Smart Environment Protection: Disaster Management of Peatland Forest Fire in Brunei

Wida Susanty Haji Suhaili (GL), Somnuk Phon-Amnuaisuk, S.H. Newaz, Thien-Wan Au, Minh-Son Dao, UTB and Ali Selamat, UTM

ASEAN IVO Presentation

November 2017

Brunei

Environment Prevention

- Guard against natural disaster.
  - **Forest Fire**
  - 2013's smog was the worst where the smoke caused US$9 Billion in losses in economic activity across SEA
- Causes of forest fire
  - Dry weather
  - Fuel from dead trees and dry litters
  - Wind
  - Human
 - **Peat Fires** – peat swamp forest drainage of water

Peatland

- Peatland – good source of carbon
- Peatland – naturally can guard itself against fire and drought unfortunately when the eco system is disrupted it no longer can sustained this property
- Once fire break-out, an amount of carbon is release
- As the eco-system disrupted natural source of water is no longer available
- To get to the location is also difficult
- In densely peat forest, to bring in the water source to kill the water will be tedious and an expensive task
- 2016 , US$5.6Millions to water bomb Brunei forest fire using helicopter.

Side affects of peatland forest fire

- Cost to kill the fire (can be costly – water bomb - millions)
- Economy: Disrupt daily operation of the area affected
- Last long depending on severity
- Health: Haze affect those with respiratory problems & children
- Haze can be so thick that it can affect neighbouring country, affect PSI reading for each country, leads to unexpected halt of daily operation
- And take weeks or months to clear and recover the environment

Vegetation of Brunei Darussalam
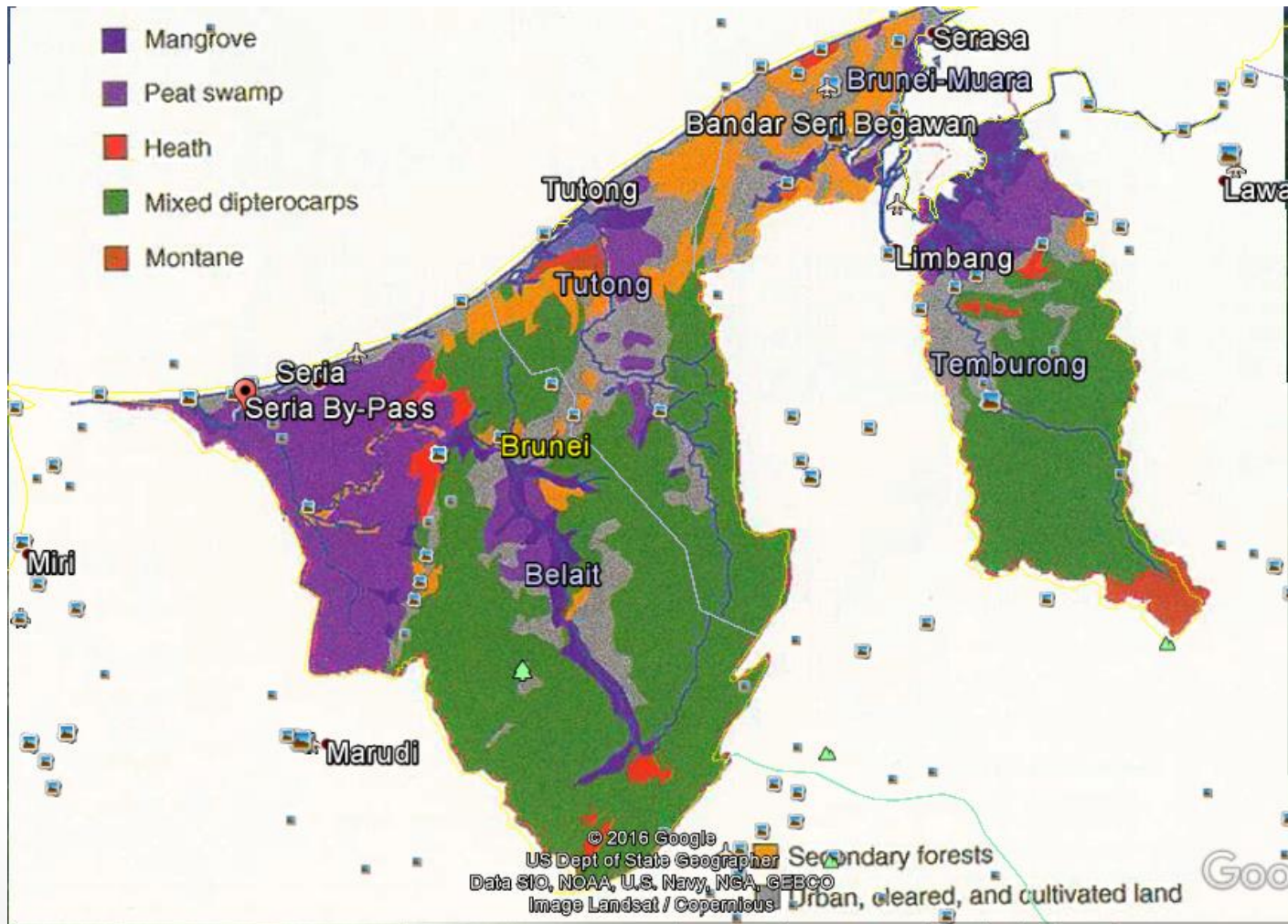
Forest Fire incident in Brunei
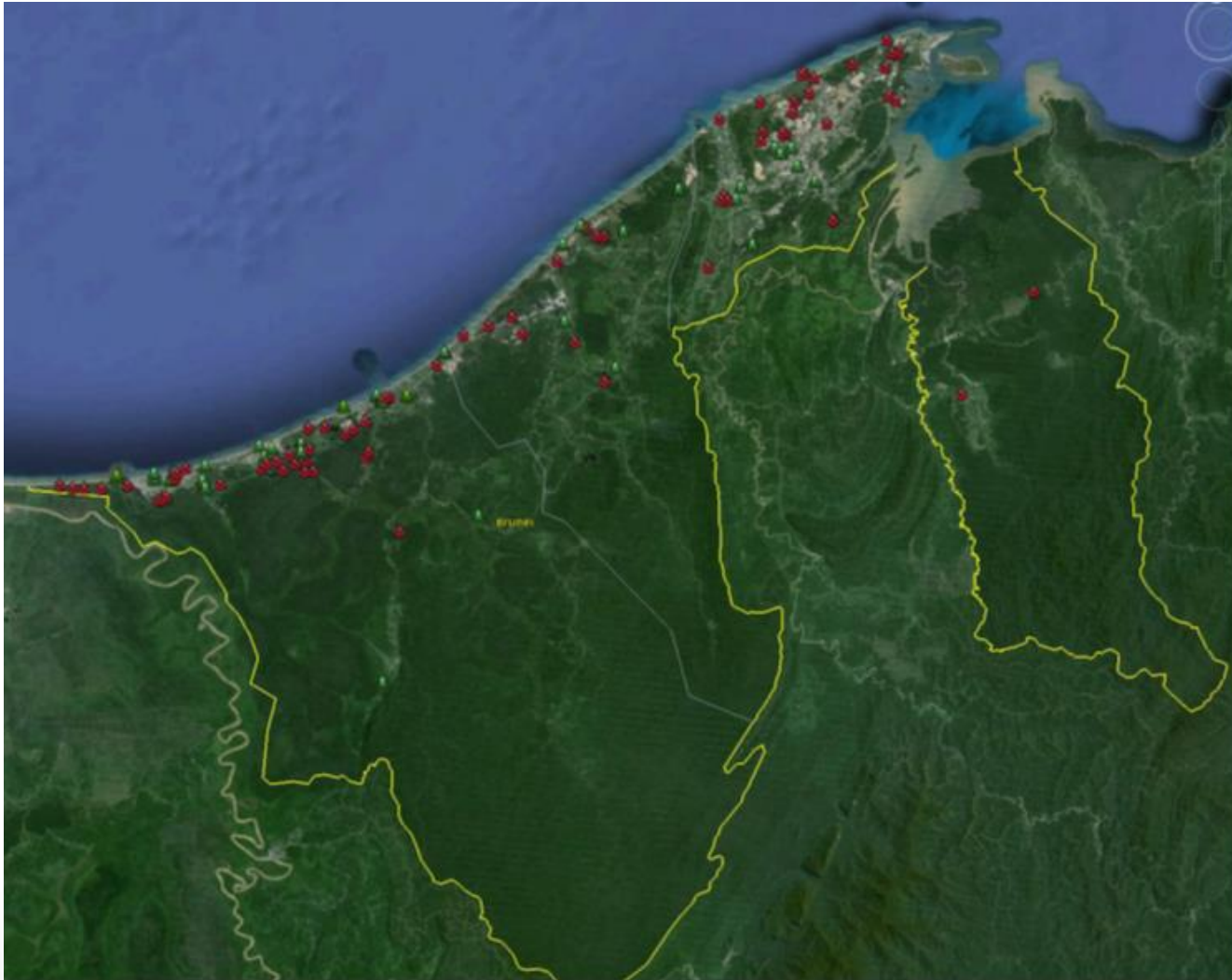
Challenges of battling peatland forest fire

- In dealing with forest fire, 3 action will come into place: Monitor, Respond and Recovery
- Some reason of massive forest fire, due to:
  - Too late and to act
  - Start of peatland fire is undetectable: as fire can start at the root.
  - Not visible. Difficult to know where its head as the fire can spread underneath
  - Dangerous, source of fire could be underneath
  - Costly to kill or combat
  - No source of water (effective in killing forest fire)

Peatland Forest Fire in ASEAN

- Fire from peat create impacts such as smoke haze which affect five neighbouring countries in South East Asia (Brunei, Indonesia, Malaysia, Singapore and Thailand)

- ASEAN measures:

  - ASEAN agreement on Transboundary Haze Pollution in 2002, and

  - ASEAN Peatland Management Strategy (APMS 2006 -2020) in 2006

- **Apart from preventive actions: early detection and suppression of fires is the only way to minimize the damage and losses**

Challenges for deploying sensor

- Deployment of sensors will be a challenge, in detecting the peatland forest fire.
  - Ambient, not true readings
  - Alert too late
  - Sensors burned
  - Battery life of sensor
  - Placement - positioning
  - Safety issues - stolen,

Way forward

- Discussion with stakeholders:
- So the focus are
  - To prevent forest fire from happening.
  - To avoid the start of fire by monitoring the floor and soil humidity
- Ensure humidity by using assistance from water dam (artificial or natural)
  - Water dam issue due to the different seasons (wet: flood & dry: seek other water source)
  - Location & the number

Aims

- Explore on preventive measure that focus on a disaster management system that will prevent peatland fire from occurring due to dry condition.

- This is done by advancing the restoration technique of rewetting the area by using sensors that will trigger the dam valve to release water from the dam and rewet the land to avoid any dry soil.

- At the same time proper dam management can help in irrigation as well.

Scope of research

1. Finding the optimal number of sensor nodes and their location and the appropriate location of dam (Natural and Artificial)

2. Deciding on how to collect the data (Energy efficient and QS aware data collection mechanism in such resource constraint environment

3. Construct the model and perform feasibility study through simulation

Finding the optimal number of sensor nodes and their location

- We want to study the historical data (historical information for peatland fire locations and weather variables at the time of peatland fire occurrence).

- Based on these analysis, we would like to identify the peatland fire prone areas.

- Taking into account connectivity among the Soil Moisture Sensors (SMSs) and gateways (the data aggregator), we want to calculate the optimal number of SMSs that are sufficient to identify that moisture level of those peatland fire prone areas.

- The prime goal of this research is to avoid possibility of peatland fire while reducing Capital Expenditure (CAPEX) and Operation Expenses (OPex) of SMSs network.

Sensor network deployment in forest in order to avoid peatland fire
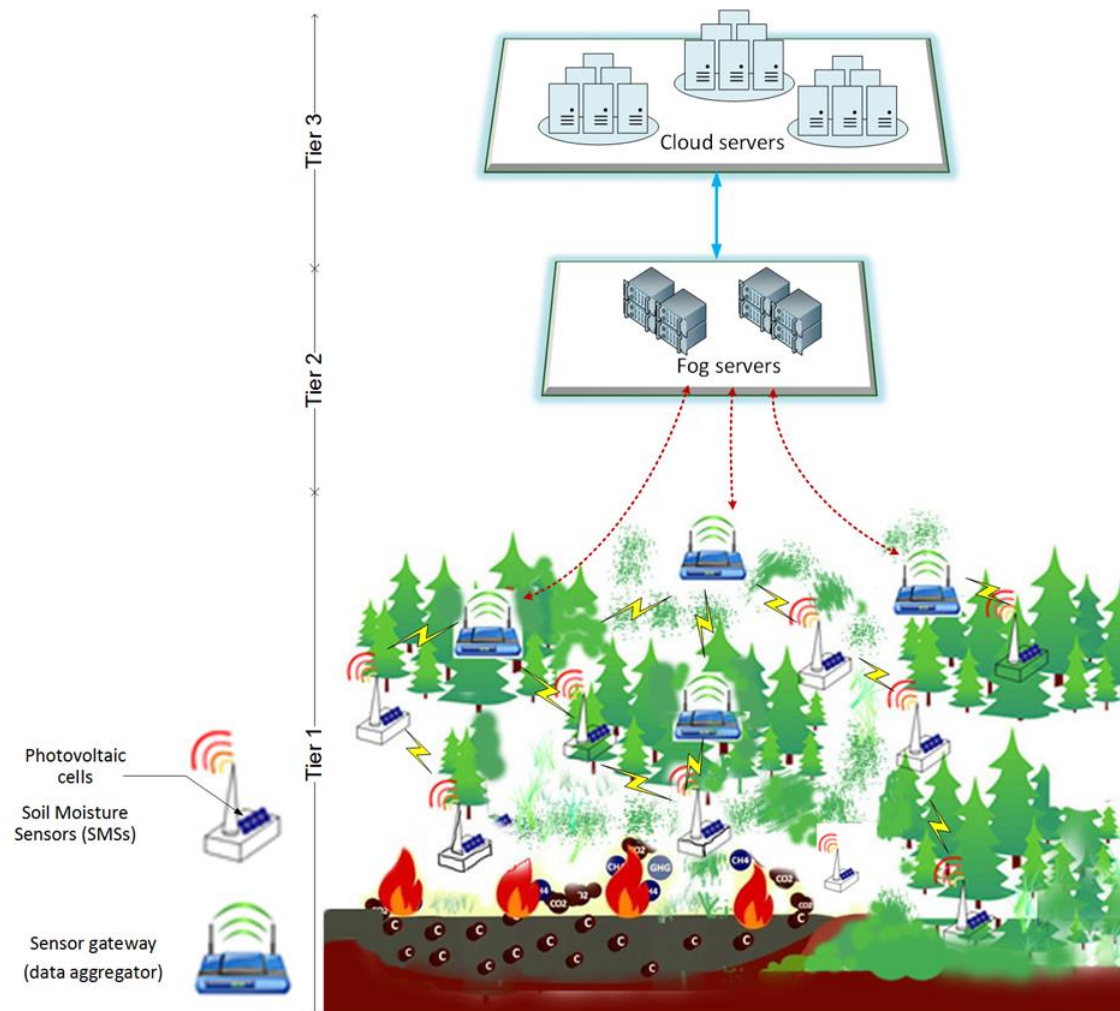
# Deciding on how to collect the data in such resource constraint environment

- To develop and energy efficient and throughput aware traffic forwarding mechanism for sensor data network
- Need to highlight that in a remote forest, frequent battery replacement and remote power supply is a cumbersome job.
- Taking this into account, we propose to use Soil Moisture Sensors (SMSs) with Photovoltaics cells.
- Currently, in the market, there are sensors with photovoltaic power source, allowing the sensors to be fully operational even in a remote location, like forest.
- Energy efficient sleep mode management in sensors (Active & Sleep mode)

Construct the model and perform feasibility study through simulation

- In the first phase of this project, information from various sources such as satellite images, weather data from meteorological department, sensors installed on watching towers in the key area and sensors installed on the peatland is collected and analyzed.

- The irrigation control model is constructed to predict the effect of irrigation planning and operations. This would ensure that the peatland moisture is maintained at the level that will prevent forest fire. A conceptual framework of the irrigation control model is illustrated in the figure below.

Conceptual Framework of the data analytics and visualisation
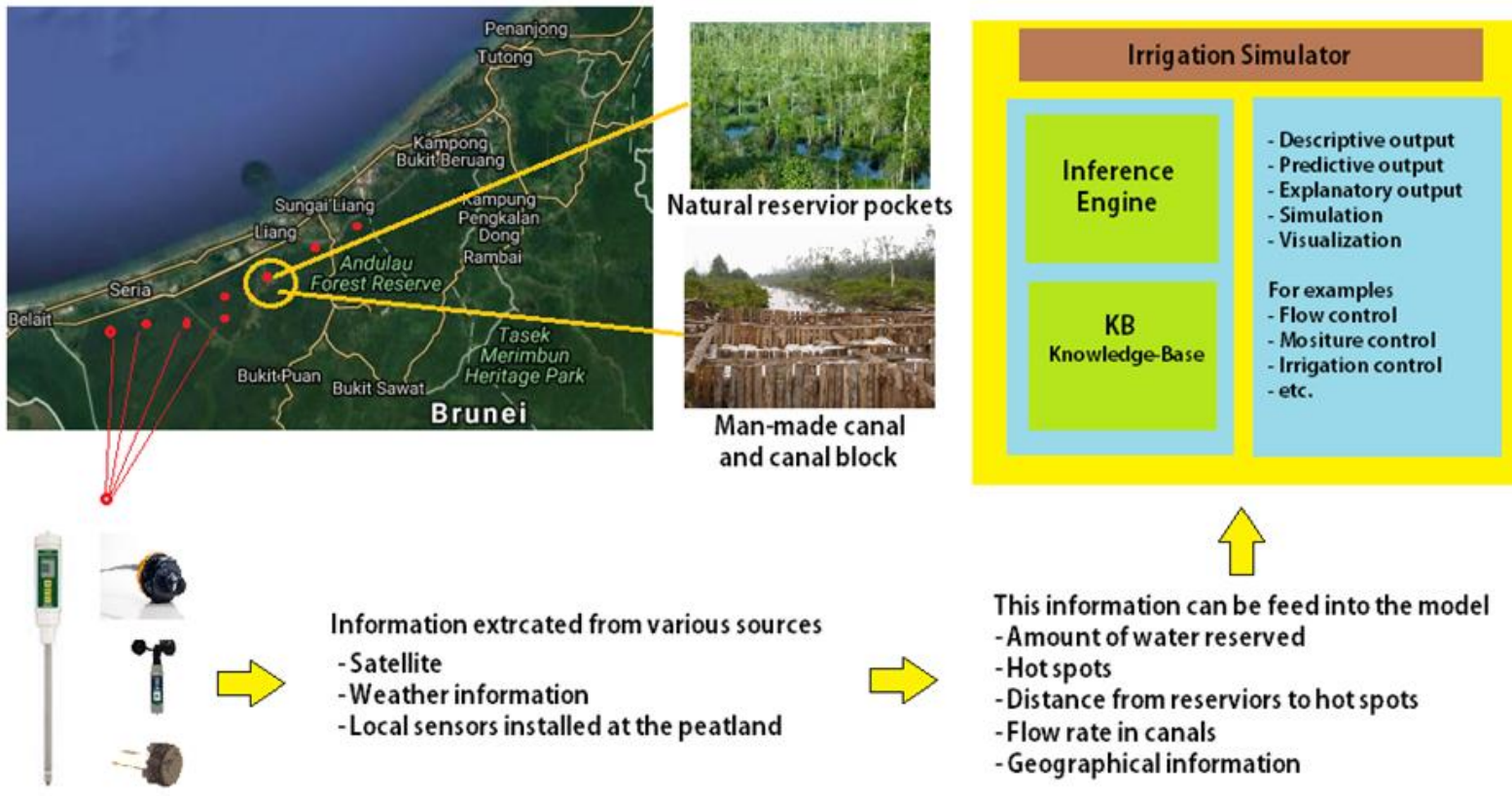
Seeking collaboration with other researchers

Contact:

Wida.suhaili@utb.edu.bn;

wida.suhaili@gmail.com

THANK YOU
OPEN FOR Q&A