In [12]:

```
import matplotlib.pyplot as plt
import matplotlib.path as mpath
import matplotlib
from matplotlib.axes import Axes
%matplotlib inline
import numpy as np
import pyvista as pv
from pyvista import examples
import pandas as pd
import xarray as xr
import time
import cartopy.crs as ccrs

pv.global_theme.jupyter_backend = 'pythreejs'
```

In [13]:

```
ds = xr.open_dataset('/scratch/project_2000789/muramarg/run_5_31/output_WAOM_chec
dt = xr.open_dataset('/scratch/project_2000789/muramarg/run_5_31/output_WAOM_chec
#dd = xr.open_dataset('/scratch/project_2000789/muramarg/run_5_31/output_WAOM_che
dg = xr.open_dataset('/scratch/project_2000789/boeiradi/waom10_frc/waom10extend_g
```

In [14]:

```
x = (ds.variables['Xgrid'].values)
y = (ds.variables['Ygrid'].values)
z = (ds.variables['Zgrid'].values)
```

In [15]:

```
print(x.shape)
```

```
(23521, 3675)
```

In [16]:

```
def make_points(i):
    """Helper to make XYZ points"""
    z1 = list(z[:,i])
    x1 = list(x[:,i])
    y1 = list(y[:,i])
    return np.column_stack((x1, y1, z1))
```

In [17]:

```
def lines_from_points(points):
    """Given an array of points, make a line set"""
    poly = pv.PolyData()
    poly.points = points
    cells = np.full((len(points) - 1, 3), 2, dtype=np.int_)
    cells[:, 1] = np.arange(0, len(points) - 1, dtype=np.int_)
    cells[:, 2] = np.arange(1, len(points), dtype=np.int_)
    poly.lines = cells
    return poly


#line = lines_from_points(points)
#line
```

In [18]:

```
# dt.variables['zice'].values
```

Attempts without looping

In [19]:

```
mask_rho = dt.variables['mask_rho']
zice = dt.variables['zice']
my_xarr = zice*mask_rho
zpts = my_xarr.to_numpy()
#poly = pv.PolyData(zpts)
#grid = pv.create_grid(zpts)
#grid
#zpts.texture_map_to_plane(use_bounds=True, inplace=True)
```

In [20]:

```
 # zice points
def get_zice_points(zice):
    value = zice.to_numpy()
    x = np.arange(value.shape[0])
    y = np.arange(value.shape[1])
    xx, yy = np.meshgrid(x, y, sparse=False)
    xx = xx.reshape(-1, 1)
    xx = xx.flatten()
    yy = yy.reshape(-1, 1)
    yy = yy.flatten()
    value = value.reshape(-1, 1)
    value = value.flatten()
    value = (value)

    return (xx,yy,value)
# test = dt.variables['zice'].values
mask_rho = dt.variables['mask_rho']
zice = dt.variables['zice']
a = zice*mask_rho
xz,yz,zz = get_zice_points(a)
```

In [21]:

```
zz = zz/1000/10
```

In [22]:

```
# print(xz,yz,zz)
z_mesh = np.array([xz,yz,zz]).T
print(z_mesh.shape)
```

```
(352800, 3)
```

In [23]:

```
z_nonzero = [i for i in z_mesh if i[2] != 0]
z_nonzero = np.array(z_nonzero)
z_nonzero.shape
```

Out[23]:

```
(19084, 3)
```

In [24]:

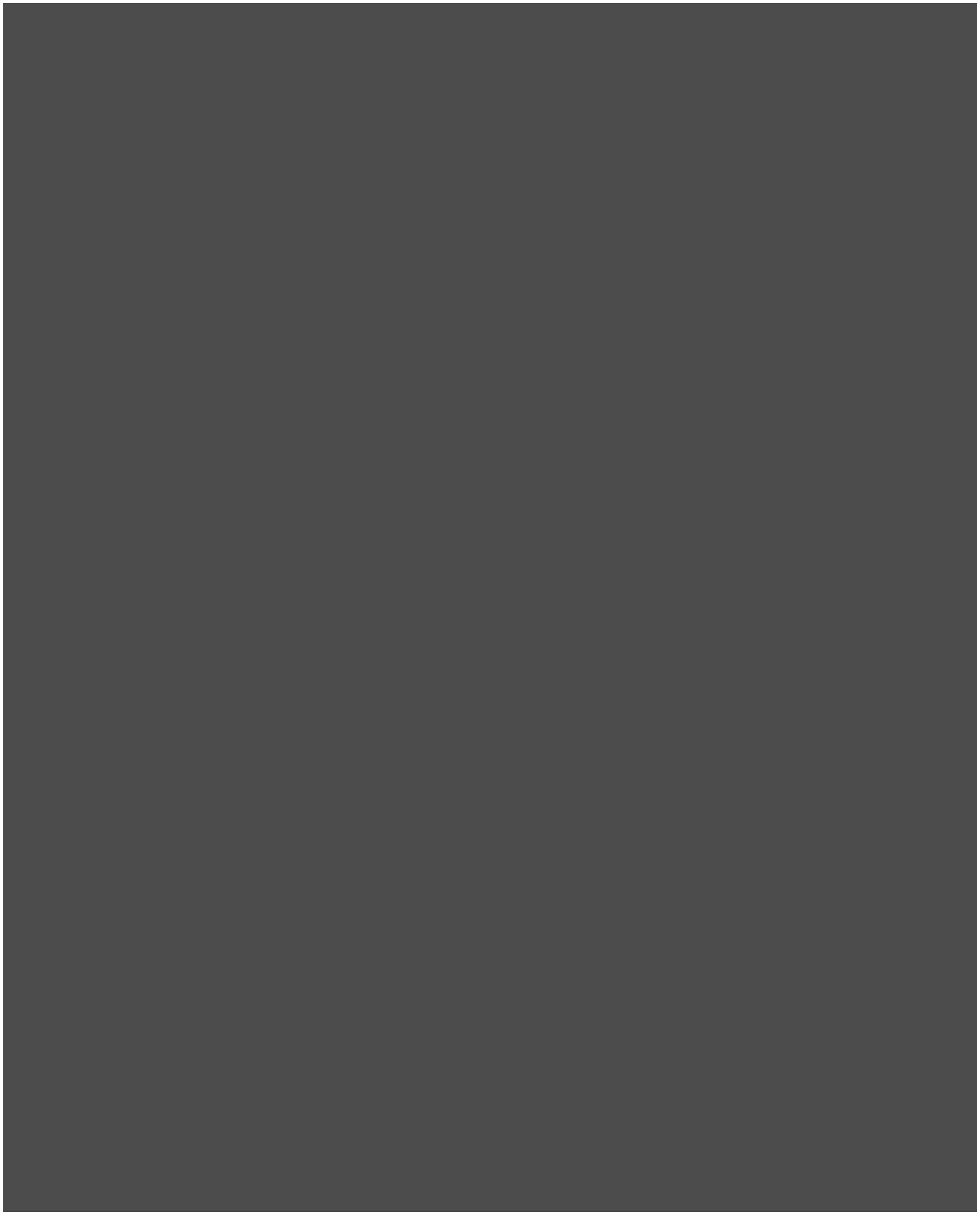
```
myz = pv.PolyData(z_mesh)
myz
```

Out[24]:

```
   PolyData               Information
    N Cells                    352800
   N Points                    352800
   X Bounds    0.000e+00, 5.590e+02
   Y Bounds    0.000e+00, 6.290e+02
   Z Bounds   -2.134e-01, 0.000e+00
   N Arrays                         0
```

In [25]:
```
myz.plot()
```

```
/users/muramarg/.local/lib/python3.9/site-packages/pyvista/jupyter/pv_pythreej
s.py:436: UserWarning: Empty or unsupported dataset attached to actor
  warnings.warn('Empty or unsupported dataset attached to actor')
```



In [26]:

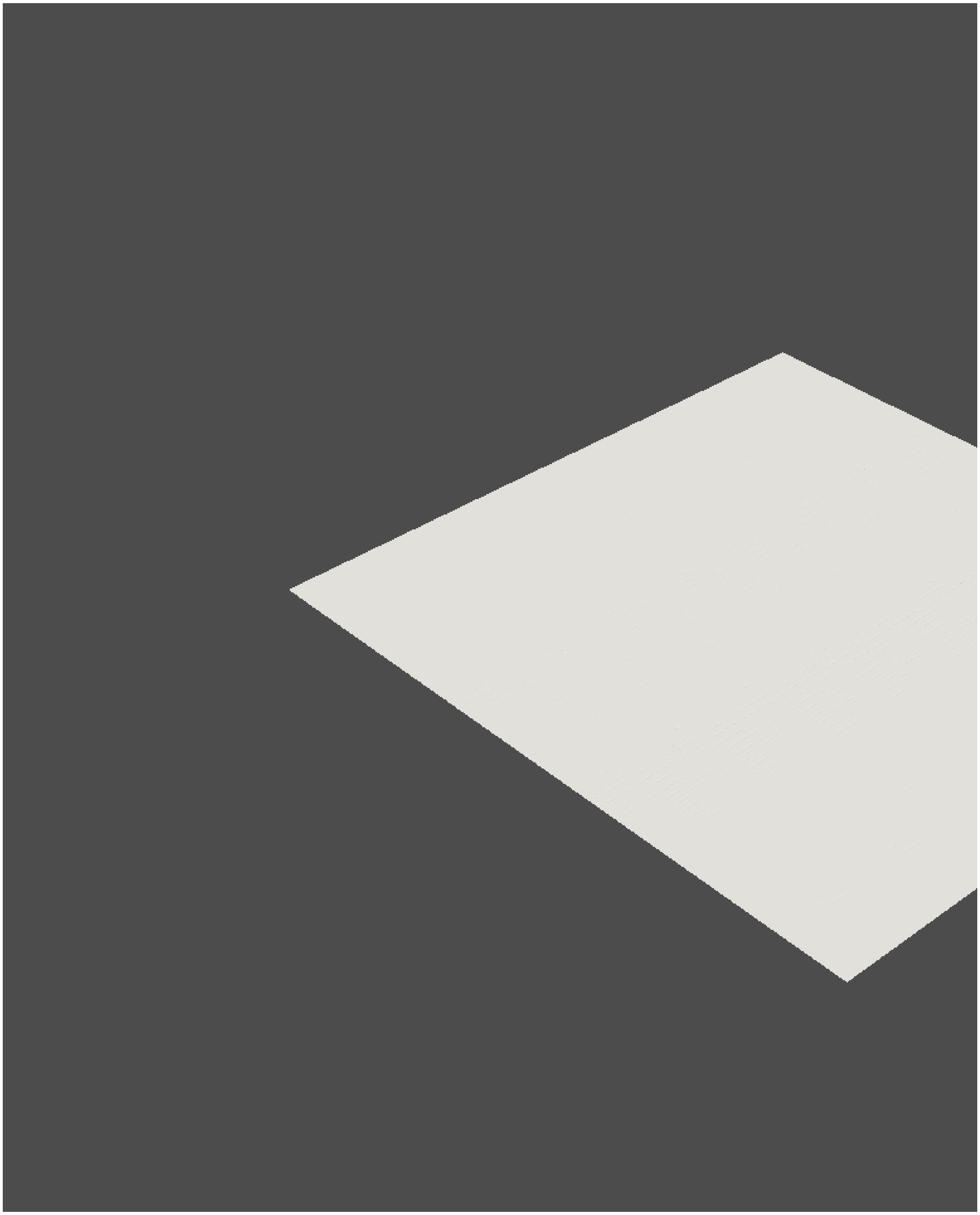
```
dfx = z_nonzero[:,0]
dfy = z_nonzero[:,1]
dfz = z_nonzero[:,2]

data = {'X': z_mesh[:,0],
        'Y': z_mesh[:,1],
        'Z': z_mesh[:,2]}

# # Create DataFrame
df = pd.DataFrame(data)
coords = df[['X', 'Y', 'Z']].values
```

```
In [27]: df
```

```
Out[27]:
              X      Y    Z
      0     0.0    0.0  0.0
      1     1.0    0.0  0.0
      2     2.0    0.0  0.0
      3     3.0    0.0  0.0
      4     4.0    0.0  0.0
    ...     ...    ...  ...
 352795   555.0  629.0  0.0
 352796   556.0  629.0  0.0
 352797   557.0  629.0  0.0
 352798   558.0  629.0  0.0
 352799   559.0  629.0  0.0

352800 rows × 3 columns
```

In [28]:

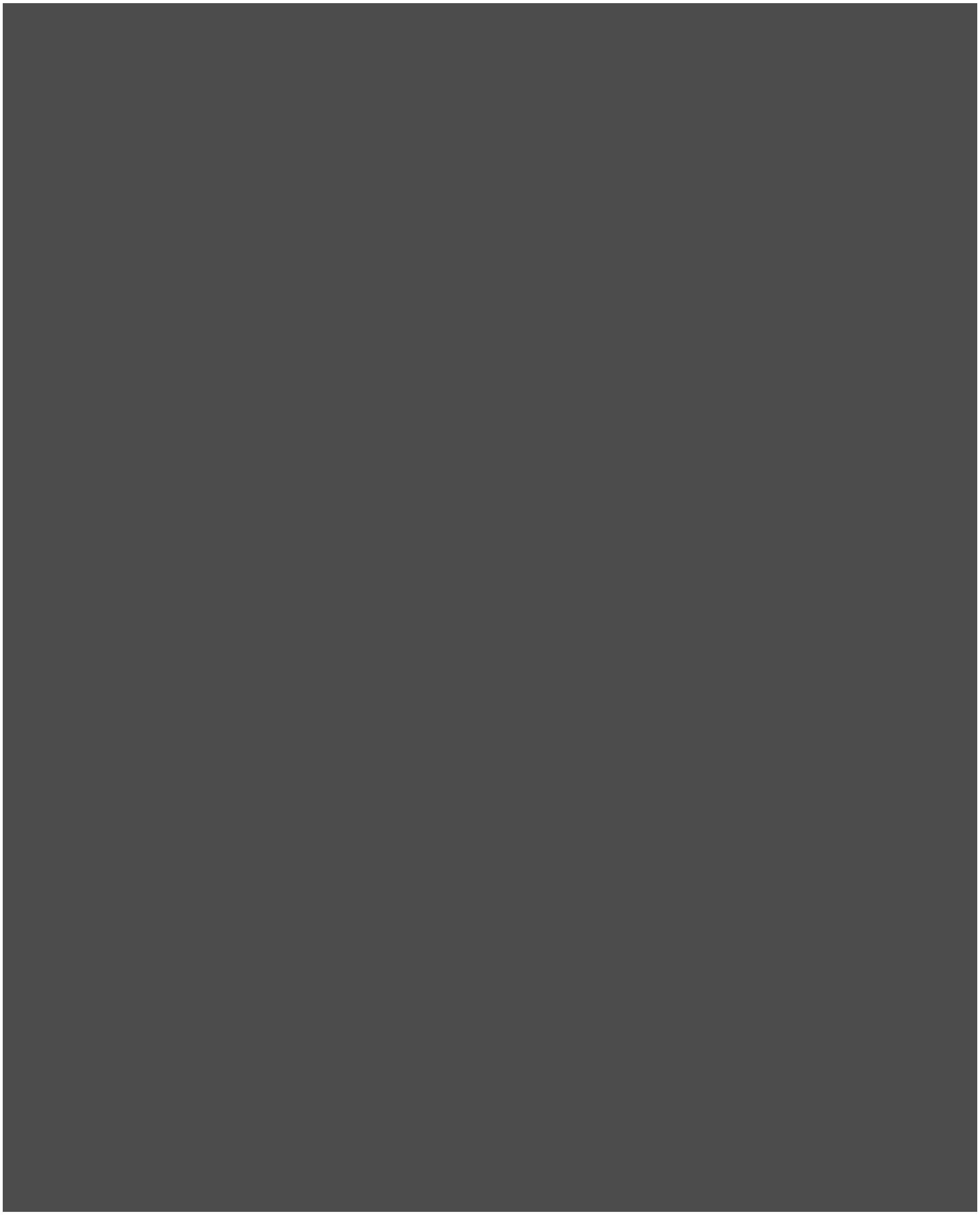
```
structured = pv.StructuredGrid()
# Set coordinates
structured.points = coords
# Set the dimensions of the structured grid
structured.dimensions = [560, 630, 1]

# Apply an Elevation filter
# elevation = structured.elevation()
# elevation.plot()
structured.plot()
```



In [29]:

```python
p = pv.Plotter()
p.add_mesh(myz)
p.show()
#myz.plot()
```

```
/users/muramarg/.local/lib/python3.9/site-packages/pyvista/jupyter/pv_pythreej
s.py:436: UserWarning: Empty or unsupported dataset attached to actor
  warnings.warn('Empty or unsupported dataset attached to actor')
```



Plotting by looping

In [30]:

```
# zice points
def get_zice_points(zice):
    x = np.array([])
    y = np.array([])
    z = np.array([])
    for i in range(len(zice)):
        for j in range(len(zice[i])):
            if zice[i][j] != 0:
                x = np.append(x,j)
                y = np.append(y,i)
                z = np.append(z,zice[i][j]/1000/10)

    return x,y,z
test = dt.variables['zice'].values
xz,yz,zz = get_zice_points(test)
```

In [31]:

```
zz = zz/1000/10
```

In [32]:

```
zpts = np.array([xz,yz,zz]).T
#print(zpts)
```

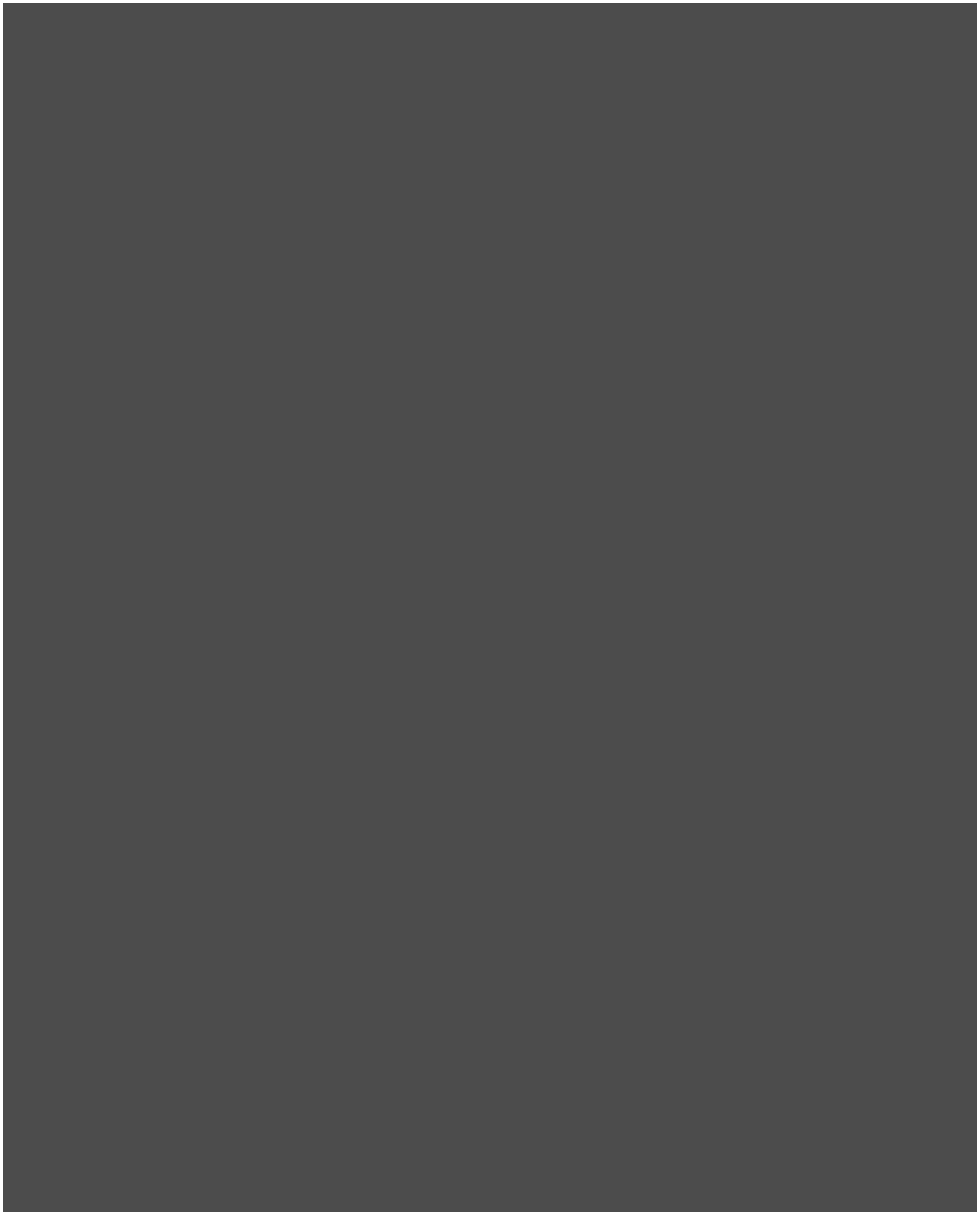
In [33]:

```
point_cloud = pv.PolyData(zpts)
point_cloud
```

Out[33]:

```
 PolyData              Information
  N Cells                   119793
 N Points                   119793
 X Bounds   4.600e+01, 5.740e+02
 Y Bounds   8.500e+01, 5.230e+02
 Z Bounds -2.534e-05, -3.069e-14
 N Arrays                        0
```

In [34]:
```
pv.global_theme.jupyter_backend = 'pythreejs'
point_cloud.plot()
```



Plotting with ccrs normally

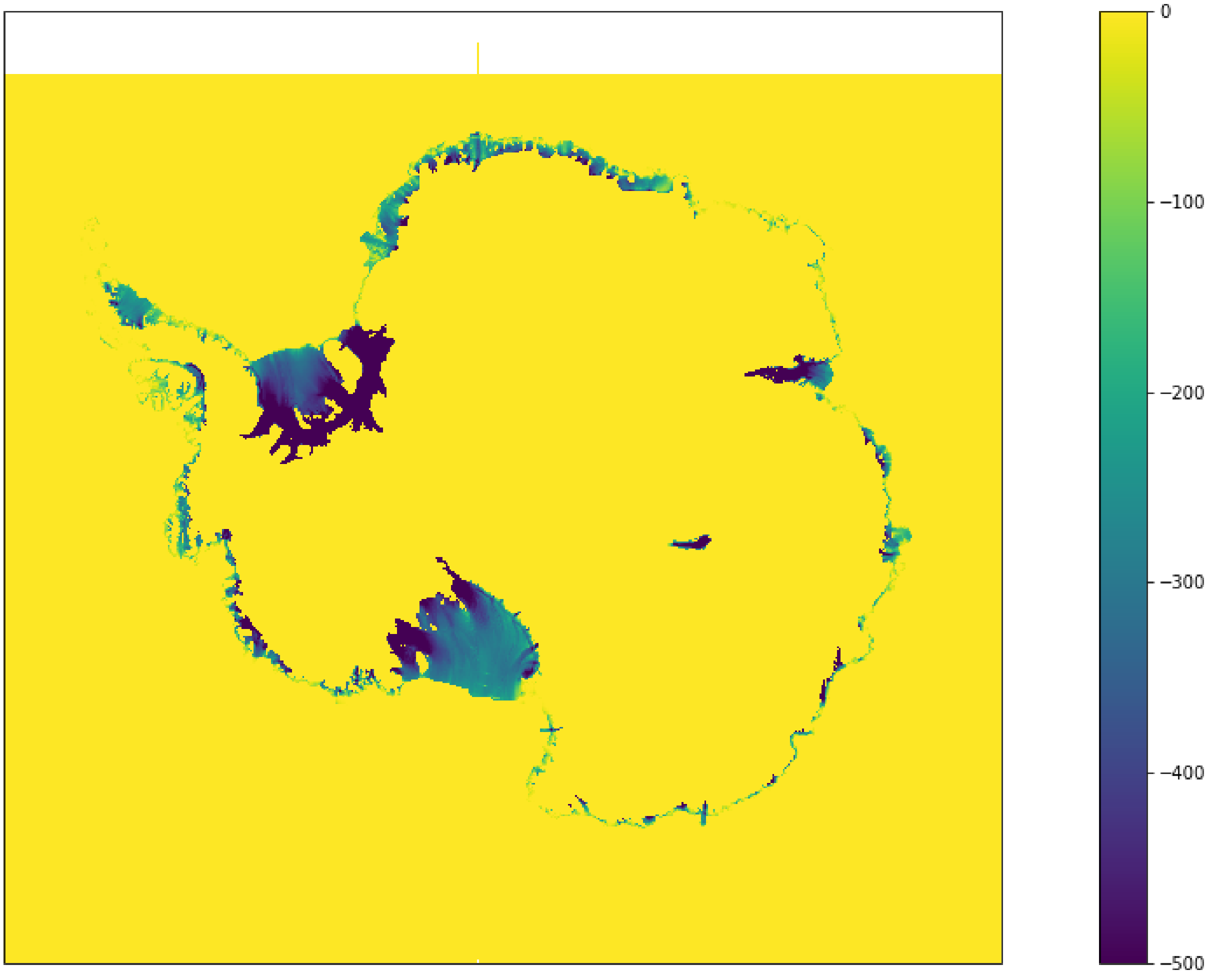
In [ ]:

```
# plt.figure(figsize=(10, 10))
# plt.scatter(zpts[:, 0], zpts[:, 1], c=zpts[:, 2])
# plt.axis("image")
# plt.xlabel("X Coordinate")
# plt.ylabel("Y Coordinate")
# plt.colorbar()
# plt.show()
```

In [35]:

```
#plt.figure(figsize=(10, 10))
# masking land points
mask_rho = dt.variables['mask_rho']
zice = dt.variables['zice']

proj = ccrs.SouthPolarStereo(central_longitude=0.0, true_scale_latitude=None, gl
fig = plt.figure(figsize=(20,10))
ax = fig.add_subplot(1, 1, 1, projection=proj)
#plt.scatter(zpts[:, 0], zpts[:, 1], c=zpts[:, 2])
# another way
plt.pcolormesh(dg.lon_rho,dg.lat_rho, zice*mask_rho,transform=ccrs.PlateCarree(),
plt.axis("image")
plt.xlabel("X Coordinate")
plt.ylabel("Y Coordinate")
plt.colorbar()
plt.show()
```

```
/CSC_CONTAINER/miniconda/envs/env1/lib/python3.9/site-packages/cartopy/mpl/geoa
xes.py:1797: UserWarning: The input coordinates to pcolormesh are interpreted a
s cell centers, but are not monotonically increasing or decreasing. This may le
ad to incorrectly calculated cell edges, in which case, please supply explicit
cell edges to pcolormesh.
  result = matplotlib.axes.Axes.pcolormesh(self, *args, **kwargs)
```



In [36]:

```
# point_cloud = pv.PolyData(zpts)
point_cloud = pv.PolyData(zpts)
point_cloud
```

Out[36]:

```
PolyData             Information
 N Cells                  119793
N Points                  119793
X Bounds    4.600e+01, 5.740e+02
Y Bounds    8.500e+01, 5.230e+02
Z Bounds  -2.534e-05, -3.069e-14
N Arrays                       0
```

In [ ]:

```
```

In [37]:

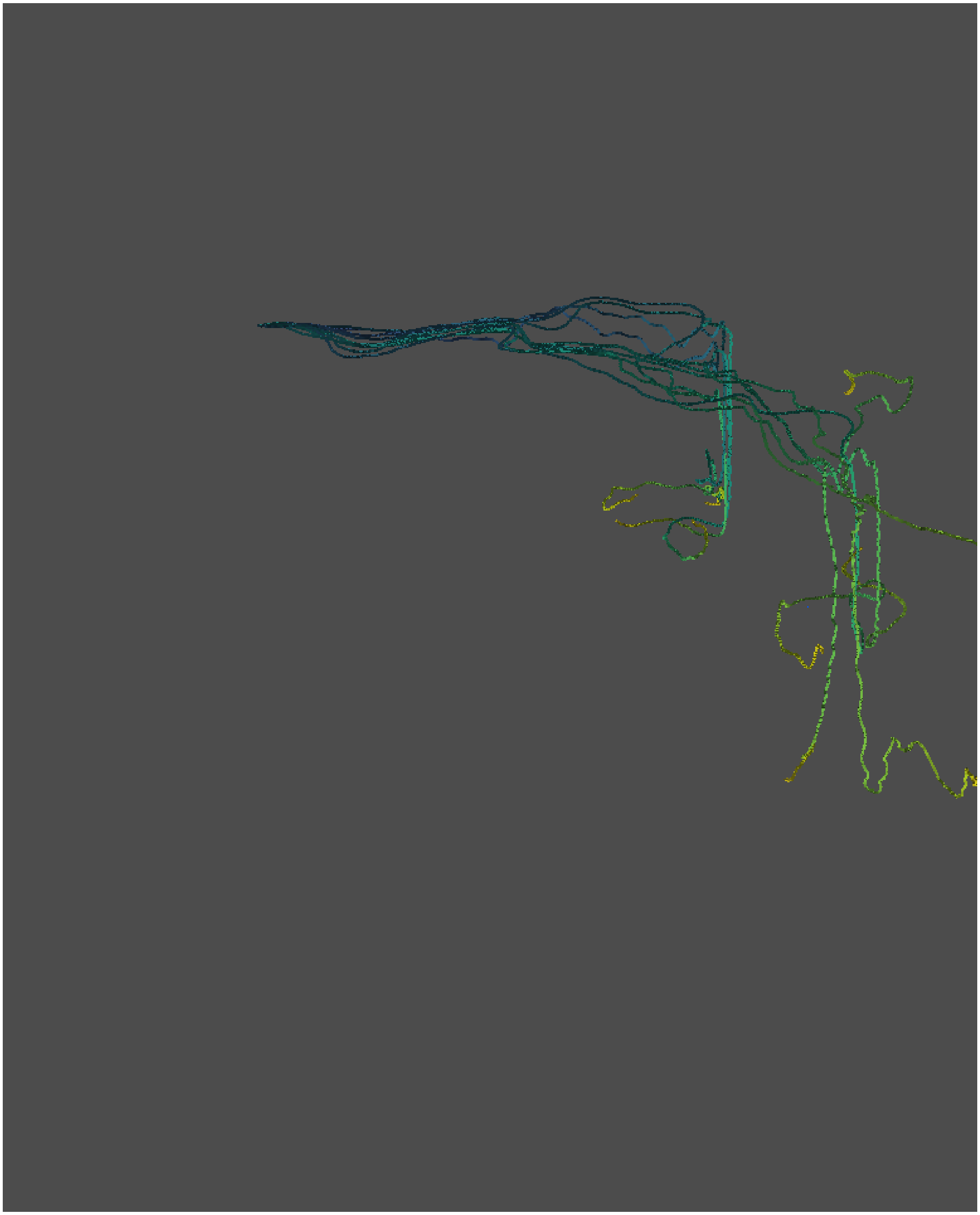
```
# pv.global_theme.jupyter_backend = 'pythreejs'
pv.global_theme.jupyter_backend = 'pythreejs'
```

plotting splines without addition of zice

In [38]:

```
def cast_all_points():
    #pv.start_xvfb()
    start_time = time.time()
    network = pv.MultiBlock()
    network.add_field_data(np.arange(x.shape[0]/900),"time")

    # add backend

    for i in range(0,10):
        if (i%5 ==0):
            print(i,'/ 105','in',(time.time()-start_time)/60)
        points = make_points(i)
        line = lines_from_points(points)
        line["days since start"] = np.arange(line.n_points)
        tube = line.tube(radius=0.1)
        network.append(tube)
        #line['time'] = np.arange(x.shape[0])

        #tube.plot(smooth_shading=True)

    # create the scalar bars and plot
    print('ok')

    p = pv.Plotter()
    sargs = dict(
        n_labels=0,
        label_font_size = 14
    )
    annotations = {
        0:'0',2820: '30', 5640: '60', 8460:'90',11280: '120', 14100:'150', 16920:
        19740:'210', 22560:'240',
    }
    #_ = p.add_mesh(network, smooth_shading=True,annotations=annotations, scalar_
    _ = p.add_mesh(network, smooth_shading=True,show_scalar_bar=True,annotations=
    #network.plot(show_scalar_bar=True)
    #_ = p.add_scalar_bar(n_labels=0,label_font_size=14,above_label=annotations)

    # add the zice shape
    print('plotting')
    # add the plot axes
    _ = p.add_axes(line_width=5, xlabel='x',ylabel='y',zlabel='z',viewport=(0,0,2
    p.show(auto_close=False)
    #p.save_graphic("testing.svg")
    print('total time:',(time.time()-start_time)/60,'min')
cast_all_points()
```

```
0 / 105 in 0.00039312044779459633
5 / 105 in 0.01955617666244507
ok
plotting
```



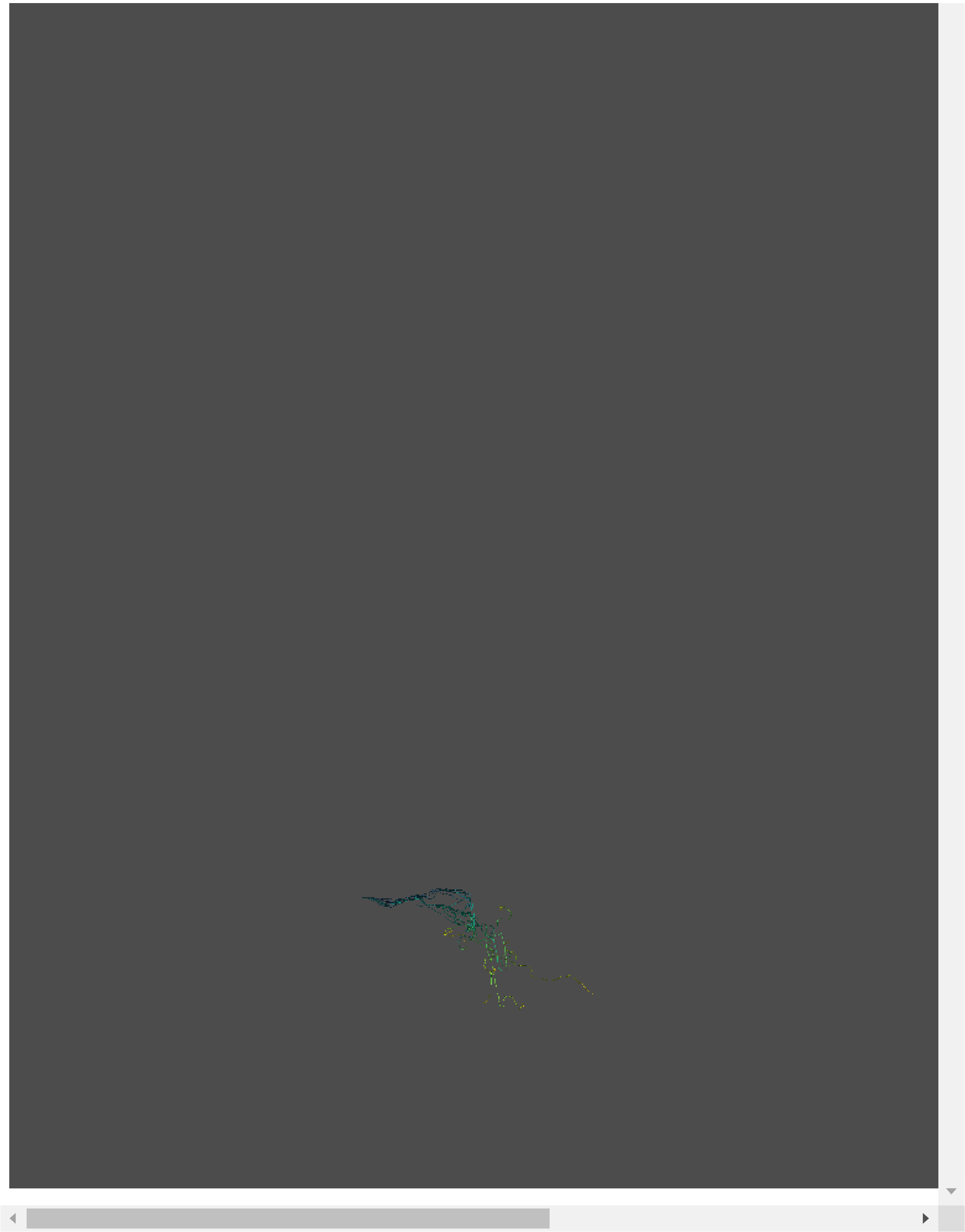
```
total time: 0.17574191490809124 min
```

plotting with attempted addition of zice

In [40]:

```
def cast_all_points(zpts):
    start_time = time.time()
    network = pv.MultiBlock()
    network.add_field_data(np.arange(x.shape[0]/900),"time")
    #print(network)
    for i in range(0,10):
        if (i%5 ==0):
            print(i,'/ 105','in',(time.time()-start_time)/60)
        points = make_points(i)
        line = lines_from_points(points)
        line["days since start"] = np.arange(line.n_points)
        tube = line.tube(radius=0.1)
        network.append(tube)
        #line['time'] = np.arange(x.shape[0])

        #tube.plot(smooth_shading=True)

    # create the scalar bars and plot
    p = pv.Plotter()
    sargs = dict(
        n_labels=0,
        label_font_size = 14
    )
    annotations = {
        0:'0',2820: '30', 5640: '60', 8460:'90',11280: '120', 14100:'150', 16920:
        19740:'210', 22560:'240',
    }
    p.add_mesh(network, smooth_shading=True,annotations=annotations, scalar_bar_a

    # add the zice shape
    point_cloud = pv.PolyData(zpts)
    p.add_mesh(point_cloud,smooth_shading=True,color='#a8a8a8')


    # add the plot axes
    _ = p.add_axes(line_width=5, labels_off=False)
    #_ = p.enable_eye_dome_lighting()
    p.show()
    print('total time:',(time.time()-start_time)/60,'min')
cast_all_points(zpts)
```

```
0 / 105 in 4.1604042053222655e-06
5 / 105 in 0.01761853297551473

/users/muramarg/.local/lib/python3.9/site-packages/pyvista/jupyter/pv_pythreej
s.py:436: UserWarning: Empty or unsupported dataset attached to actor
  warnings.warn('Empty or unsupported dataset attached to actor')
```



```
total time: 0.17025843461354573 min
```

In [ ]:

```
# def make_points(i):
#     """Helper to make XYZ points"""
#     z1 = list(z[:,i])
#     x1 = list(x[:,i])
#     y1 = list(y[:,i])
#     return np.column_stack((x1, y1, z1))
# points = make_points(1)
# line = lines_from_points(points)
```

In [ ]:

```
# line["scalars"] = np.arange(line.n_points)
# tube = line.tube(radius=0.1)
# tube.plot(smooth_shading=True)
```

In [ ]:

```
# p = pv.Plotter()
# p.add_mesh(stream.tube(radius=0.0015))
# p.view_xy()
# p.show(cpos=cpos)
```

In [ ]: