

Lidar Intensified

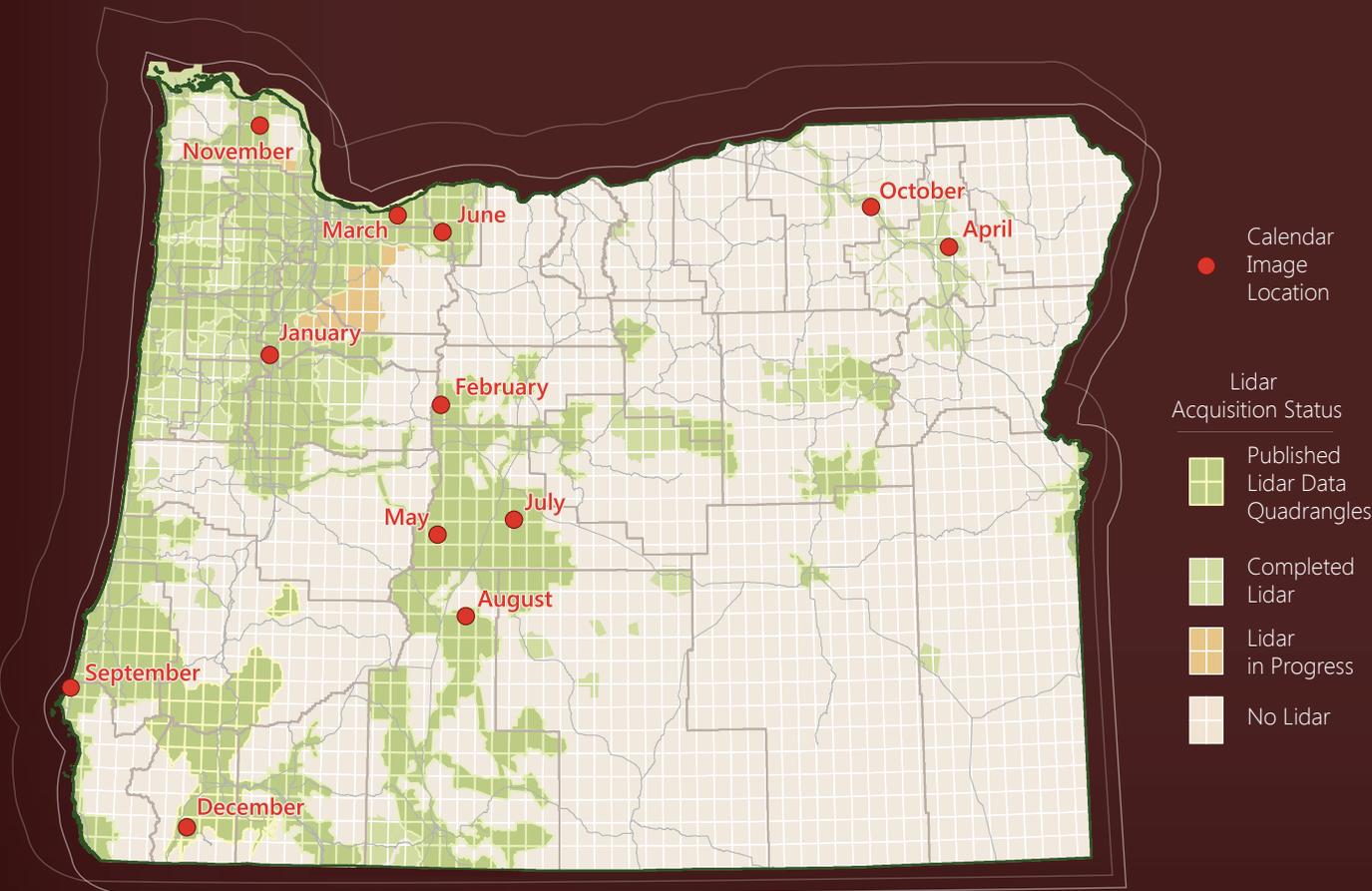
2014 Calendar



Lidar in Oregon

Lidar (light detection and ranging) is a remote sensing technique similar to radar that uses light pulses instead of radio waves. Lidar is typically “flown” or collected from planes and rapidly produces a large collection of very dense and accurate elevation points (up to 500,000 per second) over a large area. The product can be used to generate three-dimensional representations of the Earth’s surface and its features.

The Oregon Department of Geology and Mineral Industries (DOGAMI) uses lidar to create new-generation maps that are more accurate and comprehensive than any in the past. DOGAMI, via the Oregon Lidar Consortium, is continually acquiring new lidar data throughout Oregon. This calendar provides a sampling of the kinds of information that can be obtained with lidar.



DOGAMI APPLICATIONS FOR HIGH-RESOLUTION LIDAR

- Resource Mapping
 - Base topographic maps
 - Geologic mapping
 - Shoreline monitoring
 - Aggregate monitoring & permitting
 - Mine site reclamation
 - Mineral exploration
 - Geothermal development

- Asset Mapping
 - Building extraction
 - State-owned facilities
 - Essential & critical facilities
 - Utilities & energy site development
 - Population distribution
 - Transportation corridors

- Natural Hazard Mapping & Modeling
 - Landslides
 - Debris avalanches
 - Fault displacement
 - Channel migration
 - Volcanic flows
 - Coastal erosion
 - Climate change
 - Tsunami inundation
 - River & coastal flooding
 - Volcanic lahar deposits
 - Evacuation planning

**How can DOGAMI help you?
Contact us to find out!**

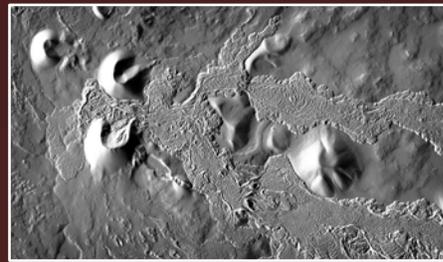
Ian Madin, DOGAMI Chief Scientist
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How are lidar images made?



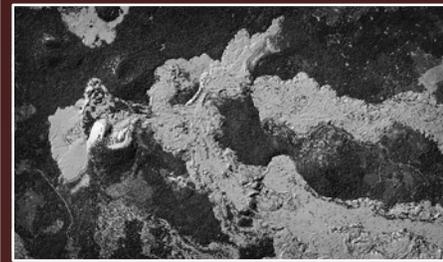
Bare-Earth DEM

Shades from dark gray to light gray represent elevation change from lowest to highest in the last-return, or bare-earth, lidar data.



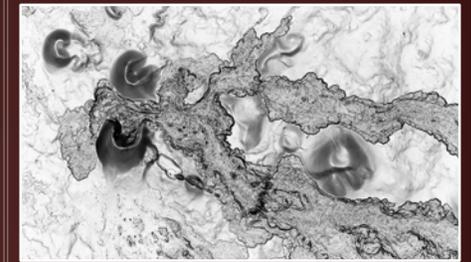
Bare-Earth Hillshade

Lighting effects can be added to a DEM to better simulate topography.



Highest-Hit Hillshade

Lighting effects can also be added to first-return, or highest-hit, lidar data to simulate the effect of topography with tree cover.



Bare-Earth Slopeshade

Change in slope can be emphasized to help visualize the shape of the landscape.

Lidar data acquisition systems produce a mass of points known as a **point cloud**. Complex algorithms classify points on the basis of relative point-to-point and absolute geometries. These classification methods allow lidar points representing returns off the ground surface to be discriminated. Ground points are interpolated to produce a **digital elevation model (DEM)** typically referred to as a **"bare-earth DEM."** The entire mass of points (ground and other points) is interpolated to a **DEM** using the highest point at a given location. This produces a **"highest-hit"** surface model. This model includes ground, trees, buildings, and all other above-ground features.



Colorized Canopy Model

A simple canopy model can be made by subtracting the bare-earth DEM from the highest-hit DEM. This results in a digital map of the height above ground of trees and structures.



Lidar Point Cloud with elevation color ramp (detailed view)

Lidar point data can be enhanced with color ramps that represent elevation change.



Perspective-view composite image

Lidar data can be combined, enhanced with color, and rotated to create 3-dimensional views of the landscape.

Composite Image

Different types of lidar imagery can be blended together and then enhanced with color to create intriguing imagery that also contains highly accurate elevation data. Additional GIS data and interpretive information can be combined with the imagery to create maps and graphics.



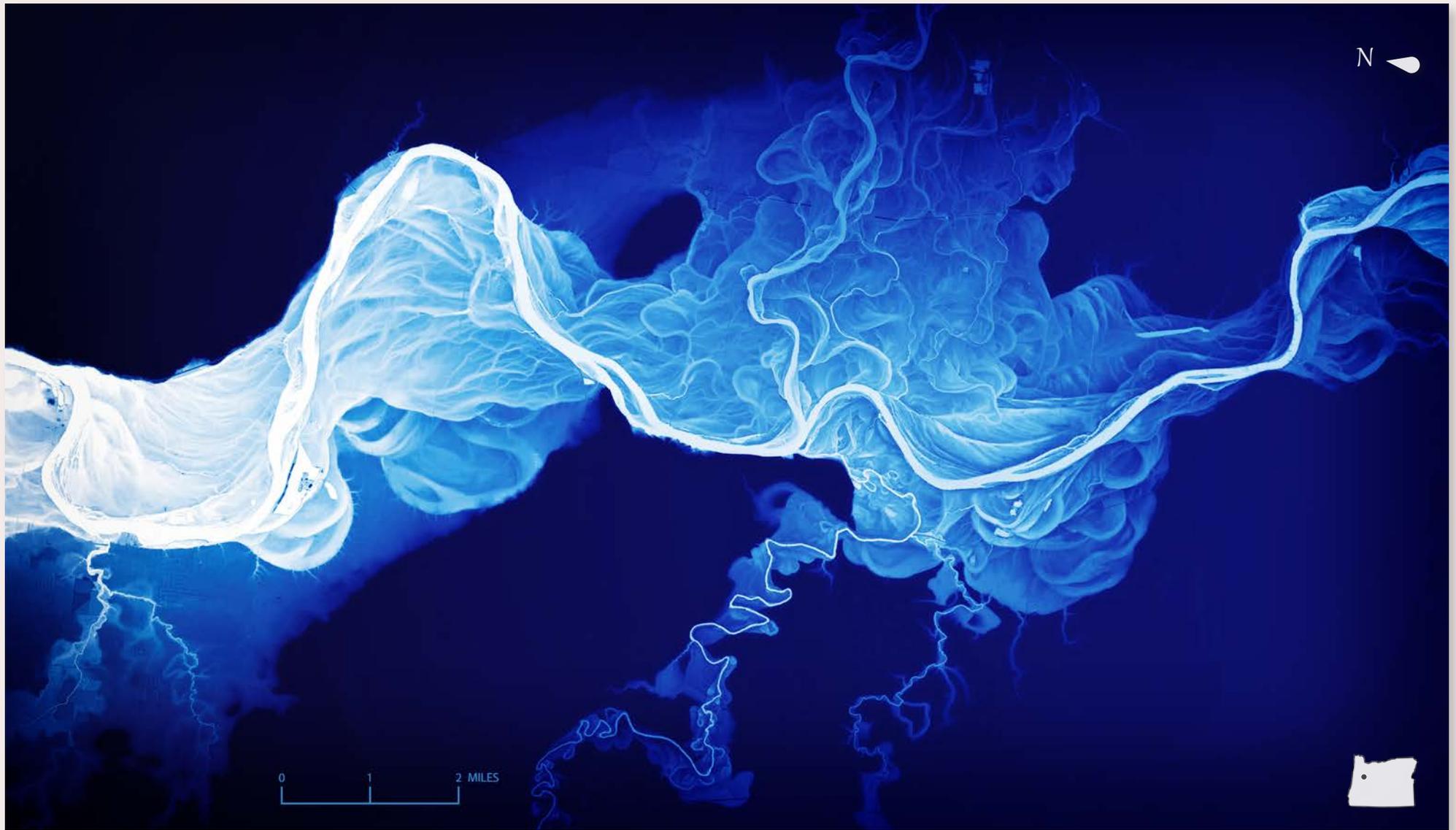
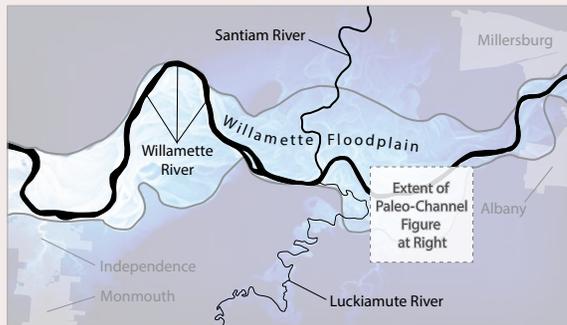


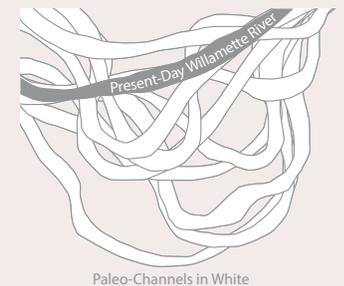
Image: Daniel E. Coe



Evolving River Channels, Willamette River and Tributaries, Central Willamette Valley, Oregon

A lidar digital elevation model of the Willamette River displays a 50-foot elevation range, from low elevations displayed in white to higher elevations displayed in dark blue. The color range replaces the relatively flat landscape of the valley floor with vivid paleo-channels (interpreted in figure at right), showing ways the river changed its course in recent millennia. This segment of the Willamette River flows past Albany on the far right of the image northward to the communities of Monmouth and Independence at the far left (see figure at left for city boundaries). The larger stream flowing into the Willamette from the bottom center is the Luckiamute River; the Santiam River flows in from the top center.

DOGAMI uses lidar to model flooding and channel migration in many of Oregon's watersheds.
 OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



DECEMBER 2013
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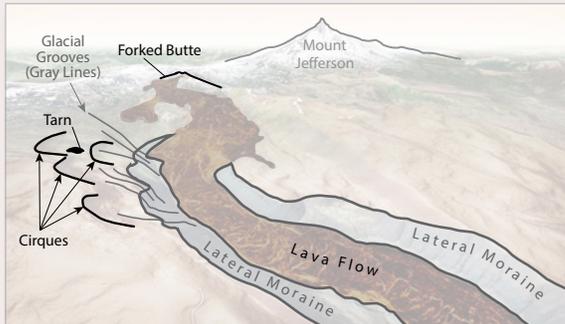
JANUARY 2014

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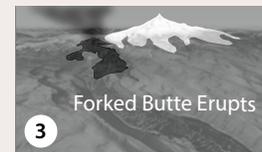
Image: Daniel E. Coe



Lava Flow and Glacial Features, Jefferson County, Oregon

On the southern flank of Mount Jefferson, a basaltic andesite lava flow occupies a glacially carved valley. This lava flow postdates the Mount Mazama eruption that created the Crater Lake caldera about 7,700 years ago. The flow erupted from Forked Butte at the upper left side of the image and was confined in this channel by a former glacier's lateral moraines. Lateral moraines are parallel ridges of glacial debris that are left behind after a glacier melts. Other glacial features such as grooves, cirques, and a tarn can be seen at the left side of the image.

DOGAMI uses lidar to map the hazards that volcanoes pose to nearby communities. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



JANUARY 2014
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FEBRUARY 2014

MARCH 2014
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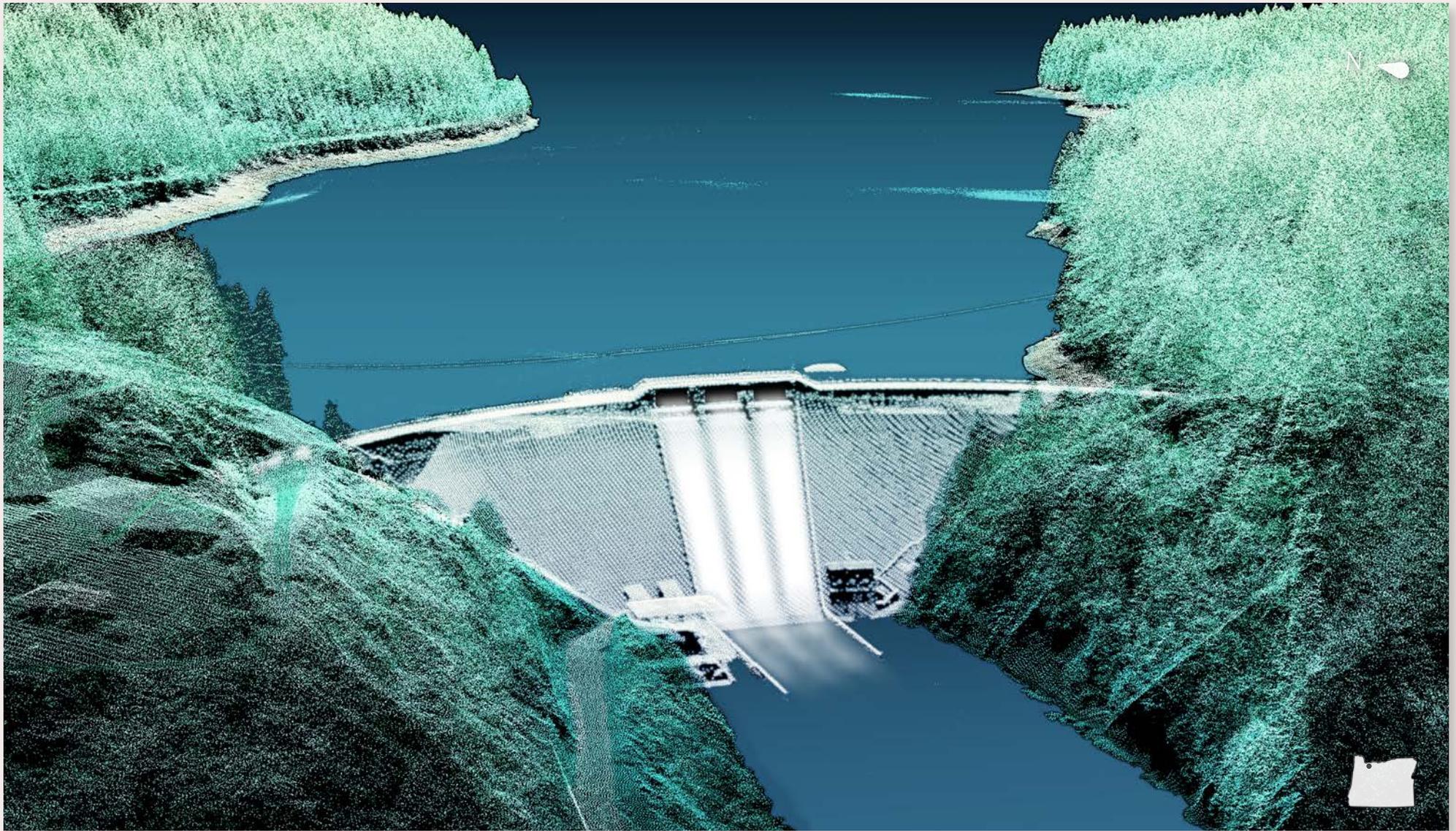
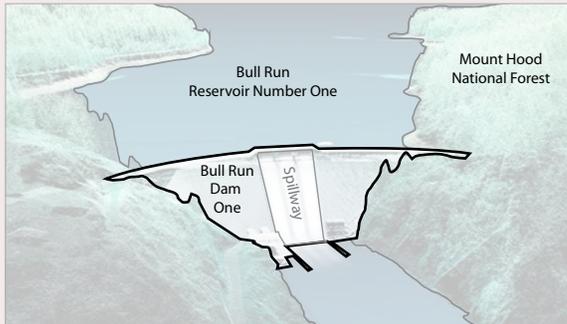


Image: Daniel E. Coe

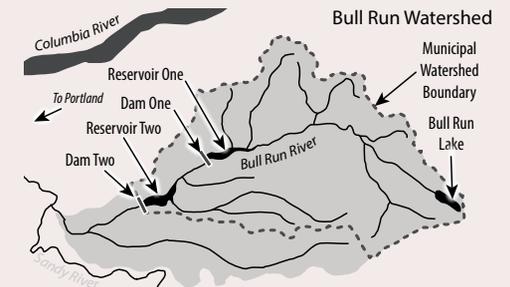


Municipal Watershed, Bull Run Dam One and Reservoir One, Multnomah County, Oregon

Completed in 1929, Bull Run Dam One impounds Reservoir One, one of the three major water repositories in the Bull Run watershed. This watershed, mostly located in Mount Hood National Forest, has been Portland's main drinking water source for more than a century and currently provides water for over 900,000 residents in the Portland area.

DOGAMI uses lidar to provide landslide risk assessments of watersheds to federal, state, and local agencies so they can plan for potential landslide impacts to water quality, infrastructure, and the environment.

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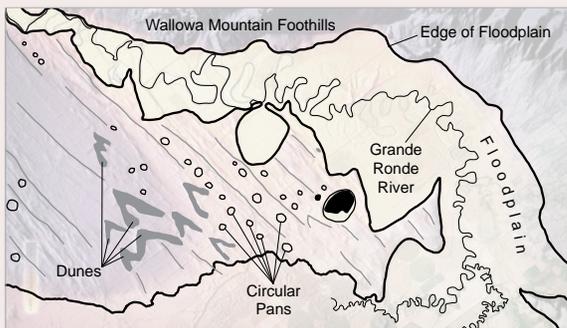
MARCH 2014

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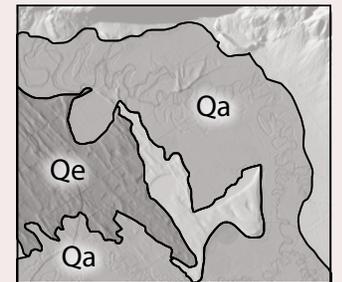
Image: Daniel E. Coe



Eolian and Fluvial Features, Grande Ronde Valley, Union County, Oregon

Wind-formed (eolian) and water-formed (fluvial) features of the Grand Ronde Valley are shown in the image above. The yellow (low elevation) area adjacent to the Grande Ronde River (see location at left) is the floodplain where the river has migrated over time, depositing sediment and leaving behind many paleo-channels where the river once flowed. The extreme meanders of the river indicate very slow moving water traveling over a relatively flat plain. Distinctive features such as V-shaped dunes and pans are visible in the purple (higher elevation) areas to the left of the floodplain. These features formed as wind blew sediment across the valley. Half-mile-diameter crop circles and other agricultural features are also visible.

DOGAMI uses lidar to map surficial geologic deposits (figure at right) in greater detail than has been possible in the past. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



Qe = Sand, Loess, and Ash (wind-formed) and Qa = Alluvium (water-formed)

MARCH 2014
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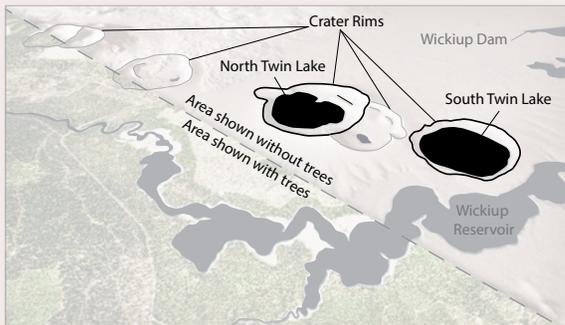
APRIL 2014

MAY 2014
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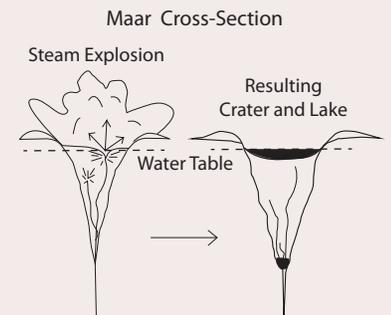
Image: Daniel E. Coe



Maars, North and South Twin Lakes, Deschutes County, Oregon

Maars are volcanic craters that form when magma comes into contact with ground water, causing steam explosions (see the figure at right). Afterward, the crater rings commonly fill with water to form lakes such as the North and South Twin Lakes shown here. These two maars formed approximately 20,000 years ago, and the lakes that now fill them are popular recreation areas. To reveal the shapes of the volcanic craters, trees and other vegetation were digitally removed in the top portion of the image. This can be done by using only the lowest-elevation (bare earth) returns from a lidar data set.

DOGAMI uses bare-earth lidar to map surficial geology and to study geological processes that form the landscape. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



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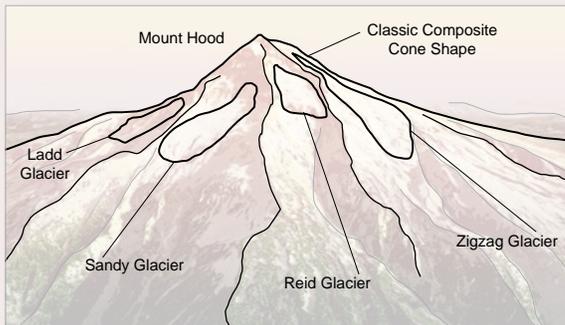
MAY 2014

JUNE 2014
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Image: Daniel E. Coe

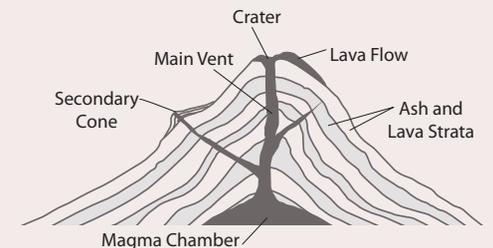


Composite Volcano, Mount Hood, Clackamas and Hood River Counties, Oregon

Composite volcanoes are characterized by steep slopes and periodic explosive eruptions. The magma involved in composite volcanic eruptions is generally high in silica and thus more viscous. Eruptions of viscous magma are explosive and can eject lava, pre-existing rock, and gases. Over time, through multiple eruptive events, a composite volcano builds a multilayered structure (seen at right). Large glaciers (seen at left) on composite volcanoes can melt during eruptions and increase the hazard.

DOGAMI uses lidar to model the hazards that composite volcanoes such as Mount Hood pose to nearby communities. These hazards include pyroclastic flows (mixtures of fast-moving volcanic debris, ash, and gases) and lahars (volcano-induced mudflows).

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May 2014
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JUNE 2014

July 2014
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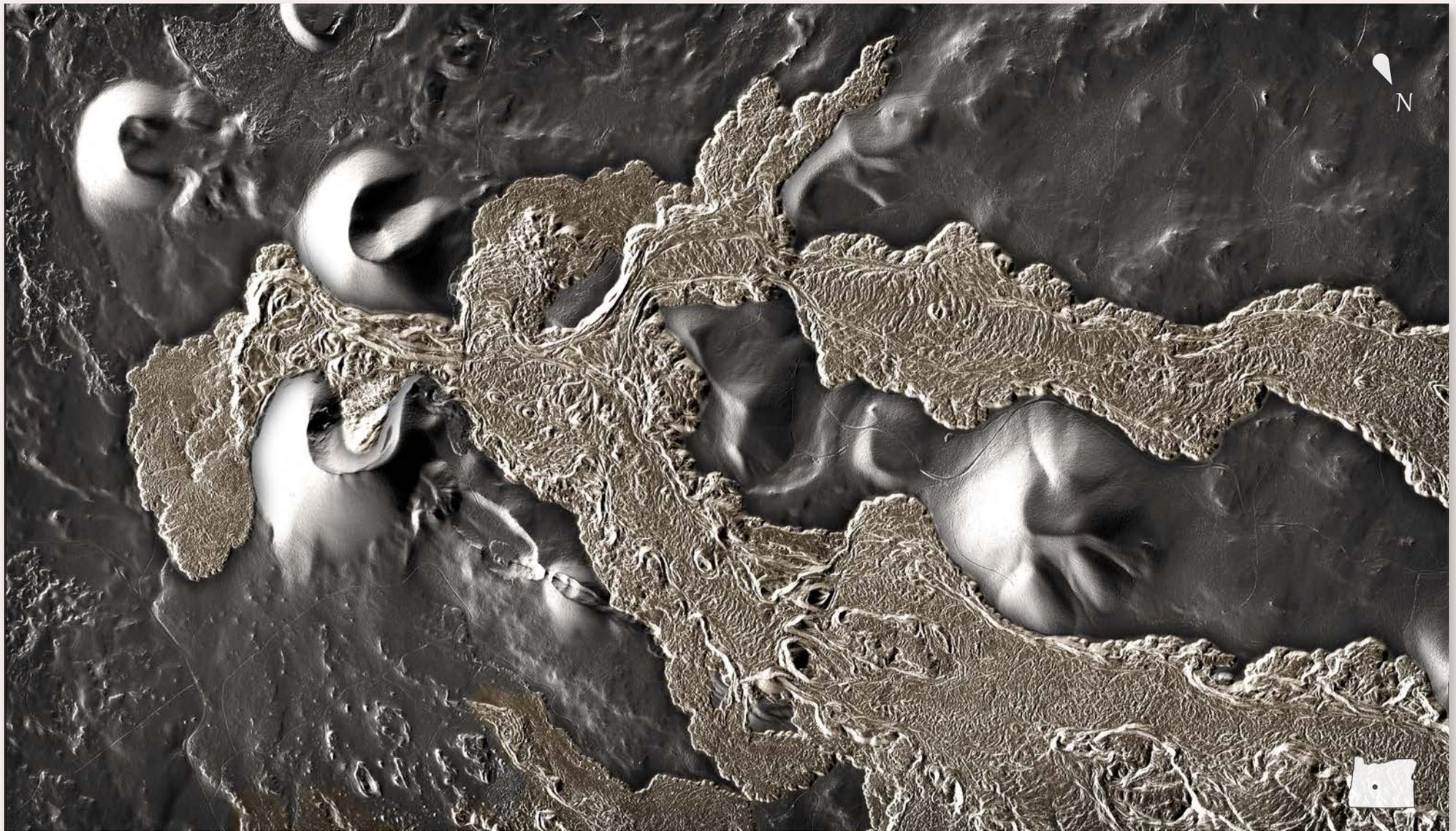
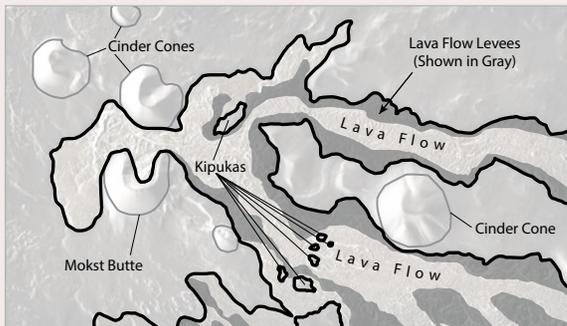


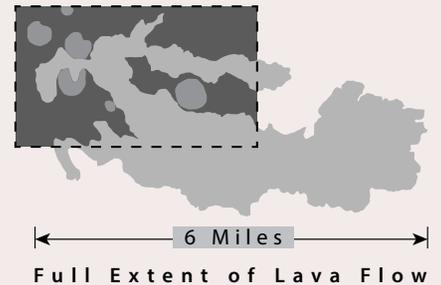
Image: Daniel E. Coe



Lava Flow and Cinder Cones, Newberry National Volcanic Monument, Deschutes County, Oregon

Mokst Butte cinder cone and lava flow are part of Newberry National Volcanic Monument in Central Oregon. This six-mile-long basaltic andesite flow, approximately 7,000 years old, is one of the youngest in the monument. With a bare-earth lidar image it is possible to discern many cinder cones and lava flow features, such as lava flow levees (lateral flow areas that solidify first and channelize the flow) and kipukas (islands in the lava flows) highlighted in the figure to the left. This area is part of Newberry Volcano's Northwest Rift Zone, which has produced many volcanic eruptions and landforms, including Lava Butte along Highway 97 near Bend.

DOGAMI uses lidar to study the hazards that large volcanoes, such as Newberry, pose to nearby communities. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



JUNE 2014
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JULY 2014

AUGUST 2014
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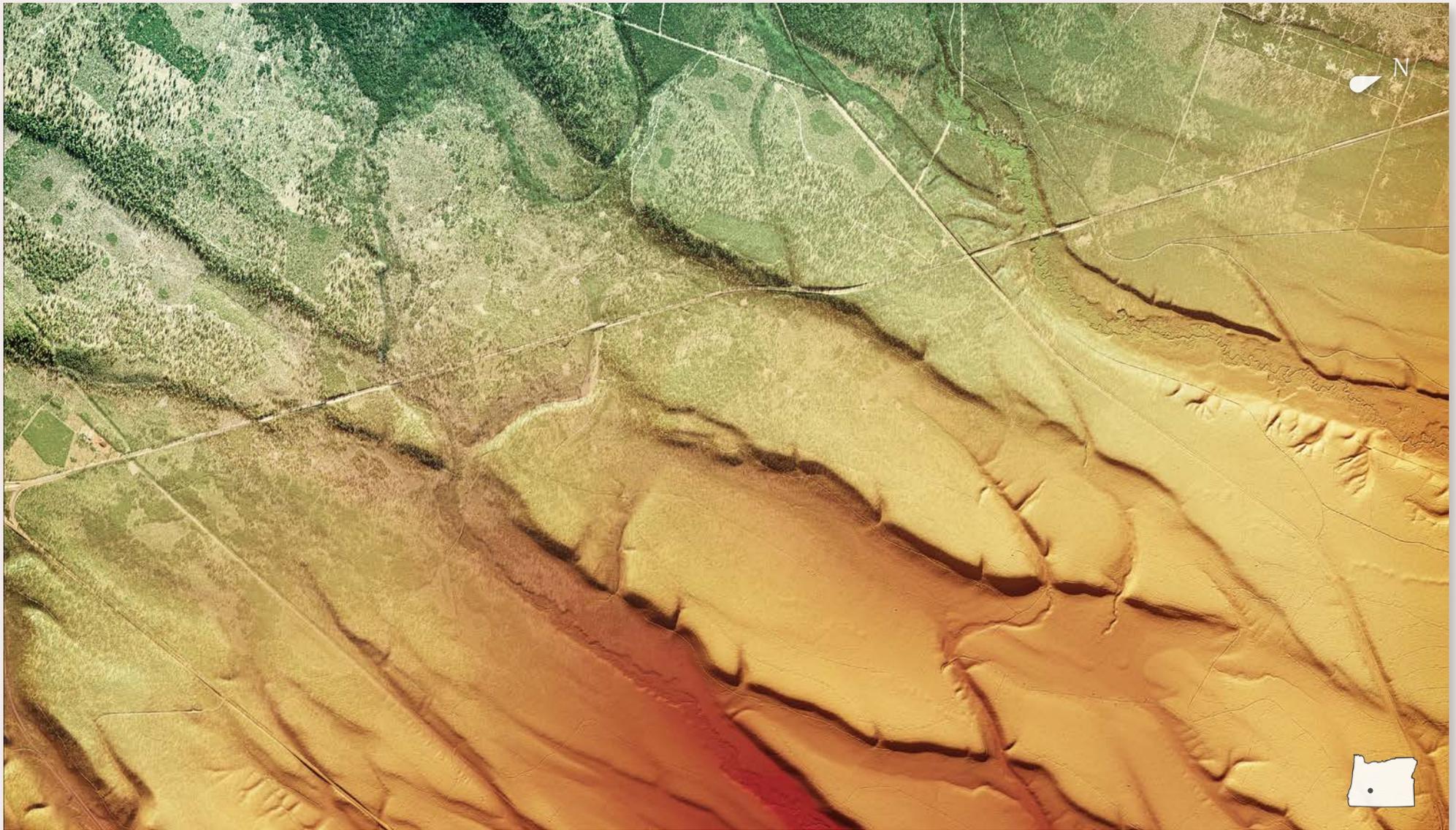
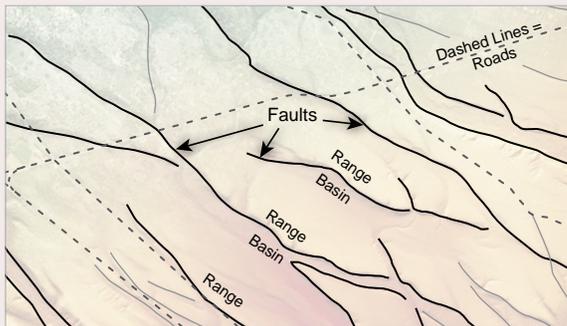


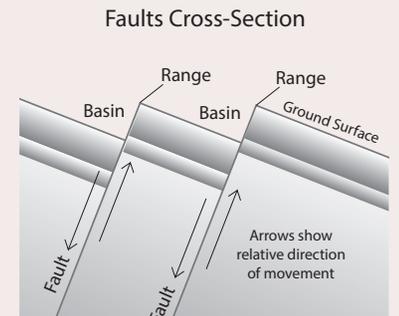
Image: Daniel E. Coe



Faults, Klamath County, Oregon

The faults shown here are characteristic of a basin-and-range fault system consisting of normal faults (see diagram at right). A normal fault occurs when one mass of rock drops down along a fracture line relative to the adjacent mass, which may be stationary or moving upward. An aerial photo transitions to a lidar bare-earth hillshade in the image above. With lidar bare-earth imagery the land surface, including fault lines, can be seen in remarkable detail. Here, roads cutting across the landscape show the size of this fault system. The faults shown here have vertical offsets up to 200 feet.

DOGAMI uses lidar to identify and map newly discovered geologic features throughout Oregon.
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July 2014
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AUGUST 2014

SEPTEMBER 2014
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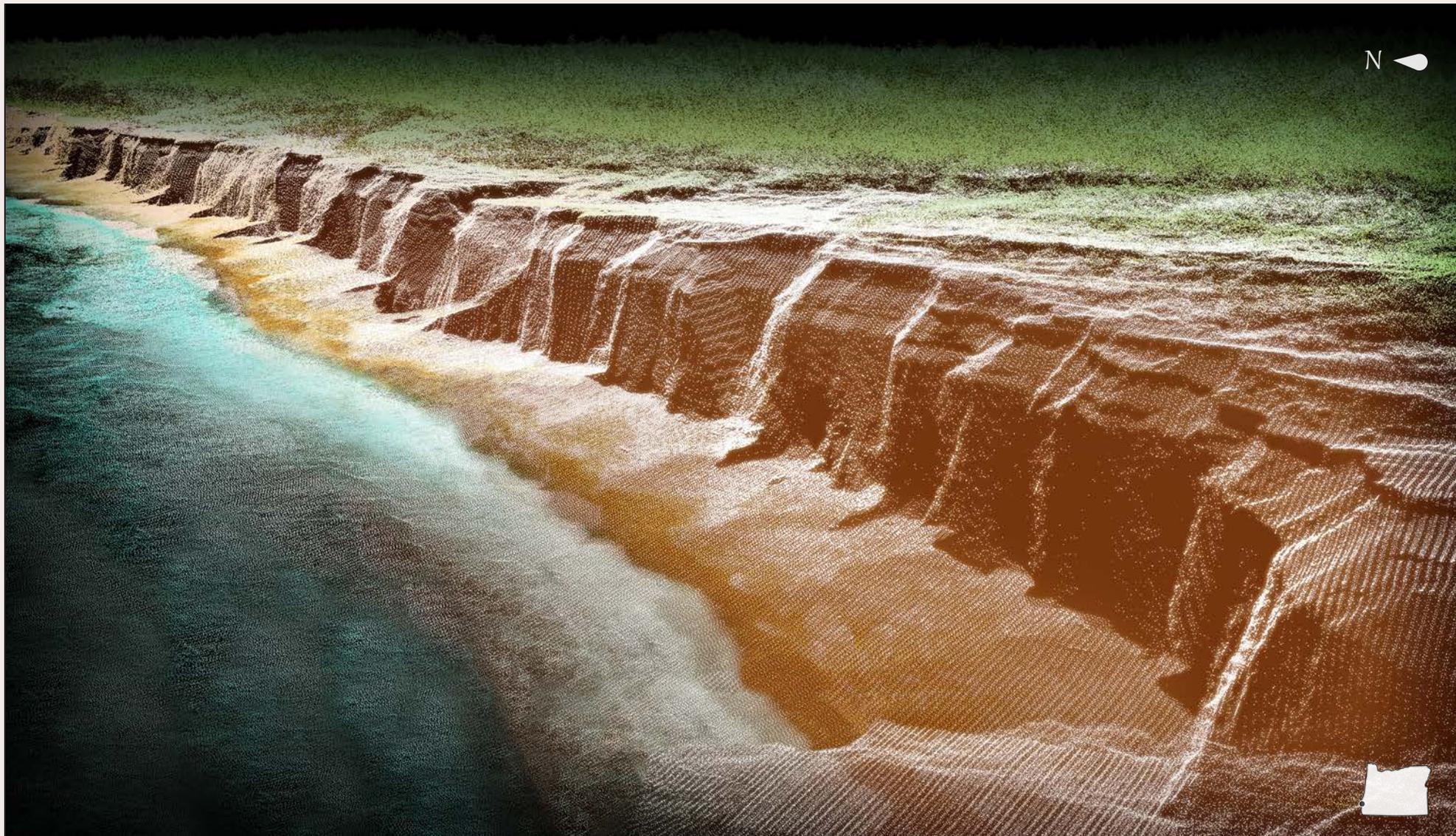
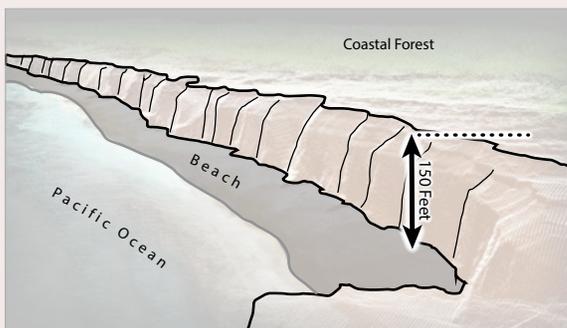


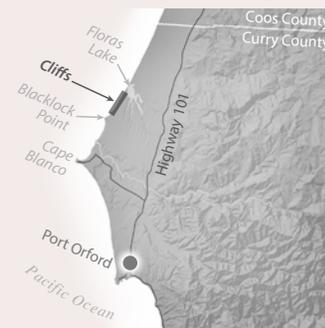
Image: Daniel E. Coe



Coastal Cliffs, Near Blacklock Point, Curry County, Oregon

The stretch of coast between Blacklock Point and Floras Lake in Curry County contains some of the most scenic sea cliffs in Oregon. At the highest point north of Blacklock Point, the relief is about 150 feet from beach to forested plateau. Interlayered sandstone and conglomerate rocks make up the cliffs. This relatively soft material is prone to mass wasting and wave attack. The Oregon coastline is unstable due to erosion/deposition cycles, sea level change, and tectonic activity. These geologic hazards can put people and property in coastal communities at risk.

DOGAMI uses lidar to identify and mitigate coastal hazards such as erosion, tsunamis, and landslides.
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AUGUST 2014
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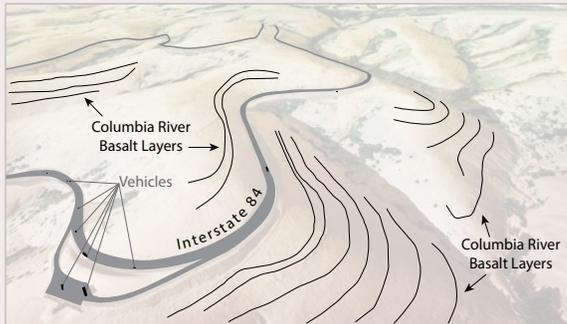
SEPTEMBER 2014

OCTOBER 2014
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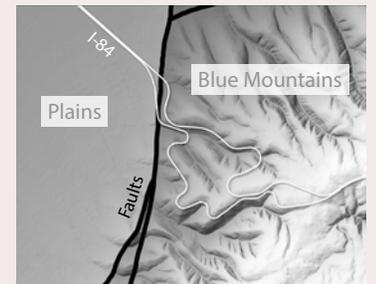
Image: Daniel E. Coe



Mountain Uplift, Blue Mountains, Umatilla County, Oregon

The image above shows a portion of Emigrant Hill, also known as Cabbage Hill, along Interstate 84 southeast of Pendleton. In this area the highway climbs from the plains below into the Blue Mountains. Here, basalt layers from the Wanapum and Grande Ronde formations of the Columbia River Basalt Group have been tectonically uplifted along faults on their western edge (see figure at right) and eroded. These basalts flowed through the area between 15.5 and 17 million years ago. Small features such as individual vehicles can also be seen in the highest-hit (first return) lidar image above.

DOGAMI uses lidar to model and measure vulnerability of man-made structures to geologic hazards such as floods and landslides. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



SEPTEMBER 2014
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OCTOBER 2014

NOVEMBER 2014
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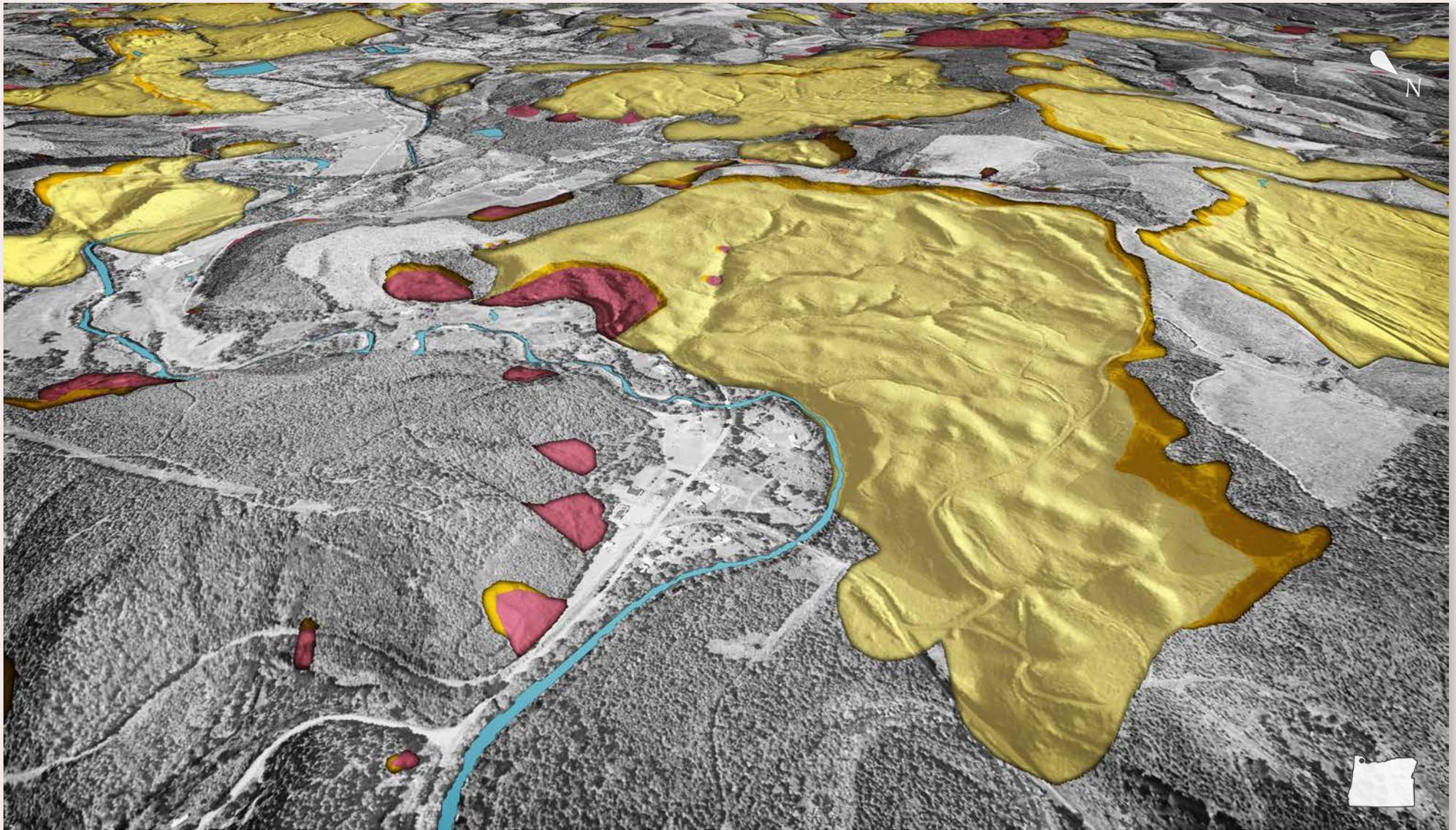
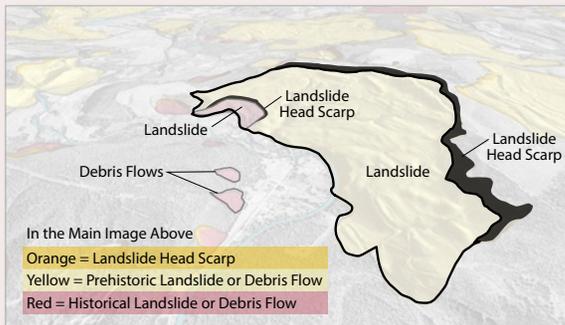
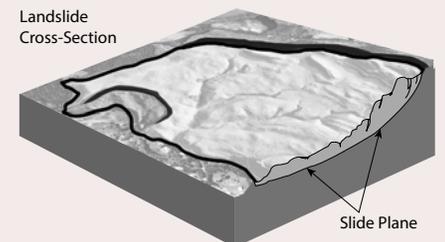


Image: Daniel E. Coe



Landslides and Debris Flows, Nehalem River Watershed, Columbia County, Oregon

Because of the underlying geology, the area around Vernonia is vulnerable to mass movement. With lidar, geologists can get very detailed and accurate images of the ground surface, even under dense vegetation, which allows them to map mass movements. Recently mapped landslides and debris flows are highlighted here by combining bare-earth lidar imagery with aerial photos. Relative age of movement is shown by color: red for movement in the past 150 years and yellow for movement older than 150 years. Landslide head scarps are shown in orange. A head scarp is the uppermost scarp which often exposes the primary failure plane of the slide. The cross-section at right shows the large landslide in the image above.



DOGAMI uses lidar to map landslides and debris flows as a first step toward risk reduction.
 OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

OCTOBER 2014
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 1 2 3 4
 5 6 7 8 9 10 11
 12 13 14 15 16 17 18
 19 20 21 22 23 24 25
 26 27 28 29 30 31

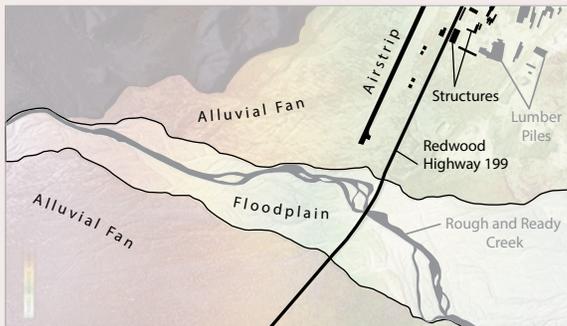
NOVEMBER 2014

DECEMBER 2014
 S M T W T F S
 1 2 3 4 5 6
 7 8 9 10 11 12 13
 14 15 16 17 18 19 20
 21 22 23 24 25 26 27
 28 29 30 31

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5		6	7
9	10	11 Veteran's Day	12	13		14
16	17	18	19	20	21	
23	24	25	26	27	28	
30				Thanksgiving Day		29



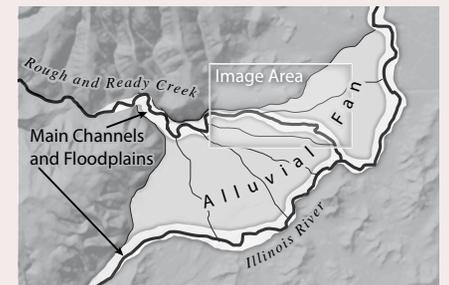
Image: Daniel E. Coe



Alluvial Fan and Floodplain, Rough and Ready Creek, Josephine County, Oregon

Rough and Ready Creek flows out of the Siskiyou Mountains south of Cave Junction. The 250-foot-elevation range is indicated by color (see color ramp at left of image). Bare-earth lidar imagery reveals the Rough and Ready Creek floodplain to be a braided floodplain depositional system. This floodplain fills during times of high water. Beyond the present-day floodplain, Illinois Valley Airport, structures, and trees can be seen with highest-hit lidar imagery. Much of the image is part of an alluvial fan (see figure at right) that Rough and Ready Creek has deposited in the Illinois River Valley after flowing out of its steep mountain channel.

DOGAMI uses lidar to create physiographic maps with vertical elevation accuracy of ± 2 inches (in flat areas) that can be used to map channel migration, surficial deposits, and flood hazard zones. OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES



NOVEMBER 2014
 S M T W T F S
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DECEMBER 2014

JANUARY 2015
 S M T W T F S
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 4 5 6 7 8 9 10
 11 12 13 14 15 16 17
 18 19 20 21 22 23 24
 25 26 27 28 29 30 31

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6 
7 Pearl Harbor Remembrance Day	8	9	10	11	12	13
 14	15	16	17	18	19	20
21	 22	23	24 Christmas Eve	25 Christmas	26	27
 28	29	30	31 New Year's Eve			

Lidar Intensified

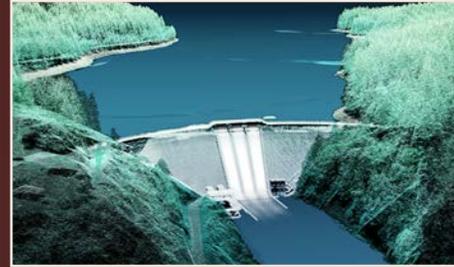
2014 Calendar



Evolving River Channels



Lava Flow and Glacial Features



Municipal Watershed



Eolian and Fluvial Features



Maars



Composite Volcano



Lava Flow and Cinder Cones



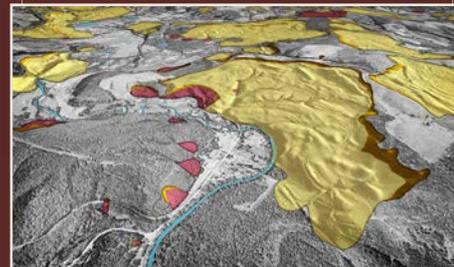
Faults



Coastal Cliffs



Mountain Uplift



Landslides and Debris Flows



Alluvial Fan and Floodplain



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