K.LAB Modeler example

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K.HAYASHI
Nagoya University, Institute of Materials and Systems for Sustainability
k. Modeler: Japan ES model

- 10m grid: DEM10m, LU10m
- Carbon stock
- Micro-climate regulation: Forest volume, LST
- Air pollution regulation: NO2, SOx, etc.
- Agri-product supply: Rice, Agri-product
- Culture ES:
Carbon stock survey

• DBH (≥ 5 cm) and tree height (H) were measured by a 15 m tree pole supported by a Laser range finder (Nikon Laser 550AS) to calculate above ground biomass (AGB).

• DBH and H in a 100 m².

• H of the 300 m² were estimated by DBH and H in the 100 m²

• the AGBs of each tree were estimated based on Tadaki et al. (2004) in Formulas.
model "local:maruhaya:es.japan.ep:InHRLULC16.02WGS84EastE134_153"
as landcover:LandCoverType
classified into
landcover:WaterBody if in (1 91),
landcover:UrbanFabric if in (2 71),
landcover:RiceField if in (3 11),
landcover:AgriculturalVegetation if 4,
landcover:NaturalGrassland if in(5 51),
landcover:DeciduousBroadleafForest if in (6),
landcover:DeciduousConiferousForest if in (7),
landcover:EvergreenBroadleafForest if in (8),
landcover:EvergreenConiferousForest if in (9),
landcover:BareArea if in (10 61),

/* "JAXA(2017) High-Resolution Land Use and Land Cover (HRLULC) map of Japan (Released in Sep. 2016 / Version 16.09)"
   dc:url "http://www.eorc.jaxa.jp/ALOS/lulc/lulc_jindex_v1602.htm#main" */
define CARBON_STOCK_TABLE_JAPAN as {{
  landcover  | carbonstock_per_ha
  ____________________________
  landcover:WaterBody      | 0,  
  landcover:UrbanFabric   | 0,  
  landcover:RiceField     | 5,  //unit t/ha///
  landcover:AgriculturalVegetation | 0,  
  landcover:NaturalGrassland | 0, 
  landcover:DeciduousBroadleafForest | 88.0,  
  landcover:DeciduousConiferousForest |125.2,  //unit t/ha, used by CF///
  landcover:EvergreenBroadleafForest |107.9,  ///unit t/ha///
  landcover:EvergreenConiferousForest |125.2,  ///unit t/ha, used by CF///
  landcover:BareArea        | 0,  
}};
model chemistry:Organic chemistry:Carbon im:Mass in t/ha
observing landcover:LandCoverType named lc
lookup (lc, ?) into CARBON_STOCK_TABLE_JAPAN ;
Micro climate regulation

• Hiruta and Ishikawa (2012) studied the heat-reduction effect by green spaces
  – Indicators: forest canopy coverage, tree volume, and ground coverage.

• Tree volume: largest especially for daytime in summer.

• Our study focused on micro climate regulation.
  – Forest volume by Formula (2) using forest cover and average tree heights (DBH ≥ 5 cm) (Kobayashi et al. 2016).
  
  \[ V_i = 104 \times (C_{\text{Hov}} - (1 - C_{\text{Cov}})C_{\text{mid}}H_{\text{mid}}) + (1 - C_{\text{Cov}})(1 - C_{\text{mid}})C_{\text{und}}H_{\text{und}} \]  
  
  – \( V_i \): forest volume in 100 m² site i (m³/ha)
  – \( C_{\text{Cov}} \): overstory cover (10 m>)
  – \( C_{\text{mid}} \): midstory cover (10 m≥, >5 m)
  – \( C_{\text{und}} \): understory cover (5 m≥, > 1m)
  – \( H_{\text{Hov}} \): average height of overstory trees (m)
  – \( H_{\text{mid}} \): average height of midstory trees (m)
  – \( H_{\text{und}} \): average height of understory trees (m)
Micro-Hydro power potential

• Mini and micro hydropower targeted
  – below 1000kW
  – Development of a potential estimation method
Method

• Yahagi River System flows down to Nagano, Gifu, and Aichi Prefectures.

• Stream length: 117 km
• Catchment area: 1,830 km²

Flow

• **Supply**
  - Micro-Hydro potential site selection
    - River flow
    - Water discharge amount
    - Potential site selection

• **Disaster risk factor**
  - Sediment erosion
  - Flood possibility

• **Environmental risk factor**
  - Nature conservation area
  - National park area
  - Wildlife sanctuary area

• Micro-Hydro potential site selection

• **Demand**
  - Urban area(10m grid = 1 household)
  - Electricity consumption

• **Balance**
  - Supply and demand relation
Method: Power Generation

• Electricity generating capacity
  – \( Pe = 9.8 \times Q \times He \times \eta \)
  – \( Pe \): amount of power generated (kW)
  – \( Q \): river discharge (m\(^3\)/s)
  – \( He \): height difference between inlet and outlet of stream (m)
    • Initial value: 5m
  – \( \eta \): dimensionless efficiency of the turbine
    • Initial value: 0.8

• Targeted power generation
  – 30 to 500 kW

Method: Cost factor

• Distance to road:
  – as a cost factor, connecting electricity power line
• Maximum value of 1.0 in the case of 100 m or less
  – Within river
• Other wise,
  – \( P_n = \frac{100}{D_n} \)
  – \( P_n \): normalized value of the potential points(n)
  – \( D_n \): distance from potential points(n).
Method: Demand

• High Resolution Land-Use and Land-Cover Map (Ver. 16.09; 10 m grid resolution; JAXA, 2016)
  – Each urban land use pixel represents one house
  – Number of household in around potential site
  – Parameter: 300m

• Annual power consumption per household (2005 to 2010; The Federation of Electric Power Companies of Japan, 2017)
Results

- Watershed
- DEM 10m
- Stream extraction
- Potential points
- Grouping
  - Connecting points is **grouped as one section**.

- Potential estimation after excluding disaster risks and environmental risks: 30 kW-500 kW

Field survey

K. Modeler: future development
Figure 4. (a) and (b)
ESs covered

- **14 ESs based on MA(2005) category**
- Provisioning services
  - food, timber and energy, and water
- Regulating services
  - CO2 absorption, preventing soil erosion, water purification
- Cultural services
  - aesthetic value, recreation and ecotourism, cultural heritage value
- Wildlife Species conservation
  - habitat, valuable species, common species

Mountain side

City side

Data source: DEM by Geospatial Information Authority of Japan
Water catchment area


City side

Feed back money
Thank you for your kind attention