Staircase global warming and its deconvolution

The following graphs all use the data obtained by the National Oceanographic and Atmospheric Administration (NOAA) TIROS-N satellite, interpreted by Dr. Roy Spencer and Dr. John Christy, both at Global Hydrology and Climate Center of the same University.

Records start from december,1978 and are regularly updated. They refer to four layers of the planet's atmosphere:

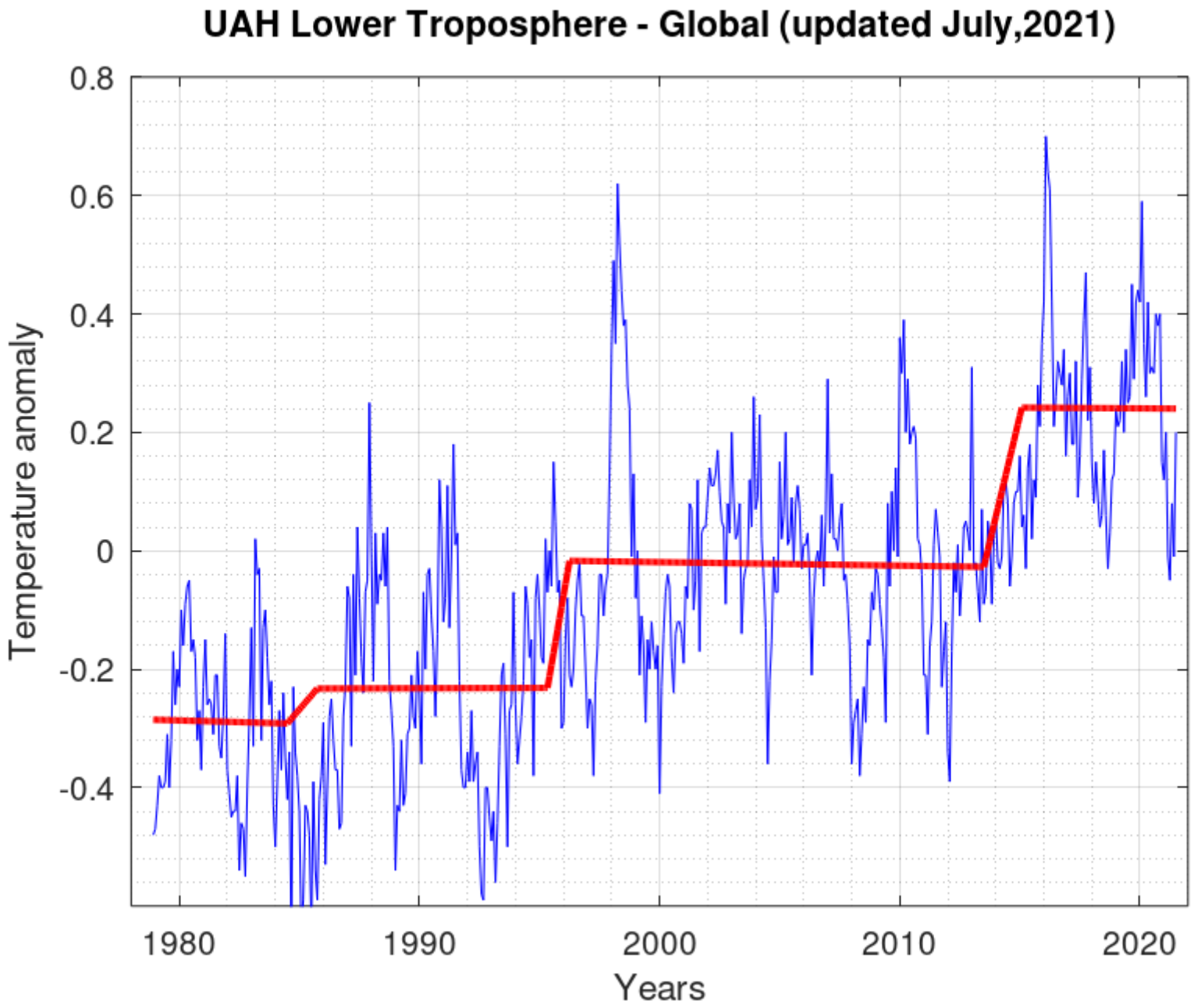
1. lower troposphere
2. middle troposphere
3. tropopause
4. lower stratosphere

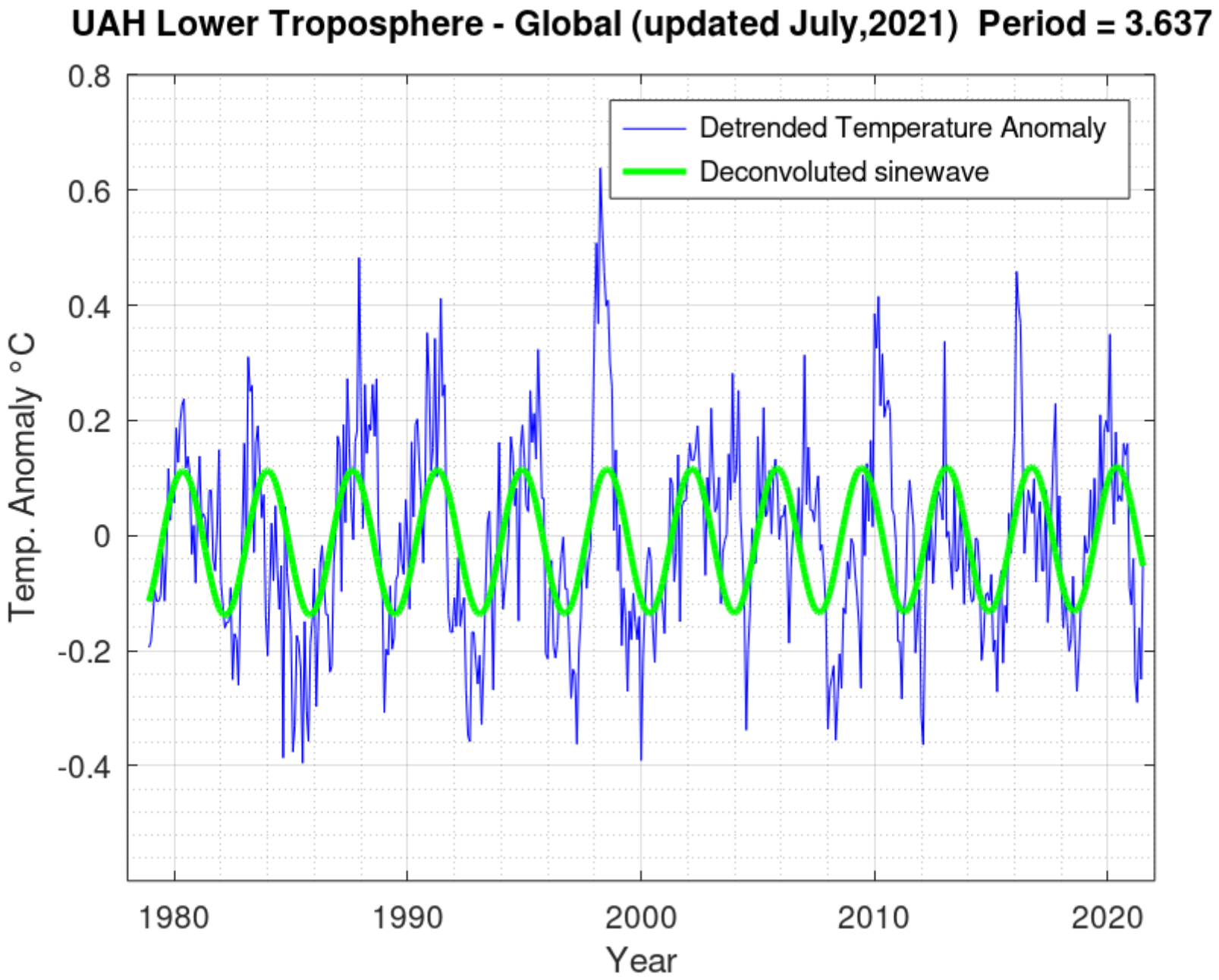
For each of the four regions of the atmosphere 24 regions of the globe are examined, namely :

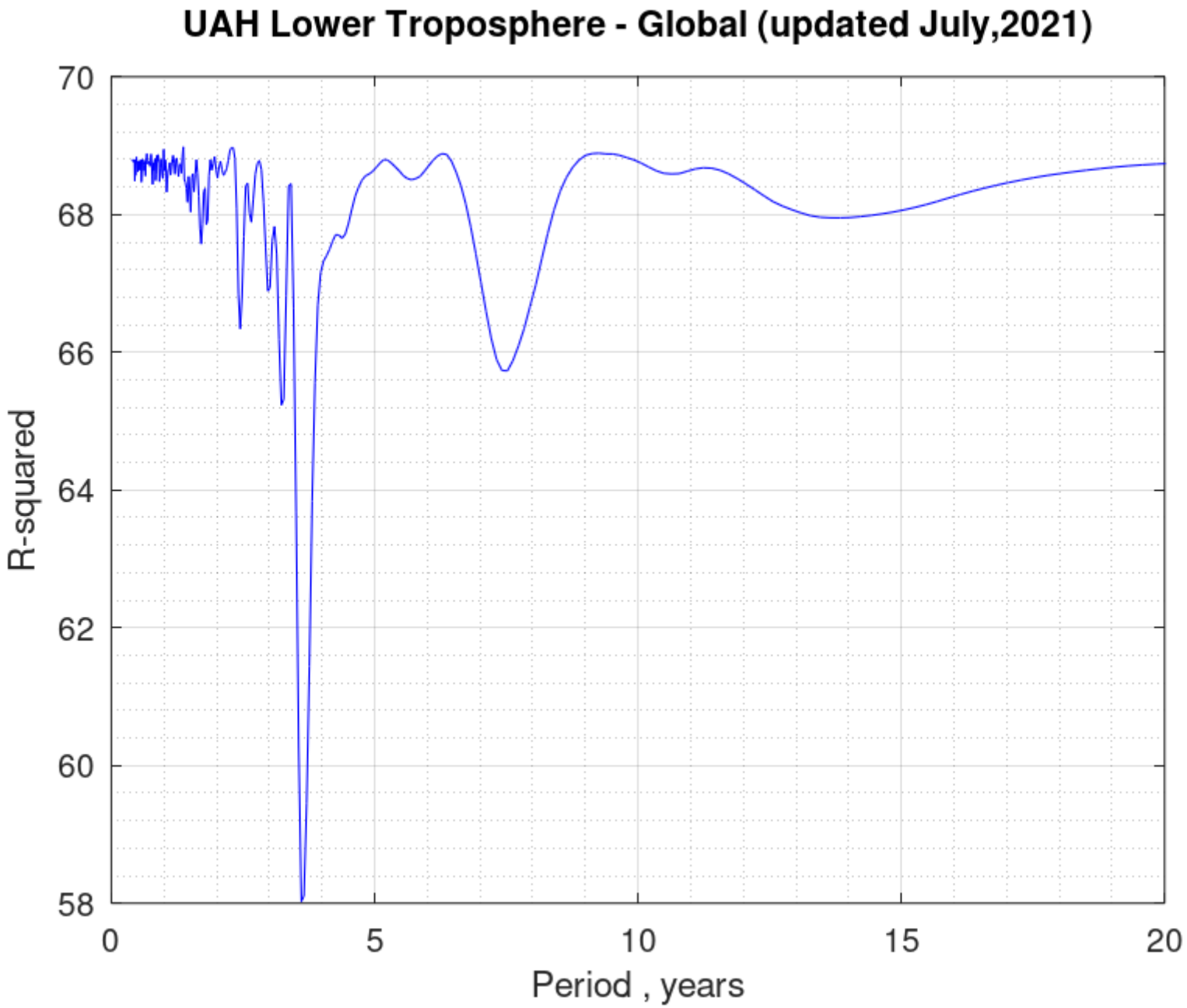
3 = Globe	*4 = Land*	*5 = Ocean*	*whole globe 90S-90N*
6 = Globe	*7 = Land*	*8 = Ocean*	*northern hemisphere 0-90N*
9 = Globe	*10 = Land*	*11 = Ocean*	*southern hemisphere 90S-0*
12 = Globe	*13 = Land*	*14 = Ocean*	*tropics 20S-20N*
15 = Globe	*16 = Land*	*17 = Ocean*	*northern extention 20N-90N*
18 = Globe	*19 = Land*	*20 = Ocean*	*southern extention 20N-90N*
21 = Globe	*22 = Land*	*23 = Ocean*	*north pole 60N-90N*
24 = Globe	*25 = Land*	*26 = Ocean*	*south pole 90S-60N*

(numbers refer to the columns in the matrix)

The combination of the 4 layers with the 24 regions gives a total of 24x4 = 96 possible graphs.
Here only the global data for the lower troposphere are examined, but the user can select other ragions by assigning the variable 'choice'


UAH Lower Troposphere - Global (updated July,2021)
Temperature anomaly
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1980
1990
2000
2010
2020
Years


UAH Lower Troposphere - Global (updated July,2021) Period = 3.637
Detrended Temperature Anomaly
Deconvoluted sinewave
Temp. Anomaly °C
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1980
1990
2000
2010
2020
Year


UAH Lower Troposphere - Global (updated July,2021)
70
68
66
64
62
60
58
R-squared
0
5
10
15
20
Period , years

```
--->Data can be downloaded directly from UAH by this octave statement
f = urlwrite('http://vortex.nsstc.uah.edu/data/msu/v6.0/tlt/uahncdc_lt_6.0.txt','uah.txt')
```

```
clear all;clc;format short;format compact;
global Ud yd xd x;
function ydRes = best(p) % ------ minimizer
  global Ud yd xd x;
  Ud(:,3) = sin(2*pi/p*x);   % sin
  Ud(:,4) = cos(2*pi/p*x);   % cos
  G = inv(Ud.' * Ud);
  xd(:,1) = G*Ud.'*yd;
  ydR = yd - Ud*xd(:,1); % residuals
  ydRes = sum(abs(ydR)); % sum of residuals
endfunction              % ------ end of minimizer
%f = urlwrite('http://vortex.nsstc.uah.edu/data/msu/v6.0/tlt/uahncdc_lt_6.0.txt','uah.txt')
S = fileread('uahncdc_lt_6.0.txt');tit='UAH Lower Troposphere - Global (updated July,2021)'
a1 = index(S,'1978');
a2 = rindex(S,'Year Mo') - 2;
M = S(a1:a2);
X = str2num(M);
x = X(':',1) + (X(':',2)-1)./12; % date in decima year
% Average satellite of the lower troposphere refers to ...
% 3 = Globe,  4 = Land,  5 = Ocean    (whole globe 90S-90N)
% 6 = Globe,  7 = Land,  8 = Ocean    (northern hemisphere 0-90N)
% 9 = Globe,  10 = Land,  11 = Ocean  (southern hemisphere 90S-0)
% 12 = Globe,  13 = Land,  14 = Ocean (tropics 20S-20N)
% 15 = Globe,  16 = Land,  17 = Ocean (northern extention 20N-90N)
% 18 = Globe,  19 = Land,  20 = Ocean (southern extention 20N-90N)
% 21 = Globe,  22 = Land,  23 = Ocean (north pole 60N-90N)
% 24 = Globe,  25 = Land,  26 = Ocean (south pole 90S-60N)
choice = 3;
ydT = X(':',3); %  3 = Globe  can be modified

% -------------------------------------------------
a1 = index(S,'1978 12') - 2;
a2 = index(S,'1984  8') - 2;
M = S(a1:a2);
X0 = str2num(M);xYear0 = X0(':',1) + (X0(':',2)-1)./12;
yd0 = X0(':',choice);a2 = a2/171 - 1;a1 = 1;

a3 = index(S,'1985 10') - 2;
a4 = index(S,'1995  6') - 2;
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```
M = S(a3:a4);a3 = a3/171;a4 = a4/171 - 1;
X1 = str2num(M);xYear1 = X1(':',1) + (X1(':',2)-1)./12;
yd1 = X1(':',choice);

a5 = index(S,'1996  4') - 2;
a6 = index(S,'2013  8') - 2;
M = S(a5:a6);a5 = a5/171;a6 = a6/171 - 1;
X2 = str2num(M);xYear2 = X2(':',1) + (X2(':',2)-1)./12; %january = 0.5
yd2 = X2(':',choice);

a7 = index(S,'2015  2') - 2;
a8 = rindex(S,'Year Mo') - 2;
M = S(a7:a8);a7 = a7/171;a8 = a8/171 - 1;
X3 = str2num(M);xYear3 = X3(':',1) + (X3(':',2)-1)./12;
yd3 = X3(':',choice);

p = polyfit(xYear0,yd0,1);y0 = polyval(p,xYear0);yNew(a1:a2) = y0;
p = polyfit(xYear1,yd1,1);y1 = polyval(p,xYear1);yNew(a3:a4) = y1;yNew(a2:a3) = linspace(y0(end),y1(1),(a3-a2+1));
p = polyfit(xYear2,yd2,1);y2 = polyval(p,xYear2);yNew(a5:a6) = y2;yNew(a4:a5) = linspace(y1(end),y2(1),(a5-a4+1));
p = polyfit(xYear3,yd3,1);y3 = polyval(p,xYear3);yNew(a7:a8) = y3;yNew(a6:a7) = linspace(y2(end),y3(1),(a7-a6+1));
yNew = yNew'; % yNew is transformed into column vector
yd = ydT - yNew;

nTot = length(yd);
Ud = zeros(nTot,4);
Ud(1:nTot,1) = 1;                       % constant plateau
Ud(1:nTot,2) = linspace(-1,1,nTot);     % linear trend (orthogonal)
n = linspace(1,nTot,nTot);
xd = zeros(4,1);
k = 0;
for i = logspace(-0.4,1.4,300);
  ++k;
  xL(k) = i;
  pL(k) = best(i);
endfor
plot (x,ydT,'b',x,yNew,'r','LineWidth',2);
xlabel ('Years');ylabel ('Temperature anomaly');title(tit);grid on;
grid minor on;axis([1978,2022,-0.6,0.8]);hold on;
figure;
plot (xL,pL,'b');grid on;grid minor on;hold on;
xlabel ('Period , years');ylabel ('R-squared');title(tit);axis([0,20]);
figure;
%--------------------------------------------------------------------
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pMin = fminbnd(@best,3,5); % 1st call to the minimizer
x2 = best(pMin);pMin           % once found , pMin is given again to the best() function
ySin = Ud*xd(:,1); % y3 is the first SINEWAVE
disp(xd);
a = xd(3);b = xd(4);r = sqrt(a^2 + b^2);q = asin(b/r);        %delay for sinewave
plot (x,yd,'b',x,ySin,'g','LineWidth',2);grid on;
grid minor on;axis([1978,2022,-0.6,0.8]);hold on;
xlabel('Year');ylabel('Temp. Anomaly °C');
title([tit,'  Period = ',num2str(pMin)]);
legend('Detrended Temperature Anomaly','Deconvoluted sinewave')
hold on;
```