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Process-based Modelling of Regional Water Demand for Electricity, Industry and Municipal **Sectors in Integrated Assessment Models**

1. Abstract

We study long-term global scale interactions between the human and natural systems using Integrated Assessment Models (IAMs) and in particular the IMAGE model. The existing themes of climate change, energy demand/supply and land use are now enriched with a model of long-term freshwater withdrawal and consumption. We focus on the Electricity, Industry and Municipal sectors, because these are growing faster than the Agricultural sector but have been studied in less detail.

To make long-term projections, our process-based models focus on physical relations. For example, water demand for Electricity is related directly to the excess heat from thermoelectric power plants, whereas previous models use the more indirect relation to electricity output in MWh.

On the other hand, we avoid physical relations that involve too many parameters. For example, the Industrial water demand model lumps together all possible industrial activities and measures them in dollars of value added (IVA\$). Thus we avoid making assumptions on future production levels for each region and each product such as steel, cement, paper or textiles.

When future developments are highly uncertain, scenarios are used to explore a range of possible outcomes, as was done for power plant cooling systems. The regional graphs below are based on the OECD Economic Outlook baseline scenario.

These models represent water demand which is not constrained by supply. A next step is to integrate demand, supply and allocation of water in a gridded global hydrological model. The physical or process-based nature of our models also enables the estimation of direct and indirect effects of various policies.







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