

Supplementary Information

MATLAB Code for ONA

%this program will look for positive (and final) changes in ATN throughout the data. This code anticipates that a variable named "BC_ONA" has already been created and has the following columns – 1) MATLAB serial timestamp, 2) original BC concentrations, 3) original ATN values.
clear BC_ONA_ATN filtchange

%create new variable

BC_ONA_ATN=BC_ONA;

%find filter change points

for i=2:length(BC_ONA)-1

temp(i,1)=abs(BC_ONA_ATN(i+1,3)-BC_ONA_ATN(i,3));

end

temp1=find(temp(:)>30 | isnan(temp));

clear temp

if isempty(temp1)==0

filtchange(1:length(temp1)+1,1)=0;

filtchange(2:end,1)=temp1;

filtchange(end+1,1)=length(BC_ONA_ATN);

else

filtchange(1,1)=0;

filtchange(2,1)=length(BC_ONA_ATN);

end

clear i temp1

%ATN default incremental value

delATN=0.05;

%calculate smoothed BC

BC_ONA_ATN(:,4)=1;

for k=1:length(filtchange)-1

j=filtchange(k)+1; %set to first point after filter change

for i=filtchange(k)+1:filtchange(k+1)

if j<filtchange(k+1)

if i==j

des_ind=find(BC_ONA_ATN(j+1:filtchange(k+1),3)<=BC_ONA_ATN(j,3)+delATN);

if isempty(des_ind)==0

%calculated smoothed new BC

BC_ONA_ATN(j:des_ind(end)+j,2)=nanmean(BC_ONA_ATN(j:des_ind(end)+j,2));

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        %calculate averaging period
BC_ONA_ATN(j:des_ind(end)+j,4)=length(BC_ONA_ATN(j:des_ind(end)+j,2));
        j=j+des_ind(end)+1;
    else
        j=j+1;
    end
end
end
end
end
clear i j des_ind ans max_ind delATN k filtchange

%METRICS OF SMOOTHING PERFORMANCE – the code from this point forwards only
displays the results and does not do any data alteration.
%1. reduction of negatives - fraction in original vs. remaining
numneg_org=length(find(BC_ONA(:,2)<0))/length(BC_ONA(:,2))
numneg_filt=length(find(BC_ONA_ATN(:,2)<0))/length(BC_ONA(:,2))
clear numneg_org numneg_filt

%2. reduction of noise
clear temp i noise
for i=1:length(BC_ONA)-1
    temp(i,1)=abs(BC_ONA(i+1,2)-BC_ONA(i,2));
    temp(i,2)=abs(BC_ONA_ATN(i+1,2)-BC_ONA_ATN(i,2));
end
noise(1,1)= nanmean(temp(:,1));
noise(1,2)= nanmean(temp(:,2));
bar(noise)
ylabel('Avg Abs(BC_t+_1_-_t) (ng m^-^3)')
clear i noise temp

%3. averaging interval and histogram of points averaged
time_inc=abs(BC_ONA(2,1)-BC_ONA(1,1))*24*60*60;
timeavg(1,1)=1*time_inc;
timeavg(1,2)=nanmean(BC_ONA_ATN(:,4))*time_inc;
figure
bar(timeavg)
ylabel('Avg timebase (s)')
clear time_inc timeavg

figure
hist(BC_ONA_ATN(:,4))
xlabel('# pts averaged')
ylabel('N pts affected')

```

```
%4. Before - top figure BC time series, bottom figure ATN time series
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```
figure  
subplot(2,1,1)  
plot(BC_ONA(:,1),BC_ONA(:,2))  
ylabel('BC (ng m-3)')  
datetick('x')  
subplot(2,1,2)  
plot(BC_ONA_ATN(:,1),BC_ONA_ATN(:,3))  
ylabel('ATN')  
datetick('x')  
clear i
```

```
%5. After - top figure BC and BC-ONA time series, bottom figure averaging
```

```
%time  
figure  
subplot(2,1,1),plot(BC_ONA(:,1),BC_ONA(:,2),'k-'  
,BC_ONA_ATN(:,1),BC_ONA_ATN(:,2),'m-')  
datetick('x','keeplimits')  
ylabel('time')  
ylabel('average BC concentration (ng m-3)')  
legend('original', 'BC-ONA')  
  
subplot(2,1,2),plot(BC_ONA_ATN(:,1),BC_ONA_ATN(:,4),'b.-')  
datetick('x','keeplimits')  
xlabel('time')  
ylabel('# pts averaged')
```