

Executive Summary for I-Corps Project

TEAM: Improve Electricity Load Forecasting and Energy Efficiency

PI: Menglin Susan Jin, Visiting Professor, University of Maryland, College Park
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Mentor: Dr. Paul Houser, President and Director, CREW Services, LLC; Professor, George Mason University

Entrepreneurial Lead: Warren Dean Porter, Ph.D student, University of Maryland, College Park

Additional Team member: summer intern (if permitted by NSF)

Current Commercialization Plan This I-Corps project has two goals:

- 1. Product Development:** Using climate model developed by National Center for Atmospheric Research (NCAR), NOAA Global Forecasting System (GFS), and NASA satellite remote sensing observations, this team proposes to develop a web-service that forecasts surface temperature, electricity need, and energy efficiency in big urban regions. The prediction will be at daily, weekly, monthly and annual basis. Previous research, supported by Jin's NSF grant as well as Jin's UMCP regional Icorp participation in January 2016, showed very encouraging results which could be transferred into a commercial product.
- 2. Market Evaluation:** This 8-month I-Corps project provides the resources to conduct interview to 100+ companies with the goal of understanding the market need, developing a user-friendly web service, and demonstrating our product.

Relevant to Current NSF awards (award number: 0855480)

Jin was the PI of NSF project: *Studying Global and Regional Land Surface Skin Temperature Using Satellite Observations and Climate Modeling*, funded by NSF Large-scale Dynamics Program (0855480), total amount: **\$510K. 2007-2014.**

Jin's NSF project studied cutting-edge topics on urban weather, climate and society. Specifically related to this I-Corps, Jin developed urban heat index using satellite observation (Jin 2012) and with this index, together with rainfall, vegetation, and population, find residential energy and water use (Jin and Shepherd, 2008; Jin 2013). We plan to apply our algorithm developed in Jin (2012) and Jin (2013) into a web-based predicting service.

Commercial Impact

How warm urban regions can be and how much energy needed for cities at different climate zone are essential for energy resources management. For example, Duck Energy purchases electricity based on temperature. Accurately predicting electricity need and assessing energy use efficiency help electricity companies, financial companies, insurance companies, and local government to manage business. Service product we develop here can be easily applied to other city, state and country. Therefore, this service has broad commercial impact. For example, Duke Energy has agreed to participate with us (support letter will be provided in proposal).

Credential of Team

Jin (PI) and Houser (Mentor) are well respected, successful researchers in the field (CV attached). Houser has outstanding leadership skills, by serving as the NASA hydrology branch head and program manager. As the president of CREW, he has applied research into industry. Warren Porter (Ph.D student) has two under degrees – atmospheric and applied math, and has strong skills in communicating and programming. He has worked in an insurance-climate company for 9 month before joining UMCP.

Paul R. Houser

1. Professional Preparation

1988-1992, University of Arizona, Hydrology and Water Resources, B.S. Cum Laude
1992-1996, University of Arizona, Hydrology and Water Resources, Ph.D.
1997, Universities Space Research Association, postdoc

2. Appointments

2005-present, Associate Professor, College of Science, George Mason University
2009-present, Co-Director, Center for Intelligent Spatial Computing, George Mason Univ.
2012-present, President & Director, CREW Services LLC, Ellicott City MD
2011-2012, Science Advisor, Bureau of Reclamation, Washington DC
2008-2010, Director of Hydrometeorology, Earthwater Global LLC, Alexandria VA
2005-2008, Director, Center for Research on Environment and Water, Calverton MD
2000-2005, Head, Hydrological Sciences Branch, Goddard Space Flight Center, MD
1999-2000, Visiting Senior Scientist, NASA Headquarters, Washington DC
1997-2005, Research Scientist, NASA Goddard Space Flight Center, Greenbelt MD

3. Products

Most closely related

Dong, X., B. Xi, A. Kennedy, Z. Feng, J. Entin, P. Houser, R. Schiffer, T. L'Ecuyer, B. Olson, K. Hsu, W. T. Liu, B. Lin, Y. Deng, T. Jiang, 2011: Investigation of the 2006 Drought and 2007 Flood Extremes at the Southern Great Plains Through an Integrative Analysis of Observations, *J. Geophys. Res.*, 116.

Schlosser CA, and Houser PR, 2007. Assessing a Satellite-Era Perspective of the Global Water Cycle. *Journal of Climate*: Vol. 20, No. 7 pp. 1316–1338.

Wood, E., J. K. Roundy, T. J. Troy, R. van Beek, M. Bierkens, E. Blyth, A. de Roo, P. Döll, M. Ek, J. Famiglietti, D. Gochis, N. van de Giesen, P. Houser, P. Jaffe, S. Kollet, B. Lehner, D. P. Lettenmaier, C. Peters-Lidard, M. Sivapalan, J. Sheffield, A. Wade, P. Whitehead, 2011: Hyper-Resolution Global Land Surface Modeling: Meeting a Grand Challenge for Monitoring Earth's Terrestrial Water. *Water Resour. Res.*, 47, W05301, doi:10.1029/2010WR010090.

Rodell, M., Houser, P. R., Jambor, U., Gottschalck, J., Mitchell, K., Meng, C.-J., Arsenault, K., Cosgrove, B., Radakovich, J., Bosilovich, M., Entin, J. K., Walker, J. P., Lohmann D. and Toll, D., 2004. The Global Land Data Assimilation System. *Bulletin of the American Meteorological Society*, 85(3):381-394.

Houser, P., Hutchinson, M. F., Viterbo, P., Hervé Douville, J., and Running, S. W. 2004. Terrestrial data assimilation, Chapter C.4 in *Vegetation, Water, Humans and the Climate*. Global Change – The IGB Series. Kabat, P. et al. (eds). Springer, Berlin.

Other Significant

Houser, P. R., De Lannoy, G., and Walker, J. P. 2010. Land Surface Data Assimilation, p549-598. In: Lahoz, W., Khatattov, B. and Menard, R. (Eds.), *Data Assimilation: Making sense of observations*, Springer, The Netherlands, 2010, 732pp.

Schlosser CA, and Houser PR, 2007. Assessing a Satellite-Era Perspective of the Global Water Cycle. *Journal of Climate*: Vol. 20, No. 7 pp. 1316–1338

Houser, P., Hutchinson, M. F., Viterbo, P., Hervé Douville, J., and Running, S. W. 2004. Terrestrial data assimilation, Chapter C.4 in *Vegetation, Water, Humans and the Climate*. Global Change - The IGB Series. Kabat, P. et al. (eds). Springer, Berlin.

Kumar, S. V., C.D. Peters-Lidard, Y. Tian, P.R. Houser, J. Geiger, S. Olden, L. Lighty, J.L. Eastman, B. Doty, P. Dirmeyer, J. Adams, K. Mitchell, E.F. Wood and J. Sheffield, 2006: Land Information System: An interoperable framework for high resolution land surface modeling. *Environmental Modelling & Software*, Volume 21, Issue 10, October 2006, Pages 1402-1415.

Twine, T.E., W.P. Kustas, J.M. Norman, D.R. Cook, P.R. Houser, T.P. Meyers, J.H. Prueger, P.J. Starks, and M. Welely. 2000. Correcting eddy-covariance flux underestimates over a grassland, *Agric. For. Meteorol.* 103 (2000):279-300.

4. Synergistic Activities

- **Teaching and Training:** Advisor and Instructor for many successful undergraduate and graduate students; Developed courses in Principles of Hydrology, Physical Climatology, Land-Climate Interactions, the Hydrosphere, and Cold Land Processes. Numerous short courses on Data Assimilation, Hydrology and the Cryosphere.
- **Development of Research Tools:** Land Information System (LIS), the North-American Land Data Assimilation System (NLDAS), the Global Land Data Assimilation System (GLDAS), Community Land Model
- **Computational and Observational Methods:** High-performance land modeling and data assimilation software development; global water cycle data systems development; development and operation of a 36-site Rocky Mountain snow, soil moisture and weather observation mesonet; soil moisture, water-level, and snow satellite mission development; water cycle satellite mission.
- **Reviewing and Editing:** Participation in many NASA, NOAA, DOE, and NSF proposal review panels. Provides frequent peer-reviews for leading journals. DOE, NOAA and NCAR advisory panels. Associate Editor of WIREs Water! And Journal of Applied Remote Sensing; Board member of Geovesi, EarthWater Global, and Water Fund.
- **Community Leadership:** : Project scientist for the NASA Energy and Water cycle Study (NEWS), Founder of the North American Water Project; Chair of the CUAHSI Hydrological Information Systems Standing Committee, American Meteorological Society Hydrology Committee Chair, American Geophysical Union Remote Sensing Committee

5. Collaborators

Anantharaj V (MS), Arsenault K (UMBC/GMU), Bambacus M (NASA), Belvedere D (USRA), Benedict S (GEWEX), Bosilovich M (NASA), Cline D (NOAA), DeLannoy G (UG), Dirmeyer P (GMU), Doorn B (NASA), Ek M (NOAA), Elder K (USFS), Entin J (NASA), Famiglietti J (UCI), Feng X (GMU), Gochis D (NCAR), Hildebrand P (NASA), Lawford R (GEWEX), Lettenmaier D (UW), Leung R (PNNL), Lohmann D (RMS), Matthews D (HydrometDSS), Njoku E (JPL), Pan M (PU), Peters-Lidard C (NASA), Pinker R (UMD), Rasmussen R (NCAR), Restrepo P (NOAA), Rodell M (NASA), Santanello J (ESSIC), Schaake J (NOAA), Schiffer R (USRA), Schlosser C (MIT), Sheffield J (PU), Shrestha, R (COLA), Shuttleworth W (UA), Sorooshian S (UCI), Sun D (GMU), Syed K (UL), Tao W (NASA), Tarpley D (NOAA), Toll D (NASA), Unninayar S (NASA), van Oevelen P (GEWEX), Walker J (UM), Welty C (UMBC), Wood E (PU), Yang C (GMU), Yilmaz, M (USDA)

6. Graduate and Postdoctoral Advisors

Shuttleworth W (UA); Dickinson R (UT); Sorooshian S (UCI); Hutchinson C (UA); Gupta H (UA); Goodrich D (USDA), Kalb M (NOAA), Rood R (UM), Engman E (SAIC)

7. Graduate and Postdoctoral Advisees

Arsenault K, Ph.D., 2011; Li W, Ph.D., 2010. Sahoo A, Ph.D. 2008, postdoc 2009; Su H, Ph.D. 2008, postdoc 2008-2009; MacCracken, R. Ph.D. 2011, postdoc 2011-2013; DeLannoy G, Ph.D. 2006 (UG), postdoc 2006-2009; Moradkhani H, Ph.D. 2004 (UCI); Ruediger C, Ph.D. 2005; Feng X, Ph.D. 2011, postdoc 2011-2013; Pan M, Ph.D. 2006; Yilmaz M, Ph.D., 2011; Rubicam C, MS 2013; Mbuh M, Ph.D. 2015; Flood J., Ph.D. 2013; Tucker E., MS.

Curriculum Vitae

Menglin Susan Jin
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POSITION

- June, 2014 – present Visiting Associate Professor**, Department of Atmospheric and Oceanic Sciences, University of Maryland, College Park
- 2008.8 -2014 – Assistant professor, Department of Meteorology and Climate Science**, San José State University, CA, USA
- 2006 – 2008.7 Associate Research Scientist, Department of Atmospheric & Oceanic Science, University of Maryland College Park
- 2003 – 2007.8 Visiting Scientist of NASA Goddard Space Flight Center, Lab of Atmospheric Science
- 2000 – 2005 Assistant Research Scientist, Department of Atmospheric & Oceanic Science, University of Maryland, College Park

RESEARCH EXPERIENCE

Land surface remote sensing, Clouds remote sensing, Clouds-Aerosol-Rainfall Interaction, Global climate change, Global/Land surface modeling, Urban climate system Data management information system (MIS).

EDUCATION

- 1999 Ph.D., Department of Atmospheric Science, University of Arizona, USA
Advised by Prof. Robert E. Dickinson
- 1995 M.S., Department of Atmospheric Science, University of Arizona, USA
- 1993 M.S. program, Institute of Atmospheric Physics,
Academia Sinica, P.R. China
- 1989 B.S., Department of Atmospheric Dynamics, Nanjing University,
P. R. China

REFEREED PUBLICATIONS (leading-authored only)

- Jin, M. and J. M. Shepherd, 2010: A new index on Urban Heat Island Effect from Remote Sensing, submitted
- Jin, M, and W. Kessomkiat, 2010: Satellite-observed Urbanization Characters in Shanghai, China: Aerosols, Urban Heat Island Effect, and Land-Atmosphere Interactions. To appear on *Remote Sensing*
- Jin, M., J. M. Shepherd and W. Zheng: Aerosol Direct Effects on Surface Skin Temperature: A Study from WRF modeling and MODIS Observations. Conditionally accepted by *Atmosphere*
- Jin, M. and R. E. Dickinson, 2010: Land Surface Skin Temperature Climatology: Benefitting from the Strengths of Satellite Observations. Accepted by *Environmental Research letter*.
- Jin, M. 2009: Greenland surface height and its impacts on skin temperature: A study using ICESat observations. *Advances in Meteorology*. Volume 2009, Article ID 189406, doi:10.1155/2009/189406.