Revisiting the Kinetic Energy (KE) Spectrum from QuikSCAT Winds

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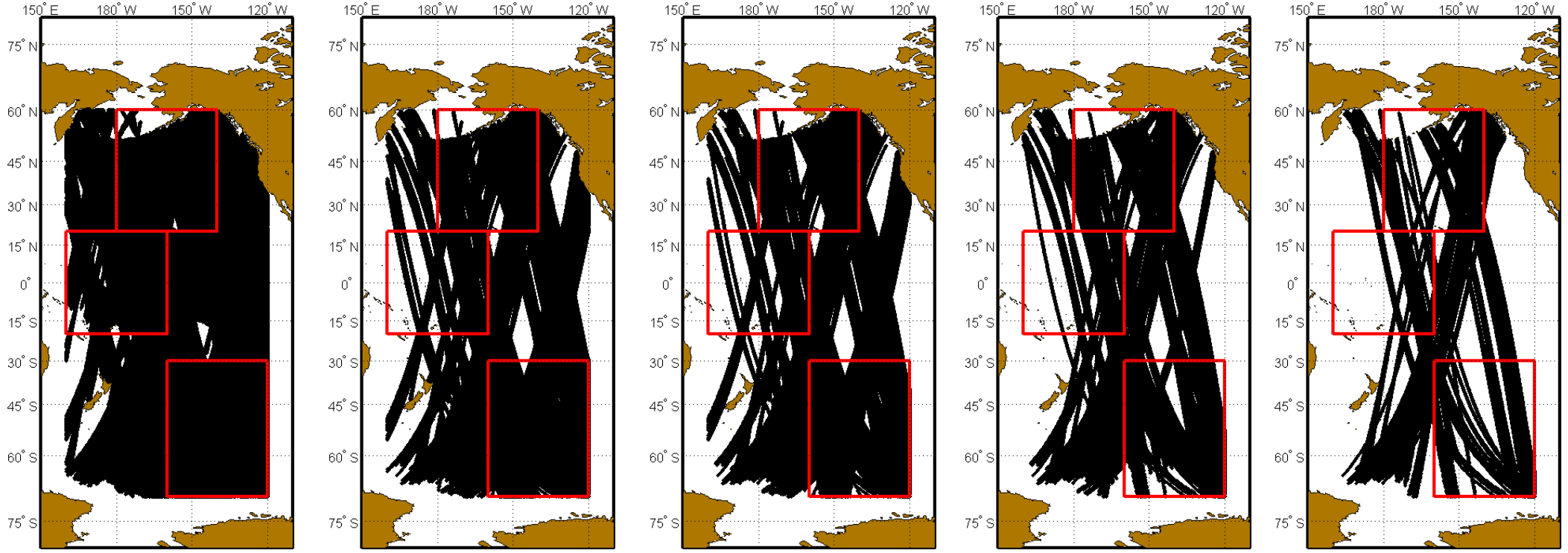
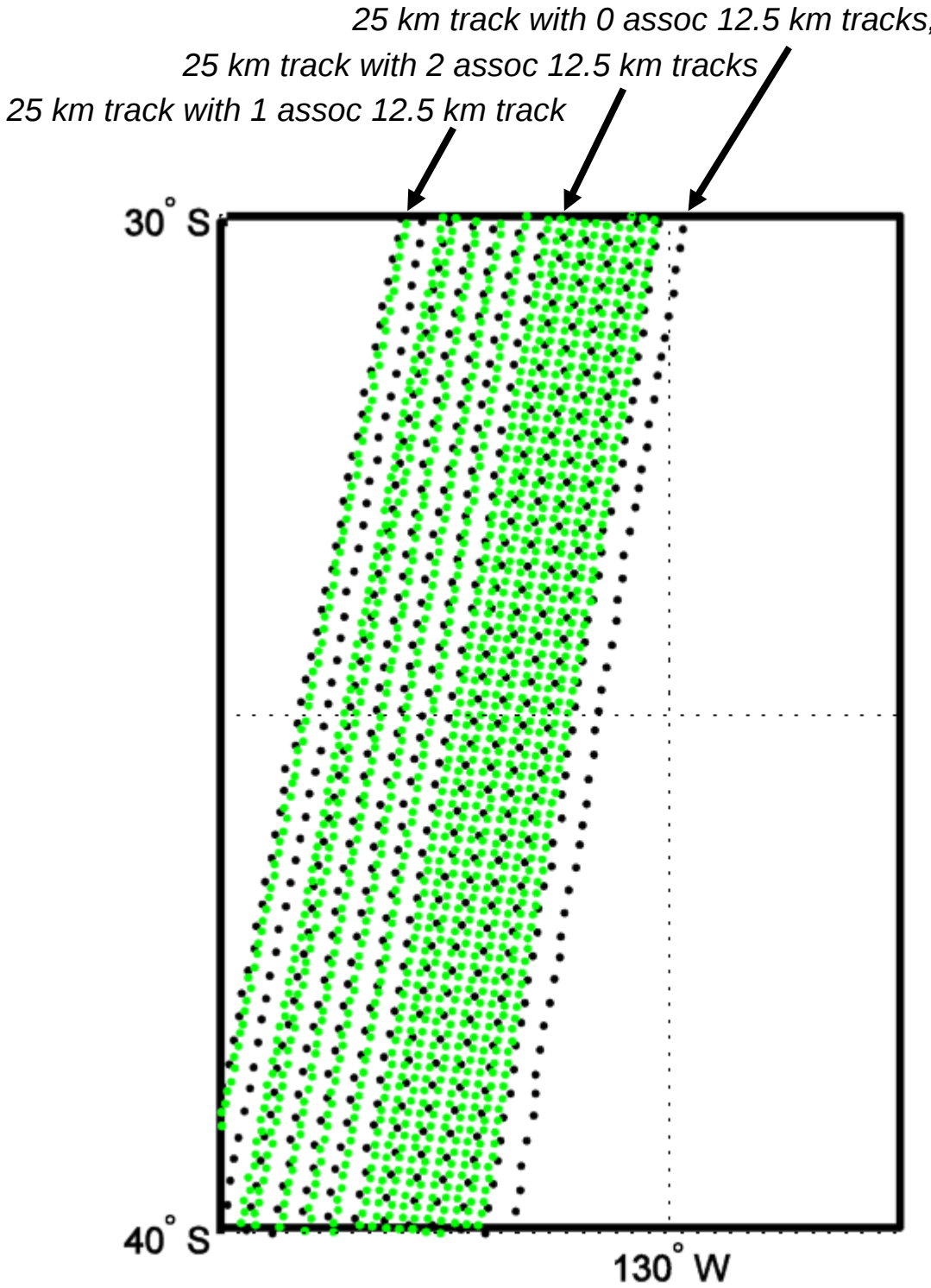
Continuous QuikSCAT "tracks" in the Pacific Ocean basin, 2008



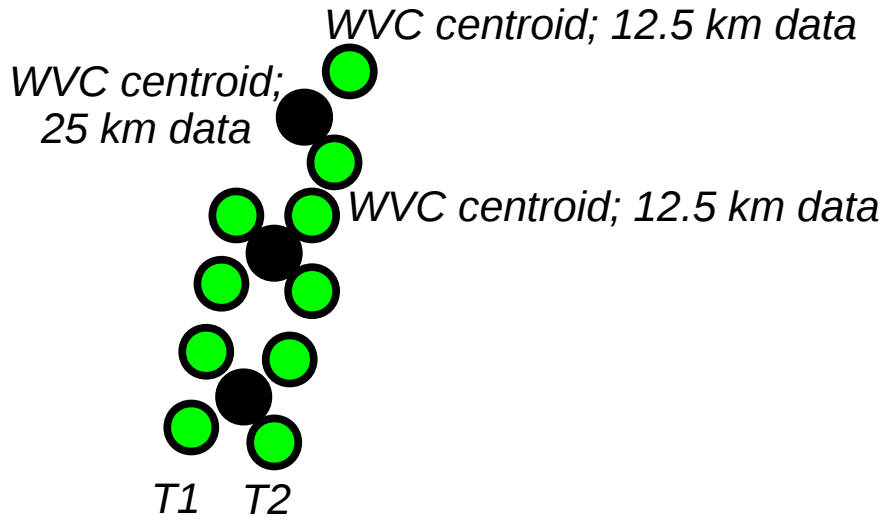
60° tracks *90° tracks* *100° tracks* *110° tracks* *120° tracks*

Mid-Latitude N. Pacific [20°N, 60°N] and [180°E, 220°E]
Tropical W. Pacific [20°S, 20°N] and [160°E, 200°E]
Mid-Latitude S. Pacific [70°S, 30°S] and [200°E, 240°E]

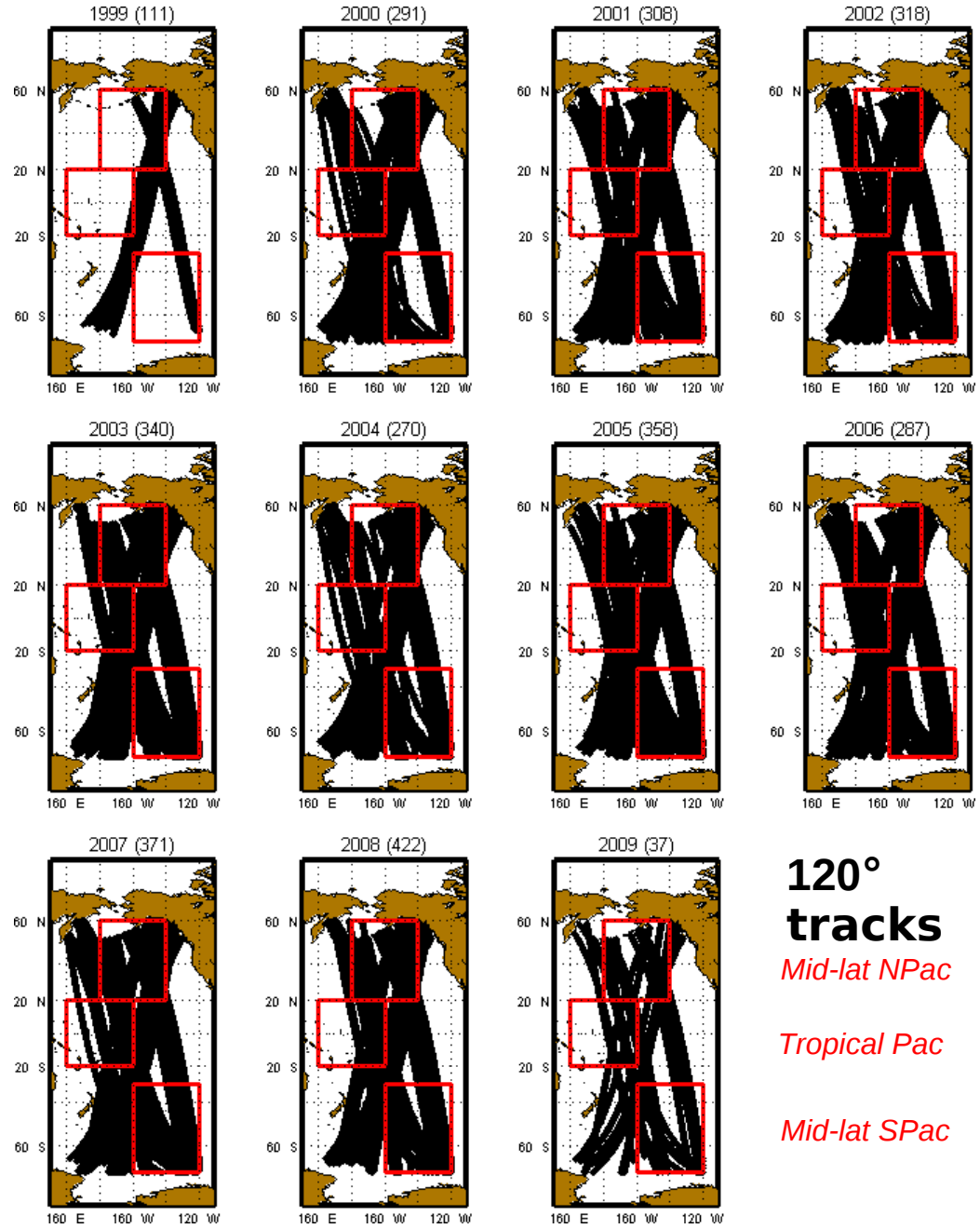


Comparison Dataset:

Match 25 km tracks with 12.5 km tracks;
(at least 1 match, not more than 2)



Data Density: *Continuous tracks in the Pacific spanning 120° (left) and 90° (right) by year*

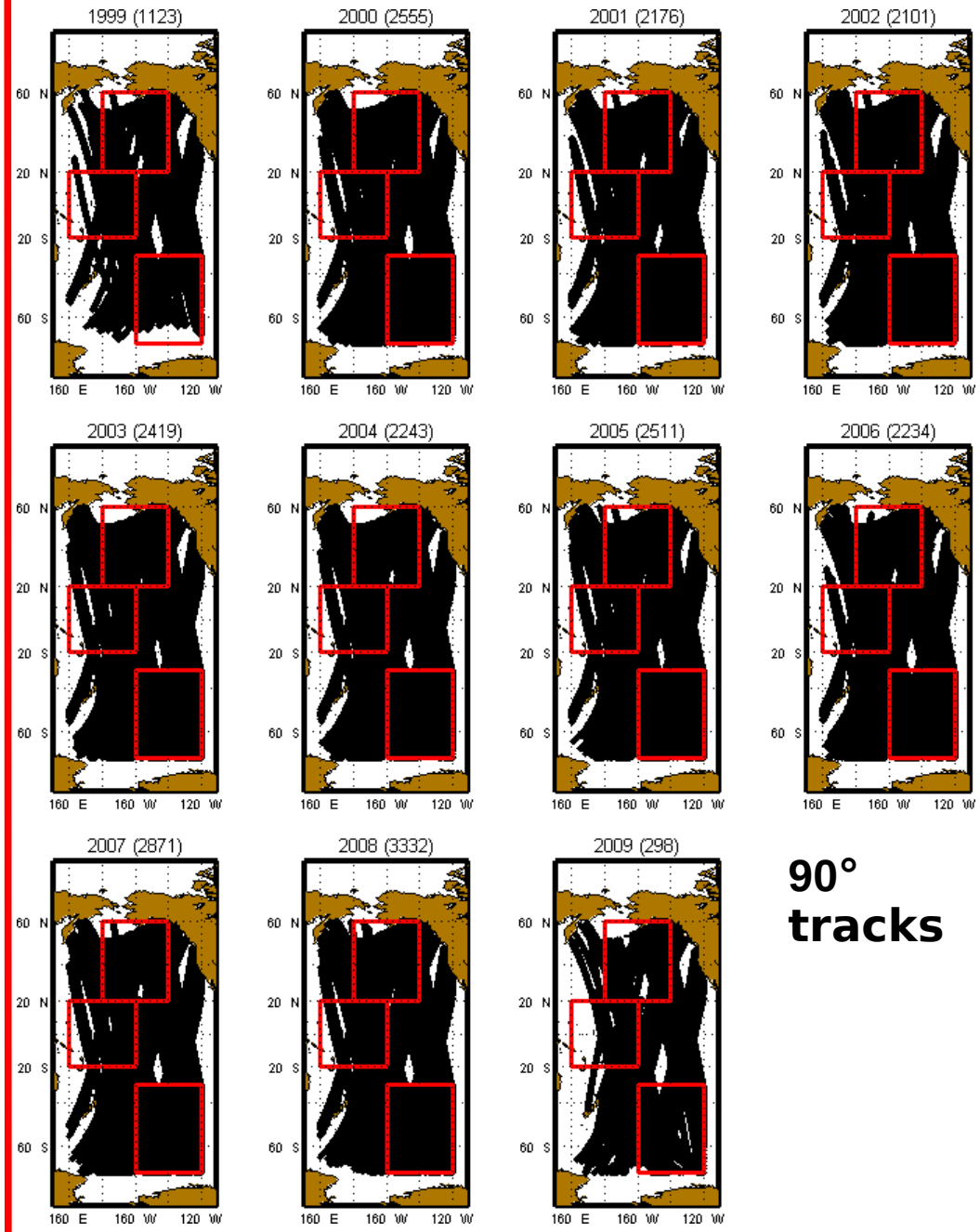


120° tracks

Mid-lat NPac

Tropical Pac

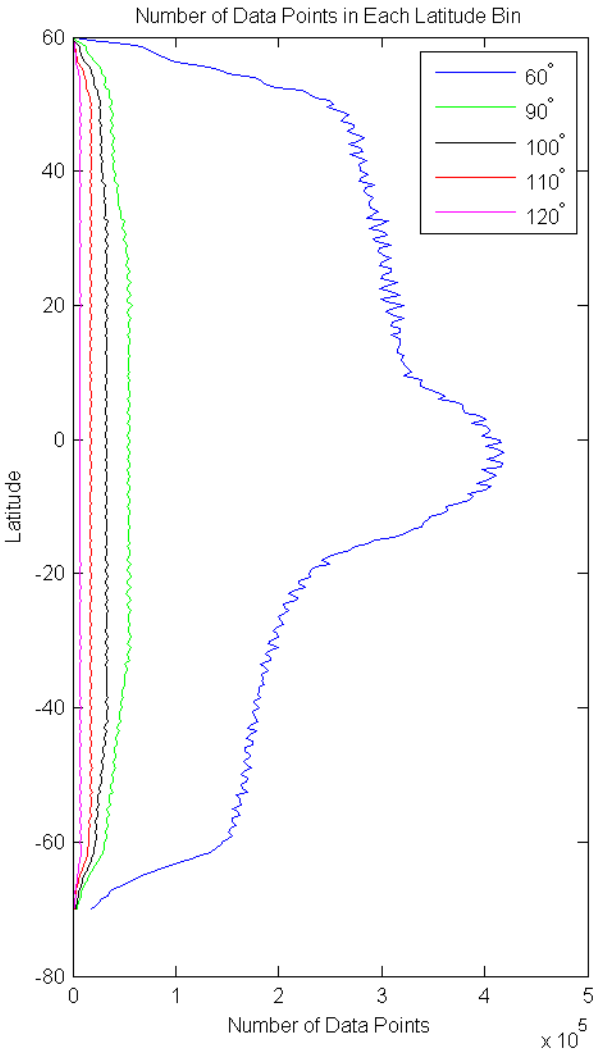
Mid-lat SPac



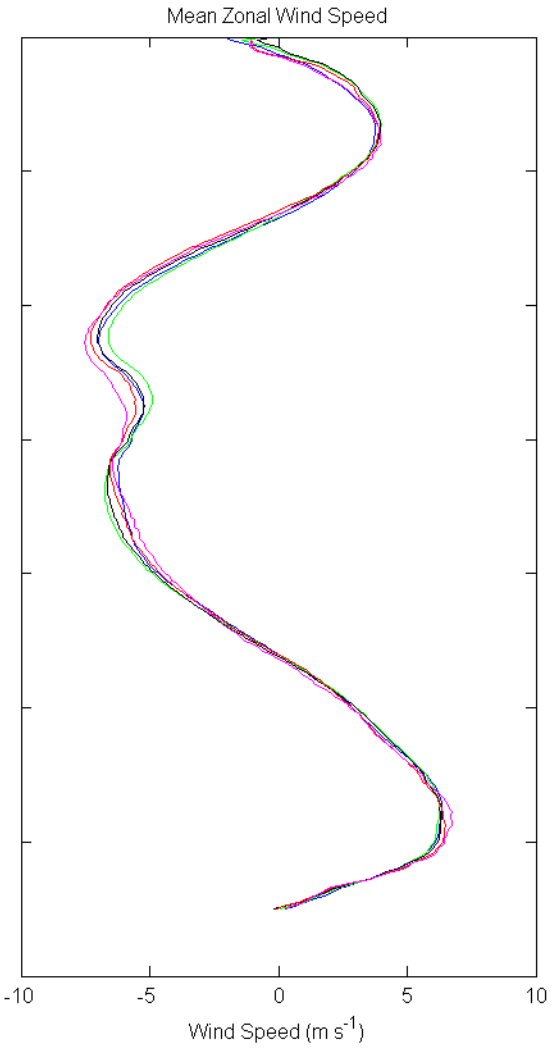
90° tracks

"track" -- <u>continuous</u> sequence of along flight-path WVC with the same cross-track index

Pan-Pacific Zonal Wind Average Profile (vs. Latitude): ~10yr average



Bin Weights

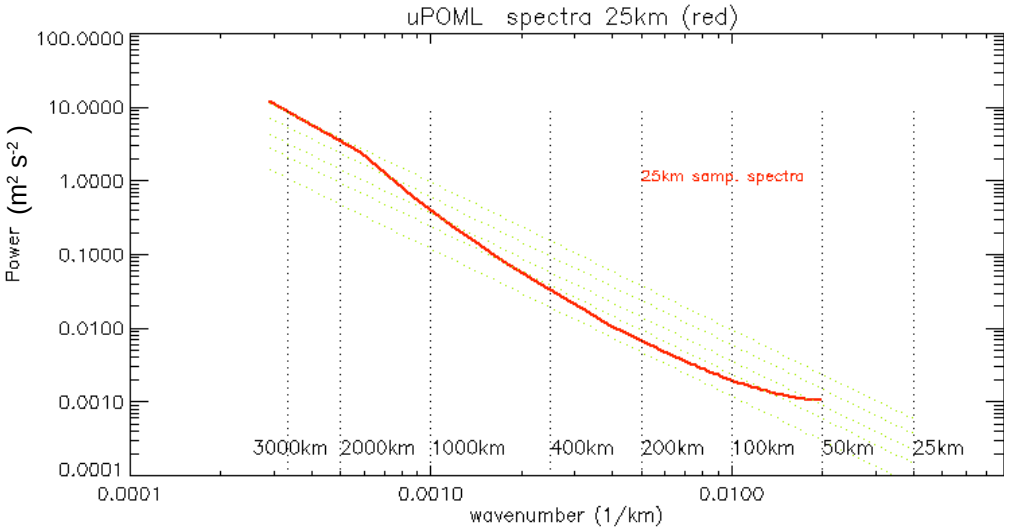


U-profile

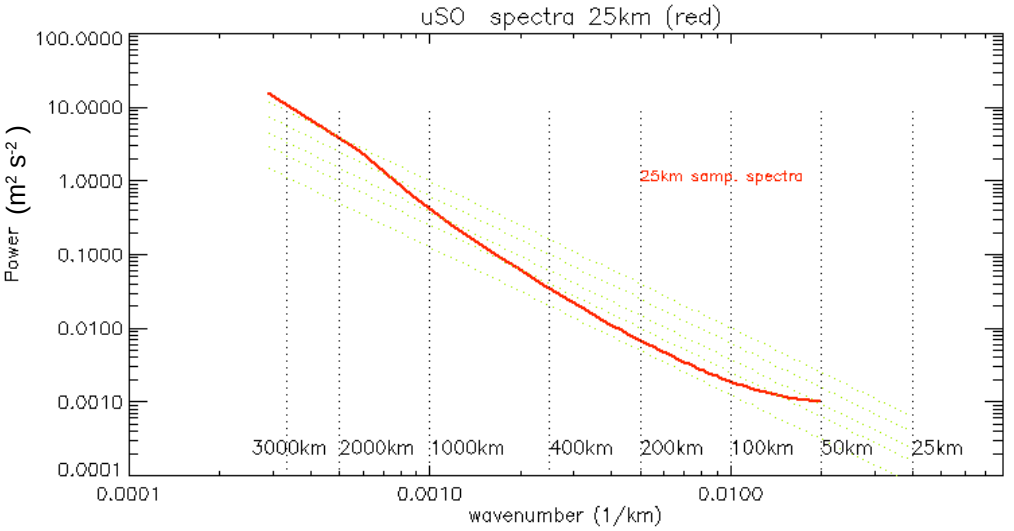
0.5° bins

Zonal velocity Kinetic Energy Spectra: ~10yr average

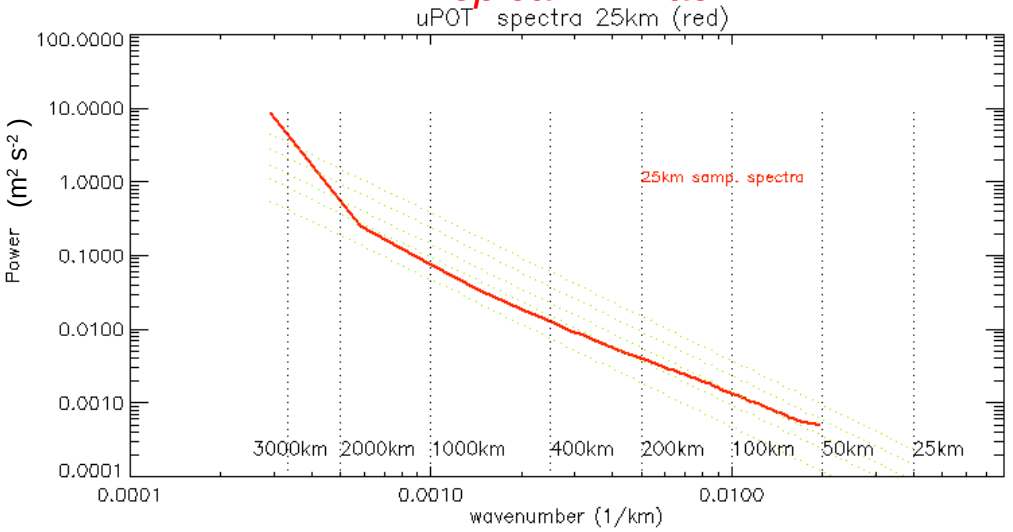
Mid-Lat N. Pac.



Mid-Lat S. Pac.



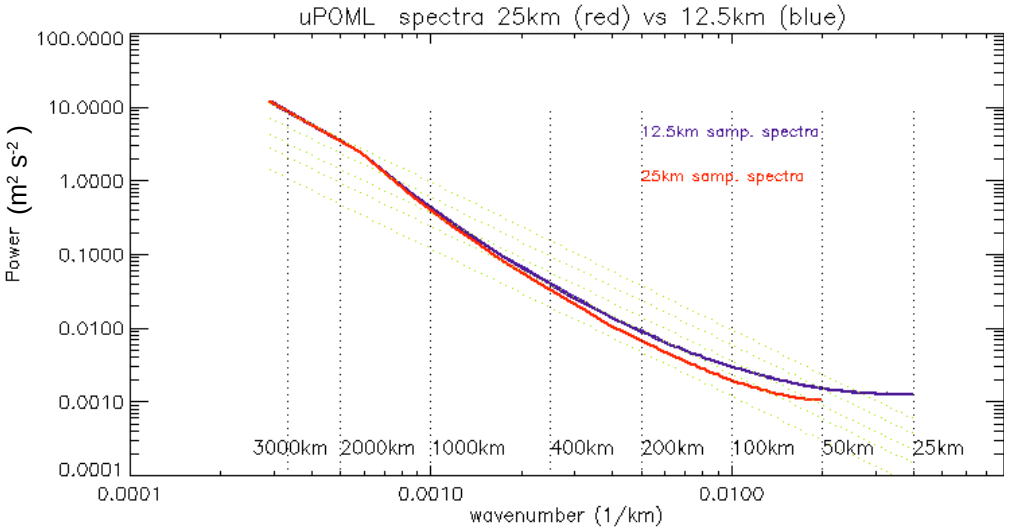
Tropical W. Pac.



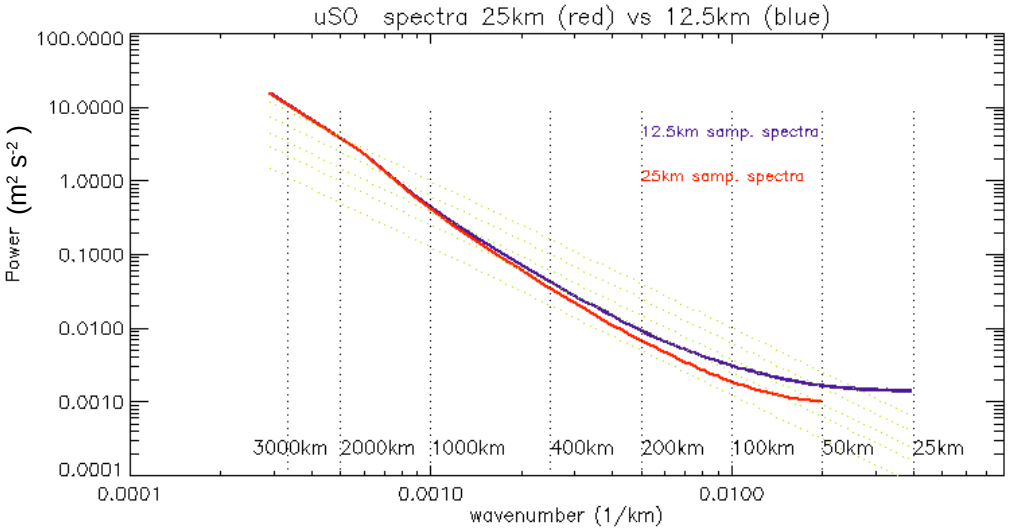
O(125K) spatial series (tracks)
Hanning window

Zonal velocity Kinetic Energy Spectra: ~10yr average

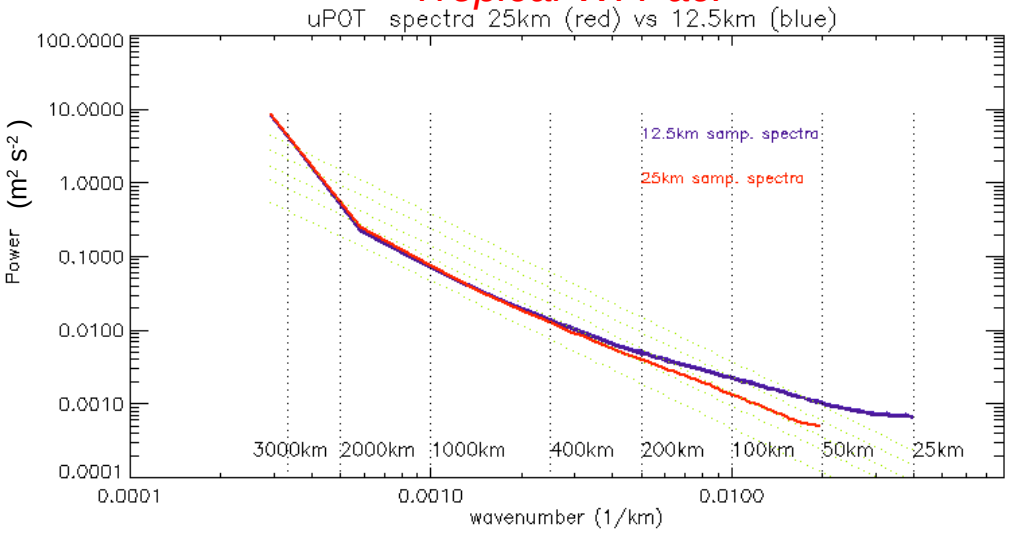
Mid-Lat N. Pac.



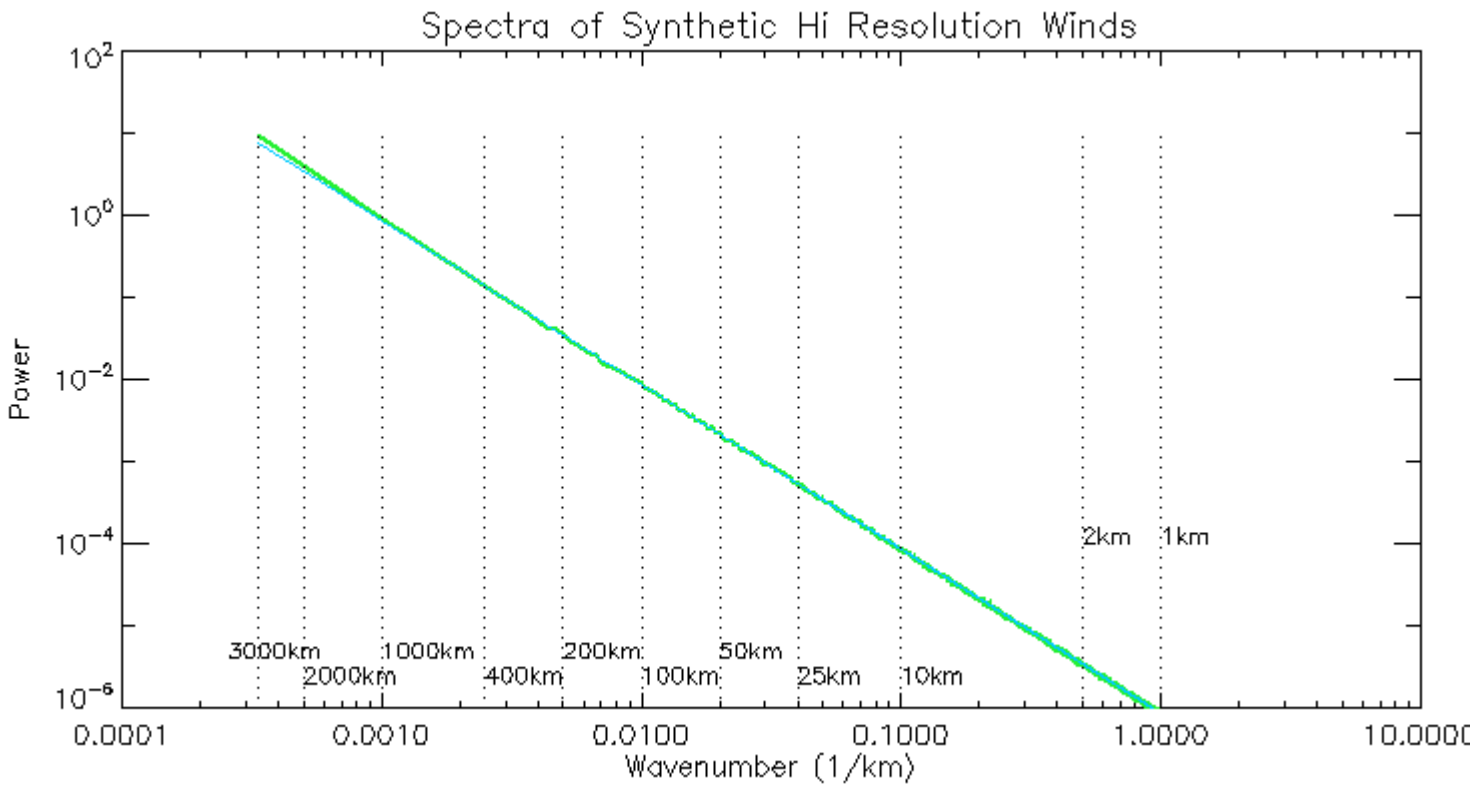
Mid-Lat S. Pac.



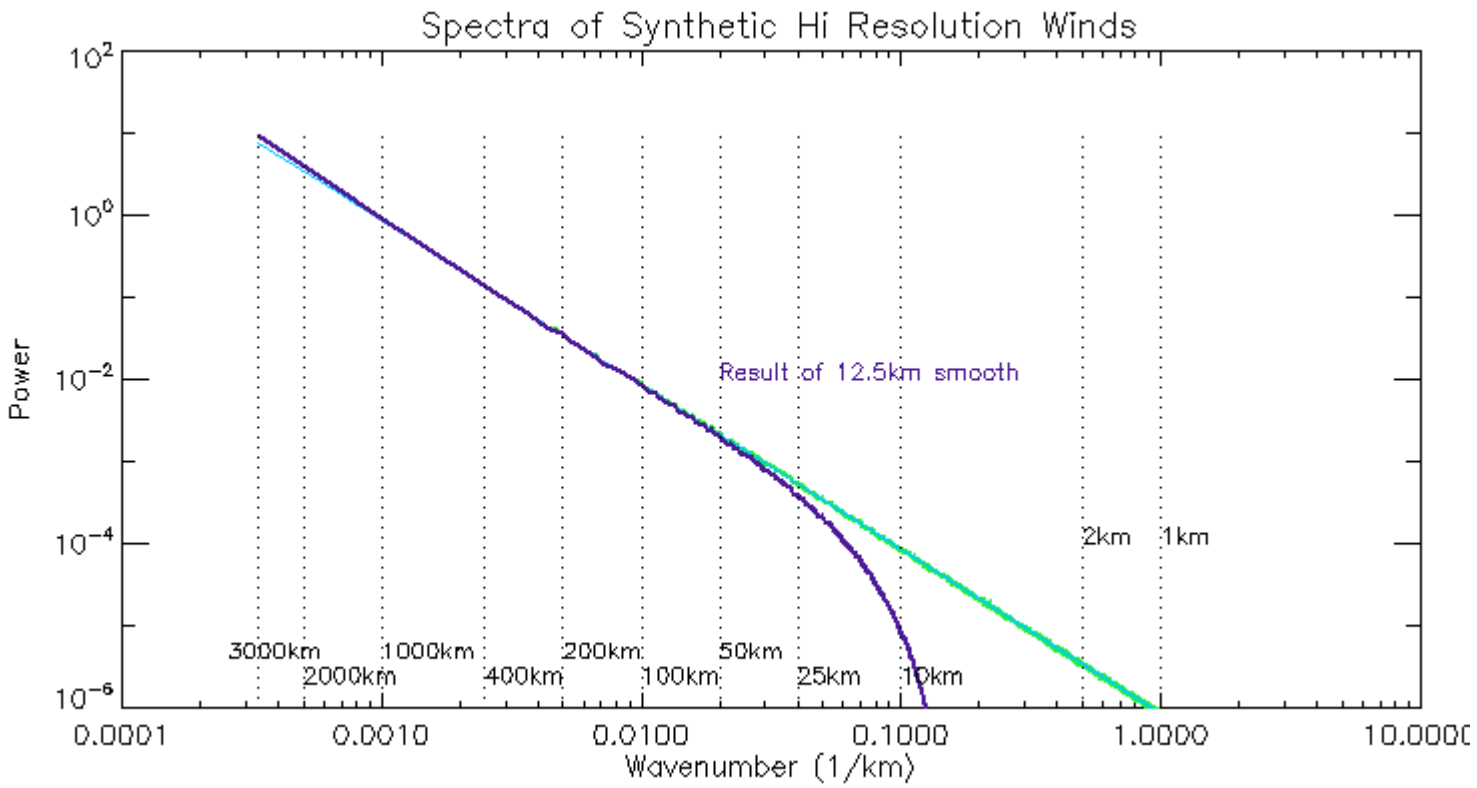
Tropical W. Pac.



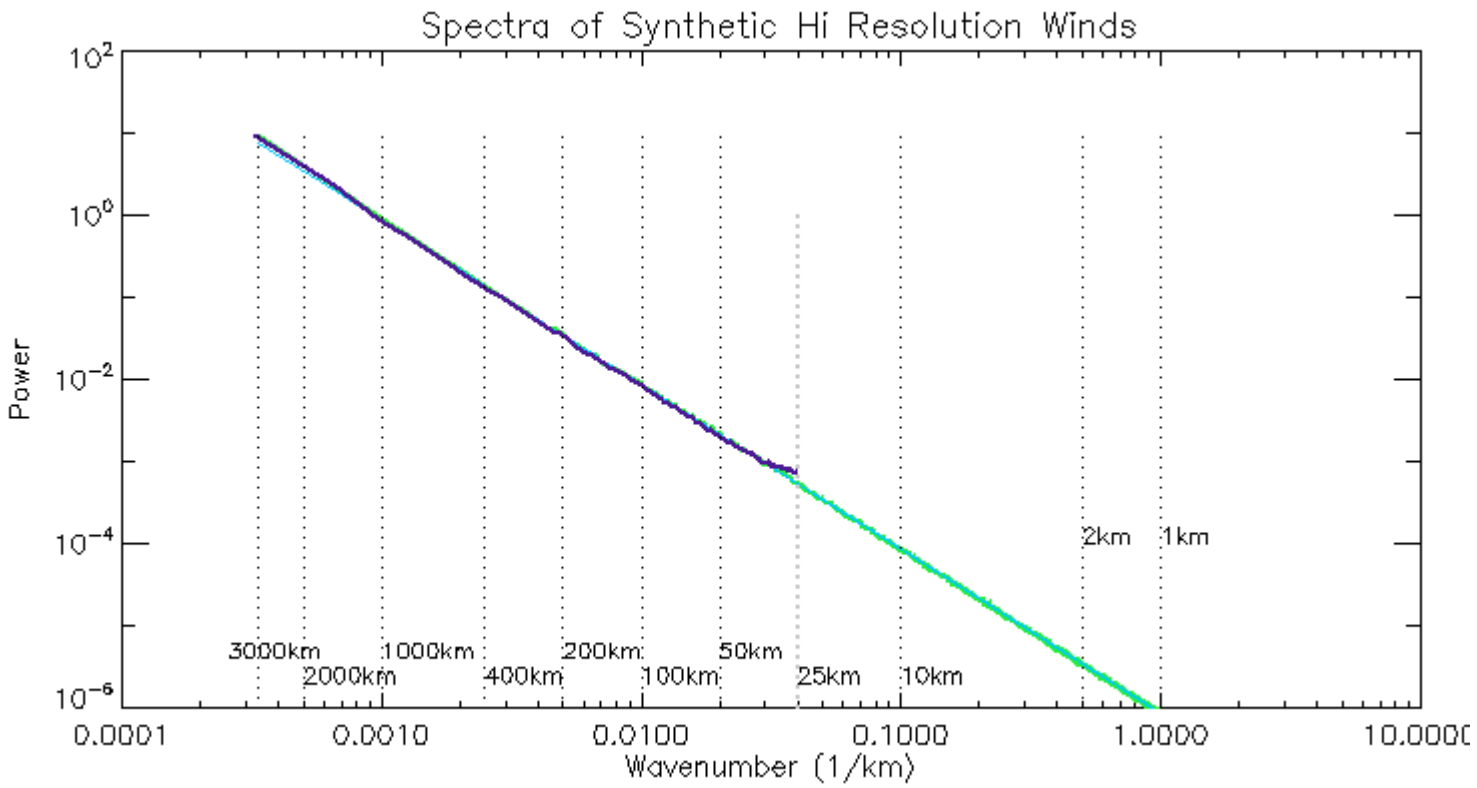
Synthetic Spectra: *1 / k² autoregressive process*



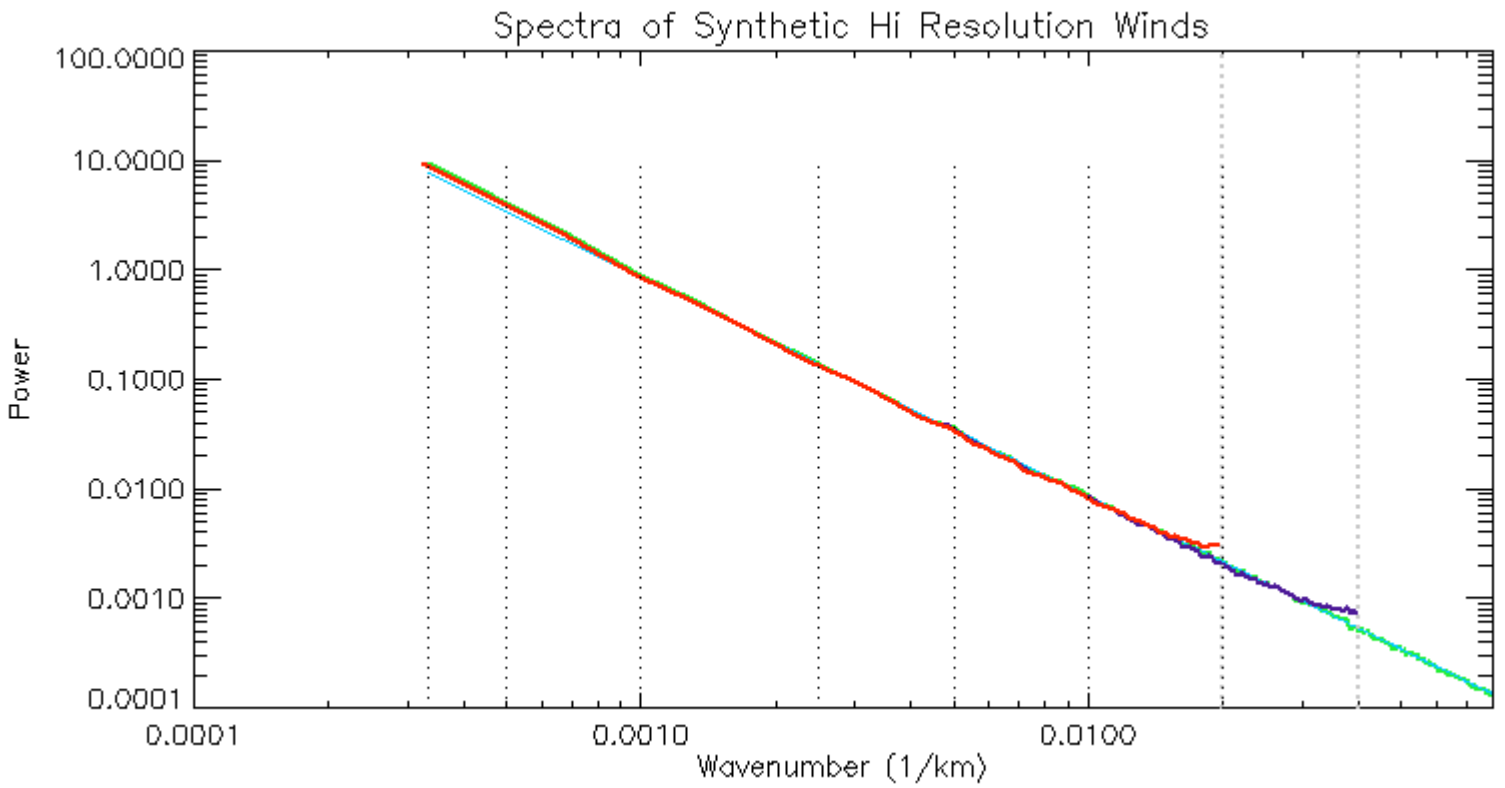
Synthetic Spectra: *1 / k² autoregressive process* +
12.5 km (running avg) smoother



Synthetic Spectra: *1 / k² autoregressive process* +
12.5 km aliasing

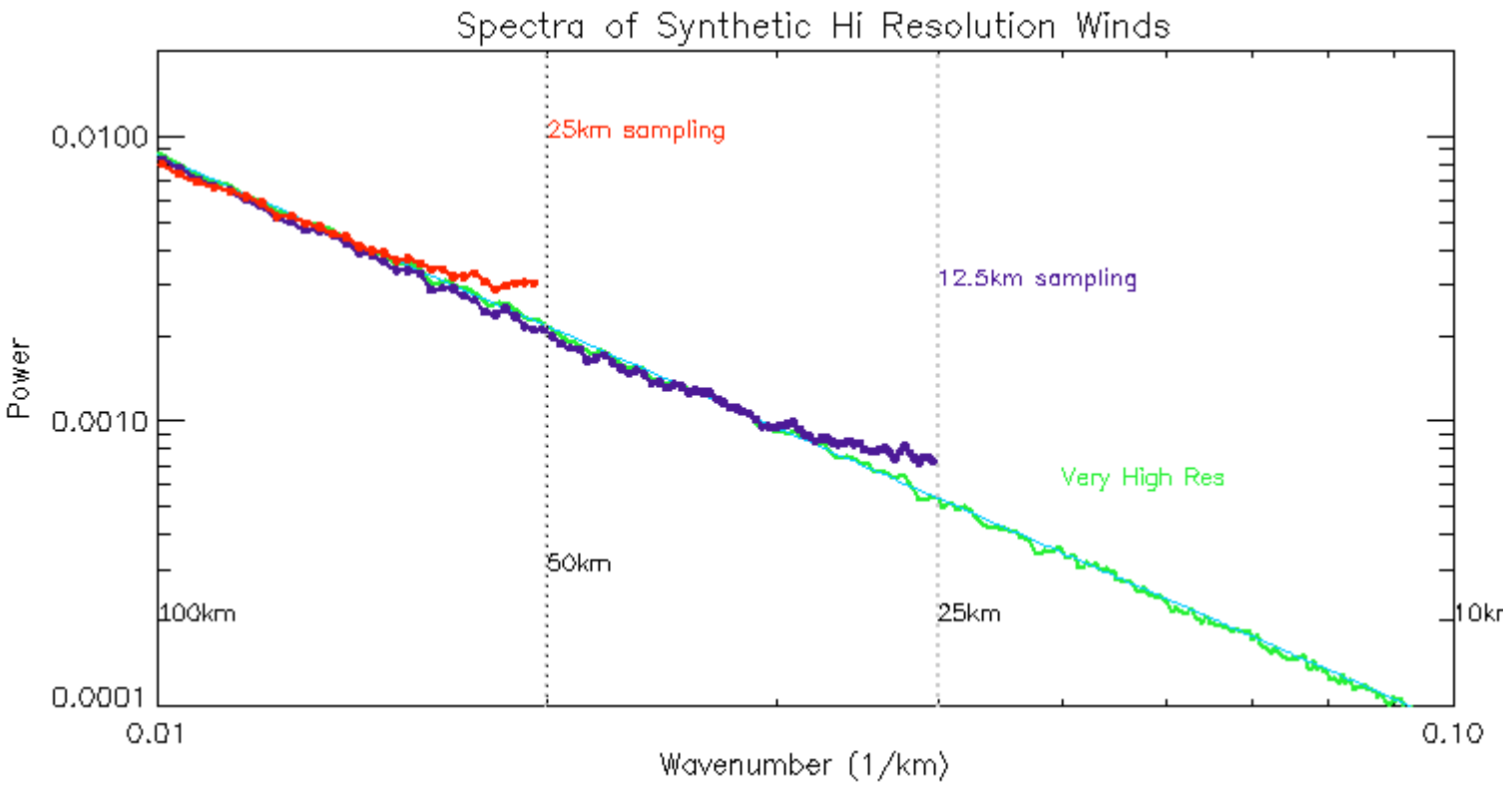


Synthetic Spectra: *1 / k² autoregressive process* +
12.5 km aliasing +
25 km aliasing



Synthetic Spectra: *1 / k² autoregressive process* +
12.5 km aliasing +
25 km aliasing

ZOOM



Ambiguity Selection Errors in 12.5 *km* Data:

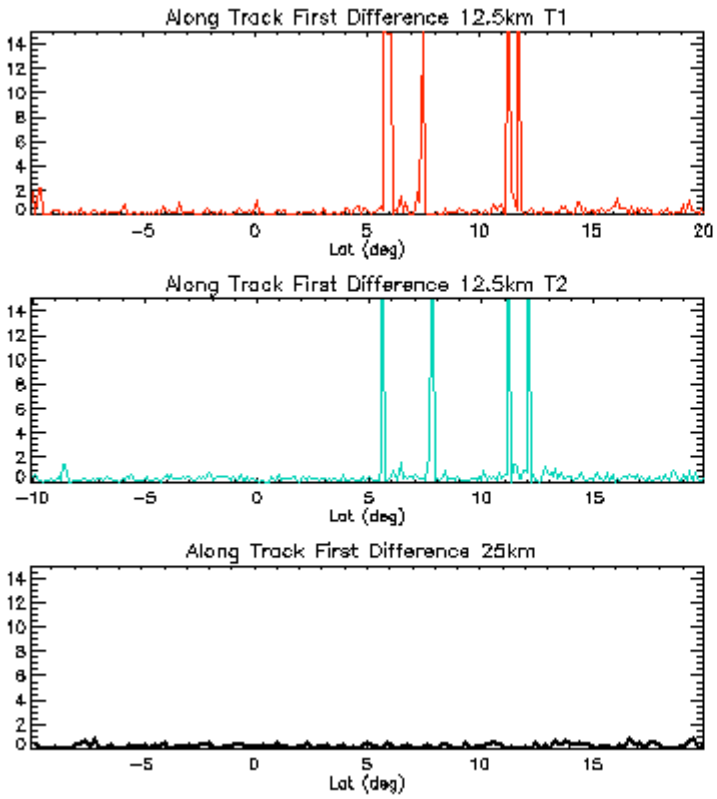
Tropical W. Pac

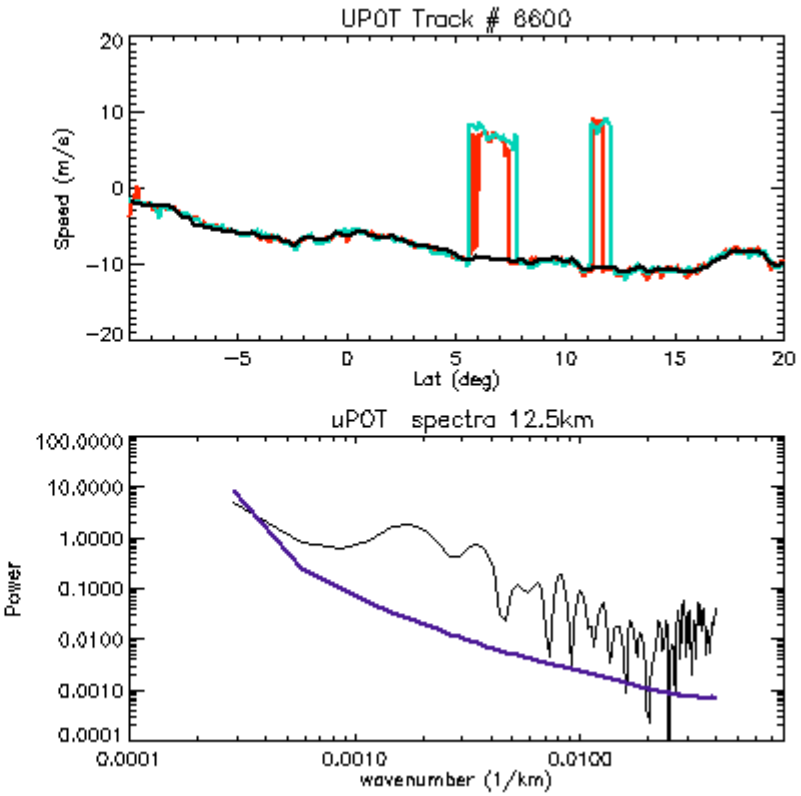
First Differences

12.5km

12.5km

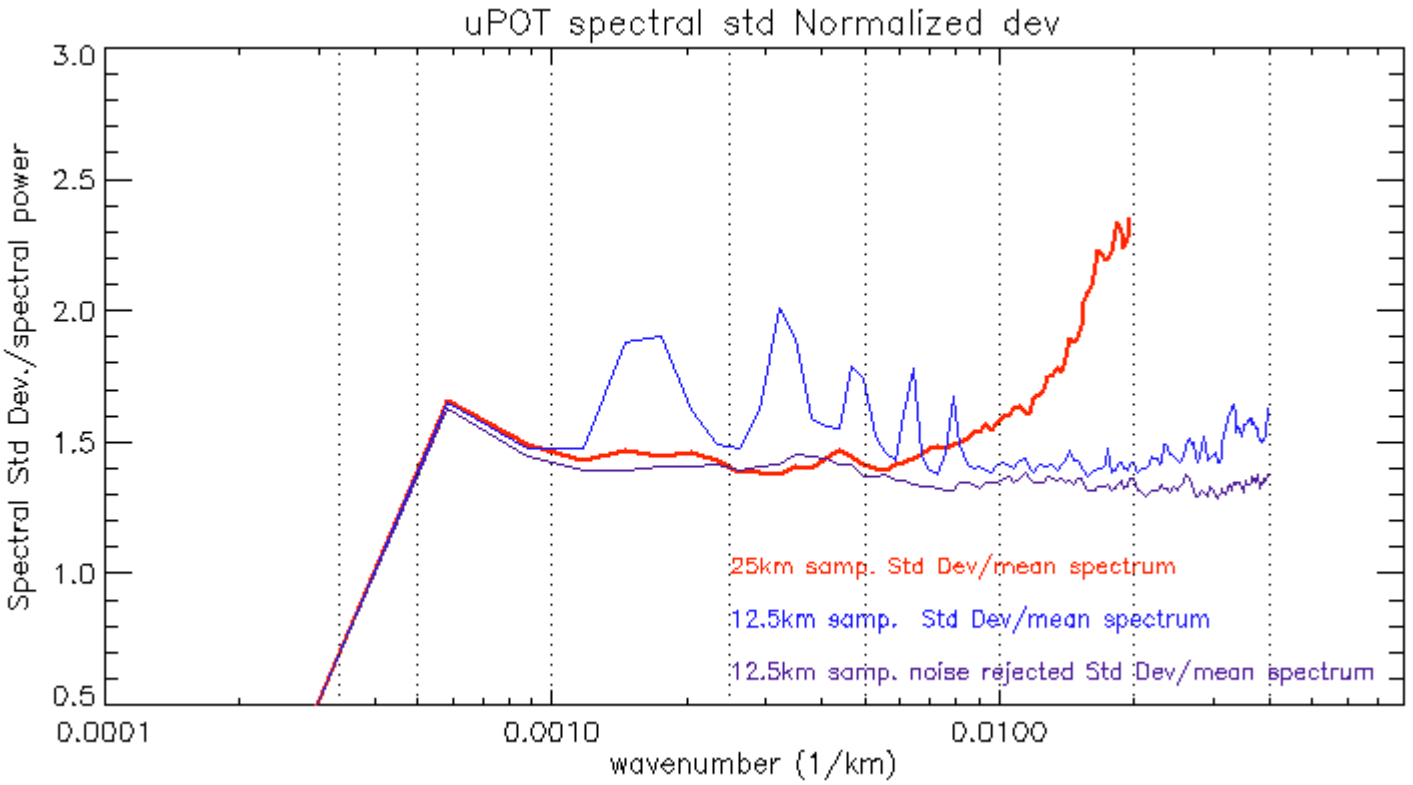
25km





~15% of 12.5 km data for first difference threshold = 10 m/s

Tropical W. Pac



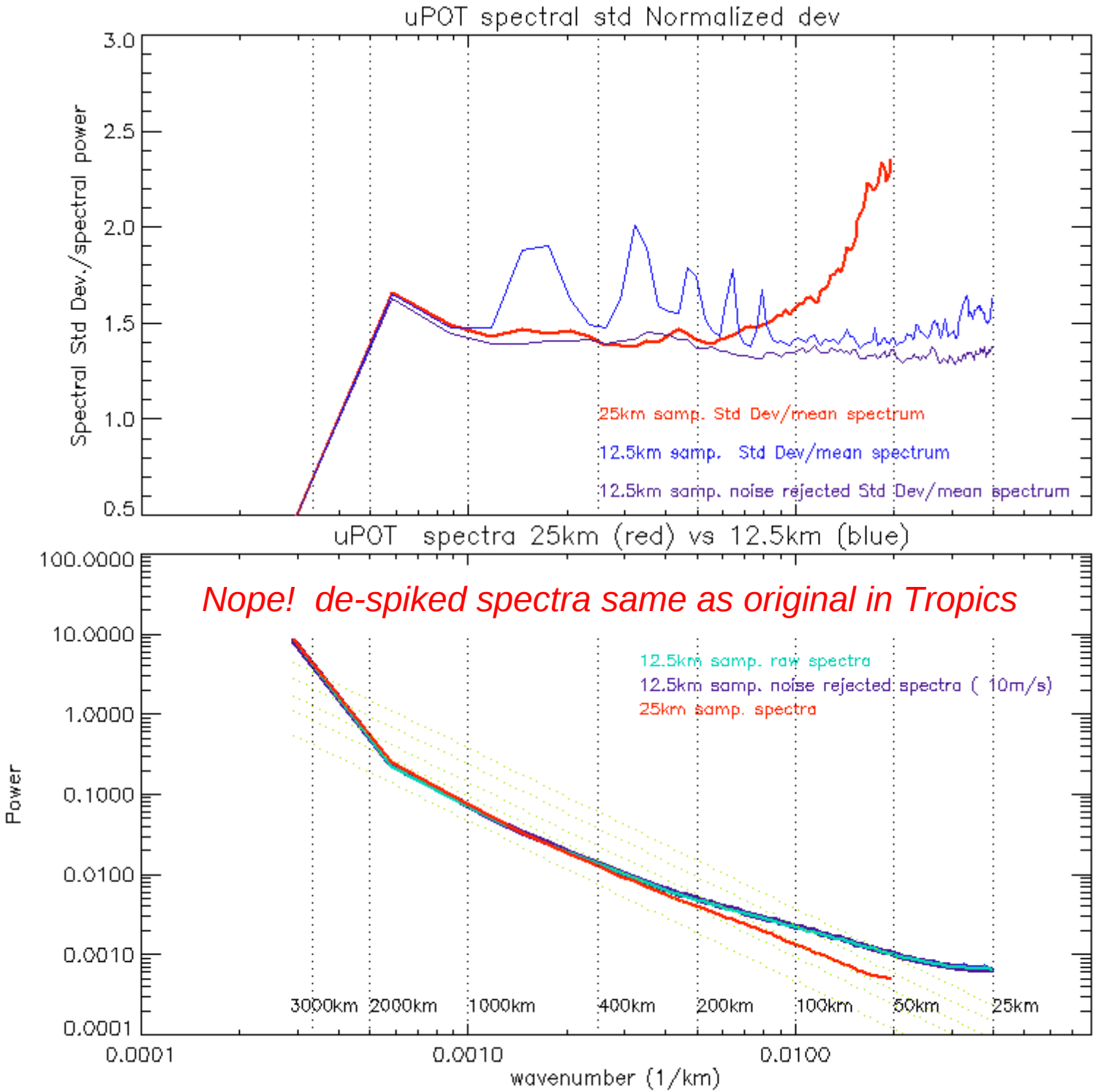
Normalized Spectra: *divide std dev(k) by PSD(k) for each k*
flat line if uncertainty in PSD is uniform in k
12.5 km data de-spiked are "flat"; 25 km data are not!*
evidence of ambiguity errors at lower k ....

Maybe ambiguity errors contribute to PSD discrepancies at lower k

What is going on with 25 km data at high k?

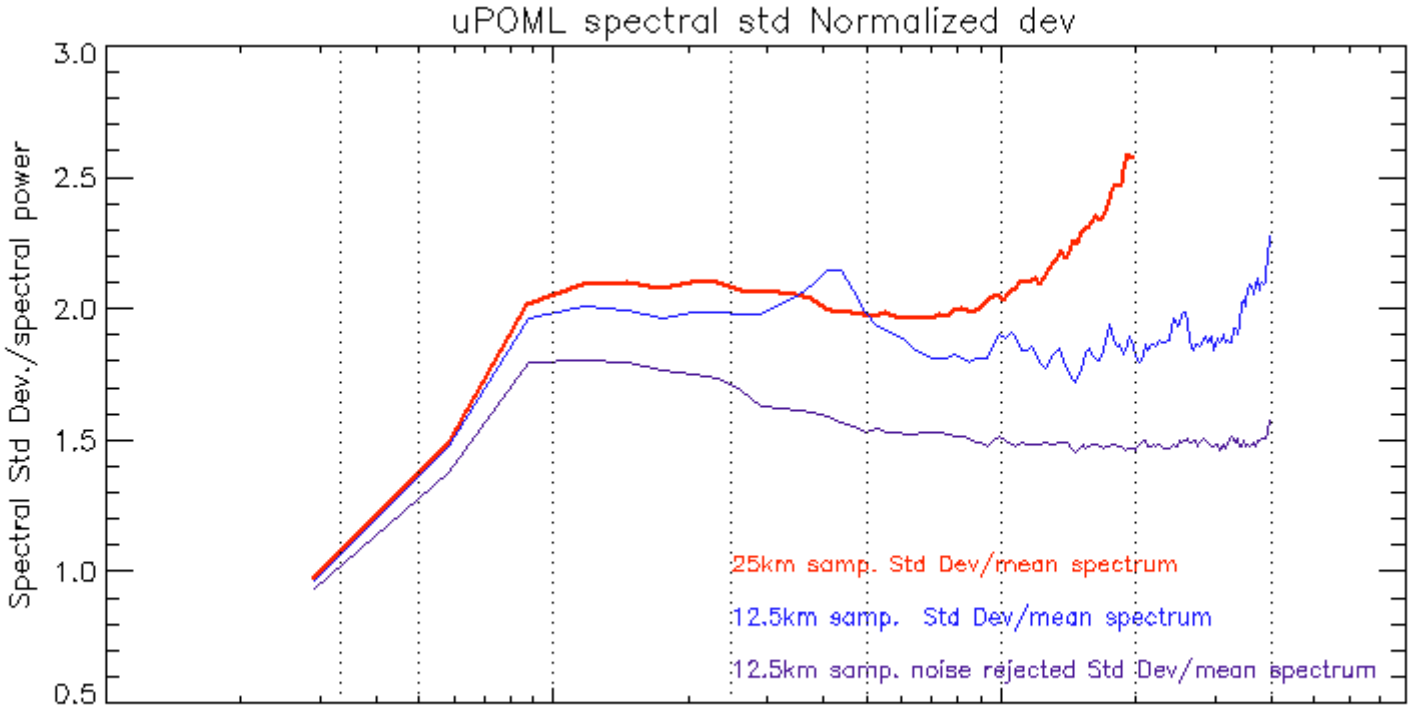
* **"de-spike" or remove ambiguity errors by rejecting an retrieval wherein the first difference exceeds 10 *m/s***

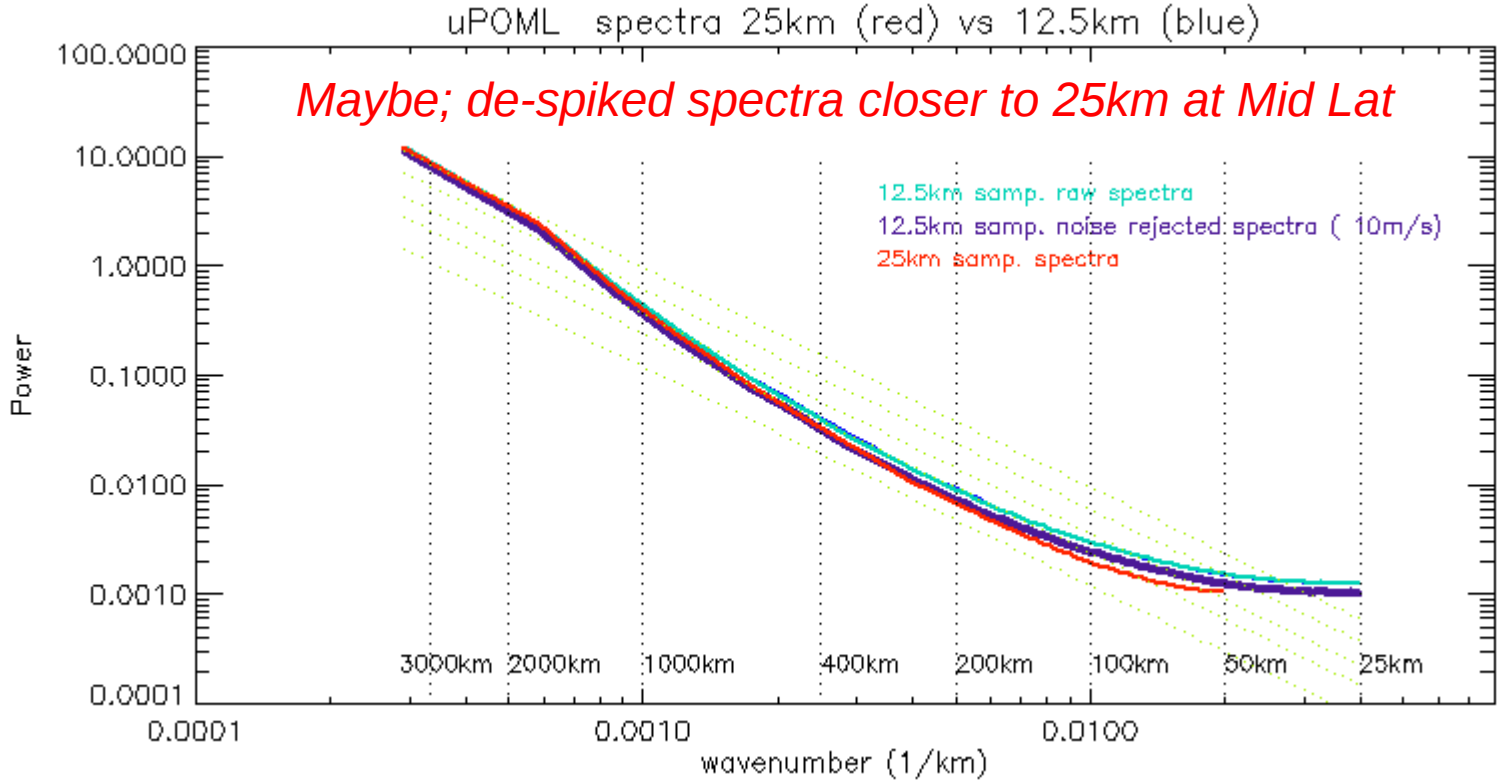
Tropical W. Pac



Nope! de-spiked spectra same as original in Tropics

Mid-Lat N. Pac





Maybe; de-spiked spectra closer to 25km at Mid Lat

Summary: Work in Progress....

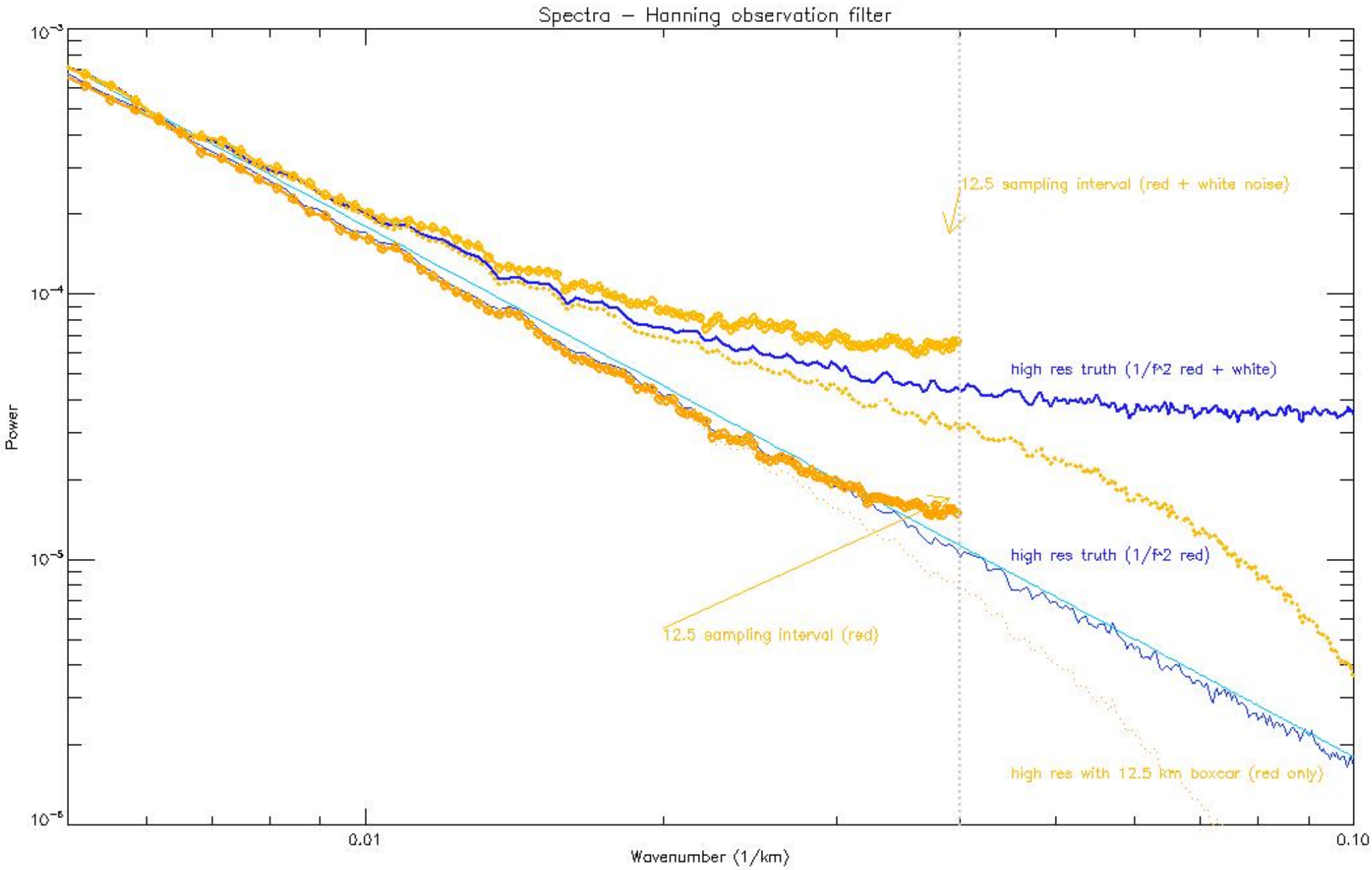
- *Gross spectral properties of QuikSCAT winds are consistent with earliest analyses*
  - *steeper slopes in mid-latitudes (baroclinic waves, forward cascade)*
  - *slightly shallower slopes in tropics (convection, upscale cascade)*

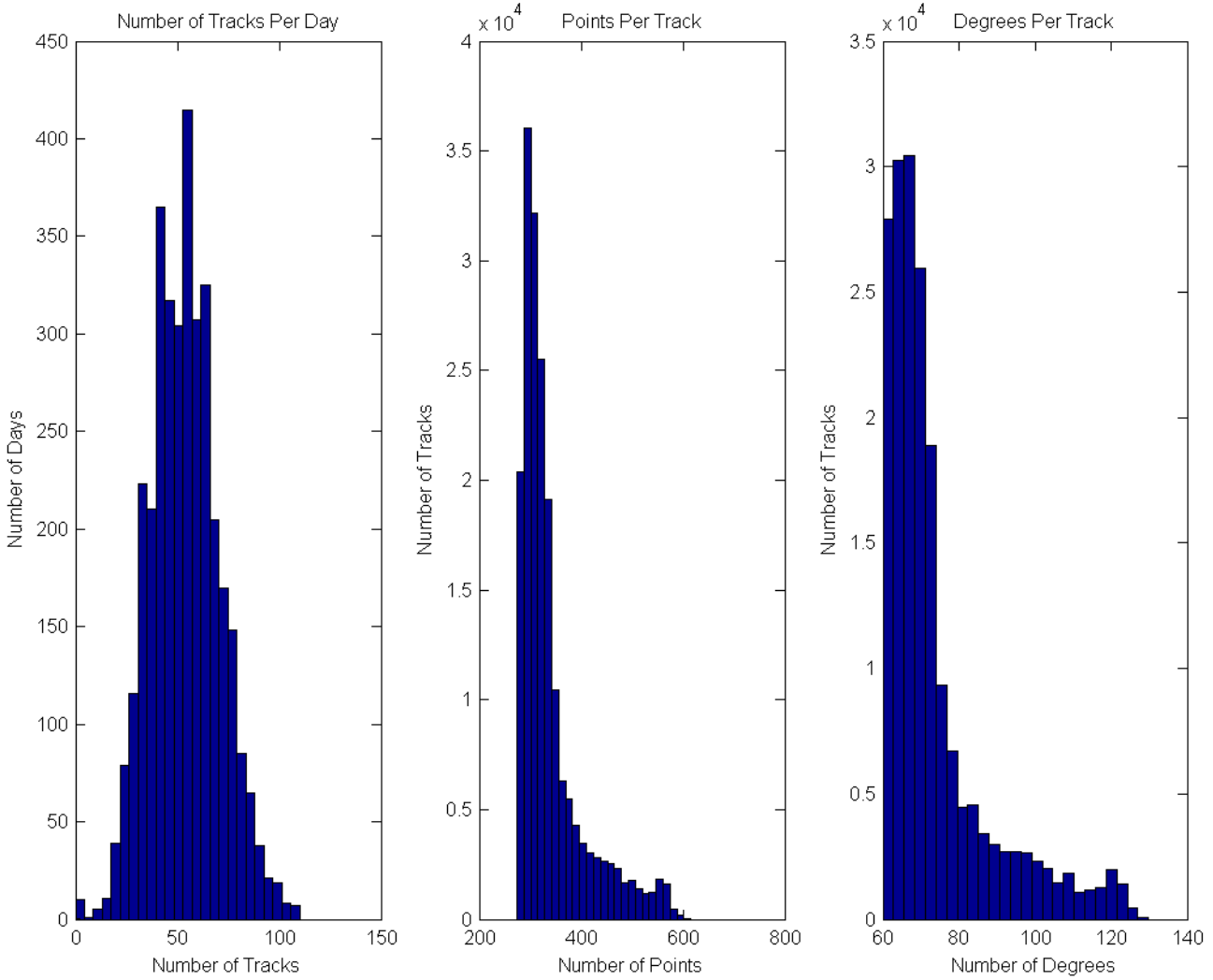
- *Departures from power-law behavior at high-wavenumbers persist*
  - *flat tails due to more than aliasing*

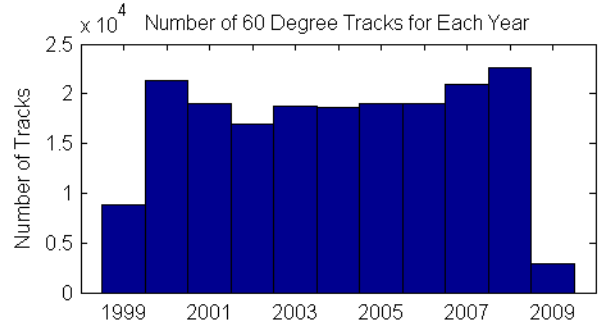
- *Low-wavenumber discrepancies in 12.5km and 25km spectra persist*
  - *stronger in the tropics*
  - *not (only) due to ambiguity errors in 12.5km data*

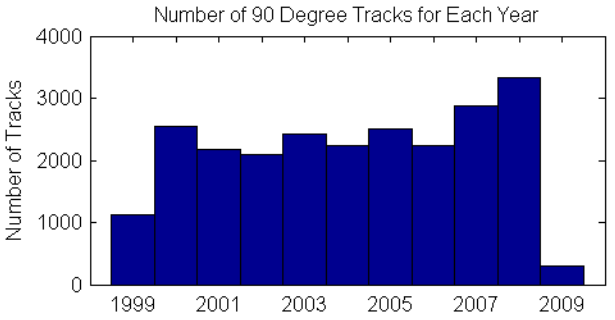
- *Normalized std dev(k) vs. k behaves differently for 25km and 12.5km data*
  - *(excessive?) uncertainty in PSD at high-wavenumbers in 25 km data*
  - *no evidence in 12.5 km data in tropics, some evidence in Mid-Lats*

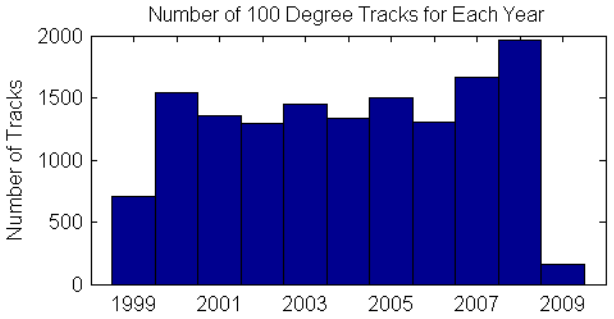
Backup Slides

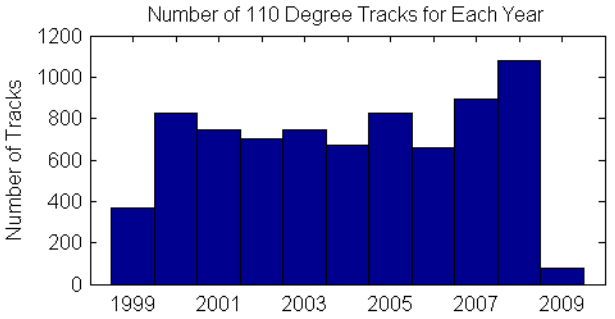

Spectra – Hanning observation filter
12.5 sampling interval (red + white noise)
high res truth (1/f^2 red + white)
high res truth (1/f^2 red)
12.5 sampling interval (red)
high res with 12.5 km boxcar (red only)
Power
Wavenumber (1/km)
0.01
0.10

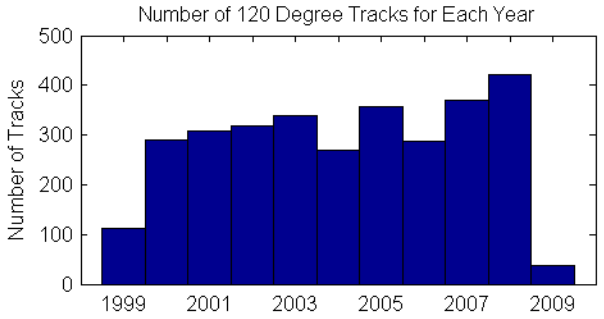

Number of Tracks Per Day
Number of Days
Number of Tracks
0
50
100
150
0
50
100
150
200
250
300
350
400
450
Points Per Track
x 10^4
Number of Tracks
Number of Points
0
0.5
1
1.5
2
2.5
3
3.5
4
200
400
600
800
Degrees Per Track
x 10^4
Number of Tracks
Number of Degrees
0
0.5
1
1.5
2
2.5
3
3.5
60
80
100
120
140

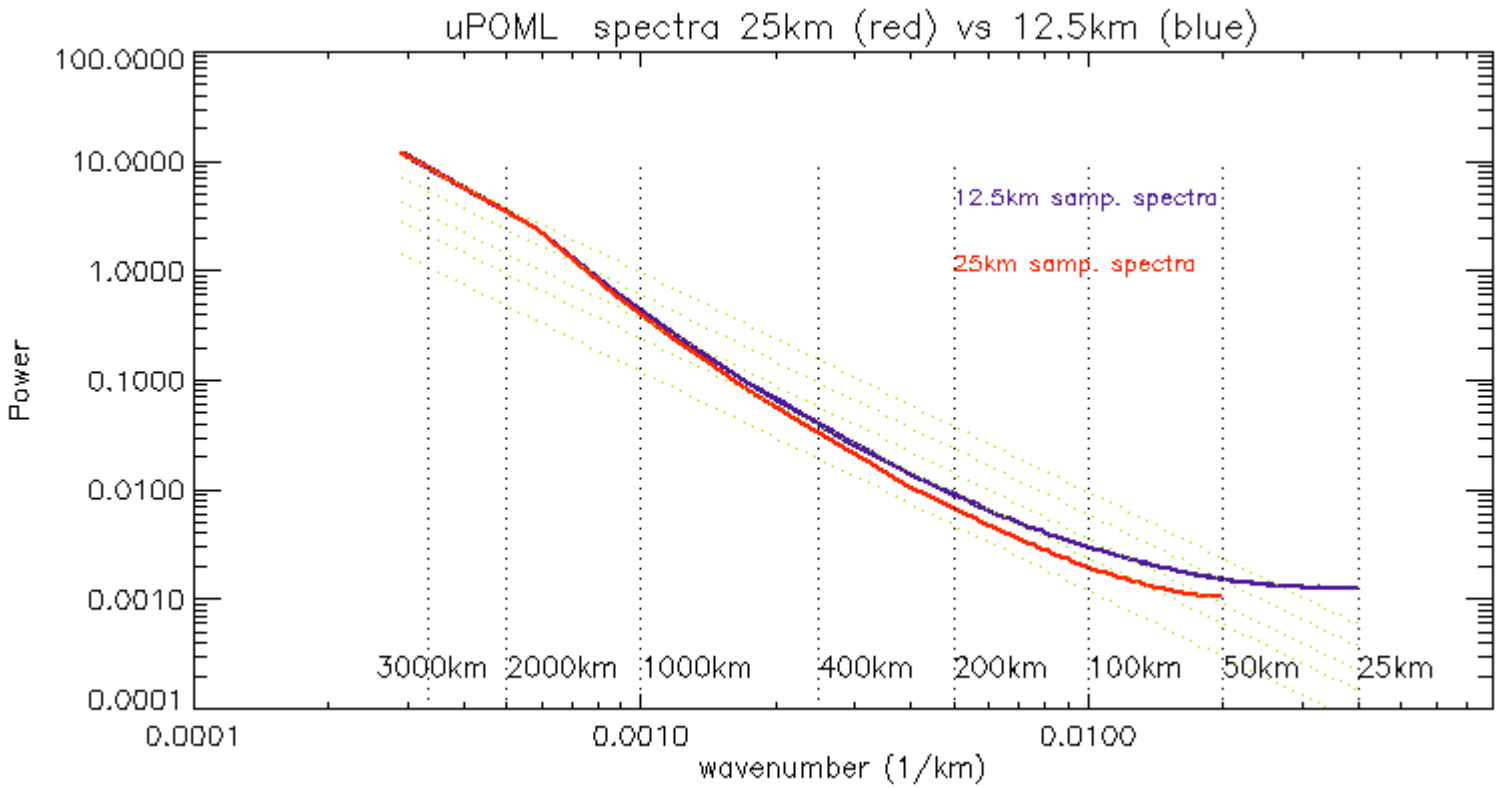

x 10^4
Number of 60 Degree Tracks for Each Year
Number of Tracks
2.5
2
1.5
1
0.5
0
1999
2001
2003
2005
2007
2009

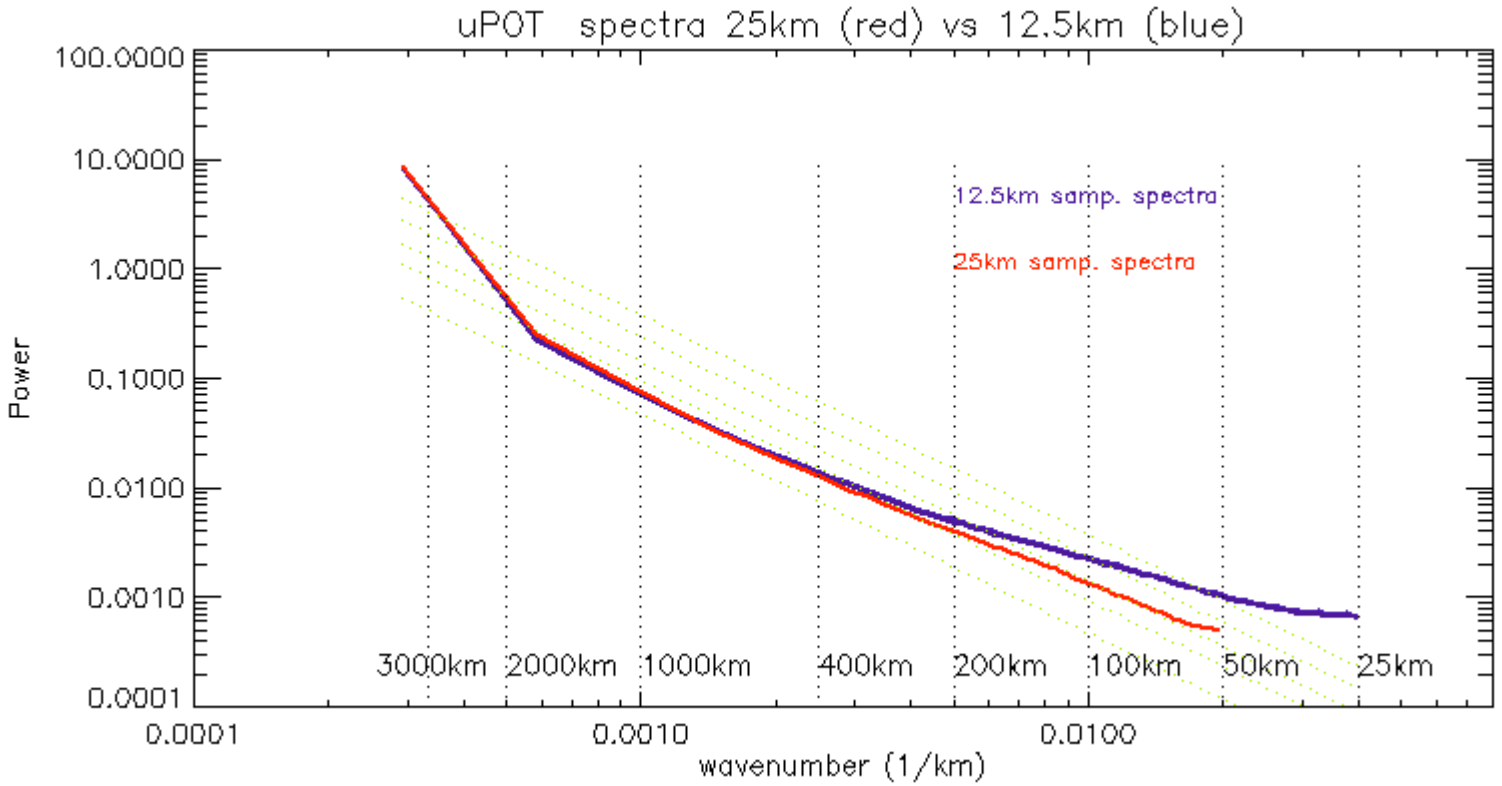

Number of 90 Degree Tracks for Each Year
Number of Tracks
4000
3000
2000
1000
0
1999
2001
2003
2005
2007
2009

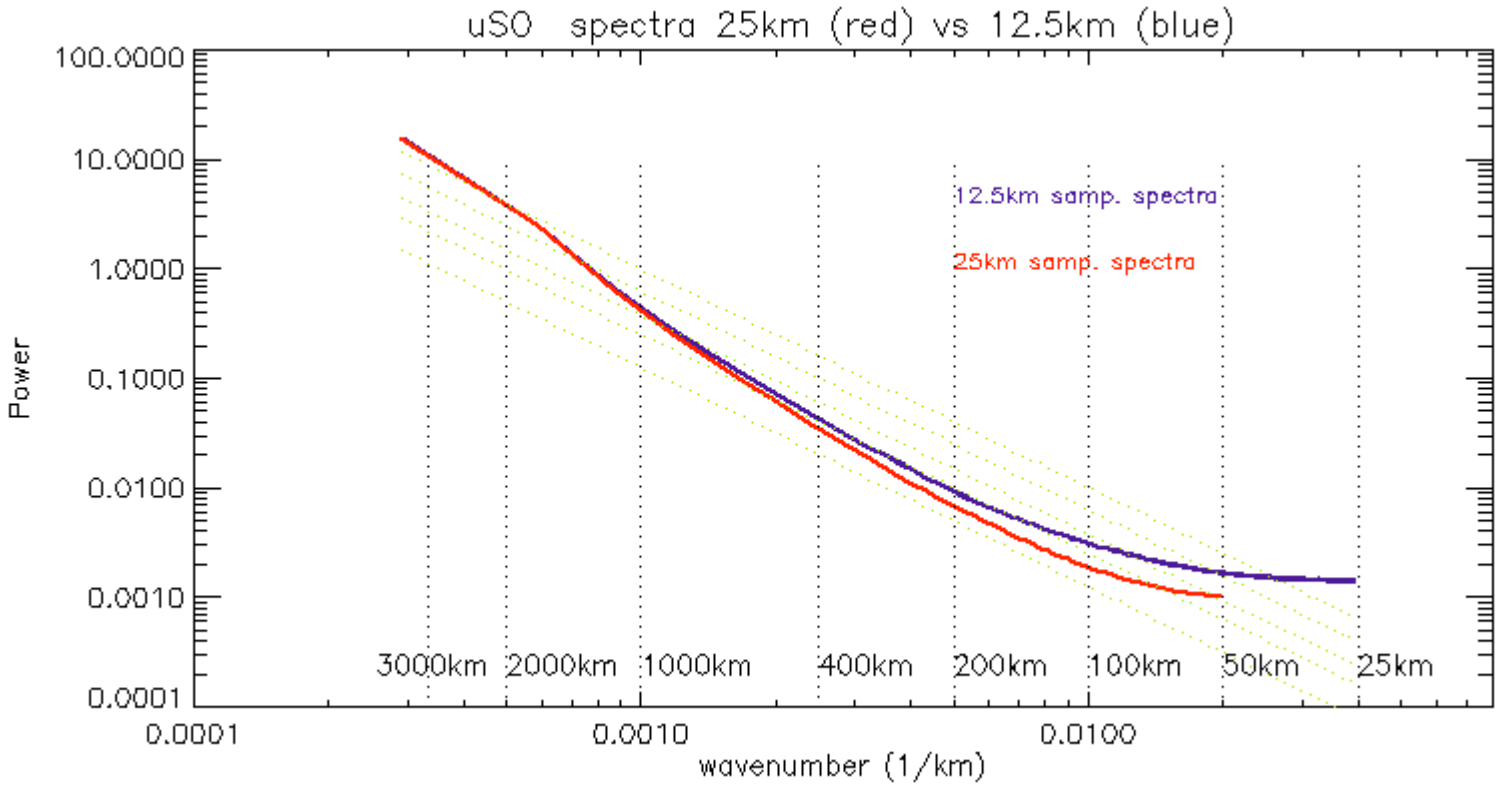

Number of 100 Degree Tracks for Each Year
Number of Tracks
2000
1500
1000
500
0
1999
2001
2003
2005
2007
2009


Number of 110 Degree Tracks for Each Year
Number of Tracks
1200
1000
800
600
400
200
0
1999
2001
2003
2005
2007
2009


Number of 120 Degree Tracks for Each Year
Number of Tracks
500
400
300
200
100
0
1999
2001
2003
2005
2007
2009


uPOML spectra 25km (red) vs 12.5km (blue)
100.0000
10.0000
1.0000
0.1000
0.0100
0.0010
0.0001
Power
12.5km samp. spectra
25km samp. spectra
3000km
2000km
1000km
400km
200km
100km
50km
25km
0.0001
0.0010
0.0100
wavenumber (1/km)


uPOT spectra 25km (red) vs 12.5km (blue)
100.0000
10.0000
1.0000
0.1000
0.0100
0.0010
0.0001
Power
12.5km samp. spectra
25km samp. spectra
3000km
2000km
1000km
400km
200km
100km
50km
25km
0.0001
0.0010
0.0100
wavenumber (1/km)


uSO spectra 25km (red) vs 12.5km (blue)
100.0000
10.0000
1.0000
0.1000
0.0100
0.0010
0.0001
Power
12.5km samp. spectra
25km samp. spectra
3000km
2000km
1000km
400km
200km
100km
50km
25km
0.0001
0.0010
0.0100
wavenumber (1/km)