

## MOHAMMAD ABOUALI, Ph.D.

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**LinkedIn:** <https://www.linkedin.com/in/mohammad-abouali-2196ba11>

(I don't have any facebook account)

## EXPERIENCE

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### Michigan State University

#### Assistant Professor (fixed term)

Feb. 2017 - Present

- Assistant Professor at Decision Support and Informatics (DSI) unit;
- Oversee all graduate and undergraduate students working in the DSI Unit on a daily basis;
- Setup and compile tasks for high performance computing and parallel processing;
- Researching & Developing geo-spatial cyber-infrastructure, web-tools, high-performance codes, and Machine Learning Algorithms for applications in Agriculture, Environment, climate modeling, hydrological modeling, and geosciences;
- Help with preparing quarterly, annual, monitoring, and evaluation reports;
- Teaching "Water Resources System Analysis & Modeling" (BE 481) and ArcGIS.

### Michigan State University

#### Research Associate

Feb. 2015 – Feb. 2017

- Postdoctoral Research Associate at Decision Support and Informatics (DSI) unit, Global Center for Food System Innovation (GCFSI);
- Oversee all graduate and undergraduate students working in the DSI Unit on a daily basis;
- Setup and compile tasks for high performance computing and parallel processing;
- Collaborate with all researchers in the GCFSI to identify computational Needs for GCFSI-MSU lead projects;
- Assist USAID GeoCenter, BFS, E3, and their missions in understanding DSI capabilities and resources to expand Collaborative work with GCFSI;
- Distribute tasks between programmers and ensure timely delivery of products;
- Help with preparing quarterly, annual, monitoring, and evaluation reports;
- Developing online geospatial processing and visualizations tools, using various technologies including (but not limited to) ESRI JavaScript API, Cesium, and DOJO;
- Teaching "Water Resources System Analysis & Modeling" (BE 481) and ArcGIS.

### Farm Intelligence<sup>2</sup> (Aglytix)

#### Data Scientists

Oct. 2013 – Feb. 2015

- Lead developer for Various remote sensing and computer vision algorithms;
- Developed machine learning algorithms to automatically process images obtained via UAVs or drones;
- Developed automatic algorithm to process imageries obtained via UAVs to produce information and maps regarding the abundance and health of the crops;
- Using various different data mining algorithms;
- Parallel processing and high-performance computing;
- Experienced Agile methodologies in software development.

## **National Center for Atmospheric Research (NCAR)**

### **Summer Internship in Parallel Computational Science (SIParCS) Intern      May – July. 2013**

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- Mentor: Alan Norton (Computational & Information System Laboratory – Data Analysis Services Group)
- Co-Mentor:
  - o Rick Brownrigg (Computational & Information System Laboratory – Data Visualization & Analysis Tools)
  - o John Clyne (Computational & Information System Laboratory – Data Analysis Services Group)
- Project Name: Visualization of Weather Simulation Data in Google Earth.
- Activities: Providing new features within the NCAR Command Language (NCL) to export Data into KML format to be visualized on Google Earth. Special functions were developed within NCL to export structured and unstructured data onto Google Earth, visualizing velocity vectors, measurements and airplane paths, and some other features.

## **University of Twente**

### **Visiting Scientists/Scholars**

**Aug. – Dec. 2011**

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- Leded developing a high performance Surface Energy Balance System (SEBS) algorithms using CUDA-C and Graphics Processing Units (GPUs). I was able to achieve over 550 times speed-up. The results were published in Environmental Modeling & Software journal and the codes were made publicly available via Google Code.
- Provided both C and Java implementation of SEBS algorithm.
- Implemented SEBS using Java API of Google Earth Engine (EE).

## **National Center for Atmospheric Research (NCAR)**

### **Summer Internship in Parallel Computational Science (SIParCS) Intern      May – July. 2011**

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- Summer Internship in Parallel Computational Science (SIParCS)
- Mentor: David Brown (Computational & Information System Laboratory – Data Visualization & Analysis Tools)
- Co-Mentor:
  - o Mary Haley (Computational & Information System Laboratory – Data Visualization & Analysis Tools)
  - o Rick Brownrigg (Computational & Information System Laboratory – Data Visualization & Analysis Tools)
  - o Dennis Shea (Climate and Global Dynamics Laboratory – Climate Analysis)
- Project Name: Implementing a new suite of remapping functions within the NCAR Command Language (NCL)
- Project Description: Certain functions were developed to assist the user interpolating data from any grid to any other. The interpolation weights are generated using Earth System Modeling Framework (ESMF), using (1) Bilinear, (2) Conservative, or (3) Patch interpolation schemes. The functions were successfully used to interpolate data from different grids, either structured or unstructured grid, to various grid types. MPAS, Tri-Polar, WRF, CRCM4, HRM3, CCSM4, EASE, Satellite Swats, Curvilinear, and regularly spaced grids are among the examples. All the functions and procedures were documented in a "User Guide" and available for the users as PDF file.

## **San Diego State University**

### **Teaching Assistant**

**Sep. 2008 – Sep. 2013**

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- Computational Modeling for Scientists (COMP 536)
- Introduction to Computational Sciences (COMP 521)
- Introduction to Geographical Information Science – Keck Training Program: Global Climate Change and the Spread of Infectious Disease

## **Middle East water & Environment Consulting Engineers**

### **Geographical Information System (GIS) Specialist**

**2004 - 2005**

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- CFD, flood, and hydrological modeling using 3D and 2D models.
- Developing GIS maps.
- Providing Digital Elevation and Terrain Models.
- Computer network and database administrator.

## **Water Research Center**

### **Research Assistant**

**2000 - 2004**

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- CFD, flood, and Hydrological modeling using 3D and 2D models.
  - Satellite Image Processing.
  - Image classification and roughness estimation as requirements in flood modeling.
  - Monitoring coastline and lake changes using Remote Sensing.
  - Digitizing Maps using scanned maps and satellite images.

## **InfoTek**

### **Instructor**

**2000 - 2005**

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- Teaching various IT Courses: CISCO Certified Network Associate (CCNA); Microsoft Certified Professional (MCP); Certified Wireless Network Administration (CWNA); A+; Networking Essentials

## **TEACHING**

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- Water Resources System Analysis and Modeling (BE 481) (Michigan State University)
  - Computational Modeling for Scientists (COMP 536) (San Diego State University)
  - Graduate Level Course: COMP521 – Computational Science (San Diego State University)
    - o Linear Algebra, Interpolation, curve fitting, non-linear equations, ODEs, PDEs, Fourier Transform
  - Introduction to Geographical Information Science in Keck Training Program - Global Climate Change and the Spread of Infectious Disease.

## **PATENTS**

### **Crop Stand Analysis**

**2016**

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- United State Patent No.: US 9,489,576 B2, Appl. No.: 14/668,249
  - Inventors: Johnson, Jerome; Nigon, Tyler John; Abouali, Mohammad;
  - Implementation: Various computer vision algorithm were developed to process RGB based images acquired by UAVs (or drones) to detect crop rows and the locations where they did not emerge. The results of this analysis combined with other information, assist the farmer to get better understanding on their yield and how their farms are performing.

## **SKILLS**

### **COMPUTER/COMPUTING**

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- Programming in FORTRAN, C/C++, CUDA-C, MATLAB
  - Parallel Programming in FORTRAN, C, MATLAB
  - Programming in JavaScript, ArcGIS API for JavaScript, DOJO
  - The NCAR Command Language (NCL)
  - Linux Shell Scripting/Programming
  - Some experience with Google Earth Engine (EE) (member of trusted tester)
  - DELFT3D Model for ocean modeling, coastal modeling, estuaries modeling and flood analysis
  - TileFlow and Cooling performance analysis of data centers
  - Computational Fluid Dynamics (CFD), Heat Transfer, and Hydrological modeling using 3D and 2D models
  - Decision Support System for Agrotechnology Transfer (DSSAT)
  - ILWIS, ENVI, ArcGIS
  - AutoCAD
  - Certificates: CCNA (Cisco), CWNA (Wireless Networks), and MCP (Microsoft)

## **MATHEMATICAL (including, not limited to)**

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- Numerical solution of Partial Differential Equations (PDE)
- Machine learning
- Data Mining
- Supervised and unsupervised clustering and learning algorithms
- Optimization
- Linear Algebra & Matrix Analysis
- Statistical Analysis
- linear and non-linear regression analysis, Partial Least Square Regression (PLSR)

## **EDUCATION**

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### **Ph.D. Computational Science** **2014**

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- Institute of Mathematical Sciences at Claremont Graduate University (CGU)
- joint with Computational Science Research Center at San Diego State University (SDSU)
- Thesis title: *Investigating Castillo-Grone's Mimetic Difference Operators in Development of Geophysical Fluid Dynamics Models Implemented on GPGPUs*

### **M.S. Computational Science** **2013**

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- Computational Science Research Center at San Diego State University (SDSU)
- Thesis title: *Developing a Nested Hydrodynamical Model for San Diego Bay, CA Using Delft3D and Delft Dashboard*
- GPA: 4.0

### **M.S. Geo-Information and Earth Observation Science** **2007**

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- M.S. with Distinction
- Faculty of Geo-Information Science and Earth Observation at University of Twente (ITC), The Netherlands
- Thesis title: *Direct Numerical Simulation of Atmospheric Flow over Rough Terrain*

### **B.S. Civil Engineering** **2005**

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- Technical Faculty at University of Tehran

## **GRANTS & AWARDS**

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- \$83,949.00, "Minimal Water and Nutrient Usage for Maximum Crop Yield using Multi-objective Evolutionary Algorithms (EAs) and Subsurface Water Retention Technology", Kalyanmoy Deb, A. Pouyan Nejadhashemi, Alvin J.M. Smucker, Andrey Guber, Mohammad Abouali, Proteek Chandan Roy, 2016.
- \$61,434.00 Equipment Grant – FieldSpec 4 Hi-Res Spectroradiometer, A. Pouyan Nejadhashemi, Kimberly A. Cassida, Mohammad Abouali, Kyla M. Dahlin, 2016.
- Outstanding Reviewer Award (Elsevier – Environmental Modeling and Software), 2015
- Outstanding Reviewer Award (Elsevier – Environmental Modeling and Software), 2014
- Applied Computational Science & Engineering Student Support (ACSESS), 2013.
- Part of the Grant Writing for "Keck Training Program: Global Climate Change and the Spread of Infectious Disease"
- Student Research Symposium President's Award in Research and Scholarship, 2010.
- Awarded European Union Erasmus Mundus L7 Scholarships, 2007.

## MEMBERSHIPS

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- Association of American Geographers
- Society for Industrial and Applied Mathematics (SIAM)
- IEEE (member ID: 92212791)
- American Physical Society (APS)
- American Geophysical Union (AGU) (member ID: 213912)
- The Society for Modeling and Simulation International
- Google Earth Engine Trusted Tester

## PUBLICATIONS & SOFTWARE

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### JOURNAL PAPERS

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- Daneshvar, F., Nejadhashemi, A.P., Adhikari, U., Elahi, B., Abouali, M., Herman, M.R., Martinez-Martinez, E., Galappi, T.J., Rohn, B.G., 2017, "Evaluating the significance of wetland restoration scenarios on phosphorus removal", *Journal of Environmental Management*, V. 192, pp. 184-196.
- Esfahanian, E., Nejadhashemi, A.P., Abouali, M., Adhikari, U., Zhang, Z., Daneshvar, F., Herman, M.R., 2016, "Development and evaluation of a comprehensive drought index", *Journal of Environmental Management*, <http://dx.doi.org/10.1016/j.jenvman.2016.10.050>.
- Esfahanian, E., Nejadhashemi, A.P., Abouali, M., Daneshvar, F., Ameli, A., Herman, M.R., Tang, Y., 2016, "Defining drought in the context of stream health", *Ecological Engineering*, V. 94, pp. 668-681, doi: 10.1016/j.ecoleng.2016.06.110.
- Daneshvar, F., Nejadhashemi, A.P., Herman, M.R., Abouali, M., 2016, "Response of benthic Macroinvertebrate communities to climate change", *Journal of Ecohydrology & Hydrobiology*, DOI: 10.1016/j.ecohyd.2016.12.002.
- Herrman, M.R., Nejadhashemi A.P., Daneshvar F., Abouali M., Ross D.M., Woznicki S.A., Zhang Z., 2016, "Optimization of bioenergy crop selection and placement based on a stream health indicator using an evolutionary algorithm", *Journal of Environmental Management*, 2016, V. 181, pp. 413-424, doi: 10.1016/j.jenvman.2016.07.005.
- Abouali, Mohammad, Nejadhashemi, A. Pouyan, Daneshvar, Fariborz, Woznicki, Sean A., 2016, "Two-phase approach to improve stream health modeling", *Ecological Informatics*, doi: 10.1016/j.ecoinf.2016.04.009
- Rojas-Downing, M. Melissa, Nejadhashemi, A. Pouyan, Abouali, M., Daneshvar, A., Al Masraf, Sabah, Herman, Matthew R., Harrigan, Timothy, Zhang, Zhen, "Pasture Diversification to Combat Climate Change Impacts on Grazing Dairy Production", Submitted to *Agriculture, Ecosystems & Environment*.
- Abouali, M., Daneshvar, F., Nejadhashemi, A.P., 2016, "MATLAB Hydrological Index Tool (MHIT): A high performance library to calculate 171 ecologically relevant hydrological indices", *Ecological Informatics*, 17 March 2016, doi:10.1016/j.ecoinf.2016.03.004.
- Woznicki, S.A., Nejadhashemi, A. P., Abouali, M., Esfahanian, E., Herman, M.R., Hamaamin, Y.A., Zhang, Z., 2016, "Ecohydrological Modeling for Large-scale Environmental Impact Assessment", *Science of the Total Environment*, Volume 543, Part A, 1 February 2016, pp. 274-286.
- Abouali M., Castillo J.E., 2014, "Solving Poisson equation with Robin boundary condition on a curvilinear mesh using high order mimetic discretization methods", *Mathematics and Computers in Simulation*, <http://dx.doi.org/10.1016/j.matcom.2014.10.004>
- Abouali M., Timmerman J., Castillo J.E., Su Z., 2013, "A High Performance GPU Implementation of Surface Energy Balance System (SEBS) based on CUDA-C", *Environmental Modeling and Software*, V. 41, pp. 134-138.
- Abouali M., Castillo J.E., 2013, "Unified Curvilinear Ocean Atmosphere Model (UCOAM): A Vertical Velocity Case Study", *Journal of Mathematical and Computer Modeling. Mathematical and Computer Modelling*, V. 57, pp. 2158-2168.
- J. Timmermans, M. Gokmen, U. Eden, M. Abouali, Z. Vekerdy, Z. Su, 2012, "Drought monitoring over the Horn of Africa using remotely sensed evapotranspiration, soil moisture and vegetation parameters", *Geophysical Research Abstracts*, V. 14.

- Bazan C., Abouali M., Castillo J.C., and Blomgren P. 2011, “*Mimetic Finite Difference PDE-based Models in Image Processing*”, Computational & Applied Mathematics, Volume 30, N.3, pp. 1-20, ISSN 0101-8205.
- Abouali M., Geurts B.J., Gieske A., 2007, “*Atmospheric Flow Simulation over Rough Terrain*”, European Research Community on Flow, Turbulence and Combustion, March 2007, pp. 7-11.

## CONFERENCE PAPERS

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- Duncan Boughton, Mayuko Kondo, Chaoran Hu, David Mather, Tom Reardon, David Tschirley, Jennifer Cairns Smart, Steve Haggblade, Jordan Chamberlain and Mohammad Abouali, 2015, Spatial Patterns of Urbanization and Smallholder Vegetable Sales in Kenya, Mozambique and Zambia, AAEA Pre-conference on Rapid Agrifood System Transformation, Globalization, and International Development. San Francisco, July 25, 2015.
- Mohammad Abouali, Jose E. Castillo, “*Stability and Performance Analysis of the Castillo-Grone Mimetic Operators in Conjunction with RK3 Time Discretization in Solving Advective Equations*”, Procedia Computer Science, Volume 18, 2013, Pages 465-472.
- Abouali, J.E. Castillo, The Castillo-Grone's Mimetic Difference Operators in 2D and 3D fully Curvilinear Grids: Case Study of Poisson's Equation, MASCOT2012 & ISGG2012, 2012.
- S. Zarei, M. Abouali, A. Mirtar, P. Salamon. “*Evaluating Spirometric Trends in Cystic Fibrosis Patients*”. BIOCOMP, 2012.
- Timmermans J. et al., “*Drought monitoring over the Horn of Africa using remotely sensed evapotranspiration, soil moisture and vegetation parameters*”, European Geosciences Union (EGU), 2012, CL5.3/HS6.7.
- Abouali M., Garcia M., Castillo J.E., Torres C., “*Model intercomparison between two curvilinear hydrodynamic ocean models*”, X Congreso Internacional de Métodos Numéricos en Ingeniería y Ciencias Aplicadas (CIMENICS'2010).
- Salama, S. and Verhoef, W. and Monbaliu, J. and Vekerdy, Zoltán and Mannaerts, C. M. and Su, Z. and Abouali, M. (2008) “*Technique for validating remote sensing products of water quality*”. In: AGRISAR and EAGLE Campaigns Final Workshop, 2007.10.15-2007.10.16., Noordwijk, Hollandia.
- “*Flood Inundation Downstream of Karkheh Dam*” presented in a conference in Ahvaz, Iran.

## TECHNICAL REPORTS

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- Abouali M., Castillo J.E., “*Shallow Water Equations Implemented on GPUs*”, CSRC Publication, 2014, CSRCR2014-03.
- Abouali M., Castillo J.E., “*Regridding Data: A Package to Interpolate, Extrapolate, and Fit a Curve*”, CSRC Publication, 2014, CSRCR2014-02.
- Abouali M., Castillo J.E., “*Solving Advective Equations Using Castillo-Grone's Mimetic Operators*”, CSRC Publication, 2012, CSRCR 2012-04.
- Abouali M., Castillo J.E., “*High Order Compact Castillo-Grone's Mimetic Operators*”, CSRC Publication, 2012, CSRCR 2012-02.
- Abouali M., Castillo J.E., “*General Curvilinear Ocean Model: Next Generation – Theory and Implementation*”, CSRC Publication, 2010, CSRCR 2010-02
- Carlos B., Abouali M., Castillo J.E., Blomgren P., “*Mimetic Finite Difference PDE-based Models in Image Processing*”, (October 30, 2009), CSRCR 2009-03.
- Miraghaie R., Abouali m., Breward C., Chan I., Ellis A., Fehribach J., Gratton M.B., Matusik K., “*The dynamics of liquid slugs forced by a syringe pump*”, Math in Industry, Siemens Healthcare, Harvey Mudd College, 2009.
- “*Offshore structures*” published in The Technical Journal – Tehran University.

## POSTERS

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- A. Pouyan Nejadhashemi, Matthew Herman, Fariborz Daneshvar, Mohammad Abouali, Dennis Ross, Sean Woznicki, Zhen Zhang, Optimization of Bioenergy Crop Selection and Placement Based on a Stream Health Indicator Using an Evolutionary Algorithm, in Computational Methods in Water Resources, June 20-24, 2016, University of Toronto, Canada.
- Fariborz Daneshvar, A. Pouyan Nejadhashemi, Mohammad Abouali, Climate Change impact on macroinvertebrate communities in the Flint River Watershed, ESPP 3<sup>rd</sup> Annual Research Symposium, International Research Collaborations: Addressing Environmental Challenges, Michigan State University, East Lansing, MI, USA.
- Elaheh Esfahanian, A. Pouyan Nejadhashemi, Mohammad Abouali, Fariborz Daneshvar, Alireza Ameli, Sean A. Woznicki, Defining Drought in the Context of Stream Health, ASABE 1st Climate Change Symposium, Chicago, IL; 05/2015
- Fariborz Daneshvar, A. Pouyan Nejadhashemi, Mohammad Abouali, Sean A. Woznicki, Matthew R. Herman, The Response of Benthic Macroinvertebrate Communities to Climate Change within the Saginaw River Watershed, ASABE 1st Climate Change Symposium, Chicago, IL; 05/2015
- Abouali M., Castillo J.E., "Stability Analysis of the Cas1llo-Grone's Mime1c Difference Operators", ACSESS 2013.
- Abouali M., Timmermans J., Su B., Castillo J.C., "Global High Resolution Estimation of Evapotranspiration – SEBS on GPU using CUDA-C", GeoMundus Conference, Muenster, Germany, 2011.
- Abouali M., Castillo J.E., "Unified Curvilinear Ocean Atmosphere Model (UCOAM) Large-Eddy Simulation of Geophysical Fluids In Complex Geometries", San Diego State University, ACSESS 2011.
- Abouali M., Zarei S., Garcia M., "Comparing Two Haar Wavelet Transform Algorithms in Image Compression", San Diego State University, ACSESS 2010.
- Abouali M., Castillo J.E., "General Curvilinear Ocean Model – Next Generation", San Diego State University, ACSESS 2010.
- Poster presentation at "2010 HMC Mathematics Conference on the Mathematics of Environmental Sustainability and Green Technology", Harvey Mudd College, Claremont CA, 2010.
- Poster Presentation at Gordon Research Conference: Coastal Ocean Circulations, New Hampshire, 2009.
- Poster presentation, General Curvilinear Ocean Model – Enabling Thermodynamics, ACSESS, San Diego State University, 2009.

## PROFESSIONAL PRESENTATIONS

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- Oral Presentation, Student Research Symposium at San Diego State University, 2013.
- GPU Technology Conference, San Jose, CA, 2013.
- American Physical Society (APS), San Diego, CA, 2012.
- Oral Presentation, Student Research Symposium at San Diego State University, 2012.
- SIAM Meetings, Geo-Sciences 2011, Long Beach, California.
- Oral Presentation, Student Research Symposium at San Diego State University, 2011
- SIAM Computational Science & Engineering 2011, Reno, Nevada:
  - o First Speech: General Curvilinear Environmental Model, Session MS22.
  - o Second Speech: Towards Future Environmental Modeling, Session MS110.
- "Unified Curvilinear Ocean Atmosphere Model (UCOAM)", San Diego State University, Computational Science Research Center Colloquium, 2009.
- Oral Presentation, Student Research Symposium at San Diego State University, 2010

## **SOFTWARE**

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- MATLAB Hydrological Indices Tool (MHIT) (High-Performance Implementation)
- Regridding using NCL with Earth System Modeling Framework (ESMF) software
- NCL Google Earth (GE) Tools
- 2D and 3D Remapping
- Curvilinear 2D Grid Laplace Operator for Poisson's equation using Castillo-Grone Mimetic Operators.
- MATLAB Implementation of Harmonic ANALysis of Time Series (HANTS)
- parseLandSat8MetaData
- LoadLandSat8
- LandSat8 Radiance, Reflectance, Brightness Temperature, and Atmospheric Correction
- AddPyramid
- Spectral Match

## **BOOKS**

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- Contributed to "Mimetic Discretization Methods", by J.E. Castillo, G.F. Miranda, CRC Press, 2013.

## **MISCELLANEOUS**

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- Training Program on DSSAT v46, 2014, Georgia, USA.
- Vegetation Analysis with ENVI, Virginia, Nov. 2013.
- "11th Workshop on the DOE Advanced CompuTaional Software (ACTS) Collection", Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA, 2010.
- "Eddy Covariance Flux Measurement summer School", 2006, Wepion, Belgium.