GONG

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The Global Oscillation Network Group (GONG) Project is a community-based activity to operate a six-site helioseismic-observing network, to do the basic data reduction and provide the data and related software tools to the community, and to coordinate analysis of the resulting rich data set. Information on the status of the project, the scientific investigations, as well as access to the data, is available at *gong.nso.edu*.

The fourth quarter of 2002 marked the beginning of a new era for GONG. With the broad appreciation of the significance of the changing dynamics of the solar interior and helioseismology's efficacy in charting its evolution, GONG is now slated for long-term operations and has become one of NSO's three flagships. The past several years of building the GONG+ high-resolution cameras and the GONG++ high-capacity computer system are finally over, and we can now settle in to routine network operations and maintenance and accelerated data processing, producing much more science.

But things never really "settle down" it seems. We are finding that "routine" operations are not routine at all, and that keeping the sites up and running will be a continuing challenge. We have experienced failures with three of our turrets (the Learmonth light-feed twice!); we're running short on spares, some of which cannot be simply replaced off-the-shelf; mechanical parts are wearing out; and we have experienced a failure in one of the optical assemblies. The Tucson engineering instrument was always foreseen as a source of "hot spares," and we've really needed it the last few months!

On the downstream side of data operations, the situation is quite different. We are bringing an operating and automated pipeline for ring-diagram analysis on-line, which begins with calibrated images from the sites and ends with flow maps. Soon other local helioseismology applications will be implemented into the GONG++ pipeline scheme as well.

There have been two significant departures from the GONG data group. First, Thierry Corbard has left to return to France and take a position at the Observatoire de la Côte d'Azur. Thierry accomplished a significant amount during his brief stay with us, implementing and methodically testing the ring-diagram pipeline. We look forward to his use of the pipeline to get exciting science out of this wonderful new tool.

The other *extremely* significant departure is the retirement of Jim Pintar after 15 years as the GONG DMAC manager. Jim's contributions were fundamental to the development of the original Classic GONG pipeline. The entire scientific community in helioseismology extends an enormous "Thank You!" to him.

Operations

Soon after we powered on the Udaipur instrument at the conclusion of the monsoon shutdown, it became apparent that something was amiss. The instrument was frequently unable to acquire and track the Sun, and then the transmission began to fall. Initially, it was thought that because the image brightness at Udaipur was somewhat less than at the other sites, adjusting software parameters would help to restore normal operation. But as days passed and adjustments were made, the images became dimmer and dimmer. With a steady stream of diagnostic procedures from the Tucson operations team and constant help from the site staff, it was determined that the problem was in the 1-angstrom Lyot filter. A replacement filter was prepared in Tucson and taken to India. After the necessary alignment checks and other more general optical maintenance, the instrument was again fully operational in mid-December. Once the old filter arrived in Tucson, inspection revealed that the ADP elements in the filter assembly had reacted with moisture in the air, bonded to the neighboring calcite elements, and turned cloudy at the interface. Consequently, the filters from the remaining sites will be rebuilt and replaced to prevent any further occurrences.

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GONG continued

In October, the Big Bear site underwent some routine maintenance, focused mainly on the optical system. This visit was scheduled in conjunction with the GONG/SoHO meeting in Big Bear to allow operations staff to meet with the visiting site representatives who were able to attend the meeting. In November, a maintenance team visited Mauna Loa, where a new set of UPS batteries was waiting to be installed. There was also a failure of the UPS batteries at El Teide, where new ones were purchased locally and installed by the observatory staff. In late December, the Learmonth site went down with a failure in the wave-place rotator circuit. The motor amplifier was damaged, which was reminiscent of the consequences of the turret failure that occurred there only six months earlier. The Tucson operations team and the on-site staff have done considerable troubleshooting, but the exact source of the trouble is still not clear. At the time of writing, a maintenance team is on its way to Learmonth to diagnose and fix the problem.

Our sincere gratitude goes to the site staff who have spent *considerable* time and effort trouble-shooting the systems.

Data Management and Analysis

During the past quarter, the DMAC produced month-long (36-day) velocity time series and power spectra for GONG+ months, 71 and 72 (ending 24 June 2002), with fill factors of 0.82 and 0.75, respectively. The Data Storage and Distribution System (DSDS) distributed 333 gigabytes in response to 47 data requests. During the preceding two quarters, the DSDS distributed 500 gigabytes and 360 gigabytes.

The DSDS has added a new data access facility. External users can now download mode-coefficient time series (for ℓ's less than or equal to 10) and the various mode frequency products directly from the project's Web page without submitting a data request. Since introduction, 350 low-ℓ time-series files and over 10,000 sets of mode coefficients have been downloaded. This self-serve data distribution channel will be extended to additional data products in the future.

The quest for more and better mode frequency products has expanded to include the fitting of the *f*-modes and the introduction of asymmetric profiles into the standard PEAKFIND procedure. In addition, a subtle, systematic difference between the results from low-ℓ fitting using a leakage matrix correction and those from the standard PEAKFIND procedure are being investigated.

Good progress has been made on the construction of the GONG++ pipeline. Thanks to the efforts of Thierry Corbard, John Bolding, Cliff Toner, Deborah Haber, and Rick Bogart, we now have an operating and automated pipeline that begins with calibrated images from the sites and goes all of the way to flow maps. Along the way, the images are merged, subrasters are remapped and tracked, ring diagrams are created and fitted, and inversions of the fitted parameters are performed. Only one more step is needed to complete the pipeline—the construction of a synoptic flow map over a Carrington rotation. This will be done shortly, and we will then be in a position to regularly produce maps of the horizontal flows beneath the surface.

The next step in the GONG++ pipeline-plumbing job is the installation of a high-degree global analysis branch, at least to the production of the time series. However, the full scientific utilization of these products must wait for the development of a useful ridge-fitting algorithm. John Bolding will soon begin integration of the near-line hierarchical storage system into the pipeline.

As mentioned in the last *Newsletter* and elsewhere in this issue, Simon Kras and Rachel Howe found a small, unexpected discrepancy of about ¼-frequency resolution bins between the frequencies derived with and without leaks. We initially suspected a bug in the fitting code that applies the leakage matrix at low degree, particularly in the specification of the frequency range of the fit. However, a test in which this range was enlarged showed that there was no effect on the discrepancy. In addition, Rachel took our standard frequencies, did an *ad hoc* correction of ¼-frequency bins to the negative *m* frequencies, refitted the splitting coefficients, and repeated the rotation inversions with the altered coefficients. She found that this substantially improved the agreement between MDI and GONG for the inferred rotation rate below the convection zone, so it would be "nice" if there really *were* a discrepancy of ¼ bin! On the other hand, it also slightly degraded the agreement near the surface. For these reasons, now we are questioning whether there is some subtle problem in our standard peak finding code, specifically in the algorithm that selects the frequency range for the fit. We are very actively investigating this anomaly.

Rudi Komm, Cliff Toner, and John Bolding have placed 30 days of merged GONG+ images on an anonymous ftp area for use in local helioseismology comparisons. We are planning to have a workshop in the near future on this topic.

Caroline Barban has found that the velocity-intensity multispectral fitting method is apparently sensitive to the frequency range of the fit, and is experimenting with different methods of specifying the range. Frequency range fitting problems seem to be a common theme right now!

Richard Clark continues to work with Jack Harvey on the correction of the GONG+ magnetogram zero point. The current approach is to use the magnetogram calibration images at a single site to first produce the "best" magnetogram of the day. This image is then used to correct the rest of the data at that site. This works reasonably well, except for one thing—the "best" magnetogram also displays temporal variations in the large spatial scale pattern. We are working on a strategy to deal with this.