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Application of an integrated assessment model in coastal Bangladesh to support strategic delta adaptation and development

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There is growing recognition that new approaches, underpinned by more system-oriented decision support tools, will be required to facilitate development compatible with the Sustainable Development Goals (SDGs) and to prevent dangerous ecological breakdown. We demonstrate the potential of Integrated Assessment Models (IAMs) to inform strategic policy decision making at the regional level, helping to understand key trade-offs and secondary impacts. We document the Delta Dynamic Emulator Model (ΔDIEM), co-produced with stakeholders, to integrate ecosystem services and household wellbeing, being utilised by the Planning Commission of the Government of Bangladesh for its strategic long-term planning. The model is applied to the southwest coastal zone (pop. 14m) where high rates of extreme poverty prevail. The model's process-based simulations plausible future ecosystem services and their link to households has helped reveal potential dynamics and movements in extreme poverty as well as responses in different characterisations of poverty (e.g. permanent versus temporary/seasonal). A key power of the model is its ability to assess both the occurrence of, and potential responses to, risk transfer, a phenomenon which threatens adaptation and development success particularly in vulnerable river delta systems.
ΔDIEM integrates the outputs of multiple established physically and process-based biophysical models, a number of newly developed process-based models simulating salinity levels and household socioeconomics and poverty with a deep stakeholder engagement process. Models that simulated areas outside the coastal zone (upstream hydrology and Bay of Bengal oceanography), are used as input scenarios (i.e. boundary conditions). Other complex biophysical models focusing on the coastal hydrology and water quality (Delft-3D, FVCOM, MODFLOW) are represented with computationally efficient statistical emulators in ΔDIEM to make tight coupling across the system elements possible. Agriculture and aquaculture are important livelihoods in Bangladesh. Thus a process-based integrated farming model (building on the FAO's CROPWAT model) was developed and included in ΔDIEM.
We report results from our analysis of two proposed interventions on behalf of the Government of Bangladesh, General Economic Division (GED) using ΔDIEM. GED has responsibility for the strategic development of the delta coastline within Bangladesh and recently enacted the first draft of the Bangladesh Delta Plan 2100 (BDP2100). The BDP2100 contains multiple possible interventions, the majority of which are only in the very early stages of development. This work is assisting in prioritising and refining these proposals. The intervention we investigated included i) A proposed extensive polder network in the south-central region of the ii) Strategic development of a chronically waterlogged area of the delta. In both areas we highlight insights on its potential implications for biophysical change and the potential associated poverty and inequality, and on risk transfer between regions and populations. In doing so we demonstrate IAMs' growing potential to ask and explore key questions and scenarios about the functioning of integrated biophysical and socioeconomic systems, but also highlight some of their key weaknesses.