Outlook on freeze risk in major peach growing regions in Korea under the RCP8.5 projected climatic condition

Soo-Ock Kim[1], Jin-Hee Kim[1], Dae-Jun Kim[1], Jin I. Yun[2]

[1]National Center for Agro-Meteorology, South Korea
[2] Kyung Hee University, South Korea

National Center for Agro-Meteorology

INTRODUCTION

- Peach (*Prunus persica)* is a temperate zone fruit tree adapted to winter cold through dormancy, but shows a relatively weak cold tolerance compared with other fruits like apples, pears and grapes
- The risk of freezing damage for dormant peach buds is affected by the dormancy depth as well as the ambient temperature
- Warm winters projected by the climate change scenarios might act adversely to the freezing risk in peach trees through weakening of cold tolerance contrary to expectations
- This study was carried out to detect a possible change in freeze risk at landscape scales in three major peach growing areas under the future climate projected by RCP8.5 scenario.

SELECTED REGIONS

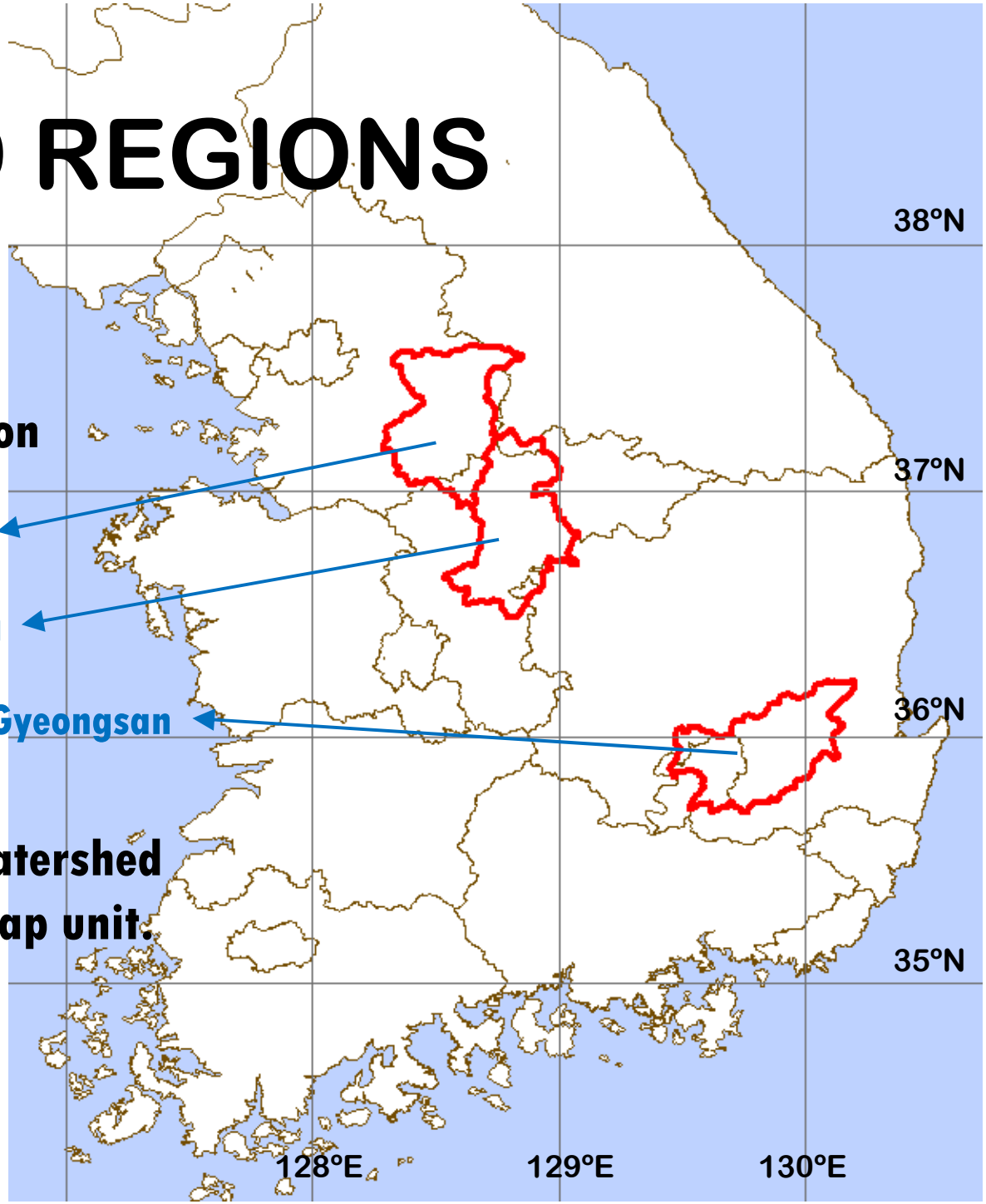
The major peach production regions

A: Icheon area

B: Chungju area

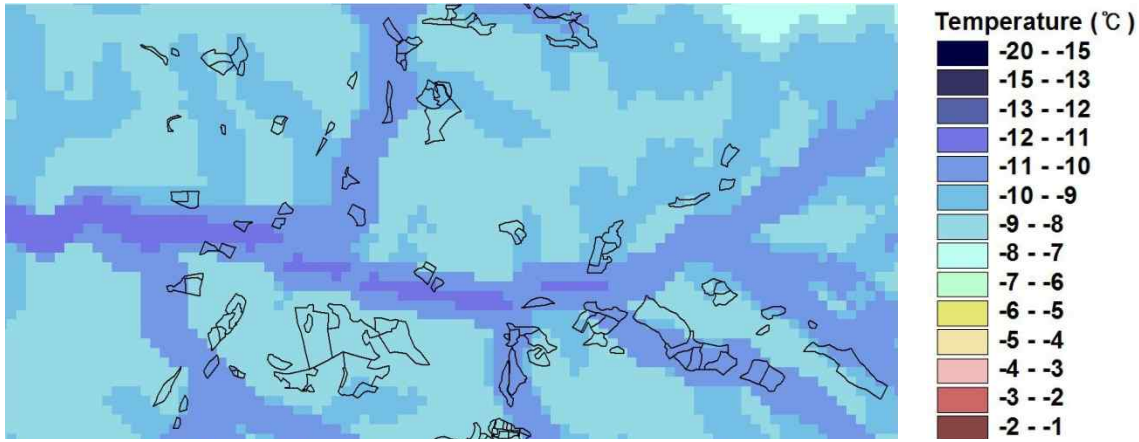
C: Yeongcheon-Gyeongsan

Each area represents a watershed which is a hydrological map unit.

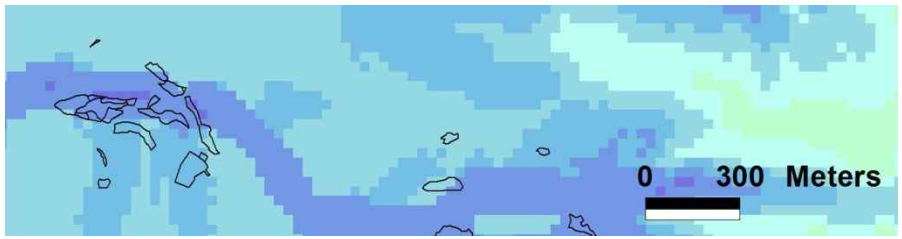


CLIMATE DATA STEP1

- The local climates at 30m grid cells reproduced by a catchment-specific climate mapping scheme based on recently developed techniques in geospatial climatology (Yun, 2010).



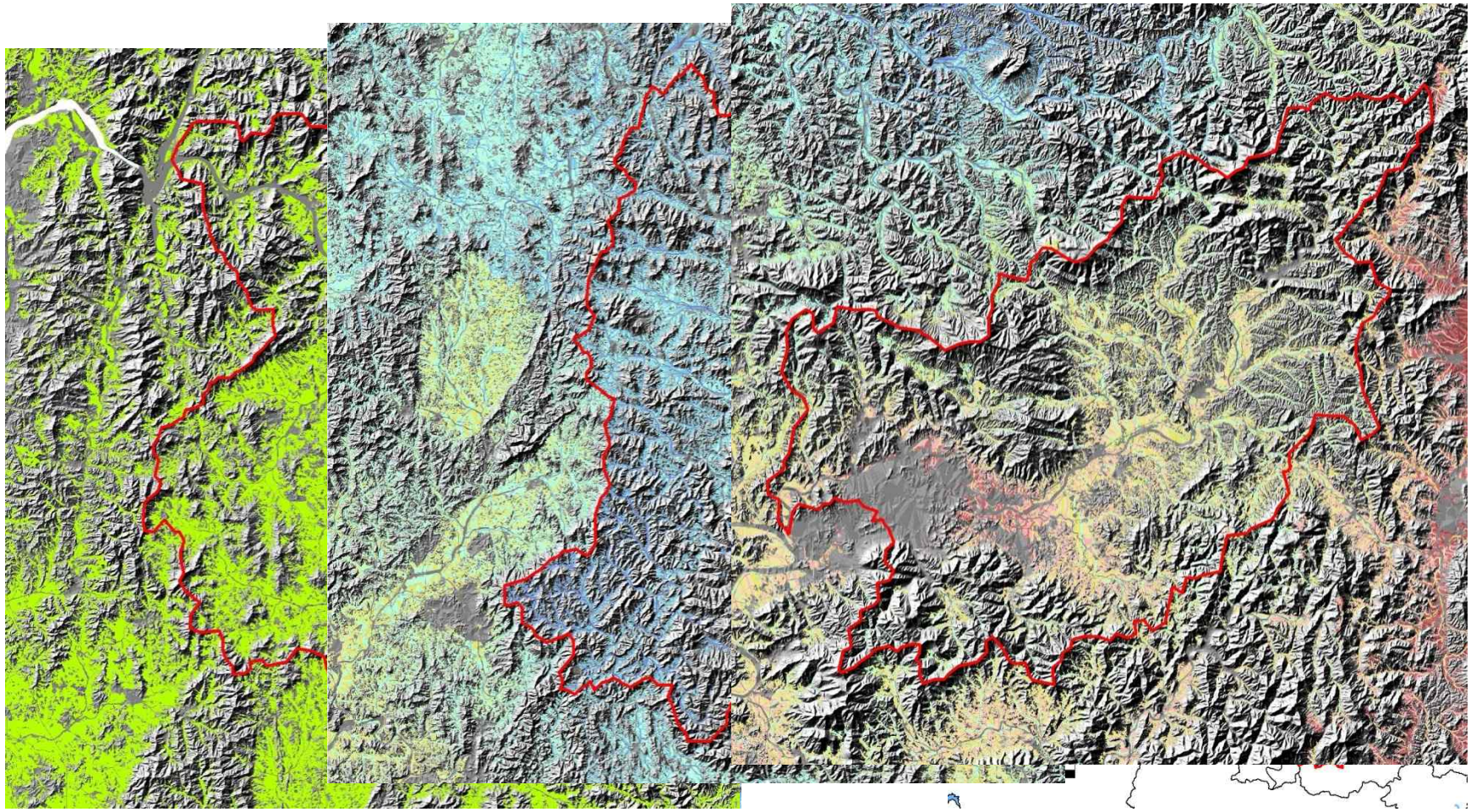
Monthly temperature maps for the present (2000s) and the future decade (2020s, 2050s, 2080s) based on RCP8.5



Yun, J. I., 2010: Agroclimatic maps augmented by a GIS technology. *Kor. J. Agric. For. Meteorol.* **12**, 63-73.

CLIMATE DATA STEP2

- Decadal monthly temperature data of the grid cells were extracted corresponding to farm lands and averaged spatially .



CLIMATE DATA STEP3

- Thirty sets of daily temperature data for each decade were generated randomly by a stochastic weather generator.

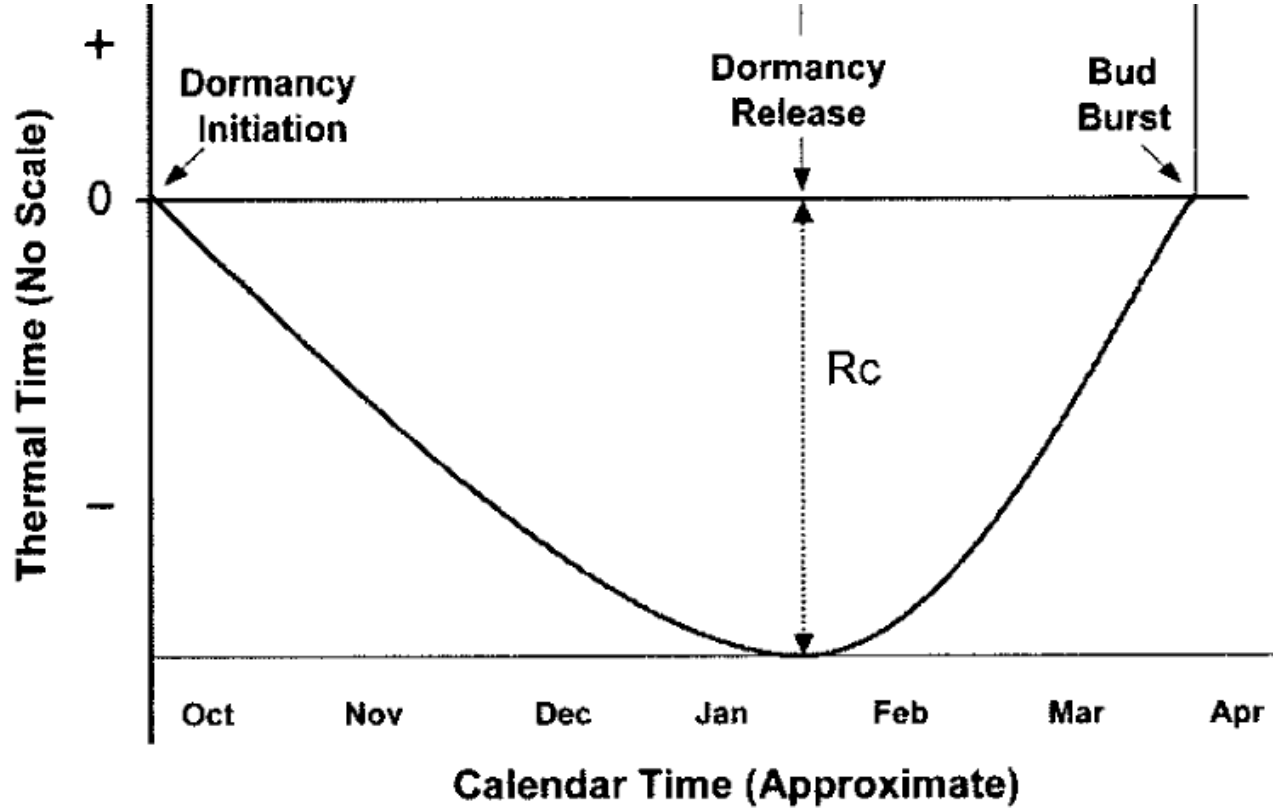
  [**365 days** × **30 sets** × **4 decades** (**2020s, 2050s, 2080s**)]

- These data could be used to simulate inter-annual variation in plant phenology (Kim et al., 2012)

Kim, D. J., U. Chung, and J. I. Yun, 2012: Feasibility of stochastic weather data as an input to plant phenology models. *Kor. J. Agri. & For. Meteorol.* **14**, 11-18.

FREEZING RISK PEACH

- The daily data were used to calculate a thermal time(Cesaraccio et al., 2004) - based dormancy depth index which is closely related to the cold tolerance of peach buds.



Cesaraccio, C., D. Spano, R. L. Snyder, and P. Duce, 2004: Chilling and forcing model to predict bud-burst of crop and forest species. *Agricultural and Forest Meteorology* **126**, 1-13.

FREEZING RISK PEACH

- Combined with daily minimum temperature, dormancy depth (cold tolerance) can be used to estimate the potential risk of freezing damage on peach buds (Kim et al., 2009)

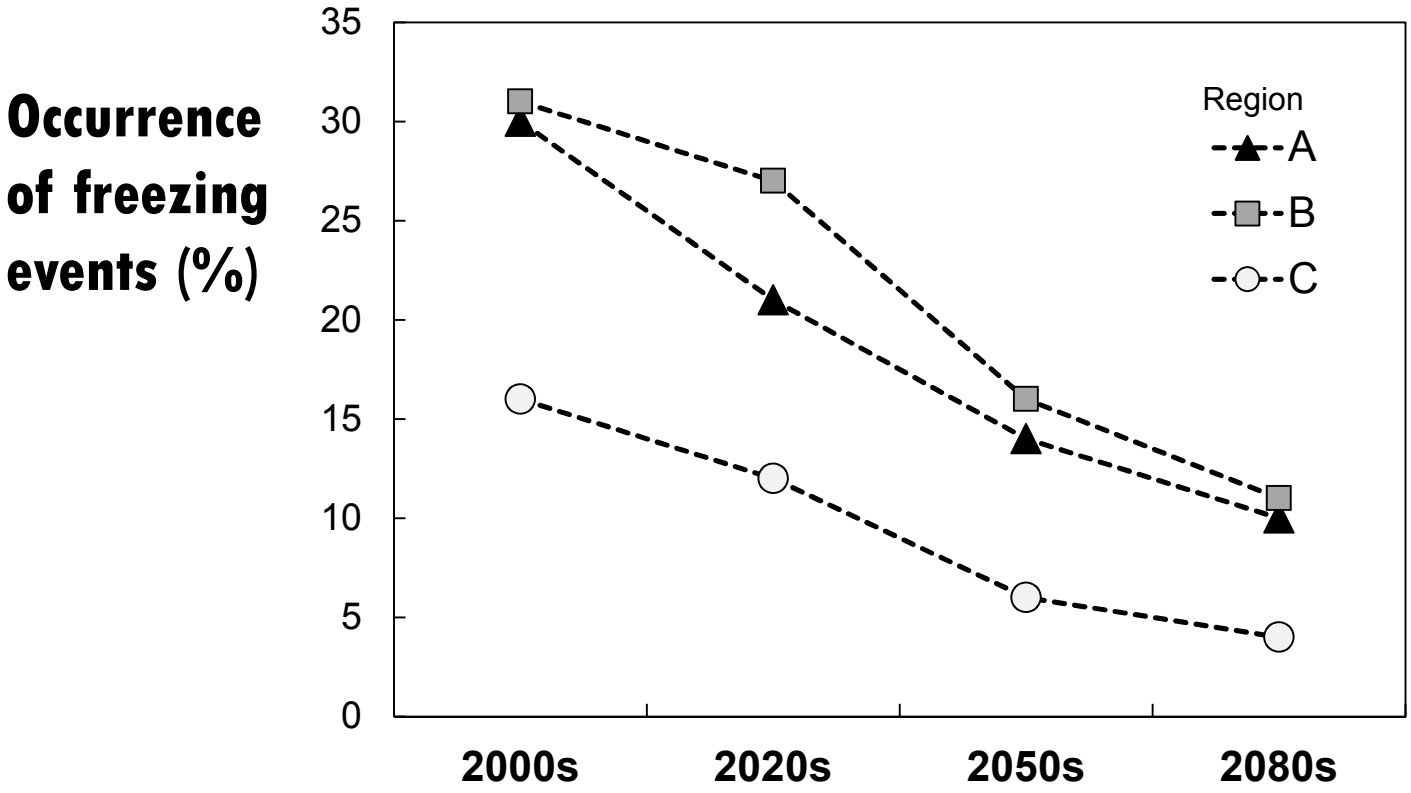
$$Risk(\%) = \frac{100}{1 + Ae^{(X+T_{\min})D_{cd}}} \qquad D_{cd} = C\left(|C_d| - 108\right)^2 + D$$

- The freezing risk for each day from November 1 to March 15 in 2000s, 2020s, 2050s, and 2080s were calculated
- The number of days with non-zero risk was counted
- 'Severe' risk : the value is over 80%

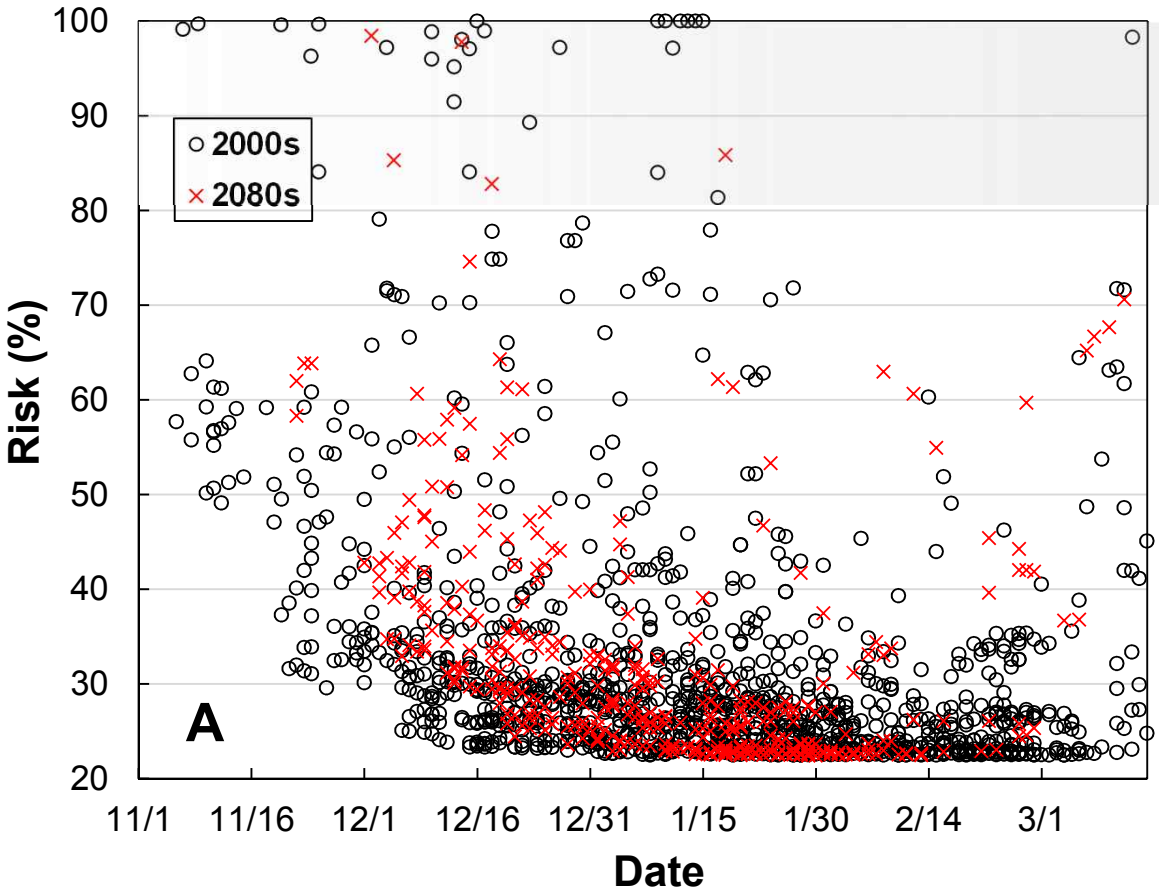
Kim, J. H., S. O. Kim, U. Chung, J. I. Yun, K. H. Hwang, J. B. Kim, and I. K. Yoon, 2009: Geospatial assessment of frost and freeze risk in 'Changhowon Hwangdo' peach (*Prunus persica*) trees as affected by the projected winter warming in South Korea Ⅱ. Freezing risk index based on dormancy depth as a proxy for physiological tolerance to freezing temperature. *Kor. J. Agric. For. Meteorol.* **11**, 213-220.

RESULTS FREEZING RISK

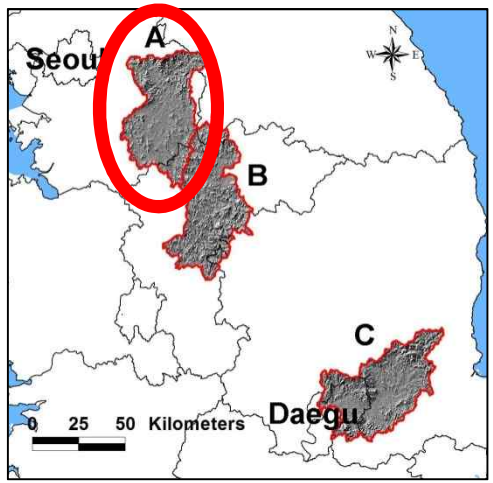
- Frequency of freezing damage during the winter period (from 1 November to 15 March) would be reduced in the future decades



RESULTS FREEZING RISK



Severe damage



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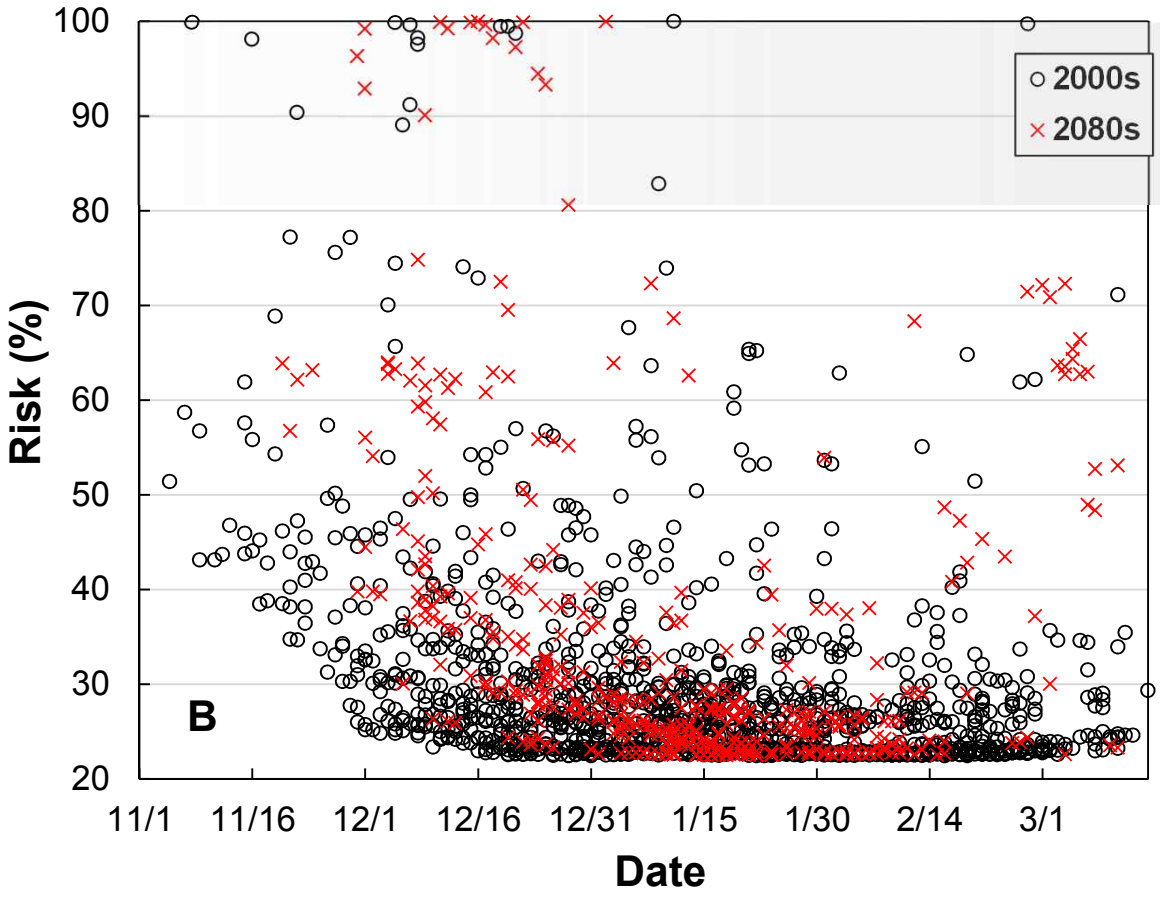
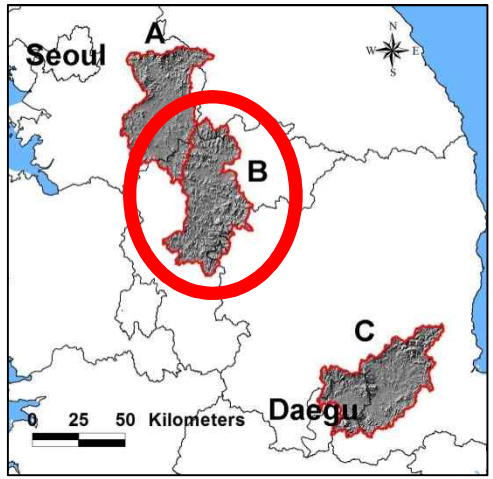


Severe damage



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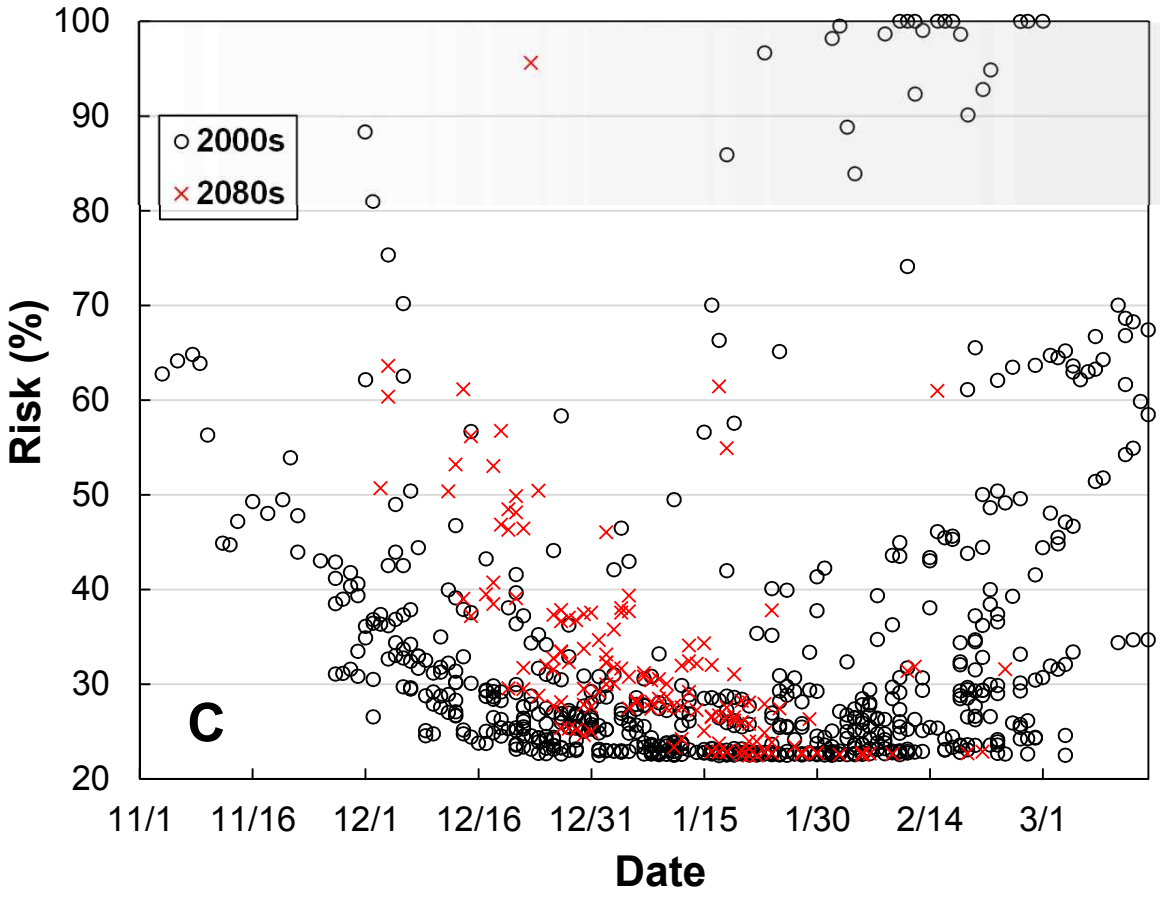
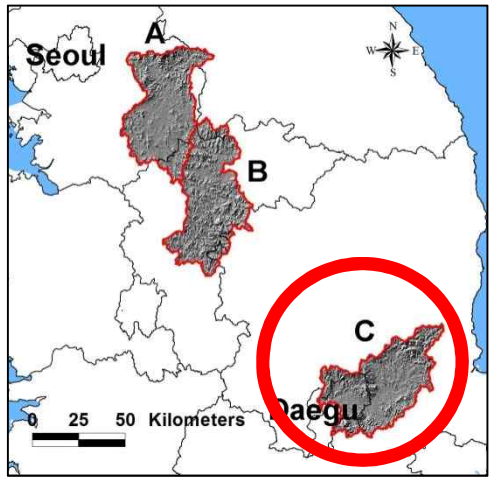
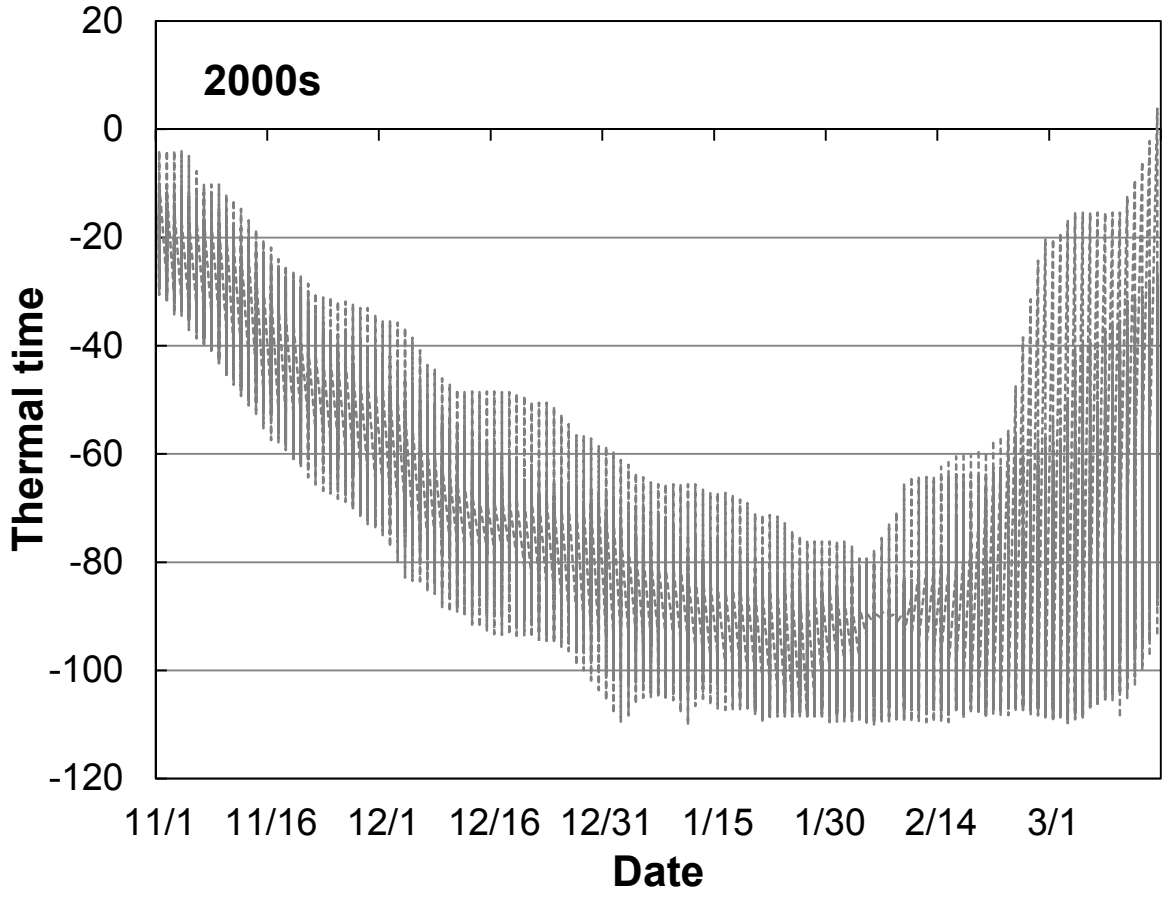


Severe damage



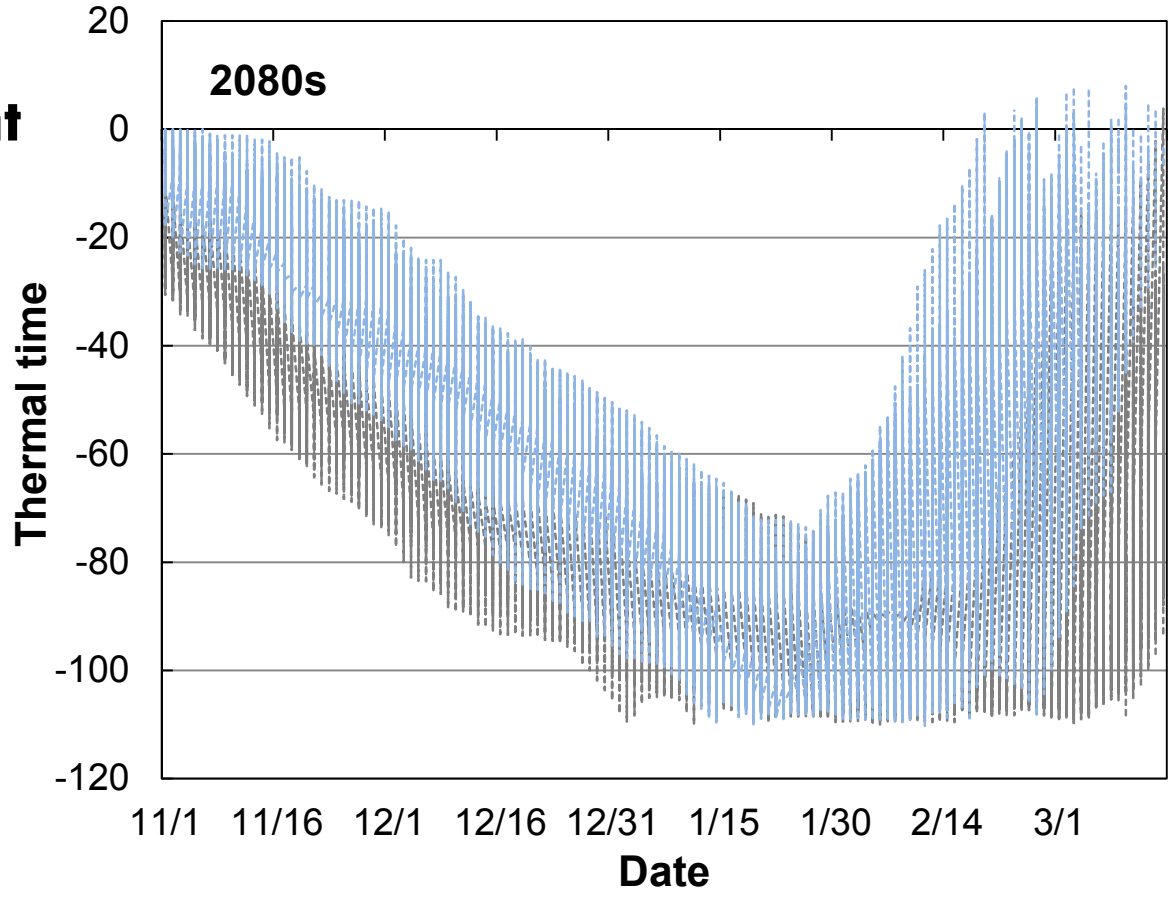
RESULTS COLD TOLERANCE

Dormancy depth in the present



RESULTS COLD TOLERANCE

Dormancy depth in the far distant future



CONCLUSION

- **Regardless of the warmer winters in the future, the severe class risk at peach orchards will not disappear**
  - shortened cold hardiness period caused by winter warming
  - sudden cold waves resulting from the inter-annual climate variability projected by the RCP8.5 scenario.

If you have any questions,
PLEASE SEND EMAIL to me. tolee7785@hanmail.net

Thank you