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Supplement of

Massive corals record deforestation in Malaysian Borneo through sediments in river discharge

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Station	Distance from river mouth [km]	SSS	Ba/Ca [µmol mol^{-1}]
Anemone's Garden	22	32.3	4.41
Eve's Garden	12	32.3	4.38
S1	10	32.3	4.47
S2	8	32.1	4.73
S3	6	32.8	4.7
S4	4	32.7	4.73
S5	2	19.2	17.68
S6	0	7.8	59.58

Table S1: Distance from river mouth, sea surface salinity and Ba/Ca ratio of each seawater sample (average of duplicates) on the transect between Anemone's Garden and the Miri River's mouth.

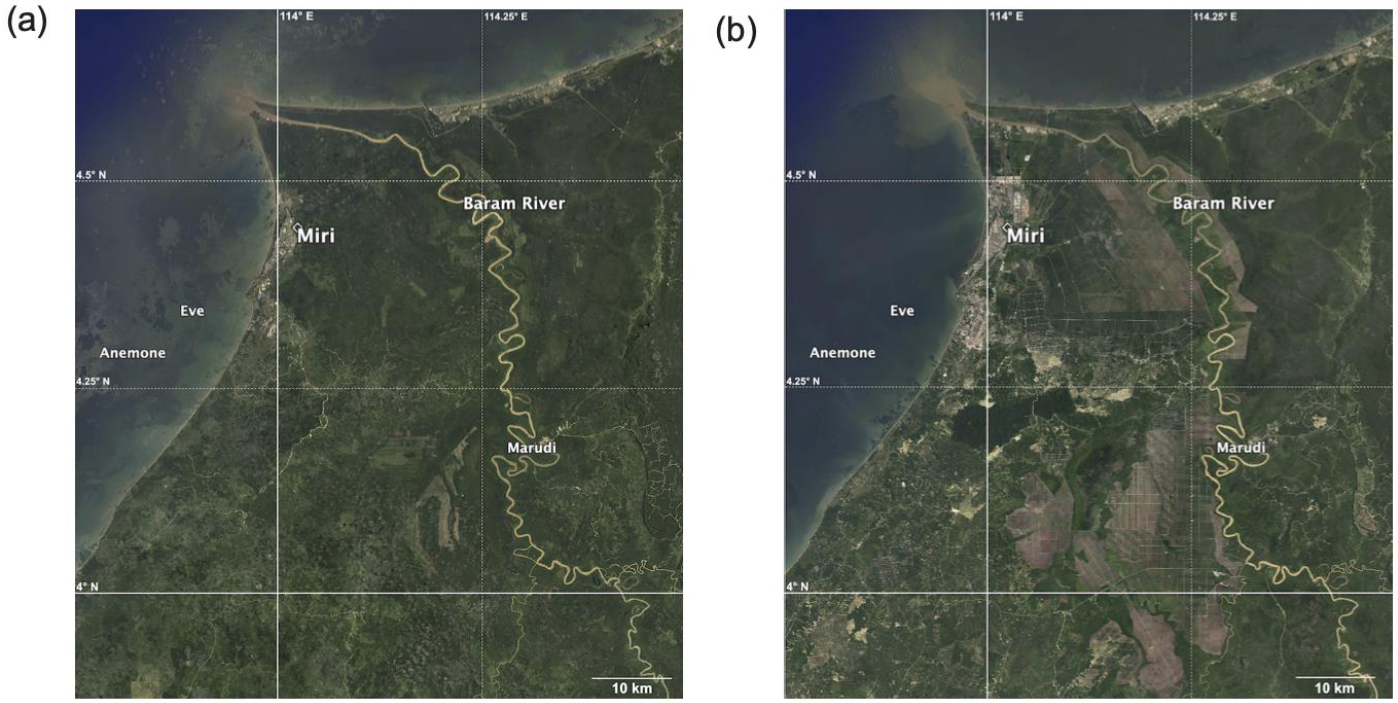

Figure S1: Satellite images of the study site and surrounding region in (a) 1990 and in (b) 2019 (Data SIO, NOAA, U.S. Navy, GEBCO. Image: Landsat/Copernicus). Notice the forest surface cover difference south of the Baram River and increase in anthropogenic land use (plantations).

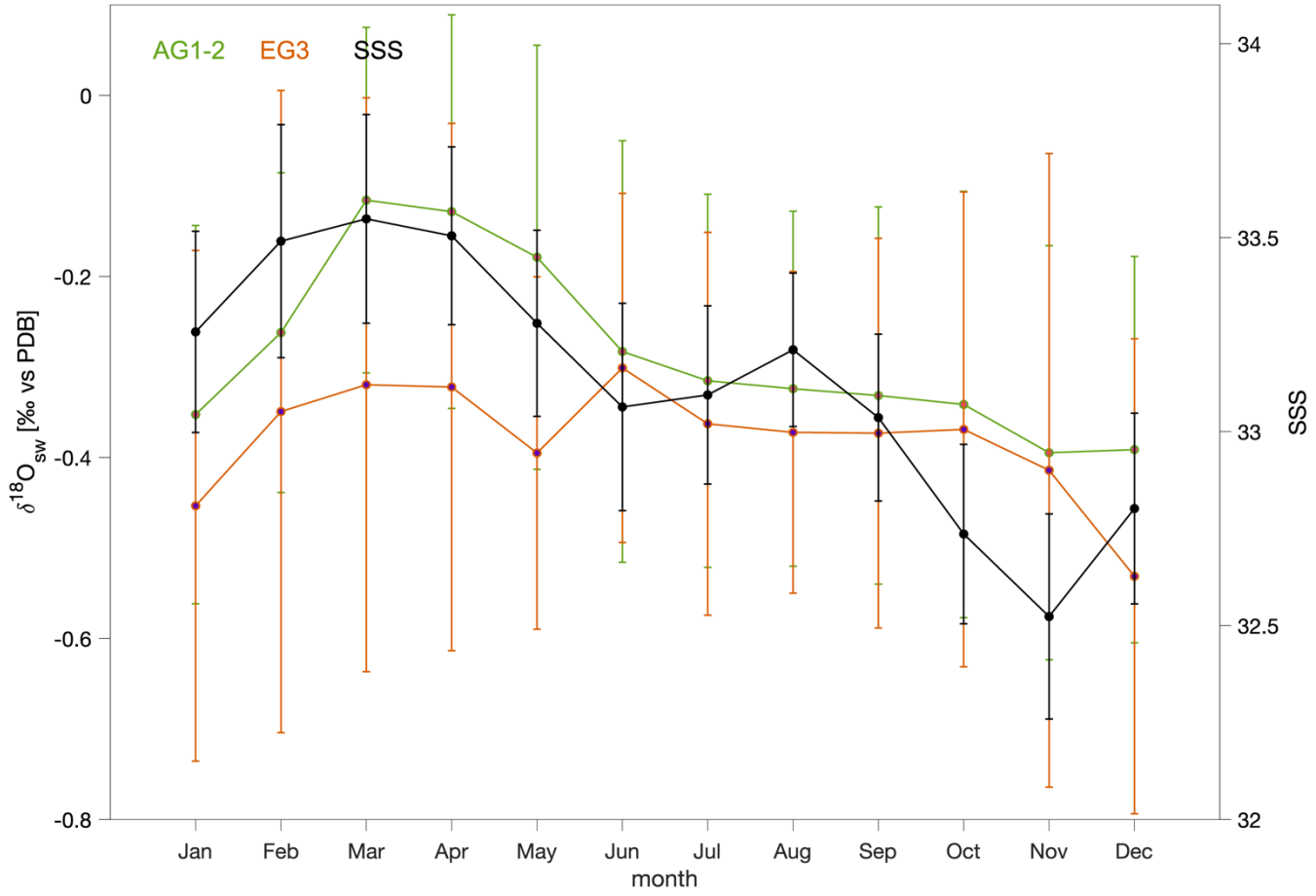

Figure S2: Monthly averages of $\delta^{18}O_{sw}$ in light green (AG1-2) and orange (EG3) and SSS in black. Monthly standard deviations shown as error bars.

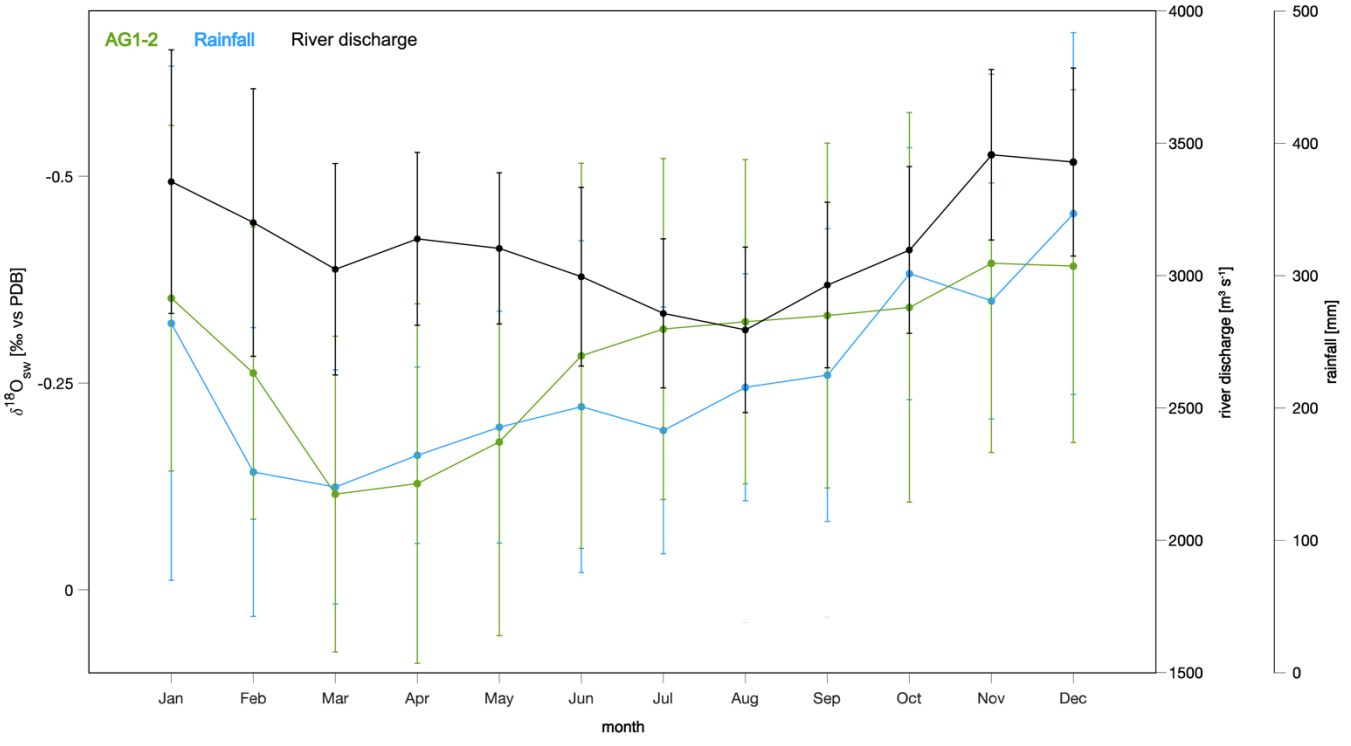

Figure S3: Monthly averages of $\delta^{18}O_{sw}$ in light green (AG1-2), rainfall in blue and river discharge in black. Monthly standard deviations shown as error bars. Note that the y axis on the left is reversed.

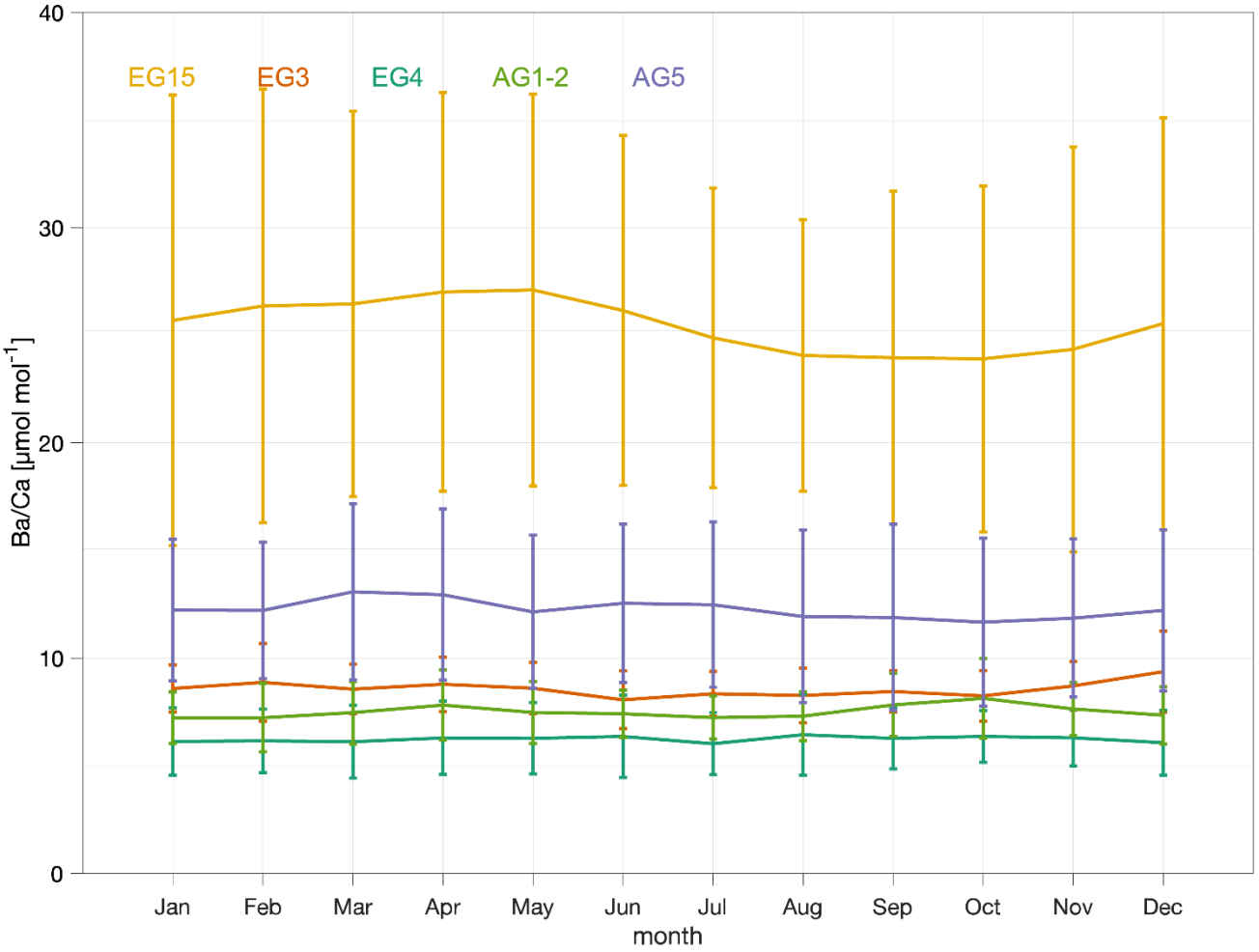

Fig S4. Monthly averages of all five Ba/Ca records, EG15 in yellow, EG3 in orange, EG4 in dark green, AG1-2 in green and AG5 in blue. Monthly standard deviations shown as error bars.

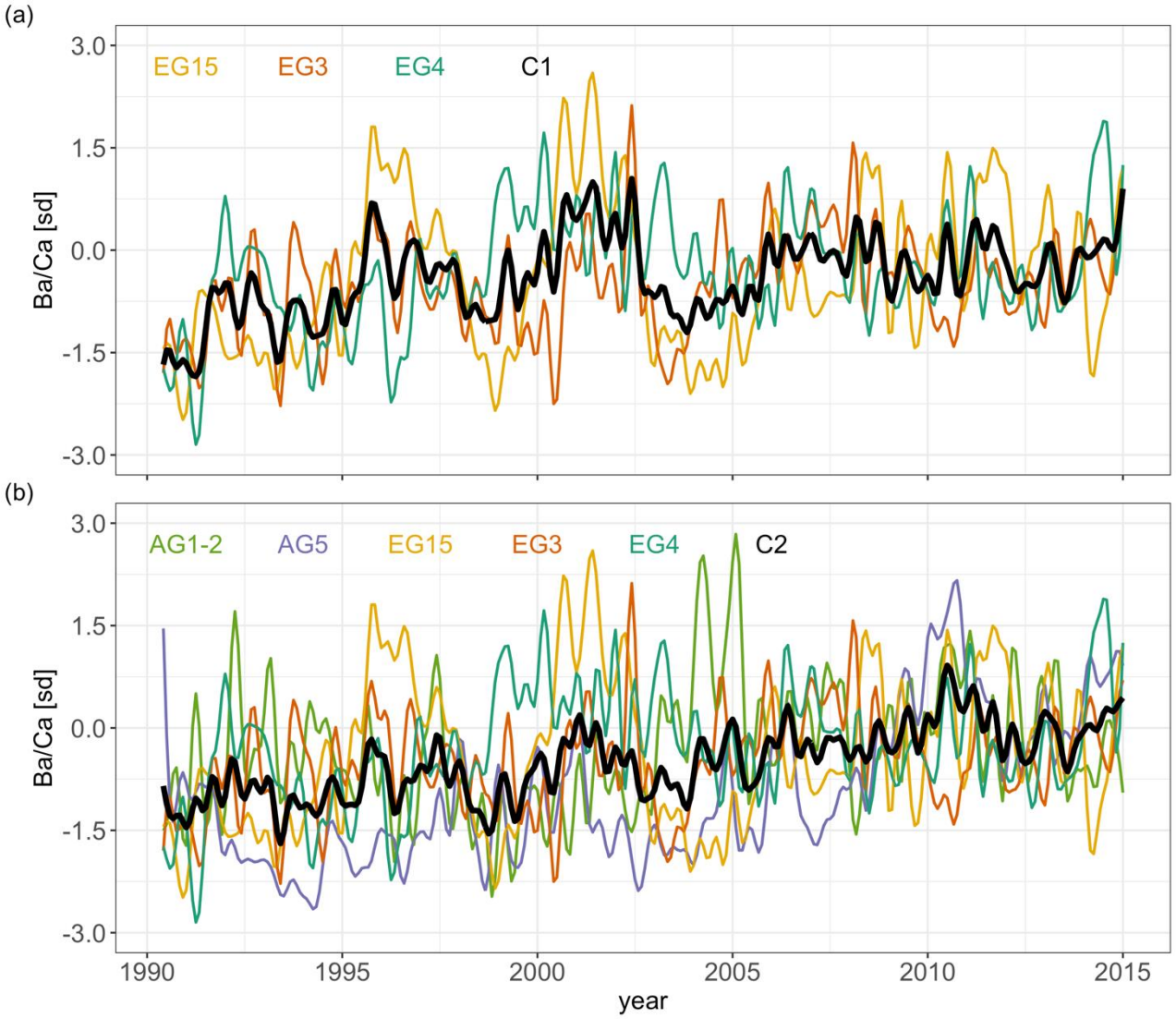

Figure S4: Monthly interpolated Ba/Ca composites time series (filtered using a low pass filter with a 5-month frequency cut off) as well as the records used for each one (a) EG15 in yellow, EG3 in orange, EG4 in dark green, (b) AG1-2 in light green, AG5 in blue and both C1 and C2 in black.

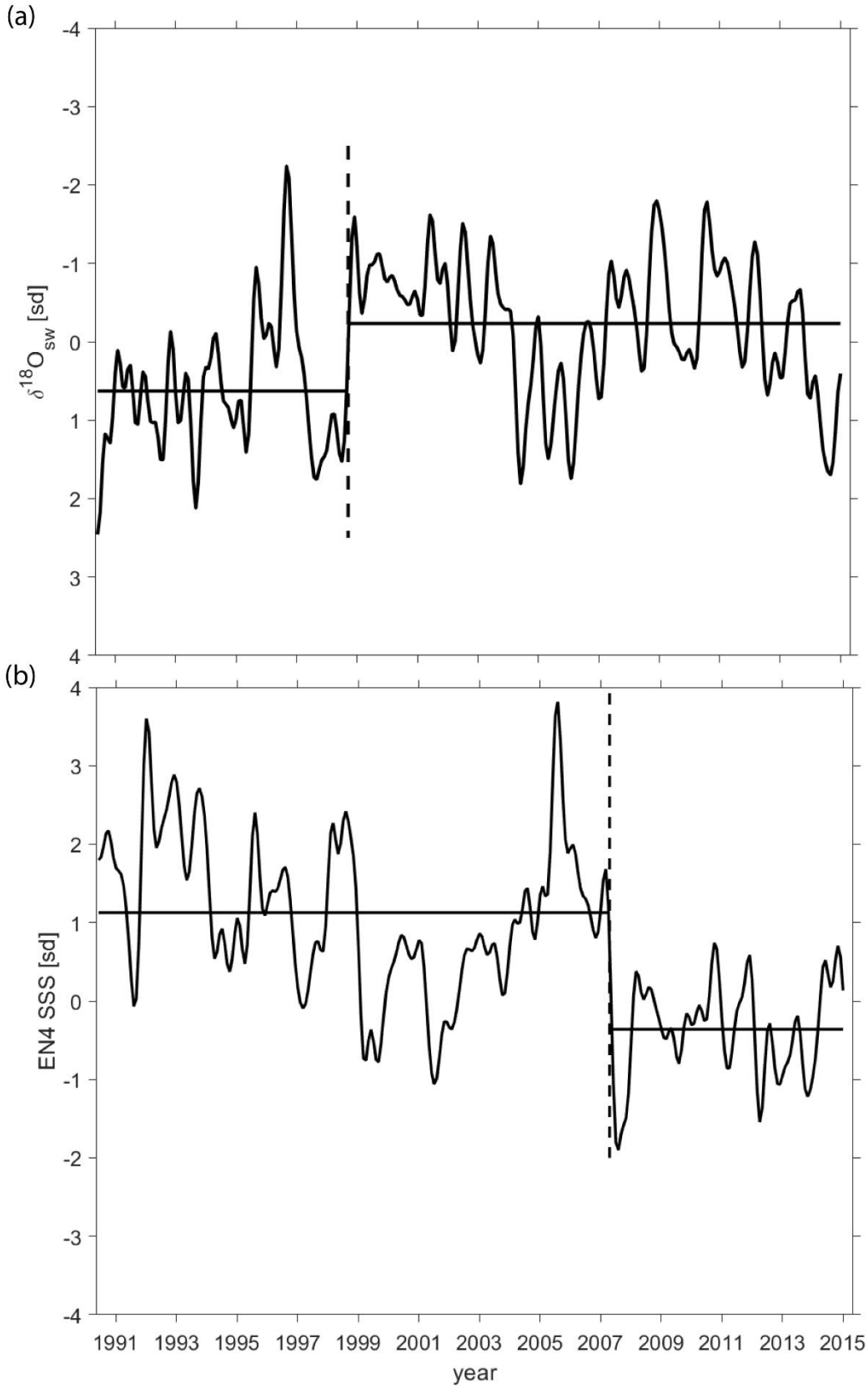

Figure S5: Change point analysis based on significant arithmetic mean change (vertical dashed line) of (a) the $\delta^{18}O_{sw}$ record from EG in 1998 and (b) the EN4 SSS record in 2007. Note that the Y axis on the (a) panel is reversed.

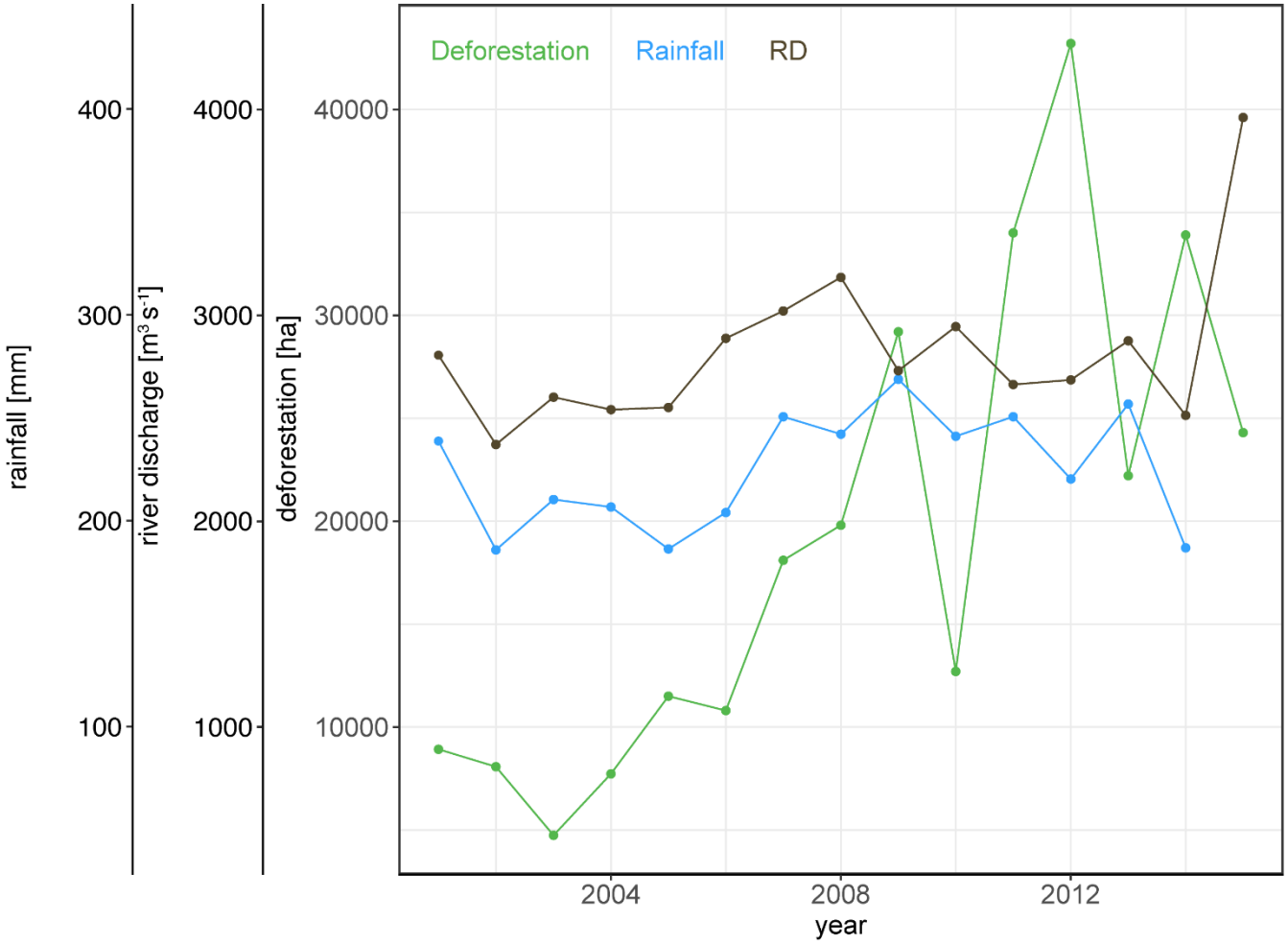

Figure S6: Annual deforestation (green), rainfall (blue) and river discharge (brown) time series from 2001 to 2015.

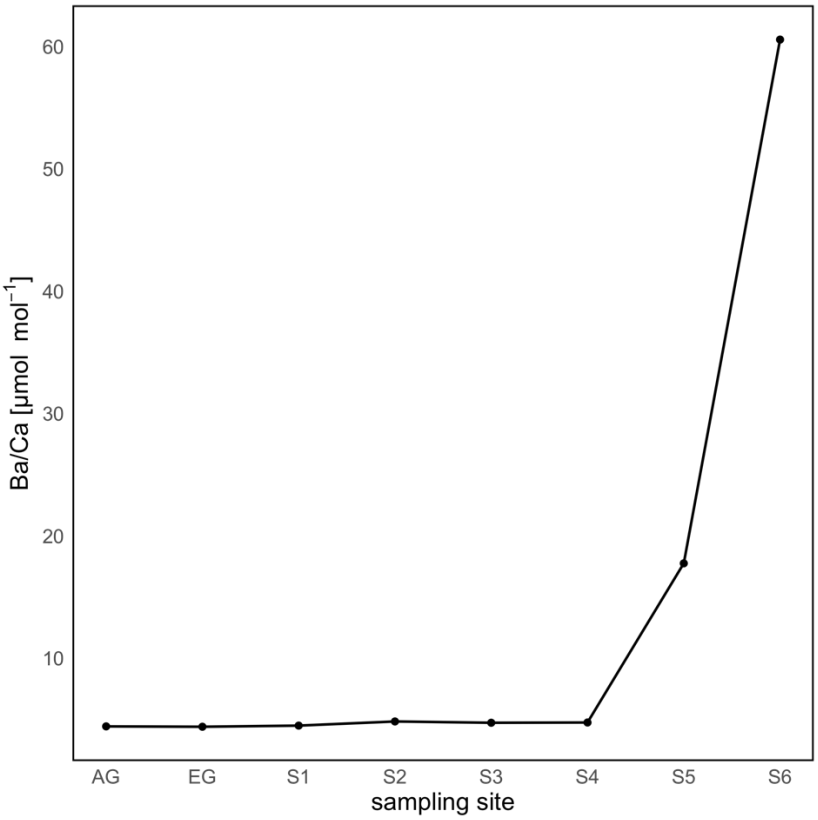

Figure S7: Ba/Ca values of seawater across a transect from both coral colonies' sites and the Miri River located approximately 11 and 21 km away from Eve's Garden and Anemone's Garden, respectively. Samples were obtained from the surface (top 10cm) on October 11th, 2019, during the monsoon transition season.

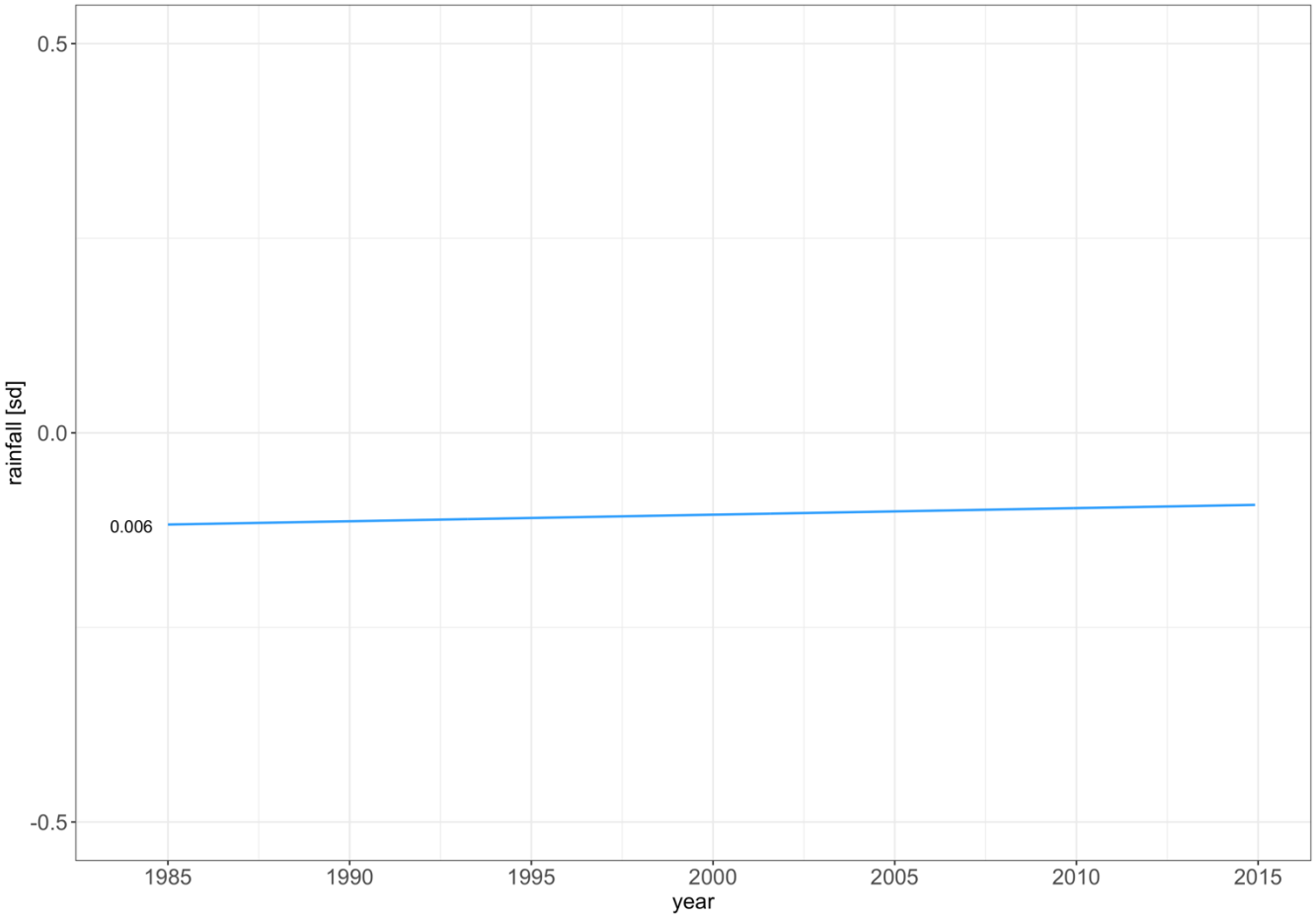

Figure S8: Trend in the rainfall average record of six stations throughout the catchment using Sen's non–parametric method. The increasing trends are indicated by the Mann–Kendall tau–b statistic next to each record, results are not significant at the 0.05 level (p = 0.866).

Satellite imaging

To create the annual deforestation time-series for Sarawak, the Global Forest Change (GFC) dataset (Hansen et al., 2013) was projected into the local coordinate system (UTM 49 N, WGS 1984 – WKID 32649) and then clipped via the boundaries of a Baram catchment shapefile, within the GIS software ArcMap 10.8 (ESRI, 2022). The deforestation time-series was converted from a raster to a vector format and the shapefile table was exported as a csv to calculate deforestation area statistics using Python within the PyCharm IDE (JetBrains, 2022).
Below is the script used to calculate annual deforestation and to plot them in a bar graph as well as the corresponding map.

Listing 1: Python code for deforestation graph and map

```
# import libraries#
system commands import os
```

```
# data manipulation import
pandas as pd import geopandas
as gpdimport numpy as np import
rasterio
from rasterio.plot import show
from rasterio.plot import show hist
import rasterstats

# graphing
import matplotlib.pyplot as plot
from mpl toolkits.axes grid1 import make axes locatable
import seaborn
import contextily as ctx

# specify and change directory
Dir = r'C:\Sarawak\datasets'os.chdir
(Dir)
```

```
# read in shapefiles
    gfc shapefile = gpd.read file('_
        gfc 2001 2019 baram 32649 vector ErasedRivers.shp'
                                        ).drop(['Shape Leng', 'Id', '
                                            OBJECTID'], axis = 1)
    rivers shapefile = gpd.read file('_
        hotosm mys waterways Baram 32649.shp')
    basin shapefile = gpd.read file('Baram River Basin.shp')

    # read in raster
    # this is used as a forest basemap in the map
    raster = rasterio.open('GFC 2000 TreeCover Baram 3857 nodata_ _
        .tif')

    # read in as csv for graphing
    rivers = r'gfc 2001 2019_ Baram 32649 vector1KmRiver.csv'whole basin = r'
        gfc 2001 2019 Baram 32649 vector Erased Rivers.csv'

    # all basin deforestation graph

    # convert m2 to km2
    gfc shapefile['areakm2'] = gfc shapefile['aream2'] / (1000 *
         1000)

    bar = seaborn.barplot(x = gfc shapefile['gridcode'], y =gfc shapefile[
        'areakm2'], data = gfc shapefile ,
                                ci = None,
                                estimator = np.sum,
                                facecolor = 'white',
```

```
                                edgecolor = 'black'
                                )

plot.xticks(rotation = 30)
plot.xlabel('Year', weight = 'bold')
plot.ylabel('Deforestation Area (Km$^{2}$)', weight = 'bold'
    )
plot.title('Deforestation within Sarawak Baram River
    Catchment, Malaysia')
plot.tight layout()

Dir = r'C:\Sarawak\outputs'os.chdir
(Dir)
plot.savefig(
      fname = 'graph.png',dpi =
      1200,
      format = 'png'

)
plot.show()

# map creation

fig, ax = plot.subplots(1)

# convert dfs to 3857 prj to overlay with contextily basemapprj
gfc shapefilePrj = gfc shapefile.to crs(epsg = 3857)
rivers shapefilePrj = rivers shapefile.to crs(epsg = 3857)basin shapefile
Prj = basin shapefile.to crs(epsg = 3857)

# add categorical class to df so matplotlib cmap accepts forl
      egend
```

```
rivers_shapefilePrj['class'] = 'Baram basin _ _rivers'
#footwork for neater fitting colour ramp
divider = make_axes_locatable(ax)
cax = divider.append_axes('bottom', size = '5%', pad = 0.2)

# rivers
rivers_shapefilePrj.plot(column = 'class',
                         ax = ax,
                         legend = True,cmap = '
                         cool',
                         linewidth = 0.6,
                         zorder = 4)

# basemap for area outside of Baram Basin
ctx.add_basemap(ax = ax,
                source = ctx.providers.CartoDB.Voyager,zorder = 1)

# forest cover
rasterio.plot.show(raster,
                   ax = ax,
                   cmap='Greens',zorder = 3
                   ,
                   alpha = 0.5)

# deforestation
gfc_shapefilePrj.plot(column = 'gridcode',
                      ax = ax,
                      cax = cax,
                      legend = True,
                      legend_kwds = {'label': 'Annualde_
                          forestation',
```

```
                                        'orientation':      'horiz
                                            ontal',
                                        'shrink':    0.8,   'pad':0.04},
                                cmap = 'plasma',zorder = 5)

# Baram basin      outline
basin shapefilePrj.plot(ax = ax,
                        facecolor = 'none',edgecolor
                        ='black',zorder = 2)

ax.set xticklabels([])ax.set ytickl
abels([])

plot.suptitle('Deforestation      within the Baram River Basin,Malaysia', y =
    0.95)

Dir = r'C:\Sarawak\outputs'os.chdir(Dir)
plot.savefig(
     fname = 'map.png',
     dpi = 1200, format = 'png')

plot.show()
```