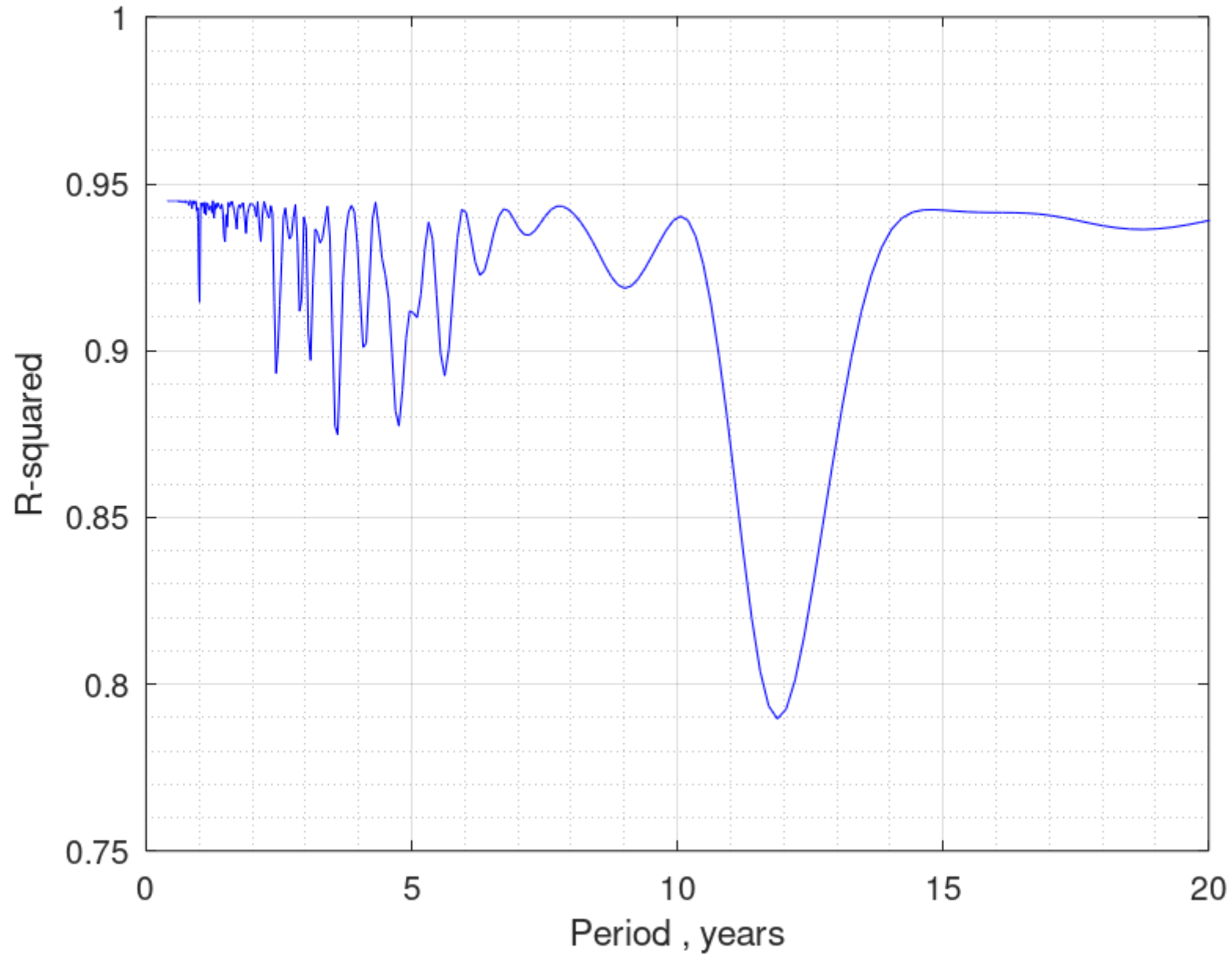
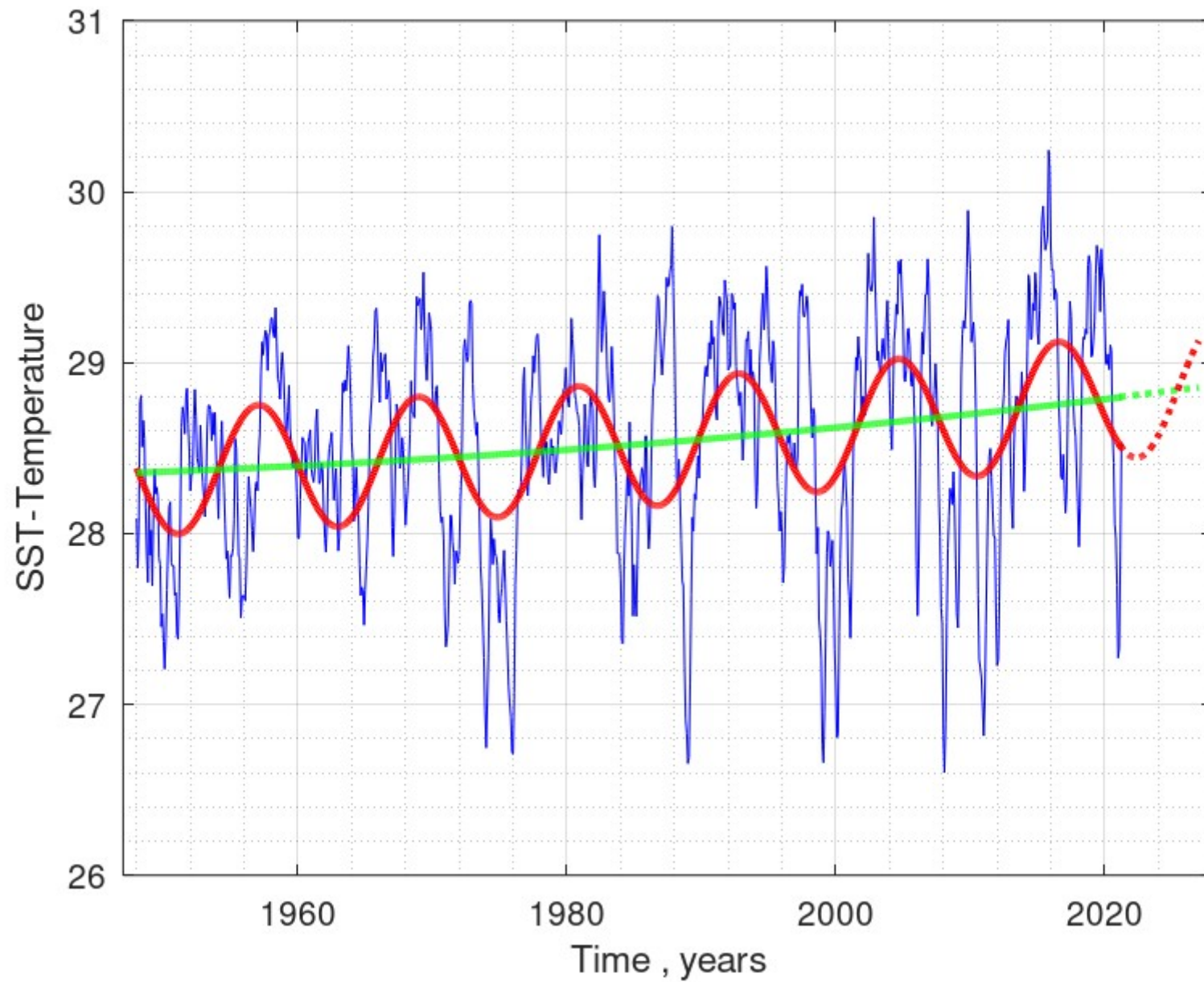


Frequency Analysis with Octave Package:

### Frequency analysis Nino-4 5N-5S from 1948



# PSL Gridded Datasets reanalysis Nino-4 5N-5S from 1948



```

% NOAA Physical Sciences Laboratory
% Sea Surface Temperatures (Minthly data)
% Location = Nino-4  5N-5S  160E-150W
% https://psl.noaa.gov/cgi-bin/data/timeseries/timeseries1.pl
% ASCII data are collected and saved on the local file SST-Nino-4.txt

clear all;clc;format short;format compact;
global Ud yd xd x sumS; % global variables
function Rsquared = best(p) % ----- minimizer of the squared residuals
    global Ud yd xd x sumS;
    Ud(:,4) = sin(2*pi/p*x); % sin
    Ud(:,5) = cos(2*pi/p*x); % cos
    G = inv(Ud.' * Ud);
    xd(:,1) = G*Ud.'*yd;
    ydR = yd - Ud*xd(:,1); % residuals
    Rsquared = sumsq(ydR)/sumS; % sum of residuals
endfunction % ----- end of minimizer

% main program
tit = 'SST-Nino-4'
S = fileread([tit,'.txt']);
a1 = rindex(S,'1948'); % january = 0/12
a2 = rindex(S,'2021') - 1 + 114 % Line lenght = 114
M = S(a1:a2);
X = str2num(M);k = 0;
for j = 1:(2021 - 1948 + 1);
    for i = 2:13
        ++k;a3 = X(j,i);
        if a3> -999
            yd(k) = a3;x(k) = X(j,1) + (i-2)/12;
        else
            break;
        endif
        yd(k) = X(j,i);
    endfor
endfor
x = x';yd = yd'; % row vectors are transformed in column vectors
nTot = length(yd);sumS = sumsq(yd - mean(yd));
startYear = 1948; % <<<< User
endYear = 2021;

```

```

% ----- end of data collection

Ud = zeros(nTot,5);
Ud(1:nTot,1) = 1; % constant plateau
Ud(1:nTot,2) = linspace(0,1,nTot); % linear trend
Ud(1:nTot,3) = linspace(0,1,nTot).^2; % parabolic trend
xd = zeros(5,1);
k = 0;
for i = logspace(-0.4,1.4,300);
    ++k;
    xL(k) = i;
    pL(k) = best(i);
endfor
plot (xL,pL,'b');grid on;grid minor on;
xlabel ('Period , years');ylabel ('R-squared');title('Frequency analysis Nino-4 5N-5S from 1948');axis([0,20]);
% plot data with superimposed sinewave
pMin = fminbnd(@best,10,12); % 1st call to the minimizer <<<< User
x2 = best(pMin);pMin % once found , pMin is given again to the best() function
ySin = Ud*x2(:,1); % ySin is the first SINEWAVE
yLin = Ud(:,1:3)*xd(1:3,1); % yLin is the first LINEAR TREND
disp(xd);
figure;

n5 = 72 % Number of future months <<<< User

plot (x,yd,'b',x,ySin,'r','Linewidth',2,x,yLin,'g','Linewidth',2);
grid on;grid minor on;axis([startYear-1,endYear + 1 + n5/12]);hold on;
title('PSL Gridded Datasets reanalysis Nino-4 5N-5S from 1948');
xlabel ('Time , years');ylabel ('SST-Temperature');
% ----- future trend -----
for j = 1:n5
    x1(j) = endYear + j/12;
    y1(j) = xd(1,1) + xd(2,1)*(j/nTot + 1) + xd(3,1)*(j/nTot + 1)^2;
    y2(j) = y1(j) + xd(4,1)*sin(2*pi/pMin*x1(j)) + xd(5,1)*cos(2*pi/pMin*x1(j));
endfor
plot (x1,y1,'g','Linewidth',2,'LineStyle',':',x1,y2,'r','Linewidth',2,'LineStyle',':');

```