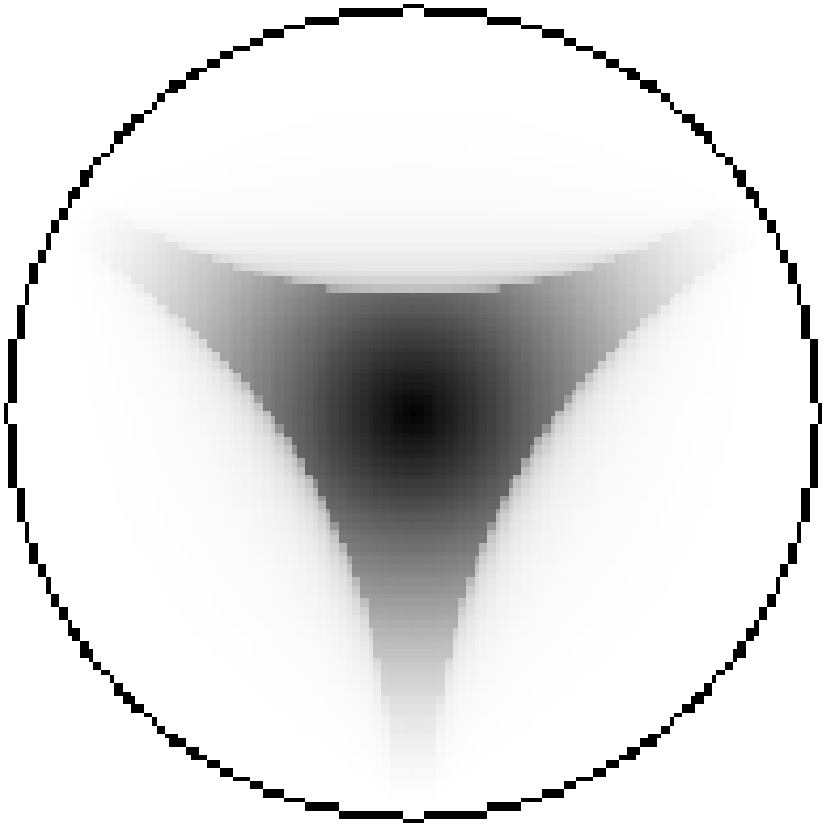
Preliminary Transfer Function of the LARES Satellite

The LARES satellite uses the same design approach as LAGEOS and has similar properties. It has 92 uncoated 1.5 inch diameter cube corners on a 182 mm sphere.

Geometry of the array

- Each hemisphere has a pole cube and 4 rings of cubes containing 5, 10, 14, and 16 cubes.
- There are 4 bolt holes along the equator for handling of the spacecraft.
- The center of the front face of the cubes is recessed 3.5 mm below the surface of the sphere. This places the front face at a distance of 178.5 mm from the center.

Response of an uncoated cube corner vs incidence angle



- The radial distance is the angle between the incident beam and the normal to the cube.
- The azimuthal angle is the longitude of the incident beam.
- The circle is the absolute cutoff angle of the cube corner.
- There is a real back edge pointing up.
- Black = highest intensity

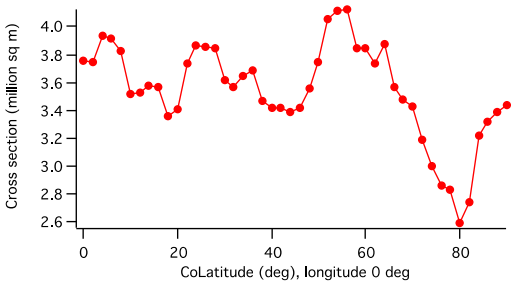
Conditions for following simulations

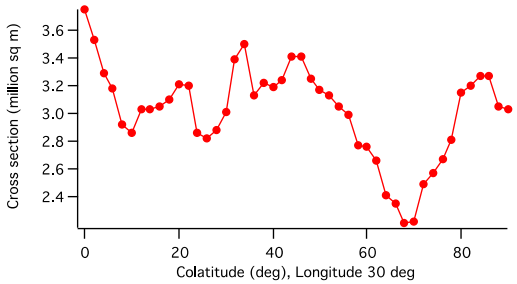
- Circular polarization.
- Average cross section and range correction over the velocity aberration annulus from 30 to 45 microradians is plotted.
- Cross section given in million sq meters is the equivalent size of a diffuse target.
- Range correction is the distance from the centroid of the return to the center of the satellite.

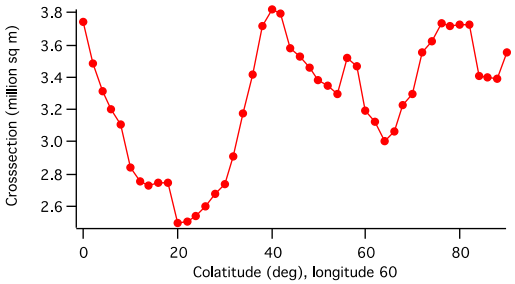
CoLatitude 0-90°,Longitude 0°,30°,60°

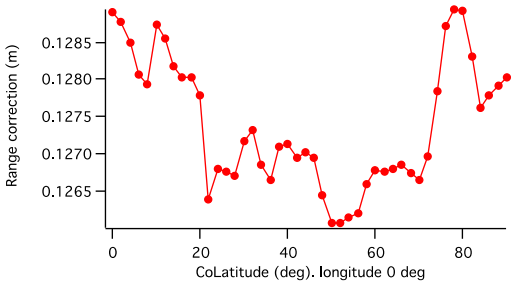
Top row - cross section

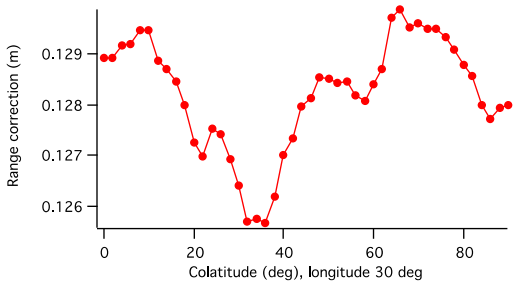
Bottom row - range correction

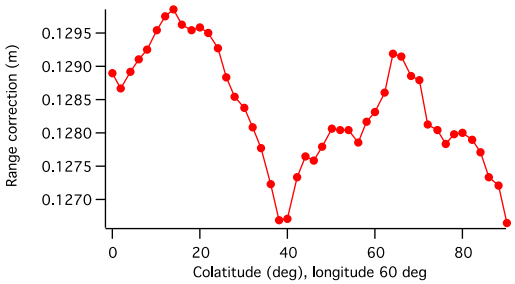




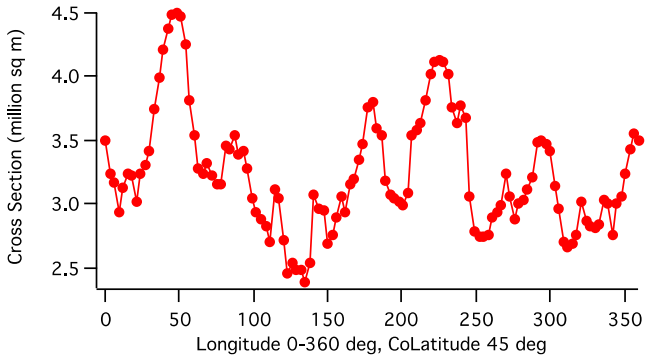


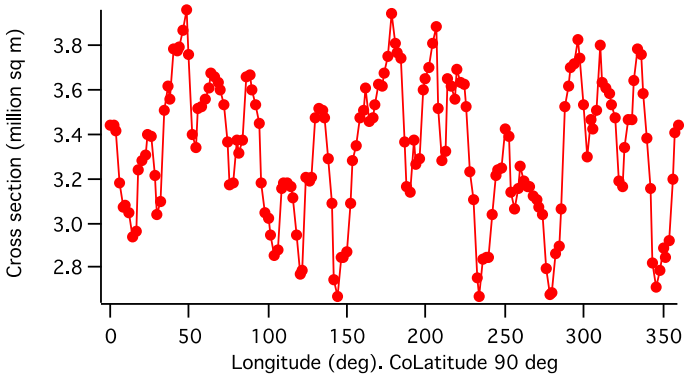


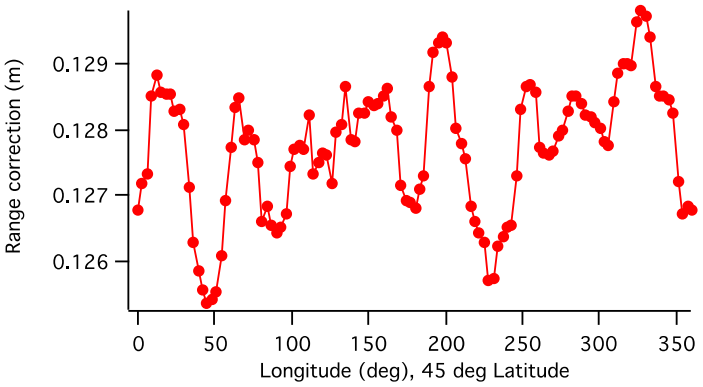


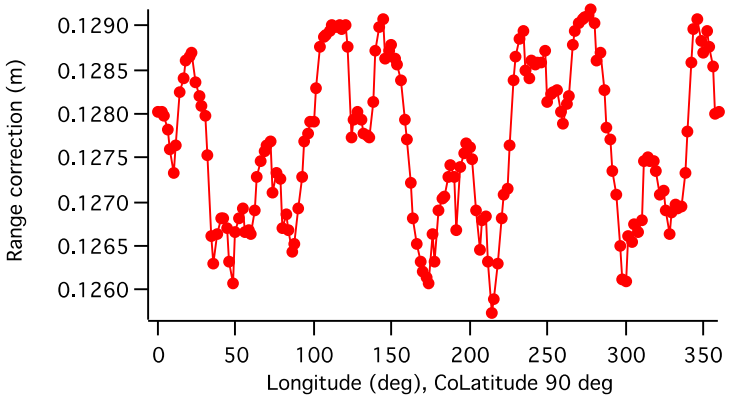


CoLatitude 45˚ ,90˚ ,vs Longitude
Top row - cross section
Bottom row - range correction



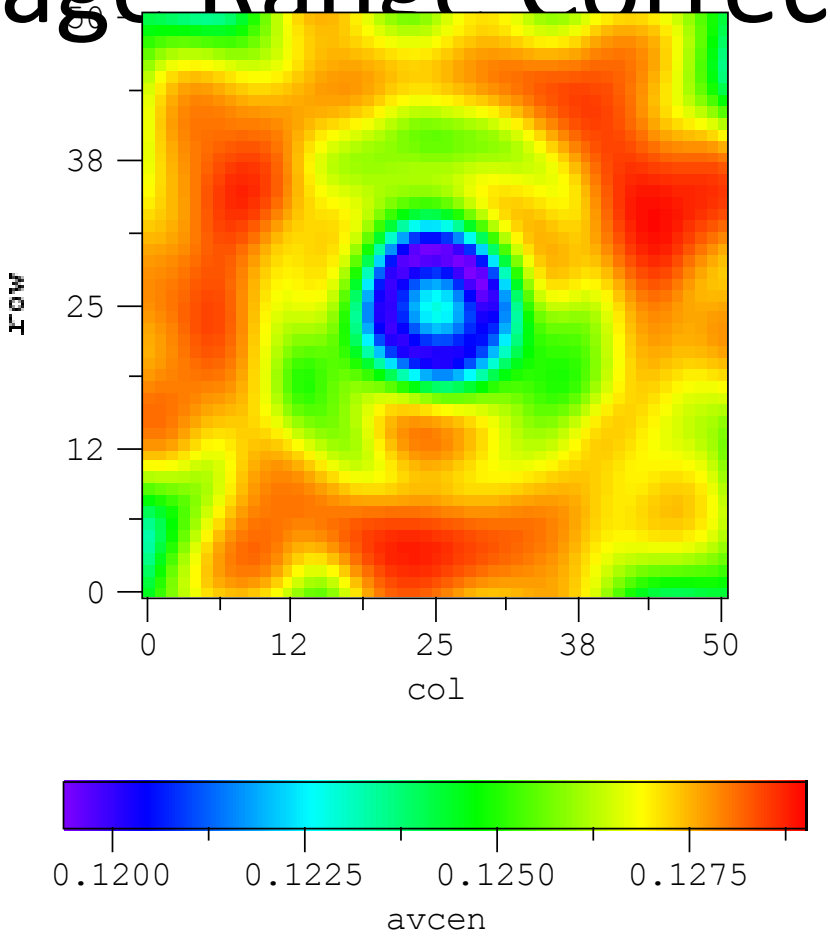






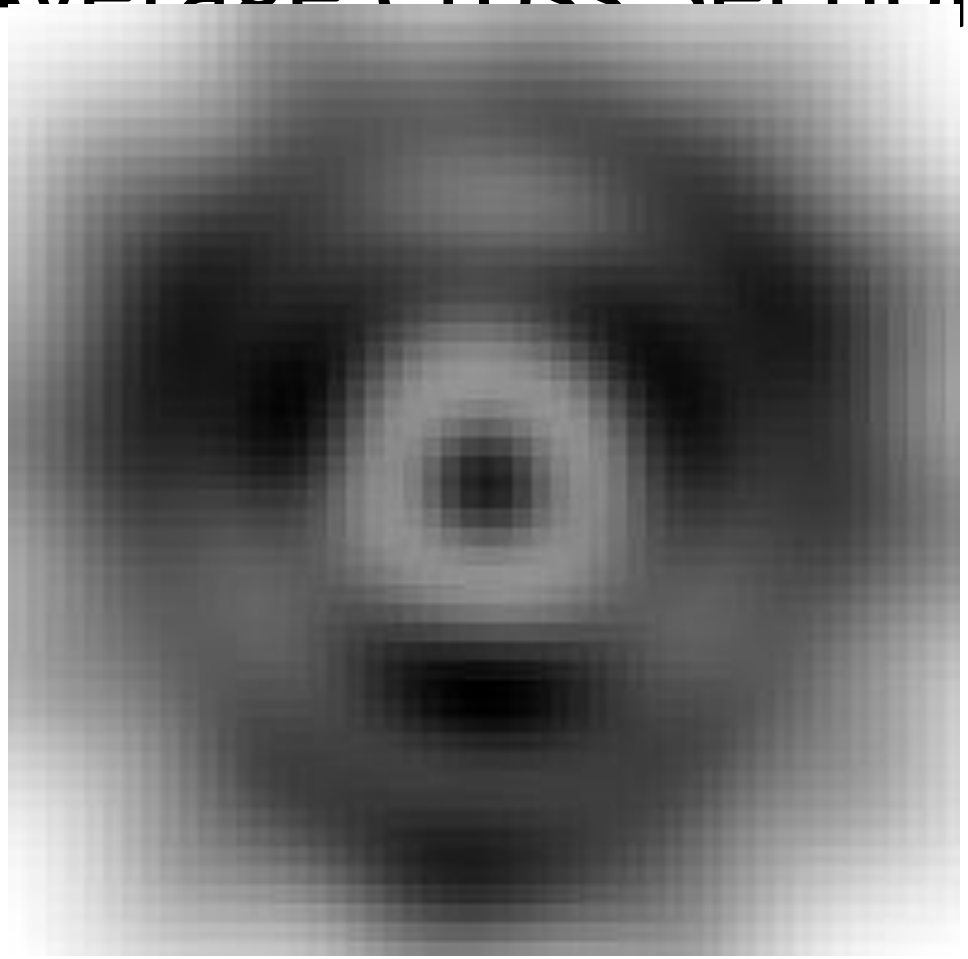
CoLatitude 90° ,Longitude 0-360°

Average Range Correction



CoLatitude 90° ,Longitude 0-360°

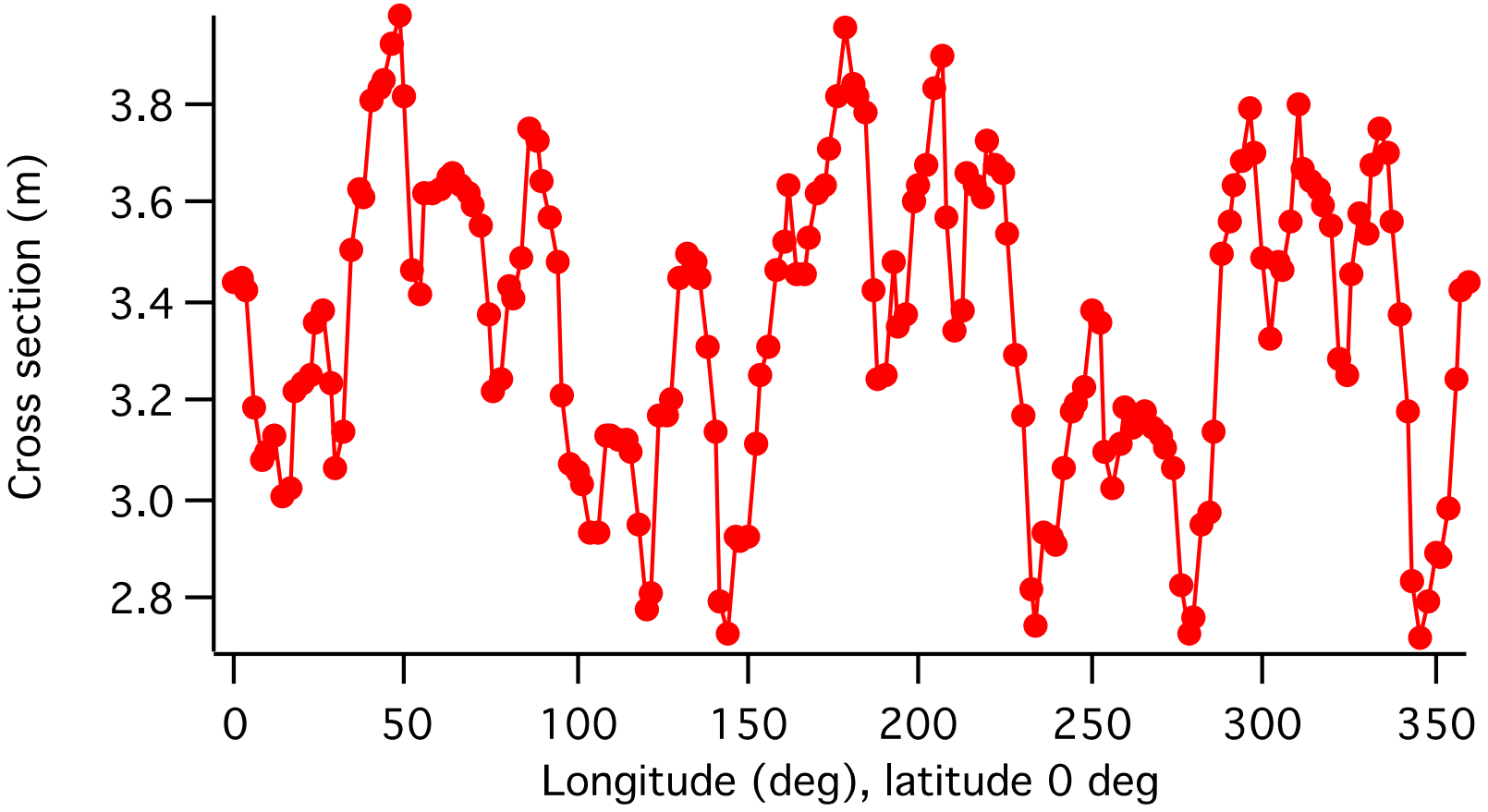
Average Cross Section



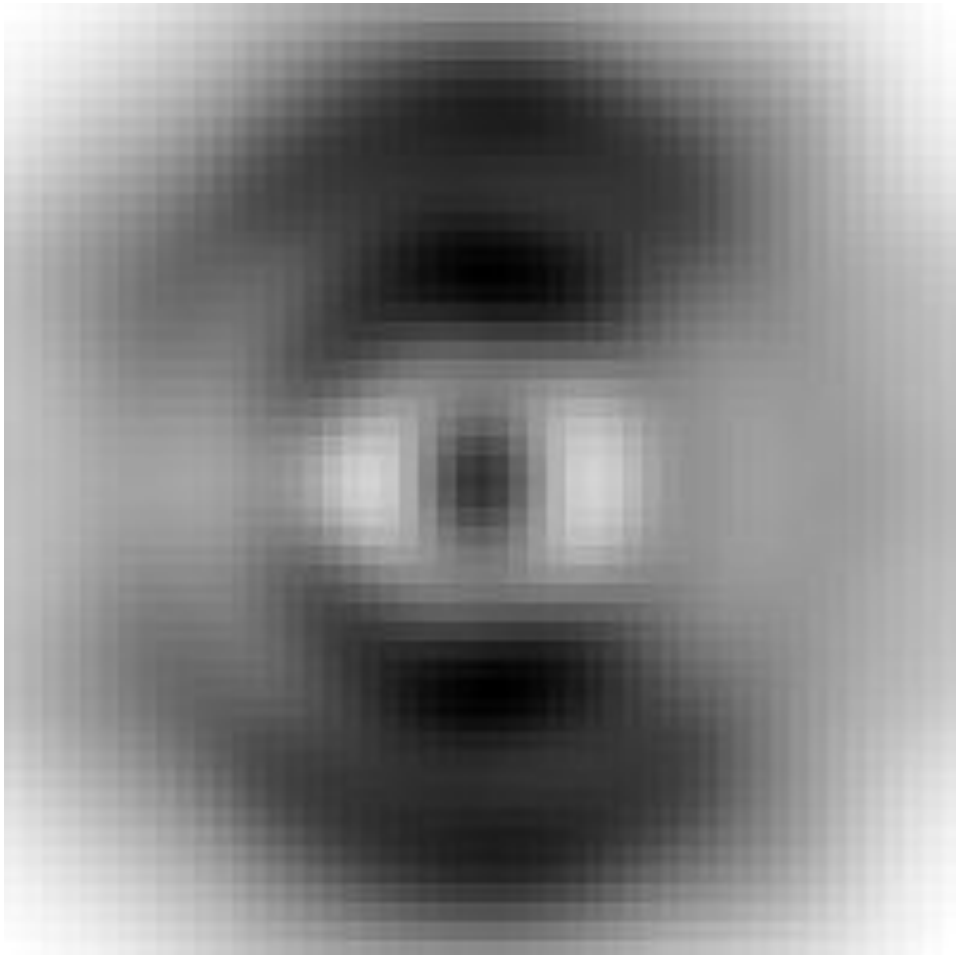
Average range correction
Average cross section

- The average range and cross section matrices are computed from a 51 x 51 matrix with spacing 2 microradians. The axes of the plot are -50 to +50 microradians. The plots are an average of 180 simulations at 2 degree intervals along the equator of the satellite.
- The plots show roughly circular symmetry as a result of using circular polarization
- The following simulations are linear polarization and do not show circular symmetry

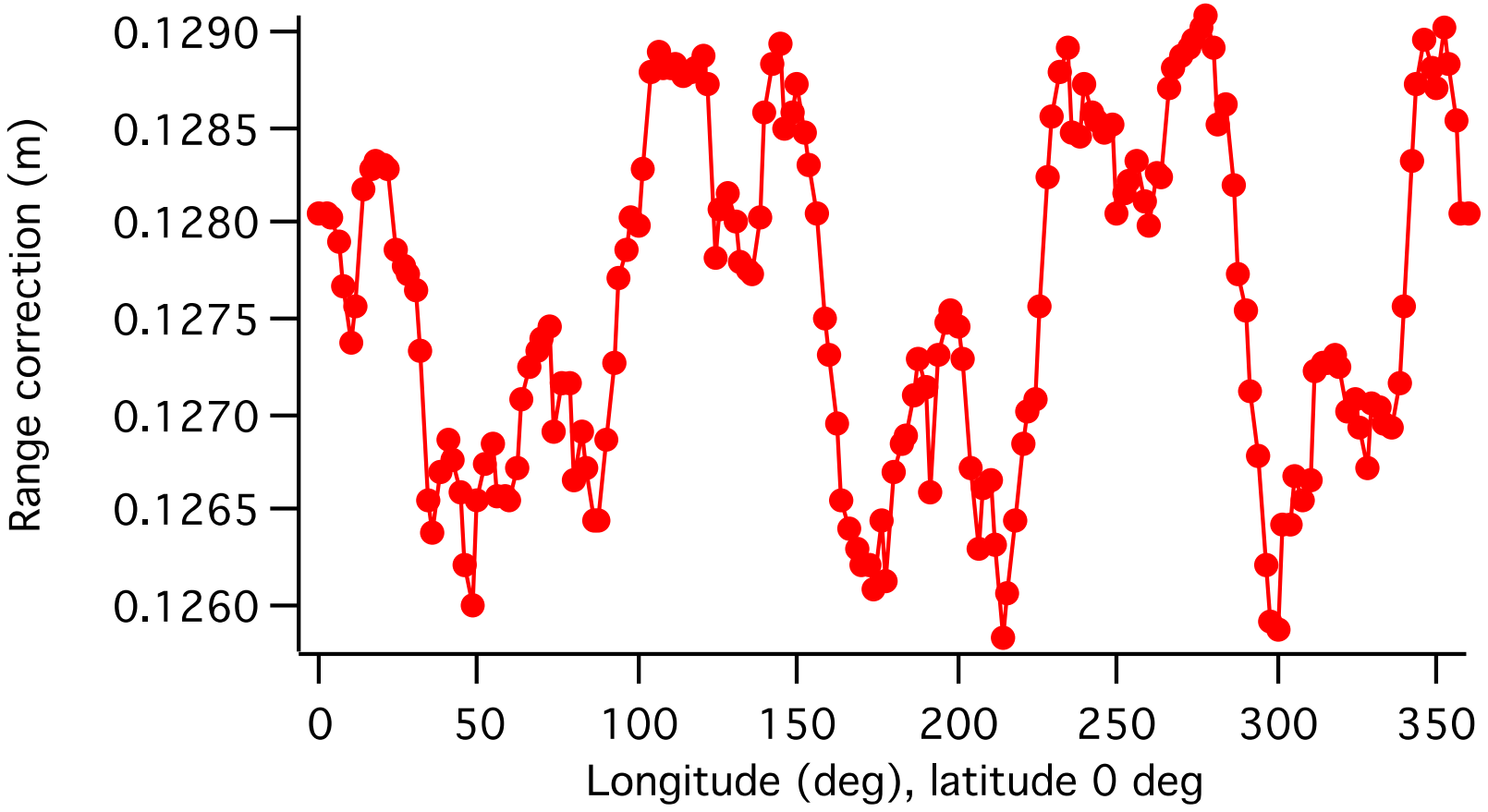
CoLatitude 90° ,Longitude 0-360°
Cross section – Linear polarization



CoLatitude 90°,Longitude 0-360°
Average Cross section

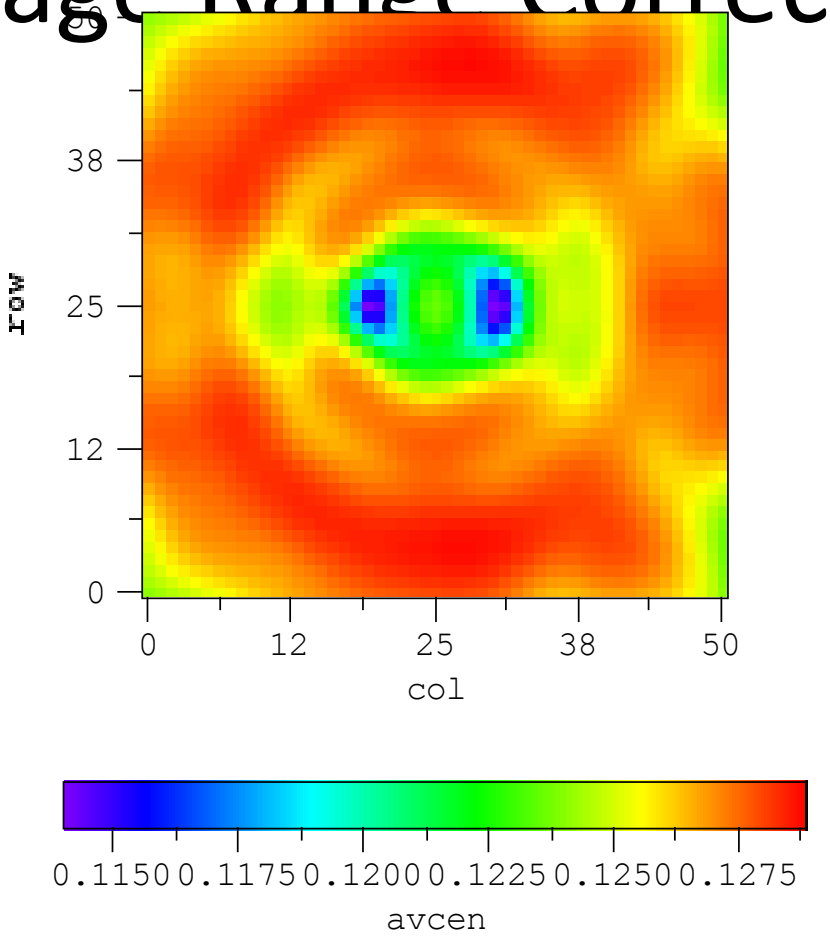


CoLatitude 90° ,Longitude 0-360°
Range Correction – Linear polarization

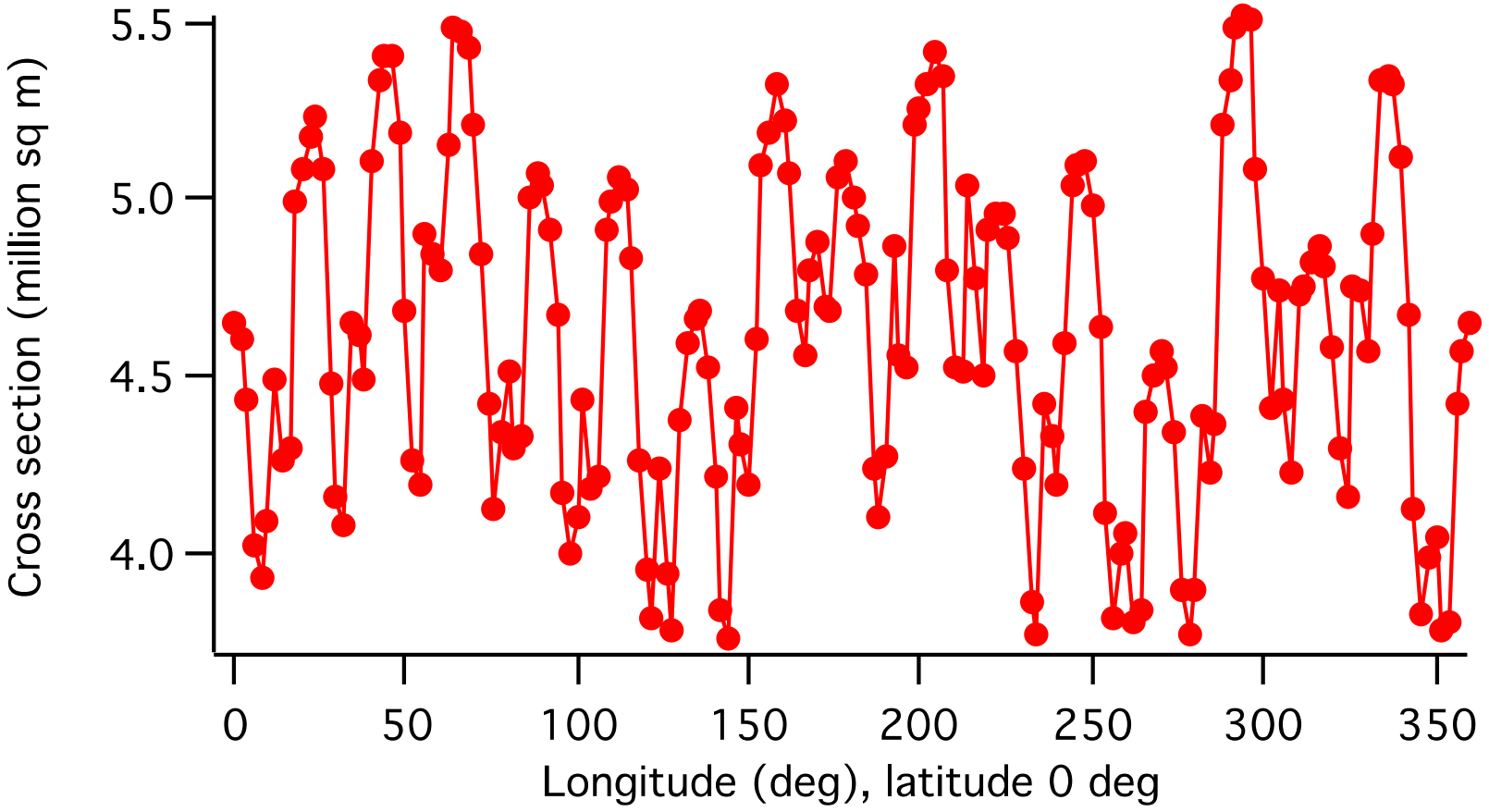


CoLatitude 90° ,Longitude 0-360°

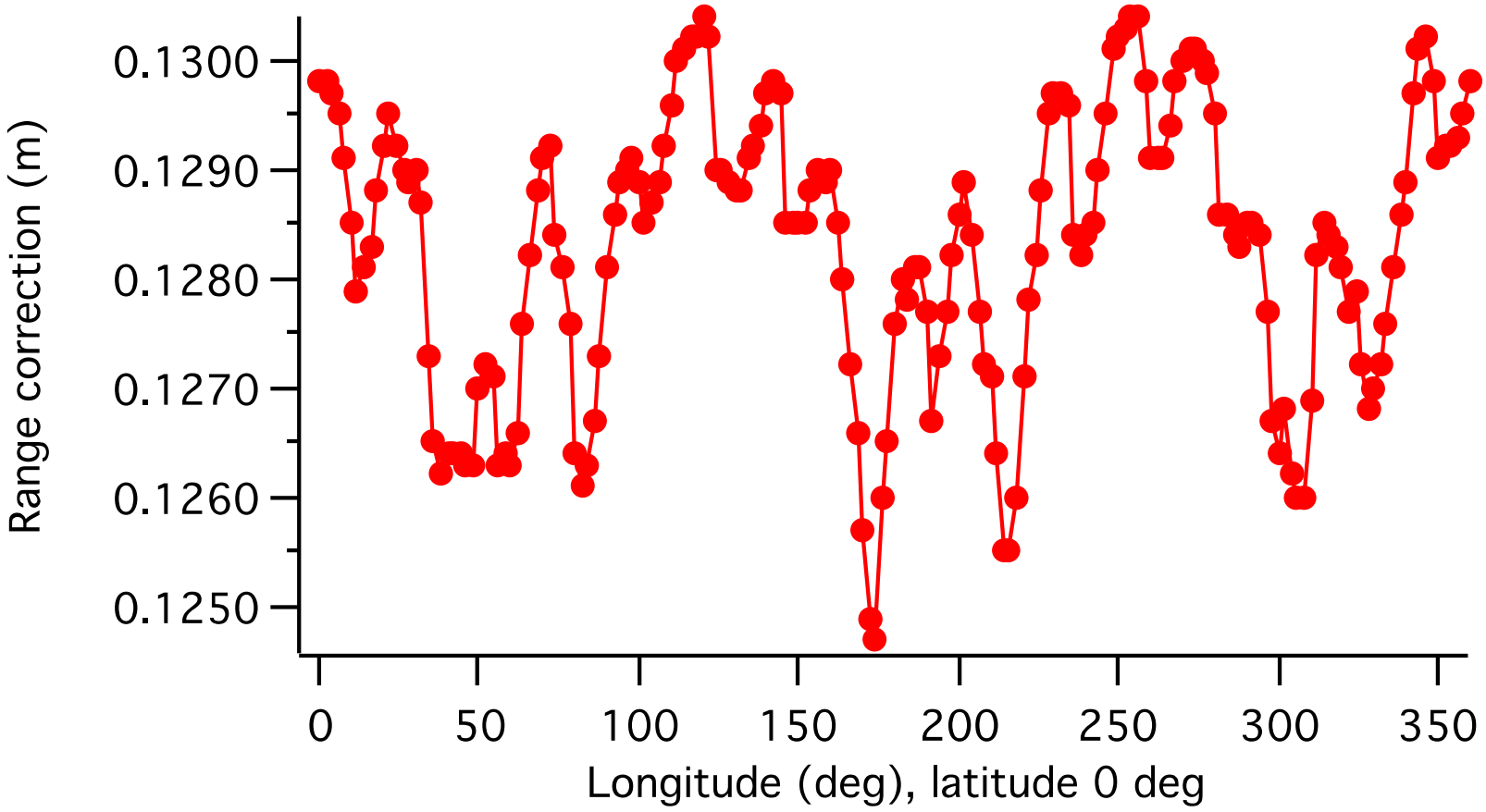
Average Range Correction



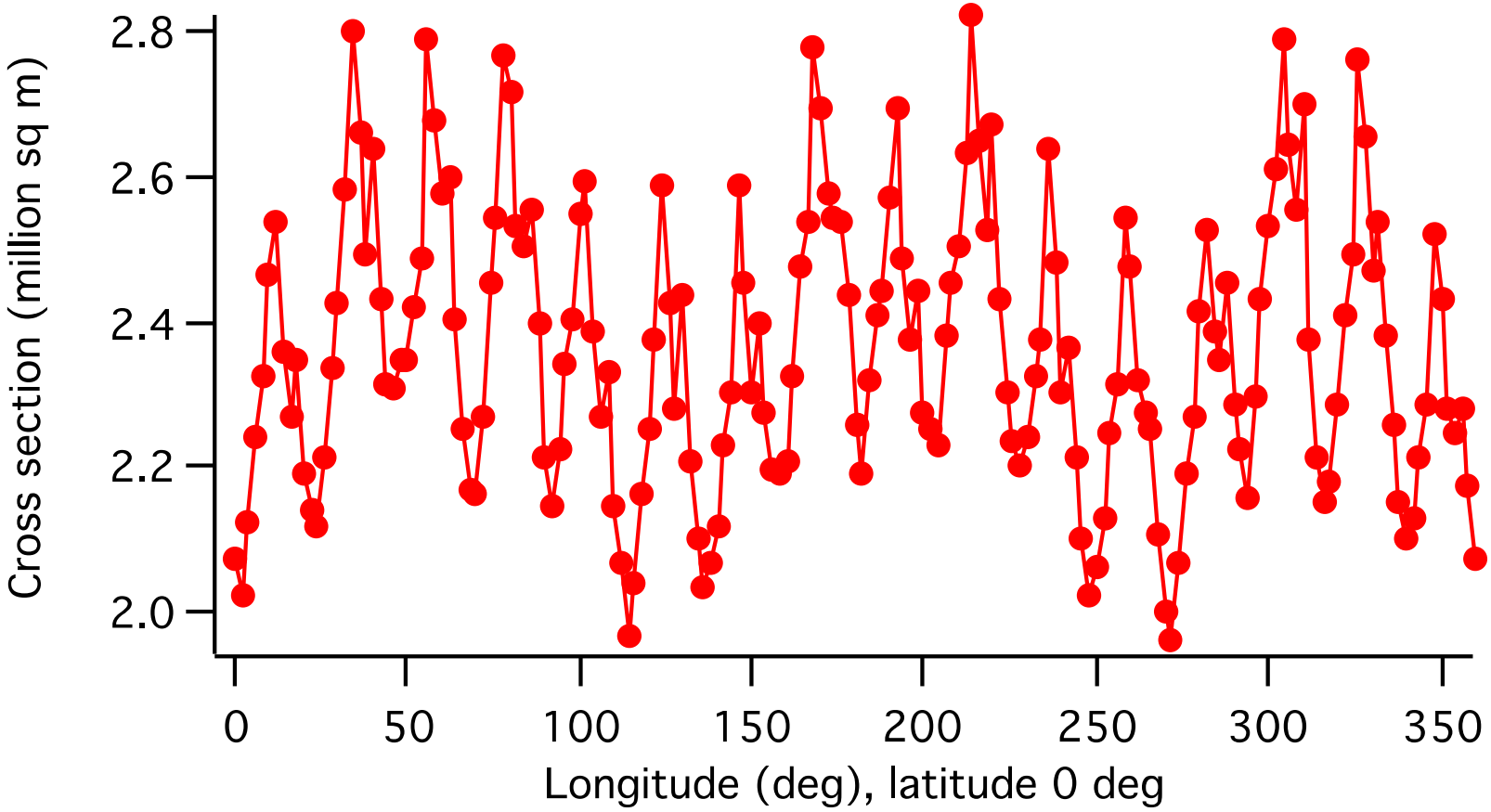
Colatitude 90° ,Longitude 0-360°
Cross section at (0,36) μrad
Linear polarization



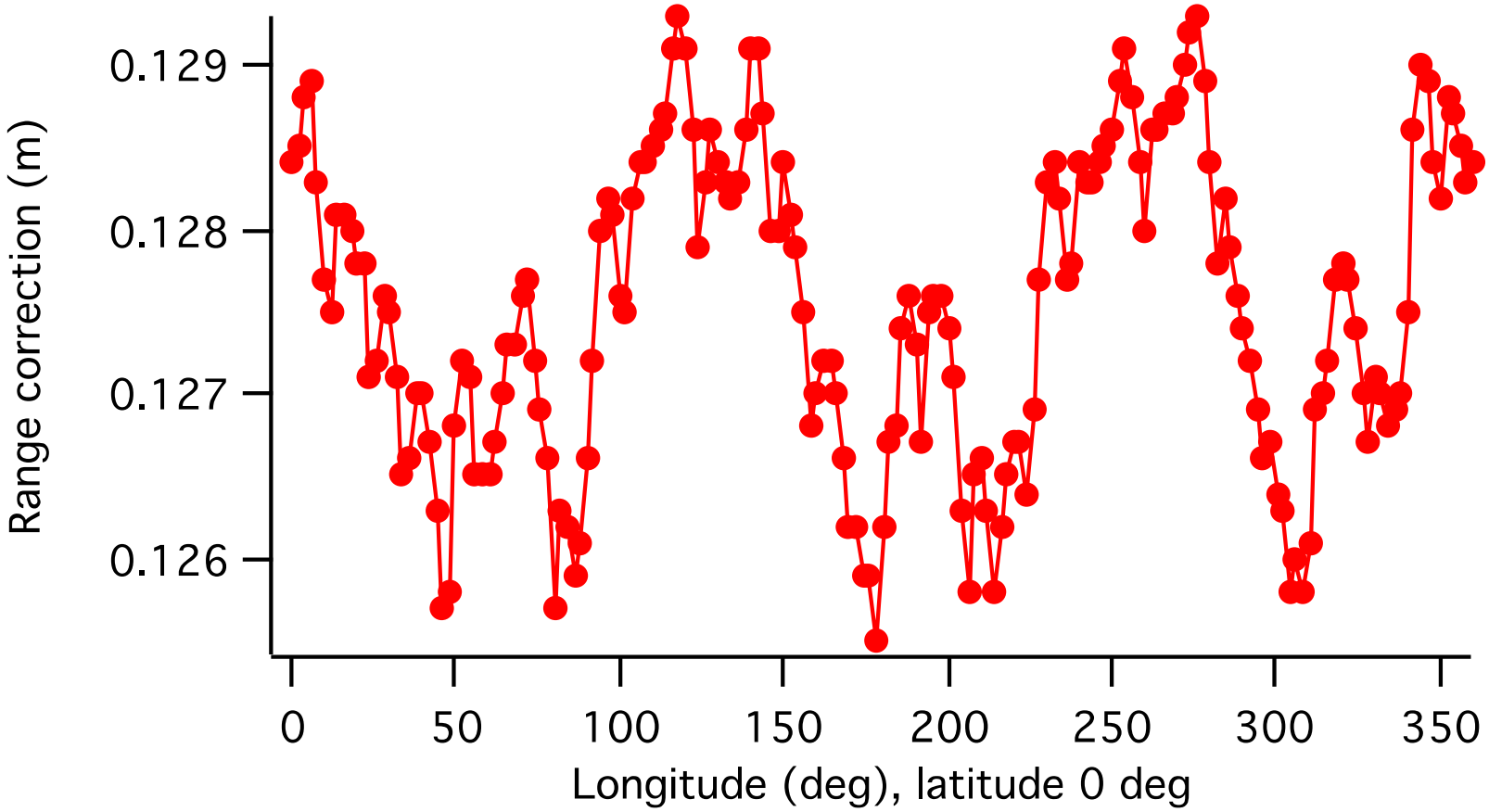
Colatitude 90° ,Longitude 0-360°
Range correction at (0,36) µrad
Linear polarization



Colatitude 90° ,Longitude 0-360°
Cross section at (36,0) μrad
Linear polarization



Colatitude 90° ,Longitude 0-360°
Range correction (36,0) µrad
Linear polarization



Range Correction

- **circular polarization**

Long	CoLat	Vel. Ab.	Minimum	Maximum	Diff	Average	S.D.
0	0-90	annulus	0.1260	0.1289	0.0028	0.1273	0.00085
30	0-90	annulus	0.1256	0.1298	0.0042	0.1282	0.00110
60	0-90	annulus	0.1266	0.1298	0.0032	0.1283	0.00085
0-360	45	annulus	0.1253	0.1298	0.0044	0.1277	0.00099
0-360	90	annulus	0.1257	0.1291	0.0034	0.1276	0.00089

- **linear vertical polarization**

Long	CoLat	Vel. Ab.	Minimum	Maximum	Diff	Average	S.D.
0-360	90	annulus	0.1258	0.1290	0.0032	0.1275	0.00088
0-360	90	(0,36)	0.1247	0.1304	0.0057	0.1283	0.00129
0-360	90	(36,0)	0.1255	0.1293	0.0038	0.1275	0.00095

Cross Section

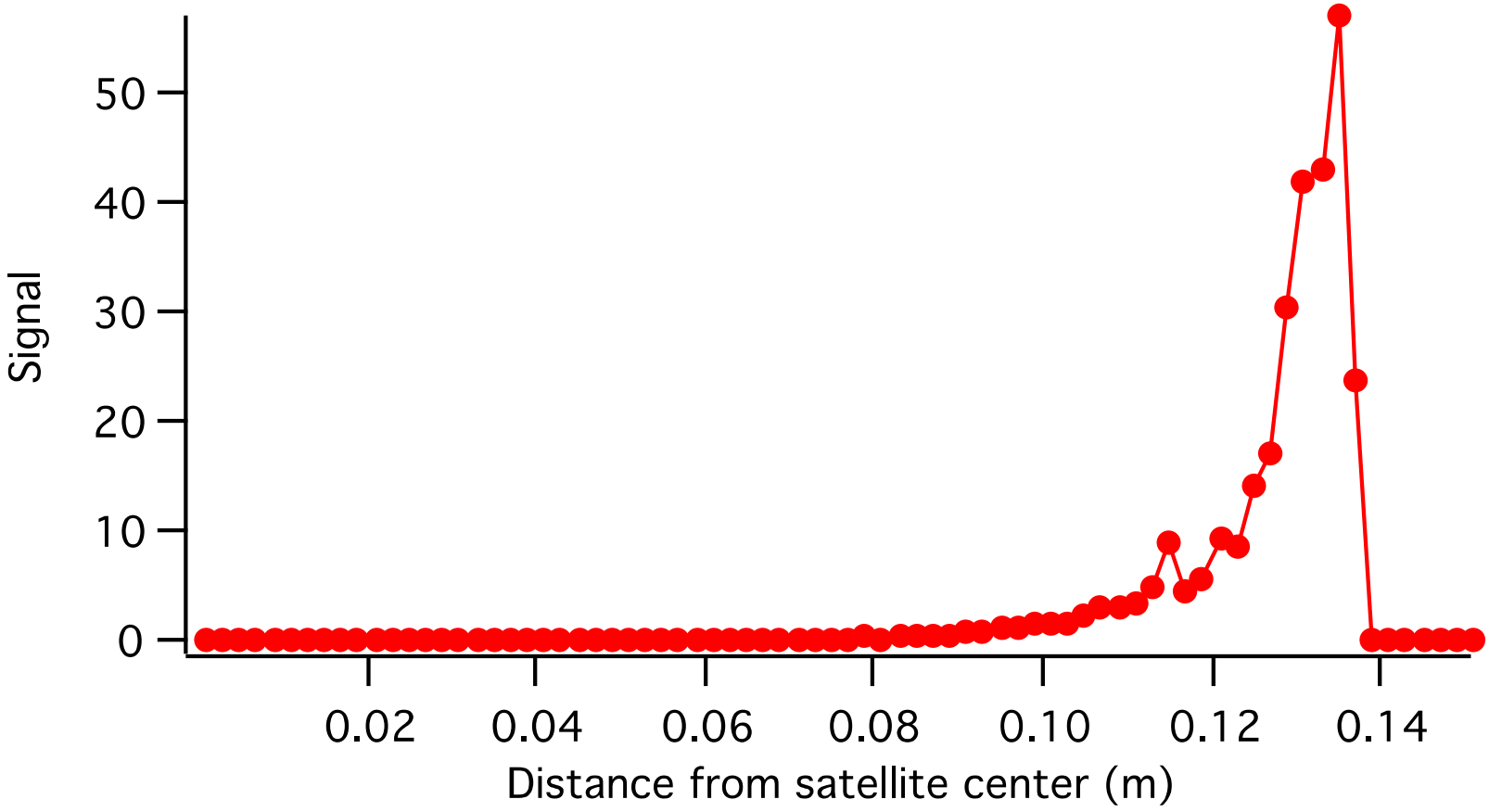
circlar polarization

Long	CoLat	Vel. Ab.	Minimum	Maximum	Diff	Average	S.D.
0	0-90	annulus	2.5864	4.1247	1.5382	3.5414	0.3441
30	0-90	annulus	2.2150	3.7519	1.5368	3.0181	0.3353
60	0-90	annulus	2.4964	3.8214	1.3250	3.2482	0.3887
0-360	45	annulus	2.3859	4.4988	2.1129	3.2421	0.4611
0-360	90	annulus	2.6704	3.9568	1.2863	3.3281	0.3094

linear vertical polarization

Long	CoLat	Vel. Ab.	Minimum	Maximum	Diff	Average	S.D.
0-360	90	annulus	2.7182	3.9787	1.2605	3.3526	0.3042
0-360	90	(0,36)	3.7628	5.5172	1.7544	4.6227	0.4630
0-360	90	(36,0)	1.9622	2.8221	0.8599	2.3625	0.1930

Pulse Histogram



Summary & Conclusions

- The average range correction is about .128 meters with an r.m.s variation of about 1 mm.
- The average cross section is about 3.3 million sq m with an r.m.s variation of about .35 million sq m
- There does not seem to be any systematic variation in the range correction with incidence angle or polarization.