1 Appendix A: Figures

1.1 Q1.1.1 Figures

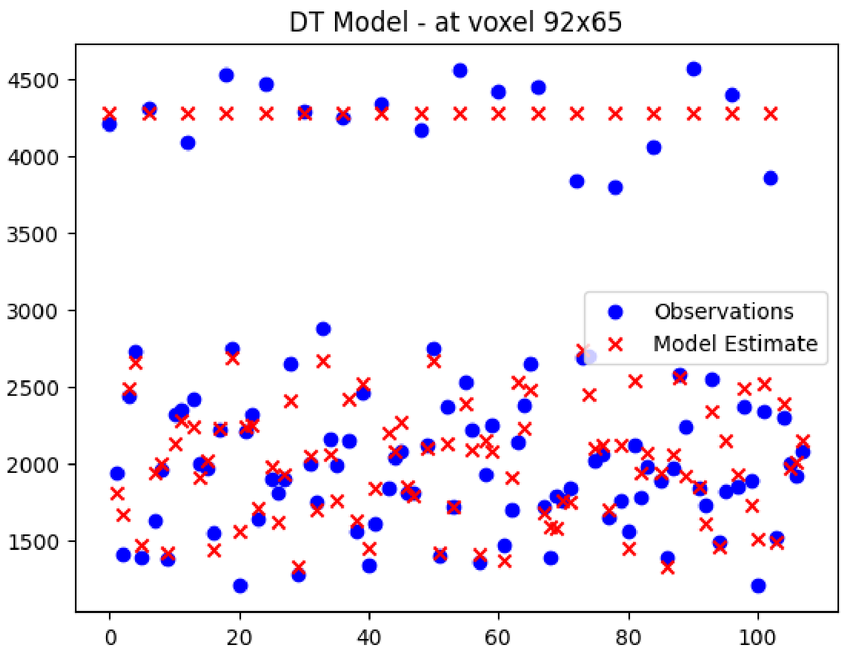

Figure 1 DT model calculated signals at voxel 92x65 vs observed signals. Using found parameter **x** using Weighted Least Squares

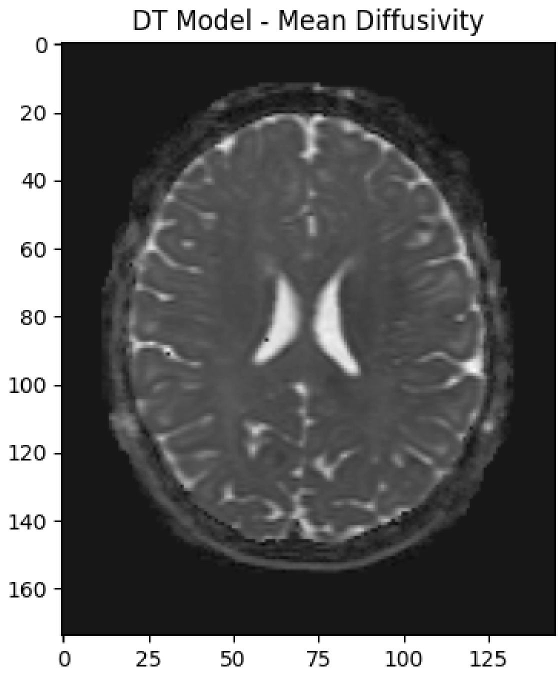

Figure 2 Estimated mean diffusivity across slice 72 using DT Model

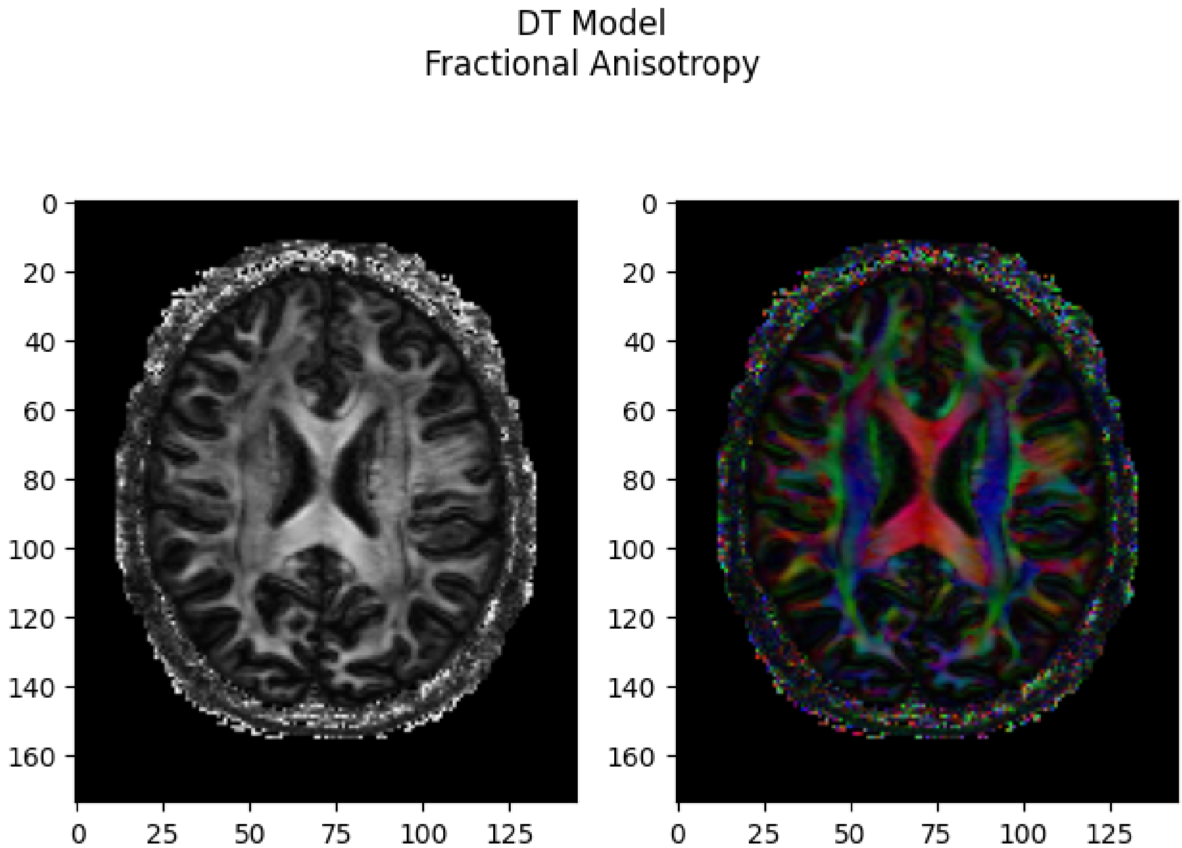

Figure 3 left: Fractional Anisotropy (FA) mapped across image slice 72. right: FA values weighted with normalised eigenvalues. Red: left-right, Green: front-back, Blue: top-bottom

1.2 Q1.1.2 Figures

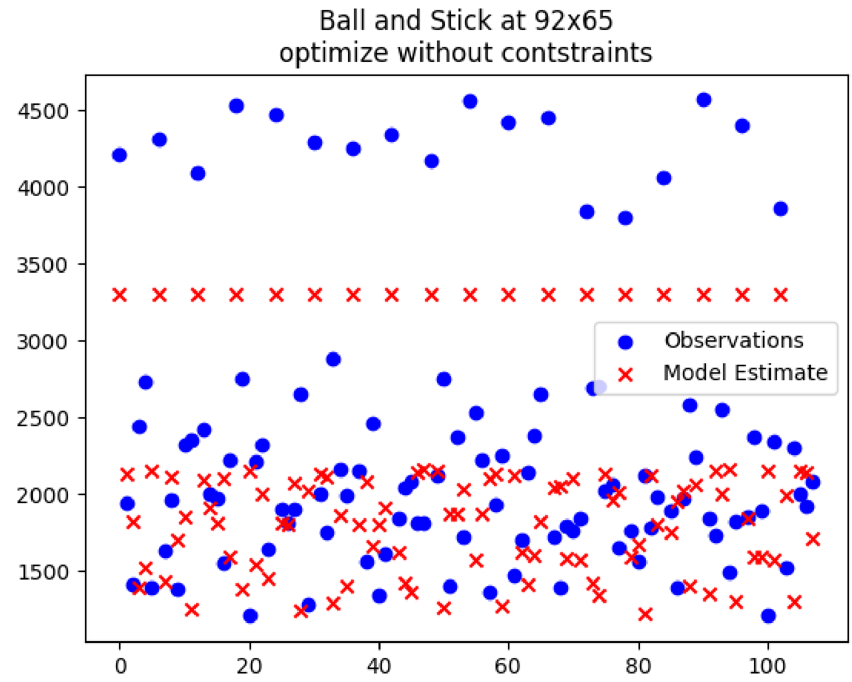

Figure 4 Ball and Stick model calculated signals using the failed found fitted parameter vs observed signals. The model doesn't fit the observed data very well

1.3 Q1.1.3 Figures

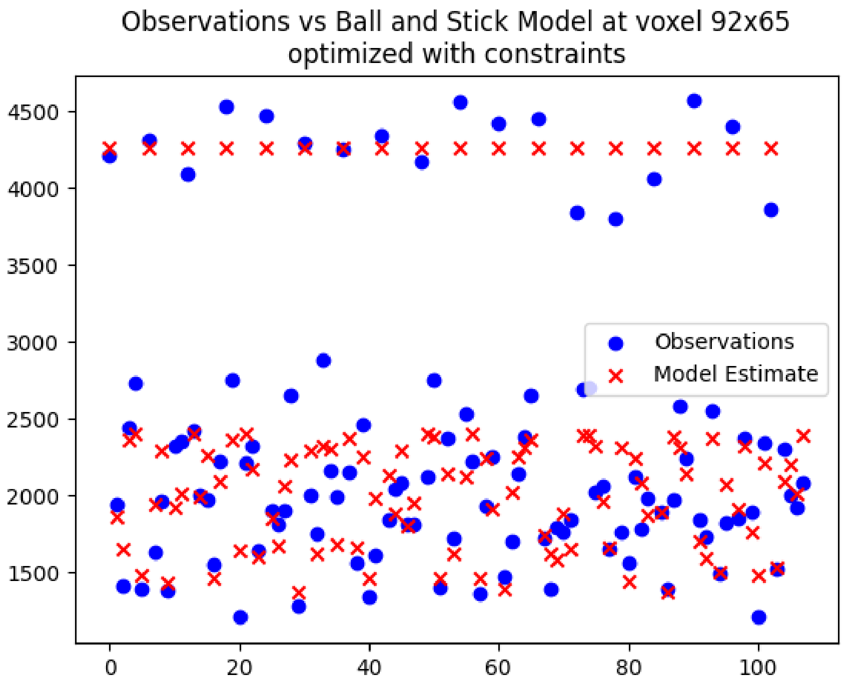

Figure 5 Ball and Stick model calculated signals using the fitted parameter vs observed signals using the Transformation Constraint optimise method. The model fits the observed data much better than the previous figure

1.4 Q1.1.4 Figures

Voxel Location	Ratio of runs finding global min	N
92x65	0.82	2
61x61	0.99	1
56x56	1.00	1
81x61	0.81	2
86x56	0.28	10
86x56	0.34	8
71x71	0.99	1

Table 1: Ball & Stick Model - Transform Constrain Method run 100 times on a number of different voxels across image slice 72. The ratio of the number of times the smallest RESNORM was found, is in the second column, and the number of runs required to have a 95% probability of finding the global minimum in the last column

1.5 Q1.1.5 Figures

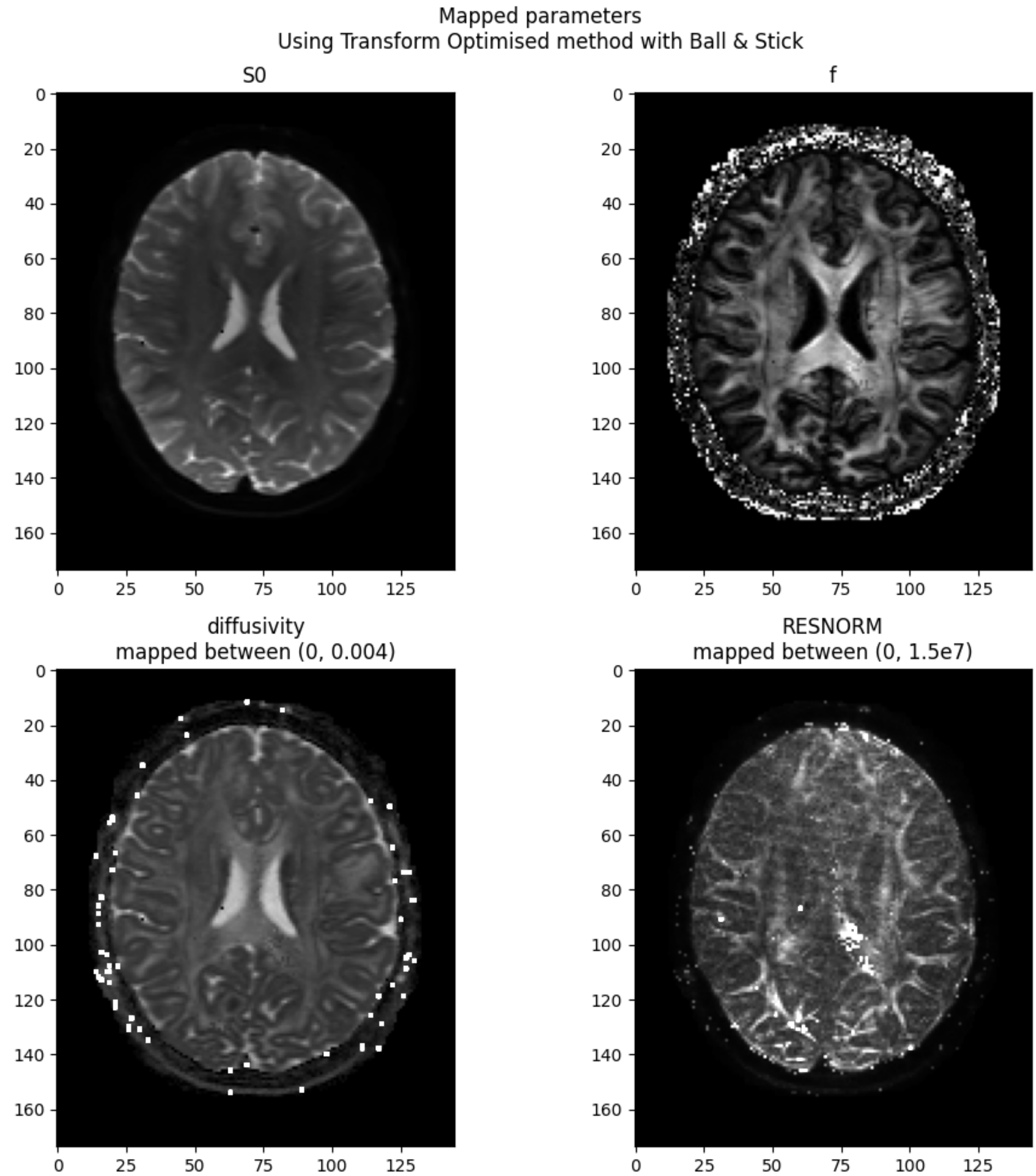

Figure 6 Ball and Stick model optimised across the whole image using the transform constrain optimize method. Note: Diffusivity and RESNORM maps have been mapped to a maximium domain. This is because there are outliers in their results which show as bright spots in the Figure.

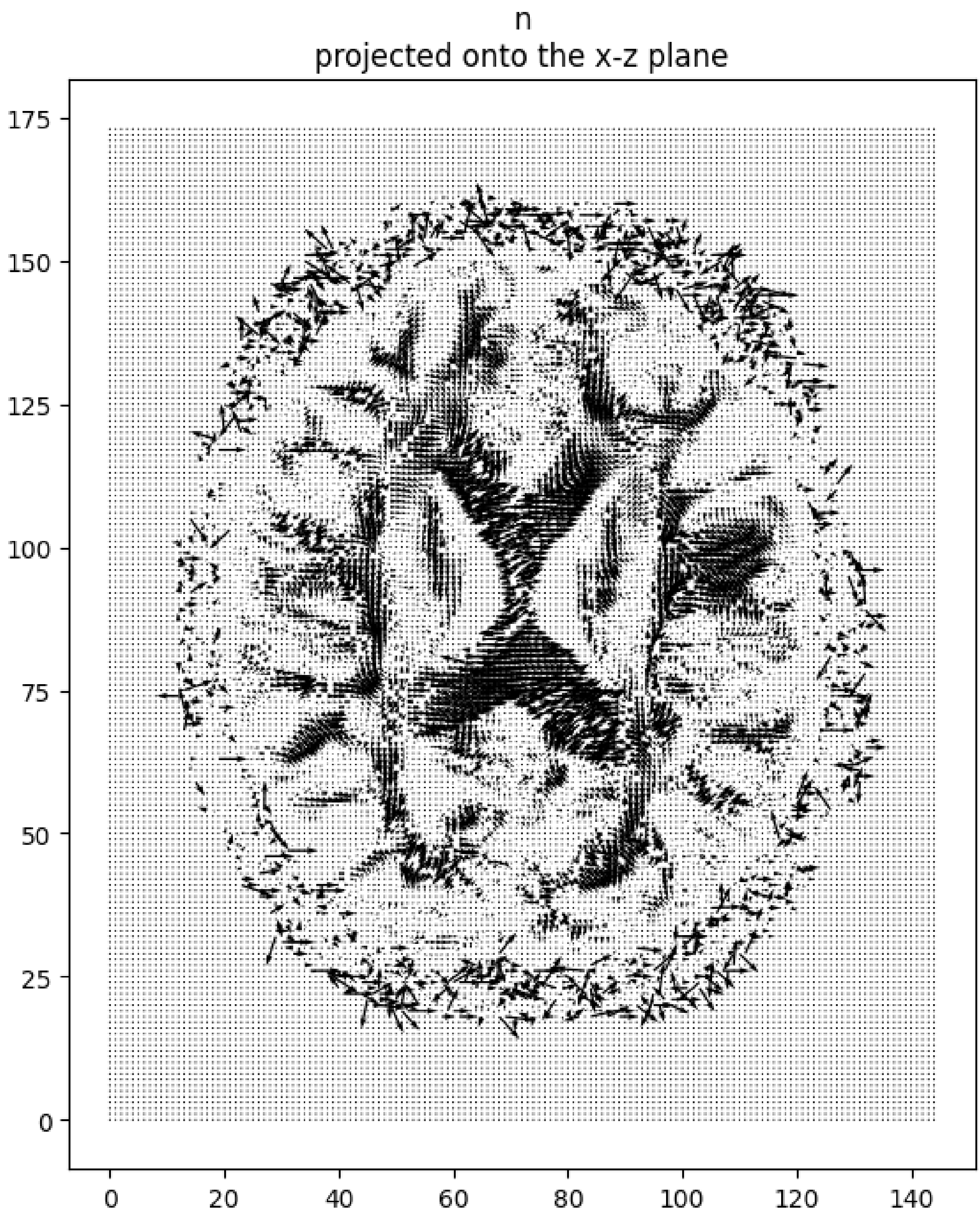

Figure 7 Ball and Stick model optimised across the whole image using the transform constrain optimize method. Note: Diffusivity and RESNORM maps have been mapped to a maximium domain. This is because there are outliers in their results which show as bright spots in the Figure.

1.6 Q1.2.1 Figures

Parameter	Bootstrap Mean	95% range	2σ range
$S(0,0)$	2513	(2304, 2849)	(2241, 2784)
$diff$	2.17e-4	(5.67e-17, 3.97e-4)	(2.55e-5, 4.09e-4)
f	0.928	(0.463, 1)	(0.581, 1.27)

Table 2: Ball & Stick Model - Bootstrap mean fitted parameter on the Voxel 92x65, 95% range and 2σ range.

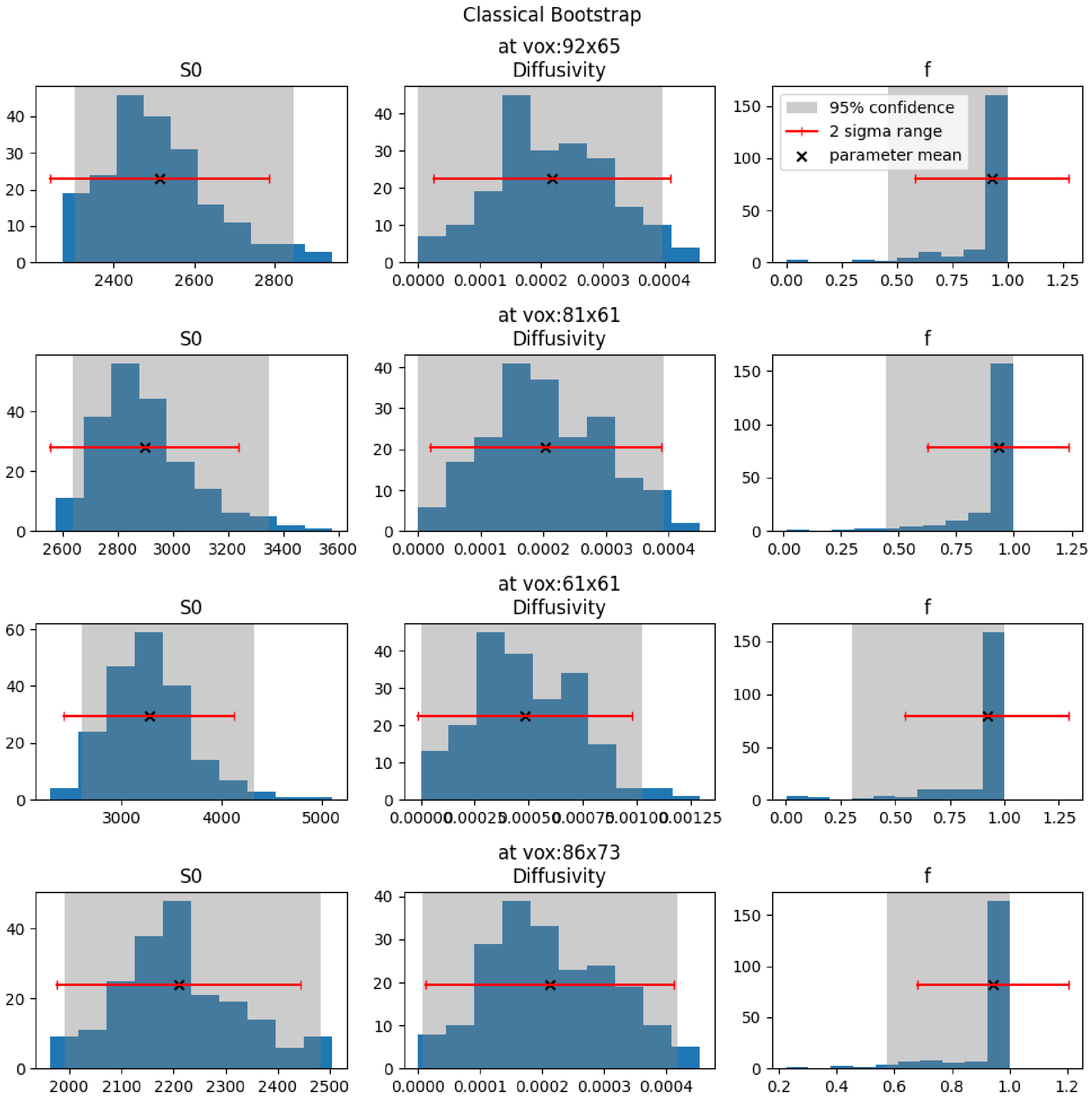

Figure 8 Ball & Stick Model using Classical Bootstrap on the signal dataset. Bootstrap was used 200 times to get a sample of 200 fitted parameters for each voxel. Each row of figures is showing the sampled parameters for a single voxel, and in each row we see the distribution for each parameter. The grey region shows where 95% of the distribution is, and the red bar shows the 2 σ range on the distribution.

1.7 Q1.2.2 Figures

Parameter	MCMC Mean	95% range	2σ range
$S(0,0)$	4256	(4163, 4344)	(4164, 4348)
$diff$	1.14e-3	(1.08e-3, 1.20e-3)	(1.08e-3, 1.20e-3)
f	0.357	(0.322, 0.392)	(0.321, 0.393)

Table 3: Ball & Stick Model - MCMC mean fitted parameter on the Voxel 92x65, 95% range and 2σ range.

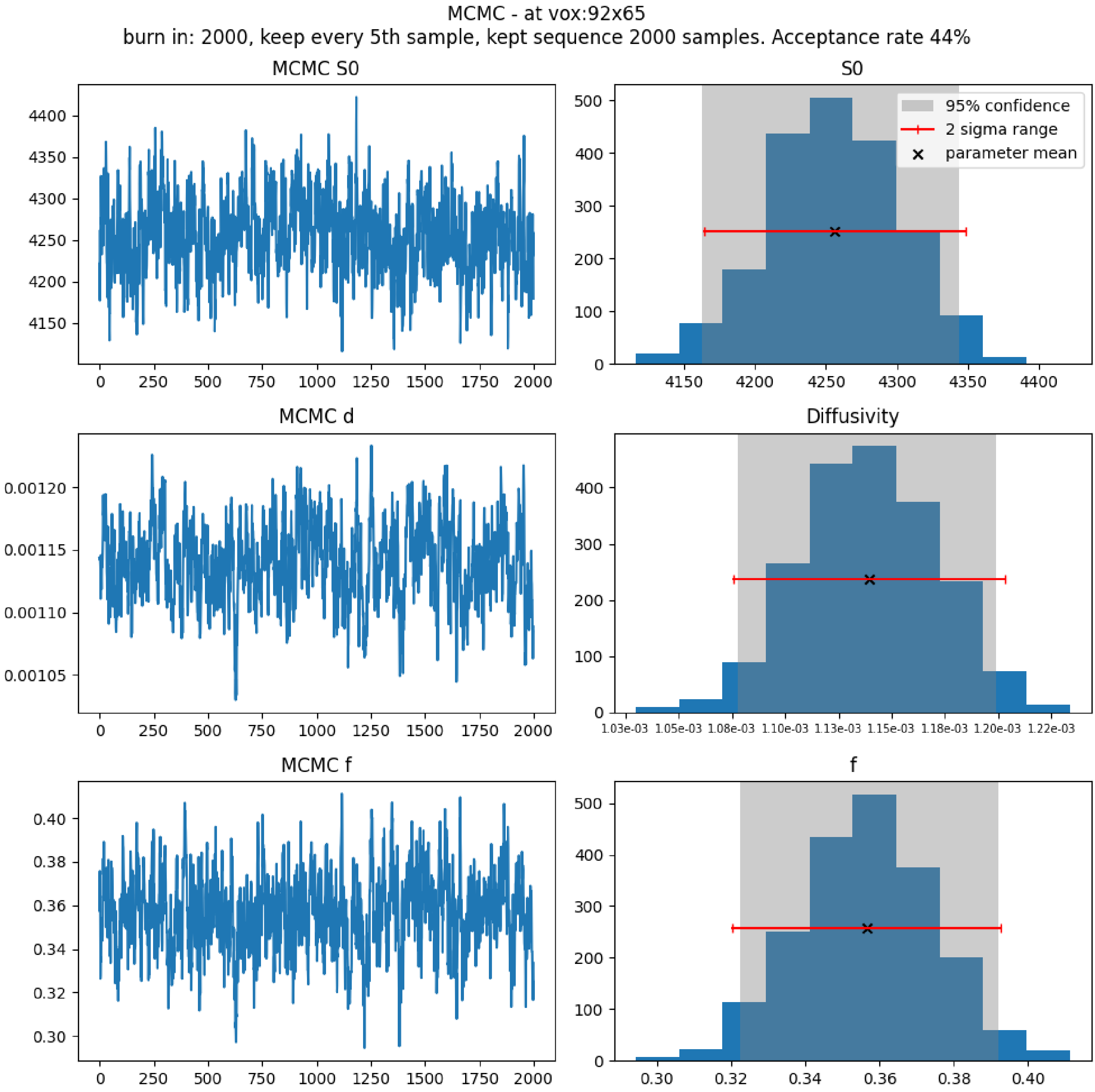

Figure 9 Ball and Stick model optimised across the whole image using MCMC. This is performed on voxel 92x65. Left figures show the sampled parameter from each MCMC step, and the right figures show the final distribution. Grey region shows where 95% of the distribution is in, and the red line shows the 2σ region. Note that these two regions align giving evidence that the distributions are Gaussian.

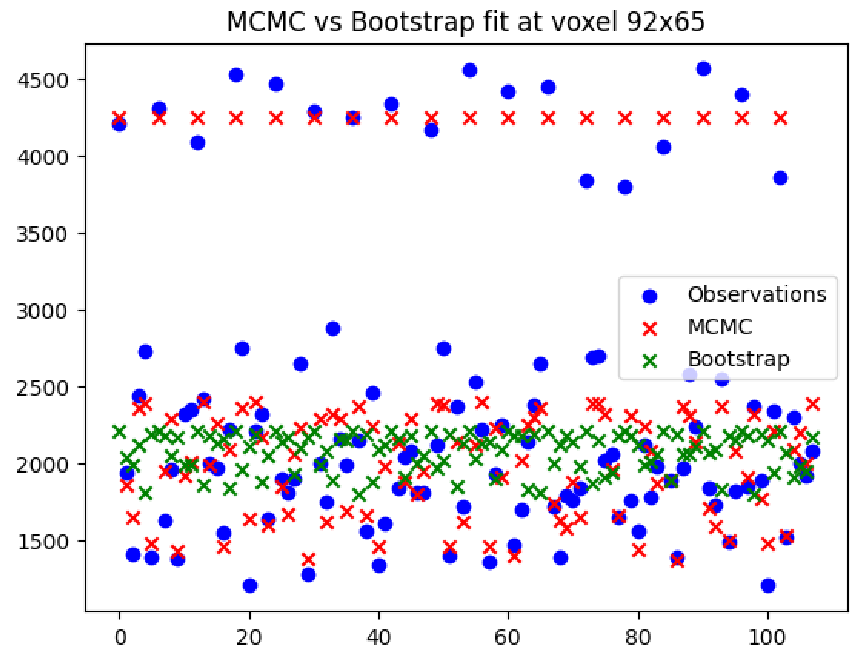

Figure 10 Fitted model using MCMC and Bootstrap are plotted against the true signals. This is calculated on voxel 92x65. We can see MCMC captures the less common signal with $b = 0$ whereas Bootstrap doesn't beacause there will be sampled datasets that don't capture many of these signals.

1.8 Q1.3.1 + Q1.3.2 Figures

Voxel Number	Ratio of runs finding global min	N	min RESNORM
1	0.09	32	15
2	0.06	49	17
3	0.10	29	20
4	0.10	29	22
5	0.05	59	19
6	0.05	59	17

Table 4: Ball & Stick Model - Transform Constrain Method run 100 times on all 6 voxels in larger data set. Using the same starting point for all voxels and same constraints as in Q1.1.3

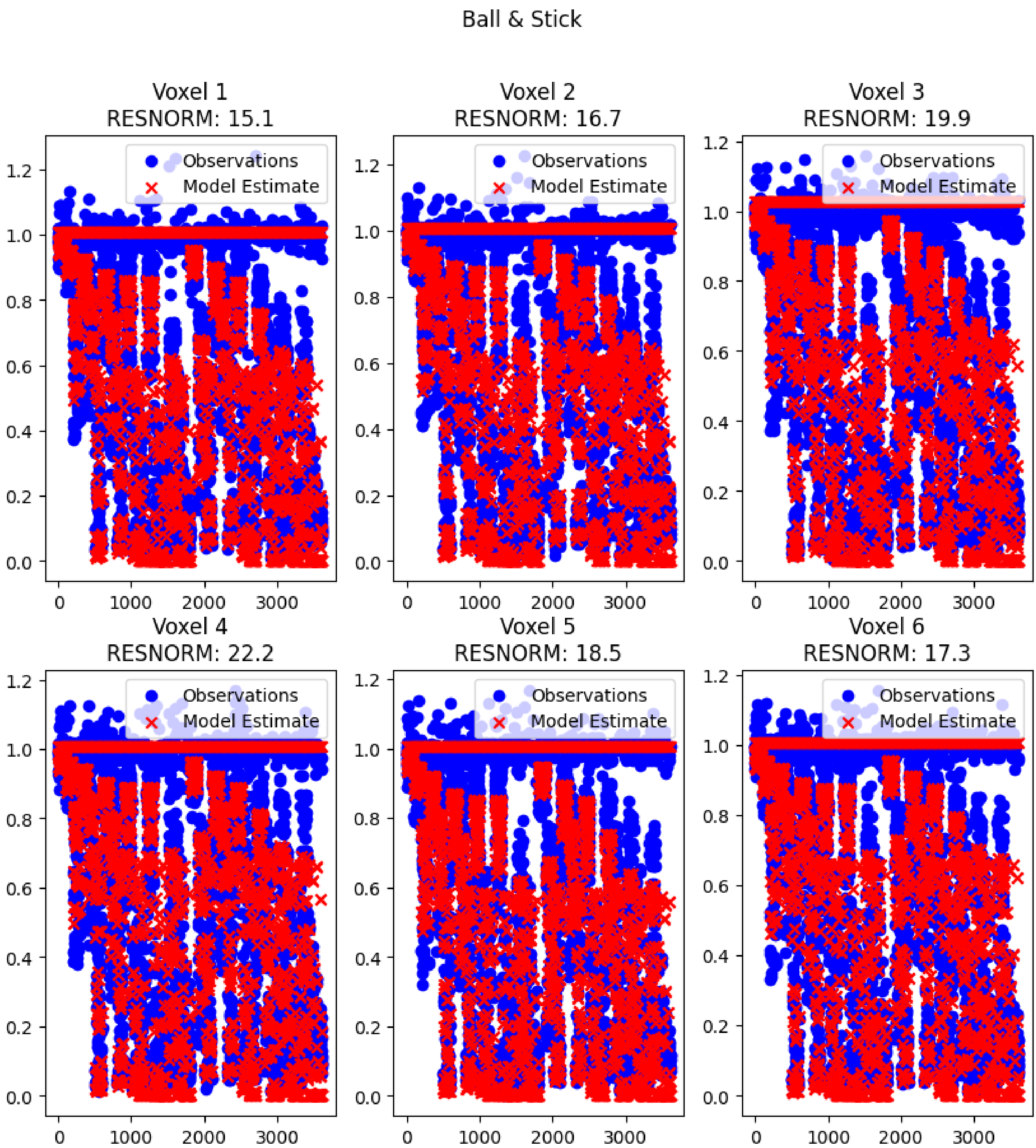

Figure 11 Ball & Stick Model - Fitting on the larger data set using Transform Constrain Optimise method

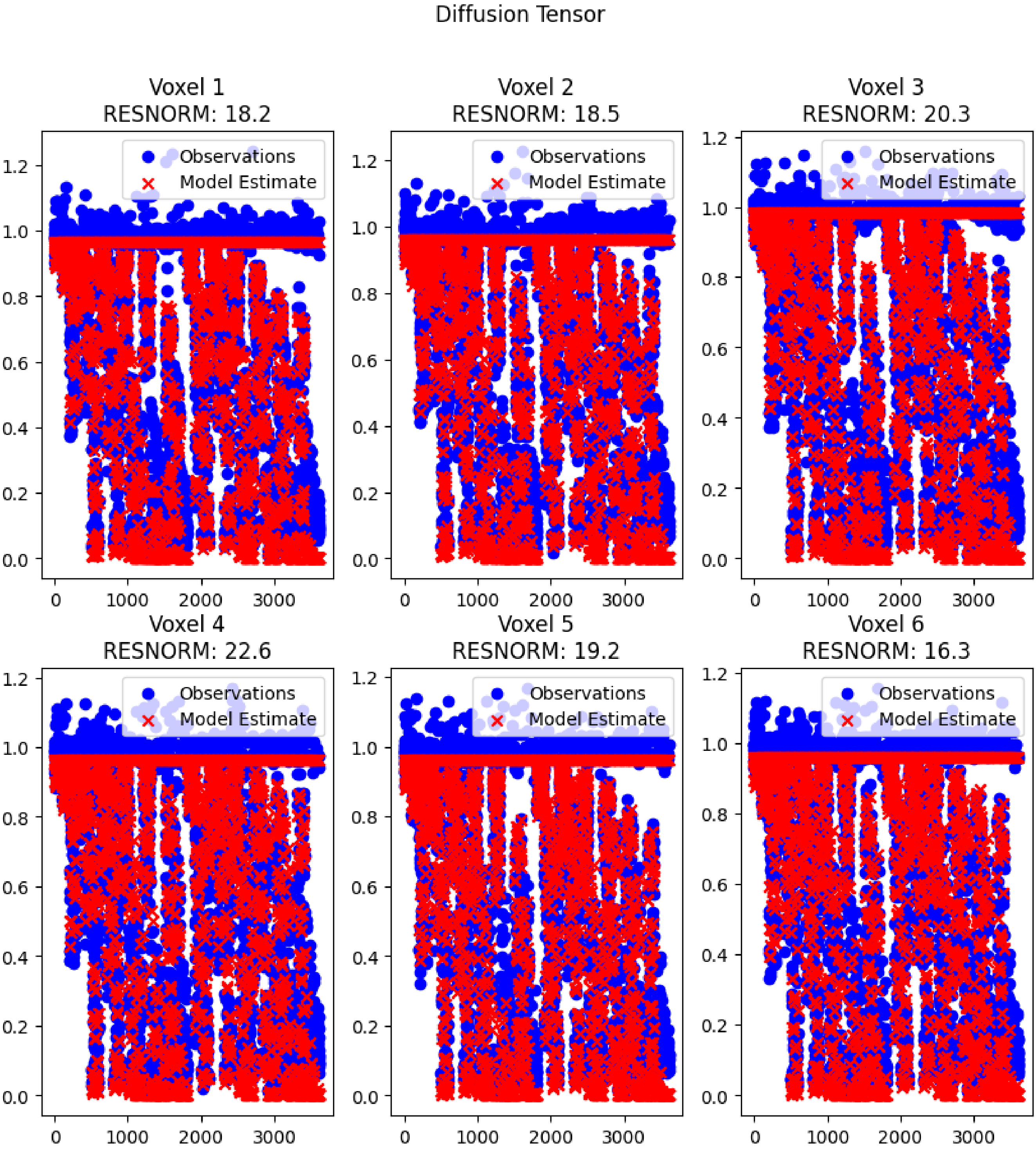

Figure 12 Diffusion Tensor Model - Fitting on the larger data set using Transform Constrain Optimise method

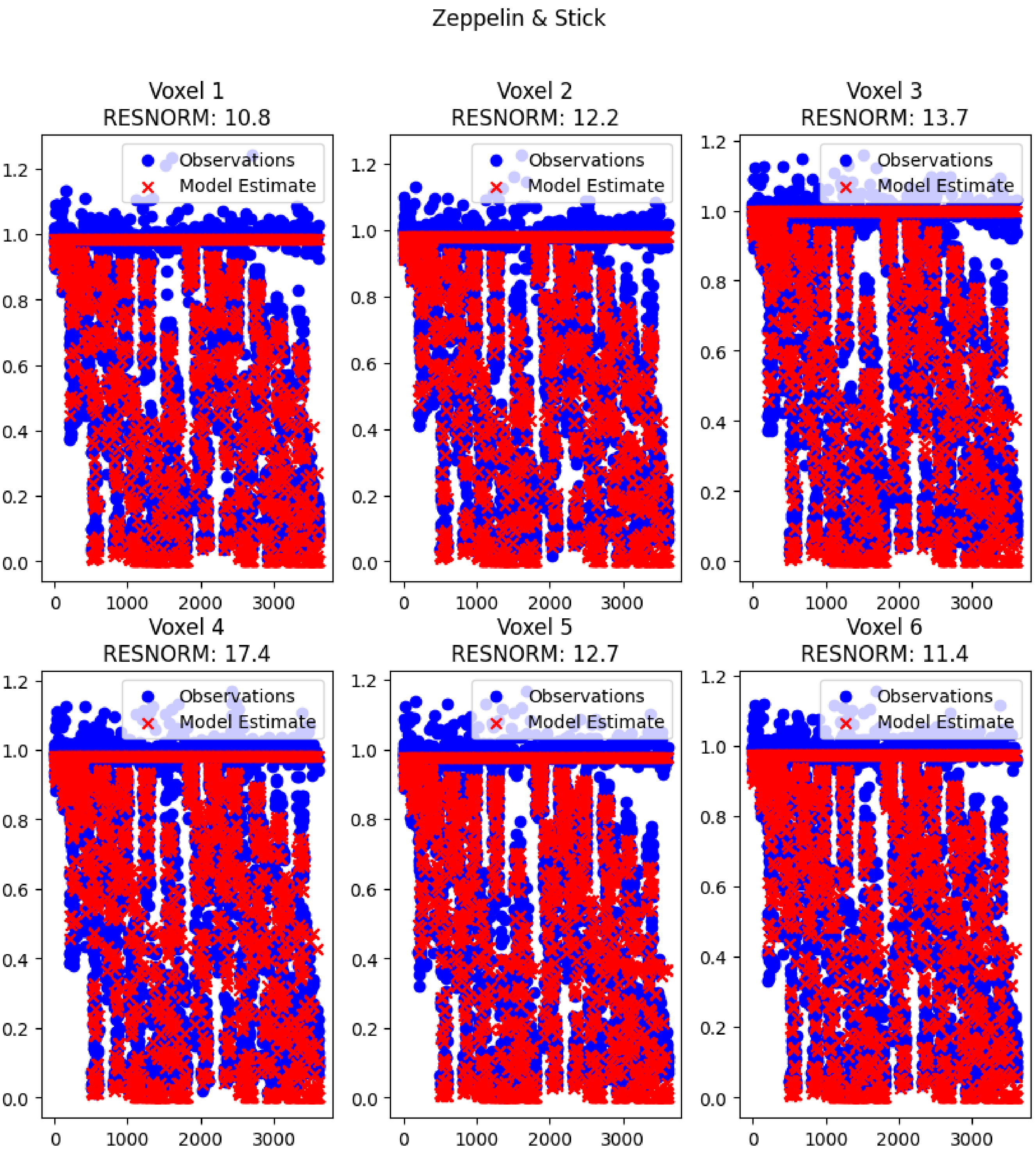

Figure 13 Zeppelin & Stick Model - Fitting on the larger data set using Transform Constrain Optimise method

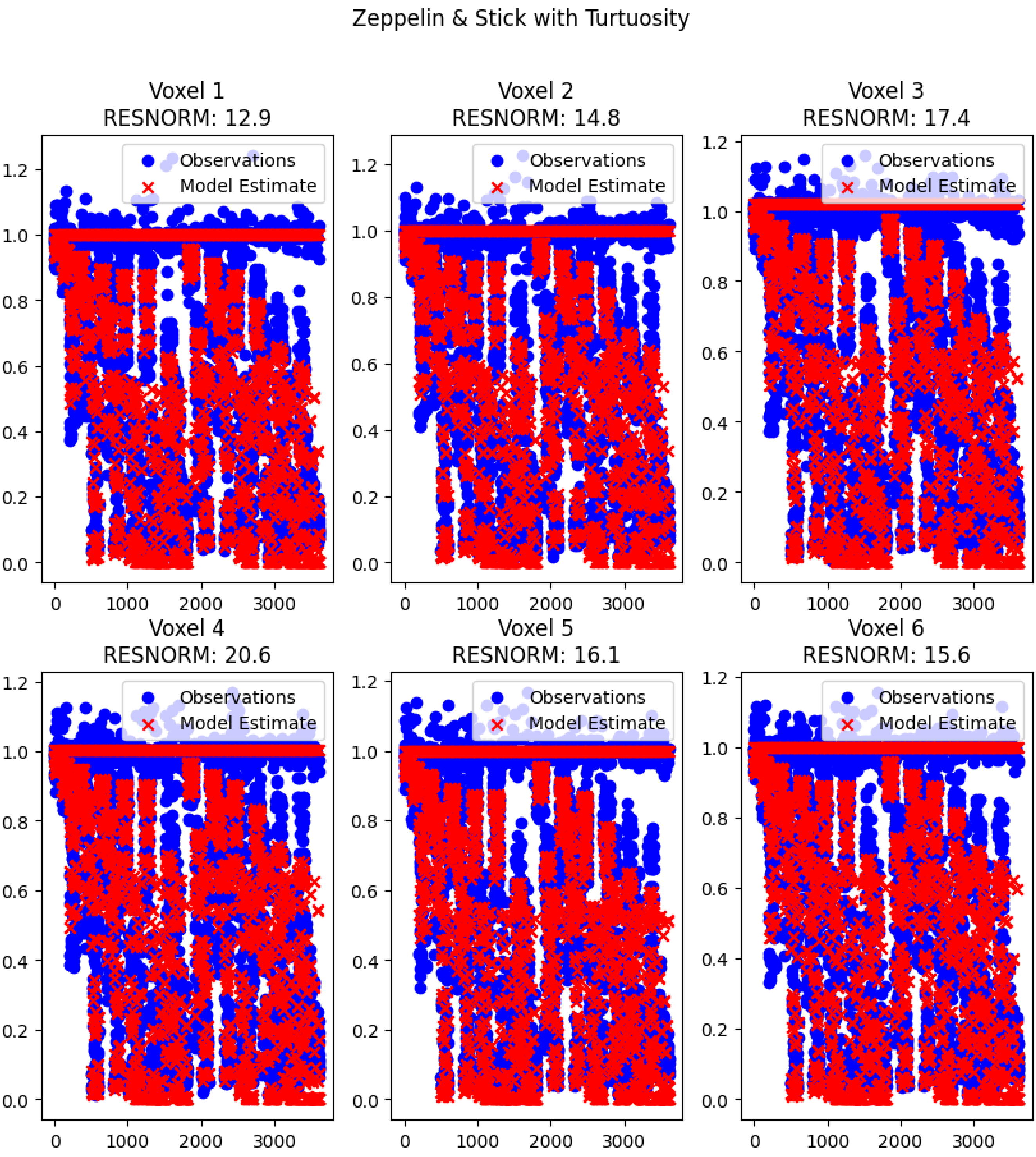

Figure 14 Zeppelin & Stick with Turtuosity - Fitting on the larger data set using Transform Constrain Optimise method

1.9 Q1.3.3 Figures

Model	Ranking: Voxel 1	Voxel 2	Voxel 3	Voxel 4	Voxel 5	Voxel 6
Ball & Stick	2	3	2	3	2	3
Diffusion Tensor	4	4	3	4	3	2
Zeppelin & Stick	1	1	1	1	1	1
Zeppelin with Turt.	3	2	4	2	4	4

Table 5: AIC and BIC rankings (they are the same) for each of the six voxels in the larger data set. Notice that Zepplin & Stick is always ranked first, but otherwise the other rankings change with each voxel