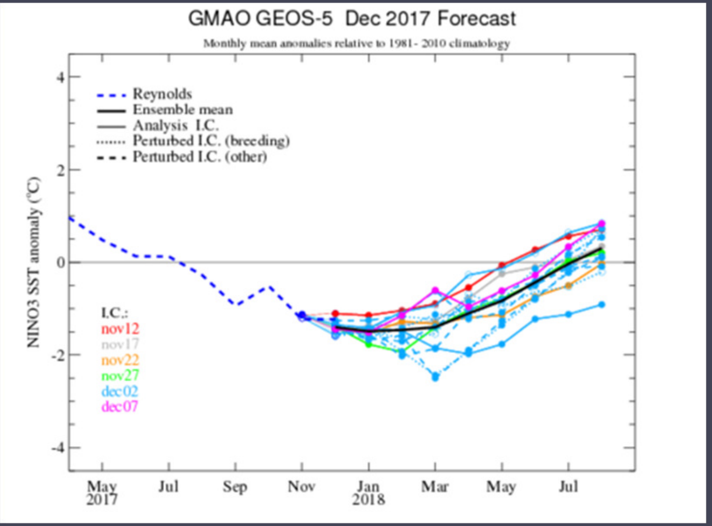


The Climate-system Historical Forecast Project (CHFP)

CITES2019

Ramiro Saurral (CIMA, Buenos Aires, Argentina)

Moscow, Russia. 28 May 2019

Background and main objectives of CHFP

First steps…

The CHFP was born in 2007 as part of the Working Group on Seasonal to Interannual Prediction (currently Working Group on Subseasonal to Interdecadal Prediction; WGSIP), having the nature of a multi-model and multi-institutional experimental framework for **sub-seasonal to decadal** **complete physical climate system** prediction.

By the complete physical climate system, we mean contributions from the atmosphere, oceans, land surface cryosphere and atmospheric composition in producing regional and sub-seasonal to decadal climate anomalies. This experimental framework is based on advances in climate research during the past years, which have lead to the understanding that modeling and predicting a given climate anomaly over any region is incomplete without a proper treatment of the effects of SST, sea ice, snow cover, soil wetness, vegetation, stratospheric processes, and atmospheric composition (carbon dioxide, ozone, etc.). **CHFP is particularly focused on the sub-seasonal to seasonal scale**.

Objectives

- Provide a baseline assessment of our seasonal prediction capabilities using the best available models of the climate system and data for initialisation
- Provide a framework for assessing of current and planned observing systems, and a test bed for integrating process studies and field campaigns into model improvements
- Provide an experimental framework for focused research on how various components of the climate system interact and affect one another
- Provide a test bed for evaluating IPCC class models in seasonal prediction mode

An introduction to CHFP

- The CHFP database hosts forecast systems outputs from retrospective predictions of the seasonal global climate from year to year, initialized at least twice a year across recent decades, and is freely available for research use.

http://chfps.cima.fcen.uba.ar/

Is monthly initialization worth the computational cost?

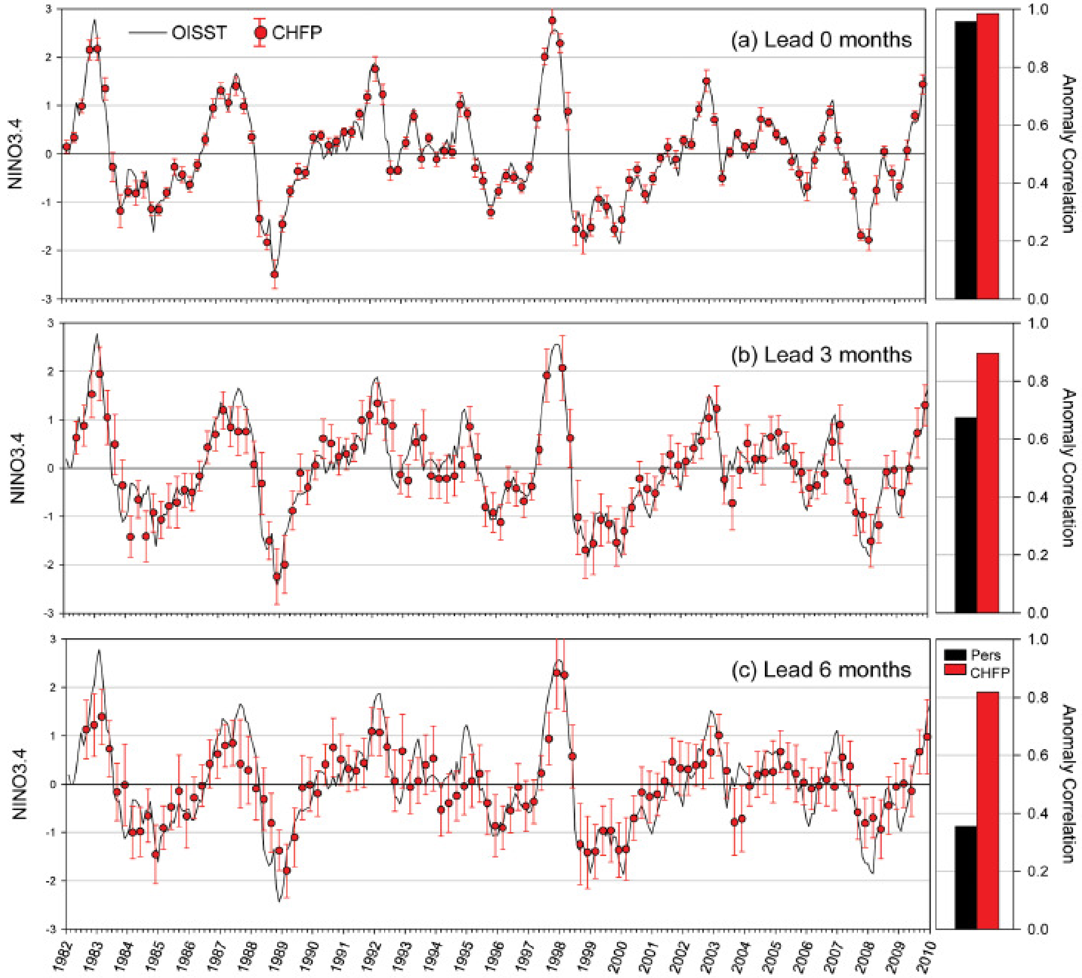


FIG. 2. (left) Seasonal-mean Niño-3.4 index (area-averaged SST anomaly in 5°S–5°N, 170°–120°W), as observed (OISST analysis; black) and predicted by CHFP models (red) initialized from February, May, August, and November 1982–2009 at (a) 0-, (b) 3-, and (c) 6-month lead times. Circles indicate mean values and error bars indicate standard deviations of predictions from 95 ensemble members. (right) Comparison of CHFP anomaly correlation skill values with those based on persisting the observed Niño-3.4 value prior to the start of the forecast.

From Tompkins et al. (2017), BAMS

The CHFP database currently contains data from 16 coupled forecast systems and hosts more than 10 TB of information in NetCDF format.

It is continuously growing and will continue to do so over the coming years to serve as a record of progress in global seasonal forecasting capability.

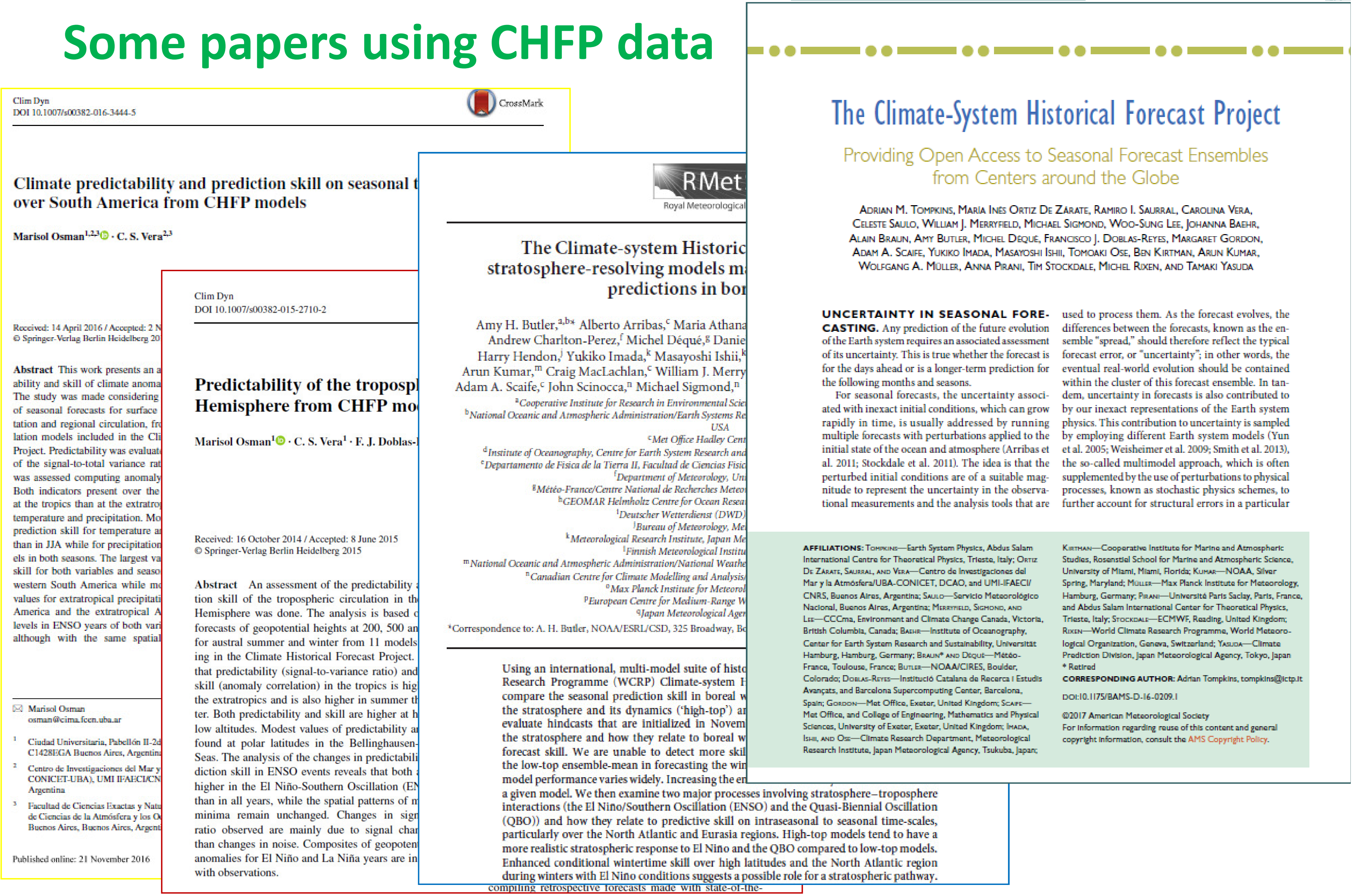
Forecast system	Research Center/Country
ARPEGE	MétéoFrance (France)
CCCma-CanCM3	CCCma (Canada)
CCCma-CanCM4	CCCma (Canada)
CFS	NCEP (USA)
CMAM	Canada
CMAMlo	Canada
ECMWF-S4	ECMWF (UK)
GloSea5	MetOffice (UK)

Forecast system	Research Center/Country
JMA/MRI-CGCM1	JMA (Japan)
JMA/MRI-CGCM2	JMA(Japan)
L38GloSea4	MetOffice (UK)
L85GloSea4	MetOffice (UK)
MIROC5	CCSR (Japan)
MPI-ESM-LR	MPI (Germany)
MPI-ESM-MR	MPI (Germany)
POAMA	BoM (Australia)

Near future: NMME (Phase 1 and 2), RHMC SL-AV, SINTEX-2

- According to CHFP protocols, forecast systems within CHFP **MUST** include seasonal (4-month lead-time) forecasts initialized **AT LEAST** twice a year, in May and November. If available, additional start times are also welcome (several models have start times every month, or 4 times a year, which is of course useful).
- Data from each forecast system is hosted in its native resolution (i.e. there is not any regridding onto a same grid).
- CHFP hosts both monthly mean and daily data.
- Forecasts start near 1979 and end around 2010.
- Some of the variables included in CHFP are 2m mean, minimum and maximum temperatures, total precipitation, zonal and meridional winds, heat fluxes and soil moisture, among others for the atmosphere, while several others are available related to the ocean (SST, sea ice, …)

Some papers using CHFP data



Clim Dyn
DOI 10.1007/s00382-016-3444-5

Climate predictability and prediction skill on seasonal t…
over South America from CHFP models

Marisol Osman[1,2,3] · C. S. Vera[2,3]

Received: 14 April 2016 / Accepted: 2 N…
© Springer-Verlag Berlin Heidelberg 20…

Abstract This work presents an a… ability and skill of climate anoma… The study was made considering… of seasonal forecasts for surface… tation and regional circulation, fr… lation models included in the Cl… Project. Predictability was evaluat… of the signal-to-total variance rat… was assessed computing anomaly… Both indicators present over the… at the tropics than at the extratrop… temperature and precipitation. Mo… prediction skill for temperature a… than in JJA while for precipitation… els in both seasons. The largest va… skill for both variables and seaso… western South America while m… values for extratropical precipitati… America and the extratropical A… levels in ENSO years of both vari… although with the same spatial…

Marisol Osman
osman@cima.fcen.uba.ar

1 Ciudad Universitaria, Pabellón II-2d… C1428EGA Buenos Aires, Argentin…
2 Centro de Investigaciones del Mar y… CONICET-UBA), UMI IFAECI/CN… Argentina
3 Facultad de Ciencias Exactas y Natu… de Ciencias de la Atmósfera y los O… Buenos Aires, Buenos Aires, Argent…

Published online: 21 November 2016

Clim Dyn
DOI 10.1007/s00382-015-2710-2

Predictability of the troposp…
Hemisphere from CHFP mo…

Marisol Osman[1] · C. S. Vera[1] · F. J. Doblas-…

Received: 16 October 2014 / Accepted: 8 June 2015
© Springer-Verlag Berlin Heidelberg 2015

Abstract An assessment of the predictability… tion skill of the tropospheric circulation in th… Hemisphere was done. The analysis is based o… forecasts of geopotential heights at 200, 500 an… for austral summer and winter from 11 models… ing in the Climate Historical Forecast Project… that predictability (signal-to-variance ratio) and… skill (anomaly correlation) in the tropics is hig… the extratropics and is also higher in summer th… ter. Both predictability and skill are higher at h… low altitudes. Modest values of predictability a… found at polar latitudes in the Bellinghausen-… Seas. The analysis of the changes in predictabili… diction skill in ENSO events reveals that both… higher in the El Niño-Southern Oscillation (EN… than in all years, while the spatial patterns of m… minima remain unchanged. Changes in sign… ratio observed are mainly due to signal chan… than changes in noise. Composites of geopoten… anomalies for El Niño and La Niña years are in… with observations.

RMet…
Royal Meteorological…

The Climate-system Historic…
stratosphere-resolving models m…
predictions in bor…

Amy H. Butler,[a,b*] Alberto Arribas,[c] Maria Athana… Andrew Charlton-Perez,[f] Michel Déqué,[g] Danie… Harry Hendon,[j] Yukiko Imada,[k] Masayoshi Ishii,[k]… Arun Kumar,[m] Craig MacLachlan,[c] William J. Merry… Adam A. Scaife,[c] John Scinocca,[n] Michael Sigmond,[n]…

[a] Cooperative Institute for Research in Environmental Scie…
[b] National Oceanic and Atmospheric Administration/Earth Systems Re… USA
[c] Met Office Hadley Cent…
[d] Institute of Oceanography, Centre for Earth System Research and…
[e] Departamento de Física de la Tierra II, Facultad de Ciencias Físic…
[f] Department of Meteorology, Uni…
[g] Météo-France/Centre National de Recherches Météo…
[h] GEOMAR Helmholtz Centre for Ocean Resea…
[i] Deutscher Wetterdienst (DWD)…
[j] Bureau of Meteorology, Me…
[k] Meteorological Research Institute, Japan Me…
[l] Finnish Meteorological Institu…
[m] National Oceanic and Atmospheric Administration/National Weathe…
[n] Canadian Centre for Climate Modelling and Analysis…
[o] Max Planck Institute for Meteorol…
[p] European Centre for Medium-Range W…
[q] Japan Meteorological Agen…

*Correspondence to: A. H. Butler, NOAA/ESRL/CSD, 325 Broadway, Bo…

Using an international, multi-model suite of histo… Research Programme (WCRP) Climate-system H… compare the seasonal prediction skill in boreal w… the stratosphere and its dynamics ('high-top') ar… evaluate hindcasts that are initialized in Novem… the stratosphere and how they relate to boreal w… forecast skill. We are unable to detect more skil… the low-top ensemble-mean in forecasting the win… model performance varies widely. Increasing the en… a given model. We then examine two major processes involving stratosphere–troposphere interactions (the El Niño/Southern Oscillation (ENSO) and the Quasi-Biennial Oscillation (QBO)) and how they relate to predictive skill on intraseasonal to seasonal time-scales, particularly over the North Atlantic and Eurasia regions. High-top models tend to have a more realistic stratospheric response to El Niño and the QBO compared to low-top models. Enhanced conditional wintertime skill over high latitudes and the North Atlantic region during winters with El Niño conditions suggests a possible role for a stratospheric pathway.

compiling retrospective forecasts made with state-of-the-

The Climate-System Historical Forecast Project

Providing Open Access to Seasonal Forecast Ensembles from Centers around the Globe

Adrian M. Tompkins, María Inés Ortiz De Zárate, Ramiro I. Saurral, Carolina Vera, Celeste Saulo, William J. Merryfield, Michael Sigmond, Woo-Sung Lee, Johanna Baehr, Alain Braun, Amy Butler, Michel Déqué, Francisco J. Doblas-Reyes, Margaret Gordon, Adam A. Scaife, Yukiko Imada, Masayoshi Ishii, Tomoaki Ose, Ben Kirtman, Arun Kumar, Wolfgang A. Müller, Anna Pirani, Tim Stockdale, Michel Rixen, and Tamaki Yasuda

UNCERTAINTY IN SEASONAL FORECASTING. Any prediction of the future evolution of the Earth system requires an associated assessment of its uncertainty. This is true whether the forecast is for the days ahead or is a longer-term prediction for the following months and seasons.

For seasonal forecasts, the uncertainty associated with inexact initial conditions, which can grow rapidly in time, is usually addressed by running multiple forecasts with perturbations applied to the initial state of the ocean and atmosphere (Arribas et al. 2011; Stockdale et al. 2011). The idea is that the perturbed initial conditions are of a suitable magnitude to represent the uncertainty in the observational measurements and the analysis tools that are used to process them. As the forecast evolves, the differences between the forecasts, known as the ensemble "spread," should therefore reflect the typical forecast error, or "uncertainty"; in other words, the eventual real-world evolution should be contained within the cluster of this forecast ensemble. In tandem, uncertainty in forecasts is also contributed to by our inexact representations of the Earth system physics. This contribution to uncertainty is sampled by employing different Earth system models (Yun et al. 2005; Weisheimer et al. 2009; Smith et al. 2013), the so-called multimodel approach, which is often supplemented by the use of perturbations to physical processes, known as stochastic physics schemes, to further account for structural errors in a particular

AFFILIATIONS: Tompkins—Earth System Physics, Abdus Salam International Centre for Theoretical Physics, Trieste, Italy; Ortiz De Zárate, Saurral, and Vera—Centro de Investigaciones del Mar y la Atmósfera/UBA-CONICET, DCAO, and UMI-IFAECI/CNRS, Buenos Aires, Argentina; Saulo—Servicio Meteorológico Nacional, Buenos Aires, Argentina; Merryfield, Sigmond, and Lee—CCCma, Environment and Climate Change Canada, Victoria, British Columbia, Canada; Baehr—Institute of Oceanography, Center for Earth System Research and Sustainability, Universität Hamburg, Hamburg, Germany; Braun* and Déqué—Météo-France, Toulouse, France; Butler—NOAA/CIRES, Boulder, Colorado; Doblas-Reyes—Institució Catalana de Recerca i Estudis Avançats, and Barcelona Supercomputing Center, Barcelona, Spain; Gordon—Met Office, Exeter, United Kingdom; Scaife—Met Office, and College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, United Kingdom; Imada, Ishii, and Ose—Climate Research Department, Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan; Kirtman—Cooperative Institute for Marine and Atmospheric Studies, Rosenstiel School for Marine and Atmospheric Science, University of Miami, Miami, Florida; Kumar—NOAA, Silver Spring, Maryland; Müller—Max Planck Institute for Meteorology, Hamburg, Germany; Pirani—Université Paris Saclay, Paris, France, and Abdus Salam International Center for Theoretical Physics, Trieste, Italy; Stockdale—ECMWF, Reading, United Kingdom; Rixen—World Climate Research Programme, World Meteorological Organization, Geneva, Switzerland; Yasuda—Climate Prediction Division, Japan Meteorological Agency, Tokyo, Japan
* Retired

CORRESPONDING AUTHOR: Adrian Tompkins, tompkins@ictp.it

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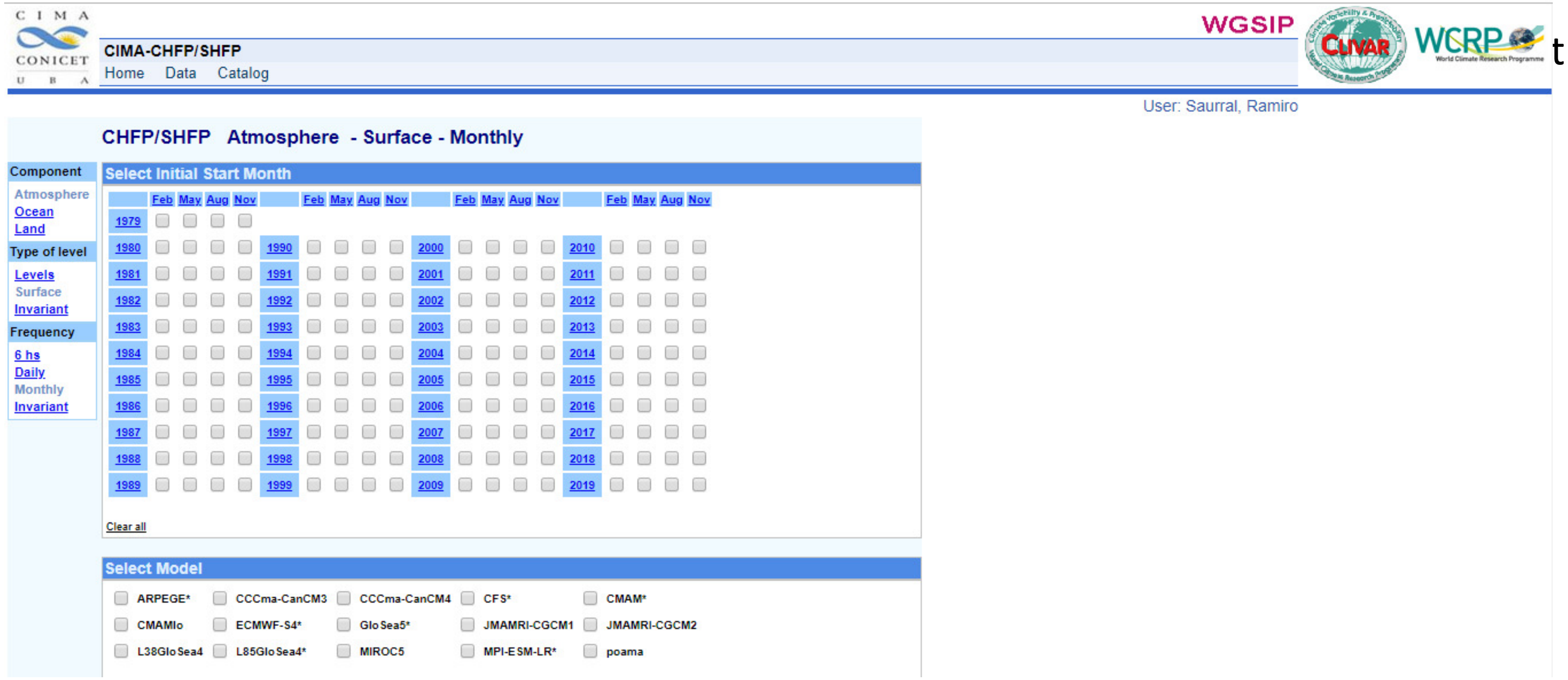
How to access the data

Downloading and using CHFP is very easy! The steps are:

1) Register at the CHFP website (http://chfps.cima.fcen.uba.ar)



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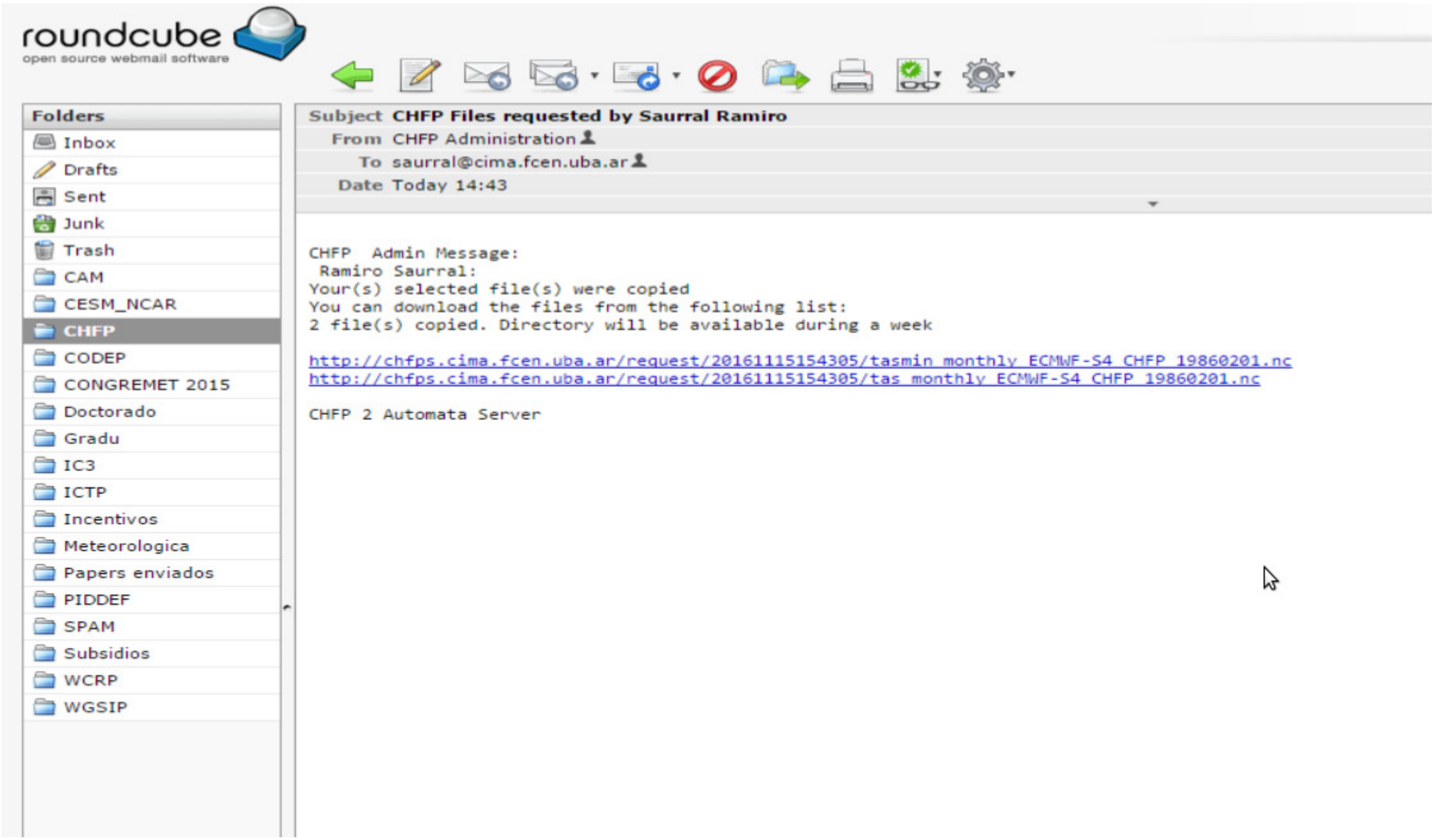
roundcube
open source webmail software
Folders
Inbox
Drafts
Sent
Junk
Trash
CAM
CESM_NCAR
CHFP
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ICTP
Incentivos
Meteorologica
Papers enviados
PIDDEF
SPAM
Subsidios
WCRP
WGSIP
Subject CHFP Files requested by Saurral Ramiro
From CHFP Administration
To saurral@cima.fcen.uba.ar
Date Today 14:43
CHFP Admin Message:
Ramiro Saurral:
Your(s) selected file(s) were copied
You can download the files from the following list:
2 file(s) copied. Directory will be available during a week
http://chfps.cima.fcen.uba.ar/request/20161115154305/tasmin_monthly_ECMWF-S4_CHFP_19860201.nc
http://chfps.cima.fcen.uba.ar/request/20161115154305/tas_monthly_ECMWF-S4_CHFP_19860201.nc
CHFP 2 Automata Server

How to access the data

Files can be downloaded individually or (more efficiently) using scripts.

An easy way to go in Linux is to download the list of files and use wget…

- Save the list of files (received by email) in a .txt file (e.g. file_list.txt)

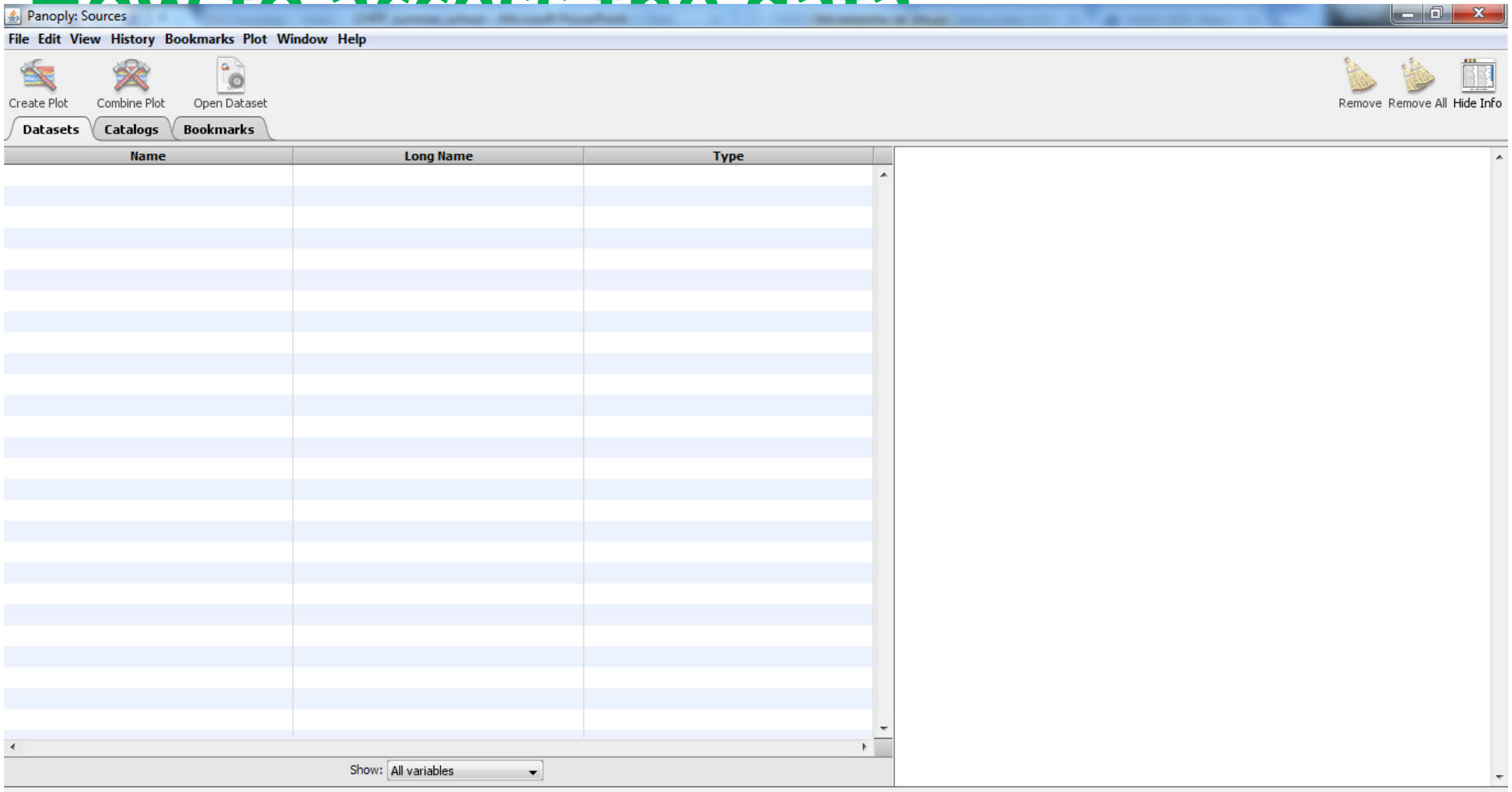
  http://chfps.cima.fcen.uba.ar/request/20140128131722/tasmin_monthly_ECMWF-S4_CHFP_19810201.nc
  http://chfps.cima.fcen.uba.ar/request/20140128131722/tasmin_monthly_ECMWF-S4_CHFP_19820201.nc
  http://chfps.cima.fcen.uba.ar/request/20140128131722/tasmin_monthly_ECMWF-S4_CHFP_19830201.nc

- Use wget:

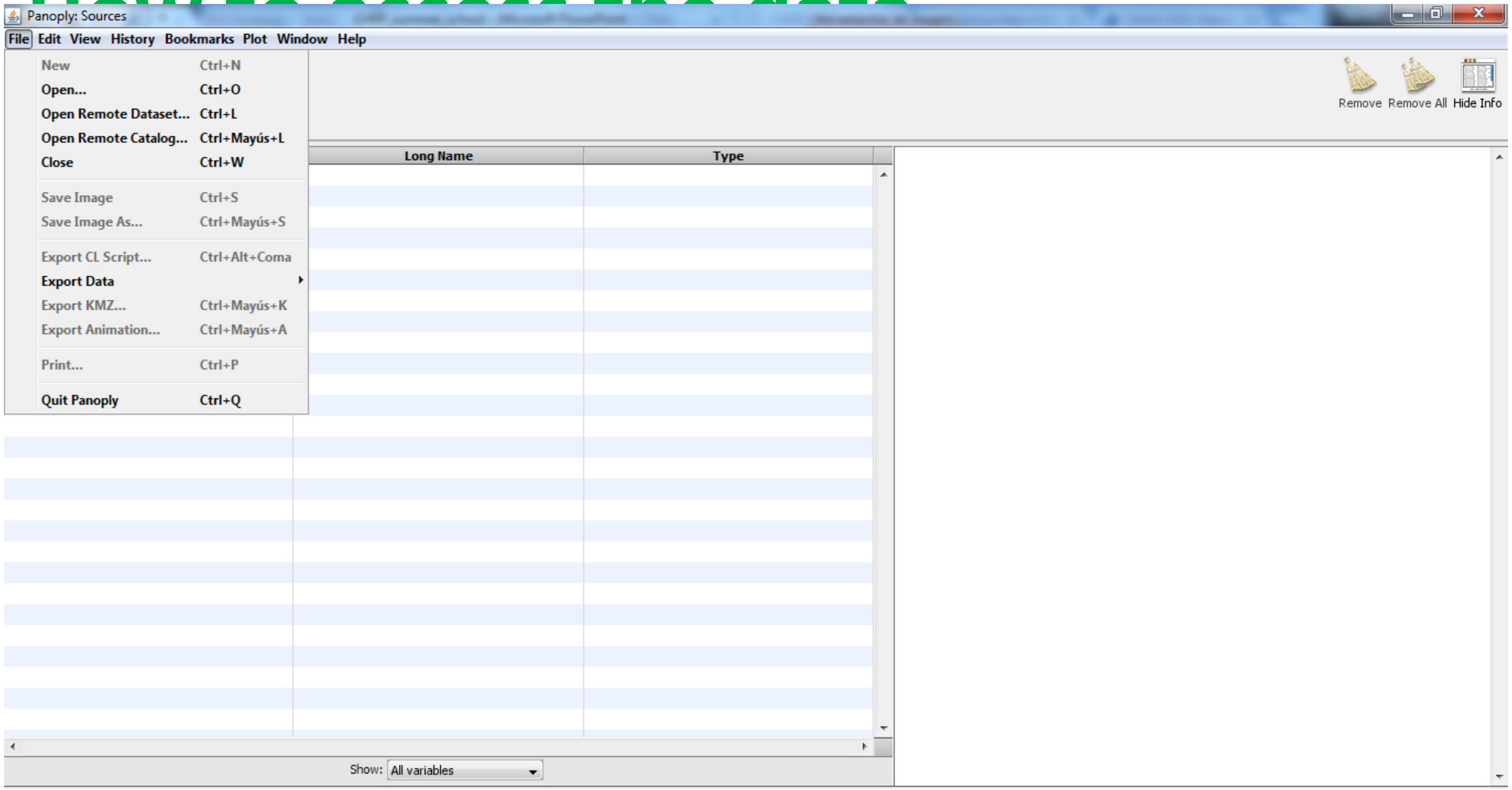
```
$ wget -b -c -nd t=0 -i file_list.txt -o log_01
```

In the example above, file "log_01" will contain all the information regarding the download speed and status.

How to access the data



How to access the data



How to access the data

Another good option is to use OpenDAP, which allows to use NCO tools to subset, split and merge files <u>before</u> download.

Atmosphere

	Surface																								
Frecuency	Monthly																								
Model/Vble	Period	clt	hflsd	hfssd	mrsov	prlr	psl	rlds	rls	rlt	rsds	rss	rst	snld	tas	tasmax	tasmin	tauu	tauv	tauy	tdps	ts	uas	vas	
ARPEGE	1979 2007					174	174															174			522
CCCma-CanCM3	1979 2010	120	120	120	120	120	122	120	120	120	120	120	120	120	120	120	120					120	120	120	2282
CCCma-CanCM4	1979 2010	120	120	120	120	120	122	120	120	120	120	120	120	120	120	120	120					120	120	120	2282
CFS	1981 2007					53	53								53							53			212
CMAM	1979 2008					60	60								60							60			240
CMAMlo	1979 2008					60	60								60							60			240
ECMWF-S4	1981 2010	120			120	120	120	120	120	120	120	120	120	120	120	120	120	120	120		120	120	120	120	2400
GloSea5	1996 2009					56	56							56	56							56			280
JMAMRI-CGCM1	1979 2010	128	128	128		128	128	128	128	128	128	128	128	116	128	128	128					128	128	128	2292
JMAMRI-CGCM2	1981 2010	120	120	120		120	120	120	120	120	120	120	120		120	120	120	120	120				120	120	2160
L38GloSea4	1989 2002					56	56							56	56							56			280
L85GloSea4	1989 2009					84	84							84	84							84			420
MIROC5	1979 2011	132	132	132		132	132		132	132	132	132	132	132	132	132	132	132	132			132			2244
MPI-ESM-LR	1982 2011	60	60	60		60	60	60	60	60	60	60	60	60	60	60	60	60	60		60	60	60	60	1260
poama	1980 2009		120	360		360	360	360		360			360	360	360			360		360		360			4080
Total Files:		800	800	1040	360	1703	1707	1028	800	1160	800	800	1160	1224	1529	800	800	792	432	360	180	1583	668	668	**21194**

	Levels						
Frecuency	Monthly						
Model/Vble	Period	g	hus	ta	ua	va	
ARPEGE	1979 2007	174	174	174	174	174	870
CCCma-CanCM3	1979 2010	122	120	120	122	120	604
CCCma-CanCM4	1979 2010	122	120	120	122	120	604
CFS	1981 2007	53	53	53	53	53	265
CMAM	1979 2008	60		60	60	60	240
CMAMlo	1979 2008	60		60	60	60	240
ECMWF-S4	1981 2010	120	120	120	120	120	600
GloSea5	1996 2009	56		56	56	56	224
JMAMRI-CGCM1	1979 2010	128	128	128	128	128	640
JMAMRI-CGCM2	1981 2010	120	120	120	120	120	600
L38GloSea4	1989 2002	56		56	56	56	224
L85GloSea4	1989 2009	84		84	84	84	336
MIROC5	1979 2011	132	132	132	132	132	660
MPI-ESM-LR	1982 2011	60	60	60	60	60	300
MPI-ESM-MR	1981 2011	62	62	62	62	62	310
poama	1980 2009		360	360	360	360	1440
Total Files:		1409	1449	1765	1769	1765	**8157**

	Surface																								
Frecuency	Daily																								
Model/Vble	Period	clt	hflsd	hfssd	mrsov	prlr	psl	rlds	rls	rlt	rsds	rss	rst	snld	tas	tasmax	tasmin	tauu	tauv	tauy	tdps	ts	uas	vas	
CCCma-CanCM3	1979 2008	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120					120	120	120	2280
CCCma-CanCM4	1979 2008	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120					120	120	120	2280
CFS	1981 2007					53	53								53										159
CMAM	1979 2008					60	60								60										180
CMAMlo	1979 2008					60	60								60										180
JMAMRI-CGCM1	1979 2006		112	112		112	112	112	112	112	112	112	112	112		112	112					112			1568
MIROC5	1979 2011		132	132	132	132	132	132	132	132	132	132	132	132		132	132	132	132			132			2244
Total Files:		240	484	484	372	657	657	484	484	484	484	484	484	484	413	484	484	132	132	0	0	484	240	240	8891

	Levels						
Frecuency	Daily						
Model/Vble	Period	g	hus	ta	ua	va	
CCCma-CanCM3	1979 2008	120	120	120	120	120	600
CCCma-CanCM4	1979 2008	120	120	120	120	120	600
CMAM	1979 2008	60		60	60		180
CMAMlo	1979 2008	60		60	60		180
GloSea5	1996 2009				56		56
JMAMRI-CGCM1	1979 2006	112	112	112	112	112	560
L85GloSea4	1989 2009				83		83
MIROC5	1979 2011	132	132	132	132	132	660
Total Files:		604	484	604	743	484	2919

Ocean

	Surface									
Frecuency	Monthly									
Model/Vble	Period	hfns	rss	shfo	swhfo	tauxo	tauyo	wo	zoh	zmlo	
CCCma-CanCM3	1979 2008								120	120	240
CCCma-CanCM4	1979 2008								120	120	240
JMAMRI-CGCM1	1979 2010								128	128	256
JMAMRI-CGCM2	1981 2010	120	120						120		360
MIROC5	1979 2011	132	131						132	132	527
Total Files:		252	251	0	0	0	0	0	620	500	1623

	Levels						
Frecuency	Monthly						
Model/Vble	Period	thetao	saltfo	so	uo	vo	
CCCma-CanCM3	1979 2008	120		120	120	120	480

Let's download some data

- Username: user.chfp@gmail.com
  Password: hindcast

Some useful links

CHFP:
chfps.cima.fcen.uba.ar

Panoply:
www.giss.nasa.gov/tools/panoply/

NCO tools:
nco.sourceforge.net

Quick introduction to NCO tools

Cut files (along the dimension of a variable): ncks

Example: Want to keep only latitudes from 0 to 20N

$ ncks –d latitude,0.,20. [input file] [output file]

Merge files: ncrcat

$ ncrcat precip* precip_merged.nc