

Using Oblique Historical Photos to Determine Past Mountain Pine Beetle Susceptibility

Principal Investigator:
Chris Stockdale
burning ecoLogic

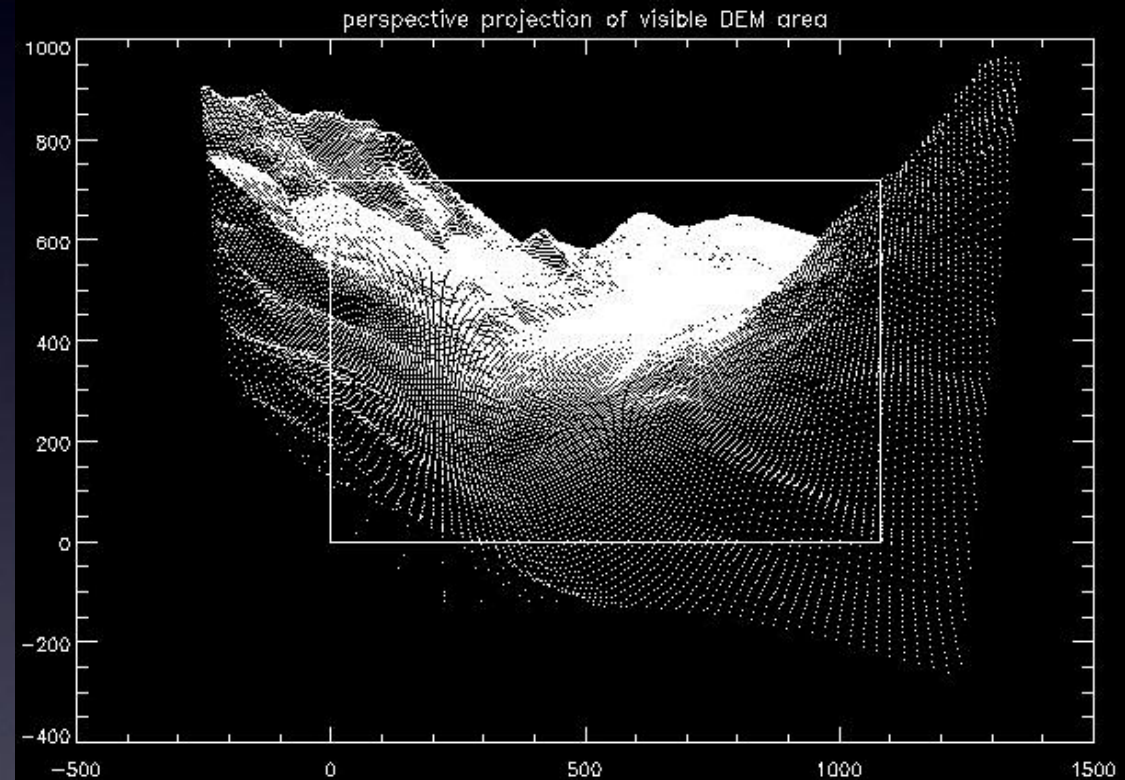
Phase I Collaborators:

Eric Higgs (UVic)

Rick Arthur (AB SRD)

Katelyn Loukes (BCIT)

Oliver Clovis (BCIT)



Understanding the Epidemic

- Why is current epidemic so massive?
 - Convergence of many factors
 - Interruption/alteration of the factors that normally control landscape outbreaks

Cross-scale Drivers of Natural Disturbances Prone to Anthropogenic Amplification: The Dynamics of Bark Beetle Eruptions

KENNETH F. RAFFA, BRIAN H. AUKEMA, BARBARA J. BENTZ, ALLAN L. CARROLL, JEFFREY A. HICKE, MONICA G. TURNER, AND WILLIAM H. ROMME

Bioscience 58(6) 2008

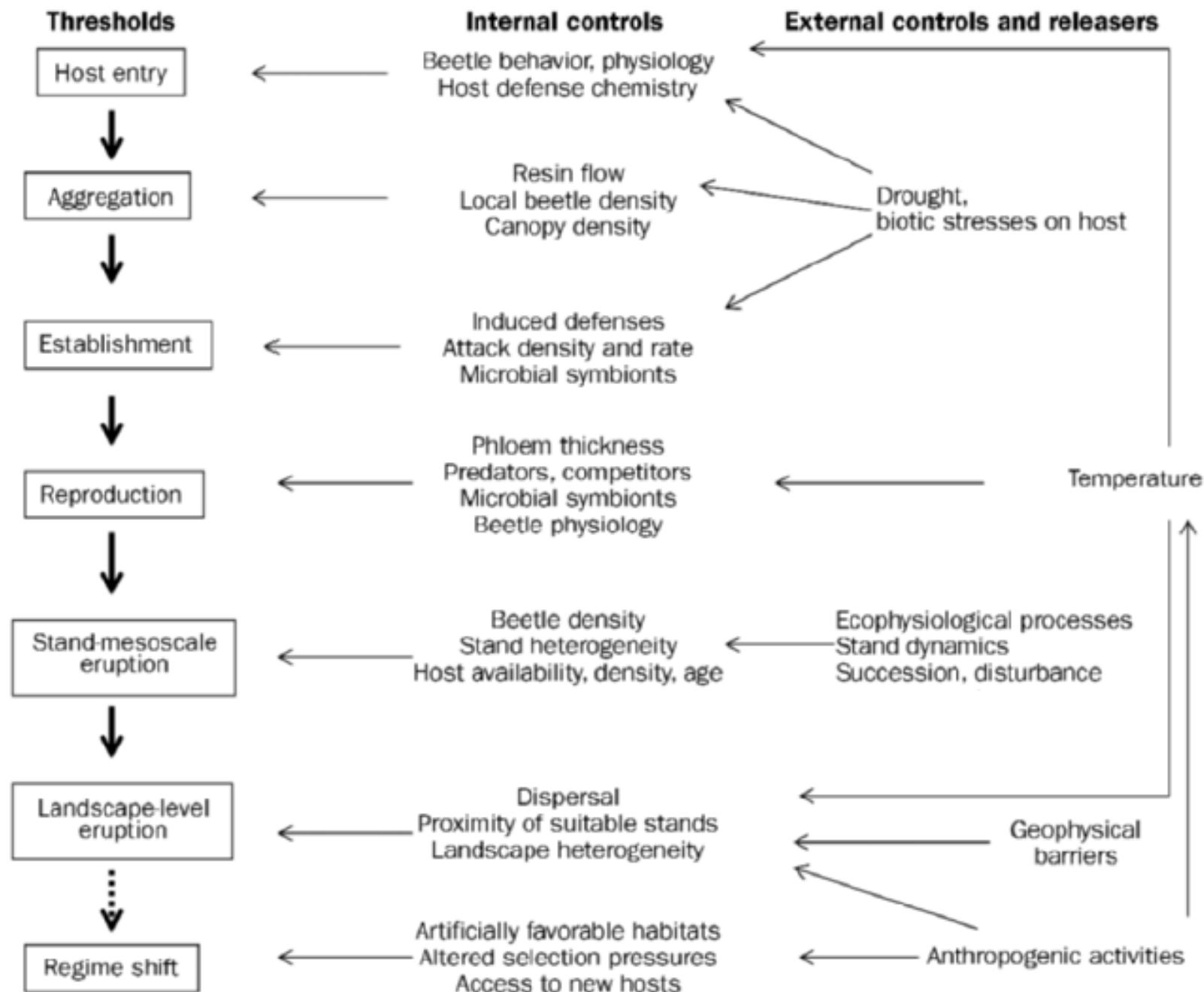


Figure 2. Thresholds, multiple causalities, and sources of feedback in the population dynamics of bark beetles: Conceptual diagram of the sequence of thresholds (solid boxes) that must be crossed to produce a landscape-scale eruption. Thresholds progress across hierarchical scales from individuals (host entry),

Understanding the Epidemic

- Interruption of disturbance dynamics
- Less fire* = more trees. Mostly pine. Mostly beetle food.
- But we have not quantified changes in landscape structure directly (has been inferred, and back-casted, but not directly measured)

Learning from the Past

- What if we could directly measure historical landscape structure?
 - Could evaluate many historical changes:
 - Vegetation composition
 - MPB susceptibility
 - Grizzly habitat
 - Caribou habitat
 - Fire risk
 - Fire regimes



Phototopographic surveying: 1880's-1950's
Repeat Photography (Mountain Legacy Project):
1998-Ongoing

THE MOUNTAIN LEGACY PROJECT

1. The largest repeat photography project in the world.
2. 140,000+ images from western Canadian mountain regions
3. Taken by several surveyors from the late 19th to the early 20th centuries.
4. Most of these images were taken using 4" by 6" glass plate negatives, which reveal astonishing clarity.
5. 4,000+ of these images have been repeated by taking images from the exact locations as the originals
6. Allows researchers to examine historical landscape change.

Ya-ha Tinda, 1918

M.P. Bridgland



6-10

Ya-ha Tinda, 2009

Higgs



Saskatchewan Crossing, 1927

M.P. Bridgland



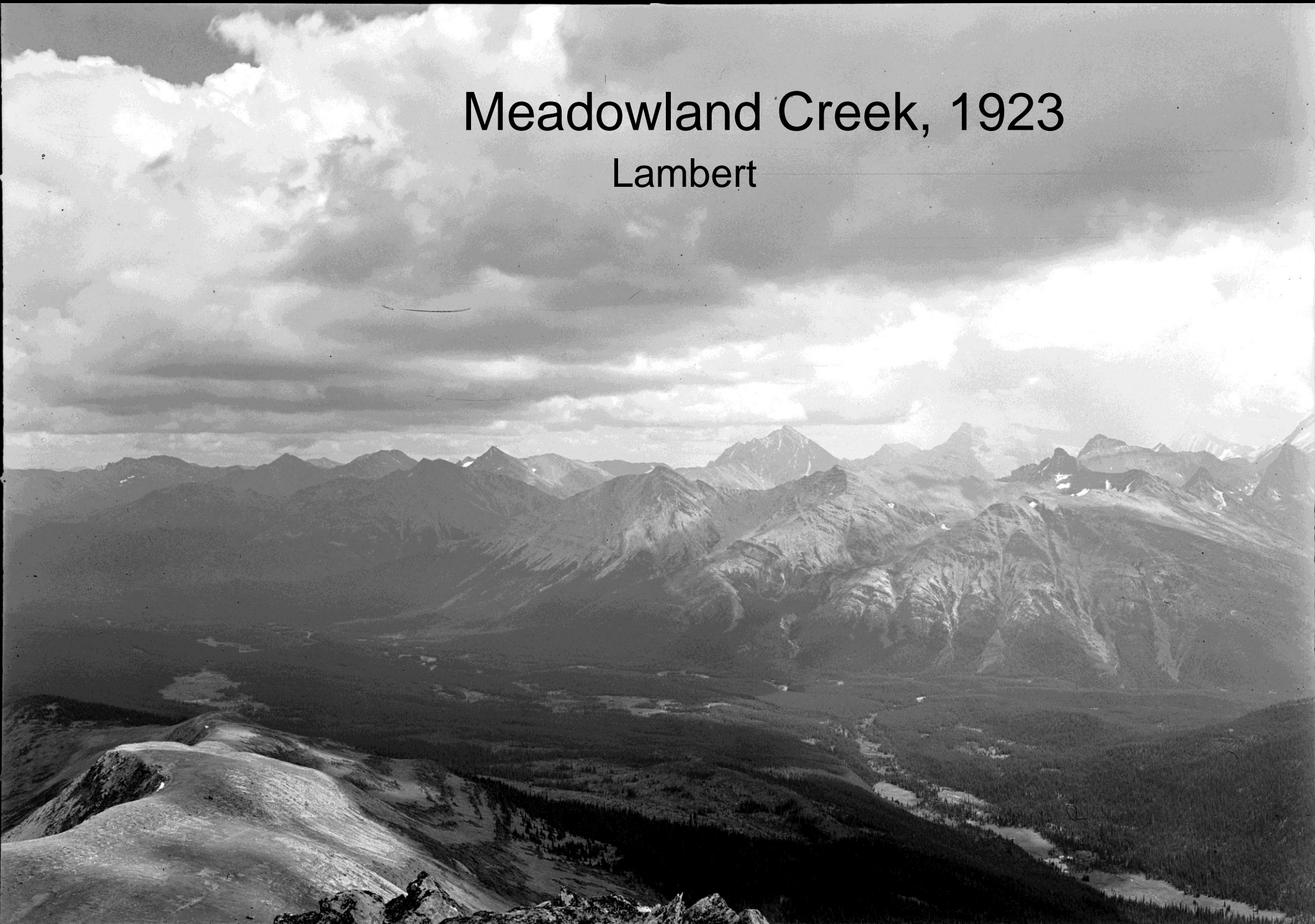
Saskatchewan Crossing, 2009

Higgs



Meadowland Creek, 1923

Lambert



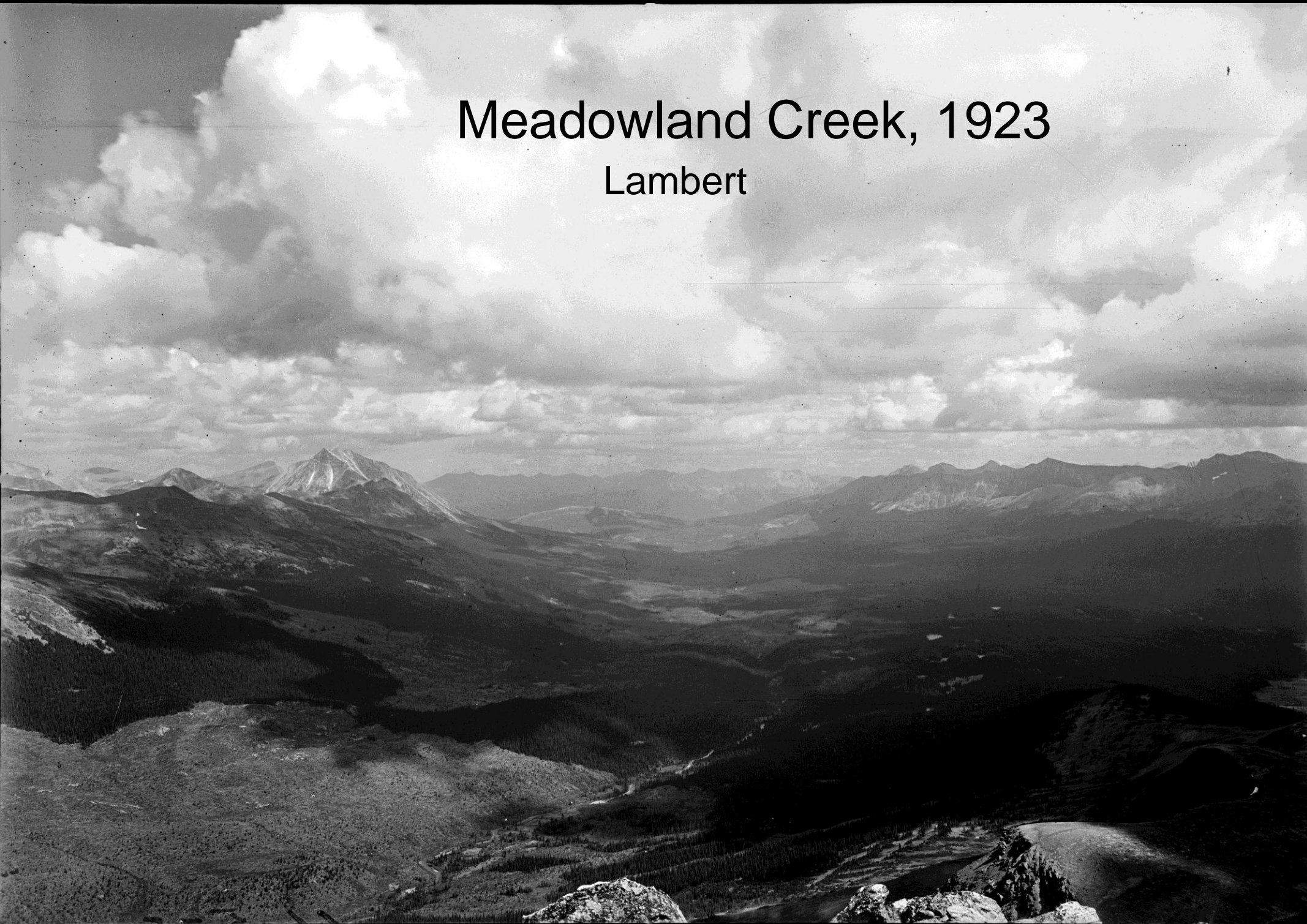
Meadowland Creek, 2009

Higgs



Meadowland Creek, 1923

Lambert



Meadowland Creek, 2009

Higgs



Moose Mountain, Kananaskis 1895

Wheeler



2009
Higgs







Requirements

Photos

Multiple photo stations

Clear images

Original and Repeat images

Accurate location data

Data/Technology

Detailed DEM

Readily available software

Affordable software

Wheeler Irrigation Survey, 1895-1897



Jumping Pound North Station



Jumping pound summit station



Moose Mountain Centre Station



Moose Mountain West station



Image © 2010 TerraMetrics

© 2010 Tele Atlas
Image © 2010 GeoEye

©2009 Google

ery Date: Sep 12, 2002

11 U 642966.55 m E 5847933.44 m N elev 1765 m

Eye alt 13.35 km

Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

© 2010 Tele Atlas

Image © 2010 GeoEye

11 U 649175.54 m E 5645047.02 m N elev 1828 m

©2009 Google

Eye alt 13.35 km

Imagery Dates: Jun 16, 2002 - Sep 12, 2002



Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

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Image © 2010 GeoEye

11 U 642457.76 m E 5648238.87 m N elev 1789 m

©2009 Google

Eye alt 13.35 km

Imagery Date: Sep 12, 2002

Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

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11 U 643779.59 m E 5646262.72 m N elev 1795 m

©2009 Google

Eye alt 13.35 km

Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

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11 U 643147.06 m E 5647509.28 m N elev 1780 m

©2009 Google

Eye alt 13.35 km

Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

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Image © 2010 GeoEye

11 U 643271.46 m E 5646149.86 m N elev 1816 m

©2009 Google

Eye alt 13.35 km



Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

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11 U 642555.22 m E 5647905.39 m N elev 1852 m

©2009 Google

Eye alt 13.35 km

Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

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Image © 2010 GeoEye

11 U 643600.90 m E 5648041.30 m N elev 1738 m

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Eye alt 13.35 km

Jumping pound summit station

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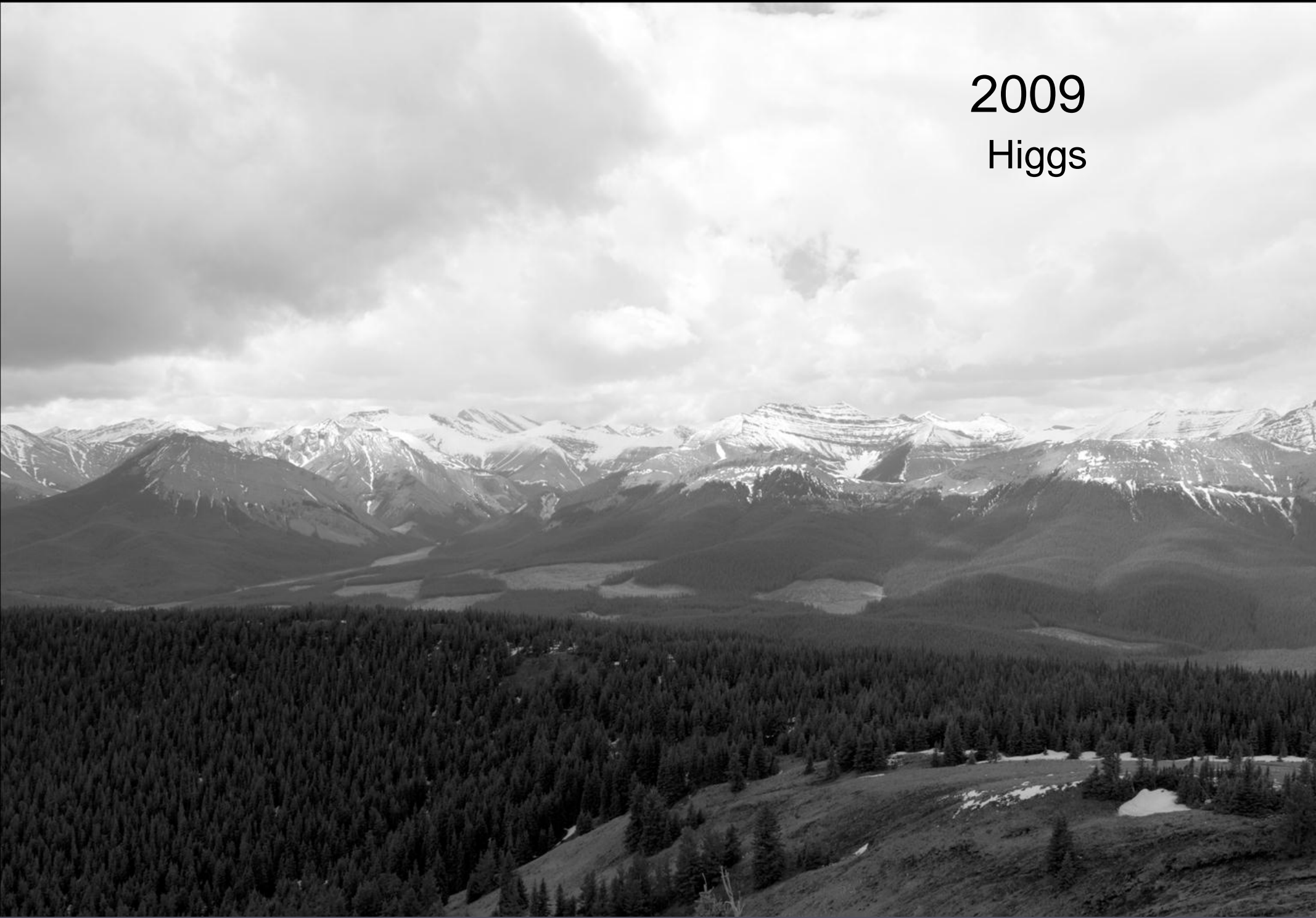
11 U 645920.23 m E 5645402.43 m N elev 1927 m

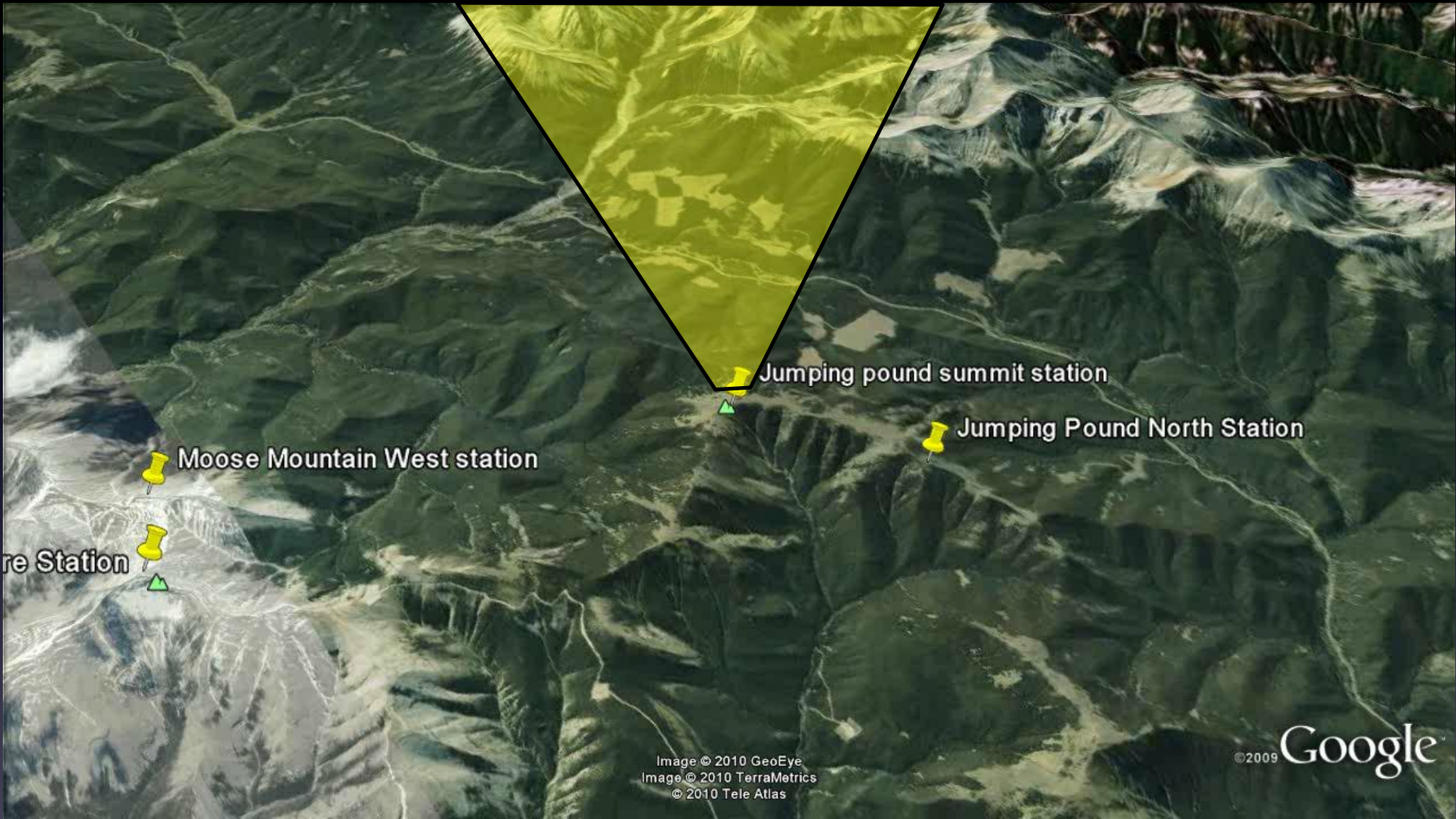
Eve alt: 7.85 km

c.1895
Wheeler



2009
Higgs





Moose Mountain West station

Jumping pound summit station

Jumping Pound North Station

re Station

Image © 2010 GeoEye
Image © 2010 TerraMetrics
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Image © 2010 GeoEye
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11 U 644038.06 m E 5640922.30 m N elev 1832 m

Eye alt 5.89 km

INT. J. REMOTE SENSING, 20 DECEMBER, 2004,
VOL. 25, NO. 24, 5705–5729



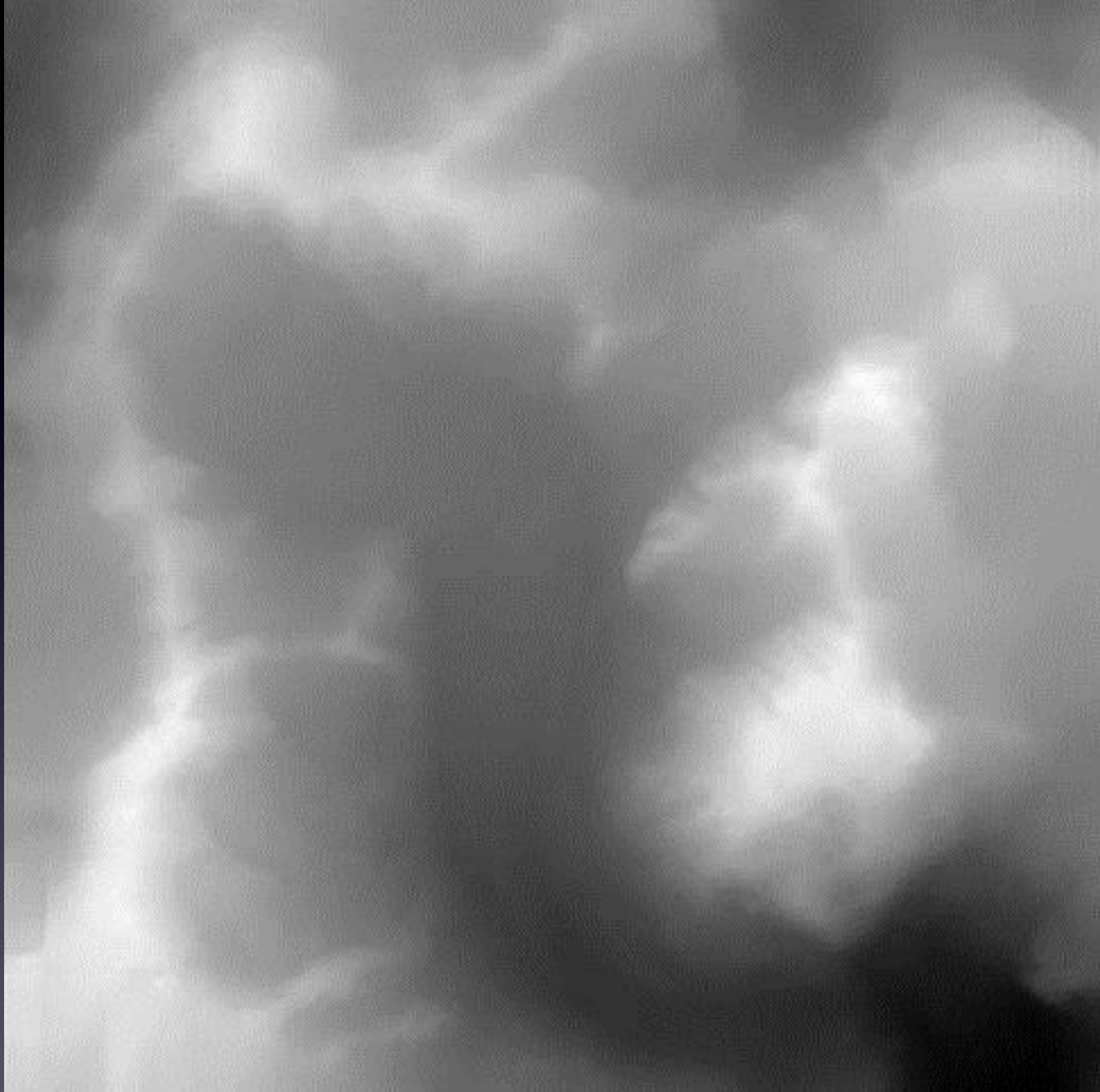
Taylor & Francis
Taylor & Francis Group

Snow surface albedo estimation using terrestrial photography

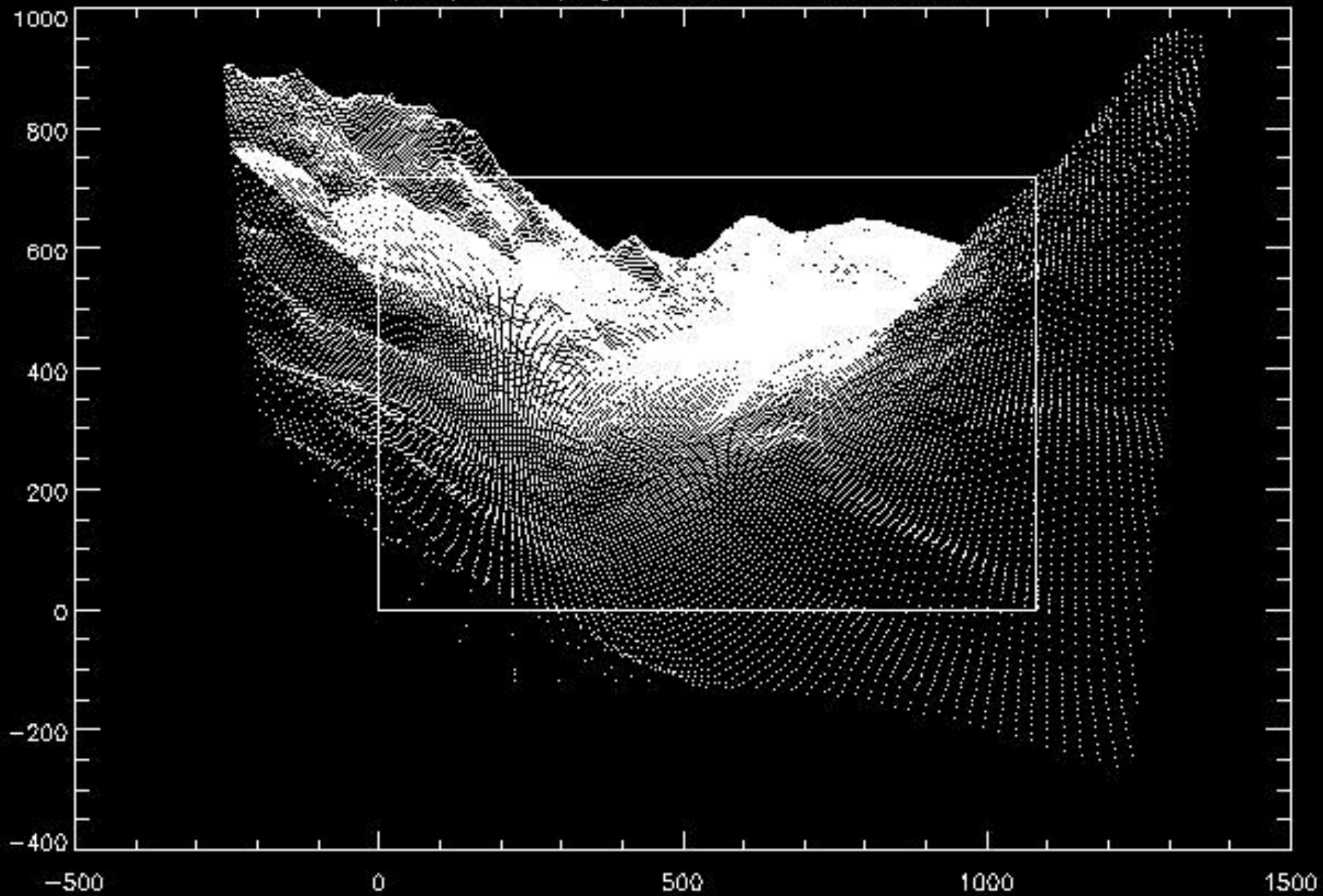
J. G. CORRIPIO*

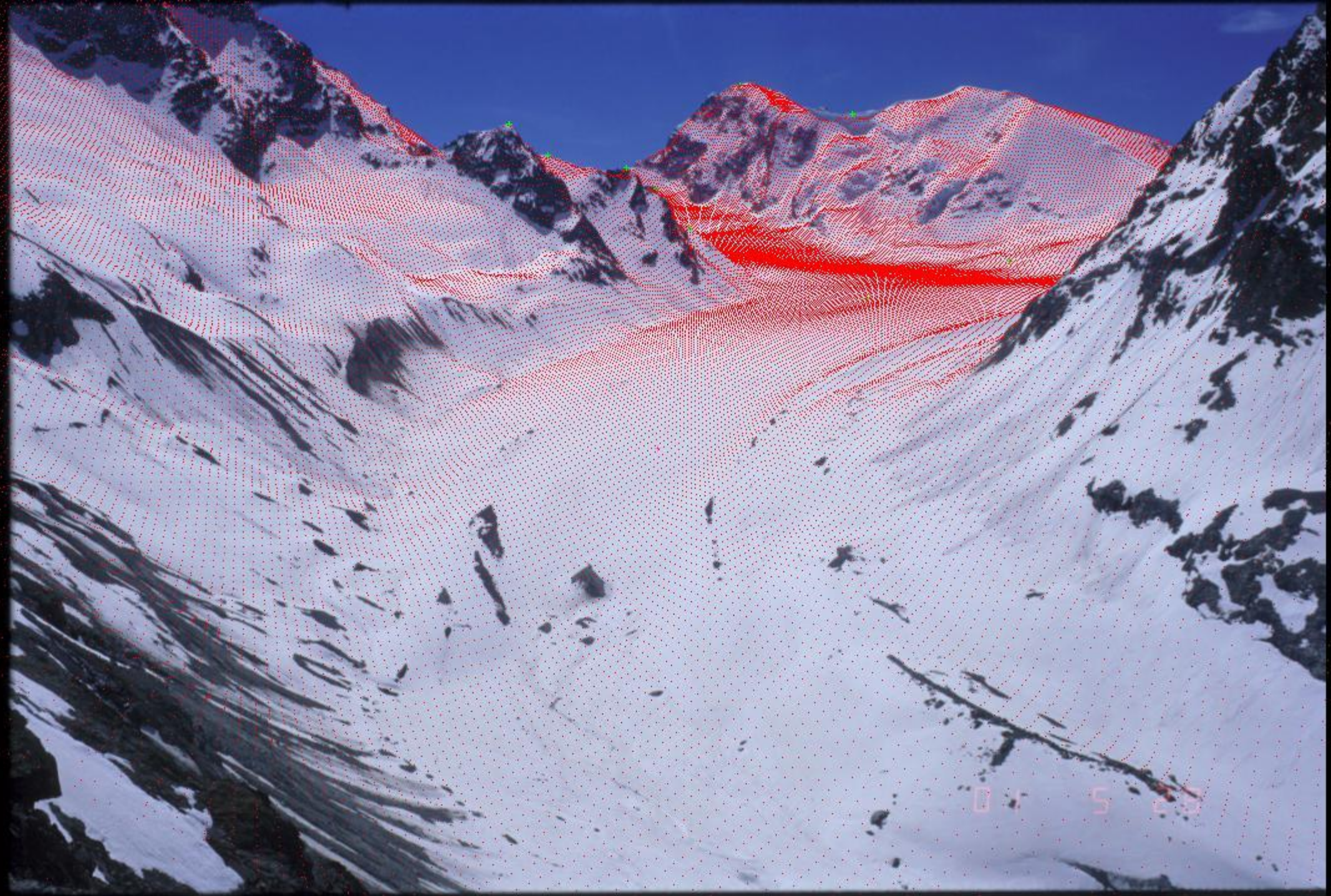
Department of Geography, University of Edinburgh, Drummond Street,
Edinburgh EH8 9XP, UK





perspective projection of visible DEM area





DEM: demfilename.tif image: imgfilename.tif visibility: demvis.tif GCPs: asciiGCP.dat

camera coordinates X: 605805 Y: 93636 Z: 2827

target coordinates X: 606495 Y: 92310 Z: 2657

focal length	resolution dpcm	film width m	film height m	offset x:	offset y:	camera rotation (degrees)
0.0350000	300.000	0.0360000	0.0240000	0	0	0.000000



help

SETTINGS

load settings

save settings

PROCESS

load data

preview gcps

run

zoom

accept

start again

ACCESSORY FUNCTION

convert to GeoTiff

convert to ascii

quit



Jumping Pound North Station

Jumping pound summit station

Moose Mountain Centre Station

Moose Mountain West station

Image © 2010 TerraMetrics

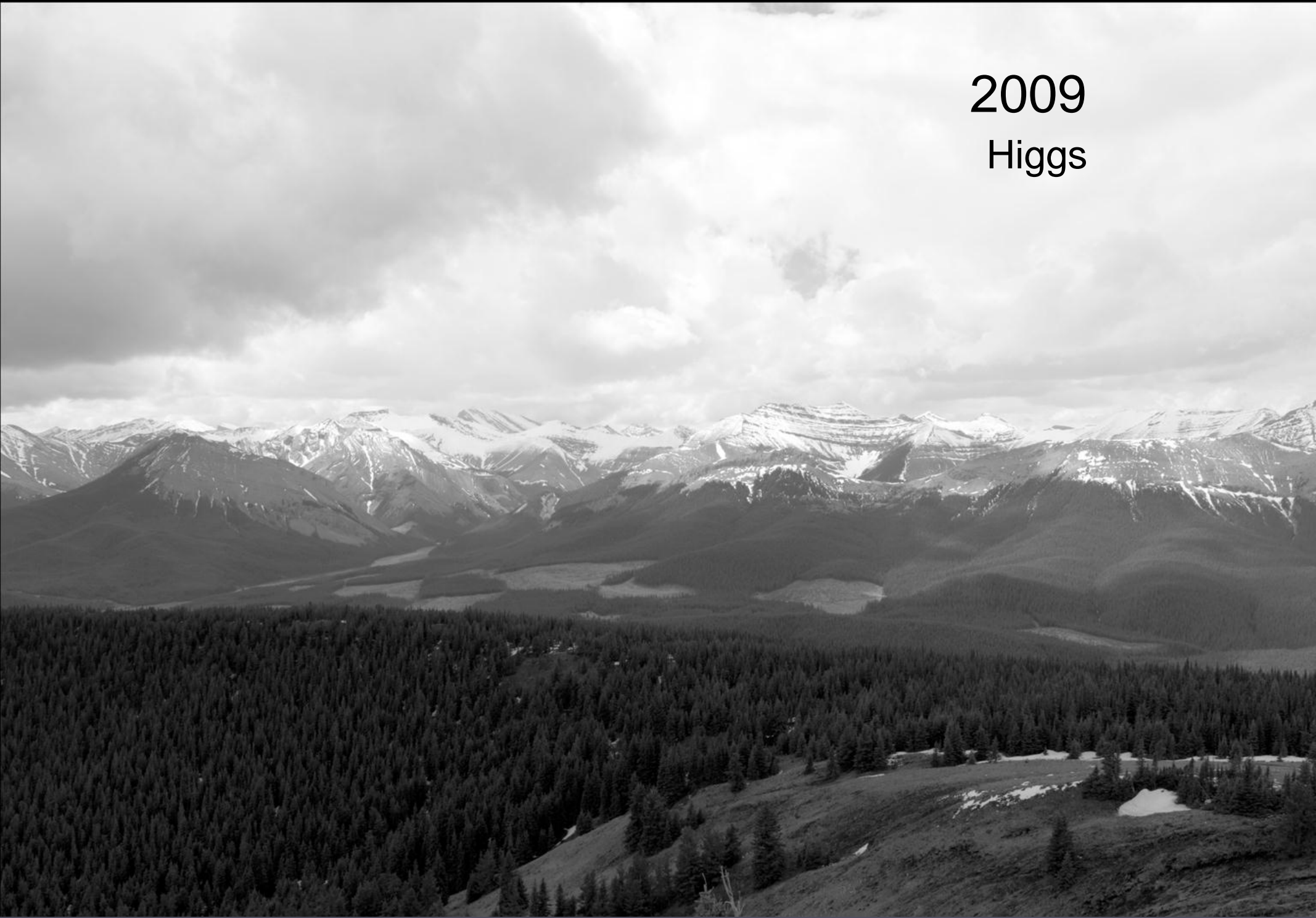
Image © 2010 GeoEye
© 2010 Tele Atlas

11 U 642536.06 m E 5648752.85 m N elev 1760 m

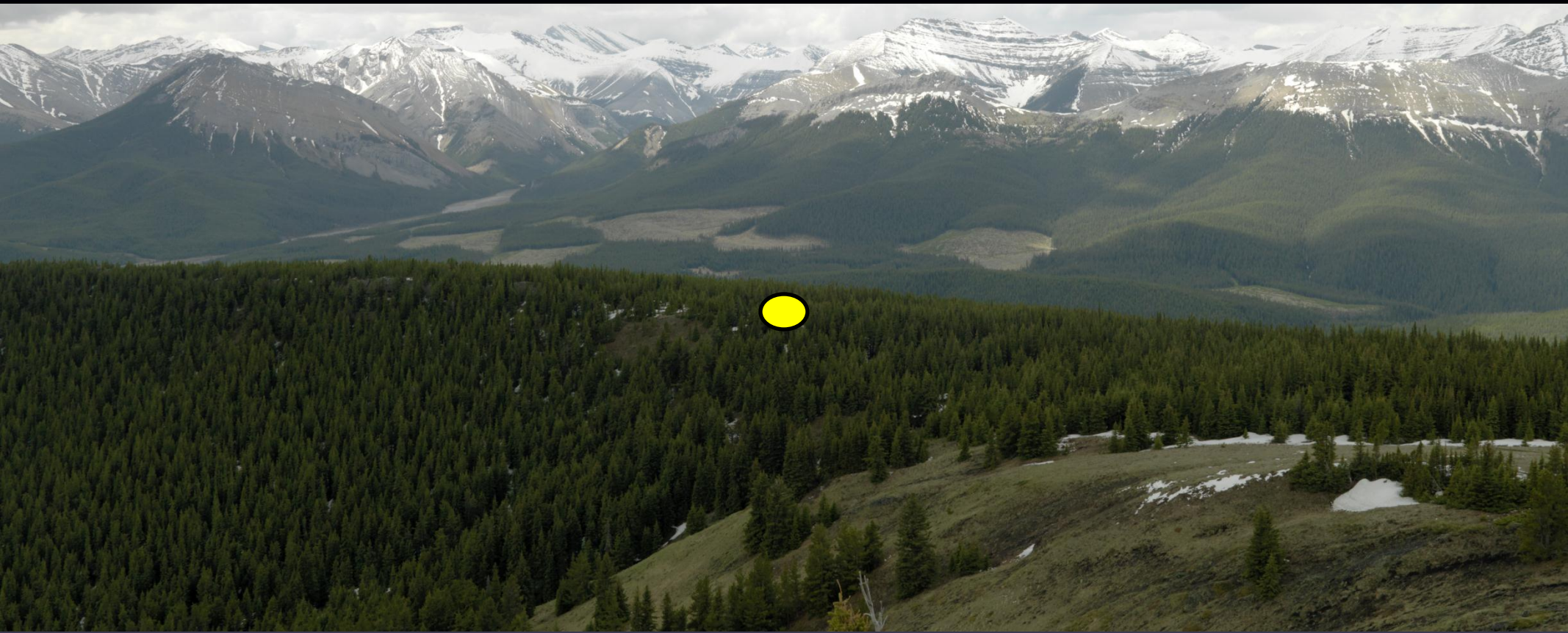
2009 Google

Eye alt 13.34 km

2009
Higgs



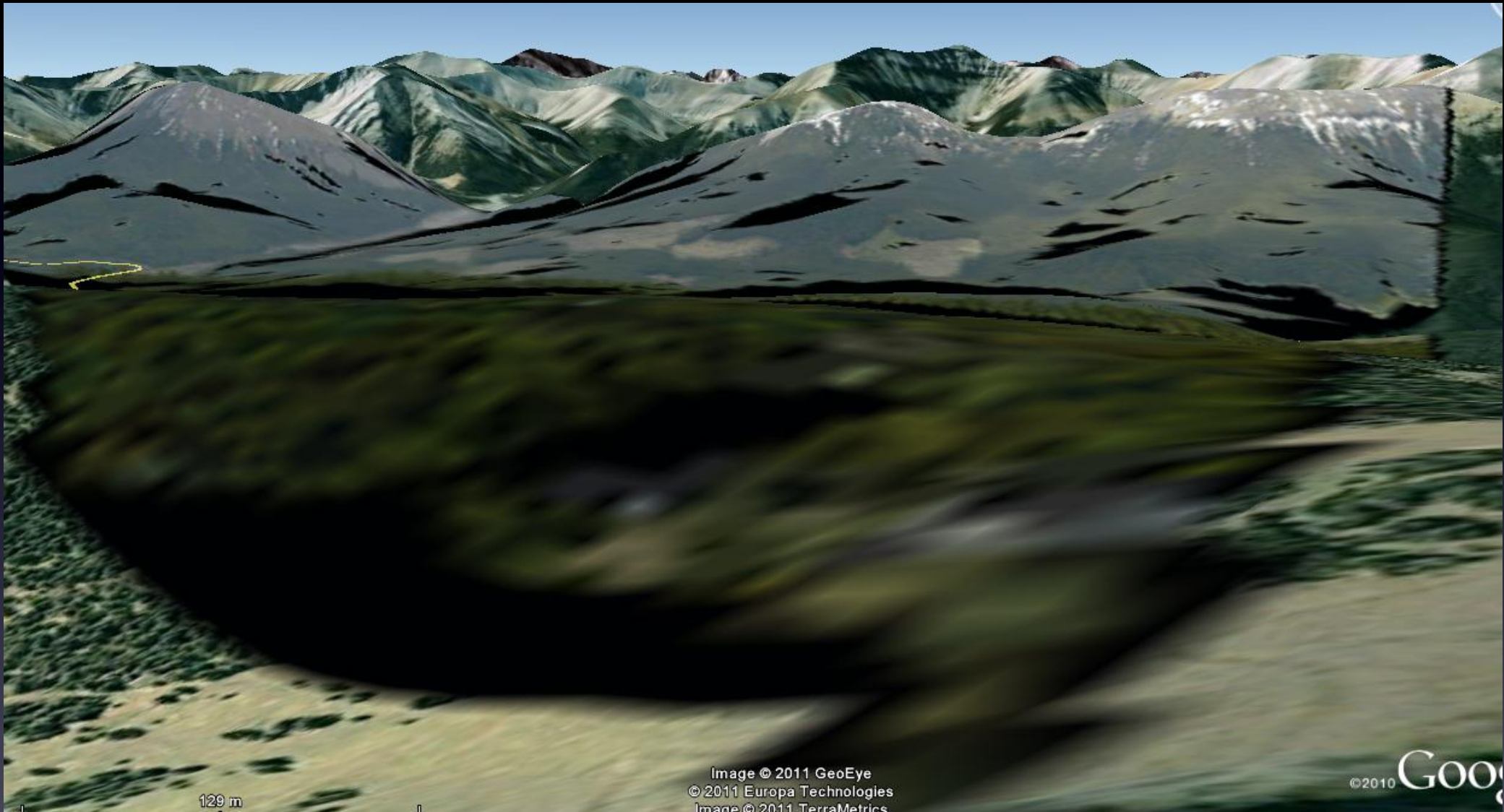






Jumping pound summit station

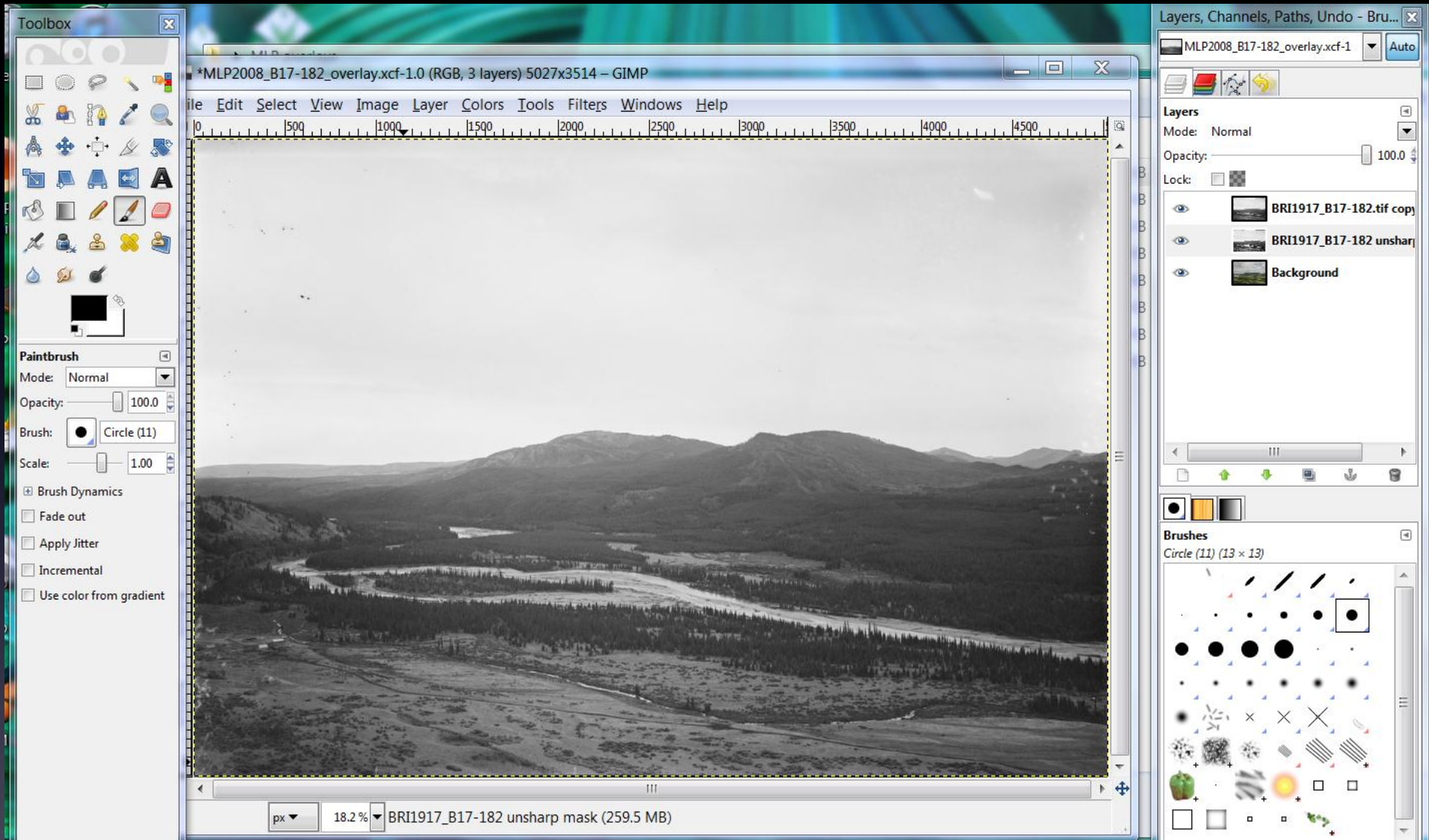





129 m

Image © 2011 GeoEye
© 2011 Europa Technologies
Image © 2011 TerraMetrics

©2010 Google



Toolbox



Paintbrush

Mode: Normal

Opacity: 100.0

Brush: Circle (11)

Scale: 1.00

Brush Dynamics

Fade out

Apply Jitter

Incremental

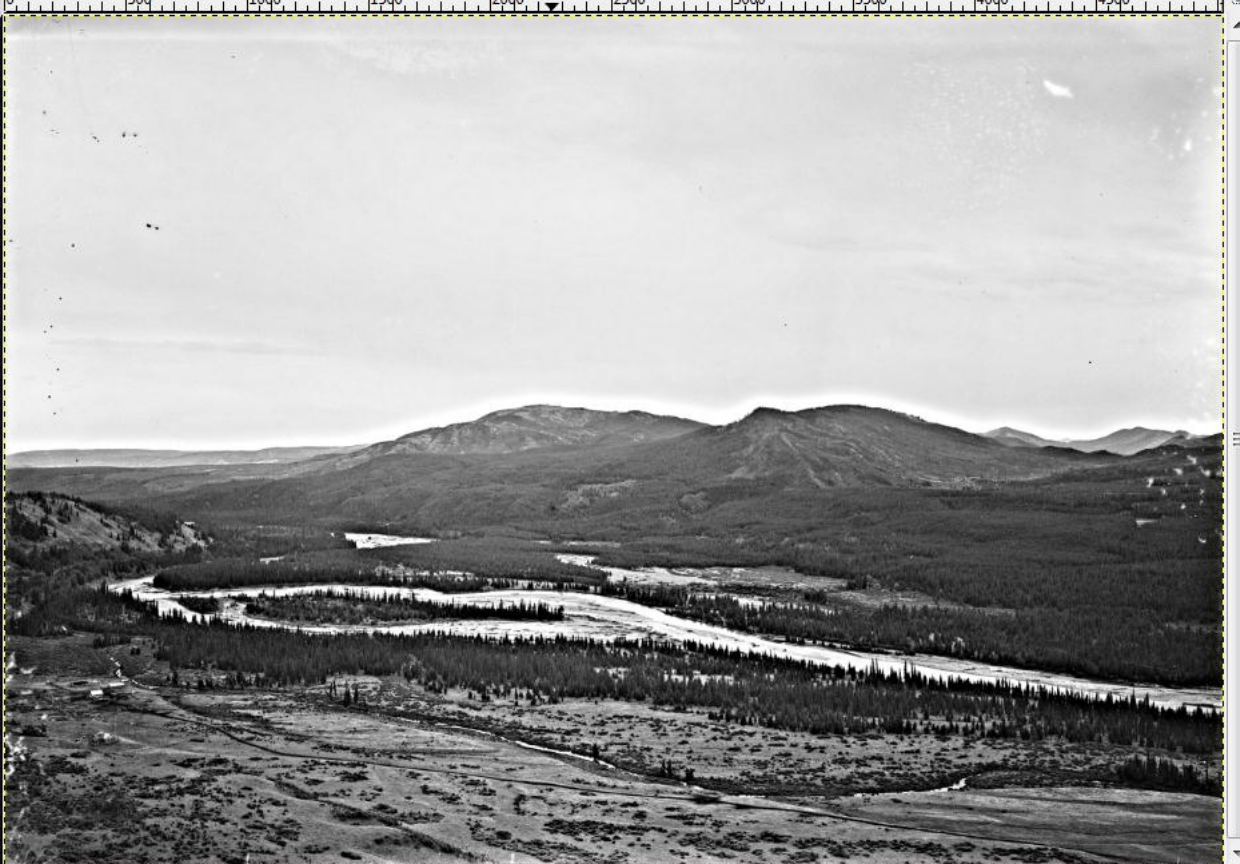
Use color from gradient

Picture Tools March 2011 Workshop _project overview.ppt [Compatib...

Animations Slide Show Review View Nitro PDF Professional Format

*MLP2008_B17-182_overlay.xcf-1.0 (RGB, 3 layers) 5027x3514 - GIMP

File Edit Select View Image Layer Colors Tools Filters Windows Help



px 18.2% BRI1917_B17-182 unsharp mask (261.3 MB)

Layers, Channels, Paths, Undo - Bru...

MLP2008_B17-182_overlay.xcf-1 Auto

Layers

Mode: Normal

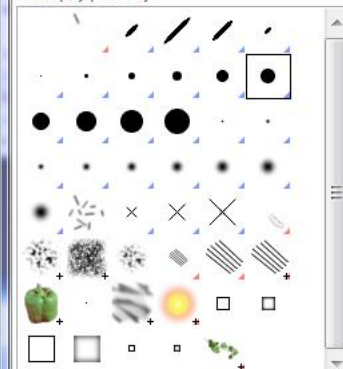
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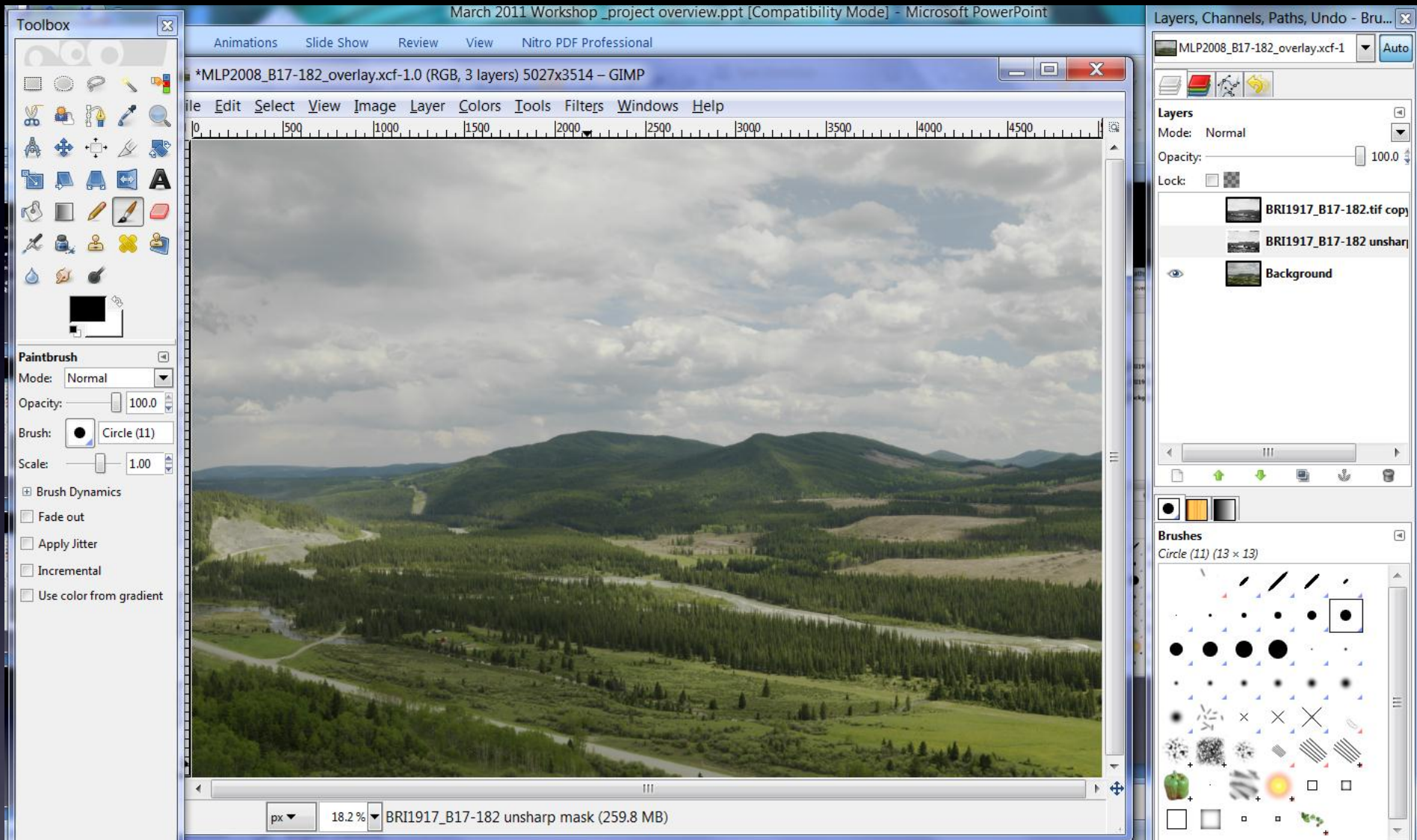
Lock:

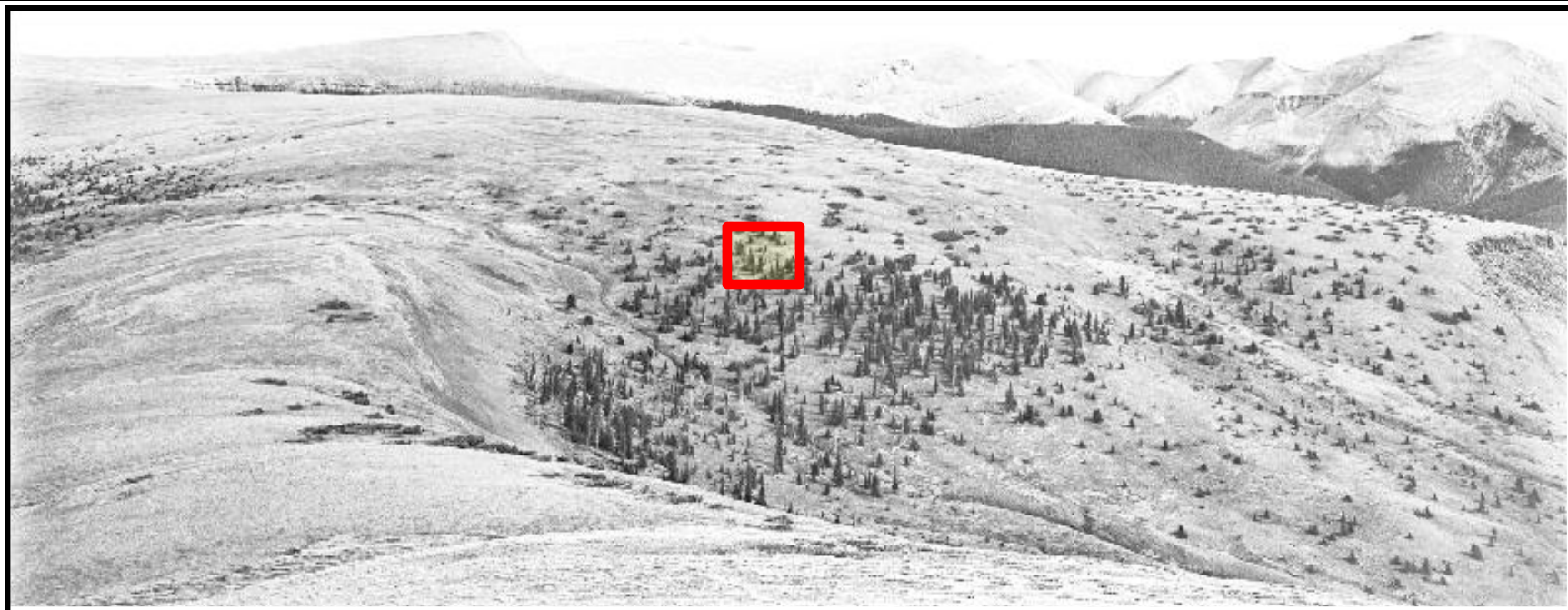
- BRI1917_B17-182.tif copy
- BRI1917_B17-182 unsharp mask
- Background

Brushes

Circle (11) (13 x 13)





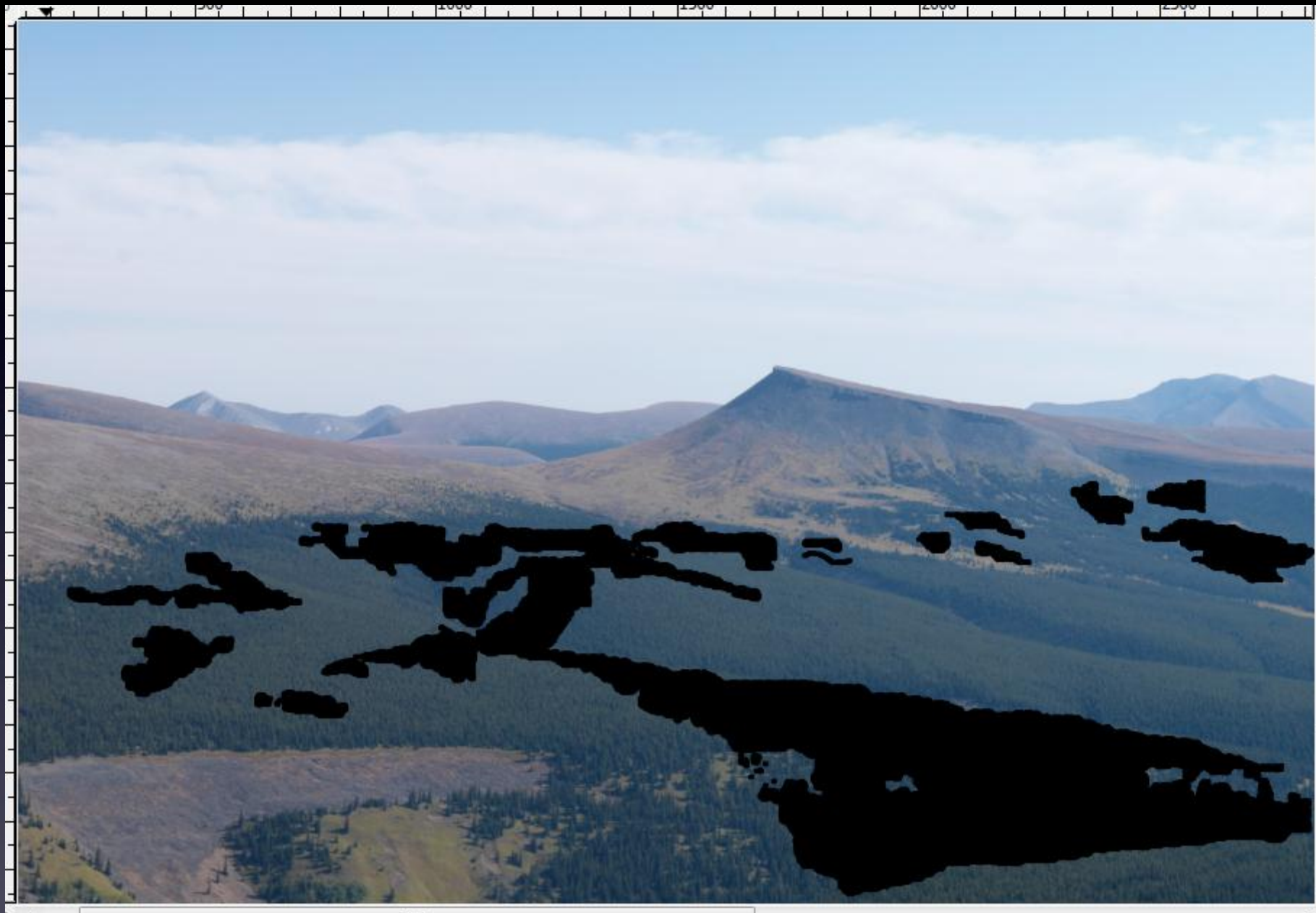


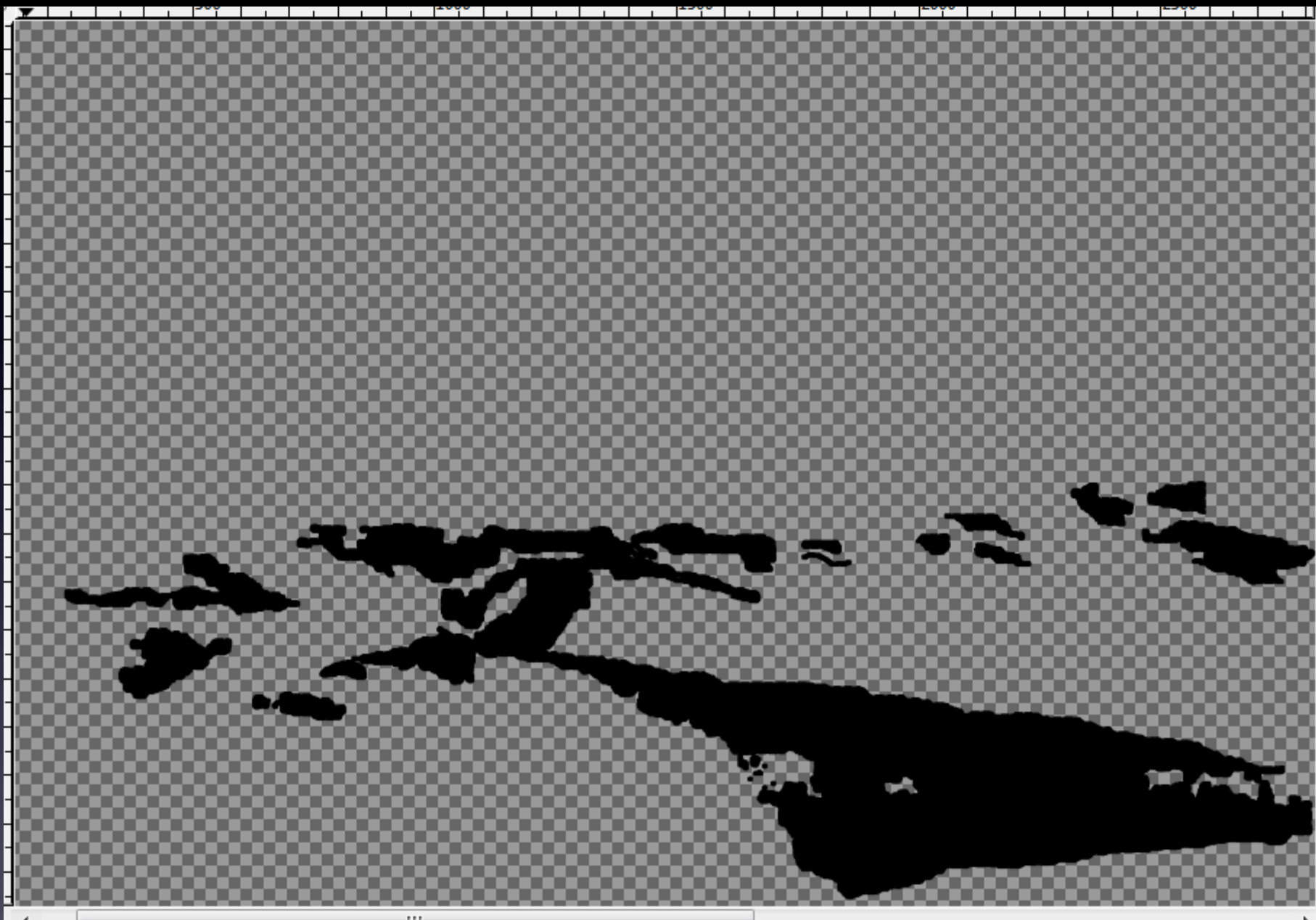


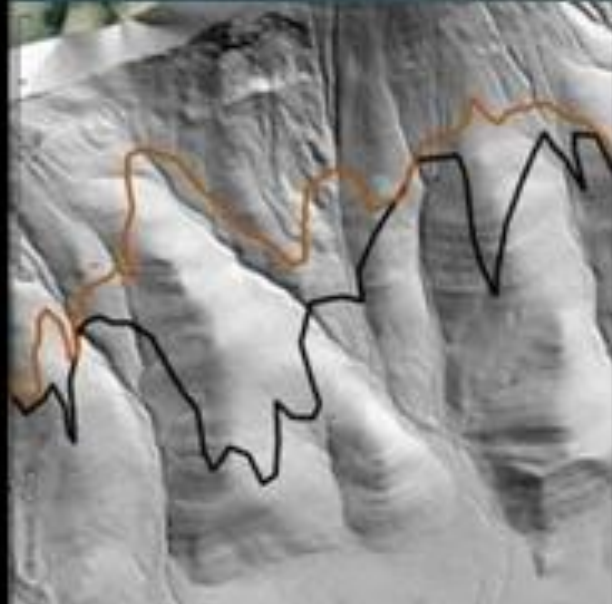
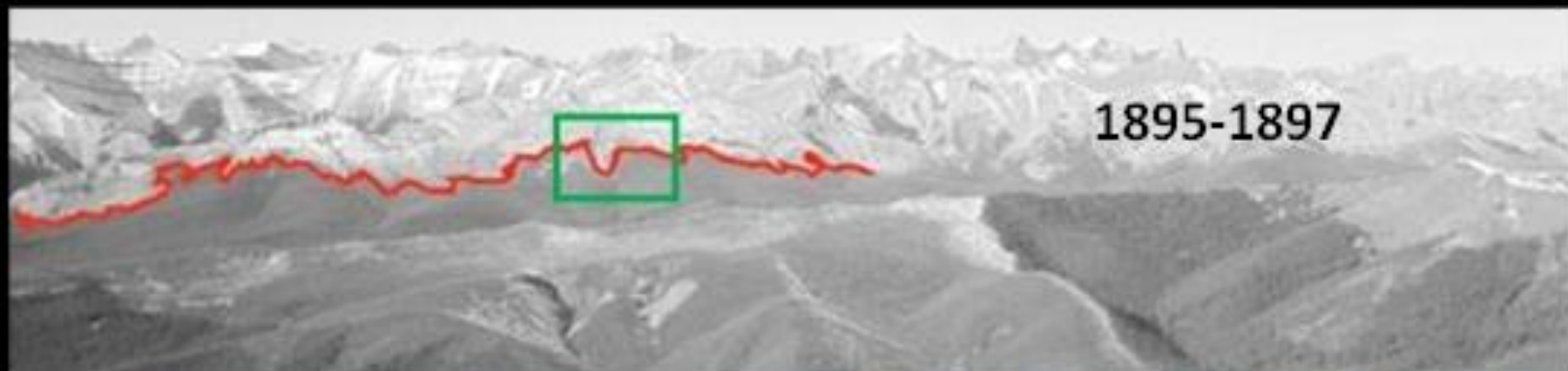












Analysis of change in treeline location. Moose Mountain Centre, Image 12-3

After georeferencing, the vectors drawn in the images can be examined in a GIS (shown in bottom image, overlain on DEM). The treeline vectors within the green square are shown in black line (1895-1897), and orange (2009).



Georeferencing accuracy

White dots = reference point located from oblique image

Red dots = "real world location" of reference points (from orthophoto).

Error = 37.7m (+/- 4.9m MSE)

Georeferencing Oblique Historical Photos to Document Century-scale Changes in Foothills and Rocky Mountain Ecosystems

PhD study:

Chris Stockdale

(supervisor Ellen MacDonald)

Funded by:

NSERC

Stay tuned!

Much more to come by ~2014?