Preliminary study of Compound Events in Greece using high-resolution downscaled climate data

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Abstract

Climate change is set to result in an increase of extreme weather events such as extreme precipitation, heatwaves, floods, droughts etc. The study of the possibility of the increase of such events is of high importance, but equally important is to study the combination of these events, meaning the study of Compound Events. In our case we focus on the combination of extreme precipitation with extreme wind speed for the region of Greece. Greece located in the region of the Eastern Mediterranean Sea is prone to Climate Change as the whole region of the Mediterranean Basin. So, it is crucial to understand how the country is affected by Compound Events of extreme precipitation and extreme wind speed. As a first step, we study the historic period 1980–2009 using the model output data. The data for the historic period analysis have been produced from Weather Research Forecast (WRF) 5km downscaled model output with temporal resolution of 6 hours, using as input ERAINTERIM data. The downsampling study that has produced the atmospheric model dataset is described in Politi, et al. (2018). The methodology for studying Compound Events in the area is presented together with the preliminary results.

Objectives- area of study

The goal of this study is to find the probability of compound events of 6 hour temporal resolution extreme wind speed and precipitation happening simultaneously in different regions of Greece. The matter of damages caused by such events also concerns insurance companies and is important to define the regions that are more vulnerable to dangerous storms.

Methods-models

1. We obtain the data from the dynamical downsampling of WRF model (Politi, et al. 2018) at 6 hour temporal resolution and 5km grid space.
2. We calculate the 90°, 95° and 99° percentile threshold for wind speed and precipitation output of 43852 values at each grid point and calculate the possibility of both variables exceeding these thresholds.
3. We calculate the probability of precipitation exceeding the threshold of 10 and 35 mm and wind speed 17 and 20 m/s. Also we calculate the possibility of the combination these thresholds are exceeded respectively.
4. We choose 4 Greek cities to see how possible is these extreme events to affect some residential areas.

Results

<table>
<thead>
<tr>
<th>CITY</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>(%)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLOS</td>
<td>22.62</td>
<td>20.86</td>
<td>1.30</td>
<td>3.47</td>
</tr>
<tr>
<td>RHODES</td>
<td>28.25</td>
<td>31.03</td>
<td>0.15</td>
<td>0.85</td>
</tr>
<tr>
<td>PATRAS</td>
<td>39.36</td>
<td>23.07</td>
<td>0.94</td>
<td>1.27</td>
</tr>
<tr>
<td>ALEXANDROUPOLIS</td>
<td>38.65</td>
<td>25.87</td>
<td>0.12</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table that shows the values of the probability exceeding the thresholds for precipitation and wind speed for the cities that is shown with the markers on the maps.

Conclusions

- Highest precipitation values on mountainous regions
- Highest wind speed values over the Aegean Sea
- Combination of extreme precipitation and extreme wind speed mostly located on the coastal regions of Magnisia, Mount Pelio, Sporades islands, Northeast Evia Island and Southern Chalkidiki.
- We also observe high values over other regions of Aegean and Ionian Sea.
- The regions with the highest values are being affected by strong Northern winds carrying moisture from the Aegean and falling on the obstacles of the mountains of mainland Greece create violent storms.

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References