Barcelona Supercomputing Center
Centro Nacional de Supercomputación

R user meeting

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Agenda

1. Ice-breaker: R-community
2. News
   - s2dv
   - ClimProjDiags
   - CSTools
   - CSIndicators
3. User presentation: Scorecards [Nadia]
4. Q&A
   - Change user meeting time [Aude]
   - Read GRIB by R [An-Chi]

Ice-breaker

Recap of last Christmas

R-community

- The backbone of the R language is its community of users, contributors and supporters.
- The R community hosts many conferences and in-person meetups. Some of these groups include:

- **R-Ladies** promote gender diversity in the R community
- **UseR!** annual international R user conference
- **posit::conf**

@_useRconf
@_R_Foundation
@RLadiesGlobal
@RLadiesBCN
@R_Hisp

II Congress #R Barcelona 2023 @R_Hisp

s2dv

RMSSS() development

New parameters:

- “**memb_dim**”: to compute ensemble mean
- “**ref**”: to allow the computation of the RMSSS of the forecast with respect to a reference forecast (other than the climatological forecast)
- “**sig_method**”: one-sided Fisher test or two-sided Random Walk test

status: In master

Check issue: https://earth.bsc.es/gitlab/es/s2dv/-/issues/84

RandomWalkTest()

New parameters:

- “**alpha**”: The significance level to be used in the statistical significance test (output "sign"). The default value is 0.05. For "two.sided.approx", alpha can only be 0.05.
- “**test.type**”: "two.sided.approx" ,"two.sided", "greater", or "less".
- “**pval**” and “**sign**”: Boolean value to decide whether to return p-value and significance.

New outputs:

- “**p.val**” and “**sign**”

status: In master

CRPSS(): Cross-validation for climatological forecast

When `ref = NULL` (i.e., using climatological forecast), for each year, its corresponding value is excluded when building the climatological forecast for that year.

```
for (i in 1:obs_time_len) {  # loop over forecast years
  ref[i, ] <- obs[-i]
}
```

status: In master

New function: ROCSS()

This function computes the Relative Operating Characteristic Skill Score.

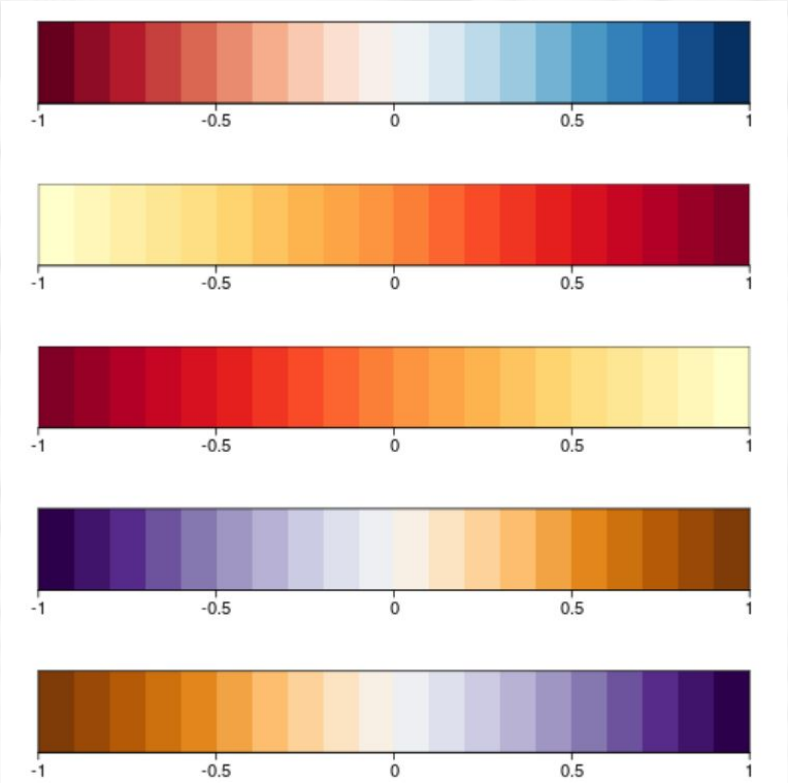
status:under review, branch develop-ROCSS

clim.palette(): new palettes

Options: “redblue”, “yellowred”, “redyellow”, “purpleorange”, “orangepurple”

- The new ones are colorblind friendly
- More palettes are welcomed!!

status: In master



Vignettes

The vignettes in s2dverification were moved to s2dv. In README.md - Overview, you can find the list of the vignettes.

Overview

The s2dv scheme is composed of four modules:
Data retrieval -> **Statistics** -> **Verification** -> **Visualisation**

- **Data retrieval** module: The first step is to gather and homogenize NetCDF data files from forecasts, hindcasts or observations stored in a local or remote file system. Some simple previous steps are required, however, to set up some configuration parameters so that the module can locate the source files and recognize the variables of interest.
- **Statistics** module: Once the data has been loaded into an R object, some statistics can be computed, such as drift-corrected anomalies, trend removal, frequency filtering and more.
- **Verification** module: Either after computing statistics or directly from the original data, the verification functions allow you to compute deterministic and probabilistic scores and skill scores such as root mean square error and correlation with reliability indicators such as p-values and confidence intervals.
- **Visualization** module: Plotting functions are also provided to plot the results obtained from any of the modules above.

If it's your first time using s2dv you can check an **Example** of use spanning its four modules or review the **Tutorial**.
You will find more detailed examples in the documentation page of each module.

ClimProjDiags

Functions to accept non-numerical data

To make SelBox() and ShiftLon() accept non-numerical data input. E.g., A boolean array of significance or mask.

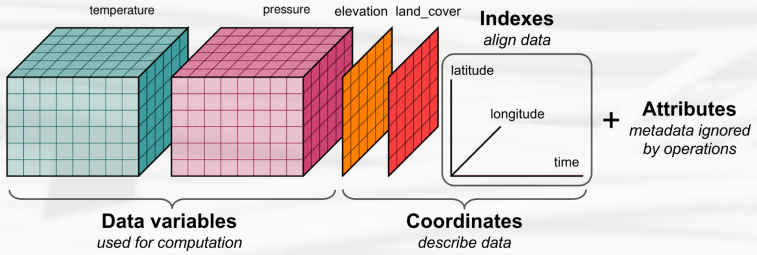
- SelBox(): Select spatial region from multidimensional arrays
- ShiftLon(): Shift longitudes of a data array

status: Fixed, in branch develop-ShiftLon_input_type

Check issue: https://earth.bsc.es/gitlab/es/ClimProjDiags/-/issues/12

s2dv_cube changes

What is an s2dv_cube?



- "N-D labeled arrays in R"
- An object class for netCDF-like data
- The object is a list with the data array and its attributes including metadata
- Used in CSTools and other CS* packages (e.g., CSIndicators, CSDownscale)

Example:

List

+

Fixed structure

```
List of 8
 $ data     :  num [1, 1:15, 1:6, … ] 280 ...
 $ lon      :  num [1:53(1d)] 0 1 2 ...
 $ lat      :  num [1:22(1d)] 48 47 46 ...
 $ Variable
     ..$ varName: chr "tas"
 $ Datasets
 $ Dates
     ..$ start  : POSIXct[1:18], format: "2000-11-01" ...
     ..$ end    : POSIXct[1:18], format: "2000-12-01" ...
 $ when         : POSIXct[1:1], format: "2019-03-27 17:48:29"
 $ source_files: NULL
 - attr(*, "class")= chr "s2dv_cube"
```

s2dv_cube structure changes

Old s2dv_cube

```
$ data
$ lon
$ lat
$ Variable
$ Datasets
$ Dates
$ when
$ source_files
```

Data dimensions don't match with coordinates!

```
> dim(obj$data)
dataset member sdate ftime lat lon
    1      6      3    31   4   4
```

New s2dv_cube

```
$data: An array
$dims
$coords
    $sdate
    $time
    $lon
    [...]
$attrs
    $Variable
    $Datasets
    $source_files
    $when
    $Dates
    $load_parameters
```

Match data dimensions with each coordinate dimension

Dates always have time dimensions

More similar to xarray

Changes in functions

1. Changes in auxiliary functions

- **s2dv_cube()**
  - Builds an `s2dv_cube` object with one array and its attributes
  - Useful for CST_* functions but the input data is not `s2dv_cube` yet
- **as.s2dv_cube()**
  - Convert `'startR_array'` or 'list' object to `s2dv_cube`

2. Changes in CST functions

- CSTools
- CSIndicators
- CSDownscale

3. Other changes

- Correct simplified functions that are hard-coded for spatial coordinates names (`$lon`/`$lat`).
- Vignettes
- Sample data

More info:
CSIndicators: https://earth.bsc.es/gitlab/es/csindicators/-/issues/25
CSTools: https://earth.bsc.es/gitlab/external/cstools/-/issues/112

How I adapted the functions

Example with Spatial coordinates:

```
# Check 's2dv_cube'
 if (!inherits(expL, "s2dv_cube") || !inherits(obsL, "s2dv_cube")) {
   stop("Parameter 'expL' and 'obsL' must be of the class 's2dv_cube', ",
        "as output by CSTools::CST_Load.")
 }
 # Check 'obsL' object structure
  if (!all(c('data', 'coords', 'attrs') %in% names(obsL))) {
    stop("Parameter 'obsL' must have 'data', 'coords' and 'attrs' elements ",
         "within the 's2dv_cube' structure.")
  }

  if (!any(names(obsL$coords) %in% .KnownLonNames()) |
      !any(names(obsL$coords) %in% .KnownLatNames())) {
   stop("Spatial coordinate names of parameter 'obsL' do not match any ",
        "of the names accepted by the package.")
 }
 lon_name <- names(obsL$coords)[[which(names(obsL$coords) %in% .KnownLonNames())]]
 lat_name <- names(obsL$coords)[[which(names(obsL$coords) %in% .KnownLatNames())]]
```

How to adapt your scripts

1. Spatial coordinates: longitudes and latitudes vectors:

```
# Old s2dv_cube:
lat = exp$lat
lon = exp$lon
```

→

```
# 1. Find the longitude and latitude names
lonname <- names(exp$coords)[[which(names(exp$coords) %in% .KnownLonNames())]]
latname <- names(exp$coords)[[which(names(exp$coords) %in% .KnownLatNames())]]
# 2. Access to the spatial coordinates vector:
lon <- exp$coords[[lon_name]]
lat <- exp$coords[[latname]]
```

2. Dates element:

```
# Old s2dv_cube
time_exp <- exp$Dates$start
```

→

```
# New s2dv_cube
time_exp <- exp$attrs$Dates
```

+ dimensions !!

3. Variable, Datasets, source_files or other elements:

```
# Old s2dv_cube
Datasets <- exp$Datasets
source_files <- exp_cor$source_files
```

→

```
# New s2dv_cube
Datasets <- exp$attrs$Datasets
source_files <- exp_cor$attrs$source_files
```

Element `$attrs$Variable$variables`?

```
List of 4
 $ data  : num [1, 1:6, 1:3, 1:31, 1:4, 1:4]5.65e-09 ...
 $ dims  : Named int [1:6] 1 6 3 31 4 4
 $ coords: List of 6
     ..$ dataset : int 1
     ..$ member  : int [1:6] 1 2 3 4 5 6
     ..$ sdate   : chr [1:3] "20101101" "20111101" "20121101"
     ..$ ftime   : int [1:31] 1 2 3 4 5 6 7 8 9 10 ...
     ..$ lat     : num [1:4] 47 46 45 44
     ..$ lon     : num [1:4] 6 7 8 9
 $ attrs : List of 6
     ..$ Variable        : List of 2
          .. $ varName   : chr "tas"
          .. $ variables : List of (N)
               ..$ tas   : List of 12
                    .. $ prec   : chr "float"
                    .. $ units  : chr "K"
                    .. $ dim    : List of 4
               .. $ varN :
     ..$ Datasets: List of 1
     ..$ Dates   : POSIXct[1:93], format: "2011-03-01" "2011-03-02" ...
     ..$ when    : POSIXct[1:1], format: "2023-01-09 15:04:29"
     ..$ source_files  : chr [1:3] "/system5c3s/daily_mean/prlr_s0-24h/prlr_20101101.nc"
     ..$ load_parameters :  List of 17
 - attr(*, "class")= chr "s2dv_cube"
```

- **From Start() output:**

it includes the variables in netCDF: the main variable (e.g. tas) and the coordinate variables (e.g., lat, lon, time.)

- **From Load() output:**

it only includes the main variable (e.g. tas)

Options:

a) `variables`

b) `metadata`

c) `attributes`

d) `varsData`

https://earth.bsc.es/gitlab/external/cstools/-/issues/110

CSTools

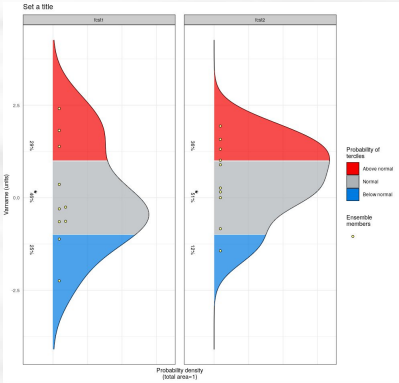
Merged developments

- Added `dat_dim` parameter in (CST_)BiasCorrection and (CST_)Calibration functions:

```
CST_Calibration(exp = exp, obs = obs, dat_dim = 'dataset')
CST_BiasCorrection(exp, obs, dat_dim = 'dataset')
```

- New color set in PlotForecastPDF Vitigeoss colors

```
PlotForecastPDF(fcsts,c(-1,1), color.set = "vitigeoss")
```



- Add 'ncores' to s2dv function calls in CST_Anomaly

- Corrected Analogs_vignette and CST_Analogs minor bug

- Reduced the computation time of the heavier examples and unit tests

status: in master

s2dv_cube development

- **Changed functions, examples and unit tests:**

  as.s2dv_cube(), s2dv_cube(), CST_Analogs, CST_Anomaly,CST_BEI_Weighting, CST_BiasCorrection, CST_Calibration,CST_CategoricalEnsCombination, CST_DynBiasCorrection,CST_EnsClustering,CST_MergeDims,CST_MultiEOF CST_MultiMetric,CST_MultivarRMSE,CST_ProxiesAttractor,CST_QuantileMapping CST_RainFARM,CST_RegimesAssign, CST_RFSlope,CST_RFTemp, CST_SplitDim,CST_WeatherRegimes, CST_RFWeights

- **Next changes (missing changes):**
  - Vignettes
  - /doc files
  - Update sample data: lonlat_temp, lonlat_prec

status: in branch develop-new_s2dv_cube

CSIndicators

s2dv_cube development

- **Changed functions, examples and unit tests:**

  AbsToProbs, MergeRefToExp, SelectPeriodOnData, SelectPeriodOnDates

- **Next changes (missing changes):**
  - Functions: AccumulationExceedingThreshold.R, PeriodAccumulation.R, PeriodMean.R, QThreshold.R, Threshold.R, TotalSpellTimeExceedingThreshold.R, TotalTimeExceedingThreshold.R, WindCapacityFactor.R, WindPowerDensity.R
  - Vignettes: AgriculturalIndicators.Rmd, EnergyIndicators.Rmd

status: in branch develop-new_s2dv_cube

Scorecards [Nadia]

Scorecards

Scorecard is a visualization representing the performance of climate models used to estimate the reliability of their predictions.

Near-Surface Air Temperature of ECMWF System 5 (cross-validation = true, skill aggregation)

(Ref: ERA5 1993-2016)

Mean bias (K) — Start date

Region	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropics	1	-0.20	-0.21	-0.16	-0.15	-0.11	-0.16	-0.18	-0.18	-0.16	-0.16	-0.21	-0.23
	2	-0.24	-0.20	-0.16	-0.09	-0.10	-0.14	-0.14	-0.15	-0.17	-0.19	-0.24	-0.24
	3	-0.19	-0.18	-0.11	-0.07	-0.09	-0.12	-0.13	-0.18	-0.18	-0.22	-0.22	-0.25
	4	-0.20	-0.15	-0.08	-0.06	-0.08	-0.11	-0.16	-0.20	-0.22	-0.22	-0.23	-0.22
	5	-0.19	-0.13	-0.08	-0.06	-0.10	-0.15	-0.19	-0.25	-0.22	-0.24	-0.21	-0.22
	6	-0.16	-0.12	-0.08	-0.07	-0.14	-0.19	-0.24	-0.24	-0.24	-0.22	-0.22	-0.20
Extra-tropical NH	1	-0.42	-0.17	-0.10	-0.12	-0.10	-0.08	-0.09	-0.03	0.07	-0.07	-0.24	-0.45
	2	-0.45	-0.20	-0.23	-0.24	-0.18	-0.11	-0.11	0.10	0.22	0.05	-0.37	-0.55
	3	-0.32	-0.34	-0.38	-0.37	-0.25	-0.20	0.04	0.27	0.32	-0.09	-0.49	-0.43
	4	-0.39	-0.46	-0.51	-0.42	-0.34	-0.11	0.17	0.31	0.06	-0.36	-0.42	-0.35
	5	-0.50	-0.58	-0.54	-0.48	-0.23	-0.06	0.21	0.11	-0.20	-0.39	-0.36	-0.41
	6	-0.62	-0.62	-0.60	-0.35	-0.18	-0.01	0.00	-0.19	-0.26	-0.32	-0.43	-0.50
Extra-tropical SH	1	-0.19	-0.12	-0.07	-0.09	-0.09	-0.13	-0.11	-0.11	-0.07	-0.09	-0.18	-0.22
	2	-0.16	-0.06	-0.07	-0.10	-0.14	-0.09	-0.10	-0.05	-0.02	-0.11	-0.22	-0.23
	3	-0.04	-0.05	-0.10	-0.15	-0.13	-0.13	-0.06	-0.02	-0.05	-0.16	-0.22	-0.15
	4	-0.02	-0.09	-0.17	-0.15	-0.17	-0.10	-0.05	-0.07	-0.14	-0.20	-0.15	-0.05
	5	-0.07	-0.16	-0.17	-0.19	-0.14	-0.11	-0.10	-0.15	-0.17	-0.15	-0.05	-0.02
	6	-0.15	-0.18	-0.21	-0.16	-0.14	-0.15	-0.17	-0.18	-0.13	-0.05	-0.02	-0.06

Correlation — Start date

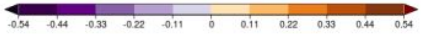
Region	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropics	1	0.81	0.86	0.83	0.83	0.80	0.80	0.78	0.80	0.79	0.79	0.78	0.79
	2	0.66	0.67	0.68	0.63	0.62	0.63	0.65	0.63	0.65	0.59	0.62	0.63
	3	0.60	0.63	0.58	0.56	0.58	0.58	0.59	0.61	0.56	0.55	0.59	0.61
	4	0.59	0.55	0.53	0.56	0.54	0.54	0.59	0.54	0.54	0.53	0.59	0.57
	5	0.52	0.50	0.53	0.52	0.53	0.55	0.51	0.52	0.54	0.53	0.55	0.55
	6	0.46	0.51	0.50	0.50	0.53	0.49	0.49	0.52	0.55	0.51	0.55	0.48
Extra-tropical NH	1	0.69	0.75	0.77	0.73	0.69	0.66	0.66	0.68	0.65	0.66	0.69	0.68
	2	0.29	0.40	0.38	0.34	0.31	0.38	0.40	0.40	0.30	0.25	0.26	0.36
	3	0.29	0.32	0.28	0.26	0.29	0.35	0.37	0.26	0.25	0.25	0.20	0.28
	4	0.25	0.25	0.24	0.26	0.30	0.32	0.30	0.20	0.22	0.23	0.26	0.23
	5	0.22	0.26	0.24	0.19	0.33	0.26	0.20	0.22	0.21	0.21	0.23	0.22
	6	0.25	0.29	0.21	0.26	0.25	0.25	0.21	0.22	0.23	0.22	0.22	0.20
Extra-tropical SH	1	0.76	0.80	0.78	0.77	0.74	0.72	0.72	0.74	0.72	0.73	0.74	0.74
	2	0.52	0.55	0.54	0.48	0.46	0.49	0.51	0.50	0.50	0.46	0.47	0.52
	3	0.47	0.49	0.43	0.40	0.43	0.44	0.45	0.45	0.42	0.42	0.44	0.47
	4	0.45	0.41	0.39	0.40	0.40	0.40	0.45	0.40	0.41	0.40	0.44	0.43
	5	0.37	0.37	0.38	0.36	0.40	0.40	0.37	0.39	0.40	0.38	0.41	0.40
	6	0.34	0.39	0.36	0.37	0.40	0.38	0.36	0.39	0.39	0.38	0.40	0.34

RPSS — Start date

Region	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropics	1	0.45	0.51	0.46	0.44	0.43	0.43	0.41	0.42	0.41	0.42	0.41	0.43
	2	0.28	0.29	0.28	0.26	0.26	0.25	0.27	0.25	0.27	0.23	0.27	0.27
	3	0.22	0.24	0.20	0.20	0.20	0.20	0.21	0.23	0.20	0.22	0.24	0.23
	4	0.20	0.18	0.17	0.18	0.16	0.17	0.20	0.19	0.19	0.19	0.22	0.18
	5	0.15	0.15	0.15	0.13	0.15	0.17	0.16	0.18	0.20	0.18	0.18	0.17
	6	0.11	0.13	0.11	0.13	0.15	0.15	0.15	0.18	0.19	0.15	0.17	0.13
Extra-tropical NH	1	0.28	0.38	0.40	0.34	0.30	0.29	0.27	0.30	0.25	0.27	0.29	0.28
	2	0.04	0.09	0.07	0.06	0.06	0.08	0.09	0.09	0.05	0.01	0.02	0.07
	3	0.04	0.05	0.04	0.03	0.03	0.06	0.07	0.02	0.02	0.02	0.01	0.04
	4	0.01	0.02	0.02	0.02	0.04	0.05	0.04	0.00	0.00	0.02	0.03	0.01
	5	0.00	0.02	0.01	-0.01	0.05	0.03	0.00	0.01	0.01	0.00	0.02	0.00
	6	0.01	0.03	0.00	0.02	0.02	0.02	0.00	0.01	0.03	0.01	0.01	0.00
Extra-tropical SH	1	0.38	0.44	0.41	0.38	0.36	0.35	0.33	0.35	0.34	0.35	0.36	0.36
	2	0.18	0.20	0.18	0.16	0.15	0.16	0.18	0.16	0.17	0.14	0.16	0.18
	3	0.14	0.15	0.12	0.11	0.12	0.12	0.13	0.13	0.12	0.13	0.14	0.15
	4	0.12	0.10	0.09	0.09	0.09	0.09	0.12	0.11	0.11	0.11	0.13	0.11
	5	0.08	0.08	0.08	0.07	0.09	0.09	0.09	0.10	0.11	0.09	0.10	0.09
	6	0.06	0.08	0.06	0.07	0.09	0.09	0.08	0.10	0.10	0.08	0.09	0.06

CRPSS — Start date

Region	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropics	1	0.40	0.47	0.43	0.41	0.38	0.37	0.35	0.38	0.36	0.37	0.35	0.38
	2	0.24	0.25	0.25	0.21	0.20	0.19	0.22	0.20	0.22	0.17	0.22	0.22
	3	0.18	0.20	0.15	0.14	0.15	0.15	0.15	0.18	0.14	0.16	0.19	0.19
	4	0.16	0.13	0.11	0.13	0.10	0.11	0.15	0.13	0.14	0.15	0.18	0.15
	5	0.09	0.08	0.09	0.09	0.09	0.11	0.09	0.12	0.15	0.13	0.14	0.11
	6	0.04	0.08	0.07	0.07	0.09	0.08	0.10	0.13	0.14	0.10	0.12	0.07
Extra-tropical NH	1	0.22	0.32	0.33	0.29	0.24	0.21	0.20	0.24	0.20	0.21	0.25	0.23
	2	0.00	0.05	0.03	0.02	0.00	0.02	0.05	0.04	0.01	-0.02	-0.01	0.02
	3	0.00	0.01	0.00	-0.02	-0.02	0.02	0.03	-0.01	-0.01	-0.02	-0.04	0.00
	4	-0.03	-0.02	-0.03	-0.02	0.00	0.01	0.00	-0.03	-0.03	-0.03	-0.01	-0.03
	5	-0.04	-0.02	-0.04	-0.04	0.01	-0.01	-0.03	-0.03	-0.03	-0.03	-0.02	-0.04
	6	-0.03	-0.01	-0.04	-0.02	-0.01	-0.01	-0.03	-0.04	-0.01	-0.03	-0.03	-0.05
Extra-tropical SH	1	0.32	0.39	0.36	0.34	0.31	0.29	0.28	0.30	0.29	0.30	0.31	0.31
	2	0.14	0.16	0.14	0.11	0.10	0.11	0.13	0.11	0.13	0.09	0.11	0.12
	3	0.10	0.11	0.07	0.06	0.07	0.07	0.08	0.09	0.07	0.08	0.09	0.10
	4	0.08	0.06	0.04	0.05	0.04	0.04	0.08	0.06	0.07	0.06	0.09	0.07
	5	0.03	0.03	0.03	0.02	0.04	0.04	0.04	0.05	0.06	0.05	0.06	0.05
	6	0.01	0.03	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.04	0.05	0.01



Scorecards

Multi-system comparison

Near-Surface Wind Speed. Region: Tropics (cross-validation = true, skill aggregation)

(Ref: ERA5 1993-2016)

Mean bias (m s-1) — Start date

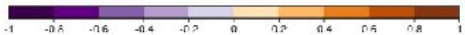
System	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ECMWF S5	1	0.16	0.16	0.12	0.07	0.17	0.17	0.18	0.20	0.15	0.11	0.11	0.14
	2	0.20	0.17	0.12	0.17	0.15	0.18	0.21	0.18	0.11	0.14	0.17	0.20
	3	0.19	0.15	0.16	0.16	0.18	0.21	0.19	0.11	0.14	0.18	0.21	0.18
	4	0.16	0.17	0.15	0.19	0.23	0.21	0.13	0.15	0.19	0.21	0.19	0.22
	5	0.18	0.14	0.18	0.23	0.21	0.14	0.15	0.18	0.21	0.20	0.22	0.18
	6	0.13	0.17	0.24	0.21	0.13	0.15	0.17	0.20	0.19	0.23	0.20	0.18
CMCC S35	1	0.07	0.06	0.07	0.04	0.12	0.06	0.00	0.10	0.08	0.09	0.06	0.07
	2	0.07	0.11	0.14	0.20	0.10	0.10	0.16	0.17	0.13	0.13	0.13	0.13
	3	0.11	0.16	0.21	0.12	0.11	0.16	0.21	0.16	0.13	0.11	0.10	0.02
	4	0.16	0.20	0.11	0.12	0.17	0.22	0.18	0.13	0.10	0.08	0.01	0.09
	5	0.19	0.11	0.11	0.18	0.22	0.17	0.11	0.10	0.08	0.01	0.08	0.15
	6	0.08	0.10	0.18	0.21	0.17	0.11	0.08	0.08	0.00	0.09	0.15	0.16
DWD S21	1	-0.21	-0.24	-0.23	-0.26	-0.20	-0.16	-0.25	-0.19	-0.21	-0.23	-0.25	-0.22
	2	-0.18	-0.18	-0.20	-0.09	-0.09	-0.13	-0.08	-0.09	-0.16	-0.14	-0.13	-0.14
	3	-0.23	-0.23	-0.19	-0.11	-0.15	-0.15	-0.14	-0.19	-0.19	-0.19	-0.20	-0.24
	4	-0.22	-0.11	-0.12	-0.18	-0.14	-0.13	-0.17	-0.18	-0.18	-0.21	-0.25	-0.26
	5	-0.11	-0.12	-0.17	-0.14	-0.12	-0.15	-0.15	-0.18	-0.21	-0.24	-0.22	-0.21
	6	-0.12	-0.16	-0.13	-0.11	-0.15	-0.14	-0.16	-0.20	-0.25	-0.22	-0.21	-0.12

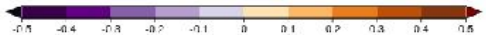
Correlation — Start date

System	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ECMWF S5	1	0.60	0.65	0.60	0.60	0.59	0.57	0.56	0.58	0.55	0.57	0.58	0.60
	2	0.30	0.28	0.31	0.29	0.27	0.29	0.30	0.30	0.33	0.25	0.30	0.31
	3	0.23	0.28	0.23	0.21	0.27	0.23	0.26	0.30	0.27	0.26	0.27	0.27
	4	0.23	0.20	0.22	0.25	0.21	0.24	0.29	0.26	0.27	0.21	0.24	0.19
	5	0.13	0.17	0.22	0.20	0.25	0.25	0.23	0.25	0.23	0.21	0.18	0.17
	6	0.12	0.22	0.19	0.19	0.22	0.23	0.21	0.21	0.20	0.18	0.19	0.13
CMCC S35	1	0.50	0.52	0.47	0.45	0.45	0.42	0.43	0.47	0.44	0.47	0.46	0.48
	2	0.26	0.25	0.27	0.25	0.20	0.26	0.27	0.25	0.30	0.26	0.29	0.29
	3	0.20	0.22	0.21	0.16	0.24	0.23	0.25	0.26	0.21	0.26	0.23	0.19
	4	0.20	0.17	0.15	0.22	0.22	0.21	0.25	0.18	0.26	0.23	0.18	0.14
	5	0.14	0.14	0.18	0.21	0.18	0.22	0.20	0.22	0.22	0.16	0.11	0.14
	6	0.11	0.16	0.18	0.17	0.18	0.18	0.20	0.19	0.16	0.10	0.14	0.12
DWD S21	1	0.38	0.42	0.38	0.34	0.35	0.38	0.36	0.37	0.37	0.37	0.36	0.40
	2	0.20	0.16	0.22	0.20	0.15	0.20	0.21	0.22	0.25	0.22	0.27	0.21
	3	0.15	0.17	0.14	0.12	0.20	0.21	0.22	0.23	0.22	0.22	0.19	0.11
	4	0.17	0.13	0.14	0.15	0.18	0.22	0.21	0.18	0.19	0.16	0.14	0.13
	5	0.12	0.09	0.14	0.16	0.17	0.16	0.17	0.17	0.17	0.15	0.09	0.14
	6	0.08	0.13	0.11	0.15	0.16	0.19	0.15	0.14	0.13	0.09	0.13	0.09

RPSS — Start date

System	Forecast month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ECMWF S5	1	0.21	0.25	0.21	0.21	0.21	0.20	0.18	0.20	0.18	0.19	0.19	0.22
	2	0.04	0.03	0.05	0.05	0.03	0.04	0.05	0.04	0.06	0.03	0.05	0.05
	3	0.02	0.04	0.02	0.02	0.04	0.02	0.02	0.05	0.04	0.03	0.03	0.03
	4	0.02	0.01	0.02	0.03	0.01	0.01	0.05	0.03	0.03	0.01	0.02	0.00
	5	-0.01	0.00	0.01	0.00	0.02	0.03	0.02	0.03	0.02	0.01	-0.01	-0.01
	6	-0.02	0.02	0.01	0.00	0.02	0.02	0.01	0.01	0.01	-0.01	0.00	-0.02
CMCC S35	1	0.13	0.15	0.10	0.10	0.10	0.08	0.07	0.12	0.09	0.11	0.11	0.13
	2	0.02	0.01	0.03	0.03	0.00	0.02	0.02	0.01	0.05	0.04	0.05	0.03
	3	0.00	0.01	0.01	-0.01	0.01	0.01	0.01	0.03	0.02	0.03	0.01	0.00
	4	0.00	0.00	-0.01	0.01	0.00	0.00	0.03	0.01	0.04	0.02	-0.01	-0.03
	5	-0.01	-0.01	0.01	0.01	-0.01	0.02	0.01	0.02	0.01	-0.01	-0.03	-0.02
	6	-0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.01	-0.01	-0.03	-0.01	-0.02
DWD S21	1	-0.12	-0.10	-0.10	-0.15	-0.12	-0.09	-0.13	-0.12	-0.13	-0.11	-0.13	-0.07
	2	-0.05	-0.08	-0.04	-0.04	-0.07	-0.06	-0.05	-0.05	-0.02	-0.03	0.00	-0.05
	3	-0.06	-0.04	-0.05	-0.06	-0.04	-0.03	-0.02	0.00	0.00	-0.01	-0.02	-0.07
	4	-0.03	-0.04	-0.04	-0.06	-0.03	-0.02	0.00	-0.01	-0.01	-0.02	-0.03	-0.05
	5	-0.04	-0.06	-0.05	-0.05	-0.04	-0.02	-0.01	-0.01	-0.01	-0.02	-0.05	-0.04
	6	-0.06	-0.06	-0.06	-0.04	-0.02	0.00	-0.02	-0.02	-0.02	-0.05	-0.04	-0.05





Scorecards - Code modules

DATA LOADING

- Loads metrics data from files for each start date.
- Data files are created by Verification Suite.

Output:

```
List of 3
 $ ecmwfs5:List of 1
  ..$ era5: num [1:360, 1:181, 1:6, 1:5, 1:12] -
```

SPATIAL AGGREGATION

- Calculates the weighted mean of the loaded metrics, for each of the regions defined by the user.
- Possibility to calculate aggregated skill score (RPSS) or calculate skill score from the aggregated score (RPS).

Output:

system	reference	metric	time	sdate	region
3	1	5	6	12	3

VISUALIZATION

- Creates scorecard visualization in png format
- Either single-system or multi-system scorecards depending on user inputs
- 4 scorecard formats are created for each dataset

Scorecards - Function inputs

```
SC_execute_scorecards(system = c('ecmwfs5','cmccs35','dwds21'),
                      reference = 'era5',
                      var = 'tas',
                      start.year = 1993,
                      end.year = 2016,
                      start.months = 1:12,
                      forecast.months = 1:6,
                      metric.aggregation = 'score'
                      metrics.load =  c('mean_bias', 'rps', 'rps_clim', 'crpss'),
                      metrics.visualize =  c('mean_bias', 'rpss_score_aggr', 'crpss'),
                      cross.validation = TRUE,
                      regions = list('Europe' = c(lon.min = -10, lon.max = 40, lat.min = 30, lat.max = 70),
                                     'Africa' = c(lon.min = -30, lon.max = 40, lat.min = -40, lat.max = 40)),
                      input.path = '/esarchive/scratch/nmilders/scorecards_data/input_data'
                      fileout = '/esarchive/scratch/nmilders/saved_scorecards',
                      ncores = 6)
```

Scorecards - Visualization module

kableExtra → Package to build complex HTML or LaTeX tables and manipulate table styles.

```
## Define data to show in table
table <- data.frame(input_data)

## Create HTML table
table.html <- kbl(table, escape = F, col.names = col.names, align = rep("c", n.columns)) %>%
  kable_paper("hover", full_width = F) %>%
  add_header_above("Table title", align = "left", font_size = 20)%>%
  add_header_above(header = header, font_size = 14) %>%

## Define colors in HTML table
column_spec(table.html, 3 , background = my.background, color = my.text.color)

## Define column sizes and outline
column_spec(1, bold = TRUE, width_min = "4cm", width_max = "4cm") %>%
column_spec(3:n.columns, width_max = "0.9cm") %>%
column_spec(c(1,2,14,26), border_right = "2px solid black") %>%
row_spec(0:n.rows, extra_css = "border-bottom: 2px solid black", hline_after = TRUE)

## Save HTML table as png image
save_kable(table.html, file = .'/scorecard.png')
```

https://rpubs.com/Sanaz/798154

Q & A

Vote for the new meeting time [Aude]

Our proposal:

- Still the first week of each month
- **Mon. 15h**
- No Tue. due to CVC meeting (11h) & internal seminar (15h)
- **Wed. 15h**
- ***Thu. 11h / 12h / 12:30h / 15h**
- No Fri. due to ESMValTool user meeting & ESS meeting

Read GRIB by R [An-Chi]

Anyone has experience?

Thanks for joining

Next meeting: xx March, xxh (TBD)