The role of mesoscale convective organization in the generation of extreme precipitation over Europe

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Mesoscale Convective Systems (MCS) are common over Europe during the warm season (Morel and Senesi, 2002b) and are able to produce severe weather such as extreme precipitation leading to flash floods (Fiori et al., 2014). Studies analyzing the climatological characteristics of MCS over Europe are rare and were often based on only a few years of data or were focused on a limited area of Europe. In their recent research, Surowiecky and Taszarek (2020) showed that MCS over Poland can frequently adopt typical morphology of mid-latitude extreme-rain producing MCS (Schumacher and Johnson, 2005).

With the recent Integrated Multi-satellitE Retrievals for Global Precipitation Measurement (IMERG; Huffman et al., 2019) satellite precipitation climatology, we identify and track MCS for nearly 20 years over Europe. Our detection/tracking algorithm is inspired from the one proposed by Feng et al. (2021). Cell-tracking from precipitation data is not straightforward, especially for fast moving and small systems. Here, we make use of a spatio-temporal filter and track cells according to the overlapping of filtered precipitation patches between two consecutive time steps. We fit an ellipse to the precipitating patches for a quick scan of their morphology and orientation. The algorithm distinguishes between non-convective rain bands from convective rain patches by using lightning data, thus reducing potential identification errors.

We use this new European MCS climatology to evaluate their main characteristics in Europe and their potential evolution over the last 20 years. In particular, we examine their occurrence frequency in extreme rainfall events in this region and the environmental conditions leading to these extremes, with respect to other (non-MCS) convective systems. This work contributes to better understanding the role that convective organization plays in driving extreme rain in mid-latitudes from an observational perspective.

References

Feng Z, Leung LR, Liu N, Wang J, Houze RA, Li J, Hardin JC, Chen D, Guo J. 2021. A global high-resolution mesoscale convective system database using satellite-derived cloud tops, surface precipitation, and tracking. Geophys. Res. Atmos., 126, e2020JD034202, doi: 10.1029/2020JD034202.

Fiori E, Comellas A, Molini L, Rebora N, Siccardi F, Gochis D, Tanelli S, Parodi A. 2014. Analysis and hindcast simulations of an extreme rainfall event in the Mediterranean area: the Genoa 2011 case. Atmos. Res., 138, pp. 13–29, doi: 10.1016/j.atmosres.2013.10.007.

Huffman GJ, Stocker EF, Bolvin DT, Nelkin EJ, Tan J. 2019. GPM IMERG final precipitation L3 half hourly 0.1 degree x 0.1 degree V06, Greenbelt, MD, Goddard Earth Sciences Data and Information Services Center. doi: 10.5067/GPM/IMERG/3B-HH/06.

Morel C, Senesi S. 2002b. A climatology of mesoscale convective systems over Europe using satellite infrared imagery. II: Characteristics of European mesoscale convective systems. Quart. J. Roy. Meteor. Soc., 128, 1973–1995, doi: 10.1256/003590002320603494.

Schumacher RS, Johnson RH. 2005. Organization and environmental properties of extreme-rain-producing mesoscale convective systems. Month. Weath. Rev., 133, 961–976, doi: 10.1175/MWR2899.1.

Surowiecki, A., & Taszarek, M. (2020). A 10-Year Radar-Based Climatology of Mesoscale Convective System Archetypes and Derechos in Poland, Month. Weath. Rev., 148(8), 3471–3488, doi: 10.1175/MWR-D-19-0412.1.

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