Hokkaido University
Water Quality Control Engineering Laboratory

August 27, 2016
Japan-YWP International Symposium

Young Researchers, Be Ambitious and International!

Masaaki Kitajima

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Contents

First Research Experience in US

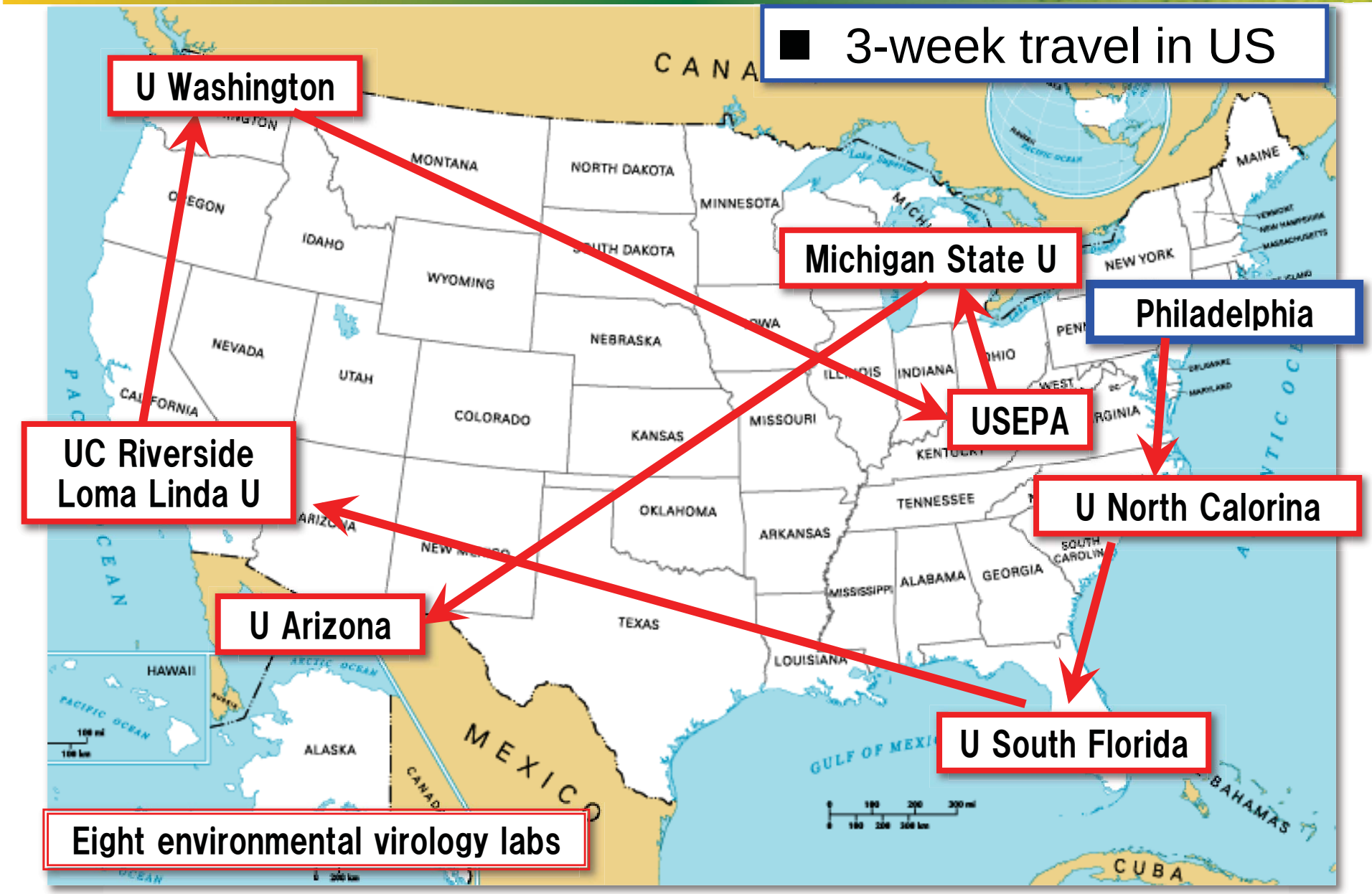
- **Why U.S.?**
  - Leading country in most scientific fields
    - Including environmental virology and microbial risk assessment
  - Train myself in the research environment in the US

- **Drexel University (Philadelphia)**
  - Visiting Research Engineer / Ph.D. Student
  - JSPS Excellent Young Researchers Overseas Visit Program
    - December 2009～February 2010

Research at Drexel University

- **Research topic: Risk assessment of H5N1 highly pathogenic avian influenza virus**
  - Prof. Charles N. Haas
    - Pioneer of quantitative microbial risk assessment (QMRA)
    - First met at an international conference
  - Computation-based research
    - i.e. no lab experiments involved
- **Published 2 first author papers**
  - *Environmental Engineering Research* (環境工学研究論文集)
    - Paper awards (環境工学研究フォーラム論文奨励賞, 土木学会論文奨励賞)
  - *Letters in Applied Microbiology*

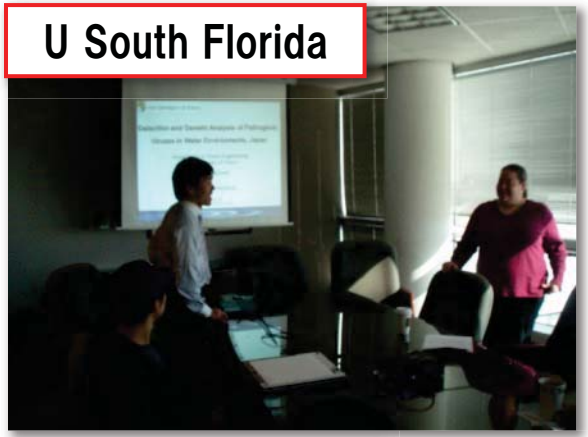
Laboratory Visits



Presentation & Discussion

"Detection and Genetic Analysis of Pathogenic Viruses in Water Environments, Japan"

U South Florida



USEPA

North Carolina U

U Arizona

- **Discussion with many researchers in the relevant research field**
- **Lab atmosphere, recent research topics/progress**
- **Human connection for postdoc in the US (through JSPS)**

Post-Doc Lab: Why Arizona?

- **Research activities on water reuse in Arizona**
  - Advanced wastewater treatment, Groundwater recharge of treated wastewater, Irrigation, etc.
- **Prof. Charles P. Gerba**
  - Pioneer of environmental virology
    - → Educated many researchers
  - Attractive research topic
    - → Laboratory visit, presentation, discussion with lab members
  - Personality of the professor, lab atmosphere
    - → Dinner (tequila?) party after lab seminar

Soil, Water and Environmental Science
The University of Arizona
College of Agriculture and Life Sciences

Research Activities in Arizona

THE UNIVERSITY OF ARIZONA

- **Post-Doc**
  - JSPS Postdoctoral Fellow for Research Abroad (“海外学振”)
    - 2011 April~2013 March（2 years）
  - Postdoctoral Researcher
    - 2013 April~2013 December
- **Contribution to the lab**
  - Quantitative PCR, cloning, sequencing, etc.
  - New types of viruses
  - Broaden availability of techniques in the lab
- **High publication record in a productive lab**
  - Behavior of pathogenic viruses in water recycle systems
  - Peer-reviewed papers: 17 (＋several papers in review/preparation)
    - **Appl Environ Microbiol** (IF=3.668) x3, **Sci Total Environ** (IF=4.099) x3, **Environ Sci Technol** (IF=5.330) x1, etc.

Virus Occurrence & Reduction

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Relative abundance and treatment reduction of viruses during wastewater treatment processes — Identification of potential viral indicators

Masaaki Kitajima *, Brandon C. Iker, Ian L. Pepper, Charles P. Gerba

Department of Soil, Water and Environmental Science, The University of Arizona, 1117 E. Lowell St., Tucson, AZ 85721, USA

Environmental Science & Technology

Article

pubs.acs.org/est

Virus Reduction during Advanced Bardenpho and Conventional Wastewater Treatment Processes

Bradley W. Schmitz,*[,†,§] Masaaki Kitajima,[‡] Maria E. Campillo,[†] Charles P. Gerba,[†] and Ian L. Pepper[†]

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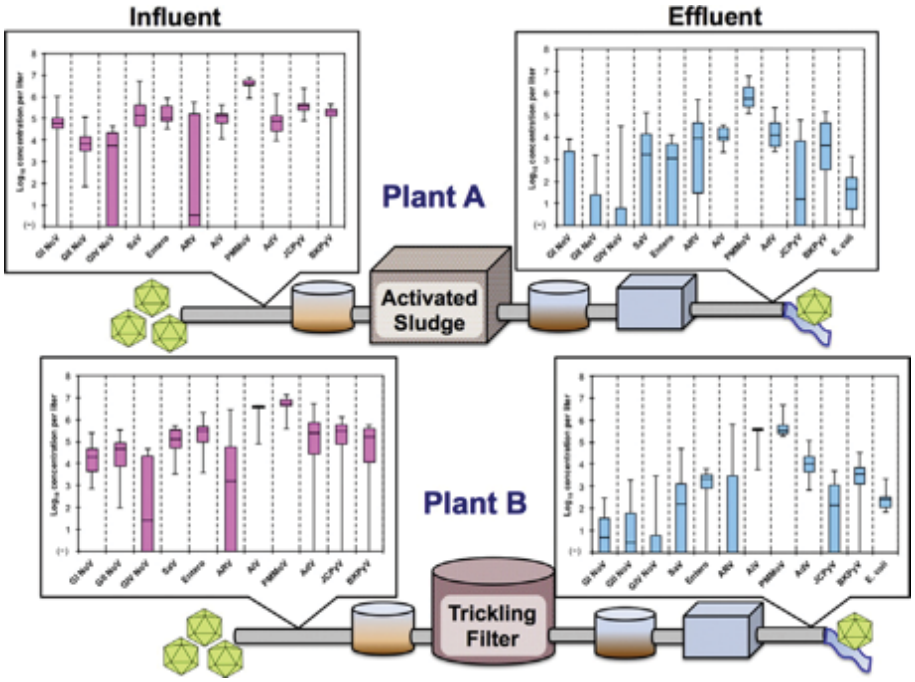
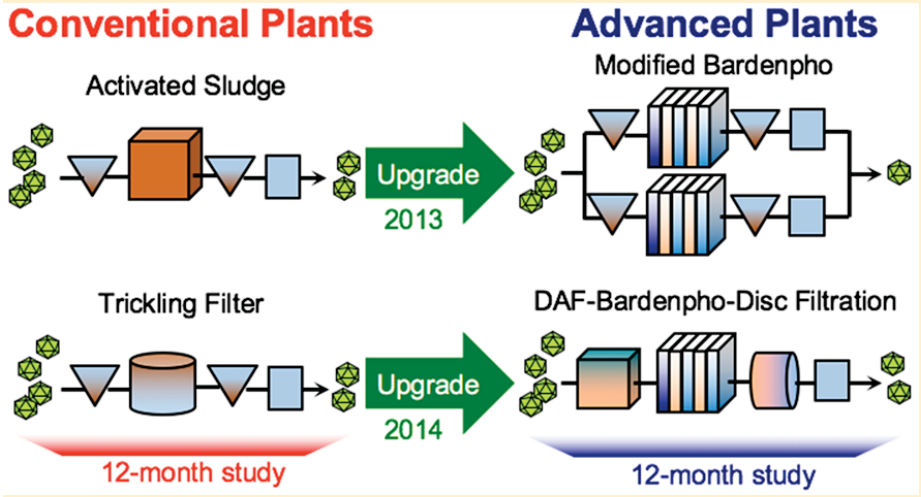
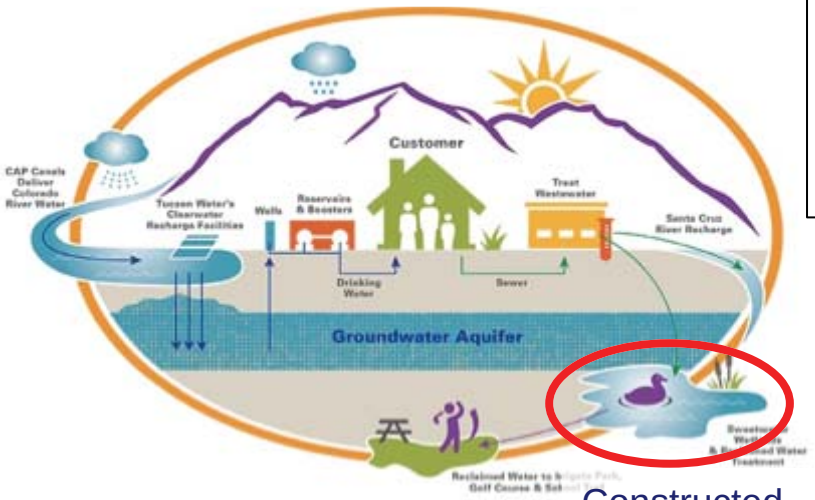




Virus Removal by Wetlands

THE UNIVERSITY OF ARIZONA

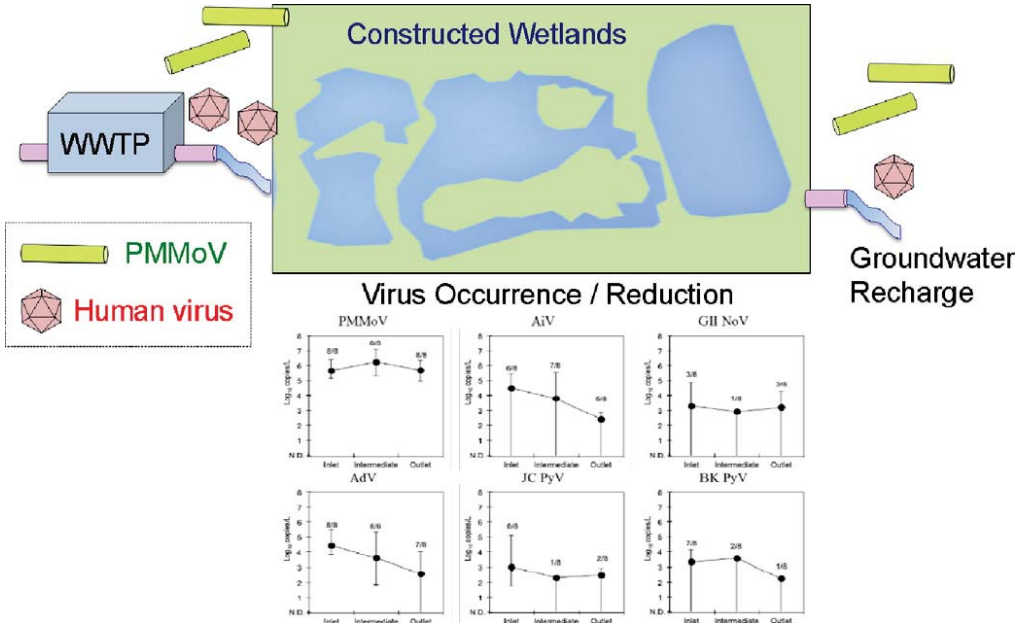


Constructed wetlands

Contents lists available at ScienceDirect
Science of the Total Environment
journal homepage: www.elsevier.com/locate/scitotenv

Enteric and indicator virus removal by surface flow wetlands

Andri T. Rachmadi [1], Masaaki Kitajima [2], Ian L. Pepper, Charles P. Gerba *
Department of Soil, Water and Environmental Science, The University of Arizona, 1117 E. Lowell St., Tucson, AZ 85721, USA



Master's work of Mr. Andri Rachmadi (Currently PhD student in our lab at Hokkaido University)

Job Application in US

- **Post-Doc job advertisement from MIT**
  - Job search on internet (in US)
  - 2013 August (3rd year in US)
    - Project: water quality monitoring in drinking water distribution systems
    - Application: cover letter, CV, list of references
    - Recommendation letters from 3 references
    - Skype interview with the professor (twice)
    - Submission of a mini research proposal
    - Job offer (negotiation of salary, start date, etc.)
    - Research center in Singapore

Prof. Andrew Whittle
（Civil & Environmental Engineering, MIT）

Massachusetts Institute of Technology

Singapore-MIT Alliance for Research and Technology

- **Research center of MIT fully funded by Singapore Government**
  - Approx. 60 MIT professors involved
    - Each professor supervises a project team and stays in Singapore for ~2 mo/yr (home job: lecture/research at MIT)
  - 5 interdisciplinary research groups
    - BioSystems and Micromechanics
    - Infectious Diseases
    - Future Urban Mobility
    - Low Energy Electronic Systems
    - **Center for Environmental Sensing and Modeling**

Massachusetts Institute of Technology

SMART
Singapore-MIT Alliance for Research and Technology

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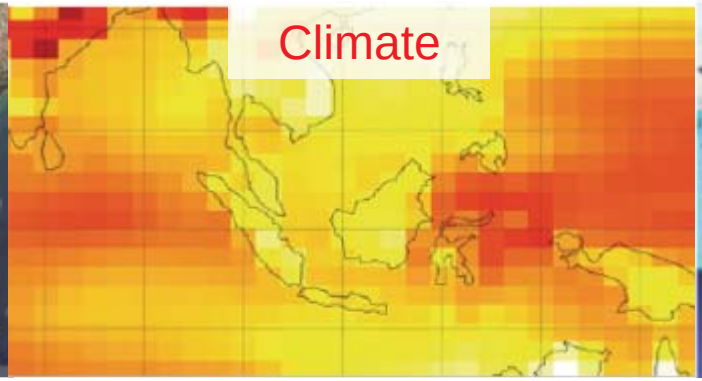
Center for Environmental Sensing and Modeling

- **One of the research groups at SMART**
  - Founded in 2008


International Research Environment


Super computer facility

- **Three major research fields**

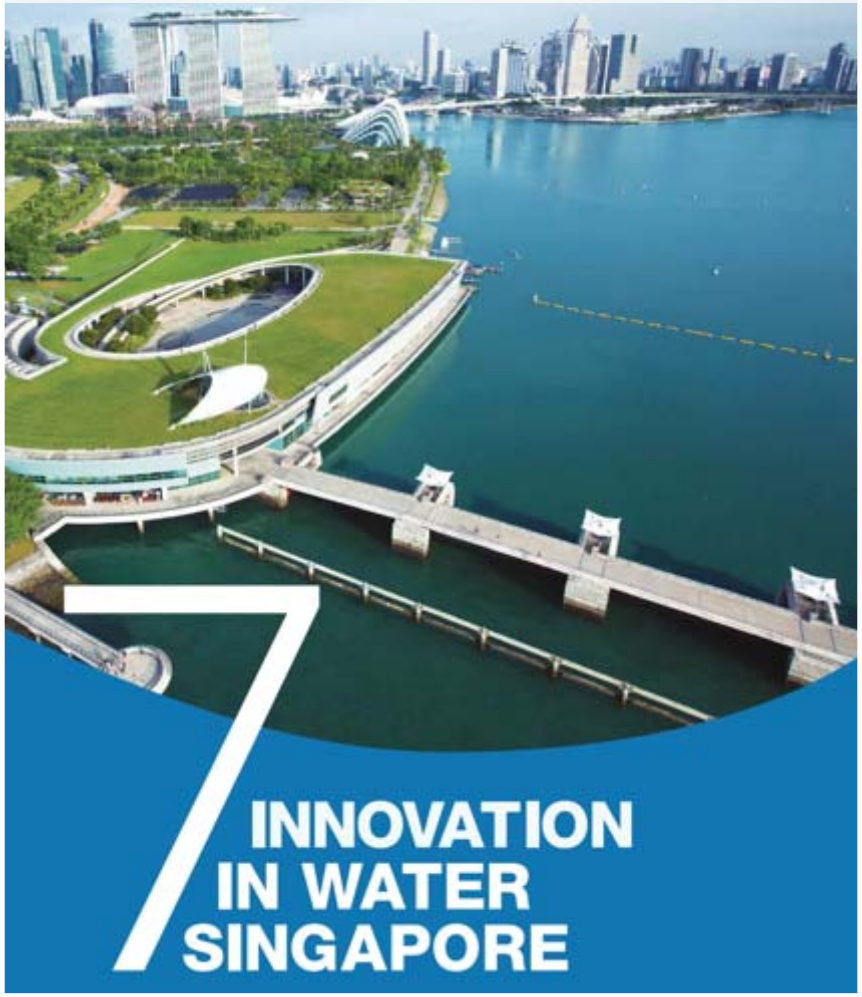


Experience at SMART-CENSAM

- **Unique Post-Doc position/experience**
  - Higher requirement of ability to work **independently** and yet **collaboratively**
    - Boss spends most of time at MIT in Boston (~2 mo/yr in Singapore)
    - Negotiation with collaborators, local water agency, etc.
  - Communication with researchers in other disciplines
    - Boss: geotechnical engineer (no microbiology background)
    - Collaborators: environmental chemistry, mechanical engineering, etc.
- **Excellent colleagues**
  - MIT Professors
  - Post-Docs graduated from top-tier universities
    - e.g., Harvard, MIT, Oxford, Cambridge, UC Barkley, Davis, etc.
- **Currently: Visiting Researcher**
  - Continued contribution/collaboration

Drinking Water Biofilms

Publication from Public Utilities Board (PUB, local water agency) on up-to-date research in Singapore



Solving the mystery of biofilm growth in pipes

Operation and validation of an in-pipe sensor to monitor biofilm development in water distribution systems

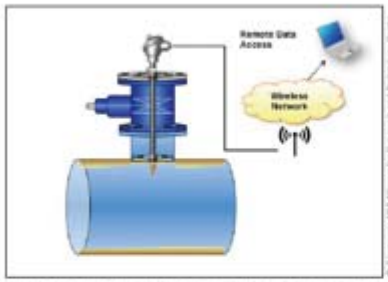


Fig. 1: Installation of an in-pipe biofilm sensor with online monitoring data acquisition within a water pipe

Fig. 2: Investigating the occurrence of target microbes in biofilms using molecular biological methods

Biofilms occur universally on submerged surfaces in water supply systems, including storage tanks, distribution networks, consumer taps and showerheads. While biofilms play a beneficial role in some water treatment processes (e.g. slow sand filtration and biological activated carbon), its development in water distribution systems is usually considered undesirable, and is associated with the decay of residual disinfectant, nitrification, and microbiologically-influenced corrosion.

There is limited knowledge of biofilm growth rates within the potable water network, and its relationship with the local hydraulic regime, water age and water quality. In practice, it is difficult to collect biofilm samples as access to pipe surfaces within an operational water distribution system is limited. In a collaborative project with PUB, Andrew Whittle and Masaaki Kitajima from the Massachusetts Institute of Technology and Singapore-MIT Alliance for Research and Technology Centre aim to measure biofilm growth rates using in-pipe sensors as a first step towards the development of strategies for managing the associated water quality issues.

Whittle and Kitajima plan to install wireless in-pipe sensors to measure the electrochemical activity of aquatic biofilms at selected locations within the water distribution system (Fig. 1). These sensors are attached to the ends of steel rods and installed within the distribution pipes via the gate valves. The strength of the electrochemical signal captured by the sensor is proportional to the sensor surface area covered by bacteria, giving a real-time indication of the biofilm growth rate. The online monitoring data (i.e. quantitative measurement of biofilm growth rate) will be transmitted to the team wirelessly.

The performance of the in-pipe biofilm sensors will be evaluated by validating the sensor response with offline biofilm measurements, conducted by sampling biofilms from the bottom surface of coupons attached to the sensor rods. These biofilm samples will be brought back to the laboratory and subjected to quantification of microbial numbers with culture-based assays and quantitative polymerase chain reaction (q-PCR) (Fig. 2).

According to Whittle, the results of the study will provide insights to how biofilm development is related to factors such as pipe size, material and age, local hydraulic conditions (operating pressures, flow rates, water age), and local chemical environment and water quality (turbidity, oxidation-reduction potential, residual chlorine, microbial numbers).

"This study will allow us to generate more comprehensive and detailed information on biofilms within the potable distribution system, ultimately improving control of the quality of water that is delivered to consumers," says Whittle.

Researchers and affiliations

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Singapore-MIT Alliance for Research and Technology Centre

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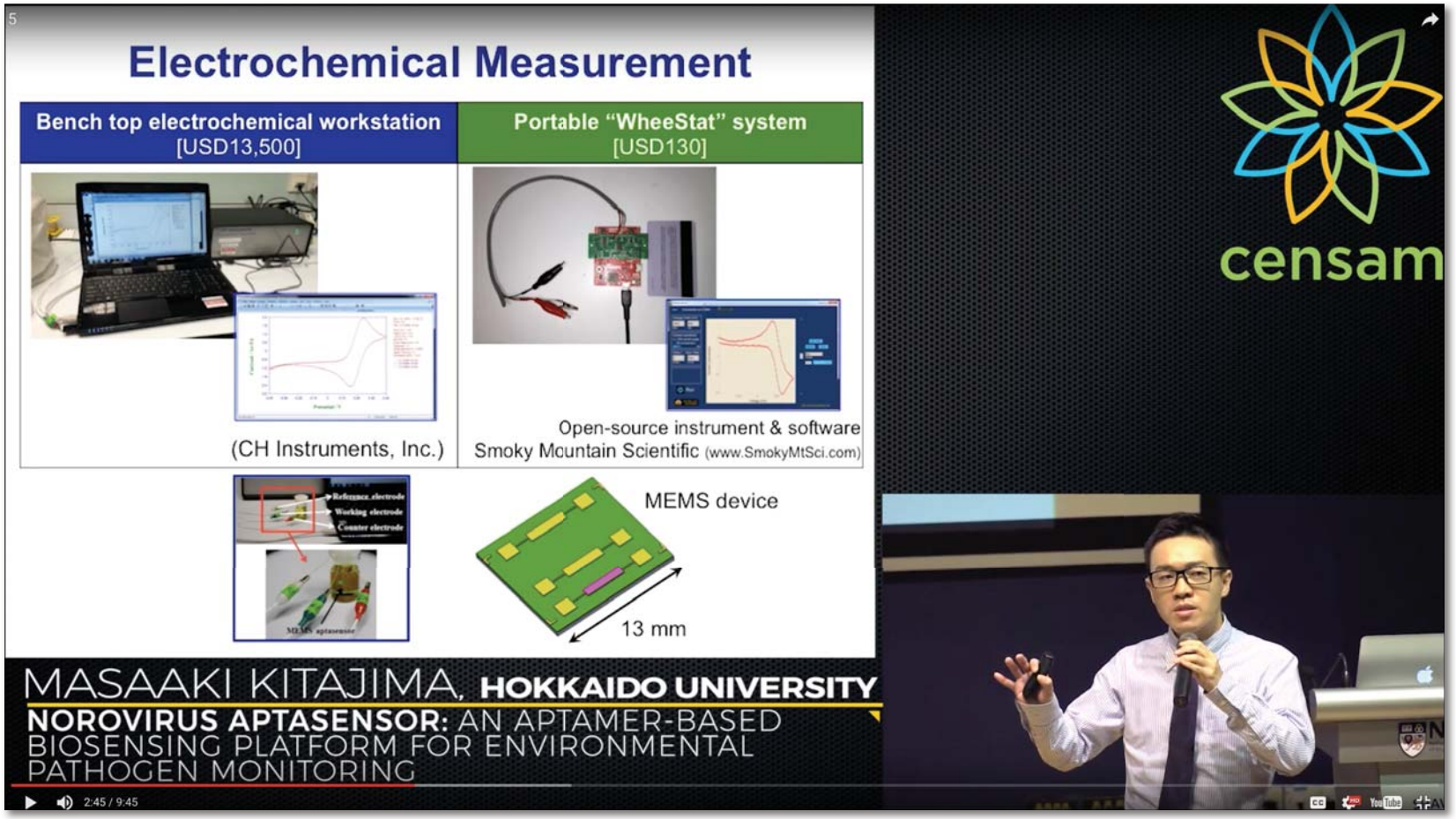
http://www.pub.gov.sg/mpublications/Innovation/Pages/default.aspx

Research Initiative Project

- **Proposal competition among CENSAM researchers**
  - 7 projects funded out of 27 proposals
    - ➔ Project outcome: Kitajima *et al*. Development of a MEMS-based electrochemical aptasensor for norovirus detection. ***Micro & Nano Letters***, in press.



CENSAM Workshop 2016 presentation on YouTube (https://youtu.be/OR0vS7cihfE)

1. Who am I?

~ Research Experience on Health-Related Water Microbiology in Overseas ~

- Drexel University, USA
- University of Arizona, USA
- Singapore-MIT Alliance for Research and Technology

2. Message for Young Researchers

Be Ambitious!

Merits of Studying/Working in Overseas - 1

- **"A picture's worth a thousand words"**
  - Research environment & skills in a world-leading lab
    - ➔ Including unpublished techniques & knowledge
  - Keep access to up-to-date information
- **Improve language skill**
  - Verbal & written communication in English
- **Higher productivity?**
  - Choose a lab with high publication record
  - If you have a good technical writing skill…
    - ➔ Co-authored for contribution to writing process
    - ➔ **Publish papers in English (reputable international journals)!!**

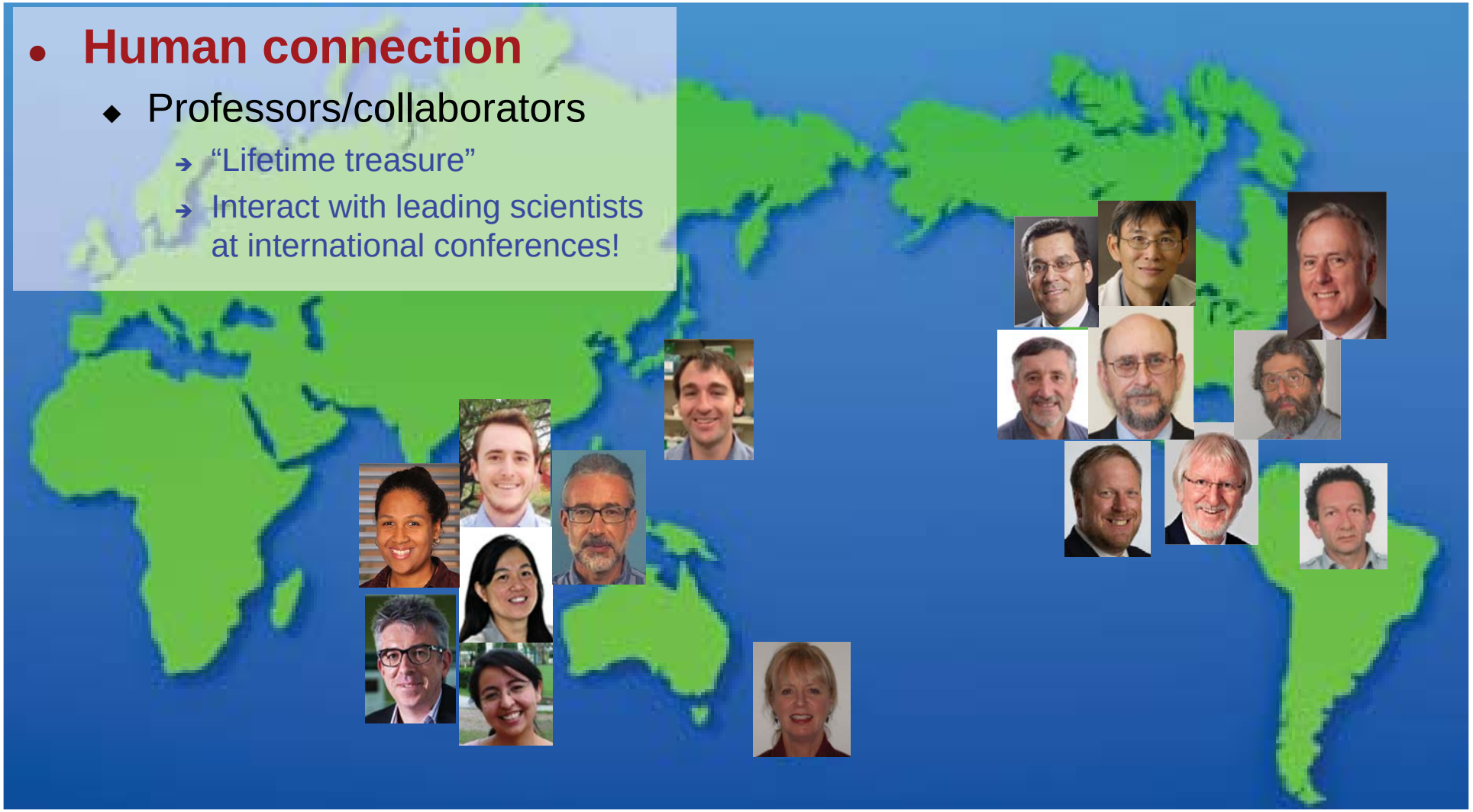
Work Opportunities in Overseas

- **Visitor**
  - JSPS, Fellowship, etc.
    - ➔ Cover the visiting researcher's salary
  - Host researcher not need to pay for salary
    - ➔ Easier to join & stay in the team
    - ➔ Not necessarily demonstrate substantial recognition by the team
  - Need to establish own research project
    - ➔ Bring new research idea
  - (JSPS Fellow/Visiting Scholar in Arizona)
- **Employee**
  - Employers require performance matching your salary
    - ➔ Evidence for substantial recognition by the team (successful "survival")
  - (Post-Doc in Arizona, Singapore)

Be International!

Merits of Studying/Working in Overseas - 2

- **Human connection**
  - Professors/collaborators
    - ➔ “Lifetime treasure”
    - ➔ Interact with leading scientists at international conferences!



Overseas Life Is Fun!

- **New friends**
  - Colleagues, neighbors, etc.
- **New environment**
  - Language, food, weather, etc.
- **Lots of memories**
  - Travels, intercultural experience

Wait, Why Abroad?

- **Choose the hard road – the road least traveled**
  - Rewarded many times over the efforts
- **Set clear goals**
  - Why abroad? Why not accomplished in your home country?
  - Specific goals
    - Research, language, human connections, etc.
- **Information on the host lab/university/country**
  - Productivity, atmosphere, living conditions, etc.

Masaaki Kitajima Contact Info

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- **Laboratory HP**
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