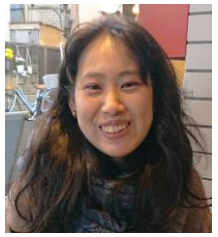
Enhance Earth Observation with Mobile Big Data

Mariko Shibasaki

LocationMind Inc.,

CSIS, The University of Tokyo

Mariko SHIBASAKI (Ms.)



LocationMind

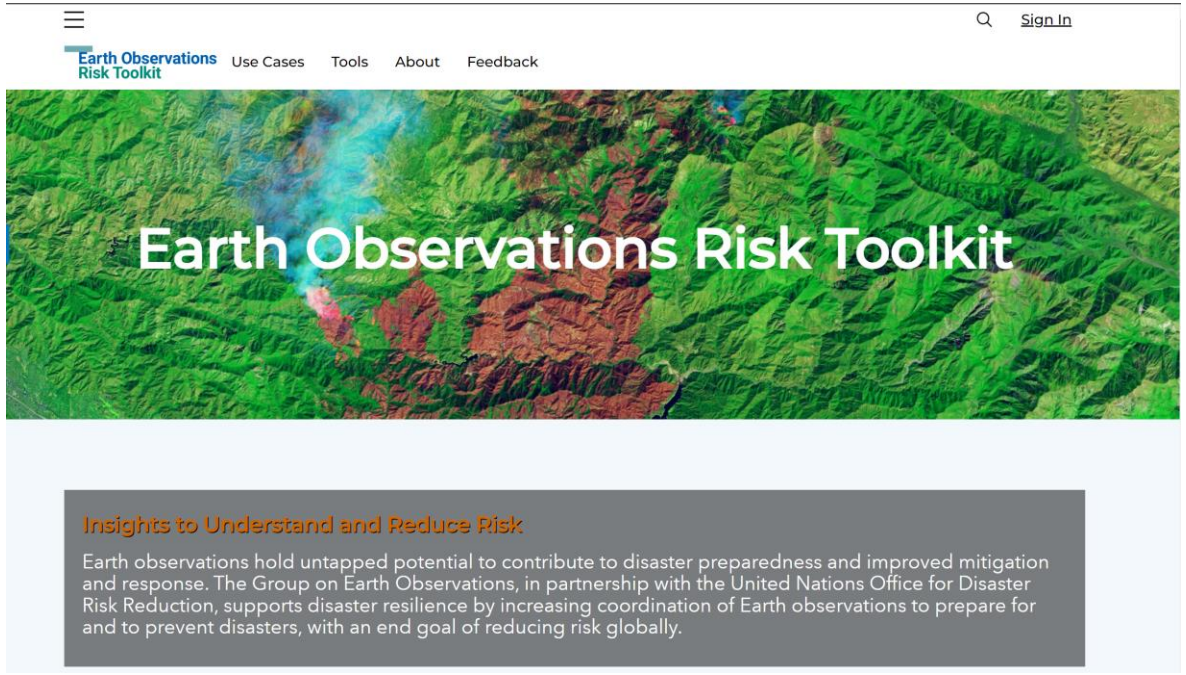
CSIS 東京大学 空間情報科学研究センター Center for Spatial Information Science The University of Tokyo

- An Engineer and A Consultant at LocationMind Inc.
  - LocationMind Inc is a **Geospatial AI company**, a start-up of CSIS, University of Tokyo.
- My working experiences include;
  - IBM Japan (IT engineer)
  - LIRNEasia (volunteer as a young research assistant for research on seasonal worker migration. LIRNEaisa is NGO. Sri Lanka for improving people's life and support policy-making for human development.)
- My interests include Geospatial technology development and applications to;
  - Humanitarian assistance and
  - Sustainable balance with wildlife/nature environment and human society using technology and a socially inclusive approach.

- Now Working in GEO Disaster Risk Reduction (DRR) Working Group from 2021

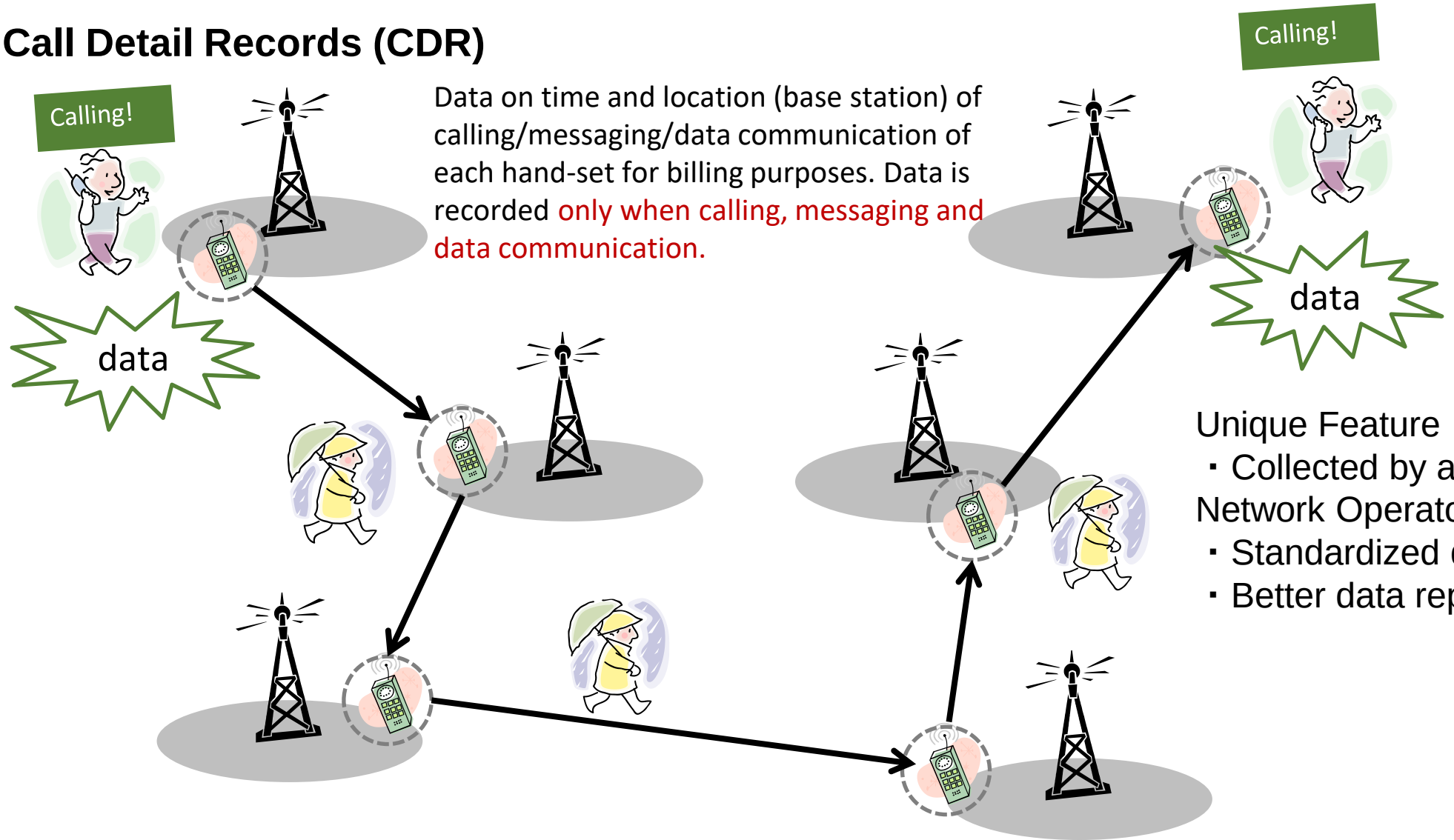
EO Risk Toolkit by GEO Disaster Risk Reduction (DRR) Working Group

- DRR working group is developing EO Risk Toolkit in collaboration with the UNDRR flagship initiative Global Risk Assessment Framework (GRAF) and ESRI.
- Satellite imagery plays a major role in the EO Risk toolkit. However, considering the impact of disasters on human activity, society, and economy, it is also very important to quickly monitor human activities.
- Mobile big data from mobile phones has great potential and is available in all countries.



Approach to human activity **with Mobile Big Data**

- **Call Detail Records (CDR)**

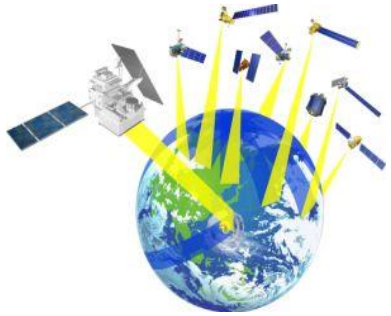


Data on time and location (base station) of calling/messaging/data communication of each hand-set for billing purposes. Data is recorded only when calling, messaging and data communication.

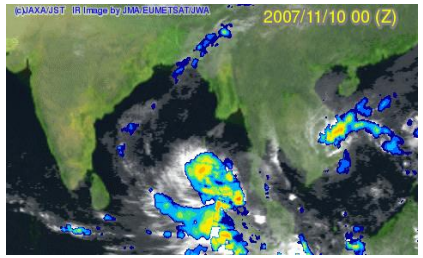
Unique Feature
- Collected by all Mobile Network Operators.
- Standardized data
- Better data representative

ADB-JAXA-UT Project (Technical Assistance as Proof of Concept)

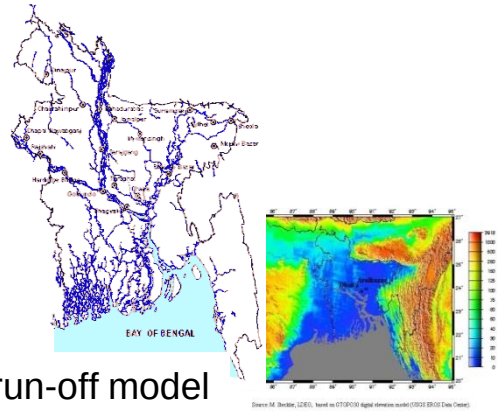
"Flood Warning Service from Space to Mobile Phones" in Bangladesh



Observation from Satellites



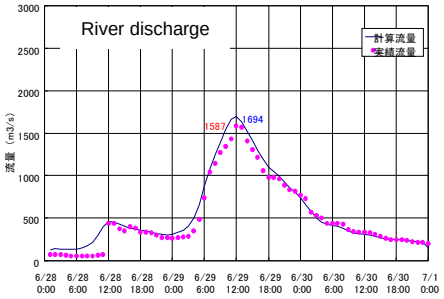
Real-time rainfall measurement



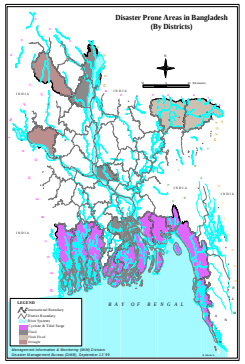
Water run-off model

People evacuation monitoring
with mobile phone location data

Disseminating
Warning Information
through Mobile phone



Flood Forecast



Machine Learning-based Anonymized Mobile Phone Data and Satellite Imagery Analysis for Disaster Vulnerable Population Extraction Modeling: A Case Study in Maputo, Mozambique.

- We developed a model to estimate slums through machine learning, and to analyze the number of vulnerable populations living in these areas and their actual movements using satellite image and Call Detailed Records.

Slum detection model using satellite image

・Features for City structure

Calibrated by field survey

CDR

Aggregation of population distribution by socio-economic attribute using CDR

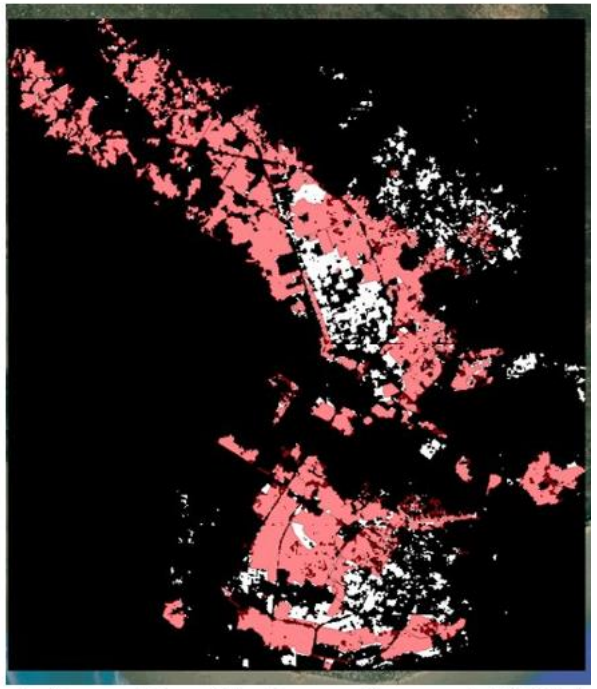
・Income level
・Season / Timeslot
⇒Socially Vulnerable people distribution

・Grid data of Disaster Vulnerable Population

Open-Source Software ➡ Algorithm／Analysis Tool

Flow of slum detection from Satellite image with machine learning

Satellite image



Learning with feature of city structure and training data from result of field survey
-shape and density of building
-regularity of road network etc.

Detected slum area from our model

図 衛星画

Slum area found by field survey

Evaluation our model

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Disaster Vulnerable Population Extraction from CDR

- Mobile Phone ownership rate
  →**68%** of household
- Mobile Phone sharing ownership rate
  →**1%** of household

Population distribution in Dry season

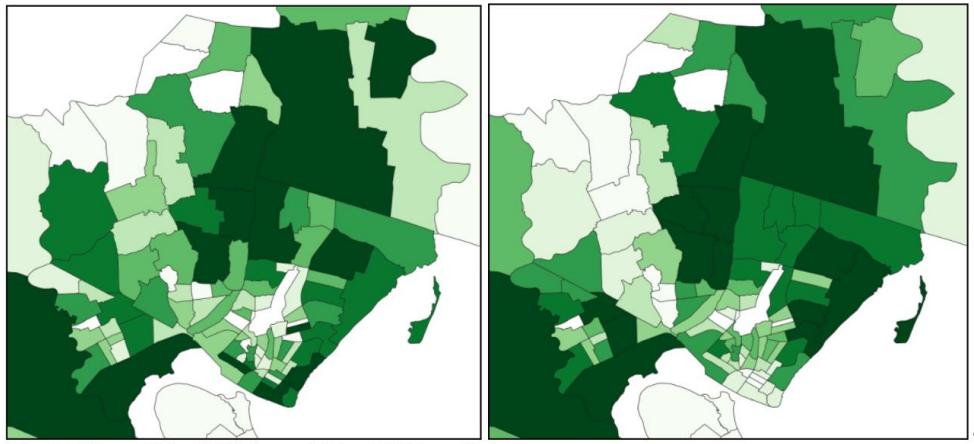

図　乾期の（左）昼間人口（右）夜間人口分布

In daytime

In nighttime

Different distribution in Different income group

Low-income group

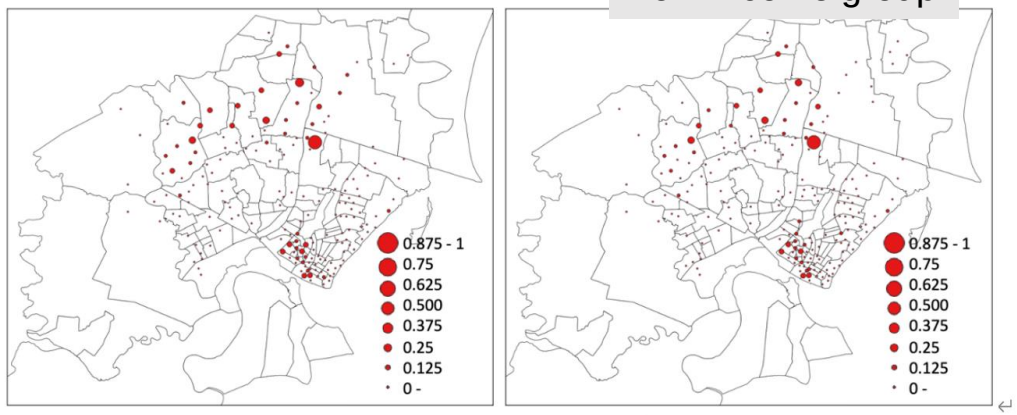

図　所得層別の乾期（左）と雨期（右）の昼間時間に人口が集中する場所：Lowe-income group

Lower-middle income group

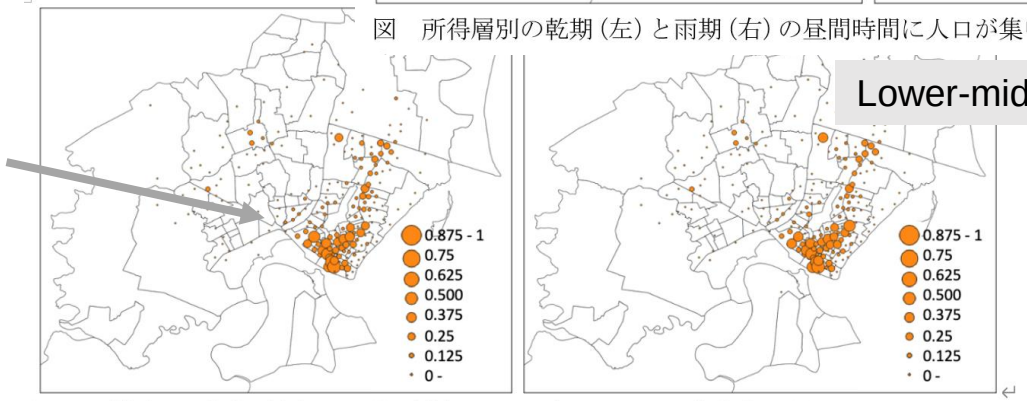

図　所得層別の乾期（左）と雨期（右）の昼間時間に人口が集中する場所：Lower-middle income group

In daytime(Left)

In nighttime(Right)

Future Direction

- Integrate satellite-based **Earth observation** with data on human activities to better quantify the impact of human activities on the **environment** and **local socio-economy**.
- **Summarize** the results of GEO's activities using natural language processing(NLP) and AI for use by experts in different and varied fields.