CLIM-FO Climate Change & Forestry

Electronic Journal and Newsletter May 2013
FAO, Forestry Department, Forest and Climate Change Team
Food and Agriculture Organization of the United Nations

CONTENTS

I. IN THE PRESS

3 May 2013 - UN News Centre

Countries focus on 'concrete solutions' to build new UN-backed global climate accord

Delegates from more than 160 countries have agreed on a set of climate change policy measures as part of an ongoing United Nations-led effort to create a new, universal climate accord by 2015 to limit global warming to 2 degrees Celsius (3.6 degrees Fahrenheit) from pre- industrial levels.

2 May 2013 - World Meteorological Organization

WMO Annual Climate Statement Confirms 2012 as Among Top Ten Warmest Years

The World Meteorological Organization's Statement on the Status of the Global Climate says that 2012 joined the ten previous years as one of the warmest — at ninth place — on record despite the cooling influence of a La Niña episode early in the year.

April 2013 - IISD

UN-REDD E discussions Address REDD+ Corruption Risks

The UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) has released a summary of the e-discussions on addressing REDD+ corruption at the local level.

April 2013 - IISD

FAO's Voluntary Guidelines on Tenure Newsletter Highlights Awareness Raising and REDD+ Workshops

The Food and Agriculture Organization of the UN (FAO) has released its March newsletter on the Voluntary Guidelines on Tenure Governance Initiative. This edition reports on regional awareness raising workshops for francophone and anglophone Africa.

30 April 2013 - IISD

Study Explores Adaptation of Pine Forestry to Climate Change

A recent publication by a group of research institutions, including Bioversity International, documents the results of multi-site trials on pine species that aim to better understand options for choosing optimal species for forestry in the face of climate change.

26 April 2013 - EU Press Release

Spotlight on Africa's life source – first Soil Atlas of Africa

The European Commission has today presented the first Soil Atlas of Africa, highlighting a vital natural resource which provides food, fodder, fuel wood, reduces flood risk and protects water supplies. With full colour maps and illustrations, the atlas explains in a simple and clear manner the diversity of soil across the African continent and emphasizes the importance of this non-renewable resource. Coordinated by the European Commission's in-house science service, the JRC, an internationally renowned group of soil scientists from Africa and Europe has contributed to this atlas. The aim is to raise awareness at all levels – from politicians to the general public - of the significance of soil to life in Africa.

26 April 2013 - IISD

UNFCCC Publishes Views on REDD+

The UNFCCC Secretariat has released a compilation of 11 views presented by parties (FCCC/SB/2013/MISC.3) on issues related to activities described in paragraph 70 of decision 1/CP.16 (Reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries- REDD+). Three submissions from NGOs were posted on the UNFCCC website.

24 April 2013 - UNECE

UNECE/FAO survey confirms wood as leading source of renewable energy in the UNECE region

Overall wood energy accounts for 3.4% of the total primary energy supply and 38.9% of the renewable energy supply in 27 UNECE member countries in 2011, confirming its role as the leading source of renewable energy. And around 40% of all mobilized woody biomass supply is used for energy purposes.

24 April 20132 - IISD

CGIAR Creates Open Access to Agriculture Information

The Consultative Group on International Agricultural Research (CGIAR) has taken steps to move toward wider availability of information and data through the circulation of a draft Open Access policy among the CGIAR Programs and Centers.

II. MULTILATERAL PROCESSES IN CLIMATE CHANGE

Past events

Ad Hoc Working Group on the Durban Platform

29 April - 3 May 2013, Bonn, Germany

The second session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP 2) took place between 29 April - 3 May 2013 at the World Conference Centre Bonn, in Bonn, Germany. **More**

In addition to the session of the ADP and some workshops, a "Workshop on opportunities for mitigation and adaptation related to land use" was held on the afternoon of 1 May. The workshop addressed forest management, reducing emissions from deforestation and forest degradation and action in other land use areas. For information on the workshop, see the following **link**. A summary report will be made available on the UNFCCC website.

Upcoming events

Bonn Climate Change Conference

3-14 June, Bonn, Germany

The thirty-eighth sessions of the Subsidiary Body for Implementation (SBI 38) and the Subsidiary Body for Scientific and Technological Advice (SBSTA 38), as well as the third session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP 3) will be held at Maritim Hotel from 3-14 June 2013 in Bonn, Germany. **More**

III. EVENTS & MEETINGS

Past events

International Conference on Forests for Food Security and Nutrition

13-15 May, Rome, Italy

The International Conference on Forests for Food Security and Nutrition took place in Rome 13-15 May. See the following **link** for more information on the outcomes.

Upcoming events

International Conference on Climate Change and Tree Responses in Central European Forests

1-5 September 2013, Zürich, Switzerland

The conference aims at exchanging the state of the art regarding direct (physical environment) and indirect effects (interspecific interactions) of climate change on the performance of trees and forest ecosystems. Topics to be discussed stretch from tree physiology and genetics to disturbances and community diversity, with a clear regional focus on Central Europe including the Alps and Carpathians. Keynotes on the response of trees/forest ecosystems to Climate Change (CC) in the focal region and in other regions of the world will frame the sessions, which are open for contributed talks. **More**

Forests Africa. Opportunities for a Green Economy

17 – 19 September, Nairobi, Kenya.

The United Nations Environment Programme (UNEP) and the Centre for International Forestry Research (CIFOR) will convene a three-day conference, Forests Africa: Opportunities for a Green Economy. The conference will be supported by the UN-REDD Programme, the World Agroforestry Centre and will be open for partnerships with other organizations. The event will provide a platform for key players from government, the private sector (formal and informal), civil society, media, as well as the research and development sectors, to openly discuss the challenges and opportunities that Africa's forests present for the development and comparative advantage of the continent and its transition to a Green Economy. The conference will aim to take a step toward repositioning forests within Africa's economic and political landscape. In transitioning to a Green Economy, Africa will require economic growth pathways that are diversified, generate greater employment, produce higher outputs with lower inputs, reduce environmental risks and enhance competitiveness for African economies. The conference will increase awareness of the challenges and opportunities for forests to contribute to green economies at the local, national and regional levels through sustainable management, REDD+, trade of forest products and services, and inclusive processes. It will also identify the range of enabling policies required. Delivering on such a goal will require coordinated collaboration among a broad range of policy and non-state stakeholders – especially those from outside the forestry sector. **More**

EFI 20 Years Science and Policy Forum

23 – 27 September, 2013, Nancy, France

European Forest Institute (EFI) celebrates its 20th anniversary in 2013. The commemoration is also an opportunity to develop an analysis of the future of our forests, and on how EFI and its partners can contribute to meet the challenges related to the various changes, risks and uncertainties to which the forests will be exposed. The EFI 20 Years Science and Policy Forum will stimulate balanced discussion between policy/decision makers, stakeholders and scientists on concrete issues related to the future of our forests, and the risks and opportunities their face. On 25 September, a high-level conference **"Our forests in the 21st century – ready for risks and opportunities?"** gathers both scientists and decision-makers. The follow-up of the conference on 26 September continues with a session "Risks to European Forests - What added value can a European Forest Risk Facility provide?" **More**

IV. RESEARCH ARTICLES

The GHG contribution of the cascaded use of harvested wood products (HWP) in comparison with the use of wood for energy - A case study on available forest resources in Canada

Sikkema, R., Junginger, M., McFarlane, P., Faaij, A.

Environmental Science & Policy Volume 31: 96-108

Some Parties (Countries) to the UNFCCC decided to include the carbon uptake by harvested wood products (HWP) in a new general accounting framework after 2012 (post Kyoto). The analysis aims to make a comparison between the cascaded use of HWP and the use of wood for energy. We combine the new HWP framework with an assumed increased 50 million m3 harvest level in Canada and evaluate the impact of the GHG emissions over a 100-year period. Our reference case assumes all harvested wood is an immediate CO2 emission (IPCC default) and no substitution effects, i.e. annual GHG emissions of 41 million tonnes CO2eq. In our wood utilization scenario's, harvested trees are allocated (in varying shares) to three end-products: construction wood, paper products and pellets for power production. In comparison with our base case, a combination of fossil fuel substitution, material substitu-tion and temporary carbon uptake by HWP leads to significant decreases in GHG emissions. All scenario's show annual GHG emission between 18 and 21 million tonnes CO2eq except for triple use without recycling (at least 24 million tonnes CO2eq). We conclude that GHG emissions of our scenarios are substantially lower than IPCC default. However, it is difficult to incorporate one single method to account for GHG uptake and emissions by HWP, due to end use efficiency and recycling options. Further GHG allocation over individual countries is not straightforward and needs further research.

Projected US timber and primary forest product market impacts of climate change mitigation through timber set-asides

Nepal, P.; Ince, P. J.; Skog, K. E.; Chang, S. J

Canadian Journal of Forest Research; 2013. 43: 3, 245-255

Whereas climate change mitigation involving payments to forest landowners for accumulating carbon on their land may increase carbon stored in forests, it will also affect timber supply and prices. This study estimated the effect on US timber and primary forest product markets of hypothetical timber set-aside scenarios where

US forest landowners would be paid to forego timber harvests for 100 years to increase carbon storage on US timberland. The scenarios featured payments to landowners of $0 (business-as-usual (BAU)), $10, and $15 per each additional metric ton (t) of carbon dioxide equivalent (CO_2e) sequestered on the set-aside timberlands, with maximum annual expenditures of $3 billion. For the set-aside scenarios, reduction in timberland available for harvest resulted in increased timber prices and changes in US domestic production, consumption, net export, and timber market welfare. Economic analyses indicated that the scenario with more area set aside and the largest carbon mitigation benefit (lower carbon price, $10/t CO_2 would result in the largest decrease in market welfare, suggesting that climate change mitigation policies and programs would need to consider such impacts when evaluating the costs and benefits of climate change mitigation strategies in the forest sector

Comparison of approaches for reporting forest fire-related biomass loss and greenhouse gas emissions in southern Europe

Chiriacò, M.V., Perugini, L., Cimini, D., D'Amato, E., Valentini, R., Bovio, G., Corona, P., Barbati, A.
International Journal of Wildland Fire - http://dx.doi.org/10.1071/WF12011

Wildfires are the most common disturbances in Mediterranean forest ecosystems that cause significant emissions of greenhouse gases as a result of biomass burning. Despite this, there is reasonably high uncertainty regarding the actual fraction of burnt biomass and the related CO2 and non-CO2 gas emissions released during forest fires. The aim of this paper is to compare existing methodologies adopted in the National Greenhouse Gas Inventory reports of five of the most fire-affected countries of southern Europe (Italy, Spain, Greece, Portugal, France) with those proposed in the literature, to operationally estimate forest fire emissions, and to discuss current perspectives on reducing uncertainties in reporting activities for the Land Use, Land Use Change and Forestry sector under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. Five selected approaches have been experimentally applied for the estimation of burnt biomass in forest fire events that occurred in Italy in the period 2008–2010. Approaches based on nominal rates of biomass loss can lead to an overly conservative value or, conversely, to underestimation of the fraction of burnt biomass. Uncertainties can be greatly reduced by an operational method able to assess inter-annual and local variability of fire effects on fire-affected forest types.

Using FLUXNET data to improve models of springtime vegetation activity onset in forest ecosystems

Melaas, E. K.; Richardson, A. D.; Friedl, M. A.; Dragoni, D.; Gough, C. M.; Herbst, M.; Montagnani, L.; Moors, E.
Agricultural and Forest Meteorology; 2013. 171/172: 46-56

Vegetation phenology is sensitive to climate change and variability, and is a first order control on the carbon budget of forest ecosystems. Robust representation of phenology is therefore needed to support model-based projections of how climate change will affect ecosystem function. A variety of models have been developed to predict species or site-specific phenology of trees. However, extension of these models to other sites or species has proven difficult. Using meteorological and eddy covariance data for 29 forest sites (encompassing 173 site-years), we evaluated the accuracy with which 11 different models were able to simulate, as a function of air temperature and photoperiod, spatial and temporal variability in the onset of spring photosynthetic activity. In parallel, we also evaluated the accuracy with which dynamics in remotely sensed vegetation indices from MODIS captured the timing of spring onset. To do this, we used a subset of sites in the FLUXNET La Thuile database located in evergreen needleleaf and deciduous broadleaf forests with distinct active and dormant seasons and where temperature is the primary driver of seasonality. As part of this analysis we evaluated predictions from refined versions of the 11 original models that include parameterizations for geographic variation in both thermal and photoperiod constraints on phenology. Results from cross-validation analysis show that the refined models predict the onset of spring photosynthetic activity with significantly higher accuracy than the original models. Estimates for the timing of spring onset from MODIS were highly correlated with the onset of photosynthesis derived from flux measurements, but were biased late for needleleaf sites. Our results demonstrate that simple phenology models can be used to predict the timing of spring photosynthetic onset both across sites and across years at individual sites. By extension, these models provide an improved basis for predicting how the phenology and carbon budgets of temperature-limited forest ecosystems may change in the coming decades.

Soil volume and carbon storage shifts in drained and afforested wetlands of the Parana River Delta

Ceballos, D. S.; Frangi, J.; Jobbagy, E. G.;
Biogeochemistry; 2013. 112: 1/3, 359-372

Wetland ecosystems have a high carbon storage potential as a result of high primary productivity and low decomposition rates dictated by water saturation. In the herbaceous wetlands of the Parana River Delta,

drainage and afforestation with poplars represents one of the dominant land uses. We explored the effects of these interventions on the volume and carbon storage of the young sedimentary soils of the region. At three sites we identified paired stands occupying similar landscape positions and soil types but subject to natural flooding and covered by natural herbaceous communities or drainage and flood control by dikes and covered by poplar plantations established 12, 17 and 19 years ago. Soil sampling at these sites revealed a reduction of the litter compartment (-86%) and decreasing volume and porosity of its underlying mineral layer (0-10 cm in the wetland reduced to 0-4 cm in the plantation). Our comparisons of carbon storage accounted for these volumetric shifts by using accumulated mineral mass rather than depth as a reference, showing that tree plantations gained in the mineral soil (22 Mg C ha^{-1}) almost as much as what they lost in the litter. These gains were particularly large at intermediate depths (4-43 cm in the plantations) were soil porosity remained unaffected and C was raised by 64% explained by (1) the pulse of inputs from overlaying litter and organic layers subject to rapid decomposition and mobilization after drainage and (2) root colonization, since tree plantations had 75% of their fine root biomass at these intermediate soil depths, whereas roots in the wetlands did not explore the mineral soil profile and were completely confined to the organic layer. A neutral C balance following wetland drainage and afforestation resulted from the opposing effects of aeration, favouring decomposition in the organic layer, root colonization and organic matter stabilization, favoring its accumulation in the mineral soil.

Topographically regulated traps of dissolved organic carbon create hotspots of soil carbon dioxide efflux in forests

Creed, I. F.; Webster, K. L.; Braun, G. L.; Bourbonniere, R. A.; Beall, F. D.

Biogeochemistry; 2013. 112: 1/3, 149-164

Soil carbon pools are an essential but poorly understood factor in heterotrophic soil respiration on forested landscapes. We hypothesized that the topographically regulated distribution of dissolved organic carbon (DOC) is the dominant factor contributing to soil CO_2 efflux. We tested this hypothesis by monitoring soil CO_2 efflux and sampling particulate and dissolved substrates (both mobile DOC in soil solution and DOC potentially sorbed onto Fe and Al oxyhydroxides) in surface (freshly fallen leaves (FFL) and forest floor) and near-surface (A-horizon or top 10 cm of peat) soils along three hillslope transects (15 degrees , 25 degrees and 35 degrees slopes) that included upland (crest, shoulder, backslope, footslope, and toeslope) and wetland (periphery and central) topographic features during the snowfree season within a sugar maple forest. We observed that median snowfree season soil CO_2 efflux ranged from <1 to >5 micro mol CO_2 m^{-2} s^{-1}. Substrates in the near-surface mineral soil were most strongly related to median soil CO_2 efflux, and when combined mobile DOC and sorbed DOC together explained 78% of the heterogeneity in median soil CO_2 efflux (p<0.001). When the carbon pool in FFL (an important source of DOC to the forest soils) was included, the explanation of variance increased to 81% (p<0.001). Topographically regulated processes created high concentrations of mobile DOC at the footslope, and high concentrations of sorbed DOC further downslope at the toeslope, forming distinct traps of DOC that can become hotspots for soil CO_2 production. A reduction in the uncertainty of forest carbon budgets can be achieved by taking into consideration the topographic regulation of the substrates contributing to soil CO_2 efflux.

Vital ecosystem security: emergence, circulation, and the biopolitical environmental citizen

Baldwin, A.

Geoforum; 2013. 45: 52-61

This paper provides an account of 'vital ecosystem security'. The central claim is that 'vital ecosystem security' and the processual ontology of 'complex adaptive becoming' provide useful terms with which to think environmental citizenship biopolitically within the contingent matrix of climate change. The paper identifies how complex adaptation, the operative form of vital ecosystem security, defines an emerging form of environmental citizenship, which can be found operating at the interface of a new type of forestry and the global carbon cycle. The specific case developed here concerns the boreal forest of northern Canada.

Impact of future climate on radial growth of four major boreal tree species in the eastern Canadian boreal forest

Huang JianGuo; Bergeron, Y.; Berninger, F.; Zhai LiHong; Tardif, J. C.; Denneler, B

PLoS ONE; 2013. 8: 2, e56758

Immediate phenotypic variation and the lagged effect of evolutionary adaptation to climate change appear to be two key processes in tree responses to climate warming. This study examines these components in two types of growth models for predicting the 2010-2099 diameter growth change of four major boreal species *Betula papyrifera*, *Pinus banksiana*, *Picea mariana*, and *Populus tremuloides* along a broad latitudinal gradient in eastern Canada under future climate projections. Climate-growth response models for 34 stands over nine latitudes were calibrated and cross-validated. An adaptive response model (A-model), in which the

climategrowth relationship varies over time, and a fixed response model (F-model), in which the relationship is constant over time, were constructed to predict future growth. For the former, we examined how future growth of stands in northern latitudes could be forecasted using growthclimate equations derived from stands currently growing in southern latitudes assuming that current climate in southern locations provide an analogue for future conditions in the north. For the latter, we tested if future growth of stands would be maximally predicted using the growth-climate equation obtained from the given local stand assuming a lagged response to climate due to genetic constraints. Both models predicted a large growth increase in northern stands due to more benign temperatures, whereas there was a minimal growth change in southern stands due to potentially warm-temperature induced drought-stress. The A-model demonstrates a changing environment whereas the F-model highlights a constant growth response to future warming. As time elapses we can predict a gradual transition between a response to climate associated with the current conditions (F-model) to a more adapted response to future climate (A-model). Our modeling approach provides a template to predict tree growth response to climate warming at mid-high latitudes of the Northern Hemisphere.

Organic carbon storage in four ecosystem types in the karst region of southwestern China

Liu YuGuo; Liu ChangCheng; Wang ShiJie; Guo Ke; Yang Jun; Zhang XinShi; Li GuoQing
PLoS ONE; 2013. 8: 2, e56443

Karst ecosystems are important landscape types that cover about 12% of the world's land area. The role of karst ecosystems in the global carbon cycle remains unclear, due to the lack of an appropriate method for determining the thickness of the solum, a representative sampling of the soil and data of organic carbon stocks at the ecosystem level. The karst region in southwestern China is the largest in the world. In this study, we estimated biomass, soil quantity and ecosystem organic carbon stocks in four vegetation types typical of karst ecosystems in this region, shrub grasslands (SG), thorn shrubbery (TS), forest-shrub transition (FS) and secondary forest (F). The results showed that the biomass of SG, TS, FS, and F is 0.52, 0.85, 5.9 and 19.2 kg m^{-2}, respectively and the corresponding organic cabon storage is 0.26, 0.40, 2.83 and 9.09 kg m^{-2}, respectively. Nevertheless, soil quantity and corresponding organic carbon storage are very small in karst habitats. The quantity of fine earth overlaying the physical weathering zone of the carbonate rock of SG, TS, FS and F is 38.10, 99.24, 29.57 and 61.89 kg m^{-2}, respectively, while the corresponding organic carbon storage is only 3.34, 4.10, 2.37, 5.25 kg m^{-2}, respectively. As a whole, ecosystem organic carbon storage of SG, TS, FS, and F is 3.81, 4.72, 5.68 and 15.1 kg m^{-2}, respectively. These are very low levels compared to other ecosystems in non-karst areas. With the restoration of degraded vegetation, karst ecosystems in southwestern China may play active roles in mitigating the increasing CO_2 concentration in the atmosphere.

Disentangling biodiversity and climatic determinants of wood production

Vila, M.; Carrillo-Gavilan, A.; Vayreda, J.; Bugmann, H.; Fridman, J.; Grodzki, W.; Haase, J.; Kunstler, G.; Schelhaas, M.; Trasobares, A
PLoS ONE; 2013. 8: 2, e53530

Background: Despite empirical support for an increase in ecosystem productivity with species diversity in synthetic systems, there is ample evidence that this relationship is dependent on environmental characteristics, especially in structurally more complex natural systems. Empirical support for this relationship in forests is urgently needed, as these ecosystems play an important role in carbon sequestration. Methodology/Principal Findings: We tested whether tree wood production is positively related to tree species richness while controlling for climatic factors, by analyzing 55265 forest inventory plots in 11 forest types across five European countries. On average, wood production was 24% higher in mixed than in monospecific forests. Taken alone, wood production was enhanced with increasing tree species richness in almost all forest types. In some forests, wood production was also greater with increasing numbers of tree types. Structural Equation Modeling indicated that the increase in wood production with tree species richness was largely mediated by a positive association between stand basal area and tree species richness. Mean annual temperature and mean annual precipitation affected wood production and species richness directly. However, the direction and magnitude of the influence of climatic variables on wood production and species richness was not consistent, and vary dependent on forest type. Conclusions: Our analysis is the first to find a local scale positive relationship between tree species richness and tree wood production occurring across a continent. Our results strongly support incorporating the role of biodiversity in management and policy plans for forest carbon sequestration.

Assessment of above ground biomass and carbon pool in different vegetation types of south western part of Karnataka, India using spectral modeling

Devagiri, G. M.; Money, S.; Sarnam Singh; Dadhawal, V. K.; Prasanth Patil; Anilkumar Khaple; Devakumar, A. S.; Santosh Hubballi

Tropical Ecology; 2013. 54: 2, 149-165

Remote sensing and GIS based approach was used for estimation of above ground biomass (AGB) and carbon pool at regional scale in south western part of Karnataka. Present study integrates field measured biomass with spectral responses of different bands and indices of MODIS 250 m spatial resolution. Based on relative forest area within the MODIS pixel, area weighted biomass was estimated for each site using ground measured plot (0.4 ha) biomass. Field measured AGB ranged between 7.25 to 287.047 t-dry wt ha^{-1} across different vegetation types in the region. The best fit regression equation ($Y=0.053e^{9.382x}$) was obtained between area weighted AGB (Y) and NDVT of December month (x) with R^2 value of 0.8074. This equation was further used for spectral modeling to estimate the AGB and vegetation carbon pool and to prepare a map to understand the geospatial distribution in the region. Total AGB on dry weight basis was estimated at 6.43 Mt (mean biomass density of 70 t ha^{-1}) and carbon stock of 3 Mt (mean carbon density of 33 t ha^{-1}) in the entire region. The present study revealed that remote sensing technique combined with field sampling provides quick and reliable estimates of above ground biomass and carbon pool and such approach could be used more conveniently for carbon inventories at the State and National level.

The role of glacial cycles in promoting genetic diversity in the Neotropics: the case of cloud forests during the Last Glacial Maximum

Ramirez-Barahona, S.; Eguiarte, L. E

Ecology and Evolution; 2013. 3: 3, 725-738.

The increasing aridity during the Last Glacial Maximum (LGM) has been proposed as a major factor affecting Neotropical species. The character and intensity of this change, however, remains the subject of ongoing debate. This review proposes an approach to test contrasting paleoecological hypotheses by way of their expected demographic and genetic effects on Neotropical cloud forest species. We reviewed 48 paleoecological records encompassing the LGM in the Neotropics. The records show contrasting evidence regarding the changes in precipitation during this period. Some regions remained fairly moist and others had a significantly reduced precipitation. Many paleoecological records within the same region show apparently conflicting evidence on precipitation and forest stability. From these data, we propose and outline two demographic/genetic scenarios or cloud forests species based on opposite precipitation regimes: the dry refugia and the moist forests hypotheses. We searched for studies dealing with the population genetic structure of cloud forest and other montane taxa and compared their results with the proposed models. To date, the few available molecular studies show insufficient genetic evidence on the predominance of glacial aridity in the Neotropics. In order to disentangle the climatic history of the Neotropics, the present study calls for a general multi-disciplinary approach to conduct future phylogeographic studies. Given the contradictory paleoecological information, population genetic data on Neotropical cloud forest species should be used to explicitly test the genetic consequences of competing paleoecological models.

Emerging threats to forests: resilience and strategies at system scale

Randhir, T. O.; Erol, A

American Journal of Plant Sciences; 2013. 4: 3A, 739-748

Forests provide multiple ecosystem services that are critical to sustain societies and ecosystems. Protecting the forest systems become imperative as human demand for forest products and services increase. In addition to current stressors, several emerging threats pose serious implications on the survival and sustainability of forest ecosystems. These include climatic change, invasive species, natural disasters, land use change, and pest/diseases that can severally impact the ability of forest to sustain ecosystem services. There is a need for using a systems-based framework to increase resilience of forest systems to cope with these threats. We review literature on these threats and propose a systems-framework for forest resilience. While strategies for each threat are often easier, comprehensive strategies that can handle multiple threats and specific to forest type is required. There is also a need for further research into forest resilience and landscape-scale response and resilience.

Phytoclimatic dynamics of Mediterranean forests under climate change. A case study in a southern European Pinus sylvestris L. stand

Garcia-Lopez, J. M.; Allue, C

American Journal of Plant Sciences; 2013. 4: 3A, 655-662

Some effects of climate change on the composition and competitive capacity of southern European *Pinus sylvestris* L. forests in the Mediterranean basin were evaluated. The variation over the period 1910-2008 through 30-year mobile averages of a Phytoclimatic Suitability Index (PSI) of the main tree species of the forest cover are used to indicate the competitive hierarchy of *Pinus sylvestris* and *Fagus sylvatica* L. The methodology was applied at a specific location on the Spanish south-facing slopes of the Pyrenees mountain range in the Iberian Peninsula, where the increase in the average temperature was 1.4 degrees C in the period of observation. The results indicated that the apparent equilibrium between the two species studied changed

from the 1934- 1963 average. Due to the loss of competitive capacity of Scots pine with respect to European beech, particularly from the years 1970-1999, the model predicted an inversion of the situation as it was up until now, so that beech had a higher PSI than pine. The phytoclimatic approach proposed here offers new methodological horizons for the study of the effects of climate change on the future of the forests.

Do thinnings influence biomass and soil carbon stocks in Mediterranean maritime pinewoods?

Ruiz-Peinado, R.; Bravo-Oviedo, A.; Lopez-Senespleda, E.; Montero, G.; Rio, M
European Journal of Forest Research; 2013. 132: 2, 253-262

The effects of silvicultural treatments on carbon sequestration are poorly understood, particularly in areas like the Mediterranean where soil fertility is low and climatic conditions can be harsh. In order to improve our understanding of these effects, a long-term thinning experiment in a stand of Mediterranean maritime pine (*Pinus pinaster* Ait.) was studied to identify the effects of thinning on soil carbon (forest floor and mineral soil), above and belowground biomass and fine and coarse woody debris. The study site was a 59-year-old pinewood, where three thinnings of differing intensities were applied: unthinned (control), moderate thinning and heavy thinning. The three thinning interventions (for the managed plots) involved whole-tree harvesting. The results revealed no differences between the different thinning treatments as regards the total soil carbon pool (forest floor+mineral soil). However, differences were detected in the case of living aboveground biomass and total dead wood debris between unthinned and thinned plots; the former containing larger amounts of carbon. The total carbon present in the unthinned plots was 317 Mg ha^{-1}; in the moderately thinned plots, it was 256 Mg ha^{-1} and in the case of heavily thinned plots, 234 Mg ha^{-1}. Quantification of these carbon compartments can be used as an indicator of total carbon stocks under different forest management regimes and thus identify the most appropriate to mitigate the effects of global change. Our results indicated that thinning do not alter the total soil carbon content at medium term, suggesting the sustainability of these silvicultural treatments.

Postfire changes in forest carbon storage over a 300-year chronosequence of *Pinus contorta* dominated forests

Kashian, D. M.; Romme, W. H.; Tinker, D. B.; Turner, M. G.; Ryan, M. G
Ecological Monographs; 2013. 83: 1, 49-66

A warming climate may increase the frequency and severity of stand-replacing wildfires, reducing carbon (C) storage in forest ecosystems. Understanding the variability of postfire C cycling on heterogeneous landscapes is critical for predicting changes in C storage with more frequent disturbance. We measured C pools and fluxes for 77 lodgepole pine (Pinus contorta Dougl. ex Loud var. latifolia Engelm.) stands in and around Yellowstone National Park (YNP) along a 300-year chronosequence to examine how quickly forest C pools recover after a stand-replacing fire, their variability through time across a complex landscape, and the role of stand structure in this variability. Carbon accumulation after fire was rapid relative to the historical mean fire interval of 150–300 years, recovering nearly 80% of prefire C in 50 years and 90% within 100 years. Net ecosystem carbon balance (NECB) declined monotonically, from 160 g C·m−2·yr−1 at age 12 to 5 g C·m−2·yr−1 at age 250, but was never negative after disturbance. Decomposition and accumulation of dead wood contributed little to NECB relative to live biomass in this system. Aboveground net primary productivity was correlated with leaf area for all stands, and the decline in aboveground net primary productivity with forest age was related to a decline in both leaf area and growth efficiency. Forest structure was an important driver of ecosystem C, with ecosystem C, live biomass C, and organic soil C varying with basal area or tree density in addition to forest age. Rather than identifying a single chronosequence, we found high variability in many components of ecosystem C stocks through time; a >50% random subsample of the sampled stands was necessary to reliably estimate the nonlinear equation coefficients for ecosystem C. At the spatial scale of YNP, this variability suggests that landscape C develops via many pathways over decades and centuries, with prior stand structure, regeneration, and within-stand disturbance all important. With fire rotation projected to be <30 years by mid century in response to a changing climate, forests in YNP will store substantially less C (at least 4.8 kg C/m2 or 30% less).

Low gains in ecosystem carbon with woody plant encroachment in a South African savanna

Coetsee, C.; Gray, E. F.; Wakeling, J.; Wigley, B. J.; Bond, W. J

Journal of Tropical Ecology; 2013. 29: 1, 49-60.

Total ecosystem carbon storage has frequently been found to increase with woody encroachment in savannas. However the loss of grass roots associated with woody encroachment can lead to a decrease in below-ground carbon storage which is not compensated for by an increase in aboveground carbon. To investigate how the extent of total woody cover affected ecosystem carbon, soil and above-ground carbon storage along eight thicket-savanna and five forest-grassland boundaries were measured. To investigate whether changes in soil carbon concentrations were related to the percentage of C4 (grass) roots to total roots and root quantity and

quality, we measured fine-root biomass, root C:N ratios, root N, and % C4 roots at three different depths across thicket patches of different ages (n=189). Forests contained significantly more carbon than adjacent grasslands in both above-ground carbon (mean difference 12.1 kg m^{-2}) and in the top 100 cm of the soil (mean difference 4.54 kg m^{-2}). Thickets contained significantly more aboveground carbon than adjacent savannas (3.33 kg m^{-2}) but no significant differences in soil carbon were evident. Total fine-root biomass appeared to be more important than root quality (root C:N) in determining soil carbon concentrations during the encroachment process (i.e. in thicket of different ages). Similarly for thickets, the % C4 roots had no significant effect on soil carbon concentrations. In conclusion, thicket invading into open savanna vegetation did not lead to significant gains in ecosystem carbon at this study site. Significant gains were only evident in mature forest, suggesting that the process may take place very slowly.

Restoring forest resilience: from reference spatial patterns to silvicultural prescriptions and monitoring

Churchill, D. J.; Larson, A. J.; Dahlgreen, M. C.; Franklin, J. F.; Hessburg, P. F.; Lutz, J. A

Forest Ecology and Management; 2013. 291: 442-457

Stand-level spatial pattern influences key aspects of resilience and ecosystem function such as disturbance behavior, regeneration, snow retention, and habitat quality in frequent-fire pine and mixed-conifer forests. Reference sites, from both pre-settlement era reconstructions and contemporary forests with active fire regimes, indicate that frequent-fire forests are complex mosaics of individual trees, tree clumps, and openings. There is a broad scientific consensus that restoration treatments should seek to restore this mosaic pattern in order to restore resilience and maintain ecosystem function. Yet, methods to explicitly incorporate spatial reference information into restoration treatments are not widely used. In addition, targets from reference conditions must be critically evaluated in light of climate change. We used a spatial clump identification algorithm to quantify reference patterns based on a specified inter-tree distance that defines when trees form clumps. We used climatic water balance parameters, downscaled climate projections, and plant associations to assess our historical reference sites in the context of projected future climate and identify climate analog reference conditions. Spatial reference information was incorporated into a novel approach to prescription development, tree marking, and monitoring based on viewing stand structure and pattern in terms of individuals, clumps, and openings (ICO) in a mixed-conifer forest restoration case study. We compared the results from the ICO approach with simulations of traditional basal area and spacing-based thinning prescriptions in terms of agreement with reference conditions and functional aspects of resilience. The ICO method resulted in a distribution of tree clumps and openings within the range of reference patterns, while the basal area and spacing approaches resulted in uniform patterns inconsistent with known reference conditions. Susceptibility to insect mortality was lower in basal area and spacing prescriptions, but openings and corresponding opportunities for regeneration and in situ climate adaptation were fewer. Operationally, the method struck a balance between providing clear targets for spatial pattern directly linked to reference conditions, sufficient flexibility to achieve other restoration objectives, and implementation efficiency. The need to track pattern targets during implementation and provide immediate feedback to marking crews was a key lesson. The ICO method, especially when used in combination with climate analog reference targets, offers a practical approach to restoring spatial patterns that are likely to enhance resilience and climate adaptation.

Coarse woody debris carbon storage across a mean annual temperature gradient in tropical montane wet forest

Iwashita, D. K.; Litton, C. M.; Giardina, C. P

Forest Ecology and Management; 2013. 291: 336-343

Coarse woody debris (CWD; defined here as fallen and standing dead trees and tree ferns) is a critical structural and functional component of forest ecosystems that typically comprises a large proportion of total aboveground carbon (C) storage. However, CWD estimates for the tropics are uncommon, and little is known about how C storage in CWD will respond to climate change. Given the predominant role that tropical forests play in global C cycling, this information gap compromises efforts to forecast climate change impacts on terrestrial C balance. The primary objectives of this study were to: (i) quantify CWD C storage in a tropical montane wet forest; and (ii) determine if CWD C storage varies with mean annual temperature (MAT). Coarse woody debris C was quantified with line-intercept sampling techniques in nine permanent plots located across a highly constrained 5.2 degrees C MAT gradient spanning 800 m elevation on the eastern slope of Mauna Kea Volcano, Island of Hawaii. Forests across this tropical montane MAT gradient contained large quantities of CWD C (44.3+or-11.2 Mg ha^{-1}; Mean+or-1 SE), which accounted for an estimated 17% of total aboveground C storage. Across the entire gradient, CWD C was found primarily as: moderately decayed CWD (Decay Class 2); tree CWD; fallen CWD; and small diameter CWD (2-10 cm). Tree ferns accounted for an average of ~20% of total CWD C, but are rarely included in tropical CWD estimates. Overall, total CWD C ranged from 12.2 to 104.6 Mg ha^{-1} across the MAT gradient, and decreased with increasing MAT. The negative relationship between CWD and MAT

was driven by large accumulations of standing tree CWD at cooler MATs, as fallen CWD did not vary with MAT. The results presented here are in line with limited evidence from tropical studies showing that CWD can make up a large fraction of total aboveground C storage. In addition, these data suggest that CWD could become a net C source to the atmosphere in tropical forests with future warming. A decrease in tropical montane CWD C storage would have important implications for global C dynamics and atmospheric CO_2 levels.

Carbon concentration of standing and downed woody detritus: effects of tree taxa, decay class, position, and tissue type

Harmon, M. E.; Fasth, B.; Woodall, C. W.; Sexton, J

Forest Ecology and Management; 2013. 291: 259-267

The degree to which carbon concentration (CC) of woody detritus varies by tree taxa, stage of decay, tissue type (i.e., bark versus wood), and vertical orientation was examined in samples of 60 tree species from the Northern Hemisphere. The mean CC of 257 study samples was 49.3% with a range of 43.4-56.8%. Angiosperms had a significantly lower CC than gymnosperms, with means of 47.8% and 50.6%, respectively. For whole-stems (i.e., wood and bark), the CC of gymnosperms significantly increased from 49.3% to 53.5% with decomposition, while angiosperms had no significant change. The CC of bark was higher than wood across all stages of decay by an average of ~1.0%. A similar magnitude of difference was found for standing versus downed dead wood in the later stages of decay, with the former having a higher CC than the latter. Differences between angiosperms and gymnosperms are hypothesized to be associated with initial lignin concentrations as well as subsequent decomposition by white- versus brown-rot fungal functional groups. The higher abundance of brown-rots in decomposing gymnosperms may lead to an increase in lignin concentrations, a compound that has higher CC than cellulose. As a result of these findings, uncertainties associated with forest carbon inventories may be reduced by using detrital CC specific to general taxa (angiosperms versus gymnosperms) and stage of decay rather than a single assumed value of 50% as commonly practiced.

Forest degradation and recovery in a miombo woodland landscape in Zambia: 22 years of observations on permanent sample plots

Chidumayo, E. N

Forest Ecology and Management; 2013. 291: 154-161.

Because dry tropical forests cover 40% of tropical forest area and contain considerable biomass and carbon stocks, deforestation and forest degradation of these forests have global significance. However, in most developing countries with dry forests there is no quantitative information on past trends of forest degradation so that the development of historical reference levels is virtually impossible. This study assessed impacts of forest practices on forest degradation from 1990 to 2012 using data from destructive tree sampling and permanent sample plots in a miombo woodland landscape in central Zambia. Aboveground live wood biomass was estimated using allometric equations developed from 113 felled trees. Resprouting was a major source of regeneration on clear-cut subplots and the rate of aboveground wood biomass accumulation was much higher on regrowth sites than on old-growth sites. Changes in aboveground live wood biomass on uncut subplots were linked to biomass loss due to fire, harvesting and conversion to crop cultivation on the one hand and biomass increment due to growth of remaining trees on the other hand. Forest degradation was estimated to cause aboveground wood biomass loss of 0.3 t ha^{-1} $year^{-1}$on the least impacted site to 4.0 t ha^{-1} $year^{-1}$ on the most impacted site. Control of fire and harvesting for charcoal production is recommended if miombo woodland is to be managed for biomass and carbon storage and sequestration. The study also found that negative trends in woody biomass accumulation rate and standing stocks are good indicators of forest degradation while positive trends in species diversity indices and standing wood biomass are useful indicators of forest recovery. However, the application of these indicators requires repeated inventories at permanent sample plots to establish reference levels against which changes in these indicator variables can be compared.

Spatio-temporal prediction of tree mortality based on long-term sample plots, climate change scenarios and parametric frailty modeling

Nothdurft, A.

Forest Ecology and Management; 2013. 291: 43-54

An approach is presented to predict the effects climate change may have on mortality of forest trees. Mortality is modeled using long-term observations from the Pan-European Programme for Intensive and Continuous Monitoring of Forest Ecosystems plots, retrospective climate data and frailty models having a parametric baseline hazard function. The linear predictor is modeled by Bspline regression techniques to allow for nonlinear cause-and-effect curves. Spatio-temporal predictions of mortality of four major tree species in the German state of Baden-Wurttemberg were derived in terms of unconditional hazard ratios and based on climate projection data. According to the model, marginal risk of tree death for 100 year old Norway spruce trees will be doubled until 2100. Hazard rates of common beech will be halved in low elevation areas and will

be reduced by 25% in higher elevations until 2100. Hazard rates of silver fir will be less affected by a changing climate and will increase by at least 25% and by a maximum of 100% in mountainous regions. Scots pines hazard rates will be halved on higher elevation sites and will increase on lower elevation sites.

Tree species controls on soil carbon sequestration and carbon stability following 20 years of afforestation in a valley-type savanna

Tang GuoYong; Li Kun

Forest Ecology and Management; 2013. 291: 13-19

In the farmland/forest ecotone of southwestern China, many areas are experiencing afforestation and subsequent shift in the ecosystem carbon (C) stocks. The effects of five tree species on soil organic C (SOC) accumulation and C stability following 20 years of afforestation in a valley-type savanna since 1991 were investigated in fractions below 0.25 mm. The bulk soils were fractionated with a combination of density fractionation and acid hydrolysis techniques. The results showed that SOC densities in the afforested stands have accumulated since the changes in the land uses. The surface soil C sequestration rates varied substantially among the five stands and ranged from 0.13 tC ha-1 year-1 to 0.47 tC ha-1 year-1 during the two decades of afforestation. The percentage of organic C in the heavy fraction (via density fractionation) relative to the total SOC was 61.9-68.0% under the five stands after 20 years of afforestation. The overall biochemical recalcitrant C density accounted for 37.6- 49.9% of the total SOC in these stands in 2011. The tree species controls on the soil C sequestration and on the C in the separated fractions following 20 years of afforestation in a valleytype savanna. However, the biochemical stability of the physically protected C remained lower than that of the unprotected C, irrespective of the tree species. Among the five studied tree species, Leucaena leucacephala was the most suitable tree species for afforestation in the valleytype savanna for the higher C sequestration rates in the soils and for the moderate stability of SOC, which potentially, at least theoretically, lead to the high biological utilisation (e.g. nutrient release) of soil organic matter when SOC decays.

Differential ecophysiological response of a major Mediterranean pine species across a climatic gradient

Klein, T.; Matteo, G. di; Rotenberg, E.; Cohen, S.; Yakir, D

Tree Physiology; 2013. 33: 1, 26-36

The rate of migration and in situ genetic variation in forest trees may not be sufficient to compete with the current rapid rate of climate change. Ecophysiological adjustments of key traits, however, could complement these processes and allow sustained survival and growth across a wide range of climatic conditions. This was tested in *Pinus halepensis* Miller by examining seven physiological and phenological parameters in five provenances growing in three common garden plots along a climatic transect from meso-Mediterranean (MM) to thermo-Mediterranean (TM) and semi-arid (SA) climates. Differential responses to variations in ambient climatic conditions were observed in three key traits: (i) growing season length decreased with drying in all provenances examined (from 165 under TM climate to 100 days under SA climate, on average); (ii) water use efficiency (WUE) increased with drying, but to a different extent in different provenances, and on average from 80, to 95, to 110 micro mol CO2 mol^{-1} H_2O under MM, TM and SA climates, respectively; (iii) xylem native embolism was stable across climates, but varied markedly among different provenances (percent loss of conductivity, w s below 5% in two provenances and above 35% in others). The results indicated that changes in growing season length and WUE were important contributors to tree growth across climates, whereas xylem native embolism negatively correlated with tree survival. The results indicated that irrespective of slow processes (e.g., migration, genetic adaptation), the capacity for ecophysiological adjustments combined with existing variations among provenances could help sustain *P. halepensis*, a major Mediterranean tree species, under relatively extreme warming and drying climatic trends.

Improving national-scale carbon stock inventories using knowledge on land use history

Schulp, C. J. E.; Verburg, P. H.; Kuikman, P. J.; Nabuurs, G. J.; Olivier, J. G. J.; Vries, W. de; Veldkamp, T.

Environmental Management; 2013. 51: 3, 709-723.

National-scale inventories of soil organic carbon (SOC) and forest floor carbon (FFC) stocks have a high uncertainty. Inventories are often based on the interpolation of sampled information, often using a number of covariables to help such interpolation. The rationale for the choice of these covariables is not always documented, despite the fact that many local-scale studies have identified the factors explaining spatial variability of SOC and FFC stocks. These studies indicate, among others the importance of long-term land use history. Despite this, information on the effects of land use history has never been used to explain variability of carbon stocks in national-scale inventories. We designed an alternative method to improve national-scale inventories of SOC and FCC for the Dutch sand area that takes stock of the findings of detailed case studies.

Determinants for SOC and FFC stocks derived from landscape-scale case studies were used to map national-scale spatial variability and to calculate national totals. The resulting national-scale spatial distribution was compared with the SOC stock map from the current Dutch greenhouse gas inventory. Using land use history to explain SOC variability decreased the error of the SOC stock estimate in 60% of the area. The error in FFC stocks decreased in half of the forest area after including soil fertility, tree species, and forest age as explanatory factors. Estimates with reduced uncertainty will make land use and land management a more attractive and acceptable mitigation option to reduce emissions of greenhouse gases for the LULUCF sector.

Substantial amounts of carbon are sequestered during dry periods in an old-growth subtropical forest in South China

Yan JunHua; Liu XingZhao; Tang XuLi; Yu GuiRui; Zhang LeiMing; Chen QingQing; Li Kun
Journal of Forest Research; 2013. 18: 1, 21-30.

A number of continuous eddy covariance measurements and long-term biomass inventories had proved that old-growth forests are carbon sinks worldwide. The present study estimated the net ecosystem productivity (NEP) for an old-growth subtropical forest at the Dinghushan Biosphere Reserve in South China to investigate the temporal pattern of carbon sequestration, both seasonally and annually. The measured NEP over 7 years (from 2003 to 2009) showed that this forest was a net carbon sink, ranging from 230 (in 2008) to 489 g C m^{-2} $year^{-1}$ (in 2004). The greatest value of NEP was found in the driest year and the lowest value in the wettest year during the study period. Within a year, NEP during the dry season was about 81.4% higher than for the wet season. Accordingly, the dry season at seasonal scale and dry years at interannual scale are key periods for carbon sequestration in this forest. The strong seasonality of ecosystem or soil respiration (ER or SR) compared with gross primary productivity (GPP) resulted in substantial amounts of carbon being sequestered during dry seasons. A decrease of GPP and an increase of ER or SR demonstrated the lower carbon uptake in rainy years. From this study, we conclude that GPP and living biomass carbon increment are not overriding parameters controlling NEP. The variations in ER or SR driven by the rainfall scheme were the dominant factor determining the magnitude of NEP in this forest in South China.

Importance of regional climates for plant species distribution patterns in moist Afromontane forest

Schmitt, C. B.; Senbeta, F.; Woldemariam, T.; Rudner, M.; Denich, M
Journal of Vegetation Science; 2013. 24: 3, 553-568

Questions: How are plant species distribution patterns in tropical montane forest linked to altitude, regional climate and geographic location? Which climatic variables are most important in explaining variations in floristic diversity? What are potential effects of climate change on species diversity? Location: Ethiopia. Methods: Vegetation surveys were conducted in 180 study plots distributed across five moist montane forest areas in southwest and southeast Ethiopia (1000-2300 m a.s.l.). Temperature and precipitation data, as well as bioclimatic variables, were derived for each study plot from the WorldClim global climate data set. Species and climate data were analysed with direct and indirect ordination techniques and multivariate regression trees (MRT). Results: Each of the sampled forest areas showed a distinct species composition and was governed by a particular regional temperature and precipitation pattern related to the topographic variability of the Ethiopian highlands. Hence, a general altitudinal cut-off level for different forest types applicable in all five moist montane forest areas could not be identified. The most important bioclimatic variable in determining species distribution patterns was the amount of precipitation after the dry season (i.e. precipitation in the warmest quarter), followed by minimum temperature in the coldest month. At a lower hierarchical level, temperature and precipitation seasonality were also identified as significant discriminating variables. Generally, in areas with high precipitation during the warmest quarter (>=288 mm) and low minimum temperature in the coldest month (<10.9 degrees C), the number of Afromontane species was highest and that of Guineo-Congolian species lowest. Conclusions: The altitudinal effect on species diversity in the Ethiopian moist montane forests is strongly modified by regional differences in precipitation and temperature regime. The predicted increase in temperature for the Ethiopian highlands due to climate change is likely to affect the distribution of the endemic Afromontane species. Furthermore, the study highlights the need for systematic on-the-ground measurements of climate variables in tropical montane areas in order to understand the currentclimate regime and as a basis for modelling future changes.

Criteria and indicators of sustainable forest management in a changing climate: an evaluation of Canada's national framework

Steenberg, J. W. N.; Duinker, P. N.; Damme, L. van; Zielke, K
Journal of Sustainable Development; 2013. 6: 1, 32-64

Sustainability is now woven throughout forest management and policy. Criteria and indicators (C&I) provide a means of defining the concepts of sustainability in the context of forest management and establishing goals to

gauge progress. There have been no major research initiatives to determine the implications of climate change for C&I. We evaluated the 46 indicators of the 2003 Canadian Council of Forest Ministers framework. Indicators were evaluated for their relationships with climate, relationships with other indicators, robustness and utility under climate change, and future prospects, including abandonment, improvement, or continued use. An evaluation framework was developed to analyze indicator linkages, direct and indirect climate-change influence, and potential modifications. 12 indicators were considered unaffected by climate change. The remaining 34 indicators were considered to be influenced by climate change. No modification seemed warranted for 23 of these indicators, while modifications for the remaining 11 indicators were recommended. Six new indicators were identified for monitoring forests sustainably under climate change. The difference between action and state indicators had implications for the influence of climate change on indicator effectiveness. State indicators were more prone to declines in their tracking ability, while action indicators were often unaffected, or even improved under climate change, as measured by several key traits of indicator effectiveness. The most prevalent theme in the evaluations was a decline in indicator predictability. We suggest moving from predominantly retrospective analysis to a balance of retrospective and prospective analysis, given that monitoring is inherently backwardlooking and the threats and uncertainties of climate change are impending.

Consequences of widespread tree mortality triggered by drought and temperature stress

Anderegg, W. R. L.; Kane, J. M.; Anderegg, L. D. L

Nature Climate Change; 2013. 3: 1, 30-36

Forests provide innumerable ecological, societal and climatological benefits, yet they are vulnerable to drought and temperature extremes. Climate-driven forest die-off from drought and heat stress has occurred around the world, is expected to increase with climate change and probably has distinct consequences from those of other forest disturbances. We examine the consequences of drought- and climate-driven widespread forest loss on ecological communities, ecosystem functions, ecosystem services and land-climate interactions. Furthermore, we highlight research gaps that warrant study. As the global climate continues to warm, understanding the implications of forest loss triggered by these events will be of increasing importance.

Biomass and carbon storage in an age-sequence of Japanese red pine (*Pinus densiflora*) forests in central Korea

Li XiaoDong; Son YeongMo; Lee KyeongHak; Kim RaeHyun; Jin GuangZe; Son YoWhan; Park PilSun; Yi MyongJong

Forest Science and Technology; 2013. 9: 1, 39-44

The biomass and carbon (C) storage of the main ecosystem components were examined in an agesequence of six Japanese red pine forest stands in central Korea. The tree biomass was determined by the destructive method, and the C storage of the tree biomass, forest floor and mineral soil was estimated by analyzing the C concentration of each component. The above-ground and total tree biomass increased from 21.76 and 28.82 Mg ha^{-1} in the 17-year-old stand to 308.83 and 385.74 Mg ha^{-1} in the 73-year-old stand. The comparisons of above-ground tree and tree root biomass in replicate stands indicated that stand density has an effect on tree biomass partitioning for Japanese red pine, especially on the biomass allocation of above-ground tree and tree roots. The C concentrations were lowest in the tree roots while the highest concentrations were found in the foliage across the six Japanese red pine forest stands. The C storage in the forest floor and mineral soil were age-independent. The above-ground and total ecosystem C stocks increased from 19.40 and 43.49 Mg ha^{-1} in the 17-year-old stand to 162.72 and 247.39 Mg ha^{-1} in the 73-year-old stand. Although the total tree biomass C showed considerable accumulation with stand age, the relative contribution of the below-ground ecosystem to the total ecosystem C storage demonstrated large variation. The results of this study assist in understanding C storage and its change with stand development in Japanese red pine forests, which makes this species a large sink for atmospheric C at the regional scale.

Forest management planning technology issues posed by climate change

Bettinger, P.; Siry, J.; Merry, K

Forest Science and Technology; 2013. 9: 1, 9-19.

Given the widespread attention paid to global climate change over the last decade or so, a potential need has arisen to develop forest management plans for broad areas that address vulnerabilities and complexities in the environment with respect to potential changes in air temperature and precipitation patterns. These planning issues include recognizing potential range shifts in forest vegetation, changes in land uses, and changes in the growth and yield of forest tree species, particularly along the leading or trailing edges of the shifting ranges. In addition to assessing traditional forestry concerns (production, sustainability, fragmentation, and ecosystem health), planning processes will likely one day incorporate natural disturbance regimes and the impacts of invasive species. As these are often unpredictable events, planning processes will therefore probably have

numerous stochastic processes that suggest the use of simulation models rather than the more popular deterministic mathematical programming models that are often used in forest planning today (e.g. linear programming). This review examines the changes that have occurred in forest planning since 2009, when a set of challenges facing forest planning, with respect to potential changes in the climate, were posed. We noted through a review of the literature that some areas of concern have received considerable attention of late (shifts in vegetation patterns, assessments of carbon sequestration, disaggregation of global climate model results), while other areas (e.g. natural disturbance modeling) have received less attention. These results relate directly to the use of concepts in forest planning rather than theoretical advancements along different lines of inquiry; therefore there may be some lag time involved in transitioning from theory to practice.

Selection of Provenances to Adapt Tropical Pine Forestry to Climate Change on the Basis of Climate Analogs

Leibing, C., Signer, J., Zonneveld van, M., Jarvis, A., Dvorak, W.
Forests 2013, 4, 155-178

Abstract: Pinus patula and Pinus tecunumanii play an important role in the forestry sector in the tropics and subtropics and, in recent decades, members of the International Tree Breeding and Conservation Program (Camcore) at North Carolina State University have established large, multi-site provenance trials for these pine species. The data collected in these trials provide valuable information about species and provenance choice for plantation establishment in many regions with different climates. Since climate is changing rapidly, it may become increasingly difficult to choose the right species and provenance to plant. In this study, growth performance of plantings in Colombia, Brazil and South Africa was correlated to the degree of climatic dissimilarity between planting sites. Results are used to assess the suitability of seed material under a changing climate for four P. patula provenances and six P. tecunumanii provenances. For each provenance, climate dissimilarities based on standardized Euclidean distances were calculated and statistically related to growth performances. We evaluated the two methods of quantifying climate dissimilarity with extensive field data based on the goodness of fit and statistical significance of the climate distance relation to differences in height growth. The best method was then used as a predictor of a provenance change in height growth. The provenance-specific models were used to predict provenance performance under different climate change scenarios. The developed provenance-specific models were able to significantly relate climate similarity to different growth performances for five out of six P. tecunumanii provenances. For P. patula provenances, we did not find any correlation. Results point towards the importance of the identification of sites with stable climates where high yields are achievable. In such sites, fast-growing P. tecunumanii provenances with a high but narrow growth optimum can be planted. At sites with climate change of uncertain direction and magnitude, the choice of P. patula provenances, with greater tolerance towards different temperature and precipitation regimes, is recommended. Our results indicate that the analysis of provenance trial data with climate similarity models helps us to (1) maintain plantation productivity in a rapidly changing environment; and (2) improve our understanding of tree species' adaptation to a changing climate.

V. PUBLICATIONS, REPORTS AND OTHER MEDIA

National Adaptation Plans. Technical guidelines for the national adaptation plan process

UNFCCC

These technical guidelines for the NAP process are designed to support countries in their planning and implementation of adaptation at the national level. There are numerous other existing guides and resource materials for different levels and decision units, and it is assumed that parts of them will be applicable to the development of a national adaptation plan. **The publication**

Developing Financeable NAMAs. A Practitioner's Guide

IISD

Nationally appropriate mitigation actions (NAMAs) are fast becoming the climate finance vehicle of choice to help developing countries transition to low-carbon, climate-resilient futures. Developing countries, their development partners and other actors in and around the United Nations Framework Convention on Climate Change (UNFCCC) are working to operationalize the concept to leverage domestic climate finance with bilateral and multilateral support, and through carbon markets. To help operationalize NAMAs, the International Institute for Sustainable Development has produced an easy-to-use-guide to help practitioners successfully identify and prioritize financeable NAMAs. The guidebook is a time saver, with easy-to-follow instructions based on real experience and a proven track record of success. IISD's climate change and energyteam's step-by-step guide is based on its technical expertise and lessons learned from work

in Kenya, Bangladesh, Trinidad and Tobago, and Congo Basin countries, including Democratic Republic of Congo and Rwanda. The guidebook offers a Quick Screen methodology to identify NAMA opportunities with potential for climate financing, and a Deep Screen methodology to analyze and determine the most appropriate development options to meet country-specific needs. The process has been tailored to produce NAMA concepts and proposals that align with the requirements of the UNFCCC NAMA registry that will open this year. The guide walks policy-makers through all the steps needed to successfully develop NAMAs and demonstrate preparedness to access available funding. The guidebook is part of IISD's effort to support low-carbon, climate-resilient development in developing countries. **The publication**

IGES Briefing Note on REDD+ Negotiation. UNFCCC COP 18, Doha, Qatar, Nov. – Dec. 2012

IGES

At the 18th session of the UNFCCC Conference of the Parties (COP 18) in Doha, from 26 November to 8 December 2012, negotiations on REDD+ made limited progress. Their outcome is included in the draft conclusions of the Chairs of the SBSTA and the AWG-LCA, respectively. The SBSTA agreed to carry over the outstanding decisions on modalities for national forest monitoring systems and forest carbon MRV as well as REDD+ finance to the 38th session of the subsidiary bodies (SBSTA and SBI) in Bonn in 2013. The AWG-LCA was not able to overcome major differences on results-based finance, but agreed on a Work Programme for 2013 including in workshops to be held prior to COP 19. It also recognised the need to initiate consultations on "ways to incentivize non-carbon benefits" of REDD+. **The publication**

A review of selected REDD+ project designs

IGES

This report aims to present a succinct overview of REDD+ projects to provide an understanding of their designs and to enable comparison between them. The review covers 27 projects using a template that includes common issues for all REDD+ projects aiming to generate carbon credits. **The publication**

Challenges for a climate compatible development. How to strengthen agricultural, livestock and forestry public policies

Plataforma Clim'aatica Latinoamericana.

This document of policy recommendations is based on the report "The State and the Quality of Public Policies in Latin America. Agricultural, Livestock and Forestry Areas" by Daniel Ryan (2012) within the framework of a study promoted by the Latin American Climate Platform in the region. This report is, in turn, based on national documents from ten Latin American countries, such as: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Paraguay, Peru and Uruguay. Furthermore, it takes into consideration contributions and recommendations based on the experiences learned in each of the countries, recorded and discussed in the Regional Forum: "Public Policies on Climate Change and Development: From the discourse to the change"; organized by the Latin American Climate Platform and Climate and Development Knowledge Network (CDKN) with the support of Fundación Futuro Latinoamericano and Fundación Cambio Democrático (Democratic Change Foundation): which was held on October 1 and 2, 2012 in Lima, Peru. **The publication**

Demand-side interventions to reduce deforestation and forest degradation

IIED

Global demand for food, wood products, biofuels and other agricultural products drives the majority of deforestation and forest degradation. The importance of trade and increasing dominance of a relatively small number of multinational traders and retailers suggest a role for demand-side interventions to reduce incentives for deforestation driven by the expansion of commodity production. A variety of demand-side measures have been developed and implemented over the last decade or more by government, private sector and civil society. Examples include legislation, public procurement policies, voluntary bilateral arrangements, multi-stakeholder roundtables, independent certification, moratoria, voluntary disclosure, investor activism and consumer campaigns. This paper reviews demand side measures affecting five types of 'forest risk commodity', namely timber, soy, palm oil, beef/leather and biofuels. Information was collected from literature, interviews and an international meeting to identify challenges and opportunities. **The publication**

Papua New Guinea REDD+ Readiness – State of Play

IGES

This report provides an overview of the state of REDD+ readiness in PNG, as of August 2012. It is part of a regional study on national REDD+ readiness conducted by the Institute for Global Environmental Strategies

(IGES) that aims to share infor-mation and lessons from readiness pro-cesses. Information for the report is drawn from the literature and interviews with REDD+ stakeholders in PNG. The re-port is also informed by discussions at two national workshops in PNG on REDD+ or-ganised by the PNG Institute of National Affairs and IGES. **The publication**

LAD PDR REDD+ Readiness – State of Play

IGES

This report provides an independent review of the state of REDD+ readiness in Lao PDR as of December 2012. It is part of a regional study on national REDD+ readiness funded by the Ministry of Environment of Japan and conducted by the Institute for Global Environmental Strategies (IGES) which aims to share information and lessons from readiness processes. Information for the report is drawn from the literature and from interviews with REDD+ stakeholders in Lao PDR. **The publication**

Indonesia REDD+ Readiness – State of Play

IGES

This report provides a review of Indonesia's REDD+ readiness processes as of November 2012. It follows up on the IGES report compiled by Scheyvens and Setyarso (2010) and is part of a regional study on national REDD+ readiness funded by Japan's Ministry of Environment that aims to share information and lessons from readiness processes. The data for this report were obtained from a literature review as well as from interviews with REDD+ stakeholders in Indonesia, including governmental bodies, nongovernmental organisations (NGOs), and donors. **The publication**

Soil Atlas of Africa

A collaborative initiative of European Union, African Union and FAO

The first ever SOIL ATLAS OF AFRICA uses striking maps, informative texts and stunning photographs to answer and explain these and other questions. Leading soil scientists from Europe and Africa have collaborated to produce this unique document. Using state-of-the-art computer mapping techniques, the Soil Atlas of Africa shows the changing nature of soil across the continent. It explains the origin and functions of soil, describes the different soil types that can be found in Africa and their relevance to both local and global issues. The atlas also discusses the principal threats to soil and the steps being taken to protect soil resources. The Soil Atlas of Africa is more than just a normal atlas. It presents a new and comprehensive interpretation of an often neglected natural resource. The Soil Atlas of Africa is an essential reference to a non-renewable resource that is fundamental for life on this planet. **More**

V.I JOBS

Project Officer – Africa Programme

Forest Peoples Programme - The deadline for application is 15th of June 2013

Forest Peoples Programme is looking for a Project Officer to support their Africa programme work in Cameroon and the Congo basin. Successful applicants will speak and write fluently in French and English, and have a master's degree (or higher) that is relevant to their work. S/he will join our work on the ground with forest peoples and their support organisations to help indigenous and local forest communities protect their forests and exercise their self-determination. The successful candidate must be committed to the principle of self-determination for indigenous peoples and local communities. S/he must be prepared to travel often and be competent in providing technical support to our project teams around the Congo basin region, including reporting on activities and events, and monitoring budgets. **More**

VII. ANNOUNCEMENTS

Open Call for Innovative Private Sector Projects in FIP, PPCR and SREP Pilot Countries

Climate Investment Funds

Private sector participation and financing is key to the overall CIF strategy. Although there has been tangible

progress in encouraging private sector investment in the area of energy efficiency and clean technologies, more can be done to engage and encourage private sector investments in the areas of:

- Supporting the reduction of emissions from deforestation and degradation, conservation and sustainable management of forests, and the enhancement of forest carbon stocks (FIP)
- Integrating climate resilience into national development strategies and actions (PPCR)
- Stimulating energy access and economic growth by adopting renewable energy (SREP). More

CLIM-FO INFORMATION

The **objective** of CLIM-FO-L is to compile and distribute recent information about climate change and forestry. CLIM-FO-L is issued monthly.

Past issues of CLIM-FO-L are available on the website of ***FAO Forest and Climate Change***:

http://www.fao.org/forestry/climatechange/en/

For technical help or questions contact **CLIM-FO-Owner@fao.org**

The Newsletter is compiled by Marc Dumas-Johansen and Susan Braatz.

We appreciate any comments or feedback.

How to subscribe/unsubscribe

- To join the list, please send an e-mail to **listserv@listserv.fao.org** containing the message "Subscribe CLIM-FO-L followed by your name. Leave the subject line blank.
- To unsubscribe, please send an e-mail to **listserv@listserv.fao.org**, leaving the subject line blank and containing the following message: Unsubscribe CLIM-FO-L followed by your name

Your information is secure - we will never sell, give or distribute your address or subscription information to any third party.

How to contribute

We welcome subscribers' contributions of news, articles, publications and announcements of events. Once on the list, to make a contribution please contact the following address: **CLIM-FO-Owner@fao.org**

We thank everyone for their contribution.

Disclaimer

The author does not guarantee the accuracy or quality of the content of the compiled information.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention or omission of specific companies, their products or brand names does not imply any endorsement or judgement by the Food and Agriculture Organization of the United Nations.