ABSTRACTS

15.06 Solar Granulation: Simulations versus Observations

N.E. Hurlburt (Lockheed Palo Alto Research Laboratory)

The results of observational and computational studies of solar convection have been converging over the past five years as the techniques and equipment have improved. Indeed, images of numerical simulations of granulation are now difficult to discern from observations. It is now feasible to use the results of numerical simulations to test the accuracy and validity of several observational techniques. We investigate how well the velocity fields deduced by correlation tracking techniques applied to the results of numerical simulations agree with the true velocities.

This work was supported by NASA contract NAS8-32805 (SOUP) and Lockheed Independent Research Funds.

15.07 On the Fractal Dimension of Granulation

J. Newbury, (Carnegie Mellon University, Pittsburgh, PA), S.L. Keil (USAF/Phillips Lab/Sacramento Peak)

The fractal dimension of the solar granulation can be used to distinguish between models of the turbulent flow in the solar atmosphere. Roudier and Muller (1986, Solar Phys. 107, 11) report a break in the fractal dimension of the granules at 1.37'' with \( D = 1.26 \) below 1.37'' and \( D = 2.15 \) above 1.37'', where \( P \sim A^{0.5} \) and \( P \) is the perimeter, \( A \) the area and \( D \) the fractal dimension of a granule. Roudier and Muller use a high-resolution image of the granulation taken with the 50cm refractor at Pic-du-Midi. Using data taken with the SOUP instrument on Spacelab 2, Title et al. (1986, Astrophysical Journal 316, 476) report they see no change in the granular properties at this scale. We report on an independent determination of the fractal dimension using a high-resolution granulation image made with the 70cm NSO/SF Vacuum Tower Telescope. Our data supports the conclusion that there is no break in the dimensionality of the granulation at 1.37''.

15.08 Granulation Spectroscopy: First Results from VTT–Tenerife

A. Nesis (KIS, Freiburg, Germany), A. Hanslmeier (University Graz, Austria), R. Hammer, R. Komm, W. Mattig, and J. Staiger (KIS)

We present series of spectrograms taken with the newly installed vacuum tower telescope (VTT) at Izaña (Tenerife) in June 1990. The spectrograms have an excellent spatial resolution and show many interesting details, such as strongly asymmetric granular flow patterns.

The high resolution allows us to study the distribution of the intensity as a function of structure size at different heights in the solar photosphere. Taking the power spectrum of the continuum as a reference, we compared the power of the intensity at different positions on the blue and red wings of several absorption lines. The investigation shows that the intensity power distribution at the red wing of a line changes for spatial scales \( A \leq 0.7 \) arcsec, whereas changes at the blue wing of the line are restricted to \( A \geq 0.7 \) arcsec. Since the blue and red wing of the line are partially influenced by upwards and downwards motions, respectively, we attribute these changes of the intensity power spectra to vertical motions in the atmosphere. The association of the downwards velocities with the small scales is not surprising. Unexpected, however, is the finding that the upwards motions seem to be constrained to scales \( A \geq 0.7 \) arcsec. This could be interpreted as the existence of a lower limit to the size of overhanging parts of solar granules. Equivalently, in velocity space intergranular regions appear to be constrained to scales smaller than this limit.

15.09 Convective Flows around Sunspot-Like Objects

Peter A. Fox, Sabatino Sofia (Yale/CSMR), and K. C. Chan (NASA/SGFC)

Results are given for calculations of convective flows around objects in the outer layers of the Sun that have similar characteristics to small sunspots, using numerical models for a fully compressible convection zone. The objects are allowed to radiatively (diffusively) exchange heat with their surroundings, but convective motions within them are absent. This assumption is based on the presumption that a sunspot magnetic field maintains pressure equilibrium with the surrounding medium and prevents convective exchange with that medium.

After a period of adjustment, shortly after the sunspot-like object is placed into the domain, the layer readjusts itself so that most of the heat flux actually reappears at the surface, although some fraction of the flux is carried horizontally far from the object. There is no indication of long-term storage of the heat flux that would normally appear in the place where the object resides.

Finally, when the object is removed, the surrounding medium responds very quickly and soon returns to the original undisturbed state. Since our sunspot is treated crudely, and is somewhat smaller than a real sunspot, a discussion of the applicability of our results to real solar conditions will be presented.

This work is supported by NASA (NAGS-486) and the USAF (AFOSR-91-0053).

15.10 Power Spectra of Flows and Magnetic Fields in the Solar Photosphere

T.D. Tarbell, G.L. Slater, Z.A. Frank, K.P. Topka (Lockheed PARL), G. Scharmer (SSO), and W. Schmidt (KIS)

We present spatial and spatio-temporal power spectra of measured velocities and longitudinal magnetograms with high resolution for various photospheric regions. These spectra are of interest in models of convection and magnetoconvection, transport of magnetic flux, and generation of coronal fine structure by an MID turbulent cascade. Horizontal velocities are measured by correlation tracking of granulation in continuum movies, including SOUP movies from Spacelab 2 and several movies from ground-based observatories. The divergence and curl of these give a pseudo-vertical velocity and vertical component of the vorticity, respectively. Doppler velocities and magnetograms come from La Palma observations with the SOUP/OSL instrument. The observed spectrum of magnetic fields is compared with the spectrum of an advected passive scalar (i.e., cork pattern) in the observed velocity field.

This work was supported by NASA contracts NAS8-32805 (SOUP), NAS8-38106 (BSOUP), NAS8-26813 (OSL), and Lockheed Independent Research Funds.

15.11 On the Dissipation of Magnetic Fields in the Solar Convection Zone


A key ingredient for any dynamo theory is the efficient dissipation of magnetic fields. Both mean field theories, and current self-consistent models of the solar dynamo rely on turbulence to increase the magnetic diffusivity substantially above its molecular