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%This code can be used to plot empirical conditional probability density
%functions (cPDF) of CO2 fluxes. It creates 2 subplots in 1 column. Each
%subplot contains 2 cPDF of different soil temperatures. To ensure we have
%enough data points to plot a cPDF, we set a range of +- 0.5 soil
temperature.
% Inputs:
%- CO2 Flux = Co2_flux as a column vector
%- Soil Temperature = Tsoil as a column vector
%
% Outputs:
%- Temp = soil temperature value
%- Area = Area (%) under the cPDF curve (exceeding the selected threshold)
%
%Release: 06/04/2018
%
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Area_exc_PDF = []; g = 1; k = 1;
% long-term mean of CO2 Flux
Trshld = nanmean(Co2_flux);
% Threshold to plot cPDF
n = 100;
% create two plots in one Figure und use various line styles
Panels = {'A', 'B'}; LineStyle = {':', '-', ':', '-'};
% use Color to plot each PDF in each Panel
Col_Pnl = {[0.9542 0.6406 0.3750], [0.9792 0.5000 0.4453], ...
            [0.9594 0.0781 0.2344], [0.6553 0.1328 0.1328]};
% plot a figure
figure ();

for Temp = 14:3:23 %Temperature with 3-degree steps

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% Create FIRST subplot for cPDF's conditioned on Temp 14*C and 17*C
if ismember(Temp, [14 17])
    g = 1;
    subplot(2,1,g);
end
% Create SECOND subplot for Temp 20*C and 23*C
if ismember(Temp, [20 23])
    g = 2;
    subplot(2,1,g);
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% FIND CO2 flux DATA BETWEEN THE SOIL TEMP. RANGE AND PLOT cPDF %
% Delete data of the variables after each loop
Fa = []; Xa = []; cPDF_idx = []; Area = []; Area_exc_PDF = [];

% Find data of Co2 Flux between a soil temp. range of +-0.5*C
cPDF_idx = Co2_flux(Tsoil >= (Temp-0.5) & Tsoil <= (Temp+0.5));

% Only if we have more than 100 data points calculate the cPDF
if length(cPDF_idx) >= n

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% calculate the cPDF of the CO2 Flux
[Fa,Xa] = ksdensity(cPDF_idx,[-1:0.01:15]);

% Calculate the Area of cPDF after exceeding the threshold
Area = trapz(Xa(Xa >= Trshld),Fa(Xa >= Trshld));
Area = sprintf('%.f',(Area*100));

% Plot each cPDF
plot(Xa,Fa,'Color',Col_Pnl{k},'linestyle',LineStyle{k},...
      'Linewidth',4,'Displayname',['Tsoil=' num2str(Temp) '*C']);
hold on;
% Color the exceeding area under the cPDF
Area_exc_PDF = area(Xa(Xa>=Trshld),Fa(Xa>=Trshld));

% Set the right color for each plot and panel
set(Area_exc_PDF,'FaceColor',Col_Pnl{k},'FaceAlpha',0.7,...
      'EdgeColor','none','Displayname',['CO_2 flux>1.2']);
legend('show');

% display CO2 flux release in % by exc. long-term mean
text(Xa(1,35),Fa(1,55),[num2str(Area) '%']...
      , 'fontweight','bold','FontSize',16);
k = k+1;
end

% Set x and y axis and set your xlim
xlabel('CO_2 flux (\mu mol / m^2 s^1)');
ylabel('PDF');
xlim([-1 5]);

end

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