CHARACTERIZATION OF AIR QUALITY IN GLOBAL MEGA-CITIES BY REMOTE SENSING AND INVENTORY DATA

Aya Fujikawa and Wataru Takeuchi
IIS, the University of Tokyo, Japan

Abstract: According to previous study, aerosol is classified into two types –natural or artificial. However, it isn't so clear that what rate does aerosol contain in the air and how much two types aerosol affects. The objective of this study is to clear the relation between air pollution and human activity, so we use indexes as angstrom exponent (ANG), Aerosol Optical Depth (AOD) by MODIS. Firstly, aerosol condition was classified by ANG-AOD. A scatter plot was made about 61 mega cities. Air conditions of cities were revealed three characteristics- the environmentally friendly cities(European cities, Tokyo, New York, etc)・the cities influenced artificial aerosol(Shanghai, Lagos, etc)・the cities influenced natural aerosol (Kabul, Baghdad, etc). Secondly, the value of ANG-AOD was transformed to the value of RGB color space. Not only chosen cities but also cities where are not chosen and the other areas are categorized. Thirdly, the value of RGB was found trend. The RGB data of monthly average were compared in Tokyo, Kabul and Shanghai. The superiority of the effect of natural or artificial aerosol was different with seasons and the combination of them was different with cities. In the future, the result of this research could be an index of the choice to invest for the air pollution improvement.

1.Background

Today, it is considerably revealed that what is the aerosol itself. However, it isn't so clear that how much range natural or artificial aerosol affects and that how different it affects by each seasons. Especially, it isn't so clear how much degree aerosol in the field of transportation affects atmosphere. So, I focus on Angstrom exponent (ANG) and optical thickness of aerosols (AOD) to analyze the state of the atmosphere.

Recently there face severe air pollution in China, India, Mexico and so on. In past, Japan had the health damage caused by the air pollution, and at present developing countries have it. Fu Zhe (2011) showed a relation between air pollution and health damage in Shanghai. Also, Ewing et al. (2010) developed a method for tracing fine airborne particulate pollution with origins in East Asia and found the median proportion of Asian lead in the PM2.5 was 29% in the San Francisco Bay Area. Air pollution is a severe problem in the world. It is necessary to grasp a situation of the atmosphere not only in the part area but also in the whole area of the world.

The objective of this research is to find the characteristic of each cities or the regionality by researching Angstrom exponent (ANG) and optical thickness of aerosols (AOD) and comparing the data of each year or monthly average.
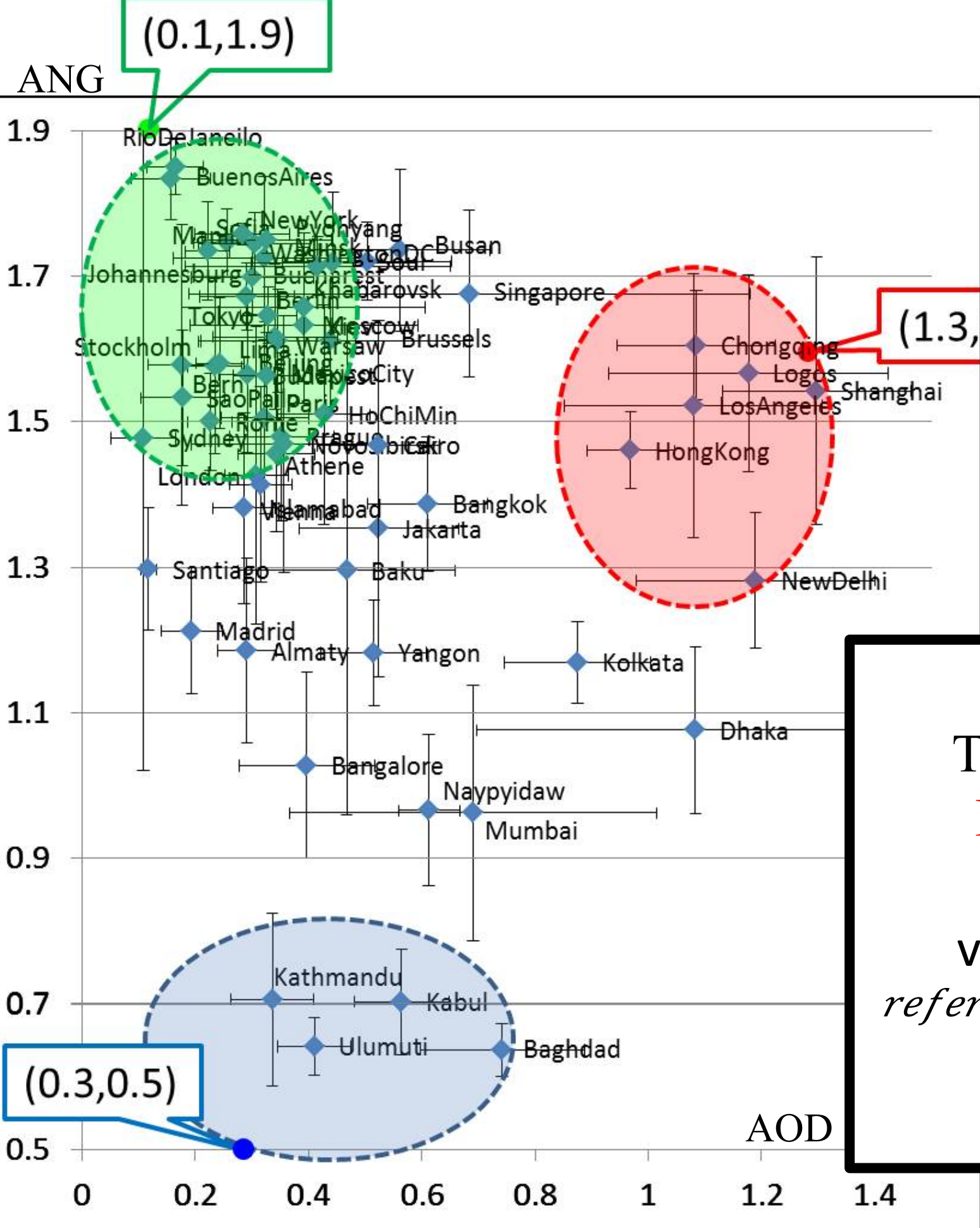
2.Methodology

Figure 1 flow chart of this research

3.Result

The reference points are determined
R(1.3,1.6) G(0.1,1.9) B(0.3,0.5)
↓
$value = 255 \times (1 - distance\ from\ a\ point\ to\ reference\ point / the\ length\ of\ perpendicular\ line\ )$
(When a value≤0, it is 0.)

Figure 2 Scatter plot(used data 2001-2010)

2013/09 average
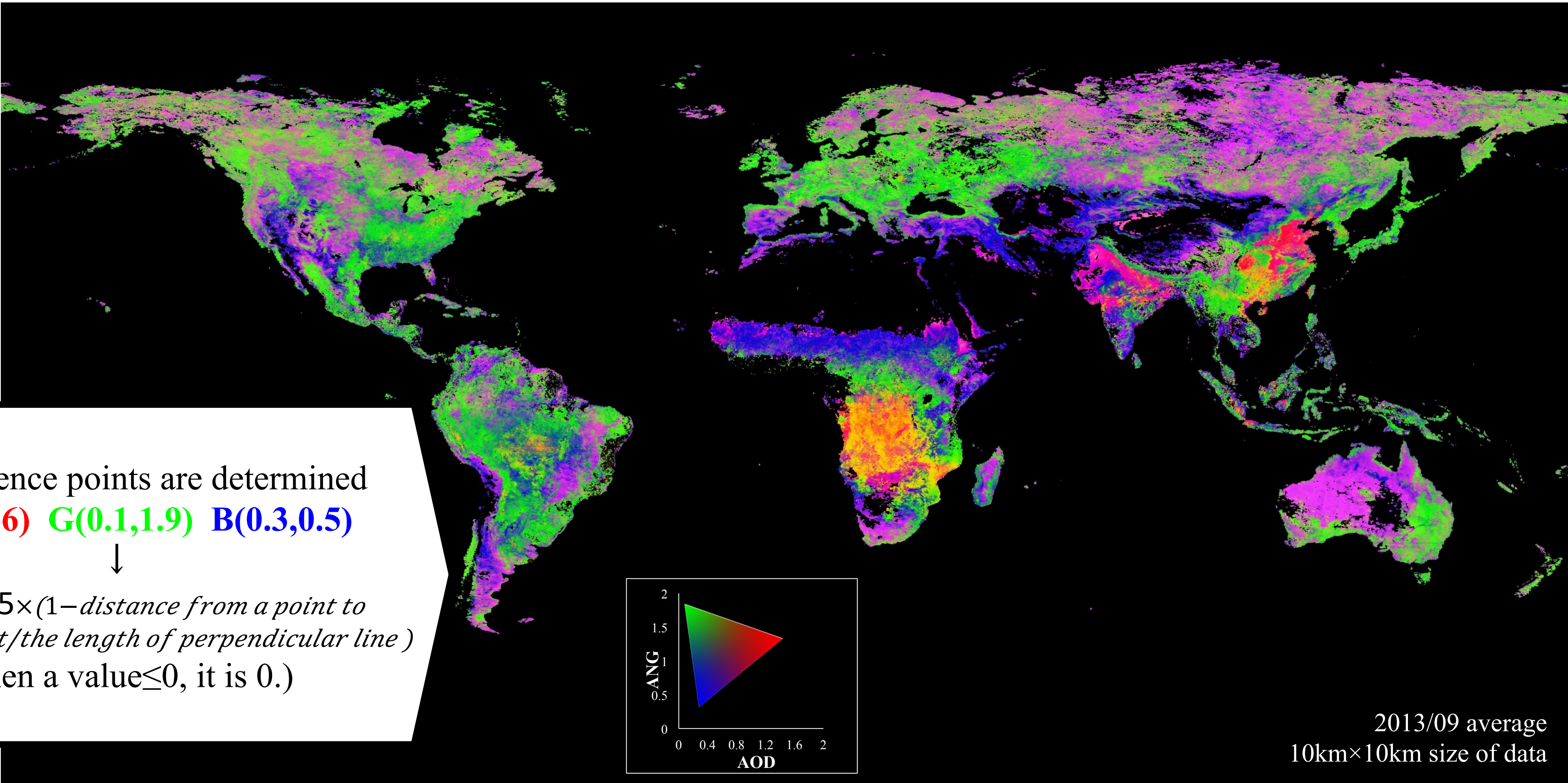10km×10km size of data

Figure 3 RGBmap (for example:2013/09 monthly average)
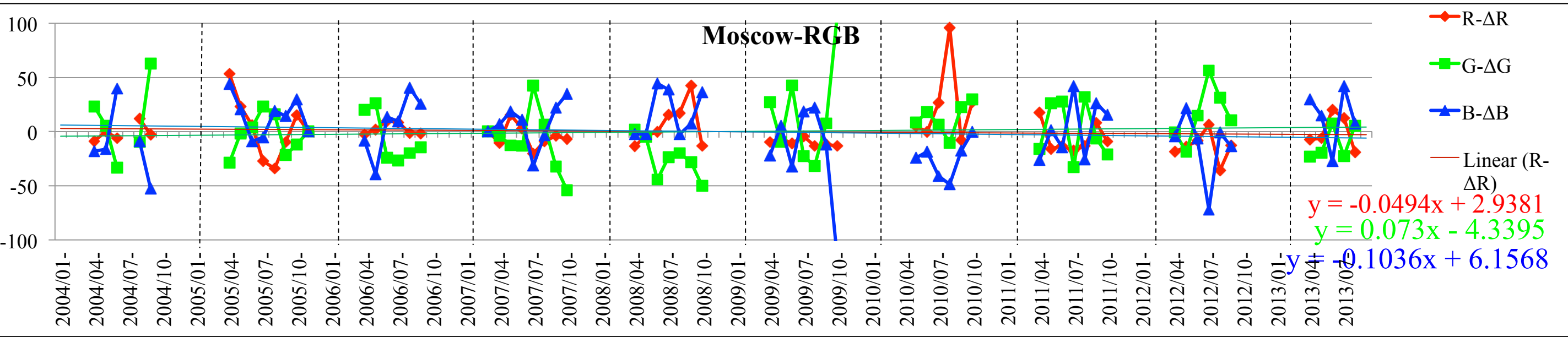

Figure 4 Secular change around Moscow (LAT:55°45N,LON:37°34E)
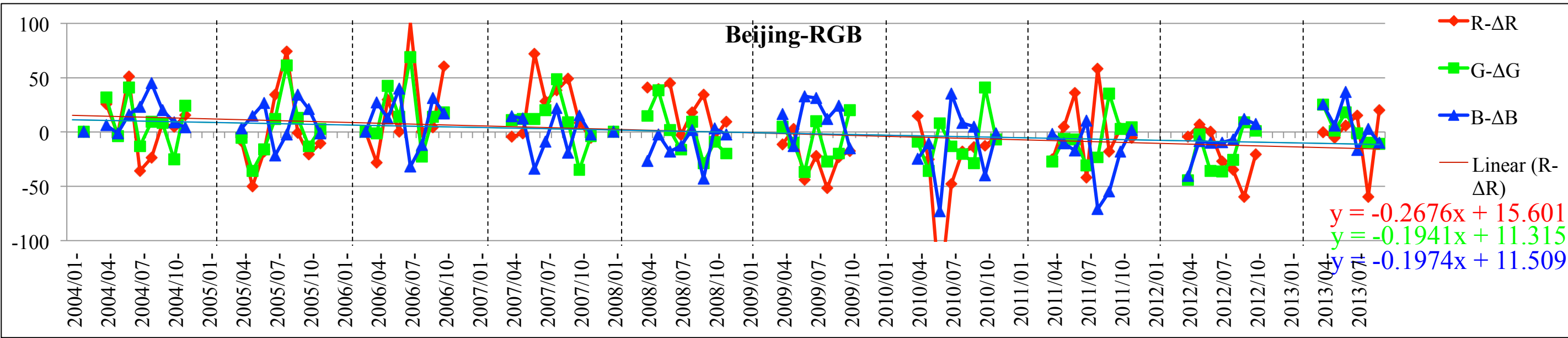

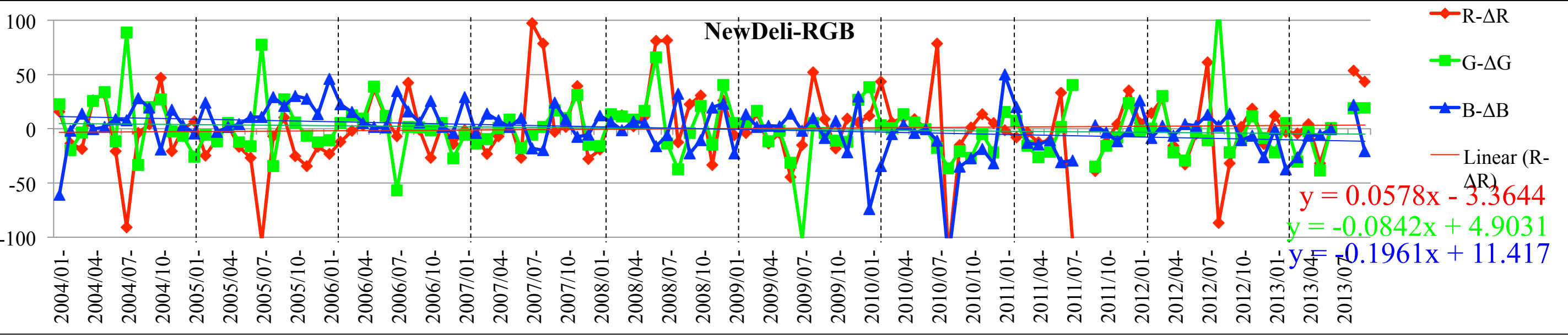**Figure 6 Secular change around Beijing (LAT:39°55N,LON:116°19E)**

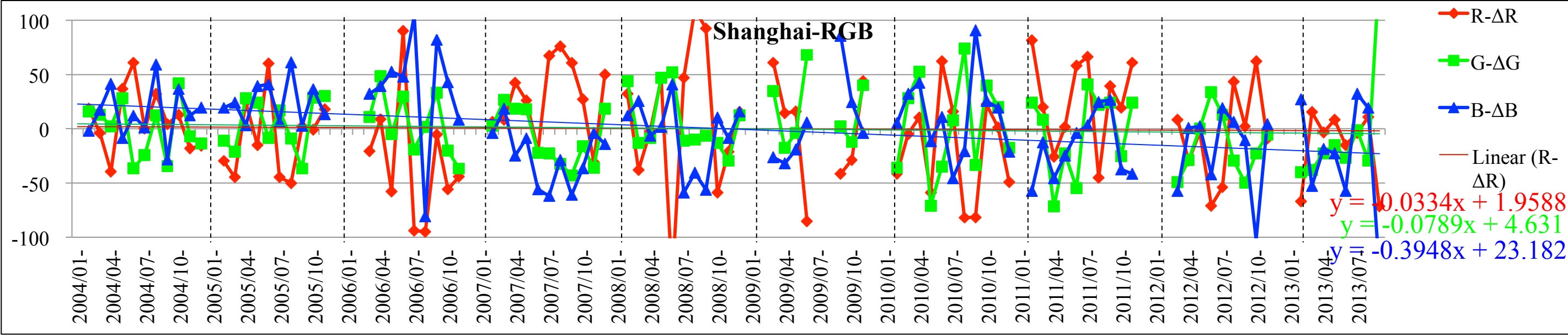**Figure 5 Secular change around New Deli (LAT:28°40N,LON:77°9E)**

Figure 7 Secular change around Shanghai (LAT:31°10N,LON:121°29E)

Figure 8 Secular change around Tokyo (LAT:35°45N,LON:139°39E)

4.Conclusion

・AOD and ANG can be understood visually by making scatter plot and convert RGB.
・The 61 cities in the world are divided three atmosphere characteristics –the environmentally friendly city, the city influenced artificial aerosol, the city influenced natural aerosol-.
・Secular change may be characteristic each city or region. It is clear some value of RGB is changing year by year.

5.Future works

・add NO2 data to analyze the value of red means the effect of artificial origin including natural fire and exhaust gas
・inventory data coupled with these satellite-derived and in-situ results are carried out to investigate a relationship between GDP, population density, environmental regulation of vehicles and so on

Reference
[1] ITAHASHI ET AT AL, 2012: INTERANNUAL VARIATION IN THE FINE-MODE MODIS AEROSOL OPTICAL DEPTH AND ITS RELATIONSHIP TO THE CHANGES IN SULFUR DIOXIDE EMISSIONS IN CHINA BETWEEN 2000 AND 2010
[2]FU ZHE, 2011, AIR POLLUTION AND HEALTH DAMAGE IN SHANGHAI THE ISSUE FROM EPIDEMIOLOGICAL STUDY
[3]STEPHANIE A. EWING ET AT AL, 2010, Pb ISOTOPES AS AN INDICATOR OF THE ASIAN CONTRIBUTION TO PARTICULATE AIR POLLUTION IN URBAN CALIFORNIA
[4]KITAJIMA ET AT AL, 2002, PHOTOPOLARIMETORY OF ATMOSPHERIC AEROSOLS
[5]HARA ET AT AL, 2012, RECENT INTER-ANNUAL TREND OF SPHERICAL AEROSOL IN EAST ASIA
[6]YAMAGATA ET AT AL, 1997, DEVELOPMENT OF VEGETATION-SOIL-WATER INDEX ALGORITHMS AND APPLICATIONS
[7]TSUTSUMI ET AT AL, 2003, A DIFFERENCE BETWEEN AEROSOL OPTICAL THICKNESS AND ANGSTROM EXPONENT BY YELLOW SAND IN JAPAN IN SPRING 2000