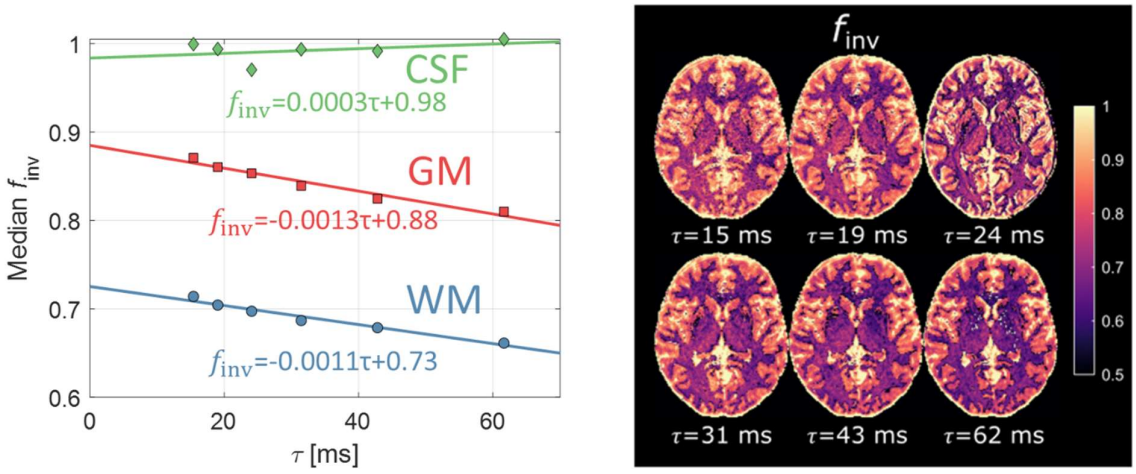
Supplementary Material to NMR Biomed 70067 (2025)

Adiabatic pulse duration and peak B_1

To disentangle the reduction in f_{inv} stemming from T_2 decay and the reduction stemming from MT, two additional PS-MP4RAGE experiments were performed: (i) To study the effect of T_2, the duration of the HS pulse was changed through 15, 19, 24, 31, 43, and 61 ms while the RF power integral was kept constant by concomitantly decreasing peak B_1 through 20, 18, 16, 14, 12, and 10 µT. (ii) To study the effect of MT, the power integral of the HS pulse was changed by varying peak B_1 through 8, 10, 12, 14, 16, and 18 µT while keeping the duration of the pulse constant at 20.6 ms.

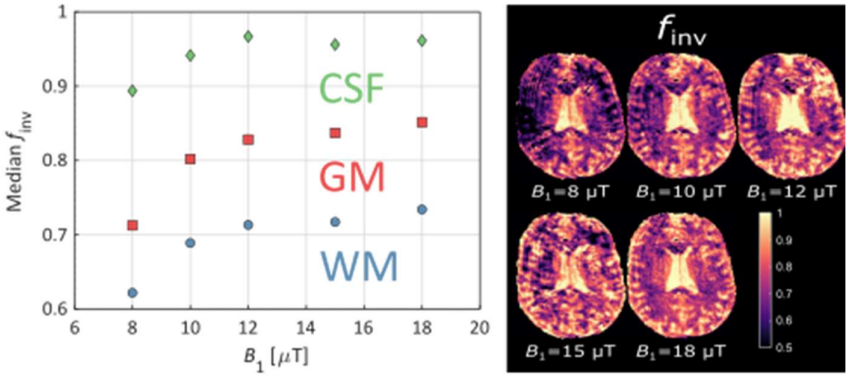
Increasing the pulse duration at constant pulse power revealed a trend of decreased f_{inv}, by ~0.4±0.2 1/s in ROIs of WM and GM (Supplementary Figure 1). This is likely caused by T_2-relaxation losses during adiabatic inversion.



Supplementary Figure S1. Apparent inversion efficiency vs adiabatic inversion pulse duration. A clear negative correlation was observed between f_{inv} and pulse duration in the short(er) T_2 brain parenchyma relative CSF.

A trend of increasing apparent f_{inv} was observed when increasing the adiabatic inversion peak B_1 (Supplementary Figure S2). The trend was somewhat stronger in the brain parenchyma than in the CSF (which is to be expected) although results were much less conclusive than in the analogous pulse duration experiment (Supplementary Figure S1). f_{inv} approached an upper limit when the power of

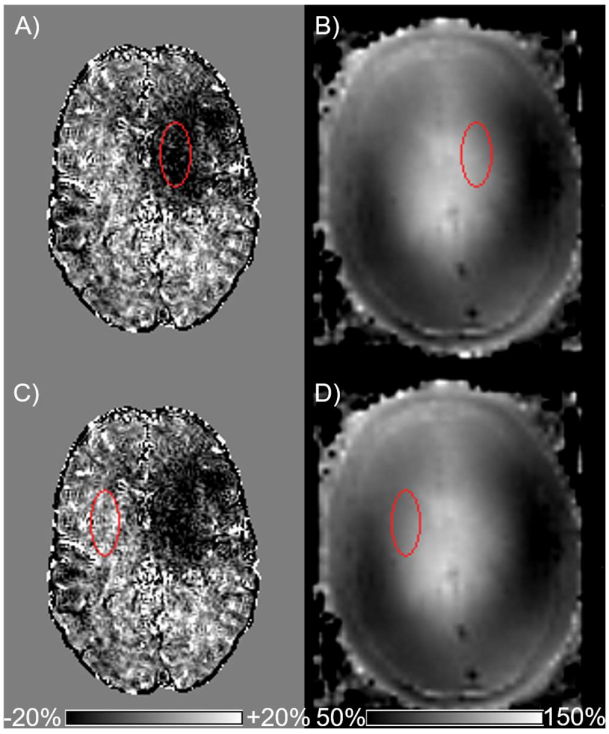
the inversion pulse was increased, as the bound pool was driven further into saturation. This plateau in f_{inv} appeared somewhere between 12 and 15 µT. It is expected that the dependence of f_{inv} on peak B_1 observed here should be translatable also to the spatial variation of the transmit field at 7T. This aspect could be added to enhance the suggested model but the amount of data available for this work was not sufficient to implement this with any accuracy.



Supplementary Figure S2. Apparent f_{inv} vs adiabatic inversion peak B_1. A trend of increasing f_{inv} with increasing peak B_1 is observed with a plateau beyond 12 µT. Accordingly, regions of low B_1^+ exhibited lower f_{inv}. The trend is stronger in the brain parenchyma compared to CSF although the difference is less accentuated than in the pulse duration experiment (Supplementary Figure S1).

Residual differences in the 3D validation of MP2RAGE against PS-MP4RAGE

Some residual spatial differences in the T_1 estimate of MP2RAGE and PS-MP4RAGE were observed (Figure 4). This difference was most notable in the anterior part of the brain between the right and left hemisphere of Sub01 (Figure 4, top row). To elucidate whether this difference was correlated to the transmit field, the difference map was compared to a co-registered B_1^+ map via ROI analysis (Supplementary Figure S3 and Supplementary Table S4). This comparison revealed no evident relationship between low/high B_1^+ and a large difference between MP2RAGE and PS-MP4RAGE T_1 estimation. We speculate that the right-left difference could stem from slight variations between the transmit channel phase combination of the MP2RAGE and PS-MP4RAGE sequences respectively.



Supplementary Figure S3. A) Difference map with ROI in high-difference area. B) B_1^+ map with ROI in same location as A). C) Difference map with ROI in a low-difference area. D) B1+ map with ROI in same location as C).

Supplementary Table S4. Mean±standard deviation of the ROIs in Supplementary Figure S3.

Panel	**Map**	**Mean±SD**
A)	Difference	-9.5±2.8%
B)	B1+	106±10%
C)	Difference	+2.9±5.1%
D)	B1+	98±7%