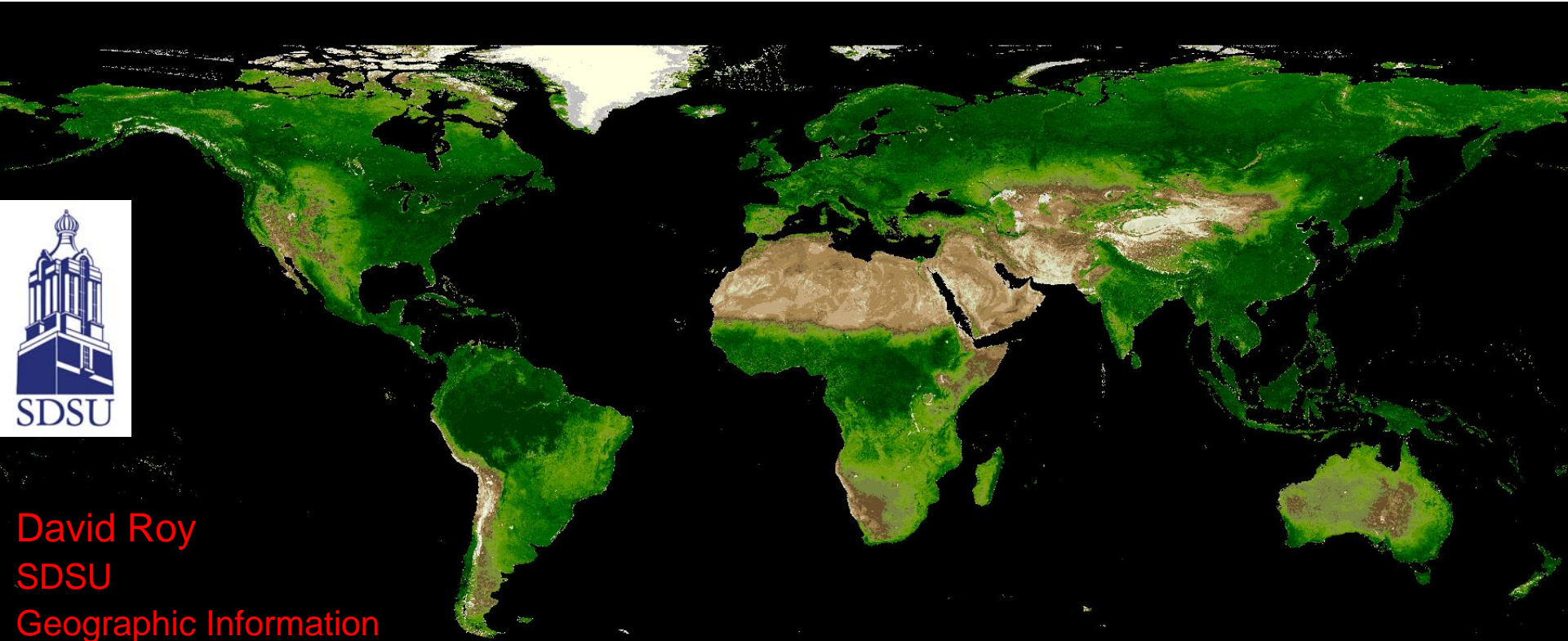# Quantitative Remote Sensing for Terrestrial Monitoring

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Vegetation Indices
[October 23]

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# Homework (1/3 pages of instructions)

- Check out this MODIS Web Site
  **http://www.modis.ornl.gov/modis/modis_products_table.cfm**

- Pick a geographic site that contains MODIS Collection 4 Terra data for at least 2001-2003. Only choose a site that your ANIMAL lives near
  - if you are an aquatic or cartoon animal pick a site anywhere you want
  - do not pick a site that you know someone else has picked

- Download these MODIS-Terra product ASCII data for your site
  - **Surface Reflectance (M0D09A1)**
  - **Reflectance Nadir BRDF-Adjusted (NBAR) (MOD43B4)**
  - **Vegetation Indices (NDVI, EVI) (M0D13A2)**

- You may want to do some research on the characteristics and generation of the above 3 MODIS products (e.g., visit MODIS web sites, read product descriptions, literature)

# Homework (2/3 pages of instructions)

- A) Extract the 16-day NDVI values from the M0D13A2 data

- B) Extract the 8-day MODIS Band 1 (red) and Band 2 (NIR) values from the MOD09A1 data and compute the NDVI from these values.

- C) Extract the 16-day MODIS Band 1 (red) and Band 2 (NIR) values from the MOD43B4 data and compute the NDVI from these values.

- Use S, R, Excell, or some other computer graphing program, to produce one plot that shows NDVI against time for 2001-2003, showing
  - NDVI values derived (A), (B) and (C)
  - Legend/text that labels the 3 lines clearly
  - X and Y axes labels
  - An appropriate Y axis scale so that the dynamic ranges of the NDVI date are clearly evident

- Note these ASCII data are defined over 7*7km areas – if you are smart you will plot the mean or median of the values for each time period, if not you will have a lot of points (not so smart). Also, if you are smart you will ignore pixels with "fill" values as these convey no useful information (i.e. don't plot them, i.e. don't use them if you compute mean/median value).
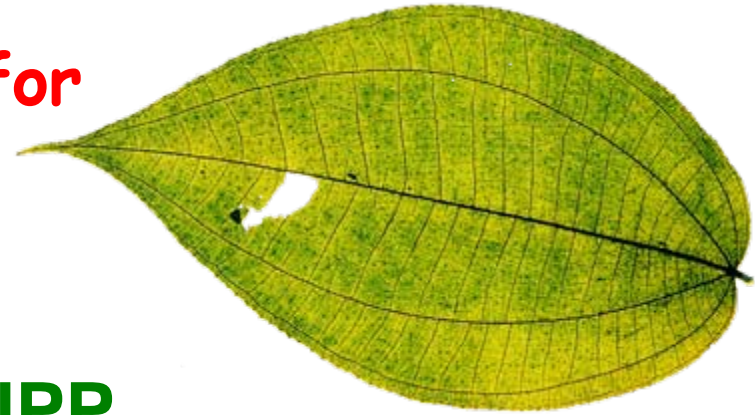
# Homework (3/3 pages of instructions)

- Put your graph into a Powerpoint Presentation so that it fits into one slide.

- Annotate your graph in PowerPoint to indicate
  - the site name, location, and typical vegetation
  - your ANIMAL name
  - how you derived the NDVI values (e.g. raw data in 7*7km subset plotted, or raw data ignoring fill values, or mean of non-fill value data)
  - what you think any inter-annual temporal NDVI variation is due to
  - representative times when the NDVI data on the 3 lines are different (use circles or arrows)
  - text describing what these representative differences may be due to (hint: this is related to the product characteristics and generation algorithm)

- Email the .PPT file to david.roy@sdstate.edu so that it arrives *before* 4.50pm October 30th – submissions past this date & time will not be graded

- Everyone's graphs will be shown for discussion/grading at the beginning of the October 30th lecture

- 50% of the marks will go to making and displaying the graph clearly, 50% to the annotation text.

# Quantitative Remote Sensing for Terrestrial Monitoring

## Lai/FPAR/NPP

## [October 30]

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# Homework (1/3 pages of instructions)

- Goto this MODIS Web Site
  **http://www.modis.ornl.gov/modis/modis_products_table.cfm**

- Pick a geographic site that contains MODIS Collection 4 Terra data for at least 2001-2004. Only choose a site that your ANIMAL lives near
  - if you are an aquatic or cartoon animal pick a site anywhere you want
  - you can use the same site as last week's homework or a new one

- Download these MODIS-Terra product ASCII data for your site
  - **Surface Reflectance (MOD09A1)**
  - **Leaf Area Index/Fraction of Photosynthetically Acitve Radiation (LAI/FPAR) (MOD15A2)**

- You may want to do some research on the characteristics and generation of the above 2 MODIS products (e.g., visit MODIS web sites, read product descriptions, literature)

# Homework (2/3 pages of instructions)

- A) Extract the 8-day LAI & FPAR values from the M0D15A2 data
- B) Extract the 8-day MODIS Band 1 (red) and Band 2 (NIR) values from the MOD09A1 data and compute the NDVI from these values.

- Note these ASCII data are defined over 7*7km areas. Calculate the mean or median of the values for each 8-day time period, ignoring pixels with "fill" values (as these convey no useful information) and ignoring bad quality/unreliable pixels (**do some research** to work out the QA bit format).

- Produce plot(s) that show
    - 1) LAI against time for 2001-2004
    - 2) FPAR against time for 2001-2004
    - 3) NDVI against time for 2001-2004

- Select **2 years** from your 2001-2004 time series that you think have the *most* different NDVI characteristics due to inter-annual vegetation differences (and not due to errors associated with cloud or remote sensing artifacts).

- Produce plots that show separately for each of your 2 selected years
    - 4) NDVI (y axis) against LAI (x axis)  -  a regression line & associated regression statistics (i.e. $R^2$, equation of line) would be nice (use linear, quadratic or cubic regression as appropriate)
    - 5) NDVI (y axis) against FPAR (x axis) - a regression line & assoc. stats. would be nice
    - *So for example, you could plot NDVI V LAI 2002,  NDVI V FPAR 2002,  NDVI V LAI 2004,  NDVI V FPAR 2004*

# Homework (3/3 pages of instructions)

- Put your graphs into a Powerpoint Presentation or a Word Document
  - use as many slides/pages as you want

- Annotate your graphs in PowerPoint/Word to indicate
  - the site name, location, and typical vegetation
  - your ANIMAL name
  - how you derived the NDVI, LAI and FPAR values, especially with respect to the QA bits
  - on the NDVI against time plot, indicate the two years you selected

- Add summary power point slide(s)/page(s) that describe the relationships between NDVI and LAI, the relationships between NDVI and FPAR, and differences between the two different years. Include discussion text on what these may be due to.

- Email  the .PPT/Word file to david.roy@sdstate.edu  so that it arrives *before* 4.50pm November 6th – submissions past this date & time will not be graded

- 50% of the marks will go to making, displaying and labeling the graphs clearly,  50% to the discussion in the summary slide(s)/page(s).