Measuring rifting processes in Iceland between 1957-2002 from combinations of different optical datasets

1. Introduction
2. Tectonics of NE Iceland
3. 1975-1984 Krafla rifting crisis
   (constraints from spy image matching)
4. 1975-1984 Krafla rifting crisis
   (constraints from aerial photos)
5. Conclusions

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Tuesday 30th March 2010
The Hector Mine horizontal coseismic field (NS and EW) derived from 10m SPOT4 1998 and 10m SPOT2 2000 images.
The 1999 Mw 7.1 Hector Mine Earthquake

Medium resolution optical satellite data (late 20th Century…)

LANDSAT (30/15 m)
ASTER (15 m)
SPOT1-4 (10 m)

High resolution optical satellite data (21st Century onwards…)

Quickbird (0.6 m)
SPOT5 (2.5 m)
Ikonos (0.8 m)
WorldView (0.5 m)
Kompsat (1 m)
EROS (0.7 m)
CARTOSAT-1 (2.5 m)
PLEIADES (0.5 m)

The Hector Mine horizontal coseismic field (NS and EW) derived from 10m SPOT4 1998 and 10m SPOT2 2000 images.

Can we make use of other (non-digital) optical datasets, acquired over the 20th Century, to measure tectonic deformation?

declassified spy satellite imagery
USA: CORONA, **HEXAGON**, etc
RUSSIA: KVR-1000, KATE-200, TK-350, etc

aerial photos
(various resolutions and coverage)

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1970-80
29,000 images - $30 per image USGS
Extension in the Krafla rift crisis (1975-84):

- Plate Spreading rate = 20 mm/yr

NE Iceland (Northern Volcanic zone)

July 1978

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4. Krafla - airphotos
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from Árnadóttir, et al., 2009
Extension in the Krafla rift crisis (1975-84):

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KH9 – SPOT5

EW displacement

1977-2002
Best fitting 2nd order polynomial coefficients = 

-8.02e-005
9.15e-007
1.59e-005
8.74e-002
4.62e-003
-2.05e+001
1977-2002

EW displacement (de-trended)

KH9 – SPOT5
Dip = 75°, length = 25 km
Opening = 6 m, strike = 011°
Depth to dike top = 0.3 km
Depth to dike bottom = 3.5 km

1977-2002
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1957-1990 aerial Photo correlation

(to obtain the total EW extension, and see which faults and fissures it occurred on)
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Correlation time difference = 33 years
Extension in the Krafla rift crisis from aerial photos (1957-1990):

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Typically: standard deviation < 1 pixel
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Map of subsidence during the Krafla rift crisis (1975-1984):

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1990-57 DEM difference
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Regional context:

**General:**
- Monitor any 20th century ground displacements (horizontal or vertical) of 1+ m (spy image) or 10+ cm (aerial photos), where we have data coverage!

**Iceland specific:**
- 7-8 m extension in each dike injection
- Begin to reconcile how episodic dike injections add up to the long term plate spreading rate.

**STILL NEEDED!**
- Complete global archive of aerial and satellite imagery for the 20th Century.
- Declassification of spy image camera calibration information.
- Improved resampling to account for film distortions in spy images (using reseau grid).
- Support for panoramic camera systems (e.g. Corona images).
- Access to declassified Russian spy imagery.
- Bundle block gcp optimization to mosaic aerial photos
- Epipolar geometry for SPOT

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