(At least) the 10th anniversary of rainfall monitoring using microwave links from cellular communication networks

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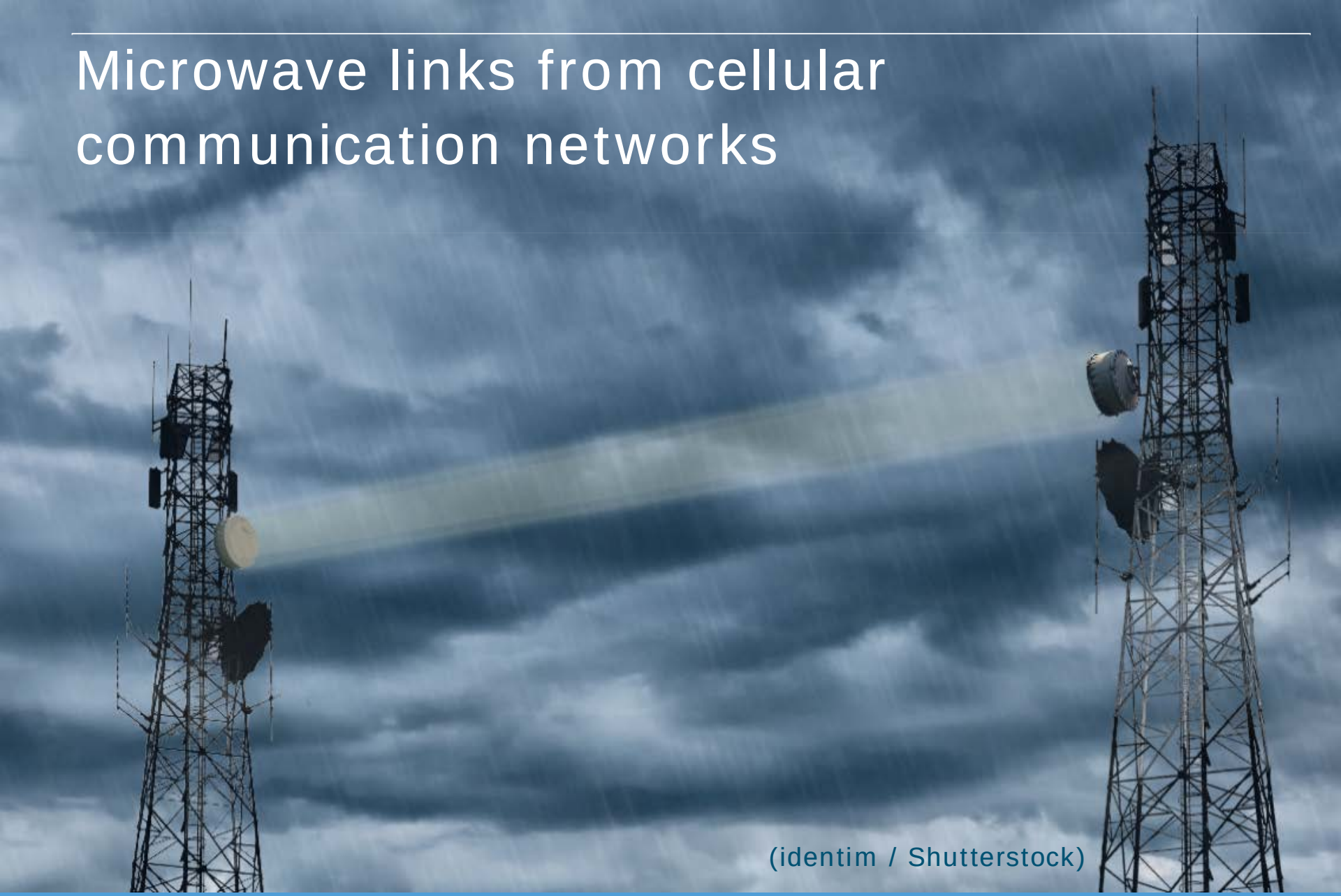
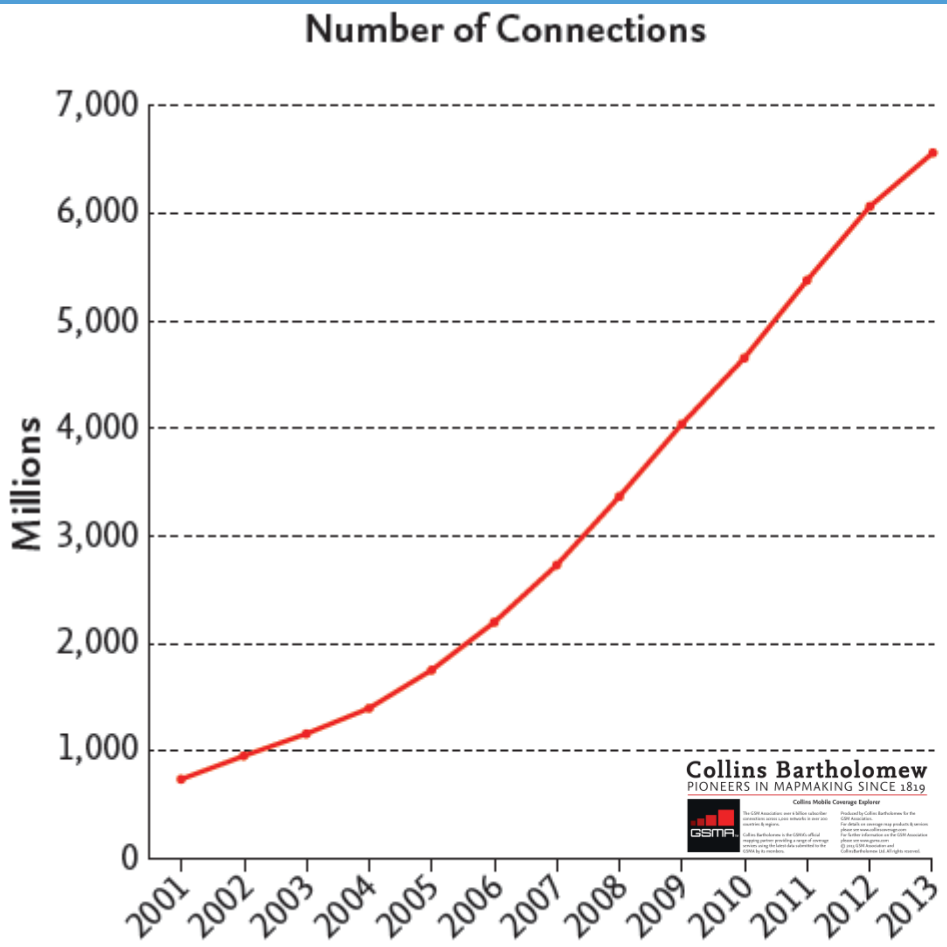
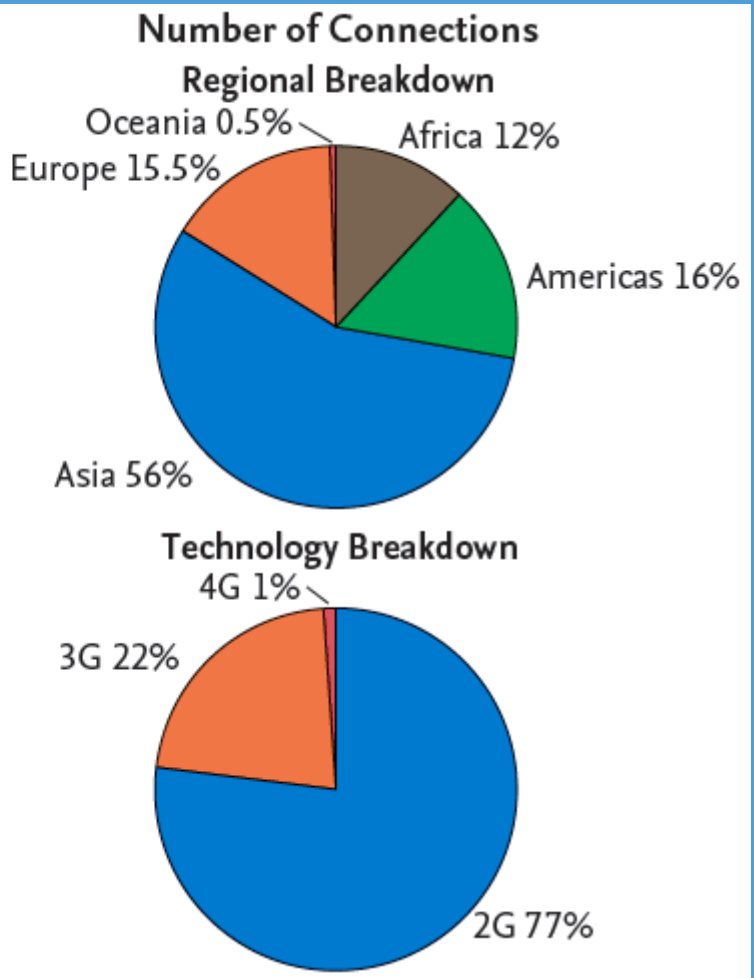
Microwave links from cellular communication networks



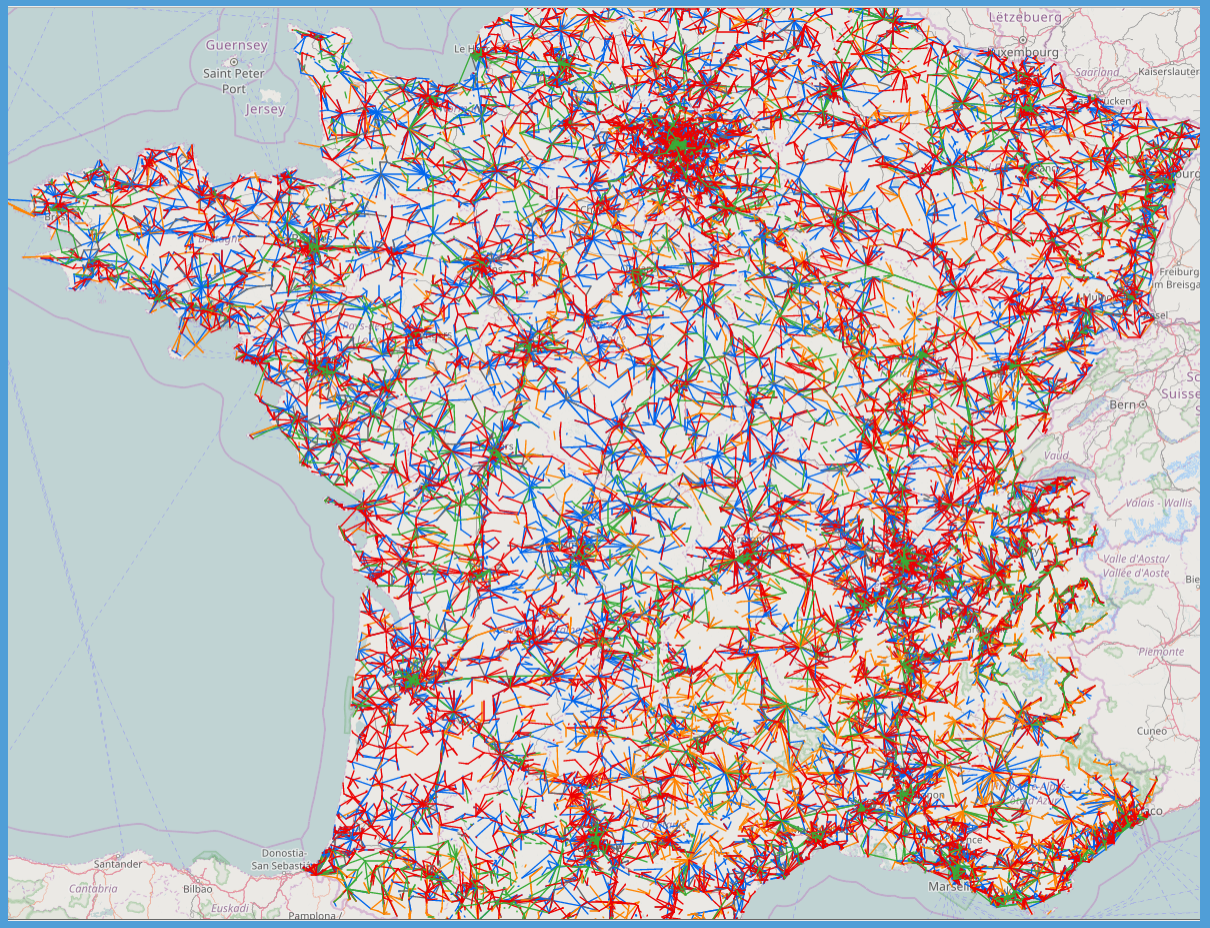
(identim / Shutterstock)

Rapid growth cellular telecommunication





46,400 links (6–80 GHz) in France



(https://carte-fh.lafibre.info/)

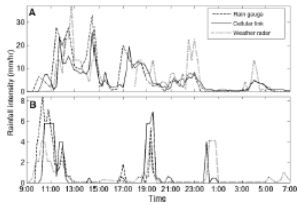
A short (and biased) history...

(Messer et al., 2006)

BREVIA

Environmental Monitoring by Wireless Communication Networks

Hagit Messer,[1]* Artem Zinevich,[2] Pinhas Alpert[2]



(Leijnse et al., 2007)

WATER RESOURCES RESEARCH, VOL. 43, W03201, doi:10.1029/2006WR005631, 2

Click Here for Full Article

Rainfall measurement using radio links from cellular communication networks

H. Leijnse,[1] R. Uijlenhoet,[1] and J. N. M. Stricker[1]

Received 18 October 2006; revised 22 December 2006; accepted 17 January 2007; published 23 March 2007.

[1] We investigate the potential of radio links such as employed by commercial cellular communication companies to monitor path-averaged rainfall. We present an analysis of data collected using two 38-GHz links during eight rainfall events over a 2-month period (October–November 2003) during mostly stratiform rainfall in the Netherlands. Comparisons between the time series of rainfall intensities estimated using the radio links and those measured by a nearby rain gauge and a composite of two C band weather radars show that the dynamics of the rain events is generally well captured by the radio links. This shows that such links are potentially a valuable addition to existing methods of rainfall estimation, provided the uncertainties related to the reference signal level, signal level resolution, wet antenna attenuation, and temporal sampling can be resolved.

Citation: Leijnse, H., R. Uijlenhoet, and J. N. M. Stricker (2007), Rainfall measurement using radio links f communication networks, *Water Resour. Res.*, *43*, W03201, doi:10.1029/2006WR005631.

1. Introduction

[2] Digital fixed radio systems, the type of wireless communication networks employed by commercial cellular communication companies, have recently been proposed as a

retrieval method is based on measure signal level, estimation of the rain-inc the application of a power law relatio and rain rate to estimate path-averaged

(Leijnse, 2007)

Hydrometeorological application of microwave links

Measurement of evaporation and precipitation

Hidde Leijnse

Country-wide rainfall maps from cellular communication networks (Overeem et al., 2013)

PNAS

Aart Overeem[a,b,1], Hidde Leijnse[b], and Remko Uijlenhoet[a]

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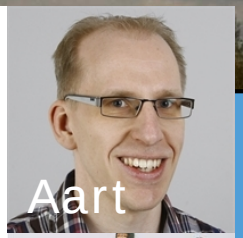
Edited by Soroosh Sorooshian, University of California, Irvine, CA, and accepted by the Editorial Board December 8, 2012 (received fo October 16, 2012)

Accurate and timely surface precipitation measurements are crucial potential benefit of link rainfall data lies in r



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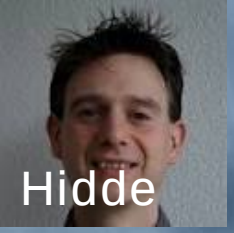
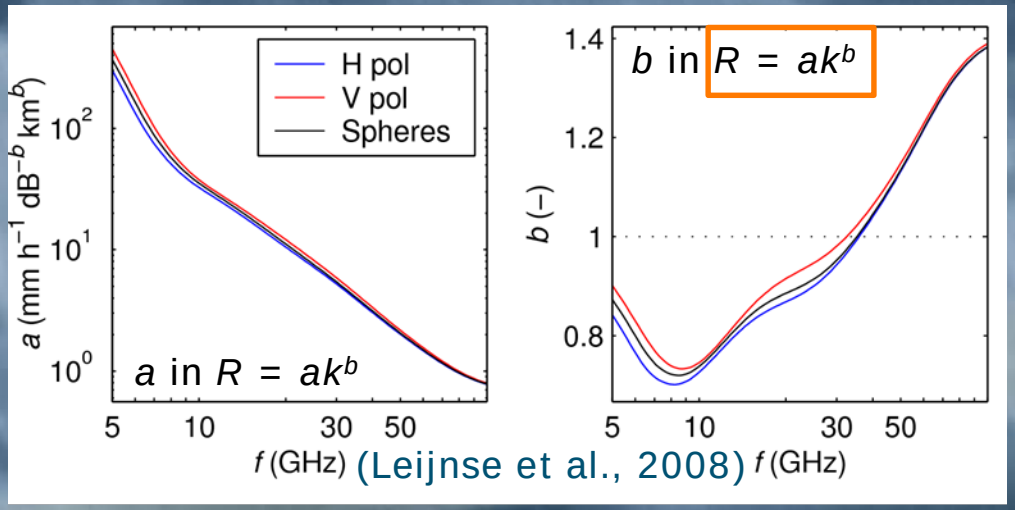
Raincell Africa Training School

(Gosset et al., 2016)

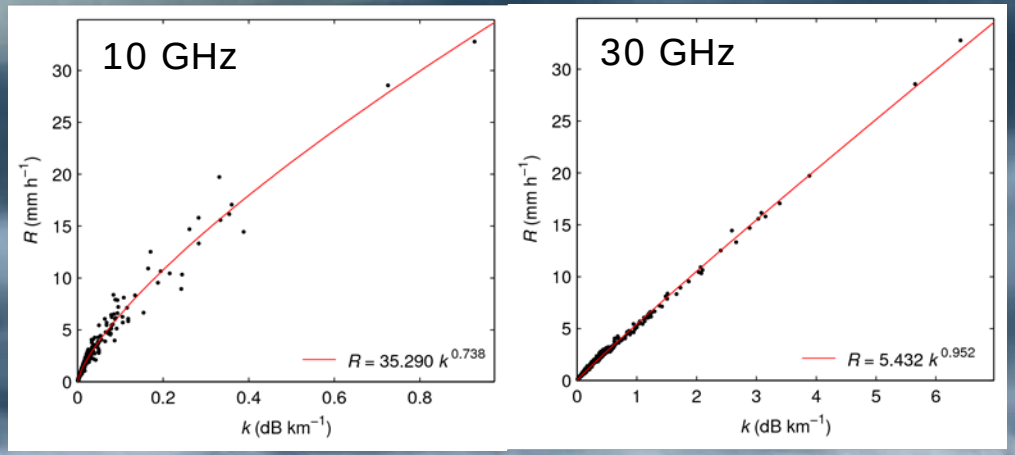
- Ouagadougou, Burkina Faso, 30 March – 2 April 2015



(Power-law R–k relations)



(Leijnse et al., 2008)



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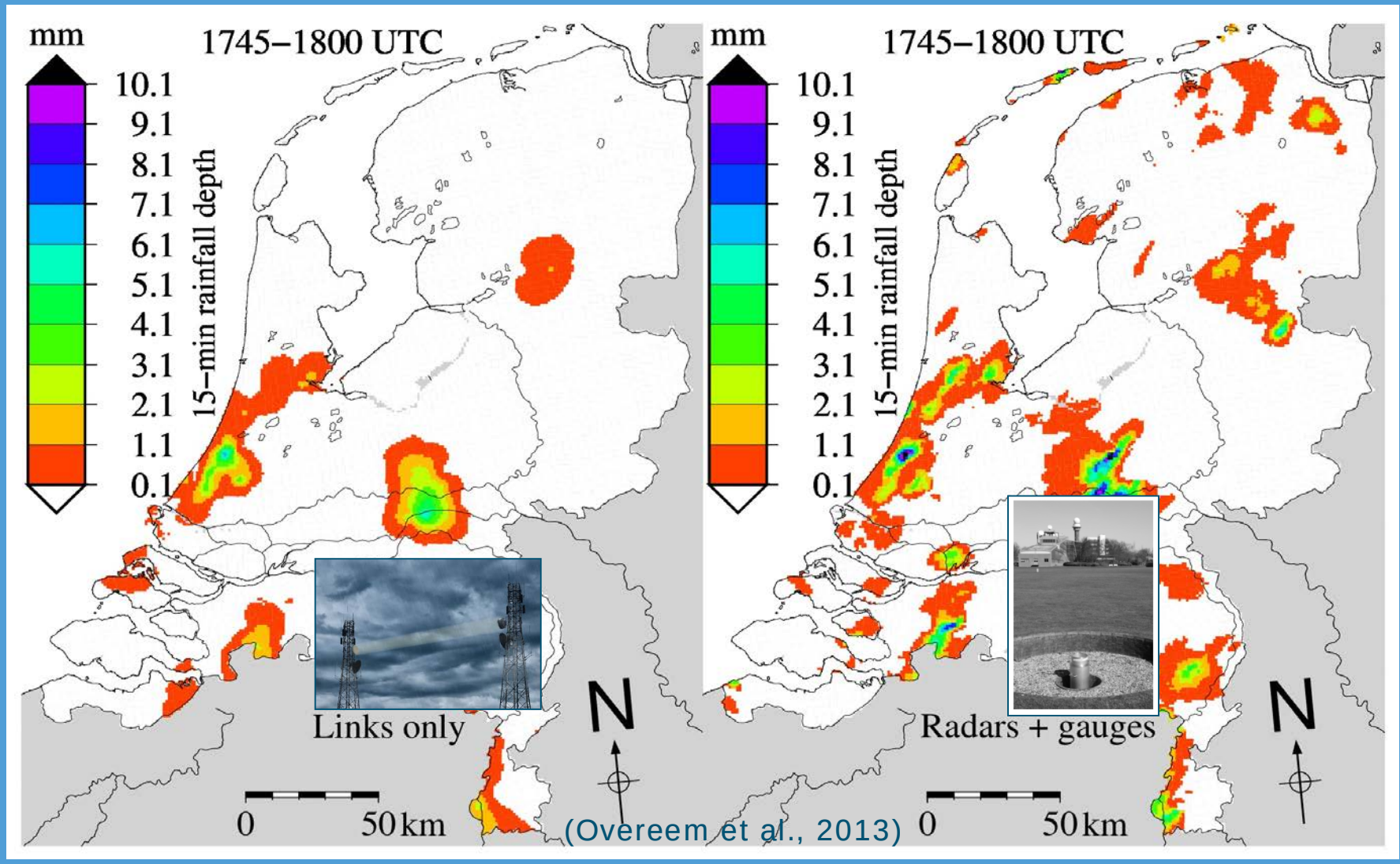
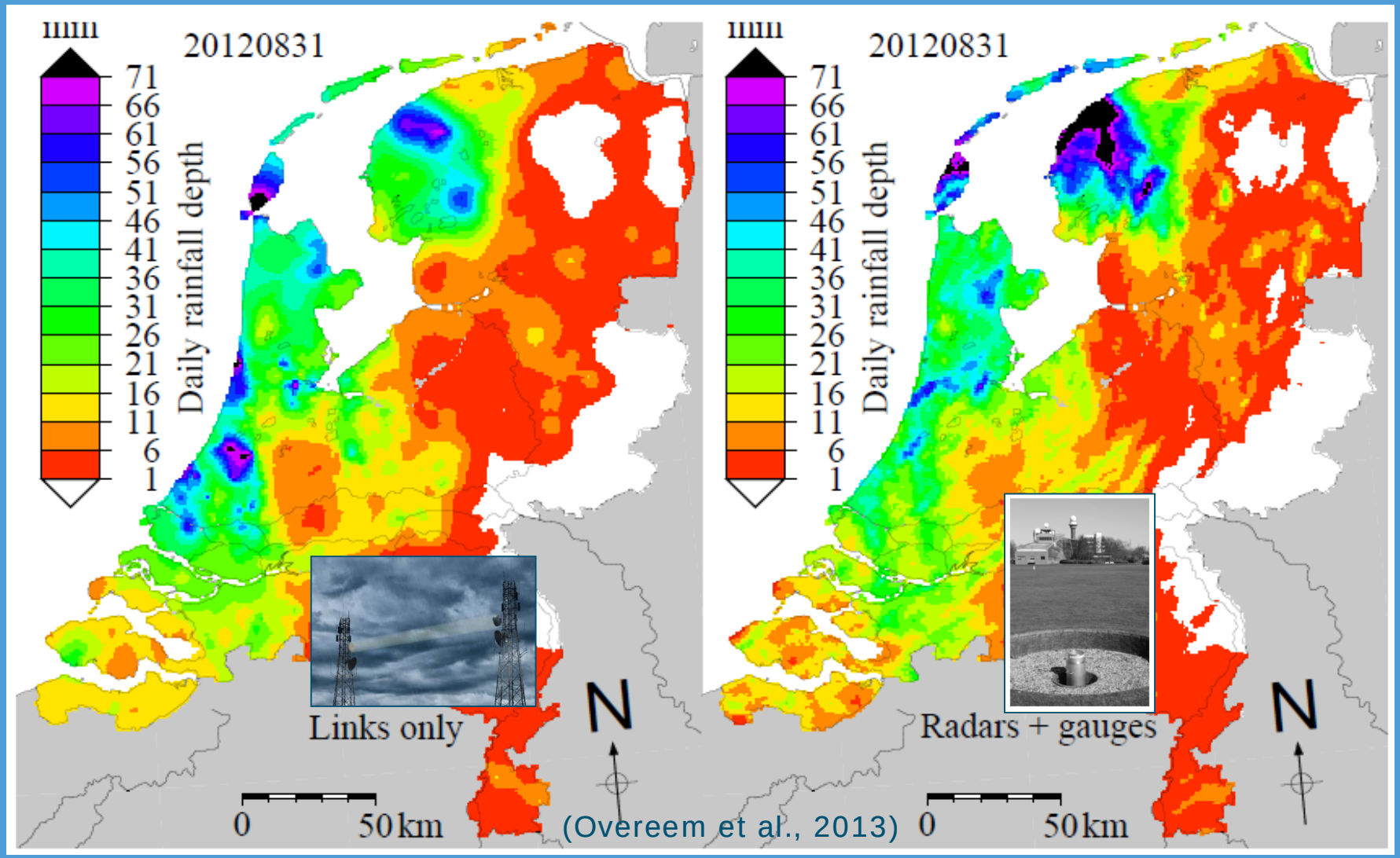
Microwave links versus radar + gauges



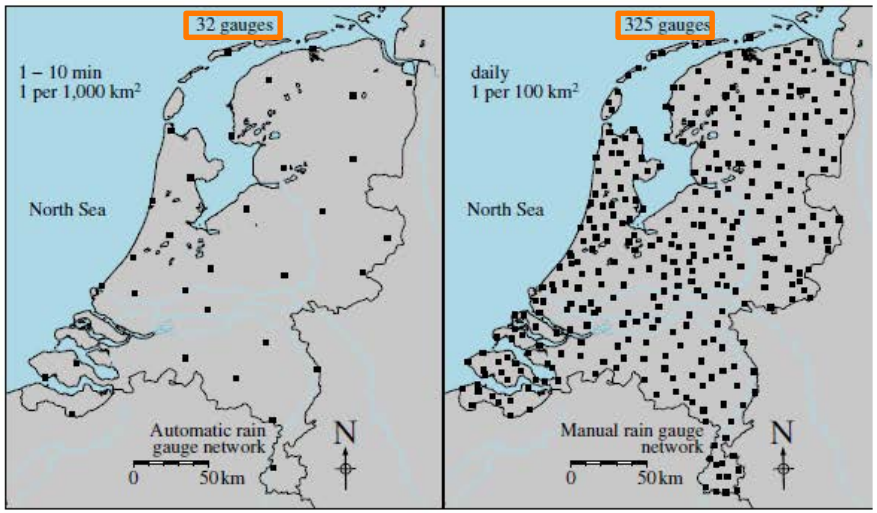
(Overeem et al., 2013)

Microwave links versus radar + gauges

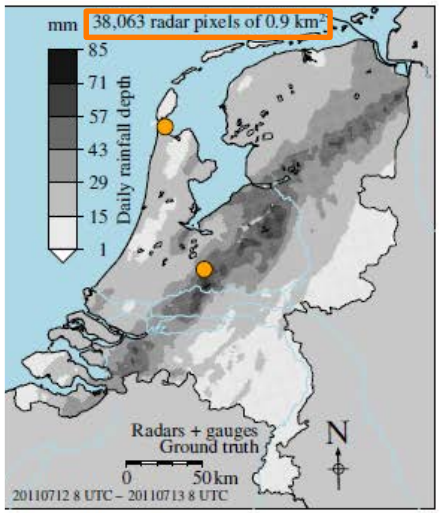


(Overeem et al., 2013)

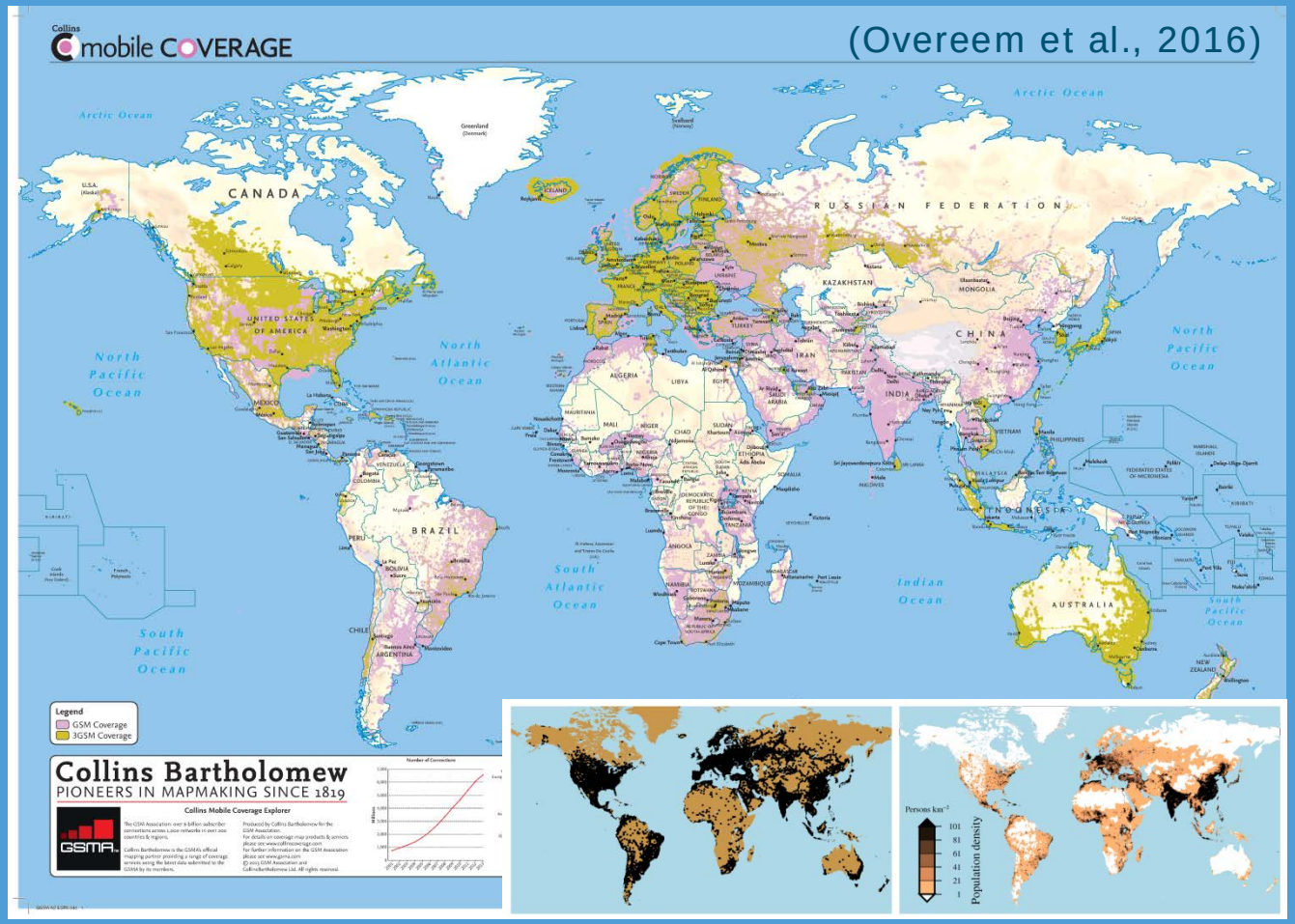
Many more microwave links than gauges



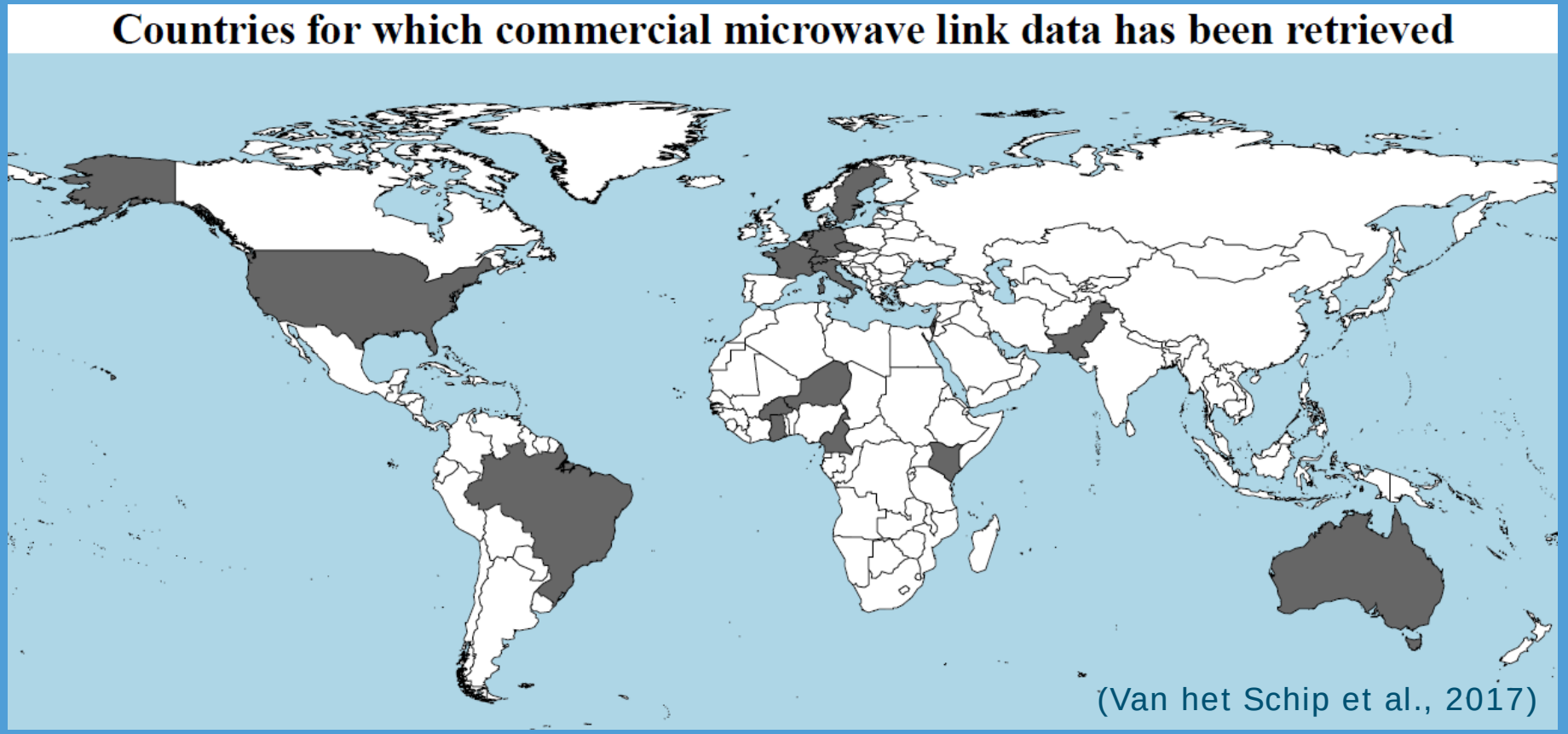
Room for opportunistic sensors



Potential complementary source of information over poorly gauged regions



India can likely be added to this map



Semi-operational applications

- https://www.climacell.co/
- https://www.smhi.se/en/services/professional-services/micro-weather-live-data/

ATMOSPHERIC SCIENCE

Rain forecasts go mobile

Analysis of wireless communications data could give accurate weather at street level.

BY JEFF TOLLEFSON

Meteorologists have long struggled to forecast storms and flooding at the level of streets and neighbourhoods, but they may soon make headway thanks to the spread of mobile-phone networks.

The strategy relies on the physics of how water scatters and absorbs microwaves. In 2006, researchers demonstrated that they could estimate how much precipitation was falling in an area by comparing changes in the signal strength between communication towers[1]. But mobile-phone companies were reluctant to give researchers access to their signal data, and the field progressed slowly. That is changing now, enabling experiments across Europe and Africa.

The technology could lead to more-precise flood warnings — and more-accurate storm predictions if the new data are integrated into modern weather-forecasting models. Proponents also hope to use this approach to expand weather services in developing countries.

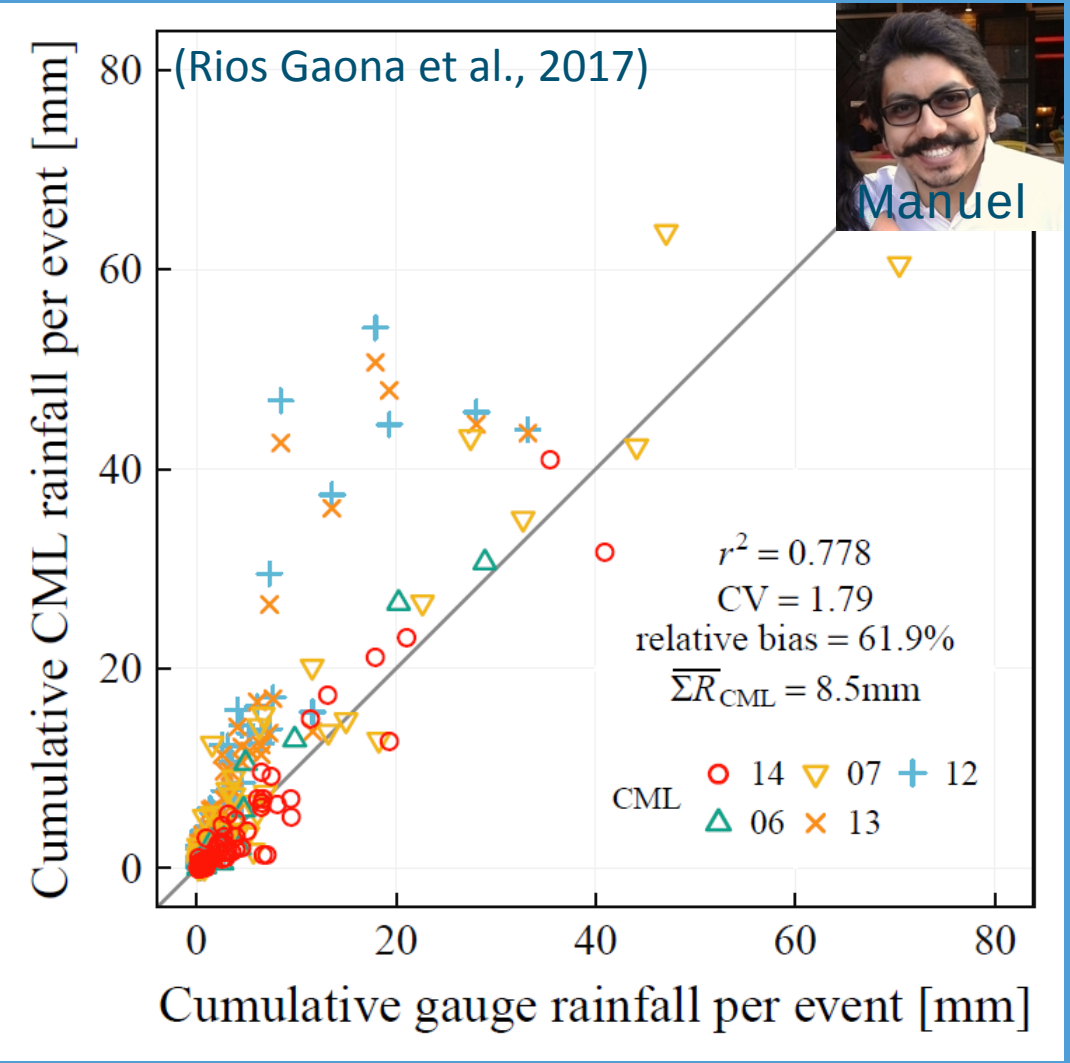
The newest entry into this field is ClimaCell, a start-up company in Boston, Massachusetts, that launched on 2 April. The 12-person firm says that it can integrate data from microwave signals and other weather observations to create more-accurate short-term forecasts. It notes it can provide high-resolution, street-level weather forecasts three hours ahead, and will aim to provide a six-hour forecast within six months. The company has yet to make information on its system public or publish it in peer-reviewed journals.

ClimaCell will start in the United States and other developed countries, but plans to move into developing countries, including India, later this year. "The signals are everywhere, so basically we want to cover the world," says Shimon Elkabetz, ClimaCell's chief executive and co-founder.

But the fledgling company faces competition from researchers in Europe and Israel who have tested systems at multiple scales, including countries and cities, over the past several years. The scientists recently formed a consortium to advance the technology using open-source software. Coordinated by Aart Overeem, a hydrometeorologist at the Royal Netherlands Meteorological Institute in De Bilt, the group is seeking nearly €5 million (US$5.3 million) from the European Commission to create a prototype rainfall-monitoring system that could eventually be set up across Europe and Africa.

"There is a lot of evidence that this technology works, but we still need to test it in more regions with large data sets and different networks," Overeem says. Although ClimaCell has made bold claims about its programme, Overeem says he cannot properly review the

272 events (5 links) in São Paulo, Brazil



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(Victoria Roberts, 2000)