NCAR Command Language

NCL is an interpreted language designed specifically for scientific data analysis and visualization.

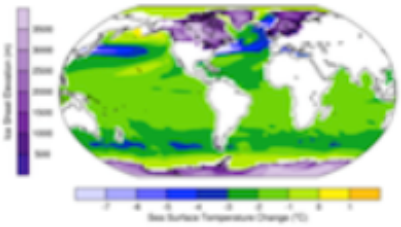
Portable, robust, and free, NCL is available as binaries or open source.

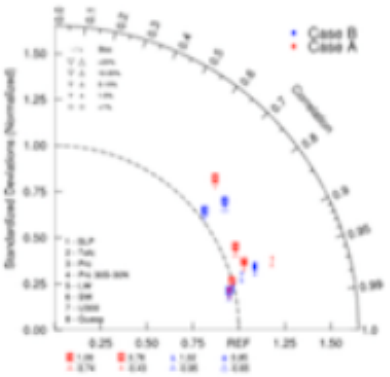
Supports NetCDF 3/4, GRIB 1/2, HDF 4/5, HDF-EOS 2/5, shapefile, ASCII, binary.

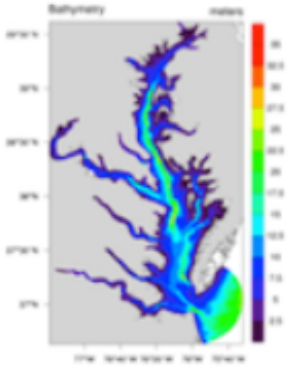
Numerous analysis functions are built-in.

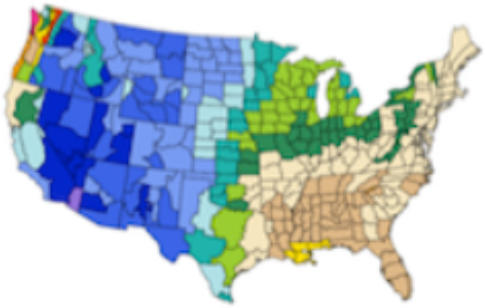
High-quality graphics are easily created and customized with hundreds of graphic resources.

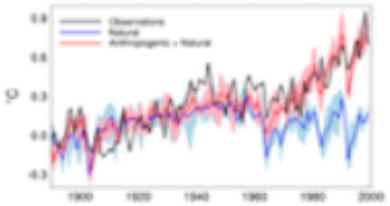
Many example scripts and their corresponding graphics are available.

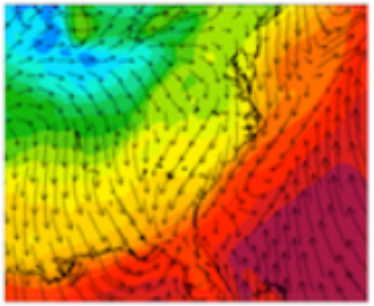


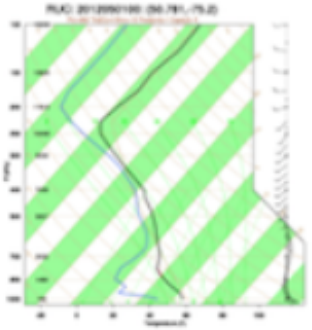












Ejemplos Generales

Datasets
- AVHRR
- ARM
- Arctic Systems Reanalysis
- CALIPSO
- classification data: vegetation/cloud
- CloudSat
- COAMPS
- COADS
- CRU
- DAYMET
- EASE
- ERA40, ERA-I, ERA-20C
- GODAS
- GOES
- GPCP
- HDF/HDF4/5-EOS: AIRS,HIRDLS,MLS MOPITT,MODIS,OMI SeaWIFS,TES,TRMM
- High Res Precipitation GPM,TRMM,CMORPH PERSIANN,CPC_Famine
- IBTrACS
- LDAS: NLDAS/GLDAS
- MCSST
- NARR
- NIC snow & ice data
- NOGAPS
- PRISM
- seaWiFs
- Shapefiles
- SSMI (v7)
- station data
- topographic data

Map projections
- Maps only
- NEW Map outlines
- Map lat/lon grids
- General
- Coastlines
- Cylindrical equidistant
- Lambert conformal (masked)
- Lambert conformal (native)
- Native grid
- Polar stereographic
- Rotated lat-lon
- Satellite
- Tickmarks: map

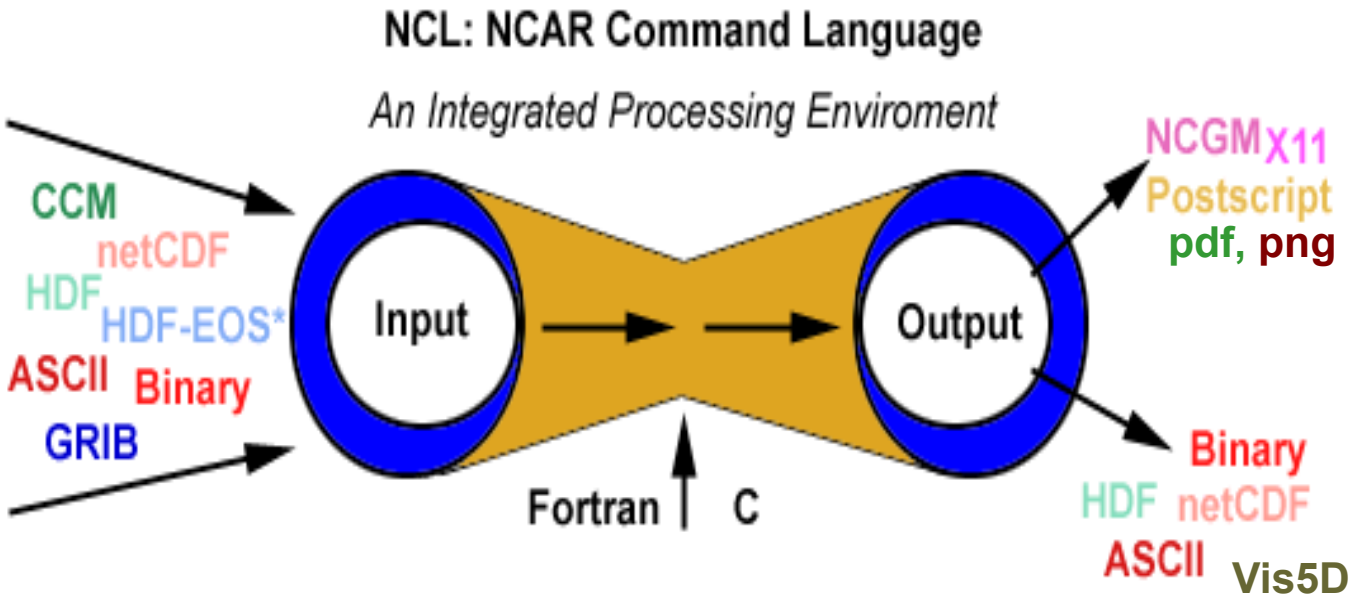
Models
- COAMPS
- CCCMA: CRCM
- CESM: Ice (CISM)
- CESM: Land
- CESM: POP
- COSMO
- HOMME (SEAM)
- ICON
- MPAS
- NOGAPS
- Ocean: HYCOM
- Ocean: NCOM
- Ocean: NLOM
- Ocean: ORCA
- Ocean: ROMS
- Paleoclimatology
- PIPS
- Regional Climate Model
- REMO
- TIGGE Project
- Toulouse models
- WRF

Data Analysis
- Anomalies
- Binning
- Climate Indices
- Climatology
- COADS
- Complex Coefficients (GRIB)
- Correlations
- NEW Crop: Evapotranspiration; Penman-Monteith (FAO-56); Thornthwaite
- Divergent and rotational wind components
- NEW Eliassen-Palm flux; Brunt/Ri/Eady
- ESMF regridding
- EOFs
- Filters
- Fourier Analysis
- NEW Gradients
- GrADS CTL files
- Grid_filling
- NEW Heat Index/Stress
- Isentropic levels
- Local minima and maxima
- Meridional overturning
- MJO Clivar
- NCL system interactions and scripting
- Omega
- One-dimensional interpolation
- PV: Potential Vorticity and Temperature; Static Stability
- PDF: Probability Distributions
- POP: Principal Oscillation Patterns
- Random Data to Grid
- NEW Regression, Trend
- Regridding
- Sigma coordinate interpolation

Plot Types
- Bar charts
- Box plots
- Contours: no maps
- Contours: cylindrical equidistant

Plot Techniques
- 2-dimensional vertical coordinates
- Animations
- Annotations

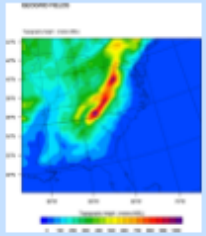
Special Plots
- Evans plots
- Histograms
- Iso levels
- Meteograms
- Pie charts


NCL: NCAR Command Language
An Integrated Processing Enviroment
CCM
netCDF
HDF
HDF-EOS*
ASCII
Binary
GRIB
Input
Output
Fortran
C
NCGM
X11
Postscript
pdf, png
Binary
HDF
netCDF
ASCII
Vis5D

http://www2.mmm.ucar.edu/wrf/OnLineTutorial/Graphics/NCL/NCL_examples.htm

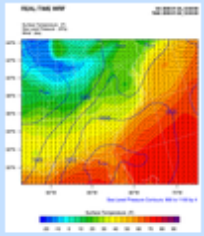
Ejemplos para
Las salidas WRF

Basic Plots



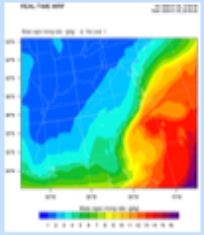
Basic Plot Setup
(This series of examples takes users though same basic steps in generating plotting scripts.)
Get and plot a single field
Multiple input files
Plot all fields in a file

Basic Surface Plots



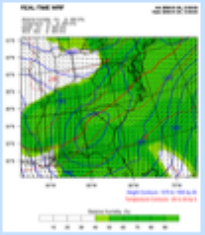
Surface 1
Surface 3
Surface 2
Surface with multiple input files

Plots on Model Levels



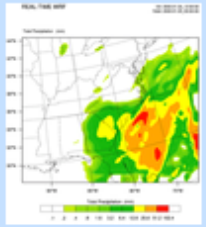
Clouds
Levels from wrfout files
Levels from metgrid files

Plots on Interpolated Levels



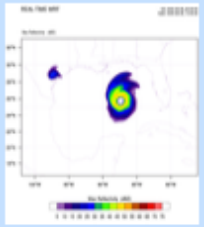
Height Levels
Pressure Levels

Plotting Precipitation



Precipitation

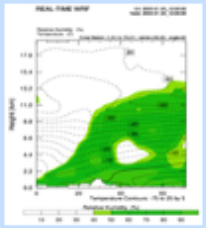
Diagnostics



CAPE
dBZ
PW
Vorticity
helicity
updraft_helicity

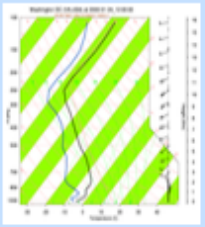
(More diagnostics are available, shown are only some newer/special diagnostics)

Cross-section Plots



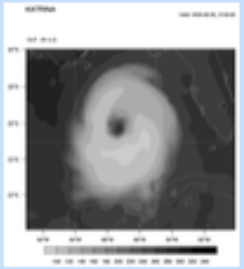
Height - Through a Pivot Point
Height - Point A to Point B
Pressure
Limited Vertical Extent
For 2D fields
Smooth terrain

Skew_T Plots



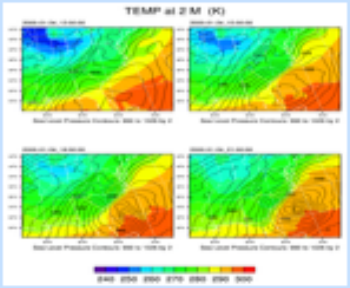
Skew_T

Overlay and Zoom



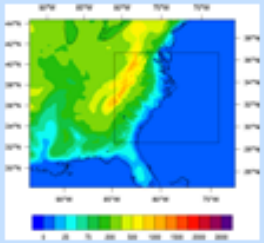
Overlay
Zoom
Overlay & Zoom

Panel Plots



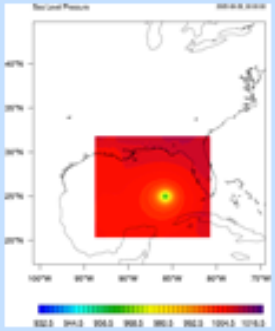
Panel 1
Panel 2

Overlay Domains



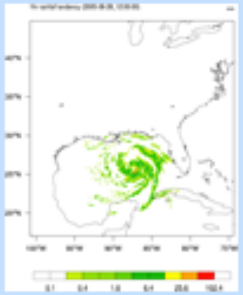
Overlay 2 domains

Moving Nest



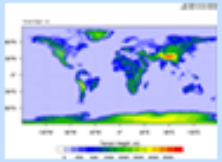
Moving Nest
Keeping a fixed background for moving nest domain

Moving Nest



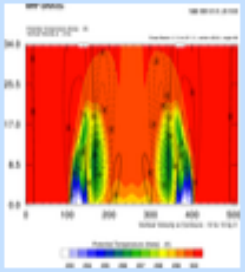
Precip Tendencies for a Moving Nest
Keeping a fixed background for moving nest domain, and plotting rainfall tendencies in the overlapping regions
Domain 1 and 2 Precip Tendencies on a single plot (domain 2 is a moving nest)

Global WRF



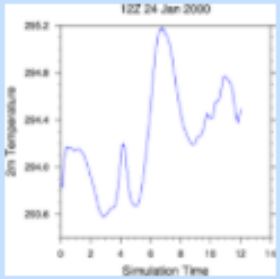
gWRF_merc

Idealized cases



wrf_Grav2x
wrf_Hill2d
wrf_Squall_2d_x
wrf_Squall_2d_y
wrf_Seabreeze2x
wrf_BWave
wrf_QSS

Time Slice Plots

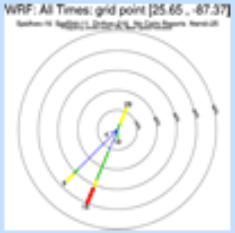


Meteograms
WRF Time Series data

Track Cyclone

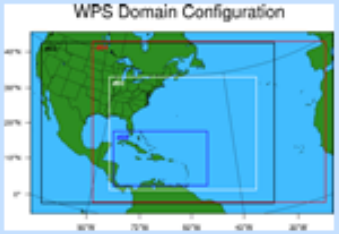
Plot Cyclone Vortex

Wind Roses



Create a wind rose

Preview Domain



Preview
Note: This example script makes use to the WPS namelist directly

Como usar NCL ?

2 Maneras :

- 1. Usando la manera interactiva :

```
macbook-de-clementine-junquas:~ clementinejunquas$ ncl
 Copyright (C) 1995-2013 - All Rights Reserved
 University Corporation for Atmospheric Research
 NCAR Command Language Version 6.1.2
 The use of this software is governed by a License Agreement.
 See http://www.ncl.ucar.edu/ for more details.
ncl 0>
```

- 2. Creando un script : « plot.ncl » que contiene el codigo para crear una figura por ej. :

```
load ncl library scripts
begin
; Open input file(s)
; Open graphical output
; Read variables
; Set up plot resources & Create plots
; Output graphics
end
```

→ Lanzarlo : *ncl plot.ncl* o *ncl < plot.ncl*

Matrices en NCL

";" para comentarios

Definiciones

A=new(2,float)
A=(/10.,20./) ; El "punto" para numeros "real", sin el punto si es un "integer"
B=new((/ntime,nlev,nlat,nlon/),float)
delete(A) ; para borrar la matrice A
delete([/ A, B, C /]) ; para borrar varias matrices
free memory ; si falta memoria

Interactivo :

print(M) ; para que aparezca la matrice en la pantalla (= *M* en matab)
print(dimsizes(M)) ; para que aparezca las dim de M en la pantalla (=*size(M)* en matlab)

Funciones utiles generales

M=(/(/1,3/),(/7,2/)/)
M(0:,:) ; **Importante** : En NCL se cuentan las dimensiones a partir de 0, como en NCOs
transpose(M) ; = M'
dim_sum(M) ; = suma de cada linea (1era dimension)
dim_sum_n(M,1) ; = suma de cada columna (2da dimension)
sum(M) ; = todos los elementos
dimsizes(M) ; = size(M) en matlab
product(dimsizes(M)) ; = length(M) en matlab

EJEMPLO 1

```
ncl 0> x=new(2,float)
ncl 1> x=(/10.,20./)
ncl 2> print(x)


Variable: x
Type: float
Total Size: 8 bytes
            2 values
Number of Dimensions: 1
Dimensions and sizes:   [2]
Coordinates:
Number Of Attributes: 1
  _FillValue :  9.96921e+36
(0)     10
(1)     20
ncl 3>
```

EJEMPLO 2

```
ncl 4> A=(/(/1,3/),(/7,2/)/)
ncl 5> print(A)


Variable: A
Type: integer
Total Size: 16 bytes
            4 values
Number of Dimensions: 2
Dimensions and sizes:   [2] x [2]
Coordinates:
(0,0)   1
(0,1)   3
(1,0)   7
(1,1)   2
```

```
ncl 7> print(dimsizes(x))
 (0)     2
ncl 8> print(dimsizes(A))
 (0)     2
 (1)     2
```

Matrices en NCL

Funciones utiles en climatologia

promediar= average en ingles

dim_avg(A(0,:))

dim_avg_n(A,x) *;* promedio sobre la dimension x

*reshape(A,(/2*2/))* *; =*reshape en matlab

permute=X(lat|:,lon|:,lev|:)

funcion divergence *= uv2dv_cfd* ; si lat/lon grid

squeeze en matlab = *rm_single_dims(M)*

ncrcat en NCO = *array_append_record(M1,M2,x)* ;= se juntan 2 matrices en la dimension x

smth9 para suavizar orografia por ej.

linint2 para hacer interpolacion lat/lon

crear archivo txt :

asciiwrite("qum_vertint.txt",qum)

leer archivos .txt :

qum = asciiread("qum_vertint.txt",(/nlat,nlon/),"float")

Convertir del formato GRIB a NETCDF :

grib a netcdf con NCL : ncl_convert2nc file.nc

netcdf a grib con CDO : cdo -f grb copy infile.nc outfile.grb

Loops

if (i .gt. 0) then
…
end if

do i=0,ntimes-1
…
end do

do while (i .lt. 10)
…
end do

a .and. b
a .or. b
.not. A
a .eq. B ; equal
a .lt. B ; lower than
a .gt. B ; greater than
a .le. B ; lower or equal
a .ge. B ; greater or equal
a .ne. b ; not equal

Funciones WRF

wrf_user_ij_to_ll ; encuentra lat/lon mas proximo de un punto preciso

wrf_user_intrp2d ; linea
wrf_user_intrp3d ; vert cross-section

wrf_pvo ; vorticidad potencial
wrf_rh ; humedad relative
wrf_slp ; sea level pressure
…
http://www.ncl.ucar.edu/Document/Functions/list_alpha.shtml#W

Hacer una figura con NCL

```
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
load "$NCARG_ROOT/lib/ncarg/nclscripts/wrf/WRFUserARW.ncl”

begin
      a = addfile("./wrfout_d01_2012-09-28_00:00:00.nc","r")

      wks = gsn_open_wks(“X11”,"plt_Surface")

      T2 = wrf_user_getvar(a,"T2",0)

      ; Set up plot resources & Create plots

      ; Output graphics

end
```

librerias

Puede ser « w » o « c »
(read, write, create)

Define formato y nombre de la figura
(X11, pdf, png, cgm)

wrf_user_getvar

Get fields from input file

ter = wrf_user_getvar(a,"HGT",0) {ter=a->HGT(0,:,:)}

t2 = wrf_user_getvar(a,"T2",-1) {t2=a->T2}

slp = wrf_user_getvar(a,"slp",1)

avo/pvo: Absolute/Potential Vorticity,
eth: Equivalent Potential Temperature,
cape_2d: 2D mcape/mcin/lcl/lfc,
cape_3d: 3D cape/cin,
dbz/mdbz: Reflectivity (3D and max),
geopt/geopotential: Geopotential,
helicity/updraft_helicity: Storm Relative Helicity/Updraft helicity,
omg, Omega, p/pres/pressure: Pressure, pw: Precipitable Water,
rh/rh2: Relative Humidity (3D and 2m),
slp: Sea Level Pressure, times: Time as a string [(Times: Time as characters)],
td/td2: Dew Point Temperature (3D and 2m),
tc/tk: Temperature (C and F),
th/theta: Potential Temperature,
tv: Virtual Temperature,
twb: Wetbulb Temperature,
z/height: Height,
ua/va/wa: wind on mass points,

Hacer una figura con NCL

```
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
load "$NCARG_ROOT/lib/ncarg/nclscripts/wrf/WRFUserARW.ncl”

begin
      a = addfile("./wrfout_d01_2012-09-28_00:00:00.nc","r")

      wks = gsn_open_wks(“X11”,"plt_Surface")

      T2 = wrf_user_getvar(a,"T2",0)

      ; Set up plot resources & Create plots :
pltres = True
mpres = True
opts = True
opts@cnFillOn = True

      ; Output graphics :
contour_t2 = wrf_contour(a,wks,T2,opts)

plot= wrf_map_overlays(a,wks,(/contour_t2/),pltres,mpres)

end
```

librerias

Puede ser « w » o « c »
(read, write, create)

Define formato y nombre de la figura
(X11, pdf, png, cgm)

pltres: Plotting resources – like overlays
mpres: Map resources – like map resolution and zooming option
opts: Resources associated with each individual plot

Para varias variables en el mismo mapa :

```
T2 = wrf_user_getvar(a,"T2",0)
slp = wrf_user_getvar(a,”slp",0)

pltres = True
mpres = True

;;;; Opciones para T2
opts = True
opts@cnFillOn = True                    ; like fill/shade
contour_t2 = wrf_contour(a,wks,T2,opts)
delete(opts)

;;;; Opciones para slp
opts = True
opts@cnLineColor = "Blue”               ; like contour
contour_slp = wrf_contour(a,wks,slp,opts)
delete(opts)

plot = wrf_map_overlays(a,wks,(/contour_t2,contour_slp/), pltres, mpres)
```

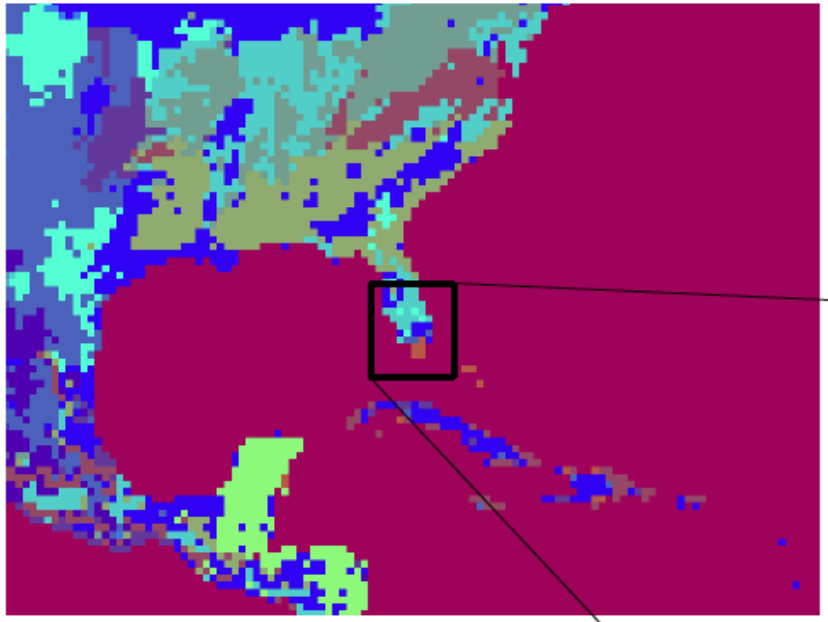
/datastore/datos/WRF/
Figuras_NCL/

```
;;;;;;;;;;;;; Resources
  res = True      ; caracteristicas de las variables
  pltres = True   ; caracteristicas del plot
  mpres = True    ; caracteristicas del mapa

;;;;;;;; MAPA
  ; contornos politicos
  mpres@mpGeophysicalLineColor      = "Black"  ; Overwrite basic map settings
  mpres@mpGridLineColor             = "Black"
  mpres@mpNationalLineColor         = "Black"
  mpres@mpGeophysicalLineThicknessF = 2.0
  mpres@mpGridLineThicknessF        = 2.0
  mpres@mpLimbLineThicknessF        = 2.0
  mpres@mpNationalLineThicknessF    = 2.0
  mpres@mpOutlineBoundarySets = "National"

  ; Dominio
  mpres@mpLimitMode="LatLon"
  mpres@mpMinLatF=-20.
  mpres@mpMaxLatF=0.
  mpres@mpMinLonF=-82.
  mpres@mpMaxLonF=-64.

  ;Proyeccion
  mpres@mpProjection = "Orthographic"
  mpres@mpGridAndLimbOn = False
  mpres@mpGridSpacingF = 5

  ;GRID AND TICKMARK
  mpres@tmXBLabelFontHeightF = 0.015                ; resize tick labels
  mpres@tmYLLabelFontHeightF = 0.015
  mpres@tmYLLabelsOn=True
  mpres@tmXBLabelsOn=True
  mpres@tmXTOn=False
  mpres@tmYROn=False
  mpres@tmYLMinorOn=True
  mpres@tmXBMinorOn=True
  mpres@tmXBTickSpacingF = 5.0
  mpres@tmYLTickSpacingF = 5.0
```

```
;;;;;;;;VARIABLES
;;;;;;;;;;;;;; Resources
        r_res = res
        r_res@cnFillOn = True
        r_res@cnInfoLabelOn         = False
        r_res@cnLevelSelectionMode = "ExplicitLevels"
        r_res@cnLevels             = (/2.,4.,6.,8.,10.,15.,20.,30.,40.,50./)
        r_res@MainTitlePos = "Center"
        r_res@MainTitle = "Precipitation mean"
        r_res@Footer = False
        r_res@InitTime = False
        r_res@lbBoxMinorExtentF = 0.2
        r_res@pmLabelBarOrthogonalPosF = -0.05           ; move whole thing down
        contour_r = wrf_contour(a,wks,rainvm,r_res)

        hgt_res = res
        hgt_res@cnLineLabelsOn        = False
        hgt_res@cnInfoLabelOn         = False
        hgt_res@cnLineThicknessF      = 1
        hgt_res@ContourParameters = (/ 500., 6000., 500. /)
        hgt_res@Footer = False
        hgt_res@InitTime = False
        contour_hgt = wrf_contour(a,wks,hgt,hgt_res)

        hgt_res2 = res
        hgt_res2@cnLineLabelsOn        = False
        hgt_res2@cnInfoLabelOn         = False
        hgt_res2@cnLineThicknessF      = 4
        hgt_res2@ContourParameters = (/ 500., 3500., 3000. /)
        hgt_res2@Footer = False
        hgt_res2@InitTime = False
        contour_hgt2 = wrf_contour(a,wks,hgt,hgt_res2)

;;;;;;;;PLOT
pltres@NoTitles = True
pltres@CommonTitle = True
;pltres@PlotTitle="Precipitation mean (mm/day)"

plot = wrf_map_overlays(a,wks,(/contour_r,contour_hgt,contour_hgt2/),pltres,mpres)
```

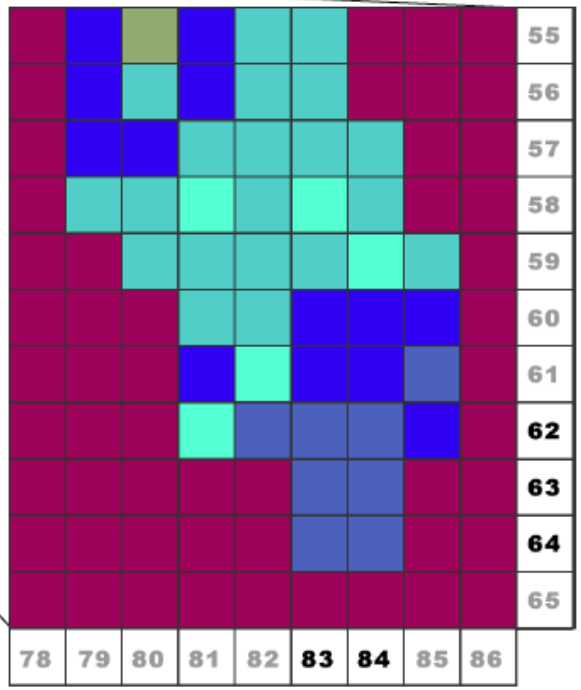
Cambiar una variable en un archivo netcdf :

```
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"
begin
        a = addfile("./met_em.d01.2000-01-24_12:00:00.nc",”w")
        sst = a->SST ; read a field
        sst = sst + 1 ; change the field
        a->SST = sst ; write the field
end
```



Cambiar landuse :

```
a = addfile("./geo_em.d01.nc",”w”
var= a->LANDUSE

var(:,63:64,83:84) = 7
var(:,62,84) = 7

a->LANDUSE = var
```



ALGO MAS ?

- **Interactive Mode (Command line)**
  - **ncl** *[options][command-line-arguments]* <return>

    ncl> enter commands

    ncl> **quit** <return>
  - can save (record) interactive commands

    ncl> **record** "file_name"

    ncl> …. enter commands …

    ncl> **stop record**

ncl> **record** "file_name"
ncl> …. enter commands
ncl> **stop record**

```
ncl 0 > f = addfile ("UV300.nc", "r")      ; open file (nc, grb, hdf, hdfeos)
ncl 1 > u = f->U                           ; import STRUCTURE
ncl 2 > printVarSummary (u)                ; overview of variable
```

NCL Syntax Characters (subset)

- = - assignment
- := - reassignment (v6.1.2)
- ; - comment [can appear anywhere; text to right ; ignored]
- -> - use to (im/ex)port variables via addfile(s) function(s)
- @ - access/create attributes
- ! - access/create named dimension
- & - access/create coordinate variable
- {…} - coordinate subscripting
- $...$ - enclose strings when (im/ex)port variables via addfile(s)
- (/../) - array construction (variable); remove meta data
- [/../] - list construction;
- [:] - all elements of a list
- : - array syntax
- | - separator for named dimensions
- \ - continue character [statement to span multiple lines]
- :: - syntax for external shared objects (eg, fortran/C)