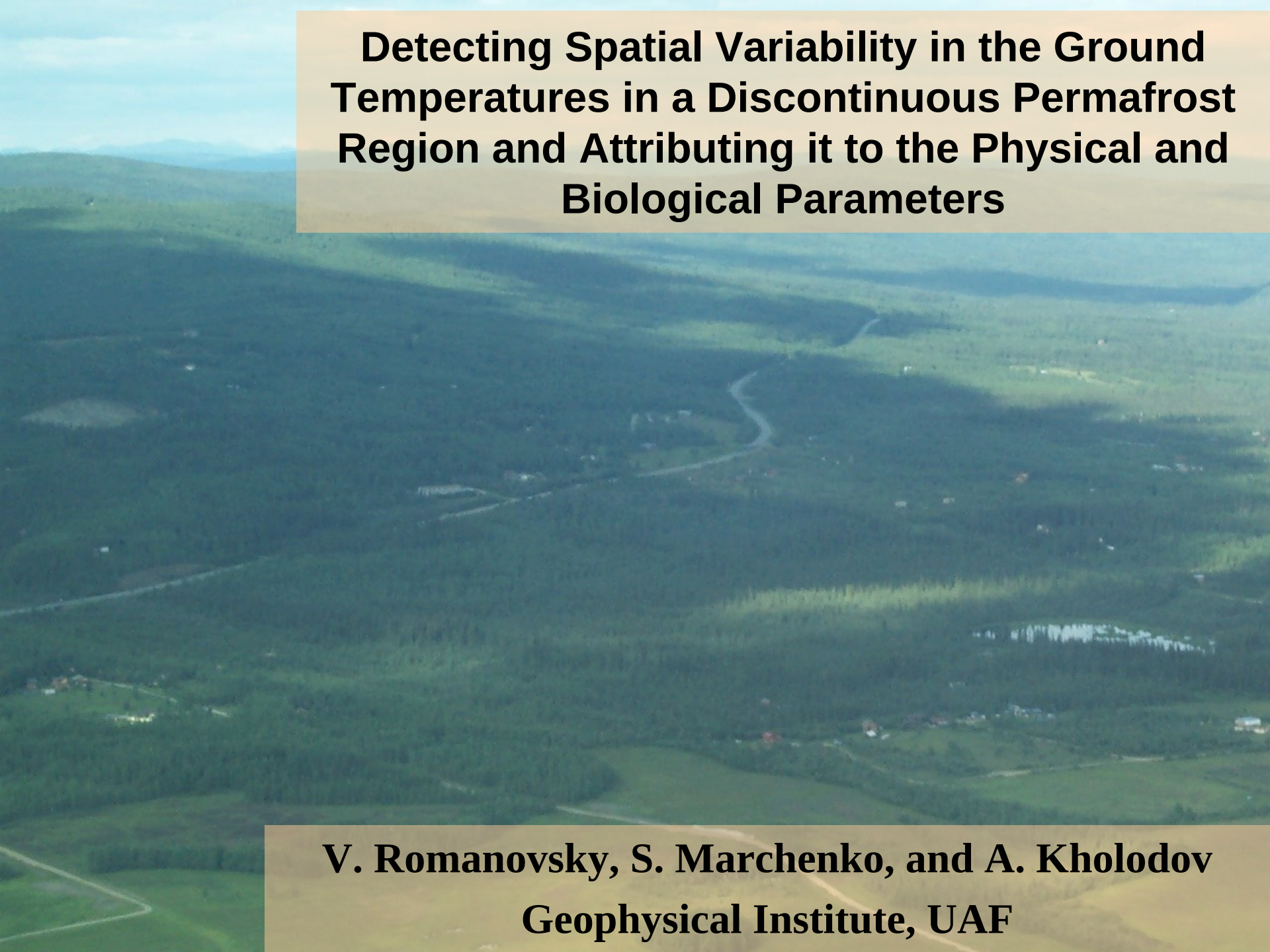
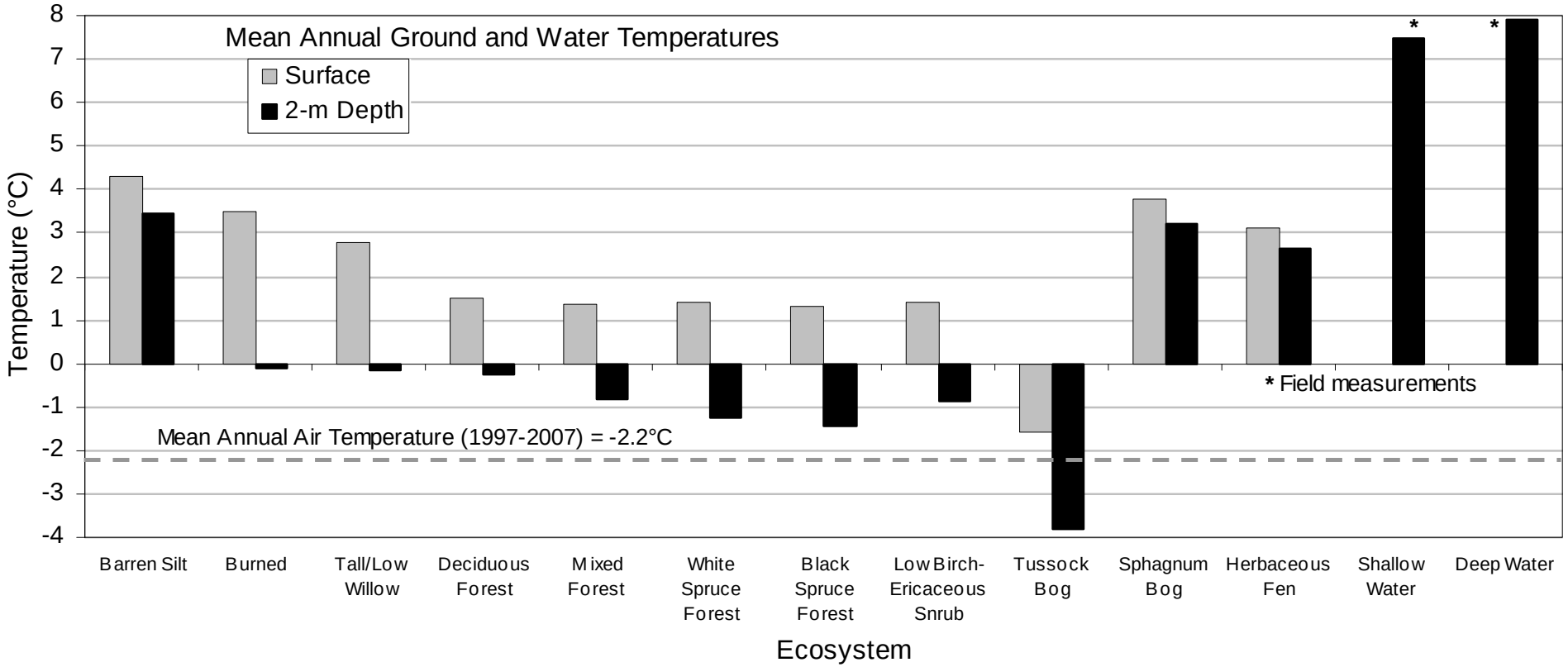


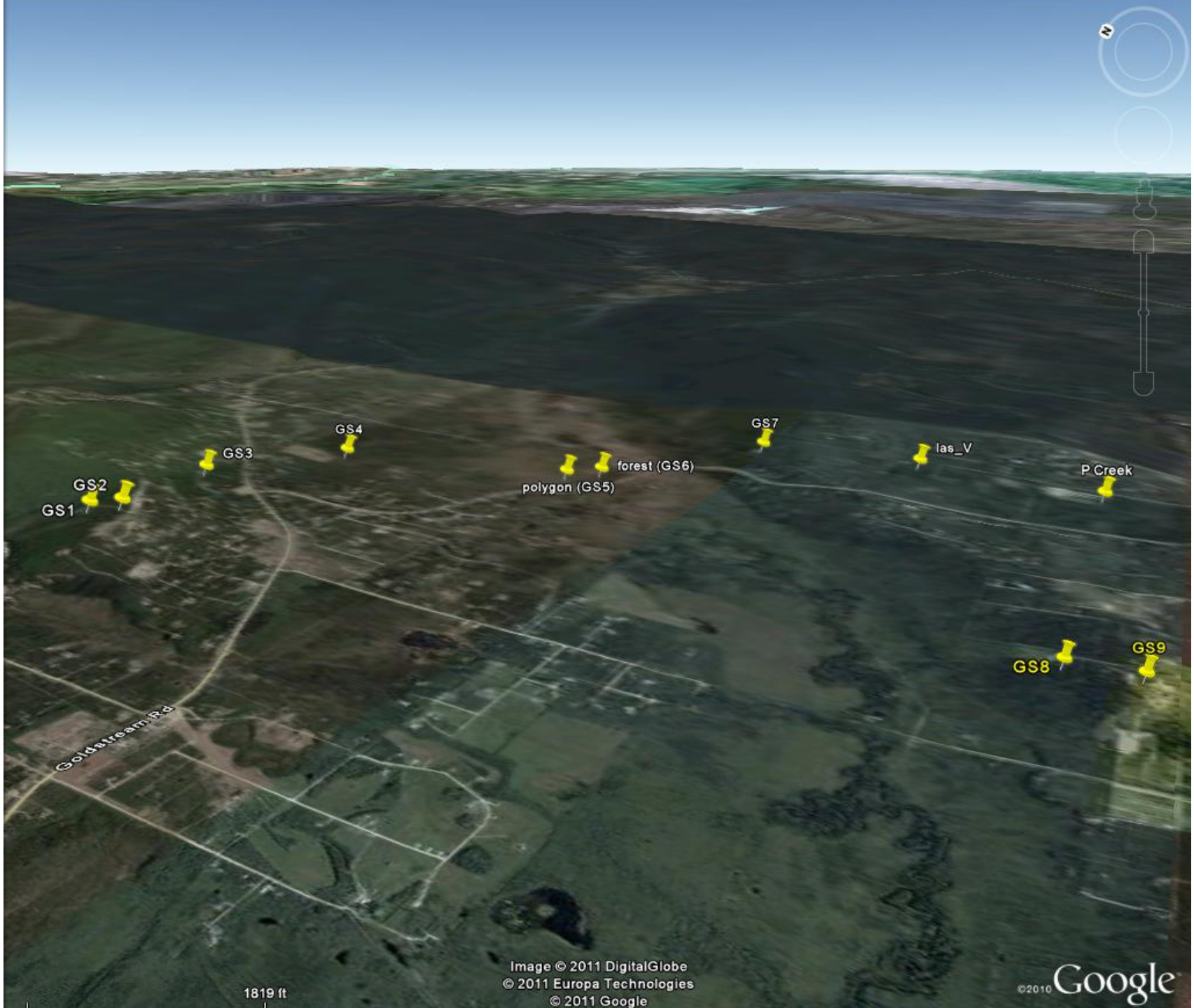
Detecting Spatial Variability in the Ground Temperatures in a Discontinuous Permafrost Region and Attributing it to the Physical and Biological Parameters

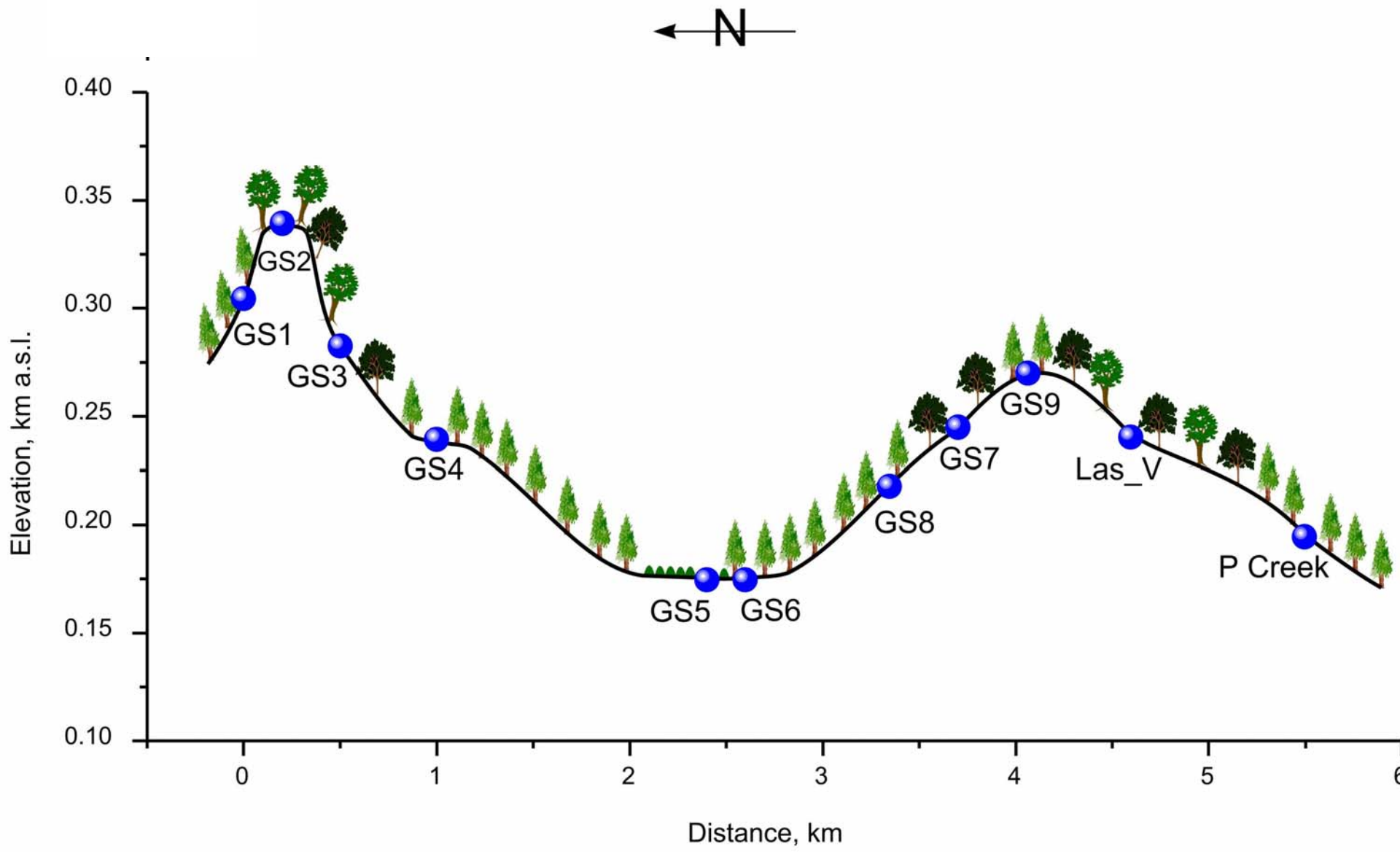
V. Romanovsky, S. Marchenko, and A. Kholodov

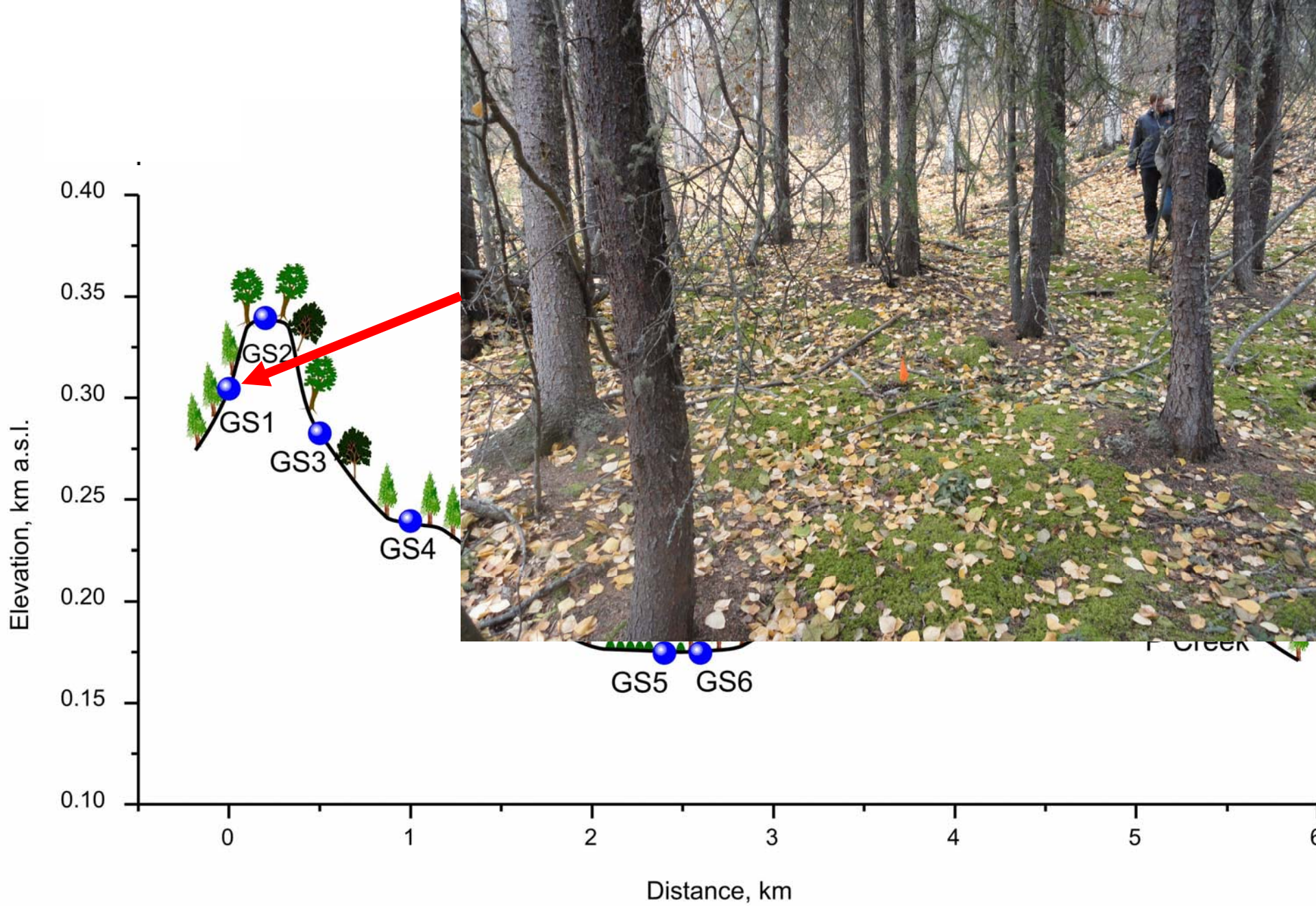
Geophysical Institute, UAF

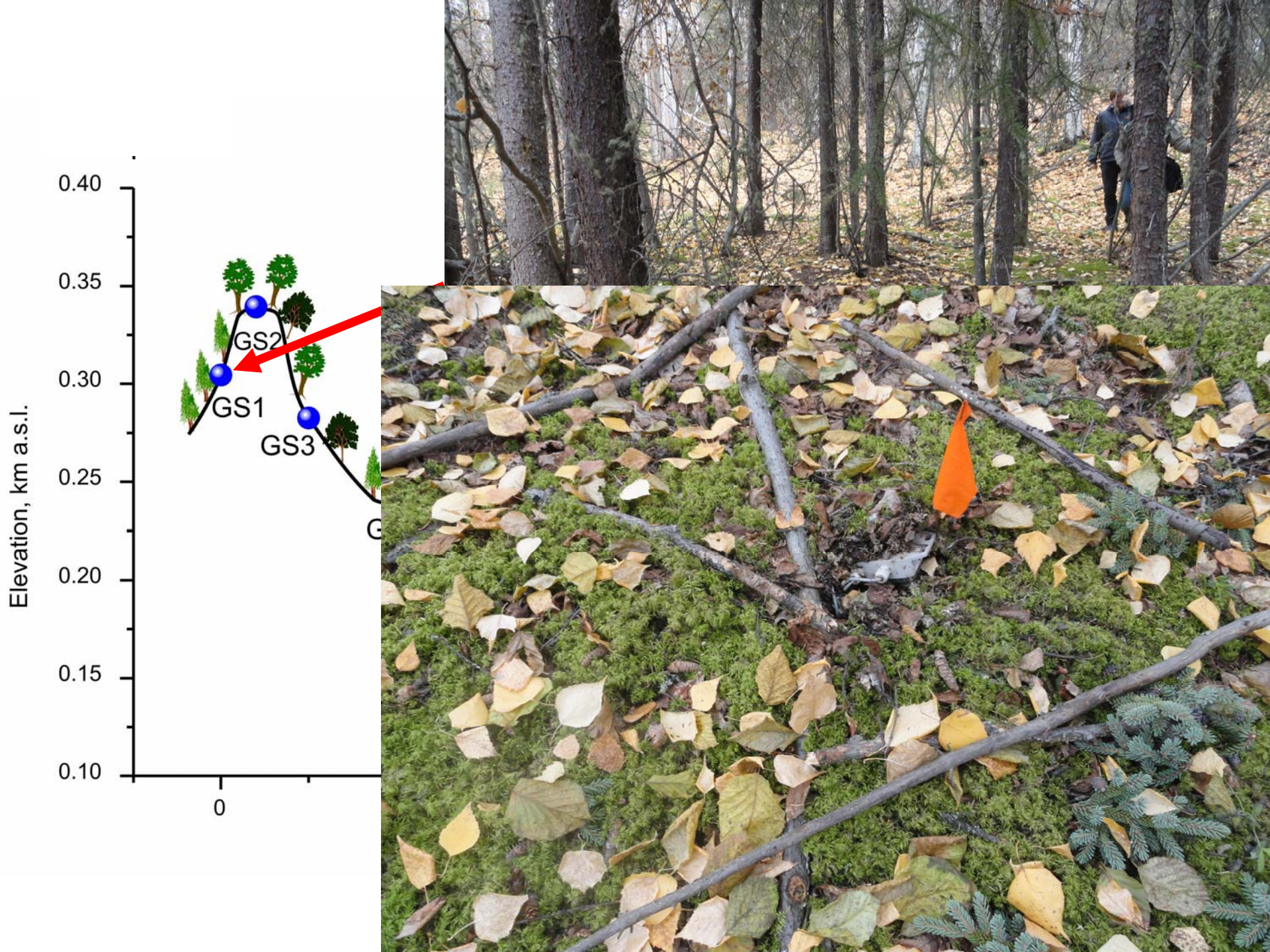


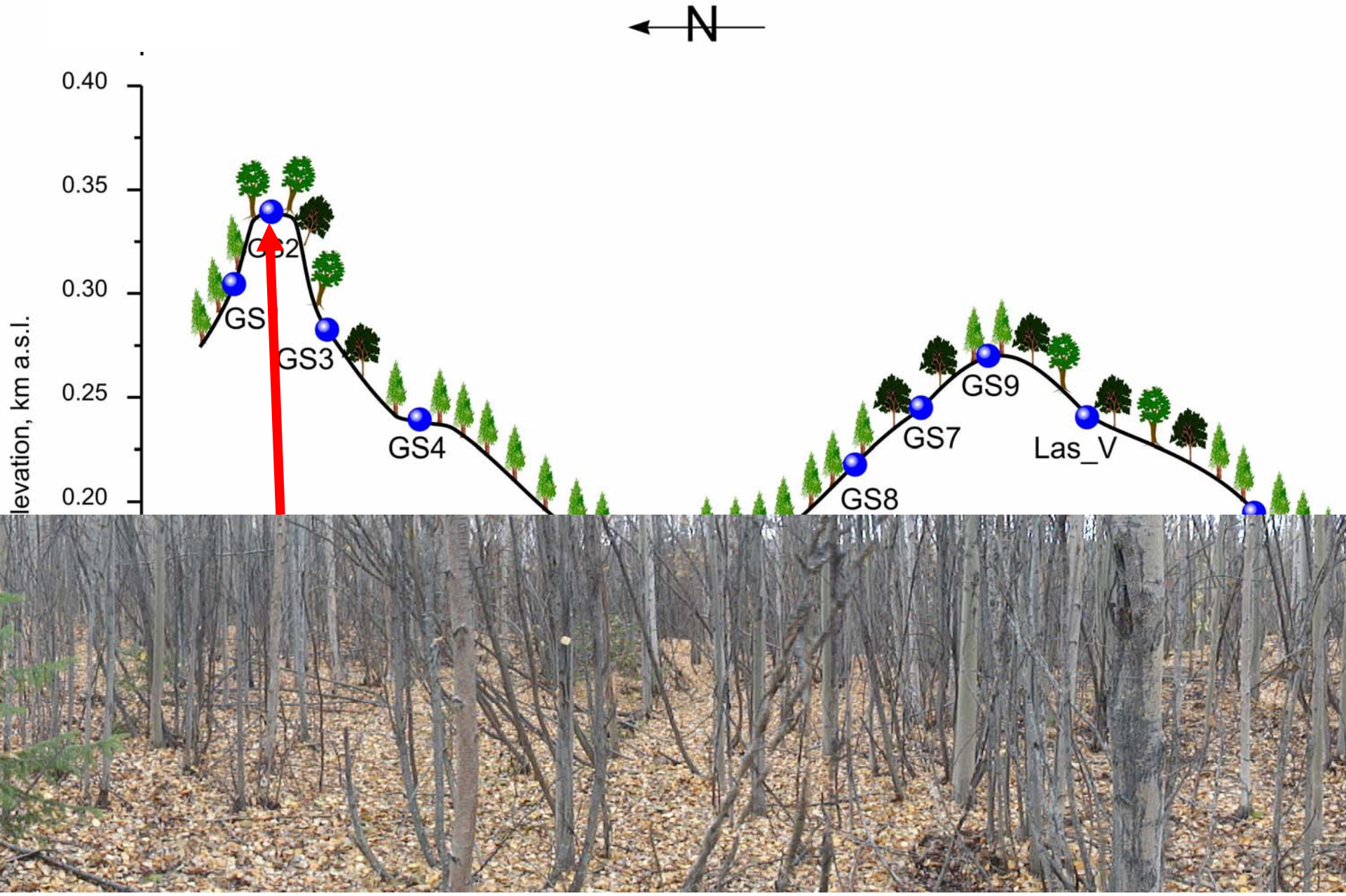
Jorgenson, Romanovsky et al, 2010

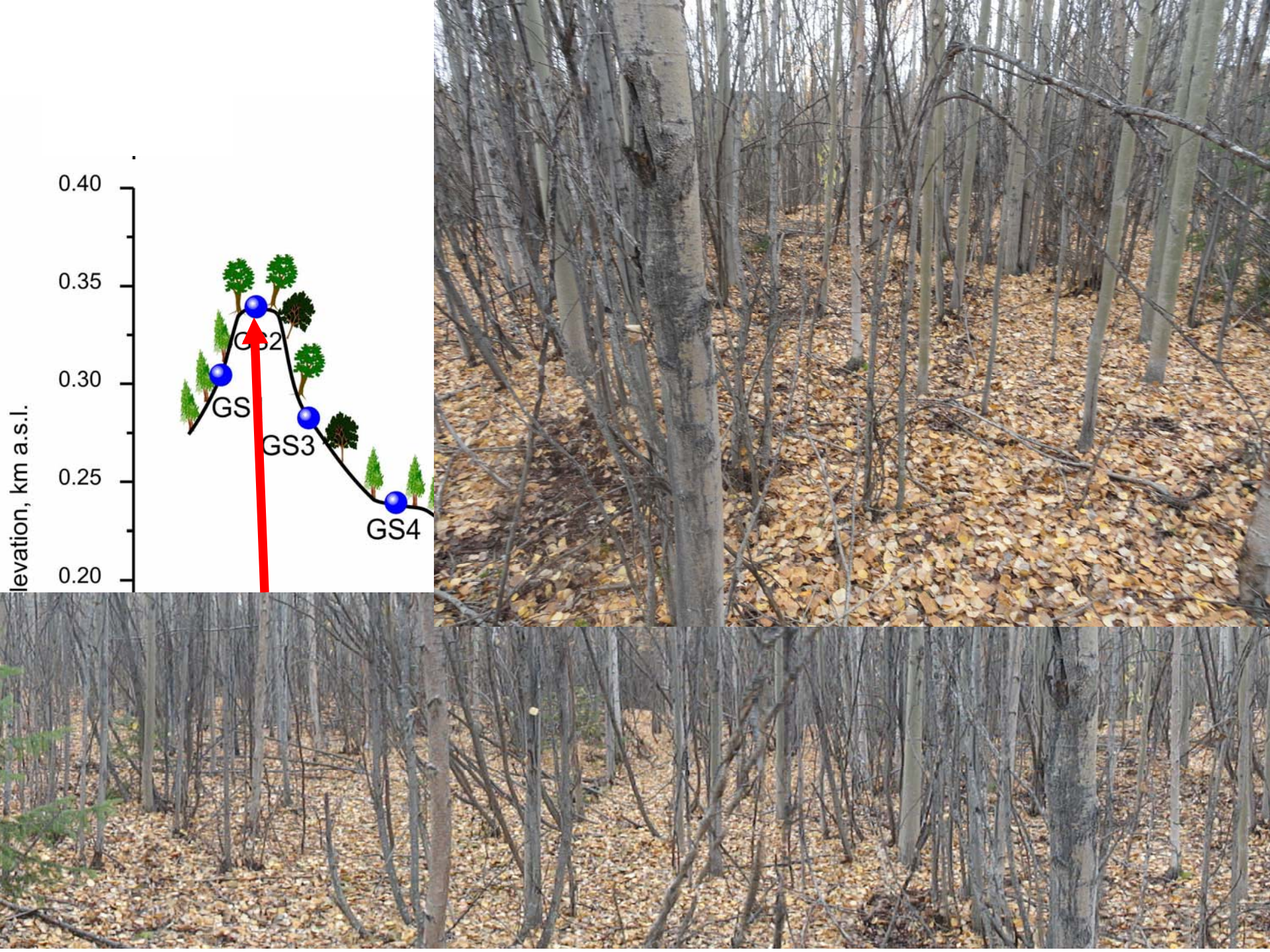

GS1
GS2
GS3
GS4
polygon (GS5)
forest (GS6)
GS7
las_V
P Creek
GS8
GS9
Goldstream Rd
1819 ft
Image © 2011 DigitalGlobe
© 2011 Europa Technologies
© 2011 Google
©2010 Google

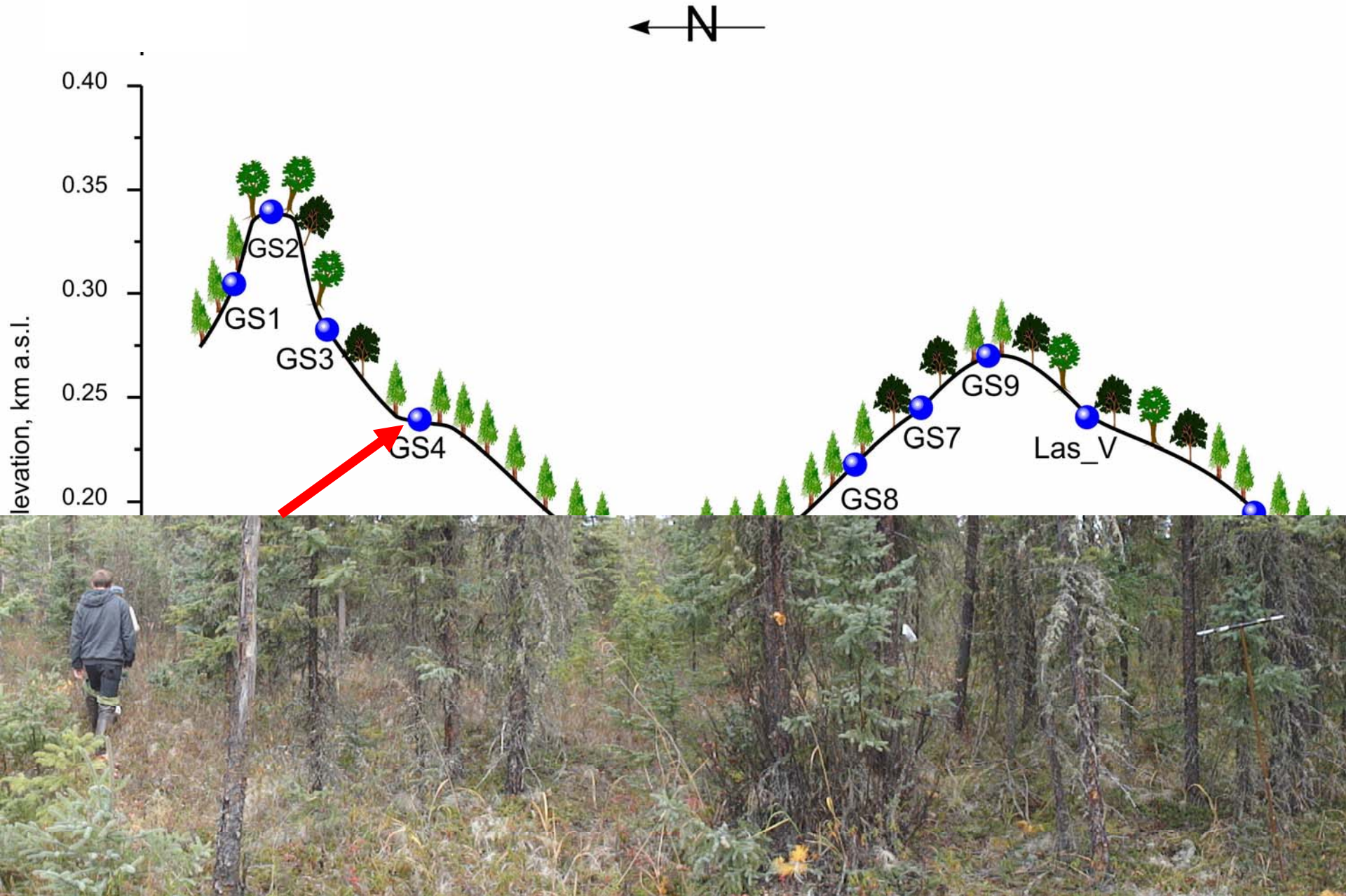

N
0.40
0.35
0.30
0.25
0.20
0.15
0.10
Elevation, km a.s.l.
GS1
GS2
GS3
GS4
GS5
GS6
GS7
GS8
GS9
Las_V
P Creek
0
1
2
3
4
5
6
Distance, km

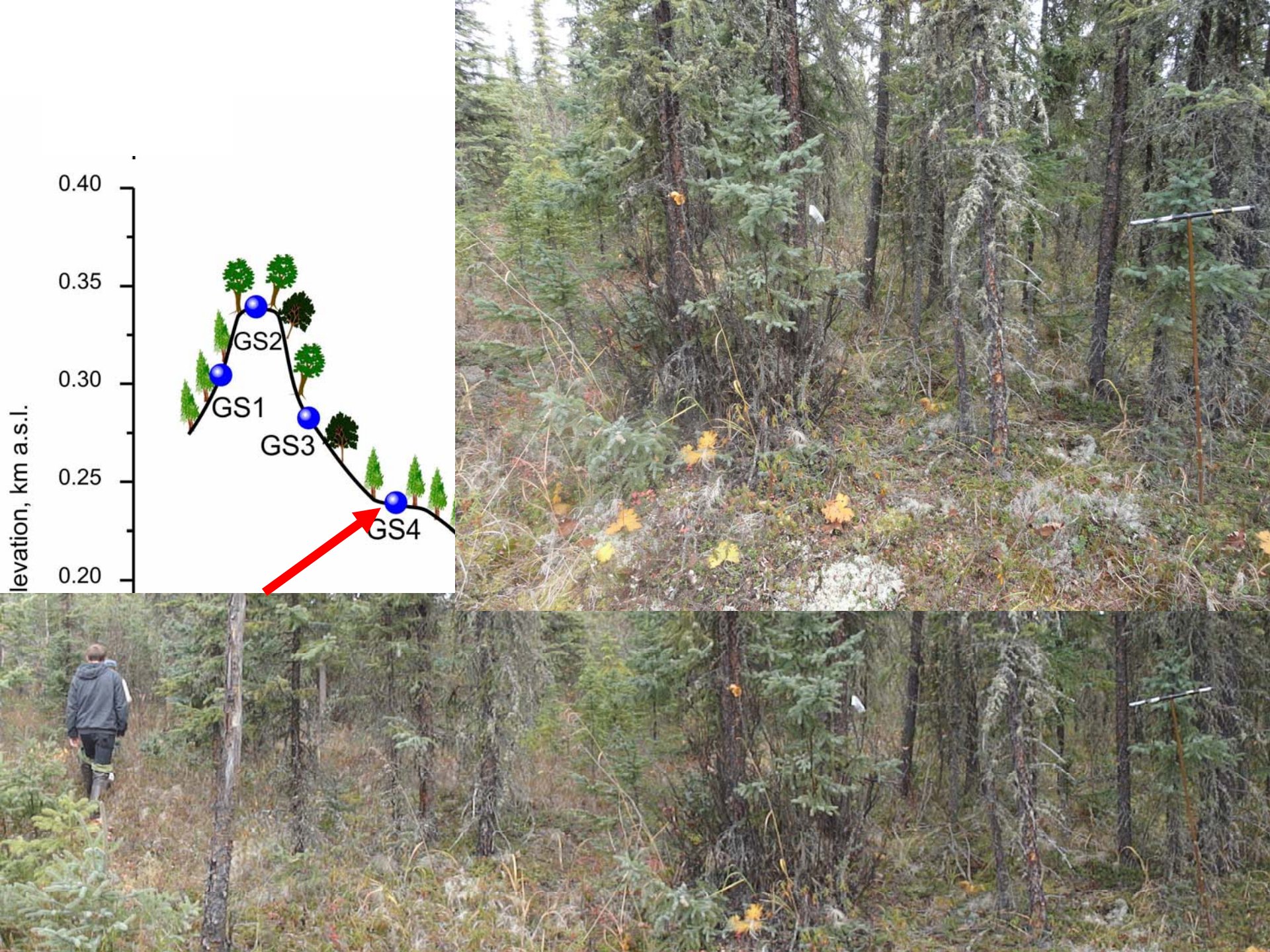

0.40
0.35
0.30
0.25
0.20
0.15
0.10
Elevation, km a.s.l.
GS1
GS2
GS3
GS4
GS5
GS6
0
1
2
3
4
5
Distance, km

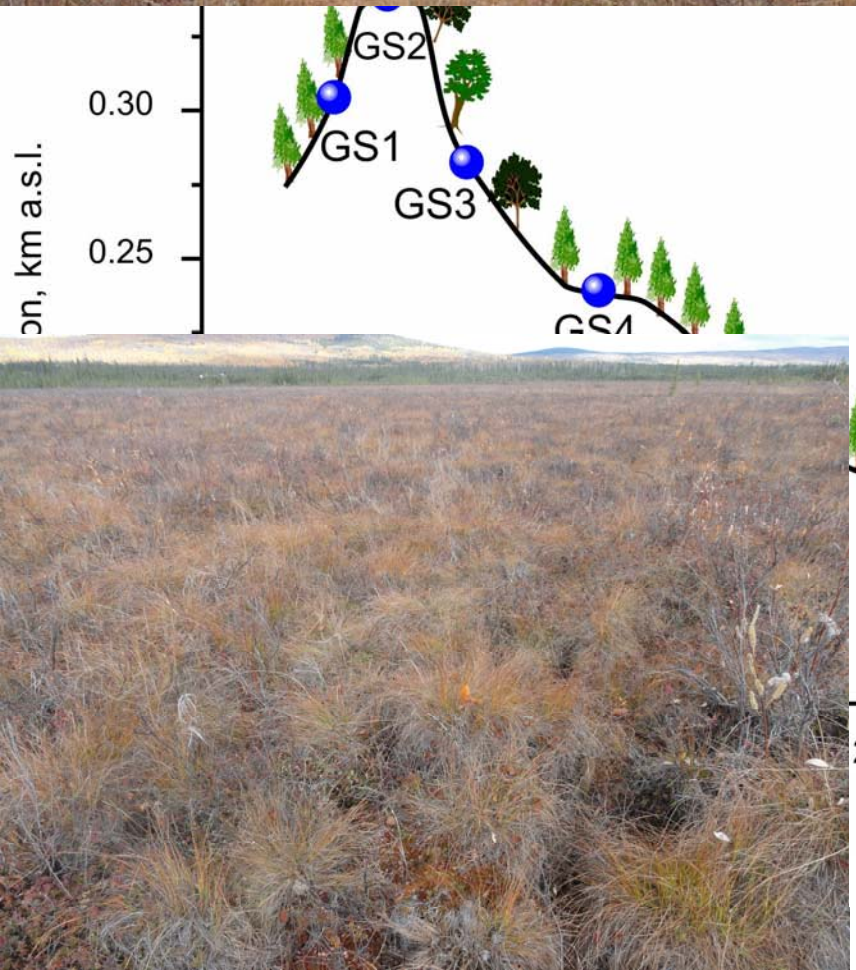

0.40
0.35
0.30
0.25
0.20
0.15
0.10
Elevation, km a.s.l.
0
GS1
GS2
GS3

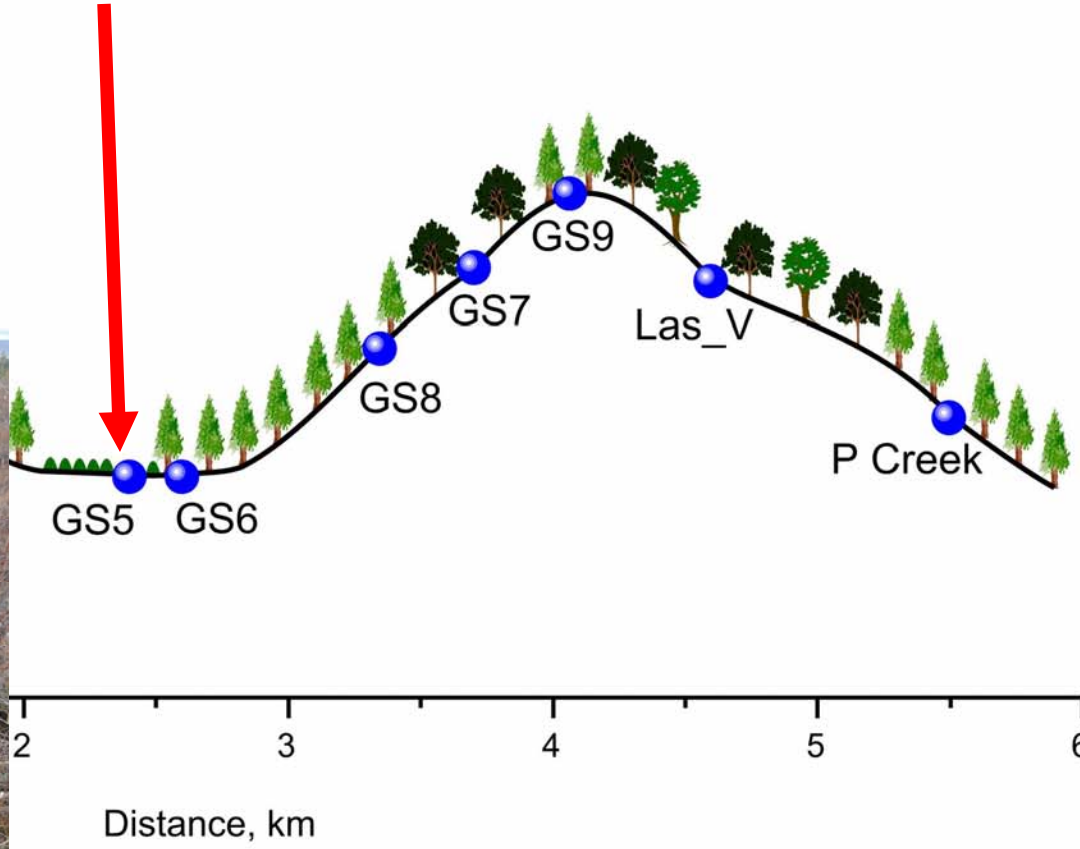

N
0.40
0.35
0.30
0.25
0.20
levation, km a.s.l.
GS
GS2
GS3
GS4
GS8
GS7
GS9
Las_V

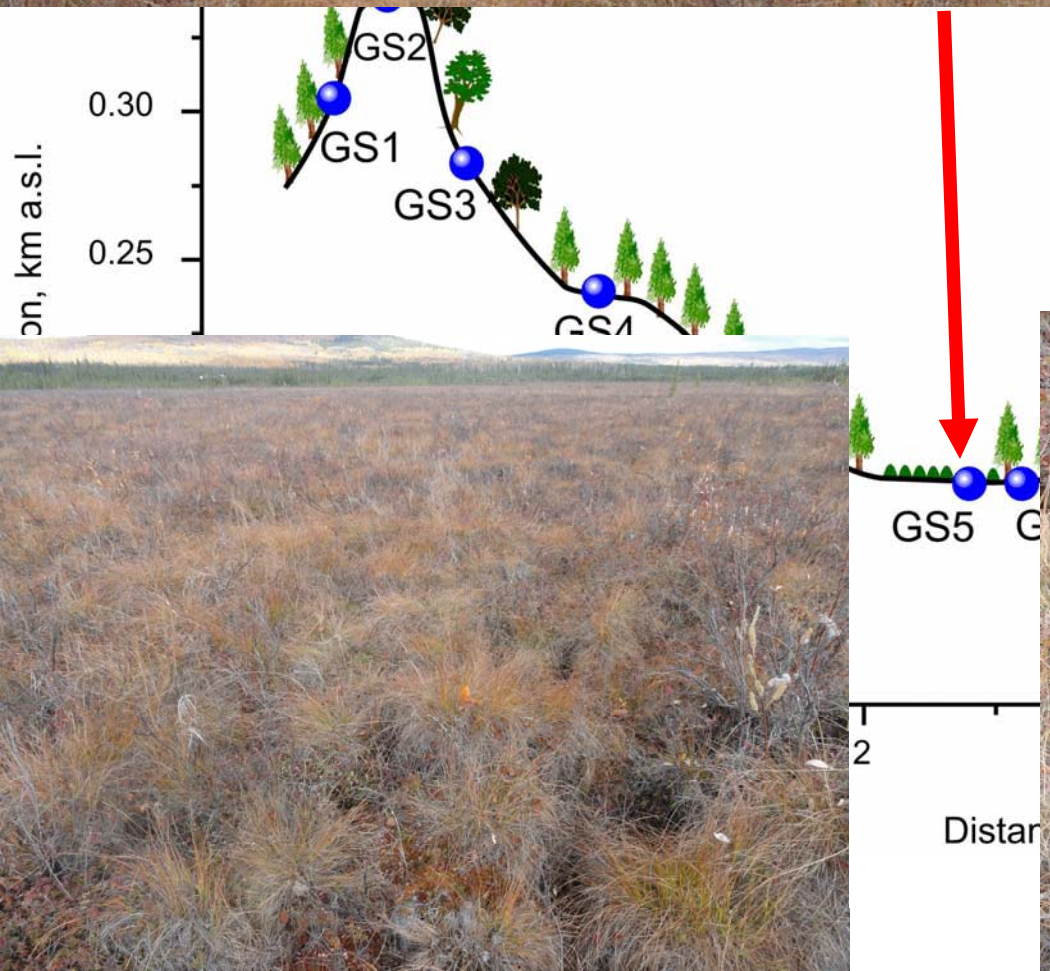

0.40
0.35
0.30
0.25
0.20
levation, km a.s.l.
GS
GS2
GS3
GS4

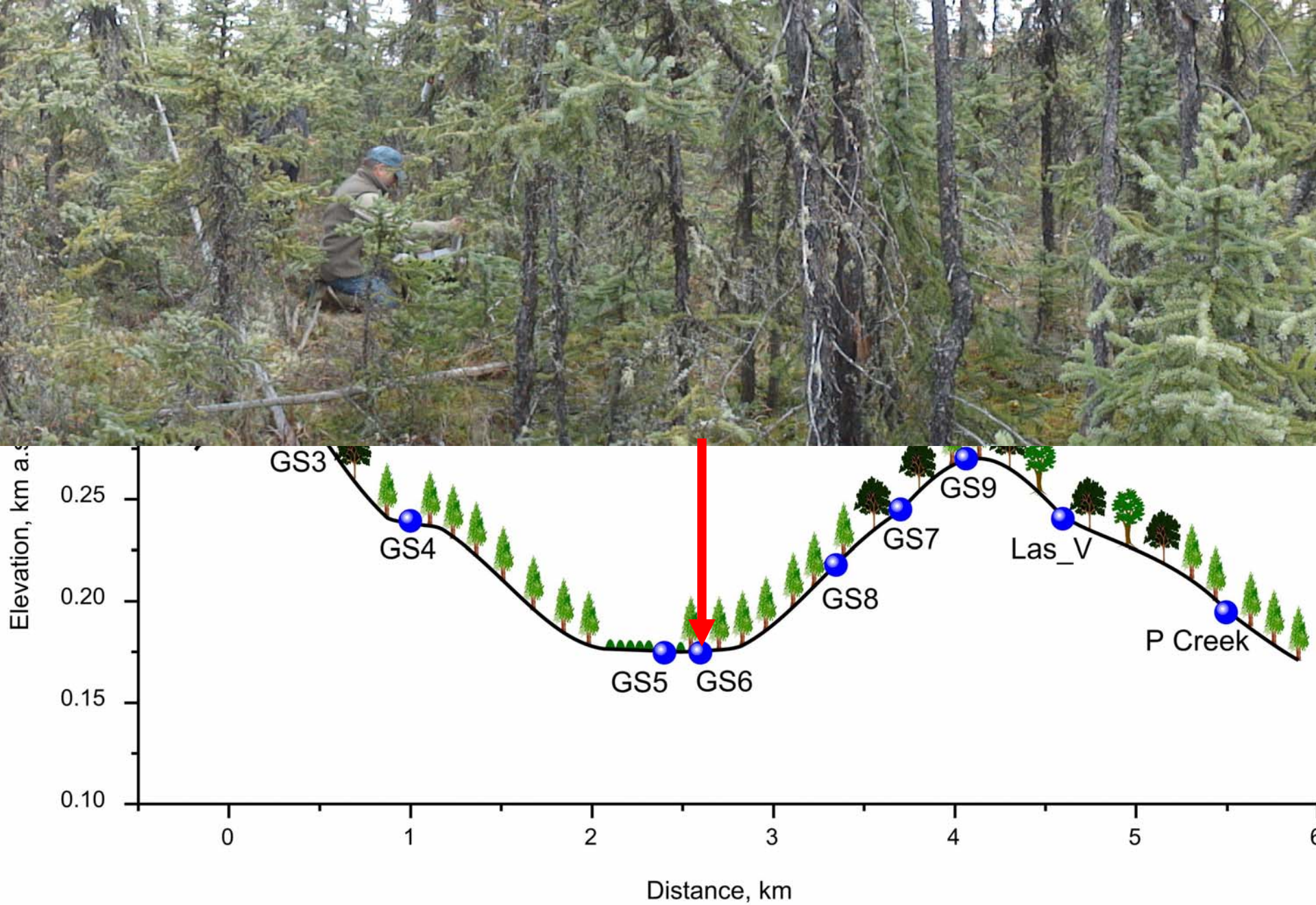

N
0.40
0.35
0.30
0.25
0.20
levation, km a.s.l.
GS1
GS2
GS3
GS4
GS7
GS8
GS9
Las_V


0.40
0.35
0.30
0.25
0.20
levation, km a.s.l.
GS1
GS2
GS3
GS4

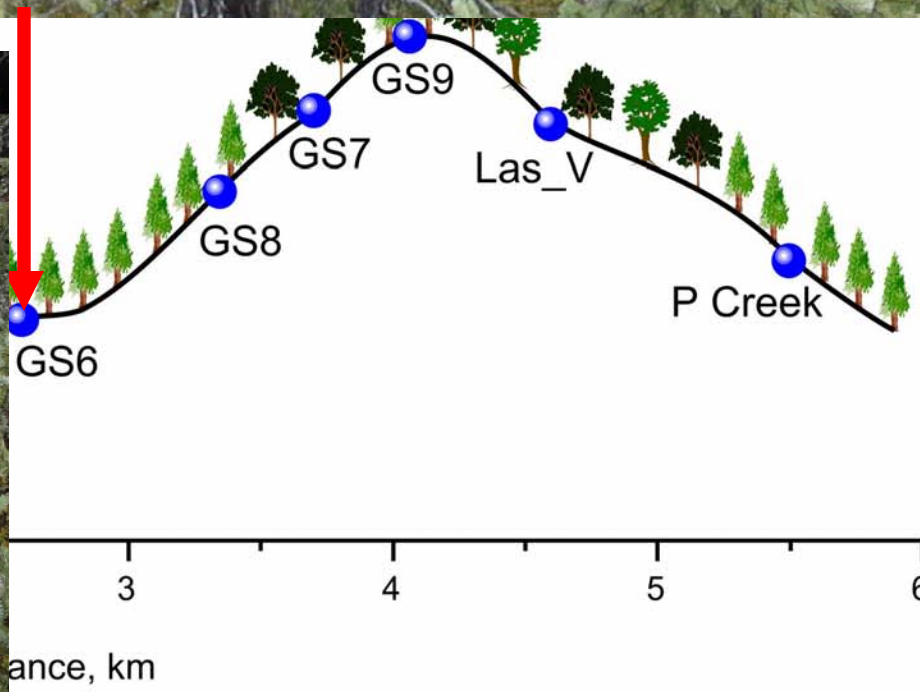

0.30
0.25
on, km a.s.l.
GS1
GS2
GS3

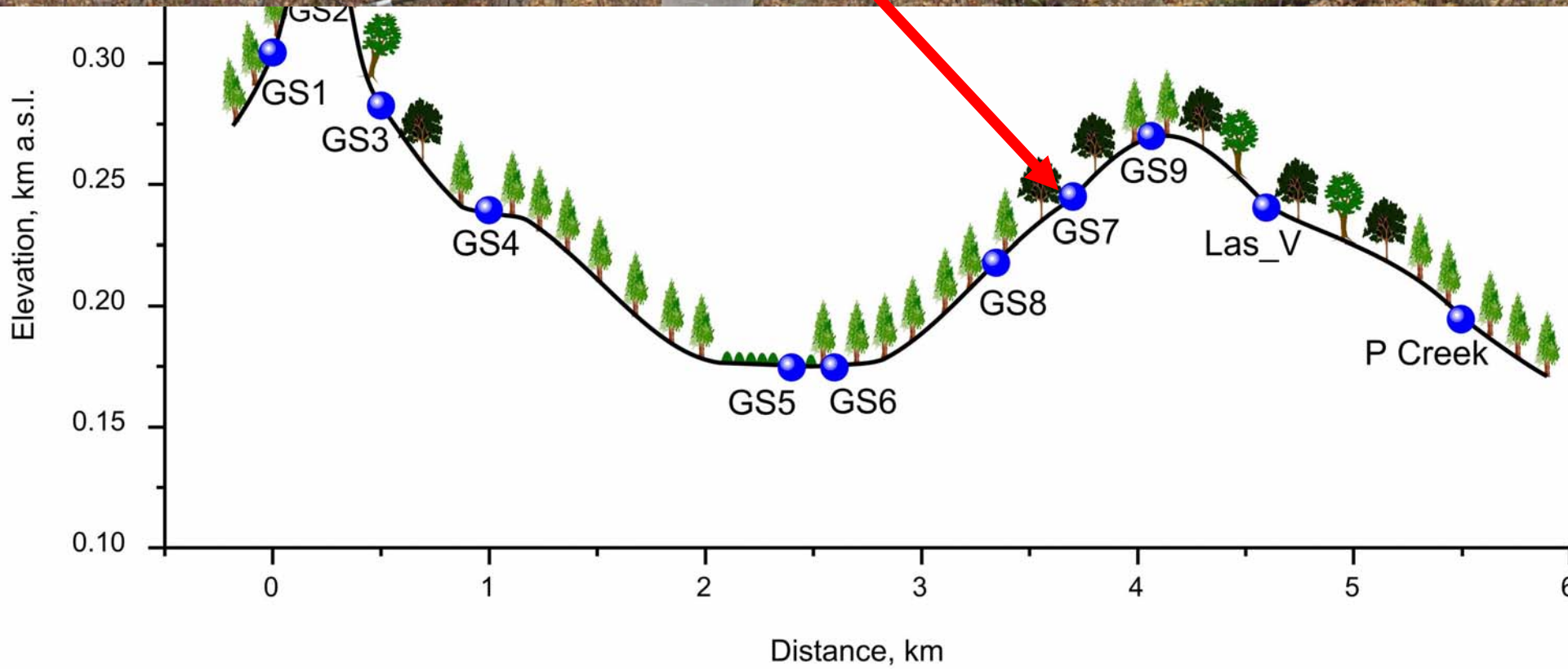

GS5
GS6
GS8
GS7
GS9
Las_V
P Creek
2
3
4
5
Distance, km

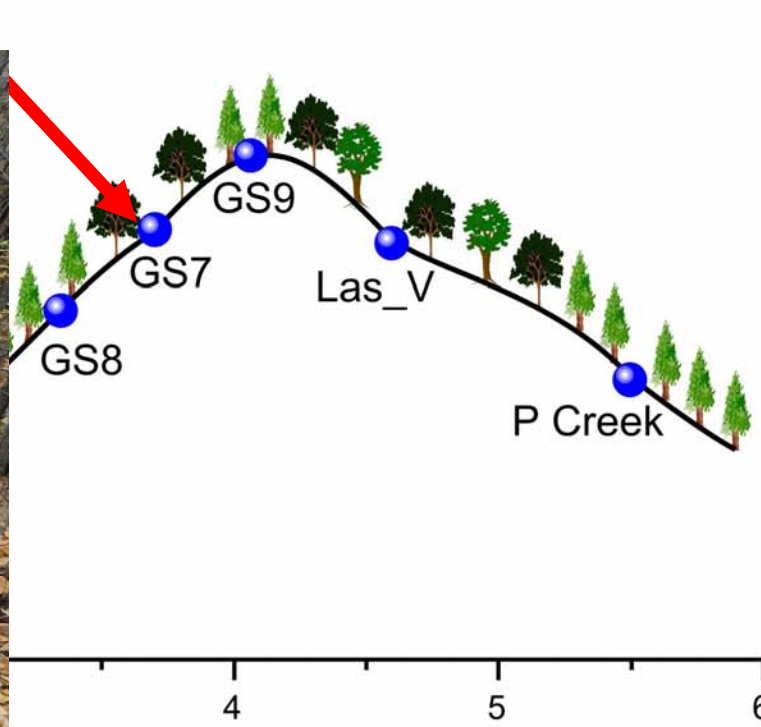

0.30
0.25
GS1
GS2
GS3
GS5
GS9

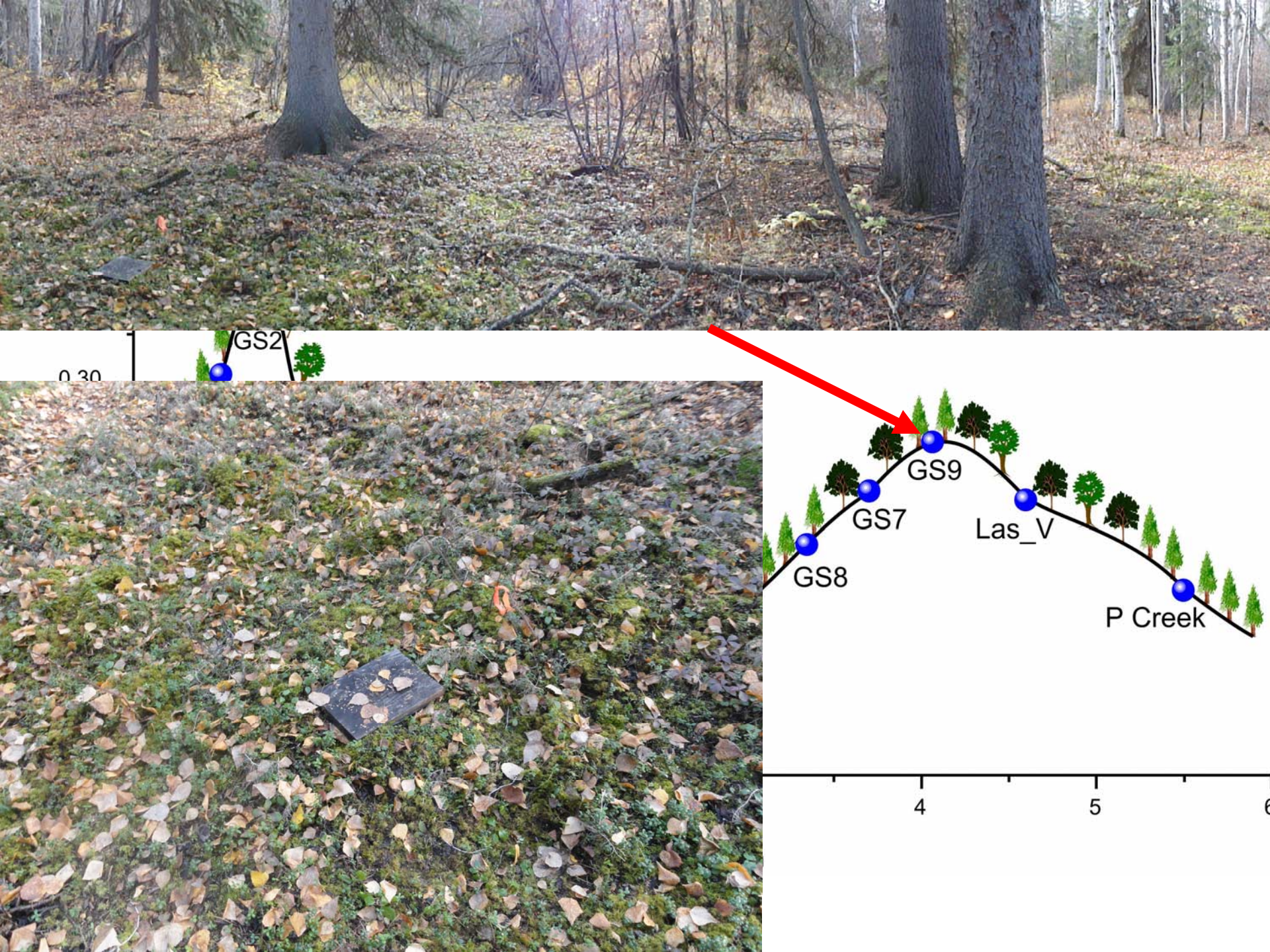

GS3
GS4
GS5
GS6
GS7
GS8
GS9
Las_V
P Creek
Elevation, km a.s
0.25
0.20
0.15
0.10
0
1
2
3
4
5
Distance, km

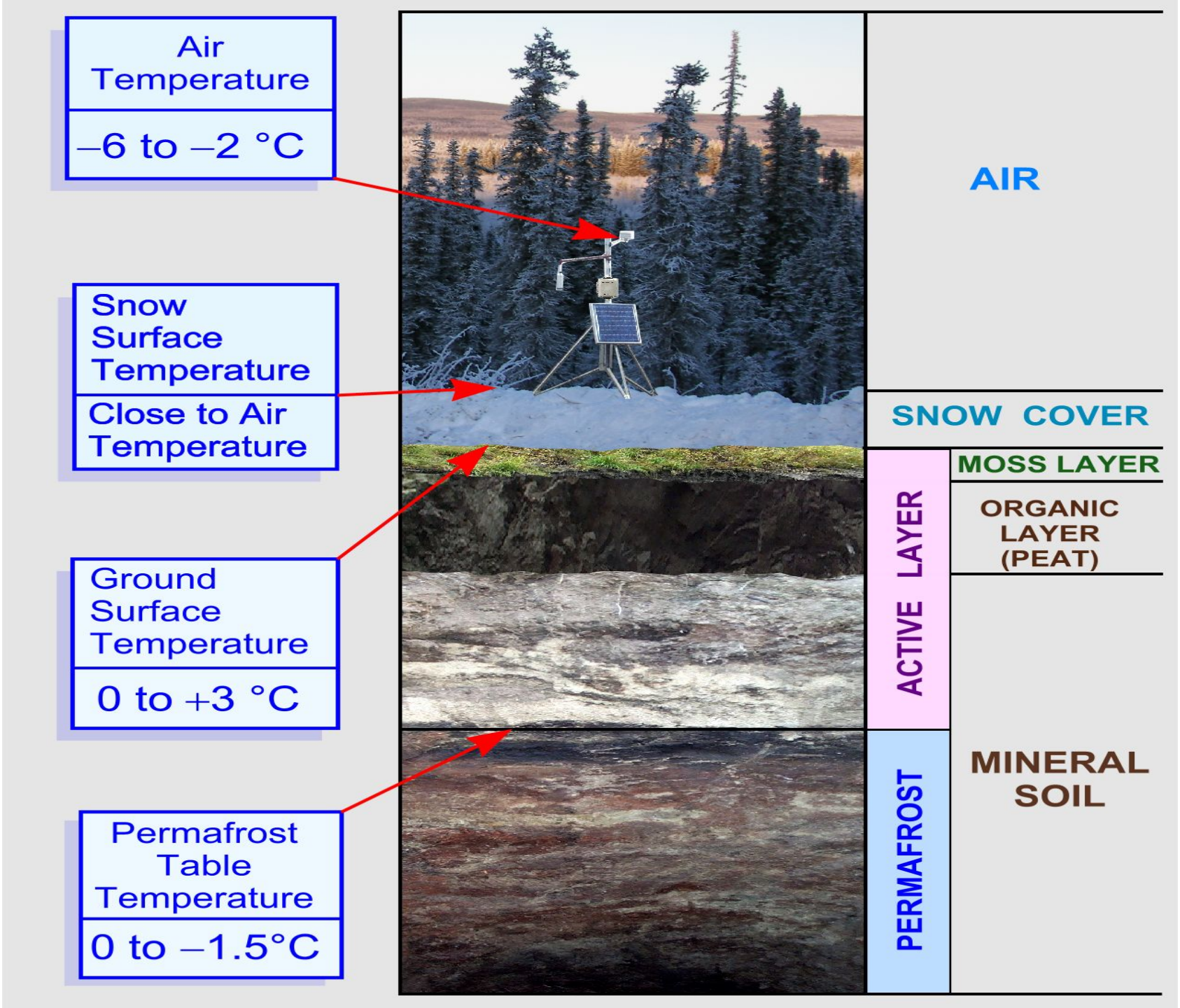
GS3


GS9
GS7
Las_V
GS8
P Creek
GS6
3
4
5
ance, km

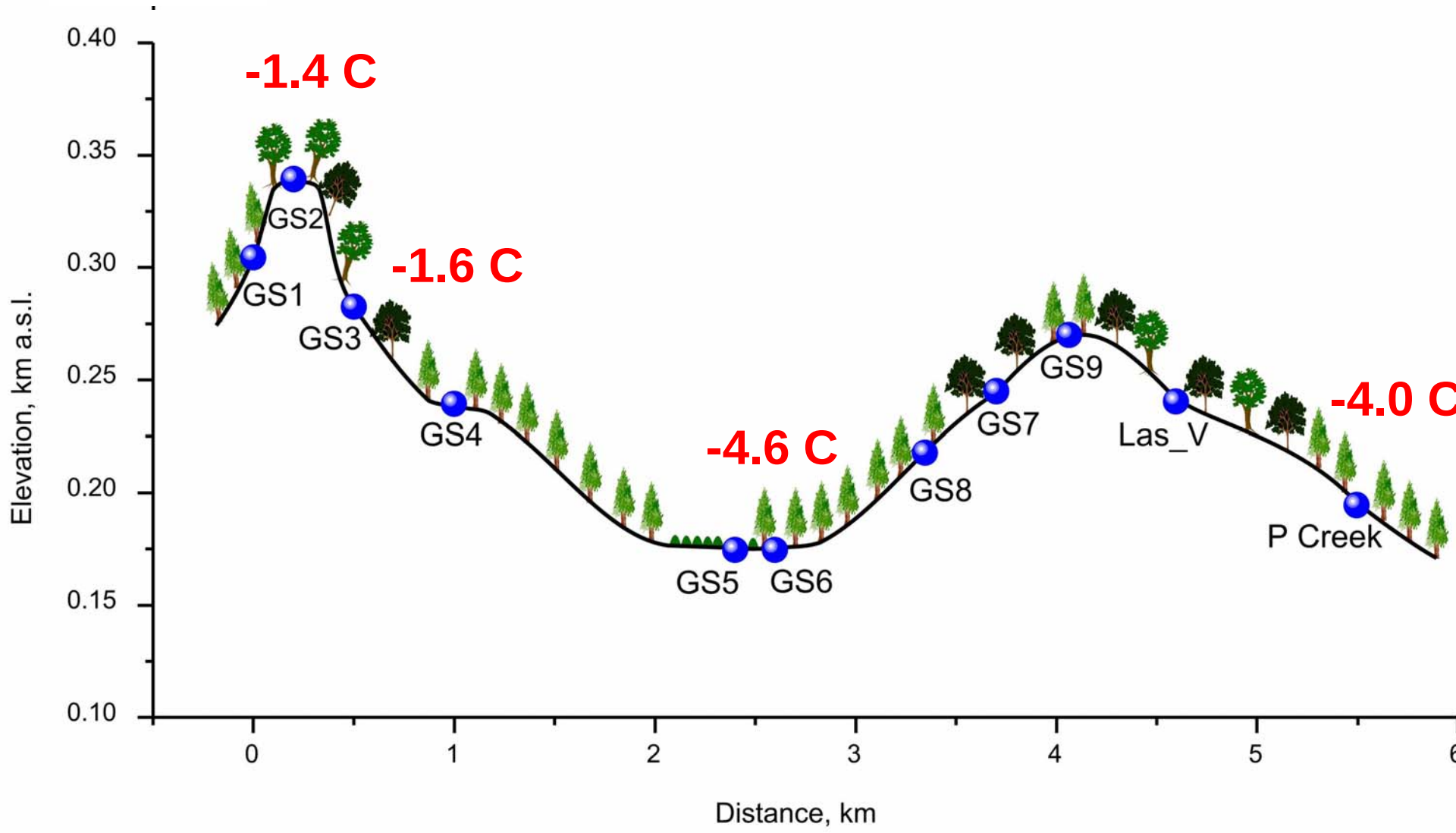

GS2
GS1
GS3
GS4
GS5
GS6
GS7
GS8
GS9
Las_V
P Creek
0.30
0.25
0.20
0.15
0.10
Elevation, km a.s.l.
0
1
2
3
4
5
6
Distance, km


GS9
GS7
Las_V
GS8
P Creek
4
5

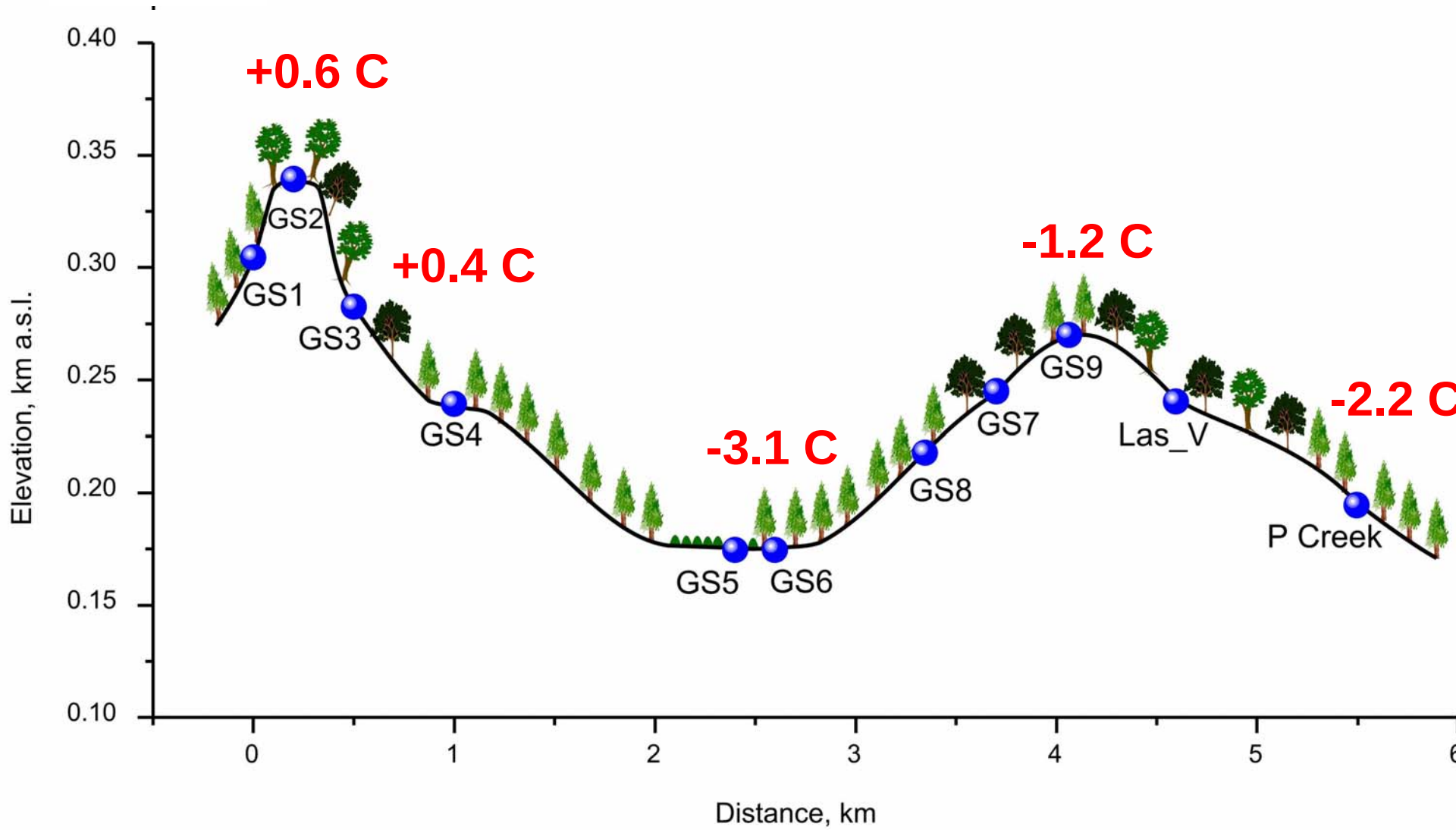

GS2
0.30
GS9
GS7
Las_V
GS8
P Creek
4
5


Air Temperature
–6 to –2 °C
Snow Surface Temperature
Close to Air Temperature
Ground Surface Temperature
0 to +3 °C
Permafrost Table Temperature
0 to –1.5°C
AIR
SNOW COVER
MOSS LAYER
ORGANIC LAYER (PEAT)
ACTIVE LAYER
PERMAFROST
MINERAL SOIL

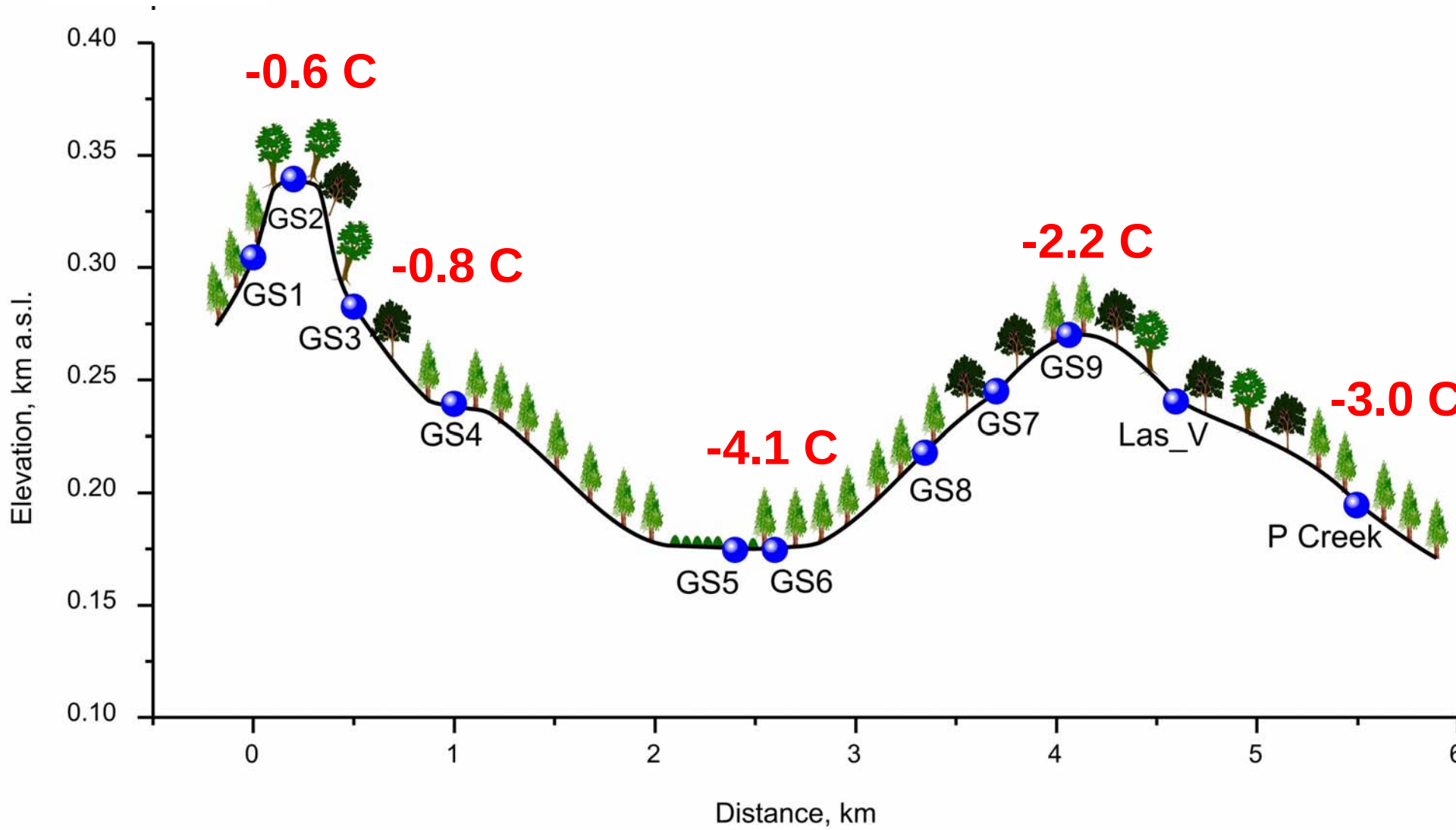
Air Temperature
2009



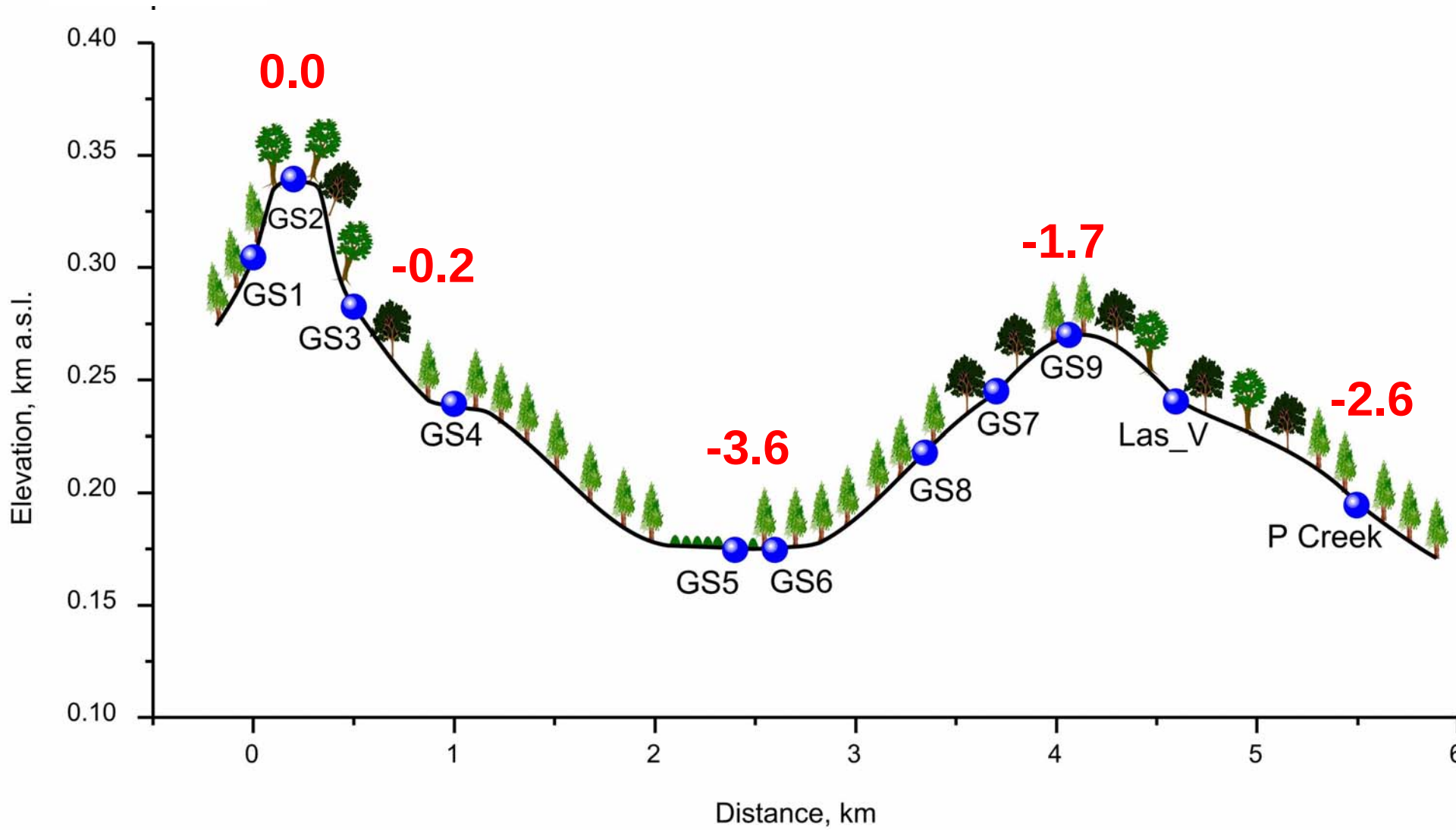
Air Temperature
2010



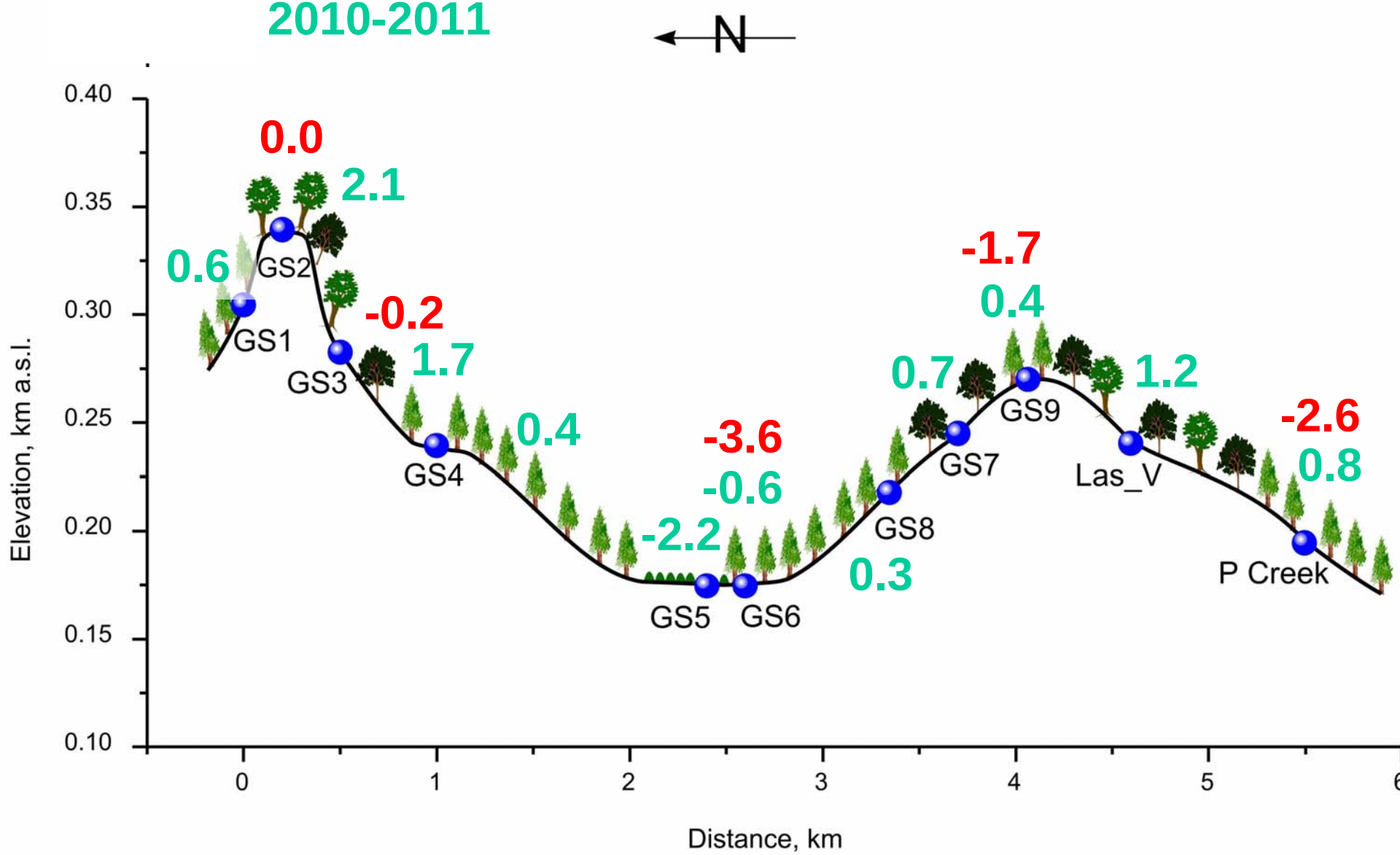
Air Temperature
2011



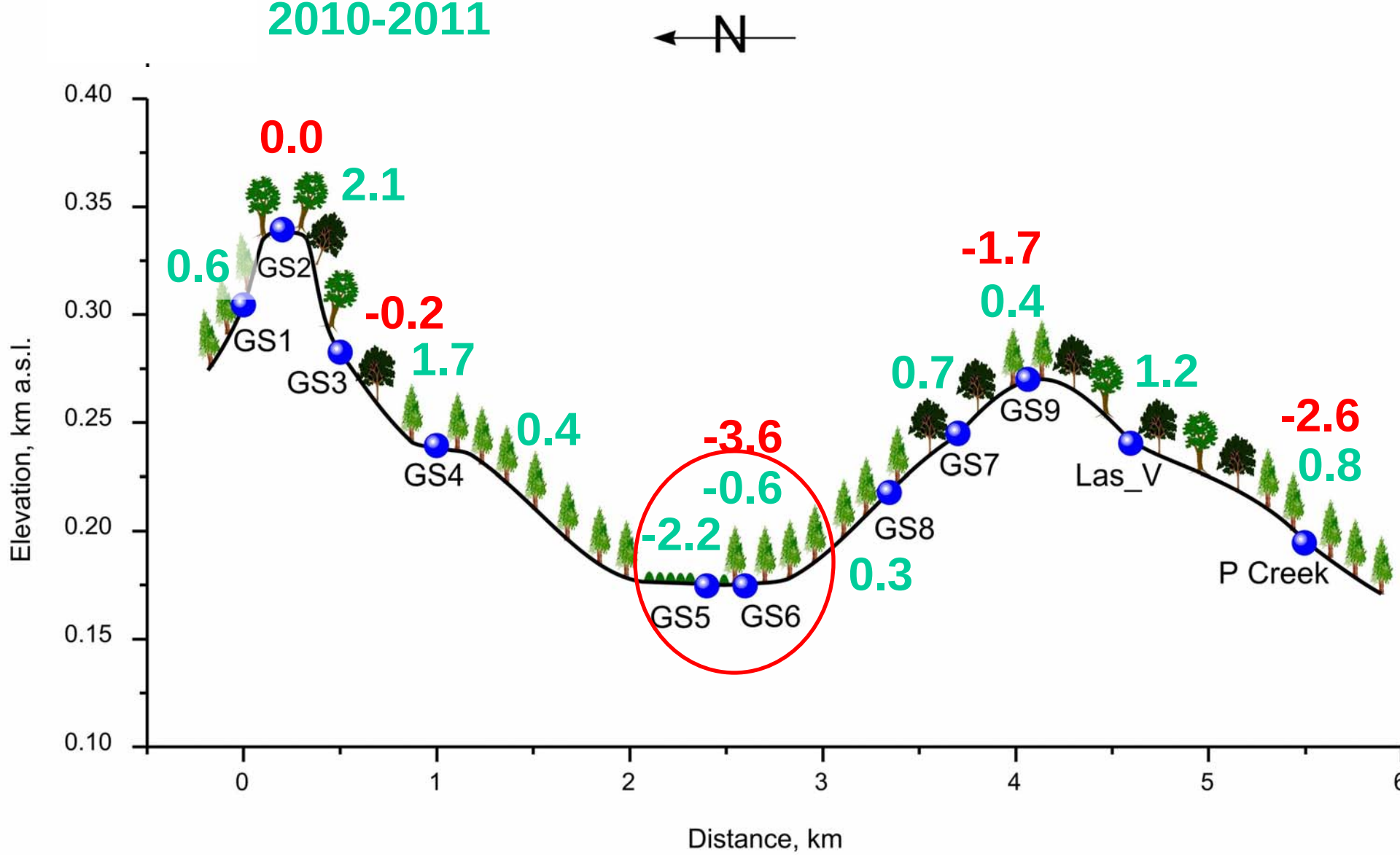
Air Temperature
2010 - 2011

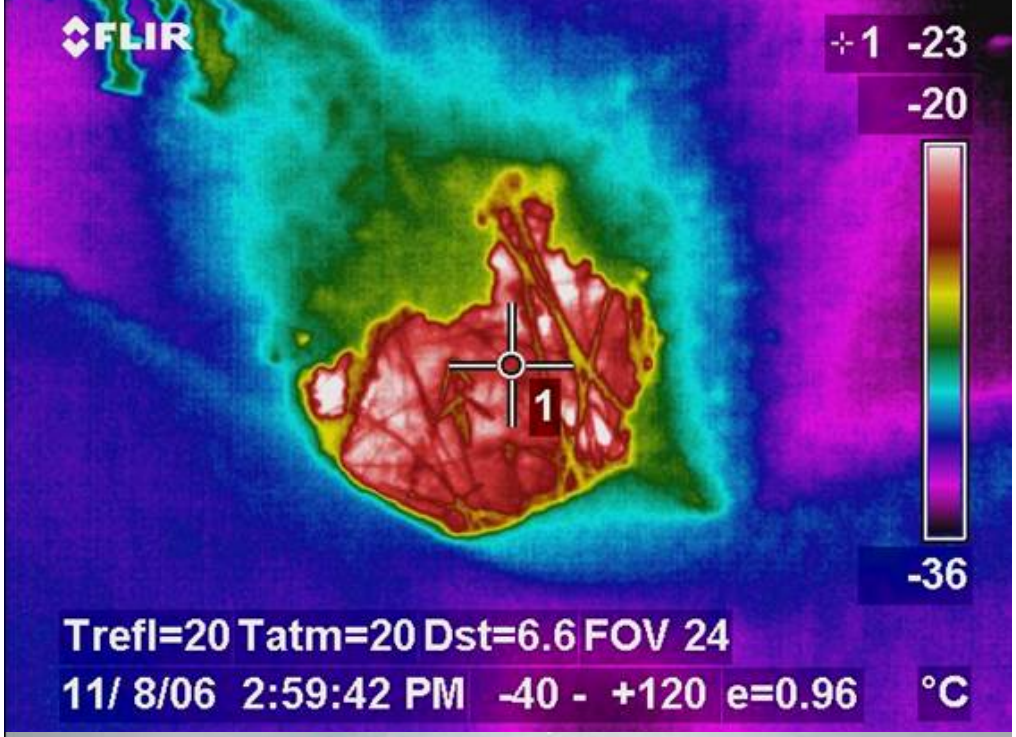


Surface Temperature
2010-2011

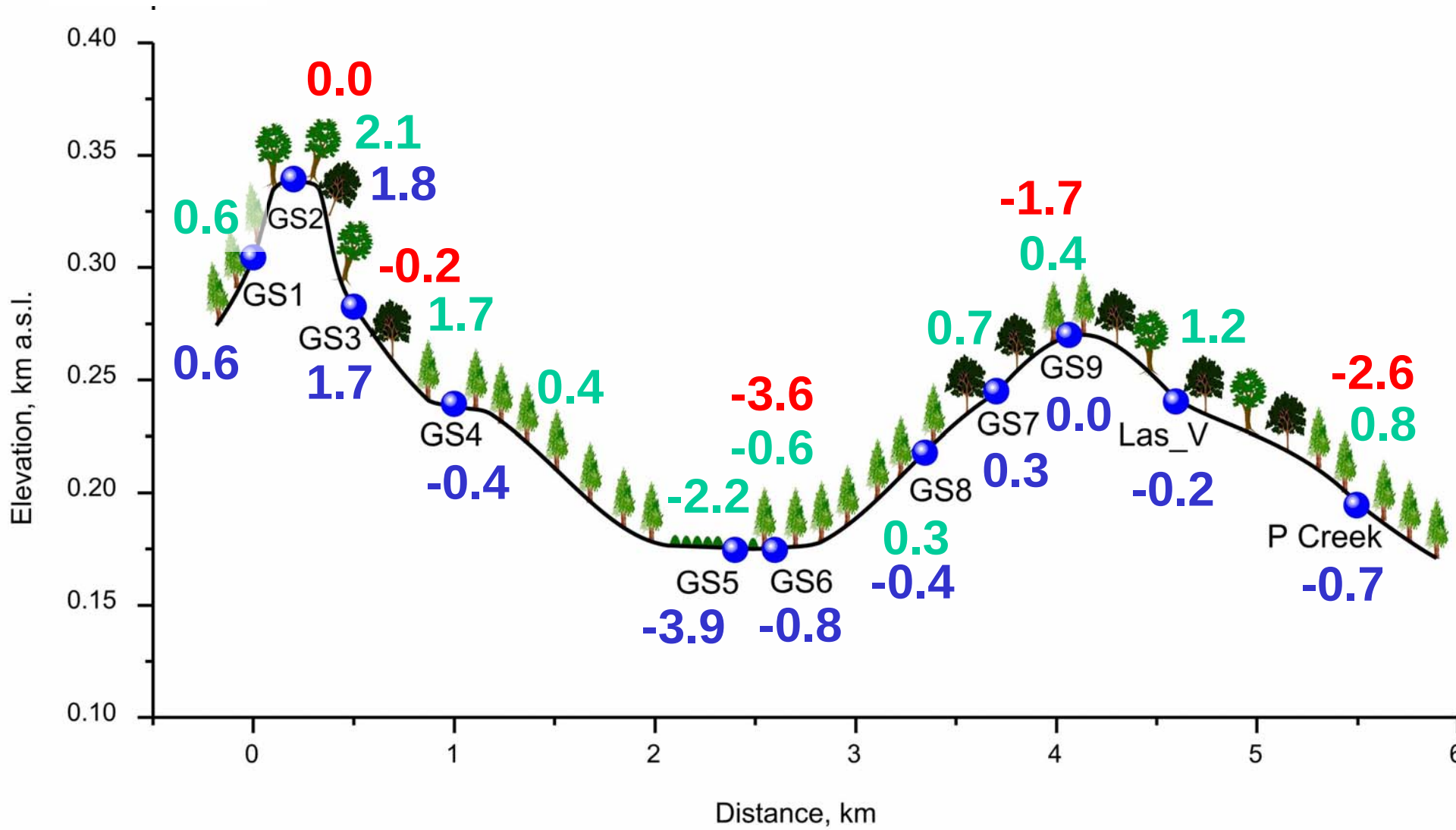


Surface Temperature
2010-2011

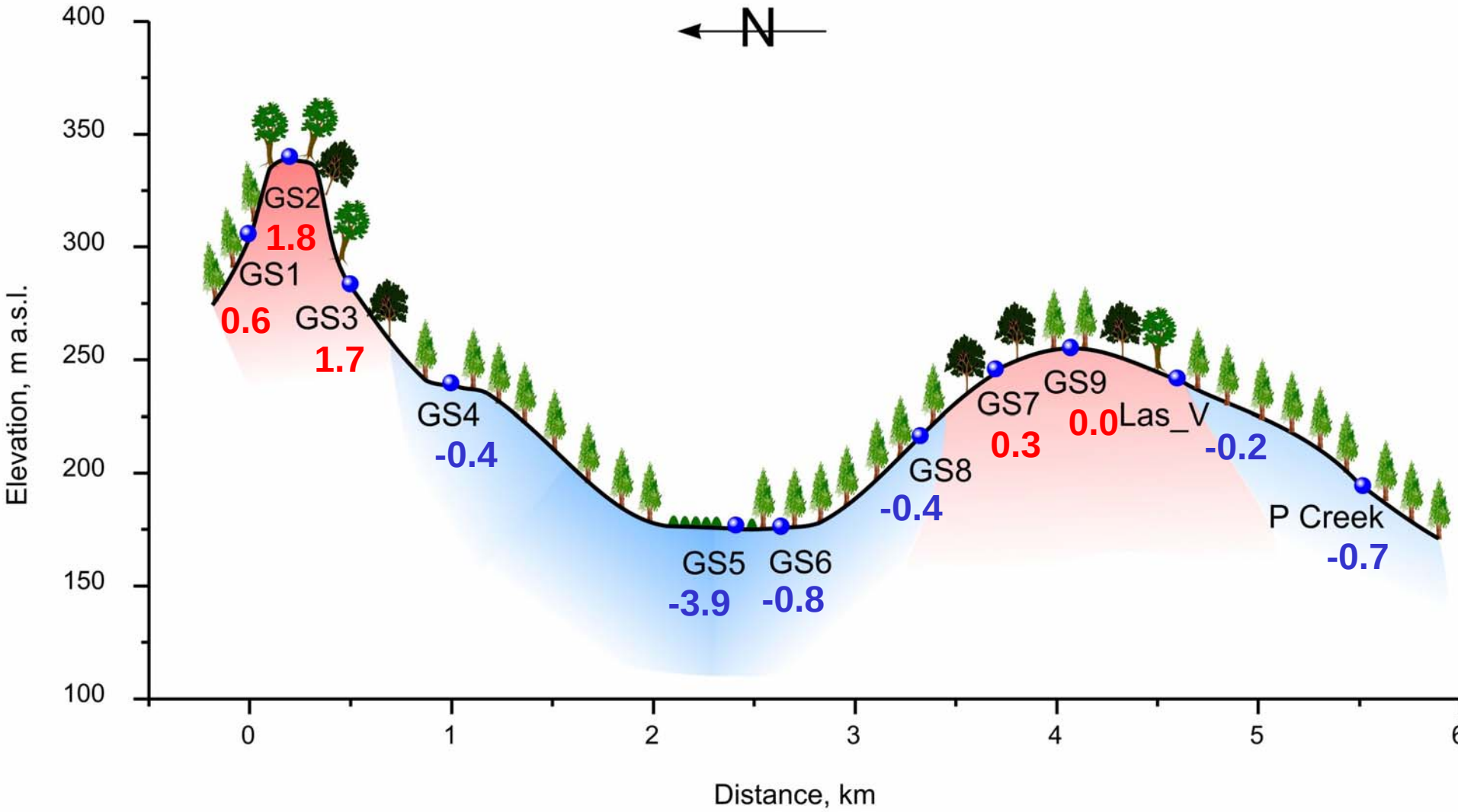



FLIR
1 -23
-20
-36
1
Trefl=20 Tatm=20 Dst=6.6 FOV 24
11/ 8/06 2:59:42 PM -40 - +120 e=0.96
°C

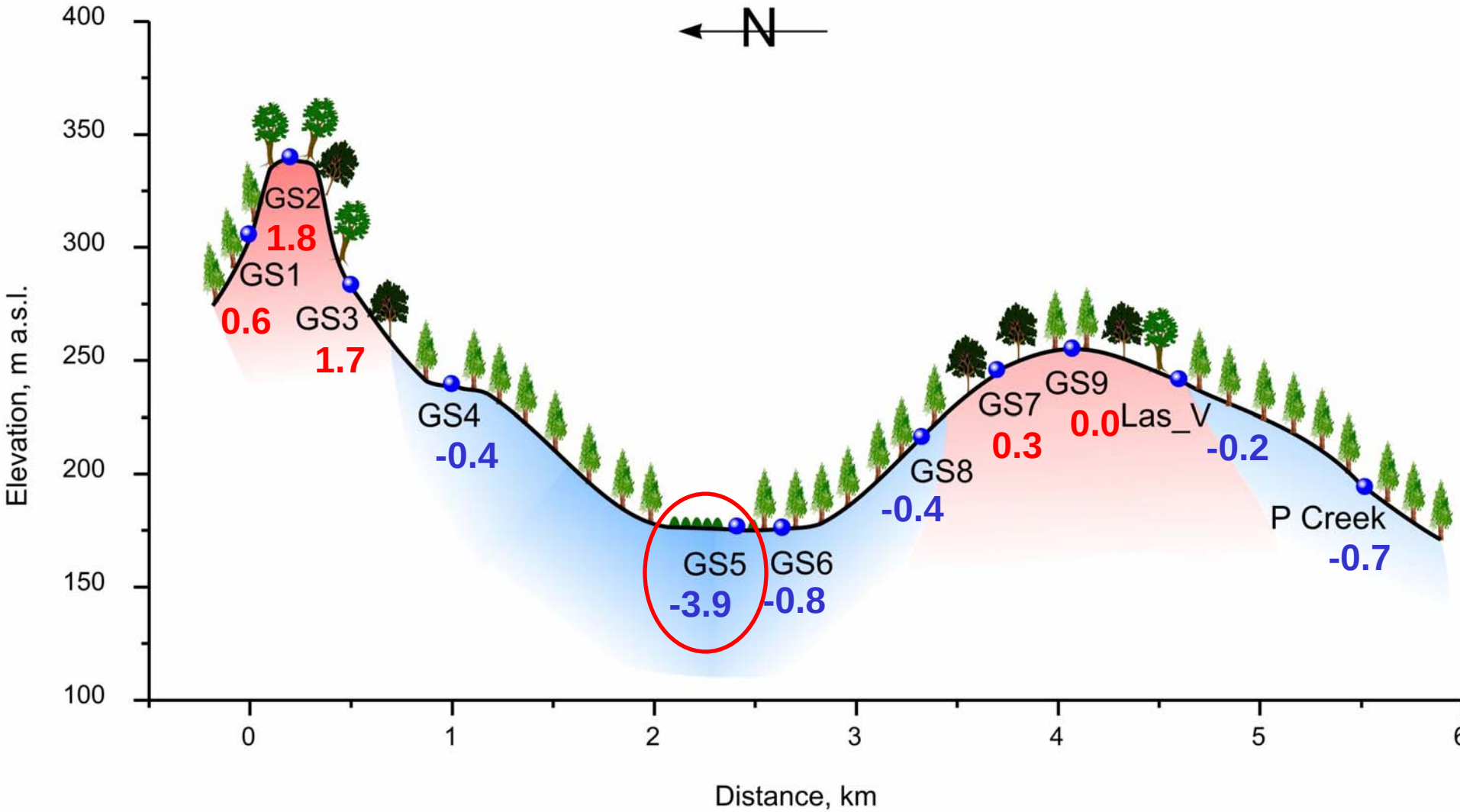
Temperature at 1.2 m
2010-2011



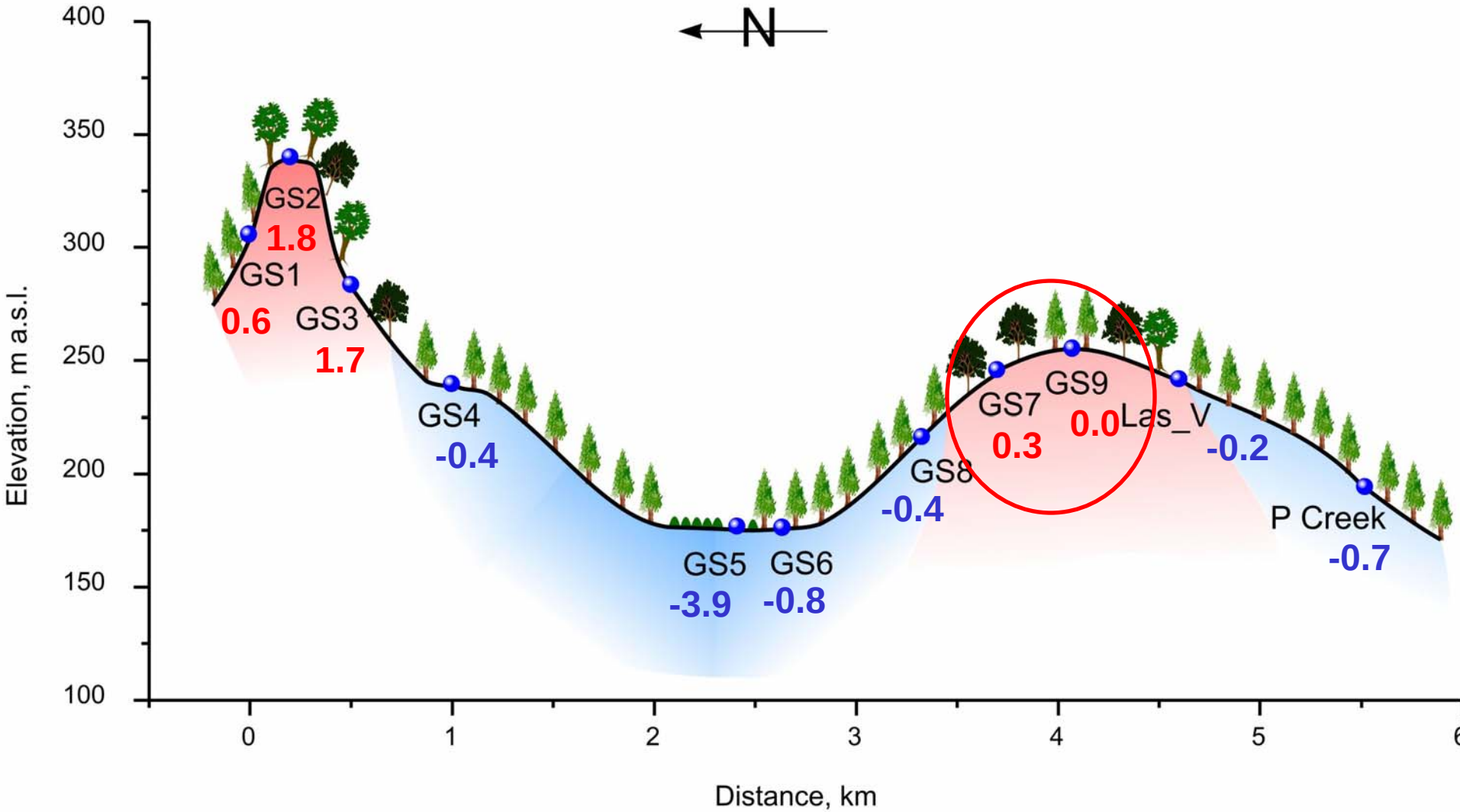
Temperature at 1.2 m
2010-2011

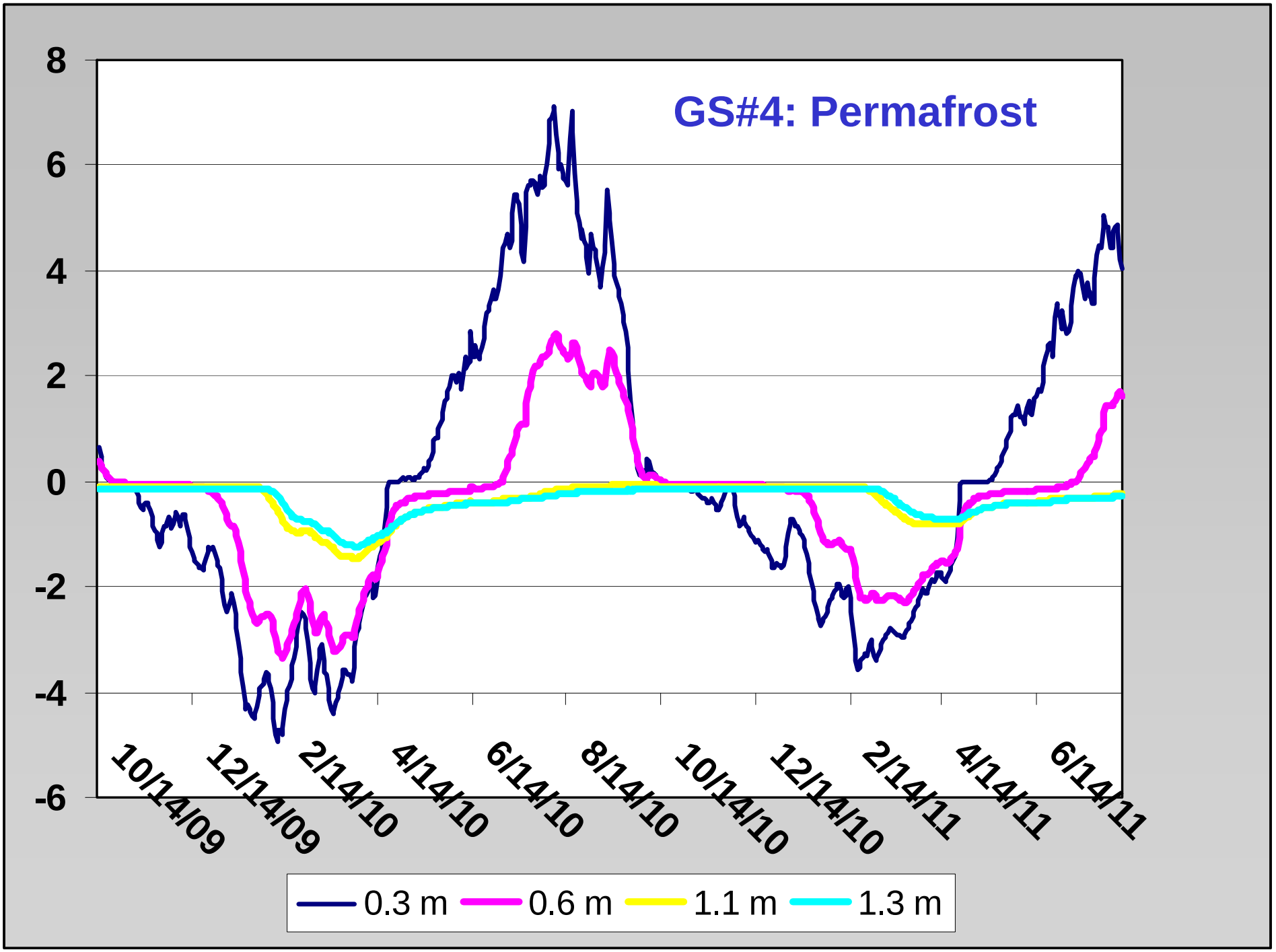


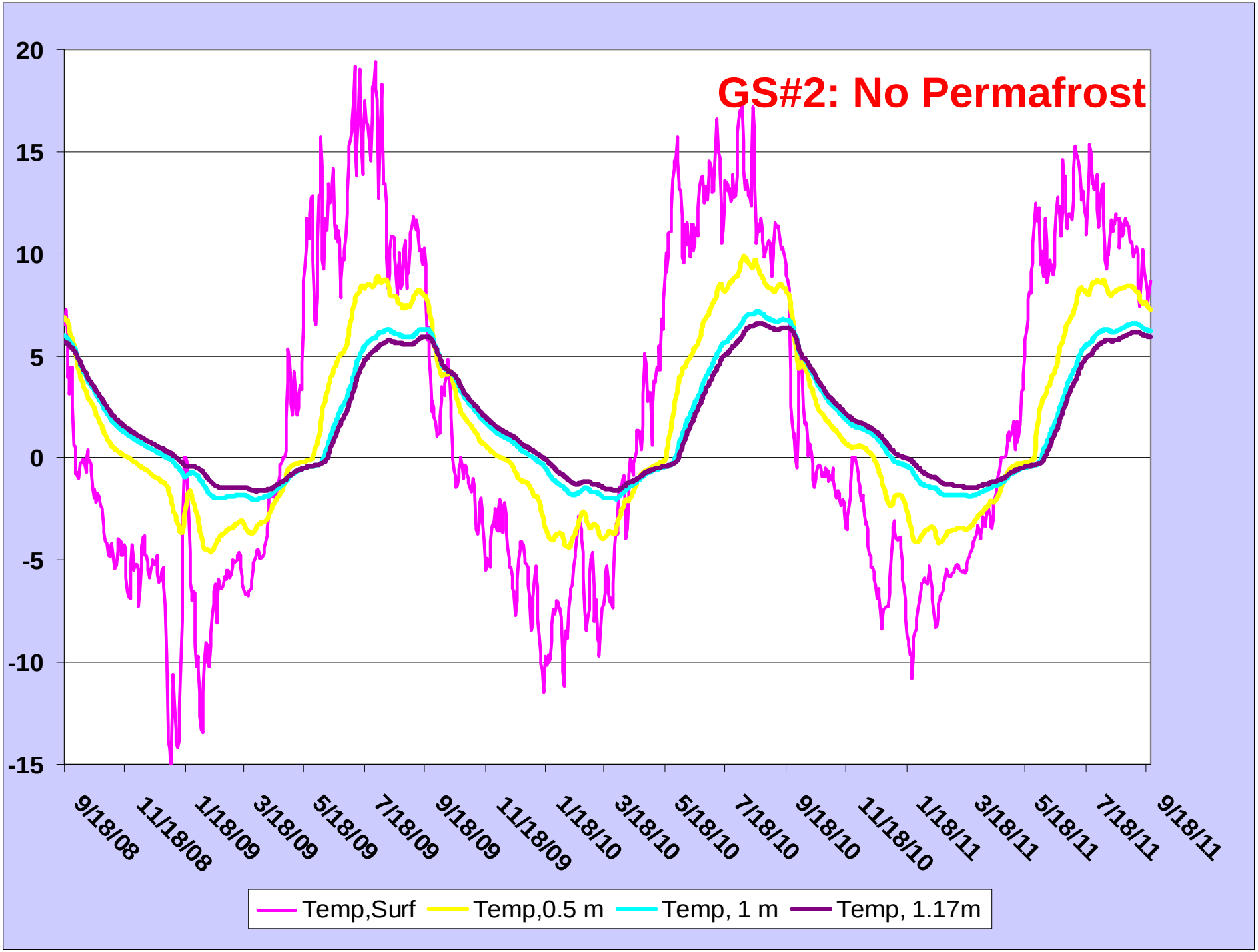
Temperature at 1.2 m
2010-2011

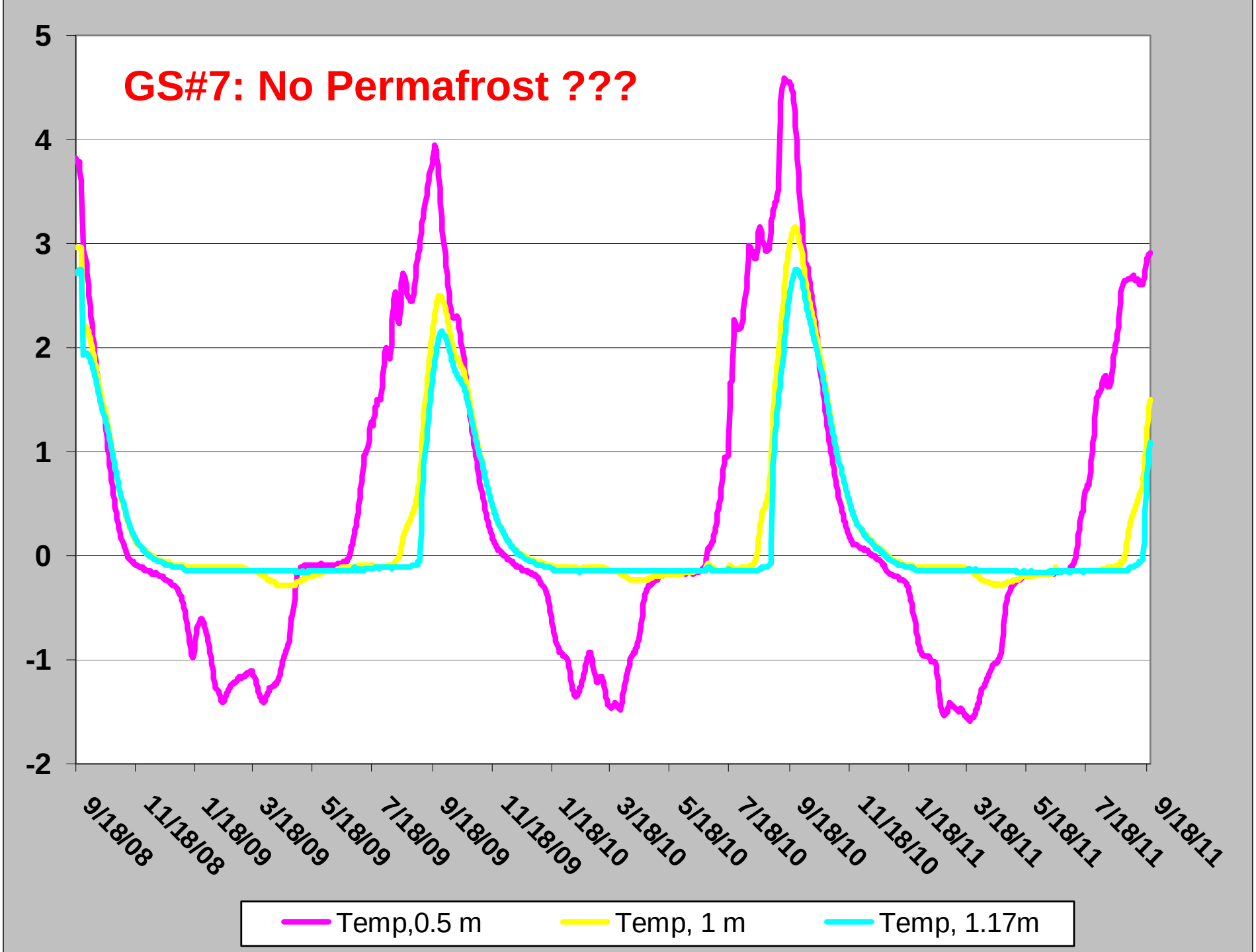


Temperature at 1.2 m
2010-2011

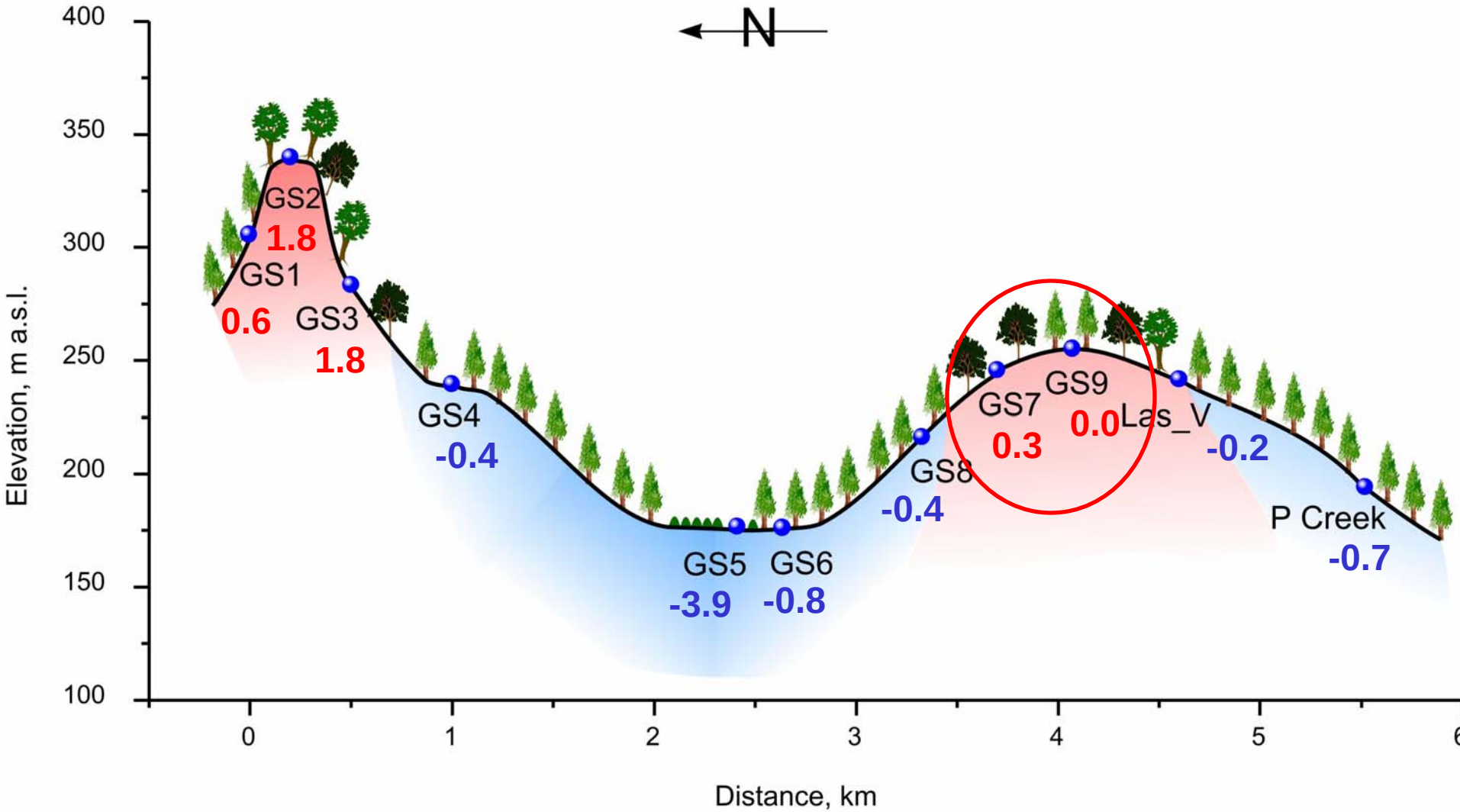


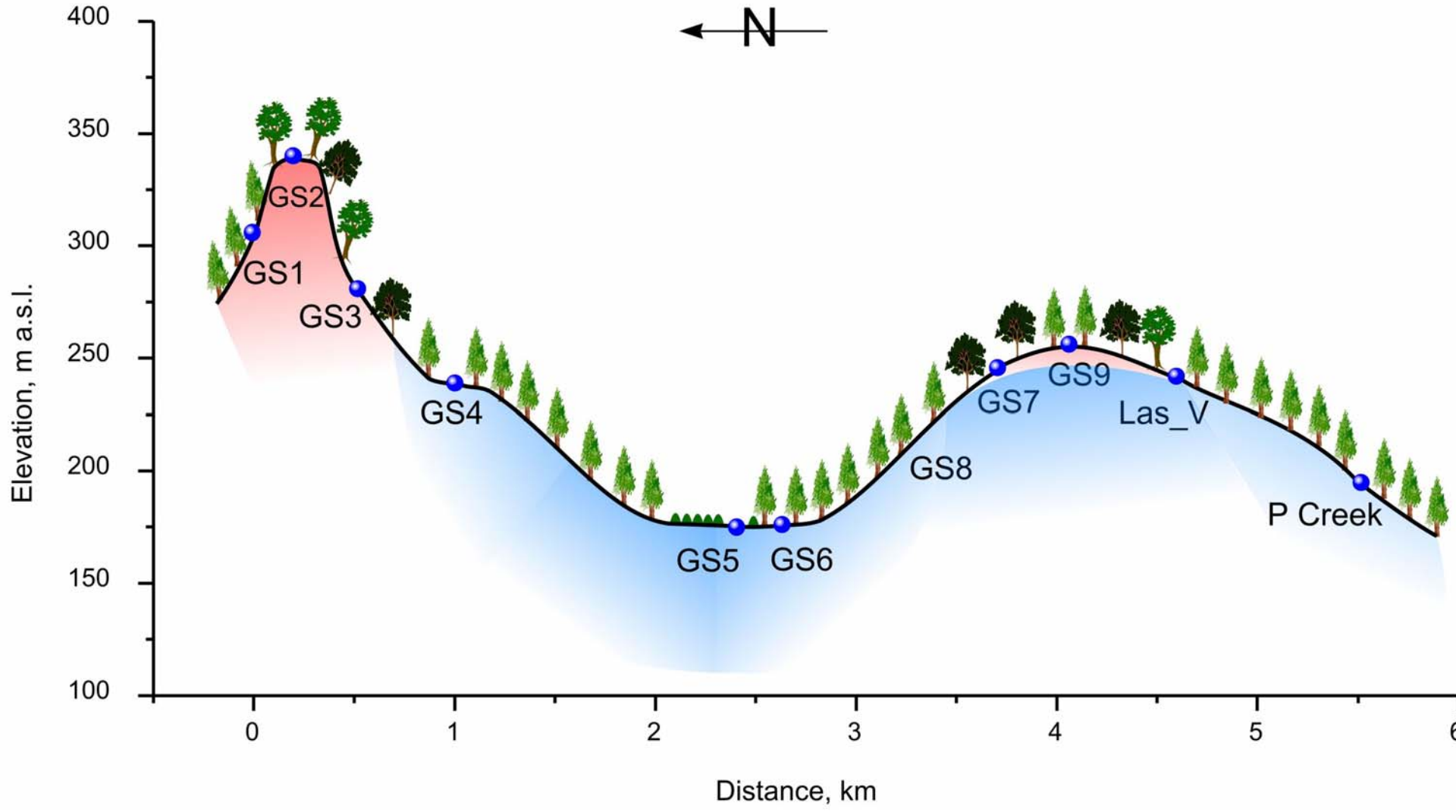

GS#4: Permafrost
8
6
4
2
0
-2
-4
-6
10/14/09
12/14/09
2/14/10
4/14/10
6/14/10
8/14/10
10/14/10
12/14/10
2/14/11
4/14/11
6/14/11
0.3 m
0.6 m
1.1 m
1.3 m


GS#2: No Permafrost
20
15
10
5
0
-5
-10
-15
9/18/08
11/18/08
1/18/09
3/18/09
5/18/09
7/18/09
9/18/09
11/18/09
1/18/10
3/18/10
5/18/10
7/18/10
9/18/10
11/18/10
1/18/11
3/18/11
5/18/11
7/18/11
9/18/11
Temp,Surf
Temp,0.5 m
Temp, 1 m
Temp, 1.17m


GS#7: No Permafrost ???
5
4
3
2
1
0
-1
-2
9/18/08
11/18/08
1/18/09
3/18/09
5/18/09
7/18/09
9/18/09
11/18/09
1/18/10
3/18/10
5/18/10
7/18/10
9/18/10
11/18/10
1/18/11
3/18/11
5/18/11
7/18/11
9/18/11
Temp,0.5 m
Temp, 1 m
Temp, 1.17m

Temperature at 1.2 m
2010-2011




N
GS1
GS2
GS3
GS4
GS5
GS6
GS7
GS8
GS9
Las_V
P Creek
Elevation, m a.s.l.
400
350
300
250
200
150
100
0
1
2
3
4
5
6
Distance, km

Conclusions

- At any given climate sub-zone, there is a wide variety of permafrost conditions governed by local topography, vegetation, soil and hydrology
- Future changes in climate will have a very different effect on permafrost in different environmental settings
- Future changes in vegetation and hydrology that partly will be governed by changes in permafrost will add even more complexity in the response of permafrost to changing climate

Thank you very much !

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