

# **Four Decades of Progress in Monitoring and Modeling of Processes in the Soil- Plant-Atmosphere System: Applications and Challenges 2013**

**Procedia Environmental Sciences Volume 19**

**Naples, Italy  
19-21 June 2013**

**ISBN: 978-1-63266-367-2**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© by Elsevier B.V.  
All rights reserved.

Printed by Curran Associates, Inc. (2014)

For permission requests, please contact Elsevier B.V.  
at the address below.

Elsevier B.V.  
Radarweg 29  
Amsterdam 1043 NX  
The Netherlands

Phone: +31 20 485 3911  
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)



ELSEVIER

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

SciVerse ScienceDirect

Procedia Environmental Sciences 19 (2013) iii–vi

Procedia

Environmental Sciences

## Contents

Preface	1
A. Santini	1
Contribution of the “Portici Group” to the Development of Agricultural Hydraulics	3
G.B. Chirico, G. Ciollaro, V. Comegna, A. Coppola, G. D’Urso, M. Palladino, N. Romano, G. Severino, A. Sommella	3
Fifty Years of Study of S-P-A Systems: Past Limitations and a Future Direction	15
J.M. Norman	15
Bayesian Inference of Tree Water Relations Using a Soil-Tree-Atmosphere Continuum Model	26
J. Rings, T. Kamai, M. Kandelous, P. Hartsough, J. Simunek, J.A. Vrugt, J.W. Hopmans	26
Influence of Three Root Spatial Arrangement on Soil Water Flow and Uptake. Results from an Explicit and an Equivalent, Upscaled, Model	37
N. Beudez, C. Doussan, G. Lefeuvre-Mesgouez, A. Mesgouez	37
Using a Diagnostic Soil-Plant-Atmosphere Model for Monitoring Drought at Field to Continental Scales	47
M.C. Anderson, C. Cammalleri, C.R. Hain, J. Otkin, X. Zhan, W. Kustas	47
Implementation of a Root Water Extraction Module in CATHY: Comparison of Four Empirical Root-density Distribution Models	57
M. Muma, S.J. Gumiere, A.N. Rousseau, C. Scudeler, C. Paniconi	57
A New Ecohydrological Model based on Richard Equation	67
C. Cortis, N. Montaldo	67
Leaf and Soil-Plant Hydraulic Processes in the Transpiration of Tropical Forest	77
Y. Miyazawa, N. Kobayashi, R.G. Mudd, M. Tateishi, T. Lim, N. Mizoue, T.W. Giambelluca, T. Kumagai	77
Feedbacks between Vegetation, Surface Structures and Hydrology during Initial Development of the Artificial Catchment ‘Chicken Creek’	86
W. Schaaf, M. Elmer, A. Fischer, W. Gerwin, R. Nenov, H. Pretzsch, M.K. Zaplata	86
Modelling the Functional Role of Microorganisms in the Daily Exchanges of Carbon between Atmosphere, Plants and Soil	96
H. Ibrahim, A. Hatira, M. Pansu	96
Tracing the Water Sources of Trees and Streams: Isotopic Analysis in a Small Pre-Alpine Catchment	106
D. Penna, O. Oliviero, R. Assendelft, G. Zuecco, I. (H.J.) van Meerveld, T. Anfodillo, V. Carraro, M. Borga, G.D. Fontana	106
Curve-Number/Green-Ampt Mixed Procedure for Net Rainfall Estimation: A Case Study of the Mignone Watershed, IT	113
A. Petroselli, S. Grimaldi, N. Romano	113
Olive Agroecosystems in the Mediterranean Basin: Multitrophic Analysis of Climate Effects with Process-based Representation of Soil Water Balance	122
L. Ponti, A.P. Gutierrez, B. Basso, M. Neteler, P.M. Ruti, A. Dell’Aquila, M. Iannetta	122
Olive Yield and Future Climate Forcings	132
F. Viola, D. Caracciolo, D. Pumo, L.V. Noto	132
Water Limitation and Negative Plant-Soil Feedback Explain Vegetation Patterns along Rainfall Gradient	139
A. Marasco, A. Iuorio, F. Carteni, G. Bonanomi, F. Giannino, S. Mazzoleni	139
Effects of Variably Layered Coarse Textured Oils on Plant Available Water and Forest Productivity	148
M. Huang, S.L. Barbour, A. Elshorbagy, J. Zettl, B.C. Si	148
Catchment Multisite Discharge Measurements for Hydrological Model Calibration	158
L. Boscarello, G. Ravazzani, M. Mancini	158
Modelling Vegetation Patterns in Semiarid Environments	168
S. Manfreda, T. Pizzolla, K.K. Caylor	168
Coupled Spatial Distribution of Rainfall and Temperature in USA	178
F. De Paola, M. Giugni	178
Analysis of Near-surface Soil Moisture Spatial and Temporal Dynamics in an Experimental Catchment in Southern Italy	188
P. Nasta, B. Sica, G.B. Chirico, S. Ferraris, N. Romano	188
Using HydroGeoSphere in a Forested Catchment: How does Spatial Resolution Influence the Simulation of Spatio-Temporal Soil Moisture Variability?	198
T. Cornelissen, B. Diekkruiger, H. Bogena	198
Analysis of Inter-Storm Period Soil Moisture Dynamics	208
E. Khaertidova, A. Longobardi	208
Water Balance in Afforestation Chronosequences of Common Oak and Norway Spruce on Former Arable Soils in Denmark as Evaluated Using the DAISY Model	217
O. Salazar, S. Hansen, P. Abrahamsen, K. Hansen, P. Gundersen	217
Utility of a Thermal-based Two-source Energy Balance Model for Estimating Surface Fluxes over Complex Landscapes	224
W.P. Kustas, M.C. Anderson, C. Cammalleri, J.G. Alfieri	224
Mass and Surface Energy Balance Approaches for Monitoring Water Stress in Vineyards	231
M. Palladino, A. Staiano, G. D’Urso, M. Minacapilli, G. Rallo	231
The Differential Response of Surface Fluxes from Agro-ecosystems in Response to Local Environmental Conditions	239
J.G. Alfieri, W.P. Kustas, J. Prueger, J. Baker, J. Hatfield	239
An Assessment of the Surface Energy and Water Balance in Mediterranean Desert Areas based only on Satellite Data	246
L. Campo, F. Caparrini	246

Recent Micrometeorological Studies of Sensible Heat Flux in the Plant-Atmosphere System F. Castellví, S. Consoli, R. Papa .....	256
Thermographic Imaging: Assessment of Drought and Heat Tolerance in Spanish Germplasm of <i>Brachypodium Distachyon</i> E. Benavente, L. García-Toledano, J.M. Carrillo, M. Quemada .....	262
The use of Micrometeorological data to Identify Significant Variables in Evapotranspiration Modeling A. Longobardi, P. Villani .....	267
Assessment of the Water Balance in an Alpine Climate: Setup of a Micrometeorological Station and Preliminary Results A. Negm, M. Falocchi, S. Barontini, B. Bacchi, R. Ranzi .....	275
Multi-pixel Calibration of a Distributed Energy Water Balance Model using Satellite data of Land Surface Temperature and Eddy Covariance data C. Corbari, G. Ravazzani, A. Ceppi, M. Mancini .....	285
Operative use of Eddy Covariance Measurements: Are High Frequency data Indispensable? D. Masseroni, C. Corbari, A. Ceppi, C. Gandolfi, M. Mancini .....	293
EVASPA (EVapotranspiration Assessment from SPACE) Tool: An Overview B. Gallego-Elvira, A. Oliosio, M. Mira, S. Reyes-Castillo, G. Boulet, O. Marloie, S. Garrigues, D. Courault, M. Weiss, P. Chauvelon, O. Boutron .....	303
Cellular Automata based Modeling for the Assessment of Ecohydrological Dynamics at the Hillslope Scale: Preliminary Results G. Mendicino, J. Pedace, A. Senatore .....	311
Modeling Groundwater-Soil-Plant-Atmosphere Exchanges in Fractured Porous Media A.M. Ireson, G. van der Kamp, U. Nachshon, A.P. Butler .....	321
Numerical Experiments on the Age of Seasonal Rain Water in Hillslopes A. Fiori, D. Russo .....	331
Comparing the Hydraulic Properties of Forested and Grassed Soils on an Experimental Hillslope in a Mediterranean Environment M. Pirastru, M. Castellini, F. Giadrossich, M. Niedda .....	341
Hillslope Vineyard Rainfall-runoff Measurements in Relation to Soil Infiltration and Water Content M. Biddoccu, S. Ferraris, E. Cavallo, F. Opsi, M. Previati, D. Canone .....	351
Monitoring and Modeling Farmland Productivity along the Venice Coastland, Italy G. Manoli, S. Bonetti, E. Scudiero, P. Teatini, P.J. Binning, F. Morari, M. Putti, M. Marani .....	361
Nonlinear Rhizosphere Dynamics Yields Synchronized Oscillations of Microbial Populations, Carbon and Oxygen Concentrations, Induced by Root Exudation B. Faybishenko, F. Molz .....	369
Going Back to the Roots: The Need to Link Plant Functional Biology with Vadose Zone Processes M.J. van der Ploeg, A.J. Teuling .....	379
Three-and-a-half Decades of Progress in Monitoring Soils and Soil Hydraulic Properties R.H. Cuenca, Y. Hagimoto, M. Moghaddam .....	384
Monitoring Soil-Plant Interactions in an Apple Orchard Using 3D Electrical Resistivity Tomography J. Boaga, M. Rossi, G. Cassiani .....	394
Can We Use Electrical Resistivity Tomography to Measure Root Zone Dynamics in Fields with Multiple Crops? S. Garré, I. Coteur, C. Wonglecharoen, K. Hussain, W. Omsunrarn, T. Kongkaew, T. Hilger, J. Diels, J. Vanderborgh .....	403
Soil Databases in Support of Pan-European Soil Water Model Development and Applications G. Tóth, M. Weynants, M. van Liedekerke, P. Panagos, L. Montanarella .....	411
Use of a Fractional Brownian Motion Model to Mimic Spatial Horizontal Variation of Soil Physical and Hydraulic Properties Displaying a Power-law Variogram A. Comegna, A. Coppola, V. Comegna, A. Sommella, C.D. Vitale .....	416
Wireless Sensor Network Deployment for Monitoring Soil Moisture Dynamics at the Field Scale B. Majone, F. Viani, E. Filippi, A. Bellin, A. Massa, G. Toller, F. Robol, M. Salucci .....	426
A Geostatistical Approach to Estimate Soil Moisture as a Function of Geophysical data and Soil Attributes D. De Benedetto, A. Castrignanò, R. Quarto .....	436
A Non-invasive Approach to Monitor Variability of Soil Water Content with Electromagnetic Methods B. Ortuani, A. Benedetto, M. Giudici, M. Mele, F. Tosti .....	446
Towards Improved Understanding of Land Use Effect on Soil Moisture Variability: Analysis and Modeling at the Plot Scale G. Zuecco, M. Borga, D. Penna, D. Canone, M. Previati, S. Ferraris .....	456
Spreadsheet Soil Moisture Dynamics T. Aoda, K. Noborio, E. Inao .....	465
TDR-LAB 2.0 Improved TDR Software for Soil Water Content and Electrical Conductivity Measurements E. Fatás, J. Vicente, B. Latorre, F. Lera, V. Viñals, M.V. López, N. Blanco, C. Peña, C. González-Cebollada, D. Moret-Fernández .....	474
Principles and Applications of a New Class of Soil Water Matric Potential Sensors: The Dihedral Tensiometer C.M.P. Vaz, A.G. Calbo, L.F. Porto, L.H. Porto .....	484
Prediction of Soil Texture Distributions Using VNIR-SWIR Reflectance Spectroscopy D. Curcio, G. Ciraolo, F. D'Asaro, M. Minacapilli .....	494
Characterization of Evapotranspiration over Irrigated Crops in a Semi-arid Area (Marrakech, Morocco) using an Energy Budget Model A. Diarra, L. Jarlan, S. Er-Raki, M. Le Page, S. Khabba, G. Bigeard, A. Tavernier, J. Chirouze, P. Fanise, A. Moutamanni, J. Ezzahar, M.H. Kharrou, G. Chehbouni .....	504
Towards Optimizing Experiments for Maximum-Confidence Model Selection between Different Soil-Plant Models T. Wöhling, A. Geiges, W. Nowak, S. Gayler, P. Högy, H.D. Witzmann .....	514
The SudMed Program and the Joint International Laboratory TREMA: A Decade of Water Transfer Study in the Soil-Plant-Atmosphere System over Irrigated Crops in Semi-arid Area S. Khabba, L. Jarlan, S. Er-Raki, M. Le Page, J. Ezzahar, G. Boulet, V. Simonneaux, M.H. Kharrou, L. Hanich, G. Chehbouni .....	524
Improving Simulation of Soil Water Balance Using Lysimeter Observations in a Semiarid Climate M. Soldevilla-Martinez, R. López-Urrea, L. Martínez-Molina, M. Quemada, J.I. Lizaso .....	534

Estimating Precipitation and Actual Evapotranspiration from Precision Lysimeter Measurements F. Schrader, W. Durner, J. Fank, S. Gebler, T. Pütz, M. Hannes, U. Wollschläger .....	543
Modeling Soil Water Movement under Low Head Ponding and Gravity Infiltration Using Data Determined with Different Methods E.V. Shein, A.V. Dembovetsky, S.S. Panina .....	553
Specific Water Regime in Technogenic Soils: Preferential Water Flow Formation A.B. Umarova, E.V. Shein, E.Yu. Milanovskiy, A.V. Dembovetsky .....	558
Simultaneous Estimation of Soil Hydraulic and Root Distribution Parameters from Lysimeter Data by Inverse Modeling H. Schelle, W. Durner, S.C. Iden, J. Fank .....	564
Parameter Identification for Root Growth based on Soil Water Potential Measurements – An Inverse Modeling Approach K. Zhang .....	574
Estimate of Soil Hydraulic Properties from Disc Infiltrometer Three-dimensional Infiltration Curve: Theoretical Analysis and Field Applicability B. Latorre, D. Moret-Fernández, C. Peña .....	580
Inferring the Hydraulic Properties of a Historical Soil: A Revisiting of Perrault's Experiments S. Barontini, M. Grotto, M. Pilotti .....	590
Testing a Simplified Approach to Determine Field Saturated Soil Hydraulic Conductivity V. Bagarello, M. Castellini, S. Di Prima, G. Giordano, M. Iovino .....	599
Prediction of Unsaturated Relative Hydraulic Conductivity from Kosugi's Water Retention Function P. Nasta, S. Assouline, J.B. Gates, J.W. Hopmans, N. Romano .....	609
Scaling Analysis of Water Retention Curves: A Multi-fractal Approach M. Veltri, G. Severino, S. De Bartolo, C. Fallico, A. Santini .....	618
Consequences of Salinity-induced-time-dependent Soil Hydraulic Properties on Flow and Transport in Salt-affected Soils D. Russo .....	623
Stochastic Modelling of the Length of Steady Plumes Undergoing Bioremediation A. Zarlenga, A. Fiori .....	633
Monitoring and Modeling Root-uptake Salinity Reduction Factors of a Tomato Crop under Non-uniform Soil Salinity Distribution N. Chaali, A. Comegna, G. Dragonetti, M. Todorovic, R. Albrizio, D. Hijazeen, N. Lamaddalena, A. Coppola .....	643
Soil Chemical Aspects of Water Management: Modeling Topsoil Water, Salt and Sodicity Dynamics S.E.A.T.M. van der Zee, S.H.H. Shah, A. Leijnse .....	654
The Impact of Field Data Acquisition Methodology upon Prediction of Transport in the Made Aquifer A. Fiori, G. Dagan .....	663
Contamination of the Environmental Matrices in Agricultural Areas Produced by Industrial Discharges: The Case Study of the Land of the City of Statte (Taranto, Southern Italy) S. Pascuzzi, G. Russo, G.S. Mugnozza, G. Verdiani, G. Lagattolla .....	671
Increasing Evidence for Chaotic Dynamics in the Soil-Plant-Atmosphere System: A Motivation for Future Research F. Molz, B. Faybishenko .....	681
Modelling of Drainage and Hay Production over the Crau Aquifer for Analysing Impact of Global Change on Aquifer Recharge A. Oliosio, R. Lecerf, A. Baillieux, A. Chanzy, F. Ruget, O. Banton, P. Lecharpentier, F. Trolard, A.-L. Cognard-Plancq .....	691
Dielectric Response of a Variable Saturated Soil Contaminated by Non-Aqueous Phase Liquids (NAPLs) A. Comegna, A. Coppola, G. Dragonetti, A. Sommella .....	701
A Stochastic Texture-based Approach for Evaluating Solute Travel Times to Groundwater at Regional Scale by Coupling GIS and Transfer Function A. Coppola, A. Comegna, G. Dragonetti, L. De Simone, N. Lamaddalena, P. Zdruli, A. Basile .....	711
Effective Size Characteristics of Suspended Sediment and Nutrient Concentrations during Flood Events in the Reno River Tributaries (Northern Italy) D. Pavanelli, L. Selli .....	723
Testing Different Topographic Indexes to Predict Wetlands Distribution R. Infascelli, S. Faugno, S. Pindozi, L. Boccia, P. Merot .....	733
Assessment of the SiSPAT SVAT Model for Irrigation Estimation in South-East France I. Braud, F. Tilmant, R. Samie, I. Le Goff .....	747
Factors Explaining On-site Irrigation Performance Variability in Triffa's Irrigated Perimeter (East Morocco) N. Feltz, M. Vanclooster .....	757
Strategies to Improve Cereal Production in the Terai Region (Nepal) during Dry Season: Simulations with Aquacrop N. Shrestha, D. Raes, S.K. Sah .....	767
Real Time Drought Forecasting System for Irrigation Management A. Ceppi, G. Ravazzani, C. Corbari, S. Meucci, F. Pala, R. Salerno, G. Meazza, M. Chiesa, M. Mancini .....	776
Calibration of WAVE in Irrigated Maize: Fallow vs. Cover Crops J.L. Gabriel, M. Quemada, J. Vansteenkiste, J. Diels, M. Vanclooster .....	785
Monitoring and Modelling Evapotranspiration in Flooded and Aerobic Rice Fields A. Facchi, O. Gharsallah, E.A. Chiaradia, G.B. Bischetti, C. Gandolfi .....	794
An Agent based Modeling for the Gravity Irrigation Management S. Belaqziz, A. El Fazziki, S. Mangiarotti, M. Le Page, S. Khabba, S. Er Raki, M. El Adnani, L. Jarlan .....	804
Effectiveness Assessment of Pipe Systems by Means of Transient Test-based Techniques B. Brunone, M. Ferrante, S. Meniconi, C. Massari .....	814
IRRINET: Large Scale DSS Application for On-Farm Irrigation Scheduling P. Mannini, R. Genovesi, T. Letterio .....	823
Climate Variability and Durum Wheat Adaptation using the AquaCrop Model in Southern Sardinia A. Soddu, R. Deidda, M. Marrocu, R. Meloni, C. Paniconi, R. Ludwig, M. Sodde, G. Mascaro, E. Perra .....	830
Using EM Equipment to Verify the Presence of Seepage Losses in Irrigation Canals D. Pognant, D. Canone, M. Previati, S. Ferraris .....	836

Hydrological Minimal Model for Savanna Fire Frequency Assessment N. Ursino . . . . .	846
Spatio-Temporal Vegetation Recuperation after a Grassland Fire in Lithuania P. Pereira, A. Cerda, A. Jordan, V. Bolutiene, M. Pranskevicius, X. Ubeda, J. Mataix-Solera . . . . .	856
Invasion Impact of the Nitrogen-fixing Shrub <i>Genista aetnensis</i> on Vesuvius Grand Cone A. Stinca, P. Conti, G. Menegazzi, G.B. Chirico, G. Bonanomi . . . . .	865
On the Estimation of Surface Runoff through a New Plot Scale Rainfall Simulator in Sardinia, Italy R. Corona, T. Wilson, L.P. D'Adderio, F. Porcù, N. Montaldo, J. Albertson . . . . .	875
Hyperspectral Image Analysis in Environmental Monitoring: Setup of a New Tunable Filter Platform M. Moroni, E. Lupo, E. Marra, A. Cenedese . . . . .	885
Fluorescent Particles for Non-intrusive Surface Flow Observations F. Tauro, S. Grimaldi, M. Porfiri, A. Petroselli . . . . .	895
Effect of Vegetation on Fluvial Erosion Processes: Experimental Analysis in a Laboratory Flume D. Termini . . . . .	904
Impact of Land Cover Change on Soil Erosion Hazard in Northern Jordan Using Remote Sensing and GIS M.M. Alkharabsheh, T.K. Alexandridis, G. Bilas, N. Misopolinos, N. Silleos . . . . .	912
Effects of the Vegetation on the Hydrological Behavior of a Loose Pyroclastic Deposit L. Comegna, E. Damiano, R. Greco, A. Guida, L. Olivares, L. Picarelli . . . . .	922
Role of Vegetation on Slope Stability under Transient Unsaturated Conditions G.B. Chirico, M. Borga, P. Tarolli, R. Rigon, F. Preti . . . . .	932
Optimization of on Demand Pressurized Irrigation Networks and On-Farm Constraints R. Khadra, N. Lamaddalena, N. Inoubli . . . . .	942
Characterization of the Heterogeneous Flow and Pollutant Transfer in the Unsaturated Zone in the Fluvio-glacial Deposit T. Winiarski, L. Lassabatere, R. Angulo-Jaramillo, D. Goutaland . . . . .	955
Thanks to our Reviewers . . . . .	965