Generic Procedure for Using ImageJ to Reduce Images

Download ImageJ from http://rsbweb.nih.gov/ij/ Install the program (with Java, if you don't have Java on your machine). Download the Astronomy Plugin Package at www.astro.physik.uni-goettingen.de/~hessman/ImageJ/ and download www.umanitoba.ca/faculties/science/astronomy/jwest/otherplugins/jrasc_plugins.zip Extract the hessman zip file into folder C:\Program Files\ImageJ\ Extract the jwest zip file into C:\Program Files\ImageJ\plugins.

To process your image use the following steps. Remember, the basic procedure for processing a sky image is to subtract a dark image (of the same exposure), then divide that result by a dark-corrected, normalized flatfield image taken with the same filter as the sky image. A "normalized" flatfield image will have pixel values which are approximately 1 near the center of the image (where the sensitivity of the telescope/ccd system is maximum) to values somewhat less than 1 near the corners of the flatfield image, where the sensitivity of the system drops off a bit. If your flatfield and sky images were dark-corrected at the observatory, then you can skip the dark correction steps given below.

1) Prepare your image folders.
    a. Put all the dark images for one exposure length in a folder. Dark images for other exposure lengths go in their own separate folders. *[If you dark-corrected your flatfield and object images at the observatory, then you can skip this step.]*
    b. Put all the flatfield images for one filter in a folder. Flatfield images for other filters go into their own separate folders. Your flats for a specific filter should be of the same exposure length.
    c. Put all images of a specific sky object, taken with the same exposure time and with the same filter, in one folder. Use separate folders for each other object, exposure time, or filter.
2) Average the dark images taken with a specific exposure length to create a master dark image for a specific exposure time. *[If you dark-corrected your flatfield and sky images at the observatory, then you can skip this step.]*
    a. Use **File | Import | Image Sequence** to open an entire folder of dark images as a "stack." Open the folder containing the darks, click on the first dark image in the folder, then hit the Open button; use the default options in the Sequence Options Box that opens.
    b. Use **Image | Type | 32-bit** to convert the stack of dark images to 32-bit real-valued images.
    c. Use **Process | Math | Subtract**, to subtract 100 from all the images in the stack.
    d. Use **Image | Stacks | Z Project** to average the stack of dark images. Use the "Average Intensity" option to do an arithmetic average.
    e. Use **Image | Rename** to rename the resulting image to something like "MasterDark30sec". You should probably save this image using **Plugins | FITS | SaveAs Fits** in case you need it later.
    f. You can close the dark-image stack, but keep open the master dark.
    g. Repeat these steps for each separate dark-image folder creating MasterDark30sec, MasterDark10sec, etc.,
3) Average your flatfield images, if any, to create a master flatfield image for a specific filter.
    a. Use **File | Import | Image Sequence** to open an entire folder of flatfield images as a "stack." Open the folder containing the flats, click on the first flatfield image in the folder, then hit the Open button; use the default options in the Sequence Options Box that opens.
    b. Use **Image | Type | 32-bit** to convert the stack of flatfield images to 32-bit real-valued images.
    c. Use **Process | Math | Subtract**, to subtract 100 from all the images in the stack.
    d. Dark correct the flatfield stack, using the appropriate master dark image (i.e., the master dark with the same exposure time as your flatfield images). *[If you dark-corrected your flatfield images at the observatory, then you can skip this step.]* Use **Process | Image Calculator**: For Image 1 select the name of the stack of flatfield images, for Operation select Subtract, for Image 2 select the name of the master dark image, keep Create New Window selected, and select 32-bit Result. This produces a stack of dark-corrected flatfield images for this object, in this filter.
    e. Use **Plugins | Stacks | Normalize Stack** to normalize the flatfield images in the stack to have a median value of 1.00.
    f. Use **Image | Stacks | Z Project** to average the stack of flatfield images. Use the "Average Intensity" option to do an arithmetic average.
    g. Use **Image | Rename** to rename the resulting image to something like "MasterFlatRfilter". You should probably save this image using **Plugins | FITS | SaveAs Fits** in case you need it later.

h. You can close the flat-field stack, but keep open the master flat.
i. Repeat these steps for each separate flat-field folder.

4) Process one of the folders of sky images (e.g., the series of 30 second, R filter images, of the same object). If you have only one sky image, you don't need to import a sequence, of course.
   a. Use the same steps as discussed above images to import the sequence, convert the sequence to 32-bit images, and subtract 100 from each image in the stack.
   b. Dark correct the stack, using the appropriate master dark image (i.e., the master dark with the same exposure time as your sky images). *[If you dark-corrected your sky images at the observatory, then you can skip this step.]* Use **Process | Image Calculator**: For Image 1 select the name of the stack of sky images, for Operation select Subtract, for Image 2 select the name of the master dark image, keep Create New Window selected, and select 32-bit Result. This produces a stack of dark-corrected sky images for this object, in this filter.
   c. Flat correct the (*dark-corrected*) stack, using the master flatfield image for this filter, by **Process | Image Calculator**. For Image 1 select the name of the stack of object images, for Operation select Divide, for Image 2 select the name of the master flatfield image, keep Create New Window selected, and select 32-bit Result. This produces a stack of flat-corrected sky images for this object, in this filter.
   d. Use **Plugins | StackReg** to align (register) the stack of object images, if they are not already well aligned with each other. "Rigid Body" is a reasonable option for the alignment procedure.
   e. Use **Image| Stacks | Z Project** to average the stack of sky images. Use the "Average Intensity" option to do an arithmetic average.
   f. You will probably want to use **Image | Rotate | Flip Vertically** to flip the image over it matches the view in CCDOps (i.e., a view where East in the image is 90 degrees counterclockwise from North).
   g. Use **Plugins | FITS | SaveAs FITS** to save the final image as a 32-bit FITS image.
   h. For future use of the image in CCDOps, or IRIS, or Astrometrica,…
      i. Use **Process | Math | Add** to add 100 to the final image.
      ii. Use **Image | Type | 16-bit** to convert the image to 16-bit unsigned integers.
      iii. Use **Plugins | FITS | SaveAs FITS** to save the image as a FITS file of 16-bit unsigned integers.
   i. Repeat this process for each separate folder of sky images.