D5.4.1 First release of software adapted to new viewer architecture.

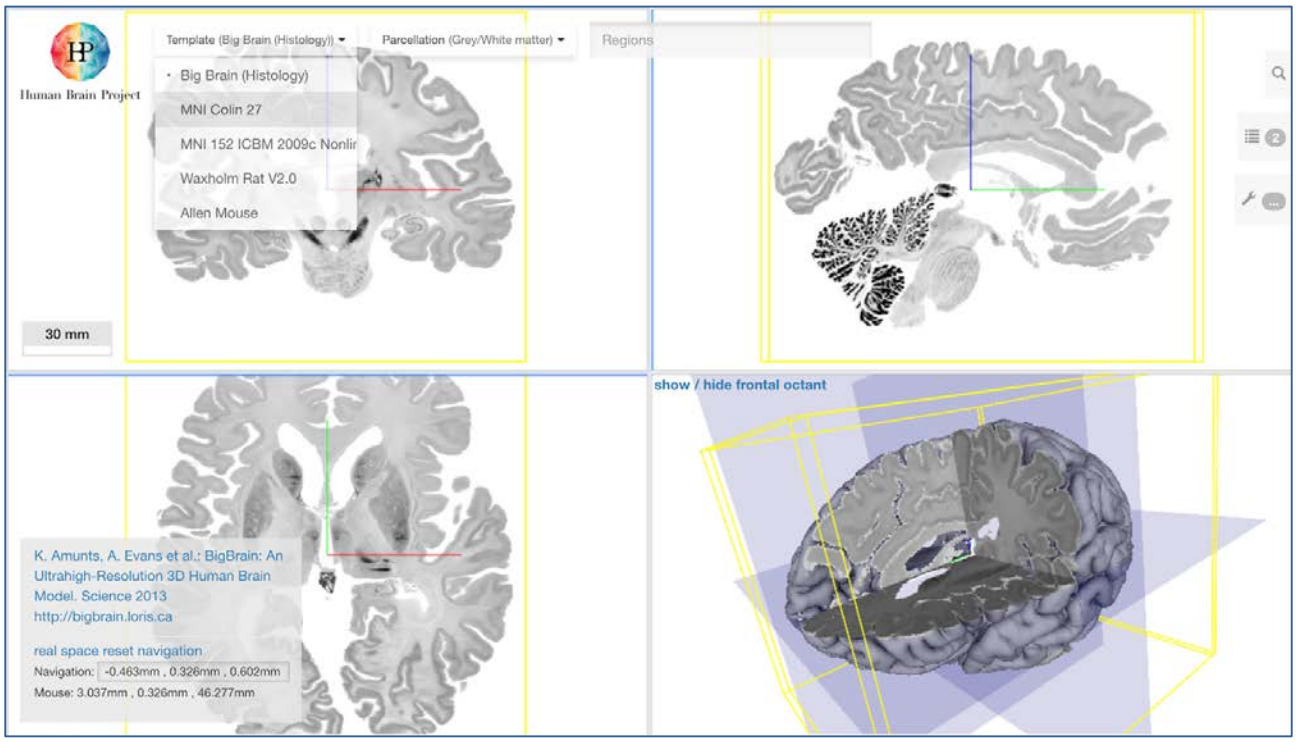

Figure 1: Interactive selection of different reference atlases in the recent release of the interactive atlas viewer ("NeHuBa-UI") unifies four previously independently deployed custom configurations.

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Description in GA	Coordinated release of several services related to atlas viewers, adapted to a more unified viewer infrastructure. The architecture of this unified viewer ecosystem will be specified by SP5 towards the end of SGA1 and become the basis for this work.
Abstract:	The report summarises the current development of the interactive atlas viewer.
Keywords:	Atlas, NeHuBa, architecture, software, API, brain, ilastik
Target Users/Readers:	Neuroscientists

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History of Changes made to this Deliverable (post Submission)

Date	Change Requested / Change Made / Other Action
20 Dec 2018	Deliverable submitted to EC
22 Jul 2019	Resubmission with specified changes requested in Review Report Main changes requested: • a clear user-centered requirements list, status of achievement and validation. • describe if and how user feedback e.g. from the reported hands-on workshops is collected and integrated into future developments. • References to use cases etc are missing.
18 Oct 2019	Revised draft sent by SP/CDP to PCO. Main changes made, with indication where each change was made: • Tables of user requests and status have been included (see Annex 1) • Procedure of how to collect and integrate user feedback have been described (see section 1 and Annex 1). • References to SGA2 Use Cases have not been included as these are internal and not available to the public. The Use Case referred to in Version 1 with requirements for exploring human and rodent 3D atlases, as specified in the public SGA1 Deliverable D5.8.1, remains.
23 Oct 2019	Revised version resubmitted to EC by PCO via SyGMa

1. Introduction

In the current state of the Neuroinformatics Platform (NIP), the core viewer component is the interactive atlas viewer ("NeHuBa-UI"). This interactive application has received several releases that implement a significantly stronger integration with the overall ecosystem of the NIP. It is accessible online via direct link (http://kg.humanbrainproject.eu/viewer), and prominently linked with direct entry points to popular reference atlases via the "explore the brain" page of the HBP (https://www.humanbrainproject.eu/en/explore-the-brain/). The core features of the interactive atlas viewer are defined in the workplan description of Task T5.4.3. As a key achievement, the currently released version of NeHuBa-UI now implements all features required for exploring human and rodent 3D atlases, as defined in the SGA1 Deliverable D5.8.1 (D73.1, D50) – "Strategy and Architecture for HBP Data Viewers". It provides a significantly deeper integration with Platform services (as described in the next section). The embedded viewer component "NeHuBa" now provides an extended API that makes it much more suitable to be embedded as a component in other web applications (as described in Section 3). The interactive viewer and its extensions are presented in courses and training workshops on an increasingly regular basis. Important user feedback from such events is collected in a table, and taken into account together with the core requirements in the planning of releases. A recent version of the table is included in Annex 1 of this document.

2. Deeper integration of the interactive atlas viewer with NIP infrastructure services

The current software release of NeHuBa-UI achieves a new level of technical unification and integration.

1) It unifies the previously independently deployed and customised viewers for four different reference atlases (JuBrain, Waxholm, BigBrain and Allen Mouse Brain) into one single application with interactive selection of different templates. Although they are now all provided through the same application, we can still provide customised settings for each of them to optimise the handling (Figure 1). This became possible by implementing an API for the viewer component NeHuBa that allows dynamic configuration by the embedding web application.
2) It provides a "Data Browser" tool that connects directly to the new HBP Knowledge Graph API to retrieve metadata information for datasets linked to specific brain areas. Previously, such region-specific datasets had to be independently prepared and deployed for the atlas viewer. Now, the viewer can directly exploit the results of the standard curation process for the Knowledge Graph (Figure 2).
3) It provides a spatial search dialogue that queries HBP's prototype spatial search engine to retrieve electrode locations for the current viewport. This functionality connects across three software components: The NeHuBa viewer (providing the viewport via API), the NeHuBa-UI interactive application (performing the search query and populating a list with search results), and the spatial search (delivering the point locations inside the given bounding box with their metadata). *As the spatial search is not yet in production release, this functionality is still disabled in the public release of the interactive atlas viewer.*

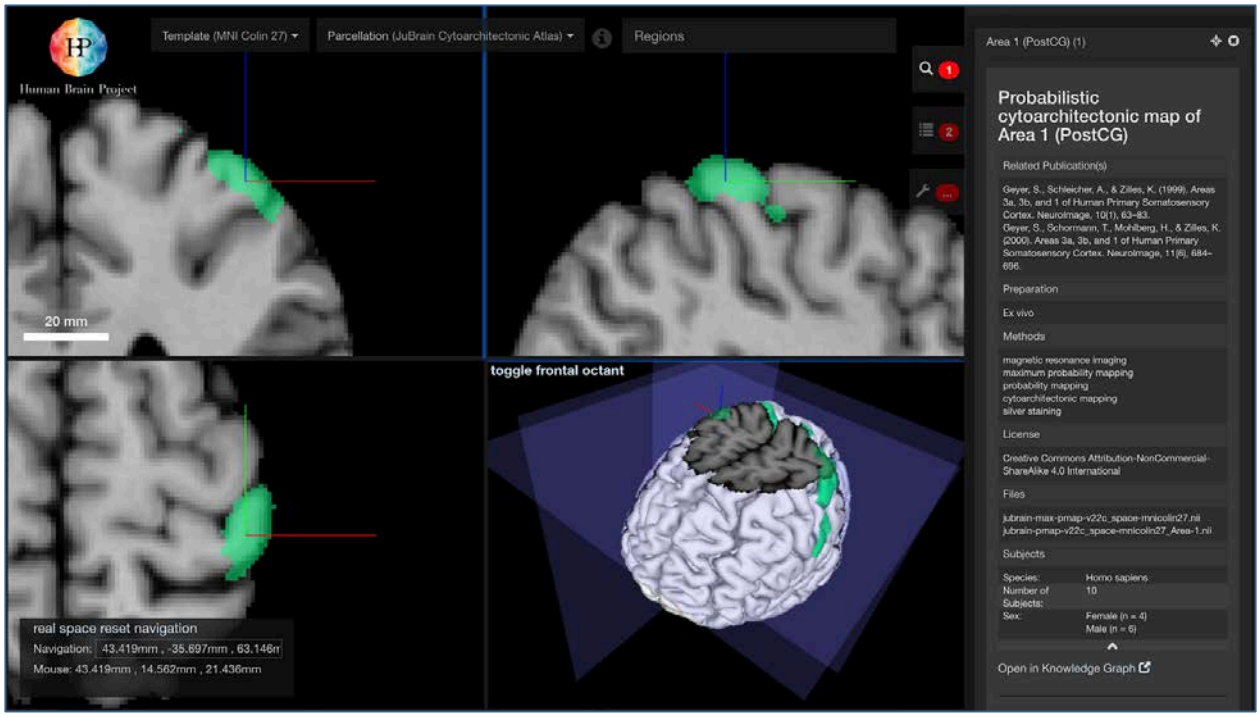

Figure 2: The "Data Browser" inside the interactive atlas viewer ("NeHuBa-UI") now fetches metadata of region-specific data directly from the Knowledge Graph.

3. Improved NeHuBa API to use the volumetric viewer as a software component in additional applications

The volumetric viewer NeHuBa is based on Google's neuroglancer project. It is designed in such a way that it exposes and optimises the look and feel specifically for brain atlases, while still being compatible with the original project. NeHuBa now provides a comprehensive API that allows it to be easily extended, configured and used as a visualisation widget in other applications. Most notably, this API has been exploited to provide the dynamic configuration and rendering of reference atlases in HBP's interactive atlas viewer ("NeHuBa-UI"), as described in the previous section.

Meanwhile, we have also made successful use of it to prototypically visualise image segmentation results computed with ilastik. This co-development with EMBL, Heidelberg (WP5.6), is ongoing and also includes interaction with University of Oslo on workflows for feature extraction (WP5.2 and WP5.4), followed by atlas-based analysis currently implemented in rodents.

NeHuBa is also currently used to implement an additional workflow step of the interactive online tool for anchoring of partial volumetric data to the Big Brain (*VoLuBa*, previously denoted as *landmark-reg)*. This additional step allows users to directly manipulate the position and orientation of a partial volume on top of the high-resolution reference atlas by interactive clicking and dragging (Figure 3), to efficiently move the volume close to the target position before starting to enter corresponding landmarks in separated views. This leads to a significantly more efficient overall workflow, and results from user feedback collected during the past year (see Annex 1).

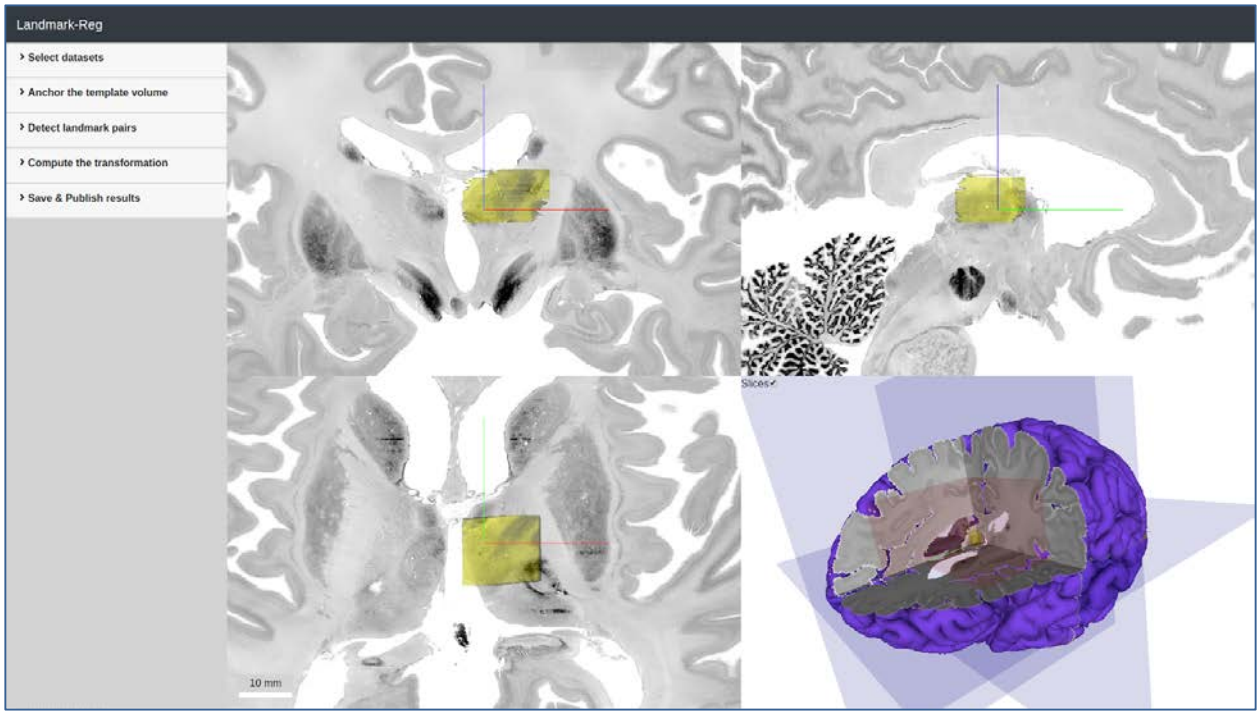

Figure 3: Alternative implementation of landmark-reg, using the NeHuBa viewer as a software component for rendering overlays of volumetric brain data, and interacting with them.

The enhanced API of NeHuBa now also allows to dynamically infer the current region of interest, laying the basis for region-based (semantic as well as landmark based) queries and other contextual information. For example, when a user selects a parcellation region the user finds all the datasets carried out related to the parcellation region; or when a user zooms in on a specific area, the viewer queries and displays all the landmarks in the field of view (Figure 4).

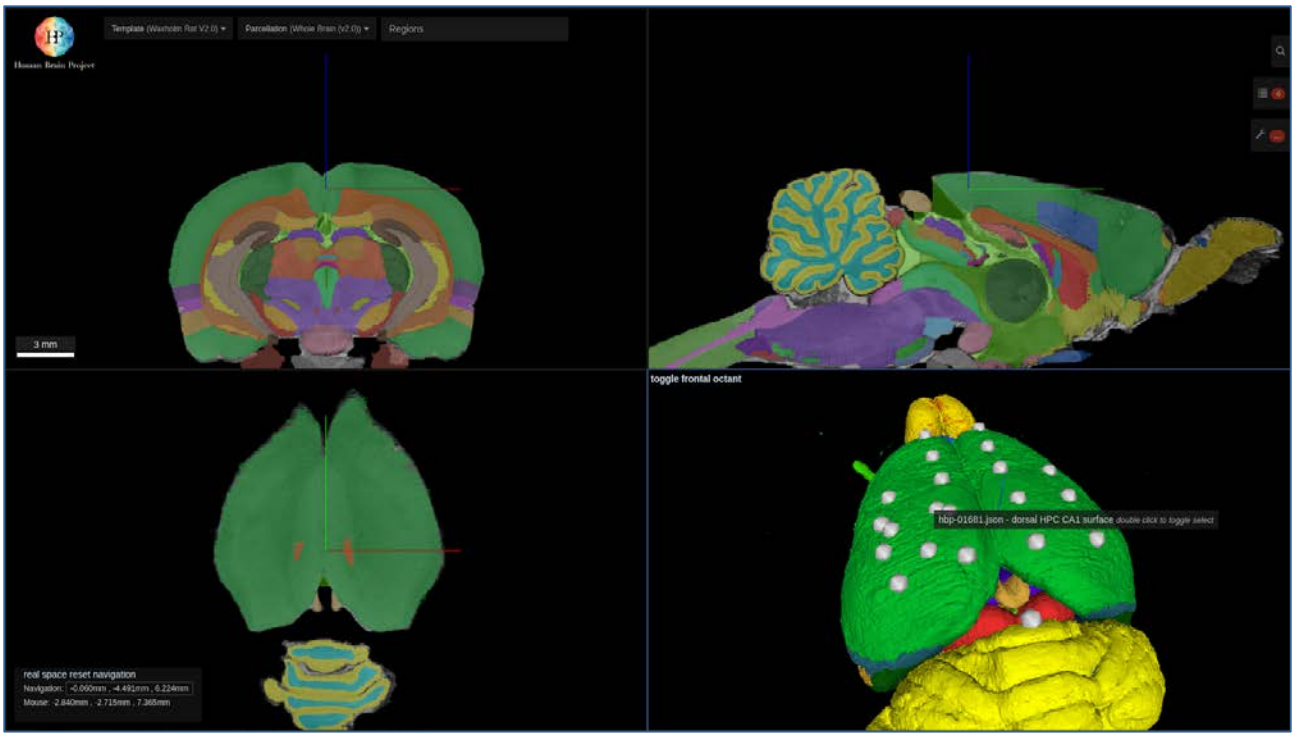

Figure 4: HBP's interactive atlas viewer (NeHuBa-ui) queries and displays landmarks in the Waxholm atlas space

4. Annex 1

4.1 User feedback tables

To include user experience and feedback into the incremental development, the tools are presented to users in workshops and training courses on a regular basis. Feedback from these courses is collected and regularly reviewed by the developer teams. Depending on effort, feasibility, and alignment with the HBP strategy, user requests are scheduled for implementation, testing, and inclusion in future releases of the tools. Current versions of the user feedback tables (Summer 2019) are included below.

Table 1: Interactive Atlas Viewer (NeHuBa-UI).

User feedback	Origin of feedback	Status Oct, 2019	Implementation plan
Automatically close probability map layer when the corresponding information panel is closed, or when a new area is selected.	Brain Atlas Workshop, INCF congress (08/2019; Warsaw)	Under review	
Interpretation of hemispheres is inconsistent across some parcellations	Brain Atlas Workshop, INCF congress (08/2019; Warsaw)	To be verified in all spaces and fixed in next release	
Add zoom buttons to the UI for interactive atlas viewer users on a touch device.	HBP Young Researcher Event (09.07.2019; Belgrade)	Added to backlog for release planning	Early 2020 release
Reduce number of button clicks for discovering region-related multimodal data. Suggestion is to open the search panel by right-clicking an area.	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Included for testing in current release candidate	Autumn 2019 release
Too many different ways for enabling and disabling previews of region-specific data	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Under review	
"Eye-button" to turn data previews on and off needs to be more conspicuous.	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Under review	
Data search option is not visible enough, should be more obvious without reading documentation	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Candidate solution implemented in current release candidate	
Short and long fibre bundles should be integrated into one atlas	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Under review – data issue, needs consultation with data provider	
Improved font colors for bright background view (BigBrain)	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	Under review	

Brain region /location should be approximately preserved when switching to another template space	HBP Young Researcher Event 2019 (09.07.2019; Belgrade)	In development, depends on release of coordinate transformation backend which is at prototype stage	Start of SGA3
Allow alternative ways of cutting the 3D overview volume, in particular along one or two single planes instead 3	HBP Summit Maastricht, 10/2018	Added to backlog for release planning	
Allow maximization of any of the planar views or the 3D overview to full screen	BigBrain Workshop, August 2019, Jülich	Implemented in current release candidate	Autumn 2019 release
More visible "home button" to get to the default position and orientation of a template	Presentation at MPI Tübingen, 11/2018	Under review	
Explicit button for submitting user feedback from within the atlas viewer	BigBrain Workshop, August 2019, Jülich	Under review	
Alternative navigation mode where the haircross position is manipulated instead of the image volume - similar to the way ITK Snap is implemented	BigBrain Workshop, August 2019, Jülich	Technical feasibility under investigation, implications expected for high-resolution volumes.	Added to backlog for a future release.

Table 2: JuBrain Differential Gene Expression Analysis Extension (JuGEx).

User feedback	Origin of feedback	Status Oct, 2019	Implementation plan
Preview selected probes in the interactive atlas viewer	HBP Summit Maastricht (10/2018)	In development	Early 2020 release
Support for regions defined by the Allen Brain Atlas	JuGEx assessment in JUELICH, 04/2019	under review	
Allow the import of gene-list in json and txt file formats	Brain Atlas Workshop, INCF congress (08/2019; Warsaw)	under review	
Export analysis as a Jupyter Notebook	JuGEx assessment in JUELICH, 04/2019	under review	