s2dverification: an R package for climate forecast verification

Nicolau Manubens[1], Virginie Guemas[1, 2], Alasdair Hunter[1], Louis-Philippe Caron[1], Niti Mishra[1]

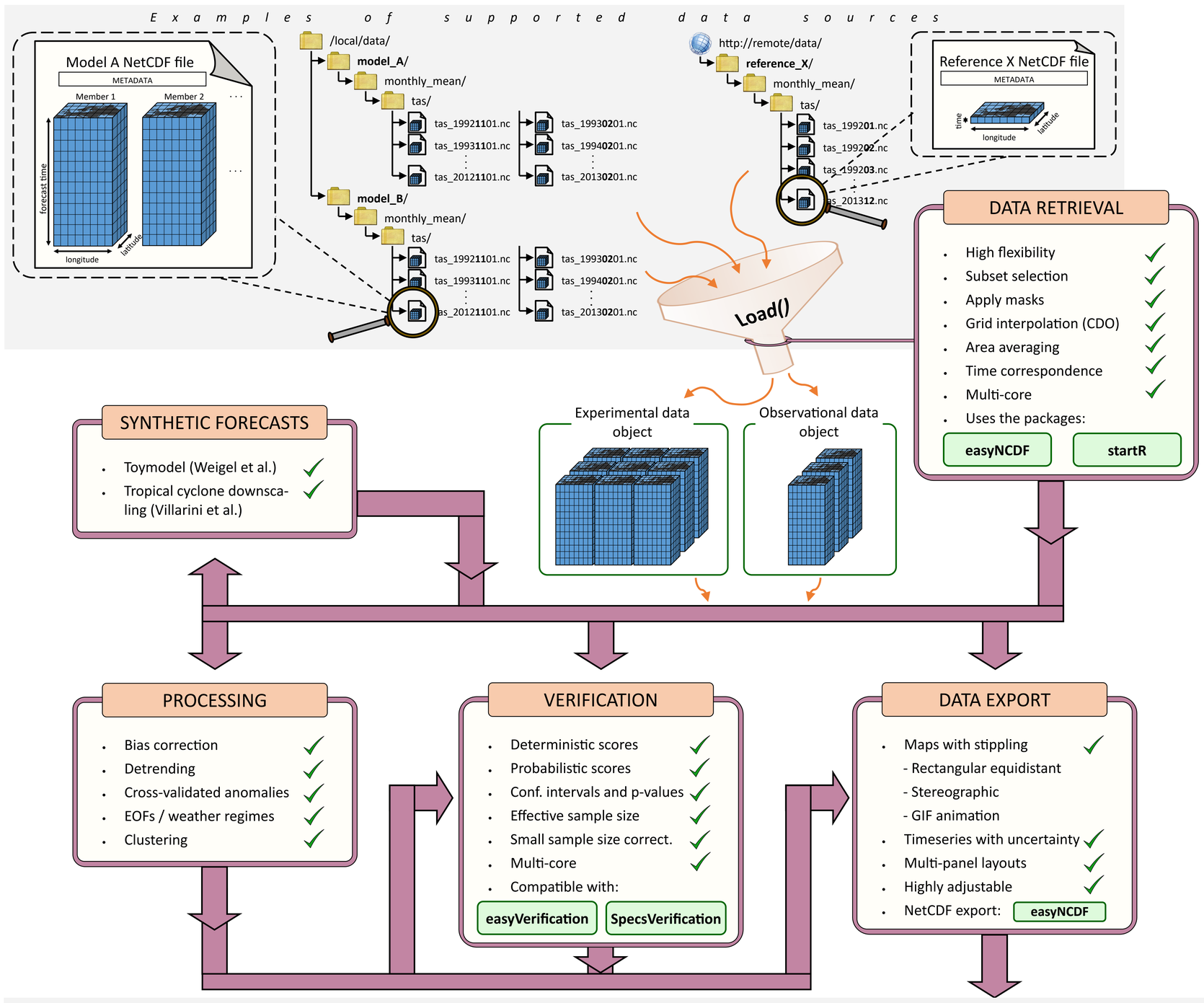
(1) Earth Sciences Department, Barcelona Supercomputing Center, Spain (2) Centre National de Recherches Météorologiques, France

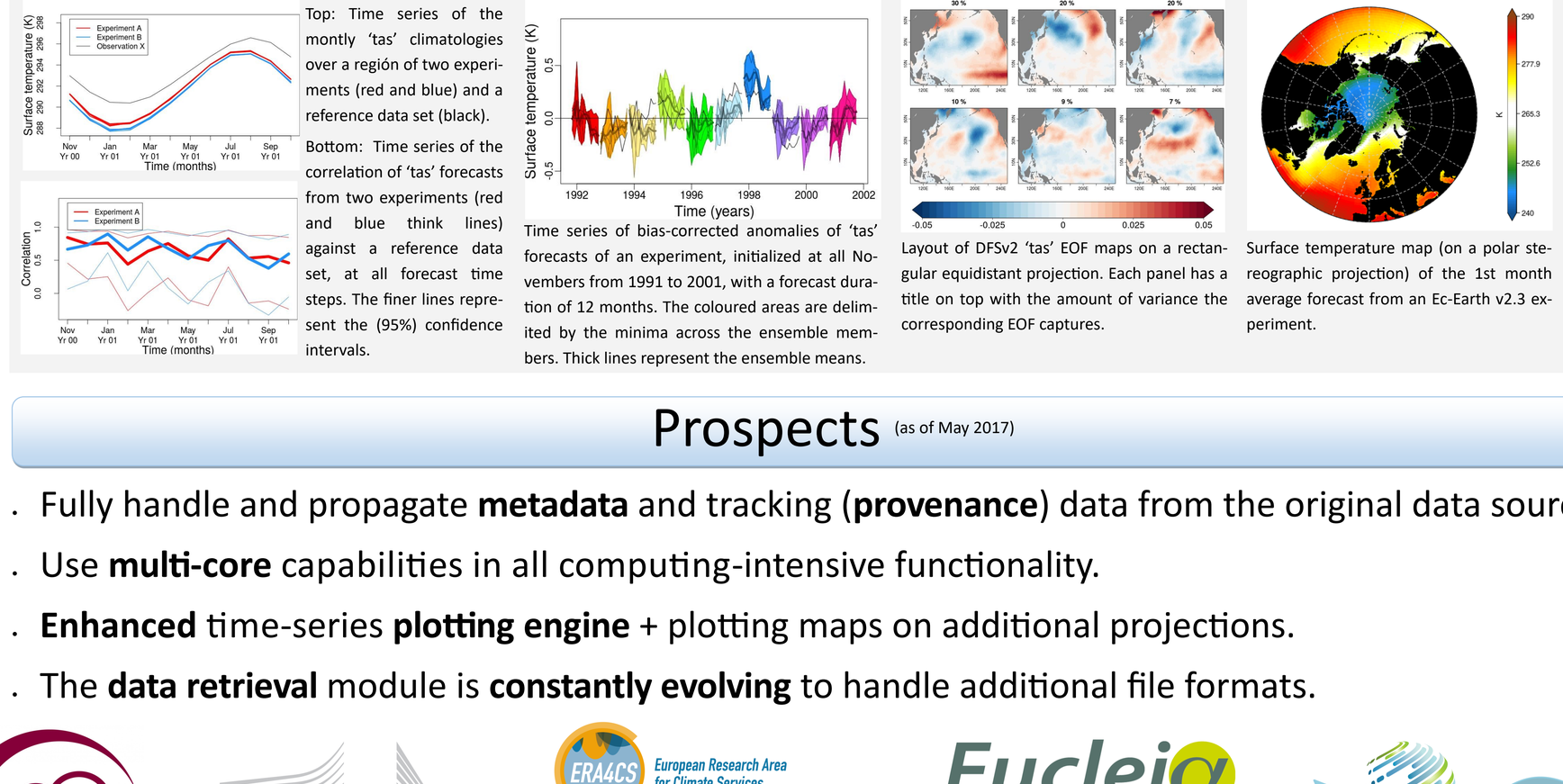
Introduction

s2dverification v2.8.1 is an open-source R package for the quality assessment of seasonal to decadal climate forecasts using state-of-the-art verification scores. It can also be used for forecast verification in other fields or on different timescales. The package provides tools for each step of the verification process: data retrieval, processing, calculation of verification measures and visualisation of the results. It becomes straightforward to analyse and assess the quality of multi-model ensemble forecasts.

Functionality

The following diagram shows the s2dverification modules (maroon boxes) and their interactions, as well as the features each module provides. The shaded regions on the top and bottom contain, respectively, examples of data sources and examples of plot outputs.





Top: Time series of the montly 'tas' climatologies over a región of two experiments (red and blue) and a reference data set (black).

Bottom: Time series of the correlation of 'tas' forecasts from two experiments (red and blue think lines) against a reference data set, at all forecast time steps. The finer lines represent the (95%) confidence intervals.

Time series of bias-corrected anomalies of 'tas' forecasts of an experiment, initialized at all Novembers from 1991 to 2001, with a forecast duration of 12 months. The coloured areas are delimited by the minima across the ensemble members. Thick lines represent the ensemble means.

Layout of DFSv2 'tas' EOF maps on a rectangular equidistant projection. Each panel has a title on top with the amount of variance the corresponding EOF captures.

Surface temperature map (on a polar stereographic projection) of the 1st month average forecast from an Ec-Earth v2.3 experiment.

EUROSIP example

This example shows how the package has been used to compute the correlation of surface temperature JJA forecasts (initialized each May from 1992 to 2012) from the EUROSIP multi-model set against the ERA-Interim reconstruction, over Europe.

```
library(s2dverification)
```

After some preliminary configuration to register the location of the input data sets, Load() is used to retrieve temperature data:

```
. . .

data <- Load('tas',
  exp = list('glosea5', 'ecmwf_s4',
             'metfr_s4', 'ncep'),
  obs = list('eraint'),
  sdates = paste0(1992:2012, '1101'),
  lonmin = -20, lonmax = 70,
  latmin = 25, latmax = 75,
  output = 'lonlat',
  grid = 'r256x128')
```

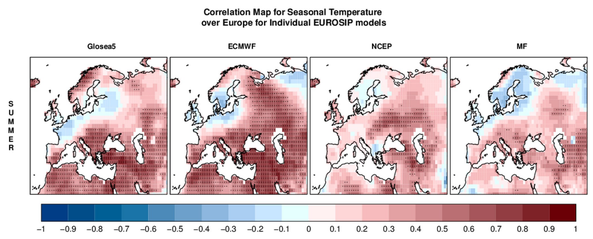
Computing bias-corrected anomalies and seasonal means:

```
ano <- Ano_CrossValid(data$mod,
                      data$obs)
ano_exp <- Season(ano$ano_exp,
  monini = 5, moninf = 6, monsup = 8)
ano_obs <- Season(ano$ano_obs,
  monini = 5, moninf = 6, monsup = 8)
```

Computing and plotting the ensemble-mean correlation:

```
corr <- Corr(
  Mean1Dim(ano_exp, 'member'),
  Mean1Dim(ano_obs, 'member'))

PlotLayout(
  PlotEquiMap, c('lat', 'lon'),
  corr, ...)
```



Layout of EUROSIP correlation maps (on a rectangular equidistant projection) of the JJA averages of 'tas' forecasts (initialized each May rom 1992 to 2012) against ERA-Interim observational reference. Cells with statistically significant correlation (95%) are marked with dots.

Prospects (as of May 2017)

- Fully handle and propagate **metadata** and tracking (**provenance**) data from the original data source to the final products.
- Use **multi-core** capabilities in all computing-intensive functionality.
- **Enhanced** time-series **plotting engine** + plotting maps on additional projections.
- The **data retrieval** module is **constantly evolving** to handle additional file formats.

A major release, s2dv v3.0.0, is expected by the end of 2017.

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