

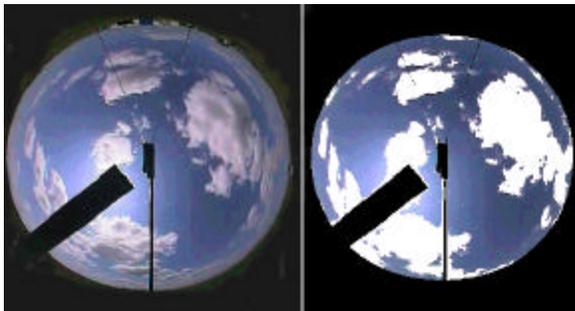
TOTAL SKY IMAGER MODEL TSI-440A

BULLETIN TSI-440B

General Description

The Model 440 Total Sky Imager (TSI-440) is a full color sky camera and software package that offers the forecaster as well as the atmospheric research community an easy-to-use and reliable field sensor for sky imaging. The TSI-440 is designed for long-term field installations and features state-of-the-art camera optics as well as user-serviceable mirror components. The system captures images into industry-standard JPEG format data files, which are then analyzed for fractional cloud cover. At installations where it can be connected to a TCP/IP network, the system acts as a *sky image server* to web browsers via the Internet. In many meteorological forecasting applications, the accurate determination of sky conditions is a highly desirable yet rarely attainable goal.

Traditionally, trained human observers have reported sky conditions, resulting in considerable discrepancies from subjectivity in observations. In practice, the use of human observers is not always feasible due to budgetary constraints. The TSI-440 offers reliable real-time sky imaging at a reasonable cost. Once the system is set up, there is very little maintenance other than periodic cleaning of the mirror.



Raw sky image (left) Processed image (right)

The side-by-side cloud images show a raw image before any processing has been performed and the same image with a software filter applied. The filter, a sophisticated image-analysis algorithm, clearly defines the clouds so that fractional cloud cover can then be calculated.



Model TSI-440 Total Sky Imager

Principle of Operation

Images from the sky are captured via a solid state CCD imaging camera that looks downward on a heated hemispherical mirror. The mirror images the hemisphere over the system into the lens, and has a solar-ephemeris guided shadowband to block the intense direct-normal radiation from the sun. An image processing program running on a user-provided PC workstation captures images via TCP/IP at a user-defined sampling rate and saves them to JPEG files for analysis. The analysis software first masks out known obstructions-the camera, its arm, and the sun-blocking shadowband. The raw color image is analyzed for fractional cloud cover and both are stored as files.

Features

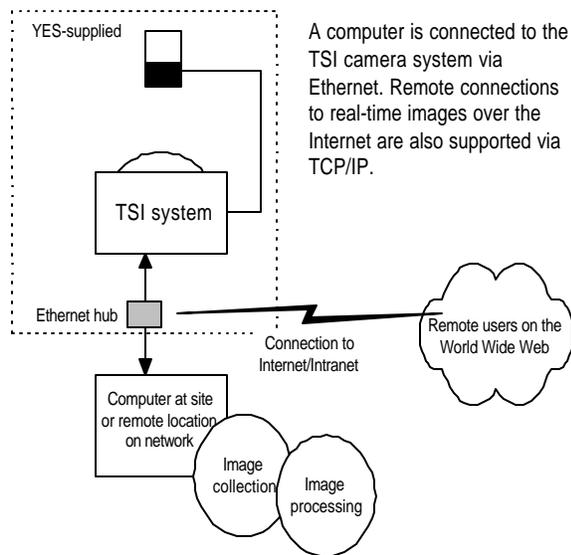
- Real-time cloud images accessible via a web browser using TCP/IP
- Open architecture uses standard JPEG files
- TSI-Manager image processing application collects data and converts raw images into cloud cover on your workstation
- Color imager uses reliable CCD technology
- Environmentally sealed for long-term field use

Applications

The TSI-440 is well suited for:

- Cloud cover analysis
- General meteorology
- Atmospheric research
- Pollution monitoring and plume research
- UV prediction

Because images are stored in a standard JPEG format, third-party tools may also be used to view and modify the images.



TSI-440 Communications Options

The TSI-440's 10Base-T Ethernet port is typically connected directly to a local area network. At remote sites, a TSI-440 system can be connected directly to a local PC workstation via its uplink Ethernet port. TCP/IP is used to collect images and store them onto disk. For remote operation, field personnel must either visit the site periodically to retrieve stored images from the hard disk, or use a modem to retrieve the images over the phone line (e.g. via PC-Anywhere™). The rate at which the drive fills up depends on the sampling rate. Typically images are ≈25 KB; for 5 minute samples and 12-hour days, ≈3.5 MB of images a day are stored.

Specifications

Image Resolution:	352 x 288 color, 24-bit, computer-automated rotating mirror with shadowband
Sampling rate:	Variable, with a maximum of one image every 30 seconds
Operating Range:	-30°C to +34°C
Weight/Size:	Approx. 50 lbs. (20 kg); dimensions: base is 16" x 30" (41cm x 76cm); height is 28" (71cm)
Power Requirements:	115/230 VAC; Heater duty cycle varies with air temperature: approx. 600 watts with heater on; 50 watts off
Software:	Image application supports MS-Windows® 9x/NT
Data Storage:	Local workstation disk
Communication:	10BaseT/RJ45 (15m)

Also Available

The Model TSI-880 automated total sky imager contains an embedded image processing system that automatically processes raw images into percent cloud cover and presents the results via a web interface. Because it does not require a local image processing workstation, the TSI-880 system is truly standalone. Its built-in cooling system also permits higher temperature operation, as well as remote data collection via a Data Storage Module option. The TSI-880 is designed for challenging professional meteorological, aviation and military applications where automated 24x7 reliability is required. However, both the TSI-440 and TSI-880 share the same charge-coupled-device based imagers.



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