



**Supplementary Figure 1.** Illustration of measurement selection during SARDU-Net training on *in vivo* brain DRI data. As an example, the figure illustrates the selection of  $D = 8$  out of  $M = 32$   $(b, TI)$  measurements. In each panel, the selector scores  $\mathbf{w}$  are illustrated as training progresses. Zero entries of  $\mathbf{w}$  are reported in white, while non-zero entries of  $\mathbf{w}$  are colour-coded and point towards measurements that are selected. Different columns refer to different  $(b, TI)$  measurements, while rows refer to different network parameter updates (here we report the first 3000 updates). Panel A (top), B (middle) and C (bottom) respectively refer to a case when training is performed leaving subject 1, 2 and 3 out as test set (training folds 1, 2 and 3).