Mudanças Climáticas

- Mudanças no Quaternário
- Presente e Mudanças Futuras
- Modelagem das Mudanças Costeiras

COASTAL ENVIRONMENTS AND GLOBAL CHANGE

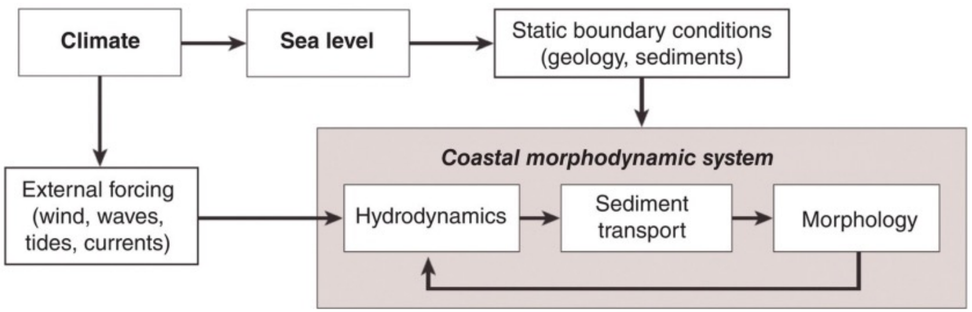

Fig. 1.5 Conceptual diagram illustrating the morphodynamic approach, showing the coastal morphodynamic systems and the environmental boundary conditions (sea level, climate, external forcing and static boundary conditions).

(Source: Masselink 2012. Reproduced with permission from Pearson Education Ltd.)

Mudanças no Quaternário

- O clima na Terra esta mudando constantemente.
- O início do Quaternário data de 2,6 Mi de anos atrás
- O Período é caracterizado por mudanças climática bruscas e frequentes.

- Mais de 50 ciclos glaciais e inter-graciais
- Esses períodos estão registrados nos sedimentos
- Mudanças climáticas, glaciações e mudanças no nível do mar são as características do Quaternário

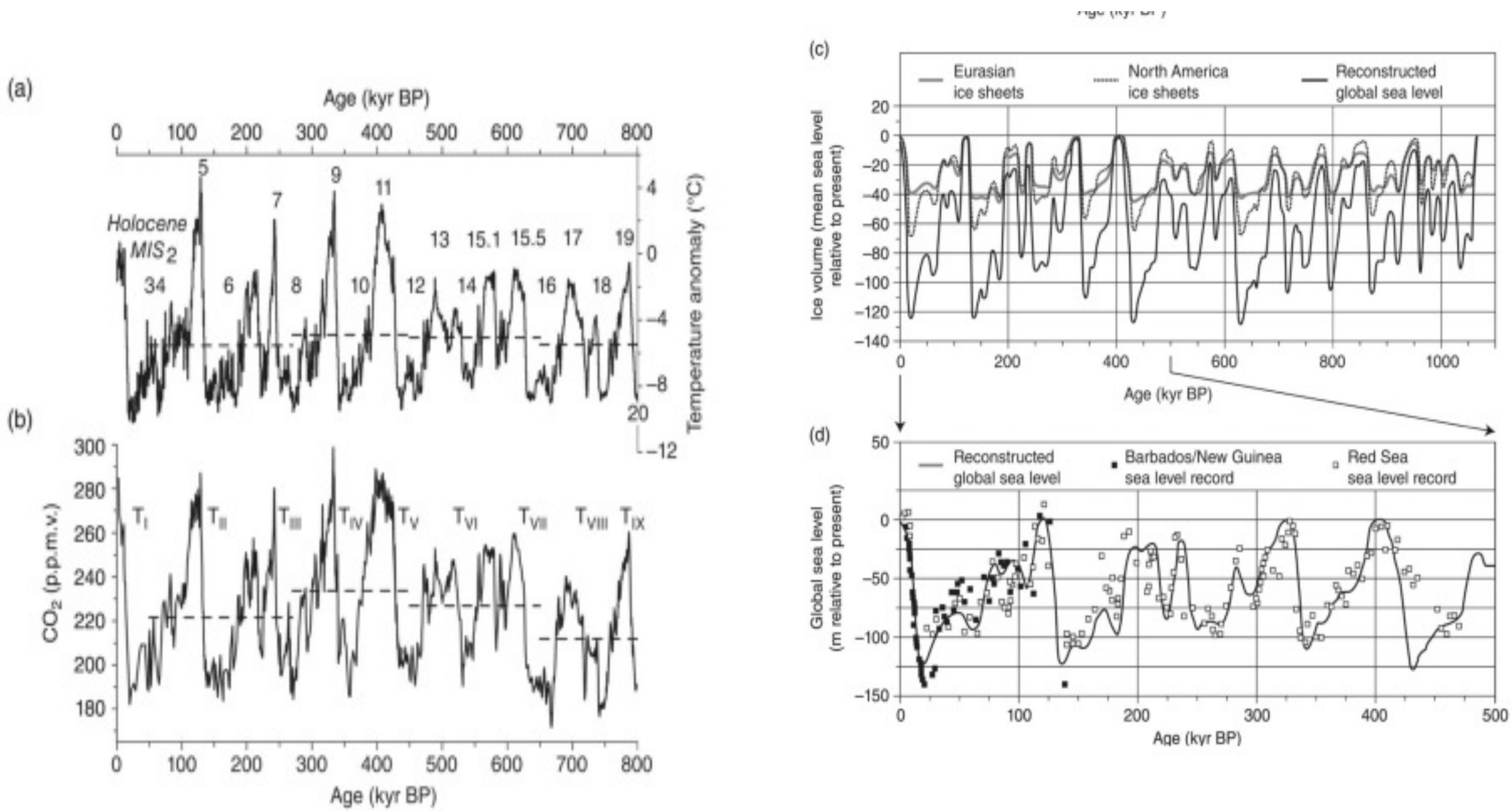

Fig. 1.13 Temperature (a) and carbon dioxide record (b) from Antarctica. (Source: Lüthi et al. 2008. Reproduced with permission of Nature Publishing Group.) (c) Modelled global sea-level record for the past 1M years, with contributions from Eurasian and North American ice sheets (Source: Bitanja et al. 2005). In (d), the model output is compared with the longest Quaternary sea-level record in the world, the record from the Red Sea (Source: Siddall et al. 2003), and with coral reef data from Barbados and New Guinea (Source: Lambneck and Chappell 2011).

Mudanças Climáticas: Presente e Futuro

- Embora a variação no nível do mar seja o fator mais agudo, não é o único a alterar a linha de costa

Table 1.1 Climate drivers and their effects on coasts.

(Source: Adapted from Nicholls et al. 2007.)

Climate driver	Trend	Effects
CO_2 concentration	Rising, 0.1 pH unit since 1750	Ocean acidification
Sea-surface temperature	Rising, 0.6°C since 1950	Circulation changes, sea-ice reduction, coral bleaching and mortality, species migration, algal blooms
Sea level	Rising, 1.7 ± 0.5 mm/yr since 1900	Flooding, erosion, saltwater intrusion, rising groundwater table and impeded drainage
Storm intensity	Rising	Erosion, saltwater intrusion, coastal flooding
Storm frequency, storm tracks, wave climate	Uncertain	Altered storm surges and storm waves
Run-off	Variable	Alterations in flood risk, water quality, fluvial sediment supply, circulation and nutrient supply

Forçantes Radiativos

- As mudanças e alterações no balanço energético ocorrem por 3 mecanismos de controle sujeitos a variações complexas

- Energia do Sol
- Propriedades da superfície da Terra
- Composição da atmosfera

As mudanças ocorrem por alterações nos forçantes

- Ciclo no sistema Terra Sol
- Variação no albedo
- Mudança na camada de gelo
- Aerosol na atmosfera
- Gases estufa

- Os forçantes radiativos são expressos em W/m2
- Se positivo – aquecimento
- Se negativo – resfriamento

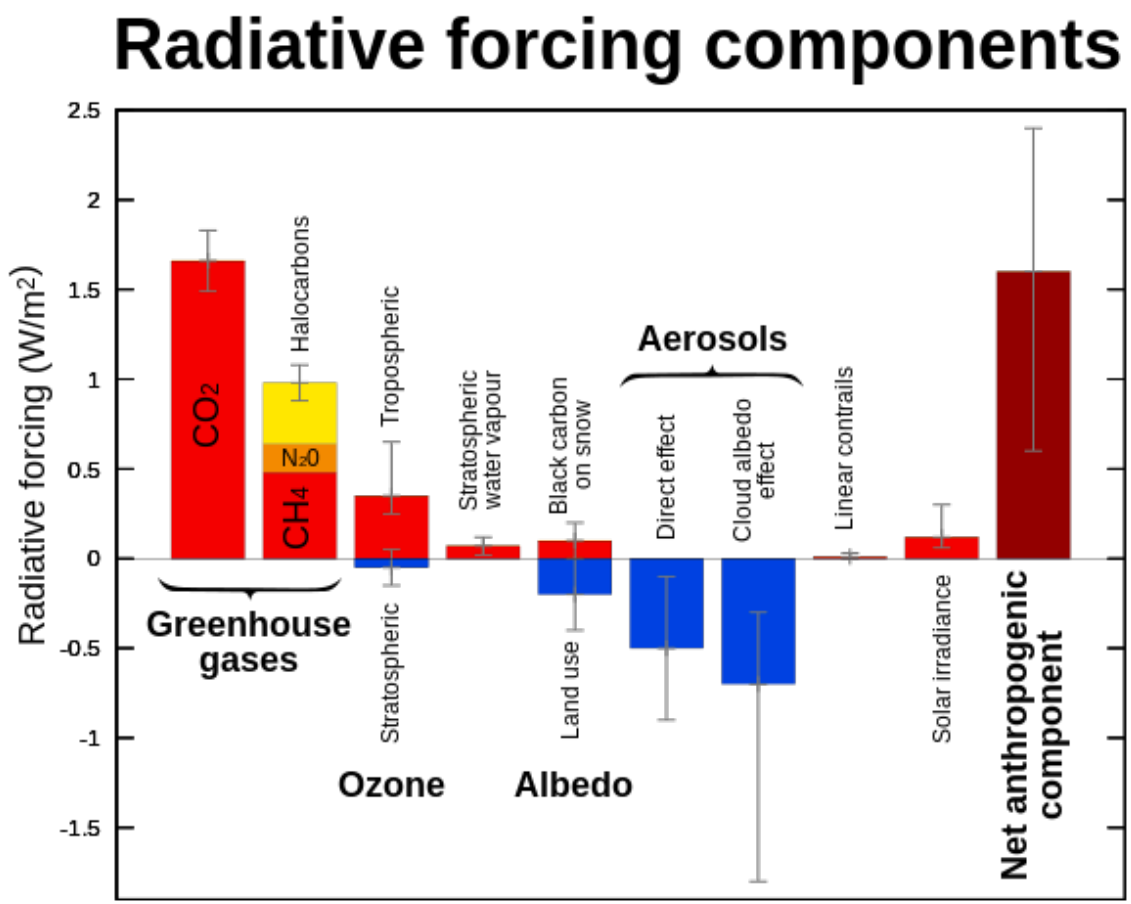

IMAGE CREDITS: ANNA, FLICKR.

Em função dos forçantes o ICPP constroi cenários para os modelos

Table 1.2 Selected features of the Intergovernmental Panel on Climate Change (IPCC) emission scenarios from the Special Report on Emission Scenarios (SRES). Data are for the year 2100 and are from Nakićenović et al. (2000). Temperature forecasts are from Solomon et al. (2007).

(Source: Data from Nakićenović et al. 2000.)

Family			**A1**		**A2**	**B1**	**B2**
Scenario group	**1990**	**A1F1**	**A1B**	**A1T**	**A2**	**B1**	**B2**
Population (billion)	5.3	7.1	7.1	7	15.1	7	10.4
World gross domestic product (GDP) (trillion 1990$US/yr)	21	525	529	550	243	328	235
CO_2 emissions from fossil fuels (GtC/yr)	6.0	30.3	13.1	4.3	28.9	5.2	13.8
Percentage of carbon-free energy usage	18	31	65	85	28	52	49
Range of projected temperature increase (°C)	0	2.4–6.4	1.7–4.4	1.4–3.8	2.0–5.4	1.1–2.9	1.4–3.8

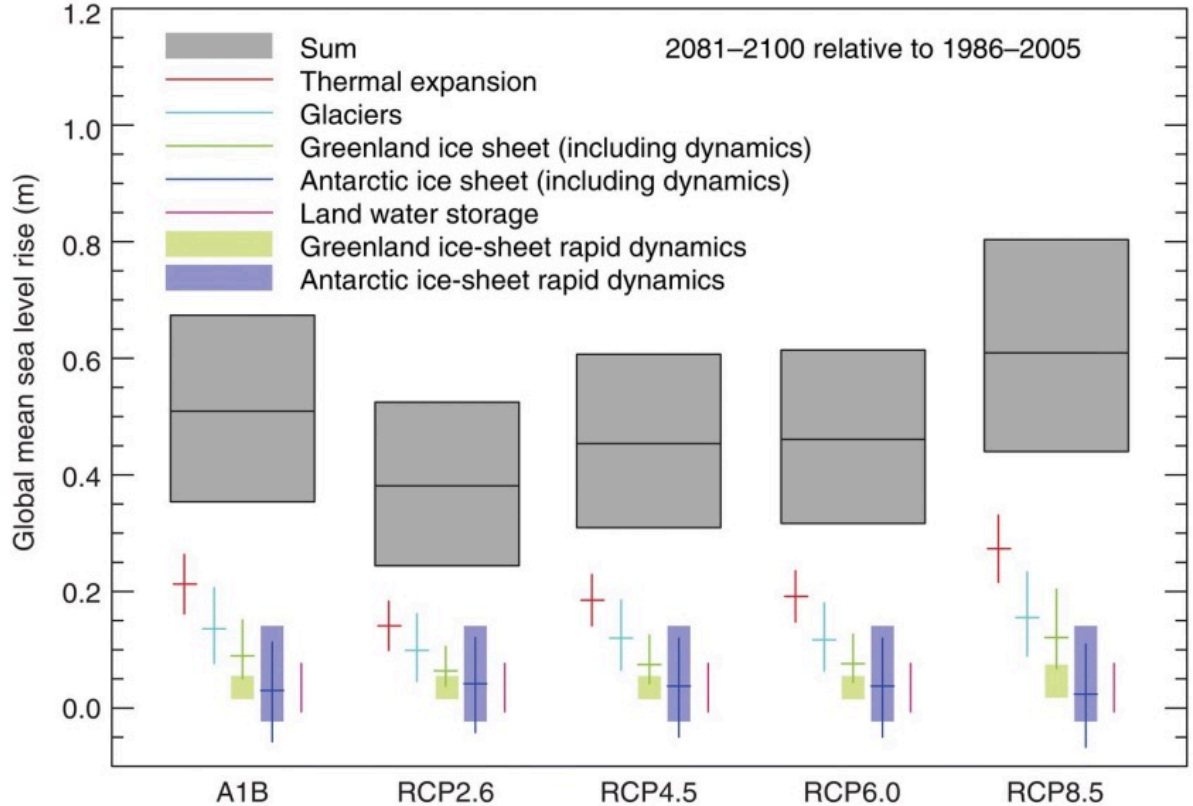

Fig. 1.14 Projections from process-based models with likely ranges and median values for global mean sea-level rise and its contributions in 2081–2100 relative to 1986–2005 for the four RCP scenarios and scenario SRES A1B used in the AR4. From Church et al. (2014).

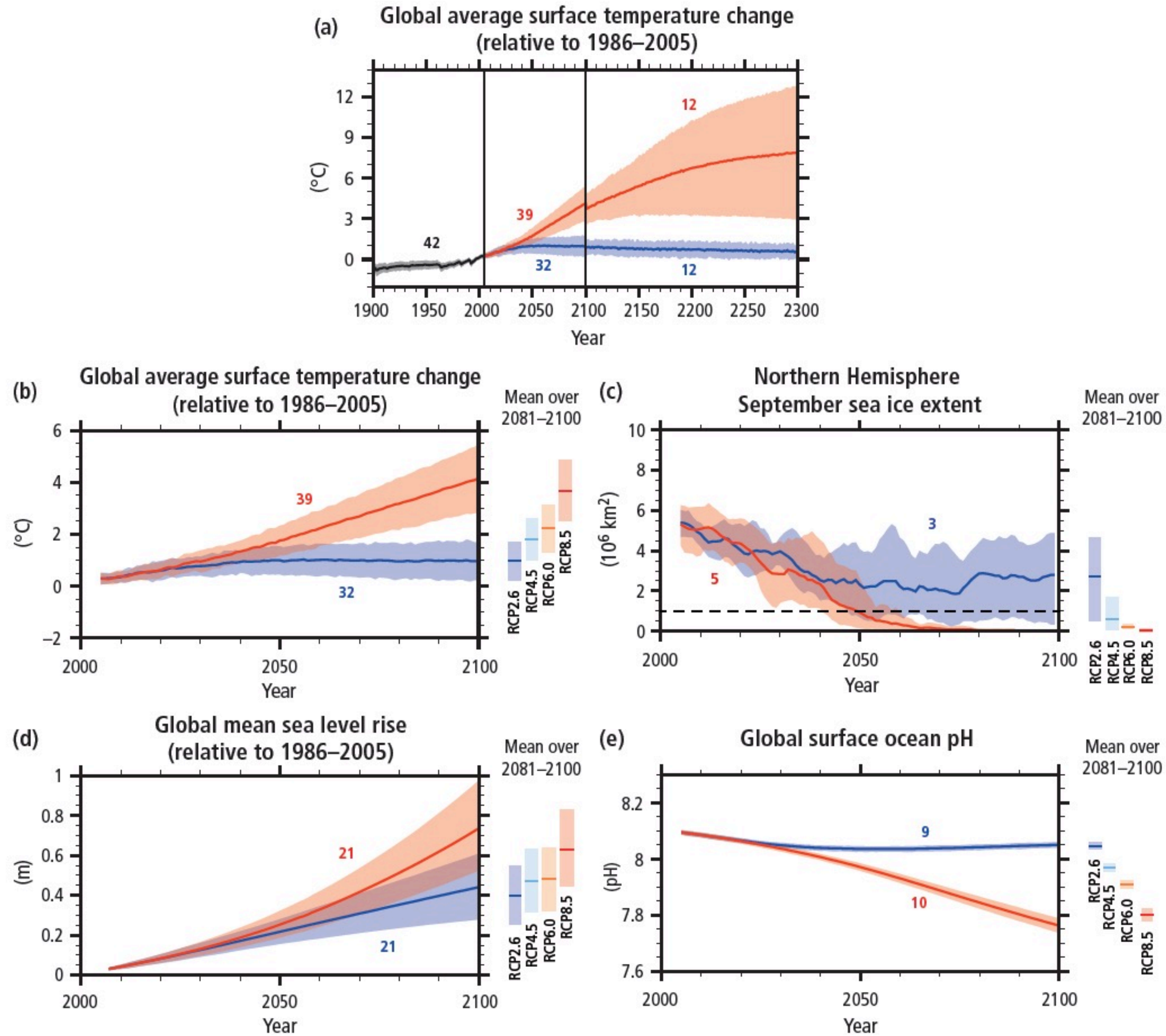

Figure 2.1 | **(a)** Time series of global annual change in mean surface temperature for the 1900–2300 period (relative to 1986–2005) from Coupled Model Intercomparison Project Phase 5 (CMIP5) concentration-driven experiments. Projections are shown for the multi-model mean (solid lines) and the 5 to 95% range across the distribution of individual models (shading). Grey lines and shading represent the CMIP5 historical simulations. Discontinuities at 2100 are due to different numbers of models performing the extension runs beyond the 21st century and have no physical meaning. **(b)** Same as (a) but for the 2006–2100 period (relative to 1986–2005). **(c)** Change in Northern Hemisphere September sea-ice extent (5 year running mean). The dashed line represents nearly ice-free conditions (i.e., when September sea-ice extent is less than 10^6 km^2 for at least five consecutive years). **(d)** Change in global mean sea level. **(e)** Change in ocean surface pH. For all panels, time series of projections and a measure of uncertainty (shading) are shown for scenarios RCP2.6 (blue) and RCP8.5 (red). The number of CMIP5 models used to calculate the multi-model mean is indicated. The mean and associated uncertainties averaged over the 2081–2100 period are given for all RCP scenarios as coloured vertical bars on the right hand side of panels (b) to (e). For sea-ice extent (c), the projected mean and uncertainty (minimum–maximum range) is only given for the subset of models that most closely reproduce the climatological mean state and the 1979–2012 trend in the Arctic sea ice. For sea level (d), based on current understanding (from observations, physical understanding and modelling), only the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the *likely* range during the 21st century. However, there is *medium confidence* that this additional contribution would not exceed several tenths of a meter of sea level rise during the 21st century. *{WGI Figure SPM.7, Figure SPM.9, Figure 12.5, 6.4.4, 12.4.1, 13.4.4, 13.5.1}*

Previsões frente aos ”Representative Concentration Pathways” Tendências de concentração representativa – 2.6 estratégia de mitigação agressiva – 8.5 “tudo como sempre”

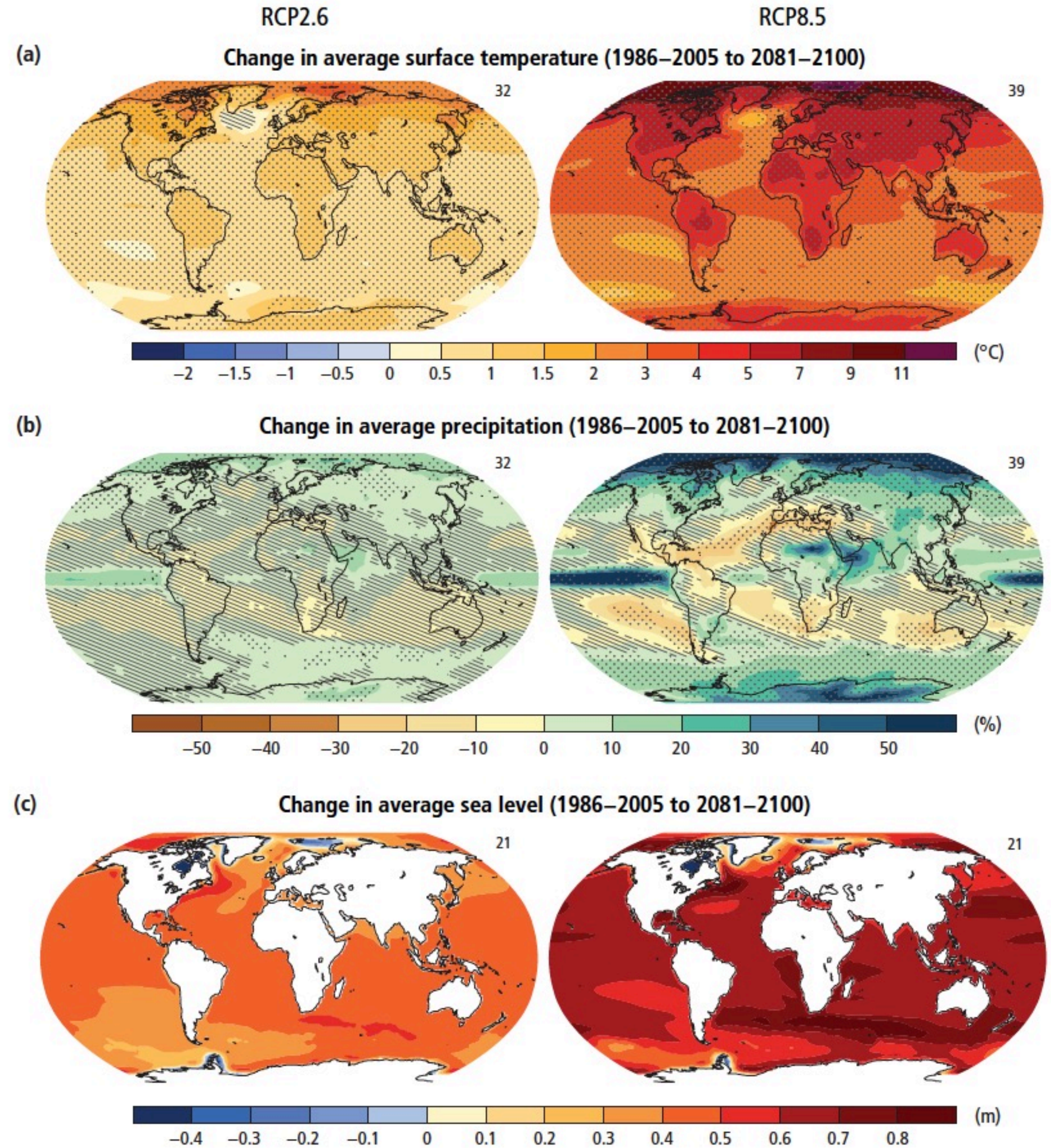

Figure 2.2 | Coupled Model Intercomparison Project Phase 5 (CMIP5) multi-model mean projections (i.e., the average of the model projections available) for the 2081–2100 period under the RCP2.6 (left) and RCP8.5 (right) scenarios for **(a)** change in annual mean surface temperature and **(b)** change in annual mean precipitation, in percentages, and **(c)** change in average sea level. Changes are shown relative to the 1986–2005 period. The number of CMIP5 models used to calculate the multi-model mean is indicated in the upper right corner of each panel. Stippling (dots) on (a) and (b) indicates regions where the projected change is large compared to natural internal variability (i.e., greater than two standard deviations of internal variability in 20-year means) and where 90% of the models agree on the sign of change. Hatching (diagonal lines) on (a) and (b) shows regions where the projected change is less than one standard deviation of natural internal variability in 20-year means. *{WGI Figure SPM.8, Figure 13.20, Box 12.1}*

Idealmente as projeções devem ser ajustadas regionalmente as escalas de interesse

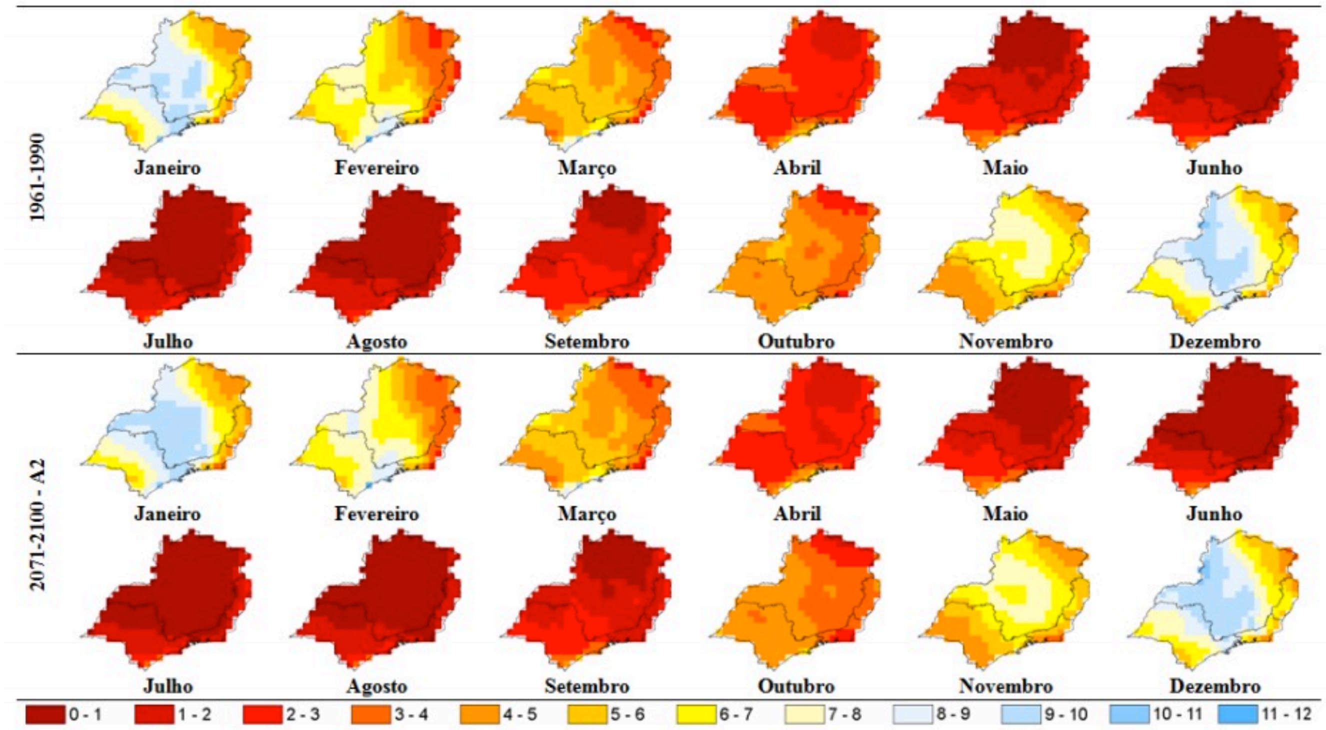

FIGURA 5. Precipitação média mensal (mm/mês) de janeiro a dezembro da normal climatológica de 1961-1990 e da média de 15 GCMs do período de 2071-2100, cenário A2 do IPCC-AR4, na região Sudeste do Brasil.

Modelagem das alterações ambientes costeiros com fins preditivos

- Mudança no nível do mar*
- Aumento em tempestades*
- Derretimento de falézias de permafrost
- Redução da cobertura de gelo
- Mudança precipitação – estabilidade de encostas
- Branqueamento coral
- Etc..

Passos para o desafio da previsão região Costeira

- Escolha do cenário apropriado
- Aplicação de modelos acoplados
- Avaliação das alterações de nível e clima de ondas
- Previsão dos forçantes costeiros e transporte de sedimentos

Diferentes tipos de modelos

- Conceitual
- Empírico
- Comportamento Orientado
- Processo Orientado
- Físico

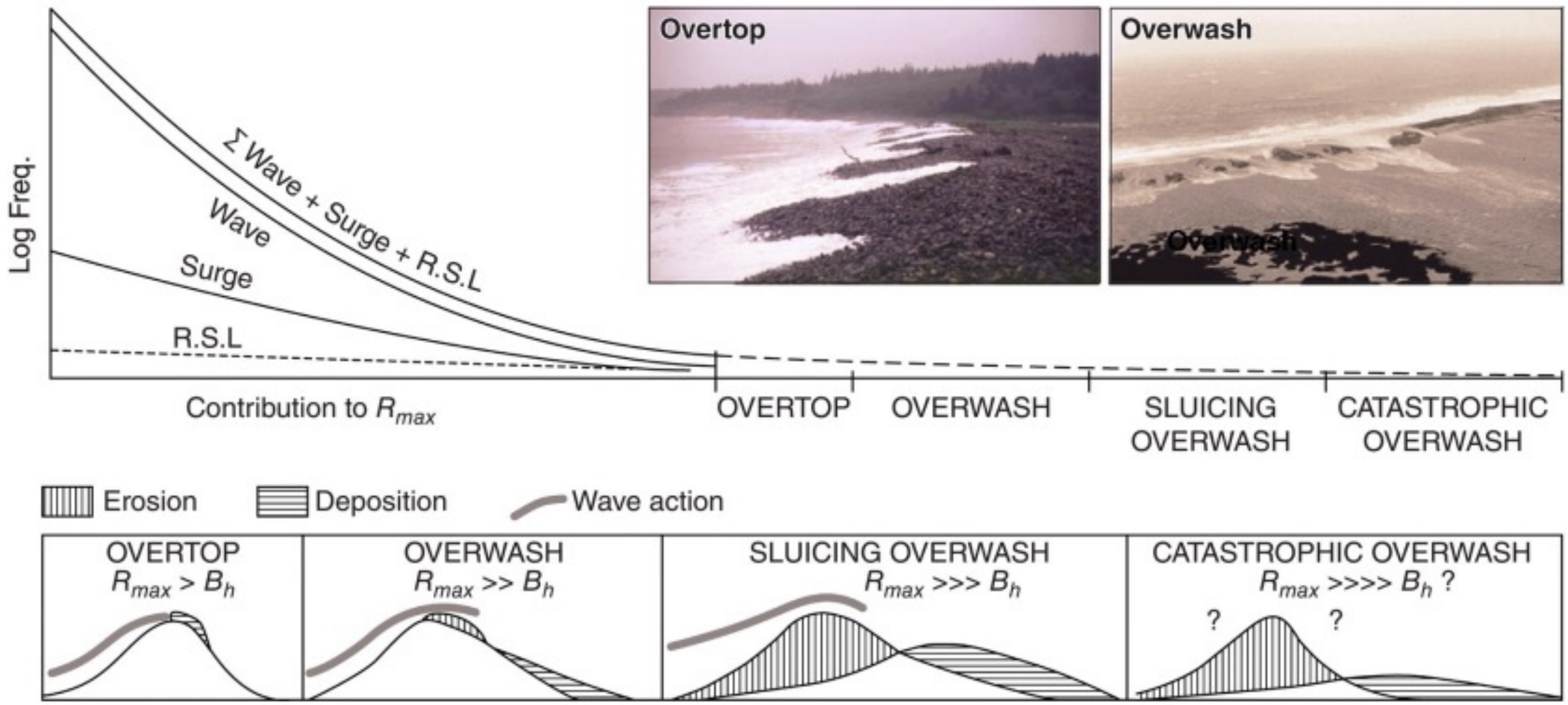

Fig. 1.16 Conceptual model showing the different stages of barrier response to increasing wave and water-level conditions. R_{max} and B_h refer to maximum run-up height and barrier height, respectively. For positive freeboard $R_{max} < B_h$, and for negative freeboard $R_{max} > B_h$. The

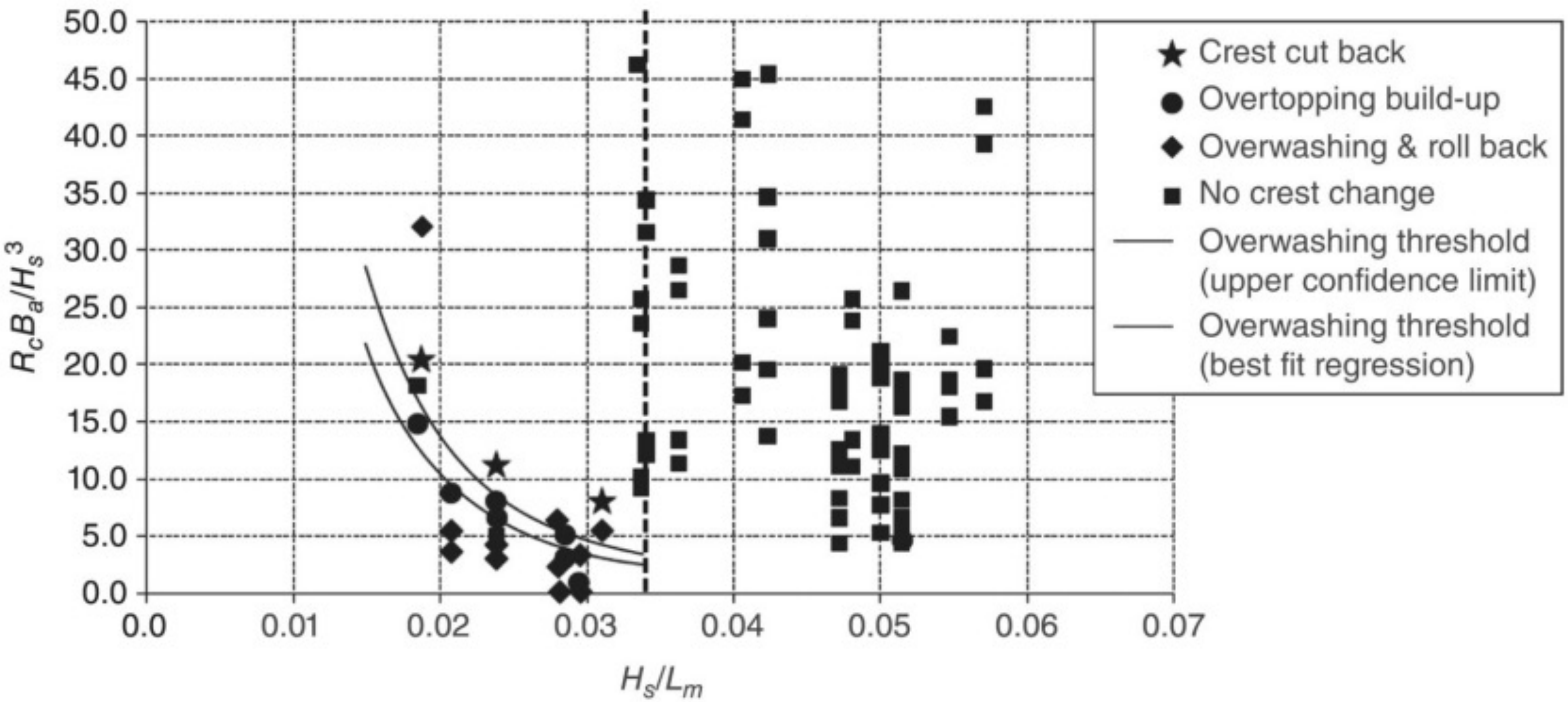

Fig. 1.17 Testing of the empirical model of Bradbury (1998) using Hurst Spit, UK. The model is based on barrier inertia parameter $R_cB_a/H_s{}^3$ and wave steepness H_s/L_m, where R_c is the barrier freeboard, B_a is the cross-sectional area of the barrier above still water level, H_s is the significant wave height, and L_m is the deep water wave steepness based on the mean wave period T_m ($L_m = gT_m{}^2/2\pi$, where g is gravity). The line represents the overwashing threshold, whereby conditions below the line predict barrier overwash.

(Source: Data from Bradbury et al. 2005.)

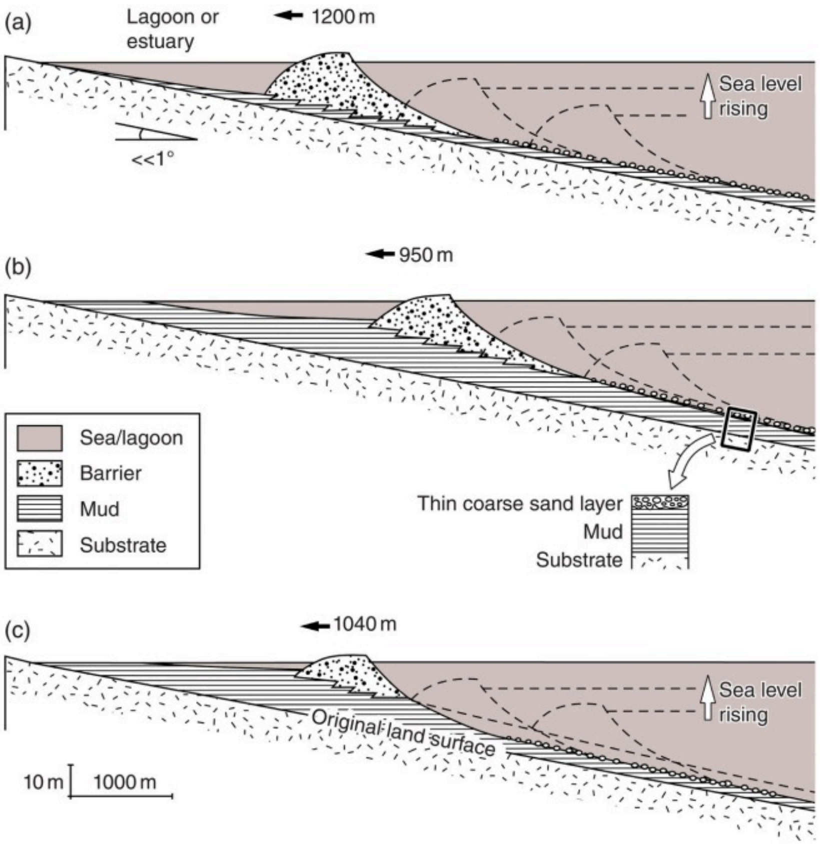

Fig. 1.18 Example of output of the Shoreline Translation Model (STM) of Cowell et al. (1995) showing the response of a barrier to sea-level rise. In Case (a), a small amount of mud deposition in the back barrier lagoon has little effect on barrier size or coastal behaviour, but with mud accumulating almost as fast as sea level is rising, as in Case (b), the barrier decreases in size and recession slows down. In Case (c), a deficit in the nearshore sediment budget, for example induced by a negative littoral drift differential, is superimposed on Case (b), resulting in a reduction in the size of the barrier and an increase in the recession rate. In addition to showing the different stages of barrier recession, the model also reproduces the stratigraphy, and in all cases lagoonal muds conformably blanket the substrate beneath and to the seaward of the barrier; after the barrier passes, wave reworking ensures that the bed is soon veneered by a coarse lag.

(Source: Roy et al. 1994. Reproduced with permission of Cambridge University Press.)

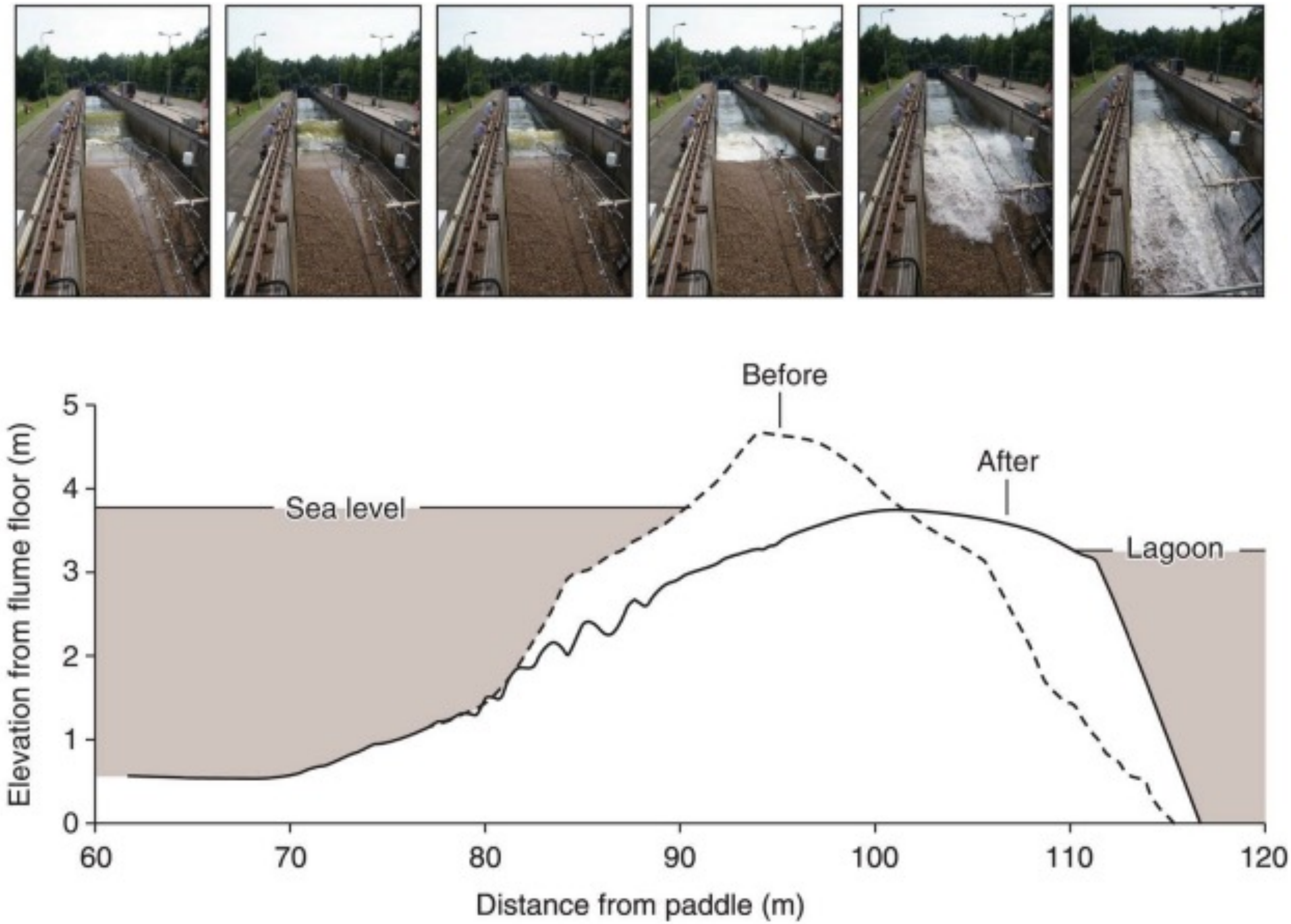

Fig. 1.21 Physical simulation of overwash on a gravel barrier constructed in the Delta Flume, The Netherlands, during the BARDEX experiment. (Source: Williams et al. 2012. Reproduced with permission of Elsevier.) The sequence of photos in the top panels represents the various stages of wave transformation of one of the overwashing waves. The bottom panel shows the morphological change after 2.5 hours of exposure to overwash, characterized by a lowering of the barrier crest by about 1 m and the development of an extensive washover deposit at the back of the barrier. The wave conditions during this test were characterized by a significant wave height of 0.8 m and a peak wave period of 8 s.

https://www.ted.com/talks/gavin_schmidt_the_emergent_patterns_of_climate_change#t-714154

Sumário (2 e 3)

- A região costeria de hoje é produto dos processoa atuais e da herança do passado. Com isso é ter uma perspectiva de evolução de longo prazo
- De acordo com o paradigma morfodinâmico, os sistemas costeiros compreende 3 elementos conectados: morfologia, processos e transporte de sedimentos. Esses elementos possuem um certo grau de autonomia mas respondem a fatores ambientais
- Sistema costerios tendem a mudança quando sujeitos a um feedback positivo e a estabilizar com um feedback negativo.
- Os sistemas podem se autoorganizar por propriedades emergentes
- Durante o século 20 o nível do mar subiu cerca de 20 cm e a tendência é um aumento de até 1 m nos próximos 80 anos
- Modelos podem prever as mudanças. No entando, são modelos que simplificam e devem ser vistos com cautela.