EMS Annual Meeting Abstracts
Vol. 16, EMS2019-820, 2019

Development of a muddy flood early warning system using high-resolution radar precipitation forecasts and process-based erosion modelling

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The monitoring and analyses of extreme heavy rain events is not only crucial fur urban areas, but for agricultural landscapes with its settlements and transport infrastructure as well. Thunderstorms and accompanying heavy rain occurring over sparsely vegetated or exposed arable fields can trigger muddy floods. Beside the primary impact of soil loss and decreasing soil fertility on the field, these large amounts of muddy runoff can inundate neighbouring traffic routes, settlements or water ecosystems. In late spring 2016, extreme heavy rain events triggered muddy floods and flash floods causing severe devastations of infrastructure and settlements throughout Germany. In the Free State of Saxony, Eastern Germany, the rail service between Germany and the Czech Republic was disrupted twice due to two muddy floods at the end of May 2016. Another muddy flood was reported for the same period in a small town in middle Saxony. In a first step, this approach illustrates the reconstruction of the three muddy floods in ungauged agricultural landscapes. This reconstruction was performed by high-resolution radar-based precipitation data of the German Meteorological Service (DWD), process-based erosion modelling, and Unmanned Aerial Vehicle (UAV) monitoring. In a further step, historical radar precipitation forecasts of the DWD served as input data for the process-based erosion model to test the forecast of the muddy floods retrospectively. Model results indicate a possible warning, but, at best, 15 minutes in advance. Finally, this approach assesses the feasibility of a muddy flood early warning system in ungauged agricultural landscapes by high-resolution radar precipitation forecasts and process-based erosion modelling.