Spatial Variability in the Antarctic Circumpolar Current:

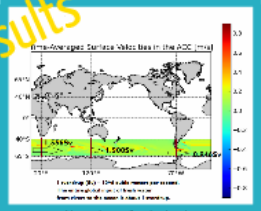
a preliminary study of ocean circulation in a coupled climate model

Mihai Baltatescu and Judy Twedt

CSE140: Professor Michael Ernst

March 18, 2013

Results



Net volume flux by basin:

Indian: 0.056 Sv Pacific: 0.55 Sv Atlantic: -0.61 Sv

What we learned about python and climate data along the way...

Climate model data is stored in NetCDF format and contains both the model data and meta-data, like units, the variable dimensions and variable sizes.

Many fields are stored in masked, multi-dimensional arrays.

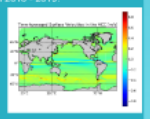
Libraries used:
pickle
numpy
NetCDF4
matplotlib.pyplot
mpl_toolkits.basemap
sys
pdb

Many thanks to Professor Ernst and the terrific CSE140 staff for an outstanding introduction to Data Analysis with python!

Methods:

We used the Community Climate System Model (CCSM4) output to answer our question, and considered only the eastward surface velocities (first 5 meters) of the ocean between 2010 - 2019.

The amount of water flowing into or out of the ACC for each ocean basin can be calculated by the difference of the flow in from the west and the flow out at the east.



Specifically, we calculated the volume flux at the west and east boundaries of each basin.

The volume flux is dV/dt = avg velocity x area

A little background

Climate scientists use coupled models to understand the earth system. These models simulate how the atmosphere, ocean, land, and sea ice will change under different conditions.

In the southern hemisphere, there is a swirling current, the Antarctic Circumpolar Current (ACC), which flows completely around the globe. It plays a significant role in general ocean circulation and climate.

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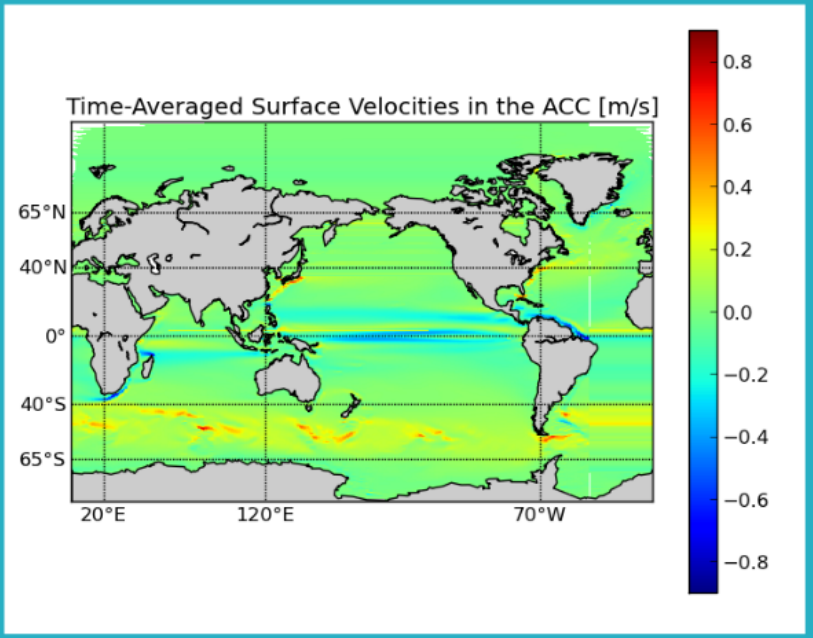

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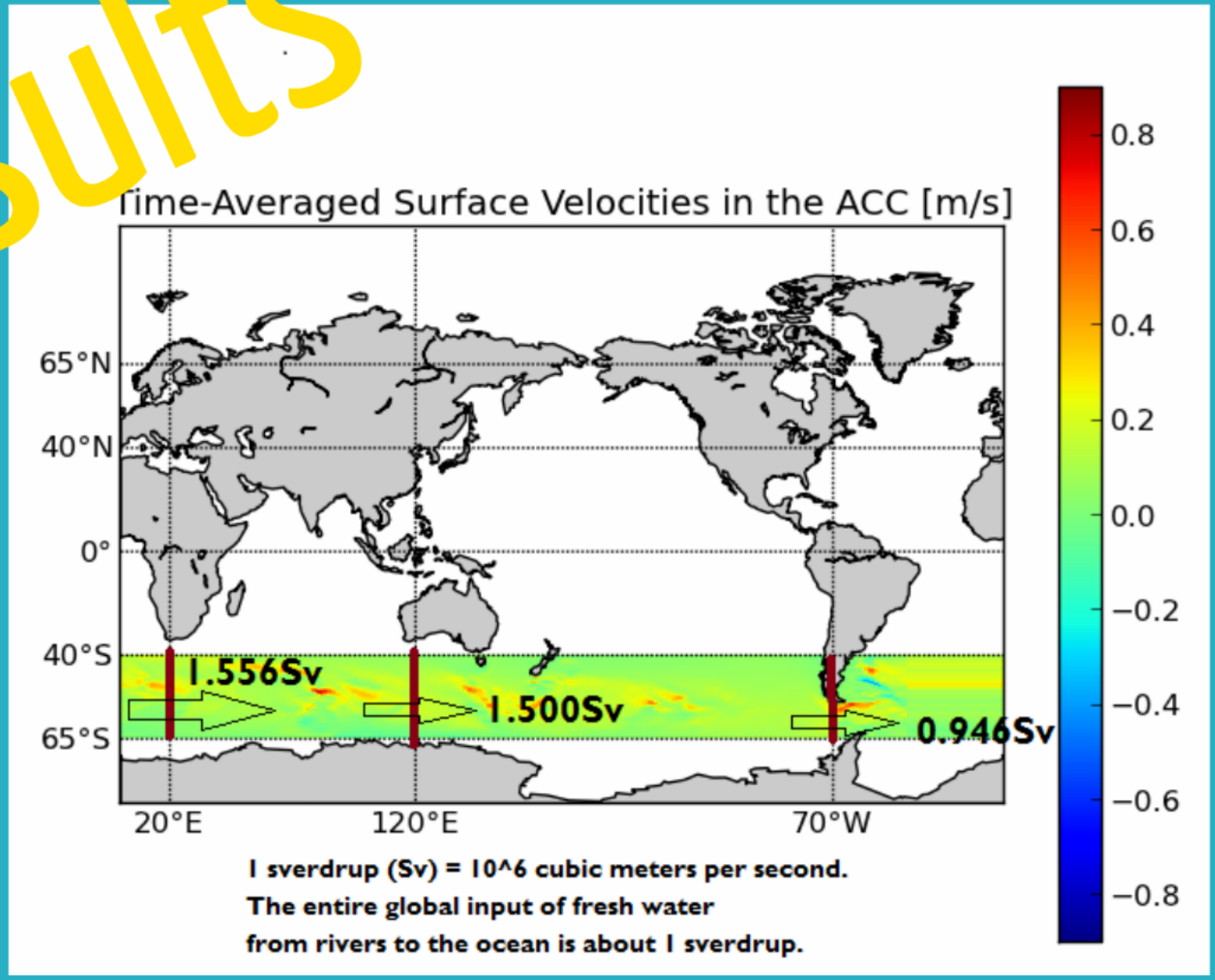

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38 ##### Functions #####
39 def get_ACC_vals(latitude, field):
40     '''
41     Takes a latitude grid (ndmasked 2-dimensional array) and field, both ndarrays, and
42     masks the values that are outside the north and south boundaries of the ACC
43     '''
44     # in essence field is masked for all values except the ones within the boundary
45     # of the acc, 40 (acc2) to 64 (acc1)
46     return MA.masked_where(np.logical_or(latitude < acc1, latitude > acc2), field)
47
48 def get_vol_flux(lon_index, ACCvel, ACClat):
49     '''
50     Given the velocity profile, the depth in km,
51     and the distance of the array, returns the volume flux (a float)
52     through that transect
53     '''
54     (velocity_transect, dist) = get_ACC_transect_and_dist(lon_index, ACCvel, ACClat)
55
56     return MA.mean(velocity_transect)*dist*depth
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