

SUPPLEMENTARY MATERIAL 1

Figure S1.1: Locations of reference slices (see manuscript for details; lateral view, midline slice merging WAIR and DCE): coro MIP, axial ACPC, coro-fw BRT, coro-bw MSV, coro ALic, coro AC, coro PC, coro RV, MB-PC axial-uw VF, axial-uw BFG, axial uncinata and the axial cow acpc; ACPC system (yellow box), y-length (ACPC length)=30 mm, z-height=60 mm; 3D views of red nucleus (red), mammillary body (green), subthalamic nucleus (yellow), ventral tegmental area (beige), nucleus ventrointermediate of thalamus (purple) and pedunculopontine nucleus (carmine).

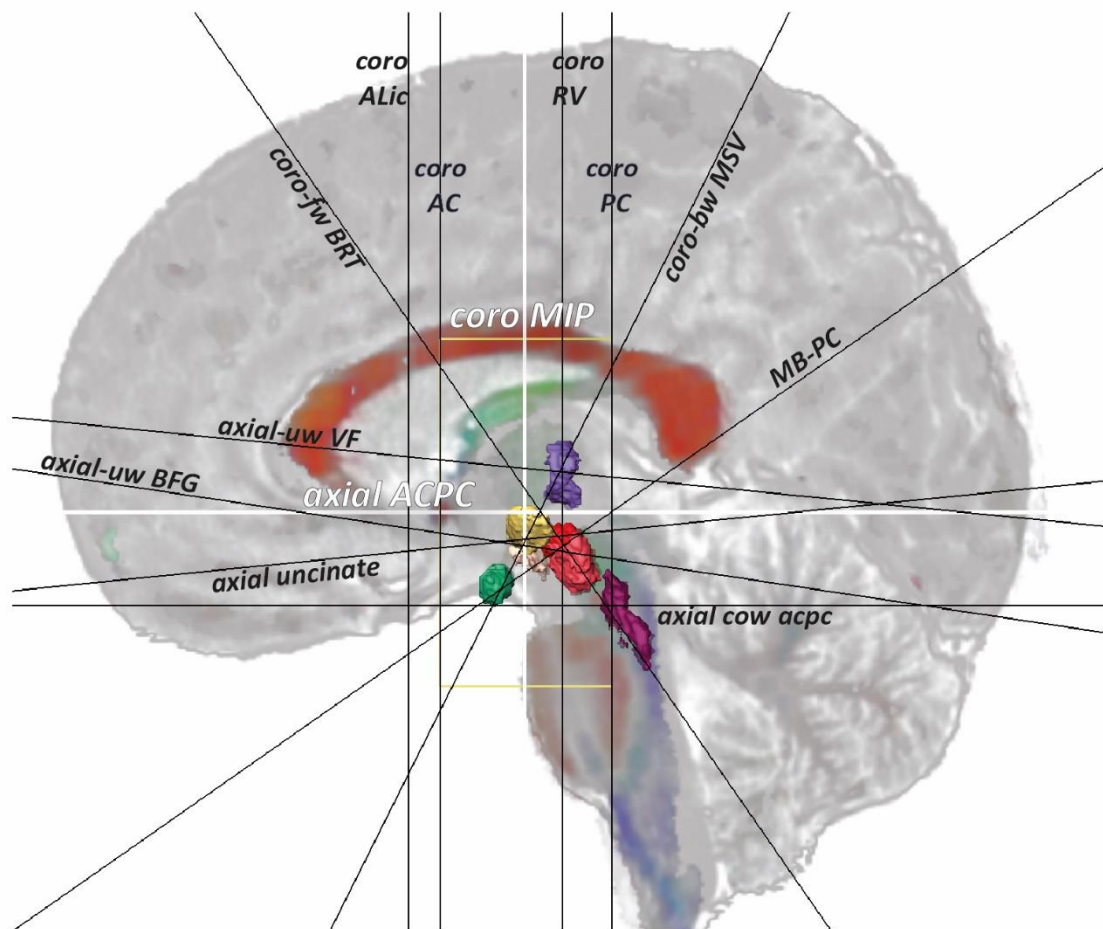


Figure S1.2: Slices of Charcot (1876) and Dejerine (1901) [coro MIP]

Top left, drawing/slice modified from Jean-Martin Charcot (1876), “verticale et transversale”; top right, equivalent slice modified from Dejerine (1901); bottom, equivalent coro MIP WAIR slice with eMDBA contours.

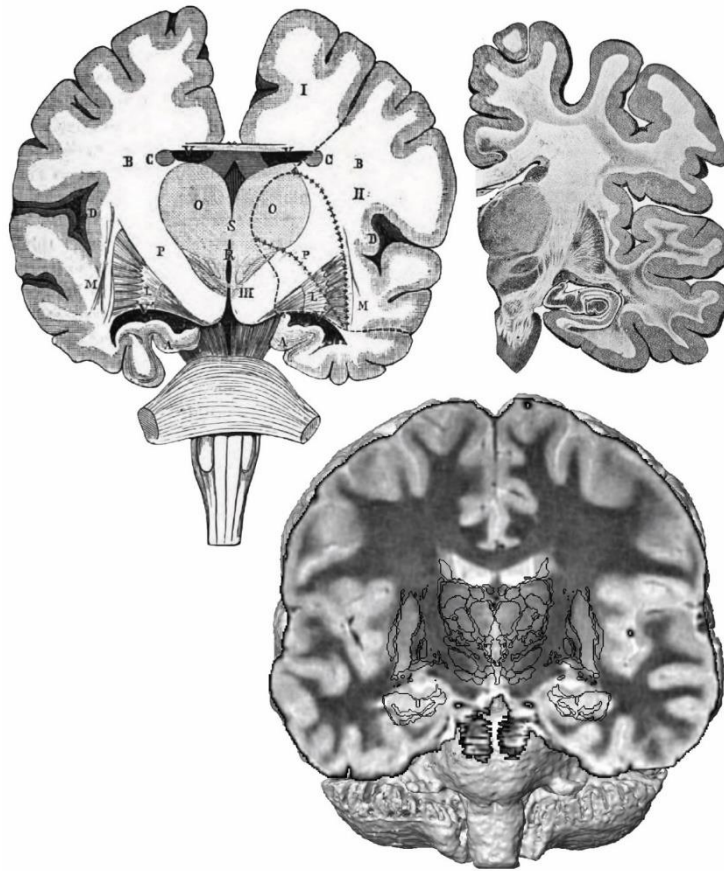


Figure S1.3: Slice of Dejerine (drawing H Gillet, 1901) [axial ACPC]

Left, ACPC axial slice modified from Dejerine (1901), and, right, equivalent axial ACPC WAIR slice with eMDBA contours.

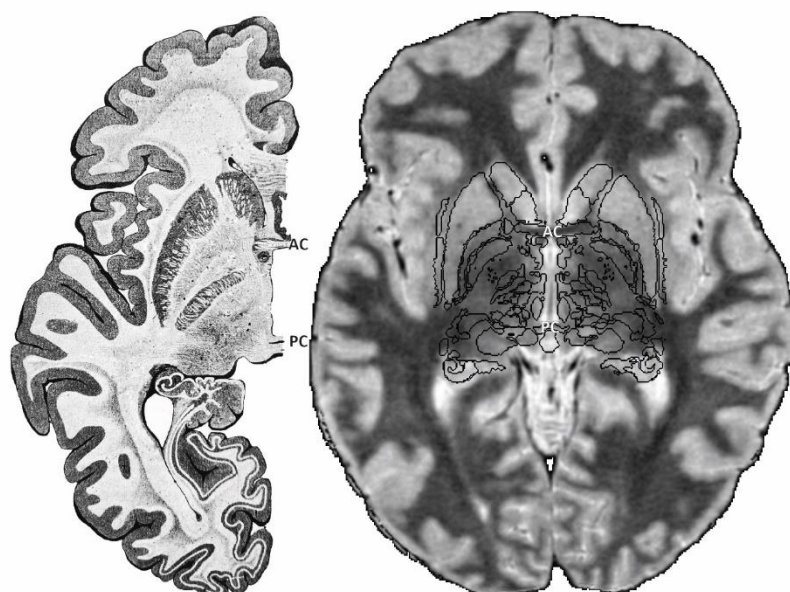


Figure S1.4: Pseudo-coronal slices going through the brachium conjunctivum, the red nucleus and the thalamus [coro-fw BRT]

Left, reconstructed histological slice modified from Riley (1946) showing the brachium conjunctivum (BC), the red nucleus (RN), the subthalamic nucleus (STN) and the anterior thalamus (tha); right, equivalent pseudo-coronal WAIR (coro-fw BRT) slice, with eMDBA contours.

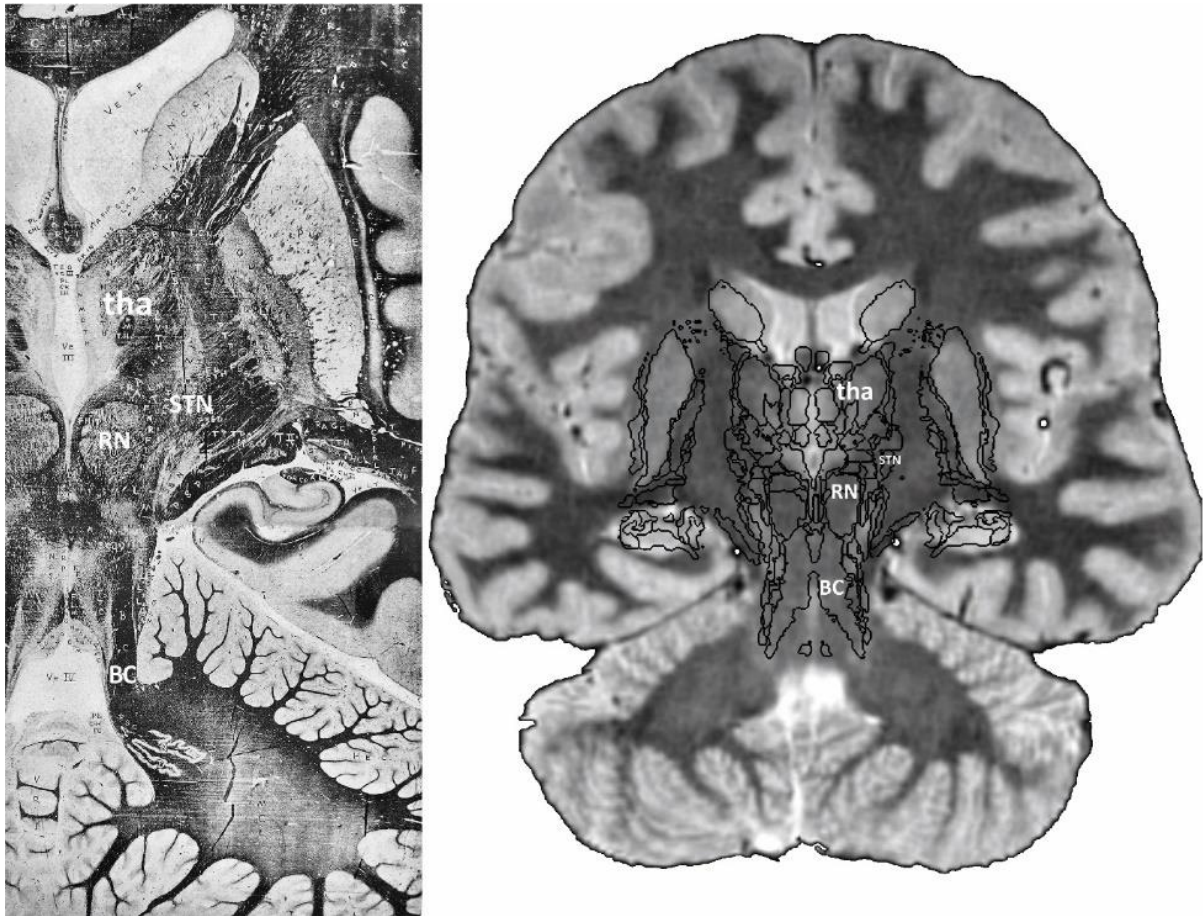


Figure S1.5: Pseudo-axial slice going through the basal forebrain gate [axial-uw BFG]

Top, modified drawing from a photograph of Luys (1873) of a pseudo axial section of deep brain showing the region of the triangle of Sano (see manuscript); bottom left, equivalent section modified from Schaltenbrand and Wahren (1977); bottom right, equivalent pseudo-axial WAIR (axial-uw BFG) slice, with eMDBA contours and labels; red nucleus, RN; subthalamic nucleus, STN; internal capsule, IC; medial geniculate body, MGB; optic tract, OT; ansa lenticularis, AL; innominate substance, Si; putamen, Put; anterior commissure, AC; pallidum, GP; intern pallidum, gpi; putamen rubral, PuR; fornix, Fo; hypothalamus, hyp; mammillo-thalamic fascicle, mtf; ventral tegmental area, VTA; red nucleus, cranial, RNcr, and caudal, RNcd; zona incerta, ZI; caudate, cau; stria terminalis, St; lateral geniculate body, LGB; peripeduncular nucleus, PerPn; medial lemniscus, ML; central tegmental tract, CTT; tegmental reticular formation, TegRF; periaqueductal gray, Pag; medial longitudinal fascicle, mlf; dorsal longitudinal fascicle, dlf; retroflexus fascicle, RF; hippocampus, hip; central zone of tegmentum, cz; nucleus of ansa lenticularis, nAL.

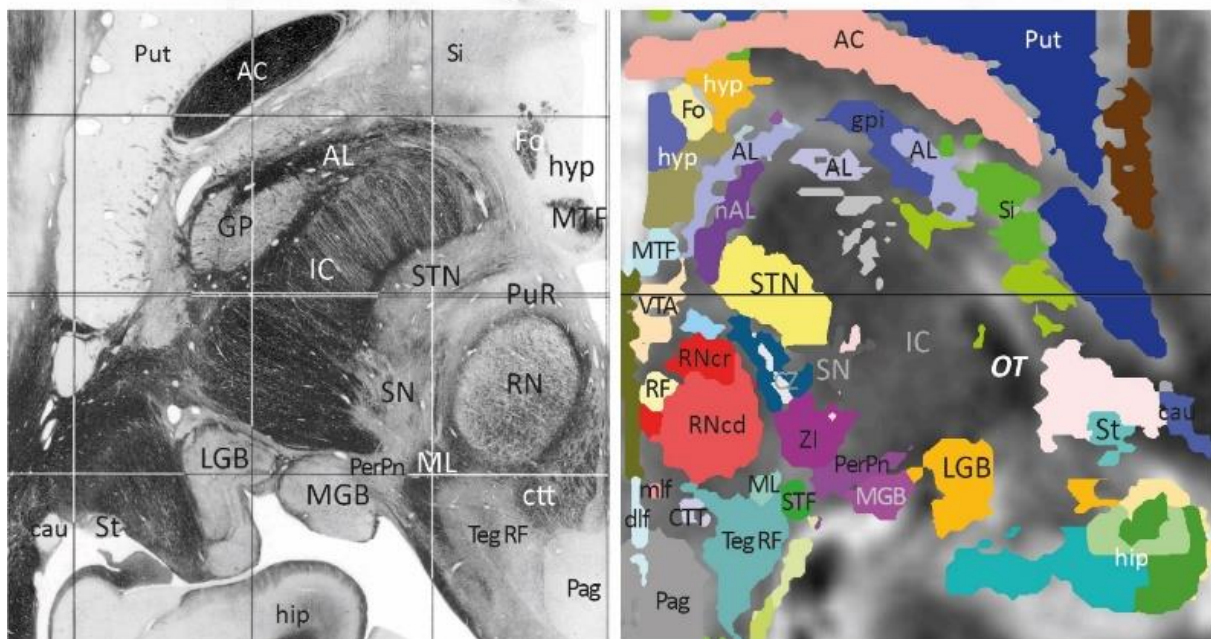
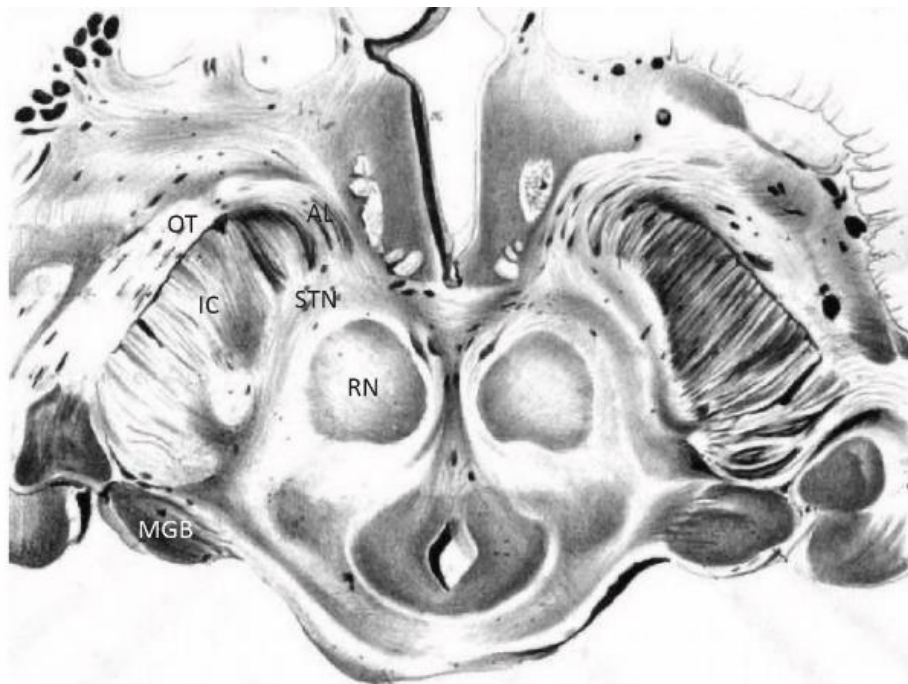


Figure S1.6: Pseudo-coronal slices going through the mammillary body, the subthalamus nucleus and the thalamus [coro-bw MSV]

Top left, histological slice adapted from Dejerine (1901), and, bottom left, drawing adapted from Nieuwenhuys et al (2008), showing the internal capsule (IC), the medial nucleus of thalamus (M), the mammillary body (MB), the lateral-extern nucleus of thalamus (Ne), the subthalamic nucleus, STN, the ventrolateral nucleus of thalamus (VL) and the zona incerta (zi); right, equivalent pseudo-coronal WAIR (coro-bw MSV) slice, with eMDBA contours.

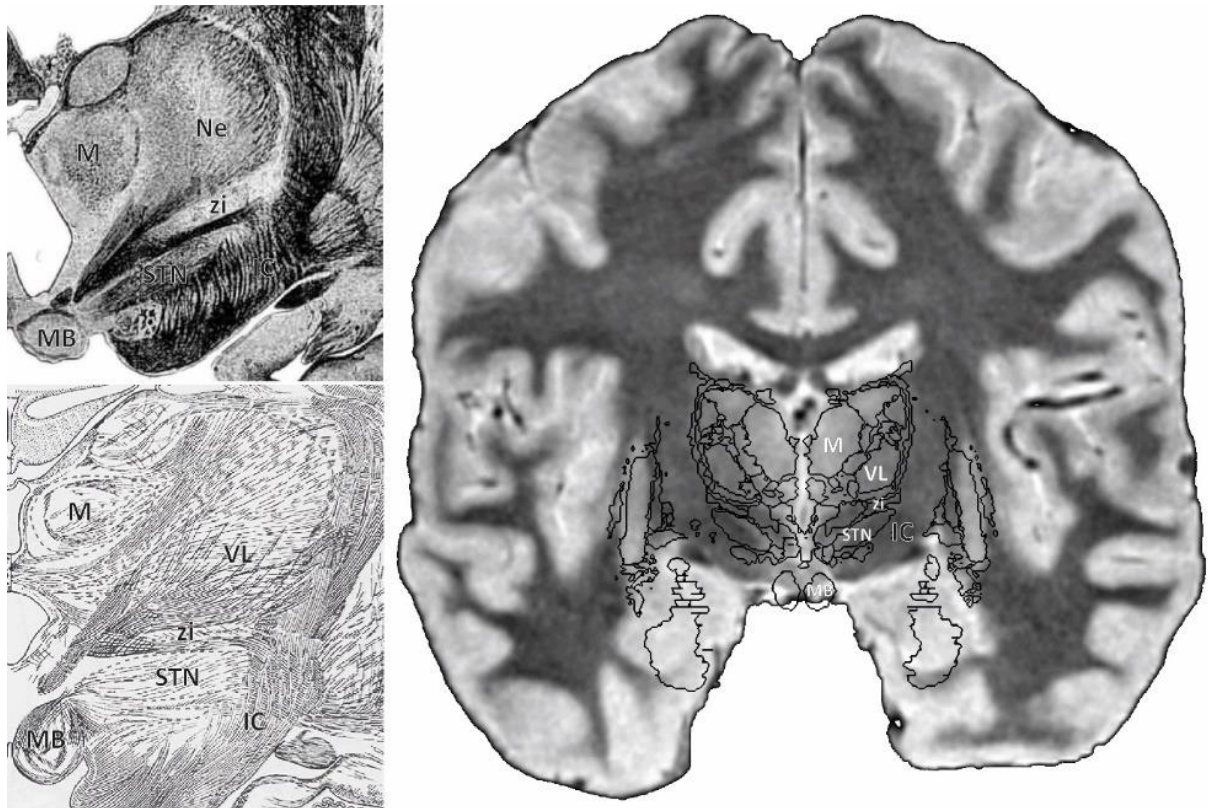


Figure S1.7: Pseudo-axial slice going through the ventricular foramen [axial-uw VF]

Top left, adapted photograph from Luys (1873), top right and bottom left, adapted histological drawings from Dejerine (1901), bottom right, equivalent pseudo-axial WAIR (axial-uw VF) slice, with eMDBA contours: caudate, cau; nucleus centromedian, CM; fornix, Fo; habenula, hab; lamina cornea, Lc; mammillo-thalamic fascicle, mtf; pallidum, GP (e, extern); putamen, Put; pulvinar, Pu.

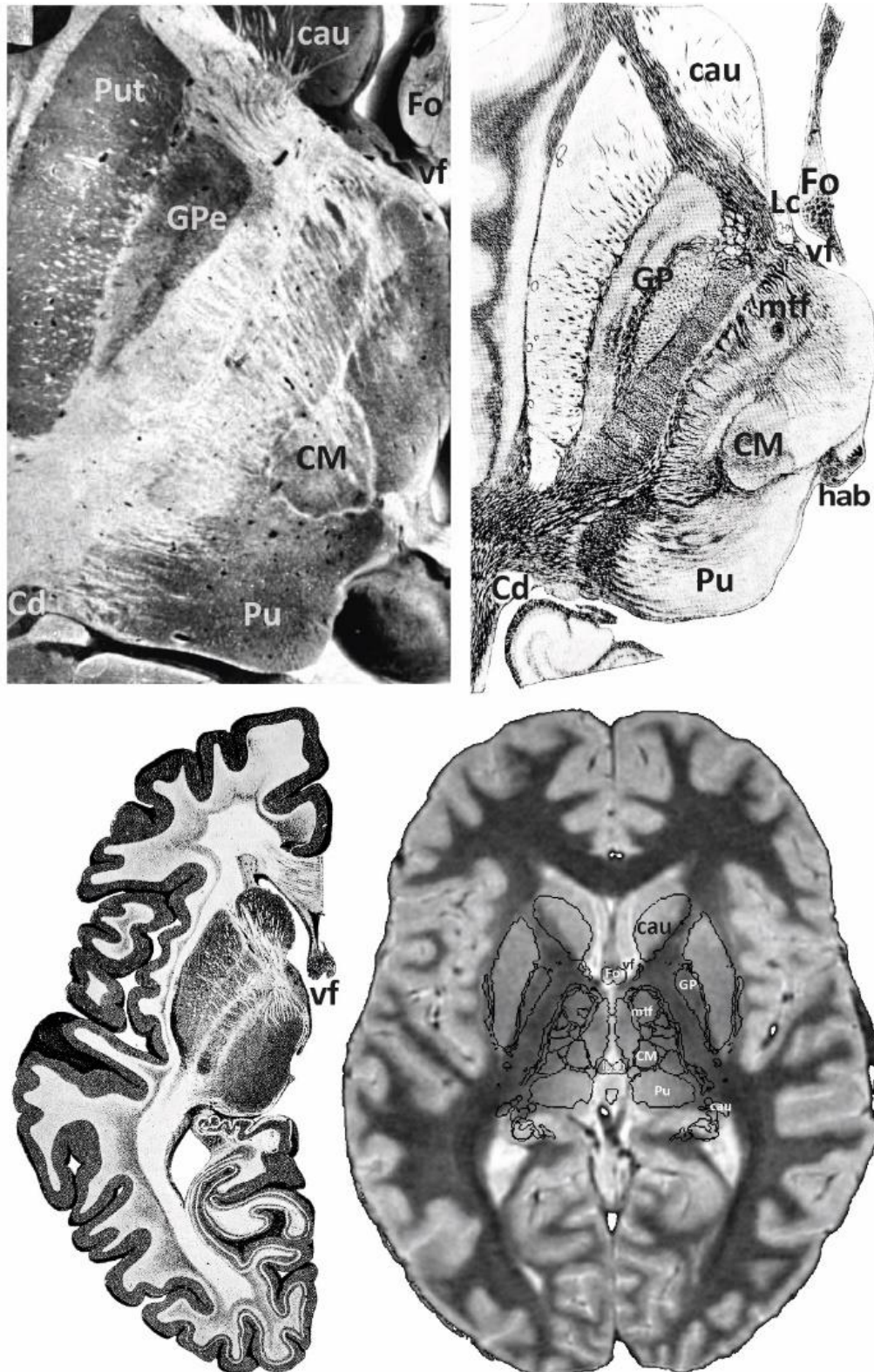


Figure S1.8: Coronal slice going through the posterior commissure [coro PC]

Left, histological slice adapted from Dejerine (1901), and, right, equivalent coronal WAIR (coro PC) slice, with eMDBA contours: caudate, cau; thalamus, Tha; medial and lateral geniculate bodies (mgb, lgb, both gb), inferior longitudinal fascicle (ILF), fronto-occipital fascicle (FOF), temporo-thalamic fascicle of Arnold that belongs to the inferior cortico -thalamic fibers (ArF), hippocampus (hip).

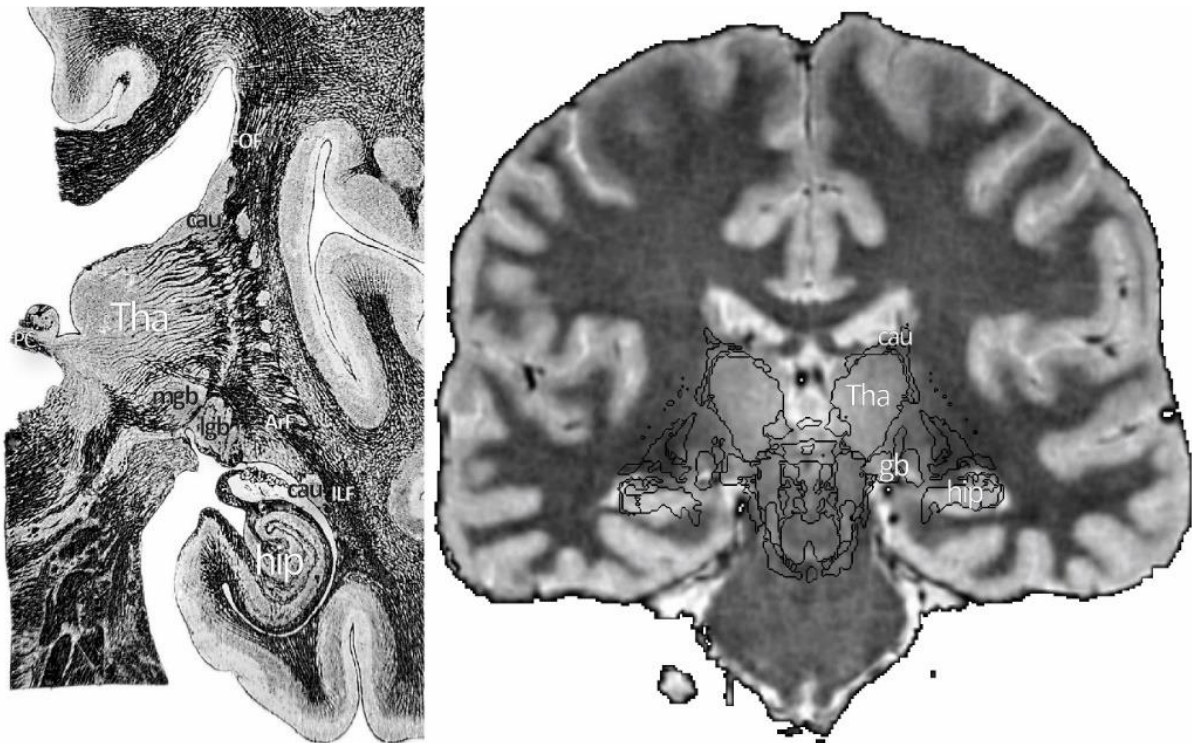


Figure S1.9: Coronal slice going through the uncinate fascicle [axial uncinata]

Top, pseudo axial slices (frontward, anterior wise) going through the uncinate fascicle (UF) adapted from Dejerine (1901), bottom, equivalent pseudo-axial WAIR (axial uncinata) slice, with eMDBA contours: nucleus accumbens (acc), inferior longitudinal fascicle (ILF), putamen (Pu), innominate substance (is), red nucleus (RN), hypothalamus (hyp), anterior commissure (AC), subthalamic nucleus (STN), fornix (Fo), mammillo-thalamic fascicle (mtf), pallidum (gp).

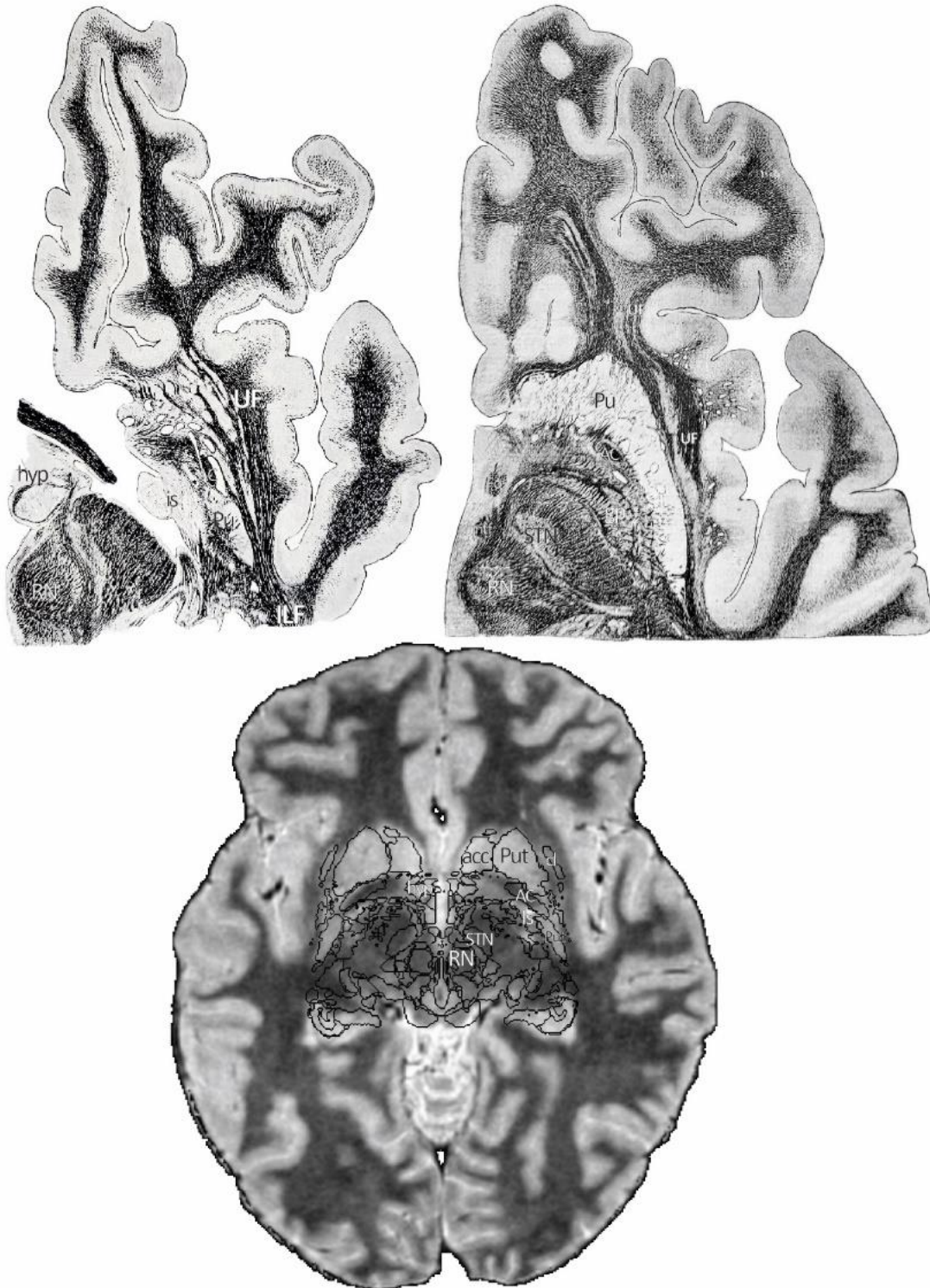
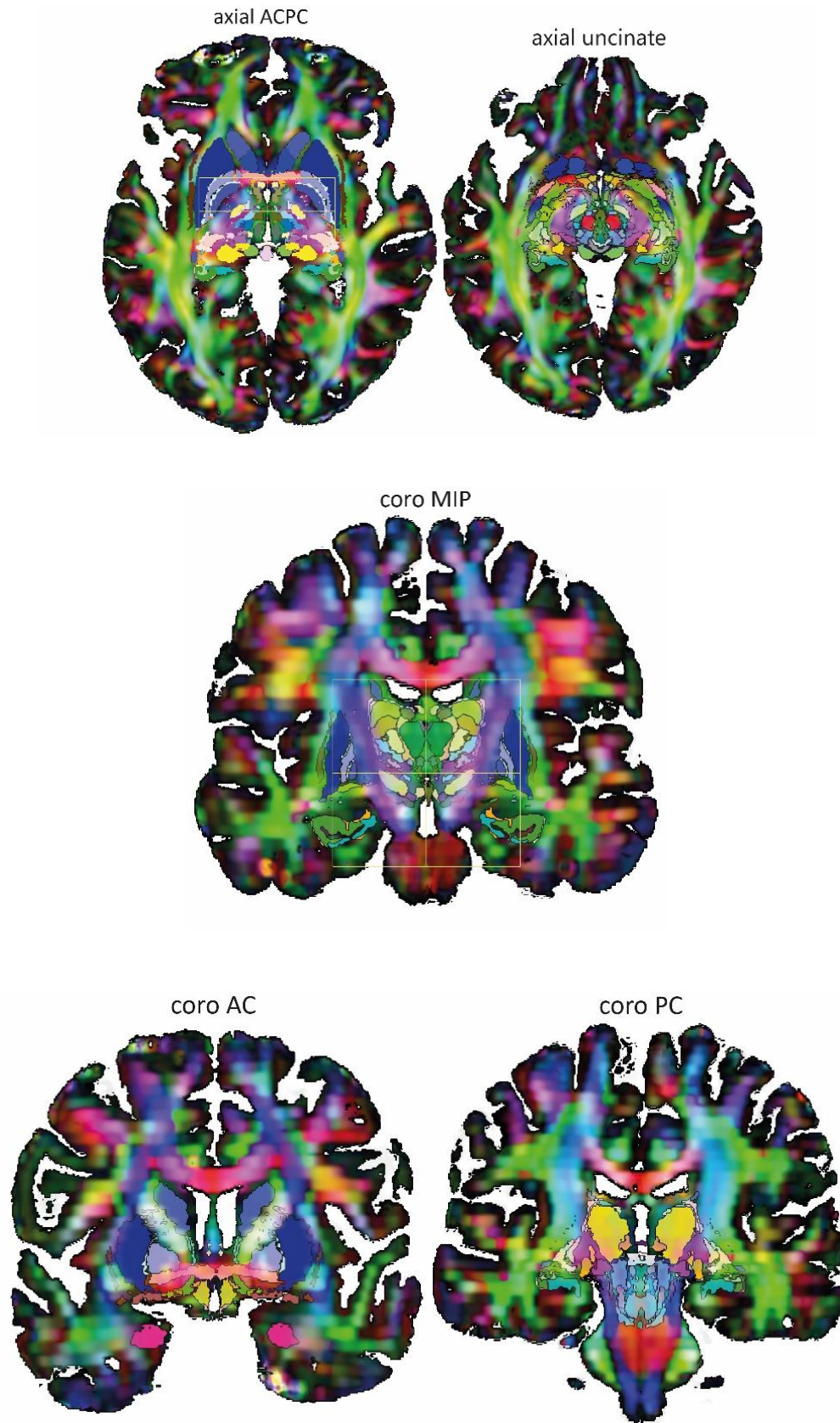
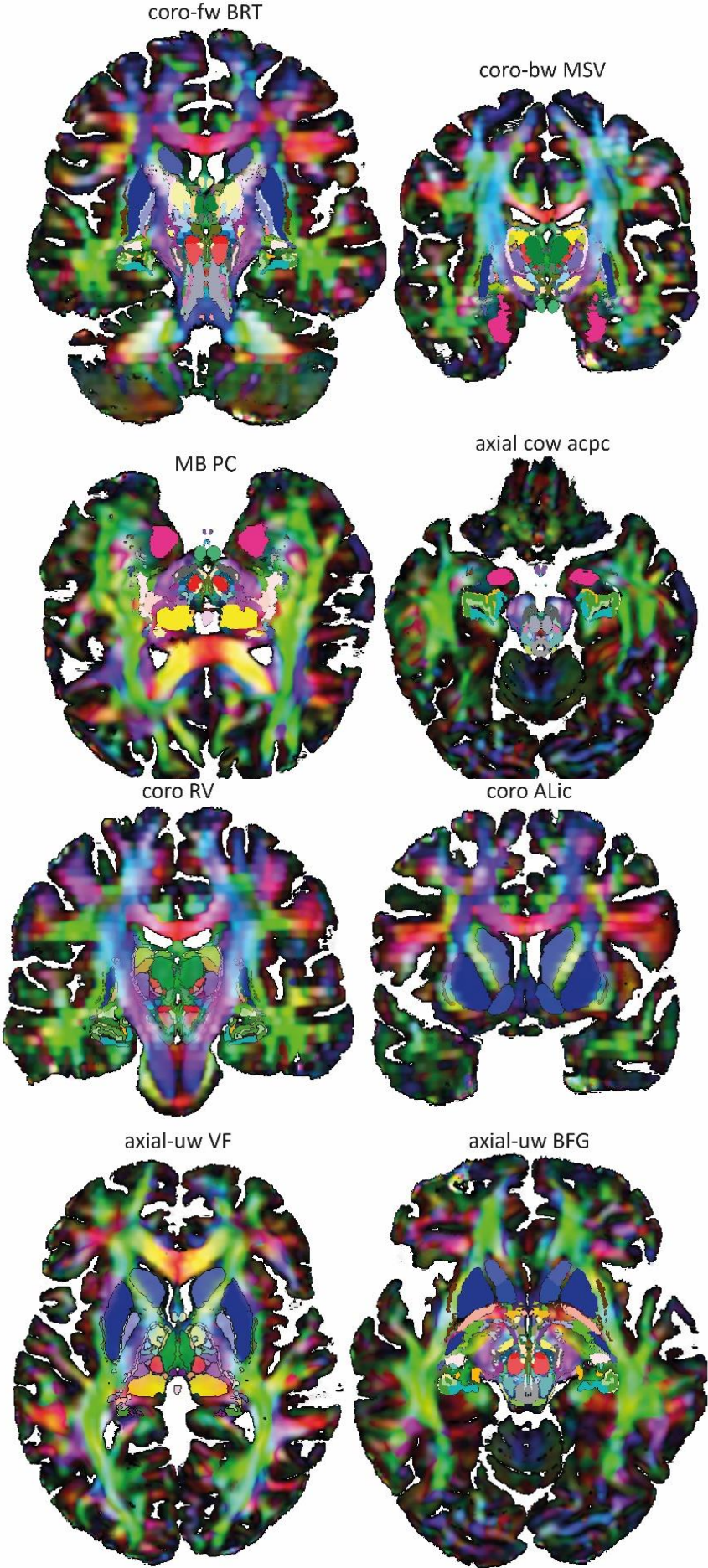


Figure S1.10: Reference slices (n=13; eMDBA color code: eMDBA Labels.xlsx); DCE with eMDBA slices; ACPC system (box), x-width=60 mm, y-width=60 mm, z-length=60 mm





SUPPLEMENTARY MATERIAL 2

Figure S2.1: *MNI152 and CIT168 data sets registered to the WAIR template*

ICBM152 (left) and CIT168 T1-T2 (right) population-based atlases, ACPC aligned and registered (affine) to the WAIR template: axial=horizontal plan going through ACPC (top row); coronal plan going through the midpoint between AC and PC (intermediate row); sagittal plan going through the midplane (bottom row); ACPC system (yellow box), x-width=60 mm, y-length (ACPC length)=30 mm, z-height=60 mm.

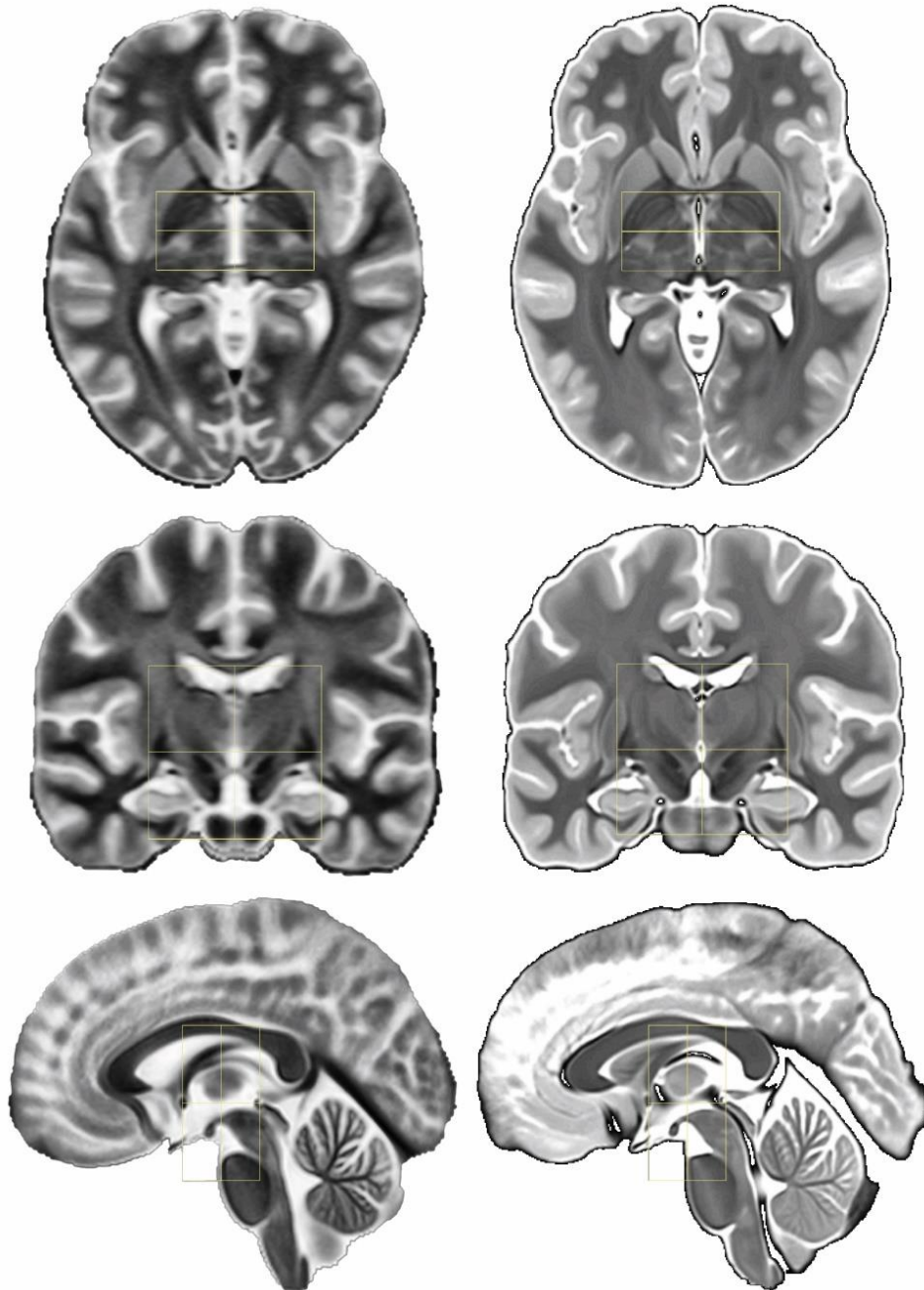


Figure S2.2: Comparison of T1 and WAIR Healthy Subject Image Data Sets

T1 (top row) and WAIR (bottom row) coro MIP slice (no filtering), without (left) and with eMDBA labels, showing the ability of Inversion-Recovery sequence to detail the structural nuclear based parcellation of deep brain; ACPC system (yellow box; x-width=60 mm, z-height=60 mm).

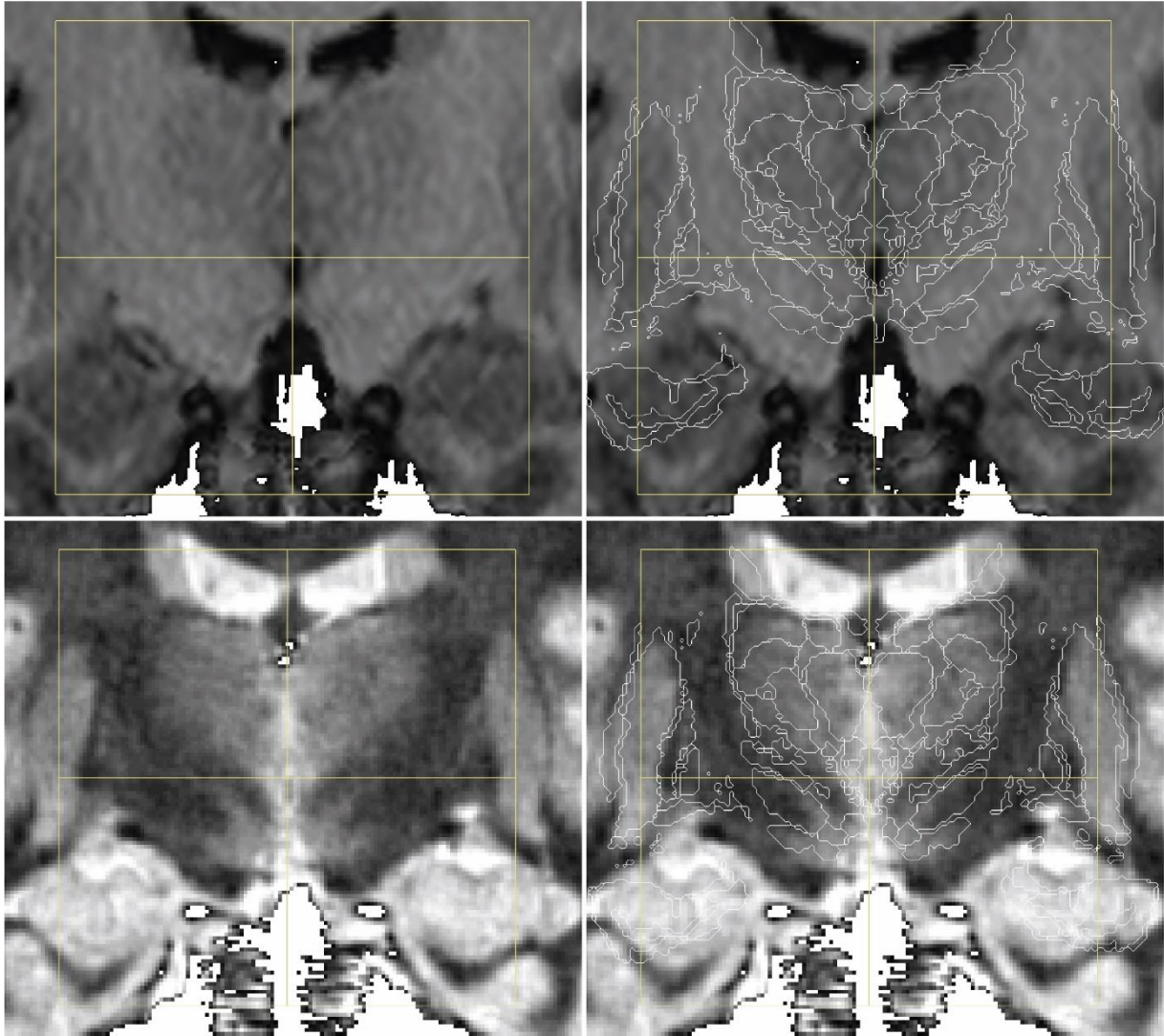


Figure S2.3: *Tracing of large subcortical fascicles crossing or bordering the deep brain - Coro ALic slice*

Coro ALic slice (anterior view) showing the cingulum (CIN), the corpus callosum FT (CC FT), the fronto-occipital fascicle (FOF) and the pre commissural fornix (pCFo); DCE with eMDBA labels; caudate, cau; putamen, put; nucleus accumbens, acc.

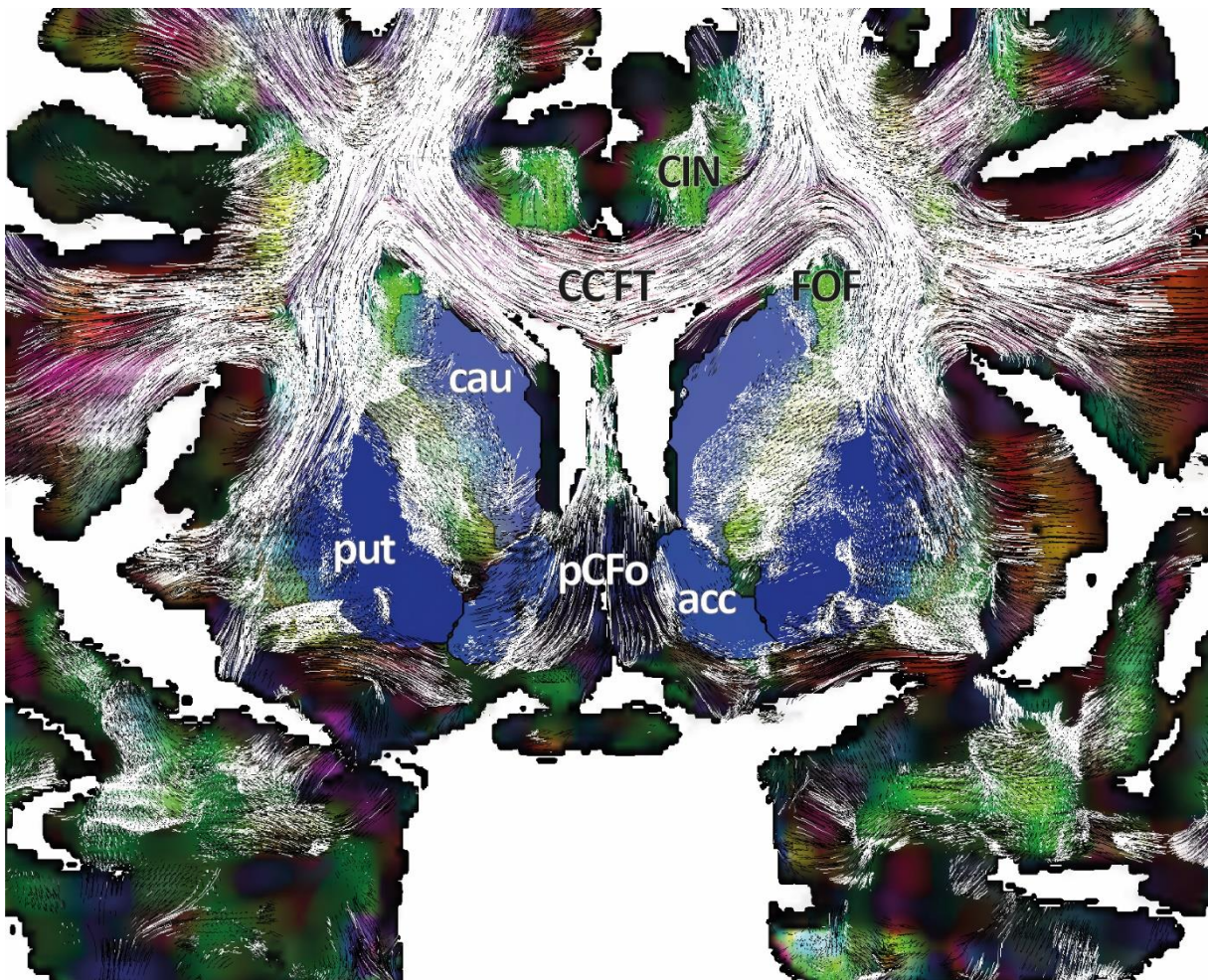


Figure S2.4: Tracing of large subcortical fascicles crossing or bordering the deep brain - coronal AC slice

Fiber tracing on DCE map and eMDBA along the coronal AC slice: cingulum (CIN), callosal FT (CC FT), fronto-occipital fascicle (FOF), inferior longitudinal fascicle (ILF), basal forebrain FT (BF FT), uncinata fascicle (UF), anterior commissure (AC), fornix (Fo), hypothalamus (hyp), putamen (Pu), extern pallidum (gpe), caudate (cau), olfactive area (Oa), diagonal band of Broca (dbb), innominate substance (is).

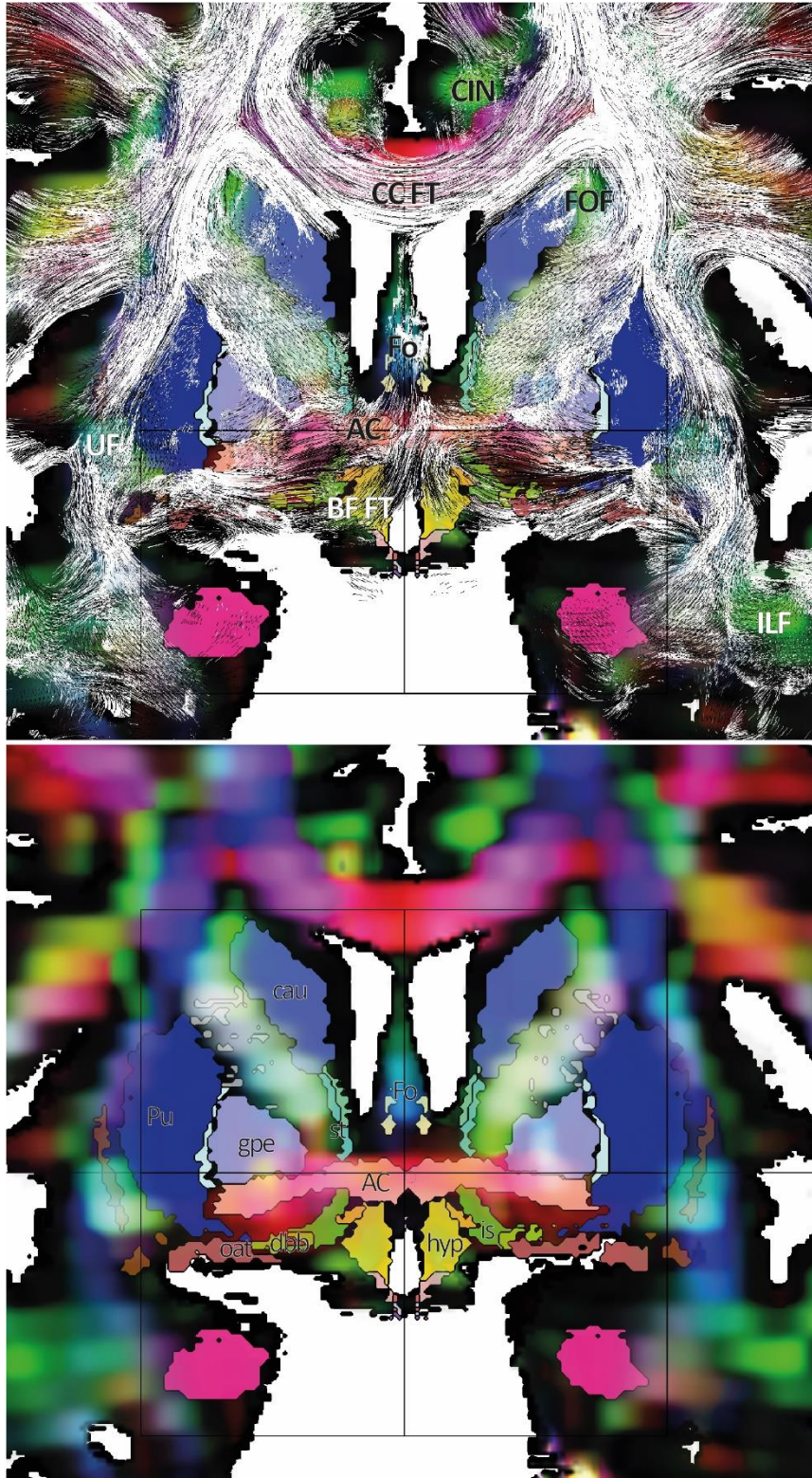


Figure S2.5: Tracing of large subcortical fascicles crossing or bordering the deep brain - Coro MIP slice

Coro MIP slice (anterior view) showing the cingulum (CIN), the corpus callosum FT (CC FT), the fronto-occipital fascicle (FOF), the cortico-caudal FT (Cx FT), the inferior longitudinal fascicle (ILF), the fascicle of Türk (TF) and the fascicle of Arnold (ArF); DCE with eMDBA labels; thalamus (tha), subthalamus (subtha), lenticular nucleus (len), and hippocampus (hip).

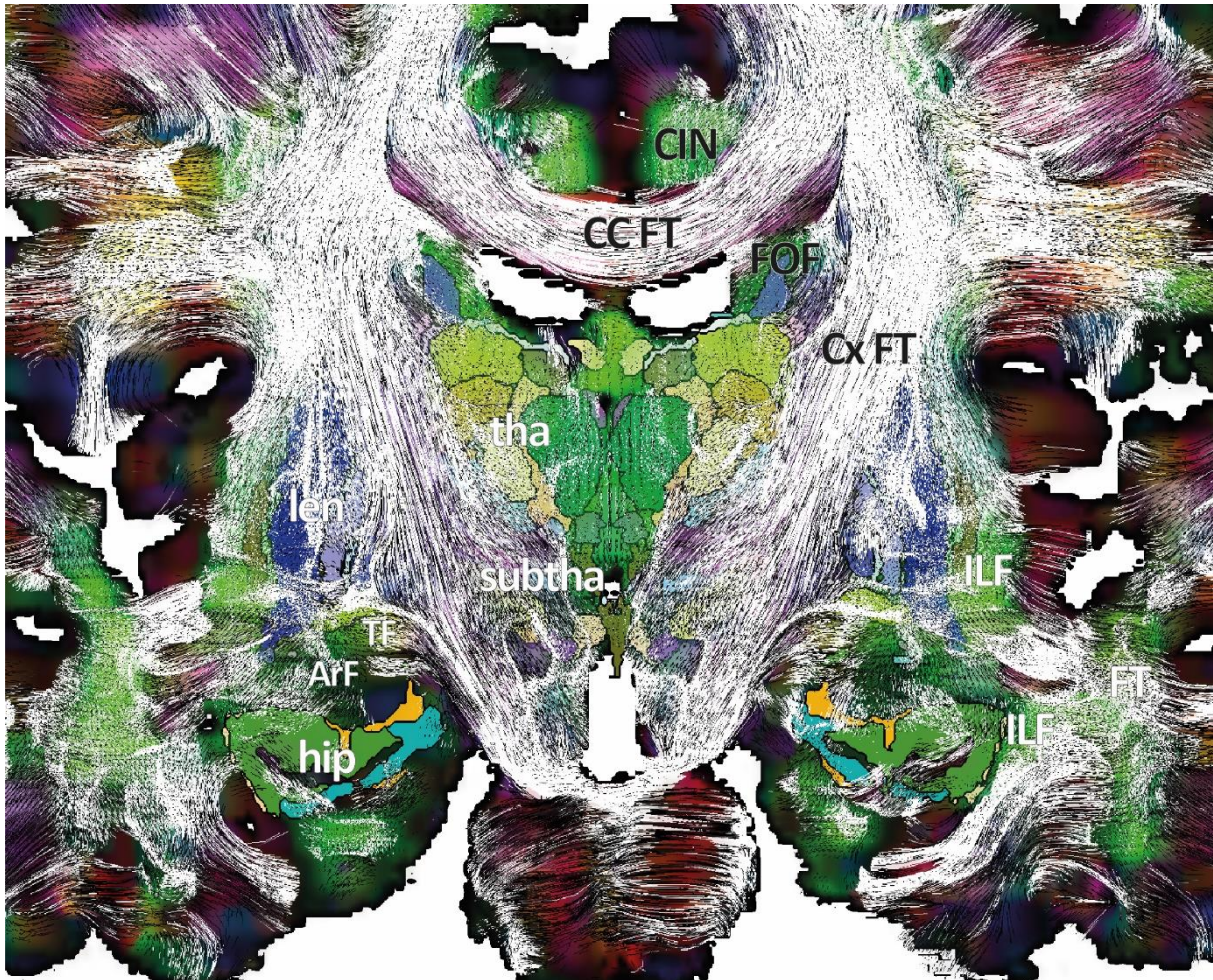


Figure S2.6: Tracing of large subcortical fascicles crossing or bordering the deep brain - MB-PC slice

MB-PC slice (superior view) showing the cingulum (CIN), the corpus callosum FT (CC FT), the inferior longitudinal fascicle (ILF), the tapetum (TP), the fascicle of Arnold (ArF) and the fascicle of Türk (TF); DCE map with eMDBA labels; thalamus (tha), subthalamus (subtha), hypothalamus (hyp), amygdala (am), posterior commissure (PC), zone of Wernicke (zow) and internal capsule (ic).

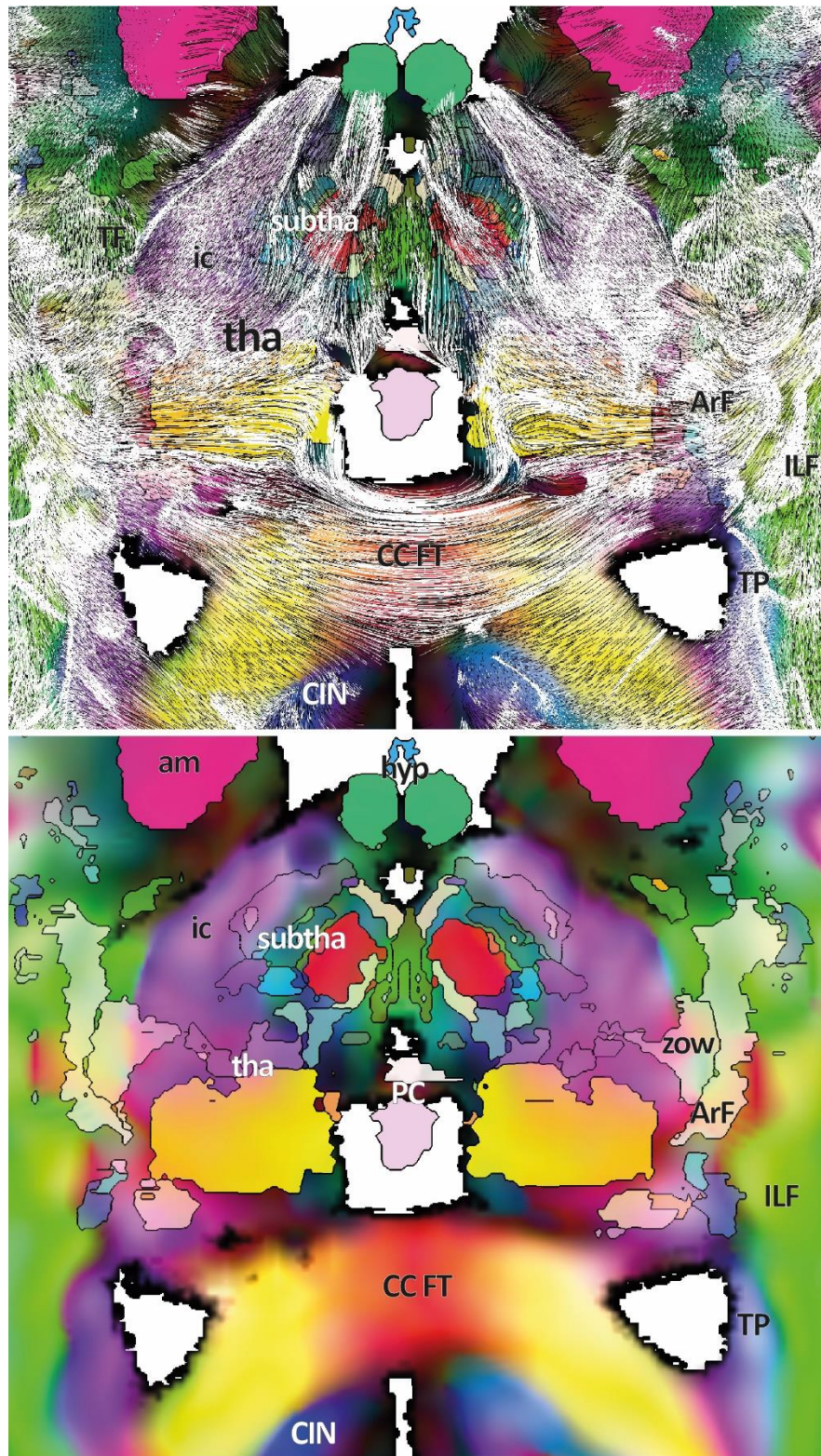


Figure S2.7: Tracing of large subcortical fascicles crossing or bordering the deep brain - Uncinate slice

Uncinate slice (superior view) showing the uncinate fascicle (UF), the inferior longitudinal fascicle (ILF), the fascicle of Türk (TF), the temporo-thalamic fascicle of Arnold (ArF), and the thalamic radiations (RTh; here the posterior TR that participates to the optic radiations of Gratiolet); DCE map with eMDBA labels; subthalamic nucleus (STN), red nucleus (RN), nucleus accumbens (acc), caudate (cau), putamen (Pu), anterior-margin sulcus of insula (ams), third or inferior frontal gyrus (F3), innominate substance (is), hypothalamus (hyp), anterior commissure (AC), extreme capsule (exc), fornix (Fo) and mammillothalamic fascicle (mtf).

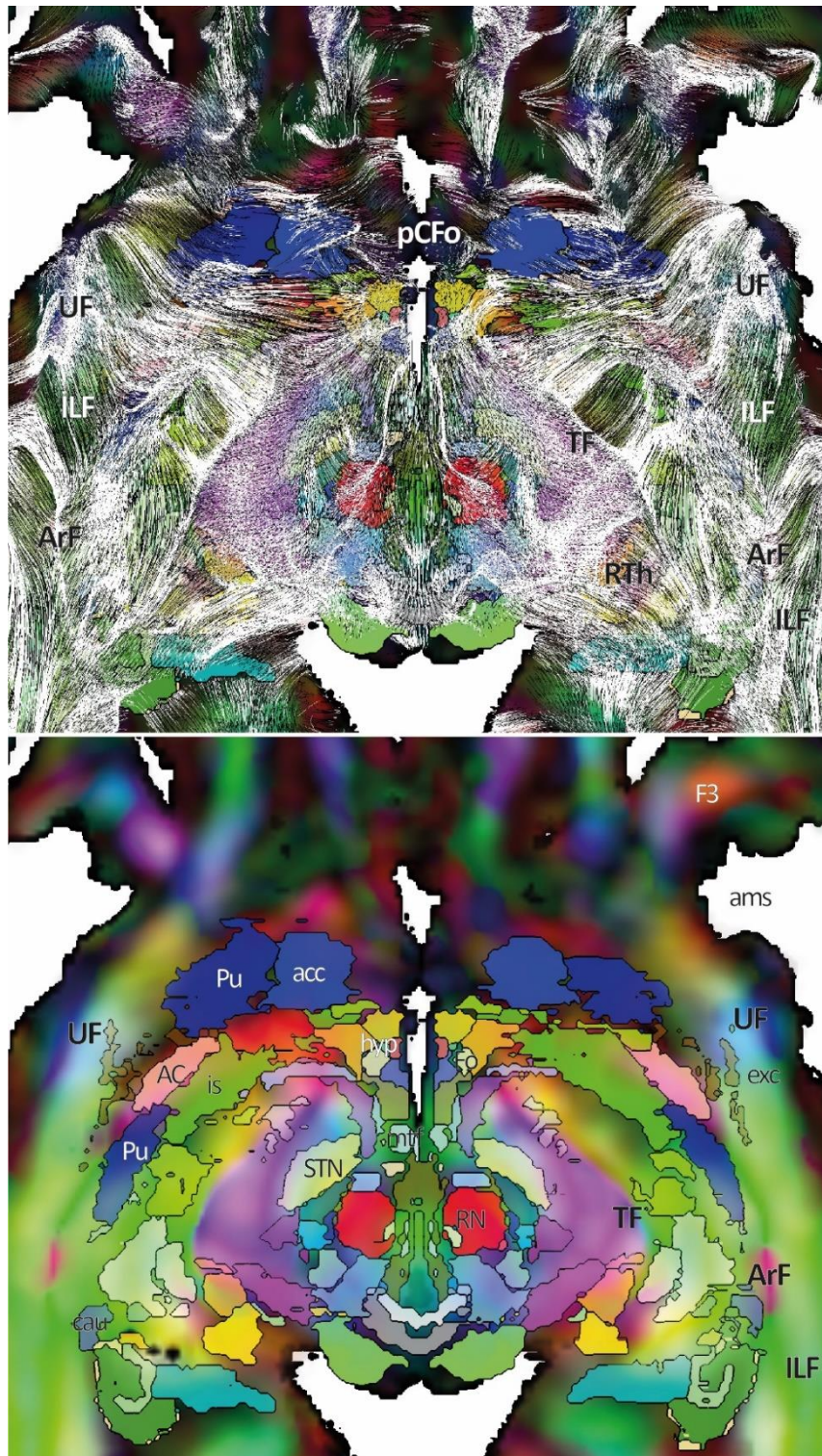


Figure S2.8: Tracing of large subcortical fascicles crossing or bordering the deep brain - Coro PC slice

Coro PC slice (posterior view) showing the inferior longitudinal fascicle (ILF), the pontine transversal fibers (PonTF), the fascicle of Türk (TF), the temporo-thalamic fascicle of Arnold (ArF), the fronto-occipital fascicle (FOF), the cortico-caudal FT (Cx FT); DCE map with eMDBA labels; middle cerebellar peduncle (mcp), brachium conjunctivum (BC), hippocampus (hip), medial lemniscus (ML), tegmental mesencephalic reticular formation (tmrf), medial longitudinal fascicle (mlf), pedunculo-pontine nucleus (PedPn), peripeduncular nucleus (PerPn), hypothalamus (hyp), posterior commissure (PC), medial and lateral geniculate bodies (mgb, lgb). Zone of Wernicke (zow), pulvinar (Pu), caudate (cau), stria terminalis (st), fimbria (fm), fornix (Fo).

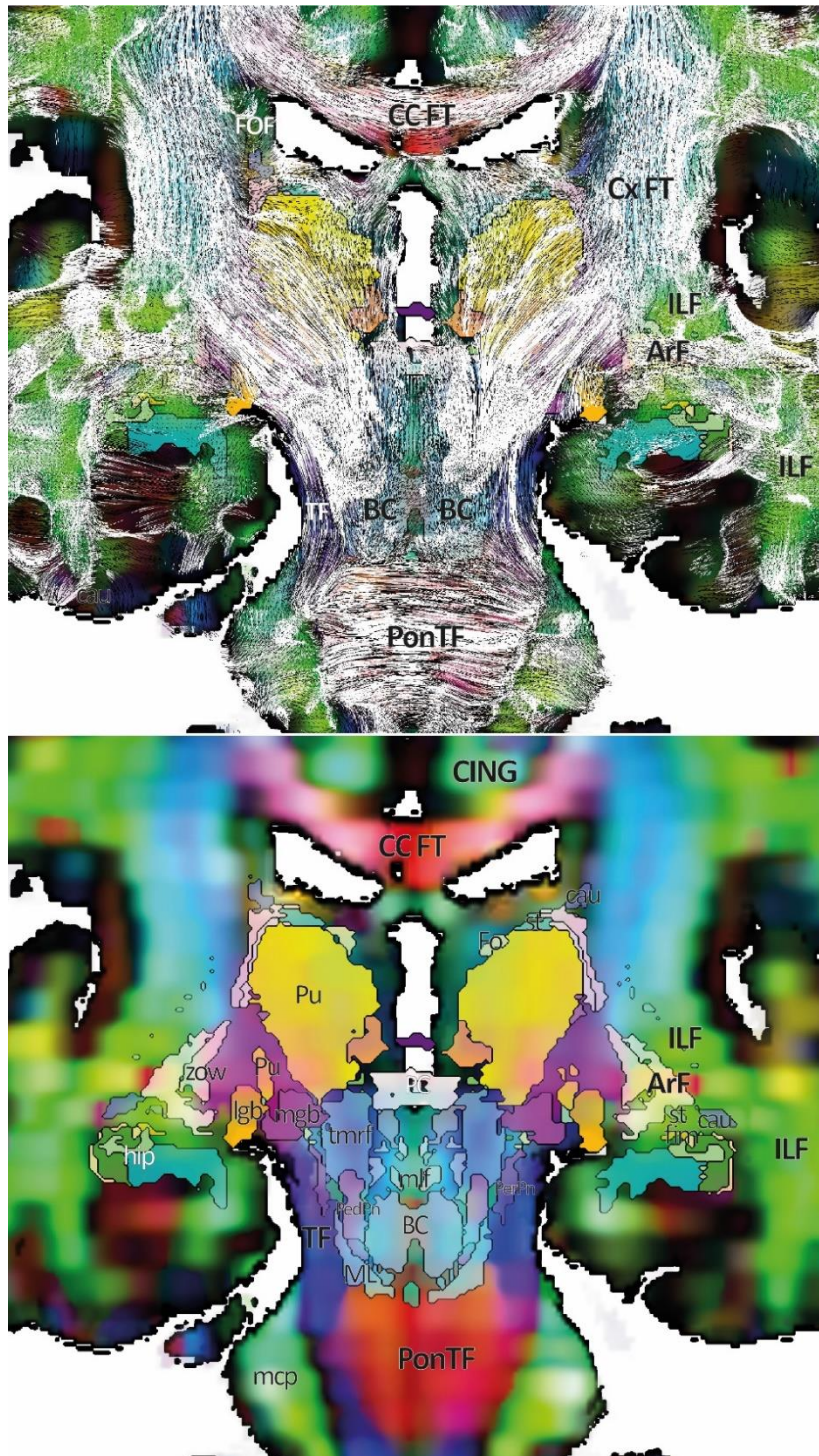


Figure S2.9: *eMDBA based interpretation of DTI structural topography – axial slice 1 mm above ACPC*

Fiber tracing on DCE map and eMDBA along the axial slice going through the lenticular fascicle (LF) (1 mm above ACPC) showing the lenticular fascicle (LF), the basal forebrain FT (BF FT), the fornix (Fo), the anterior commissure field (AC) and the the lenticulo-thalamic and -subthalamic FT (LT/LST FT); pallidum extern (gpe) and intern (gpi), thalamic fascicle (Tf), interbrain central gray (icg), superficial medial thalamus (smt), nucleus ventrocaudal medial of thalamus (VCM), nucleus ventrocaudal lateral of thalamus (VCL), nucleus ventrointermediate of thalamus (Vim), subthalamic tegmental fields (stf), zona incerta (zi), inferior thalamic peduncle (ip), superficial lateral thalamus (slt), pulvinar (Pu).

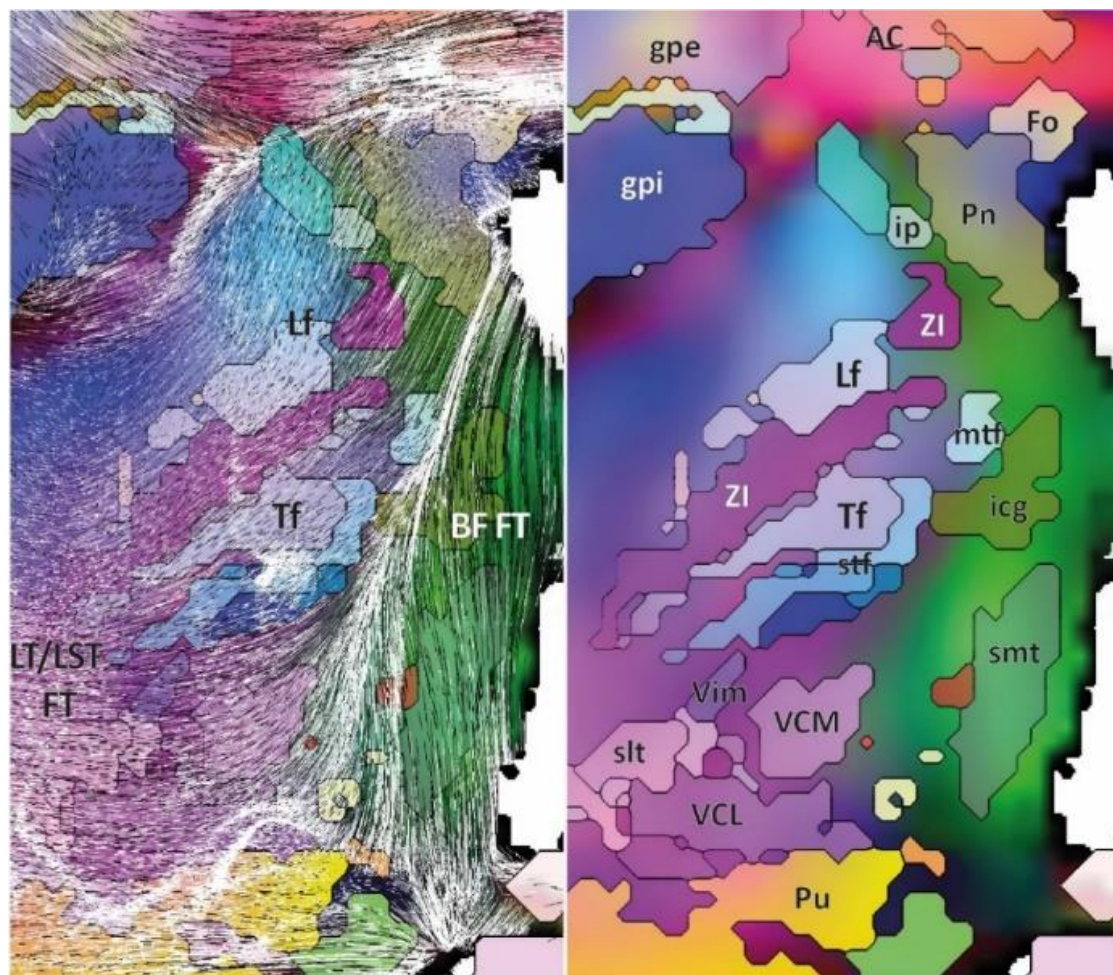


Figure S2.10: *eMDBA based interpretation of DTI structural topography - Coro-fw BRT slice*

Coro-fw BRT slice (posterosuperior view), top, DCE with eMDBA (contours, left; labels, right), bottom, tracing on DCE and eMDBA labels, showing the cerebello-rubro-thalamic pathway (CRTC): rubral radiations (RR), brachium conjunctivum (BrC), commissure of Wernick (CW), commissure of Bechterew (CB) and the cortico-caudal FT (Cx FT); red nucleus, caudal (RNcd) and cranial (RNcr), interbain central gray (lcg), mammillo-thalamic fascicle (MTF), medial nucleus of thalamus (M), anterolateral nucleus of thalamus (AL), thalamic fascicle (Tf), zona incerta (ZI), subthalamic nucleus (STN), central zone of tegmentum (czt), fronto-pontine fascicle (FPf), substantia nigra (SN), medial lemniscus (ML), pedunculopontine nucleus (PedPn), peripeduncular nucleus (PerPn), spinothalamic fascicle (STf).

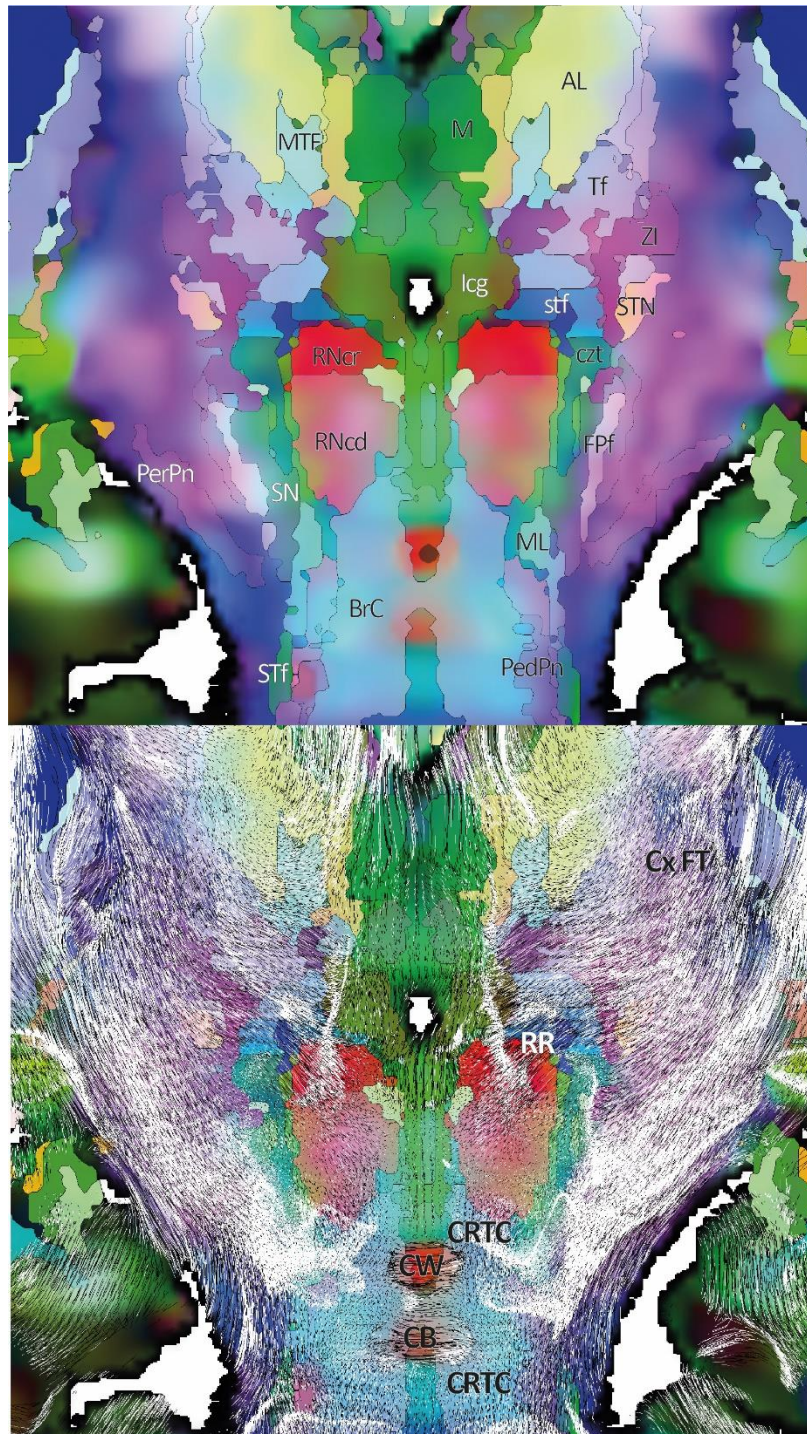


Figure S2.11: *eMDBA based interpretation of DTI structural topography - Axial cow acpc slice*

Axial cow acpc slice (superior view): top, slice adapted from Dejerine (1901), bottom left, DCE with eMDBA labels, bottom right, tracing, showing the brachium conjunctivum (BrC), the commissure of Wernekink (CW) and the cerebello-rubro-thalamic pathway (CRTP); cerebral peduncle (CP), interpeduncular-paranigral nucleus (IPN), substantia nigra (SN), medial lemniscus (ML), pedunculo-pontine nucleus (PedPn), peripeduncular nucleus (PerPn), spinothalamic fascicle (STf), periaqueductal gray (Pag), medial longitudinal fascicle (MLf) and central tegmental tract (CTT).

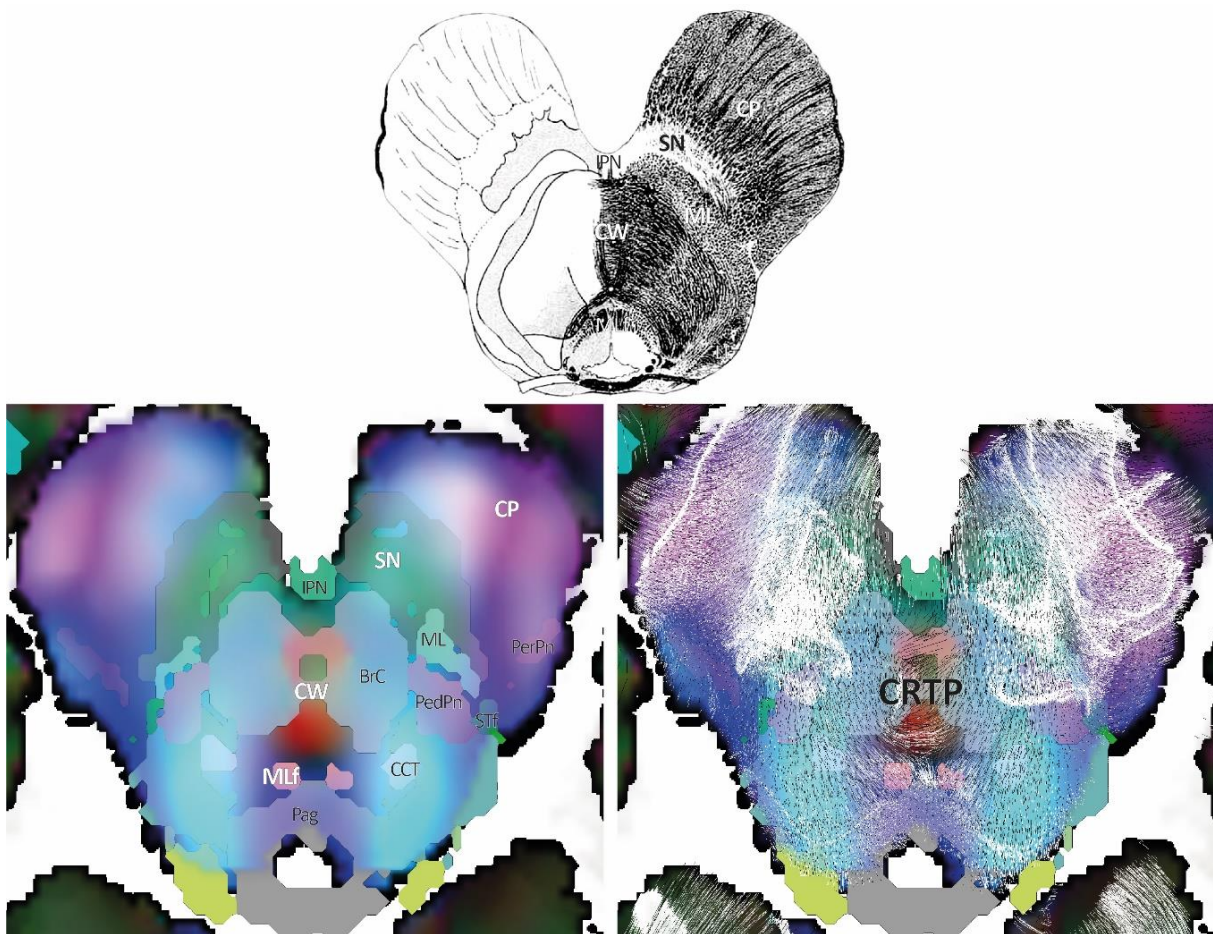


Figure S2.12: *eMDBA based interpretation of DTI structural topography - Sagittal slice crossing the BFG*

Sagittal slice crossing the BFG, 4 mm lateral (left) to the midline showing the anterior thalamic radiation (ATR), the fornix (Fo), the BF FT and the ansa lenticularis (top, tracing on eMDBA; bottom equivalent slice adapted from Dejerine (1901): medial nucleus of thalamus (M), anteromedial nucleus of thalamus (AM; d, dorsal; I, intermediate, v, ventral), mammillo-thalamic fascicle (mtf), posterior nucleus of hypothalamus (Pn), tuberomammillary nucleus of hypothalamus (TMn), preoptic nucleus of hypothalamus (POn), anterior commissure (AC), ansa lenticularis (AL), nucleus of ansa lenticularis (nAL), ventral tegmental area (VTA), red nucleus (RN), retroflexus fascicle (Rf), superficial medial thalamus (SM), Interbrain central gray (Icg), habenula (hab) and substantia nigra (SN).

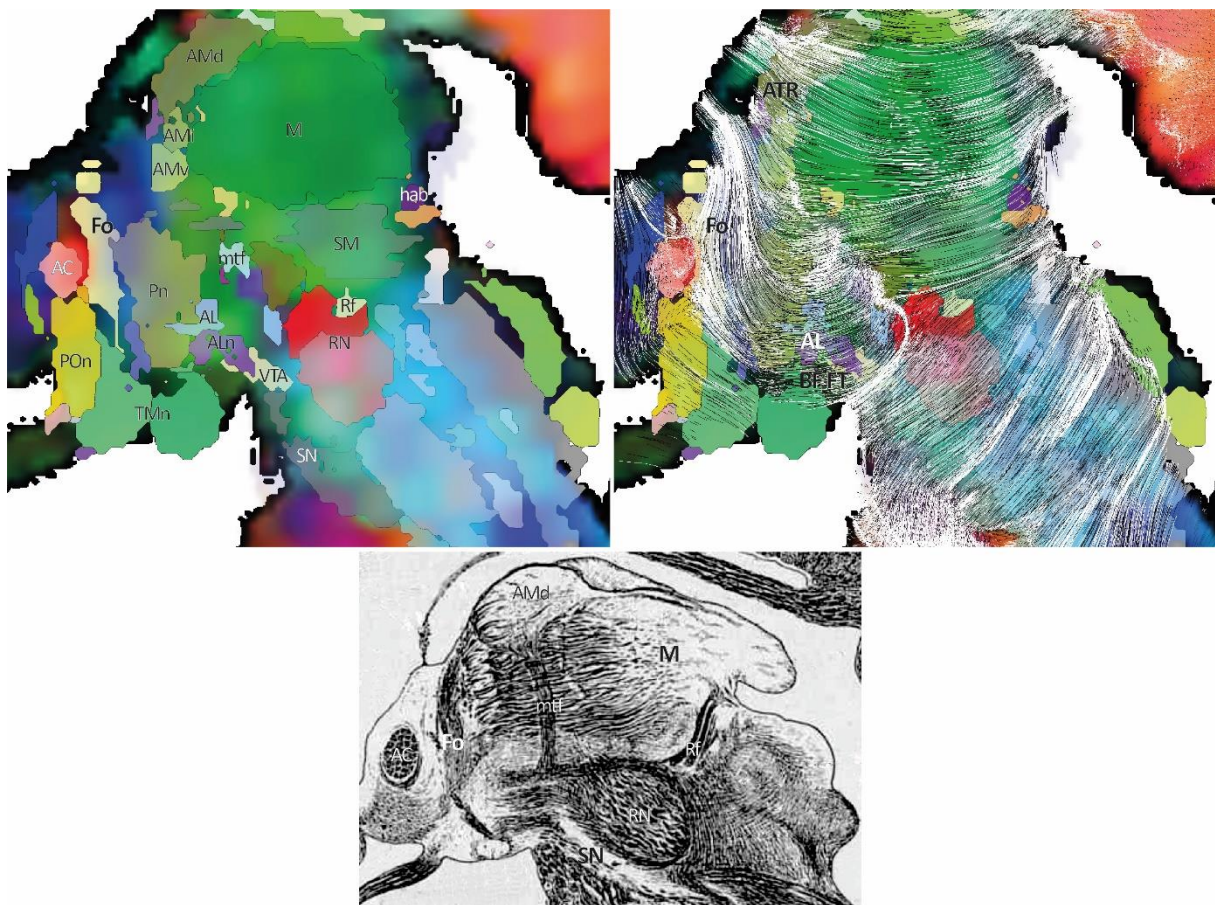


Figure S2.13: *eMDBA based interpretation of DTI structural topography - Sagittal slice 11 mm lateral (left) to the midline*

Sagittal slice going through the medial part of STN, and laterally to the BFG slice, 11 mm lateral (left) to the midline showing the anterior thalamic radiation (ATR), the inferior thalamic peduncle (ipT), the ansa lenticularis (AL), the ansa peduncularis (AL + ipT), the thalamic fascicle (Tf), and the lenticular fascicle (Lf) (top left, eMDBA labels; top right, tracing on eMDBA labels; bottom corresponding slice adapted from Dejerine (1901)); ventro-oral nucleus of thalamus (VO), medial nucleus of thalamus (M), anterolateral nucleus of thalamus (ALn), mammillo-thalamic fascicle (mtf), hypothalamus (hyp), subthalamic tegmental fields (STF), central zone of tegmentum (czt), innominate substance (is), diagonal band of Broca (dbb), nucleus accumbens (acc), anterior commissure (AC), ansa lenticularis (AL), nucleus of ansa lenticularis (nAL), red nucleus (RN), retroflexus fascicle (Rf), stria terminalis (st), substantia nigra (SN), zona incerta (ZI), septo-thalamic fascicle (STf), tip pallidum fascicle of ansa lenticularis (Alt) and inferior thalamic peduncle (ipT).

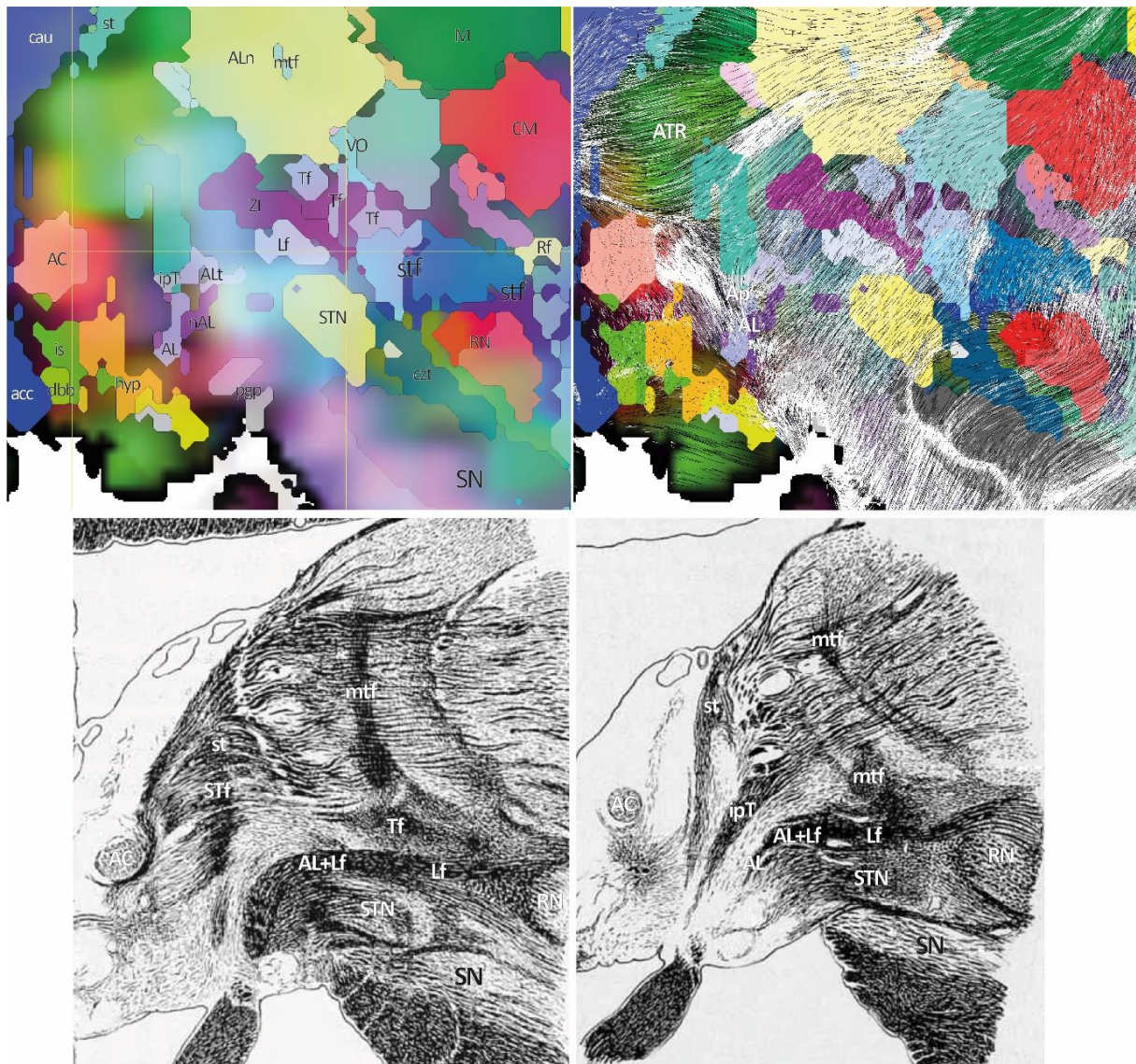


Figure S2.14: *eMDBA based interpretation of DTI structural topography – ALic slice*

Fiber tracing on DCE map and *eMDBA* pseudo sagittal along the anterior limb of the left internal capsule (ALic) showing the anterior thalamic radiations (ATR), the ansa lenticularis (AL), the tip fascicle of the ansa lenticularis (ALT) and the basal forebrain FT (BF FT); ACPC plan, putamen (Pu), caudate (cau), nucleus accumbens (acc), olfactory area (oA), innominate substance (Is), hypothalamus (hyp), extern pallidum (gpe), superficial lateral thalamus (SL), anterolateral nucleus of thalamus (ALn), laminar oral nucleus of thalamus (LaO), medial nucleus of thalamus (M), zona incerta (ZI), stria terminalis (st), mammillo-thalamic fascicle (mtf).

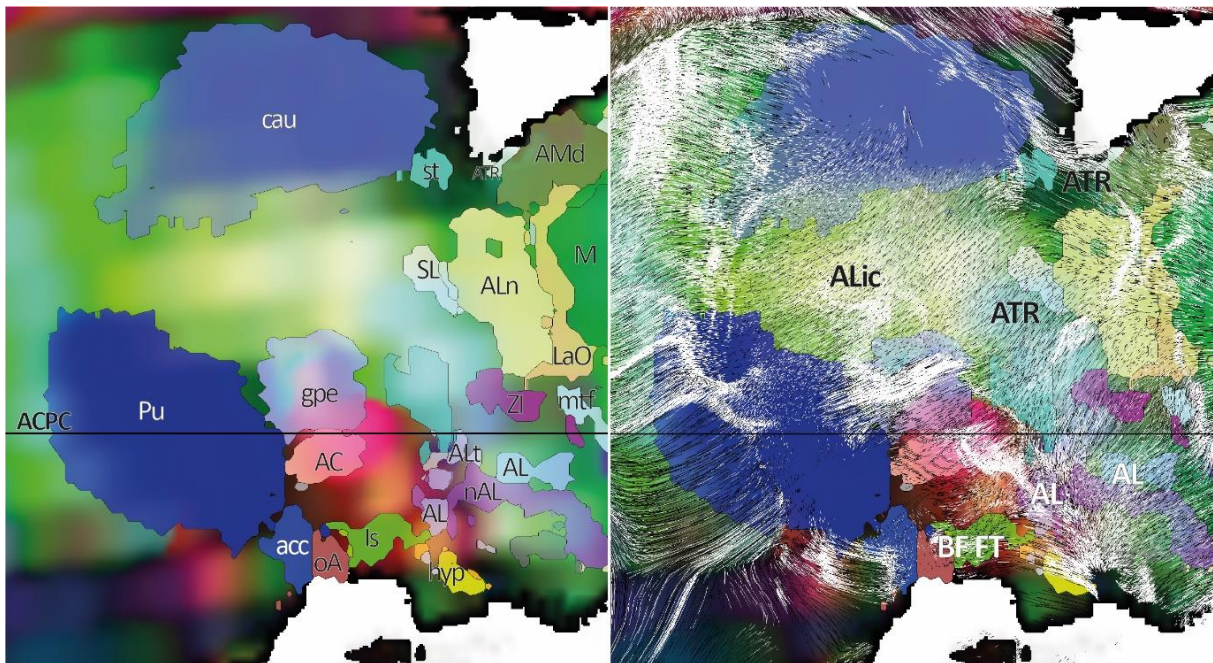


Figure S2.15: *eMDBA based interpretation of DTI structural topography – axial slice 2.5 mm below ACPC*

Fiber tracing on DCE map and *eMDBA* along the axial slice showing the striato-Luysian radiations (SLR), about 2.5 mm below the axial ACPC slice (right); equivalent slice adapted from Dejerine (1901) (left); ansa lenticularis (AL), lenticulo-subthalamic FT (LST FT), pulvino-cortical radiations (PCR), subthalamic nucleus (STN), red nucleus (RN), zona incerta (ZI), superior colliculus (SC), pulvinar (Pu), fimbria (fim), zone of Wernicke (zow), lateral and medial geniculate bodies (lgb, mgb), medial lemniscus, (ML), hypothalamus (hyp), tip pallidal fascicle of ansa lenticularis (Alt), putamen (Pu), pallidum intern and extern (GPI, GPe), anterior commissure (AC), inferior peduncle of thalamus (Itp), subthalamic tegmental fields (stf).

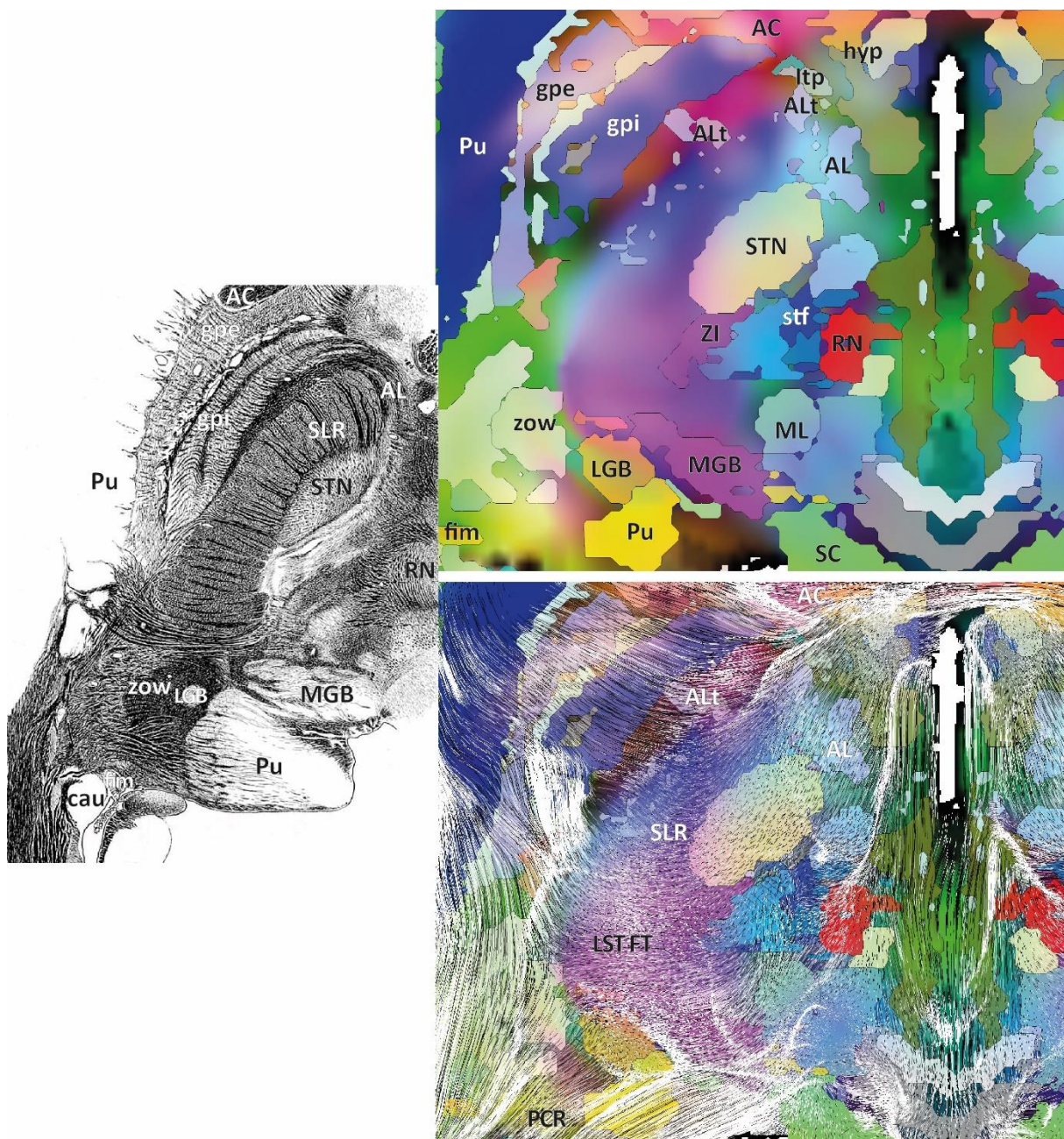


Figure S2.16: Drawing of thalamo-subthalamic connectivity according to the whole brain FT

Lenticulo-thalamic and lenticulo-subthalamic fibers (LT/ST f), fascicle of Türk (TF), thalamic fascicle of Arnold (ArF), strio-Luysian radiations (sLR), basal forebrain FT (BF FT), frontal FT (F FT), lenticular fascicle (Lf), rubro-subthalamic FT (RSFT within the radiations of the “calotte”, RC), pre lemniscal radiations (Plr), anterior thalamic radiations (ATR), superior thalamic radiations (STR), hyper direct cortico-subthalamic pathway (hdp), cortico-intern-globus-pallidum FT (Cgpi FT), cortico-reticular fibers (CRtf), cortico-caudal FT (Cx FT); hypothalamus (hyp), thalamus (tha), lenticular nucleus (Ln), red nucleus (RN), subthalamic nucleus (STN), ventrointermediate nucleus of thalamus (Vim), olfactory tubercle (Ot), ventral tegmental area (VTA).

