

TABLE 4.4. day $\rightarrow$ gay : Likelihood Model: AIC at resolution level 3

<i>SPATIAL MODELS</i>		
<i>Location</i>	<i>REML</i>	<i>ML</i>
1	62.1	65.4
2	71.3	73.3
3	58	60.5
4	144	151
5	143	150
6	131	139
7	56.4	61
8	59.5	62.4

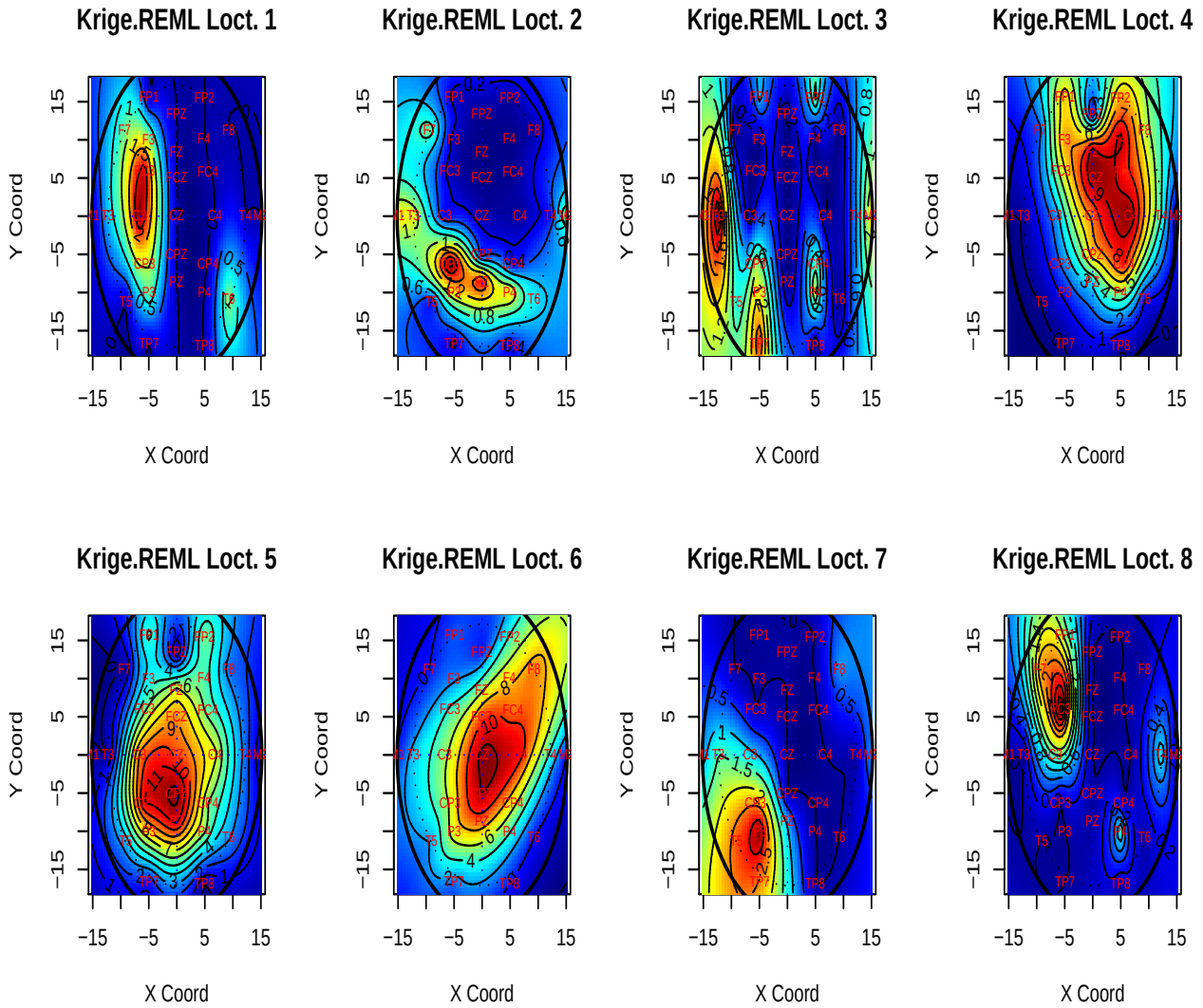
From these results we note that a spatial model using REML provides a suitable model.

Spatial interpolation. As we now have a method to at least estimate our spatial parameters, we may now undertake Kriging.

Using the `krige.conv` command within the `geoR` package where we have estimated our model parameters as previously mentioned, using REML we obtain the ordinary kriging result, from which we may generate a graphic form.

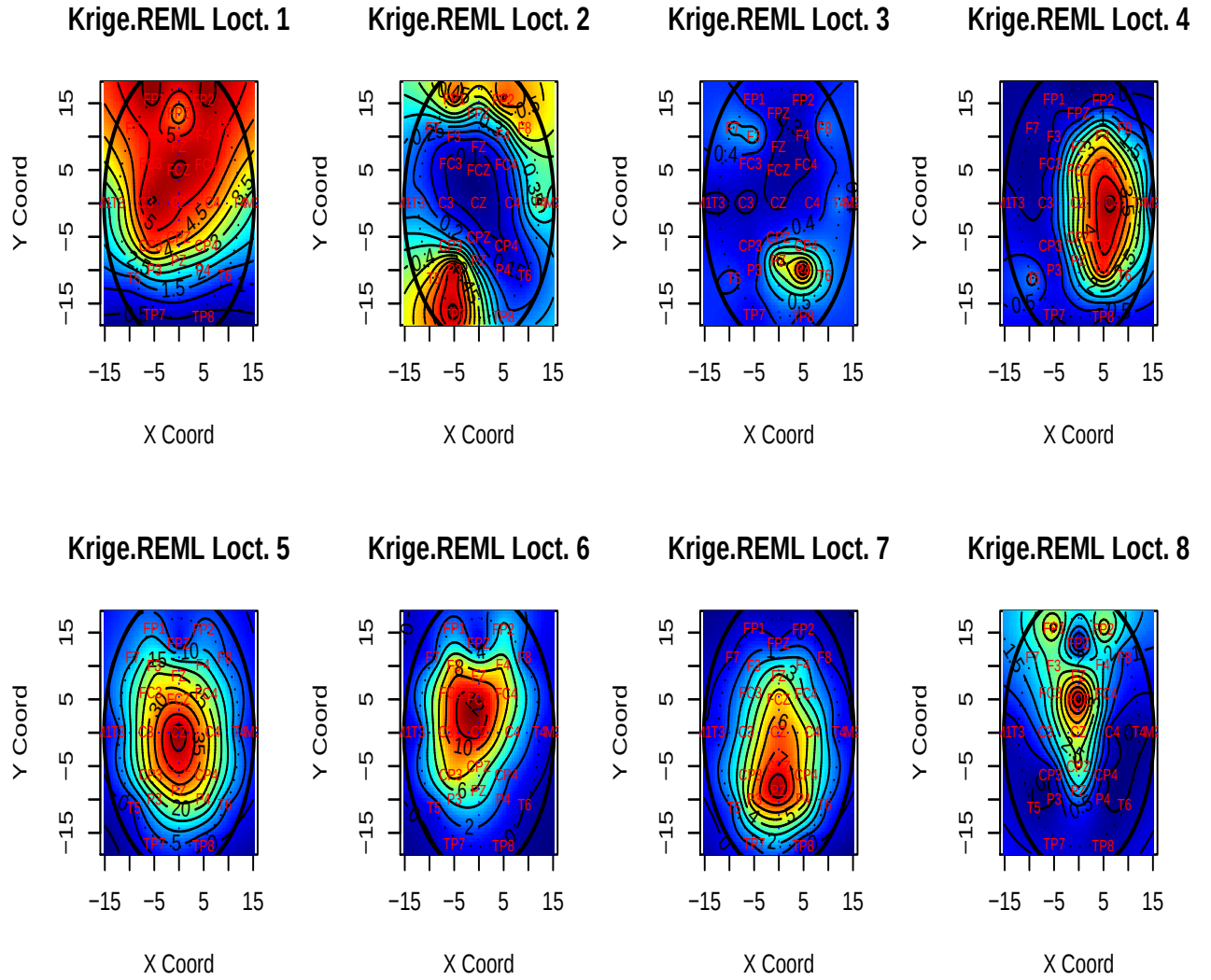
For the day $\rightarrow$ gay trial at Energy level 3, across the 8 time locations we have, Figure 4.12, with activity building from time location 3.

FIGURE 4.12. Kriging: day $\rightarrow$ gay at level 3



Now by implementing similar model, this time on the $de \rightarrow ge$ trial where the AIC informs that a “better” model results by using REML together with fixing the anisotropy parameter, Figure 4.13 results.

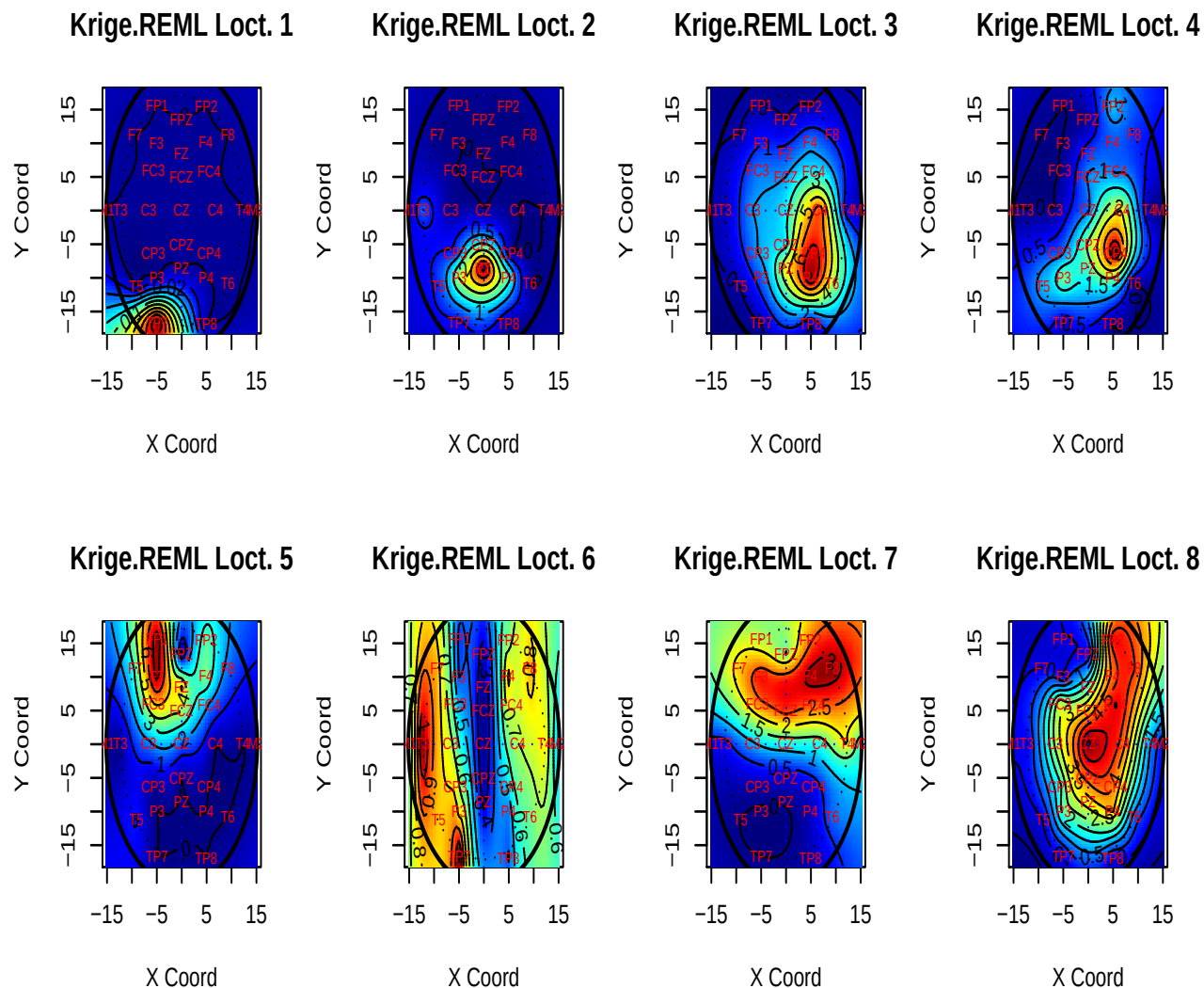
FIGURE 4.13. Kriging: $de \rightarrow ge$ at level 3



As previously noticed in the results from the Bayesian Hierarchal model, as was seen in Figures 4.6 and 4.7, again here in this Kriging model using REML to estimate our spatial parameters, considerable activity begins around time locations 3 to 4 in the day $\rightarrow$ gay trial, while such activity is noticeable around time locations 4 to 5 in the $de \rightarrow ge$ trial but with some initial clutter around time location 1. Nevertheless using these elementary models across all time locations within a given trial still provides us with some indication as to when activity starts to increase.

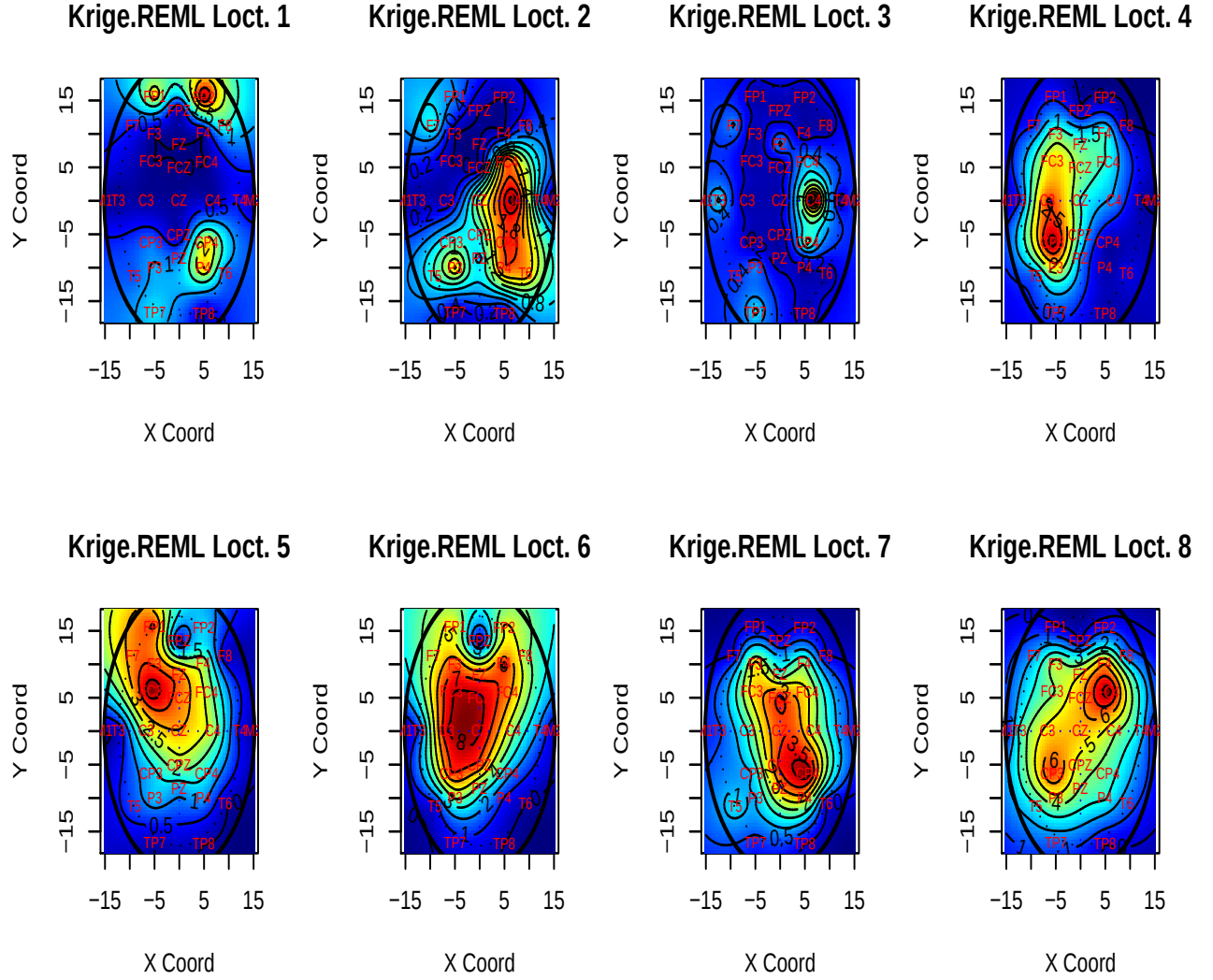
Again using the *Krig.Reml* model, we compare, *de* $\rightarrow$ *day* against a non-word deviant among a word standard, *day* $\rightarrow$ *de*. Using a similar model as used in the *day* $\rightarrow$ *gay* trial, as on page 44, and using the AIC to determine a better fit we obtain Figure 4.14.

FIGURE 4.14. Kriging: *de* $\rightarrow$ *day* at level 3



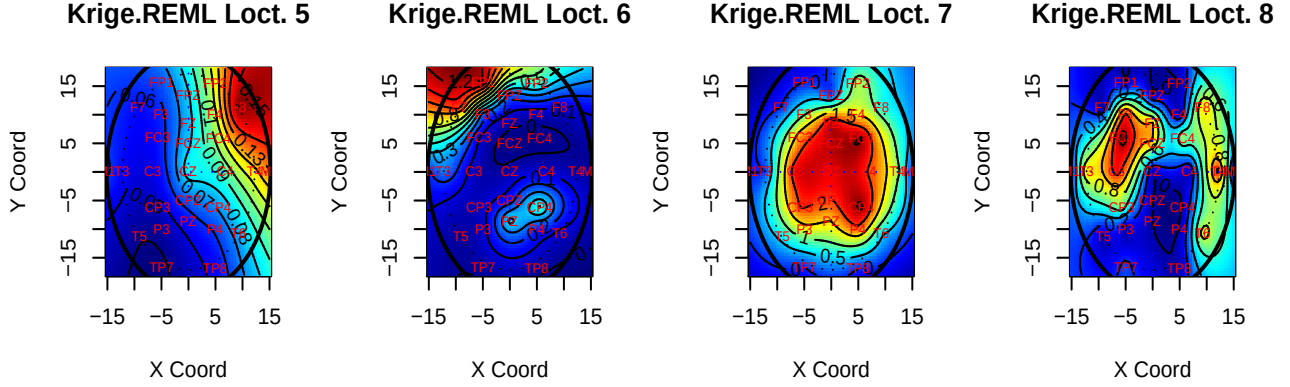
For the trial day $\rightarrow$ de we construct a similar Krig.Reml model model and obtain Figure 4.15.

FIGURE 4.15. Kriging: day $\rightarrow$ de at level 3

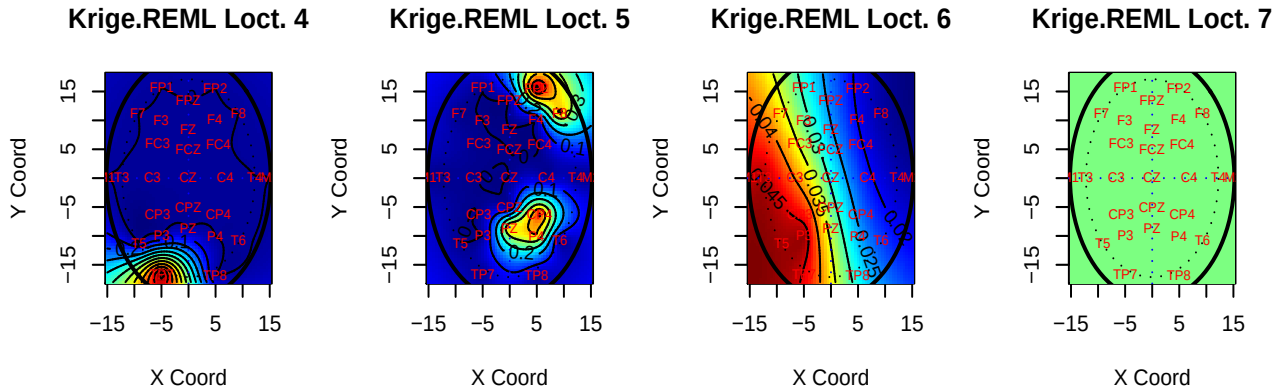


From Figures 4.14 and 4.15, we note that similarly to the previous Bayesian Hierarchical model, this trial of a non-word deviant from a word standard, i.e. day $\rightarrow$ de (Figure 4.15), shows that the initial larger MMN response was obtained at a later latency when compared to the trial of a real-word deviant from a non-word standard, de $\rightarrow$ day (Figure 4.14).

We may be able to investigate this further by moving to higher energy resolution level, level 4, where we obtain Figure 4.16.

FIGURE 4.16. Kriging: de $\rightarrow$ day at level 4

From Figure 4.16 we note minor activity at time locations 5 and 6 with an increase at location 7 (out of 16). Attempting to do the same refinement, i.e. using energy level 4, with the day $\rightarrow$ de trial (Figure 4.17), results in extremely low energy values across time locations values 6, 7 and 8⁹. This results in dilated or constant valued graphics at these low valued time locations. Time location 7 of Figure 4.17 demonstrates that we have reached a resolution where the energy of the EEG signal almost vanishes (no details in that scale).

FIGURE 4.17. Kriging: day $\rightarrow$ de at level 4

Nevertheless this still tends to indicate that the MMN activity increases at an earlier stage in the de $\rightarrow$ day trial when compared to the day $\rightarrow$ de trial and agrees with the results as seen in Pettigrew, (2004).

⁹Time location 8 at this scale is not shown, being similar to time location 7.

4.2.1.3. *Log-Normal Kriging.* If we assume the energies obtained from the wavelet transform form a gamma random field, then as the log-normal distribution is a close approximation for the gamma distribution, we may undertake a similar kriging methodology on the log values of the energies, noting that while our energy values will alter we still may be able compare the graphic contours obtained. So as previously undertaken, we build our models similar to the previous geostatistics kriging models in the section, using the R package geoR. We estimate the initial spatial parameters via the restricted likelihood method and use such to build our Kriging model at each time location.

FIGURE 4.18. Log-Normal Kriging: day $\rightarrow$ gay at level 3

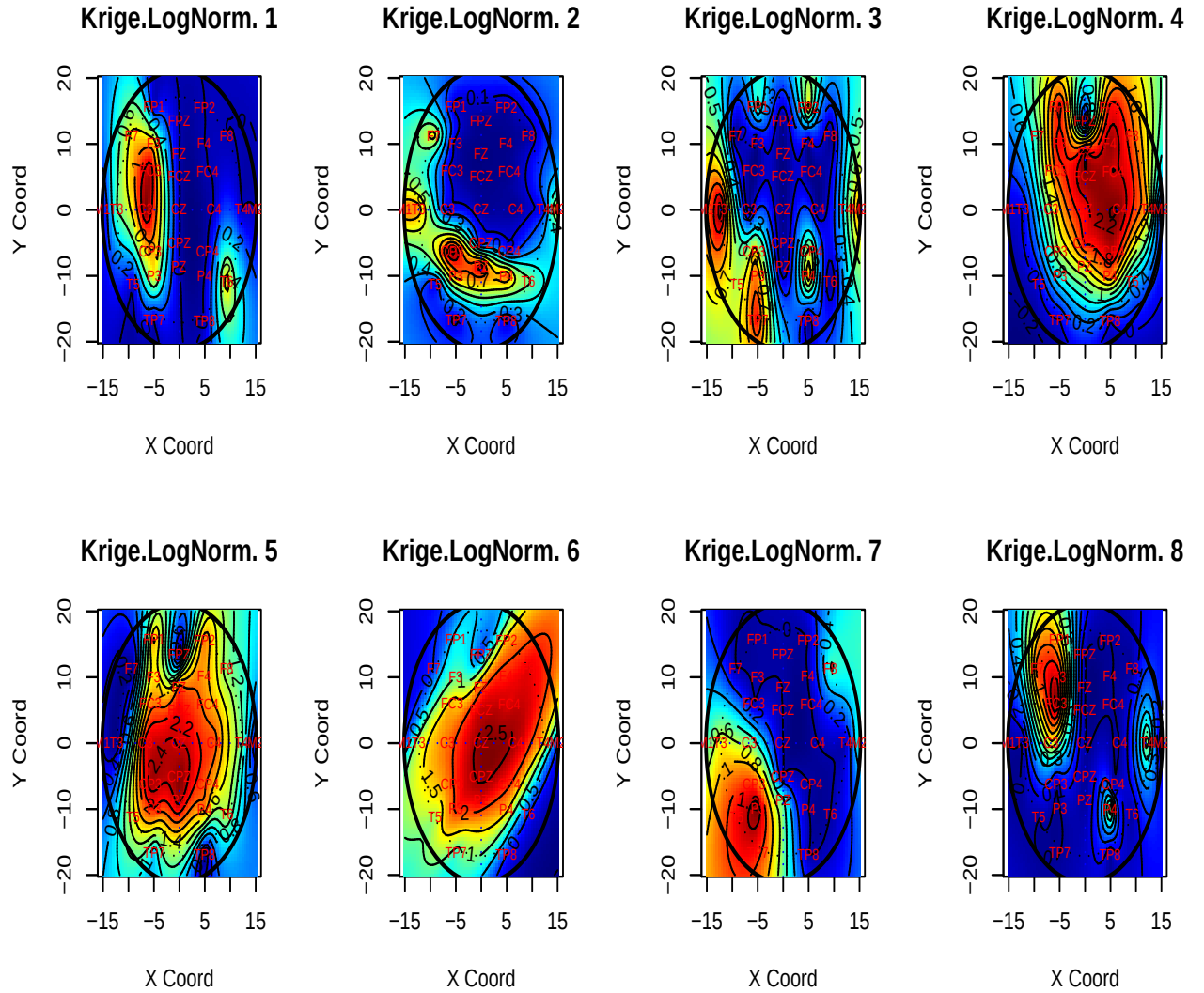
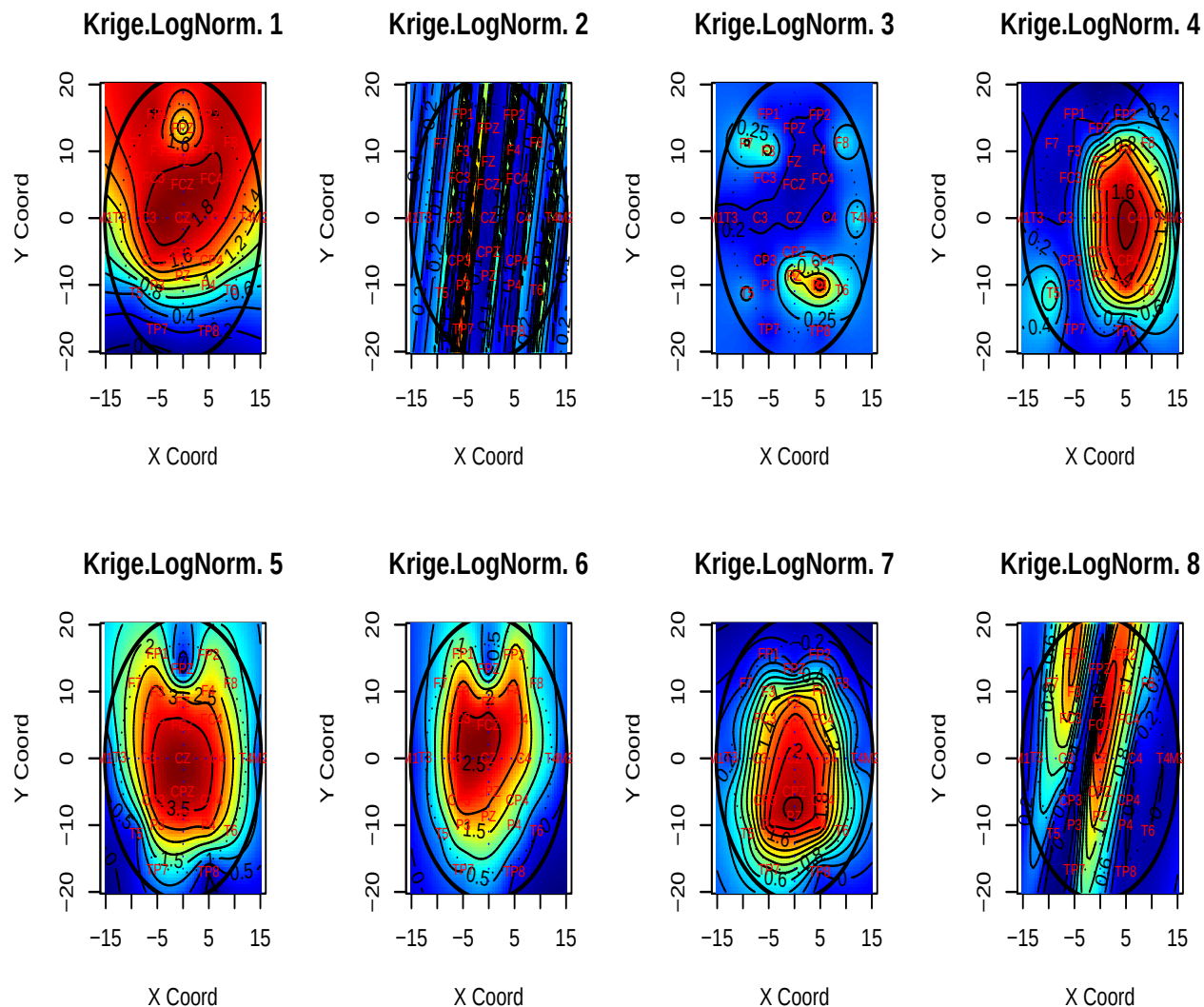


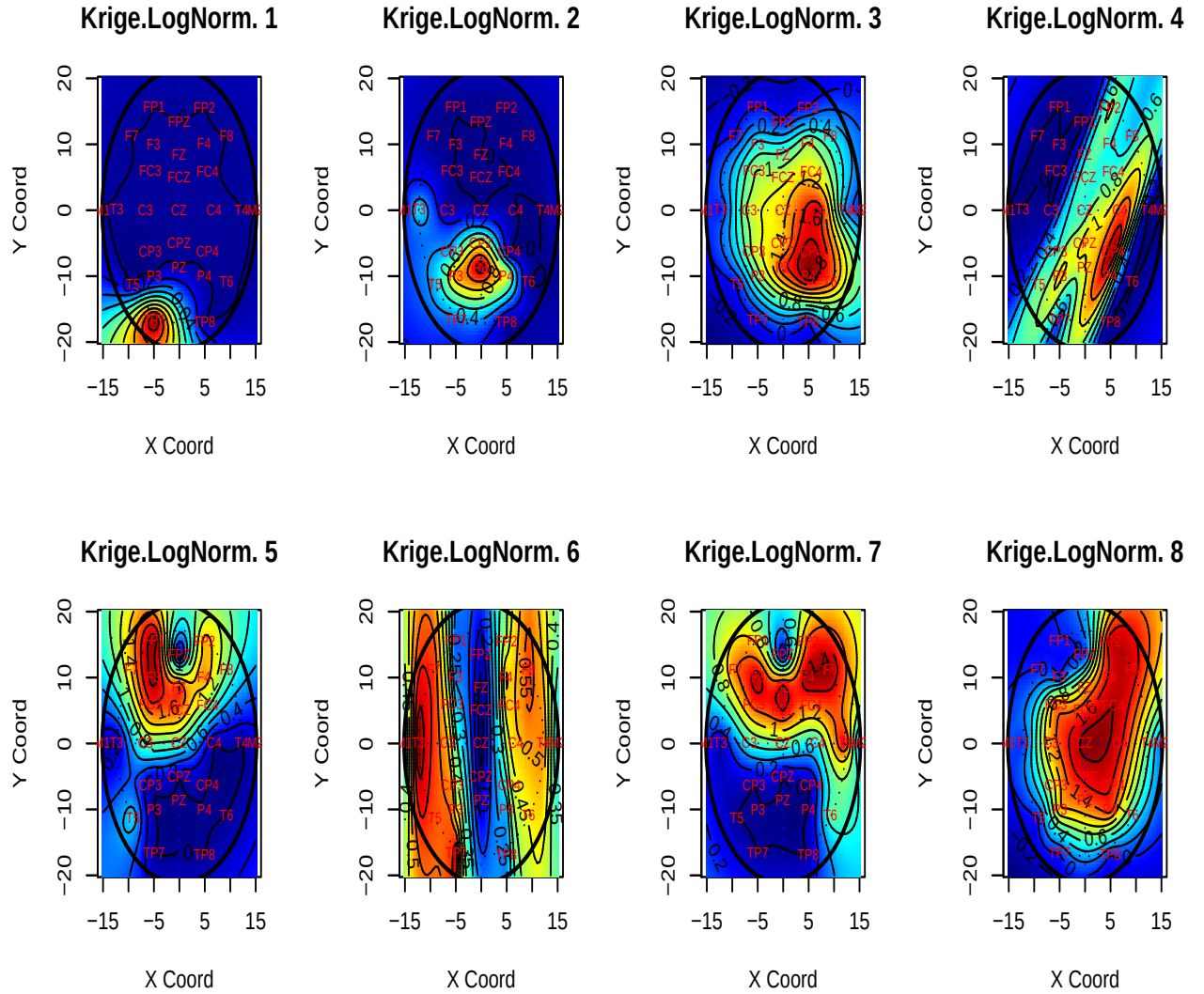
FIGURE 4.19. Log-Normal Kriging: $de \rightarrow ge$ at level 3



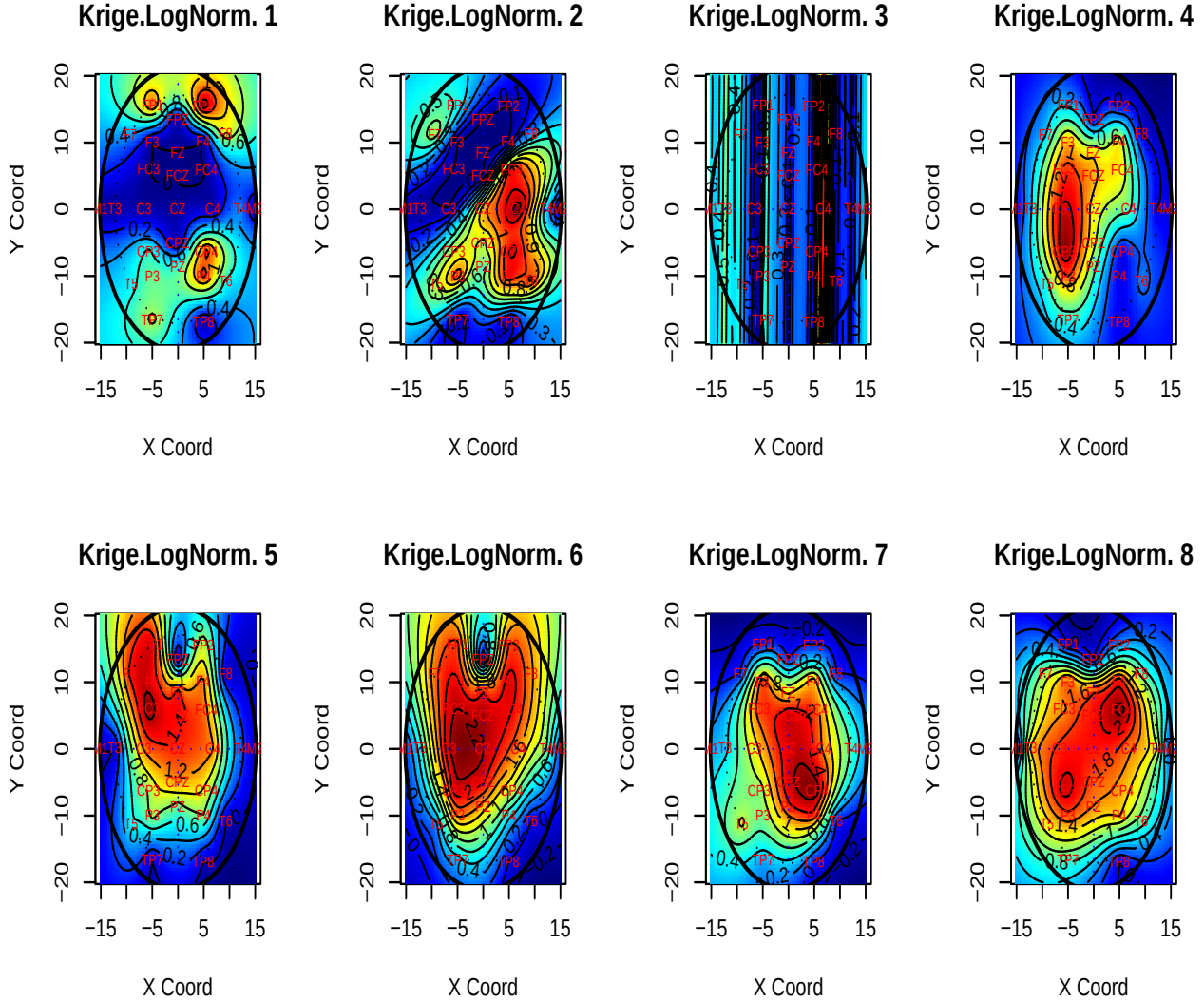
Here in this Kriging model, Figure 4.19 using REML to estimate the spatial parameters of our log values, considerable activity begins around time location 4 while such activity is noticeable around time locations 3 to 4 in the day $\rightarrow$ gay trial, (Figure 4.18). Nevertheless using this log-normal model across all time locations within a given trial still provides us with some indication as to when activity starts to increase, but no further refinement is evident when compared to the previous models. Also of concern is the “low” values, confusing the model, as shown in time location 2 in Figure 4.19.

Following the procedure as used for the *Krige.Reml* model, we compare $de \rightarrow day$ against a non-word deviant among a word standard, $day \rightarrow de$. Here, Figure 4.20, we continue using the log values of the energies. Of concern are the low values, which at time location 6 appear to be dilating the contours.

FIGURE 4.20. Log-Normal Kriging: $de \rightarrow day$ at level 3



Now we apply the same methodology to the $day \rightarrow de$ trial, Figure 4.21.

FIGURE 4.21. Log-Normal Kriging: day $\rightarrow$ de at level 3

From Figure 4.21, again the low values at time location 3 have confused the estimation of the initial spatial parameters and the Kriging model, hence the rather “non-smooth” outcome. Moving to a higher energy resolution further highlights the effect of these low valued energies on our model. While it appears likely this model may reflect the findings of the previous models, we may not be certain of this, as we cannot ascertain which of $de \rightleftharpoons day$ trials, provides the earliest larger MMN response.

4.2.2. Models in the Plane $\sim$ Outcome. These three models we have utilised, in an attempt to illustrate the MMN responses to the various trials have provided mixed results, Table 4.5. While we could approximately estimate at which time location the MMN response began to exhibit an increase in activity in a trial, when comparing specific