MATLAB live script for a draft reproduction of Figures

This live script reproduces draft versions of Figures 1 through 8 from the paper *Atmosphere circulation patterns synchronize pan-Arctic glacier melt and permafrost thaw* by Sasgen et al. (2024). The data used for this reproduction are stored here https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/XTETA5.

The primary goal of this script is to facilitate the further use of the data. By producing the figures, we aim to clarify the units and demonstrate how the data are stored in the `.mat` file.

For additional information, please contact Ingo Sasgen at ingo.sasgen@awi.de .

```
clear all
```

Figure 1. Glacier and permafrost regions in the Arctic. (Figure 1b only)

```
load('FIG1b_DATA.mat','LONinit','LATinit','DATA1');
close gcf
subplot(1,3,1);
imagesc(DATA1);
xlabel('x-grid node')
ylabel('y-grid node')
title('Data');
colormap('jet')
cb=colorbar; cb.Label.String='Permafrost fraction (%)';

subplot(1,3,2);
imagesc(LONinit);
xlabel('x-grid node')
ylabel('y-grid node')
title('Latitude (°)');

subplot(1,3,3);
imagesc(LATinit);
xlabel('x-grid node')
ylabel('y-grid node')
title('Latitude (°)');
```

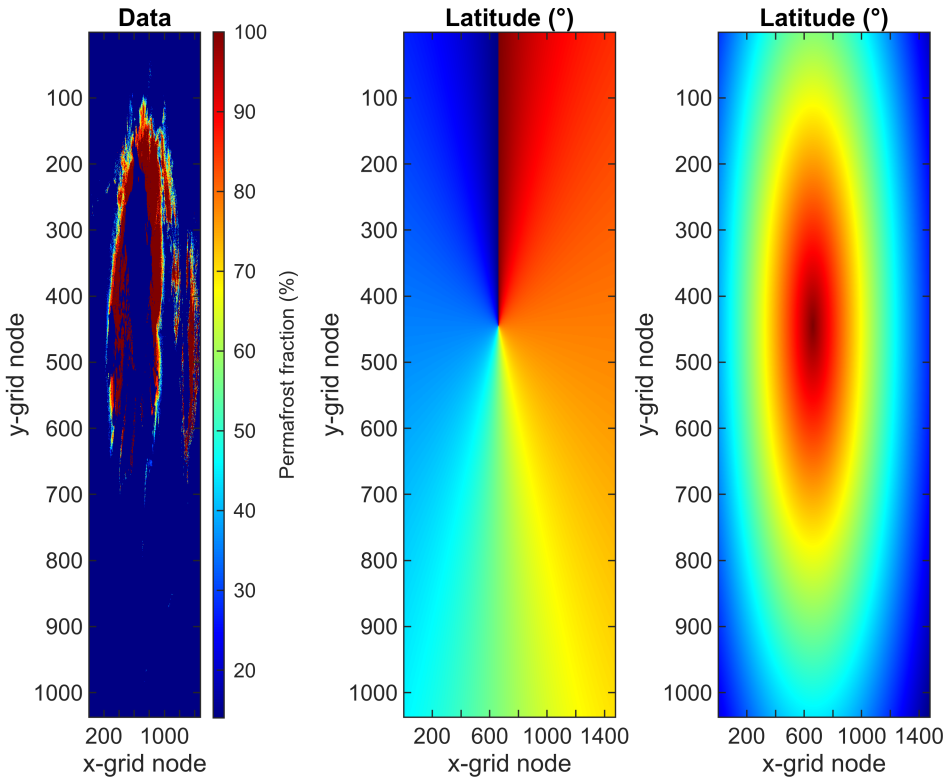


Figure 2. Time series of changes in glacier mass and active layer thickness.

```
load('FIG2_DATA.mat','DATA','META');
close gcf
for i = 1:size(DATA,2);
subplot(2,5,i);
t=DATA{i}(:,1);
y=DATA{i}(:,2);
e=DATA{i}(:,3);
name=META{1}{i};
errorbar(t,y,e); hold on;
plot(t,y)
title(name);
xlabel('Time (yr)')
ylabel('Specific mass change (m)');
if i>=9; ylabel('Active Layer Thickness (cm)'); end;
hold off
end
```

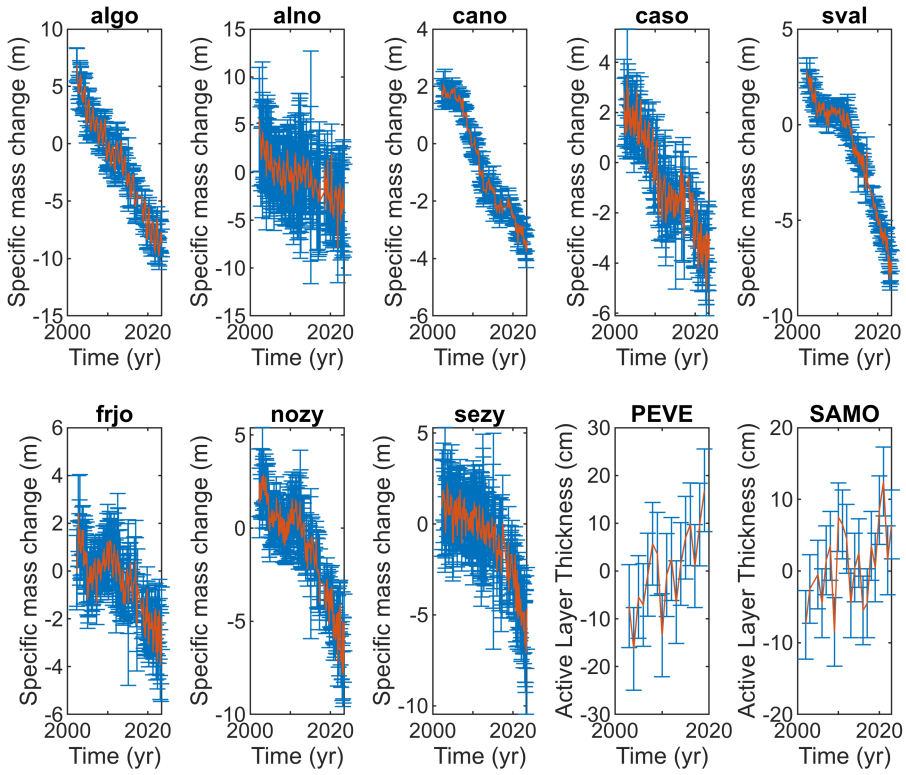


Figure 3 [NEED CHECKING!!!]. Correlation of glacier mass balance and active layer thickness in Artic permafrost regions.

```
load('FIG3_DATA.mat','DATA','META')
close gcf
for i=1:size(DATA,2);
    LATinit=DATA{i}{1};
    LONinit=DATA{i}{2};
    DATA1=DATA{i}{3};
    %% Areas of signficance
    SIG=DATA{i}{4};
subplot(2,4,i);
imagesc(DATA1);
title(META{i})
colormap('jet')
cb=colorbar; cb.Label.String='Correlation';
caxis([-1 1]);
xlabel('x-grid node')
ylabel('y-grid node')
end
```

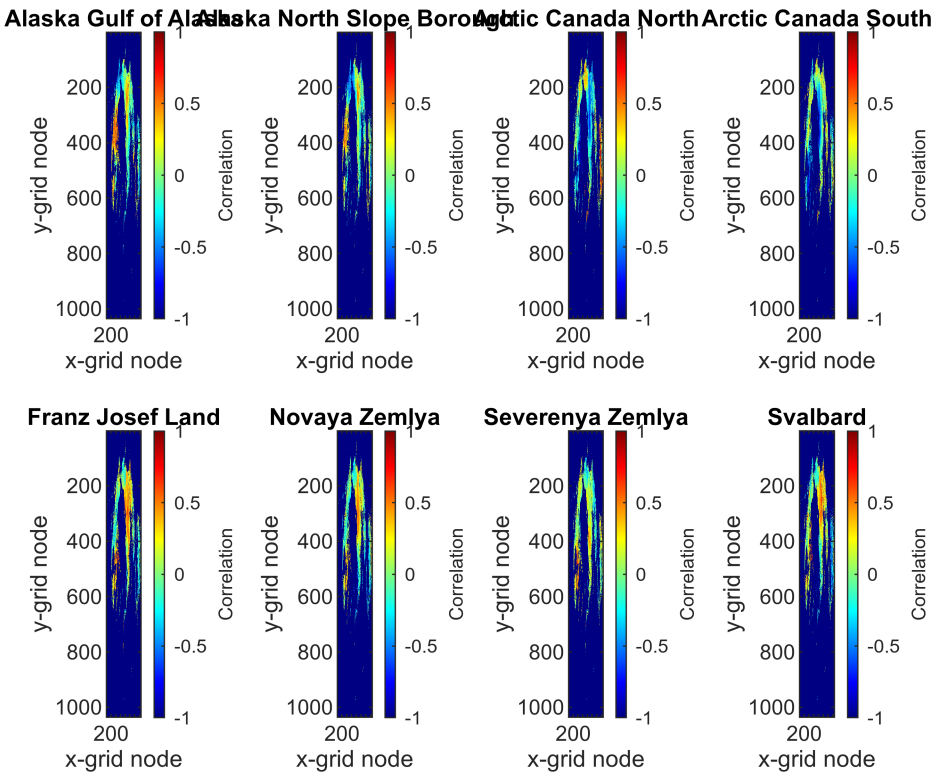


Figure 4. Factor analysis of changes in glacier mass and active layer thickness.

```
load('FIG4_DATA.mat','DATA','META')
close gcf
imagesc(DATA); hold on;
set(gca,'yticklabels',META);
set(gca,'xtick',[1 2])
set(gca,'XTickLabels',{ 'Factor 1' ,'Factor 2' })
ylabel('Location');
colormap(jet);
caxis([-1 1]);
cb=colorbar;
cb.Label.String='Loading';
title('Maximum');
```

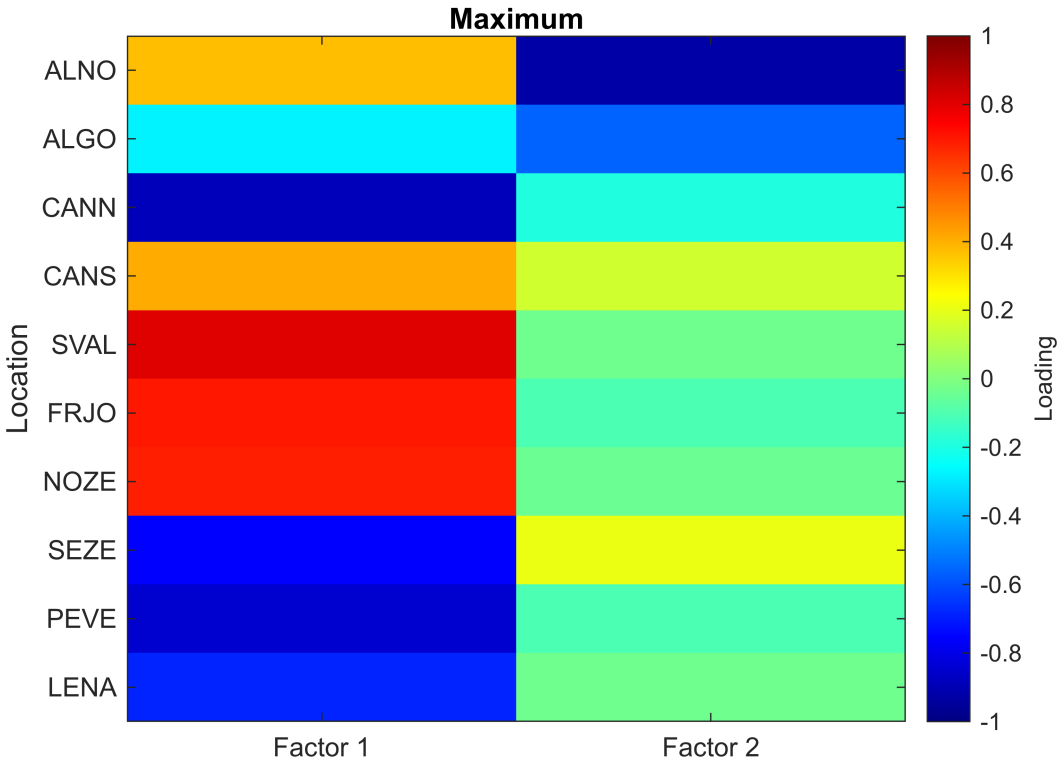
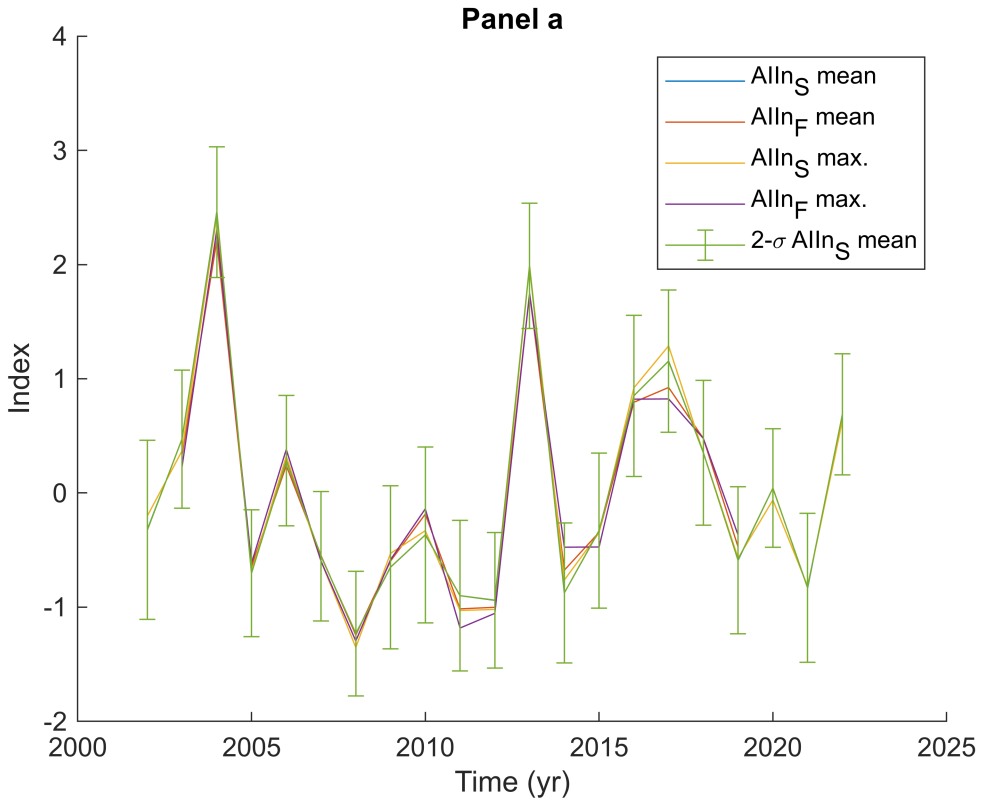
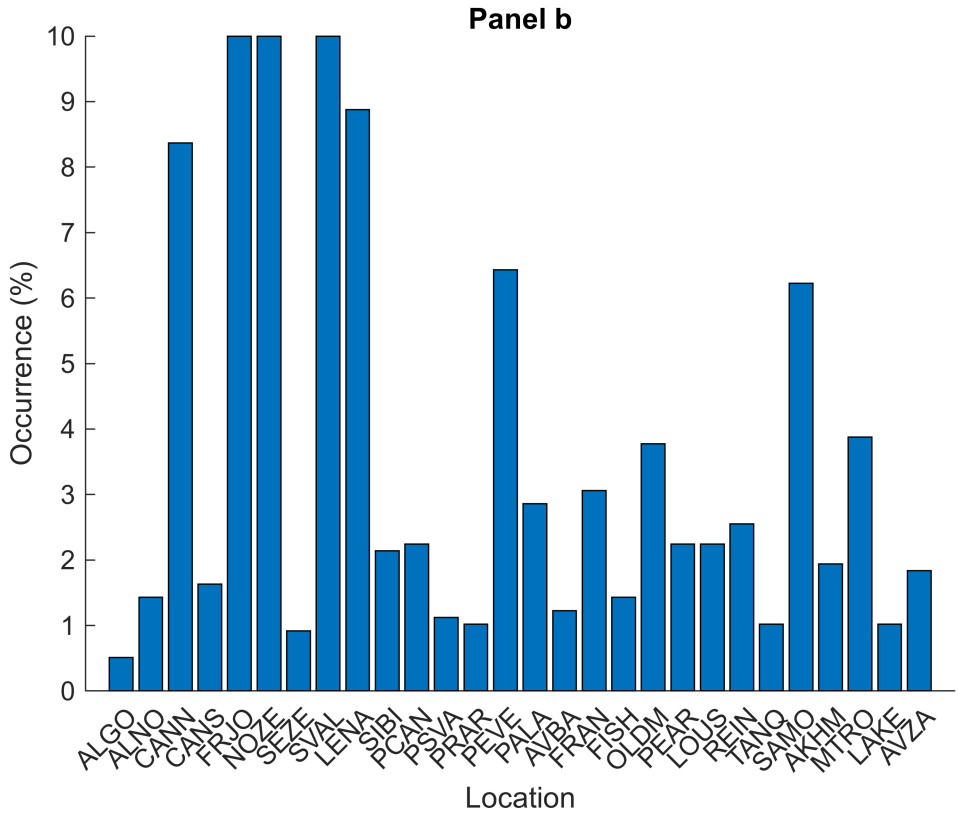


Figure 5. Time series and location composition of Arctic Impact Indices.

```
load('FIG5_DATA.mat','DATAp1','DATAp2','DATAp3','METAp1','METAp2','METAp3');
close gcf

% Panel a
figure
title('Panel a'); hold on;
for i=1:4;
t=DATAp1{i}(:,1);
y=DATAp1{i}(:,2);
plot(t,y); hold on;
end
t=DATAp1{1}(:,1);
y=DATAp1{1}(:,2);
e=DATAp1{1}(:,3);
errorbar(t,y,e); hold on;
legend([METAp1{1},['2-\sigma',' ', METAp1{1}{1}]])
ylabel('Index');
xlabel('Time (yr)');
```




```
% Pabel b
figure
title('Panel b'); hold on;
b=bar(DATAp2{1}); hold on;
xticks(b.XData);
xticklabels(METAp2{1});
xlabel('Location');
ylabel('Occurrence (%)');
```




```
% Panel c
figure
title('Panel c'); hold on;
b=bar(DATAp3{1});
xticks([1:5]);
xticklabels(METAp3{1});
legend('All','Neg. sig.','Pos. sig.');
xlabel('Sector');
ylabel('Occurrence (%)');
```

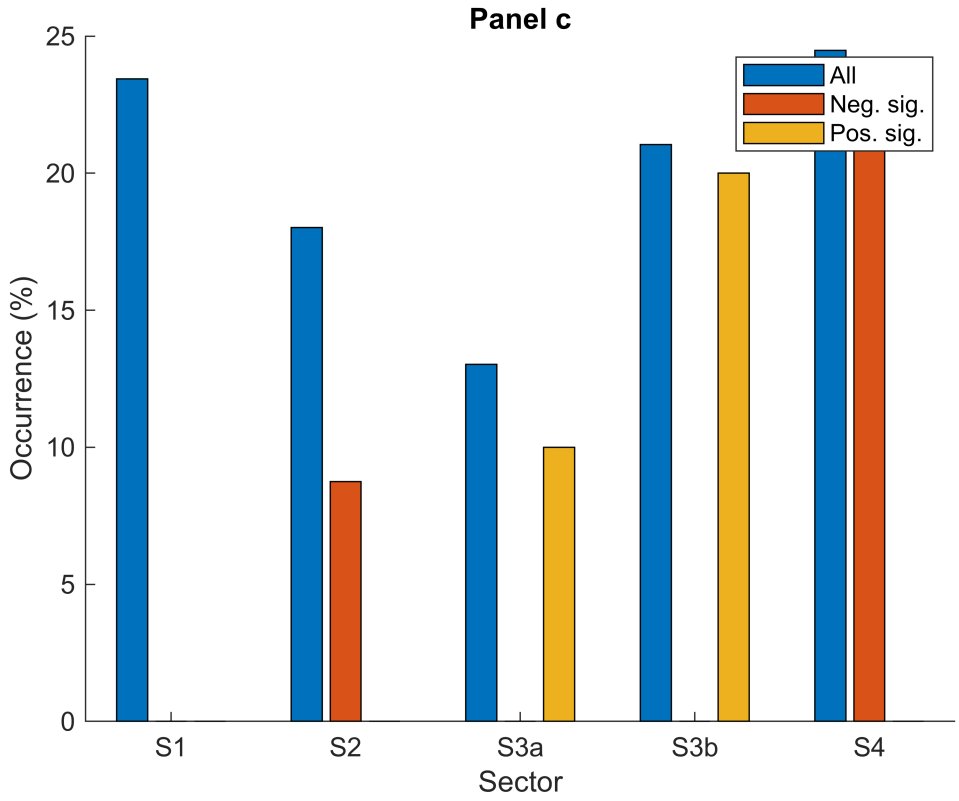


Figure 6. Correlation of Arctic Impact indices with atmospheric variables.

```
% Panels ab
load('FIG6ab_DATA.mat','DATAz500','LAT','LON');
load('FIG6cd_DATA.mat','DATAt700','LAT','LON');
name = {'AIIn_S mean' 'AIIn_F mean' 'AIIn_S max.' 'AIIn_F max.' };
n=1;
for i=1:2
subplot(2,2,n)
title(name{n}); hold on
% Area of significance
SIG=DATAz500{i}{2};
scatter(LON{i}(:),LAT{i}(:),[],DATAz500{i}{1}(:));
colormap('jet'); caxis([-1 1])
cb=colorbar; cb.Label.String='Correlation with z500';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
n=n+1;
end

for i=1:2
subplot(2,2,n)
title(name{n}); hold on
% Area of significance
SIG=DATAt700{i}{2};
```

```
scatter(LON{i}(:),LAT{i}(:),[],DATAt700{i}{1}(:));
colormap('jet'); caxis([-1 1])
cb=colorbar; cb.Label.String='Correlation with t700';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
n=n+1;
end
```

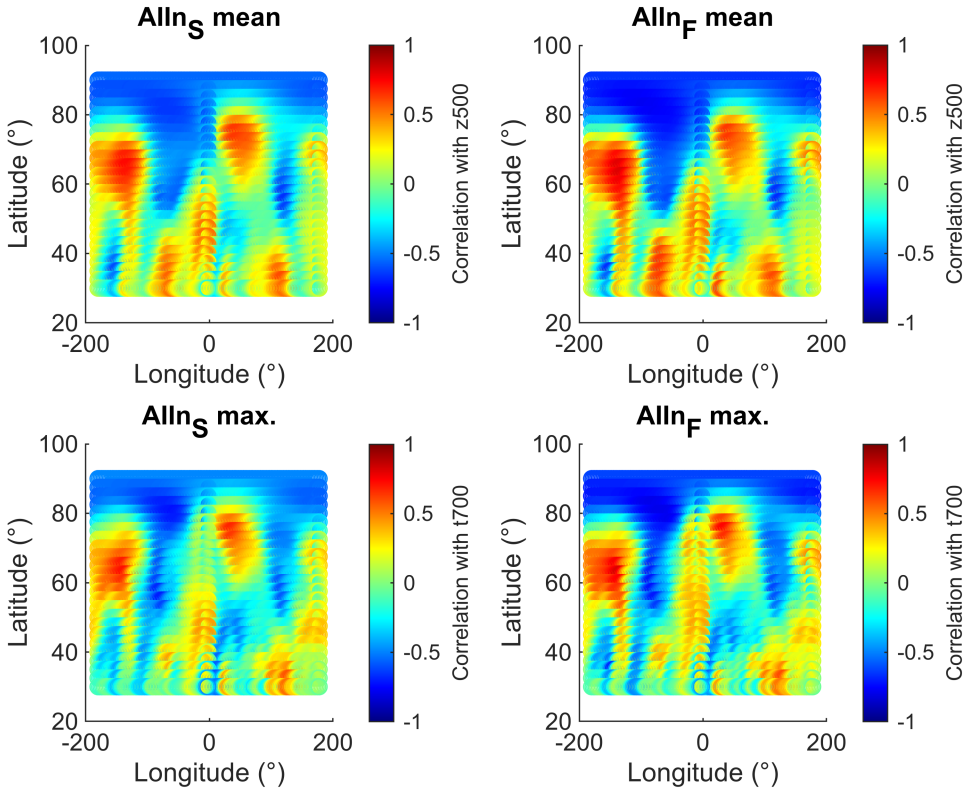
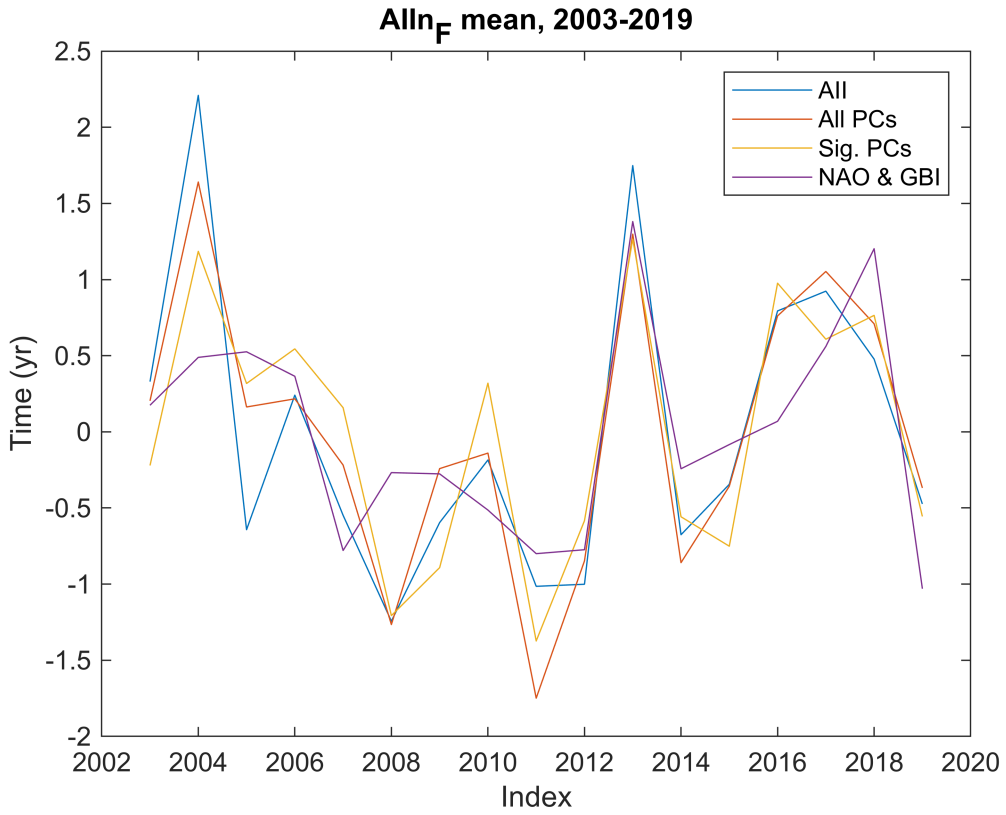


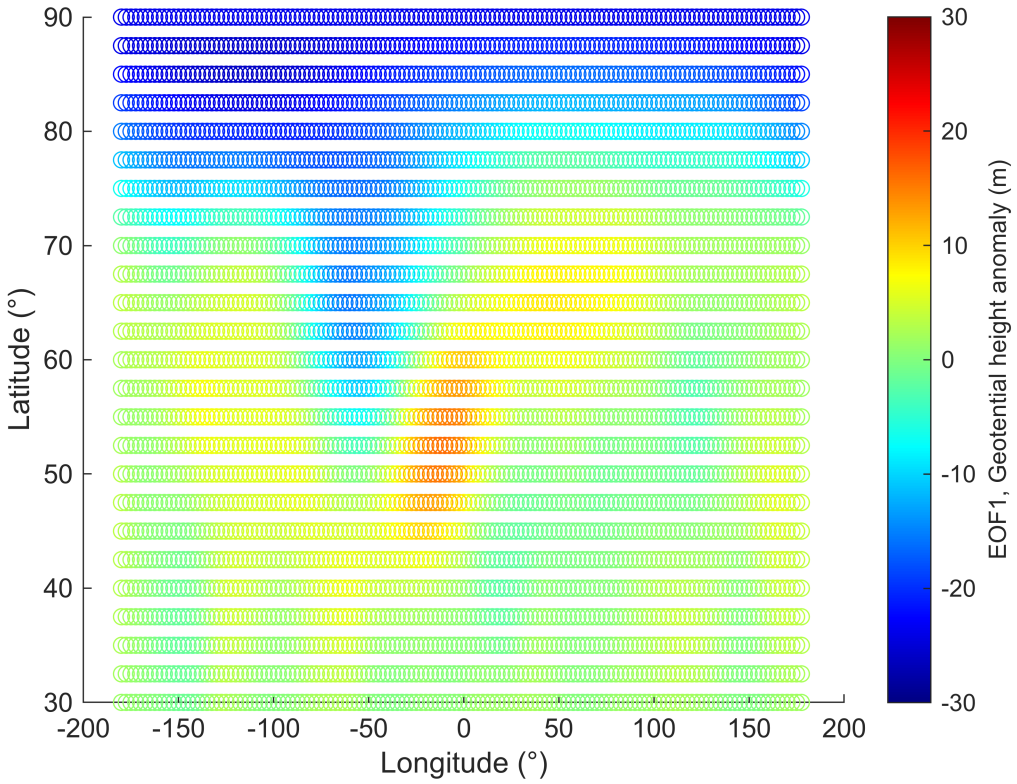
Figure 7. Arctic Impact indices and primary components of atmospheric variability.

```
load('FIG7ab_DATA.mat','DATAab');
load('FIG7cdef_DATA.mat','DATAcdef');

% Panel a
figure
for i=1:4
t=DATAab{1}(:,1);
y=DATAab{1}(:,i+1);
plot(t,y); hold on;
end
legend('AII','All PCs','Sig. PCs','NAO & GBI');
title(['AIIn_S mean, ', '2002-2022']);

% Panel b
```

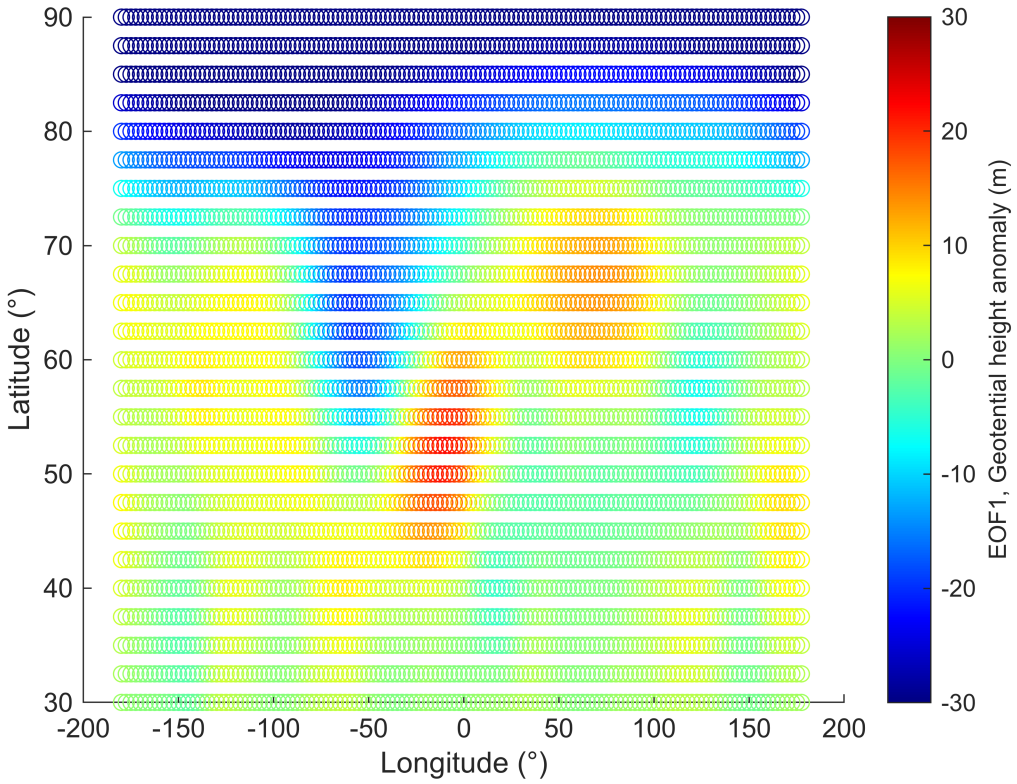
```
figure
for i=1:4
t=DATAab{2}(:,1);
y=DATAab{2}(:,i+1);
plot(t,y); hold on;
end
legend('AII','All PCs','Sig. PCs','NAO & GBI');
xlabel('Index')
ylabel('Time (yr)');
title(['AIIn_F mean, ', '2003-2019']);
```



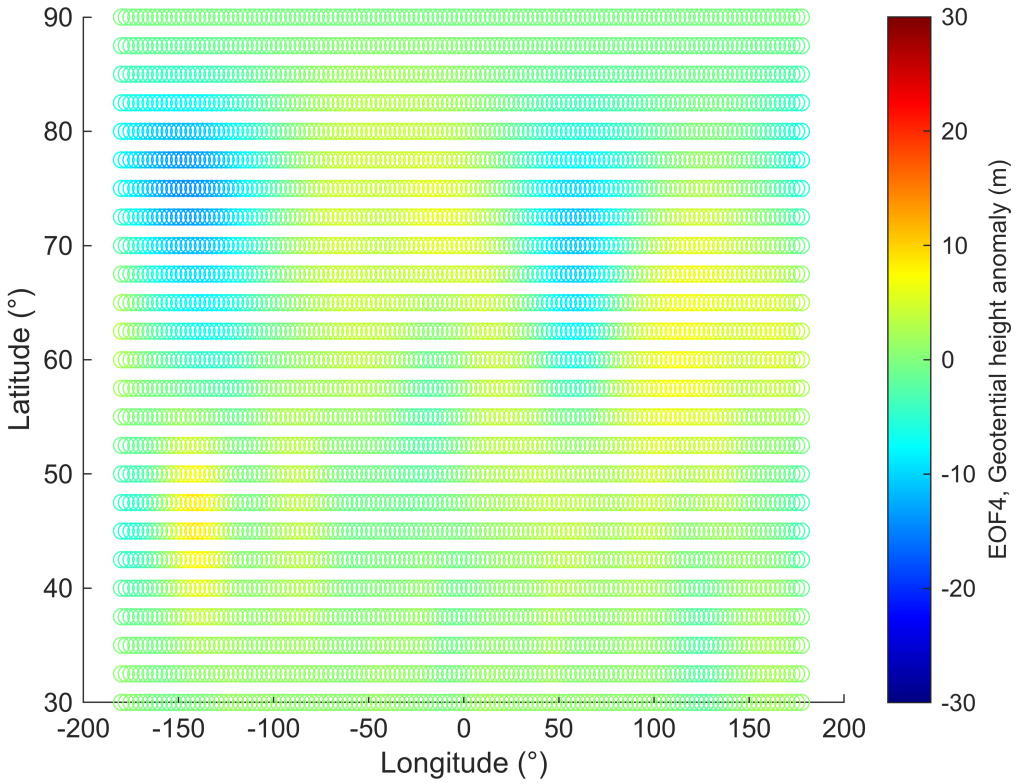

```
% Panel c
figure
scatter(DATAcdef{1}{1}{3}(:),DATAcdef{1}{1}{2}(:),[],DATAcdef{1}{1}{1}(:));
colormap('jet'); caxis([-30 30])
cb=colorbar; cb.Label.String='EOF1, Geotential height anomaly (m)';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
```




```
% Panel d
figure
scatter(DATAcdef{2}{1}{3}(:),DATAcdef{2}{1}{2}(:),[],DATAcdef{2}{1}{1}(:));
colormap('jet'); caxis([-30 30])
cb=colorbar; cb.Label.String='EOF1, Geotential height anomaly (m)';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
```




```
% Panel e
figure
scatter(DATAcdef{1}{4}{3}(:),DATAcdef{1}{4}{2}(:),[],DATAcdef{1}{4}{1}(:));
colormap('jet'); caxis([-30 30])
cb=colorbar; cb.Label.String='EOF4, Geotential height anomaly (m)';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
```




```
% Panel f
figure
scatter(DATAcdef{2}{5}{3}(:),DATAcdef{2}{1}{2}(:),[],DATAcdef{2}{5}{1}(:));
colormap('jet'); caxis([-30 30])
cb=colorbar; cb.Label.String='EOF5, Geotential height anomaly (m)';
xlabel('Longitude (°)');
ylabel('Latitude (°)');
```

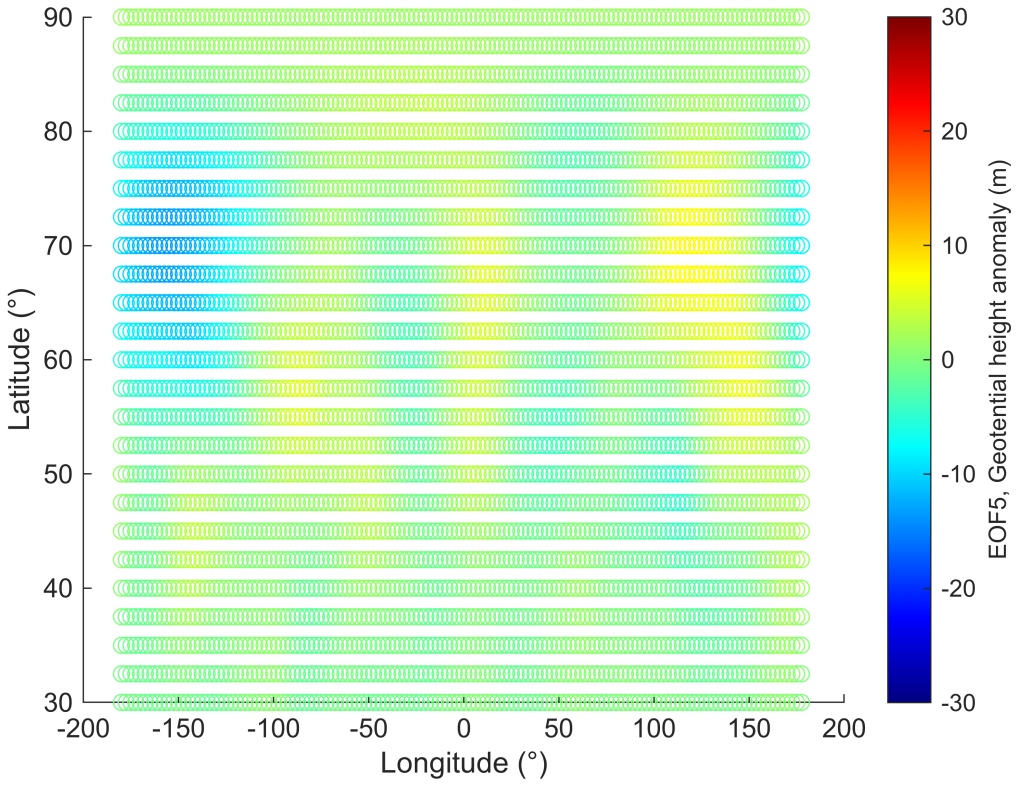
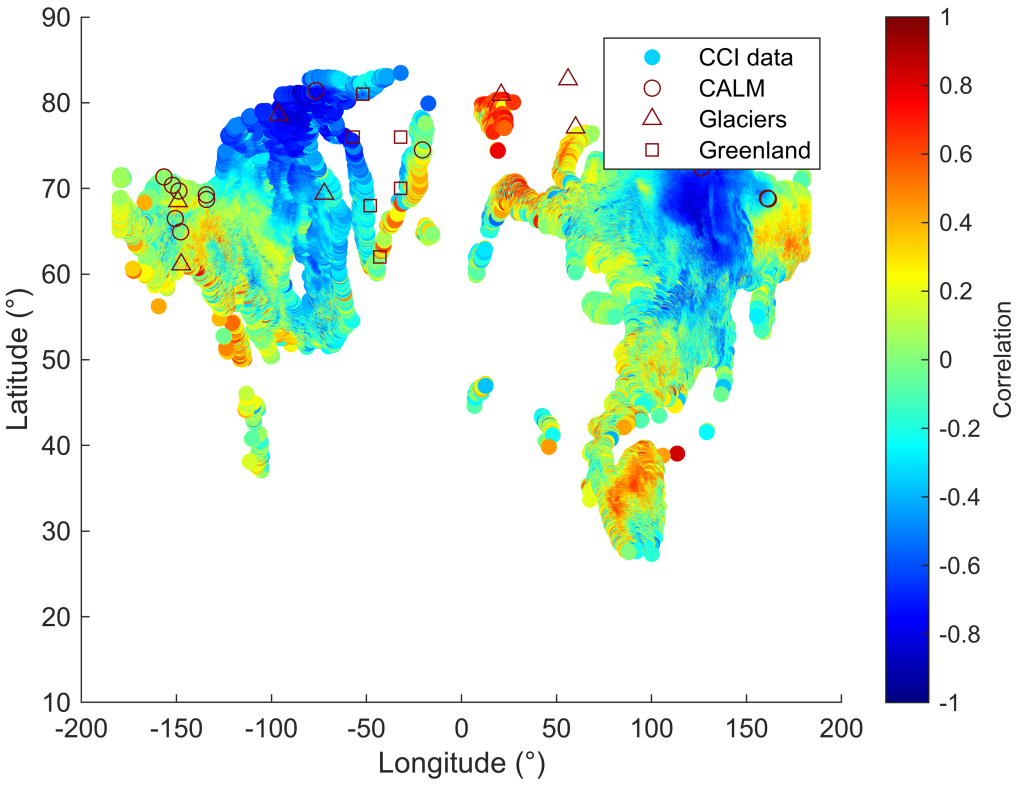


Figure 8.Correlation of Arctic Impact indices with observations of changes in glacier mass and active layer thickness.

```
load('FIG8_DATA.mat','DATA')

% Correlation AII and CCI
scatter(DATA{1}{4}(:),DATA{1}{3}(:),[],DATA{1}{1}(:),'filled');
colormap('jet'); caxis([-1 1])
cb=colorbar; cb.Label.String='Correlation';
 hold on;

%% CALM
scatter(DATA{2}(:,2),DATA{2}(:,1),[],DATA{2}(:,1),'Marker','o'); hold on;
%% GLACIERS
scatter(DATA{3}(:,2),DATA{3}(:,1),[],DATA{3}(:,1),'Marker','^'); hold on
%% GREENLAND
scatter(DATA{4}(:,2),DATA{4}(:,1),[],DATA{4}(:,1),'Marker','square'); hold on;
xlabel('Longitude (°)');
ylabel('Latitude (°)');
legend('CCI data','CALM','Glaciers','Greenland')
```


CCI data
CALM
Glaciers
Greenland
Latitude (°)
Longitude (°)
Correlation
90
80
70
60
50
40
30
20
10
-200
-150
-100
-50
0
50
100
150
200
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1