

37th International Liège Colloquium on Ocean Dynamics (2-6 May 2005)

GAS TRANSFER AT WATER SURFACES

The focus of the 37th Liège Colloquium on Ocean Dynamics is gas transfer at water surfaces with oral and poster presentations of recent advances in this field. Discussions will identify the most critical conceptual and experimental improvements for future. Specific topics cover:

- * Laboratory and/or field measurements of air-water transfer of gas, heat, vapour and particles using various approaches (mass balance of natural, anthropogenic or deliberate tracers and micro-meteorological methods).
- * Theoretical and/or experimental studies of the various aspects of air-water transfer: turbulence, surfactants, spray, bubbles, chemical enhancement and chemical gradients in the surface micro-layer
- * Parameterization of the gas transfer velocity based on modelling, remote sensing or experimental approaches.
- * Recent technical improvements in measurements of the air-water gas gradients.
- * Physical and biogeochemical processes controlling air-water gas gradients at different temporal and spatial scales, with particular emphasis on climatic feedbacks.
- * Budgets of gas transfer (CO₂, CH₄, N₂O, DMS, CO ...) at regional and global scale (including open oceanic, coastal and fresh water realms).

[Clickable link to full list of abstracts in pdf](#)

[Clickable link to contributions listed alphabetically by authorship](#)

ORAL SESSIONS (Building B7 - "Hall Petits Amphithéâtres")

For oral presentations, please allow a minimum of 5 min. for questions and discussion.

A PC (Windows 2000 + Microsoft Powerpoint + Adobe Acrobat + CD&DVD reader + USB port), a LCD projector and a lazer pointer will be available.

Participants can also use their own portable computer.

Monday 2 May

09:00-09:50 Registration

09:50-10:00 Borges et al. - welcome note and tribute to Michel Frankignoulle

Session : Theoretical and modelling investigations of transfer at water surfaces (Chairperson R. Wanninkhof)

10:00-10:40 Donelan M.A.

[A coupled boundary layer mixing length model for gas transfer at the air-water interface \(Key note presentation\)](#)

10:40-11:05 Zappa C.J., W.R. McGillis, P.A. Raymond, J.B. Edson, E.J. Hints, H.J. Zemmeling, J.W.H. Dacey, D.T. Ho

[Scaling Gas Transfer with Turbulent Dissipation for a Range of Environmental Processes](#)

11:05-11:25 Break

11:25-11:50 Tsumori H., Y. Sugihara

[Relationship between free-surface turbulence and air-water gas transfer](#)

11:50-12:15 Masoom S., P.M. Steffler, M.R. Loewen

[Modeling the turbulence generated by microscale breaking waves](#)

12:15-12:40 Chu P.C., K.F. Cheng, Y.C. Chen

[Wave Effect on the Gas Transfer at Water Surfaces](#)

12:40-14:00 Break

Session : Theoretical and modelling investigations of transfer at water surfaces (Chairperson W.R. McGillis)

14:00-14:40 Orr J.C., Z. Lachkar, P. Jean-Baptiste, O. Aumont, K.B. Rodgers, J.-C. Dutay

[What can global simulations of transient tracers tell us about quadratic vs. cubic formulations for air-sea CO₂ exchange? \(Key note presentation\)](#)

14:40-15:05 Jenkins A.D.

[Dynamically Consistent Computation of Exchange Processes at the Air-Sea Interface](#)

15:05-15:30 Asher W.E., M.A. Atmane, A.T. Jessup

[An Application of a Surface Penetration Model to Air-Water Gas Transfer](#)

15:30-15:50	Break	
15:50-16:15	Hwang P.A.	Spectral signature of breaking surface waves
16:15-16:40	Frew N.M., D.M. Glover, S.J. McCue	Air-sea gas transfer velocity estimates from the Jason-1 and TOPEX altimeters - prospects for a long-term global time series
16:40-17:05	Soloviev A., M. Donelan, H. Graber, B. Haus	Estimation of near-surface turbulence and CO2 transfer velocity from satellite data
17:05-17:30	Kettle H., C. Merchant	Influence of sub-daily processes on the air-sea flux of CO2
17:30-18:30	Poster Session	
18:00-19:00	Reception	

Tuesday 3 May

Session : Laboratory and field investigations of transfer at water surfaces (Chairperson Soeren Larsen)

09:00-09:40	Jähne B., R. Nielsen, C. Popp, U. Schimpf, C. Garbe	Air-Sea Gas Transfer; Schmidt Number Dependency and Intermittency (Key note presentation)
09:40-10:05	Jessup A.T., K.R. Phadnis, M.A. Atmane, C.J. Zappa, M.R. Loewen, W.E. Asher	A Laboratory Study of Infrared Techniques to Measure Heat Flux
10:05-10:30	Elkamash M.K., M.R. Loewen	Experiments Investigating Gas Transfer and Momentum Flux across Air-Water Interfaces
10:30-10:50	Break	
10:50-11:15	Hara T., J. Wendelbo, C. Garbe, U. Schimpf, N. Frew	Estimation of air-sea gas and heat fluxes from infrared imagery and surface wave measurements
11:15-11:40	Variano E.A., E.A. Cowen	Quantitative Visualization of CO2 Gas Transfer at a Turbulent Free Surface
11:40-12:05	Sarma V.V.S.S., O. Abe, T. Saino	Estimation of transfer velocity using triple oxygen isotopes
12:05-12:30	Sugihara Y., H. Tsumori, A. Takasaki	Experimental investigation of turbulent boundary layer beneath a wind-driven water surface

12:30-14:00 Break

Session : Laboratory and field investigations of transfer at water surfaces (Chairperson Bernd Jähne)

14:00-14:25	Szczodrak M., M.A. Donelan, P.J. Minnett, B.K. Haus	Heat fluxes across the water surface and the variability of the surface skin temperature: results from a wave tank experiment
14:25-14:50	Gade M., P. Lange, R. Käse, D. Stammer	A Laboratory Investigation of the Effect of Rain on CO2 Gas Exchange
14:50-15:15	Ho D.T., W.R. McGillis, F. Veron, N. Scott	Rain and wind-induced air-water gas exchange
15:15-15:40	Mukto M.A., M.A. Atmane, M.R. Loewen	The effect of surfactant concentration on the properties of the aqueous boundary layer beneath wind waves
15:40-16:00	Break	
16:00-16:40	McGillis W.R., K. Tanno, J.W.H. Dacey, J.D. Ware, D.T. Ho, J.T. Bent, W.E. Asher, R. Wanninkhof, S. Komori	Measurements of the air-water CO2 flux using atmospheric profiles (Key note presentation)
16:40-17:05	Sørensen L.L., S. Larsen	Fluxes of water vapour and CO2 using the dissipation technique
17:05-17:30	Drennan W.M., J. Zhang, C.A. McCormick, J. French, P.G. Black	Measurements of humidity flux in Hurricanes Fabian and Isabel
17:30-17:55	McNeil C., E. D'Asaro	Air-Sea Fluxes of O2 and N2 Observed During Hurricane Frances
17:55-18:55	Poster Session	

Wednesday 4 May

Session : Laboratory and field investigations of transfer at water surfaces (Chairperson M. Donelan)

09:00-09:40	Woolf D.K.	Parameterizations of bubble-mediated gas transfer; fundamental principles and a laboratory test (Key note presentation)
09:40-10:05	Leifer I., G. Caulliez, G. De Leeuw	Bubble Plumes, Bubbles, and Wave Characteristics from Wind-Steepened, Breaking Waves
10:05-10:30	Sugihara Y., H. Tsumori, T. Ohga, H. Yoshioka, S. Serizawa	Variations of whitecap properties with meteorological and wave-field conditions
10:30-10:50	Break	
10:50-11:15	Lafon C., J. Piazzola, P. Forget, S. Despiau	Modelling of whitecap coverage in coastal environment
11:15-11:40	Calleja M.Li., C.M.Duarte, Y.Prairie, S. Agustí, G.J. Herndl	Evidence for an important role of surface water layer processes on air-water gas transfer in the Subtropical Atlantic Ocean
11:40-12:05	DeGrandpre M.D., R. Wanninkhof, W.R. McGillis, W.M. Drennan	Sea surface pCO₂ and diurnal mixed-layer dynamics
12:05-12:30	Drennan W.M., W.R. McGillis, M.D. DeGrandpre, P.G. Strutton, M.A. Donelan	The Labrador Sea Gas Exchange Study during a Phytoplankton Bloom
12:30-14:00	Break	

Session : Inland waters fluxes (Chairperson A.V. Borges)

14:00-14:40	Raymond P.A., W. McGillis, J. Bauer, N. Caraco, J. Cole	A Sensitivity Analysis of Gas Exchange Measurements for a Large River Carbon Isotope Mass Balance (Key note presentation)
14:40-15:05	Abril G., Guérin F., Richard S., Delmas R.	CH₄ and CO₂ emissions and carbon imbalance in a 10-years old tropical reservoir (Petit-Saut, French Guiana)
15:05-15:30	Guérin F., G. Abril, D. Serça, C. Delon, S. Richard, R. Delmas, A. Tremblay, L. Varfalvy	Gas Transfer Velocities in a Tropical Reservoir and its River Downstream: Wind Speed and Rainfall Effect
15:30-15:55	Billet M.F., F. Harvey	Measuring Gas Exchange Rates in Upland Streams: Challenges and Solutions
15:55-16:15	Break	
16:15-16:40	Silvennoinen H., A. Liikanen, C.F. Stange, R. Russow, P.J. Martikainen	Effluxes of N₂O and N₂ and Nitrogen Cycling in River and Estuarine Sediments of Bothnian Bay (Northern Baltic Sea)
16:40-17:05	Asher W.E., J.F. Pankow, K. W. Robinson, K.W. Campo, D.A. Bender, J.S. Zogorski	The Role of Air-Water Gas Exchange in the Source Apportionment of Volatile Organic Compounds in Streams
17:05-17:30	Granin N.G., A.I. Obzhairov, I.B. Mizandrotsev, A.A. Salyuk	Methane in Lake Baikal
20:00-23:00	Reception & dinner at Château de Colonster (the "Colloquium bus" will pick up participants at their hotels and bring them back)	

Thursday 5 May

Session : Coastal Ocean fluxes: a tribute to Michel Frankignoulle (Chairperson M. DeGrandpre)

09:00-09:40	Friederich G.E., F.P. Chavez	Time Series of pCO₂ in the Central California Upwelling System: 1993-2004 (Key note presentation)
09:40-10:05	Padin X.A., A. Rios, F.F. Perez	Surface CO₂ measurements in the English Channel with VOS
10:05-10:30	Schneider B.	Peculiarities in the CO₂ gas exchange during intense nitrogen fixation in the Baltic Sea
10:30-10:50	Break	

10:50-11:15	Kuss J., B. Schneider, A. Weiss, G. Peters	Parameterization of the CO2 air-sea transfer velocity using an inorganic carbon mass balance approach and a micro-meteorological method: two studies from the Baltic Sea
11:15-11:40	Gypens N., C. Lancelot*, A.V. Borges	Mechanisms controlling the air-sea exchanges of CO2 in the eutrophied coastal waters of the Southern Bight of the North sea: a modelling study
11:40-12:05	Schiettecatte L.-S., F. Gazeau, M. Frankignoulle, A.V. Borges	CO2 air-sea exchange and NEP in the Scheldt plume (Belgian coast) over 4 years
12:05-14:00	Break	
Session : Coastal Ocean fluxes: a tribute to Michel Frankignoulle (Chairperson G. Friederich)		
14:00-14:40	McNeil C.L., B. Ward, W.R. McGillis, M.D. DeGrandpre, L. Marcinowski	Fluxes of N2, O2 and CO2 in Nearshore Waters off Martha's Vineyard (Key note presentation)
14:40-15:05	Barnes J., R.C. Upstill-Goddard	How significant are tropical coastal zones in Global trace gas emissions and what role will the Asian Tsunami play?
15:05-15:30	Ferron S., T. Ortega, J.M. Forja, A. Gomez-Parra	Seasonal Variations in the Concentrations of Three Greenhouse Gases (CH4, CO2 and N2O) in a Shallow Coastal Area Affected by Inputs of Organic Matter and Nutrients
15:30-15:55	Kitidis V., L. Tizzard, G. Uher, A. Judd, R. Upstill-Goddard, I. Head, N. Grey, S. Garcia-Gil	The biogeochemical cycling of methane in a shallow coastal inlet at the onset and end of seasonal upwelling (Ria de Vigo, NW Spain)
15:55-16:15	Break	
16:15-16:40	Bargeron C.P., D.J. Hydes, B.A. Kelly-Gerreyn*	Oxygen fluxes and new production between the Northwest European shelf and the open ocean : results from a ship of opportunity
16:40-17:05	Borges A.V.	Diversity of Ecosystems and Coastal Ocean CO2 Fluxes
17:05-18:05	Poster Session	

Friday 6 May

Session : Polar Ocean fluxes (Chairperson J.-L. Tison)

09:00-09:40	Delille B., A.J. Trevena, V. Schoemann, C. Lancelot, D. Lannuzel, M.-L. Sauvée, J. de Jong, B. Tilbrook, M. Frankignoulle, A.V. Borges, J.-L. Tison	Carbon dioxide dynamics in Antarctic pack ice and related air-ice CO2 fluxes (Key note presentation)
09:40-10:05	Zemmelink H.J., L. Houghton, B. Delille, J.L. Tison, J. Stefels, J.W.H. Dacey	Fluxes of DMS and CO2 over Antarctic pack ice
10:05-10:30	Miller L.A., O. Owens, A. Mucci, T.N. Papakyriakou, N.E. Sutherland, J. Ehn, C.J. Mundy	Sea-ice carbon biogeochemistry: Relationship to atmospheric CO2 fluxes
10:30-10:50	Break	
10:50-11:15	Semiletov I., A. Makshatas*, E. Andreas	Air-Sea Ice-Water CO2 Balance: the Arctic Ocean
11:15-11:40	Boutin J., L.Merlivat, K.Currie	Seasonal variability of ocean CO2 partial pressure and air-sea CO2 fluxes in the subantarctic zone of the Southern Ocean
11:40-12:05	Bakker D.C.E., J.M.J. Hoppema, H.J.W. De Baar, A.J. Watson	Southern Ocean blooms promote atmospheric CO2 uptake

12:05-14:00 Break

Session : Open Ocean fluxes (Chairperson N. Metzl)

14:00-14:40	Sweeney C., E.M. Gloor, A.J. Jacobson, R.M. Key, G. McKinley, J.L. Sarmiento	Estimating air-sea gas exchange using bomb 14C: Revisited (Key note presentation)
14:40-15:05	Mouchet A., E. Driesschaert, T. Fichfet, H. Goosse, G. Munhoven, V. Brovkin	Future anthropogenic emissions and climate change impact on the carbon cycle: a study with the LOVECLIM model

15:05-15:30	Ufermann S.	Comparing parameterizations of gas transfer velocity and their effect on the global marine CO2 budget
15:30-15:55	Wanninkhof R., A. Olsen, J. Trinanes, B. Huss	Air-Sea CO2 Fluxes in the Caribbean Sea
15:55-16:15	Break	
16:15-16:40	Merlivat, G. Caniaux, L. Barbero-Munoz	Diurnal variations of air-sea flux of CO2, ocean CO2 partial pressure, SST and mixed layer depth along drifter trajectories in the North-Eastern Atlantic
16:40-17:05	Jurado E., J. Dachs, R. Simó	Oceanic air-water exchange of persistent organic pollutants and aerosol organic carbon at a global scale
17:05-17:10	Closing Note	

POSTER SESSIONS (Building B7 - "Hall Petits Amphithéâtres")

All poster Sessions will be held in "Hall des Petits Amphithéâtres". Posters can be put on display (and removed) AT ANY TIME but authors are expected to present and discuss their poster during the sessions.

Posters are formatted in Portrait and must be limited to one page, < 95 cm (width), < 130 cm (length).

Monday 2 May (17:30-18:30)

Session : Theoretical and modelling & Laboratory and field investigations of transfer at water surfaces

Borges A.V., J.-P. Vanderborght, L.-S. Schiettecatte, F. Gazeau, S. Ferrón-Smith, B. Delille, M. Frankignoulle	Variability of the gas transfer velocity of CO2 in a macrotidal estuary (The Scheldt)
Bortkovski R.S.	Model estimates of air-sea gas exchange under non-stationary high wind conditions
Cai W.J., Z. Zhang, F. Chen, Y. Wang	Direct measurement of pH profiles in seawater surface microlayer: ramification to air-sea CO2 exchange
Drennan W.M., W.R. McGillis, M.D. DeGrandpre, P.G. Strutton, M. A. Donelan	An Air-Sea Gas Exchange Buoy in the Labrador Sea
Glushkov A.V, V.N. Khokhlov, N.S. Loboda	Influence of oceanic biota on carbon dioxide flux at atmosphere-ocean interface
Jähne B., U. Schimpf, G. Balschbach	The Heidelberg Aelotron - new perspectives for laboratory investigations of small-scale air-sea interaction
Kudryavtsev V.	On the marine atmospheric boundary layer at very strong winds
Patro R., I. Leifer	Experimental Determination of Gas Transfer Velocity of CO2 Bubble
Leifer I., G. De Leeuw	Bubble Plume Bubbles from Wind-Steepened Wave Breaking
Soloviev A.V.	Modeling surface renewals
Ward B.	ASIP: Air-Sea Interaction Profiler

Tuesday 3 May (17:55-18:55)

Session : Inland waters & Coastal Ocean fluxes

Alin S., Salimon C., Richey J., Krusche A.	Carbon Dioxide Evasion from Large Tropical Rivers: Measurements from the Amazon and Mekong River Basins
Cocquempot B., P. Morin, S. Forner, P. Le Corre	Seasonal variations of VHOC concentrations and fluxes at the ocean - atmosphere interface in a coastal area of the Western English Channel
Dai M., X. Guo, W. Zhai, L. Yuan, B. Wang, P. Cai, T.Tang, W.-J. Cai	Carbon dioxide production and oxygen depletion in the upper reach of the Pearl River estuary during a very drought winter

De la paz M., J.M. Forja, A. Gomez-Parra	CO2 variability in the Guadalquivir Estuary (SW Iberian Peninsula)
Elkalay K., H. Thomas, Y. Bozec, A.V. Borges, L.S. Schiettecatte, R. Heerdink, P. Ruardij, H. de Baar	Biogeochemical 1D ERSEM ecosystem model applied to recent carbon dioxide and nutrient data in the North Sea
Gazeau, F., J.-P. Gattuso, M. Frankignoulle, B. Delille, A.V. Borges	Gas Transfer Velocity as a critical variable in coastal ecosystem metabolism studies
Harlay J., C. van der Zee, L.-S. Schiettecatte, N. Roevros, L. Rebreanu, P.-E. Lapernat, A.V. Borges, L. Chou	Dissolved Inorganic Carbon dynamics in the northern Bay of Biscay during a Coccolithophore bloom
Padin X.A., F.F. Perez, A. Rios	Temporal variability of atmospheric CO2 in the Bay of Biscay
Purvaja R., Barnes, R. Ramesh, M.D.A. Le-tissier, G. Uher, R.C. Upstill-Goddard	Dissolved CH4 and N2O concentrations during a full tidal Cycle at Wright Myo Mangroves, Andaman Islands, India
Thomas H., Y. Bozec, K. Elkalay, H.J.W. deBaar	Enhanced open ocean storage of CO2 from shelf sea pumping
Tokoro T., A. Watanabe, H. Kayanne, K. Nadaoka, H. Tamura, K. Nozaki, K. Kato, A. Negishi	Effects of bottom shear stress and biological activity on CO2 flux between air and coastal water
Zhai W., M. Dai, W.-J. Cai, Y.Wang, B.Chen	The partial pressure of carbon dioxide and air-sea fluxes in the northern South China Sea: seasonal variation and its possible controls

Thursday 5 May (17:05-18:05)

Session : Polar & Open Ocean fluxes

Bellerby R., C. Kivimæ, A. Omar, A. Sundfjord, A. Olsen, T. Johannessen	Shifting constraints on carbon dioxide exchange and carbon cycling in the Arctic: a case study of the Barents Sea
Brévière E., A. Poisson, B. Tilbrook, N. Metzl, A. Lenton, B. Schauer, M. Pretty, C. Brunet	Seasonal and interannual air-sea CO2 exchange between Tasmania and Antarctica: a high variability
Capouillez N., H. Goosse, A. Mouchet	Model study of the interannual variability of CO2 air-sea fluxes
Corbière A., N. Metzl, G. Reverdin, C. Brunet, T. Takahashi	Interannual variability of the carbon dioxide system and air-sea CO2 fluxes in the high latitudes of the North Atlantic Ocean: 1993-2003 (SURATLANT Program)
González-Dávila M., M.J. Santana-Casiano	Seasonal and interannual variability of sea-surface carbon dioxide species at the ESTOC site between 1996 and 2004
Metzl N., O. Aumont, P. Bousquet, E. Brévière, C. Brunet, C. Lo Monaco, C. Pierre, A. Poisson, M. Ramonet, K.Rodgers, B. Tilbrook	Interannual variability of Air-Sea CO2 fluxes in the Southern Indian Ocean : comparing observations, atmospheric inversions and ocean models
Omar A., T. Johannessen, R. Bellerby, A. Olsen, L.G. Andersen, C. Kivimæ	Sea ice and brine formation in Storfjorden: implications for the Arctic winter time air-sea CO2 flux
Pozzer A., A. Colomb, V. Gross, J. Williams, L. Ganzeveld, J. Lelieveld	Role of air-sea exchanges in the atmospheric budget of oxygenated volatile organic compounds: Model evaluation based on the MANCHOT campaign
Shakhova N., I. Semiletov, N. Bel'cheva	The Air-Water CH4 Gradient in the Siberian Arctic Seas
Shanmuganandan S.	Global Climate Change and Gas Transfer at Water Surfaces in Indian Ocean Region: A study on dynamics of rate of air-sea CO2 exchange: identification of major dimensions
Shi L., C. Zhao	Seasonal and annual variability of pCO2 in the North Pacific Ocean Using Satellite Data
Tokieda T., M. Ishii	Seasonal variation of Chlorofluorocarbons saturation in the water of mixed layer in the western North Pacific
Zhao C., L. Shi	Air-Sea surface CO2 gas transfer velocity : A Review