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Towards the identification of climate information needs for building socio-ecological trajectories in alpine valleys

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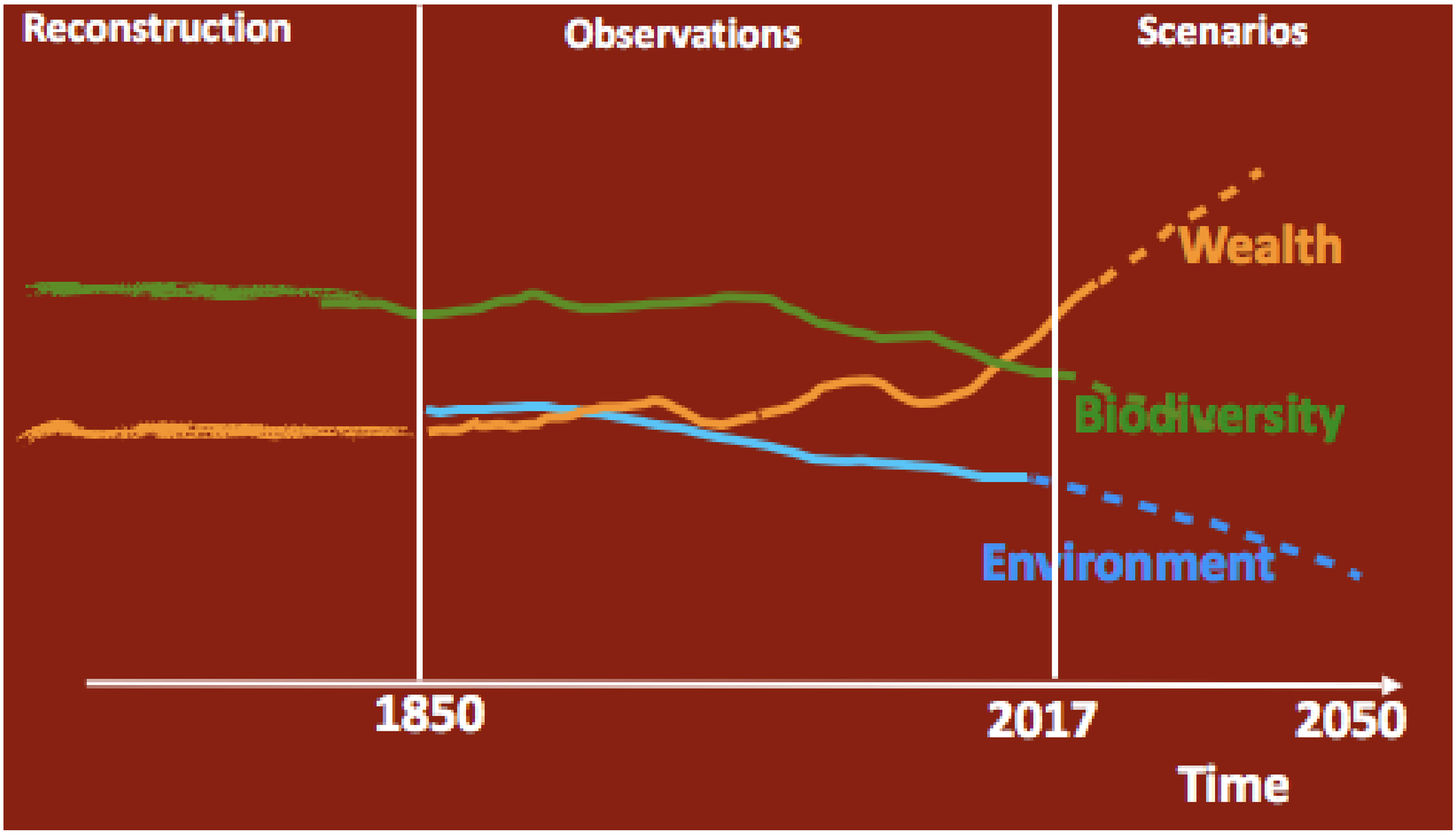
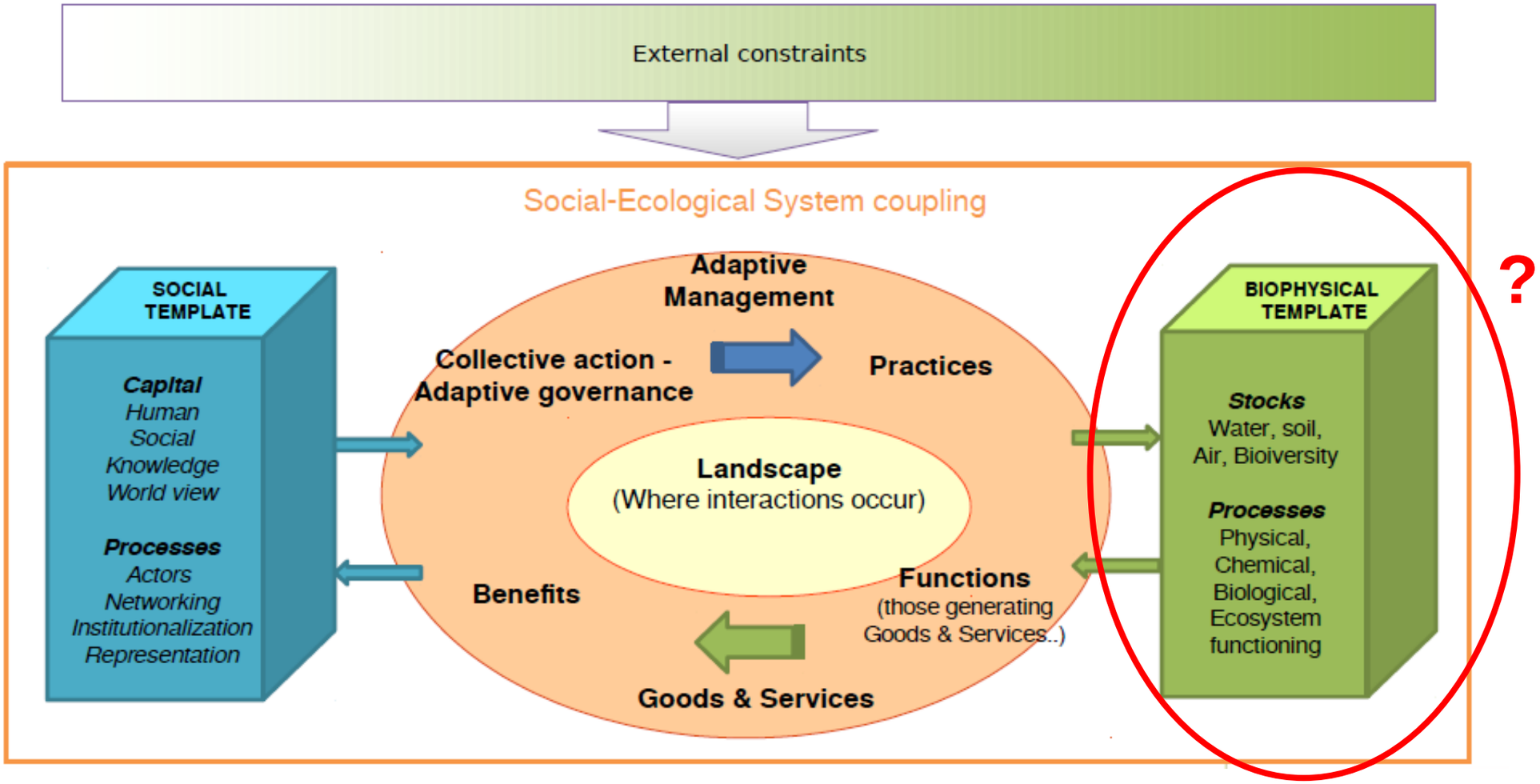
IGE

A project anchored in interdisciplinary



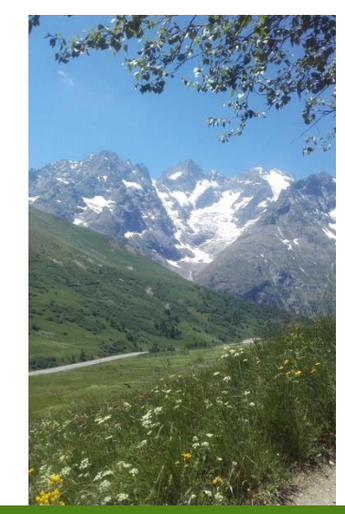
For three Alpine valleys

A project for a better Socio-ecocological system understanding



Arve

Maurienne



Pays de la Meije

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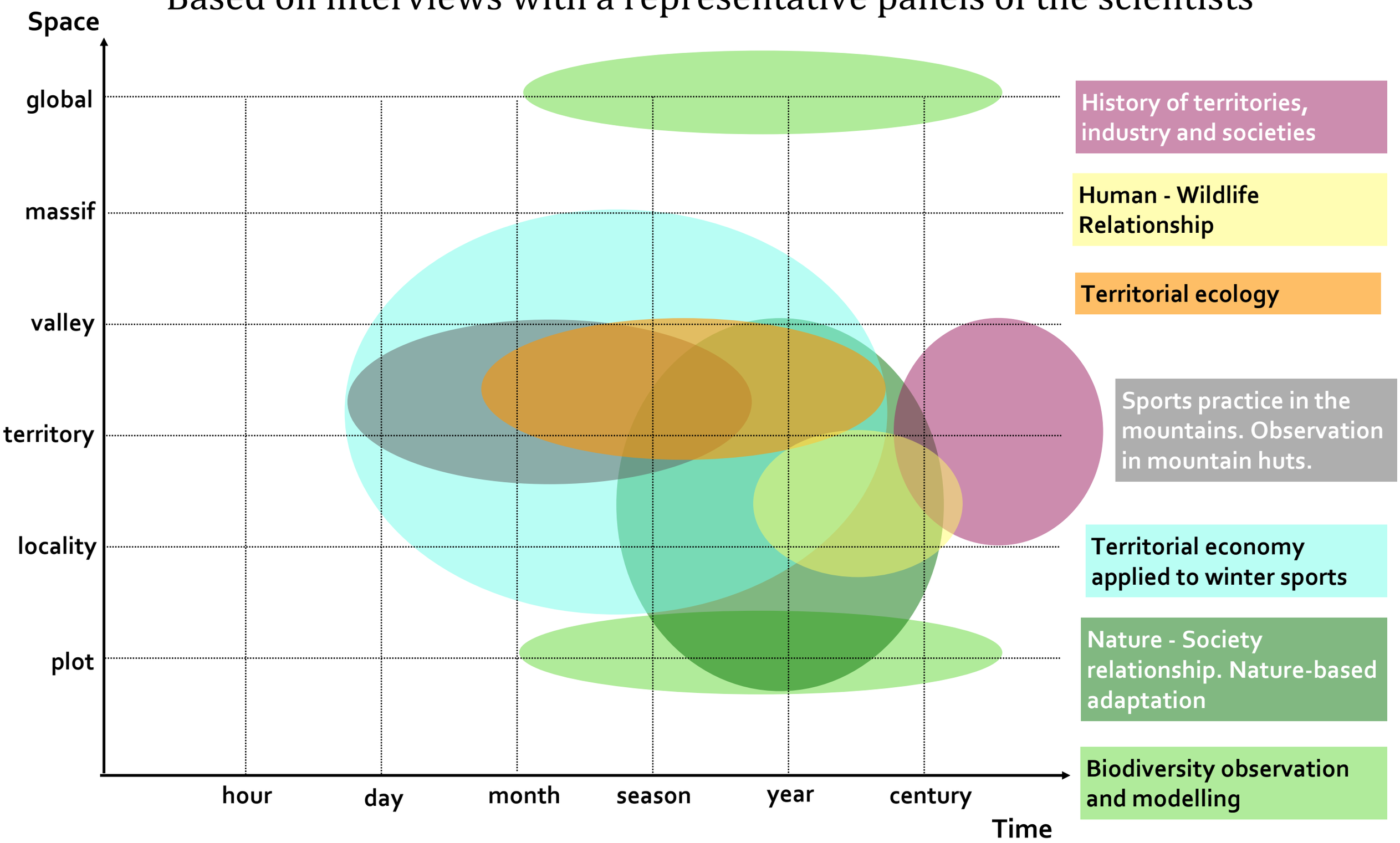
Spatio-temporal Scales of the fields of studies

Based on interviews with a representative panels of the scientists



Climate « objects » linked to thefields of study

History of territories, industry and societies	**Climatic accidents** (poor harvests (*drought*); *floods*).
Human - Wildlife Relationship	**Drought; Shifting seasons ; Exceptional years** (temperature, precipitation; snow extremes (min and max) ; number of frost days)
Territorial ecology	**Water resources** (for domestic; hydro-electricity) ; **Drought** (for fodder production).
Sports practice in the mountains. Sentinel shelter	**Seasonal and Daily weather conditions**; **Night frost**; altitude of the 0°C isothermal; **Glacier retreat** ; **Glacial hasard** ; **Rock falls** (permafrost).
Territorial economy applied to winter sports	**Duration and quantity of snow cover ; weather conditions for the production of artificial snow; summer season duration**.
Nature - Society relationship. Nature-based adaptation strategy	**Degree-day** for plant growth **; Potential Evapo-transpiration** ; **snow depth** ; **Daily precipitation accumulation** (liquid and solid) ; **number of frost days**.
Biodiversity observation and modelling	**Ground temperature; Degree-day for plants growth** ; **Potential Evapo-transpiration** ; **snow depth** ; **Daily precipitation accumulation** (liquid and solid) ; **number of frost days; Glacial retreat**.

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Variables associated with the climate « objects » required for the fields of study

Water resources	**Precipitation accumulation** (month; season; year); **Rain-snow limit** ; **Mean Relative humidity** (month; season; year); **Mean daily** (Tmax-Tmin) (month; season) ; **Mean ETP** (month; season; year); **Water deficit** (Precipitation-ETP) (month; season; year)
Drought	**Number of no-precipitation days** (season; year); **Precipitation accumulation** (2, 4, 6, 8-day; month; season; year) ; **mean temperature** (month; year) ; **Mean daily** (Tmax-Tmin) (month; season) ; **Mean ETP** (month; season; year); **Water deficit** (Precipitation-ETP) (month; season; year)
Fodder production	**Precipitation accumulation** (month; season; year) ; **mean temperature** (month) ; **Soil moisture**; **Wind**; **Growing Degree Day**; **Mean ETP** (month; season; year); **Water deficit** (Precipitation-ETP) (month; season; year);
Glacial retreat	**Glacier mass balance** (season, year) ; **mean temperature** (day; season; year) ; **Solar radiation** (daily); **Wind** (daily); **cloudiness** (daily)
Ski resort sustainability	**Snow depth** (m); **Snow cover duration** (day); **Number of snowing days**; **Rain-snow limit**; **Number of days where -5°C<T<5°C** ; **Wind** (max); **Mean temperature** (day; month); **10<RH<50%**
Daily weather conditions	**Temperature**; **Precipitation**; **night frost**; **altitude of the 0°C isothermal**; **snow depth**; **wind**; **Solar radiation**
Floods	**Precipitation accumulation** (day; month); **Rain-snow limit**; **soil moisture**; **ETP**; **discharge**
Shifting seasons	**Mean Temperature** (month); **Mean precipitation accumulation** (month); **mean solar radiation** (month)
Sate of the biodiversity	**Mean ground temperature** (month); **Mean soil moisture** (month); **Mean air temperature** (month); **Degree-day for plant growth** (year); **Potential Evapo-transpiration** (month; year); **snow cover duration** ; **Daily precipitation accumulation** (liquid and solid) ; **Glacial retreat** (year)

Main challenges

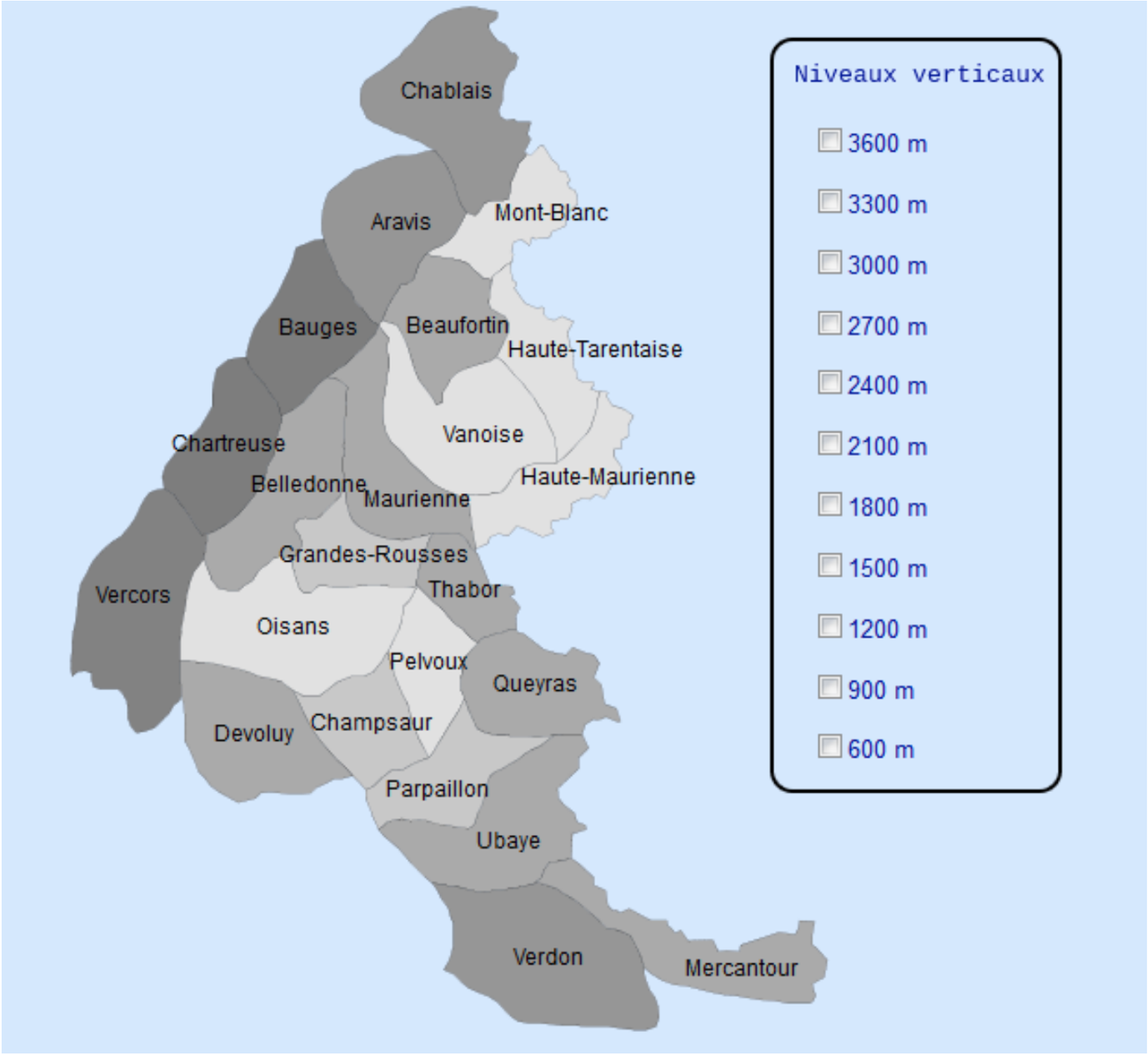
1/ To have the data set at the right T-S scales

2/ To be able to compute or to extract the relevant variable for a given time window associated with the modelling purposes

Model implementation	Scenario
Model evaluation	Projection
Process understanding	Pathway identification

Past **Present** **Future**

A few examples based on ADAMONT* data set



23 massifs
300m altitude bands
1950 - 2100

Verfaillie, D., Déqué, M., Morin, S., and Lafaysse, M.: The method ADAMONT v1.0 for statistical adjustment of climate projections applicable to energy balance land surface models, Geosci. Model Dev., 10, 4257-4283, https://doi.org/10.5194/gmd-10-4257-2017, 2017.

* downscaled/adjusted EUROCORDEX data for the French Alpes, available online on the Drias climate services portal. http://www.drias-climat.fr/

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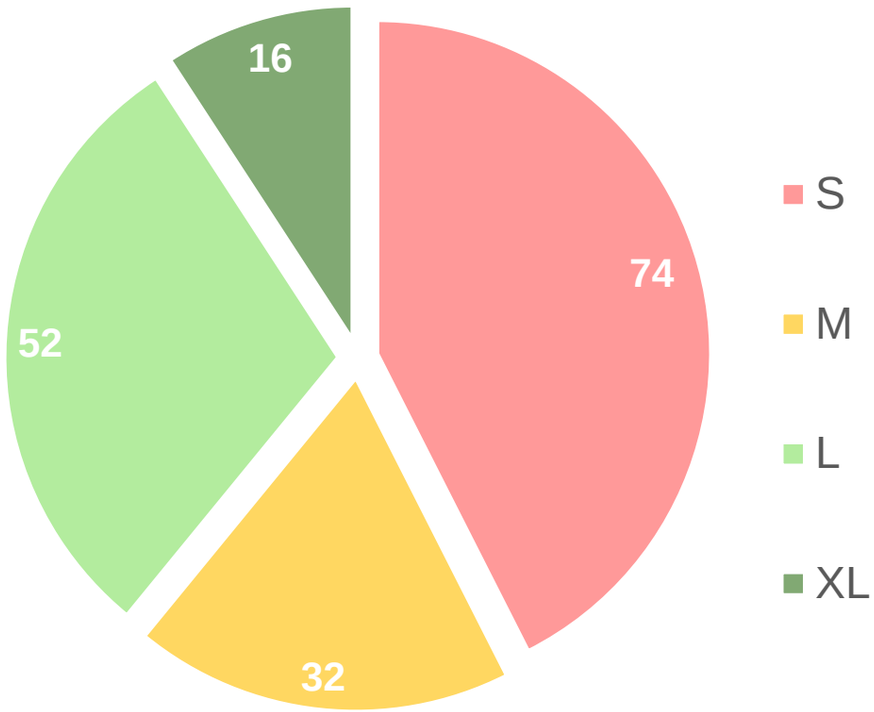
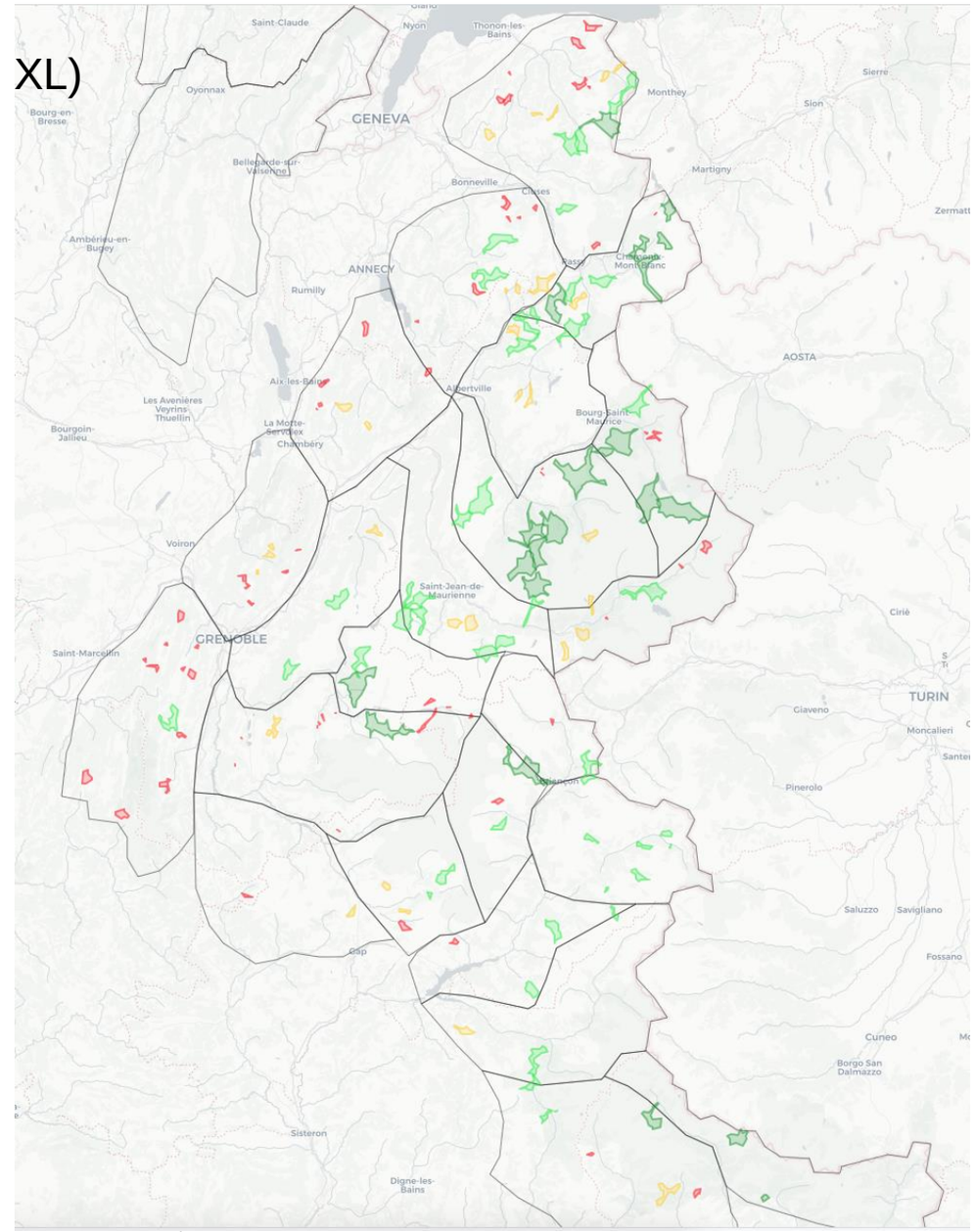
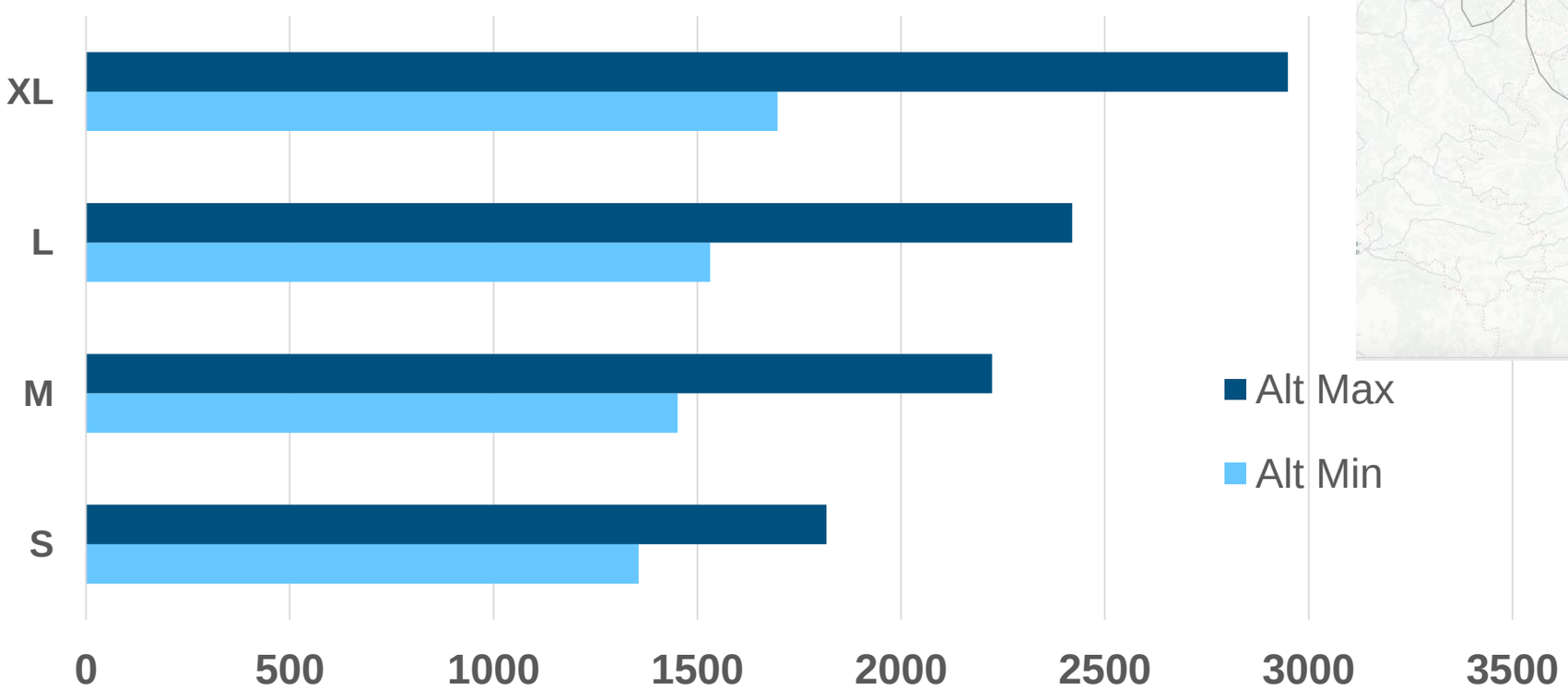
Sustainaibility of the ski resorts under climate evolution

174 ski resorts in the French Alps, distributed with 4 class types (S, M, L, XL)







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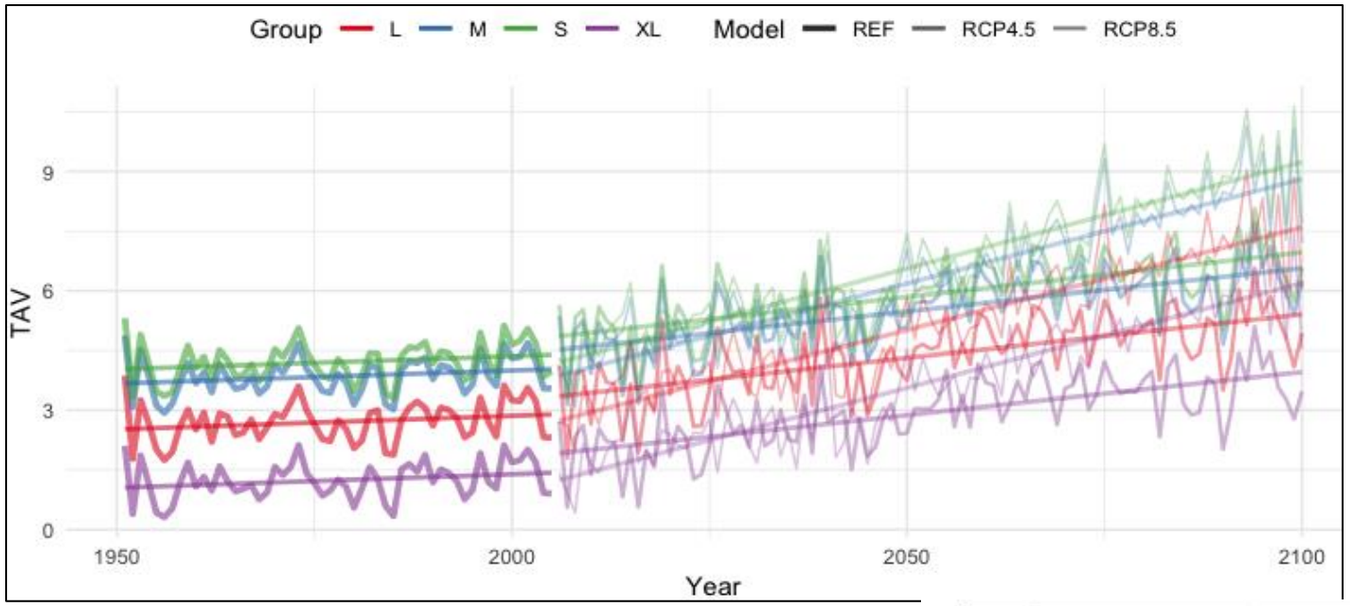
Sustainability of the ski resorts under climate evolution

The indicator is calculated with the ADAMONT dataset.

Average temperature …



… at all the ski resorts

S

M

L

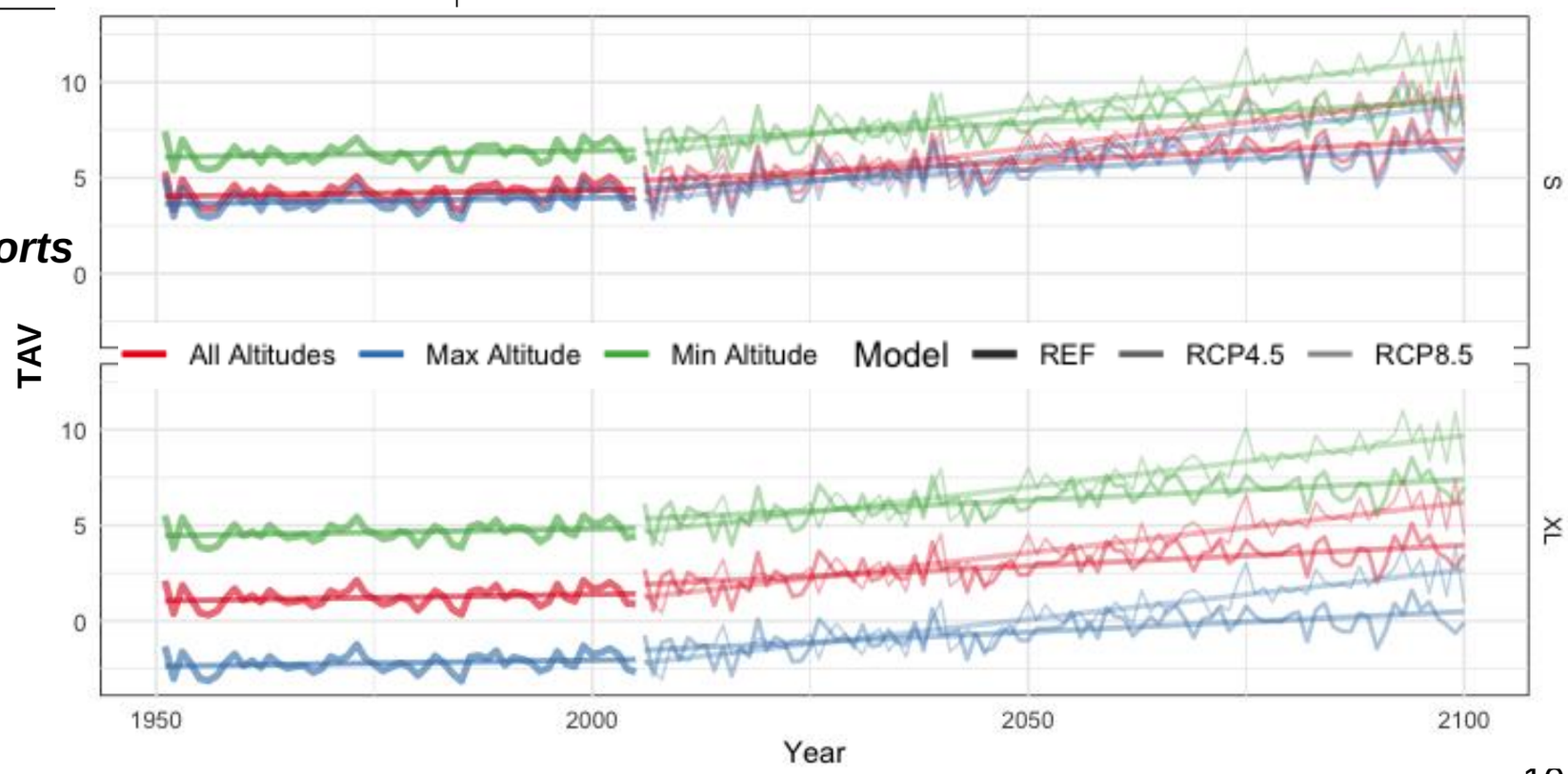
XL

… at a given altitude for S and XL ski resorts

Min Altitude

Max Altitude

Integrated on the ski resort area



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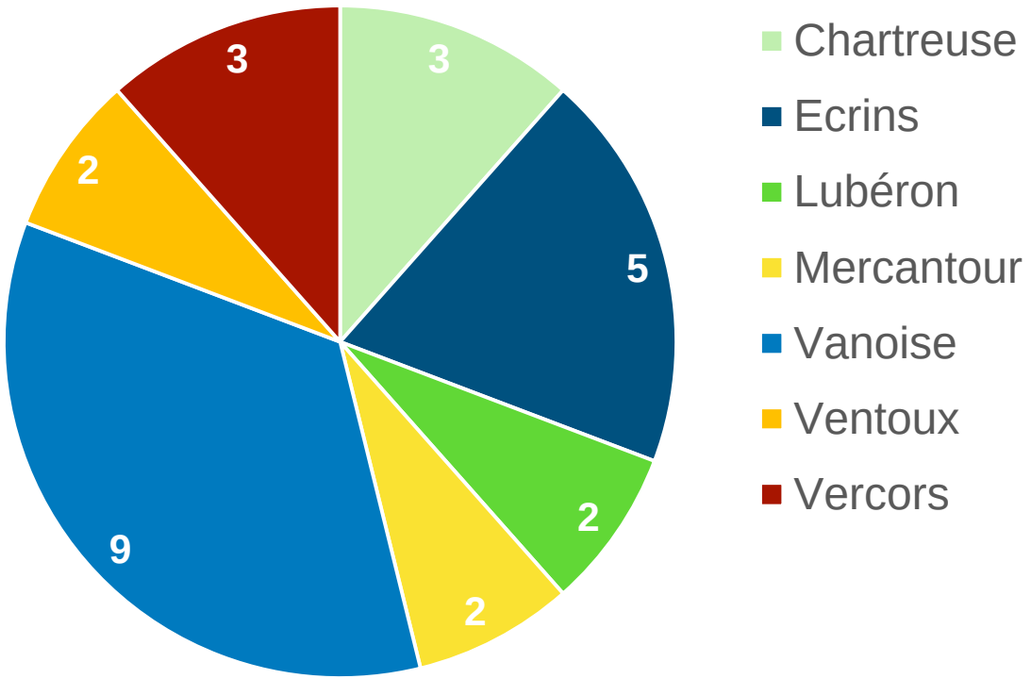
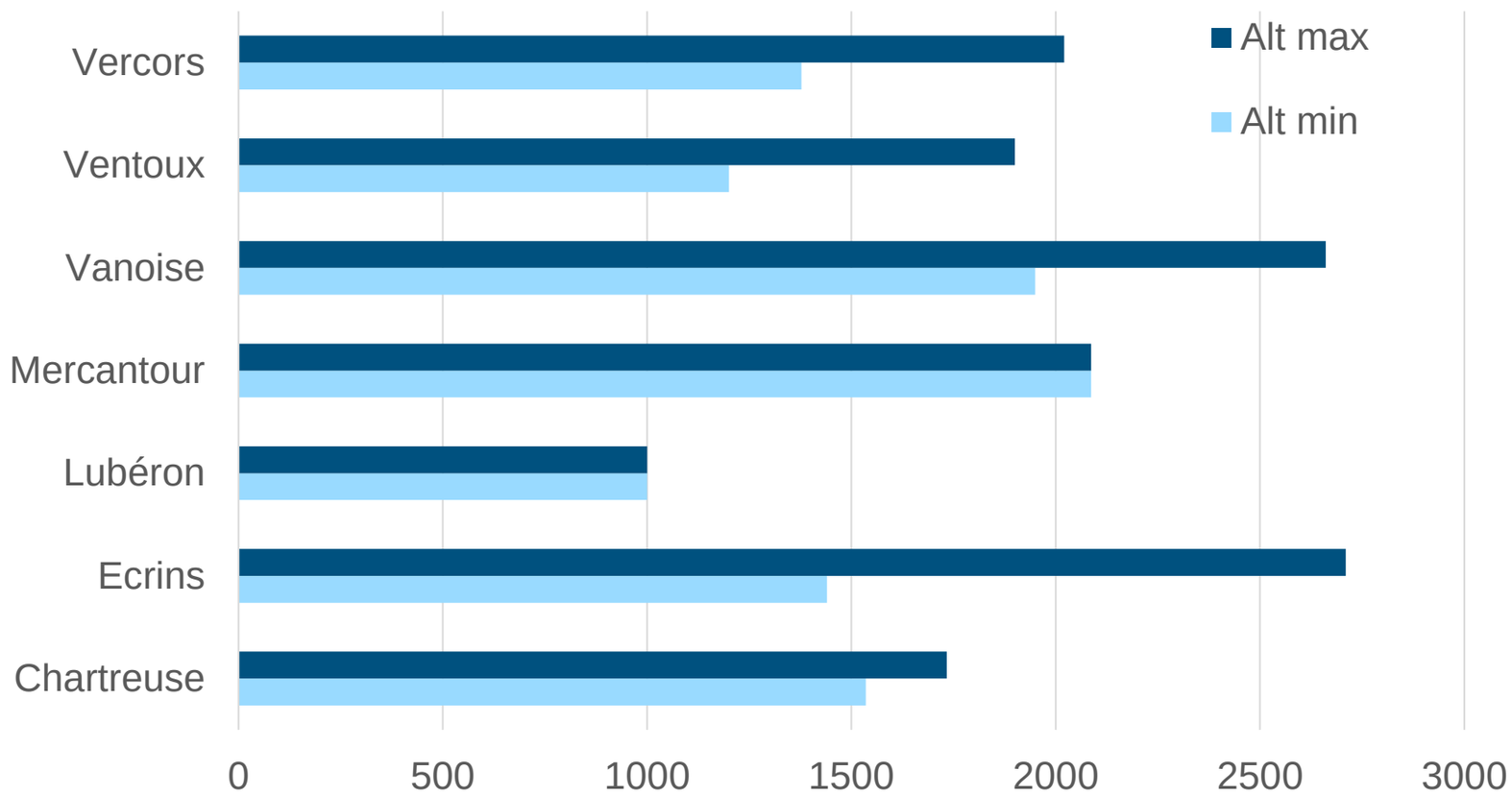
Biodiversity evolution under climate change



26 alpine pastures in the Alpine space, distributed with 7 different massifs



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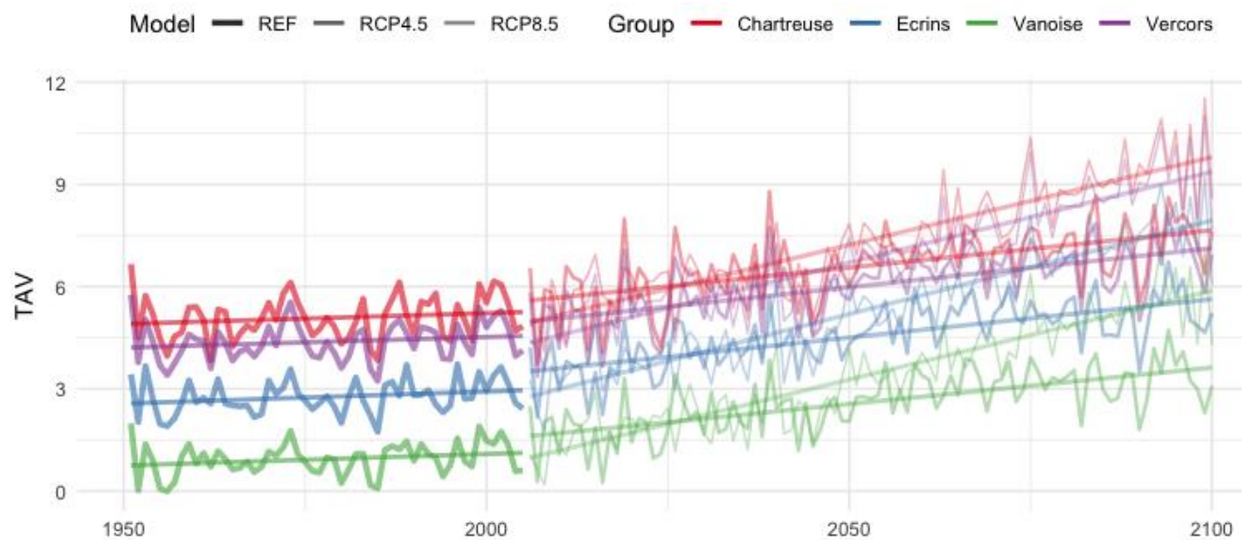
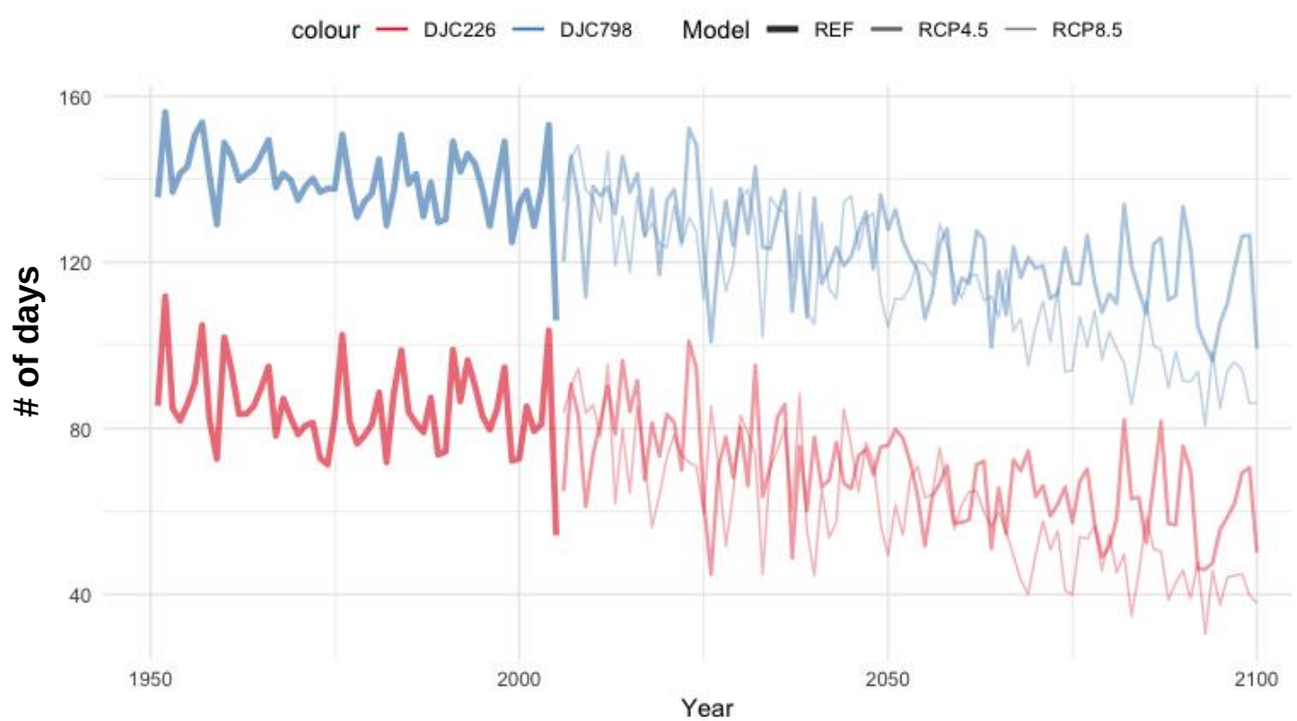
Biodiversity evolution under climate change

The indicator is calculated with the ADAMONT dataset.

Average temperature at the pastures in the different massifs



Degree-day for plant growth at a given pasture



Trisetum flavescens
798°

Sesleria caerulea
226°

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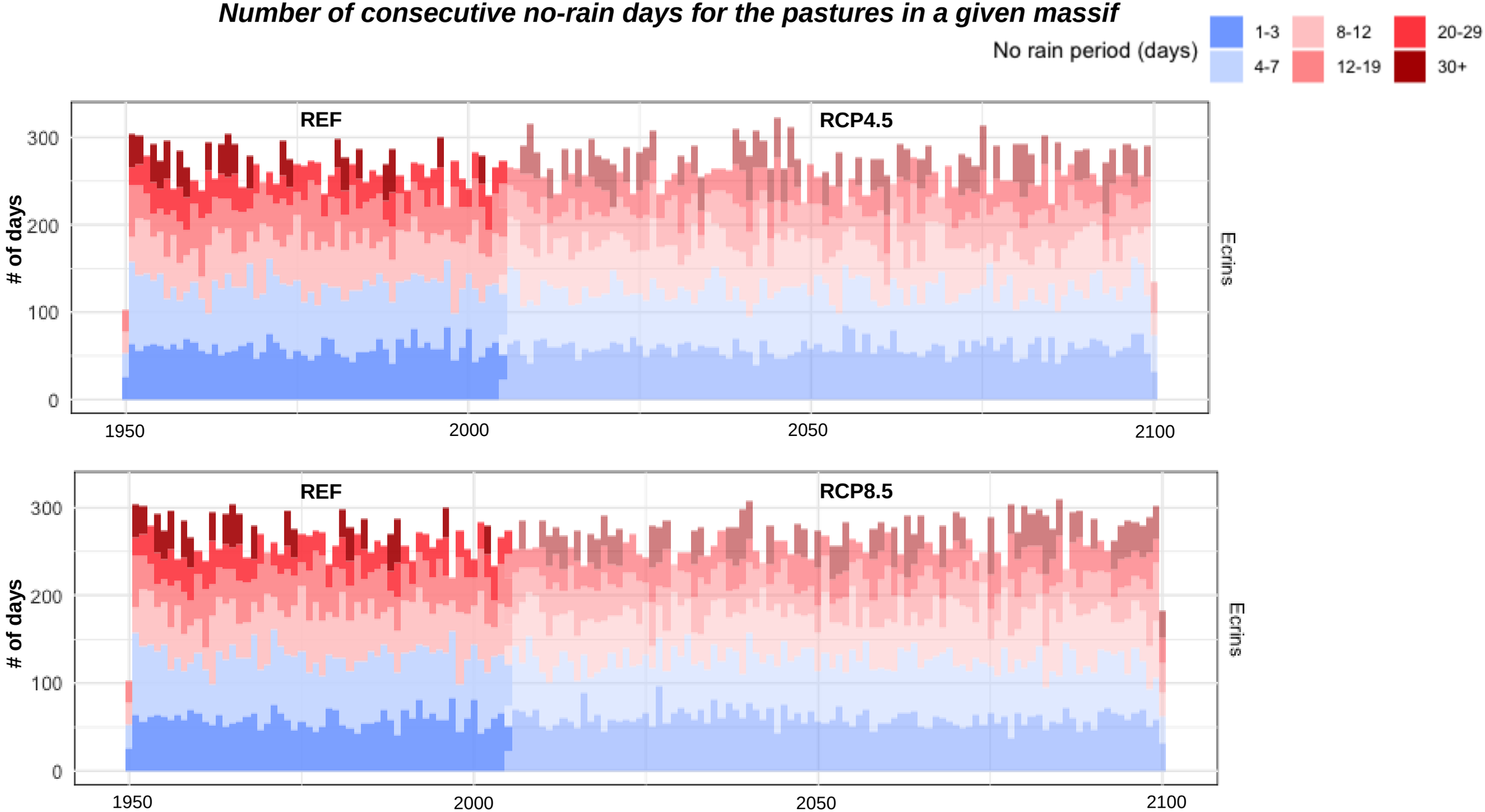
Number of consecutive no-rain days for the pastures in a given massif