Urban green space change in large Japanese cities from 2000-2012.

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Intro: Why are urban trees important?

Among other things, they:

- **Preserve biodiversity**
- **Improve air and water quality**
- **Reduce the urban heat island effect**
- **Reduce stress**

Background: How is urban greening being promoted in Japan?

National level

2004: Inter-Ministry Coordination Committee's policy recommendations:

1. Facilitate tree-planting on private and public facilities and promote construction of urban parks.
2. Better link green space by constructing new large green spaces and better connecting parks

City level

Many city-level greening programs exist.

e.g. **2008**: Nagoya City implemented Japan's 1st incentive-based greening program (low-interest loans for certified "green" facilities, subsidies for property greening).
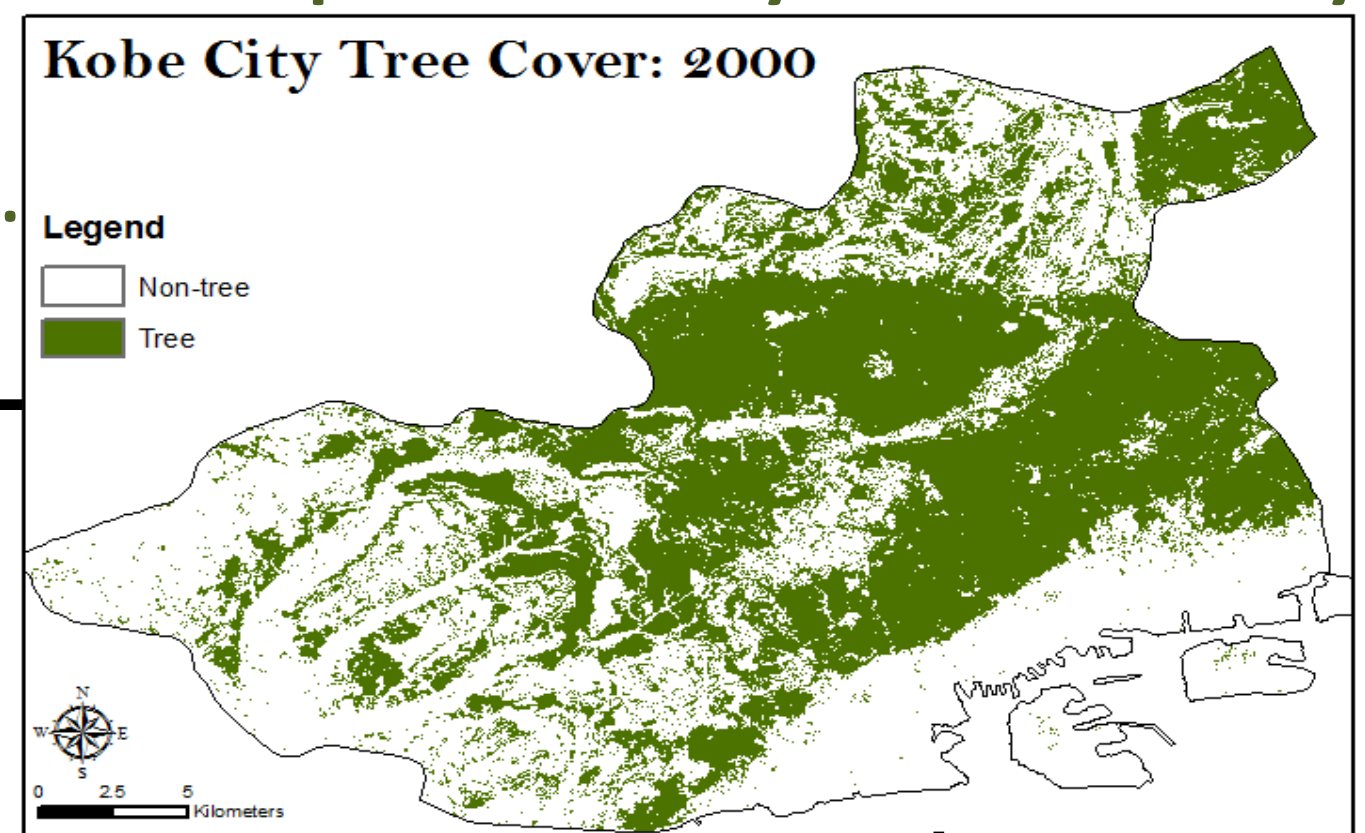
Objectives

- **Monitor changes in urban tree cover in large Japanese cities using remote sensing and Geographic Information Systems (GIS) data.**

- **Evaluate the cities' progress in greening using some simple quantitative metrics.**
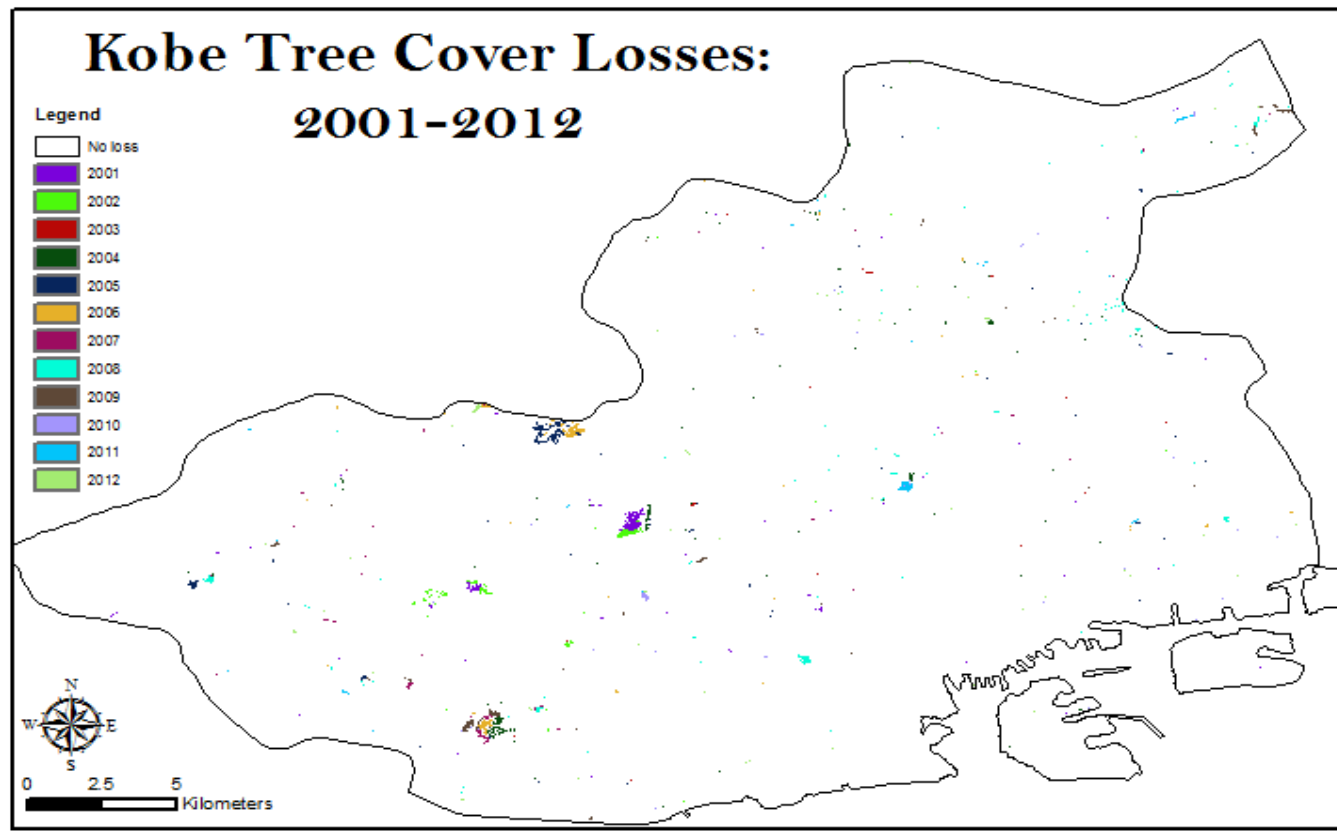
Methods: GIS Analysis

1. High resolution (30m x 30m pixel size) global tree cover data* overlaid onto city boundaries.

2. Spatial Analysis performed to calculate losses and gains in tree cover relative to the 2000 baseline.
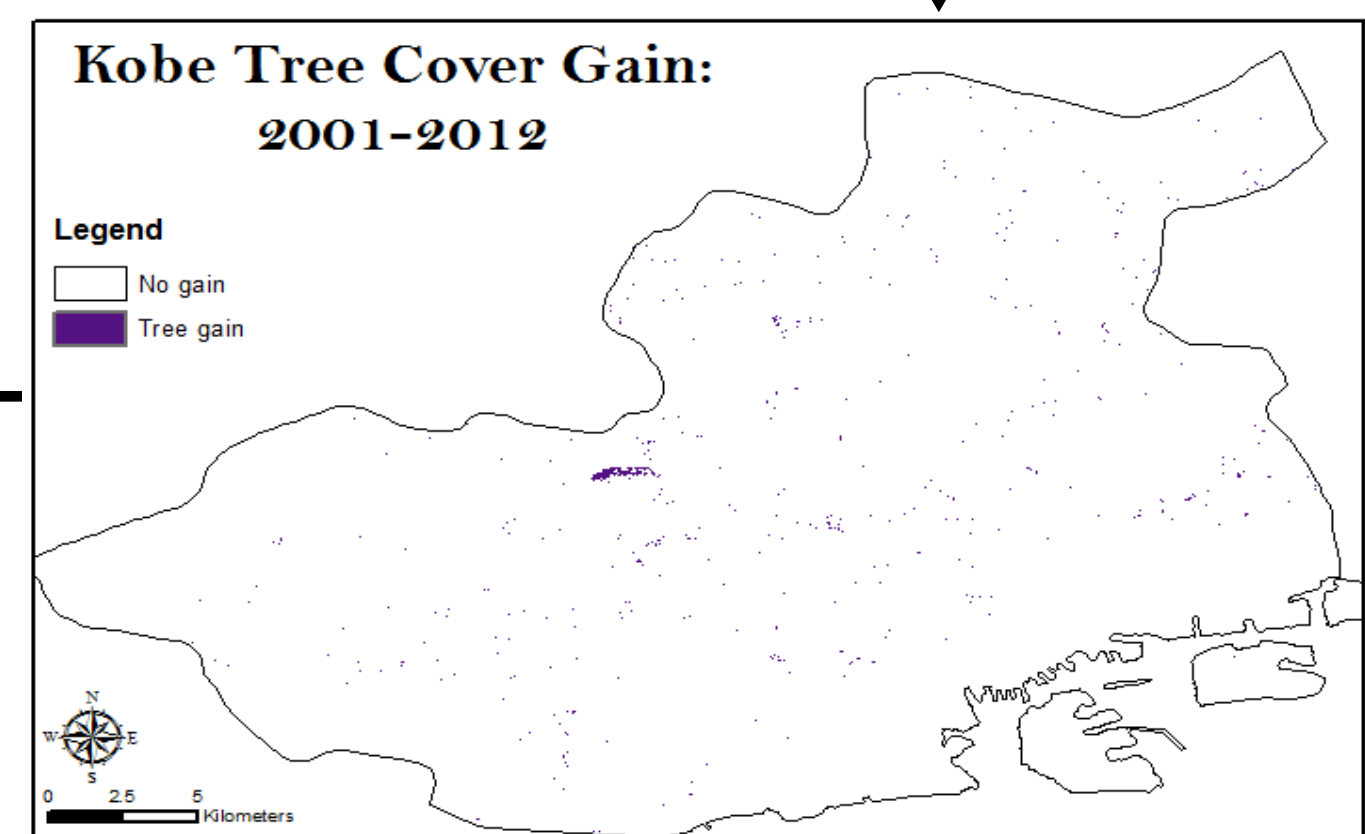
Example: GIS Analysis for Kobe City

Kobe City Tree Cover: 2000
Legend: Non-tree / Tree

Baseline tree cover = 30,367 ha. (47% of city area)

Gross loss of 469 ha.

Kobe Tree Cover Losses: 2001-2012

Gross gain of 212 ha.

Kobe Tree Cover Gain: 2001-2012
Legend: No gain / Tree gain

Net loss of 257 ha. (0.85% of tree cover)

*This is the same tree cover dataset used by World Resources Institute for "Global ForestWatch" (www.globalforestwatch.org), but applied at the city level rather than the national level. The dataset was created by the University of Maryland using Landsat 7 satellite imagery.

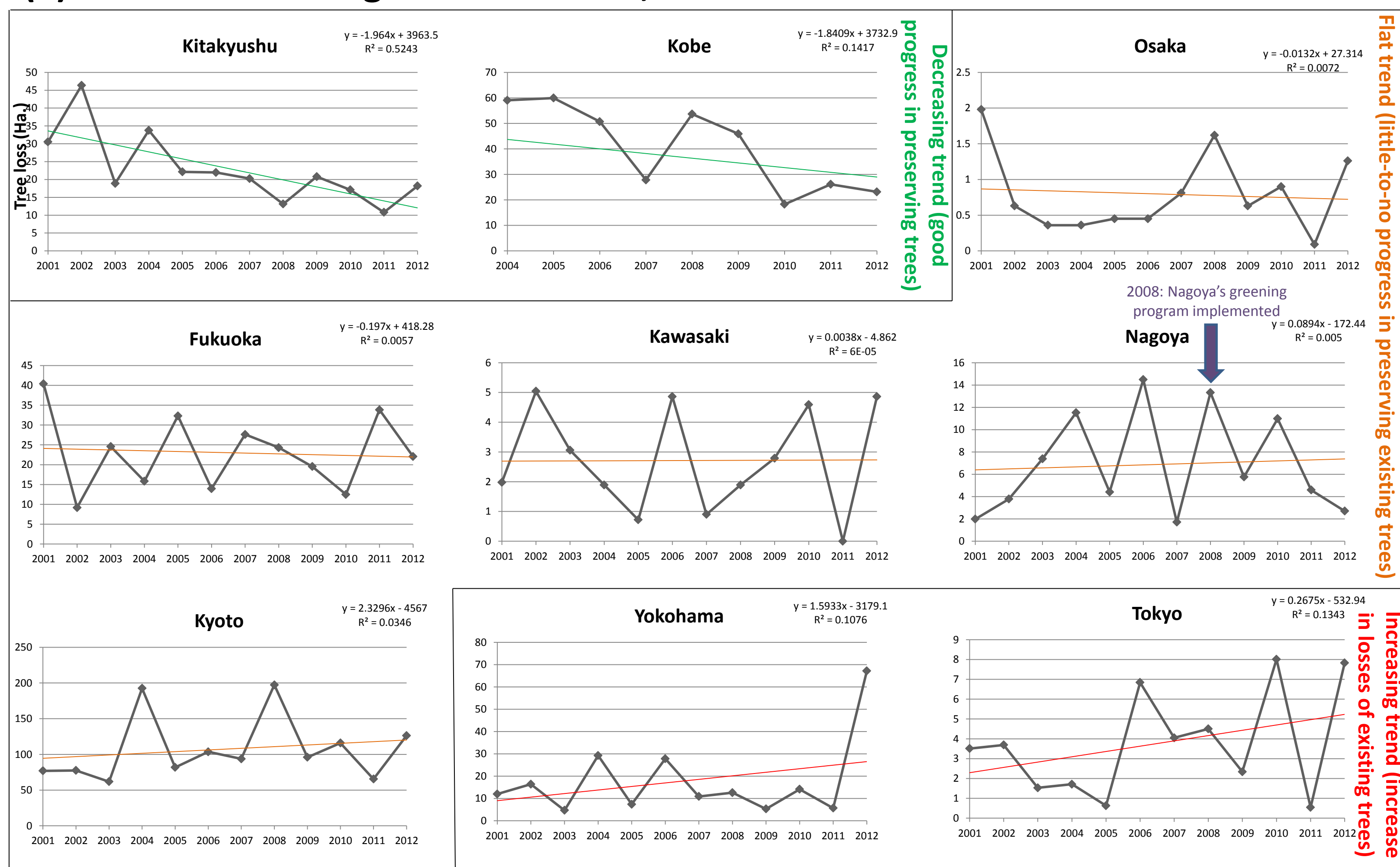## Methods (cont.): Metrics to evaluate urban greening

(i) **Net change (%) in tree cover**: To evaluate total losses/gains in tree cover

(ii) **Trend in existing (gross) tree cover loss**: To assess whether progress is being made in preserving existing tree areas.

Results

(i) Net change in tree cover, 2000-2012

Minor net tree loss (< 1%):
- Kitakyushu: **-0.49%** — Tree loss 0.99%, Tree gain 0.50%
- Kyoto: **-0.72%** — Tree loss 1.71%, Tree gain 0.98%
- Tokyo: **-0.80%** — Tree loss 0.85%, Tree gain 0.05%
- Kobe: **-0.85%** — Tree loss 1.55%, Tree gain 0.70%

Net tree loss 1 - 2%:
- Kawasaki: **-1.10%** — Tree loss 1.12%, Tree gain 0.02%
- Fukuoka: **-1.23%** — Tree loss 1.76%, Tree gain 0.53%
- Yokohama: **-1.43%** — Tree loss 1.48%, Tree gain 0.05%
- Osaka: **-1.97%** — Tree loss 2.94%, Tree gain 0.97%

Net tree loss > 2%:
- Nagoya: **-2.88%** — Tree loss 3.08%, Tree gain 0.21%

(ii) Trend in existing tree cover loss, 2000-2012

Decreasing trend (good progress in preserving trees):
- Kitakyushu: $y = -1.964x + 3963.5$, $R^2 = 0.5243$
- Kobe: $y = -1.8409x + 3732.9$, $R^2 = 0.1417$

Flat trend (little-to-no progress in preserving existing trees):
- Osaka: $y = -0.0132x + 27.314$, $R^2 = 0.0072$
- Fukuoka: $y = -0.197x + 418.28$, $R^2 = 0.0057$
- Kawasaki: $y = 0.0038x - 4.862$, $R^2 = 6E-05$
- Nagoya: $y = 0.0894x - 172.44$, $R^2 = 0.005$ (2008: Nagoya's greening program implemented)
- Kyoto: $y = 2.3296x - 4567$, $R^2 = 0.0346$

Increasing trend (increase in losses of existing trees):
- Yokohama: $y = 1.5933x - 3179.1$, $R^2 = 0.1076$
- Tokyo: $y = 0.2675x - 532.94$, $R^2 = 0.1343$

Conclusions

Summary of results

- **Kitakyushu made the most progress in urban greening, followed by Kobe.**
- **Nagoya had the highest net loss of tree cover, BUT existing tree cover losses have been decreasing since 2008 (the year the city's greening program was implemented).**
- **The rate of existing tree loss is increasing in Tokyo and Yokohama, so further efforts are needed to preserve existing tree areas in these two cities.**

Broader significance

- **The proposed methods can be applied to any city because the tree cover dataset has global coverage (but higher resolution data would be needed to analyze changes smaller than 30m x 30m).**
- **Different baseline years can be set to evaluate the effectiveness of specific urban greening policies (i.e. baseline year can be set to the year a specific policy was implemented).**