

The 6th International Symposium on Gas Transfer at Water Surfaces

Kyoto Garden Palace

May 17-21, 2010

Conference Program

| Sunday, May 16 | |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17:00 - 18:00 | Registration (Symposium Venue) |
| 18:00 - 20:00 | Reception (Symposium Venue) |
| Monday, May 17 | |
| 08:00 - 08:50 | Registration |
| 08:50 - 09:30 | Opening Ceremony Opening address Guidance on program and Kyoto |
| Session 1 09:30 - 10:30 Chairman: S. Komori | |
| 09:30 - 10:30 | [Invited Lecture] Air-Water Gas Transfer in the Environment: Achievements and Challenges W.R. McGillis |
| 10:30 - 11:00 | Coffee Break |
| Session 2 11:00 - 13:00 Chairman: T. Kunugi | |
| 11:00 - 11:40 | [Keynote Lecture] (Memorial lecture for G.H. Jirka) Direct Numerical Simulation of Interfacial Mass-Transfer with Far-Field Homogeneous Turbulent Flow H. Herlina, J.G. Wissink and G.H. Jirka |
| 11:40 - 12:00 | Characteristics of Gas-Flux Distribution at the Water Surface W.-T. Tsai and L.-P. Hung |
| 12:00 - 12:20 | Numerical Simulation of Interfacial Mass Transfer Using the Immersed Interface Method P.G. Jayathilake, B.C. Khoo and Z. Tan |
| 12:20 - 12:40 | Mass Transfer at the Surface in LES of Wind-Driven Shallow Water Flow with Langmuir Circulation C. Akan, A.E. Tejada-Martínez and C.E. Grosch |
| 12:40 - 13:00 | Validation of Eddy-Renewal Model by Numerical Simulation L.-P. Hung, C.S. Garbe and W.-T. Tsai |
| 13:00 - 14:20 | Lunch |
| Session 3 14:20 - 16:00 Chairman: J.S. Gulliver | |
| 14:20 - 14:40 | Evidence for Complete and Partial Surface Renewal at an Air-Water Interface A.T. Jessup, W.E. Asher, M. Atmane, K. Phadnis, C.J. Zappa and M.R. Loewen |

Monday, May 17

- 14:40 - 15:00 **Statistical Approximations in Gas-Liquid Mass Transfer**
H.E. Schulz, A.L.A. Simões and J.G. Janzen
- 15:00 - 15:20 **A Laboratory Study of the Schmidt Number Dependency of Air-Water Gas Transfer**
K. Richter and B. Jähne
- 15:20 - 15:40 **Wind/Wave-Tunnel Measurements of Chemical Enhancement of the Carbon Dioxide Gas Exchange Rate**
B. Jähne, K. Degreif, J. Kuss and F. Friedl
- 15:40 - 16:00 **Turbulent Gas Flux Measurements near the Air-Water Interface in an Oscillating-Grid Tank**
J.G. Janzen; H.E. Schulz and G.H. Jirka
- 16:00 - 16:30 Coffee Break & Poster

Session 4
16:30 - 18:10
Chairman: W.K. Melville

- 16:30 - 16:50 **Parameterization of Gas Transfer at the Air-Sea Interface based on Physics of the Turbulent Boundary Layer and Properties of the Sea Surface**
A. Soloviev, B. Haus and M. Donelan
- 16:50 - 17:10 **Rainfall Generated Near-Surface Turbulence**
J. Beya, W. Peirson and M. Banner
- 17:10 - 17:30 **Wind and Rain Effects on Air-Water Gas Transfer**
E.L. Harrison, P.M. Orton, S. Eggleston, F. Veron, W.R. McGillis and D.T. Ho
- 17:30 - 17:50 **Laboratory Estimates of Air-Water CO₂ Exchange under Wind and Rain Conditions: A Comparison of Mass Balance and Profile Methods**
P.M. Orton, W.R. McGillis, D.T. Ho, F. Veron, E.L. Harrison and S. Eggleston
- 17:50 - 18:10 **Effect of Rainfall on Wave Development and Turbulence near Air-Water Interface**
D. Zhao, X. Ma and B. Liu

Tuesday, May 18

08:00 - 08:30 Registration

Session 5
08:30 - 10:30
Chairman: P.S. Liss

- 08:30 - 09:30 **[Invited Lecture]**
The Influence of Different Reanalysis Wind Products on the Spatio-Temporal Variability of the Air-Sea Flux of CO₂ and ¹⁴CO₂
J. Majkut, J.L. Sarmiento, S. Mikaloff-Fletcher, K.B. Rodgers, R. Slater and C. Sweeney
- 09:30 - 09:50 **The Effect of Small Scale Variability in Wind and CO₂ Fields on Global Air-Sea CO₂ Fluxes**
R. Wanninkhof, D.B. Chelton and G.-H. Park
- 09:50 - 10:10 **Wind-Wave Coupling Parameterization for Fully Coupled Atmosphere-Wave-Ocean Models**
S.S. Chen, W. Zhao and M. Donelan
- 10:10 - 10:30 **Precipitation and the Global Air-Sea CO₂ Flux**
C.J. Zappa, D. Turk and W.R. McGillis
- 10:30 - 11:00 Coffee Break & Poster

Tuesday, May 18

Session 6
11:00 - 13:00
Chairman: J.L. Sarmiento

- 11:00 - 11:40 **[Keynote Lecture]**
Atmosphere-Ocean Interactions: What Goes Up Must Come Down (and Vice Versa)
P.S. Liss
- 11:40 - 12:00 **Air-Sea CO₂ Flux in the Equatorial Pacific: Sensitivity to Gas Exchange and Biological Formulations**
X. Wang
- 12:00 - 12:20 **Estimation of Biological Production and Remineralization Using Dissolved Nitrogen, Argon and Oxygen in the Ocean**
S.S. Tanaka, Y.W. Watanabe, K. Sasaki, S. Watanabe and T. Ono
- 12:20 - 12:40 **Transfer Velocities for a Suite of Trace Gases of Emerging Biogeochemical Importance: Liss and Slater (1974) Revisited**
M.T. Johnson, P.S. Liss, T.G. Bell, C. Hughes and J. Woeltjen
- 12:40 - 13:00 **A Global Parameterization of Bubble-Mediated Air-Sea Gas Flux Based on Deep-Ocean Inert Gas Measurements**
D. Nicholson, S. Emerson, R. Hamme and C. Stump

13:00 - 14:20 Lunch

Session 7
14:20 - 16:00
Chairman: R. Rocholz

- 14:20 - 15:00 **[Keynote Lecture]**
Gas Transfer from Bubble Swarms
J.S. Gulliver and J.P. Giovannettone
- 15:00 - 15:20 **A Simple Model of Bubble Void Fraction and Dynamics under Breaking Surface Waves**
W.K. Melville and X. Wang
- 15:20 - 15:40 **Laboratory Measurements of Air Bubbles in the Surf Zone**
N. Mori
- 15:40 - 16:00 **Gas Transfer Velocity of Single CO₂ Bubble**
R. Patro and I. Leifer

16:00 - 16:30 Coffee Break & Poster

Session 8
16:30 - 18:10
Chairman: W.E. Asher

- 16:30 - 16:50 **Mass Transfer across Single Bubbles**
K. Loh, B.C. Khoo and R. Uittenbogaard
- 16:50 - 17:10 **Wind-Dependence of DMS Transfer Velocity: Comparison of Model with Recent Southern Ocean Observations**
P. Vlahos, E.C. Monahan, B.J.Huebert, J.B. Edson and B.W. Blomquist
- 17:10 - 17:30 **Noble Gas Tracer Modeling in the North Pacific**
T. Ito, R. Hamme, P. Covert and S. Emerson
- 17:30 - 17:50 **Modification of Turbulence at the Air-Sea Interface Due to the Presence of Surfactants and Implications for Gas Exchange: Laboratory Experiment**
A. Soloviev, S. Matt, M. Gilman, H. Huehnerfuss, B. Haus, D. Jeong, I. Savelyev and M. Donelan
- 17:50 - 18:10 **Modification of Turbulence at the Air-Sea Interface Due to the Presence of Surfactants and Implications for Gas Exchange: Numerical Simulations**
S. Matt, A. Fujimura, A. Soloviev and S.H. Rhee

Wednesday, May 19

08:00 - 08:30 Registration

Session 9
08:30 - 10:30
Chairman: S. Banerjee

08:30 - 09:30 **[Invited Lecture]**

Turbulence Dynamics across Gas-Liquid Interfaces

J.C.R. Hunt, S.E. Belcher, D.D. Stretch, S.G. Sajjadi and J. Clegg

09:30 - 09:50 **Breaking Waves and Their Effects on Air-Sea Momentum and Scalar Transfer**

T. Hara, T. Kukulka and B. Haus

09:50 - 10:10 **High-Resolution Simulations for Turbulent Clouds Developing over the Ocean**

R. Onishi, K. Takahashi and S. Komori

10:10 - 10:30 **Turbulent Transport in Closed Basin with Wind-Induced Water Waves**

M. Sanjou , I. Nezu and A. Toda

10:30 - 11:00 Coffee Break & Poster

Session 10
11:00 - 13:00
Chairman: J.C.R. Hunt

11:00 - 11:20 **The Influence of Wind-Wave Breaking on the Dissipation of the Turbulent Kinetic Energy in the Upper Ocean and its Dependence on the Stage of Wind-Wave Development**

S. Kitaigorodskii

11:20 - 11:40 **Marvellous Self-Consistency Inherent in Wind Waves --- Its Origin and Some Items Related to Air-Sea Transfers**

Y. Toba

11:40 - 12:00 **Effects of Wind-Ruffled Mechanically Generated Waves on Current and Wind Profiles across the Air-Water Interface**

S. Mizuno

12:00 - 12:20 **Micro to Macroscale Breaking Wind Wave Dynamics**

G. Caulliez

12:20 - 12:40 **The Relationship between Occurrence Frequency of Air Flow Separation over Wind Waves and Statistic Values of Wind Waves**

N. Mizutani and E.A. Cowen

12:40 - 13:00 **The Calculation of the Gas Transfer between the Ocean and Atmosphere**

S. Kitaigorodskii

13:00 - 14:20 Lunch

Session 11
14:20 - 15:00
Chairman: M.-J. Ni

14:20 - 15:00 **[Keynote Lecture]**

Near Surface Turbulence and Its Relationship to Air-Water Gas Transfer Rates

S. Banerjee and D. Turney

Poster Session
15:00 - 16:50

18:30 - Banquet (Japanese Restaurant)

Thursday, May 20

08:00 - 08:30 Registration

Session 12
08:30 - 10:30
Chairman: I. Nezu

- 08:30 - 08:50 **The Role of Carbon Dioxide in Acidification of Water by Outboard Engine Emissions**
R. Situ, R.J. Brown and G. Will
- 08:50 - 09:10 **Application of a Tracer Gas Method for the Measurement of Oxygen Transfer in a Subsurface Horizontal Flow Constructed Wetland**
L. Tyroller, D. Rousseau, S. Santa and J. García
- 09:10 - 09:30 **Arctic Air-Sea CO₂ Fluxes in the Beaufort Sea Using Shipboard Measurements and QuikSCAT Scatterometer**
D. Bogucki, W. Drennan, S. Woods, S. Gremes-Cordero and T. Papakyriakou
- 09:30 - 09:50 **Estimating Fluxes of CO₂ from High Frequency Measurements Using Different Techniques**
M. Norman, A. Rutgersson, L.L. Sørensen and E. Sahlée
- 09:50 - 10:10 **High Wind Air-Sea Exchanges (HiWASE): Direct Measurement of CO₂ Fluxes and a Novel Correction for Sensor Salt Contamination**
J. Prytherch, M.J. Yelland, R.W. Pascal and B.I. Moat
- 10:10 - 10:30 **Accurate Measurement of Air-Sea CO₂ Flux with Open-Path Eddy-Covariance**
O. Tsukamoto and F. Kondo

10:30 - 11:00 Coffee Break & Poster

Session 13
11:00 - 13:00
Chairman: T. Hara

- 11:00 - 11:40 **[Keynote Lecture]**
Investigating the Mechanisms of Air-Water Gas Transfer by Quantitative Imaging Techniques: History, Current Progress and Remaining Challenges
R. Rocholz and B. Jähne
- 11:40 - 12:00 **Estimating the Surface Divergence from IR Imagery and Surface Fluorescence**
W. Asher, H. Liang, A. Jessup and C. Zappa
- 12:00 - 12:20 **Damping of Humidity Fluctuations in a Closed-Path System – A Method for Removing the WPL-Correction**
E. Sahlée, K. Kahma, H. Pettersson and W. Drennan
- 12:20 - 12:40 **Vortex Generation under Wind Wave Surface**
K. Takehara, Y. Takano and T.G. Etoh
- 12:40 - 13:00 **Recovering High Spatio-Temporal Resolution Topography of Capillary-Gravity Waves in an Open Ocean Environment**
H. Schultz, C.J. Zappa, M. Banner and L. Pezzaniti

13:00 - 14:20 Lunch

Session 14
14:20 - 16:00
Chairman: R. Wanninkhof

- 14:20 - 15:00 **[Keynote Lecture]**
Influence of Ocean Surface Processes on Gas Transfer during the Southern Ocean Gas Exchange Experiment
C.J. Zappa, W.R. McGillis, A. Cifuentes-Lorenzen, J.B. Edson, M. DeGrandpre, C. Sabine, L. Bariteau and C. Fairall

Thursday, May 20

| | |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15:00 - 15:20 | Parameterizing Gas Exchange in Rivers and Estuaries D.T. Ho, P. Schlosser and P.M. Orton |
| 15:20 - 15:40 | Insights from Open-Ocean Eddy Covariance Measurement of CO₂ and DMS Air-Sea Exchange B. Huebert, B. Blomquist, M. Yang, C. Fairall, J. Hare, J. Edson, E. Saltzman, C. Marandino and S. Miller |
| 15:40 - 16:00 | Air-Sea Carbon Dioxide Exchange during Upwelling H. Pettersson, K.K. Kahma, A. Rutgersson and M. Pertilä |
| 16:00 - 16:30 | Coffee Break & Poster |
| Session 15 16:30 - 17:50 Chairman: D. Zhao | |
| 16:30 - 16:50 | Air-Sea CO₂ Exchange in an Arctic Polynya System: Observations from the 2007-08 CFL Overwintering Study B. Else and T. Papakyriakou |
| 16:50 - 17:10 | Factors Controlling Surface Water Fugacity of CO₂ in the North-Eastern Shelf of the Gulf of Cadiz (Southwest Iberian Peninsula) M. Ribas-Ribas, J.M. Forja and A. Gómez-Parra |
| 17:10 - 17:30 | Observations of Air-Sea Exchange of N₂ and O₂ during the Passage of Hurricane Gustav in the Gulf of Mexico during 2008 C.L. McNeil, E.A. D'Asaro and J.A. Nystuen |
| 17:30 - 17:50 | First Results of the 2009 SOPRAN Active Thermography Pilot Experiment in the Baltic Sea U. Schimpf, L. Nagel and B. Jähne |

Friday, May 21

| | |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 08:00 - 08:30 | Registration |
| Session 16 08:30 - 10:30 Chairman: W.-T. Tsai | |
| 08:30 - 09:10 | [Keynote Lecture] Including Mixed Layer Convection When Determining Air-Sea CO₂ Transfer Velocity A. Rutgersson, A. Smedman and E. Sahlée |
| 09:10 - 09:30 | Gas Transfer at the Air-Water Interface induced by Buoyant Convective Turbulence A. Niepelt, H. Herlina and G.H. Jirka |
| 09:30 - 09:50 | Exchange of Scalars between the Ocean and the Atmosphere during Two Special Conditions: Swell and Unstable Very Close to Neutral Conditions A.S. Smedman, U. Högström, A. Rutgersson and E. Sahlée |
| 09:50 - 10:10 | Gas Transfer across an Air-Water Interface under Short Fetch Wind Induced Waves A. Tamburrino and L. Rayo |
| 10:10 - 10:30 | Combined Visualization of Wind Waves and Water Surface Temperature R. Rocholz, U. Schimpf, C.S. Garbe and B. Jähne |
| 10:30 - 11:00 | Coffee Break |

Friday, May 21

Session 17
11:00 - 13:00
Chairman: C.S. Garbe

- 11:00 - 11:20 **Spatio-Temporal Fluctuations of Water-Sided Gas Concentration Fields under Wind-Induced Turbulence**
A.G. Herzog, F. Friedl and B. Jähne
- 11:20 - 11:40 **Remote Sensing and In Situ Aerial, Surface, and Submarine Methane Sea-Air Fluxes from Natural Marine Hydrocarbon Seepage**
I. Leifer, D. Roberts, E. Bradley, G. Diskin, D. Tratt, T. Short, S. Toler, D. Culling and B.P. Luyendyk
- 11:40 - 12:00 **The Effect of Wind Variability on the Air-Sea CO₂ Gas Flux Estimation**
N. Suzuki, S. Komori and M.A. Donelan
- 12:00 - 12:20 **Estimating Air-Sea Exchange Coefficients through an Adjoint Data Assimilation Method with the Intermediate Tropical Cyclone Model**
K. Ito, Y. Ishikawa and T. Awaji
- 12:20 - 12:40 **On Air-Sea Fluxes at High Winds**
W.M. Drennan, E. Sahlee and J.A. Zhang
- 12:40 - 13:00 **Laboratory Measurements of the Moist Enthalpy Transfer Rate across the Air-Sea Interface in High Winds**
B.K. Haus, D. Jeong and M.A. Donelan

13:00 - 14:00 Lunch

Session 18 (CREST Session)
14:00 - 16:00
Chairman: R. Kurose

- 14:00 - 14:40 **[Keynote Lecture]**
Impacts of Atmosphere-Ocean Coupled Interaction in Typhoon Simulations on the Earth Simulator
K. Takahashi, R. Onishi, T. Sugimura, Y. Baba, S. Kida, K. Goto and H. Fuchigami
- 14:40 - 15:00 **One-Fluid Unified Numerical Simulations of Turbulent Structures and Transport Processes over Air/Water Interfaces**
F. Xiao, S. Yamashita, C.G. Chen, T. Aoki and K. Takahashi
- 15:00 - 15:20 **Simulation of MagnetoHydroDynamics of Multi-Fluid Flows at Low Magnetic Reynolds Number**
M.-J. Ni, Y. Pan, S.-P. Zhang and Z.-H. Wang
- 15:20 - 15:40 **Structure Variation Dependence of Tropical Squall Line on the Tracer Advection Scheme in Cloud Resolving Model**
Y. Baba and K. Takahashi
- 15:40 - 16:00 **Development of Oil-Spill Simulation System based on the Global Ocean-Atmosphere Model**
Y.J. Choi, A. Abe and K. Takahashi

16:00 - 16:20 Closing Ceremony
Closing remarks

16:20 - 18:20 Laboratory Tour (for applicants)

Poster Session

- P01 **PIV Measurements of Langumuir Circulation Generated by Wind-Induced Water Waves**
M. Sanjou, I. Nezu and Y. Akiya
- P02 **Microscopic Sensors for Oxygen Measurements at Air-Water Interfaces and in Sediment Biofilms**
B.C.G. Gonzalez, A.W. Lamon, J.G. Janzen, J.R. Campos and H.E. Schulz
- P03 **Evaporation Mitigation Using Rock and Sand Storages**
W.L. Peirson, G.A. Lee, C. Waite and P. Onesemo
- P04 **Determining the Schmidt Number Dependency of Low Solubility Gas Transfers across Air-Water Interfaces from Direct Observations of the Aqueous Diffusion Sublayer**
X. Yan, J.W. Walker, W.L. Peirson and M.L. Banner
- P05 Cancelled
- P06 **Air-Sea Flux of Carbon Dioxide in the Arctic Ocean**
L.G. Anderson and S. Jutterström
- P07 Cancelled
- P08 **Air-Sea Flux Measurements by Eddy Correlation off the Southwestern Ireland Coast – Preliminary Results**
M. Defossez, B. Ward and N. Fitzpatrick
- P09 **Turbulence Dissipation Estimates near the Air-Sea Interface**
B. Ward and A.H. Callaghan
- P10 **Optical Method for Measuring Size-Distribution and Lifetime of Bubbles**
W. Mischler, R. Rocholz and B. Jähne
- P11 **Improved Optical Instrument for the Measurement of Water Wave Statistics in the Field**
D. Kiefhaber, R. Rocholz and B. Jähne
- P12 **A New Approach for 3C3D Measurements of Aqueous Boundary Layer Flows Relative to the Wind-Wave Undulated Interface**
B. Voss, A. Heinlein, B. Jähne and C.S. Garbe
- P13 **Heat and Momentum Fluxes - a Thermographic Approach**
C.S. Garbe and A. Heinlein
- P14 **Future Global Mapping of Air-Sea CO₂ Exchange by Using Wind and Wind-Wave Distribution of CMIP3 Multi-Model Ensemble**
Y. Suzuki and Y. Toba
- P15 **Vertical CO₂-Flux Gradients in the Marine Boundary Layer?**
M. Krupski, G. Peters, F. Ament and H. Münster
- P16 **The Effects of Ice Formation and Evolution on Gas Transfer as Seen through Infrared Imagery**
B. Loose, C.J. Zappa and W.R. McGillis
- P17 **Rain and CO₂ Exchange in the Western Equatorial Pacific**
D. Turk, C.J. Zappa, C.S. Meinen, J.R. Christian, D.T. Ho, A.G. Dickson and W.R. McGillis
- P18 **The Effect of High Wind Bora Events on Water *p*CO₂ and CO₂ Exchange in Coastal Northern Adriatic**
D. Turk, B. Petelin, V. Malacic, J.W. Book and W.R. McGillis
- P19 **The Effect of Atmospheric Stability on Gas Transfer and Regional Estuarine CO₂ Flux**
C.J. Zappa, P. Raymond and W.R. McGillis
- P20 **Tidal and Atmospheric Influences on the Near-Surface Turbulent Energy Budget of an Estuary**
P. Orton, C. Zappa and W. McGillis

Poster Session

- P21 **Sea Breeze Forcing of Estuary Turbulence and Air-Water Exchanges**
P. Orton, W. McGillis and C. Zappa
- P22 **DNS and LES of Wind-Driven Turbulence and Scalar Transfer at Sheared Gas-Liquid Interfaces**
R. Kurose, T. Ukai and S. Komori
- P23 **The Effect of Counter-Swell on Mass Transfer across the Air-Water Interface**
K. Iwano, N. Takagaki, R. Kurose and S. Komori
- P24 **The Effects of Rainfall on CO₂ Transfer across the Wavy-Sheared Air-Water Interface**
N. Takagaki, K. Fujii and S. Komori
- P25 **Sensible and Latent Heat Transfer across the Air-Water Interface in Wind-Driven Turbulence**
N. Takagaki, K. Iwano, S. Shimada, R. Kurose and S. Komori