Trans-African Hydro-Meteorological Observatory

Nick van de Giesen
(n.c.vandegiesen@tudelft.nl)
John Selker (OSU)

Outline

- **Flashflood & DTS**
- **Approach**
- **Design**
- **Operation**
- **Education**

Flashfloods & DTS

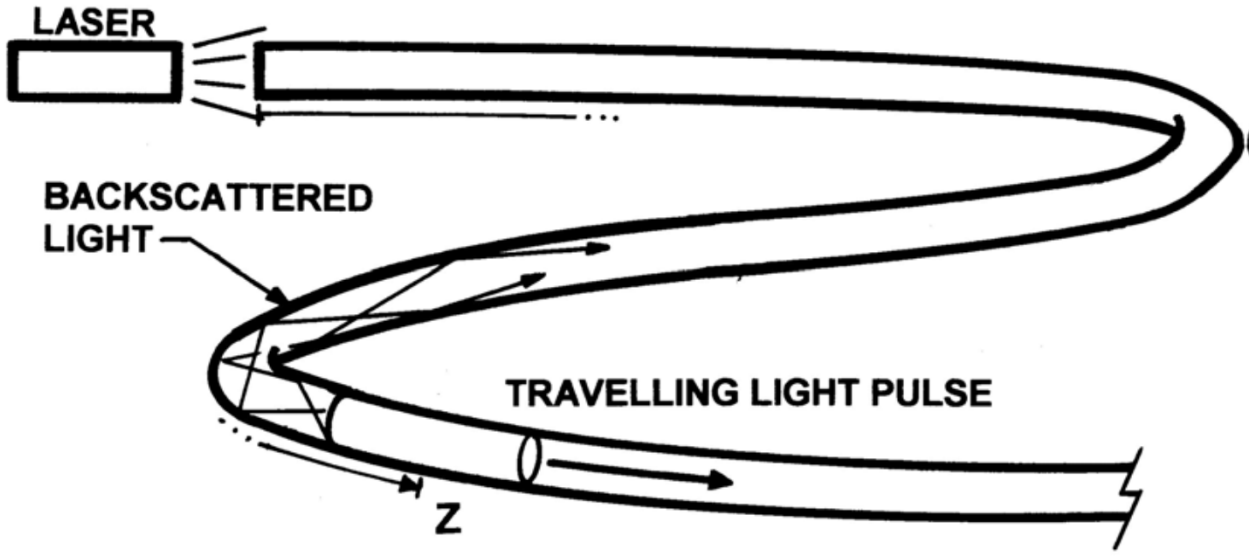
Distributed Temperature Sensing

- **Fiber optic cable**
- **Laser pulse (5 ns)**
- **Reflections**

Principles DTS

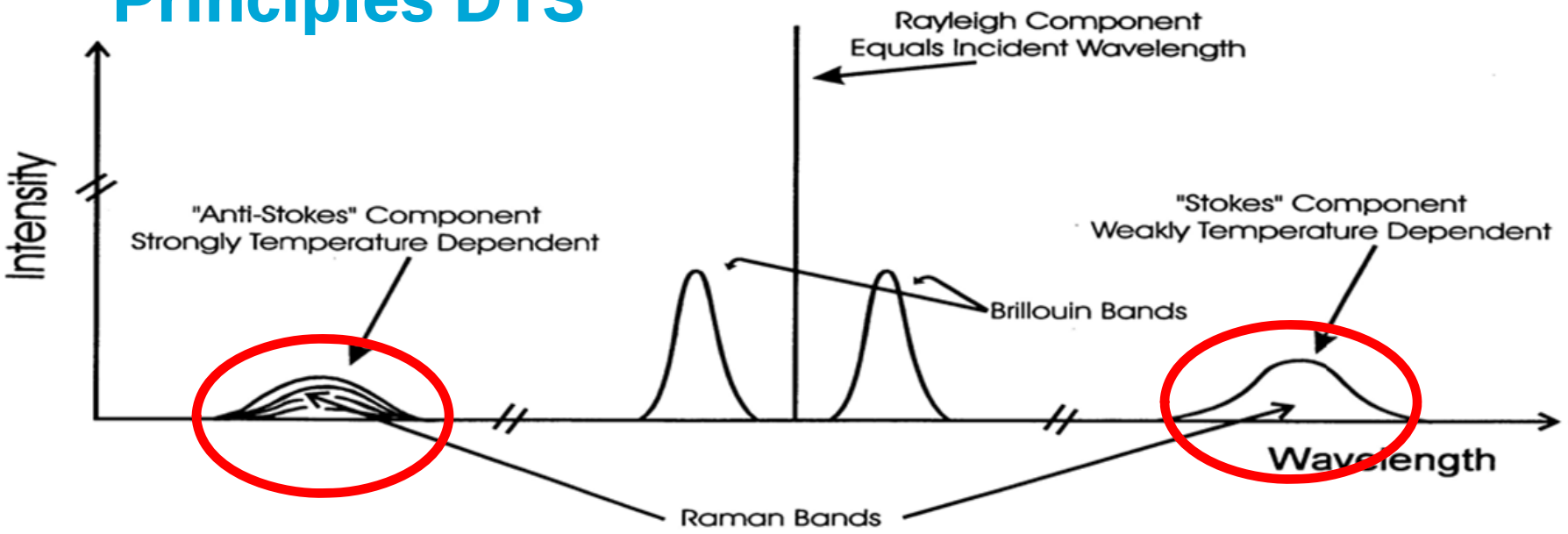
Time of flight (1 m resolution)

$$v = c/n = (3 \times 10^8)/1.5 = 2 \times 10^8 \text{ m/s}$$



Flashfloods & DTS

Principles DTS



Principles DTS

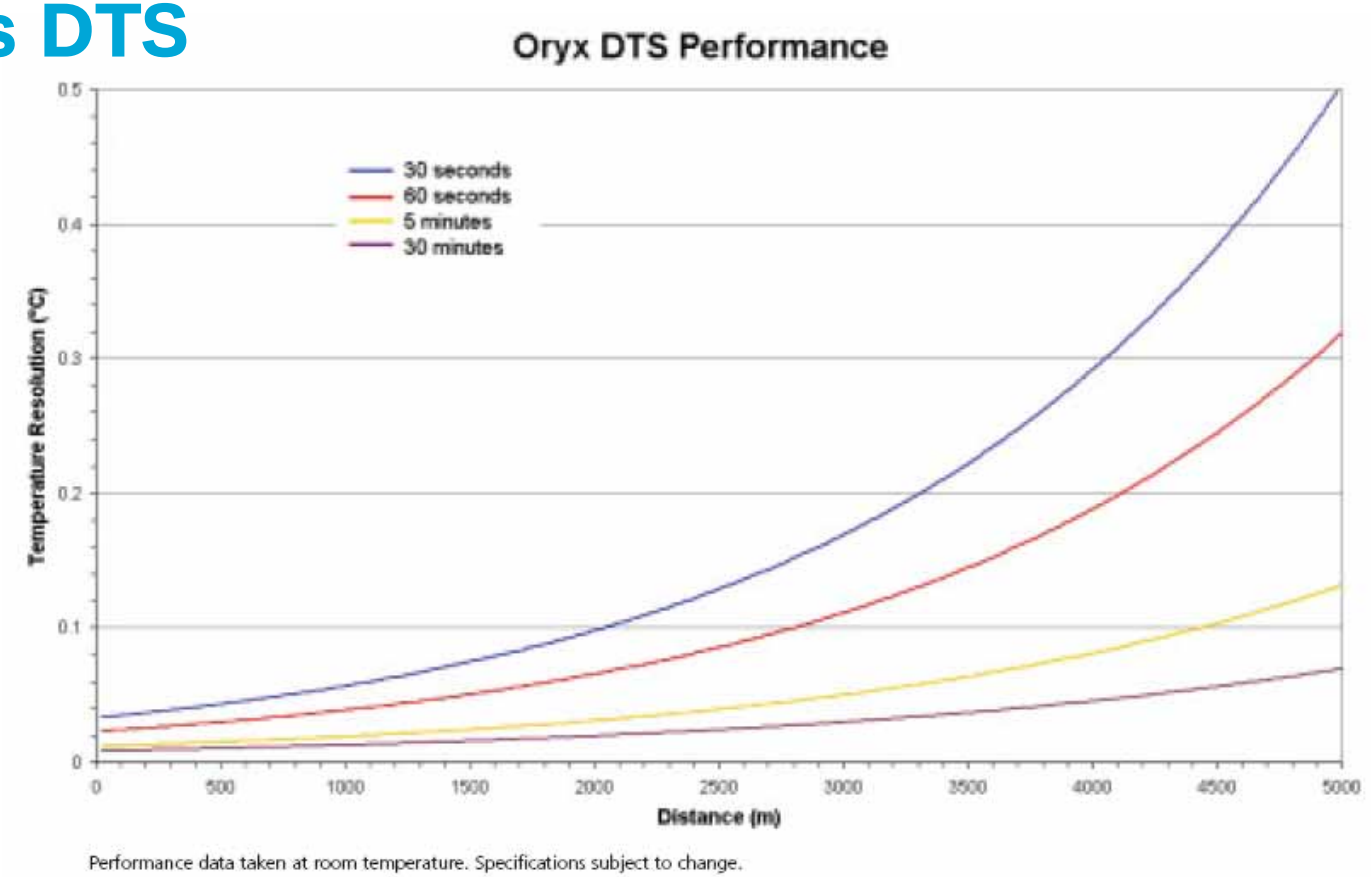
Specs

- **1 m spatial resolution**
- **Cable up to 5 km (50 km?)**
- **30 s temporal resolution**
- **0.01 K (30’ integration)**

Flashfloods & DTS

Principles DTS

Specs



Flashfloods & DTS

Flash floods

Stream

Flashfloods & DTS

Flash floods

Leak detection irrigation

Coleambally

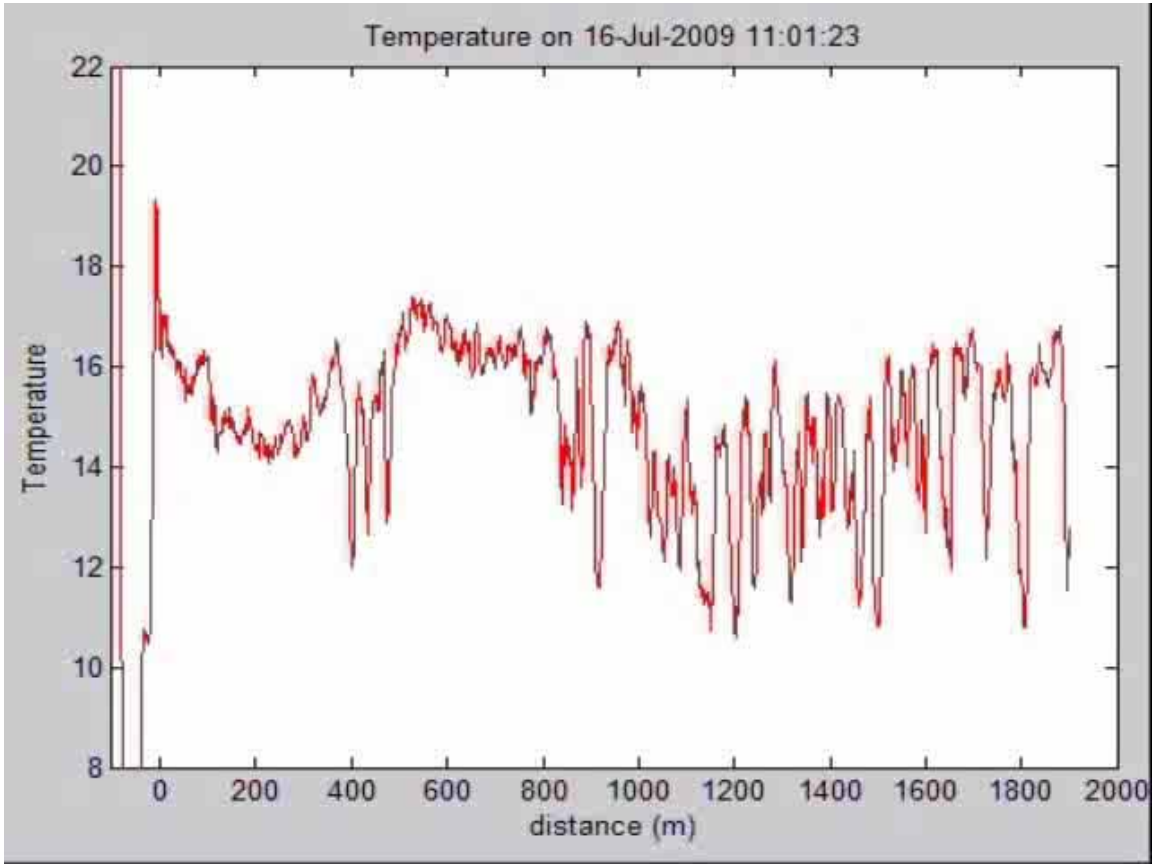
Flashfloods & DTS

Flash floods

Leak detection irrigation

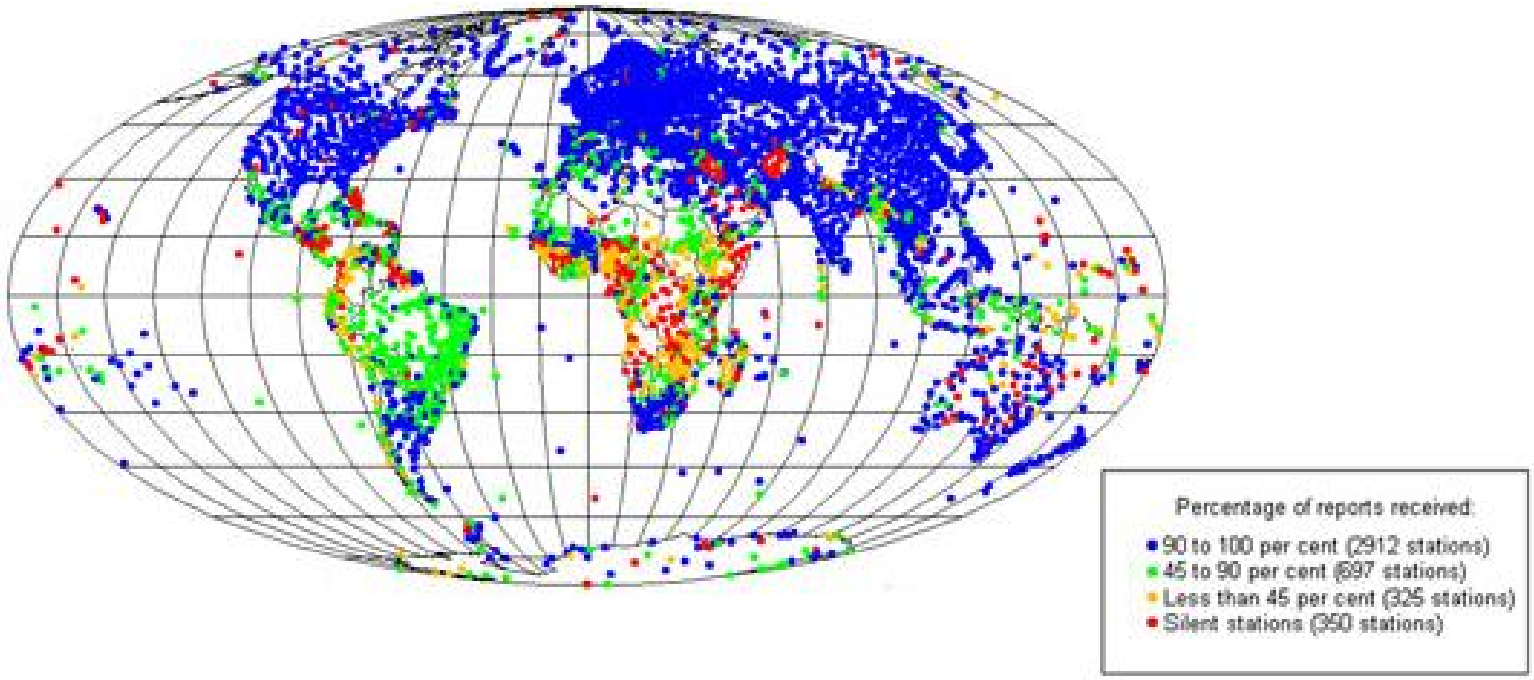
Coleambally

http://youtu.be/KapqCCnQzdc



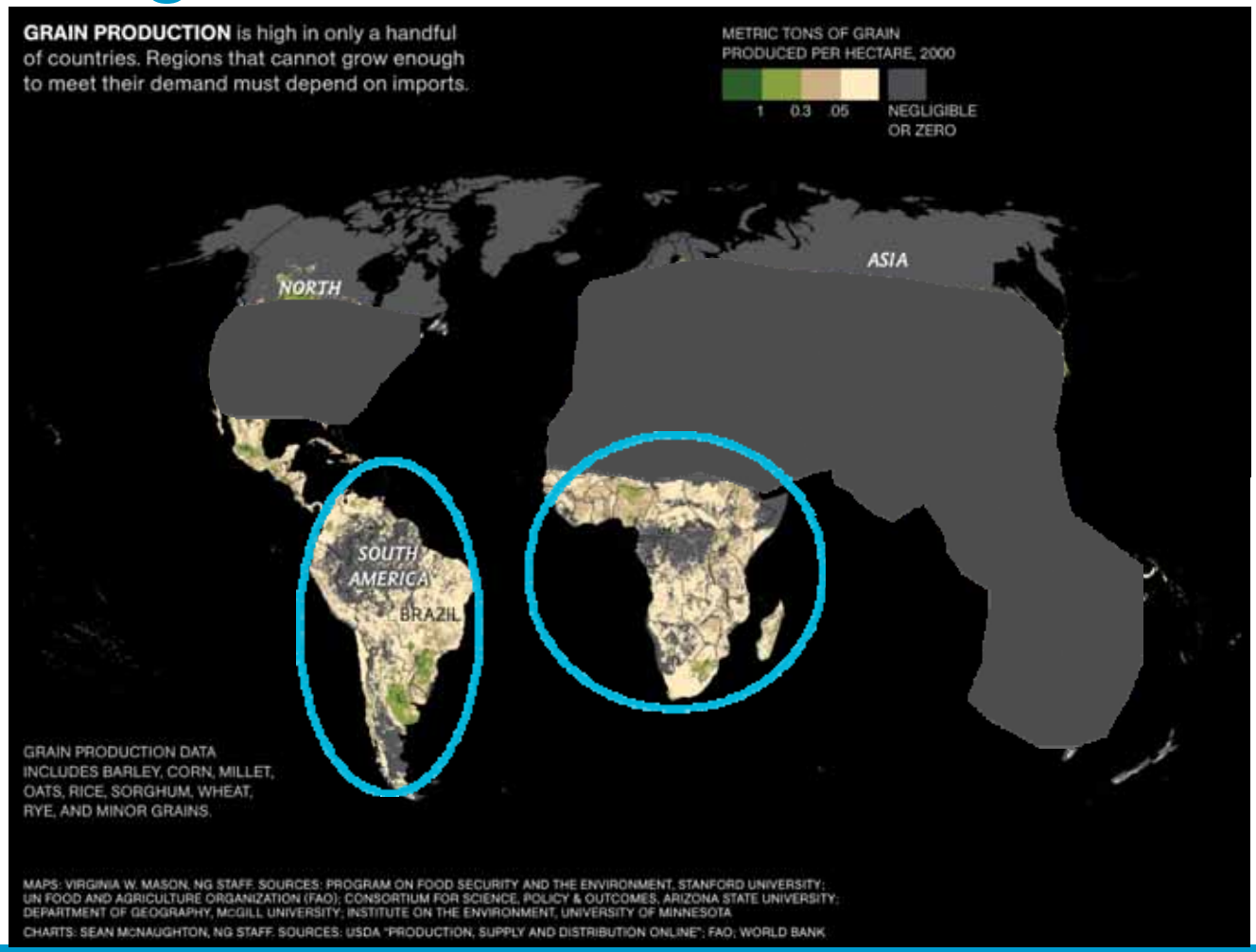
Background

WMO Stations



WMO Secretariat

Irrigatie


GRAIN PRODUCTION is high in only a handful of countries. Regions that cannot grow enough to meet their demand must depend on imports.
METRIC TONS OF GRAIN PRODUCED PER HECTARE, 2000
1
0.3
.05
NEGLIGIBLE OR ZERO
NORTH
ASIA
SOUTH AMERICA
BRAZIL
GRAIN PRODUCTION DATA INCLUDES BARLEY, CORN, MILLET, OATS, RICE, SORGHUM, WHEAT, RYE, AND MINOR GRAINS.
MAPS: VIRGINIA W. MASON, NG STAFF. SOURCES: PROGRAM ON FOOD SECURITY AND THE ENVIRONMENT, STANFORD UNIVERSITY; UN FOOD AND AGRICULTURE ORGANIZATION (FAO); CONSORTIUM FOR SCIENCE, POLICY & OUTCOMES, ARIZONA STATE UNIVERSITY; DEPARTMENT OF GEOGRAPHY, MCGILL UNIVERSITY; INSTITUTE ON THE ENVIRONMENT, UNIVERSITY OF MINNESOTA
CHARTS: SEAN MCNAUGHTON, NG STAFF. SOURCES: USDA "PRODUCTION, SUPPLY AND DISTRIBUTION ONLINE"; FAO; WORLD BANK

Background

Geophysical Research Abstracts
Vol. 16, EGU2014-10300, 2014
EGU General Assembly 2014

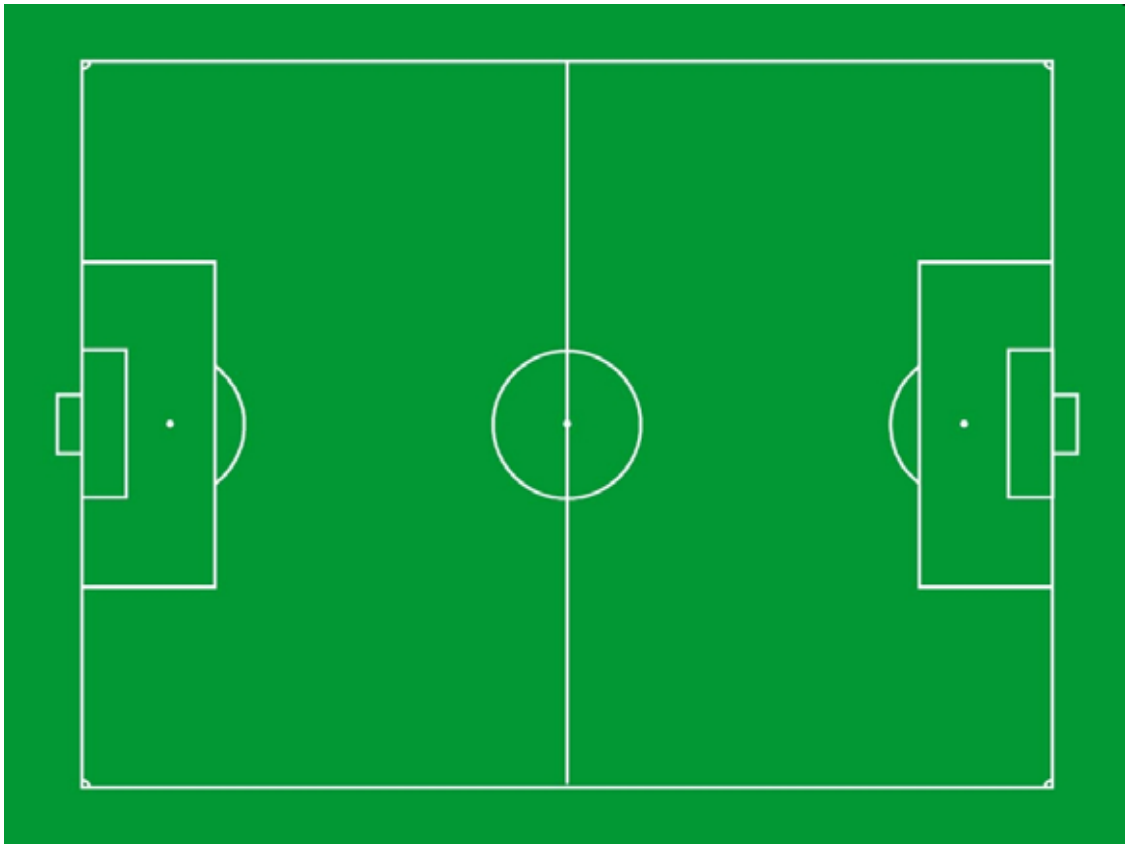
So, how much of the Earth's surface is covered by rain gauges?

Chris Kidd (1), George Huffman (2), Dalia Kirschbaum (2), Gail Skofronick-Jackson (2), Paul Joe (3), and Catherine Muller (4)

(1) Earth System Science Interdisciplinary Center, University of Maryland, College Park, Maryland, 20740 and NASA/Goddard Space Flight Center, Greenbelt, Maryland. 20771, (2) NASA/Goddard Space Flight Center, Greenbelt, Maryland, 20771 , (3) Environment Canada, Meteorological Research Division, Toronto, Canada, (4) School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston,

Background

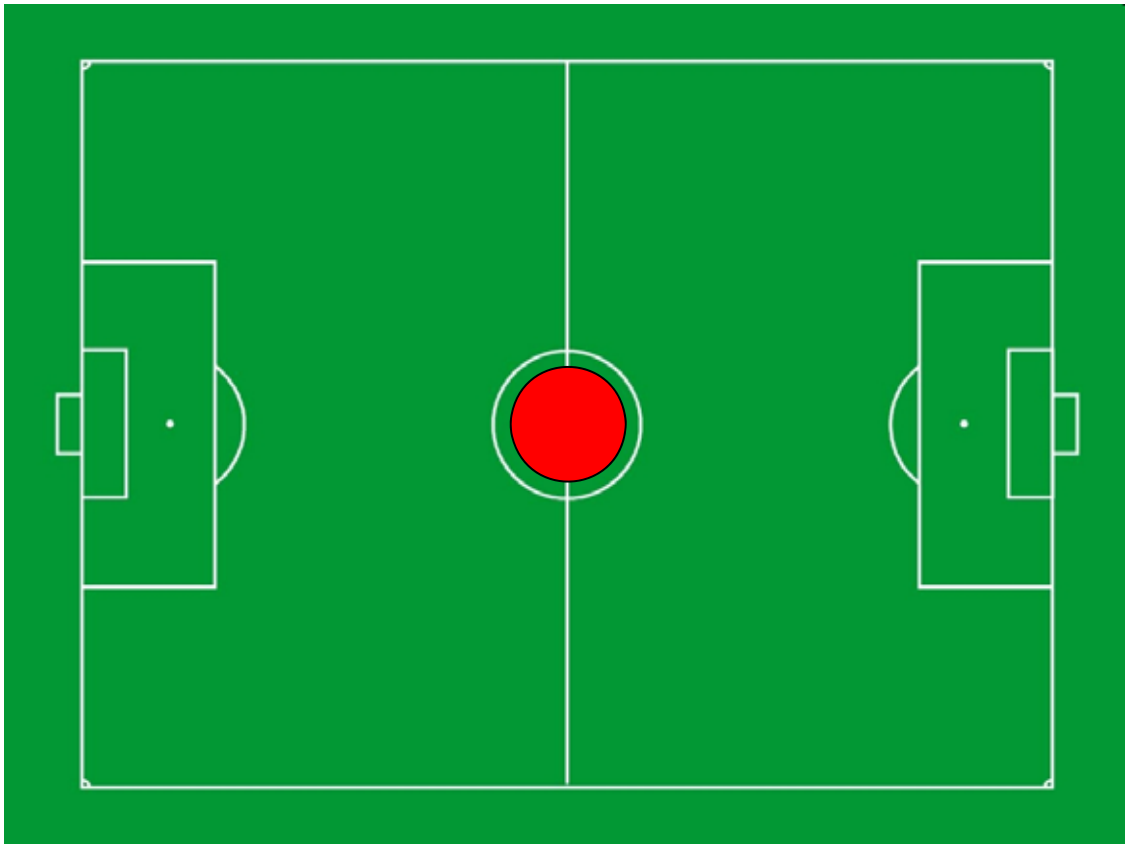
WMO Stations



Background

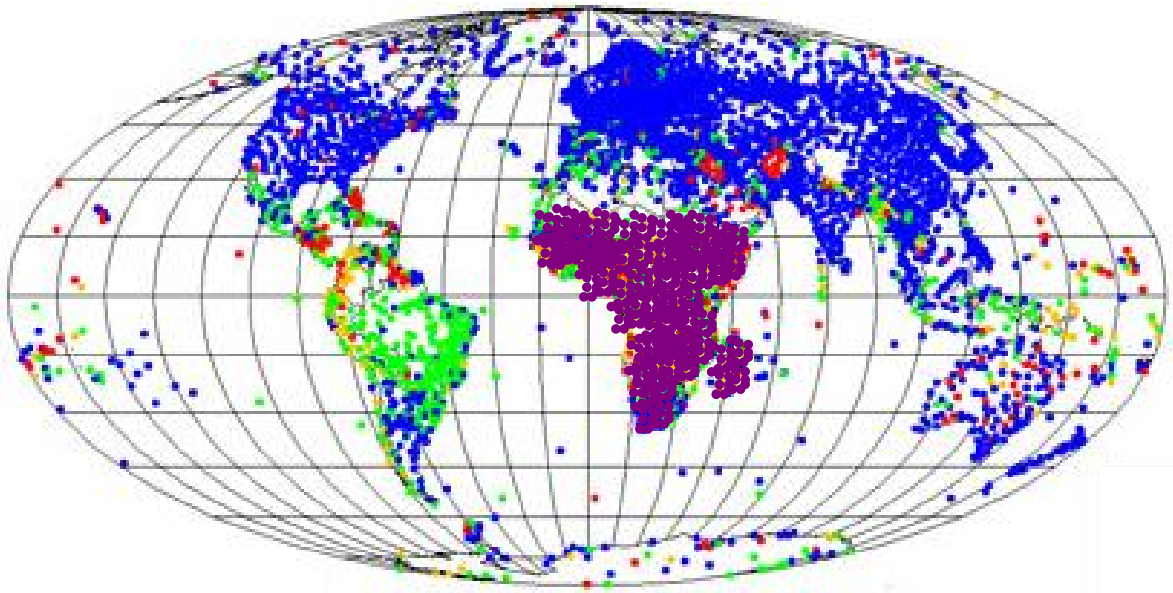
WMO Stations

5,000



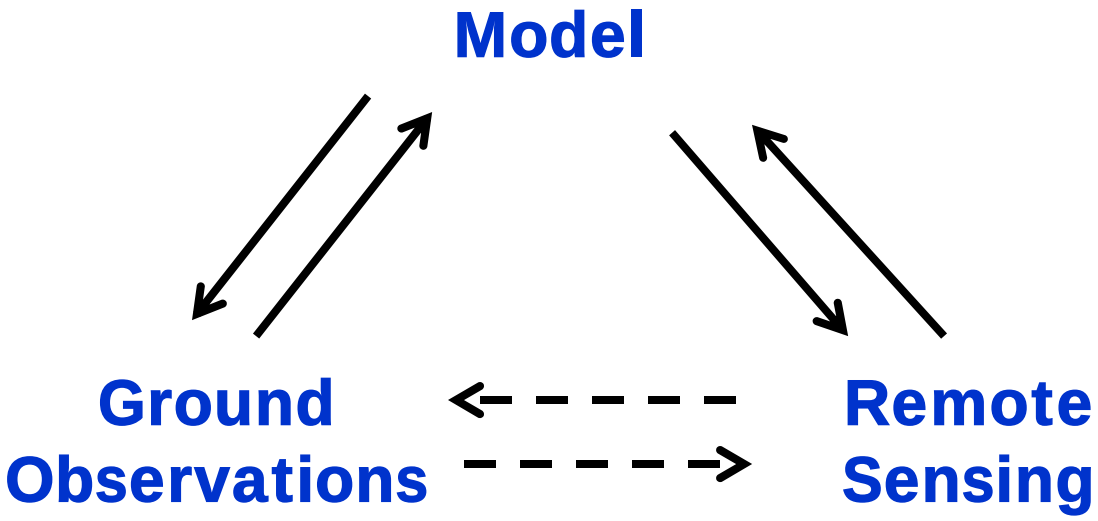
Background

Leapfrog: 20,000 TAHMO Stations!



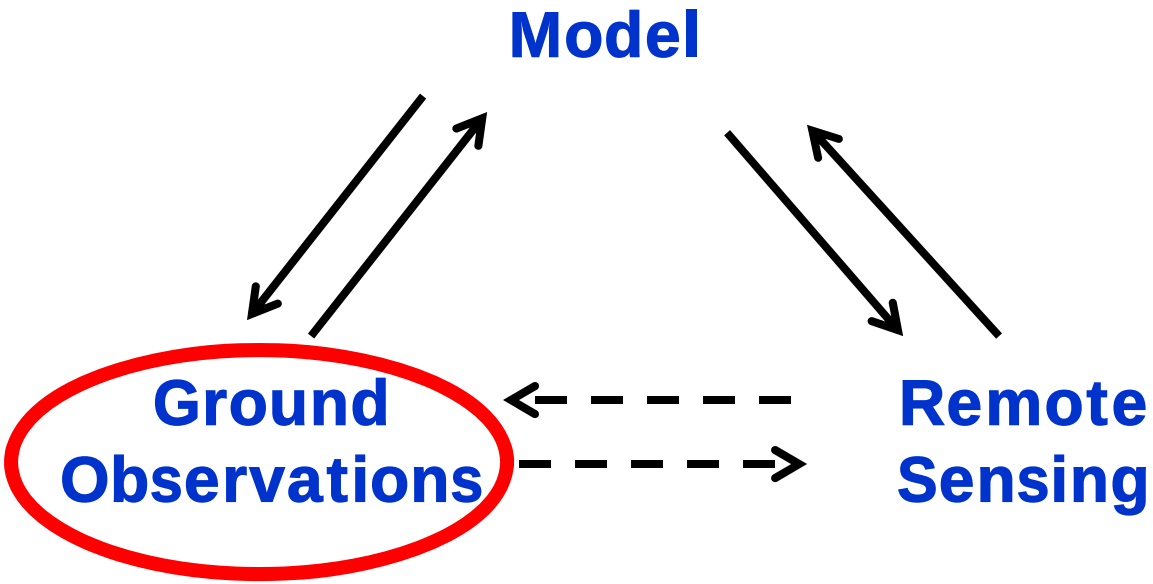
Background

Data assimilation



Background

Data assimilation

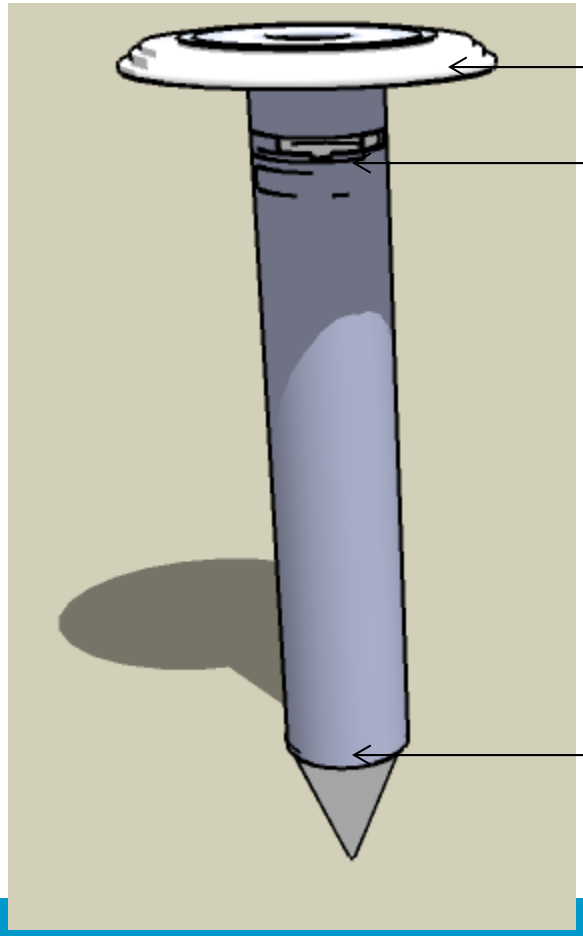


Approach

- **Design**
- **Operation**
- **Education**

Approach

Design



P, R_{sd}, R_{ld}, u

T, RH

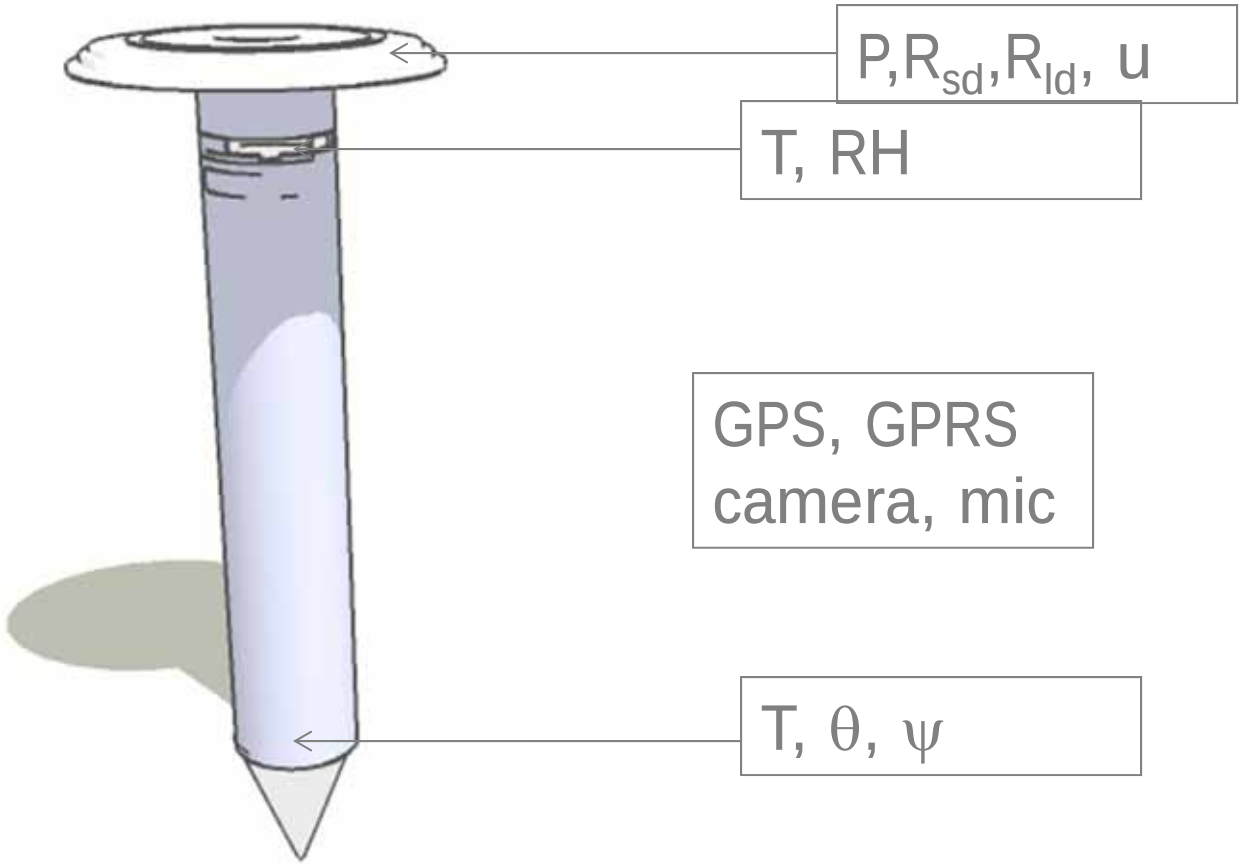
GPS, GPRS
camera, mic

T, θ, ψ

Approach

Design

$500
20,000
(35 km)



Design

Use existing sensors

- Automotive
- Household

ZyTemp TN9

Design

Principles

- **Robust**
- **No moving parts**
- **No cavities**
- **Cheap (<$500)**
- **Self calibrating**
- **Cross calibrating**

Design

Principles

- **Robust**
- **No moving parts**
- **No cavities**
- **Cheap (<$500)**
- **Self calibrating**
- **Cross calibrating**

Design

Picture: Jens Liebe

Design

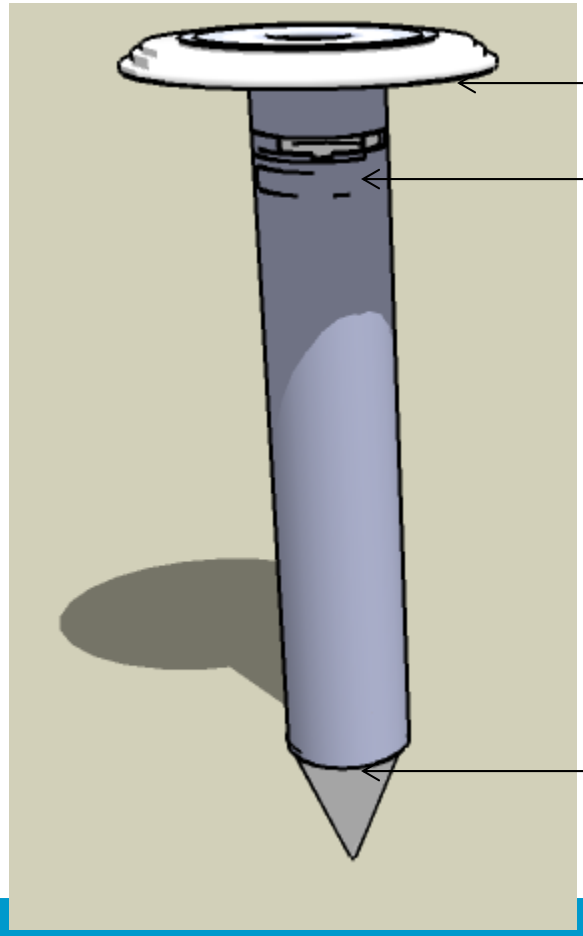
Principles

- **Robust**
- **No moving parts**
- **No cavities**
- **Cheap (<$500)**
- **Self calibrating**
- **Cross calibrating**

Picture: Jens Liebe

Design

Precipitation



Design

Precipitation

Coen Degen

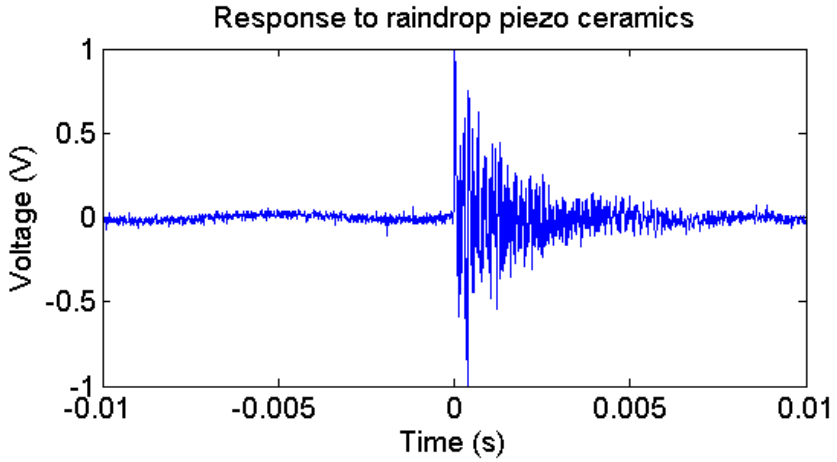
Piezo ceramic element
(+ other)

Design

Precipitation

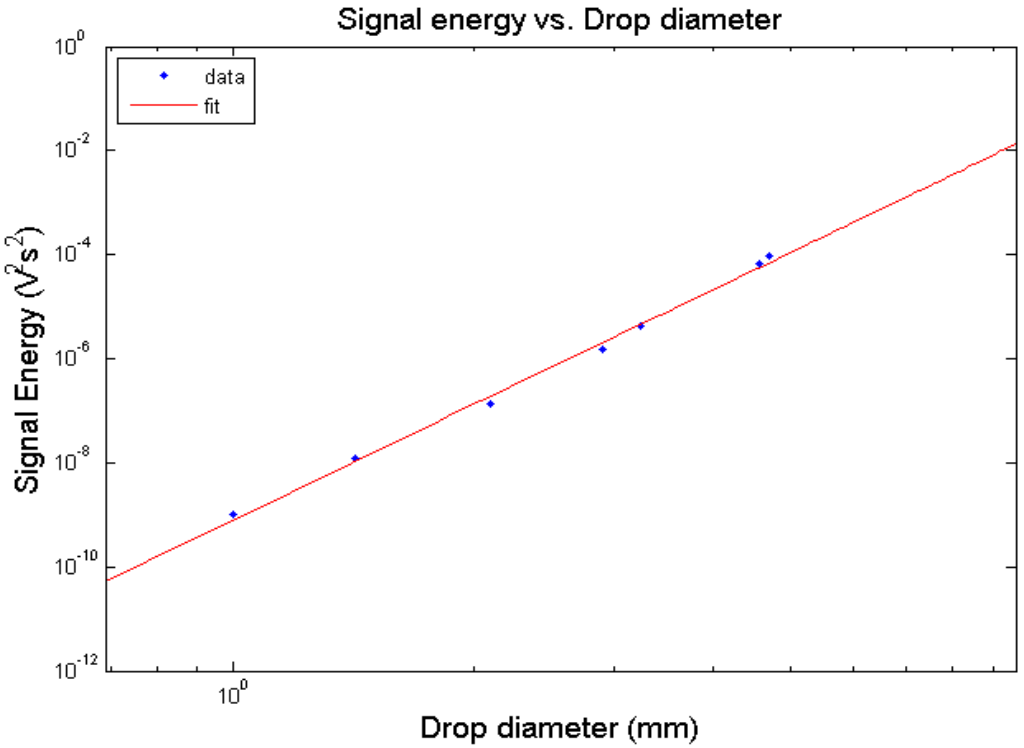
Coen Degen

Piezo ceramic element



Design

Precipitation



$$E_s = 8 \cdot 10^{-10} \cdot D^{7,34}$$

Design

One sensor down… n to go!

Design

Present model

Operation

Costs (M$)

• Construction	10
• Design	2
• Educational package	2
• Role out	8
• Computation / RS	4

Total 26 M$

Running costs 2 M$/yr

Operation

Business case

Needed: $ 2M / yr

Operation

Business case: Commodity hedging

- Cotton
- Coffee
- Tea
- Cocao
- ...

Operation

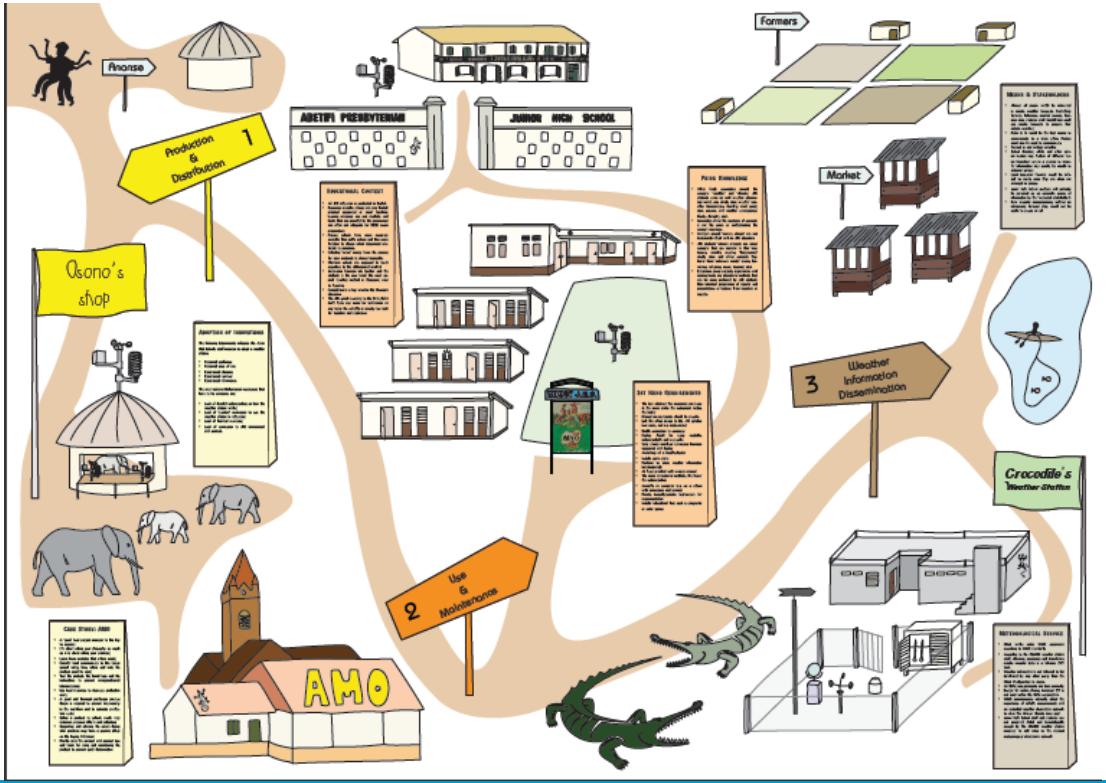
Business case: Insurance

- Droughts
- Floods
- Diseases?

Education

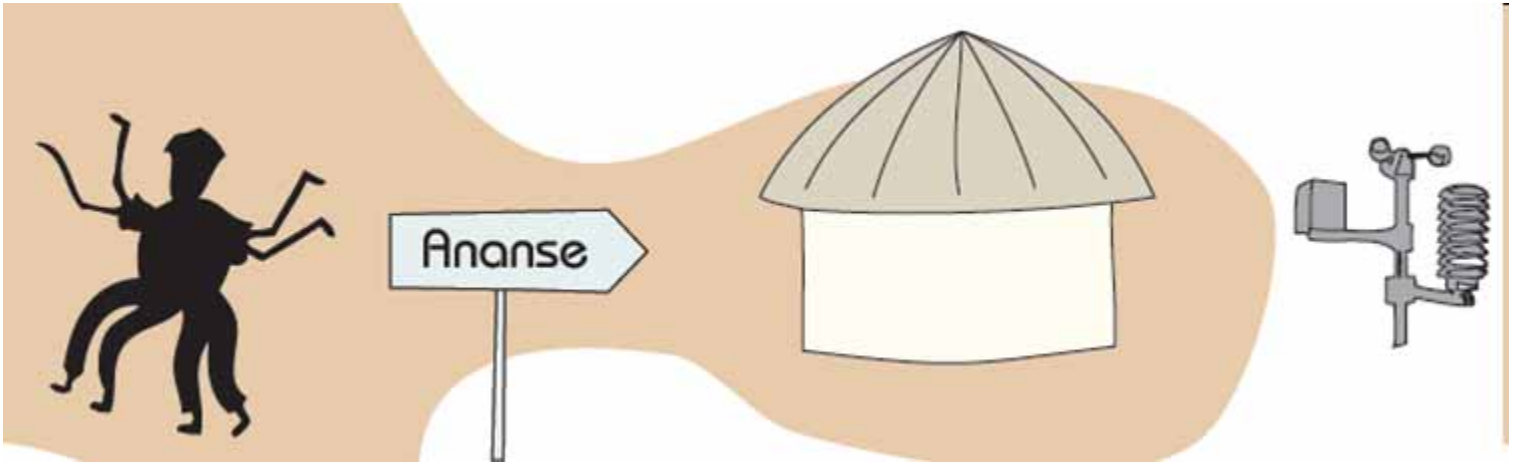
Role out TAHMO

High schools curriculum



Education

Role out TAHMO



School-to-School

Education

- **Associate with schools**
- **Develop environmental education package**
- **Teach children about their environment**
- **Teach children about their environmental connectedness**

Education

Universities

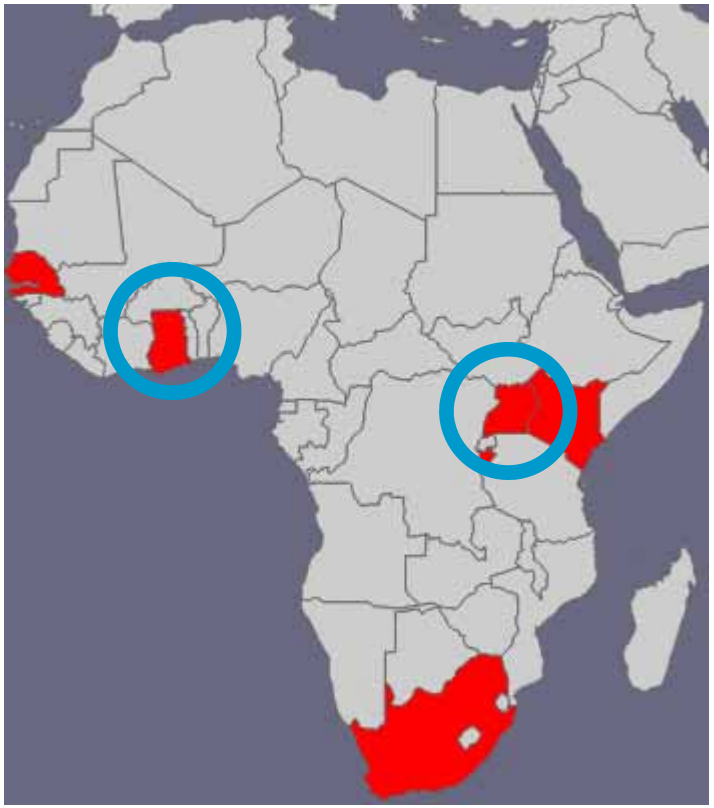
- Nairobi
- Akure

Sensor Design Competition

Next steps

Pilots

- Ghana
- Kenya



Join!

WWW.TAHMO.ORG

n.c.vandegiesen@tudelft.nl