RAINCELL : Rainfall Measurement from Cell phone network

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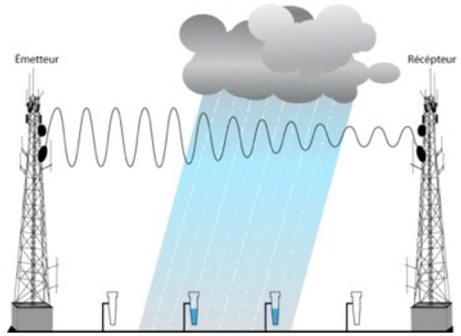
24/10/2022



Needs for better rainfall measurement techniques

- Rain Gauge network not dense enough and decreasing

- Radar –Brillant but very expensive (initial investment and maintenance)
- Satellite (MSG/MTG + GPM) :greatly improved but still some needs for improvement at small scales (20 km/3 h or better) and RT

A solution in telecom network ?

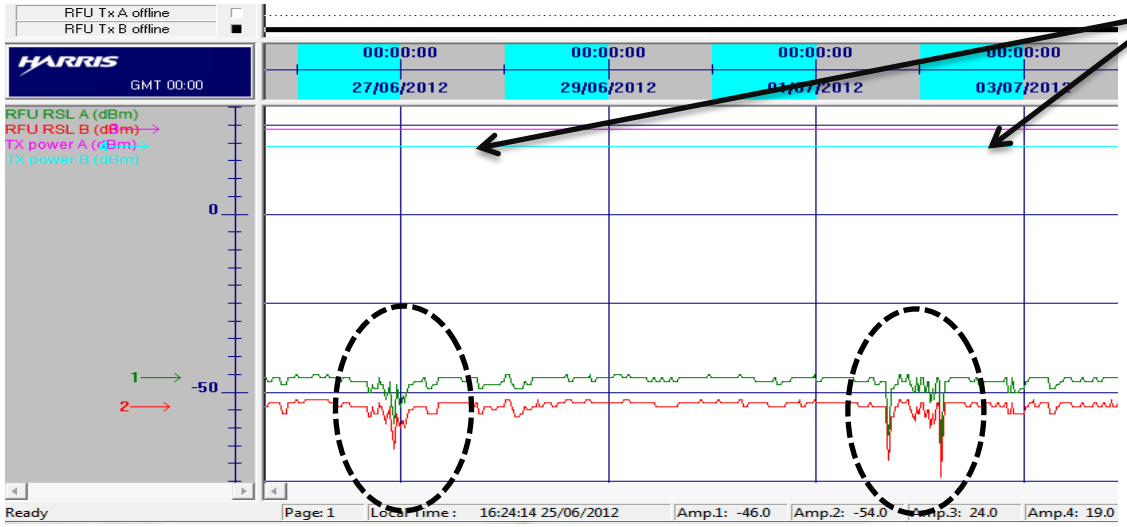
- Telecommunication networks are increasing

(density : several hundreds or thousands of links/ for a single rain gauge)

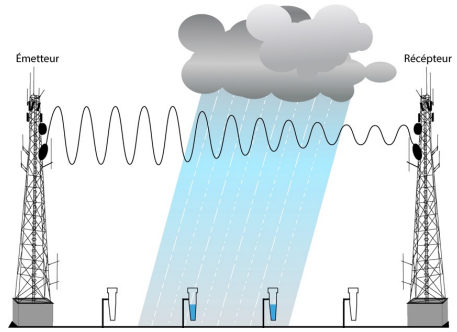
- Already dense in major cities
- Future plan to cover Africa more densily
- Radio Wave are sensitive to rainfall

TELECOM NETWORK -> RAINFALL Measurement !

- Radio transmission are used in some part of the mobile telecom network (backhaul)
- Rain attenuates the signal between the antennas
- Il we measure these fluctuations we can estimate the amount of rain fall over the given period.

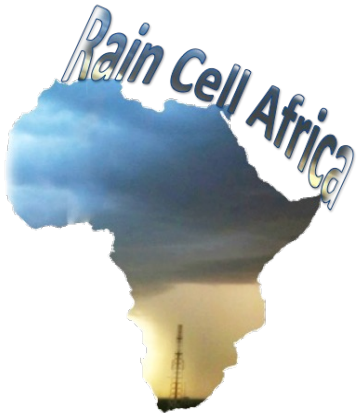


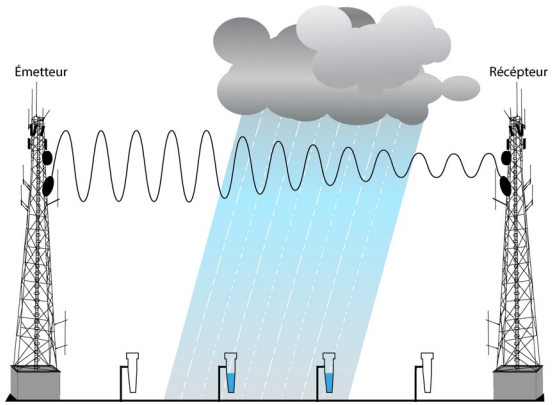
Typical signature
of a storm
on received (Rx)
signal levels



Crédits Télécel Faso

Previously On rain Cell : AFRICA – Several pilot test beds – with real time data

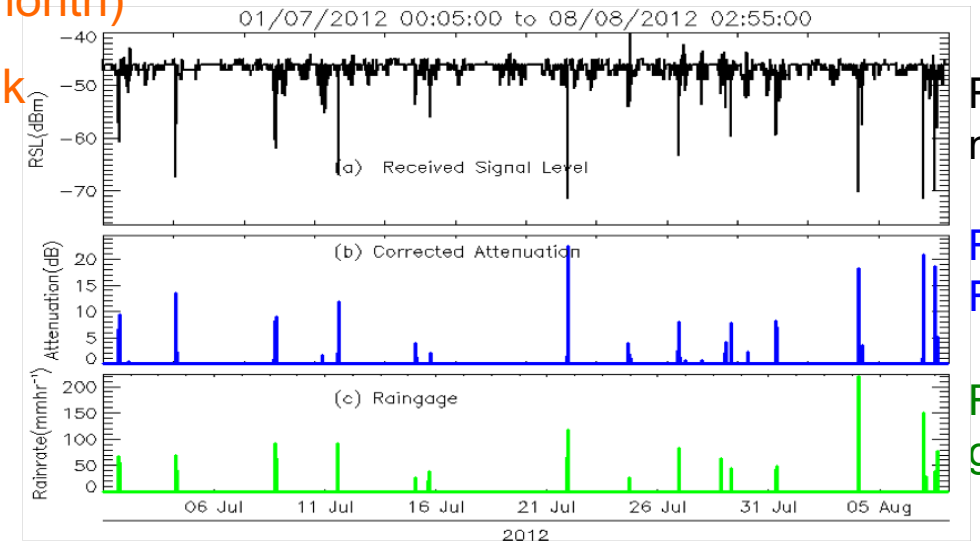




2012(2 month)

7 Ghz link

40 km



Raw Rx from mobile operator

Rain event detected From raw data analysis

Rain measured by rain gauge

Figure 1 : **(a) Received minus Transmitted Raw Microwave Signal level. (b) path attenuation due to rain. (c) rain rate time series from the gauge situated below the link.**

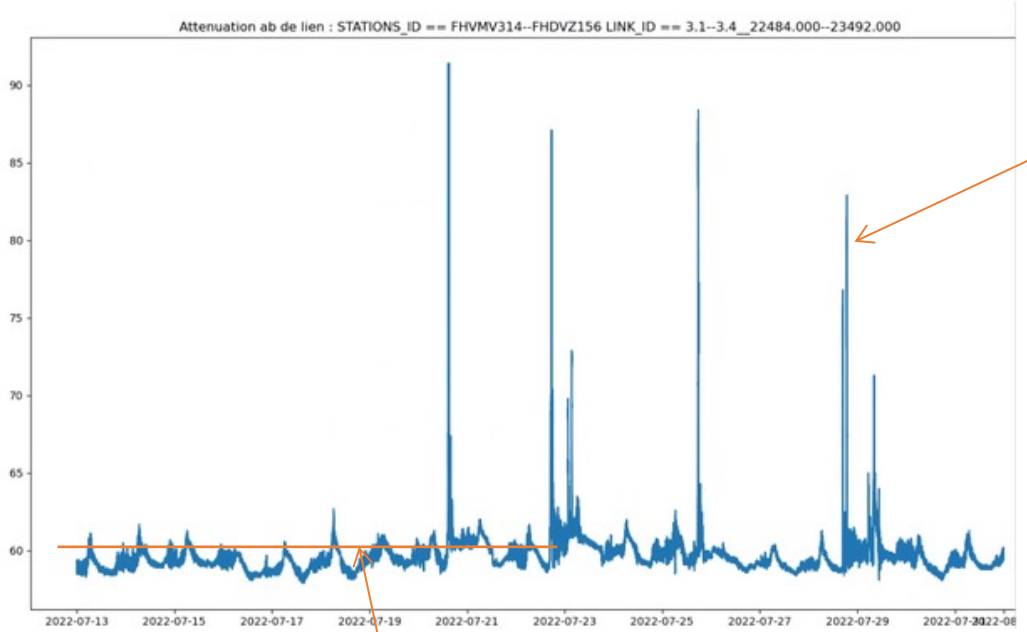
Processing steps /where IA could help ?

- Detection of the dry period to determine baseline level
- Isolating fluctuations due to Rainfall from other sources

- Quantify attenuation due to rain along the path
- attenuation from rain over the antenna

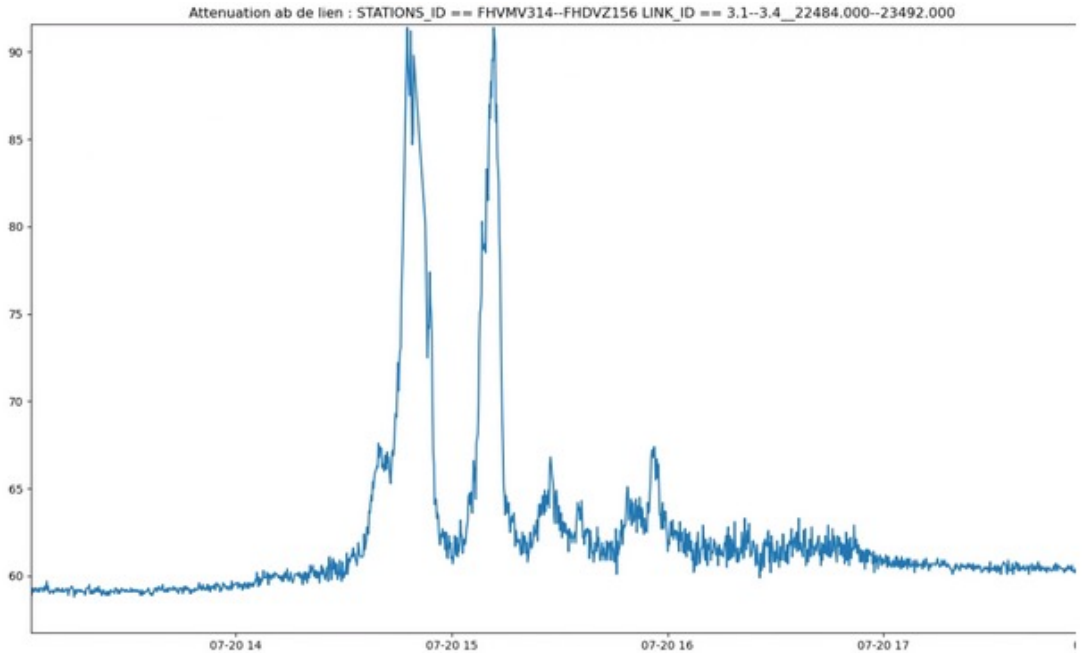
- Improve rainfall estimation algorithms /parameters

Exemple of time series (France / 12 seconde time step)

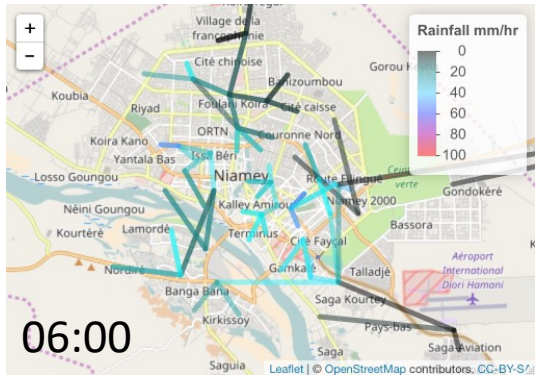


Rain peaks

Base line level ?

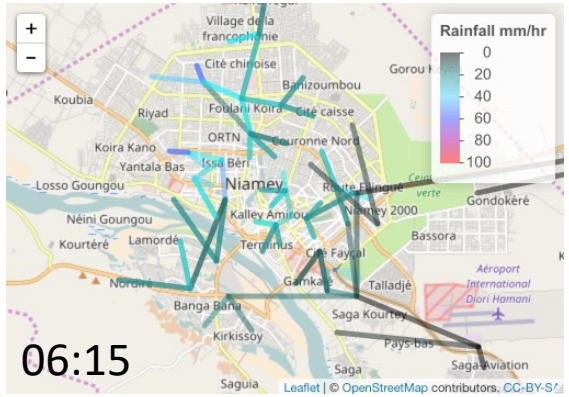


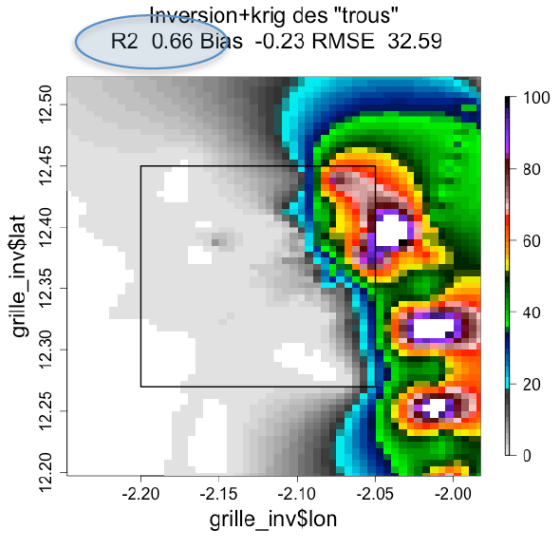
Rain Cell : step 2
Collecting data over the network to produce high resolution Rain Maps



Estimation at each link

?

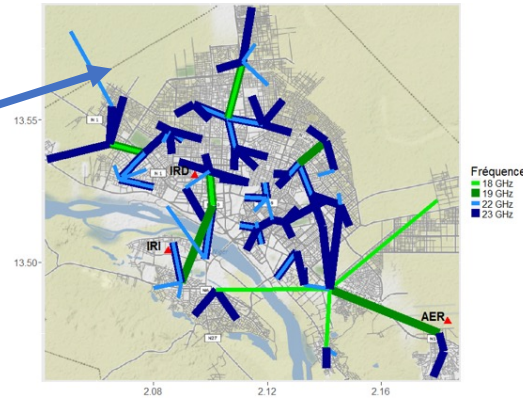


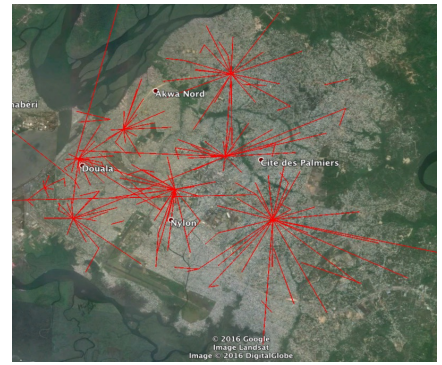


Regular grid map

Processing steps /where IA could help ?

- Interpolation methods
- 2D (or 3D with time) spatio-temporal interpolation
- From a heterogenous network
- Links length / frequency / orientation
- Parameters of attenuation k dB/km versus rain rate R mm/h relationships
- **Uncertainty / quality** depends on links characteristic
- Uncertainty / quality depends on **network density**
- How to use the redondancy of information among links ?





Thank you