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Session: Mapping Forest and Tracking Carbon

Integration of forest information: Japan's forest carbon accounting system for Kyoto reporting

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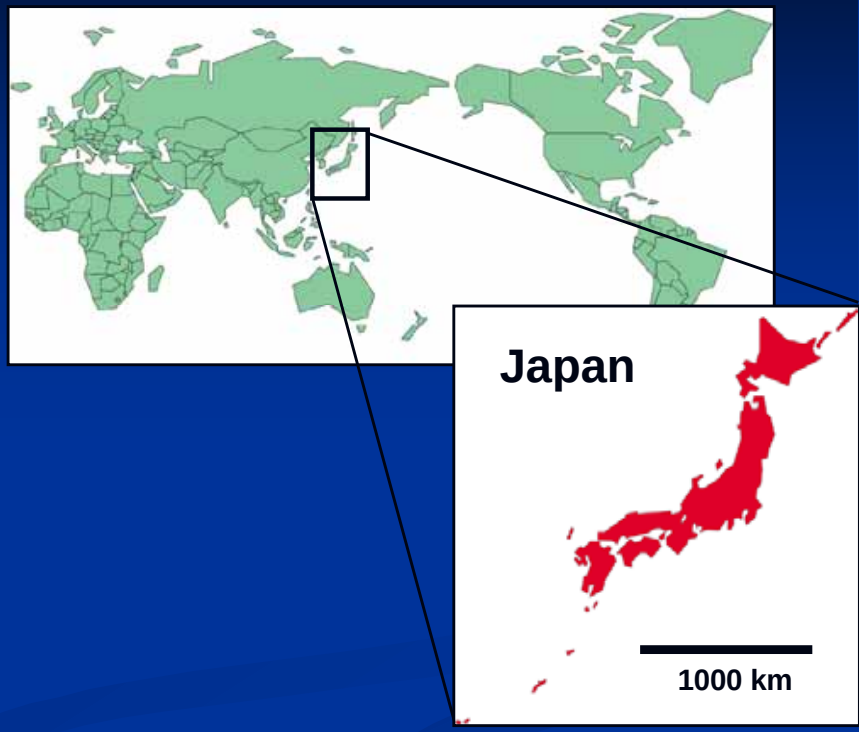
Background

- FFPRI and Forestry Agency Japan developed a forest carbon accounting and reporting system, and National Forest Resources Database for national reports under the Kyoto protocol.
- The system integrated various forest information including forest registers, forest maps, sampling systems and remote sensed images.
- Based on the experiences, I will make a introduction of the system and a recommendation to discussion on REDD.

Japan's Forest

- Total land is 37 km^2 and islands are distributed over about 3,000km from South-West to North-East.
- Four climatic zones:
  - Sub-tropic,Warm temperate, Cool temperate, Boreal



- Large amount of precipitation (about 1,700 mm/year)
- Large proportion of land is occupied by steep mountains with forest cover.

- 67% of total land is forest
- 40% of forest is planted forest and 60% is semi-natural forest
- 69% of forest is private and 31% is national

Requirements for Kyoto Reporting

- Definition and choice
  - Definition of “Forest”
  - Election of Article 3.4 activities
    - Definition of Forest management
  - Choice of reporting method
- Data and methods for accounting
  - Transparent data source and methods
  - Uncertainty assessment, Verification and QA/QC
- Accounting methods
  - Carbon in 5 pools
    - Above ground biomass, Below ground biomass, Dead wood, Litters and Soil organic matter
  - Article 3.3 ARD
  - Article 3.4 FM lands
- Accounting and reporting systems

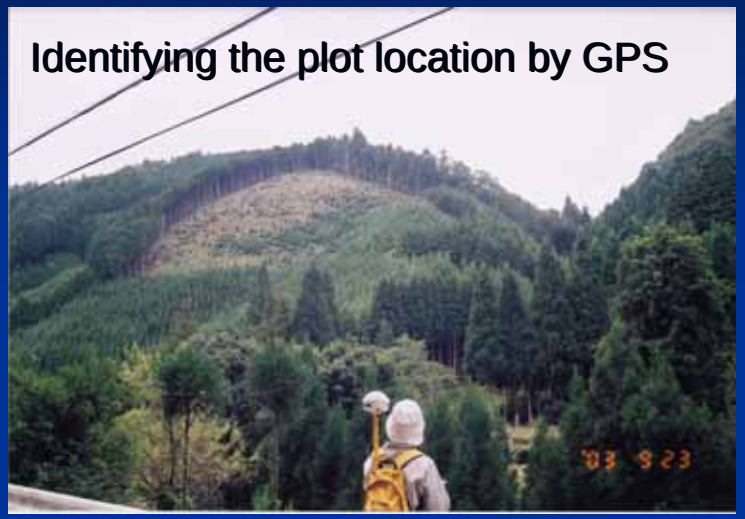
Japan's Forest Inventory System Based on Forest registers and Forest maps

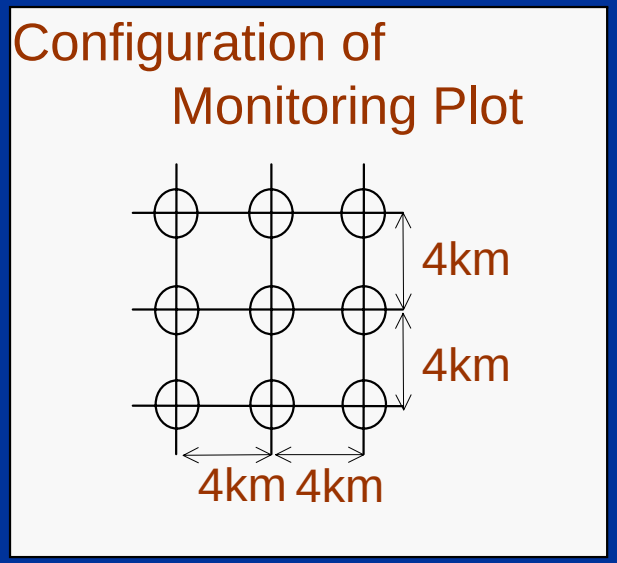
- Forest registers
  - Enumeration
    - Attribute information : Area, Species, Age, DBH, Volume etc.
  - Every sub-compartment of all private and national forests
    - Total 41 M records
  - Updating every 5 years
  - Linkage with boundaries in forest planning maps

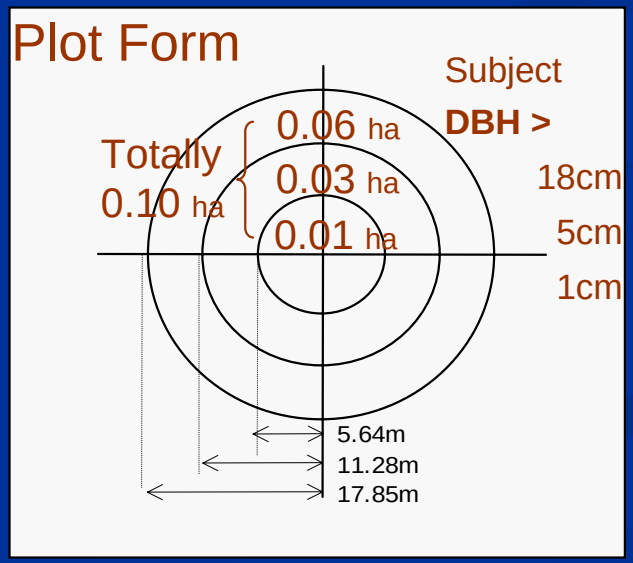
- Forest maps
  - 1/5000 scale maps
  - Boundaries of forest compartments and sub-compartments
  - 100% of the boundaries of forest components have been digitized for GIS.
  - Around 80% of the boundaries of sub-compartments have been digitized for GIS

Forest Resources Monitoring Survey

- Started from 1999
- About 15,700 permanent plots on 4km✕4km grid points over the whole of national territory
- Each plot is surveyed every 5 years. 3,200 plots are surveyed annually.
- Each monitoring plot: triple circle of 0.1 ha

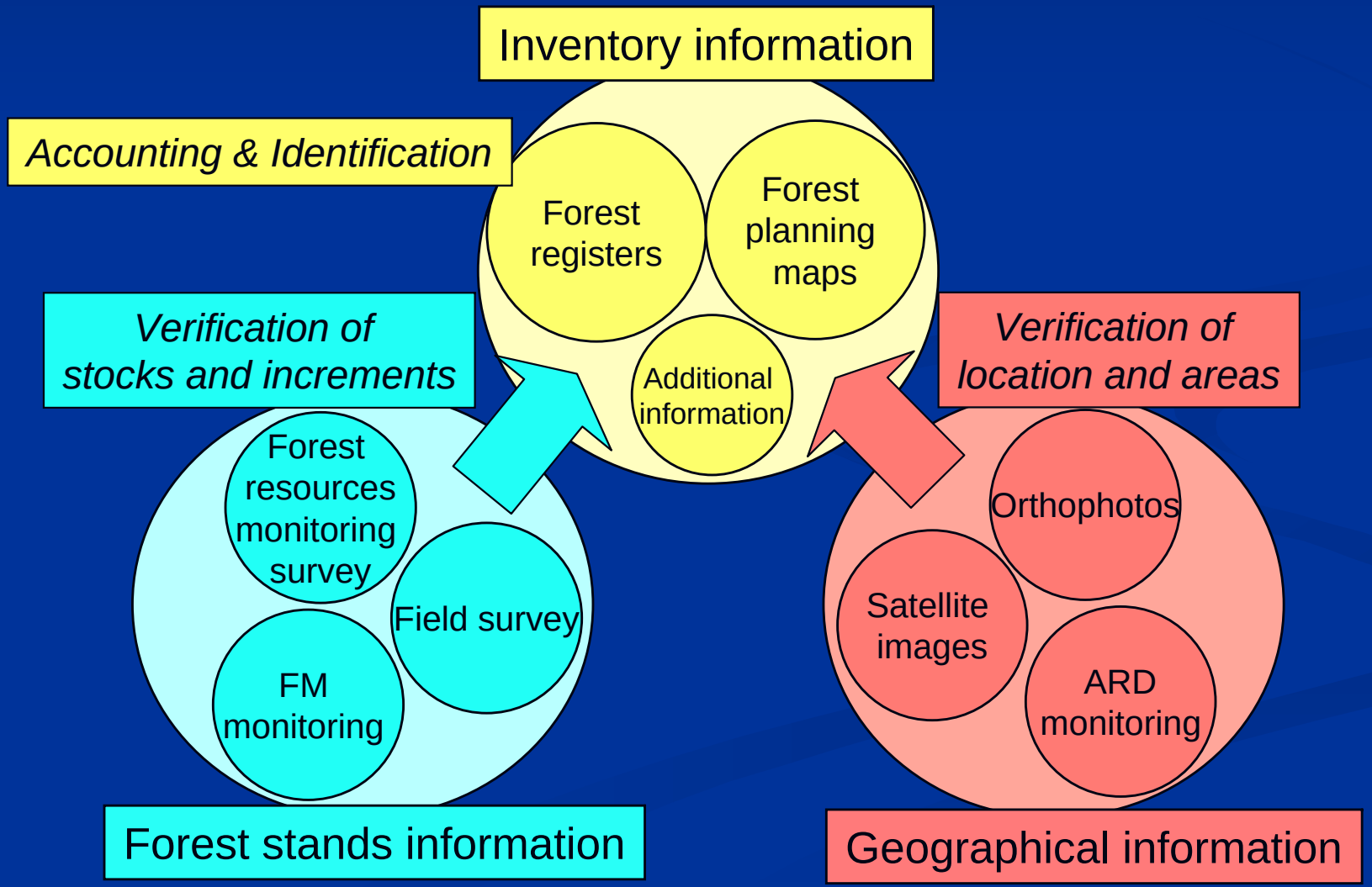






Design of Accounting and Reporting System

- Accounting is based on forest registers and forest planning maps mainly
- Verification with independent stands and geographical information



Data and Method for Carbon Flux Estimation

- Base data
  - Forest registers
  - Forest planning maps

- Estimation methods
  - Stock change method
  - Carbon flux

    = (C stocks at t_2 - C stocks at t_1) /(t_2 - t_1)
  - Carbon stocks

    = Volume ✕ Density ✕ BEF ✕ (1＋R/S ratio) ✕ Carbon fraction

BEF, Root/Shoot ratio and Density

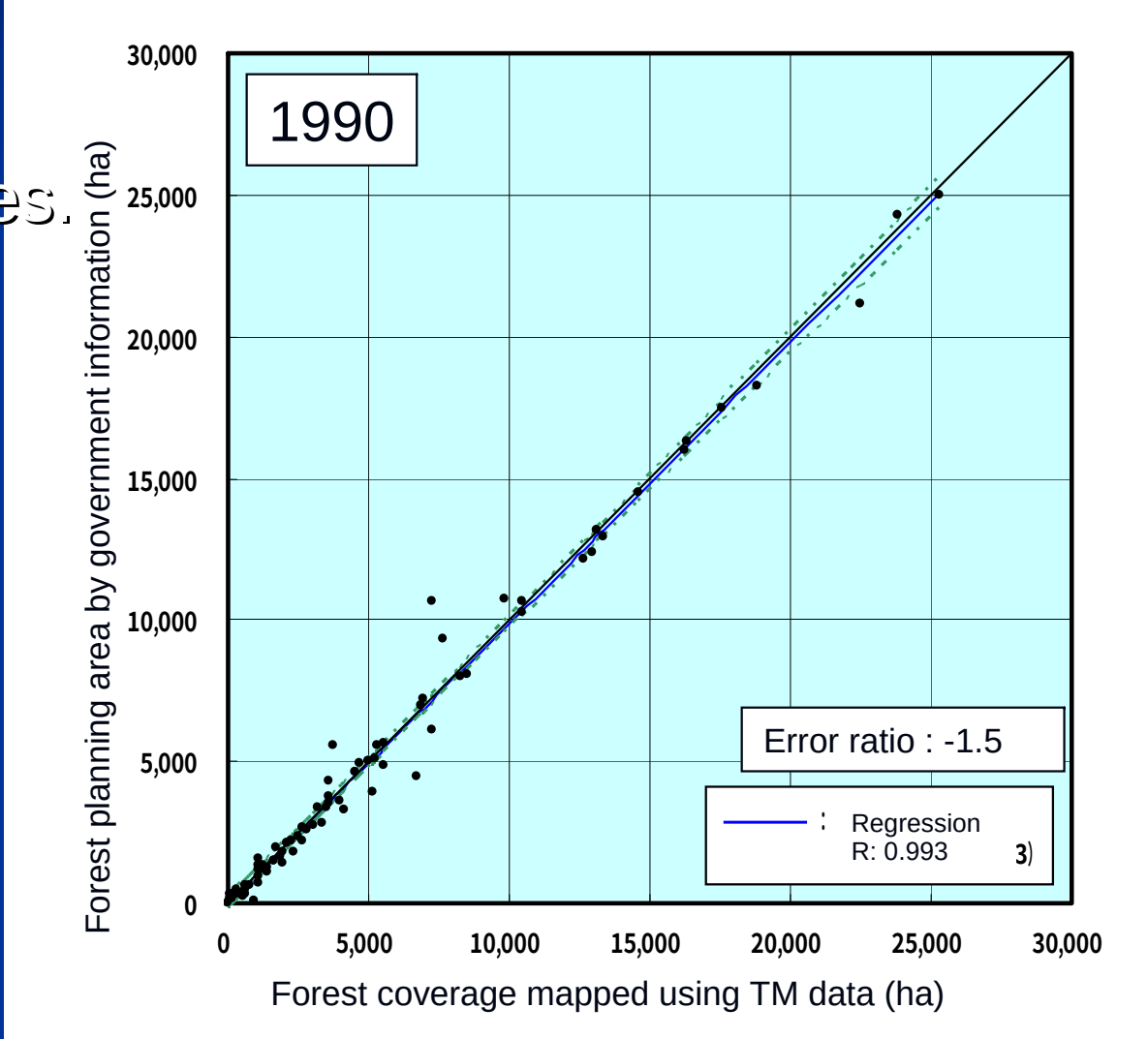
		BEF		R	D
		≦20	>20		
Conifer trees	Japanese cedar	1.57	1.23	0.25	0.314
	Hinoki cypress	1.55	1.24	0.26	0.407
	Sawara cypress	1.55	1.24	0.26	0.287
	Japanese red pine	1.63	1.23	0.27	0.416
	Japanese black pine	1.39	1.36	0.34	0.464
	Hiba arborvitae	2.43	1.38	0.18	0.429
	Japanese larch	1.50	1.15	0.29	0.404
	Momi fir	1.40	1.40	0.40	0.423
	Sakhalin fir	1.88	1.38	0.21	0.319
	Japanese hemlock	1.40	1.40	0.40	0.464
	Yezo spruce	1.92	1.46	0.22	0.348
	Sakhalin spruce	2.15	1.67	0.21	0.364
	Japanese umbrella pine	1.39	1.23	0.18	0.455
	Japanese yew	1.39	1.23	0.18	0.454
	Ginkgo	1.51	1.15	0.18	0.451
	Exotic conifer trees	1.41	1.41	0.17	0.320
	Other conifer trees	2.55	1.32	0.34	0.352
		1.39	1.36	0.34	0.464
		1.40	1.40	0.40	0.423

Verification of Forest Volume

- Estimated forest volume by Forest resources monitoring survey was 13.8% larger than one by forest registers.

Verification of forest area
- RS mapping and forest registers -

- Comparison of forest area by TM and forest registers in municipalities.
- Error ratios were less than 5%



Identification of Article 3.3 ARD

- ARD
  - Afforestation, Reforestation and Deforestation
  - Land-use changes form/to forests
  - Temporal harvesting is not deforestation

Detected Changes with TM and Orhophotos

Interpretation of land-use change with orthophotos

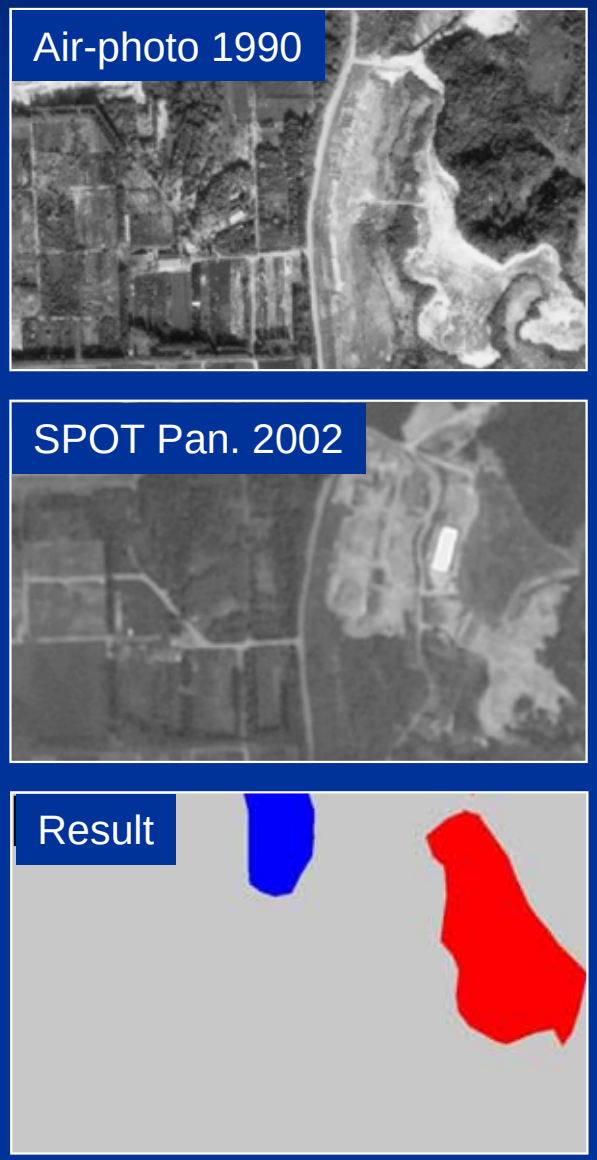
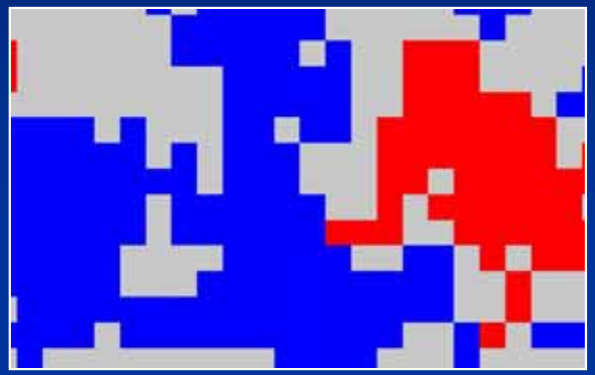


Image analysis of land-cover change with TM



	Area by TM	Area by Photo	Ratios
AR	8816.9 ha	11.9 ha	0.15 %
D	5753.0 ha	449.5 ha	7.8%

Identification of Article 3.3 ARD

- Detection of land-cover changes by image analysis of TM images is not effective in Japan.
  - Differences between land-cover changes and land-use changes

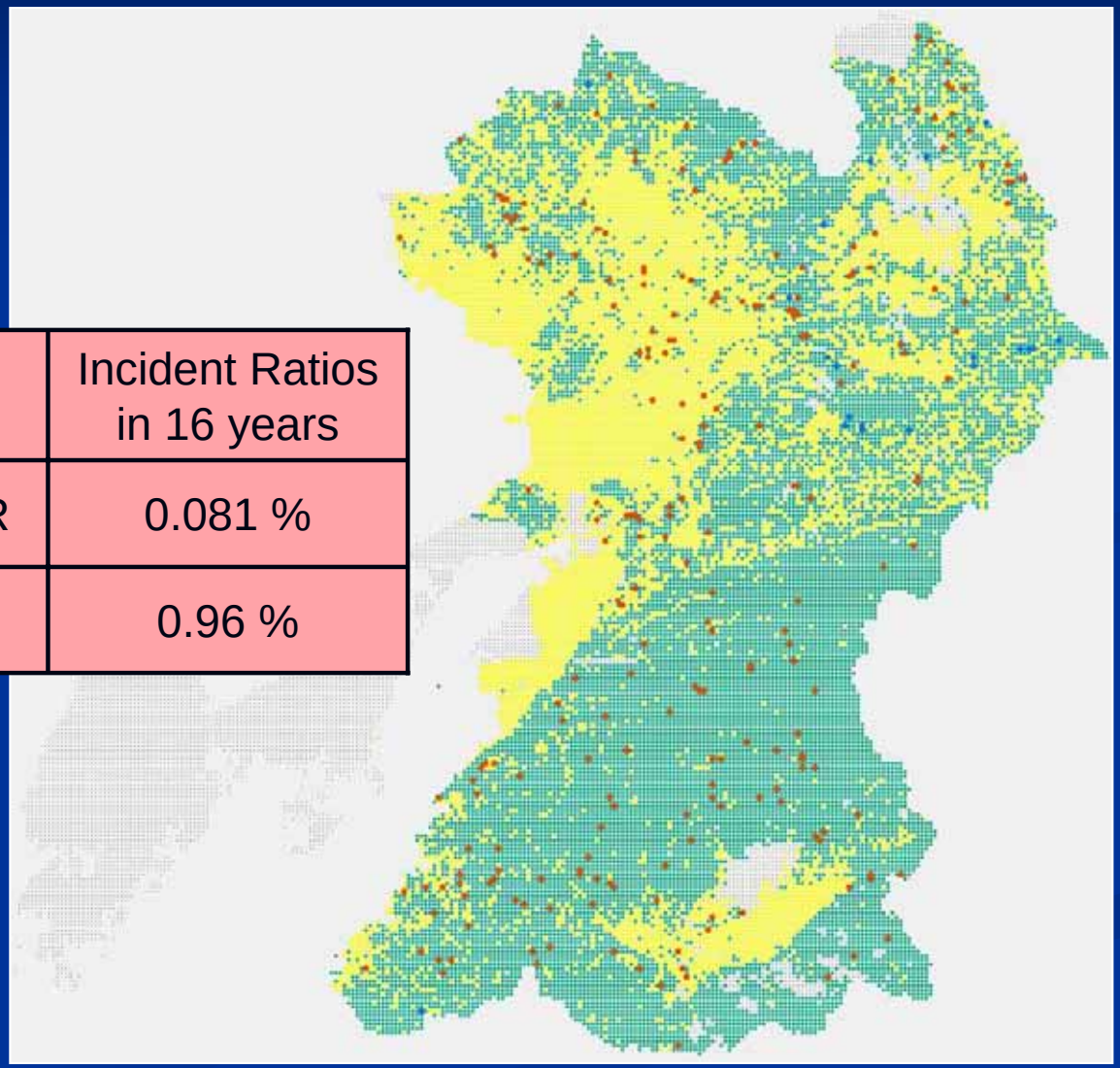
- An alternative method
  - We tried to monitor ARD by systematic sampling with 500m grids on orhtophotos in 1990 and high resolution satellite images in the relevant year.

ARD Detection by Interpretation of Orthophotos and SPOT Images on 500m grids

【 ARD Interpretation 】

	Incident Ratios in 16 years
AR	0.081 %
D	0.96 %

【 Result of ARD Detection 】



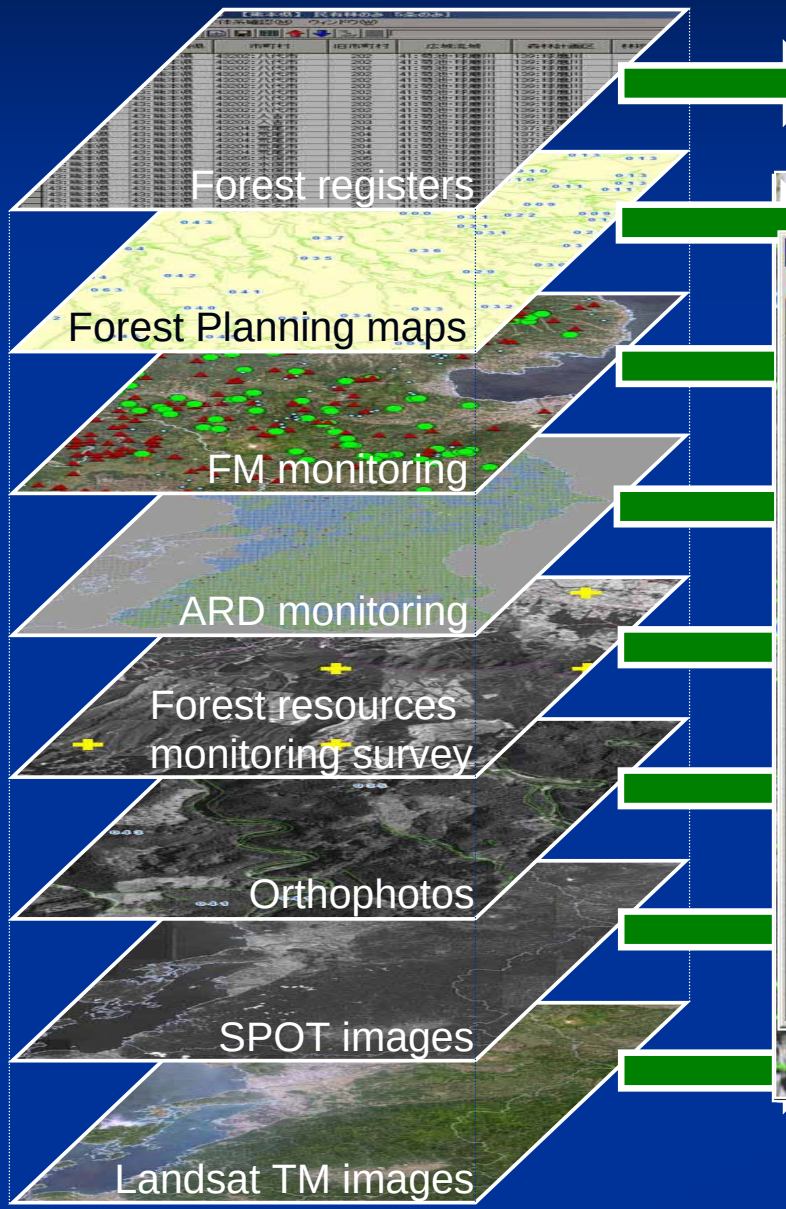
●：Non-changed forests, ●：Non-changed Non-forests, ●：AR、●：D

National Forest Resources Database – NFRDB –

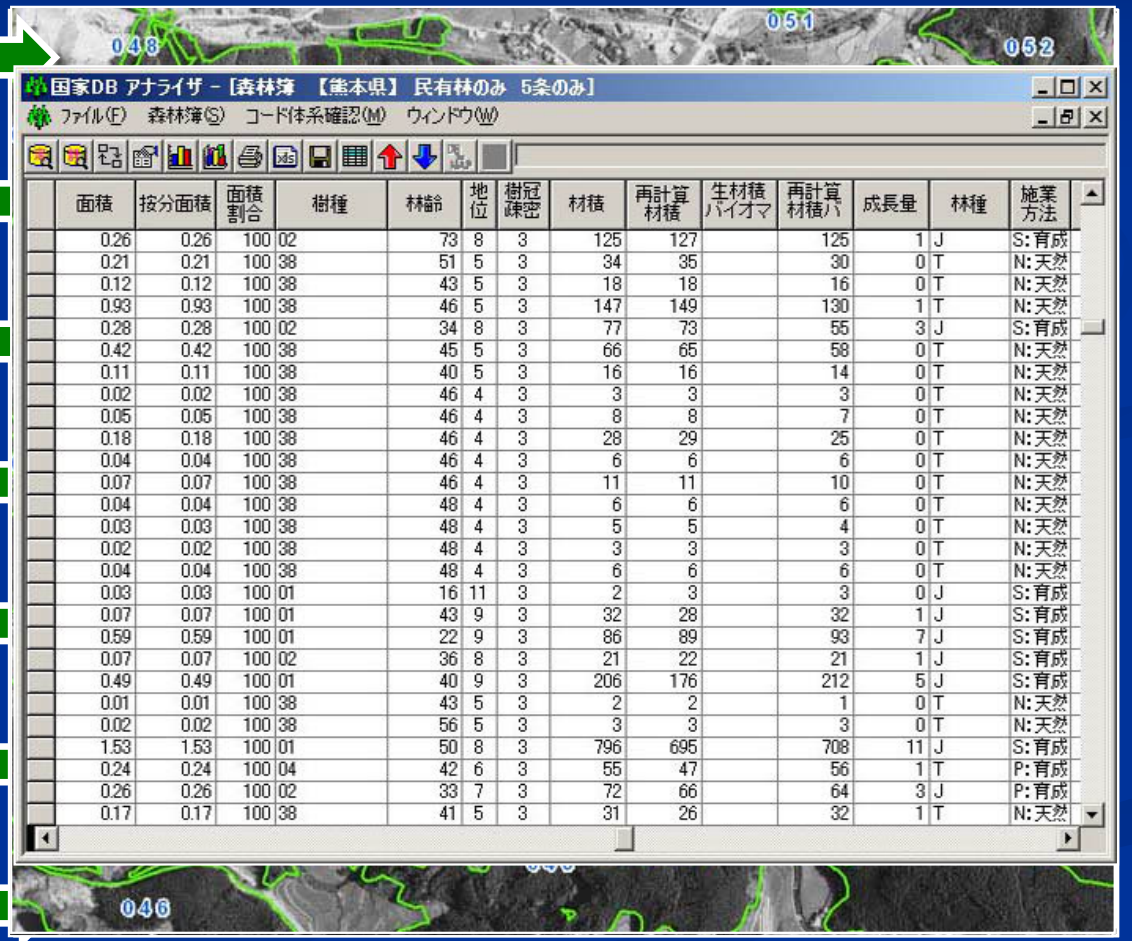
- Two servers
  - Main system in Forestry agency
    - Ordinary use
  - Sub system in FFPRI
    - Backup system
    - Research and development

Database Room in Forestry agency

Main Data on NFRDB



Attribute data of forest registers with 41M records



面積	按分面積	面積割合	樹種	林齢	地位	樹冠疎密	材積	再計算材積	生材積バイオマ	再計算材積バ	成長量	林種	施業方法
0.26	0.26	100	02	73	8	3	125	127		125	1	J	S:育成
0.21	0.21	100	38	51	5	3	34	35		30	0	T	N:天然
0.12	0.12	100	38	43	5	3	18	18		16	0	T	N:天然
0.93	0.93	100	38	46	5	3	147	149		130	1	T	N:天然
0.28	0.28	100	02	34	8	3	77	73		55	3	J	S:育成
0.42	0.42	100	38	45	5	3	66	65		58	0	T	N:天然
0.11	0.11	100	38	40	5	3	16	16		14	0	T	N:天然
0.02	0.02	100	38	46	4	3	3	3		3	0	T	N:天然
0.05	0.05	100	38	46	4	3	8	8		7	0	T	N:天然
0.18	0.18	100	38	46	4	3	28	29		25	0	T	N:天然
0.04	0.04	100	38	46	4	3	6	6		6	0	T	N:天然
0.07	0.07	100	38	46	4	3	11	11		10	0	T	N:天然
0.04	0.04	100	38	48	4	3	6	6		6	0	T	N:天然
0.03	0.03	100	38	48	4	3	5	5		4	0	T	N:天然
0.02	0.02	100	38	48	4	3	3	3		3	0	T	N:天然
0.04	0.04	100	38	48	4	3	6	6		6	0	T	N:天然
0.03	0.03	100	01	16	11	3	2	3		3	0	J	S:育成
0.07	0.07	100	01	43	9	3	32	28		32	1	J	S:育成
0.59	0.59	100	01	22	9	3	86	89		93	7	J	S:育成
0.07	0.07	100	02	36	8	3	21	22		21	1	J	S:育成
0.49	0.49	100	01	40	9	3	206	176		212	5	J	S:育成
0.01	0.01	100	38	43	5	3	2	2		1	0	T	N:天然
0.02	0.02	100	38	56	5	3	3	3		3	0	T	N:天然
1.53	1.53	100	01	50	8	3	796	695		708	11	J	S:育成
0.24	0.24	100	04	42	6	3	55	47		56	1	T	P:育成
0.26	0.26	100	02	33	7	3	72	66		64	3	J	P:育成
0.17	0.17	100	38	41	5	3	31	26		32	1	T	N:天然

Carbon Flux in Japanese Forests in 2005 under UNFCCC and the Kyoto Protocol

1,000t-C/yr

	Above-ground Biomass	Below-ground Biomass	Dead wood	Litter	Soil	Total
Carbon Sinks	23,599		▲ 168	—	434	23,865
Carbin Sinks under KP	7,759	1,922	▲ 214	63	138	9,667
Aforestation and Reforestation	55	14	11	5	7	93
Deforestation	▲ 312	▲ 96	▲ 119	▲ 52	▲ 78	▲ 657
Forest Management	8,016	2,003	▲ 106	110	209	10,231

Conclusions and Recommendations

- Integration of various forest information was powerful for accounting and reporting under the Kyoto protocol.
- Especially it helped verification on stand volume and forest area.
- More attention must be paid to differences between deforestation and temporal harvesting.
- Strong linkages between field survey and remote sensing are crucial for monitoring forest carbon flux.

Thank you for your attention