Agenda

1. Ice-breaker: Checking available resources and memory in R
2. News
   - s2dv
   - startR
   - CSTools
   - SUNSET
3. Presentation: Nadia Milders
4. Q&A

Ice-breaker

Checking available resources and memory in R

Different R functions can give us information about how much memory we are using and how much memory is available to the R session.

★ Let's check the available memory in our WS/personal laptop/BSC Hub, and how to determine the size of objects. Open an R session:

```
> library(memuse)
> library(pryr)
# Let's find out information about our RAM availability and usage.
# Sys.meminfo() shows the total RAM and free RAM in our platform
> Sys.meminfo()
# Sys.procmem() shows the amount of ram used by the current R process.
> Sys.procmem()
# We can create an object and check its size with object.size()
> my_array <- rnorm(30000000)
> print(object.size(my_array), units = "MB")
228.9 Mb
# Run Sys.meminfo() and Sys.procmem() again. What changed?
```

Checking available resources and memory in R

Another important piece of information is the number of cores that we can use to parallelize processes with functions like `parallel:mclapply()` or `multiApply::Apply()`.

★ For example, if we request an interactive session on Nord3v2:

```
salloc -t 00:30:00 -n 4
```

```
# Let's find out information about our RAM availability and usage.
> library(parallel)
> parallel::detectCores()
[1] 16
# This is not the correct number of cores! detectCores() returns the total number of cores
# in the node, NOT the number of cores available to the R session!
> library(future)
> future::availableCores()
cgroups.cpuset
            4
# To get a numeric value that we can use directly as the input for a function:
> as.numeric(future::availableCores())
[1] 4
```

Checking available resources and memory in R

Some resources to learn more about memory, parallel computing and profiling in R:

★   Memory usage · Advanced R by Hadley Wickham

★   Quick Intro to Parallel Computing in R by Matt Jones

★   multiApply - in-house BSC-ES package for parallel computing

★   Simple Memory Profiling in R by Henrik Bengtsson

Does anyone have any other resources or functions that they like to use? Please share!

s2dv

Barcelona
Supercomputing
Center
Centro Nacional de Supercomputación

New parameter 'return_mean' in RPS() and CRPS()

The default behavior of `sd2v::RPS()` and `s2dv::CRPS()` is to return the metric averaged over the dimension specified in time_dim. If the new parameter return_mean is set to FALSE, this temporal mean will not be compute. The default value of the parameter is return_mean = TRUE.

Example:
```
> crps <- CRPS(exp = lonlat_temp$exp$data, obs = lonlat_temp$obs$data, return_mean = TRUE)
> crps_nomean <- CRPS(exp = lonlat_temp$exp$data, obs = lonlat_temp$obs$data, return_mean = FALSE)
> dim(crps)
dataset    ftime      lat      lon
      1        3       22       53
> dim(crps_nomean)
sdate dataset    ftime      lat      lon
    6        1        3       22       53
```

MR: https://earth.bsc.es/gitlab/es/s2dv/-/merge_requests/179

status: in master

NAO(): Allow time_dim to be NULL

The `NAO()` function required a forecast time dimension ftime_dim to be present in the data. However, this dimension is only used in the function when ftime_avg = TRUE (i.e., when temporal aggregation is requested).

The function check has been modified so that ftime_dim is only mandatory when `ftime_avg = TRUE`. This gives more flexibility to the function, so that it can be used inside a startR workflow chunking along the time dimension.

MR: https://earth.bsc.es/gitlab/es/s2dv/-/merge_requests/180

status: in master

CDORemap() irregular grid interpolation error

Depending on the dimensions of the input array, CDORemap() can raise an error when interpolating from an irregular grid to a gaussian grid.
This was due to a bug in the code that was causing incorrect matching of the dimensions.

Careful! The function match() only matches vector **values**, it does not take into account vector names! For example:

```
original_dims <- c(time = 10, lat = 23, lon = 36, ensemble = 10)
new_dims <- c(lat = 23, lon = 36, ensemble = 10, time = 10)

# If we use match() to compare the position of the dimensions in two arrays:
match(original_dims, new_dims)
[1] 3 1 2 3 # WRONG!
match(names(original_dims), names(new_dims))
[1] 4 1 2 3 # OK!
```

Issue: https://earth.bsc.es/gitlab/es/s2dv/-/issues/114

status: in branch dev-fix_cdoremap_irregular_grid, ready to test

Minor correction to the documentation of Start()

The documentation of the output given by the `startR::Start()` function was missing two attributes:

- `$ExpectedFiles`: When `retrieve = FALSE`, the data in the files is not retrieved, and only the metadata is loaded. In this case, the attribute $Files is actually named $ExpectedFiles, but this was not stated in the documentation.

- `$PatternDim`: The name of the file pattern dimension. This attribute was missing from the documentation.

MR: https://earth.bsc.es/gitlab/es/startR/-/merge_requests/232

status: in master

CSTools

CST_MergeDims(): Error when merging time dimensions

A new bug was introduced in the latest version of CSTools in the CST_MergeDims() function. If the user wants to merge two or more time dimensions, and more than one dimension has length > 1, the function returns an error: '`dims do not match the length of object`'.

This error is caused by a bug in the way the dimensions of the $Dates attribute were merged.

Issue: https://earth.bsc.es/gitlab/external/cstools/-/issues/149

status: in branch develop-fix_CST_MergeDims_Dates

SUNSET

Release 2.0.0

The code for SUNSET v2.0.0 is available in the production branch.

This latest internal release includes many of the features that we have added in the past few months:

- Autosubmit as a workflow manager
- Recipe division and a launcher script to easily execute atomic recipes in parallel in the cluster
- New modules: Units, Indices, Downscaling and Scorecards
- Hands-on use cases
- Sample dataset and conda environment to facilitate usage

Many bug fixes and several other new developments are also included; you can find the complete list in the release notes.

Units module bugfix and 'Scorecards' output format

The bug in the Units module regarding the transformation of monthly precipitation has been fixed. The fix was included in the latest release.

MR: https://earth.bsc.es/gitlab/es/sunset/-/merge_requests/117

status: in production (included in v2.0.0)

For the 'Scorecards' output format, the skill metrics are now saved in individual netCDF files instead of being saved as different variables in the same netCDF file. There is also the possibility of requesting some metrics that are not aggregated by the 'syear' dimension.

MR: https://earth.bsc.es/gitlab/es/sunset/-/merge_requests/120

status: in master

New Statistics module

The new Statistics module allows the user to compute relevant statistics such as the variance, covariance or the standard deviation. The format to request statistics in the recipe is similar to the Skill module:

```
Statistics:
  metric: cov std var n_eff # list of the statistics to be computed
  save: 'all' # 'all' or 'none'
```

The output of this module is a list of named arrays that can be plotted with the Visualization module using the new function parameter `statistics`.

MR: https://earth.bsc.es/gitlab/es/sunset/-/merge_requests/120

status: in master

Multimodel module

The first version of the Multimodel module is now in the master branch. The 'pooled' method is the currently available method. It can be used **with and without Autosubmit**, but Autosubmit is the recommended option for efficiency.

```
Datasets:
  System:
    - {name: ECMWF-SEAS5.1}
    - {name: CMCC-SPS3.5}
    - {name: DWD-GCFS2.1}
  Multimodel:
    execute: yes
    approach: pooled
    createFrom: Anomalies
```
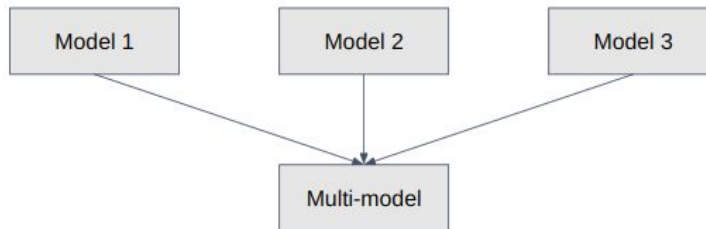

Example scripts and recipes are available in the SUNSET GitLab. You can find example scripts and recipes here:

More development is underway to improve efficiency and include different methods.

Issue: https://earth.bsc.es/gitlab/es/sunset/-/issues/69

Multimodel module: requesting resources

When using Autosubmit, the user can choose to request different resource directives for the single-model and multi-model jobs:

```
auto_conf:
    script: ./example_scripts/multimodel_seasonal.R
    expid: a6wq
    hpc_user: bsc32762
    wallclock: 01:00
    wallclock_multimodel: 02:00
    processors_per_job: 4
    processors_multimodel: 16
    custom_directives: ['#SBATCH --exclusive']
    custom_directives_multimodel: ['#SBATCH --exclusive', '#SBATCH --constraint=highmem']
```

If the _multimodel directives are filled, they will be used for the multi-model jobs. If left empty, the normal single-model job directives will be used as the default.

status: in master

Default plot format changed to PDF

In order to avoid [a bug in PlotEquiMap](#), the plots created by the Visualization module are now saved in PDF format by default.

There is a new parameter in the recipe, `file_format`, that can be defined to choose the desired format for the outputs If chosen, all the plots will be converted:

```
Visualization:
    plots: most_likely_terciles, skill_metrics, forecast_ensemble_mean
    projection: cylindrical_equidistant
    file_format: PNG
```

The available formats are: PNG, PDF, EPS, JPG and JPEG.

MR: https://earth.bsc.es/gitlab/es/sunset/-/merge_requests/122

status: in master

User presentation

What is a scorecard?

→**A visualization to help assess the quality of a model**

Example:

I want to analyse the quality of ECMWF SEAS5 comparing against reanalysis of ERA5, for seasonal data and 6 forecast months…

… starting with the metric mean bias.

Mean bias for 12 months and 6 forecast month = **72 maps**
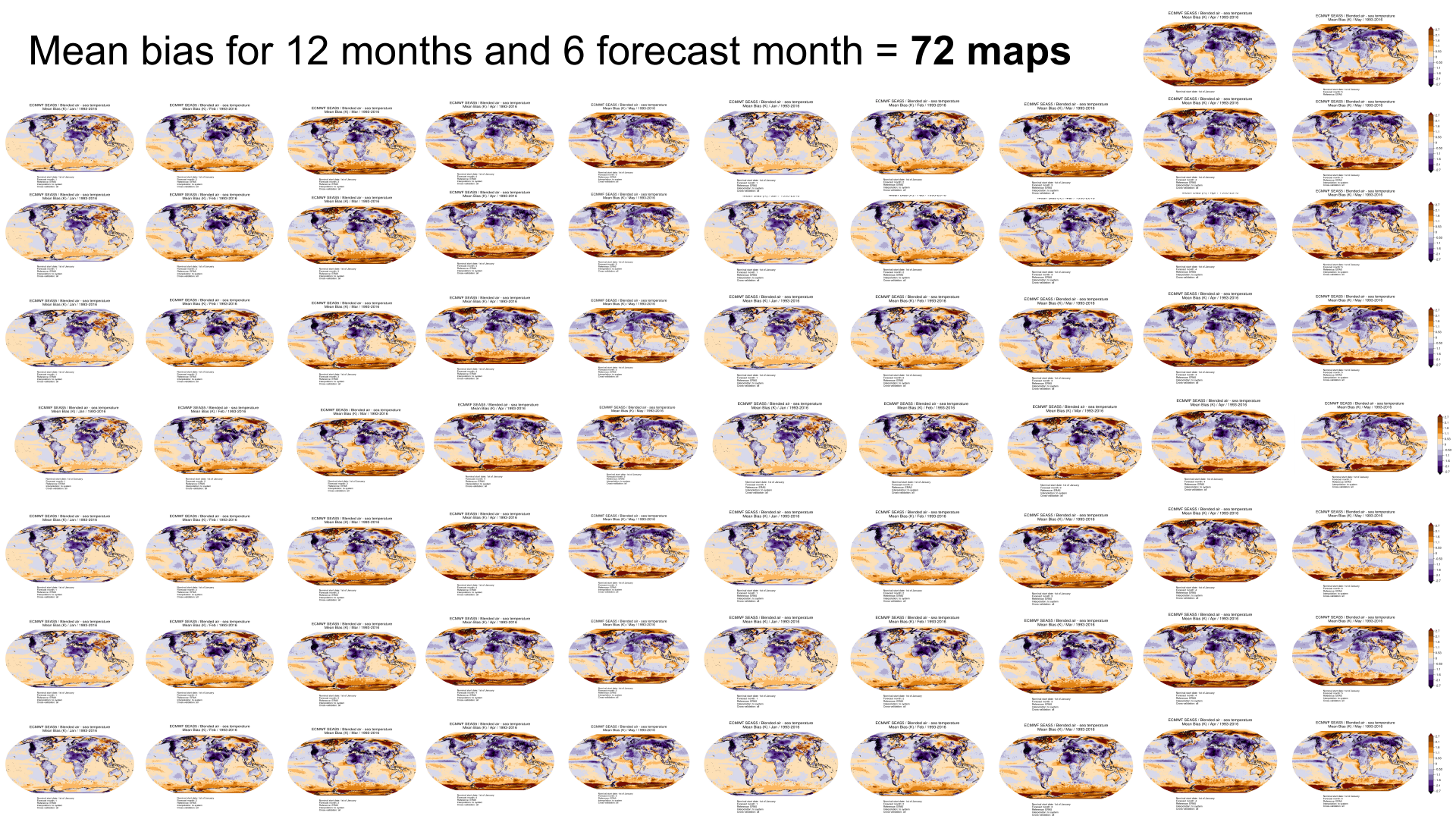
Splitting the map into desired regions and aggregating the data:
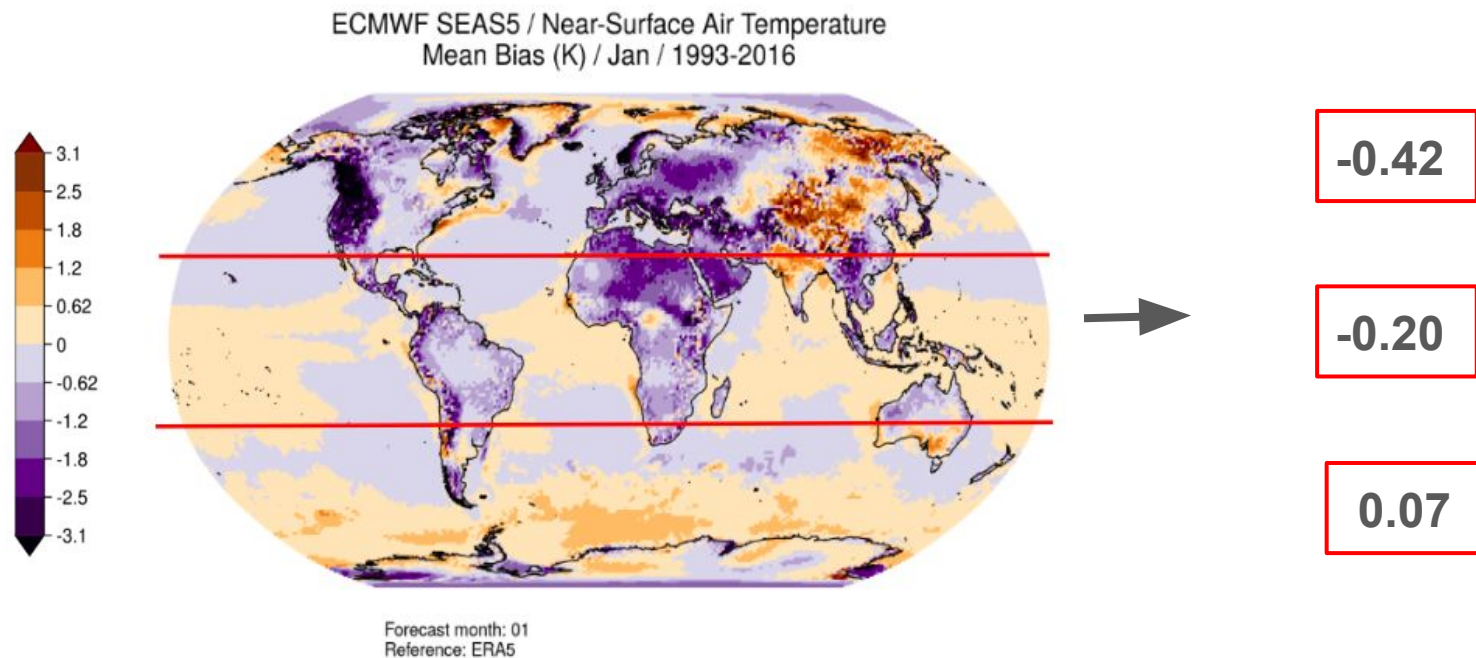
ECMWF SEAS5 / Near-Surface Air Temperature
Mean Bias (K) / Jan / 1993-2016

```
WeightedMean(mean_bias,
             region,
             lon,lat,
             londim,latdim)
```

Forecast month: 01
Reference: ERA5

Splitting the map into desired regions and aggregating the data:

ECMWF SEAS5 / Near-Surface Air Temperature
Mean Bias (K) / Jan / 1993-2016

-0.42

-0.20

0.07

Forecast month: 01
Reference: ERA5

Near-Surface Air Temperature of ECMWF SEAS5

(Ref: ERA5 1993-2016)

Mean bias (K)

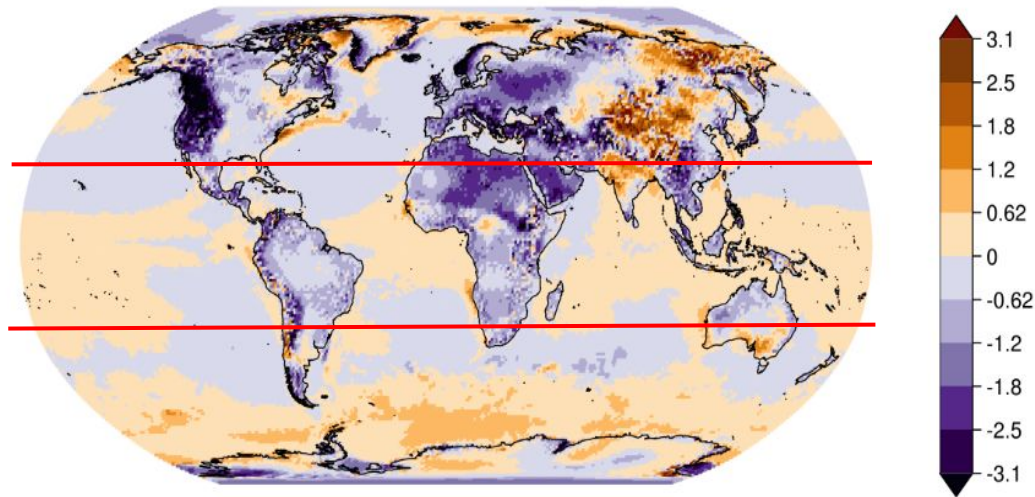| Region	Forecast Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tropics	1	-0.20	-0.21	-0.16	-0.15	-0.11	-0.16	-0.18	-0.18	-0.16	-0.16	-0.21	-0.23
	2	-0.24	-0.20	-0.16	-0.09	-0.10	-0.14	-0.14	-0.15	-0.17	-0.19	-0.24	-0.24
	3	-0.19	-0.18	-0.11	-0.07	-0.09	-0.12	-0.13	-0.18	-0.18	-0.22	-0.22	-0.25
	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	-0.41
	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
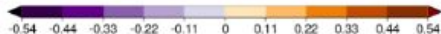
-0.54 -0.44 -0.33 -0.22 -0.11 0 0.11 0.22 0.33 0.44 0.54

ECMWF SEAS5 / Near-Surface Air Temperature
Mean Bias (K) / Jan / 1993-2016

3.1
2.5
1.8
1.2
0.62
0
-0.62
-1.2
-1.8
-2.5
-3.1

Forecast month: 01
Reference: ERA5

More metrics can also be included…

Near-Surface Air Temperature of ECMWF SEAS5 (Interpolation = to system, Aggregation level = score, Cross-validation = anomalies & terciles & crps_clim) (Ref: ERA5 1993-2016)
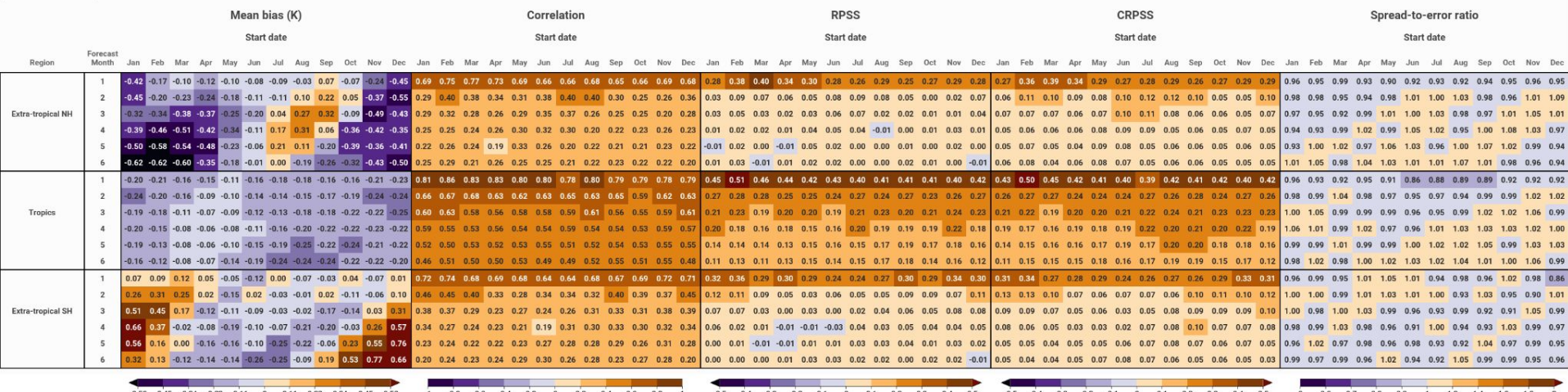
Why aggregate metrics?

- Aggregating climate variables (i.e. temperature) would smooth out discrepancies between model and observations.

- By first calculating the the metric for each grid point these discrepancies can be better captured.

- Type of aggregation depends on type of product → scorecards are to measure quality of the model

Recipe input for loading and processing data:

```
Analysis:
  Horizon: seasonal # Mandatory, str: 'subseasonal', 'seasonal', or 'decadal'
  Variables:
    # name: variable name(s) in the /esarchive (Mandatory, str)
    # freq: 'monthly_mean', 'daily' or 'daily_mean' (Mandatory, str)
    # units: desired data units for each variable. Only available for temperature,
    #   precipitation, and pressure variables.
    - {name: 'tas', freq: 'monthly_mean', units: 'C'}
  Datasets:
    System:
      # name: System name (Mandatory, str)
      # member: 'all' or individual members, separated by a comma and in quotes (decadal only, str)
      - {name: 'ECMWF-SEAS5', member: 'all'}
    Multimodel: no # Either yes/true or no/false (Mandatory, bool)
    Reference:
      - {name: 'ERA5'} # Reference name (Mandatory, str)
  Time:
    sdate: '1101' # Start date, 'mmdd' (Mandatory, int)
    fcst_year: '2020' # Forecast initialization year 'YYYY' (Optional, int)
    hcst_start: '1993' # Hindcast initialization start year 'YYYY' (Mandatory, int)
    hcst_end: '2016' # Hindcast initialization end year 'YYYY' (Mandatory, int)
    ftime_min: 1 # First forecast time step in months. Starts at "1". (Mandatory, int)
    ftime_max: 6 # Last forecast time step in months. Starts at "1". (Mandatory, int)
  Region:
    latmin: -90 # minimum latitude (Mandatory, int)
    latmax: 90  # maximum latitude (Mandatory, int)
    lonmin: 0   # minimum longitude (Mandatory, int)
    lonmax: 359.9  # maximum longitude (Mandatory, int)
  Regrid:
    method: bilinear # Interpolation method (Mandatory, str)
    type: to_system # Interpolate to: 'to_system', 'to_reference', 'none',
```

Scorecards with SUNSET *(Currently only for seasonal)*

Scorecard recipe inputs:

```
Scorecards:
  execute: yes
  regions:
    Extra-tropical NH:  {lonmin: 0,  lonmax: 360, latmin: 30, latmax: 90}
    Tropics: {lonmin: 0,  lonmax: 360, latmin: -30, latmax: 30}
    Extra-tropical SH : {lonmin: 0,  lonmax: 360, latmin: -90, latmax: -30}
  start_months: 'all'
  metric: mean_bias enscorr rpss crpss enssprerr
  metric_aggregation: 'score'
  inf_to_na: TRUE
  table_label: NULL
  fileout_label: NULL
  col1_width: NULL
  col2_width: NULL
  calculate_diff: FALSE
```

In execute script after loading data and calculating metrics…

```
source("modules/Scorecards/Scorecards.R")
Scorecards(recipe)
```

Scorecards outside of SUNSET

Git repository **esviz:** (https://earth.bsc.es/gitlab/es/esviz)

```r
VizScorecard <- function(data, sign = NULL, row_dim = 'region',
                         subrow_dim = 'time', col_dim = 'metric',
                         subcol_dim = 'sdate', legend_dim = 'metric',
                         row_names = NULL, subrow_names = NULL,
                         col_names = NULL, subcol_names = NULL,
                         row_title = NULL, subrow_title = NULL,
                         col_title = NULL, table_title = NULL,
                         table_subtitle = NULL, legend_breaks = NULL,
                         plot_legend = TRUE, label_scale = 1.4,
                         legend_width = NULL, legend_height = 50,
                         palette = NULL, colorunder = NULL, colorsup = NULL,
                         round_decimal = 2, font_size = 1.1,
                         legend_white_space = 6, columns_width = 1.2,
                         col1_width = NULL, col2_width = NULL,
                         fileout = './scorecard.png') {
```

Scorecards outside of SUNSET

```r
data <- array(rnorm(1000), dim = c('sdate' = 12, 'metric' = 3, 'region' = 3, 'time' = 6))
sign <- array(c(rep(T, 200), rep(F, 300), T, F, rep(T, 200), rep(F, 162)), dim = dim(data))

row_names <- c('Tropics', 'Extra-tropical NH', 'Extra-tropical SH')
col_names <- c('Mean bias (K)', 'RPSS', 'CRPSS')

VizScorecard(data = data,
             sign = sign,
             row_names = row_names,
             col_names = col_names,
             row_title = 'Region',
             subcol_names =  month.abb[as.numeric(1:12)],
             col_title = 'Start date')
```
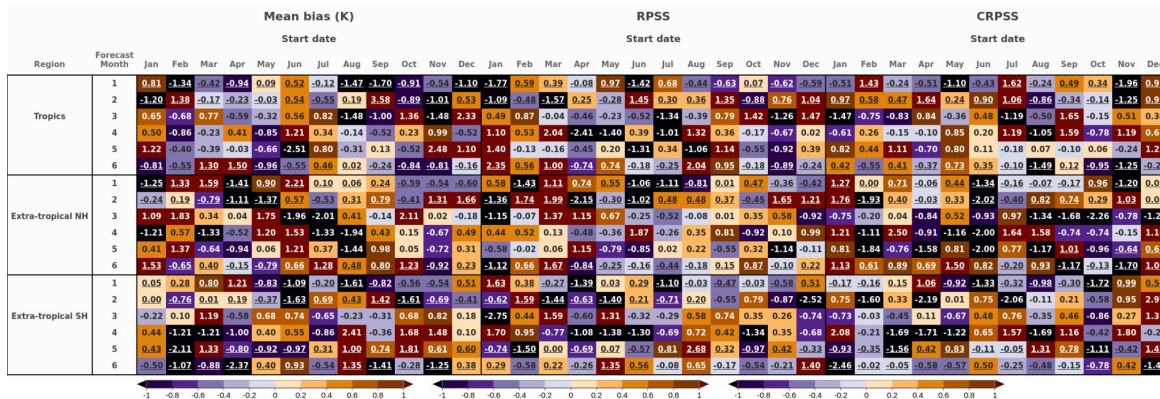
Forecast quality (measured with ACC using ERA5land as reference) over Tanzania

Years: 1961-2022; Calibration: False

Multi-model

Variable	Forecast period	Arusha	Dar-es-salaam	Dodoma	Geita	Iringa	Kagera	Kaskazini Pemba	Kaskazini Unguja	Katavi	Kigoma	Kilimanjaro	Kusini Pemba	Kusini Unguja	Lindi	Manyara	Mara	Mbeya	Morogoro	Mtwara	Mwanza	Njombe	Pwani	Rukwa	Ruvuma	Shinyanga	Simiyu	Singida	Songwe	Tabora	Tanga
TAS - OND	Year 1	0.58	0.77	0.49	0.69	0.59	0.80	0.82	0.80	0.63	0.68	0.61	0.81	0.74	0.64	0.52	0.52	0.60	0.52	0.71	0.66	0.70	0.66	0.67	0.62	0.61	0.51	0.50	0.62	0.57	0.64
	Year 2	0.60	0.76	0.51	0.67	0.59	0.79	0.81	0.80	0.60	0.69	0.65	0.80	0.74	0.64	0.56	0.55	0.57	0.54	0.67	0.63	0.67	0.64	0.66	0.57	0.62	0.53	0.50	0.58	0.56	0.65
	Years 1-2	0.68	0.86	0.64	0.79	0.73	0.87	0.89	0.90	0.67	0.77	0.73	0.89	0.85	0.78	0.65	0.67	0.71	0.68	0.82	0.75	0.82	0.76	0.73	0.73	0.71	0.64	0.64	0.66	0.66	0.75
	Years 1-5	0.86	0.91	0.83	0.82	0.84	0.93	0.90	0.94	0.67	0.80	0.85	0.91	0.90	0.83	0.84	0.80	0.74	0.76	0.87	0.84	0.88	0.81	0.75	0.80	0.74	0.76	0.75	0.66	0.67	0.78
	Years 2-5	0.84	0.88	0.78	0.81	0.81	0.91	0.90	0.92	0.67	0.77	0.85	0.90	0.87	0.81	0.81	0.78	0.72	0.73	0.86	0.82	0.87	0.80	0.71	0.80	0.74	0.74	0.75	0.65	0.66	0.78
	Year 3	0.59	0.76	0.53	0.67	0.61	0.79	0.78	0.78	0.60	0.68	0.67	0.78	0.74	0.63	0.59	0.52	0.59	0.55	0.65	0.62	0.70	0.65	0.65	0.61	0.61	0.51	0.52	0.59	0.55	0.65
	Years 2-3	0.73	0.85	0.67	0.87	0.74	0.86	0.88	0.89	0.67	0.76	0.79	0.88	0.84	0.75	0.73	0.69	0.71	0.69	0.79	0.75	0.81	0.74	0.71	0.72	0.71	0.66	0.68	0.66	0.67	0.74
TAS - MAM	Year 1	0.63	0.79	0.67	0.87	0.74	0.91	0.80	0.77	0.86	0.89	0.54	0.80	0.74	0.68	0.61	0.80	0.79	0.72	0.58	0.84	0.73	0.76	0.86	0.69	0.82	0.79	0.74	0.79	0.80	0.65
	Year 2	0.35	0.66	0.41	0.69	0.52	0.74	0.70	0.68	0.63	0.71	0.35	0.69	0.61	0.53	0.31	0.55	0.58	0.58	0.37	0.61	0.57	0.64	0.67	0.49	0.56	0.48	0.50	0.58	0.54	0.55
	Years 1-2	0.68	0.81	0.69	0.91	0.75	0.91	0.81	0.79	0.83	0.89	0.60	0.81	0.77	0.66	0.61	0.82	0.80	0.71	0.57	0.90	0.72	0.74	0.83	0.69	0.85	0.82	0.75	0.79	0.81	0.69
	Years 1-5	0.81	0.89	0.76	0.93	0.83	0.93	0.89	0.87	0.85	0.92	0.77	0.89	0.86	0.83	0.74	0.92	0.89	0.81	0.71	0.93	0.80	0.85	0.91	0.81	0.89	0.88	0.82	0.86	0.81	0.81
	Years 2-5	0.75	0.87	0.70	0.90	0.83	0.91	0.86	0.86	0.82	0.89	0.74	0.86	0.84	0.77	0.69	0.89	0.85	0.78	0.63	0.91	0.76	0.83	0.87	0.75	0.86	0.86	0.75	0.80	0.77	0.82
	Year 3	0.47	0.59	0.39	0.75	0.45	0.78	0.62	0.59	0.65	0.73	0.38	0.62	0.54	0.47	0.37	0.67	0.55	0.50	0.30	0.74	0.47	0.56	0.66	0.43	0.68	0.61	0.51	0.54	0.61	0.48
	Years 2-3	0.57	0.78	0.58	0.84	0.67	0.86	0.77	0.77	0.74	0.81	0.57	0.77	0.75	0.66	0.53	0.75	0.73	0.69	0.54	0.83	0.64	0.75	0.76	0.62	0.77	0.73	0.64	0.72	0.68	0.69
TAS - NDJFMA	Year 1	0.35	0.80	0.40	0.78	0.59	0.85	0.79	0.80	0.66	0.79	0.49	0.80	0.78	0.59	0.31	0.51	0.61	0.57	0.57	0.66	0.75	0.70	0.71	0.64	0.59	0.50	0.51	0.62	0.58	0.68
	Year 2	0.55	0.77	0.53	0.80	0.63	0.86	0.75	0.77	0.69	0.80	0.60	0.76	0.76	0.64	0.50	0.67	0.58	0.62	0.57	0.75	0.71	0.70	0.72	0.61	0.69	0.62	0.55	0.60	0.63	0.69
	Years 1-2	0.63	0.86	0.64	0.88	0.76	0.91	0.84	0.87	0.77	0.87	0.70	0.84	0.83	0.75	0.61	0.74	0.74	0.71	0.68	0.85	0.85	0.81	0.80	0.77	0.78	0.72	0.69	0.71	0.72	0.80
	Years 1-5	0.86	0.95	0.86	0.92	0.89	0.95	0.91	0.94	0.84	0.93	0.89	0.91	0.93	0.88	0.86	0.90	0.83	0.85	0.87	0.93	0.92	0.94	0.88	0.88	0.89	0.88	0.84	0.78	0.79	0.92
	Years 2-5	0.82	0.94	0.84	0.91	0.88	0.93	0.89	0.92	0.81	0.91	0.88	0.89	0.90	0.86	0.81	0.88	0.80	0.85	0.83	0.92	0.90	0.90	0.86	0.86	0.88	0.86	0.81	0.75	0.77	0.90
	Year 3	0.46	0.76	0.47	0.79	0.61	0.84	0.71	0.73	0.68	0.78	0.52	0.72	0.74	0.61	0.42	0.64	0.60	0.59	0.57	0.76	0.73	0.67	0.71	0.65	0.68	0.61	0.53	0.61	0.63	0.65
	Years 2-3	0.71	0.85	0.67	0.88	0.78	0.90	0.81	0.84	0.79	0.88	0.77	0.81	0.82	0.76	0.68	0.79	0.74	0.77	0.71	0.87	0.84	0.80	0.80	0.78	0.81	0.76	0.69	0.71	0.74	0.81
PR - OND	Year 1	-0.17	-0.14	-0.21	-0.32	-0.25	-0.41	0.07	-0.05	-0.18	-0.30	-0.10	-0.07	-0.07	-0.25	-0.13	-0.21	-0.18	-0.26	-0.24	-0.24	-0.19	-0.16	-0.10	-0.27	-0.32	-0.23	-0.18	-0.23	-0.29	-0.01
	Year 2	0.08	-0.16	0.04	-0.10	-0.09	-0.16	0.04	-0.08	-0.15	-0.09	0.06	0.01	-0.09	-0.06	0.13	-0.01	-0.11	-0.01	-0.06	-0.04	0.04	-0.13	-0.10	0.07	-0.08	0.00	-0.08	-0.04	-0.10	-0.01
	Years 1-2	-0.03	-0.05	-0.18	-0.34	-0.26	-0.41	0.20	0.07	-0.22	-0.33	0.13	0.18	0.05	-0.26	-0.11	-0.22	-0.06	-0.28	-0.27	-0.34	0.11	-0.05	-0.06	-0.13	-0.32	-0.18	-0.18	-0.02	-0.22	0.09
	Years 1-5	0.23	0.04	-0.12	-0.52	-0.19	-0.63	0.35	0.15	-0.27	-0.48	0.27	0.34	0.21	-0.21	0.13	-0.06	-0.15	-0.23	-0.17	-0.49	-0.18	0.07	-0.18	-0.14	-0.45	-0.09	-0.11	-0.23	-0.26	0.29
	Years 2-5	0.32	0.06	0.04	-0.42	-0.04	-0.53	0.19	0.07	-0.17	-0.40	0.30	0.16	0.18	-0.04	0.19	0.07	-0.12	-0.07	0.02	-0.26	0.06	-0.07	0.02	-0.25	0.11	-0.01	-0.10	-0.10		0.15
	Year 3	-0.20	-0.17	-0.22	-0.30	-0.15	-0.40	-0.16	-0.21	-0.19	-0.25	-0.29	-0.16	-0.21	-0.31	-0.17	-0.14	-0.04	-0.27	-0.33	-0.41	-0.04	-0.23	-0.16	-0.21	-0.35	-0.23	-0.13	-0.13	-0.22	-0.12
	Years 2-3	0.05	-0.12	0.02	-0.25	-0.07	-0.32	-0.02	-0.12	-0.21	-0.23	0.05	-0.04	-0.08	-0.14	0.06	-0.08	-0.08	-0.05	-0.10	-0.21	0.04	-0.12	-0.15	0.04	-0.13	0.05	-0.07	-0.08	-0.12	-0.02
PR - MAM	Year 1	0.11	0.04	0.07	-0.14	0.11	-0.25	-0.02	-0.04	0.03	-0.15	0.11	-0.01	-0.02	0.13	0.08	-0.11	0.13	0.01	0.12	-0.13	0.13	0.05	0.22	0.10	-0.07	-0.06	0.05	0.14	-0.03	-0.12
	Year 2	-0.17	-0.03	-0.18	-0.21	-0.16	-0.05	0.00	-0.08	-0.36	-0.24	-0.05	-0.02	-0.09	-0.03	-0.14	-0.11	-0.24	-0.10	-0.07	-0.12	-0.13	0.03	-0.20	-0.13	-0.23	-0.19	-0.24	-0.27	-0.30	0.01
	Years 1-2	-0.02	0.13	0.04	-0.22	0.02	-0.32	0.00	0.02	-0.18	-0.25	0.10	0.02	0.09	-0.13	0.01	-0.22	0.02	-0.12	-0.07	-0.25	-0.03	0.06	0.00	-0.11	-0.22	-0.19	-0.04	-0.06	-0.21	-0.03
	Years 1-5	-0.22	0.14	-0.07	-0.53	-0.18	-0.61	0.30	0.26	-0.56	-0.60	-0.01	0.29	0.29	-0.10	-0.16	-0.46	-0.30	-0.10	-0.11	-0.50	-0.16	0.08	-0.41	-0.09	-0.49	-0.42	-0.32	-0.34	-0.50	0.07
	Years 2-5	-0.28	-0.02	-0.15	-0.61	-0.29	-0.58	0.24	0.20	-0.63	-0.65	-0.05	0.27	0.19	-0.26	-0.20	-0.48	-0.50	-0.11	-0.25	-0.53	-0.24	-0.02	-0.58	-0.08	-0.57	-0.43	-0.46	-0.52	-0.58	0.08
	Year 3	-0.09	-0.14	-0.06	-0.30	-0.17	-0.31	0.08	-0.06	-0.22	-0.26	0.08	0.10	-0.03	-0.29	-0.02	-0.26	-0.16	-0.19	-0.18	-0.32	-0.02	-0.16	-0.16	-0.06	-0.26	-0.22	-0.23	-0.14	-0.25	0.03
	Years 2-3	-0.18	-0.08	-0.16	-0.39	-0.27	-0.37	0.05	0.03	-0.51	-0.45	0.11	0.06	0.03	-0.12	-0.10	-0.34	-0.41	-0.11	-0.17	-0.36	-0.28	-0.07	-0.46	-0.04	-0.37	-0.33	-0.38	-0.44	-0.45	0.10
PR - NDJFMA	Year 1	-0.31	-0.10	-0.24	-0.46	-0.25	-0.47	0.08	0.00	-0.38	-0.48	-0.13	0.09	-0.02	-0.23	-0.26	-0.38	-0.36	-0.24	-0.21	-0.44	-0.19	-0.12	-0.23	-0.17	-0.47	-0.40	-0.34	-0.37	-0.40	-0.16
	Year 2	-0.02	0.02	-0.08	-0.30	-0.18	-0.28	0.07	0.00	-0.25	-0.34	0.08	0.09	0.03	-0.09	0.01	-0.07	-0.26	-0.12	-0.03	-0.23	-0.07	-0.02	-0.14	-0.09	-0.30	-0.15	-0.23	-0.20	-0.27	-0.03
	Years 1-2	-0.23	0.04	-0.29	-0.65	-0.32	-0.58	0.14	0.05	-0.51	-0.61	0.07	0.15	0.10	-0.30	-0.24	-0.52	-0.42	-0.34	-0.21	-0.60	-0.01	-0.14	-0.24	-0.31	-0.59	-0.48	-0.42	-0.36	-0.53	-0.06
	Years 1-5	-0.39	0.03	-0.45	-0.73	-0.43	-0.65	0.17	0.04	-0.58	-0.69	0.02	0.21	0.16	-0.49	-0.43	-0.57	-0.42	-0.53	-0.37	-0.71	-0.04	-0.26	-0.45	-0.31	-0.67	-0.55	-0.55	-0.47	-0.58	-0.20
	Years 2-5	-0.20	0.08	-0.27	-0.67	-0.27	-0.61	0.12	0.08	-0.50	-0.61	0.05	0.16	0.16	-0.33	-0.25	-0.45	-0.27	-0.44	-0.17	-0.67	0.13	-0.18	-0.32	-0.17	-0.63	-0.45	-0.42	-0.31	-0.50	-0.17
	Year 3	-0.33	0.00	-0.32	-0.54	-0.28	-0.33	0.17	0.08	-0.40	-0.54	-0.25	0.18	0.00	-0.34	-0.01	-0.35	-0.21	-0.36	-0.27	-0.58	0.07	-0.20	-0.20	-0.15	-0.54	-0.46	-0.38	-0.23	-0.44	-0.02
	Years 2-3	-0.09	0.07	-0.14	-0.54	-0.19	-0.46	0.15	0.08	-0.44	-0.53	0.12	0.16	0.10	-0.28	-0.11	-0.27	-0.31	-0.31	-0.16	-0.48	0.10	-0.09	-0.27	-0.22	-0.47	-0.30	-0.38	-0.30	-0.40	-0.01

Thanks for joining

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Next meeting: May 2nd