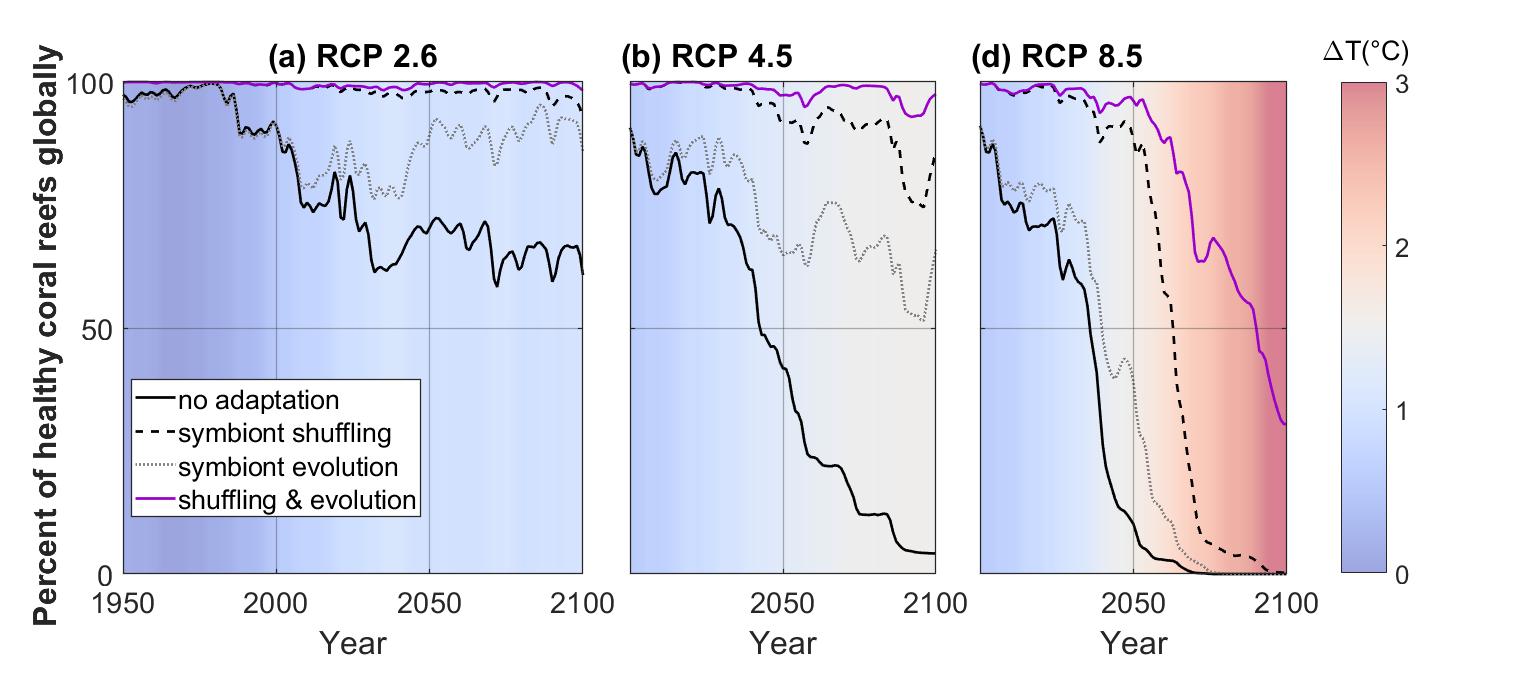
Generating figures for the coral modeling paper, as of Jan 12, 2020

This is just a cheat sheet, and is very rough, but it should have the key steps to generating most of the figures, including all which had to be updated this month.

Note that for all figures the process can be sensitive to directory paths. In general, you want to run MATLAB in the same directory where the figure script is stored, either FigureGeneration or FigureManipulation. The main program directory (one level up) should be on the path. Where directory names are specified, it will be near the top of the file. Names should end with a directory separator character.

**Figure 1**



This compares the number of healthy reefs over time for various scenarios. The required data are written to one \*.mat file per run, labeled by RCP, E, OA, and superAdvantage options. Symbiont introduction mode is not indicated.

Two sets of cases (no advantage and with a shuffling advantage) are run for each RCP scenario (2.6, 4.5, and 8.5 are used) using AutoRepeatModelRuns.m. Be sure to set **doDetailedStressStats=true** so the curve data will be written to the output directory. The mat files will be in a subdirectory called “bleaching”.

After each set of cases, the mat files must be copied to a directory with a unique name. Currently, D:\GitHub\Coral-Model-V12\FigureData\healthy\_4panel\_figure1\<*some distinctive name*>\ is used. Otherwise, outputs with the same names will overwrite the data when the model is run again.

Set 1, using default single symbiont mode (mode 0):

1. E=0
2. E=1

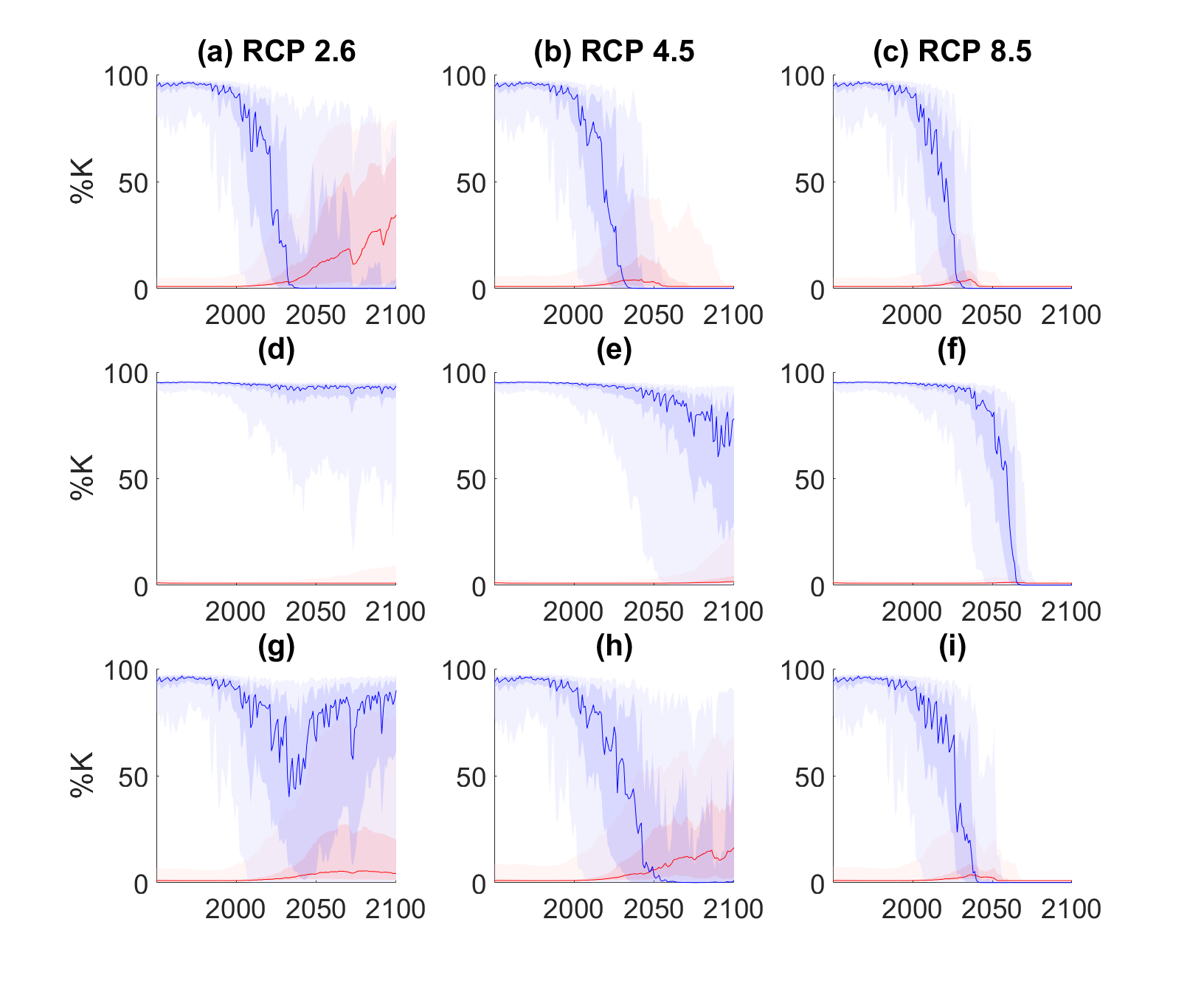
Set 2:

1. Mode 9 shuffling, advantage 1.0 C E=0
2. Mode 9 shuffling, advantage 1.0 C E=1

From the FigureGeneration directory, run BleachingHistory\_Subplots\_WithDT\_Row.m after setting the relPath and shufflePath variables to match the mat file locations.

Save the figure as a \*.fig and \*.png or \*.jpg. The saveCurrentFigure script is more reliable than the export option of the figure window in some versions of MATLAB.

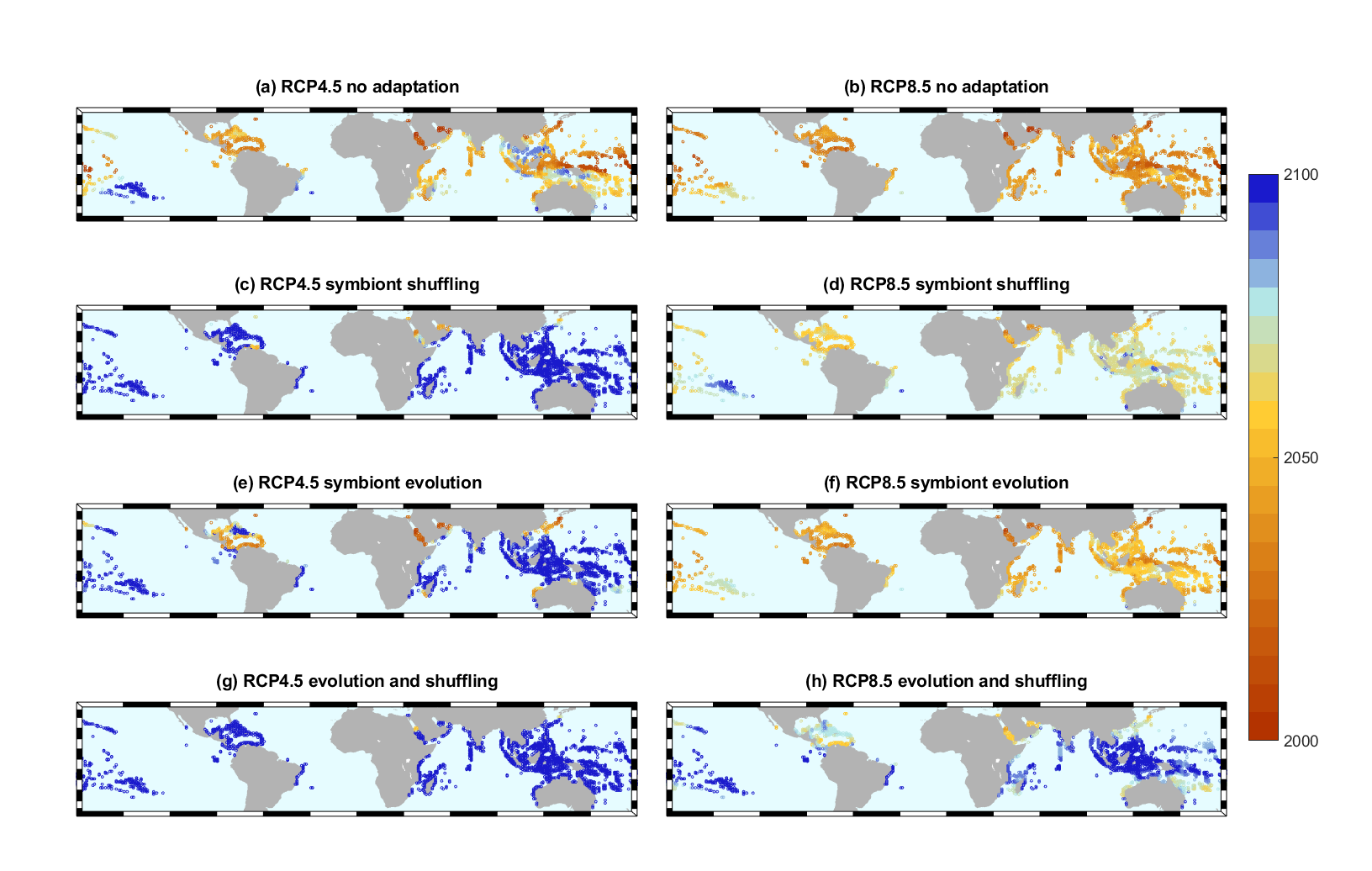
**Figure 2**



The individual panels of Figure 2 are taken unmodified from figures generated at runtime (with doCoralCoverFigure=true). The figures have names like GlobalCoralCover\_rcp26\_E0OA0\_SymStrategy0Adv0.00C, and those needed should be gathered into a single directory from the \*\_map directories generated at runtime. For each of the 3 RCP values, E=0, Advantage 0; E=0, Advantage 1; and E=1, Advantage 0 are needed. In Windows, a search pattern such as filename:GlobalCoralCover\_rcp??\_E1OA0

Is useful. The files are combined using MergeCoverPlots\_NineCases.m.

**Figure 3**

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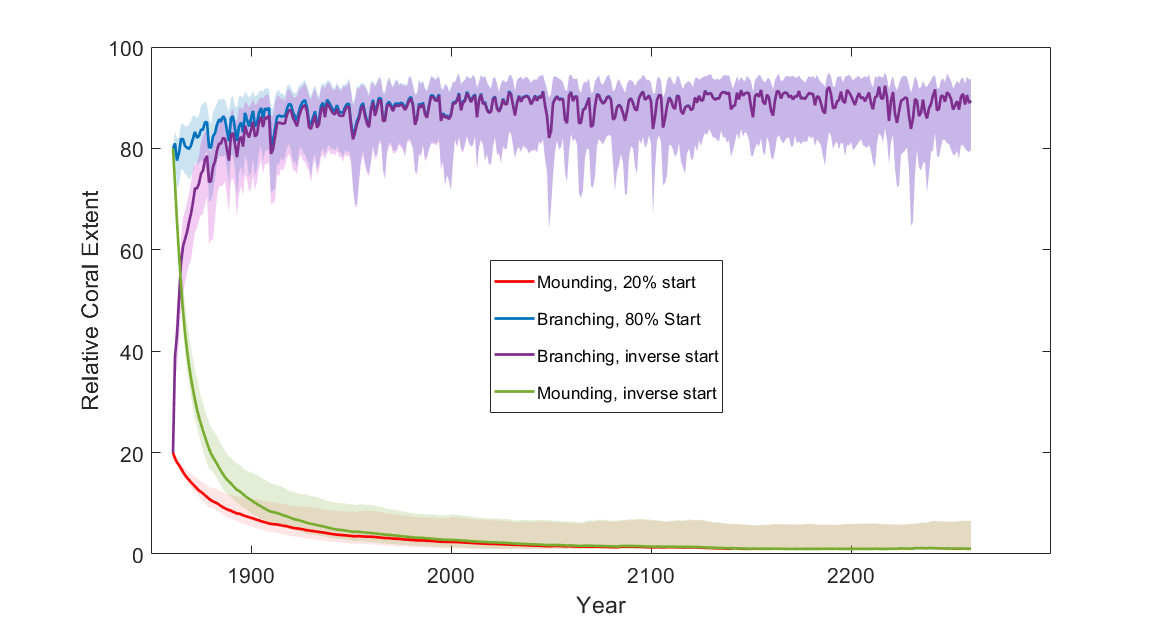
This figure shows the last year of coral survival for RCP 4.5 and 8.5 under 4 different assumptions.

The component maps are generated at run time for all cases, provided doCoralCoverMaps is true. The required 8 maps must be manually gathered into a single directory, such as FigureData/LastYearMaps\_Figure3 in the model directory. Their names look like ESM2M.rcp85.E0.OA0.sM9.sA1\_LastHealthyBothTypesV2.fig. On Windows:

filename:ESM2M.rcp85\*LastHealthyBothTypesV2

Go to FigureManipulation, edit inputPath if necessary, and run MergeSelectedLastYearMaps\_shuffle.m.

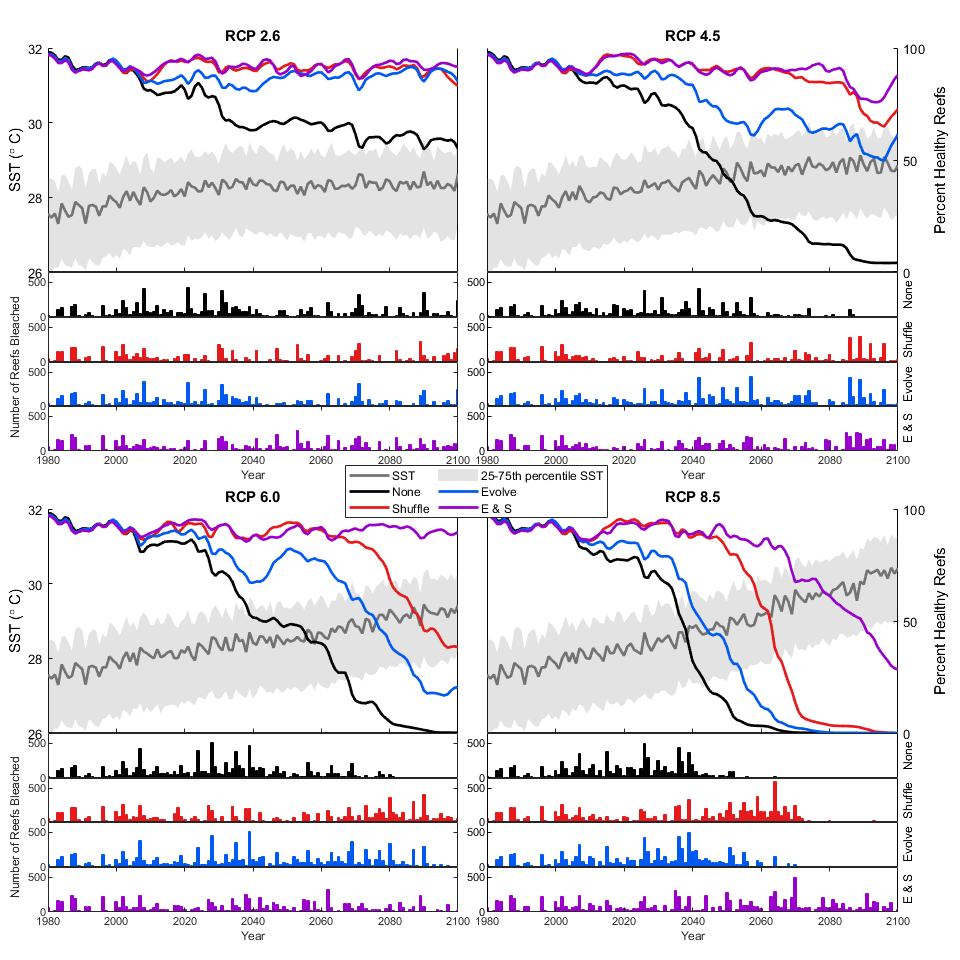
**Figure S2**



This is created by manually copying lines from the Global Coral Cover figure from one control400 run to another made with reversed initial populations. In a figure, select Plot Browser in View to turn of any unwanted shaded areas. Remaining areas are most easily omitted from the legend by setting HandleVisibility to off. The figure can also be created (or at least started) with spinupFigure.m.

**Figure S3**

Use SST\_Bleaching\_miniBars.m



**Figure S4 (removed version)**

This takes the 4-panel figures which are generated for each reef and combines 3 pairs of them. The 6 originals should be gathered into a single directory. Then update the path name (and file names if necessary) in FigS4\_4\_panel\_overlay.m and run the script. It will write the 3 merged versions into the same directory.

**Figure S4 (was S6) – SST analysis**

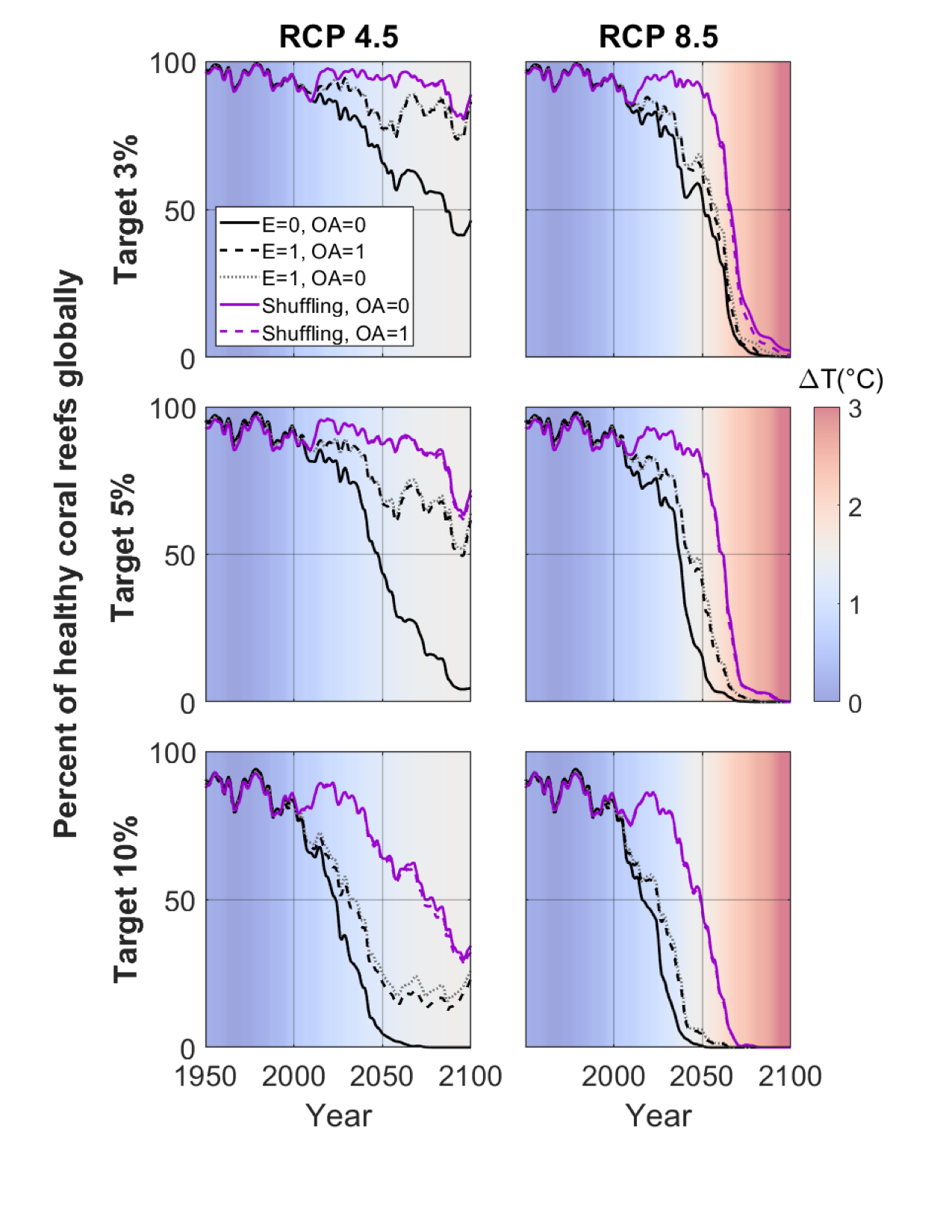
This figure shows maps with various combinations of SST, sdev(SST), and changes in those values over time. There are also RCP 4.5 and RCP 8.5 versions of each map. Combining figures manually is tedious, and combining them in a script is tricky, but a script now exists. Run everything from the FigureGeneration directory. The main script is SST\_ChangeMaps\_Combined.m.

* The script has some hardwired directory paths at the top. Update them to match your model location.
* At about line 13, enter the numbers of all the maps to include in the output figure. The 16 options (oddly numbered 9 to 24) are described in the comments on following lines.
* Run the script. Go for a short run.
* You will find a figure sized to fit your screen, but possibly too small to read. In the program directory (FigureGeneration) there will be a file called combinedSSTMaps.png which has the figure at higher resolution. If you want it bigger or smaller, repeat the print command echoed at the end of the script, changing the “-r” argument until you get what you want.
* Move the figure if you are making another version. Each run will overwrite the last combinedSSTMaps.png.

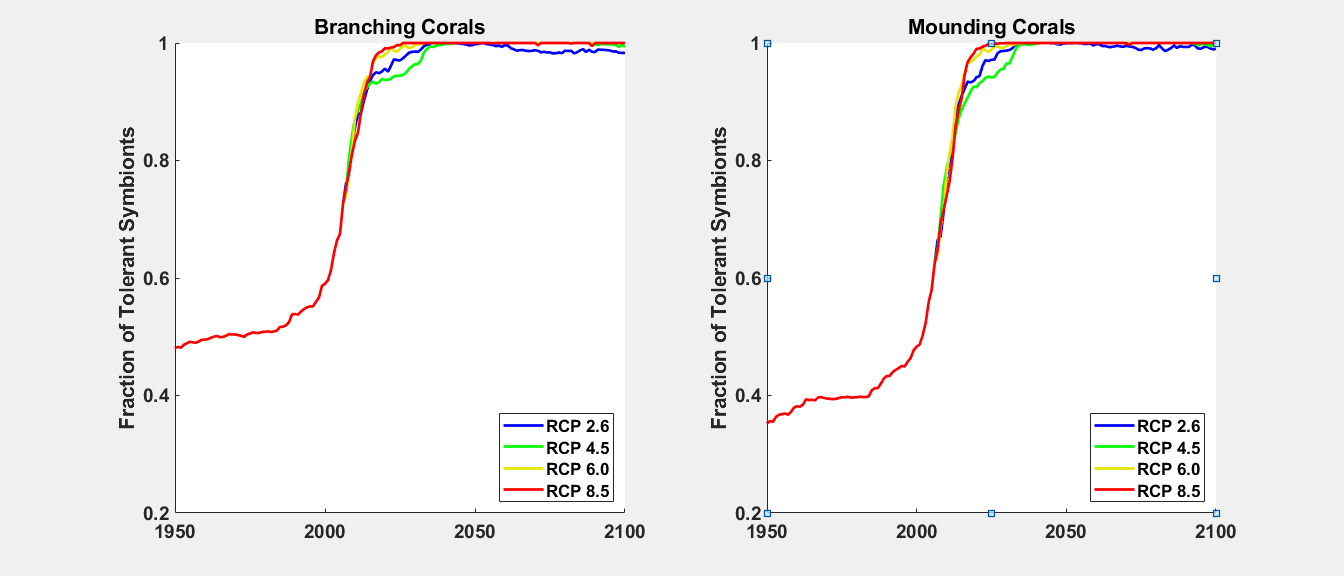
Note: this isn’t working as expected in June 2020. The figure comes out at different sizes, but the fonts scale differently than the maps, and every version is bad in the same way. Fortunately, the File->Export setup process works well with default settings. I deleted the little corner brackets manually from the final figure, but it is a slow process with so much data and 40 objects to delete. In the future, edit the original separate maps before combining them.

**Figure S5 – Percent healthy coral by target bleaching amount and OA**

Was Healthy\_6panel\_3Targets. Now Healthy\_4panel\_2Targets\_FigS5.m. Requires appropriate BleachingHistory\*.mat files in FigureData/healthy\_4panel\_figure1/

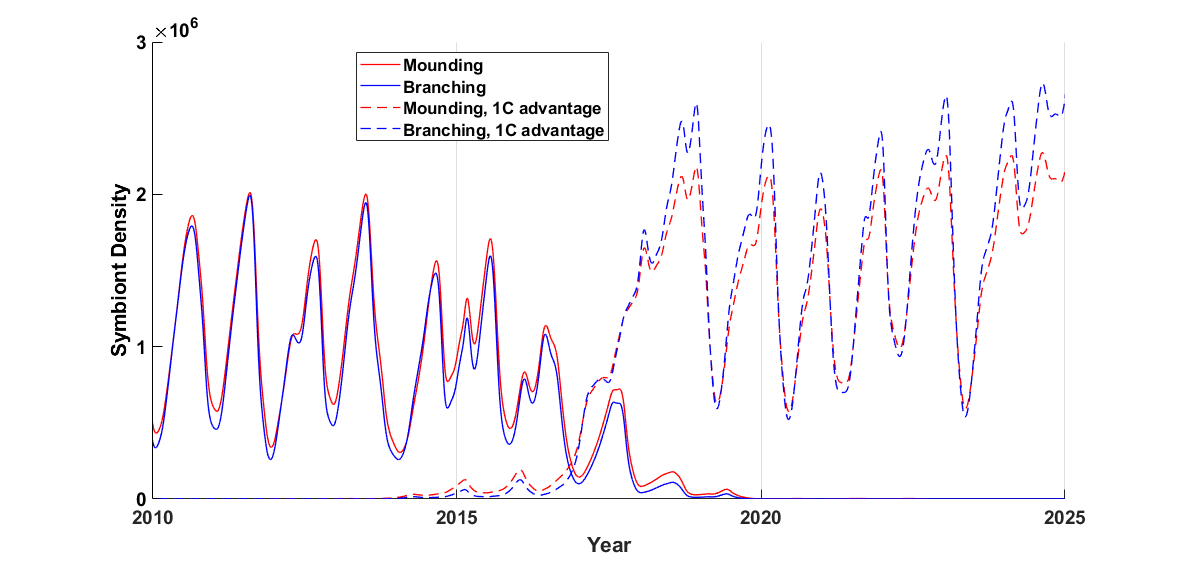


**Figure Sx – symbiont dominance**

Use giStats/TolerantSymbiontDominance.m

**Figure S6 – Fine-scale symbiont shuffling**

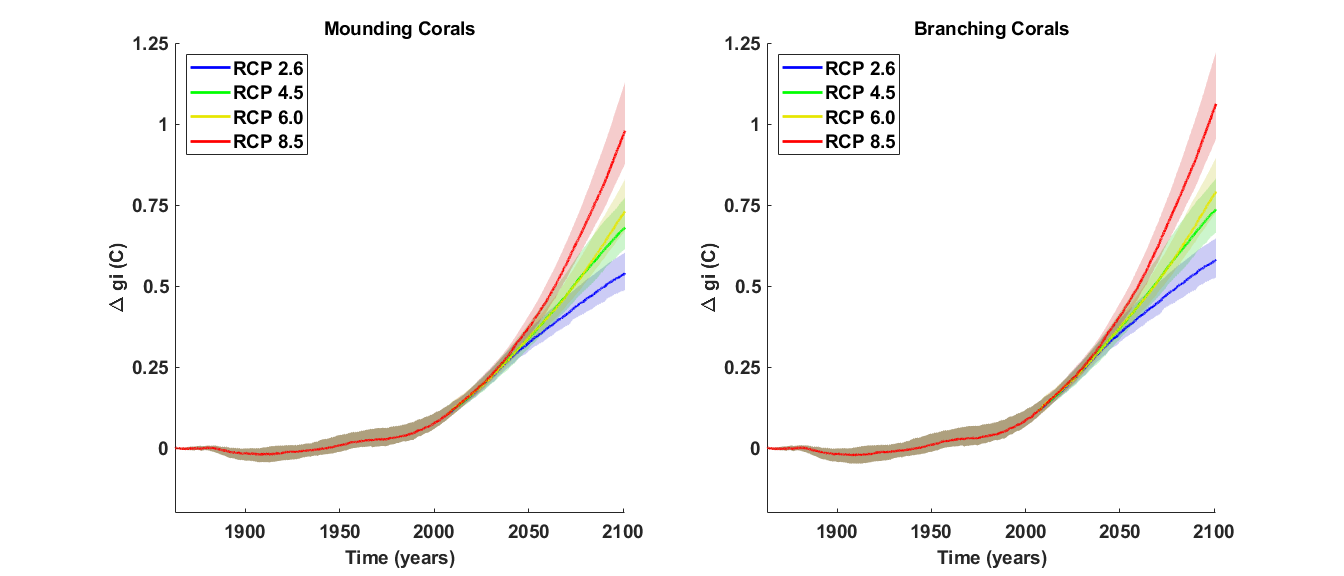
This figure is generated by PlotCurrentS.m in FigureGeneration. Input is by manually loading a file such as DetailedSC\_Reef36.mat written from the main program and stored in mapDirectory. It initially showed the density of the 4 symbiont populations for the shuffling case. As of November 2020 it may be gaining an additional line on the right axis for SST.



**Figure S7 – Symbiont genotype changes**

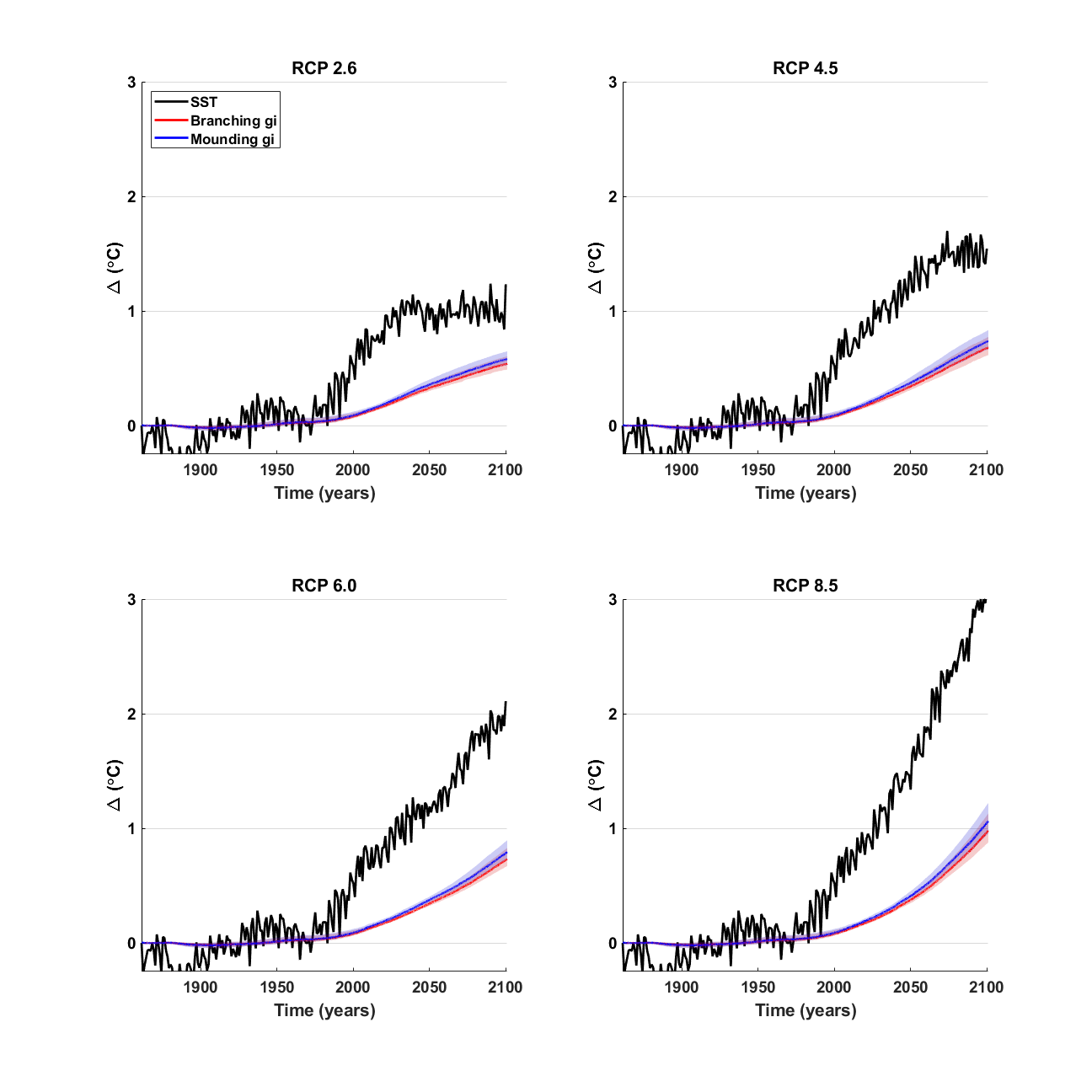
This shows the genotype (adapted temperature) for each coral type in the runs with evolution only. The median is shown as a line and the interquartile range is shaded. This is generated by giStats/giStats.m, which creates several plots, but this is the only one used. There are some stats printed as the script runs which may be used in the text.

A new version, giStats\_RCPfacets\_AllDelta.m, facets by RCP and adds SST delta from 1860 to each facet.



**Figure S8 – Symbiont genotype changes and SST**

This is a replacement for what was S7. It is now generated by giStats\_RCPfacets\_AllDelta.m. This script has access to the gi deltas, but does not print them in text form. The runs supporting this must include gi output (saveGi=true). The numbers used in the text are printed only by the older script giStats\_RCPfacets.m. This should be fixed, and should be easy to do.



**Table 1**

The values here are manually copied from console.txt files during each run. Getting the right ones is a matter of searching for the file and selecting the required directory names. The directory names look like ESM2M.rcp60.E0.OA0.sM9.sA1.5.20200109\_maps.

You will use three of four consecutive lines near the end of the file. The list entry before “1925” is to be subtracted from 100 to get “% Not Bleached”. The second line has “% Coral Cover” and the 4th times 100 is “% Heat Sensitive”.

All Reefs 6.03 11.22 4.57 11.43 15.58 28.05 1925

Global average percent coral cover: 43.6

Percent of reefs with less than 10 pct cover: 26.3

Fraction of reefs dominated by branching coral: 0.326

Table S3

A useful command line for getting more readable subsets, using the appropriate E and OA values. Run this in the containing directory for all the output files.

Similar lines can be used for the other two values in the table.

$ grep -r "coral cover" \*/console.txt | grep E0 |grep OA0| cut -c 7-11,25-28,90- --output-delimiter=" " | grep -v A1.2

$ grep -r "branching" \*/console.txt | grep E0 |grep OA0| cut -c 7-11,25-28,100- --output-delimiter=" " | grep -v A1.2 | grep -v A0.2

In this one the “awk” part prints every 6th line, because there are 6 similarly-formatted tables but we only want the last. The character range of 1330-1340 works when doDetailedStressStats is true. For the default table formats, reduce this to 106-112.

$ grep -r "All Reefs" \*/console.txt | grep E0 |grep OA0 | grep -v A1.2 | grep -v A0.2 | awk '!(NR%6)' | cut -c 7-11,25-28,1330-1340 --output-delimiter=" "

On Windows an old utility called Cygwin Terminal (mintty.exe) works well for these Unix commands.

The color scale in the table can be duplicated in Excel by setting the following 3 colors. At 0 (255,102,102); at 45 (252,206,135); at 90 (226,237,220).

**Table S4**

This table summarizes correlations between coral cover and various SST statistics. The raw numbers are produced by SST\_Stats.figure.m and then block of lines representing the same comparison over different years are averaged in CorrelationTable.xlsx.

# Other numbers and figures used in verification, but not published

Blocks of values like this are used to compare mortality to preceeding cold/warm bleaching events:

**RCP 8.5, 1985-2010 (normalization)**Of 68 mortality events in Mounding corals, 1985 to 2010  
0.0% / 26.5% had cwb / wwb events the same year.  
0.0% / 54.4%  had a cwb / wwb event in 2 years.

They come from the script MortalityVsBleachingEvents.m

Thermal tolerance increases are mentioned in the paper and shown in Figure S8. giStats\_RCPfacets.m prints those values.

Unrelated to any specific figure, this is handy for getting and setting figure data:

% Commands like these are really handy for grabbing data from the figure on

% the screen and possibly manipulating it.

% masspop = get(gco, 'YData');

% set(gco, 'CData', cdatacopy)

% Also useful:

h2 = findobj('Type', 'line');

# Required Runs

There are a great many possible runs with different input parameters. In addition, some current runs are slow because parallel processing must be disabled. This is an attempt to determine the minimum set of runs needed to support the paper. There may also be a list of commonly-needed runs for diagnostics.

Model variations:

RCP – 2.6, 4.5, 6.0, 8.5 (RCP4 refers to all four)

E – 0, 1

Advantage – 0, 0.5, 1.0, 1.5

Let Adapt4 refer the all combinations of E=0, 1, Adv = 0, 1.0

OA – 0, 1

Target = 3, 5, 10 (assume 5 if not noted)

Runtime requirements:

saveReefParams requires parfor to be commented, collectSelV and other reefParams uncommented in the main loop. (slow)

saveGi – where adaptation plots are needed, some extra disk space and time.

keyReefs – where per-reef plots are needed. Slow if all reefs are selected.

dataReefs – where full time histories of C and S are needed (disk space intensive)

detailedStressStats – expand the end-of-run tables to almost yearly for smooth plotting. This is reflected in larger bleaching/BleachingHistory\* files.

doCoralCoverFigure – red/blue plot of cover over time.

doCoralCoverMaps – several different maps of coral status

The following maps and tables require program output (some others only need the SST data).

Table 1: RCP4, Adapt4

Figure 1: RCP[2.6, 4.5, 8.5], Adapt4, doDetailedStressStats = true

Figure 2: RCP[2.6, 4.5, 8.5], Adapt4, doCoralCoverFigure = true

Figure 3: RCP[4.5, 8.5], Adapt4, doCoralCoverMaps = true

Table S1: RCP4, E=0, 1, Adv=0, 0.5, 1.0, 1.5. No extra options required

Figure S2: control400 temperatures, RCP n/a, E=0, Adv=0.0, doCoralCoverFigure=true, One run manually modified for inverse starting percentages.

Figure S3: RCP4, Adapt4, doCoralCoverFigure = true, detailedStressStats = true;

Figure S5: RCP[4.5, 8.5], E=0,1, Adv=0.0, 1.0. OA=0, 1 (5 of the 8 E/OA/Adv combinations are actually used). Target = 3, 5, 10.

Figure S6: RCP4, E=0, Adv=1.0. Built from plots which are always generated if doPlots=true.

Figure S7: RCP as desired (2.6?), E=0, Adv=1.0, OA=0, saveGi = true in A\_Coral\_Model, reef of interest listed in dataReefs to get S, C files. (most recently reef 1487, RCP 2.6)

Figure S8: RCP4, E=1, OA=1, Adv=0.0, saveGi = true

Additional runs may be needed to support unpublished diagnostic figures:

Cover\_CWB\_Selv\_comparison: RCP 4.5, E=0, Adv=1.0, saveReefParams=true in A\_Coral\_Model, parallel loop disabled.

Run sets to support this are chosen as a balance between runtime, storage used, and manual effort. Target=5 unless otherwise noted.

Set 1:

* RCP4, Adapt4, OA=0, doDetailedStressStats=true, doCoralCoverFigure=true, doCoralCoverMaps=true
* 16 runs
* Supports: T1, F1, F2, F3, S3, S6

Set 2:

* RCP4, E=0, 1, Adv=0.5, 1.5, OA=0 (other Adv values covered in Set 1)
* 16 runs
* Supports TS1

Set 3:

* Control400 (normalize for this), choices above
* 2 runs
* Supports FS2

Set 4:

* RCP[4.5 8.5], Adapt4, OA=1, Target=5
* Supports FS5

Set 5:

* RCP[4.5 8.5], Adapt4, OA=0,1, Target=3
* Different output directory
* Supports FS5

Set 6:

* RCP[4.5 8.5], Adapt4, OA=0,1, Target=10
* Different output directory
* Supports FS5

Set 7:

* RCP 2.6 (?), E=0, Adv=1.0, OA=0, saveGi=true, dataReefs includes 1487.
* Supports FS7

Set 8:

* RCP4, E=1, OA=1, Adv=0.0, saveGi=true
* SupportsFS8

These in turn must be supported by optimizations of the psw2 inputs. Note that these must always include all four RCP cases, because averaged values from that set are used in the actual runs.

Opt Set 1:

* RCP4, Adv=0.0, 0.5, 1.0, 1.5, E=0, 1 OA=0
* Supports sets 1, 2, 7

Opt Set 2:

* Control400, either starting population
* Supports set 3

Opt Set 3:

* RCP4, Adapt4, OA=1
* Supports set 4, 8

Opt Set 4:

* Target=3, RCP4, Adapt4, OA=0, 1
* Supports set 5

Opt Set 5:

* Target=10, RCP4, Adapt4, OA=0, 1
* Supports set 6