

Study finds land surface conditions can affect mesoscale convective systems while they are on the move

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Intense dust storms, such as this haboob in Mali in August 2006, proceed torrential rain. Credit: Françoise GUICHARD / Laurent KERGOAT / CNRS Photo Library

Ground-breaking scientific research will make it easier to predict the path of some of the world's most powerful storms, enabling communities to better protect themselves from severe flooding.

Mesoscale convective systems (MCSs) are 'megastorms' that affect large parts of the world, including Africa, Australia, Asia and the Americas, causing human and livestock deaths plus major damage to infrastructure. They can potentially:

- last from several hours up to two days
- release energy equivalent to the UK consumption for an entire year
- be bigger than the size of England and travel 1,000kms in distance
- unleash over 100mm of rainfall in just an hour

In Sahelian Africa, these [extreme storms](#) have tripled in frequency since the 1980s due to global warming.

Until now, it was thought that the path of these complex weather systems was largely unpredictable.

However, a new study by the UK Centre for Ecology & Hydrology (UKCEH) has found that land surface conditions frequently affect the direction and intensity of megastorms after they have formed.

The research is now helping scientists to develop online tools to better forecast the path and strength of an approaching [storm](#), which will inform alert systems for communities across Africa, providing them with up to six hours' warning. This includes Senegal, where UKCEH is working with the national meteorological service, ANACIM, to see how useful very [short-term forecasts](#) are for local emergency responses.

The new study, published in the journal *PNAS*, was funded by the Department for International Development (DFID) and Natural Environment Research Council (NERC) as part of the UK aid Future Climate for Africa research programme.

The researchers looked at [satellite data](#) on the activity of thousands of storms, plus land temperatures, in the Sahel for the period 2006 to 2010.

Lead author Dr. Cornelia Klein of UKCEH explains: "It is well known that heat provides thunderstorms with great energy, but it was commonly thought that once they are moving, they were not affected by the state of the ground over which they travelled.

"However, we found that drier soils increased the intensity of an MCS mid-storm, affecting the amount of rainfall they release and also where they travel. Conversely, we found storms were often weakened over moister soils."

"Our finding means that, for the first time, we can predict, from satellite-observed surface conditions, how these extremely large West African storms may behave when, for example, they approach a city. A more effective alert system will enable local people to take action to protect themselves as well as their homes, livestock and possessions, plus plan emergency responses."

Flash flooding frequently occurs during the storm season in the Sahel, peaking between June and September, and can have a serious impact, with water entering homes and people losing property and a safe, dry space to live. Flooding can also cause sewage overflow from [inadequate drainage systems](#), posing a health risk to humans and animals.

The study's authors say the results have important implications for 'nowcasting' (forecasting for several hours ahead) of severe weather not

just in the Sahel, but potentially other MCS hotspot regions of the world.

Professor Chris Taylor of UKCEH, co-author of the new paper, adds: "The pattern of these megastorms is supposed to be difficult to forecast but we found a surprising level of predictability. Very dry soils influenced around half of storms in late afternoon or early evening, when they are at their peak.

"Further research and advances in satellite technology will increase our certainties about their movement. In decades to come, scientists will look back at this latest study as a gamechanger in the reliable forecasting of these devastating storms."

The research is part of the UKCEH-led [AMMA-2050 project](#), which is carrying out multidisciplinary climate research to support improved forecasting, in order to enable better decision making by town planners, farmers and communities. Comprising partners from Europe and West Africa, it is funded by DFID and NERC.

A DFID spokesperson said:

"Highly destructive megastorms are becoming much more common because of climate change. They can devastate entire communities and it is the world's poorest people who are most at risk.

"UK aid is supporting ground-breaking research, led by British experts, to better anticipate storms so vulnerable African communities can better prepare for their impact, protecting themselves and their families, and making their economies more resilient to climate shocks."

More information: Cornelia Klein et al., "Dry soils can intensify mesoscale convective systems," *PNAS* (2020).

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Provided by UK Centre for Ecology & Hydrology

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