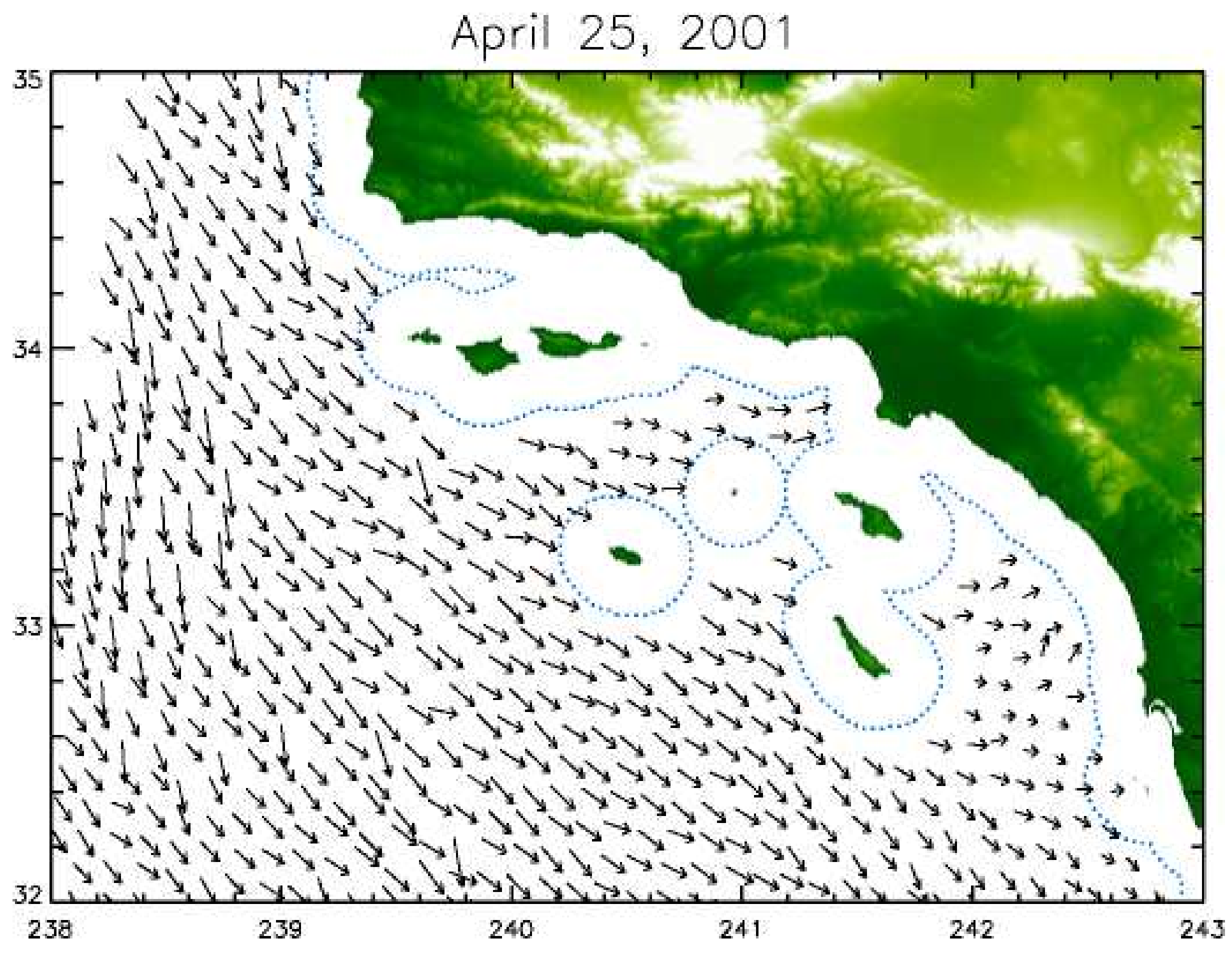
- Processing
  - Simple code adaptations allow for use of new land mask
  - Merging with science winds allows for rapid retrieval times
- Validation
  - Low vector correlations result from little “signal” in offshore direction
  - Along-coast correlations are high, ~0.9
  - Dir diff RMS is slightly larger than open-ocean (~30 deg vs. ~24 deg)
  - Spd diff RMS increases as QuikSCAT wind vectors get closer to land; SCAT speed histograms are narrower

Future Work

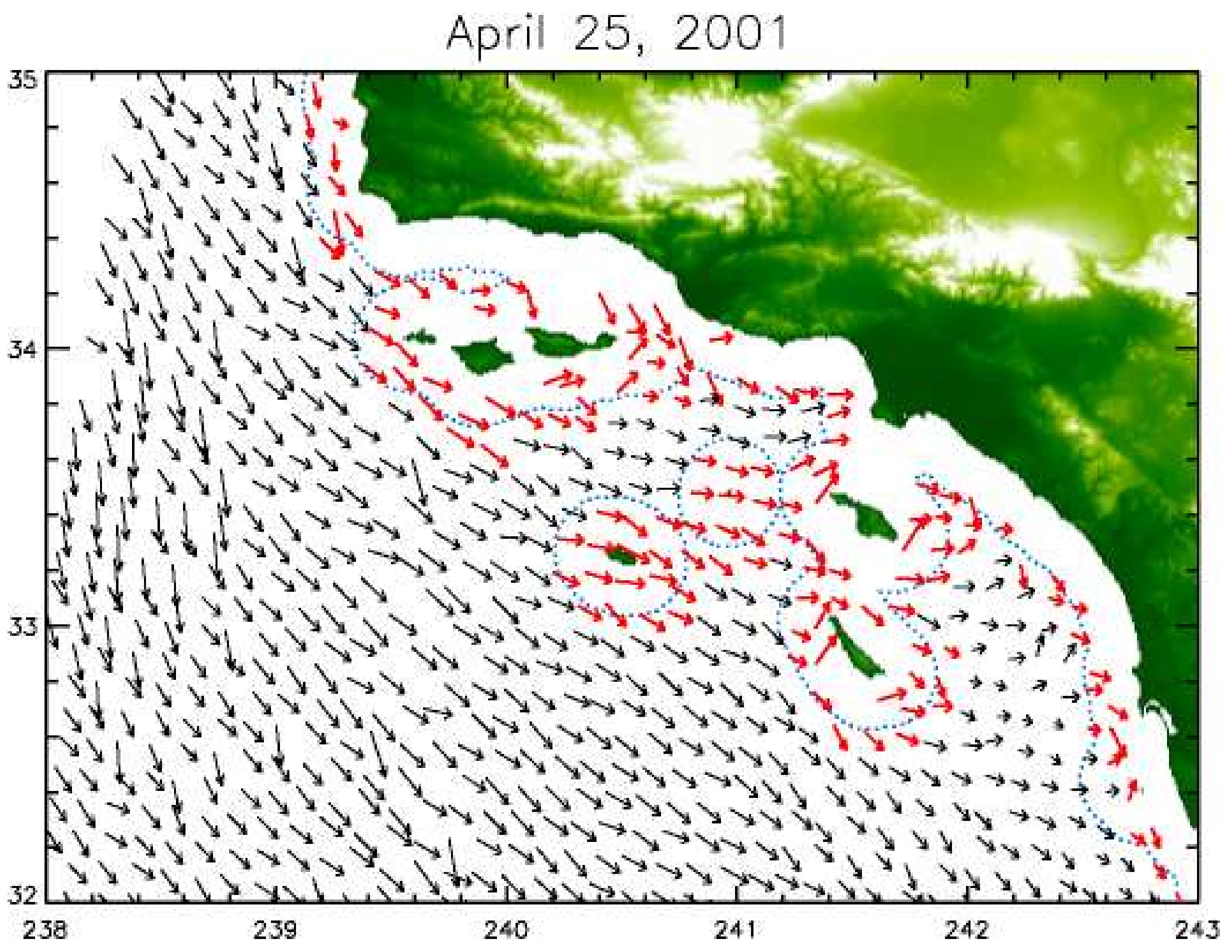
- Expand analysis to other regions
- Validate using SAR
  - Use open ocean QuikSCAT/SAR comparison as benchmark;
  - Use results from open-ocean comparison to validate coastal QuikSCAT wind vectors

END

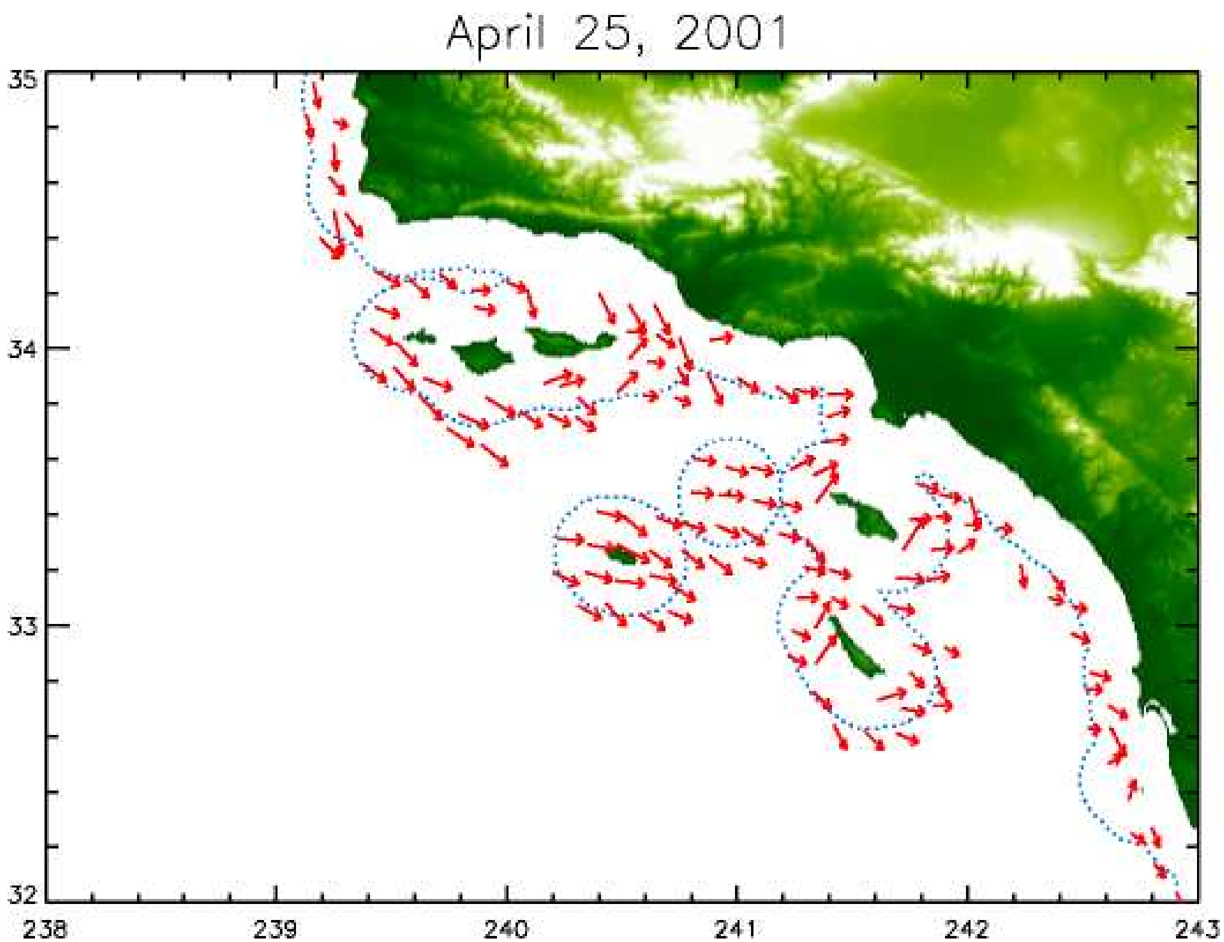
Science Retrievals



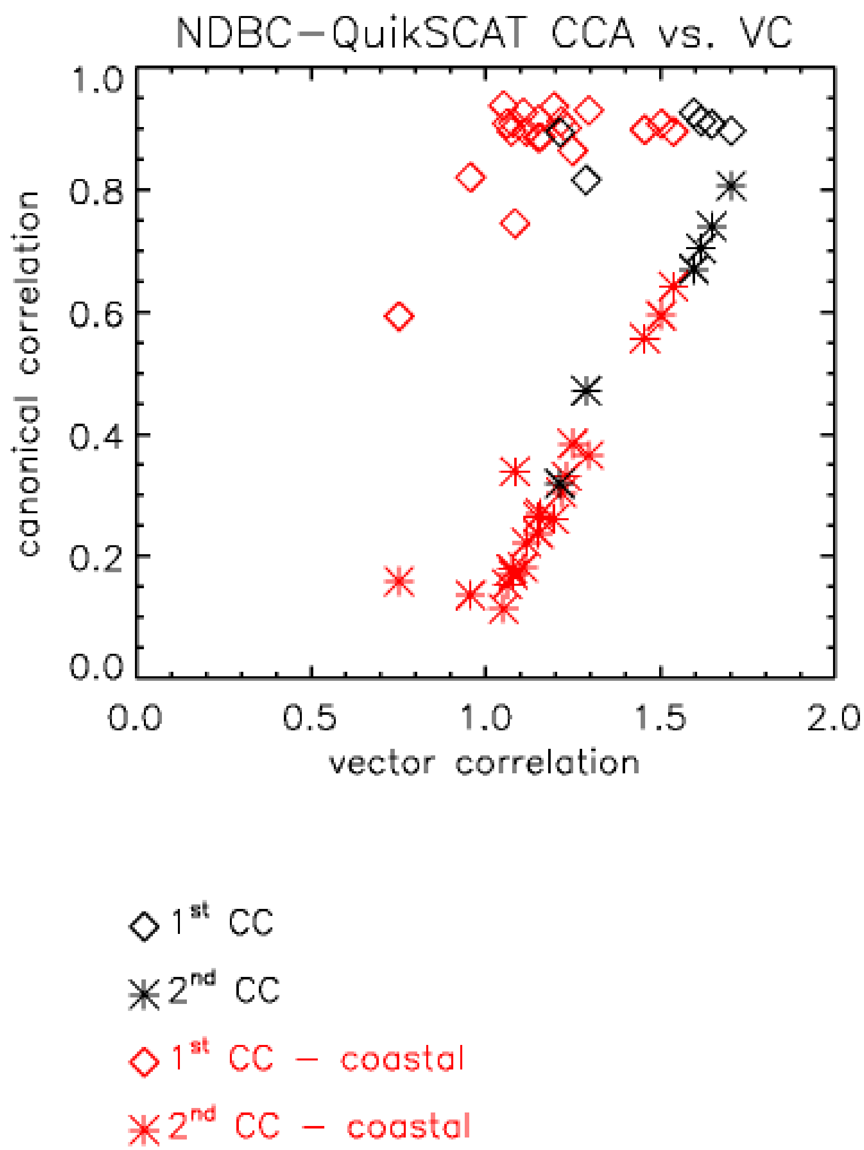
Merged Retrievals



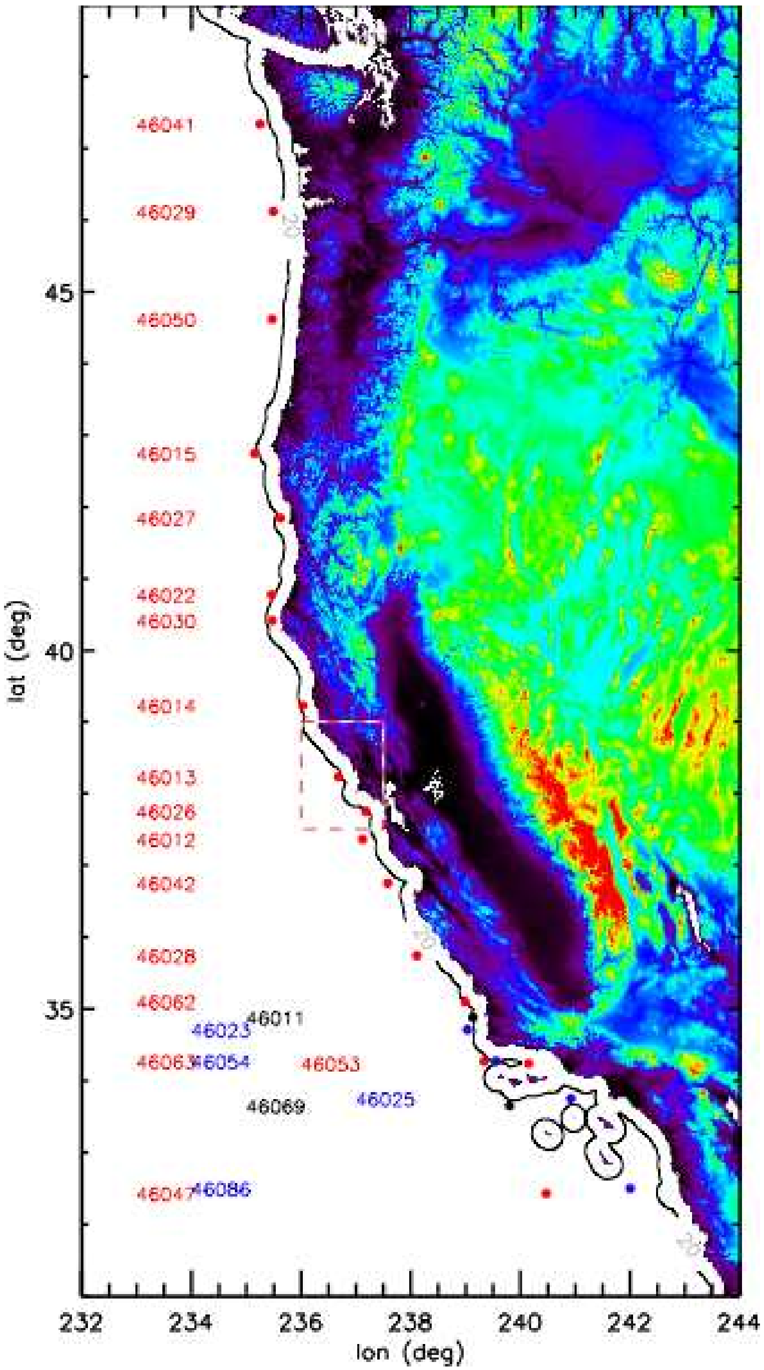
Coastal Retrievals



Canonical Correlations vs. VC



NDBC Buoys



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46011
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46063
46054
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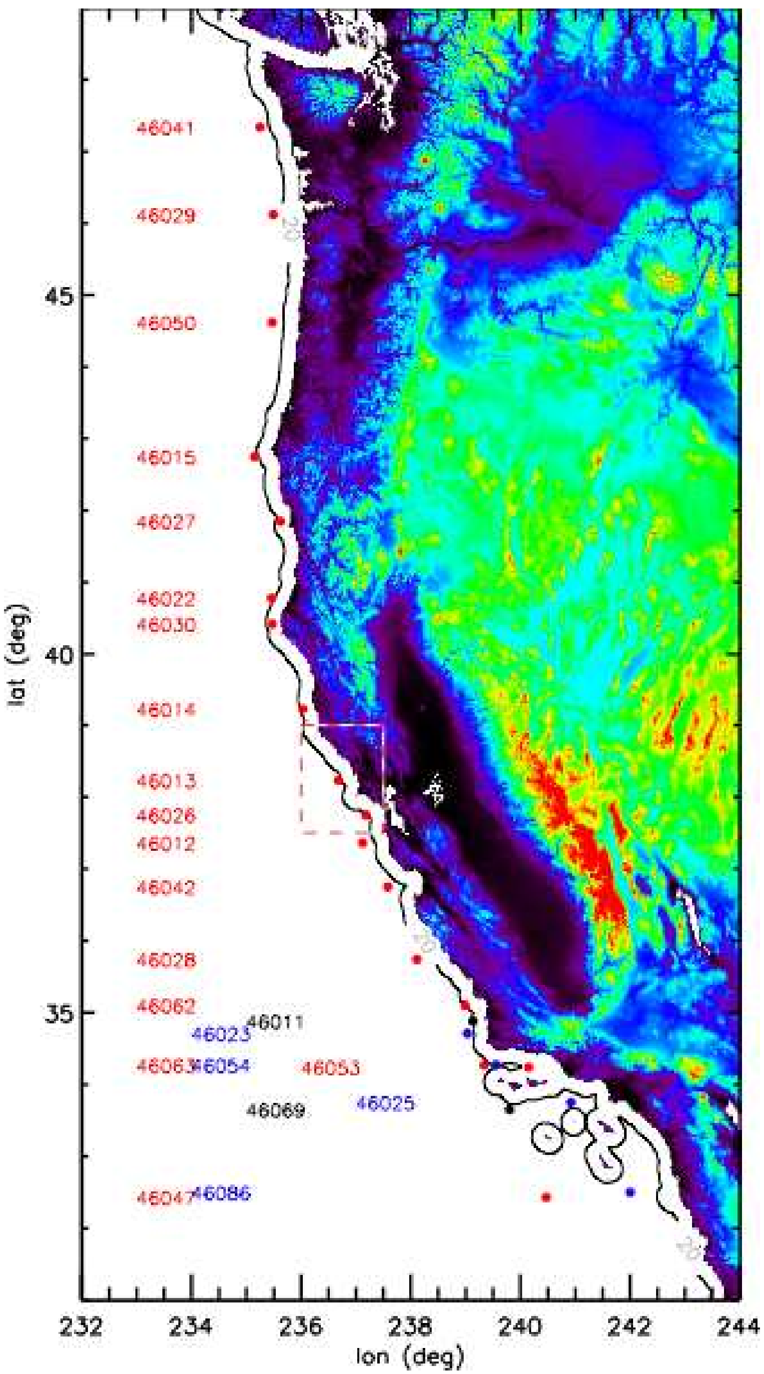
46086
lat (deg)
232
234
236
238
240
242
244
lon (deg)

NDBC Buoys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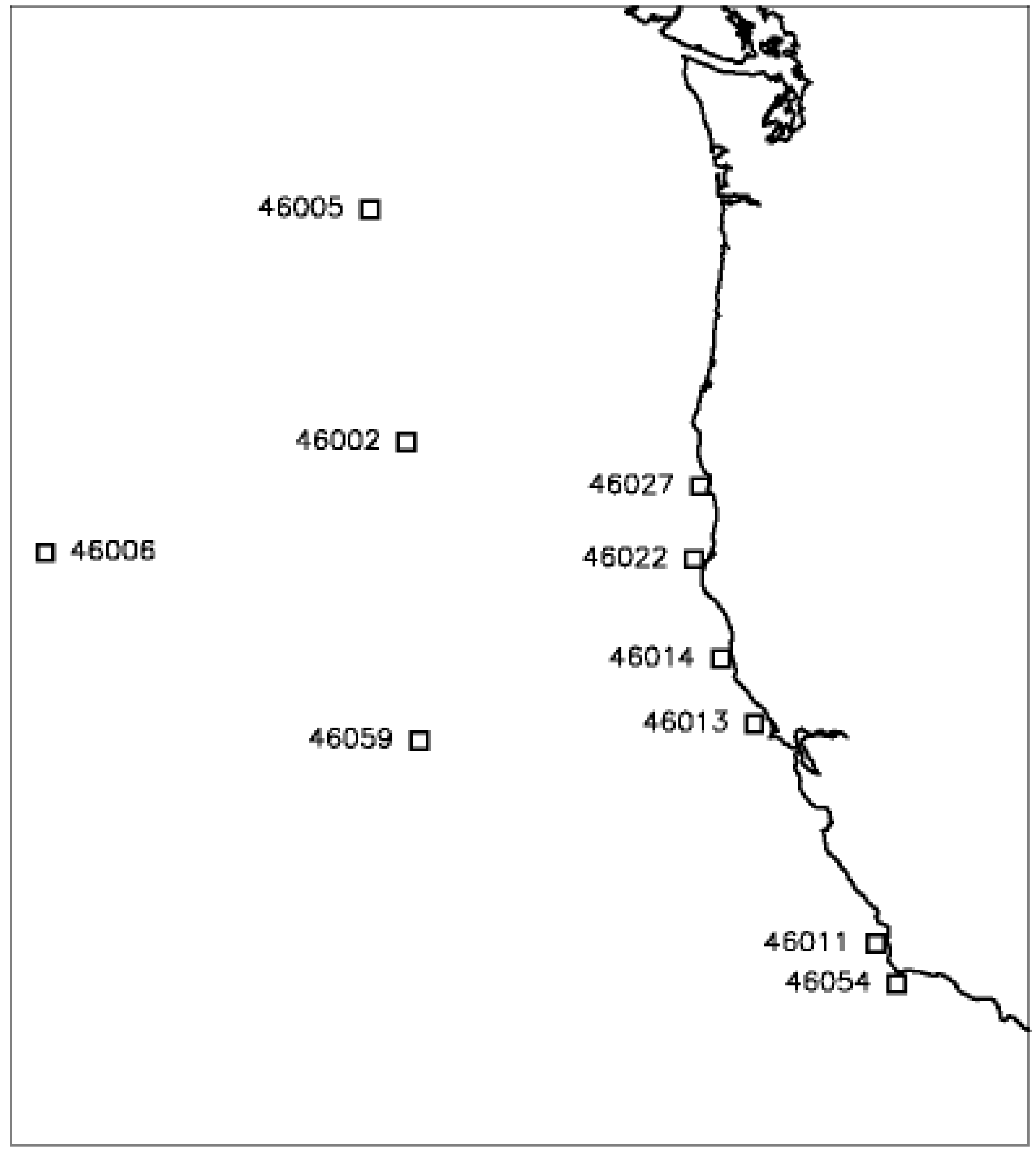
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