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Model-based estimation of carbon emission from wildfires in East and Southeast Asia

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Emission by biomass burning is an important component of the global carbon cycle, which is closely linked with climatic change. Fire is one of the major disturbances for natural ecosystems, and human activities are likely to affect the natural process. Detection, understanding, and impact evaluation of wildfire are an urgent issue. We developed a coupled carbon cycle and fire regime model, which was firstly applied to Siberian larch forest. The fire regime module simulates fire behaviors in a spatially explicit manner, such that ignition, expansion, and extinction of fires are simulated on a cellular automaton. In the Monte Carlo simulations, probabilities of these processes are affected by environmental and fuel loading conditions. The carbon cycle module estimates net biome production (NBP) for each cell: NBP = photosynthetic assimilation A¦ autotrophic respiration A¦ heterotrophic respiration A¦ biomass burning. The specific processes are evaluated using ecophysiological and empirical relationships. Recently, as the JST-SORST project, we coupled the model system with satellite-based active fire map, so that we can perform a semi-real time impact assessment and forecast of fires for hazard assessment. The Moderate Resolution Imaging Spectroradiometer (MODIS) data of East and Southeast Asia are received at the Institute of Industrial Science (IIS), University of Tokyo, Japan, and the Asian Institute of Technology (AIT), Thailand, and then processed promptly to detect active fires using an algorithm. Weather conditions including the present analysis and 96-hour forecast are obtained from the Japan Meteorological Agency. Thus, at the active fire points, the carbon-fire model is conducted by assuming ignition at the center of the cellular automaton. This system is useful, because it allows us to detect active fires, to evaluate their impact and carbon emission, and to predict fire propagation.