Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

U04-P01 会場:3 階ポスター会場 時間:4 月 29 日 14:00-15:15

航空機によって捕集された人為起源およびバイオマス燃焼から発生したエアロゾル粒子の電子顕微鏡分析
Aerosol particles collected using aircrafts from anthropogenic sources and biomass burning and electron microscopy

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Aerosol particles collected during four sampling campaigns using aircrafts were analyzed using transmission electron microscopes (TEM). The samples were collected from two A-Force campaigns in 2013 (winter and summer) conducted in Japan and Korea, BBOP campaign in 2013 in the USA, and MILAGRO campaign in 2006 in Mexico. These campaigns aim to characterize aerosol particles from regional transportation, biomass burning, and both. The samples collected using aircrafts are useful for characterization of particle agings, especially changes of their mixing states, from emissions as the aircrafts can chase plumes of different aging periods. An example of such aerosol-particle aging is tar ball formation in biomass burning smoke. Tar ball is spherical, organic aerosol particles commonly from combustion smoke of a wide range of biomass burning. At the early stage of the emission, tar balls are liquid but as they age in the smoke, they become solid and spherical. Sets of biomass burning aerosol samples with different aging stages collected using an aircraft revealed such processes in atmosphere. I will also discuss the samples collected over Japan during the A-Force campaigns.

キーワード: 電子顕微鏡, 東アジア, 米北西部, A-Force, BBOP, MILAGRO
Keywords: Electron microscope, East Asia, Northwest US, A-Force, BBOP, MILAGRO

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東シナ海上空における窒素化合物の航空機観測
Aerial observations for nitrogen compounds over the East China Sea

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In order to clarify long-range transport of air pollutants from the Asian continent, we have conducted aerial observation over the East China Sea and measured air pollutants centering on aerosols, as part of Grant-in-Aid for Scientific Research on Innovative Areas “ Impacts of Aerosols in East Asia on Plants and Human Health (ASEPH) ” . In this presentation, the results of nitrogen compounds such as nitrate are mainly described.

The aerial observations were conducted in October, 2009 (autumn), December, 2010 (winter) and March, 2012 (spring) over the East China Sea. The flights were performed between Fukue Island and the southern offing of Jeju Island and the flight altitudes were 500, 1000, 2000 and 3000 m. Onboard measurements of gaseous total odd nitrogen species, gaseous nitric acid (HNO_3(g)), O_3, SO_2, CO and black carbon were made and particles were collected on filters for ionic and metal component analyses.

The concentration ratios of particulate nitrate (NO_3^-(p)) to inorganic total nitrate (T.NO_3 = HNO_3(g) + NO_3^-(p)) were less than 0.5 in most of the flights except under high concentrations of dust particles (Kosa) or transboundary air pollutants. Most of NO_3^-(p) would be $NaNO_3$ formed by the reaction of gaseous nitric acid (HNO_3(g)) with sea salt aerosols during the observations in autumn and winter except on October 17 and December 11, when high concentrations of Kosa were transported. In the spring observation, the fraction of $NaNO_3$ in NO_3^-(p) was low and a large part of NO_3^-(p) would be originated from reactions of HNO_3(g) with gas phase ammonia and soil dust particles.

O_3 concentrations decreased with altitude in autumn and increased in winter. Positive and negative correlations between NO_y-T.NO_3 and O_3 concentrations were observed throughout the flights in autumn and winter, respectively. This indicates that the major components of NO_y-T.NO_3 were secondary photochemical nitrogen oxides such as PANs and NO_x, in autumn and winter, respectively. The differences of vertical distribution and NO_y components between autumn and winter may be caused by the variation of solar radiation intensity.

キーワード: 航空機観測, 硝酸 (塩), 反応性総窒素酸化物, 東アジア
Keywords: aerial observation, nitrate, total odd nitrogen species, East Asia

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航空機搭載ライダーによる水蒸気分布観測
Airborne lidar measurements of water-vapor profiles

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大気中の水蒸気は、熱や水循環を通して気象・気候に重要な役割を演じている。また、二酸化炭素などの増加に伴う地球温暖化によって大気中の水蒸気がどのように変化していくかを監視していくことは気候の将来予測を行う上で重要である。水蒸気の観測は現在ゾンデや衛星から広く行われているが、飛翔体搭載ライダーを用いればさらに高い高度分解能で広範囲の水蒸気分布の観測が可能となる。我々は最終的には衛星搭載を目指した航空機搭載水蒸気差分吸収ライダーの開発を行い、1999 年に実際に航空機に搭載し測定実験を行った。開発されたライダーは当時世界最高性能のものであった。

ライダーの心臓部となるレーザーとして、水蒸気吸収の強いものと弱いもの、それに吸収しない 820 nm 付近の 3 波長のレーザーを 1.2 ms 間隔で発振でき、それらトリプルパルスを 50 Hz で送信できる LD（レーザーダイオード）励起 Nd:YLF レーザー（平均出力 50 W）の SHG (平均出力 30 W、200 m J、150 Hz) で励起された Ti:sapphire レーザーを開発した [1]。光音響セルを利用して水蒸気の吸収線に同調した単一モードの LD をリング型共振器で構成された Ti:sapphire レーザーに注入同期して、スペクトル幅 0.045 pm、スペクトル安定度 0.06 pm、平均出力 6.8 W（パルス当たり 45 mJ）を得た。

開発したレーザーを航空機に搭載して実験を行った。受信望遠光の口径は 20 cm で検出器には APD を用いた。送信、受信の視野はそれぞれ 0.8、1.6 mrad で、干渉フィルターの半値全幅 0.6 n mであった。観測は名古屋・東京・つくば上空を含む往復で行った。航空機搭載ライダーで測定された水蒸気分布と名古屋大学で同期観測されたラマンライダーによる水蒸気分布はよい一致を示した。

当時は励起用 LD の寿命が短いのが難点であったが、15 年経った今では、LD の技術も進んでおり、よりコンパクトで長寿命の航空機搭載水蒸気ライダーシステムの実現が可能である。

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キーワード: 水蒸気, 航空機搭載, ライダー
Keywords: water vapor, airborne, lidar