

## Protein trafficking and synaptic demand configure complex and dynamic synaptome architectures of individual neurons

### Supplementary Figure 1:

Model of a pyramidal CA1 neuron colour coded by values for normalised PSD95 puncta density taken on days 0 through day 7 of the Halo-ligand injection (from Bulovaite et al., 2022). See also main manuscript, figure 1A.

### Supplementary Figure 2:

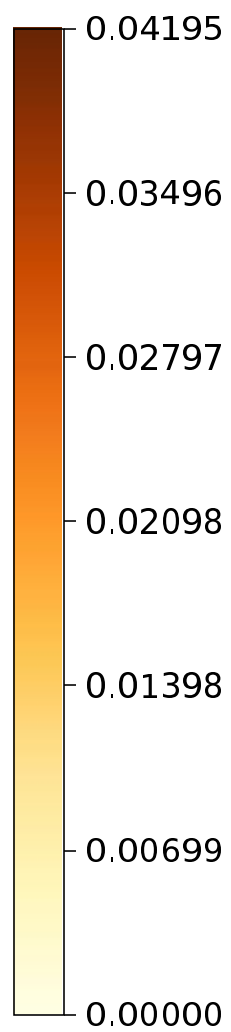
- A. Distribution of the difference between  $a$  and  $b$  ( $a-b$ ) rendered along the dendritic tree, shown along the normalised puncta density values at Day0 and Day7. It can be seen that  $a > b$  in most compartments and takes the max value in the most distal regions of the neuron (CA1Isms).
- B. Same distribution as in A with the Demand values shown

### Supplementary Figure 3:

Distribution of average value for difference between  $a$  and  $b$  trafficking rate constants ( $a-b$ ) for each of 20 segments of the dendritic tree as described in manuscript.

### Supplementary Table 1:

List of parameters used in three main versions of the model (each with increasing granularity): Version I – Three compartments with one degradation value and three local demand values; Version II – Three compartments with three degradation and three local demand values; Version III – 20 compartments with 20 local demand values and a linear model for degradation. Parameters are classified as global or local / subregion-specific (i.e. dependent on local demand). The column “fitting” indicates where parameter values were obtained by fitting the model to experimental data.



Puncta density

0:00

1:00

2:00

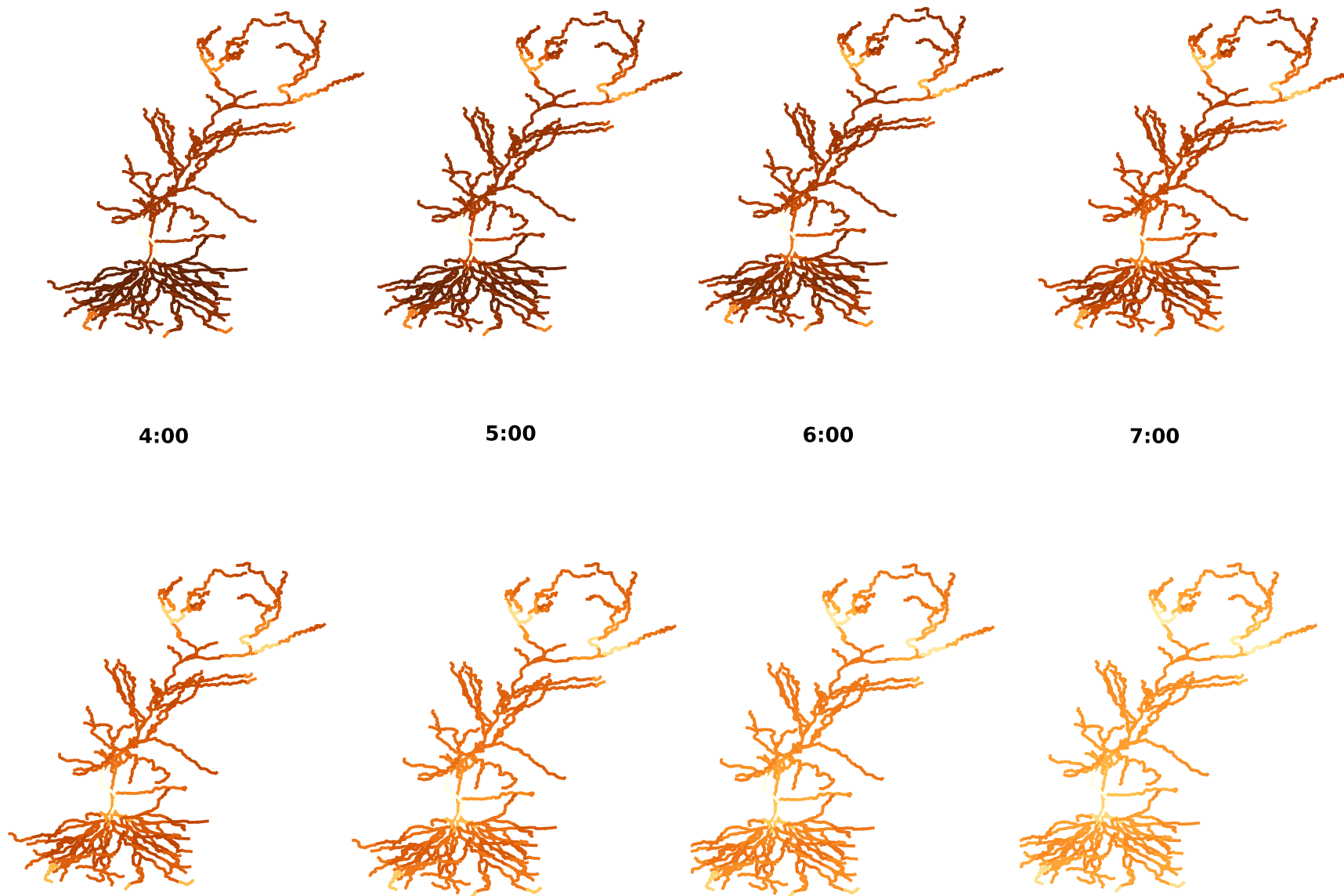
3:00

4:00

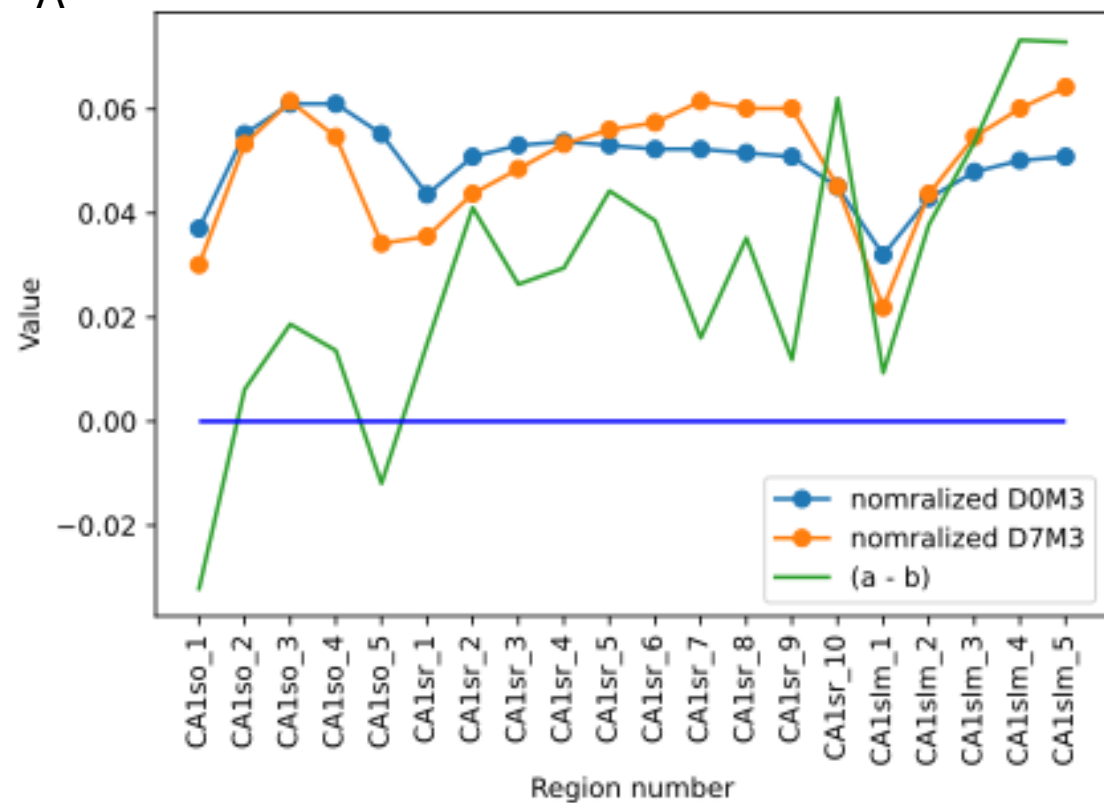
5:00

6:00

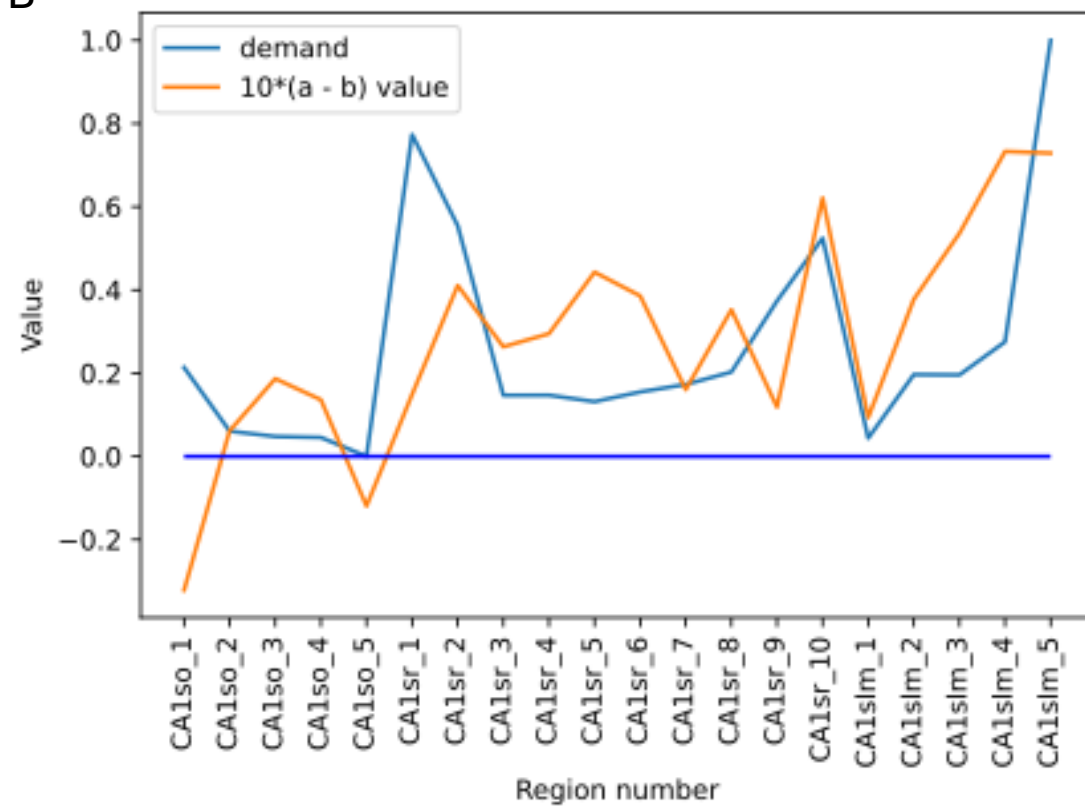
7:00



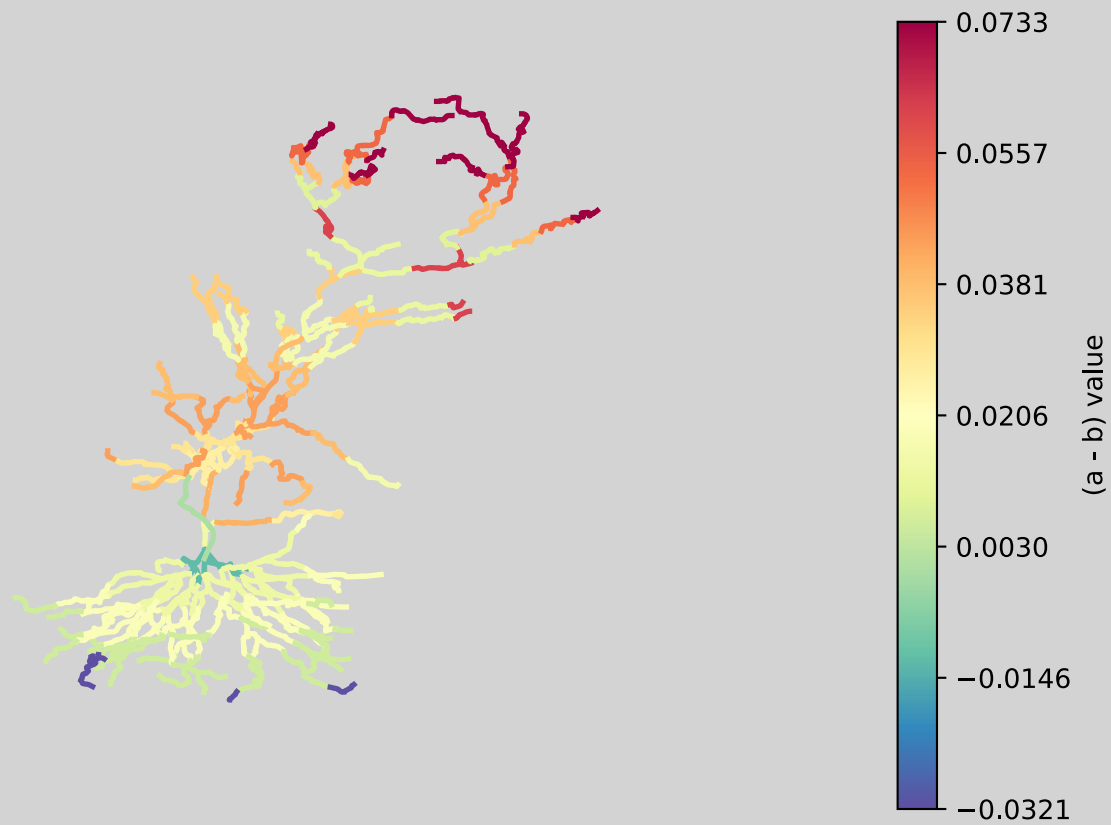
A



B



## Average (a - b) distribution



| Parameter name                                           | Definition                                                                                 | Dimension     | Model version |     |     | Global/Local | Fitting |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------|---------------|-----|-----|--------------|---------|
|                                                          |                                                                                            |               | I             | II  | III |              |         |
| <b><i>u</i></b>                                          | concentration of PSD95 protein, attached to microtubules                                   | dimensionless | YES           | YES | YES | Local        | NO      |
| <b><i>u*</i></b>                                         | concentration of the protein detached from microtubules                                    | dimensionless | YES           | YES | YES | Local        | NO      |
| <b><i>a</i></b>                                          | rate of forward traffic                                                                    | 1/s           | YES           | YES | YES | Local        | NO      |
| <b><i>b</i></b>                                          | rate of backword traffic                                                                   | 1/s           | YES           | YES | YES | Local        | NO      |
| <b><i>c</i></b>                                          | rate of detachment                                                                         | 1/s           | YES           | YES | YES | Local        | NO      |
| <b><i>d</i></b>                                          | rate of degradation                                                                        | 1/s           | YES           | YES | NO  | Local        | YES     |
| <b>dvA</b>                                               | Intercept for degradation linear approximation                                             | 1/s           | NO            | NO  | YES | Global       | YES     |
| <b>dvB</b>                                               | Slope for degradation linear approximation                                                 | 1/s           | NO            | NO  | YES | Global       | YES     |
| <b><i>F</i></b>                                          | Ratio between DDT (1) and DDD (0) modes                                                    | dimensionless | YES           | YES | YES | Global       | YES     |
| <b>Ctau</b>                                              | Coefficient for demand-dependent detachment                                                | dimensionless | YES           | YES | YES | Global       | YES     |
| <b>mProp</b>                                             | Ratio between attached and detached protein pools                                          | dimensionless | YES           | YES | YES | Global       | YES     |
| <b>Demand_CA1i</b><br>( $\tilde{u}_i$ in <sup>13</sup> ) | Local demand value for each compartment: 3 values for Model 1 and II, and 20 for Model III | dimensionless | YES           | YES | YES | Local        | YES     |