



Spatio-temporal downscaling of temperature and VPD

Example project - Proseminar in Geocomputation and Earth Observation



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[Josep Peñuelas](#) , [Philippe Ciais](#), [Josep G. Canadell](#), [Ivan A. Janssens](#), [Marcos Fernández-Martínez](#), [Jofre Carnicer](#), [Michael Obersteiner](#), [Shilong Piao](#), [Robert Vautard](#) & [Jordi Sardans](#)

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 **RESEARCH ARTICLE**

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Recent global decline of CO₂ fertilization effects on vegetation photosynthesis

[SONGHAN WANG](#) , [YONGGUANG ZHANG](#) , [WEIMIN JU](#) , [JING M. CHEN](#) , [PHILIPPE CIAIS](#) , [ALESSANDRO CESCATTI](#) , [JORDI SARDANS](#) ,

[IVAN A. JANSSENS](#) , [MOUSONG WU](#) , [\[...\]](#) AND [JOSEP PEÑUELAS](#)  **+25 authors** [Authors Info & Affiliations](#)

SCIENCE • 11 Dec 2020 • Vol 370, Issue 6522 • pp. 1295-1300 • DOI: 10.1126/science.abb7772

Motivation

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RESEARCH ARTICLE | ECOLOGY

Increased atmospheric vapor pressure deficit reduces global vegetation growth

WENPING YUAN¹, YI ZHENG², SHILONG PIAO³, PHILIPPE CIAIS⁴, DANICA LOMBARDOZZI⁵, YINGPING WANG⁶, YOUNGYEL RYU⁷, WENJIE DONG¹, [...] AND SONG YANG¹

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Motivation

"the impacts of VPD on vegetation growth should be adequately considered to assess ecosystem responses to future climate conditions."

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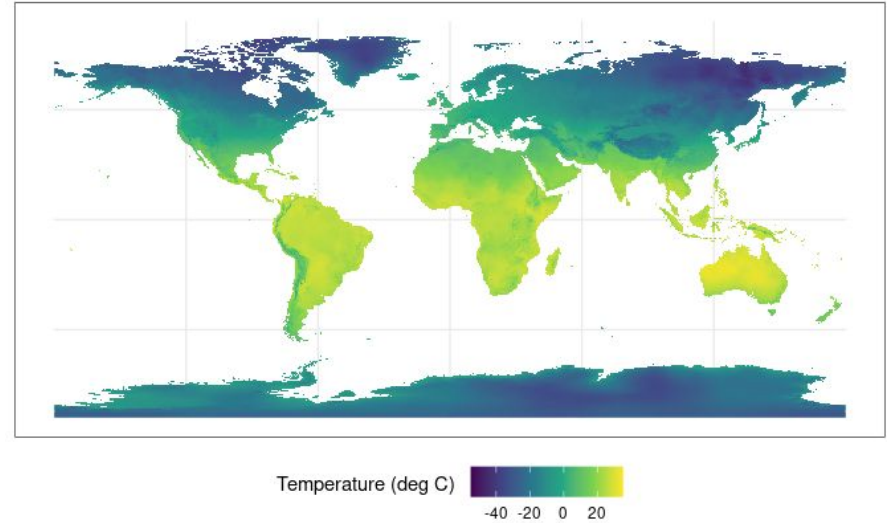
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Project goal

Create a dataset of daily temperature and VPD at high spatial resolution

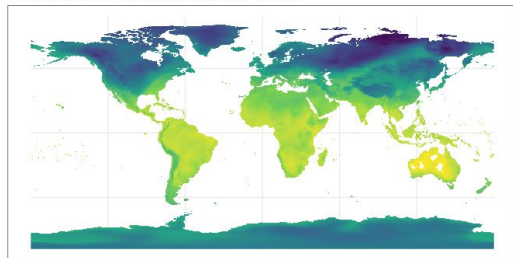
Average January temperature 1970-2000 (WorldClim)



Data selection

WATCH-WFDEI

1st January 1979 temperature (WATCH-WFDEI)

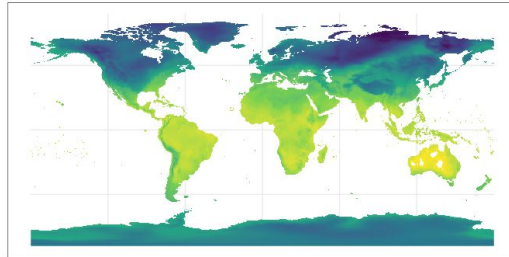


Temperature (deg C) -40 -20 0 20

Data selection

WATCH-WFDEI

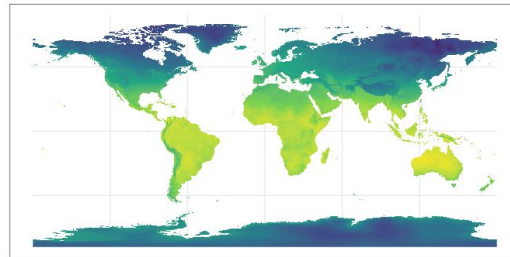
1st January 1979 temperature (WATCH-WFDEI)



Temperature (deg C)
-40 -20 0 20

WorldClim

Average January temperature 1970-2000 (WorldClim)

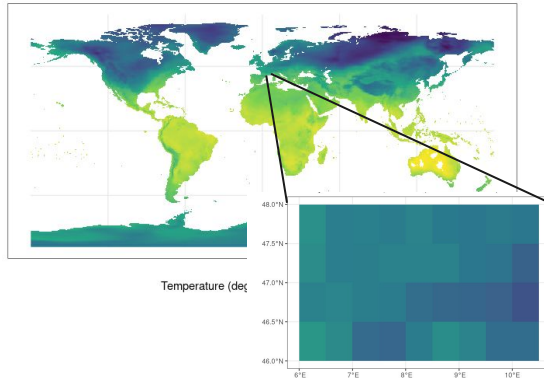


Temperature (°C)
-40 -20 0 20

Data selection

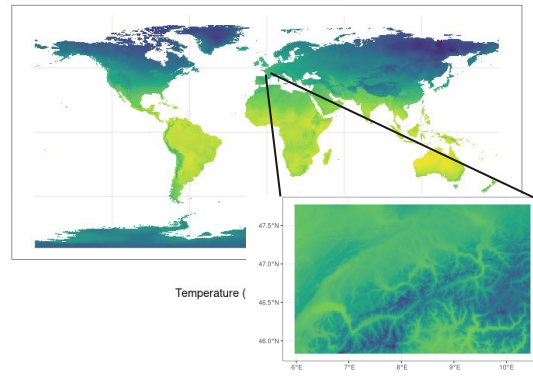
WATCH-WFDEI

1st January 1979 temperature (WATCH-WFDEI)



WorldClim

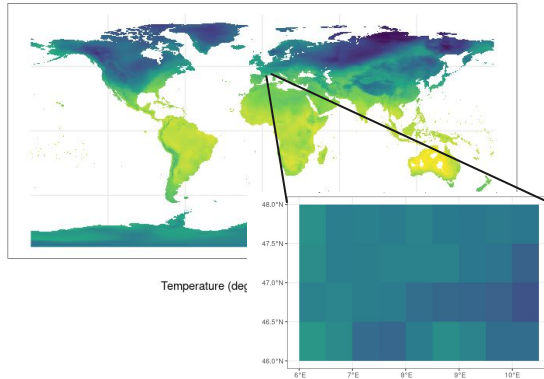
Average January temperature 1970-2000 (WorldClim)



Data selection

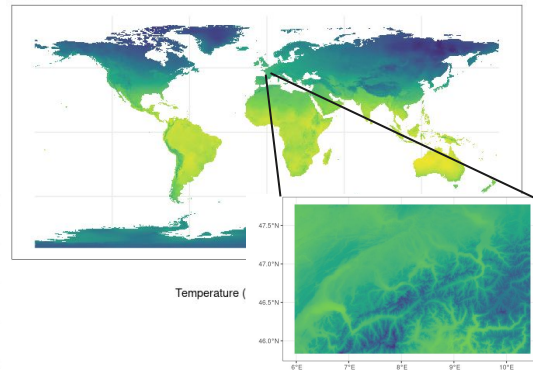
WATCH-WFDEI

1st January 1979 temperature (WATCH-WFDEI)



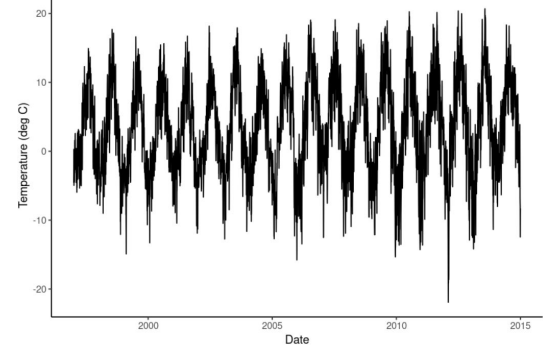
WorldClim

Average January temperature 1970-2000 (WorldClim)



FLUXNET2015

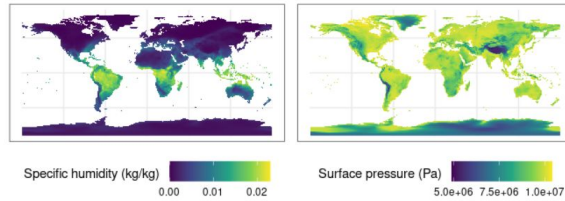
Temperature in Davos (FLUXNET2015)



Data selection

WATCH-WFDEI

1st January 1979 specific humidity and pressure (WATCH-WFDEI)

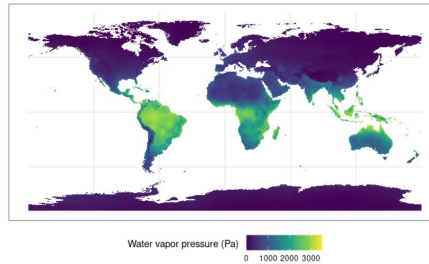


Humidity (q)

P_{air}

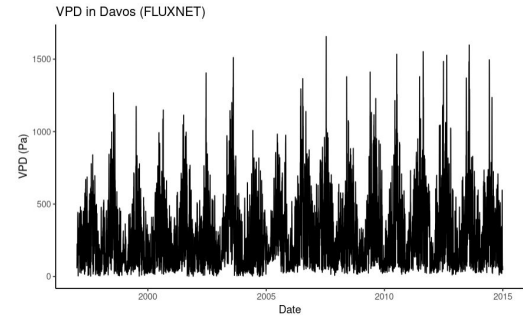
WorldClim

Average January vapor pressure 1970-2000 (WorldClim)



VP_{air}

FLUXNET2015



VPD



Computing VPD

$$\text{VPD} = \text{VP}_{\text{saturated}} - \text{VP}_{\text{air}}$$

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WorldClim & WATCH-WFDEI

$$\text{VP}_{\text{saturated}}(T) = 611 \exp \left(\frac{17.27 T}{T + 273.3} \right)$$

Computing VPD

$$\text{VPD} = \text{VP}_{\text{saturated}} - \text{VP}_{\text{air}}$$

WorldClim

$$\text{VP}_{\text{saturated}}(T) = 611 \exp \left(\frac{17.27 T}{T + 273.3} \right)$$

$$\text{VP}_{\text{air}} = 1.608 q P_{\text{air}}$$

WATCH-WFDEI

Computing VPD

$$\text{VPD} = \text{VP}_{\text{saturated}} - \text{VP}_{\text{air}}$$

WorldClim

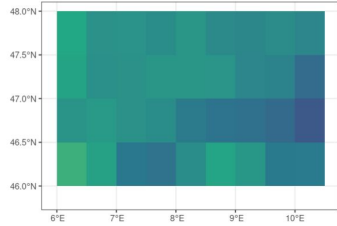
WorldClim & WATCH-WFDEI

$$\text{VP}_{\text{saturated}}(T) = 611 \exp \left(\frac{17.27 T}{T + 273.3} \right)$$

$$\text{VP}_{\text{air}} = 1.608 q P_{\text{air}}$$

WATCH-WFDEI

Data processing



WATCH-WFDEI

Jan 1st 1979

⋮

Jan 31st 1979

⋮

⋮

Jan 1st 2000

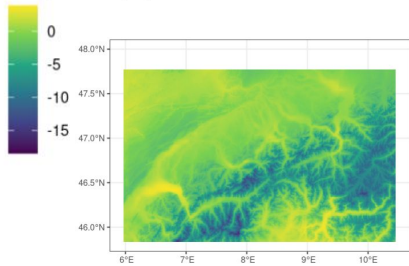
⋮

Jan 31st 2000

WorldClim

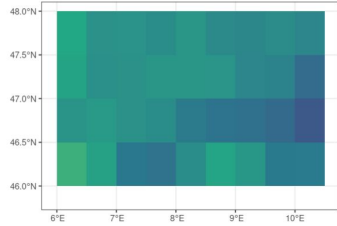
Mean Jan 1970-2000

Temperature (°C)

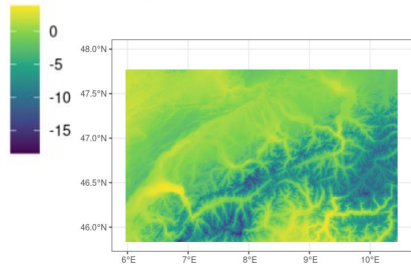


GECO

Data processing



Temperature (°C)



GECO
[Logo]

WATCH-WFDEI

Jan 1st 1979
⋮
Jan 31st 1979
⋮
Jan 1st 2000
⋮
Jan 31st 2000

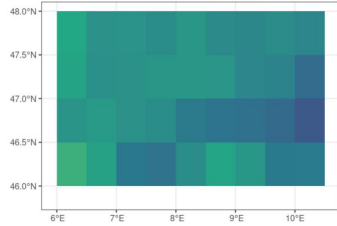
WATCH-WFDEI

Mean Jan 1979-2000

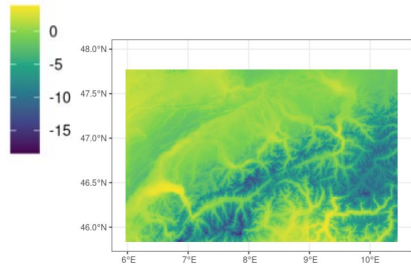
WorldClim

Mean Jan 1970-2000

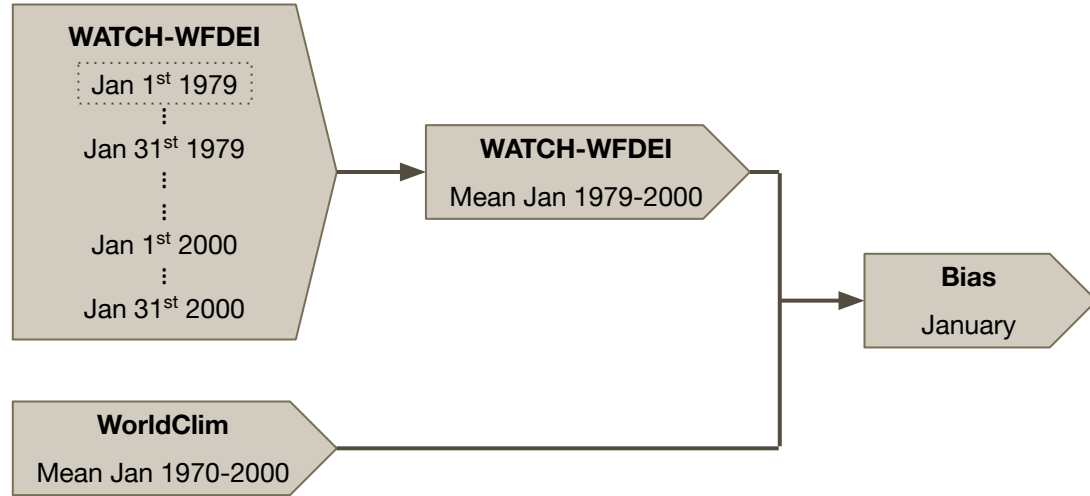
Data processing



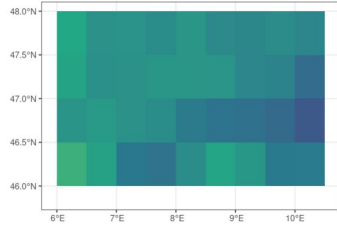
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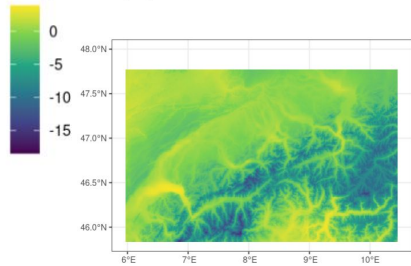
GECO



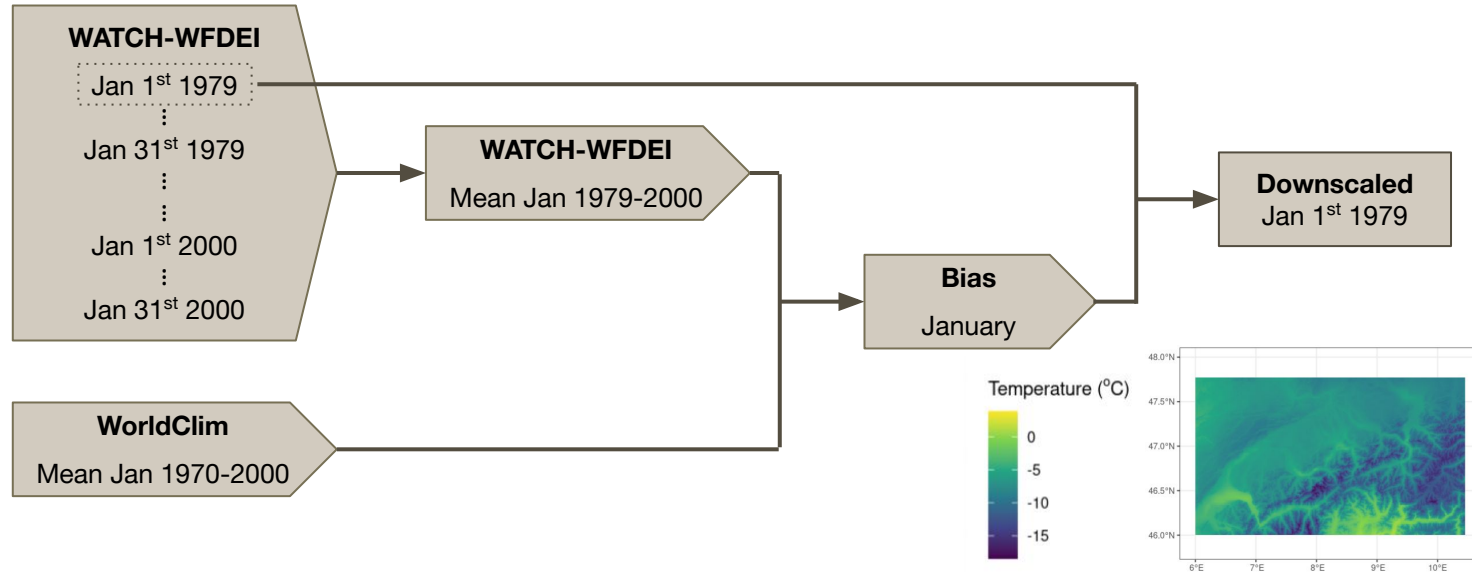
Data processing



Temperature (°C)

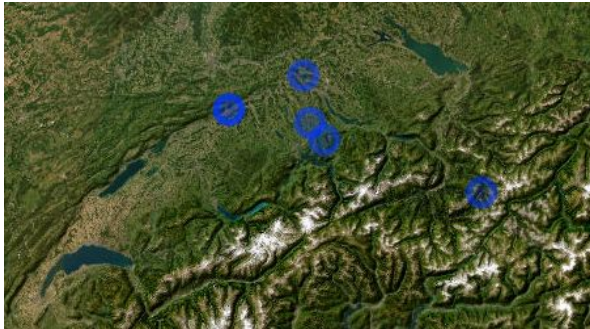


GECO



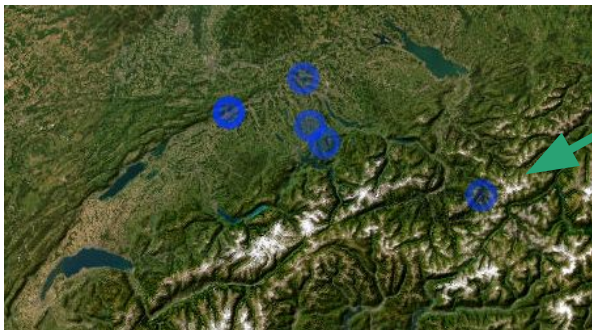
Evaluation

Swiss FLUXNET sites

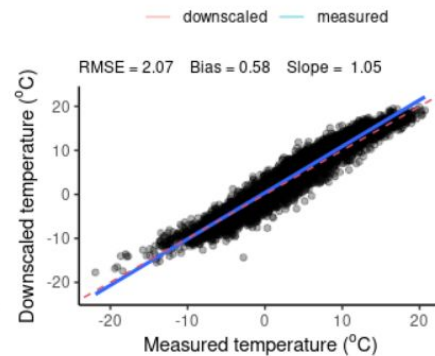
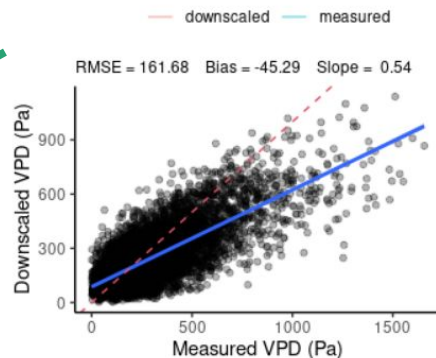
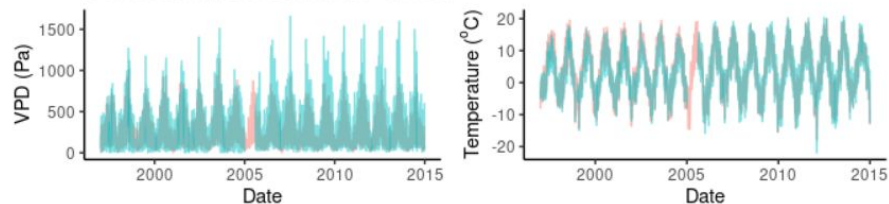


Evaluation

Swiss FLUXNET sites



Downscaling evaluation for CH-Da





Conclusion

- T downscaling is appropriate
- **VPD** downscaling needs improvement
 1. Downscale T , q and P_{air} ; then compute VPD
 2. Use a regression method (on temp, elev...) instead of de-biasing

Implementation

The screenshot shows a GitHub repository page for 'agds_proseminar_example' by user 'pepaaran'. The repository is public and has 1 branch and 0 tags. The main branch is 'main'. The repository contains a table of files and folders, a README.md file, and a .gitignore file. The README.md file contains the title 'Proseminar in Geocomputation and Earth Observation - Example project' and a description of the repository's purpose. The right sidebar contains sections for 'About', 'Releases', 'Packages', and 'Languages'.

pepaaran / agds_proseminar_example

Type to search

<> Code Issues 1 Pull requests Actions Projects Wiki Security Insights Settings

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main 1 branch 0 tags Go to file Add file Code

Pepa Aran Paredes update methods e87eb8 6 minutes ago 62 commits		
R	format improvements	28 minutes ago
analysis	markdowns used for parts of the project implementaion	2 weeks ago
renv	add renv	3 weeks ago
src	add coments	last month
vignettes	format improvements	28 minutes ago
.gitignore	allow knitted report	2 weeks ago
README.md	update methods	6 minutes ago
agds_proseminar_example.Rproj	create Rproj	2 months ago
renv.lock	packages for formatted tables	2 weeks ago

README.md

Proseminar in Geocomputation and Earth Observation - Example project

This repository serves as a project sample for the Proseminar in Geocomputation and Earth Observation.

NOTE: Throughout the proposal, report and slides, there will be notes like this one indicating instructions and tips for your project implementation. You don't need to include such notes in your submission.

About

This repository serves as a project sample for the Proseminar in Geocomputation and Earth Observation

geco-bern.github.io/agds_proseminar/

Readme Activity 0 stars 1 watching 0 forks

Releases

No releases published
[Create a new release](#)

Packages

No packages published
[Publish your first package](#)

Languages

HTML 95.2% R 4.0% Other 0.8%

Repository structure

Spatial downscaling of meteorological variables

Repository structure

All of the code necessary to reproduce the results in this project is available in the repository. Public datasets downloaded from the web are kept separately because of their size.

```
| README.md          <- The top-level README includes instructions to use this repository and the project proposal for the AGDS Proseminar
|
| agds_proseminar_example.Rproj  <- R project file
|
| renv.lock           <- file to keep package versions for reproducibility
|
| data-raw/           <- folder for data downloaded from the web, unprocessed (this folder is never pushed, see .gitignore)
|   |
|   | wfdei_weedon_2014/
|   | worldclim_fick_2017/
|   | fluxnet_pastorello_2020/
|
| data                <- folder for data produced by the repository
|
| analysis            <- R markdown scripts used for the development of the report, includes intermediate data analyses
|
| vignettes           <- R markdown files
|   | report.Rmd      <- main file containing the submitted report
|   | slides.Rmd      <- file creating presentation slides
|   | references.bib   <- bibliography file
|
| src                 <- bash code for this project, contains scripts for data download
|
| R                   <- R functions used in the project, contains one function per script
```


Repository structure

Project proposal

Report

Spatial downscaling of meteorological variables

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Questions?
