‘EarthsCAN’ Initiative (CCArray)

(Boggs, K. (MRU), Eaton, D. (UofC), Hyndman, R. (PGC/UVic), Audet, P. (UofO), Schmidt, M. (UofC), Aster, R. (CSU), Schutt, D. (CSU), Rowe, C. (McGill), Morell, K. (UVic), Leonard, L. (UVic), and many others)

Goals:

1. Unify the Canadian Earth Sciences community
2. Create new research networks to improve holistic understanding of entire Earth Systems
3. Put geosciences on a national standing equivalent to the other natural sciences
4. Public benefits – hazard mitigation, strategic significance for transportation corridors; outreach/education

Godfrey Nowlan: “We have only one planet and it is important to us”
CCArray Proposed Organizational Structure

**Board of Directors**
Seismologist, Petroleum, Mining, GSC? (TBD)

**Director**
(Dave Eaton; UofCalgary)

**Operations Manager**
(TBD – need seed funds)

**Sci. Committee Chair**
(TBD – after theme leads established)

**OEC Chair**
(Katherine Boggs; MRU)

**Operations Team**
(Future)

**Scientific Committee**
(theme leads from thematic working groups)

**OEC Team**
(being established)

**Advisory Board**
Jeff Freymueller
(Earthscope/GNSS)
Seismic (TBD)
Geosciences (TBD)
GSC? (TBD)

**Executive Committee**

**Thematic Working Groups**
- Geohazards
- Resources & Infrastructure
- Coastal Hazards/Earthquakes
- Neotectonics

- Critical Zone?
- Geochemistry

- Tectonic Processes
  Plate Boundary Evolution,
  Lithosphere Tectonics,
  Crustal Deformation

- Atmosphere/Magnetosphere?/Numerical Weather Modelling

- Regional Geology
  Volcanism,
  Metamorphism,
  Stratigraphy,
  Mining, Petroleum

- Geothermal Energy
Tomography Resolution Before

CRUST 2.0, 2000

Resolution After

Shen and Ritzwoller, CU-Boulder, 2013
AGU Fall Meeting

Bassin et al., 2000
AGU Fall Meeting
3-D - subducted Farallon plate under North America

(Sigloch et al. 2008)

Subducted Farallon plate - S1, S2, N1, N2, W – Cascadia
F1, F2 – predecessor
F1 – slab material shaded blue

A lateral tear between upper and lower mantle
First White Paper – Cascadia Forearc active faults
(Amos (WWU), Harrington (McGill), Kirkpatrick (McGill), Leonard (UVic), Levson (UVic), Liu (McGill), Morrell (UVic), Regalla (Boston U), Rowe (McGill); Morrell et al GSA Today 2016)

- overview presentation by Kristin Morell (just this slide)

Red – active crustal faults

Recent lidar, field work, & paleoseismic trenching
→ large (M6-7) late Quaternary Eq on Leech River Fault

Proposed:
Expand lidar, seismic, GPS
→ fieldwork, trenching
→ ID other active crustal faults in western (and NW) Canada

USGS - Barrie and Greene, 2015
Heat Flow Map: Geothermal Energy Potential

NOTE:
Gaps & Bright spots:
S Cordillera
W Coast BC

(Grasby et al 2009)
Expand Critical Zone Science North??

-presentation by Nicole West on Critical Zone

**Critical Zone Science**

Earth's permeable near-surface layer from the tops of the trees to the bottom of actively cycling groundwater.

- Where rock, soil, water, air, and living organisms interact and shape the Earth's surface.
- Critical to sustaining the earth’s sustaining services
  - Clean water
  - Productive soil
  - Balanced atmosphere

(ahm-2014-Integrated-data-management)
Wavewatch-III swell field and microseism beams. When a large long-period swell hits the Cdn coast, the lower attenuation frequency microseism beam (red arrow) switches to that azimuth, while the double frequency microseisms (magenta arrow) stays on the SSW azimuth (these swells trigger microseisms across entire continent (Schulte-Pelkum et al 2004).
Magnetosphere - Auroras

Collaborate with European Space Agency??
SWARM mission to study Earth’s magnetic field
(SWARM logo)
Next Steps?
Discussion Points

1. **Other ideas?** - applications of Earth Observation Network Stations (with power & telemetry)
2. **Funding** – start planning/permitting spring 2017
   How to split funding US-Canada??
3. **How to spread the word?**
   May 2017 – sessions/workshops at CGU & GAC-MAC
   June 8-10; 2017 GSA Rocky Mtn Section Mtg (MRU) – Earthscope to EarthsCAN/CCArray session & meeting

**FUTURE?**  Next stage of EarthsCAN - Arctic? Roll east?
St Lawrence Seaway & Charlevoix Structure??
Thank you:

Sponsors:
Atmospheric studies

Dots show station barometric pressure as it varies over a period of ten days in April 2011. A severe outbreak of Tornados (red squares) occurred and spawned a pressure wave rolling north thousands of miles into Canada.
Seismometers can detect landslides in remote areas. A 200 million ton landslide on Tyndall Glacier was detected. Seismic data discerns time, location, size, direction, and velocity. AK.PIN is located approximately 70km away from the landslide.
Seismometers can track the status of sea ice extent in northern Alaska. High noise (red) corresponds to open water after the peak of summer.
Yellowstone – Magma Plumbing System
(other possibilities)

(Smith et al 2009; J Volc Geo Res)

(Huang et al 2015; Science)
Evidence recent tectonic features:

- Not parallel to ice flow direction
- Many scarps are uphill facing, in bedrock
- Fault gouge observed in field
- Features align along strike
- Channels & interfluves cutting <15 ka sediment are offset
- Recent paleoseismic trenching confirms faulting of young (<15 ka) sediment
May 2016: Paleoseismic trenching
Trench site scarp: only identifiable from lidar data (James et al. 2010).

Young (<15 ka) colluvium deformed adjacent to the Leech River fault

Clasts coseismically rotated parallel to the fault zone

Field photo from trench

Fault gouge

Leech River Schist bedrock

Confirmed: up to 3 large earthquakes since the last glaciation (~15 ka)
Students Key to TA Site
Reconnaissance

- Direct student participation in national science project
- Altered students’ studies and careers
“I especially enjoyed the traveling aspect of reconnaissance in an endeavor to become a ‘salesman for science.’ We brought EarthScope’s mission to people who otherwise would never have even considered earthquakes in their state or the impressive earth sciences beneath their own feet…I would consider my summer task an absolute success and would do it again in a heartbeat.”

“Seeing my state in this way was a life altering experience and to know that I helped a scientific community in learning more about earth structure gives a sense of pride.”

“My experience this summer was absolutely a positive one. It gave me the opportunity to travel, improve my communication skills…and start to focus on the upcoming school year. I could not recommend this program enough to other future students in the Earth Sciences.”
31 schools (51 total) and 67 students (131 total) participated in the summer siting program during the award.