WALLABY Memo 22 v1.0: Sky Tiling

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Overview

In this document we look at pragmatic options for WALLABY tiling, informed by results from the ASKAP performance by D McConnell (ASKAP memo 015, 3rd Oct 2017) and work carried out by A Robotham and presented by L Staveley-Smith at various WALLABY meetings.

Noise Effective Area

In the work originally carried out by A Robotham in 2016 a simple combination of a beam and tile response functions was explored. Using predicted beam response (assumed to be Gaussian) and measured tile response (using the sensitivity profile of the MkI BETA PAFs from Aaron Chippendale), the FoV sensitivity with no offsetting was computed. The most efficient effective area was computed for different beam pitches, with a peak value around 0.9 degrees, implying an effective tile size of just over 5x5 degrees (see Figure 1). Since the exact tile size looked to be flexible around this value, different tile sizes need to be experimented with when deciding on the final tiling.

Offsetting

Given the optimal sized tile, we built a repeating pattern of the throughput with no offsetting (see Figure 3). This produces a pattern with variances notable at the scale of the beam pitch and the tile scale. The question then was what combination of tile offsets creates the most uniform response over large contiguous areas (assuming regular square tiling)? The obvious options to look at were the half pitch scale offsets (roughly 0.5 deg), and half tile scale offsets (roughly 2.5 degrees). Figure 2 gives and example of what a half beam offset would look like on the sky.

Figure 4 shows the effect of offsetting by a half beam scale, where the dynamic range (the ratio in reponse between the 84th/16th percentile of sensitivity, where nearer to 1 means more uniform) drops from 1.213 (with no offsetting) to 1.086, i.e. the field is significantly more uniform.

Figure 5 shows the effect of offsetting by a half tile scale, where the dynamic range drops from 1.213 (with no offsetting) to 1.192, i.e. the field is slightly more uniform.

Figure 6 shows the effect of offsetting by a half beam and half tile scales, where the dynamic range drops from 1.1213 (with no offsetting) to 1.031, i.e. the field is significantly more uniform. This is also a marked improvement on the beam only offsetting (which returned 1.086). The suggestion from this early work was that half beam offsetting is vital (which has been implemented in early science observations for the most part), and half tile offsetting is desirable where appropriate. The caveat here is that the tiling structure would need to be well aligned and square in nature to get the full benefit of half tile offsetting. Given the complexity of tiling a sphere with square tiles (the problem facing WALLABY) it might not be appropriate to implement both offsets in all regions of sky. For smaller area suveys (e.g. DINGO) for types of offsetting should be utilised.

WALLABY Sky Tiling

With an idea of an optimal way to treat the ASKAP tile size (somewhere near 5x5 degrees) the next question was how to most efficiently tile the WALLABY sky, which is effectively all of the sky below Dec +30 deg.

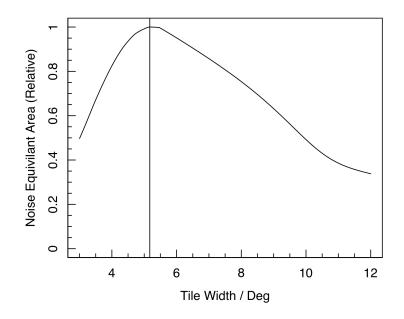


Figure 1: The optimal tile size in terms of Noise Effective Area.

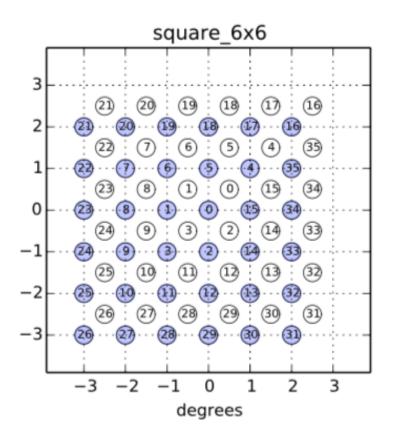


Figure 2: Example half beam offset for 6x6 beams configuration (taken from D McConnell Memo 015).

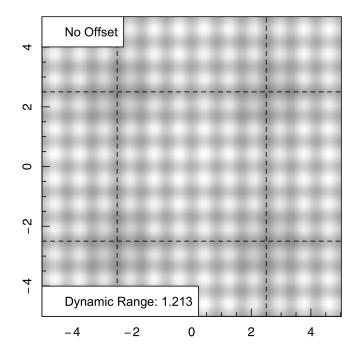


Figure 3: The raw combined beam and tile response.

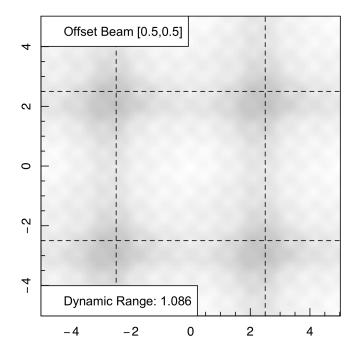


Figure 4: Half beam offset response.

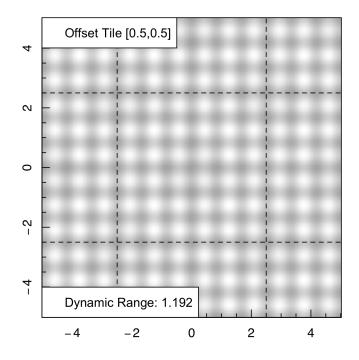


Figure 5: Half tile offset response.

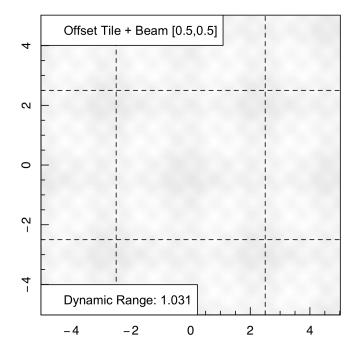


Figure 6: Half beam and half tile offset response.

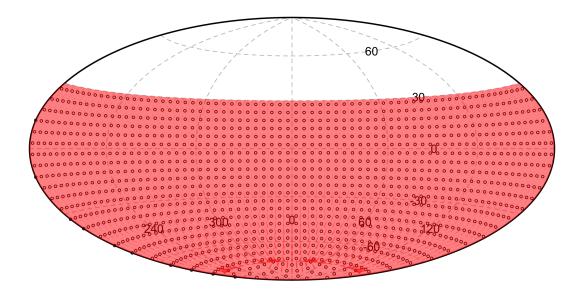


Figure 7: Spherical cap WALLABY tiling example.

Two schemes were investigated in some detail: spherical cap tiling and tennis ball tiling.

Spherical cap tiling former breaks the sky into two zones, one where the tiling is achieved by assembling rings of tiles in right ascension down to some declination, after which point the remaining spherical cap is tiled by rotating the sky 90 degrees and tiling the remaining circular region with strips of tiles (e.g. Figure 7). Tennis ball tiling is achieved by treating the full sky like the two strips that assemble a tennis ball, where each is tiled as strips, but the two strips interleave at 90 degrees with respect to each other (e.g. Figure 8).

When computing the above, the key concept is the sky tiling efficiency in terms of excess coverage, which is simply the percentage of excess sky area observed compared to the sky area tiled uniquely. I.e. if this is 0% then the sky is perfectly tiled, with no overlap between our square tiles (impossible) and if it is 10% then roughly 10% of sky has been tiled more than once due to tile overlaps (so will be deeper) and 90% has been observed once. Since we want to be efficient and uniform, excess coverage values nearer to 0% are desirable.

It was established for WALLABY that given our declination selection, spherical cap tiling is certainly going to be more efficient, so the remaining question is then what tile size and spherical cap size produce the most efficient survey. For certain tile sizes big improvements in efficiency can sometimes be gained by varying the declination at which we swap to cap tiling and by slightly adjusting the declination limit of WALLABY. Figure ?? shows the results of varying both.

In general it was found that smaller tiles are easier to tile with. For an optimal sky tiling, the key things are that the spherical cap angle (θ_{cap}) needs to be an integer multiple of the tile size (T_{dim}) , and the declination limit (ϕ_{lim}) must be such that $(90 - \theta_{cap}/2 + \phi_{lim})/T_{dim}$ is also an integer. To have even better tiling it is slightly advantageous that $360/T_{dim}$ is also an integer since the equatorial RA rings disproportionately dominate the sky area.

Whilst there are slightly better hot spots given the above constraint, in general the differences are small. There might be pragmatic reasons to prefer a smaller cap size, e.g. it is easier to schedule the RA strips given the lack of field rotation required.

Specific Recommendations

In the ASKAP performance by D McConnell (Memo 015, 3rd Oct 2017) more accurate measurements were made of optimal pitch and effective tile areas (see Figures 9 and 10). WALLABY is most interested in tiling

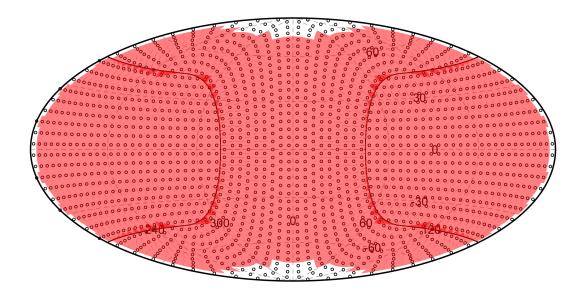


Figure 8: Tennis ball all sky tiling example.

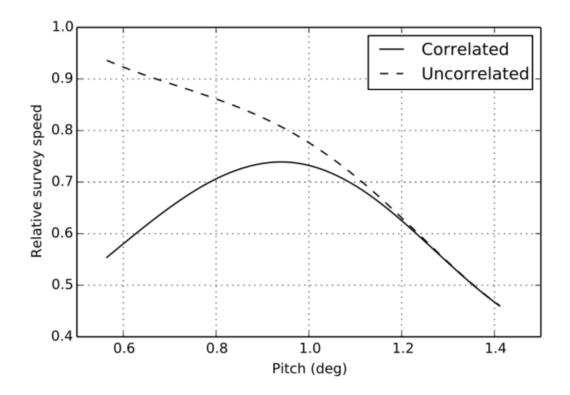


Figure 9: New ASKAP performance measurements.

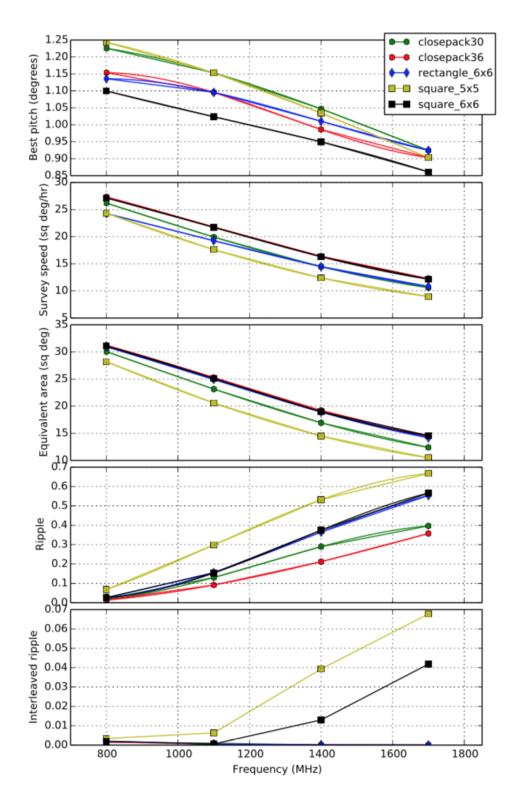


Figure 10: New ASKAP performance measurements.

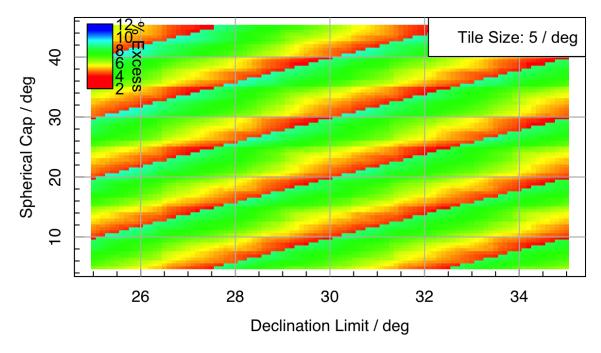


Figure 11: Example tile optimisations. Redder is better, and bluer worse.

performance at frequencies near 1360 MHz (corresponding to the predicted peak in redshift of around 0.04). In this regime a square 6x6 grid of beams tiling with a pitch of around 0.95 deg (a 5.7 degree tile) is close to optimal. To bracket the options we look at three reasonable schemes using $T_{dim} = 5.0 / 5.7$ and 6.0 degrees for the final part of this memo.

Optimal Tiling Grids

Figures 11–13 shows the results from experimenting with a fine grid of possible spherical cap sizes and declination limits. Given what was stated above regarding optimal solutions, it is easy to see the repeating bands of optimal solutions that combine good choices of both together given the target tile size.

There is not a huge variation in the quality of the different 'best' solutions, but ones near a cap size of about 30 degrees tend to be marginally preferable. For the final example sky tiling plots (Figures 14–16ß) we create close to optimal solutions with good spherical caps nearest to this value.

Example Tile Position Information

Tile: 5 Degrees

The starting RA and Dec for the RA strips, and all spherical cap tiles.

Table 1: Spherical cap tile positions and rotation angles (East from North in deg). The type specifies whether this represents the starting tiling of a strip (1), or the cap (2).

RA / deg	Dec / deg	Type	Ang-N2E / deg	N Strip	RA Offset / deg
2.727	27.500	1	0.000	66	5.455
2.647	22.500	1	0.000	68	5.294
2.571	17.500	1	0.000	70	5.143

$\overline{\mathrm{RA}}$ / deg	Dec / deg	Type	Ang-N2E / deg	N Strip	RA Offset / deg
2.535	12.500	1	0.000	71	5.070
2.500	7.500	1	0.000	72	5.000
2.500	2.500	1	0.000	72	5.000
2.500	-2.500	1	0.000	72	5.000
2.500	-7.500	1	0.000	72	5.000
2.535	-12.500	1	0.000	71	5.070
2.571	-17.500	1	0.000	70	5.143
2.647	-22.500	1	0.000	68	5.294
2.727	-27.500	1	0.000	66	5.455
2.857	-32.500	1	0.000	63	5.714
3.051	-37.500	1	0.000	59	6.102
3.214	-42.500	1	0.000	56	6.429
3.529	-47.500	1	0.000	$50 \\ 51$	7.059
3.830	-52.500	1	0.000	47	7.660
4.286	-52.500 -57.500	1	0.000	42	8.571
4.865	-62.500	1	0.000	$\frac{42}{37}$	9.730
$\frac{4.805}{5.806}$	-67.500	1	0.000	31	11.613
7.200		1	0.000	$\frac{31}{25}$	14.400
	-72.500	$\frac{1}{2}$		23 NA	NA
35.236	-74.634 74.624	$\frac{2}{2}$	36.225	NA	NA
144.764	-74.634		53.775		
215.236	-74.634	2	36.225	NA	NA
324.764	-74.634	2	53.775	NA	NA
57.177	-76.066	2	57.952	NA	NA
122.823	-76.066	2	32.048	NA	NA
237.177	-76.066	2	57.952	NA	NA
302.823	-76.066	2	32.048	NA	NA
19.508	-76.725	2	20.002	NA	NA
160.492	-76.725	2	69.998	NA	NA
199.508	-76.725	2	20.002	NA	NA
340.492	-76.725	2	69.998	NA	NA
78.595	-77.256	2	78.869	NA	NA
101.405	-77.256	2	11.131	NA	NA
258.595	-77.256	2	78.869	NA	NA
281.405	-77.256	2	11.131	NA	NA
0.000	-77.500	2	0.000	NA	NA
180.000	-77.500	2	0.000	NA	NA
43.058	-79.709	2	43.522	NA	NA
136.942	-79.709	2	46.478	NA	NA
223.058	-79.709	2	43.522	NA	NA
316.942	-79.709	2	46.478	NA	NA
71.505	-82.097	2	71.669	NA	NA
108.495	-82.097	2	18.331	NA	NA
251.505	-82.097	2	71.669	NA	NA
288.495	-82.097	2	18.331	NA	NA
17.337	-82.141	2	17.492	NA	NA
162.663	-82.141	2	72.508	NA	NA
197.337	-82.141	2	17.492	NA	NA
342.663	-82.141	2	72.508	NA	NA
44.973	-86.465	2	45.027	NA	NA
135.027	-86.465	2	44.973	NA	NA
224.973	-86.465	2	45.027	NA	NA
315.027	-86.465	2	44.973	NA	NA

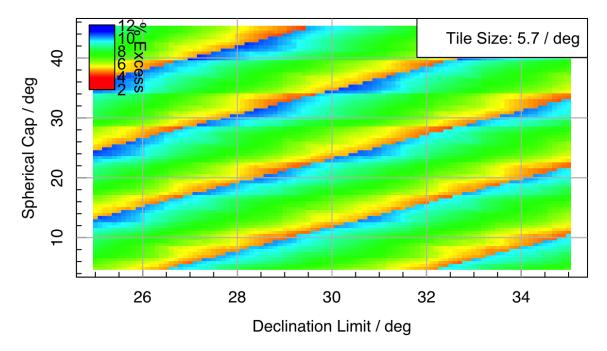


Figure 12: Example tile optimisations. Redder is better, and bluer worse.

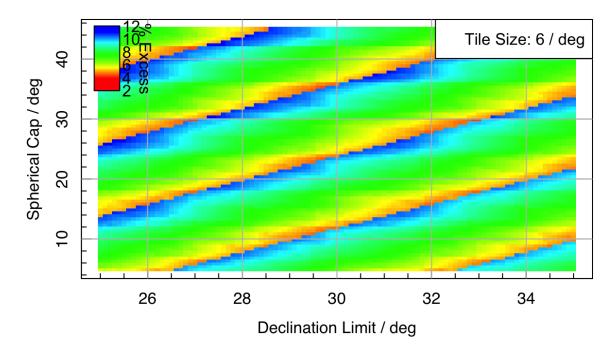


Figure 13: Example tile optimisations. Redder is better, and bluer worse.

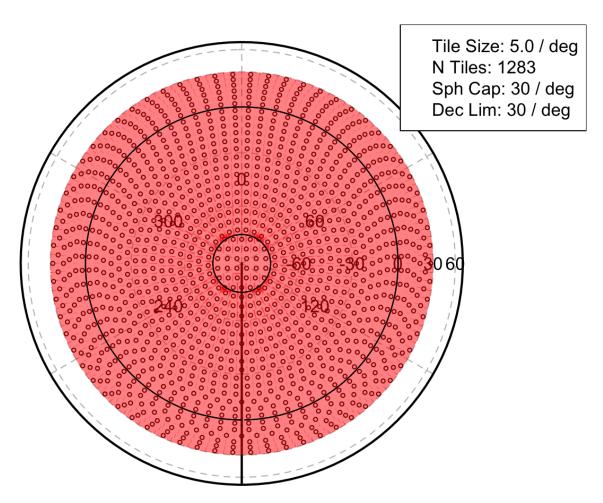


Figure 14: Example sky tiling. Principle RA and Dec limits in degrees are as labelled.

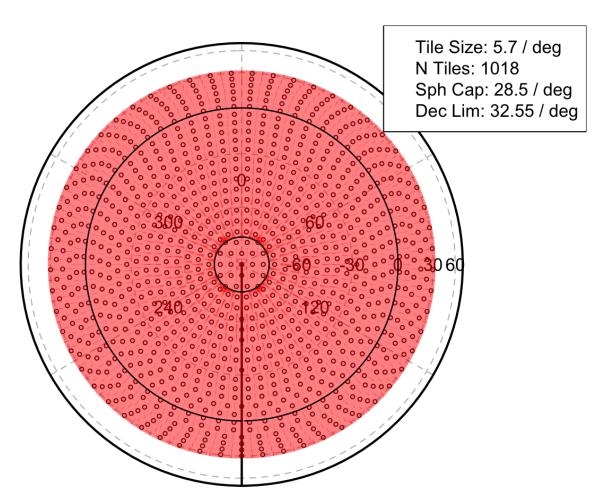


Figure 15: Example sky tiling. Principle RA and Dec limits in degrees are as labelled.

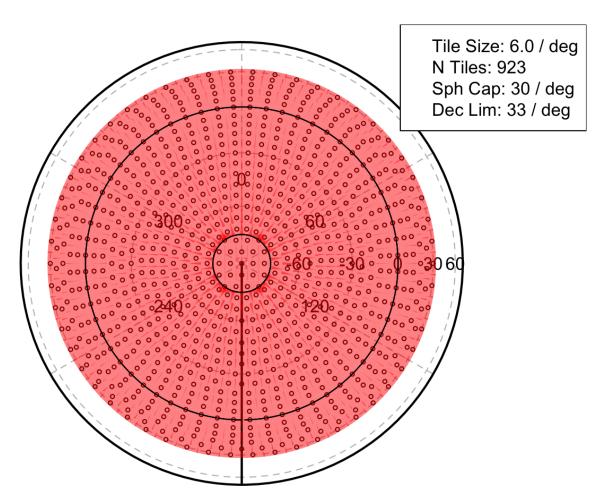


Figure 16: Example sky tiling. Principle RA and Dec limits in degrees are as labelled.

Tile: 5.7 Degrees

The starting RA and Dec for the RA strips, and all spherical cap tiles.

$\begin{array}{c c c c c c c c c c c c c c c c c c c $						
3.051 24.000 1 0.000 59 6.102 2.951 18.300 1 0.000 61 5.902 2.857 12.600 1 0.000 63 5.714 2.812 6.900 1 0.000 64 5.625 2.812 -4.500 1 0.000 64 5.625 2.812 -4.500 1 0.000 64 5.625 2.857 -10.200 1 0.000 62 5.806 3.000 -21.600 1 0.000 60 6.000 3.103 -27.300 1 0.000 58 6.207 3.273 -33.000 1 0.000 52 6.923 3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 48 7.500 4.186 -50.100 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 37.419 NA 323.441 -75.755 2 37.419 NA <	RA / deg	Dec / deg	Type	Ang-N2E / deg	N Strip	RA Offset / deg
2.95118.30010.000615.9022.85712.60010.000635.7142.8126.90010.000645.6252.8121.20010.000645.6252.812-4.50010.000635.7142.903-15.90010.000625.8063.000-21.60010.000606.0003.103-27.30010.000556.5453.462-38.70010.000526.9233.750-44.40010.000487.5004.186-50.10010.0003310.9096.429-67.20010.0002812.8578.182-72.90010.0002216.364143.441-75.755252.581NANA216.559-75.755237.419NANA323.441-75.755252.581NANA216.721-77.484226.721NANA217.779-77.484226.721NANA219.929-78.250214.215NANA13.929-78.250214.215NANA13.929-78.250214.215NANA13.929-78.250214.215NANA13.929-78.250214.215NANA13.929 <t< td=""><td>3.158</td><td>29.700</td><td>1</td><td>0.000</td><td>57</td><td>6.316</td></t<>	3.158	29.700	1	0.000	57	6.316
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2.812	-4.500	1	0.000	64	5.625
3.000 -21.600 1 0.000 60 6.000 3.103 -27.300 1 0.000 58 6.207 3.273 -33.000 1 0.000 55 6.545 3.462 -38.700 1 0.000 52 6.923 3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 216.559 -75.755 2 37.419 NANA 22.441 -75.755 2 52.581 NANA 22.12 -77.484 2 26.721 NANA 22.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 242.721 -77.484 2 26.721 NANA 13.929 -78.25	2.857	-10.200	1	0.000	63	5.714
3.103 -27.300 1 0.000 58 6.207 3.273 -33.000 1 0.000 55 6.545 3.462 -38.700 1 0.000 52 6.923 3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 216.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 227.279 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 193.929 -78.250 2 75.785 NANA 290.000 -78.839 2 0.000 NANA 24.252 -82.030 2 45.470 NANA 24.252 -8	2.903	-15.900	1	0.000	62	5.806
3.273 -33.000 1 0.000 55 6.545 3.462 -38.700 1 0.000 52 6.923 3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 216.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 26.721 NANA 17.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 346.071 -78.250 2 45.470 NANA 135.748 -82.030 <	3.000	-21.600	1	0.000	60	6.000
3.462 -38.700 1 0.000 52 6.923 3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 323.441 -75.755 2 52.581 NANA 224.2721 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 139.929 -78.250 2 75.785 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 24.252 -82.030 2 45.470 NANA 24.252 -82.030 2 45.470 NANA 135.748 -82.030 </td <td>3.103</td> <td>-27.300</td> <td>1</td> <td>0.000</td> <td>58</td> <td>6.207</td>	3.103	-27.300	1	0.000	58	6.207
3.750 -44.400 1 0.000 48 7.500 4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 62.721 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 13.929 -78.250 2 75.785 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 24.252 -82.030 2 44.530 NANA 24.252 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 136.000 -84.300 2 0.000 NANA 136.000 -84.300 2	3.273	-33.000	1	0.000	55	6.545
4.186 -50.100 1 0.000 43 8.372 4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 17.279 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 24.252 -82.030 2 44.530 NANA 24.252 -82.030 2 45.470 NANA 24.252 -82.030 2 45.470 NANA 27.000 -84.300 2 0.000 NANA 27.000 -84.420 2 0.000 NANA 27.000 -84.420 2	3.462	-38.700	1	0.000	52	6.923
4.615 -55.800 1 0.000 39 9.231 5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 17.279 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 242.52 -82.030 2 45.470 NANA 242.52 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 90.000 -84.420 2	3.750	-44.400	1	0.000	48	7.500
5.455 -61.500 1 0.000 33 10.909 6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 139.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 90.000 -78.839 2 0.000 NANA 242.52 -82.030 2 45.470 NANA 242.52 -82.030 2 45.470 NANA 90.000 -78.839 2 0.000 NANA 135.748 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 90.000 -84.420 2 0.000 NANA 90.000 -84.420 2 0.000 <	4.186	-50.100	1	0.000	43	8.372
6.429 -67.200 1 0.000 28 12.857 8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 139.929 -78.250 2 14.215 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 242.52 -82.030 2 44.530 NANA 270.000 -78.839 2 0.000 NANA 242.52 -82.030 2 45.470 NANA 135.748 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 90.000 -84.300 2 0.000 NANA 90.000 -84.420 2 0.000 <td< td=""><td>4.615</td><td>-55.800</td><td>1</td><td>0.000</td><td>39</td><td>9.231</td></td<>	4.615	-55.800	1	0.000	39	9.231
8.182 -72.900 1 0.000 22 16.364 143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 166.071 -78.250 2 75.785 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 44.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 315.748 -82.030 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 90.000 -84.420 2 0.000 N	5.455	-61.500	1	0.000	33	10.909
143.441 -75.755 2 52.581 NANA 216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 44.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 0.000 -84.300 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 270.000 -84.420 2 0.000 NANA	6.429	-67.200	1	0.000	28	12.857
216.559 -75.755 2 37.419 NANA 36.559 -75.755 2 37.419 NANA 323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 63.279 NANA 242.721 -77.484 2 26.721 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 193.929 -78.250 2 75.785 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 44.252 -82.030 2 44.530 NANA 224.252 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 0.000 -84.300 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 270.000 -84.420 2 0.000 NANA	8.182	-72.900	1	0.000	22	16.364
36.559-75.755237.419NANA323.441-75.755252.581NANA62.721-77.484263.279NANA117.279-77.484226.721NANA242.721-77.484263.279NANA297.279-77.484226.721NANA13.929-78.250214.215NANA166.071-78.250275.785NANA193.929-78.250214.215NANA90.000-78.83920.000NANA270.000-78.83920.000NANA135.748-82.030244.530NANA315.748-82.030245.470NANA315.748-82.030245.470NANA3000-84.30020.000NANA90.000-84.30020.000NANA270.000-84.42020.000NANA	143.441	-75.755	2	52.581	NA	NA
323.441 -75.755 2 52.581 NANA 62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 63.279 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 166.071 -78.250 2 75.785 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 90.000 -78.839 2 0.000 NANA 44.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 90.000 -84.300 2 0.000 NANA 20.000 -84.300 2 0.000 NANA 270.000 -84.420 2 0.000 NANA	216.559	-75.755	2	37.419	NA	NA
62.721 -77.484 2 63.279 NANA 117.279 -77.484 2 26.721 NANA 242.721 -77.484 2 63.279 NANA 297.279 -77.484 2 26.721 NANA 13.929 -78.250 2 14.215 NANA 166.071 -78.250 2 75.785 NANA 193.929 -78.250 2 14.215 NANA 193.929 -78.250 2 14.215 NANA 90.000 -78.839 2 0.000 NANA 90.000 -78.839 2 0.000 NANA 270.000 -78.839 2 0.000 NANA 44.252 -82.030 2 45.470 NANA 224.252 -82.030 2 45.470 NANA 315.748 -82.030 2 45.470 NANA 315.748 -82.030 2 0.000 NANA 90.000 -84.300 2 0.000 NANA 90.000 -84.300 2 0.000 NANA 90.000 -84.420 2 0.000 NANA 90.000 -84.420 2 0.000 NANA	36.559	-75.755	2	37.419	NA	NA
117.279-77.484226.721NANA242.721-77.484263.279NANA297.279-77.484226.721NANA13.929-78.250214.215NANA166.071-78.250275.785NANA193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA135.748-82.030245.470NANA315.748-82.030245.470NANA315.748-82.03020.000NANA90.000-84.30020.000NANA270.000-84.42020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	323.441	-75.755	2	52.581	NA	NA
242.721-77.484263.279NANA297.279-77.484226.721NANA13.929-78.250214.215NANA166.071-78.250275.785NANA193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA135.748-82.030244.530NANA224.252-82.030245.470NANA315.748-82.030245.470NANA180.000-84.30020.000NANA270.000-84.42020.000NANA180.000-84.42020.000NANA270.000-84.42020.000NANA	62.721	-77.484	2	63.279	NA	NA
297.279-77.484226.721NANA13.929-78.250214.215NANA166.071-78.250275.785NANA193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA135.748-82.030244.530NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA270.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA180.000-84.42020.000NANA	117.279	-77.484	2	26.721	NA	NA
13.929-78.250214.215NANA166.071-78.250275.785NANA193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030245.470NANA315.748-82.030245.470NANA0.000-84.30020.000NANA90.000-84.30020.000NANA270.000-84.42020.000NANA270.000-84.42020.000NANA	242.721	-77.484	2	63.279	NA	NA
166.071-78.250275.785NANA193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030245.470NANA315.748-82.030245.470NANA0.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	297.279	-77.484	2	26.721	NA	NA
193.929-78.250214.215NANA346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030245.470NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	13.929	-78.250	2	14.215	NA	NA
346.071-78.250275.785NANA90.000-78.83920.000NANA270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	166.071	-78.250	2	75.785	NA	NA
90.000-78.83920.000NANA270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	193.929	-78.250	2	14.215	NA	NA
270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	346.071	-78.250	2	75.785	NA	NA
270.000-78.83920.000NANA44.252-82.030244.530NANA135.748-82.030245.470NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	90.000	-78.839	2	0.000	NA	NA
135.748-82.030245.470NANA224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	270.000	-78.839		0.000	NA	NA
224.252-82.030244.530NANA315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	44.252	-82.030	2	44.530	NA	NA
315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	135.748	-82.030	2			NA
315.748-82.030245.470NANA0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA	224.252	-82.030	2	44.530	NA	NA
0.000-84.30020.000NANA180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA			2			
180.000-84.30020.000NANA90.000-84.42020.000NANA270.000-84.42020.000NANA						
90.000-84.42020.000NANA270.000-84.42020.000NANA						
270.000 -84.420 2 0.000 NA NA						
		-90.000			NA	

Table 2: Spherical cap tile positions and rotation angles (East from North in deg). The type specifies whether this represents the starting tiling of a strip (1), or the cap (2).

Tile: 6 Degrees

The starting RA and Dec for the RA strips, and all spherical cap tiles.

$\begin{array}{c c c c c c c c c c c c c c c c c c c $						
3.158 24.000 1 0.000 57 6.316 3.103 18.000 1 0.000 58 6.207 3.000 12.000 1 0.000 60 6.000 3.000 6.000 1 0.000 60 6.000 3.000 -6.000 1 0.000 60 6.000 3.000 -6.000 1 0.000 60 6.000 3.000 -12.000 1 0.000 58 6.207 3.113 -18.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 43 8.372 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 216.529 -76.827 2 26.683 NANA 216.529 -76.827 2 26.683 NANA 216.529 -76.827 2 26.683 NANA 216.6841 -77.631 2 75.763 NANA 216.6841 -77.631 2 75.763 NANA 19	RA / deg	Dec / deg	Type	Ang-N2E / deg	N Strip	RA Offset / deg
3.103 18.000 1 0.000 58 6.207 3.000 12.000 1 0.000 60 6.000 3.000 0.000 1 0.000 60 6.000 3.000 -6.000 1 0.000 60 6.000 3.000 -12.000 1 0.000 60 6.000 3.103 -18.000 1 0.000 58 6.207 3.158 -24.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 22.9 -76.827 2 66.33 NANA $22.66.83$ NANANA 22.699 -76.827 2 66.33 NANA 133.919 -77.631 2 14.237 NANA 135.760 -81.610 2 44.548 NANA 24.240 -81.610 2 44.548 NANA 24.240	3.333	30.000	1	0.000	54	6.667
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3.158	24.000	1	0.000	57	6.316
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3.103	18.000	1	0.000	58	6.207
3.000 0.000 1 0.000 60 6.000 3.000 -6.000 1 0.000 60 6.000 3.000 -12.000 1 0.000 58 6.207 3.158 -24.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -75.005 2 37.484 NANA 126.529 -75.005 2 37.484 NANA 226.699 -76.827 2 26.683 NANA 226.99 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NA </td <td>3.000</td> <td>12.000</td> <td>1</td> <td>0.000</td> <td>60</td> <td>6.000</td>	3.000	12.000	1	0.000	60	6.000
3.000 -6.000 1 0.000 60 6.000 3.000 -12.000 1 0.000 58 6.207 3.103 -18.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 38 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 226.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 75.763 NANA 14.240 -81.610 2 45.452 NANA 14.240 -81.610 2 45.452 NANA 14.240 <t< td=""><td>3.000</td><td>6.000</td><td>1</td><td>0.000</td><td>60</td><td>6.000</td></t<>	3.000	6.000	1	0.000	60	6.000
3.000 -12.000 1 0.000 60 6.000 3.103 -18.000 1 0.000 58 6.207 3.158 -24.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 226.683 NANANA 226.683 NANANA $227.97.631$ 2 26.683 NANA 227.99 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 75.763 NANA 13.919 -77.631 2 75.763 NANA 14.240 -81.610 2 45.452 NANA 2	3.000	0.000	1	0.000	60	6.000
3.103 -18.000 1 0.000 58 6.207 3.158 -24.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 126.529 -75.005 2 37.484 NANA 232.471 -75.005 2 52.516 NANA 232.471 -75.005 2 52.516 NANA 216.529 -76.827 2 26.683 NANA 217.301 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 242.609 -76.827 2 26.683 <t< td=""><td>3.000</td><td>-6.000</td><td>1</td><td>0.000</td><td>60</td><td>6.000</td></t<>	3.000	-6.000	1	0.000	60	6.000
3.158 -24.000 1 0.000 57 6.316 3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.001 1 0.000 33 10.909 6.429 -66.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 226.699 -76.827 2 63.317 NANA 226.99 -76.827 2 26.683 NANA 226.99 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 24.240 -81.610 2 44.548 NANA 346.081 -77.631 </td <td>3.000</td> <td>-12.000</td> <td>1</td> <td>0.000</td> <td>60</td> <td>6.000</td>	3.000	-12.000	1	0.000	60	6.000
3.333 -30.000 1 0.000 54 6.667 3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 226.699 -76.827 2 63.317 NANA 22.699 -76.827 2 26.683 NANA 22.699 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 22.4240 -81.610 2 44.548 NANA 346.081 -77.631 <	3.103	-18.000	1	0.000	58	6.207
3.529 -36.000 1 0.000 51 7.059 3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 52.516 NANA 216.529 -76.827 2 26.683 NANA 217.301 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 136.081 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 24.240 -81.610 2 45.452 NANA 24.240 -81.610 2 45.452 NANA 24.240 -81.610 <td>3.158</td> <td>-24.000</td> <td>1</td> <td>0.000</td> <td>57</td> <td>6.316</td>	3.158	-24.000	1	0.000	57	6.316
3.830 -42.000 1 0.000 47 7.660 4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 242.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 136.081 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 24.240 -81.610 2 44.548 NANA 24.240 -81.610 2 45.452 NANA 24.240 -81.610 2 45.452 NANA 24.240 -81.610 2	3.333	-30.000	1	0.000	54	6.667
4.186 -48.000 1 0.000 43 8.372 4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 223.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 227.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 224.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA 90.000 -84.125 2 <td< td=""><td>3.529</td><td>-36.000</td><td>1</td><td>0.000</td><td>51</td><td>7.059</td></td<>	3.529	-36.000	1	0.000	51	7.059
4.737 -54.000 1 0.000 38 9.474 5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 223.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 62.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 139.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 224.240 -81.610 2 44.548 NANA 315.760 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.610 2 <td< td=""><td>3.830</td><td>-42.000</td><td>1</td><td>0.000</td><td>47</td><td>7.660</td></td<>	3.830	-42.000	1	0.000	47	7.660
5.455 -60.000 1 0.000 33 10.909 6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 62.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.00	4.186	-48.000	1	0.000	43	8.372
6.429 -66.000 1 0.000 28 12.857 8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 62.699 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA	4.737	-54.000	1	0.000	38	9.474
8.182 -72.000 1 0.000 22 16.364 36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 242.40 -81.610 2 44.548 NANA 90.000 -78.251 2 0.000 NANA 242.40 -81.610 2 45.452 NANA 90.000 -78.251 2 0.000 NANA 242.40 -81.610 2 45.452 NANA 135.760 -81.610 2 45.452 NANA 135.760 -81.610 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NA <td>5.455</td> <td>-60.000</td> <td>1</td> <td>0.000</td> <td>33</td> <td>10.909</td>	5.455	-60.000	1	0.000	33	10.909
36.529 -75.005 2 37.484 NANA 143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 166.081 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 135.760 -81.610 2 45.452 NANA 224.240 -81.610 2 45.452 NANA 135.760 -81.610 2 45.452 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA 20.000 NANANA 30.000 -84.125 2 0.000 <td>6.429</td> <td>-66.000</td> <td>1</td> <td>0.000</td> <td>28</td> <td>12.857</td>	6.429	-66.000	1	0.000	28	12.857
143.471 -75.005 2 52.516 NANA 216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 66.3317 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	8.182	-72.000	1	0.000	22	16.364
216.529 -75.005 2 37.484 NANA 323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 63.317 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 13.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 346.081 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 24.240 -81.610 2 45.452 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	36.529	-75.005	2	37.484	NA	NA
323.471 -75.005 2 52.516 NANA 62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 63.317 NANA 242.699 -76.827 2 26.683 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 166.081 -77.631 2 75.763 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	143.471	-75.005	2	52.516	NA	NA
62.699 -76.827 2 63.317 NANA 117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 63.317 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 166.081 -77.631 2 14.237 NANA 193.919 -77.631 2 14.237 NANA 90.000 -78.251 2 0.000 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 224.240 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 224.240 -81.610 2 45.452 NANA 270.000 -84.000 2 0.000 NANA 270.000 -84.125 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	216.529	-75.005	2	37.484	NA	NA
117.301 -76.827 2 26.683 NANA 242.699 -76.827 2 63.317 NANA 297.301 -76.827 2 26.683 NANA 13.919 -77.631 2 14.237 NANA 166.081 -77.631 2 75.763 NANA 193.919 -77.631 2 14.237 NANA 346.081 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 135.760 -81.610 2 45.452 NANA 315.760 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	323.471	-75.005	2	52.516	NA	NA
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	62.699	-76.827	2	63.317	NA	NA
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	117.301	-76.827	2	26.683	NA	NA
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	242.699	-76.827	2	63.317	NA	NA
166.081 -77.631 2 75.763 NANA 193.919 -77.631 2 14.237 NANA 346.081 -77.631 2 75.763 NANA 90.000 -78.251 2 0.000 NANA 90.000 -78.251 2 0.000 NANA 270.000 -78.251 2 0.000 NANA 44.240 -81.610 2 44.548 NANA 135.760 -81.610 2 45.452 NANA 224.240 -81.610 2 45.452 NANA 0.000 -84.000 2 0.000 NANA 90.000 -84.000 2 0.000 NANA 90.000 -84.125 2 0.000 NANA 270.000 -84.125 2 0.000 NANA	297.301	-76.827	2	26.683	NA	NA
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	13.919	-77.631		14.237	NA	NA
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	166.081	-77.631	2	75.763	NA	NA
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	193.919	-77.631	2	14.237	NA	NA
270.000-78.25120.000NANA44.240-81.610244.548NANA135.760-81.610245.452NANA224.240-81.610244.548NANA315.760-81.610245.452NANA0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	346.081	-77.631	2	75.763	NA	NA
44.240-81.610244.548NANA135.760-81.610245.452NANA224.240-81.610244.548NANA315.760-81.610245.452NANA0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	90.000	-78.251		0.000	NA	NA
135.760-81.610245.452NANA224.240-81.610244.548NANA315.760-81.610245.452NANA0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	270.000	-78.251	2	0.000	NA	NA
224.240-81.610244.548NANA315.760-81.610245.452NANA0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	44.240	-81.610	2	44.548	NA	NA
315.760-81.610245.452NANA0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	135.760	-81.610		45.452	NA	NA
0.000-84.00020.000NANA180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	224.240	-81.610		44.548	NA	
180.000-84.00020.000NANA90.000-84.12520.000NANA270.000-84.12520.000NANA	315.760	-81.610		45.452	NA	NA
90.000-84.12520.000NANA270.000-84.12520.000NANA	0.000	-84.000		0.000	NA	NA
270.000 -84.125 2 0.000 NA NA	180.000	-84.000		0.000		
	90.000	-84.125	2	0.000	NA	NA
0.000 -90.000 2 0.000 NA NA	270.000	-84.125		0.000	NA	
	0.000	-90.000	2	0.000	NA	NA

Table 3: Spherical cap tile positions and rotation angles (East from North in deg). The type specifies whether this represents the starting tiling of a strip (1), or the cap (2).