Reforestation for the Future: Future Concerns, Shaping your Reforestation Plans and the Seedlot Selection Tool

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for the greatest good

38th Inland Empire Reforestation Council Meeting, Coeur d'Alene, ID, March 6, 2018

Objectives

1. ***Introduce the Seedlot Selection Tool***
2. ***Provide some examples***
3. ***Discuss implications of climate change***

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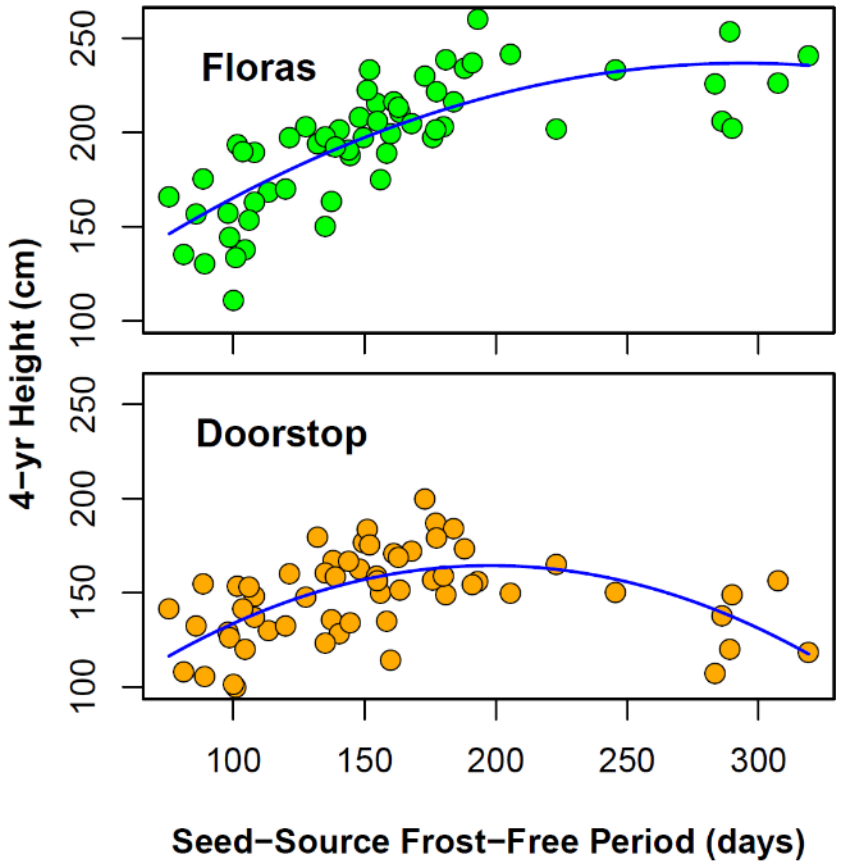
Background

1. Plants are adapted to local climates

Douglas-Fir Seed Source Movement Trial



Floras – warm site

Frost-free days = 308

Doorstop – cool site

Frost-free days = 190

Local adaptation

Sources from climates similar to the planting site are among the tallest at each site

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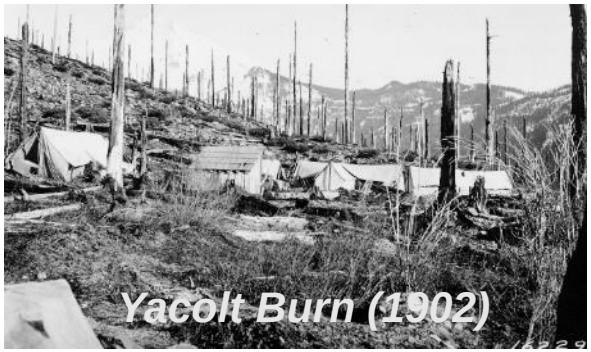
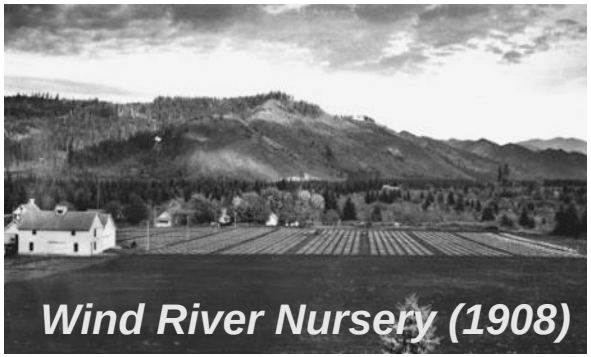
Lessons from Forestry





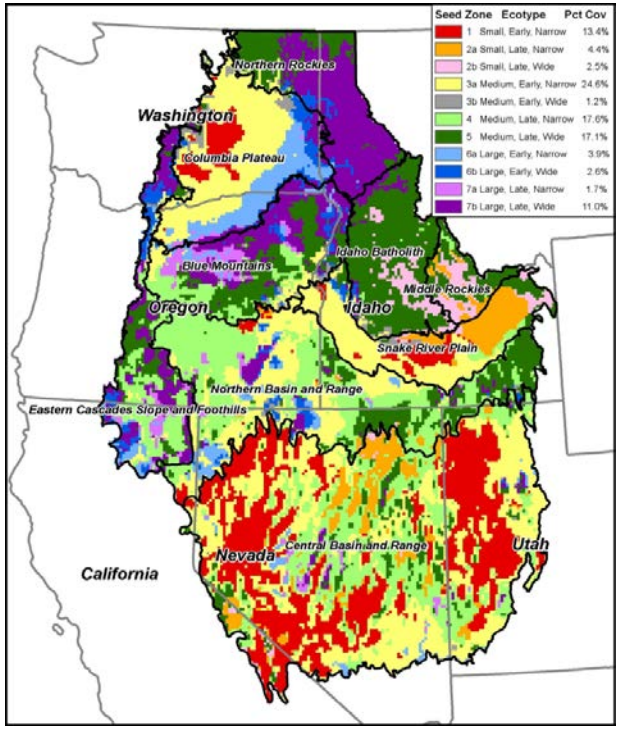
- *Early observations of poor growth and survival*
- *Maladaptation took time to develop*
- *Led to first seed movement guidelines in 1939*
  - *100 miles north or south*
  - *1,000 ft in elevation*
  - *Considerations for unusual climates, topography or soils*

2. Seed zones and population movement guidelines developed to ensure adaptation

- ***Based primarily on collective knowledge of climate and vegetation types***
- ***Includes 500 ft elevation bands within zones***
- ***Later revised in OR and WA to account for species-specific patterns of adaptation***

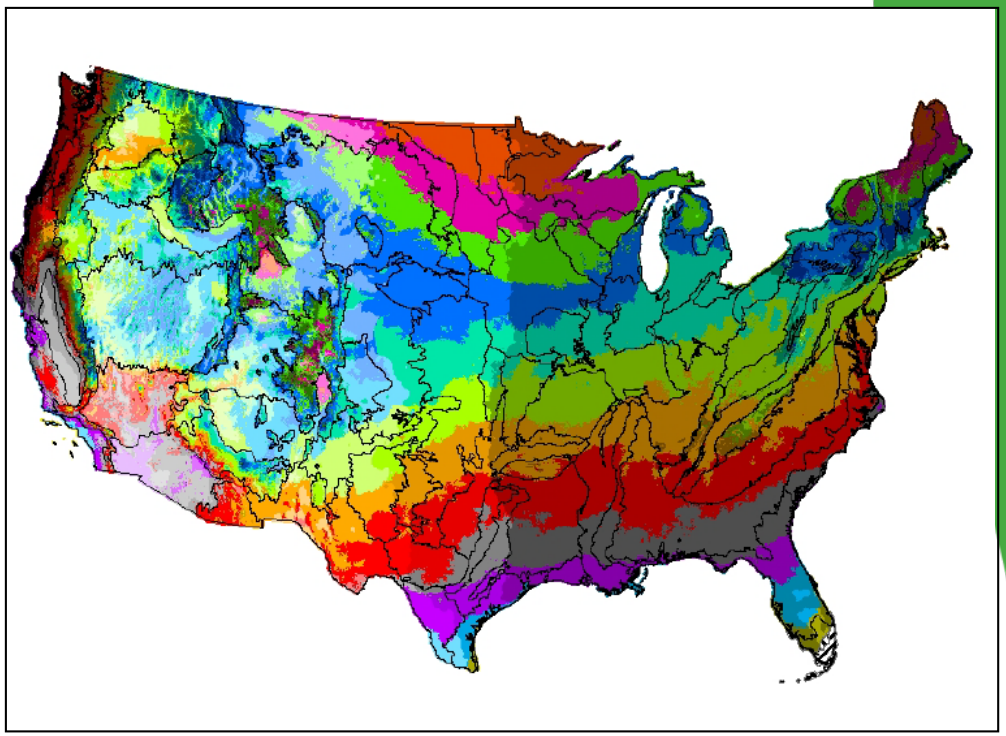
2. Seed zones and population movement guidelines developed to ensure adaptation

Bluebunch Wheatgrass Seed Zones



St.Clair, Kilkenny, Johnson, Shaw, Weaver. 2013. Genetic variation in adaptive traits and seed transfer zones for Pseudoroegneria spicata (bluebunch wheatgrass) in the northwestern United States. Evolutionary Applications 6: 933-948

Generalized Provisional Seed Zones



Bower, St.Clair, Erickson. 2014. Generalized provisional seed zones for native plants. Ecological Applications 24: 913-919

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3. But climates are changing, which affects adaptation

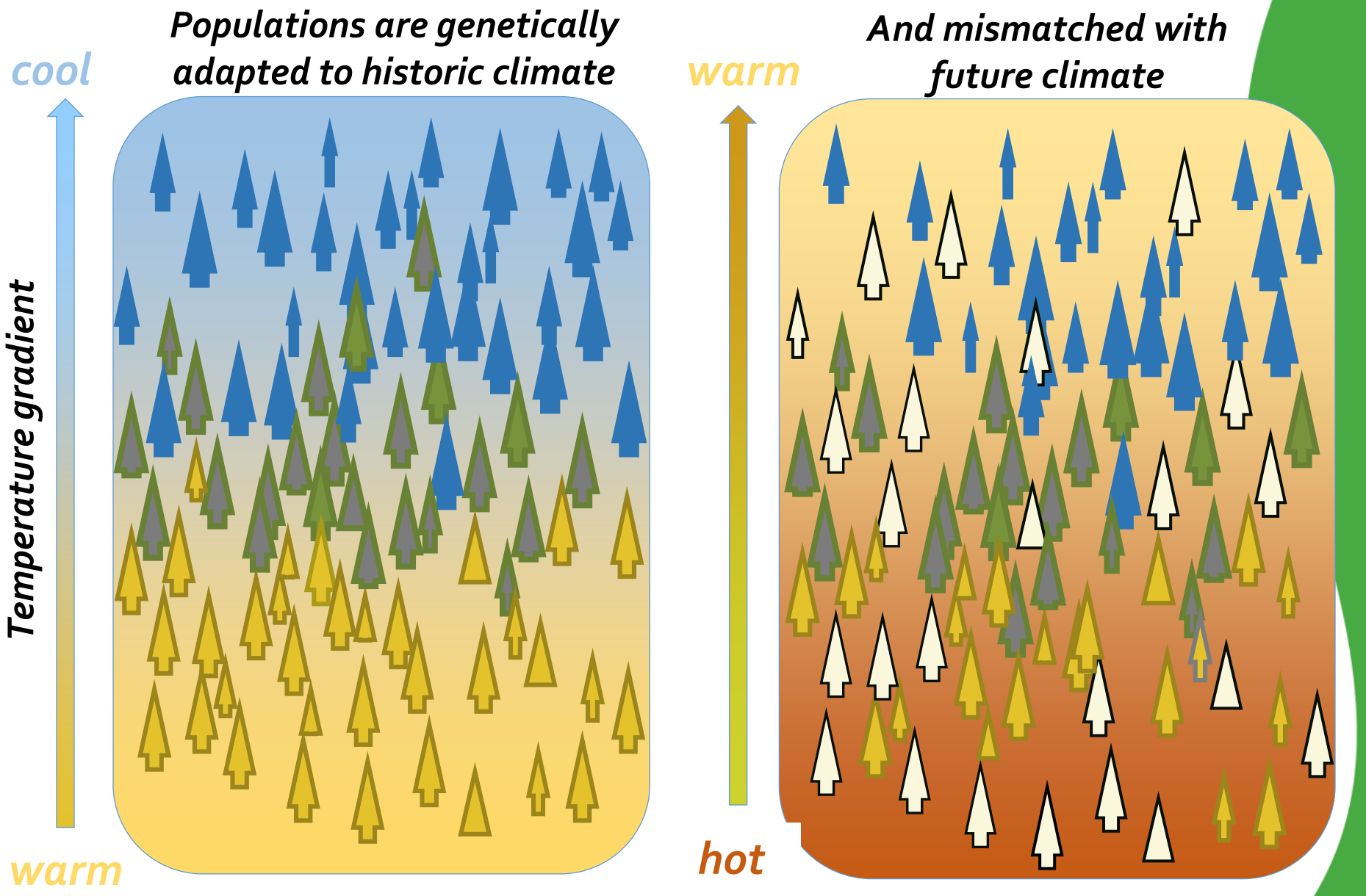
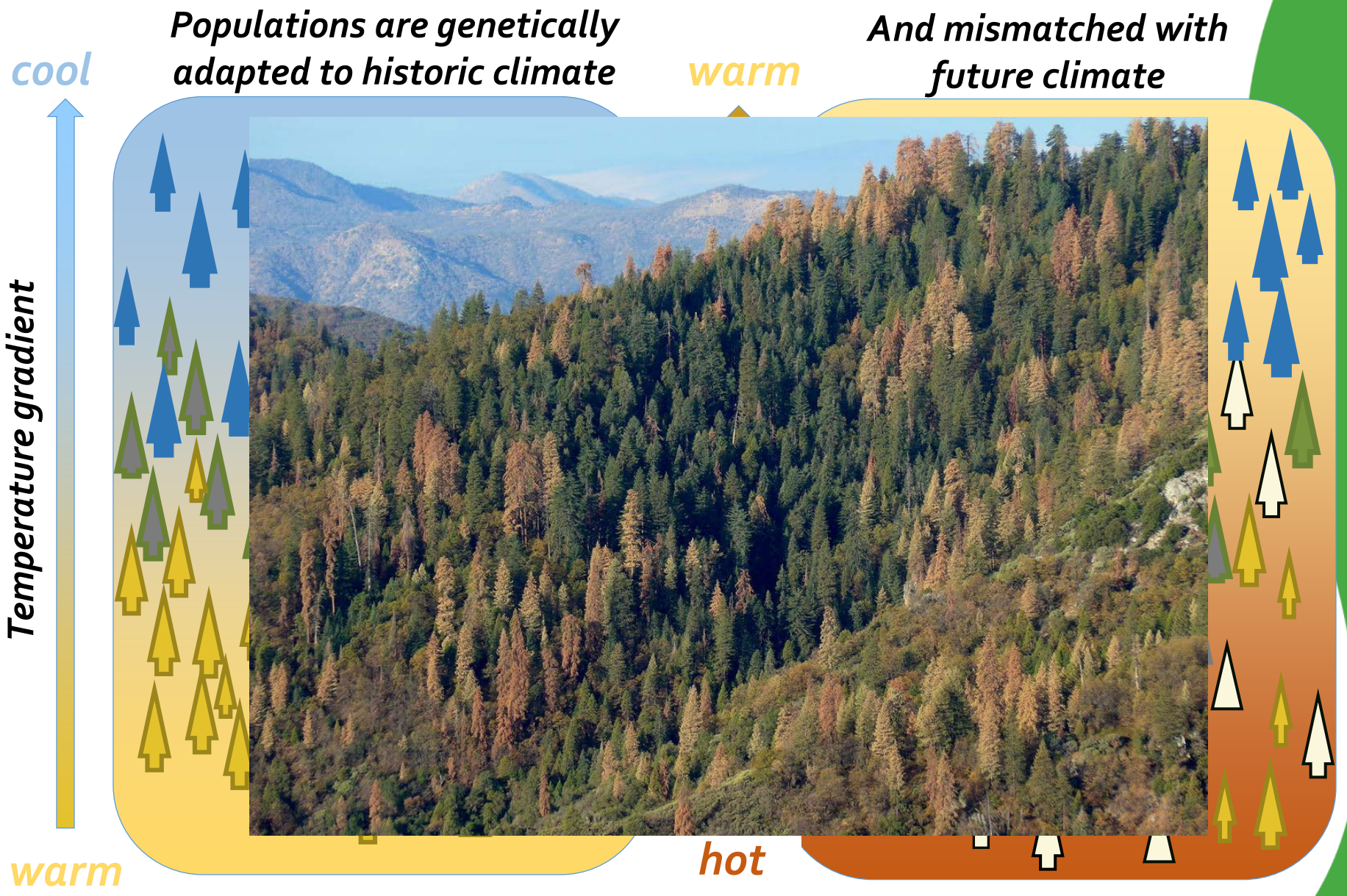


Figure courtesy of Sally Aitken, UBC

3. But climates are changing, which affects adaptation



4. We can manage genetic variation to positively influence how plants respond and adapt to climate change

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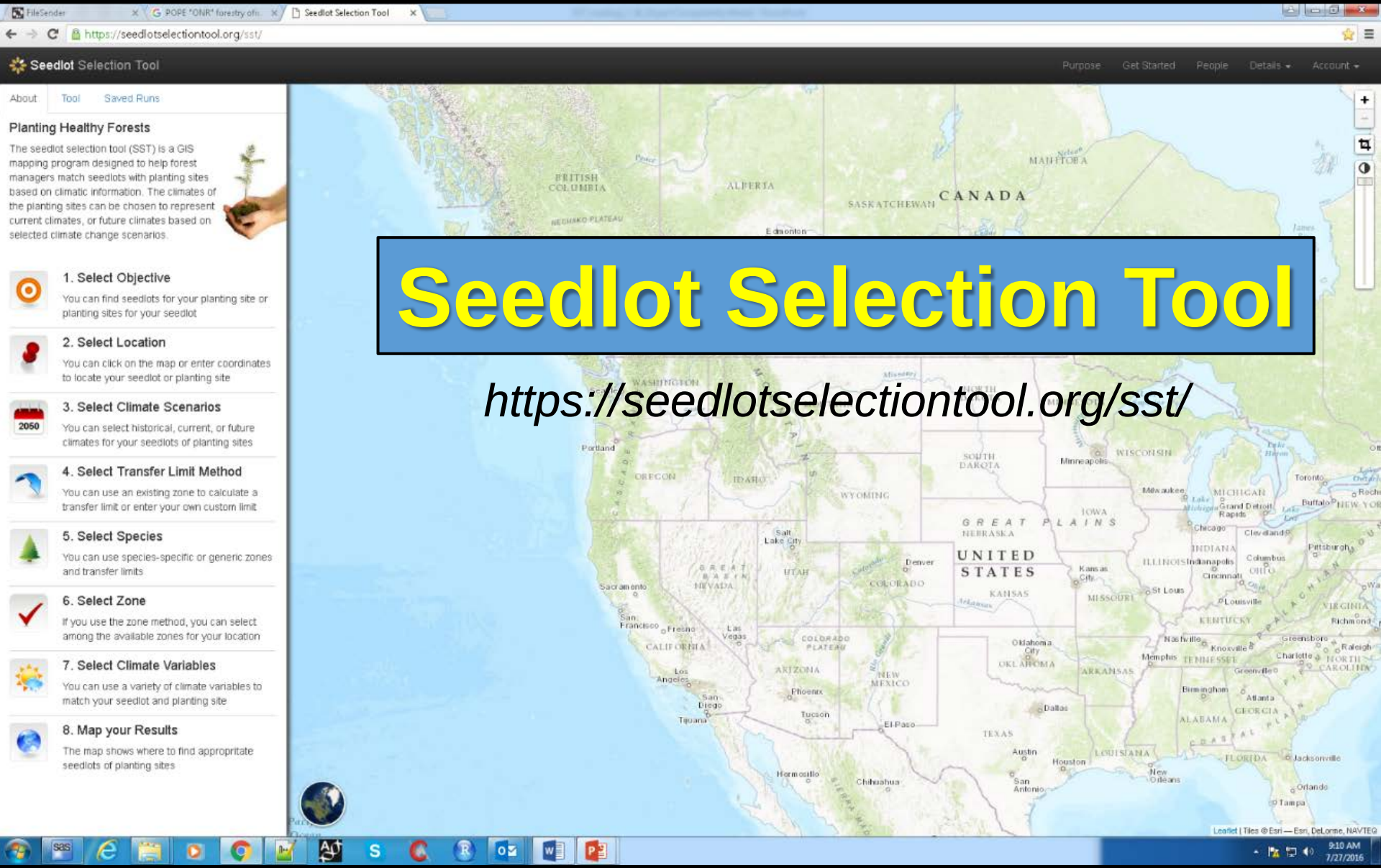
Seedlot Selection Tool
https://seedlotselectiontool.org/sst/
Seedlot Selection Tool
Purpose
Get Started
People
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Planting Healthy Forests
The seedlot selection tool (SST) is a GIS mapping program designed to help forest managers match seedlots with planting sites based on climatic information. The climates of the planting sites can be chosen to represent current climates, or future climates based on selected climate change scenarios.
1. Select Objective
You can find seedlots for your planting site or planting sites for your seedlot
2. Select Location
You can click on the map or enter coordinates to locate your seedlot or planting site
3. Select Climate Scenarios
You can select historical, current, or future climates for your seedlots of planting sites
4. Select Transfer Limit Method
You can use an existing zone to calculate a transfer limit or enter your own custom limit
5. Select Species
You can use species-specific or generic zones and transfer limits
6. Select Zone
If you use the zone method, you can select among the available zones for your location
7. Select Climate Variables
You can use a variety of climate variables to match your seedlot and planting site
8. Map your Results
The map shows where to find appropriate seedlots of planting sites
CANADA
UNITED STATES
GREAT PLAINS
Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ

Can address two objectives:

Given a planting site

Which seedlot is well adapted today…or in the future?

Find

Given a seedlot

Where is it well adapted today…or in the future?

Find

Example: Finding seedlots for Malheur NF burn site

Seedlot Selection Tool

Purpose | Instructions | More Information | People | News & Updates | Report an Issue | Account

About | Tool | Saved Runs

1 Select objective

Find seedlots | Find planting sites

2 Select planting site location

Locate your planting site
Use the map or enter coordinates

Lat: 44.4600 **Lon:** -118.5000

Elevation: 5262 ft

3 Select climate scenarios

Which climate are the seedlots adapted to?

1961 - 1990

When should trees be best adapted to the planting site?

1961 - 1990

4 Select transfer limit method

Custom | Zone

Select a species

Generic

Select zone

Oregon (1966/1973) Zone 922, 5000' - 5500'

5 Select climate variables

Units: Metric | Imperial

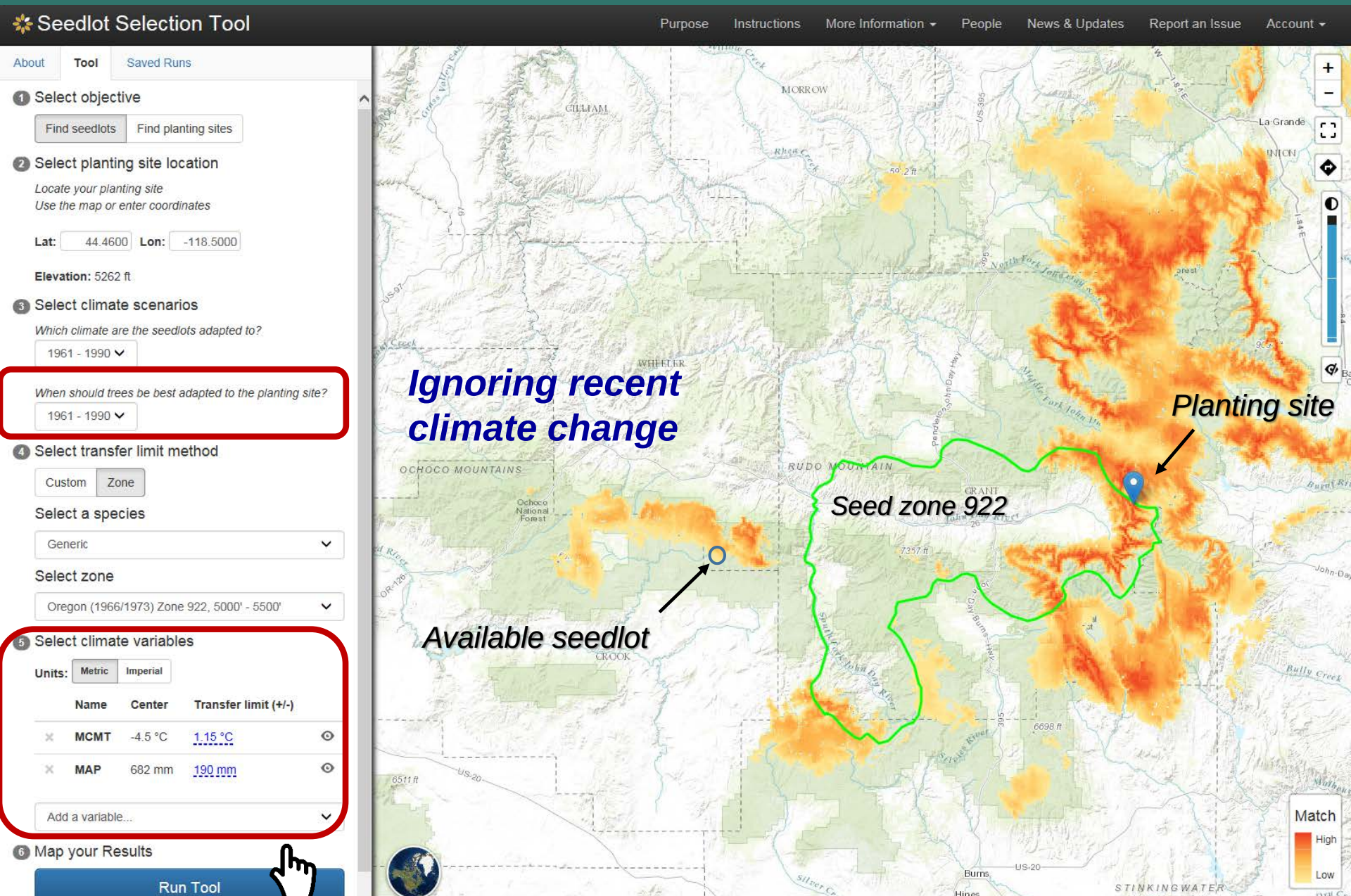
Add a variable...

6 Map your Results

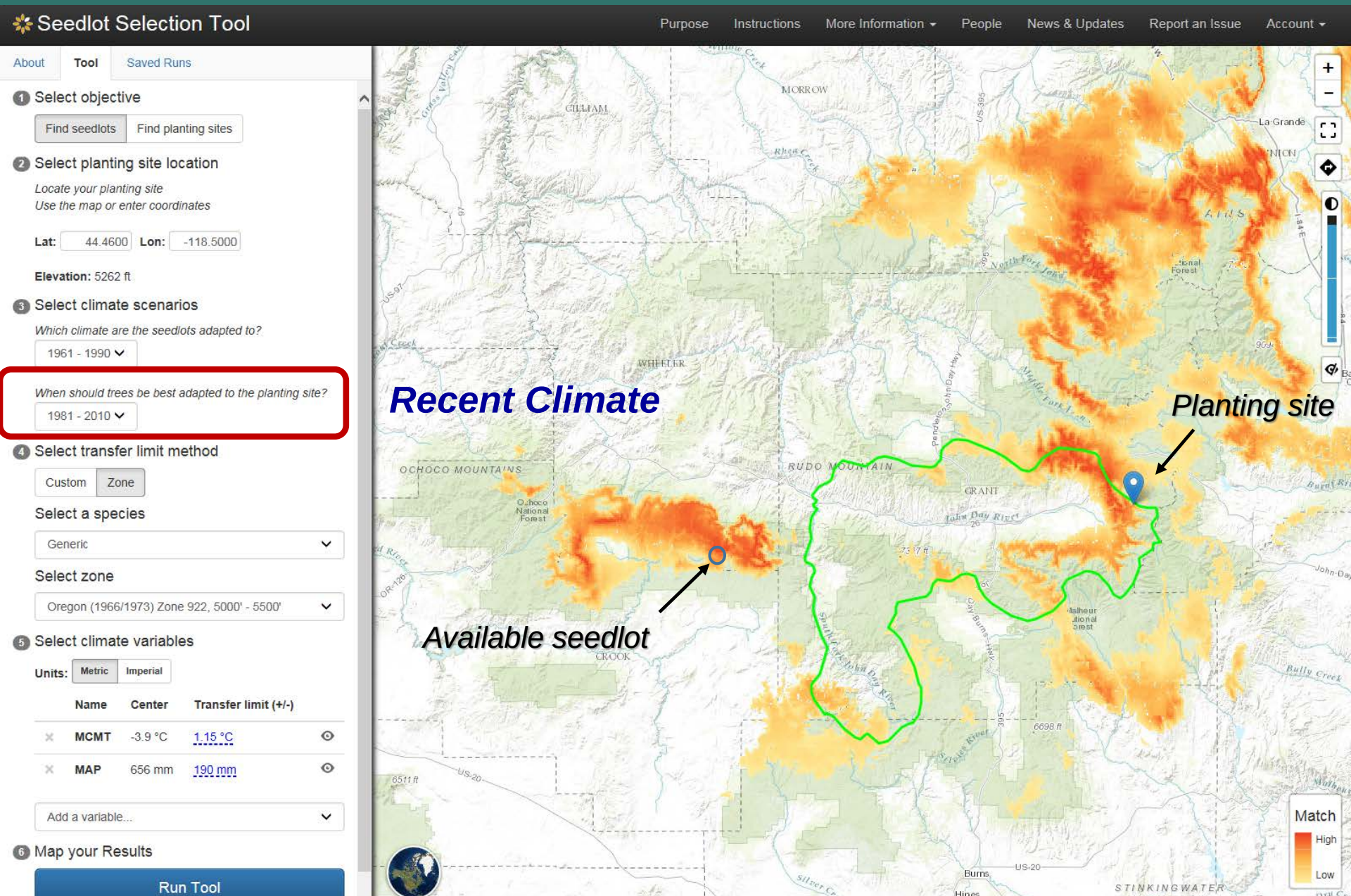
Run Tool

Save Last Run | Export PDF

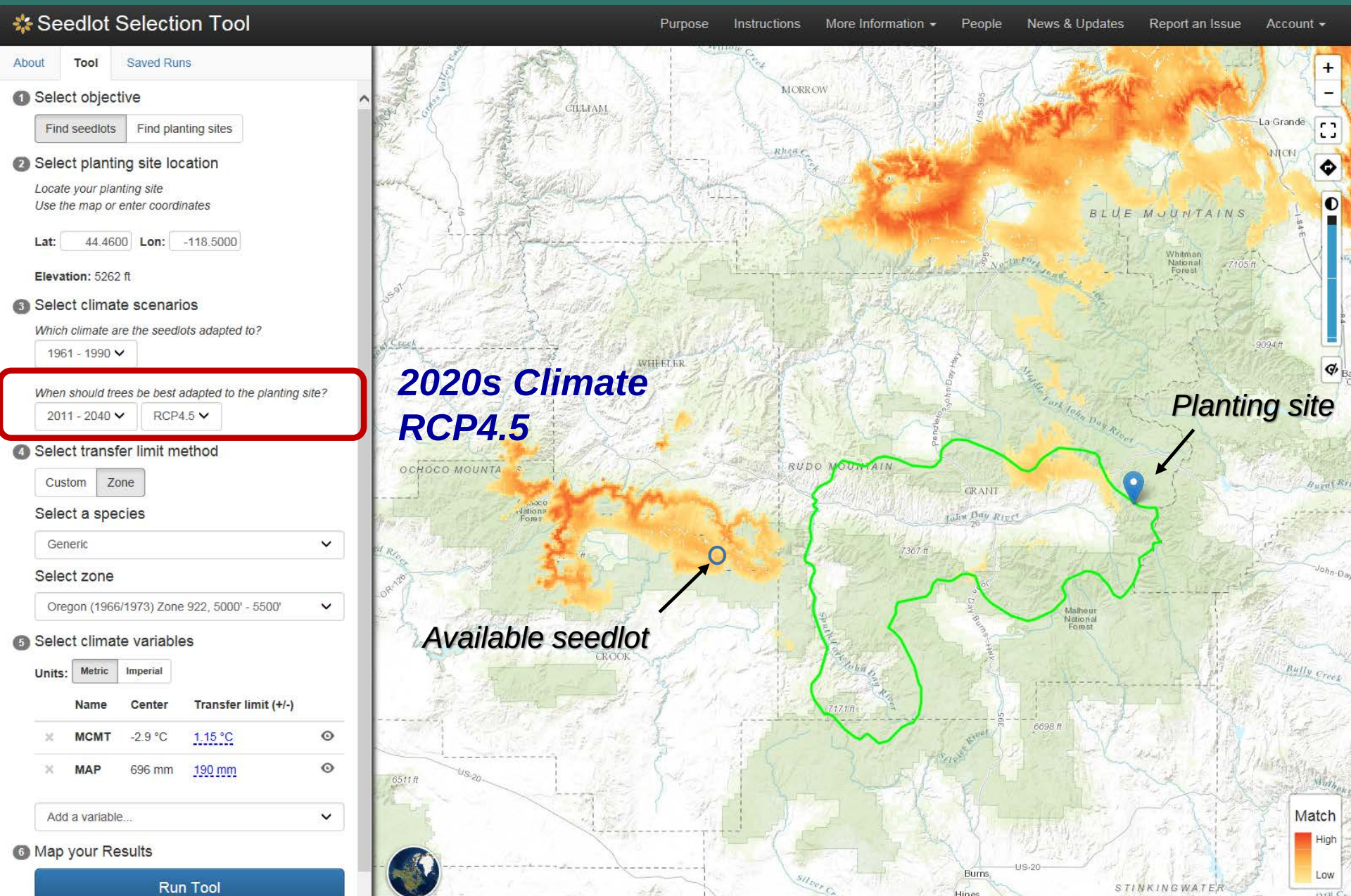
Seedlots adapted to Malheur NF planting site



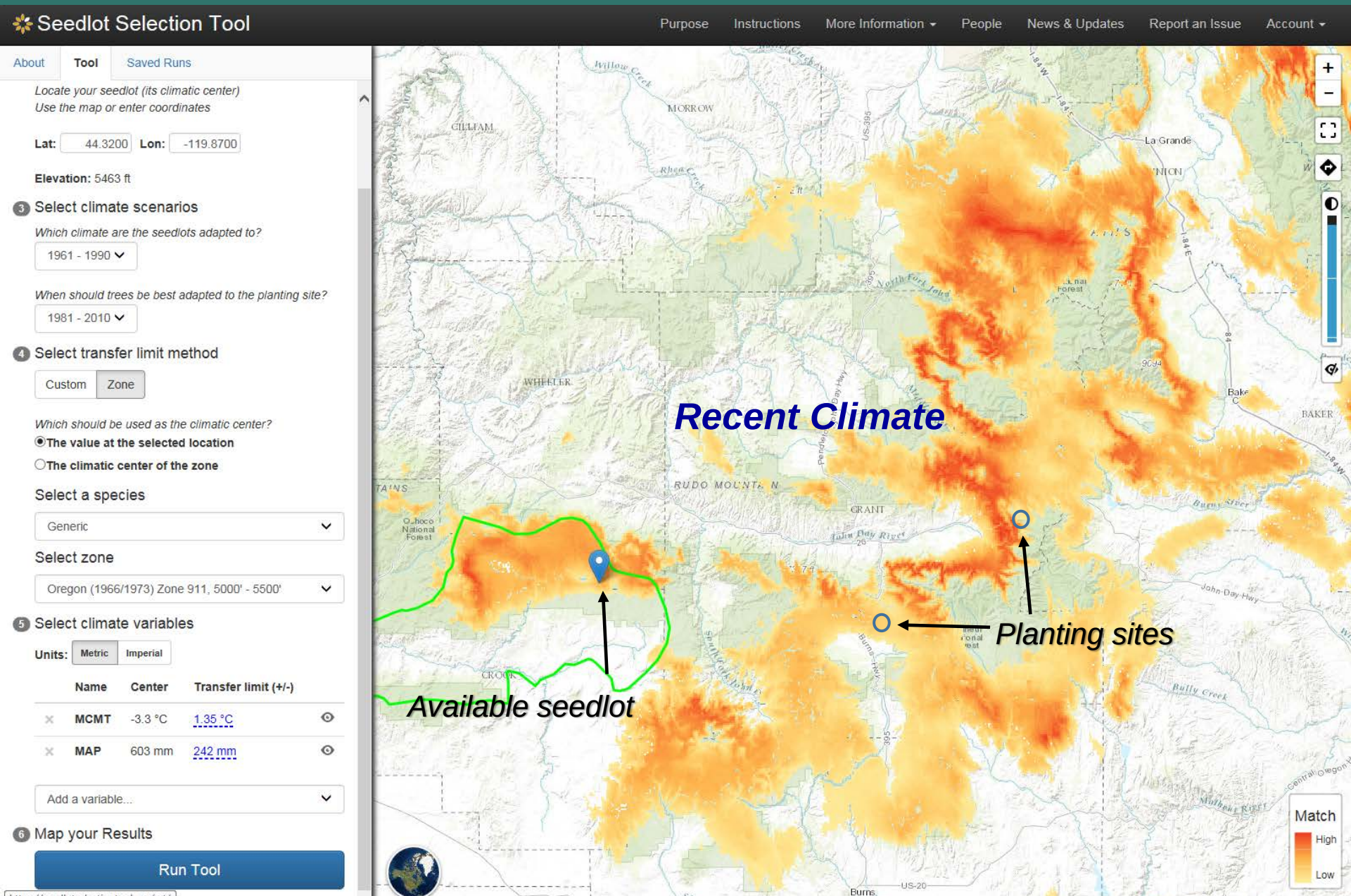
Seedlots adapted to Malheur NF planting site



Seedlots adapted to Malheur NF planting site



Planting sites for Ochoco NF seedlot



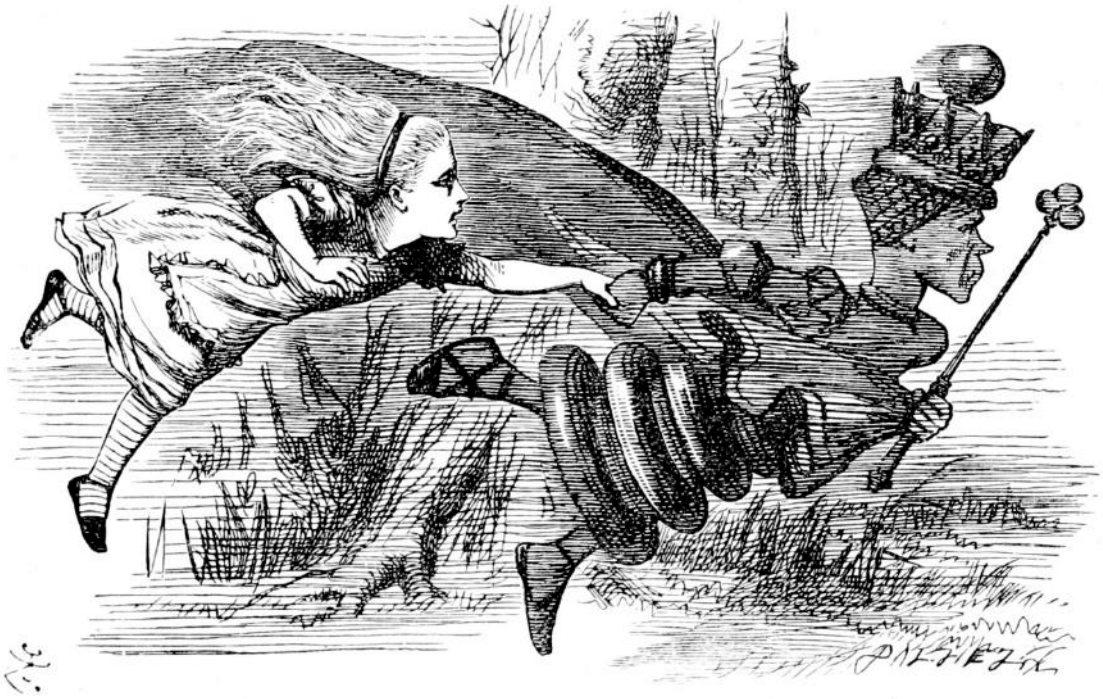
Climate Change

Do we really need to worry about climate change?

Two questions:

1. ***Are native populations adapted to current and future climates?***
2. ***If not, how far do we have to go to find populations adapted to a planting site (assisted migration)?***

Answer:



"Now, here, you see, it takes all the running you can do, to keep in the same place."

The Red Queen from Lewis Caroll's *Through the Looking-Glass*

Seedlots for Coeur d'Alene, ID

Seedlot Selection Tool

Purpose | Instructions | More Information | People | News & Updates | Report an Issue | Account

About | Tool | Saved Runs

1 Select objective

Find seedlots | Find planting sites

2 Select planting site location

Locate your planting site
Use the map or enter coordinates

Lat: 47.6654 **Lon:** -116.7805

Elevation: 2221 ft (677 m)

3 Select region

Automatic | Custom

Region: Western US

4 Select climate scenarios

Which climate are the seedlots adapted to?

1961 - 1990

When should trees be best adapted to the planting site?

1961 - 1990

5 Select transfer limit method

Custom | Zone

6 Select climate variables

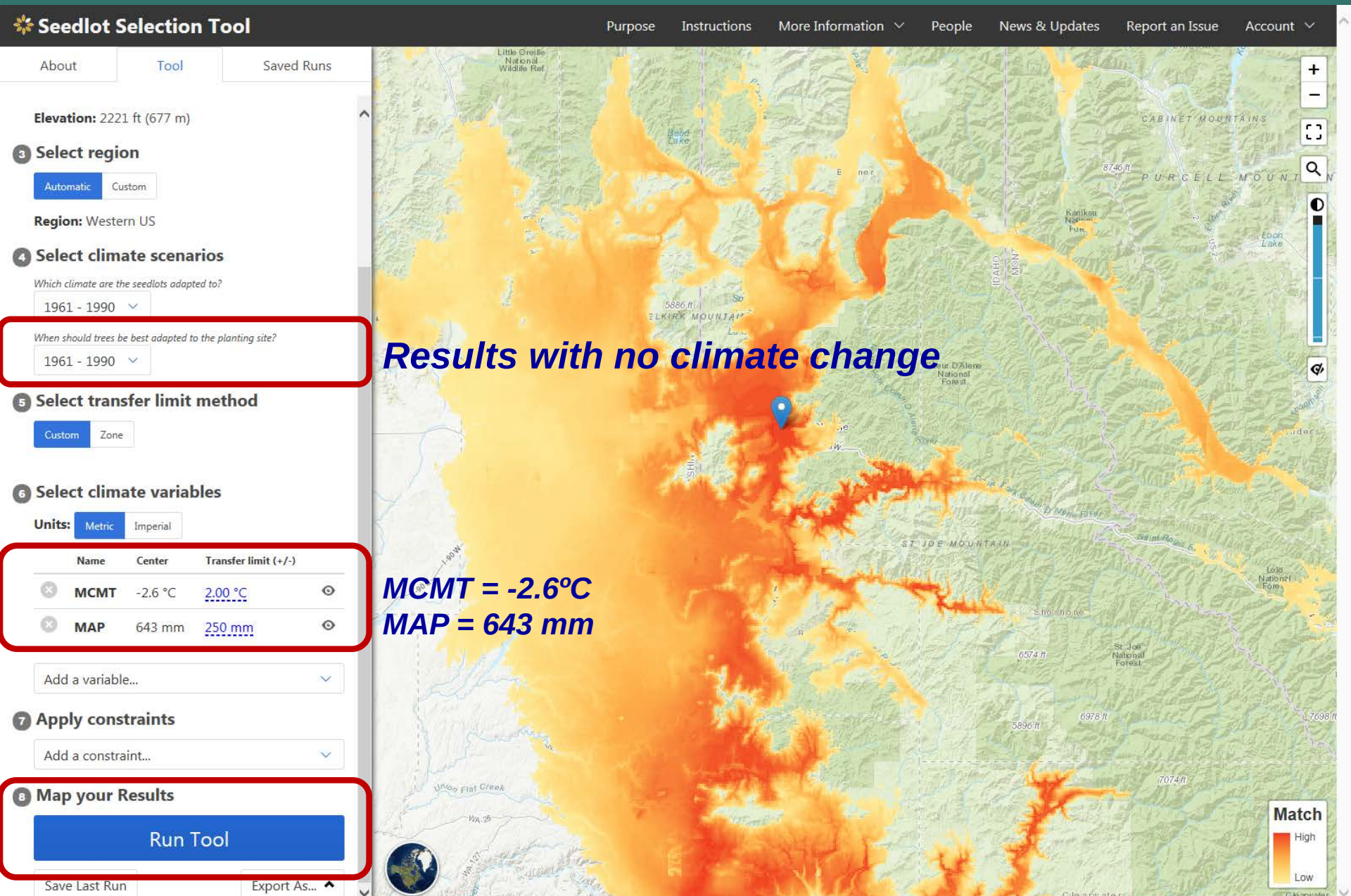
Units: Metric | Imperial

	Name	Center	Transfer limit (+/-)	
⊗	MCMT	-2.6 °C	2.00 °C	👁
⊗	MAP	643 mm	250 mm	👁

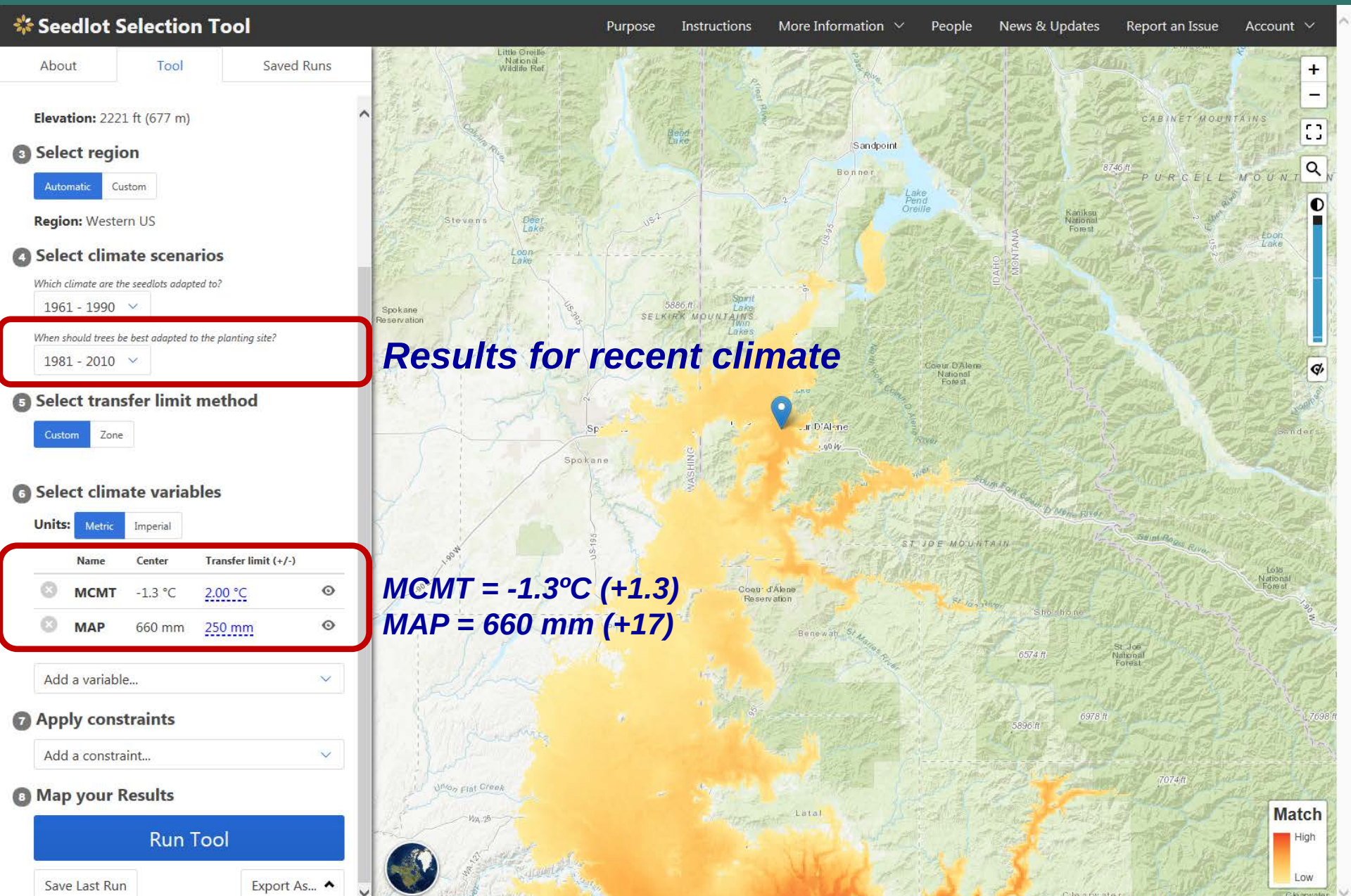
Add a variable...

MCMT = -2.6ºC +- 2.0ºC
MAP = 643 mm +- 250 mm

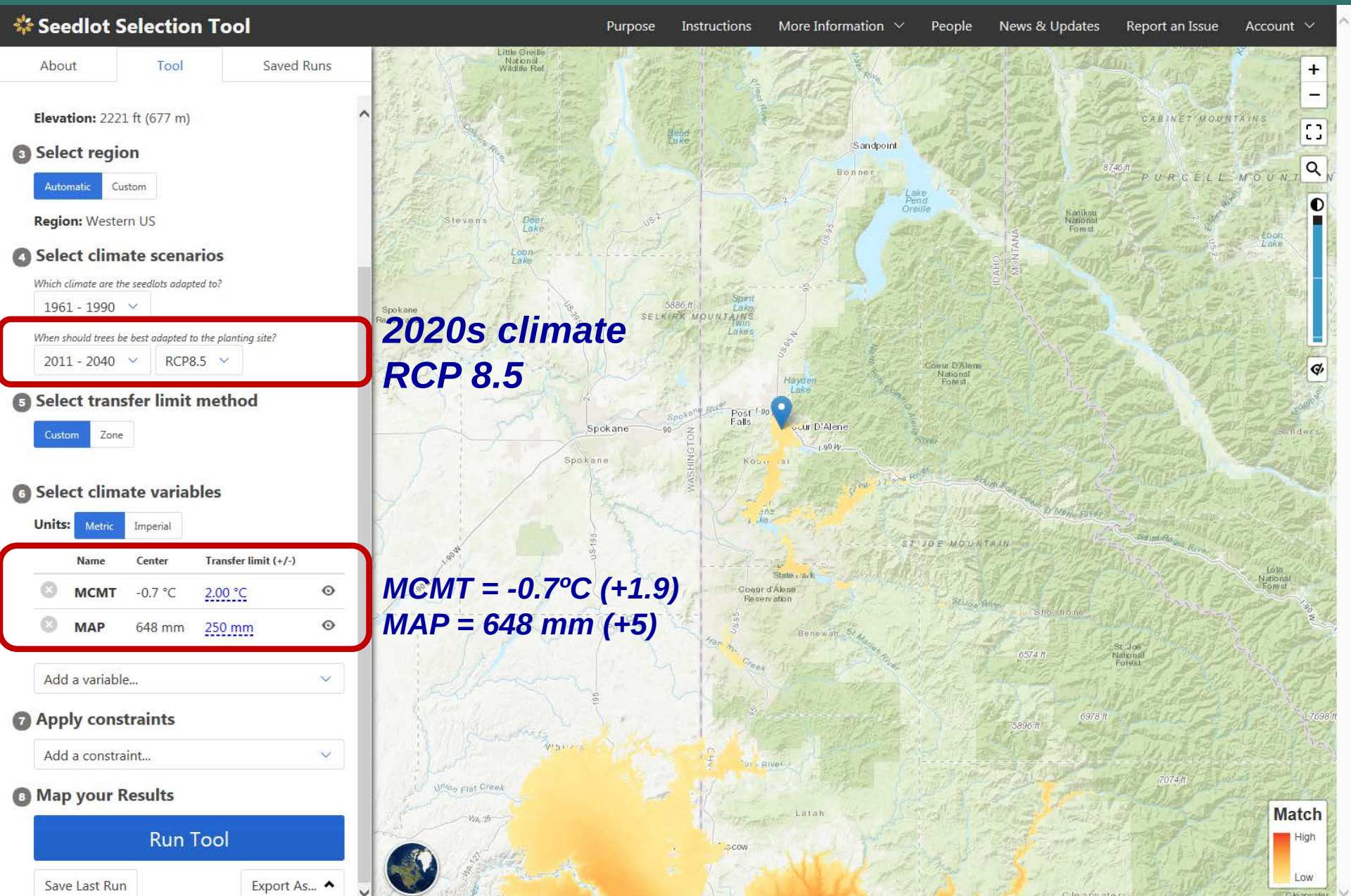
Seedlots for Coeur d'Alene, ID



Seedlots for Coeur d'Alene, ID



Seedlots for Coeur d'Alene, ID



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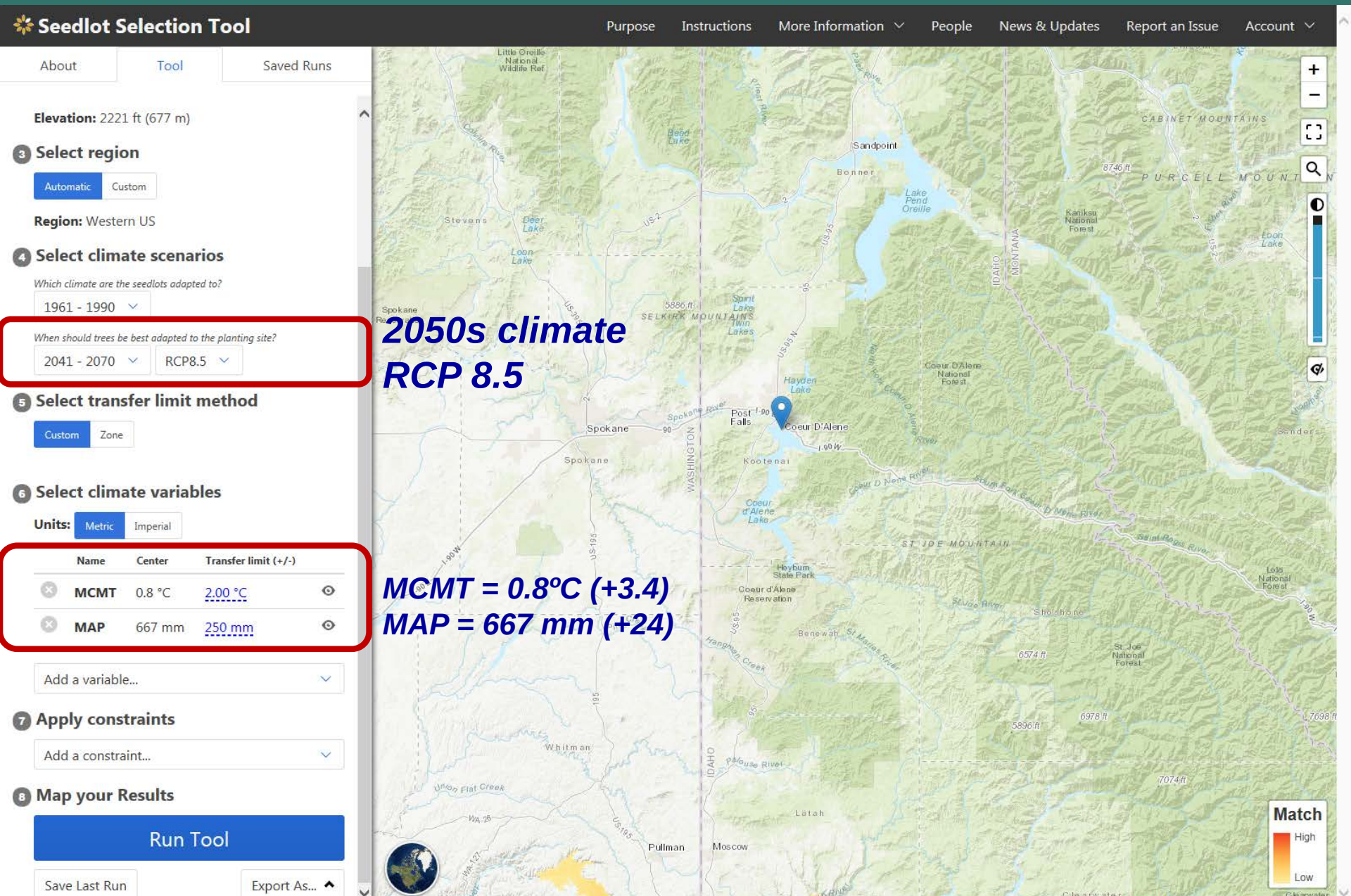

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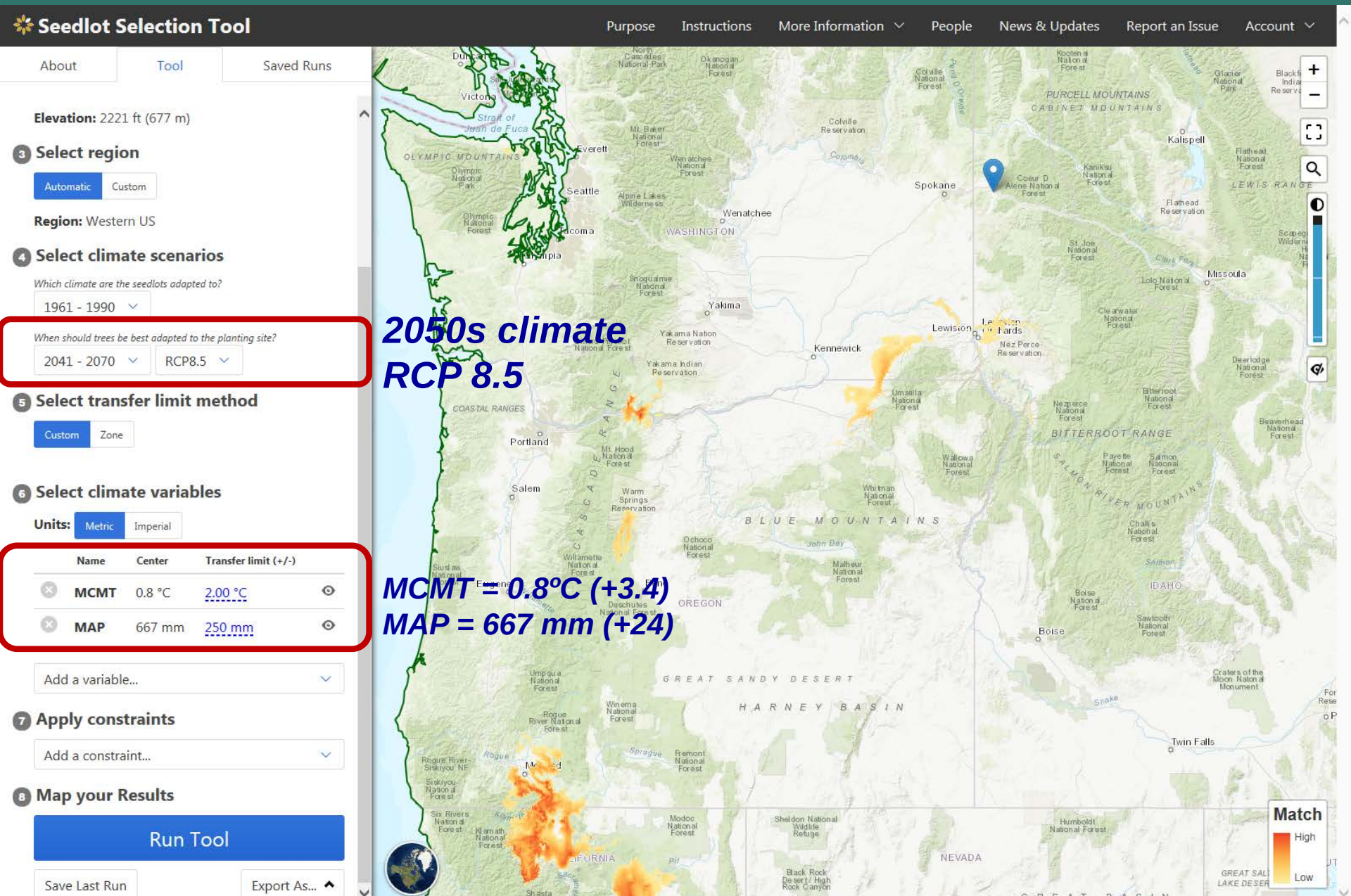
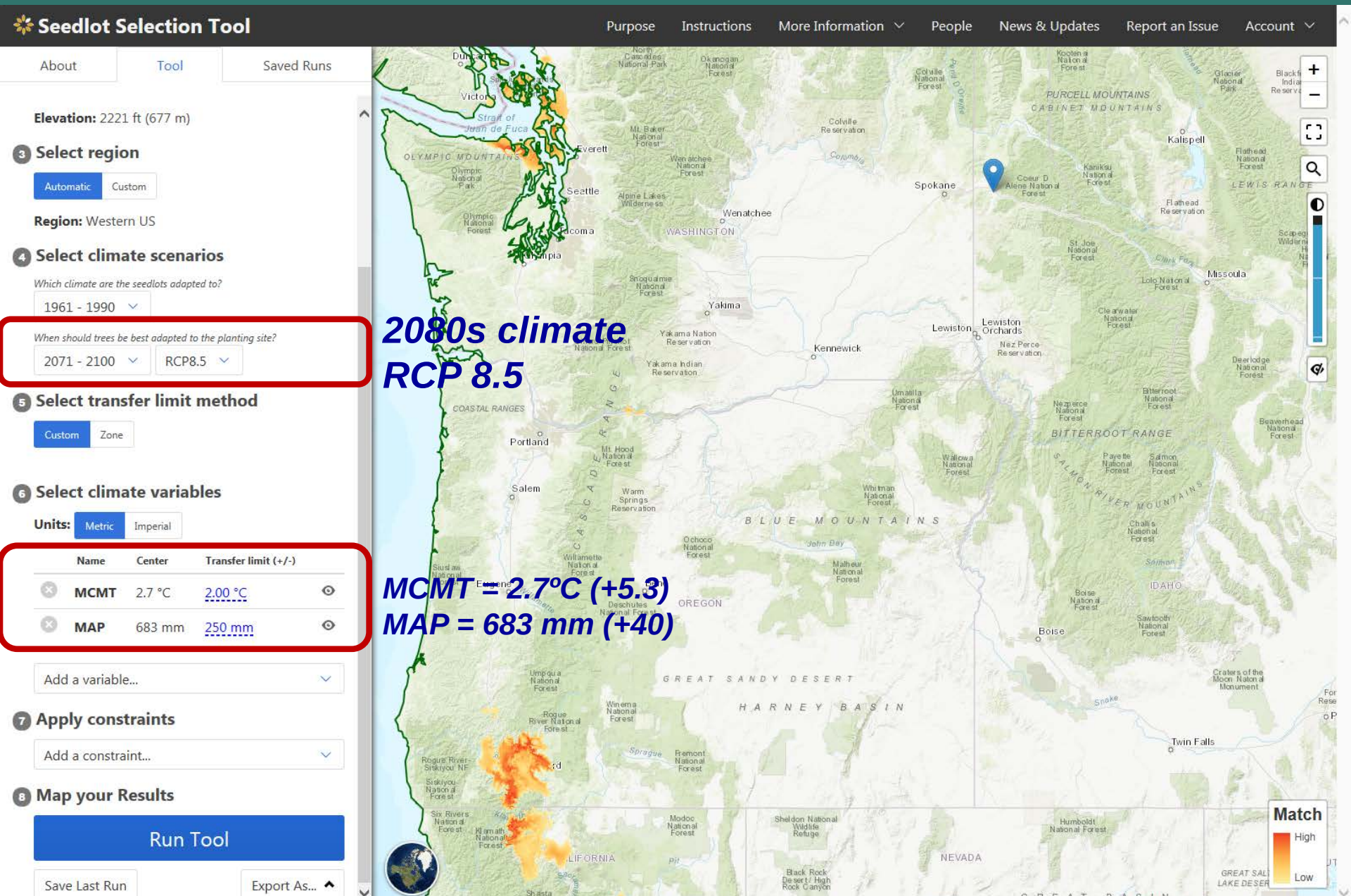
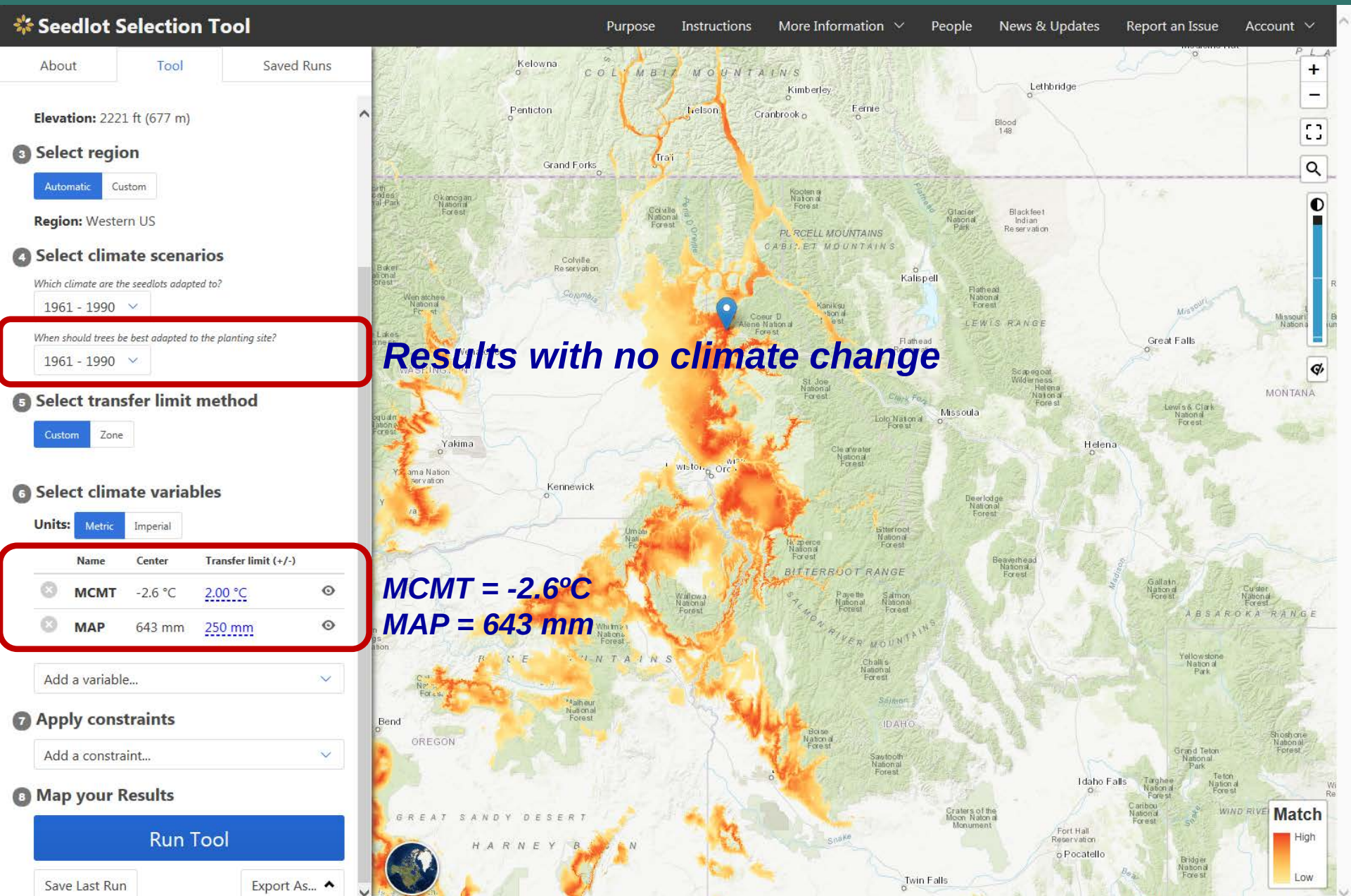


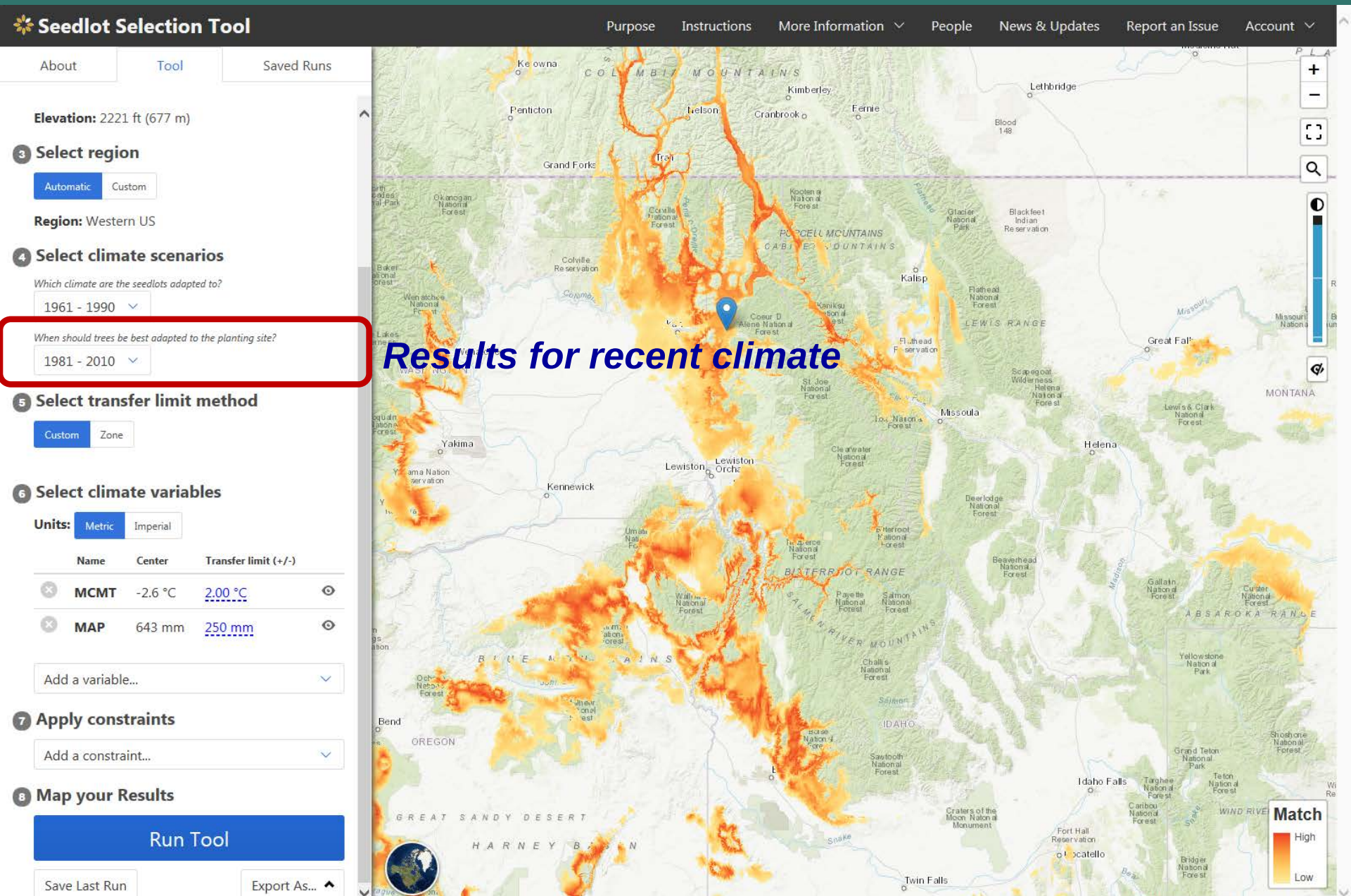
Seedlots for Coeur d'Alene, ID



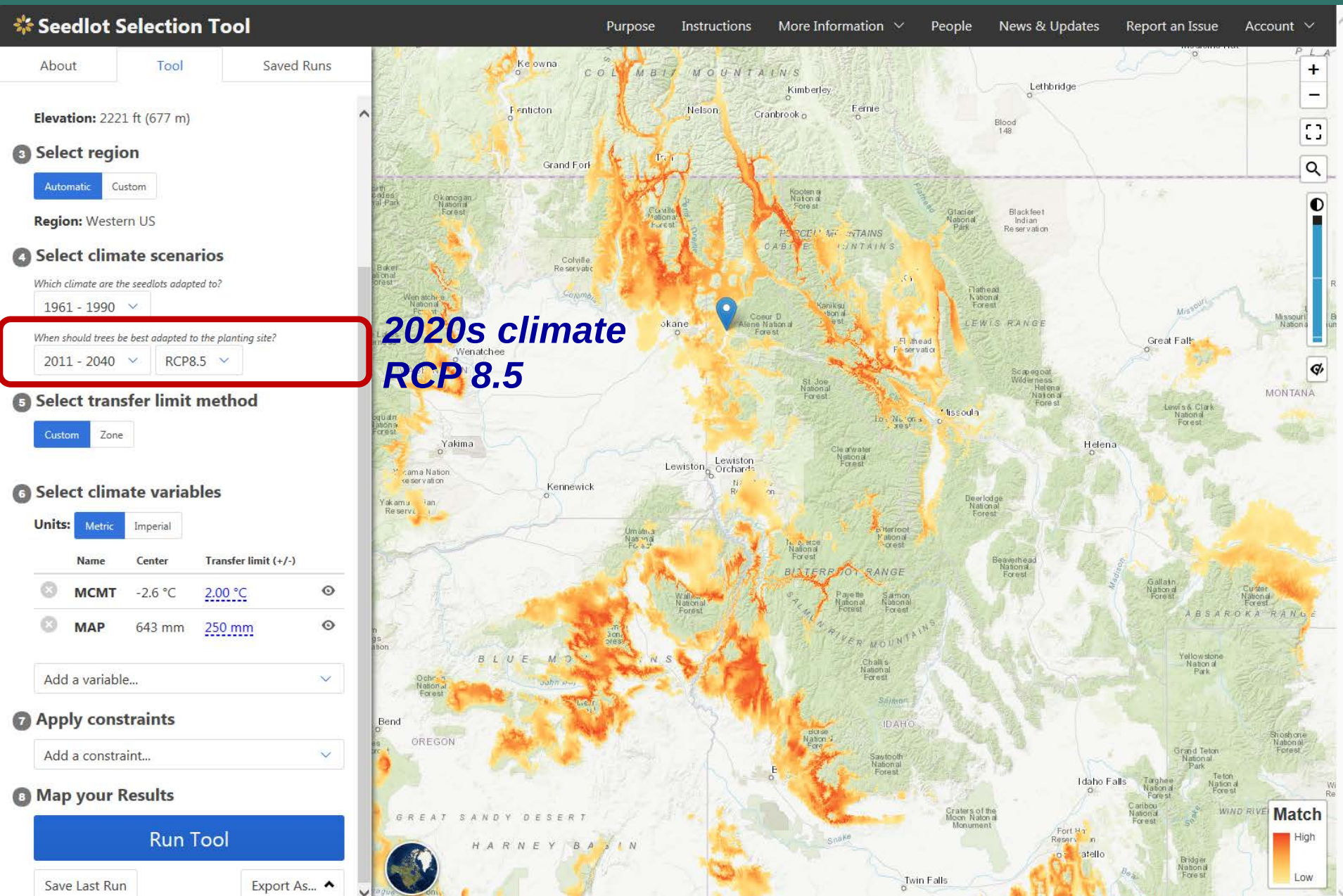
Planting sites for Coeur d'Alene seedlot



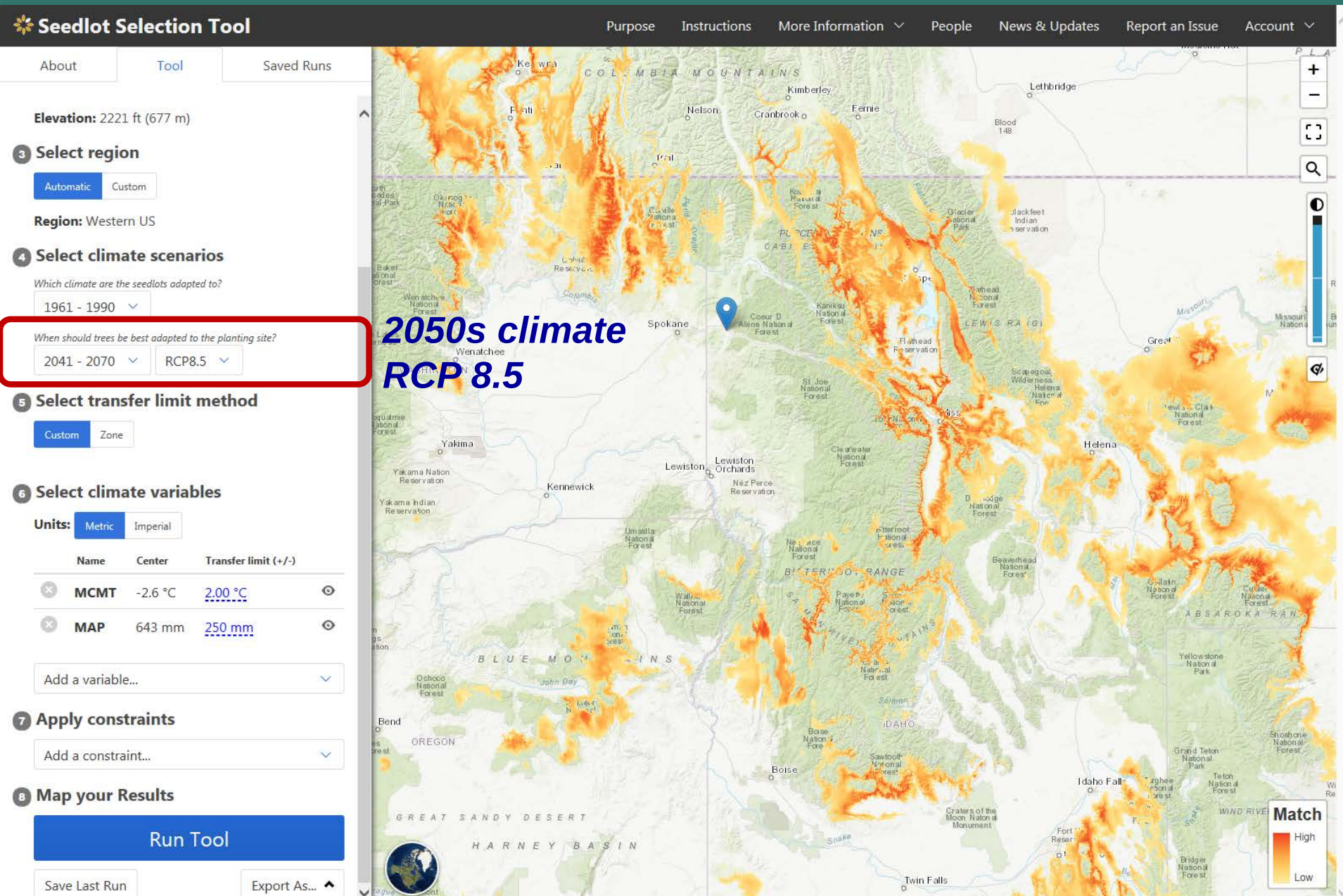
Planting sites for Coeur d'Alene seedlot



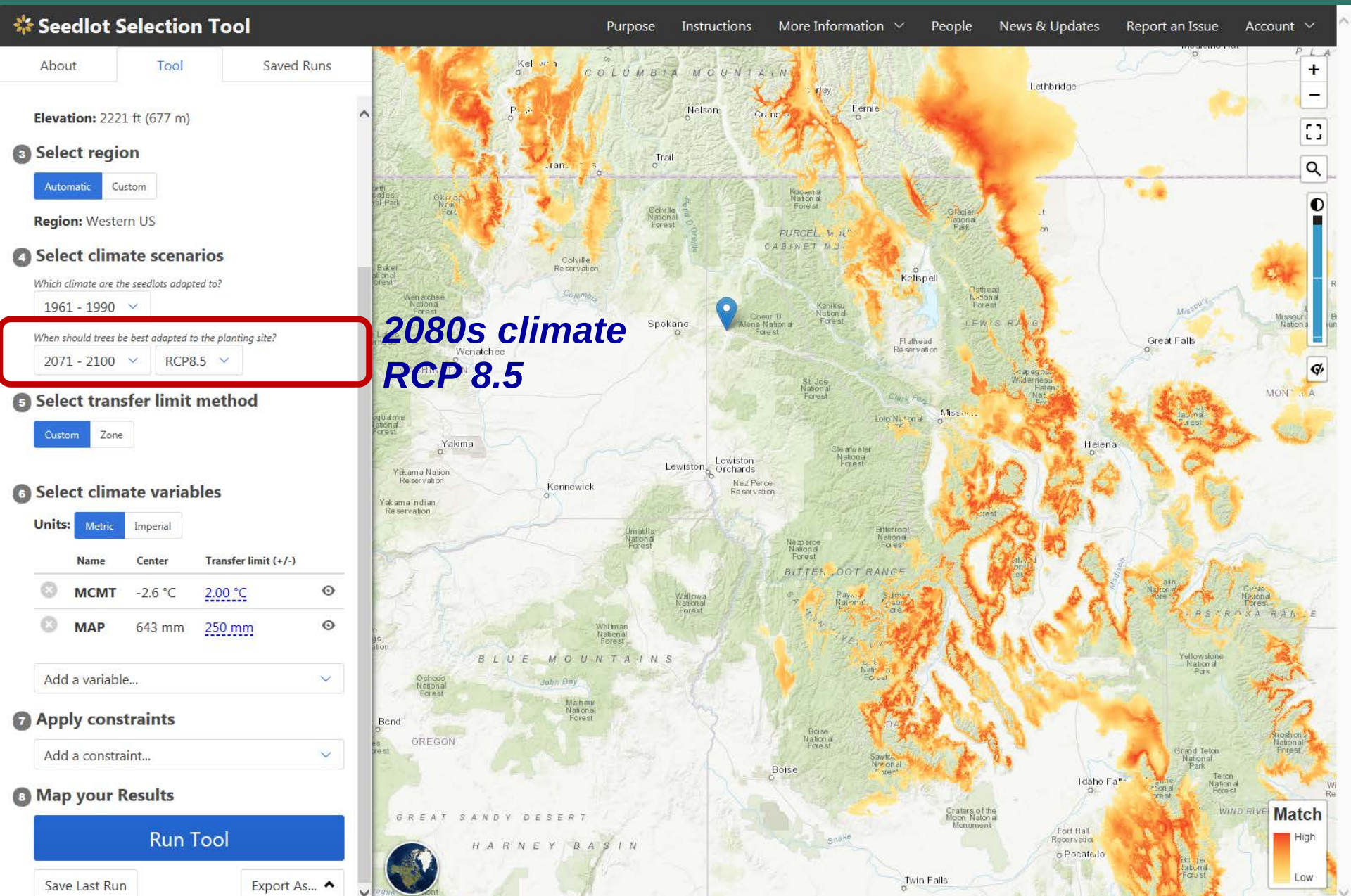
Planting sites for Coeur d'Alene seedlot



Planting sites for Coeur d'Alene seedlot



Planting sites for Coeur d'Alene seedlot



Do we really have to worry about climate change?

1. ***Are native populations adapted to current and future climates?***
2. ***If not, how far do we have to go to find populations adapted to a planting site (assisted migration)?***

- *In the short-term (next decade, maybe two), local populations are adapted to the local climate (within range of current transfer guidelines)*
- *Better-adapted populations may be found at lower elevations or further south*
- *In the long-term (by mid- to late-century), local populations are at high risk of maladaptation to the projected climates*
- *Adapted populations (i.e., from similar climates as present) are found pretty far away, generally far south*
- *In some cases, no analogous climates exist in the future*

"Now, here, you see, it takes all the running you can do, to keep in the same place."

The Red Queen from Lewis Caroll's *Through the Looking-Glass*

Climate change considerations

- *Decisions now may have long-term implications.*
- *Artificial regeneration will be more important in the future because of climate change.*
- *Most critical phase is stand establishment; although climate is a moving target, choose sources adapted to climates of the next 20 yrs.*
- *Large moves are not necessary; move to planting sites that are 2°C cooler than present; within current seed movement guidelines.*
- *Use mixtures of seed sources to account for uncertainty and climate change over the life of a stand.*
- *Seed zones and seed movement guidelines should be based on climate rather than geography; bulked over a smaller climatic range.*
- *Consider gene conservation activities to conserve populations.*
- *Research is important, but lack of knowledge is not an excuse for inaction.*

Summary

- *Powerful tool to explore where climates occur now and how those change in the future*
- *Allows user to determine appropriate seedlots or populations for reforestation or restoration*
- *Allows users to explore different assumptions*
  - *Climate variables important for adaptation for species of interest*
  - *Appropriate transfer limits for species of interest -- as well as risk level of user*
  - *Time periods of concern for adaptation*
  - *Future emission pathways*
- *Tool is only as good as the knowledge behind it*
  - *Climate interpolation*
  - *Climate change scenarios*
  - *How species are adapted to their environments*

People and funding

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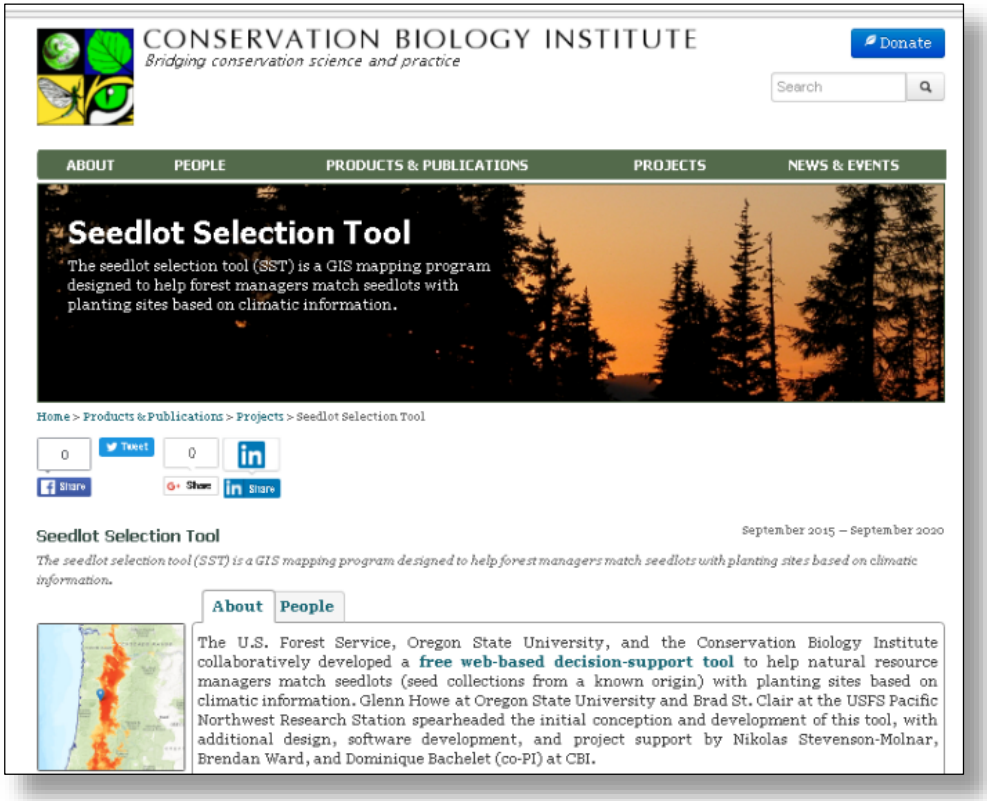


consbio.org/products/webinars/climate-smart-seedlot-selection-tool

OSU Oregon State

USDA United States Department of Agriculture
Northwest Climate Hub

“There are risks and costs to a program of action. But they are far less than the long range risks and costs of comfortable inaction.”

- John F. Kennedy

Questions
https://seedlotselectiontool.org/sst/

Gene conservation: Chihuahuan spruce

Seedlot Selection Tool

Purpose | Instructions | More Information | People | News & Updates | Report an Issue | bstclair@fs.f...

About | Tool | Saved Runs

1 Select objective

Find seedlots | Find planting sites

2 Select seedlot location

Locate your seedlot (its climatic center)
Use the map or enter coordinates

Lat: 23.6622 Lon: -105.4389

3 Select climate scenarios

Which climate are the seedlots adapted to?

1961 - 1990

When should trees be best adapted to the planting site?

1961 - 1990

4 Select transfer limit method

Custom | Zone

5 Select climate variables

Units: Metric | Imperial

	Name	Center	Transfer limit (+/-)	
×	MCMT	6.6 °C	1.50 °C	
×	MAP	1310 mm	500 mm	

Add a variable...

6 Map your Results

Run Tool

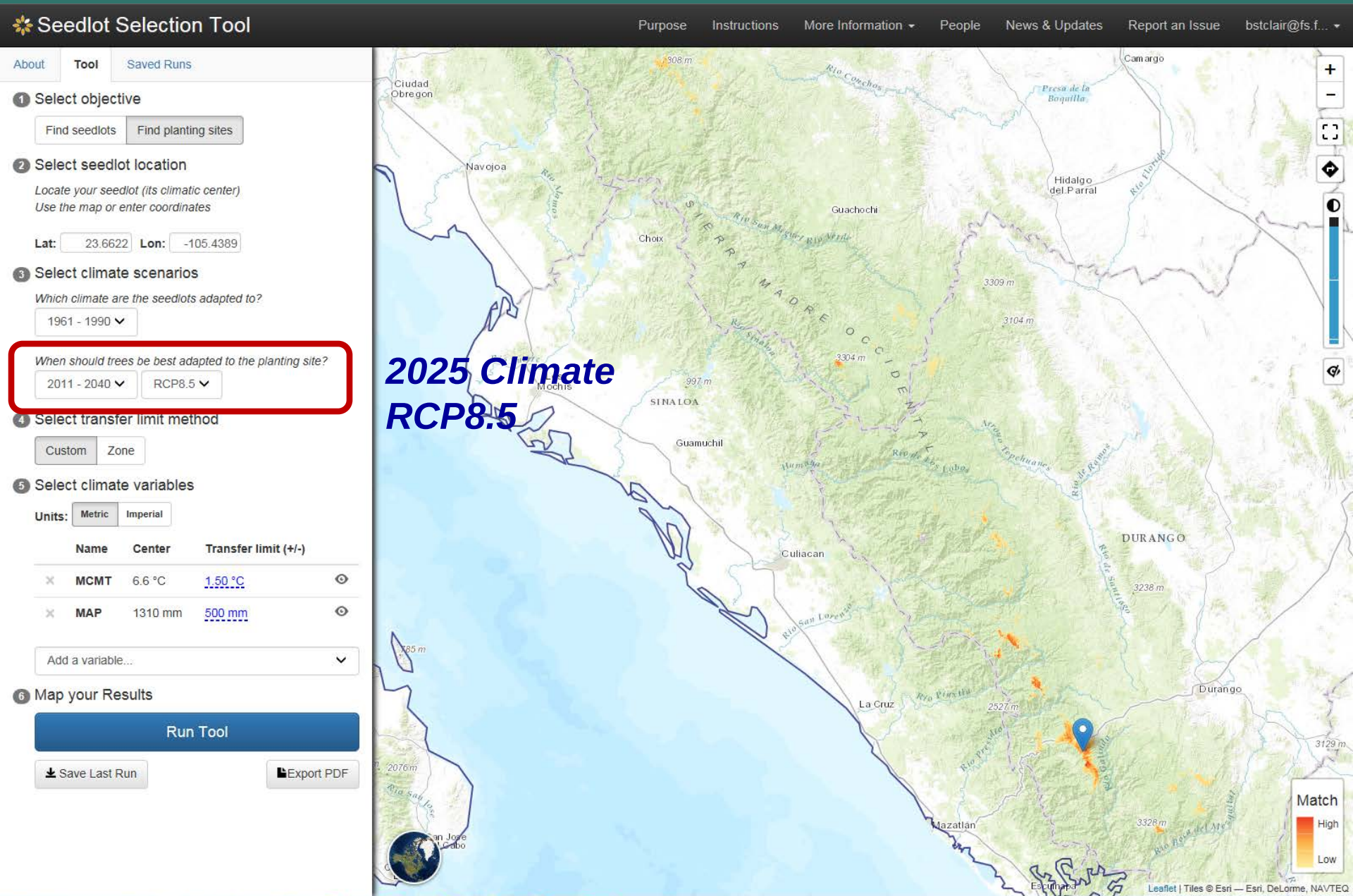
Save Last Run | Export PDF

- ***What happens to climate of native stand?***
- ***Where could we establish an ex situ planting for gene conservation?***

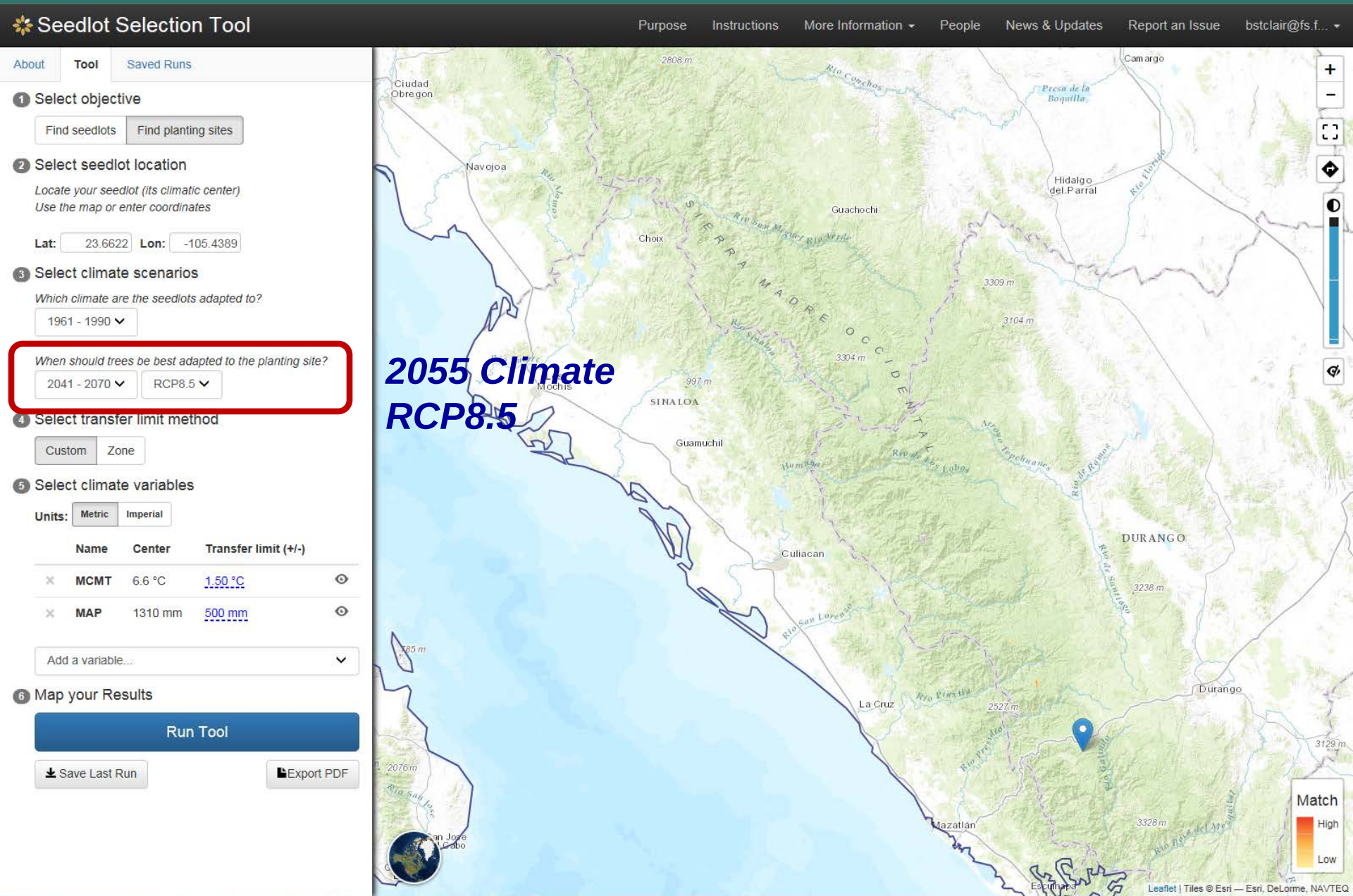
Match: High – Low

Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ

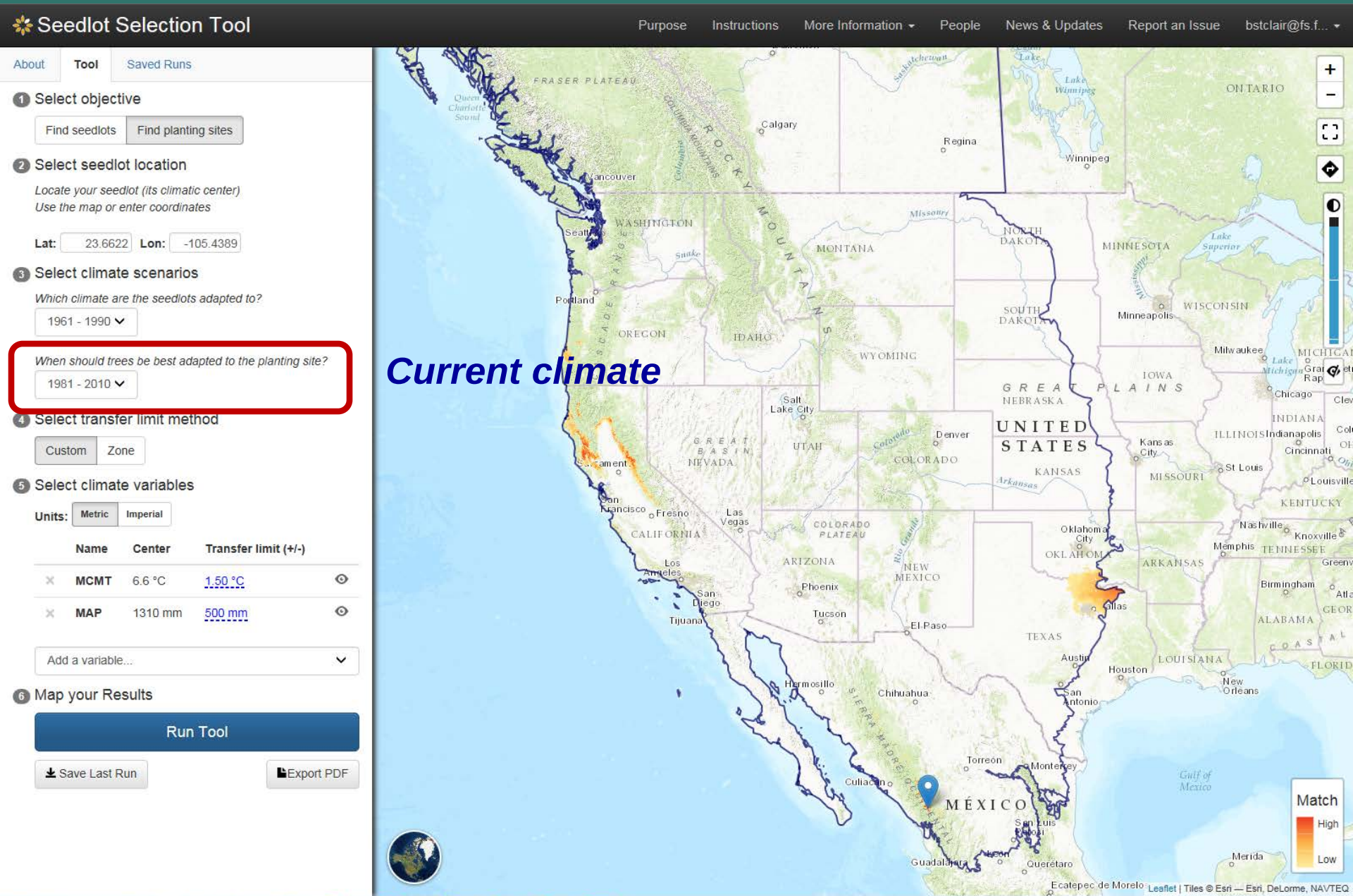
Locations of climate in 2025 + RCP8.5



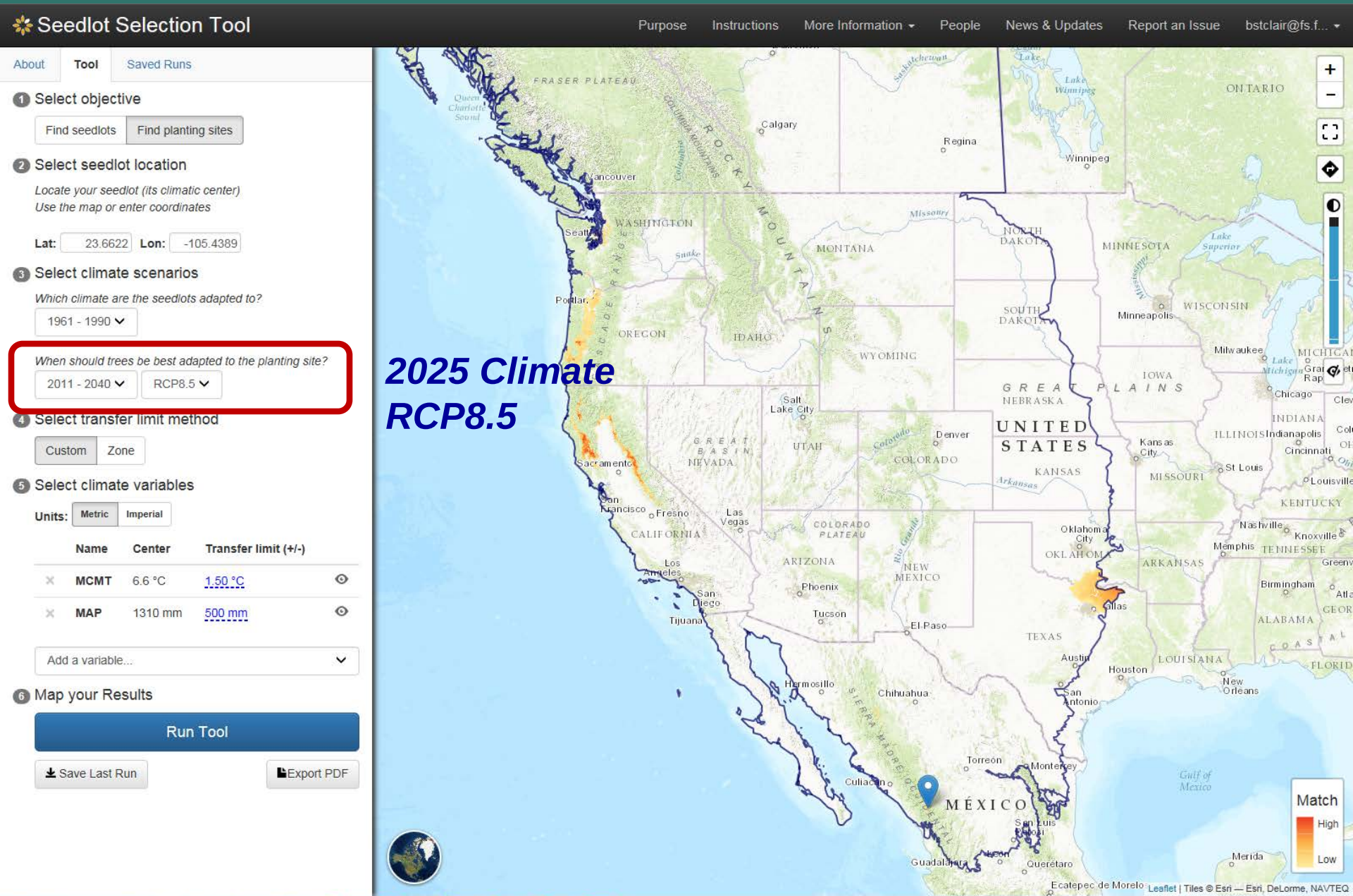
Climate space disappears by mid-century

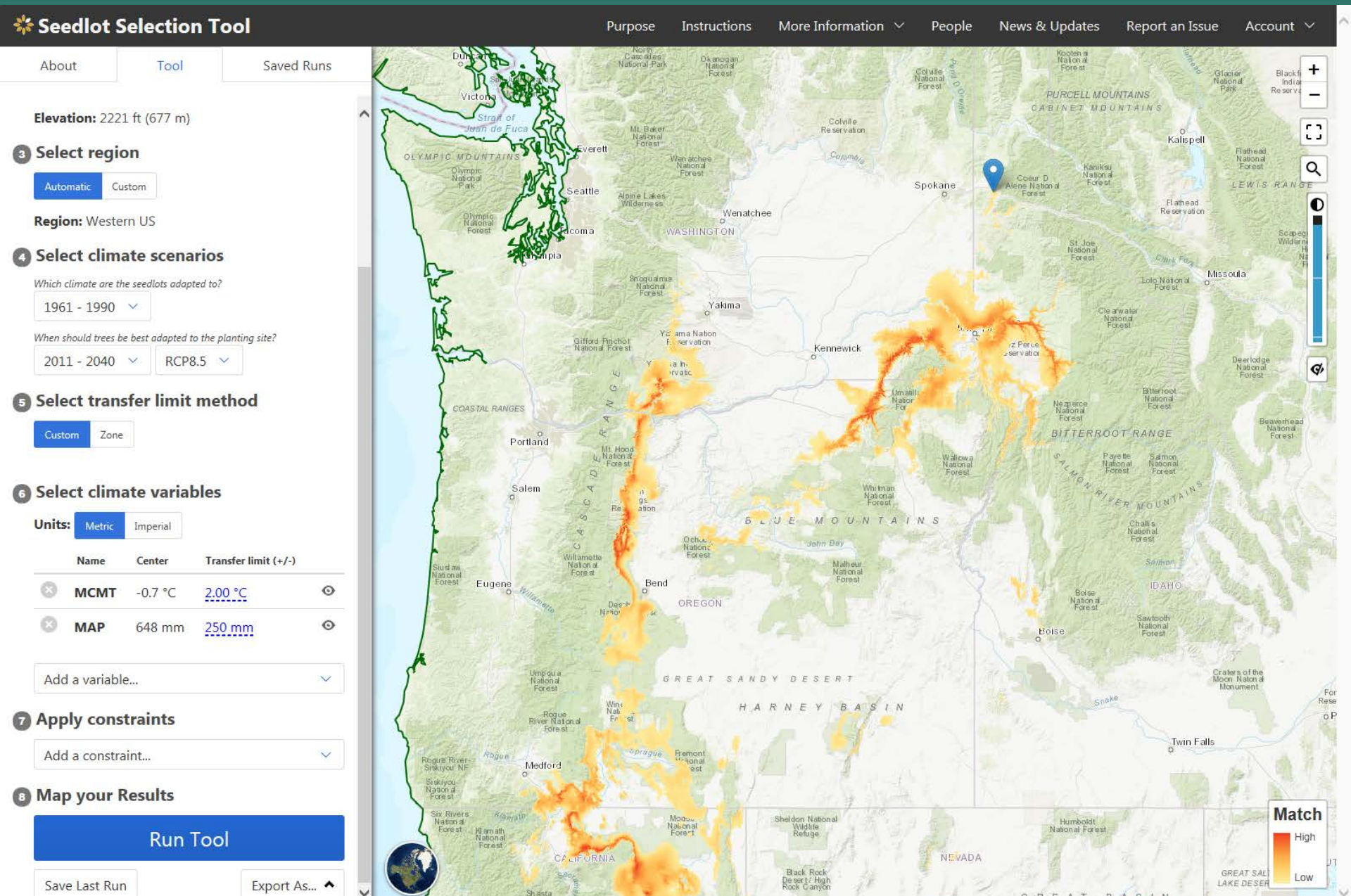


But occurs in CA and OR now…



… and in the future




Seedlot Selection Tool
Purpose
Instructions
More Information
People
News & Updates
Report an Issue
Account
About
Tool
Saved Runs
Elevation: 2221 ft (677 m)
3 Select region
Automatic
Custom
Region: Western US
4 Select climate scenarios
Which climate are the seedlots adapted to?
1961 - 1990
When should trees be best adapted to the planting site?
2011 - 2040
RCP8.5
5 Select transfer limit method
Custom
Zone
6 Select climate variables
Units:
Metric
Imperial
Name
Center
Transfer limit (+/-)
MCMT
-0.7 °C
2.00 °C
MAP
648 mm
250 mm
Add a variable...
7 Apply constraints
Add a constraint...
8 Map your Results
Run Tool
Save Last Run
Export As...
Match
High
Low
Seattle
Spokane
Portland
Salem
Eugene
Bend
Medford
Boise
Twin Falls
Kennewick
Yakima
Wenatchee
Everett
Missoula
Kalispell
OREGON
WASHINGTON
IDAHO
NEVADA
CALIFORNIA
BLUE MOUNTAINS
BITTERROOT RANGE
COASTAL RANGES
OLYMPIC MOUNTAINS
PURCELL MOUNTAINS
GREAT SANDY DESERT
HARNEY BASIN

About | Tool | Saved Runs

Elevation: 2221 ft (677 m)

3 Select region

Automatic | Custom

Region: Western US

4 Select climate scenarios

Which climate are the seedlots adapted to?

1961 - 1990

When should trees be best adapted to the planting site?

1981 - 2010

5 Select transfer limit method

Custom | Zone

6 Select climate variables

Units: Metric | Imperial

	Name	Center	Transfer limit (+/-)	
⊗	**MCMT**	-1.3 °C	2.00 °C	👁
⊗	**MAP**	660 mm	250 mm	👁

Add a variable...

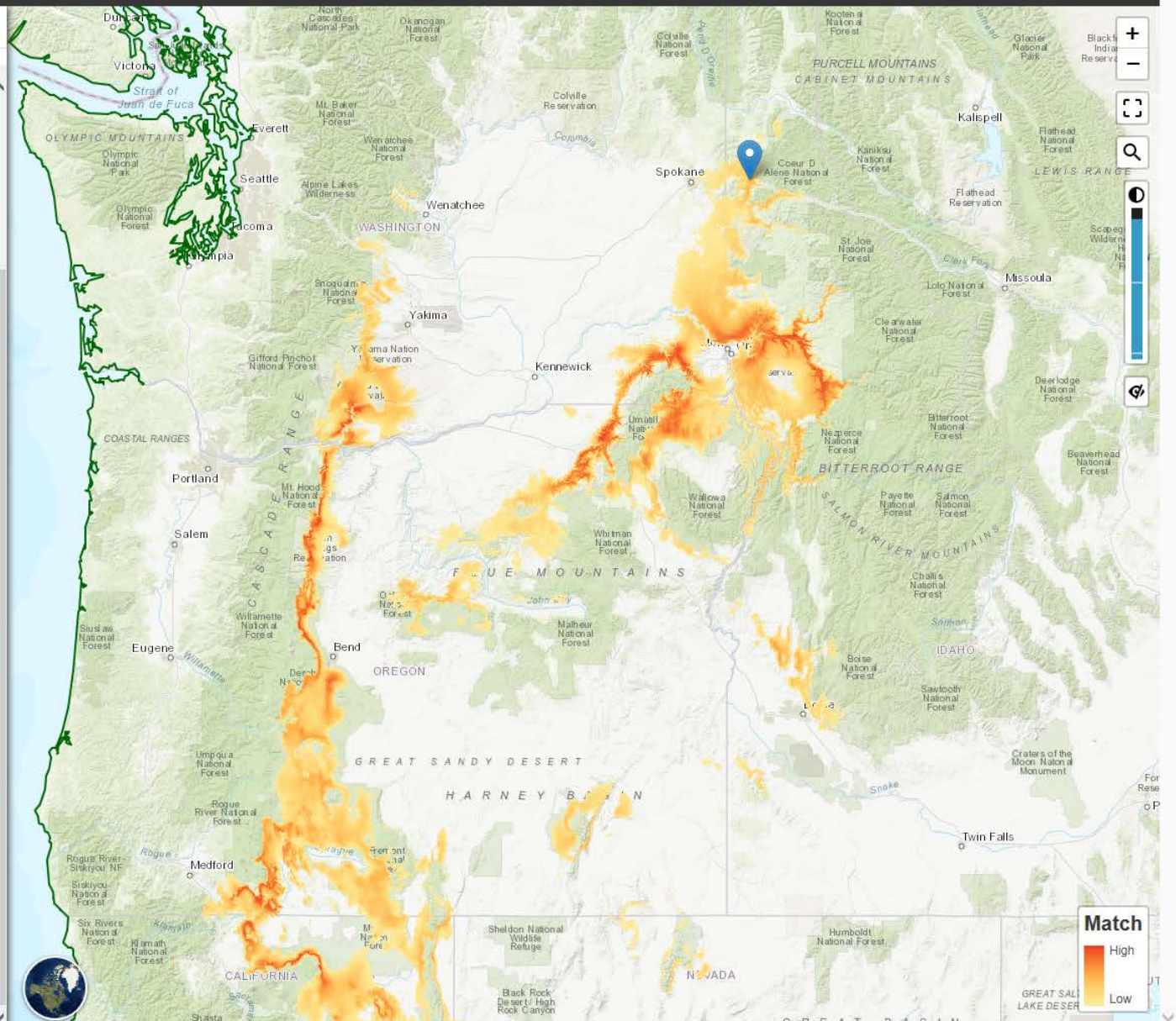
7 Apply constraints

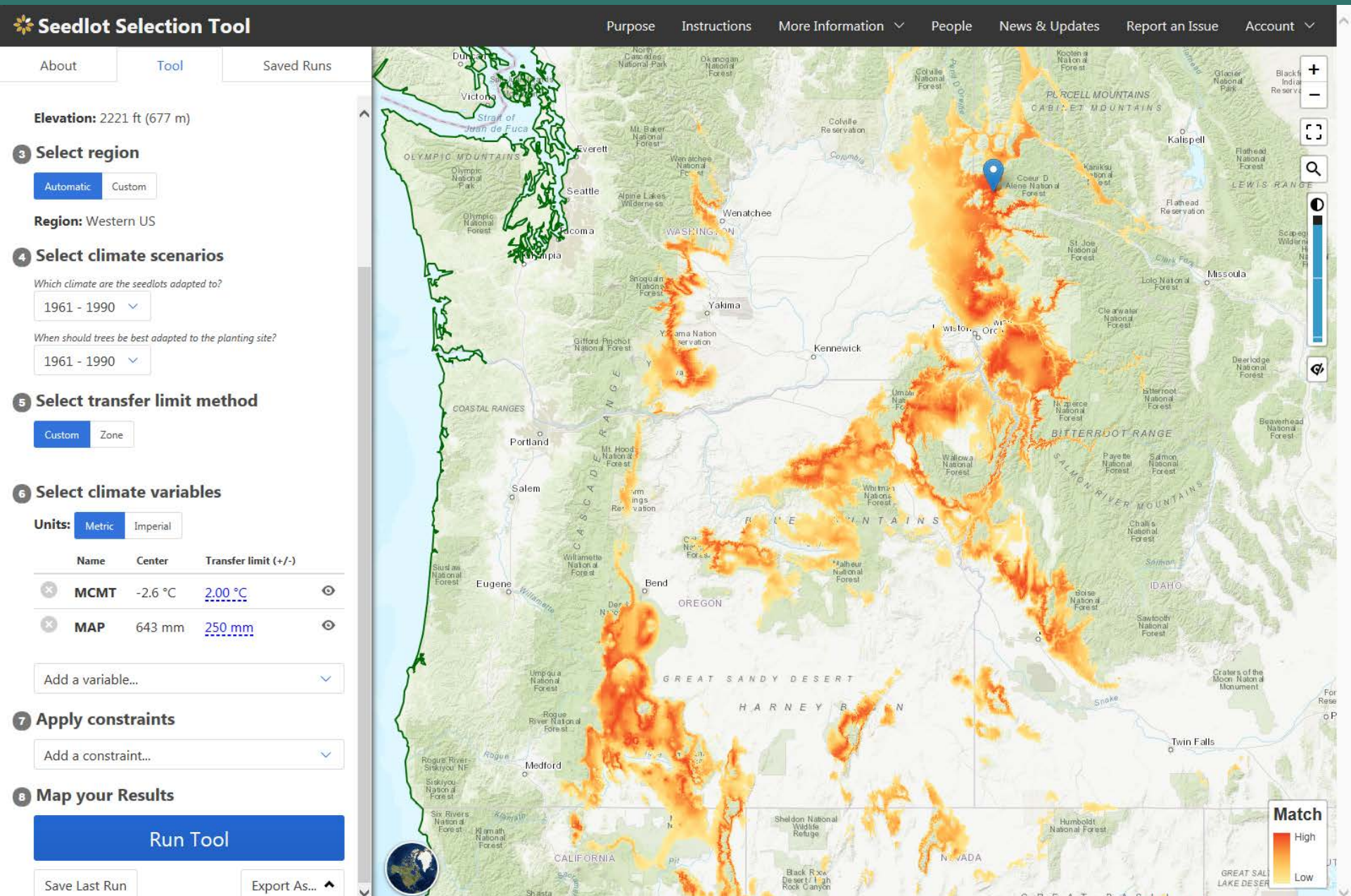
Add a constraint...

8 Map your Results

Run Tool

Save Last Run | Export As...




Seedlot Selection Tool
Purpose
Instructions
More Information
People
News & Updates
Report an Issue
Account
About
Tool
Saved Runs
Elevation: 2221 ft (677 m)
3 Select region
Automatic
Custom
Region: Western US
4 Select climate scenarios
Which climate are the seedlots adapted to?
1961 - 1990
When should trees be best adapted to the planting site?
1961 - 1990
5 Select transfer limit method
Custom
Zone
6 Select climate variables
Units: Metric Imperial
Name Center Transfer limit (+/-)
MCMT -2.6 °C 2.00 °C
MAP 643 mm 250 mm
Add a variable...
7 Apply constraints
Add a constraint...
8 Map your Results
Run Tool
Save Last Run
Export As...
Match
High
Low
Victoria
Everett
Seattle
Tacoma
Olympia
Wenatchee
Yakima
Kennewick
Portland
Salem
Eugene
Bend
Medford
Kalispell
Missoula
Twin Falls
OLYMPIC MOUNTAINS
COASTAL RANGES
BITTERROOT RANGE
GREAT SANDY DESERT
HARNEY BASIN
OREGON
IDAHO
CALIFORNIA
NEVADA

Seedlots for planting site in Oregon Cascades

Seedlot Selection Tool

Purpose | Instructions | More Information | People | News & Updates | Report an Issue | Account

About | Tool | Saved Runs

1 Select objective

Find seedlots | Find planting sites

2 Select planting site location

Locate your planting site
Use the map or enter coordinates

Lat: 44.4259 **Lon:** -122.3328

Elevation: 3002 ft

3 Select climate scenarios

Which climate are the seedlots adapted to?

1961 - 1990

When should trees be best adapted to the planting site?

1961 - 1990

4 Select transfer limit method

Custom | Zone

5 Select climate variables

Units: Metric | Imperial

Add a variable...

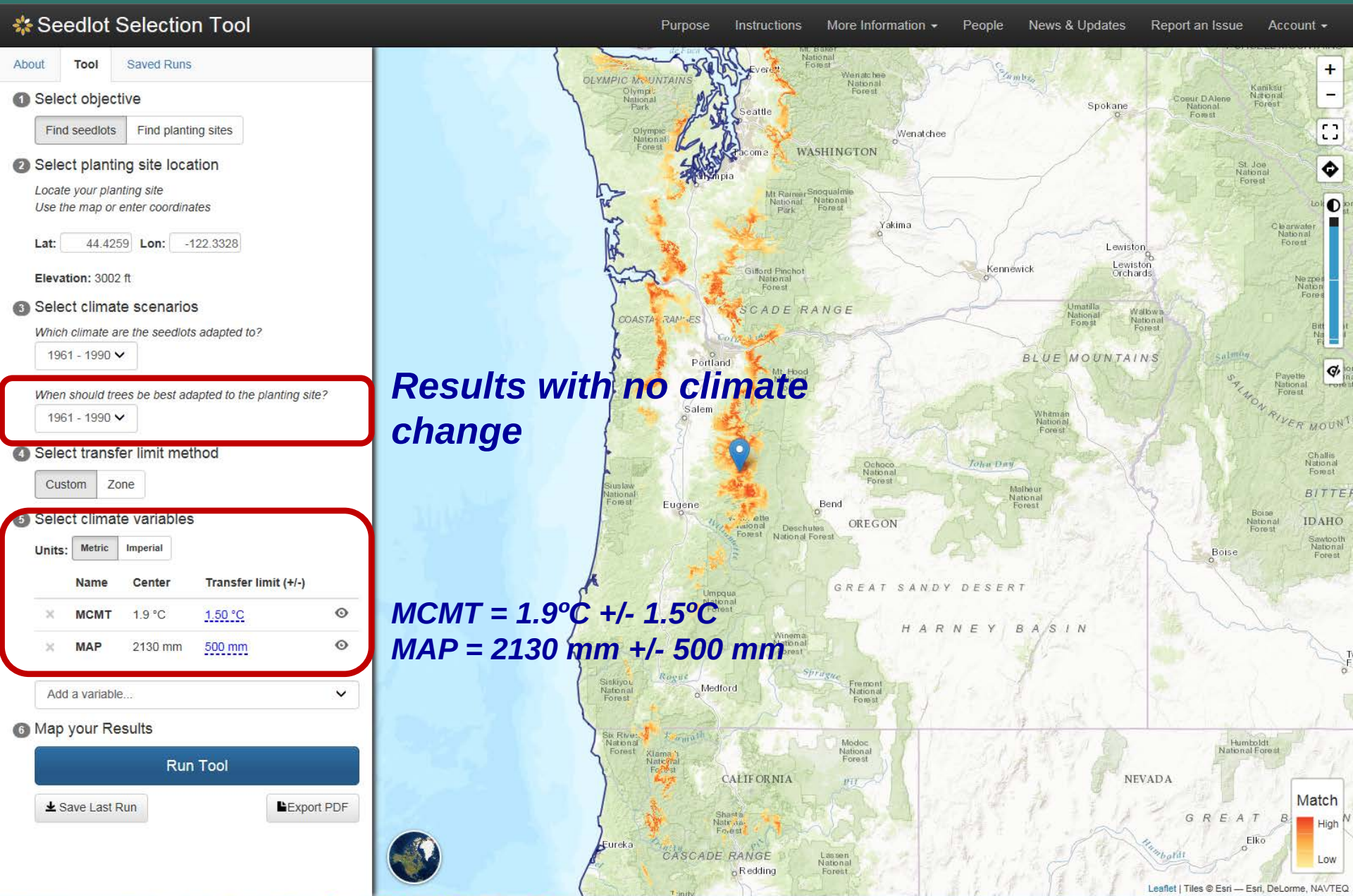
6 Map your Results

Run Tool

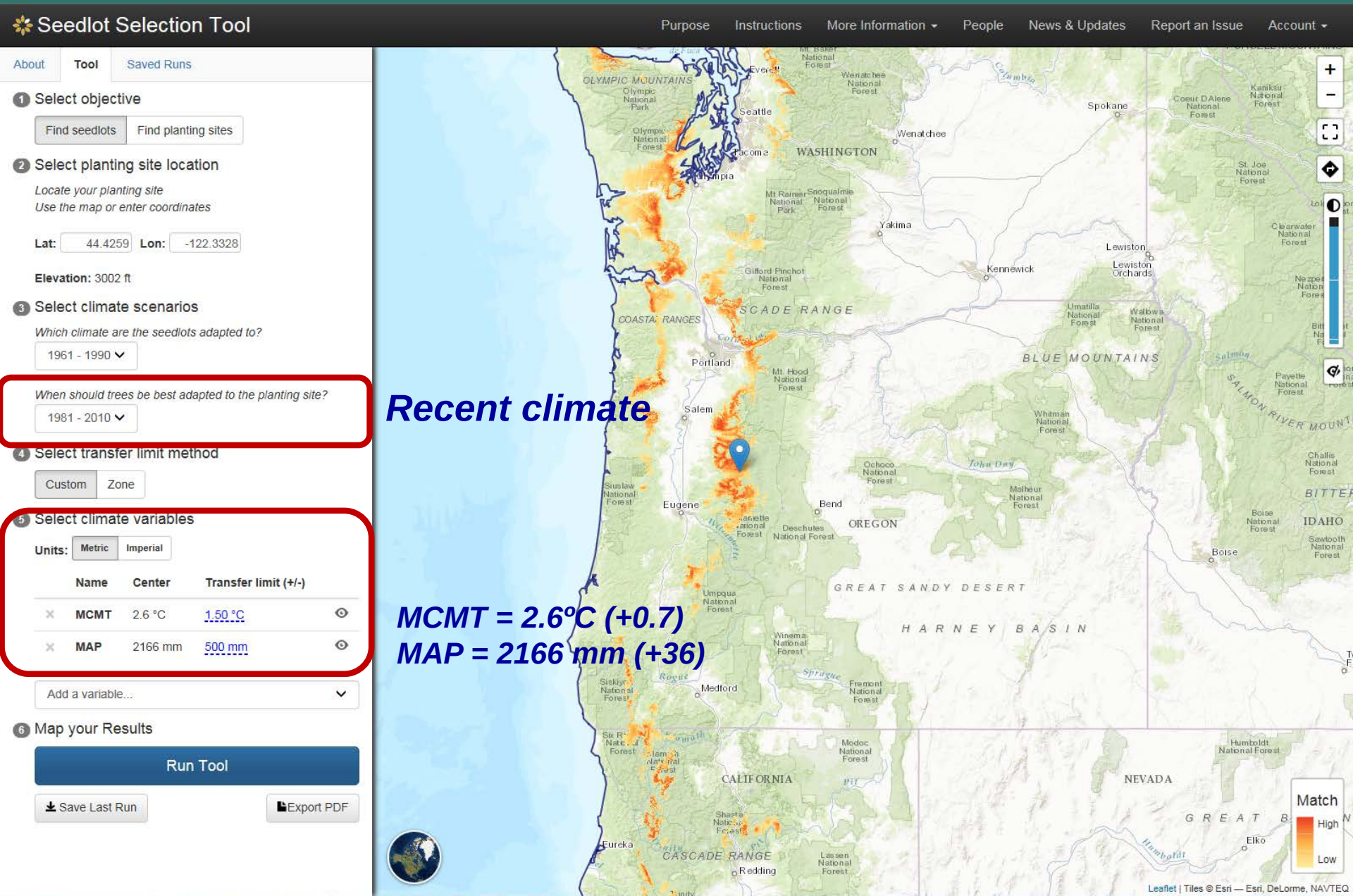
Save Last Run | Export PDF

Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ

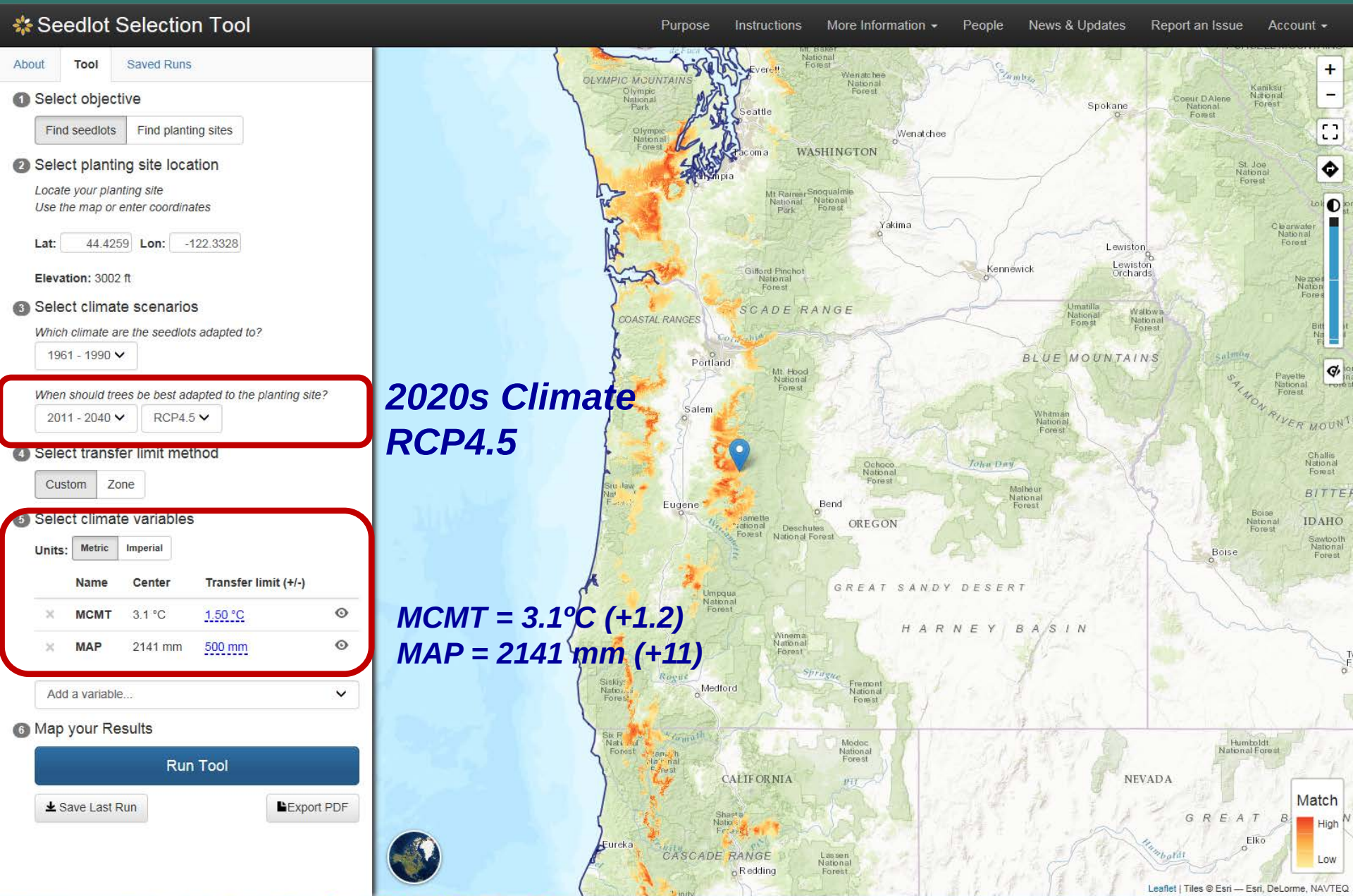
Seedlots for planting site in Oregon Cascades



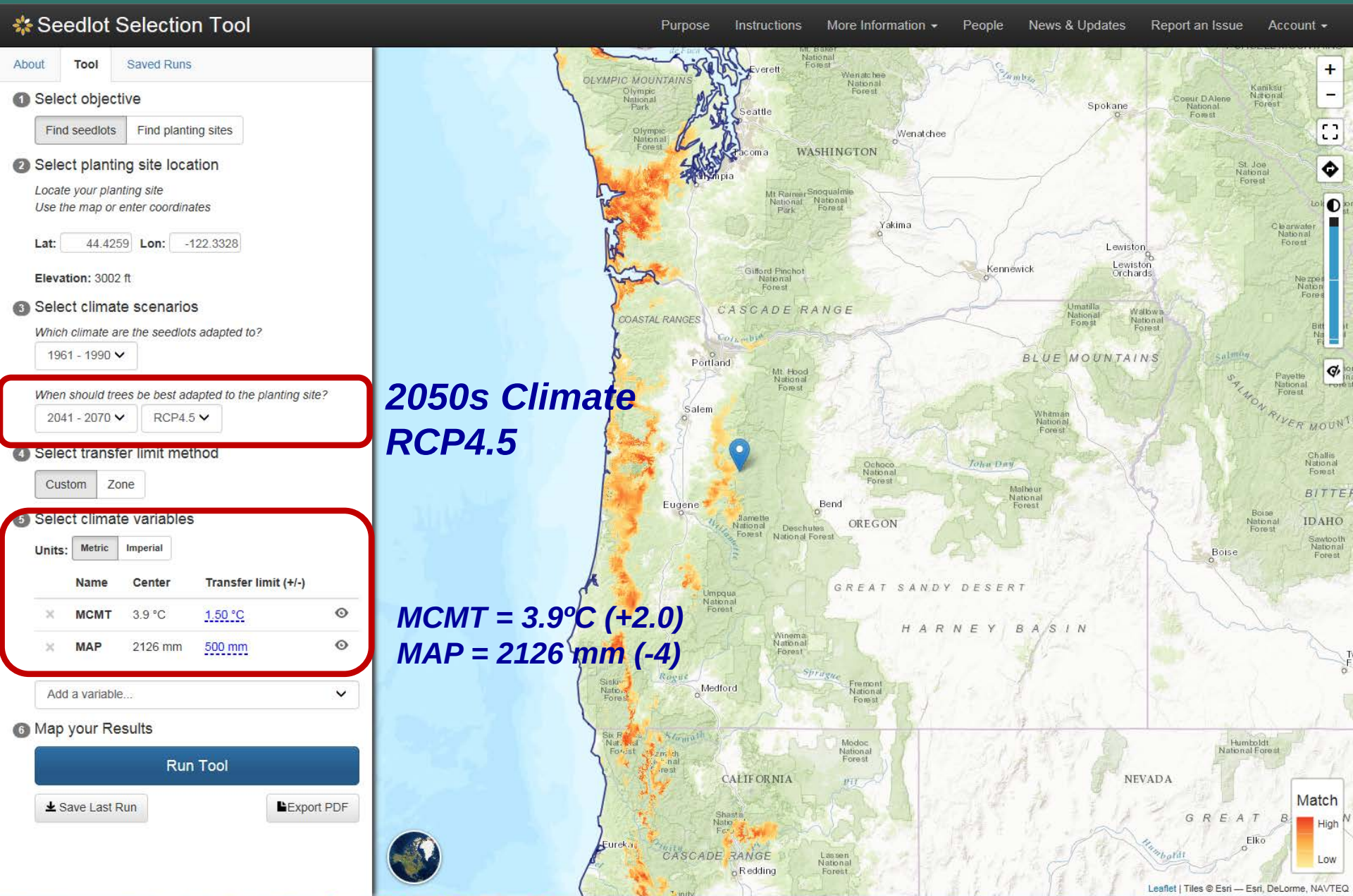
Seedlots for planting site – Recent climate



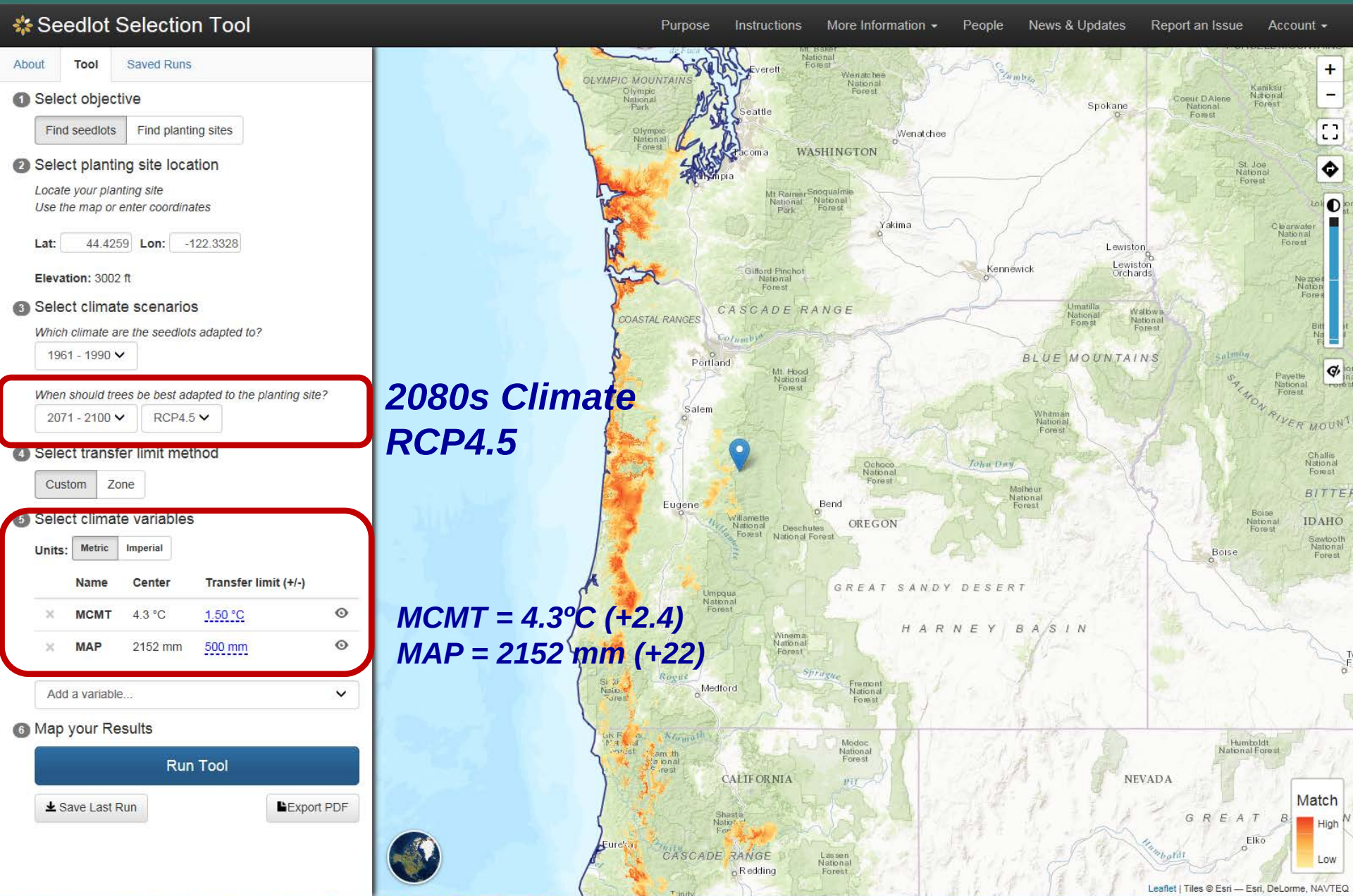
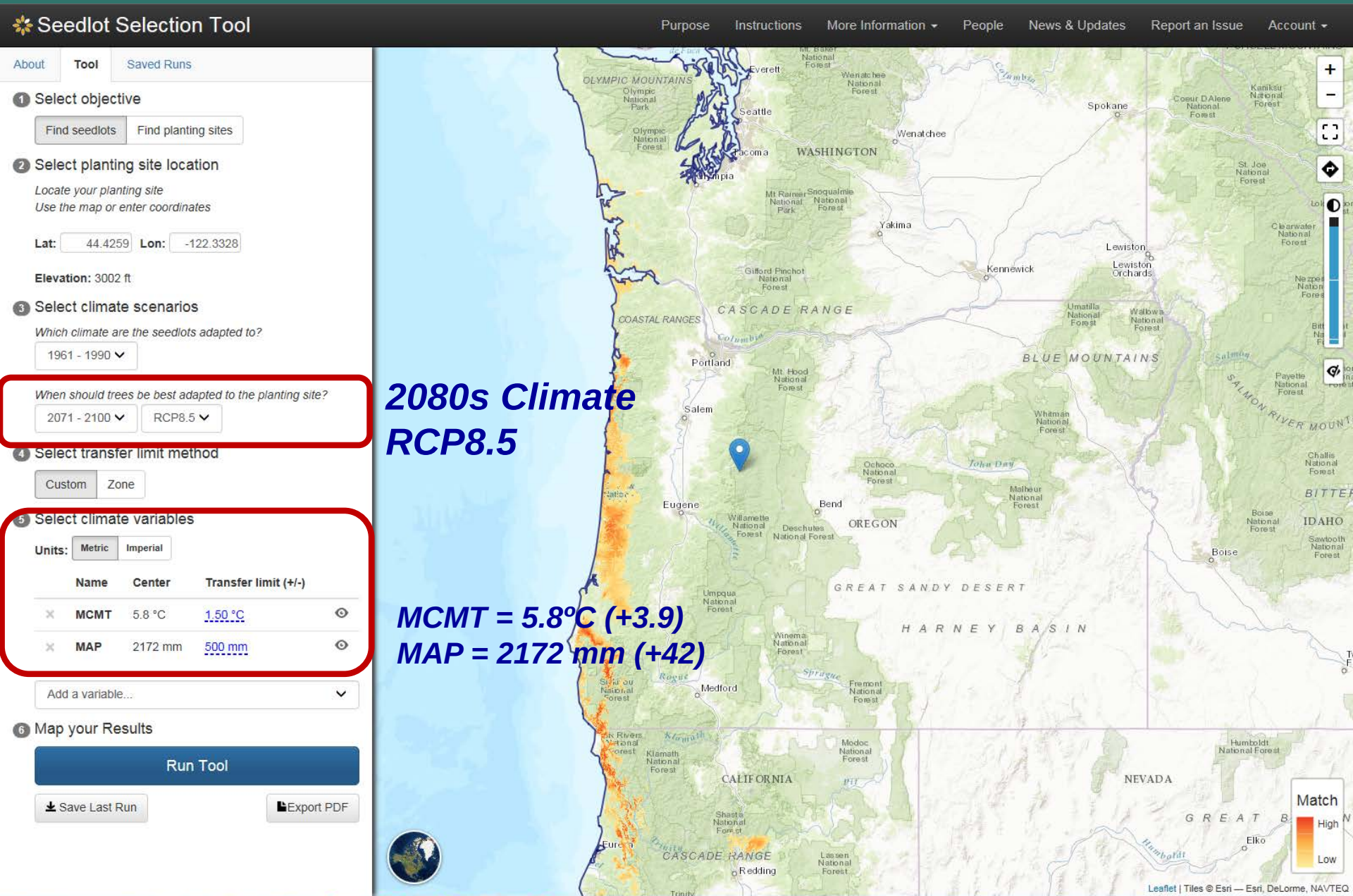
Seedlots for planting site – 2020s + RCP4.5



Seedlots for planting site – 2050s + RCP4.5



Seedlots for planting site – 2080s + RCP4.5



Seedlots for planting site – 2080s + RCP8.5