



RAUL PATTERSON

Project Engineer

Academic Background

Bachelor of Science, Civil Engineering, Florida Atlantic University, Miami, FL, 1994

Specialized Professional Competence

Mr. Patterson is a civil engineer with 15 years experience in the fields of groundwater field studies and modeling, GIS application development, and engineering in South Florida. He has provided model interfacing for major utilities, coordinating with a variety of cooperating agencies; conducted all phases of model application for simulating transport of groundwater in coastal aquifers; and served as project manager for a major hydrologic study of five urban South Florida basins. He is particularly skilled in software design for GIS-model interfacing and other aspects of GIS applications, groundwater modeling, and hydrologic studies, and has a good working knowledge of biogeochemistry. Mr. Patterson works with SWC as a contract employee, and also has his own consulting firm.

Representative Professional Experience

Project Engineer, SWC, August 2009-present, Key West, Fort Myers & Miami, FL

Provide engineering services for projects involving major GIS applications, hydrologic and geologic modeling, field data collection, report preparation, and presentation of project results.

Project Manager, 1999-2003, U.S. Geological Survey, Miami, FL

Managed federal research projects in South Florida. Projects included all phases of model application for simulating transport of groundwater in coastal aquifers with SEAWAT, GIS software development for Telescopic Mesh Refinement using MODFLOW, management of a large three-year hydrologic field testing and analysis project in five urban basins in Miami-Dade County (including plan design and implementation, logistics/operational support, GIS database design and development, and reporting).

GIS Team Leader, 1997-1999, PBS&J, Miami, FL

GIS lead for model interfacing for Miami-Dade Water and Sewer Department, GIS application developer for Federal Emergency Management Agency and Florida Department of Transportation, and provided GIS training and client support.

Examples of Relevant Projects

Quantification of Rainfall-Runoff Processes in Urban and Agricultural Areas of South Miami-Dade County, Florida, U.S. Geological Survey & South Florida Water Management District, 2000-2003

Summary: project to simulate hydrologic processes involved in the complex rainfall-runoff relationship in the urban and agricultural areas of south Florida. Infiltration was measured with double-ring infiltrometers in 100 sites distributed among the soil types and land uses. Soil testing sieve analysis was performed at each site to correlate infiltration rates with grain size distribution, yielding acceptable results. Other processes studied were rainfall and open channel flow. Rainfall was analyzed with time series analysis, including principal component analysis of daily rainfall among several rain gauges and use of NEXRAD data retrieved from NWS Office of Hydrology to spatially extrapolate rain gauge measured rainfall. The open channel flow network was modeled in GIS using the National Hydrography Dataset (NHD), a GIS network model for representing open channel networks which is the precursor of the ArcHydo data model. Raul modified the NHD to overcome its strict adherence to the dendritic network model in order to adequately represent the altered and managed system. Work included:

- Field tests of soil infiltration and hand-auger sampling using ASTM standard methods & GPS/Mapping, MS Access Database creation and automation (data management) and integration with Excel (incl. use of the Excel statistical package) for regressions using standard statistical methods (decay function model fitting by least squares, etc...).
- GIS/Geostatistical analysis to correlate field-tested soil properties with soil areas and extrapolate them using the USDA SSURGO soil maps (SFWMD source) for the C-102, C-103, HARB, Florida City Canal basins in south Miami-Dade (abutting much of the Biscayne Bay Coastal Wetlands project footprint). Correlated ASTM soil tests to the soil types and performed statistical analysis within the soil types. Used multi-level database (assembled from individual tables using documentation into an MS Access RDBMS to use the relationships between tables).



- Geostatistical: creation of Digital Terrain Model (DTM) of ground surface using LiDAR xyz point cloud data. Used levees, berms and elevated highways as breaklines, extrapolating Z values linearly along them. For natural areas and less disturbed areas, used natural trends for semivariogram modeling with acceptable results. Presented at the American Water Resources Association GIS Symposium, 2004, Nashville, TN.
- Study of water quantity and quality related to natural systems hydrodynamics (sheet flow in wetlands) as well as man-made systems (water control structures and storm water management BMPs). Sediment transport, erosion control. Review and assessment of hydraulic structures (incl. gates, weirs, culverts, water retention ponds).

Groundwater Flows to Biscayne Bay, USGS, SFWMD and Miami-Dade County, 1999-2000

Summary: a 5-year cooperative project between the USGS and SFWMD to: (1) simulate the position and shape of the transition zone (zone of diffusion between salt water and freshwater) in the *Biscayne Aquifer*, and, (2) the timing, distribution and quantity of groundwater flows to *Biscayne Bay*. Raul Patterson, while working with USGS applied SEAWAT, a MODFLOW-MT3D coupling program for simulating variable density groundwater flow. Using ArcInfo and Groundwater Vistas, input packages for SEAWAT were prepared for aquifer properties and boundary conditions to simulate the mixing zone between the freshwater flow system in the aquifer and the saltwater region of the system underlying the bay and wedging beneath the fresh water in the mainland. Stresses were averaged over 30-day periods for the 10-year simulation which included both wet and dry seasons. The shape and position of the saltwater wedge were simulated effectively; also, measured canal flows and groundwater heads were matched effectively. Project also included GIS analysis and map creation with benthic community map of Biscayne Bay (bottom covers) to compare with groundwater salinity distributions from modeling simulations.

Development of GIS software for Telescopic Mesh Refinement (MODTMR), USGS, SFWMD and Palm Beach County Environmental Resources Management, 2000-2001

Summary: A project to develop GIS software for simulating groundwater flow in embedded, finer-discretized models. The "local" model is embedded in an existing larger "Regional" MODFLOW model from which aquifer parameters and hydrostratigraphic unit geometry are extracted for the local model. Boundary conditions of head and flow are obtained from the head and flow solution files of the regional model and scaled and distributed along the boundaries of the local model using the FHB package. Three GUIs were programmed in ArcView 3.x: AvMODTMR, AvHDRD, and AvWell. AvMODTMR allows interactive creation of the local model and specification of boundary conditions, then creates the input file for MODTMR; AvHDRD and AvWell are optional and they refine spatially the geometry of Rivers, Drains and Wells in the local model, overwriting the MODTMR-created input files for those three packages.

Other Areas of Technical Experience

- Oakton Turbidity probe: turbidity monitoring during CERP earth-work activities for canal plugging of segment of L31.
- YSI Sonde w/GPS: conductivity, temperature and pH, including GPS integration for creating spatial datasets of conductivity in the Biscayne Bay Coastal Wetlands, flow-through conductivity surveys in shallow near-shore areas using kayak.
- Karst/conduit flow zones in the aquifer, including independent (unfunded) field surveys with USGS geophysicist of solution holes and fissures/laminar voids in the aquifer in the inter-phreatic zone...potential sources of Submarine Groundwater Discharge (SGD) areas.
- Lineaments (linear features/cracks in aquifer), field surveys of the Ridge/Slough ((upland/wetland) and the transitions zone (ecotones).
- Software
 - ArcGIS 9.x, ArcView 3.x
 - Microsoft: Access (advanced user), Excel (advanced user)
 - Surfer 9
 - Groundwater Vistas



- GIS
 - Spatial analysis, including Krigging (w/ semivariogram modeling)
 - Surfaces generation (from point, breaklines, to create TINs)
 - Dynamic Segmentation (including script programming for model interfacing)
 - Network design and analysis (NHD and ArcHydro)
- Programming
 - ArcView/ArcInfo VBA
 - Java
 - Visual Basic .NET
- Database/SQL and Data Processing
 - SFWMD's DBHYDRO SQL Oracle scripting to retrieve, summarize, and format data files.
 - USGS NWISWeb data retrieval for groundwater levels and stream discharge.
- Hydrologic field tests
 - Monitoring well installation (overseeing a drilling crew), development, and sampling (water quality sampling as per FDEP approved CompQAP). Approximately 15 wells.
 - Double-ring infiltrometer tests in agricultural and urban areas of coastal watersheds (C-102 and C-103 in southern Miami-Dade County). Over 100 tests performed and spatially extrapolated based on GIS soil and land use data.
 - Discharge measurements with Acoustic Doppler Velocity Meter to rate discharge measurements in an urban canal.
- Remote Sensing (hydrology-related)
 - NEXRAD data retrieval from NWS Office of Hydrology and processing to extract ASCII from binary for rainfall-runoff analysis.
 - LIDAR data processing to create DTMs in agricultural and coastal urban areas.

Publications

- Chin, D.A., Patterson, R.D., 2005, *Quantification of Hydrologic Processes and Assessment of Rainfall-Runoff Models in Miami-Dade County, Florida*. Scientific Investigations Report 2004-5191
- Langevin, C.D., 2001, *Simulation of Ground-Water Discharge to Biscayne Bay, Southeastern Florida*: [WRIR 00-4251](#), 127 p., 3 pls. (documentation of Biscayne Bay Groundwater Flows study described above), also online at http://fl.water.usgs.gov/Abstracts/wri00_4251_langevin.html
- Renken R. A., Patterson, R.D. and others. 2002, *Approach for Delineation of Contributing Areas and Zones of Transport to Selected Public-Supply Wells Using a Regional Ground-Water Flow Model, Palm Beach County, Florida*: WRIR-01-4158, online at: http://fl.water.usgs.gov/Abstracts/wri01_4158_renken.html

