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  • Historical reference period: 1995-2014, future period 2041-2060, according to the last IPCC report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

  \[-4{°}C \leq \text{Tmin} \leq 0.5{°}C \quad \text{AND} \quad -0.5{°}C \leq \text{Tmax} \leq 5{°}C \quad \text{AND} \quad \text{Precip} \geq 10\text{mm}\]

  => 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
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
AVERAGE NUMBER OF EVENTS

SSP1-2.6
SSP2-4.5
SSP3-7.0
SSP5-8.5

Grey : non significant
MAXIMUM RAINFALL AMOUNT

SSP1-2.6  SSP2-4.5  SSP3-7.0  SSP5-8.5

Grey : non significant

< -2  -2 < -1.5  -1.5 < -1.  -1. < -0.5  -0.5 < 0  0 < 0.5  0.5 < 1.  > 1.
Summary

• Selection of days when weather conditions are prone to wet snow events
  • From the observations E-OBS 0.1° over the period 1995-2014
  • 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
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MAXIMUM RAINFALL AMOUNT: best performing models only

SSP1-2.6

SSP2-4.5

SSP3-7.0

SSP5-8.5

Grey: non significant

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