Carbonate & Biogenic Sediments Models

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Note: This list is incomplete in many important ways.
If you have more information to add please contact chris.jenkins@colorado.edu in the CSDMS.

Name	Reference	Release Year	Authors / Institution
Source: Miscellaneous References and Citations			
SEDPAK		2005-13; Sedpak 5.4 (final)	Department of Earth and Ocean Sciences, University of South Carolina
Cyclopath		2005	Shell International E&P
CarboCAT	Burgess, P.M., 2013. CarboCAT: A cellular automata model of heterogeneous carbonate strata, Computers & Geosciences, Volume 53, 129-140	2008	Shell International E&P
Boscher & Schlager Model	BOSCHER, H. & SCHLAGER, W. 1992. Computer simulation of reef growth. Sedimentology, 39, 503-512.	1992	Boscher & Schlager / Institute for Earth Sciences, Vrije Universiteit, The Netherlands
FUZZIM	Nordlund, U. 1990. FUZZIM: forward stratigraphic modeling made simple, Computers & Geosciences v. 25, p 449-456	1990	Nordlund / Department of Earth Sciences, Historical Geology and Paleontology, Uppsala University

SEDSIM	CSIRO, (2004), Promotional brochure on the use of Sedsim. Predictive Geoscience Group, CSIRO Petroleum, pp. 22 [Brochure]	2004	Griffiths / CSIRO, Australia
Dionisos	Bassant, P. & Harris, P.M. 2008. Analyzing Sequence Architecture and Reservoir Quality of Isolated Carbonate Platforms with Forward Stratigraphic Modeling. In: SEPM Special Publication Volume 89. DOI: 10.2110/pec.08.89.0343	2008	
carb3D+	Paeterson et al 2006; Paterson et al 2008; Granjeon and Joseph, 1999	2008	Smart and Whitaker ; Bristol Carbonates Consortium, UK
carboCELL and carboLOT			Jenkins, Burgess, Potts; INSTAAR/CU & etc
ReefHab	Kleypas JA (1997) Modeled estimates of global reef habitat and carbonate production since the last glacial maximum. Paleoceanography 12: 533–545.	1997	Kleypas / UCAR
ReefSAM	http://onlinelibrary.wiley.com/doi/10.1029/2006GC001415/full	2006	Webster Univ. Sydney; ##
Intermediate Complexity Marine Model	http://usjgofs.whoi.edu/mzweb/syn-mod.htm		US JGOFS
COMBO	https://sourceforge.net/projects/combocoralreef/		
Biogeochemical Elemental Cycling (BEC) model	http://www.cesm.ucar.edu/models/cesm1.1/pop2/doc/sci/ecosys_placeholder.html	2012	Keith Lindsay; NCAR

(Coral Competition Model)	Maguire, L.A. and Porter, J.W., 1977. A spatial model of growth and competition strategies in coral communities. Ecol. Modelling, 3: 249--271.	1977	Maguire, Oak Ridge National Laboratory; Porter, University of Michigan
Ecosim with Ecopath	http://www.ecopath.org/; Christensen and Pauly, 1992; Pauly et al., 2000	1992, 2000	Christensen NOAA; Pauly UBC

Source:

CSM Carbsim	Taizhong Duan,2000
REPRO	Hussner et al, 2001
SedTec 2000	Boylan et al, 2002
CARBONATE 3D	Warrlich et al, 2002
SIMSAFADIM	Bitzer and Salas, 2002
FUZZYREEF	Parcell, 2003
TAWIC+?	Quinquerez et al, 2004
CARBONATE GPM	Hill et al in prep
PHAST	Parkhurst et al, 2004
TOUGHREACT	Xu et al, 2004
GEOCHEMISTS WORKBENCH	Bethke, 2007
FACIES 3D	Matsuda et al, 2004
BASIN 2	Bethke et al, 2007

Source: http://pft.ees.hokudai.ac.jp/maremip/models/index.shtml

Model	Author
BEC	S. Doney & K. Lindsey

NOBM		Watson Gregg
AusCom		R. Matear
TOPAZ		J. Dunne
MEM-MRI.com	http://www.jamstec.go.jp/frcgc/eng/program/ecrp/group03.html; 2003; 2 versions: MEM-COCO; NPZD	H. Nakano FRCGC/JAMSTEC, JP
PISCES	"Pelagic Iteraction Scheme for Carbon and Ecosystem Studies"; 2004; http://www.lodyc.jussieu.fr/~aumont/OPA_model.html	L. Bopp; Laboratoire d'Océanographie DYnamique et de Climatologie (LODYC), FR

PlankTOM	Global Change Biology (2005) 11, 2016–2040, doi: 10.1111/j.1365-2486.2005.01004.x;	E. Buitenhuis & C. Le Quéré; University of East Anglia, UK
ERSEM		I. Allen
BFM-PELAGOS		M. Vichi
MEM-COCO		Y. Yamanaka & T. Hashioka

DARWIN	S. Dutkiewicz & M. Follows
REcoM2	Judith Hauck & Christoph Völker

Materials	Chemistry	Physics / Oceanography	Biology	Spatial Scale
All sediment types	-	Water Depth	None	Basin / platform
Carbonates	-		None	Platform
Carbonates	-	Simple sediment transport; depth-dependent sediment production; subsidence; eustatic oscillations	None	Platform interiors
Coral Reefs	-	Depth, Light (Beer-Lambert Law) & Temperature	Hermatypic corals	Reef
All sediment types	-	Depth		Basin / platform

All sediment types	-		Biofacies	
All sediment types; E&P oriented		Diffusional transport	-	Platform
		waves (shoaling) and currents; diagenetic processes		Platform
Carbonate environments	-	World Ocean Atlas; MODIS irradiances	Carbonate skeletal	local representations of broad facies; sealevel changes
Coral Reefs	Nutrient and Dissolution	Temperature, Light	Hermatypc Corals	85km2 cellsize; global oceans
Plankton	Ocea nutrient & saturation	Ocean Circulation inputs	Plankton	Global; 0.25 dg

Hermatypic corals	No	No	Hermatypic corals	Metres
Living actors	Nutrients		Trophic webs; predator-prey; mortalities	An ecosystem
		Sedimentology		Basin / platform
		Sedimentology		
		Sedimentology		
		Sedimentology		
		Sedimentology	Biofacies compete	
		Sedimentology		
		Sedimentology		
		Sedimentology		
		Diagenesis		
		Diagenesis		
		Diagenesis		
PFTs	**Main focus**	**<<**	**<<**	**<<**
plankton: pico/nano,; diatoms; diazotrophs; adaptive zooplankton	Primary production, carbon cycle, other biogeochemical			

plankton: diatoms; chlorophytes; cyanobacteria; coccolithophores; zooplankton			Phytoplankton phenology, primary production, carbon cycle	
plankton: silicifiers; calcifiers; N2-fixers; microzoo; mesozoo	Interactions between the high-resolution ocean physics and biogeochemistry			
plankton: small phytoplankton; large phyto; protists; filter feeders			Phytoplankton physiology, such as development of optimal allocation theory & N:P cellular quotas.	
	Interactions between the high-resolution ocean physics and biogeochemistry			1 x 1 degrees
plankton: diatoms; nanophyto; microzoo; mesozoo		Currently interfaced with the OPA model, an Ocean General Circulation Model also developed atLODYC. beta-version of PISCES coupled to the regional ocean model ROMS	Primary production, carbon cycle, other biogeochemical cycles.	

plankton: silicifiers; calcifiers; Phaeocystis; nanophyto; pico-autotrophs; N2-fixers; pico-heterotrophs; protozoo; mesozoo; macrozoo	Carbon cycle, other biogeochemical cycles. 22-39 prognostic variables describing the C, O, N, Si, P and Fe cycles and phytoplankton chlorophyll.	Embedded in the NEMO general circulation model (GCM); Stokes' law particle settling. The vertical eddy diffusivity and viscosity coefficients are calculated using a 1.5 order turbulent closure scheme which explicitly calculates mixed layer depth and produces a minimum of diffusion in the thermocline.	Ecosystem-climate interactions, particularly those involving zooplankton. microzooplankton physiology and biomass; iron-light colimitation photosynthesis model
diatoms; dinoflagellates; flagellates; picophyto; bacteria; heterotrophs; microzoo; mesozoo	Biogeochemical interactions in the coastal ocean (upcoming global version).		Phytoplankton physiology (quota model). Interactions with fish. Complex interactions with sediment and microbial processes.
plankton: diatoms; flagellates; picophyto; large phyto; bacteria; heterotrophic nanofl; heterotrophs; microzoo; carnivores; omnivores			
plankton: diatoms; small phyto; small zoo; copepods; euphausids; fish	Carbon cycle, biological pump.		Ecosystem interactions with coral reefs and fisheries.

plankton: 78 phytoplankton; zooplankton		
plankton: diatoms; small phyto; zooplankton	Primary production, biogeochemical cycles, CO2 uptake, dynamic stoichiometry, Si-cycle	Southern Ocean.

Stratigraphy	Method/s	Time Scale	Code Availability	Code Type
Litho- and chronostratigraphy	spatial/temporal accumulation	10^7 yr	http://sedpak.geol.sc.edu/	Executable: Redhat Linux Version 8.0 or 9.0 (Not a Windows or Mac application)
2D/3D model of cyclicity	spatial/temporal mosaic of production & transport	10^6 yr	https://github.com/csdms-contrib/cyclopath	C
horizontal and vertical distributions of carbonate lithofacies	cellular automaton	10^6 yr	https://github.com/csdms-contrib/cyclopath	Matlab
	Fuzzy Set Theory			

3D lithofacies	Fuzzy Set Theory (in part)		Commercial	
Spatial 3D; Processes 1-2D			Commercial	
Spatial 3D; Processes 1-2D?			Commercial	
1D on 3D terrain, etc	carboCELL - cellular automaton; carboLOT - calculus population ecology; ground conditions	months to 10,000 yrs	On request	Python 2.7
No	Box Model	Present	No	
				Matlab
No	Intermediate Complexity	Present	NCAR	

No	Cellular model; spatial simulation	Present	Unpublished	-
No		Present	NOAA; http://www.ecopath.org/	Windows Executable (based on Java)
	Facies templates by environment			
<<	<<	<<		
		Climate-biogeochemical feedbacks.		

Use of parameter optimisations and size-based parameters.		
	30yr +	
Adjoint version and high resolution physics.	Climate-biogeochemical feedbacks.	

Acclimation.
Climate-
biogeochemic
al feedbacks.

climate-
biogeochemic
al feedbacks.

Climate-
biogeochemic
al feedbacks.

Flexible community structure and emergent properties.	Ecosystem - climate interactions.

Other Refs

Bassant and Harris, 2008; Williams, 2010, unpubl. PhD thesis

Guan Y, Hohn S, Merico A (2015) Suitable Environmental Ranges for Potential Coral Reef Habitats in the Tropical Ocean. PLoS ONE 10(6): e0128831.

http://usjgofs.whoi.edu/mzweb/smpstatus.html

Moore, J. K., S. Doney, J. Kleypas, D. Glover, and I. Fung, An intermediate complexity marine ecosystem model for the global domain, Deep-Sea Res. II, 49, 403--462, 2002

Arias-González, J.E., Nuñez-Lara. E., González-Salas, C. & Galzin, R., 2004. Trophic models for investigation of fishing effect on coral reef ecosystems. Ecological Modelling 172,197–212.

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http://lgmacweb.env.uea.ac.uk/green_ocean/model/model.shtml?r1