PETER K. KANG

Assistant Professor & Gibson Chair of Hydrogeology
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RESEARCH INTERESTS

My research advances the understanding, modeling and prediction of fluid flow and reactive transport in porous and fractured media. We combine theory, high performance numerical simulation and visual laboratory experiments to understand how the coupling between multiple processes controls fluid flow and reactive transport across scales: from pore to fracture to field scale. Based on the understanding of the multi-scale phenomena, we develop predictive models for subsurface energy and environment applications.

EDUCATION

Massachusetts Institute of Technology — Cambridge, MA, USA
Ph.D. in Civil and Environmental Engineering — May 2014
Thesis: Anomalous Transport through Porous and Fractured Media — **GPA: 5.0/5.0**
Advisor: Prof. Ruben Juanes

M.S. in Civil and Environmental Engineering — June 2010
Thesis: Transport in Lattice Fracture Networks: Concentration Mean and Variance

Seoul National University — Seoul, South Korea
Bachelor of Civil, Urban and Geosystem Engineering — 2004 - 2008
Graduated with *summa cum laude* — **GPA: 3.99/4.3**

The University of Auckland — Auckland, New Zealand
Exchange Student — 2007

PROFESSIONAL EXPERIENCE

Assistant Professor & Gibson Chair of Hydrogeology — August 2018 -
Department of Earth Sciences, University of Minnesota — Minneapolis, MN, USA

Research Scientist at the Center for Water Resources Cycle Research — July 2015 - July 2018
Korea Institute of Science and Technology (KIST) — Seoul, South Korea

Research Affiliate in Subsurface Energy and Mechanics Lab — July 2015 - June 2018
Massachusetts Institute of Technology (MIT) — Cambridge, MA, USA

Postdoctoral Associate in Earth Resources Laboratory — June 2014 - June 2015
Earth, Atmospheric, and Planetary Sciences, MIT — Cambridge, MA, USA

FELLOWSHIPS and SCHOLARSHIPS

U.S. Environmental Protection Agency (EPA) STAR Fellowship award, 2014
Martin Family Society of Fellows for Sustainability, MIT, 2013
Department of Energy Office of Science Graduate Fellowship (DOE SCGF) award, 2010-2013
: One of 150 awardees selected from over 3,200 applicants in STEM field ($50,500 per year)
National Science Foundation Graduate Research Fellowship (NSF GRF) award, 2010
Full Undergraduate Tuition Scholarship from Korea Science and Engineering Foundation, 2004

AWARDS

Research and Academic related

Best paper award from Korean Society of Soil and Groundwater Environment, 2016
New England Water Environment Association (NEWEA) award, 2014
Outstanding Student Presentation Awards (OSPA) from AGU Fall meeting, 2010, 2011
Top honor from graduating Civil, Urban and Geosystem Engineering Department at SNU, 2008
Outstanding paper award from Korea Water Resource Corporation, 2007
Outstanding research award from BK SIR technical competition in South Korea, 2007

Extracurricular related

The Carroll L. Wilson Award for biosand filter projects in Tanzania and Nigeria, MIT, 2014
MIT Global Startup Workshop (GSW) Fellowship, 2014
Public Service Fellowship, MIT, 2013
Community choice award from MIT IDEAS / Global Challenge competition, 2011
Research grant on dam design optimization from the Center of Teaching and Learning at SNU, 2006

JOURNAL PUBLICATIONS

- W. Lee, **P. K. Kang**, A. S. Kim, and S. Lee, Impact of surface porosity on water flux and structural parameter in forward osmosis. *Desalination*, 439, 46-57, doi.org/10.1016/j.desal.2018.03.027, (2018).
- S. Yoon, J. R. Williams, R. Juanes, and **P. K. Kang***. Maximizing the value of pressure data in saline aquifer characterization. *Advances in Water Resources*, 109, 14-28, doi:10.1016/j.advwatres.2017.08.019, (2017).
- **P. K. Kang**, W. Lee, A. S. Kim, and S. Lee. Origin of structural parameter inconsistency in forward osmosis models: a pore-scale CFD study. *Desalination*, 421, 47-60, doi:10.1016/j.desal.2017.05.018, (2017).
- **P. K. Kang**, J. Lee, X. Fu, S. Lee, P. K. Kitanidis, and R. Juanes. Improved characterization of heterogeneous permeability in saline aquifers from transient pressure data during freshwater injection. *Water Resources Research*, 53(5), 4444-4458, doi:10.1002/2016WR020089, (2017).
- **P. K. Kang***, M. Dentz, T. Le Borgne, S. Lee, and R. Juanes, Anomalous transport in disordered fracture networks: Spatial Markov model for dispersion with variable injection modes. *Advances in Water Resources*, 106, 80-94, doi:10.1016/j.advwatres.2017.03.024, (2017).
- M. Dentz, **P. K. Kang**, A. Comolli, T. Le Borgne, and D. R. Lester, Continuous time random walks for the evolution of Lagrangian velocities. *Physical Review Fluids*, 1(7), 074004, doi:10.1103/PhysRevFluids.1.074004, (2016).
- **P. K. Kang**, S. Brown, and R. Juanes, Emergence of anomalous transport in stressed rough fractures. *Earth and Planetary Science Letters*, 454, 46-54, doi:10.1016/j.epsl.2016.08.033, (2016).
- **P. K. Kang**, Y. Zheng, X. Fang, R. Wojcik, D. McLaughlin, S. Brown, M. C. Fehler, D. R. Burns, and R. Juanes. Sequential approach to joint flow-seismic inversion for improved characterization of fractured media. *Water Resources Research*, 52(2), 903–919, doi:10.1002/2015WR017412, (2016).
- **P. K. Kang**, M. Dentz, T. Le Borgne, and R. Juanes. Anomalous transport on regular fracture networks: impact of conductivity heterogeneity and mixing at fracture intersections. *Physical Review E*, 92, 022148, doi:10.1103/PhysRevE.92.022148, (2015).
- **P. K. Kang**, T. Le Borgne, M. Dentz, O. Bour, and R. Juanes. Impact of velocity correlation and distribution on transport in fractured media: field evidence and theoretical model. *Water Resources Research*, 51(2), 940-959, doi:10.1002/2014WR015799, (2015).
- M. Dentz, **P. K. Kang**, and T. Le Borgne. Continuous time random walks for non-Local radial solute transport. *Advances in Water Resources*, 82, 16-26, doi:10.1016/j.advwatres.2015.04.005, (2015).

- **P. K. Kang**, P. de Anna, J. P. Nunes, B. Bijeljic, M. J. Blunt, and R. Juanes. Pore-scale intermittent velocity structure underpinning anomalous transport through 3D porous media. *Geophysical Research Letters*, 41(17), 6184-6190, doi:10.1002/2014GL061475, (2014).
- A. Servi, **P. K. Kang**, D. Frey, and S. Murcott. A holistic optimization framework for improving ceramic pot filter performance. *IEEE GHTC*, 355-360, doi:10.1109/GHTC.2013.6713711, (2013).
- **P. K. Kang**, M. Dentz, Tanguy Le Borgne, and R. Juanes. Spatial Markov model of anomalous transport through random lattice networks. *Physical Review Letters*, 107, 180602, doi:10.1103/PhysRevLett.107.180602, (2011).
- **P. K. Kang**, M. Dentz, and R. Juanes. Predictability of anomalous transport on lattice networks with quenched disorder. *Physical Review E*, 83(3), 030101(R), doi:10.1103/PhysRevE.83.030101, (2011).

JOURNAL PUBLICATIONS submitted

- J. D. Hyman, M. Dentz, A. Hagberg, and **P. K. Kang**, What controls asymptotic transport properties in fractured media? Uncovering a connection between fracture network properties and particle behavior.
- J. D. Hyman, M. Dentz, A. Hagberg, and **P. K. Kang**, Linking structural and transport properties in three-dimensional fracture networks.
- E. Bresciani, **P. K. Kang**, and S. Lee, Theoretical analysis of local groundwater flow patterns.
- **P. K. Kang**, E. Bresciani, S. An, and S. Lee, Impact of pore-scale incomplete mixing on biodegradation in aquifers: from batch experiment to field-scale modeling.

PROJECTS AND GRANTS

01/2019-12/2023 *Banded together: modern water-microbe-mineral feedbacks in the deep Archean lithosphere*, Co-PI (Lead PI: Brandy Toner)
Funded by the National Science Foundation Integrated Earth Systems ($ 1,976,370)

01/2019-12/2019 *Data-model fusion approach for characterizing managed aquifer recharge sites*, PI
Funded by Korea Institute of Science and Technology ($ 45,000)

09/2018-12/2022 *Predicting subsurface contaminant transport with discrete fracture network modeling*, PI
Funded by the Ministry of Environment in South Korea ($ 365,000)

ORGANIZED WORKSHOPS & CONFERENCES

- **Session chair at American Geophysical Union (AGU) Fall Meeting**: Chaired a session H040 titled "Coupled Processes in Fractured Media Across Scales: Experimental and Modeling Advances" at AGU held in Washington, D.C., USA (December 10-14, 2018).
- **Workshop on subsurface contamination, characterization and remediation**: Organized a workshop at the University of Minnesota (August 20-23, 2018). Sixteen South Korean scientists and scientists from UMN, MGS, DNR, and MPCA participated the workshop.
- **Chair of Gordon Research Seminar, "Flow and Transport in Permeable Media"**: Elected as a chair for the seminar held in ME, USA (July 7-8, 2018).
- **Session chair at World Congress on Computational Mechanics (WCCM)**: Chaired a session titled "Numerical Simulation of Coupled Geomechanics and Flow in Reservoir Engineering" at WCCM held in Seoul, South Korea (July 24–29, 2016).
- **International workshops on aquifer storage and recovery in saline aquifers**: Organized two international workshops at KIST, South Korea (March 22-24, 2016; December 4-8, 2017). Prof. P. Stuyfzand from Technical University Delft, Dr. G. van den Berg from KWR Watercycle Research Institute, and Dr. J. Lee from Stanford University were invited speakers for 2016 workshop. Dr. V. Post and Dr. G. Houben from BGR were invited speakers for 2017 workshop.

REVIEWER for INTERNATIONAL JOURNALS

- Water Resources Research, Advances in Water Resources, Geophysical Research Letters, Hydrology and Earth System Sciences, Physical Review Letters, Physical Review E, Water Research, Journal of Hydrology, Transport in Porous Media, Hydrogeology Journal, Journal of Contaminant Hydrology, Chaos, Solitons & Fractals, and Water.

SELECTED INVITED SEMINARS

- **University of Pittsburgh**: Civil & Environmental Engineering Department Seminar. (March, 2017).
- **University of Minnesota Twin Cities**: Earth Sciences Department Seminar. (January, 2017).
- **National University of Singapore (NUS)**: Centre for Offshore Research and Engineering (CORE) Seminar in Civil and Environmental Engineering Department. (October, 2015).
- **Stanford University**: Energy Resources Engineering Seminar. (May, 2015).

ADVISING EXPERIENCE

Postdoctoral researchers supervised

- JUNSONG KIM: Characterizing flow and transport processes at a fluid-porous media interface using PIV & Hyporheic flow and transport processes characterization at SAFL Outdoor StreamLab (10/2018 - present).
- SEONKYOO YOON: Understanding anomalous transport in fractured media & Data-model fusion approach for subsurface characterization (09/2018 - present).
- SANGHYUN LEE: Coupling among fluid flow, metals and bacterial biofilms in rough fractures: a microfluidic study (09/2018 - present).

Doctoral students supervised

- WOONGHEE LEE: Experimental and numerical investigations of fracture dissolution and precipitation at mineral - fluid interfaces (09/2018 - present).

Master's students supervised

- WOONGHEE LEE: Impact of surface porosity on water flux and structural parameter in forward osmosis: a pore-scale CFD study (08/2015 - 08/2017). Coadvised with Dr. Seockheon Lee at KIST.

TEACHING at the University of Minnesota (UMN)

- ESCI 4702: General Hydrogeology, Spring 2019
- ESCI 4971W/5971: Hydrogeology Field Camp, Summer 2019
- ESCI 3202: Fluid Earth Dynamics, Fall 2019 (expected)

CONFERENCE PAPERS & PRESENTATIONS

- **P. K. Kang**, J. D. Hyman and M. Dentz. Anomalous Transport in 3D Discrete Fracture Networks: Interplay between Aperture Heterogeneity and Particle Injection Modes. American Geophysical Union (2018)
- E. Bresciani, **P. K. Kang** and S. Lee. Fundamentals of Darcy Flow: Local Groundwater Flow Patterns Unraveled. American Geophysical Union (2018) **Oral presentation**.
- S. H. Lee and **P. K. Kang**. Understanding Mixing and Reaction at Rough Fracture Intersections with Microfluidics Experiment. American Geophysical Union (2018)
- W. Lee, S. Yoon and **P. K. Kang**. Mixing and Mass Partitioning at Fracture Intersections: The Effects of Surface Roughness and Flow Rate. American Geophysical Union (2018)

- **P. K. Kang**, Q. Lei, M. Dentz and R. Juanes. Stress Induced Anomalous Transport in Natural Fracture Networks. International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application (2018)
- Q. Lei, X. Wang, **P. K. Kang**, J.-P. Latham, C.-F. Tsang and R. Juanes. Stress-Induced Flow Heterogeneity on the Bedding Plane of Fractured Layered Rock. International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application (2018)
- **P. K. Kang**, Q. Lei, S. Lee, M. Dentz and R. Juanes. Anomalous Transport in Natural Fracture Networks Induced by Tectonic Stress. American Geophysical Union (2017) **Oral presentation**.
- S. Yoon, J. R. Williams R. Juanes and **P. K. Kang**. Impact of Variable-Density Flow on the Value-of-Information from Pressure and Concentration Data for Saline Aquifer Characterization. American Geophysical Union (2017) **Oral presentation**.
- **P. K. Kang**, Q. Lei, M. Dentz and R. Juanes. Impact of Stress on Anomalous Transport in Fractured Rock. 14th International Conference on Flow Dynamics, Sendai, Japan (2017) **invited**.
- **P. K. Kang**, M. Dentz, T. Le Borgne, S. Lee and R. Juanes. Anomalous Transport in Disordered Fracture Networks: Evolution of the Lagrangian Velocity Distribution and CTRW Model for Arbitrary Injection Modes. SIAM Conference on Mathematical and Computational Issues in the Geosciences (2017) **invited**.
- **P. K. Kang**, Q. Lei, S. Lee, M. Dentz and R. Juanes. Impact of Stress on Anomalous Transport in Fractured Rock. American Geophysical Union (2016)
- M. Dentz, **P. K. Kang**, A. Comolli, T. Le Borgne and D. R. Lester. Continuous Time Random Walks for the Evolution of Lagrangian Particle Velocities in Heterogeneous Porous and Fractured Media Flows. American Geophysical Union (2016)
- T. Le Borgne, O. Bochet, M. Klepikova, **P. K. Kang**, A. Shakas, L. Aquilina, A. Dufresne, N. Linde, M. Dentz and O. Bour. Coupled Transport, Mixing and Biogeochemical Reactions in Fractured Media: Experimental Observations and Modelling at the Ploemeur Fractured Rock Observatory. American Geophysical Union (2016)
- **P. K. Kang**, Q. Lei and R. Juanes. Impact of Stress on Anomalous Transport in Fractured Rock: From a Single Rough Fracture to Discrete Fracture Networks. Gordon Research Seminar and Conference: Flow and Transport in Permeable Media (2016) **Oral presentation**.
- **P. K. Kang**, J. Lee, X. Fu, S. Lee, P. K. Kitanidis and R. Juanes. Joint Inversion of Density-driven Flow and Tracer Transport Data for Characterizing a Managed Aquifer Recharge and Recovery Site. World Congress on Computational Mechanics (WCCM) (2016) **Oral presentation**.
- **P. K. Kang**, W. Lee, A. S. Kim and S. Lee. Development of CFD Modeling Framework for Flow and Mass Transfer in Forward Osmosis Membrane with Porous Substrate. World Congress on Computational Mechanics (WCCM) (2016) **Oral presentation**.
- **P. K. Kang**, Q. Lei and R. Juanes. Impact of Stress on Anomalous Transport in Fractured Rock: From a Single Rough Fracture to Discrete Fracture Networks. World Congress on Computational Mechanics (WCCM) (2016) **Oral presentation**.
- **P. K. Kang**, S. Brown, J. A. da Silva and R. Juanes. Emergence of Anomalous Transport in Stressed Rough Fractures. American Geophysical Union (2015) **Oral presentation**.
- J. A. da Silva, **P. K. Kang**, Z. Yang, L. Cueto-Felgueroso and R. Juanes. Impact of Normal Stress on Multiphase Flow through Rough Fractures. American Geophysical Union (2015)
- T. Le Borgne, **P. K. Kang**, N. Guihéneuf, A. Shakas, O. Bour, N. Linde and M. Dentz Field Signatures of Non-Fickian Transport Processes: Transit Time Distributions, Spatial Correlations, Reversibility and Hydrogeophysical Imaging. American Geophysical Union (2015)
- M. Dentz, T. Le Borgne and **P. K. Kang**. Continuous Time Random Walks and the Causes of Non-Fickian Transport in Heterogeneous Media. American Geophysical Union (2015)

- **P. K. Kang**, S. Brown, and R. Juanes, Emergence of Anomalous Transport in Stressed Rough Fractures. Cargèse summer school (2015) **invited research seminar**.
- Y. Li, Y. Shen and **P. K. Kang**. Integration of Seismic and Fluid-flow Data: Two-way Road Linked by Rock Physics. European Association of Geoscientists & Engineers (2015) **Oral presentation**.
- **P. K. Kang**, T. Le Borgne, M. Dentz, O. Bour and R. Juanes. Impact of Velocity Correlation and Distribution on Transport in Fractured Media: Field Evidence and Theoretical Model. American Geophysical Union (2014) **Oral presentation**.
- **P. K. Kang**, T. Le Borgne, M. Dentz, O. Bour, and R. Juanes. Anomalous Transport through Fractured Media: Field Evidence and Modeling. Gordon Research Conference: Flow and Transport in Permeable Media (2014)
- **P. K. Kang**, P. de Anna, J. P. Nunes, B. Bijeljic, M. J. Blunt, and R. Juanes. Three-dimensional Analysis and Modeling of Pore-scale Anomalous Transport in Sandstone. Gordon Research Seminar: Flow and Transport in Permeable Media (2014)
- **P. K. Kang**, P. de Anna, J. P. Nunes, B. Bijeljic, M. J. Blunt, and R. Juanes. Pore-scale Origin of Anomalous Transport in 3D Porous Media. American Geophysical Union (2013)
- **P. K. Kang**, Y. Zheng, X. Fang, R. Wojcik, D. McLaughlin, S. Brown, M. C. Fehler, D. R. Burns and R. Juanes. Joint Flow-seismic Inversion for Characterizing Fractured Reservoirs: Theoretical Approach and Numerical Modeling. Society of Exploration Geophysicist (2013) **Oral presentation**.
- **P. K. Kang**, J. Song and S. U. Hong. An International Development Project Combining Appropriate Technology and Mobile Application: Proposal and Preliminary Field Work. *International Development and Cooperation Review*, (2012).
- **P. K. Kang**, T. Le Borgne, O. Bour, M. Dentz and R. Juanes. Anomalous Transport in Fracture Networks: Field Scale Experiments and Modeling. American Geophysical Union (2012)
- **P. K. Kang**, T. Le Borgne, O. Bour, M. Dentz and R. Juanes. Upscaling Fractured Media to Heterogeneous Lattice Networks: Modeling and Observations from a Field Tracer Tests in Fractured Granite. Gordon Research Conference: Flow and Transport in Permeable Media (2012)
- **P. K. Kang**, Marco Dentz, Tanguy Le Borgne, Ruben Juanes. Macroscopic Modeling of Anomalous Transport on Heterogeneous Lattice Networks. Gordon Research Seminar: Flow and Transport in Permeable Media (2012) **Oral presentation**.
- **P. K. Kang**, Marco Dentz, Tanguy Le Borgne, Ruben Juanes. Macroscopic Modeling of Anomalous Transport on Heterogeneous Lattice Networks. Computational Methods in Water Resources (2012). **Oral presentation**.
- **P. K. Kang**, T. Le Borgne, O. Bour, M. Dentz and R. Juanes. Origin of Anomalous Transport through Fractured Media: Modeling and Observations from a Field Test in Fractured Granite. American Geophysical Union (2011) **Oral presentation. OSPA award received**.
- C. Nicolaides, **P. K. Kang**, L. Cueto-Felgueroso, M. Dentz, and R. Juanes. Disease Spreading in Lattice Networks with Flux Disorder. American Geophysical Union (2011)
- **P. K. Kang**, M. Dentz and R. Juanes. Effective Transport in Lattice Fracture Networks with Uncorrelated and Correlated Velocity Field. American Geophysical Union (2010). **OSPA award received**.
- **P. K. Kang**, M. Dentz and R. Juanes. Effective Solute Transport with Linear Sorption in Lattice Fracture Networks. Computational Methods in Water Resources (2010). Oral presentation.
- **P. K. Kang**, M. Dentz and R. Juanes, Effective Transport in Fracture Networks: Concentration Mean and Variance. American Geophysical Union (2009).
- **P. K. Kang**, I. O. Jun, I. W. Seo and S. W. Park. A Study on Applicability of Fusegate as a Flood Control Gate of Dam and Levee. Korea Water Resource Corporation (2007).

OUTREACH & BROADER IMPACTS

Recoplastic, Lagos, Nigeria 2013 - 2015
Title: Chief Technology Officer
• Supported Recoplastic which is a company that recycles plastic in Lagos, Nigeria.
• Designed and implemented a rainwater harvesting system and a low-cost wastewater treatment system for sustainable plastic recycling.

Project AQUA, Dar es Salaam, Tanzania 2011 - 2014
Title: Founder
• Initiated a student-led project tackling drinking water problems in developing countries through the integration of water filtration technologies and a community-based web platform.
• Won project funds from MIT IDEAS / Global Challenge, MIT public service center and Korea appropriate technology research center.
• Visited Kiwalani community in Tanzania three times to install biosand filters, and initiated sustainable neighborhood level water distribution service (served more than 150 people).

SPARK and SPLASH programs at MIT, Cambridge, MA 2010 Spring, Fall
Title: Class organizer and Teacher
• Physical experiment and numerical simulation of groundwater flow and its' influence on global warming for 7th-12th graders (SPARK).
• Hydraulic fracturing and flow through fractures for 7th-12th graders (SPLASH).

TEACHING EXPERIENCE prior to UMN

University of Science & Technology, Seoul, South Korea 2017 Fall.
Title: Full time lecturer for *Groundwater Flow and Transport Modelling*
• Taught a graduate level class on groundwater flow and transport modelling.
• The lecture material and problem set codeveloped with Dr. Etienne Bresciani.

Korea University, Seoul, South Korea 2016 Fall.
Title: Full time lecturer for *Computational Hydrogeology*
• Taught a graduate level class on computational methods for flow and transport in porous media.
• The lecture material and problem set codeveloped with Dr. Etienne Bresciani.

Massachusetts Institute of Technology (MIT), Cambridge, MA 2013 Spring.
Title: Guest lecturer for *Water and Sanitation Infrastructure in Developing Countries* (1.851J)
• Taught classes on groundwater issues in developing countries and physics of groundwater flow
• The lecture format and problem set supervised by Susan Murcott (senior lecturer in course 1).

RESEARCH EXPERIENCE prior to UMN

Korea Institute of Science and Technology (KIST), Seoul, South Korea 2015 - current
Title: Research Scientist
• Field-scale subsurface characterization for a managed aquifer recharge site in South Korea.
• Reactive transport modeling of a river bank filtration site in South Korea
• Coupling between porous media flow and geochemical reactions at pore scale: a microfluidic study

Massachusetts Institute of Technology (MIT), Cambridge, MA 2014 - 2015
Title: Postdoctoral Associate
Supervisor: M. Fehler, Earth Resources Laboratory (ERL)
• Flow and transport through stressed rough fractures.
• Joint inversion of flow and seismic data to characterize subsurface structure.

Massachusetts Institute of Technology (MIT), Cambridge, MA 2008 - 2014
Title: Graduate Research Assistant
Supervisor: R. Juanes, Department of Civil and Environmental Engineering
• Anomalous transport through porous and fractured media
• Joint inversion of flow and geophysics data to characterize fractured media.

University of Rennes 1, Rennes, France 2011 Summer, 2012 Summer
Title: Visiting Research Assistant
Faculty host: T. Le Borgne, O. Bour, Department of Geosciences
• Multi-tracer transport experiment on fractured granite site under ambient, single and cross-borehole pumping conditions to understand origins of anomalous transport through fractured media.

Technical University of Catalonia, Barcelona, Spain 2009 Summer, 2010 Summer, 2013 Summer
Title: Visiting Research Assistant
Faculty host: M. Dentz, Department of Geosciences (IDAEA-CSIC)
• Modelling of anomalous transport through highly heterogeneous fracture networks.

NASA′s Goddard Space Flight Center, Greenbelt, Maryland 2007 Winter
Title: Undergraduate Research Assistant
Faculty host: William K.-M. Lau, Chief of the Laboratory for Atmospheres
• Investigated sources of aerosols over East Asia and their interaction with cloud and precipitation via back particle tracking.

The University of Auckland, Auckland, New Zealand 2007 Fall
Title: Undergraduate Research Assistant
Faculty host: B. Melville, Hydraulics Laboratory
• Sediment transport and deposition in river systems (laboratory experiment).

Seoul National University, Seoul, South Korea 2006 - 2007
Title: Undergraduate Research Assistant
Faculty host: I. -W. Seo, Department of Civil, Urban and Geosystem Engineering
• Flow and pollutant dispersion in meandering channels (laboratory experiment).

Seoul National University, Seoul, South Korea 2006
Title: Principal investigator
Project funder: The Center of Teaching and Learning at Seoul National University
• Initiated and conducted research on effective spillway gate to enhance flood control capabilities of dams.