Plan for Assessment of Seismic and Magnetic Correlations

The overall plan is to compare, for each half day, seismic signatures in a sector in the far hemisphere spanning approximately 13.3° in longitude, i.e., one day times the mean synodic Carrington rotation rate (see Fig 1), with magnetic signatures ($|\mathbf{B}|$, $|B_r|$), in the region in the near hemisphere to which this sector will have rotated a few days thence, over a latitudinal range of ±60°.

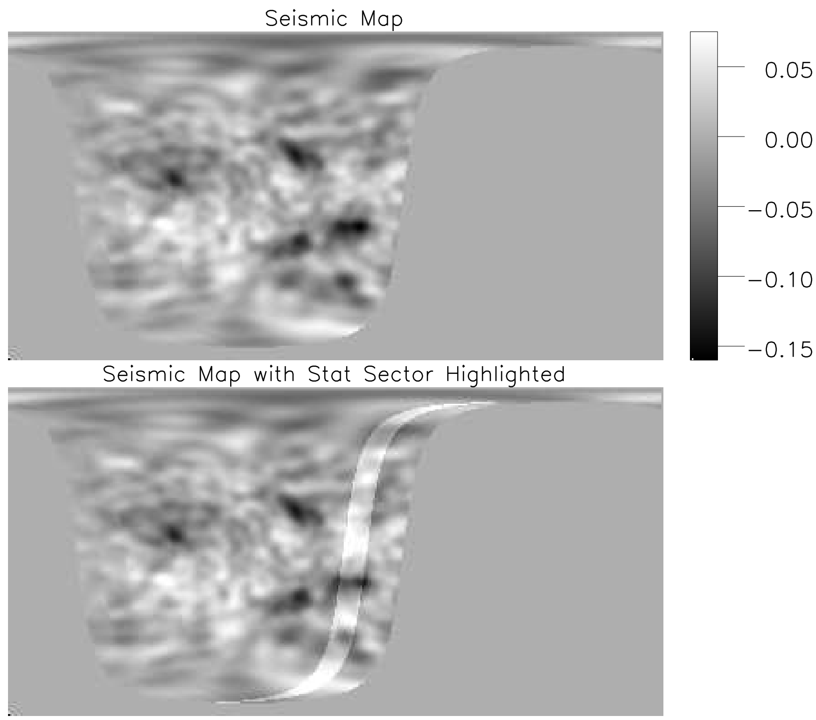

Figure 1. Map of a 1-day "reference sector" in the Sun's far hemisphere to be correlated with magnetic signatures to appear when visible from Earth. Top frame shows seismic map of the far hemisphere on 2011 March 20.0. Bottom frame shows the same with the reference sector whose center is two days before crossing the limb into direct view from Earth.

In order to make the comparisons with subsequent magnetic signatures, the Carrington-rotated seismic maps are to be projected onto the magnetic maps as viewed by HMI. This avoids interpolation errors, which are large for the high-resolution vector-magnetic maps and small for the low-resolution seismic maps, on account of their relative smoothness.

The tentative plan is to make the comparisons in various latitudinal ranges ∼4 days after the date of the seismic maps, with control comparison 8.5 days after the seismic maps, when the reference sector is crossing the meridian in the near hemisphere. The control case is the easiest to show graphically, because the projection in the near hemisphere is spread over a greater area. This is shown in Figure 2.

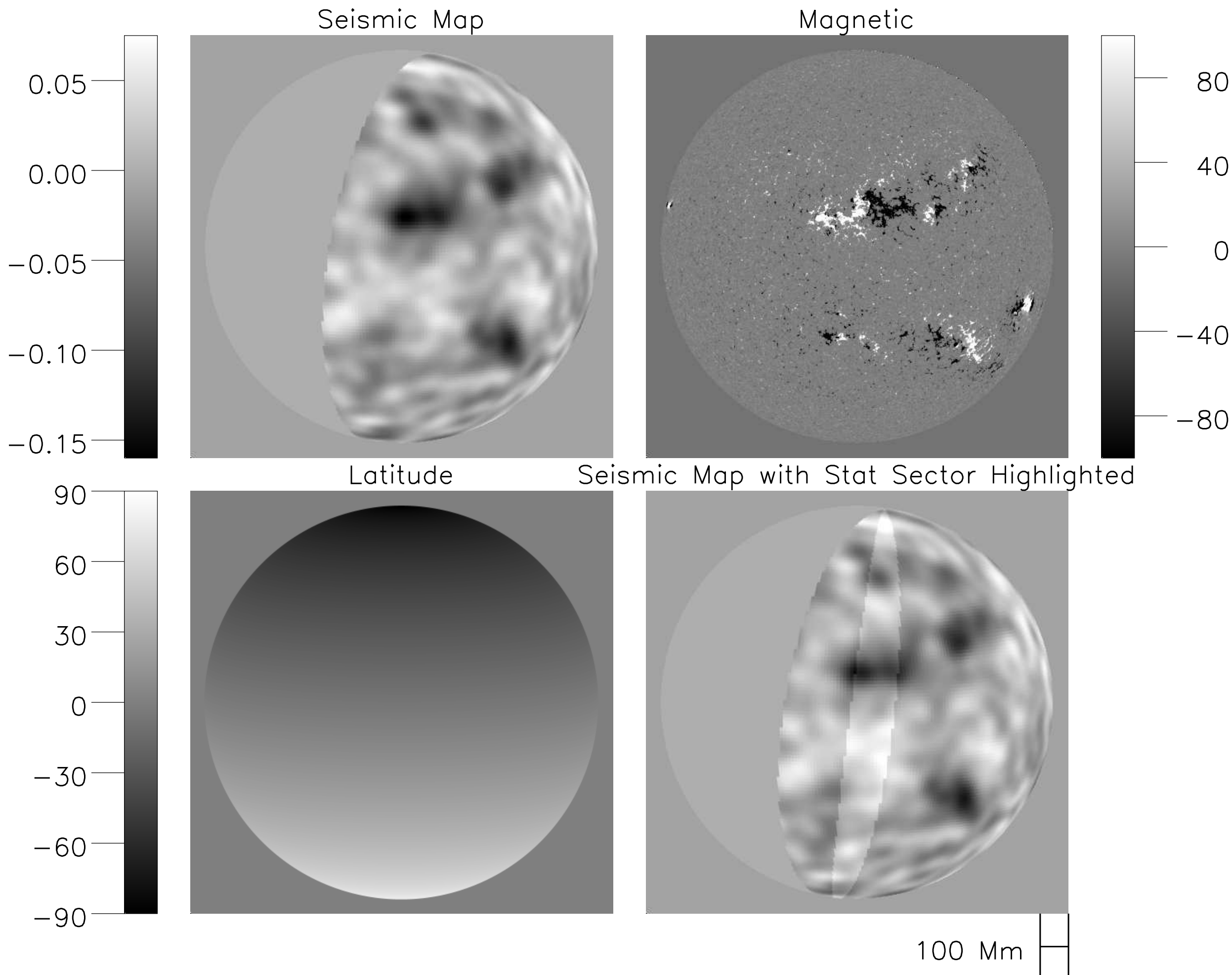

Figure 2. Carrington-rotated seismic map in longitude-latitude format in Figure 1, 2011-03-20 is projected onto SDO/HMI's view of the region in the near hemisphere 8.5 days thence (top left), i.e., at 2011-03-28.5. The HMI line-of-sight magnetogram for that moment is rendered in the top-right frame. A cospatial map of the latitude is shown at bottom left. Note that the image is inverted, with the north pole at the bottom of the image. Bottom right frame shows the seismic map with the reference sector highlighted.

The case for the 4-day delay (2011-03-24.0) from the reference date (2011-03-20.0) is shown in Figure 3. at this point the reference sector lies in a thin crescent just inside the Sun's eastern limb, at right in HMI's reference frame.

The advantage of the correlations with a 4-day delay is that changes in the magnetic configuration—particularly those due to the emergence of new magnetic flux—are minimized. The advantage of the correlations with a 8.5-day delay is that errors in the radial component of the magnetic field are considerably reduced, as is loss of spatial discrimination due to foreshortening.

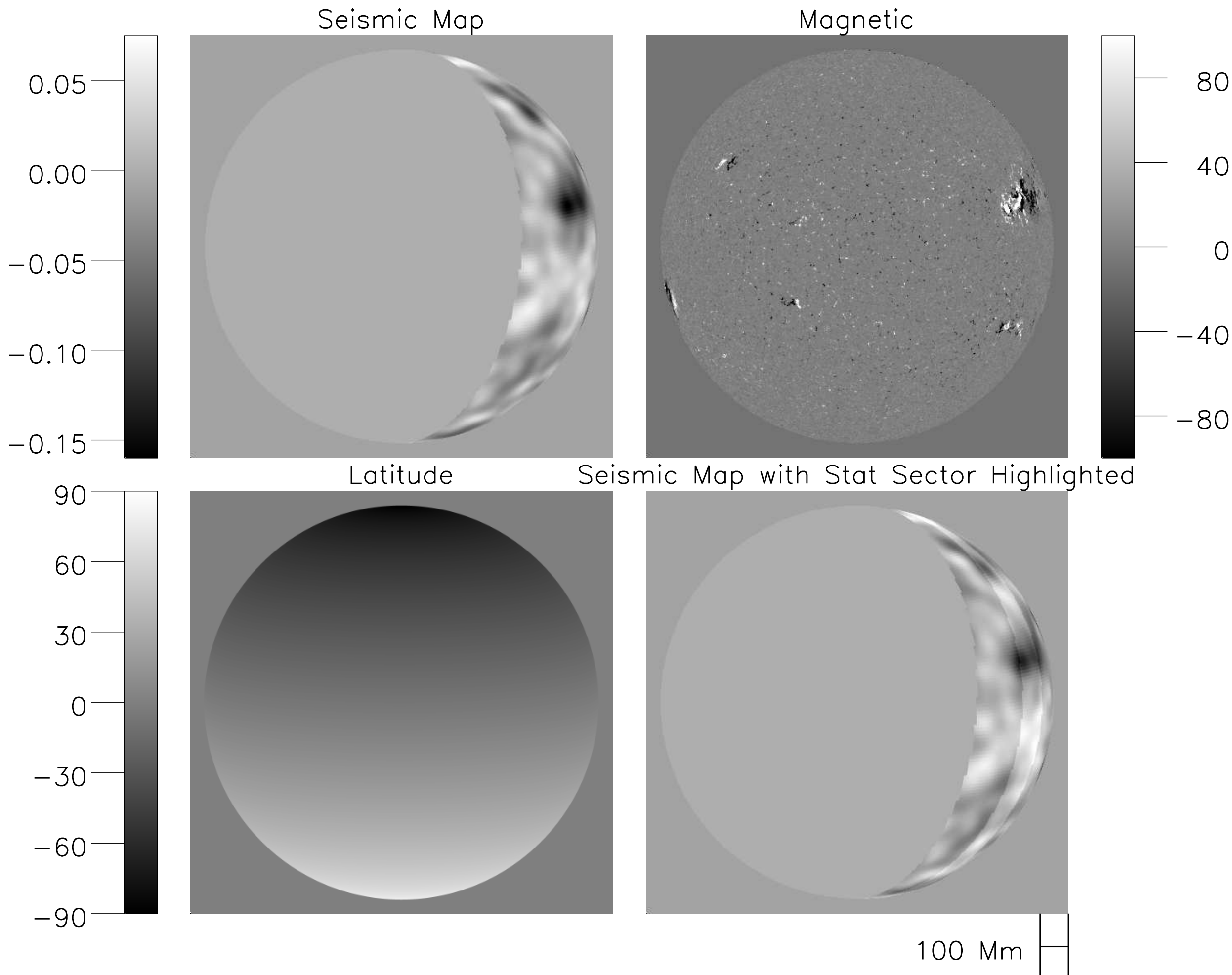

Figure 3. Same as Figure 2, but the seismic map is Carrington-rotated only four days (2011-03-24.0) from the reference date (2011-03-20.0), at which point the reference sector lies in a thin crescent just inside the Sun's eastern limb (keeping in mind that the HMI map is oriented so that north is almost directly downward).

Plan for Update of Assessment of Seismic and EUV Correlations

The plan for this is to rerun the statistics presented in the Second Interim Report with the new FITS maps of STEREO HeI 304-Å-intensity maps computed for Paulett by Jeff Hall (JPL). Paulett sent us these maps for 2011 last week. Figure 3 shows a scatter plot of the seismic and EUV-intensity signatures for these data. These correlations look roughly consistent with the ones in the Second Interim Progress Report. However, the maps are obviously nicer, having a much finer discrimination in intensity and not subject to saturation in bright regions as the previous maps (reconstructed from JPEG images) were. Paulett sent us the last of the maps for 2012 just this morning.

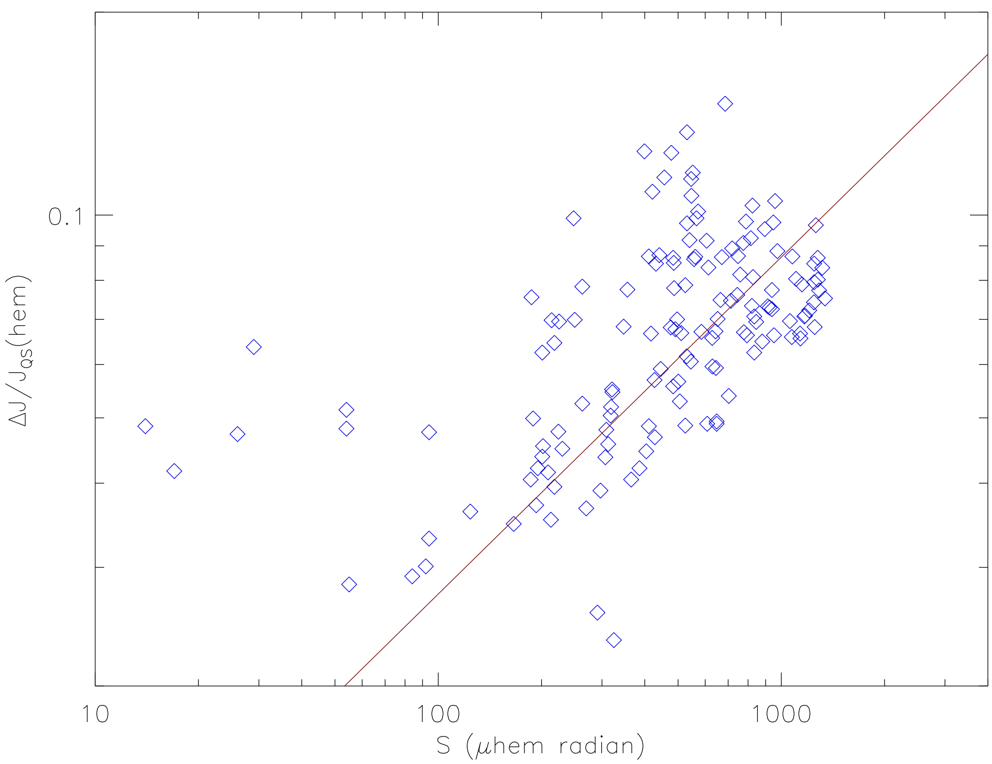

Figure 3. Scatter plot of seismic strengths, S (abscissa), and EUV radiances (J—normalized to the mean quiet Sun integrated over the near hemisphere—ordinate) Magneta-colored curve shows eyeball fits of data points to a curve that equates J to a constant times the square root of the seismic signature.