

Effects of Climate Changes on the Species Composition and Vegetation Productivity in Arid Areas

- Present patterns and future prospects for potential vegetation in the Eastern Mediterranean Region of Turkey -

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1. Introduction

Even in the Eastern Mediterranean Region there are many vegetation types along the climatic and topographic gradient in Turkey (Yilmaz, 1998; Altan, 2000). Dominant tree species were *Pinus halepensis* in the coastal regions. *Pinus brutia* and *Quercus coccifera* are found relatively large area from lowland to highland. *Arbutus andrachne*, *Quercus infectoria* and *Styrax officinalis* were limited to mid-altitude regions. Maquis shrubs (Maki) include *Arbutus andrachne* and *Quercus coccifera*. *Carpinus betulus*, *Carpinus orientalis* and *Quercus cerris* were found only at the lower part of high altitude region. While *Cedrus libani* and *Pinus nigra* were found only at the higher part of the high latitude regions (Sano et al., 2003).

In this study our purpose is to estimate changes in the vertical and horizontal distribution of vegetation especially of those tree species after climate changes in this region.

2. Methods

We used two approaches for the purpose, (1) making present vegetation map by using satellite photographs (LANDSAT ETM+, 13 June 2000), and (2) estimation of potential vegetation by using the Thornthwaite p/e Index (PEI) and the Warmth Index (WI) calculated from the climate data in present and future in this region. The definition of each climate-vegetation index is as follows:

Thornthwaite p/e Index:

$$p/e = 0.164 \{ p / (t + 12.2) \}^{1.11} \quad PEI = 10 \Sigma p/e$$

PEI

T10: <16: Perarid

T20: 16~32: Arid

T30: 32~64: Semi-arid

T40: 64~: Humid

(Thornthwaite, 1931, 1948)

Warmth Index (WI):

$$WI = \Sigma(t-5) \quad t > 5^{\circ}\text{C}$$

W1: 15-45: sub-arctic zone, evergreen coniferous forest

W2: 45-85: cool-temperate zone, broadleaved deciduous forest

W3: 85-180: warm-temperate zone, evergreen forest
(Kira, 1976)

We combined these two index for classification of potential vegetation.

T10W3 (13): Desert

T20W3 (33): Steppe

T30W2 (32): Woodland a

T30W3 (33): Woodland b

T40W1 (41): Evergreen coniferous forest

T40W2 (42): Broadleaved deciduous forest

T40W3 (43): Maquis

Also we analyzed the climate factors affecting tree distribution of predominant species. Then present patterns and future prospects for potential vegetation were estimated in the Eastern Mediterranean Region of Turkey

3. Results and Discussion

A present vegetation map obtained from unsupervised classification (ISODATA) method is represented as Figure 1. We found eleven classes for land use patterns. Most

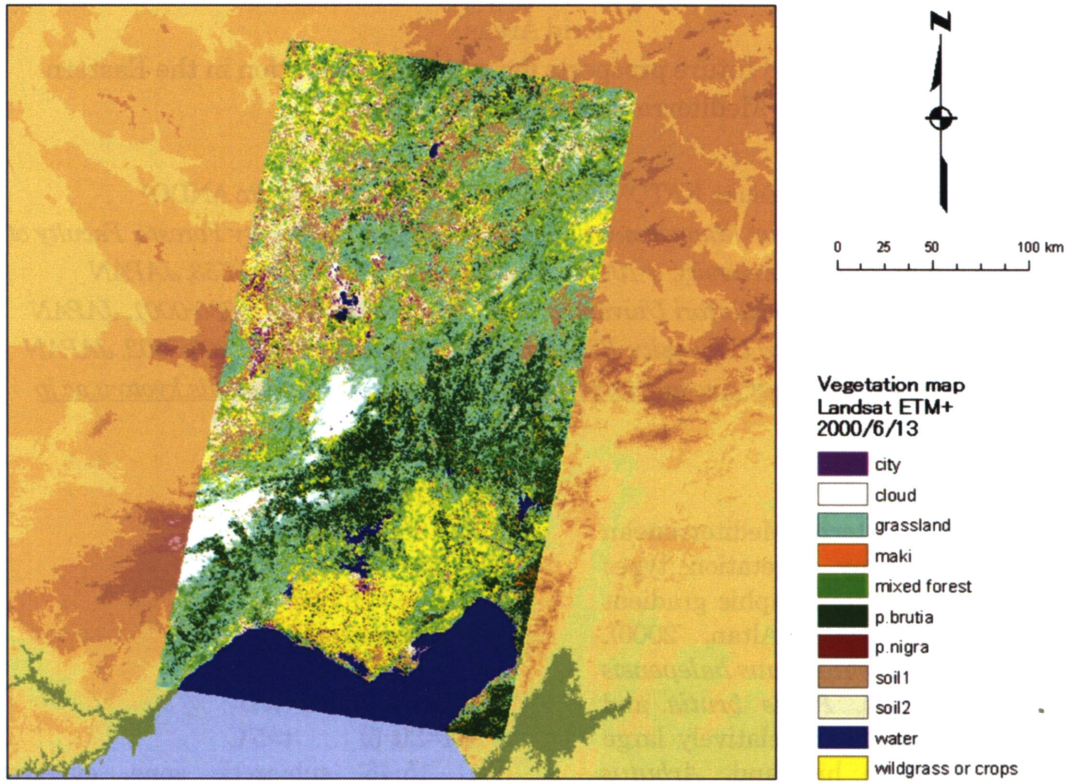


Figure 1. Present vegetation map of the research site on 13 June 2000 (LANDSAT ETM+)

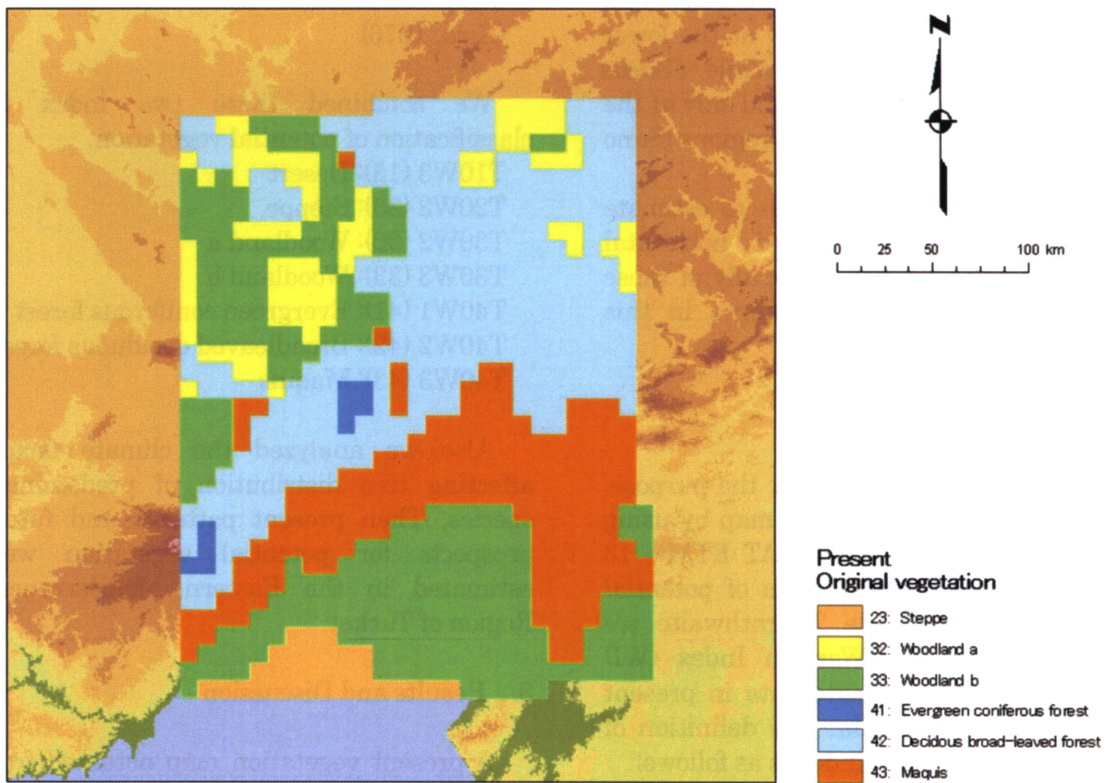


Figure 2. Potential vegetation map at present

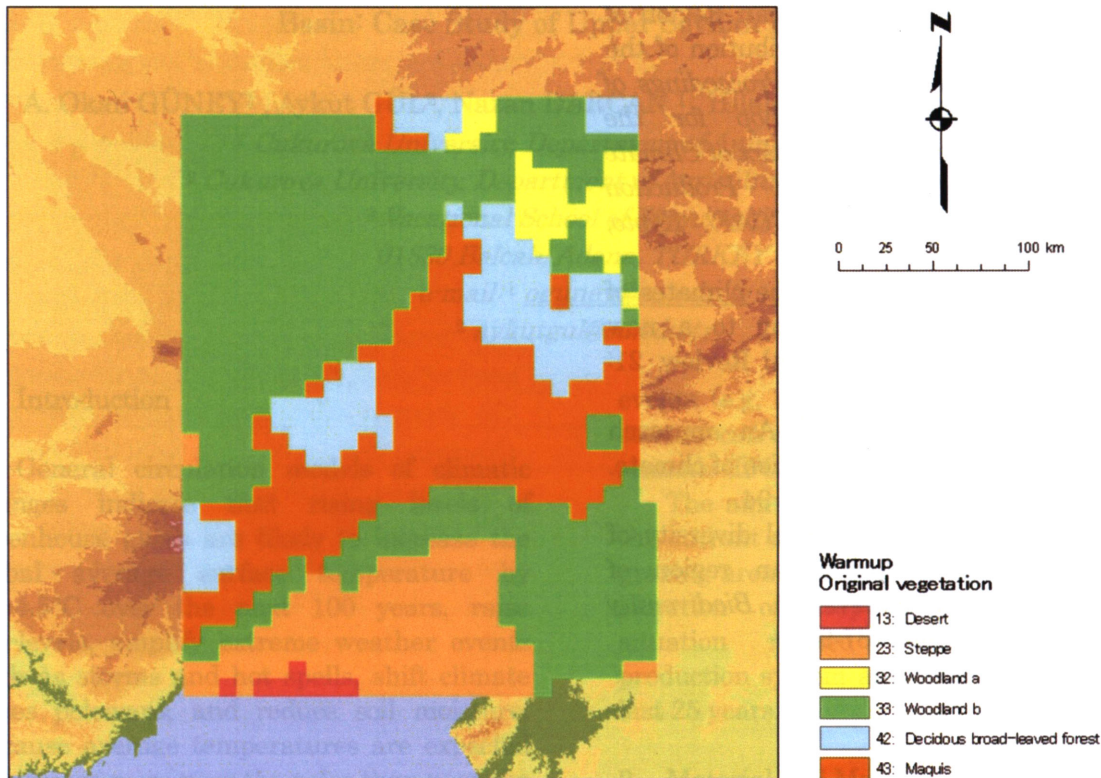


Figure 3. Potential vegetation map after climate change in the future

abundant class was grassland (23.9 %), and wildgrass or crops (22.6 %), soil 1 (16.3 %), *Pinus brutia* (10.5 %), water (9.8 %), soil 2 (8.2 %), and mixed forest (3.9 %) were followed. Maquis and *Pinus nigra* had very low values (0.8 and 0.3 %, respectively).

Relative frequency of each vegetation class along elevation showed that. *Pinus nigra* and mixed forests were found at higher elevation parts, and maquis shrubs were found at lower parts. The other class (grassland and *Pinus brutia*) were found at relatively whole classes. These would indicate the impact of human beings especially for lowland in this region.

Present and future potential vegetation were estimated as Figure 2 and 3. These were produced from the classification of the Thornthwaite Index and WI. Relative areas of Steppe, Woodland a, Woodland b, Evergreen coniferous forest, Broadleaved deciduous forest and Maquis were 1, 10, 26, 1, 45, 18 %, respectively in the present patterns (Figure 3). While those of Desert, Steppe, Woodland a, Woodland b, Broadleaved deciduous forest and Maquis were different

(Figure 4). These indicate the strong impact of global warming and drier climate in the future prospects for potential vegetation after climate changes in the Eastern Mediterranean Region of Turkey.

4. Acknowledgment

We sincerely thank to Drs. Watanabe, Fujihara at RIHN, and Dr. Tanaka at Kyoto University for great help for our research, and to Drs. Altan, Atmaca, Kaplan and Yilmaz for arrangement and assistance of field work in Turkey.

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Composition and Vegetation Productivity in the Eastern Mediterranean Region of Turkey - The Vertical Distribution of the Dominant Tree Species -. *Proceedings of the International Workshop for the Research Project on the Impact of Climate Change on Agricultural Production System in Arid Areas (ICCAP), Kyoto, Japan: 49-52.*

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