Beyond the usual suspects P&T

Deriving multivariate high-resolution transient forcings for land surface models

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EU Interreg V-A project EFA210/16 **PIRAGUA**

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Availability of downscaled projections

Variables × spatial domain

Variables

- Usual focus on P & T, possibly Tx & Tn
- Relative humidity, wind speed, visible and infrared radiation not always available

Spatial domains

- Usual focus of statistically downscaled/bias-corrected projections on specific domains (e.g. country)
- Coherence issue across regions

Issue for running land surface models offline

- Deriving high-resolution projections for transboundary basins

Case study: basins draining the Pyrenees

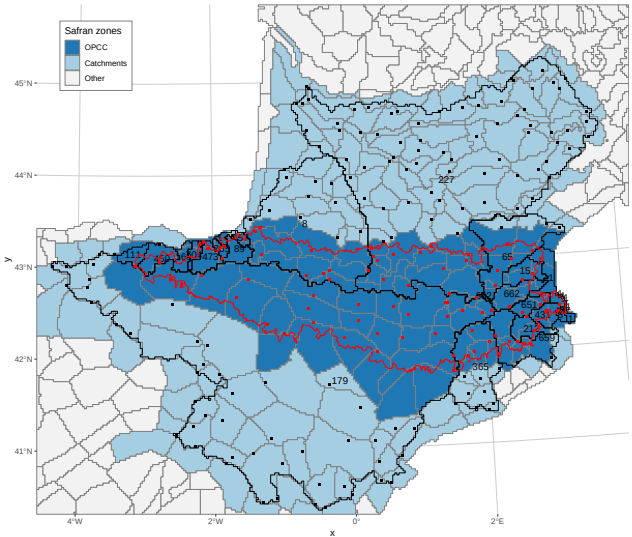
PIRAGUA project: Evolution of water resources in the Pyrenees

Reanalysis

- **Safran-PIRAGUA** 2.5-km surface reanalysis as a merging of Safran-France (Vidal et al., 2010) and Safran-Spain (Quintana-Seguí et al., 2017)
- All variables
- Whole hydrological domain

Projections

- Statistically downscaled projections from CMIP5 GCMs under RCP4.5 and RCP8.5 (Amblar-Francés et al., 2020)
- P, Tn, Tx only
- Pyrenees only on a 5-km grid



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Analogue resampling

Extension of the work by Clemins et al. (2019)

Analogy

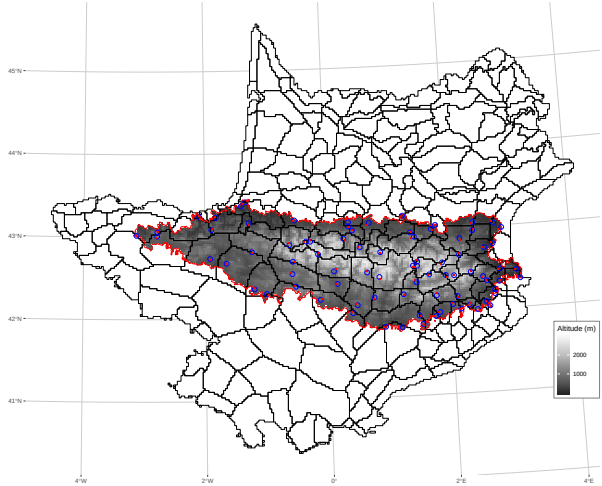
- 83 grid cells over the Pyrenees (one per climatically homogeneous zone)
- (P, Tn, Tx) ; weights: (2,1,1)
- **Daily standardized anomalies** wrt 1961-2005 monthly climatology

Archive

- Safran-PIRAGUA reanalysis 1961-2005

Hypothesis

- Analogue dates for (P,Tn,Tx) are also valid for other variables



Dealing with larger domain and T changes

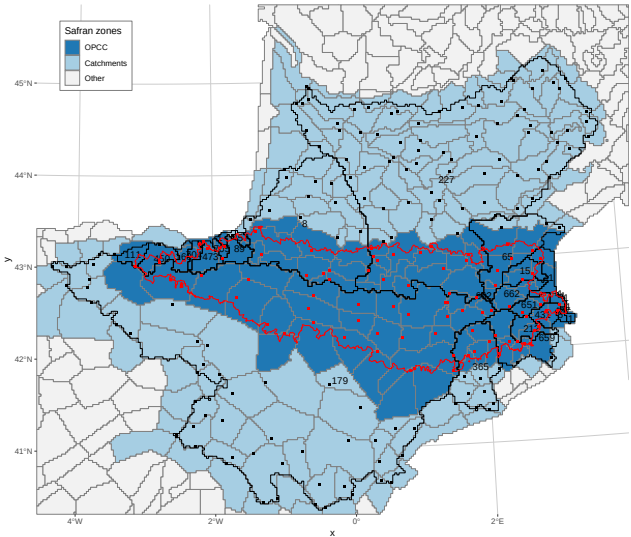
Greater Pyrenean Region (GPR)

Target on a larger domain

- Hypothesis: analogue dates are valid for the whole GPR

Future T values larger than historical maxima

- Linearly transient **Tn** and **Tx** baseline climatology from 2006 onwards in projections
- Regional average trend over the Pyrenees
- To add to resampled variables from analogue dates



Dealing with changes on other variables

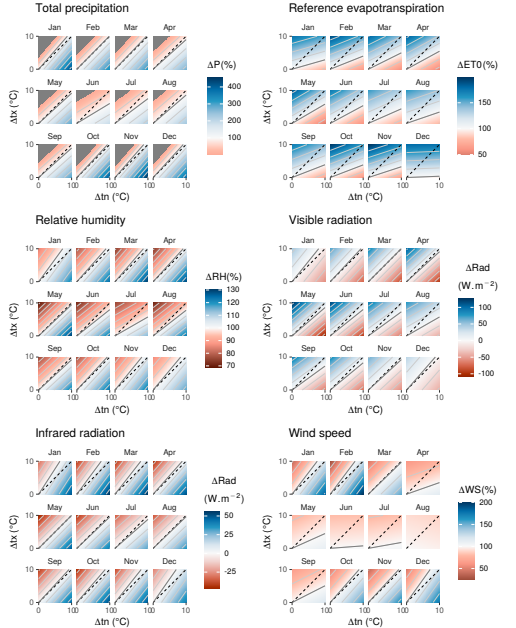
With reference to changes in T

Relationship between (Tn,Tx) anomalies and (PR,RH,LW,SW,WS) anomalies

- Calibrated within the Safran-PIRAGUA reanalysis
- Hypothesis: linear relationship for each month

Application along the 21st century

- Hypothesis: relationships hold in the future with a higher temperature baseline



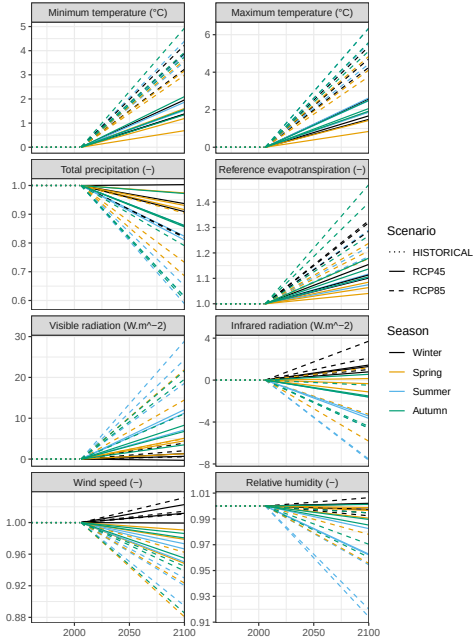
Transient baseline climatology

Example of CNRM-CM5

Aggregated by season

- Decrease in total precipitation
- Decrease in relative humidity
- Decrease in wind speed
- Increase in visible radiation

Higher changes under RCP8.5

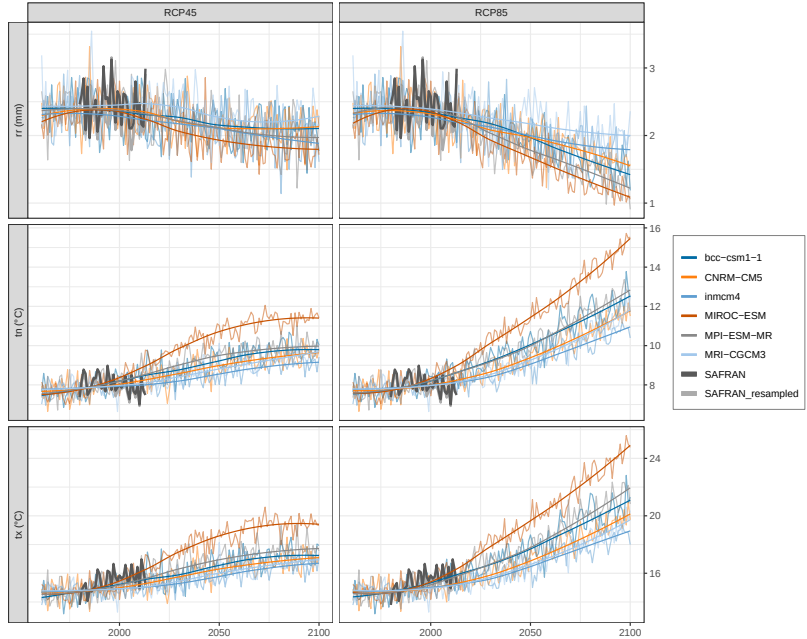


Pyrenees

Resampled projections

Effects of resampling

- Non linear projections
- Bias-correction with respect to Safran-PIRAGUA
- Year-to-year variability

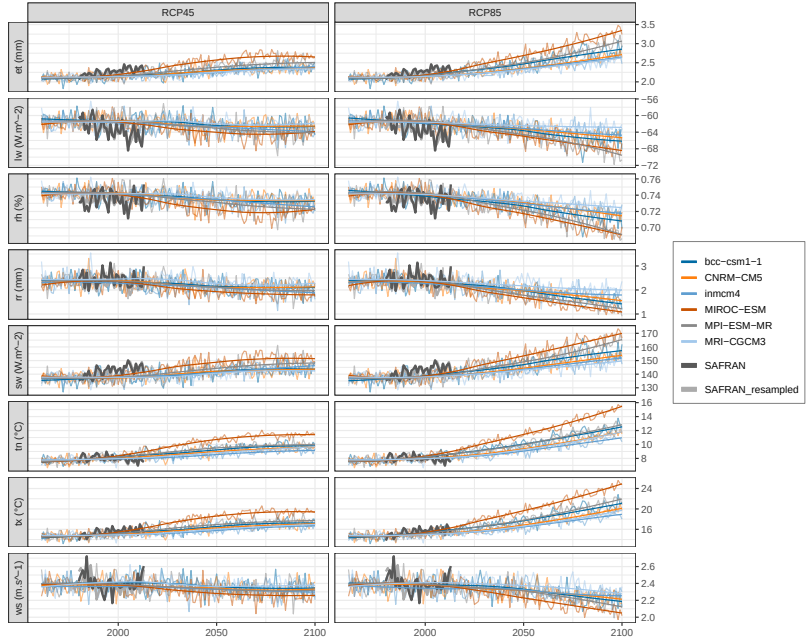


Pyrenees

Resampled projections

Effects of resampling

- All required variables!



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Thank you for your attention!

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