



SCRIPPS INSTITUTION OF
OCEANOGRAPHY

UC San Diego

SOCIAL SCIENCES
Anthropology

Course Title: Coastal geomorphology and GIS applications
(ANAR115)

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Building and Classroom: ERC Administration South – 117

Class door codes: Door erc-117 **0747776**; Door mcgill-2148 **0747776**

Class hours: 5:00 – 7:50 pm

Office Hours: Scheduled appointment upon request

Course Description: Coastal zones are located at the interface of three natural systems: the atmosphere, ocean, and terrestrial landscape. Processes operating in all three systems are responsible for the constant change of the coastal zone, and the interaction between these processes makes the coastal zone extremely dynamic. The coastal zone is also an area of material transfer. This process includes conveyance from the land surface to the ocean system and vice versa through various transport mechanisms, including rivers, glaciers, wind, waves, and runoff. The coast's attractiveness, a cause for the dense populations of many of the world's shorelines, is now a well-entrenched part of today's socio-cultural framework. This zone's appeal also implies major problems along many of the world's shores due to the destabilization of ecosystems and anthropogenic influences on the physical processes resulting in yet another modern-day forcing factor in charge of the evolution of this relatively confined environment. The ever-closer relationship between society and the coastal zone urges a better understanding of how shores function. This course aims to develop a general understanding of the morphological features identified in coastal systems and the short-long term processes that shape them. The students participating in the course will become familiar with the terminology, approaches, and methodologies used in coastal geomorphological research, emphasizing Israel's coast. This area is ideal for learning coastal geomorphological processes because it has been inhabited almost consecutively over the last 10,000 years. Thus, it will provide a base for understanding and analyzing maritime and coastal civilizations and their altering influence. The course participants will also be acquainted with a highly applicative commercial-grade geographic information system software, Arc-View GIS, enabling the students to conduct a small research project on Israel's coast. This project will help develop appropriate skills in research operation, data analysis, interpretation, and encourage the class participants to active learning.



Course per week outline

Week	Unit	Topic	Themes
1 (4.3.23)	A	Intro	<ul style="list-style-type: none"> • Course topics • Class participants acquaintance • Literature review of appropriate reading material and student assignments • Definition and scope of coastal geomorphology • Understanding why this course is relevant
1 (4.3.23)	A	Coast classification and processes	<ul style="list-style-type: none"> • Primary and secondary coast • Physical coastal processes
2 (4.10.23)	A	Coastal zone sediments and coastal transport	<ul style="list-style-type: none"> • The Mediterranean sea and its geophysical characteristics • Sediment volume contribution, Littoral cell, water budget – past and present • Coastal zone sediment characterization • Transport mechanisms of the coastal zone: Marine transport - Currents and wave
2 (4.10.23)	A	<u>Class exercise:</u> Depositional environments and processes of the coastal area	<ul style="list-style-type: none"> • Sediment grain size classification • Deposition environments and processes
3 (4.17.22)	A	Sea level fluctuations and contribution to coastal changes	<ul style="list-style-type: none"> • Sea level change in various temporal and spatial scales • Scientific review 101
4 (4.24.22)	B	<u>Discussion</u> – Recent studies investigating the coastal area	<ul style="list-style-type: none"> • Anthropogenic overprints on natural coastal aeolian sediments: a study from the periphery of ancient Caesarea, Israel (Shtienberg et al., 2017) • Two hundred years of coastal changes in Caesarea, Israel (Shtienberg et al., 2014) • Holocene-era submerged notches along the southern Levantine coastline: Punctuated sea level rise? (Goodman-Chernov et al., 2016)
5, 6 (5.1.23 - 5.8.23)	C	<u>ArcView workshop</u> - Introduction to ArcView GIS and map creation	<ul style="list-style-type: none"> • Intro to Geographic Information System • Uploading database to Arc View • Working with the help module • Database creation through ArcCatalog/ArcMap • Spatial data-set manipulation and presentation
7 (5.15.23)	C	<u>ArcView workshop</u> -	<ul style="list-style-type: none"> • Geo-referencing of historical, geographical documentation • Digitization of shore markers



		Temporal shore changes	Time-based shore-area change calculation
8, 10 (5.22.23)	C	<u>ArcView workshop</u> - Final Project: Bathymetric map creation I	<ul style="list-style-type: none"> • XYZ upload and point shapefile creation • Tide calculations • DEM surface creation through interpolation technics
10 (6.5.23)	C	<u>ArcView workshop</u> - Final Project: Bathymetric map creation II	<ul style="list-style-type: none"> • Bathymetric map creation • Volume change calculations • Summary conclusions and Test preview • Summary conclusions and Test preview

Goals: During the extent of the course, the students will:

- Get an understanding of the forcing factors that contribute to the constant evolution of the coastal area.
- Acquire the relevant scientific terminology used in coastal geomorphological research.
- Get familiar with the various morphologies that are found in coastal zones.
- Assess standard methodologies used in geomorphological research conducted in coastal areas.
- Improve practical reading and reviewing skills.
- Be able to analyze and interpreted geospatial data in geographic information system software – ArcMap GIS

Optional reading material:

- Robin, D. A., 2010. Introduction to Coastal Processes and Geomorphology. Cambridge University Press. (Chapter I; pages 1 - 15).

Unit Schedule

Unit A (Weeks 1-3)

Unit outcome:

Over the first three weeks, we will discuss processes contributing to coastal changes in various temporal and spatial scales while using the accepted terminology used in coastal geomorphology. We will also get familiarized with Israel's physiographic coastal characteristics, transport mechanisms, coastal features formation, and timing.

Week 1: Acquaintance, course description, and introduction



Goals for the week

We get to know each other and review the course topics, class activities, proposed reading material, student exercises, and course grading. During this week, we will also discuss the definition and scope of coastal geomorphology and why this course is so relevant for anthropology/archaeology majors. We will also briefly discuss the Mediterranean Sea's Physiography and the Nile Delta's influence on this semi-enclosed basin.

By the end of this week, the students will be able to:

1. Recognize the names of class participants and the course's instructor.
2. Be familiar with the course topics, student exercises, and grading policy.
3. Discuss the course's objectives and aims.
4. Recognize the contemporary importance of coastal geomorphology.
5. Comprehend the Physiography of the southeastern part of the Mediterranean Sea and the significance of the Nile delta in shaping this part of the semi-closed basin.

Optional reading material:

- Robin, D. A., 2010. Introduction to Coastal Processes and Geomorphology. Cambridge University press. (Chapter 1; pages 1 - 15).

Week 2: General Physiography of the Israeli coast

Goals for the week:

During the second week we will go into sea level fluctuation in various spatial and temporal scales and debate how these fluctuations shape and the coastal zone. Additionally, the various surveying methodologies used in the coastal geomorphological studies will be presented.

By the end of the second week the students will:

1. Get acquainted with the general Physiography of the Mediterranean Sea characterization of the coastal.
2. Be able to classify the zones found in the coastal area.
3. Characterize the sedimentological boundaries of the coastal area of Israel.
4. Get familiar with the coastal features that comprise the Israeli coast.



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5. Critic the first published geomorphological peer review paper.

This week's in class activity

Class discussion on the working methodology presented in the paper by Zveily and Klien 2004 and its suitability for answering their research question/fulfilling the research aim.

Week 3: Sea level fluctuations and implicating coastal change

Goals for the week:

During the third week we will converse on the dominant mechanisms responsible for sea-level fluctuations in various temporal and spatial scales and its contribution to coastal changes. We will also devote some time for assessment of publications and peer review process.

By the end of the third week the students will:

1. Get familiar with short – long periodic sea level variation.
2. Apprehend sea level as a major force in shaping the coastal zone.
3. Be acquainted with scientific review of manuscripts intended for journal publication.

Home activity:

Write a half a page summary on Shtienberg et al. 2013 (non-refereed journal). Key points to include in the summary are - what is the main statements presented in the article and is it backed up with relevant scientific facts?

Rubric of student assignment

Half a page summary/review on Shtienberg et al. 2013 (non-refereed journal)

Criteria	Possible	Earned
Main statements presented in the article	2	
Who are the potential readers of this article	2	
Identify fact from fiction – was the papers statement backed up by actual results or at least a scientist/researcher (run a	6	



background check in google scholar) that conducted a study that verified the claims presented in the article?		
TOTAL	10	

Unit Schedule (Unit B)

Week 4: Selected topics in coastal geomorphology

Goals for the week:

In week four we will discuss examples of research conducted in the coastal in studies covering the topics taught in in week 1 - 3. The given examples will be presented through three peer review papers (see required readings below) that studied the coastal area of central Israel. Each example will be followed by a class discussion in which the strength and weaknesses of the paper will be reflected.

By the end of the fifth week the students will:

1. Get familiar with how anthropogenic impact has shaped that coastal environment of Caesarea in two different periods.
2. Strengthen reviewing skills.
3. Strengthen research design.

Required reading for class discussion:

- Goodman-Tchernov, B., Katz, O., 2016. Holocene-era submerged notches along the southern Levantine coastline: Punctuated sea level rise? Quaternary International 401, 17-27.
- Shtienberg, G., Zviely, D., Sivan, D., Lazar, M., 2014. Two centuries of coastal change at Caesarea, Israel: natural processes vs. human intervention. Geo-Marine Letters 34, 365-379.
- Shtienberg, G., Dix, J.K., Shahack-Gross, R., Yasur-Landau, A., Roskin, J., Bookman, R., Waldmann, N., Shalev, S., Sivan, D., 2017. Anthropogenic overprints on natural coastal aeolian sediments: a study from the periphery of ancient Caesarea, Israel. Anthropocene 19, 22-34.

Unit Schedule (Unit C)

Weeks 5 - 8: Selected topics in coastal geomorphology



Unit outcome:

The aim of the unit is to introduce the very basics of the ESRI Arc-GIS package. This will be achieved by conducting a geospatial analysis of historical geographical documentation (Historical aerial photographs) Digital Elevation models (DEM), Bathymetric data and basic ground truth sources all acquired from the coast of Israel.

Weeks 5 and 6: introduction to Arc-GIS

Goals for the week:

The goals for weeks 5 and 6 are to get acquainted with ArcGIS/ArcCatalog software to the course participants and highlight its relevance for geospatial (geomorphology, geology, archaeology, anthropology) research and work.

By the end of this week the students will be able to:

1. Introduction to ArcMap and ArcCatalog.
2. Identify between various types of data used in ArcGIS (raster/shapefiles).
3. Upload various types of data to the ArcGIS platform.
4. Establishment of a geospatial database.
5. Working with the use of the help module.

This week's in class/home activity

Map creation and presentation of the geospatial database.

Optional reading material:

- ArcGIS Help>>>map

Rubric of student assignment

Map creation and presentation of geospatial database

Criteria	Possible	Earned
Upload of geospatial data and database establishment	5	
Map creation and presentation of database	10	



TOTAL	15	
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Week 7: Historical documentation and tempo-spatial change

Goals for the week:

During the seventh week we will explore 70 years of shoreline changes in the coastal area of Caesarea, Israel through historical aerial photographs.

By the end of this week the students will be able to:

1. Identify and upload an historical aerial photograph geographic raster files.
2. Establish a spatial reference (i.e., Georeferencing) to unrectified geographic raster files.
3. Digitize shoreline markers from the historical documentations.
4. Assess shore area changes.

This week's activity

Asses the shore changes that occurred in the coast of Caesarea over the last 70 years through a series of aerial photographs.

Required reading material:

- Klein, M., Zviely, D., 2001. The environmental impact of marina development on adjacent beaches: a case study of the Herzliya marina, Israel. Applied Geography 21, 145-156.
- Klein, M., Lichter, M., 2006. Monitoring changes in shoreline position adjacent to the Hadera power station, Israel. Applied Geography 26, 210-226.
- ArcGIS Help>>Georeferencing
- ArcGIS Help>>editor

Rubric of student assignment

Assessment of the shore changes the occurred in Caesarea over the last 70 years

Criteria	Possible	Earned
Georeferencing of historical documentation	4	



Digitization of coastal feature and calculation of shore area	5	
Analysis of shore area change over the last 70 years	6	
TOTAL	15	

Week 8 and 10: Bathymetric map: from raw data to 2chart creation

Goals for the week:

During week eight a bathymetric map will be created by the students. This will be achieved through the use of raw point data sampled in a shallow water single beam survey after accounting for tide changes and identifying the most suited method for interpolation.

By the end of this week the students will be able to:

1. Create a bathymetric map from raw XYZ point data.
2. Select interpolation models based on needs.
3. Calculate sediment volume changes and evaluate variation in sediment mobility.

This week's activity

Bathymetric map creation and evaluation of temporal seabed change.

Optional reading material:

- <https://en.wikipedia.org/wiki/Tide>
- https://en.wikipedia.org/wiki/Mediterranean_Sea
- ArcGIS Help>>Interpolation

Rubric of student assignment (date of submission XXX)

Shallow water bathymetric map creation and sediment volume change evaluation (unit B)

Criteria	Possible	Earned
Raw data (XYZ) processing	5	
Selection of most suitable of interpolation method	5	
Bathymetric map	7	



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Analysis of seabed change over selected years	8	
TOTAL	25	