Visualising Astronomy: Let the Sun Shine In

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Key Words

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I grew up in Arizona, so I like to believe I have a natural affinity with the Sun. (Let's just say that San Francisco doesn't afford quite the same experience of our nearest star.) Even if I weren't already so inclined, however, I think the recent images from the Solar TErrestrial RElations Observatory (STEREO) and Solar Dynamics Observatory (SDO), among others, would certainly win me over.

Right now, you can get your solar imagery fix by heading over to the STEREO website[1] or its SDO counterpart[2]. The SDO homepage sports an intuitive viewer showing "The Sun Now", so you don't need to click through a bunch of separate images. Eventually, it seems that the slick Helioviewer software[3] will support SDO data, but for the moment, it's all SOHO, all the time. There's at least one truly innovative interface to some imagery, however...

3D Sun, a simple but spiffy iPhone app from the STEREO team, allows you to interact with the latest data from the twin spacecraft (Figure 1). It pretty much works as advertised on the website: "You rotate the Sun with your finger to view it from any angle. You pinch in and out to zoom in for a closer look at the Sun's ever-changing surface"[4]. The three-dimensional features become smoothed out, alas, so one loses the sense of prominences and flares and filaments and all the messiness that makes solar imagery so enchanting. I find it slightly ironic that an app promising a "3D Sun" actually flattens the Sun's most engaging three-dimensional attributes. But ultimately, I feel quite satisfied, spinning a little sphere wrapped in the latest solar data while waiting for the bus or train. Just because I can't see the Sun in the sky doesn't mean I shouldn't enjoy it on my smartphone. The 3D Sun app also provides regular announcements about solar conditions and space weather: at the time I'm writing this, a coronal mass ejection is making its way towards Earth, so folks in the northern hemisphere can mark their calendars for some impressive aurorae.

To get a real sense for the lush garden of structures that spring from the Sun's surface, it helps to seek out moving imagery. The dimensionality of the data becomes evident when you see material travelling along the magnetic field lines — or observe the slight parallax shift of relatively static structures moving with the Sun's rotation.

The first time I had this kind of experience was watching imagery from the Transition Region and Coronal Explorer (TRACE) mission back in 2000, when I sat in an SGI Reality Center (basically a high-resolution, all-digital Cinerama set-up, quite sophisticated for the time) and watched the limb of the Sun appear to rotate in front of me. Captivating. I could have sat there all day.

I had a similar feeling, albeit in a less immersive environment, when I first saw clips from the Hinode spacecraft[5]. The Sun's surface, as it turns out, appears to have been poorly executed with a CGI particle system by a second-rate visual effects house. At least that's what I thought when I first saw the movies: "Wow, that's cool. Sure looks fake." I mean, really, if I'd seen something similar in a planetarium show, I would have dissed it.

The video coming from SDO elicits a different response. Now, the spatial and temporal resolution seem sufficient to provide a sense of realism, and the hot plasma arcing along magnetic field lines has a "weight" to it that earlier, more sped-up movies lacked. (Either that, or the Sun went to a better visual effects house for its new look.) So

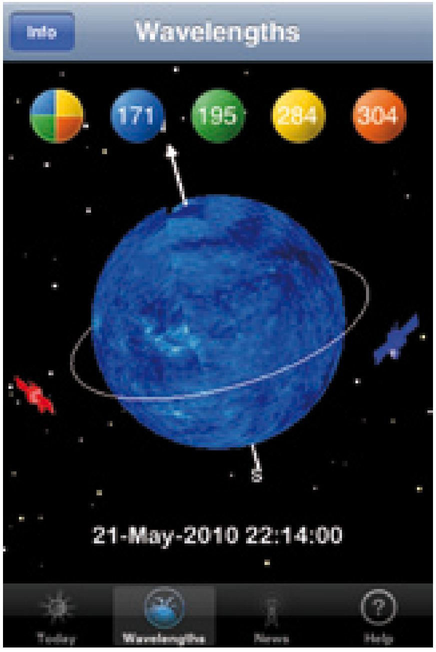

Figure 1. The simple, sweet interface for the 3D Sun iPhone app from NASA's STEREO mission. Note the option to select from four wavelengths at the top of the screen. Credit: NASA/STEREO.

run, don't walk, to your nearest computer and start watching movies! For better or for worse, YouTube seems to have become the preferred distribution mechanism for SDO movies[6]. Yeah, YouTube supports HD and blah blah blah, but the compression in the movies always bugs me, and the SDO imagery deserves better: particularly for the educational and public outreach (EPO) community, we need a high quality outlet for this extraordinary media.

The one thing that bugs me about the SDO images? The colours. If you look at the imagery offered up by the SDO "Sun Now" menu (Figure 2), the colour palette just feels weird, chaotic.

In case you don't feel similarly, take another look at that 3D Sun interface (Figure 1). The three little circles above the model of the Sun correspond to the bandpasses of the instrument at 171 Å, 195 Å, 284 Å, and 304 Å. Note that the colour-coding goes from blue to green to yellow to orange in what we'd call chromatic order, in which the choice of representative colour increases in wavelength along with the data. Most EPO imagery follows this convention. SDO flaunts it.

Of course, three or four colours spread out over the spectrum rather easily, and the STEREO approach adopts a straightforward solution. SDO's Atmospheric Imaging Assembly (AIA), on the other hand, provides continuous snapshots of the Sun in no less than ten bandpasses! (For the exhaustive list, take a look at the caption for Figure 2.) The breadth of coverage offers a serious challenge for assigning a range of chromatically ordered colours, but SDO's solution defies any logic I can discern. To complicate matters, the imagery isn't even presented in order of wavelength, so I'm left with an impression of total disorder.

The other oddity is the combination of saturated and (to use Robert Hurt's word) "pastel" colours they chose to employ. Typically, if one were creating a composite from several images, one would use a saturated colour for each bandpass. (To understand what I mean by saturated, think of the little wheel that pops up when software asks you to pick a colour: saturated colours are along the circumference of the wheel, not its interior.) Then, when you create a composite image from the various constituents, you're maximising the colour space in which information resides. Rector et al. (2007) provides an excellent (and exhaustive) introduction to image processing for EPO applications[7], or if you prefer not to delve into such a magnum opus, take a look at Hubble's "Behind the Pictures" page about the meaning of colour[8].

Whatever the motivation, the meaning of SDO's colours leaves me baffled. And although I tried to contact the folks who run the gallery, I haven't had any luck getting answers to my questions. (I may have to do a follow-up if I learn more, so watch this space.)

Here in the foggy City by the Bay, I'll take the Sun however I can get it. If not in the blinding heat of a desert sky, then in the soft glow of my computer monitor. Or my iPhone.

Notes

[1] http://stereo.gsfc.nasa.gov/gallery/gallery.shtml

[2] http://sdo.gsfc.nasa.gov/data/

[3] Available as a Java application at http://www.jhelioviewer.org/ or via an online interface at http://www.helioviewer.org/

[4] http://3dsun.org/

[5] http://solarb.msfc.nasa.gov/news/movies.html

[6] http://sdo.gsfc.nasa.gov/gallery/youtube.php

[7] T.A. Rector et al. 2007, *Image-Processing Techniques for the Creation of Presentation-Quality Astronomical Images*, Astron.J., 133, 598 (available online at http://arxiv.org/pdf/astro-ph/0412138)

[8] http://hubblesite.org/gallery/behind_the_pictures/meaning_of_color/index.php

Biography

Ryan Wyatt is the Director of Morrison Planetarium and Science Visualization at the California Academy of Sciences in San Francisco, California, USA. He writes a sadly irregular blog, "Visualizing Science," available online at http://visualizingscience.ryanwyatt.net/.

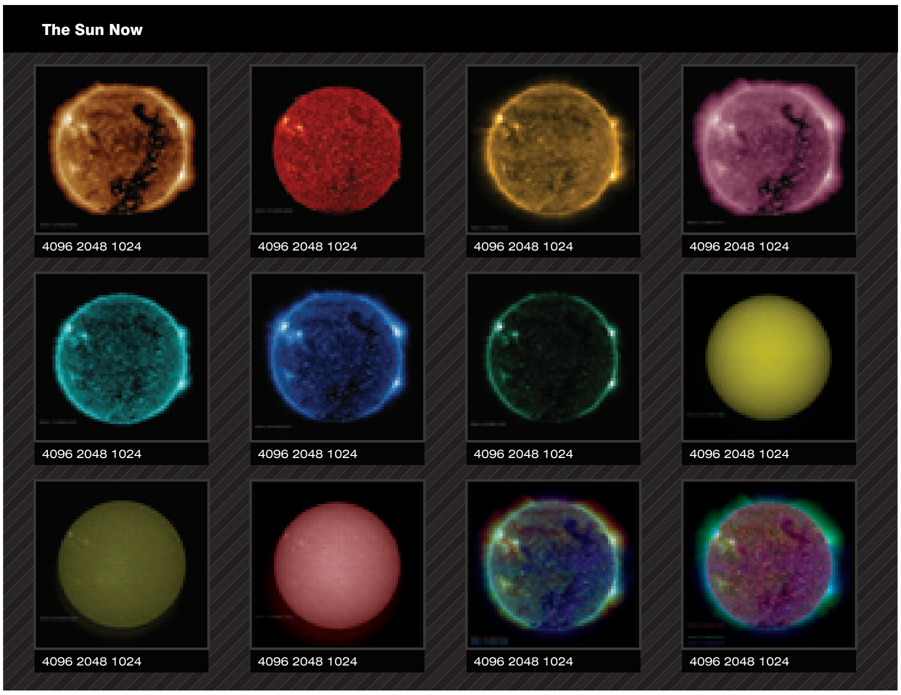

Figure 2. A screenshot from the SDO website, serving up the latest mission data. The dozen images, from upper left to lower right, represent data at 193 Å, 304 Å, 171 Å, 211 Å, 131 Å, 335 Å, 94 Å, 4500 Å, 1600 Å, 1700 Å, composite (211 Å, 193 Å, 171 Å), and composite (304 Å, 211 Å, 171 Å). Credit: SDO.