

# Options to adapt the inhomogeneity correction procedure in BrainVoyager

This is no official Brain Innovation support document. For any questions or remarks contact [heinecke\(at\)brainvoyager\(dot\)com](mailto:heinecke(at)brainvoyager(dot)com)

BrainVoyager version used. BVQX 2.84 (Windows7, 64bit)

Dataset used: Getting Started Guide (CG) anatomy

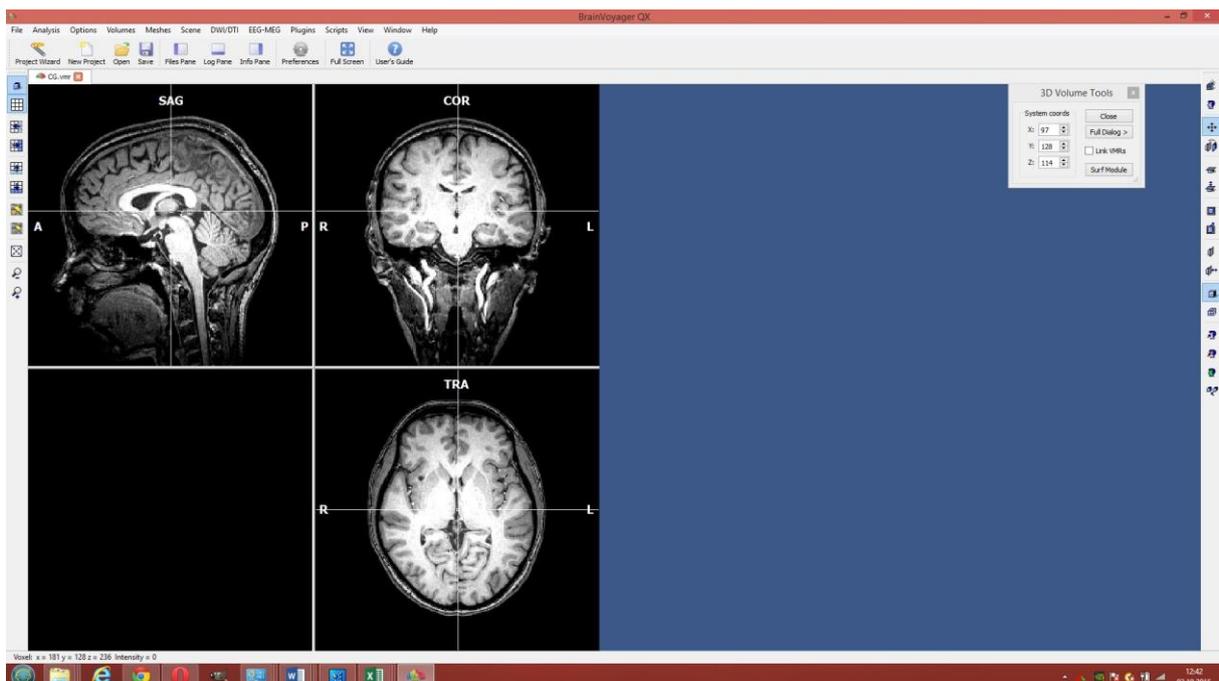
For many advanced anatomical data processing steps in BrainVoyager it is crucial to correct the inhomogeneity within the VMR project created on the basis of the 3D anatomical data. Depending on the scanner and aquisition details, there are different types and „strenghts“ of inhomogeneity in the data.

The standard automatic intensity based inhomogeneity correction is usually sufficient for many purposes, but depending on the types of final analysis you have in mind for your anatomical data, more adaptive inhomogeneity correction steps are advised. At least when one wants to create proper surface reconstructions (esp. „flat map“ representations), run the cortex-based alignment or a cortical thickness analysis, this is a highly advised.

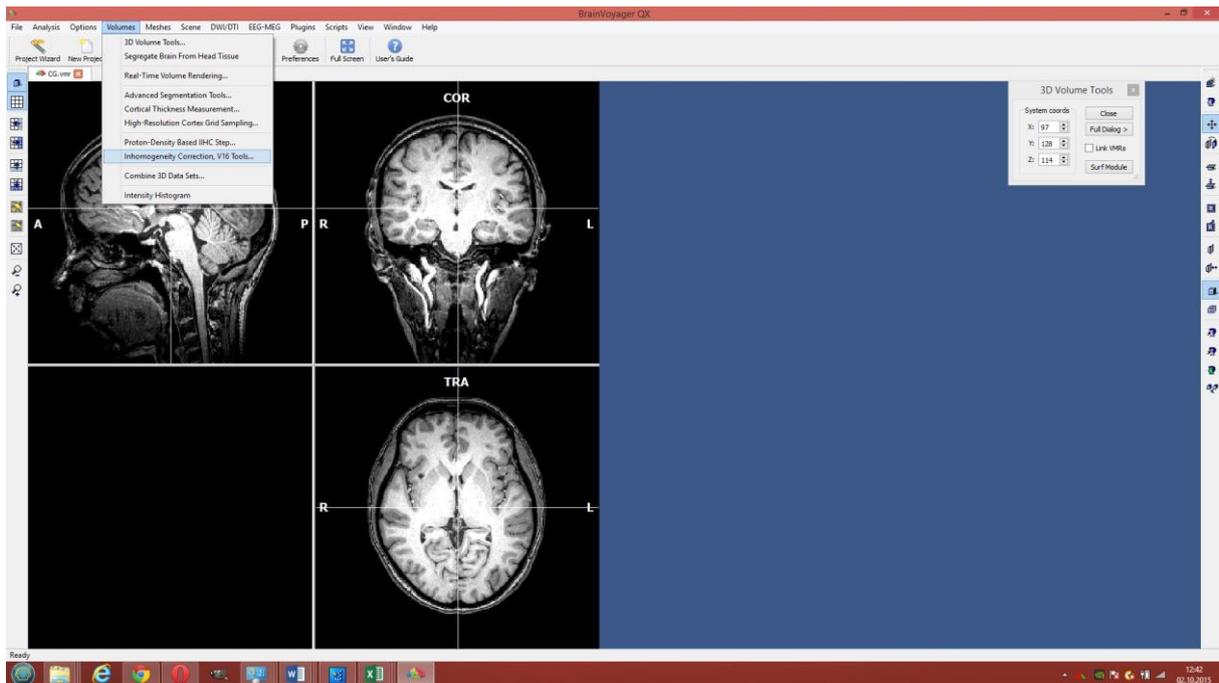
This document describes a usually quite effective adaptation of the automatic inhomogeneity correction procedure in BrainVoyager.

## 1. Automatic inhomogeneity correction

We load the first version of the VMR.



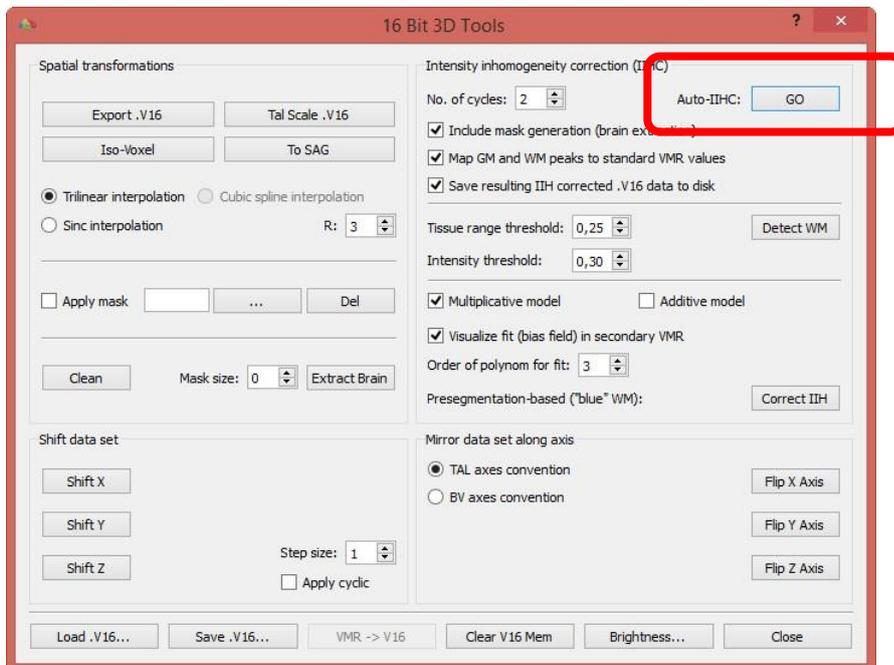
We open the V16 dialog from the Volumes menu.



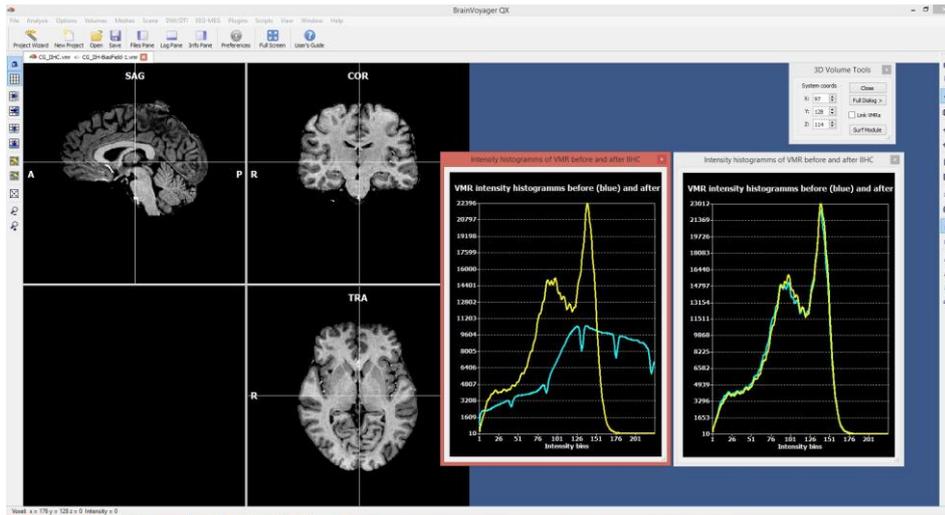
This dialog is based on the automatically created and linked V16 file.

This contains the original intensities of the data, while the VMR contains only the truncated 8bit version of the data (this stores the voxel intensities in 226 greyscale values. In case this dialog should appear greyed out (not functional), there is either no V16 available or the names of the VMR and V16 file differ (this will never be the case for the first projects created by BrainVoyager).

We start the automatic inhomogeneity correction via the „GO“ button.



The procedure include an automatic extraction of the brain. The results are stored as \_IIHC.vmr and IIHC.v16 file.



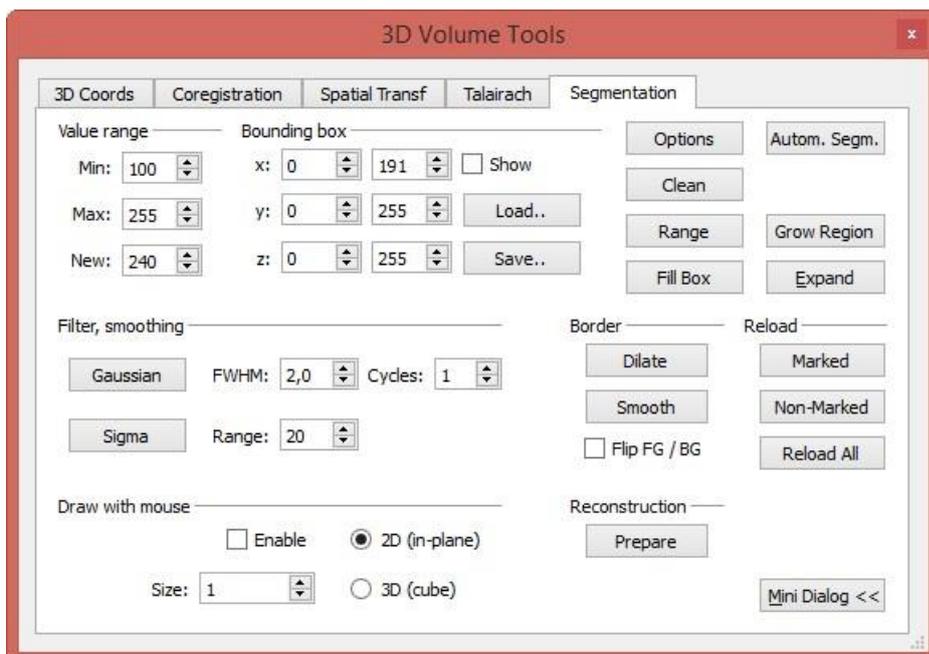
Two intensity histogram show the distribution of intensities after the first and second correction cycle.

For standard usage of the VMR, one could stop the inhomogeneity correction now and proceed e.g. with normalising the data into Talairach space.

## 2. Additional manual correction

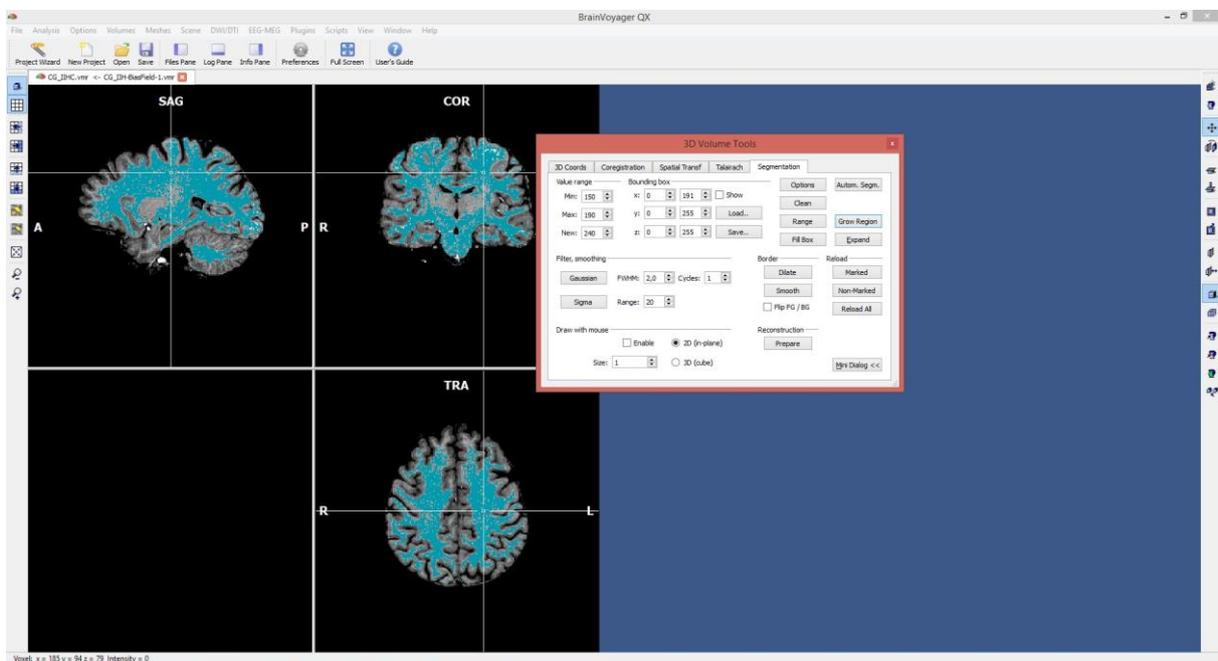
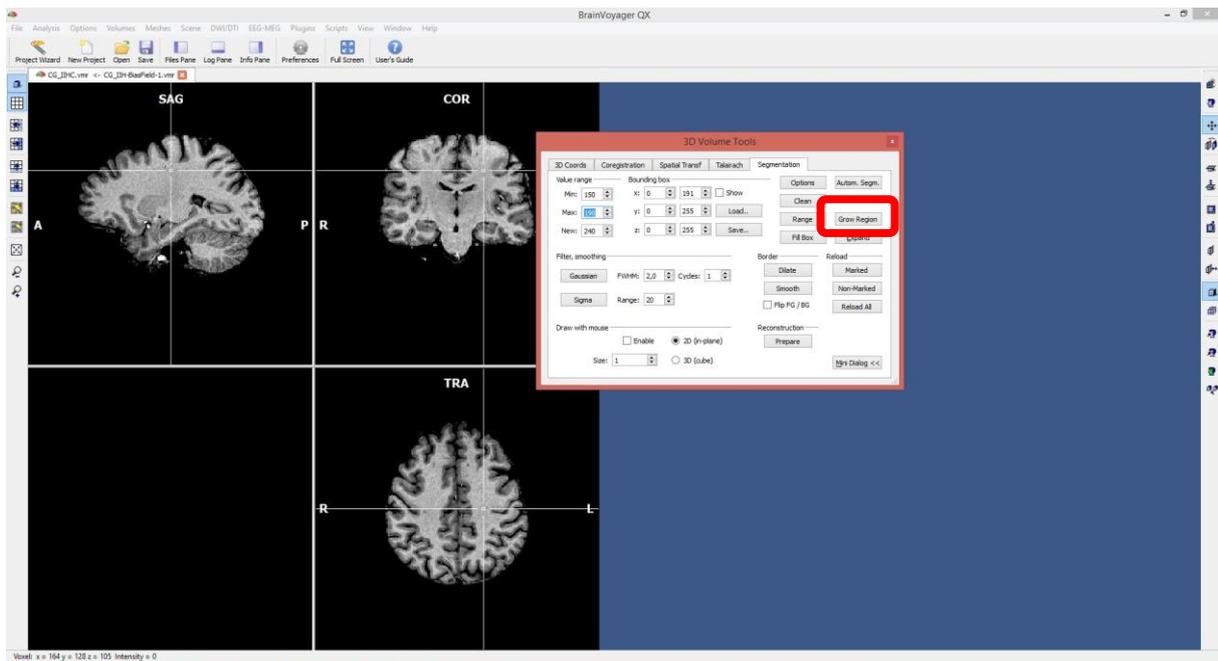
When one has some more advanced anatomical processing steps in mind, a manual inhomogeneity correction can be added.

To do so, we have to first create a manual selection of the white matter (so called „presegmentation“). We can best obtain this goal by using the tools of the „Segmentation“ tab on the 3D volume tools.



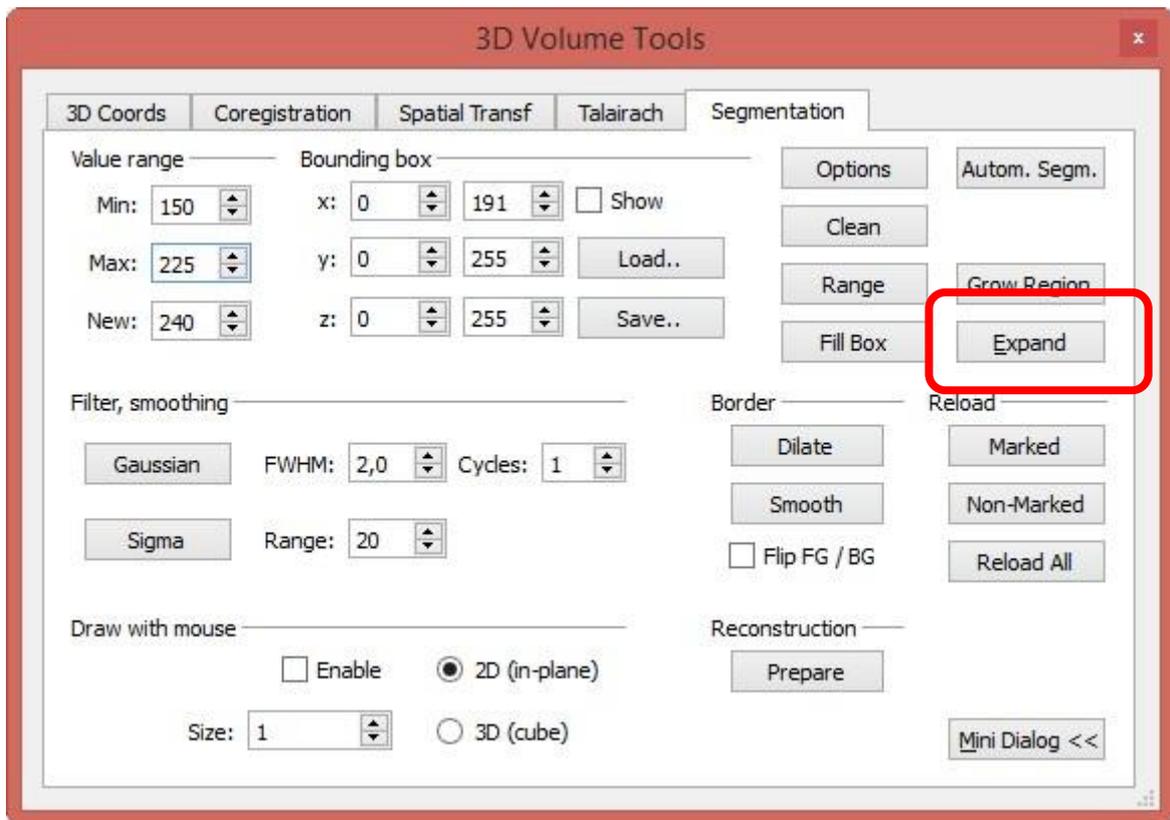
To start, we best use the „Grow Region“ button. The procedure selects all voxel (spreading out from the the current mouse position) within a specified intensity range.

Because we already performed the automatic inhomogeneity correction, we can select the Min: and Max: values of the Value range quite easily. Very often a starting range of about 150 to 190 leads to satisfying results. One has to click within the white matter to properly start the procedure. If the intensity of the selected seed voxel is for some reason outside the selected value range, no voxel will be demarcated.

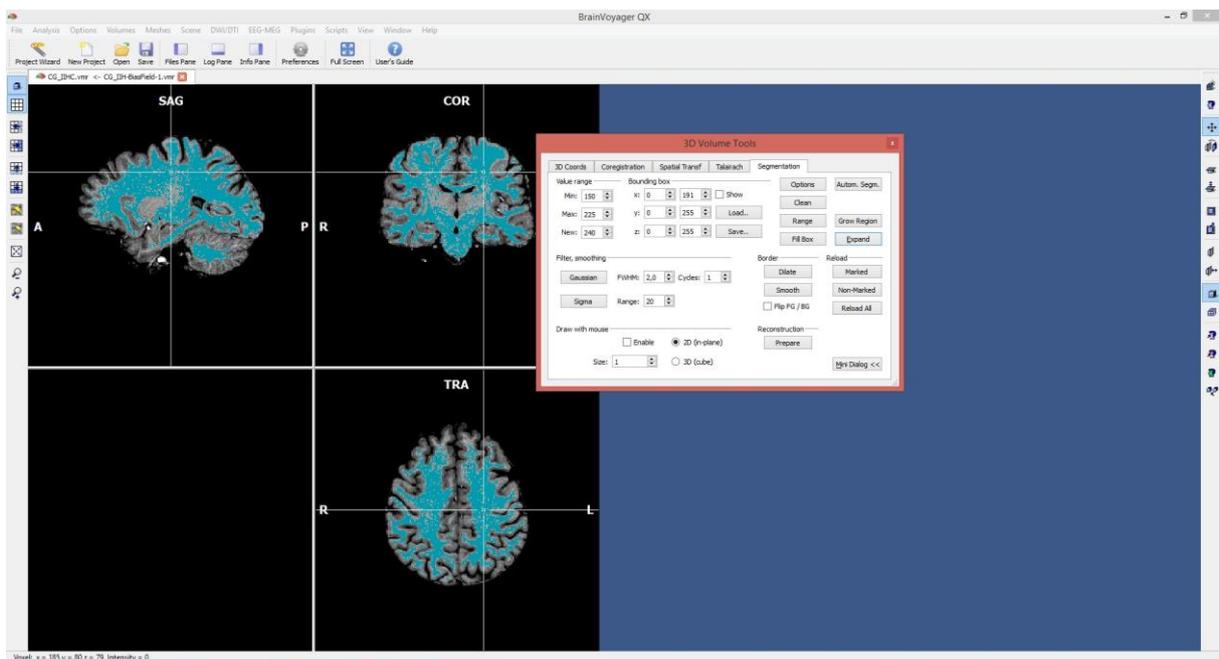


After clicking the „Grow Region“ button, a good part of the white matter is selected. But there are still some white matter voxels with values either below the selected minimum or above the selected maximum value. The best option to proceed is to use the „Expand“ function. This just marks neighbours of already selected voxels.

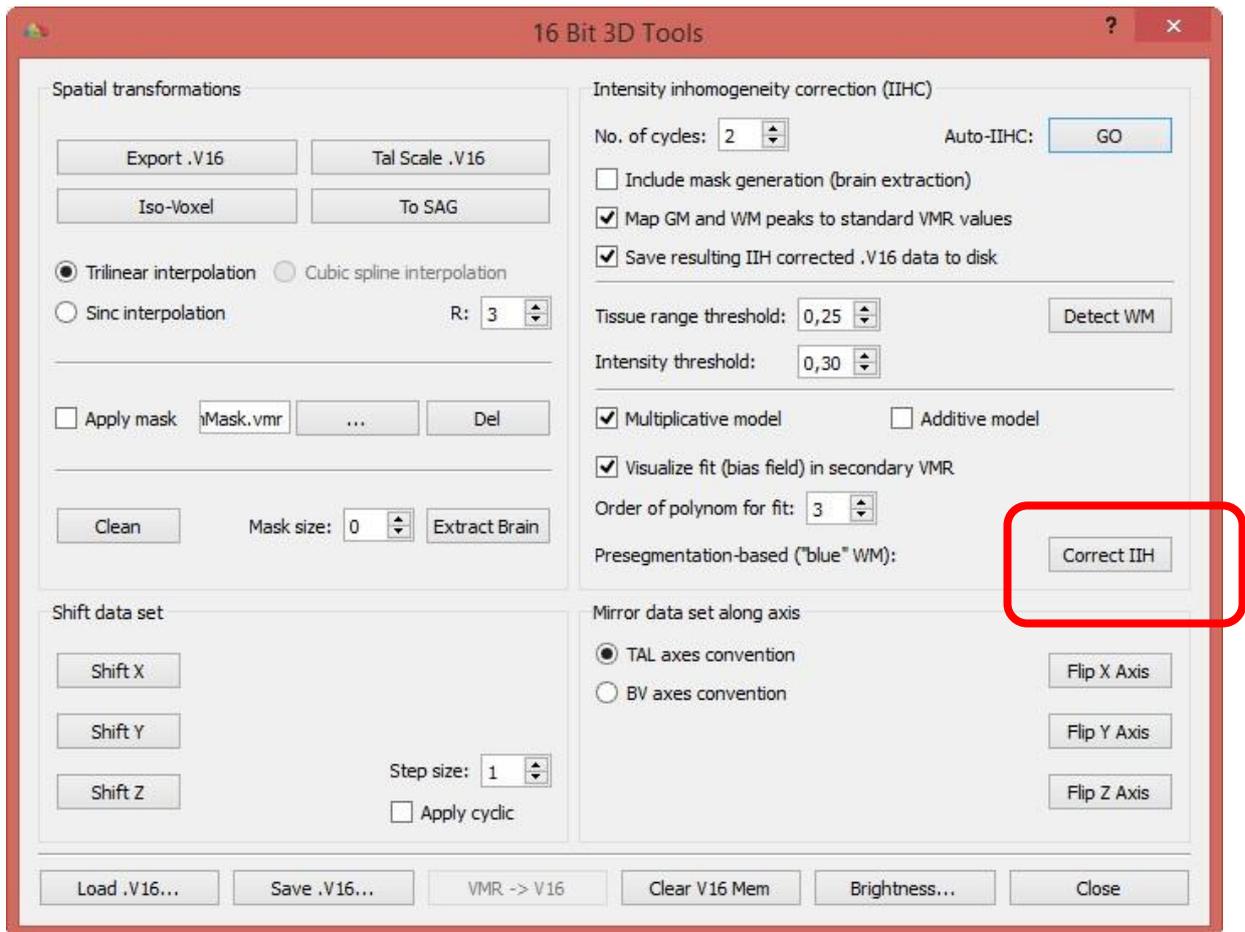
We expand the „Max“ value to 225 (the maximal intensity value) and click the „Expand“ button.



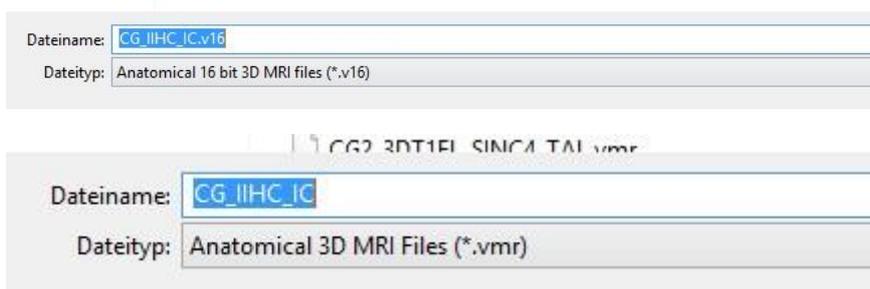
The „Expand“ button can be used multiple times (based on the fact that each neighbouring voxel has again new neighbours). In some cases, it may also be necessary to reduce the Min: value



To start the manual inhomogeneity correction, we open the V16 tool and use the „Correct IIH“ button.



It is important to note that the manual correction does NOT automatically save the VMR or V16 file. So we have to save both files manually. I usually add another part the end of the name, this way the last created file is easier to find.



The manual inhomogeneity correction procedure can be repeated multiple times. Each time, a new white matter selection has to be performed.

### 3. First running the manual inhomogeneity correction

As an alternative approach to the procedure described in section 1 and 2, one can also run the manual inhomogeneity correction first. This is based on the idea that the automatic

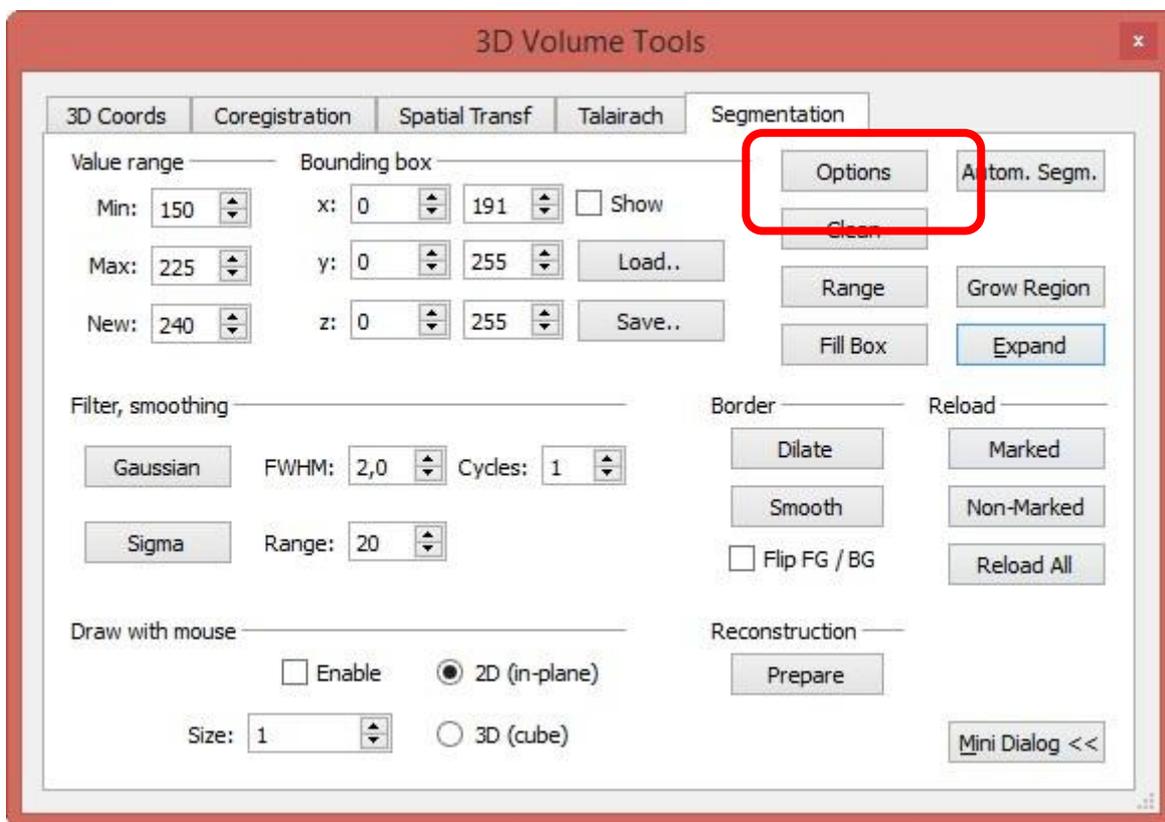
inhomogeneity correction may introduce a bias in the intensity distribution and thus running the first correction on an improved sample of the white matter can lead to improved results.

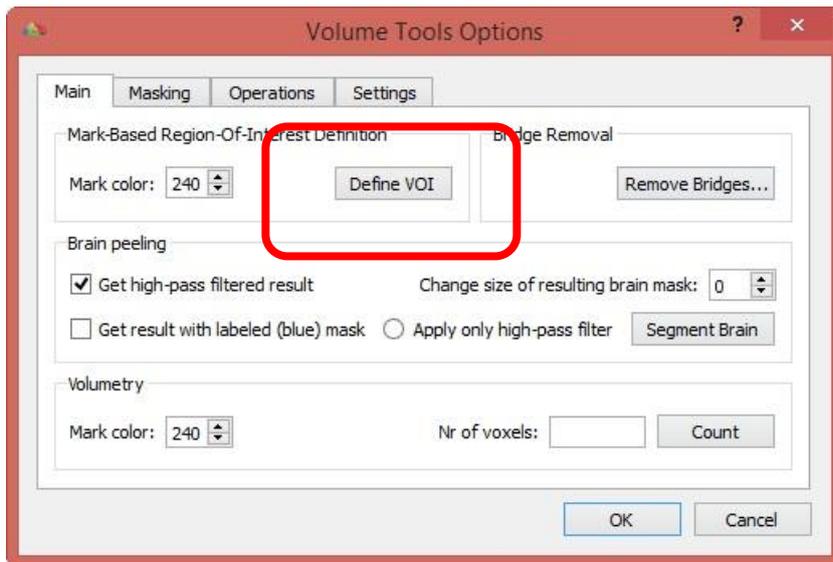
The main problem is to get a proper selection of the white matter – this would be a problem using the inhomogeneous VMR as the starting point. Quite often one is either selecting too few white matter or too many grey matter voxels in this case.

So we use a trick and basically utilize the result of the automatic inhomogeneity correction to then select the white matter with a simple range of intensities.

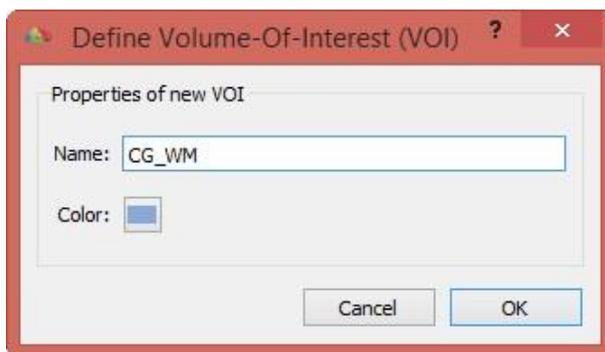
We run the steps described in section 1 and 2 up to the level of white matter selection (before pressing the „Correct IIH“ button).

We open the „Options“ of the „Segmentation“ tab.

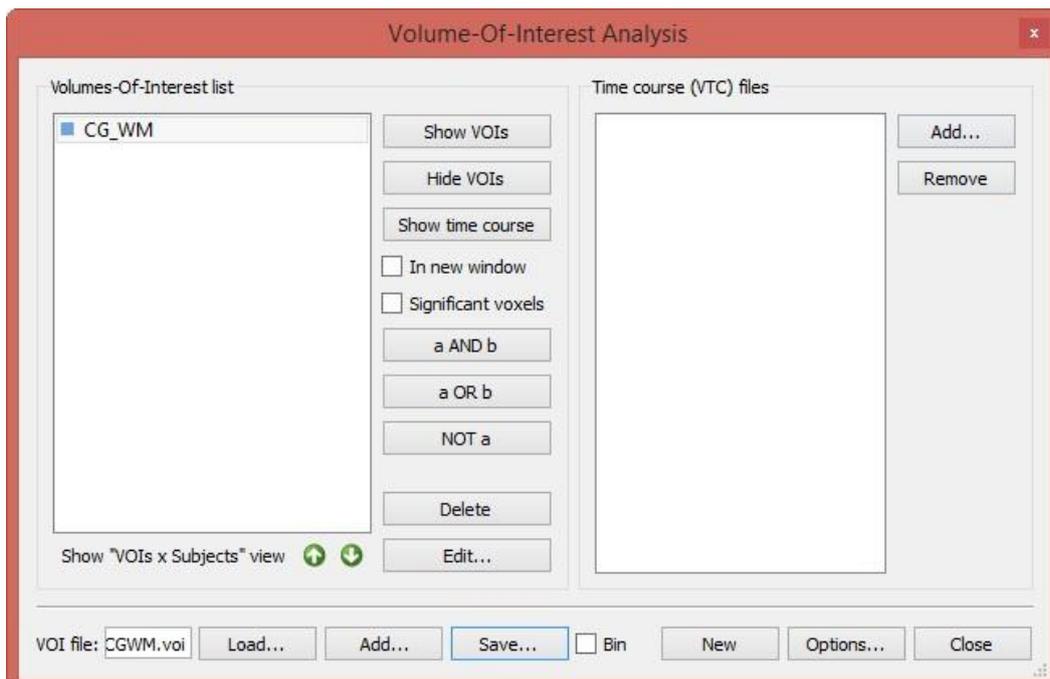




We click the „Define VOI“ button. It is usually a good idea to add the name of the subject into the VOI name. In some cases, VOIs of different subjects are combined and this way there are no problem regarding the assignment of regions to subjects.

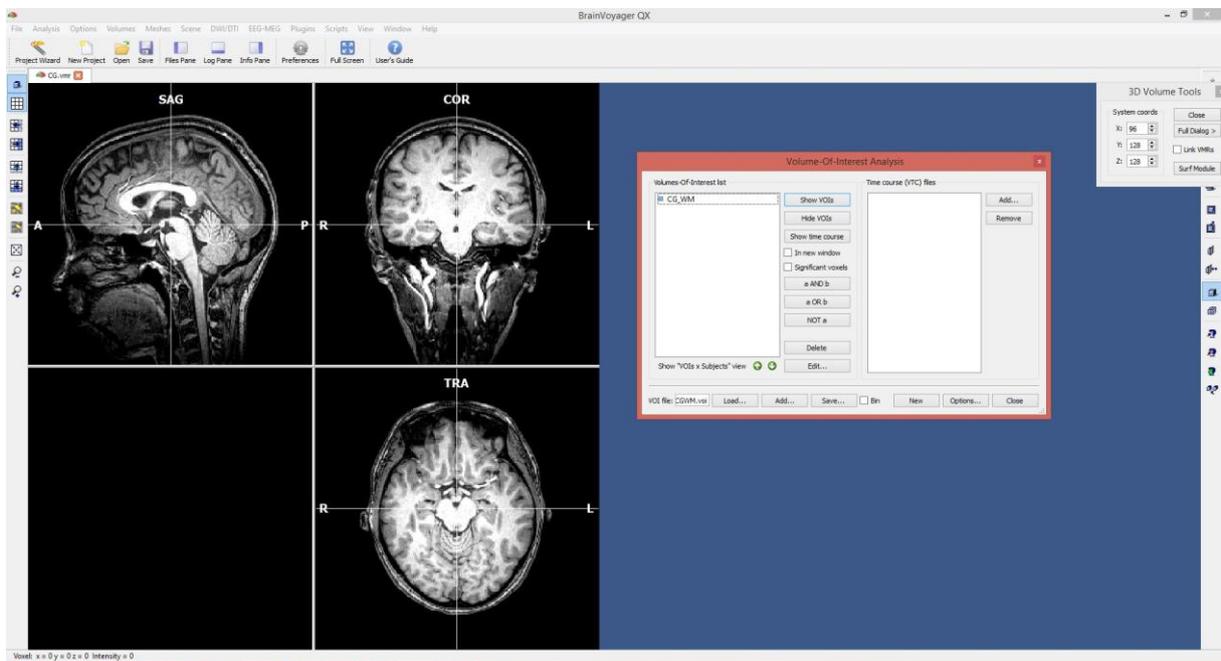
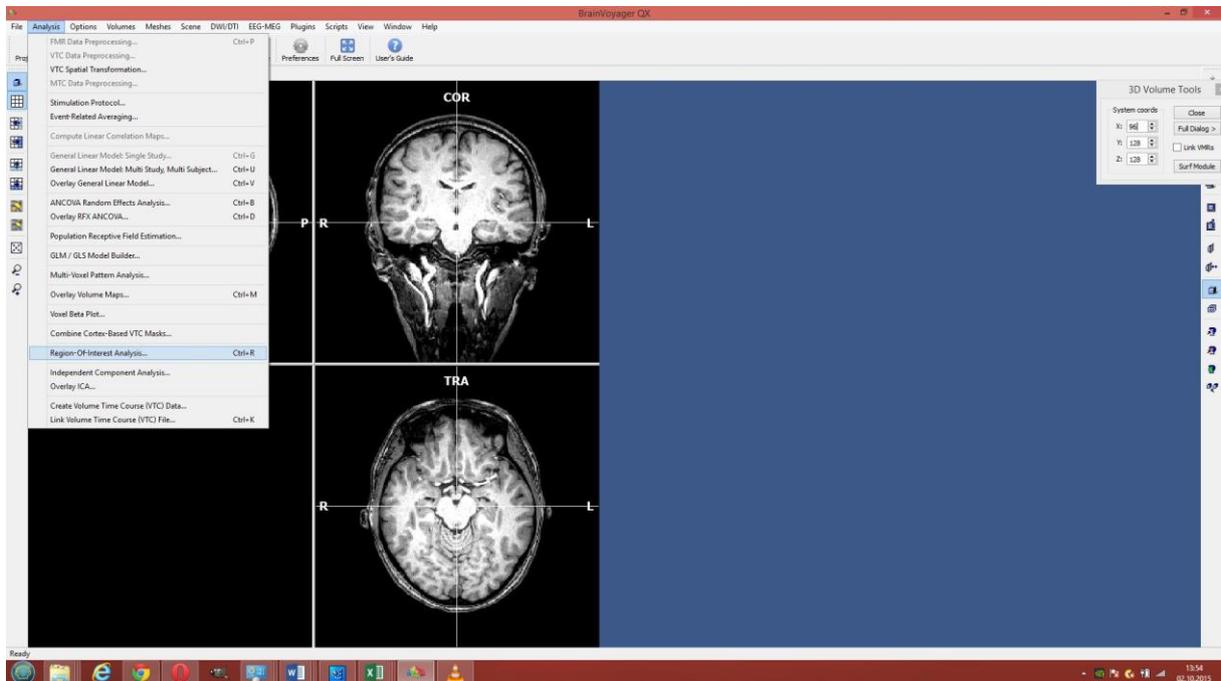


At this point it is also advised to save the VOI file itself, which is not done automatically.

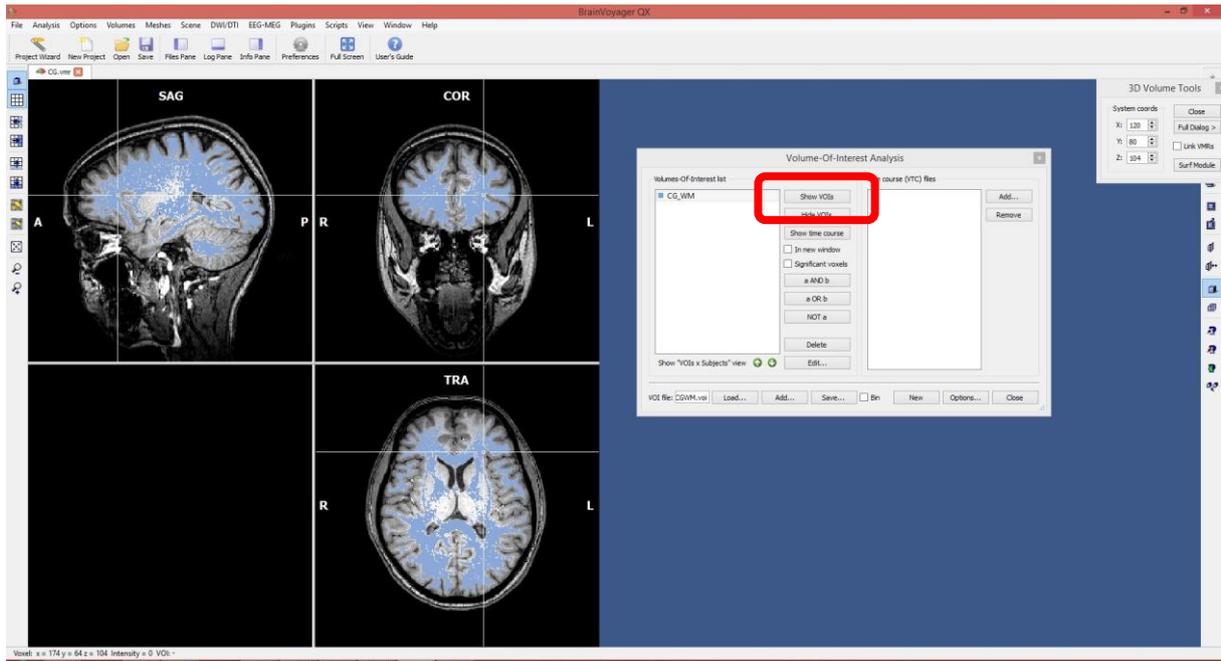


We open the first (uncorrected) version of the VMR project.

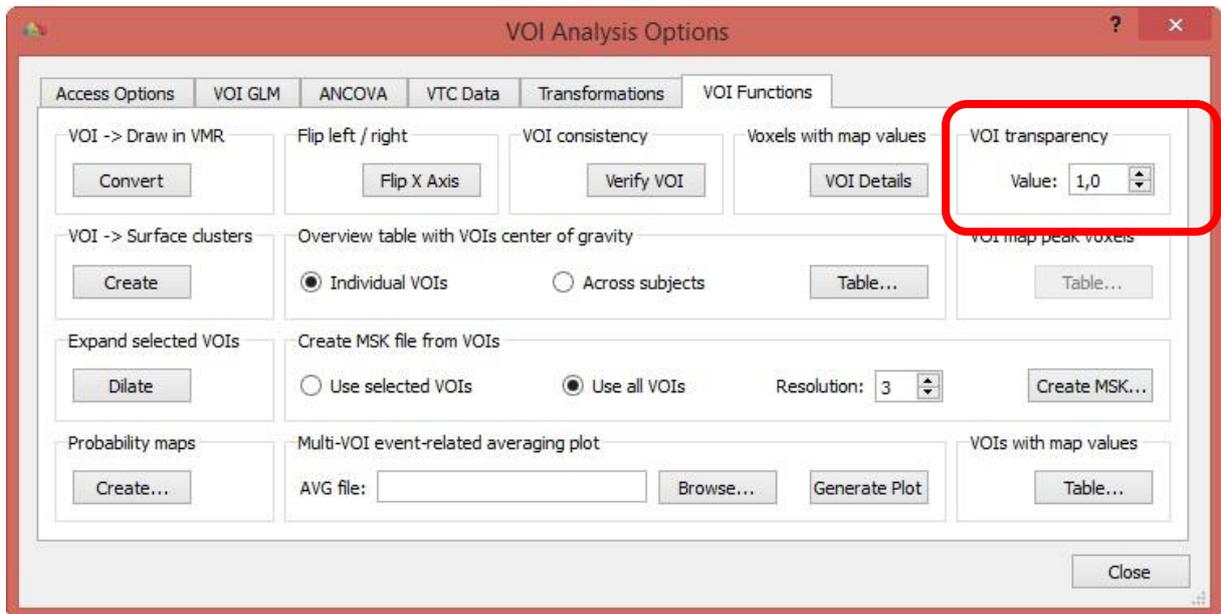
We open the region of interest analysis tool and load the white matter voi file which has been stored before.



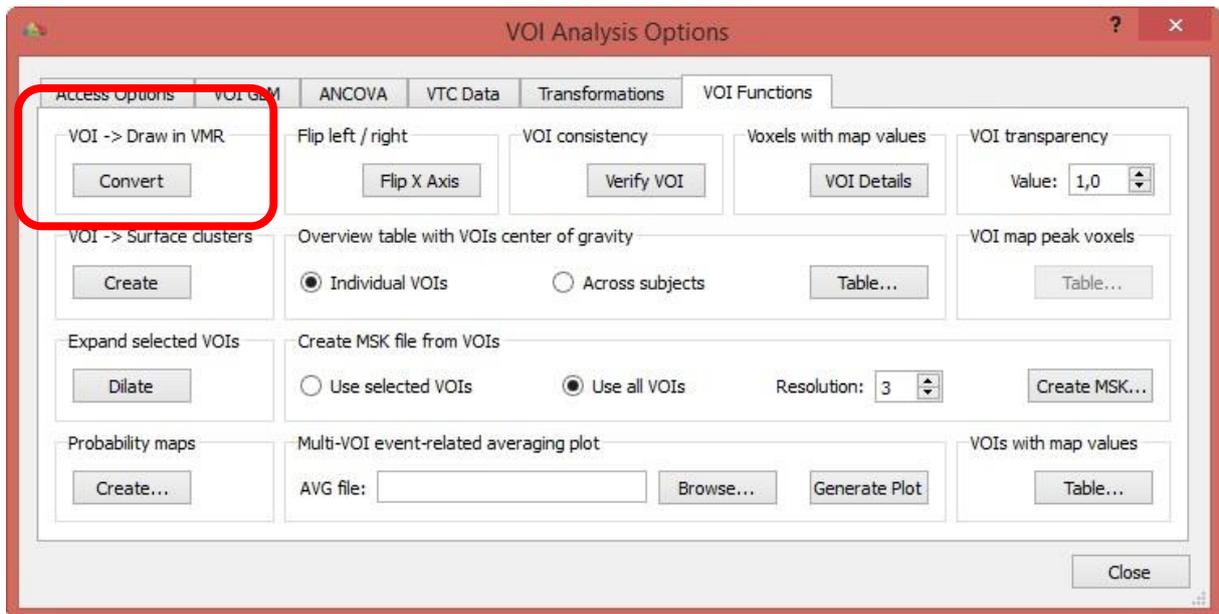
We click on the VOI and use the „Show VOIs“ button.



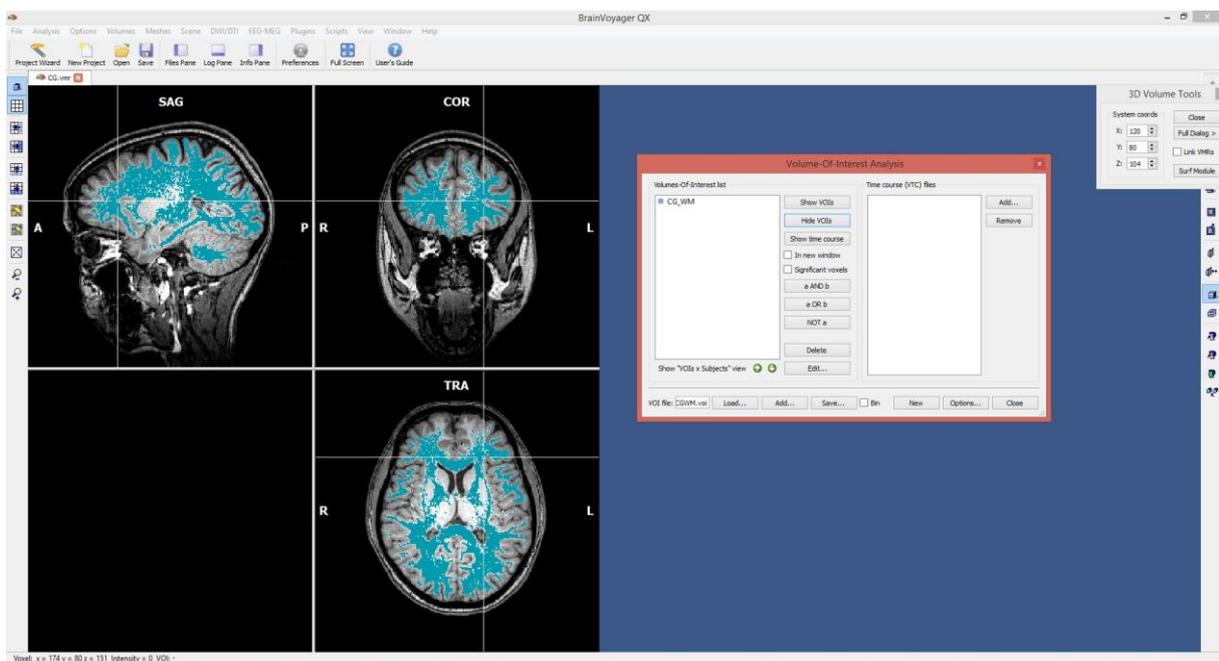
The visualisation of the VOI will depend on the selected color of the VOI (which can be changed via the „Edit“ button and the transparency of the VOI (which can be changed via the „VOI Functions“ tab of the VOI Options).



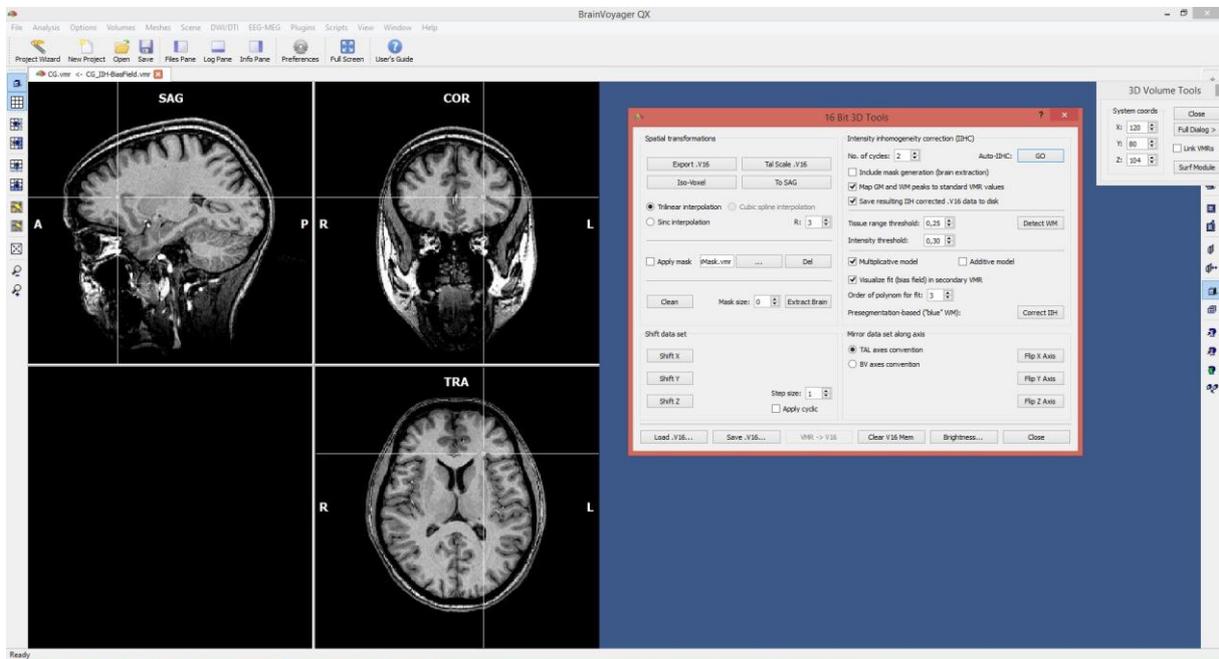
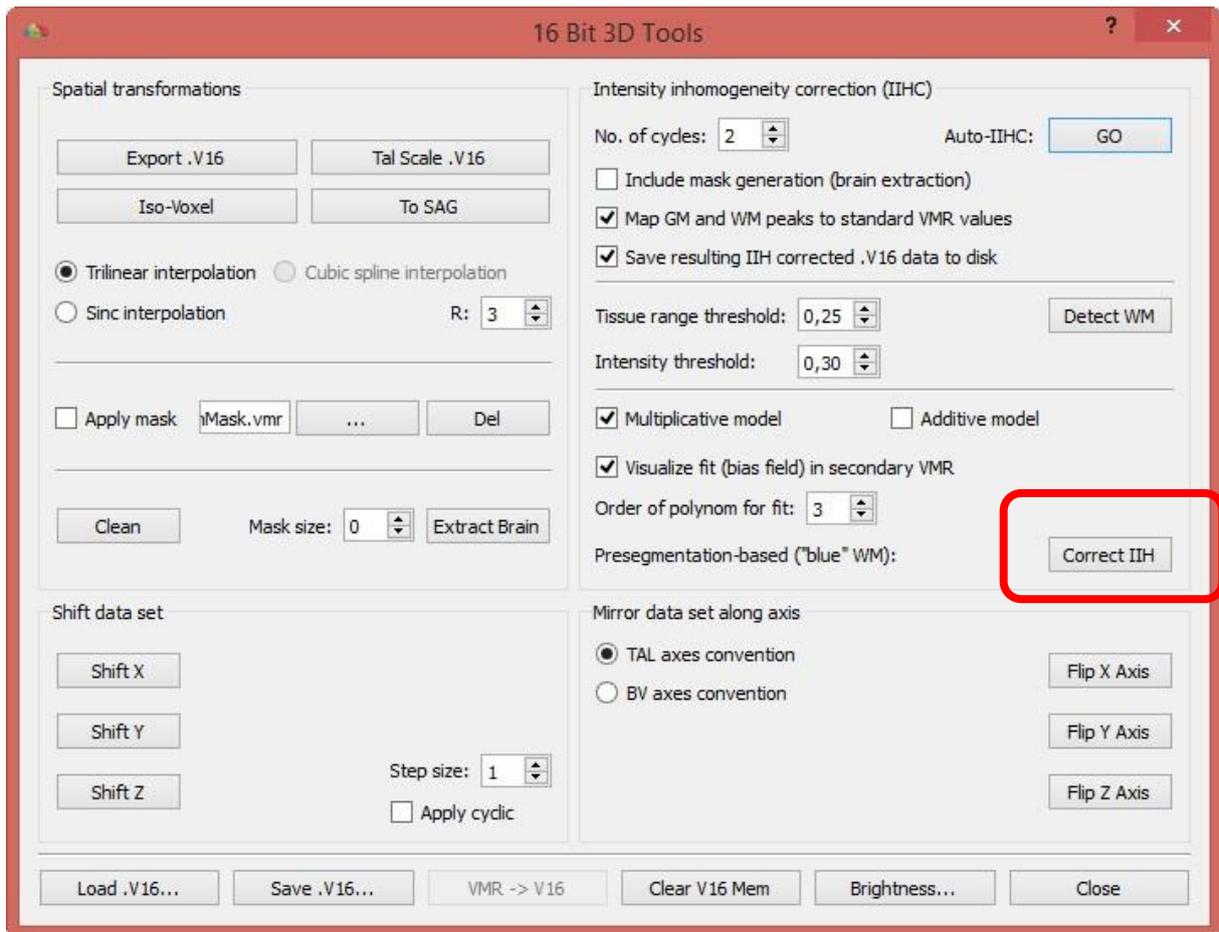
Before we can start the manually driven inhomogeneity correction, we have to turn the VOI into a voxel demarcation. We can do this via the „Convert“ button on the VOI Functions tab.



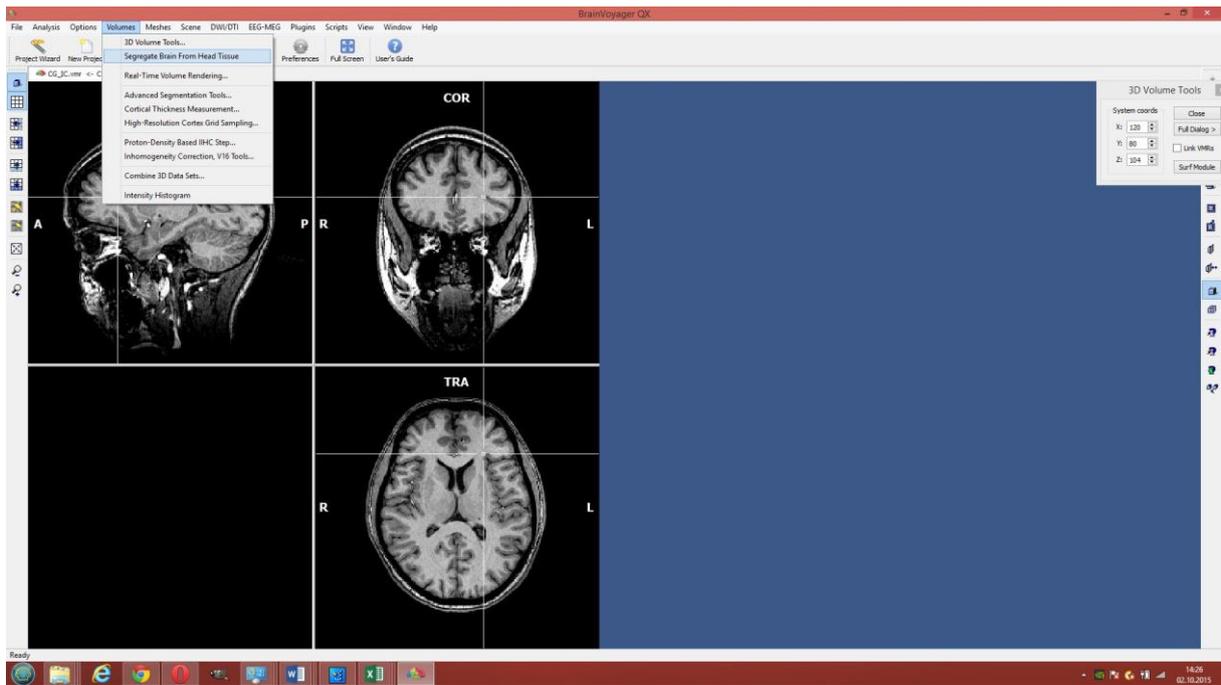
The next screenshot shows the VOI after pressing the „Convert“ button and clicking „Hide VOIs“.



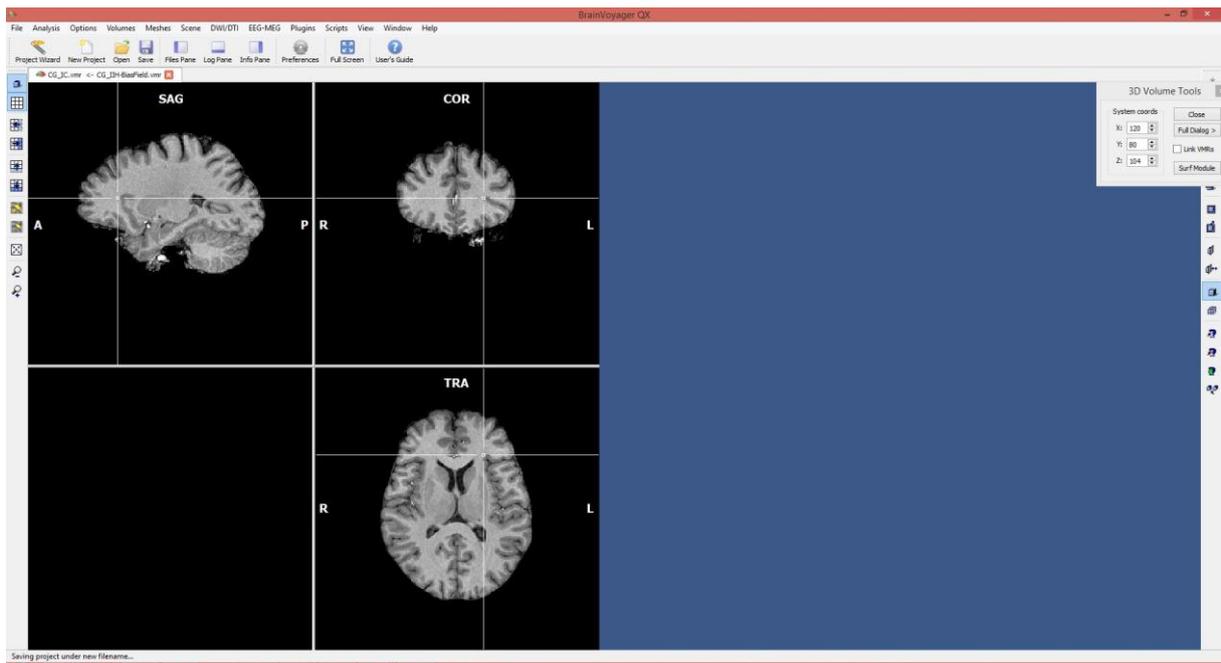
To start the manually driven inhomogeneity correction, we open the V16 tools dialog and click the „Correct I1H“ button.



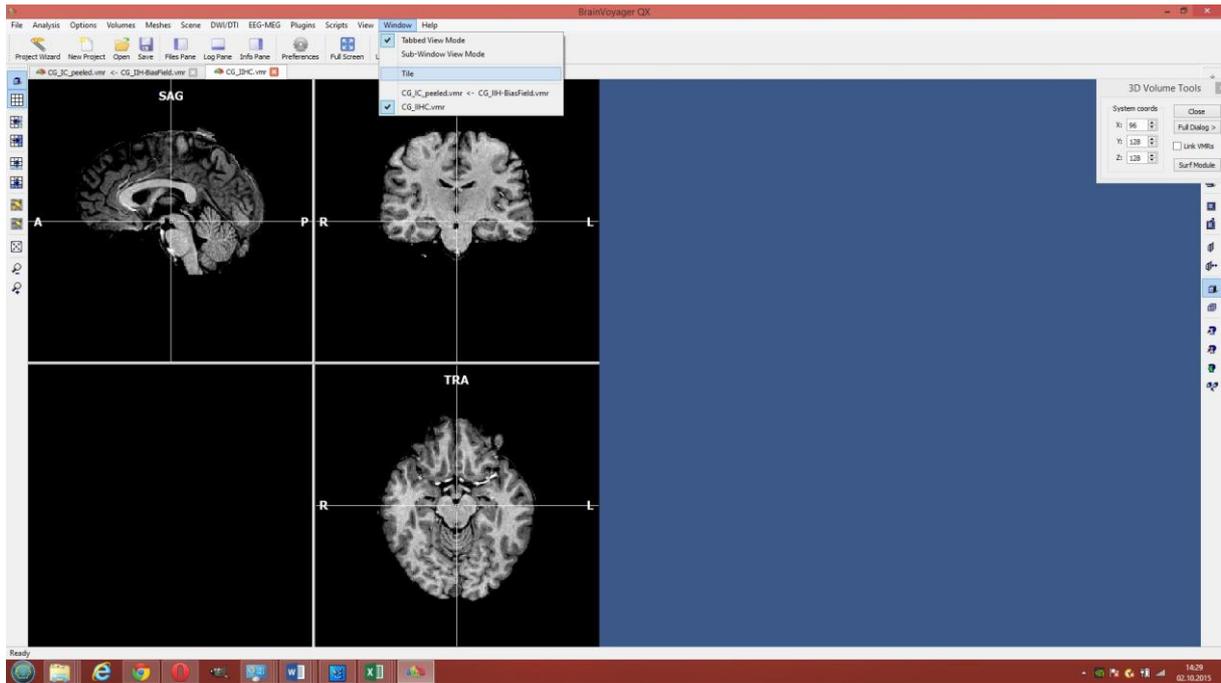
After the manual procedure, we again have to save the result (V16 and VMR file) manually. The brain extraction can be performed via the „Volumes“ menu.



It is advised to save the resulting VMR with a new name.



The results of the different inhomogeneity correction procedures can be compared in different ways. A simple option would be to load both VMR (automatic and manually driven result) and use the Tile mode in the Window menu.



Afterwards, one can best use the Link VMRs checkmark in the 3D Volume tools. This makes sure that the same position is represented in all loaded VMRs. The right side of the next screenshot shows the manually corrected VMR.

