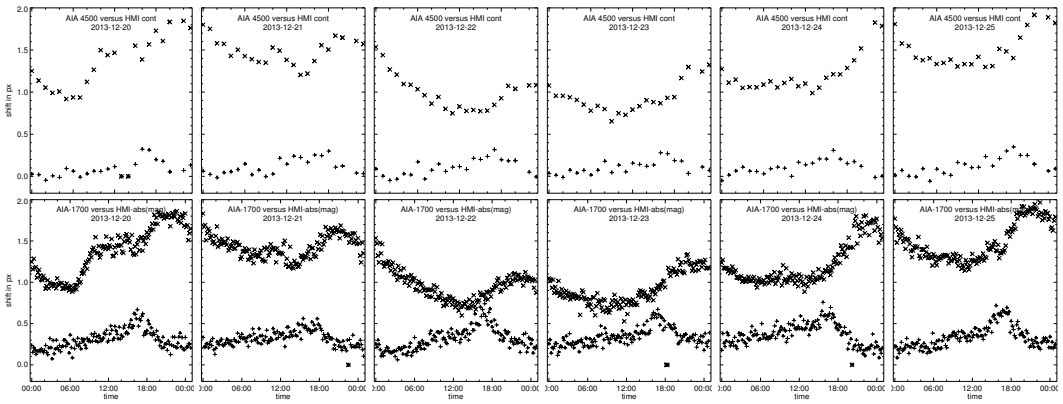
Spatial AIA – HMI offsets



Spatial offsets between AIA and HMI diagnostics during consecutive days (dates specified in each panel; times in UT). The measurements used cross-correlation between the 512×512 px central parts of full-disk images. Units: AIA pixels (0.6 arcsec). Upper row: between AIA 4500 and HMI continuum images at 60-min cadence. Lower row: between AIA 1700 images and HMI magnetograms at 10-min cadence. Cross signs: offset in X. Plus signs: offset in Y (lower curves).

The 1700 Å images were lower-limit clipped to roughly reduce the effect of acoustic internetwork grains. The HMI magnetograms were converted to absolute value with values above 750 Gauss replaced by the mean value to roughly undo the reversed 1700-field contrast in umbrae.

Values equal to zero (asterisks when both X and Y) are for times when the file download failed.

The 4500-continuum comparison sometimes gave weird results and these also differed between repeated runs of the same program for the same day. Some have to do with failed file transfers (using the SSW "`vso_get`" command which I found erratic and unreliable); others I don't understand. The upper plots are selected cases taken from multiple runs, selecting days with non-weird results.

The 1700-magnetogram comparison seems more robust, but it is noisier. Earlier tests showed that applying such 1700-magnetogram offset values does reduce the small-scale jitter in blink movies.

The figure suggests:

1. during these days there were varying AIA–HMI offsets of 1-2 px in X and 0-0.5 px in Y;
2. the 4500-continuum and 1700-magnetogram comparisons agree very well (when the first functions properly), except that
3. there seems to be a small fixed offset in Y between AIA 1700 and 4500;
4. the measurements have noise of order 0.1 px for 4500-continuum, 0.2 px for 1700-magnetogram;
5. there are daily variations that may have a fixed pattern but not clearly for X. The Y offsets seem to peak around SDO noon (about 19:00 UT, time of largest Earthshine), with a slow rise and a faster decay.

I now use a single-moment large-field 1700-magnetogram comparison of this type in co-aligning small-field "im_patch" cutouts from JSOC and this correction seems to help, but some leftover subpixel jitter usually remains. (I don't want to do multiple large-field comparisons because my game is to obtain and process only small cutouts, for download and storage optimizaton.)

I remove the remaining jitter by co-aligning the time averages of my AIA 1600 and HMI magnetogram cutout sequences each to the AIA 1700 cutout sequence. I then apply the magnetogram shifts also to the HMI Dopplergram and continuum cutout sequences. Note that the height of formation difference of about 300 km may upset such magnetogram–1700 alignment near the limb.

I see no easy way to automatedly co-align the AIA EUV channels with the UV and visible diagnostics. Dark filamentary features caused by bound-free neutral-hydrogen scattering common to all (even 304) may serve to inter-align these but I haven't worked on that.

The programs that collected these data and made these plots are [were earlier versions of] the ones with "shift" in their names at `http://www.staff.science.uu.nl/~rutte101/rridl/sdolib` where I also post my other SDO cutout processing programs, together with a brief instruction.

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