

AI-based Segmentation in 3D Slicer

Sonia Pujol, Ph. D Brigham and
Women's Hospital, Harvard Medical
School Boston. MA

Manual vs AI-powered Segmentation

Medical images have traditionally been manually segmented, which is a time-consuming process that requires intensive effort by radiologists and is subject to inter-reader variability.

Manual vs AI-powered Segmentation

In the past decade, image segmentation has been powered by the development of deep learning algorithms (e.g. nnUNet by the German Cancer Research Center (DKFZ)/Helmholtz Research).

AI-powered segmentation tools can reduce the segmentation time and provide more reproducible results.

AI Terminology

A is an AI algorithm that was trained to perform a specific task (e.g. brain tumor segmentation model).

The Weights of an AI model are small numbers that determine how much importance the model gives to different image features.

During the Training phase, a Model learns patterns from data labelled by experts and adjusts its weights to improve its predictions.

During the Validation/Test phase, the model is evaluated on a separate set of data not used during the Training phase.

During Inference, the model is applied to new datasets to perform the specific task it was trained for.

3D Slicer AI Workshop

This tutorial focuses on running inference tasks using various pretrained AI models for automated segmentation of anatomical and pathological structures.

MONAIAuto3DSeg Slicer extension

This tutorial uses the pre-trained models of the MONAIAuto3DSeg Slicer extension.

The tool is designed to work on laptops or on average desktop computer without a GPU.

MONAIAuto3DSeg Slicer extension

Multiple modalities Support (CT, MRI).

Multiple anatomies (head, thorax, abdomen, pelvis, etc.).

Multiple pathologies (tumor, hemorrhage, edema).

Slicer AI Tutorial: Segmentation

Tasks

Segmentation Task #1: Prostate.

Segmentation Task #2: Brain Glioma.

Segmentation Task #3: Whole Body Segmentation.

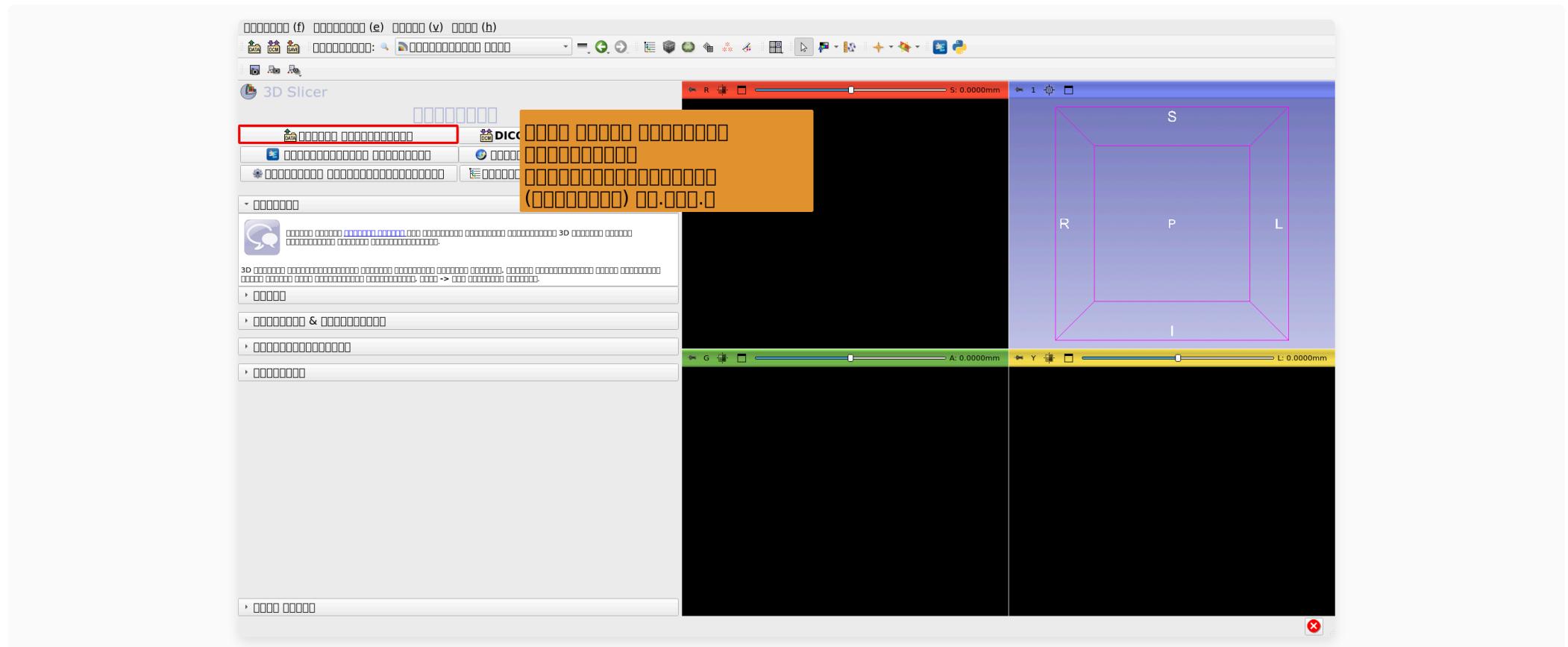
AI Segmentation Task #1: Prostate

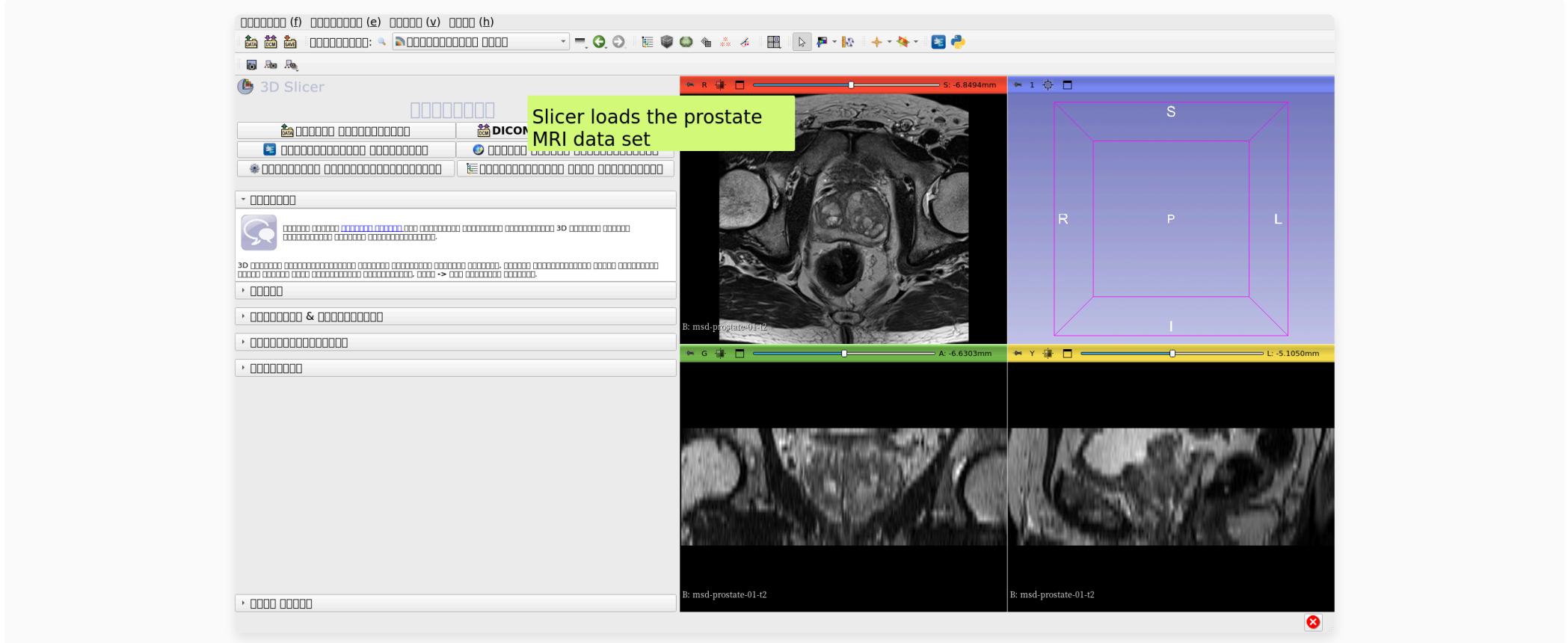
AI-based Segmentation of Peripheral Zone (PZ) and Transition Zone (TZ) of the prostate on T2-weighted MRI Images.

Dataset:

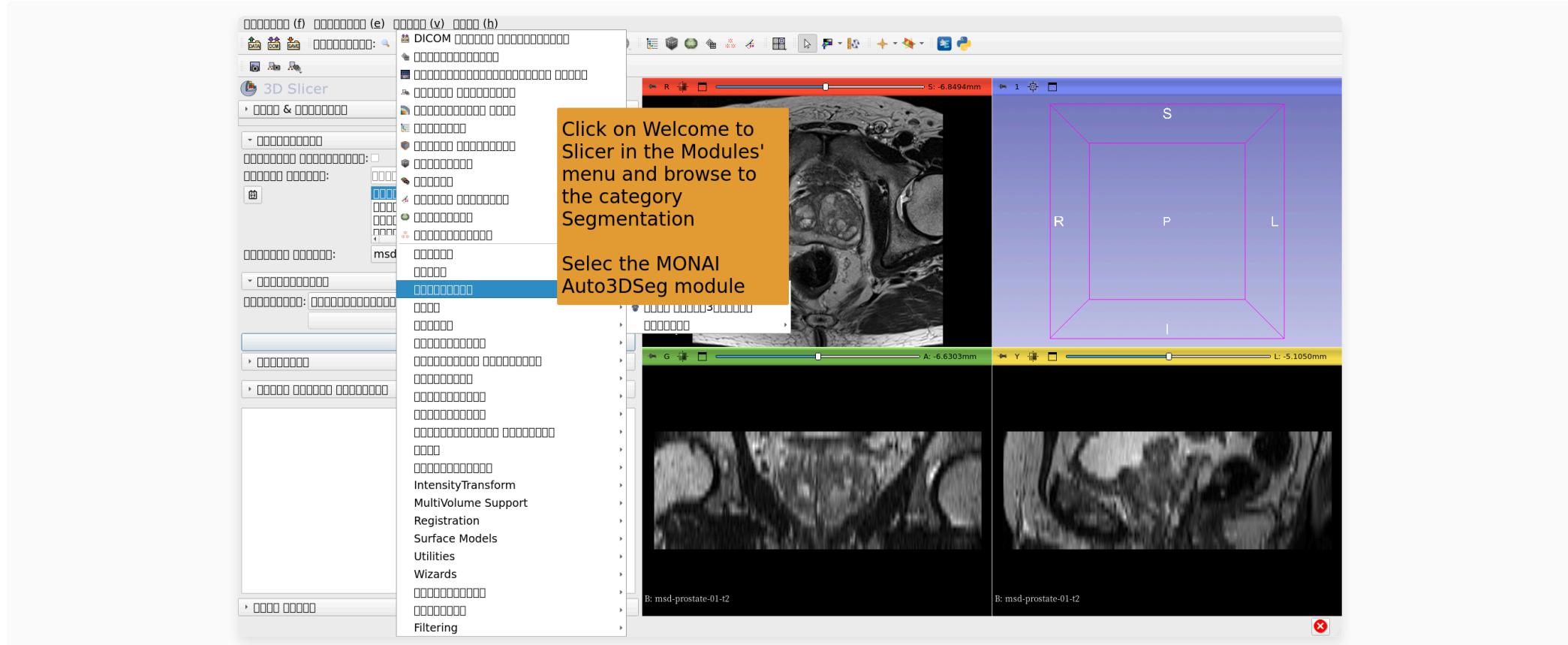
msd_prostate_01-t2

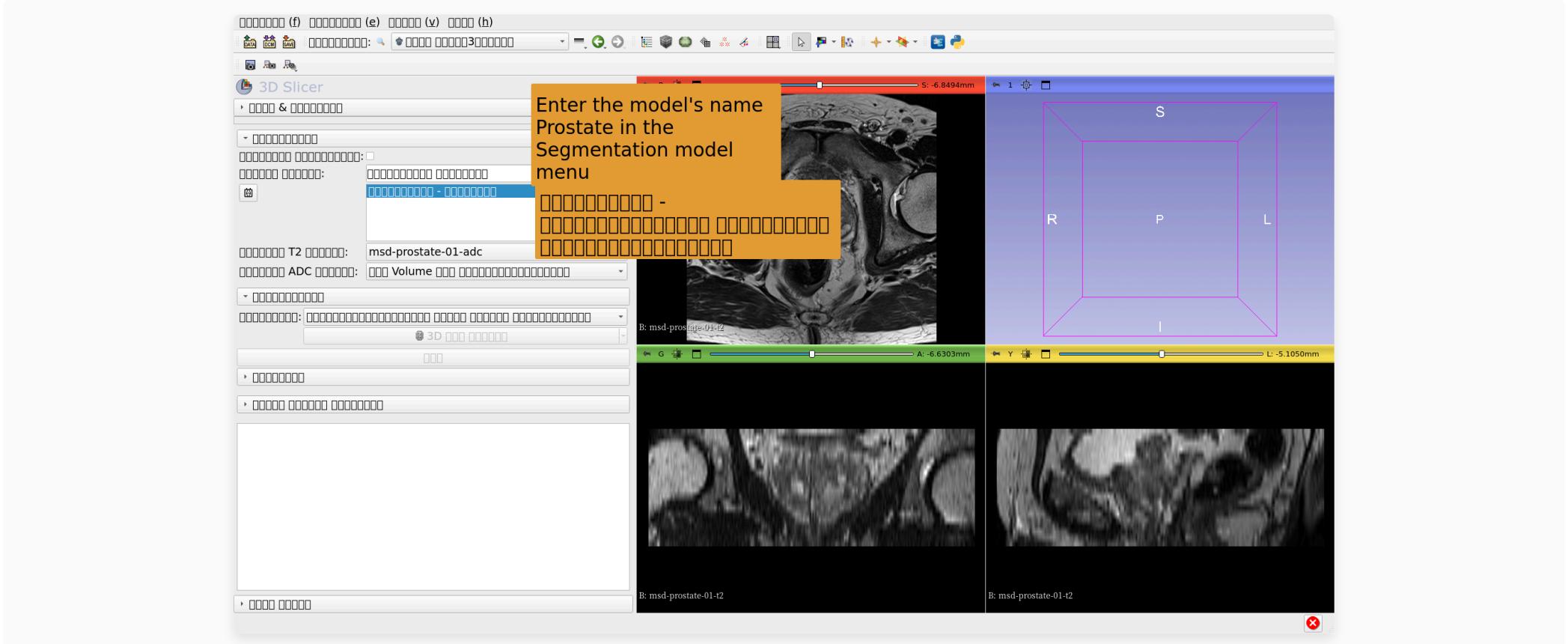
msd_prostate_01-adc

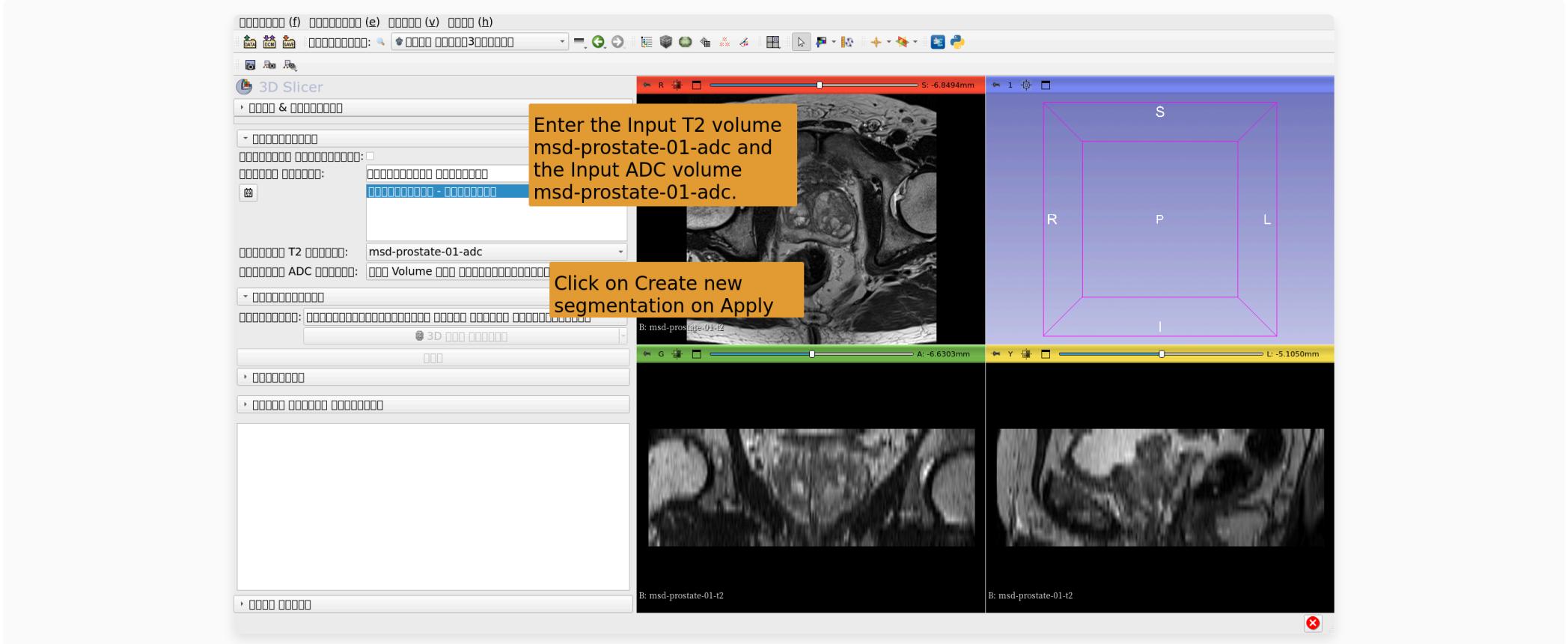


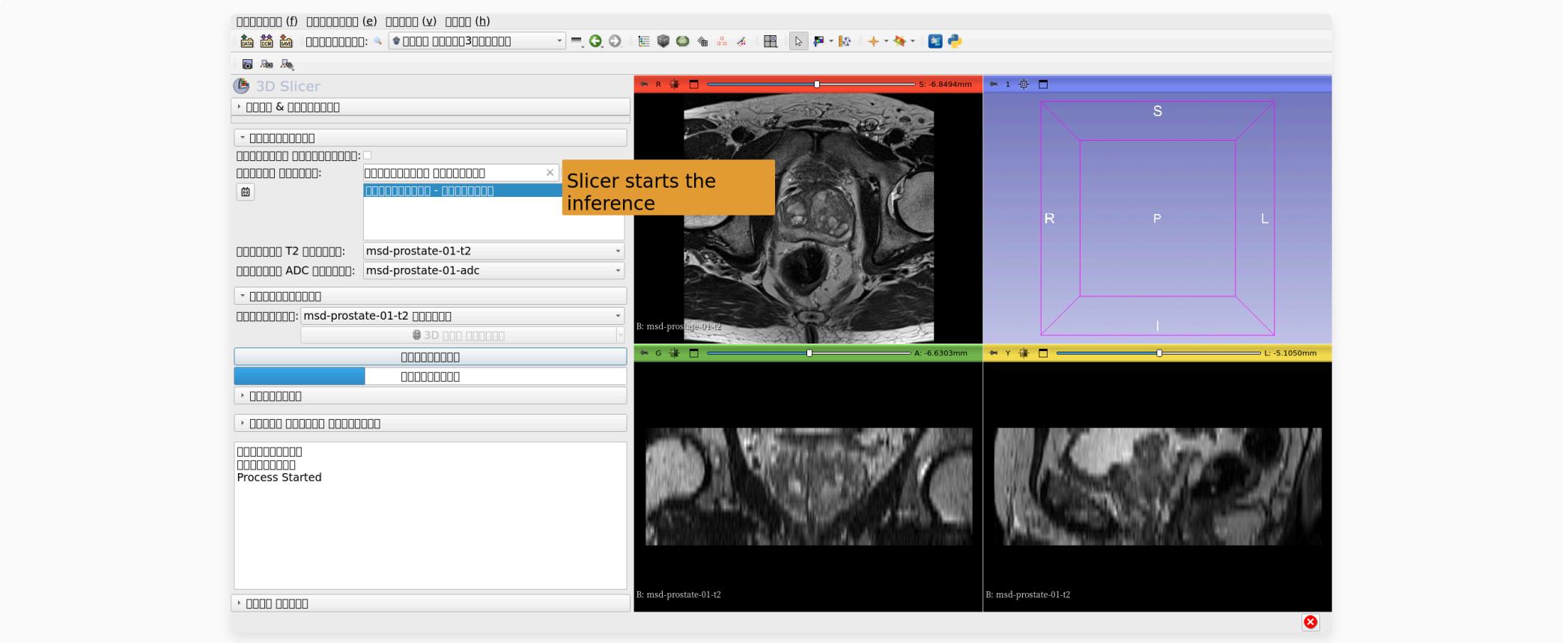


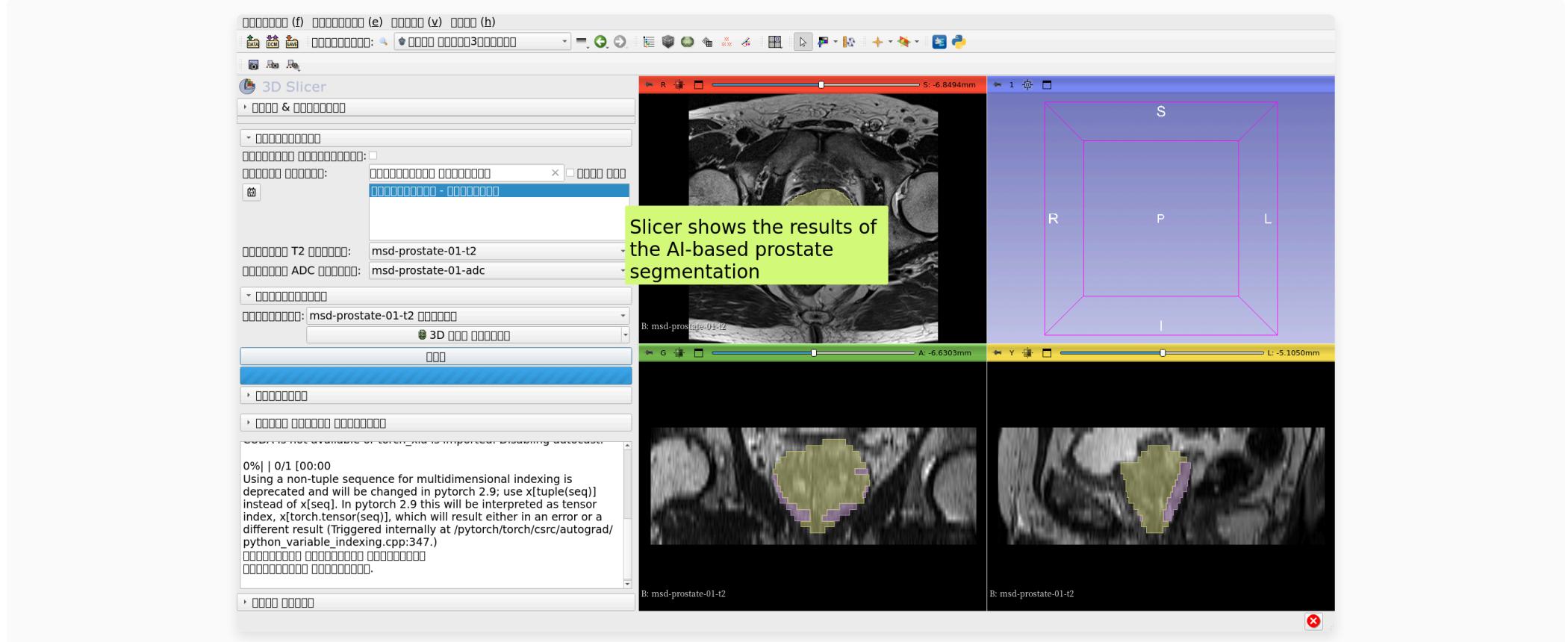
Click on Welcome to Slicer in the Modules' menu and browse to the category Segmentation
Select the MONAI Auto3DSeg module









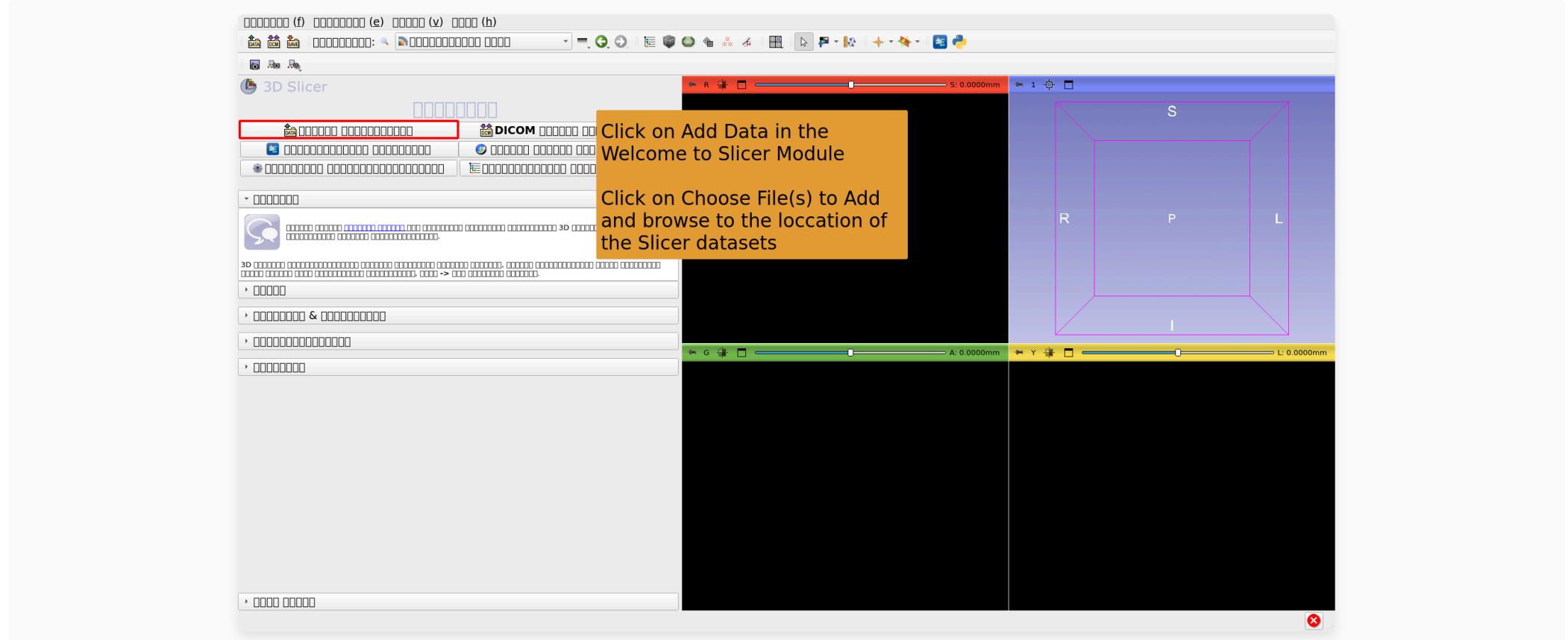


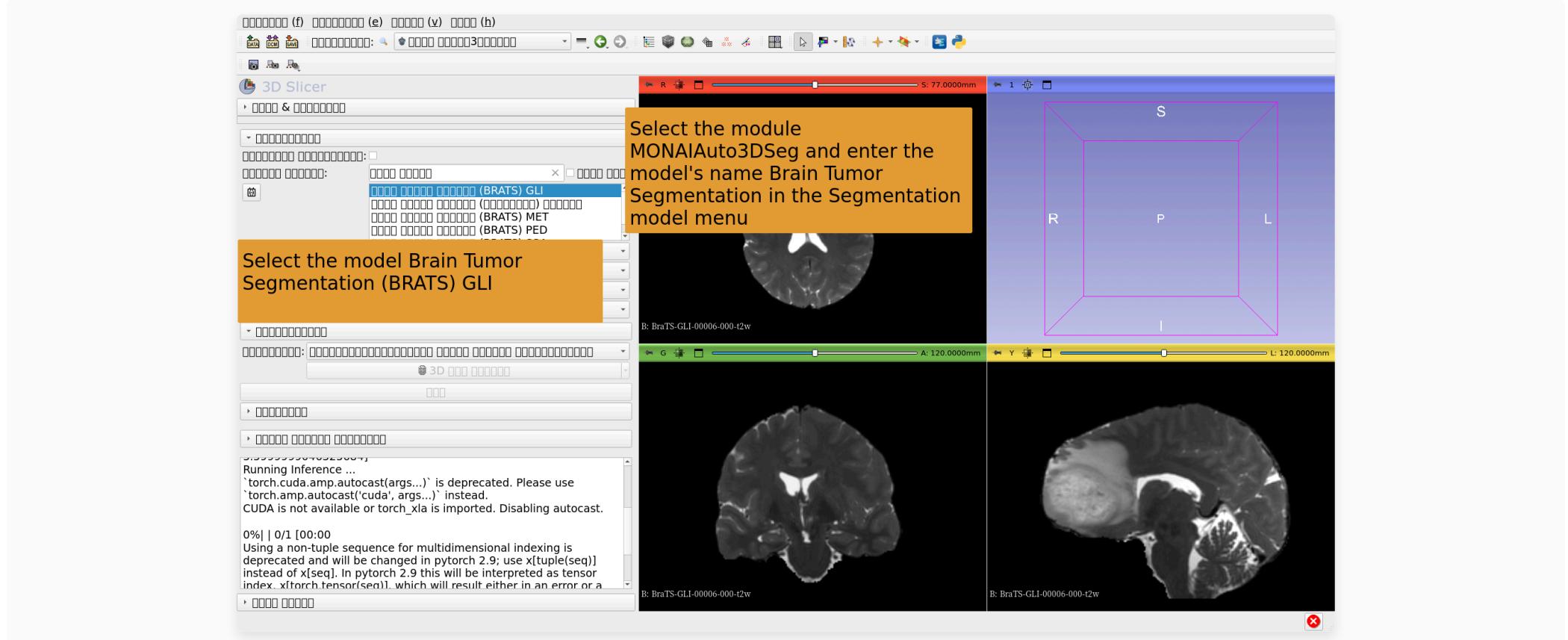
AI Segmentation Task #2: Brain Glioma

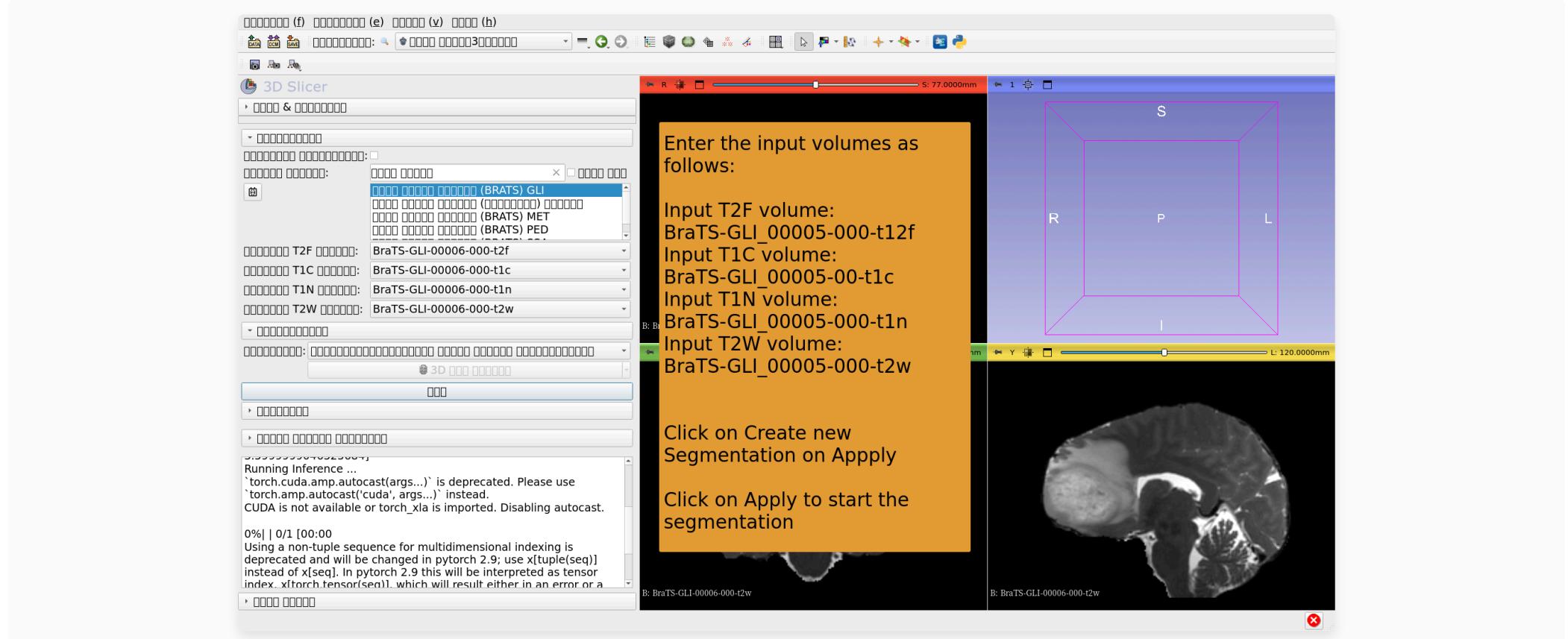
AI-based Segmentation of Neoplasm, Necrosis and Edema in Brain MRI images.

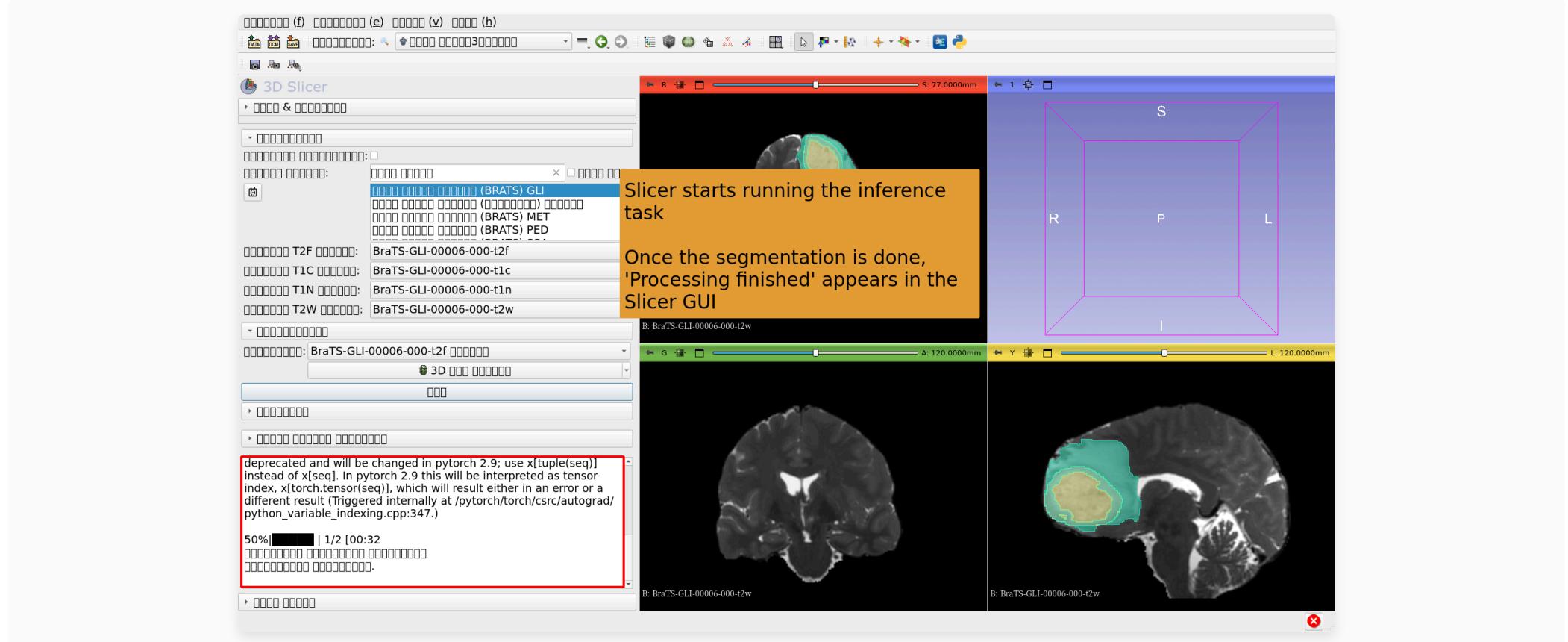
Datasets:

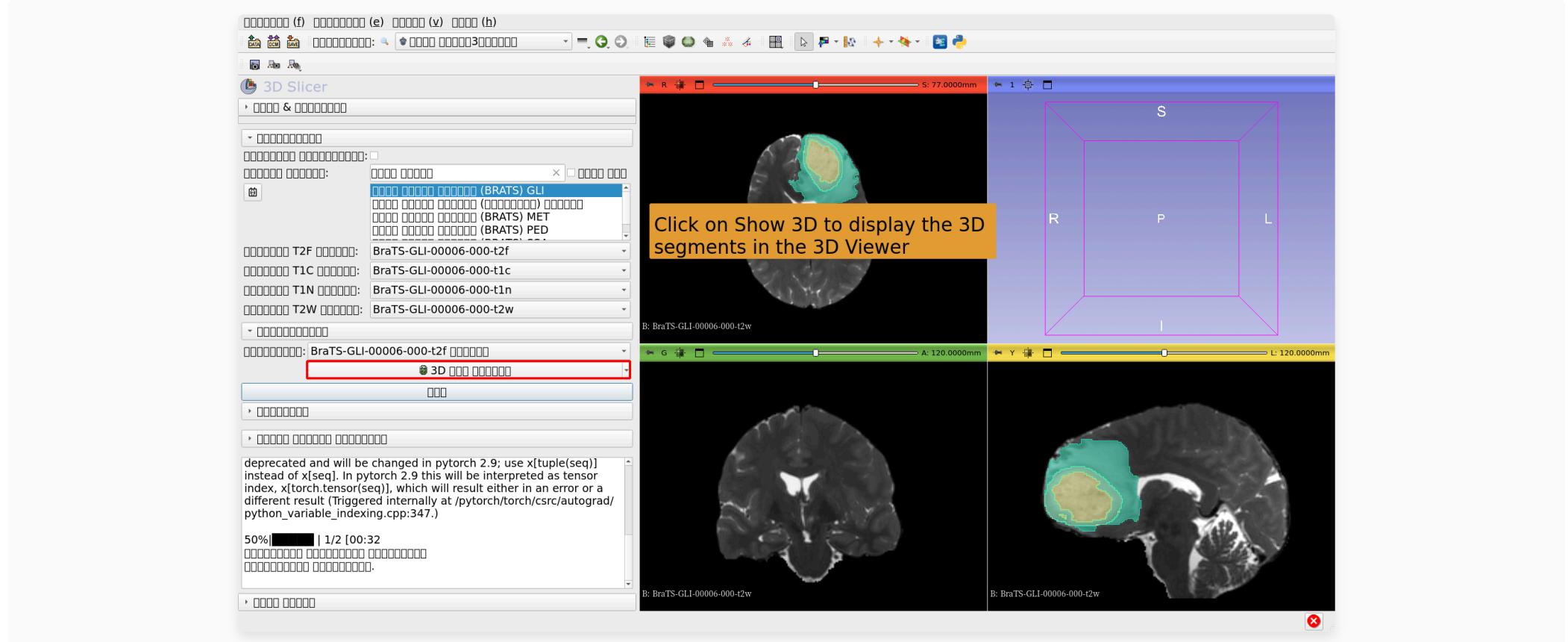
- 1) BraTS-GLI_00005-000-t1n (T1-weighted)
- 2) BraTS-GLI_00005-000-t1c (T1-weighted post-Gd)
- 3) BraTS-GLI_00005-000-t2w (T2-weighted)
- 4) BraTS-GLI_00005-000-t2f (T2-FLAIR)









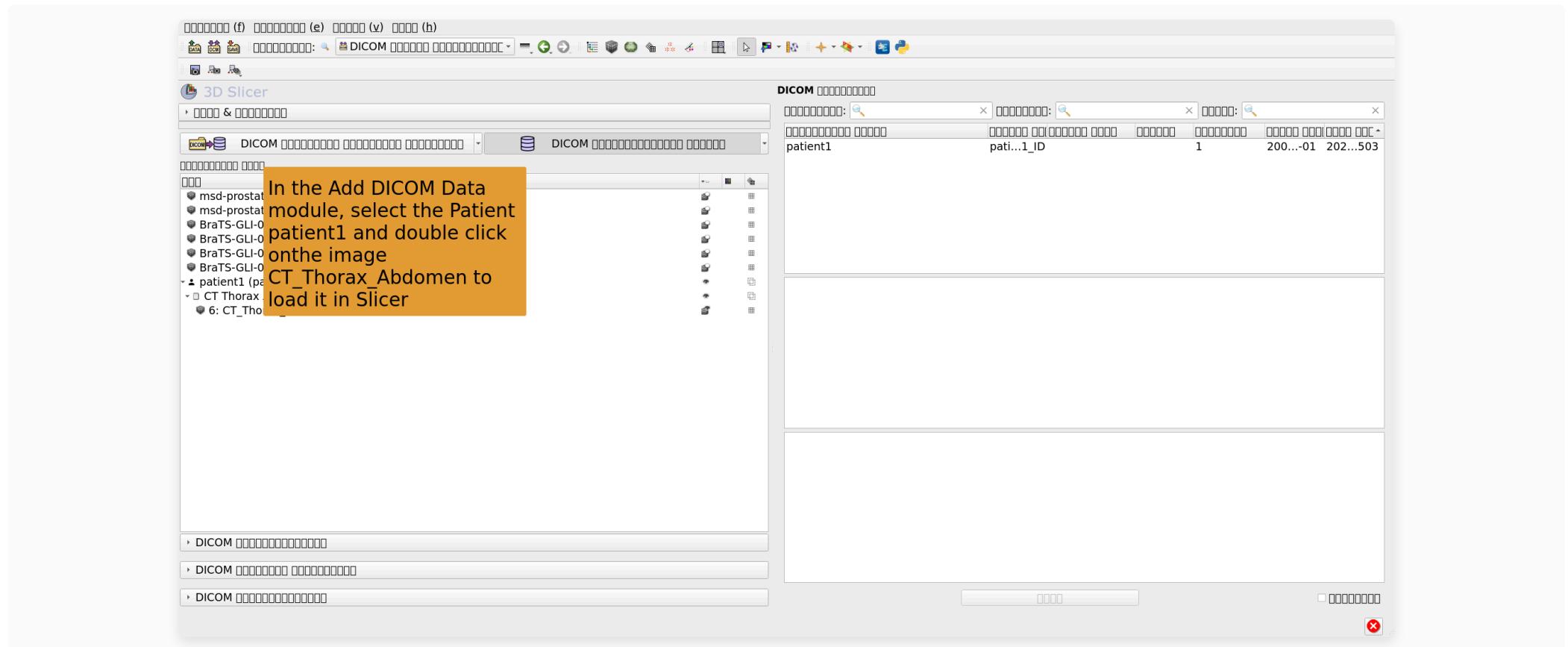


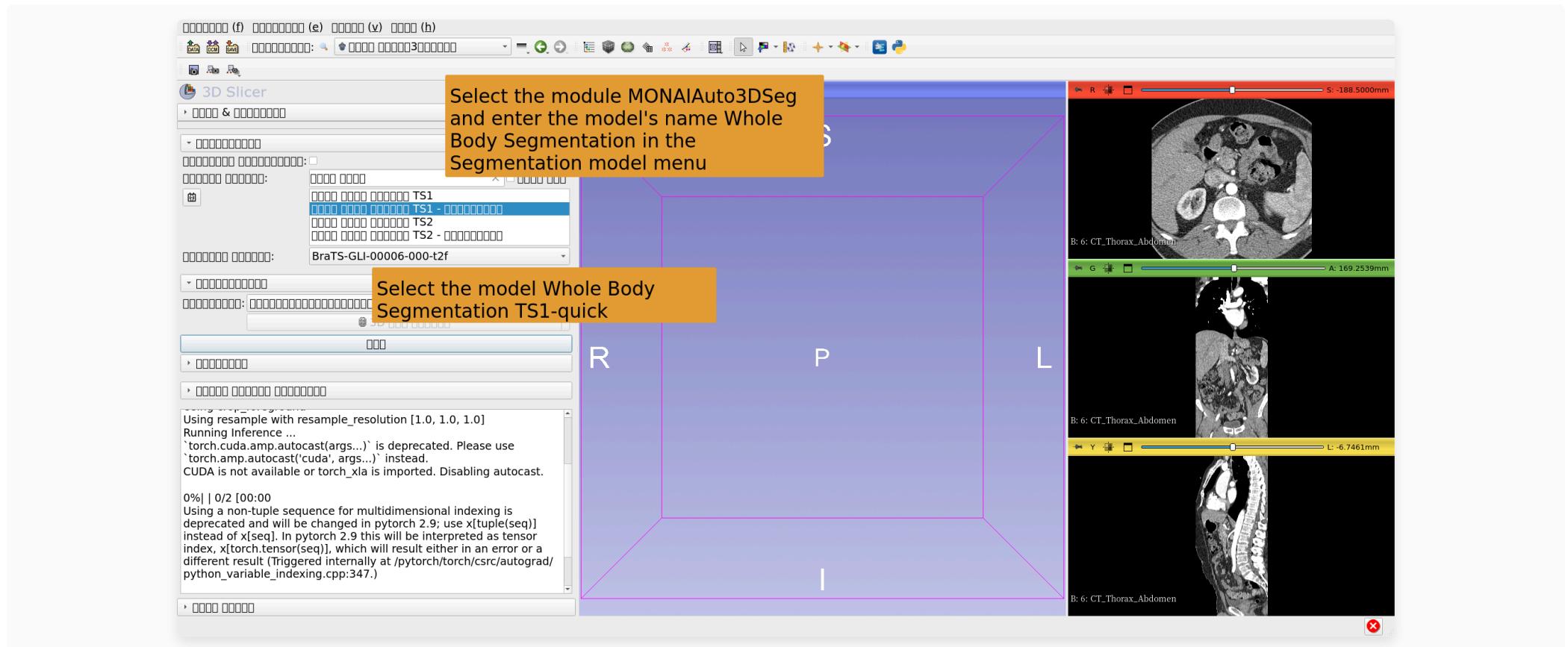
AI Segmentation Task #3: Whole Body Segmentation

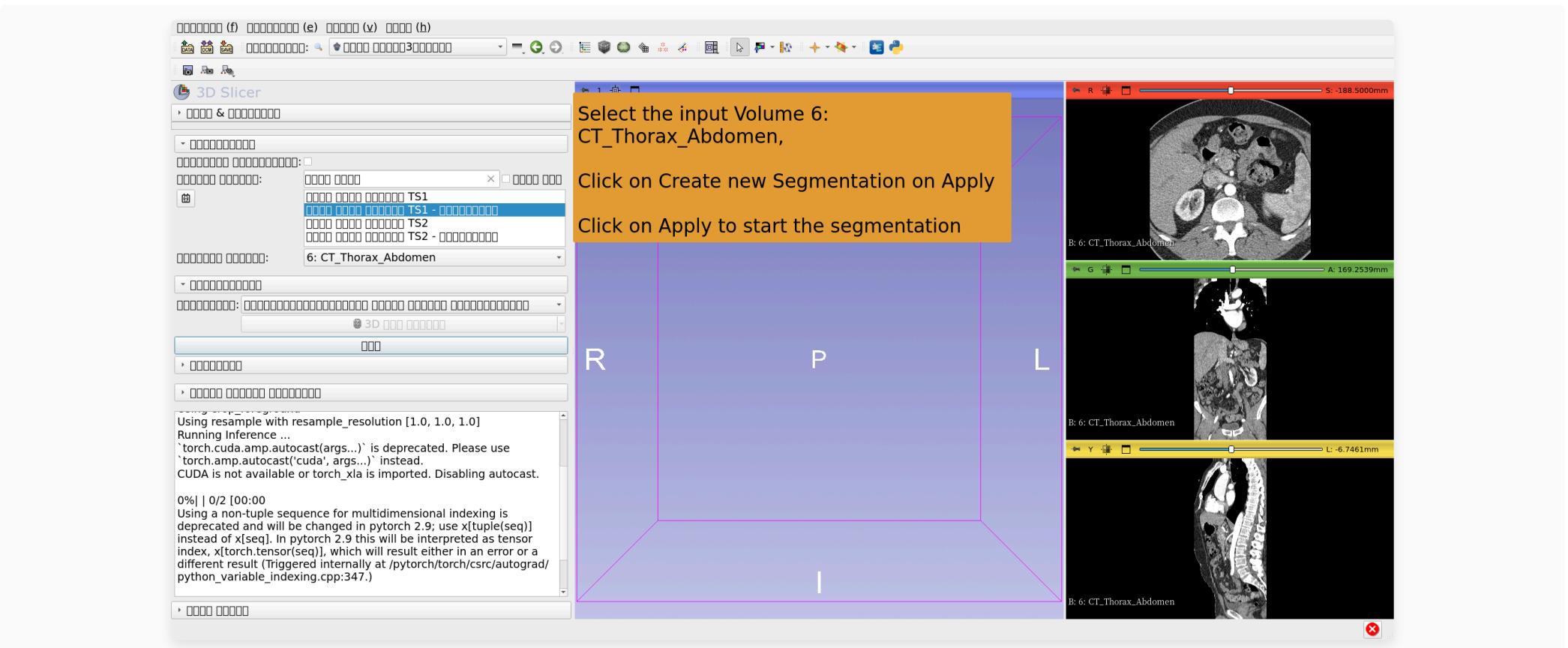
AI-based Segmentation of the whole body.

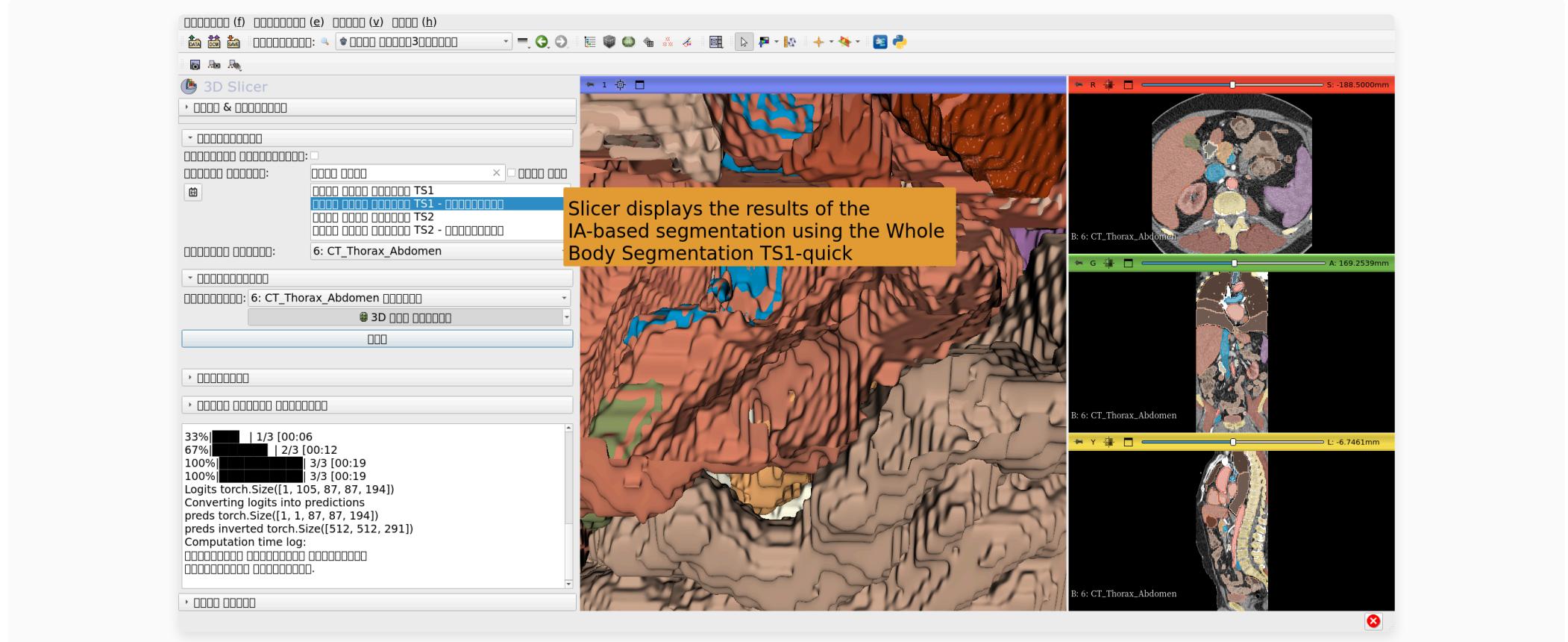
Dataset:

CT_ThoraxAbdomen









Conclusion

The 3D SlicerMONAIAuto3DSeg extension provides fast AI-based segmentation of anatomical and pathological structures.

The module can run on standard laptop and desktop computers with no GPU.

Acknowledgements

The 3D Slicer internationalization project and the 3D Slicer for Latin America project have been made possible by two CZI Essential Open Source Software for Science (EOSS cycle 4 & 5) grants.