University of Florence, Italy
2019. 6. 24-29.

Application of numerical weather prediction data to forecast possible risks of crop disease and insect pests

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Contents

I. Objectives

- Implementation of Information system for disease and insect pest forecasts for **practical use** by crop growers
  - Information needs to be:

➢ Site-specific → High spatial resolution

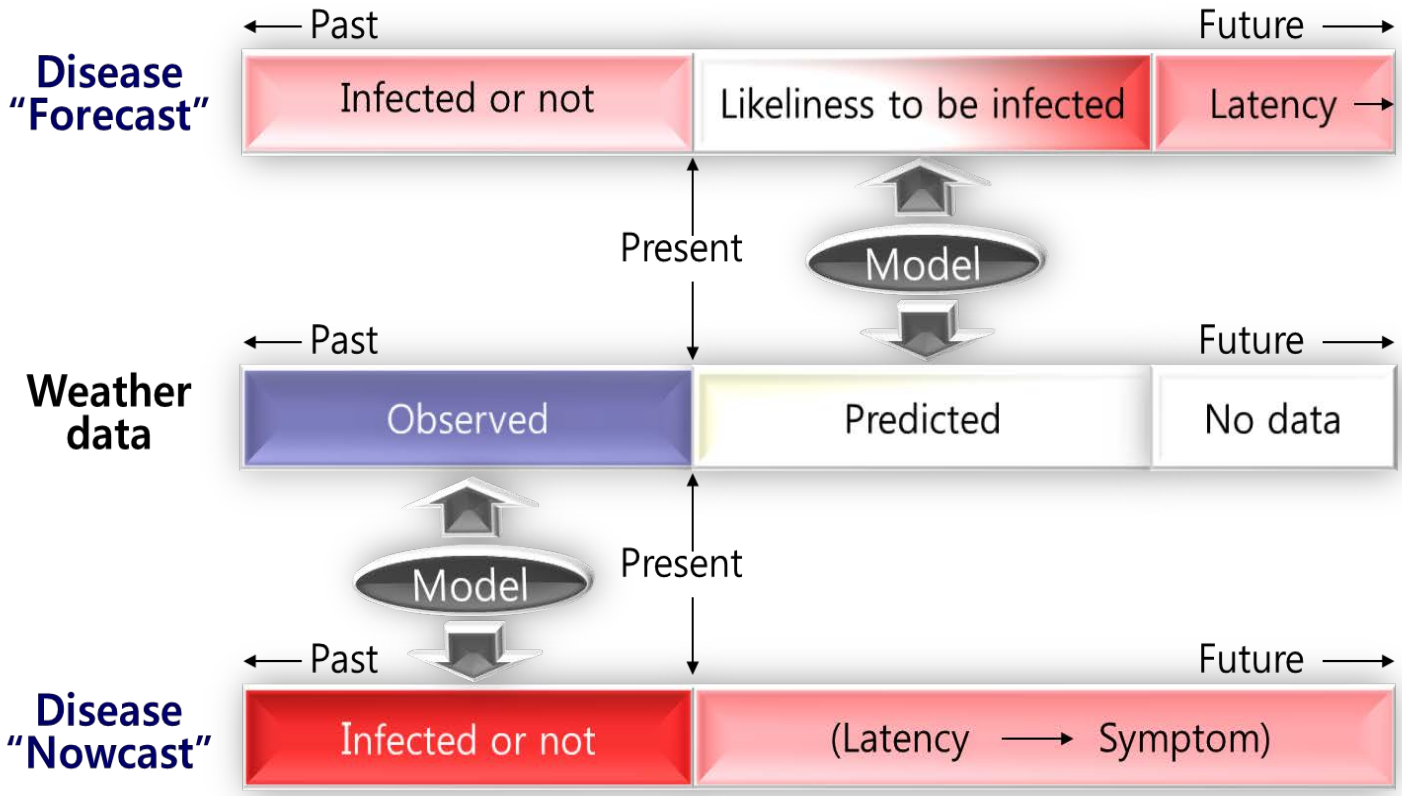
➢ Extended forecast → Weather prediction data

➢ Crop-based systems → Multiple pests forecast

➢ Easy to access → Mobile APP & internet homepage

II. Why use weather prediction data?

1. Time frame for disease forecast in relation to weather data



II. Why use weather prediction data?

2. Advantages in pest management

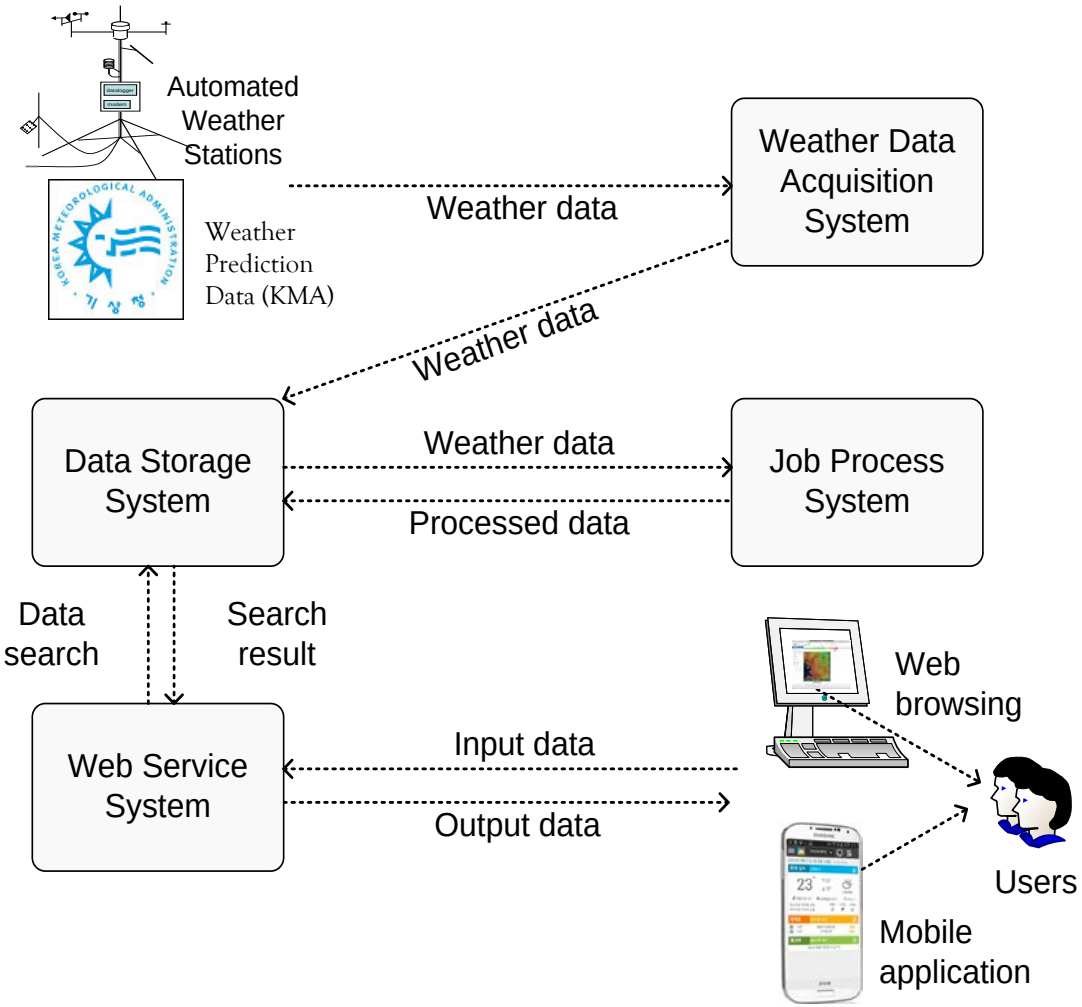
1) Predicts possible infection or attack by pests in advance of actual occurrence

2) Allows use of protective pesticides

3) Provides better pesticide options in pest management system, which results in:

- Cost-efficient pest control and
- Suppression of pesticide-resistant pests

III. Information Delivery System



Weather data process: Spatial resolution of 240m~1.5km

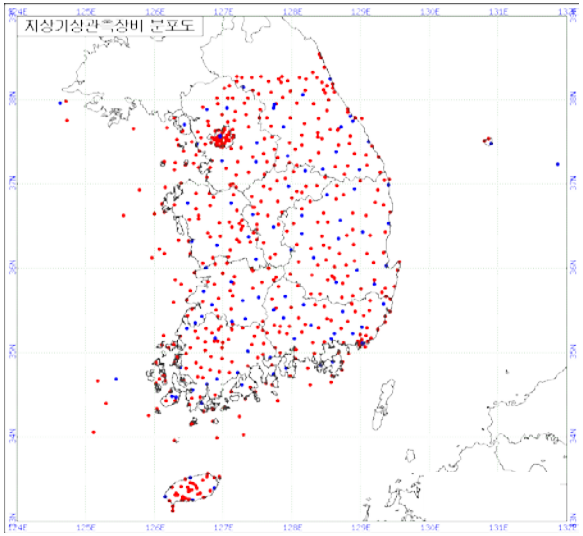
Near real-time operation

Forecast models: 17 diseases and 21 insects on 7 crops

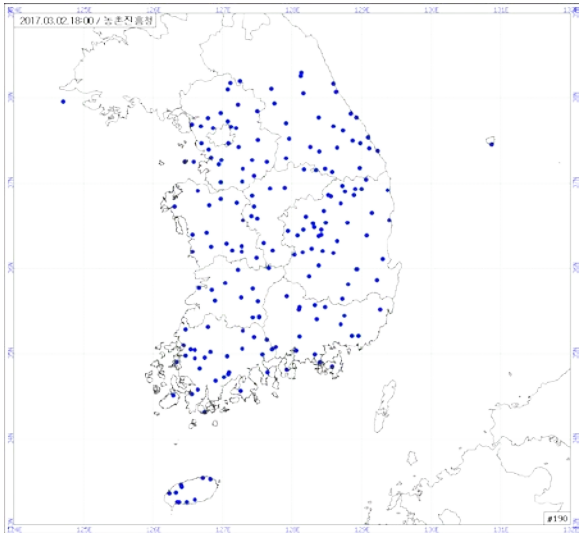
Web & Mobile App information delivery

IV. Weather data

1. Observed by automated weather stations (AWS)
   - More than 790 sites in Korea



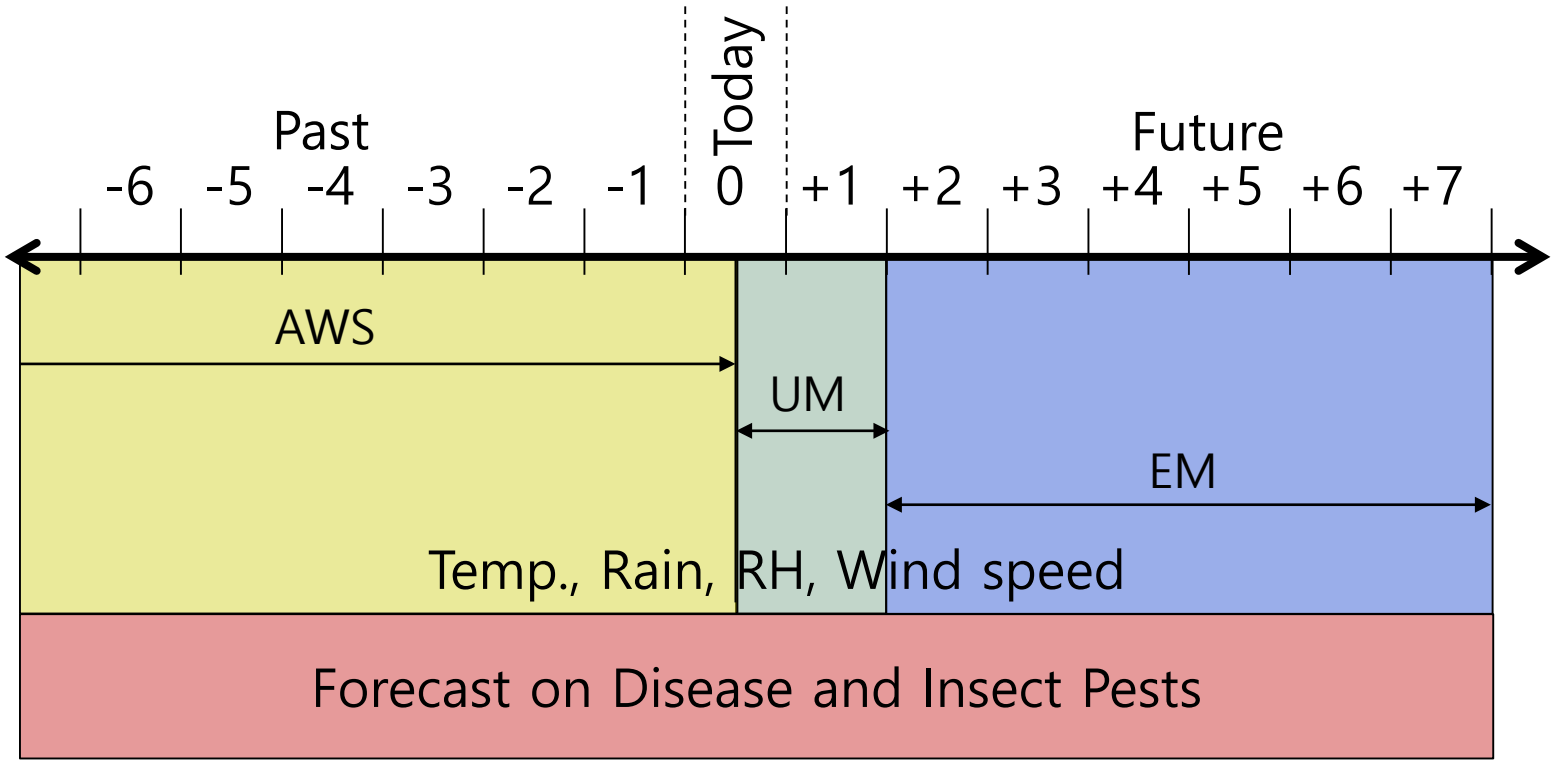
KMA (599 sites)



RDA (191sites)

IV. Weather data

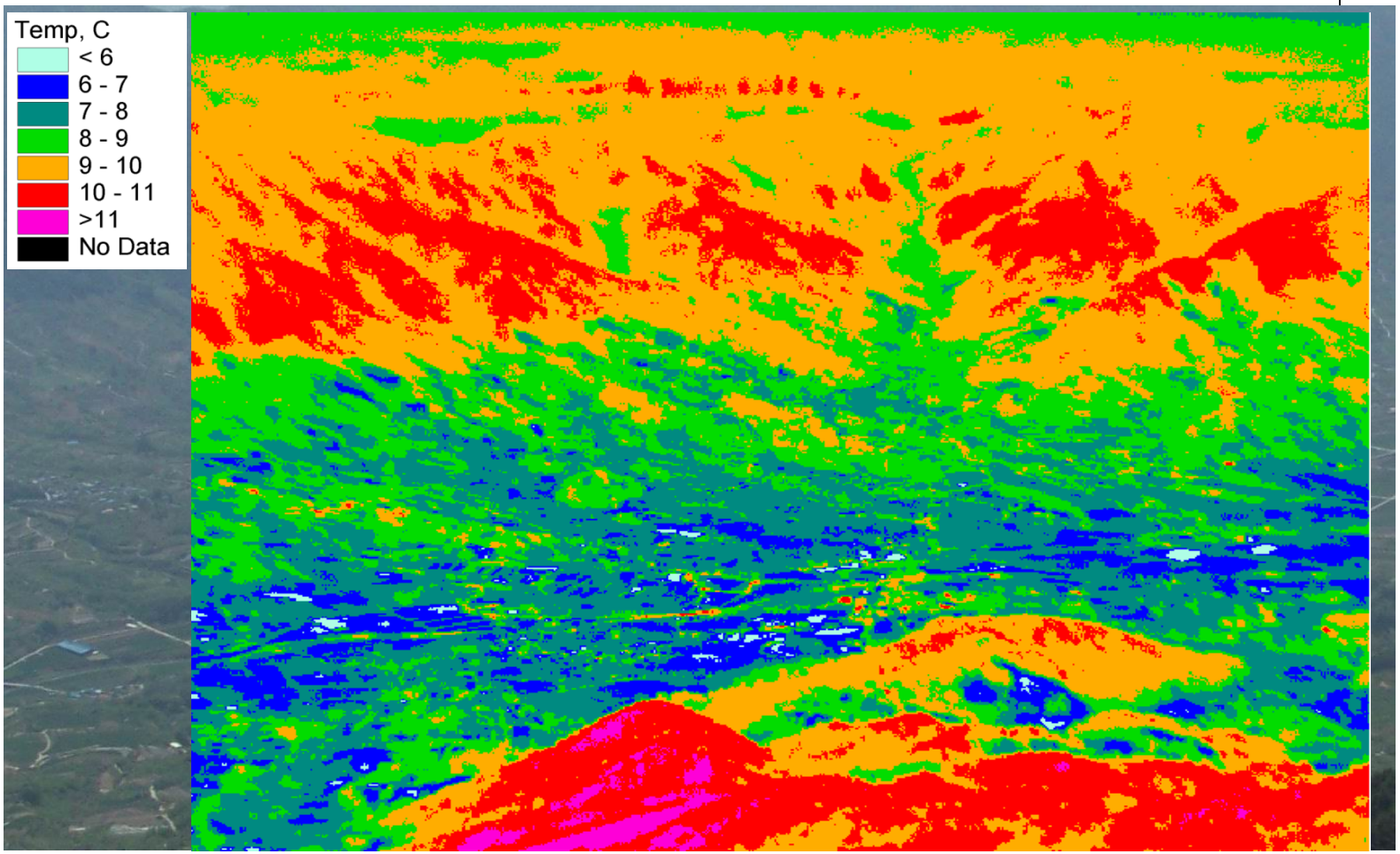
2. Predicted by KMA using numerical weather prediction models
   - United model (UM)
   - Ensemble model (EM)



IV. Weather data

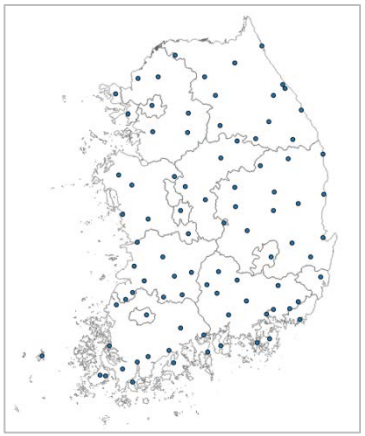
2. GIS application for spatial resolution enhancement
   - Temperature distribution in a farm village
   - Weather data downscaling
     - Inverse distance weighting with correction for elevation
     - Small-scale climate models
   - Web map interface
     - Web map server
     - Web map viewer

- Temperature distribution over a farm village (Akyang valley) at 05:20 on 17 May, 2011



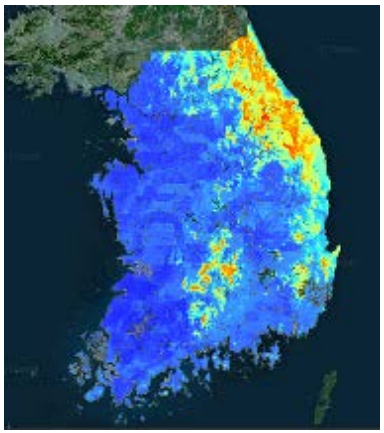
Yun, J. I. 2011. Korean J. Agric. Forest Meteol. 13:79-86

Weather data downscaling



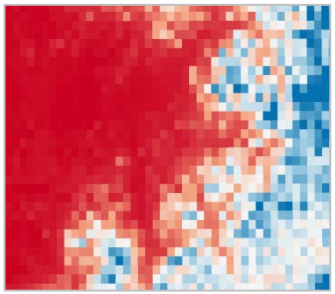
point data

Statistical downscaling

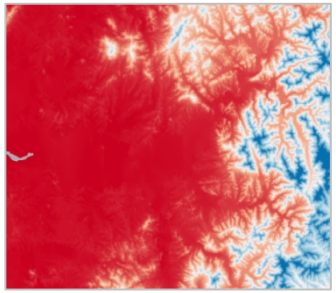


gridded data

- Temperature
  - IDW w/ correction for elevation
  - Small-scale climate models for slope aspect, thermal belt, cool air drainage & accumulation, solar irradiance, & sunshine duration
- Rainfall
  - Radar echo data and PRISM



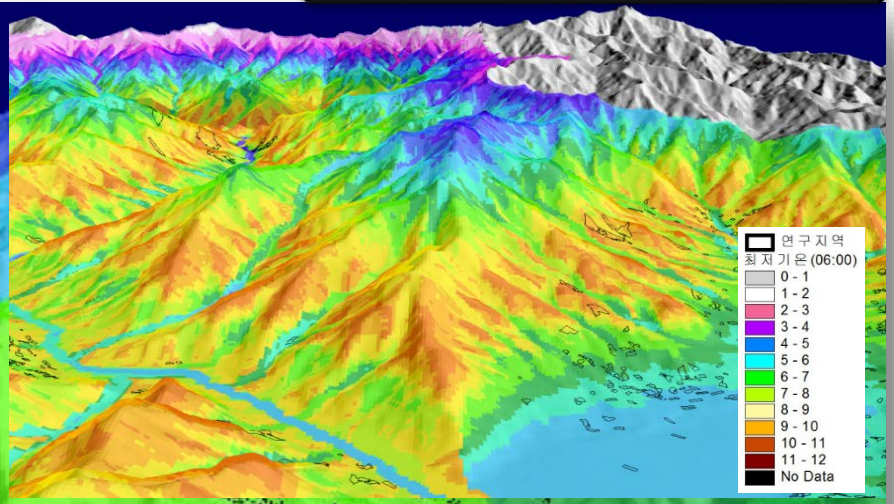
gridded data at lower resolution



gridded data at higher resolution

KMA data at 5km x 5 km

Farm weather at 30m x 30m



Topology data

Cold air drainage

Outflow coeff.

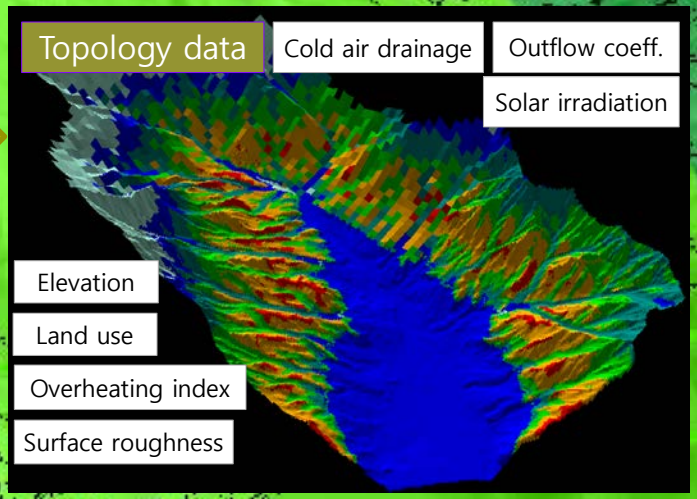
Solar irradiation

Elevation

Land use

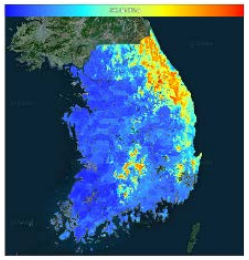
Overheating index

Surface roughness

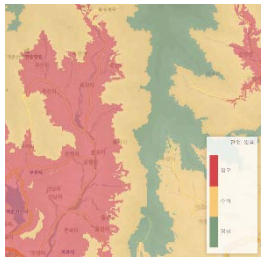


Observed data		Forecast data	
AWOS	Satellite data	KLAPS	Midterm forecast
ASOS	Radar echo image data	Digital forecast	

- Web map interface



weather maps

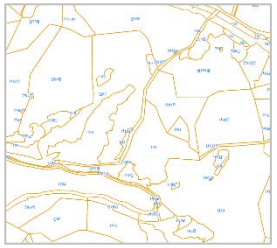


disease forecast maps

forecast maps

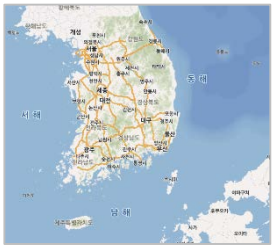
Web map servers

background maps from www.vworld.kr



cadastral map

satellite image



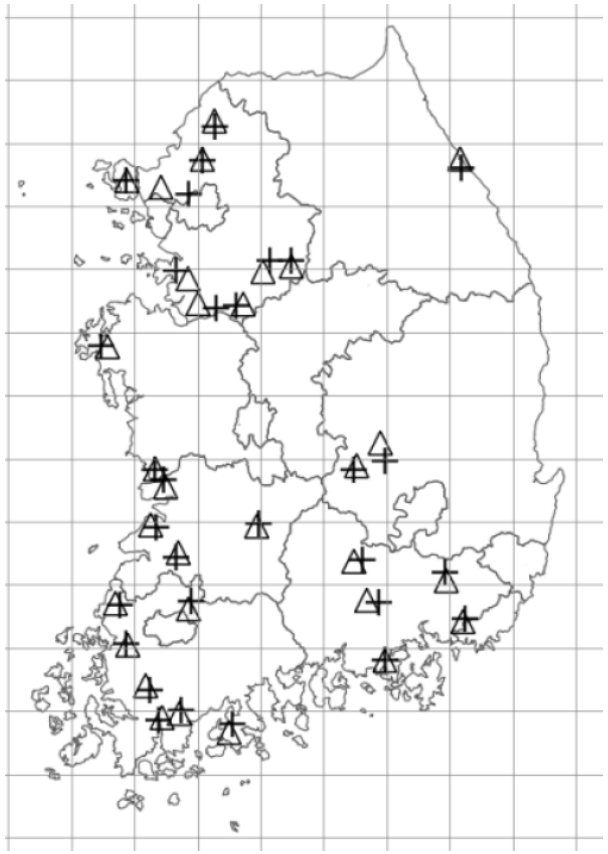
road map

Web map viewer
running in web browser

zoom in, zoom out, and panning of maps

V. Evaluation of weather prediction data

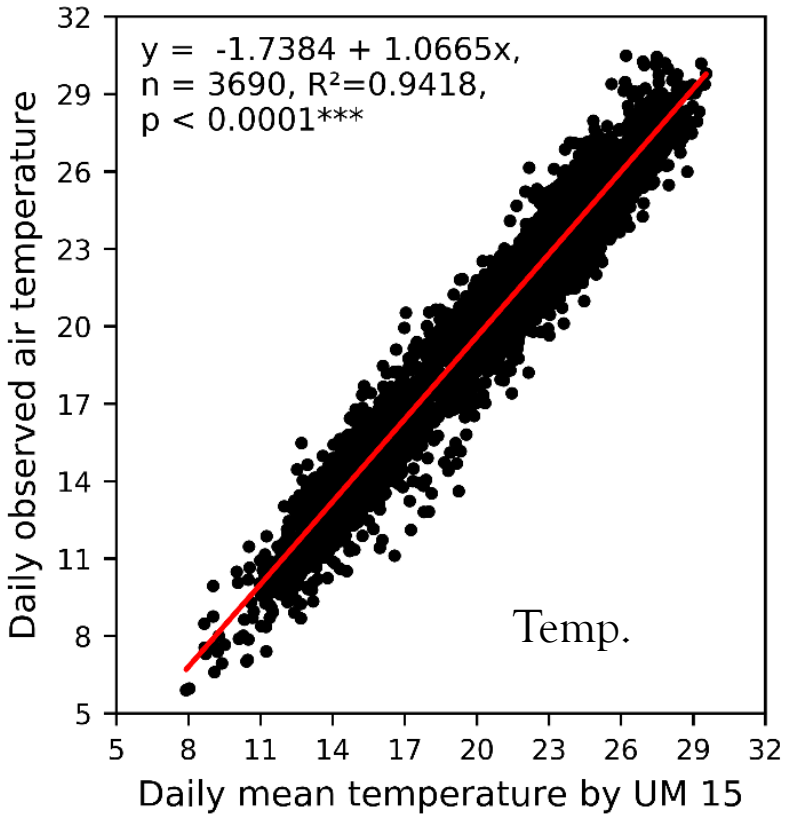
1. Observed by AWS vs. Predicted by UM (2014)

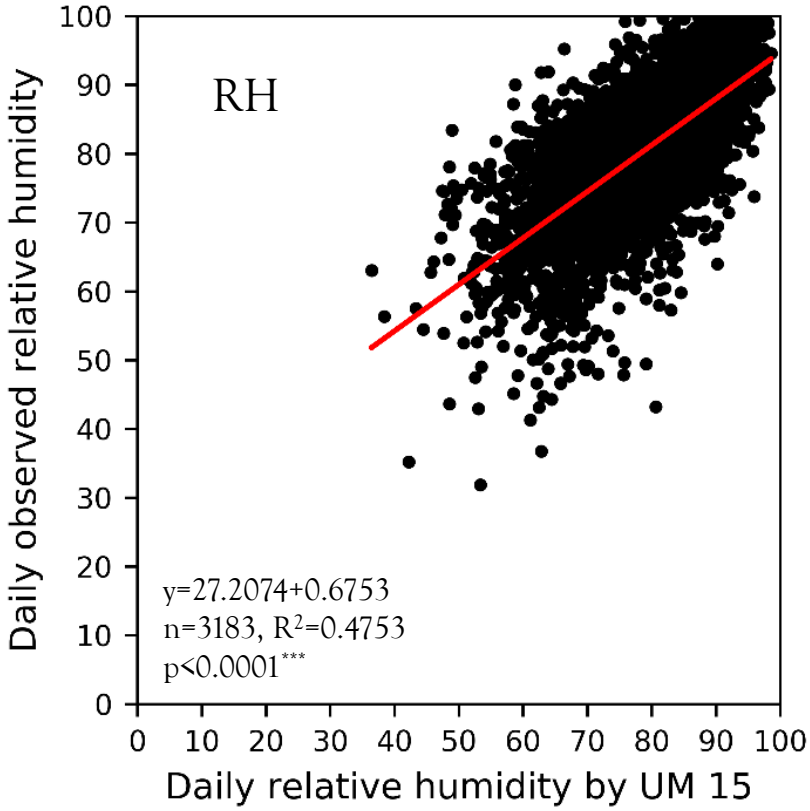


- 30 sites:
  △ BGR survey plots
  + Nearby AWS sites
- 123 days:
  1 Jul. ~ 21 Oct., 2014

V. Evaluation of weather prediction data

- Temperature and relative humidity

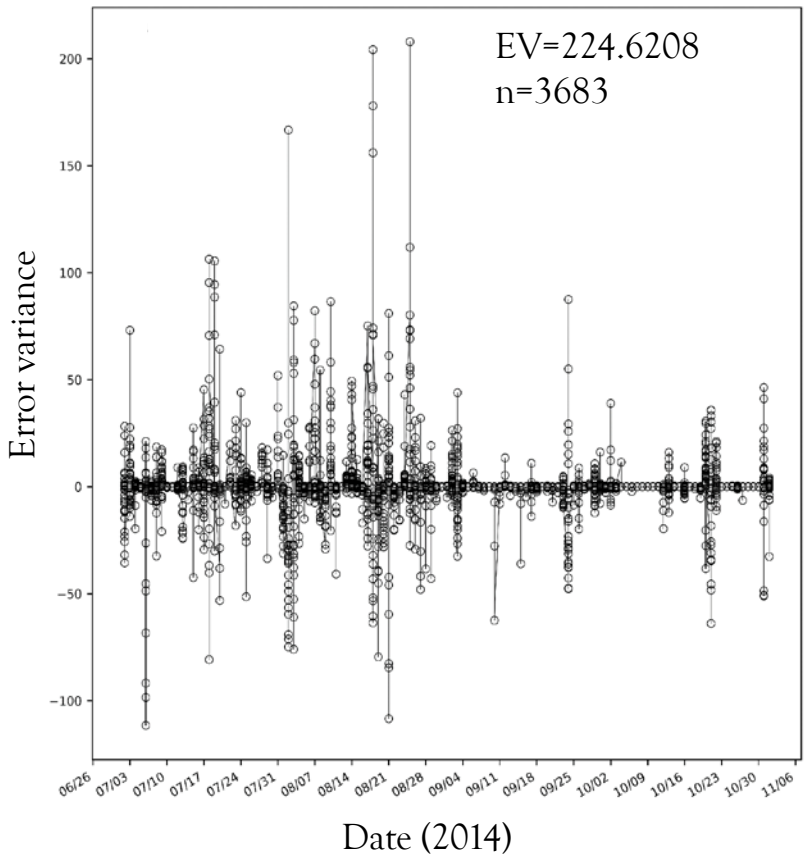




V. Evaluation of weather prediction data

- Rainfall

Error variance



Contingency table analysis

파일 홈 삽입 페이지 레

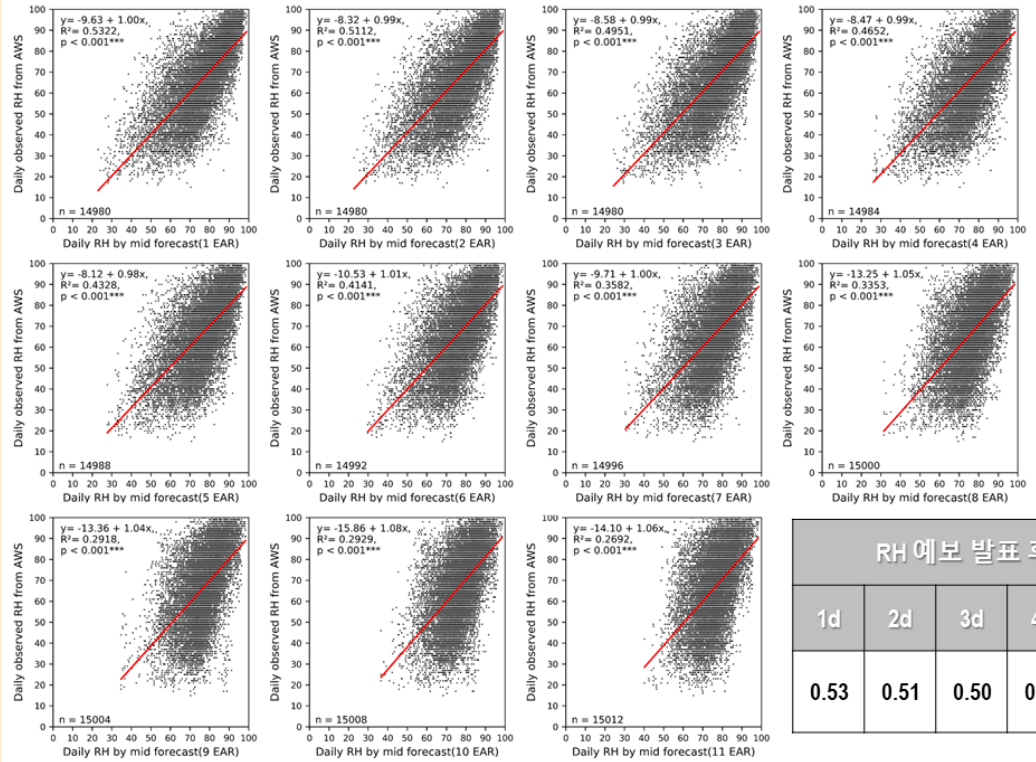
A1

	A	B
1	Index	value
2	Num_Est.	3683
3	HIT	1034
4	FALSE	421
5	MISS	266
6	CORRECT_N	1962
7	BIAS	1.12
8	POD	79.54%
9	POFD	17.67%
10	FAR	28.93%
11	CSI	60.08%
12	SR	71.07%
13	ACC	81.35%

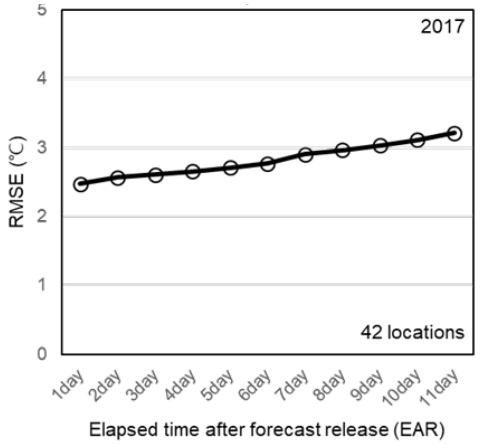
V. Evaluation of weather prediction data

2. Observed by AWS vs. Predicted by EM (2017)

Relative humidity



Temperature



RH 예보 발표 후 경과일에 따른 R^2 변화 (2017, 42 locations)

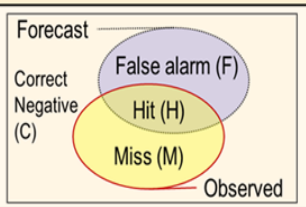
1d	2d	3d	4d	5d	6d	7d	8d	9d	10d	11d
0.53	0.51	0.50	0.47	0.43	0.41	0.36	0.34	0.29	0.29	0.27

V. Evaluation of weather prediction data

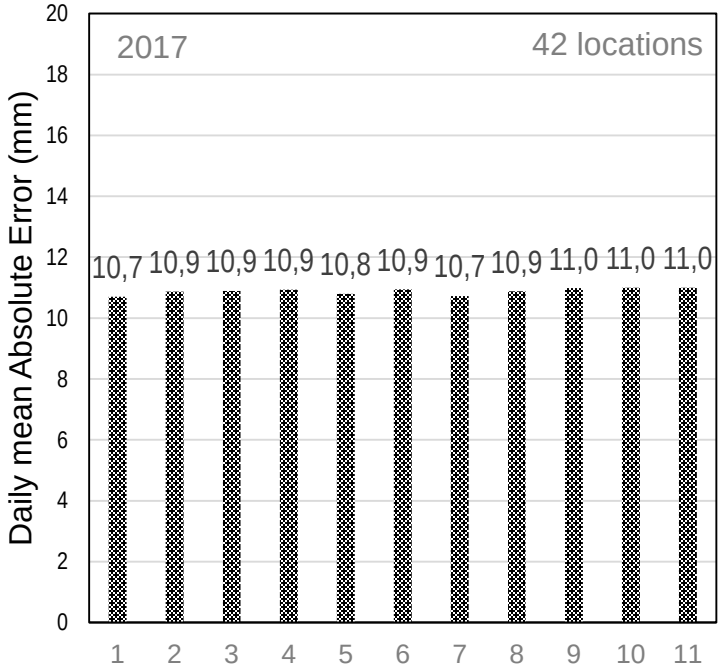
Rain event

EAR (days)	BIAS	POD	FAR	ACC
1	1.22	77.49%	36.51%	85.18%
2	1.11	73.16%	34.08%	84.24%
3	0.98	64.76%	33.72%	81.13%
4	0.92	59.48%	35.13%	78.71%
5	0.84	54.90%	34.51%	76.30%
6	0.77	49.88%	35.34%	73.04%
7	0.78	47.57%	39.27%	71.55%
8	0.68	43.32%	36.52%	68.00%
9	0.60	39.85%	33.95%	63.84%
10	0.61	38.35%	36.98%	62.00%
11	0.60	36.51%	38.68%	60.15%

Index	Description
BIAS	Forecast/Observed; (F+H)/(M+H)
POD	Probability of detection; H/(M+H)
FAR	False alarm ratio; F/(F+H)
ACC	Accuracy; (H+C)/Total events



Rainfall

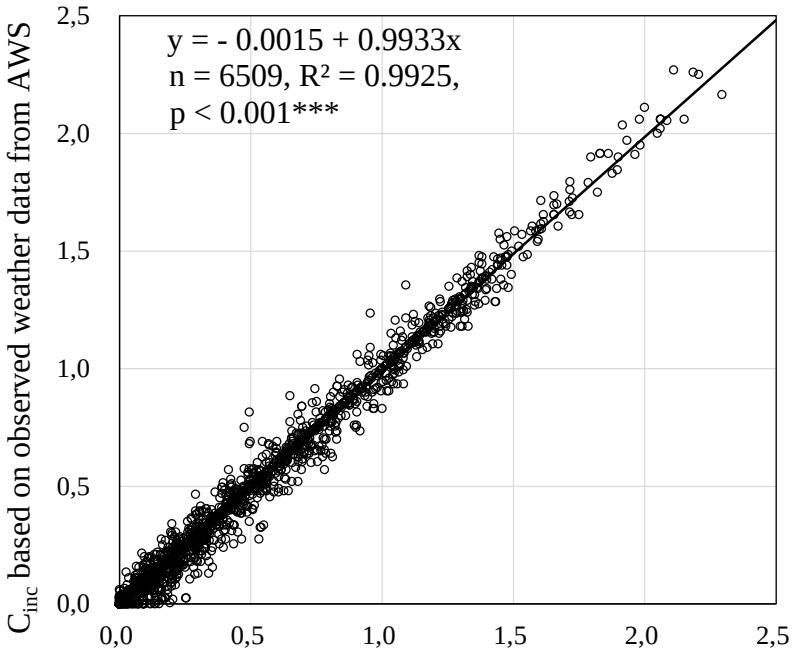


Elapsed days after forecast release (EAR)

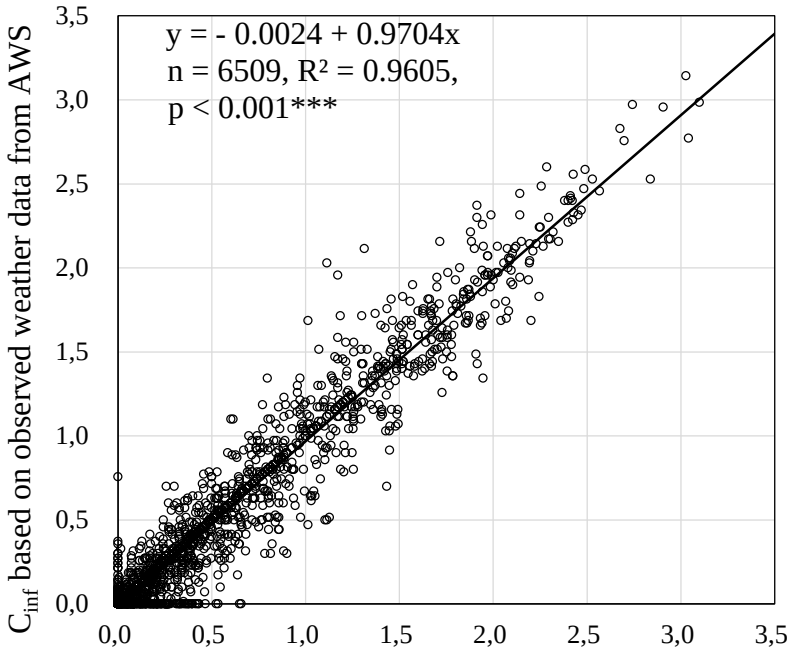
VI. Application of WPD in disease and insect pest forecasts

1. Bacterial grain rot of rice (*Burkholderia glumae*)

- AWS vs. UM



C_{inc} based on weather forecast data by UM 06

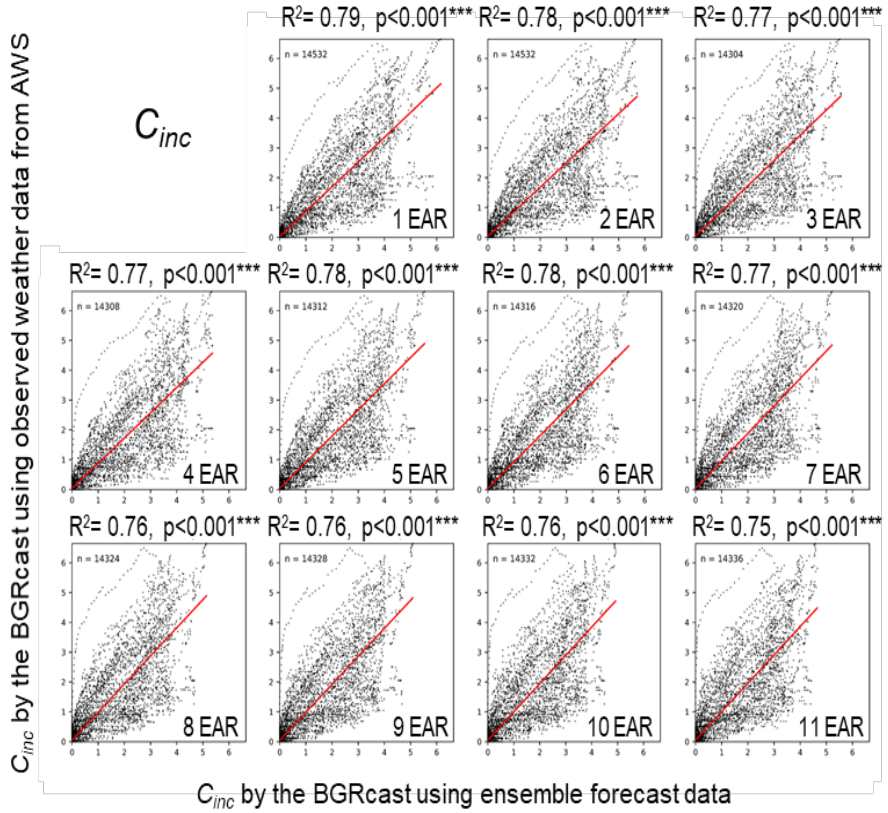


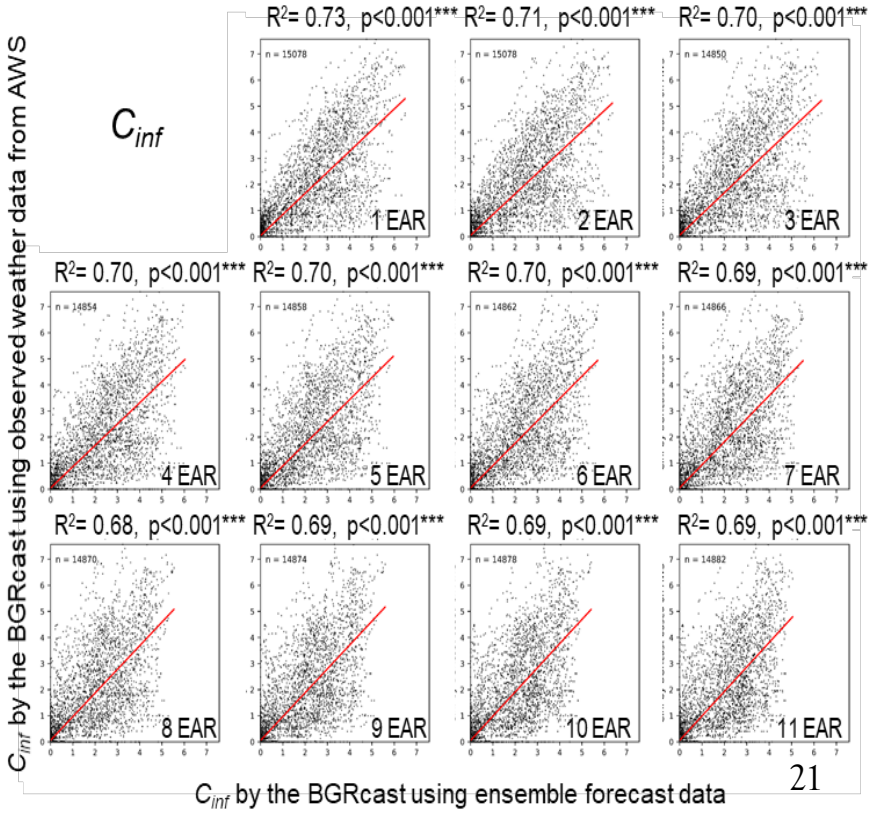
C_{inf} based on weather forecast data by UM 06

VI. Application of WPD in disease and insect pest forecasts

1. Bacterial grain rot of rice (*Burkholderia glumae*)

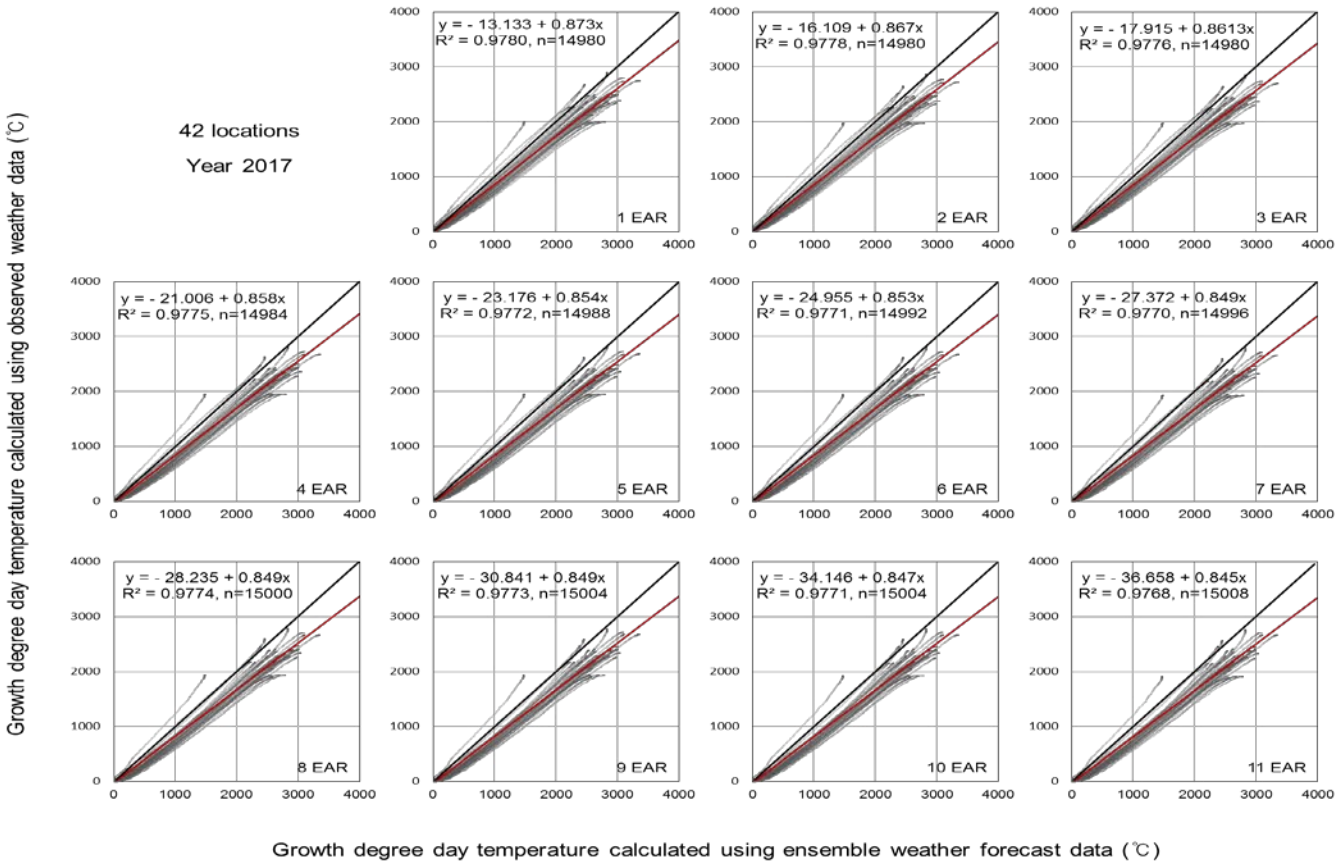
- AWS vs EM





VI. Application of WPD in disease and insect pest forecasts

2. Asiatic leafroller (*Archips breviplicanus*)



VII. Conclusion

1. It is inevitable to use weather prediction data (WPD) to make pest forecast information more useful to farmers in practice.
2. Accuracy of WPD as compared with observed weather data indicates that pest forecasts up to 3 days to the future would be reliable enough to be integrated in decision-making for pesticide sprays.
3. Pest forecasts beyond 3days would be useful information that can be considered in planning weekly activities for pest management by farmers.

VII. Conclusion

4. Small-scale climate models should be applied to enhance spatial resolution of weather data in order to make pest forecasts specific to small-scale farms.
5. Disease and insect pest forecast will become an essential information in consulting business for IPM under climate change and weather variability.

VIII. Crop pest forecast services in Korea

- Website: http://df.ncam.kr
- Mobile App: "농작물 병해충 예보서비스"
  - Available only in Korea
  - 7 crops, 17 diseases, and 21 insects
    - rice, pepper, apple, pear, grape, peach, tangerine
  - Use weather prediction data provided by KMA
    - Spatial resolution: 1.5km x 1.5km
    - Daily pest forecasts for D0 ~ D7
  - Use of observed weather data
    - Daily pest forecasts for the past since 2017

- Mobile App: “농작물 병해충 예보서비스”

First page

Site selection (Rsgistration of 3 sites)

Risk forecast (D0~D7), Pesticide spray weather index

Pest risk in the past (Since 2017년)

Risk map (Spatial resolution: 1.5km x 1.5km)

Pest information(Photos, Epidemiology, Control)

Registered pesticide information

National Center for Agro-Meteorology (NCAM)

Brief history

- 10 Jul., 2009: MOU among RDA, KFS, KMA, and SNU
- 3 Nov., 2009: Legal establishment of NCAM in SNU
- 11 Nov., 2009: Opening NCAM

업무 협약식

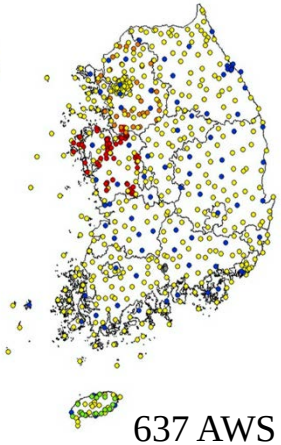
센터 개소식

Graduate program in Agricultural and Forest Meteorology

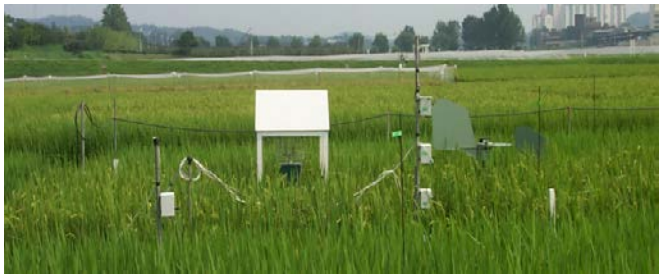
- Post-graduate programs fo MS and PhD in agro-meteorolgy
- Established at SNU in 2011

EPINET
Environment & Plant Information Network

EPINET was founded as a venture business of the **Plant Disease Epidemiology Lab of Seoul National University** in 2002.



637 AWS



Technology

- Plant diseases and insect pests forecast models
- Plant phenology models
- Maintenance & networking of AWS
- Data processing using various meteorological models
- Big data analysis
- High resolution Web-GIS technology
- Software development & system integration
- Real-time information delivery system
- Mobile application development

Grazie per l'attenzione!

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