GOES-11 AND GOES-8 SOUNDERS DURING THE INTERNATIONAL H2O PROJECT (IHOP)-2002 FIELD EXPERIMENT

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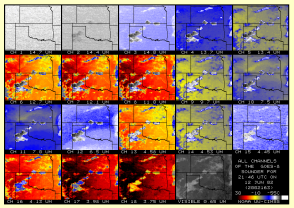
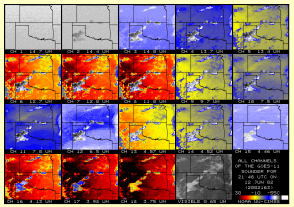
1. Background on application of GOES Sounder data for IHOP objectives

The International H2O Project (**IHOP**) was a field experiment conducted over the Southern Great Plains of the United States (US) from 13 May to 25 June 2002. The main purpose of the IHOP was to improve the characterization of the atmospheric water vapor distribution and its application to prediction of convection. The Geostationary Operational Environmental Satellites (**GOES**), operated by the National Environmental Satellite, Data, and Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA), provided an essential component of the observation capabilities used for the IHOP. The focus of this presentation is to describe the display and use, during IHOP, of data from the **Sounder** instrument on GOES. The Sounder provides radiance measurements in 19 spectral bands (with temperature and moisture sounding channels) at hourly intervals or better with sub-satellite horizontal resolution of 10 km (Menzel and Purdom, 1994).



All **GOES-8** channels at 22 UT on 12 June 2002

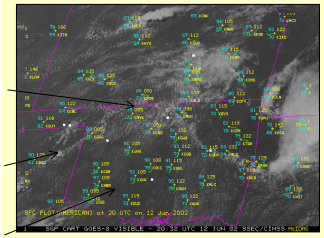
GOES-8 (launched in 1994 and stationed over the equator at longitude 75 West) was the primary geostationary satellite available to support IHOP and it provided data throughout the field campaign. In addition, NESDIS took **GOES-11** (launched in 2000 and stationed over the equator at longitude 100 West) out of on-orbit storage on 29 May 2002 and returned it to storage mode on 21 June 2002.



All **GOES-11** channels at 22 UT on 12 June 2002

The advantages of GOES-11 data over that from GOES-8 during IHOP included improved viewing geometry, better signal-to-noise ratio, and higher temporal resolution. During the GOES-11 post-launch test in the summer of 2000, it was shown that the **GOES-11** Sounder was superior in terms of radiances observed (**less noise and less striping**), compared with those from GOES-8 (Daniels and Schmit, 2001).

On 12 June 2002, the IHOP operations plan was set for a "Convective Initiation" mission in the eastern Oklahoma Panhandle. The focus was on the evolution of a surface "triple point" at the extreme northeastern edge of the Oklahoma Panhandle. The point of interest was at the intersection of a larger scale outflow boundary (that resulted from a mesoscale convective system (MCS) that had moved across Kansas overnight), oriented east-west across northwest Oklahoma, and a cold front/surface trough, oriented southwest-northeast, from the central Texas Panhandle into the northeast corner of the Texas Panhandle. Southerly winds ahead of the cold front brought very warm, very moist (dewpoints of 70+ F) air into the southeastern Texas Panhandle and into central and western Oklahoma

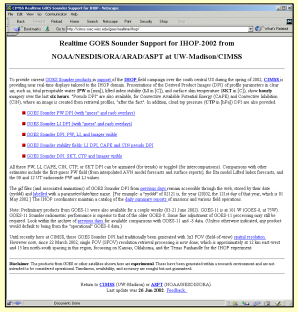


Web capture of GOES-8 visible image at 2032 UT on 12 June 2002 with surface data overlay.

For more on current GOES Sounder data at CIMSS or animations from the 12 June 2002 data, go to:
http://cimss.ssec.wisc.edu/goes/realtime/realtime.html or
http://cimss.ssec.wisc.edu/goes/realtime/ihop/arc/02163a/

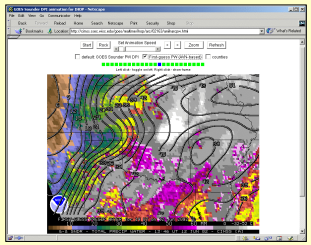
2. Real time GOES Sounder products generated during IHOP

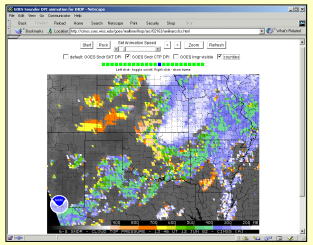
Retrieved atmospheric profiles (or "**retrievals**") from the GOES Sounders were produced with a physical retrieval algorithm that uses the observed GOES radiances as well as an ancillary first-guess field generated from the latest surface observations and a numerical model forecast (Hayden, 1988; Ma et al., 1999).



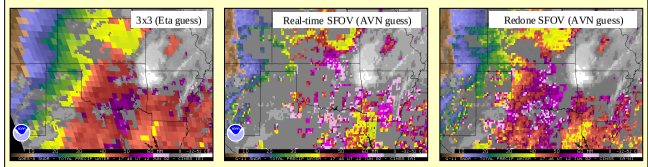
Main title page of the CIMSS GOES Sounder Page for IHOP

GOES retrieval profiles were accessible to IHOP scientists and forecasters as text files (ASCII) from the web. However, in real-time, the emphasis was to showcase the SFOV DPI over the IHOP domain. Various image displays, animations, and overlays were provided on the CIMSS GOES IHOP web page. The Java "AnimationS" applets, developed by T. M. Whittaker, were utilized to provide an easy means to observe temporal trends as well as to allow interactive comparisons of the GOES DPI in a variety of ways. These included toggling on/off first-guess fields, radiosonde values, visible imagery, and different satellites (GOES-11 versus GOES-8). County map overlays were available as well.





Retrieval profile information was thus also presented in an image format, known as Derived Product Images (**DPI**). Sample web captures of the displays for 14 UT on 12 June 2002 are shown above for total precipitable water DPI (with its first guess overlay) [***left***] and cloud top pressure DPI (with a county map overlay) [***right***].

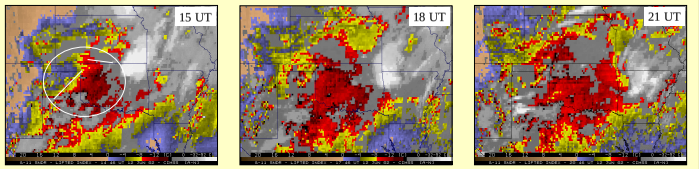


Traditionally, GOES Sounder retrievals at CIMSS have been generated with a **3x3** field-of-view (FOV) spatial resolution; historically, this was done to take advantage of spatial averaging (to reduce noise) and to process in a timely fashion. However, faster computers, better radiometric signal (with the newer GOES satellites), and a desire to take advantage of the best resolution available (especially for an experiment like IHOP that focuses on mesoscale events) all contributed to achieving implementation, at CIMSS, of GOES Sounder retrieval processing at single FOV (**SFOV**) resolution before IHOP (Bayler et al., 2001).

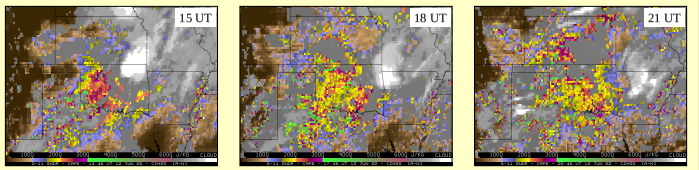
In real-time during IHOP, the GOES SFOV retrieval processing was not optimal due to inadequate determination of some noise threshold coefficients. Thus, unfortunately, some clear areas in the retrieval DPI (including high interest portions over IHOP) were often incorrectly set to being cloudy (due to retrievals failing to converge). Since then, noise levels for the longwave window bands have been adjusted, resulting in much improved coverage, as shown by the images above: real-time [***center***] versus re-processed [***right***].

3. Refinement and application of GOES Sounder products for case of 12 June 2002

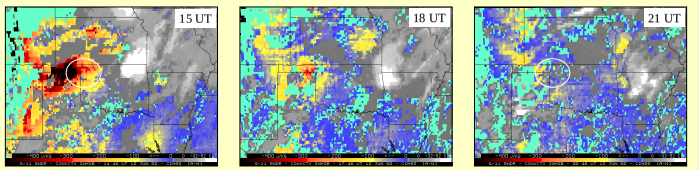
GOES Sounder moisture and stability DPI showed similarly very favorable patterns for strong convection across the IHOP domain on 12 June 2002. GOES TPW values [***previous figure – left***] over central Oklahoma and north central Texas already were in the 40-50+ mm range overnight, with some values approaching 60 mm by mid-morning. Although some individual cloud adjacent FOVs may be suspect, abundant moisture was evident. The strength of the GOES data lies not in its absolute magnitude, but rather in its spatial patterns and temporal trends (Menzel et al., 1998; Dostalek and Schmit, 2001; Schrab, 2001; Schmit et al., 2002; Weaver et al., 2002).



GOES **LI** DPI [***above***] showed an instability pattern by mid-morning that focused attention towards the "warm sector" delineated by the Texas Panhandle cold front and the old outflow boundary across northern Oklahoma.

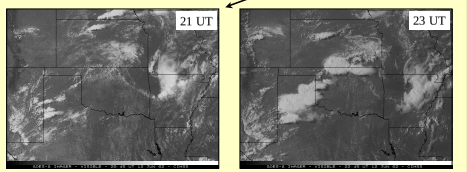


By mid-day, the GOES derived **CAPE** values [***above***] (the "positive energy area" on a thermodynamic diagram) also showed a favorable air mass over the middle portions of the IHOP domain, with very unstable values (isolated values to 2500+ J/kg surrounded by much 2000 J/kg data).



The CIN DPI [***above***] did show decreases from inhibiting values earlier in the morning over the Oklahoma Panhandle and far northwest corner of Oklahoma (more than (-) 300-400 J/kg) to minimal levels (much less than (-) 50 J/kg) by mid-afternoon.

Moisture and stability patterns appeared reasonable, but further comparison with the re-processed DPI is needed to show significant impact or improvement to first-guess fields. Other more detailed comparisons of GOES Sounder data with the wide variety of available special and unique co-located measurements (remote and in-situ) during IHOP will also continue (Feltz et al., 2003).



By 2100 UTC, convection was starting in far northern northwest Oklahoma; the storms continued to develop across the area south of the central Oklahoma/Kansas border and later became severe. Some convection did also develop in the Texas Panhandle, but the Oklahoma activity was stronger and longer lived.