Monitoring the Effects of Power Plant Emissions on Air Quality Using NASA EOS

Fall 2012

Virginia Air Quality Team

Earthzine Video Script

NASA DEVELOP Wise Program
PO Box 1254
Wise, VA 24293

Scene 1: Video Introduction

Background music: "Constance" by Kevin MacLeod

Fade in and zoom from center: Title of video in Stencil font and white text.

Text:

> **"**Monitoring the Effects of Power Plant Emissions on Air Quality Using NASA EOS."

Fade out.

Fade in and zoom from center: Text of DEVELOP project in Stencil font and white text.

Text:

> "A NASA DEVELOP Project"

Music and text fades out.

End Scene 1

Scene 2: Site and Project Intro

Fade in background music: "Enter the Maze" by Kevin MacLeod

Fade in: Video of Virginia City Hybrid Energy Center.

Voice over (Kaitlyn):

> "Two distinct power plants lie in the Coalfields of Southwest Virginia. The Virginia City Hybrid Energy Center, or VCHEC, is located near Virginia City of Wise County, Virginia. This plant utilizes clean coal burning technology and began commercial operations in July 2012.

Video of VCHEC fades out.

Fade to video of Clinch River Plant.

Voice over (Kaitlyn):

> "In nearby Russell County, Virginia, the Clinch River Plant is a traditional coal-fired plant that has been active since 1957. With two different coal-burning power plants present within 11 miles of one another, this project aims to utilize NASA Earth observations to monitor and compare the environmental impacts of different coal burning technologies and to better understand the effects on air quality in the region."

Video of Clinch River Plant fades out.

Fade in: Team picture with names and school attending below. Text is in Stencil font and white text. Fade in from center.

Voice over (Kaitlyn):

> "The goal of this project is to provide an improved understanding of the lessened impact of clean coal burning technology and how this technology has been improved since the 1950s."

Text:

> "Paul Warner, Idalina Walker, Kaitlyn Hall, Kajli Agrawal"

"UVA-Wise, UVA-Wise, MECC, UND"

Image and background music fades out.

End Scene 2

Scene 3: Study Area

Fade in background music: "Invariance" by Kevin MacLeod
Appear: Google Earth image of study area. (State view)
Appear: Google Earth image of study area zoomed. (County view)
Voice over (Paul):

"The two study areas are only eleven miles apart from one another. This creates a stronger urge to determine how the surrounding area is being affected by the emissions."

Appear: Images of the power plants

This includes the following (in order of appearance):
Clinch River Plant: Station
VCHEC: Station, fluidized beds, fluidized beds extended, air quality center, emissions, fly over (showing entire station), and coal station.

Voice over (Paul):

"The Clinch River Plant, owned by American Electric Power, uses traditional coal-burning technology. The Virginia City Hybrid Energy Center, owned by Dominion Power, utilizes clean-coal burning technology. This is a newly innovated technology with the application of circulating fluidized beds. It uses air-cooled condensers to eliminate evaporation and uses less than one million gallons of water per day. Limestone is burned along with the fuel, absorbing about 95% of the sulfur, thus reducing SO2 formation. This plant is able to use a wide array of fuels like coal, waste coal, and biomass."

End Scene 3

Scene 4: Methodology

Continued background music: "Invariance" by Kevin MacLeod
Appear: Methodology slide (PPT)
Voice over (Kajli):

"The study period for this project is May 2012 to October 2012. For data acquisition, we obtained different parameters from numerous satellites. The Aura (OMI) data was used to obtain tropospheric NO2 measurements. Terra (MODIS) and Aura (OMI) are used for aerosol optical depth measurements. Due to the close proximity of areas of interest, to obtain satellite data which can associate both of the power plants was a challenge."

Appear: Plot of MODIS Daily Aerosol Optical Depth (PPT)

Appear: Image of MODIS Daily Aerosol Optical Depth (PPT)
Voice over (Kajli):

"We began data processing with generating time series plots for years 2011 and 2012 using the Giovanni Database. Aerosol optical depth was obtained from Terra (MODIS) and NO2 tropospheric total column values from Aura (OMI). We determined some noticeable points with the help of these initial plots."

Appear: Plot of Aura/OMI NO2 (PPT)
Appear: Image of Aura/OMI NO2 (PPT)
Voice over (Kajli):

"Above parameter values showed the same variation pattern before the activation of VCHEC in 2011 and after its activation in year 2012. However, there is a definite difference between the peak values for different time frames."

Appear: In-situ slide (PPT)
Appear: In-Situ DEQ Clinch River Plant Data slide (PPT)
Voice over (Kajli):

"To obtain in-situ emission data, we contacted the environmental managers from both facilities and the Virginia Department of Environmental Quality. DEQ archives all emission data provided by both facilities and validates these values with their own results. This data is provided in yearly formats of numerous pollutants. Because of yearly processing, DEQ does not have 2012 data publically available until spring of 2013. However, we received data for the Clinch River Plant for years 2010 and 2011. We also noticed a drop in emissions between these years. For any further analysis, we must wait until 2012 data becomes publically available which is spring 2013."

End Scene 4

<u>Scene 5: HYSPLIT</u>
Continued background music: "Invariance" by Kevin MacLeod
Appear: HYSPLIT slide (PPT)
Voice over (Kaitlyn):

"The HYSPLIT model was used to plot forward trajectory simulations and dispersion modeling for both power plants to determine how the emissions were traveling as well as their concentration throughout a given time period. These simulations were run for each day during the study period for a 24 hour time frame. For the HYSPLIT trajectory models, we determined that there was a limitation in monitoring emissions. Along with the mountainous terrain, we determined that wind speed and wind direction play a big role in where the particles travel."

Appear: Video of HYSPLIT discussion between Kaitlyn and Kajli (team members)
Voice over (Kaitlyn):

"We also noted that both stations follow a similar path, meaning that it was difficult to dissociate between plants. In order to validate our HYSPLIT results, we have contacted VCHEC and the National Weather Service office in Morristown, TN for meteorological data. This data will be processed and compared with HYSPLIT trajectory models and deposition models during Phase Two."

Background music fades out.

End Scene 5

<u>Scene 6: Conclusion</u>

Continued background music: "Wet Riffs" by Kevin MacLeod
Fade in: Video of Virginia City Hybrid Energy Center at dusk.
Voice over (Idalina):

"Although our research is still in progress and will be extended to another DEVELOP term, the team hypothesizes that clean-coal burning technology implemented at the Virginia City Hybrid Energy Center is producing less harmful emissions as compared to the traditional coal-fired technology found at the Clinch River Plant.

Appear: Approach to end-user slide (PPT)
Voice over (Idalina):

"Upon completion of this project, our clients will receive all deliverables from this project including a booklet of tutorials of all software utilized in this project, a technical report, and all maps created. This information will help our project partners in the continuation of air quality studies."

End Scene 6

<u>Scene 7: Future Study</u>

Continued background music: "Wet Riffs" by Kevin MacLeod
Appear: Future work slide (PPT)
Voice over (Idalina):

By 2014, the Clinch River Plant will close down one of the three units located at the facility. The remaining unit will be converted natural gas and will begin operations again in 2014. Future DEVELOP teams will continue similar comparative studies between the Clinch River Plant and the Virginia Hybrid Energy Center, relating clean-coal to natural gas technology.

End Scene 7

Scene 8: Acknowledgements

Continued background music: "Wet Riffs" by Kevin MacLeod
Background image of joined DEVELOP and NASA logos.
Text will appear in a credit-like animation and will scroll from bottom to top. Text is blue Arial font.

Voice over (Paul):

"**We would like to acknowledge the following:**"

Text in credit-like animation:

Science Advisors:
Dr. Richard Ferrare, NASA LaRC
Dr. Kenton Ross, NASA LaRC
Dr. Ana Prados, Joint Center for Earth Systems Technology, University of Maryland Baltimore County
Edward A. Celarier, NASA Goddard Space Flight Center

Partner:
Dominion Power
Virginia DEQ, Air Quality Division

Collaborators:
NOAA Air Resources Laboratory (ARL)
Wise County GIS Department

Mentors:
Honorable J. Jack Kennedy Jr.
Giovanni Colberg
Yanina Colberg

The research team would also like to acknowledge Bob Spera, for the flight over VCHEC, and the Wise County Court House Staff.

End Scene 8

Scene 9: DEVELOP Closing

Continued background music: "Wet Riffs" by Kevin MacLeod
Background image of joined DEVELOP and NASA logos. (Same as Scene 9)
Text fades in after Scene 9 text.

Voice over (Kaitlyn):

"If you would like more information on our project or would like to know more about the DEVELOP program, visit our website at develop.larc.nasa.gov. Thank you for watching!"

Text and music fades

End Video