Analysis of Antarctic sectors

There are three sectors available:

1. SA := South Africa,
2. WS := Weddell Sea,
3. and EA := East Antarctica

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1. Preamble

```matlab
%% Read in the data.
clear
close all
addpath functions
%ncdisp(filename)

% Parameters
sector = "SA";
grid = 'gx1';
filedir = 'cases/12monthswim/history/iceh.2005-09-30.nc';
[lat,lon,row] = grid_read(grid);

% Make sector mask
[len,wid] = size(lat);
```

2. Ice area

```matlab
variable = "aice";
sector_data = data_format_sector(filedir,variable,sector);
%data = data(sector_mask);
%color_map = seaicecolormap();
latitude = [-90,-60];
longitude = [10,50];
figure(1)
w = worldmap('world');
    axesm miller; %, eqaazim eqdazim vperspec, eqdazim flips the x-axis, and y-axis to
    setm(w, 'Origin', [0 0 0]);
    setm(w, 'maplatlimit', [-70,-40]);
    setm(w, 'maplonlimit', [10,50]);
```

```
    setm(w, 'meridianlabel', 'on')
    setm(w, 'parallellabel', 'on')
    setm(w, 'mlabellocation', 10);
    setm(w, 'plabellocation', 10);
    setm(w, 'mlabelparallel', 0);
    setm(w, 'grid', 'on');
    setm(w, 'frame', 'on');
    setm(w, 'labelrotation', 'on')
    pcolorm(lat,lon,sector_data)
    land = shaperead('landareas', 'UseGeoCoords', true);
    geoshow(w, land, 'FaceColor', [0.5 0.7 0.5])
    colorbar
    caxis(colorlims(variable));
    title(strcat("AICE in the ", sector_name(sector)), 'interpreter','latex','FontSize
```


AICE in the South African Antarctic
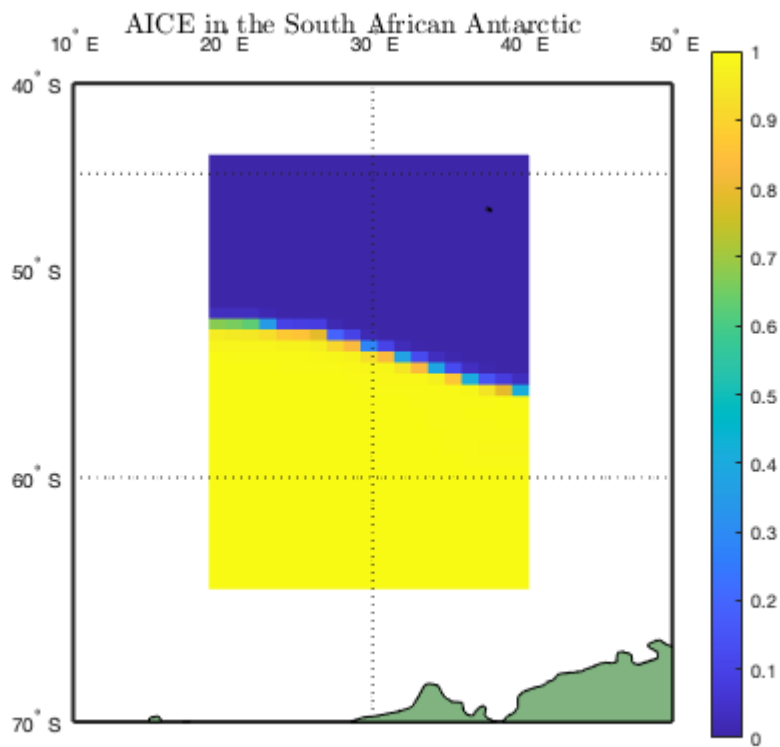
3. Pancake ice concentration

Floe size categories:

```
nfsd = ncread(filedir,'NFSD')
```

nfsd = 12×1 single column vector
```
      2.6884
      9.7984
     21.6721
     40.7349
     70.1407
    113.6938
    175.5771
    259.8365
```

```
     369.6202
     506.2401
        ⋮
        ⋮
```

Define floes with radii < 10m as pancakes (i.e., the smallest two FSD categories).

```matlab
variable = "afsd";
 % Grid
grid = "gx1";
[lat,lon,row] = grid_read(grid);
% Read in data
dim = 3;
data = data_format(filedir,variable,row,lat,lon,dim);
data = data(:,:,1) + data(:,:,2); % Smallest 2 categories combined (ie. pancake)
ocean_mask = data_format(filedir,'tmask',row,lat,lon);
% Coordinates
coords = sector_coords(sector); % (NW;NE;SW;SW) (lat,lon)
for i = 1:4
    [lat_out(i),lon_out(i)] = lat_lon_finder(coords(i,1),coords(i,2),lat,lon);
end
[len,wid] = size(data);
sector_data = zeros(len,wid);
sector_mask = false(len,wid);
sector_data = ~ocean_mask*NaN;
for i = 0:lat_out(1)-lat_out(2)
    sector_mask(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = true;
    sector_data(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = data(lon_out(1):lon_
end


latitude = [-90,-60];
longitude = [10,50];
figure(3)
w = worldmap('world');
    axesm miller; %, eqaazim eqdazim vperspec, eqdazim flips the x-axis, and y-axis to
    setm(w, 'Origin', [0 0 0]);
    setm(w, 'maplatlimit', [-70,-40]);
    setm(w, 'maplonlimit', [10,50]);
    setm(w, 'meridianlabel', 'on')
    setm(w, 'parallellabel', 'on')
    setm(w, 'mlabellocation', 10);
    setm(w, 'plabellocation', 10);
    setm(w, 'mlabelparallel', 0);
    setm(w, 'grid', 'on');
    setm(w, 'frame', 'on');
    setm(w, 'labelrotation', 'on')
    pcolorm(lat,lon,sector_data)
    land = shaperead('landareas', 'UseGeoCoords', true);
    geoshow(w, land, 'FaceColor', [0.5 0.7 0.5])
    colorbar
    caxis(colorlims(variable));
    title(strcat("Pancakce ice concentration in the ", sector_name(sector)), 'interpret
```

Pancakce ice concentration in the South African Antarctic
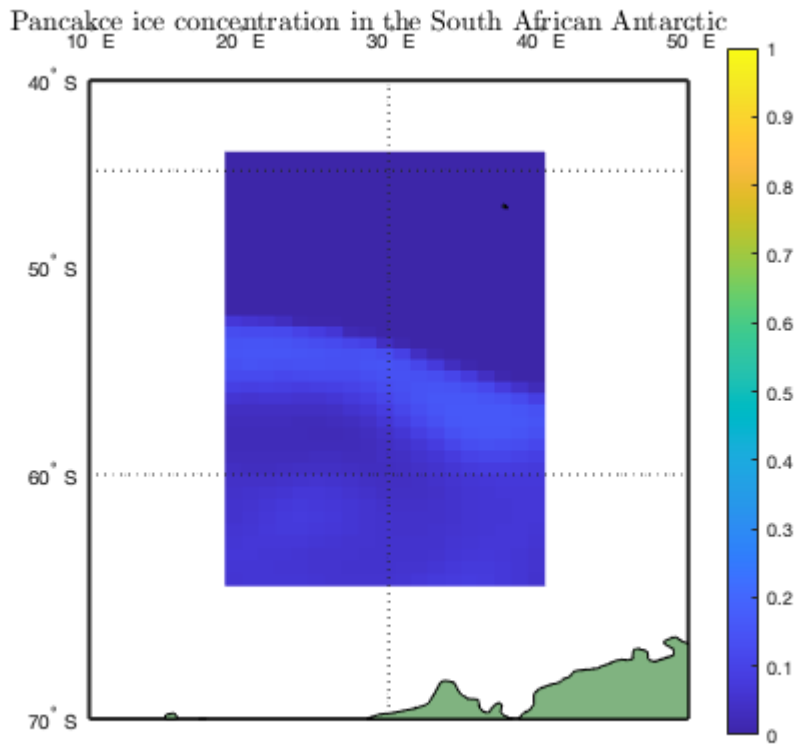
```
%colormap turbo
```

3. a) FSD into the ice pack

```
addpath packages/joyPlot
variable = "afsd";
transect_coords = [coords(1,1), (coords(1,2) + coords(3,2))/2];
 % Grid
grid = "gx1";
[lat,lon,row] = grid_read(grid);
% Read in data
dim = 3;
data = data_format(filedir,variable,row,lat,lon,dim);
data_pancake = data(:,:,1) + data(:,:,2); % Smallest 2 categories combined (ie. pancake
ocean_mask = data_format(filedir,'tmask',row,lat,lon);
% Coordinates
coords = sector_coords(sector); % (NW;NE;SW;SW) (lat,lon)
for i = 1:4
    [lat_out(i),lon_out(i)] = lat_lon_finder(coords(i,1),coords(i,2),lat,lon);
end
[len,wid] = size(data_pancake);
sector_data = zeros(len,wid);
sector_mask = false(len,wid);
sector_data = ~ocean_mask*NaN;
for i = 0:lat_out(1)-lat_out(2)
    sector_mask(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = true;
    sector_data(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = data_pancake(lon_out
end
```

```matlab
[lat_tran,lon_tran] = lat_lon_finder(transect_coords(1),transect_coords(2),lat,lon);
for j = lat_tran:-1:1
    for i = 1:length(nfsd)
        if isnan(sum(data(lon_tran,j,i)))
            transect_fsd(j,i) = 0;
        else
            transect_fsd(j,i) = data(lon_tran,j,i);
        end
    end
end

% latitude = [-90,-60];
% longitude = [10,50];
figure(31)
joyPlot(transect_fsd',1:length(nfsd),0.05,'FaceColor',[0 0.4470 0.7410],'StrokeColor',
xlabel("FSD categories")
ylabel("Latitudes along 30 \degree E")
```
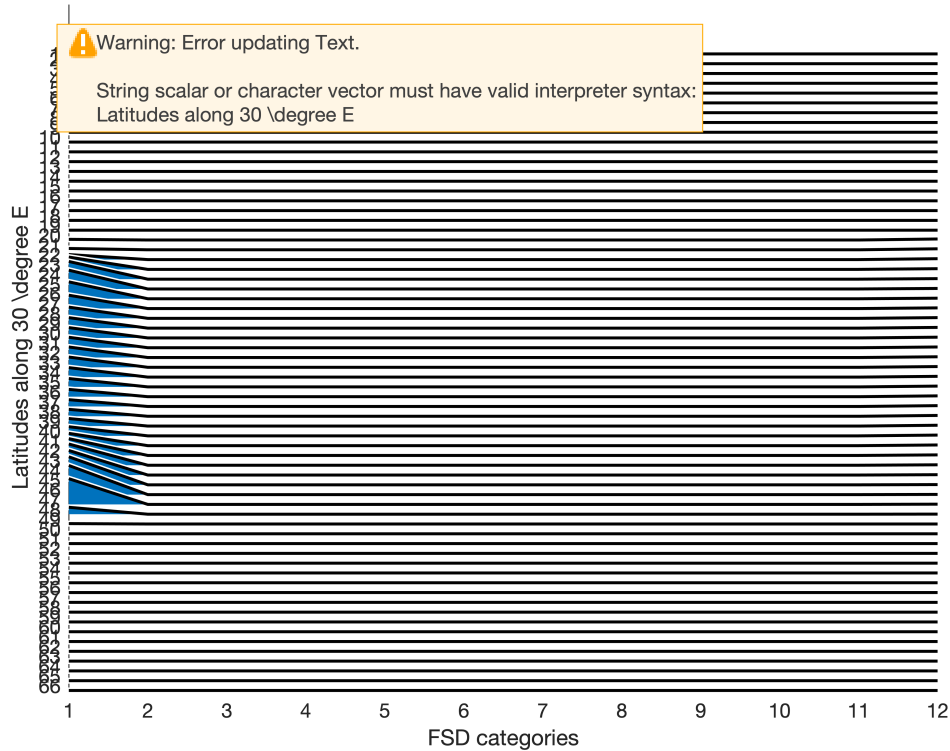


```matlab
% title("Cell rest")
```

4. Pancake ice width

5. Pancake ice growth

```matlab
variable = "fsdrad";
sector_data = data_format_sector(filedir,variable,sector);
%data = data(sector_mask);
%color_map = seaicecolormap();
%colormap turbo
latitude = [-90,-60];
longitude = [10,50];
figure(5)
w = worldmap('world');
    axesm miller; %, eqaazim eqdazim vperspec, eqdazim flips the x-axis, and y-axis to
    setm(w, 'Origin', [0 0 0]);
    setm(w, 'maplatlimit', [-70,-40]);
    setm(w, 'maplonlimit', [10,50]);
    setm(w, 'meridianlabel', 'on')
    setm(w, 'parallellabel', 'on')
    setm(w, 'mlabellocation', 10);
    setm(w, 'plabellocation', 10);
    setm(w, 'mlabelparallel', 0);
    setm(w, 'grid', 'on');
    setm(w, 'frame', 'on');
    setm(w, 'labelrotation', 'on')
    pcolorm(lat,lon,sector_data)
    land = shaperead('landareas', 'UseGeoCoords', true);
    geoshow(w, land, 'FaceColor', [0.5 0.7 0.5])
    colorbar
    caxis(colorlims(variable));
    title(strcat("FSDRAD in the ", sector_name(sector)), 'interpreter','latex','FontSi
```

FSDRAD in the South African Antarctic
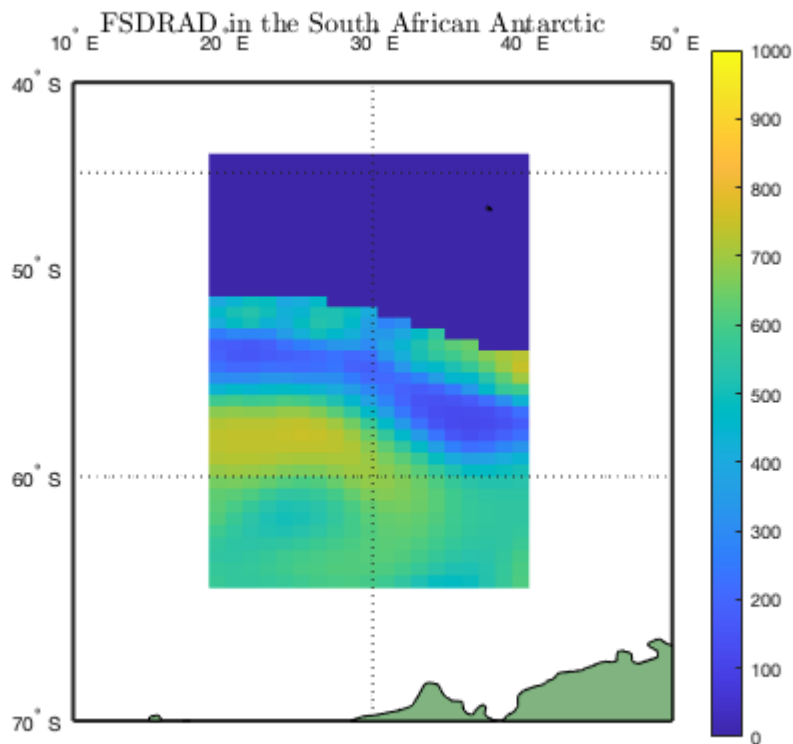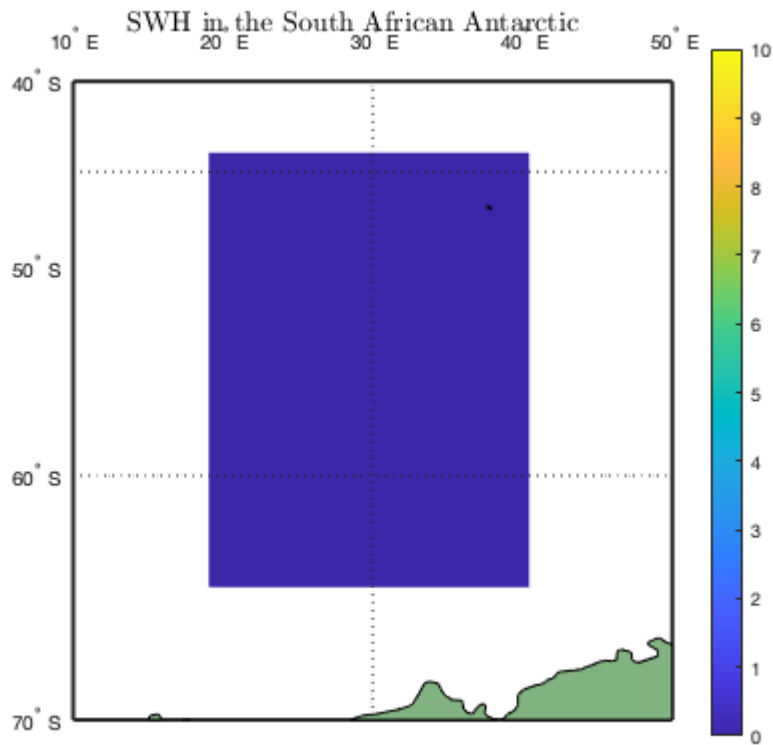
```
%colormap turbo
```

6. SWH presence

```
variable = "wave_sig_ht";
sector_data = data_format_sector(filedir,variable,sector);
%data = data(sector_mask);
%color_map = seaicecolormap();
%colormap turbo
latitude = [-90,-60];
longitude = [10,50];
figure(6)
w = worldmap('world');
    axesm miller; %, eqaazim eqdazim vperspec, eqdazim flips the x-axis, and y-axis to
    setm(w, 'Origin', [0 0 0]);
    setm(w, 'maplatlimit', [-70,-40]);
    setm(w, 'maplonlimit', [10,50]);
    setm(w, 'meridianlabel', 'on')
    setm(w, 'parallellabel', 'on')
    setm(w, 'mlabellocation', 10);
    setm(w, 'plabellocation', 10);
    setm(w, 'mlabelparallel', 0);
    setm(w, 'grid', 'on');
    setm(w, 'frame', 'on');
    setm(w, 'labelrotation', 'on')
```

```
        pcolorm(lat,lon,sector_data)
        land = shaperead('landareas', 'UseGeoCoords', true);
        geoshow(w, land, 'FaceColor', [0.5 0.7 0.5])
        colorbar
        caxis(colorlims(variable));
        title(strcat("SWH in the ", sector_name(sector)), 'interpreter','latex','FontSize'
```


SWH in the South African Antarctic

```
    %colormap turbo
```

7. SWH distance into the ice

8. Ice velocities

9. Wind and ice velocity relationship

10. Ice thickness

```
variable = "hi";
sector_data = data_format_sector(filedir,variable,sector);
```

```matlab
%data = data(sector_mask);
%color_map = seaicecolormap();
%colormap turbo
latitude = [-90,-60];
longitude = [10,50];
figure(2)
w = worldmap('world');
    axesm miller; %, eqaazim eqdazim vperspec, eqdazim flips the x-axis, and y-axis to
    setm(w, 'Origin', [0 0 0]);
    setm(w, 'maplatlimit', [-70,-40]);
    setm(w, 'maplonlimit', [10,50]);
    setm(w, 'meridianlabel', 'on')
    setm(w, 'parallellabel', 'on')
    setm(w, 'mlabellocation', 10);
    setm(w, 'plabellocation', 10);
    setm(w, 'mlabelparallel', 0);
    setm(w, 'grid', 'on');
    setm(w, 'frame', 'on');
    setm(w, 'labelrotation', 'on')
    pcolorm(lat,lon,sector_data)
    land = shaperead('landareas', 'UseGeoCoords', true);
    geoshow(w, land, 'FaceColor', [0.5 0.7 0.5])
    colorbar
    caxis(colorlims(variable));
    title(strcat("Ice thickness in the ", sector_name(sector)), 'interpreter','latex',
```


Ice thickness in the South African Antarctic
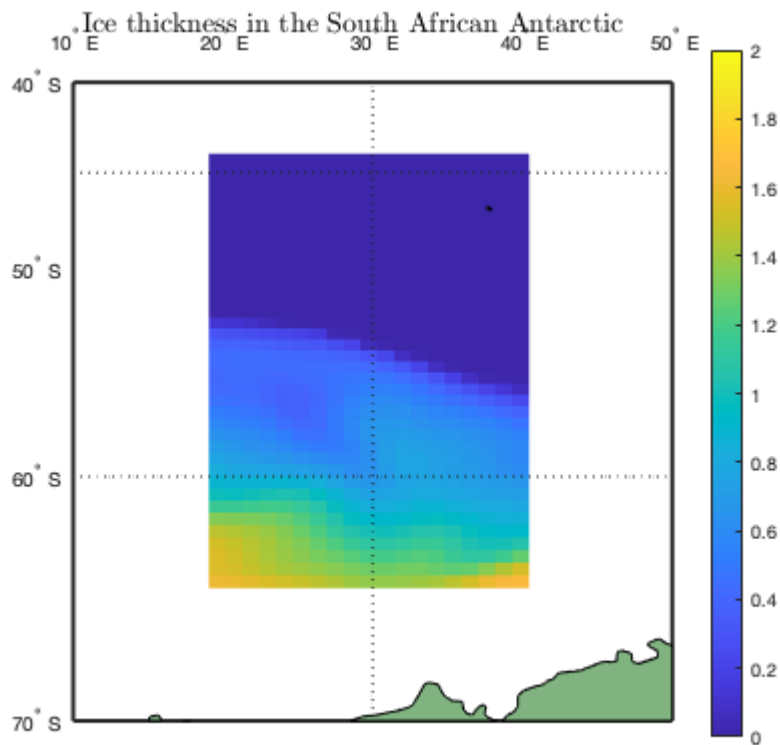
```matlab
    %colormap turbo
```

Functions

```matlab
function coords = sector_coords(sector)
% Coordinates of sector
%   There are three sectors available:
%       SA := South Africa,
%       WS := Weddell Sea,
%       and EA := East Antarctica
    if sector == "SA"
        coords = [-45,20;-65,20;-45,40;-65,40]; %(NW;NE,SW,SE)
    elseif sector == "EA"
        coords = [];
    elseif sector == "WS"
        coords = [];
    end
end

function sector_data = data_format_sector(filedir,variable,sector,dim)
    if ~exist('dim', 'var')
        dim = 2;
    end

    % Grid
    grid = "gx1";
    [lat,lon,row] = grid_read(grid);
    % Read in data
    data = data_format(filedir,variable,row,lat,lon,dim);
    ocean_mask = data_format(filedir,'tmask',row,lat,lon);
    % Coordinates
    coords = sector_coords(sector); % (NW;NE;SW;SW) (lat,lon)
    for i = 1:4
        [lat_out(i),lon_out(i)] = lat_lon_finder(coords(i,1),coords(i,2),lat,lon);
    end
    [len,wid] = size(data);
    sector_data = zeros(len,wid);
    sector_mask = false(len,wid);
    sector_data = ~ocean_mask*NaN;
    for i = 0:lat_out(1)-lat_out(2)
        sector_mask(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = true;
        sector_data(lon_out(1):lon_out(3), lat_out(1)-i:lat_out(3)) = data(lon_out(1):
    end

end

function name = sector_name(sector)
    if sector == "SA"
        name = "South African Antarctic";
```

```
    elseif sector == "WS"
        name = "Weddell Sea";
    elseif sector == "EA"
        name = "East Antarctic";
    else
        name = "";

    end
end
```