

## Data Generation

The dataset comprises 2000 simulated images, each with 256 pixels, split equally into groups A and B, represented by  $z_i$  (1 for A, 0 for B). The effect size, captured by the  $\beta$  vector, is set to 1 within a central 8x8 region of each image, indicating the area of group A's influence, while the rest is 0, showing no effect. The random error  $\epsilon_i$  for each image follows a multivariate normal distribution with zero mean and an exponential correlation structure with rate equals 1.

## VBM

In the VBM analysis, a Generalized Linear Model (GLM) was applied pixel-wise to assess group effects on pixel intensities. The analysis yielded effect size estimates and p-values for each pixel, which were corrected for multiple comparisons using the Bonferroni method. The results were visualized in two maps: one showing effect sizes and another depicting significant differences ( $p < 0.05$ ) in black, illustrating the focal areas of group differences in the simulated brain images.