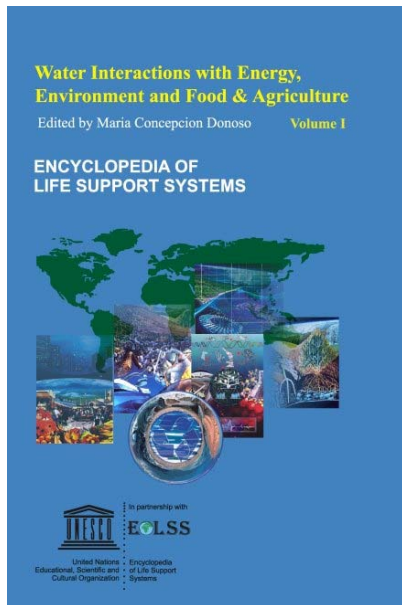


# CONTENTS

## WATER INTERACTIONS WITH ENERGY, ENVIRONMENT, FOOD, AND AGRICULTURE



### **Water Interactions with Energy, Environment, Food, and Agriculture - Volume 1**

**No. of Pages:** 454

**ISBN:** 978-1-84826-172-3 (eBook)

**ISBN:** 978-1-84826-622-3 (Print Volume)

### **Water Interactions with Energy, Environment, Food, and Agriculture - Volume 2**

**No. of Pages:** 438

**ISBN:** 978-1-84826-196-9 (eBook)

**ISBN:** 978-1-84826-646-9 (Print Volume)

For more information of e-book and Print  
Volume(s) order, please [click here](#)

[Or contact : eolssunesco@gmail.com](mailto:eolssunesco@gmail.com)

## CONTENTS

### VOLUME I

#### **Water Interactions with Energy, Environment, Food, and Agriculture** **1**

Maria Concepcion Donoso, *Environment and Water Sciences, Montevideo, Uruguay*

N.M. Vargas, *Graduate Research Assistant, Illinois State University, Normal, Illinois, USA*

1. Water and the Environment
  - 1.1. The Hydrological Cycle
  - 1.2. Surface Water and Groundwater
  - 1.3. Aquatic Ecosystems
  - 1.4. Water Quality and Health
  - 1.5. Climate Variability and Water Resources
  - 1.6. Climate Change and Water Resources
  - 1.7. Other Threats Linked to Water Resources
2. Water and Food: Agriculture
  - 2.1. Water Requirements
  - 2.2. Farming with Agrochemicals
  - 2.3. Water and Animal Production Systems
  - 2.4. Aquaculture and Fisheries
  - 2.5. Water and Diseases Linked to Food Production
3. Water and Energy
  - 3.1. Hydroelectric Power
  - 3.2. Thermal Pollution
  - 3.3. Tidal and Wave Power
  - 3.4. Hydrothermal Power
  - 3.5. Ocean Thermal Energy Conversion
  - 3.6. Nuclear power
4. Conclusions

#### **Thermal Impact on Water Systems** **22**

Roy A. Watlington, *Division of Science & Mathematics, University of the Virgin Islands, Virgin Islands*

1. Introduction
2. Interactions of Heat and Water in Natural Phenomena
  - 2.1. Solid Earth Thermal Interactions
  - 2.2. Climatic Impacts of the Thermal Energizing of the Ocean
  - 2.3. Anomalous Ocean Temperatures and Coral Bleaching
  - 2.4. Global Climate Change versus Biodiversity
3. Thermal Impacts through Technology
  - 3.1. Hydropower
  - 3.2. Waste Heat and Cooling Water
  - 3.3. OTEC
4. Mitigation

#### **Environment-Water Interactions** **31**

Alicia Fernandez Cirelli, *Faculty of Science, University of Buenos Aires, Argentina*

1. Introduction
  - 1.1. The properties of water
  - 1.2. The movements of water
2. Water as a Function of Ecosystem Character
3. Water Quality and the Environment
  - 3.1. Understanding the environment

- 3.2. Water and health
- 3.3. High water quality and sanitation
4. Climate Change and Water Resources
5. Aquatic Ecosystems
6. Environmental Management and Water Quality and Quantity
  - 6.1. River basin management
  - 6.2. Groundwater management
  - 6.3. The need of data
  - 6.4. Scientific progress and technological advances, and water management innovations
  - 6.5. Linking science, policy, environment and basic human needs

### **Water and Ecosystem Character**

**60**

Geraldo Stachetti Rodrigues, *Embrapa Environment, Jaguariúna (SP), Brazil*

1. Introduction
2. Water is the linking substance for all ecosystems on Earth
  - 2.1. Water quality and quantity determining the character of ecosystems
    - 2.1.1. Continental scale: Eurasia freeze down in the greenhouse
    - 2.1.2. Regional scale: the Aral Sea demise
    - 2.1.3. Local scale: tearing down Snake River dams to save salmon runs
  - 2.2. Ecosystem character determining water quality and quantity
    - 2.2.1. Continental scale: giant Antarctic ice sheet collapse and coastal lands flooding
    - 2.2.2. Regional scale: Great Plains agriculture suffocating the Gulf of Mexico
    - 2.2.3. Local scale: Urbanization spreading over desert biodiversity sanctuaries
3. Ecodynamics the contending forces of nature and ecosystems stability
4. Water resources and the consequences of human activities
  - 4.1. Environmental management and water conservation in industrial activity
  - 4.2. Environmental management and water conservation in agricultural activity
5. Conclusion - Sustainable Environmental Management

### **Water Quality and the Environment**

**72**

Jorge Quintanilla Aguirre, *Instituto de Investigaciones Químicas, Universidad Mayor de San Andrés, La Paz – Bolivia*

1. Introduction
  - 1.1. Water uses and human impact on water quality
  - 1.2. Pollutant sources and pathways
    - 1.2.1. Point sources
  - 1.3. Temporary and spatial variations of water quality
2. Water quality
3. Natural factors regulating water quality
4. Hydrology
5. Thermal characteristics
6. Suspended solids and water quality
7. Water pollution caused by point source waste discharges
  - 7.1. Overall patterns
  - 7.2. Main point-source waste discharges
  - 7.3. Industrial effluent
    - 7.3.1. Effluent flows from manufacturing
    - 7.3.2. Mining and the processing of minerals
8. Non-point source water pollution
  - 8.1. Run-off from agricultural land
    - 8.1.1. Fertilizers
    - 8.1.2. Pesticides, herbicides, insecticides and other chemical substances
    - 8.1.3. The regional situation
  - 8.2. Storm-water run-off

- 8.3. Percolation of polluted water into groundwater
- 8.4. Precipitation of polluted water
- 9. The impact of water pollution on human health and welfare
  - 9.1. Human wastes and human health
  - 9.2. The consequences of the use of polluted water for irrigation
  - 9.3. Recreation and health
- 10. Water pollution control
  - 10.1. Laws aimed at controlling water pollution
  - 10.2. Water quality in lakes
    - 10.2.1. Lake eutrophication
    - 10.2.2. Sediment cores

**Climate Change and Water Resources**

**108**

Nicolaas de Groot, *Water Center for the Humid Tropics of Latin America and the Caribbean, CATHALAC, Republic of Panama / Resource Analysis, the Netherlands*

- 1. Introduction
- 2. Climate Impacts on Water Supplies
- 3. Climate Change and Hydrological modeling
- 4. Sea Level Rise
- 5. Climate Impacts on Water Demand
  - 5.1. Increasing competition between users
    - 5.1.1. Population Growth and Urbanization
    - 5.1.2. Agricultural activities
    - 5.1.3. Industrial and thermoelectric power uses
- 6. Socioeconomic Impacts and Policy Implications
- 7. Conclusions and Recommendations

**Environmental Management and Water Quality and Quantity**

**126**

Mantha Mehallis, *Center for Information Transfer, and Environmental MBA Graduate Program, Florida Atlantic University, USA*

- 1. Environmental Management
- 2. Who is Responsible for Environmental Management?
  - 2.1. National Governments
  - 2.2. State/Provincial Governments
  - 2.3. Local Governments
  - 2.4. Industry
  - 2.5. Non-Governmental Organizations
- 3. Management Mechanisms
  - 3.1. Policy Formulation
    - 3.1.1. Statutory Mechanisms
    - 3.1.2. Non-Statutory Mechanisms
- 4. Geographic Parameters
- 5. Public Participation of Stakeholders
- 6. Types of Environmental Management
  - 6.1. Aboriginal Water Management
  - 6.2. Collaborative or Community Based Management
  - 6.3. Governmental Regulation Management
  - 6.4. Private Industry Management
  - 6.5. Comparison of Types of Management
- 7. Water Resources Management: Degrees of Social Responsibility
  - 7.1. Industry
  - 7.2. Industrial Associations or Organizations
- 8. International Bodies/Global Issues
  - 8.1. Managing Global Issues Common to More Than One Nation

- 8.2. Managing Transboundary Issues
- 9. Water Quality and Quantity Information Management Systems
- 10. The Guiding Principle: Sustainable Development
  - 10.1. National Level
    - 10.1.1. Mexico
    - 10.1.2. Israel
  - 10.2. Basin level
    - 10.2.1. Integrated Watershed Management for the Pantanal and Upper Paraguay River Basin
  - 10.3. Municipal Level (e.g. Paris, France)
  - 10.4. Participation
    - 10.4.1. Public Participation in Brazilian Watersheds

**Water Resources for Agriculture and Food Production**

**148**

Carlos Him-Gonzalez, *Universidad de Panamá, República de Panamá*

- 1. Introduction
- 2. Surface Water Resources
- 3. Underground Water Resources
- 4. Integrated Resources
- 5. Water Resources Availability
- 6. Water Resources Development and Management.
- 7. Preserving Water Quality
- 8. Challenges and Opportunities

**Water Balance in Agricultural Areas**

**160**

Carlos Him-Gonzalez, *Universidad de Panamá, República de Panamá*

- 1. Introduction
- 2. Net Water Requirements
- 3. Gross Water Requirements
- 4. Improving the Water Balance for Agriculture

**Water Contamination from Rural Production Systems**

**168**

Maria Alejandra Herrero, *Department of Animal Production, School of Veterinary Sciences, University of Buenos Aires, Argentina*

I.M.E. Thiel, *University of Buenos Aires, Argentina*

- 1. Introduction
- 2. Water Pollutants in rural areas
  - 2.1. Nitrogen
  - 2.2. Phosphorus
  - 2.3. Pesticides
  - 2.4. Metals and persistent elements
  - 2.5. Microorganisms
  - 2.6. Residues of Medicines
- 3. Water pollution in rural production systems
  - 3.1. Agricultural systems
  - 3.2. Animal production systems
    - 3.2.1. Water quality issues in pasturelands
    - 3.2.2. Water quality issues in intensive systems
- 4. Future Demands
- 5. Conclusions

**Quality and Quantity of Water for Agriculture****203**Peter Cullen, *CRC for Freshwater Ecology, University of Canberra, Australia*

1. Introduction
2. The World's Freshwater Resource
3. Utilization of the Freshwater Resource
  - 3.1. Agricultural Uses
  - 3.2. Ecosystem Services
4. Inefficiency and its Consequences
  - 4.1. Salinity
    - 4.1.1. Dryland Salinity
    - 4.1.2. Salinity in Irrigated Areas
  - 4.2. Nutrients and Agricultural Chemicals
5. Overextraction of Water and its Consequences
6. Climate Change and Water Availability
7. Allocation of Water for the Environment
8. Evolving Management Frameworks
  - 8.1. The Issue of Allocation
9. Whole System Management

**Drainage of Farmlands****219**Maslov B.S, *Russian Academy of Agricultural Sciences, Moscow, Russia*

1. Introduction
2. Needs for Drainage and Land Reclamation Resources
3. Types of Soil Water Supply
4. Crop Demands and Drainage Regimes
5. Drainage Methods
6. Drainage Systems and Their Constituents
  - 6.1. Drainage Systems
  - 6.2. Drainage Technology
  - 6.3. Open Channels
  - 6.4. Closed Drainage
  - 6.5. Agromeliorative Measures
  - 6.6. Enclosing Networks
  - 6.7. Conducting Drainage Networks
  - 6.8. Closed Collectors
  - 6.9. Structures Within Drainage Networks
  - 6.10. Water Intakes
7. Polders: Mechanical Drainage
8. Drainage of Peatlands, Forests, and Parks: Colmatage and Other Types of Drainage
  - 8.1. Bog Drainage for Peat Extraction
  - 8.2. Drainage of Forests and Parks
  - 8.3. Colmatage and Other Drainage Methods
9. Drainage–Irrigation Systems
10. Land Amelioration
11. Use of Drained Lands
12. Drainage and Environmental Protection Issues

**Irrigation****267**P.I. Kovalenko, *Institute of Hydraulic Engineering and Land Reclamation of the Ukrainian Academy of Agrarian Science, Kiev, Ukraine.*Yu.A. Mikhaylov, *Institute of Hydraulic Engineering and Land Reclamation of the Ukrainian Academy of Agrarian Science, Kiev, Ukraine.*O.I. Zhovtonog, *Institute of Hydraulic Engineering and Land Reclamation of the Ukrainian Academy of Agrarian Science, Kiev, Ukraine.*

1. A demand for irrigation
2. Regime of irrigation
3. Water resources and water quality
4. Reservoirs for irrigation purposes
5. Means of irrigation and watering facilities
6. Irrigation system and network
7. Rice systems
8. Spillway network
9. Irrigation management and automation of irrigation systems
  - 9.1. Watering control
  - 9.2. Water distribution control
  - 9.3. Irrigation system automation
10. Irrigation productivity
  - 10.1. Irrigation economy
  - 10.2. Irrigation ecology

### **Environmental Structure and Function: Climate System**

304

G.V. Gruza, *Institute for Global Climate and Ecology, Moscow, Russia*

1. Introduction
2. Processes in the Global Climate System
  - 2.1. Atmospheric Processes
    - 2.1.1. Atmospheric Radiative Fluxes
    - 2.1.2. Water Vapor
    - 2.1.3. Clouds
    - 2.1.4. Atmospheric Precipitation
    - 2.1.5. Atmospheric Chemistry
    - 2.1.6. Atmospheric Circulation
  - 2.2. Snow and Ice Processes
  - 2.3. Ocean Processes
    - 2.3.1. Ocean Surface Layer Fluxes
    - 2.3.2. Ocean Deep Convection and Circulation
  - 2.4. Terrestrial Processes
3. Climate Now
  - 3.1. Classification of climates
  - 3.2. Observed Climate as it is seen today
4. Weather Systems and Weather Forecasting
  - 4.1. Airmasses and atmospheric fronts
  - 4.2. Cyclones and anticyclones
  - 4.3. Circulation systems
  - 4.4. Weather forecasting
  - 4.5. Intentional weather modification
5. Observed Climate Change in the Twentieth Century
  - 5.1. Surface Temperature and Precipitation Patterns
  - 5.2. Upper Air Temperature
  - 5.3. Atmospheric Circulation Patterns
  - 5.4. Oceans
  - 5.5. Glaciers and Ice Sheets
  - 5.6. Permafrost
  - 5.7. Climatic Extremes
6. Global Climate Models
7. Climate Projections and Future Climate
  - 7.1. Model Experiments
  - 7.2. Emission Scenarios and Climate Projections
  - 7.3. Global Patterns of Expected Climate Change
  - 7.4. Regional Trends
8. International Activity Concerning Climate

- 8.1. World Climate Program (WCP)
- 8.2. Global Climate Observing System (GCOS)
- 8.3. The Intergovernmental Panel on Climate Change (IPCC)
- 8.4. UN FCCC and The Kyoto Protocol on Climate Change
- 9. Conclusion

**Index** **383**

**About EOLSS** **393**

## VOLUME II

**Sustainable Development/Water Interactions** **1**

John Gladwell, *President, Hydro Tech International, Newcastle, Washington, USA*

- 1. Introduction. What is Sustainable Development?
- 2. Planning Concepts
  - 2.1. Single or Multiple Purpose (B/C ratio) Planning
  - 2.2. Multiple Objective Planning
  - 2.3. Integrated Water Resources Planning and Management
  - 2.4. Sustainable Development Planning
- 3. Sustainable Development Concepts and Procedures
  - 3.1. Introduction
  - 3.2. Acceptance of the Inevitability of Change
  - 3.3. Considerations of Scale
  - 3.4. Sustainability and Technology
  - 3.5. Considerations of Risk
  - 3.6. Considerations of the Environment
  - 3.7. Capacity Building
  - 3.8. Socio-Cultural Aspects
  - 3.9. Sustainability and Science
- 4. Achieving Sustainability
- 5. Conclusions

**Human Development and Water** **37**

Antonnius Bakkum, *Water Center for Humid Tropics of Latin America and the Caribbean, CATHALAC, Panama*

Maaik Kempkes, *Water Center for Humid Tropics of Latin America and the Caribbean, CATHALAC, Panama*

- 1. Introduction
- 2. The concept of human development
- 3. The Human Development Index
  - 3.1. When to use the HDI?
  - 3.2. Disaggregated HDI
  - 3.3. Country specific HDI
- 4. The concept of sustainable development
- 5. Water resources for human development

**Economic Development and Water** **45**

Leonard Berry, *Center for Environmental Studies, Florida Atlantic University, USA*

- 1. Introduction



2. Water and Economic Development at the National Level: General Principles
  - 2.1. Water and Economic Development in Sudan
  - 2.2. Tennessee Valley Authority (TVA)
  - 2.3. China: The Three Gorges Project
  - 2.4. The Pantanal
3. Sector Use of Water and Economic Development
4. Water Use in Irrigated Agriculture for Economic Growth
5. Urban Water and Economic Development
6. Conclusions

**Cultural Development and Water**

**60**

Tamara M. C. Beekman, *Psychologist - Brasilia , Brazil*

1. Introduction

**Human Interaction with Land and Water:A Hydrologist's Conception**

**73**

Malin Falkenmark, *Stockholm International Water Institute (SIWI), Sweden*

1. Freshwater: Our Joint Lifeblood
  - 1.1. Water and Life
  - 1.2. The Ongoing Paradigm Shift
2. Man and the Water Cycle
  - 2.1. Biosphere and Technosphere Share the Same Water
  - 2.2. Human Activities Involve Land and Water Manipulation
  - 2.3. A Land-Use Decision is also a Water Decision
  - 2.4. Upstream/Downstream Compromise Building
3. The Water Scarcity Syndrome
  - 3.1. Water Shortage Problems for Plant Production
  - 3.2. Extra Water is Crucial in Dry Climate Regions
  - 3.3. Basic Regional Differences in Water Predicament
  - 3.4. Implications for Food Production
  - 3.5. Adding the Coping Capability Dimension
4. Overcoming the Sectorization Scourge
  - 4.1. Many Different Water Functions to be Mastered
  - 4.2. Linking Professionals
5. Challenge for the Future: Handling Complexity

**Land Hydrology**

**93**

Stewart William Franks, *Centre of Environmental Dynamics, University of Newcastle, New South Wales, Australia*

1. Introduction
2. Traditional Hydrologic Field Measurement
  - 2.1. Discharge
  - 2.2. Rainfall
  - 2.3. Evapotranspiration
  - 2.4. Storage (Sub-surface Flows)
3. Spatial Analyses
  - 3.1. Digital Terrain Models (DTM)
  - 3.2. Groundwater Mapping and Management
4. Geoinformatics and Hydrological Modelling
  - 4.1. Distributed Hydrological Catchment Modelling
  - 4.2. Distributed Hydrological Measures
    - 4.2.1. Incorporating Distributed Measures of Water Table Dynamics
    - 4.2.2. Microwave Remote Sensing of Soil Moisture Fields

- 4.2.3. Incorporating Estimates of Saturated Areas
- 4.3. Estimation of Evapotranspiration
  - 4.3.1. Energy Balance Approaches to Estimating Spatially-variable Evapotranspiration
  - 4.3.2. Modelling Spatial Variability in Evapotranspiration
- 4.4. Floodplain Mapping and Inundation Modelling

**The Role of Forests in the Hydrological Cycle**

**114**

John M. Roberts, *Chief Plant Physiologist, Centre for Ecology and Hydrology-Wallingford, Wallingford, UK*

- 1. Introduction
- 2. The Hydrological Cycle in Forests
- 3. Forests and Hydrological Processes
  - 3.1. Forests and Rainfall
  - 3.2. Cloud Water Deposition
  - 3.3. The Physical and Physiological Background to Forest Evaporation
  - 3.4. Evaporation of Rain Intercepted by Forest Canopies
  - 3.5. Measurement and Modeling of Rainfall Interception
  - 3.6. Transpiration Loss from Forests
  - 3.7. Measurement of Forest Transpiration
    - 3.7.1. Soil Water Depletion
    - 3.7.2. Micrometeorological Methods
    - 3.7.3. Sap Flow Techniques
    - 3.7.4. Leaf/Branch Gas Exchange
  - 3.8. Controls of Forest Transpiration
    - 3.8.1. Forests and Solar Radiation
    - 3.8.2. The Roughness of Forests
    - 3.8.3. Surface Conductance of Forests
    - 3.8.4. Air Humidity Deficit
    - 3.8.5. Soil Water Availability
    - 3.8.6. Forest Understories
- 4. Effects of Afforestation/Deforestation on Streamflow
  - 4.1. Effects on Streamflow Amounts
    - 4.1.1. Clear Felling
    - 4.1.2. Thinning of Forests
  - 4.2. Forests and the Timing of Streamflow
- 5. Influence of Forests on Water Quality
  - 5.1. Forests and Stream Sediment
  - 5.2. Forests and Dissolved Substances
  - 5.3. Stream Salinity
  - 5.4. Acidification
  - 5.5. Streamside Buffer Strips

**Climate Change and Fisheries**

**149**

Salvador E. Lluch-Cota, *Centro de Investigaciones Biológicas del Noroeste (CIBNOR), P.O. BOX 128, La Paz, Baja California Sur 23000, Mexico*

- 1. Climate change
- 2. Fisheries
- 3. Fisheries and climate
- 4. Climate changes in the interannual to multidecadal scales
  - 4.1. ENSO impacting fisheries
  - 4.2. Other interannual signals
  - 4.3. Pacific Decadal Oscillation
  - 4.4. North Atlantic Oscillation
  - 4.5. Multidecadal regimes

- 4.6. Regime shifts
5. Global warming
6. Economic and social aspects of climate change and fisheries
7. Conclusions

**Melting of Polar Icecaps: Impact on Fisheries**

**162**

Mark Belchier, *British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge, UK.*

1. Introduction
2. Climate change and the melting of polar icecaps
3. Impacts on marine fisheries
4. Sea-level rise
5. Impact of sea level rise on marine fisheries
  - 5.1. Ecosystem impacts
  - 5.2. Infrastructure impacts on fishing communities
6. Reduction of Sea-Ice cover
7. Ice shelves and icebergs
8. Impact of salinity changes
  - 8.1. Ecosystem impacts
9. Discussion

**Dams, Pollution and Other Impediments to Migration and Spawning**

**177**

A. Bardonnnet, *Institut National de la Recherche Agronomique, Unite de Recherches en Hydrobiologie, St Pée sur Nivelle, France.*

R. Radtke, *University of Hawaii at Manoa, Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, USA*

1. Introduction
2. Impediments to Migration: River Obstacle Construction, Fishing, and Water Quality
  - 2.1. Physical Obstacles
  - 2.2. Fishing
  - 2.3. Water quality, flow regime and other factors
    - 2.3.1. Water quality
    - 2.3.2. Flow regime
    - 2.3.3. Other factors
3. Reproduction: Impact of pollutants and temperature, modifications of spawning habitat characteristics and danger of hybridization
  - 3.1. Water pollution and Temperature
  - 3.2. Spawning habitat
    - 3.2.1. Consequences of impoundment
    - 3.2.2. Consequences of channelization, water and gravel removal
  - 3.3. Hybridization
4. Perspectives

**Floods And Soil Erosion**

**195**

A.F. Mandych, *Department of Physical Geography and Land Use, Institute of Geography, Moscow, Russia*

1. Introduction
2. Water Erosion
3. Watershed Erosion
  - 3.1. Uniform Slope Site Erosion
  - 3.2. Slope Erosion
  - 3.3. Gully Erosion

4. Fluvial Systems
  - 4.1. Factors of Fluvial System Origination and Development
  - 4.2. Processes in River Channels
  - 4.3. Floods, Erosion, and Sediment Load
  - 4.4. Extreme Flood Erosion

**Classification Of Floods**

**218**

A.F. Mandych, *Department of Physical Geography and Land Use, Institute of Geography, Moscow, Russia*

1. Introduction
2. Factors and Conditions of Flood Generation
3. River Floods
  - 3.1. Long Duration Floods of Melt Water
  - 3.2. Short Duration Floods of Melted Water
  - 3.3. Ice Gorge Floods
  - 3.4. Ice Jam Floods
  - 3.5. Long Duration Floods of Rainwater
  - 3.6. Floods of Monsoon Rains
  - 3.7. Flash Floods
  - 3.8. Dam Break Floods
  - 3.9. Backwater Floods
  - 3.10. Mudflows
  - 3.11. Floods Caused by Icing
4. Inundation of Seacoasts
  - 4.1. Tides
  - 4.2. Storm Surges
  - 4.3. Tsunami
5. Floods of Inland Seas and Lakes
  - 5.1. Tides
  - 5.2. Wind Surges
  - 5.3. Seasonal Flooding
  - 5.4. Seiches
6. Human Impact
  - 6.1. Flooding of Urban Areas
  - 6.2. Prolonged River Floods
  - 6.3. Flash Floods
  - 6.4. Flooding due to Groundwater Rise
  - 6.5. Flooding by Irrigation
  - 6.6. Tsunami
7. Conclusion

**Infiltration and Ponding**

**245**

David Andrew Barry, *Ecole Polytechnique Fédérale de Lausanne, Switzerland*  
 Marc B. Parlange, *Ecole Polytechnique Fédérale de Lausanne, Switzerland*  
 Jean-Yves Parlange, *Cornell University, College of Engineering, USA*  
 Meng-Chia Liu, *Cornell University, College of Engineering, USA*  
 Tammo S. Steenhuis, *Cornell University, College of Engineering, USA*  
 Graham C. Sander, *Loughborough University, UK*  
 David A. Lockington, *University of Queensland, Australia*  
 Ling Li, *University of Queensland, Australia*  
 Frank Stagnitti, *Deakin University - School of Life & Environmental Science, Australia*  
 Shmuel Assouline, *Volcani Center, Israel*  
 John Selker, *Oregon State University, USA*  
 Dong-Sheng Jeng, *University of Sydney, Australia*  
 Randel Haverkamp, *Universite Joseph Fourier, France*

William B. Hogarth, *University of Newcastle, Australia*

1. Introduction
2. The Green and Ampt (1911) Model
  - 2.1. Derivation
3. Green and Ampt Model and Richards' Equation
4. Richards' Equation and Profile Analysis
  - 4.1.  $\theta_s$  Constant
  - 4.2.  $q$  Constant
5. Gravity Effects
6. Conclusions

### Mathematical Models of Soil Irrigation and Salting

270

Ludmila V. Kireycheva, *All-Russian Research Institute of Hydraulic Engineering and Land Reclamation, Russia*

1. Introduction
2. Balance models of calculation of the irrigation regime and crops productivity.
  - 2.1. The calculation of actual time and water delivery
  - 2.2. Water and salt balance calculation under slow drainage
  - 2.3. "Soil-water-crop-atmosphere" water exchange and crop species in modeling
  - 2.4. The calculation of scheduling program for sprinkler irrigation
  - 2.5. Water stress influence on crop yield at different phenological phases in irrigation scheduling
3. Simulation of water and salts transport in unsaturated-saturated soils.
  - 3.1. Vertical water transport in drainage and subsurface irrigation
  - 3.2. The one-dimensional model of vertical water salt transport
  - 3.3. One-dimensional model of salinity transport in unsaturated-saturated zone. Estimation of ion exchange and sorption
  - 3.4. The estimation models for the influence of salinity on ground water quality and crop yield
4. The complex simulation models
  - 4.1. Simulation of water flow, solute transport and plant growth in the "soil-water-atmosphere-plant-environment"
5. Conclusion

### Mathematical Soil Erosion Modeling

318

Graham C. Sander, *Loughborough University, UK*

C.W. Rose, *Griffith University, Australia*

W.L. Hogarth, *University of Newcastle, Newcastle, Australia*

Jean-Yves Parlange, *Cornell University, College of Engineering, USA*

I.G. Lisle, *University of Canberra, Australia*

1. Introduction
2. Surface Hydrology
  - 2.1. Analytical Solutions
  - 2.2. Field Applications
3. Soil Erosion Processes
  - 3.1. WEPP
  - 3.2. EUROSEM
  - 3.3. Rose - Hairsine Model
4. Steady State Solutions of the Rose - Hairsine Model
  - 4.1. Net Erosion Solutions ( $q_s = 0$  at  $x = 0$ )
    - 4.1.1. Rainfall-driven Erosion
    - 4.1.2. Flow Driven Erosion,  $\Omega > \Omega_{cr}$
  - 4.2. Net Deposition Solutions ( $q_s \neq 0$  at  $x=0$ )
    - 4.2.1. Single Size Class Solutions
    - 4.2.2. Multi-Size Class Solutions

- 4.2.3. Multi-Size Class Solutions with Rainfall Redetachment
- 5. Dynamic Erosion - Time Dependence
  - 5.1. Solutions for  $q = 0$  at  $x = 0$
  - 5.2. Solutions for  $q \neq 0$  at  $x = 0$
  - 5.3. Stochastic Sediment Transport Model
- 6. Field Scale

**Index** **369**

**About EOLSS** **377**