The Cooperative Institute for Meteorological Satellite Studies (CIMSS)

Quarterly Report
for
GOES Improved Measurements and Product Assurance Plan (GIMPAP)

for the period
1 October 2007 to 31 December 2007

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1. Single Field-of-View (SFOV) Sounding Retrieval Science
Lead Scientist: Jun Li

1.1. GOES single field-of-view cloudy sounding research started

Forecasts in cloudy regions usually are worse than that in clear regions. However, moisture soundings in cloudy skies are very import to the forecast model. The goal is to derived soundings from GOES Sounder radiances contaminated with thin or low clouds. A one-layer cloudy radiative transfer model accounting for atmospheric molecular absorption, cloud absorption and scattering is used in the cloudy sounding retrieval. The cloudy training data set over Continental United States (CONUS) is developed, the dataset contains temperature profile, moisture profile, surface skin temperature, surface infrared emissivities at GOES Sounder spectral bands, cloud-top pressure, cloud optical depth, and cloud particle size in radius. The cloudy training dataset is used to generate cloudy regression coefficients for ice cloudy and water cloudy situations. Figure 1 shows the GOES-12 Sounder lifted index (LI) from clear skies (left panel), clear plus cloudy skies (middle), along with the forecast (GFS) LI. The back/white area is the cloudy brightness temperature from GOES-12 Sounder 11 μm band, time is 21 UTC on 24 April 2007. The cloudy LI in thin or low cloudy situations expands the unstable region that links to the supercell development.

1.2. Manuscript on improved GOES soundings and applications accepted by Geophysical Research Letters for publication

The manuscript on GOES single field of view improved sounding algorithm and applications has been accepted by Geophysical Research Letters (GRL) for publication. The paper summarizes the improved GOES sounding algorithm recently implemented into the CIMSS merged retrieval system and its potential for operational implementation. The applications of improved GOES SFOV soundings on severe weather nowcasting are demonstrated in the manuscript.

1.3. Collaboration with EUMETSAT on legacy profile algorithm development

Invited by Dr. Marcelino Manso, Manager of EUMETSAT NoWCasting Satellite Application Facility (NWCSAF) at Instituto Nacional de Meteorología (INM) in Madrid, Spain, Jun Li visited the NWCSAF from November 19 - 30, 2007. Dr. Li collaborated with INM scientists on implementing the legacy profile algorithm for SEVIRI (Spinning Enhanced Visible and InfraRed Imager) operational nowcasting products at NWCSAF, and on the use of SEVIRI for algorithm development and improvement. He also attended the "Workshop on Physical Retrieval of Clear Air Parameters" held November 28-29, 2007 and gave a talk entitled "Development of physical retrieval algorithm for clear sky legacy profiles from SEVIRI and ABI infrared radiances". About 30 researchers and scientists attended the workshop. Jun Li's travel was supported by EUMETSAT.
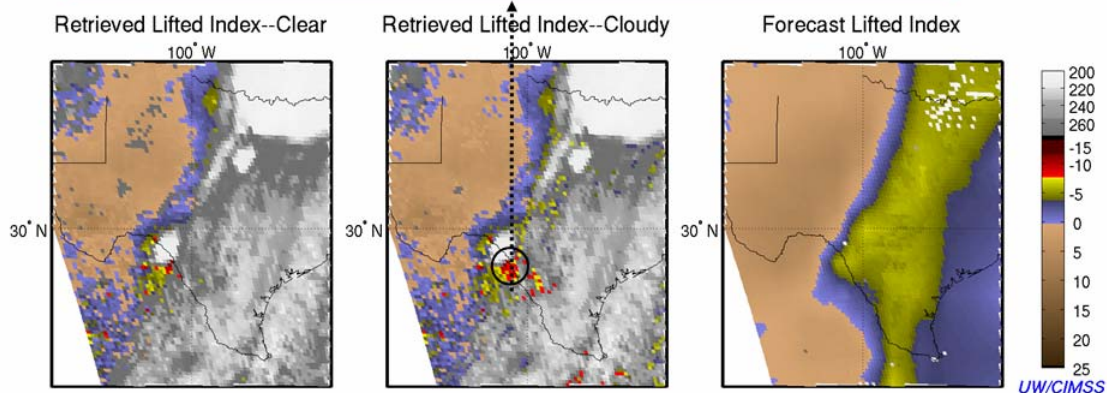
Figure 1. The GOES-12 Sounder lifted index (LI) from clear skies (left panel), clear plus cloudy skies (middle), along with the forecast (GFS) LI. The back/white area is the cloudy brightness temperature from GOES-12 11 μm band, time is 21 UTC on 24 April 2007.

Related presentations and publications during 01 October – 31 December 2007
(1) Jun Li attended the "Workshop on Physical Retrieval of Clear Air Parameters" held November 28-29, 2007 in Madrid, Spain and gave a talk entitled "Development of physical retrieval algorithm for clear sky legacy profiles from SEVIRI and ABI infrared radiances".
(2) Li, Zhenglong, W. P. Menzel, T. J. Schmit, J. P. Nelson, J. Daniels, and S. A. Ackerman, 2007: GOES sounding improvement and applications to severe storm nowcasting, *Geophysical Research Letters* (in press).

2. **Global Observing System Studies - Intercalibration**
   Lead Scientists: Mat Gunshor, Tim Schmit

2.1 *Global Observing System Studies - Intercalibration*

Background
The primary purpose of the intercalibration project is to compare select infrared channels on geostationary instruments (GOES, Meteosat, etc) with those obtained from polar-orbiting instruments (NOAA AVHRR and HIRS, EOS AIRS). This proposal covers

research into new/improved methods, testing new satellite instruments, diagnosing problems on existing instruments, and the analysis and presentation of results.

Summary

Work continues to bring in IASI data for comparisons to the world's geostationary imagers. There is a larger effort at CIMSS to provide IASI data to a number of scientists and that work may be leveraged in the future. While that project is developing, there is a more rudimentary method of obtaining data and several dozen cases of IASI matched with GOES-12, GOES-11, GOES-10, METEOSAT-9, MTSAT, and FY-2C (at the GEO sub-points) have been collected thus far. The collection of data will continue, as the infrastructure for beginning more frequent IASI/GEO comparisons is built, and analysis will begin in the next year. Work also continues to expand a SPIE conference paper into a refereed journal article. Comparisons with the imagers on GOES-10, GOES-11, MET-9, MTSAT-1R, and FY-2C have been processed and the results are being analyzed. During this analysis it was discovered that one particular comparison between MET-8 and AIRS yielded a temperature difference around 8K in the IR window, though the average over the course of the study period was much closer to zero. This unlikely result was investigated and it was discovered that MET-8 was actually just coming out of a maintenance period and furthermore that EUMETSAT did not provide any products for the data at that time. Still, data were distributed for that time period and were not representative of the system's true capabilities.

The topic of the GOES-13 Imager 13.3 micrometer band was revived. In the first quarter of this year, CIMSS reported that during the GOES-13 post-launch checkout a significant mean bias on the order of -2K was discovered in comparisons to AIRS. This was reported in a memo along with a proposed method of correcting for it. In subsequent communications with NOAA and ITT, including a teleconference, it became apparent that the proposed method of correcting this problem had some merit. This method would be to shift the GOES-13 spectral response function (SRF) until the mean comparison to AIRS is as close to a null temperature difference as possible. At this point, however, it has been left to NOAA to verify that the results found by CIMSS are reasonably accurate. An unfortunate by-product of intercalibration is that the number of cases can affect the results and the GOES-13 science test was not long enough to collect a large number of comparisons. It is still possible that the GOES-13 spectral response functions could be corrected before the satellite becomes operational once some confidence is achieved in these results.

2.2   Intercalibration of GOES and POES

Background

Calibration and instrument intercomparison are the main methods by which individual instruments can be validated against one another between the geostationary and polar orbiting platforms. Routine automated intercalibration provides information on how operational geostationary environmental satellites around the globe compare radiometrically. CIMSS has been intercalibrating satellite instruments routinely since 1999 and the methodology is documented in the research journal literature (Gunshor et al.

2004). Research into new/improved methods, testing new satellite instruments, diagnosing problems on existing instruments, and the analysis and presentation of results are covered under the broader Global Observing System Studies section. This GIMPAP funding covers the routine production of results, the routine posting of results on the World Wide Web, software maintenance, and the implementation of knowledge gained from the research done under the broader Global Observing System Studies section.

The primary purpose of the Intercalibration of GOES and POES project is to compare the infrared window, water vapor, and 13.3 micrometer CO_2-absorption band channels on geostationary instruments (e.g. GOES, Meteosat) by using the same spectral bands on polar-orbiting instruments (e.g. NOAA AVHRR and HIRS). This task is accomplished by making multiple comparisons at the geostationary sub-satellite points and finding an average brightness temperature difference between the geostationary and the polar orbiter spectral bands.

Comparison of satellite radiances leading to an improved knowledge of calibration is important for various global applications of satellite data where data from more than one instrument are combined for a single purpose. The CGMS (Coordination Group for Meteorological Satellites) has requested satellite operators to regularly perform satellite intercalibration. The World Meteorological Organization (WMO) has initiated a global intercalibration project called the Global Space-based Intercalibration System (GSICS) with NOAA/NESDIS as a lead agency. This intercalibration work directly supports this international collaboration among satellite providers.

Summary
Regular oversight of the automated features of this task was the primary function this quarter. The data collection and processing results were monitored as well as the output generated for the Internet. Everything is working smoothly after last quarter's transition to the 2007 version of McIDAS.

3. **GOES Winds**
   Lead Scientist: Chris Velden

Accomplishments over the past 3-months include (but are not limited to):

1)   The data assimilation community continues to struggle with effective integration of satellite-derived winds into current variational analysis schemes. As a result, observing system experiments show the winds offer only a modest positive impact on NWP forecasts. We continue to test a new regression-based quality indicator referred to as the "Expected Error" (EE). This index is designed to attach to every vector record and indicate the confidence in the form of an expected vector RMSE. Our analyses suggest the EE is a better indicator of quality than the existing operational quality indicators.

We continue to examine the skill of the EE in removing poor AMVs and comparing its skill to the auto-editor. As included in the last report, lowering the maximum expected

error reduces the RMS vector difference. It also, however, reduces the average AMV speed of the dataset. As speed is one of the expected error predictors, high-speed AMVs tend to have higher AMVs than average. Therefore, it will be necessary to have a threshold that varies as a function of speed in order to prevent the unnecessary removal of high-speed AMVs. We are currently addressing this.

2)   We have taken a fresh look at the height assignments of atmospheric motion vectors, or AMVs (including GOES). Instead of treating the AMVs as representing discrete levels, our analysis has focused on tropospheric layers. Using collocated rawinsonde and wind profilers, large samples GOES AMV datasets are matched to the vertical wind profiles and a "layer of best fit" (minimization of RMSE) is identified. Our results show clearly that the AMVs matched to rawinsonde layers yield significantly lower differences then the levels to which they were originally assigned. This work was recently presented at the AMS Satellite Conference, and a journal publication has been submitted.

4.   GOES Tropical Cyclone Applications
**   Lead Scientists: Chris Velden (4.1), Jim Kossin (4.2)**

4.1   Derived Products, ADT and Integrated Intensity Algorithms
*   Lead Scientist: Chris Velden*

Accomplishments over the past 3 months include (but are not limited to):

1)   The CIMSS Tropical Cyclones (TC) group continues to develop diagnostic fields derived from GOES winds analyses for applications to TCs. These products include analyses of vertical wind shear, vorticity, upper-level divergence, vertical wind shear tendency, steering currents, and surface adjusted cloud-drift winds. All of these products are featured on the CIMSS Tropical Cyclones web site, which has become an extremely popular "public outreach" site for the general public, researchers, and forecasters during TC events. During this reporting period we have continued working on a new innovative web page site that will allow increased user interaction and visualization capabilities: http://cimss.ssec.wisc.edu/tropic2 Also, GOES datasets and products are continuously requested and provided to the user community for expanding scientific research on TCs. Therefore, we are beginning the development of an on-line GOES TC product archive.

2)   We continue to conduct basic research and upgrade the Advanced Dvorak Technique (ADT) algorithm, which is now used by several NOAA and DoD tropical cyclone analysis centers. We also continue to work to ensure (through NOAA G-PSDI funding) that the latest versions are available to NESDIS/SAB and NOAA/TPC and CPHC. More information can be found at: http://cimss.ssec.wisc.edu/tropic2/misc/adt

3)   The CIMSS TC group continues to explore an integrated approach to satellite-based TC intensity estimation through a weighted consensus of satellite-based ADT, and AMSU methods derived at CIMSS and at CIRA. The approach (SATCON) has first identified the strengths and weaknesses of each individual method, which is then used to

assign weights towards a consensus algorithm designed to better estimate TC intensity. A statistical analysis reveals the approach is superior to the independent algorithms evaluated alone. In this reporting period we have investigated a cross-platform approach that uses information derived from the estimate methods (CLW, AMSUB 89 GHz, ADT Eye temps and RMW) to make adjustments to the individual members. Once these adjustments are made we then apply the weighting scheme. This has resulted in an improvement in skill compared to simply weighting the members with no adjustments. The focus now is on displaying the information in a way that is most meaningful to the users and tweaking the real-time code. This new approach will be tested in near real time during the 2008 hurricane season. For more information, see: http://cimss.ssec.wisc.edu/tropic/satcon/satcon.html

4.2   GOES Imager Applications to Hurricane Intensity Change
Lead Scientist: Jim Kossin
Postdoctoral Fellow Christopher Rozoff

In addition to progress toward an improved rapid intensification index for hurricanes, which is outlined below, we performed a short side-project for the SHIPS model development. The goal of this short side-project was to determine whether the skill of the SHIPS model might be increased through the removal of dependencies among the predictors. The SHIPS model is a linear model based on multivariate regression. It is well known that the skill of such models, when measured through *independent* testing, can be degraded by the inclusion of new predictors that are correlated with the existing predictors. A method for removing predictor correlation from multivariate regression models was introduced to the meteorology community by Lorenz in 1956. The procedure requires performing principal component analysis on the predictor suite, which rotates the predictors into new predictors that are orthogonal to each other (i.e., they are completely independent of one another). These new predictors are ordered in terms of the amount of explained variance of the original predictor suite. The idea is that most of the model's independent skill will come from the leading predictors (which explain most of the variance of the actual predictors), while the trailing predictors contain mostly noise that is uncorrelated with the model predictand. Since the SHIPS model utilizes a large number of predictors, we felt that there was a reasonable chance that we could increase skill through this method. As it turns out, this is not the case.

Our procedure is outlined here:
1) Ingested SHIPS Atlantic developmental dataset (spans 1982–2006).
2) Formed predictor suite. We chose the $t = 24$ h forecast interval as the predictand for this experiment. In this case, we had 226 potential predictors and 4613 fixes.
3) Performed a forward stepping procedure to reduce the predictor suite dimensionality. Here we used the MATLAB utility "stepwise". This reduced the number of predictors to 43. The evolution of dependent RMS error during the forward stepping procedure is shown in Fig.1a. For the final step (43 predictors), the dependent RMS error within the full ($n = 4613$) sample was **11.72 kt**.

4) Independent testing was then performed with a "leave one out" procedure in which we removed each of the 25 years, trained the model on the remaining years, and tested on the year that was removed. The errors for each year were accumulated for all years. The resulting independent RMS error was **11.99 kt**.

5) From the above, it became clear that the margin on which improvement might be realized was very narrow. RMS error can never be reduced below the dependent RMS error of 11.72 kt, and the 43-predictor model already has an independent RMS error of 11.99 kt.

6) Despite there being little room for improvement, at this stage of the project it was simple enough to perform the principal component analysis on the 43 predictors, and repeat the independent test with the rotated predictors. The evolution of independent RMS error with the incremental additions of the new predictors is shown in Fig. 2b. The point of diminishing returns occurs at around the 11th predictor, similarly to the forward stepping procedure shown in Fig. 2a. This suggests that the forward stepping already does a good enough job of eliminating predictors that correlate too strongly with other predictors relative to the desired correlation with the predictand.
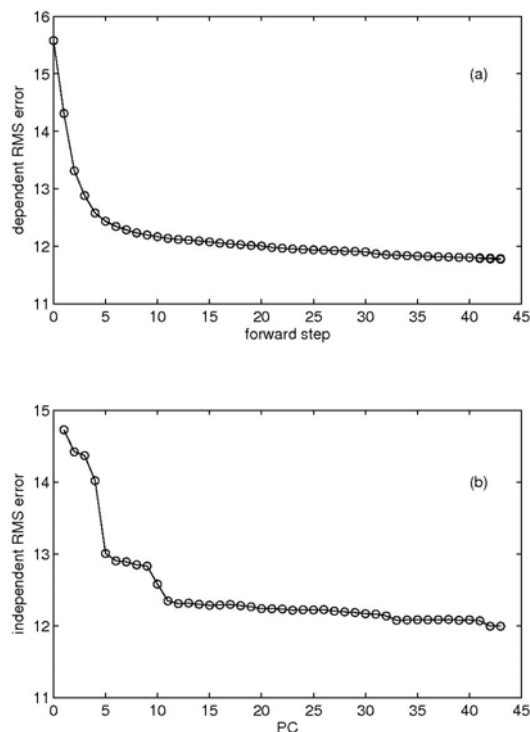

Figure 2: (a) Evolution of dependent RMS error during forward stepping procedure. (b) Evolution of independent RMS error as the new rotated predictors are added. The rotated predictors are the principal components of the original predictor suite. They are ordered in terms of variance explained of the original predictors.

In addition to the brief side-project described above, we have also started our work toward constructing a new rapid intensification index for Atlantic and Eastern Pacific hurricanes. Here we used the National Hurricane Center and Statistical Hurricane Intensity Prediction Scheme (SHIPS) databases and probabilistic tools to study the large-

scale properties of rapidly intensifying Atlantic basin tropical cyclones. As a first step, we re-examined the results of Kaplan and DeMaria (2003) (hereafter KD) constructing composite differences between tropical cyclones that rapidly intensified and those that did not. As in KD, we defined rapid intensification (RI) as the 95th percentile of over-water 24-h intensity changes over the entire dataset, which is about 30 kt over a 24-h period in both KD and the current results (see Fig. 3). The dataset of KD covered all tropical cyclones that developed from 1989 to 2000, whereas our results extend the dataset through the end of the 2006 hurricane season. Overall, our results are largely confirmatory of their earlier results and provide greater statistical confidence in KD's key indicators of Atlantic tropical cyclone rapid intensification.
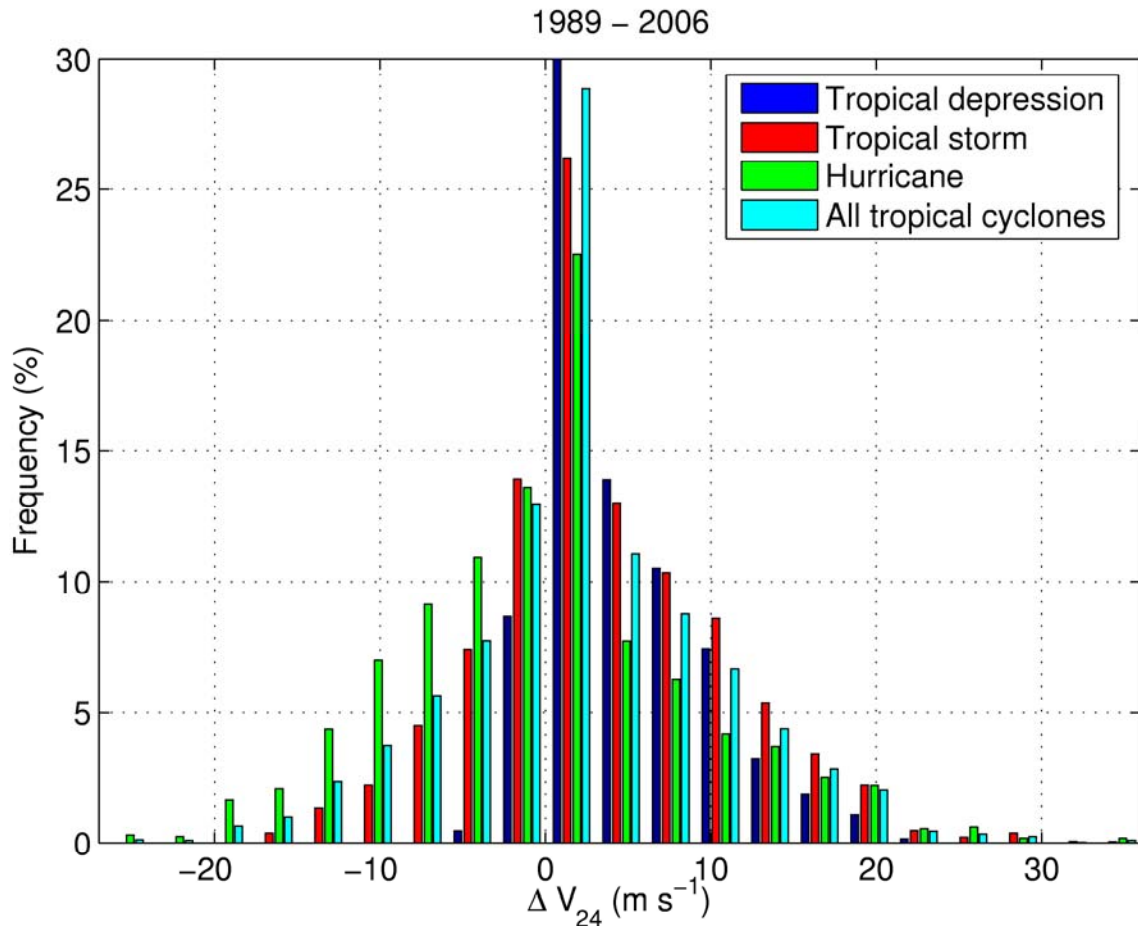

Figure 3: The frequency distribution of 24-h intensity change stratified by tropical cyclone intensity at all data over sea.

Table 1 shows the mean differences in essential variables between storms that underwent rapid intensification (RI) and those that did not (non-RI). The variables VMX, LAT, LON, DVMX, and USTM, which are obtained from the HURDAT database, are the maximum surface wind speed, the latitude and longitude of the storm center, the intensity change over the previous 12 hours, and the zonal component of storm motion, respectively. The remaining variables obtained from the SHIPS archive are the Reynolds sea surface temperature (SST), potential intensity (POT), the vertical wind shear obtained

from subtracting the 850- and 200-hPa wind vectors averaged over r = 200 – 800 km.
(SHR), the 200-hPa zonal wind (U200), 850 – 700-hPa average relative humidity
averaged from $r = 200 – 800$ km (RHLO), the area average ($r = 0 – 1000$ km) 850-hPa
vorticity averaged over $r = 200 – 800$ km (Z850), the steering layer averaged over r = 200
– 800 km (SLYR), and the relative eddy momentum flux convergence (REFC) evaluated
from

$$\mathrm{REFC} = -r^{-2}\frac{\partial}{\partial r}\left(r^2\overline{U'_L V'_L}\right)$$

where U and V are the storm relative 200-hPa radial and tangential winds, the overbar
represents an azimuthal average, and the primes are the perturbations from the mean.

TABLE 1. The mean magnitudes of the initial ($t = 0$ h) climatological and synoptic variables of
the RI and non-RI samples from 1989 to 2006. Differences (RI – non-RI) are also shown. A
single, double, or triple asterisk is placed beside the differences if the difference is statistically
significant (using a two-sided t test) at the 95 %, 99 %, or 99.9 % level, respectively.

Variable	Units	RI Mean	Non-RI Mean	Difference
VMX	m s^{-1}	30.56	30.54	0.02
LAT	^{O}N	19.48	24.09	-4.61***
LON	^{O}W	62.21	57.81	4.41***
DVMX	m s^{-1}	4.81	1.18	3.63***
USTM	m s^{-1}	-3.50	-1.71	-1.79***
SST	^{O}C	28.54	27.50	1.05***
POT	m s^{-1}	61.45	51.27	10.19***
SHR	m s^{-1}	5.23	8.59	-3.37***
U200	m s^{-1}	-0.77	3.76	-4.53***
RHLO	%	70.55	66.25	4.31***
Z850	10^{-7} s^{-1}	36.44	23.24	13.20***
REFC	m s^{-1} day^{-1}	0.97	2.39	-1.42**
SLYR	hPa	582.46	622.71	-40.26***

Our results contain 234 tropical cyclones, which is 71 more tropical cyclones than in the
original KD dataset, yielding 252 and 3910 RI and non-RI samples compared to KD's
159 and 2462 RI and non-RI samples. As a result, our composites contain greater
statistical significance than the original KD dataset, although the updated results are
consistent with KD's composites. Climatologically, Atlantic tropical cyclone RI is
favored further south and west and for storms that have more of a westward track motion.
Also, storms that were intensifying more rapidly over the previous 12 hours are more
likely to experience rapid intensification over the next 24 hours. From a thermodynamic
standpoint, enhanced SSTs, potential intensity, and low-level relative humidity are more
favorable for RI. Enhanced shear, westerly upper level flow, eddy momentum flux
convergence, and a lower altitude of storm steering are less favorable for RI. Finally,
KD's results suggested that periods of RI were preceded by greater low-level vorticity
(i.e., Z850) but their results were not statistically significant at the 95 % level, whereas
our larger dataset provides greater confidence in this result with statistical significance at
the 99.9 % level. Because the mean maximum surface winds of RI and non-RI samples

are essentially the same, we conclude that enhanced area-averaged low-level vorticity seems to be an important requirement for rapid intensification.

Another benefit of our larger dataset is the greater confidence in stratifying our results in terms of tropical depressions (VMX < 18 m s^{-1}), tropical storms (18 m s^{-1} ≤ VMX < 33 m s^{-1}), and hurricanes (VMX ≥ 33 m s^{-1}). Interestingly, while RI for all tropical cyclones favor lower REFC and contain no significant differences in 200-hPa temperatures, RI in tropical depressions is slightly more favored in the situation of enhanced REFC and lower 200-hPa temperatures. Therefore, upper level disturbances may be important in the rapid intensification in the weaker tropical cyclones. This is not the case for tropical storms and hurricanes. Finally, although there is no difference in VMX between RI and non-RI storms for all tropical cyclones, RI cases occurring in hurricanes occur for initially lower wind speeds than non-RI cases. Part of the explanation for this is that RI systems are further from their potential intensities. This tendency is borne out in the frequency distribution of 24-h intensity change, as depicted in Figure 3. Tropical depressions and tropical storms are more likely to intensify and hurricanes contain a higher probability of weakening, due to the thermodynamic upper bound of tropical cyclones.

Our preliminary results toward a new algorithm for predicting rapid intensification are shown in Fig. 4. We will continue developing this algorithm and will perform error and skill analyses. One exciting prospect of applying our Bayes classification algorithm to the rapid intensification problem is that our algorithm allows more than two classes (binary classification). Thus we can predict probabilities for different intensification thresholds, which removes some of the subjective constraints from the problem. We are looking more deeply into this now.
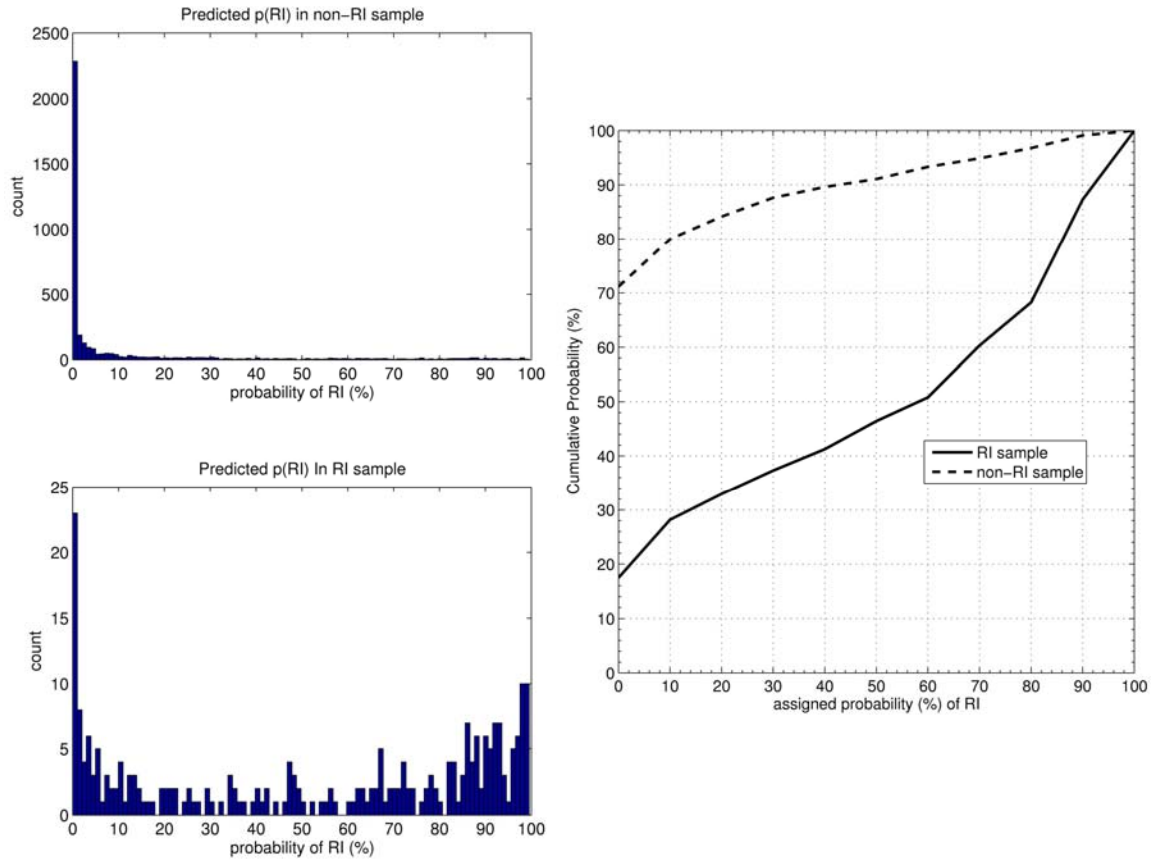
Figure 4: Preliminary results using Bayes classification on a small number of features.

5.   Biomass Burning Research
Lead Scientists: Elaine Prins, Chris Schmidt

The UW-Madison CIMSS burning team proposed four major tasks for 2007. CIMSS proposed to continue the GOES WF_ABBA trend analysis throughout the western hemisphere to assess changes in biomass burning and collaborate with the user community in environmental applications of the WF_ABBA data base. These collaborations include ongoing activities with the atmospheric modeling community to assimilate geostationary WF_ABBA fire products into aerosol/trace gas transport models. A new effort in collaboration with Dr. R. Rabin (NOAA/NSSL) and Dr. P. Bothwell (NOAA/NWS, Storm Prediction Center) focuses on applications of Rapid Scan GOES fire products for early detection of wildfires and agricultural burning and diurnal monitoring of fire variability. Finally, CIMSS proposed to continue to work with GTOS GOFC/GOLD, CGMS, and GEOSS to foster the development and implementation of a global geostationary fire monitoring network with international involvement.

Accomplishments:
During the fourth quarter of 2007 the CIMSS biomass burning team continued to collaborate with the international aerosol/emissions modeling and data assimilation communities. On December 12-14, 2007, CIMSS scientists attended a Fire Locating and

Monitoring of Burning Emissions (FLAMBE) workshop at NRL in Monterey, CA to discuss progress and future plans in support of the multi-agency (NASA, NOAA, DOD) funded FLAMBE program to assimilate real-time fire products in operational Navy aerosol transport models. Specific topics included assimilation of global geostationary fire products beginning in 2008, assessment and characterization of fire radiative power (FRP), MODIS and GOES fire product validation studies, plans to account for cloud obscured fire activity, a second generation FLAMBE source function, and assimilation of fire data in COAMPS-OS.

Over the past year the CIMSS biomass burning team continued GOES Wildfire ABBA (WF_ABBA) trend analyses throughout the Western Hemisphere and provided the WF_ABBA database (2000 – present) to the user community via an ftp site at CIMSS and an on-line database (http://www.nrlmry.navy.mil/flambe/index.html). Figure 5 provides a summary of GOES WF_ABBA fire detection from 2000 through 2007 by latitude. The figure does not include fire activity in the Western Hemisphere from December 4-12, 2007 due to lack of GOES-12 during this time. This time period typically accounts for only 1% of the annual burning for the Western Hemisphere and the lack of this data should not significantly affect the annual results for 2007. There was an overall increase of 50% in fire activity in the Western Hemisphere during 2007. In North America the WF_ABBA recorded a 12 % increase in fire activity associated with burning in California, Florida, Utah, Montana, Florida, Georgia, and across Canada. In South America the increase was the largest observed over the past 8 years with nearly a 64% increase over 2006 and a 45% increase over the annual average for the previous 7 years. The 2006 fire season showed a substantial reduction in fire activity which had been attributed to a tri-national policy put into effect to reduce catastrophic burning associated with drought conditions. As prices for soy and cattle surged in 2007, deforestation and soybean production and associated burning also soared in states along the southern and eastern perimeters of the Amazon (Mato Grosso, Para, Tocantins, Amazonas) (http://news.mongabay.com/2007/1021-amazon.html).
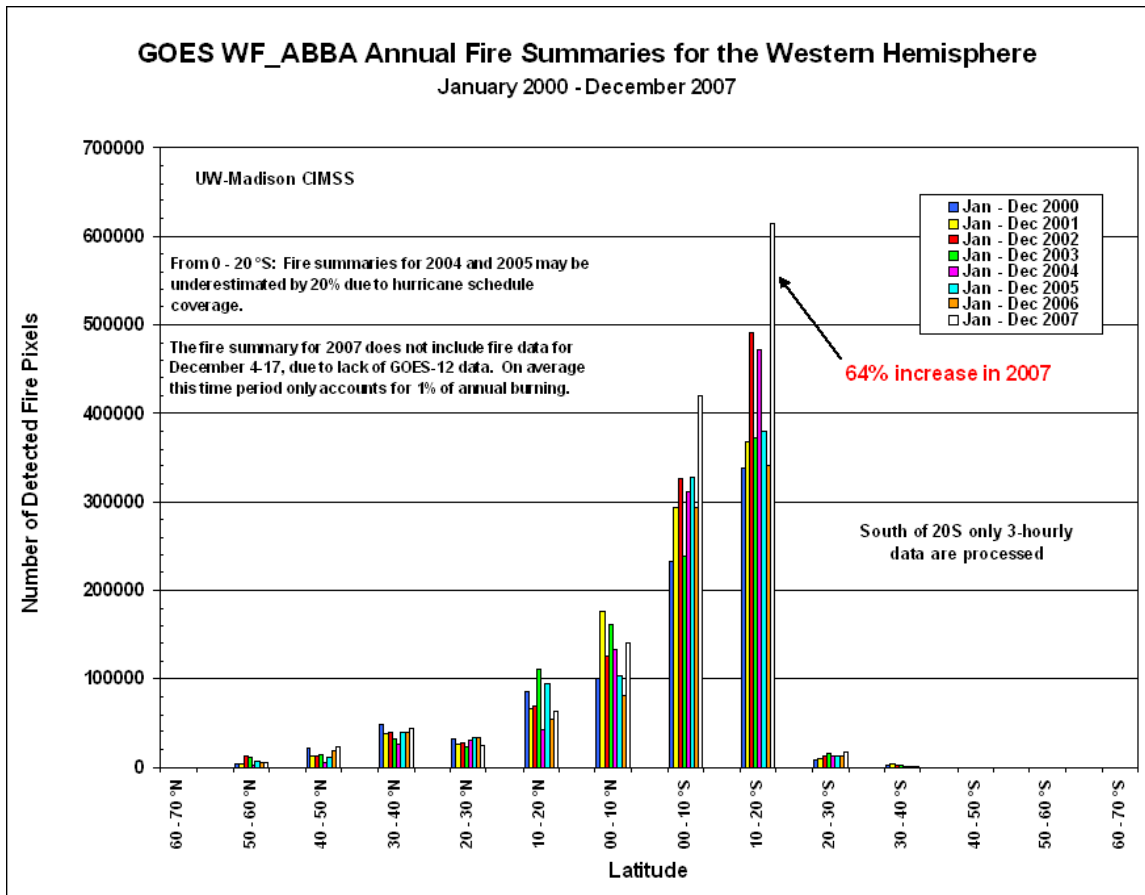
Figure 5. GOES WF_ABBA fire detection from 2000 - 2007 by latitude

**6.   GOES Imager SATellite Convection AnalySis and Tracking (SATCAST)
        System Product Evaluation by NOAA/NESDIS Operations
        Lead Scientists: Wayne Feltz, Kris Bedka**

Background
CIMSS, in collaboration with the University of Alabama in Huntsville, currently
produces a set of GOES-12 Imager satellite-derived products for diagnosing and
nowcasting thunderstorm development, evolution, and motion. These products have been
under development for four years under the NASA-supported Advanced Satellite
Aviation-weather Products initiative for use in aviation safety applications (Mecikalski et
al., 2006). CIMSS is currently providing these products to several groups, including the
NOAA/NESDIS Satellite Application Branch (SAB) precipitation desk, in near real-time.
The goal of this collaboration is to improve upon existing SAB satellite-derived guidance
and precipitation forecasts. CIMSS convective weather products can identify rapidly
developing convective storms, which should be monitored for heavy rainfall and flash
flooding potential. SAB precipitation estimates are provided directly to National
Weather Service Forecast Offices and Regional Forecast Centers and contribute to
forecasts disseminated to the general public.

The use of geostationary satellite imagery provides a clear advantage over operational NWP model guidance for short-term convective weather forecasting, as satellites observe the true state and evolution of a convective event at high temporal/spatial resolution, whereas NWP models often incorrectly simulate the timing and location of convective storm development. Satellite-derived products also have an advantage over WSR-88D radar products in that convective storm initiation is observed in satellite imagery before precipitation echoes are detectable by radar, providing valuable lead time for operational forecasters.

Accomplishments
1) Convective diagnostic and nowcasting products continue to flow to the SAB for optimal display, NWS end-user feedback, data interpretation, and plans. Convective initiation algorithm testing is ongoing. A new box-average cooling rate field is now being provided to NOAA SAB for user evaluation. New FY2008 milestones have been discussed with SAB

2) A training PowerPoint has been constructed and provided to interested users, including the NOAA NESDIS SAB team.

3) The software continues to operate on larger real-time domains. Kristopher Bedka has provided software support and evaluation is ongoing.

4) We continue to work with local NWS offices (Sullivan, Green Bay, and La Crosse) to acquire user feedback and improve upon products where necessary. A briefing at the Green Bay NWS office occurred on January 7, 2008, and enthusiastic support was received for mesoscale winds and convective nowcasting. Further evaluation of new convective initiation box averaging method is continuing and initial validation is ongoing.

5) We are coordinating with scientists at NSSL and CIRA on CIMSS aviation activities. Bob Rabin (NOAA NESDIS) and CIMSS aviation team continue collaborations to foster introduction of new convective nowcasting techniques at NSSL.

7.   **Cloud Products**
      Lead Scientists: Mike Pavolonis, Andy Heidinger

Brief Description of work proposed
With the advent of the GOES-R Algorithm Working Groups, NOAA has begun to develop consensus prototype algorithms for GOES-R. Particularly, the cloud application team has developed a prototype system for testing cloud algorithms applied to geostationary imager data (GEOCAT). GEOCAT can process geostationary imager data from GOES, MSG/SEVIRI and MTSAT. Beyond the cloud height and effective cloud amount product from the GOES-12 imagers and the cloud mask from Clear-Sky Brightness Temperature (CSBT), NOAA makes no other operational cloud products from the GOES Imager. Most of the proposed GOES-R cloud products can in fact be

produced from the current GOES imagers albeit with reduced accuracy. We proposed to implement GEOCAT applied to the GOES imager data in real-time at CIMSS and to make cloud products available to all interested users for evaluation and comment.

Summary of Results for Past Quarter
This quarter we continued to focus on the real-time GOES processing. The GOES-R cloud algorithms have been adjusted so they can be run with the current GOES platforms and ingested into the real-time processing. Producing the cloud mask, optical properties and height data on a full disk requires about 5 minutes processing time. After running GEOCAT for several months it appears to be a reliable system for controlling and running the cloud algorithms. A webpage is under construction that will display the results of the real-time products as they are produced.

To date, several ABI cloud algorithms have been modified for GOES-NOP and implemented into GEOCAT. As algorithms are developed under the GOES-R AWG effort, we produce versions modified for the GOES-NOP platform. These include the cloud mask, cloud type/phase and cloud optical/microphysical properties. Until the AWG cloud height algorithm is finished, the GOES-12 CO_2 slicing is run on the GOES-EAST and the AVHRR split-window on GOES-WEST.   To illustrate this effort, the figure below shows the modified ABI cloud type algorithm run on GOES-12.

During this quarter, our SSEC processing system failed (thor.ssec.wisc.edu) and a replacement was purchased using the hardware funds allotted under this project. The new system should be functional by the end of January 2008.
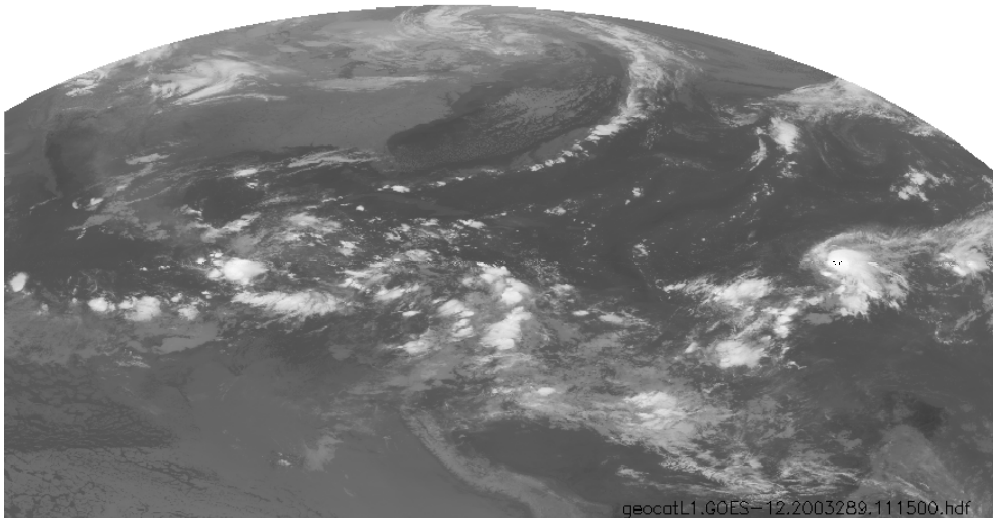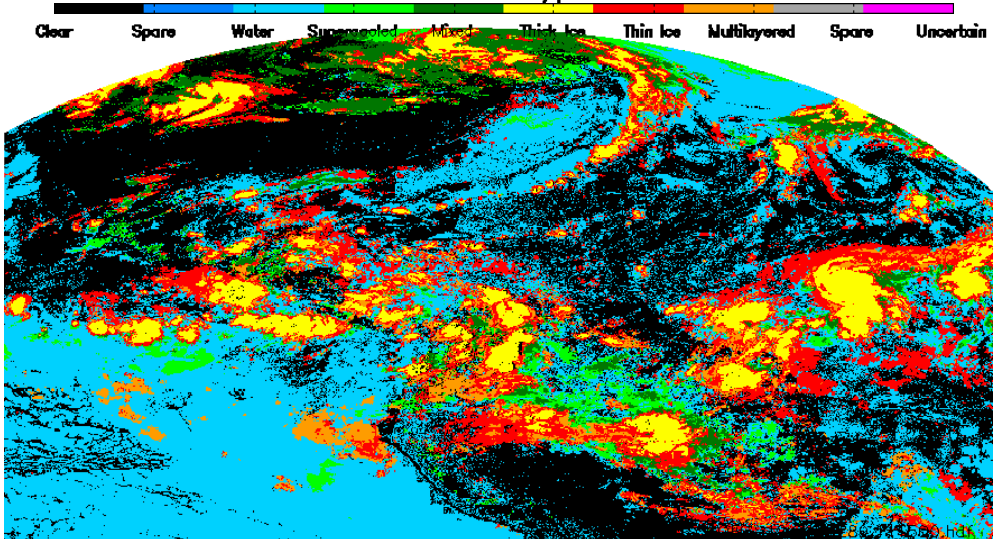
Figure 6. Results of the GOES-R AWG Cloud Application Team cloud type algorithm applied to GOES-12. The top image is GOES 11um window channel brightness. The bottom image identifies cloud type.