Renewables on the right spot: spatial matching in models for low carbon energy system design

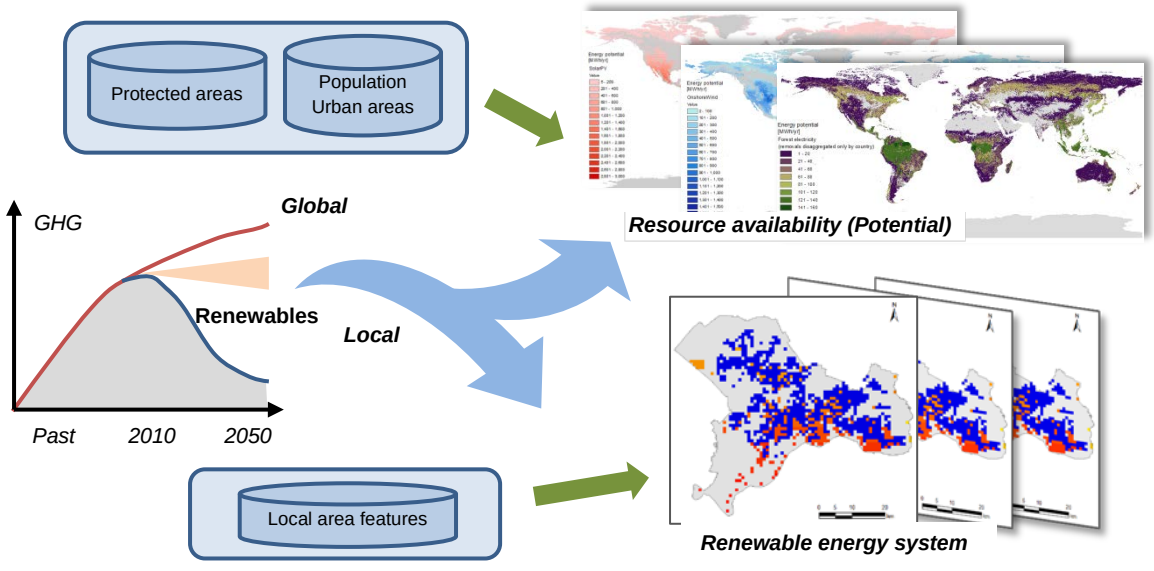
Diego SILVA HERRAN
National Institute for Environmental Studies (NIES), Japan

Keywords: Renewable energy supply, Spatial matching, GIS, Low carbon energy system

This research introduces models developed to estimate renewable energy supply considering spatial matching with energy demand side. Different to conventional approaches, these models take advantage of GIS data to account for the spatial relationship of renewable resources with respect to the location of energy demand. Model's application provides a more realistic perspective of renewable energy's contribution to low carbon energy systems.

The renewable energy potential model, used to estimate global potential, has been improved to account for land use restrictions for nature conservation purposes. Technical potential of renewables and unit supply costs for 35 world regions have been estimated using a grid cell scale with resolution of over 1 km^2. Currently, this model is being improved by considering the spatial matching of energy supply and demand. For that purpose, distance of renewable electricity supply sites to closest populated area is estimated. This approach introduces a threshold for electricity transmission distance and a factor for transmission losses per kilometer.

For the local scale of renewable energy supply a new energy system model has been formulated. The model provides the optimal location of renewable power plants, and the optimal allocation of renewable resources (in particular of biomass) to these plants, based on the spatial distribution of renewable resource and the distance to urban areas. The model formulation is based on mixed integer programming, and evaluates the optimal mix of solar PV, onshore wind and forest biomass for a given annual electricity supply. The model has been applied for Iskandar region in Malaysia to evaluate the feasibility of renewable energy targets as part of low carbon development initiatives.



Design of low carbon energy systems considering spatial matching of renewable supply