

MATH-541B: PCA Assignment

Saket Choudhary
2170058637

Mean Patch Photo Images

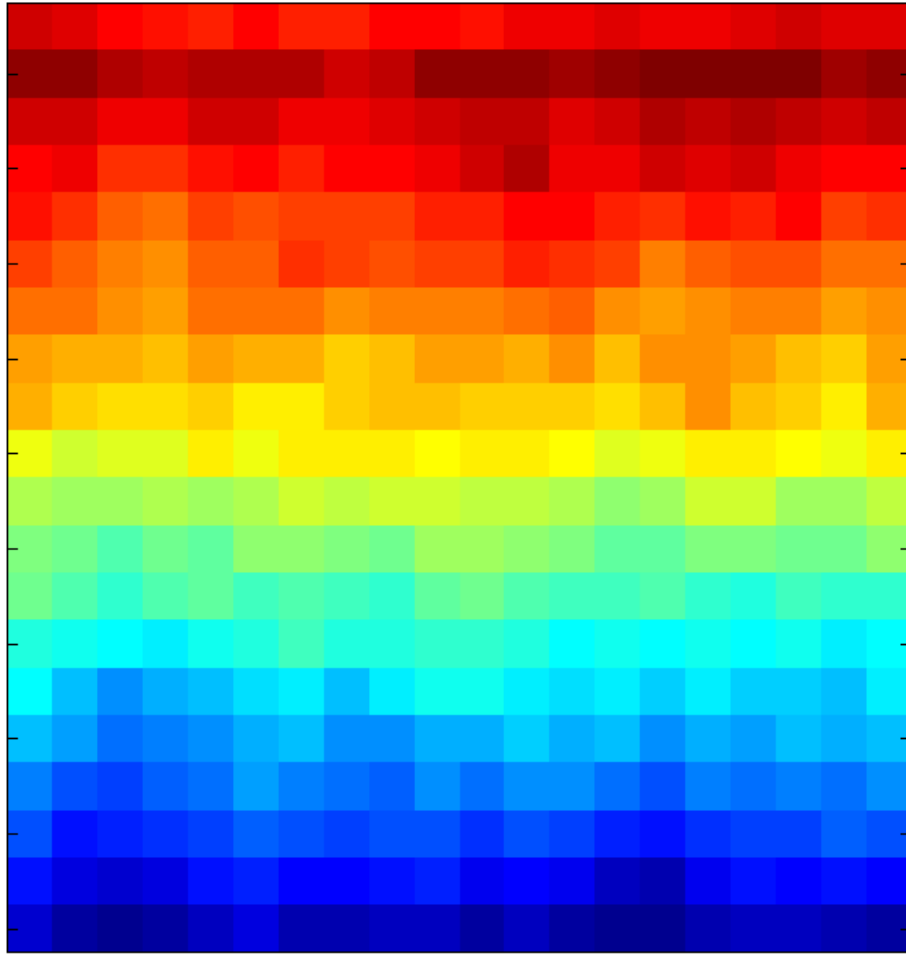


Figure 1: Mean Patch for Photo Images

1 Part a

1.1 Photo Image

General feature of Photo Image: Band of colors with gradual descent(colors merge into one another), indicating image has less features(less variance) overall.

1.2 VTEC Image

General features of VTEC Image: Band of colors which form a steep gradient(different colors do not merge into one another), indicating that the image has more features (the total variance is high)

Mean Patch VTEC Images

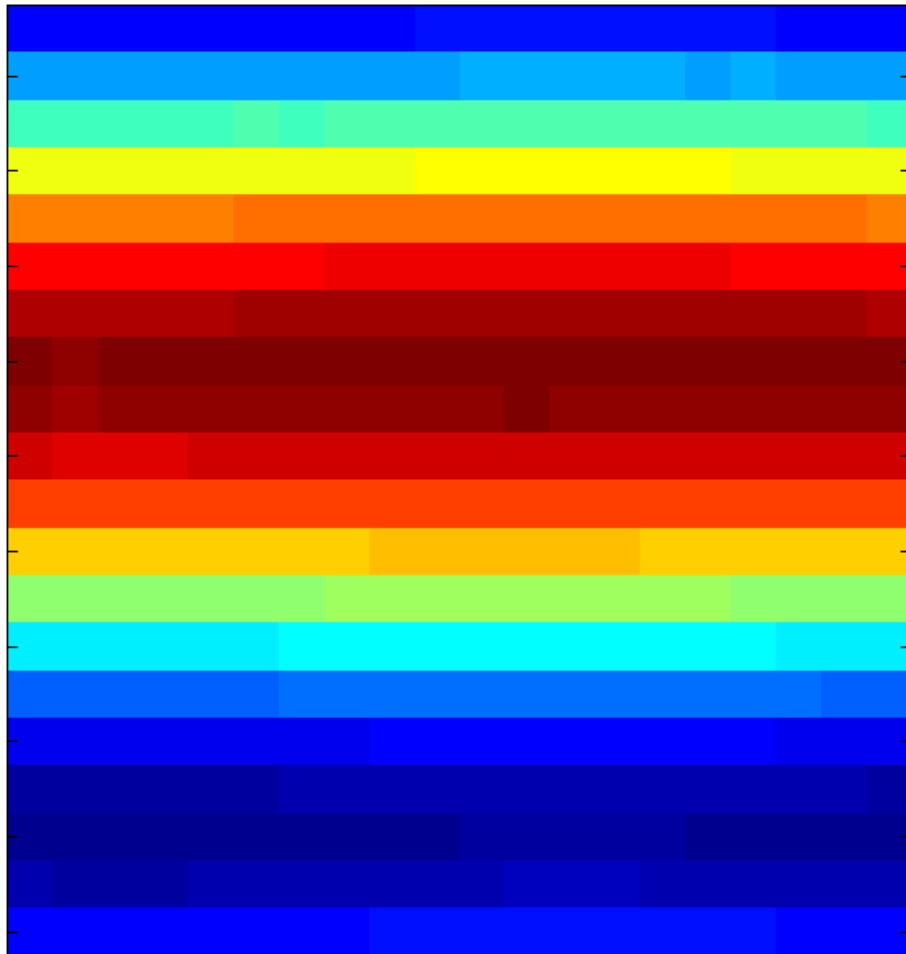


Figure 2: Mean Patch for VTEC Images

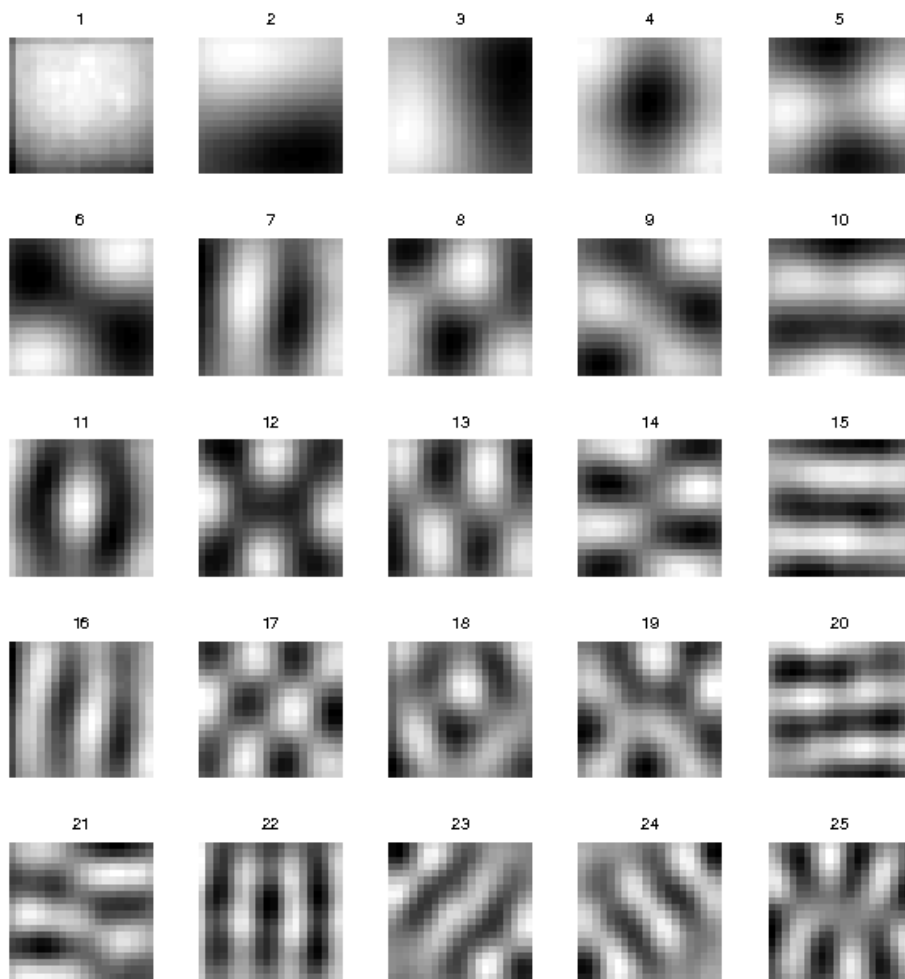


Figure 3: First 25 eigen vectors of Photo Image. The images exhibit high variance

2 Part b

2.1 Photo Image

2.2 VTEC Image

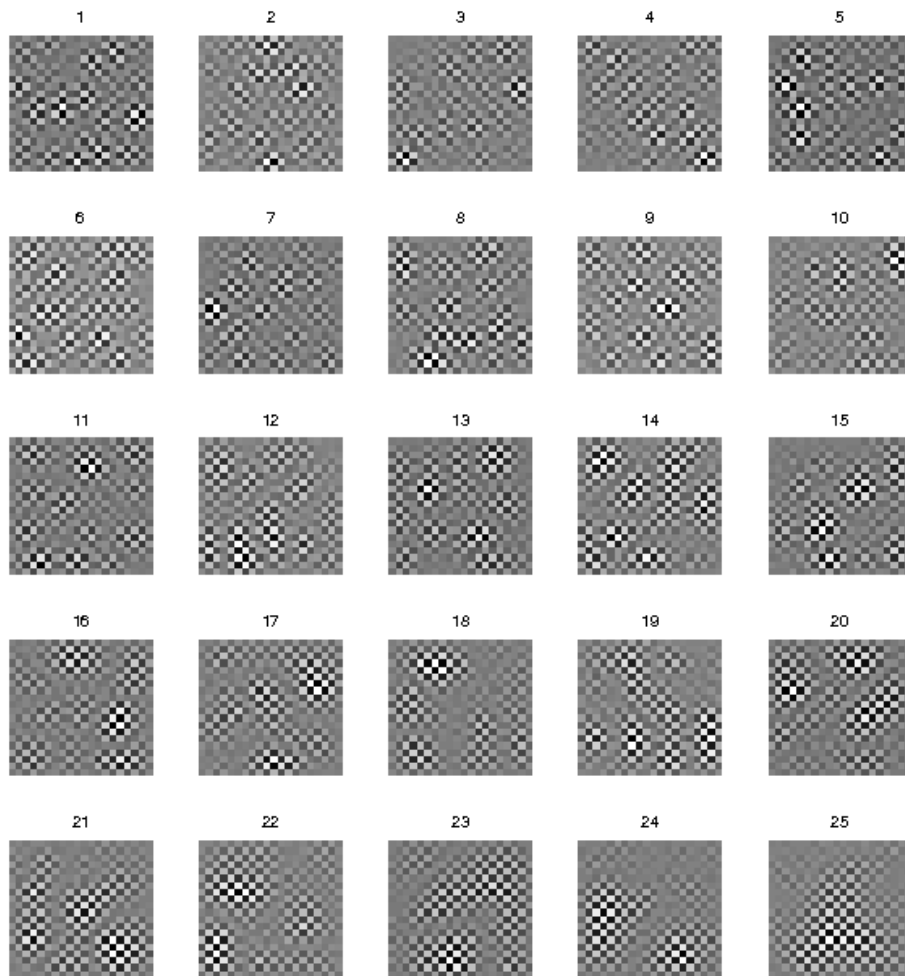


Figure 4: Last 25 eigen vectors of Photo Image. Images exhibit low variance and hence are indistinguishable

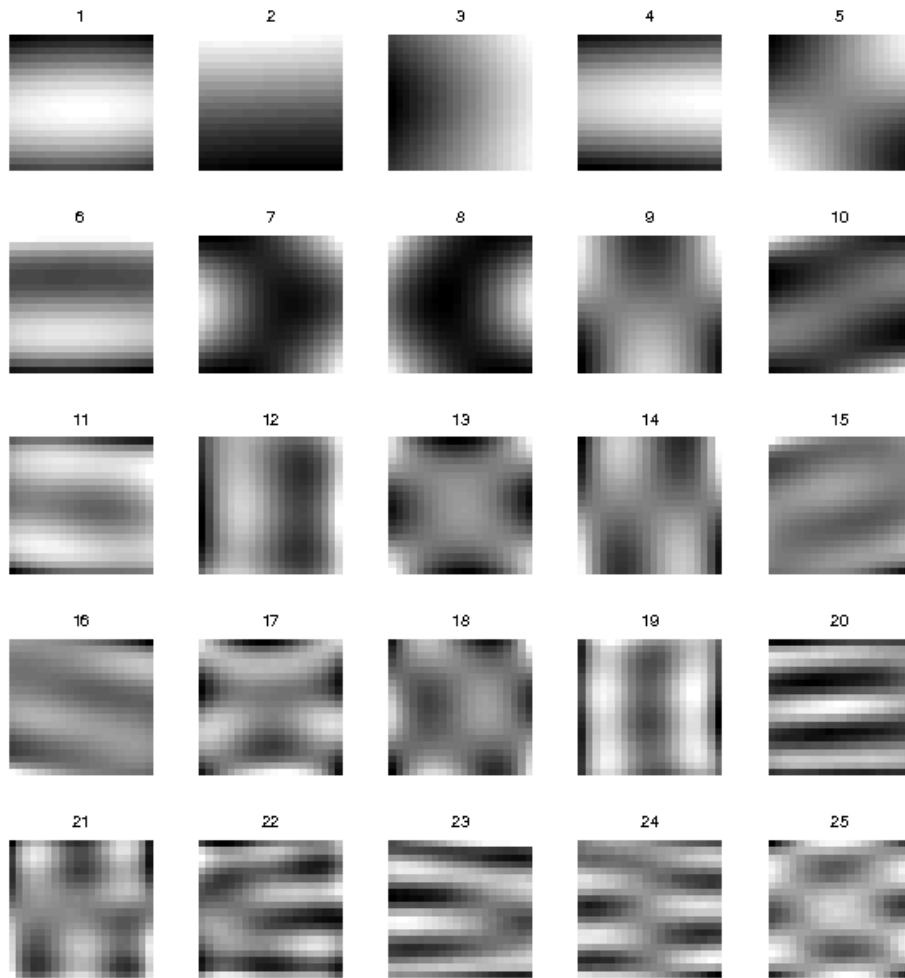


Figure 5: First 25 eigen vectors of VTEC Image. Images exhibit high variance.

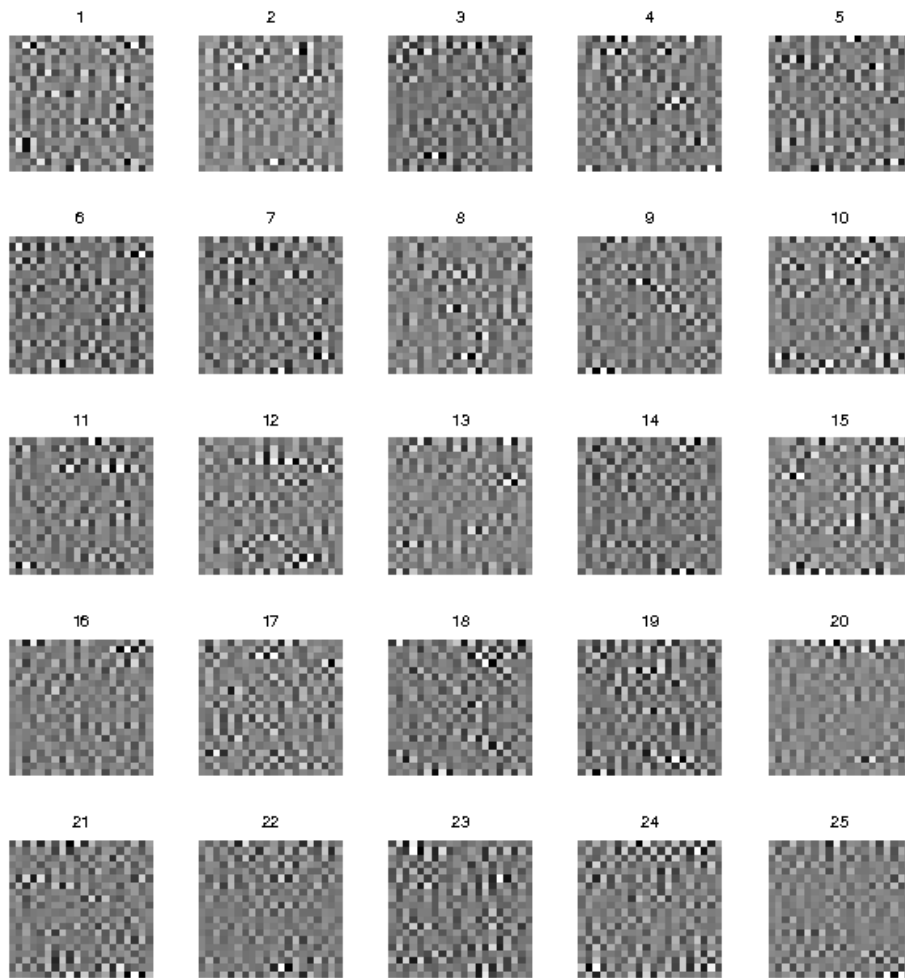


Figure 6: Last 25 eigen vectors of VTEC Image. Images exhibit low variance and are indistinguishable

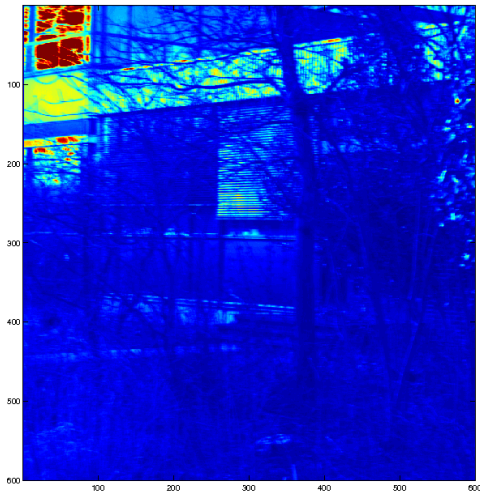


Figure 7: Original 170th Photo Image

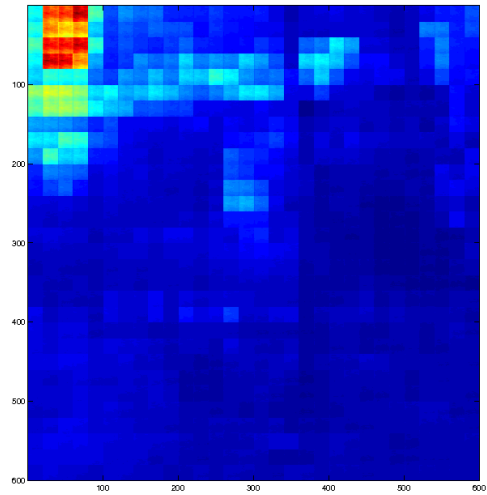


Figure 8: $r=1$. % variance = 78.7749

3 Part c,d,e

Given that we are compressing a 600×600 to a $400 \times r$ matrix of eigen vectors (assume the eigen values vector of length r occupies negligible space), we can simply store this eigen vector matrix, we attain a $\frac{400}{r}\%$ reduction. For example with $r = 1$ we are attaining a 400% reduction, with $r = 80$ it is 5%. With $r = 10$, it is 40%.

3.1 Photo Images

3.2 VTEC Images

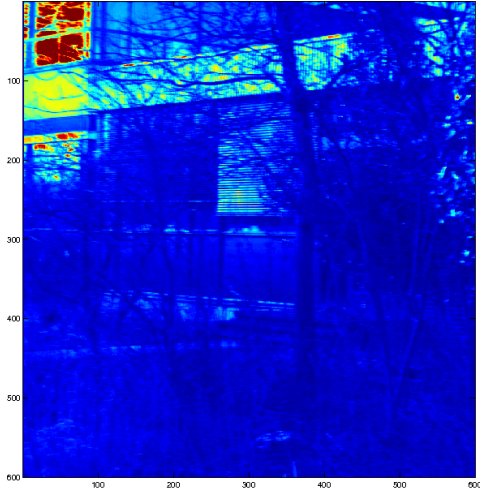


Figure 9: Original 170th Photo Image

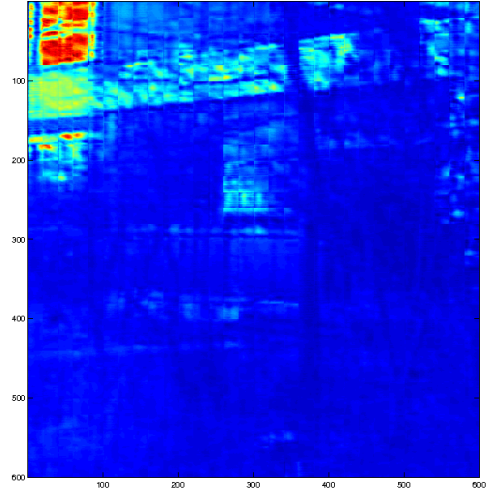


Figure 10: $r=10$. % variance = 92.1408

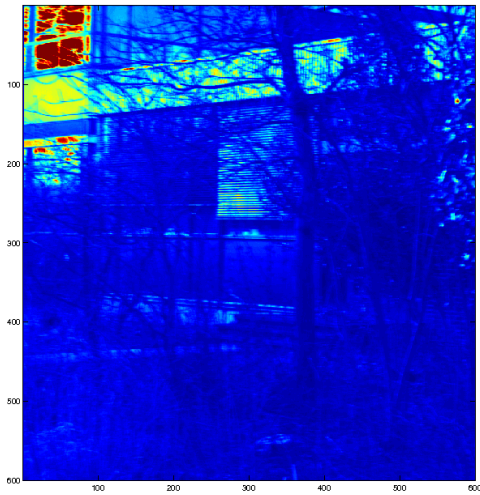


Figure 11: Original 170th Photo Image

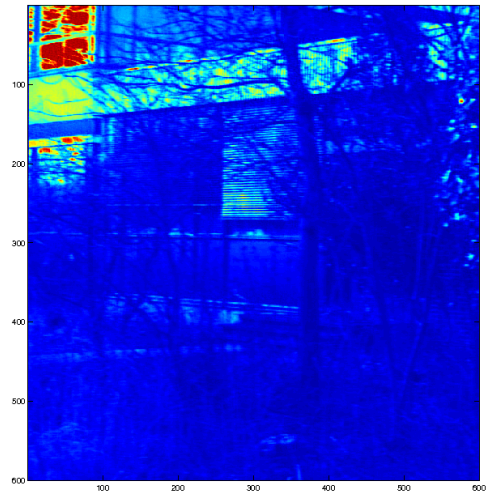


Figure 12: $r=80$. % variance = 99.3984

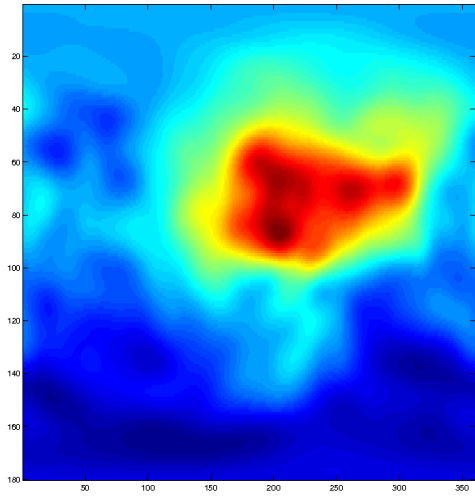


Figure 13: Original 170th VTEC Image

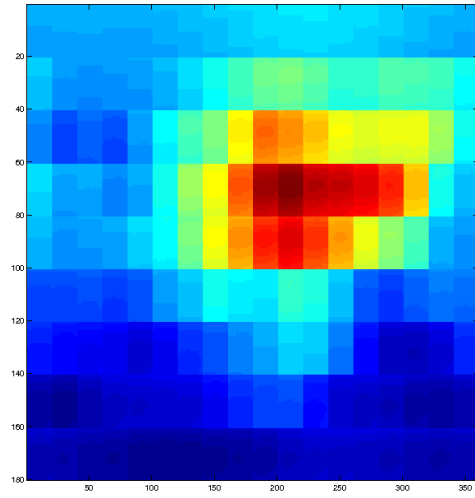


Figure 14: $r=1$. % variance = 95.3856

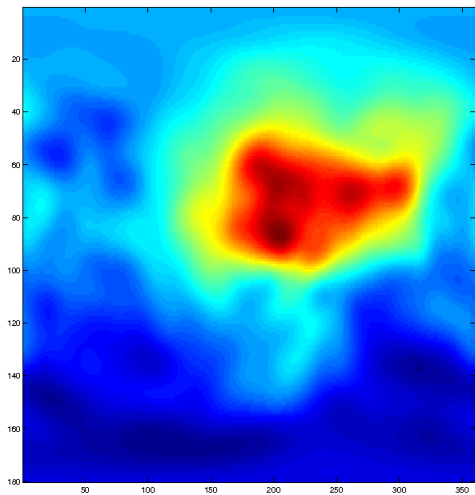


Figure 15: Original 170th VTEC Image

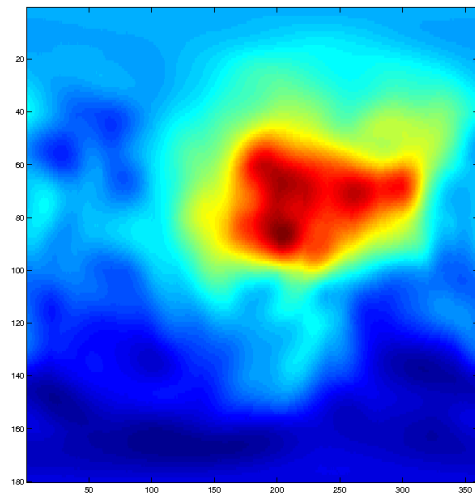


Figure 16: $r=10$. % variance = 99.9930

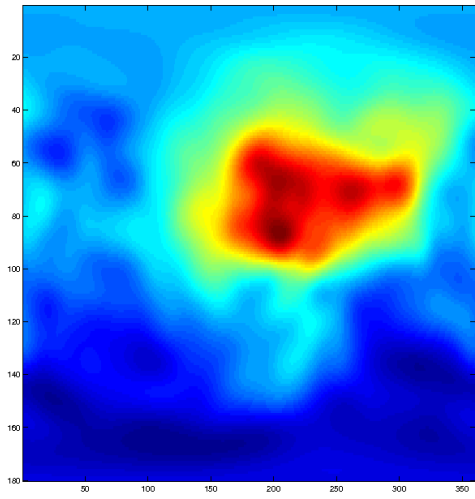


Figure 17: Original 170th VTEC Image

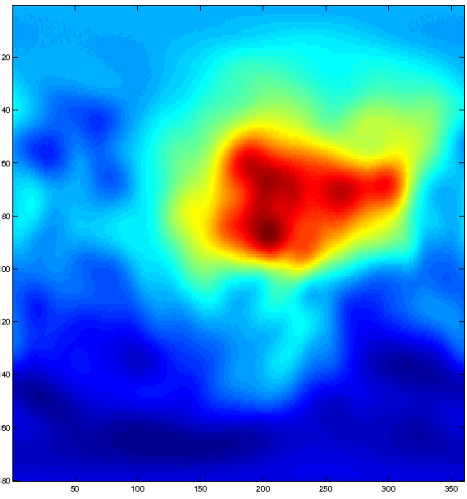


Figure 18: $r=80$. % variance = 99.9991