Using NASA EOS to Assess Burn Severity and Perform Fire Risk Mapping of the 2011 North Carolina Wildfire Season

NASA DEVELOP – Langley Research Center

by

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Introduction:

NASA Earth Science Logo with black background.
Fade into the DEVELOP logo with royalty-free background music "Radio Stager 05" playing.
Fade into title screen that reads "North Carolina Disasters & Ecological Forecasting –Using NASA EOS to Assess Burn Severity and Perform Fire Risk Mapping of the 2011 North Carolina Wildfire Season" with a forest fire burning in the background with sound of fire.
Fade into team standing in front of NASA Langley HQ building.

Rachael:

We are the North Carolina Disasters and Ecological Forecasting team. *(Caption of everyone's name in front of them at the bottom of the screen)*

The rest of the video has a royalty-free background song, "Pendulum" playing.
Fade to royalty-free footage of forest fires gathered from the web with Ryan G.'s voice over.

Ryan G:

During 2011, over 100,000 acres of forest succumbed to fire in North Carolina. Two of these fires burned more than three-quarters of that total. Started by natural causes, these fires were sustained by extreme drought conditions and high temperatures. After the smoke had cleared, the state of North Carolina had spent over $17.6 million trying to put these two fires out.

Fade to Google Earth zoom-in to study area with Ryan J.'s voice over of background information.

Background:

Ryan J:

This project focuses on two major fires in the Coastal Plains Region of North Carolina during 2011, both started by lightning; the Juniper Road fire in Pender County *(Cut to map of Pender County)* and the Pains Bay fire in Dare County. *(Cut to map of Dare County)* The Juniper Road fire started in June and burned over 31,000 acres, *(cut to Juniper Road burn scar map)* most of which belonged to the Holly Shelter Game Land. The Pains Bay fire was the largest of the season, burning more than 45,000 acres *(cut to Pains Bay burn scar map)*, including a military bombing range and Alligator River National Wildlife Refuge.

Cut to Ryan J. at Great Dismal Swamp National Wildlife Refuge with a caption reading "Ryan Johansen."

In the months leading up to the fires, North Carolina experienced severe drought condition, which increased the fuel load on the

forest floor. The fires were unique because they burned on grounds composed of peat, *(Ryan picks up a piece of example peat)* which is an organic soil found mostly in swampy areas that has a long decomposition time. Peat becomes very flammable when it is dry *(cut to footage of a firefighter on grasslands)* and it burns similar to coal, which smolders and can even burn underground making it hard to spot and extinguish.

Fade.

Project Partners:

Fade into logos (obtained with permission) with Ande's voice over.

Ande:

Our project partnered with two organizations, the North Carolina Forest Service *(cut to NCFS logo)* who is charged with protecting state and private land from wildfires, and the Alligator River National Wildlife Refuge *(cut to ARNWR logo)*, where much of the Pains Bay fire occurred.

Cut to Ande at Great Dismal Swamp National Wildlife Refuge in front of fire truck with a caption reading "Ande Ehlen."

NASA's Earth Observing Systems have many applications toward assessing wildfires, and our project hopes to bring remote sensing methodology to our partners in order to enhance the assessment and predictions of future wildfires.

Fade.

Project Objectives:

Fade into Amanda voicing over an animation of a NASA satellite fly-by.

Amanda:

Using NASA EOS, our project sets out to evaluate drought conditions leading up to the fires *(cut to burnt swamp footage from the Dismal Swamp)* by assessing vegetation and soil moisture. We also analyzed burn severity created by the Pains Bay and Juniper Roads fires. *(Cut to Amanda at the Dismal Swamp National Wildlife Refuge with caption reading "Amanda Taylor")* We will be creating fire risk maps, and providing a tutorial for our partners to recreate these products in other areas and future fires.

Methodology/Results:

Rachael in the NASA DEVELOP Langley office at her computer with ArcGIS on the screen with caption reading "Rachael Maingot."

Rachael:

In order to evaluate drought severity, we acquired satellite imagery from Landsat 5 satellite *(cut to animations of the satellites),* and from the MODIS sensor on both the AQUA and TERRA satellites. *(Transition to footage of Amanda using ArcGIS, followed by footage of multiple team members at work at their desks at the Langley DEVELOP office).* We acquired this data from free public online databases. We used three well-known remote sensing indices. Using Landsat 5, we used NDVI and NDMI *(cut to time lapse of an NDVI being created in ArcGIS with caption reading "Normalized Difference Vegetation Index (NDVI) & Normalized Difference Moisture Index (NDMI)")* to look at vegetation greenness and vegetation moisture in order to evaluate which areas were experiencing high vegetation stress. *(cut back to Rachael in front of her computer with caption reading "Normalized Multi-band Drought Index (NMDI)")* Using the MODIS data, we used NMDI in order to evaluate daily drought conditions for before and during the fires.

Cut to Andrea standing on the banks of a water body at Langley Air Force Base with caption reading "Andrea Beale."

Andrea:

Through the NDVI and NDMI images created with Landsat 5 data, we observed a decrease in vegetation health in both study areas.

Cut to time lapses of NMDI of Pains Bay fire with Andrea's voice over and caption reading "NMDI Pains Bay Fire."

With the MODIS NMDI data, we again could observe the amount of vegetation stress before and during the fires. Additionally, we were able to see how dry the soil became during the fires, which is critical for peat fires.

Cut back to Andrea in front of water.

The indices used with the Landsat 5 images were helpful for analyzing drought conditions up to a year before the fire, as they are taken every 16 days. The index used with the MODIS data was effective in analyzing drought conditions immediately before, during, and after the fires, as they are taken daily.

Cut to Beth in front of a NASA Langley fire truck with caption reading "Beth Brumbaugh."

Beth:

Our next step was to measure burn severity by analyzing the extent of vegetation loss and patterns of initial regrowth.

Cut to dNBR and RdNBR images with Beth's voice over and captions reading "differenced Normalized Burn Ratio (dNBR)" and "Relative differenced Normalized Burn Ratio (RdNBR)" on either side of the screen.

We did this by creating dNBRs and RdNBRs with Landsat 5 imagery. These processes show a qualitative measure of environmental change and classifies burn severity from enhanced regrowth to severely burned.

Cut back to Beth now standing outside in front of a wooded area.

These burn severity maps assess the condition of the land during the middle and the end of each fire. Through dNBR and RdNBR, we are able to assess which areas were most severely burnt and which areas are experiencing immediate regrowth.

Cut to slides of Fire Risk map components with Rachael's voice over.

Rachael:

(Start with complete Fire Risk Map of both fires) We concluded our project with fire-risk assessment maps *(fade to slide of different parameters of fire risk)* by including factors such as proximity to roads, fuel load, soil type, slope, and a wildland-urban interface to highlight areas at high risk. (Show fire-risk maps for each county with blue outlines of fire areas with caption reading "Dare County Peninsula Fire Risk Map" on the first image and "Pender County Fire Risk Map" on the second image) These areas outlined in blue demonstrate where the two fires that we studied were located. These maps will allow our partners to see which areas may be more prone to wildfires in Dare and Pender County in the future. *(fade to example of roads to compare weighted and fuzzy memberships)* As part of our method, the Fuzzification Method of the Multi-Criteria Evaluation, includes a series of new tools in ArcGIS 10 that attempts to blur the crisp boundary lines to be more intuitive to how the phenomenon actually occurs in nature.

Cut to Anthony sitting at his desk in front of his computer with caption reading "Anthony Gaudino."

Anthony:

At the end of our term, we will provide our partners with a user-tutorial. This will provide them with NASA EOS methodology to help recreate these products and to analyze drought analysis, assess burn severity, and recreate fire-risk maps for other counties and future wildfires.

Fade to black with acknowledgements scrolling up in white font with Amanda's voice over.

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LANDFIRE

USGS

Google Earth

US Department of Argiculture

www.nasa.gov/multimedia

www.archive.org

Amanda:

We'd like to thank the following individuals for their assistance with this project.

Show NASA meatball animation with Ryan G.'s voice over.

Ryan G.

Thank you for watching our video. For more information about the NASA DEVELOP Program or other projects, please visit the DEVELOP website.