Eco System Research:

Assessment Research based on Remote Sensing Data

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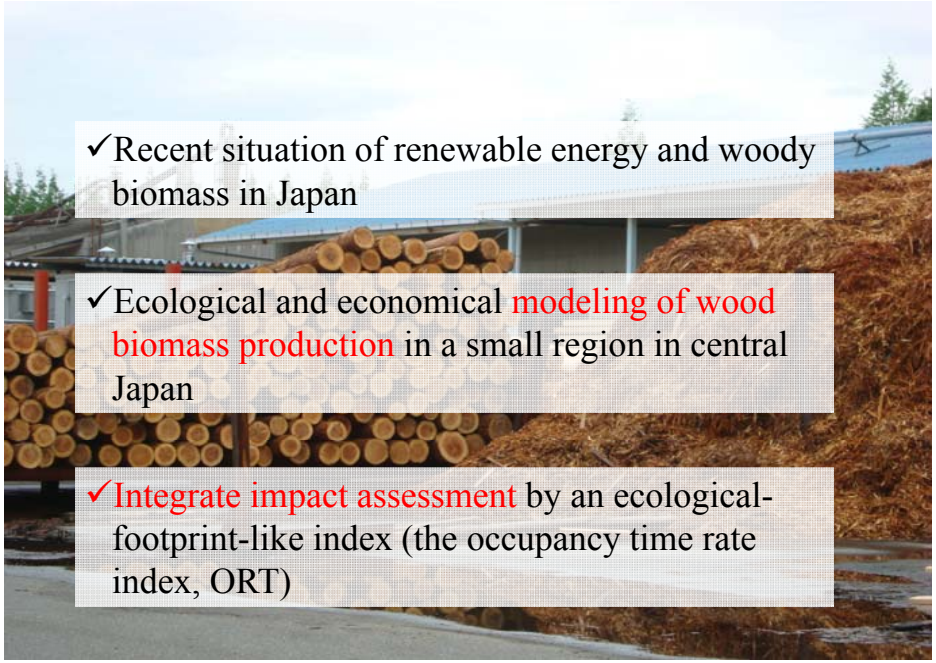
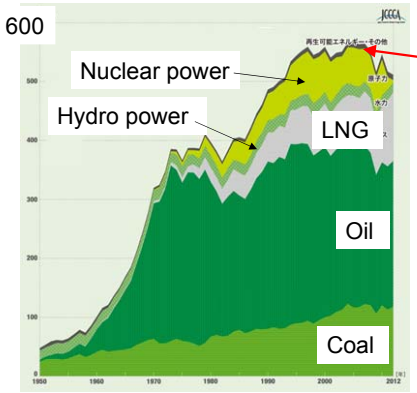


- ✓Recent situation of renewable energy and woody biomass in Japan
- ✓Ecological and economical modeling of wood biomass production in a small region in central Japan
- ✓Integrate impact assessment by an ecological-footprint-like index (the occupancy time rate index, ORT)

Biomass usage in Japan



(Unit, 10^{13} kcal)

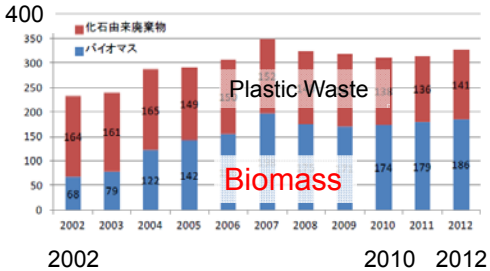
Source: Japan Center for Climate Change Actions

Total energy consumption in Japan

Renewable energy
including solar, wind, and geothermal, and various biomass energy

Biomass use in Japan

Not increase, innovatively, despite of intensive research and development by both governmental and private sectors



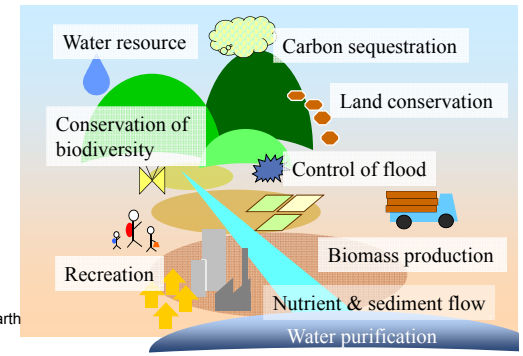
(Unit, 10^4 kL eq.)

Source: Mizuho Research Institute

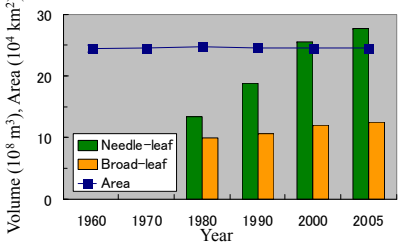
Ecosystem Services from Forest

- Abundant Wood Biomass in Japan
- Forest ecosystems also provide the ecosystem services to human society

Google Earth



Increase of timber volume accumulation and forest area in Japan



Unmanaged forest
(No understory vegetation)

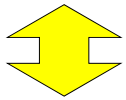
Disaster by driftwoods from unmanaged forests

Troubles with wildlife

http://www.komeri-npo.org/record/downpour/gihu/h12/14/index.html

Difficulties: Sustainable biomass use

- Energy & heat from biomass is renewable and carbon neutral
- Sustainable usage of domestic wood biomass will conduct promoting domestic forestry and enhancing conservation of forest ecosystems in Japan



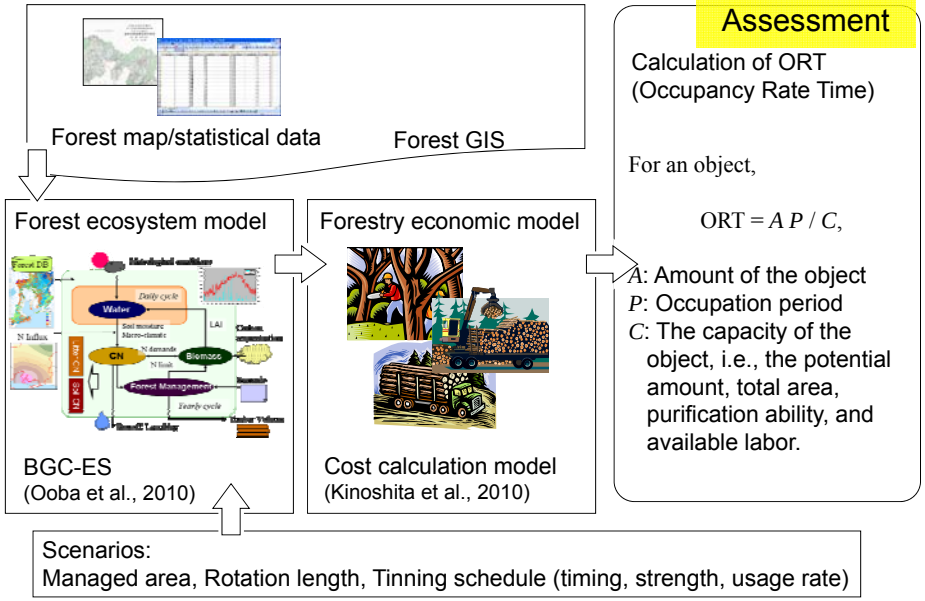
- Wood biomass can be supplied continuously from the forests without serious disturbance on ecosystems ?
- Relatively high costs for forest managements and biomass productions in Japan.
- Integrated assessments are needed for production & usage of domestic wood biomass.

Objectives

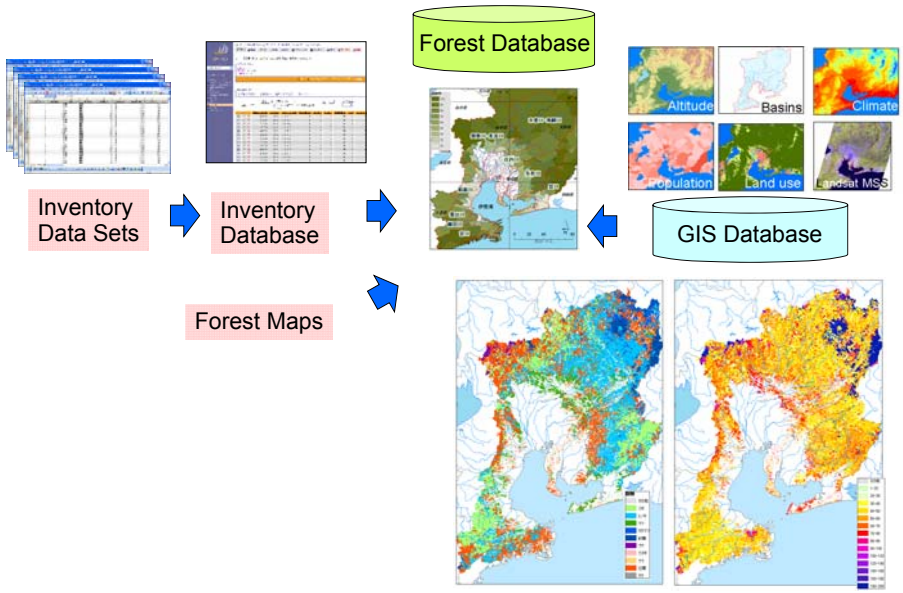
➢Biomass production and related environmental effects are simulated for a long-term (-2200) by ecological and cost calculation models in a selected small area

➢Form the simulation results, impacts under various scenarios of forest management are assessed by a ecological-footprint-like index (the occupancy time rate index)

Study Framework

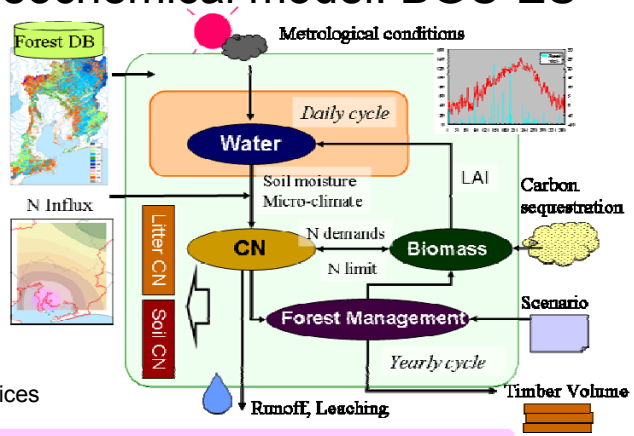


Development of GIS database



Forest biogeochemical model: BGC-ES

Ooba et al. (2010)
Ecological Modelling 221: 1979-1994.



Output:
Ecosystem services

Quantitative Evaluation

From the past to futures under various scenarios

- Carbon sequestration: Caron emission, climate regulation
- Water runoff: Water resource
- Timber volume: Woody biomass
- Nitrogen leaching: Water quality
- Erosion prevention: Disaster control, water quality

Cost calculation model

Kinoshita et al. (2010)

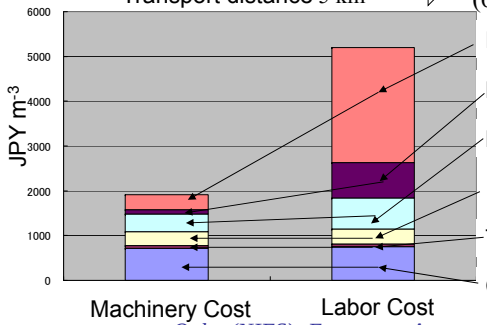
The model was parameterized according to their comprehensive research and data about costs and usage of various forestry machineries in Japan

Harvester

$$C = (1+\lambda)\sum(C_m+C_l)+C_{st}+C_{road}$$

$C_{m\,i}$ cost of forestry machines
$C_{l\,i}$ cost of labor
C_{st} fixed cost
C_{road} access-road clearing cost
λ rate for overhead cost

Example: Logging distance 250 m, Transport distance 5 km ⇨ 8,590 JPY m^{-3} (66 EUR m^{-3})



Arbro400S
http://www.forest-machine.jp/catalog/harvester_a8m_arbro400.html

Swing Yarder

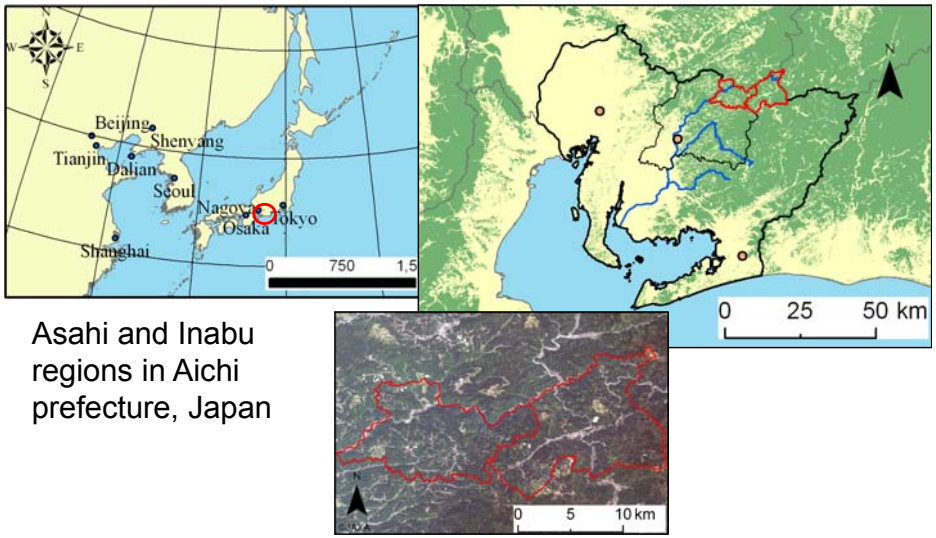
http://www.iwafuji.co.jp/lineup/forest/sw.htm

Chipper

FPC1700
http://www.kawarockdrill.co.jp/products/chipper/spec/FPC1700.htm

Study area

Ooba et al., (2013) SDEWES conference, Dubrovnik, Croatia,
Ooba et al., (2014) *J. Cleaner Production.* (Submitting)



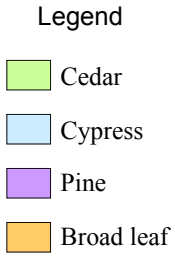
Asahi and Inabu regions in Aichi prefecture, Japan

Forest conditions in the study area

Forest type

Tree type	Area (ha)	
	Plantation	Other forest
Cedar	5,789	
Cypress	5,376	
Pine	75	239
Needle leaf	82	3
Broad leaf		3,353
total	11,322	3,595

Distribution

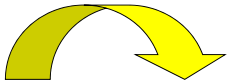


Simulated forest scenarios

		Management Type*	Forestry Activity	Conversion to Secondary Forest
BAU	Business as usual	Standard	Low	No
FM1	Intensive management	**Modified**	Low	No
FM2	Intensive & extended management	**Modified**	**2 times higher**	No
CNV	Forest conversion	**Modified**	**2 times higher**	**Yes** (30%)

Economically poor productivity plantations
(Steep slope, far from roads, bad soil condition, etc)

Current Distribution

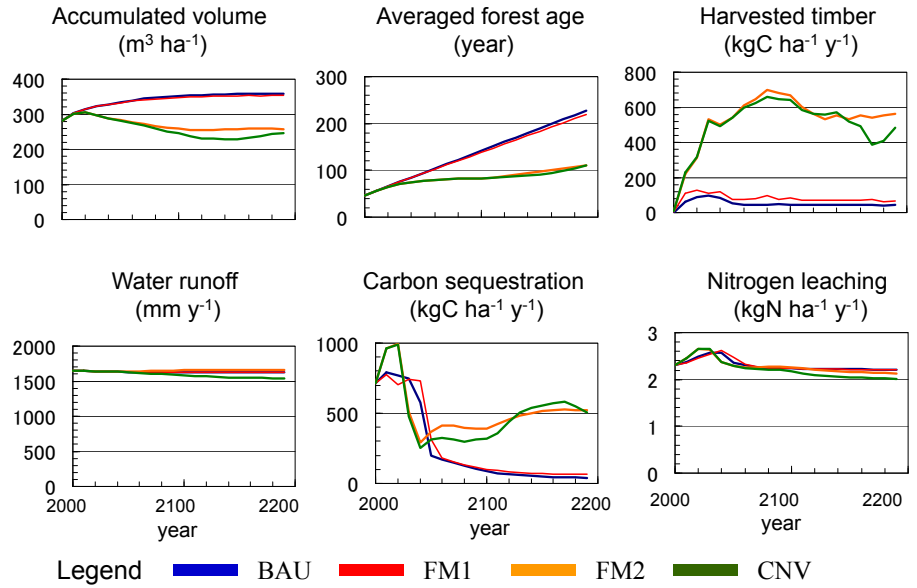


CNV scenario

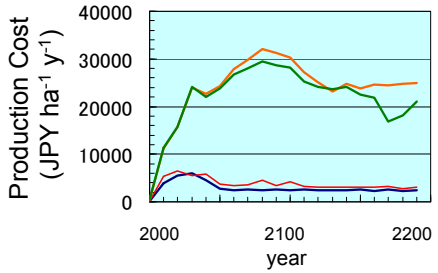
Convert to secondary forests (30%).

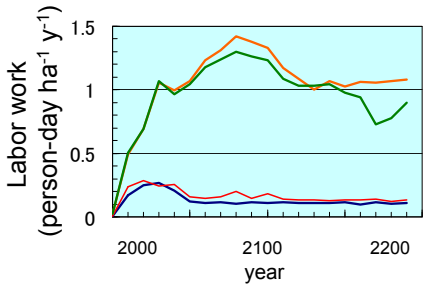
Secondary and natural forest provide relatively high quality habitat and biodiversity

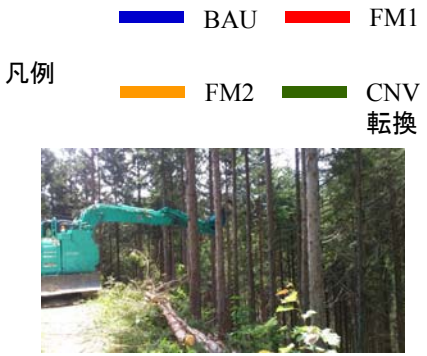
Simulation results



Cost calculation







Chubu Forest Management, Co. Ltd.

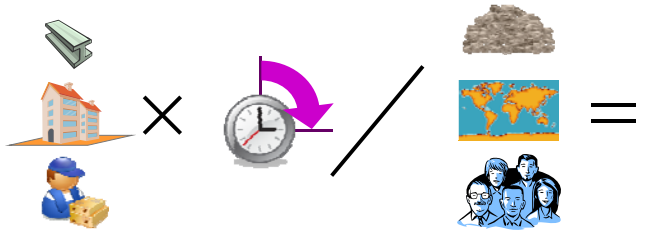
Material [kg]
Landuse [km^2]
Labor [person]

Span [year]

Stock [kg]
Total land [km^2]
Population [person]

OA *TM* *TA*

Fijii et al. (2010, 2013)



Pollution [kg]
Water use [m^3]

Absorb capacity [kg/year]
Annual precipitation [m^3/year]

Occupancy Rate Time [year]

ORT

Each value of ORT for any object has the temporal dimension, and it can be compared to others. Sum of ORT provides an index for the all impacts

Ooba (NIES): Ecosystem Assesments based on Remote Sensing

ORT Calculation in this study

Landuse

Carbon balance

Labor

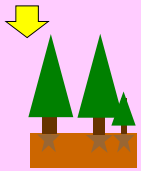
Artificial (plantation) forest

(1) Absorb

(2) Emission

Estimated workload

Numerator (Simulated)



(3) Offset

Study area

18,000(ha)

Potential carbon absorb rate in the area

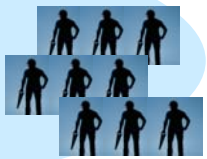
90 Gg-C y^{-1}

* Maximum absorb rate

5.0 Mg-C y^{-1} ha^{-1}

Potential workload in the area

45,000 person-days

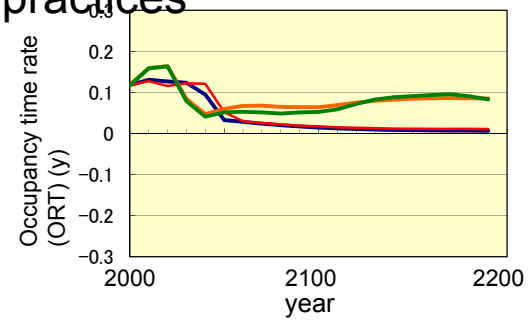


*Estimated from number of forestry worker

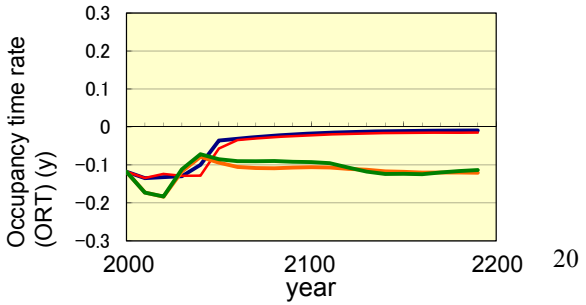
Denominator (Constant)

Ooba (NIES): Ecosystem Assesments based on Remote Sensing

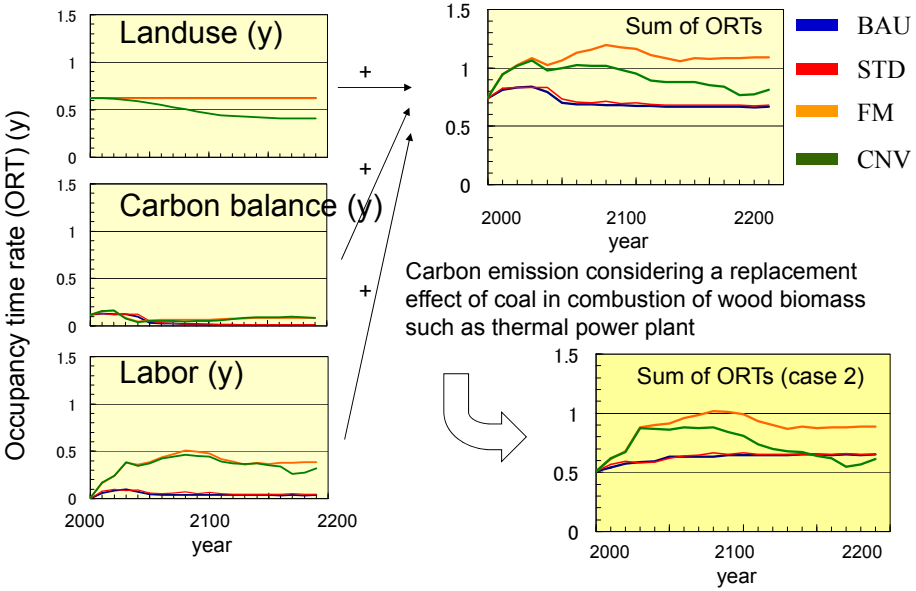
Carbon balance between absorptions and practices



Combustion Offset



Integrating ORTs



Remarks

For sustainable wood biomass production

- Carbon sequestration, which is a significant ecosystem service derived from plantation forests, can be enhanced by promoting forest management practices
- Consideration of wood biomass in the ORT calculation reveals that conversion of plantations to secondary forests, where maintenance is expensive (high amount of labor work), has a good effect on ecological and social systems, if the biomass usage is taken into account using a suitable system of carbon offsets.

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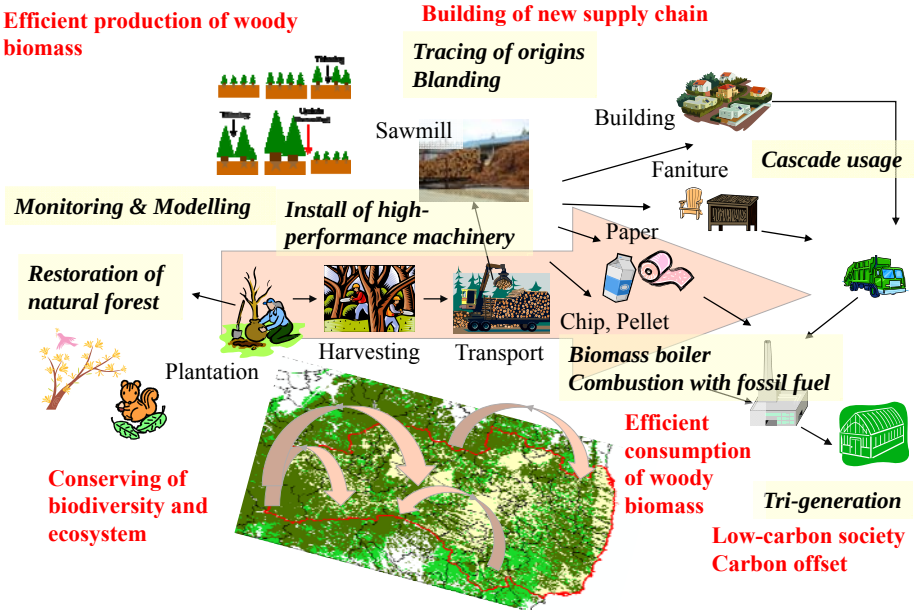
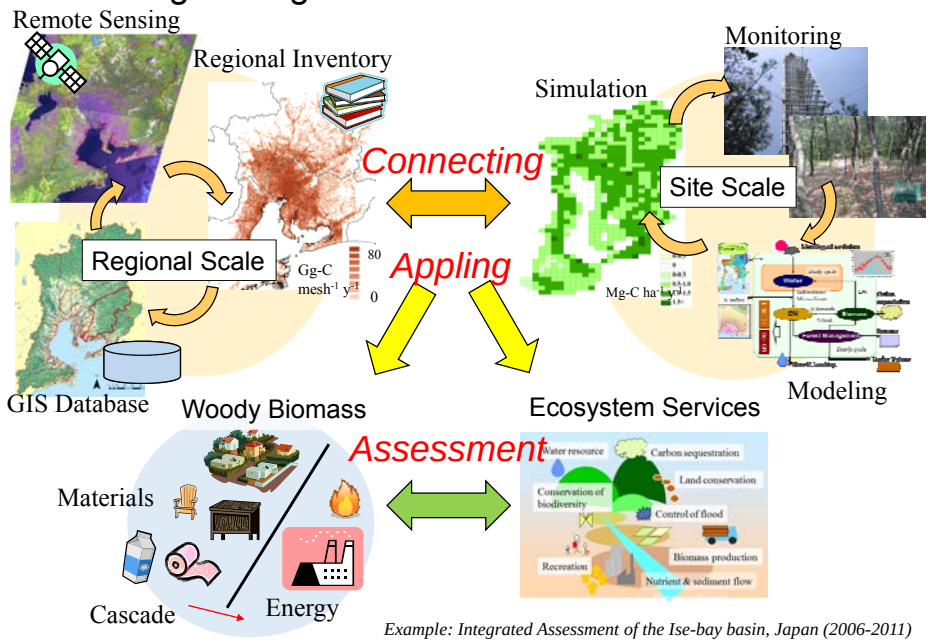
Comprehensive modeling from upstream to downstream



Connecting among multi-scale data and models



Example: Integrated Assessment of the Ise-bay basin, Japan (2006-2011)

Recent publications

M. Ooba, K. Hayashi, M. Fujii, T. Fujita, T. Machimura, T. Matsui. (2014) **Ecological, economical, and sustainability assessment for wood biomass production by a temporal dynamic method**. *Journal of Cleaner Production.* (in press)

M. Ooba, K. Hayashi, T. Machimura, T. Matsui. (2014) **Assessments of regional carbon circulation by a biogeochemical model from multi aspects: A case study of forests in Toyota city**. *Journal of Agricultural Meteorology*. 70, 41-54.

M. Ooba, T. Fujita, M. Mizuochi, T. Machimura, T. Matsui. (2012) **Sustainable use of regional wood biomass in Kushida River Basin, Japan**. *Waste and Biomass Valorization*, 3: 425-433.

M. Ooba, T. Fujita, M. Fujii, M. Mizuochi, S. Murakami, Q. Wang, K. Kohata. (2013) **Biogeochemical forest model for evaluation of ecosystem services (BGC-ES) and its application in the Ise Bay basin**. *Procedia Environmental Sciences*, 13: 274-287.

Acknowledgements

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Thank you for your kind attention.

Ooba (NIES): Ecosystem Assesments based on Remote Sensing