BUILDING A HIGH RESOLUTION RAINFALL MONITORING MODEL USING MOBILE SIGNALS.

Isaac Mugume[1,2]

Ph.D (Mak), M.Sc(NUIST), MBA(SMU), GMET(Mak), B.Sc(MUST)

[1]**Hub for Environmental & Atmospheric Research**
[2]**Department of Geography, Geoinformatics & Climatic Sciences**
Makerere University

MAKERERE UNIVERSITY-SWEDEN BILATERAL RESEARCH COOPERATION ANNUAL REVIEW MEETING FOR RESEARCH SUPPORT TO UGANDA

30th September 2019

Promoters:



- Prof. Patrick Eriksson
- Dr. Andersson Jafet

Contents

- Introduction to the study
- Case studies
- Existing rainfall monitoring techniques
- Why customize for Uganda
- Expected outcomes

Contents

- Introduction to the study
- Case studies
- Existing rainfall monitoring techniques
- Why customize for Uganda
- Expected outcomes

Contents

- Introduction to the study
- Case studies
- Existing rainfall monitoring techniques
- Why customize for Uganda
- Expected outcomes

Contents

- Introduction to the study
- Case studies
- Existing rainfall monitoring techniques
- Why customize for Uganda
- Expected outcomes

Contents

- Introduction to the study
- Case studies
- Existing rainfall monitoring techniques
- Why customize for Uganda
- Expected outcomes

Introduction to the study

- existing influence of weather on signal strength
- using the variation of signal strength to monitor the weather
- predicting weather using signal strength
- potential of improving monitoring over sparse areas

Introduction to the study

- existing influence of weather on signal strength
- using the variation of signal strength to monitor the weather
- predicting weather using signal strength
- potential of improving monitoring over sparse areas

Introduction to the study

- existing influence of weather on signal strength
- using the variation of signal strength to monitor the weather
- predicting weather using signal strength
- potential of improving monitoring over sparse areas

Introduction to the study

- existing influence of weather on signal strength
- using the variation of signal strength to monitor the weather
- predicting weather using signal strength
- potential of improving monitoring over sparse areas

Case studies

- Rainfall Estimation Using Commercial Microwave Links Attenuations for the case of the Extreme Event of 1^{st} September 2009 in Ouagadougou [1]

Findings:

- $r \approx 0.63$ for 1 hour **RF** | microwave link.
- The cumulative rainfall bias during the event less than 5%.
- The opportunity to use microwave backhauling to assess **RF** in Africa.

Case studies

- Rainfall Estimation Using Commercial Microwave Links Attenuations for the case of the Extreme Event of 1^{st} September 2009 in Ouagadougou [1]

Findings:

- $r \approx 0.63$ for 1 hour **RF** | microwave link.
- The cumulative rainfall bias during the event less than 5%.
- The opportunity to use microwave backhauling to assess **RF** in Africa.

Case studies

- Rainfall Estimation Using Commercial Microwave Links Attenuations for the case of the Extreme Event of 1^{st} September 2009 in Ouagadougou [1]

Findings:

- $r \approx 0.63$ for 1 hour **RF** | microwave link.
- The cumulative rainfall bias during the event less than 5%.
- The opportunity to use microwave backhauling to assess **RF** in Africa.

Case studies

- Rainfall Estimation Using Commercial Microwave Links Attenuations for the case of the Extreme Event of 1^{st} September 2009 in Ouagadougou [1]

Findings:

- $r \approx 0.63$ for 1 hour **RF** | microwave link.
- The cumulative rainfall bias during the event less than 5%.
- The opportunity to use microwave backhauling to assess **RF** in Africa.

Case studies

- Rainfall Estimation Using Commercial Microwave Links Attenuations for the case of the Extreme Event of 1^{st} September 2009 in Ouagadougou [1]

Findings:

- $r \approx 0.63$ for 1 hour **RF** | microwave link.
- The cumulative rainfall bias during the event less than 5%.
- The opportunity to use microwave backhauling to assess **RF** in Africa.

Case studies

- Rainfall estimation by signal attenuation analysis in mobile systems [2]

Findings

- the mobile phone signals have the potential to estimate rainfall in real time
- it can be implemented in hydro–meteorological models.

Case studies

- Rainfall estimation by signal attenuation analysis in mobile systems [2]

Findings

- the mobile phone signals have the potential to estimate rainfall in real time
- it can be implemented in hydro–meteorological models.

Case studies

- Rainfall estimation by signal attenuation analysis in mobile systems [2]

Findings

- the mobile phone signals have the potential to estimate rainfall in real time
- it can be implemented in hydro–meteorological models.

Case studies

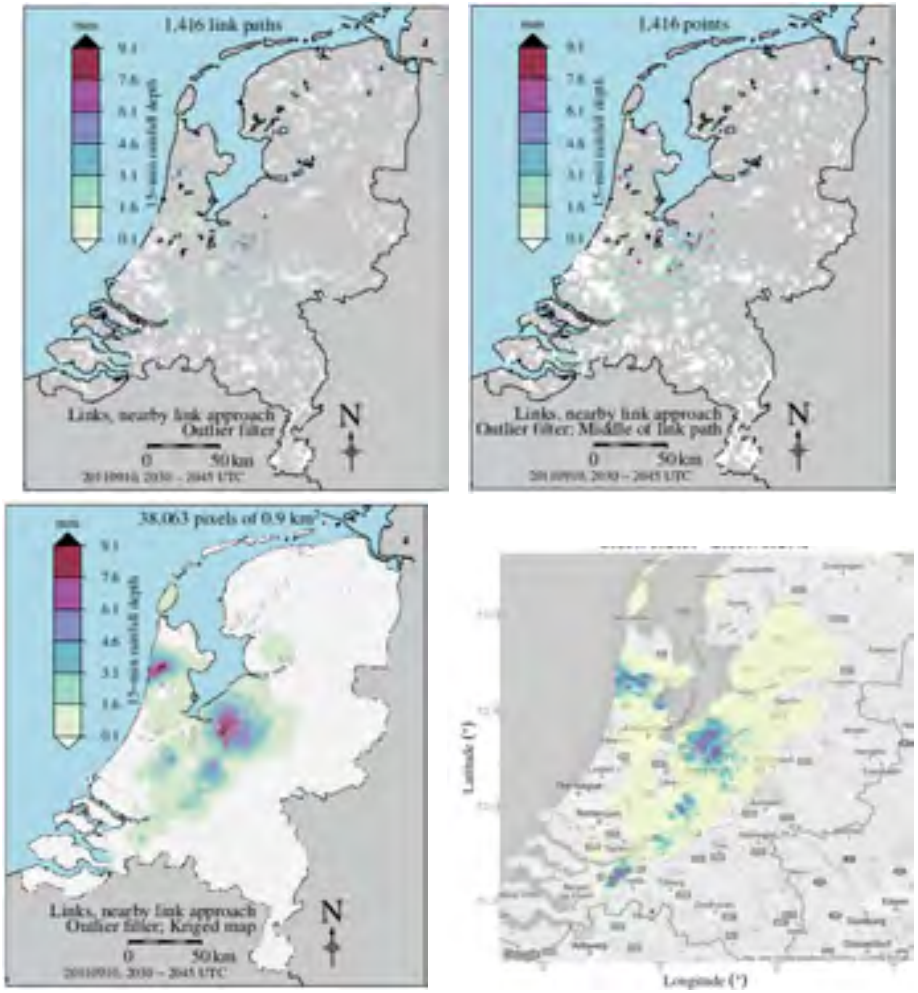
- Rainfall estimation by signal attenuation analysis in mobile systems [2]

Findings

- the mobile phone signals have the potential to estimate rainfall in real time
- it can be implemented in hydro–meteorological models.

Case studies

- Retrieval algorithm for rainfall mapping from microwave links in a cellular communication network [3].
- Netherlands ($\approx 35,500 Km^2$; 15 minutes resolution; using 2,400 microwave links)

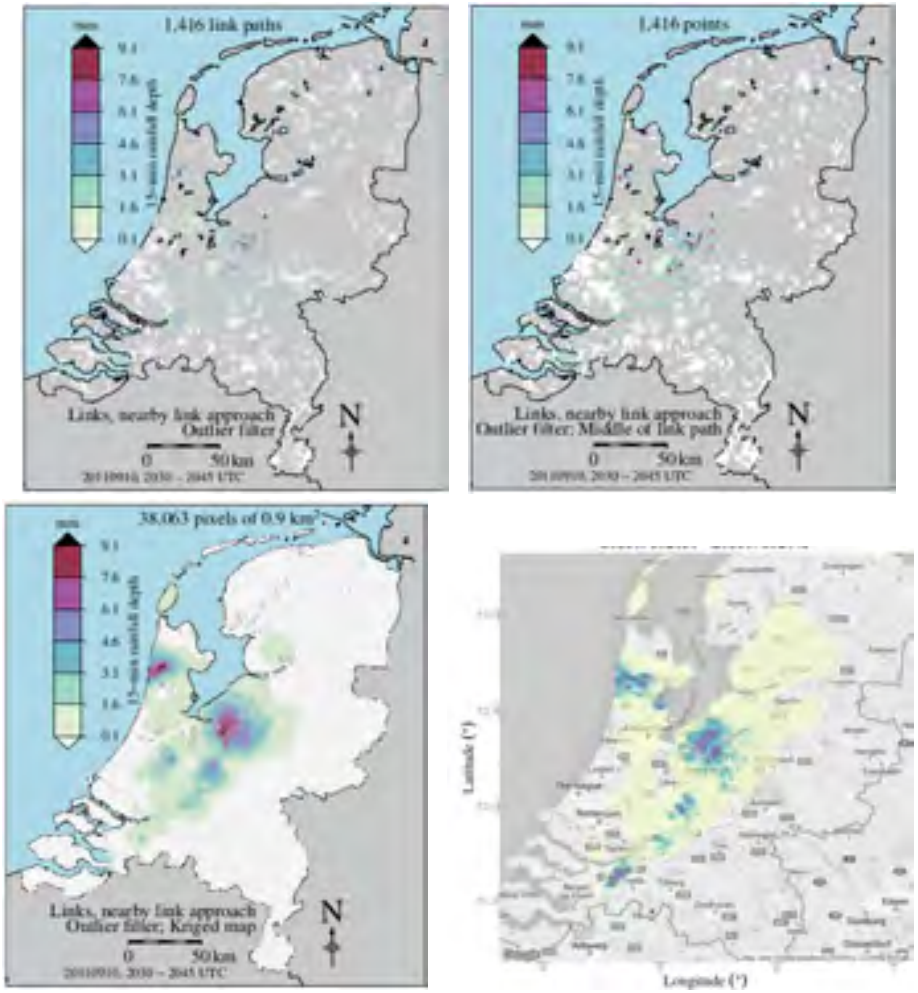


Source: https://www.atmos-meas-tech.net/9/2425/2016/

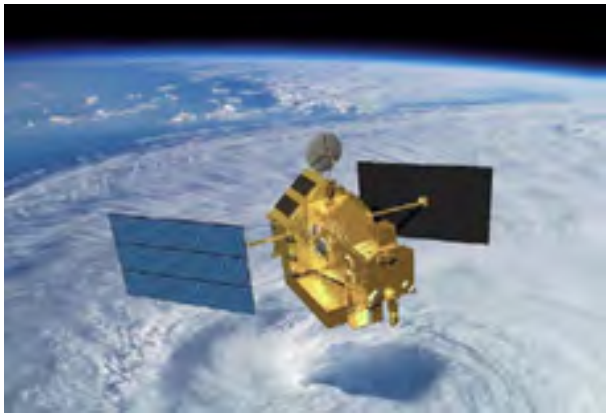
Case studies

- Retrieval algorithm for rainfall mapping from microwave links in a cellular communication network [3].
- Netherlands ($\approx 35,500 Km^2$; 15 minutes resolution; using 2,400 microwave links)

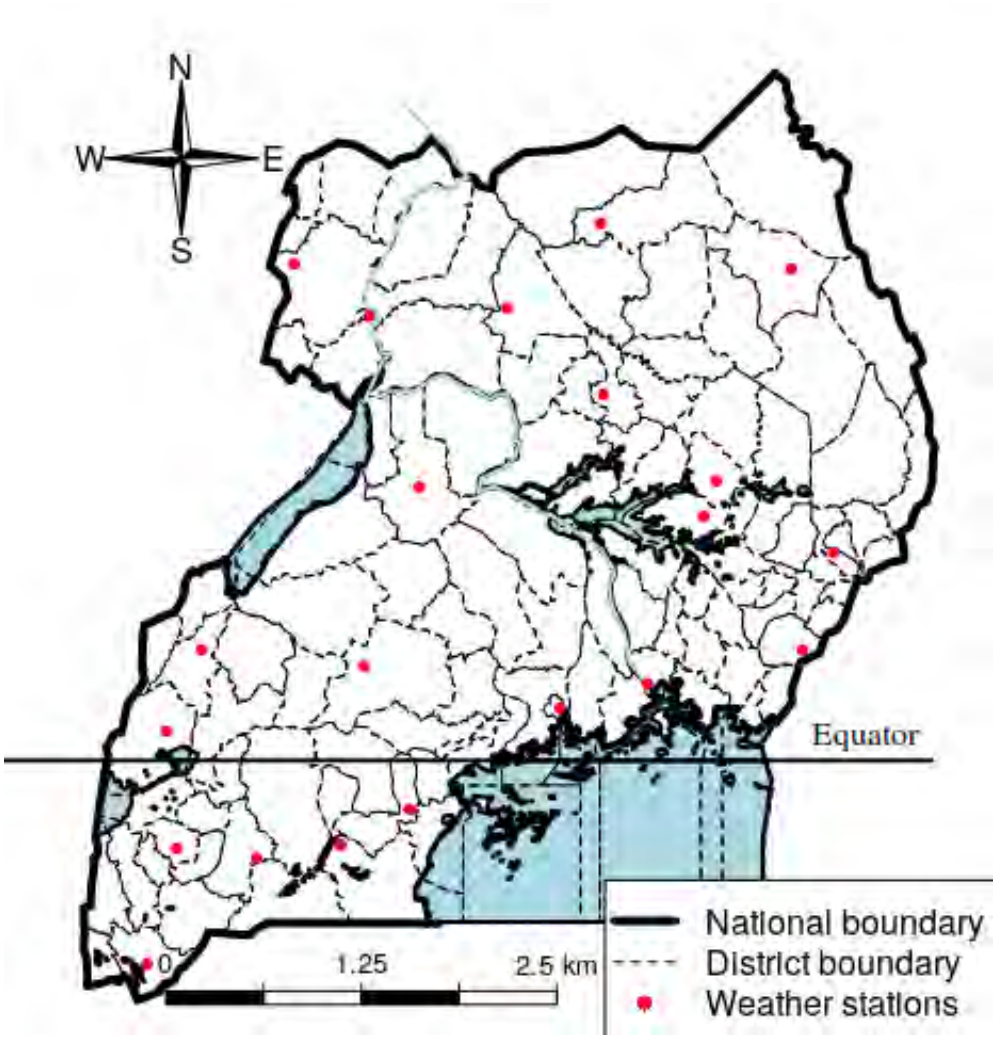
Source: `https://www.atmos-meas-tech.net/9/2425/2016/`



Existing rainfall monitoring techniques



Distribution of rainfall monitoring stations



Why the need for Uganda?

- manual systems – human errors
- maintenance & calibration challenges
- errors in remote sensing instruments
- costs

Can't we just transfer skill? i.e. pick & plant here?

Why the need for Uganda?

- manual systems – human errors
- maintenance & calibration challenges
- errors in remote sensing instruments
- costs

Can't we just transfer skill? i.e. pick & plant here?

Why the need for Uganda?

- manual systems – human errors
- maintenance & calibration challenges
- errors in remote sensing instruments
- costs

Can't we just transfer skill? i.e. pick & plant here?

Why the need for Uganda?

- manual systems – human errors
- maintenance & calibration challenges
- errors in remote sensing instruments
- costs

Can't we just transfer skill? i.e. pick & plant here?

Why the need for Uganda?

- manual systems – human errors
- maintenance & calibration challenges
- errors in remote sensing instruments
- costs

Can't we just transfer skill? i.e. pick & plant here?

Expected output

- comparing the variation of microwave signals to changes in weather;
- spatializing the weather fields generated by microwave signals; and
- using the variation of microwave signals as short–term predictors of weather fields.
- seminar(s) & conference(s)
- demonstrate the economic potential of the findings

Expected output

- comparing the variation of microwave signals to changes in weather;
- spatializing the weather fields generated by microwave signals; and
- using the variation of microwave signals as short–term predictors of weather fields.
- seminar(s) & conference(s)
- demonstrate the economic potential of the findings

Expected output

- comparing the variation of microwave signals to changes in weather;
- spatializing the weather fields generated by microwave signals; and
- using the variation of microwave signals as short–term predictors of weather fields.
- seminar(s) & conference(s)
- demonstrate the economic potential of the findings

Expected output

- comparing the variation of microwave signals to changes in weather;
- spatializing the weather fields generated by microwave signals; and
- using the variation of microwave signals as short–term predictors of weather fields.
- seminar(s) & conference(s)
- demonstrate the economic potential of the findings

Expected output

- comparing the variation of microwave signals to changes in weather;
- spatializing the weather fields generated by microwave signals; and
- using the variation of microwave signals as short–term predictors of weather fields.
- seminar(s) & conference(s)
- demonstrate the economic potential of the findings

A. Doumounia, M. Sawadogo, S. R. Sanou, and F. Zougmoré, "Rainfall estimation using commercial microwave links (cmls) attenuations: Analyse of extreme event of 1 st september 2009 in ouagadougou," *American Journal of Environmental Protection*, vol. 8, no. 1, p. 1, 2019.

R. I. F. Rodriguez, G. Prez, M. Werner, A. G. Castaño, and A. Cano, "Rainfall estimation by a signal attenuation analysis in mobile systems," in *XV Symp. SELPER*, 2012.

A. Overeem, H. Leijnse, and R. Uijlenhoet, "Retrieval algorithm for rainfall mapping from microwave links in a cellular communication network," *Atmospheric Measurement Techniques*, vol. 9, no. 5, pp. 2425–2444, 2016.