AGRICULTURE IN CHANGING CLIMATE

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

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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.


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Fruit dynamics

WINKLER INDEX

II and III Zone => III and IV Zone => V Zone

HUGLIN INDEX

Temperate and Temperate warm => Temperate warm and Warm => Very warm

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Harmful organism appearance - *Aedes albopictus*


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Adapt to climate change = Face with weather

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Land–Only Temperature Departure from Average Dec 2015–Feb 2016
(with respect to a 1981–2010 base period)

Data Source: GHCNM v3.3.0
# Observed Changes in PhENOLOGY Dynamics

<table>
<thead>
<tr>
<th>Region</th>
<th>Dates</th>
<th>Change (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novi Sad</td>
<td>13.03.2015.</td>
<td>- 58</td>
</tr>
<tr>
<td></td>
<td>14.01.2016.</td>
<td></td>
</tr>
<tr>
<td>Bačka Topola</td>
<td>19.03.2015.</td>
<td>- 58</td>
</tr>
<tr>
<td></td>
<td>20.01.2016.</td>
<td></td>
</tr>
<tr>
<td>Pančevo</td>
<td>12.03.2015.</td>
<td>- 26</td>
</tr>
<tr>
<td></td>
<td>15.02.2016.</td>
<td></td>
</tr>
<tr>
<td>Ruma</td>
<td>22.02.2015.</td>
<td>- 53</td>
</tr>
<tr>
<td></td>
<td>31.12.2015.*</td>
<td></td>
</tr>
<tr>
<td>Sombor</td>
<td>03.03.2015.</td>
<td>- 73</td>
</tr>
</tbody>
</table>

**Growing Problem**

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

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Forecasting and Warning Service of Serbia in plant protection

Authors: Republic and Regional Centres, Forecast and Warning Service in Plant Protection, Republic of Serbia
WWW.PISSRBIIJA.COM • WWW.PISVOJVODINA.COM

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
Facing weather

EXAMPLE OF SOLUTIONS - LOCATIONS

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

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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

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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


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RESULTS - CALCULATED PHENOLOGY DYNAMIC

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Application of short range weather forecast

♦ AgM - forecasting: ♠ leaf wetness and temperature ♠ canopy air temperature and humidity ♠ soil temperature and moisture ♠ precipitation ...

♦ AgM - forecasting application: ♠ fruit vegetation dynamic (in progress)
♠ meteorological conditions for plant disease appearance (done)
## SHORT RANGE WEATHER FORECAST

Source: Work Eta Numerical weather prediction model

<table>
<thead>
<tr>
<th>Forecast: 1 - 31 March 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model: <strong>BAHUS biometeorological model</strong></td>
</tr>
<tr>
<td>Methodology: Comparison of model outputs obtained using observed and simulated weather data</td>
</tr>
<tr>
<td>Cultivar: Apple</td>
</tr>
</tbody>
</table>

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


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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

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Downy mildew of wine grape

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

Cerevic, 2016

First observed downy mildew in the field

Incubation period

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
Incubation period forecasting

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

[Graph showing incubation period calculation]

Čerević
Lat 45.1916, Lon 19.669
09/05/2016

Downy mildew observed in the field

4 day run of WRF-ARW

EMS2016 | 12–16 September 2016 | Trieste, Italy