Utilization of GOES Rapid-Scan Wind Data for Tropical Cyclone Predictability Experiments

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LONG-TERM GOALS

The overarching goal is to obtain special data sets of GOES rapid-scan (RS) atmospheric motion vectors (AMV) to assimilate and test for improvements in NAVY global numerical model (NOGAPS) forecasts of tropical cyclones (TC) using targeting information provided by NRL-MRY. There is the potential for forecast benefits with the GOES R/S-AMV since the higher image frequency yields more accurate observations in comparison to routinely-produced GOES AMV data. This is the motivation for this investigation.

OBJECTIVES

This proposed two-year effort will focus on the collection and processing of the RS datasets by CIMSS during two, 3-month focused periods of Atlantic TC activity in 2005 and 2006. These experimental and advanced datasets will be used 1) to demonstrate targeting concepts, 2) for satellite data assimilation trials, and 3) to test for predictability impacts on NOGAPS forecasts of TC tracks and intensity.

APPROACH

RS-AMV from GOES-12 VIS and IR imagery (7.5 minute image intervals) are being provided for this study using the CIMSS automated processing algorithm. The CIMSS PI contacts the NOAA/NESDIS Satellite Operations Center to alert them for requests of special RS schedules to be invoked during targeted TCs (based on NRL-MRY guidance on potential targets of opportunity from NOGAPS adjoint singular vector approaches. When the requests for the GOES-12 R/S are approved, RS-AMV datasets are derived by CIMSS every hour the R/S data are available. These datasets are being archived at CIMSS.

To-date, AMV assimilation has not generally benefited from good knowledge of observation errors. New quality control (QC) indices under development at CIMSS will be applied to the RS-AMV after the 3-month production period. This information will result in improved QC estimates of AMV accuracy and estimated correlated error, which in turn can be employed to improve super-ob or thinning procedures used to assimilate the AMV into NOGAPS.

A comprehensive evaluation of the RS-AMV data will be conducted using NOGAPS predictions of targeted TCs to determine observation impact on measures of forecast quality. Of special interest will be experiments where the R/S datasets are partitioned and only assimilated into the NRL targeted regions to assess the sensitivity of targeted observing approaches on NOGAPS TC track/intensity forecasts.

WORK COMPLETED

GOES-12 R/S AMV datasets have been successfully collected during several major Atlantic hurricanes in 2005 (including hurricanes Dennis, Emily, Katrina, Ophelia and Rita), and several storms in 2006 (processing will continue on targeted TCs through November). A web site with real time and collected/archived datasets produced for this study can be found at:

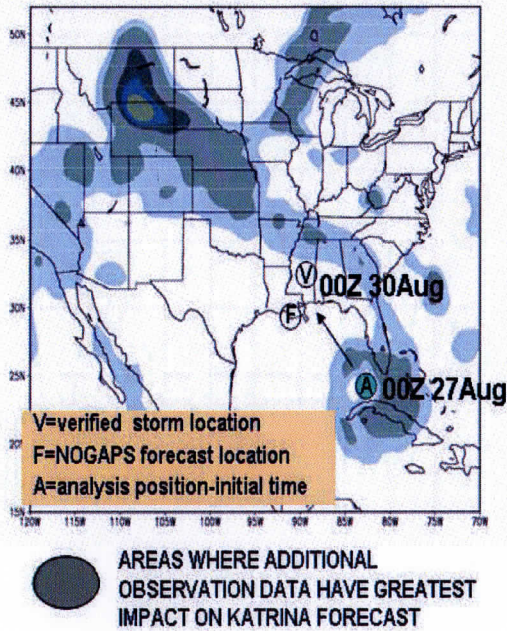http://cimss.ssec.wisc.edu/tropic/tropex/index.html

RESULTS

In a first test, the GOES-12 rapid-scan wind data was used in a numerical model impact study designed to test an observation targeting strategy during Hurricane Katrina. The winds were assimilated into the Navy NAVDAS (in collaboration with Rolf Langland at NRL-MRY), which provides the initial conditions for the NOGAPS forecast model (see Fig. 1). The resulting NOGAPS Katrina 72-hr track forecast position is improved by 25% (Fig. 2). Further data assimilation and modeling experiments are in progress. Not only is this innovative approach to deriving high quality wind information from GOES a benefit to the hurricane research community, but the exercise also demonstrates the GOES wind products can be better assimilated and employed for improving NWP.
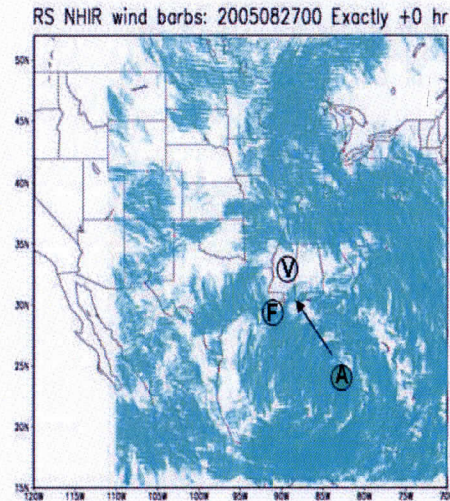
IMPACT/APPLICATIONS

The basic hypothesis in this study is that regions of TC analyses that are sensitive to initial conditions can be successfully targeted, and when enhanced data are applied to those regions, the numerical forecasts will improve. If this theory is further proven in this study, it could have a significant impact on future operational procedures to observe TCs, provide a better understanding of the processes affecting track and motion, and improve their predictability.

RAPID-SCAN WINDS FOR TARGETING

SENSITIVE REGIONS FOR TARGETED OBSERVATIONS IN 72h FORECAST OF KATRINA LANDFALL – Aug 2005, forecast position error approx. 210 nm.

THESE ADDITIONAL HIGHER-QUALITY **GOES-12 WIND OBSERVATIONS** IMPROVE THE **NAVDAS** ANALYSIS IN SENSITIVE REGIONS – AND THE **NOGAPS** FORECAST OF KATRINA LANDFALL

V=verified storm location
F=NOGAPS forecast location
A=analysis position-initial time

AREAS WHERE ADDITIONAL OBSERVATION DATA HAVE GREATEST IMPACT ON KATRINA FORECAST

WIND DATA PROVIDER WEB SITE:
cimss.ssec.wisc.edu/tropic/tropex/

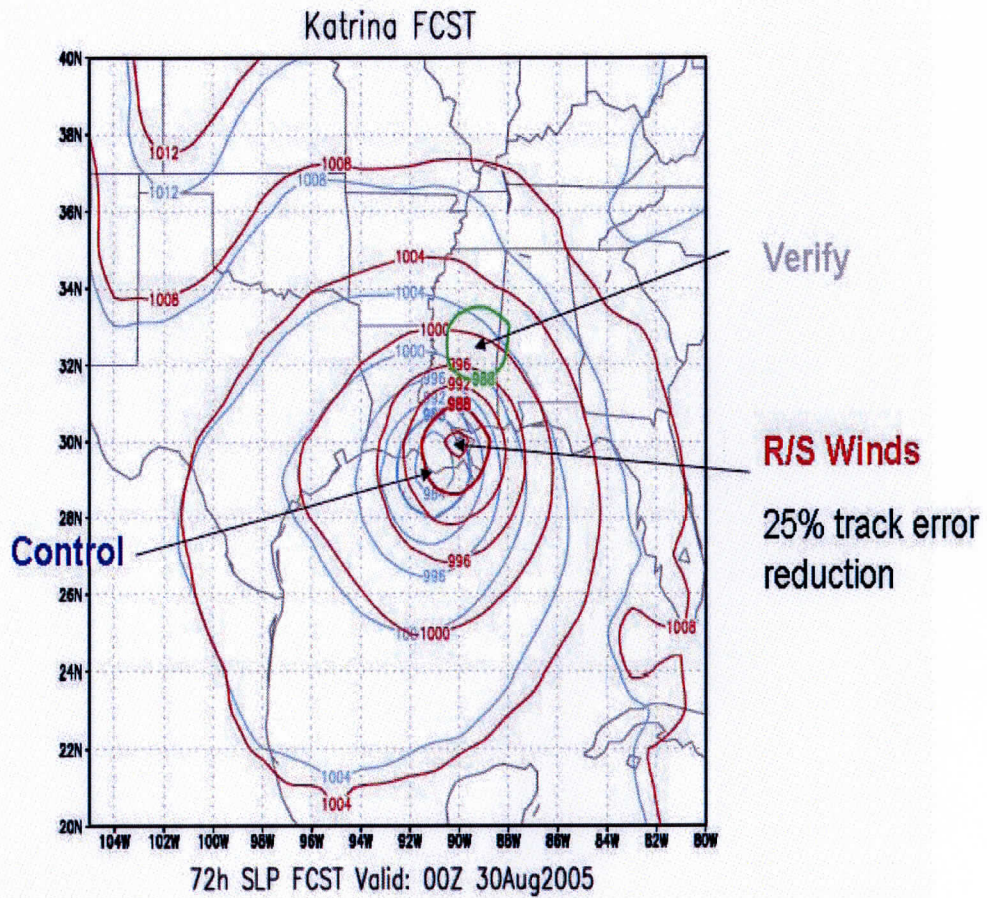*Fig. 1. GOES-12 rapid scan winds data assimilation experiment for Hurricane Katrina.*

Fig. 2. Results of a NAVDAS data assimilation experiment for Hurricane Katrina showing improved hurricane track using GOES 12 rapid-scan winds.

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| Authors	Annual Reports
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