Introduction to netCDF

NCL variable based on a netCDF
variable model

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netCDF files

- **self describing**
  - (ideally) all info contained within file
  - no external information needed to determine file contents
- **portable**   [machine independent]

- **software** [source Unidata]
  - designed for generality, not high performance
  - parallel reads are possible; no parallel writes [version 3.6]

- **variable model: simple array oriented**
  - (may) have descriptive info [meta data]
  - limited data structures
    - no ragged arrays; no record/nested structures
  - only one "unlimited" (record) dimension [version 3.6]

Examining a netCDF file

- ncdump   file_name | less
  - dumps the entire contents of a file
- ncdump -h   file_name | less
  - dumps the header info
  - NCL equivalent: **print** (f)
- ncdump -v U file_name | less
  - NCL equivalent: **print** (U)
- Note: ncdump is a Unidata utility
  - not a netCDF Operator (NCO)
  - not associated with NCL

- **ncview** to visualize file contents [COARDS]

- **ncl_filedump** file_name   [more general]
  - netCDF, GRIB, HDF, HDF-EOS

Parts of netCDF file
ncdump -h 1999.nc

DIMENSIONS:
dimensions:
   lat = 64 ;
   lon = 128 ;
   time = 12 ;

FILE ATTRIBUTES:
global attributes:
   :title = "Temp: 1999" ;
   :source = "NCAR" ;
   :conventions = "None" ;

VARIABLES:
Names , Attributes, Coordinates
variables:
 float lat(lat) ;
   lat:long_name = "latitude" ;
   lat:units = "degrees_north" ;
 float lon(lon) ;
   lon:long_name = "longitude" ;
   lon:units = "degrees_east" ;
 int time(time) ;
   time:long_name = "time" ;
   time:units = "Month of Year" ;
 float T(time, lat, lon) ;
  T:long_name = "Temperature";
  T:units = "C" ;
  T:missing_value = 1.e+20f ;
  T:_FillValue = 1.e+20f

exercise: ncdump –h UV300.nc | less

netCDF [NCL] Variable model

X

Scalar
or
Array

attributes
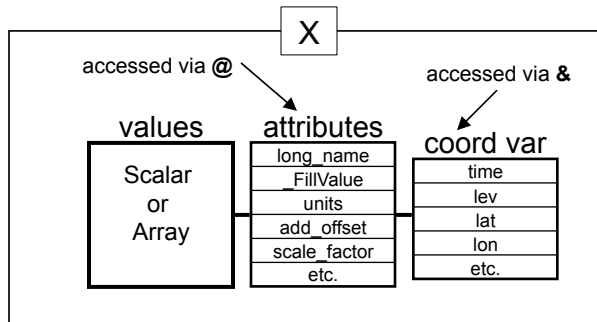
long_name
_FillValue
units
add_offset
scale_factor
etc.

coordinates

time
lev
lat
lon
etc.

f = **addfile**("foo.nc","r")   ; grb/hdf
x = f->X

**NCL reads the scalar/array,
attributes, and coordinate
variables as an object**

X

accessed via **@**

accessed via **&**

values

Scalar
or
Array

attributes

long_name
_FillValue
units
add_offset
scale_factor
etc.

coord var

time
lev
lat
lon
etc.

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netCDF Version 3.6

- current version 3.6 [released Feb 2005]
    - **L**arge **F**ile **S**upport [LFS] available
        - Files > 2GB, though any one variable can not > 2GB
        - All 64-bit architectures have LFS
        - Some 32-bit OS have LFS, **including linux**
        - Portability can be issue if others do not have LFS

netCDF Version 4.0 [Oct 2006?]

- **netCDF API implemeneted on top of HDF5**
  - will write HDF5 but use netCDF API
- **many new capabilities**
  - backward compatible
  - compression
  - multiple unlimited dimensions
  - parallel IO
  - multi-dimensional coordinate variables [? V4.1]
  - hierarchial grouping of data
  - user data types

☺ **NCL developers working with Unidata** ☺

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netCDF Info

- URLs
  - http://www.unidata.ucar.edu/software/netcdf
    - What's New
  - http://www.unidata.ucar.edu/software/netcdf/docs/**BestPractices**.html
    - Good info to know
  - http://www.unidata.ucar.edu/software/netcdf/**netcdf-4/**
    - Learn about netCDF-4

The slides that follow are …..

- For NCL class ….

Detailed Look netCDF Variable (ncl)

ncl <return>   ; **interactive mode**

 ncl 0 > f = addfile ("UV300.**nc**", "**r**")   ; **open file**

 ncl 1 > u = f->U   ; **import STRUCTURE**

 ncl 2 > printVarSummary (**u**)   ; **overview of variable**
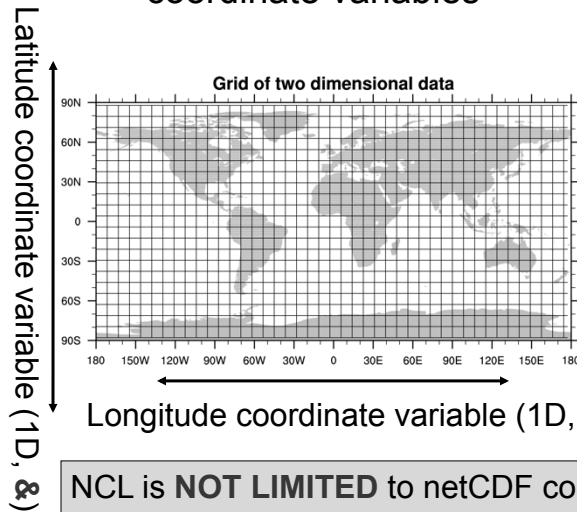
```
Variable:  u
Type: float
Total Size:  65536 bytes
             16384 values
Number of Dimensions:  3
Dimensions and Sizes:   [time | 2] x  [lat | 64] x [lon | 128]
Coordinates:
             time:  [ 1 .. 7 ]
             lat:  [ -87.8638 ..  87.8638 ]
             lon: [ 0 .. 357.185]
Number of Attributes: 5
   _FillValue :          1e36
   units :               m/s
   long_name  :        Zonal Wind Component
   short_name :          U
   missing_value :    1e36
```

Classic netCDF
Variable Model

NCL
syntax/funcs
query
use
modify
add
any aspect of
data object

Picture: 2D netCDF Variable Model

coordinate variables

Latitude coordinate variable (1D, **&**)

attributes **@**:

• long_name

• units

Longitude coordinate variable (1D, **&**)

NCL is **NOT LIMITED** to netCDF conforming variables
• eg: 2D coordinate arrays (curvilinear coords)

UNLIMITED dimension

- **special dimension**
  - essentially a "record" dimension
  - time dimension is most frequently "unlimited"
  - used by the NCO to concatenate files
  - **no** special meaning to NCL
- **when creating output file in NCL (optional)**
  - **filedimdef** (outputfile, "time", -1, True)
- **example:** ncdump -h T2m_ud.nc

```
netcdf T2m_ud {
dimensions:
    time = UNLIMITED  ; // (204 currently)
    lat = 94 ;
    lon = 192 ;
    lev = 18}
```