Impact of land use and land cover changes on the urban climate and environment, studied with satellite observation, GIS, weather research forecast model, and atmospheric database management

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United Nations/Germany International Conference on Earth Observation  
Global Solutions for the Challenges of Sustainable Development in Societies at Risk  
Bonn, Germany; 26-28 May 2015
OUTLINE

✓ INTRODUCTION/BACKGROUND;
  Climate Change Impact:
  • Natural vulnerability vs Sustainability;
  • Indication of Changes and Variability;
  Challenge of Atmospheric Sciences and Technology (Indonesian Condition)
  • Climate Control System;
  • Observation System.

✓ PROBLEMS & SOLVING

  1. Relationship between land cover change and Urban Heat Island (UHI).
  2. Analysis of Surface Energy Balance (SEB)
  3. Drought Monitoring
  4. Design of Surface Energy Balance Interface Software (SEBALIS)
  5. Urban Climate Modelling using Weather Research Forecast (WRF) model for sustainable development
  6. ATMOSPHERIC DATABASE MANAGEMENT (BISMA)

  7. SATELLITE DISASTER EARLY WARNING SYSTEM (SADEWA)

✓ CONCLUSION

✓ Future plan & recommendation
INTRODUCTION

Atmospheric Condition and interactions

Environmental Sustainability

Social Sustainability

Economic Sustainability
SUSTAINABLE DEVELOPMENT

MITIGATION ➔
To Avoid the Unmanageable

Δ Concentration

Δ Temperature

Δ Others

Δ Sea Level Surface

Weather/Climate pattern

Emission

ADAPTATION ➔
To Manage the Unavoidable

Development Implementation

Economic disaster

Welfare

Green Dev Trap
1. Increase of Green House Gases;
2. Increase of Surface Temperature;
3. Decrease of ice area;
4. Sea Level Rise (SLR)
5. Increase of Tropical Precipitation;
6. Decrease of Tropical Salinity;
7. Decrease of Global Circulation because of thermocline difference;
8. Decrease of Global Circulation because of Surface Temperature difference between Tropical and high latitude;
9. Increase of Evaporation rate;
10. Decrease of rainfall amount;
11. Dry days getting longer;
12. The water content of diminishing ⇔ drought;
13. The increasing acidity of the ocean and the atmosphere;
14. Increased frequency of occurrence of weather and climate extremes.
Statistic of Global Disaster

- America [PERCENT AGE]
- Asia Pacific [PERCENT AGE]
- Africa [PERCENT AGE]
- Eropa [PERCENT AGE] (5%)

Global Statistic (1970 – 2013)

Hydro-meteorology Disaster

- Hydrological
- Meteorological
- Geophysical
- Climatological
- Biological
Damage rate of Land/Forest

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
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<tr>
<td>1</td>
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<td>2</td>
<td>Brazil</td>
<td>36,0</td>
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<tr>
<td>3</td>
<td>Canada</td>
<td>26,4</td>
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<td>4</td>
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<tr>
<td>5</td>
<td>Indonesia</td>
<td>15,8</td>
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</table>

Between 2000 - 2012 ⇔ 230 million Ha deforestation

Zoning changes: farm or ranch
 Processes at industrial level
Trend Pattern of Precipitation in Jakarta

- Dry season getting shorter;

- The number of rainy days is decreasing.

- The number of days of heavy rainfall is increasing.
Trend Pattern of Precipitation in Medan

- Season Pattern unclear and getting wet;
- The number of rainy days is increasing.
- The number of heavy rain is increasing.
Trend Pattern of Precipitation in Medan

- Dry season became longer;
- Decrease in number of rain day
- Increase in number of heavy rain
Observation Technology

PROBLEMS

- Solid technology;
- High investment;
- Facing the pace of automation;
- Required “special skill” to operate certification;
- Regulatory policies on the data;
- Multi-parameter information;
- Processing technology
Basic Concept of Remote Sensing
PROBLEMS

- **Rapid urbanization** is progressing in big cities in Indonesia, which resulted in urban climate change.
- **Limited study about urban climate** and its application in Indonesia.
- **Drought** is a problem that often arises in Indonesia during the dry season.
- **Non efficiency data processing** in Remote Sensing Software.
- Required **good urban design**, environmentally friendly and sustainable development.
- **Limited atmospheric data online**
PROBLEMS SOLVING

✓ Investigate relationship between land cover change and Urban Heat Island (UHI) change using remote sensing data, spatially and statistically, estimation of area changes

✓ Estimate and Analyze SEB composition in each landcover type using remote sensing.

✓ Drought monitoring using Bowen Ratio (BR) and Evaporative Fraction (EF) using remote sensing, spatially & statistically, define empirical equation of Bowen Ratio.

✓ Design of Interface Software for Satellite Data processing (SEBALIS).

✓ City design and its aspect on the Urban Heat Island using Weather Research Forecast (WRF) Model.

✓ Atmospheric Database Management
Urban Heat Island (UHI)
Urban Heat Islands: Processes

Mesoscale

- Addition of heat from roofs and tops of urban street canyons
- Rough urban surface slows winds
- Warmer, more polluted urban boundary layer
- Addition of anthropogenic heat from chimneys and vents.

Microscale

- Absorption of solar radiation by low reflectance surfaces and trapping by reflections
- Insulated surfaces lead to high daytime surface temperatures
- Obstructed view of sky: trapping of radiation heat by surfaces
- Addition of anthropogenic heat, humidity, and pollutants.
- Winds slowed, turbulence increased
- Warmer air temperature

- Impermeable surfaces – reduced surface moisture and evapotranspiration
- Irrigation of select surfaces
- Increase of stored heat by thermal properties of urban materials and increased surface area
Effect of Land Cover Change to Surface Energy Balance (SEB)

\[ R_n = L + G + H \]

\( R_n = \) Net Radiation  
\( L = \) Latent Heat Flux  
\( G = \) Soil Heat Flux  
\( H = \) Sensible Heat Flux
METHODOLOGY
UHI, SEB and Drought monitoring estimation relate with Land cover

Map of Area Study

LANDSAT TM/ETM DATA

2,4,5

BAND

1,2,3,4,5,6,7

Spectral Radiance

Surface Temperature ($T_s$) ($UHI_s$)

Sensible Heat Flux ($H$)

Latent Heat Flux ($LE$)

Evapotranspiration ($ETP$)

Air Temperature ($T_a$) (UHI)

OUTPUT

Land cover types

UHI

SEB

Drought monitoring

SW Radiation emitted (Surface to Atmosphere) $R_s^\uparrow$

SW Radiation coming to Surface $R_s^\downarrow$

LW Radiation emitted (Surface to Atmosphere) $R_L^\uparrow$

Bowen Ratio ($BR$)

Evaporative Fraction ($EF$)

Net Radiation ($Rn$)

Soil Heat Flux ($G$)
Study area

INDONESIA

JAKARTA
640 km²

BANDUNG
2820 km²

SEMARANG & surrounding
1441 km²
Flowchart of Surface Energy Balance Information System (SEBALI)S Design

INPUT: ASCII Data: DEM, Land Cover Classification, Band

Data Processing using SEB

OUTPUT:
Ts, Ta, Rn, H, G, LE, Albedo, ETP, NDVI, BR, EF, Land Cover

Visualization and Analysis

Data Processing using RS Software
Data Processing using SEBALIS
Data Processing using GIS Software
RESULT AND ANALYSIS
1. Relationship between UHI and Land cover

Spatial map of land cover classification in Jakarta (A) 1989 and (B) 2002
## STATISTIC OF LAND COVER, Jakarta

Change detection of Landcover change using overlay matrix in Jakarta

<table>
<thead>
<tr>
<th>Land cover (ha)</th>
<th>Waterbody (ha)</th>
<th>Industry (ha)</th>
<th>Residence (ha)</th>
<th>Vegetation (ha)</th>
<th>Cloud (ha)</th>
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<td>970</td>
<td>415</td>
<td>605</td>
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<td>54</td>
<td>145</td>
<td>140</td>
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<td>35</td>
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</table>
URBAN HEAT ISLAND, Jakarta

Criteria of Correlation Coefficient:
1. 0.00 – 0.20: very weak
2. 0.21 – 0.40: weak
3. 0.41 – 0.70: strong
4. 0.71 – 0.90: very strong
5. 0.91 – 0.99: very very strong
6. 1.00: perfect

Validation Ts satellite vs T observation (1989)

Validation Ts satellite vs T observation (2002)
Statistic of Surface Temperature, Jakarta

Boxplot Ts in land cover types
2. Surface Energy Balance (SEB) analysis

Land cover classification of Semarang & surrounding 2002
Composition of surface energy balance in land cover types

**Urban Area**
- **Residence**: LE 18%, L 11%, H 71%
- **Open Land**: LE 18%, L 11%, H 71%
- **Industry**: LE 18%, L 11%, C 8%, H 74%

**Vegetation Area**
- **Forest**: LE 54%, L 23%, H 23%
- **Plantation**: LE 54%, L 31%, H 15%
- **Paddy Field**: LE 73%, L 9%, H 18%

**Wet/water Area**
- **Water Body**: LE 84%, L 9%, H 7%
- **Embankment**: LE 84%, L 9%, H 7%
3. Drought Monitoring

Land use classification, Bandung 2001

\[ L = \frac{Rn - G}{1 + BR} \]

\[ EF = \frac{L}{Rn - G} \]

\[ EF = (1 + BR)^{-1} \]
Latent Heat Flux ($L$)
Bowen ratio and Evaporative Fraction using satellite data for Practical Drought Risk Monitoring

- Crop failure, no harvest ???
Bowen Ratio (β) is the comparison between the flux of air heating (H) and heating the water vapor flux (λE) can be expressed as a ratio of Bowen (Bowen Ratio)

• Bowen ratio was higher, the higher level of drought
EVAPORATIVE FRACTION

• The concept of energy balance to calculate the fraction of evaporation for monitoring drought is the evaporative Fraction (EF), which would low value for the dry areas.

\[ EF = \frac{\lambda \cdot ET}{R_n - G} \]

• \( EF \) is the evaporative Fraction, \( \lambda \cdot ET \) is the energy for evapotranspiration, \( R_n \) is net radiation and \( G \) is the energy to heating the soil.
Bowen Ratio & Evaporative Fraction, Bandung 2001

DRY if BR >>

DRY if EF <<
4. Design of SEBALIS using Visual Basic and GIS

Menu map, table & graph in SEBALIS for NDVI

Data processing:
Without SEBALIS ~ 1 week
With SEBALIS ~ 1 hours

Map of NDVI

Table & Graph

Export to Excel
5. Urban Climate Modelling using Weather Research Forecast (WRF)

<table>
<thead>
<tr>
<th>Field</th>
<th>Domain 1</th>
<th>Domain 2</th>
<th>Domain 3</th>
<th>Domain 4</th>
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<td>121</td>
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<td>Zonal Grid</td>
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<td>Vertical Level</td>
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<td>27 km</td>
<td>9 km</td>
<td>9 km</td>
<td>1 km</td>
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<td>Terrain Resolution</td>
<td>10 min (~18 km)</td>
<td>5 min (~9 km)</td>
<td>2 min (~4 km)</td>
<td>3 km (~0.9 km)</td>
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<td>Explicit Moisture</td>
<td>WRF SM 3-class scheme</td>
<td>WRF SM 3-class scheme</td>
<td>Purdue Lin</td>
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<tr>
<td>Longwave Radiation</td>
<td>RTM scheme</td>
<td>RTM scheme</td>
<td>RTM scheme</td>
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<tr>
<td>Scheme</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Shortwave Radiation</td>
<td>Dudia scheme</td>
<td>Dudia scheme</td>
<td>Dudia scheme</td>
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<td>Scheme</td>
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<td>Surface Layer</td>
<td>MM5 similarity</td>
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<td>MM5 similarity</td>
<td>MM5 similarity</td>
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<td>5-layer thermal diffusion</td>
<td>5-layer thermal diffusion</td>
<td>5-layer thermal diffusion</td>
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<td>Cumulus Scheme</td>
<td>Betts-Miller-Janjic scheme</td>
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<td>Kar-Fritsch scheme</td>
<td>No cumulus scheme</td>
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<td>Scheme</td>
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<td>YSU scheme</td>
<td>YSU scheme</td>
<td>YSU scheme</td>
<td>YSU scheme</td>
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</table>

Benchmark configuration of PC Cluster, to run WRF Model

- Application: Advance Research WRF V 3
- 1 server: Processor dual core AMD, Motherboard, Memory DDR2 4112232KB (4GB), SATA 300GB.
- 15 Nodes of Cluster:
  1 node: Processor Dual core AMD1212 1GHz, Motherboard sata Raid, Memory DDR2 2GB, Hardisk SATA 500GB.
- OS: Redhat Enterprise Linux 5, Linux version 2.6.18-8.el5
- Compilers: Fortran 77
- Softwares: GrADS, NetCDF, HDF4, Matlab, Vis5D, MPICH2(PGI+GCC), Apache, Php, mySQL.
Urban Climate Modeling with landuse modification

WRF-ARW Modeling System Flow Chart

- **External Data Source**
  - WRF Pre-Processing System
  - WRF-ARW Model

- **Post-Processing & Visualization**
  - Ideal Data
    - 2D: Hill, Gray, Squall Line & Seabreeze
    - 3D: Supercell, LES & Baroclinic Waves
    - Global/Regional
  - VAPOR
  - NCL
  - ARWpost
  - VisWx
  - RIIP
  - WIPP
  - GEMPAK
  - MET

- **Classification**
  - Delphi
  - Python

- **Landuse data**
  - (NCEP, satellite)

- **Landuse simulation**

- **Landuse modification**

- **WRF Model**

- **Output Visualization**

- **Quantitative comparison**

- **Analysis**

- **Report & Recommendation**
Comparison of Land Use USGS and Land Use from Urban Classification

LU USGS (default)

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Urban</td>
</tr>
<tr>
<td>2</td>
<td>Dryland Crop/Past</td>
</tr>
<tr>
<td>3</td>
<td>Irrig. Crop/Past</td>
</tr>
<tr>
<td>4</td>
<td>Mix. Dry/Crop</td>
</tr>
<tr>
<td>5</td>
<td>Crop/Gst. Mosaic</td>
</tr>
<tr>
<td>6</td>
<td>Crop/Wood Mosaic</td>
</tr>
<tr>
<td>7</td>
<td>Grassland</td>
</tr>
<tr>
<td>8</td>
<td>Shrubland</td>
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<tr>
<td>9</td>
<td>Mix Shrub/Gst.</td>
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<td>10</td>
<td>Savanna</td>
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<td>11</td>
<td>Decids. Broadf.</td>
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<td>Decids. Needlef.</td>
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<td>14</td>
<td>Evergn. Needlef.</td>
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<tr>
<td>15</td>
<td>Mixed Forest</td>
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<tr>
<td>16</td>
<td>Water Bodies</td>
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<tr>
<td>17</td>
<td>Herb. Wetland</td>
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<tr>
<td>18</td>
<td>Wooded wetland</td>
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<td>19</td>
<td>Bar. Sparse Veg.</td>
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<tr>
<td>20</td>
<td>Herb. Tundra</td>
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<td>21</td>
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<td>22</td>
<td>Mixed Tundra</td>
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<td>24</td>
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<td>25</td>
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LU Reclassification using LU actual/origin
Modification of Landuse runs in Weather Research Forecast (WRF) model

1) Grassland to urban

2) +58% grassland

3) +95% grassland

4) +440% grassland
Statistical Analysis of Landuse

Land use before and after modification (km²)

Land use changes of LU after modification (km²)
SPATIAL ANALYSIS OF UHI (306 K)

1) Grassland to urban
   Area of UHI: +5%

2) +58% grassland
   Area of UHI: -48%

3) +95% grassland
   Area of UHI: -54%

4) +440% grassland
   Area of UHI: -88%
Statistical analysis of Air Temperature (Ta or T2m)

Distributions of Ta from the results of WRF model runs

<table>
<thead>
<tr>
<th>Ta (K)</th>
<th>scenario 1</th>
<th>scenario 2</th>
<th>scenario 3</th>
<th>scenario 4</th>
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<tr>
<td>301</td>
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<td>47%</td>
<td>16%</td>
<td>5%</td>
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<td>302</td>
<td>-7%</td>
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<td>303</td>
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<td>10%</td>
<td>11%</td>
<td>-16%</td>
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<td>304</td>
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<td>11%</td>
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<td>305</td>
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<td>14%</td>
<td>15%</td>
<td>37%</td>
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<tr>
<td>306</td>
<td>5%</td>
<td>-48%</td>
<td>-54%</td>
<td>-88%</td>
</tr>
</tbody>
</table>

The changes of Ta area after land use modification

Changes of Ta area from origin in percentage
Cross section of Ta (T2m)

A - B

C - D
Air Temperature (UHI) (T2m) for 48 hours WRF Model runs in 6.25 S (A-B) cross section
MODEL VALIDATION

Criteria of Correlation Coefficient:
1. 0.00 – 0.20: very weak
2. 0.21 – 0.40: weak
3. 0.41 – 0.70: strong
4. 0.71 – 0.90: very strong
5. 0.91 – 0.99: very very strong
6. 1.00: perfect
BASIS DATA ATMOSFER INDONESIA (BISMA) [INDONESIAN ATMOSPHERIC DATABASE] http://bisma.sains.lapan.go.id/
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<td>Aqua (Parepare)</td>
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### Info Alat TRMM

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<td>Lokasi</td>
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<td>Posisi Lintang</td>
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<td>Posisi Bujur</td>
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<tr>
<td>Lembaga/Badan Pemilik</td>
<td>NASA</td>
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<tr>
<td>Tahun Mulai Beroperasi</td>
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#### Curah hujan (3B42RT)

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<td>3B42RT.2014102812.7.bin.gz</td>
<td>2014-10-28 12:00:00</td>
<td></td>
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</tbody>
</table>

TAMPILKAN INFO DATA
### Equatorial Atmosphere Radar (EAR)

<table>
<thead>
<tr>
<th>Angin Meridional (Angin Selatan Positif)</th>
<th>Angin Vertikal</th>
<th>Angin Zonal (Angin Barat Positif)</th>
<th>Raw</th>
</tr>
</thead>
</table>

#### rentang waktu:
- yyyy-mm-dd
- s/d yyyy-mm-dd

<table>
<thead>
<tr>
<th>Rentang Waktu</th>
<th>Tampilan INFO ALAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131222.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-22 00.00.00</td>
</tr>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131221.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-21 00.00.00</td>
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<tr>
<td>EAR.ANGIN.MERIDIONAL.20131220.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-20 00.00.00</td>
</tr>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131219.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-19 00.00.00</td>
</tr>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131218.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-18 00.00.00</td>
</tr>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131217.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-17 00.00.00</td>
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<tr>
<td>EAR.ANGIN.MERIDIONAL.20131216.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-16 00.00.00</td>
</tr>
<tr>
<td>EAR.ANGIN.MERIDIONAL.20131215.vwnd.csv (122.12K)</td>
<td>tgl data : 2013-12-15 00.00.00</td>
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<tr>
<td>EAR.ANGIN.MERIDIONAL.20131214.vwnd.csv (138.34K)</td>
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<tr>
<td>EAR.ANGIN.MERIDIONAL.20131213.vwnd.csv (104.00K)</td>
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<tr>
<td>EAR.ANGIN.MERIDIONAL.20131212.vwnd.csv (138.34K)</td>
<td>tgl data : 2013-12-12 00.00.00</td>
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### INSITU LAINNYA

<table>
<thead>
<tr>
<th>No</th>
<th>Letak</th>
<th>Deskripsi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C02 Monitor (Watukosek)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AQMS</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C02 Monitor (Bandung)</td>
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</tr>
<tr>
<td>4</td>
<td>Dasibi (Ozon Permukaan)</td>
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</tr>
</tbody>
</table>

### CO2 Monitor (Bandung)

<table>
<thead>
<tr>
<th>Tanggal</th>
<th>Rentang Waktu</th>
<th>CO2 (Karbon Dioksida) per 1 jam</th>
<th>CO2 (Karbon Dioksida) per 1 menit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-12-27</td>
<td>yyyy-mm-dd</td>
<td>0.008</td>
<td>tgl. data : 2011-12-27 00:00:00</td>
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<tr>
<td>2011-12-26</td>
<td>yyyy-mm-dd</td>
<td>0.864</td>
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<tr>
<td>2011-12-25</td>
<td>yyyy-mm-dd</td>
<td>0.816</td>
<td>tgl. data : 2011-12-25 00:00:00</td>
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<tr>
<td>2011-12-24</td>
<td>yyyy-mm-dd</td>
<td>0.816</td>
<td>tgl. data : 2011-12-24 00:00:00</td>
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<tr>
<td>2011-12-23</td>
<td>yyyy-mm-dd</td>
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<td>tgl. data : 2011-12-23 00:00:00</td>
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### Parameter Fisika Atmosfer

<table>
<thead>
<tr>
<th>Visible</th>
<th>Data hasil pengukuran dari alat MTSAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profil Vertikal Atmosfer (MOD07)</td>
<td>Data hasil pengukuran dari alat Terra (Porospor)</td>
</tr>
<tr>
<td>Profil Vertikal Atmosfer (MOD07)</td>
<td>Data hasil pengukuran dari alat Aqua (Porospor)</td>
</tr>
<tr>
<td>IR4</td>
<td>Data hasil pengukuran dari alat MTSAT</td>
</tr>
<tr>
<td>IR3</td>
<td>Data hasil pengukuran dari alat MTSAT</td>
</tr>
<tr>
<td>IR2</td>
<td>Data hasil pengukuran dari alat MTSAT</td>
</tr>
<tr>
<td>IR1</td>
<td>Data hasil pengukuran dari alat MTSAT</td>
</tr>
<tr>
<td>Data AWS (Temperatur, Curah Hujan, Angin, UV, Radiasi Matahari)</td>
<td>Data hasil pengukuran dari alat AWS (Tanjung Sari)</td>
</tr>
<tr>
<td>Data AWS (Temperatur, Curah Hujan, Angin, UV, Radiasi Matahari)</td>
<td>Data hasil pengukuran dari alat AWS (Bandung)</td>
</tr>
<tr>
<td>Curah hujan (3B42RT)</td>
<td>Data hasil pengukuran dari alat TRMM</td>
</tr>
</tbody>
</table>

### Parameter Kimia Atmosfer

<table>
<thead>
<tr>
<th>O3 (Ozon) Permukaan</th>
<th>Data hasil pengukuran dari alat Dasibi (Ozon Permukaan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data AQMS (CH4, NMHC, THC, CO, NO, NO2, NOx, O3, SO2, PM10) per 30 Menit</td>
<td>Data hasil pengukuran dari alat AQMS</td>
</tr>
<tr>
<td>Data AQMS (CH4, NMHC, THC, CO, NO, NO2, NOx, O3, SO2, PM10) per 3 menit</td>
<td>Data hasil pengukuran dari alat AQMS</td>
</tr>
<tr>
<td>CO2 [Karbon Dioksida] per 1 jam</td>
<td>Data hasil pengukuran dari alat CO2 Monitor (Bandung)</td>
</tr>
<tr>
<td>CO2 [Karbon Dioksida]</td>
<td>Data hasil pengukuran dari alat CO2 Monitor (Wasukosek)</td>
</tr>
</tbody>
</table>
Technical Guidance Online

Bimat online is a feature that gives a tutorial Bhishma processing some of the data that is in Bhishma.

Here is a link to:

MTSAT Data Processing

MTSAT Data Processing Tutorial

For both data processing MTSAT IR1, IR2, IR3, and IR4 takes the following applications:

1. Grads
2. Gzip
3. gawk
4. zcat.exe
5. pgm2raw.exe
6. pgm2fib.exe
7. tgh2ascf.exe
MTSAT Data Processing Tutorial

Please download the application support for MTSAT data processing, by clicking the link below:

1. Grads
2. Gzip
3. gawk
4. zcat.exe
5. pgm2raw.exe
6. pgm2fctb.exe
7. tgh2ascf.exe

When finished downloading the required application, the next is doing the install for each application.

1. Install Applications Grads
   To install the application for Mens. grads please double click the downloaded installer with filename "grads-2.0.4.064.gna.1.win32_xpspspack.exe". And follow the instructions provided when installing. No special configuration is done during install, you just need to press the next button and finish. Ensure grads applications stored in the directory C:\GrADS20 (default setting)

2. Install Applications GZIP
   To install the application for Mens. gzip please double click the downloaded installer with file name "gzip-1.3.12-1-setup.exe". And follow the instructions provided when installing. No special configuration is done during install, you just need to press the next button and finish.

3. Install Applications gawk
   Same thing with installing GZIP. To install gawk application for Mens. please double click the downloaded installer with filename "gawk-1.1.5-1-setup.exe". And follow the instructions provided when installing. No special configuration is done during install, you just need to press the next button and finish.

4. Copy and Paste zcat.exe, pgm2raw.exe, pgm2fctb.exe, tgh2ascf.exe, tail.exe
   Create a folder in C: \ with the name Pelanihan/MTSAT and create folders within folders Pelanihan/MTSAT support. Copy and Paste application with the file name "zcat.exe", "pgm2raw.exe", "pgm2fctb.exe", "tgh2ascf.exe", "tail.exe" to the folder C:\Pelainhan/MTSAT\support that was created earlier.
To begin to support applications, first need to configure the Windows system variables, including the path of supporting applications that are stored in the directory: C:\PolarStar\TSAT\support. Here are the steps:

1. Right-click My Computer and select Properties.
2. System Properties window will appear and select Advanced system settings.
3. Select the Advanced tab as shown below.

4. Click the Environment Variables button...

5. Environment Variables window will appear.

6. In the System Variables, find the variable in the Variable column named Path, select it and click the Edit button.
7. It would appear from the Edit System Variables. There are two (2) input as shown.

8. Edit Variables value add the final section: C:\PolarStar\TSAT\support (note the semicolon (;)), and click the OK button.
10. Press the OK button on the System Properties window.
In this tutorial MTSAT IR1 will process data at 00 UTC 2012-01-01 date. To get started please follow the steps below:

1. Create a directory with the name of "if" in the directory C:\PelatihanMTSAT, and in the directory "if" create a directory "IR1".
2. Download and save the file MIR1_2012010100.pgm.gz to the directory C:\PelatihanMTSAT\if\IR1
3. Download and save the file MTS212050908CAL.dat.gz to the directory C:\PelatihanMTSAT\if
4. Open the application editor (notepad), copy and paste the script below:

```bash
echo off
set_pgmfile = MTIR1_2012010100.pgm
set_calfile = IR1CAL.dat
gzip -dc C:\PelatihanMTSAT\if\IR1\MTIR1_2012010100.pgm.gz>%_pgmfile%
xcat C:\PelatihanMTSAT\if\MTS212050908CAL.dat.gz | awk -F/ "IR1 Temperature / {print $2} >>%_calfile%
```

save the script with the name "mtsatread1.bat" to the directory C:\PelatihanMTSAT\ though, make sure the Save As Type option is set to All files

5. Open the application editor (notepad), copy and paste the script below:

```bash
pgm2raw.exe MTIR1_2012010100.pgm IR1cal.txt
```

save the script with the name "pgm2raw.bat" to the directory C:\PelatihanMTSAT\ though, make sure the Save As Type option is set to All files

6. Run the second script by double clicking the file "mtsatread1.bat" and then run "pgm2raw.bat".
7. After running "mtsatread1.bat", in direktori C:\PelatihanMTSAT \ will it appear two files named "IR1CAL.dat", and "MTIR1_2012010100.pgm"
8. After running the script "pgm2raw.bat", in direktori C:\PelatihanMTSAT \ will appear if a file with the name "TB2001_2012010100.raw"
To perform a data plot with Grads, be prepared to do the following steps. Here are the steps to create a file called

1. Open the application editor (openedit), copy and paste the script below

```bash
your template options
DSER C:\Prelim\MTSAT \1f \TB001 \2012010100.raw
TITLE TBB
#1
XDEF LINEAR 70 0.5 2800 0.5
YDEF 3800 0.05-69 0.05 LINEAR
Linear ZDEF 1 1
TDEF 24 LINEAR 0 0 0 0 0 0 0 0
VARS 1
IR 1 0 0 0 0 0 0 0
ENDVARS
```

Save the script with the file name "prelim.mtsat.raw" and store in the directory C:\Grads\data. Make sure the Save As Type option is set to All files.

2. Run the program by clicking on Grads

Start -> All Programs -> Grads 2.0 -> Grads

It would appear the app (2) new windows. The first window is the place to give orders, and the 2nd is the window to display the results of the plot.

3. Type in the first window: open prelim.mtsat.raw and press the enter key

4. Then type: set grid lines and press the enter key

5. Then type: contour on and press the enter key

6. Then type: set lat -10 10 and press the enter key

7. Then type: set lon 10 140 and press the enter key

8. Then type: d IJ = 100 and press the enter key

9. Then type: show and press the enter key

10. Then type: title draw MTSAT TBB January 1, 2012 00 UTC and press the enter key

11. To save the plot in the form of images with extension "PNG", type: print C:\Prelim\MTSAT \1f \mtsat_tbb_jan201200utc.png.png white and press the enter key

The result will be as shown below:
Metode SPI:

\[ SPI = \frac{X_i - \bar{X}}{\sigma} \]

dimana

- \( X_i \) = curah hujan bulan ke \( i \),
- \( \bar{X} \) = curah hujan rata-rata periode tertentu,
- \( \sigma \) = standar deviasi periode tertentu.

Nilai SPI : transformasi dari distribusi gamma \( G(x) \) menjadi standar normal.

Validasi:
Validasi data dilakukan dengan cara membandingkan kualitas data dengan menggunakan parameter statistika antara lain:
- koefisien korelasi,
- koefisien determinasi,
- RMSE,
- Bias,
- MAE
- STDEV.

dimana \( \text{Bias} = \frac{1}{n} \sum (E_i - O_i) \)

\[ \text{MAE} = \frac{1}{n} \sum |E_i - O_i| \]

\[ \text{RMSE} = \sqrt{\frac{1}{n} \sum (E_i - O_i)^2} \]

Normal AMK & AMH berdasarkan TRMM di Jabar

Normal MK & MH, PMK & PMH
Berdasarkan SPI TRMM di Jabar

<table>
<thead>
<tr>
<th>No</th>
<th>Kauatelen</th>
<th>Posisi</th>
<th>Posisi</th>
<th>Rata-rata MK</th>
<th>Panjang MK</th>
<th>Rata-rata MH</th>
<th>Panjang MH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bandung 1</td>
<td>174.743</td>
<td>107.15</td>
<td>15.50</td>
<td>15.90</td>
<td>30.16</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Bandung 2</td>
<td>174.429</td>
<td>107.15</td>
<td>15.50</td>
<td>15.90</td>
<td>30.16</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>Karawang 1</td>
<td>175.430</td>
<td>107.30</td>
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<td>15.90</td>
<td>30.16</td>
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<td>4</td>
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<td>107.30</td>
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<td>15.90</td>
<td>30.16</td>
<td>21</td>
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<tr>
<td>5</td>
<td>Sukabumi 1</td>
<td>172.431</td>
<td>107.60</td>
<td>15.50</td>
<td>15.90</td>
<td>30.16</td>
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<tr>
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<td>15.50</td>
<td>15.90</td>
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<tr>
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<td>106.15</td>
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<td>15.90</td>
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<tr>
<td>10</td>
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<td>106.30</td>
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<td>15.90</td>
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<tr>
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<td>15.90</td>
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<tr>
<td>16</td>
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<td>106.30</td>
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<tr>
<td>17</td>
<td>Cimenyan 3</td>
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<td>106.30</td>
<td>15.50</td>
<td>15.90</td>
<td>30.16</td>
<td>21</td>
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<tr>
<td>18</td>
<td>Majalengka</td>
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<td>106.30</td>
<td>15.50</td>
<td>15.90</td>
<td>30.16</td>
<td>21</td>
</tr>
</tbody>
</table>
Sistem peringatan dini bencana dapat mengurangi resiko bencana dengan meningkatkan kecepatan dalam menghadapi bencana. Sadewa menyoroti kejadian hijau ekstrem yang berpotensi menimbulkan bencana banjir dan longsor di seluruh wilayah Indonesia dengan resolusi 5 km². Membagi real-time dan menimbulkan informasi peringatan dini melalui website, e-mail dan pesan singkat (SMS) kepada pihak-pihak yang terkait dengan penanggulangan bencana.

Sadewa terdiri dari sub-sistem pemantauan, sub-sistem prakiraan, dan sub-sistem peringatan.
SO₂ GAS DISTRIBUTION and Emission Particulate of Sinabung Mountain in Sumatera

Domain penelitian

Sinabung

Hari aktif

Tidak ada kenaikan SO₂ yang tinggi dalam domain yang diduga berasal dari Sinabung → maksimum SO₂ di luar domain/ emisi SO₂ kecil

Hari sebelum aktif

Hari setelah aktif

Level 1 (8 m)
Level 9 (219 m)
Level 25 (6375 m)

Calms: 0.00%
OZON AND UV RADIATION

Ozon Total di wilayah Jakarta, Bandung, Yogyakarta, Watukosek dan Denpasar
ANALYSIS OF AEROSOL AND CO and the IMPACTS TO CLOUD ICE PARTICLE SIZE IN INDONESIA

ANALISIS CO SEBAGAI PROKSI AEROSOL

IWC Awan Terpolusi AURA MLS 215 hPa (CO > 108 ppbv)
Ags 2004 ~ Des 2011

IWC (< 2 mg m⁻³) dan CO > 108 ppbv (Sumatera dan Kalimantan)

AOD (> 0,1 )
(Sumatera dan Kalimantan)

Nilai AOD rata-rata bulanan (Ags 2004 ~ Des 2011)

PENENTUAN CO SEBAGAI PROKSI AEROSOL

SUMATERA

Scatterplot AOD - MODIS terhadap CO-MLS pada kondisi berawan (IWC > 2 mg)
Untuk : Wilayah SUMATERA

Nilai maksimum CO = 180
Nilai minimum CO = 90

Kuartil 1 = 90 s.d 112 (awan bersih)
Kuartil 2 = 112 s.d 133
Kuartil 3 = 135 s.d 157 (awan terpolusi)
Kuartil 4 = 157 s.d 180 (awan terpolusi)

ANALISIS PENGARUH AEROSOL TERHADAP UKURAN PARTIKEL ES (rₑ)

Korelasi antara AOD dan rₑ rata-rata bulanan
(untuk KALIMANTAN)
(2004 ~ 2011)

CO high sensitivity (δ = 0,27)

CO low sensitivity (δ = 0,04)

rₑ pada kondisi awan terpolusi << kondisi bersih

Analisis Korelasi AOD dan CO
Wilayah Indonesia

CO vs AOD
Agustus 2004 - Desember 2011

Sumber : Rosida 2012
Analysis of Acid Rain and Wet Deposition in Sumatera because of forest fire and anthropogenic activity.
INFORMATION SYSTEM OF CLOUD COVER (PRECIPITATION) BASED ON SATELLITE DATA IN MOBILE PHONE

Minimum kebutuhan sistem
1. Mobile Phone Android
2. Terhubung internet

Download file di http://60.253.114.151/silaw/
Install dan kemudian jalankan aplikasinya.
Untuk non android → buka internet browser dan akses alamat :
http://60.253.114.151/silaw/silaw.php
CONCLUSION

✓ The relationship between Urban Heat Island (UHI) and land cover type has been studied comprehensively by remote sensing and GIS.

✓ UHI is found to be centralized in downtown areas and spreading to the surrounding area.

✓ Net Radiation ($R_n$) and Latent Heat Flux ($LE$) in urban area relatively lower than vegetation and water area, otherwise Sensible Heat Flux ($H$) and Soil Heat Flux ($G$) are higher than vegetation area.

✓ Evaporative Fraction ($EF$) and Bowen Ratio ($BR$) as Drought monitoring effectively analyse using satellite.

✓ $EF$ will be high on the vegetation area and waterbodies, and vice versa will be low in non-vegetation. $BR$ is the opposite value of $EF$. 
CONCLUSION (continued)

√ SEBALIS could be to overcome obstacles that complicated and repetitive work in estimating urban climate variables that integrates counting process so that it becomes more practical and easier. Without SEBALIS need ~1 week, with SEBALIS only ~1 hour.

√ LU modification from grassland to urban (scenario 1) will expand area of UHI with highest temperature (Ta 306K (33°C) by 5%). In the contrary with the addition of grassland / vegetation (scenario 2, 3 and 4) would reduce the area with high temperature (by -48%, -54% and -88% respectively).

√ Database management is benefit for R&D in climate change for researcher, student and public, DSS (such as SADEWA), and quick information on mobile phone.

√ These studies can be used as reference for good urban design and comfortable environment.
Thank you

laras.toersilowati@lapan.go.id

www.lapan.go.id
Clean, green, & beautiful