# Towards multi-scale mapping of human carbon dioxide emissions from megacity Osaka, Japan

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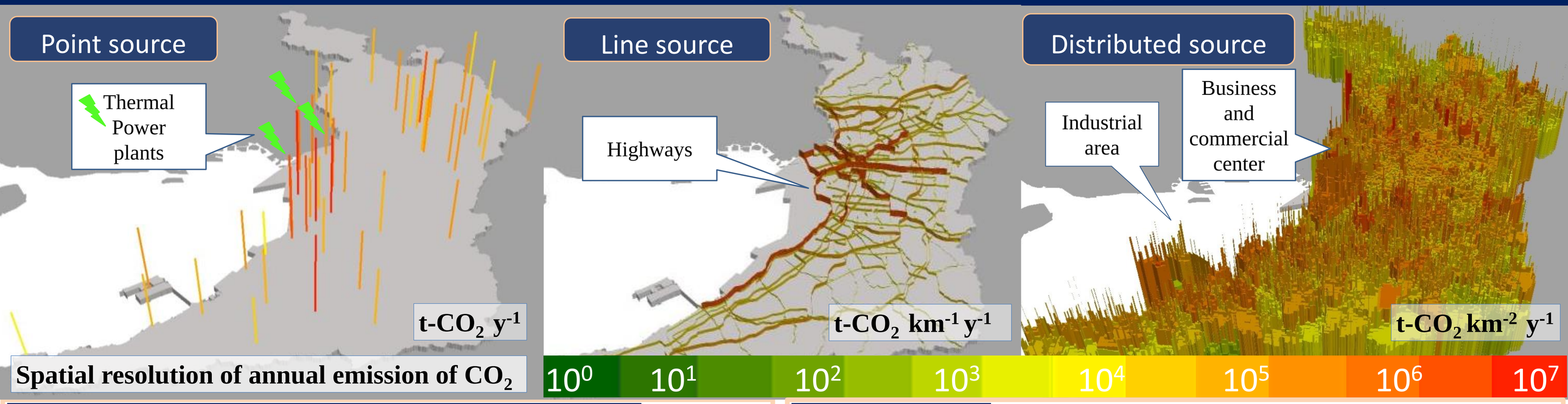



## 1.Backgrounds and Objective

High spatial and temporal resolution $CO_2$ inventory is needed for collaborative assessment with models and satellites. Presently, available $CO_2$ inventory of the highest spatial and temporal resolution in Japan is EAGrid2010-Japan[1)], which has 1km grid, monthly and hourly resolution covering all over Japan containing other greenhouse gases and air pollutants. In this study, aiming to obtain $CO_2$ inventory of the higher resolution, with separation of point and line sources, and targeting a megacity, we improved inventory method by aggregating bottom-up and top-down approaches. We compared the result with EAGrid2010-Japan to reveal the effectiveness of this methodology.

1) Akiyoshi, Kannari. 2007. Development of multiple-species 1km × 1km resolution hourly basis emissions inventory for Japan. Atmosheric Environment, 41, 3428-3439.

## 2.Methodology

In this study, we estimated the fine resolution distribution of annual $CO_2$ emission by sectors in Osaka Prefecture. We combined bottom-up and top-down approaches for the spatial and temporal resolution.

The bottom-up approach was applied for point and line sources. It calculates the emissions by multiplying the quantity of activities by emission factors, and location of emissions was identified in fine scales using postal address and satellite images on Google map ™.

The top-down approach was applied for distributed sources. It spatially divides prefecture total emissions, and weighting proxy indicators in 500m grid or the finer cell were used.

### Bottom-up approach

| Category | Sector | Quantity of Activity | Emission Factor | Time resolution |
|---|---|---|---|---|
| Point Source | Thermal power plant | Plant capacity × operation time | By fuel type | 3 minutes |
| | Incineration plant | Weight of waste burned | By waste composition | Monthly |
| | Aviation | LTO number by aircraft | By per unit LTO | 5 minutes |
| Line source | Road (class 3 and higher) | Traffic by route | By vehicle type | Hourly |

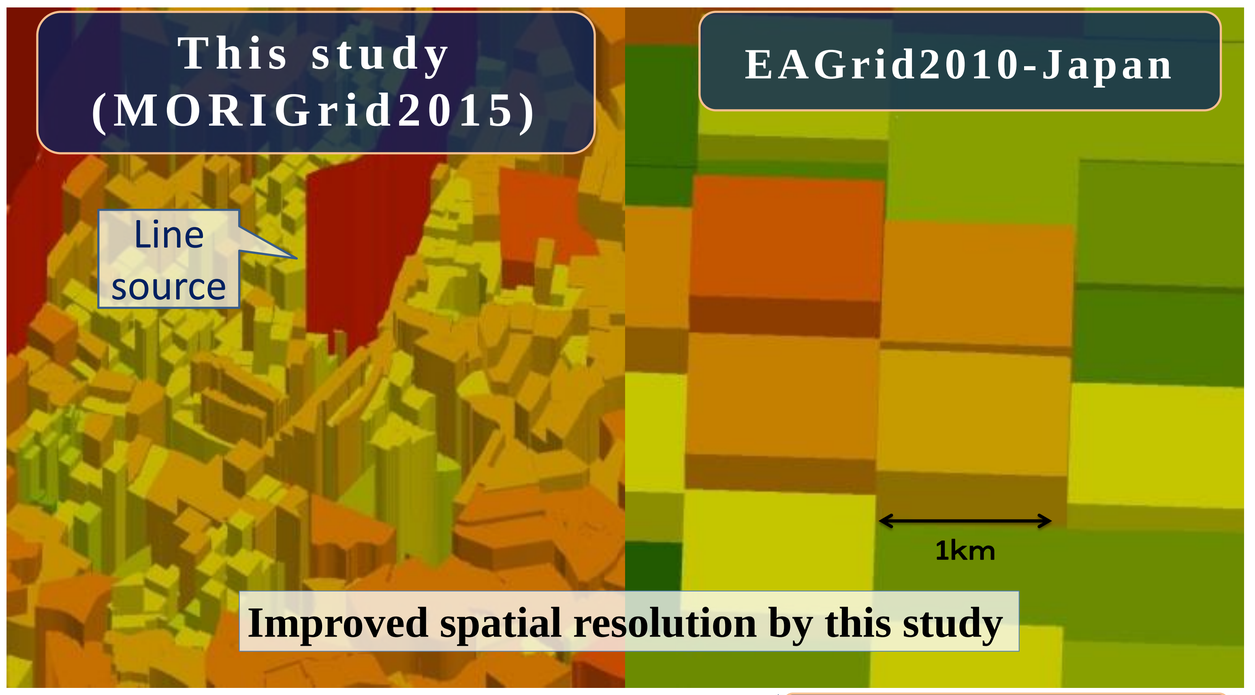
### Top-down approach

| Category/ Spatial resolution | Sector | Total emission | Weighting proxy indicators | Time resolution |
|---|---|---|---|---|
| Distributed Source/ 500m mesh Sub- regional | Road (class 4 and lower) | Road emission by EAGrid2010-Japan ― line source emission | Resident population | Hourly |
| | Manufacturing | Carbon emission by prefecture by sector | Persons engaged | Not available |
| | Construction and mining | | | |
| | Agriculture, forestry and fishery | | | |
| | Business | | | Hourly Diurnal course |
| | Household | | Resident population | |

## 3.Results

Three figures above are estimated emission maps. Point, line and distributed source reflects high emission intensity from power plants, highways, industrial area and business and commercial center. Prefecture total emission was 73.75 [Mt-$CO_2$ $y^{-1}$] and point, line and distributed sources accounted for 54%, 7% and 39%, respectively.

The cell size of distributed sources was reduced to 0.101 $km^2$ in average and to 130 $m^2$ at minimum. Below figures show comparison between this study and EAGrid2010-Japan (latest study). It emphasize effectiveness of improved spatial resolution and separation of point and line sources. The effect of improving point source positioning accuracy was found to be 22.68 [Mt-$CO_2$ $y^{-1}$] change from EAGrid2010-Japan which accounted for approximately 31% of the Osaka Prefecture total emission of the year.




## 4.Conclusion and Perspectives

We developed high spatial and temporal resolution $CO_2$ emission inventory in Osaka Prefecture. We successfully extended the use of bottom-up approaches and 61% of total emission was associated to it.

Development of spatial resolution and accuracy of emissions is expected to enhance utility of the inventory for collaborative assessment with models and satellites. We are developing temporal resolution from monthly to hourly using variation of activity and proxy indicators.