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% file SIOC 221A HW 3
%
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% Annie Adelson
%
% due date October 19, 2017

clear all; close all;

numYears = 2017-2005 + 1;

%% plotting the Scripps Pier 2015 pressure record

% create empty arrays to hold time and temp data
time = [];
pressure = [];

time = [time; ncread(strcat('http://sccoos.org/thredds/dodsC/autoss/scripps_pier-2015.
nc'),'time')];
pressure = [pressure; ncread(strcat('http://sccoos.org/thredds/dodsC/autoss/scripps_pier
2015.nc'),'pressure')];


% remove bad data using the flagged data from .nc file
pressure_flagPrimary = [];
pressure_flagPrimary = [pressure_flagPrimary; ncread(strcat('http://sccoos.
org/thredds/dodsC/autoss/scripps_pier-2015.nc'),'pressure_flagPrimary')];

% looping through to remove bad data from pressure record
for i = 1:length(pressure)
    if pressure_flagPrimary(i) ~= 1
        pressure(i) = nan;
    end
end

% examining the time increments between adjacent measurements
X = diff(time);
%figure
%plot(X);
%plot(X(1:4000))

% plot the time series
date0=datenum(1970,1,1);% give reference date (first date)
time2 = double(time)/24/3600+date0;% divide the time by 24*3600 to convert seconds into
days since 1970
figure('name','Scripps_Pier_Pressure_2015');
plot(time2, pressure,'LineWidth',1);

% label the x-axis in months
set(gca,'FontSize',16);
title('Scripps Pier Pressure');
xlabel('Date');
datetick('x','mm/dd/yy')
ylabel('Pressure (dbar)');


%% plotting just the first month of 2015
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% 2592000 seconds in 30 days
% If a measurement is taken every 361 seconds, then 30 days into the record
% should be roughly the first 7180 measurements (2592000/361) in the 2015
% series. My record is 30 days long.
time3 = time(1:7180);
pressure2 = pressure(1:7180);

% plot the time series
date0=datenum(1970,1,1);% give reference date (first date)
time4 = double(time3)/24/3600+date0;% divide the time by 24*3600 to convert seconds into
days since 1970
time4_string = datestr(time4);
figure('name','Scripps_Pier_Pressure_January_2015');
plot(1:length(pressure2),pressure2,'LineWidth',1);
title('Scripps Pier Pressure in January 2015');
xlabel('Date');
set(gca, 'xtick', 1:1000:length(pressure2),'xticklabel', time4_string(1:1000:length
(pressure2),1:6));
ylabel('Pressure (dbar)');

%% Least squares fit

% defining sine and cosine components of major tidal constituents

% convert period to days (to match x axis time units)
O1_sin = sin(2*pi*time4/(25.83/24));%O1: principal lunar diurnal
O1_cos = cos(2*pi*time4/(25.83/24));
K1_sin = sin(2*pi*time4/(23.93/24));%K1: luni-solar diurnal
K1_cos = cos(2*pi*time4/(23.93/24));
M2_sin = sin(2*pi*time4/(12.42/24));%M2: principal lunar
M2_cos = cos(2*pi*time4/(12.42/24));


A2=[ones(length(time4),1) O1_sin O1_cos K1_sin K1_cos M2_sin M2_cos];
x2=inv(A2'*A2)*A2'*pressure2;
figure('name','Pier_Pressure_Tidal_LSF');
matrixProd = A2*x2;
plot(1:length(matrixProd),matrixProd,'LineWidth',1);
hold on
plot(1:length(pressure2),pressure2,'LineWidth',1);
set(gca, 'xtick', 1:1000:length(pressure2),'xticklabel', time4_string(1:1000:length
(pressure2),1:6));
title('Pier Pressure Least Squares Fit of 3 Major Tidal Constituents');
xlabel('Time');
ylabel('Pressure (dbar)');


% Total amplitude = square root of the sum of the squares of the sine and
% cosine amplitudes)
% Units of mean and amplitude are decibars
amplitude_O1_jan = sqrt((x2(2,1))^2 + (x2(3,1))^2);
amplitude_K1_jan = sqrt((x2(4,1))^2 + (x2(5,1))^2);
amplitude_M2_jan = sqrt((x2(6,1))^2 + (x2(7,1))^2);

%% Stationarity of the tide

% Repeating the least squares fit for 30 days roughly near August 2015
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