プロジェクト - 6

地上／衛星ライダーを用いた タクラマカン砂漠のダスト研究

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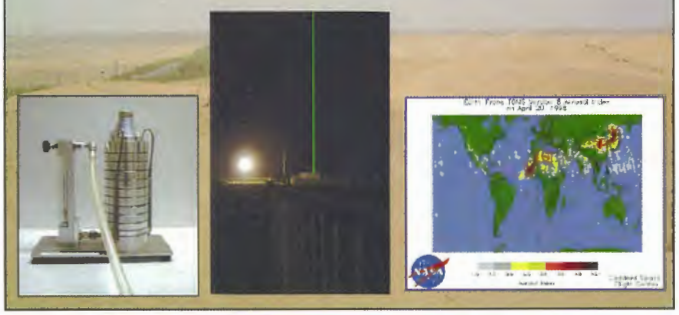
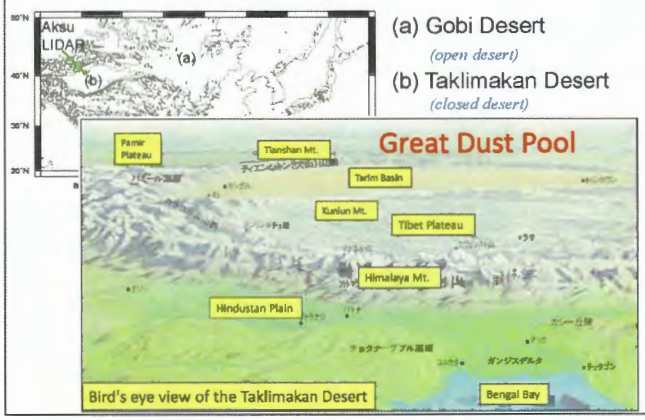
How much is the Taklimakan dust ?



Sources of Asian dust



(a) Gobi Desert
(open desert)
(b) Taklimakan Desert
(closed desert)

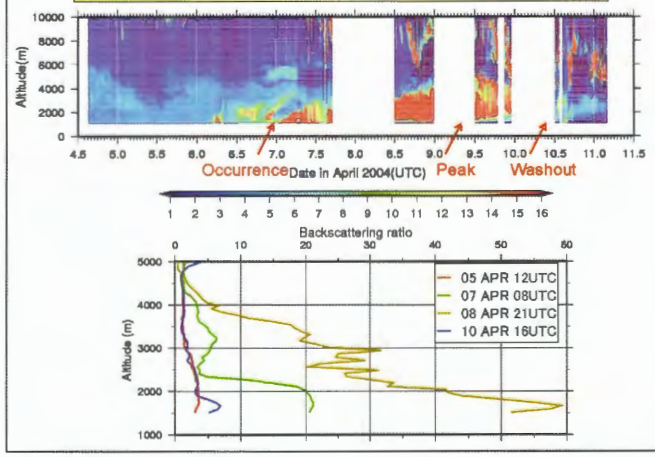
Purpose

To estimate of the total dust over the Taklimakan Desert in the spring by using the ADEC data (2000–2004: China Japan cooperative research).

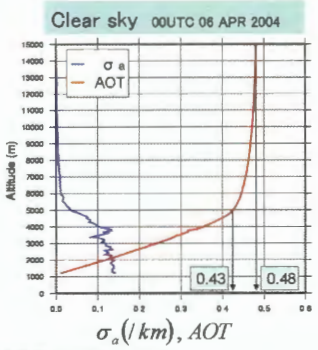
Data used in the present study

- Lidar data in April 2002 and 2004 at Aksu
  Backscattering ratio, extinction coefficient, AOT
- SYNOP data in the Taklimakan Desert
  Surface wind, visibility, precipitation and present weather
- Aerosol Index of Total Ozone Mapping Spectrometer (TOMS) in Earth Probe,NASA
- Dust concentration by Andersen sampler at Aksu

Backscattering ratio in April 2004 in Aksu



AOT: Aerosol Optical thickness

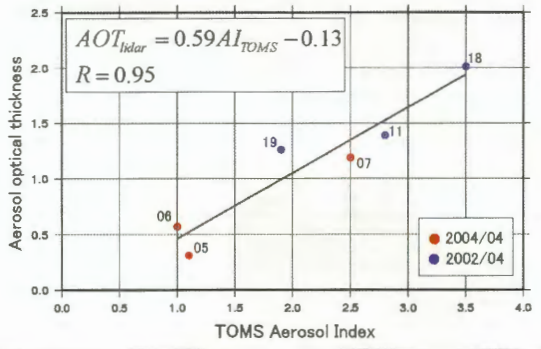


AOT is obtained by integration of aerosol extinction σa(z) from the surface to 5km.

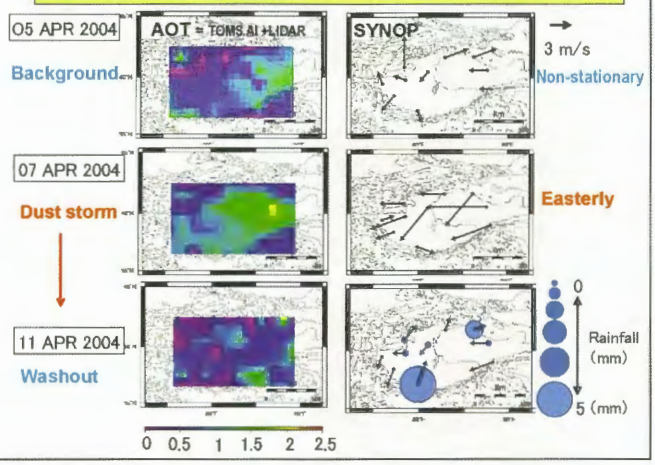
$$AOT = \int_{z_0}^{z} \sigma_a(z)dz$$

Relationship between TOMS AI and AOT

- TOMS AI is obtained according to Cakmur and Miller(2001).
- AOT is a lidar-derived AOT at 12 local time.



AOT and SYNOP before and after dust storm



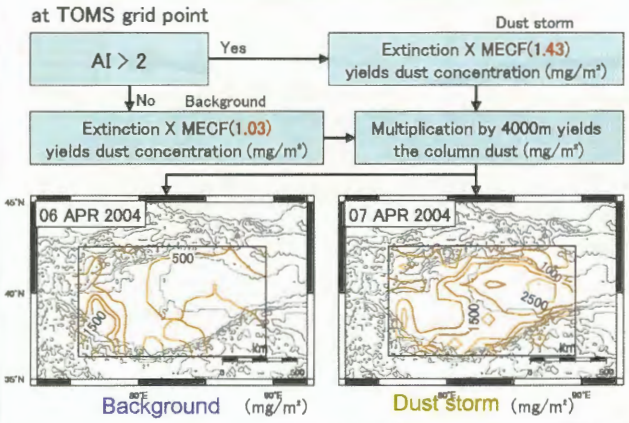
Estimation of the total dust

The total dust is estimated by using **Mass/Extinction Conversion Factor (MECF)**, which is a ratio of the surface dust concentration to the lidar-derived extinction coefficient of the dust layer.

Period	Extinction coef.* (/km)	Dust concen.** (mg/m^3)	MECF ($mg/m^3 \cdot km$)
Background 11 -13 APR 2002	0.37	0.38	1.03
Dust storm 13 - 16 APR 2002	1.52	2.17	1.43

*) Lidar observation at height of 150m
**)Andersen Samper at height of 7 m (Yabuki et al., 2005)

Estimation of the column dust



Discussion – comparison with the previous research

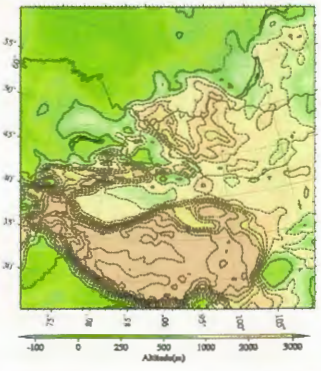
		Column density	Total amount of dust	Distance from source
Asian dust		mg/m^2	*Gg*	*km*
This study	APR 2002	3280	1082	0
	APR 2004	2250	744	0
Hara et al.(2008) *		-	184	0
Iwasaka et al.(1983) **		1760	1660	2500 Nagoya
Saharan dust				
Gringel & Muhleisen(1977)		4000 2500	- -	1400 2200
Prodi & Fea(1979)		830	-	2500

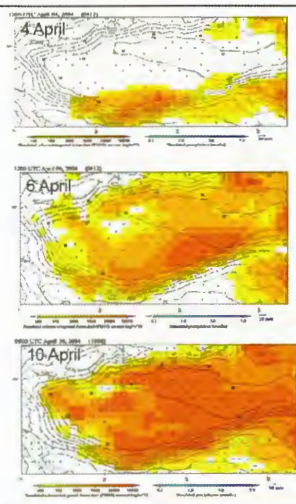
*) Hara et al. estimated the summer dust in 2008 using CALIPSO extinction (—), MECF at Beijing and regional model. The area is limited to the central part of the Taklimakan Desert (180,000km^2).
**) Iwasaka et al. (1983) estimated the dust over the wide area including Taklimakan and Gobi Deserts (1,360,000km^2).

WRF-chemの概要と計算条件

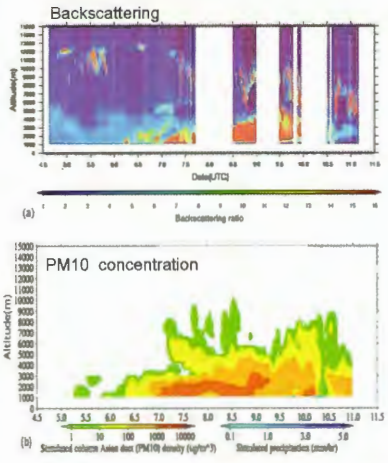
水平格子間隔	
水平格子数	
鉛直層数	
計算期間	200
長波放射過程	
短波放射過程	
大気境界層	延世大学
地表面物理過程	
地表面過程	
積雲対流過程	Kai
雲微物理過程	

PM10 = 黄砂粒子

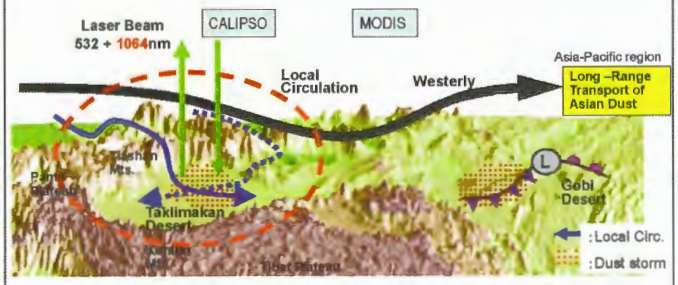




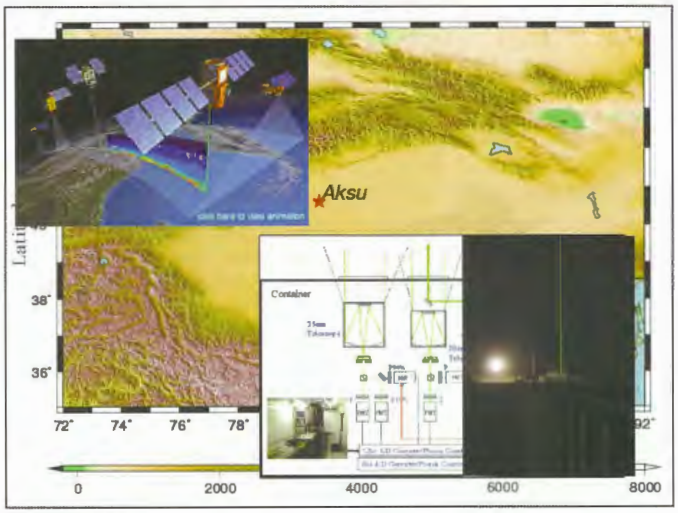
WRF-chemによる
PM10濃度の水平
分布

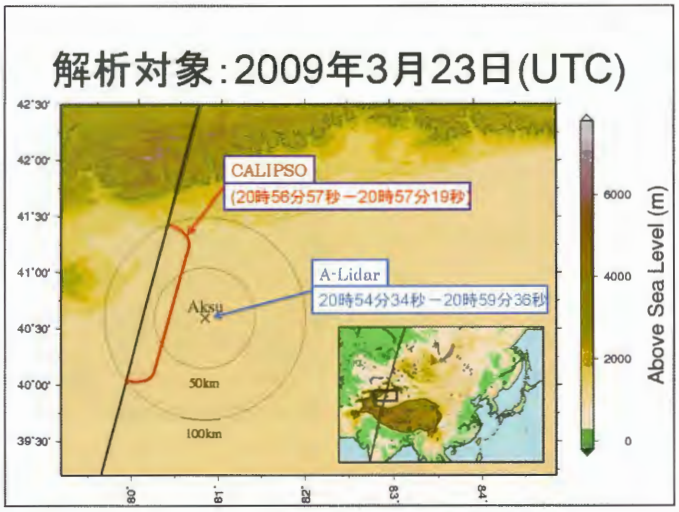


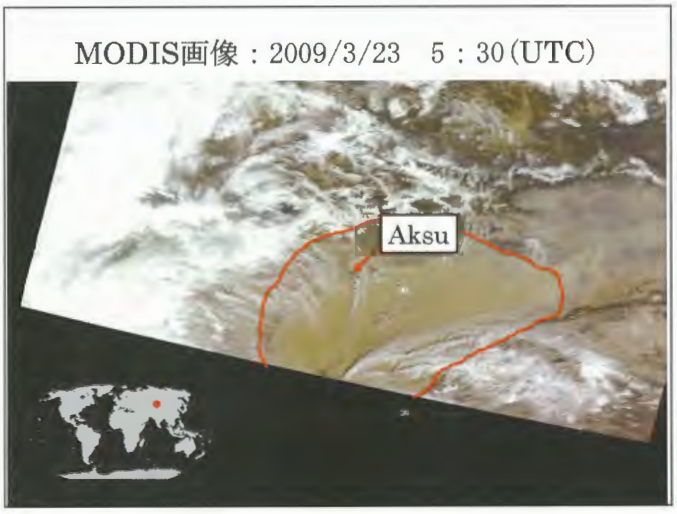
WRF-chemと
ライダー観測
の比較



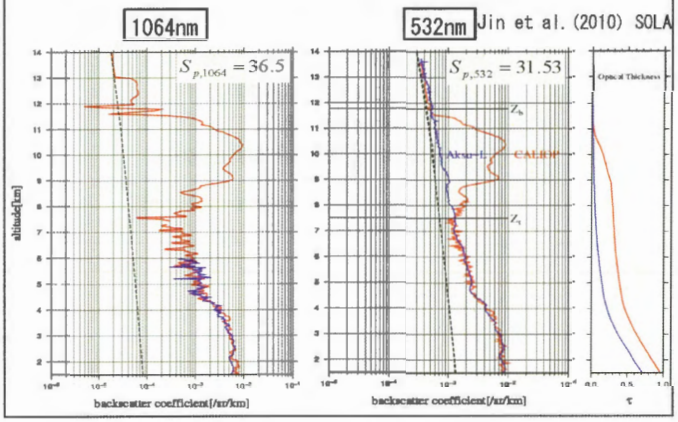
平成20-22年度科研費・基盤研究(B) 海外学術調査
タクラマカン砂漠上の局地循環と黄砂の発生機構
の解明

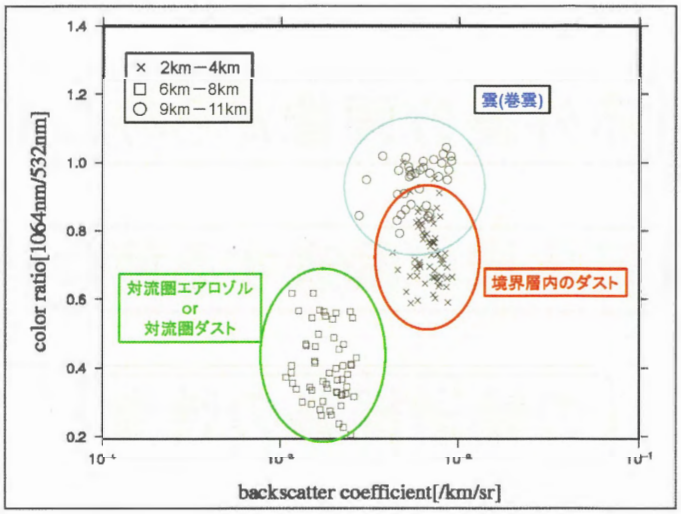






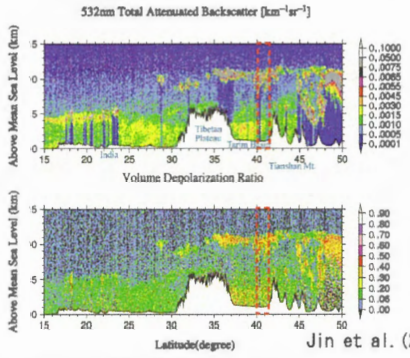
結果(ライダー比と光学特性)





International Nagoya-Workshop on Asian Dust

3 – 4 March 2011
Graduate School of Environmental Studies,
Nagoya University, Nagoya, Japan



Jin et al. (2010b) SPIE

Conclusion

- The vertical scale of the dust storm was 5 km, and the horizontal scale was 1000 km in the Taklimakan Desert in April 2004 .
- The column dust was 500 mg/m² in the background condition on 6 April 2004. The column dust increased in the whole of the desert due to the dust storm on 7 April . It was 2000 – 2500mg/m².
- Mass/Extinction Conversion Factor(MECF) was 1.03 for background conditions, and 1.43 for the dust storm.
- In April 2004 the total Taklimakan dust was 200 Gg in the back ground conditions. It peaked at 744 Gg due to the dust storm in April 2004.
- In April 2002 (=dusty year) the total Taklimakan dust was 389 Gg in the background conditions and the peak value was 1082 Gg .