Intensive dust transported from East Asia to North America during April 2010

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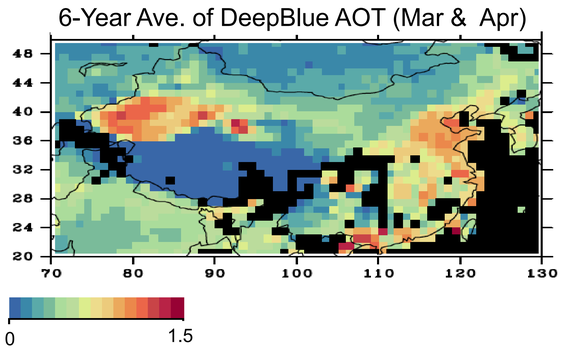
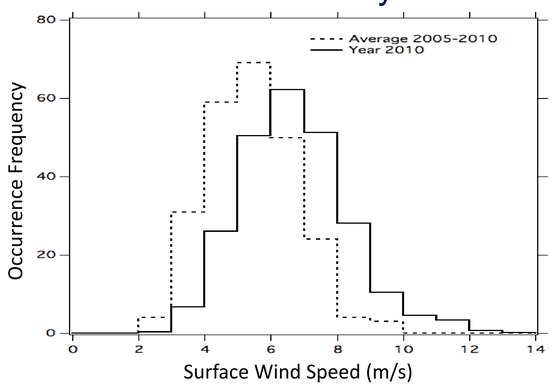
China and much of East Asia experienced a drought in the spring of 2010 that is said to be the worst in the past century. Strong winds (wind speed > 7 m/s) occurred in spring this year ~40% more than average in recent years. MODIS imagery indicates numerous major dust storms occurring in the Taklimakan and Gobi deserts. Intense, persistent dust was subsequently observed over North America by space-based, airborne and ground-based lidars during April 2010. Using CALIPSO lidar (CALIOP) measurements and air parcel back trajectories, we track the dust measured over North America back to East Asian source regions (mainly in the Tarim Basin). We also interpret the CALIOP and other A-Train observations using results from a 3D chemical transport model (GEOS-Chem) and investigate the meteorological context that gave rise to these dust storms.

DeepBlue AOD

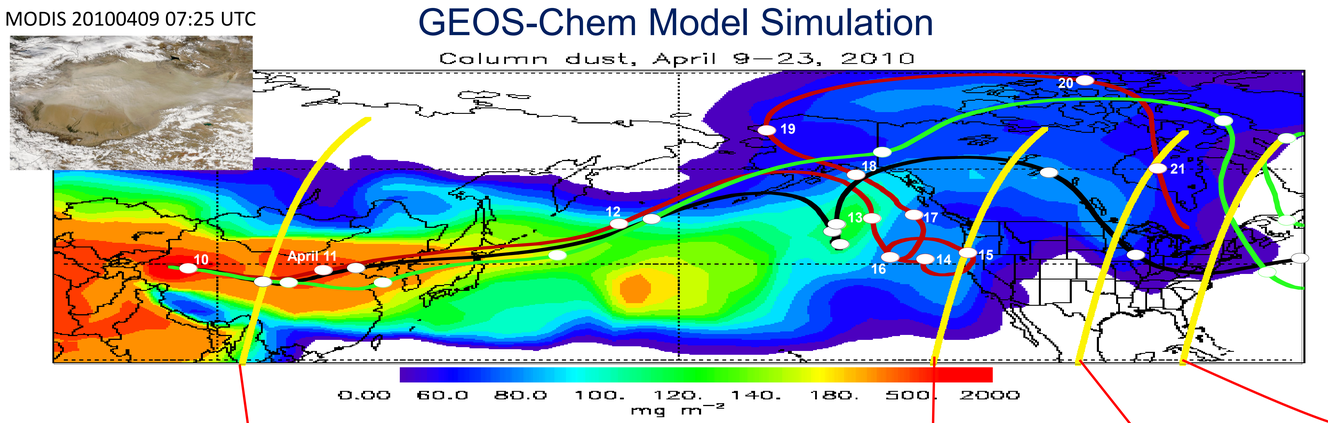


NCEP Reanalysis



The NCEP reanalysis data indicates that the occurrence frequency of surface wind exceeding 7 m/s is about 40% larger than the average value of 2005-2010. This may be one reason for the observed intensive dust over North America this spring. The DeepBlue AOD indicates a noticeable increase this year than the average value for the past 6 years. (Uno, et al., in preparation)

GEOS-Chem Model Simulation

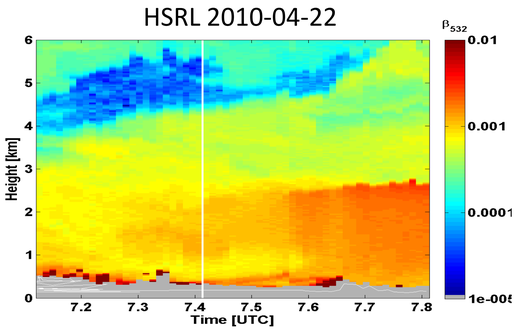


Column dust mass (mg m^{-2}) for 9–23 April simulated by the GEOS-Chem chemical transport model (Fairlie, T. D., D. J. Jacob, and R. J. Park ,2007, *Atmospheric Environment*, Vol. 41, No. 6, 1251-1266).

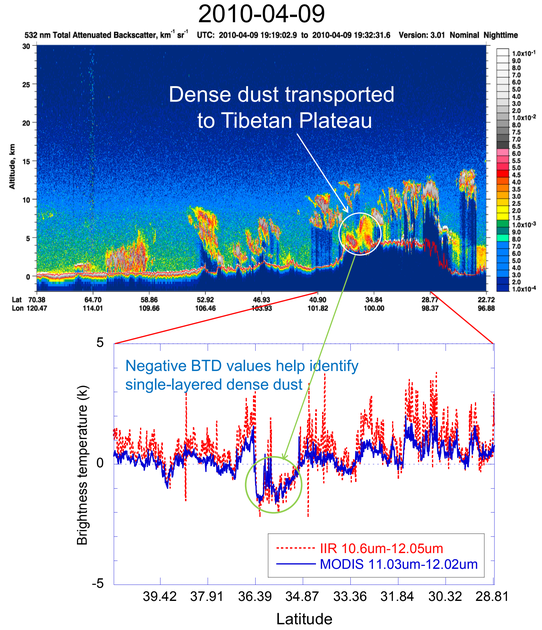
HYSPLIT forward trajectories were originated at 07:00 on April 9 at a location (40N, 82.5E) in the Taklimakan Desert for three altitudes of 2.5 km (red line), 4 km (black line) and 5.5 km (green line). Circles indicate the location corresponding to 00:00 UTC of each day and numbers denote the day in April for the trajectory originated at the altitude of 2.5 km.

The MODIS image (left-upper corner) indicates a dust storm generating on April 9 in the Taklimakan desert. The dust particles were lifted up to the upper troposphere by the strong wind along the high and steep slopes of surrounding mountains and then transported across the Pacific Ocean along the westerlies. The dust was trapped over eastern Pacific and North America (see trajectories). A meteorological analysis (Uno, et al, in preparation) reveals that the anomaly of high pressures over the North America in spring 2010 is positively large, which tends to block the air flow and yield persistent, complex structured dust clouds. The GEOS-Chem simulation reproduced the complex structure of dust clouds.

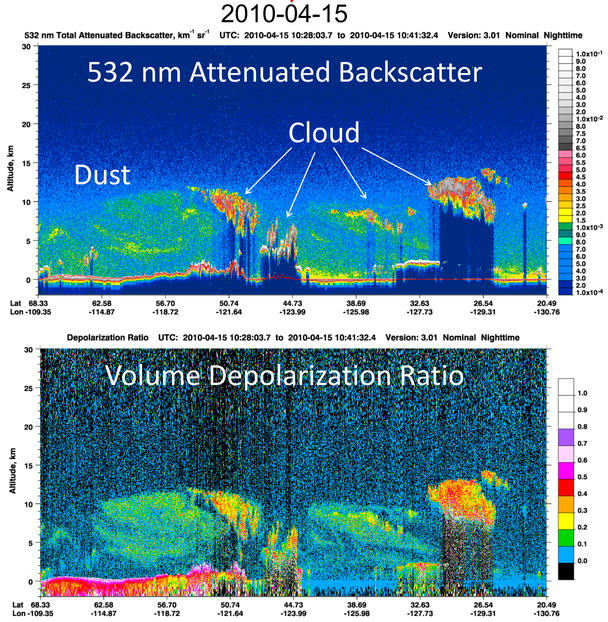
HSRL 2010-04-22



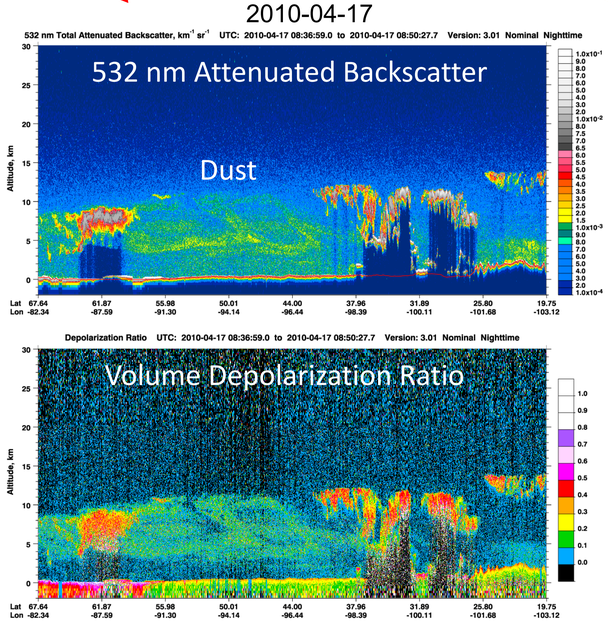
2010-04-09



2010-04-15



2010-04-17



CALIOP onboard the CALIPSO satellite is a depolarization-sensitive two-wavelength lidar. With the capability to measure the depolarization ratio and global coverage, CALIOP is suitable to measure the dust generation and long-range transport. Dust particles generally produce depolarized backscatter singles (depolarization ratio ~0.3 for pure dust and smaller in the presence of molecular scattering). Yellow-green colored layers are dust for in the browse images of 20100415 and 20100417, while cloud layers are red-grey colored. In the 20100409 image very dense dust is seen on the Tibetan Plateau and the dust layers have a similar backscatter (red-grey color) to clouds