

## **The W-PASS (Western Pacific Air-Sea interaction Study) project 2006-2010 – Linkages in biogeochemical cycles between surface ocean and lower atmosphere–**

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Climate and environmental change will have significant impacts on biogeochemical cycling in the ocean, on atmospheric chemistry, and on chemical exchange between the ocean and atmosphere. The exchanges include atmospheric deposition of nutrients and metals that control marine biological activity and hence the ocean carbon uptake, and emissions of trace gases and particles from the ocean in view of their importance in atmospheric chemistry and climate processes.

Our goal of the W-PASS (Western Pacific Air-Sea interaction Study) project, which has been newly funded for 5 years as a part of SOLAS-Japan activity in the summer of 2006, is to achieve quantitative understanding of the key biogeochemical interactions and feedbacks between the ocean and atmosphere. We aim to resolve this linkage through field observations studies mainly using research vessels over the western Pacific. Numerical modeling studies are required for systematic evaluation and quantitative assessment. Our objectives of W-PASS are:

- 1) Quantify the transport of natural and anthropogenic materials from the Asian continent to the western Pacific which contributes to primary production in the marginal and remote regions.
- 2) Determine the response of marine ecological systems to changes in atmospheric composition over the western Pacific.
- 3) Investigate the production and emissions of marine biogenic gases that might lead to changes in atmospheric composition, especially in subtropical and subarctic regions of the western Pacific.
- 4) Evaluate the contribution of marine biogenic gases to global climate change.
- 5) Provide basic knowledge of the interaction between global climate change, marine resources, and oceanic processes to policy makers.

### **A01 Dynamics of Atmospheric Composition**

#### **A01-1 Anthropogenic impact on atmospheric trace species and their effects to the air-sea chemical interaction**

Long-term continuous monitoring of nitrogenous species both in gaseous and particulate phases with other air pollutants at a remote site, Cape Hedo, in Okinawa Islands. Quantifying the annual trend and the seasonal variability of atmospheric nitrogen nutrient input to the Western Pacific Ocean. Detecting the potential impact of the economic growth in the East-Asian Continent on the air-sea chemical interaction through the increase in the nitrogen input.

Simultaneous, comprehensive and high time-resolution continuous monitoring of total NO<sub>y</sub> and nitrogenous deposition species, particulate NO<sub>3</sub><sup>-</sup> and NH<sub>4</sub><sup>+</sup> as well as gaseous HNO<sub>3</sub> and NH<sub>3</sub>.

NIES Atmospheric and Aerosol Monitoring Station at Cape Hedo, Okinawa, is providing collaborative facilities for year-round continuous monitoring of geophysical and chemical quantities related to the global environment, and is assigned as the major site in Japan for the international ABC Program.

(Hiroshi Bandow)

#### **A01-2 A study on the production and emission of marine-derived volatile halocarbons**

Measurements of marine biogenic gases in the air and surface seawater. Studies on the mechanism and controlling factors of the marine VOCs production based on cultivation of microalgae and molecular biological technique.

(Yoko Yokouchi)

#### **A01-3 Atmospheric deposition of particulate trace metals and organic carbon to the ocean and production processes of marine aerosols**

Quantify the transport and deposition of particulate trace metals and organic carbon from the Asian continent to the western North Pacific. Investigate the production and emission of biogenic gases and the gas-to-particle processes especially in subtropical and subarctic regions of the western Pacific.

Looking at nano particles by Aerosol Time-of-Flight Mass Spectrometer(ATOFMS) on shipboard.

Looking for continental biomarkers associated with soil microbial activities using a saponification on the aerosol samples, i.e., omega-hydroxy carboxylic acids, which are produced in soils by microbial omega-oxidation of fatty acids.

(Mitsuo Uematsu)

#### **A02 Variability of Gass Exchange at the Air-Sea Interface**

##### **A02-4 Trace gas geochemistry in ocean surface**

Quantify trace organic compounds in ocean using PTR-MS. Stable carbon isotopic compositions of trace non-methane hydrocarbons (NMHCs) in ocean. Production of methane in oxic seawater using dual (carbon and hydrogen) isotope tracers. High sensitivity tracer assay for N<sub>2</sub> fixation in ocean. Nitrate and nitrous oxide geochemistry using the triple oxygen isotopic compositions.

We introduced new isotope ratio mass spectrometer for this project.

(Ururu Tsunogai)

##### **A02-5 Development of direct eddy-covariance system for the air-sea trace gas flux measurements**

For the precise evaluation of air-sea trace gas fluxes, eddy-covariance method is considered as the direct and most reliable technique. In the present project, CO<sub>2</sub> and DMS are the possible candidates for the application of the eddy-covariance method. Measurement system of these trace gas density fluctuations and ship motion correction for the wind velocities are organized in the project.

(Osamu Tsukamoto)

#### **A02-6 Long-term changes of green house gases in the ocean and its feedback effect on climate.**

We have a plan to investigate oceanic parameter as green house gases with the physical-biogeochemical observations in the next five years. It focuses on the North Pacific subpolar/subtropical region in order to get a quantification of feed back parameters.

(Yutaka W. Watanabe)

### **A03 Dynamics of Marine Ecosystem**

#### **A03-7 Bioavailability and biogeochemical process of trace metals in the surface ocean**

To investigate the speciation and bioavailability of trace metals supplied from the atmosphere to the ocean surface, we will study the dissolution rate of trace metals from the atmospheric mineral dust and their speciation in seawater.

(Shigenobu Takeda)

#### **A03-8 Dynamics of biophilic elements and microbial processes in the surface ocean**

The detailed distributions of different forms of biophilic elements (C, N, P, Si) and their interaction with microbial processes in the surface water column will be elucidated in terms of biogeochemical flux between the atmosphere and the surface ocean.

(Hiroshi Ogawa)

#### **A03-9 Ecosystem response to the dust input in the western Pacific, and its feedback**

We will examine the ecosystem responses to the dust (iron) input in the subarctic and subtropical Pacific with bottle incubation. We also reanalyze the data from the mesoscale iron enrichment experiments (SEEDS and SEEDS II). We will also investigate the effects of typhoon as a mechanism to enhance the primary production in the subtropical Pacific.

(Atsushi Tsuda)

#### **A03-10 Mechanism on abrupt change of primary productivity by air-sea interaction using satellite remote sensing and numerical modeling**

To examine abrupt change of primary productivity, we will generate satellite data set on ocean color and sea surface temperature before and after typhoon passing around Japan. We will develop a numerical model of typhoon which can simulate a magnitude of mixing and upwelling in sub-surface layer and examine the relationship between moving speed of typhoon and magnitude of mixing and upwelling.

(Sei-Ichi Saitoh)

#### **A04 Modeling of Interaction between Ocean and Atmosphere**

##### **A04-11 Responses of marine ecosystem to weather disturbances of synoptic scale**

In this project, we will synthesis results obtained from the other observation project in Japan-IGBP/SOLAS activities. Especially, we will focus responses of marine ecosystem to the weather disturbances such as Typhoon and strong extratropical cyclone, which deepening the mixed layer and shutdown solar radiation during few days to a week. We will also investigate responses of marine ecosystem to aeolian dust using ecosystem model representing iron cycle processes.

(Yasuhiro Yamanaka)

#### **Field Observations in 2007**

##### **A01-1**

2007 Winter (ca. 2 weeks during Nov-Dec. 2007, period: not determined yet.) Aircraft observation campaign for aerosols over the East China Sea collaborated with a ground-base intensive observation at Cape Hedo, partly funded by Global Environmental Research Fund (MOE, Japan) and by Asian Environment Research Program, Core Project 1 (NIES).

##### **A01-2**

- (1) *Spring 2007 (KT-07-7:16-29 April)* -- Measurements of VOCs in the atmosphere and seawater
- (2) High frequency measurements of methyl halides and DMS in the atmosphere at Hateruma Island and Cape Ochiishi

##### **A01-3**

- (1) Spring 2007 (KT-07-7:16-29 April): BLOCKS (Bloom Caused by Kosa Study) in the mid latitude zone of the western North Pacific by R/V Tansei Maru
- (2) Summer 2007 (MR07-04): A longitudinal transect cruise from Japan to the North America along 47°N by R/V Mirai

##### **A02-5**

- (1) R/V MIRAI cruise: MR07-03 (June, 2007) equatorial Western Pacific
- (2) R/V MIRAI cruise: MR07-06 (Oct-Nov, 2007) Western Pacific

##### **A03-7**

- (1) Surface water clean sampling test using a newly developed "Fish". R.V. Hakuho-maru, July 24-29, 2007
- (2) Trace metal cycles in the surface layer around Kuroshio Current. R.V. Tansei-maru, Oct 21-25.

##### **A03-9**

R.V. Hakuho-maru KH-7-3 cruise, Subtropical Pacific (Argo float deployment, bottle incubation).

##### **A03-10**

R.V. Oshoro-maru IPY collaborative research cruises in Arctic Sea and Bering Sea, July 1-August 28, 2007.

## Publications

### **A01-1**

- T. Kameda, K. Inazu, Y. Hisamatsu, N. Takenaka, H. Bandow, "Isomer distribution of nitro- triphenylenes in airborne particles, diesel exhaust particles, and the products of gas-phase radical-initiated nitration of triphenylene", *Atmos. Environ.*, 40, 7742-7751 (2006).
- Y. Sadanaga, S. Kondo, K. Hashimoto, and Y. Kajii, "Measurement of the Rate Coefficient for the OH + NO<sub>2</sub> Reaction: Its Humidity Dependence", *Chem. Phys. Lett.*, 419, 474-478 (2006).
- W. Wang, H. Liu, X. Yue, H. Li, J. Chen, L. Ren, D. Tang, S. Hatakeyama, and A. Takami, "Study on acidity and acidic buffering capacity of particulate matter over Chinese eastern coastal areas in spring", *J. Geophys. Res.*, 111, D18207, doi:10.1029/2005JD006753(2005).
- K. Arao, M. Nishikawa, S. Hatakeyama, A. Takami, S. Matsuyama, and T. Hayasaka, "Atmospheric Turbid Condition due to Fine Particles in Recent Years at Nagasaki, Japan", *J. Environ. Studies, Nagasaki Univ.*, 9 23-30 (2006).
- W. Wang, S. Hatakeyama, Z. F. Wang, H. J. Liu, A. Takami, H. Li, J. H. Chen, X. Yue, L. H. Ren, H. F. Zheng, and D. G. Tang, "Intensive aircraft-based measurements of air pollutants over the eastern coast of China in Spring 2002 (I) - the temporal and spatial distribution of sulfur and its budgets". *Water, Air and Soil Pollut.*, in press.
- Chen, J. H., Z. F. Wang, S. Hatakeyama, W. Wang, A. Takami, H. Li, H. J. Liu, Z. S. Wang, X. Yue, L. Lu, H. M. Su and D. G. Tang, "Intensive aircraft-based measurements of air pollutants over the eastern coast of China in Spring 2002 (II) – the NO<sub>x</sub> distributions and ozone modeling studies", *Water, Air and Soil Pollut.*, in press.

### **A01-2**

- T. Saito, Y. Yokouchi, S. Aoki, T. Nakazawa, Y. Fujii, O. Watanabe, A method for determination of methyl chloride concentration in air trapped in ice cores, *Chemosphere*, 63, 1209-1213 (2006)
- Y. Yokouchi, S. Taguchi, T. Saito, Y. Tohjima, H. Tanimoto, and H. Mukai, High frequency measurements of HFCs at a remote site in East Asia and their implications for Chinese emissions, *Geophys. Res. Letters*, L21814 (2006)
- T. Saito, Y. Yokouchi, S. Aoki, T. Nakazawa, Y. Fujii, O. Watanabe, Ice-core record of methyl chloride over the last glacial Holocene climate change, *Geophys. Res. Letters*, 34, L03801, (2007)
- Z. Kamenarska, T. Taniguchi, N. Ohsawa, M. Hiraoka, N. Itoh, Phytochemistry, A vanadium-dependent bromoperoxidase in the marine red alga *Kappaphycus alvarezii* (Doty) Doty displays clear substrate specificity (in press)

### **A01-3**

- Nakamura, T., Ogawa, H., Kumar, D. M., and Uematsu, M., "Contribution of water soluble organic nitrogen to total nitrogen in marine aerosols over the East China Sea and western North Pacific" *Atmospheric Environment*, 40, 7259–7264 (2006).
- Ooki, A., Uematsu, M., and Noriki, S., "Size-resolved sulfate and ammonium measurements in marine boundary layer over the North and South Pacific" *Atmospheric Environment*, 41, 81-91 (2006).
- Prabir, K. P. J., Moore, K., Mahowald, M., Uematsu, M., Doney, S.C. and Nakazawa, T., "Exploring the sensitivity of interannual basin-scale air-sea CO<sub>2</sub> fluxes to variability in atmospheric dust deposition using ocean carbon cycle models and atmospheric CO<sub>2</sub> inversions" *Journal of Geophysical Research*, in press, (2007).
- Inomata, Y., Hayashi, M., Osada, K., Iwasaka, Y., Spatial distributions of volatile sulfur compounds in surface seawater and overlying atmosphere in the northwestern Pacific Ocean, eastern Indian Ocean, and Southern Ocean, *Global Biogeochemical Cycle*, 20, doi:10.1029/2005GB002518, June, 2006.

- Hara, K., Y. Iwasaka, M. Wada, T. Ihara, H. Shiba, K. Osada, T. Yamanouchi, Aerosol constituents and their spatial distribution in the free troposphere of coastal Antarctic regions, *J. Geophys. Res.*, 111, doi:10.1029/2005JD006591, August, 2006.
- Li, Jingmin and K. Osada, Water-insoluble particles in spring snow at Mt. Tateyama, Japan: Characteristics of the shape factors and size distribution in relation with their origin and transportation, *J. Meteorol. Soc. Jpn.*, accepted for publication.
- Nishita, C., K. Osada, K. Matsunaga, Y. Iwasaka, Number-size distributions of free tropospheric aerosol particles at Mt. Norikura, Japan: effects of precipitation and air-mass transportation pathways, *J. Geophys. Res.*, accepted for publication.
- Osada, K., K. Hara, M. Wada, T. Yamanouchi, K. Matsunaga, Lower Tropospheric Vertical Distribution of Aerosol Particles over Syowa Station, Antarctica from Spring to Summer in 2004, *Polar Meteorol. Glaciol.*, 20, 16-27, 2006.
- James Bendle, Kimitaka Kawamura and Koji Yamazaki, Seasonal changes in stable carbon isotopic composition of n-alkanes in the marine aerosols from the western North Pacific: Implications for the source and atmospheric transport, *Geochimica et Cosmochimica Acta*, 70, 13-26, 2006.
- Osamu Seki, Chisato Yoshikawa, Takeshi Nakatsuka, Kimitaka Kawamura and Masaaki Wakatsuchi, Fluxes, source and transport of organic matter in the western Sea of Okhotsk: stable carbon isotopic ratios of n-alkanes and total organic carbon, *Deep-Sea Research I*, 53, 253-270, 2006.
- H. Wang, K. Kawamura, and K. Yamazaki, Water-soluble dicarboxylic acids, ketoacids and dicarbonyls in the atmosphere over the Southern Ocean and western North Pacific, *J. Atmos. Chem.*, 53, 43-61, 2006.
- H. Wang and K. Kawamura, Stable carbon isotopic composition of low-molecular-weight dicarboxylic acids and ketoacids in remote marine aerosols, *J. Geophys. Res.* 111, D07304, doi: 10.1029/2005JD006466, 2006.
- K. F. Ho, S. C. Lee, J. J. Cao, K. Kawamura, T. Watanabe, Y. Cheng, J. C. Chow, Dicarboxylic acids, ketocarboxylic acids and dicarbonyls in the urban roadside area of Hong Kong, *Atmos. Environ.*, 40, 3030-3040, 2006.
- Teruyo Ieda, Yasuyuki Kitamori, Michihiro Mochida, Ryuichi Hirata, Takashi Hirano, Kou Inukai, Yasumi Fujinuma and Kimitaka Kawamura, Diurnal variations and vertical gradients of biogenic volatile and semi-volatile organic compounds at the Tomakomai larch forest station in Japan. *Tellus B*, 59B, 177-186, 2006.
- S. Fuzzi, M. O. Andreae, B. J. Huebert, M. Kulmala, T. C. Bond, M. Boy, S. J. Doherty, A. Guenther, M. Kanadidou, K. Kawamura, K.-V. Kerminen, U. Lohmann, L. M. Russell, and U. Poschl, Critical assessment of the current state of scientific knowledge, terminology, and research needs concerning the role of organic aerosols in the atmosphere, climate, and global change, *Atmos. Chem. Phys.*, 6, 2017-2038, 2006.
- Guhei Wang, Kimitaka Kawamura, Shuncheng Lee, Kinfa Ho, and Junji Cao, Molecular, seasonal and spatial distribution of organic aerosols from fourteen Chinese cities. *Environ. Sci. and Technol.*, 40, 4619-4625, 2006.
- Marc Tedetti, Kimitaka Kawamura, Bruno Charriere, Nicolas Chevalier, and Richard Sempéré, Determination of low molecular weight dicarboxylic acids in seawater samples, *Anal. Chem.*, 78, 6012-6018, 2006.
- Haobo Wang, Kimitaka Kawamura and David Shooter, Wintertime organic aerosols in Christchurch and Auckland, New Zealand: Contributions of residential wood and coal burning and petroleum utilization. *Environ. Sci. and Technol.*, 40, 5257-5262, 2006.

- Haobo Wang, Kimitaka Kawamura, K. F. Ho and S. C. Lee, Low Molecular Weight Dicarboxylic Acids, Ketoacids and Dicarbonyls in the Fine Particles from a Roadway Tunnel: Significant Secondary Production from the Precursors in Vehicular Emissions. *Environ. Sci. and Technol.*, 40, 6255-6260, 2006.
- Gehui Wang, Kimitaka Kawamura, Tomomi Watanabe, Shuncheng Lee, Kinfa Ho, and Junji Cao, High loadings and source strengths of organic aerosols in China. *Geophys. Res. Lett.*, 33, L22801, doi:10.1029/2006GL027624, 2006.
- Michihiro Mochida, Mikinori Kuwata, Takuma Miyakawa, Nobuyuki Takegawa, Kimitaka Kawamura and Yutaka Kondo, Relationship between hygroscopicity and cloud condensation nuclei activity for urban aerosols in Tokyo. *J. Geophys. Res.*, 111, D23204, doi: 10.1029/2005JD006980, 2006.
- Miyazaki, Y., Y. Kondo, N. Takegawa, Y. Komazaki, M. Fukuda, K. Kawamura, M. Mochida, K. Okuzawa, and R. J. Weber (2006), Time-resolved measurements of water-soluble organic carbon in Tokyo. *J. Geophys. Res.*, 111, D23206, doi:10.1029/2006JD007125.
- Gehui Wang, Kimitaka Kawamura, Xin Zhao, Qiuge Li, Zhaoxia Dai, and Hongyun Niu, Identification, abundance and seasonal variation of anthropogenic organic aerosols from a mega-city in China. *Atmospheric Environment*, 41, 407-416, 2007.
- Sou N. Matsunaga, Alex B. Guenther, Yusuke Izawa, Christine Wiedinmyer, Jim P. Greenberg and Kimitaka Kawamura, Importance of wet precipitation as a removal and transport process for atmospheric water soluble carbonyls. *Atmos. Environ.*, 41, 790-796, 2007.
- Murosaki, M., Fujita, S., Takahashi, A., Hayami, H., and Miura, K., "Measurements of ozone vertical distribution at Mt. Fuji using a passive sampler" *J. Jpn. Soc. Atmos. Environ.*, 41(6), 347-354 (2006).
- A02-4**
- Kim, Y.-S., N. Tanaka, F. Nakagawa, U. Tsunogai, M. Ueyama, Y. Harazono, Assessment of winter fluxes of CO<sub>2</sub> and CH<sub>4</sub> in boreal forest soils of central Alaska estimated by the profile method and the chamber method: a diagnosis of methane emission and implications for the regional carbon budget. *Tellus B*, in press.
- Kim, J.-H., M.-H. Park, U. Tsunogai, T.-J. Cheong, B.-J. Ryu, Y.-J. Lee, H.-C. Han, J.-H. Oh and H.-W. Chang (2007) Geochemical characterization of the organic matter, pore water constituents and shallow methane gas in the eastern part of the Ulleung Basin, East Sea (Japan Sea), *Island Arc*, 16, 93-104.
- Oba M., Sakata S. and Tsunogai U. (2006) Polar and neutral isopranyl glycerol ether lipids as biomarkers of archaea in near-surface sediments from the Nankai Trough. *Organic Geochemistry*, 37, 1643-1654.
- Inagaki, F., M.M.M. Kuypers, U. Tsunogai, J. Ishibashi, K. Nakamura, T. Treude, S. Ohkubo, M. Nakaseama, K. Gena, H. Chiba, H. Hirayama, T. Nunoura, K. Takai, B.B. Jørgensen, K. Horikoshi and A. Boetius (2006) Microbial community in a sediment-hosted CO<sub>2</sub> lake of the southern Okinawa Trough hydrothermal system. *Proc. Nat. Acad. Sci. U.S.A.*, 103, 38, 14,164-14,169.
- Arakawa, S., T. Sato, R. Sato, J. Zhang, T. Gamo, U. Tsunogai, A. Hirota, Y. Yoshida, R. Usami, F. Inagaki and C. Kato (2006) Molecular phylogenetic and chemical analyses of the microbial mats in deep-sea cold seep sediments at the northeastern Japan Sea. *Extremophiles*, 10, 311-319.
- Gamo, T., J. Ishibashi, U. Tsunogai, K. Okamura, H. Chiba (2006) Unique geochemistry of submarine hydrothermal fluids from arc-backarc settings of the western Pacific. In: *Back-Arc Spreading Systems: Geological, Biological, Chemical and Physical Interactions* (ed by D. Christie), Geophysical Monograph Series 166, American Geophysical Union, p.147-161.
- Toki, T., T. Gamo, and U. Tsunogai (2006) Origins of hydrocarbons at Sagara oil field, Central Japan. *Island Arc*, 15, 285-291.
- Konno, U., U. Tsunogai, F. Nakagawa, M. Nakaseama, J. Ishibashi, T. Nunoura, K. Nakamura (2006)

Liquid CO<sub>2</sub> venting on seafloor: Yonaguni IV Knoll hydrothermal system, Okinawa Trough. *Geophys. Res. Lett.*, 33, L16607, doi:10.1029/2006GL026115.

Saegusa, S., U. Tsunogai, F. Nakagawa, and S. Kaneko (2006) Development of a multi-bottle gas-tight fluid sampler WHATS II for Japanese submersibles/ROVs. *Geofluids*, 6, 234-240.

Nakagawa, T., K. Takai, Y. Suzuki, H. Hirayama, U. Konno, U. Tsunogai and K. Horikoshi (2006) Geomicrobiological exploration and characterization of a novel deep-sea hydrothermal system at the TOTO caldera in the Mariana Volcanic Arc. *Environ. Microbiol.*, 8, 37-49.

#### **A02-5**

Air-Sea CO<sub>2</sub> Flux by Eddy Covariance Technique in the Equatorial Indian Ocean

Fumiyoshi KONDO and Osamu TSUKAMOTO *Journal of Oceanography*, 2007 (Accepted)

#### **A03-7**

Hongo, Y., H. Obata, D.S. Alibo and Y. Nozaki, 2006. Spatial variations of rare earth elements in North Pacific surface water. *Journal of Oceanography*, 62: 441-455.

Maruo, M., T. Doi and H. Obata, 2006. Onboard determination of submicromolar nitrate in seawater by anion-exchange chromatography with lithium chloride eluent. *Analytical Sciences*, 22: 1175-1178.

Obata, H., T. Yoshida, and H. Ogawa, 2006. Determination of picomolar levels of platinum in estuarine waters: a comparison of cathodic stripping voltammetry and isotope dilution-inductively coupled plasma mass spectrometry. *Analytica Chimica Acta*, 580, 32-38.

Tazoe, H., H. Obata, H. Amakawa, Y. Nozaki, and T. Gamo, 2007. Precise determination of the cerium isotopic composition of surface water in the Northwest Pacific Ocean and Tokyo Bay. *Marine Chemistry*, 103, 1-14.

Okubo, A., H. Obata, T. Gamo, H. Minami, and M. Yamada, 2007. Scavenging of <sup>230</sup>Th in the Sulu Sea. *Deep-Sea Research II*, 54, in press.

Obata, H., T. Doi, Y. Hongo, D.S. Alibo, H. Minami, Y. Kato, and M. Maruo, 2007. Manganese, cerium, and iron in the Philippine, Celebes, and Sulu Seas. *Deep-Sea Research II*, 54, 38-49.

Hongo, Y., H. Obata, T. Gamo, M. Nakashima, J. Ishibashi, U. Konno, S. Saegusa, S. Ohkubo and U. Tsunogai. Rare earth elements in the hydrothermal system at Okinawa Trough back-arc basin. *Gaochemical Journal*, in press.

Johnson, K.S., E. Boyle, K. Bruland, K. Coale, C. Measures, J. Moffett, A. Aguilar-Islas, K. Barbeau, B. Bergquist, A. Bowie, K. Buck, Y. Cai, Z. Chase, J. Cullen, T. Doi, V. Elrod, S. Fitzwater, M. Gordon, A. King, P. Laan, L. Laglera-Baquer, W. Landing, M. Lohan, J. Mendez, A. Milne, H. Obata, L. Osslander, J. Plant, G. Sarthou, P. Sedwick, G. Smith, B. Sohst, S. Tanner, S. Van den Berg, J. Wu. The SAFe Iron Intercomparison Cruise: An International Collaboration. *EOS*, in press.

S. Takeda, N. Ramaiah, M. Miki, Y. Kondo, Y. Yamaguchi, Y. Arie, F. Gomez, K. Furuya and W. Takahashi (2007) Biological and chemical characteristics of high-chlorophyll, low-temperature water observed near the Sulu Archipelago. *Deep-Sea Research II*, 54(1-2), 81-102.

Y. Kondo, S. Takeda and K. Furuya (2007) Distribution and speciation of dissolved iron in the Sulu Sea and its adjacent waters. *Deep-Sea Research II*, 54(1-2), 60-80.

P.W. Boyd, T. Jickells, C.S. Law, S. Blain, E.A. Boyle, K.O. Buesseler, K.H. Coale, J.J. Cullen, H.J.W. de Baar, M. Follows, M. Harvey, C. Lancelot, M. Lefevre, R. Pollard, R.B. Rivkin, J. Sarmiento, V. Schoemann, V. Smetacek, S. Takeda, A. Tsuda, S. Turner, A.J. Watson (2007) Mesoscale iron-enrichment experiments 1993-2005: synthesis and future directions. *Science*, 315, 612-617.

S. Takeda, N. Yoshie, P.W. Boyd and Y. Yamanaka (2006) Modeling studies investigating the causes of preferential depletion of silicic acid relative to nitrate during SERIES, a mesoscale iron enrichment in the NE subarctic Pacific. *Deep-Sea Research II*, 53, 2297-2326.

C.S. Wong, W.K. Johnson, N. Sutherland, J. Nishioka, D.A. Timothy, M. Robert and S. Takeda (2006)



Iron speciation and dynamics during SERIES, a mesoscale iron enrichment experiment in the NE Pacific. *Deep-Sea Research II*, 53, 2075-2094.

- H. Saito, A. Tsuda, Y. Nojiri, J. Nishioka, S. Takeda, H. Kiyosawa, I. Kudo, Y. Noiri, T. Ono, Y. Taira, K. Suzuki, T. Yoshimura and P.W. Boyd (2006) Nutrient and phytoplankton dynamics during the stationary and declining phases of a phytoplankton bloom induced by iron-enrichment in the eastern subarctic Pacific. *Deep-Sea Research II*, 53, 2168-2181.
- T. Yoshimura, J. Nishioka, H. Saito, S. Takeda, A. Tsuda and M.L. Wells (2007) Distributions of particulate and dissolved organic and inorganic phosphorus in North Pacific surface waters. *Marine Chemistry*, 103, 112-121.
- M. Sato, S. Takeda, K. Furuya (2006) Effects of long-term sample preservation on flow cytometric analysis of natural populations of pico- and nanophytoplankton. *Journal of Oceanography*, 62, 903-908.

#### A03-8

Separation of marine bacteria according to buoyant density by use of the density-dependent cell sorting method. Inoue, K., M. Nishimura, B. B. Nayak and K. Kogure *Applied and Environmental Microbiology* in press

#### A03-9

- Saito, H., T. Ota, K. Suzuki, J. Nishioka and A. Tsuda (2006) Role of heterotrophic dinoflagellate *Gyrodinium* sp. in the fate of an iron-enrichment induced diatom bloom. *Geophysical. Res. Let.* 33, L09602, 10.1029/2005GL025366
- Tsuda, A., H. Saito, J. Nishioka, T. Ono, Y. Noiri and I. Kudo (2006) Mesozooplankton response to iron enrichment during the diatom bloom and bloom decline in SERIES (NE Pacific). *Deep-Sea Res. II*, 53: 2281-2296
- Marchetti, A., N.D. Sherry, H. Kiyosawa, A. Tsuda and P.J. Harrison (2006) Phytoplankton processes I: changes in biomass and community composition due to a mesoscale iron enrichment in the NE subarctic Pacific. *Deep-Sea Research II*. 53: 2095-2113
- Saito, H., A. Tsuda, Y. Nojiri, J. Nishioka, S. Takeda, H. Kiyosawa, I. Kudo, Y. Noiri, T. Ono, Y. Taira, K. Suzuki, T. Yoshimura and P.W. Boyd (2006) Nutrients and phytoplankton dynamics during the stationary and declining phases of a phytoplankton bloom induced by iron-enrichment in the eastern subarctic Pacific. *Deep-Sea Research II*. 53: 2168-2181
- Kudo, I., Y. Noiri, J. Nishioka, Y. Taira, H. Kiyosawa and A. Tsuda (2006) Phytoplankton community response to Fe and temperature gradient in the NE (SERIES) and NW (SEEDS) subarctic Pacific Ocean. *Deep-Sea Research II*. 53: 2201-2213.
- Yoshimura, T. J. Nishioka, H. Saito, S. Takeda, A. Tsuda, M.L. Wells (2007) Distributions of particulate and dissolved organic and inorganic phosphorus in North Pacific surface waters *Mar. Chem.* 103: 112-121
- Kishi, M.J., D.L. Eslinger, M. Kashiwai, B.A. Megrey, D.M. Ware, F.E. Werner, M. Aita-Noguchi, T. Azumaya, M. Fujii, S. Hashimoto, D. Huang, H. Iizumi, Y. Ishida, S. Kang, G.A. Kantakov, H.-c. Kim, K. Komatsu, V.V. Navrotsky, S.L. Smith, K. Tadokoro, A. Tsuda, O. Yamamura, Y. Yamanaka, K. Yokouchi, N. Yoshie, J. Zhang, Y.I. Zuenko, V.I. Zvansky, NEMURO - A lower trophic level model for the North Pacific marine ecosystem. *Ecological Modeling*, (in press)
- Boyd, P.W., T. Jickells, C.S. Law, S. Blain, E.A. Boyle, K.O. Buesseler, K.H. Coale, J.J. Cullen, H.J.W. de Baar, M. Follows, M. Harvey, C. Lancelot, M. Levasseur, N.P.J. Owens, R. Pollard, R.B. Rivkin, J. Sarmiento, V. Schoemann, V. Smetacek, S. Takeda, A. Tsuda, S. Turner, A.J. Watson, (2007) Mesoscale iron enrichment experiments 1993-2005: Synthesis and future direction. *Science* 315: 612-617

**A03-10**

Kiyofuji, H., T. Hokimoto and S. Saitoh: Predicting the spatial and temporal chlorophyll-*a* distribution in the Sea of Japan based on SeaWiFS ocean color satellite data, *IEEE Geoscience and Remote Sensing Letters*, 10.1109/LGRS.2005.861931 (2006).

Zainuddin, M., H. Kiyofuji, K. Saitoh and S. Saitoh (2006): Using multi-sensor satellite remote sensing and catch data to detect ocean hot spots for albacore (*Thunnus alalunga*) in the northwestern North Pacific, *Deep-sea Research, Part II*, 53, 419-431 (2006).

Hiroshi Murakami, Kosei Sasaoka, Kohtaro Hosoda, Hajime Fukushima, Mitsuhiro Toratani, Robert Frouin, B. Greg Mitchell, Mati Kahru, Pierre-Yves Deschamps, Dennis Clark, Stephanie Flora, Motoaki Kishino, Sei-ichi Saitoh, Ichio Asanuma, Akihiko Tanaka, Hiroaki Sasaki, Katsumi Yokouchi, Yoko Kiyomoto, Hiroaki Saito, Cecile Dupouy, Absornsuda Siripong, Satsuki Matsumura, and Joji Ishizaka (2006): Validation of ADEOS-2 GLI ocean color products using in-situ observations, *Journal of Oceanography*, 62 (3), 373-393 (2006)

Mizobata, K., J. Wang and S.-I. Saitoh : Eddy-induced Cross-Slope Exchange Maintaining Summer High Productivity of the Bering Sea Shelf Break, *Journal of Geophysical Research*, Vol. 111, C10017, doi:10.1029/2005JC003335, (2006)

Mizobata, K., S.-I. Saitoh and J. Wang: Summer biochemical enhancement in relation to the mesoscale eddy at the shelf break in the vicinity of the Pribilof Islands, *Deep-sea Research, Part II*, (in press) (2006)

Iida, T. and S.-I. Saitoh: Temporal and spatial variability of chlorophyll concentrations in the Bering Sea, *Deep-sea Research, Part II*, (in press) (2006)

**A04-11**

Hashioka, T. and Y. Yamanaka: Ecosystem change in the western North Pacific associated with global warming obtained by 3-D NEMURO. *Ecol. Modeling.* , DOI:10.1016/j.ecolmodel.2006.05.038, 2007.

Aita M. N., Y. Yamanaka, M. J. Kishi: Interdecadal Variation of the Lower Trophic Ecosystem in the Northern Pacific between 1948 and 2002, in a 3-D implementation of the NEMURO model. , DOI: 10.1016/j.ecolmodel.2006.07.045, 2007.

Yoshie N., Y. Yamanaka, K. A. Rose, D. L. Eslinger, D. M. Ware and M. J. Kishi: Parameter sensitivity study of the NEMURO lower trophic level marine ecosystem model. *Ecol. Modeling.*, doi:10.1016/j.ecolmodel.2006.07.043, 2007.

Fujii M., Y. Yamanaka, Y. Nojiri, M. J. Kishi, F. Chai: Comparison of seasonal characteristics in biogeochemistry among the subarctic North Pacific stations described with a NEMURO-based marine ecosystem model. *Ecol. Modeling.*, doi:10.1016/j.ecolmodel.2006.02.046., 2007.

Hashioka, T. and Y. Yamanaka: Seasonal and regional variations of phytoplankton groups by top-down and bottom-up controls obtained by a 3-D ecosystem model. *Ecol. Modeling.*, DOI: 10.1016/j.ecolmodel.2005.12.002, 2007.