previously parametrized and validated using large experimental datasets obtained in commercial eucalypt plantations in the state of São Paulo. Implementing an *Eucalyptus* plantation cover type within AgroIBIS, which had no Plant Functional Type dedicated to fast-growing forest plantations, required important changes in the carbon allocation turnover sub-models. This study included three phases: (1) the computational modification of AgroIBIS; (2) the model parametrization, calibration and validation using data fromintensively monitored sites or inventories datasets; and (3) model application at regional scaleusing sets of parameters which were considered to be constant in space and/or time based on data from the local experiments, and other sets of parameters which could vary spatially. Carbon fluxes of *Eucalyptus* plantations were simulated at the regional scale, and their inter-annual and spatial variabilities were analysed. Such spatial and multiannual quantification of carbon fluxesat large scalesbrings a better understanding of these forest ecosystems on global carbon cycling, which is a prerequisite to support policy decisions.

Shoot water potential of saxaul trees *Haloxylon ammodendron* (C.A.Mey.) Bunge from two distinctive populations of Mongolia

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Haloxylon ammodendron (C.A. Mey) Bunge, Amaranthacaeae (saxaul) is grows in the desert and semi-desert regions of Mongolia forming southern Saxaul forests. This species is of great ecological and economic importance, not only because it can survive in harsh environmental conditions but also because it can reduce wind erosion and sand movement. The objectives of this study were to determine the water potential of assimilation shoot of Saxaul trees of natural stands.This study was conducted in the two distinctive population differing geographical location, vegetation and climate condition. The BZ population, Bayanzag (103°42′E,44°05′N, 1,100 m, asl) is situated in the southern part of Mongolia, Umnugobi province and DU poluation, Dulaan uul (44°12′N,110°01′E, 700-1,000 m, asl) is located in the southeastern part of Mongolia, Dornogobi province. Shoot water potential were measured using a Pressure Chamber (Model 1505DPMS Instrument Company, U.S.A.) following the method of Scholander. The assimilation shoot water potential was measured in trees differing in their age classes, mature tree (200 ≤ cm), young tree (80 - 200 cm) and juvenile (≤ 80 cm) according to their stem height classes. Generally, trees BZ population trend to have higher water potential at predawn, while DU population had higher in midday. According to measurement of water potential the young and juvenile trees are more subjected water stress than that of mature trees, which shows their adaptation performance in drought conditions.

Nitrogen and sulfur deposition by rainfall and throughfall in *Pinus taeda* L. in Southern Brazil

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Soil fertility in areas planted with Pinus taeda is closely associated with nutrient input by atmospheric deposition, mainly with rainfall and throughfall. The objective of the present study is to quantify the input of nitrogen-NO_3^- and sulfur-SO_4^{2-} in Pinus taeda stand, in Cambará do Sul, Southern Brazil. For the quantification and sampling of water from rainfall, three funnels surrounded by a bird ring were installed. In order to evaluate the throughfall, nine funnels were installed. Sampling was biweekly for a period of four years. After the samples were filtered and analyzed for N-NO_3^- and S-SO_4^{2-}. The average total annual rainfall and throughfall was 2081.5 mm and 1280 mm, respectively. Rainfall added 2.70 kg ha^{-1} year^{-1} and 4.97 kg ha^{-1} year^{-1} of N-NO_3^- and S-SO_4^{2-}, respectively. The amounts added by throughfall were 2.81 kg ha^{-1} year^{-1} of N-NO_3^- and 6.53 kg ha^{-1} year^{-1} of S-SO_4^{2-}. The S-SO_4^{2-} presented an increase of 28% in the value of its quantity, after the interaction with the canopy of the trees.

Nitrogen return to soil by litterfall in Semidecidual Seasonal Forest and *Pinus taeda* L.

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The dynamics of litter and nutrients is essential to maintaining the productive capacity of native forests and commercial plantations with tree species. The objective of the present study is to characterize the return of total nitrogen, via litterfall, in a semideciduous seasonal forest and a *Pinus taeda* stands, in Quedas do Iguaçu, Paraná, Brazil. In each ecosystem three plots of 21 m x 20 m were demarcated, in which four traps with 1 m^2 of area were systematically distributed to quantify the litterfall. The amount of litterfall in native forest and pinus stands is 7.76 and 7.15 mg ha^{-1} year^{-1}, respectively. In the native forest the amount of N was 147.19 kg ha^{-1} year^{-1}, about 191.3% higher than the value found in pinus, which presents 50.53 kg ha^{-1} year^{-1}. This difference in the values obtained is explained by the presence of legume species in the native forest, which by symbiosis with bacteria of the genus Rhizobium, can fix the atmospheric nitrogen and increase the values of this element in its biomass. Litterfall is the most important source of nitrogen return to the soil.

Using process-based modelling to better understand the impact of mineral (N, P, K) cycles and climate change on stand growth and resource-use in Eucalypt plantations

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In addition to wood production services, forest ecosystems play an important role in the mitigation of anthropogenic climate change. However the role of forests as future C sinks is being discussed since there is increasing evidence of a progressive shift from carbon-limited growth to nutrient-limited growth as demonstrated in FACE experiments. The development of mechanistic models, including the main nutrient balance and their relationship with the carbon and water balances, is necessary to evaluate the future response of forests to climate change. In this contribution, we present the first joint evaluation of a coupled C-water-N-P-K model on a large number of biogeochemical measurements collected in fast-growing eucalyptus plantations in Brazil along entire rotations, including trials with variable levels of fertilisation and water availability. We have first adapted the CASTANEA ecophysiological model, primarily designed for

temperate and boreal forests, to the simulation of carbon and water fluxes in tropical Eucalypt. Then, the N, P, K fluxes and stocks within the plant were modelled based on process from the literature and calibrated on specific measurements, including the interaction between nutrient content of organs and carbon and water related processes. The final objective is to quantify the relative importance of single nutrients and water limitation on stand growth and carbon productivity, and evaluate the impact of climate change on these different cycles through a change in mean temperature, CO_2 concentration and precipitation regime.

Monitoring populations of *Picea mexicana* Martínez and conservation activities in Mexico / *Monitoreo de poblaciones de Picea mexicana Martinez y acciones de conservación en México*

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Picea mexicana es una especie de clima subalpino con distribución natural superior a los 2800 m de altitud, endémica, en riesgo y sensible al cambio climático del Norte de México. Se evaluaron sitios permanentes en las tres únicas poblaciones conocidas: La Marta, Nuevo León, El Coahuilón, Coahuila y El Mohinora, Chihuahua. Durante el periodo 2006-2018 se realizaron dos inventarios, se desarrolló una tabla de proyección de volumen, se evaluaron indicadores reproductivos de conos, semillas y germinación. Las especies dominantes en las poblaciones son *Pseudotsuga menziesii*, *Pinus rudis*, *Abies vejari*, *Abies duranguensis* y *Picea mexicana*, ésta última sobresale de las especies asociadas en incremento en volumen anual con un rango de 0.5 a 3.4 m^3/ha, sin embargo, del 49 al 85% del arbolado no hay cambio de categoría diamétrica, concentrándose la mortalidad en la población el Coahuilón para las especies *Picea mexicana* y *Pinus rudis*. El coeficiente plántulas/árboles en las poblaciones menor de 6es bajo con respecto a las especies del género *Picea*. La baja eficiencia en la producción de semillas y los tamaños de la semilla reflejan valores mayores de 0.7 en índice de endogamia, con mayor efecto en las poblaciones El Mohinora y El Coahuilón. La sequía crítica de un año con presencia de incendios ha sido la causa principal de mortalidad. Las acciones de los ejidatarios y particulares, así como el desarrollo de proyectos de investigación paralelos y de servicios ambientales en apoyo a estas áreas de conservación de montaña, favorecen la conservación in situ.

The Potential of Sentinel-2 Images to detect damage levels on *Pinus taeda* stands caused by *Sapajus nigritus* Kerr (1972)

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This study aimed to apply both regression and classification methods using Sentinel-2/MSI images to detect damage levels occurred in Pinus taeda stands caused by Sapajus nigritus (monkey). The forest stands are located in Bocaina do Sul (Santa Catarina State). Three images were selected encompassing different attack periods. We selected images before (May/2017), during (November/2017) and after attacks (April/2018). A total of 46 field plots were verified in the field where tree individuals were classified according to the damage intensity: i) no damage, ii) moderate, iii) severe, and iv) dead. In order to estimate the damage level per plot, spectral reflectance, principal component analysis (PCA), and vegetation indices (VI) were selected as regressor variables for the development of regression models using Stepwise, Support Vector Machine (SVM) and Random Forest (RF) approaches. The best model selection was based on the regression model fit statistics. The most robust indexes were MCARI, NDI45 and NDVIRR, which estimated for the classes a percentage of attack of *S. nigritus* per plot with adjusted R^2 of 0.8042, 0.4603, 0.8815 and 0.9766; Syx of 13.49, 61.42, 15.11 and 8.69 (% 0.045 ha-1) and RMSE of 1.95, 4.49, 2.11 and 0.32 (% 0.045 ha-1), respectively. It was possible to estimate and to identify areas attacked by this species highlighting the Stepwise model, followed afterward by SVM and RF. However, it is still recommended to evaluate digital images of high and ultra-high spatial resolution sensors in order to corroborate with the proposed methodology.

B8b: COOL FORESTS AND CLIMATE CHANGE: CHALLENGES OF TRANSITION TO SUSTAINABLE FOREST MANAGEMENT

Cool Forests - an introduction

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Forests developed in regions of cold climate over thousands of years. These "Cool Forests", located in boreal and mountain areas, make up more than one third of the global forest extent. They are found from the circumpolar belt in the northern hemisphere to high-elevation zones in temperate, mid-latitude and tropical zones. Cool Forests show many similarities throughout the boreal and high mountain ecozones - especially with respect to species composition, growth patterns, and response to climate exposure. They are tremendously important for carbon storage, together forming the single largest carbon pool of all terrestrial ecosystems. Cool Forests are partially underlined by permafrost soils and deliver much of the world's harvested wood products including timber, pulp, and paper. Furthermore, they are home to unique landscapes and biological diversity, providing ecosystems that are crucial for the livelihoods of millions of people. Yet, the impacts of current social, economic, environmental, climatic and technological changes on cool Forests remain uncertain. As climate is changing and temperatures rise, the permafrost is thawing, resulting in significant release of greenhouse gases which further accelerate climate change. Permafrost thawing in mountain and boreal ecozones has already caused soil collapses, landslides, rock falls, and mudflows. Rising temperatures are linked to an increase in the frequency and severity of natural disturbances such as wildfire, insect outbreaks, and wind storms and thus present a growing threat to people and nature, the bioeconomy and the climate. This presentation provides an introduction to cool Forests and why they are in danger.

The potential contributions of the forest sector to climate change mitigation and negative emissions

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The goals of the Paris Agreement cannot be reached without the support of forests and the forest sector as active carbon sinks that contribute towards net negative emissions. The design of climate effective mitigation strategies must take a systems perspective that takes into consideration the changes in emissions and removals in forest carbon stocks, in harvested wood products (HWP) carbon stocks, and in other sectors where wood products substitute for other emission-intensive materials and fossil fuels. Moreover, all mitigation options have to be assessed relative to a business as usual baseline. New spatially-explicit analyses of forest sector mitigation options in Canada demonstrate the need for regionally-differentiated strategies to climate change mitigation. Cost-effective