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Climate-Smart Irrigation Strategies

to Sustainably Maximize Potato Yield in Rain-Fed Agriculture:

A Case Study in Prince Edward Island, Canada

ASABE AIM 2025 - Toronto, Canada
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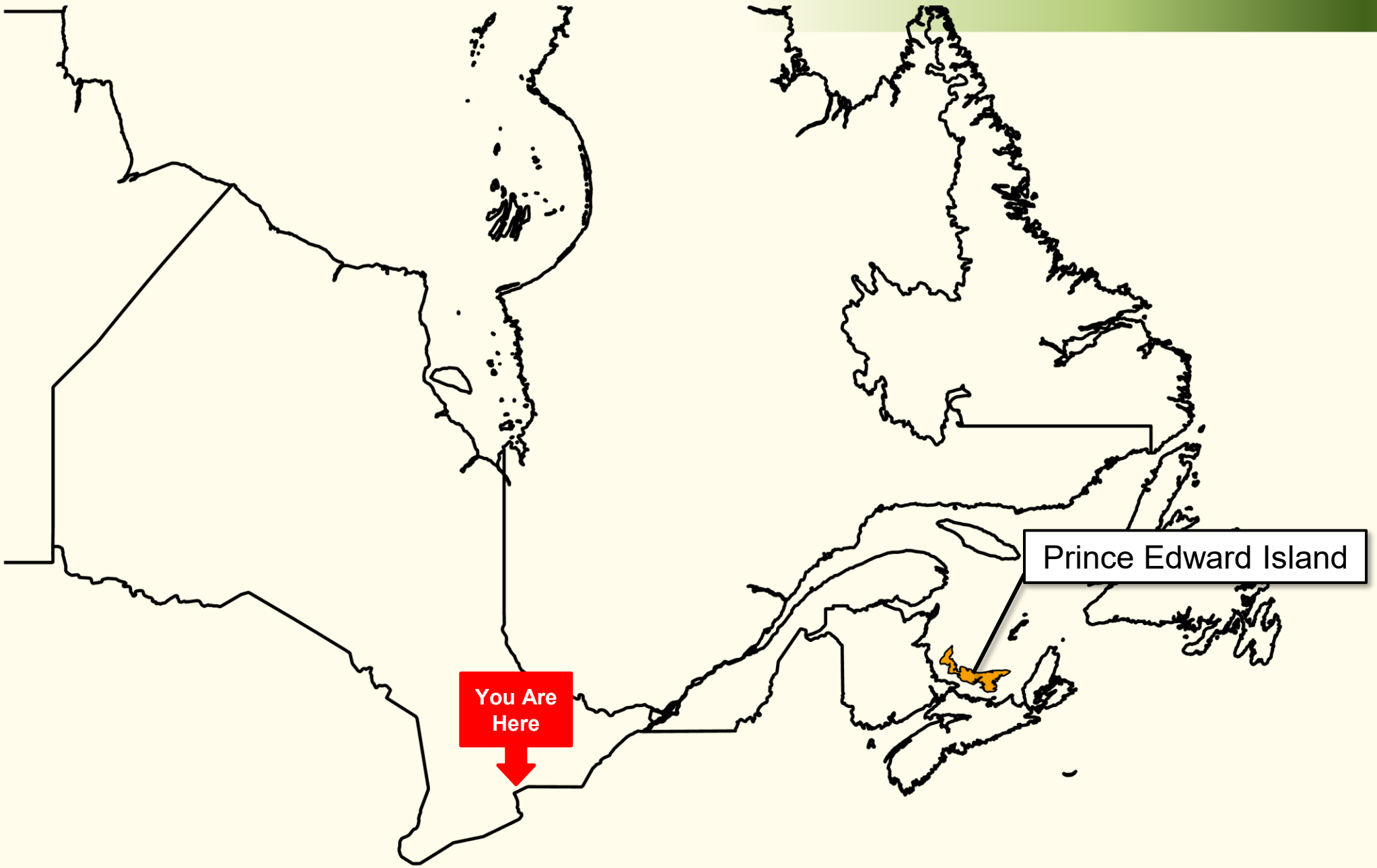

Prince Edward Island
You Are Here

Potato Production in Prince Edward Island

20.4%

of Canada's Potato Production

15.7%

of all land area

89%

of total exported agrifood products

$1.35 B

Economic impact

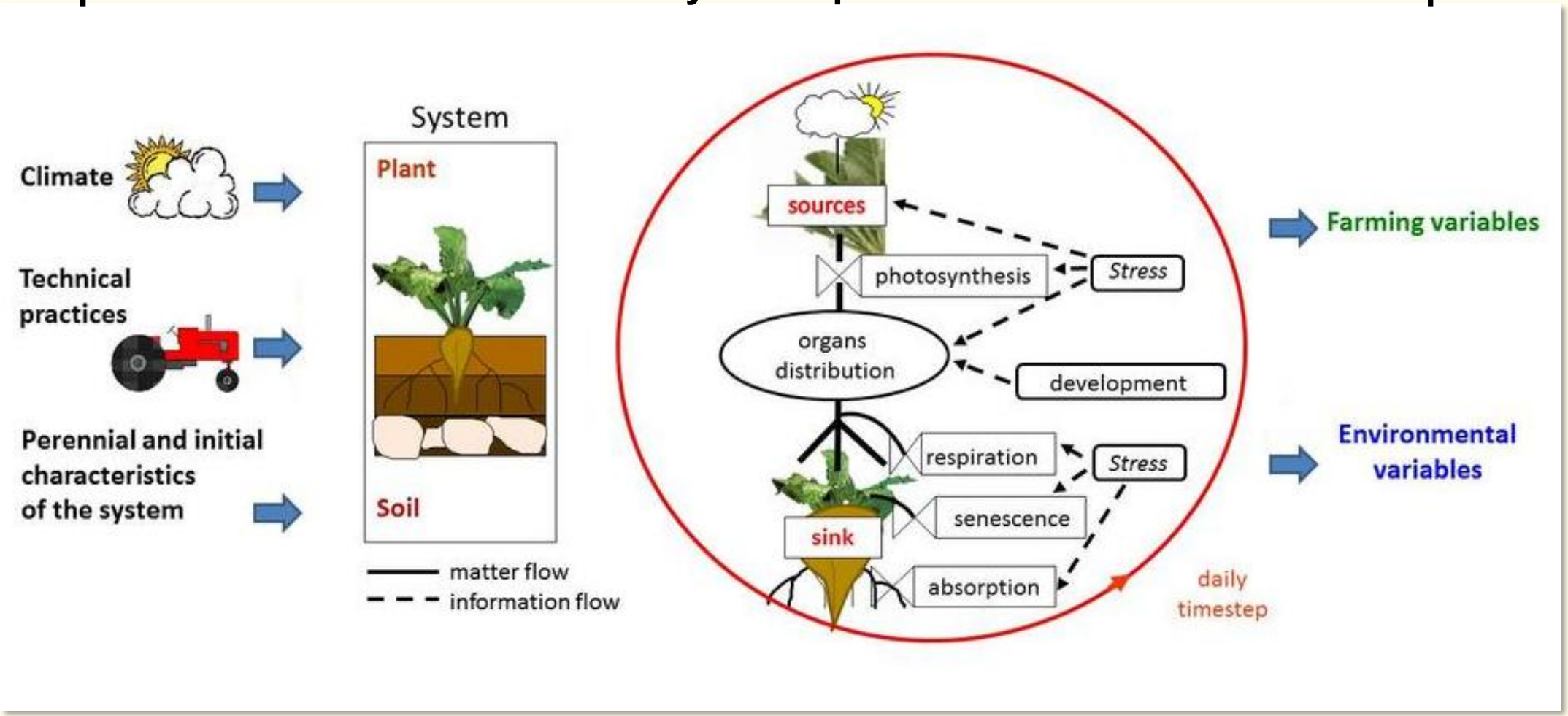
2020 Drought

12.8%

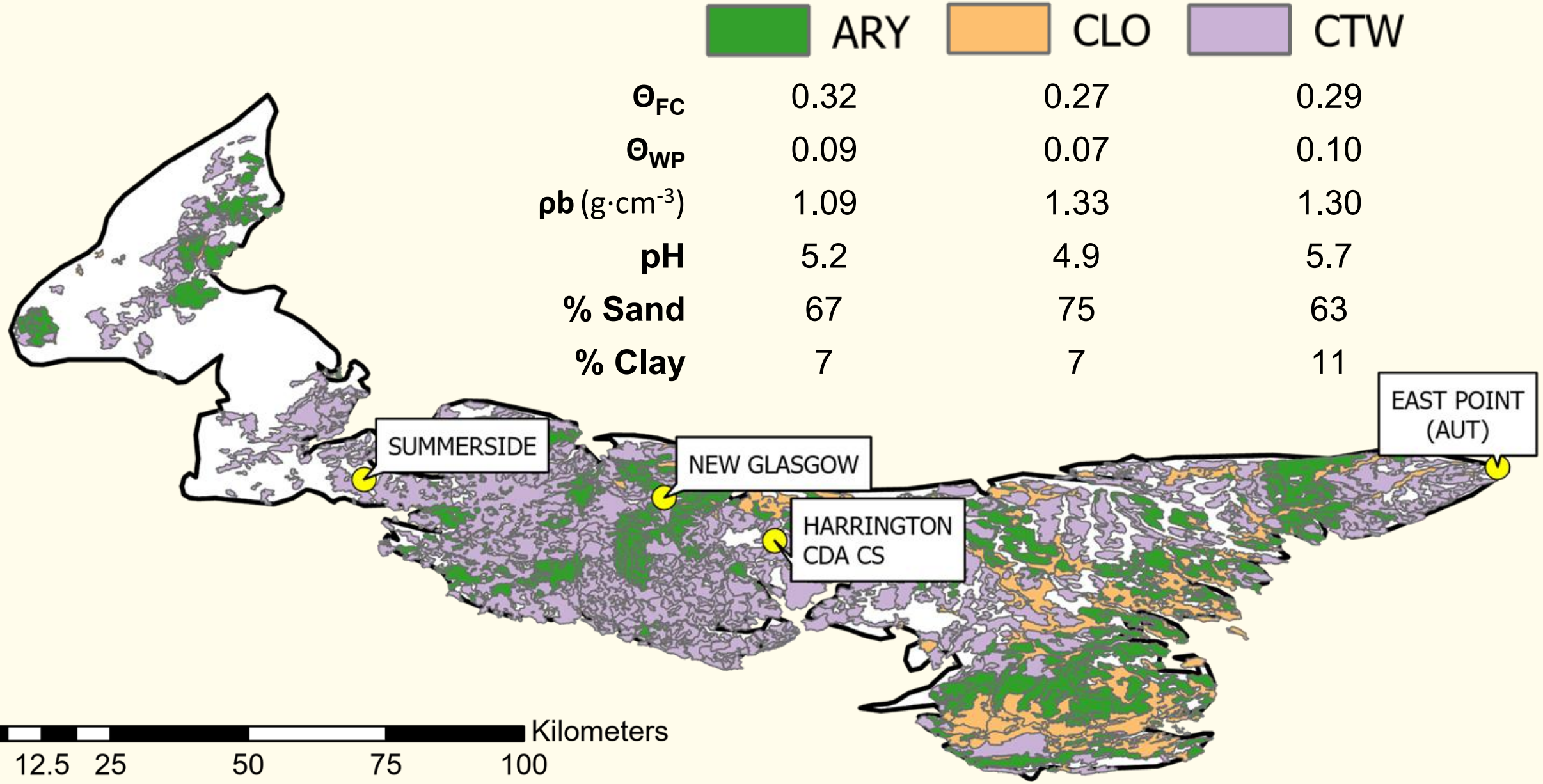
decrease in average provincial yield from 2019

STICS Crop Model

Simulateur mulTIdisciplinaire pour les Cultures Standard / Multidisciplinary Simulator for Standard Crops

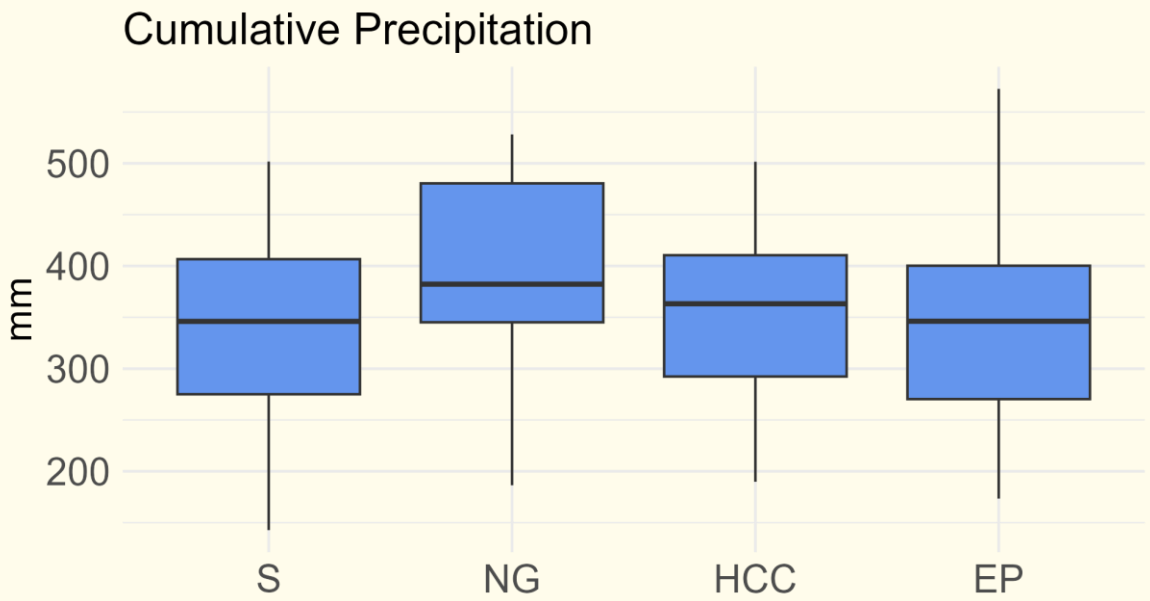


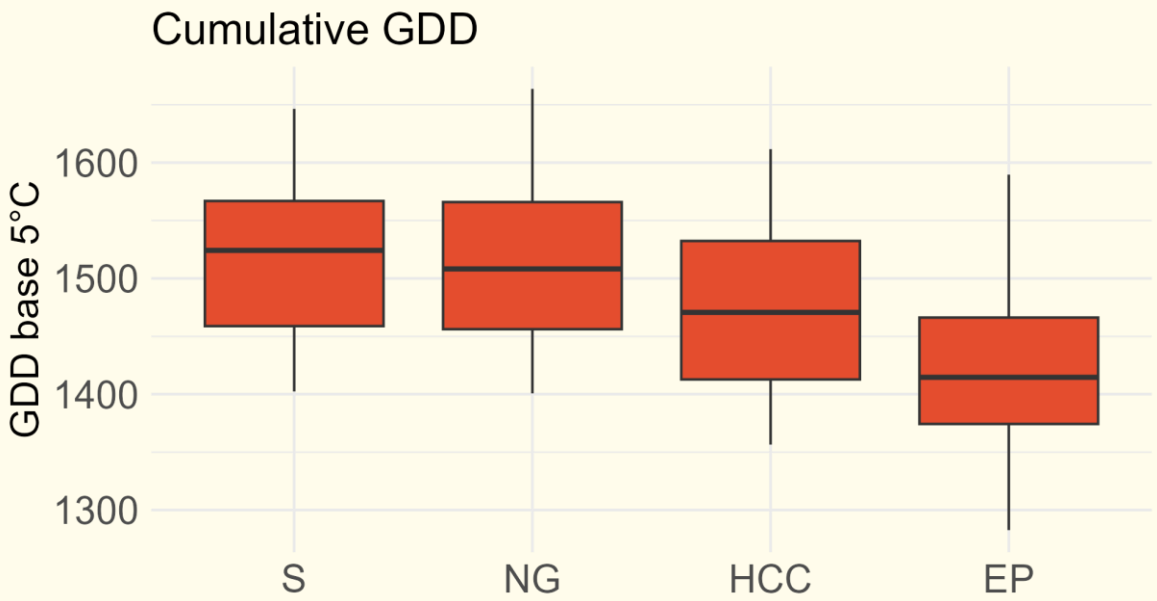
Brisson et al., 2003, Morisette et al., 2016

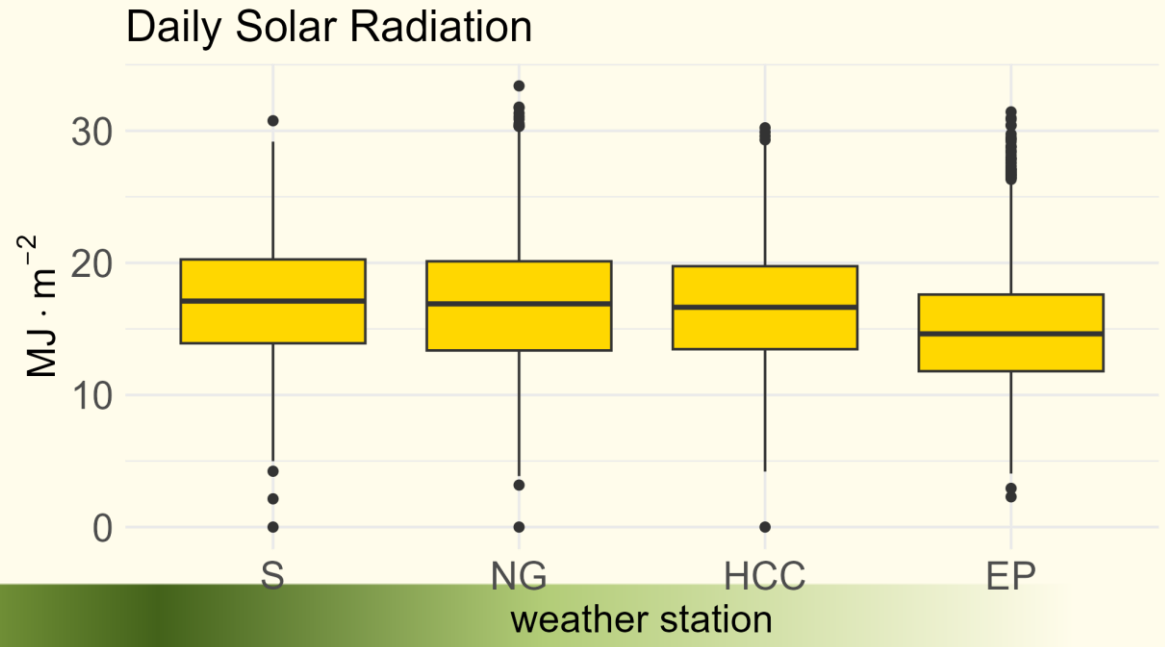


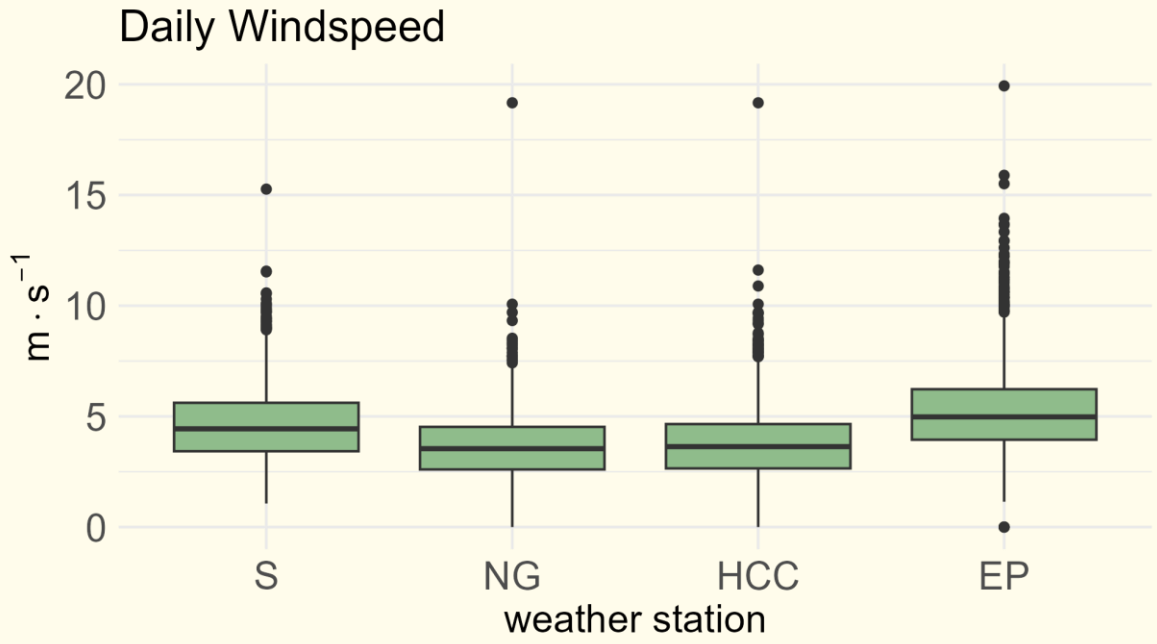
	ARY	CLO	CTW
Θ_{FC}	0.32	0.27	0.29
Θ_{WP}	0.09	0.07	0.10
ρb ($g \cdot cm^{-3}$)	1.09	1.33	1.30
pH	5.2	4.9	5.7
% Sand	67	75	63
% Clay	7	7	11

Growing Season Climate Means

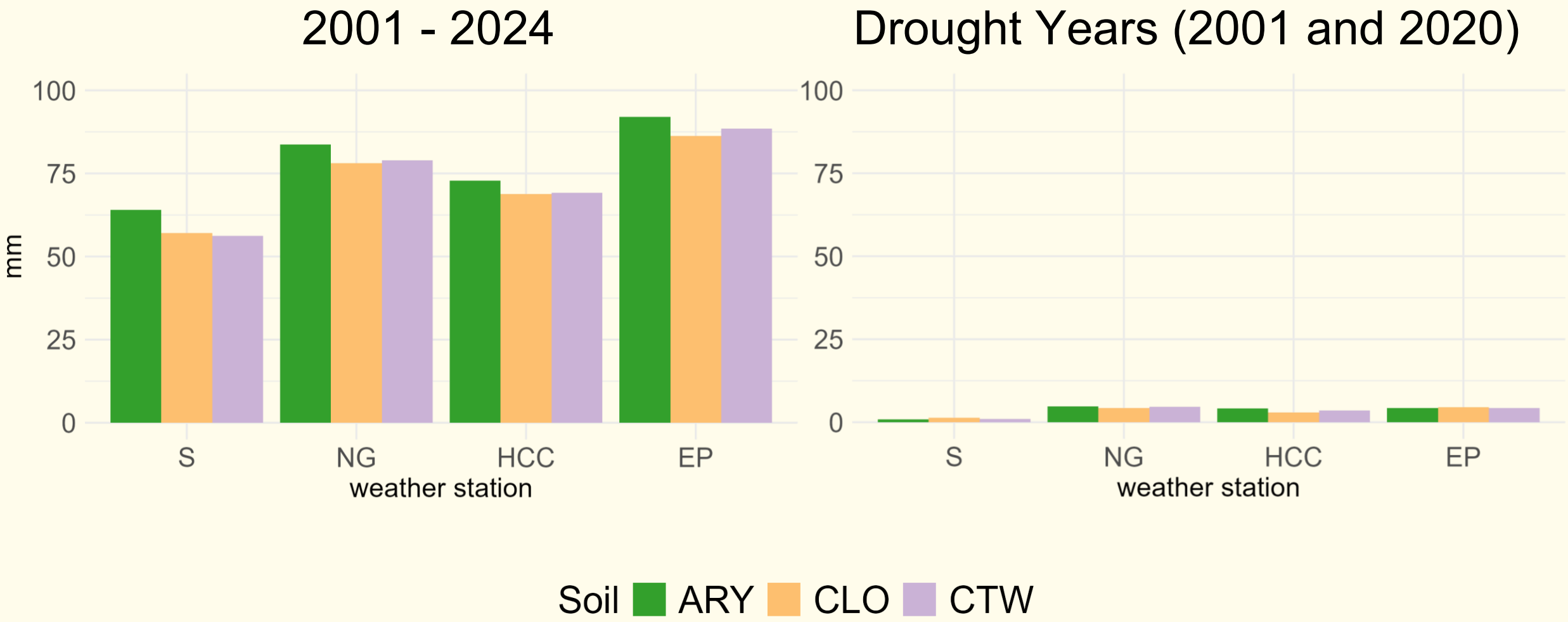




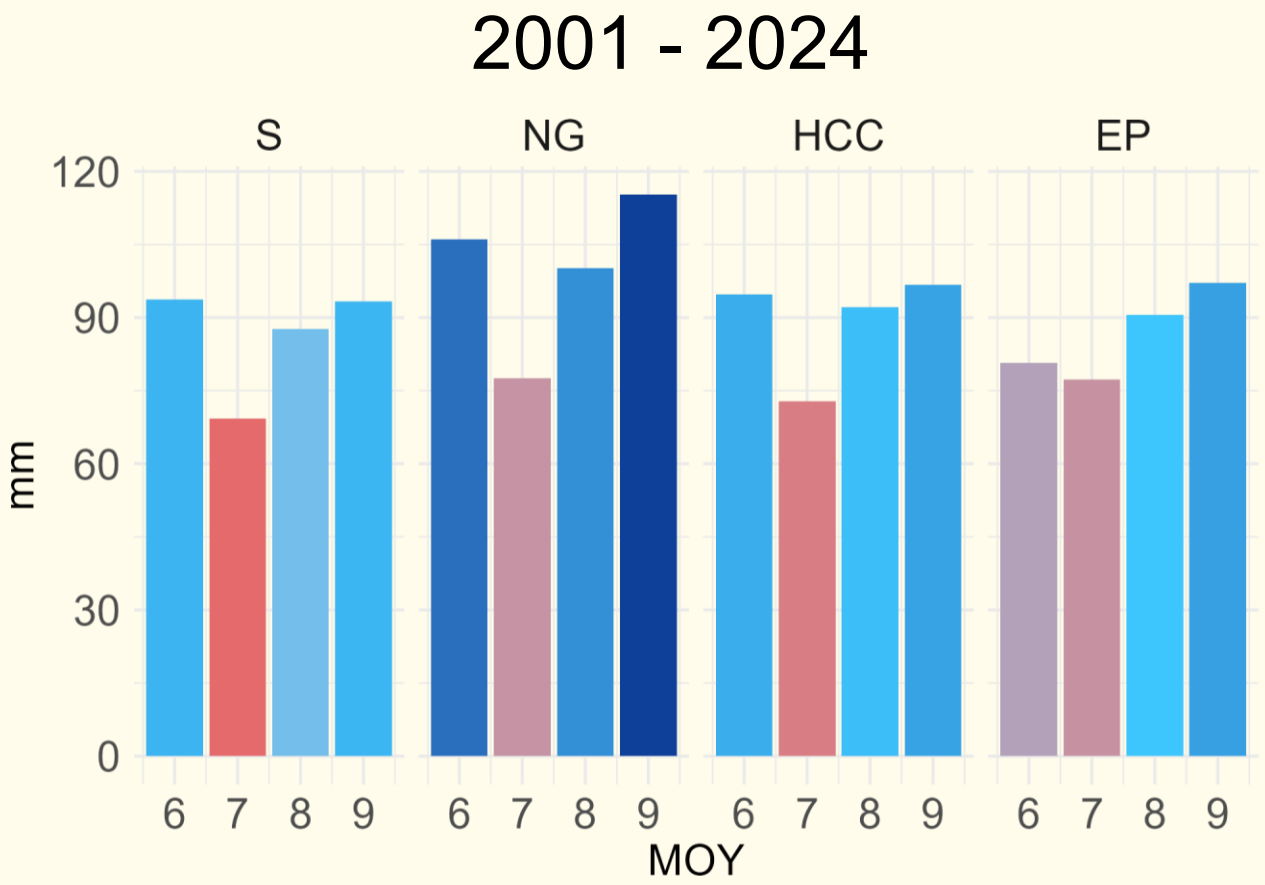


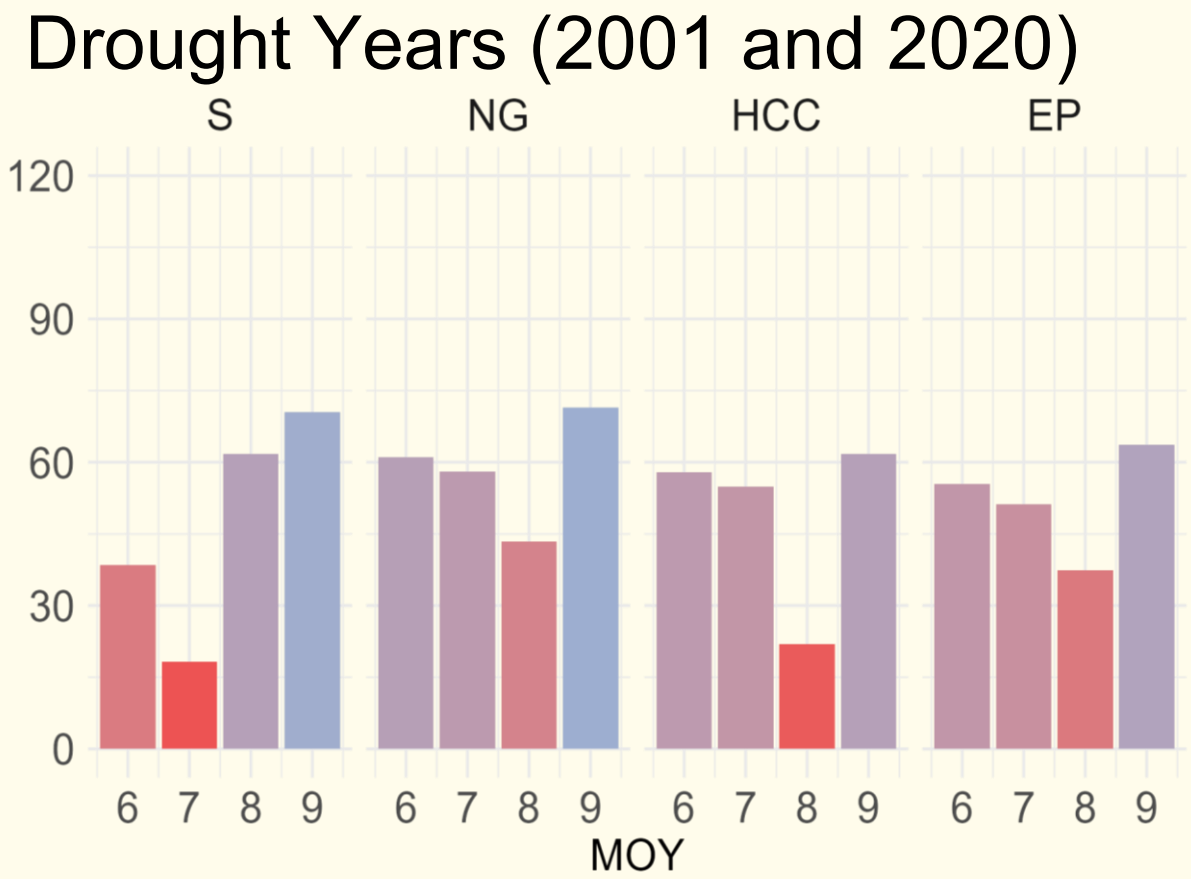


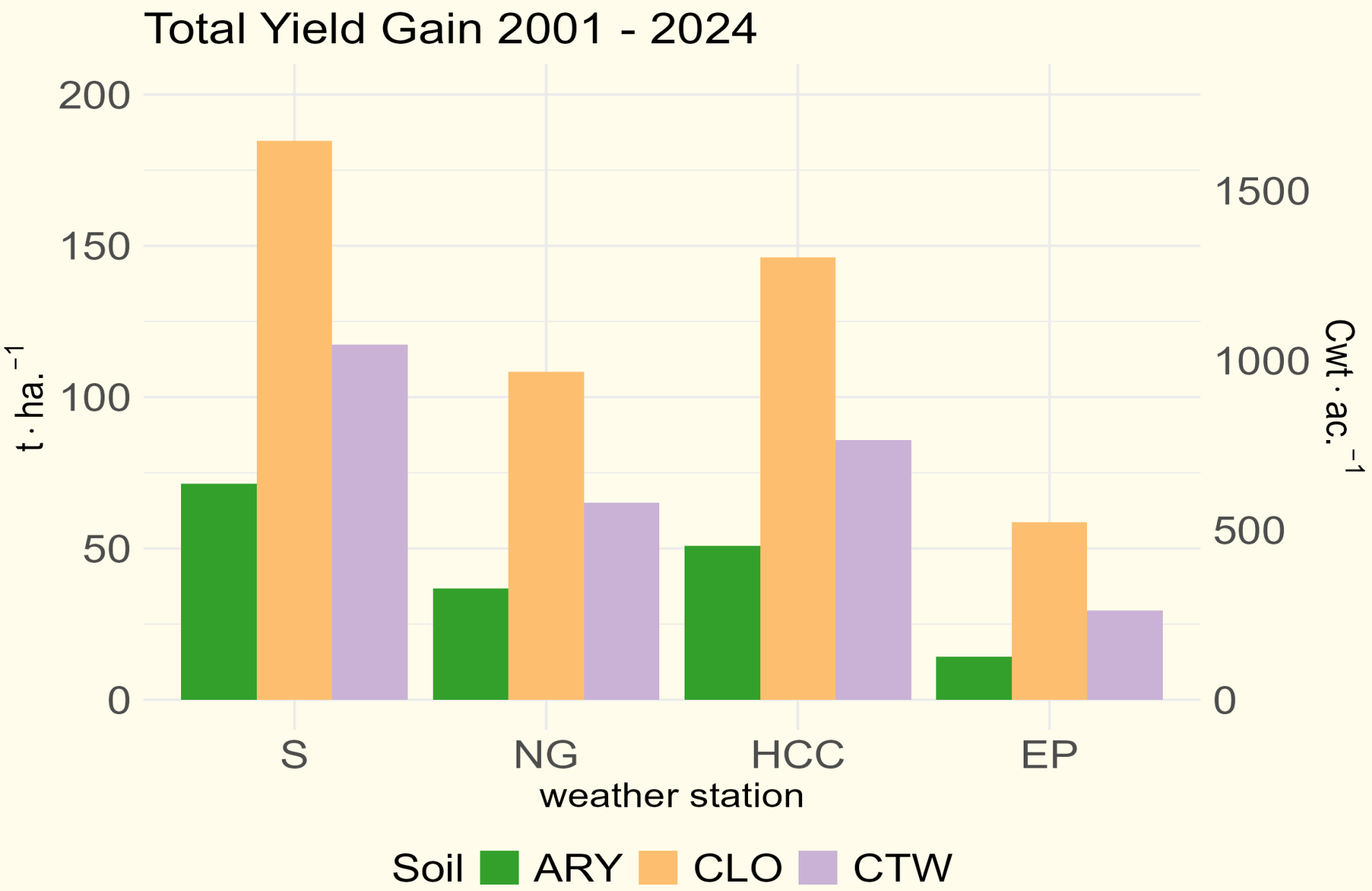
Mean Simulated Growing Season Water Balance



Mean Monthly Cumulative Precipitation






Total Yield Gain 2001 - 2024
200
150
100
50
0
t · ha.⁻¹
1500
1000
500
0
Cwt · ac.⁻¹
S
NG
HCC
EP
weather station
Soil
ARY
CLO
CTW

Pivot I

38.5 ha. Fields

Dedicated Water Supply

System	CAD 301186	USD 220000
Operation	CAD 331 ha^{-1}	USD 242

Pivot II

2 x 20 ha. Fields

Shared Water Supply

System	CAD 253000	USD 185000
Operation	CAD 71 ha^{-1}	USD 52

Hose Reel and Sprinkler

2 x 20 ha. Fields

Separate Water Supply Systems

System	CAD 412040	USD 301000
Operation	CAD 710 ha^{-1}	USD 518

Hose Reel and Boom Cart

2 x 20 ha. Fields

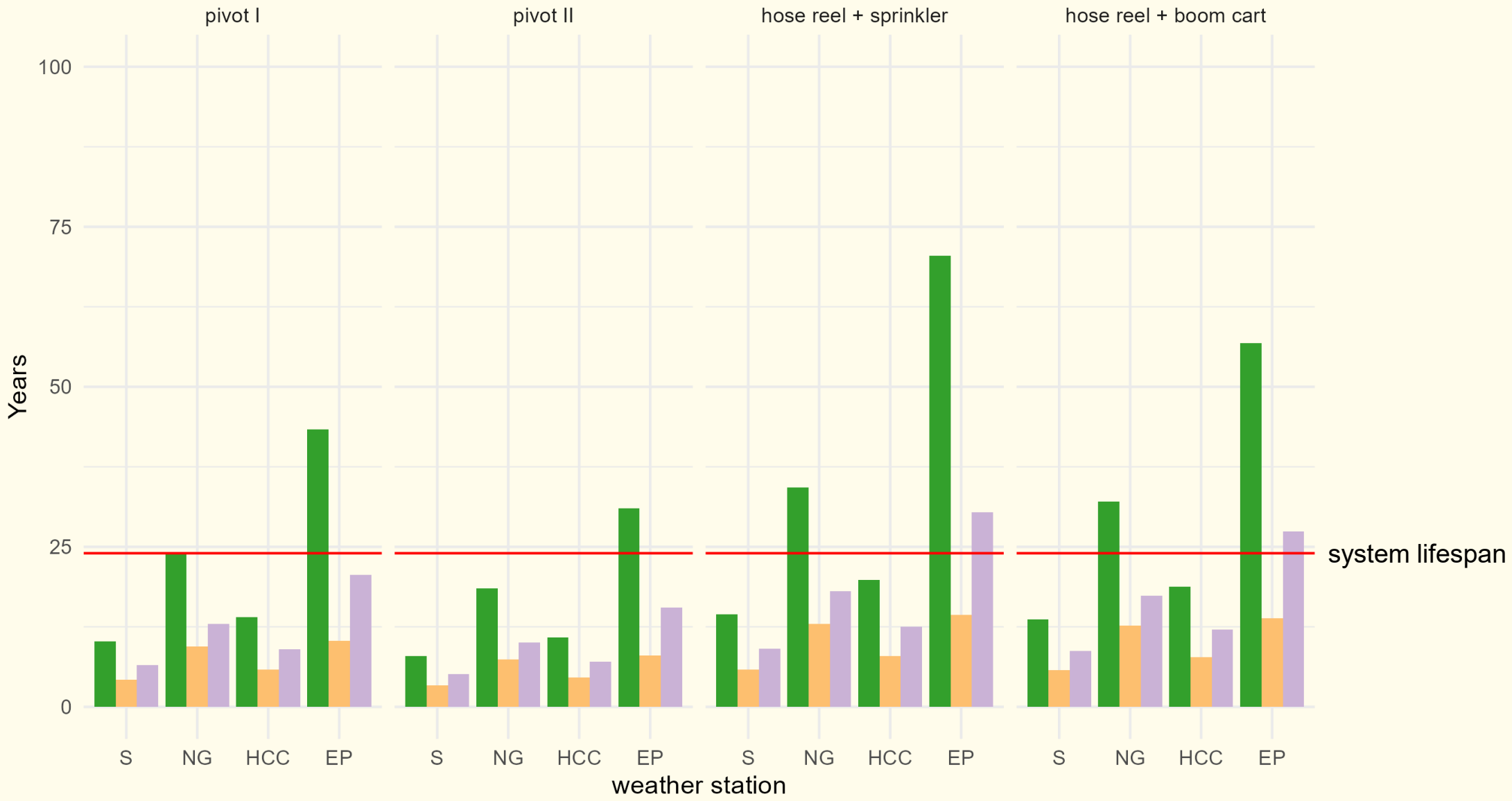
Separate Water Supply Systems

System	CAD 422480	USD 308400
Operation	CAD 269 ha^{-1}	USD 196

Jiang et al., 2024

Payback Period

Marketable Yield 90% of Total Yield



Payback Period

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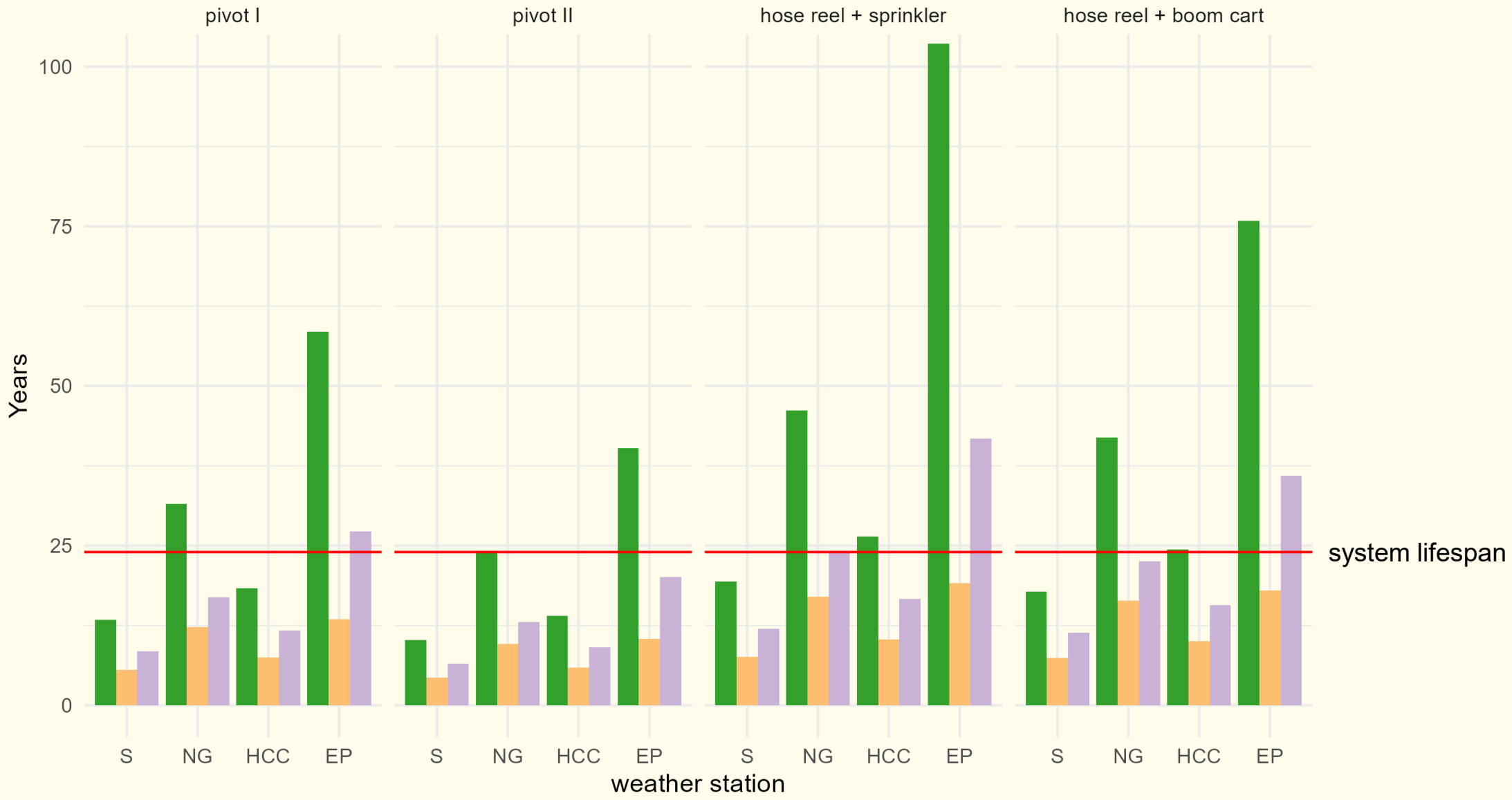

Conclusion

Supplemental irrigation was beneficial in

- 87% of high market yield scenarios
- 77% of low yield scenarios

Generally not as beneficial

- East Point Area – cooler climate with higher growing season water surplus
- ARY soil or similar soil types with high water holding capacity

Mostly Beneficial

- CTW soil type – most common on island
- 75% of low yield scenario payback periods < system lifespan

Highly Beneficial

- CLO or similar soil types with low water holding capacity
- Payback period as short as 3 years

Future Work: Simulations with CMIP climate projections

Climate smart supplemental irrigation has potential to greatly benefit potato production in PEI

Thank you

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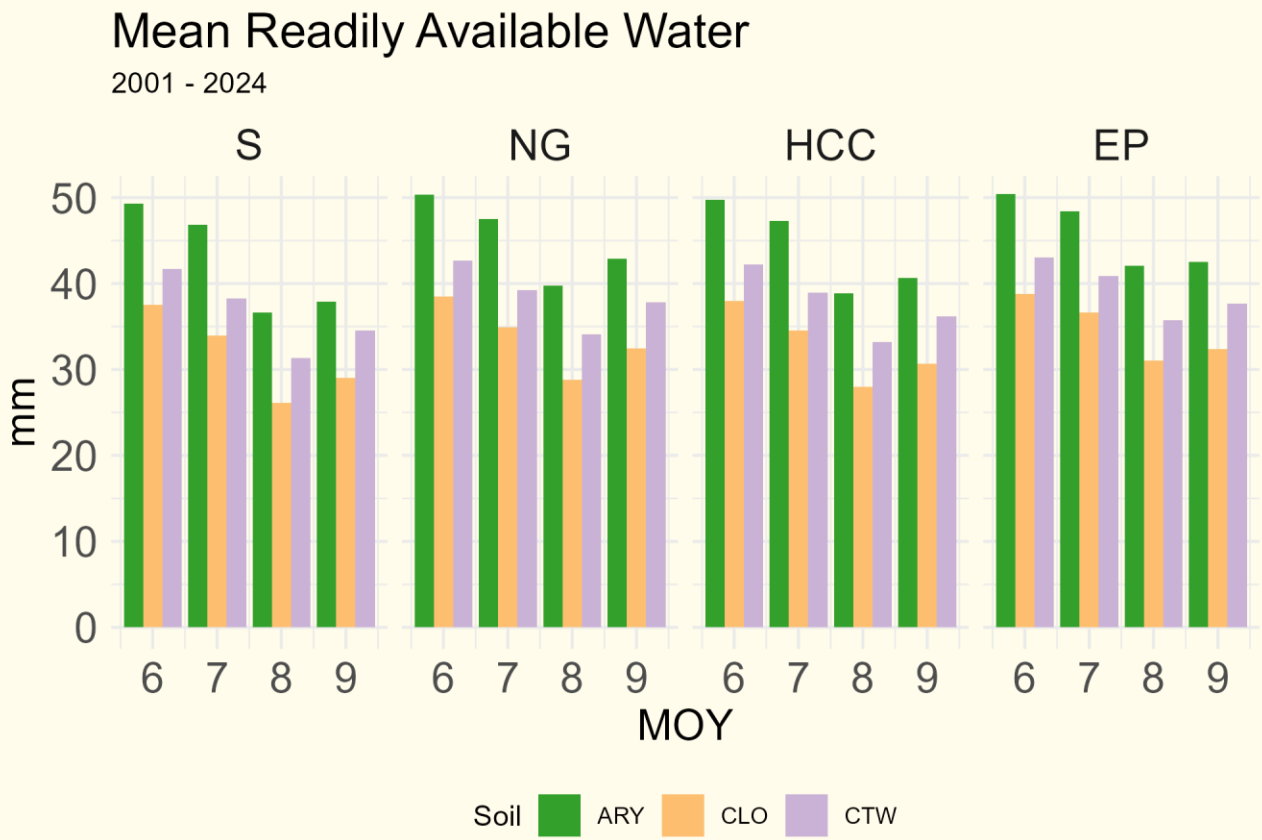
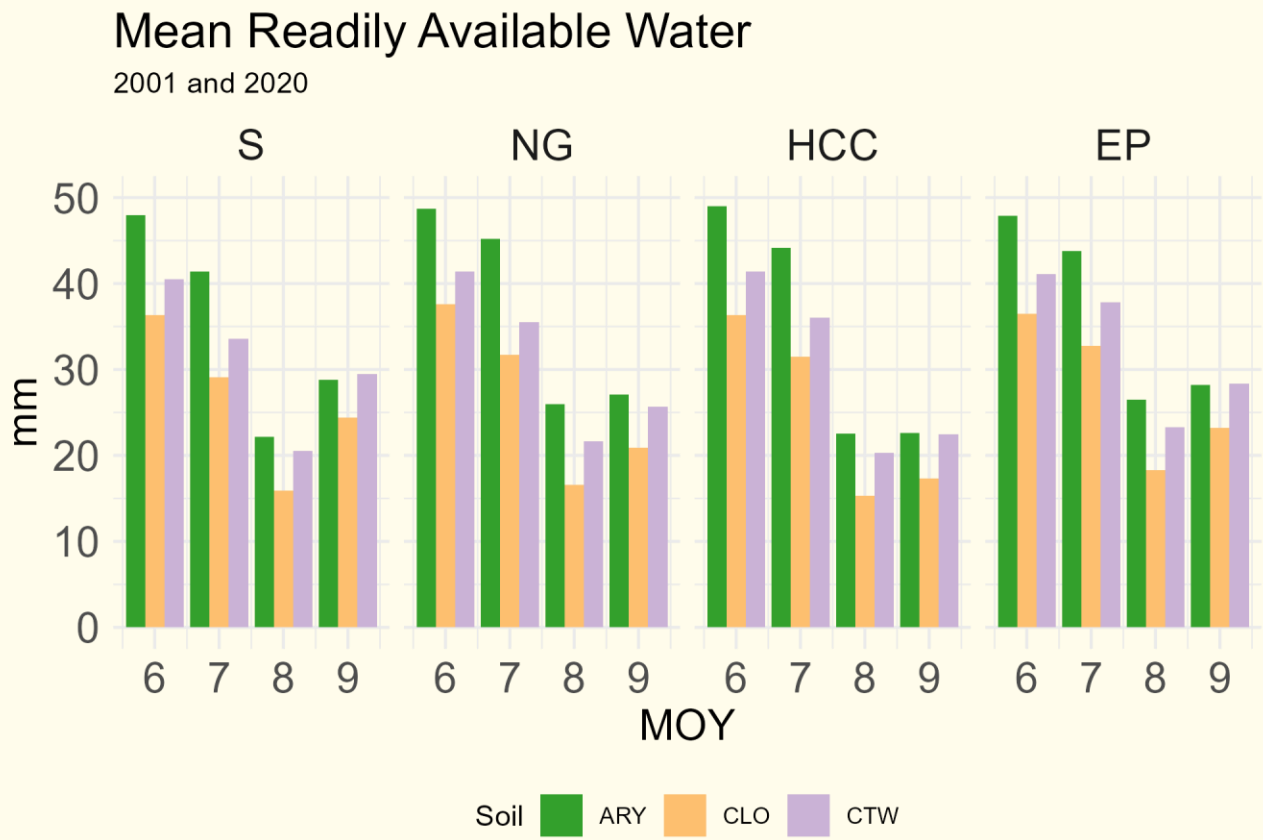
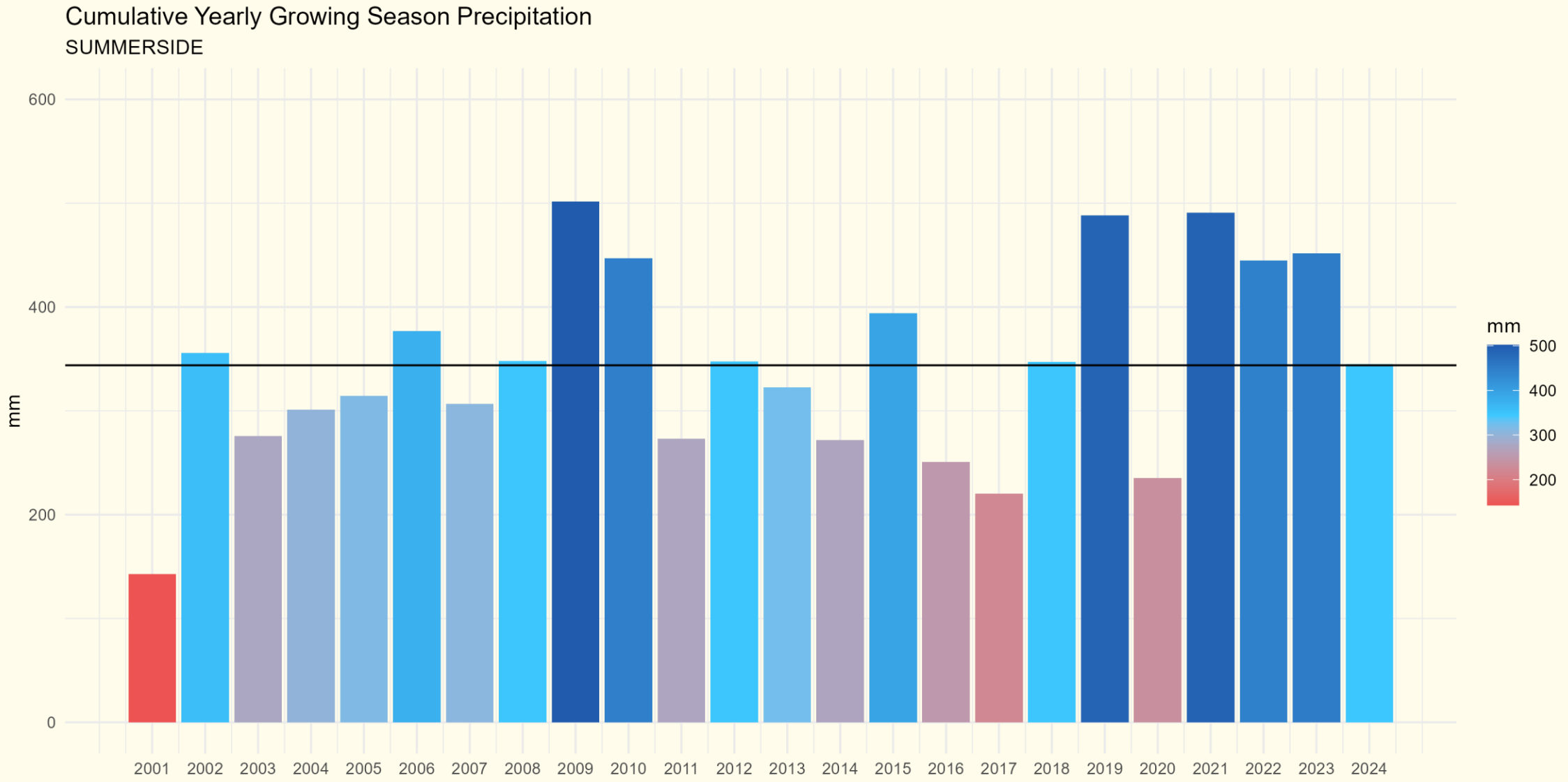
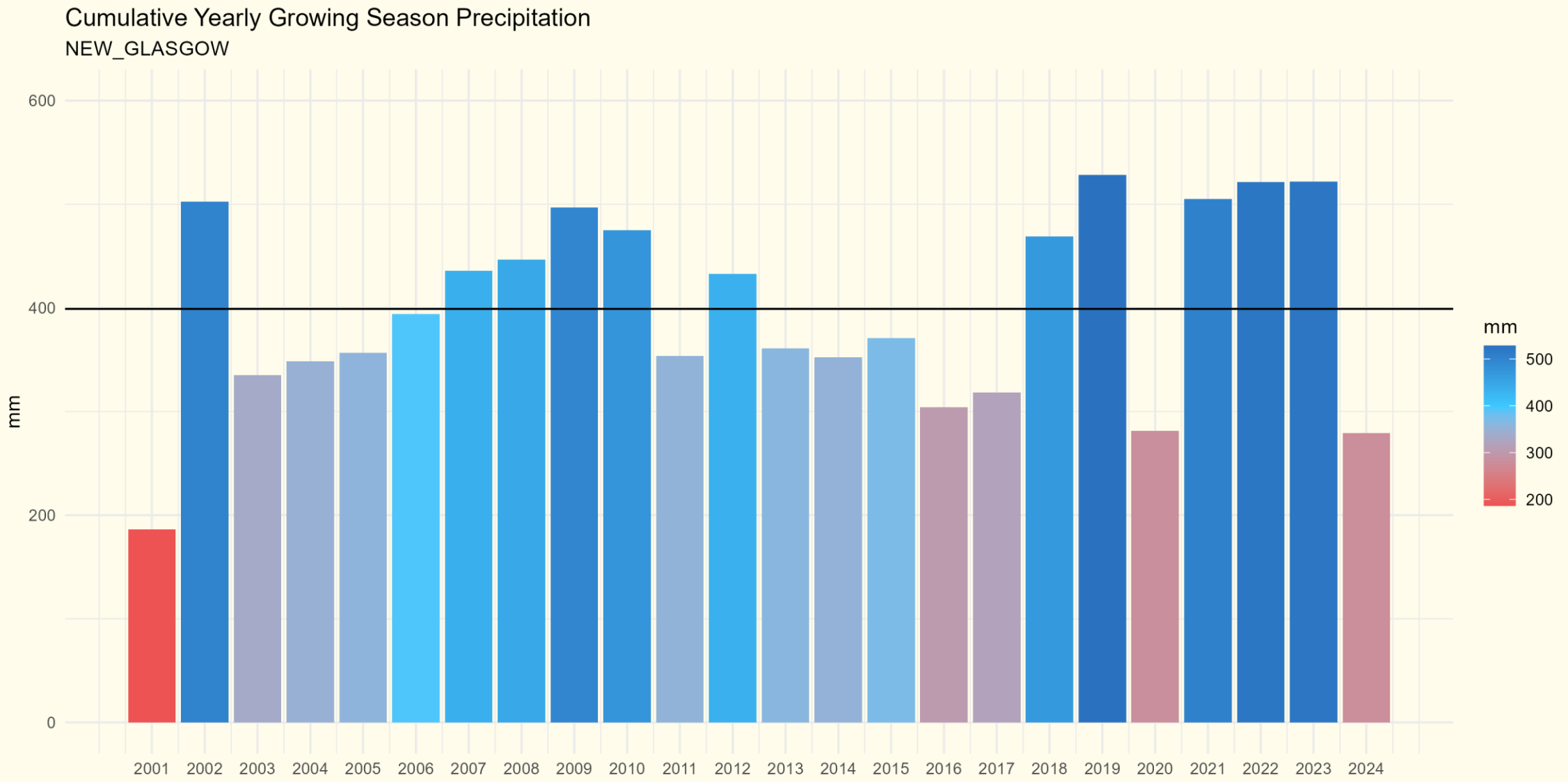
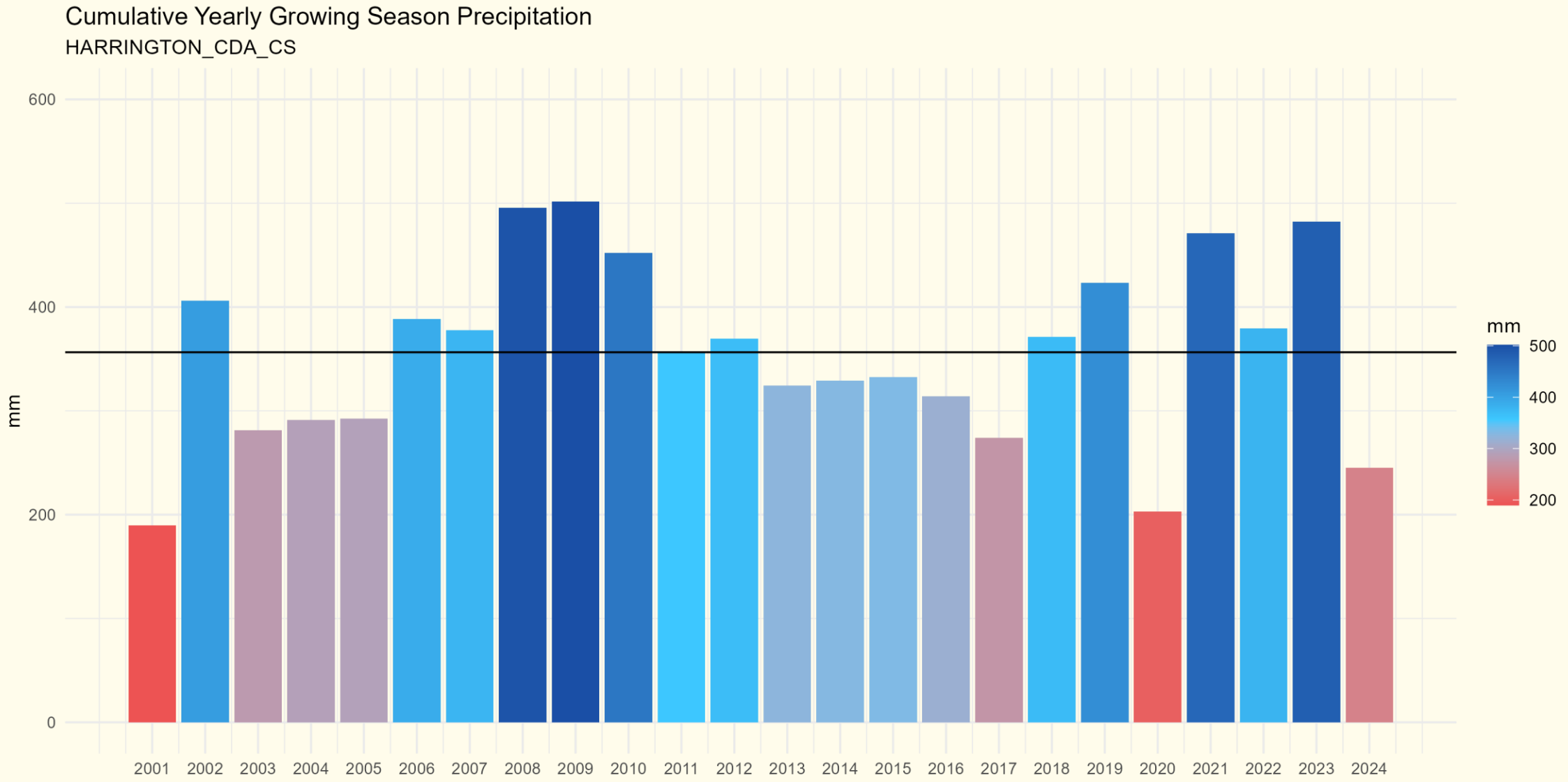
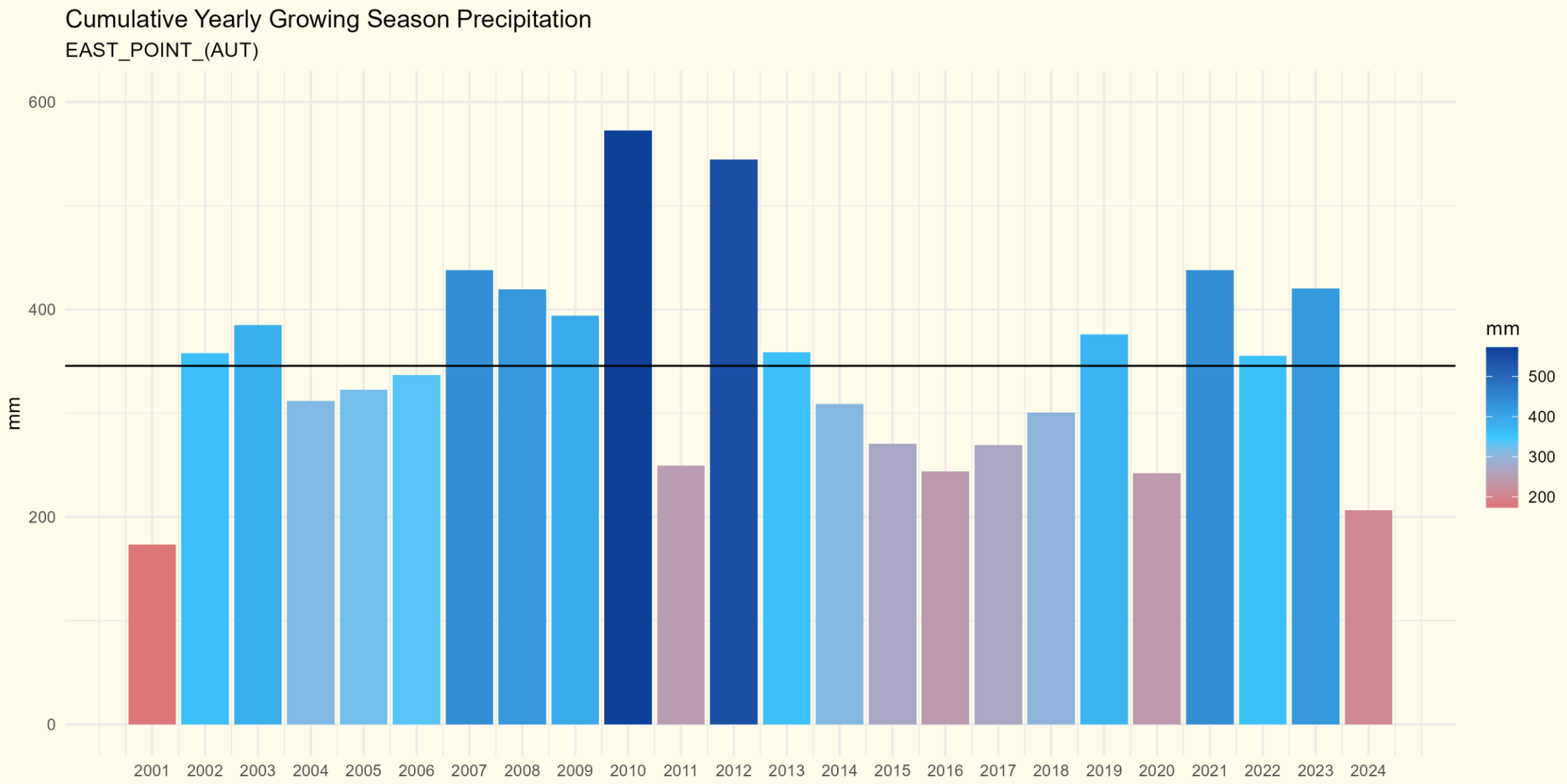

Mean Readily Available Water
2001 - 2024
S
NG
HCC
EP
mm
50
40
30
20
10
0
6
7
8
9
MOY
Soil
ARY
CLO
CTW


Mean Readily Available Water
2001 and 2020
S
NG
HCC
EP
mm
50
40
30
20
10
0
6
7
8
9
MOY
Soil
ARY
CLO
CTW


Cumulative Yearly Growing Season Precipitation
SUMMERSIDE
600
400
200
0
mm
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
mm
500
400
300
200


Cumulative Yearly Growing Season Precipitation
NEW_GLASGOW
600
400
200
0
mm
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
mm
500
400
300
200


Cumulative Yearly Growing Season Precipitation
HARRINGTON_CDA_CS
600
400
200
0
mm
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
mm
500
400
300
200


Cumulative Yearly Growing Season Precipitation
EAST_POINT_(AUT)
mm
600
400
200
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
mm
500
400
300
200