Advancing the Science and Technology of Soil Information in Asia
- Launch of GSP Asia Network and GlobalSoilMap.net East Asia Node
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Forest soils in Japan, and its state of development of soil information infrastructures

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Outline

1. Geographical background of forest soils in Japan
2. Era of the extensive soil surveys
3. (1950s–70s)
4. Measures against global warming and soil carbon stock (1990s-)
5. Summary

1. GEOGRAPHICAL BACKGROUND OF FOREST SOILS IN JAPAN

Forests covers 2/3 country (25/37 mil. ha)

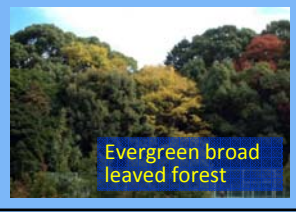
Four climatic zones:
- Sub-boreal
- Cool temperate
- Warm temperate
- Subtropical

Rainfall 1,700 mm
→ Luxuriant growth of forests covers 67% of terrain

Luxuriant forest development

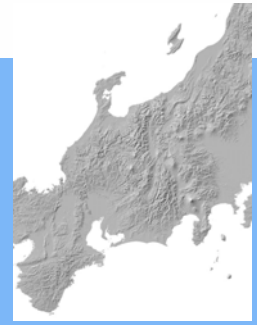

Sugi plantation forest


Beech forest


Evergreen broad leaved forest

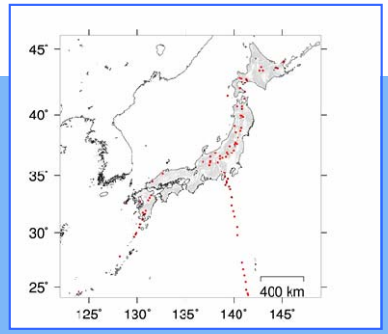

Secondary deciduous board leaved forests

Mountainous steep slopes



Materials in ICG 2001

Distribution of volcanos



The Japanese Archipelago lying on the Ring of Fire

- Fresh soil materials
- Volcanic ash soils

I. Geographical background of forest soils in Japan

$$s = f(cl, o, r, p, t, \cdots)$$

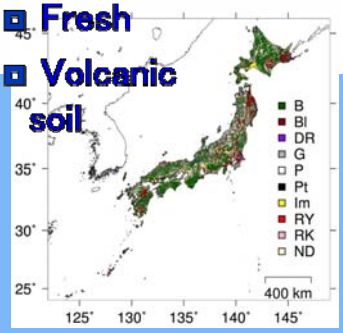
- cl:Climate
- o:Organisms
- r:Topography
- p:Parent material
- t:Time

1. Cool to warm, and humid
   → Luxuriant forest development
2. Sub-boreal to subtropical
   → High biodiversity
3. Steep slope and volcanic ash
   → Young fresh materials for soils

II. ERA OF THE EXTENSIVE SOIL SURVEYS (1950S–70S)

Major soil group and distribution of forest soils in Japan

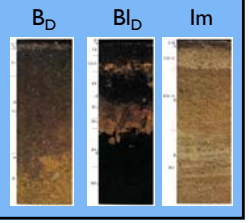
- Fresh
- Volcanic soil



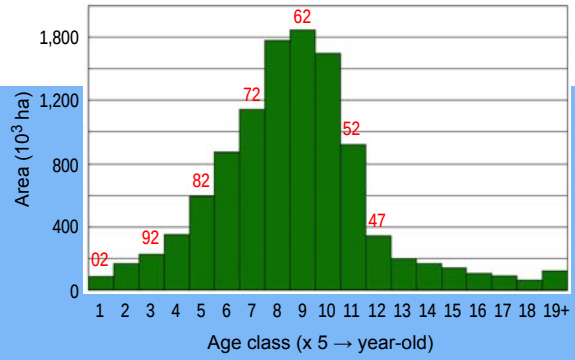
Soil Group	Soil Unit, WRB	Area (%)
Brown forest	Cambisols, Andosols	69.5
Black soil	Andosols	12.4
Podzolic soil	Podzols	3.8
Immature soil	Regosols, Arenosols, Fluvisols, Leptosols	4.2
Red and Yellow soil, Dark red soil, Gley soil, Peaty soil, (Rock and debris)	Acrisols, Alisols, Cambisols, Luvisols, Gleysols, Regosols, Arenosols, Fluvisols, Leptosols	6.8

Extensive soil surveys (1950s–70s)

1. Timber demand gone up since 1950s
   → Soil survey over the country
   → land suitability for tree species
2. Established classification (Forest soil division, 1976); **morphology** and "**catena**"
   - Color and structure
   - dry ← moist → wet
   - B_A, B_B, B_C, B_D, B_E, B_F
3. Management body worked out
   - Several ten thousand soil pits
   - many soil maps



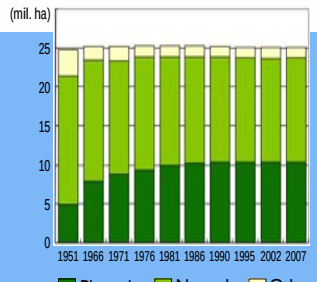
Forest area by age class in 2007



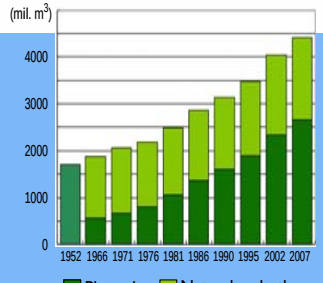
Forestry Agency (2009)

Change in forest area and growing stock

Forest area



Growing stock



Forestry Agency (2009)

II. Era of the extensive soil surveys (1950s–70s)

1. Forest soil surveys all over Japan for timber production
2. Rapid increase of planted conifer forests
3. Clarified basic characteristics and distribution of forest soils in Japan

III. MEASURES AGAINST GLOBAL WARMING (1990S–)

Needs for studies on carbon stock and dynamics (1990s–)

1. UN Conf on Environment and Development (1992)
2. Kyoto Protocol (1997) to UNFCCC
   - –3.9% of –6% target assigned to forest management

→ Studies on carbon stock and change in forest

Compilation of era of extensive soil surveys

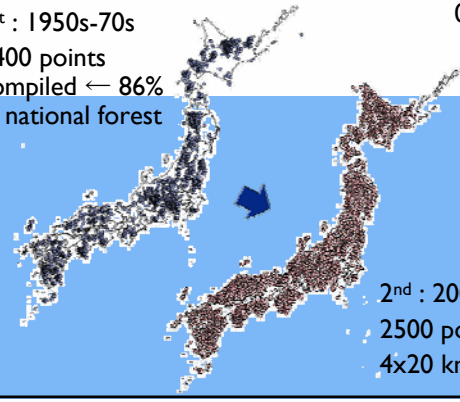
Mean organic carbon densities in forest soils

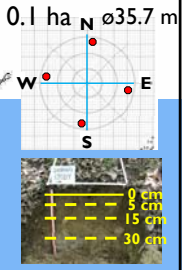
Soil Unit	N	0–30 cm (kgC m^{-2})	0–100 cm (kgC m^{-2})
Moist Brown forest soil	1259	9.2	19.5
Black soil	414	13.8	33.0
Dry Podzolic soil	199	10.1	20.8
Immature soil	88	3.9	8.2
Area-weighed average	3363	9.0	18.8
Global mean			11.3
Cool temperate wet			13.9
New Zealand			15.9

17 Morisada et al. (2004)

Soil survey : 1st phase → 2nd phase

1st : 1950s-70s
3400 points
compiled ← 86%
in national forest





2nd : 2006-2010
2500 points, 28%(NF)
4x20 km, link to NFI

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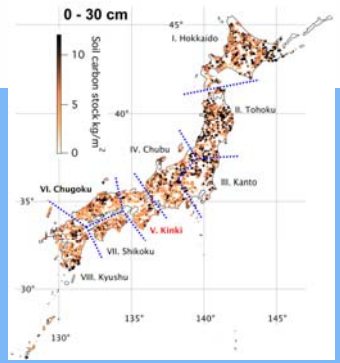
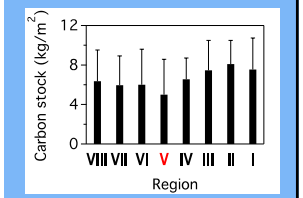
Soil carbon stock in forest soils, Japan



ca. 7 kgC m^{-2}
(2006-2010)

9.0 kgC m^{-2}
(50s-70s)



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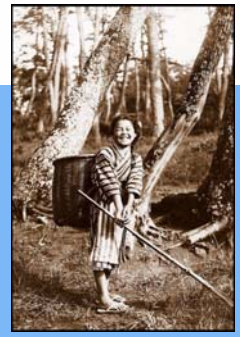
Rake litter and put branches and leaves for manure, root excavation for fuel



Walter Weston (1922)

Removal of litter, foliage, root might cause carbon decrease

Seikei zusetsu (1804)

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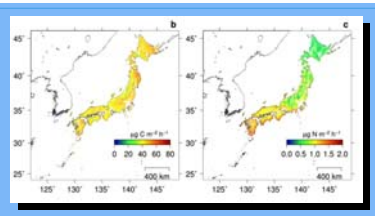
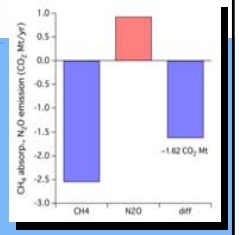
Total fluxes and distribution of soil GHG fluxes based on models

	Adsorption	Emission
Annual flux	CH_4: 91 GgC yr^{-1} (49-136)	N_2O 1.9 GgN yr^{-1} (0.7-5.2)

Net absorption!

Average flux





Hashimoto et al. (2011)

III. Measures against global warming (1990s–)

1. Compilation of soil survey data during "Era of the extensive soil surveys (1950s–70s)"
2. Promote 2nd phase of more systematic national soil surveys (2006-2010)
3. Other relevant research outcomes based on nation-wide soil map and survey data

Another soil surveys and National Land Numerical Information

1. Japan-wide soil map (1:200,000) covering both agricultural and forested area by National Land Survey Division, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 1970s
2. MLIT provides National Land Numerical Information; nature of basic land classification, climate
3. Geospatial Information Authority of Japan (GSI) provides DEM

→ Fulfilling data for soil and soil forming factors

Summary

1. Infrastructure of forest soil data in Japan built up by timber demand and global warming issues independently from agricultural soils
2. Two phases of ground soil survey data compiled into database
3. Future tasks are –
   - Development of systems for end-user
   - Integration with the soil classification system for agricultural lands

Thank you for your attention!

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