C. Woodcock BU
S. Houghton WHRC
M. Ozdogan GSFC
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V. Blujdea (Romania)
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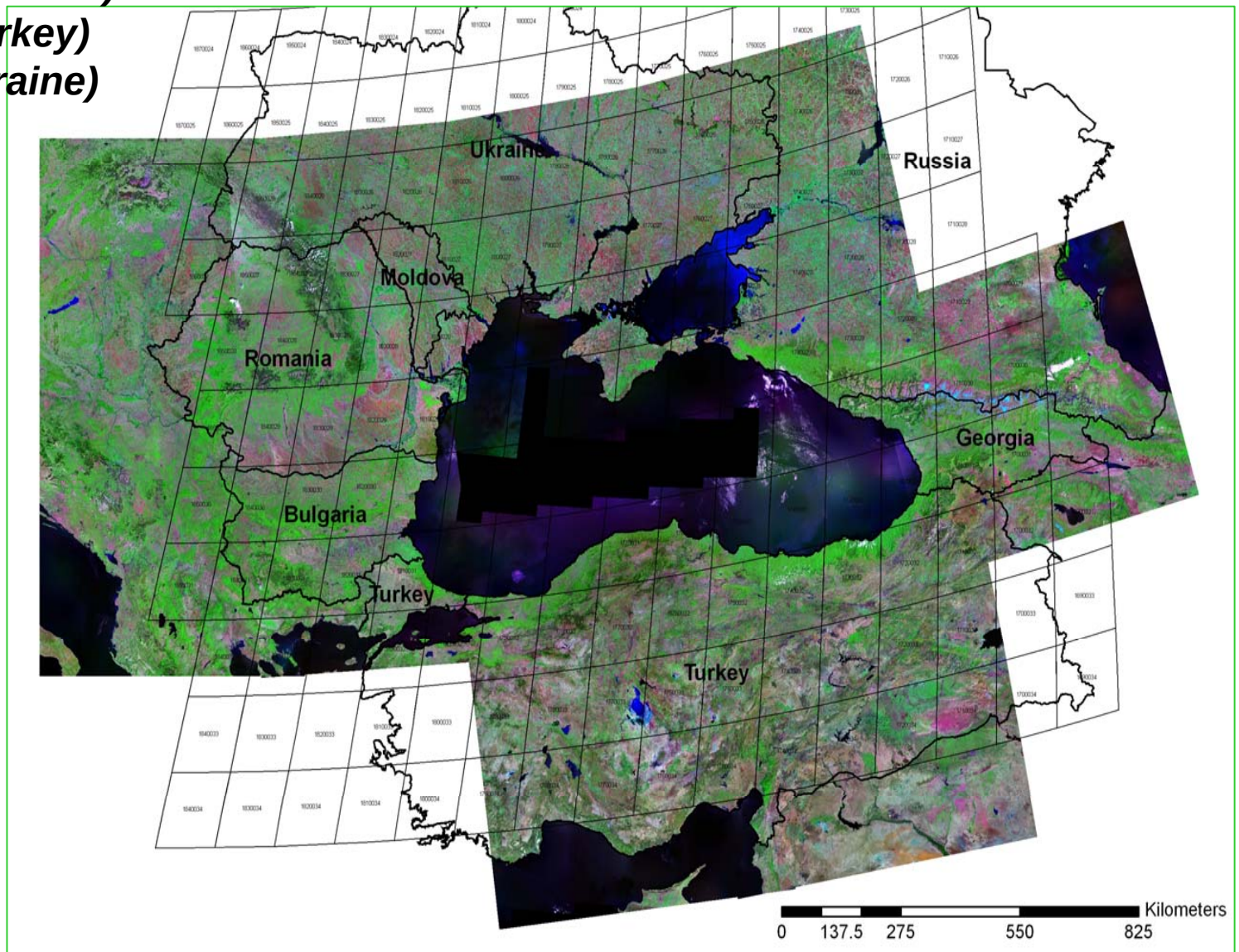
The effects of land use change on terrestrial carbon dynamics in the Black Sea Region

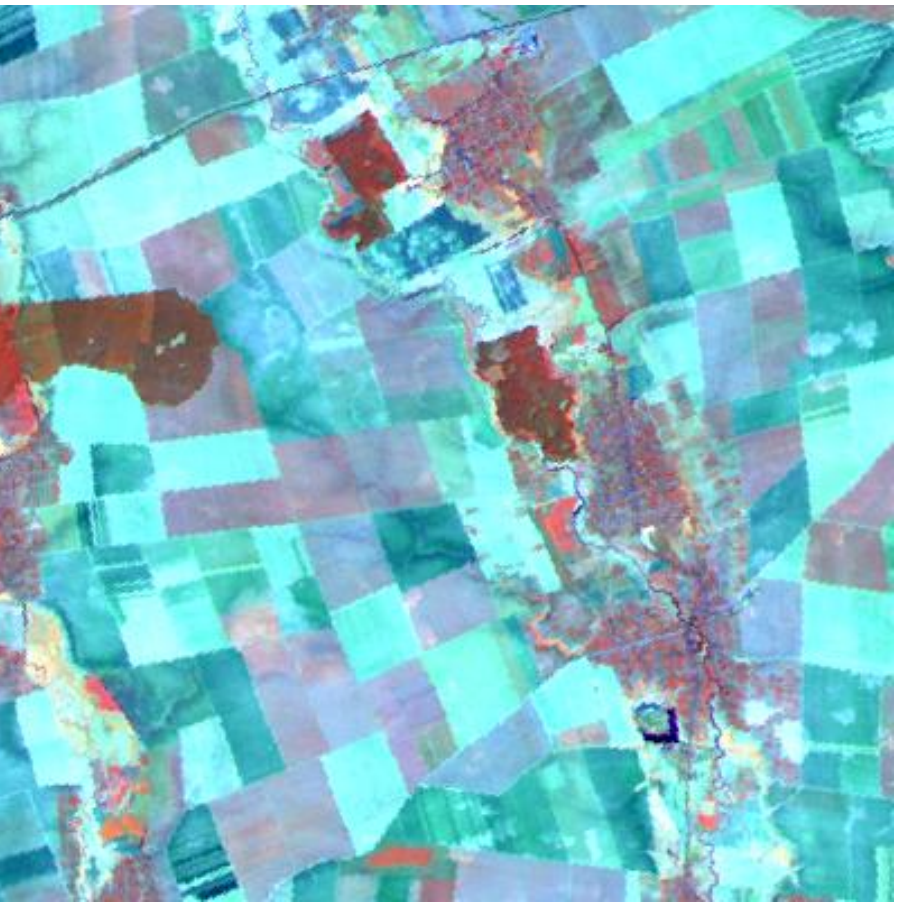


Science Goals

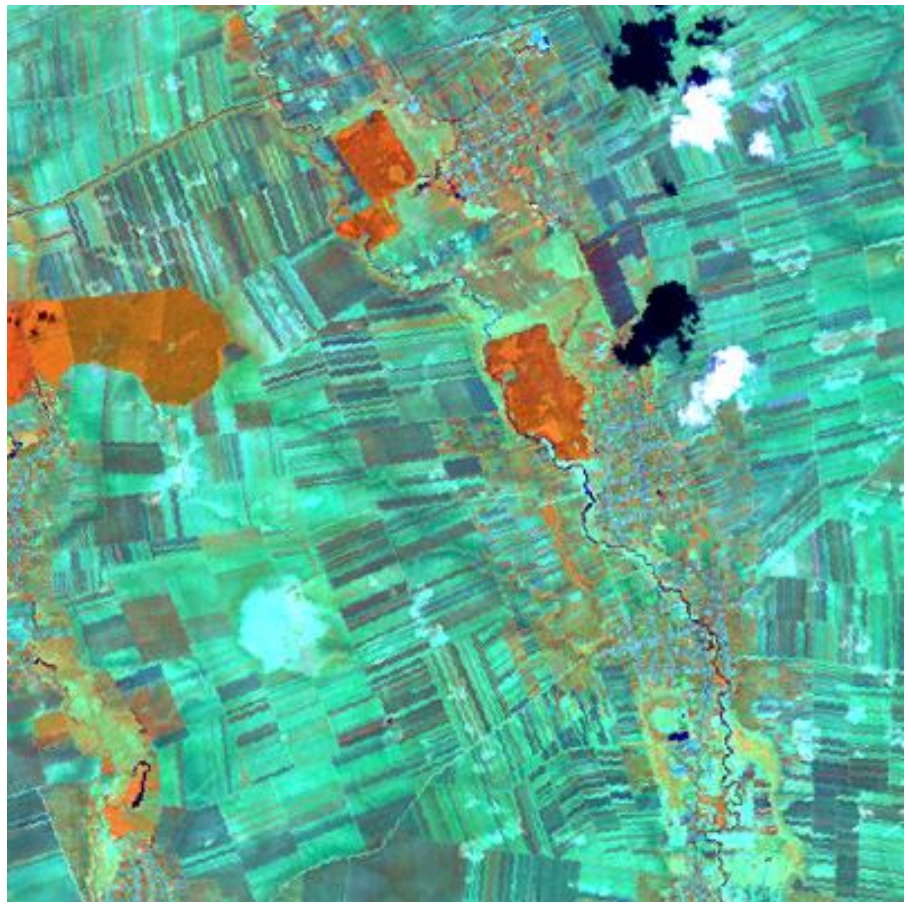
During the last decades the Black Sea region has been characterized by significant privatization of forested land; clearing for production; water resources development in forested areas. However, little information on LUC-related carbon emissions are available.

- Quantify the effects of land use change on terrestrial carbon budgets in the Black Sea Region
- Significantly minimize the uncertainties associated with the carbon cycle dynamics, particularly associated with land-use change
- Approach is to use remote sensing to measure rates of land use change
- Use those rates of land use change in Houghton's book keeping model to estimate carbon dynamics

Just for fun! Notice the incredible differences in field sizes associated with the collapse of the Soviet Union!



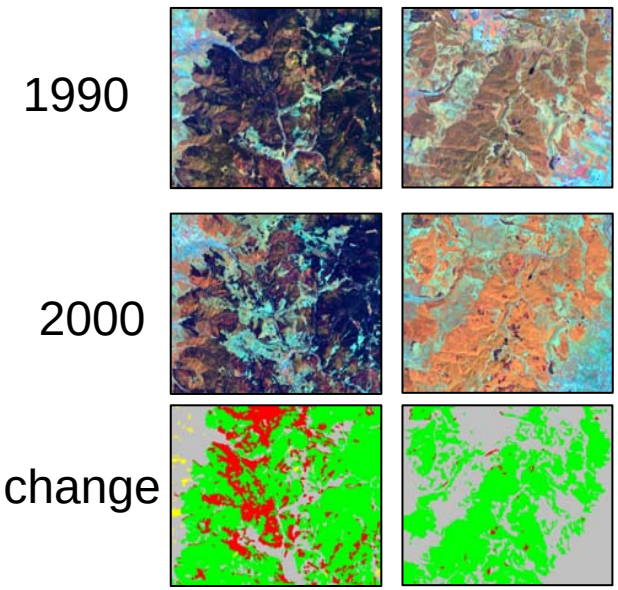
Time 1 1990/08/21



Time 2 2000/06/05

Preliminary Results

- We use remote sensing (Landsat data) to quantify the rates and kinds of land use change and carbon model to estimate the net fluxes from these regions resulting from land use change
- Preliminary results in Romania show a stable environment during the period 1990 – 2000 pointing to a significant sink (no numbers yet!)
- Policy is critical – pattern in time of returning land to original owners!



A few large changes were associated with extreme weather events (ice storm)

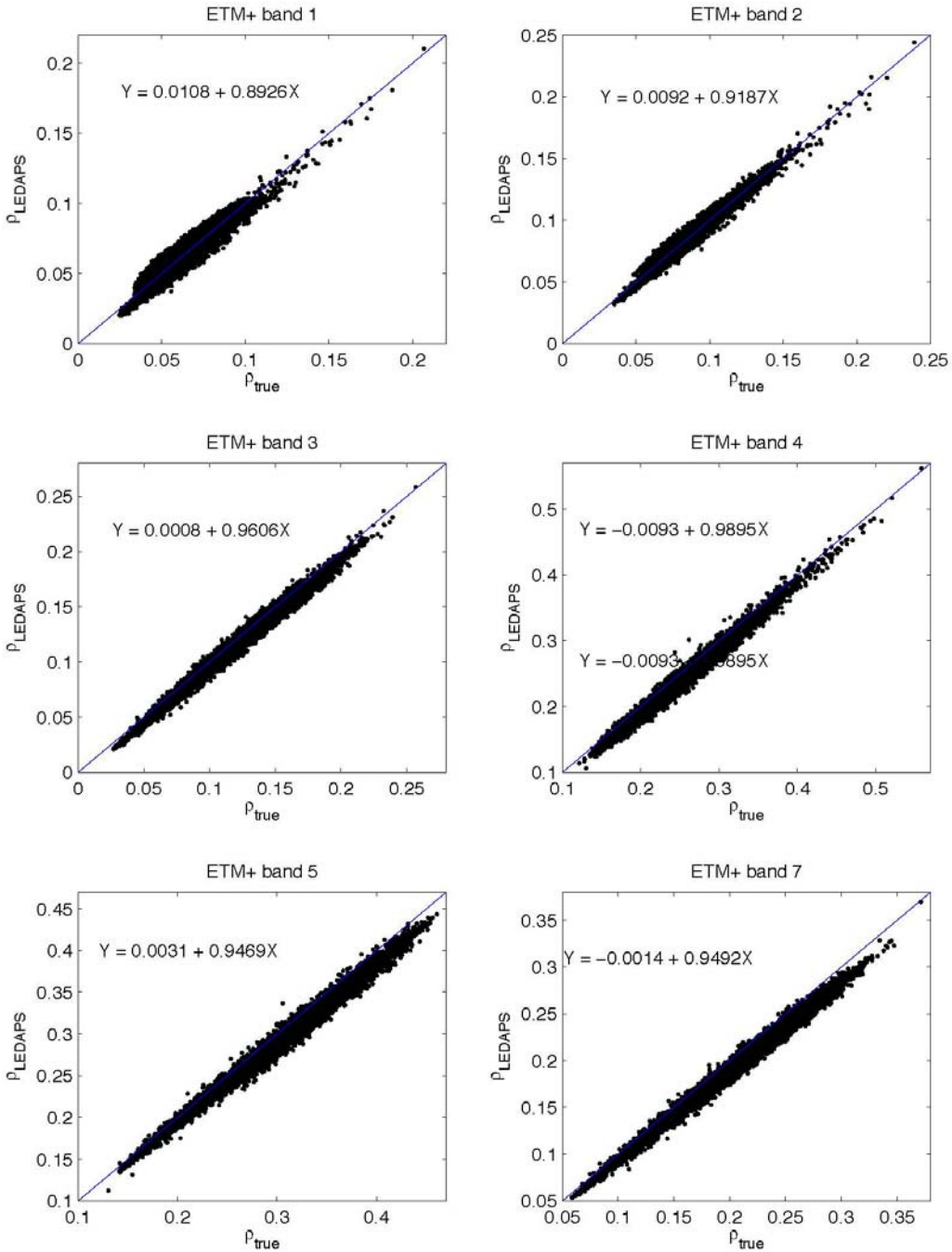
The figures show two different regions (of about 18 km x 15 km) in Romania. On the top Landsat data at the year 1989, on the center year 2000, and on the bottom the land cover change maps. The maps show in red, areas of forest loss, yellow conversion from non forest to forest, green stable forest, gray stable non forest.

Topics and Results of General Interest

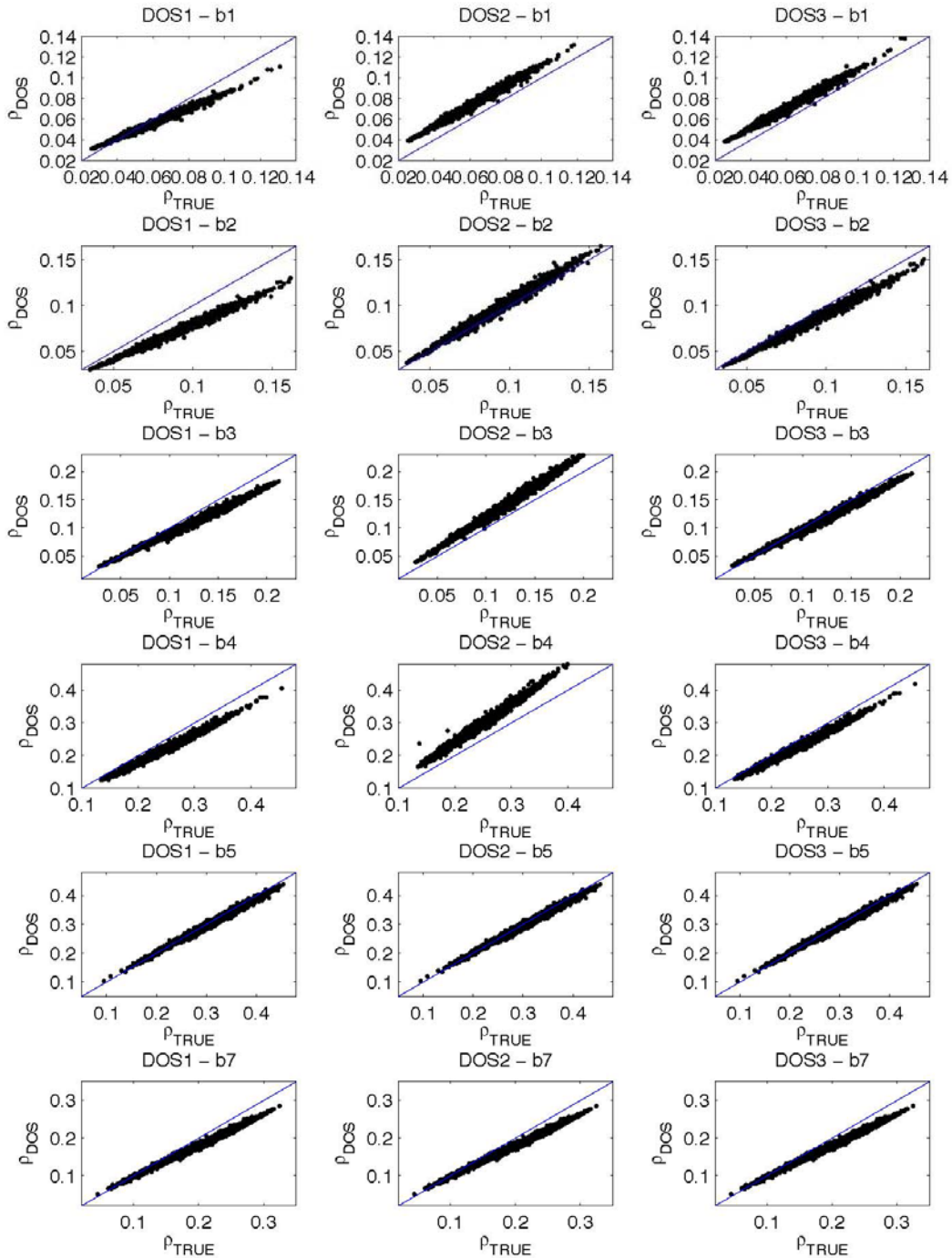
- Large area generalized analysis with Landsat imagery
- Properties of GLC datasets (1990 and 2000)
- Estimate the magnitude of errors in Landsat 7 SLC-off gap filled images using variograms

Large Area Generalized Analysis with Landsat Imagery

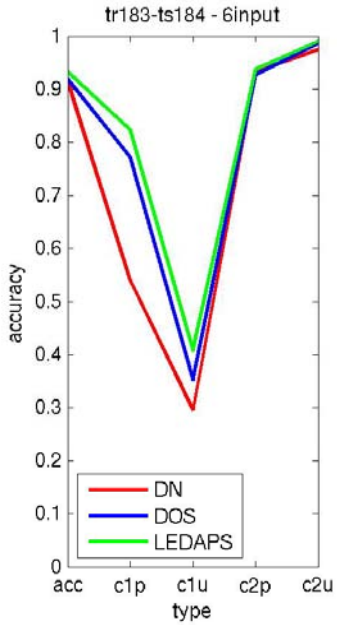
- Training
  - Timing of images (phenology)
  - Training from multiple images appears to help
- Atmospheric Correction
  - LEDAPS and DOS comparisons
  - “absolute” evaluation
  - Comparisons of the effect on change detection

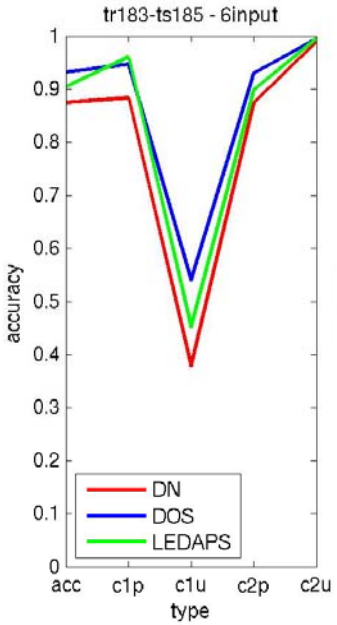


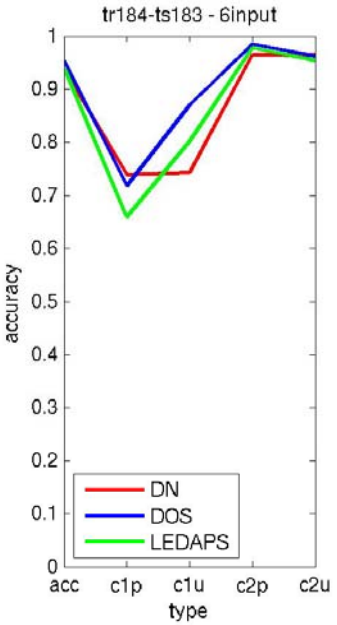
LEDAPS seems to be working well! Comparisons with images collected where data are available for “absolute” correction – these graphs show LEDAPS results relative to those “absolute” standards

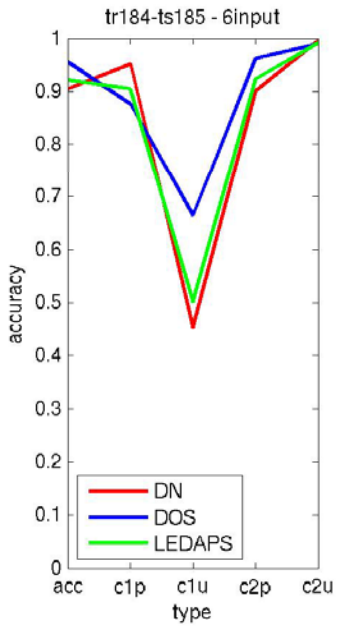


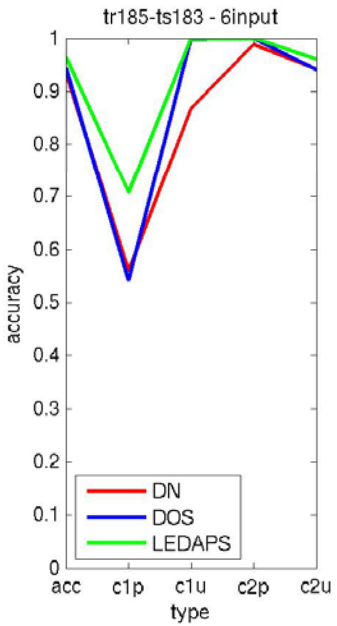
Notice that 3 versions of dark object subtraction do not appear to be as accurate as LEDAPS for this “absolute” standard

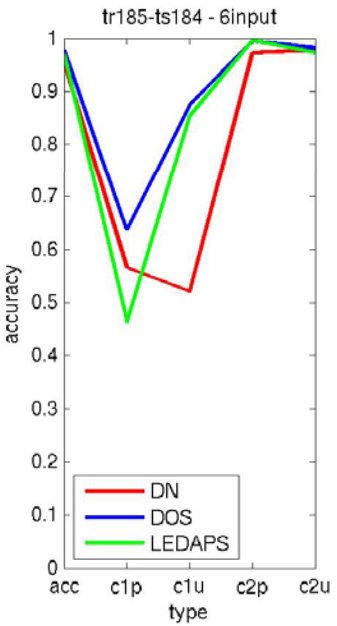




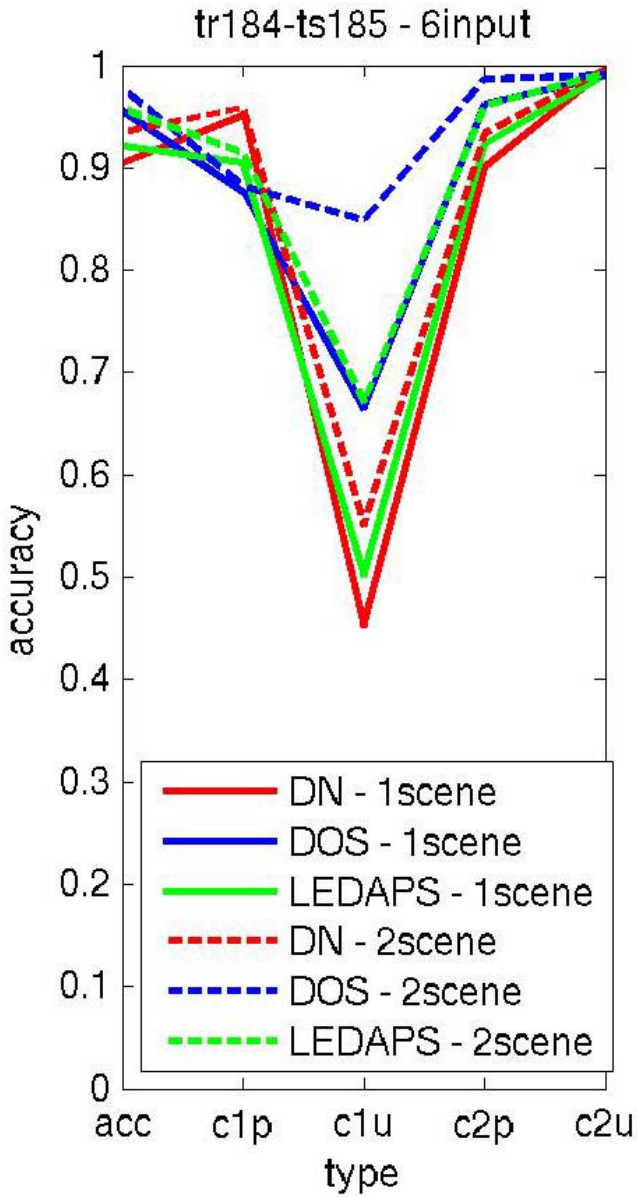








Comparisons of atmospheric correction trategies with respect to change detection



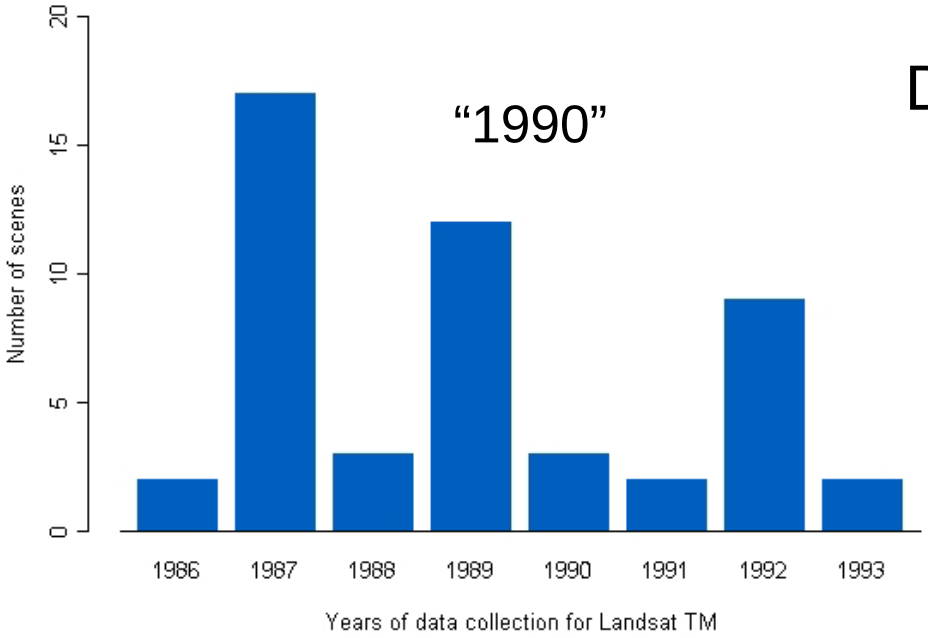
Example results of tests of using different amounts of training data (ie. Training data from multiple sets of images) on the ability to do generalized change detection for forest clearing

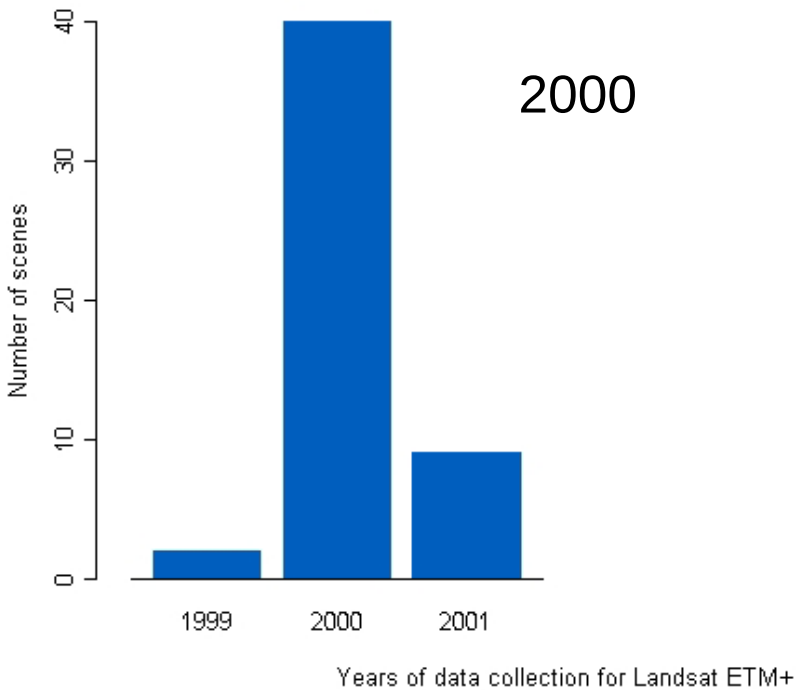
It appears that results improve when many sets of images are used in training!

Properties of the GLC datasets from 1990 and 2000

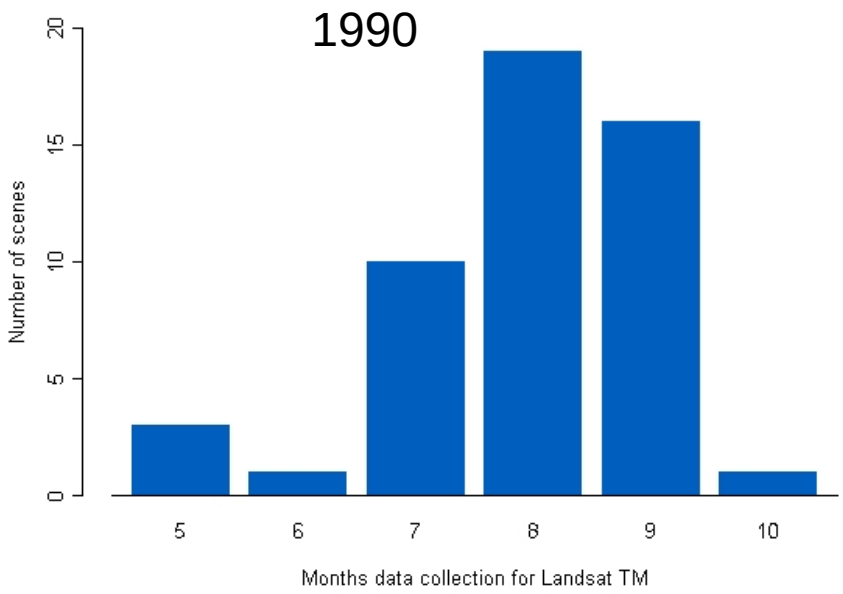
- Distribution by year
- Distribution by months
- Amount of clouds
- Considerations for the mid-decadal scene selection
- Considerations for future high resolution sensing systems

Distribution by year



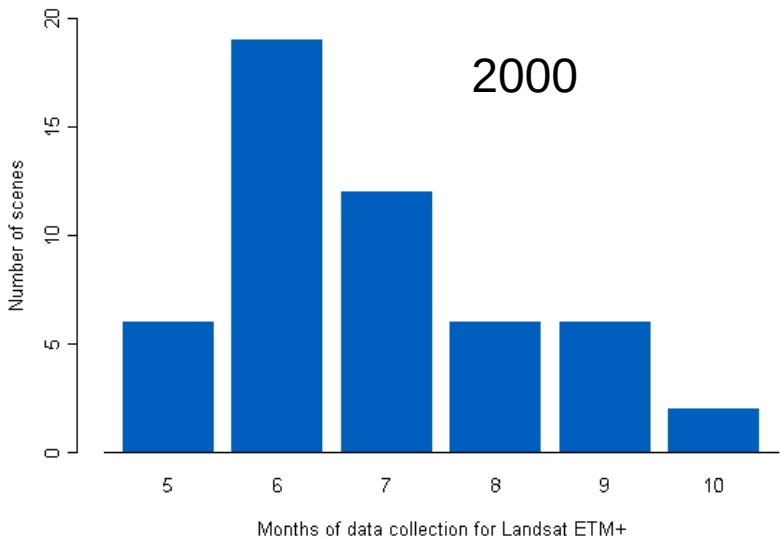


Notice that the Landsat 7 acquisition strategy has real benefits!



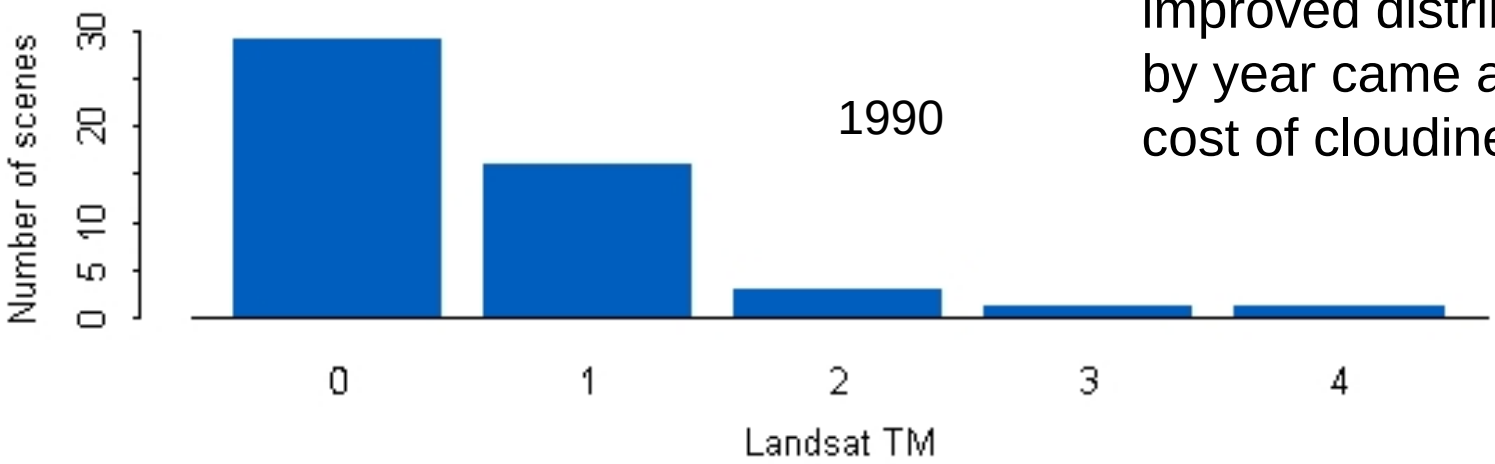
Distribution by month

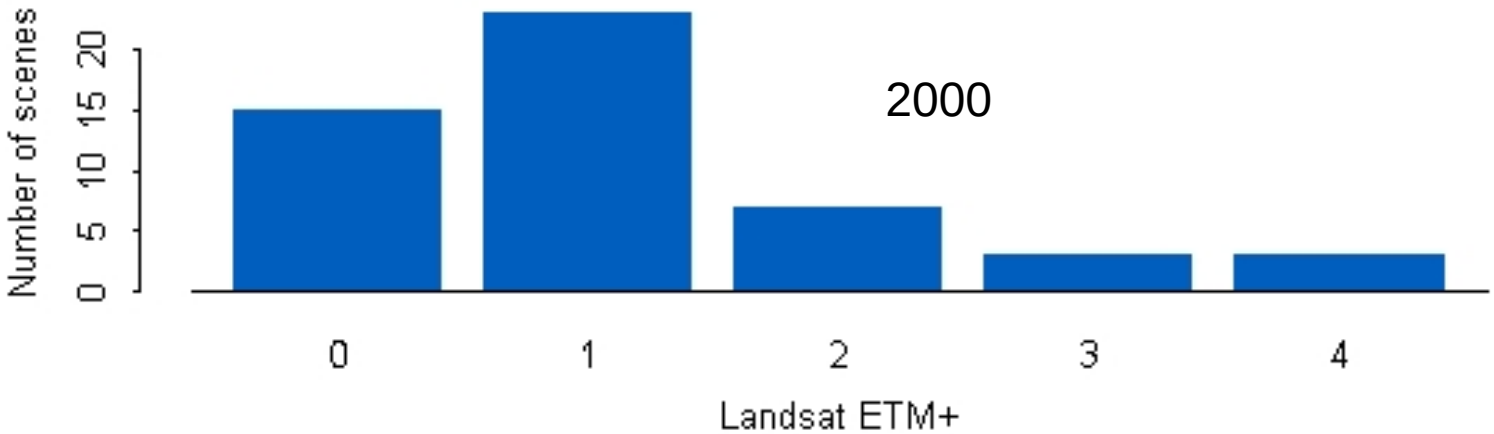
Notice there was some cost in terms of distribution by month associated with a better distribution by year



cloudiness

Notice that the improved distribution by year came at some cost of cloudiness!





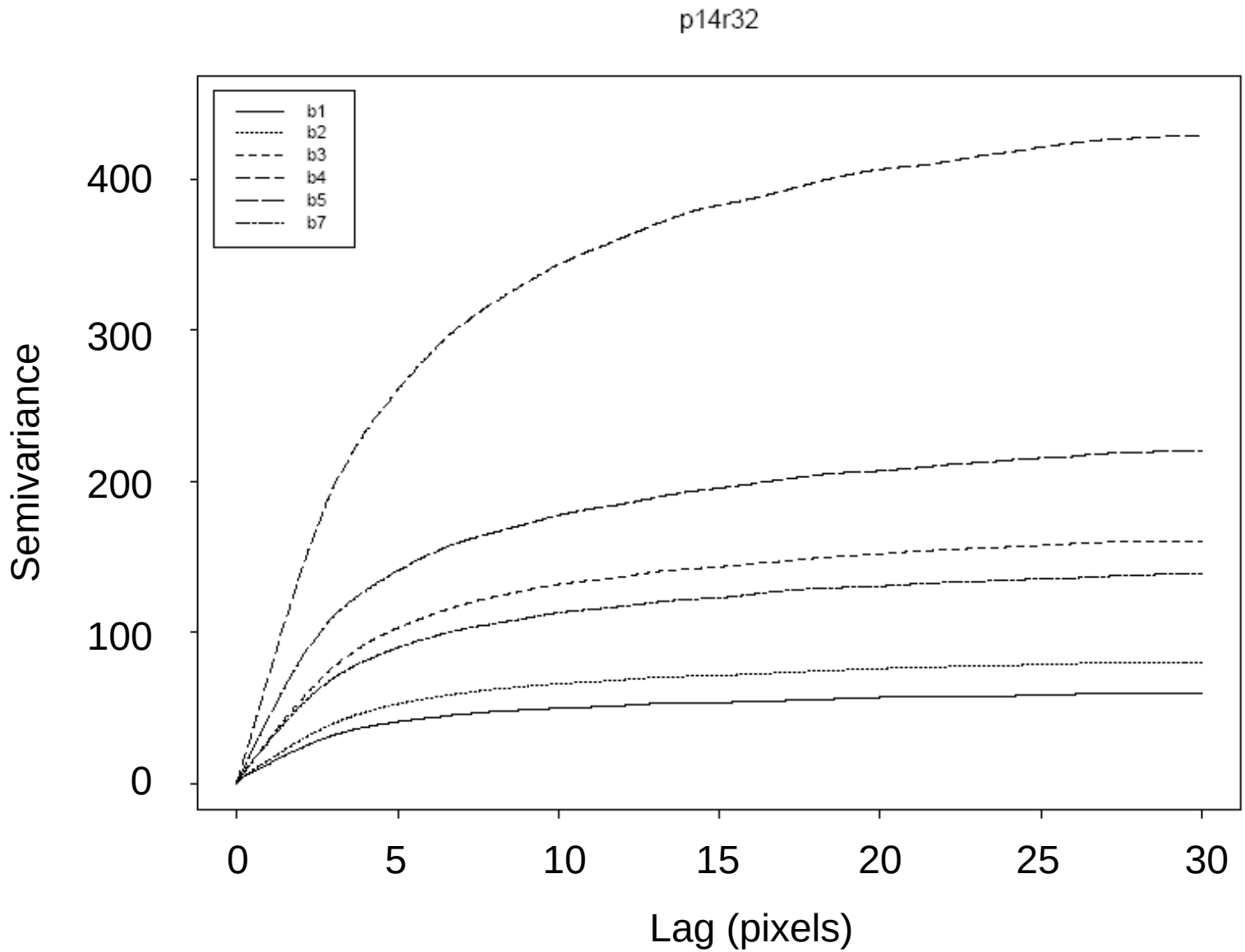
My two cents worth

- The acquisition strategy for sensing systems is a major consideration
- The long run success of automated analyses of large numbers of Landsat style images for monitoring change will be improved by better matching of pairs of images with respect to time of year
- Improved distribution with respect to time of year and cloudiness may be preferable to distribution by year (meaning I'd be willing to have some of the images in the 2000 dataset come from years outside of 2000 if they were better in terms of time of year and cloudiness!)

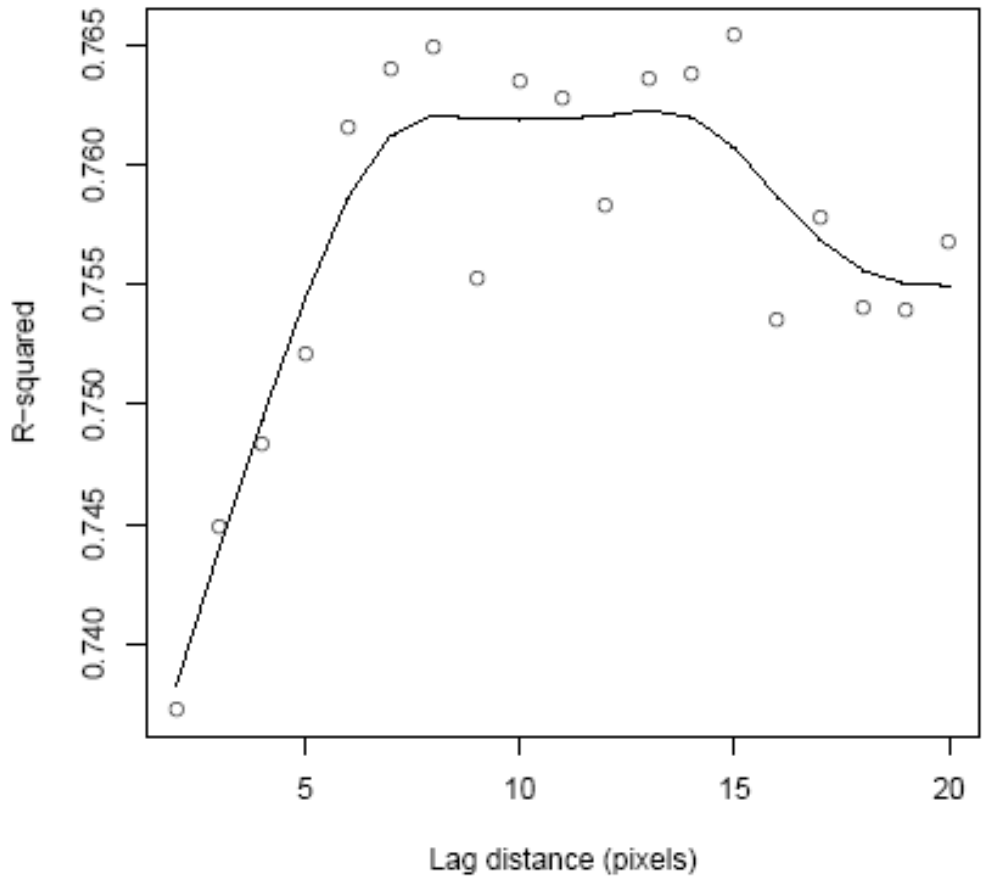
Evaluation of Gap-Filling in SLC-off L7 imagery

- Trying to understand the magnitude of errors in gap-filled products (ie the difference between the values that would have been observed and the values used to fill the gaps)
- Using a simulation approach by artificially overlaying the pattern of gaps typical in SLC-off imagery – and then using a different image to fill the gaps –
- RMSE between observed and “fill” values
- Images and help from Jim Storey – EDC
- Can we estimate the magntidue of the errors in filled gaps using variograms from the images???
- Hope is to develop a simple method that people could use to estimate the magnitude of errors they might see in specific images

Variograms for different ETM+ Bands

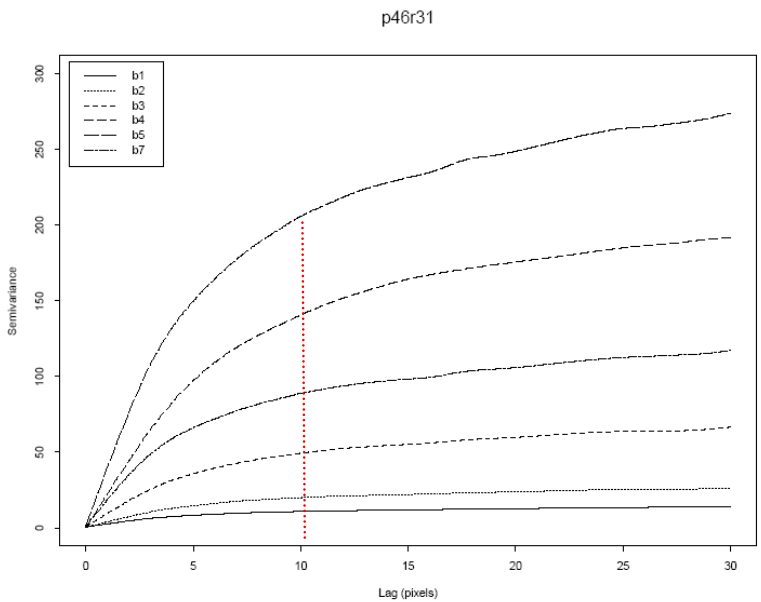


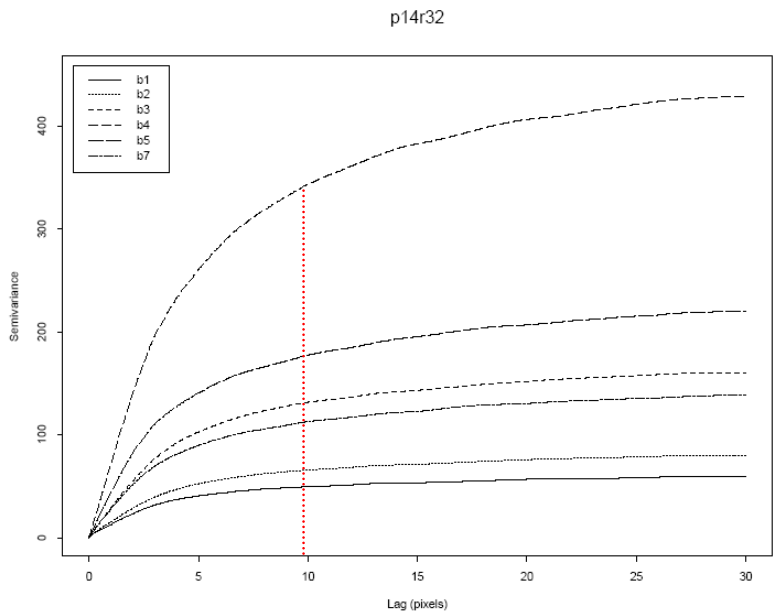
Effectiveness of different lags from variograms for estimating the magnitude of errors in SLC-off gap filled products



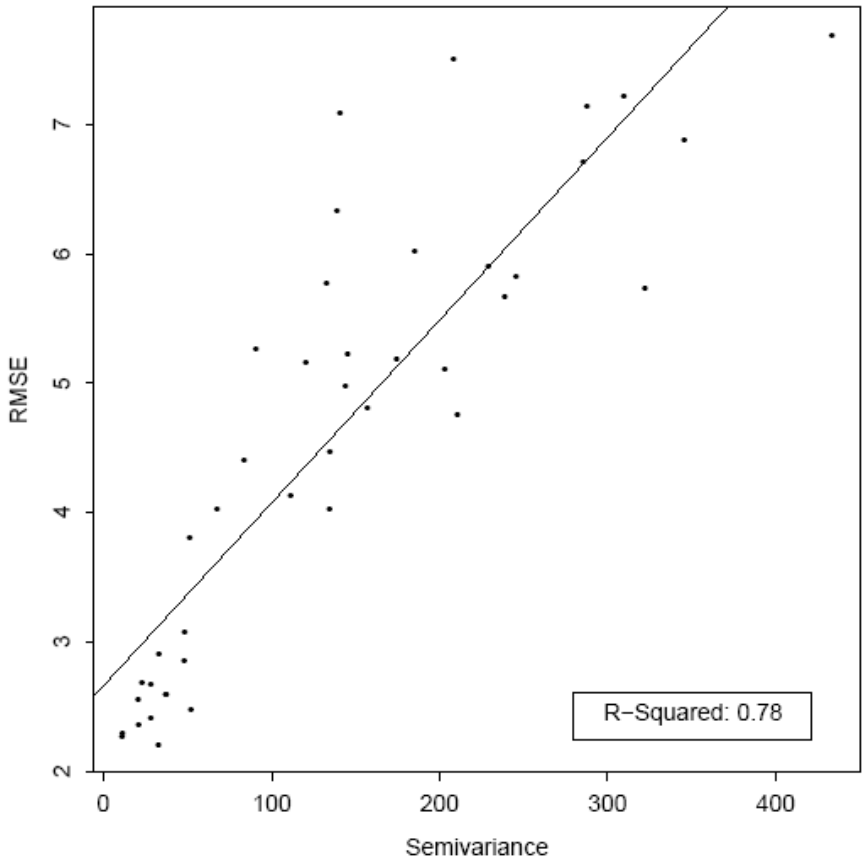
Notice that lags of between about 6-12 pixels work well

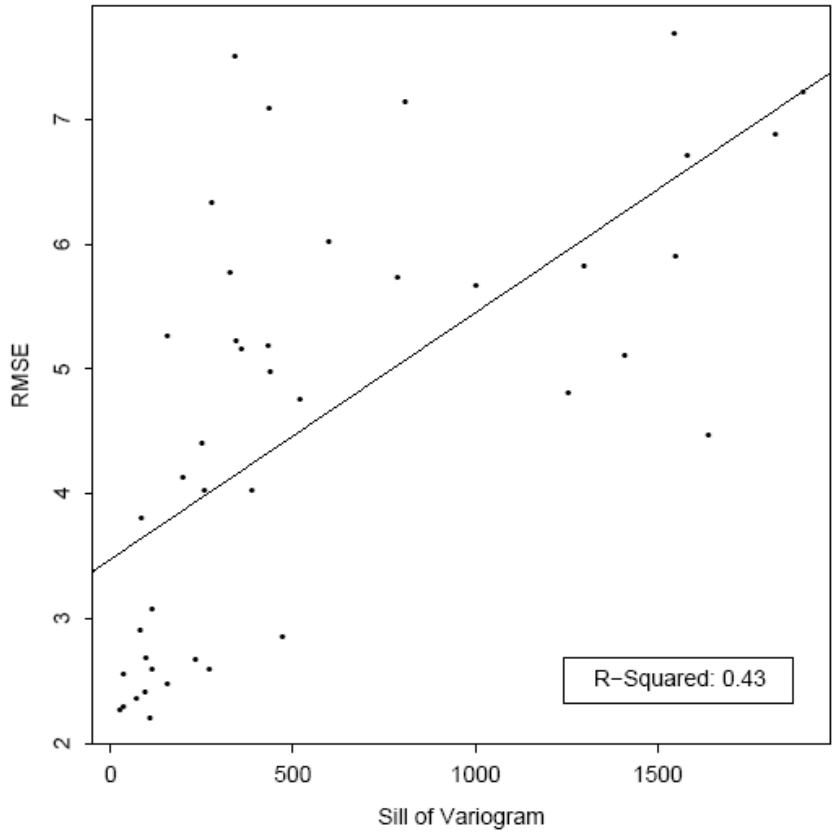
Variogram values at a lag of 10 pixels were used in a simple linear regression to estimate error magntidutes (RMSE)



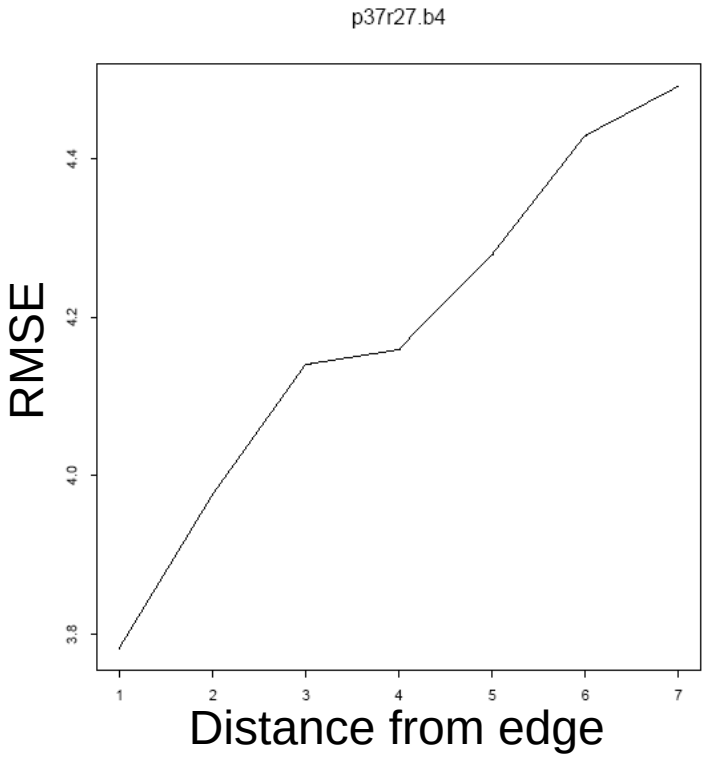


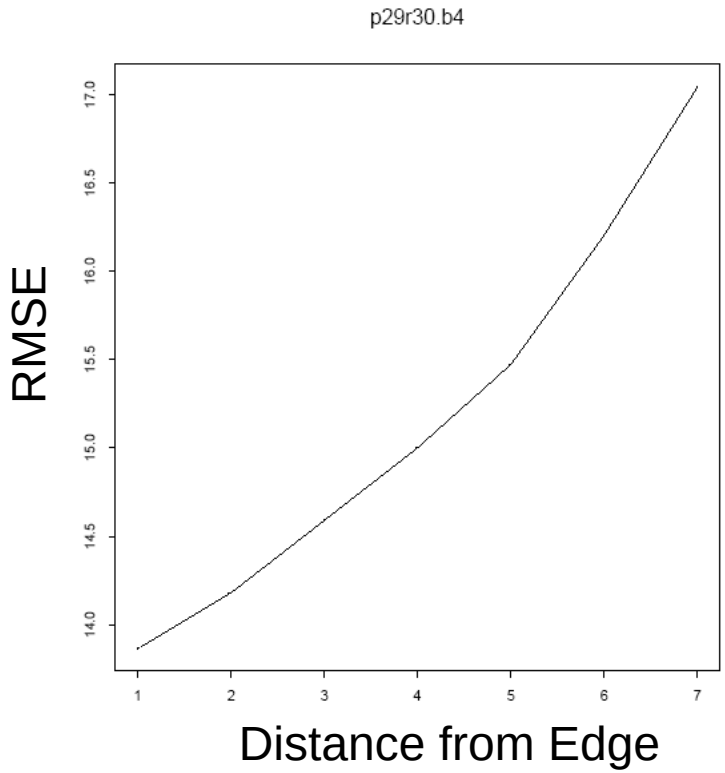
Simple regression results: lag 10 results much better than the sills (R-square of .78 vs .43)





Magnitude of errors related to the distance from the edge of the gaps





If you exclude images with clouds and those with dynamic agricultural settings (lots of surface change between dates used to fill gaps, it is possible to estimate reasonably well the magnitude of errors in gap filled products using data from variogams derived from the images