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RECERCA I TECNOLOGIA AGROALIMENTÀRIES

Potential changes in water deficit and phenology of grapevine under climate change conditions in NE Spain: A modelling approach to watershed level.

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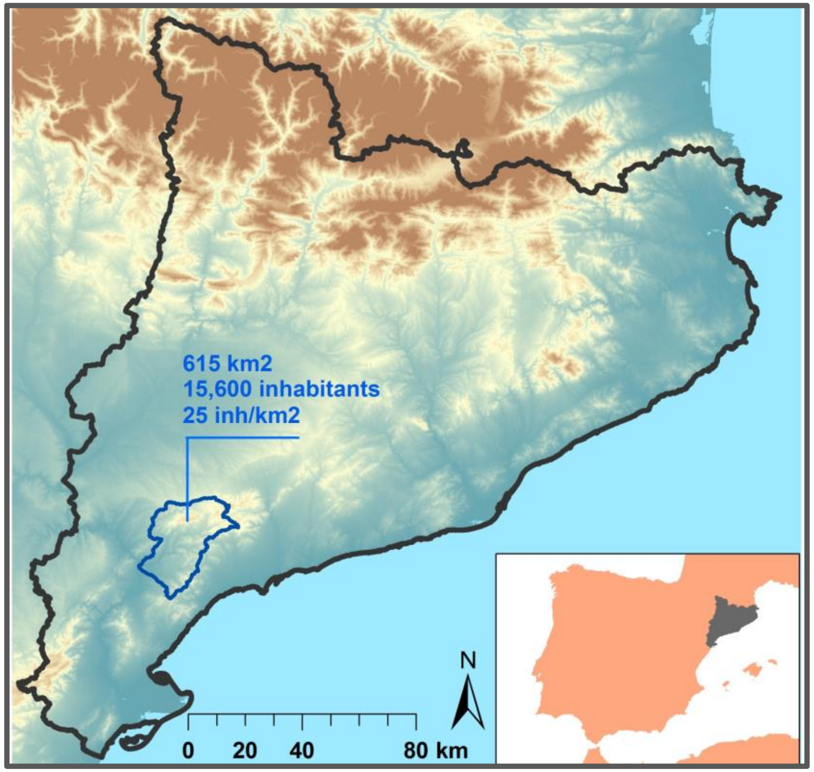
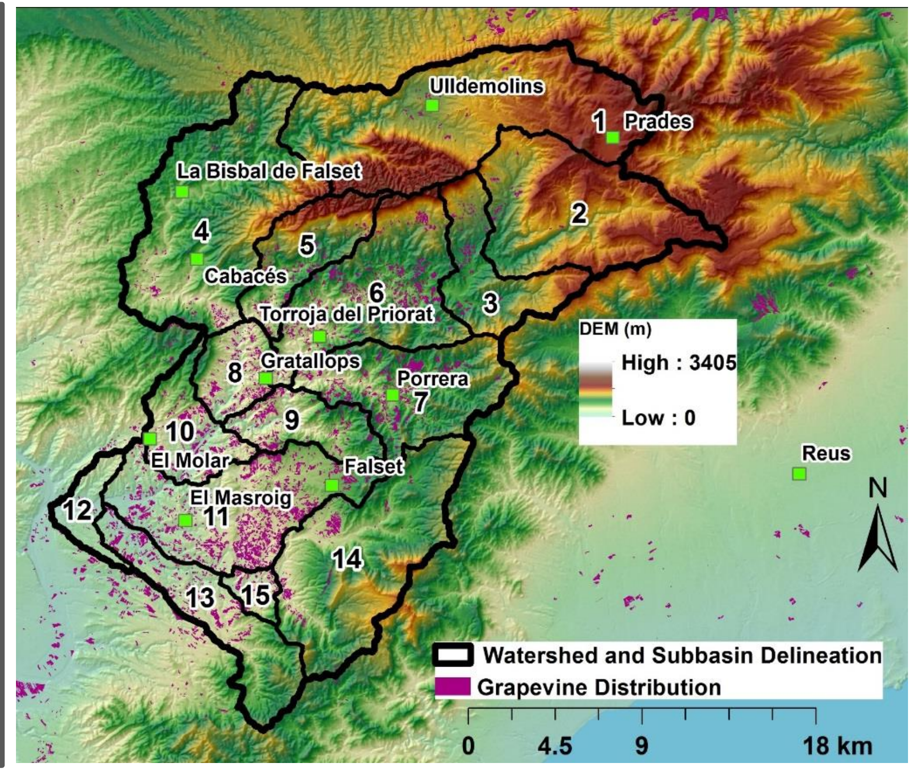
Generalitat de Catalunya

The Siurana basin





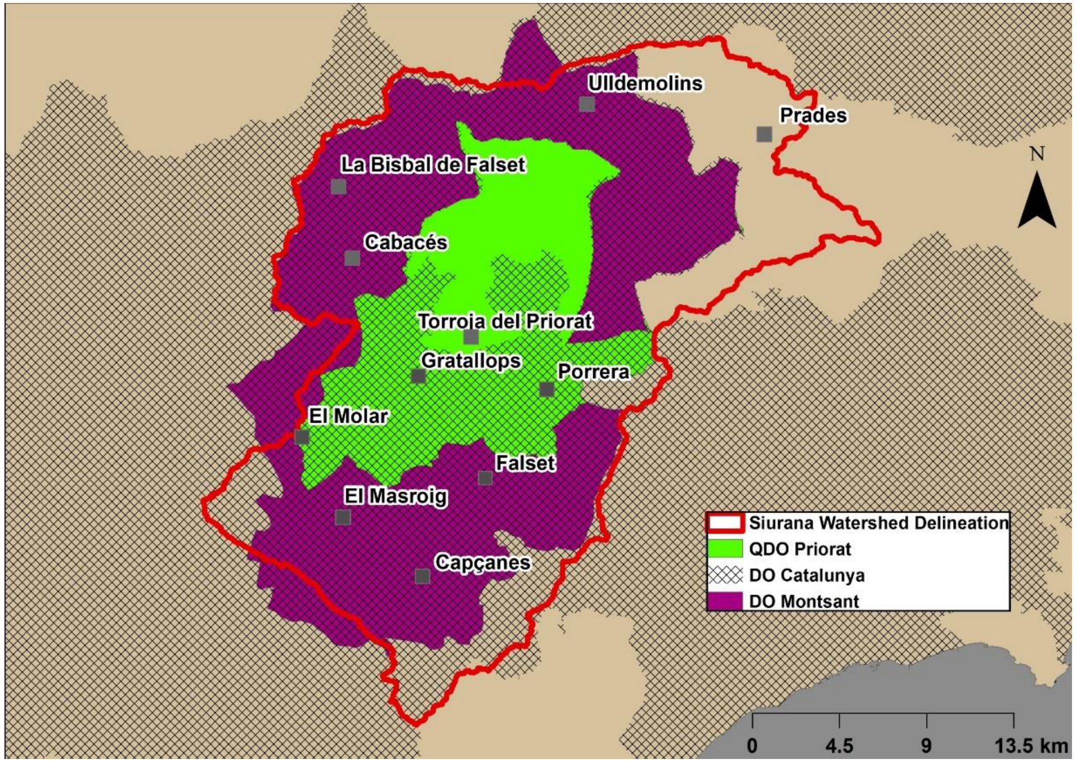
Siurana is a small river lightly regulated which disembogues in the Ebro

Land uses are about 75% forest, 22% crops and 2% artificial

Rainfed crops (60% of agricultural surface: almond, olive, hazel and vines)

Winegrowing 16% of crops (about 3.000 ha)

Context The Siurana basin and viticulture



Objective

To evaluate the vulnerability to climate change of winegroving under Mediterranean conditions in the Siurana watershed

Water needs

Phenological changes

Methods

DOWNSCALING

Climate projections for 21st century using a

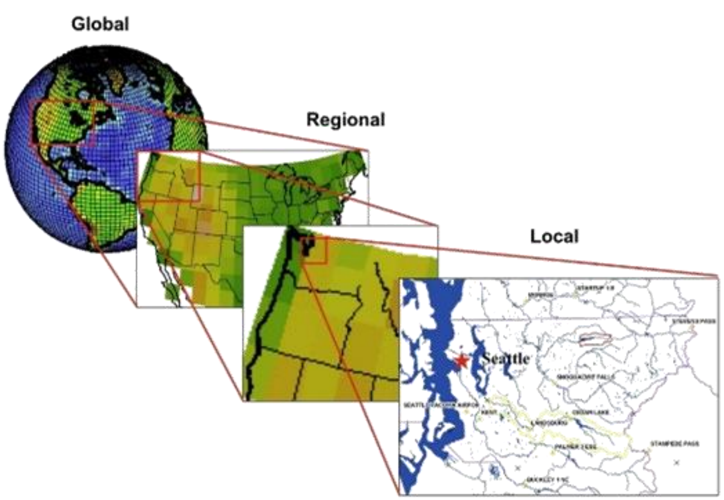
combination of downscaled climate projections

General circulation model: ECHAM5

Dynamic Regionalization: MM5 ← SMC
Resolution 6 h and 15 km
(*Barrera-Escoda and Cunillera, 2011*)

in two IPCC scenarios (B1 and A2, SRES AR4),

watershed hydrological model (SWAT) → 15 subbasins



Methods: Net Irrigation Needs (NIN) calculation

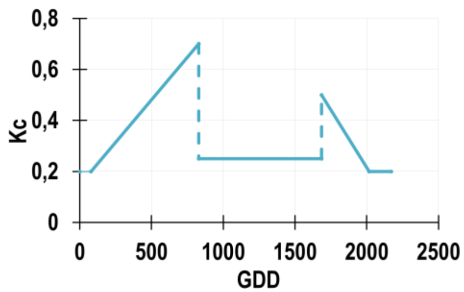
FAO-56 procedure to calculate crop potential evapotranspiration

Climate data

$P_{effective}$
Effective rainfall
(*USDA-SCS; Clarke, 1998*)

$ETc = Eto \times Kc$

RAW = Readily available water in the soil
(*soil maps + FAO-56*)

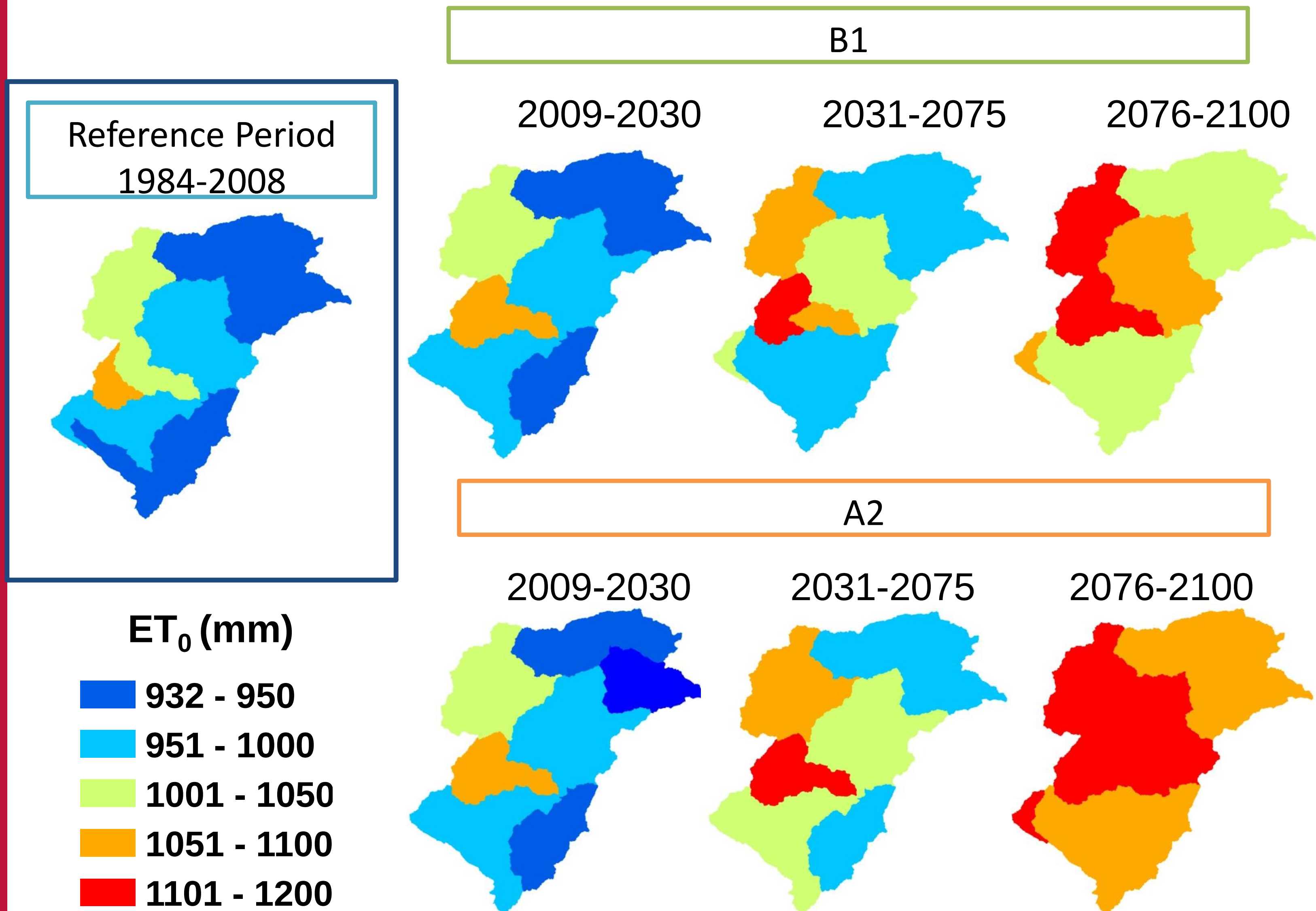


Kc (*Girona et al., 2002, 2004, 2010; Marsal et al., 2002*)

$ET_{actual} = (P_{effective} + RAW)$	*when* $ETc > (P_{effective} + RAW)$
$ETactual = ETc$	*when* $Etc < (P_{effective} + RAW)$

$$NIN = ETc - ETactual$$

Results : ETo projections



Results : Rainfall projections

Reference Period
1984-2008

B1

2009-2030 | 2031-2075 | 2076-2100

A2

2009-2030 | 2031-2075 | 2076-2100

Pp (mm)

- 325 - 350
- 351 - 400
- 401 - 500
- 501 - 600
- 601 - 700
- 701 - 750

ClimWine 2016: *"Sustainable grape and wine production in the context of climate change"*
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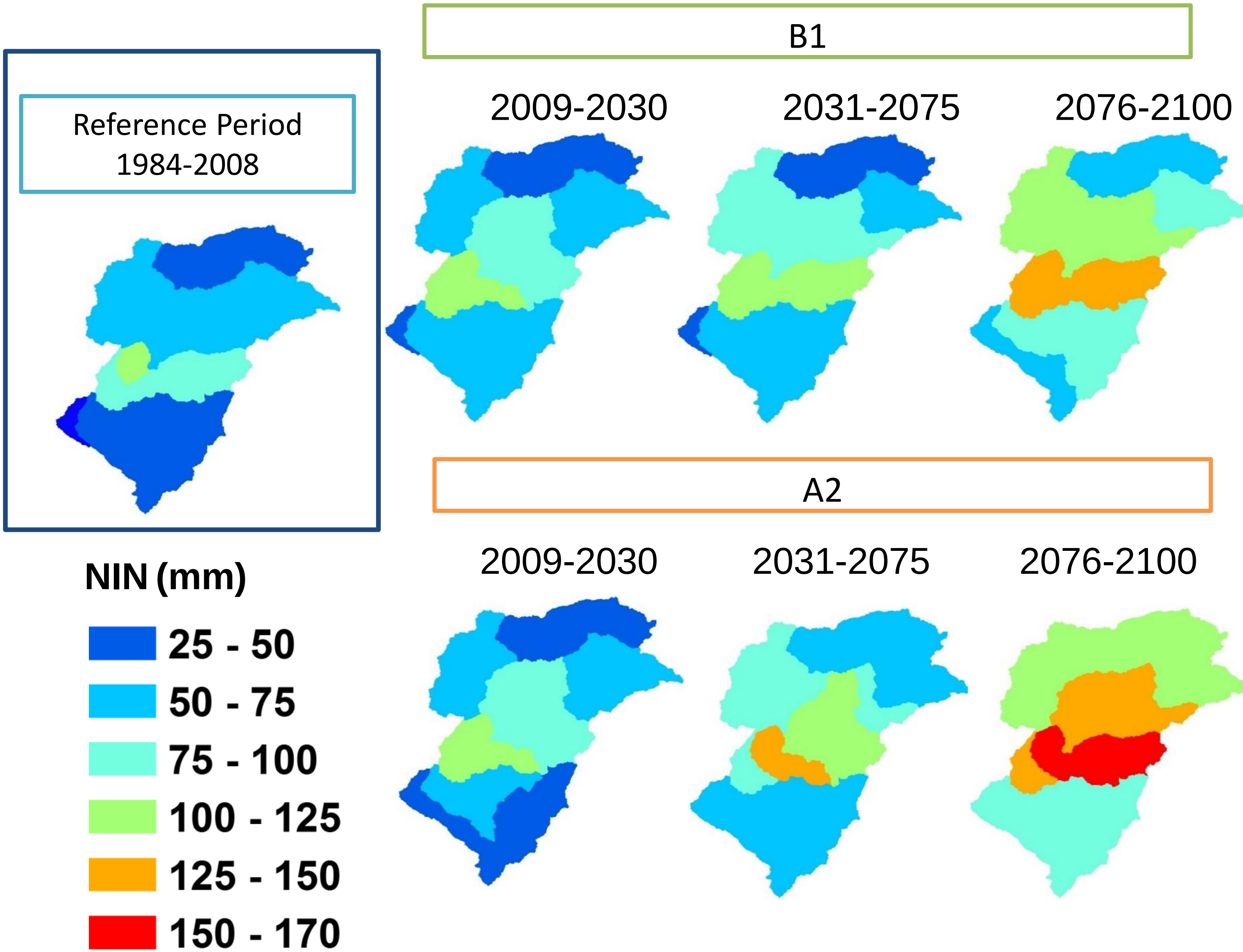
Results : NIN projections



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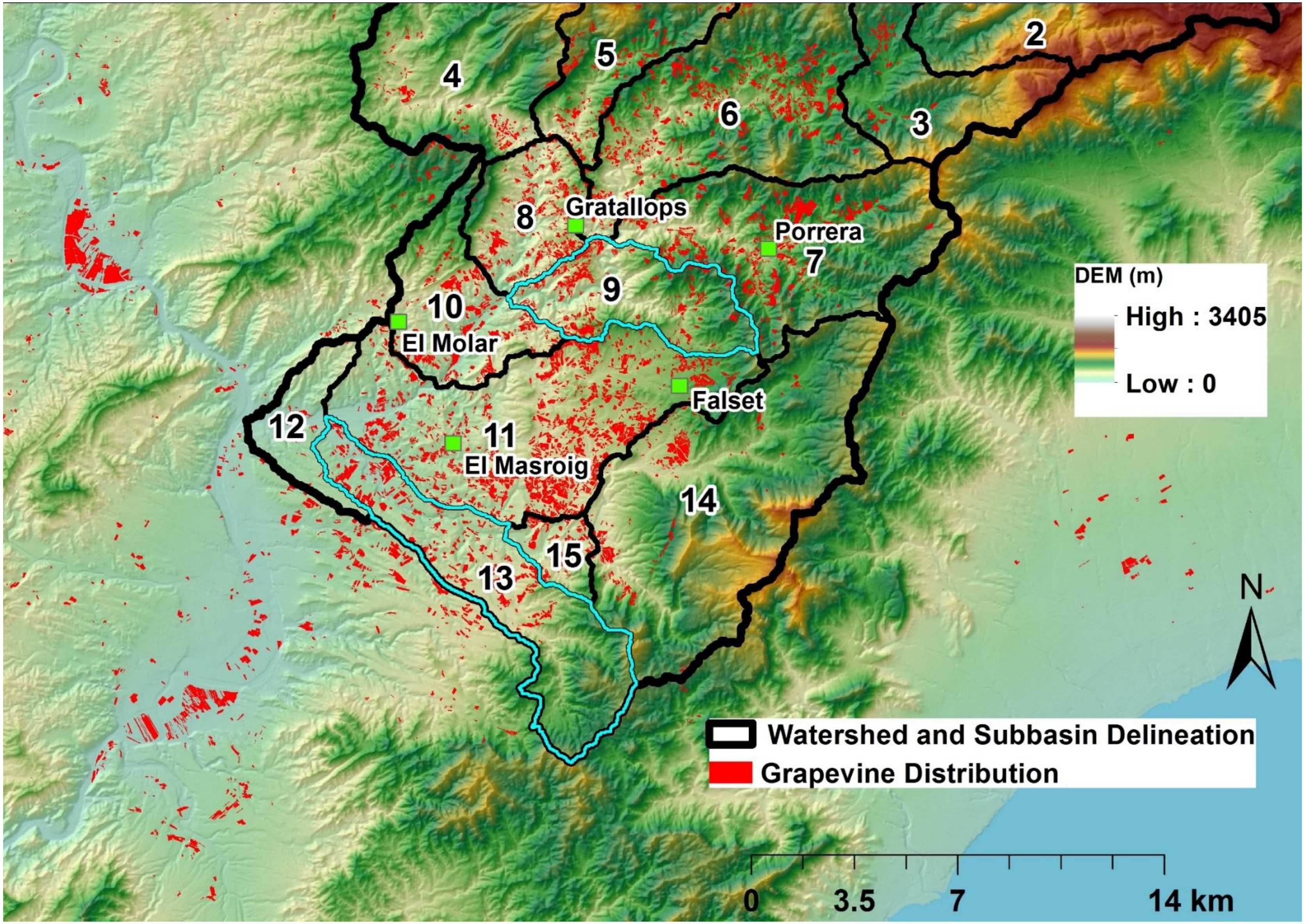
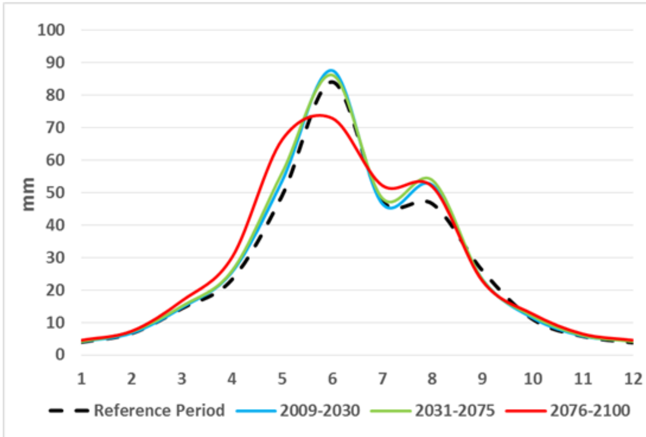
Results: Monthly Analysis: 2 contrasted subbasins



Results: Crop evapotranspiration

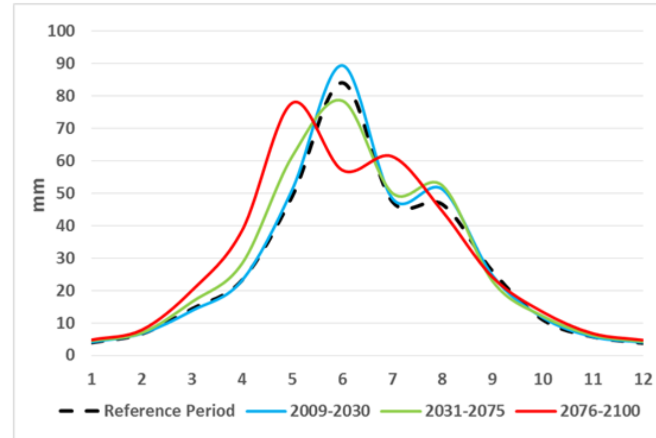
B1 climate change scenario

Most Impacted Subbasin



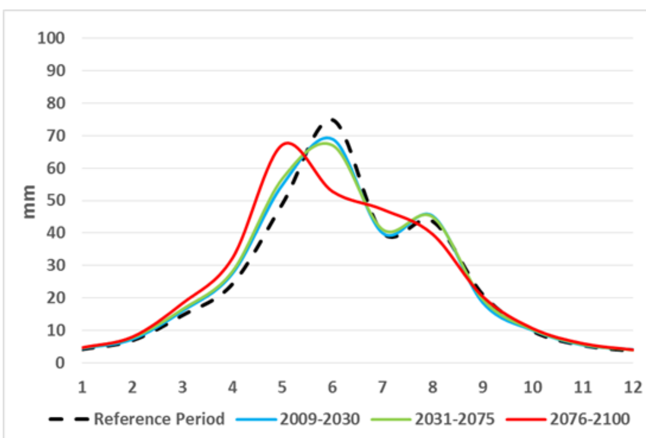
A2 climate change scenario

Most Impacted Subbasin

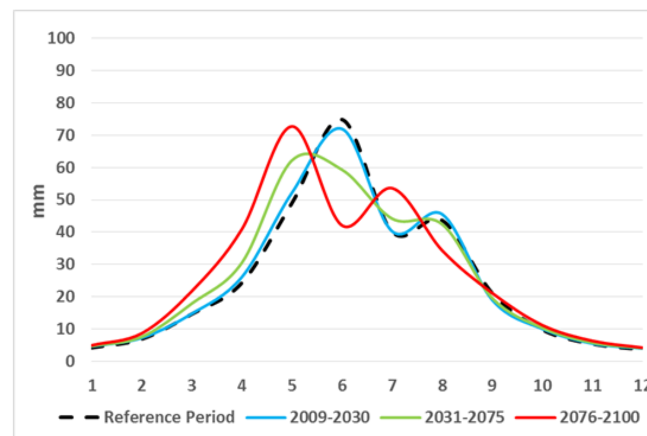


Reference Period — 2009-2030 — 2031-2075 — 2076-2100

Least impacted Subbasin



Least impacted Subbasin



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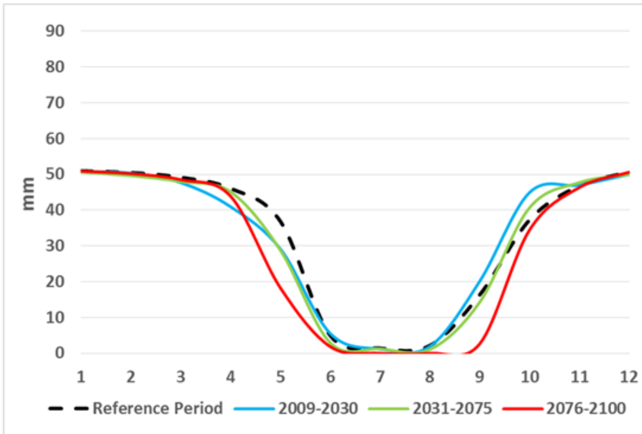
Results: Rainfall

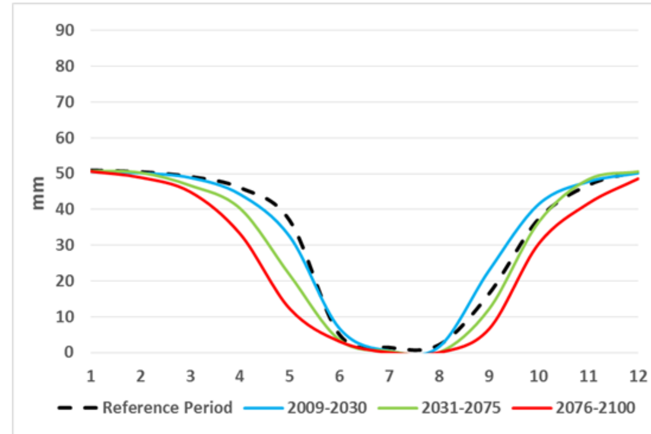
B1 climate change scenario

Most Impacted Subbasin



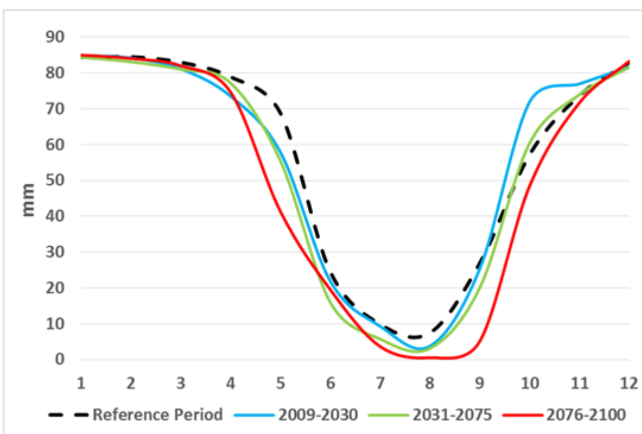
A2 climate change scenario

Most Impacted Subbasin

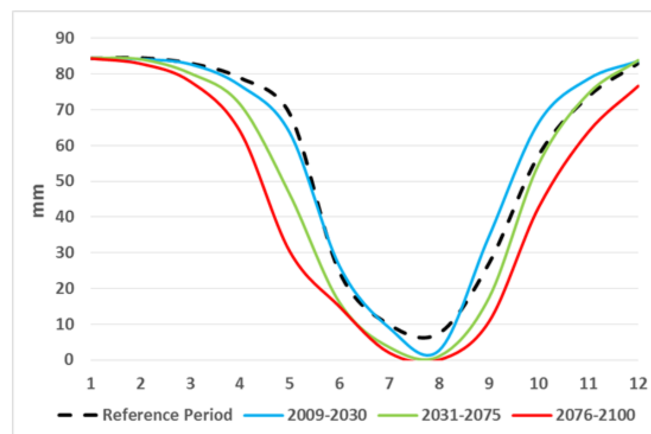


Reference Period — 2009-2030 — 2031-2075 — 2076-2100

Least impacted Subbasin (B1)



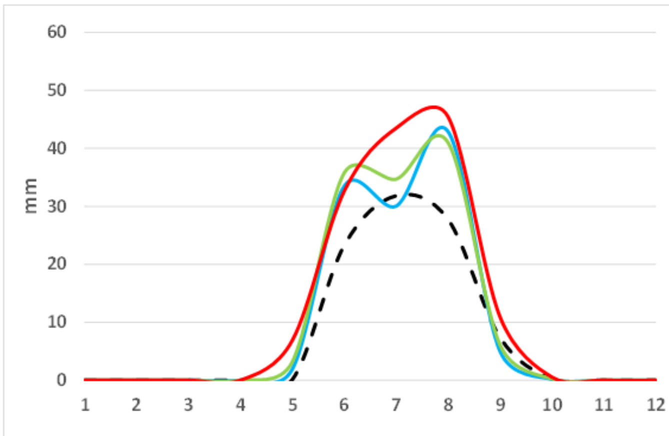
Least impacted Subbasin (A2)



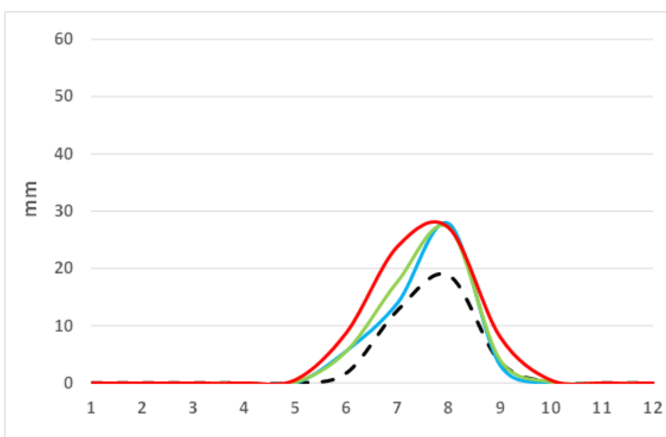
Results: Net Irrigation Needs

B1 climate change scenario

Most Impacted Subbasin

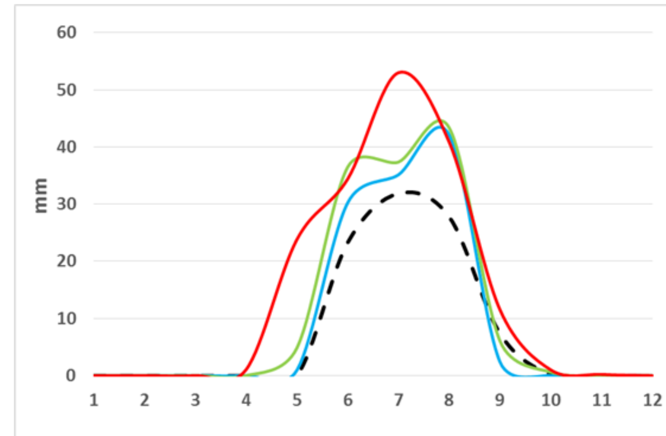


Least impacted Subbasin

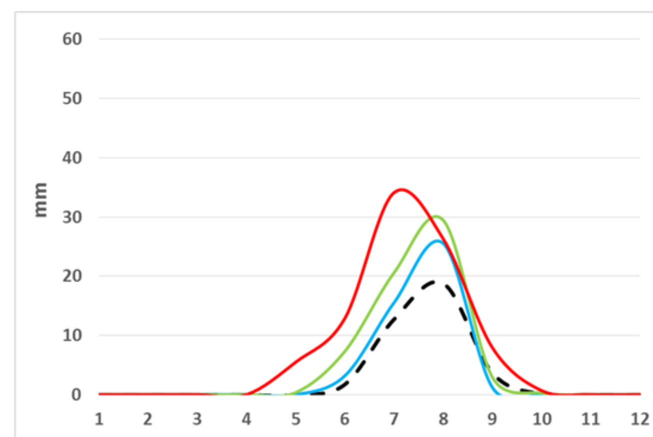


A2 climate change scenario

Most Impacted Subbasin



Least impacted Subbasin



--- Reference Period — 2009-2030 — 2031-2075 — 2076-2100

Results: Thermal indicators of Siurana watershed

Thermal Indicator	Reference Period 1984-2008	Climate Change Scenario	Short Term 2009-2030	Mid Term 2031-2075	Long Term 2076-2100
FO_{March}	3.2	B1	2.4	2.0	1.3
		A2	3.1	1.7	0.5
FO_{April}	0.5	B1	0.5	0.5	0.1
		A2	0.6	0.3	0.0
$HS30_{August}$	19.1	B1	21.5	24.4	27.9
		A2	22.2	25.8	29.7
$HS30_{September}$	3.6	B1	2.9	6.6	11.1
		A2	3.9	8.5	13.9
$HS35_{August}$	2.8	B1	4.1	7.3	12.9
		A2	4.9	9.0	18.3
$HS35_{September}$	0.0	B1	0.1	0.2	0.5
		A2	0.1	0.4	1.6

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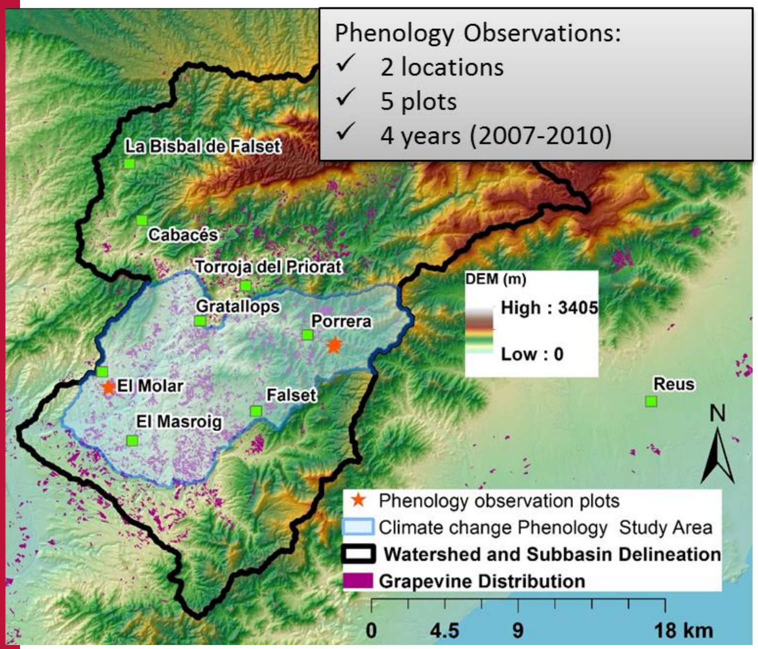
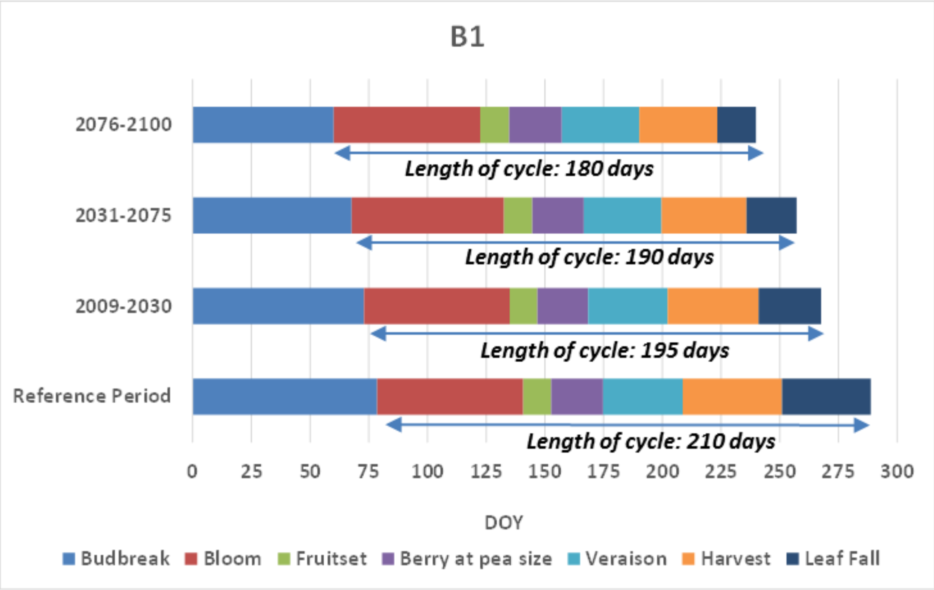
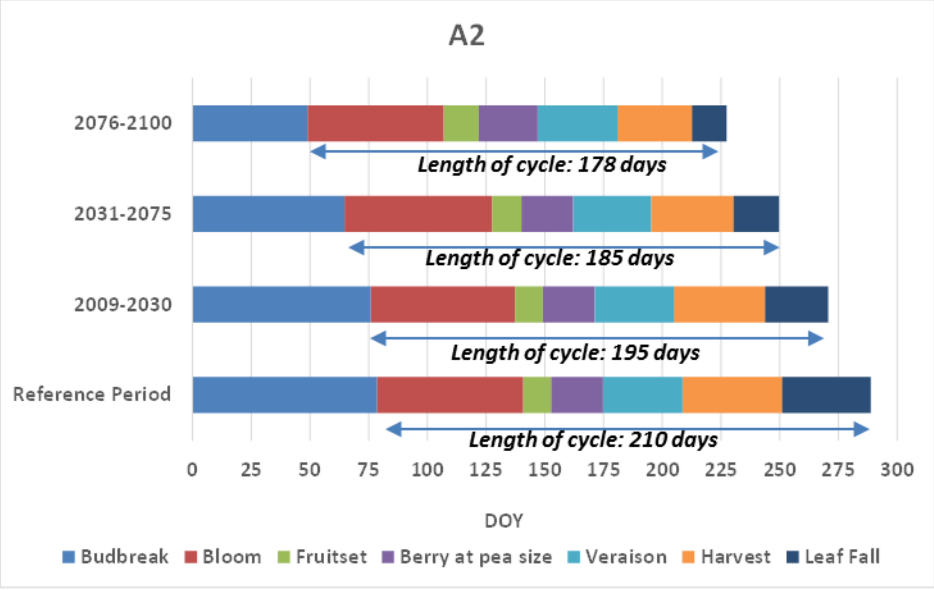
Results: Estimating timing of phenology

Calculating Mean GDD accumulated from 1st January needed for reaching each phenological stage...

Stage	Budbreak	Bloom	Fruitset	Berry at pea size	Veraison	Harvest	Leaf Fall
GDD	71	319	429	697	1221	1857	2163







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Conclusions

- This region will suffer from the temperature increase and rainfall shortage, an increase of net irrigation needs
- The growing season will be earlier and shorter
- Conditions may trespass critical thresholds in some subbasins and vineyards
- To face it:
  - ✓ water management
  - ✓ more efficient varieties and rootstocks
  - ✓ canopy management

Acknowledgements

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Thank you for your attention