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Side Event: No North without South, no South without North: the urgent need for an integrated view on global forests

Carbon Science Economics Convergence Research for Mid-Latitude Ecotone

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IIASA | Thursday 12:45 | Hall 4D

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Motivation

A step toward latitudinal approach: focusing on Mid-Latitude region

The mid-latitude zone can be broadly defined as part of the Northern Hemisphere between 30° - 60° North latitude (Figure 1). In terms of demographics and level of economic advancement in the mid-latitude region, approximately 50% of the global population live in this and adjusted areas (particularly between 20°N - 40°N), which thus hosts most of the world's development and poverty related problems (Varis et al., 2011). In addition, the most populated latitudes are short of water resources and land which has exploited more intensively for agricultural purposes than in any other part of the globe. These include all of the United States, China, and Europe to west from the Ural Mountains, most of the agriculturally important parts of Canada and the countries in territories of the former Soviet Union, and India (Crosson, 1989).

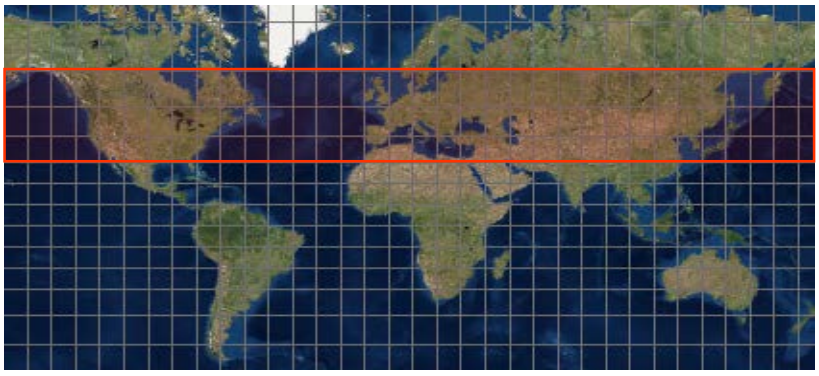

Figure 1. Mid-Latitude Zone

Major part of this ecotone is known as a xeric belt, the territory of a climatically driven transition from forest to steppe zone. The climate of mid-latitude regions is characterized by large differences between the winter and summer radiation balances. Just a few countries within the mid-latitude zone, including Korea, are known to have abundant vegetated land.

The land cover of the mid-latitude zone is comprised mostly of dryland or desert due to extreme weather, environmental conditions and unsystematic economic development (Figure 2). In addition, increased desertification and droughts in some parts of this region threaten many of the terrestrial ecosystems and people's livelihoods. When considering the problem of desertification, Central Asia is a logical place to focus our attention to. The region has one of the driest climates, and has been subject to increased human pressures that have exacerbated its already harsh conditions.

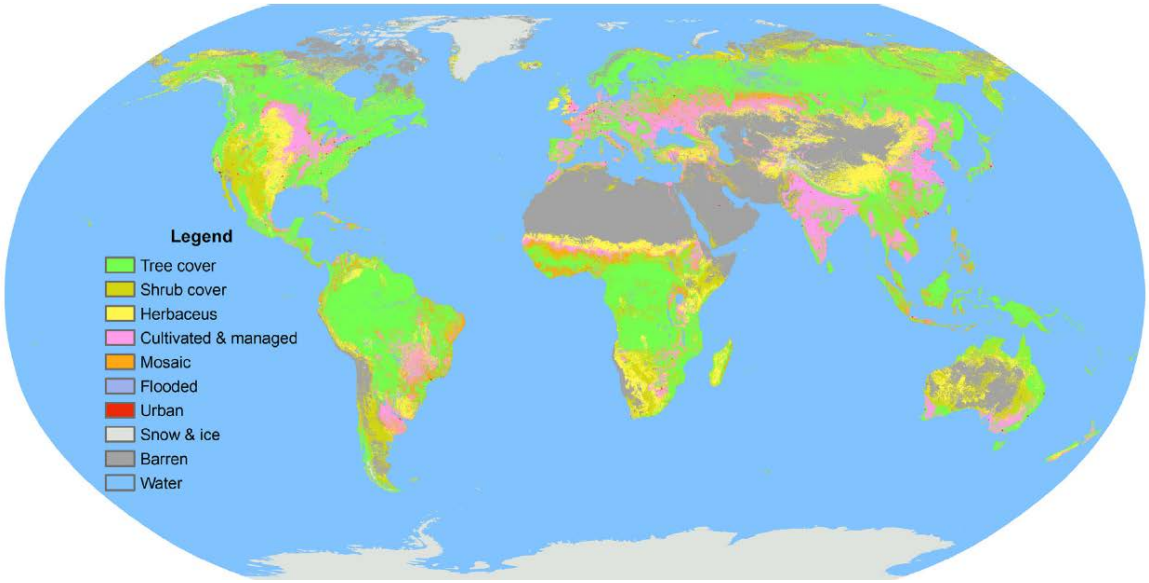

Figure 2. Land cover map showing desertification in mid-Latitude (See et al., 2014)

Ongoing climate change reveals substantial increase of temperature and simultaneously decrease of (basically summer) amount of precipitation across vast continental regions. It increases droughts and water stress of vegetation, particularly forests. According to climatic predictions, these tendencies will be enforced during the 21st century. In addition, climatic predictions are most uncertain for this zone; even small changes of climatic indicators (temperature, precipitation) may provide substantial impacts on ecosystems; and forest is particularly vulnerable in this zone. The warmer and drier climate will negatively impact productivity and vitality of forest ecosystems and provoke acceleration of natural disturbances like fire and outbreaks of dangerous agricultural and forest pests.

Despite different climatic conditions, the cause of desertification and land degradation can be both anthropogenic and natural. Regardless of its dry climate, severe desertification can be generally driven by unsustainable use of land and water resources. Anthropogenic influence on the desertification and land degradation can be observed in many regions of the zone, e.g., on the Korean peninsula (Choi et al, 2014). The Korean peninsula, which is divided into South and North Korea, is characterized by drastically different vegetation status. Land degradation of North Korea has been exacerbating at a noticeable pace due to excessive logging and the conversion of forested areas into agricultural land. According to Choi et al (2014), the level of net ecosystem production (NEP) in the Korean peninsula has been changing over time as a result of land use change. However, as Figure 3 illustrates, there is a sharp contrast between the North and South with respect to NEP.

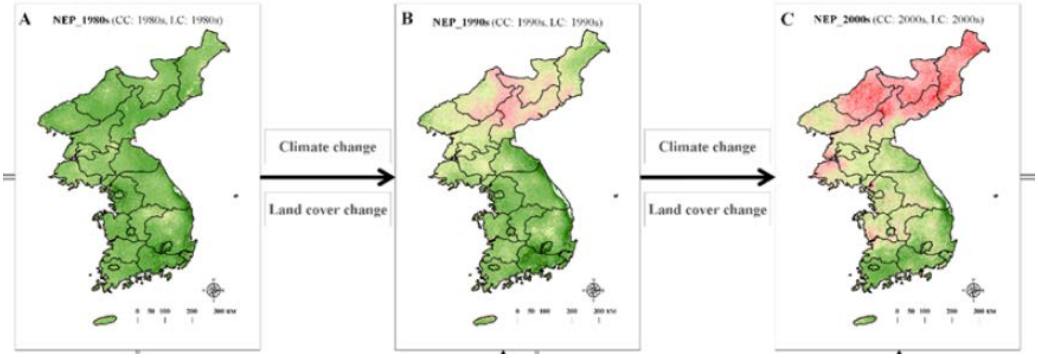

Figure 3. Spatial distribution change of NEP of the Korean Peninsula in the 1980s (left most panel), 1990s (middle panel) and 2000s (right most panel). (Source: Choi et al., 2014)

Global forests are usually classified based on their latitudinal location: boreal, temperate and tropical forests. Since the ecosystems' carbon exchange between the atmosphere and the land is predominantly determined by the amount of soil moisture available to plants and climatic conditions, some previous research tried to demonstrate the role of forests in global temperatures and global CO_2 (Swann et al, 2012; Wofsy et al, 1993). In terms of analyzing the role of forests located at different latitudes, the amount of carbon sequestered and released varies depending on the region. Global carbon circulation is simulated by climate model experiments, and the findings suggest that the terrestrial ecosystem has sequestered significant amounts of atmospheric CO_2 since 1980, with major contributions from northern mid-latitude forests (Barford et al, 2001). Predicted impoverishment and death of forests over major parts of the ecotone will negatively impact the regional carbon budget. Decrease of the forest cover will have also other negative impacts on environment and stability of landscapes (Swann et al, 2012).

The need of interdisciplinary and systems analysis approaches in dealing with the complexity of environmental problems in mid-latitude region

The complexity of the problems described above demands a comprehensive approach. To tackle the challenging circumstances, the use of a systems analysis approach seems valid. Systems analysis is a problem-solving process that involves scientists of relevant disciplines as well as stakeholders, such as decision-makers. The central purpose of systems analysis is to help private decision-makers and policymakers resolve the problems they face in the short, medium, and long term. In order to avert the – partially predictable - damages resulting from the impact of climate change, which will appear in the coming decades and even further in the future, we need to develop a strategy for managing the risks and exploiting opportunities. To reduce the uncertain consequences of climate change, the projection of climate change requires better knowledge of the regions and processes governing the present carbon sink and its variations. In this context - because forest ecosystems are subject to direct human intervention - one promising avenue for managing long-term rates of carbon sequestration is sustainable forest management (SFM).

In order to tackle diverse and complicated problems existing and arising in the Mid-Latitudes, we have started with an intiative called Carbon Science Economics Convergence Research. In a nutshell, the prime of this initiative is to examine the concepts of social benefits and costs of different development strategies facing climate change. Such an interdisciplinary approach should provide guidelines in identification of policy issues raised by climate change. We should aware that the costs and benefits of climate change are unpriced and so as the consequences of climate change. So in order to curtail the negative impacts of climate change and consider the benefits, environmental studies should include societal demands and consider the study's complexity in a holistic way.

The Figure 4 below illustrates both the complexity of climate change and proposed way that research should approach the problem. Climate change, thus, does not only refer to the change in atmospheric composition, but also affects a wide array of social issues such as aging population, urbanization etc. Such problems are what international community is facing today. Thus, when people debate climate change, we should remind ourselves that carbon is a basic building block of life and society.

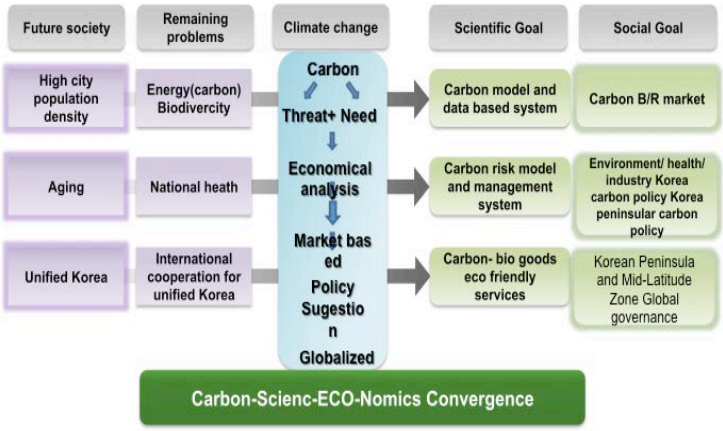

Figure 4. Flowchart of Carbon Science Economics convergence research scheme

The crux of the mid-latitude research lies in taking a comprehensive approach to achieving an interdisciplinary research structure. Dealing with climate change and its impacts on regional forests is largely uncertain and costly. Thus, the projection of climate change requires better knowledge of regions and processes governing the present carbon budget and its variations, and such research findings should be used for further enhancement of curtailing the high social costs coupled with climate change. Research should be directed in a way to consider the benefits, in damages averted and proposing alternative policies, which all in all can be used to strategize in dealing with complex problems.

Summary in three sentences

- The mid-latitude zone in which 50% of world population resides is expected to be affected by land use change and decrease of environmental resource use due to population growth.
- Changes in mid-latitude forests will impact the carbon budget in a negative way, although this impact will not be large at the global level. However, such changes will influence social and environmental conditions and economic activities in the agricultural sector.
- In this context, sustainable forest management becomes an important factor. Management has to be implemented at national scale. Research findings should be used for establishing a management framework, developed through a systems analysis approach involving diverse stakeholders.

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