Session 4. Impacts of climate change on forest growth

Summary report

Scientists must go from giving correct answers to approximate problems, to giving approximate answers to the correct problems. (Dieter Schoene, keynote speech)

Participants noted the following examples of current changes in forests and the forest sector which could be attributed to climate change.

- A reduction in insect diversity as generalist species are favoured to the detriment of specialists.
- Extreme events (e.g. drought) producing lag responses in tree growth, with the importance of the effect growing more rapidly than the importance of the stress (non-linearity of the effect).
- Apparent impact on the health and degradation of freshwater coastal forest swamps in the US resulting from salt water intrusion following drought and storm surges.

It was noted that there are importance differences in how different species react to climate stressors, and the differences among species can vary with stand age and other factors. Such differential responses appear difficult to predict without relatively local knowledge.

The expected future impacts of climate change on forests were discussed by the session participants. Based on the presentations and subsequent discussions the following items were noted.

- Under the IPCC climate change scenarios A2 and A1b, beech and oak are predicted to react differently to climate change in northern France, with both increasing in growth, but with oak being advantaged over beech.
- Instability in climate (e.g. transition to a new steady state) will lead to a decrease in insect diversity, towards fewer specialists and more generalists.
- The total impact of stressors on forest growth and productivity increases faster than the severity of the stressor (non-linear response). These non-linearities must be incorporated into models predicting the impact of climate change on growth.
- In New Zealand weed competition may have a large negative impact on *Pinus radiata* growth in areas with water limitation. Growth of *P. radiata* is very susceptible to modes drop in water availability (problems start with water availabilities dropping <70 percent). Increased temperatures and CO_2 concentrations are expected to result in positive change in forest productivity in New Zealand. However risk factors, such as weeds, pests, and diseases, may counterbalance the forest growth in the country.
- Medium and longer term impacts of pests on forest carbon have received limited attention. This should be considered when assessing the role of forests in carbon sequestration.
- There is no generalized response of forests to climate change; responses differ between regions, as a function of predicted climate scenarios, and between species. For example, *Pinus pinaster* is predicted to have decreased growth in Spain, but the decrease will be greater in areas with greater projected drought. Beech and oaks are predicted to increase in growth in northern France, but beech might be negatively impacted by climate change in Austria. Impacts will be regional.
- There is a need to estimate the impact of cascading systems, i.e. how insect range and defoliation will be impacted by climate change and how this will affect the growth of trees.
- The effects of climate change on forests will happen through extreme events that, by definition, are not common. Effort must therefore be put into extending databases and developing empirical knowledge on extreme events.

- There is a lack of information on the growth of tropical forests, and how climate change will affect that growth.

In considering the future impacts of climate change on people and institutions the participants pointed out that invasive species and expanding populations of native pests have large potential impacts and increasing vulnerabilities of economic systems.

A number of potential management responses and actions were identified by the participants. It was stressed that any forest management plan must incorporate explicitly uncertainty, either through an adaptive framework of periodic plan revision (e.g. every 10 years), or a probabilistic approach where risk and uncertainty are factored in at the outset. The development of international trade standards and increased pest surveillance in response to the threat of invasive species were recommended.

Since many of the predictions regarding climate change and its impacts are known with a great degree of certainty (i.e. very large convergence of climate models), participants noted that it is possible to start now in devising solutions and adaptation plans. For example, Mediterranean countries such as Spain will see a dramatic reduction in productivity of main tree species (*P. pinaster*). In this case it would be possible to perform a socio-economic analysis of forest cover loss and devise adaptation plans such as planting other vegetation types to maintain ecological services.

It was noted that adaptation will be best supported when there is a translation of results from process or empirical models into economic and social terms. Approaches like those used in the field of climate modelling may be useful examples.

Participants considered the policies needed to support the adaptation of forests and the forest sector to climate change. They reiterated comments by Dieter Schoene in his keynote speech that we must not count only on autonomous adaptation, but develop planned adaptation measures that may incorporate awareness building in professional and local communities, monitoring of particularly vulnerable areas as test sites, etc. They noted that such an approach needs to be implemented in addition to the usual arsenal of “autonomous” adaptation measures. Participants also made the following conclusions in relation to policy and research needs.

- Policy decisions need to accept flexibility and uncertainty. There is a need to increase the flexibility and diversity of forests in order to make them more robust and resistant; however the most diverse ecosystems are not necessarily the most stable and resilient ones. It is not clear what type of forest is best suited to future conditions (e.g. more diverse versus less diverse forests), and hence it is difficult to develop adaptation policies, as biological systems are inherently complex, and this complexity is compounded by the long-lived nature of the trees. This likely explains the paucity of information on adaptation policies.
- There is a need in research in tropics; conservation of tropical forests should be a priority. The Center for International Forestry Research (CIFOR) has established plots in tropical forests worldwide in Asia, Africa and Latin America. Global efforts are needed to model tropical forest conditions and provide likely scenarios for forest policy.
- Process-based models predict future conditions based on current conditions in different climatic zones. These models should include excess of CO_2, more frequent extreme climate events, etc. Models are available to forecast future probable situations under specific situations, but are still very much limited in scope. Using meta-modelling approaches, as used by the Intergovernmental Panel on Climate Change (IPCC), to provide information on future scenarios relevant for policy-making could be useful.