

**FLORIDA STATE UNIVERSITY  
(DEPARTMENT OF GEOGRAPHY)**

# LIVING IN A HAZARDOUS ENVIRONMENT

## GEO 4340

**Dr. Jay Baker**  
**Department of Geography**  
**Florida State University**

- I. Hurricanes
  - A. Formation
  - B. Structure
    - 1. Eye
    - 2. Right front quadrant
    - 3. Profile
  - C. Hazard Components
    - 1. Wind
    - 2. Storm surge
    - 3. Erosion/scour
    - 4. Wave battering
    - 5. Rainfall
  - D. Saffir-Simpson Scale
  - E. Hurricane Climatology in U.S.
  - F. Forecasting and Warning
    - 1. Forecasting tools
    - 2. Forecast error
    - 3. National Hurricane Center Forecast products
      - a. Public advisories
      - b. Marine advisories
      - c. Watches/Warnings
      - d. Landfall probabilities
    - 4. Response decision making
  - G. Evacuation Studies
    - 1. SLOSH simulations
    - 2. Population at risk
    - 3. Clearance times
    - 4. Shelter analysis
  - H. Public Response
  - I. Public Awareness Materials
  - J. Insurance
  - K. Building Codes
    - 1. Stringency
    - 2. Enforcement
    - 3. Performance vs. prescription
  - L. Development Policies

1. Set-backs
  2. Density restrictions
  3. Population caps
  4. Developments of regional impact
  5. Public acquisition
  - M. National Flood Insurance Program
    1. Elevation requirements
    2. A-Zone vs. V-Zone
    3. History of program
    4. Insurance
    5. Effect on development rate
  - N. COBRA
  - O. Hurricane Modification
  - P. Federal Disaster Assistance
- II. Coastal Erosion
- A. Beach Formation
  - B. Barrier Island Structure
  - C. Acute Erosion vs. Chronic Erosion
  - D. Causes of Erosion
    1. Sea level rise/island migration
    2. Man-made structures
    3. Storms
  - E. Erosion problem areas in U.S.
  - F. Sea Walls
  - G. Groins and Jetties
  - H. Beach Renourishment
  - I. Set Back Regulations
  - J. Dune Protection Regulations
  - K. Retreat
  - L. Public Awareness Materials
  - M. Construction on Pilings
- III. Tsunamis
- A. Causes
  - B. Speed vs. Height vs. Water Depth
  - C. Tsunami-prone Areas of U.S.
  - D. Trans-oceanic Tsunamis
  - E. Effects on Structures
  - F. Local Maps of Tsunami Inundation Areas
  - G. Warning Systems
  - H. Insurance
  - I. Public Awareness Materials
- IV. Riverine Floods
- A. Causes

- B. Flash Floods vs. Conventional Floods
  - C. Effect of Urbanization
  - D. Floodplain, Floodway, and Floodway Fringe
  - E. Types of Damage
    - 1. Hydrodynamic pressure
    - 2. Hydrostatic pressure
    - 3. Saturation
  - F. Distribution of Flood Events in U.S.
  - G. Prediction
  - H. Warning
  - I. Mapping
  - J. National Flood Insurance Program
    - 1. Construction requirements
      - a. Floodproofing
      - b. Elevation
      - c. Displacement limits
      - d. Floodway obstructions
    - 2. Insurance
      - a. Setting of premiums
      - b. Inducement to take risk issue
  - K. Dams
  - L. Levees
  - M. Channelization
  - N. Floodplain Acquisition
  - O. Barriers
  - P. Public Awareness Materials
- V. Tornadoes
- A. Causes
  - B. Distribution in U.S.
  - C. Variation by Season of Year
  - D. Structure
    - 1. Funnel clouds
    - 2. Suction vortices
    - 3. Peak winds
    - 4. Width
    - 5. Length of track
    - 6. Duration
  - E. Causes of Damage
    - 1. Wind
    - 2. Pressure differential
  - F. Failure Modes in Structures
  - G. Prediction
    - 1. National Severe Storms Forecast Center
    - 2. Local NWS offices
    - 3. Watches vs. Warnings

- 4. Doppler radar
- 5. SKYWARN
- H. Warning
  - 1. NOAA Weather Radio
  - 2. Sirens
  - 3. TV/Radio
- I. Public Awareness Materials
- J. Building Codes
- K. Community Shelters
  
- VI. Lightning
  - A. Causes
  - B. Types
  - C. Vulnerability vs. Height
  - D. Distribution of Thunderstorms in U.S.
  - E. Thunder vs. Lightning
  - F. Types of Damage
    - 1. Deaths
    - 2. Forest fires
    - 3. Fires in structures
  - G. Lightning Protection
  
- VII. Hail
  - A. Formation
  - B. Size
  - C. Distribution in U.S.
  - D. Variation by Season of Year
  - E. Types of Damage
    - 1. Crops
    - 2. Roofs
    - 3. Vehicles
  - F. Suppression
  - G. Crop hybrids
  
- VIII. Winds (other than hurricane and tornado)
  - A. Thunderstorm Downbursts
    - 1. Causes
    - 2. Severity
    - 3. Duration
    - 4. Areal extent
    - 5. Damage
      - a. Structures
      - b. Aviation
    - 6. Prediction
  - B. Localized Wind Hazards
    - 1. Santa Anna Winds in Southern California

- 2. Chinook and other orographic effect winds
- C. Distribution of Wind Hazards in U.S.

IX. Drought

- A. Definition
  - 1. NWS
  - 2. Palmer index
- B. Variation in U.S.
- C. Cycles
- D. Effects
  - 1. Crops
  - 2. Urban areas
- E. Cultivation practices
- F. Irrigation
- G. Crop varieties
- H. Wind breaks
- I. Cover crops
- J. Crop insurance

X. Heat

- A. Extreme events
- B. Heat Index (Heat + Humidity)
- C. Weather Stress Index
- D. Health effects
- E. Shelters

XI. Cold

- A. Extreme events
- B. Wind chill
- C. Weather Stress Index
- D. Health effects
- E. Frost/Freeze vs. Crops
  - 1. Advective vs. radiated frost
  - 2. Prediction and warning
  - 3. Crop resistance
  - 4. Topographic factors
  - 5. Mitigation
    - a. Heaters
    - b. Smudge pots
    - c. Wind turbines
    - d. Spraying
  - 6. Shelters

XII. Snow and Ice Storms

- A. Definitions
  - 1. Blizzard

- 2. Winter storm
- B. Variation in U.S.
- C. Prediction and Warning
- D. Effects
  - 1. Health
  - 2. Property damage
  - 3. Economic disruption
  - 4. Lifelines
- E. Adjustments
  - 1. Plows
  - 2. Salting and sanding
  - 3. “Snowfests”
  - 4. Materials design

### XIII. Forest and Brush Fires

- A. Major events
- B. Urban-wildfire interface
- C. Causes of fires
- D. Types of fires
- E. Fire behavior
  - 1. Fuel load
  - 2. Weather conditions
  - 3. Topography
- F. Firefighting
  - 1. Firebreaks
  - 2. Fuel breaks
  - 3. Backfiring
  - 4. Water and chemicals
- G. Prescribed burns
- H. Construction materials

### XIV. Earthquakes

- A. Plate Tectonics
  - 1. Continental drift
    - a. Evidence
    - b. Prehistoric alignments
  - 2. Geology of the earth’s crust and mantle
  - 3. Plate boundaries
    - a. Oceanic divergent zones
    - b. Subduction zones
    - c. Transform zones
    - d. Continental convergent zones
    - e. Continental divergent (rift) zones
- B. Faults
  - 1. Stress
  - 2. Focus

3. Types of faults
4. Examples
- C. Effects
  1. Physical phenomena
    - a. Elastic rebound
    - b. Seismic waves
    - c. Surface displacement
    - d. Ground shaking
    - e. Liquefaction
    - f. Landslides
    - g. Seiche
    - h. Tsunami
  2. Attenuation effects due to soil and geology
  3. Measurement
    - a. Seismometers and seismographs
    - b. Triangulating the epicenter
    - c. Metrics
      - i. Magnitude
      - ii. Intensity
      - iii. Moment
  4. Vulnerability of structures
    - a. Failure modes
    - b. Damage curves
    - c. Construction materials and techniques
    - d. Building height and period of vibration
  5. Lifelines, fires, and other secondary effects
- D. Prediction
  1. Short term
    - a. Successes
    - b. Failures
    - c. Occasional precursors
      - i. Seismic wave velocity
      - ii. Surface deformation
      - iii. Radon in well water
      - iv. Electrical resistivity of rock
      - v. Number of small earthquakes
      - vi. Animal behavior
  2. Long term
    - a. Seismic gaps
    - b. Return periods
- E. Hazard Mapping
- F. California Altquist-Priolo Act
- G. Building Codes
- H. Setback Zones
- I. Fluid Injection
- J. Insurance



- XV. Volcanoes
  - A. Origin
    - 1. Magma
    - 2. Tectonic plate boundaries
    - 3. Hot spots
  - B. Major types
    - 1. Shield
    - 2. Cinder cones
    - 3. Composite cones
  - C. Hazards
    - 1. Lava
    - 2. Pyroclastics
    - 3. Toxic gases
    - 4. Glowing avalanches
    - 5. Lahars
  - D. Prediction, Warning, and Evacuation
  - E. Hazard Mapping
  - F. Diversion Barriers
  
- XVI. Landslides and Mass Movement
  - A. Factors Affecting Slope Stability
    - 1. Angle of repose
    - 2. Soil and rock structure
    - 3. Water content
    - 4. Particle packing
  - B. Types of Mass Movement
    - 1. Dimensions
      - a. Particle size
      - b. Speed of movement
    - 2. Classifications
      - a. Rockfalls
      - b. Landslides and rockslides
      - c. Slumps
      - d. Earthflows and mudflows
      - e. Soil creep
      - f. Solifluction
      - g. Avalanches
  - C. Prediction and Warning
  - D. Hazard Mapping
  - E. Grading Regulations
  - F. Drainage systems
  - G. Retaining barriers
  
- XVII. Soil Hazards
  - A. Subsidence Due to Withdrawal of Oil and Water

- B. Subsidence Due to Excavation
- C. Limestone Solution Sinkholes
  - 1. Karst topography
  - 2. Triggering activities
  - 3. Effects
  - 4. Hazard identification
- D. Swelling clays
  - 1. Effects
  - 2. Testing
  - 3. Mitigation

#### XVIII. Radon

- A. Source
- B. Health Effects
- C. Identification of Hazard Areas
- D. Mitigation

#### XIX. Technological Hazards

- A. Principles and concepts of pollution and toxicology
  - 1. Dispersal and dilution
  - 2. Biological magnification
    - a. Bioconcentration
    - b. Appearance delay
  - 3. Persistence
    - a. Biodegradation
    - b. Half-life
  - 4. Acute vs. chronic exposure
  - 5. Duration of exposure
  - 6. Immediate vs. delayed effects
  - 7. Local vs. systemic effects
  - 8. Interaction effects
    - a. Synergy
    - b. Potentiation
    - c. Antagonism
  - 9. Duration of exposure
  - 10. Dose/response rates
    - a. Expressions
      - i. Thresholds
      - ii. Linear vs. non-linear relationships
      - iii. LD<sub>50</sub>
    - b. Methods of analysis
      - i. Animal experiments
      - ii. Human epidemiology
      - iii. Human experiments
  - 11. Mutagens
  - 12. Carcinogens

13. Teratogens
  14. Form of economic system vs. pollution
  15. Economics of pollution control
- B. Air pollution
1. Global air pollution problems
    - a. Climate change
      - i. Historical background
      - ii. Theory
      - iii. Empirical evidence
      - iv. Predictions
      - v. Consequences
    - b. Ozone depletion
      - i. Types of UV radiation
      - ii. Creation and depletion of stratospheric ozone
      - iii. Ozone depleting chemicals
      - iv. Theory of CFC's vs. ozone
      - v. Empirical evidence
      - vi. Possible effects of surface UVA and UVB
    - c. Acid precipitation
      - i. Sources
      - ii. Economic costs
  2. Sources and effects of major air pollutants
    - a. Oxides of sulfur
    - b. Oxides of nitrogen
    - c. Carbon monoxide
    - d. Heavy metals
    - e. Total suspended particulates (TSP's)
    - f. Volatile organic compounds (VOC's)
  3. Air pollution prevention and control
    - a. Technologies
      - i. Source controls
      - ii. Emission controls
    - b. Clean Air Act(s)
    - c. Trends in air pollution levels
  4. Temperature inversions
- C. Water pollution
1. Sources and effects of major types of water pollution
    - a. Oxygen demanding wastes (BOD)
    - b. Disease causing agents (pathogens)
    - c. Plant nutrients and detergents
    - d. Heavy metals
    - e. Acids
    - f. Sediments
    - g. Salts
    - h. Radioactivity
    - i. Heat

- j. Oil
      - k. Pesticides
    - 2. Pollution prevention and control
      - a. Point vs. non-point sources
      - b. Clean Water Act(s)
      - c. Safe Drinking Water Act
      - d. Municipal water and waste treatment
- D. Hazardous Waste
  - 1. Major types
    - a. Toxic and caustic chemicals
    - b. Radioactive
  - 2. Major incidents
  - 3. Resource Conservation and Recovery Act
  - 4. Superfund and SARA
  - 5. Toxic Substances Control Act
  - 6. Disposal
- E. Industrial accidents
  - 1. Major incidents
  - 2. SARA Title III
  - 3. CERCLA
  - 4. Evacuation
- F. Hazardous Material Transportation Accidents
  - 1. Major incidents
  - 2. DOT guide
  - 3. On-line resources
  - 4. Evacuation
- G. Nuclear Power Plant Accidents
  - 1. Nuclear fuel cycle
  - 2. Principles of fission
  - 3. Reactor components
  - 4. Loss of coolant accidents
  - 5. Safety systems
  - 6. Probabilities of meltdown sequences (fault trees)
  - 7. Factors affecting the consequences of meltdowns
    - a. Release categories
    - b. Atmospheric conditions
    - c. Dosimetry
    - d. Population at risk
    - e. Evacuation
  - 8. Health effects
  - 9. Economic costs

10. Comparative risks
11. Major incidents
12. Nuclear Regulatory Commission
13. Emergency planning

Textbook:	Nicholas K. Coch, <i>Geohazards: Natural and Human</i> . Miscellaneous xerox materials
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Grading:	Four exams of equal weight
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# **DISASTER PREPAREDNESS AND HAZARD MITIGATION**

## **GEO 5345**

**Dr. Jay Baker**  
**Department of Geography**  
**Florida State University**

- I. Selected Hazards and Their Distribution in the U.S.
  
- II. Measures of the Effects of Hazardous Events
  - A. Types of Effects
    - 1. Life and health
    - 2. Economy
      - a. Property
      - b. Production
      - c. Employment
    - 3. Housing
    - 4. Infrastructure
    - 5. Public services
    - 6. Environment
    - 7. Population distribution
  - B. Loss-management Frameworks
    - 1. Average annual losses
    - 2. Catastrophe potential
    - 3. Distributional goals
      - a. Equity
      - b. Reliance
  - C. Trends in losses
  
- III. Hazard Analysis and Mapping
  - A. Delineation of the Physical Event System
  - B. Inventory of Population and Property at Risk
  - C. Specification of Damage Curves for Structures
  - D. Anticipating Loss of Life and Injuries
  - E. Simulation Methods and Issues
  - F. Scale Issues
  - G. Output Options
  - H. Geographic Information Systems
  
- IV. Warning and Evacuation
  - A. Planning
    - 1. Hazard analysis and display
    - 2. Population and facility inventory
    - 3. Behavioral analysis

- 4. Transportation analysis
    - 5. Shelter analysis
  - B. Response and Logistics
    - 1. Detection and evaluation
    - 2. Decision making
    - 3. Dissemination
    - 4. Coordination and control
  - C. Reducing Evacuation Times
  - D. Preventing Impossible Evacuation Situations
  
- V. Development Management
  - A. Hazard Analysis and Mapping
    - 1. Technical feasibility
    - 2. Scale
    - 3. Cost
    - 4. Output media and formats
  - B. Market Failures and Arguments for Regulation
  - C. Approaches to Regulation
    - 1. Regulations affecting how structures and facilities are built
    - 2. Regulations affecting where structures and facilities are built
    - 3. Regulations affecting the density of structures and facilities
    - 4. Regulations requiring modification or protection of the building site
  - D. Government Acquisition of Land
  - E. Siting and Funding of Public Facilities
  - F. Assessing Fees for Occupants of Hazardous Areas
  - G. The Taking Issue
  - H. Political Considerations
  - I. Environmental Considerations
  - J. Economic Considerations
  - K. Land Use Benefits Foregone
  
- VI. Structural Protection Works
  - A. Dams, Levees, and Channelization of Streams
  - B. Seawalls, Armoring, Groins, Jetties, and Beach Nourishment
  - C. Diversions and Barriers
  
- VII. Insurance
  - A. Spreading Risk
  - B. Actuarial Programs
  - C. Subsidized Programs
  - D. Market Factors
  - E. The Role of Government
  
- VIII. Response and Recovery
  - A. Search and Rescue
  - B. Damage Assessment

- C. Needs Assessment
  - D. Essential Goods
    - 1. Food
    - 2. Water
    - 3. Medical care
  - E. Shelter
  - F. Security
  - G. Communications
  - H. The Role of Donations and Volunteer Organizations
  - I. Emergency Operating Center (EOC) Structures
    - 1. Emergency Support Functions (ESF's)
    - 2. Incident Command System
  - J. The Role of Government
    - 1. Local
    - 2. State
    - 3. Federal
  - K. Repair and Reconstruction
  - L. Redevelopment
  - M. Use of New Technologies
    - 1. Portable satellite communications
    - 2. Computer mapping and GIS software
    - 3. Global Positioning Systems (GPS)
    - 4. Cellular modems
    - 5. Computer simulations
    - 6. Remote sensing
- IX. Hazard Perception and Public Response
- A. Beliefs about Hazards
  - B. Concerns about Hazards and Determinants of Concern
  - C. Individual Differences
  - D. Hazard Disclosure
  - E. Risk Communication
  - F. Behaviors
    - 1. Preparedness actions
    - 2. Evacuation
    - 3. Insurance purchase
    - 4. Political involvement
    - 5. Residential location
- X. Policy Evaluation
- A. Acceptable Risk
  - B. Risk Comparisons
  - C. Benefit-Cost (Risk) Analysis
  - D. Political Considerations



TEXTBOOK: David Alexander, *Natural Disasters*, NY: Chapman and Hall, 1993 plus supplementary readings

GRADING: Research Paper 40%  
Mid-Term Exam 15%  
Final Exam 15%  
Class Participation 10%