Opportunistic sensing of rainfall

RealPEP conference, QPE session, abstract 73

5 Oct 2020, Remko Uijlenhoet, Lotte de Vos, Aart Overeem, and Hidde Leijnse

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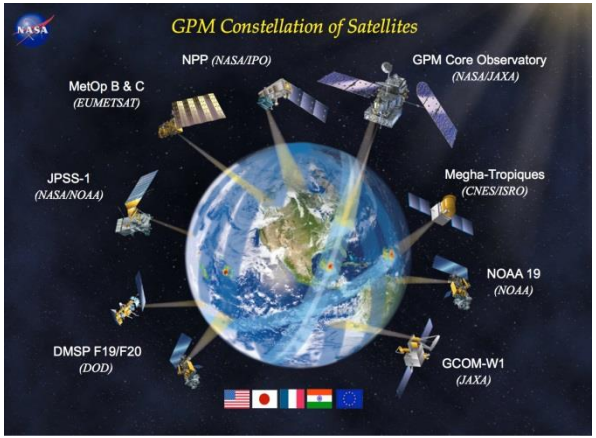
(NASA)

Average of ALL AVAILABLE Rainfall mm/dd (3B43) 1998 to 2007



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(Heistermann et al., 2012)

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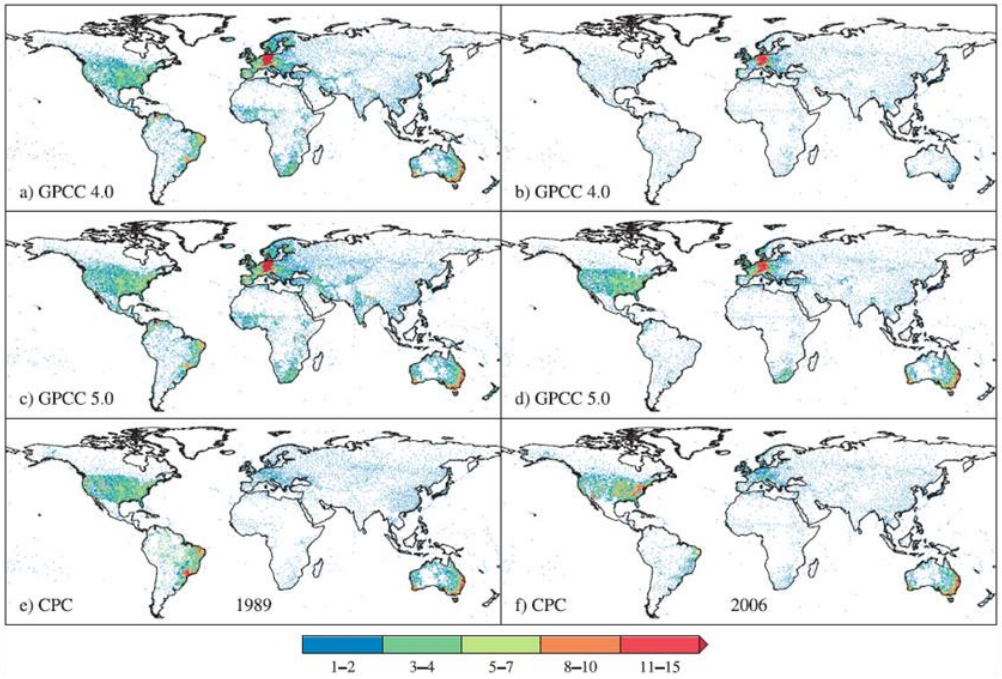

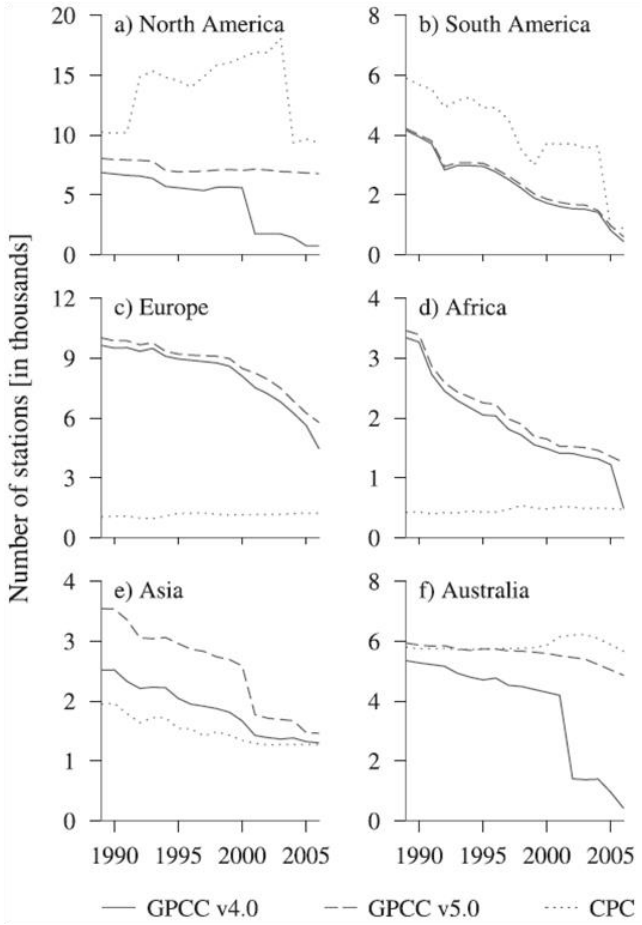

(Lorenz and Kunstmann, 2012; NY Times green blog, 2 July 2012)

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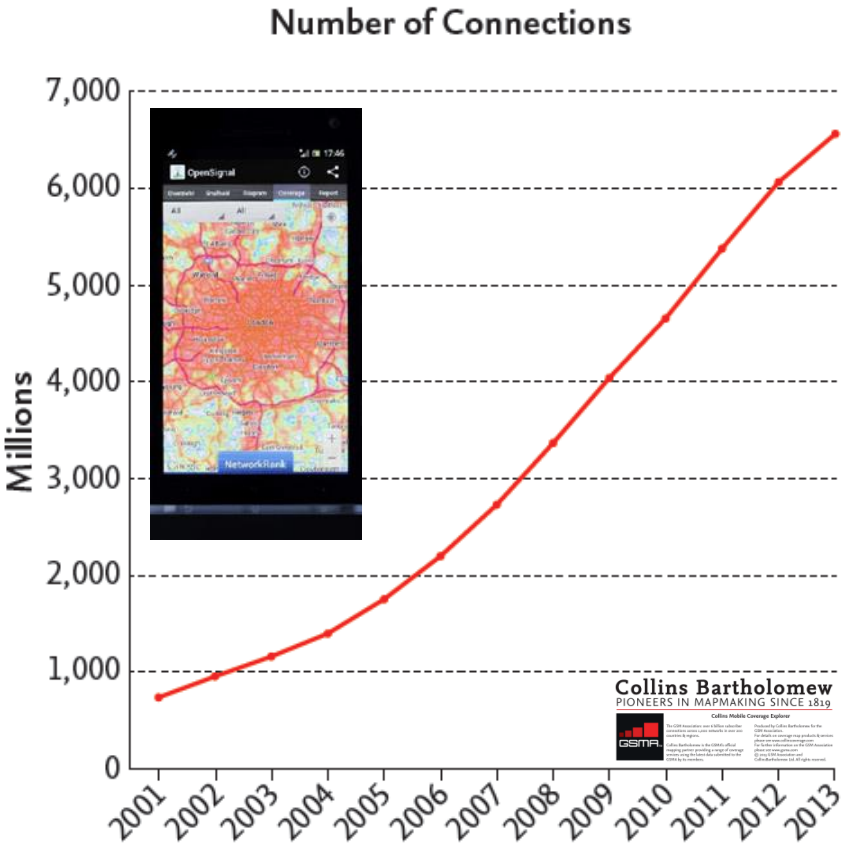

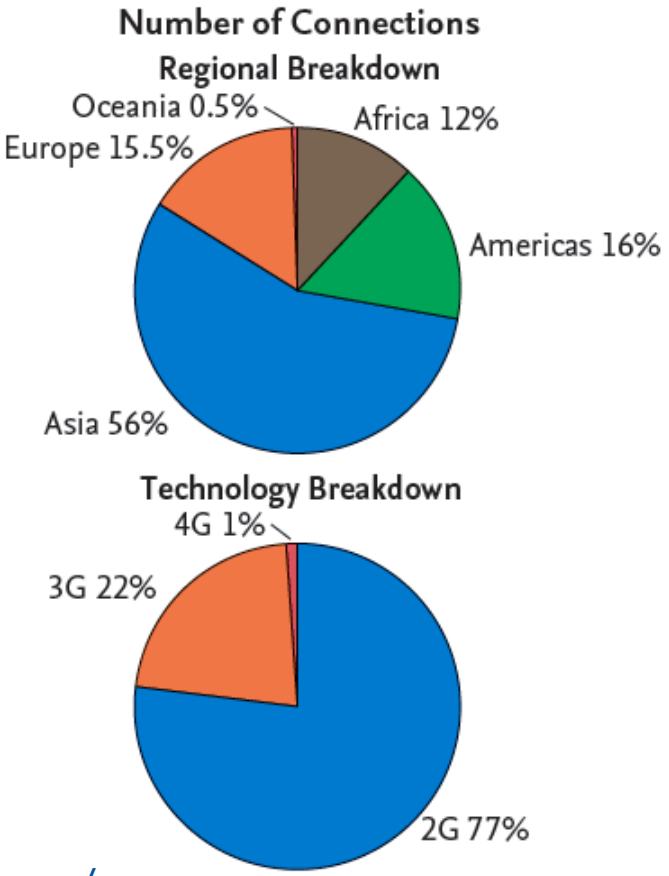

(Collins Bartholomew / GSMA, 2013)

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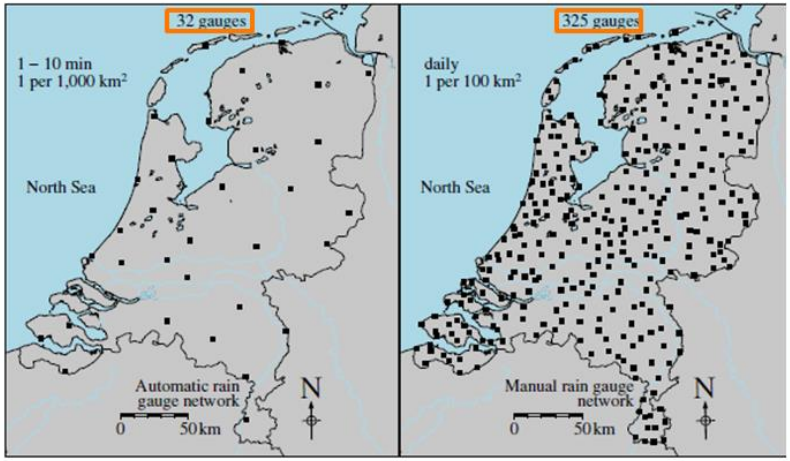
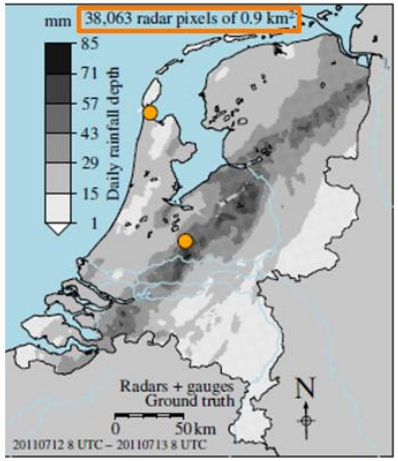


Room for opportunistic sensors



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(identim / Shutterstock)

- → **Can microwave links from cellular communication networks be employed to monitor our environment?**
- → Can smartphones be employed as environmental sensors?
- → What can citizen science bring to hydrologic science and applications?

(Uijlenhoet et al., 2018)

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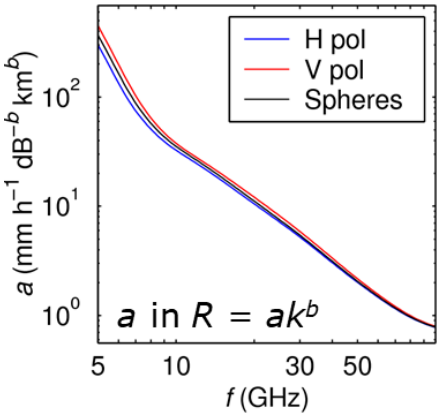
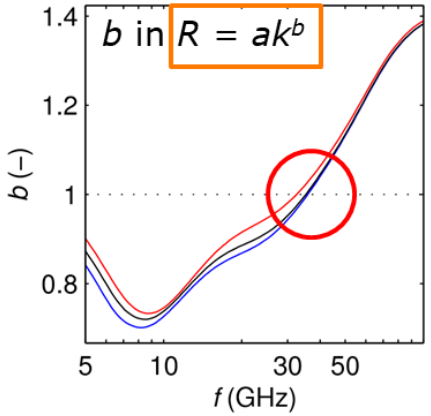
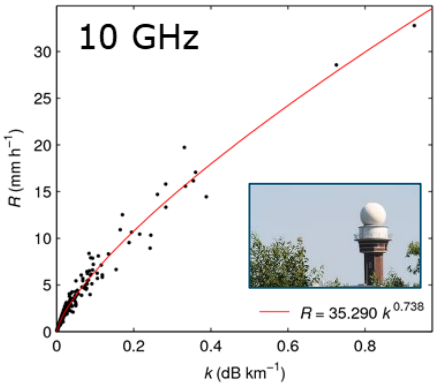
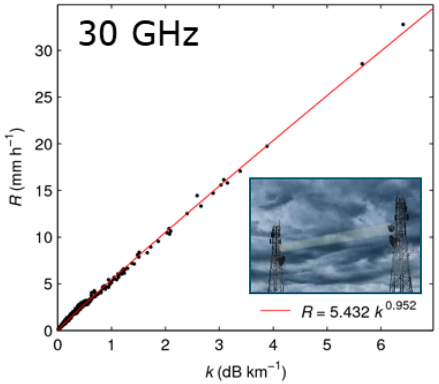




→ Microwave links from cellular communication networks can be used as path-average rain gauges





(Leijnse et al., 2008)

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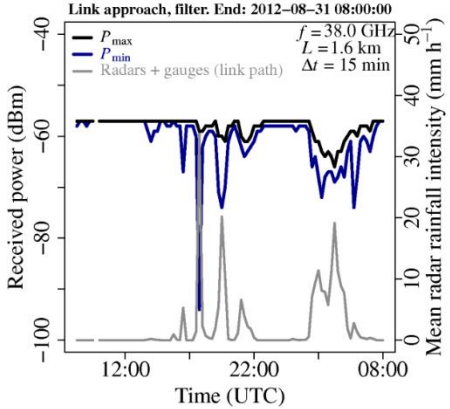
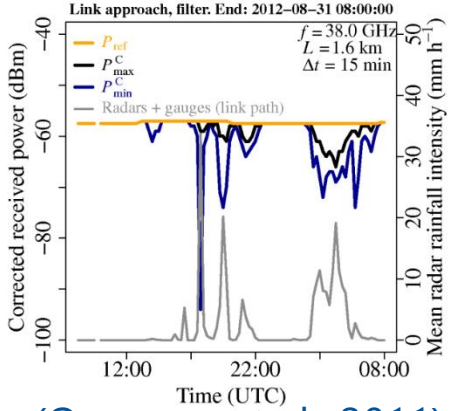
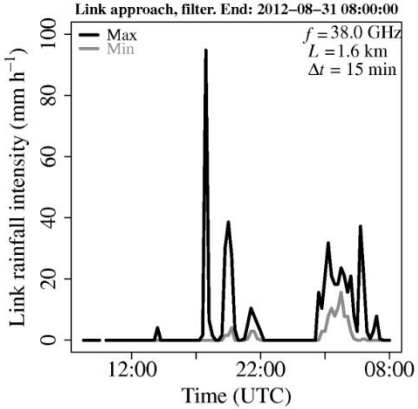
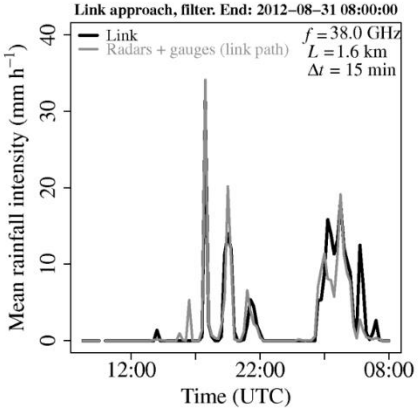
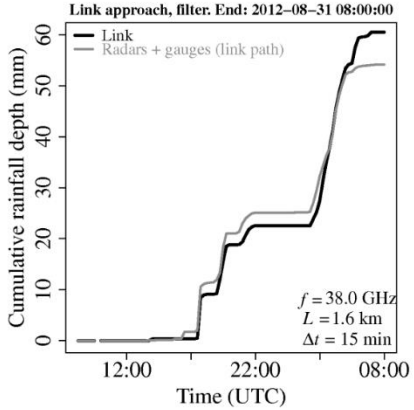


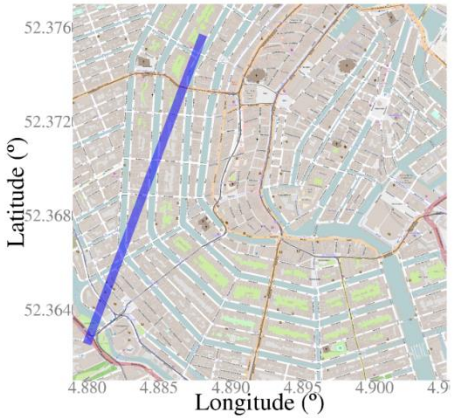




(Overeem et al., 2011)







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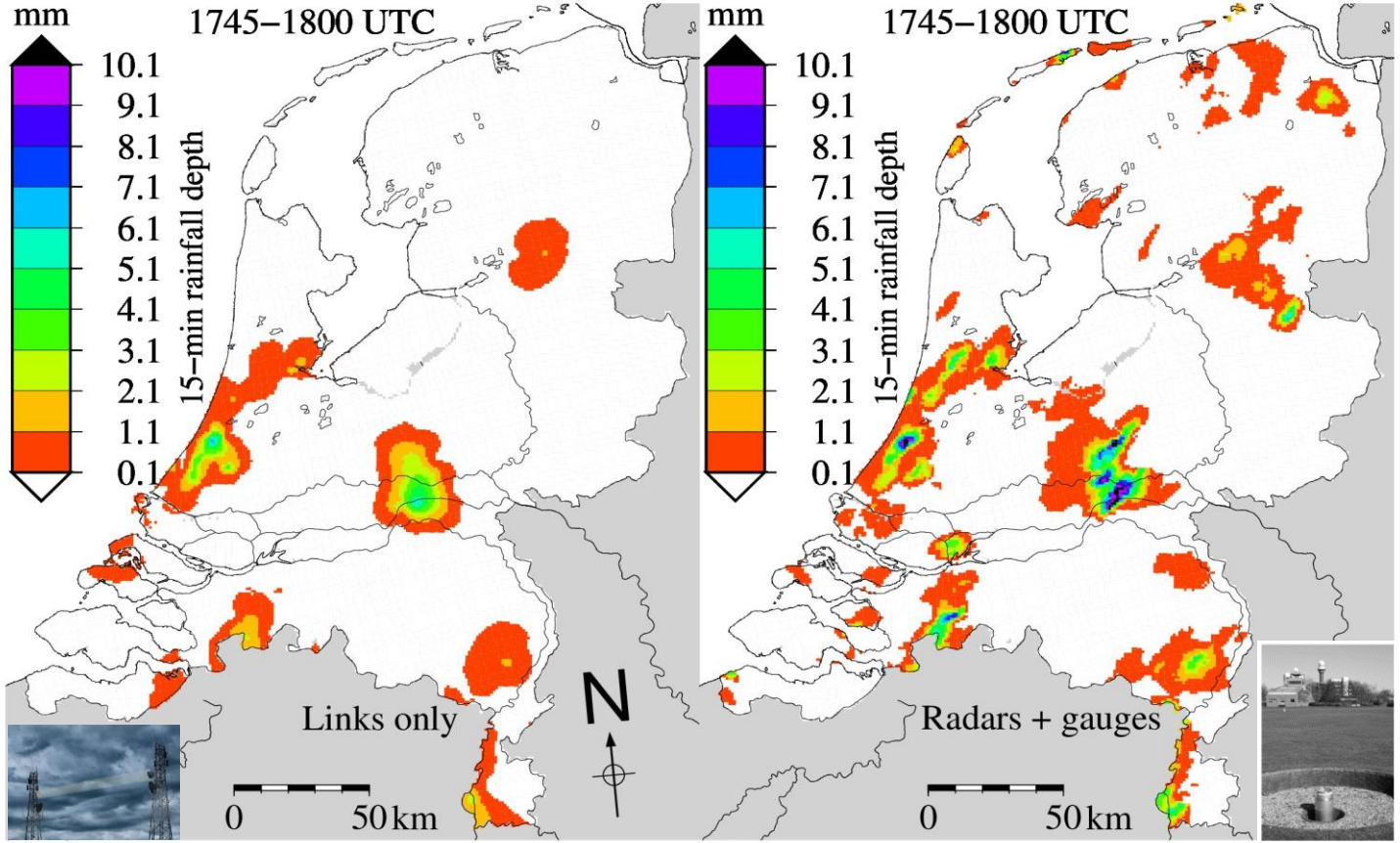

(Overeem et al., 2013)

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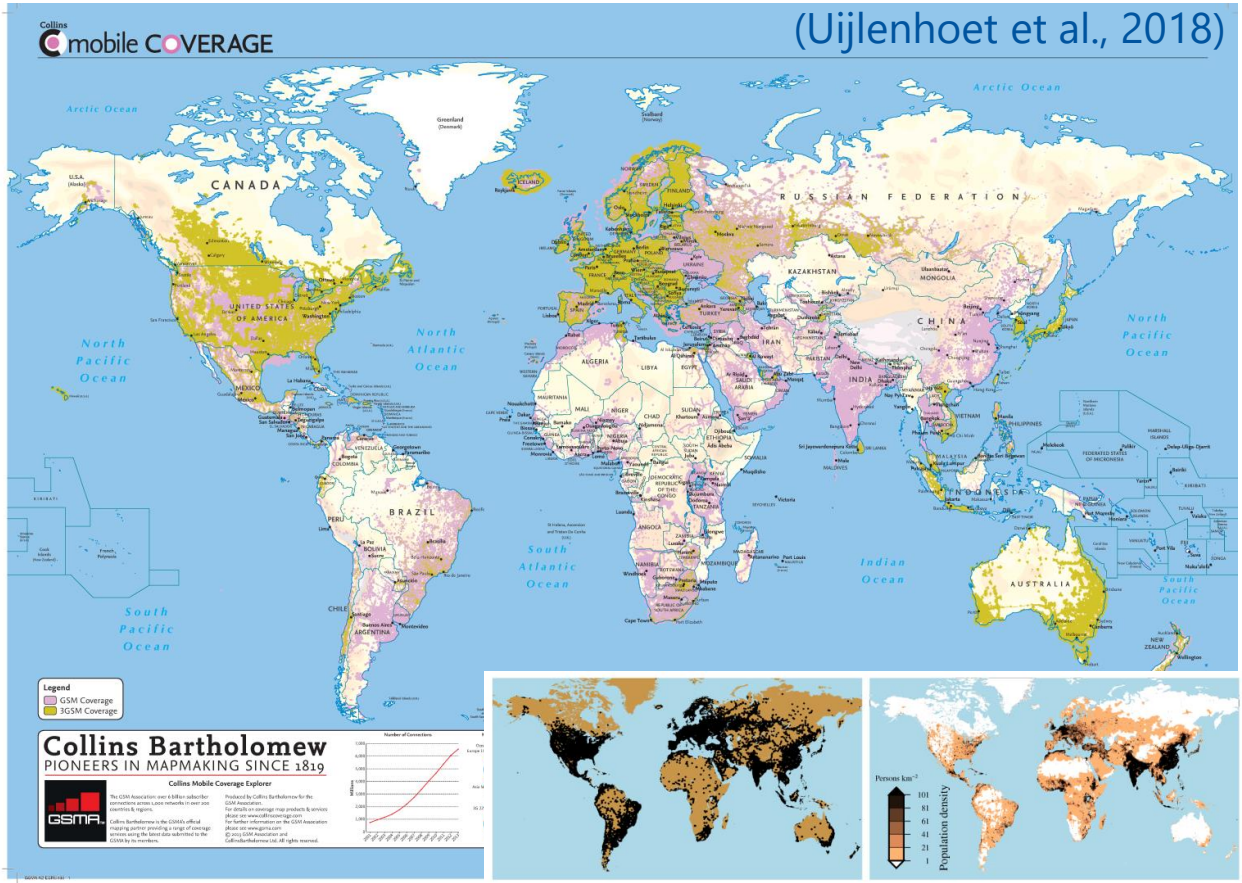

(Uijlenhoet et al., 2018)

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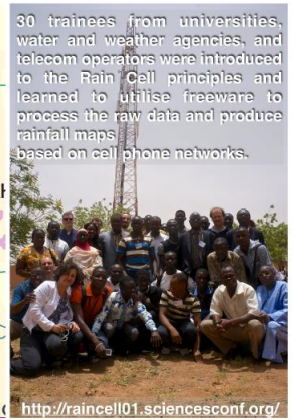
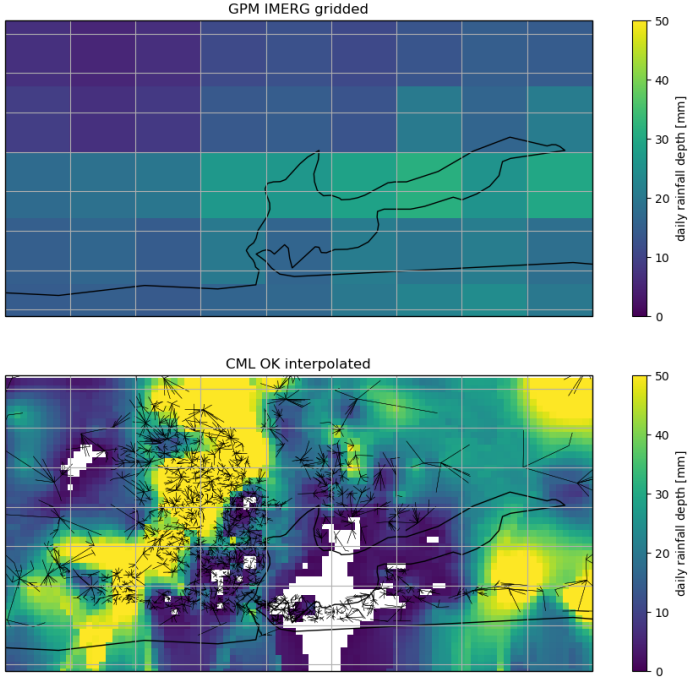
Raincell Africa Training School (Ouagadougou, Burkina Faso, 30 March – 2 April 2015)



(Gosset et al., 2016)

8,500 microwave links in Lagos, Nigeria



(Overeem et al., 2020)

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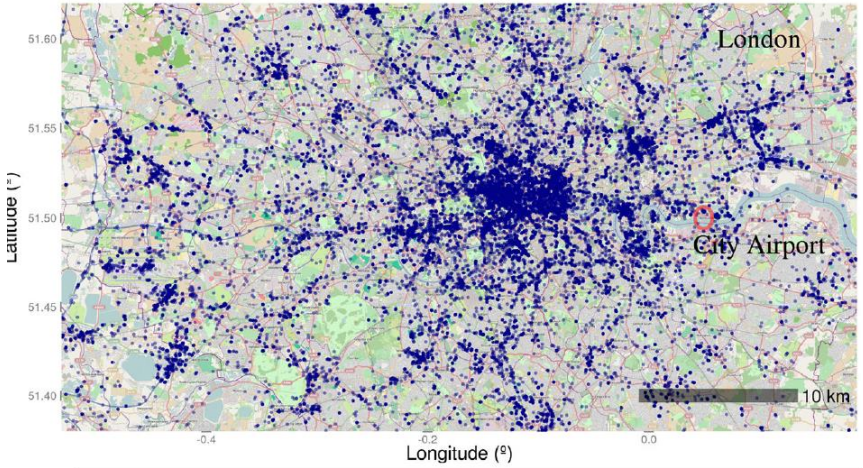
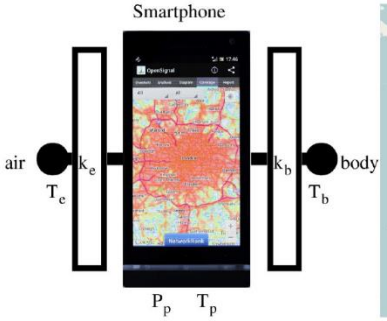
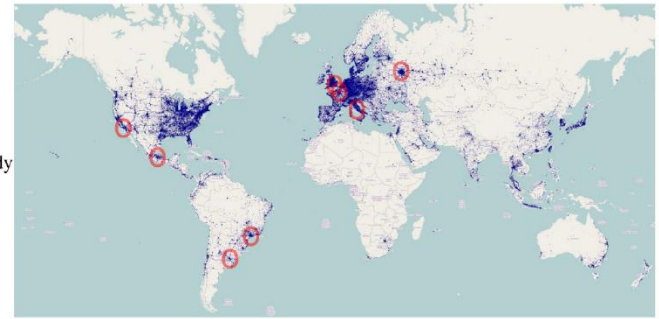
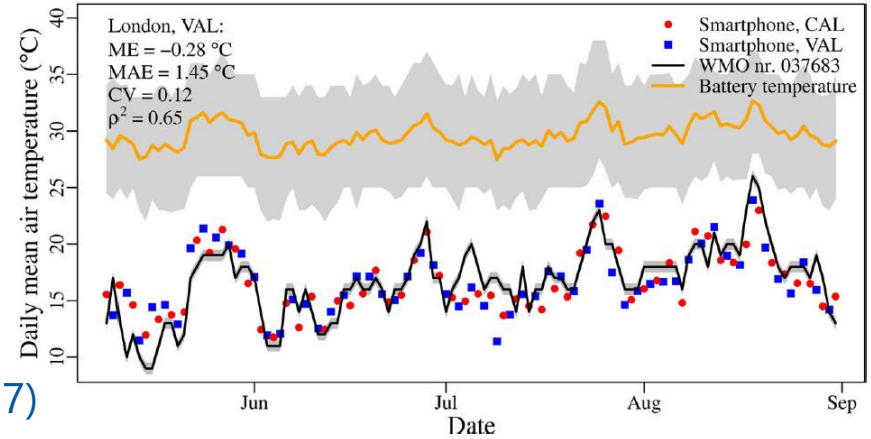
→ Smartphones can be employed to estimate average inner-city air temperatures









(Overeem et al., 2013; Droste et al., 2017)

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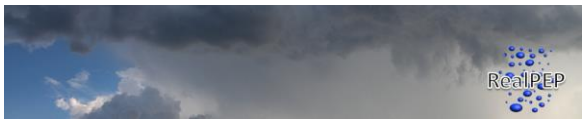
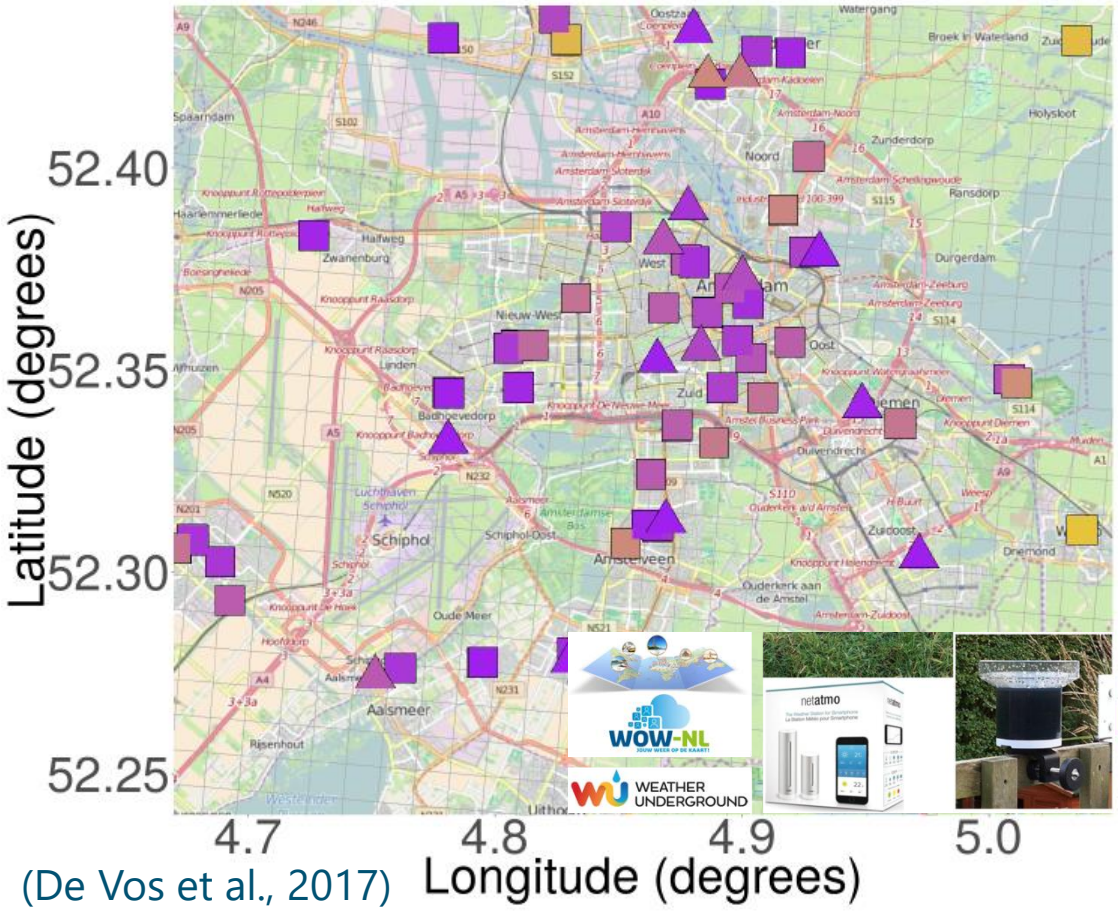
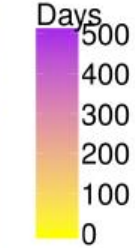
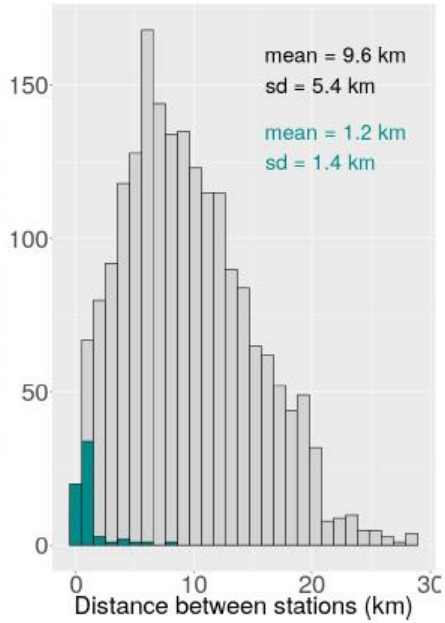




(De Vos et al., 2017)





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(De Vos et al., 2017)

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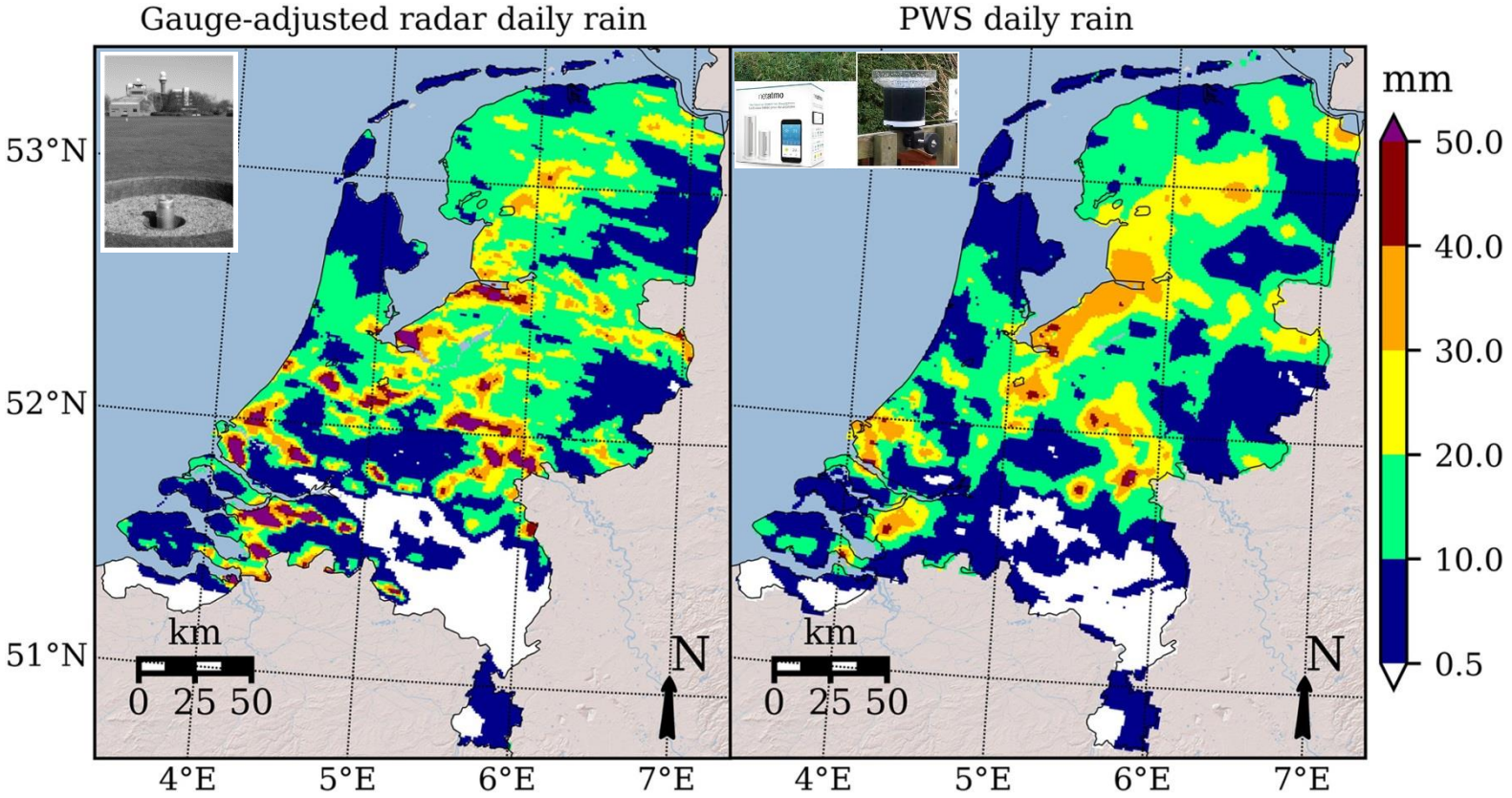

(De Vos et al., 2019; 2020)

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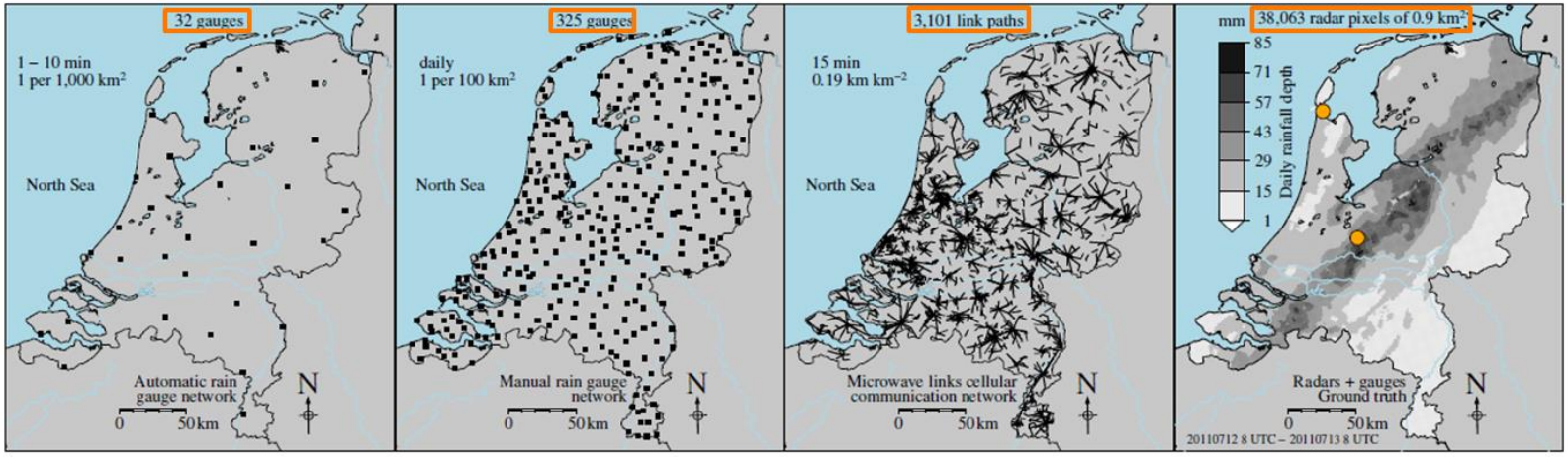

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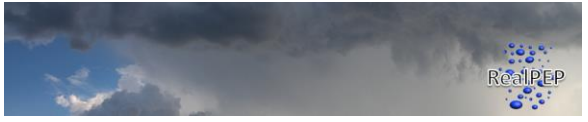

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- Opportunistic sensors complement dedicated sensor networks
- Cellular communication revolution (5G and beyond) provides opportunities for hydrologic monitoring
- Real-time data access requires business models for mobile network operators
- Paradigm shift: government agencies no longer have monopoly as data providers for hydrologic sciences and applications

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Geophysical Research Letters

RESEARCH LETTER
10.1029/2020GL089365

Rainfall Nowcasting Using Commercial Microwave Links

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[1]Hydrology and Quantitative Water Management Group, Wageningen University & Research, Wageningen, The Netherlands, [2]Operational Water Management & Early Warning, Department of Inland Water Systems, Deltares, Delft, The Netherlands, [3]R&D Observations and Data Technology, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands

Key Points:

- Probabilistic rainfall nowcasts are constructed with rainfall estimates from commercial microwave links
- The nowcasts are compared to radar rainfall nowcasts for 12 summer days
- Nowcast skill depends on link network density and is generally comparable to that of radar rainfall nowcasts

Supporting Information:

- Supporting Information S1
- Movie S1
- Movie S2

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Abstract Accurate and timely precipitation forecasts are crucial for early warning. Rainfall nowcasting, the process of statistically extrapolating recent rainfall observations, is increasingly used for short-term forecasting. Nowcasts are generally constructed with high-resolution radar observations. As a proof of concept, we construct nowcasts with country-wide rainfall maps estimated from signal level data of commercial microwave links (CMLs) for 12 summer days in the Netherlands. CML nowcasts compare well to radar rainfall nowcasts. Provided well-calibrated CML rainfall estimates are employed, CML nowcasts can outperform unadjusted real-time radar nowcasts for high rainfall rates, which are underestimated as compared to a reference. Care should be taken with the sensitivity of the advection field derivation to areas with low CML coverage and the inherent measurement scale of CML data, which can be larger than the application scale. We see potential for rainfall nowcasting with CML data, for example, in regions where weather radars are absent.

Thank you

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100years
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