Rainfall monitoring with mobile phones

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Pylon with telecommunication antenna and meteorological measuring station in Burkina Faso. Credit: IRD / F. Cazenave

Agriculture, water resource management, drought and flood warnings, etc.: rainfall monitoring is vital in many areas. But the observation networks remain insufficient. This is not the case for antennas for mobile telephones, which cover 90% of the world's inhabited areas. Besides transmitting radio signals, they record signal disturbances, which are partly due to precipitation, in order to monitor the quality of networks. The idea of the Rain Cell Africa consortium researchers is to

benefit from this amount of data to improve rainfall monitoring and spatialisation. This is a method whose effectiveness has been proven, with a reliability rate of 95% for detecting rainfall events. This work, which was conducted in Burkina Faso, has just been published in the *Geophysical Research Letters* journal.

An ingenious idea

The scientists of the Rain Cell Africa consortium recently successfully tested a highly innovative method of monitoring rainfall in Burkina Faso. The idea is simple. It means taking advantage of a property of rainfall that is well-known to telecommunications professionals: drops of water reducing the radio signal transmitted between two antennae. Two phenomena are involved. On the one hand, they absorb a fraction of the energy carried by the waves. On the other hand, they spread these waves and turn them away from their original course. So, when it rains between two antennas, the intensity of the signals received falls. This is major concern for mobile telephone companies, who measure and record these radio signal disturbances to be able to check the state of health of their network at any time.

Proven effectiveness

National telephone companies therefore have a wealth of information on the rains in their country. This is a godsend for rainfall monitoring and spatialisation studies, particularly in Africa. Thanks to a partnership with the Burkinabe operator Télécel Faso, researchers from the Lame laboratory at the University of Ouagadougou GET (IRD / CNRS / Toulouse 3 University) laboratories and LTHE (IRD / CNRS / Grenoble 1 University / Grenoble INP) were able to access valuable data on the reduction of the radio signal recorded by the company during the monsoon of 2012. They deduced the volumes of rain that fell during this

period and compared them with traditional radar and rain gauge measurements. The effectiveness of the method was demonstrated: 95% of rainfall events were detected. This is the first time that this technique has been evaluated quantitatively. These results have just been published in the *Geophysical Research Letters* journal.

Taking over from inadequate systems

Rainfall monitoring in Africa is a major issue for many research applications (hydrological, climatic and agricultural modelling), as well as for operational applications (meteorology, water services, food safety, drought and flood warnings, etc.). However, the observation networks on the ground (rain gauges), which are costly to implement and maintain, are inadequate and deteriorating. Satellite monitoring and weather forecasts are still full of uncertainties, especially the extremely fine spatial and temporal scales. However, 20% of the world's land area has a mobile phone network, covering 90% of the world population. And these networks are constantly expanding. In particular in cities, where the network density is high, this technique will make it possible to provide highly accurate rainfall maps for areas where the risk of flooding is increased.

One condition remains: convincing domestic mobile telephone operators to collaborate on this mission of general interest, by submitting their raw data to the research teams.

More information: Doumounia A., Gosset Marielle, Cazenave Frédéric, Zougmore F., Kacou M. "Rainfall Monitoring based on Microwave links from cellular telecommunication Networks: First Results from a West African Test Bed." *Geophysical Research Letters*, 2014. DOI: 10.1002/2014GL060724