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Bridging the gap between coarse and fine resolution models to inform integrated water-energy-land planning at decision-relevant scales

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In the next few decades increasing and shifting populations, urbanization, technological advances, pollution and climate change will all contribute to increased stress on limited water, energy, and land resources in several regions across the world. It is becoming increasingly clear that the feedback between these different sectors are critical and that planners and decision makers need to account for the inter-sectoral dependencies in order to capitalize on key opportunities as well as avoid unforeseen challenges which may be ignored when using single-sector approaches. In addition to cross-sectoral linkages, equally important is the spatial scale at which the resources are analyzed and managed, both because of the inherent characteristics of each resource as well as the administrative or legislative boundaries over which decisions are made and implemented. As sectoral planners adopt integrated planning approaches, a key challenge is collecting, harmonizing and synchronizing data across sectors and at decision-relevant spatial scales from large multinational regions to river sub-basins.

This study seeks to contribute to this integrated panning challenge by introducing a new framework which offers planners a tool to analyze cross-sector dynamics at decision-relevant spatial scales. The framework is designed to utilize data from various models operating at different resolutions so as to capture both broader global dynamics across a range of earth and human systems (as usually done in global integrated assessment models), as well as finer-resolution sector-specific models which may capture details outside the scope of coarse-scale integrated assessment models. All data is harmonized to the spatial boundaries of interest to the stakeholder and then inter-sectoral and inter-regional links are captured via technological and trade input-output matrices. Impacts of policies and changes in one sector can then be tracked across other sectors and regions.

In partnership with various government ministries and universities in Latin America, several case studies are designed to demonstrate the capabilities of the framework to analyze how various policies of interest and socio-economic changes influence the evolution of national and sub-national energy, water, and land systems in the context of a changing climate. The resulting sectoral synergies, conflicts and investment needs carry important implications for national resource management and infrastructure planning.