**NASA Earth Observations Monitor Aerosols over Eastern China**

**Video Transcript**

**Slide 1**

Greetings from the NASA DEVELOP Program! During the summer of 2011, a group of DEVELOP students at Langley Research Center, including MyNgoc Nguyen, Peter Johnson, Catherine Morel, Samantha Gough, and Chelsea Brown conducted research on the topic of monitoring aerosol changes over eastern China using NASA Earth Observations. The following presentation provides an overview of their work.

**Slide 2**

Eastern China is home to roughly a billion people. Agriculture, industry, and energy are major contributors of air pollution for the country. Due to severe health implications for the people of China and nearby countries, the DEVELOP team conducted an assessment of air quality methods that can be utilized by an end user. The team focused their efforts on conducting a case study of the 2008 Beijing Olympics.

When constructing their research methodology, the students also wanted to approach this topic from the perspective of the end-user: how hard to use are the available air quality datasets and models?

Before we proceed further, I would like to extend a special recognition and thanks to Dr. Richard Ferrare at Langley Research Center, who served as a mentor for the students conducting this project.

**Slide 3**

The study area covered the whole of eastern China, but the students placed special emphasis on Beijing, Shanghai, Linfen, and Changsha due to their high levels of air pollution. Their goal was to provide a methodology to end users for future air quality monitoring, which would provide the benefit of measuring aerosols and enhancing the effectiveness of large-scale air quality monitoring.

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To understand aerosol activity and composition, the students utilized MODIS aerosol optical depth (AOD) products for land and ocean, and CALIOP aerosol profile features. In addition, the team used NOAA HYSPLIT model Trajectories to track air pollution plumes from each city. The students acquired datasets for the project through NASA's Warehouse Inventory Search Tool (WIST), which provides a web-based gateway to Earth Science and remote sensing datasets stored at several distributed active archive centers (DAACS) and also from Giovanni, a web-based application for visualizing and analyzing remote sensing data. The team also collected information from the U.S. Embassy in Beijing. No additional processing was required for the pre-processed MODIS and CALIOP datasets, and Google Earth was used to visualize the MODIS data in a meaningful and easily-understood manner.

**Slide 5**

On this slide, you can see examples of MODIS AOD data plotted in Google Earth and split by season from December 2004 through November 2005. The yellow and orange shades depict higher AOD values; whereas the blue and purple hues depict lower values. Cooler months generally have lower AOD than warmer months, which you can see illustrated on the graphics above where the winter and fall months show generally lower AOD values in the blue and green shades.

**Slide 6**

On this slide, you can see four different plots of MODIS AOD values for the city of Beijing. In the top left graphic, two years of monthly MODIS AOD values have been plotted to demonstrate the seasonal variation of AOD values. You can see the rise in AOD values during the warmer months and fall of AOD values in the cooler months. In the top right graphic, monthly AOD data has been plotted for all months from the year 2000 through April 2010. In the lower left graphic, the 2006 to 2008 time period has been separated from the others, showing a trend line. This is the time frame encompassing the 2008 Beijing Olympics. In the lower right, all data *except* for 2006 – 2008 is depicted. The slope of the trends indicates no statistically significant improvement on air quality leading up to the 2008 Olympic events.

**Slide 7**

This graphic depicts MODIS AOD summer time data from 2000-2009. The red circle indicates year 2008. The month of August is when the summer Olympic Games took place, and the August AOD value is lowermost point circled in red. Of the three data points shown here in the red circle, August is lowest, but you can see from the rest of the graph that this August 2008 value is *not* the lowest overall from 2000 to 2009. This result suggests that one cannot determine with certainty that there were any significant improvements in air quality leading up to the Olympic Games.

**Slide 8**

To gain insight into the composition of the aerosols over eastern China, the students conducted a thorough analysis of several CALIOP aerosol profiles. In summary, they traced one swath for each designated coordinate and analyzed the type and magnitude of aerosols monthly from 2006 to 2010.

When interpreting this data, some uncertainties that must be considered are that dust is non-spherical and may be picked up more by the LiDAR and also that the swath is not exactly over the coordinates. However, the aerosol subtype feature does help give an idea of what types of aerosols are present in Beijing, Linfen, Shanghai, and Changsha.

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After analyzing the CALIOP aerosol profiles, the team used Microsoft Excel to organize the data according to month, year, and season. The graphs above show the measured percentage of each aerosol present in each city for the spring and summer seasons. The spring and summer seasons are shown here because these two seasons show elevated levels of air pollution.

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Overall, there is dust, polluted dust, and smoke present all year in all cities. The CALIPSO data generally suggests improved air quality in all four cities, particularly Beijing. However, there is not enough evidence to indicate a positive correlation between Beijing Olympic efforts and improved air quality. (Please note here, however, that there are only a few CALIOP images per month and that it is difficult to use CALIOP for distinguishing smoke and dust.)

**Slide 11**

This slide shows HYSPLIT trajectory maps for Beijing, Shanghai, Linfen, and Changsha. To the left of each map, the prevailing wind direction predicted for the HYSPLIT model run for each season is noted.

In the cities of Beijing and Linfen (shown on the left side of the screen), HYSPLIT results were consistent with general local wind patterns as was expected.

However, some of the HYSPLIT results also contradicted local the wind pattern data, especially for the cities of Shanghai and Changsha (shown on the right side of the screen). For example, available wind pattern data suggest that Shanghai's overall pattern is dominantly ESE, but HYSPLIT outputs show a NE prevailing wind. Similarly, in Changsha, wind pattern data imply an overall prevailing wind from a northwesterly direction, but HYSPLIT outputs show a southwesterly result.

Several times, the students found that the seasonal correlations for the wind pattern data was the exact opposite of what the data for the HYSPLIT correlations said.

| Example: Changsha wind pattern: | HYSPLIT |
|---|---|
| - winter = NW | - winter = SW |
| - spring =NW | - spring = SW |
| - summer = S | - summer = NE |
| - fall = NW | - fall = SW |

Although HYSPLIT model outputs were fairly consistent with local wind pattern data in the east and west directions, they were generally reversed in the north and south directions.

Some possible explanations of this include:

*weather inconsistencies such as storms

*cold fronts

*height at which the wind pattern data was taken

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Overall, the students concluded that MODIS AOD and CALIPSO data products, used in conjunction with HYSPLIT trajectories, provide a satisfactory macro-scale assessment of aerosols. However, from the perspective of an end-user decision maker, many of the models and datasets are difficult to use.

Additionally, statistics based on the students' 2008 Olympics case study do not identify any decrease in air pollution beyond natural variability during the 2006 to 2008 time period.

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That concludes this presentation. Thank you for listening!