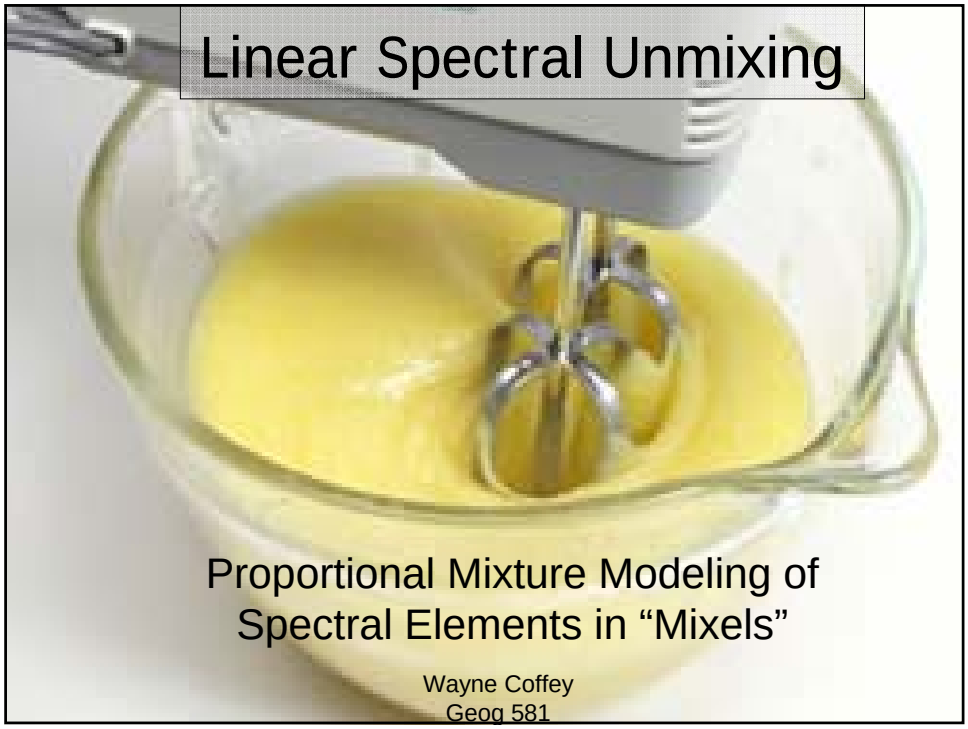
Linear Spectral Unmixing



Proportional Mixture Modeling of Spectral Elements in “Mixels”

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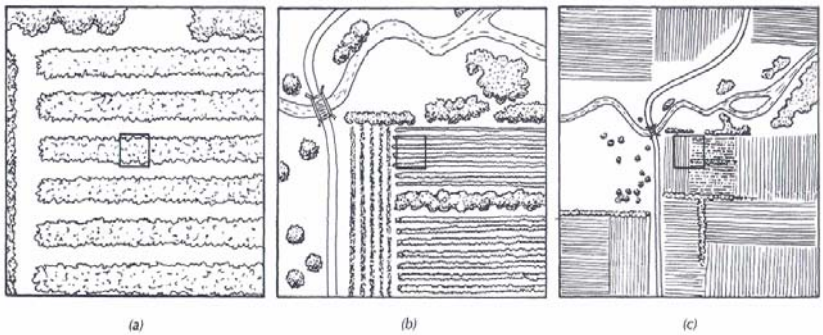
Geog 581

The Situation



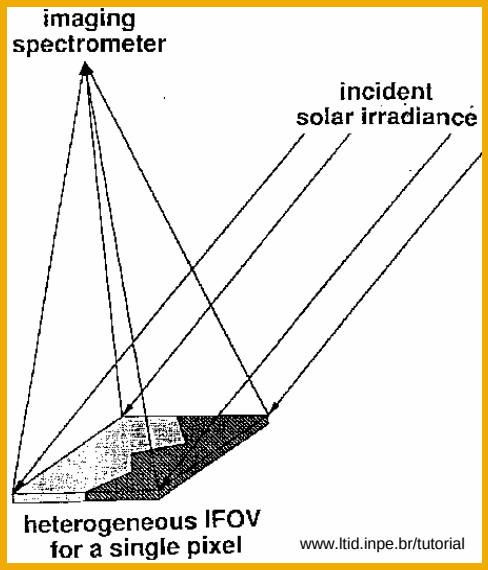
(a) (b) (c)

Ground resolution cell size effect: (*a*) small, (*b*) intermediate, and (*c*) large ground resolution cell size.
(Lillesand *et al* 2004*)*

Minimum Mapping Units and spatial resolution of sensors vary. Components within an image may vary with pixel size.

The Problem

IFOV covers more than one characteristic in the classification scheme.



Assumptions

"The method of mixture modeling starts from the explicit assumption that the characteristics of the observed pixels constitute mixtures of the characteristics of a small number of basic cover types, or end members." (228)

The Process
"Mixel Alchemy"

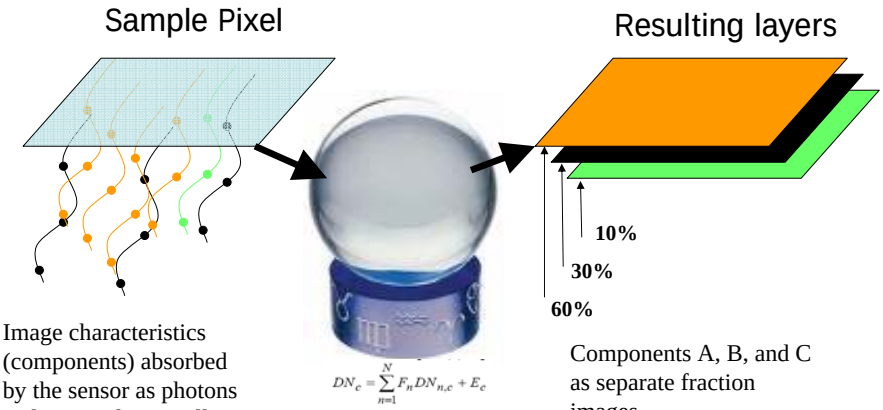
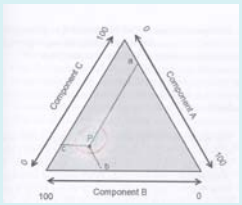


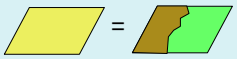
Image characteristics (components) absorbed by the sensor as photons and grouped spectrally

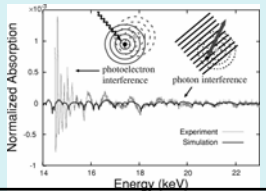
$$DN_c = \sum_{n=1}^{N} F_n DN_{n,c} + E_c$$

Components A, B, and C as separate fraction images.

Considerations





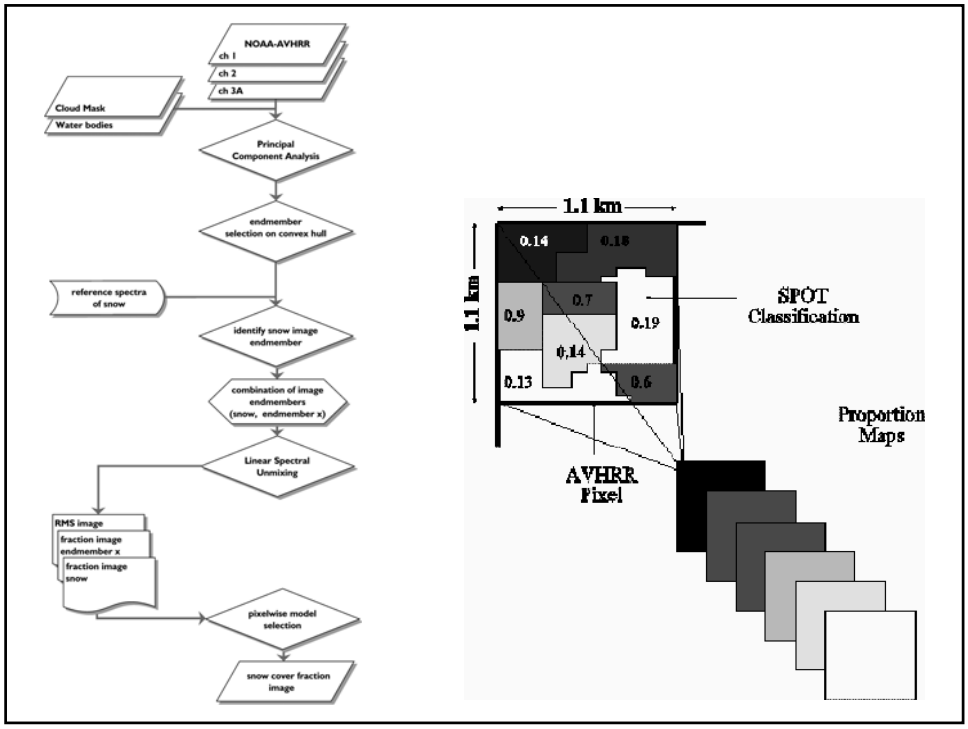


- Components cannot exceed number of spectral bands.

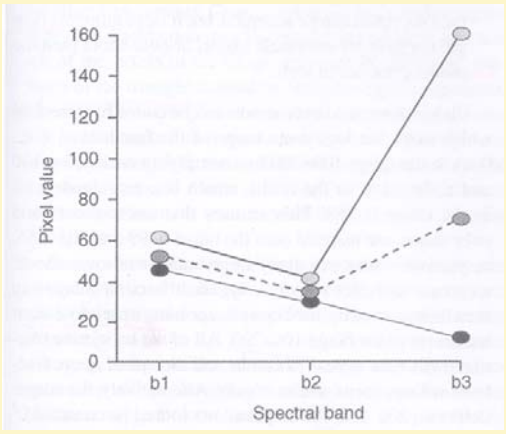
- Spectral reflectance curve may represent one or a combination of many elements. Elements must be of a pure spectra.

- End member values should represent best pixel example.

- Multiple reflections interfere with linear photon capture.



Deriving Proportions



	C1	C2	M
b1	46	62	52.4
b2	31	42	35.1
b3	12	160	68.8

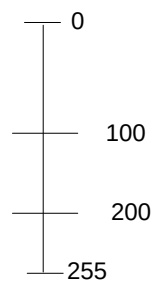
$46f_1 + 62f_2 = 52.4$

$31f_1 + 42f_2 = 35.4$

$12f_1 + 160f_2 = 71.2$

Scaling fractions into the color range

$$\varepsilon = \sqrt{\frac{\sum_{c=1}^{M} E_c^2}{M}}$$



The Result

(b), (c) and *(d) represent trees, shrubs and herbaceous plants respectively. The brighter pixels in each image indicate the higher proportion component.*

(Lillesand *et al* 2004)