Evolution of the wet snow hazard for the electricity network in Corsica in 2050

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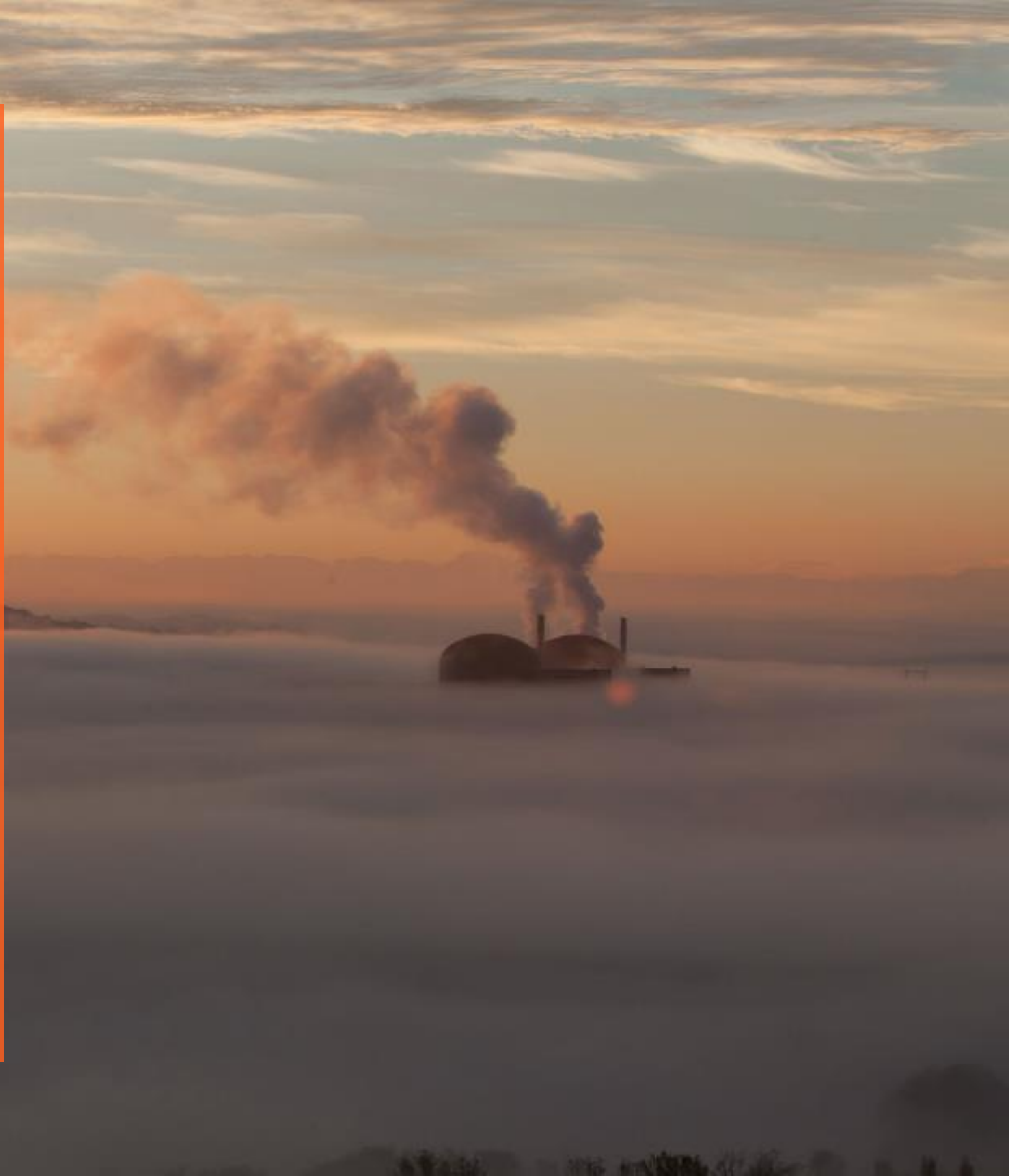


Wet snow and electrical network

- Wet snow is a hazard impacting overhead lines in winter when:
  - A quite large amount of snow falls
  - While temperature is around 0°C => the liquid content of the snow is high
  - Under windy (but not too much) conditions
- This creates overloads on the wires:
  - Snow freezes when hitting the wire (once the wire temperature is lower than 0°C)
  - The overload induces a rotation of the wire, creating an overload which can cause the ruin of the line
- Forecasts are made in winter, and teams are prepared to fix the damaged sections if needed

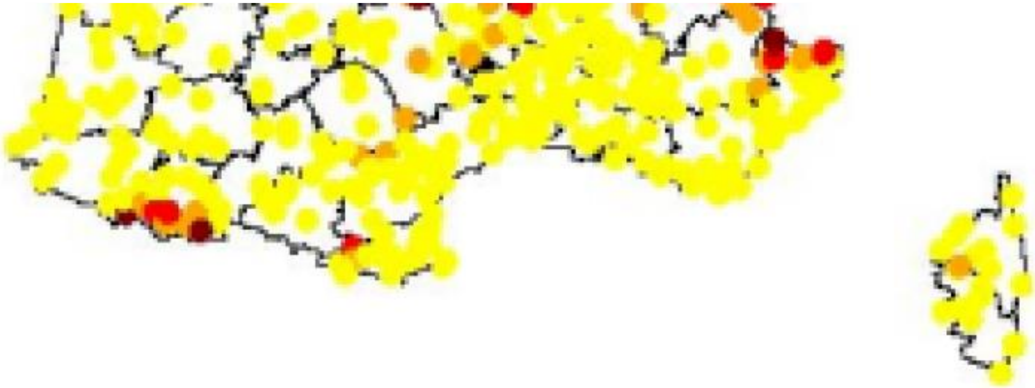
Data and hazard identification

- Data used
  - EOBS 0.1° dataset 1950-2021: daily minimum and maximum temperature, daily rainfall amount
  - Climate projections: 13 CMIP6 models available at EDF/R&D (through our internal climate service) for which Tmin, Tmax, precip were available at the time of the study for the historical period and SSP1-2.6,SSP2-4.5,SSP3-7.0 et SSP5-8.5
  - Historical reference period: 1995-2014, future period 2041-2060, according to the last IPCC report
- How to identify wet snow events?
  - Design of an « ad hoc » criterium in previous studies, based on comparison with detailed weather data and damage reporting

-4°C ≤ Tmin ≤ 0,5°C	AND	-0,5°C ≤ Tmax ≤ 5°C	AND	Precip ≥ 10mm

=> Days when the weather conditions are prone to wet snow events

Observations: Comparison to the previous study



Previous study for the period 1984-2001

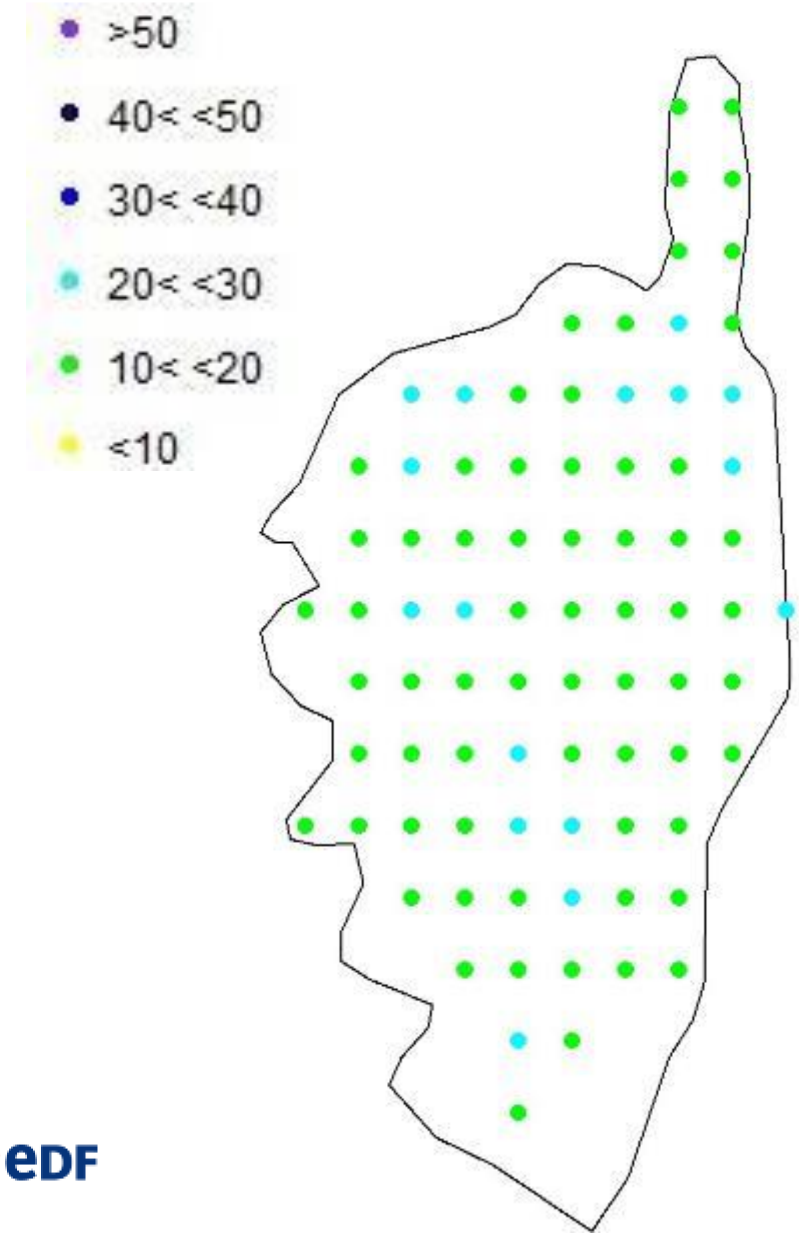
Yellow: <2 events per year on average

Orange : 2< <4

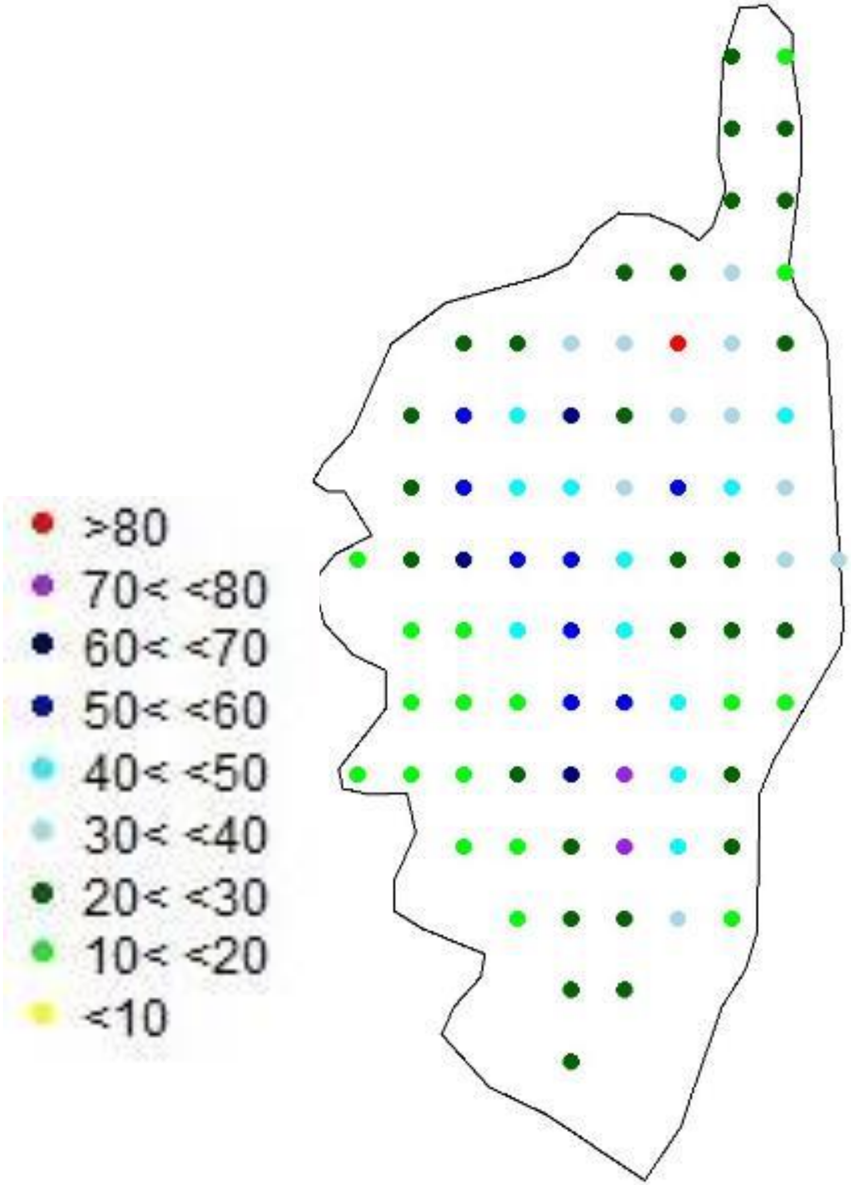
Average number of events per year

Observations: rainfall amount during the events

mean rainfall amount



maximum rainfall amount per event



Historical period

- Downscaling / bias adjustment of climate projections
  - Statistical method CDFt: 1 climate model grid point downscaled on all E-OBS nearest points
- Average number of events
  - 13 maps (one for each model) compared to the map obtained with observations
  - Computation of the correlations between each model map and the observation-based map with a significance test
  - Good correlations for all models, all significant at the 95% confidence level
- Associated rainfall amounts
  - In the same way: correlations with observation-based map: better results for the maximum rainfall amounts than for the average amount
  - Average amount quite uniforms across the territory => small geographical differences downgrades the correlation level

Future risk

- Non-parametric test for assessing the significance of the projected changes
  - For each grid point and each projection: merge historical values with the projected ones
  - Compute the mean for each period separately (historical / future)
  - Then repeat a large number of times (5000) the following steps:
    - Randomly mix both series of values in order to mix historical and future values
    - Create 2 samples of the same length as the historical and projection samples
    - Compute the mean for each of these new samples (randomly mixing historical and projection results)
  - We then get a distribution of differences between randomly composed sample means
  - If the difference between historical and projection means lies inside the obtained distribution, then the difference is not significant, otherwise, it is
- The testing procedure has been applied to the average number of events and to the maximum rainfall amount per event
  - Difference maps: only the significant differences are plotted

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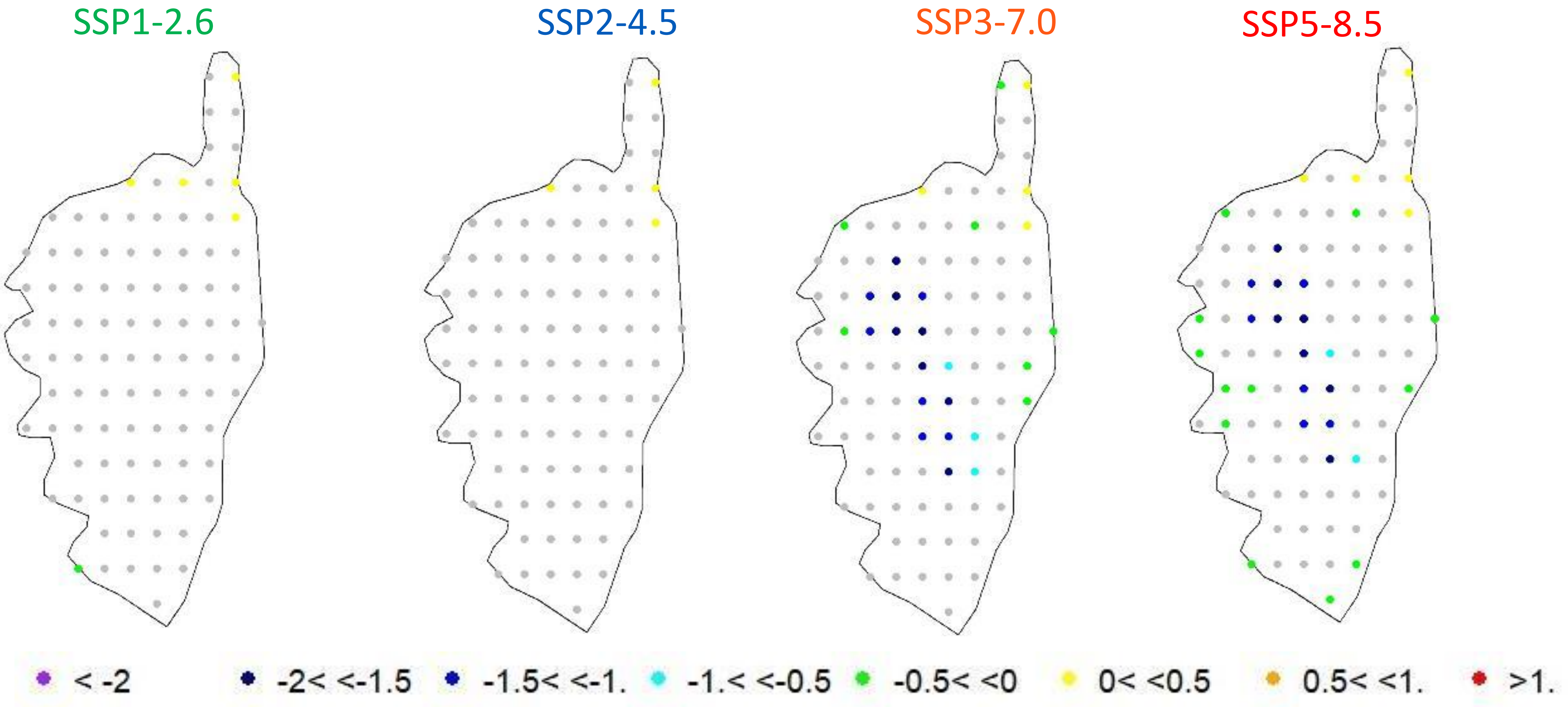
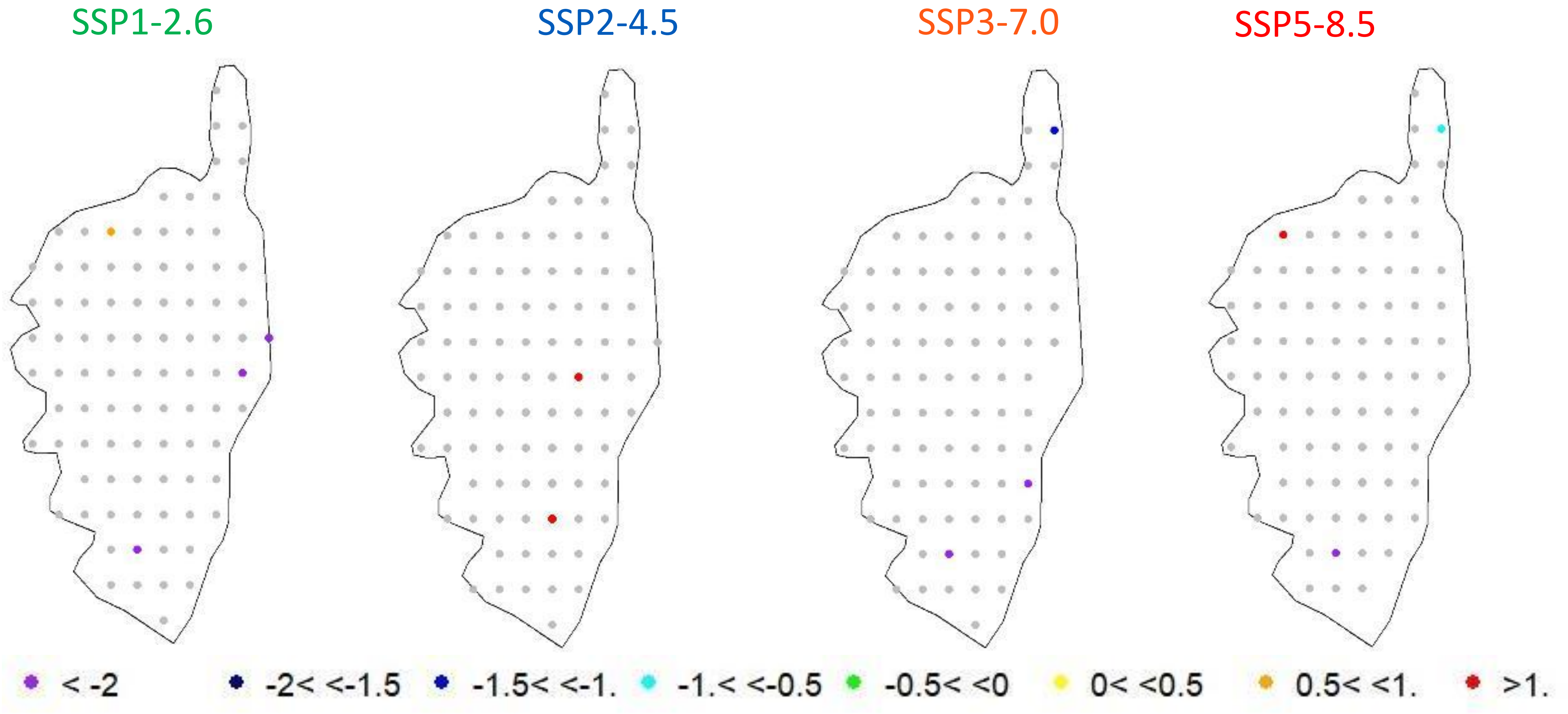
AVERAGE NUMBER OF EVENTS



Grey : non significant

MAXIMUM RAINFALL AMOUNT



Grey : non significant

Summary

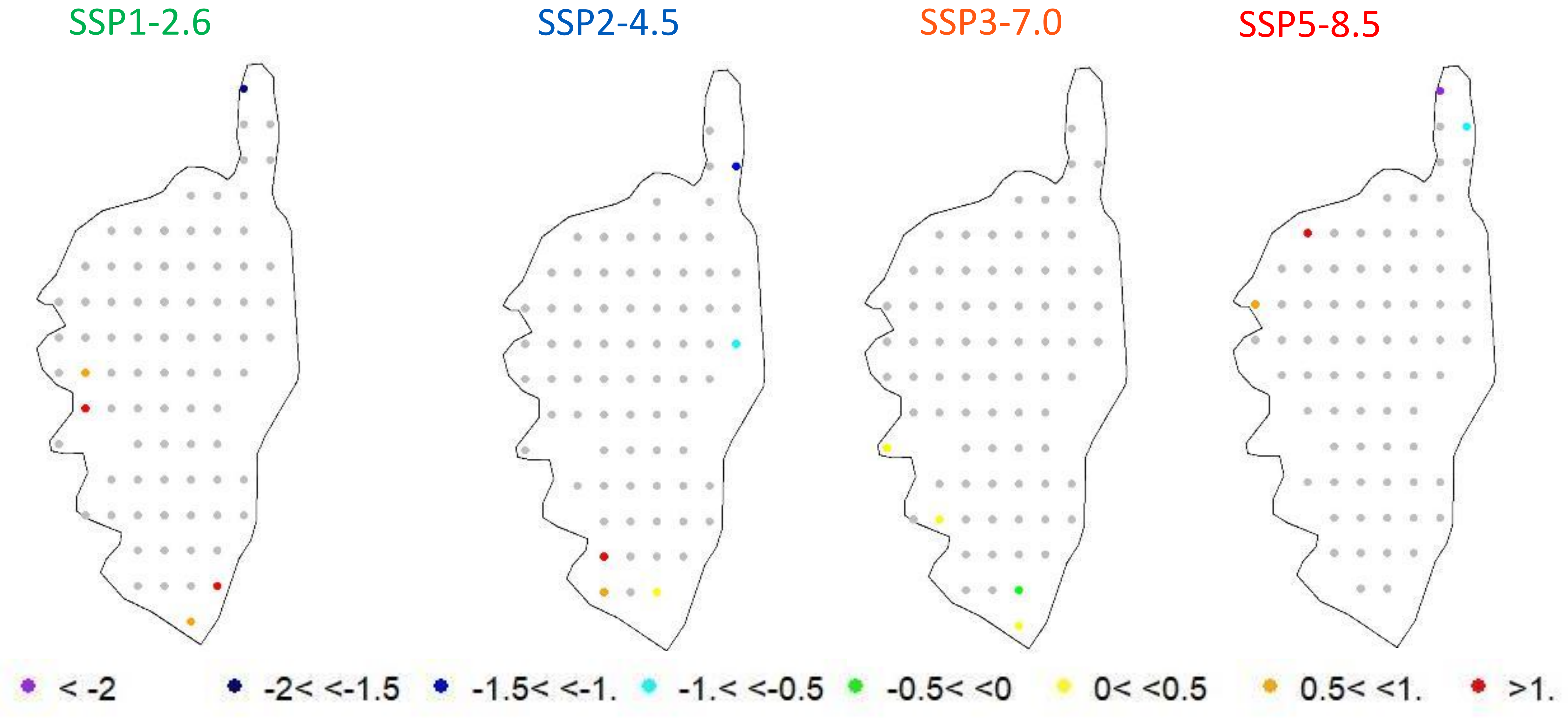
- Selection of days when weather conditions are prone to wet snow events
  - From the observations E-OBS 0.1° over the period1995-2014
  - From 13 climate model projections
    - For the historical period 1995-2014
    - For the future 2041-2060, with 4 scenarios SSP1-2.6, SSP2-4.5, SSP3-7.0 et SSP5-8.5
- Mean number of days per year
  - Good model performance
  - Significant decrease with scenarios SSP3-7.0 et SSP5-8.5
  - No change with scenarios SSP1-2.6 and SSP2-4.5, temperature increase causes changes from dry snow to wet snow
- Associated rainfall amount
  - Better performance of the models for the maximum than for the average, however lower than for the mean number of days
  - Very few significant changes


Thanks

MODEL PERFORMANCES

Model	Average number		Average rainfall amount		Maximum rainfall amount	
	Correlation	**p-value**	**Correlation**	**p-value**	**Correlation**	**p-value**
ACCESS-ESM1-5	0.7912827	7.421525e-27	0.1567308	0.06494863	0.4226978	6.476524e-07
AWI-CM-1-1-MR	0.7463606	7.951427e-22	0.07446809	0.4627629	0.4081633	4.335704e-05
BCC-CSM2-MR	0.8551668	4.12422e-30	0.01202212	0.8874458	0.3291627	0.0001076464
CNRM-ESM2-1	0.710813	1.470082e-19	0.3797909	0.0003042645	0.564788	1.384595e-07
EC-Earth3	0.7503792	5.771744e-21	0.1428571	0.2272002	0.4539683	5.93249e-05
FGOALS-g3	0.5635337	1.523686e-12	0.1951952	0.09167828	0.4834835	1.232883e-05
GFDL-ESM4	0.8066069	1.0651e-24	-0.00110742	1	0.4573643	7.733858e-06
IPSL-CM6A-LR	0.7727906	1.650019e-25	-0.2031935	0.009410746	0.1682178	0.0316843
KACE-1-0-G	0.6670304	4.831326e-20	-0.1827431	0.02319368	-0.005089059	0.9496085
MIROC-ES2L	0.741803	1.519033e-20	0.5529412	8.170916e-07	0.5361345	1.942919e-06
MPI-ESM1-2-LR	0.8364353	1.278869e-27	0.0693816	0.4678516	0.3719351	0.0001000701
MRI-ESM2-0	0.7657853	5.640506e-25	0.09423077	0.2671579	0.4515509	1.059998e-07
NorESM2-LM	0.7714624	2.918204e-22	0.4954955	7.024605e-06	0.5405405	7.116371e-07

MAXIMUM RAINFALL AMOUNT: best performing models only



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