12 Coastal Systems

12.1 Scenarios

Climate change affects coastal systems through rising mean and extreme sea levels, causing damages through temporary flooding and losses due to permanent submergence of land. To assess these impacts, climate scenarios have to be complemented by sea-level-rise projections. While the information about thermal expansion and dynamical changes of sea level is provided by the four GCMs considered, contributions from mountain glaciers and ice sheets have to be added from other sources, which introduces a further dimension of uncertainty (see Section 5). The uncertainty range introduced is substantial and a least on equal footing with the climate model and scenario uncertainty (e.g. Kopp et al. 2014). To reflect this aspect, we include an additional scenario dimension in the scenario design for this sector and sample this by providing projections for the median and 5th and 95th percentiles of the contributions from ice sheets and mountain glaciers to sea-level rise. One aspect specific to the coastal-systems sector is that impacts are extremely non-linear in and sensitive to adaptation. Impacts without adaptation are 2-3 orders of magnitudes higher than those with adaptation (Hinkel et al. 2014). This leads to the circumstance that the regions with the highest infrastructure damages under the scenarios without adaptation are actually the regions least vulnerable to sea-level rise, because it is highly cost-efficient and standard practise to protect those regions against sea-level rise. Scenarios including adaptation are therefore added to the protocol to provide projections of climate change risks including adaptation potentials.

Those models that do not account for varying societal conditions (population, GDP, protection levels etc.) should keep these fixed at year 2005 levels throughout the simulations (**2005soc** scenario in Group 1 (dashed line in **Figure 1**) + **rcp26soc** or **rcp60soc** scenario in Group 2). They only need to run the first pre-industrial period of Experiment I (1661-1860). Group 3 runs only refer to models that are able to represent future changes in societal conditions.

Climate & CO_2 scenarios	
picontrol	Pre-industrial climate (year specific for the entire period 1661-2299).
historical	Historical climate and CO_2 concentration.
rcp26	Future climate and CO_2 concentration from RCP2.6.
rcp60	Future climate and CO_2 concentration from RCP6.0.
rcp85	Future climate and CO_2 concentration from RCP8.5.
Human influence & land-use scenarios	
1860soc	Pre-industrial society and protection.
2005soc	Representation of fixed year 2005 society and protection.
ssp2soc	Varying society and protection according to SSP2.
2100ssp2soc	Representation of fixed year 2100 society and protection according to SSP2.

Table 45 ISIMIP2b scenario specification for the simulations of impacts on coastal systems.

Experiment	Input	Pre-industrial	Historical	Future	Extended future

			1661-1860	1861-2005	2006-2099	2100-2299
I	no climate change, pre-industrial CO_2	Climate & CO_2	**picontrol**	**picontrol**	**picontrol**	**picontrol**
	varying society & protection up to 2005, then fixed at 2005 levels thereafter	Human & LU	Option 1:**1860soc**	Option 1: **histsoc**	**2005soc**	**2005soc**
			Option 2*: **2005soc**	Option 2*: **2005soc**		
II	RCP2.6 climate & CO_2	Climate & CO_2	Experiment I	**historical**	**rcp26**	**rcp26**
	varying society & protection up to 2005, then fixed at 2005 levels thereafter	Human & LU		Option 1*: **histsoc**	**2005soc**	**2005soc**
				Option 2*: **2005soc**		
III	RCP6.0 climate & CO_2	Climate & CO_2	Experiment I	Experiment II	**rcp60**	not simulated
	varying society & protection up to 2005, then fixed at 2005 levels thereafter	Human & LU			**2005soc**	
IV	no climate change, pre-industrial CO_2	Climate & CO_2	Experiment I	Experiment I	**picontrol**	**picontrol**
	varying society & protection up to 2100 (SSP2), then fixed at 2100 levels thereafter	Human & LU			**ssp2soc**	**2100ssp2soc**
VI	RCP2.6 climate & CO_2	Climate & CO_2	Experiment I	Experiment II	**rcp26**	**rcp26**
	varying society & protection up to 2100 (SSP2), then fixed at 2100 levels thereafter	Human & LU			**ssp2soc**	**2100ssp2soc**
VII	RCP6.0 climate & CO_2	Climate & CO_2	Experiment I	Experiment II	**rcp60**	not simulated
	varying society & protection (SSP2)	Human & LU			**ssp2soc**	
VIII	RCP8.5 climate & CO_2	Climate & CO_2	Experiment I	Experiment II	**rcp85**	not simulated
	varying society & protection up to 2005, then fixed at 2005 levels thereafter	Human & LU			**2005soc**	

12.2 Output data

Table 46 Variables to be reported by coastal-systems models.

Variable (long name)	Variable name	Unit (NetCDF format)	Resolution	Comments
Expected number of people flooded annually	**par**	thousands/yr (1000 yr-1)	Time resolved grid	Par = People at risk.
Expected seaflood costs	**seafloodcost**	million dollars/yr (mio 2005US$ yr-1)		Expected annual damage caused by seafloods
Adaptation costs of building and upgrading dikes	**seadikecost**	million dollars/yr (mio 2005US$ yr-1)		Cost for building/upgrading dikes
Adaptation costs of maintaining dikes	**seadikemain**	million dollars/yr (mio 2005US$ yr-1)		Cost for maintenance of dikes build since the initial year (2000), but not cost for dikes “build” in the initialization of the model.

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