Dipper downscaling

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Example of downscaling a population of species

We can use the assumption of Poisson-type distribution for a count of e.g. population or events such as the bird "dipper" that lives in a colony in southern Norway. The dipper is a type of bird that lives in water falls. Its population is affected by the temperature and weather the water freezes during the winter.

This analysis was carried out for M. Gamelon, who provided the data on the dipper population
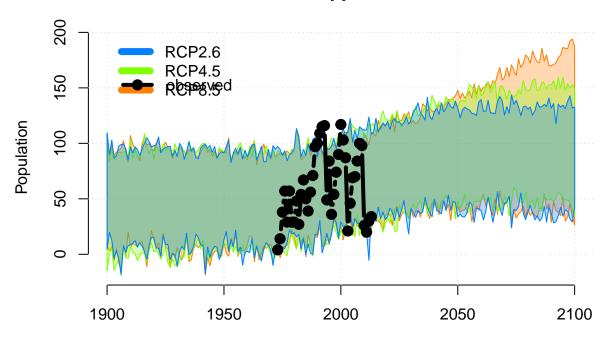
R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com.

```
## R-script to analyse dipper population

library(esd)
```

```
## Loading required package: ncdf4
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
##
## Attaching package: 'esd'
```

```
## The following object is masked from 'package:base':
##
##     subset.matrix
```

```
library(ncdf4)

examine <- FALSE

dipper <- read.table('~/data/dipper.csv',sep=',',header=TRUE)

dipper <- zoo(x=dipper[[2]],order.by=dipper[[1]])
y <- as.station(dipper,loc='Lyngdalselva',
                lon=7,lat=58.5,alt=520,
```

```
                  param='population',unit='count',
                  reference='Marlène Gamelon')

predictor <- retrieve("air.mon.mean.nc",lon=c(-1,17),lat=c(57,62))
```

```
## [1] "Warning : Calendar attribute has not been found in the meta data and will be set automatically.
```

```
## Only use the winter temperature:
predictor <- aggregate(subset(predictor,it='djf'),year,FUN='mean')
```

```
## Warning in if (deparse(substitute(by)) == "year") {: the condition has
## length > 1 and only the first element will be used
```

```
if (examine) {
  ## Check the distribution
  n <- seq(0,150,by=10); mu <- mean(dipper)
  hist(coredata(dipper),breaks=n,freq=FALSE,col='grey')
  lines(x,dpois(x,mu),lwd=2,col='red')

  ## Single ESD for inspection
  X <- EOF(predictor)
  z <- DS(y,X)
  plot(z,new=FALSE)
}
```

```
## Downscale the dipper population directly based on the large-scale
## annual mean temperature

if (!file.exists('dipper.Z.rcp45.rda')) {
  Z.rcp45 <- DSensemble.annual(y,biascorrect=TRUE,
                                predictor=predictor,
                                lon=c(-1,17),lat=c(57,62),
                                abscoords=TRUE)
  save(file='dipper.Z.rcp45.rda',Z.rcp45)
} else load('dipper.Z.rcp45.rda')

if (!file.exists('dipper.Z.rcp85.rda')) {
  Z.rcp85 <- DSensemble.annual(y,biascorrect=TRUE,
                                rcp="rcp85",predictor=predictor,
                                lon=c(-1,17),lat=c(57,62),
                                abscoords=TRUE)
  save(file='dipper.Z.rcp85.rda',Z.rcp85)
} else load('dipper.Z.rcp85.rda')

if (!file.exists('dipper.Z.rcp26.rda')) {
  Z.rcp26 <- DSensemble.annual(y,biascorrect=TRUE,
                                rcp="rcp26",predictor=predictor,
                                lon=c(-1,17),lat=c(57,62),
                                abscoords=TRUE)
  save(file='dipper.Z.rcp26.rda',Z.rcp26)
} else load('dipper.Z.rcp26.rda')
```

```
year <- year(Z.rcp45)
ci90.rcp45 <- apply(coredata(Z.rcp45),1,quantile,
                    probs=c(0.05,0.95),na.rm=TRUE)
ci90.rcp26 <- apply(coredata(Z.rcp26),1,quantile,
                    probs=c(0.05,0.95),na.rm=TRUE)
ci90.rcp85 <- apply(coredata(Z.rcp85),1,quantile,
                    probs=c(0.05,0.95),na.rm=TRUE)

par(bty='n')
plot(range(year),range(ci90.rcp45,ci90.rcp26,ci90.rcp85,y),
     type='n',xlab='',ylab='Population',main='Dipper',
     sub=loc(y))
grid()
polygon(c(year,rev(year)),c(ci90.rcp85[1,],rev(ci90.rcp85[2,])),
                             col=rgb(1,0.5,0,0.3),border=rgb(1,0.5,0))
polygon(c(year,rev(year)),c(ci90.rcp45[1,],rev(ci90.rcp45[2,])),
                             col=rgb(0.5,1,0,0.3),border=rgb(0.5,1,0))
polygon(c(year,rev(year)),c(ci90.rcp26[1,],rev(ci90.rcp26[2,])),
                             col=rgb(0,0.5,1,0.3),border=rgb(0,0.5,1))
lines(year(y),coredata(y),lwd=4,pch=19,type='b')

legend(1900,200,c('RCP2.6','RCP4.5','RCP8.5'),
       col=c(rgb(0,0.5,1),rgb(0.5,1,0),rgb(1,0.5,0)),
       lwd=7,lty=1,bty='n')
legend(1905,170,'observed',lwd=4,pch=19,lty=1,bty='n')
```