A practical guide to read and plot IMOS netCDF files into R

The present document has been produced to provide practical help to researchers willing to read and plot IMOS netCDF files into R. The first section of this tutorial solely covers those basic steps while the second part focuses on a slightly more complex scenario: plotting IMOS gridded netCDF files. This succinct guide only aims to cover those essential steps and can therefore be easily understood by beginners in R. Further supporting material regarding the R software is available at http://cran.r-project.org/.

As the netcdf R packages for Windows are not yet opendap-enabled, it is currently not possible for R users to use netCDF files straight from Opendap. We therefore recommend downloading the netCDF files you need from the IMOS HTTP server (Figure 1).

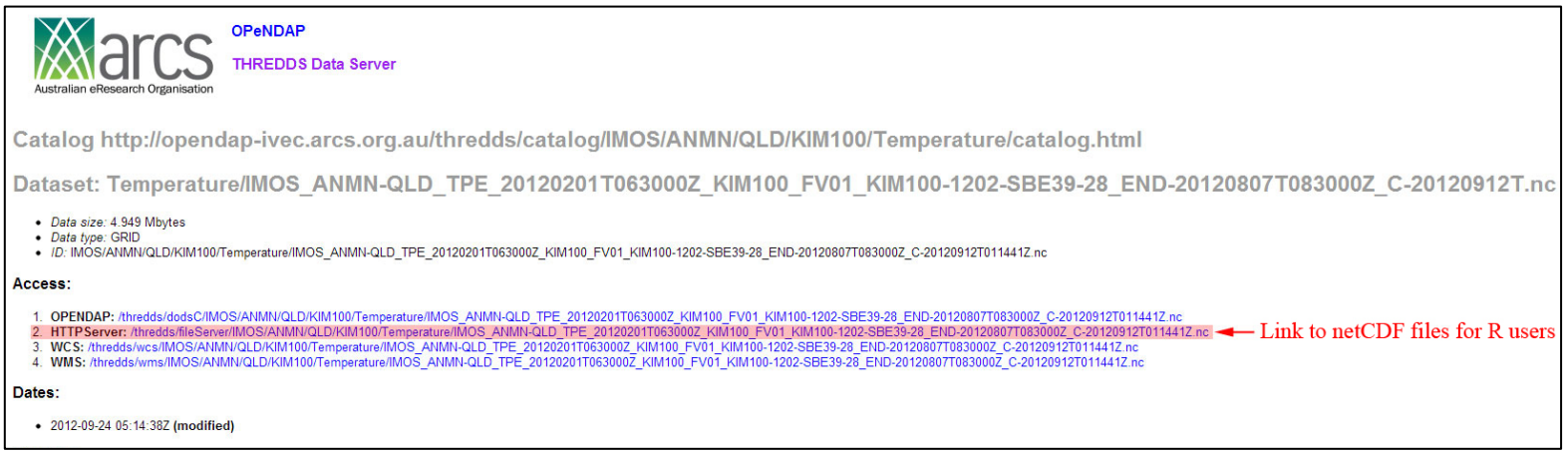

Figure 1: Download link to be used by R users to get a R compatible netCDF file

1. Opening and plotting a non-gridded netCDF file

Once the IMOS netCDF file has been downloaded (*e.g.* an Argo netCDF file renamed argo_float.nc), move it to your current R working directory (*e.g.* C:\Research\R\Argo). To read the IMOS netCDF file argo_float.nc, first open R. If you haven't installed the ncdf package, install it now through the Packages tab → Install package(s).

In R, type the following commands to open the netCDF file, extract variables and produce basic plots.

```
################################## CODE STARTS ##################################
rm(list=ls())  ### Removes everything in the working environment
setwd("C:\\Research\\R\\Argo") ### Sets up the location of the working directory
library(ncdf)  ### Provides a high-level R interface to Unidata's netCDF data files


nc<-open.ncdf("argo_float.nc")  ### Opens up a netCDF file for reading
print(nc)  ### Provides information on variables of the netCDF file
str(nc)  ### Displays the internal structure of the netCDF file along with metadata information


time<-get.var.ncdf(nc,"JULD")  ### Reads data value from the JULIAN DAY variable
temp<-get.var.ncdf(nc,"TEMP")   ### Reads data value from the TEMPERATURE variable
sal<-get.var.ncdf(nc,"PSAL")   ### Reads data value from the SALINITY variable
depth<-get.var.ncdf(nc,"PRES")   ### Reads data value from the SEA PRESSURE variable


### The numerical vector "time" currently consists of decimal dates (i.e. number of days since 01/01/1950)
date<-as.POSIXlt(time*3600*24,origin="1950-01-01",tz="UTC") ### Converts the time vector of decimal dates into a vector of calendar dates and times


### Plots water temperature and salinity profiles

split.screen(c(1,2))
screen(1)
par(mar=c(4.5,4.5,0.5,0.5))
plot(temp,-depth,type="b",pch=19,xlab="Water temperature (°C)",ylab="Depth
(m)",cex.lab=1.3,cex.axis=1.1)
screen(2)
par(mar=c(4.5,2.5,0.5,0.5))
plot(sal,-depth,type="b",pch=19,yaxt="n",xlab="Salinity (psu)",ylab="",cex.lab=1.3,cex.axis=1.1)
axis(2,at=seq(-2000,0,500))
close.screen(all=TRUE)

 ################################## CODE ENDS ##################################
```

2. Opening and plotting a gridded netCDF file

Once the IMOS netCDF file has been downloaded (*e.g.* a monthly aggregated ACORN netCDF file renamed ACORN_monthly_aggr.nc, see http://opendap-qcif.arcs.org.au/thredds/catalog/IMOS/ACORN/monthly_gridded_1h-avg-current-map_QC/), move it to your current R working directory (*e.g.* C:\Research\R\ACORN).

```
################################## CODE STARTS ##################################
rm(list=ls())  ### Removes everything in the working environment
setwd("C:\\Research\\R\\ACORN") ### Sets up the location of the working directory
library(ncdf) ### Provides a high-level R interface to Unidata's netCDF data files
library(DAAG) ### To get the pause function
library(maps) ### To get access to a world map
library(raster) ### To be able to plot the gridded netCDF file


nc<-open.ncdf("ACORN_monthly_aggr.nc")  ### Opens up a netCDF file for reading
print(nc)  ### Provides information on variables of the netCDF file
str(nc)  ### Displays the internal structure of the netCDF file along with metadata information


time<-get.var.ncdf(nc,"TIME")  ### Reads data value from the TIME variable
x<-get.var.ncdf(nc,"LONGITUDE")   ### Reads data value from the LONGITUDE variable
y<-get.var.ncdf(nc,"LATITUDE")   ### Reads data value from the LATITUDE variable
speed<-get.var.ncdf(nc,"SPEED")   ### Reads data value from the SPEED variable
speed[,,][which((speed[,,])==9999)]<-NA  ### Assigns a NA value to each speed value of 9999.
date<-as.POSIXlt(time*3600*24,origin="1950-01-01",tz="UTC") ### Converts the time vector of
decimal dates into a vector of calendar dates and times


### Plots an ocean current map for each date

for (i in 1:length(time)){
        rast<-raster("ACORN_monthly_aggr.nc",varname="SPEED",band=i)
        par(mar=c(4.5,4.5,4.5,4.5))
        plot(rast,col=colorRampPalette(c("blue","yellow","red"))(255),main=date[i],xlim=c(min(x),
        max(x)),ylim=c(min(y),max(y)),xlab="Longitude",ylab="Latitude",cex.lab=1.3,cex.axis=1.
        1,zlim=c(min(speed[,,],na.rm=TRUE),max(speed[,,],na.rm=TRUE)))
        map('world',fill=TRUE,add=T)
        pause()
        print(i)
        }

 ################################## CODE ENDS ##################################
```

For any further enquiries in relation to the use of IMOS data files in R, please contact the eMII Project Officer Dr. Xavier Hoenner: Xavier.Hoenner@utas.edu.au, tel: (+61) 03 6226 1752.