

PhenoCam Troubleshooting Tips

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We have put this document together to help you resolve potential questions you may have or issues you may be experiencing. Please read through the entire document before emailing us with questions—but if something isn't covered here, let us know and we'll get it added. Please note that we are a small team and we don't have the capacity to provide extensive support; if you don't have expertise with networking, power over ethernet, ftp, telnet, etc. then we recommend you work with your institution's IT specialist to get the help you need.

This list is broken down into the following categories:

- (1) Setting up your camera
- (2) Issues that may arise after setup
- (3) How to access data and images
- (4) General questions about cameras, images, or the PhenoCam web page

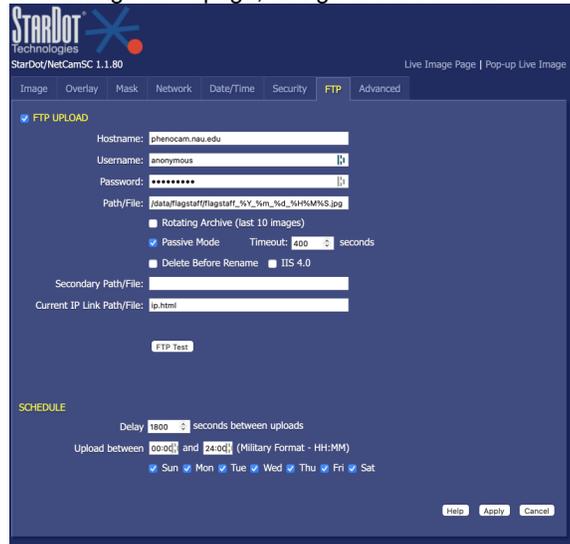
| Category | Question | Answer |
|---------------|---|---|
| (1) Set-up | Is there a way to manually trigger an image upload to the PhenoCam server? | Yes. First, see the above instructions on how to telnet into your camera (What if I don't see that the "login successful" and "transfer complete" messages when I test my FTP connection?). Log in to your camera via telnet, and then from the command prompt type "sh phenocam_upload.sh." This will execute the shell script and upload an image to our server. |
| (1) Set-up | Why are the images sent at random times (not at :00 & :30)? | This is intentional. When the camera is configured with the PIT, the upload schedule is randomly offset from the half hour by a few minutes so that not every camera in the PhenoCam network is trying to simultaneously send images to our server. |
| (1) Set-up | Why is my camera sending an image in the middle of the night? Is there something wrong? | This is also intentional. The camera automatically reboots itself every night. This allows the camera to re-check its network connections and also to reset in the case of an internal malfunction or error. Because the PIT configures each camera to send an image on reboot (which makes upload scheduling easier for off-grid sites where the camera is switched on and off during the day), our server receives an image, usually black, from most cameras around midnight. Don't worry about it! It's a sign your communications are working. |
| (1) Set-up | I want to do something different from the standard set-up. Is that allowed? | We strongly discourage using any non-standard set-ups, unless you have the expertise and familiarity with how the camera works, networking, scripting, etc. to figure out all the components of the custom setup yourself. Non-standard set-ups have proven to be non-trivial. Unfortunately, we don't have the resources to provide additional troubleshooting for such cases. |
| (1) Set-up | How do I turn off the LED light on the camera to reduce reflections? | See pages 19 & 20 of the StarDot NetCam manual: https://stardot.makekb.com/file/63/?f=1 |

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| (1) Set-up | Why didn't I receive an email once my site was set up on the server? | The set-up email will be sent to the email addresses provided in the site survey form, and NOT to the email associated with the google account used to fill out the form. Please also check your spam folder. We have also found that many email addresses are entered incorrectly! |
| (1) Set-up | Do I need a reference panel in the camera's field-of-view? | We recommend using a reference panel only to monitor image-to-image variability in the incident solar radiation. We have not found that using the reference panel to normalize the DN values is useful (i.e., it doesn't improve the GCC data). We have yet to identify a reference panel that is low-cost and at the same time would be useful for calibration or standardization—let us know if you figure something out! |
| (1) Set-up | Why isn't my new site appearing on the website? | Initially, site pages are "hidden", and the only way to view the images is through the "latest" link (<a href="https://phenocam.nau.edu/data/latest/<sitename>.jpg">https://phenocam.nau.edu/data/latest/<sitename>.jpg). Because of privacy concerns, we do this so that photos of your lab, office, or home living room are not posted to our server. Once the camera is set up in the field, please send us an email (phenocam@nau.edu), and we will make the site page visible in the gallery. We can also delete images recorded before the field-setup was complete. |
| (1) Set-up | I am using a cell modem to send images from my camera. Can I remotely access the camera? | You will need to set up port forwarding on the modem. This requires some knowledge of networking, and how this port forwarding is done is different on every modem. Please refer to your modem's instruction manual. Done correctly, you will be able to remotely access the modem's configuration pages. BUT we recommend you do not leave this access turned on when you don't need it, unless you either incoming IPs to a narrow range (e.g. institution addresses) — We've seen cameras get hacked and many GB of data streamed over the cell modem, resulting in cell phone bills of thousands of dollars. |
| (1) Set-up | How do I upload images to my own FTP server, in addition to the PhenoCam server? | There are two ways to do this. One is to add a second server address in the server.txt file, as described here: https://bluegreen-labs.github.io/phenocam_installation_tool/ . The other is to configure the ftp upload page on the camera's web server, as described in the StarDot manual. Keep in mind that we do not have the resources available to provide extensive support or troubleshooting for each site. |

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| (1) Set-up | I ran the PIT but am not sure it worked. How do I tell? | <p>A few minutes after you execute the PIT script, you should see:</p> <pre> Saving configuration files... Configuration files saved. #----- # # Done !!! - close the terminal if it remains open ! # #----- </pre> <p>If you don't see the "DONE" message, the process was **not** successful.</p> <p>There are many possible reasons for the PIT not running correctly. These include:</p> <ol style="list-style-type: none"> 1. Your camera doesn't have an outgoing network connection (note: you CANNOT run the PIT with your camera plugged directly into the network port on your computer). 2. Two way traffic (camera pulling data from the PhenoCam web server; camera pushing data to the PhenoCam FTP server) to the camera is blocked by the local network (solution: talk to institution's IT specialist). 3. Your slow internet connection is timing out (don't try to run the PIT on a weak cell modem connection; do it in the lab or at home and ensure everything is functional). 4. You made a mistake in the specification of the camera settings when you called the PIT script (there is little or no error checking, so a missed or incorrect parameter setting will cause problems). Check your syntax and try again. 5. You don't have telnet installed on your computer. See "What if I don't see that the "login successful" and "transfer complete" messages when I test my FTP connection?" for instructions. 6. Your computer and camera are on different networks (e.g. computer is on wifi, and the camera is plugged in to an ethernet socket). <p>Note that sometimes a second attempt to run the PIT script will solve your problems.</p> |
| (1) Set-up | I want to run my site on solar power. How big a panel and battery do I need? | <p>This is a very difficult question to answer because the weather and amount of sunshine at each site is different, and also it depends on what other devices you are powering off the same panel and battery system. We recommend contacting a dealer such as Northern Arizona Wind and Sun (https://www.solar-electric.com) and asking for help in designing a system. Make sure you have a proper solar charge controller (we recommend one with low voltage disconnect) and, also, err on the side of over-sizing your system. Do not try to get by with a small panel and a car battery—this is guaranteed to lead to frustration.</p> |
| (1) Set-up | I want to use a cell modem at my site. What kind of modem should I use? | <p>We have had good experiences with Sierra Wireless modems, specifically the RV50x. But, there are a lot of options out there, and the best solution may depend on your site location and your local cell providers. We have purchased equipment from Craig King <cking@discountcell.com> in the past, and recommend reaching out to him to find out about the latest hardware.</p> |
| (1) Set-up | How do I configure my modem so I can access my camera remotely? | <p>We can't provide guidance on this as there are too many variables (modem make and model, cell phone company, other network devices, etc.). You'll have to work through your modem's manual, and seek help from your organization's IT specialist. But, you will definitely want to request a static IP address for the modem from your cell phone company, and you will need to set up port forwarding on the modem so you can access the camera. Be careful about security settings, as you do not want to allow everyone around the world to stream images from your camera, or you will use up an enormous amount of cell data.</p> |

(1) Set-up If my site is still hidden, is there still a way to see the latest image? A properly-configured camera should regularly send images to the PhenoCam server. The latest image will always be displayed at: `http://phenocam.sr.unh.edu/data/latest/<sitename>.jpg` where `<sitename>` is the name of your site. Images may take 15–30 minutes to appear. The “latest” image is only updated if the image is not too dark. So for testing, make sure the lens cap is off and the camera view is well lit.

(1) Set-up Is there a way to test whether my FTP connection to the NAU server is working? There are a few ways. Here’s a relatively easy way. Connect to your camera’s web configuration page, and go to the FTP tab.



Enter the hostname `phenocam.nau.edu`, username `anonymous`, password `anonymous`. For path/file, enter `/data/<sitename>/<sitename>_%Y_%m_%d_%H%M%S.jpg`.

Then hit the “FTP test” button. You should see text like:

```
220 (vsFTPd 3.0.3)
331 Please specify the password.
230 Login successful.
...
200 Switching to Binary mode.
227 Entering Passive Mode (134,114,138,125,233,59).
150 Ok to send data.
#####
226 Transfer complete.
279964 bytes sent in 0.332 secs (823.08 Kbytes/sec)
350 Ready for RNT0.
250 Rename successful.
221 Goodbye.
```

Do not leave the “FTP Upload” box checked, or it will conflict with the crontab settings programmed by the PIT.

(1)
Set-up

What if I don't see that the "login successful" and "transfer complete" messages when I test my FTP connection?

If you do not get the "login successful" message, try replacing the domain name phenocam.nau.edu with the IP address 134.114.138.125. Then hit the "FTP test" button again. If you can connect to our server with the IP address but not with the domain name, then there's a problem with the camera's DNS settings.

If you still cannot connect to our server, try the following:

- 1) Can your computer, connected to the same network, access a web page like Google? If not, then your network probably is offline (i.e. you don't have an outgoing connection). Talk to your organization's IT specialist.
- 2) Connect to your camera via telnet. You will likely have to install a telnet client on your computer, as this has been disabled in most current operating systems. First, Google "install telnet windows" (and follow instructions to "turn windows features on or off") or "install telnet Mac OS" (and follow instructions to install using homebrew). Once you have telnet installed, go to your command or terminal prompt, and enter "telnet <your camera's IP address>". Login with username and password, and then enter "ping 8.8.8.8" and "ping google.com". You should see output similar to what is below, indicating a successful response from the server. If instead you get a timeout message, then your network is offline or your camera's outgoing traffic is being blocked. Talk to your organization's IT specialist.

```
% telnet 192.168.1.128
Trying 192.168.1.128...
Connected to 192.168.1.128.
Escape character is '^['.
```

```
netcamsc login: admin
Password:
```

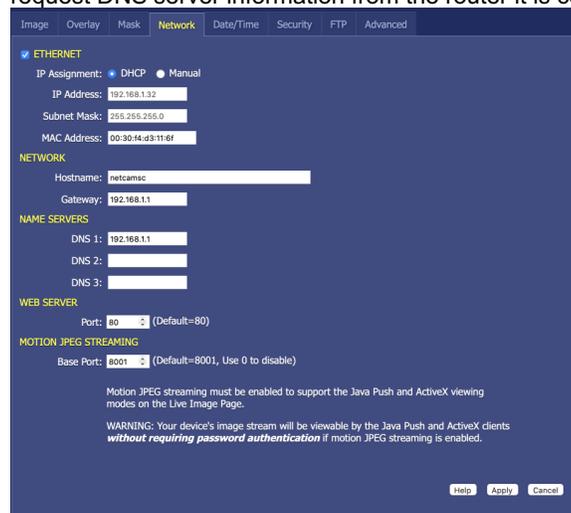
```
BusyBox v0.60.0 (2013.11.14-19:38+0000) Built-in shell (msh)
Enter 'help' for a list of built-in commands.
```

```
[~]# ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8): 56 data bytes
64 bytes from 8.8.8.8: icmp_seq=0 ttl=55 time=27.9 ms
64 bytes from 8.8.8.8: icmp_seq=1 ttl=55 time=45.7 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=55 time=31.0 ms
```

(1)
Set-up

What if I can connect to or ping an IP address (8.8.8.8) but not a domain name (google.com)

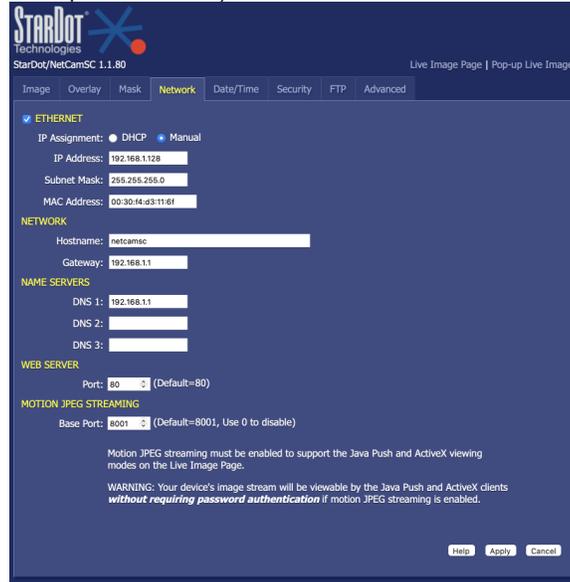
This can happen if your network is blocking access to the DNS server (Google's DNS server, 8.8.8.8) programmed into the camera by the PIT—the camera can resolve 134.114.138.125, which is the IP address for the domain name phenocam.nau.edu. We have found that *some* university networks expect devices to use the University's own DNS. If this is the case, then clear out the DNS1 server entry on the "network" tab, and hit apply. This should force the camera to request DNS server information from the router it is connected to.



(1)
Set-up

How do I give my camera a static IP address?

Sometimes you will want to enter a static or fixed IP address on your camera. That way, the camera doesn't need to be "given" an IP address by the network router each time it boots up; it knows its own IP address (on the Network settings tab, shown below, IP assignment would be set to manual rather than DHCP) already. This can be particularly useful if, for example, your camera and modem are only turned on periodically to enable image uploads (usually the camera will boot up faster than the modem, and without a static IP address the camera will end up kind of "lost").



You should make sure that the fixed IP address programmed into the camera is also programmed into your modem or router and assigned to the camera's MAC address (there is usually a tab on the router's configuration page, "Static IP Reservation" or something similar). Seek help from your organization's IT specialist if necessary.

Note that a static IP can cause problems if that camera is then moved to another network with different IP address settings or different IP address availability. If you can't connect to the camera on a new network, resetting to factory defaults is always one option and it usually achieves the desired results — but the camera will have to be reconfigured using the PIT before it will again send images.

(2) Issues arising

My camera shifted and the ROI is no longer correct. What do I do?

Please email us (phenocam@nau.edu) to make us aware of the camera shift and we'll adjust the ROI mask. Note: we recommend periodically checking all your mounting hardware to minimize the likelihood of camera shifts, as these have the potential to greatly reduce the quality of data we can get from your images.

(2) Issues arising

How many site contacts will be notified of site issues?

In the event that your camera doesn't send any images for 3 days, our system will automatically send a message to the 2 site contacts who were identified in the initial site survey. Our database is not set up to handle more than 2 contacts.

(2) Issues arising

Is it a problem that we are occasionally missing a few images?

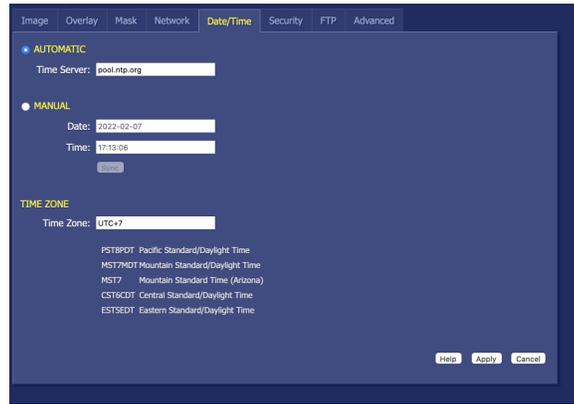
At most sites with a good internet connection, we usually get all of the expected images, though occasionally 1 or 2 drop out on a given day. We generally do not worry about that—if we're getting 90% of the expected images in any week-long period, there is no reason for concern. While it might be nice to have the missing images, they don't add much to our understanding of phenology or changes in vegetation or canopy structure. You will get an automated email if we go 3 days without receiving an image from your camera.

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| (2) Issues arising | What do I do if I need images removed from the archive (pictures of lab, camera fell/moved)? | Please email us (phenocam@nau.edu) with a list of the images (or a range of dates if there are a lot of those images) to remove and we'll take care of it. |
| (2) Issues arising | My camera was sending images to the PhenoCam server at NAU, but I received a notification that no images have been received in 3 days. Help! How do I figure out what's wrong? | <p>If your camera stopped sending images to the PhenoCam server, or if something else seems wrong, here are basic troubleshooting tips:</p> <ol style="list-style-type: none"> 1. Are the camera's power supply plugged into the wall, and is the camera's network cable plugged into an outlet with functioning network access? 2. Check power — is the green light on the front of the camera on? Is it an orange light? Is there no light? 3. If the front light is green—good. If the front light is orange—the camera isn't powering up properly and there is probably internal damage to the camera from lightning or other power surge. Contact Anthony Watts anthony@stardot.com and arrange for an RMA and repair (usually \$75, though sometimes not repairable). 4. If there is no light and the camera is powered by 12V DC through the barrel jack on the back of the camera, is the jack delivering 12V with the correct polarity? Does another 12V device plugged into the same power source turn on properly? If the camera is powered by POE (power over ethernet) can you verify that the POE injector is good? This will require another compliant 802.11af (see https://en.wikipedia.org/wiki/Power_over_Ethernet) device—you can't just try to measure 48V across pairs of the CAT5 wires. Note that for POE to work, you have to have a correctly-constructed CAT5 cable (some cables don't use all 8 pairs, or don't have the 8 pairs in the correct order, which won't work for POE). While you can make your own CAT5 cables and save money over a store-bought cable, store-bought cables tend to have better durability, and you can be pretty sure they have been correctly built. 5. If the front light is green, then check network connection – do the indicator lights on the ethernet socket flicker when you try to connect to the camera's web configuration pages? If there are no indicator lights lit up, the network board is likely fried. Contact Anthony Watts anthony@stardot.com and arrange for an RMA and repair. 6. Check the network cable and/or ethernet socket the cable is plugged into – can another device (laptop) plugged into the same cable (or the same ethernet socket) connect to a site like Google.com? If in doubt about the quality of the network connection, try running a speed test at https://www.speedtest.net. There are also lots of inexpensive CAT5 cable test units available through Amazon etc. (https://www.amazon.com/CAT5-Cable-Tester/). These can be very helpful when it comes to troubleshooting. 7. Check DNS server settings (see below). 8. Reset camera and re-run PIT (see below). 9. Use a CCTV tester to see if the camera is producing images. A variety of inexpensive CCTV testers are available through Amazon. In the past, our preferred model was made by Vitek, but it is no longer available. Connected to the back of the camera via the camera's BNC socket, these devices are handy because you can see the image the camera is producing without having to have a network connection. If there is no image, or if the image is not as expected (strange colors, lines, etc.) contact Anthony Watts anthony@stardot.com and arrange for an RMA and repair. 10. Does the camera work when plugged in to 12V power and your home network? Go through the above steps to check and isolate the problem. We recommend using your home network because it is usually easier than using your institution's network, which may require devices to be registered before they are assigned IP addresses. 11. If the above steps don't get you anywhere, contact Anthony Watts anthony@stardot.com and arrange for an RMA and repair. |

(2) Issues arising

My camera's clock seems to be off. What do I do?

The PIT sets all cameras to use local standard time, and we calculate sunrise and sunset times based on your camera's latitude and longitude. If you are somewhere that observes daylight savings, you will see that during the summer months the camera's clock appears to be an hour slow. This is completely normal. If your camera's clock appears to be drifting, make sure that the "AUTOMATIC" button is clicked, and the time server is set to pool.ntp.org. Your camera should check its internal time against the time server at every reboot (midnight) and every day at noon.



(2) Issues arising

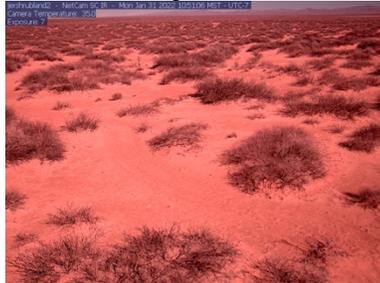
How do I do a factory reset on my camera?

Sometimes it is necessary to reset a camera to factory settings. On the back of the camera there should be a small opening labeled "reset". With the camera powered on, use a paper clip or pin to depress the recessed button for about 5-10 seconds. The green light on the front of the camera should go out and then come back on. If you have an IR-enabled camera, you should hear a faint click as the camera reboots and the filter moves out and then back in position.

(2) Issues arising

Why do my images look red, like I'm on Mars?

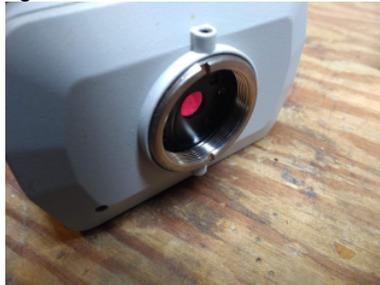
Sometimes images look like this, with a reddish cast



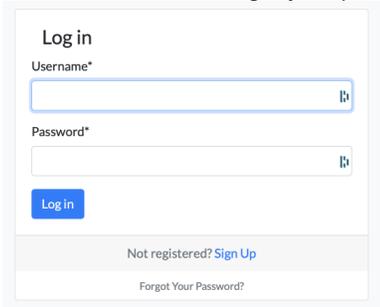
This is what a normal picture should look like



The red color comes from the IR filter being stuck in the "open" position, meaning that infrared photons are hitting the imaging sensor and exciting the red channel. Sometimes this happens because the back-focus ring (the little silver ring between the lens and the camera body) is screwed down too tight, and it presses against the filter mechanism. Here's a photo of the ring:



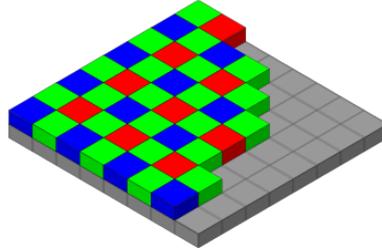
There is a set screw designed to hold the ring in place when you focus the camera but if these are not tight enough then when the lens is turned for focusing, the ring will slip and get screwed in tighter. The filter may also get stuck in the open position for other reasons, including mechanical failure (it is quite delicate). This also seems to happen sometimes in very hot environments. There are two options if this is a persistent problem. Contact Anthony Watts <anthony@stardot.com> and arrange a repair, or manually return the filter to its correct position and then edit the camera scripts so that the filter is not triggered.

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| (3) Data access | I forgot my website login information. What do I do? | You can follow the “Forgot your password?” link on the login page. |
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| | | Note that your username is usually NOT your email address. The login page asks for your username, whereas to reset your password you will need to enter your email address. |
| (3) Data access | My camera is now sending images—what do I need to do to get an ROI set up? | We are happy to make 1 ROI per vegetation type per camera for automated processing. Please draw the ROI you’d like on an image from your camera and email it to phenocam.nau.edu. You should be sure to identify the sitename and the vegetation type in your message, as it is sometimes difficult for us to distinguish AG from GR sites, DN from EN sites, or DB from EB sites. |
| (3) Data access | I can see the Gcc data for my camera’s ROI, how do I get a copy of that data set? | There should be a “provisional data link” under the graph. The format of the data set and the associated data records is described in Richardson et al. 2018 (https://www.nature.com/articles/sdata201828) |
| (4) General | I submitted lat/long information to 8 decimal places. Why doesn't the website show the full site coordinates? | The website truncates the coordinates of any site to a precision of 4 decimal places, but the database reflects the full-length coordinates. Note that according to Wikipedia, "A value in decimal degrees to an accuracy of 4 decimal places is accurate to 11.1 meters (+/- 5.55 m) at the equator." |
| (4) General | How do the cameras take RGB and IR images at the same time? | The two pictures are taken back to back. First the camera records a visible wavelength image, then the camera’s built-in IR cut filter is triggered, and a VIS+IR image is recorded. The images are taken about 30 s apart, and under mixed sun/cloud conditions the lighting may be quite different between the two pictures (this is one reason the NDVI data are noisier than the Gcc data). The IR image is denoted by _IR in the filename. |
| (4) General | I want to install cameras at more than one of my field sites. Is there a limit to how many of my cameras you will archive images from? | We can only offer to archive and process imagery for up to two cameras per research group without asking for a monetary contribution to help sustain our operations. Please contact PI Andrew Richardson (andrew.richardson@nau.edu) for more details. |
| (4) General | Do you have a record of my camera’s username or password? | No. We don’t maintain records of camera login information. You can always reset the camera and re-run the PIT if you don’t know your login credentials. The camera default is admin/admin. We strongly recommend you change this if the camera is on an open network. |

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| (4) General | I want to move an old camera to a new site. How do I change the name shown on the site overlay and the uploaded files? | Re-run the PIT. Please do this BEFORE you move the camera. |
| (4) General | Can I re-name an existing site? | No. Due to the large amount of work required to rename all the files, move the metadata, and adjust the processing, we are not able to re-name sites once they have been set up. |
| (4) General | Do you provide cameras? | No, we do not have the resources to provide cameras for collaborating sites. Sorry! |
| (4) General | Can you mask out people's faces from the images? | No, we are unable to do this. If you have privacy concerns, you need to be responsible for filtering the uploaded images yourself. |
| (4) General | How do I find my camera's MAC address? | Your camera's MAC address is the same as its serial number, which is printed on label on the underside of the camera. |
| (4) General | How do I find my camera's IP address? | There are three easy ways to do this. (1) Run the StarDot tools program (https://stardot.makekb.com/files/3/); (2) Log in to your router and identify its MAC address in the list of connected devices; (3) Ask your organization's IT specialist. |
| (4) General | Why do I need to have my camera set to fixed white balance? | When a camera is set to auto white balancing, the sensitivity of each color channel is constantly being adjusted in response to changing lighting conditions and to what is in the camera field of view. For example, when leaves emerge in spring and the image goes from mostly gray (bare canopy) to mostly green (full canopy), the camera "compensates" for this by dialing down the sensitivity of the green channel and dialing up the sensitivity of the blue and red channels. This can lead to purple skies, and other weirdness. The image-to-image variability in the retrieved RGB signal is accentuated and the seasonal cycles are muted. With fixed white balance, this doesn't happen and the data quality is much better. |
| (4) General | Why doesn't PhenoCam include images from game cams, trail cams, or other similar cameras? | There are many reasons for this decision. First, imagery from these cameras is usually acquired using auto white balancing, which can negatively impact the quality of data derived from the imagery. Second, imagery from these cameras usually has a very unstable field of view (for example, every time batteries are replaced or the memory card is swapped, the camera is usually nudged a bit). Third, the image filenames usually don't conform to our standard (<sitename>_%Y_%m_%d_%H%M%S.jpg), meaning that additional work is required to get them into our processing pipeline. |
| (4) General | I want to use a less expensive camera than a StarDot. What are my options? | We have long looked for a less-expensive alternative, but have yet to find one that can reliably handle FTP image uploads or that produces images that are equal in quality to those produced by StarDot cameras. Let us know if you find a good option! |

(4) General Why do we recommend operating a 5MP camera at only 1296 x 960 resolution (1.3MP)?

This is because of the camera's Bayer filter. The imaging sensor has 5,000,000 pixels on it. But, $\frac{1}{4}$ of these are red pixels, $\frac{1}{2}$ are green pixels, and $\frac{1}{4}$ are blue pixels. Here's an illustration of a Bayer filter:



But, a true 5MP image file has 5MP in each of the 3 color layers, and for the StarDot cameras, this means this means that for red and blue channels $\frac{3}{4}$ of the pixels are interpolated ("filled in," or estimated), and $\frac{1}{2}$ of the green pixels are interpolated. There is not a lot of "real" information in those interpolated pixels, and the file size is essentially 4x larger than it needs to be, given the information content.

Note that the 1.3MP StarDot and 5MP StarDot cameras have identical imaging sensors. The software on the 5MP just allows a 5MP image to be produced. The 1.3MP image from a 5MP StarDot camera is exactly the same quality as the image from a 1.3MP StarDot camera.