Tutorial 01 LiveCROCO: Basic Use

1 Purpose

In this tutorial we will review the basic instructions for using the LiveCROCO virtual machine, based on Sepúlveda et al. (2011), which will allow you to to have a work environment with CROCO and CROCO_TOOLS in your PC.

2 VirtualBox

Virtual machines are autonomous work environments that you can install in your PC, which do not require a hard drive partition. First you need a software that you can run virtual machines. In this case we will use the software **VirtualBox**, where we will install a Linux virtual machine and many of the necessary software to run CROCO. We will name this virtual machine **LiveCROCO**.

Make sure you have enough RAM, 4GB or more, and hard disk space, more than 100GB free to use.

Note that the screen information you see here may be different, depending on your operating system.

2.1 VirtualBox installation

Install **VirtualBox** from this web page

```
https://www.virtualbox.org/
```



Figure 1: VirtualBox web site

and install in your PC.

2.2 LiveCROCO installation

Download the this file.

```
http://mosa.dgeo.udec.cl/LiveCROCO/LiveCROCO_v1.3.0a.ova
```

```
Attention that it is a 16GB file!
```

To verify that the file was completely downloaded in Linux we use the command $\mathbf{md5sum}$

md5sum LiveCROCO_v1.3.0a.ova

you should get

```
c39691f82b9b1e7df4489490d5fdf0a0 LiveCROCO_v1.3.0a.ova
```

while in the Windows command prompt you can do

```
certutil -hashfile LiveCROCO_v1.3.0a.ova MD5
```

Open the **VirtualBox** software and select the **File** tab. Select the **Import virtualized service...** option (Fig. 2)

Oracle VM VirtualBox Administrador

0
Preferencias Ctrl+G
🔊 Importar servicio virtualizado Ctrl+1
🚯 Exportar servicio virtualizado Ctrl+E
Nueva MV en la nube
Administrador de medios virtuales Ctrl+D
Administrador de red de anfitrión Ctrl+H
Administrador de operaciones de red
🚭 Comprobar actualizaciones
Reiniciar todas las advertencias
Salir Ctrl+Q

Figure 2: Importing virtualized service

Then find the .ova file you just downloaded (Fig. 3)

		?	×
← Importa	ar servicio virtualizado		
Servicio	o a importar		
Please ch	oose the source to import appliance from. This can be a local file system to import OVF archive or one of known cloud service providers to import cloud VM	I from.	
Fuente:	Sistema de archivos local		•
Seleccion continuar	e un archivo desde el que importar el servicio virtualizado. VirtualBox actualmente soporta importar servicios guardados en Open Virtualization Format (OV , seleccione el archivo a importar abajo	/F). Para	l.
Archivo:			

Figure 3: Find virtualized service

and select it (Fig. 4).

> -> 🕆 🕂 Ste equipo > Descargas		🗸 🖸 🔎 Bus	car en Descarga	15
Organizar 🔻 Nueva carpeta				
Nombre	Fecha de modificación	Тіро	Tamaño	
Acceso rapido VEl mes pasado (2)				
Descargas BLiveCROCO_v1.0	20-12-2020 17:29	Open Virtualizatio	6.013.658 KB	
Descargas Sectorgas Sectorgas Descargas Sectorgas Descargas Sectorgas Descargas Sectorgas Sectorgas Descargas Sectorgas	20-12-2020 16:51	Open Virtualizatio	6.001.607 KB	
► Imágenes				
Groco tools	02-09-2020 15:59	Acceso directo	1 KB	
InformeFinal	22-11-2019 10:54	Acceso directo	1 KB	
CROCO_MEETING_May2017	08-11-2020 23:32	Carpeta de archivos		
NOLAND	21-08-2020 16:35	Carpeta de archivos		
Postulaciones_C	19-05-2020 15:53	Carpeta de archivos		
🐉 Dropbox 🔤 Rachid	18-05-2020 22:38	Carpeta de archivos		
00 Fondecyt Ma	31-03-2020 0:34	Carpeta de archivos		
Journal and the second	30-03-2020 21:23	Carpeta de archivos		
😹 00_Magallanes_p				
Souther States S				
Newber		On an Min	Augustian Francis	

Figure 4: Select virtualized service

Press **Next** button (Fig. 5)

			~
< Importa	ar servicio virtualizado		
Servicio	o a importar		
Please ch	noose the source to import appliance from. This can be a local file system to import OVF archive or one of known cloud service providers to import cloud VM	from.	
Fuente:	Sistema de archivos local		-
Seleccion continuar	e un archivo desde el que importar el servicio virtualizado. VirtualBox actualmente soporta importar servicios guardados en Open Virtualization Format (OV , seleccione el archivo a importar abajo	F). Para	1
Archivo:	C: Users dgeo Dropbox Wi PC (dgeo) Downloads LiveCROCO_v1.2Beta.ova		

Figure 5:	Upload the file	

Modo experto Next Cancelar

and then **Import** (Fig. 6).

propiedades mostradas haciendo doble dic en los elen	icio y las preferencias sugeridas de las máquinas virtuales importadas de VirtualBox. Puede cambiar varias de las enos y deshabilitar otras usando las casillas de verificaión de abajo.
Sistema virtual 1	
💝 Nombre	LiveCROCO_Beta
🔠 Tipo de SO invitado	💋 Ubuntu (32-bit)
🔲 СРИ	2
RAM	2048 MB
 DVD 	
🤌 Controlador USB	
🕪 Tarjeta de sonido	CH AC97
🖶 Adaptador de red	Intel PRO/1000 MT Desktop (82540EM)
🔷 Controlador de almacenamiento (IDE)	PIIX4
🔷 Controlador de almacenamiento (IDE)	PIIX4
✓	AHCI
Imagen de disco virtual	LiveCROCO_Beta-disk1.vmdk
Carpeta base	C:\Users\dgeo\VirtualBox VMs
🔂 Grupo primario	1
arpeta base de máquina: C:\Users\dgeo\Virtual	Box VMs
Política de dirección MAC: Incluir solo las direcciones	NAT de adaptador de red

Figure 6: Starting the installation

This start the installation process (Fig. 7).

Ũ	Importando se	rvicio virtualizado: Importing appliance 'C:\User	s\dge	. ×
	9	Importing virtual disk image 'LiveCROCO_Beta-disk1.v Tiempo restante: 3 minutos	mdk' 1%	(2/3) X

Figure 7: Virtualized service installation bar

When the installation is finished, you will see a screen similar to this, showing the virtual machine you just imported among your options (Fig. 8).

Oracle VM VirtualBox Administrador Archivo Minuina Avuda		- 🗆 ×
Herramientas	Neve Configuradon Descritor Inicar	
₩ WRF_v4.0a @ Apogoda	General Nontre: LiveCRCC0_v1.28ETA Statema operative: Liumta (64-84)	Previsualización
LiveCROCO_v1.28ETA	Sistema Menorio bose: 3113/MB Orden dia arrange:: Gao data Code dia arrange:: Gao data Code dia arrange:: Code data Sistema Sistema Code dia arrange:: Code data Co	LiveCROCO_v1.2BETA
VecCROCO_v1.0	Pantalla	
	Image: Second	

Figure 8: Virtual machines available

Select LiveCROCO_v1.2.1b option and press the start button (green arrow). That will activate the virtual machine and after a while you can see this Fig. 9



Figure 9: LiveCROCO home screen

The username and password is *livecroco*. Whit this user you can use *sudo*.

3 Using LiveCROCO

3.1 Creating the working directory Run_BENGUELA_LR

The simplest example of CROCO is the configuration called BENGUELA_LR which corresponds to a low resolution Benguela Upwelling domain. This is the default configuration in CROCO code and what we will do is similar to what is described in Penven et al. (2001)

First step is open the terminal clicking in red icon on the left, under the Firefox symbol, and in the terminal type

cd Desktop]
then	
/create config hash	J

showing

1	Your choices :	
2	- CROCO_DIR :	/home/livecroco/croco
3	- TOOLS_DIR :	/home/livecroco/croco_tools
4	- CONFIG_HOME_DIR :	/home/livecroco/Desktop
5	- CONFIG_WORK_DIR :	/home/livecroco/Desktop
6	- CONFIG_NAME :	Run
7	- OPTIONS :	oe-dev
8	Do you want to proce	ed ? [Y/n]

1 2 and pressing the Y key shows

Creating configuration ...



Figure 10: Creating a configuration in LiveCROCO

This script makes a directory with the name given in CONFIG_NAME with all codes necessary to run your simulation, this will be your working directory. The content of this folder should be similar to the following:

1	cppdefs.h	domain_def.xml	namelist_pisces_ref	SCRATCH
2	create_config.bash.B0	CK field_def.xml_full	namelist_pisces_ref.1	sediment.in
3	CROCO_FILES	iodef.xml	oct_start.m	start.m
4	croco.in	jobcomp	param.h	TEST_CASES
5	croco.in.1	Misc	README_XIOS	xios_launch.file
6	croco_inter.in	NAMELIST_OANALYSIS	run_croco.bash	
7	crocotools_param.m	namelist_pisces_cfg	run_croco_forecast.bash	
8	DATA	namelist_pisces_cfg.1	run_croco_inter.bash	

4 Compiling CROCO

First the CROCO executable is compiled using the following instructions

```
1 cd Run
2 ./jobcomp
```

and the code compilation start with the following lines on the screes

```
OPERATING SYSTEM IS: Linux
   cp: -r not specified; omitting directory '/home/livecroco/croco/OCEAN/../PISCES/SED'
2
     file namelist_pisces exists in Run directory
3
   Checking COMPILEAGRIF...
4
   Checking COMPILEMPI...
\mathbf{5}
   Checking COMPILEXIOS...
6
   Checking COMPILEOASIS...
7
   Checking COMPILEOMP...
8
   cpp -traditional -DLinux -P -I/usr/include
9
   -ICROCOFILES/AGRIF_INC mpc.F > mpc_.f
10
   gfortran -O3 -fdefault-real-8 -fdefault-double-8 -o mpc mpc_.f
11
   cpp -traditional -DLinux -P -I/usr/include
12
   -ICROCOFILES/AGRIF_INC cppcheck.F | ./mpc > cppcheck_.f
13
   gfortran -c -O3 -fdefault-real-8 -fdefault-double-8 cppcheck_.f
14
   -o cppcheck.o
15
   gfortran -O3 -fdefault-real-8 -fdefault-double-8 -o cppcheck
16
17
   cppcheck.o
   cat cppdefs.h cppdefs_dev.h > mergcpp.txt
18
```

You have to wait a couple of minutes for the **gfortran** compiler to generate the executable file. When the build finishes successfully, you will see the following lines on your screen

```
_rho.o def_floats.o init_arrays_floats.o random_walk.o
1
   get_initial_floats.o init_sta.o wrt_sta.o step_sta.o
2
   interp_sta.o def_sta.o init_arrays_sta.o biology.o o2sato.o
3
   sediment.o bbl.o MPI_Setup.o MessPass2D.o MessPass3D.o
4
   exchange.o autotiling.o zoom.o update2D.o set_nudgcof_fine.o
5
   zoombc_2D.o zoombc_3D.o uv3dpremix.o t3dpremix.o update3D.o
6
   zoombc_3Dfast.o Agrif2Model.o send_xios_diags.o
\overline{7}
   cpl_prism_define.o cpl_prism_put.o cpl_prism_init.o
8
   cpl_prism_get.o cpl_prism_getvar.o cpl_prism_grid.o -L/usr/lib
9
   -lnetcdff -Wl,-Bsymbolic-functions -Wl,-z,relro -Wl,-z,now
10
   -lnetcdf -lnetcdf
11
   mv a.out croco
12
```

On the last line you see how the compiled file **a.out** (default name) is renamed **croco**. That is the executable we will use.

5 Creating the input files

To create the input files to be read by the **croco** executable we will use a catalog of functions called **CROCO_TOOLS**. These functions were written in Matlab (Penven et al., 2008) and have been adapted to work in Octave, using the OCTCDF package.

5.1 Using Octave

To create the input files using Octave we start with

octave-cli

First define the search paths of the tools used by CROCO_TOOLS

oct_start

showing

1 >> oct_start
2 Add the path

Add the paths of the different toolboxes

Then we write the instruction to generate the model grid, which is described in the file **croco_grd.nc** that will be generated in the **CROCO_FILES** directory

```
>> make_grid
1
   mkdir: cannot create directory '/home/livecroco/Desktop/Run/CROCO_FILES/':
2
   File exists
3
4
    Making the grid: /home/livecroco/Desktop/Run/CROCO_FILES/croco_grd.nc
\mathbf{5}
6
    Title: Benguela Model
7
8
    Resolution: 1/3 deg
9
10
    Create the grid file ...
11
     LLm = 41
12
    MMm = 42
13
14
    Fill the grid file...
15
16
    Compute the metrics...
17
18
    Min dx=29.1913 km - Max dx=33.3244 km
19
    Min dy=29.2434 km - Max dy=33.1967 km
20
^{21}
    Fill the grid file...
22
^{23}
     Add topography...
^{24}
       CROCO resolution : 31.3 km
25
       Topography data resolution : 3.42 km
26
       Topography resolution halved 4 times
^{27}
       New topography resolution : 54.6 km
^{28}
   Processing coastline_1.mat ...
29
30
     Filter topography ...
31
     Apply a filter on the Deep Ocean to reduce isolated seamounts :
^{32}
       4 pass of a selective filter.
33
     Apply a selective filter on log(h) to reduce grad(h)/h :
34
       20 iterations -r_{max} = 0.27931
35
       29 iterations - r_{max} = 0.24975
36
     Smooth the topography a last time to prevent 2DX noise:
37
       2 pass of a hanning smoother.
38
39
     Write it down...
40
```

and we will get Fig. 11



Figure 11: Final map of the Benguela domain

The next instruction is **make_forcing** which generates the file **croco_frc.nc** with the atmospheric forcing information.

```
>> make_forcing
1
   mkdir: cannot create directory '/home/livecroco/Desktop/Run/CROCO_FILES/':
2
   File exists
3
4
   Benguela Model
5
6
     Read in the grid...
7
8
    Create the forcing file...
9
   Getting taux for time index 1
10
   Getting tauy for time index 1
11
   Getting taux for time index 2
^{12}
   Getting tauy for time index 2
^{13}
   Getting taux for time index 3
14
   Getting tauy for time index 3
15
   Getting taux for time index 4
16
17
    . . . .
   Getting shortrad for time index 7
^{18}
   Getting shortrad for time index 8
^{19}
   Getting shortrad for time index 9
20
   Getting shortrad for time index 10
^{21}
   Getting shortrad for time index 11
22
   Getting shortrad for time index 12
^{23}
   >>
^{24}
```

showing 7 figures, Figs 12-15.



Figure 12: Atmospheric forcing variables: surface wind stress and net surface heat flux



Figure 13: Atmospheric forcing variables: fresh water surface balance (E-P) and sea surface temperature



Figure 14: Atmospheric forcing variables: sea surface salinity and sea surface temperature sensitivity of latent heat flux



Figure 15: Atmospheric forcing variables: shortwave solar radiation.

Now we do **make_bry**to create the file **croco_bry.nc** with the ocean boundary condition

```
make_bry
1
   >>mkdir: cannot create directory '/home/livecroco/Desktop/Run/CROCO_FILES/':
2
   File exists
3
4
   ans = 1
\mathbf{5}
   temp_month_data = /home/livecroco/DataSets/WOA2009/temp_month.cdf
6
   temp_ann_data = /home/livecroco/DataSets/WOA2009/temp_ann.cdf
\overline{7}
   salt_month_data = /home/livecroco/DataSets/WOA2009/salt_month.cdf
8
   salt_ann_data = /home/livecroco/DataSets/WOA2009/salt_ann.cdf
9
10
    Making the file: /home/livecroco/Desktop/Run/CROCO_FILES/croco_bry.nc
11
^{12}
```

showing 8 figures, similar to Fig. ??.



Figure 16: Oceanic lateral forcing variables: vertical sections of v velocity at t = 6.

Finally we use the command that creates the initial conditions file **croco_ini.nc**, which is **make_ini**.

```
octave:3> make_ini
1
   mkdir: cannot create directory '/home/livecroco/Desktop/Run/CROCO_FILES/': File exists
2
   ans = 1
3
4
    Making initial file: /home/livecroco/Desktop/Run/CROCO_FILES/croco_ini.nc
\mathbf{5}
6
    Title: Climatology
\overline{7}
8
     Creating the file : /home/livecroco/Desktop/Run/CROCO_FILES/croco_ini.nc
9
     VTRANSFORM = 2
10
11
     Interpolations / extrapolations
^{12}
```

and produces plots like Fig. 17.



Figure 17: Oceanic surface salinity at t = 1.

```
croco_bry.nc croco_frc.nc croco_grd.nc croco_ini.nc
```

The files you get should be the same as those found in

```
http://mosa.dgeo.udec.cl/LiveCROCO/Tutorial01/ArchivosIniciales/
```

if you had problems with this step, copy those files to the **CROCO_FILES** directory to proceed to the next section using the instructions

```
1 cd CROCO_FILES
2 wget http://mosa.dgeo.udec.cl/LiveCROCO/Tutorial01/ArchivosIniciales/croco_grd.nc
3 wget http://mosa.dgeo.udec.cl/LiveCROCO/Tutorial01/ArchivosIniciales/croco_frc.nc
4 wget http://mosa.dgeo.udec.cl/LiveCROCO/Tutorial01/ArchivosIniciales/croco_bry.nc
5 wget http://mosa.dgeo.udec.cl/LiveCROCO/Tutorial01/ArchivosIniciales/croco_ini.nc
```

6 Running climatological simulation

To run simulation you have to write, from working directory ${\bf Run}$

```
./run_croco.bash
```

and you will get

```
Getting croco from /home/livecroco/Desktop/Run
1
   Getting croco_bry.nc from /home/livecroco/Desktop/Run/CROCO_FILES
^{2}
   /bin/cp: cannot stat '/home/livecroco/Desktop/Run/CROCO_FILES/croco_bry.nc':
3
   No such file or directory
4
   Getting croco_grd.nc from /home/livecroco/Desktop/Run/CROCO_FILES
5
   Getting croco_frc.nc from /home/livecroco/Desktop/Run/CROCO_FILES
6
   Getting croco_blk.nc from /home/livecroco/Desktop/Run/CROCO_FILES
7
   /bin/cp: cannot stat '/home/livecroco/Desktop/Run/CROCO_FILES/croco_blk.nc':
8
   No such file or directory
9
   Getting croco_clm.nc from /home/livecroco/Desktop/Run/CROCO_FILES
10
   Getting croco_runoff.nc from /home/livecroco/Desktop/Run/CROCO_FILES
11
   /bin/cp: cannot stat '/home/livecroco/Desktop/Run/CROCO_FILES/croco_runoff.nc':
12
   No such file or directory
^{13}
   Getting croco_ini.nc from /home/livecroco/Desktop/Run/CROCO_FILES
14
   Getting croco_inter.in from /home/livecroco/Desktop/Run
15
16
   Writing in croco_inter.in
17
   USING DT
                   = 3600
18
   USING NFAST
                   = 60
19
   USING NUMTIMES = 720
20
   USING NUMAVG
                  = 72
^{21}
   USING NUMHIS
                   = 720
22
   USING NUMRST
                   = 720
23
^{24}
   Computing for Y1M1
^{25}
   mié ene 6 23:45:40 -03 2021
26
```

7 Output files

Once simulation finishes successfully, we will find the output files in CROCO_FILES directory.

8 Results display

8.1 ncdump

The **ncdump** tool is very useful for displaying contents of NetCDF file. Remember that both input files and output files of CROCO are in NetCDF format.

The command

```
ncdump -h SCRATCH/croco_avg_Y1M1.nc | less
```

will show information about the content of the croco_avg_Y1M1.nc file

```
netcdf croco_avg_Y1M1 {
1
   dimensions:
^{2}
            xi_rho = 43;
3
            xi_u = 42;
4
            eta_rho = 44;
5
            eta_v = 43;
6
            s_rho = 32;
\overline{7}
            s_w = 33;
8
            time = UNLIMITED ; // (120 currently)
9
            auxil = 4;
10
   variables:
11
            char spherical ;
12
                     spherical:long_name = "grid type logical switch" ;
^{13}
                     spherical:option_T = "spherical" ;
14
                     spherical:option_F = "cartesian" ;
15
16
            float xl ;
                     xl:long_name = "domain length in the XI-direction" ;
17
                     xl:units = "meter" ;
^{18}
```

In this way we can see details such as dimensions of domain and number of time steps recorded there. We can compare this to our estimates of number of time steps it should record, for example. To exit **ncdump** you have to press \mathbf{q} key.

8.2 ncview

The neview program is very useful for previewing files, in NetCDF format. For this we do

```
ncview SCRATCH/croco_avg.nc
```

this shows us the following interface

\otimes	Neview 2.1.7							
	no variable selected							
Noview 2	Noview 2.1.7 David W. Pierce 29 March 2016							
*** SELE(CT A VARIABLE T	O START *	**					
Quit ->1 📢 4 Ⅱ 🕨 🗮 Edit ? Delay: Opts								
() Jgauss	liny P liny C	[Mag X1]	Línear	Axes	Range	blowup Print		
Var:	sc_r	sc_\	"	С	s_r	Cs_w		
h		f		pm		pn		
lon_rho		lat_rho		lon_u		lat_u		
lon_v		lat_v		angle		mask_rho		
time_step		scrum_	time	Z	eta	ubar		
vbar		u		v		temp		
	salt	omeç	ga		w	bostr		
	wstr	sustr		svstr		AKt		
	hbl	hbbl		shflux		swflux		
	swrad							
Dim:	Name:	Min:	Curre	ent:	Max:	Units:		
	time	Min:	Curr	ent:	Max:	Units:		
	s_rho	Min:	Curr	ent:	Max:	Units:		
	eta_rho	Min:	Curr	ent:	Max:	Units:		
	xi_u	Min:	Curr	ent:	Max:	Units:		

Figure 18: Graphic interface of neview.

clicking the variable ${\bf temp}$ gives

	800	Ncview 2.1.7	ז בו					
	BENGUELA TEST MODEL							
	displaying averaged potential temperature frame 1/10 displayed range: 0 to 22.5779 Celsius							
	Current: (1=42, j=34) 0 (x=22, y=-28.56045)							
	Quit				2 Dolovi I	Onto		
	Quit			Euit				
	3gauss	Inv P Inv C	C M X7	Linear Axe	s Range	Bi-lin Print		
	ó	ś	10		ıś	20		
croco_avg.nc (on lettraru2)	Var	50 F			Cor I	Cem		
				·····	<u></u>	C3_W		
		h			pm	pn		
		lon_rho	lat_r	ho	lon_u	lat_u		
		lon_v	lat_	v	angle	mask_rho		
		time_step	scrum_	time	zeta	ubar		
		vbar	u		v	temp		
		salt	ome	ga	w	bostr		
		wete			evetr			
		wsu		·	avau	AIN		
		hbl	hbb		shflux	swflux		
		swrad						
	Dim:	Name:	Min:	Current:	Max:	Units:		
	Scan:	time	131400	131400	2.4642e+0	6 second		
		s_rho	-0.984375	-0.984375	-0.015625			
	Y:	eta_rho	-38	-¥-	-25.8968			
	X:	xi_rho	8	-X-	22			

Figure 19: Sea temperature

This figure shows us the sea temperature in deepest sigma layer of model. If we want to see the values of sea surface temperature, we click the right mouse button on the box that has value -0.984375 that corresponds to vertical level s_rho that we want to analyze. Doing this changes the value of that box to -0.015625. It is also convenient to click on button that says **Bi-lin**, so that neview does not interpolate values that were calculated in each cell. Once this is done we get the following figure

	8 🛇 🛇	Ncview 2.	1.7					
				BENGUE	ELA TEST	MODE	iL	
	displayir	ig averaged	potent	ial temp	erature			
	frame 1/1	U d range: 0 to	. 22 577					
	Current:	(i=17, i=0) 1	, 22. <i>377</i> 8.3032	9 Cersii (x=13.66	us 1667.v=-	38)		
	Quit	->1 📢) }	Edit ?	Delay:	Opts
	3gauss	Inv P In	IV C	M X7	Linear	Axes	Range	Repl Print
	ó	ś			ó		iś	20
(on lettraruz)	Var:	sc_r		sc	w	0	Cs_r	Cs_w
		h		f	-		pm	pn
		lon_rho		lat_	rho	lo	on_u	lat_u
		lon_v		lat	_ v	a	ngle	mask_rho
		time_ste	p	scrum	_time	7	zeta	ubar
		vbar u salt omega					v	temp
							W	bostr
		wstr		sus	str	S	vstr	AKt
Restaurant		hbl		hb	bl	S	hflux	swflux
		swrad						
	Dim:	Name:	h	/lin:	Curr	ent:	Max:	Units:
				1400	131	400	2.4642e+0)6 second
		s_rho		84375	-0.01	5625	-0.015623	5 .
		eta_rho		-38		<i>[-</i>	-25.8968	
	X:	xi_rho		8	->	¢.	22	

Figure 20: Surface temperature

If we now click with the mouse on any point of the sea, noview shows us the time series, on surface, of that variable.



Figure 21: Times series

In summary, **ncview** is a very fast and simple tool that allows us to have an immediate visualization of files. It is very useful to use it to see if results are, at first sight, reasonable.

8.3 CROCO_TOOLS

CROCO_TOOLS contains several functions that are useful for visualizing results of our simulation. These functions do not allow making various types of graphs such as vertical sections, surface maps, depth profiles, time series and others. The detail of its use is described in another tutorial.

9 Advanced details

There are important aspects to running a simulation using **CROCO** that depends on how we configure the files.

```
    crocotools_param.m
    cppdefs.h
    param.h
    croco.in
```

In this case, everything is limited because these files are preconfigured for the **Run** example. In the next tutorial we will discuss what to modify from those files to study the area that is of interest to you.

10 Conclusion

In this tutorial you learned how to install the **LiveCROCO** virtual machine, compile the **croco** model, and prepare the input files with the **croco_tools** code. In addition, the basic simulation for the Benguela zone was run and the results visualized using **ncview**.

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11 References

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Penven, P., Marchesiello, P., Debreu, L., & Lefèvre, J. (2008). Software tools for pre-and post-processing of oceanic regional simulations. Environmental Modelling & Software, 23(5), 660-662.

Sepúlveda, H. H., Artal, O. E., & Torregrosa, C. (2011). LiveROMS: A virtual environment for ocean numerical simulations. Environmental Modelling & Software, 26(11), 1372-1373.

12 Helpful Links

12.1 CROCO model

http://www.croco-ocean.org

12.2 CROCO user forum

https://forum.croco-ocean.org/questions/

12.3 CROCO tutorials

https://croco-ocean.gitlabpages.inria.fr/croco_doc/index.html

12.4 OctCDF package

http://modb.oce.ulg.ac.be/mediawiki/index.php/Octcdf

12.5 LiveCROCO Video: Basic Steps

https://www.youtube.com/watch?v=caxqeAgBM-U

13 Errata Compendium

• If you get an error message like this

Oracle VM VirtualBox Administrador Archine Ministra Aurola		- 0 ×
Herramientas	Neve Adder Configuración Descartar Inder	
ViveCROCO_v1.2.1b	General Pre Nombre: LiveCROC0_v1.2.1b Statem operative: Ubuntu (64-bit)	VM Name: LiveCROCO_v1.2.15
	Sistema Memoria base: 3739 MB Processores: 2 Orden de arranque: Disco duro Aceterador: Parevirtualización KUM	(HVPs) (VERR_NetM_NOT_AVAILABLE). VT-x is disabled in the BIOS for all CPU modes (VERR_VNX_MSR_ALL_VMX_DISA BLED). Result_Code: T_TAIL (02250004005) Component Consel
	Pantalla Menoria de video: 16 MB Controlador gráfico: V80x/SVGA Servido de escritorio renoto: Inhobitado Grábación: Inhobitado	Interface: IConsole (5ar83d89-5ee7-4e3 3-8ee5- b257b2e81be8)
	Almacenamiento Controlador: DE DE Secundario meetro: [Unidad óptica] Vacio Controlador: SATA Puerto SATA Puerto SATA C: LiveCROCO_v1.2.1b-didx01.vd((kormal, 207,31.GB)	100%
	()2 Audio Controlador de antifrión: Windows DirectSound Controlador: ICH ACS7	
	Red Adaptador 1: Intel PRO/1000 MT Desktop (NAT)	
	USB Controldor USB: OHCI Filtros de dispositivos: 0 (0 activo)	
	Carpetas compartidas Vinguno	
	Descripción Ninguno	
Octado 27°C Soleado	Q Búsqueda 🔲 🖸 📋 🧔 🧐 🔮 🔹 🖍 ESP	奈 (4)) 値 18:23 16-01-2023 (3)

Figure 22: Error message when launching the virtual machine

when launching the virtual machine Fig. 22, you might need to activate virtualization in the BIOS of your machine (thanks to Valentina Nuñez for pointing out this issue).