

**Integrating Ecosystems in Coastal Engineering**

**Practice (INECEP)**

Summer School on

September 18 –29, 2017 Puerto Morelos, Mexico



**GENERAL**

**PROGRAMME**

Funded by



# CONTENT

## INTRODUCTORY SESSION

* 1. TOPIC 1: Coastal systems, Beach dynamics, Coastal risk, Coastal management

1. 1.1. Integrating ecosystems in coastal engineering: Where are we now, and where to go next?
2. 1.2. Coastal eco-engineering in Latin America: Problems, challenges and perspectives
3. 1.3. Monitoring ecosystem changes in nature-based solutions: Sentinel indicators, strategies and techniques
4. 1.4. Groundwater ecosystem services & functions and impacts on coastal ecosystems: Processes, scales and challenges
5. 1.5. Conventional methods for coastal protection against flood & erosion: Problems and challenges

## PART 1: Theoretical background, concepts and structuring framework

* 1. TOPIC 2: Ecosystems: Ecological functioning and coastal protection efficiency

1. 2.1. Environmental gradients on the coast (salinity, flooding, sediments, ecosystems)
2. 2.2. Beaches and coastal dunes (abiotic and biotic characteristics, functioning, regional variation, ecosystem, services)
3. 2.3. Mangroves (abiotic and biotic characteristics, functioning, regional variation, ecosystem, services)
4. 2.4. Wetlands (abiotic and biotic characteristics, functioning, regional variation, ecosystem, services)
5. 2.5. Coral reefs
   1. TOPIC 3: Modelling framework “Ecopath with Ecosim and Ecospace” (EwE-E)
6. 3.1. Introduction to EwE-E
7. 3.2. Overview, capabilities, limitations and best practice of EwE-E modelling framework
8. 3.3. Ecospace: Potential applications for environmental impact assessment and coastal protection
   1. TOPIC 4: Ecosystem services with a focus on coastal protection
9. 4.1. Overview of services/benefits of ecosystems for coastal protection:
10. 4.2. Concepts methods/models for quantifying/ valuing ecosystem services
11. 4.3. Efficiency of coastal protection ecosystems against waves, floods and erosion:
12. 4.4. Ecological modelling: Introduction and overview

## FIELD WORK

* 1. TOPIC 5: Field work: Coral reefs/Wetlands/Beach/Dunes

1. 5.1. Preparatory course for field work
2. 5.2. Monitoring and visits to selected sites
3. 5.3. Field data processing and analysis

## PART 2: Ecosystem-based coastal protection: Modelling/implementation/monitoring/management

* 1. TOPIC 6: Management and legal issues

1. 6.1. The ecosystem base for Coastal Management
2. 6.2. From a sectorial to an ecosystem-based approach
3. 6.3. Proposed steps toward Ecosystem-Based Management
4. 6.4. Matrix of Ecosystems and Services and its multiple applications
5. 6.5. Environmental Port Management as an example of EBM implementation
6. 6.6. Methodological approaches on natural coastal systems for eco-engineering based management
7. 6.7. Elements for decision making
   1. TOPIC 7: Coastal protection with nature-based and hybrid solutions
8. 7.1. Ecological impact of traditional hard/engineering solution
9. 7.2. Basic principles on the functioning of estuarine and coastal ecosystems
10. 7.3. Introduction to ecosystem-engineers & implications.
11. 7.4. Understanding biophysical interactions, and resulting ecosystem services: coastal defence & shoreline stabilization
12. 7.5. How to integrate coastal ecosystems in coastal protection schemes? Soft & hybrid solutions
    1. TOPIC 8: Ecosystem approach, integrated framework, tools and monitoring
13. 8.1. Ecosystem approach to coastal protection and management
14. 8.2. Integrative frameworks and tools for ecosystem approaches
    1. TOPIC 9: Other ecosystem functions
15. 9.1. Groundwater – Surface water relationship regulating environmental characteristics in coastal areas
16. 9.2. Seagrass

## PART 3: CASES STUDIES/LESSONS LEARNED AND CLOSURE

* 1. Cases studies by lecturers
  2. Closing lecture and discussion

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| **SCHEDULE** | |
| Day 1 – September 18 | |
| ALL DAY | Arrival of participants with “Ice Breaker” in the late afternoon |
| **INTRODUCTORY SESSION** | |
| Day 2 – September 19 | |
| 09:00 – 10:00 | 1. Welcome by Rodolfo Silva 2. Introduction of participants 3. “Rationale behind INECEP Summer School” by Hocine Oumeraci |
| **TOPIC 1** | **Coastal systems, Beach dynamics, Coastal risk, Coastal management** |
| Hocine Oumeraci (TU Braunschweig) | |
| 10:00 – 11:30 | 1. Integrating ecosystems in coastal engineering: Where are we now, and where to go next? |
| Rodolfo Silva (II-UNAM) | |
| 11:30 – 13:00 | 1. Coastal eco-engineering in Latin America: Problems, challenges and perspectives |
| 13:00 – 14:00 | LUNCH |
| Pedro Pereira (UFPE) | |
| 14:00 – 15:00 | 1. Monitoring ecosystem changes in nature-based solutions: Sentinel indicators, strategies and techniques |
| Malva Mancuso (UFSM/FW) | |
| 15:00 – 16:00 | 1. Groundwater ecosystem services & functions and impacts on coastal ecosystems: Processes, scales and challenges |
| 16:00 – 16:30 | COFFEE BREAK |
| Edgar Mendoza (II-UNAM) | |
| 16:30 – 17:30 | 1. Conventional methods for coastal protection against flood & erosion: Problems and challenges |
| 17:30 – 18:00 | Discussions and feedback from participants |
| **PART 1: Theoretical background, concepts and structuring framework** | |
| Day 3 – September 20 | |
| **TOPIC 2** | **Ecosystems: Ecological functioning and coastal protection efficiency** |
| Patricia Moreno (INECOL), Marisa Martínez (INECOL) | |
| 09:00 – 10:00 | 1. Environmental gradients on the coast (salinity, flooding, sediments, ecosystems) |
| 10:00 – 12:00 | 1. Beaches and coastal dunes (abiotic and biotic characteristics, functioning, regional variation, ecosystem, services) |
| 12:00 – 13:00 | 1. Wetlands (abiotic and biotic characteristics, functioning, regional variation, ecosystem, services) |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 16:00 | 1. Mangroves (abiotic and biotic characteristics, functioning, regional variation, ecosystem services) |
| Ismael Mariño (CINVESTAV) | |
| 16:00 – 18:00 | 1. Coral reefs    * General overview of wave-generated dynamics at tropical coastlines and effects on coastal sediment dynamics.    * The concept of roughness and the approaches to approximate it. How can we measure this in the field?    * Estimations of roughness of natural reefs, and its effects on waves and currents.    * The coastal protection service provided by coral reefs and future tendencies |
| 18:00 – 19:00 | **Presentations of case studies by attendees: Session A**   1. Karoline Angélica Martins (Federal University of Pernambuco)   The role of coral reefs in coastal protection: case of Pontal do Cupe beach, Brazil   1. Johann Khamil Delgado Gallego (National University of Colombia)   Wave energy dissipation on the Caribbean insular coral reefs of Colombia   1. Oriana Daza Brito (Fundación Universidad del Norte)   Modelling morphodynamic variability on in artificial beaches   1. Laíssa Baltazar (Federal University of Rio de Janeiro)   Multi-channel estuarine system at the Amazon and Pará Rivers |
| Day 4 – September 21 | |
| **TOPIC 3** | **Modelling framework “Ecopath with Ecosim and Ecospace” (EwE-E)** |
| Sheila Heymans (Scottish Marine Institute) | |
| 09:00 – 13:00 | 1. Introduction to EwE-E    * Using EwE models and procedure on applying Ecopath, Ecosim and Ecospace in combination    * Limitations of EwE-E modelling and challenges for applications to EBM 2. Overview, capabilities, limitations and best practice of EwE-E modelling framework    * Ecopath: Theoretical background, software, capabilities, limitations and implementation steps, best practice for creating, balancing and using EwE models    * Ecosim: Theoretical background, implementation steps, capabilities and model fitting |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 16:30 | * + Ecosim (Continued): Best practices for fitting and using an Ecosim model, uncertainty testing using Monte Carlo routines  1. Ecospace: Potential applications for environmental impact assessment and coastal protection    * Ecospace: theoretical background, capabilities, data needed. Case studies for environmental impact assessment of marine/coastal infrastructures |
| 16:30 – 18:00 | * + Capabilities and limitations for applications to assess the ecological impact of coastal protection   + Challenges for research and software developments   + Overview of related research programmes and ongoing/future projects in UK |
| 18:00 – 19:00 | **Presentations of case studies by attendees: Session B**   1. Ana Patricia Ruiz Beltran (UNAM)   Impact and recovery assessment of the mangroves affected by Hurricane Patricia   1. Mireille del Carmen Escudero Castillo (UNAM)   Protection services of the ecosystems of Sian Ka’an at south of Tulum, Mexico   1. Yandy Rodríguez (UNAM)   Changes in coastal ecosystems’ role against hurricane and storm surge at Ana María Gulf, Cuba |
| 19:00 – 19:30 | FIELD WORK 5.1. Preparatory course for field work |
| Day 5 – September 22 | |
| **TOPIC 4** | **Ecosystem services with a focus on coastal protection** |
| Katie Arkema (Stanford University) | |
| 09:00 – 13:00 | 1. Overview of services/benefits of ecosystems for coastal protection:    * Types of ecosystems to reduce wave action and coastal erosion    * Resilience/adaptive capacity of selected coastal ecosystems    * Limitations for extreme events & necessity of hybrid solutions    * Case studies from U.S. Gulf of Mexico and Belize 2. Concepts methods/models for quantifying/ valuing ecosystem services    * Marine EBM concept and framework    * Methods/concepts/practice for ecosystem quantification/valuation in the US    * Overview of research programmes in the US 3. Efficiency of coastal protection ecosystems against waves, floods and erosion:    * Role of modelling for quantifying coastal protection of ecosystems    * Importance of locations/index-based models for identification of suitable areas/case studies |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 16:30 | * + Overview of capabilities/limitations of existing models/future needs  1. Ecological modelling: Introduction and overview    * Types of available ecological models-A brief overview    * Introduction to InVEST model suite: modules/ structure/capabilities/limitations |
| 16:30 – 18:00 | * + Example applications/case studies using InVEST, e.g. from NatCap |
| 18:00 – 19:00 | **Presentations of case studies by attendees: Session C**   1. César Acevedo Ramirez (CINVESTAV)   Wavelet as roughness indicator for bathymetric profiles   1. Alejandro Astorga Moar (II-UNAM)   Coastal dynamics under coral reef scenarios   1. Cesia Jaqueline Cruz Ramírez (UNAM)   Numerical modeling of artificial reefs in Chuburna, Yucatan   1. Juan David Osorio-Cano (Universidad nacional de Colombia at Medellín)   Coastal ecosystem services provided by coral reefs at Tesoro Island, Colombia |
| 19:00 – 19:30 | FIELD WORK 5.1. Preparatory course for field work (Continued) |
| **FIELD WORK** | |
| Day 6 – September 23 | |
| **TOPIC 5** | **Field work: Coral reefs/Wetlands/Beach/Dunes** |
| 09:00 – 18:00 | 5.2. Monitoring and visits to selected sites |
| Day 7 – September 24 | |
| SUNDAY | Tentatively free |
| **PART 2: Ecosystem-based coastal protection: Modelling/implementation/monitoring/management** | |
| Day 8 – September 25 | |
| **TOPIC 6** | **Management and legal issues** |
| Milton Asmus (FURG) | |
| 09:00 – 13:00 | 1. The ecosystem base for Coastal Management 2. From a sectorial to an ecosystem-based approach 3. Proposed steps toward Ecosystem-Based Management 4. Matrix of Ecosystems and Services and its multiple applications 5. Environmental Port Management as an example of EBM implementation |
| 13:00 – 14:00 | LUNCH |
| Andrés Osorio (UNAL) | |
| 14:00 – 16:30 | 1. Methodological approaches on natural coastal systems for eco-engineering based management    * From wind waves (full spectrum behaviour) to nearshore hydrodynamics around natural ecosystems (coral reefs and mangroves)    * From small scales (species) to large scales (nearshore ecosystem):    * knowledge and limitations    * Combination from laboratory experiments and field works    * Roughness effect on coastal management objectives (manage flooding and erosion) (ICZM strategy)    * Numerical engineering models and how to use them for decision making (ICZM strategy) |

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| Edgar Mendoza | |
| 16:30 – 18:00 | 1. Elements for decision making |
| 18:00 – 19:00 | **Presentations of case studies by attendees: Session D**   1. Angel Kuc Castilla (UNAM)   Design of strategies for the control of beach erosion with an ecosystem-based management approach   1. Nadia Selene Zamboni (Federal University of Rio Grande do Norte)   Economic value estimation of mangrove areas: a study case in northeast of Brazil   1. Débora Libertad Ramírez Vargas (UNAM)   Elements that induce a coastal squeeze on the coasts of Sabancuy, Campeche, Mexico |
| 19:00 – 19:30 | FIELD WORK 5.3. Field data processing and analysis |
| Day 9 – September 26 | |
| **TOPIC 7** | **Coastal protection with nature-based and hybrid solutions** |
| Edgar Mendoza | |
| 09:00 – 10:30 | 1. Ecological impact of traditional hard/engineering solutions    * Ecological impact of hard structures and possible improvements    * Ecological impact of beach/dune nourishment & improvements    * Coastal squeeze and ecosystem remediation |
| Tjeerd J. Bouma (Groningen University) | |
| 10:30 – 13:00 | 1. Basic principles on the functioning of estuarine and coastal ecosystems    * Relevant ecosystems & organisms    * Spatial organization    * Changing ecosystem structure and functioning due to climate change & human impacts 2. Introduction to ecosystem-engineers & implications.    * General concept of habitat modification by ecosystem engineers    * Examples of ecosystem engineering    * Implication of ecosystem engineers for system dynamics |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 16:30 | 1. Understanding biophysical interactions, and resulting ecosystem services: coastal defence & shoreline stabilization    * Efficiency & reliability of nature-based coastal defence    * Long-term sustainability of nature-based coastal defence    * Uncertainty due to human impacts and climate change |
| 16:30 – 18:00 | 1. How to integrate coastal ecosystems in coastal protection schemes? Soft & hybrid solutions    * Knowledge and techniques regarding    * Ecosystem management    * Governance issues |
| 18:00 – 19:00 | **Presentations of case studies by attendees: Session E**   1. Talia Schoonees (Leibniz University Hannover)   Ecosystem-based adaptations for stepped revetments: an application to Strand, South Africa   1. Babette Scheres (RWTH Aachen University)   Enhancing the ecological value of dikes at the German coast   1. Angélica Felix Delgado (UNAM)   Natural/hybrid solutions for beach erosion of Holbox at Yucatan peninsula   1. Francisco Fabián Criado Sudau (Universidade Federal de Rio de Janeiro)   Rip currents in an intermediate beach with a natural submerged rocky ban |
| 19:00 – 19:30 | FIELD WORK 5.3 Field data processing and analysis (Continued) |
| Day 10 – September 27 | |
| **TOPIC 8** | **Ecosystem approach, integrated framework, tools and monitoring** |
| Angel Borja (AZTI) | |
| 09:00 – 12:30 | 1. Ecosystem approach to coastal protection and management    * Grand challenges in marine ecosystems ecology. 2. Integrative frameworks and tools for ecosystem approaches.    * Necessity of tools to monitor and assess status of marine waters/ecosystem components    * DPSIR/nested SPR: Strengths/limitations/ refinements as structuring framework for ecosystem-based coastal protection. Incl. *example applications/lessons learned*    * Development of indices, concept of reference conditions, & overview of different assessment methods: The Ecosystem Approach- Theory and Practice |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 16:00 | * + Introduction to the “Catalogue of Marine Biodiversity Indicators” developed in DEVOTES project   + Using assessment tools for single ecosystem components: Ecological indices based on macro-benthos- the case of AMBI and M-AMBI in assessing seafloor integrity status (possibly also for intertidal zone), including practical exercises for using AMBI and M-AMBI software. |
| 16:00 – 18:00 | * + Using assessment tools for integrative assessment of multiple components: Introduction to *NEAT ‘*Nested Environmental status Assessment Tool’, including example applications and best practice using NEAT software and lessons drawn from case studies performed in DEVOTES Project and other applications (EIA, etc.). |
| Milton Asmus | |
| 18:00 – 19:00 | * + Integrated monitoring: methods and techniques: A proposed model to evaluate environment risk as the “risk to lose ecosystem services” |
| 19:00 – 20:00 | **Presentations of case studies by attendees: Session F**   1. Aalaa Amr (Mansoura University)   Impact of pollution on the plankton community in coastal waters Hurghada Red Sea, Egypt   1. Gabriela Buraschi (Federal University of Rio de Janeiro)   Challenges and strategies to model marine litter in the Guanabara Bay   1. Manuela König (TU Braunschweig)   Desalination plants - the environmental impact on coral reefs in the northern Red Sea |
| Day 11 – September 28 | |
| **TOPIC 9** | **Other ecosystem functions** |
| Eleonora Carol (CONICET-UNLP) | |
| 09:00 – 11:00 | 1. Groundwater – Surface water relationship regulating environmental characteristics in coastal areas    * Groundwater and surface water (tidal flow) hydrodynamics in coastal environments (marshes, coastal lagoons, coastal levees, etc.). Factors regulating these processes such as geomorphological, lithological, biological, etc.    * Geochemical processes in coastal environments determined by groundwater- surface water interaction.    * Environmental characteristics related to the exchange between groundwater and tidal flows. Modifications of hydrological functioning by engineering works. |
| Brigit van Tussenbroek (ICMYL-UNAM) | |
| 11:00-13:00 | 1. Seagrass    * The role of seagrass meadows in the regulation of coastal dynamics    * Case-studies on (Mexican) Caribbean coasts |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 15:00 | **Presentations of case studies by attendees: Session G**   1. Saber Elsayed (TU Braunschweig)   Modelling and management of storm-driven saltwater intrusion in freshwater aquifers: The case of near Bremerhaven, Germany   1. Jéssica Formentini (Federal University of Santa Maria)   Numerical modeling applied to the industrial use of groundwater in coastal aquifer   1. Arlett Rosado Torres (CINVESTAV)   Submarine groundwater discharges and their influence on benthic cover and reef roughness at Puerto Morelos reef lagoon   1. Iris Neri-Flores (Universidad Veracruzana)   Groundwater fluctuations and its interactions with rivers and wetlands in coastal zones |
| 15:00 – 16:00 | **Presentations of case studies by attendees: Session H**   1. Diana Berriel (CINVESTAV)   Oceanographic conditions linked to the arrival and departture of *sargassum sp*. on a fringing reef lagoon in Puerto Morelos, Quintana Roo   1. Sanaz Hadadpour (TU Braunschweig)   Numerical modelling of wave attenuation performance of coastal vegetation   1. Weiwei Zhou (Beijing Normal University)   Physiological and biochemical responses of saltmarsh plant spartina alterniflora to long-term wave exposure   1. Alejandro Cáceres Euse (Universidad Nacional de Colombia)   Development of the Kelvin-Helmholtz instability to the passage of an oscilatory flow on a seagrass canopy |
| 16:00 – 17:00 | **Presentations of case studies by attendees: Session I**   1. Silke Andrea Judith Tas (TU Delft)   Biomanco: Bio-morphodynamic modelling of mangrove-mud coasts (large scale)   1. Alejandra Gijón Mancheño (TU Delft)   Biomanco: bio-morphodynamic modelling of mangrove-mud coasts (small scale)   1. David Sanchez (Universidad Nacional de Colombia, Sede Caribe)   Coastal erosion control in fringe mangroves affected by logging in the Colombian Caribbean   1. Valeria Chávez Cerón (UNAM)   Performance of mangroves as coastal protection elements in La Mancha, Mexico |
| 17:00 – 18:00 | **Presentations of case studies by attendees: Session J**   1. Marianella Bolívar Carbonell (Fundación Universidad del Norte, Colombia)   Erosion of Puerto Colombia coast by maritime activities   1. Román Canul Turriza (UNAM)   Development of a methodology for the control of erosion and decrease of coastal vulnerability: a focus on large scale   1. Johnny Ferreira (Centro Universitário Tabosa de Almeida, Brazil)   Shoreline erosion in the Boa Viagem Beach, Northeast Brazil   1. Luis Fernando López Arias (University of Costa Rica)   Moin beach and his morphological change due to Moin Container Terminal project |
| **PART 3: CASES STUDIES/LESSONS LEARNED AND CLOSURE** | |
| Day 12 – September 29 | |
| **Cases studies by lecturers** | |
| 09:00 – 10:00 | 1. Milton Asmus   Cases on intending to produce the ecosystem base for EBM in Southern Brazil coastal areas |
| 10:00 – 11:00 | 1. Andrés Osorio   Wave energy dissipation on natural ecosystems: several cases studies from small (laboratory) to large scales (field) |
| 11:00 – 12:00 | 1. Eleonora Carol   Salinization of marshes in Argentina: natural vs anthropic factors |
| 12:00 –13:00 | 1. Ismael Mariño   Wave energy dissipation on natural coral reef systems of varying roughness |
| 13:00 – 14:00 | LUNCH |
| 14:00 – 14:50 | 1. Pedro Pereira   The erosion case of Carne de Vaca beach. |
| 14:50 – 15:40 | 1. Edgar Mendoza   Developing ecosystem based alternatives for wetland protection. Carmen-Pajonal-Machona wetland, Tabasco, Mexico |
| 15:40 – 16:30 | 1. Marisa Martínez   Long-term beach and coastal dune dynamics in response to natural and human-made factors |
| **Closing lecture and discussions** | |
| Hocine Oumeraci and Rodolfo Silva | |
| 16:30 – 18:00 | 1. Summary and conclusions of the course, including final discussions 2. Evaluation of the course and suggestions for future collaboration |
| 20:00 – 23:00 | Farewell dinner and attendance certificates |
| Day 13 – September 30 | |
| SATURDAY | Departure |