Effects of orography on spatial distribution of convective precipitation in Banská Bystrica district (Slovakia)

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Introduction

The presence of elevated terrain influences atmospheric processes hundreds of kilometers away from its exact geographical location and many kilometers above the highest point of the elevation. Mountainous terrain can affect the atmospheric air flows within its surroundings in an active way (thermally forced flows) or in the inactive way (dynamically forced flows) [1]. The question of how orography influences spatial distribution of convective precipitation over complex terrain runs up against several issues. Using radar detection to research precipitation clouds in the mountains represents one of the potential problems due to the inability of the radar beams to reach lower levels behind the obstructing summits [2]. Orography that initiates the formation of convective precipitation clouds and the precipitation distribution in the mountains, influences time and spatial precipitation distribution over the near plains as well, but usually in the late part of a day [3]. The shape and size of mountains play a crucial role in microphysics, thermodynamics and dynamics of convective clouds and we can declare the significant and positive influence of orography on aggregate precipitation totals [2]. The key aspect is the configuration of the mountain range relative to the present wind flows or the overall synoptic situation, respectively. Finally, isolated convective cells or multicell convective storms can merge and form into expansive mesoscale convective systems with contiguous precipitation areas and mostly originate heavy rain. These systems usually cannot come to existence without the presence of mountains [1, 2, 3].

1. Geographic characteristics

2. Precipitation events

3. Spatial distribution of precipitation

4. Relation with altitude

5. Event 2011-07-20

Conclusion

• After summing the precipitation totals, the areas around foothills, especially in the Slovak Ore Mountains (the centre and NE of the district), demonstrate the highest daily amounts with the most frequent recurrences of heavy rain. Usually, the lowest parts of the district (Juhošlovenská basin) record reduced precipitation totals opposed to relatively high amounts in the mountains (Figure 3).

• The strongest correlation was detected with the altitude. A continual growth of minimum precipitation amounts is observed along with increasing altitude, whereas the highest precipitation totals are concentrated in the foothills (700 – 800 m) of the Carpathians (Figure 4).

• Considering that greater terrain values of relative altitude and slope usually occur in high mountain ranges, the geographical location seems to be the prime explanation of higher precipitation amounts in these small areas rather than the direct orographic influence on existing precipitation clouds (Figure 3 and 5).

• The orientation of terrain plays an important role in the formation of convective clouds, while the windward or leeward effects do not show a significant impact on short-time precipitation events (Figure 5).

• The most dominant influence in the convective storms formation during precipitation events was local convective flow intensification on the windward, leeward and edge sides of the mountains (Figure 2).

References

