AWiFS Imagery: Processing & Automated Feature Extraction

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"Advanced Technology Solutions for Geospatial Applications"

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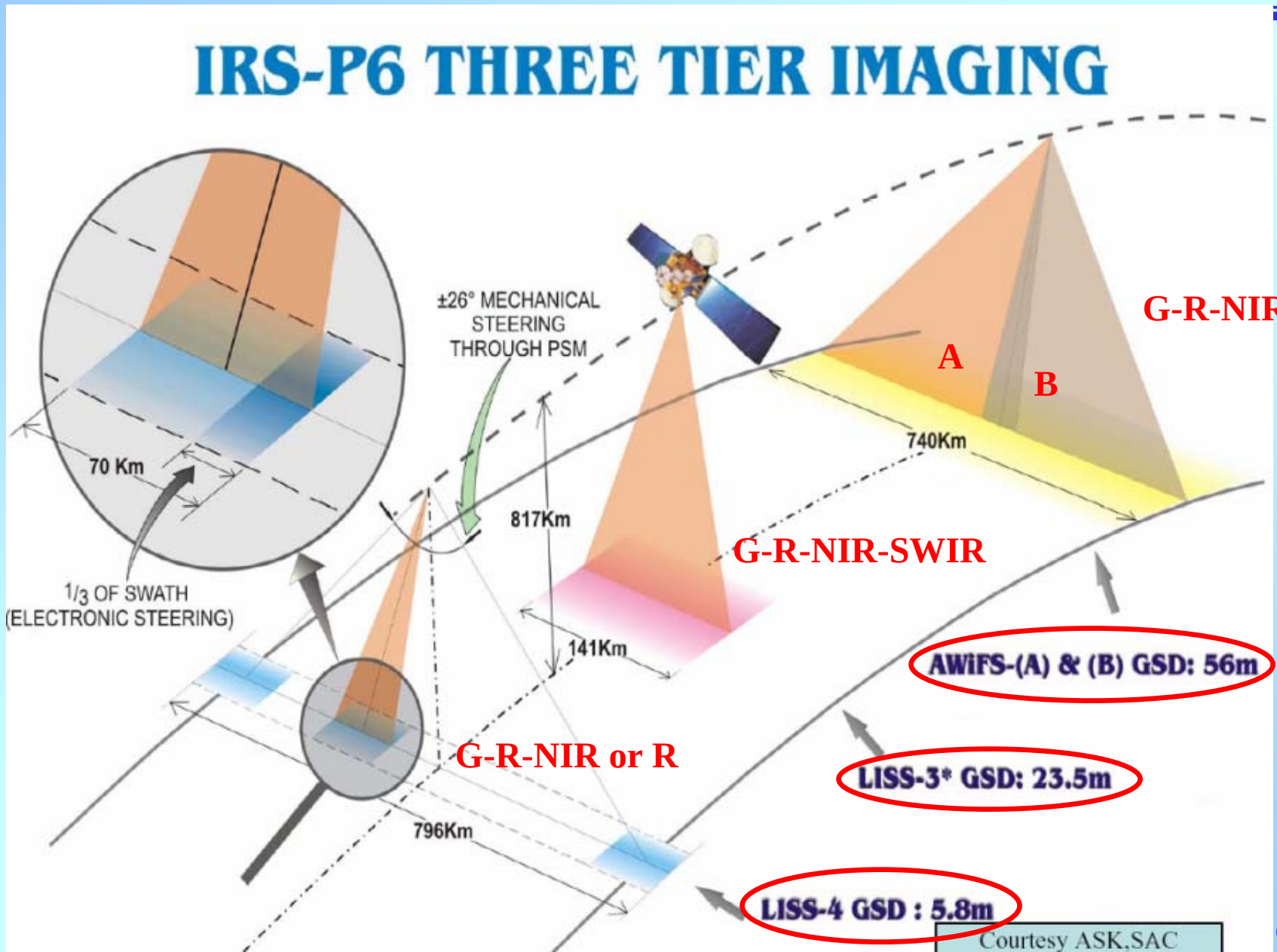
Outline

- AWiFS Overview
- AWiFS Surface Reflectance Calibration
- Cloud Detection in AWiFS -- CASA-AWiFS
- Feature Detection in AWiFS: Water, Snow/Ice
- GDA Future R&D Plans
- Questions

IRS-P6: AWiFS+Liss3+Liss4



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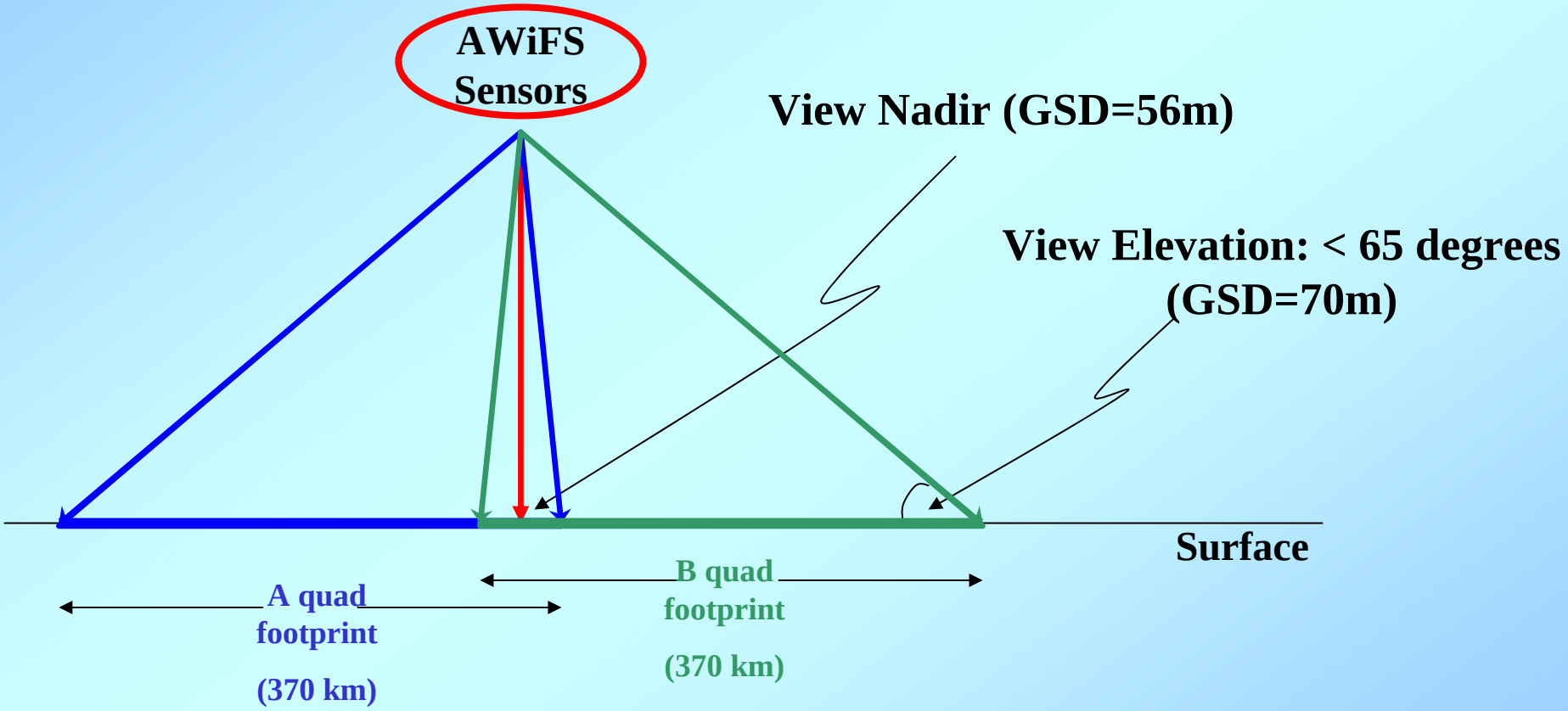
AWiFS Geometry

AWiFS: 11.94 degrees tilt between A & B cameras



View Elevation Change from 90 (nadir) to ~65 degrees

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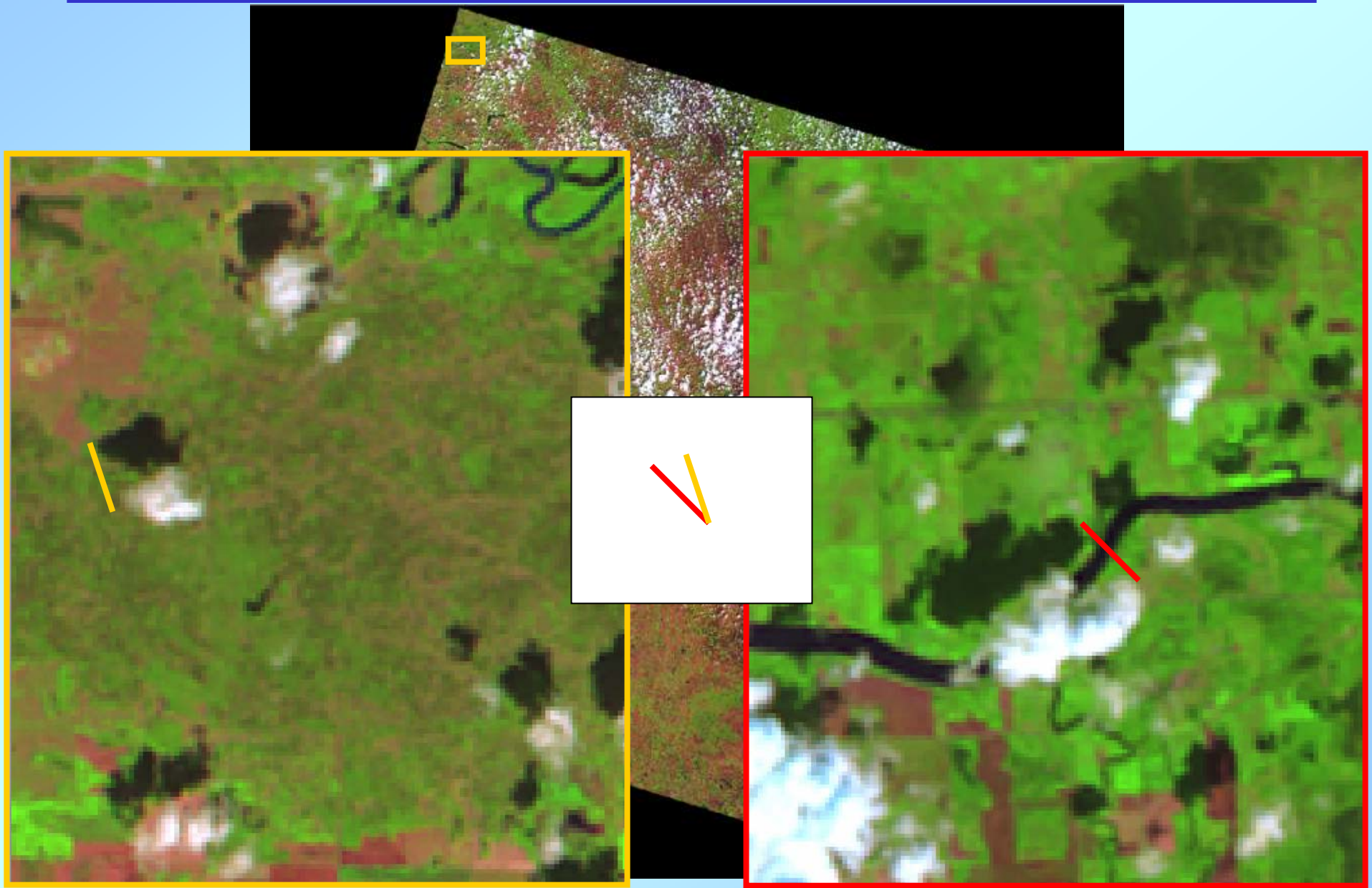
AWiFS Geometry



AWiFS Surface Reflectance

Unlike other medium resolution imagery, AWiFS has (among other things):

- **Significant variation of view elevation angles across the scene, and hence**
- **Per pixel differences in atmospheric transmittance along the view path.**

GDA Surface Reflectance Calibration:

- **Corrects for variations in view geometry & atmospheric transmittance across the scene.**
- **Calculates surface reflectance values, assuming (i) standard atmosphere and (ii) no surface LC and relief anisotropy, *i.e.*, no BDRF effects and, currently, flat terrain.**
- **SRS – Surface Reflectance for Standard Atmosphere**
- **A general equation is below**

$$\rho = (\pi \bullet (L_\lambda - L_p) \bullet d^2) / (\cos(\Theta) \bullet E_0 \bullet T_z + E_d) \bullet T_v$$

ρ is surface reflectance,
L_λ is at-sensor spectral radiance,
L_p is path radiance,
d is earth-sun distance in astronomical units, varies according to the Julian day,
Θ is sun elevation,
E_o is mean per band solar spectral irradiance value,
E_d is diffuse sky irradiance,
T_z is atmospheric transmittance along the solar path,
T_v is atmospheric transmittance along the view path.

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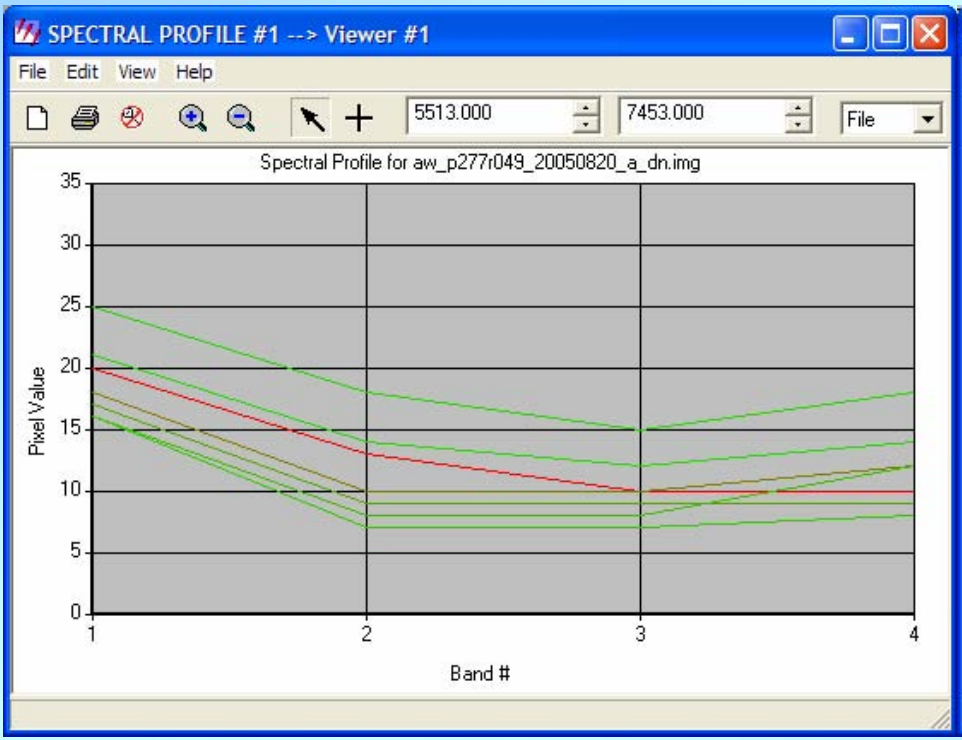
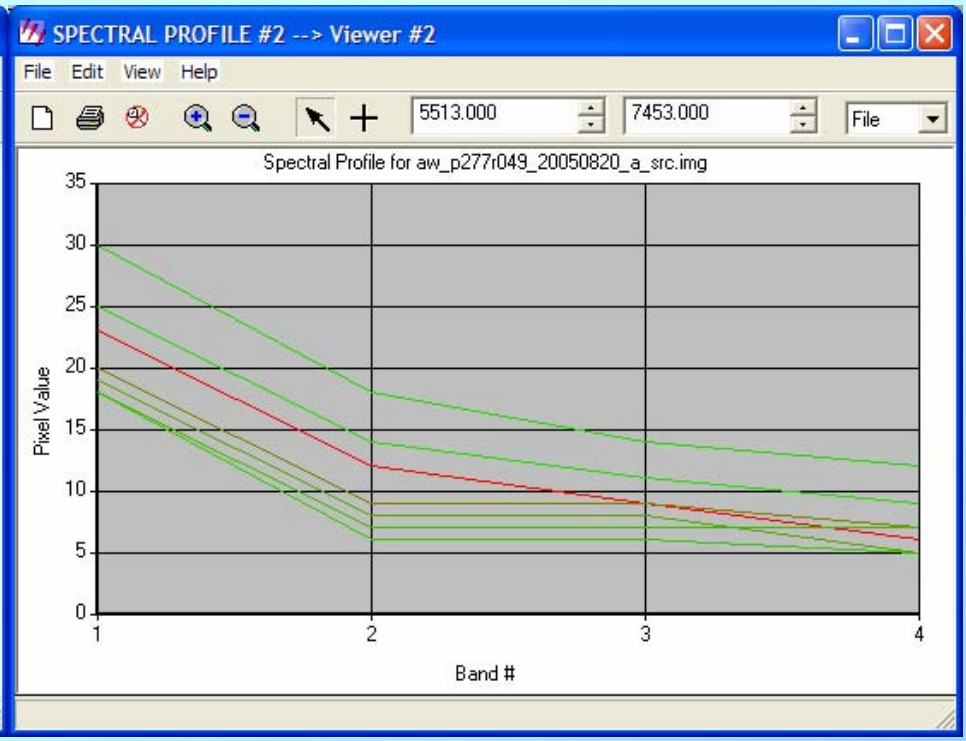
AWiFS Surface Reflectance

Water Spectral Properties

DN values



SRS values



- **The same water locations were sampled across DN and SRS imagery**

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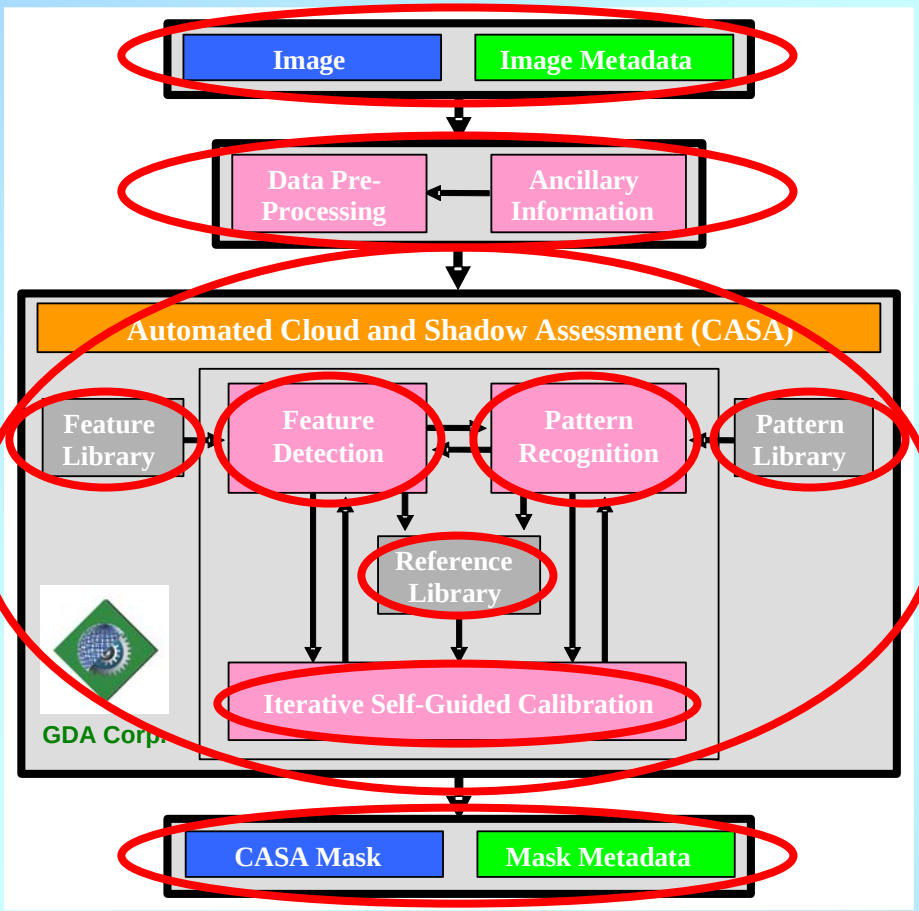
CASA: Cloud And cloud Shadow Assessment

CASA is a hierarchical self-learning expert system for the automated extraction of a predefined class of features.



Iterative Evidence / Knowledge Accumulation

- From Global to Scene Specific Knowledge Database
- Spectral
- Spatial
- Contextual / Pattern / Association
- Ancillary Data

Probability Based

- per Pixel
- per Object

Flexible

- Can be set to be more or less "aggressive"
- Can work in an interactive mode

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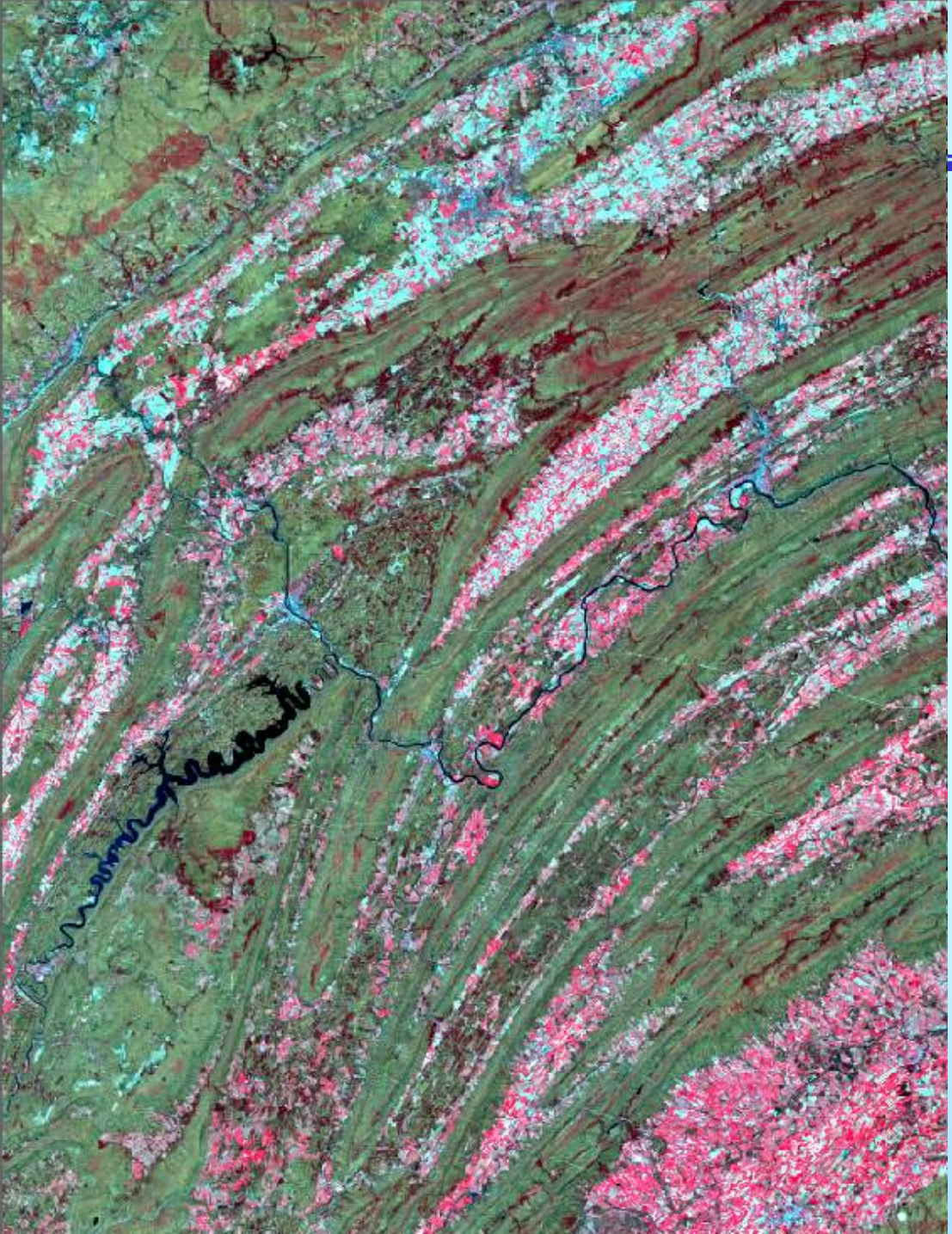

CASA-AWiFS

Image Pre-Processing:

- Surface Reflectance (SRS) Calibration
- Confusion Suppression, including
  - Topographic Normalization
  - Water Detection
  - Snow and Ice Detection

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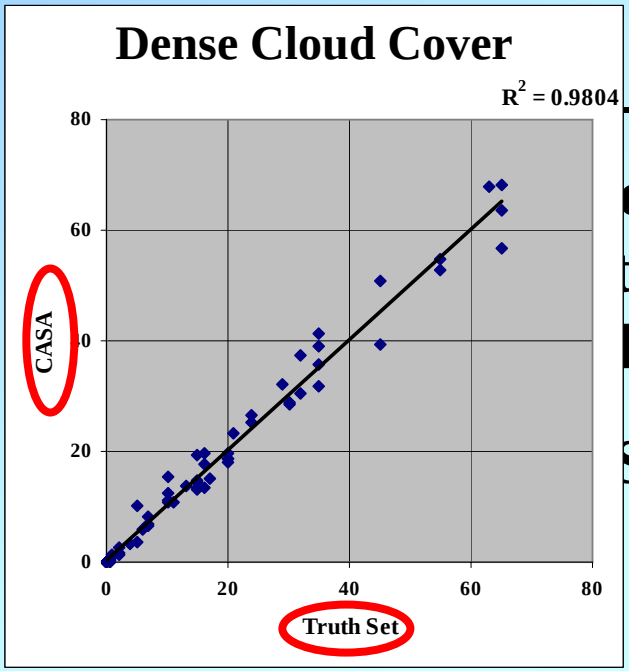
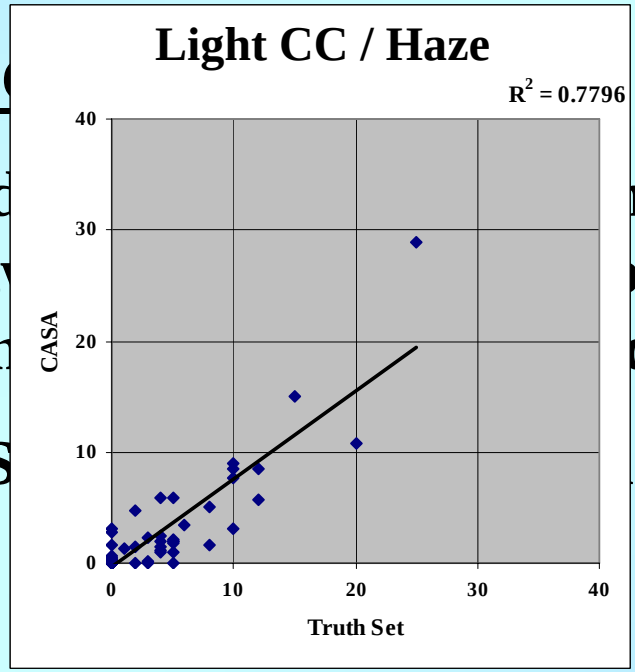
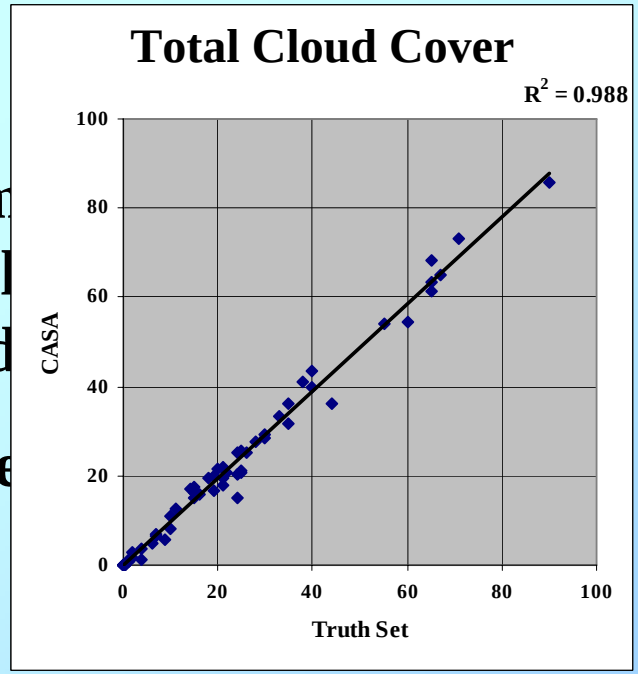
CASA-AWiFS

Accuracy of Cloud Detection: CASA *vs*. Truth Dataset







Correlation Values:

Dense clouds: 99.0%

Light, transparent clouds and haze: 88.3%

Combined, clouds and haze: 99.4%

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CASA-AWiFS

CASA *vs.* Truth Dataset: Differences in cloud cover estimates by level of error

CASA Error Level	Percent of Scenes		
	Dense Cloud Cover	Light Cloud / Haze Cover	Total Cloud / Haze Cover
0 to 1%	46%	52%	48%
0 to 2%	70%	63%	70%
0 to 5%	89%	94%	95%
0 to 10%	100%	100%	100%
Max Error	8%	9%	9%

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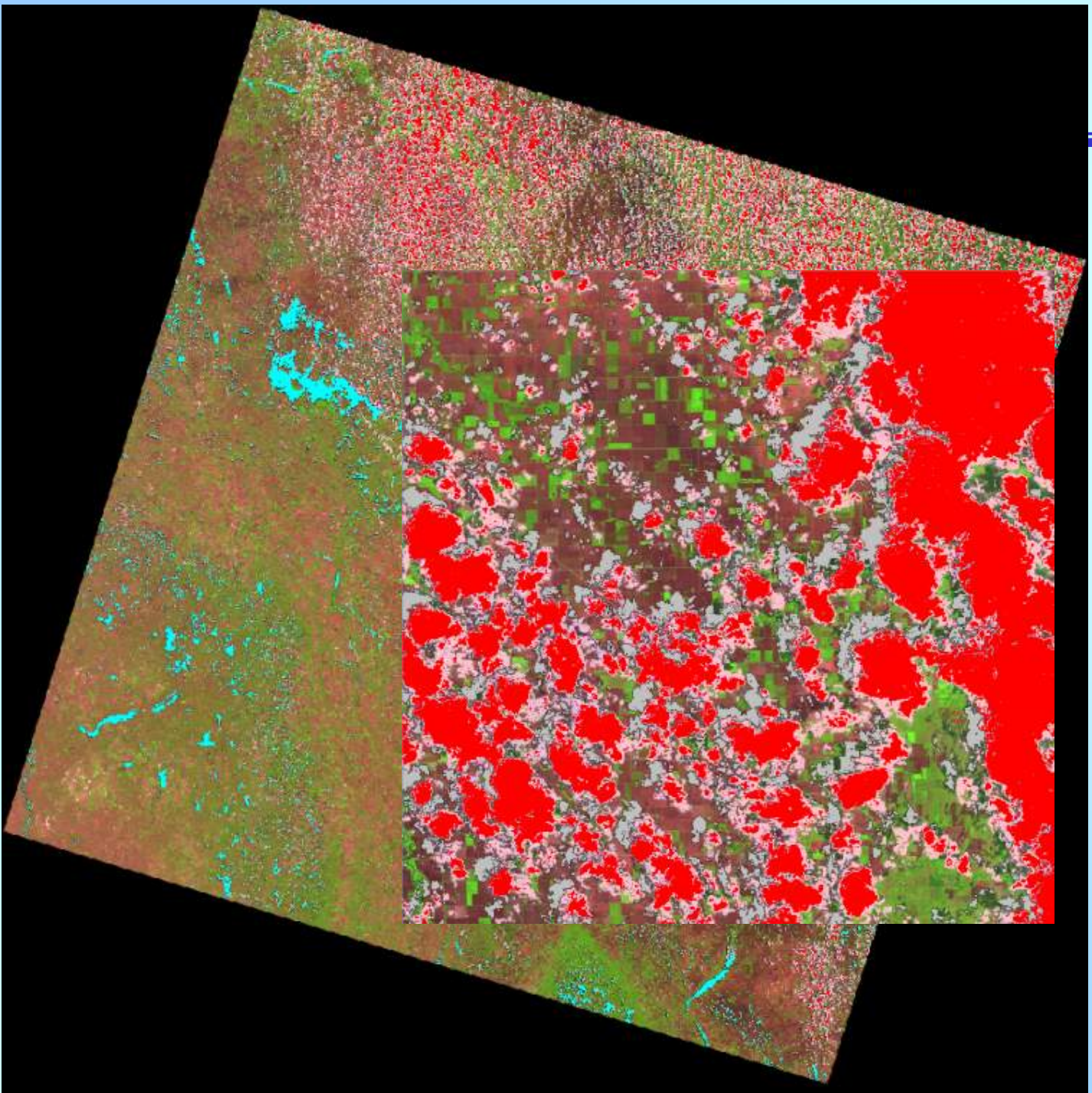

CASA-AWiFS

- dense cloud
- light cloud / haze
- cloud shadow
- water

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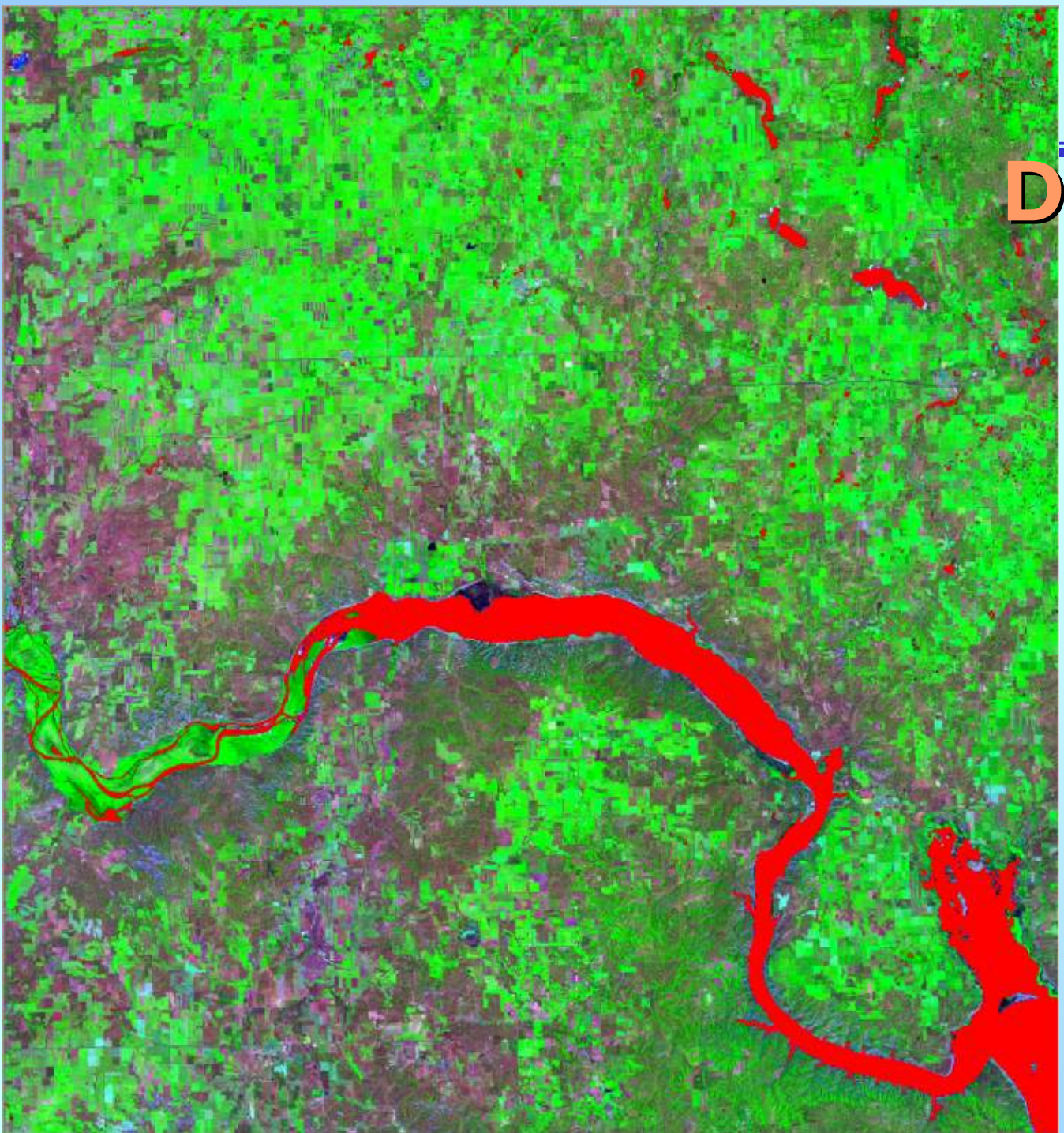

Feature Detection: Water

- Self-learning expert system
- Relies on a global knowledge base about water properties and extends global knowledge to the properties of a given scene
- If available, uses ancillary LC information as an extra line of evidence in the decision making process

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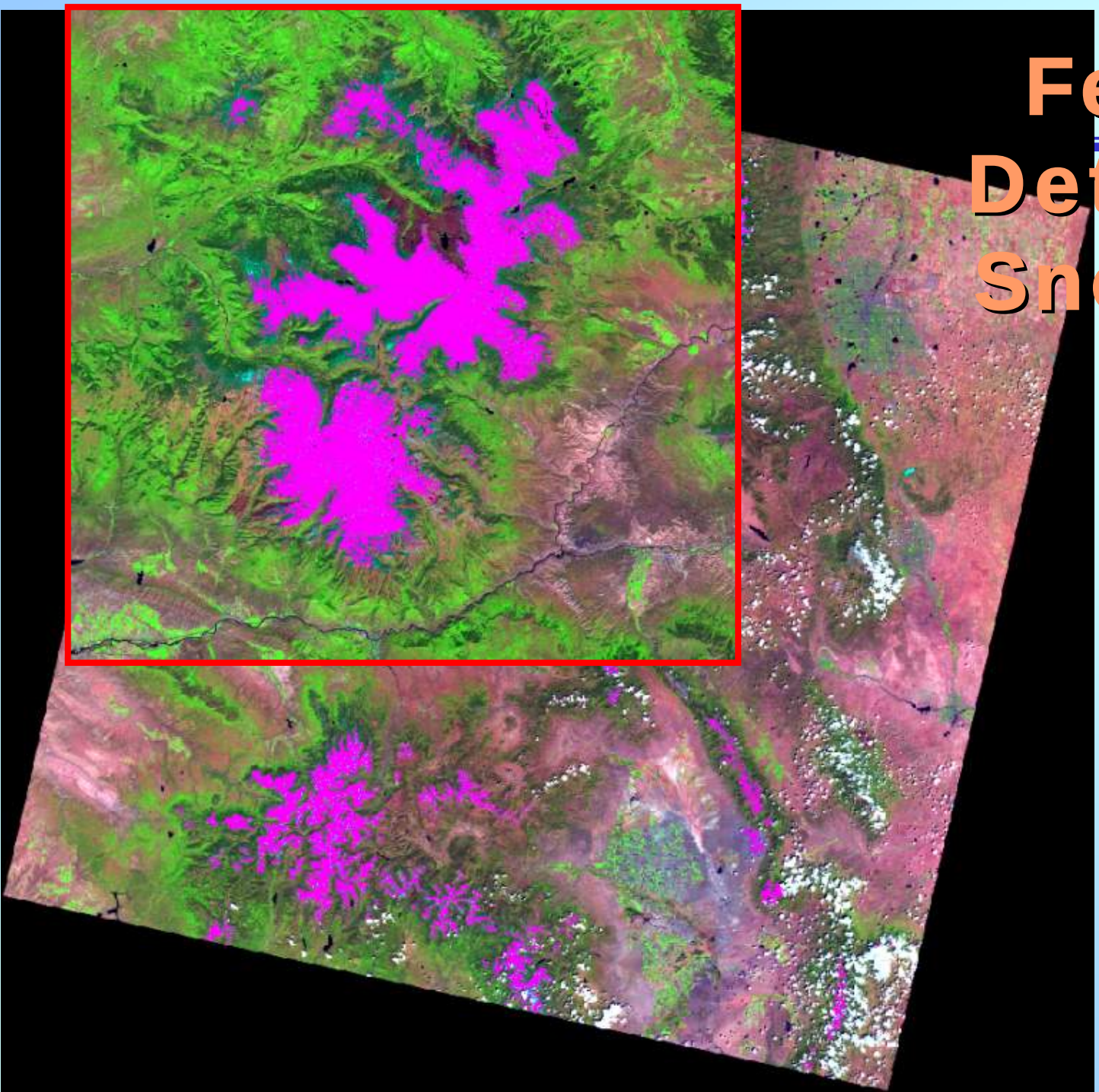

Feature Detection: Snow / Ice

The same approach is used as for water and cloud / cloud shadow detection

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Future R&D Plans

- **Develop CASA-Liss3 version.**
- **Introduce terrain anisotropy into surface reflectance calibration.**
- **Extend feature detection technology to other features such as roads, agricultural fields, buildings, airports, individual trees, *etc*.**
- **Complete an automated image classifier for 7 class mapping, including water, transportation, built-up/urban, ground/non-woody vegetation, woody vegetation, snow/ice, and other barren.**

Acknowledgements

- CASA-AWiFS R&D was supported by a NASA Dual Use grant, and advice on this and other CASA projects from NASA COTR, Tom Stanley.
- AWiFS imagery has been supplied by the USDA SIA with the help of Bob Tetrault, SIA Manager.
- Technical details on AWiFS radiometry and geometry were provided by James Lutes, GeoEye.

Additional CASA Info

http://www.gdacorp.com/projects/CASA.html

See bottom of the page for CASA-AWiFS white paper

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