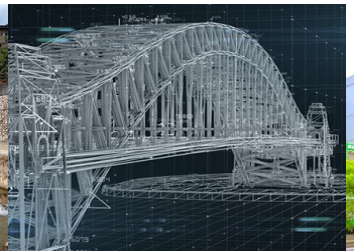
神戸大学

Department of Civil Engineering

Kobe University

July 3, 2025





Our goals

- The Department of Civil Engineering aims to create a safe and secure society that coexists harmoniously with the environment by constructing and maintaining essential social infrastructure.

- Civil Engineering education is dedicated to fostering environments in cities and regions that are resilient to natural and social disasters and that coexist harmoniously with nature, through the preservation, lifelong management, and renewal of urban infrastructure.

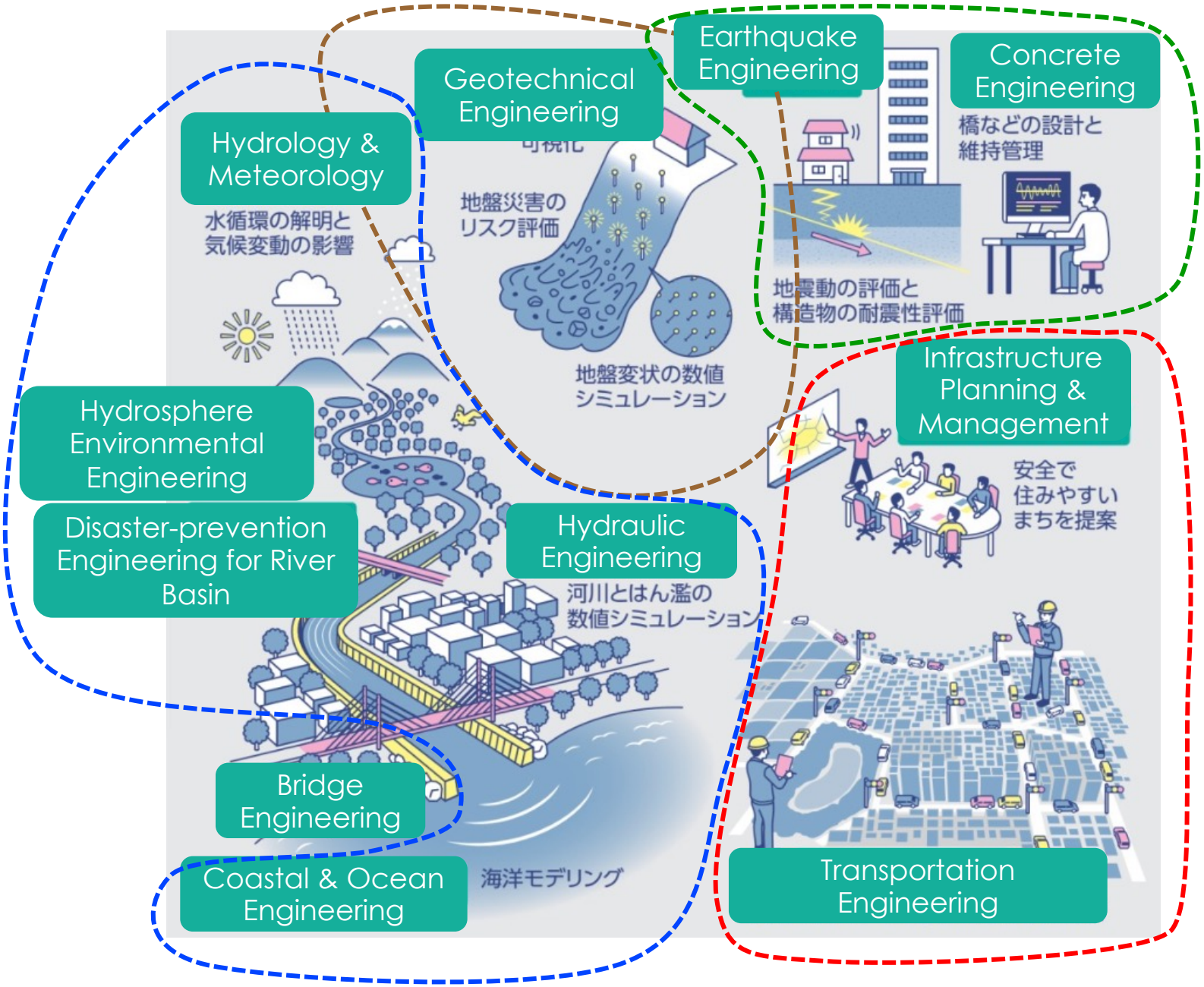
Divisions

- The Department of Civil Engineering is composed of two divisions: the Engineering of Human Safety Division and the Engineering of Environmental Symbiosis Division.

- **Engineering of Human Safety Division** conducts education and research on urban safety in the face of natural and social disasters.

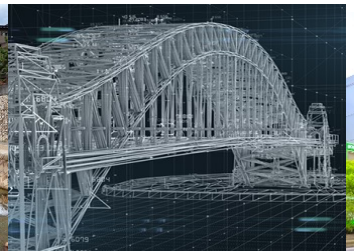
- **Engineering of Environmental Symbiosis Division** focuses on education and research related to creating urban and regional environments that coexist harmoniously with nature, as well as the preservation, lifecycle management, and revitalization of urban facilities.

Subject Categories



Structural Engineering





Structural Engineering for Urban Safety

Dr. Tomohiro Miki, Professor

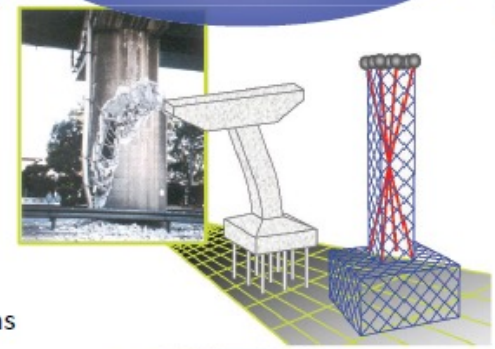
FINAL GOAL: **Advanced Structural Concrete Mechanics and Design**

Aging Structures

- Steel Corrosion
- Alkali-Silica Reaction (ASR)

Example: Corroded reinforced concrete beam and it evaluation by loading tests and extensive observations

Nonlinear Analysis



New Materials

Steel fiber reinforced concrete (SFRC)

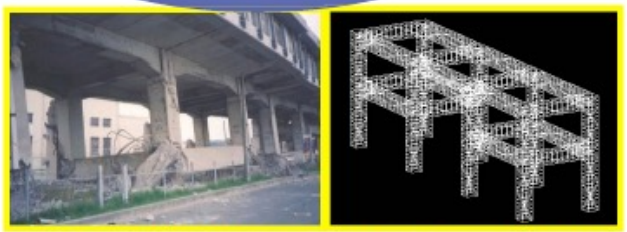
Ultra-high strength fiber reinforced concrete (UFC)

-Steel fiber
φ=0.2mm, L=15 mm
fu=2500N/mm²

+

-Cement
-Silica fume
-Silica sand

Seismic Performance



Damage of Shinkansen express train viaduct at Kobe earthquake and its seismic performance re-evaluation by using 3D Lattice Model

Experiment with Image Analysis

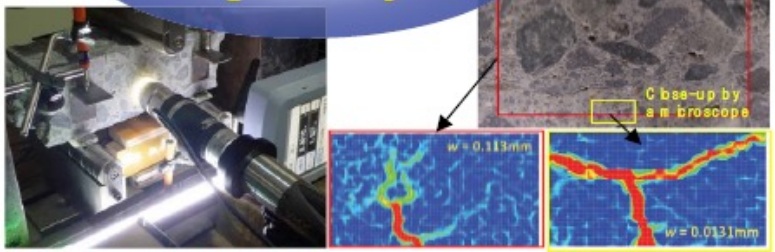


Image based detection for concrete fracture
Fracture properties of concrete damaged due to ASR in tension was evaluated based on loading tests and an image analysis.

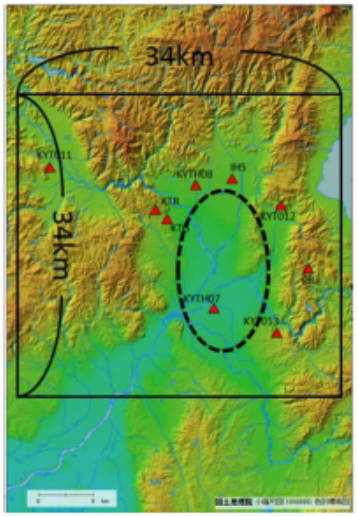
New Technology

Design and application in the seismic regions
- Prestressed Concrete
- Precast Concrete structural members

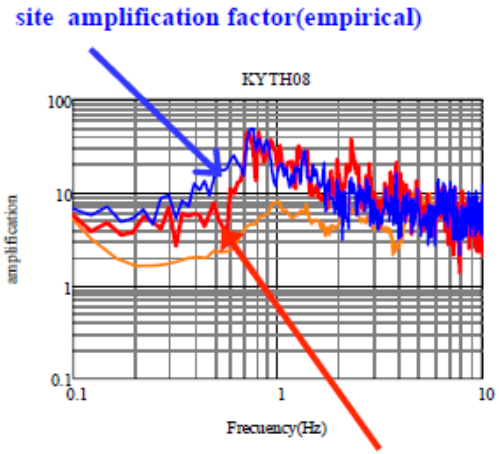
Earthquake Engineering

Dr. Takashi Nagao, Professor

Evaluation of earthquake ground motion and site amplification factor

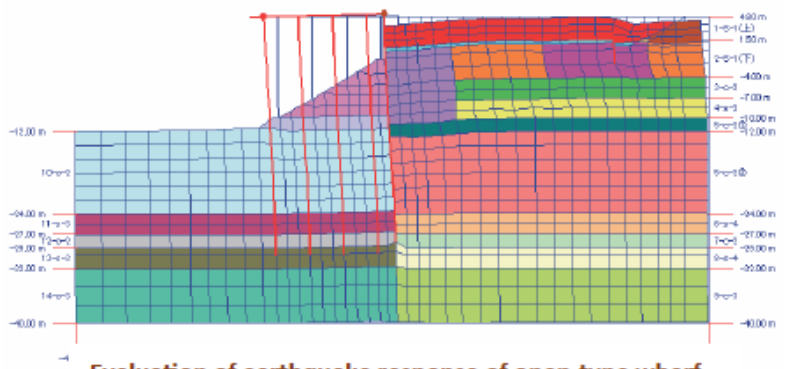


3 dimensional earthquake response analysis

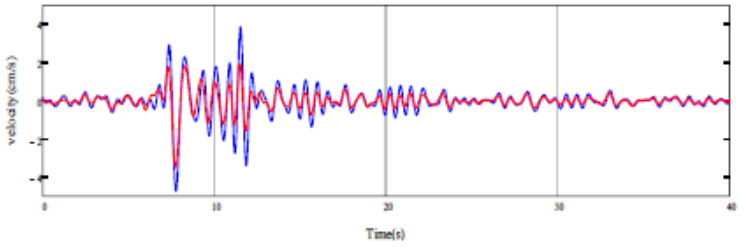


Evaluation of site amplification factor

Evaluation of earthquake resistance of structures



Evaluation of earthquake response of open-type wharf



Analysis & Empirical

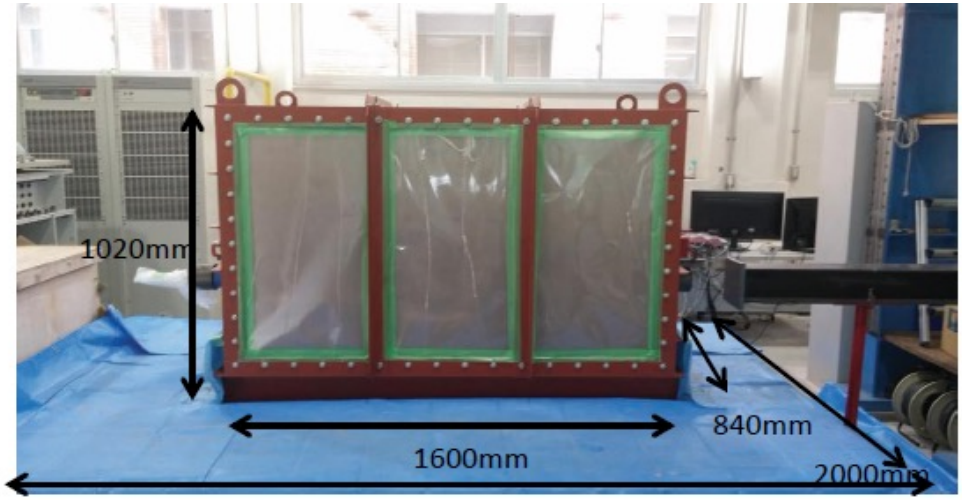
Evaluation of earthquake ground motion

Earthquake Disaster Mitigation Engineering

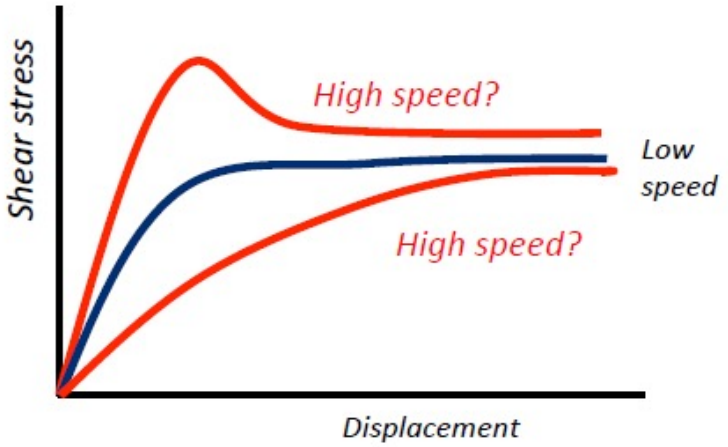
Dr. Yasuko Kuwata, Professor

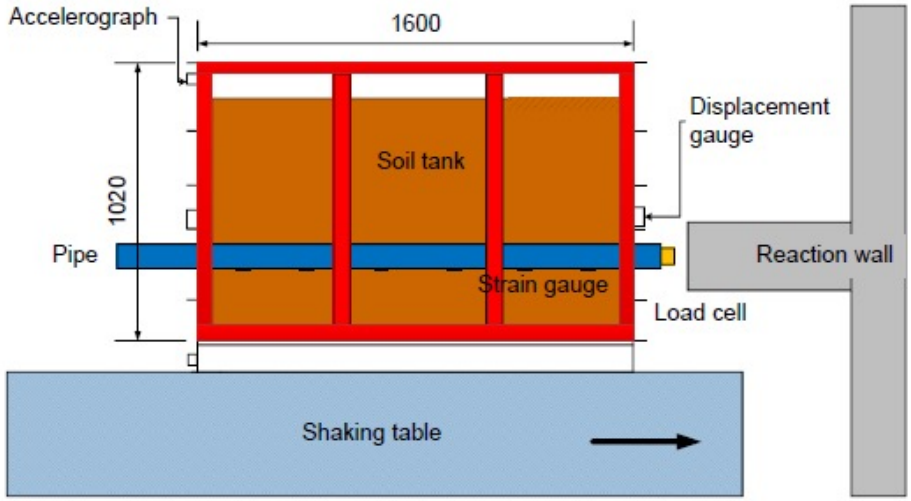
Experimental study on dynamic soil friction along a buried pipe

This study attempts to clarify the velocity dependency of soil friction from a pipe pulling test using a shaking table.



Shaking table 3000mm

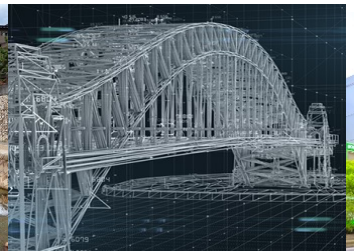




Vertical view

Geotechnical Engineering





Geotechnical Engineering for Disaster Reduction

Dr. Tomohide Takeyama, Professor

Liquefaction Analysis Considering Variation in Boring Survey

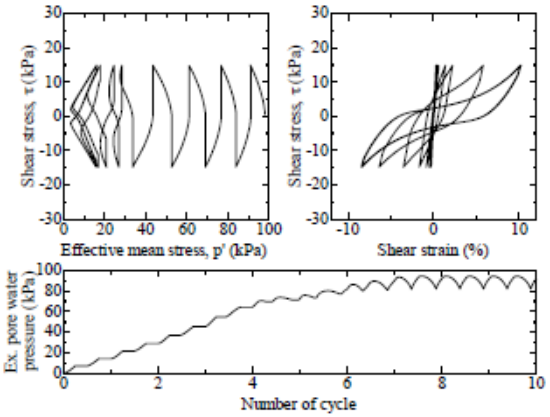
1. Introduction

The supercomputer "K" is used to simulate the processes of earthquake occurrence, structural response, and disaster response for the entire city by integrating the fundamental technologies such as earthquake ground motion prediction, earthquake response analysis, automatic generation of urban digital data, etc. This research aims to estimate liquefaction in a wide area with high accuracy by FEM.

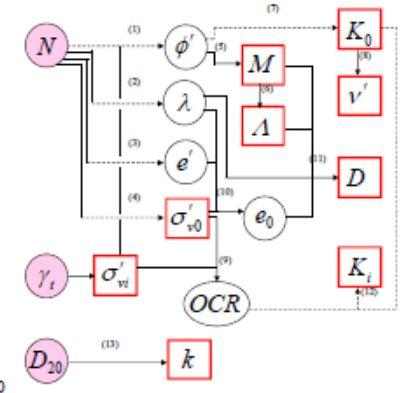
2. Constitutive model and material parameters

An elasto-plastic constitutive model that can express the process of liquefaction due to earthquakes is employed in this study.

The material parameters necessary to the constitutive model is estimated from SPT-*N* value and the plasticity index I_p by utilizing the database of the boring survey results. However, there are variations in the boring survey results. In this study, this variation is given as the probability distribution and the possibility of liquefaction is examined.



Simulation of cyclic simple shear

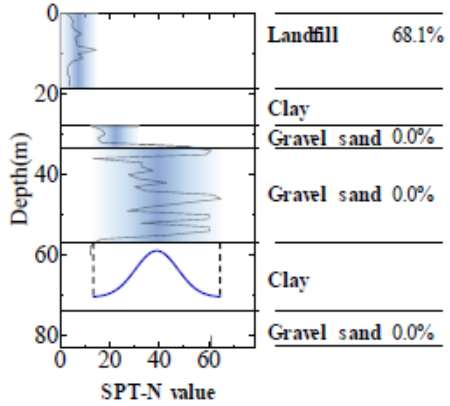


Estimation of parameters by *N* value

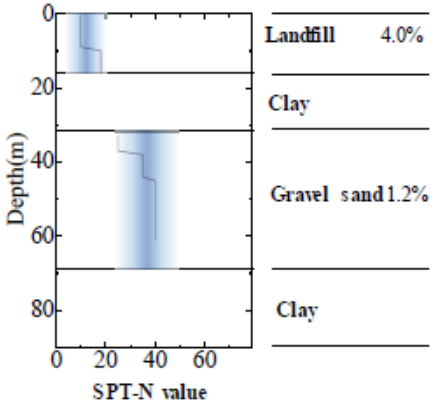
3. Estimation of liquefaction probability

Liquefaction analysis was carried out in consideration of variations in *N* values for two locations in Port Island and Rokko Island.

As a result, the liquefaction probability was calculated in landfill soil at 68.1% in Port Island and 4.0% in Rokko Island. This is consistent with observed facts during the Great Hanshin-Awaji earthquake in 1995. In Kobe City, there is a database of boring survey results of more than 10,000 locations. We'd like to conduct liquefaction analysis by using the all data.



North-west part of Port Island



South-west part of Rokko Island

Dr. Shinya Tachibana, Professor

Multi-physics Simulation in Geotechnical Engineering

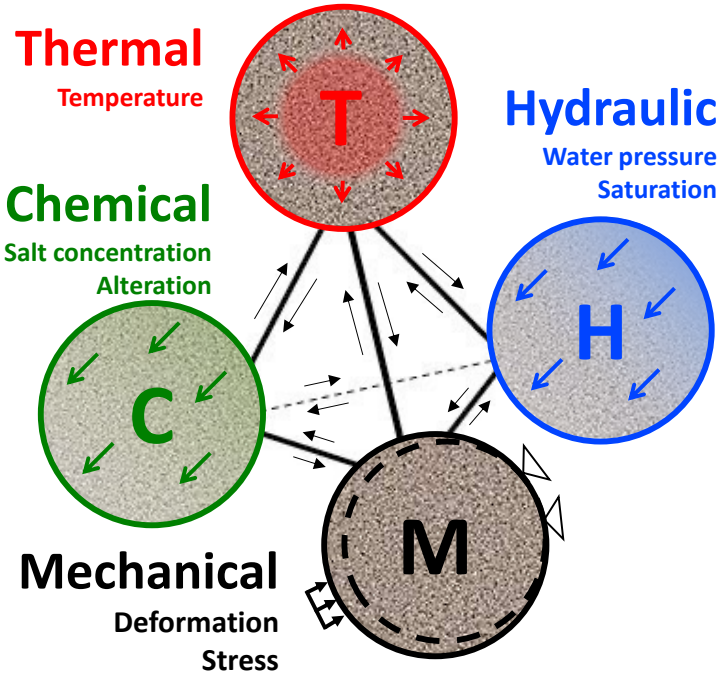
Multi-physics is a computational discipline which treats simulations that involve multiple physical models or multiple simultaneous physical phenomena.

The aim of his research is to develop a multi-physics simulator for approach to geotechnical and geo-environmental problems such as safety assessment for the disposal of radioactive waste. His research combines concepts from advanced mathematics, mechanical theories, and numerical methods to create mathematical models and corresponding computer simulations that highlight complex behaviors of multi-functional materials on various length and time scales.

Geotechnical Engineering for Urban Safety

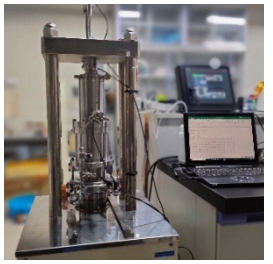
Dr. Yusuke Takayama, Associate Professor

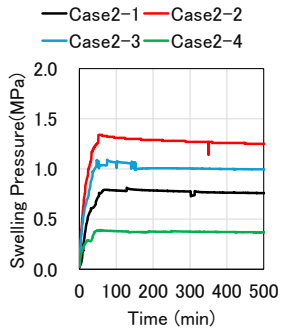
Modeling of coupled thermo-hydro-mechanical-chemical processes in geologic disposal systems for radioactive waste



LAB

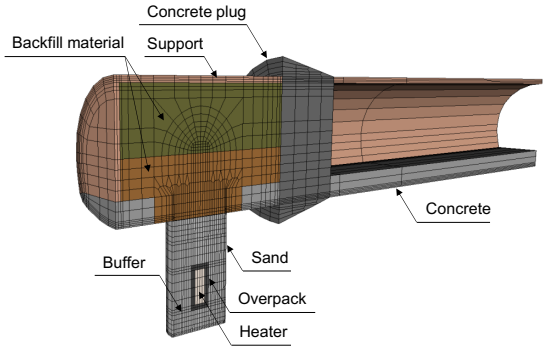
Laboratory test





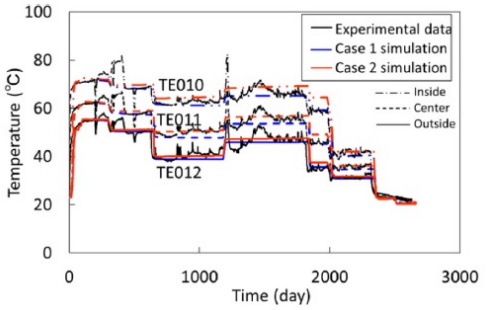
MOD

Numerical modeling



URL

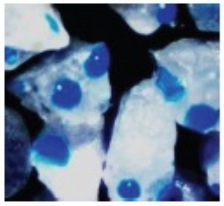
In-situ data from Underground Research Laboratory



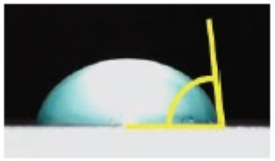
Geosphere Environmental Engineering

Dr. Shoji Kato, Associate Professor

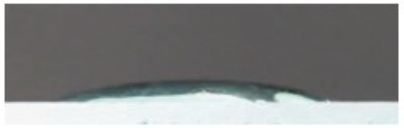
Characterization of geotechnical properties of non-wettable soils and its application for capillary barrier



Spatial distribution of water for non-wettable sand



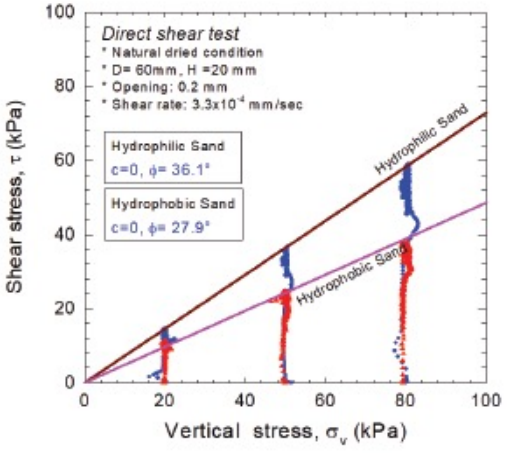
Non-wettable Θ = 13°



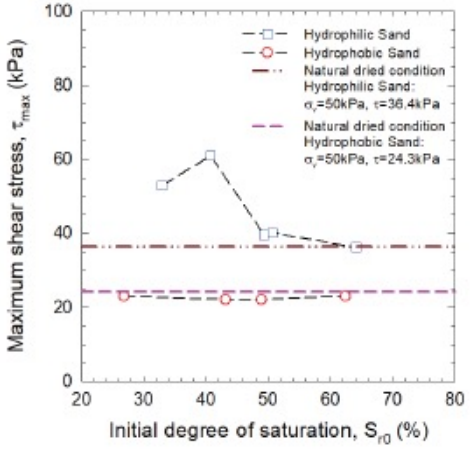
Wettable Θ = 85°

< Contact angle(Θ) on the surface >

- **Direct Shear Test**

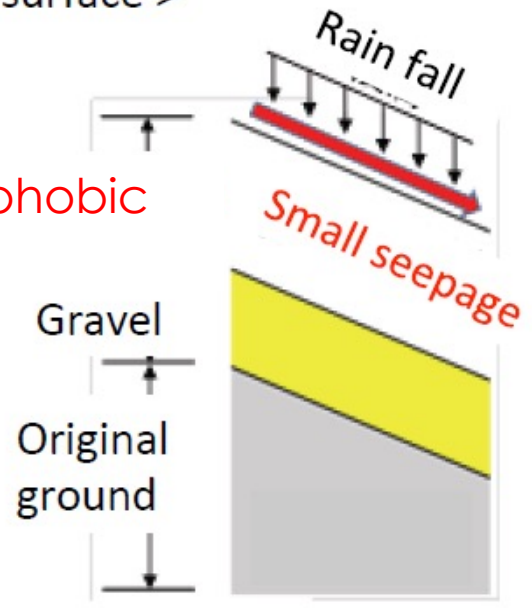


< Direct Shear Test in natural dried condition >



< Variation of τ_{max} according to the initial S >

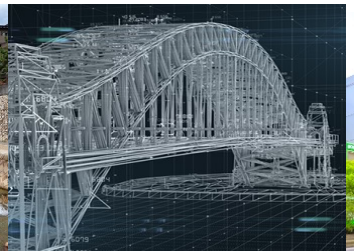
Hydrophobic sand



application for capillary barrier

Hydrology and Environmental Science

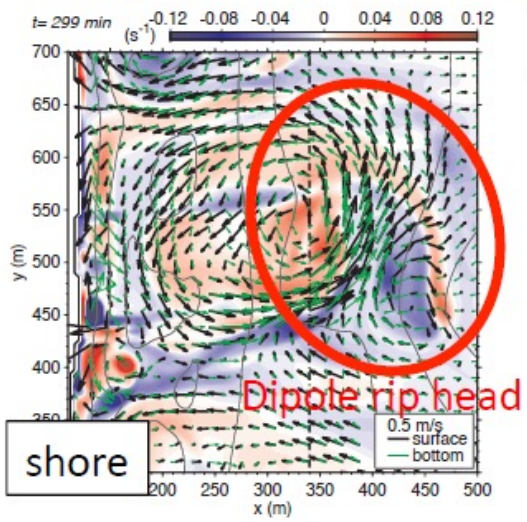




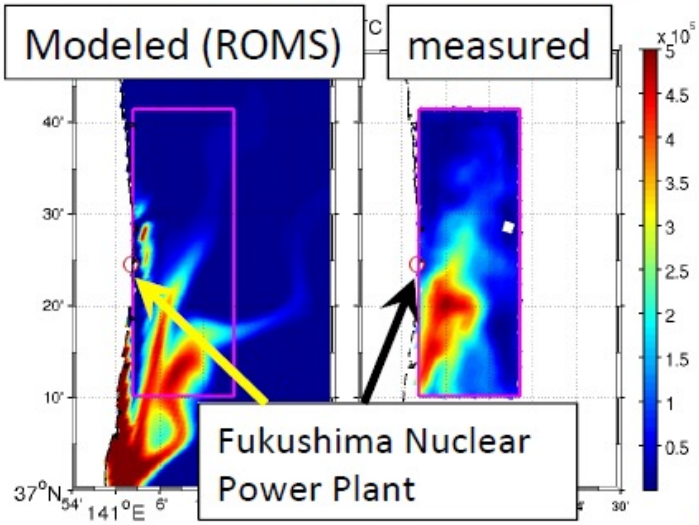
Environmental Fluid Engineering

Dr. Yusuke Uchiyama, Professor

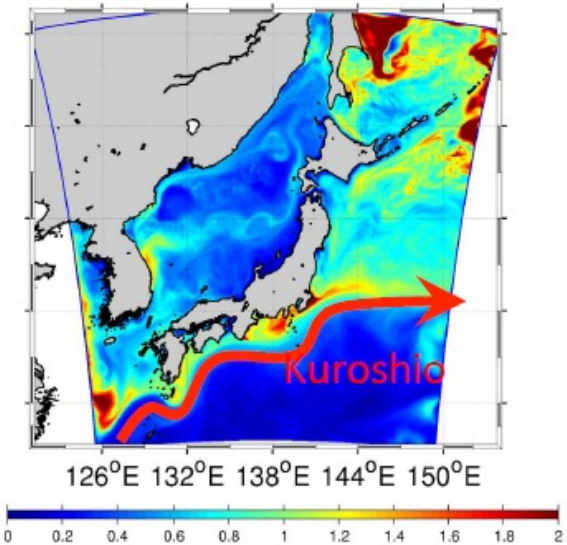
Goal: offer scientific and engineering supports for desirable aquatic environment, disaster prevention, optimal utilization of coastal areas.
Approach: numerical modeling (ROMS), theoretical GFD, and analyses of satellite remote sensing and *in situ* measurement.



3-D turbulent rip currents on a beach at Duck, NC, USA. (Uchiyama *et al.*, 2017, *J. Geophys. Res. Oceans*)



Oceanic dispersal of ^{137}Cs [Bq/m^3] after the Fukushima Nuclear Accident (Uchiyama *et al.*, 2014, *J. JSCE Ser. B*)



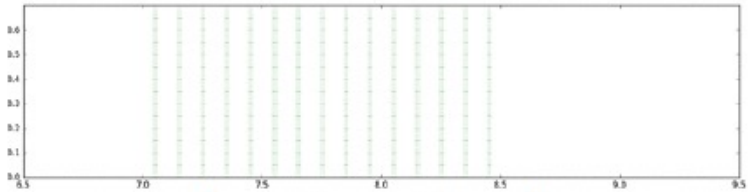
Climatological chlorophyll [μg/L] in upper ocean around Japan (Uchiyama *et al.*, 2017, *J. Geophys. Res. Oceans*)

Aquatic and Environmental Engineering

Dr. Keisuke Nakayama, Professor

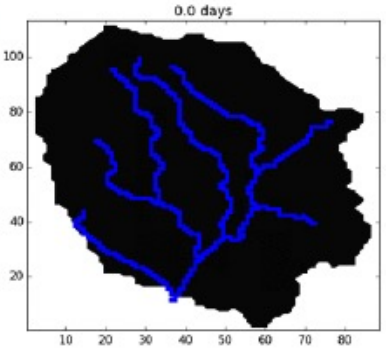
Our study purposes are to improve water quality and to sustain sound ecological system in an aquatic environment by including the influence of climate change.

Theme 1: absorption of CO2 by eelgrass in coastal regions



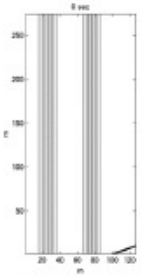
eelgrass in a uniform flow

Theme 2: mass transport in a river basin by using an object oriented programing and the Bayesian theorem

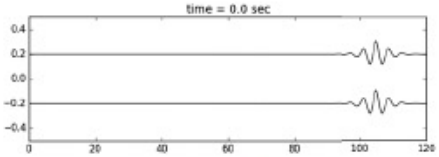


water volume in an infiltration layer (black & white) and water depth in a river network

Theme 3: surface and internal wave model by using the variational principle

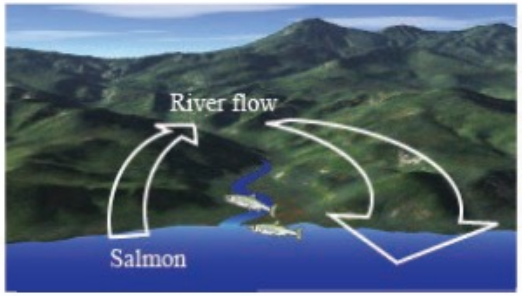


soliton resonance



breather

Theme 4: nutrient cycle between an inland and the ocean by using the stable isotope analysis



Runs of salmon are thought to play a large role in the sustainability of nitrogen cycling in ecological systems

Theme 5: stratified flow field analysis

plunging breaker of internal solitary waves

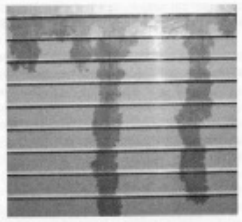
fissions of internal solitary waves

Environmental Fluid Engineering

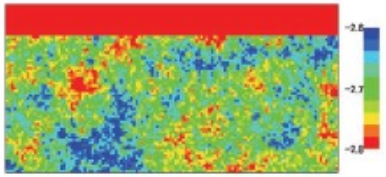
Dr. Masahiko Saito, Associate Professor

Research topics

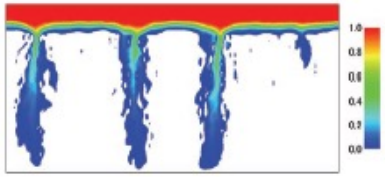
- Simulation of seepage flow and solute transport in non-uniform fields



Fingered flow



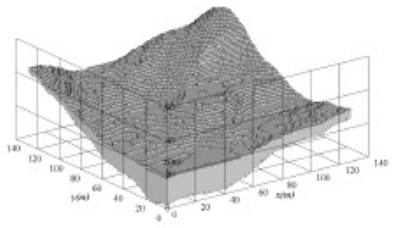
Distribution of $\log_{10}k_s$

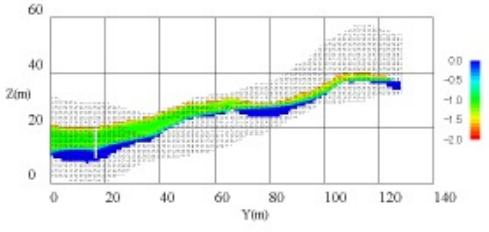


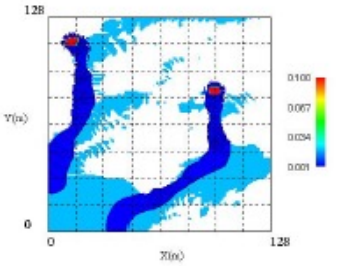
Distribution of concentration

(Example-1) Numerical simulation of fingered flow in non-uniform porous media

- Environmental groundwater modeling





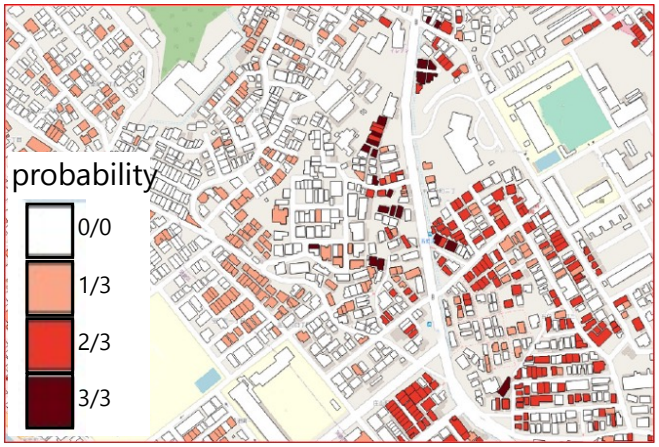


(Example-2) Numerical simulation of rainfall infiltration and mass transport in the mountainside

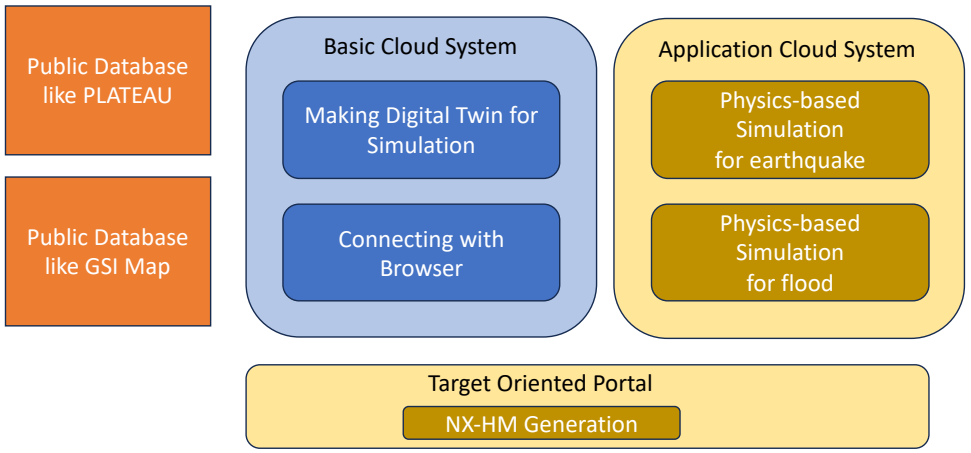
Digital Transformation and HPC/AI for Smarter Disaster Mitigation

Dr. Satoru OISHI, Professor

Digital Twins for smarter disaster mitigation combine social infrastructure data, social dynamics, observational data, and other information in cyberspace to facilitate hazard prediction, assess damage and social impact, and optimize responses to anticipated national disasters. Consequently, the "Establishment of Digital Transformation and HPC/AI for Smarter Disaster Mitigation" project aims to achieve damage mitigation and early recovery for society through practical evacuation guidance, efficient troop deployment, control of public infrastructure operations, and transportation. We develop the system to create digital twins for smarter disaster mitigation as a SaaS, connecting public databases and citizens' needs.



Probability of houses being severely damaged by the earthquake

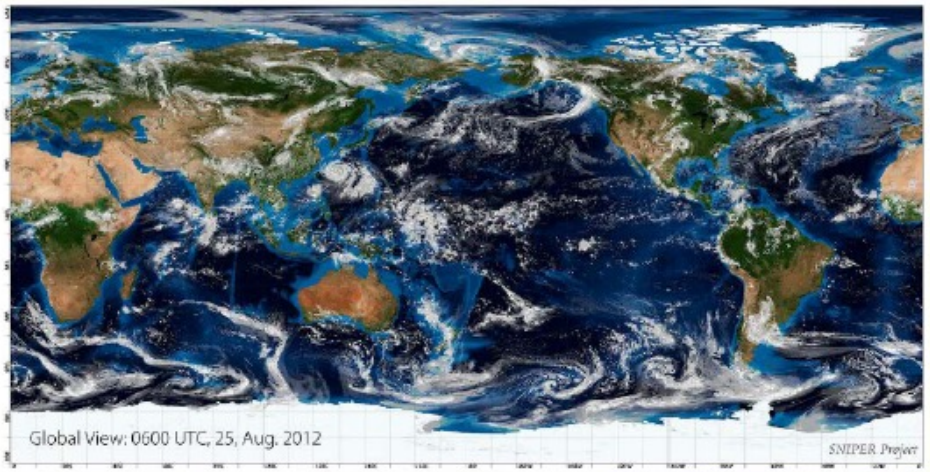


SaaS for creating digital twins for smarter disaster mitigation

Computational Climate Science Research

Dr. Yoshiyuki Kajikawa

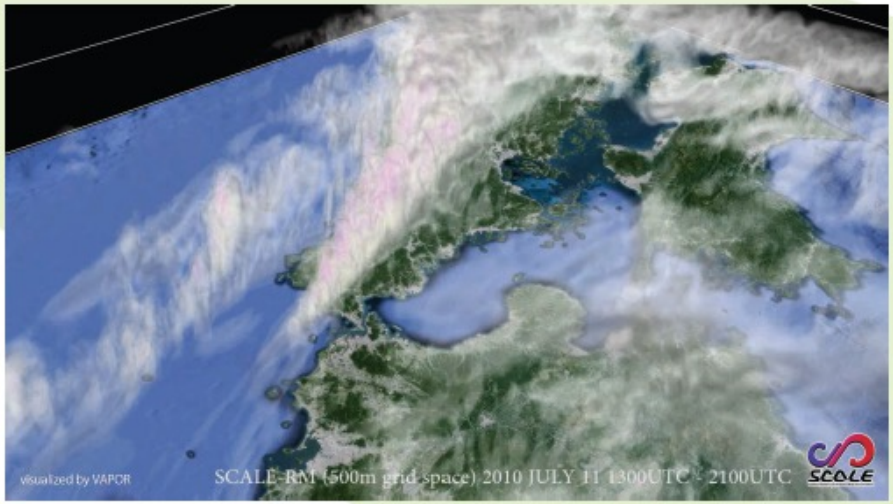
Professor responsible for Computational Climate Science



From **G**lobal to **R**egional, we are challenging to investigate the climate change by large scale numerical simulation and diagnostic Data analysis. We also closely collaborate with Computational Climate Science Research Team in RIKEN Advanced Institute for Computational Science.

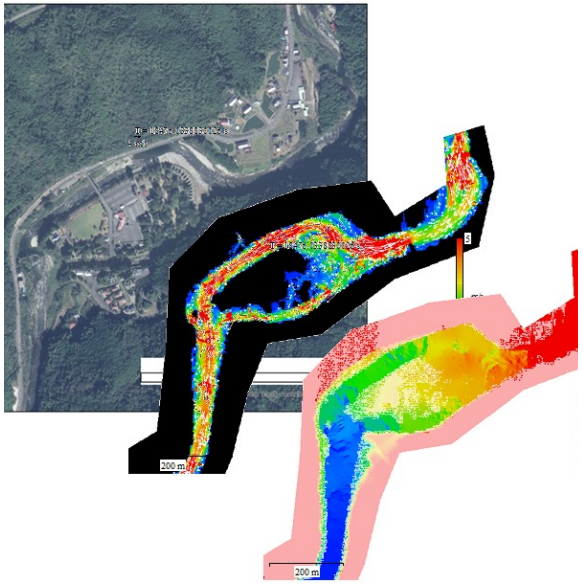
Upper: Horizontal view of the total mixing ratio of condensed water contents **in sub-kilometer** global atmospheric simulation.

Right: 3D visualization of the total mixing ratio of condensed water contents over Western Japan in 500m regional climate simulation.

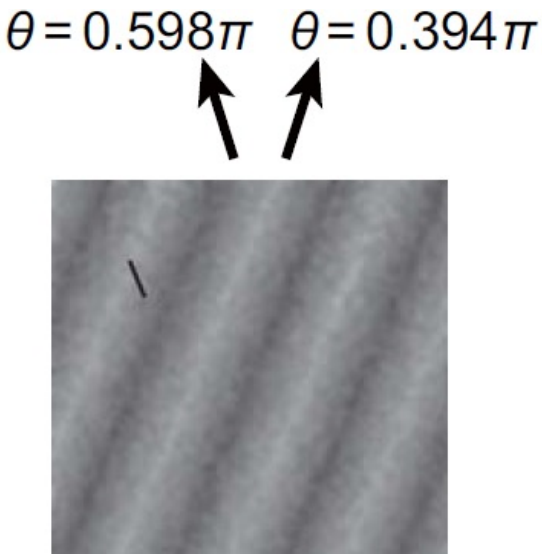


River Engineering

Dr. Ryota Tsubaki, Associate Professor



High-resolution inundation flow simulation and its application to mitigate physical and environmental risks

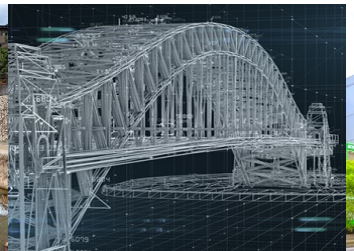


Advanced field monitoring of fluid flow and sediment transport in flooding rivers

Understanding the development process of river geomorphology and managing river geomorphology by utilizing natural processes

Infrastructure Planning and Management





Urban Systems Engineering and Management

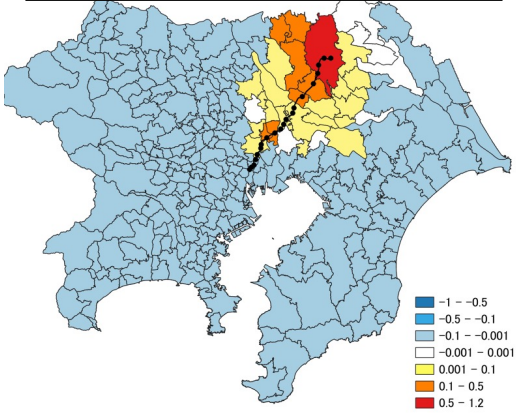
Dr. Shunsuke Segi, Associate Professor

Understanding Urban Mobility and Land Use through Modeling

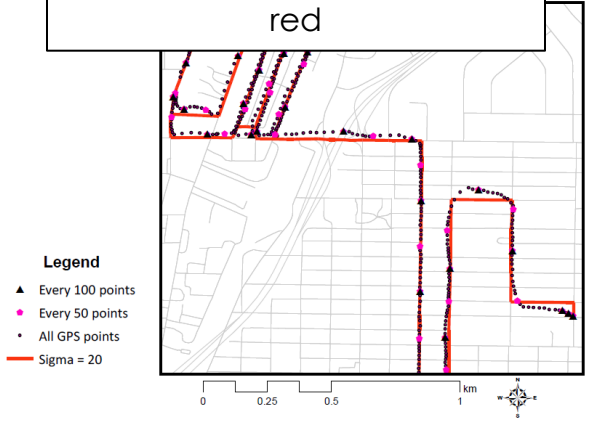
We develop mathematical models to analyze how people move, live, and interact within urban and regional spaces. Our goal is to provide insights that support real-world planning and policy decisions.

Using urban economic models and discrete choice models, we study behavior related to transportation, housing, and land use. We also evaluate the impacts of infrastructure investments, land-use policies, and disaster risk management strategies.

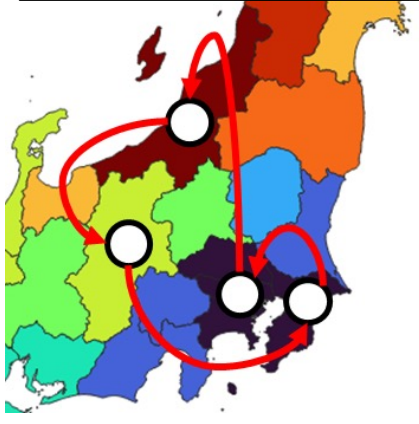
Impact of Railway Development on Residential Distribution (Urban Economic Model)



Map Matching Using GPS Data (Discrete Choice Model)
*Estimated route shown in red



Tourist Itinerary Analysis (Discrete Choice Model)
*Predicted visit sequence



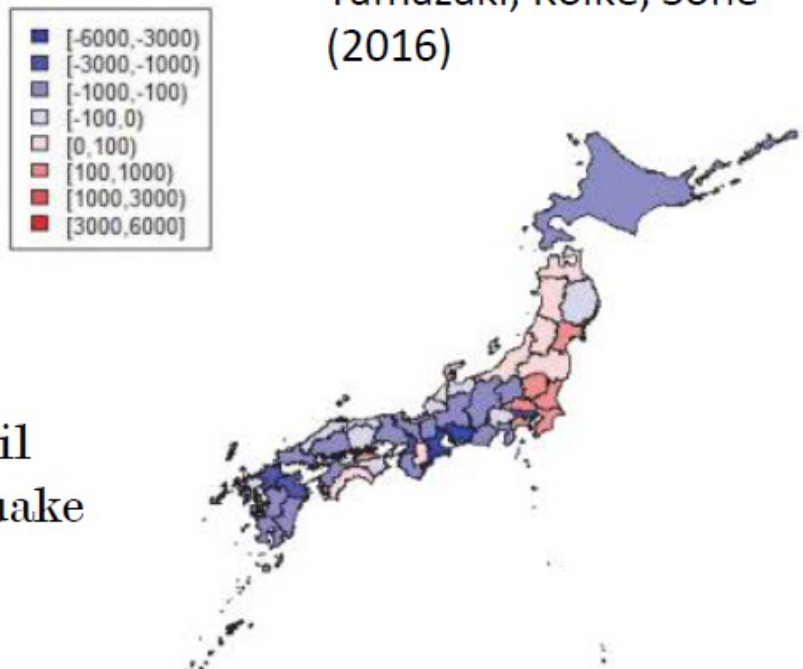
Infrastructure Planning & Management

Prof. Atsushi Koike, Prof. Toshimori Otazawa, and Assoc. Prof. Hajime Seya

Socio-economic impacts evaluation of infrastructures

- We develop theories and methods for social impacts evaluation of infrastructures based on:
  Spatial econometrics approach,
  Urban economics approach, and
  Spatial computational general equilibrium (SCGE) approach.

Yamazaki, Koike, Sone (2016)



Example of an application of SCGE model:
Economic damage assessment of shutdown of oil refineries due to Nankai Trough great Earthquake

Further Information

- Kobe University, Graduate School of Engineering, Department of Civil Engineering

  http://www.shimin.eng.kobe-u.ac.jp/en/index.html

- The Research Center for Urban Safety and Security (RCUSS)
  http://www.rcuss.kobe-u.ac.jp/English/index-e.html

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