Methods figures

Code for generating Fig. 3 (hypothesis setting with risk metrics) and Fig. 1 (TPC and time series) in the 'Materials and Methods' section.

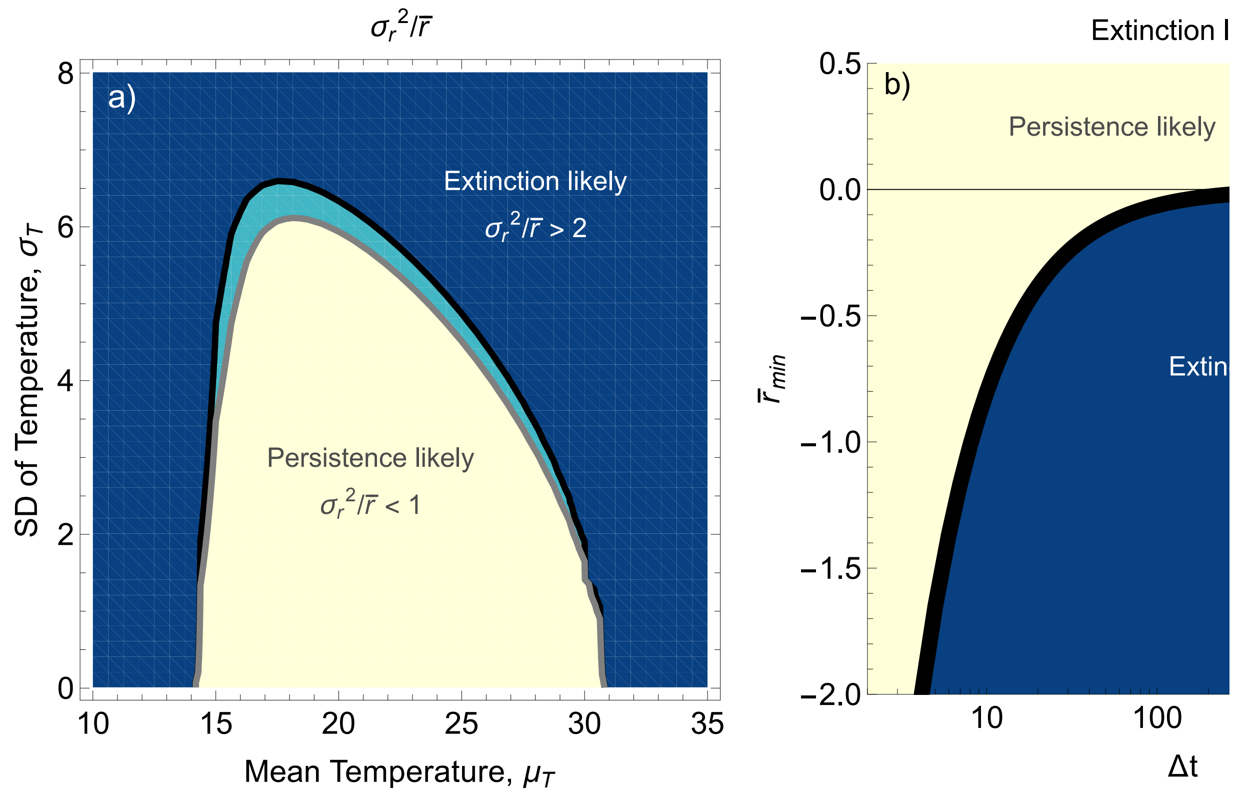
Risk Metrics

Run this code to generate Fig 3. The first block of code calculates the persistence boundaries and the second the number of time steps a population at carrying capacity can persist at any given negative growth rate.

```
directory = "/directory/";

lactin2[T_, {a_, b_, tmax_, δT_}] := Exp[a T] - Exp[a tmax - ((tmax - T) / δT)] + b;
paramsfit = {0.044, -1.774, 35.254, 5.435};
w[T_] := lactin2[T, paramsfit];

divisions = 40;
σTrange = Range[0.01, 8.01, 8 / divisions];
μTrange = Range[10, 35, 25 / divisions];

Clear[T];
moments = Flatten[ParallelTable[Module[{mean, var, skew, kurt},
     mean = NExpectation[w[T], T ≈ NormalDistribution[μT, σT]];
     var = NExpectation[(w[T] - mean) ^ 2, T ≈ NormalDistribution[μT, σT]];
     skew =
      NExpectation[((w[T] - mean)) ^ 3, T ≈ NormalDistribution[μT, σT]] / var ^ (3 / 2);
     kurt =
      NExpectation[(w[T] - mean) ^ 4, T ≈ NormalDistribution[μT, σT]] / (var ^ 2) - 3;
     {μT, σT, mean, var, skew, kurt, If[mean > 0, Log10[var / mean], 10]}],
    {σT, σTrange}, {μT, μTrange}], 1];

persistenceboundaries2 = ListContourPlot[moments[[1 ;;, {1, 2, 7}]],
   InterpolationOrder → 3, Contours → {Log10[1], Log10[2]},
   ContourStyle → {{Thickness[0.01], Opacity[1], Gray},
     {Thickness[0.01], Opacity[1], Black}}, ContourShading →
    {RGBColor["#ffffd9"], RGBColor["#41b6c4"], RGBColor["#084081"]},
   (*ColorFunction→newmap,*) ImageSize → 280, Frame → True, FrameStyle → 16,
   FrameLabel → {"Mean Temperature, μT", "SD of Temperature, σT"},
   PlotLabel → Style["σr²/r̄", 15],
```

```
    Epilog →
     {{Text[Style["a)", White, 17], {11.2, 7.7}]},
      {Text[Style["Extinction likely", White, 14], {28, 6.6}]},
      {Text[Style["Persistence likely",
          Darker[Darker[Lighter[Gray]]], 14], {21.3, 3}]},
      {Text[Style["σr²/r̄ > 2", White, 14], {28, 6}]},
      {Text[
        Style["σr²/r̄ < 1", Darker[Darker[Lighter[Gray]]], 14], {21.3, 2.4}]]}}];

ExtTime[t_, α_, N0_] :=
 r /. NSolve[1 == N0 r / α Exp[r t] / (((r / α) - N0) + N0 Exp[r t]), r, Reals][[1]];
N0 = 5000;
α = 0.0001;

extlimit2 = ListLogLinearPlot[
    ParallelTable[{t, ExtTime[t, α, N0]}, {t, 2, 9997}], ImageSize → 300,
    AspectRatio → 1, Frame → {True, True, False, False}, FrameStyle → 16,
    FrameLabel → {"Δt", "r̄min"}, PlotStyle → {Thickness[0.025], Black},
    PlotRange → {{2, 10 000}, {-2, .5}}, PlotLabel → Style["Extinction limit", 15],
    Filling → {1 → Top, 1 → Bottom},
    FillingStyle → {RGBColor["#ffffd9"], RGBColor["#084081"]}, Joined → True,
    Epilog → {Text[Style["b)", Black, 16], {1.1, 0.42}],
      {Text[Style["Extinction likely", White, 14], {6, -0.7}]},
      {Text[Style["Persistence likely",
          Darker[Darker[Lighter[Gray]]], 14], {4, 0.25}]}}];

expectations =
 GraphicsRow[{persistenceboundaries2, extlimit2}, Spacings → 10, ImageSize → 800]
(*Export[directory<>"Fig1.eps",expectations,"EPS",ImageResolution→1000];*)
```

Out[ ]=



Thermal Performance Curve

Run this code to plot the data and lactin2 TPC fit for P. caudatum (Fig. 1a). You will first need to download ‘PcaudatumTPCdata.csv.’

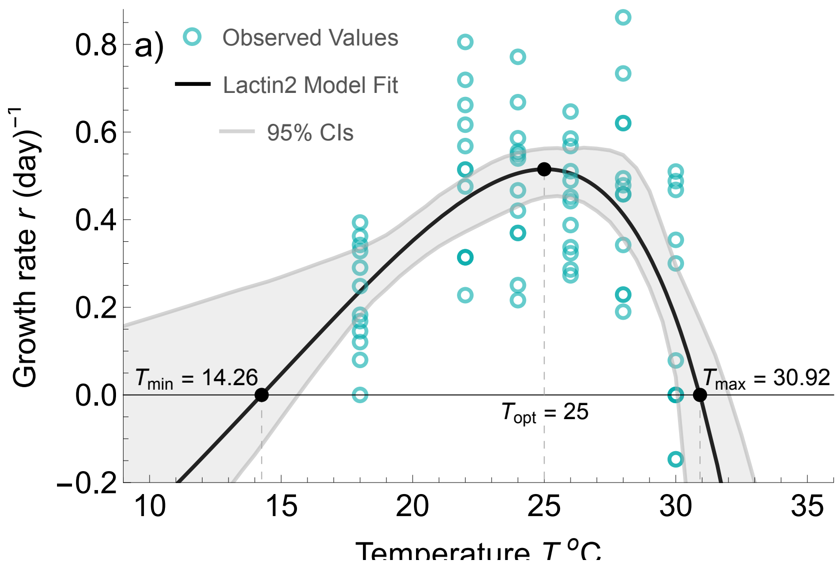
In[45]:=
```
data = Import[directory <> "TPC Data.xlsx"][[1, 2 ;;]][[1 ;; 72, {3, 8}]];

(*generate best fit params to dataset*)
lactin2[T_, {a_, b_, tmax_, δT_}] := Exp[a T] - Exp[a tmax - ((tmax - T) / δT)] + b;
nlm = NonlinearModelFit[data, {Exp[a T] - Exp[a tmax - ((tmax - T) / δT)] + b,
    a > 0, tmax > 20, δT > 1}, {a, b, tmax, δT}, T, Method → "NMinimize"];
paramsfit = {a, b, tmax, δT} /. nlm["BestFitParameters"]

(*use bootstrapping approach to generate 95% CIs*)
pt18 = Select[data, #[[1]] == 18 &];
pt22 = Select[data, #[[1]] == 22 &];
pt24 = Select[data, #[[1]] == 24 &];
pt26 = Select[data, #[[1]] == 26 &];
pt28 = Select[data, #[[1]] == 28 &];
pt30 = Select[data, #[[1]] == 30 &];
```

```
reps = 1000;
bootparams = ParallelTable[
   Module[{resampled = Join[RandomChoice[pt18, 12],
       RandomChoice[pt22, 12], RandomChoice[pt24, 12], RandomChoice[pt26, 12],
       RandomChoice[pt28, 12], RandomChoice[pt30, 12]], nlm},
    nlm = NonlinearModelFit[resampled, {Exp[a T] - Exp[a tmax - ((tmax - T) / δT)] + b,
       a > 0, tmax > 20, δT > 1}, {a, b, tmax, δT}, T, Method → "NMinimize"];
    {a, b, tmax, δT} /. nlm["BestFitParameters"]], {reps}];

jitter = {#1 + 0.3 * (RandomReal[] - 0.5), #2} & @@@ data;
imagesize = 450;
impad = {{60, 20}, {40, 20}};
ciLow = ParallelTable[
   {T, Quantile[Table[lactin2[T, bootparams〚i〛], {i, 1, reps}], 0.025]},
   {T, 9, 36, 0.5}];
ciHigh = ParallelTable[
   {T, Quantile[Table[lactin2[T, bootparams〚i〛], {i, 1, reps}], 0.975]},
   {T, 9, 36, 0.5}];

Tmax = 30.92;
Tmin = 14.26;
TPCplot =
  Show[Plot[lactin2[T, paramsfit], {T, 9, 36}, PlotRange → {{9, 36}, {-0.2, 0.88}},
    Frame → {True, True, False, False}, PlotStyle → Black, ImageSize → imagesize,
    ImagePadding → impad, FrameStyle → 16, AspectRatio → 1 / 1.5,
    FrameLabel → {"Temperature T °C", "Growth rate r  (day)^-1"}, PlotLegends →
     Placed[{Style["Lactin2 Model Fit", 12, Darker[Gray]]}, Scaled[{0.23, 0.84}]],
    Epilog → {{Text[Style["T_opt  =  25", Black, 12], {25, -.04}]},
      {Text[Style["T_min  =  14.26", Black, 12], {Tmin - 2.5, .04}]},
      {Text[Style["T_max  =  30.92", Black, 12], {Tmax + 2.5, .04}]},
      Lighter[Gray], Dashed,
      Line[{{25, 0}, {25, 0.515}}], Line[{{25, -.07}, {25, -.25}}],
      Line[{{Tmin, 0}, {Tmin, -.25}}], Line[{{Tmax, 0}, {Tmax, -.25}}],
      {Black, PointSize[0.02], Point[{Tmin, 0}]},
      {Black, PointSize[0.02], Point[{Tmax, 0}]},
      {Black, PointSize[0.02], Point[{25, 0.515}]},
      Text[Style["a)", Black, 18], {10, 0.8}]}],
   ListPlot[data, PlotStyle → {Darker[Cyan], Opacity[0.6]},
    PlotMarkers → {Graphics[{Thick, Circle[]}, ImageSize → 10]}, PlotLegends →
     Placed[{Style["Observed Values", 12, Darker[Gray]]}, Scaled[{0.23, 0.94}]]],
   ListLinePlot[{ciLow, ciHigh}, PlotStyle →
     {{Lighter[Gray], Directive[Opacity[0.5]]}}, Filling → {1 → {2}}, PlotLegends →
     Placed[{Style["95% CIs", 12, Darker[Gray]]}, Scaled[{0.23, 0.74}]]]]
```

Out[48]=

```
{0.0439224, -1.77286, 35.2468, 5.42136}
```

Out[64]=



Temperature Time Series

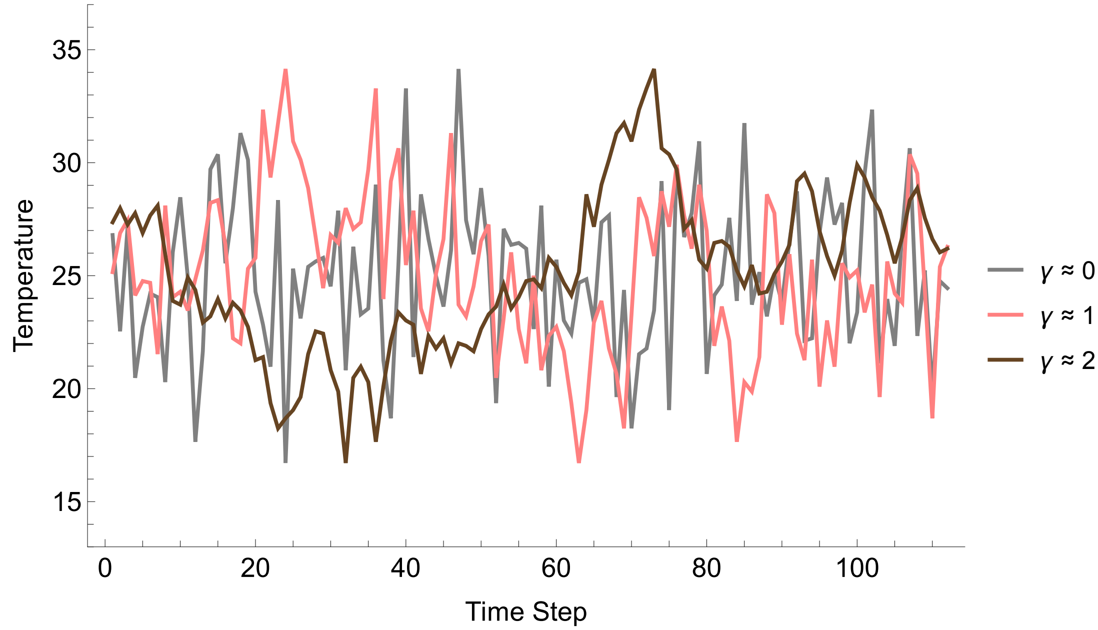
Use this code create temperature time series with spectral synthesis and spectral mimicry, then check what the resulting spectral exponent is. Because we are creating a very short time series (112 long) and keeping the values consistent with mimicry, there is some variation in the resulting values of the spectral exponent (shown in the final three output lines, where equations are b - γx). For the experimental time series, this code was rerun several times until series with spectral exponents very close to the desired values were found.

In[∘]:=

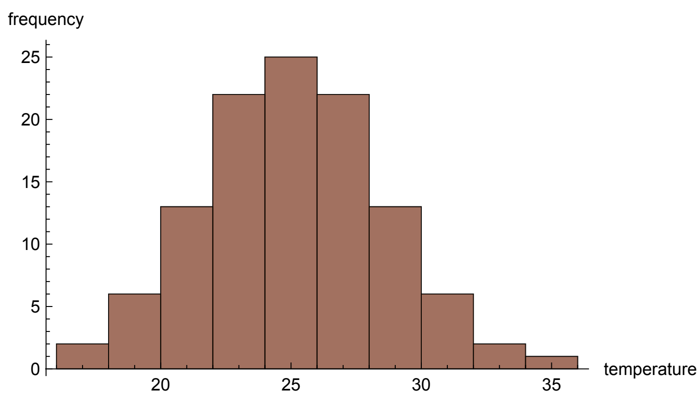
```
cmplx[mod_, arg_] := ExpToTrig[mod Exp[I arg]];

SpecSynFourier[γ_, Nobs_, μ_ : 0, σ_ : 1, seed_ : 0] := Module[{
    phase, f, vec},
   If[seed == 0, SeedRandom[], SeedRandom[seed]];
   phase = RandomReal[{0, 2 Pi}, Nobs];
   f = Range[1 / Nobs, 1, 1 / Nobs];
   vec = InverseFourier[
     Join[{0 + 0 I}, Table[cmplx[1 / (f〚i〛 ^ (γ / 2)), phase〚i〛], {i, 1, (Nobs - 1)}]],
     FourierParameters → {-1, 1}];
   Standardize[Re[vec]] * σ + μ];

Mimic1[x_, z_] := Module[{y},
   y = x;
   Do [y〚Ordering[z, i]〚i〛〛 = x〚i〛, {i, 1, Length[x]}];
```

```
   y];

γvals = Range[0, 2, 1];
μTvals = Range[25, 25, 1];
σTvals = Range[3.5, 3.5, 1];
tmax = 112;

W = ConstantArray[0, {Length[μTvals], Length[σTvals], tmax}];
Do[W⟦i, j, k⟧ = InverseCDF[NormalDistribution[μTvals⟦i⟧, σTvals⟦j⟧], k * (1 / tmax)],
 {i, 1, Length[μTvals]}, {j, 1, Length[σTvals]}, {k, 1, tmax - 1}]
Do[W⟦i, j, tmax⟧ =
   InverseCDF[NormalDistribution[μTvals⟦i⟧, σTvals⟦j⟧], (tmax - .5) * (1 / tmax)],
  {i, 1, Length[μTvals]}, {j, 1, Length[σTvals]}];

X = SpecSynFourier[γvals⟦1⟧, tmax];
Z0 = Mimic1[W⟦1, 1⟧, X];
X = SpecSynFourier[γvals⟦2⟧, tmax];
Z1 = Mimic1[W⟦1, 1⟧, X];
X = SpecSynFourier[γvals⟦3⟧, tmax];
Z2 = Mimic1[W⟦1, 1⟧, X];

ListLinePlot[{Z0, Z1, Z2}, PlotLegends → {"γ ≈ 0", "γ ≈ 1", "γ ≈ 2"},
 PlotRange → {13, 37}, PlotStyle → {Gray, Pink, Darker[Brown]},
 Frame → {True, True, False, False}, FrameStyle → 14,
 FrameLabel → {"Time Step", "Temperature"}, ImageSize → 500]
Histogram[{Z0, Z1, Z2}, ChartStyle → {Gray, Pink, Darker[Brown]},
 AxesLabel → {"temperature", "frequency"}]

lt = Flatten[Abs[Fourier[{Z0}]] ^ 2];
lt = Drop[lt, -Length[lt] / 2];
lt = Drop[lt, 1];
lt0 = MapIndexed[{#2⟦1⟧, #1} &, lt];
fit0 = Fit[Log[lt0], {1, x}, x]

lt = Flatten[Abs[Fourier[{Z1}]] ^ 2];
lt = Drop[lt, -Length[lt] / 2];
lt = Drop[lt, 1];
lt0 = MapIndexed[{#2⟦1⟧, #1} &, lt];
fit0 = Fit[Log[lt0], {1, x}, x]

lt = Flatten[Abs[Fourier[{Z2}]] ^ 2];
lt = Drop[lt, -Length[lt] / 2];
lt = Drop[lt, 1];
lt0 = MapIndexed[{#2⟦1⟧, #1} &, lt];
```

Out[ ]=



Out[ ]=



Out[ ]=

```
0.563445 + 0.44264 x
```

Out[ ]=

```
4.95341 - 1.01304 x
```

Out[ ]=

```
6.27119 - 2.04072 x
```

Use this code to plot and calculate the spectral exponents of the used temperature time series (Fig. 2b and c). As above, the ‘FittedModel’ lines give the actual spectral exponents for each series.

In[ ]:=

```
tempsequence = {28.105012956566068`, 20.973777168683974`, 21.777119582710675`,
   31.756000496201537`, 28.600816667020446`, 28.344521382791513`,
   28.47034266137066`, 23.96687349828974`, 30.63909206823437`,
   24.607518315140997`, 27.770735127101812`, 30.12831827439933`,
   24.843283381565694`, 24.129453086270793`, 23.289282561098656`,
   27.360714125686286`, 32.350579224955645`, 20.818000065734736`,
   25.63004329427447`, 25.392481684859003`, 29.90935651497313`,
```

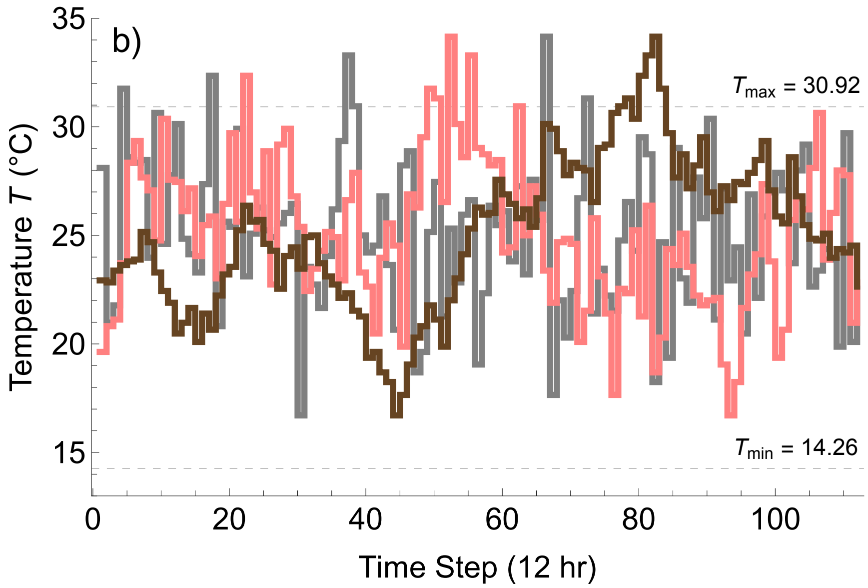
```
   23.110450057296283`, 25.078338674047963`, 26.281372248801993`,
   25.235173241485796`, 24.921661325952037`, 25.550587396135597`,
   26.03312650171026`, 26.450446653600267`, 16.710015292562446`,
   23.549553346399733`, 22.736717716225108`, 21.655478617208487`,
   24.04841998110258`, 26.19796757263583`, 29.34653377145162`,
   33.289984707437554`, 30.947121810389547`, 25.`, 24.21002216148944`,
   24.52858572096878`, 26.79954635260587`, 23.634488914372888`,
   20.65346622854838`, 28.222880417289325`, 28.8780378716445`,
   18.690399182412833`, 19.630578094766086`, 25.156716618434306`,
   27.460010808216847`, 21.263503166426503`, 25.313748228765167`,
   22.83242630671928`, 25.951580018897413`, 26.622977130100125`,
   19.052878189610453`, 22.33516086609751`, 26.365511085627112`,
   25.47141427903122`, 26.115237773875315`, 23.80203242736417`,
   27.263282283774892`, 23.20045364739413`, 27.561328293508662`,
   25.709825270812722`, 34.151719694604665`, 17.649420775044355`,
   22.009434104564036`, 20.29191678038176`, 22.438671706491338`,
   26.710717438901344`, 31.309600817587167`, 21.399183332979554`,
   23.463754792880312`, 22.229264872898188`, 21.52965733862934`,
   24.764826758514204`, 26.536245207119688`, 24.290174729187278`,
   29.521278215385287`, 28.736496833573497`, 18.243999503798463`,
   24.686251771234833`, 19.36090793176563`, 29.026222831316026`,
   23.01917912323498`, 21.894987043433932`, 27.66483913390249`,
   25.78997783851056`, 30.369421905233914`, 21.1219621283555`,
   27.167573693280715`, 22.926540726162184`, 24.449412603864403`,
   20.478721784614713`, 26.889549942703717`, 22.120769481240764`,
   25.870546913729207`, 26.98082087676502`, 27.879230518759236`,
   27.073459273837816`, 23.718627751198007`, 27.990565895435964`,
   29.18199993426526`, 22.639285874313714`, 23.377022869899875`,
   24.36995670572553`, 23.884762226124685`, 19.87168172560067`,
   29.70808321961824`, 20.09064348502687`, 22.539989191783153`};
tempsequence2 = {19.630578094766086`, 20.818000065734736`, 21.1219621283555`,
   23.718627751198007`, 28.344521382791513`, 29.34653377145162`,
   27.66483913390249`, 27.073459273837816`, 24.764826758514204`,
   30.369421905233914`, 27.561328293508662`, 27.460010808216847`,
   26.115237773875315`, 27.167573693280715`, 24.048419981102587`,
   25.47141427903122`, 25.870546913729207`, 23.01917912323498`,
   26.450446653600267`, 29.70808321961824`, 25.63004329427447`,
   32.350579224955645`, 26.98082087676502`, 25.313748228765167`,
   28.8780378716445`, 22.736717716225108`, 29.181999934265264`,
   29.90935651497313`, 26.79954635260587`, 25.392481684859003`,
   22.438671706491338`, 23.463754792880312`, 24.290174729187278`,
   25.156716618434306`, 24.921661325952037`, 22.926540726162184`,
   26.622977130100125`, 27.879230518759236`, 23.289282561098656`,
   22.639285874313714`, 20.478721784614713`, 23.96687349828974`,
```

```
    25.550587396135597`, 24.52858572096878`, 19.87168172560067`,
    26.889549942703717`, 26.281372248801993`, 29.521278215385287`,
    31.756000496201537`, 31.309600817587167`, 26.536245207119688`,
    34.151719694604665`, 30.12831827439933`, 28.600816667020446`,
    33.289984707437554`, 29.026222831316026`, 28.736496833573497`,
    28.222880417289325`, 28.47034266137066`, 24.21002216148944`,
    24.449412603864403`, 30.947121810389547`, 25.`, 27.263282283774892`,
    25.951580018897413`, 23.37702286989875`, 21.894987043433932`,
    24.686251771234833`, 24.843283381565694`, 24.607518315140997`,
    20.09064348502687`, 21.52965733862934`, 25.78997783851056`,
    23.110450057296283`, 21.399183332979554`, 17.649420775044355`,
    22.539989191783153`, 22.33516086609751`, 25.235173241485796`,
    21.263503166426503`, 26.365511085627112`, 18.690399182412833`,
    20.29191678038176`, 24.36995670572553`, 23.634488914372888`,
    25.078338674047963`, 23.549553346399733`, 22.229264872898188`,
    21.777119582710675`, 22.009434104564036`, 22.120769481240764`,
    19.052878189610453`, 16.710015292562446`, 18.243999503798463`,
    21.655478617208487`, 23.20045364739413`, 24.129453086270793`,
    27.360714125686286`, 23.80203242736417`, 19.36090793176563`,
    20.65346622854838`, 25.709825270812722`, 26.710717438901344`,
    26.19796757263583`, 28.105012956566068`, 30.63909206823437`,
    23.884762226124685`, 26.03312650171026`, 27.990565895435964`,
    27.770735127101812`, 20.973777168683974`, 22.832426306719285`};
tempsequence3 = {22.926540726162184`, 22.832426306719285`, 23.377022869899875`,
    23.634488914372888`, 23.80203242736417`, 23.884762226124685`,
    25.156716618434306`, 24.686251771234833`, 23.289282561098656`,
    22.438671706491338`, 21.894987043433932`, 20.478721784614713`,
    20.973777168683974`, 21.655478617208487`, 20.09064348502687`,
    21.399183332979554`, 20.65346622854838`, 22.229264872898188`,
    23.20045364739413`, 23.549553346399733`, 25.235173241485796`,
    26.365511085627112`, 25.63004329427447`, 25.709825270812722`,
    24.607518315140997`, 24.290174729187278`, 22.539989191783153`,
    24.048419981102587`, 24.449412603864403`, 23.463754792880312`,
    24.921661325952037`, 25.`, 23.718627751198007`, 23.110450057296283`,
    22.736717716225108`, 22.120769481240764`, 22.33516086609751`,
    21.52965733862934`, 21.263503166426503`, 19.36090793176563`,
    19.630578094766086`, 18.690399182412833`, 18.243999503798463`,
    16.710015292562446`, 17.649420775044355`, 19.052878189610453`,
    20.29191678038176`, 20.818000065734736`, 21.777119582710675`,
    21.1219621283555`, 19.87168172560067`, 22.009434104564036`,
    23.01917912323498`, 24.129453086270793`, 25.313748228765167`,
    26.281372248801993`, 25.951580018897413`, 26.03312650171026`,
    27.561328293508662`, 26.889549942703717`, 26.450446653600267`,
    25.78997783851056`, 26.19796757263583`, 25.392481684859003`,
```

```
    26.710717438901344`, 30.12831827439933`, 29.90935651497313`,
    28.8780378716445`, 27.770735127101812`, 28.344521382791513`,
    28.105012956566068`, 27.990565895435964`, 26.536245207119688`,
    29.026222831316026`, 29.181999934265264`, 30.63909206823437`,
    30.947121810389547`, 31.309600817587167`, 30.369421905233914`,
    32.350579224955645`, 33.289984707437554`, 34.151719694604665`,
    31.756000496201537`, 29.70808321961824`, 27.66483913390249`,
    28.736496833573497`, 27.167573693280715`, 28.222880417289325`,
    29.521278215385287`, 26.98082087676502`, 26.115237773875315`,
    27.263282283774892`, 26.622977130100125`, 27.460010808216847`,
    27.36071412568628`, 27.879230518759236`, 28.47034266137066`,
    29.34653377145162`, 27.073459273837816`, 25.870546913729207`,
    25.550587396135597`, 28.600816667020446`, 26.79954635260587`,
    25.47141427903122`, 24.843283381565694`, 24.764826758514204`,
    25.078338674047963`, 23.96687349828974`, 24.36995670572553`,
    24.21002216148944`, 24.52858572096878`, 22.639285874313714`};
Tmax = 30.92;
Tmin = 14.26;
thickness = .008;
compareseries =
 ListLinePlot[{tempsequence, tempsequence2, tempsequence3}, InterpolationOrder → 0,
  ImageSize → 450, PlotStyle → {{Thickness[thickness], Gray},
    {Thickness[thickness], Pink}, {Thickness[thickness], Darker[Brown]}},
  GridLines → {None, {Tmin, Tmax}}, GridLinesStyle → {Dashed, Thin},
  (*PlotLegends→Placed[{"γ = 0","γ = 1","γ = 2"},{Left,Bottom}],*)
  PlotRange → {{-.2, 113}, {13, 35}}, Frame → {True, True, False, False},
  FrameLabel → {"Time Step (12 hr)", "Temperature T (°C)"}, FrameStyle → 16,
  Epilog → {{Text[Style["Tmin = 14.26", Black, 12], {103, Tmin + 1}]},
    {Text[Style["Tmax = 30.92", Black, 12], {103, Tmax + 1}]},
    Text[Style["b)", Black, 18], {5, 34}]}]

n = 112;
X = tempsequence;
fftdata = Fourier[X, FourierParameters → {-1, 1}];
fftdata = fftdata[[1 ;; n / 2]];
mean = Abs[fftdata[[1]]];
powersp = Table[{i / n, Abs[fftdata[[i + 1]]] ^ 2}, {i, 1, n / 2 - 1}];
phasesp = Table[{i / n, Arg[fftdata[[i + 1]]]}, {i, 1, n / 2 - 1}];
psp1 = ListLogLogPlot[powersp, Joined → True, PlotStyle → {Thickness[.01], Gray},
    PlotRange → {{0.0065, 0.51}, {.000001, 5}}, Frame → {True, True, False, False},
    FrameLabel → {"Frequency", "Power"}, FrameStyle → 16,
    PlotLegends → Placed[{Style["White noise, γ = 0"(* (-2.66 - .0008x)"*),
        12, Darker[Gray]]}, {Left, Bottom}]];
lm = LinearModelFit[{Log[#1], Log[#2]} & @@@ powersp, x, x]
```

```
a1 = lm⟦1, 2, 1, 1⟧;
b1 = lm⟦1, 2, 1, 2⟧;
Show[psp1,
  LogLogPlot[Exp[a1] * x ^ b1, {x, 1 / n, 0.5}, PlotStyle → {Dashed, Black}]];

X = tempsequence2;
fftdata = Fourier[X, FourierParameters → {-1, 1}];
fftdata = fftdata⟦1 ;; n / 2⟧;
mean = Abs[fftdata⟦1⟧];
powersp = Table[{i / n, Abs[fftdata⟦i + 1⟧] ^ 2}, {i, 1, n / 2 - 1}];
phasesp = Table[{i / n, Arg[fftdata⟦i + 1⟧]}, {i, 1, n / 2 - 1}];
psp2 = ListLogLogPlot[powersp, Joined → True,
   PlotStyle → {Thickness[.01], Pink}, Frame → {True, True, False, False},
   FrameLabel → {"Frequency", "Power"}, FrameStyle → 16, PlotLegends →
    Placed[{Style["Pink noise, γ = 1"(* (-4.64 - 1x)"*), 12, Darker[Gray]]},
     {Left, Bottom}]];
lm = LinearModelFit[{Log[#1], Log[#2]} & @@@ powersp, x, x]
a2 = lm⟦1, 2, 1, 1⟧;
b2 = lm⟦1, 2, 1, 2⟧;
Show[psp2,
  LogLogPlot[Exp[a2] * x ^ b2, {x, 1 / n, 0.5}, PlotStyle → {Dashed, Black}]];

X = tempsequence3;
fftdata = Fourier[X, FourierParameters → {-1, 1}];
fftdata = fftdata⟦1 ;; n / 2⟧;
mean = Abs[fftdata⟦1⟧];
powersp = Table[{i / n, Abs[fftdata⟦i + 1⟧] ^ 2}, {i, 1, n / 2 - 1}];
phasesp = Table[{i / n, Arg[fftdata⟦i + 1⟧]}, {i, 1, n / 2 - 1}];
psp3 = ListLogLogPlot[powersp, Joined → True,
   PlotStyle → {Thickness[.01], Darker[Brown]}, Frame → {True, True, False, False},
   FrameLabel → {"Frequency", "Power"}, FrameStyle → 16, PlotLegends →
    Placed[{Style["Brown noise, γ = 2" (*(-8.16 - 2x)"*), 12, Darker[Gray]]},
     {Left, Bottom}]];
lm = LinearModelFit[{Log[#1], Log[#2]} & @@@ powersp, x, x]
a3 = lm⟦1, 2, 1, 1⟧;
b3 = lm⟦1, 2, 1, 2⟧;
Show[psp3,
  LogLogPlot[Exp[a3] * x ^ b3, {x, 1 / n, 0.5}, PlotStyle → {Dashed, Black}]];

powerspectra = Show[psp1, psp2, psp3, LogLogPlot[Exp[a1] * x ^ b1, {x, 1 / n, 0.5},
   PlotStyle → {Thickness[.007], Dashed, Black}], LogLogPlot[Exp[a2] * x ^ b2,
   {x, 1 / n, 0.5}, PlotStyle → {Thickness[.007], Dashed, Black}], LogLogPlot[
   Exp[a3] * x ^ b3, {x, 1 / n, 0.5}, PlotStyle → {Thickness[.007], Dashed, Black}],
  FrameStyle → 16, ImageSize → 400, AspectRatio → .8,
```

Out[ ]=



Out[ ]=

FittedModel[−2.66 − 0.000801 x]

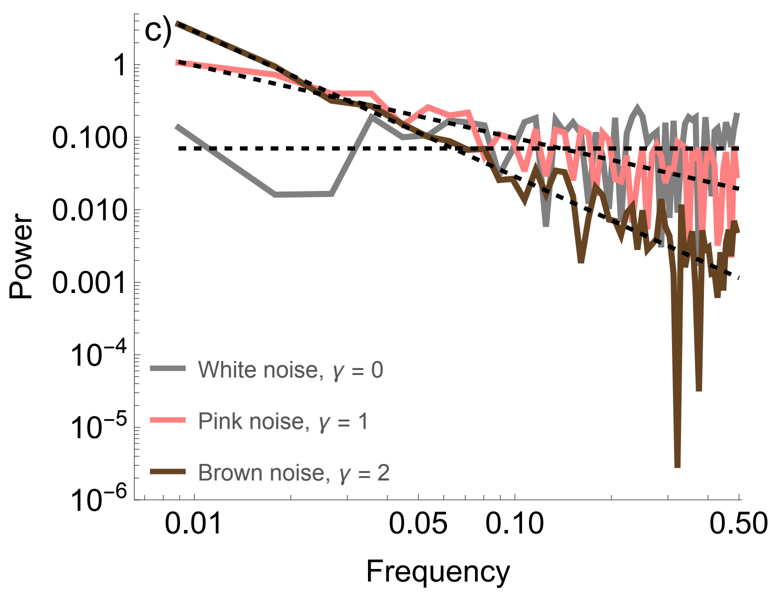
Out[ ]=

FittedModel[−4.64 − 1. x]

Out[ ]=

FittedModel[−8.16 − 2. x]

Out[ ]=



Once TPC and time series subfigures have run, use this code to create Fig. 2.

```
background = GraphicsRow[
  {TPCplot, compareseries, powerspectra}, Spacings → 2, ImageSize → 1300]
(*Export[directory<>"Fig2.eps",background,"EPS",ImageResolution→1000];*)
```

Out[ ]=