

Supplementary materials to: Objective image quality evaluation in a brain dedicated PET scanner

Maria Teresa Gandia-Ferrero^{1*}, Irene Torres-Espallardo^{1,2},
Begoña Martínez-Sanchis², Constantino Morera-Ballester³, Enrique Muñoz³,
Pablo Sopena-Novales², Gabriel González-Pavón³, Luis Martí-Bonmatí^{1,4}

^{1*}Biomedical Imaging Research Group (GIBI230), La Fe Health Research Institute (IIS La Fe), Avenida Fernando Abril Martorell, València, 46026, Spain.

²Nuclear Medicine Department, La Fe University and Polytechnic Hospital, Avenida Fernando Abril Martorell, València, 46026, Spain.

³Oncovision, Carrer de Jeroni de Montsoriu, 92, València, 46022, Spain.

⁴Radiology Department, La Fe University and Polytechnic Hospital, Avenida Fernando Abril Martorell, València, 46026, Spain.

*Corresponding author(s). E-mail(s): mteresa_gandia@iislafe.es;

Supplementary Figures:

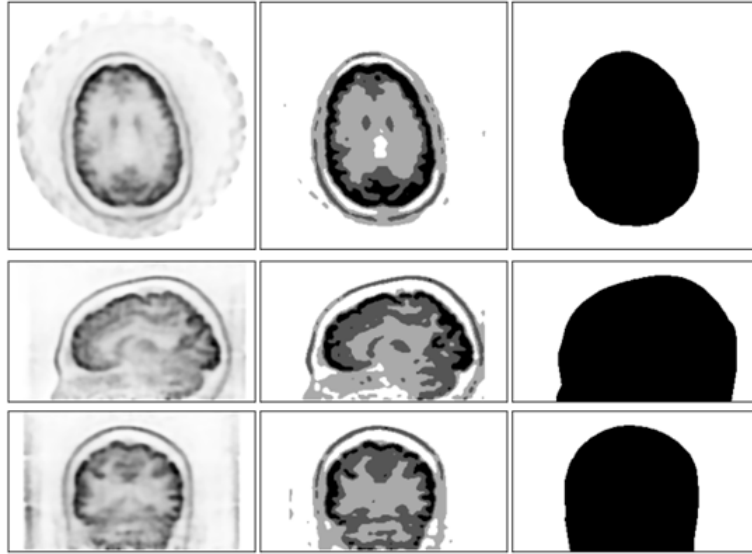


Fig. 1 Generation of the emission-based attenuation map. Different steps in the generation of the emission-based attenuation map: uncorrected emission image (left), k-means segmented image (middle) and final attenuation map (right). From top to bottom: transversal, sagittal and coronal views.

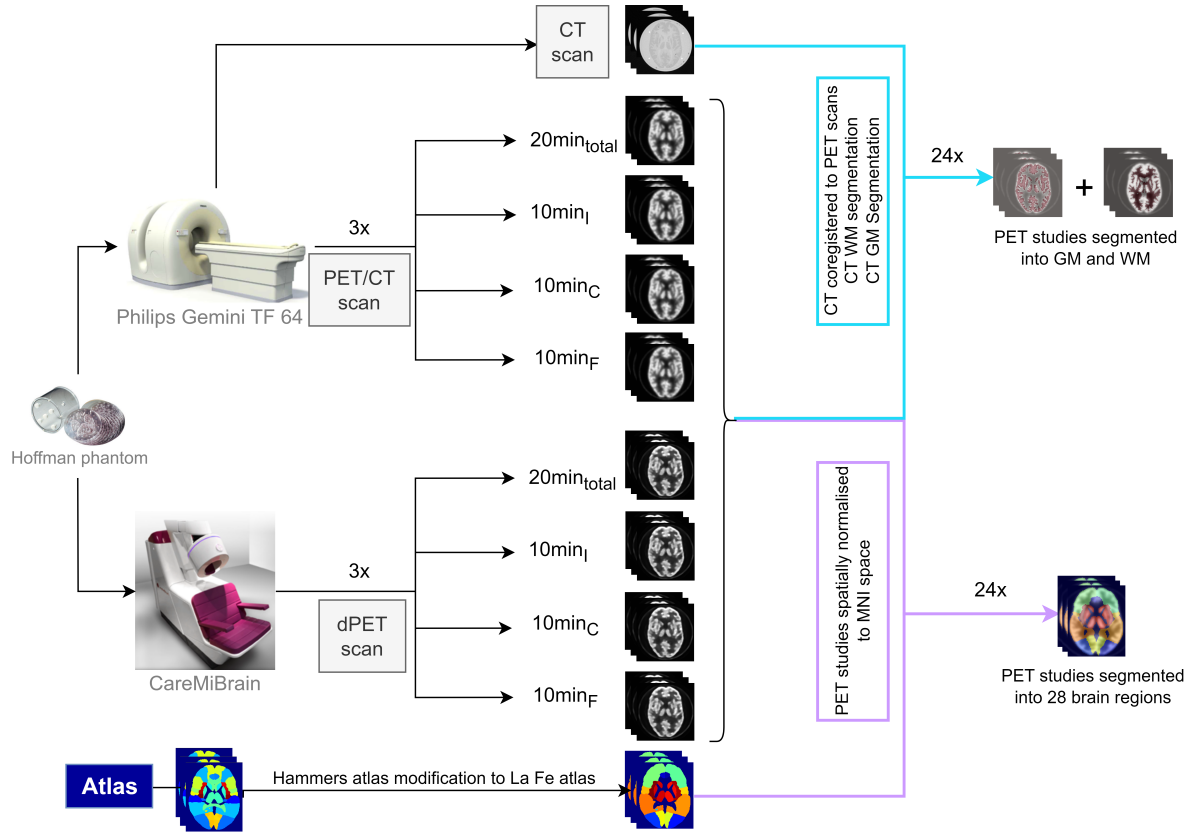


Fig. 2 Flowchart of the methodology for the Hoffman phantom.

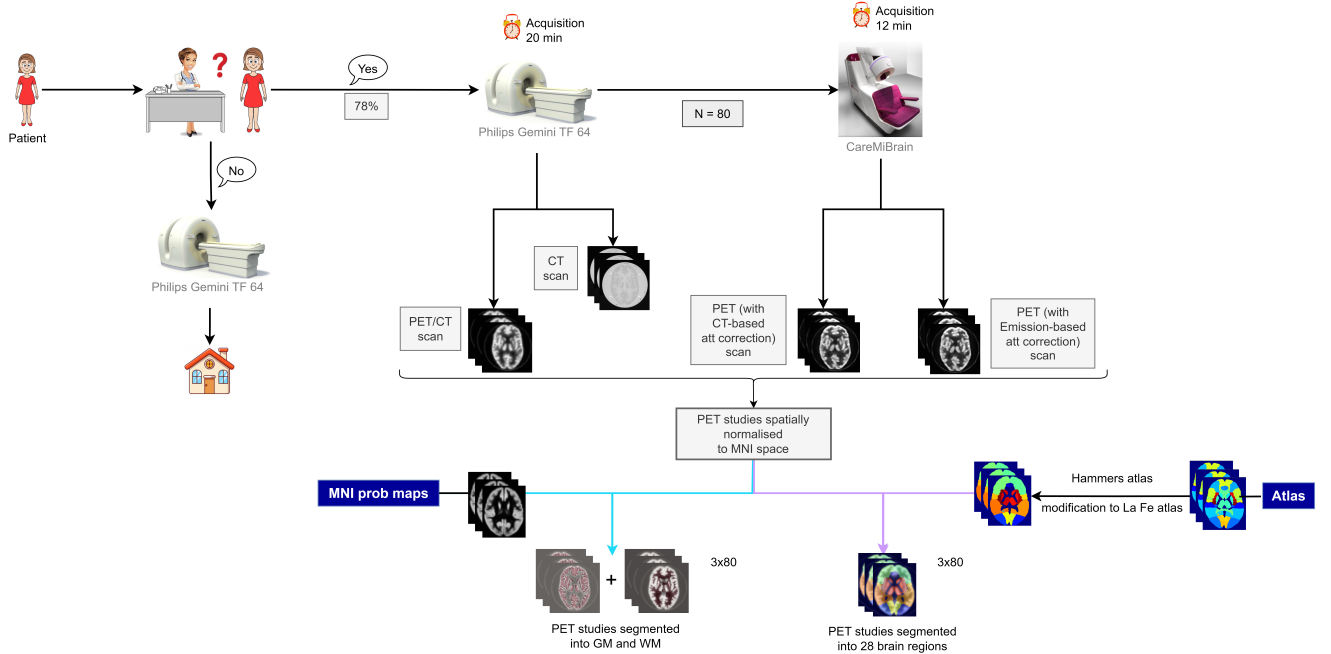


Fig. 3 Flowchart of the methodology for patients.

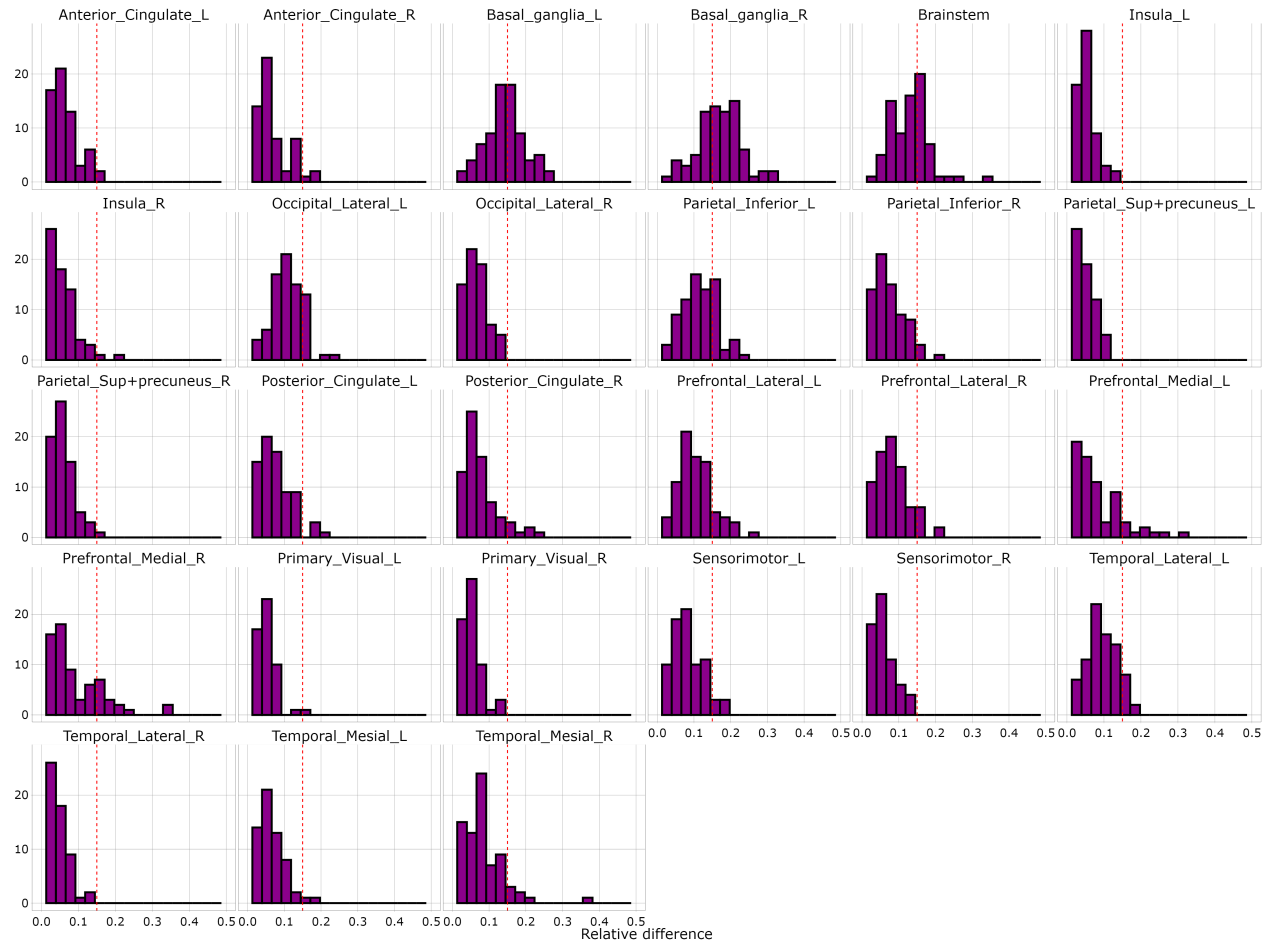


Fig. 4 SUVr relative differences for each brain region (1). SUVr relative differences between PET/CT and CMB PET images reconstructed using Emission-based attenuation map for each brain region.

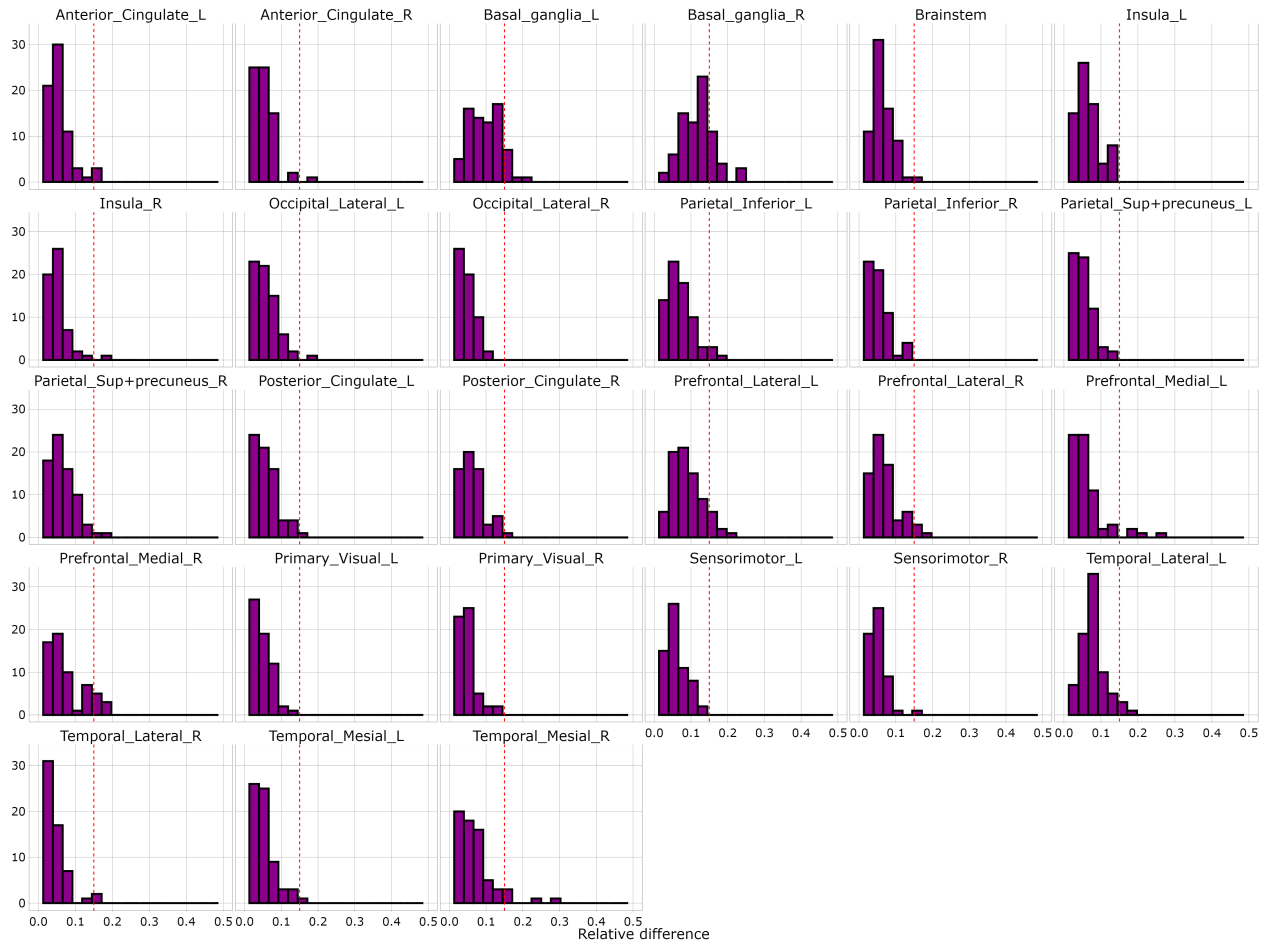


Fig. 5 SUVr relative differences for each brain region (2). SUVr relative differences between PET/CT images and CMB PET images reconstructed using CT-based attenuation map for each brain region.



Fig. 6 SUVr relative differences for each brain region (3). SUVr relative differences between CMB PET images reconstructed using CT-based attenuation map and Emission-based attenuation map for each brain region.

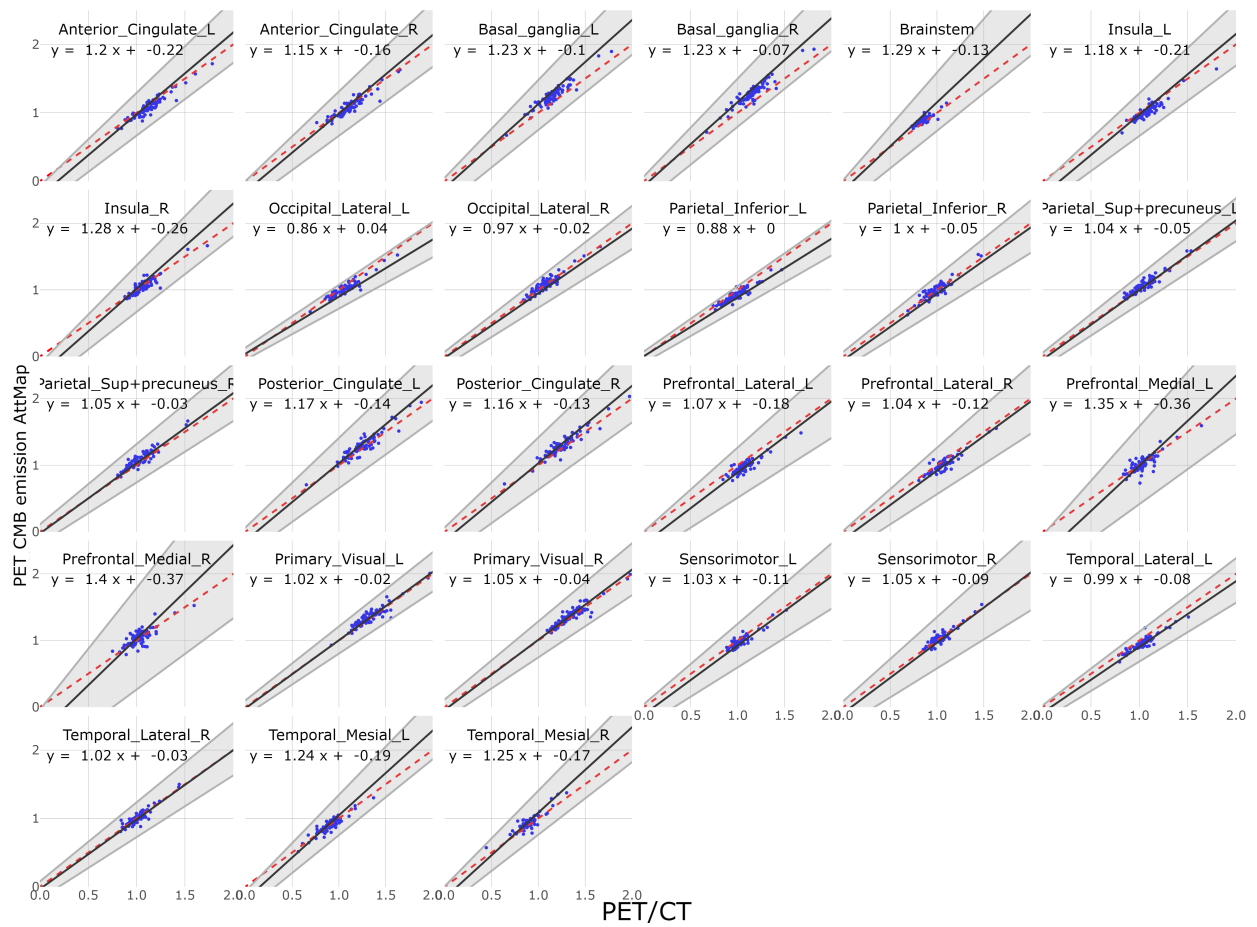


Fig. 7 SUVr Passing-Bablok regression plots between images from PET/CT and CMB with emission-based attenuation map grouped by brain regions.

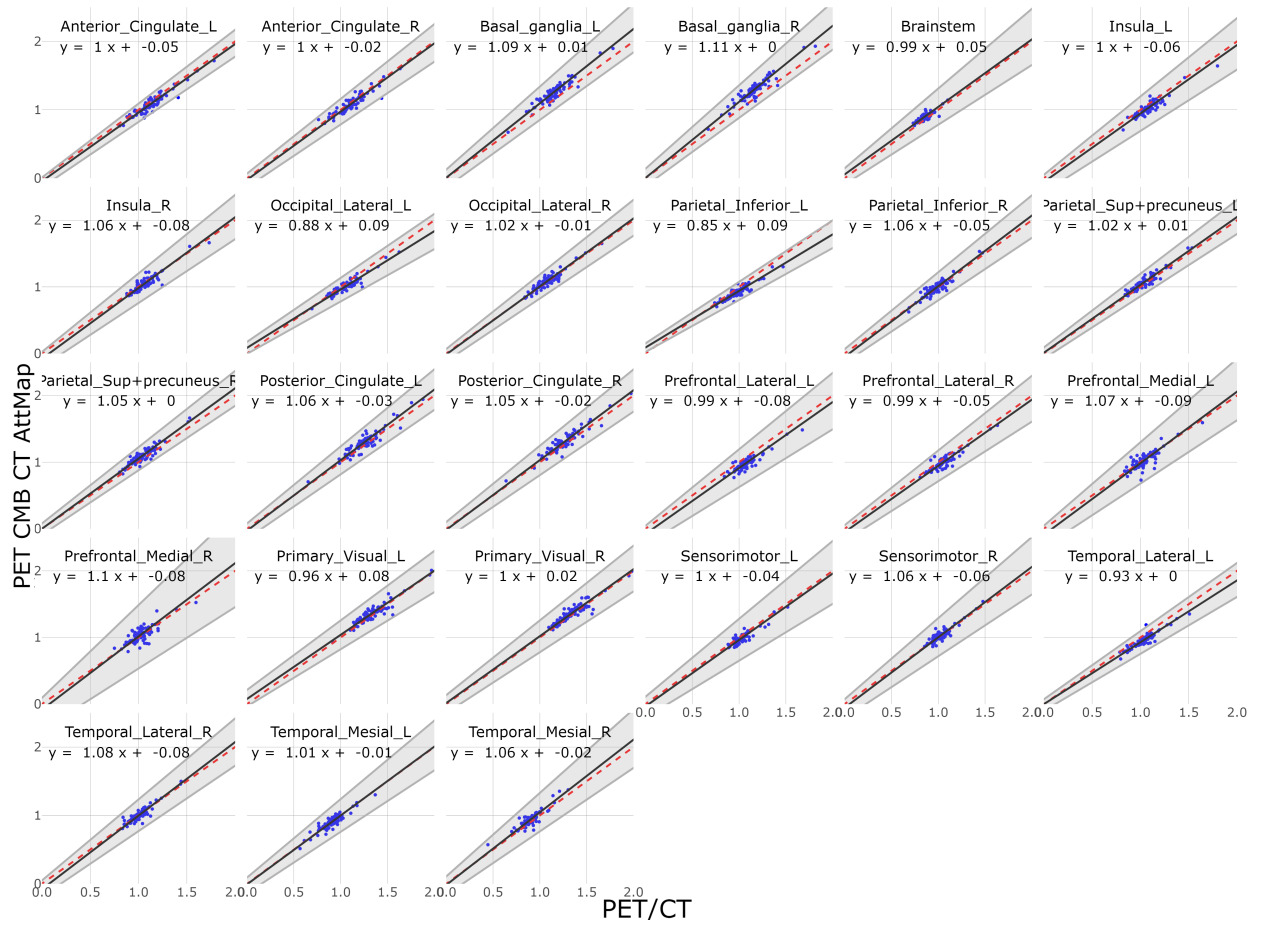


Fig. 8 SUVr Passing-Bablok regression plots between images from PET/CT and CMB with CT-based attenuation map grouped by brain regions.

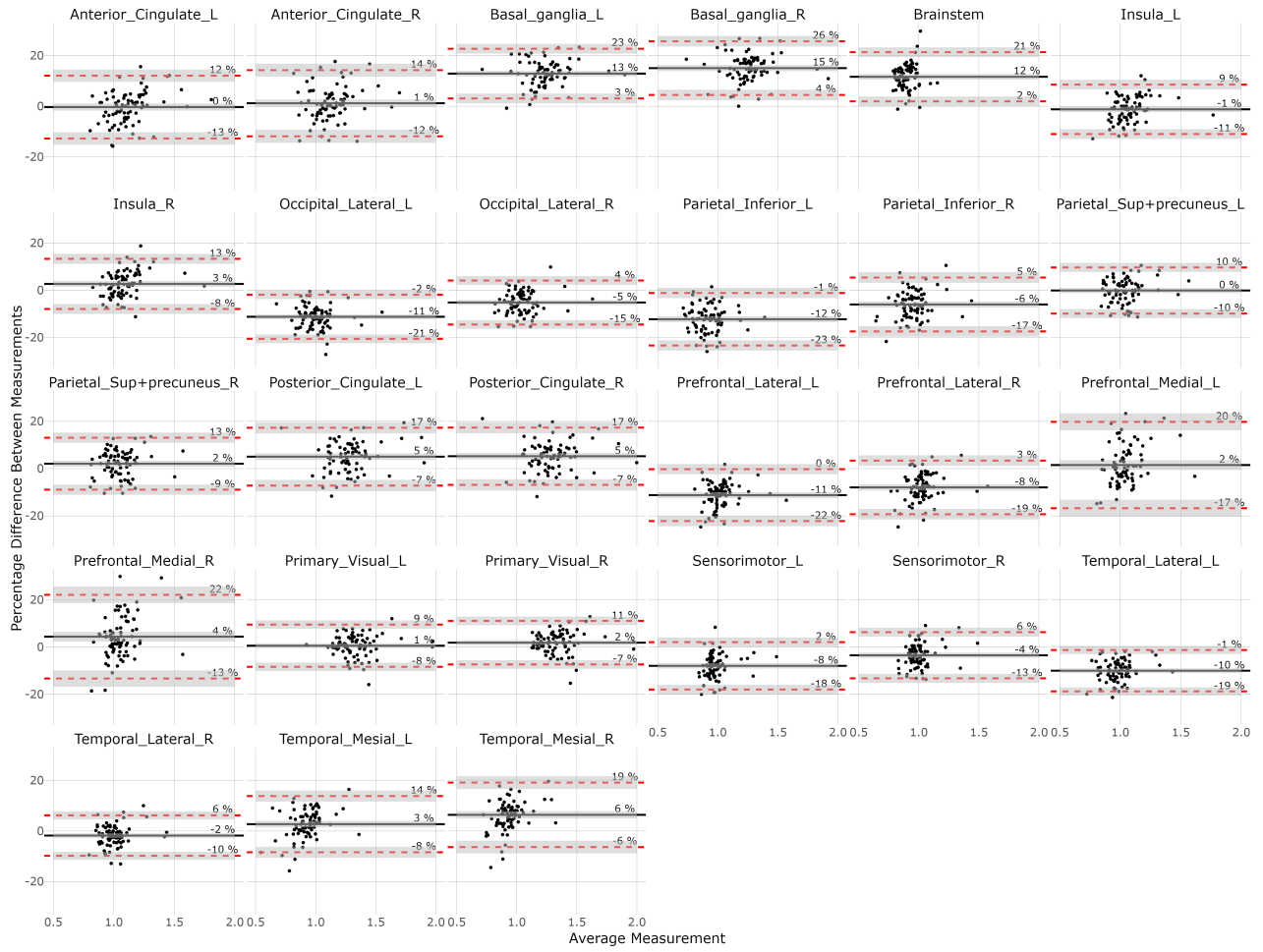


Fig. 9 Bland-Altman plot of the 27 SUVR quality metrics evaluated in patients for the comparison of PET images between PET/CT and CMB with emission-based AC.

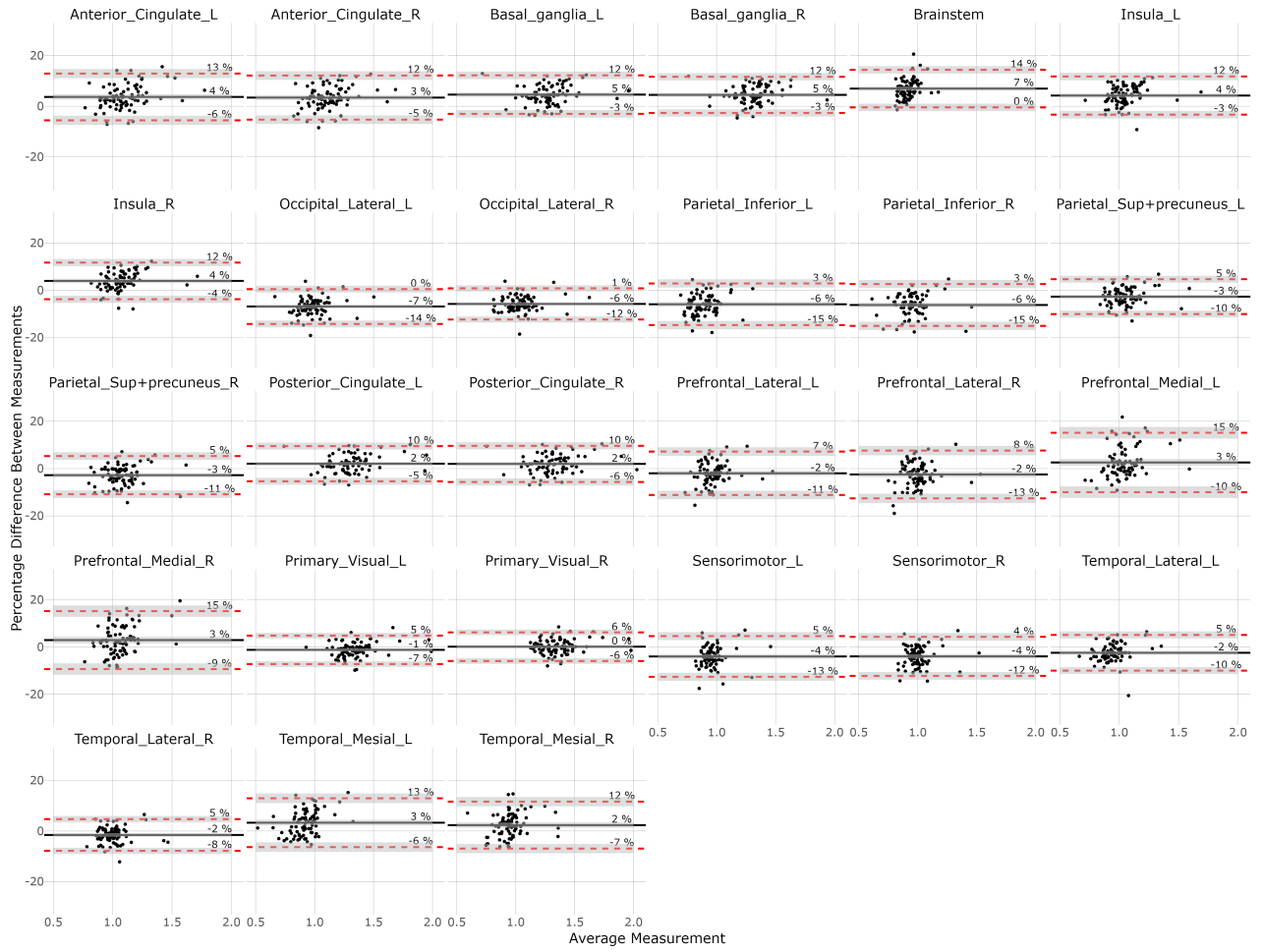


Fig. 10 Bland-Altman plot of the 27 SUVR quality metrics evaluated in patients for the comparison of PET images between CMB with CT-based AC and CMB with emission-based AC.

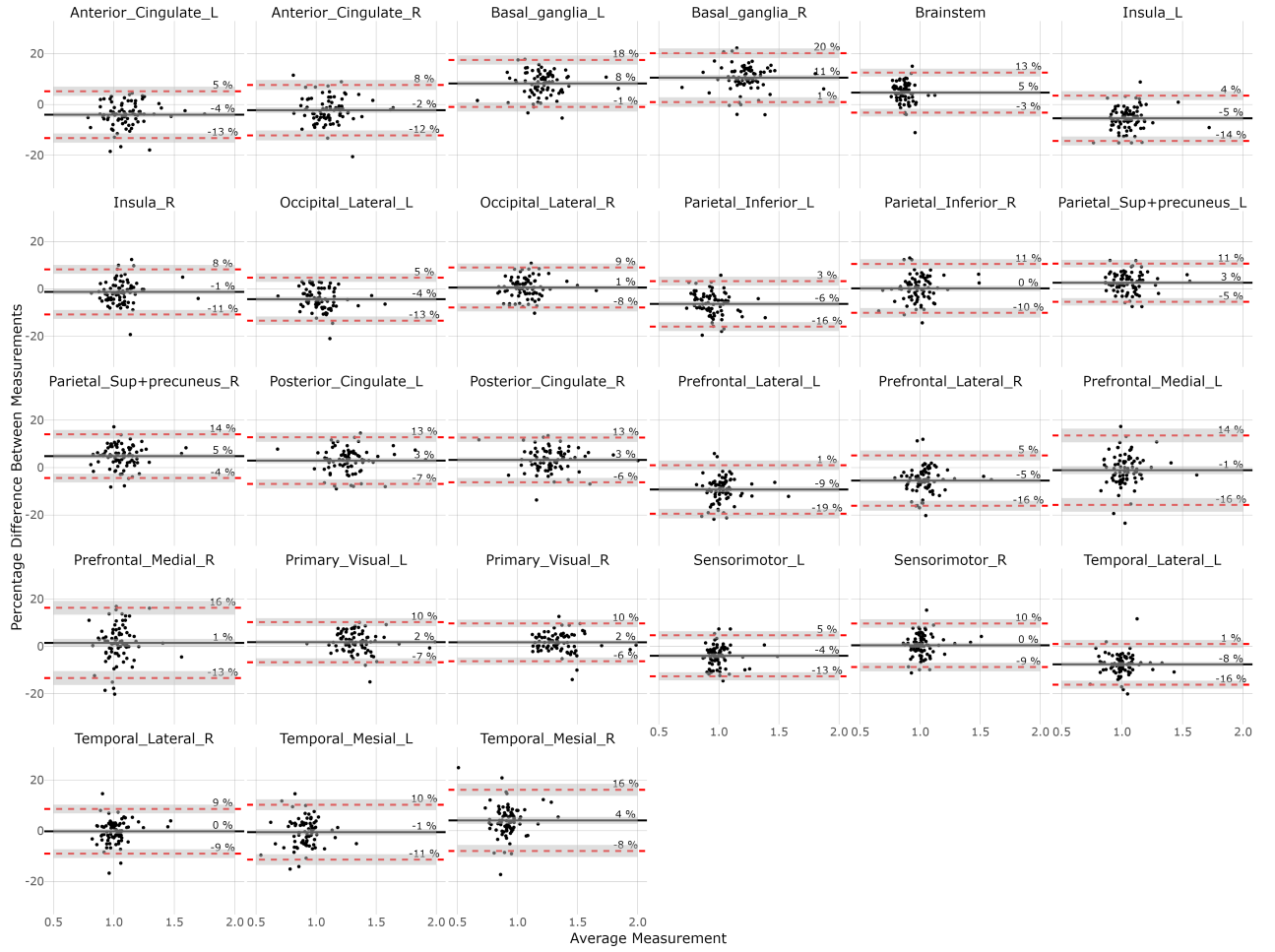


Fig. 11 Bland-Altman plot of the 27 SUVR quality metrics evaluated in patients for the comparison of PET images between PET/CT and CMB with CT-based AC.

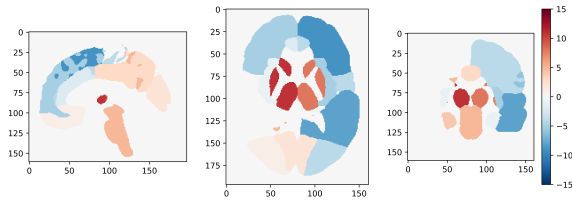


Fig. 12 Atlas La Fe plot with its regions coloured by the Bland-Altman percentage differences of the 27 SUVR quality metrics evaluated in patients between PET/CT and CMB with CT-based AC.

Supplementary Tables:

Table 1 Image quality metrics evaluated on Hoffman phantom (I). Mean $\pm$ standard deviation of contrast to noise ratio of grey matter: CNR(GM), contrast, signal to noise ratio of grey matter: SNR(GM), signal to noise ratio of white matter: SNR(WM), recovery coefficient of grey matter RC(GM), and coefficients of variation of grey matter: COV_{10min}(GM) and white matter: COV_{10min}(WM) distributions of PET/CT images and CMB PET images on Hoffman phantom.

	PET/CT	CMB
CNR (GM)	2.14 ± 0.04	2.92 ± 0.12
contrast	0.78 ± 0.00	1.53 ± 0.06
SNR (GM)	5.39 ± 0.14	3.32 ± 0.19
SNR (WM)	2.74 ± 0.05	1.92 ± 0.09
RC (GM)	0.74 ± 0.03	0.94 ± 0.03
COV_{10min}(GM)	0.19 ± 0.01	0.31 ± 0.02
COV_{10min}(WM)	0.37 ± 0.01	0.53 ± 0.03

Table 2 Image quality metrics evaluated on Hoffman phantom (II). Relative differences of mean SUVr across all the Hoffman phantom measurements between PET/CT and CMB. Values with * correspond to brain regions that presented statistically significant differences.

Region	Relative difference
Anterior_Cingulate_L	0.06*
Anterior_Cingulate_R	0.05*
Basal_ganglia_L	0.04
Basal_ganglia_R	0.04
Brainstem	0.06*
Insula_L	0.07*
Insula_R	0.02
Occipital_Lateral_L	0.04*
Occipital_Lateral_R	0.02*
Parietal_Inferior_L	0.03*
Parietal_Inferior_R	0.04*
Parietal_Sup+precuneus_L	0.08*
Parietal_Sup+precuneus_R	0.06*
Posterior_Cingulate_L	0.05*
Posterior_Cingulate_R	0.04*
Prefrontal_Lateral_L	0.04*
Prefrontal_Lateral_R	0.04*
Prefrontal_Medial_L	0.10*
Prefrontal_Medial_R	0.08*
Primary_Visual_L	0.05*
Primary_Visual_R	0.00
Sensorimotor_L	0.06*
Sensorimotor_R	0.07*
Temporal_Lateral_L	0.01
Temporal_Lateral_R	0.04*
Temporal_Mesial_L	0.06*
Temporal_Mesial_R	0.07*
MEAN	0.05

Table 3 Image quality metrics evaluated on patients (I). Mean $\pm$ standard deviation of contrast to noise ratio of grey matter: CNR(GM), contrast, signal to noise ratio of grey matter: SNR(GM) and signal to noise ratio of white matter: SNR(WM) distributions of PET/CT images, CMB PET images reconstructed using Emission-based attenuation map and CMB PET images reconstructed using CT-based attenuation map on patients.

	PET/CT	CMB Emission-based AC	CMB CT-based AC
CNR(GM)	3.03 ± 1.17	2.49 ± 1.00	2.65 ± 1.08
contrast	0.60 ± 0.24	0.70 ± 0.26	0.75 ± 0.29
SNR(GM)	7.04 ± 1.78	3.95 ± 0.49	3.95 ± 0.49
SNR(WM)	5.39 ± 1.35	3.56 ± 0.47	3.51 ± 0.49

Table 4 Mean relative difference of PET images across regions by patients

Patient	CMB CT AC CMB Emission AC	PET/CT - CMB CT AC	PET/CT - CMB Emission AC	Patient	CMB CT AC CMB Emission AC	PET/CT - CMB CT AC	PET/CT - CMB Emission AC
CMB_002	0.04	0.05	0.05	CMB_090	0.03	0.04	0.06
CMB_016	0.06	0.06	0.07	CMB_091	0.04	0.04	0.08
CMB_017	0.04	0.04	0.07	CMB_092	0.03	0.06	0.07
CMB_019	0.04	0.05	0.05	CMB_095	0.06	0.03	0.08
CMB_021	0.03	0.03	0.06	CMB_096	0.04	0.05	0.11
CMB_023	0.04	0.06	0.05	CMB_097	0.05	0.05	0.06
CMB_029	0.04	0.04	0.05	CMB_098	0.03	0.04	0.07
CMB_030	0.03	0.04	0.06	CMB_099	0.03	0.05	0.03
CMB_031	0.03	0.04	0.05	CMB_101	0.03	0.06	0.06
CMB_032	0.05	0.05	0.06	CMB_102	0.03	0.03	0.04
CMB_035	0.05	0.05	0.05	CMB_103	0.03	0.06	0.05
CMB_036	0.05	0.03	0.06	CMB_105	0.09	0.03	0.07
CMB_037	0.03	0.03	0.05	CMB_109	0.04	0.04	0.05
CMB_039	0.04	0.05	0.05	CMB_110	0.05	0.07	0.07
CMB_040	0.03	0.08	0.08	CMB_113	0.02	0.03	0.06
CMB_041	0.03	0.04	0.04	CMB_117	0.03	0.04	0.05
CMB_042	0.04	0.05	0.08	CMB_118	0.03	0.03	0.07
CMB_043	0.02	0.05	0.05	CMB_119	0.09	0.06	0.05
CMB_045	0.10	0.07	0.13	CMB_121	0.09	0.09	0.08
CMB_047	0.04	0.04	0.05	CMB_124	0.03	0.07	0.10
CMB_049	0.02	0.04	0.06	CMB_125	0.04	0.04	0.09
CMB_050	0.03	0.05	0.04	CMB_128	0.04	0.05	0.06
CMB_054	0.02	0.04	0.06	CMB_129	0.03	0.06	0.05
CMB_056	0.03	0.04	0.05	CMB_132	0.05	0.07	0.10
CMB_057	0.01	0.04	0.05	CMB_133	0.03	0.05	0.07
CMB_059	0.03	0.06	0.06	CMB_135	0.06	0.03	0.09
CMB_061	0.02	0.04	0.05	CMB_136	0.03	0.03	0.04
CMB_066	0.05	0.03	0.08	CMB_137	0.04	0.03	0.05
CMB_070	0.04	0.04	0.05	CMB_138	0.05	0.06	0.08
CMB_072	0.04	0.04	0.05	CMB_139	0.03	0.04	0.05
CMB_073	0.03	0.04	0.04	CMB_140	0.03	0.05	0.06
CMB_075	0.04	0.04	0.06	CMB_141	0.04	0.04	0.07
CMB_077	0.05	0.06	0.06	CMB_143	0.05	0.10	0.09
CMB_078	0.06	0.05	0.09	CMB_144	0.03	0.04	0.05
CMB_079	0.04	0.03	0.08	CMB_146	0.07	0.06	0.07
CMB_082	0.05	0.03	0.07	CMB_149	0.03	0.04	0.06
CMB_083	0.04	0.06	0.06	CMB_150	0.06	0.13	0.07
CMB_084	0.04	0.04	0.05	CMB_151	0.07	0.05	0.07
CMB_087	0.04	0.04	0.07	CMB_152	0.04	0.05	0.08
CMB_088	0.04	0.04	0.08	CMB_153	0.06	0.05	0.10

Table 5 Image quality metrics evaluated on patients (II). Relative differences of mean SUVr across all the Hoffman phantom measurements between PET/CT and CMB. Values with * correspond to brain regions that presented statistically significant differences.

Region	CMB CT AC – CMB Emission AC	PET/CT – CMB CT AC	PET/CT – CMB Emission AC
Anterior_Cingulate_L	0.04	0.04*	0.04
Anterior_Cingulate_R	0.04	0.04	0.04
Basal_ganglia_L	0.05*	0.09*	0.14*
Basal_ganglia_R	0.04*	0.12*	0.16*
Brainstem	0.07*	0.05*	0.13*
Insula_L	0.05*	0.06*	0.04
Insula_R	0.04*	0.03	0.04
Occipital_Lateral_L	0.07*	0.05*	0.11*
Occipital_Lateral_R	0.06*	0.03	0.05*
Parietal_Inferior_L	0.06*	0.06*	0.11*
Parietal_Inferior_R	0.06*	0.03	0.06*
Parietal_Sup+precuneus_L	0.03	0.04*	0.03
Parietal_Sup+precuneus_R	0.03	0.06*	0.05
Posterior_Cingulate_L	0.03	0.05	0.06*
Posterior_Cingulate_R	0.03	0.04	0.06*
Prefrontal_Lateral_L	0.03	0.09*	0.10*
Prefrontal_Lateral_R	0.04	0.05*	0.08*
Prefrontal_Medial_L	0.03	0.04	0.05
Prefrontal_Medial_R	0.04	0.04	0.05*
Primary_Visual_L	0.02	0.03	0.03
Primary_Visual_R	0.02	0.03	0.04
Sensorimotor_L	0.04*	0.04*	0.08*
Sensorimotor_R	0.04*	0.03	0.05*
Temporal_Lateral_L	0.03	0.07*	0.10*
Temporal_Lateral_R	0.02	0.02	0.02
Temporal_Mesial_L	0.04	0.04	0.04
Temporal_Mesial_R	0.03	0.05*	0.08*
MEAN	0.04	0.05	0.07