

GEOG 357

LECTURE 9

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- Literature Review
- Env Change Demos *(date to change?)*

Course
Schedule

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Tasseled Cap Transformation

- Tasseled Cap Transformed is a linear transformation of image data in order to project soil and vegetation information into a single two-dimensional plane.
 - In the plane, the major spectral components of an agricultural scene are displayed in.
 - The transformation consists of linear combinations of the original spectral channels to produce a set of four new variables, each describing a specific dimension of the agricultural scene.

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Tasseled Cap Transformation

- The first two variables (representing brightness and greenness) usually convey almost all the information in an agricultural scene—often 95% or more.
- Therefore, the essential components of an agricultural landscape are conveyed by a two-dimensional diagram, using those two variables for brightness and greenness.

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Tasseled Cap Transformation

- Over the interval of an entire growing season, Brightness and Greenness variables follow a typical trajectory
 - Initially, the spectral response of a field is dominated by soil, as the field is plowed, disked, and planted
 - As the crop emerges and grows it simultaneously increases in greenness and decreases in soil brightness as the leaf canopy covers more of the soil surface.
 - Then, as senescence, maturity, and harvest occur, the field decreases in greenness and increases in soil brightness to return the field back near its original position.

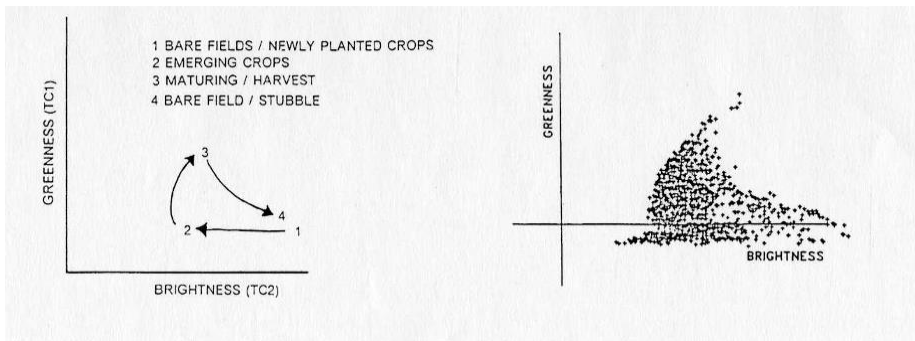
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Tasseled Cap Transformation

The technique was named after the pattern of spectral change of agricultural crops during senescence, plotting brightness (visible) against greenness (NIR).

The sequence is:

1. Bare fields / newly planted crops -high brightness, low greenness (spring)
2. Plant Growth - less soil brightness (early summer)
3. Maturity: increased greenness (late summer)
4. Senescence (harvest) - bare/stubble: less greenness, increased soil brightness (Fall)



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Tasseled Cap transformation

ArcMap 10.3

The Tasseled Cap (Kauth-Thomas) transformation is designed to analyze and map vegetation and urban development changes detected by satellite sensors. As crops grow from seed to maturity, there is a net increase in near-infrared and decrease in red reflectance based on soil color

Brightness channel = $.433 \cdot \text{Band4} + .632 \cdot \text{Band5} + .586 \cdot \text{Band6} + .264 \cdot \text{Band7}$
etc.. For Greenness and Yellowness

WEIGHTS FOR TASSELED CAP TRANSFORMATION OF LANDSAT MSS DATA				
Component	Channel 1	Channel 2	Channel 3	Channel 4
Brightness	0.433	0.632	0.586	0.264
Greenness	-0.290	-0.562	0.600	0.491
Yellowness	-0.829	0.522	-0.039	0.194
"Non-such"	0.223	0.012	-0.543	0.810

4:Green

5:Red

6:NIR1

7:NIR2

Brightness = a weighted average of all bands

Greenness = visible versus Near-IR bands (like a TM 4/3 ratio)

Yellowness = Green v Red (Non-such = the difference between the 2 IR bands)

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Tasseled Cap Transformation

Landsat 5 TM coefficients for the Tasseled Cap

New channel !

Band	Brightness	Greenness	Wetness
1	.3037	-.2848	.1509
2	.2793	-.2435	.1973
3	.4743	-.5436	.3279
4	.5585	.7243	.3406
5	.5082	.0840	-.7112
7	.1863	-.1800	-.4572

Character: **Overall reflectance** **NIR v Visible** **MIR v NVIR**

Kauth, R. J. and Thomas, G. S., 1976, The tasseled cap --a graphic description of the spectral-temporal development of agricultural crops as seen in Landsat, in Proceedings on the U.S. Department of the Interior 9 U.S. Geological Survey Symposium on Machine Processing of Remotely Sensed Data, West Lafayette, Indiana, June 29 -- July 1, 1976, 41-51.

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Tasseled Cap TM data,6-band (no thermal): Brightness, Greenness, Wetness

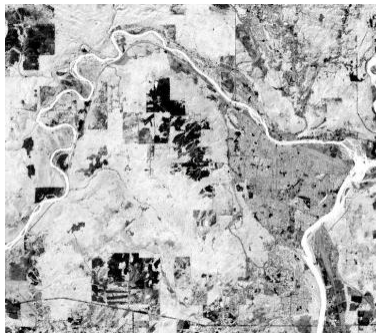
WEIGHTS FOR TASSELED CAP TRANSFORMATION OF THEMATIC MAPPER DATA						
Component	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 7
Brightness	0.3037	0.2793	0.4343	0.5585	0.5082	0.1863
Greenness	-0.2848	-0.2435	-0.5436	0.7243	0.0840	-0.1800
Wetness	0.1509	0.1793	0.3299	0.3406	-0.7112	-0.4572

Landsat 8 OLI coefficients

	<i>Coastal Band 1</i>	<i>Blue Band 2</i>	<i>Green Band 3</i>	<i>Red Band 4</i>	<i>NIR Band 5</i>	<i>Mid-IR1 Band 6</i>	<i>Mid-IR2 Band 7</i>
<i>Brightness</i>	0	0.3029	0.2786	0.4733	0.5599	0.5080	0.1872
<i>Greenness</i>	0	-0.2941	-0.2430	-0.5424	0.7276	0.0713	-0.1608
<i>Wetness</i>	0	0.1511	0.1973	0.3283	0.3407	-0.7117	-0.4559

Why are they different at all ?

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Brightness - measure of soil reflectance

Greenness - vegetation

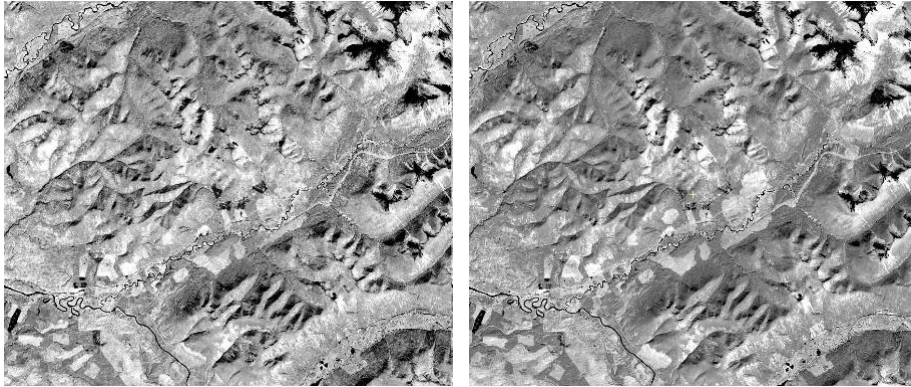
Wetness - soil / canopy moisture

tasseled cap channels 1,2,3

These would yield a higher contrast composite but with unfamiliar colours

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NDVI v Tasseled Cap greenness
both contrast NIR versus visible reflectance



TCA Greenness is similar to NDVI, with subtle differences and is used in habitat studies.

Figure : John Paczkowski MSc thesis - **remote sensing and grizzly bear habitat**

Wildlife ecologist, Kananaskis Country, Canmore, AB

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-but has only been developed for some sensors...
(the coefficients vary according to spectral wavelengths and radiometric resolution)

Catalyst

- Landsat 1-3 MSS
- Landsat 5 TM
- Landsat 7 ETM+

-NOT (why not?)

Landsat 8 OLI / Sentinel 2

Other ?:

- CBERS-02B (China/Brazil)
- Ikonos, Quickbird 2
- ASTER / MODIS

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Figure 2. The north-central part of the original true-color Landsat 7 ETM scene P22 R40.

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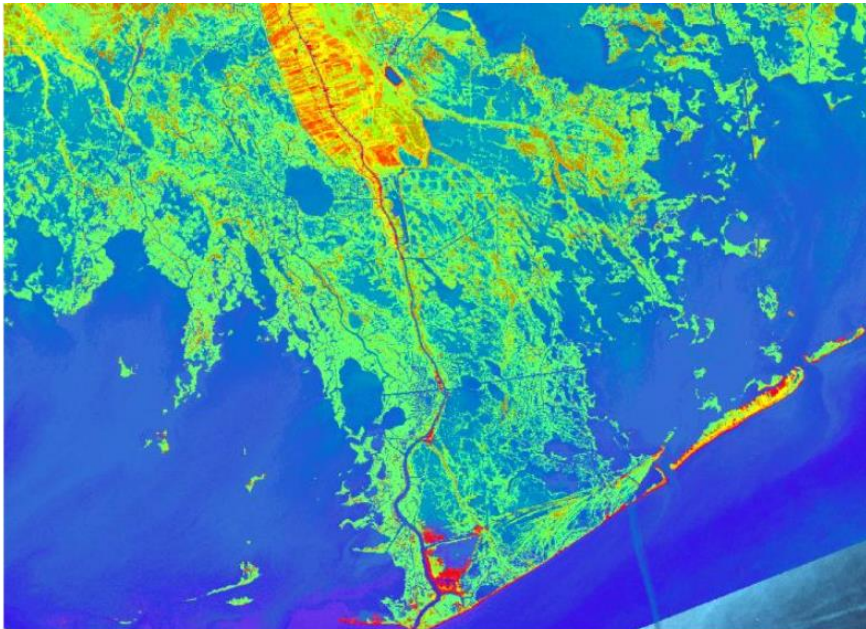


Figure 3. Three-band, 8-bit tasseled cap transformation image of the same Landsat 7 ETM.

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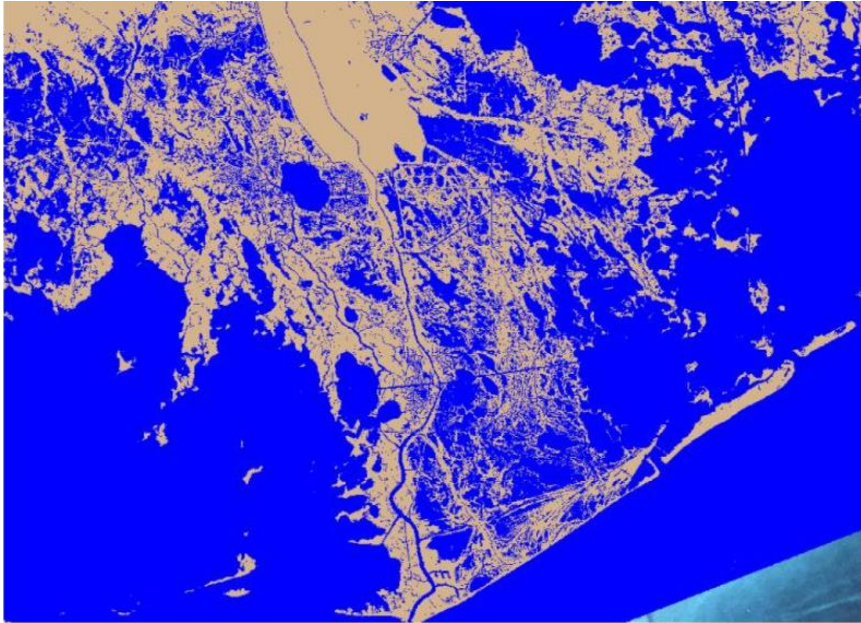


Figure 4. Two-bit raster file of the same Landsat 7 ETM scene showing pixel classification (brown) and water (blue).

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Reasons to use Tassel Cap Analysis

- **It reduces a multi band dataset (4-6) to 3 channels - Brightness, Greenness, Wetness - each might be useful**
- **The 3 channels could be used in classification**
- **The coefficients are universal for each sensor**

<https://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/tasseled-cap-transformation.htm>

<https://community.hexagongeospatial.com/t5/Spatial-Modeler-Tutorials/Tasseled-Cap-Transformation-for-Landsat-8/ta-p/1609>

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