



Permafrost Science Workshop

Yukon River Basin Ecosystem Performance Anomaly Mapping

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Workshop on State of the Science at ESS



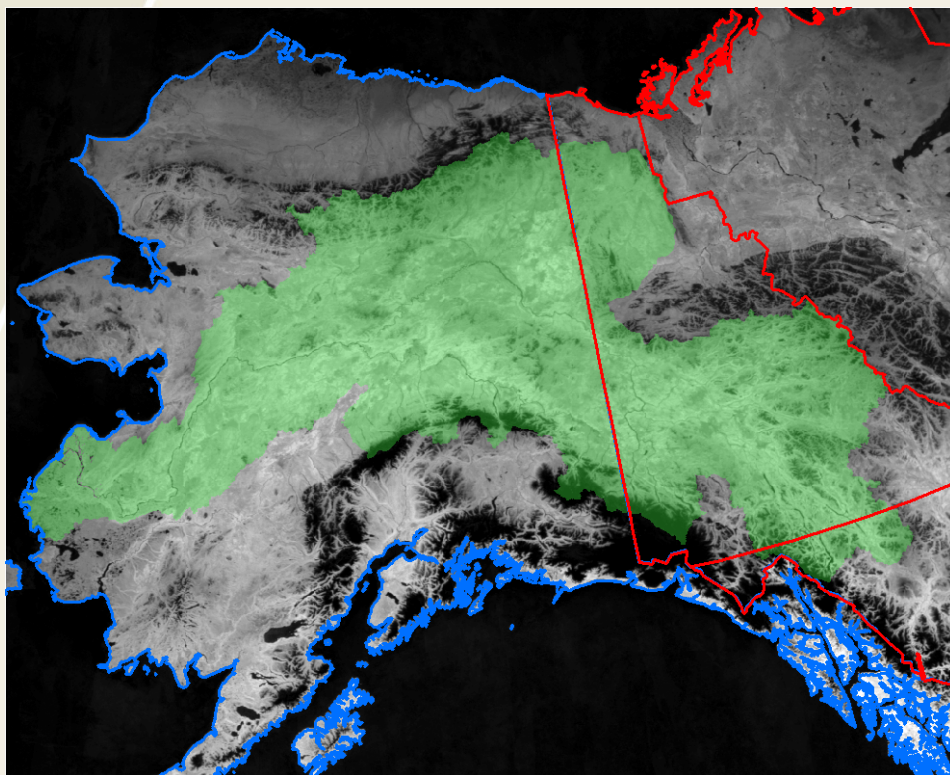
Natural Resources
Canada

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Background



- Yukon River Basin
 - Alaska, Yukon Territory, and British Columbia
 - Northern boreal ecosystem
 - Sensitive to climate change
 - Permafrost degradation
 - Forest fire frequency increase





Overview

- Monitoring Ecological System Performance spatially and temporally
 - Measure annual performance from optical satellite imagery
 - Model annual performance using site variables and weather
 - Compare performances to find anomalous areas





Scientific Application

- Measure annual performance
 - MODIS data
 - Years 2000-2005, 250 m resolution
 - Normalized Difference Vegetation Index (NDVI)
 - red/infrared ratio indicating plant vigor
 - Growing Season (May-Sept) average NDVI (GSN) proxy for vegetation production
- Model performance
 - Boreal forests of the Yukon river basin
 - Uses site Variables and weather
 - Exclude areas of recent forest fires
 - Over 15,000 training points





Rule-base multivariate linear Models

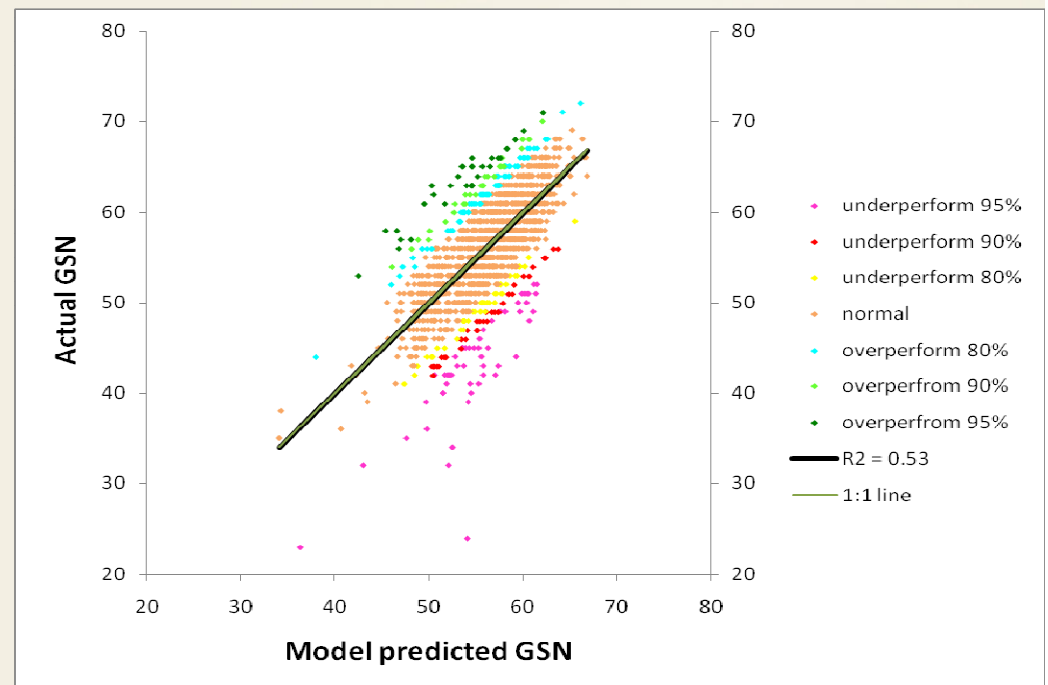
- **Site Potential** = AVHRR
long term average NDVI
- Permafrost
 - Extent, Landform, and Ice Content
- Saxton
 - PPT/PET
 - Solar Radiation
 - Clusters
- Surface Geology
- EcoRegions
- Land Cover
- Topographic
 - Elevation, CTI, Slope, Aspect
 - North and South
- **Performance** = MODIS
Annual GSNs
- Site Potential Model
- Climate – four annual periods
 - Temperature – maximum and minimum
 - Precipitation
 - Growing Degree Days





Scientific Application

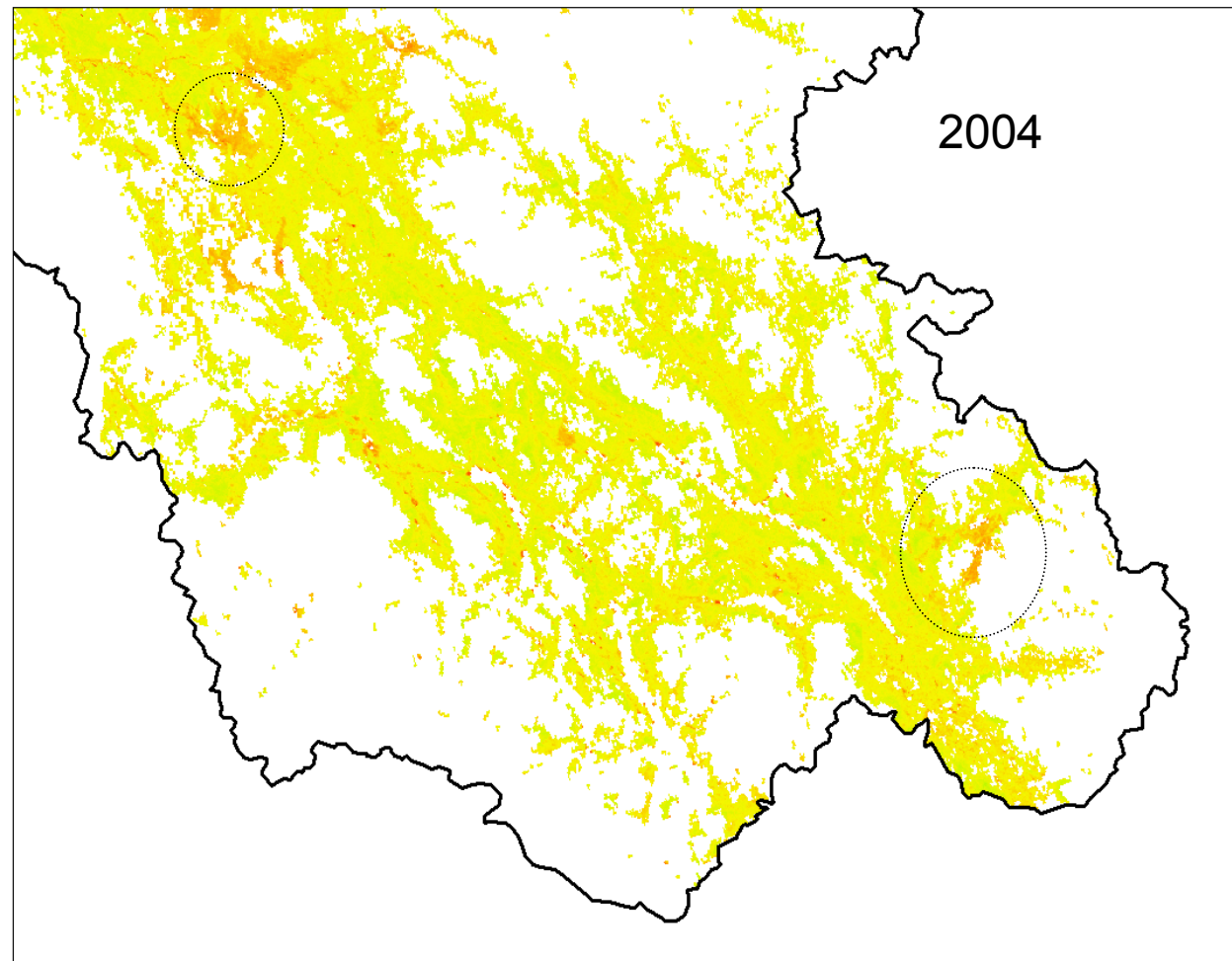
- Compare performance results
 - Residual between measured and modeled performance
 - Top 10% is over-performing
 - Bottom 10% is under-performing





Results – Annual Anomaly Maps

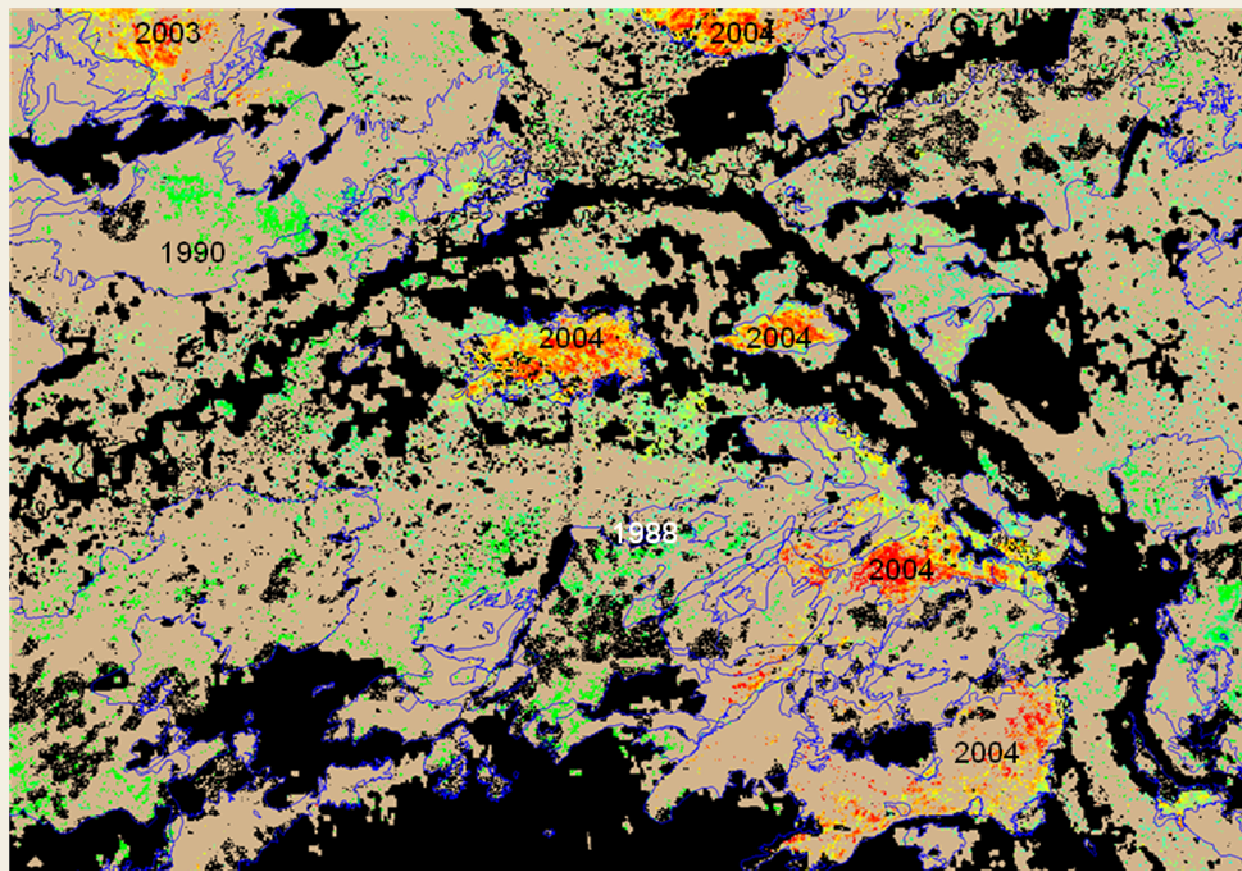
- Performance
 - Under
 - Normal
 - Over





Results - Temporal Analysis

- Comparison to known forest fires





Gaps

- Investigation of persistent anomalies
 - Ground Truth
 - Expert Partners
 - End Users





Activities

- Current
 - Publish Methodology in Journals
- Future
 - Methodology applied to an arctic ecosystem
 - Implemented as a monitoring system with annual updates





Publications

- Wylie, B.K., Zhang, L., Bliss, N.B., Ji, L., Tieszen, L.L., and Jolly, W.M., 2008, Integrating modeling and remote sensing to identify ecosystem performance anomalies in the boreal forest, Yukon River Basin, Alaska. *International Journal of Digital Earth*, 1: 196-220.
- 2008 Wylie, B.K., K. Murnaghan, L. Zhang, J. Rover, L. Ji, B. Brisco, L.L. Tieszen, “Satellite based monitoring of climate effects and disturbances in the boreal forests of the Yukon River Basin”, Park Science in the Arctic - Natural and Cultural Heritage of Greater Beringia: the 2008 Alaska Park Science Symposium,
- Wylie, B.K., Murnaghan, K., Rover, J. A., Tieszen, L. L., Brisco, B, 2009, Modeling boreal forest performance with MODIS, site characteristics, and weather to monitor climate, management, and disturbance impacts. AGU Fall 2009 Meeting Poster.
- 2009 Brisco, B., N. Short, P. Budkewitsch, K. Murnaghan and F. Charbonneau, “SAR Interferometry and Polarimetry for Mapping and Monitoring Permafrost in Canada”, POLinSAR 2009, the 4th International Workshop on Science and Applications of SAR Polarimetry and Polarimetric Interferometry, ESRIN, Frascati, Italy, 26-30 January.

