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POLJOPRIVREDNI FAKULTET

METEOROLOGIJA

AGRICULTURE IN CHANGING CLIMATE

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"Agrometeorologists for farmers in hotter, drier, wetter future", 9 - 10 November 2016, Ljubljana, Slovenia

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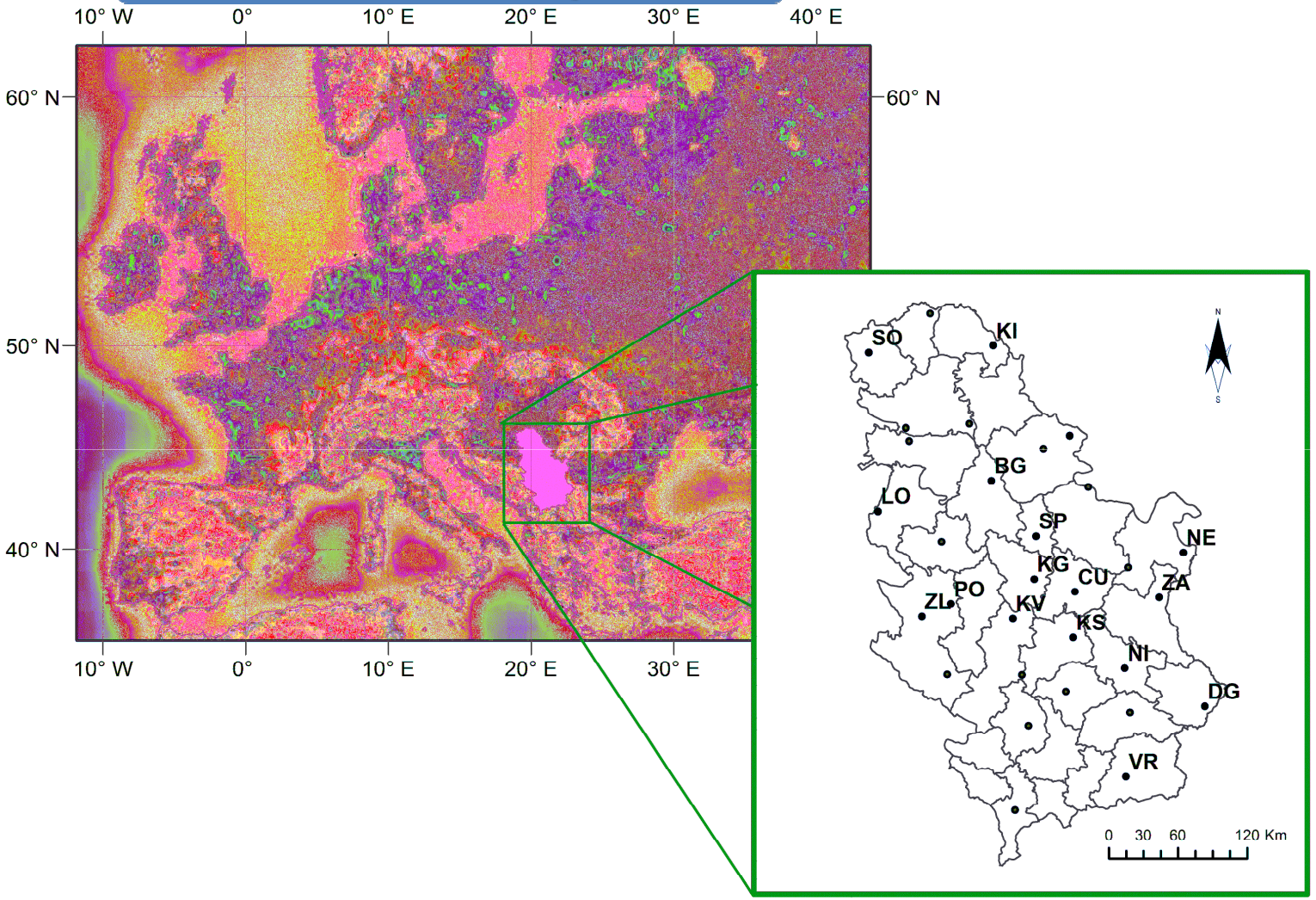
METEOROLOGIJA



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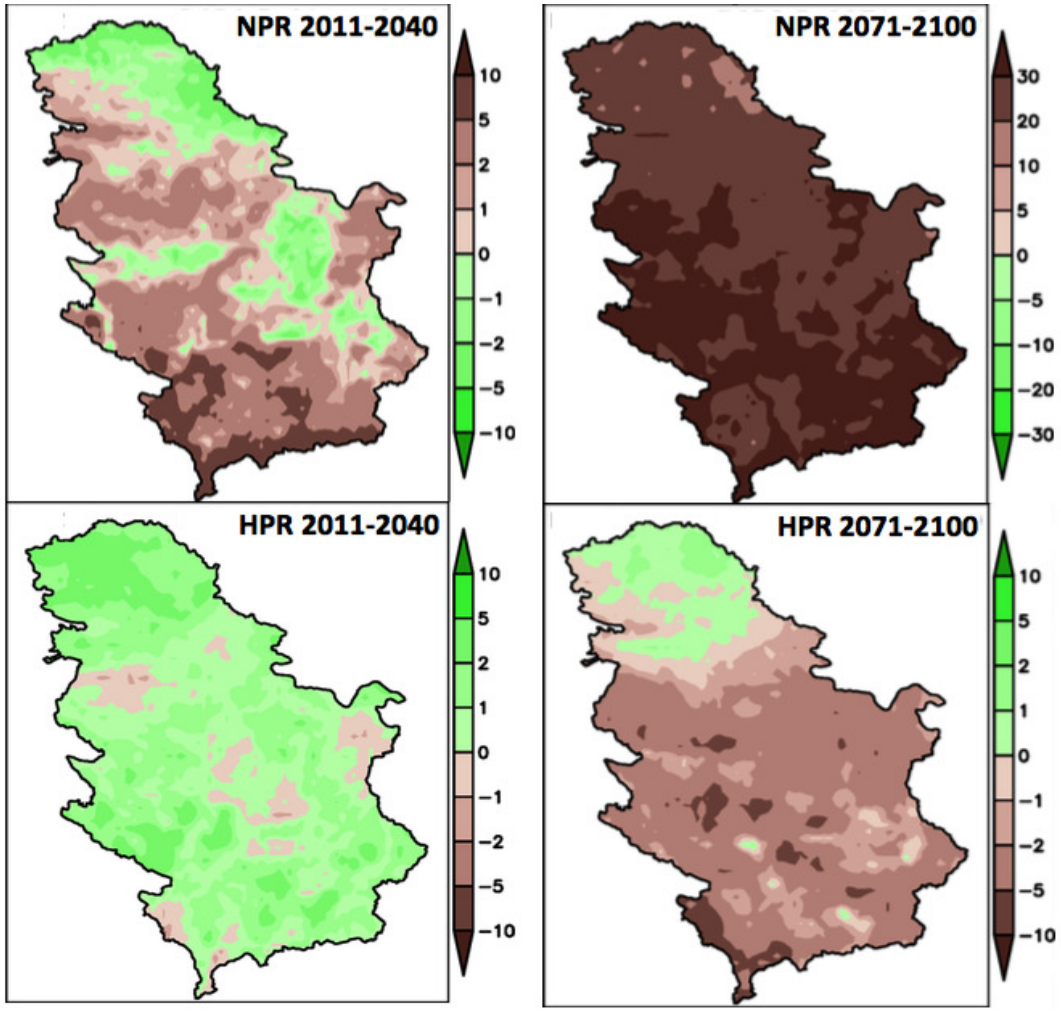
METEOROLOGIJA

CC assessment studies

Agrometeorological conditions

CHANGE IN NUMBER OF DAYS WITH PRECIPITATION >10mm DURING VEGETATION IN RESPECT TO 1971-2000

CHANGE IN NUMBER OF DAYS WITHOUT PRECIPITATION DURING VEGETATION IN RESPECT TO 1971-2000



Vujadinovic M., et al. 2016: Climate change projections in Serbian wine-growing regions, XI Terroir Congress, 10-14 July, Willamette Valley, Oregon, USA

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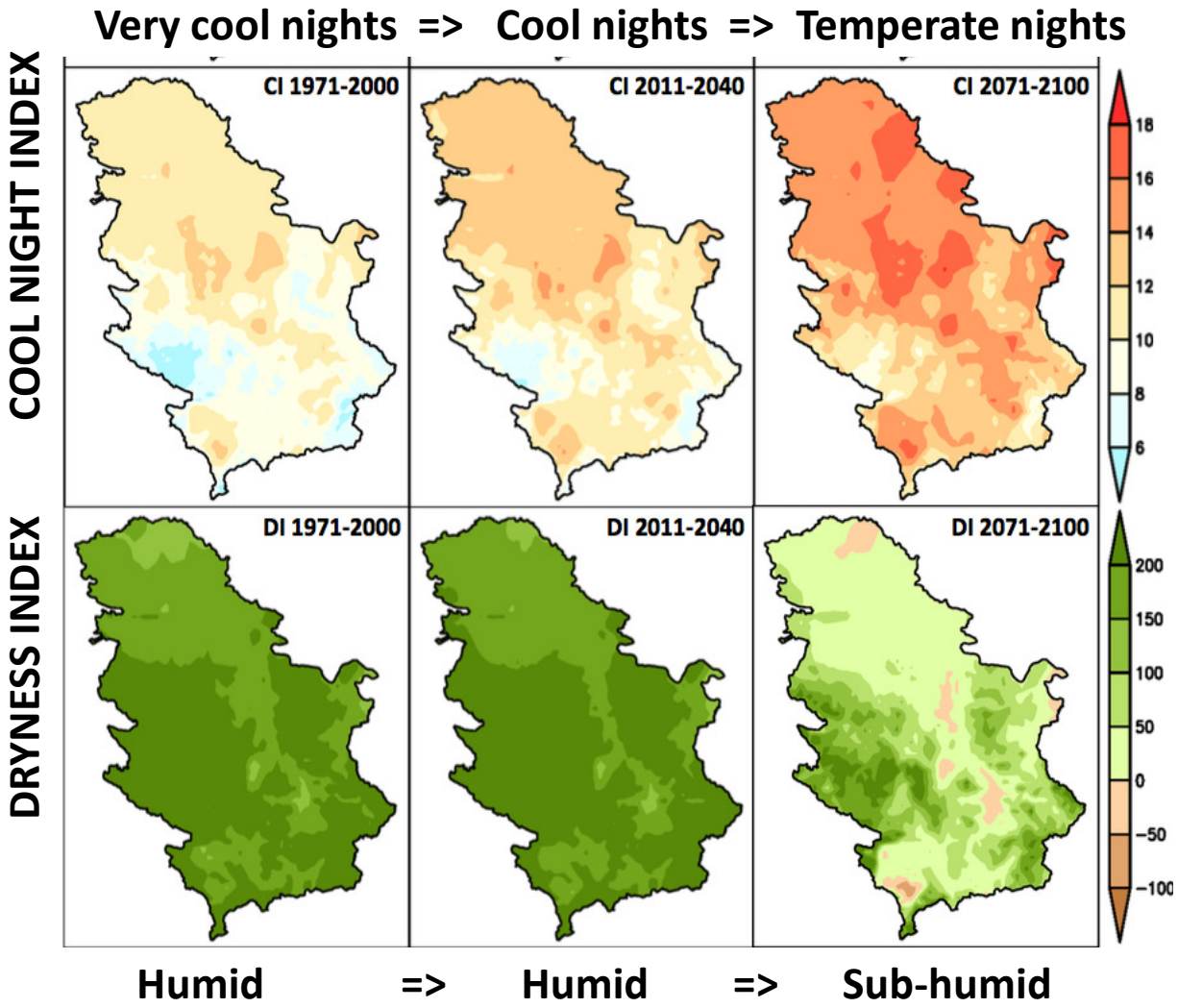
CC assessment studies

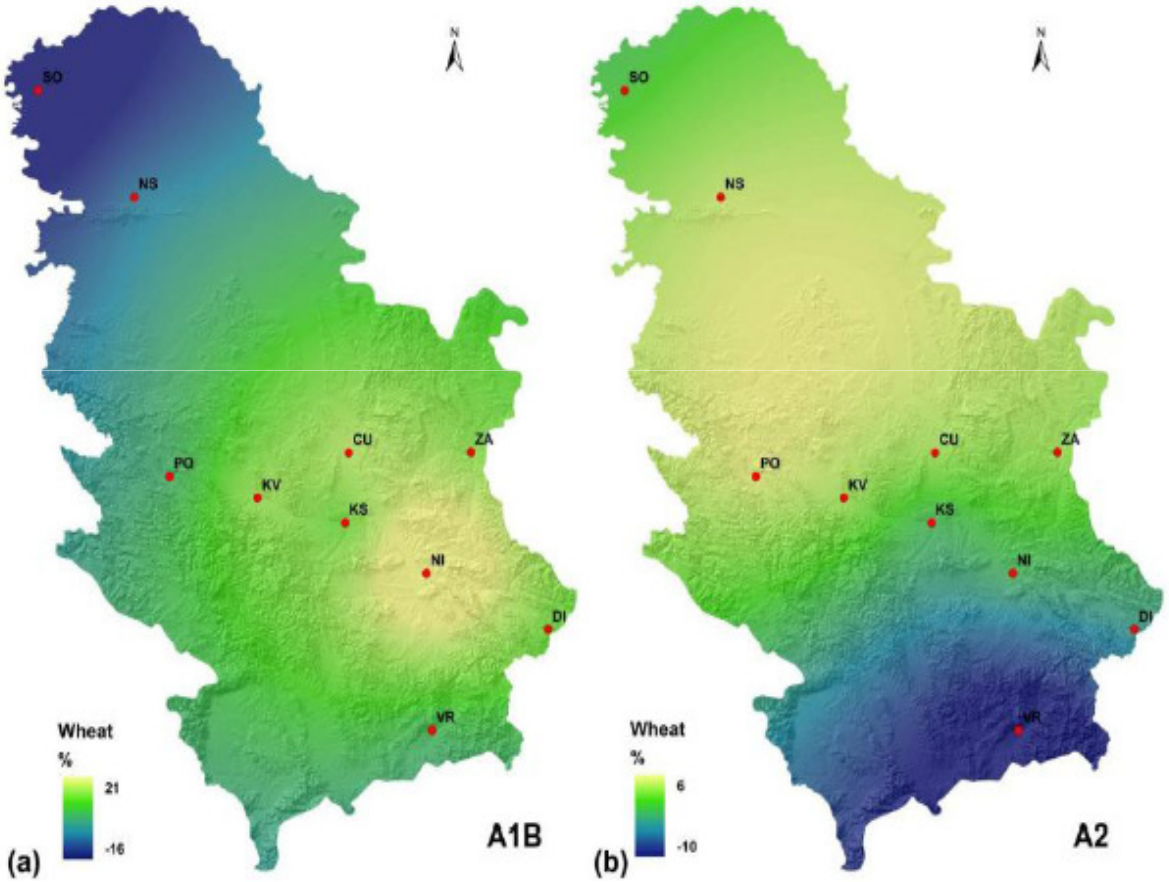
Agrometeorological conditions



Vujadinovic M., et al. 2016: Climate change projections in Serbian wine-growing regions, XI Terroir Congress, 10-14 July, Willamette Valley, Oregon, USA

CC assessment studies

Crop yield – winter wheat

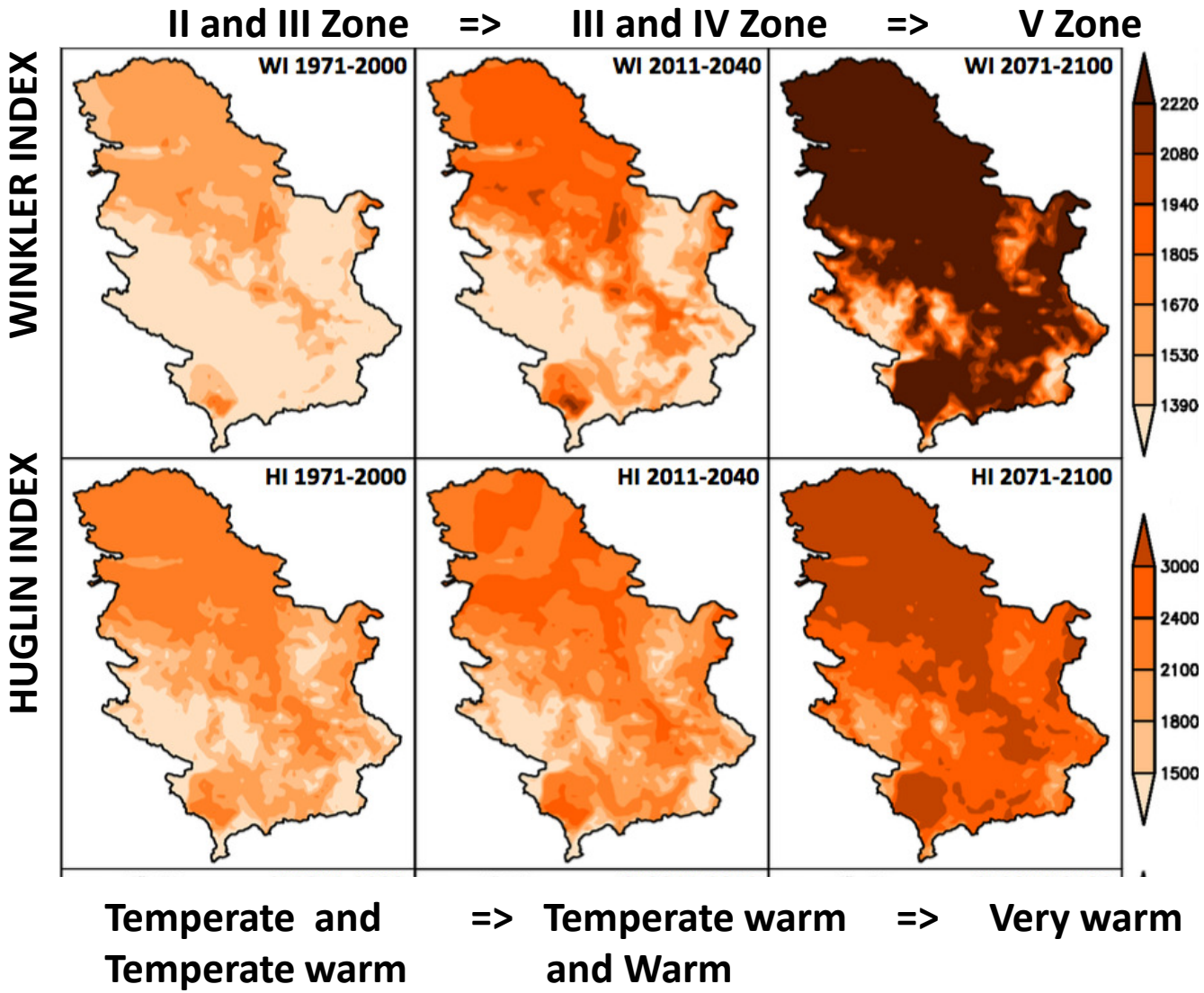


Relative change of winter wheat yield in Serbia for 2030 under the A1B scenario (a) and for 2100 under the A2 scenario (b) against the 1971–2000 period.

D.T. Mihailović, B. Lalić, N. Drešković, G. Mimić, V. Djurdjević, M. Jančić, 2015: Climate change effects on crop yields in Serbia and related shifts of Köppen climate zones under the SRES-A1B and SRES-A2, *International Journal of Climatology* 35(11), 3320–3334.

CC assessment studies

Fruit dynamics



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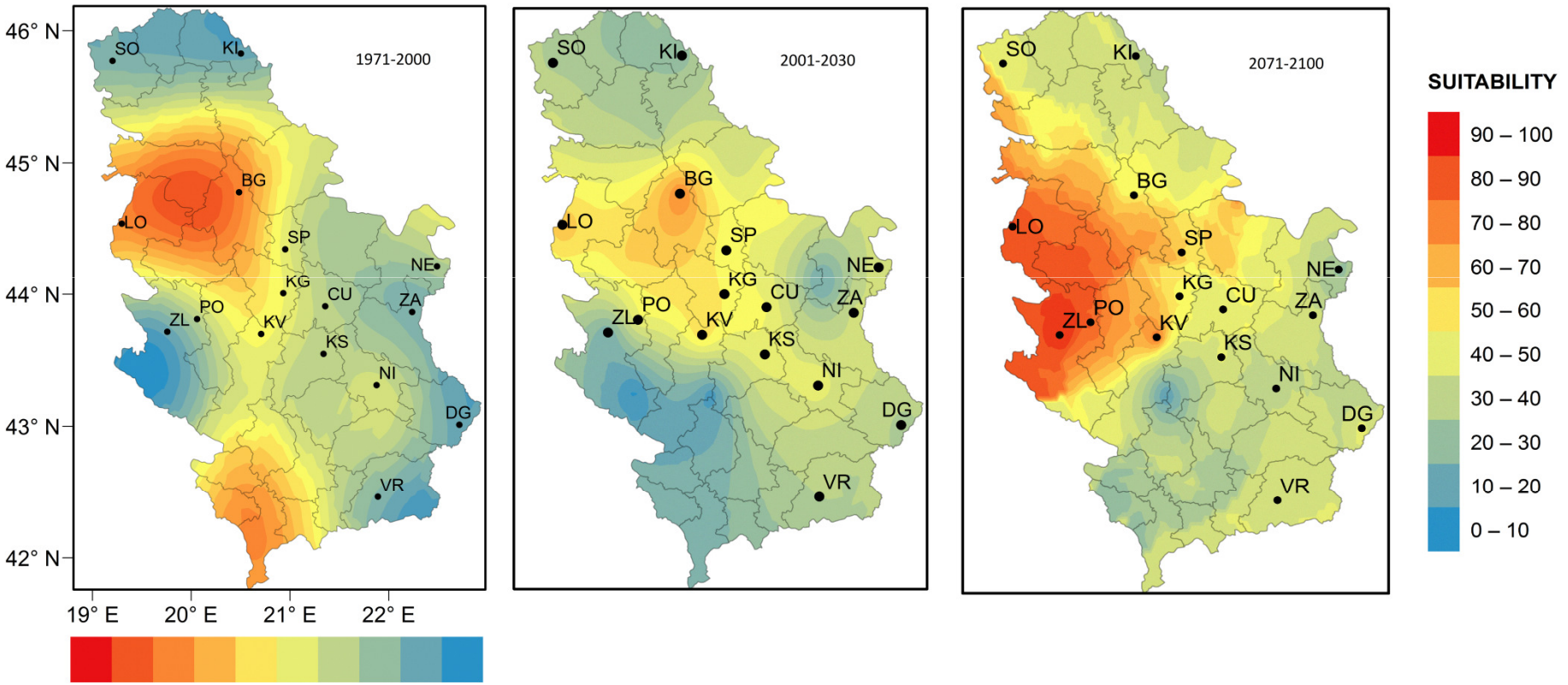
CC assessment studies

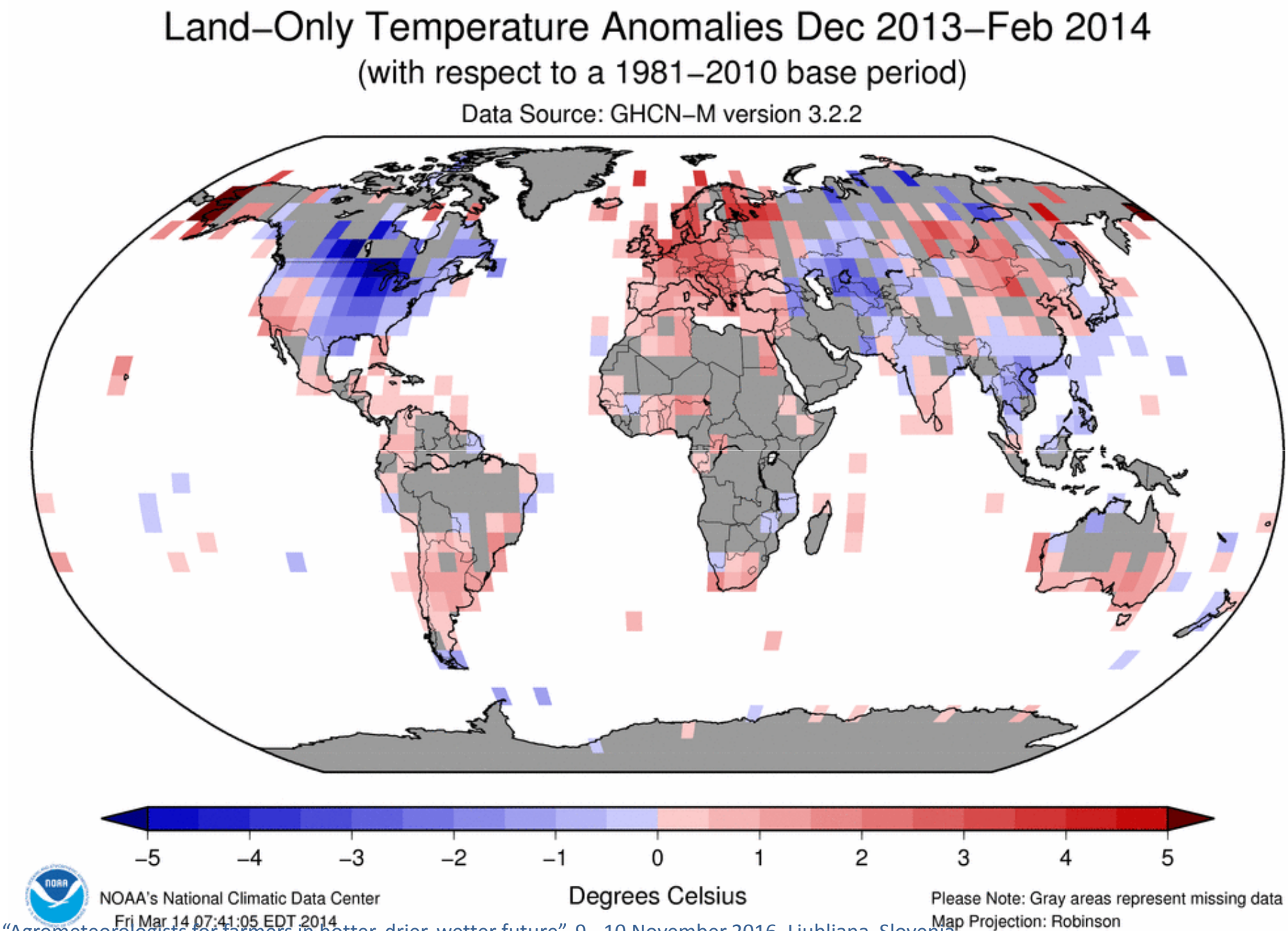
Harmful organism appereance - *Aedes albopictus*



Petrić, M., Lalić, B., Ducheyne, E., & Petrić, D. (2016). *Modelling the impact of climate change on the suitability of the establishment of the Asian tiger mosquito (Aedes albopictus) in Serbia. Climatic Change.* Manuscript submitted.

CC– time to change paradigm

Adapt to climate change = Face with weather


Land–Only Temperature Anomalies Dec 2013–Feb 2014
(with respect to a 1981–2010 base period)
Data Source: GHCN–M version 3.2.2
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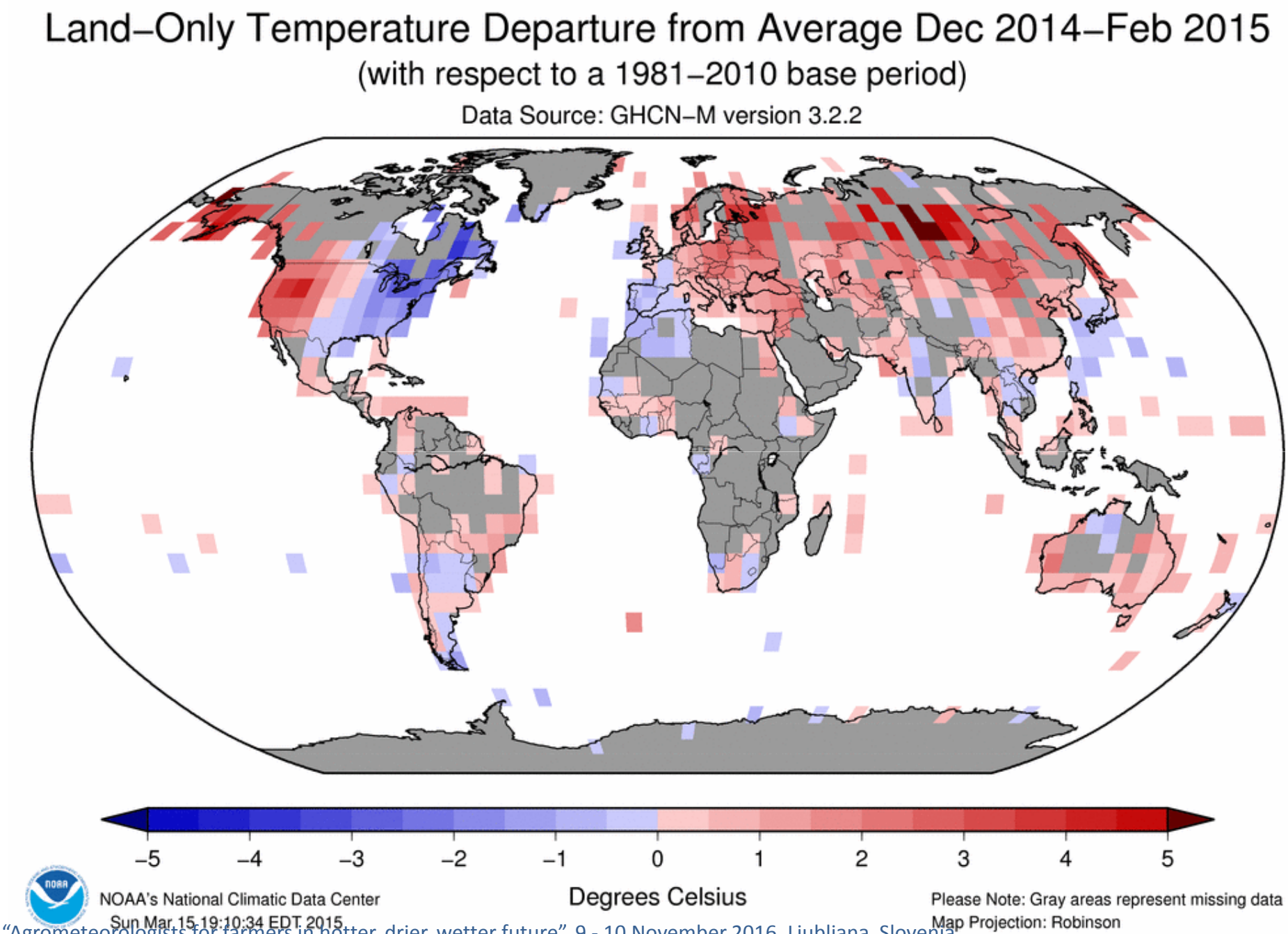
Degrees Celsius
NOAA's National Climatic Data Center
Fri Mar 14 07:41:05 EDT 2014
Please Note: Gray areas represent missing data
Map Projection: Robinson


Land–Only Temperature Departure from Average Dec 2014–Feb 2015
(with respect to a 1981–2010 base period)
Data Source: GHCN–M version 3.2.2
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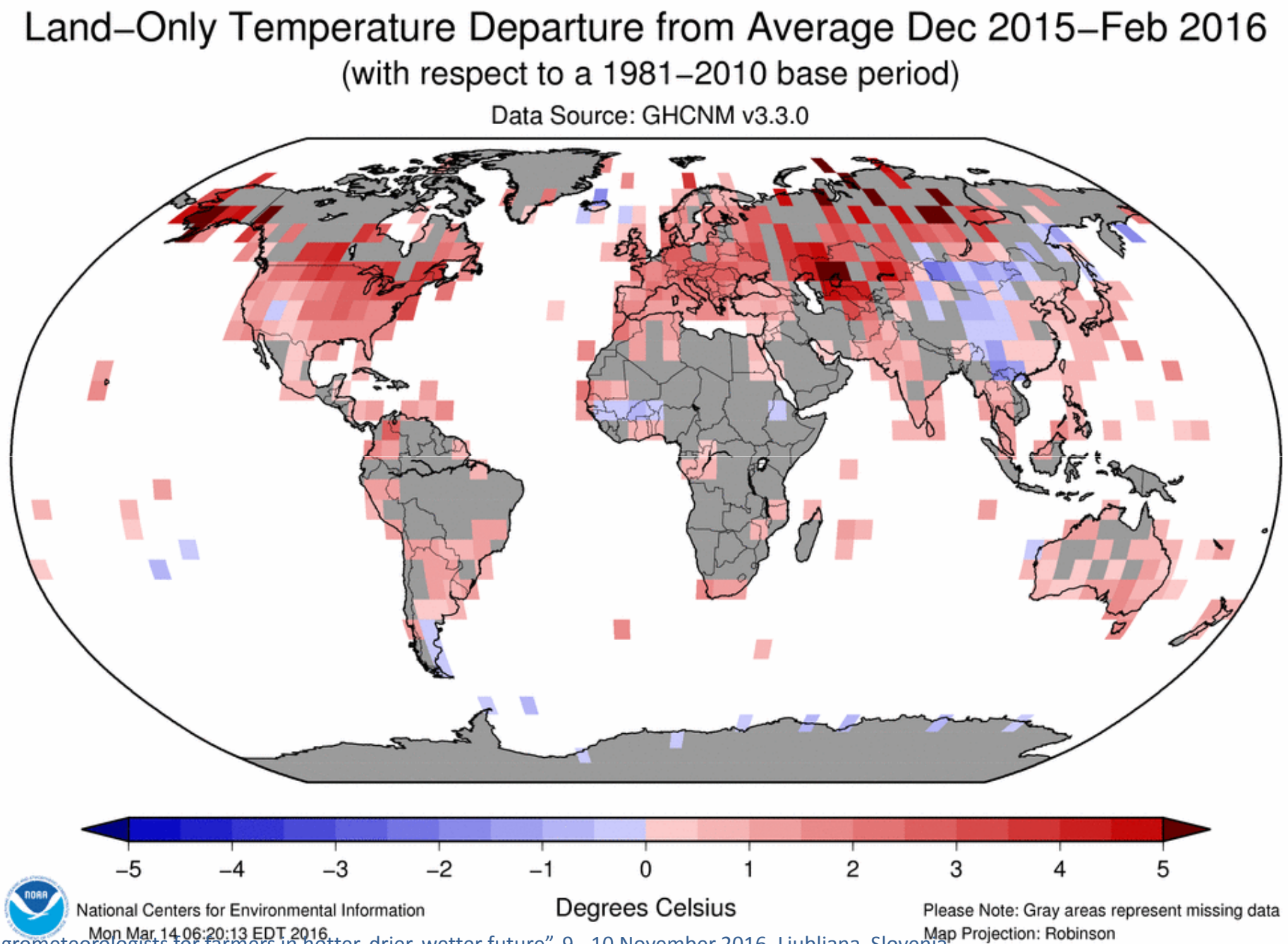
Degrees Celsius
NOAA's National Climatic Data Center
Sun Mar 15 19:10:34 EDT 2015
Please Note: Gray areas represent missing data
Map Projection: Robinson


Land–Only Temperature Departure from Average Dec 2015–Feb 2016
(with respect to a 1981–2010 base period)
Data Source: GHCNM v3.3.0
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Degrees Celsius
National Centers for Environmental Information
Mon Mar 14 06:20:13 EDT 2016
Please Note: Gray areas represent missing data
Map Projection: Robinson

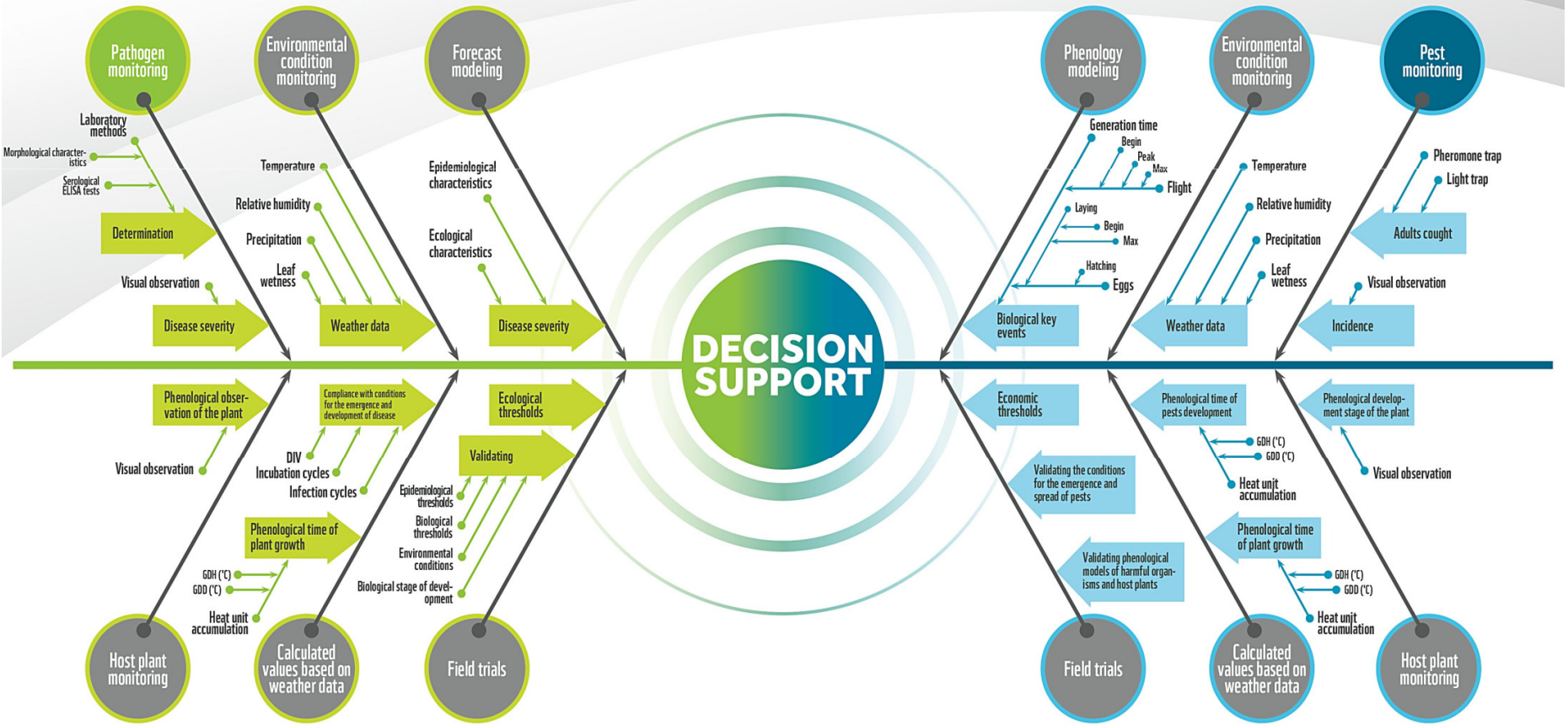
OBSERVED CHANGES IN PHENOLOGY DYNAMICS

Region	Dates	Change (days)
Novi Sad	13.03.2015.	- 58
	14.01.2016.	
Bačka Topola	19.03.2015.	- 58
	20.01.2016.	
Pančevo	12.03.2015.	- 26
	15.02.2016.	
Ruma	22.02.2015.	- 53
	31.12.2015.*	
Sombor	03.03.2015.	- 73
	21.12.2015.*	

GROWING PROBLEM

Shift in appearance of "four tillers detectable" - growing stage of winter wheat in Serbia (Source: PIS Serbia).

DECISION SUPPORT



BEST STRATEGY - TO BE A PART OF SOLUTION

Application of advanced meteorological products

- Numerical weather prediction of different scales: short range, monthly and seasonal forecast

Application through

- Plant & harmful organism phenology models
- Crop models

EXAMPLE OF SOLUTIONS - LOCATIONS

Application of Seasonal & Monthly weather forecast

♦ AgM - forecasting : ♣ air temperature and humidity ♣ solar radiation ♣ soil temperature and moisture ♣ precipitation

♦ AgM forecasting application: ♣ No. of days with extreme temperatures ♣ sun burns ♣ No. of dry days

♦ CM - ensembl forecasting : ♣ crop dynamic ♣ soil moisture deficit ♣ evapotranspiration ♣ LAI development

♦ CM ensembl forecasting application : ♣ yield and biomass formation ♣ N uptake ♣ scheduling of farm operations according to weather and crop conditions on monthly and seasonal scale ♣ optimization of irrigation, fertilization and plant protection application-spraying

RESULTS

MONTHLY WEATHER FORECAST

Source: Monthly EPS products of ECMWF (European Centre for Medium range Weather Forecast)

Forecast: March 1, 2005 - June 30, 2005;
51-member ensemble

RESULTS

PHENOLOGY MODEL

Model: **PIS_PHEN**

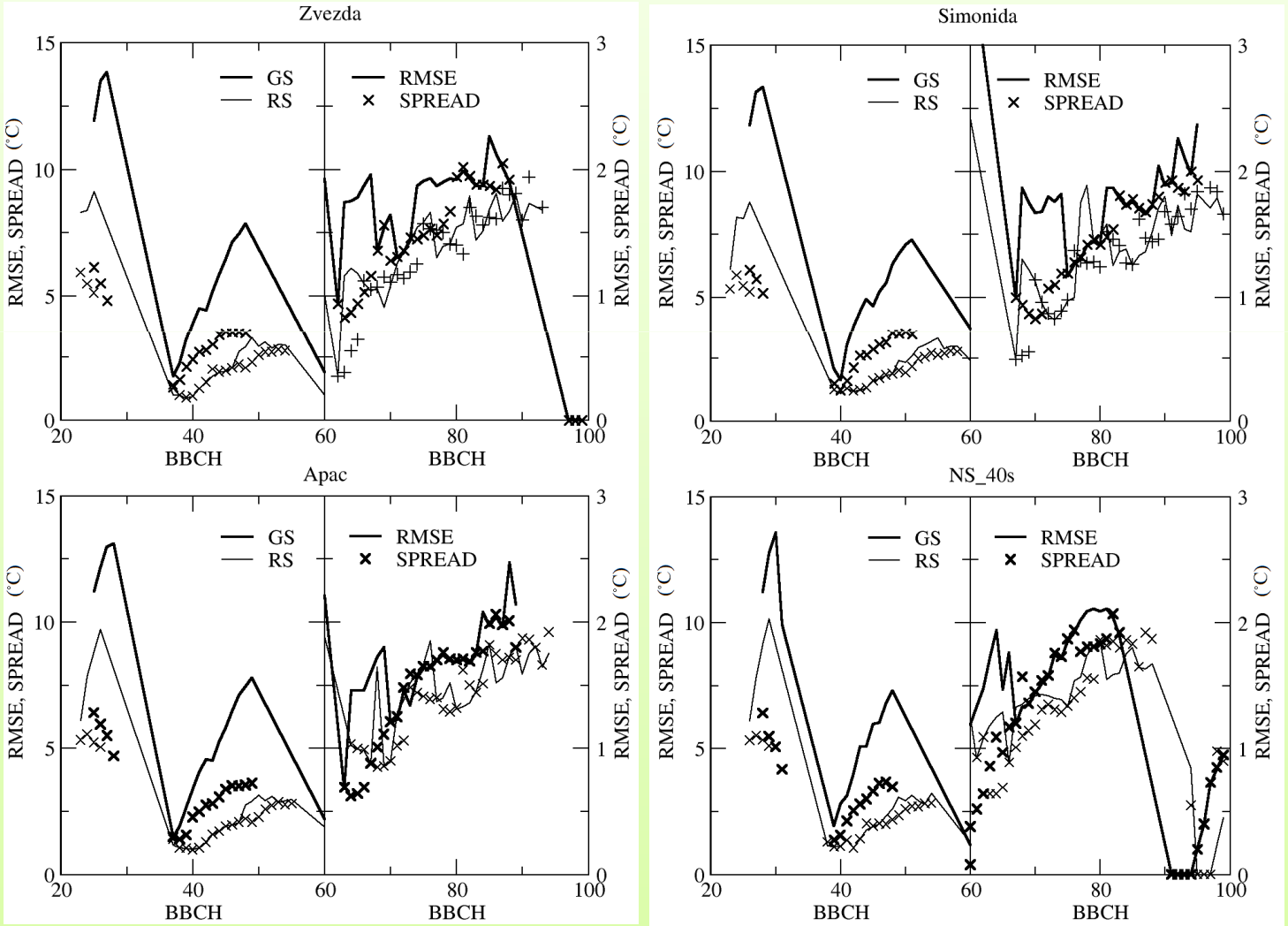
Source: Forecasting and Warning Service of Serbia in plant protection

Methodology: Continuous observation of plant growing stages according to BBCH scale

Cultivar: Winter wheat

Lalic, B., D. Jankovic, Lj. Dekic, J. Eitzinger, A. Firanj Sremac, 2016: Testing efficacy of monthly forecast application in agrometeorology: Winter wheat phenology dynamic, EOBAR Conference, Bejing, China, 16-17 May 2016, p. 8 (In press).

RESULTS - CALCULATED PHENOLOGY DYNAMIC



5 °C lower threshold

OBSERVED WEATHER VS. MONTHLY WEATHER FORECAST

Application of short range weather forecast

♦ AgM - forecasting : ♣ leaf weatness and temperature ♣ canopy air temperature and humidity ♣ soil temperature and moisture ♣ precipitation ...

♦ AgM - forecasting application : ♣ fruit vegetation dynamic (in progress) ♣ meteorological conditions for plant dissease appereance (done)

RESULTS

SHORT RANGE WEATHER FORECAST

Source: Work Eta Numerical weather prediction model

Forecast: 1 - 31 March 2011

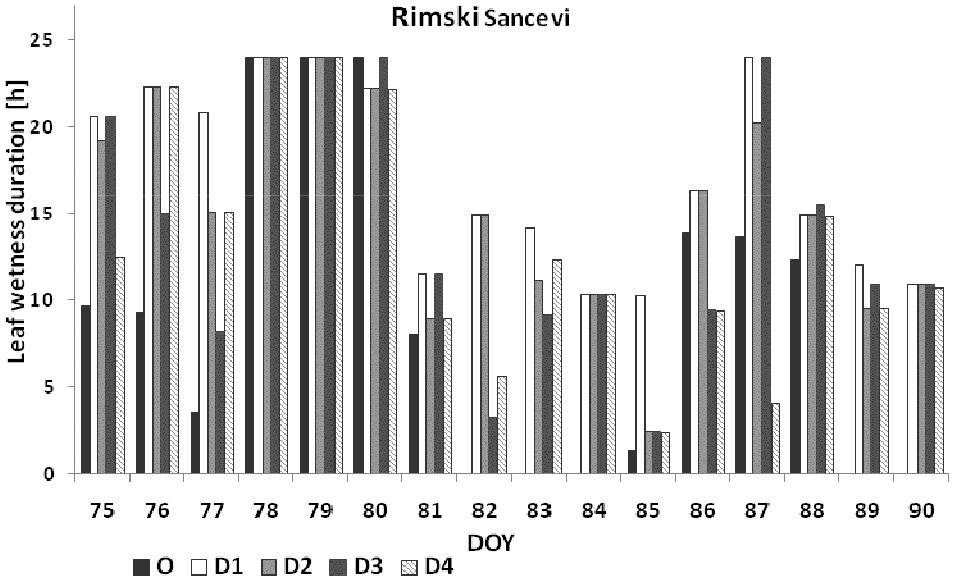
Model: **BAHUS biometeorological model**

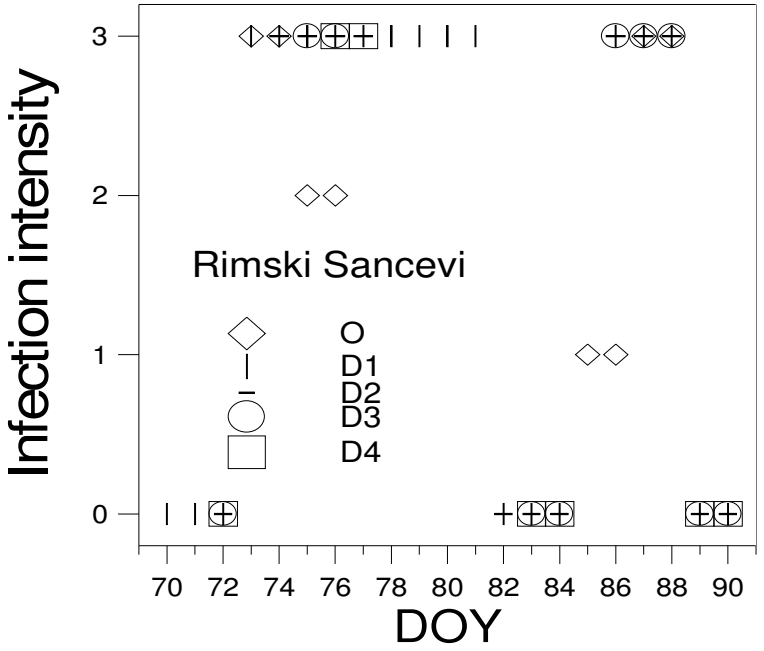
Methodology: Comparison of model outputs obtained using observed and simulated weather data

Cultivar: Apple

Facing weather

♣ Forecasting apple scab infection intensity: **TEMPERATURE & LEAF WETNESS DURATION**





Lalic, B. Francia, M., Eitzinger, J., Podrascanin, Z., Arsenic, I., 2015: Effectiveness of Short-term Numerical Weather Prediction in Predicting Growing Degree Days and Meteorological Conditions for Apple Scab Appearance, *Meteorological Applications*, DOI: 10.1002/met.1521.

RESULTS

SHORT RANGE WEATHER FORECAST

Source: WRF-ARW Numerical weather prediction model

Forecast: 9 - 29 May 2016
4 day runs

Model: **BAHUS biometeorological model**

Methodology: Comparison of model outputs obtained using observed and simulated weather data

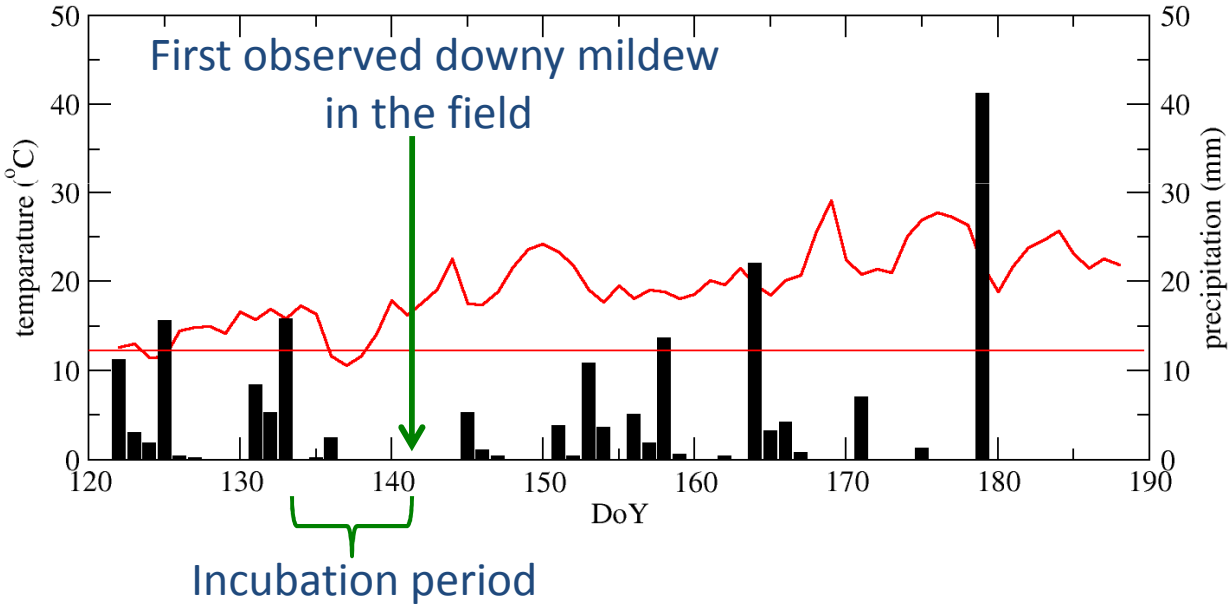
Cultivar: Wine grape

Downy mildew of wine grape

Forecasting and Warning Service of Serbia

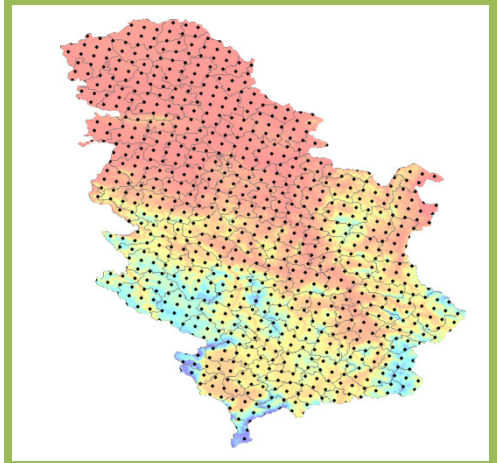
Plasmopara viticola, the causal agent of grapevine downy mildew, is a heterothallic oomycete that overwinters as oospores in leaf litter and soil.

Cerevic, 2016



Firanj Sremac, A., Lalić, B., Janković, D., 2016: The WRF-ARW application in predicting meteorological conditions for Downy mildew (*Plasmopara viticola*) appearance of wine grape. Abstract from 16th EMS Annual Meeting, 12–16 September, 2016, Trieste, Italy

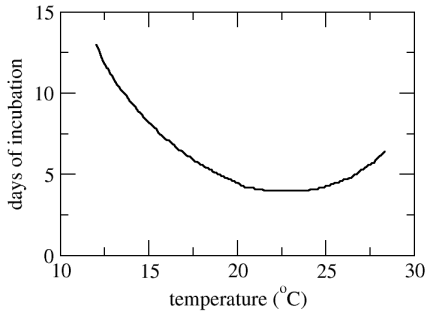
Downy mildew of wine grape - Results

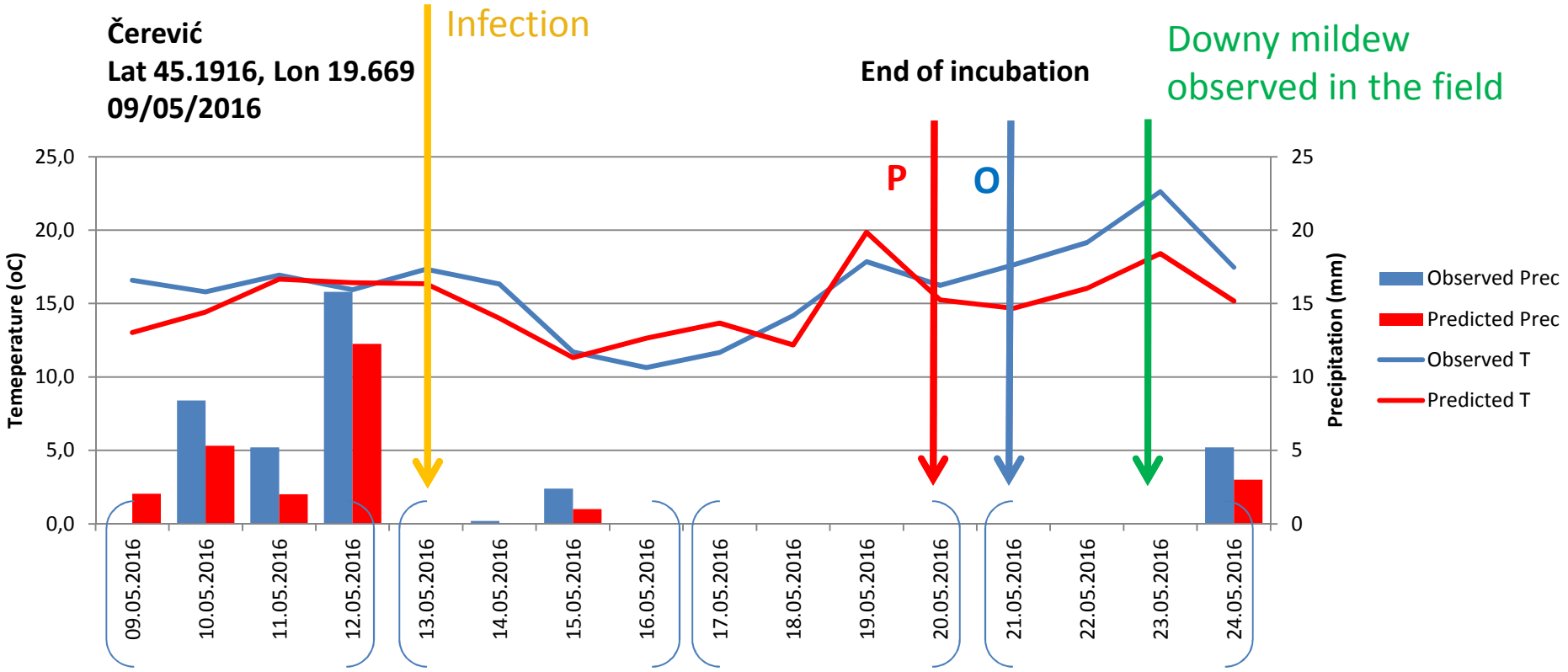


WRF-ARW temperature field

Incubation period forcasting

End of incubation period calculated with Müller's method for observed and predicted meteorological values.





4 day run of WRF-ARW