P.hD. Work Journal

SMAST - UMASSD

New Bedford - sandwich Stay

Rafael Soutelinho - Avijit Gangopadhyay

June, 2010 (BEGIN)

(END)

Working on topography - June 11th, 2010 (BEGIN) (1)

→ ETOPO 1': downloaded subset .xyz file

→ m-file for building topography without banks and seamounts → create_topog.m

→ tryed different ways of removing seamounts. The one that worked best was using low degree polynomial adjustment, so that we don't loose sharp curves (plots are attached).

→ to remove the banks, I first opted for using a sample profile (15,6 °S) and repeating it in the whole domain, with fix continental shelf width (plots are attached)

→ as a product, I came up with two different modified topographys, based on ETOPO 1':

* ETOPO 1' without seamounts
* SEMI-IDEALIZED topog. based on ETOPO 1' (no banks, no seamounts)

→ in the meanwhile, I worked on the NSF Proposal reference list and the paper is under Review

JUNE 16th (END)

WORK JOURNAL

June 16th, 2010

→ e-mail to Arijit and Ilson to update my recent efforts.

→ GRL Review arrived (decision letter). We were declined at this time, but the editor encouraged us to resubmit, answering the reviewers, point by point.

June 17th, 2010

→ exchanged e-mail with Ilson about GRL letter

→ digitalized Ilson's class notes

→ compared WOA 2001 0.25° × 0.25° with
WOA 2005 1° × 1° (BETTER ☺)

→ I figured out that WOA 2009 exists and it is available. But we need to make our own grid

→ They have it available in 1/4° grid TOO!
NODC website ⇒ "woaselect" (WOA Select)

WODSelect

June 18th, 2010

→ Spent whole day shell scripting to split WOD data

→ still no success

June 22th, 2010

→ coming back to paper (Revisors questions)

→ I did a 2 pannel figure ☐ WOA SSHA - annual

☐ AVISO SSHA - annual

→ I computed HYCOM streamfunction and ploted in the same axis of the paper figures

EXP : GLB08_exp 60.5

→ Sent e-mail to Ilson and Juliana with the plots

June 23th, 2010

→ I plotted synoptic maps of AVISO - derived streamfunction for PRO-ABROLHOS and OEZ times. Sent e-mail to Ilson with the figures.

→ Started drafting answers to the GRL reviewers

July 7th, 2010

→ Finished answers to GRL reviewers. Sent e-mail to Ilson and Arijit for their editions.

July 9, 2010

→ Downloaded WOA 2009 .csv files for (Summer, Winter, March, annual)

→ Created m-file to read data and save it into .MAT files. Created MAT files.

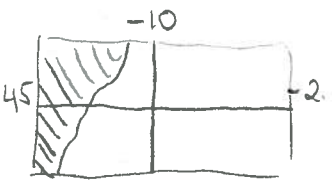
July 12, 2010

→ Taking a look at WOA 2009 data distribution. Downloaded and plotted figures for MAR - FEV - JAN - SUMMER - ANNUAL

→ prepared a MODS file to the summer.

July 13, 2010

→ First attempt to decide: { Model Domain / Horizontal resolution / Vertical resolution



roms_tools_param.m →

- $dx = dy = 1/24^\circ$
- etopo1 ⇒ topofile
- NT = 40 { $\theta_s = 5$, $\theta_b = 1$, $hc = 5$
- hmin = 10
- hmax_coast = 50

make_grid.m ↓

i j k

479 × 326 × 40

dx ≈ 4.5 km

dy ≈ 4.5 km

→ phd1_grd.nc

▽ I was writting README and stopped in the middle of it!

! I still need to struggle to use ETOPO1 in make_grid.m

July 14, 2010

→ Started browsing the material to warm up before Python course.

→ Same thing for July 15, just studying python on online tutorials.

July 30, 2010

→ Back to office after parents visit
→ Working on NSF Proposal: deadline = August 4th !!
→ making some nice plots for the proposal using PYTHON
→ Spent the weekend learning python

August 1st, 2010

→ Brief proposal meting (Anjit, André and I)
- Agulhas Rings 09:30 – 11:00 am
- Model Domains
- Deadline: Aug 04
- Reference list (My task) → for tomorrow

→ No e-mails from Ilson

→ Searching references for NSF Proposal...

August 2nd, 2010

→ Picked Gustavo @ logan and still with NSF references...

August 4, 2010

→ finally finished BCS Proposal references list

→ Ilson is still in silence

→ python in the afternoon: working on paper figures

August 5, 2010

→ Got e-mail from Avijit with new references to search...

→ Another day lost with the references...

August 9, 2010

→ working on paper figs → python

→ done with main figures in the morning

should I concat the "answers to reviewers" figs too?

↳ I did it!! only last one for tomorrow...

August 10, 2010

→ I worked on last paper figure in the morning

→ left after lunch to check Georgia's Board

→ still missing legends of another figure (time series)

August, 11, 2010

→ Not much. Attended James Morris seminar @ WITO I

August, 12, 2010

→ Morning: successfully made grid with etopo 1' topography

→ Grid PhD1_roms new attributes

Domain: 8°S, 50°W, -24°W, 28°S

$dx \sim dy \sim 5\,km \sim 1/20^\circ$

topo ≡ etopo 1'

519 x 423 x 40
i j k

$\theta_s = 5$; $\theta_b = 1$; $hc = 5$; hmin = 10

hmax_coast = 50

→ Afternoon: putting HOPS OA to wak

- did WOA 2009 summer .nod fik

August, 13, 2010

→ successfully compiled OA @ pangea

→ problems on nod fik, OA didn't run properly

August, 16, 2010

→ figured out mod file problem: Matlab CSVread has "0" (zero) as flag for empty data. To solve this I created mycsvread.m and mydlmread.m and replaced zero flag for NaN flag.

→ For the sake of organization, I must come up with a work flow for the experiments!

→ I'm tired of solving boring system issues that I've already solved in the past!

→ OA fields for summer using WOA 2009 are ready

August, 17, 2010

→ Matlab script setup_ini.m is not accepting my OA netcdf file

→ crashes at some point because of dimensions or something

→ should I go for python and finally and definitively learn all the tricky things about netCDF?

August 18, 2010

also learned how classes (python) work...

→ MORNING: learned netCDF reading and writing in python using netCDF4 module (Rob Hetland videos)

→ AFTERNOON: started to implement modelling workflow before actually starting the runs, to keep the mess organized

So, new features so far:

EXPERIMENTS file: ascii table of experiments

phd1_run.setup file: ascii file with run settings

↳ will work as a info database to future python codes that will generate model input fields

→ started to create make_ini.py script, that will create ROMS_ini.nc file

→ REMEMBER: that will depend on:

> phd1_run.setup ascii file (created!)

> roms_setup.py python class (to be created!)

> netCDF file with standard data (hops OA, for ex)

→ target for tomorrow: → roms_setup.py (possible name)

1st create a python class to storage metadata from run.setup

2nd finish make_ini.py script, test it and run it, finally creating phd1_ini.nc

August 19, 2010

→ created python class roms_setup.py

→ continued working on make_ini.py

- reading netcdf files
- initialization
- 2D interpolation (level by level)
- sigma interpolation crashed (still don't know why)

I double checked with matlab and it turns out that is some syntax differences not allowing the thing to work on python

Keep in mind for tomorrow:

- check piece by piece of the matrix what the .m is trying to do and write it differently in python if that's the case.

August 20, 2010

→ after a lot of fight, I figured out what ztosigma was doing. Tricky Matlab indexing using logical indexes.

→ managed to interpolate T,S to S-coordinates

NEXT STEP → go on with make_ini.py to create netcdf initial file

August, 23, 2010

→ Morning: finished make_ini.py and made netCDF file

→ Afternoon: stated working on make_grid.py, that depend on several functions. This one will be tough

make_grid.py → stopped in some index problem

- rho2uvp ✓
- get_metrics ✓ → working on those
  - spheric_dist ✓
    - get_metrics_tmp.py
    - spheric_dist_tmp.py

    not included into rooms_setup.py yet!
- get_angle ✓
- add_tops ✓
- process_mask, uvp_mask ✓
- smothgrid ✓

August, 24, 2010

→ Since it is going to be time consuming, I'll move on to the model run and continue the grid in python later on. Today I'll only finish the functions I started yesterday

CURRENT WORK FLOW CHART

Topography Processing — ETOPO 1' - based

~/phd/roms/topography

create_topog.m

create_topog_uniform.m

⇓

Climatology Processing — WOA 2009 - based

~/myroms/phd_run1/ihit/

/hops_oa/work

⇓

Grid Generation — RomsTools make_grid_phd1.m

~/myroms/phd_run1/ihit

⇓

Initial Fields — make_ini.py

~/myroms/phd_run1/ihit

↳ phd_run1.setup !

Model Config

~/myroms/phd_run1

→ phd1.in !

→ phd1.h !

↑

Forcing Fields

↳ setup_frc_phd1.m

(still in matlab)

⇒ **Model Compilation**

↳ occania : edit build.bash

Model running, but still with mixed processing tools :

300 time steps = 1 an

- TOPO : matlab (gotta move to python)
- OA : hops-OA / fortran (that's ok)
- got to make a script in python to create the NODS file
- GRID : matlab (got to move to python or fortran)
- INI : python !
- FRC : matlab (got to move to python)

Still @ August 24, 2010

→ While the model is running (10 days so far), I'm working on make_grid.py. Until the end of the day I finished with add_topo function

→ Now I have the topography. Need to filter yet

→ tomorrow: (1st) → look phd_run1 out puts

(2nd) → continue working on make_grid.py

> function compute_mask.m

> function smoothgrid.m

August 25, 2010

→ I basically spent the whole day translating plot_roms.m to python

→ plotted some rd-hmp movies for the surface layer

→ need to catch up with the programs to finally organize everything better

August 26, 2010

→ going through cppdefs options

→ seamount.h (maybe should try TS_DIF2, MIX_GEO_TS, UV_VIS2)

→ why do I use ANA_FLUXES?

→ plot_roms.py is already pretty

→ still need to un-hardcode some variables to make it more practical

→ explore IDV!

August, 27, 2010

→ Ideas that pop out on my mind:

- to accelerate plotting using Traits, maybe I should create NetCDF files more simple in z-coord already, using python.

→ Need to organize my ideas and focus on them one by one.

→ (1st) Doing read_roms.py to make a short NetCDF file with z-interpolated fields

↓

didn't work, not enough time saving

→ That's it week is over, let's surf Hurricane Danielle

August, 30, 2010

→ started the day plotting phd2 outputs

→ phd expt is not good!

August 31, 2010

→ phd1 running for 40 days

→ while it is running, I'll work on the flat bottom topography experiment

→ working on the huge code SMOOTHGRID.m. at least now I'll know how roms_tools was filtering my topography

→ I spoke to Ayan and he told me to try these cpp options: TS_MPDATA, DIFF_GRID, LMD_MIXING

→ made through SMOOTHGRID.m => smooth_grd.py

→ Next step: store variables into netCDF grd.nc file!

September 1st, 2010

→ make_grd.py is ready! phd1_grd.nc successfully done

→ lunch!

→ setting up flat bottom control run (exp C2)

→ topography all set

→ next page: tentative workflow:

PhD ROMS WORKFLOW

1. Edit phd2_run_setup [run directory]
   > ascii file with metadata to be loaded later on by python scripts

2. Edit and run make_grid.py [init directory] (need plots)
   > change the name of the run (phd1 -> phd2)
   > result: phd2_grd.nc generated in run directory
   > requires topography .mat file (I need to make it nc)

3. Edit and run make_ini.py [init directory]
   > phd1 -> phd2
   > result: phd2_ini.nc
   > requires OA netCDF file (need to explain how to do it)

4. Forcing file (init directory)
   > as there is no wind, just copy from phd1
   > result: phd2_frc.nc

5. Edit header file phd2.h [run dir, just copy phd1.h]

6. Edit phd2.in [copy from phd1 and change what's needed

(7) Copy files to oceania server

(8) Compile ROMS

> if there were changes in phd.h ...

(9) Run ROMS

> nohup ./ocean0 < phd2.in > phd2.out

> tail -f phd2.out to monitor

(10) Copy files to local machine

(11) Run roms_ek.sh , plot_ek.sh

> take a look into KE from the run

(12) Run plot_roms_driver.py

> look at the outputs

September 03, 2010

-> Now that I have the flat bottom run, I need to carefully take a look into the fields (INI and OUT)

September 6, 2010

> re-run of phd 2 changing advection of tracers and mixing of tracers (horizontal)

→ also turned on some keys to enable saving diagnostic outputs:

> had a conversation with Andre and decided to focus more on phd goals

→ what finally makes sure for me to start doing ??

September 7, 2010

> plotting HYCOM outputs to check SEC structure close to Brazilian coast. Still downloading hycom outputs

→ meeting w/ Arijit tomorrow: plot whole domain figures!

→ hycom downlods stopped at day: 2005-05-24

→ achar a página interativa do hycom (já plota mida)

September 9, 2010

→ had a meting w/ Avijit, that once again had totally widespread my ideas. I felt like we're loosing focus.

→ I need to draw my "box" and check what's coming in and out the domain with three possible sources of information:

✓ ⇒ OEII + AbII diag ROMS RUN

⇒ WOA2009 geostrophic velocities (problem with N.R.)

✓ ⇒ WOA 2009 climat. ROMS RUN w/ red bpog

* calculate transports in and out, check if volume is conserved

September 13, 2010

→ Finished transport analysis: climo run conserves volume, data run doesn't

Gauss function: $C(r) = (1-\varepsilon^2)e^{-r^2/L_c^2}$ (OA)

$a, b, c > 0$

$$f(x) = a \cdot \exp\left[-\frac{(x-b)^2}{2c^2}\right]$$

Playing with Feature Models:

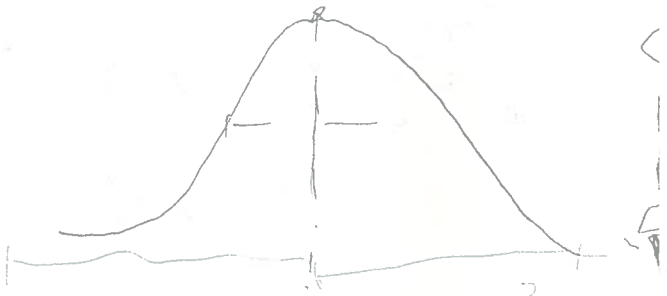
Modelling a depth-dependent gaussian jet

Gaussian Function: $f(x) = a \cdot \exp\left[-\frac{(x-b)^2}{2c^2}\right]$

$a \equiv$ peak height

$b \equiv$ position of the peak centre in x axis

$c \equiv$ peak width



In an ocean environment:

$$v(x) = v_0 \cdot \exp\left[-\frac{(x-x_0)^2}{2 \cdot \delta}\right]$$

$v_0 \equiv$ maximum velocity of the jet

$x_0 \equiv$ position of the jet core

$\delta \equiv$ jet with

Formulation for depth-dependance (SEC example)

In this case: $v = v(x,z)$, where: $v_0 = v_0(z)$

$x_0 = x_0(x)$ (SEC like flow)

$\delta = \delta(z)$

September 14, 2010

→ Now, to tune the model, we need extensive comparison with all available data we can look!

September 15, 2010

→ The best results to come up with a SEC vertical structure was the ROMS climo run

→ mean field from day 10 to day 20

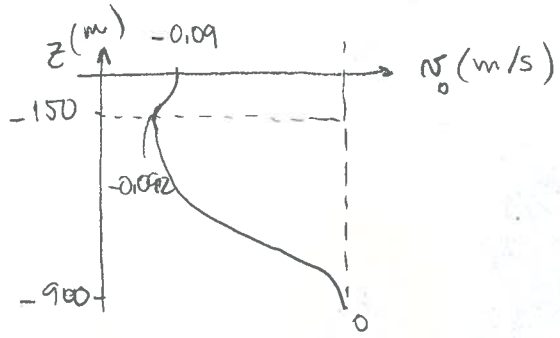
→ mean zonal velocities in a 2 degree box

36°W → 34°W

→ refer to plot_SEC.py to look into vertical plot

→ FM now:

✳ Vertical formulation for the velocity core:



v_0 ≡ velocity in the axis of the jet

$$v_0(z) = \begin{cases} (v_{core} - v_{surf}) \times \exp\left[-\dfrac{(z - z_{core})^2}{2\delta_a^2}\right] + v_{surf}, & \text{for } z_{core} < z < 0 \\ (v_{core} - v_{bot}) \times \exp\left[-\dfrac{(z - z_{core})^2}{2\delta_b^2}\right] + v_{bot}, & \text{for } -1000 < z < z_{core} \end{cases}$$

where: v_{core} ≡ velocity in the core of the jet (max. vel)

v_{surf} ≡ surface velocity in the jet axis

v_{bot} ≡ velocity at the bottom of the jet (generally = zero)

$\delta_a \equiv$ decay of jet velocity from core depth to surface

$\delta_b \equiv$ decay of jet " " core to bottom

$z_{core} \equiv$ depth of the jet core

And the best matching transport gave us these values:

$v_{core} = 0{,}092 \ m\,s^{-1}$

$v_{surf} \equiv 0{,}09 \ m\,s^{-1}$, $v_{bot} = 0 \ m\,s^{-1}$

$z_{core} = -150 \ m$

$\delta_a = 42 \ m$; $\delta_b = 225 \ m$

* Vertical formulation of the jet axis position

$$y_0(z) = \begin{cases} y_{core}, & \text{for } z_{core} < z < 0 \\ 0{,}19\,z + 633, & \text{for } -1000 < z < z_{core} \end{cases}$$

This guarantees that the axis position is constant between surface and core and also that from core to bottom it only changes by a linear function that corresponds to 1,5° of latitude using $z_{core} = -150m$ and $z_{bot} = -1000 \ m$

* Jet width → seems like a constant value is reasonable

$\delta = 170 \ km$ (gaussian decay, not width exactly)

Final equation for SEC FM

$$v(y,z) = v_0(z) \cdot \exp\left[-\frac{(y-y_0(z))^2}{2\sigma^2}\right]$$

$v_0(z) \equiv$ jet axis velocity

$y_0(z) \equiv$ jet axis position

All this is coded in ~/phd/fm/sec_fm.py

the results for transport are: DATA = -15,95 Sv

SECFM = -16,09 Sv

→ Let's work on NBUC FM. Maybe this will be:

$v = v(x,y,z)$, which is far more complex.

→ let's take a look at the ROMS WOA 2009 Run in a similar way we did for SEC

September 16, 2010

→ I divided East sector in three subsectors and made parallel means for each sector (meridional flow, meridional average

→ computing only the NBUC transport, ie, masking other flows, I got an interesting pattern for the NBUC growing northward.

→ if you don mask the flows, this is what you get:

→ 9,54 Sv
→ 5,65 v
→ -2.18 Sv

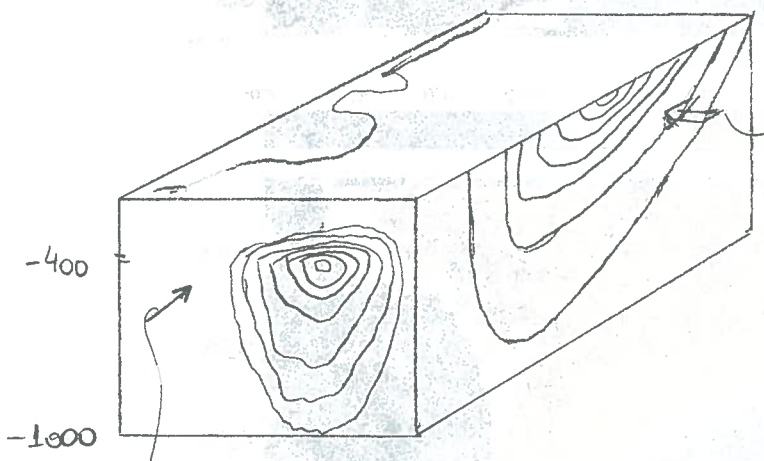
} which is still convincing!

→ So, at this point, I'll be happy to try a simple case: NBUC FM with the same vertical structure in all latitudes, but changing transport as the data changes, ie, increasing to the north

→ By the end of the day I created the FM only to a particular latitude, to match the transport of the central sector. Tomorrow I need to develop y-dependance → hard task!

→ keeping notes of Andre's suggestions:

Initial field for first sensitivity run:



SEC FM only as boundary condition in ROMS - fixed during run to guarantee Sverdrupian incoming

NBUC FM in the whole domain, increasing transport to the north. Doubt: put the NBUC topography following or straight following a meridian

* The idea is to let the transport unbalanced and let the model figure out how the southward outgoing organizes

September 17, 2010

→ Formulation of the NBUC FM :

September 21, 2010

→ I need to re-write the FM's formulation in a more math-reasonable way. Check Filipe's thesis or André's paper for ideas. That's because I need to integrate the analytical functions in order to compute ρ field.

NBUC

$$V(x,y,z) = v(y,z) \cdot \exp\left[-\frac{(x-x_0)^2}{2\delta^2}\right], \text{ where } \begin{array}{l} v \equiv \text{jet axis velocity} \\ x_0 \equiv \text{jet axis position} \end{array}$$

$$v(y,z) = v_0(y) \cdot \begin{cases} \exp\left[-\dfrac{(z - z_0(y))^2}{2\delta_s^2}\right], & \text{if } z_0 < z < 0 \\ \exp\left[-\dfrac{(z - z_0(y))^2}{2\delta_b(y)^2}\right], & \text{if } -1000 < z < z_0 \end{cases}$$

$v_0(y) = 8{,}23 \times 10^{-5} y + 7 \times 10^{-2}$ (from 7 – 14 cm/s, S to N) ≡ represent increase in transport

$z_0(y) = 0{,}18 y - 350$ (from 350 – 200 m, S to N) ≡ represent the shoaling of the jet core

$\delta_b(y) = 0{,}16 y + 220$ (from 220 – 360, S to N) ≡ represent the increase in jet thickness

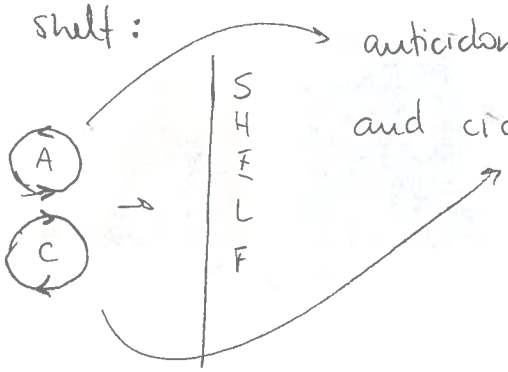
September 22, 2010

→ I came to MIT with Juliana: Shukela seminar at Sack lunch and Glenn Stability class

Notes on Shukela Seminar:

"A process of Inter-Ocean Exchange in Relation to the Ocean-Climate Meridional Overturning Circulation (MOC) of the South Atlantic"

→ dipoles coming from open ocean to shelf interact with the shelf:



- anticiclone forms a pantun ciclone and ciclone does not interact

→ dipole interaction makes agulhas rings propagate faster than the beta effect would alone.

SEC

$$\bar{V}(y,z) = v(z) \cdot \exp\left[-\frac{(y-y_0(z))^2}{2\delta^2}\right]$$

$v(z) \equiv$ jet axis vel.

$y_0(z) \equiv$ jet axis position

$$v(z) = \begin{cases} (v_0 - v_s)\exp\left[-\dfrac{(z-z_0)^2}{2\delta_a^2}\right] + v_s, & \text{for } z_0 < z < 0 \\ (v_0 - v_b)\exp\left[-\dfrac{(z-z_0)^2}{2\delta_b^2}\right] + v_b, & \text{for } -1000 < z < z_0 \end{cases}$$

$$y_0(z) = \begin{cases} y_c, & \text{for } z_0 < z < 0 \\ 0{,}19\,z + 633, & \text{for } -1000 < z < z_0 \end{cases}$$

$v_0 \equiv$ jet core velocity

$z_0 \equiv$ jet core depth

$\delta_a \equiv$ decay of jet vel. from core to surface

$\delta_b \equiv$ decay of jet vel. from core to bottom

$v_s \equiv$ vel. at the surface

$v_b \equiv$ vel. at the bottom

$v_0 = 0{,}092 \ ms^{-1}$

$v_s = 0{,}09 \ ms^{-1}$

$v_b = 0$

$z_0 = -150 \ m$

$\delta_a = 42m$; $\delta_b = 225\,m$; $\delta = 170\,km$

Computing ρ field for SEC FM:

$$U(y,z) = u(z) \cdot \exp\left[-\frac{(y-y_0(z))^2}{2\delta^2}\right]$$

Complete formulation of the model

$$\frac{\partial U}{\partial z} = +\frac{g}{\rho_0 f_0}\frac{\partial \rho}{\partial y} \rightarrow \text{thermal wind}$$

Integrating thermal wind: $$\rho(y,z) = \rho_0(z) + \frac{\rho_0 f_0}{g}\int_0^L \frac{\partial U}{\partial z}\,dx$$

October 4, 2010

→ after one week of work trying to come up with temp/salt fields for the velocity FM, I'll summarize what I did:

Computing ρ ⇒ vertical integrate of thermal wind equation: Schmidt et al (2007)

NBUC example: $$\rho(x,z) = \rho_0(z) - \frac{\bar{\rho} f_0}{g}\int_0^L \frac{\partial v}{\partial z}\,dx \qquad \bar{\rho} \equiv \text{mean}(\rho_0)$$

SEC example: $$\rho(y,z) = \rho_0(z) + \frac{\bar{\rho} f_0}{g}\int_0^L \frac{\partial u}{\partial z}\,dy$$

$\rho_0(z) \equiv$ mean ρ profile from WOA2009 inside domain of OEII

Computing T → Linearized seawater state equation

Schmidt et al (2007)

$$T(x,z) = \frac{-\frac{\rho}{\bar{\rho}} + 1 + \beta \cdot S_0(z)}{\alpha}$$

$\bar{\rho} \equiv 1000.7 \text{ kg m}^{-3}$

$\alpha = 2.2 \times 10^{-4}$

$\beta = 8 \times 10^{-4}$

$$S(x,z) = S_0(z) + 10^{-2} \cdot T(x,z)$$

← Schmidt et al. (2007)

$S_0(z) \equiv$ mean Salt profile from WOA 2009 within OEII domain

→ after this, I created buffer zones to expand the Fields and get them all set to go to ROMS grid

Next Steps:

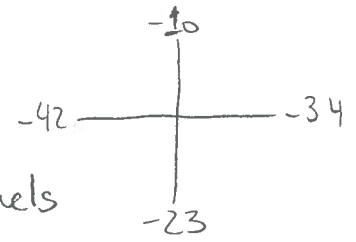
1) Create ROMS regional grid and interpolate initial fields (NBUC - FM)

2) Create ROMS boundary forcing file (SEC-FM)

October 5, 2010

* Creating ROMS regional grid

Metrics: 191 x 271 x 50 (1/20°), 50 levels



* Initial Conditions file → loads a mat file in place of NETCDF

→ created make_ini_FM.prj — loads and interpolate velocity

Creating SEC boudary forcing ROMS file

→ phd3_bry.nc created with make_bry_FM.py!

Oct 6, 2015

→ but I only created with the *_east variables and only with temp, salt, v3D(u,v)(z)

No forcing file!

Edited phd3.h → the basic changes:

1) define ANA_SMFLUX (analytical wind) → attention:
   - new .h file included. I copied SRC/User/Functionals/ana_smflux.h to phd_run and edited one of "if defined MY_APPLICATION" to PHD3 and defined ZERO wind stress field
   - now I have also to copy this file to SRC/User/Functionals/ in my build.bash script!!!

2) UNdef ANA_M3OBC (we want to use bry.nc file)

3) Changed the M3 and T east open boundaries to CLAMPED
   "Clamped boundary conditions are 100% reflective to any flow not described by the user boundary condition"
   ↳ Carter and Merrifield (2007)

Edited phd3.in with obvious apropiate changes

Model Compiled

Model Running !

Now I need to keep track and check what the confguration is doing

→ While is running, I was looking @ OCCAM data: amazing!

→ Now I'm downloading the whole annual mean data set in pacific as nohup.

→ Also download some monthly fields to plot...

October 7, 2010

→ ROMS done (phd3) !

→ OCCAM download done! Now I have the monthly fields too

→ let's look at the outputs: here are the comments:

! clearly boundary conditions problems

→ I will re-run with new CPP options:

EAST ↑ M3CLAMPED	TRADIATION	North, South	ANA_FSOBC
	M2FLATHER		ANA_M2OBC
	FSCHAPMAN		ANA_TOBC (Not using TIS from FM)
	M3RADIATION		

No ANA_M3OBC!

with RADIATION_2D and NO VOLCONS

* also added UV_COR, UV_ADV (let's see tomorrow)

comments:

→ Still boundary problems

next trys => remove SEC, decrease resolution to run faster

→ just another thoughts to next runs:

- increase grid to east
- remove ANA_OBC's

→ still remain boundary problems

→ removing ANA_OBC's (complained about absence of bry.nc file)

→ changed FSCHAPMAN for FSGRADIENT and activated SPONGE

- still reflecting!

→ back to olld boundary conditions, increasing domain to the east

- still reflecting!

→ added VOLCONS to all boundaries

- still reflecting!

→ changed everything to RADIATION

- awfull result!

October 9, 2010

Saturday

→ NORTH : RADIATION to all
EAST : RADIATION to all
SOUTH : RADIATION to M3 and T
CHAPMAN to FS
FLATHER to M2
VOLCONS

→ Comments:

MSFLATHER combines with FSCHAPMAN

In the next try, I'll probably have to provide ZETA, UBAR and VBAR in my boundaries, according to what I'm doing

* Replied Rayo regarding OCCAM ✓
* created ECMWF Forcing NETCDF file for phd2 ✓
* phd1 is running again with winds ECMWF

October 19, 2010

→ Amazingly, the winds turned on the anticiclones
→ I decided to go along with Arjit's plans, because I can't row against the flow anymore. Ilson keeps promising but never actully helping.

→ I'll try to decrease resolution in order to the model run faster.

→ From 1/20° to 1/12°

→ phd 1 → ECMWF winds

→ phd 2 → no winds

→ phd 4 → ECMWF winds → ROMS barotropic mode

October 20, 2010

→ SEMINAR: ~~David~~ Kenneth Brink (WHOI)

"A view of the Ocean Sciences : 2010"

→ 1970 - NSF beginning spending big money on oc. sci.

→ Remote Sensing (SST, SSC, SSH)

→ Moored current records
- data return improved a lot in years

→ Numerical Models
- from Bryan (1963): steady flows
- (1975): instantaneous fields, eddies, time-dependant flows, 2 kyr
- (2008): submesoscall, realistic flow, any sorts of scales
- interdisciplinary models

→ Global Observational Systems
- ARGO : 3239 floats as oct, 2010
- CODAR : real-time high resolution currents
- operational and research uses

→ Satellite winds measurements

→ Data Assimilation

→ New intelectual frontiers
- submesoscale and its biological implications

→ New concepts
- boundary layer arrest
- symmetric instability

→ diversity of approach and viewpoints increased a lot with diversity of cutting edge oceanographic institutions

→ Many new good reasons to do research
- heat transport
- carbon sink
- acidification
- fisheries
- eutrophication
- oil extraction
- floating plastics

→ Public Opinion in favor of the ocean
- visual appeal
- tangible and visible to all
- important intellectual challenges
  Eg origin of life

→ So, are we living in a golden age?

- few would say so...

because funding is increasingly difficult...

Why?

- research funding?
  - hard to track, for various reasons
- 1980 - 2002 total federal dollars were about constant
- population of researchers?
  - hard to track
    - → 2 to 3 times more people out there to compete
- DOE ended
- Office Naval Research scaled back
- NASA and NOAA have held on, remain the same
- more people turn to NSF
- NSF funding have fallen

→ But there is the OOI! (Ocean Observatories Initiative)

- cabled observatory
- permanent ~~one~~ long-lasting "sockets" in the ocean
- real time data available

October 20, 2010

→ Seriously think about moving from Vtransform/Vstretching (1) to (2)!

→ test the "undef" hypothesis

October 22, 2010

→ PHD1 → ECMWF, 90 days

→ PHD2 → NO WIND, 90 days

→ PHD3 → FEATURE MODELS SEMI-IDEALIZED

→ PHD4 → Testing things ...

October 29, 2010

→ Starting PHD 5 → pilot experiment to test use of OCCAM as boundary condition

→ new smaller grid: 42 - 32°W ; 23 - 12°S
1/24°, 40 S-levels

→ OCCAM as initial and boundary conditions

November 1st

> Meeting with Avijit in the conference room to show wind/nowind simulations

> Get back to the paper. Write up on OCCAM results, letter and paper. Ilson gave us green lights to move by ourselves.

NO WIND

IE – (1) first sgn. day 35 ↺ AC

(2) Cyclone @ 165 moves Northward and destroys the signature of IE. day 45

(3) AC (IE) reappears on day 50 – persists through day 70 once natural interference was passing Cyclones to its offshore side.

(4) The third cyclone passes offshore of IE on day 60.

RCE – (1) first strut day 35 ↺ AC

(2) Stays there till day 70.

(3) Cyclones pass offshore.

AE – (1) 1st signature day ~~35~~ 40

(2) Cyclone propagate northward and destroys AbE, ~~but it shows up again~~ on day 55.

(3) After that it doesn't show up anymore

Although AbE is the most permanent looking feature according to data, it is the one that is less permanent in the "no wind" run.

WIND

> In the no wind case, cyclones propagate faster than with wind

> With no wind, Vitiaz Eddy crosses VTR and erases AbE. This do not happen in the wind run. In the wind run, Vitiaz Eddy stays south of VTR and does not "erase" AbE.

Next steps: ideas

look into subsurface fields 1st

① Flat Bottom => mean T.S

② Move the western boundary to the east of Ab. Bank

③ forget about ① and ② and move to FMs.

November, 1st, 2010

> After-meeting tasks:

1) Plot subsurface fields
2) Set up flat bottom experiment using coastline shifting technique. Run it
3) While it runs, go back to paper re-submition

> pacific is making plots for subsurface fields

> setting up PHD6 run
- flat bottom
- initial conditions → WOA2009 - 2°W shifting
- forcing → ECMWF mean jan winds

November 2nd, 2010

> finished PHD5 run set up and it's running

> back to paper now

> I will restart PHD5 with WOA2005 as initial field, otherwise, it doesn't make sense to compare with PHD1. Roms also wasn't reading my M3 bry, only free-surface (FS)

November 3, 2020

> PHD 5 : unrealistic temperature values occurring on the boundaries. Maybe I'll move to nudging.

> re-doing PHD5 run with these new features :

- TRADIATION + TNUDGING
- FS RADIATION + FS NUDGING
- M3 RADIATION + M3 NUDGING
- M2 FLATHER

Nudging time scale = 50 days

OBCFAC = 1 (inflow = outflow)

> PHD6 → I stopped, because all the flow is contouring the boundary

> PAPER

- downloaded LaTeX trackchanges package
- did the changes required by reviewer #1

> PHD5 : above boundary condition config seems to be working fine. Now it's a good time to test Vstretching = 2 Vtransform = 2 and after that, rocons. Because the run is pretty fast now.

↳ changelog :

Vstretching = 1 → 2
Vtransform = 1 → 2

θ_s = 5 → 7
θ_b = 1 → 0.1
hc = 200 → 200
tclim = 200 → 200

New : grid
files : ini
mode : bry

*** Model Running ***

> I shouldn't have changed θ_s and θ_b, because now I have two independant variables changing:
⇒ vertical spacing and coordinate transformation

obs: since I have now less surface resolution, the surface flow is too strong, and the but let us it keep going. We'll need a comparison later on using same θ_s and θ_b though..

November 5, 2010

> for some reason, the run stopped with no signs of error. Maybe it's some crazy thing about SMAST workstations again. I restarted the run

November 8, 2010

> doing now phd5 with:

Vstretching = 2	$\theta_s = 5$
VTransform = 2	$\theta_b = 1$

> I'm getting so much strange results! going back to previous vertical configs...

> And now testing run without VOLCONS

> PAPER : I think I finished the answers to reviewers

→ now I have to work on the paper

- new figure set-up, putting OCCAM fields
- write up on OCCAM results ... ...

November 9, 2010

> PHD5_run : running without VOLCONS

> PAPER : - reading again to check where the new stuff will fit.

- reworking the plots ✓
- changes regarding new plots are done ✓

Next → write up on the introduction regarding new AVISO plot. ✓

→ write up on OCCAM plots. (Tomorrow)

November 10, 2010

> PHD5_run : again an unexplainable halt in the run, I had to re-start it. That's really anoying. But since was in the beggining, I started from 0th day and didn't change LDEFOUT and NRREC and INIMAME

> PAPER : writing up on OCCAM results

> SMAST DEOS SEMINAR : "Subtided flow in the eastern Long Island sound" - Michael M. Whitney - University of Connecticut

- want to attend!

SEMINAR NOTES => NO notes

> PAPER : first round of new write-up is done. Now I need to rest, sleep over the thoughts and review it tomorrow.

> I can still finish the figure captions today ... and then re-print the version of the paper

— November 12, 2010 —

> finished paper 1st draft after review, sent to Arijit

— November 15, 2010 —

> what to do now ? Arijit is reading the paper

> I decided to read a couple more papers from ROMS OBC's, implementations, etc ...

> PAPER: Arijit gave me back the paper. Time to fix it!

November 16, 2010

> corrected Arijit editions on the paper

> got approved in RMV writen exam

November 17, 2010

> printed new paper draft to Arijit, as well as rebuttal letter and figures

> finished the synthesis of Marchesiello et al. (2001), read Marchesiello et al. (2002) and Matano and Philander (1993) and also annotate highlights in toms_notebook.txt

> downloaded and printed Palma and Matano (1998, 2000) and took home to start reading

November 18, 2010

> early in the morning Arijit passed me his 2nd round of editions. Doing it right away to go through a 3rd round and finally finish it.

> planning also to give a final touch on the figures using matplotlib website ideas.

> paper is back with Arijit → Meeting @ 4pm today

> Now I need to do the final submission version and write a letter to the Editor (and show this letter to Arijit)

November 19, 2010

> fixing paper references

(1) look for new inputs and:

1) put it on .bib
2) copy .bib on ~/misc
3) add it on \thebibliography environment
4) compile later file again

→ remember that there are two paper versions:

1) tracked-changes → to send to the editor via e-mail
2) submission → to upload on GEMS

> Juliana and I cutted few parts of the text and we saved one page in double-spaced mode.

> Moving to submission version:

1) Fix reference citations using \cite, \citep
2) remove tracked-changes commands

\add
\change
\remove

> Submission candidate is Ready!!! Now we have to check if it will fit the GRL length

> Next step: write letter to the editor (1) and do a final review in the rebuttal letter (2)

November 22, 2010

PAPER: 1) rebuttal letter final review

→ made the rebuttal letter, edit supplementary text

→ made the editor letter

→ going to GEMS, but be careful!

before uploading response_to_reviewers.pdf, put the line numbers according to the final version of the manuscript.

November 24, 2010

PAPER: > submitted, awaiting initial quality control

> we passed initial quality control, we are under review!

RUN TOMORROW: repeat phd1_run with bigger time step and saving averages every 5 days

> trying 300s as DT; (worked perfectly fine)

November 26, 2010

PHD7: running with DT = 300s ⇒ compare results with 100s

> comming back to idealized runs ↗

PHD8 Run

> follow Peliz et al (2003) steps to implement this run

→ Same domain as in phd3, but now starting simple only with SEC FM

- SEC FM as initial field for the whole domain and as boundary condition applied to SPONGE/NUDGING layer at the EAST

- Meridional large scale density gradient forcing an inflow into the domain => SEC FM

→ No other forcing!

→ Peliz domain: 37°-43°N; 8.5°-13.5°W ~ 660 x 340 km; 2-6 km res.

My domain: 23°-10°S; 42°-32°W ~ 1000 x 1430 km; 5km res.

- depth set to 1500 km in Peliz => I'll do that too!

- change the S levels accordingly => 20 levels to save time

→ Boundary conditions

(EAST) - inflow kept quasi-steady using nudging on 6 grid points. Nudging time scale vary from 1 day in the edge to 6 days in the inner grid point of the nuging layer

- Active/Passive OBC together with the nudging (radiating out)

(NORTH/SOUTH) - Strong nudging to inflow and outflow for tracers and momentum => time-scale ≤ 1 day

> trying to get the cpp options correctly for the open boundary conditions.

> fix time of climatology file!

November 30, 2010

> PHD8: simulation ended and flow remained steady all the time. Maybe the strong nudging is being applied to the whole domain, not only in the sponge layer. I think I need to run ana_nudgcoe.

> need to fix climatology time

> Editing ana_nudgcoef.h seems to work! Now I need to add Passive/Active boundary conditions using:

phd8_bry.nc → make it

EAST, NORTH, SOUTH, T, M3, ?, ?, CLM_NUDGING cpp options

> Remember in the end to write the how-to in Roms notebook.txt

December, 01, 2010

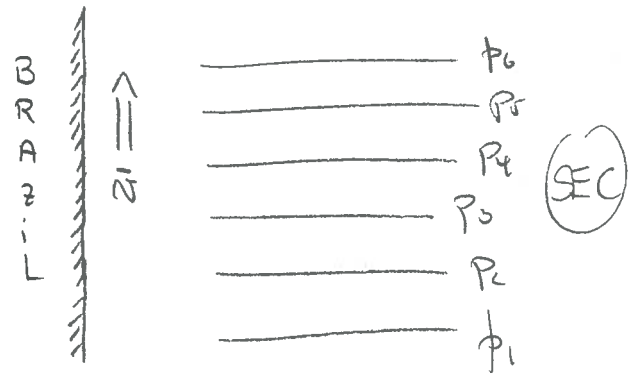
PHD8 → running

PHD9 → running

Peliz et al 2003, JPO: very important!

Peliz et al. (2003) JPO

> comments on the interaction between zonal flow and meridionally oriented slope/shelf ⇒ generation of meridional jet.



$p_1 > p_2 > \dots > p_6$

$$\rho_0 \beta h \bar{v} = -\frac{\partial p}{\partial y}\frac{\partial h}{\partial x} \quad \Rightarrow \boxed{\bar{v} > 0}$$

(1) $\quad \ominus \quad \oplus$ $\qquad$ (NBUC)?

> So, how can we use this thought on Brazil coast and explain the existence of poleward ($\bar{v} < 0$) western boundary current?

→ ideas for modifying the experiment

* does the wind play a role?
* what if I extend the domain all the way down to CF and also extend SEC flow? will I be able to use (1) the way it's written?
* if that doesn't work, maybe I can force a BC further south, where I observe it in data, clearly

December 2, 2010

> After Alvato's e-mail, here is what I'm going to try

→ use only climatology first, no bry. Change all boundaries to radiation.

(1) check if cpp option NUDGING_COFF is working, because there is no signal of ana_nudgcoef.h being read by roms

(2) also, check the clm file times

(1) → that's working fine. I figured out by looking into globaldefs.h if-else blocks

> need to see if VOLCONS is required or not (if it makes sense or not) for PHD8.

> extend domain to the north, to avoid reflection

> look to SPONGE configs.

last days of December

I was doing a very detail analysis of the effect of some cpp options on the idealized run. Some of the configurations tested were:

* viscosity, type of mixing of momentum and tracers
* nudging and sponge layers
* vertical turbulent closure scheme
* boundary conditions

Some considerations

HORIZONTAL MIXING of MOMENTUM and TRACERS

> kate's config was less stable than mine

> tracers mixing is working fine, no instabilities

> kpp is better than MY for open ocean

> VIS2 = 0 or VIS2 = 25 m^2/s gave the same flow

> FREE-SLIP x NO-SLIP => no impact on the solution

> Using nudging layers only on the east didn't generate a good result on north/south boundaries

Jan 07, 2011

So far, what is defined in the configuration as best working options:

MOMENTUM

ADV, COR, QDRAG, VIS2 -> 0 m^2/s viscosity coefficient
MIX_S_UV; smagorinsky-like viscosity

TRACERS

TS_DIF2, MIX_S_TS, DIFFGRID

VERTICAL MIXING CLOSURE

kpp (LMD), RIMIX, CONVEC, SKPP, NONLOCTL

OPEN BOUNDARIES

RADIATION for everything : M2, M3, T, FS

Need to analyse !

Best combination of :

CLM_NUDGING, NUDGING on BRY, SPONGE → yes or no ?
→ how intense ?
→ how wide ?

East + North + South nudg. layer, no BRY nudging ?

East nudg layer + Sponge + BRY nudging ?

phd 8.17 : Nudging layers on East (No BRY nudging)
Sponge layers on North, South (fac = 10) max = 5 m²/s
(VISC2 = 0)

> solution is fine until day 45

> after day 45, energy increases and eddies dilute, allowing for a BC strong jet

> problems remain in northern boundary

---

phd 8.18 | Nudging layers on East (No BRY nudg.)
Sponge layers on North, South (fac = ~~40~~) max = 50 m²/s
(VISC2 = 5)

> no important diffuence from 8.17

phd 8.19 | Nudging layers on E (No BRY)

Sponge layers on N, S (fac = 100) máx = 500 m²/s
(visc2 = 5)

> overall increase of energy, but same pattern:

grows to day 20, then decreases to day 45, increases again

> only really small differences in the solution

Jan, 11, 2011

phd 8.20 | Nudging layer on N, S, E (Still No BRY)

Sponge layers on N, S (fac = 100) máx = 500 m²/s
(visc2 = 5)

> doesn't change much the solution in the 90 days, so I'm coming back to E nudging layer only, because it makes more sense. Now I'll add active/passive open boundaries, i.e. bry files RADIATION x NUDGING

~~phd 8.21~~ | Nudging layer on E (with BRY active/passive OBCs)

Sponge layers on N, S (fac = 100) máx = 500 m²/s
(visc2 = 5)

> screwed everything up!, (not using active/passive OBC again)

phd 8.21 | Nudging only on E, no BRY

Sponge on N, S (fac = 100) (visc2 = 5) (máx = 500 m²/s)

> running for more time now: 6 months

Jan, 14, 2011

→ paper status : In Press on line, currently on "copyediting"

phd 8.22 (done) → trying to use SEC_FM only in the nudging layer, with a flat and rested initial field

→ setting grounds to the inclusion of NBUC FM

Nudging layer : 7 grid points, from 1 to 5 days (1/5° degree)

> it takes too long to make SEC reach the coast

> next idea : increase nudging layer from 7 to 40 grid points

phd 8.23 (done) → Nuging layer = 40 grid points, from 1 to 5 days (2° degrees)

→ SEC-FM @ nudging E layer only

→ rest of the ocean initialize at rest and flat

> eased the $\vec{\nabla}_p$ errors that generated premature BC in 8.22. But still worth

8.24 → trying to expand the layer more. Need to address some decrease in relaxation towards the coast to avoid strong fronts → 8.25

phd 8.24 (done) → Nudging layer = 60 points, from 1 to 5 days (3° degrees)

→ SEC-FM @ nudg E layer only

→ rest and flat initialization

> doesn't seem to change much the overall boundary solution (NBC)

but still looks better than 8.23

> northern boundary behaves better!

▽▽▽ remember to try 8.25 diminishing more the nudging scale towards coast

Jan, 17. 2011

phd 8.25 → Nudging layer = 60 points ≈ 3°, from 1 to 45 days
done
→ SEC @ nudging layer only
→ rested and flat initial conditions

> only really tiny differences, maybe I should increase to 360 days the interior nudging time scale. phd 8.24 is still the "winner"

phd 8.26 → Nudging layer = 60 points ≈ 3°, from 1 to 360 days
done
→ SEC @ nudging layer only
→ rested and flat initial conditions

> still stick with phd 8.24

Jan, 18, 2011

phd 8 | FINAL CONFIGURATION => EXP S3 → SEC only
→ Initial conditions rested and flat days
→ SEC @ E boundary nudging layer ≈ 3°, 5 → 1 time scale
SEC as velocity and baroclinic signature
→ Radiation 2D conditions for all boundaries for all variables
→ Volcons for all boundaries
→ Sponge layer for N and S only of 6 points, increasing viscosity linearly from 5 to 500 m²/s

→ decided to do a last test with bigger sponge layer. Before my sponge had 30km, now I'll put ~ 140 km

phd 8.27 → same as phd 8.24, with 20 points sponge layer in N and S boundaries.

> doesn't make much difference, so I'll call back on the old sponge and finally fix phd8 configuration, with is the one already listed on page 55.

→ Started working on phd 11, which is experiment 54, to test performance of NBUC-FM implementation.

Jan 19, 20 - 2011

→ working on python script to tune and create NBUC-FM

→ working specifically on topography-following implementation of the FM

→ let's go then to phd 11

phd 11.0 → Sponge in all boundaries, same as in phd8

→ Nudging only of Momentum 3D, north, south, with same scales as in phd8, but shorter layer
=> 30 grid points ≈ 1.5° degrees

> NBUC is generating in the domain after some days
> everything looks fine at a first glance, but to see the real thing, we have to mix with SEC

Jan, 21, 2011

> when I don't put NBUC-FM termohaline structure, the nudging takes more time to work than with SEC, that has both velocity and thermohaline

> let's move on to mix SEC with NBUC!

phd12_RUN Exp S1 => SEC + NBUC

→ Strategy: use phd8 day 45 as initial conditions

→ nudging only NBUC velocities @ N/S. Our first shot will be to keep SEC shutdown in this run, but another idea is to keep SEC with T,S structure and NBUC as velocity using the same CLM file.

→ I need to keep SEC inflow, otherwise the run gets crazy!

phd12_RUN 8 Exp S1 => SEC + NBUC

→ Strategy: start both from t=0 (need to make a mat file with flat and rest both FMs)

→ nudging: try first with velocity 3D nudging only: N, S, E

need to come back to parrows and keep SEC imposed

Jan, 31, 2011

> need to get phd12 right!

So → first attempt = phd12.0

phd12.0

> re-starting from phd8 day 30

> nudging NBUC and SEC M3 only

→ NBUC doesn't seem to develop along all the domain, only in the nudging zones. Also SEC from seems to be weaker first attempt will be include T nudging together with M3 nudging, to reinforce the flows

phd12.1 > re-starting from phd8 day 30

✓ Compiling
✓ Running

> nudging NBUC and SEC M3 and T

phd12 is complicated. Will run exp 54 that is easier

Feb, 01, 2011

phd13 represents exp 54, it run with no issues, so let's get back to phd12, the tricky one

→ My first guess to implement phd12 latter is trying to find a latter re-start day. Maybe 30 is too far...

phd 12.1

→ re-starting from day 10, same configs as phd 12.0

→ again, NBUC doesn't connect to whole W. Boundary

→ solution is very similar between 12.0 and 12.1, in general terms

phd 12.2 ✓compiling ✓ running

→ starting both NBUC and SEC together from t=0 using M3 NUDGING only

→ again, NBUC doesn't connect, only strong BC over surface and deep layer

phd 12.3 ✓waiting ✓ running

→ starting with SEC and NBUC already as initial conditions and nudging of M3

→ blowed out of proportion. Definitely, forcing velocity as initial field is not working.

Feb 04, 2011

phd 12.4 → initial flat and rested ocean

→ impose SEC as M3 and T nudging

→ impose NBUC as M2 nudging (barotropic transport)

→ better than 12.3, but still doesn't hold NBUC structure

Feb 09, 2011

phd 12.5 → initial flat and rested ocean

→ same as phd 12.4 with NBUC 10 x stronger

→ not too much of success, BC still flows through the whole water collumn.

feb 10, 2011

phd 12.6 → same as phd 12.2 with NBUC stronger ⇒ 50cm/s or so

→ maybe it's not enough

March 1st, 2011

phd 12.7 → NBUC and SEC with transports balanced:

SEC = 17 Sv, NBUC South = 5 Sv

NBUC North = 12 Sv

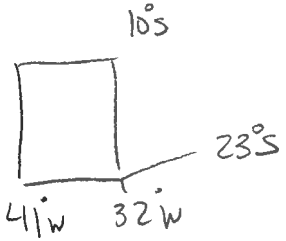
NBUC North = 23 Sv

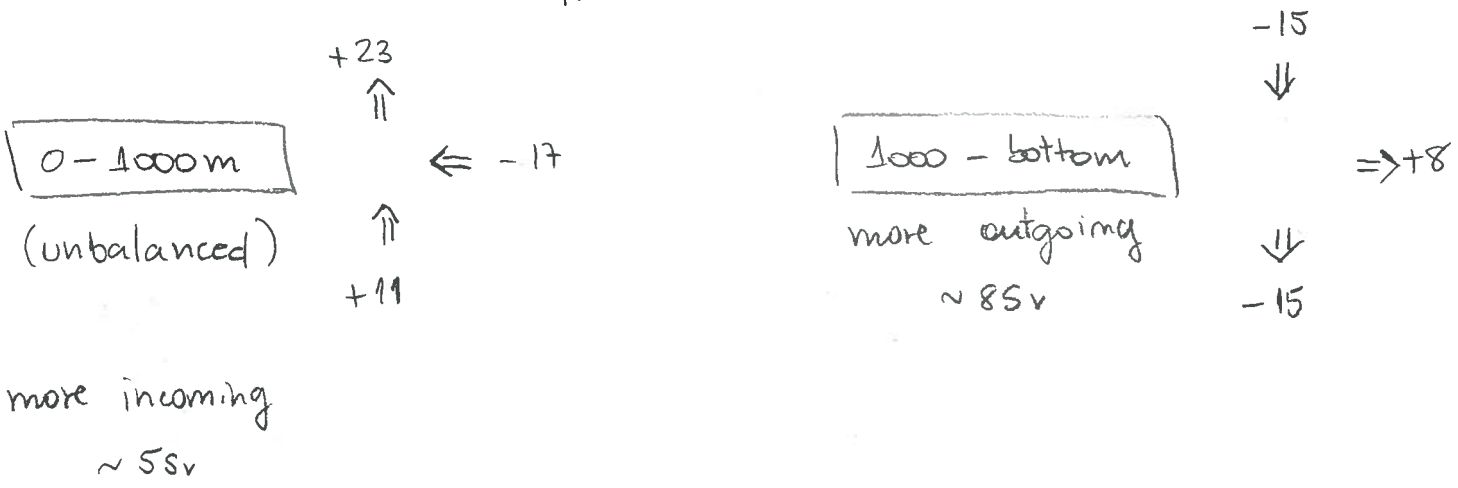
OCCAM Transports: SEC = 17 Sv

0 - 1000 m

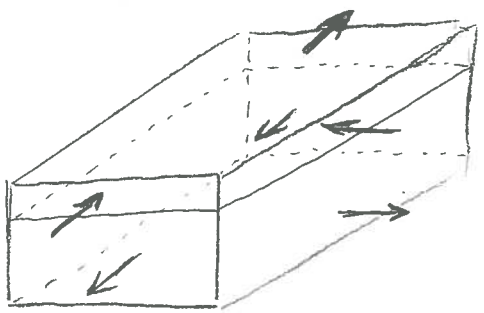
NBUC South = 11 Sv

OCCAM Transports





Conclusion: On OCCAM 2003 average, the transport balance, or volume conservation analysis, say that water is accumulating in the upper ocean and escaping through the deeper ocean



So there must be some net downward vertical velocity to expain it. Maybe that stands for the existance of permanent or recurrent anticiclones both on surface and deep layer

Feb 02, 2011

→ the idea now is to try re-starting phd 12 from phd 11, which has already a stabilished NBUC flow

→ so, let's come back and re-do phd 11 with new NBUC transport values

→ phd 11 is running with 11Sv NBUC

phd 12.8 → Initial conditions are the pre-stabilished NBUC from phd 11 (NBUC = 12 Sv)

→ Clim file will contain NBUC and SEC as M3

→ running

→ run is over. I did the figures but didn't do the directory

Feb 04, 2011

phd 12.9 same as phd 12.8 but using 20 Sv NBUC

Next steps / runs

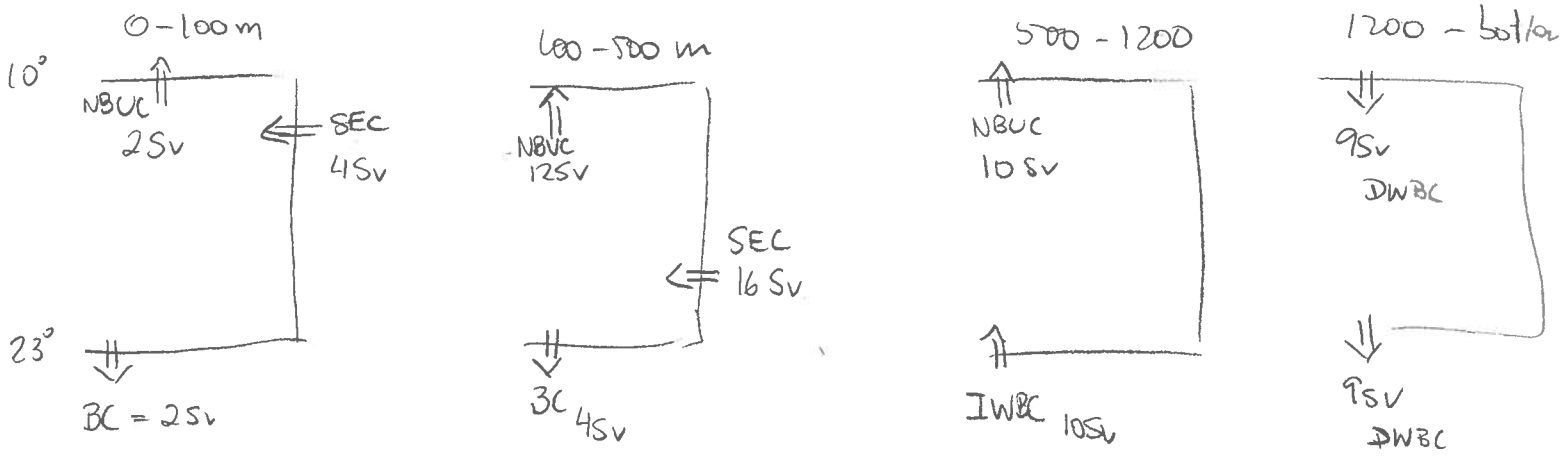
Meeting Feb 07, 2011
Ilson, Avijit

Run 1 - OCCAM 2003 as initial conditions: T, M3,
- OCCAM 2003 as boundary conditions: Nudging layers

Run 2 - FLAT and REST initial conditions (spatial average of OCCAM 2003)
- OCCAM 2003 grid-wise averaged nudging layers as boundary conditions

Run 3 - FM run with new mass balance criteria

New Mass Balance Criteria => Literature, based on data ?



Mass Balance based on OCCAM -> see figures

Ilson's suggestions

- Analysis of OCCAM quasi-daily fields
- ROMS with OCCAM forcing the boundaries
- FM-oriented runs

March 08, 2011

phd 14
- OCCAM 2003 as initial conditions : T, M3
- OCCAM 2003 as boundary conditions : Nudging layers (T, M3)

phd 15
- FLAT INITIAL conditions (spatial average of OCCAM 2003 T and zero velocities)
- OCCAM 2003 as boundary conditions : Nudging layer

→ configuring phd14

→ have to do tempflat !

→ running make_ini.py

→ need to find a solution to interpolation

March 10, 2011

→ still stuck on the interpolation of OCCAM data to ROMS grid

→ try scipy.interpolate.griddata using 'nearest'
→ maybe I have to install EPD 7.0 with python 2.7 in order to get the latest scipy

April 11, 2011

→ We are back on logging after
- Ilson's visit
- COAS talk
- Oregon/California spring break

→ doing T-S plots that Arijit requested
- N, S, E; WOA, OEZ, OCCAM T-S distributions

→ plan for tomorrow:
1) Meet with Arijit to show the TS plots → morning
2) Start doing OCCAM long term series analysis with the available monthly fields

April 12, 2011

1) Arijit didn't have time to meet me
2) Script started and also new data download

April 13, 2011

occam_analysis1.py
- time-dependant BISEC and its relation to NBC and BC transports

→ downloaded bigger domain for one level only

April 15, 2011

→ I was downloading big domain data when I realized it was coming incomplete, maybe because of the size.

April 19, 2011

→ still struggling to download OCCAM

→ downloading OFES 4 time series

→ while downloading, I started to set up the OA for OCCAM fields: making occam2mod.py

April 20, 2011

→ OCCAM download status: finished 1995, part 1

→ OCCAM - ROMS Run: ✓ finished Feb 2003 mod file
✓ running OA for Feb 2003: done

April, 21. 2011

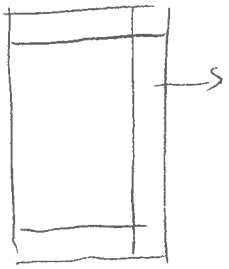
→ OCCAM download status: 2000, part 1

→ moving to initial and climatological fields construction

phd 14

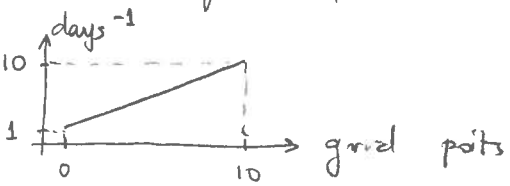
phd 14

- Initial Conditions : OCCAM Feb 2003, because it has the Eddies → 1st attempt: tracers only
- BRY Conditions : Fixed OCCAM Feb 2003, to check the Eddies behavior
  → 1st attempt: Tracers only



Nudging layers of 10 grid points

Nudging coeff :



> running

April 25, 2011

→ OCCAM download status : part 2 @ 1993 done

phd 14

1) → maybe we need to put u and v, because T, S only are not bringing the eddies

1.1) making occam_feb2003_uv.mod ✓

1.2) running OA ✓

2) Started editing occam_analysis2.py to hstack part1/part2 ✓ domains

1.3) testing occam_feb2003_uv.nc ✓

2.1) 1994 @ part 2 arriving → stopped to take care of it ✓

2.2) 1994 ready → submitting 1995 @ part2 ✓

1.4) editing make_ini_phd14.py ✓ to include u,v
make_clm_phd14.py ✓

✓ running fine, nc files created

1.5) editing phd14.h to include M3 nudging ✓
→ transfered files to pacific ✓

1.6) compiling ROMS, renaming executable to occanO_phd14 ✓

1.7) Submiting phd14 run! ✓

2.3) OCCAM 1995 arrived, submitted 1996

LUNCH

2.4) OCCAM 1996 arrived, submitted 1997

3) Reading Nature articles about phd

2.5) 1997 arrived, 1998 submitted, 1998 arrived, 1999, 2000 submitted

4) Preparing BC-NBUC feature model on BC-NBUC_FM.py

5) Reading and searching for papers

April 26, 2010

1) OCCAM download: 2000 arrived, 2001 submitted, 2002 submitted
2) restarted ROMS run because again pacific stopped out of nowhere
3) Reading Herzfeld et al 2011, OM

4) 2003 requested → 10 requests ✓

2004 → 10 requests ✓

2002 → 10 requests (there are two missing) ✓

Aug 1989 → 10 requests ✓
part 1

Feb 1990 → 10 requests ✓
part2

all 1990 → 10 requests ✓
part2

June 1990 → 10 requests ✓
part1

Oct 1993 → 10 requests ✓
part1

Dec 1997 → 10 requests ✓
part1

Oct 1997 → 10 requests
part1

April 28, 2011

1) Again, simulation phd 14 has stopped out of nowhere, had to re-start it.

2) Downloading Hycom data to do the same as in OCCAM.

→ preparing script get_hycom.py to do that

3) BC-NBUC-SEC FM is ready. We need to tweek parameters now.

May 02, 2011

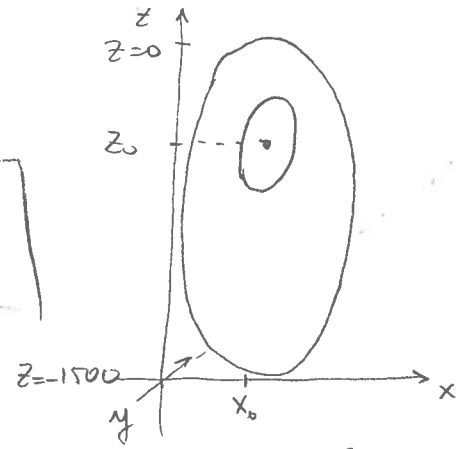
1) Feature model parameter tweek ⇒ transports are ok

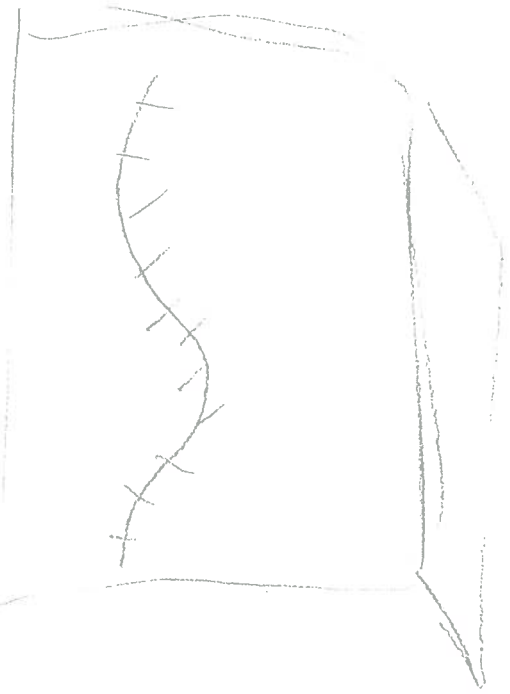
2) Isobath smoothed

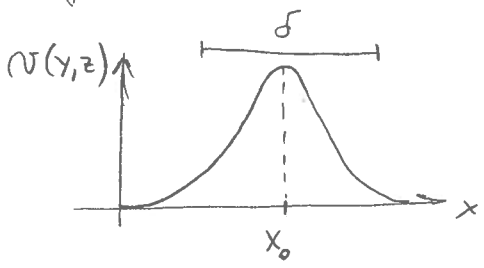
3) Fast extrapolation ⇒ ok

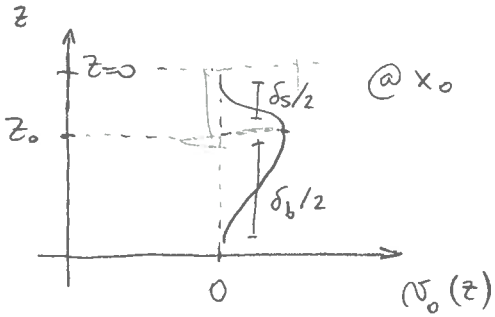
NBUC Fórmula

$$V(x,y,z) = v(y,z) \cdot \exp\left[-\frac{(x-x_0)^2}{2\delta^2}\right]$$









@ a given y location:

$$\bar{V}(x,z) = v(z) \cdot \exp\left[-\frac{(x-x_0)^2}{2\delta^2}\right] \quad ; \quad \begin{cases} v(z) = v_0 \cdot \exp\left[-\dfrac{(z-z_0)^2}{2\delta_s^2}\right], & z_0 < z < \infty \\ v(z) = v_0 \cdot \exp\left[-\dfrac{(z-z_0)^2}{2\delta_b^2}\right], & z_b < z < z_0 \end{cases}$$

problem: transport computation:

$$T = \int_0^{2x_0}\int_{z_b}^{0} \bar{V}(x,z)\, dz\, dx = \begin{cases} \displaystyle\int_{-\infty}^{\infty} v(z)\, dz = v_0\left[\frac{\delta_s\sqrt{2\pi} + \delta_b\sqrt{2\pi}}{2}\right] = \frac{v_0\sqrt{2\pi}}{2}(\delta_s+\delta_b) \\ \displaystyle\int_{-\infty}^{\infty} \bar{V}(x,z)\, dx = \left[\frac{v_0\sqrt{2\pi}}{2}(\delta_s+\delta_b)\right]\cdot\delta\sqrt{2\pi} \end{cases}$$

$$T = v_0 \cdot \delta\,(\delta_s + \delta_b)$$

Options to build Initial and Climatological fields

I) Ini: M3 (BC, NBUC) + Tracers (BC, NBUC, SEC) } from FM
Clm: M3 (BC, NBUC) + Tracers (BC + NBUC + SEC) }

II) OA the FM Tracers, computing dynht ref = 1500 m.
Then compute the associated geostrophic velocities, and:

Ini: M3 (BC + NBUC + SEC) + Tracers (BC + NBUC + SEC)

Clm: M3 (BC + NBUC + SEC) + Tracers (BC + NBUC + SEC)

III) Use the FM original data as Initial conditions and "create" a velocity nudging eastern layer just to the climatology:

Ini: M3 (BC + NBUC) + Tracers (BC + NBUC + SEC)

Clm: M3 (BC + NBUC + SEC) + Tracers (BC + NBUC + SEC)

---

1) Starting with (II), creating mod file through fm2mod.py
→ created
→ OA running with zref = 1480 m
→ OA seems to be smoothing things out a lot

May 04, 2011

> Meeting with Arjit

→ compute the Vgeo after OA and check the volume balance

For tomorrow: make a new OA

1) smaller grid and more resolution

May 05, 2011

1) did new OA, but velocities still look strange

2) submitted phd 15 run with tracers only, but it didn't look good

→ after running runs with T only and T + M3 with M3 on the WB only, got some conclusions

i) T only doesn't give me the right velocities

ii) T + M3 only at WB gives me compensation at northern boundary, because I don't have mass balance in the M3 field

May 09, 2011

> Meeting with Arijit @ 11 am

TWO IDEAS:

1) Ellipse fitting to create bifurcation

2) Fancy extrapolation of u velocity to the rest of the domain

May 10, 2011

> Meeting w/ Arijit @ 11am

→ figure out how is the termocline depth isosurface in the region, specially at the three boundaries.

→ putting his fixes at every loop to investigate what happens at the boundaries

→ ROMS is recreating a balance in other direction

→ Nudging makes it worse because since ROMS can't cancel the currents, it makes more unreal flow

→ Re-create BC-NBUC_FM.mat with 17 Sv SEC and re-run with clamped boundary conditions for M3 and T

May 11, 2011

→ after some thinking, decided to do three trial runs:

i) FLAT M3 + FM-T → compute section transports

ii) FM-M3 + FLAT-T → " " "

iii) old aproach with CLAMPED conditions

iv) try to use old nudging only with initial nest and flat

→ finally figured it out!!!

None of these worked, so I found out that I actually have to use M2 nudging or clamping to prevent VOLCONS to change things

→ right now I'm running again to let it go for several days: **phd15.1**

INI: M3, M2, T, S, full domain

CLM: M3, M2, T, S, 20 grid pts from OIT – 90 days

BRY: clamped M3, M2, T, S, FS RADIATION

* clamped is definetelly bad, causes reflection
* nudging seems too strong
* move to active/passive OBCs using SPONGE layer and see if that works

May 12, 2011

phd 15.1 looking good anyway, but we'd better get the OBCs working more efficiently.

phd 15.2

INI: M2, M3, T, S full domain

CLM: none

BRY: M2, M3, T, S RADIATION + NUDGING, 1 day / 30 day
FS Radiation

SPONGE: N, S, E, 6 grid points, factor of 4, increasing linearly

* blew up on day 24
* low SSH is propagating from North boundary up to South, passing through east. Maybe I need to prescribe SSH at the OBC's if I want to use active/passive OBC, & maybe CLM nudging will help.

phd 15.3 CLM_NUDGING + BRY_NUDGING + RADIATION

INI: M2, M3, T, S, FS

CLM: M2, M3, T, S, FS, 20 grid points from 1 to 360 days

BRY: M2, M3, T, S, FS RADIATION + NUDGING, 1 days/30 days

SPONGE: same as above

May 13, 2011

phd 15.3 a little better than 15.1, but produces all the AC's, stationarity, everything very exciting and publishable.

* From now on I guess I only need to fine tune the OBC's, only if I want, because up to day 100, OBCs don't look to make any mess

* If I want to fine turn the OBCs, maybe to analyse stationarity for more days, I suggest two alternatives:

  (1) go back to BRY only and try to avoid blow-up playing with the time-scales

  (2) keep BRY + CLM and try to tweek the scales of the nudging layer and coefficients, until I get no substantial reflection

May 16, 2011

Trying (2)

phd 15.4 → weakened nudging in the edge from 1 to 5 days

→ CLM: 20 points, from 5days to 360 days

BRY: 1 day / 30 days

SPONGE: from 5 m^2/s in the interior to 20 m^2/s in the edge (10 point

> running

* Tmr I can start coating a toms_analysis.py script while the run is still going

May 17, 2011

* I'm sticking with phd 15.4. Re-running to save diagnostic fields.

→ starting a toms_analysis.py to dissect the run

May 18, 2011

* I guess it's better to come back to phd 15.3.

* Running started @ 3:40 pm

→ Setting up flat bottom run

1) BC-NBVC_FM_flat-bottom.py
2) phd16-run.setup
3) grd ; 4) ini ; 5) clm ; 6) .in .h .ana*

May 20, 2011

* Running phd 16 @ 11:10 am
* Running phd 15 again, coming back to 5→360 NUDG @ 11:00 am

May 23, 2011

> doing Arijit's requested plots

May 24, 2011

> doing Arijit's requested plots

May 25, 2011 — Meeting with Arijit @ 9am

* correct the units of EKE plots !!! Try log(EKE) !

> It's time to write-up what we are seeing. Bullets with the remarkable realistic structure, after going through all the plots.

→ general description of the run in terms of
- transport time-series
- Eke time-series
- T and S time series

→ average fields and how do they compare with data / occam / aviso, etc. How realistic are the model fields? Which are the model's skills and short-comings?

→ synoptic fields or short-time averaged fields and how do they compare with previous knowledge

→ evolution of synoptic fields, typical patterns and scenarios

> After writing up, it's time for the next runs:

2) OE 2 run with new OBC implementation

3) flat bottom, full system

1) BC-SEC run → needs some thinking!

July, 7th, 2011

I know, I spent a long time without logging, but here is why:

1) write-up on paper methodology
2) writing GRC poster
3) Attending GRC

→ see /home/rsoutelino/phd/tex/notes.txt for a mesh-up of ideas

Right now, I'm back to drafting paper and I'll be back here to post and update as I go. Tmr we'll meet Glenn, I'll show the results and listen to his opinions

Next pages will be notes on NSF proposal meetings with Glenn and Sheckels

NSF BCS Proposal Meeting @ MIT

- Glenn, Sheckela, Juliana, Rafael, Arijit (Skype)

12 pm until 1:15 pm Notes by Rafael

> August 15 submission → try or not? INCT proposal

> Brazilian proposal will be funded one way or another because FAPESP (State agency) has only this submission.
→ broader than this, multidisciplinary and larger area

> How to better pose proposal questions towards the planned instrumentation?

-> Would Sheckela's instruments be a nice supplementation for the Brazilian proposal? (INCT proposal)

- Arijit has a digital version of the proposal that we can take a look and find out possible connections to tweek the international one towards to it.

- They have moorings indeed. We can read it carefully to find out how we can use that network and how new instruments can add to the big picture.

> Regina is probably not available. Maybe a new group from Brazil will be formed. Olga Sato, Marcelo Dottori

Olga Sato → interested in SAMOC

Marcelo Dottori → shelf dynamics

> How about the 6 C-PIES that would be funded from Brazil? INCT timing is not matching the NSF. Will Ilson still submit a separate proposal in Brazil including the C-PIES this year? If not,

(A) maybe we shouldn't target August 2011. If we want

(B) to submit in Aug 2011, we have to figure out how to joint with Brazil's INCT, maybe changing our focus a little bit.

> Some of the work in 1st NSF prop. version is already accomplished, so it can be subtracted, allowing for some new ideas. Maybe move towards the BC

(A) as part of SAMOC, changing the focus and change the observations plan accordingly. Can the

(B) C-PIES be adapted to that and also be complementary to the INCT instruments array?

> Ideas or options (A) and (B)

↓

looks more interesting to the present point, but careful reading of INCT is needed to make a decision.

Read INCT and talk to Ilson

↳ Next step

> If Ilson is favorable and INCT actually has space to our approach, let's do it. If not, we can try to fit into SAMOC with process studies and the observations.

> Discuss it again on Tuesday @Noon, July 12, assuming we will get in touch with Ilson

> Agulhas rings coming from the outer area of INCT can be addressed by us. That could fit Igor's work and also the C-PIES are good to capture the Agulhas Rings.

NSF BCS Proposal Meeting @ Skype Monday, July 12 (1)

- Glenn, Sheckela, Avijit, Juliana, Rafael

1pm until (PT)

- Ilson and Sheckela conversation
  - → Ilson agreed with option (1), and he thinks that observations and Igor's work can be complimentary to INCT.
  - → INCT answer is due at August 31 (INCT is already submm
  - → INCT now or SAMOC in february?
    (1) (2)
  - → Either one or another. Maybe is best to really focus on a strong SAMOC-related proposal in spite of risking an august 15 try.

Chat with Glenn about my results

→ If NBUC is causing the eddies or not can be investigated by removing the BC, or make sensitivity experiments sequentially damping BC up to nothing.

→ And than, if NBUC alone makes the trick, it should have analogies with Juliana's work, and it should show up in deeper levels of my current experiment.

July 13, 2011

→ Finished very raw first draft of the methodology

→ before I give it to Arijit, I need to take care of a couple of things:

① put more sofisticated discription of the FM formulation, getting ideas from Gangopadhyay 1992

② put annotations on the figs for BC, NBUC, SEC

③ update bibtex to including "?" refs

④ general review of the text and create better phases and paragraphs constructions.

Aug 2nd, 2011

→ Finished the 2nd draft, which includes:

- Introduction
- Description of Flat Bottom and BC-Only run

→ Now I will run the NBUC-only run

→ run submitted

Aug 09, 2011

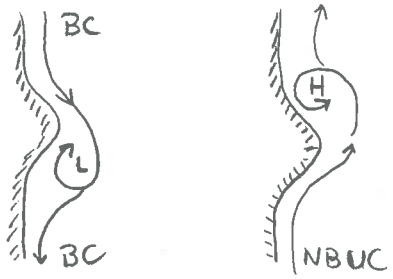
→ NBVC - only running (phd 19)

→ Waiting Ilson/Arijit get back at me about paper

→ Starting OMARSAT abstract

Aug 17, 2011 : meeting with Arijit about CSR paper @ 2 pm

Dynamical Argument



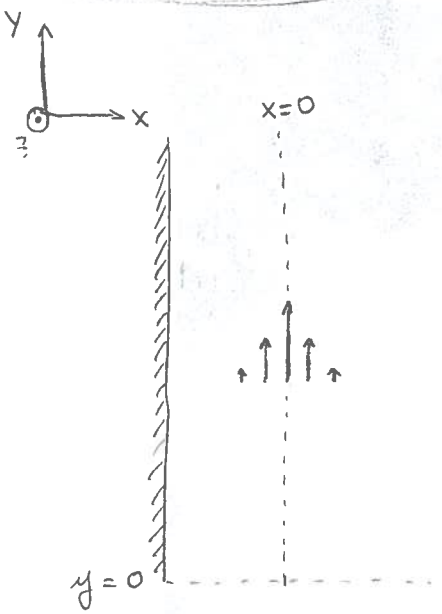
NBUC ⇒ ACY
BC ⇒ CY
} why ?

* So, If NBUC is stronger than BC, ACY prevails. With NBUC only, we might have northward propagation.

* We need to find a quantitative way of showing that argument. And maybe find a magic shear value that leads to steady ACY or not, like what happens to OCCAM.

* Maybe we need small paragraphs on introduction and discussion to talk about the Agulhas Rings.

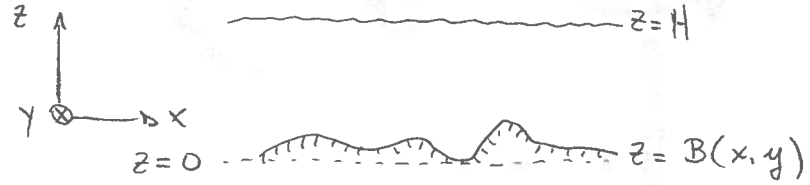
Robinson (1965) — A 3D model of inertial currents in a variable-density ocean



$\rho = \rho_0 (1-s)$ → non-dim. density anomaly

$s = 1 - \frac{\rho}{\rho_0} = a\,(T^* - T_0^*)$ → apparent temperature

$T^* - T_0^* = (T - T_0) - \left(\frac{b}{a}\right)(S - S_0)$ → $b, a \equiv$ coef thermal and haline expansion



MOMENTUM BALANCE

(1.2) $-fv = -\frac{1}{\rho_0}\frac{\partial p}{\partial x}$ → geostrophic balance along-stream

(1.3) $u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} + fu = -\frac{1}{\rho_0}\frac{\partial p}{\partial y}$ → non-linear terms included in cross-stream balance

(1.4) $-sg = -\frac{1}{\rho_0}\frac{\partial p}{\partial z}$ → hydrostatic balance in terms of "s"

(1.5) $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$ → continuity eq

(1.6) $u\frac{\partial s}{\partial x} + v\frac{\partial s}{\partial y} + w\frac{\partial s}{\partial z} = 0$ → density is only advected (adiabatic motion)

BOUNDARY CONDITIONS

$x \to \pm\infty$: $u \to U(y,z)$; $v, w \to 0$; $s \to S(y,z)$ (1.9a)

↳ no continent: $f\frac{\partial U}{\partial z} = -g\frac{\partial S}{\partial y}$ → thermal wind (no continent) (1.9b)

$x = C(y)$: $u(C(y), y, z) - v(C, y, z)\,C'(y) = 0$ (1.10)

↳ continent

$$-w(x,y,B) + u(x,y,B)\frac{\partial B}{\partial x} + v(x,y,B)\frac{\partial B}{\partial y} = w(x,y,H) = 0$$

↑ vertical Boundary condition

MOMENTUM BALANCE WITH TRANSFORMED EQUATIONS : $(x,y,z) \rightarrow (x,y,s) \Rightarrow \underline{z}$ is dependent var.

$$-fv = -\Pi_x \qquad (2.1)$$

$$u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + fu = -\Pi_y \qquad (2.2)$$

$$gz = -\Pi_s \qquad (2.3)$$

$$\frac{\partial}{\partial x}\left(u\frac{\partial z}{\partial s}\right) + \frac{\partial}{\partial y}\left(v\frac{\partial z}{\partial s}\right) = 0 \qquad (2.4)$$

$$-w + u\frac{\partial z}{\partial x} + v\frac{\partial z}{\partial y} = 0 \qquad (2.5)$$

$$\Pi = \frac{p}{\rho_0} - gsz$$

$$u\frac{\partial z}{\partial s} = -\frac{\partial \psi}{\partial y} \; ; \quad v\frac{\partial z}{\partial s} = \frac{\partial \psi}{\partial x} \qquad (2.6)$$

$$\Rightarrow \quad \frac{\partial v}{\partial x} + f = \frac{\partial z}{\partial s} P(\psi, s) \qquad (2.7)$$

conservation of P.V.

P is an arbitrary function

(2.1) & (2.7) are most relevant to the problem

If $P(\psi,s)$ in (2.7) is a function of s alone, (2.7) together with geostrophic (2.1) and hydrostatic (2.3) eqs provide three linear eqs for the variables : $\underline{v}, \underline{\Pi}, \underline{z}$

POWER SERIES EXPANSION IN THE DOWN STREAM COORDINATE y

Introducing non-dim. variables:

$U_0 \equiv$ typical value of the ejection rate $U^\infty(y,z)$

$\Delta\rho \equiv$ scale for density difference from bottom to surface

$H \equiv$ mean depth

$f_0 \equiv$ coriolis parameter at the origin

$$(3.1)\quad \xi = \left(\frac{\rho_0 f_0^2}{\Delta\rho g H}\right)^{1/2} x \quad ; \quad \eta = \left(\frac{\rho_0 f_0 U_0}{\Delta\rho g H}\right) y \quad , \quad \zeta = \frac{z}{H} \quad , \quad \theta = \left(\frac{\rho_0}{\Delta\rho}\right) s$$

→ nondim. form of the coriolis parameter:

$$\phi = \frac{f}{f_0} = 1 + \tilde{\beta}\xi + \beta^* \eta = \phi_0 + \beta^* \eta$$

where:

$$\beta^* = \frac{\beta \cos\theta\, \Delta\rho g H}{\rho_0 f_0^2 U_0} \quad ; \quad \tilde{\beta} = \frac{-\beta \operatorname{sen}\theta}{f_0^2}\left(\frac{\Delta\rho g H}{\rho_0}\right)^{1/2}$$