

EEGLAB Tutorial In MATLAB

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ارائه دهنده: آرمین عبداللهی



مقدمه ای بر سیگنال EEG و ابزار EEGLAB

- سیگنال های EEG توسط جریان های یونی در نورون های قشر مغز تولید می شوند. الکتروانسفالوگرافی (EEG) یک روشی است که فعالیت الکتریکی مغز را اندازه گیری می کند. این به طور گسترده در تنظیمات بالینی و تحقیقاتی برای مطالعه عملکرد مغز و تشخیص اختلالات عصبی استفاده می شود.
- یک ابزار متن باز MATLAB برای پردازش MEG، EEG و سایر داده های الکتروفیزیولوژیکی مرتبط. این شامل تجزیه و تحلیل مؤلفه های مستقل (ICA)، تجزیه و تحلیل زمان / فرکانس، حذف چندین نوع artifact غیر مغزی از داده های EEG، و چندین حالت مفید دیگه است.
- رابط گرافیکی EEGLAB رویکرد کاربرپسندتری دارد اما برای استفاده کامل از پتانسیل EEG، باید درک اولیه ای از زبان برنامه نویسی متلب داشته باشید.



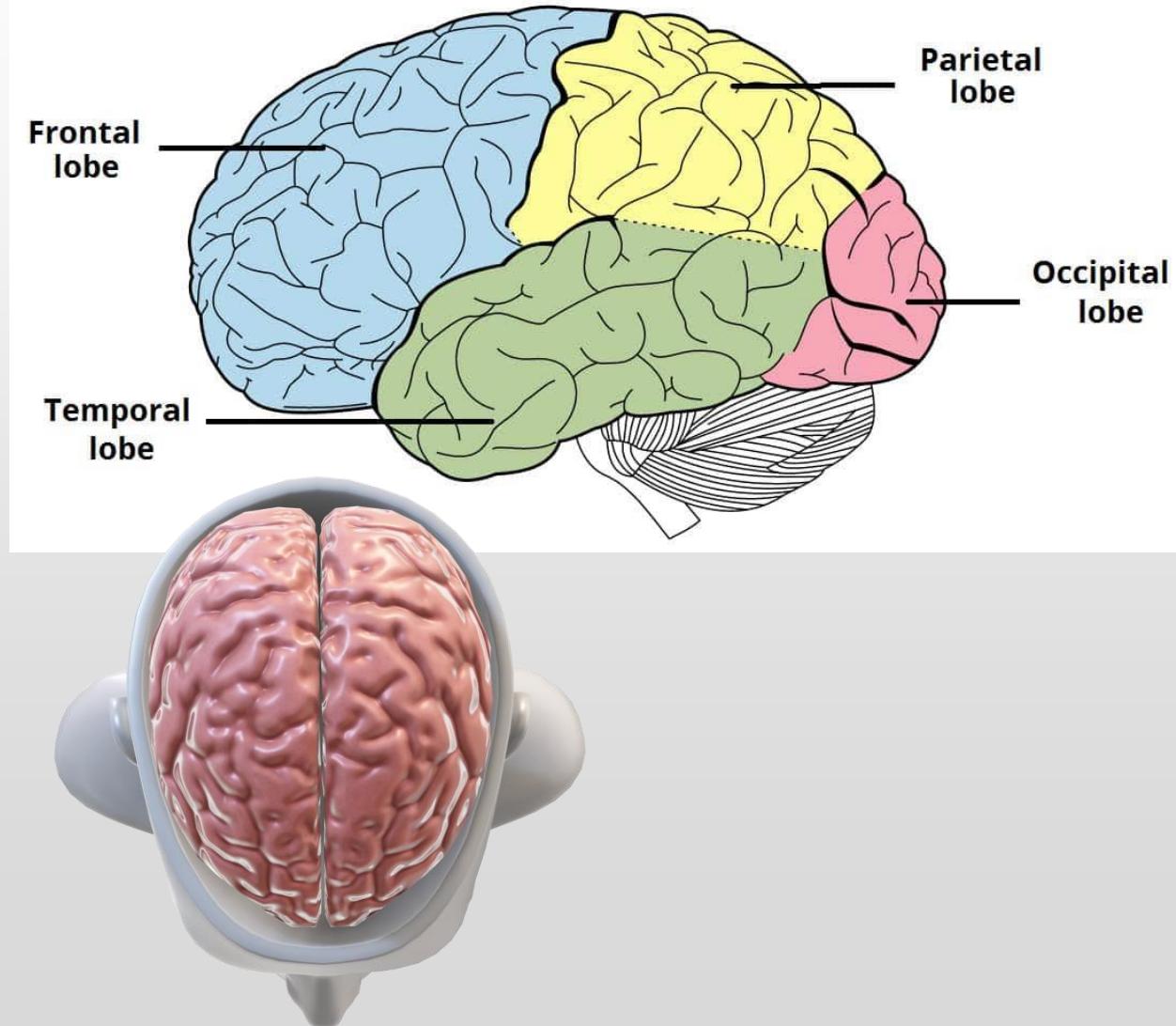
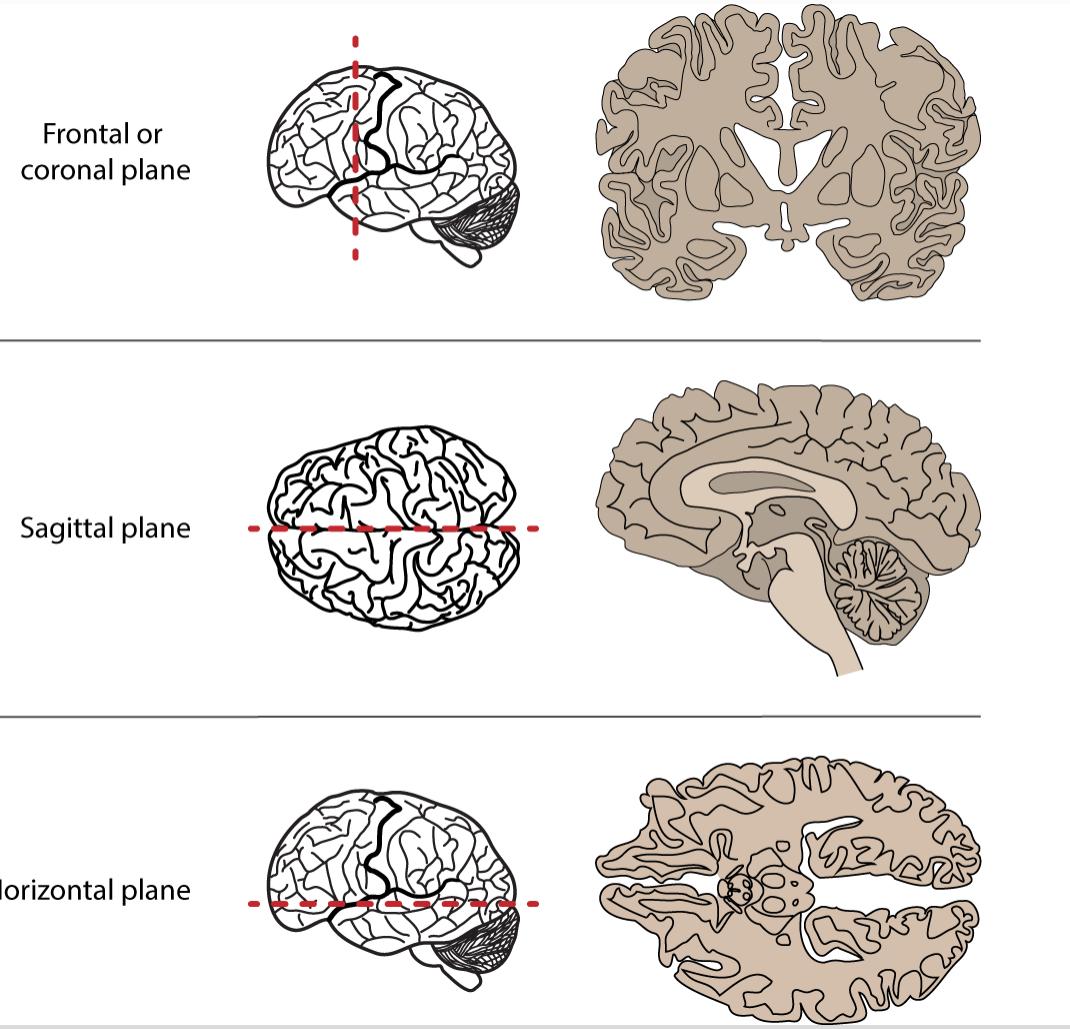
تقسیم بندی مغز

جلوی سر قرار دارد و مسئول توجه، تمرکز و ادراک است.

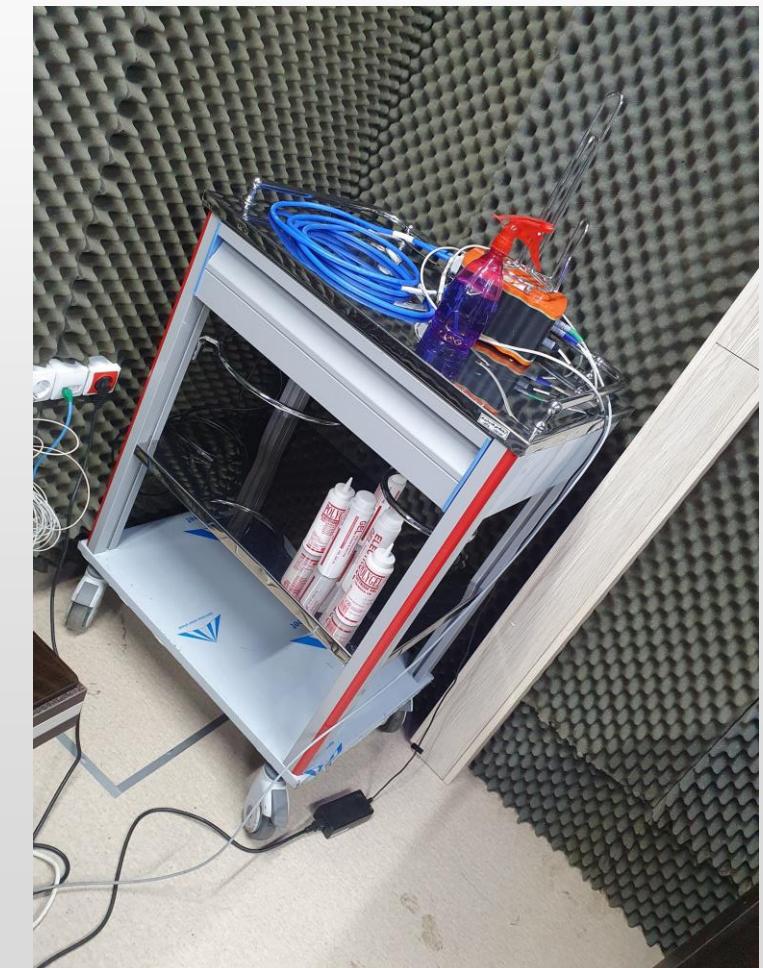
بالای گوش دو طرف قرار دارد و مسئول شنوندایی است.

پشت سر، بالای گردن قرار دارد و مسئول بینایی است.

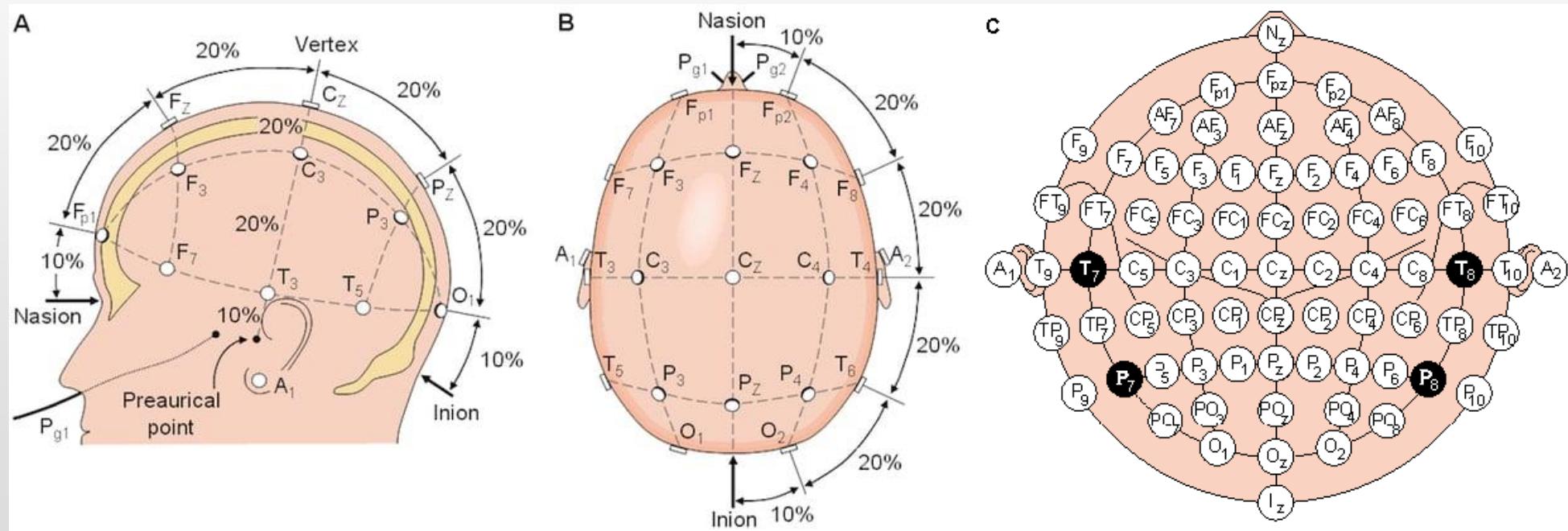
بالای سر، پس سر قرار دارد و مسئول کنترل حرکت های ما است.



نحوه ثبت سیگنال های EEG



نام گذاری الکترودها و انواع استانداردها



Transcranial Magnetic Stimulation (TMS)



About Dataset

Number	Patient ID	Age Years	Gender	Seizure	Localization	Lateralization	EEG Channel	Number Seizures	Rec Time Minutes
1	PN00	55	Male	IAS	T	R	29	5	198
2	PN01	46	Male	IAS	T	L	29	2	809
3	PN03	54	Male	IAS	T	R	29	2	752
4	PN05	51	Female	IAS	T	L	29	3	359
5	PN06	36	Male	IAS	T	L	29	5	722
6	PN07	20	Female	IAS	T	L	29	1	523
7	PN09	27	Female	IAS	T	L	29	3	410
8	PN10	25	Male	FBTC	F	Bilateral	20	10	1002
9	PN11	58	Female	IAS	T	R	29	1	145
10	PN12	71	Male	IAS	T	L	29	4	246
11	PN13	34	Female	IAS	T	L	29	3	519
12	PN14	49	Male	WIAS	T	L	29	4	1408
13	PN16	41	Female	IAS	T	L	29	2	303
14	PN17	42	Male	IAS	T	R	29	2	308



C: > Users > ASUS > Downloads >

Workspace

Name	Value
ALLCOM	1x1 cell
ALLEEG	[]
CURRENTS...	0
CURRENTS...	0
EEG	1x1 struct
globalvars	8x1 cell
LASTCOM	[ALLEEG EEG ...]
PLUGINLIST	1x9 struct
STUDY	[]
tmpEEG	1x1 struct

Command Window

```
>> eeglab
```

Some menus items hidden. Use Preference menu to show them all.
eeglab: options file is C:\Users\ASUS\eeg_options.m
Retrieving plugin versions from server...
Retrieving download statistics...
EEGLAB: adding "Biosig" v3.8.1 to the path
EEGLAB: adding "Fileio" v20230402 to the path
EEGLAB: adding "ICLabel" v1.4 (see >> help eeg
EEGLAB: adding "MFMatlabIO" v4.1 (see >> help eeg
EEGLAB: adding "bva-io" v1.71 (see >> help eeg
EEGLAB: adding "clean_rawdata" v2.8 (see >> he
EEGLAB: adding "dipfit" v5.0 (see >> help eegp
EEGLAB: adding "firfilt" v2.7.1 (see >> help e
EEGLAB: adding "neuroscanno" v1.6 (see >> help
You are using the latest version of EEGLAB.

fx >>

EEGLAB v2023.0

No current dataset

Suggested steps to get started

- Create a new or load an existing dataset:
Use "File > Import data" (new)
Or "File > Load existing dataset" (load)
(find tutorial data in sample_data folder)
- If newly imported raw dataset
"Edit > Channel locations" (look up locations)
"File > Import event info" (for continuous data)
- Filter data: "Tools > Filter data"
- Reject data: "Tools > Reject data by eye"
- Run ICA: "Tools > Run ICA" (can take time)
- Reject by ICA: "Tools > Reject data using ICA"
- Epoch data: "Tools > Extract epochs"
- Plot ERP: "Plot > Channel ERP > In scalp array"





Workspace

Name	Value
ALLCOM	1x3 cell
ALLEEG	1x1 struct
CURRENTS...	1
CURRENTS...	0
EEG	1x1 struct
globalvars	10x1 cell
LASTCOM	[ALLEEG EEG ...]
PLUGINLIST	1x9 struct
STUDY	[]
tmpEEG	1x1 struct

Command Window

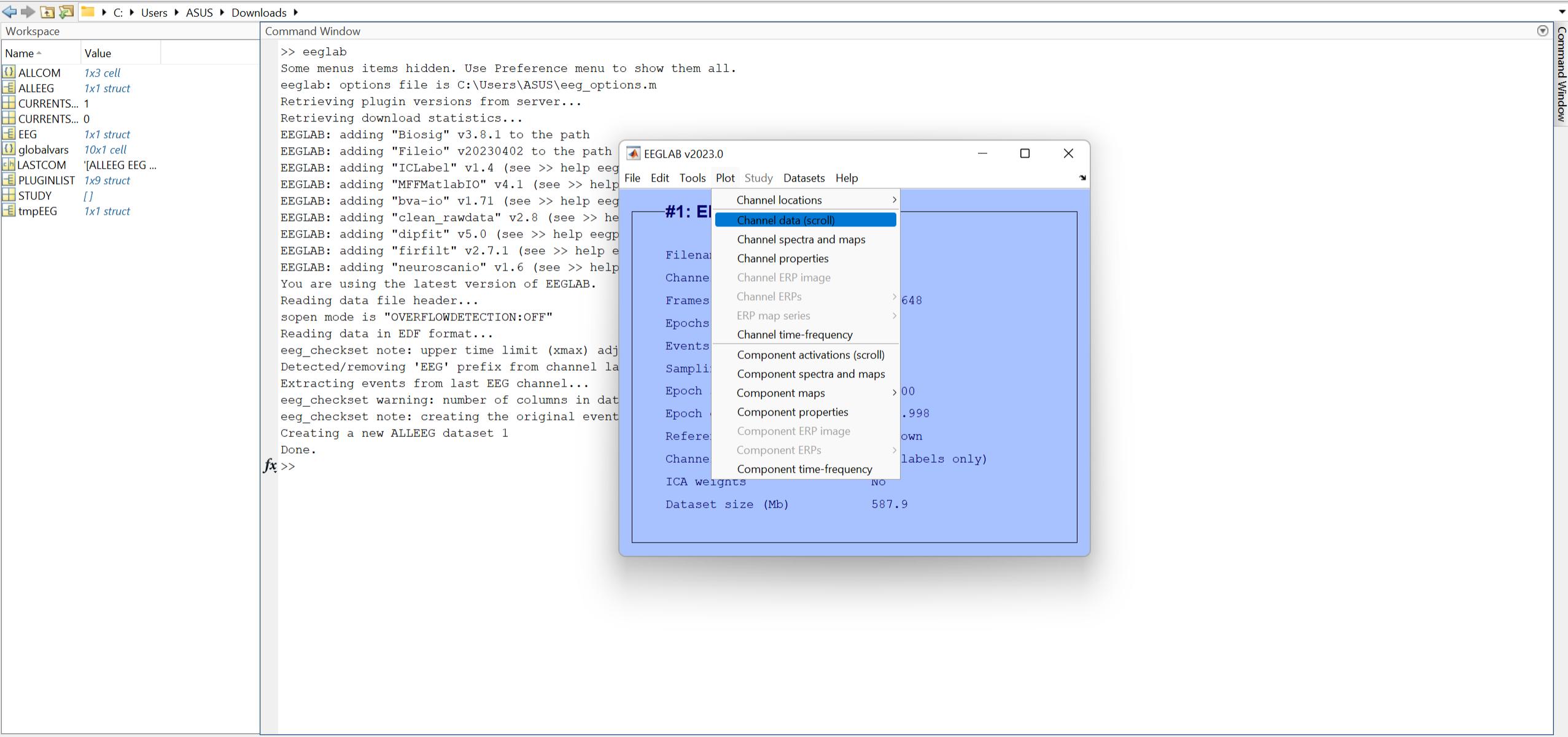
```
>> eeglab
Some menus items hidden. Use Preference menu to show them all.
eeglab: options file is C:\Users\ASUS\eeg_options.m
Retrieving plugin versions from server...
Retrieving download statistics...
EEGLAB: adding "Biosig" v3.8.1 to the path
EEGLAB: adding "Fileio" v20230402 to the path
EEGLAB: adding "ICLabel" v1.4 (see >> help eeg
EEGLAB: adding "MFMatlabIO" v4.1 (see >> help
EEGLAB: adding "bva-io" v1.71 (see >> help eeg
EEGLAB: adding "clean_rawdata" v2.8 (see >> he
EEGLAB: adding "dipfit" v5.0 (see >> help eegp
EEGLAB: adding "firfilt" v2.7.1 (see >> help e
EEGLAB: adding "neuroscanno" v1.6 (see >> help
You are using the latest version of EEGLAB.
Reading data file header...
sopen mode is "OVERFLOWDETECTION:OFF"
Reading data in EDF format...
eeg_checkset note: upper time limit (xmax) adj
Detected/removing 'EEG' prefix from channel la
Extracting events from last EEG channel...
eeg_checkset warning: number of columns in dat
eeg_checkset note: creating the original event
Creating a new ALLEEG dataset 1
Done.
```

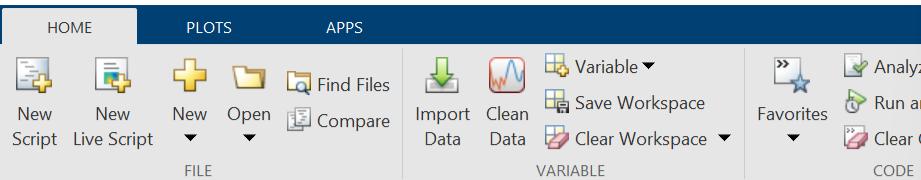
fx >>

EEGLAB v2023.0

#1: EDF file

Filename:	none
Channels per frame	36
Frames per epoch	3867648
Epochs	1
Events	5
Sampling rate (Hz)	512
Epoch start (sec)	0.000
Epoch end (sec)	7553.998
Reference	unknown
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	587.9



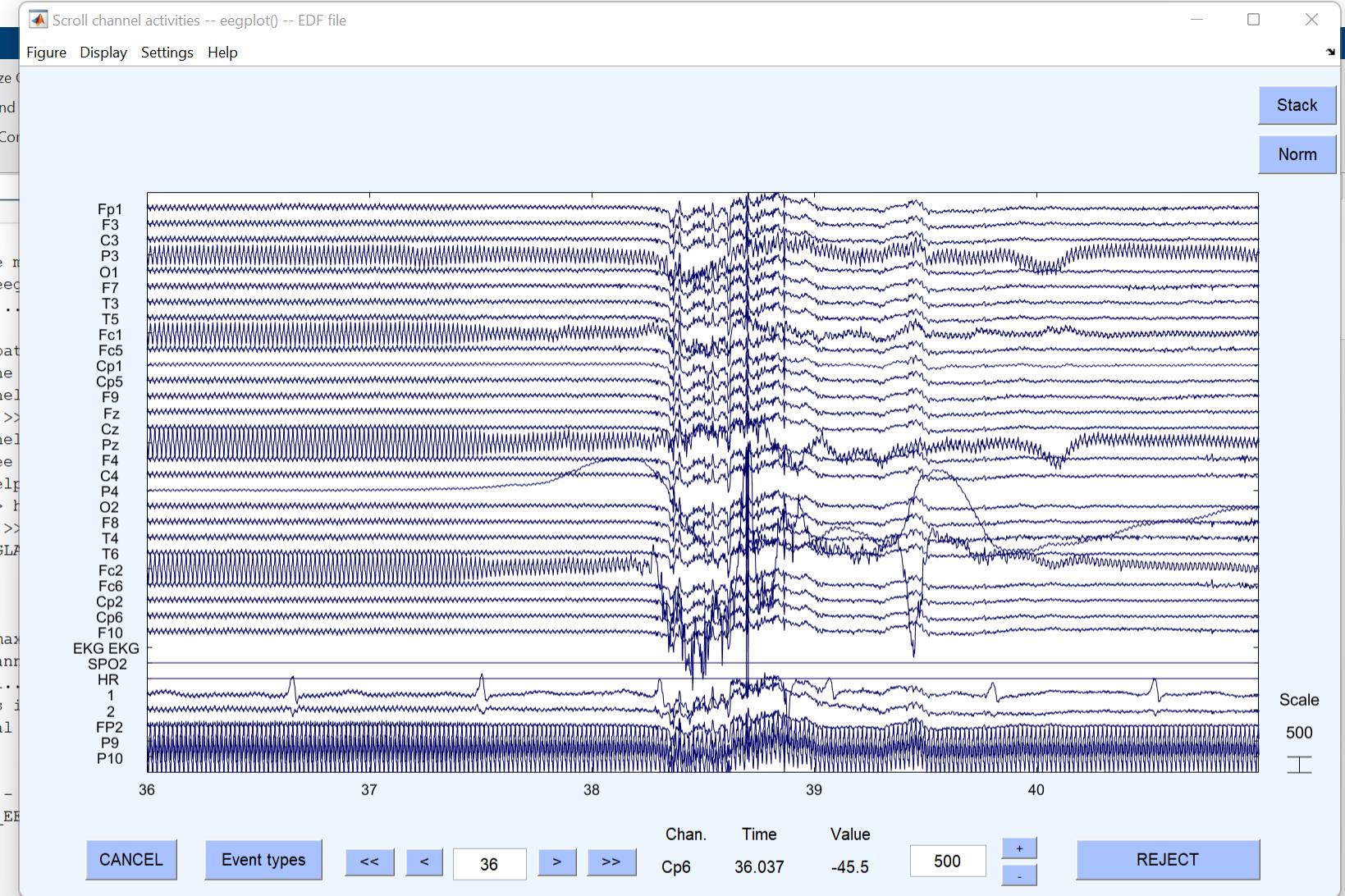


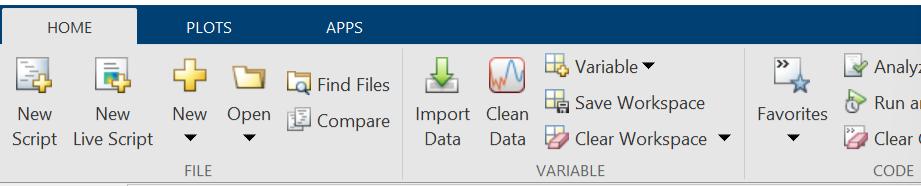
C: > Users > ASUS > Downloads >

Workspace		Command Window
Name	Value	
ALLCOM	1x4 cell	>> eeglab Some menus items hidden. Use Preference m...
ALLEEG	1x1 struct	eeglab: options file is C:\Users\ASUS\eed...
ans	[]	Retrieving plugin versions from server...
CURRENTS...	1	Retrieving download statistics...
CURRENTS...	0	EEGLAB: adding "Biosig" v3.8.1 to the pat...
EEG	1x1 struct	EEGLAB: adding "Fileio" v20230402 to the
globalv		>> hel (see >> help) 8 (see >> help) of EEGLAB
LASTCO		>> help (see >> help) of EEGLAB
PLUGIN		>> help (see >> help) of EEGLAB
STUDY		>> help (see >> help) of EEGLAB
tmpEEG		>> help (see >> help) of EEGLAB

#1: EDF file

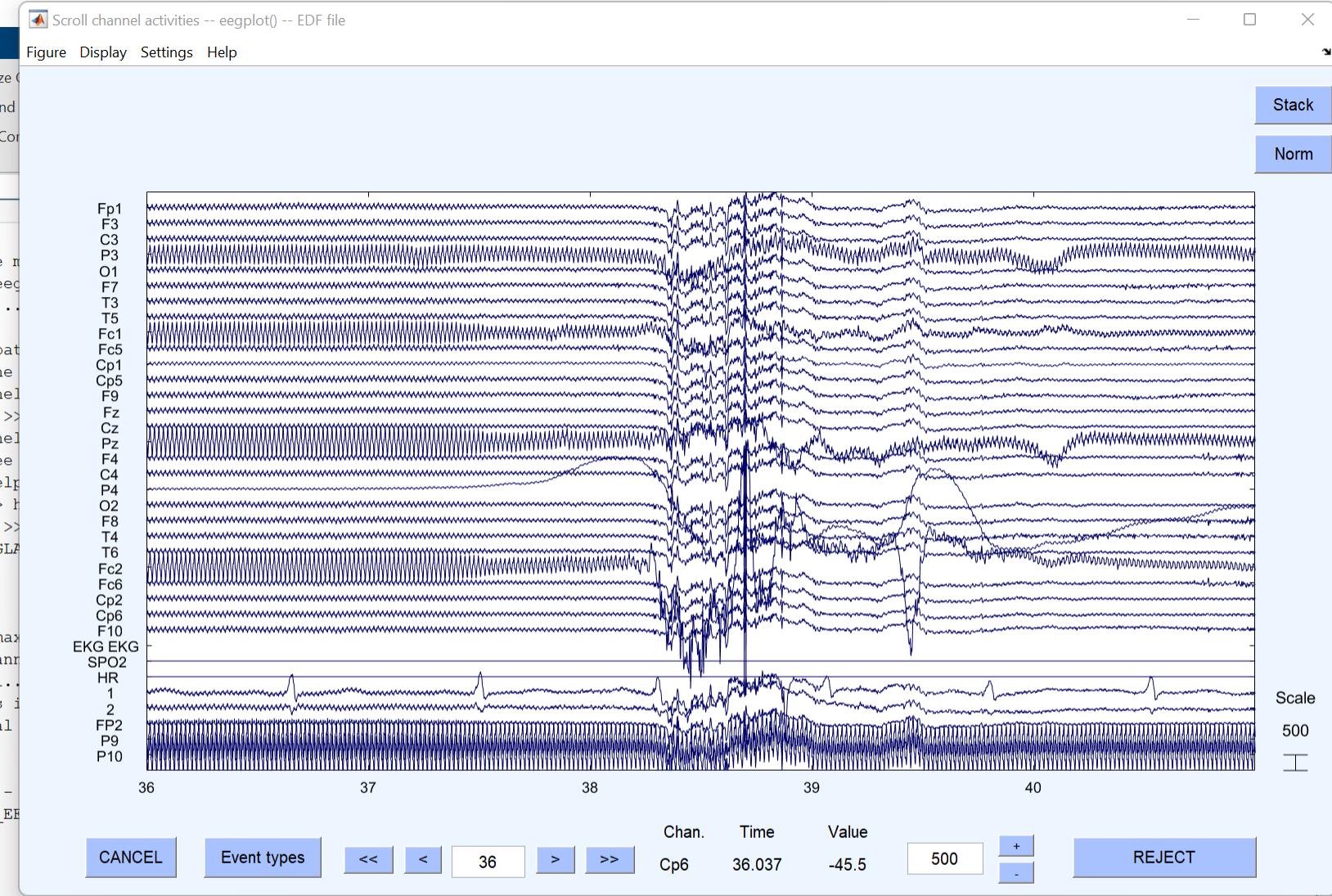
Filename: none
 Channels per frame 36
 Frames per epoch 3867648
 Epochs 1
 Events 5
 Sampling rate (Hz) 512
 Epoch start (sec) 0.000
 Epoch end (sec) 7553.998
 Reference unknown
 Channel locations No (labels only)
 ICA weights No
 Dataset size (Mb) 587.9

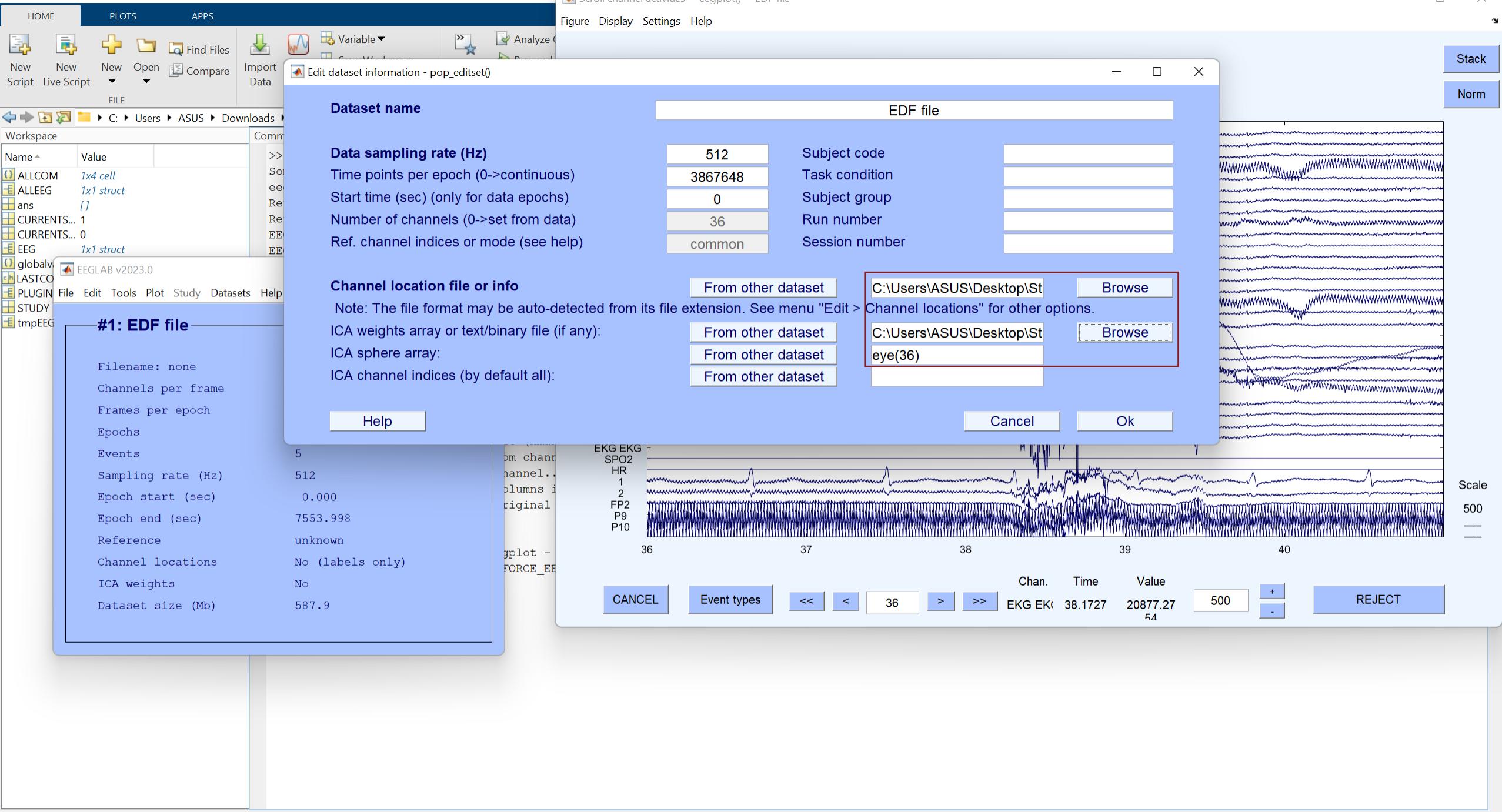


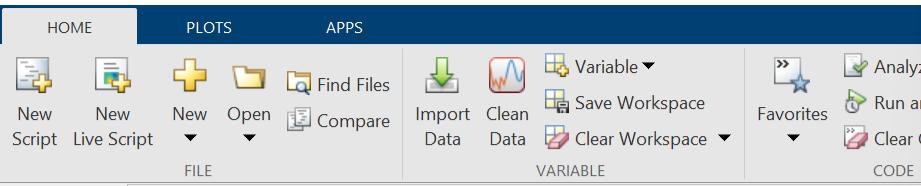


C:\Users\ASUS\Downloads>

Workspace		Command Window
Name	Value	
ALLCOM	1x4 cell	>> eeglab Some menus items hidden. Use Preference m...
ALLEEG	1x1 struct	eeglab: options file is C:\Users\ASUS\eed...
ans	[]	Retrieving plugin versions from server...
CURRENTS...	1	Retrieving download statistics...
CURRENTS...	0	EEGLAB: adding "Biosig" v3.8.1 to the pat...
EEG	1x1 struct	EEGLAB: adding "Fileio" v20230402 to the
globalv		>> hel (see >> help) 8 (see >> help) of EEGLAB
LASTCO		>> help (see >> help) of EEGLAB
PLUGIN		>> help (see >> help) of EEGLAB
STUDY		>> help (see >> help) of EEGLAB
tmpEEG		>> help (see >> help) of EEGLAB

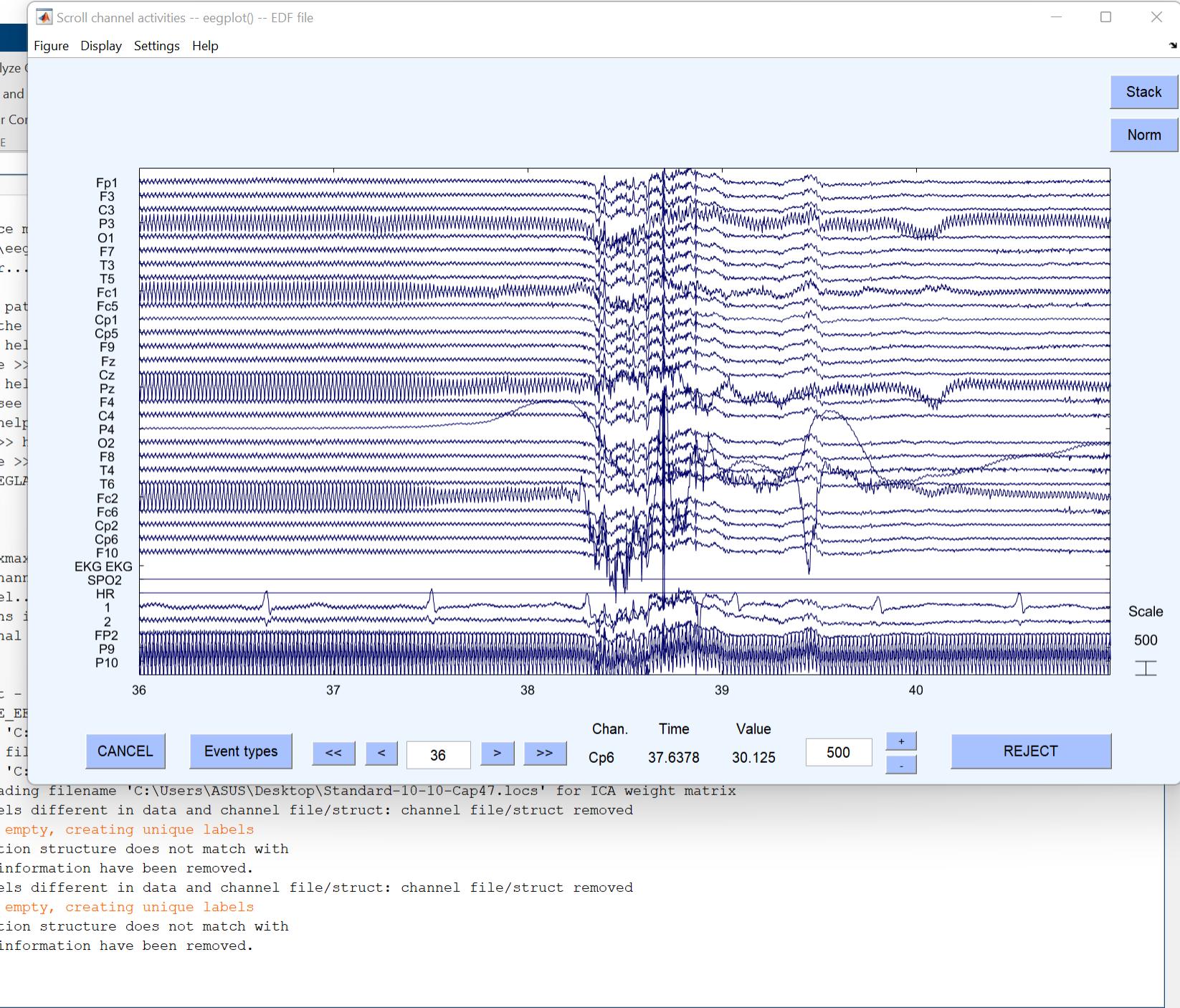


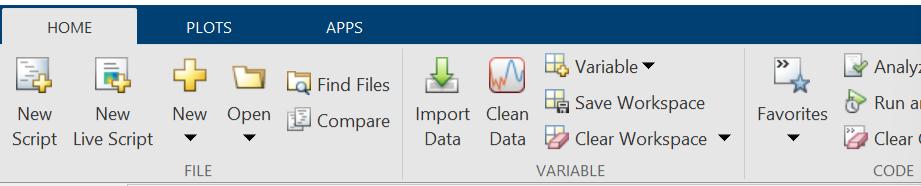




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Workspace		Command Window
Name	Value	
ALLCOM	1x6 cell	>> eeglab Some menus items hidden. Use Preference menu to show them.
ALLEEG	1x1 struct	eeglab: options file is C:\Users\ASUS\eedglab\options.edg
ans	[]	Retrieving plugin versions from server...
CURRENTS...	1	Retrieving download statistics...
CURRENTS...	0	EEGLAB: adding "Biosig" v3.8.1 to the path
EEG	1x1 struct	EEGLAB: adding "Fileio" v20230402 to the path
globalv		
LASTCO		>> help eeglab (see >> help eeglab)
PLUGIN		>> help eeglab (see >> help eeglab)
STUDY		of EEGLAB
tmpEEG		OFF"





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Workspace

Name	Value
ALLCOM	1x6 cell
ALLEEG	1x1 struct
ans	[]
CURRENTS...	1
CURRENTS...	0
EEG	1x1 struct
globalv	
LASTCO	
PLUGIN	
File	
Edit	
Tools	
Plot	
Study	
Help	

EEGLAB v2023.0

STUDY

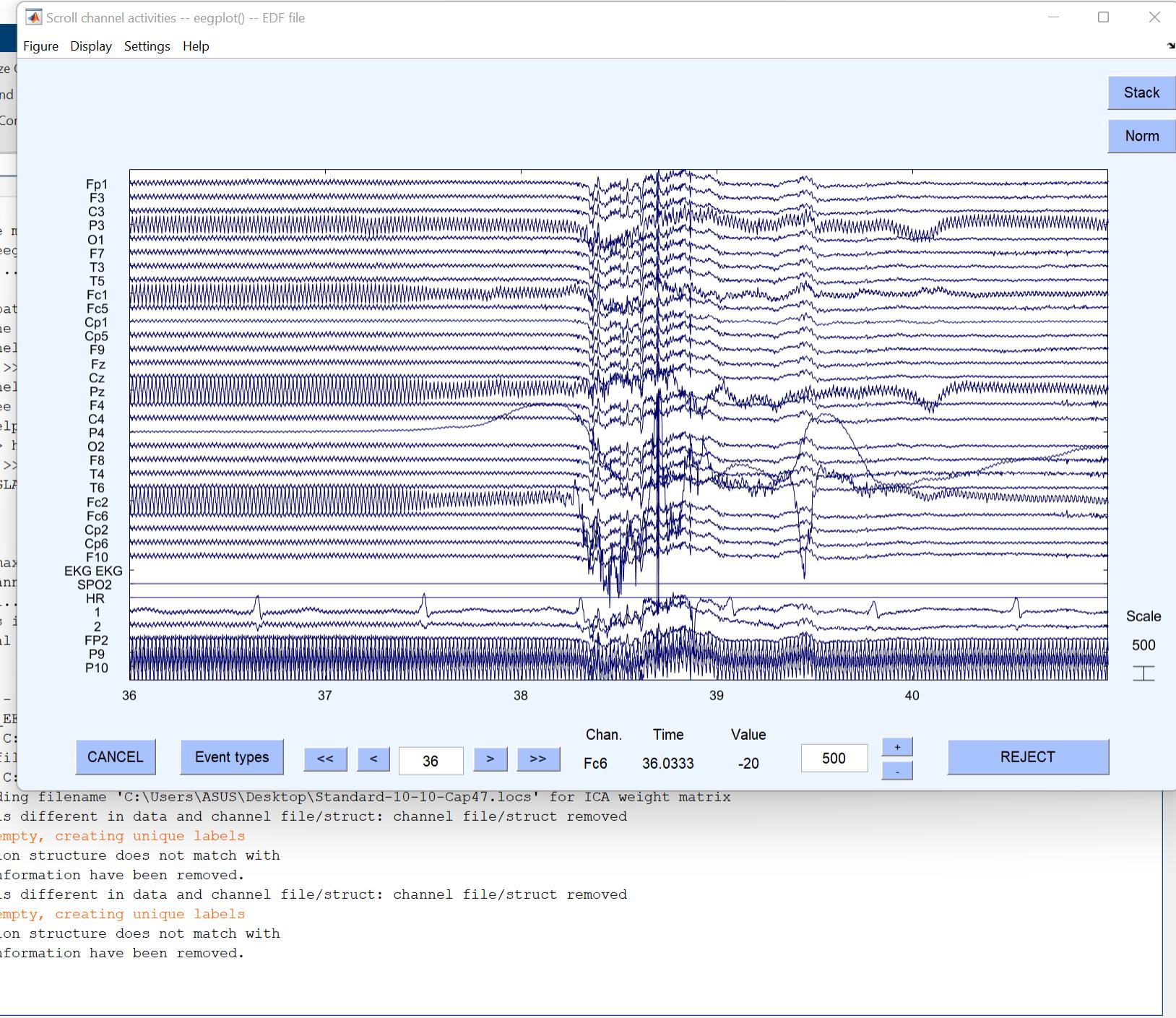
tmpEEG

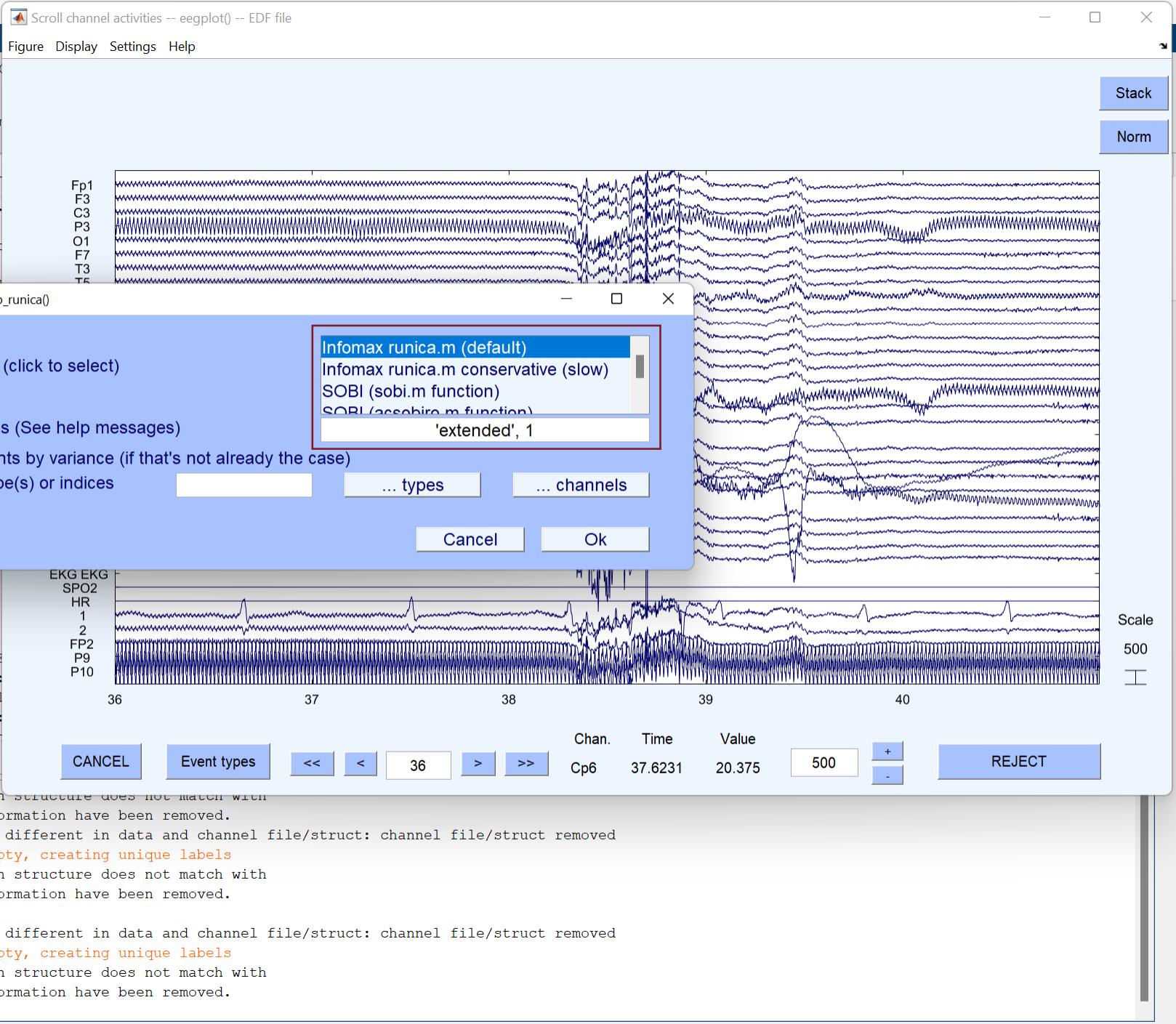
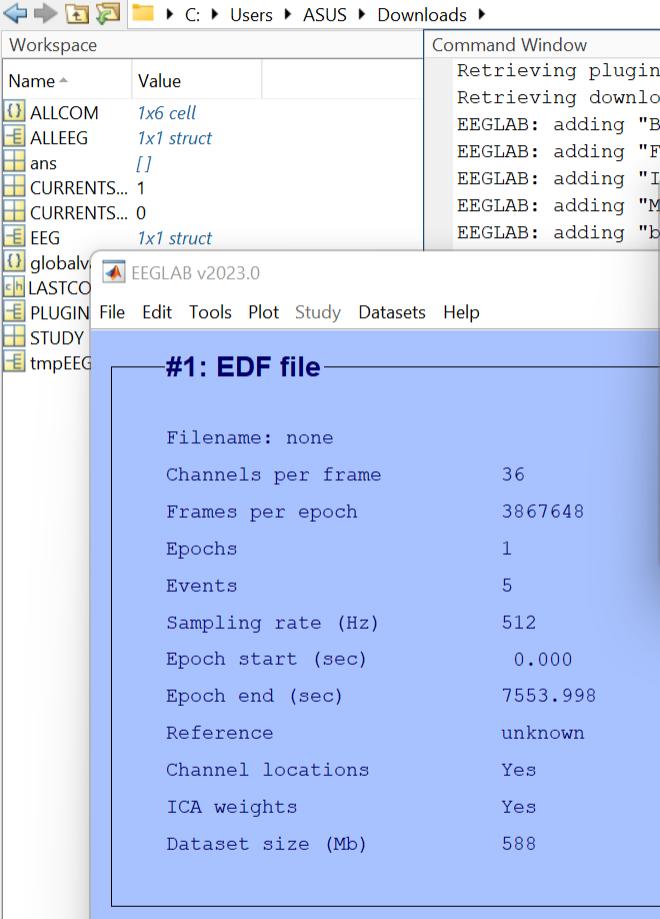
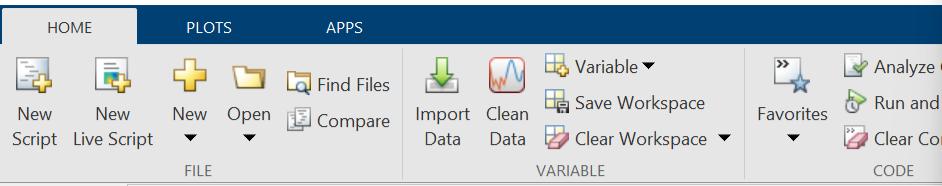
(Expand tool choices via "File > Preferences")

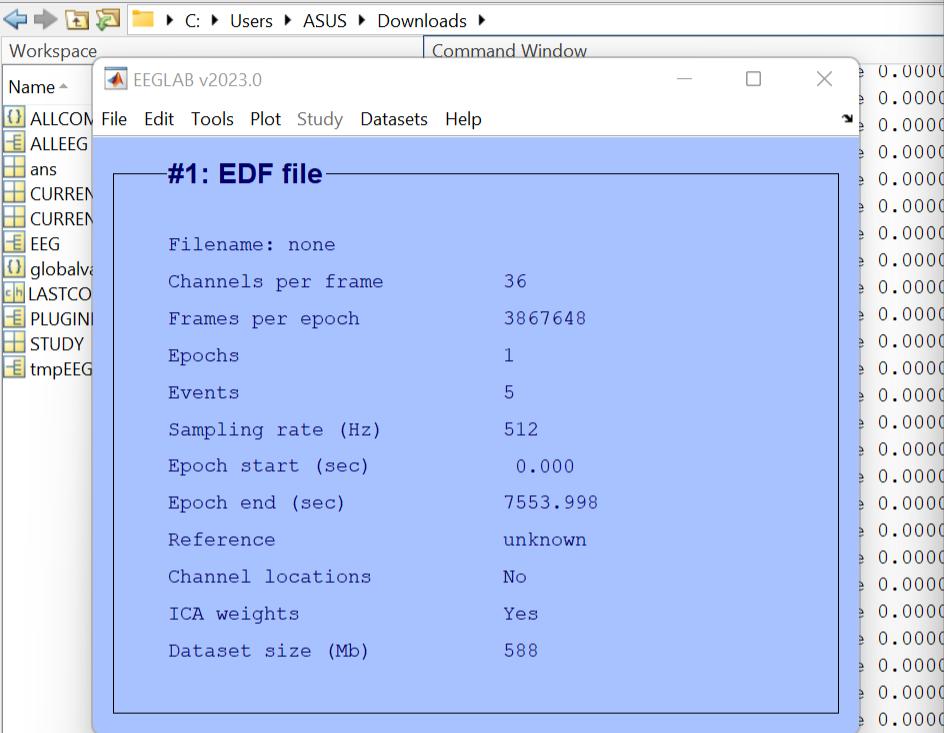
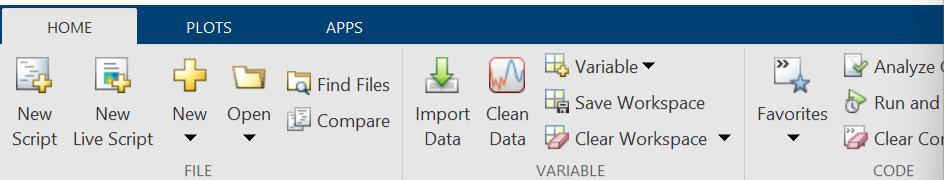
- Change sampling rate
- Filter the data
- Re-reference the data
- Interpolate electrodes
- Inspect/reject data by eye
- Reject data using Clean Rawdata and ASR
- Decompose data by ICA**
- Inspect/label components by map
- Classify components using ICLabel
- Remove components from data
- Extract epochs
- Remove epoch baseline
- Source localization using DIPFIT

ICA weights Yes

Dataset size (Mb) 588

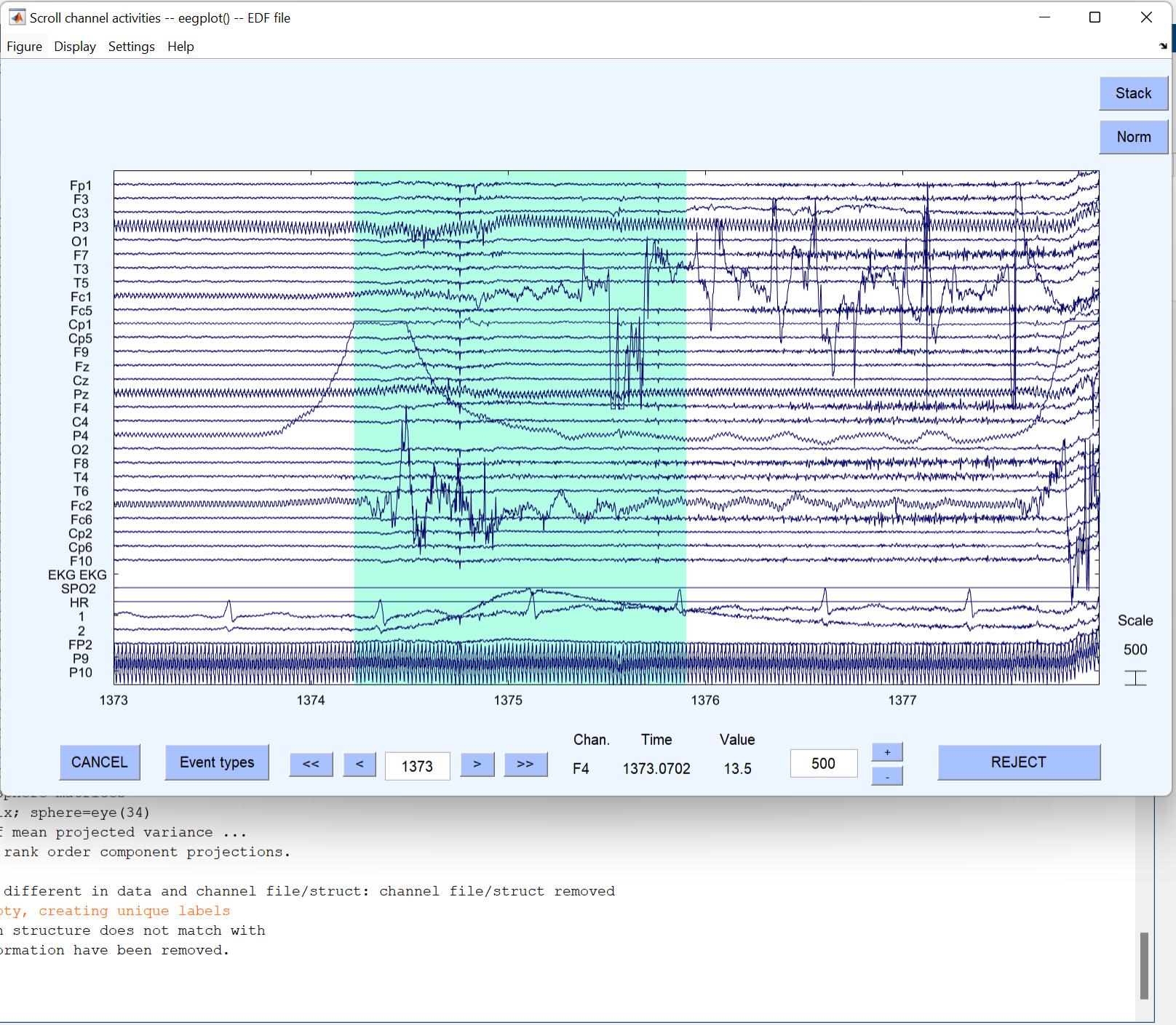


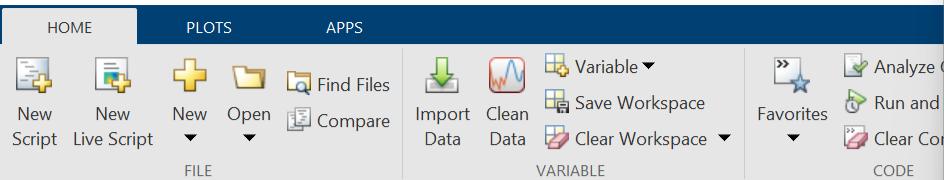




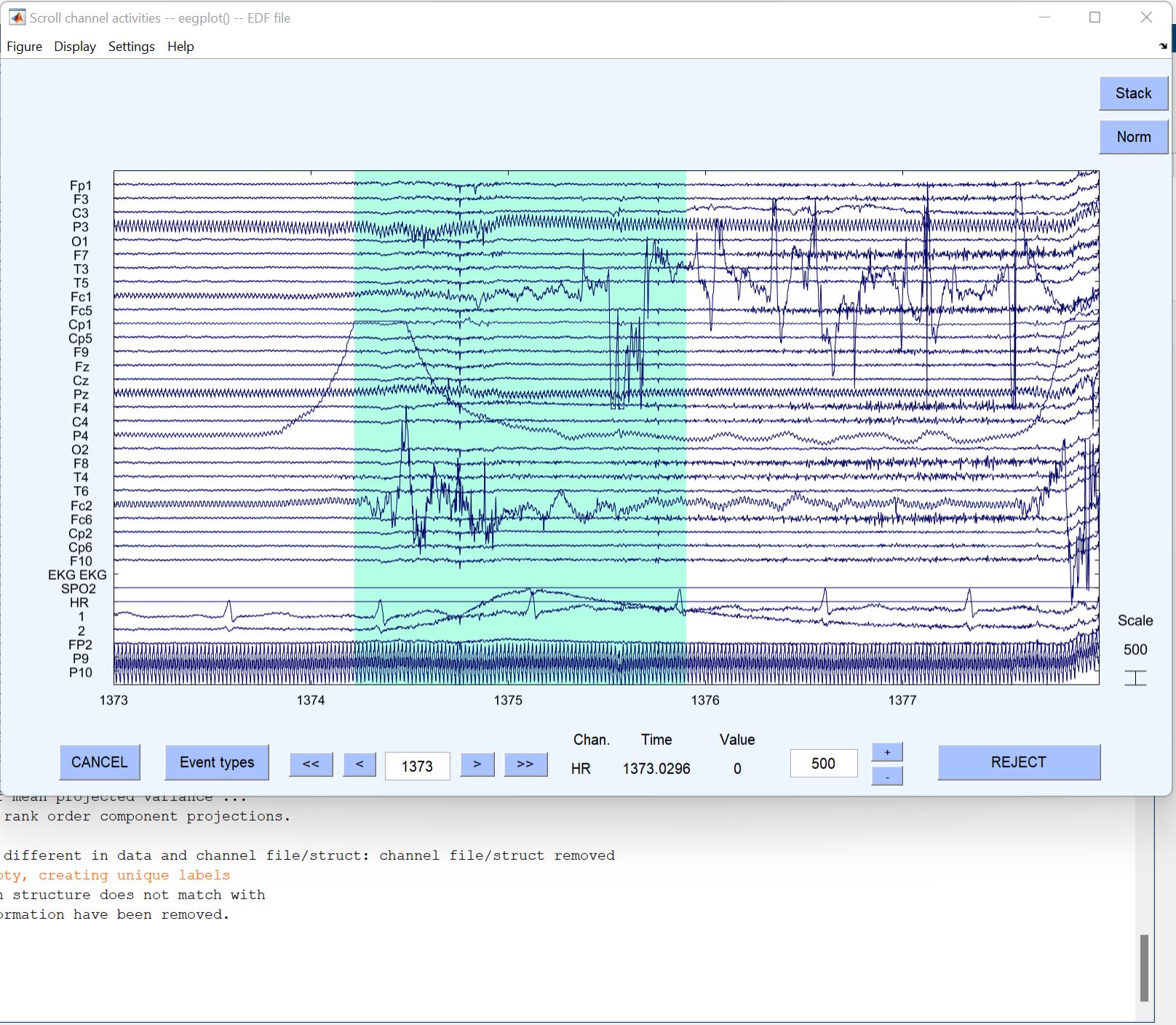
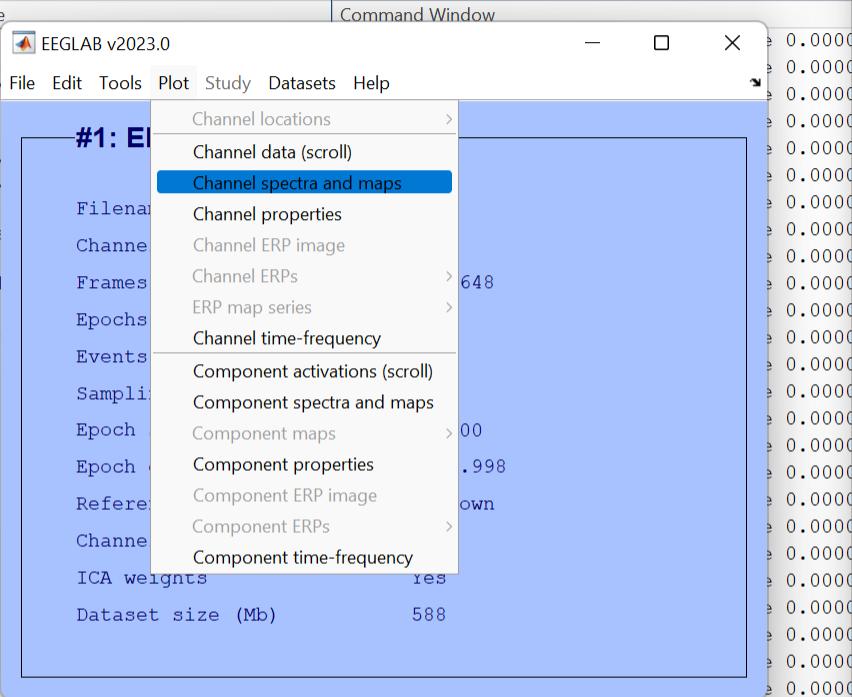
```
step 352 - lrate 0.000000, wchange 0.000000
step 353 - lrate 0.000000, wchange 0.000000
step 354 - lrate 0.000000, wchange 0.000000
step 355 - lrate 0.000000, wchange 0.000000
step 356 - lrate 0.000000, wchange 0.000000
Composing the eigenvector, weights, and sphere=eye(34)
into a single rectangular weights matrix; sphere=eye(34)
Sorting components in descending order of mean projected variance ...
Using pseudo-inverse of weight matrix to rank order component projections.
Scaling components to RMS microvolt
eeg_checkset warning: number of channels different in data and channel file/struct: channel file/struct removed
Warning: channel labels should not be empty, creating unique labels
Warning: the size of the channel location structure does not match with
number of channels. Channel information have been removed.
Scaling components to RMS microvolt
Scaling components to RMS microvolt
```

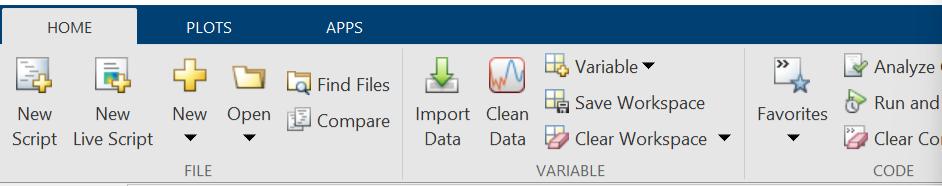
fx Done.





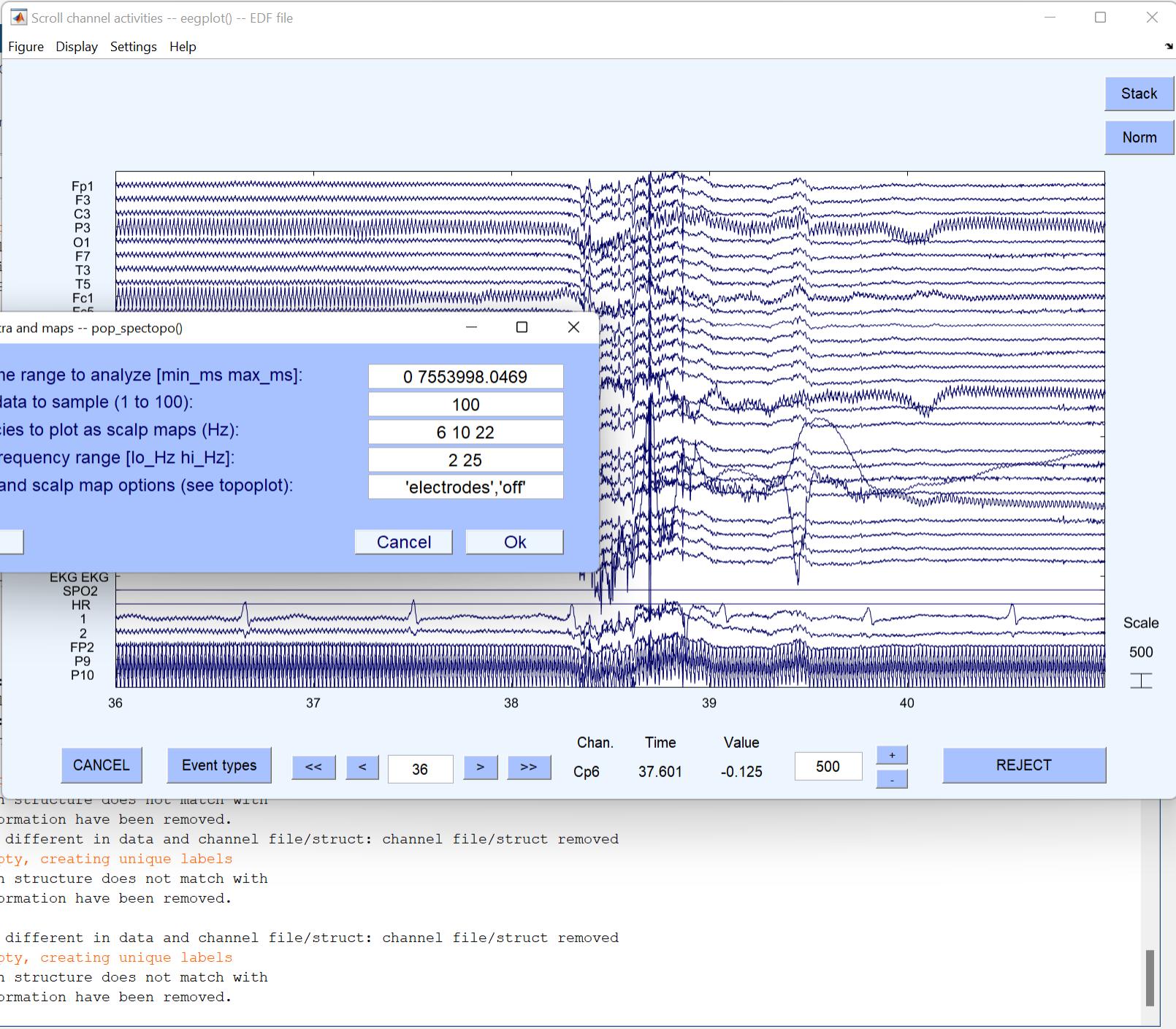
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C: > Users > ASUS > Downloads >

Workspace		Command Window
Name	Value	
ALLCOM	1x21 cell	to convert between channel location
ALLEEG	1x1 struct	Warning: channel labels should not be empty
ans		readlocs(): 'loc' format assumed from file
EEGLAB v2023.0		and in E1, LPA, RE



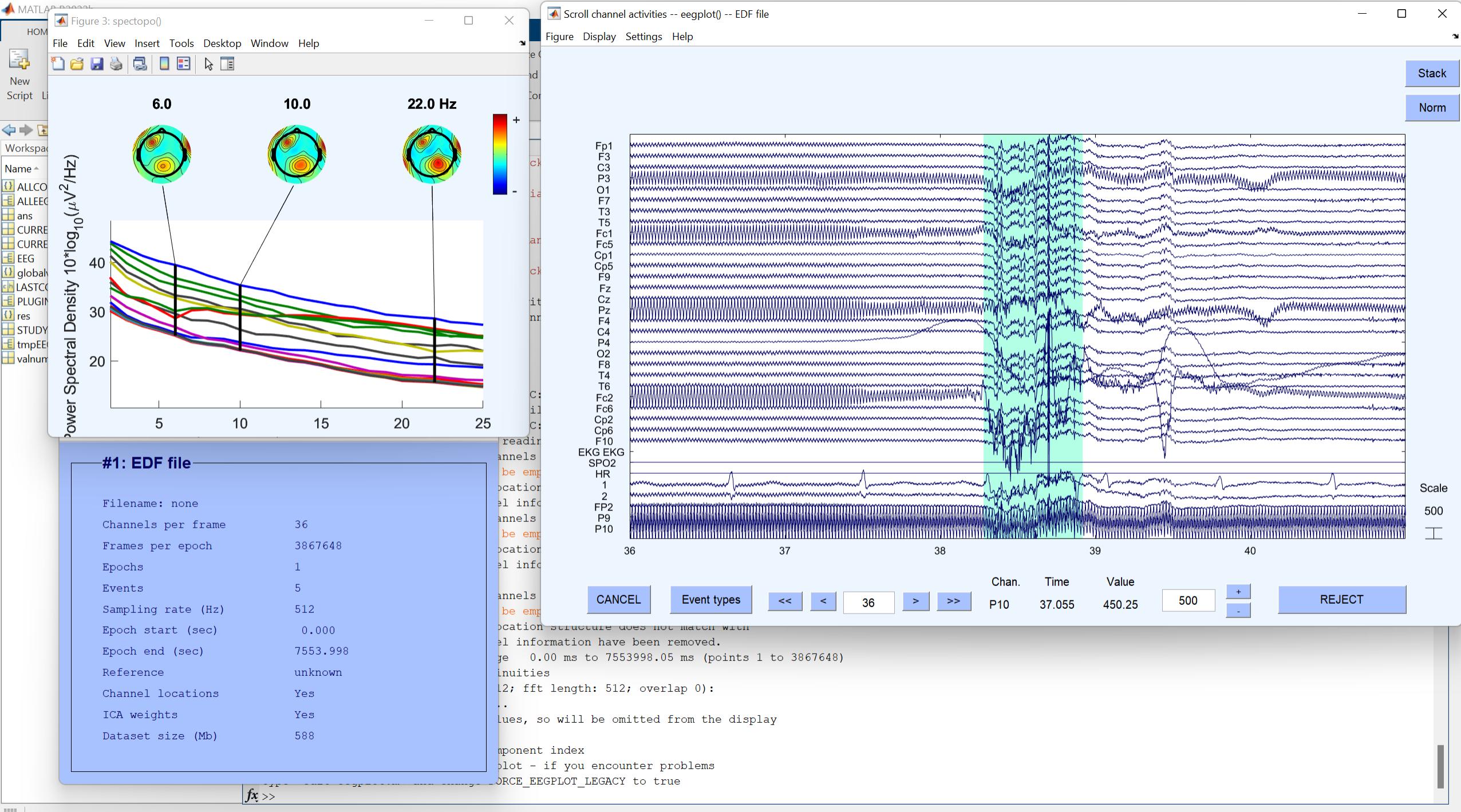
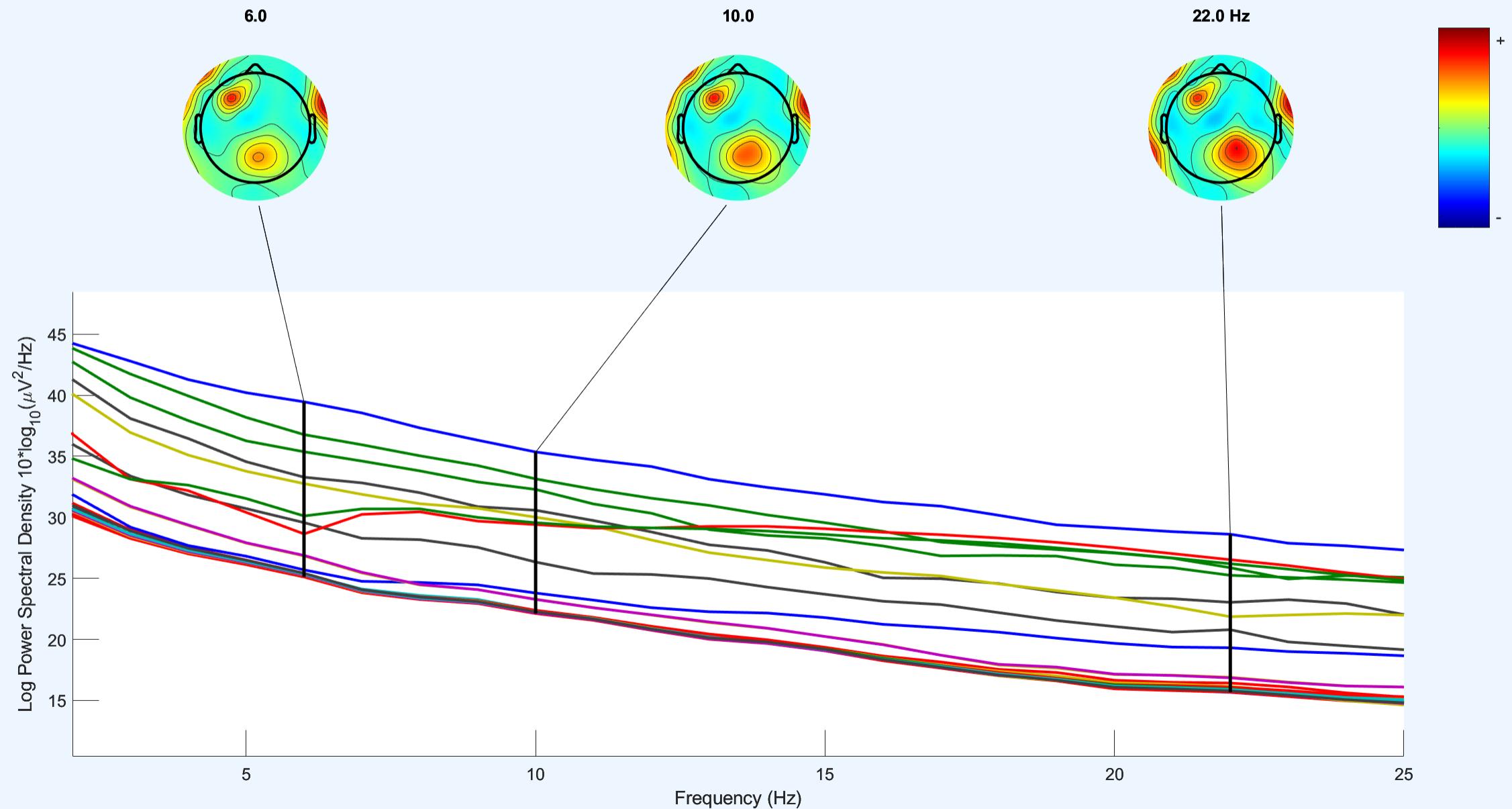


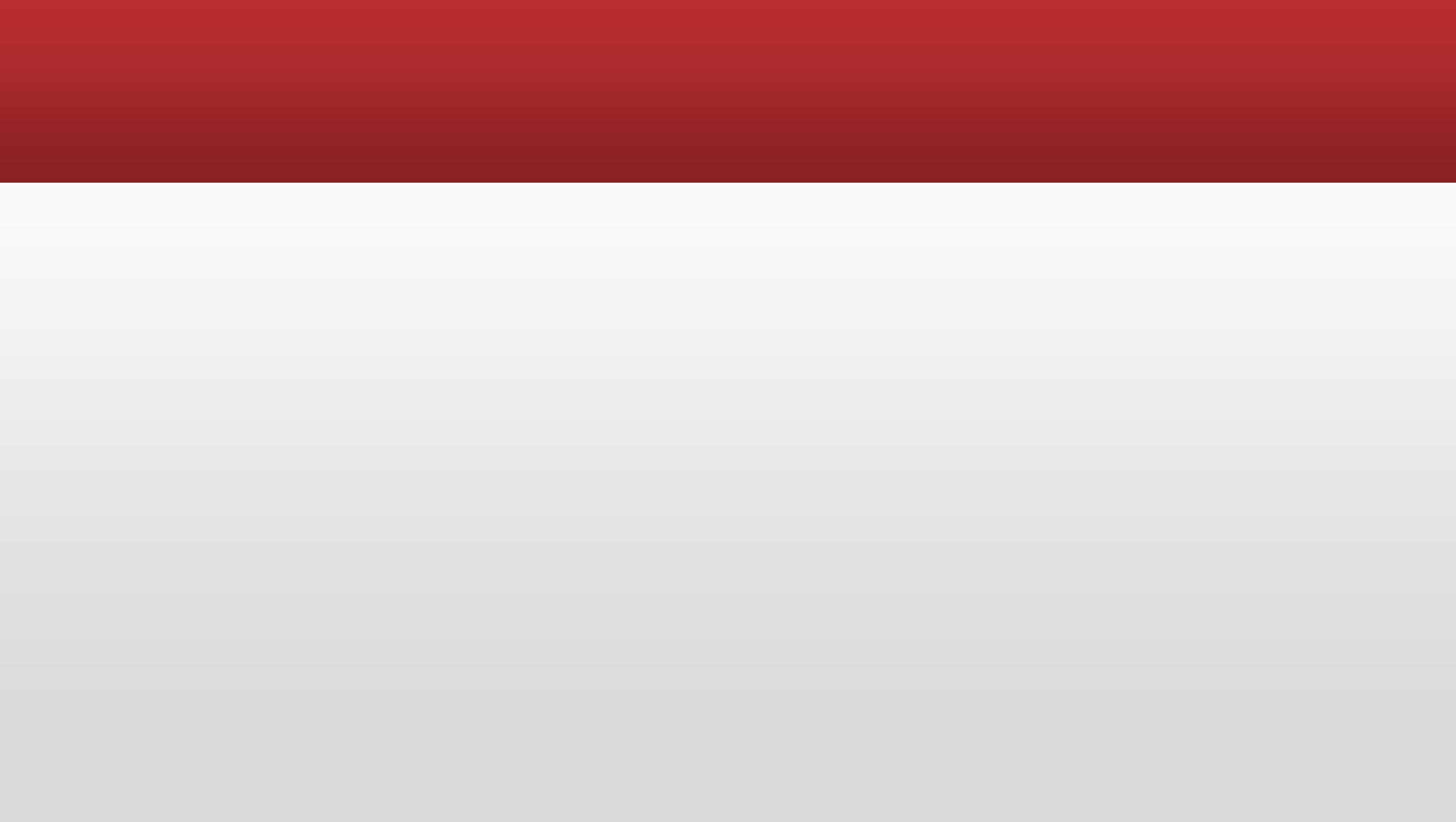
Figure 3: spectopo()

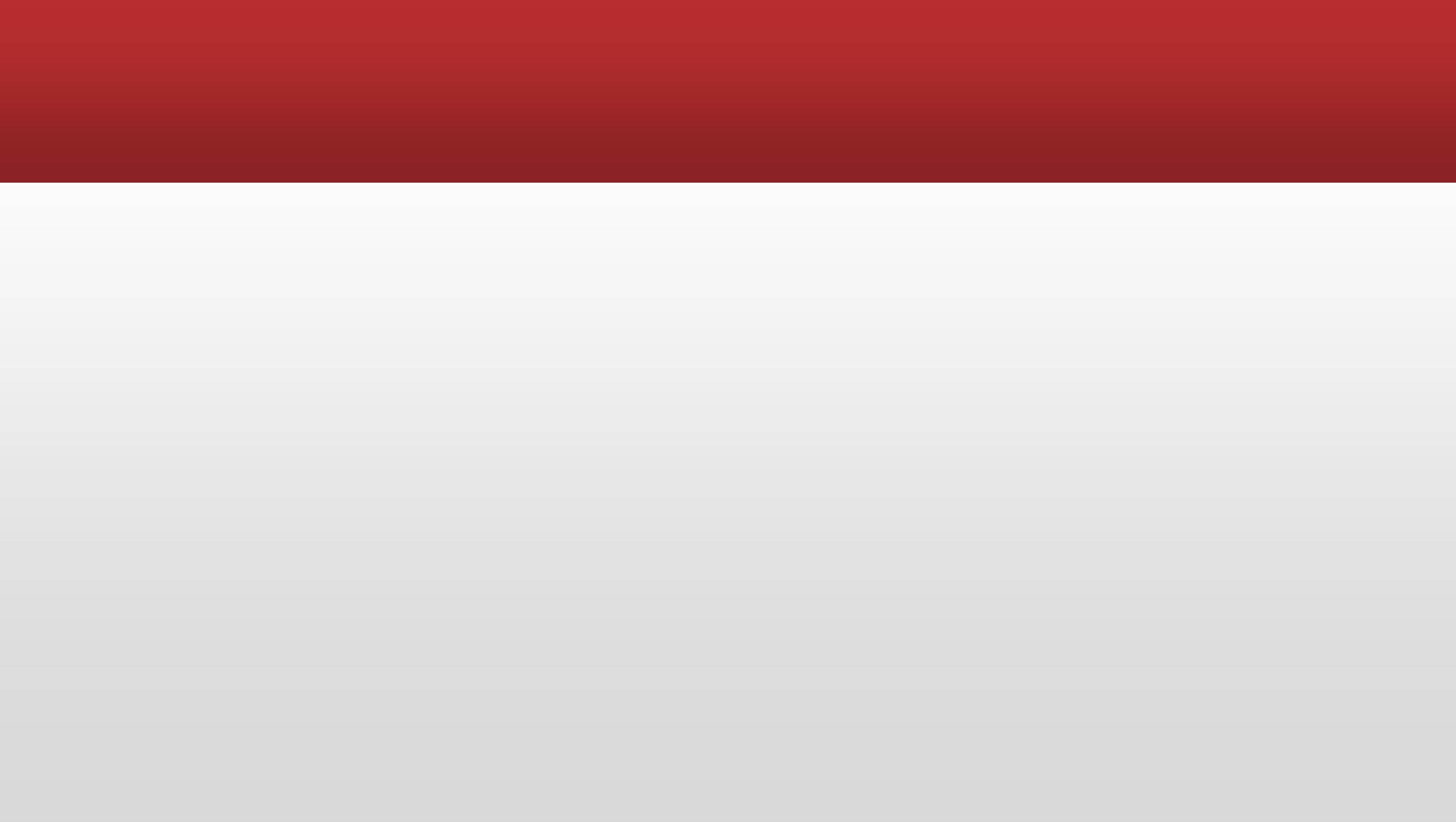
File Edit View Insert Tools Desktop Window Help

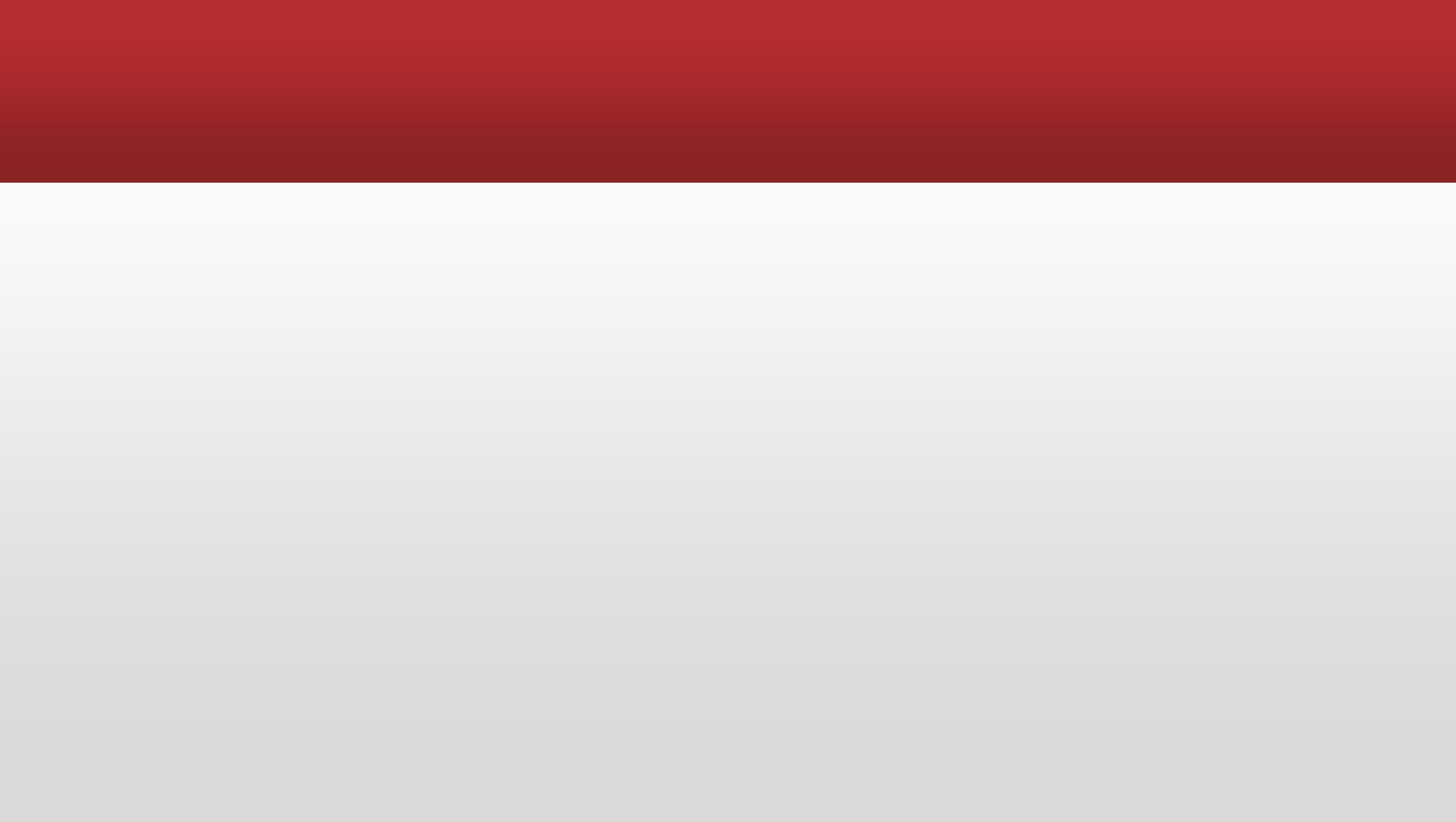


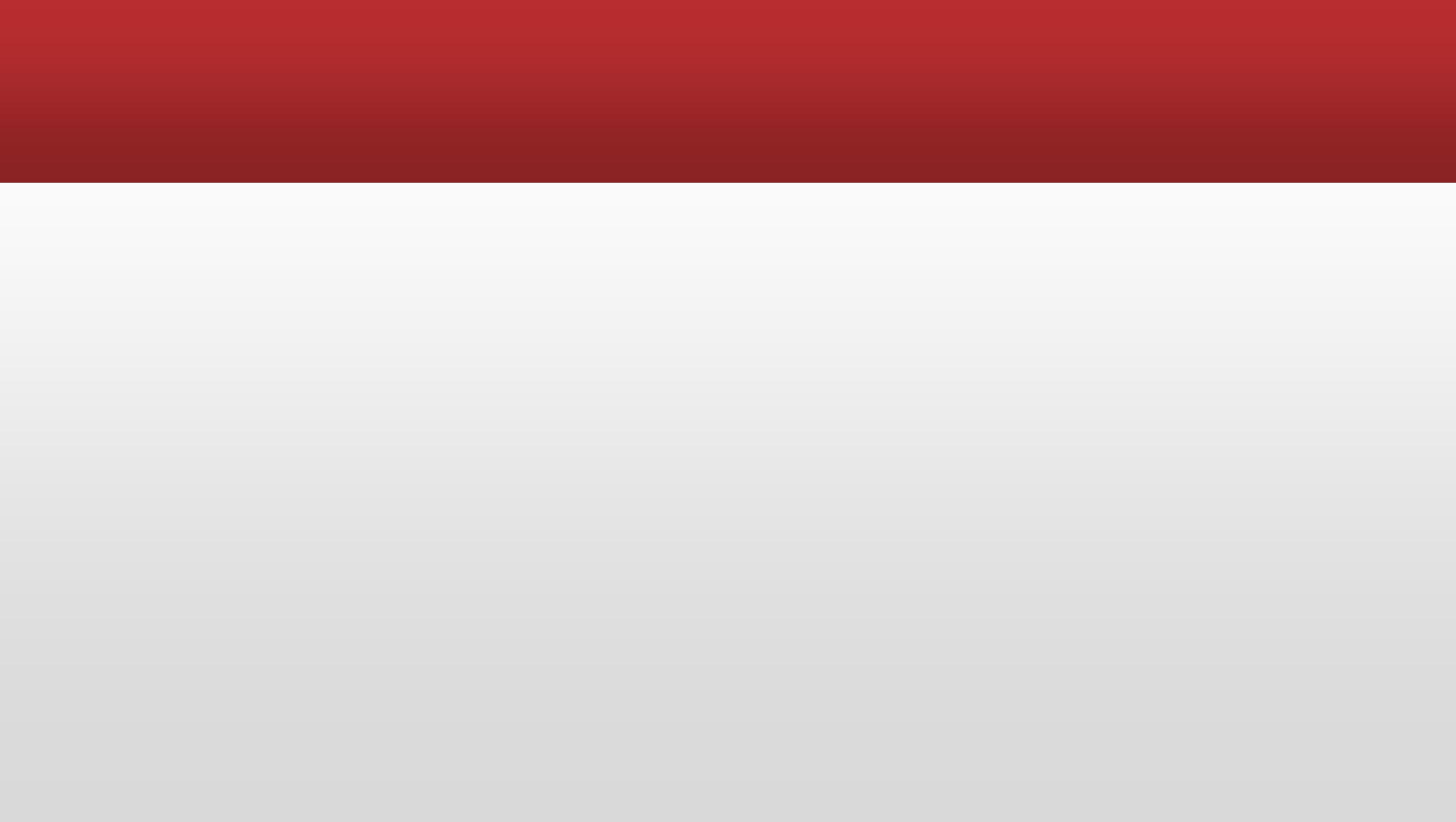
- □ X

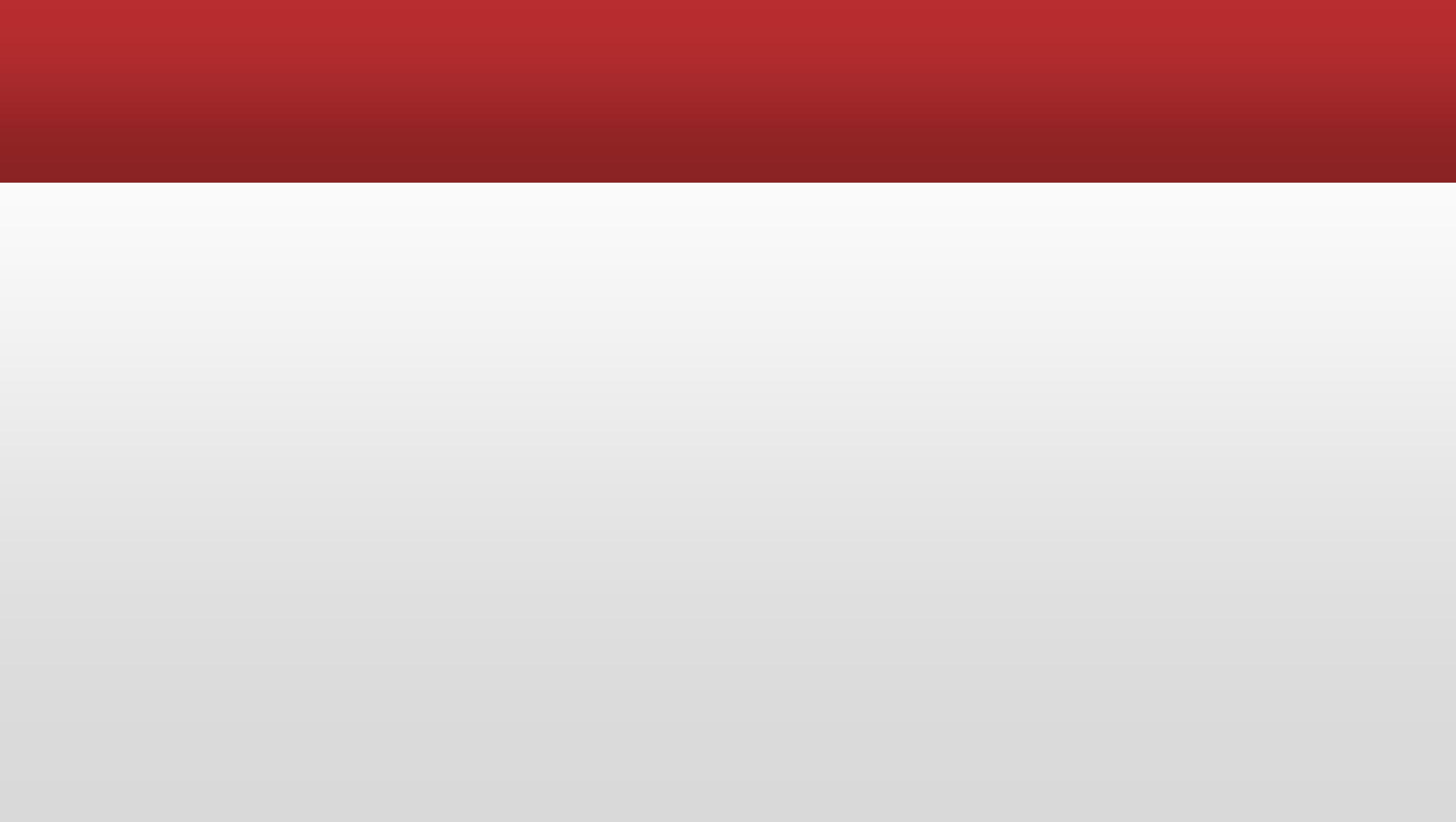


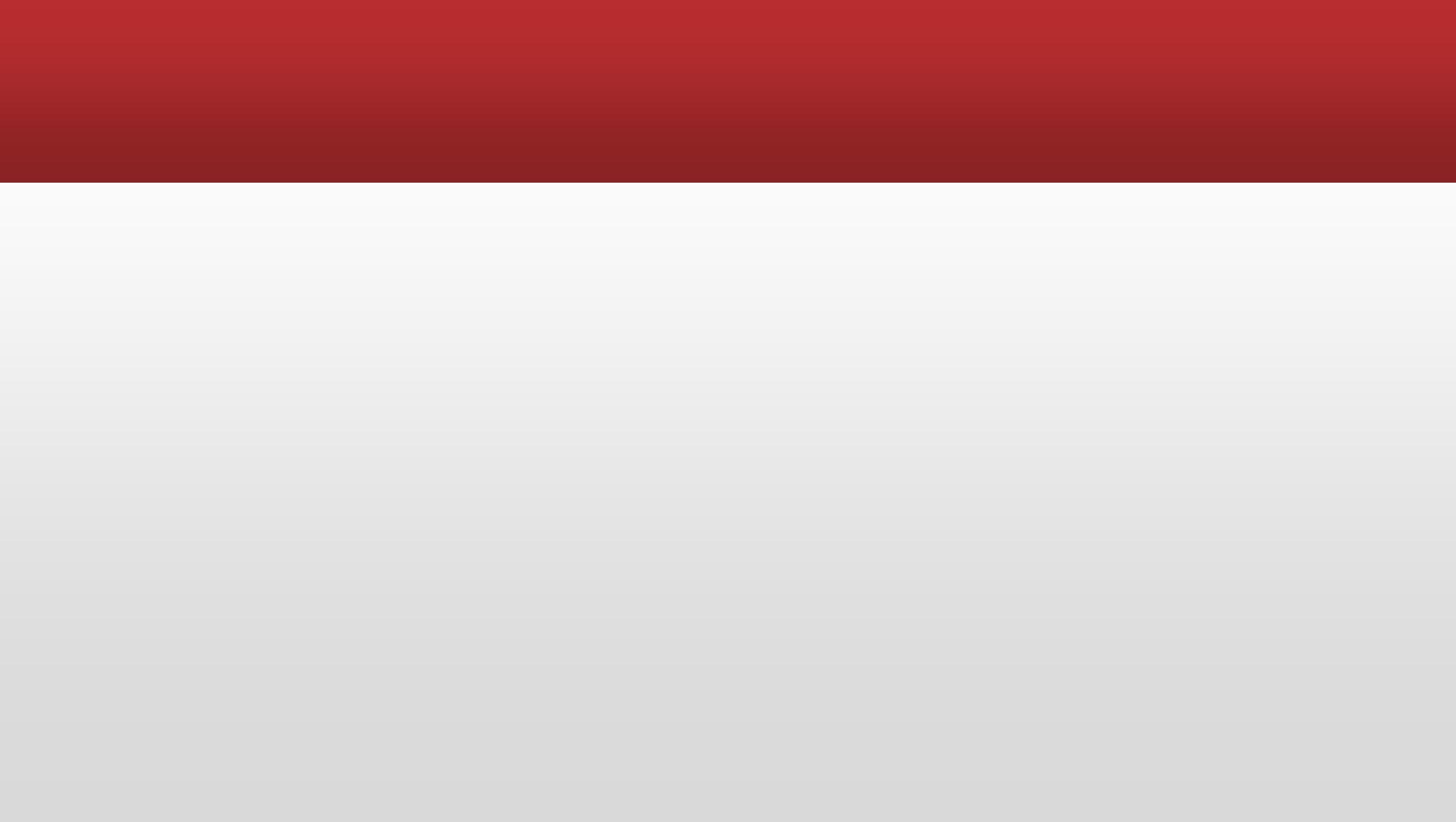


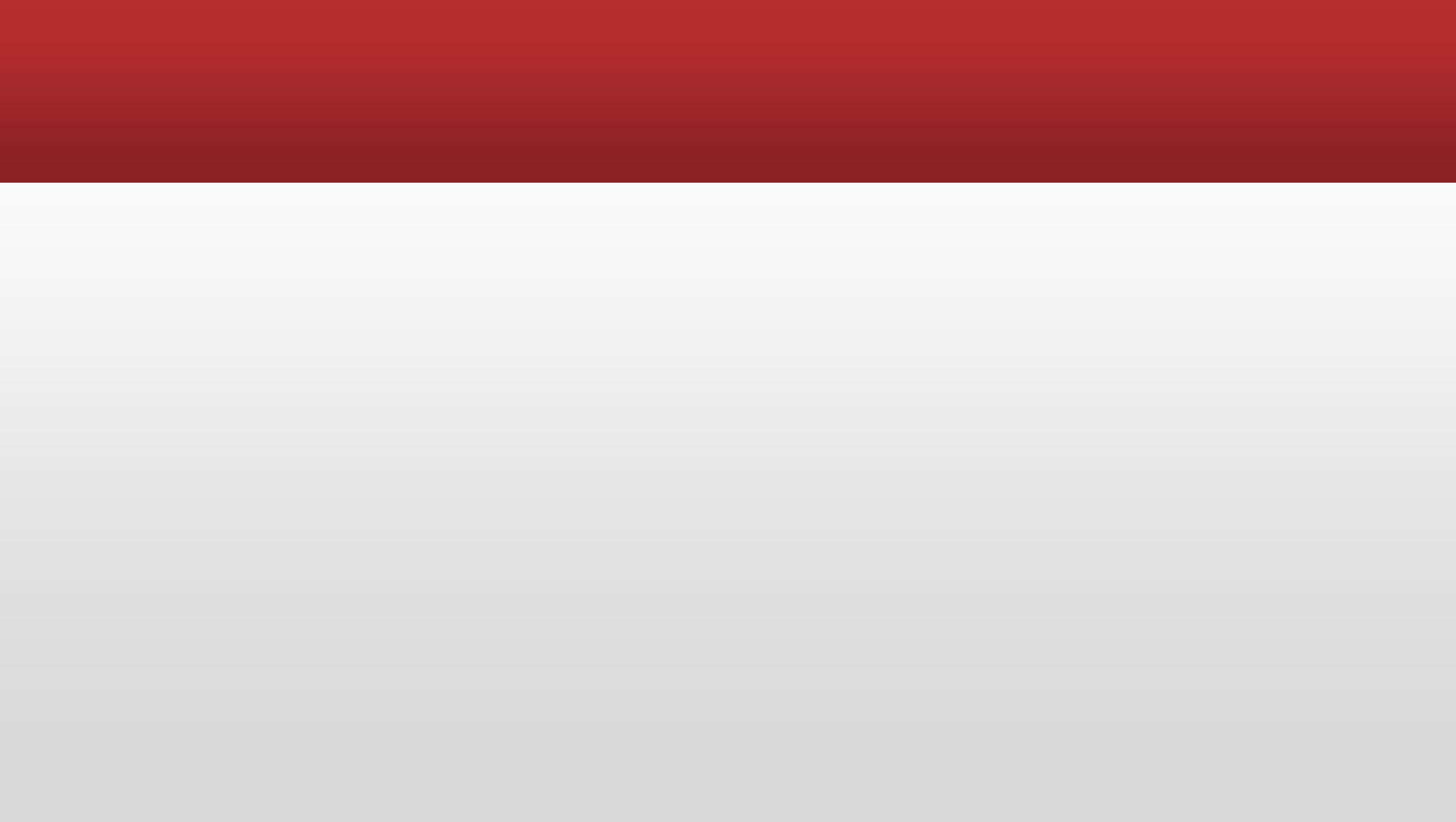


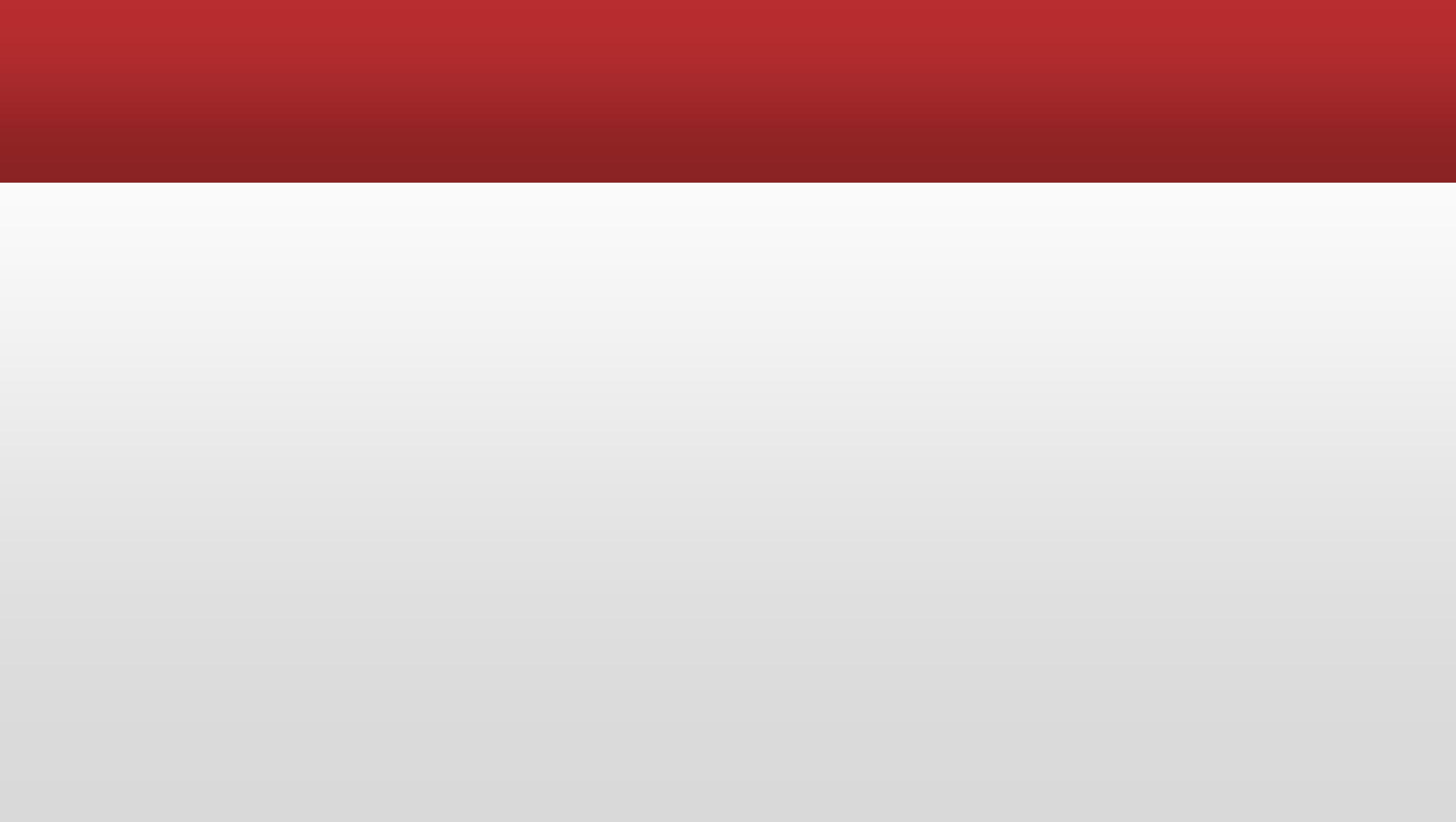


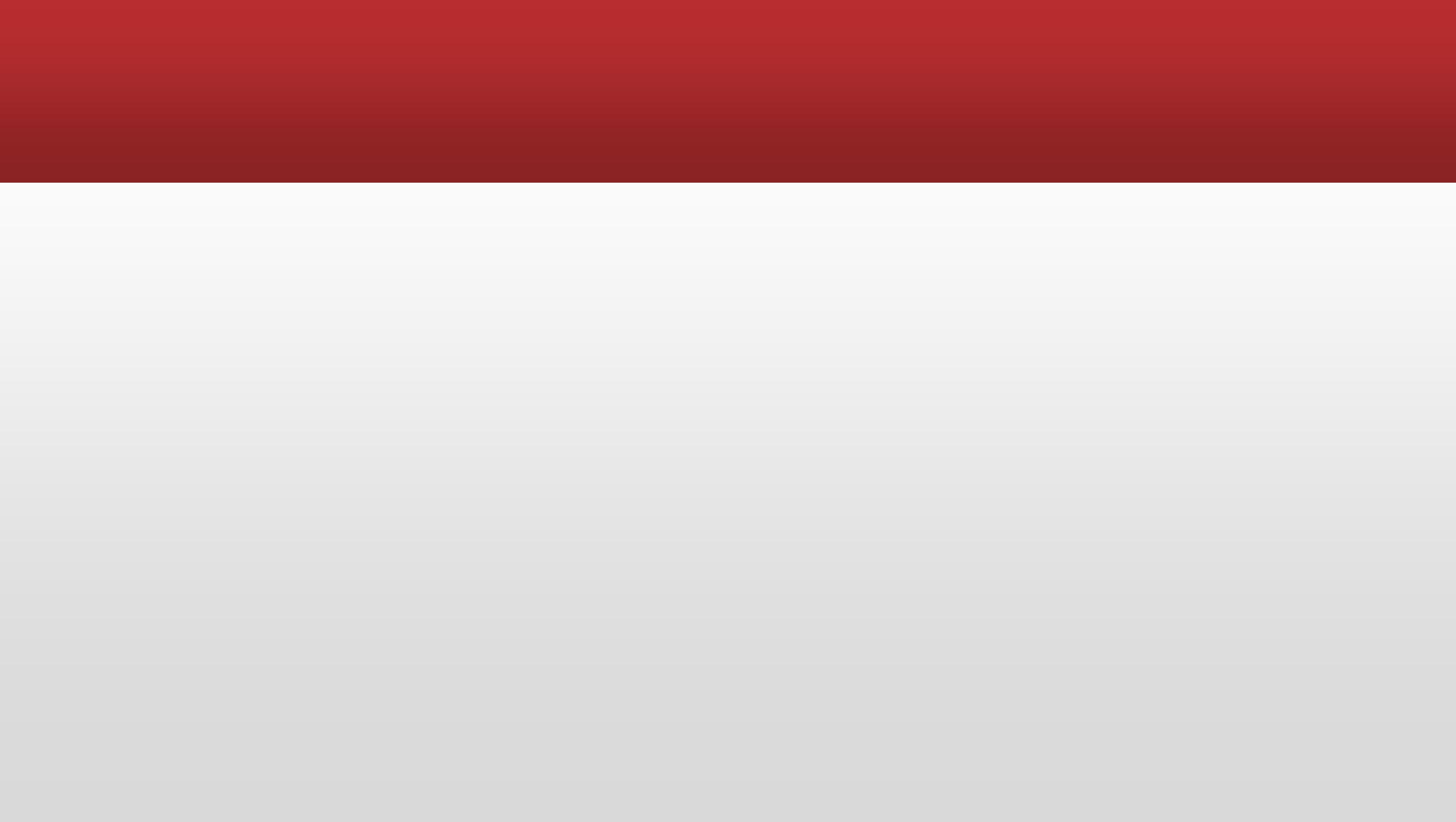


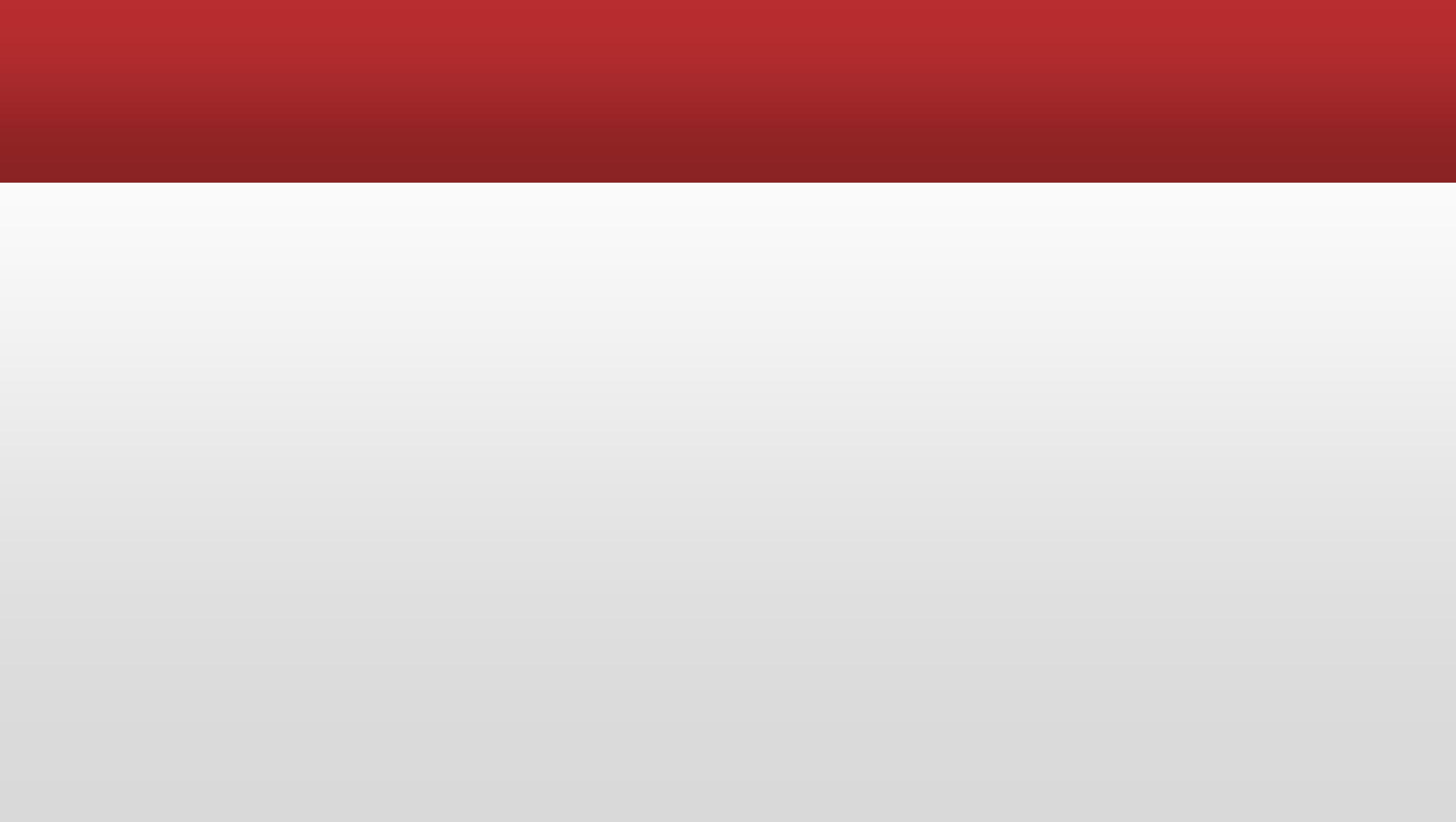












THE END