Report as of FY2006 for 2003NY33G: "An Assessment of New Advances in Low Streamflow Estimation and Characterization"

Publications

- Conference Proceedings:
  - Matonse, AH and C N Kroll, 2005, Simulation of baseflow and low streamflow statistics using the SAC-SMA model and a SAC-SMA/Hillslope-Storage Boussinesq model, Fall AGU meeting, San Francisco, California, December 2005.
  - Kroll, C N, Z Zhang, and S Hirabayashi, 2005, A comparison of regional regression and baseflow correlation for estimating low streamflow statistics, Fall AGU meeting, San Francisco, California, December 2005.
  - Zang, Z and C N Kroll, 2006, Estimation of low streamflow statistics using baseflow correlation with multiple gauged sites, American Geophysical Union conference, Baltimore, MD, Spring 2006.
- Other Publications:
  - Zhang, Z, and C N Kroll, 2005, Estimation of low streamflow statistics at ungauged sites using baseflow correlation, American Geophysical Union conference, New Orleans, LA; Spring 2005.
  - Hirabayashi, S, C N Kroll, 2005, Developing a geospatial data model to derive watershed characteristics for low streamflow prediction, American Geophysical Union conference, New Orleans, LA, Spring 2005.
- Articles in Refereed Scientific Journals:
  - Zang, Z and C N Kroll, 2005, A closer look at baseflow correlation, submitted to the ASCE Journal of Hydrologic Engineering, July 2005. Decision pending.
  - Hirabayshi S, and C N Kroll, 2006, Automating regional descriptive statistic computations for environmental modeling, resubmitted to Computers & Geosciences, January 2006. Decision pending.
- Dissertations:
  - Hirabayashi, S, 2005, Examining the Impact of Raster Datasets on Flood and Low Streamflow Regional Regession Models Using a Custom GIS Application,MS Thesis, Dept. of Environmental Resources and Forest Engineering, SUNY College of Environmental Science and Forestry, Syracuse, NY
  - Zhang, Z, 2005, Advances in Low Streamflow Statistics Estimation Using Baseflow Correlation, PhD Thesis, Dept. of Environmental Resources and Forest Engineering, SUNY College of Environmental Science and Forestry, Syracuse, NY
  - Luz, J, 2005, Investigating Improvements in Low Streamflow Regression Models, PhD Thesis, Dept. of Environmental Resources and Forest Engineering, SUNY College of Environmental Science and Forestry, Syracuse, NY

Report Follows

Title: An Assessment of New Advances in Low Streamflow Estimation and Characterization

PI Chuck Kroll

Principal findings or significant results:
Research on this project began in May 2004, and thus we have completed 2 years of this 3 year project. We have focused our primarily research on two data sets: the USGS's Hydro-Climatic Data Set (HCDN) and a study area encompassing eastern Tennessee and western North Carolina that was chosen by personnel from the USGS's Reston, VA office. Using these study areas, the following has been found:

1. Most of the underlying assumptions of the baseflow correlation technique appear to be valid for the continental United States.
2. The baseflow correlation technique can be improved if multiple sites are used to transfer information to the ungauged site. These improvements are greatest when less than 8 baseflow observations are available, and diminish with more than 8 observations.
3. In the eastern Tennessee/western North Carolina study area, lowflow regional regression models were greatly improved by inclusion of mapped values of the baseflow index. These findings have encouraged us to pursue an investigation of spatial interpolation of watershed hydrogeologic characteristics.
4. The horizontal resolution of the DEM employed to derived watershed boundaries had little impact on the quality of the derived watershed characteristics. This may have to do with the large horizontal resolution of the raster datasets employed in this study.
5. The use of raw MODIS data appears to have some predictive information for hydrologic modeling, though interestingly it appears to have more of an impact on floods than droughts. We are further investigating this issue with multi-band remotely sensed indexes.
6. Regional regression and baseflow correlation perform similarly in the eastern Tennessee/western North Carolina study area, with regional regression outperforming baseflow correlation, especially when the baseflow index is included in the regression models.
1. We are now beginning research in Idaho, where the USGS has been performing numerous low streamflow investigations. We also hope to select a more arid study region, as low streamflow estimation typically performs poorly in these areas.

Notable Achievements:
This research has resulted in two notable achievements. The first is the development of a GIS tool to automate the calculation of descriptive statistics from multiple raster datasets across watersheds in a region of interest. This tool was created to be of use with any polygon coverage, and thus can be employed with state, county, city, property, or any other boundaries of interest. Such flexibility makes this tool of wide interest to many researchers, not only hydrologists. The tool is freely available to the public and can be downloaded at www.esf.edu/erfeg/kroll. A tutorial has been created to aid users of this tool. The second notable achievement is that this research has inspired the creation of an International Association of Hydrologic Sciences (IAHS) Prediction at Ungauged Basins (PUBs) low streamflow work group. This group is currently being formed as a joint venture with the Northern European Flow Regimes from International Experimental and Network Data (NE FRIEND), and will focus on international cooperation and information exchange with respect to low streamflow estimation. Through this group, a number of low streamflow study areas will be created throughout the world. These study areas will be the focus of long-term low streamflow research. Research from this group will help us better understand the performance of various estimators of low streamflow statistics at ungauged river sites in different hydrologic setting, as well as the uncertainty associated with these estimators.

Student support:

1. Zhenxing Zhang, PhD, Area of Study: Water Resource Engineering, PhD Topic: Baseflow Correlation.
2. Satoshi Hirabayashi, MS, Area of Study: GIS and Water Resources, MS Topic: GIS Tools Watershed Characterization.
3. Adao Matonse, PhD, Area of Study: Water Resource Engineering, PhD Topic: Hillslope Models for Low Streamflow Prediction.
4. Satoshi Hirabayashi, PhD, Area of Study: GIS and Water Resources, PhD Topic: Advanced Mapping Techniques to Aid in Low Streamflow Prediction.

Publications:

Journal Articles (numerous articles are in progress)

- Zhang, Z, and C N Kroll, 2005, A Closer Look at Baseflow Correlation, submitted to the ASCE Journal of Hydrologic Engineering, July 2005. Decision Pending.
- Hirabayashi, S, and C N Kroll, 2006, Automating regional descriptive statistic computations for environmental modeling, resubmitted to Computers & Geosciences, January 2006. Decision Pending.

Theses

- Hirabayashi, S, Examining the Impact of Raster Datasets on Flood and Low Streamflow Regional Regression Models Using a Custom GIS Application, MS Thesis, December, 2005.
- Zhang, Z, Advances in Low Streamflow Statistics Estimation Using Baseflow Correlation, PhD Thesis, December, 2005.
- Luz, J., Investigating Improvements in Low Streamflow Regression Models, PhD Thesis, January, 2005.

Conference Proceedings/Presentations

- Zhang, Z, and C N Kroll, 2005, Estimation of low streamflow statistics at ungauged sites using
- baseflow correlation, American Geophysical Union conference, New Orleans, LA; Spring 2005.
- Hirabayashi, S, and C N Kroll, 2005, Developing a geospatial data model to derive watershed
- characteristics for low streamflow prediction, American Geophysical Union conference, New
- Orleans, LA, Spring 2005.
- Matonse, A H, and C N Kroll, 2005, Simulation of baseflow and low streamflow statistics using the SAC-SMA model and a SAC-SMA/Hillslope-Storage Boussinesq model, Fall AGU meeting, San Francisco, California, December 2005.
- Kroll, C N , Z Zhang, and S Hirabayashi, 2005, A comparison of regional regression and baseflow correlation for estimating low streamflow statistics, Fall AGU meeting, San Francisco, California, December 2005.
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