P4.4 GWINDEX - *G*OES RAPID-SCAN *WIND*S *EX*PERIMENT: APPLICATIONS FOR WEST COAST FORECASTING

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1. INTRODUCTION

GWINDEX was carried out in January through March of 2001. It was designed to demonstrate the improvement that could be gained in both the quantity and quality of satellite-derived cloud-motion winds using 7.5 minute interval rapid-scan visible (0.65 μm channel, VIS) and infrared (10.7 μm channel, IR) imagery from GOES-10. The primary goal of this experiment was to provide improved wind information over the data sparse northeast Pacific Ocean. Data and mission planning support was also provided to the coincident Pacific Landfalling Jets Experiment (PACJET).

The datasets were evaluated in real time by NWS forecasters, and assessed through impact studies on the Rapid Update Cycle (RUC) model short-term forecasts. A brief review of the satellite wind derivation process used is presented in section 2. Details of the experimental set-up can be found in section 3. A preliminary assessment of the impacts made by the satellite wind products is presented in section 4.

2. BACKGROUND

Automated wind extraction algorithms developed at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) employ a series of sequential geostationary satellite images to generate three dimensional wind products (Nieman et al. 1996; Velden et al. 1998). Cloud-motion vectors calculated from IR imagery can be produced in cloud covered regions at any time of the day. During daylight hours, cloud elements can be tracked in high resolution VIS images. The water vapor sensitive 6.7 μm channel (WV) images can be used to produce motion vectors at upper levels in both cloud and clear scenes (Velden et al., 1997).

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2.1 Basic Wind Vector Processing

Cloud or water vapor features are tracked across three consecutive satellite images. Traditionally, these images are 15 to 30 minutes apart. The process begins by subjecting the image triplet to a careful registration check. Registration is a measure of navigation consistency from image to image. Images with inconsistent navigation would result in artificial tracking errors.

Next, the middle image is used for the selection of tracking targets. These targets are identified by bidirectional brightness temperature gradients calculated around each pixel. Targets are selected if they exceed minimum threshold values and pass a filtering process.

Once targets are identified, initial height assignments are made. Each target is assigned to a pressure level using one of several techniques (Nieman et al., 1993). The initial assignment method used depends on the image channel.

Displacement vectors can then be calculated from the target (middle) image; one forward to the final image and one backward to the initial image. Coherent pattern matches are sought in the non-targeted images and correlated with the target. The two resulting vectors must meet empirically determined consistency thresholds to eliminate excessive accelerations. If they pass, the two vectors are averaged to create a final vector. The trackability of cloud features is highly dependent on the tracking interval. It has been shown that more frequent imaging enhances the reliability of the automated correlation tracking techniques.

At this point the wind vector field is run through automated quality control procedures designed to reassess vector height assignments, edit out vectors that are in obvious error, and provide end users with discretionary vector quality flags (Velden et al., 1997; Holmlund et al., 2001).

2.2 Impacts of Satellite-Derived Winds

High-density satellite-derived winds from multispectral imagery are produced at operational weather centers around the globe. NOAA/NESDIS derives datasets from two operational GOES satellites on a 3-hourly basis. These winds cover much of the Western Hemisphere, and are ingested into NCEP and US Navy operational models on a routine basis. It has been shown these data can have a significant impact on numerical weather prediction (Velden et al. 1997, 1998; Goerss et al. 1998; Soden and Velden 2001; Holmlund et al. 2001; Xiao et al. 2001).

3. GWINDEX

3.1 Experiment Description

Beginning in January 2001, NOAA implemented a special (and temporary) scanning schedule for GOES-10 that allowed one extra image each hour over the eastern North Pacific region (Fig. 1). This extra image resulted in a set of three successive images approximately 7.5 minutes apart encompassing the same geographic area (with daily exceptions for routine satellite maintenance at 0400, 1600, and 2200 UTC). This extra Pacific Ocean sector image was delivered through March 2001. Special GWINDEX wind fields were limited to the region displayed in Fig. 1, but only north to 60 degrees latitude and from 115 to 175 degrees west longitude.

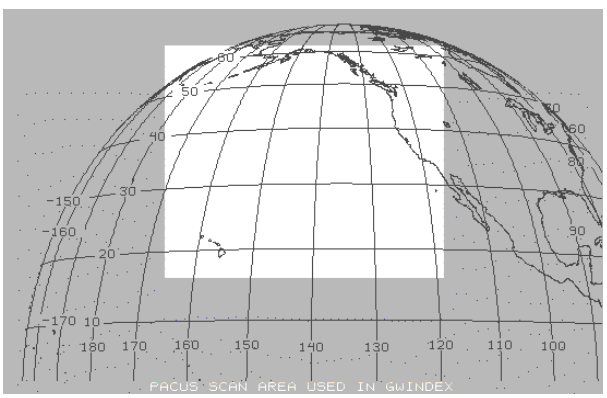

Figure1: GWINDEX coverage (unshaded region).

During the GWINDEX period, satellite derived wind sets were generated by CIMSS on an hourly basis using the 7.5 minute interval VIS and IR image triplets. The VIS winds were created only from 1500 UTC through 0300 UTC, IR winds could be run throughout the day. A combined data set in ASCII text format was made available for RUC model runs and forecaster use within an hour of the nominal time. WV winds were produced at NOAA/NESDIS using one-hour interval image triplets. The WV product spatial coverage was coincident with the VIS and IR products.

Within two hours of each processing time, the GWINDEX products were available for use by forecasters on a CIMSS web site. Very high-density vector plots each hour were focused on California and on Washington/Oregon providing close-ups on landfalling systems for the PACJET users. Three-hourly lower resolution plots provided synoptic scale perspectives for the entire northeastern Pacific Ocean region.

During GWINDEX, the most recent day's worth of products was displayed, with previous datasets stored in an accessible on-line archive. Currently, all plots generated during GWINDEX are available from this archive at http://gale.ssec.wisc.edu/.

3.2 GWINDEX Product Examples

An example of the PACJET regional upper tropospheric winds plot from 2300 UTC on 18 March, 2001 is depicted in Fig. 2. Winds included in this plot are derived from both GWINDEX rapid-scan IR and one-hour interval WV. The plotted wind field has been decluttered (vector filtering was used) to allow better interpretation of the data.

The lower tropospheric winds for the same location and time are shown in Fig. 3. Since this time period was during daylight hours, most of the winds shown were derived from rapid-scan VIS images. Some rapid-scan IR winds are also included.

4. SUMMARY AND PRELIMINARY ASSESSMENT

Initial feedback on the impact of the GWINDEX datasets has been positive. The PACJET community used the data to help in mission planning and will evaluate the data with in situ observations taken during the experiment. An initial assessment on the impact of the datasets on RUC forecasts is given in this volume (Weygandt et al.). Further data assimilation experiments are underway or planned (Mecikalski et al., this volume). A statistical analysis is being performed, but qualitative indications are that the rapid-scan data are coherent and the quantities produced vastly exceed those produced routinely using traditional image intervals.

A second experiment is planned for the summer/fall of 2001. This exercise will employ GOES-8 rapid-scan schedules to observe Atlantic hurricane activity. It is hoped the GWINDEX demonstrations will lead to permanent operational 7.5 minute rapid scan schedules for GOES.

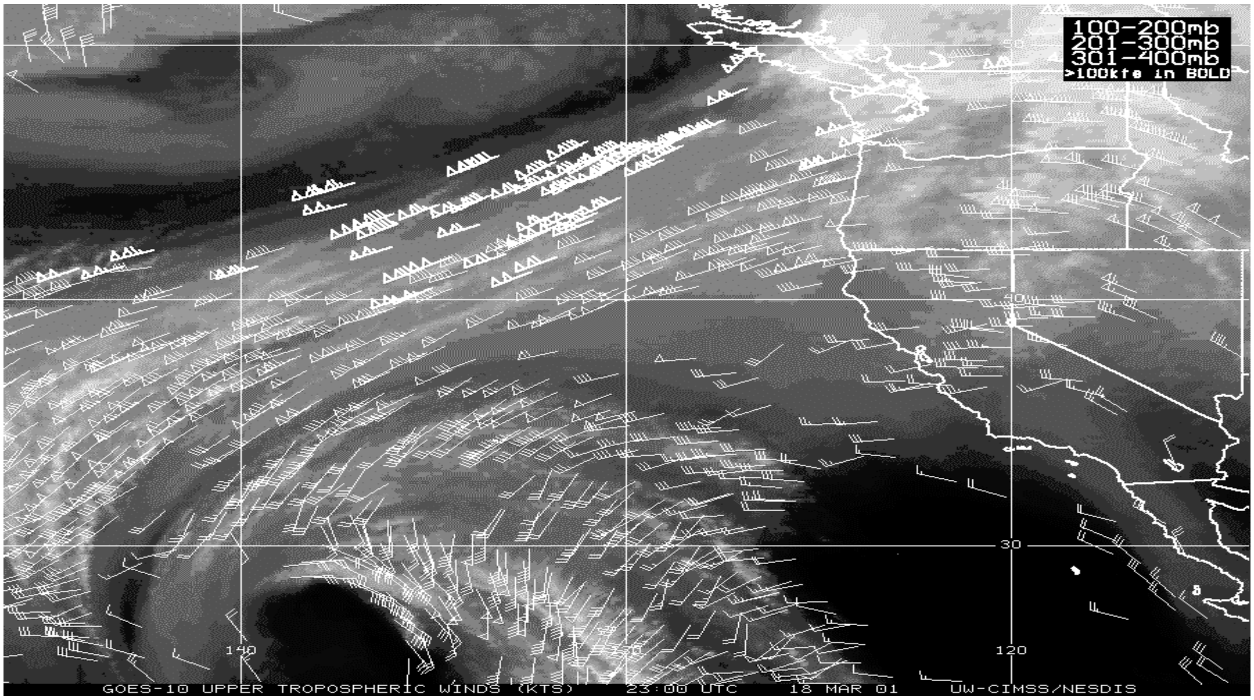

Figure 2: Upper-tropospheric wind plot over the GWINDEX region at 2300 UTC on 18 March, 2001. Vectors have been filtered for plotting purposes.

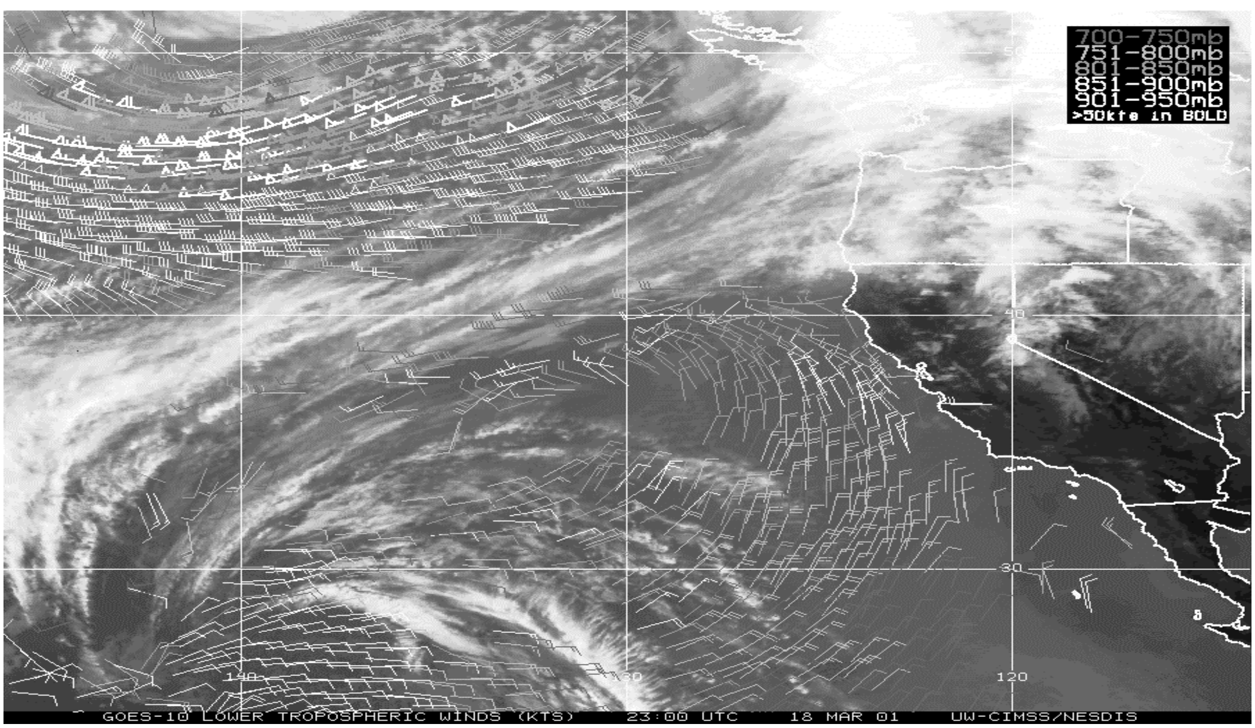

Figure 3: Same as Fig. 2, except for lower-troposphere.

5. REFERENCES

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