11.2 USE OF EARTH OBSERVING SATELLITES FOR OPERATIONAL HAZARD SUPPORT: CURRENT AND EMERGING APPLICATIONS

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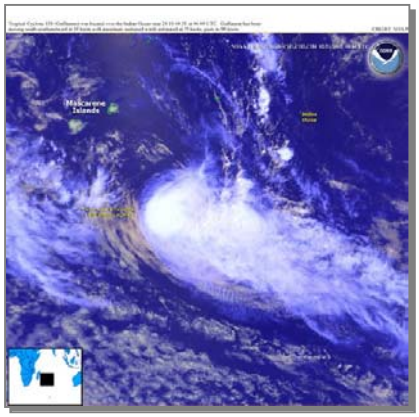
ABSTRACT
NOAA's mission to monitor, predict, and assess changes in the Earth's atmosphere, land, and oceans relies on Earth observing satellite data. NOAA satellites carry communications systems used to support search and rescue missions and to transmit environmental information from remote data collection platforms to a variety of users. Satellite data are used to help lessen the impacts of natural and technological disasters due to tropical cyclones, flash floods, heavy snowstorms, volcanic ash clouds (for aviation safety), sea ice (for shipping safety), oil spills and harmful algal blooms along U.S. coastlines. Even now, capabilities are being developed to make use of satellite data for other hazard areas such as earthquakes, solid earth dimensions of volcanic activity, and flood mapping, among others.

This paper provides an overview of NOAA's operational use of satellites for hazard support as well as examples of emerging applications of Earth observing satellites to other hazard areas.

I. INTRODUCTION

The National Environmental Satellite, Data, and Information Service (NESDIS) within NOAA provides and ensures timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life.



Severe weather and hazardous events (e.g. flash floods, fires, winter storms, volcanoes, and solar flares), and their increasing cost to the Nation, continue to demand further research to use existing and new satellite observations from NOAA satellites as well as those launched by NASA and our international partners. NESDIS satellite and information services feed weather forecasting models and improve services that protect life and property, maintain the Nation's economic infrastructure, and support management of energy, water, and other natural resources.

NESDIS provides local, national, and international emergency managers with tools and products to help reduce risk to lives and property. NESDIS' efforts in this area place critical environmental products and information in the hands of local, state, and Federal disaster management and response personnel, where and when they are needed. Earth observing satellites provide operational hazard support for disasters due to tropical cyclones, flash floods, other floods, heavy snowstorms, volcanic ash clouds, sea ice, harmful algal blooms, droughts, and fires.

II. TROPICAL CYCLONES

While NOAA's National Hurricane Center is responsible for predicting tropical cyclones affecting the U.S. mainland, NESDIS is continuously watching the tropics worldwide, relaying valuable satellite interpretations of tropical system strength and position to users throughout the world. Products include sequences of satellite imagery and text bulletins such as the example shown below.

TROPICAL CYCLONE BULLETIN

WWIO21 KWBC 212130
SATELLITE WEATHER BULLETIN
SOUTH INDIAN OCEAN MET-5 IRNIGHT
.
FEBRUARY 21 2002 2100Z
.
25.9S 61.8E T2.5/3.5/W2.5/24HRS GUILLAUME(15S)
.
PAST POSITIONS....24.2S 60.5E 21/0830Z VIS/IRDAY
22.9S 60.4E 20/2100Z IRNIGHT
.
REMARKSCLASSIFICATION USING SHEAR PATTERN YIELDS DT OF 2.0 WITH CENTER 1.6 DEGREES FROM CONVECTION. MET IS 4.0 AND PATTERN IS 2.0. FINAL-T BASED ON DT AND PATTERN WITHIN CONSTRAINTS.
.
POSITION ACCURATE WITHIN 60 NMI.
.
THE NEXT BULLETIN WILL BE ISSUED BY 22/0400Z.

III. FLASH FLOODS AND WINTER STORMS

To support the monitoring, prediction, and assessment of flash floods and winter storms, NOAA sends out messages alerting U.S. weather forecast offices whenever satellite imagery indicates the occurrence of

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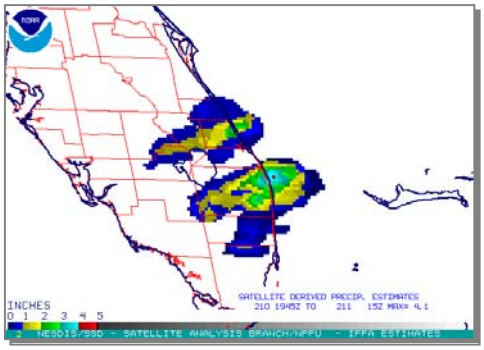
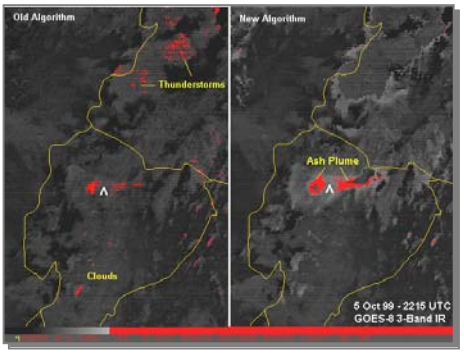
heavy rain or snow. In addition to satellite imagery and text products, derived precipitation images and graphic products are produced such as the image shown below.



IV. VOLCANIC ASH ADVISORIES

Recognizing the need to keep aviators informed of volcanic hazards, the International Civil Aviation Organization (ICAO) and other aviation concerns created nine Volcanic Ash Advisory Centers (VAAC's) to monitor volcanic ash plumes within their assigned airspace. NESDIS hosts one of the VAAC's and has primary responsibility for the continental U.S., Caribbean, and adjacent oceans.

Experimental products include images derived from multiple sensor channels. These products increase the ability to see thin ash clouds and to distinguish them from other clouds. A comparison with older methods is shown below.



V. SEA ICE AND ICEBERGS

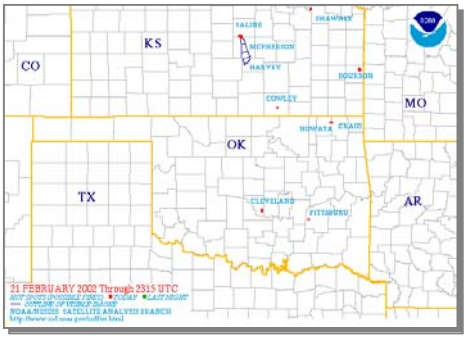
Satellites help NOAA ensure safe navigation of ships through sea ice by measuring the extent, thickness, and age of ice as well as sea surface winds over the polar regions, coastal areas, and inland waterways.

VI. ALGAL BLOOMS

Satellites also help NOAA monitor U.S. coastal areas for dangerous algal blooms or other toxic effects to fish and sea mammals. The NOAA CoastWatch Program and NOAA's National Ocean Service provide algal bloom bulletins derived from satellite ocean color sensors, satellite surface wind sensors, and other sources.

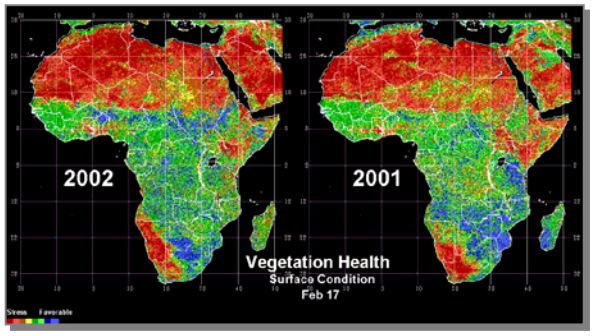
VII. FIRES

NESDIS produces experimental fire products such as the one below. Products are derived from NOAA polar and geostationary satellite data as well as Defense meteorological satellite data and NASA Moderate Resolution Imaging Spectroradiometer (MODIS) data. Products integrate hot spots and smoke derived from automated techniques and analyses by image analysts.



VIII. DROUGHTS

NOAA's polar satellite AVHRR sensor is used for global vegetation applications such as estimating vegetation stress due to drought. As an example, the image below shows the change in vegetation health over a period of one year.



IX. EMERGING APPLICATIONS

Enhanced support addresses needs in such diverse areas as aviation safety, coastal hazards, severe weather events, wildfire management, and solar storm prediction and warnings. Capabilities are also being developed to make use of satellite data for earthquakes and flood mapping, among others.

It is also worth noting that many of the products discussed here have multiple applications. For example, hot spot detection and monitoring using data from satellite thermal sensors apply to volcanoes as well as fires. Precipitation products apply to droughts as well as floods.

X. CONCLUSION

The use of Earth observing satellites for operational hazard support protects life and property through improved prediction, preparedness, response, recovery and mitigation of natural and technological hazards. Hazards such as tropical cyclones and heavy snowstorms or volcanic ash clouds and droughts can be monitored by Earth observing satellites, providing information to those who need to know — when they need to know.

XI. ACKNOWLEDGEMENTS

The text, image, and graphic products used in this paper come directly from NESDIS web-sites and web-sites of multi-agency organizations of which NESDIS is a member. This information is a selection of current and sample products provided by NESDIS Office of Satellite Data Processing and Distribution, NESDIS Office of Research and Applications, NOAA CoastWatch Program, NOAA Nation Ocean Service, and the National Ice Center.

XII. ADDITIONAL INFORMATION

The original images used in this paper are color and have been reduced from their original size. The following web-sites provide access to full sized color images and additional information on these products and other products.

http://www.noaa.gov
http://www.nesdis.noaa.gov
http://www.ssd.noaa.gov/
http://www.ssd.noaa.gov/PS/prodnsvcs.html
http://www.natice.noaa.gov/
http://coastwatch.noaa.gov/cw_collab.html
http://orbit-net.nesdis.noaa.gov/crad/sat/surf/vci/