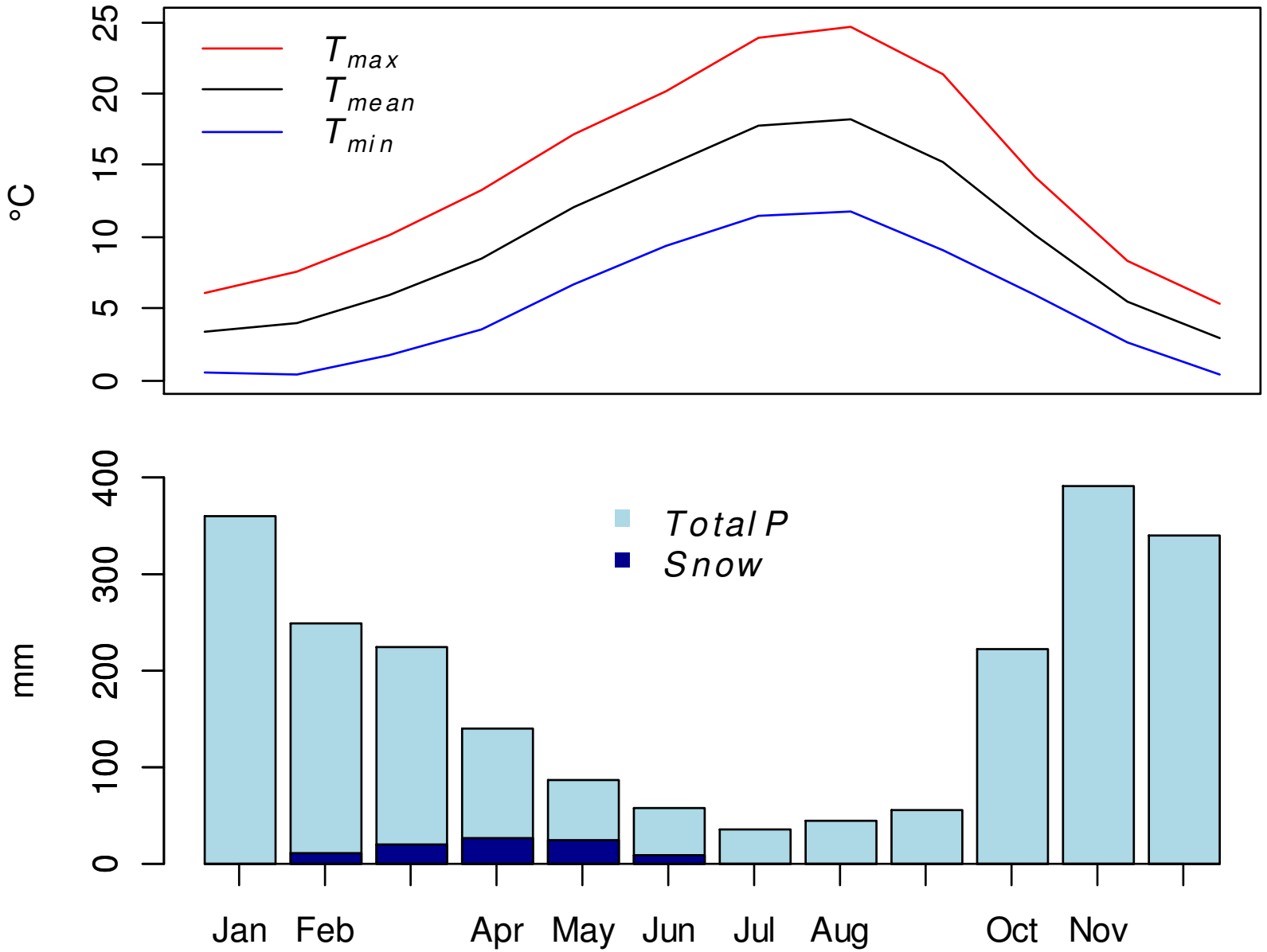
Influences of forestry on hydrology and streamflow

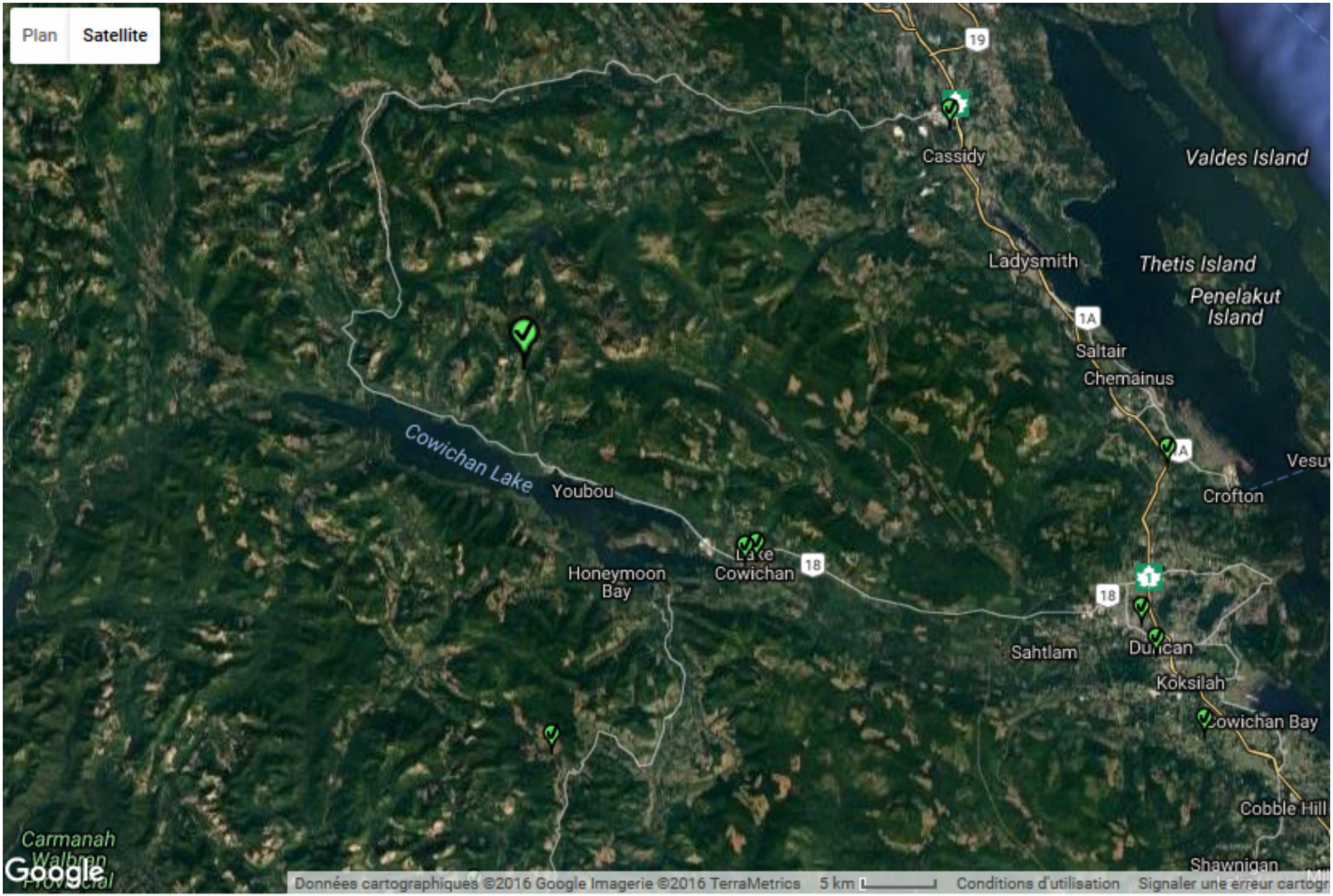
Photo: J. Richardson

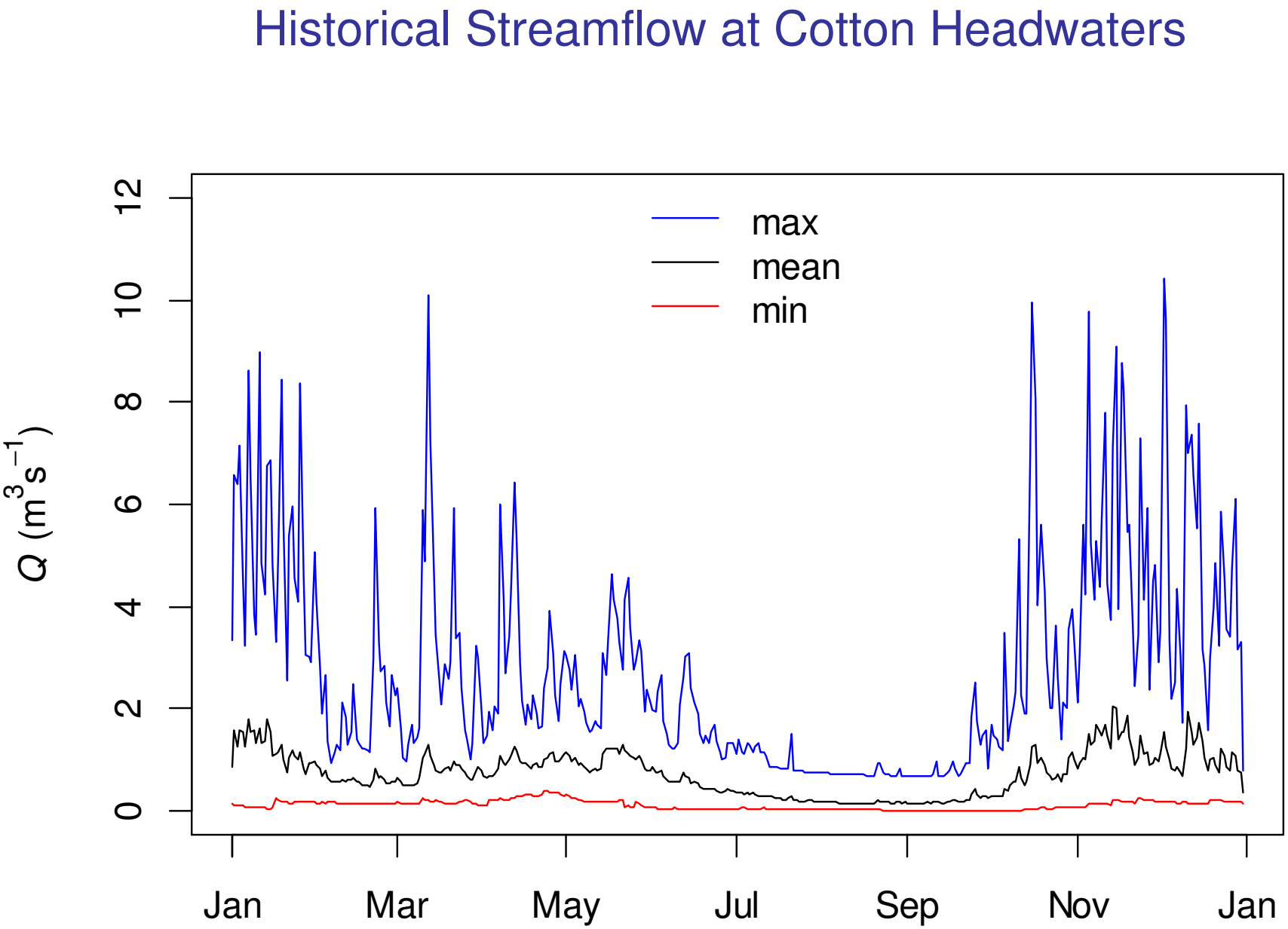
Outline

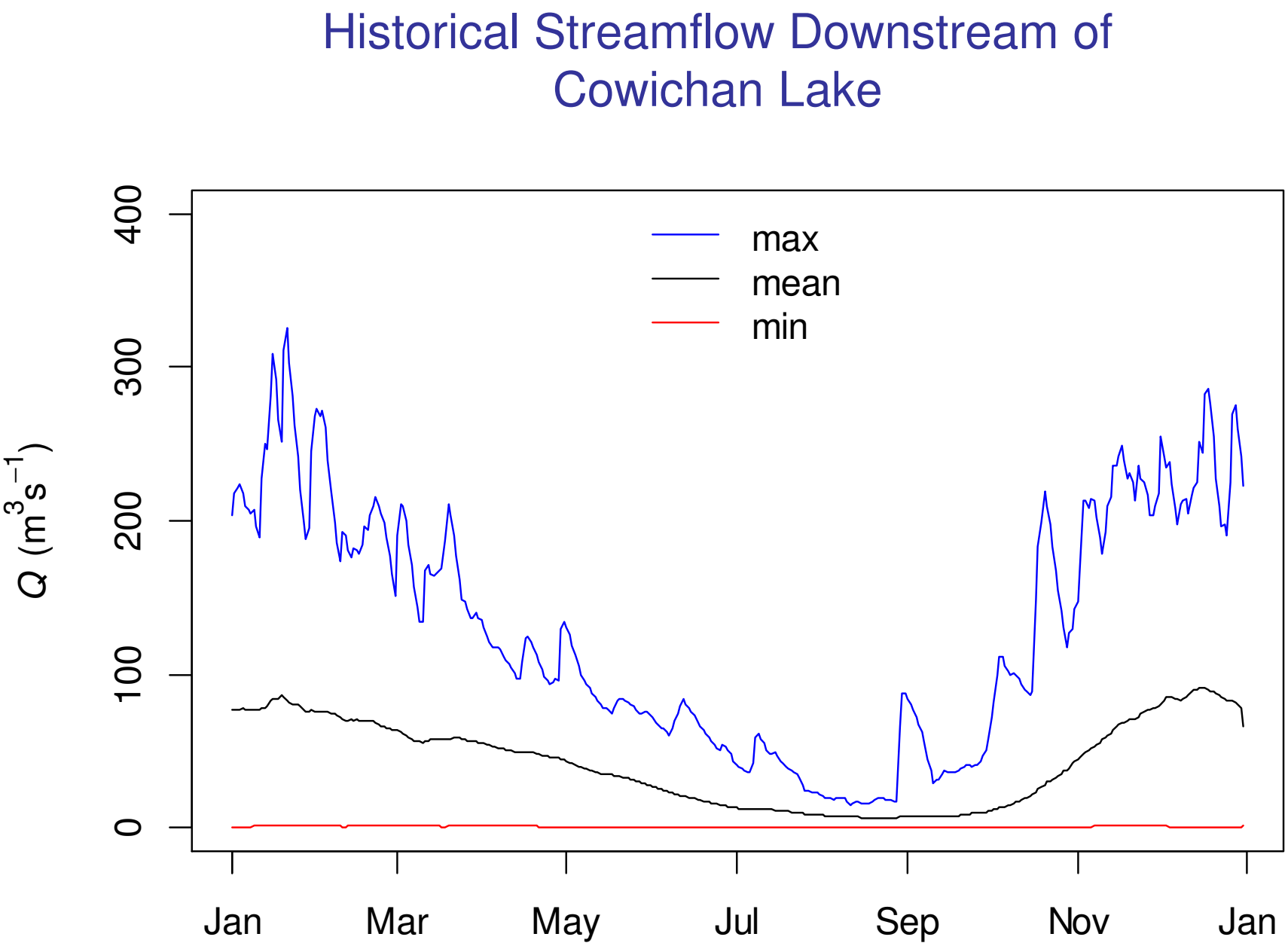
- Hydrologic regime of the Cowichan watershed
- Effects of forests on the water balance
- Hydrologic effects of forest roads
- Catchment-scale effects of forest harvesting
- Summary

Climate Normals – Lake Cowichan Forestry Centre (177 m asl)

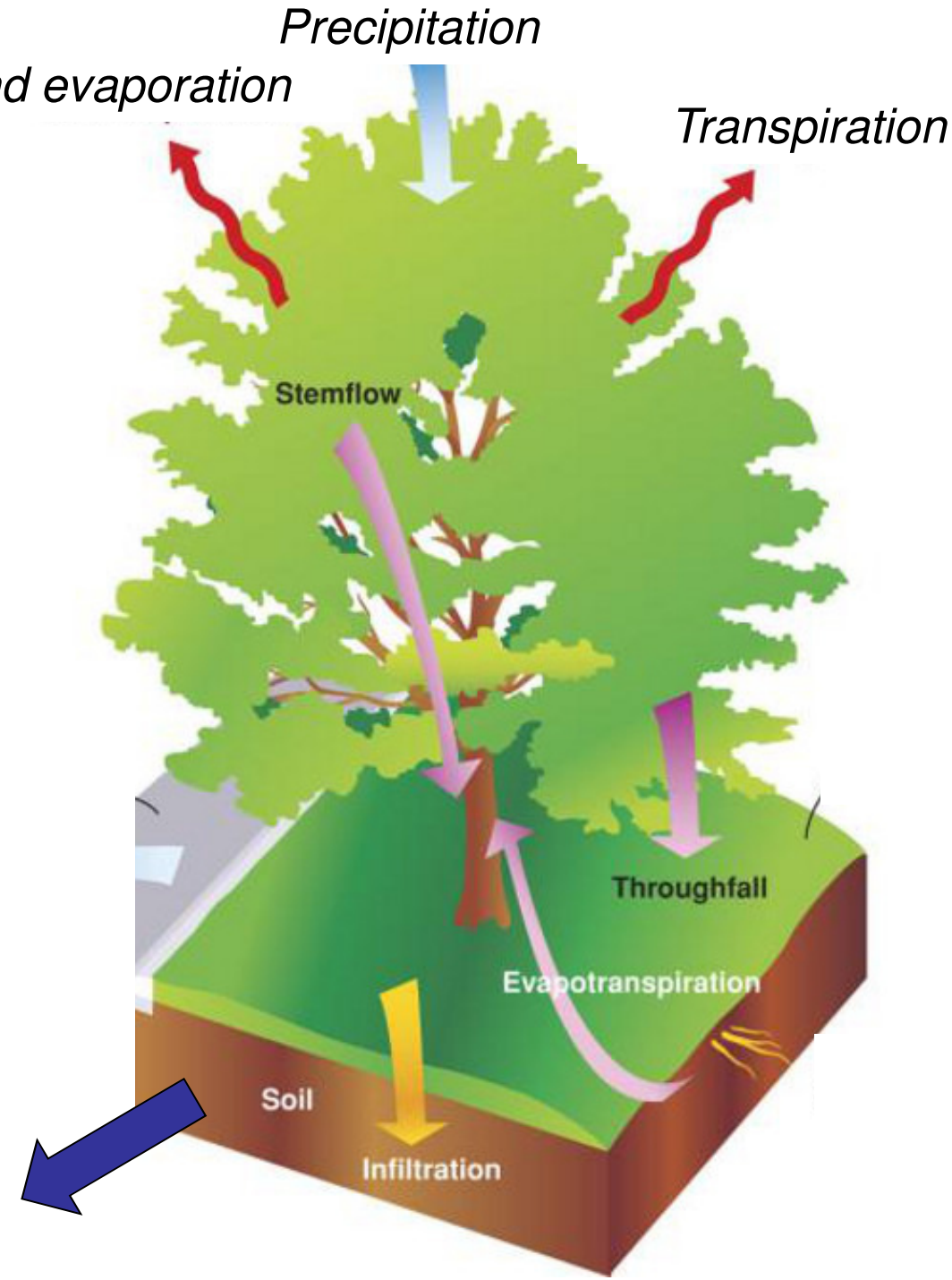



Plan
Satellite
19
Cassidy
Valdes Island
Ladysmith
Thetis Island
Penelakut Island
1A
Saltair
Chemainus
A
Crofton
Vesuv
Cowichan Lake
Youbou
Lake Cowichan
18
Honeymoon Bay
1
18
Sahtlam
Duncan
Koksilah
Cowichan Bay
Cobble Hill
Shawnigan
Carmanah Walbran Provincial
Google
Données cartographiques ©2016 Google Imagerie ©2016 TerraMetrics
5 km
Conditions d'utilisation
Signaler une erreur cartogr


Historical Streamflow at Cotton Headwaters
max
mean
min
Q (m3s−1)
0
2
4
6
8
10
12
Jan
Mar
May
Jul
Sep
Nov
Jan


Historical Streamflow Downstream of Cowichan Lake
max
mean
min
Q (m3s−1)
0
100
200
300
400
Jan
Mar
May
Jul
Sep
Nov
Jan

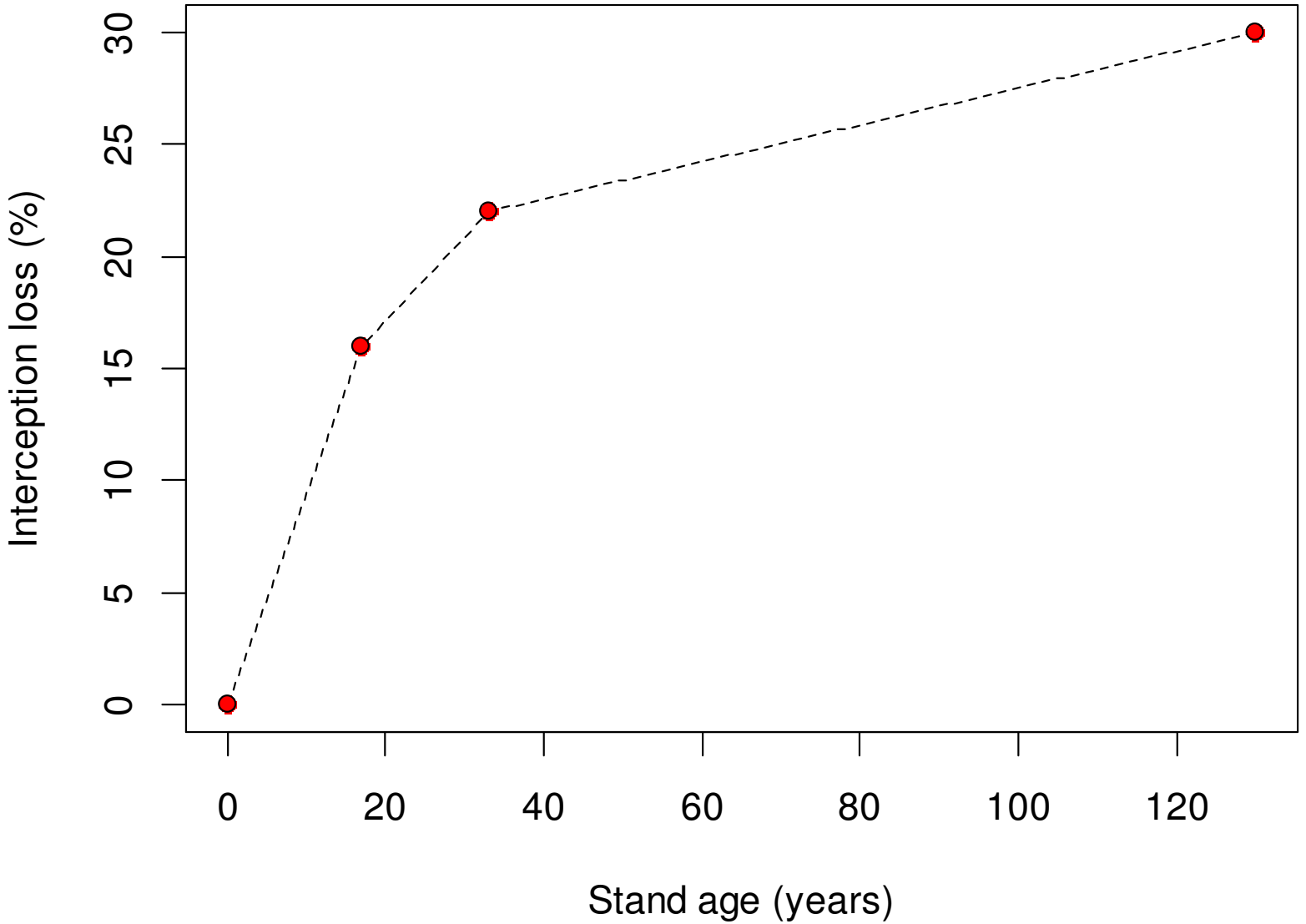
Effects of forests on the water balance



Rainfall Interception in Coastal Forests

- On an annual basis, up to about 30% of rainfall is lost via interception
- Higher in summer
- Higher for small rain storms
- Depends on tree density, tree height, species, …

Annual interception loss as a function of stand age



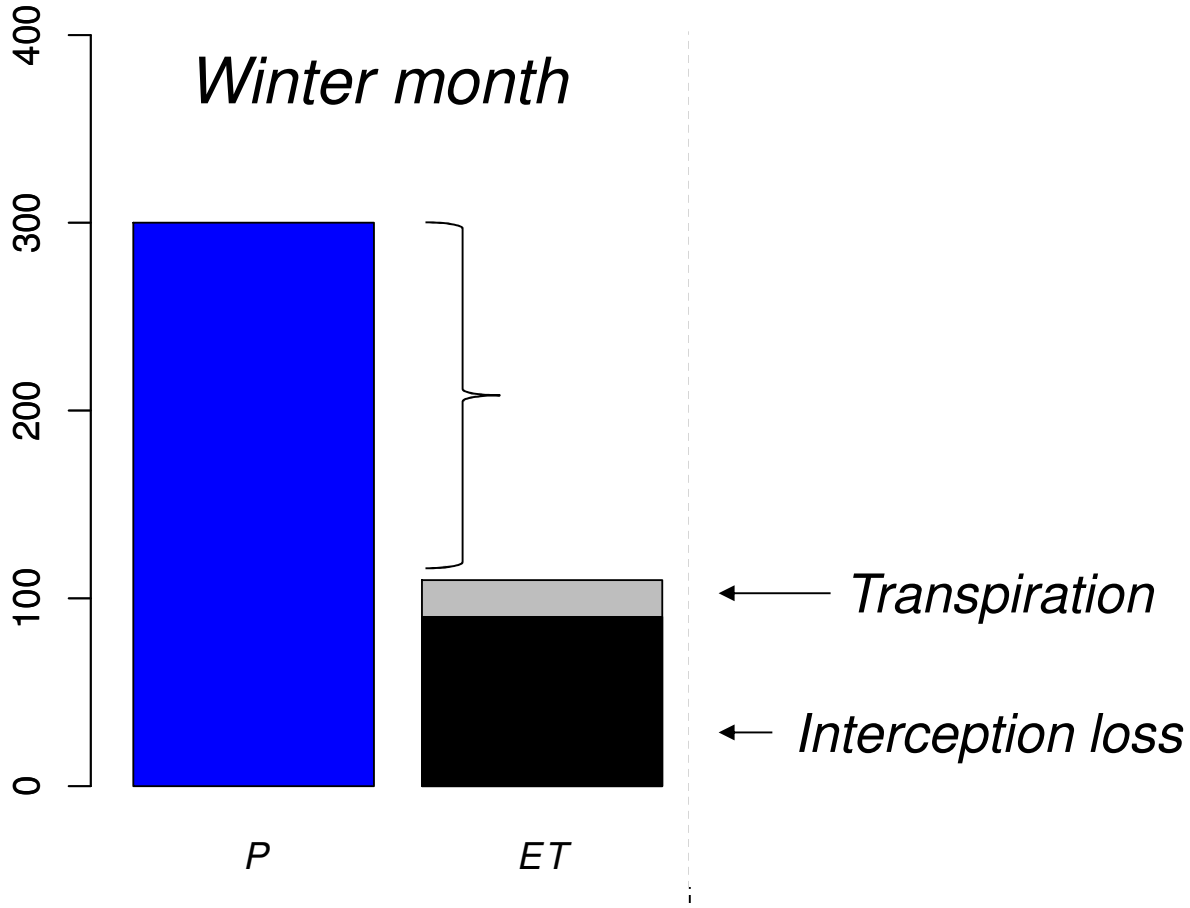
Spittlehouse (pers. comm.)

Transpiration in Coastal Forests

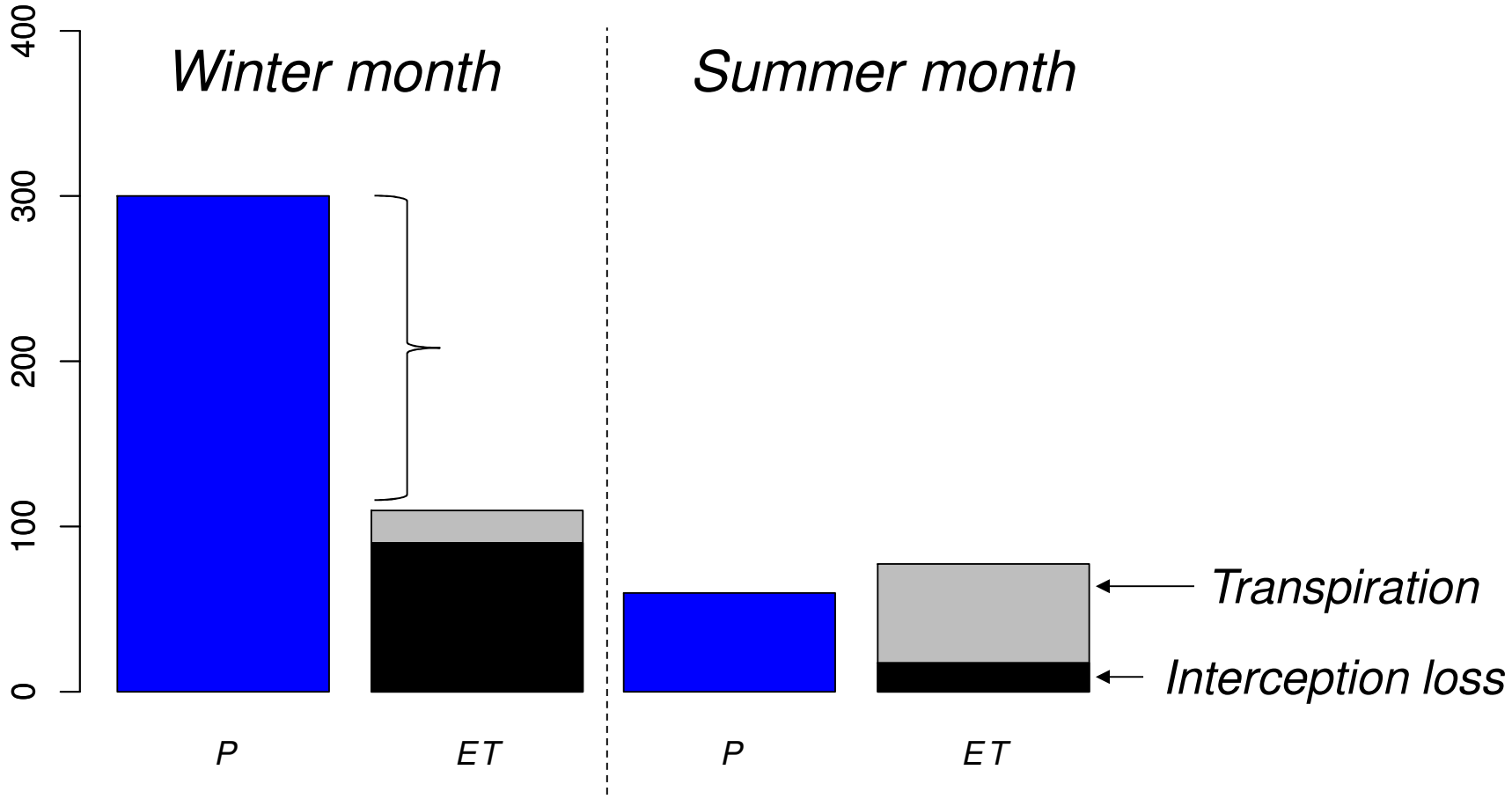
- Depends on weather, season, soil wetness, forest characteristics (species, tree density, stand age, …)
- Typical values for Douglas-fir:
  - 10 to 30 mm/month in winter
  - 50 to 100 mm/month in summer
- Oregon study found that 40-year-old Douglas-fir transpired significantly more than old growth*

* Moore, G.W. et al., 2004. Structural and compositional controls on transpiration in 40-and 450-year-old riparian forests in western Oregon, USA. *Tree Physiology*, 24, 481–491.

Overview – forests and the water balance
Typical illustrative values



Overview – forests and the water balance
Typical illustrative values



Note: soil and understory evaporation/transpiration not included

Forests and snow

- Forests reduce snow accumulation relative to clearings
- Forests shade the snowpack and reduce wind speed
  - Promote slower melting of snowpack

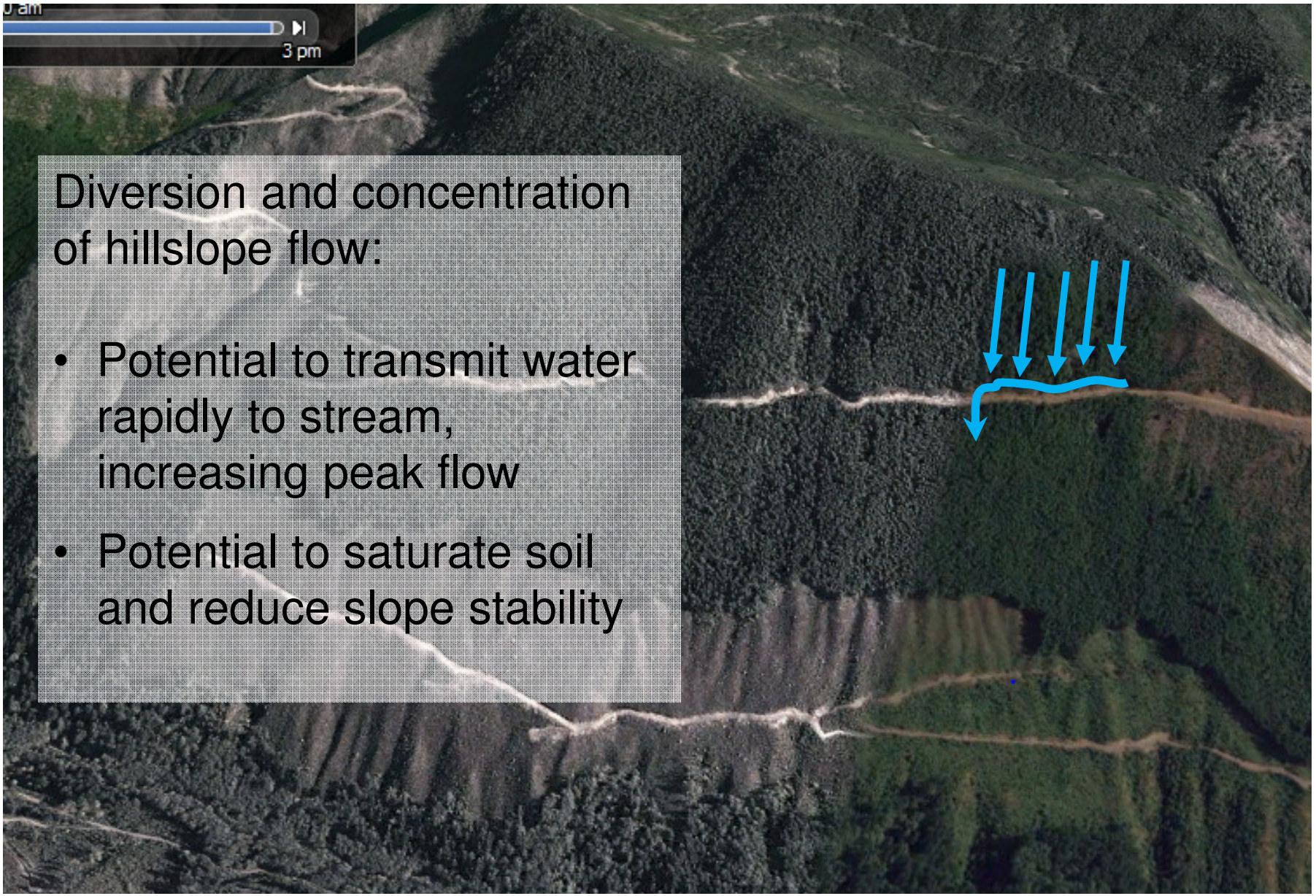
Forest soils and hydrology

- High infiltration capacity
  - Minimize overland flow
  - Minimize soil erosion
- Provide cohesion via root network
  - Slope stability

Forest roads and hydrology

- Roads and other compacted surfaces have reduced infiltration capacity
  - Frequent overland flow
  - Increased risk of soil erosion and increased sediment in streams and lakes

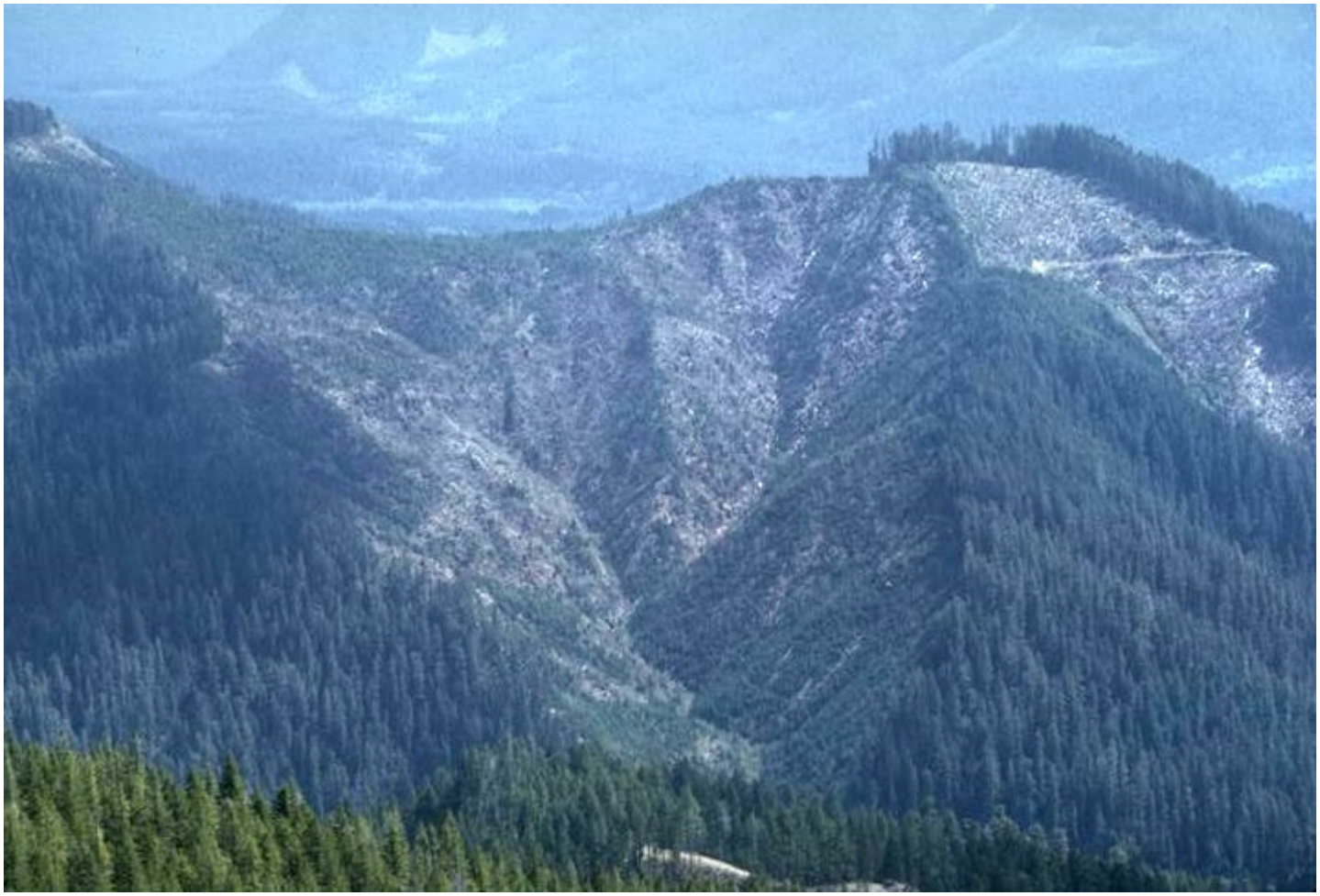
Forest roads and hydrology



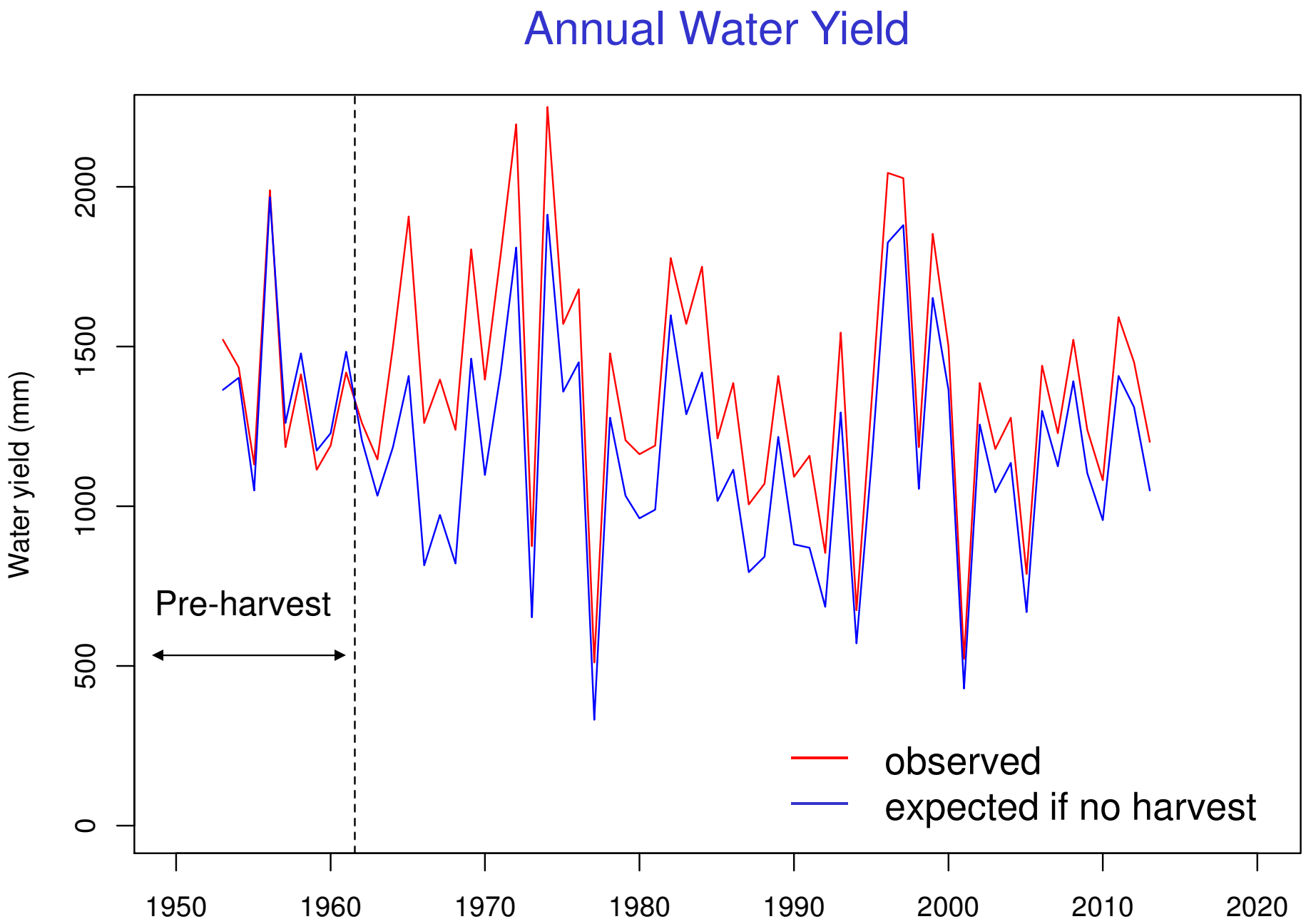
Diversion and concentration of hillslope flow:

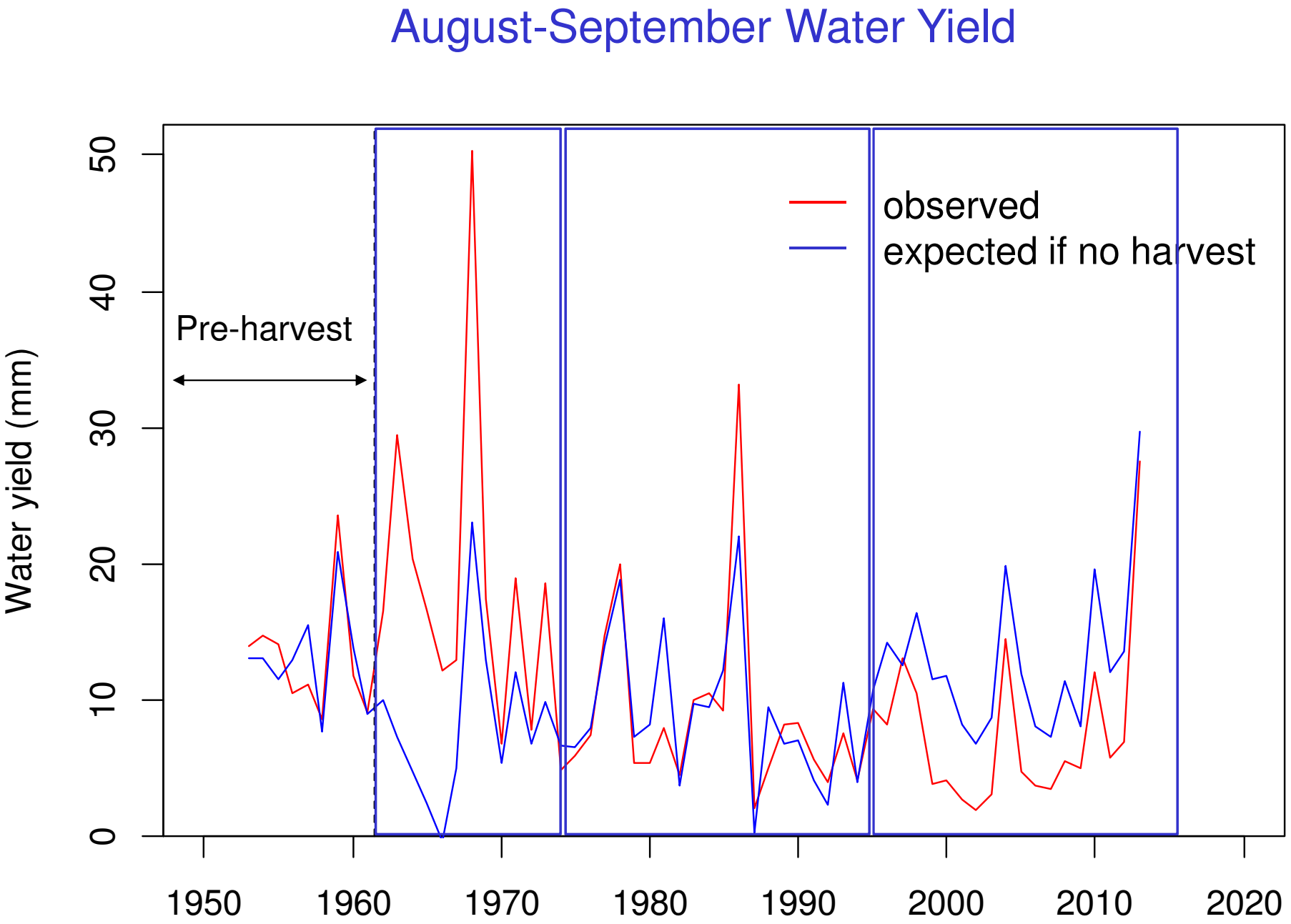
- Potential to transmit water rapidly to stream, increasing peak flow
- Potential to saturate soil and reduce slope stability

Catchment-scale hydrologic response to forest harvesting
H.J. Andrews Experimental Forest, Watershed 1



Watershed 1 – 20 years after harvest (photo: Dick Fredriksen)


Annual Water Yield
Water yield (mm)
0
500
1000
1500
2000
1950
1960
1970
1980
1990
2000
2010
2020
Pre-harvest
observed
expected if no harvest


August-September Water Yield
Water yield (mm)
0
10
20
30
40
50
1950
1960
1970
1980
1990
2000
2010
2020
observed
expected if no harvest
Pre-harvest

Overview

- In the first decade following harvest, both annual yield and summer flows increase due to a reduction in interception loss and transpiration
- In the longer term, the persistent reduction of interception loss maintains elevated annual water yield for decades
- However, it appears that enhanced transpiration from maturing stands, in combination with recovery of interception loss, can result in reduced late-summer streamflow – needs further study