Spatial distribution of corn water requirements in the Sao Paulo State

Antônio H. de C. Teixeira, Fernando B. T. Hernandez, Ricardo G. Andrade, Janice F. Leivas, Daniel de C. Victoria, Edson L. Bolfe
EMBRAPA, UNESP

OBJECTIVE

The objective of the current research was to combine geo technologies for modeling the corn water requirements on a large scale, for both commercial goals, grains and silage, in the growing regions of Sao Paulo State, Brazil, to subsidize improvements on the water productivity, under the conditions of rapid increase of corn second-harvest crop.

INTRODUCTION

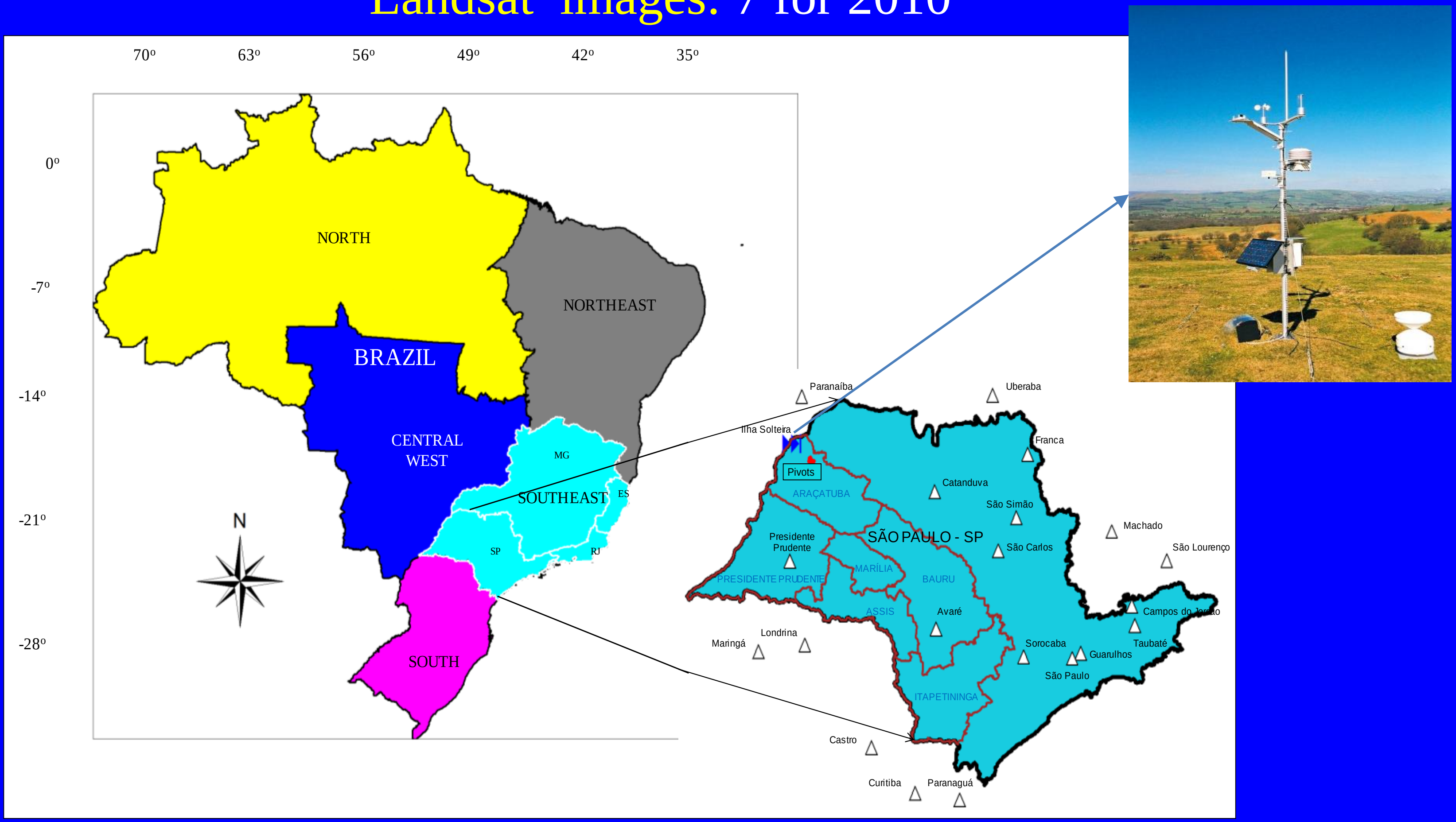
*Southeast region of Brazil: Corn has been realized out in two times of the year. The first-harvest crop is between October and November, with the seed sown at the start of the rainy periods, whiles the second-harvest crop, the seed sown dates are from February to March.

*Knowledge about water variables on a large scale is important when aiming the rational management of the natural resources. For this purpose, tools such as remote sensing from satellites and Geographic Information Systems (GIS) can be used

*For the current study, due to its applicability, the SAFER algorithm was used to estimate ET, while to take into account the corn water requirements (RH), specific relations for grains and silage between crop coefficients (Kc) and the accumulated degree-days (DD_{ac}) were elaborated.

LOCATION OF PETROLINA AND AGROMETEOROLOGICAL STATIONS

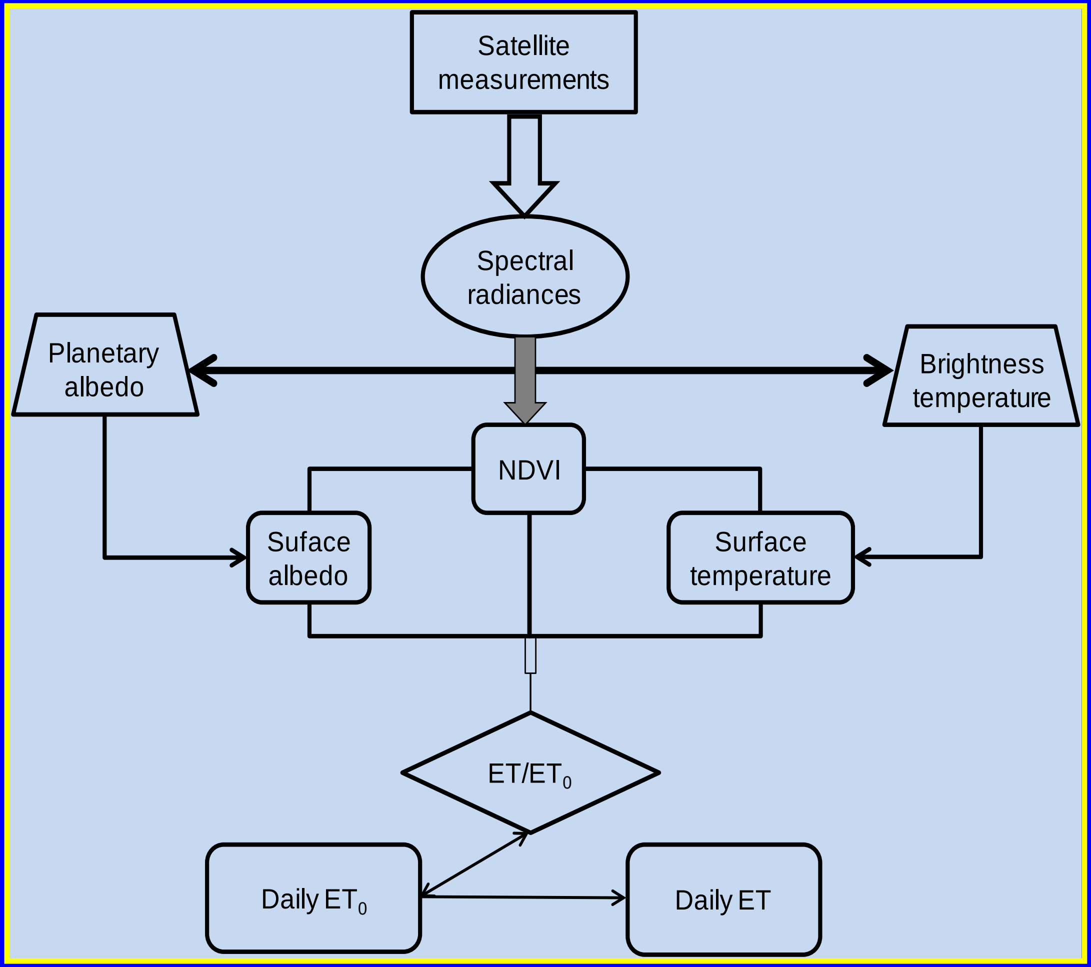
Landsat images: 7 for 2010



*Location of the São Paulo State, highlighting corn growing regions, the agrometeorological stations used, and the corn central-pivots where the Landsat images where used for modelling in the Southeast Brazil.

MODELLING LARGE-SCALE ET

SAFER (Simple Algorithm For Evapotranspiration Retrieving)



$$ET = ET_0 \times ET/ET_0$$

MODELLING LARGE-SCALE DAILY ET VALUES

SAFER (Simple Algorithm For Evapotranspiration Retrieving)

$$\frac{ET}{ET_0} = \exp\left[a + b\left(\frac{T_0}{\alpha_0 NDVI}\right)\right]$$

ET – Actual evapotranspiration (mm d^{-1})

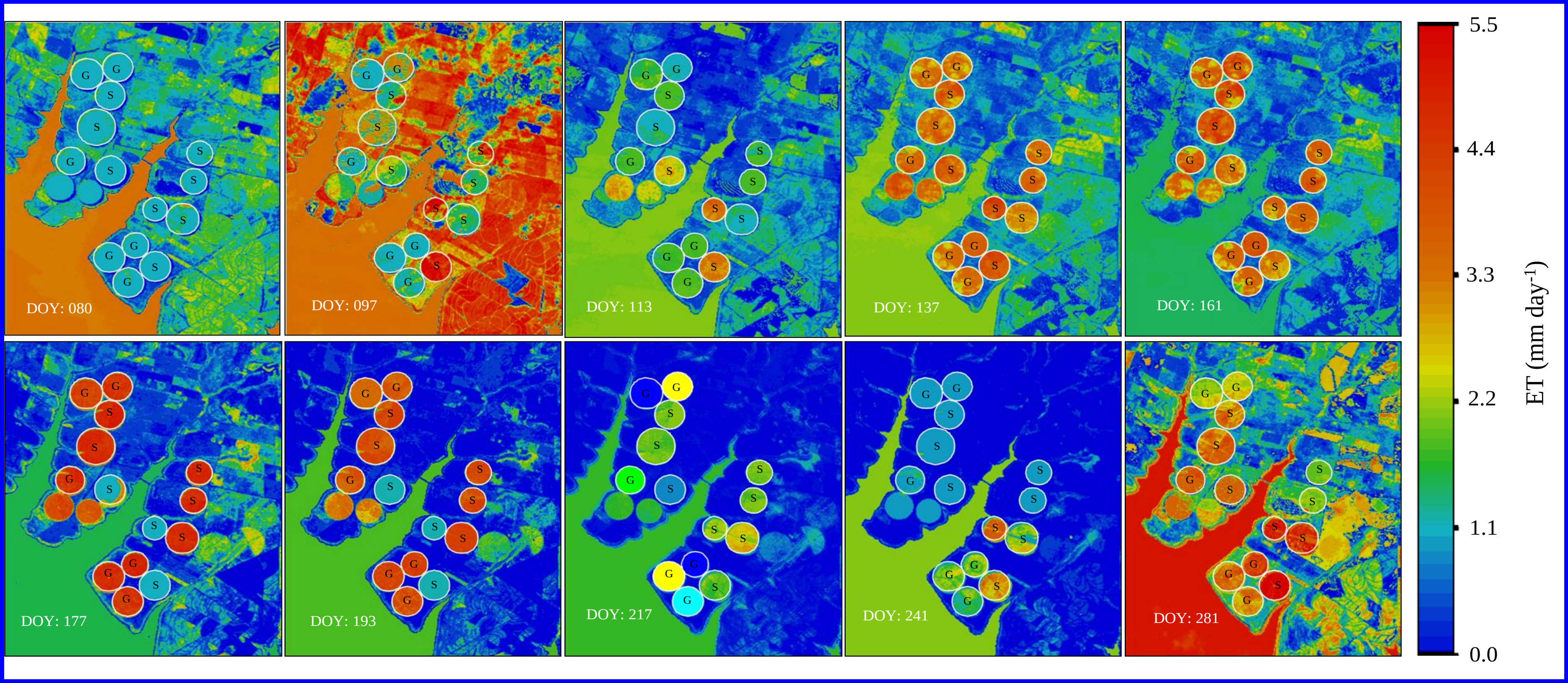
ET_0 – Reference evapotranspiration (mm d^{-1})

T_0 – Surface Temperature (^oC)

α_0 - Surface Albedo (-)

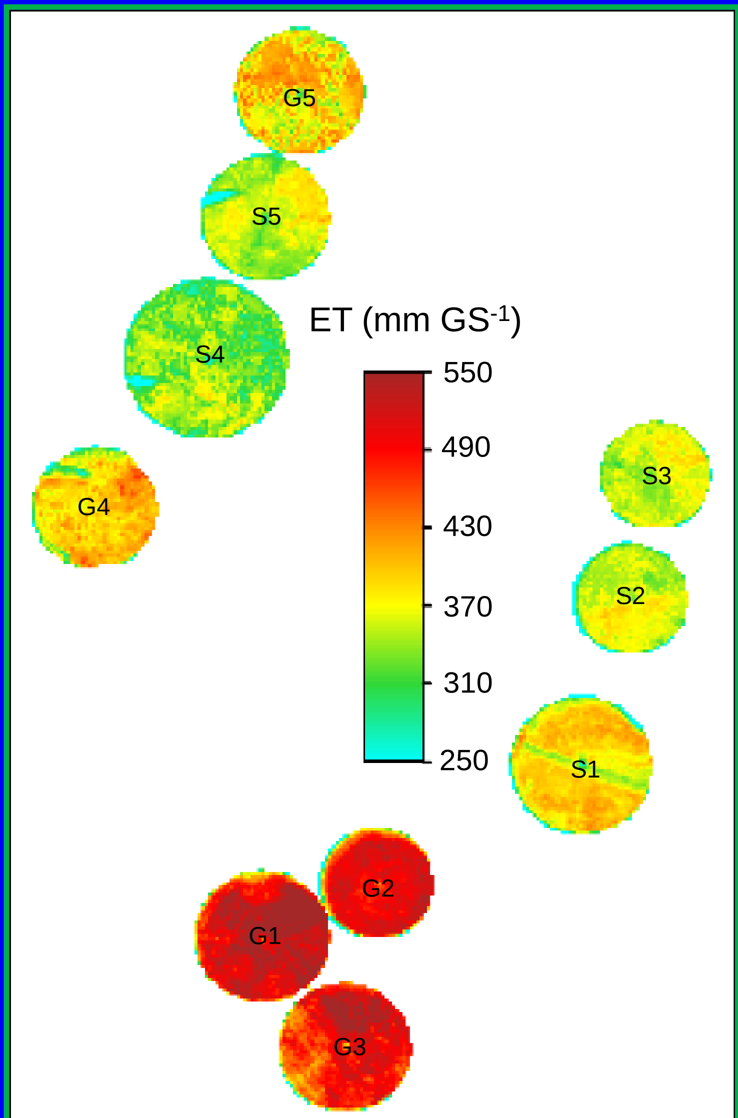
NDVI – Normalized Difference Vegetation Index

Daily actual evapotranspiration (ET) in irrigation pivots, located in the Northwestern side of Sao Paulo State, Southeast Brazil.



*For grains (G), the mean values of ET ranged from 1.5 to 4.4 mm day^{-1}, while for silage (S) the values were between 2.8 and 3.9 mm day^{-1}.

Spatial distribution of actual evapotranspiration (ET) for a growing season (GS) for both, grains (G) and silage (S), in the Northeastern side of São Paulo State. DOY means Day of the Year.

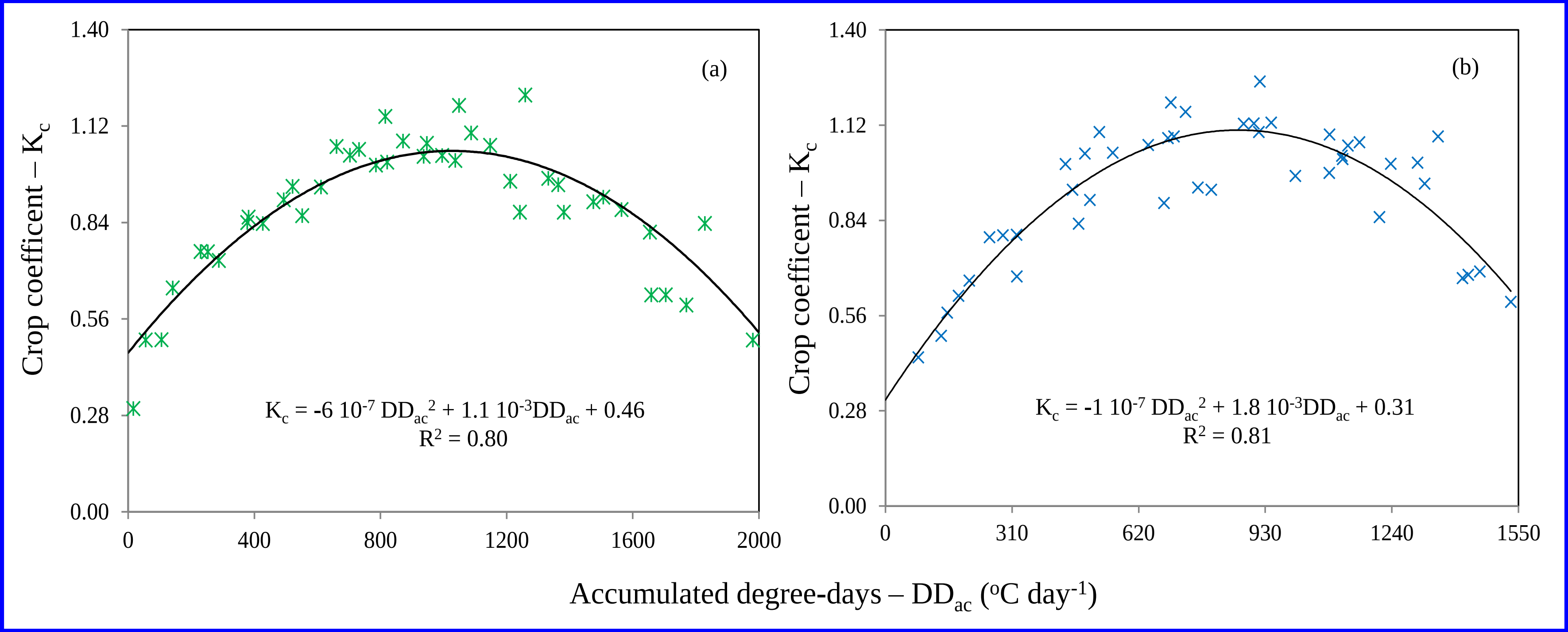


*For grains: several pixels above 450 mm, while for S1,
*For silage pixels bellow 400 mm.

*The highest water consumption are due to the highest atmospheric demands.

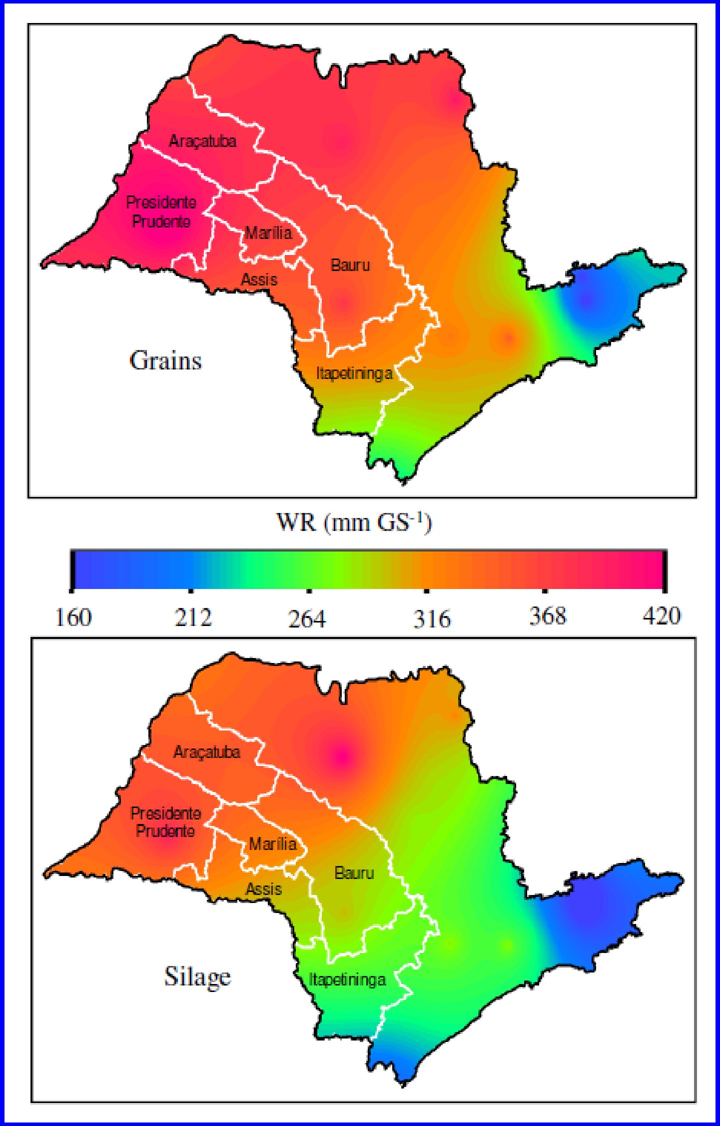
*The larger ET values for grain than for silage, are due to the GS lengths, which were in average, respectively 160 and 120 days.

Relations between the average values of crop coefficient (K_c) and the accumulated degree-days (DD_{ac}) for corn crop in the Northwestern side of Sao Paulo State, Southeast Brazil. (a) for grains; (b) for silage. A basal temperature (T_b) of 10 °C is considered.



Kc at different corn crop stages, were between 0.3 and 1.2. The advantage of using the equations depicted in Figure 3 is the possibility of up scaling Kc values to different thermal conditions

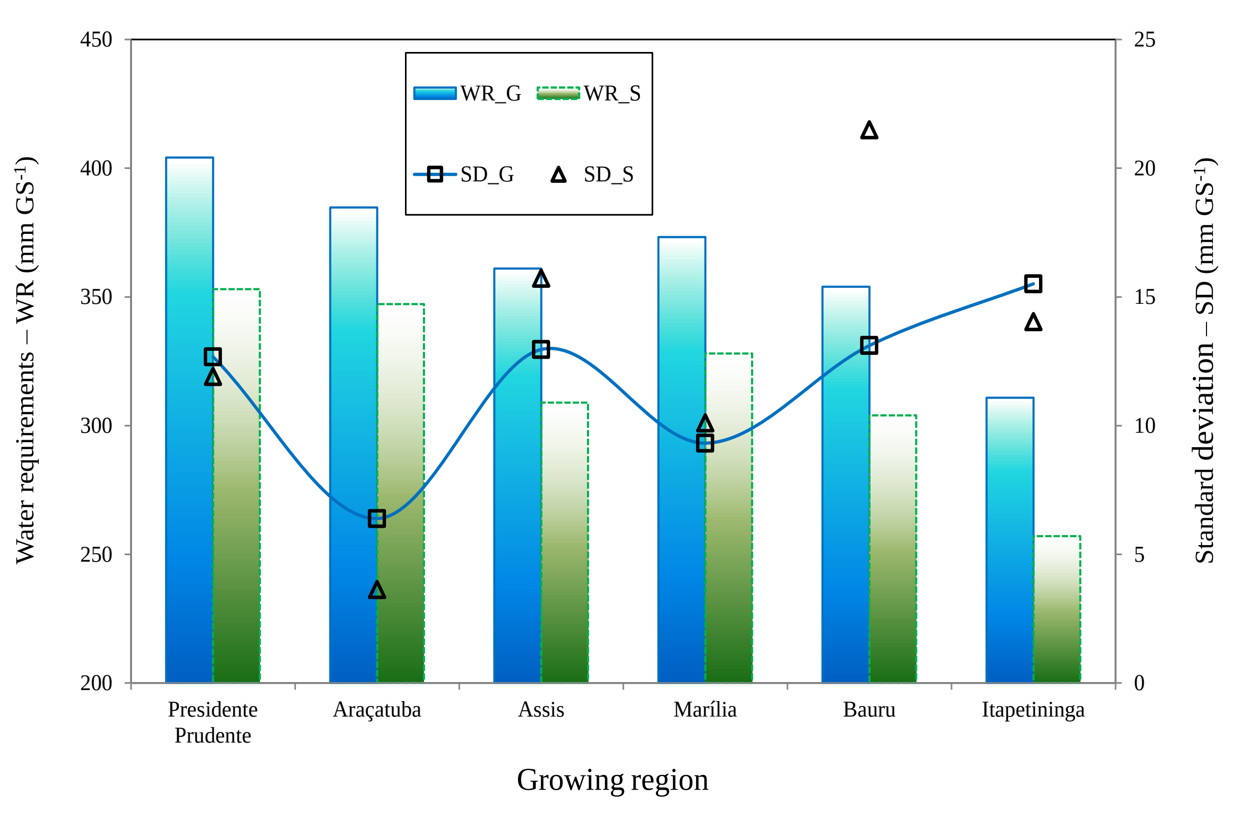
Spatial distribution of water requirements for a second-harvest corn growing season (GS), from March to August 2012, in São Paulo State, Southeast Brazil, highlighting the growing regions.



$$WR = K_c \ ET_0$$

*Gradient of the WR values, with the low end from the coastal side, bellow 250 mm GS^{-1} to the west side of the State, where the values are higher than 400 mm GS^{-1}, for both, grains and silage productions.

Mean WR for the main corn growing regions in Sao Paulo state



*Presidente Prudente is highlighted with the highest water demand, with mean WR_{GS} pixel values of 404 ± 13 mm GS^{-1}, while the lowest ones go to Itapeninga, 311 ± 16 mm GS^{-1}. The corresponding values for silage production were 353 and 257 ± 16 mm GS^{-1} for respectively, the first and the second growing regions.

CONCLUSIONS

Regression models based on the relation between the actual to the reference evapotranspiration and the accumulated degree-days, allowed the determination of corn water requirements in São Paulo state, for both grains and silage productions.

Differences of water demands among growing regions were observed, with the highest values for Presidente Prudente, while the lowest happened in Itapetinga.

The results of the modelling are useful for improving corn water productivity, according with the commercial interest, for both, irrigation and rainfed conditions.


Thank you
heriberto.teixeira@embrapa.br

Characterization of the wine grape themohydrological conditions in the Brazilian Semi-Arid region

Antônio H. de C. Teixeira, Jorge Tonietto, Ricardo G. Andrade, Janice F. Leivas,
EMBRAPA

OBJECTIVE

This paper aimed the characterization of the wine grape thermohydrological conditions on large scale in the growing regions of Petrolina and Juazeiro municipalities, located in the Brazilian semi-arid region, simulating different pruning dates. The results can subsidizes for the rational expansion of commercial vineyards with higher probability of success.

INTRODUCTION

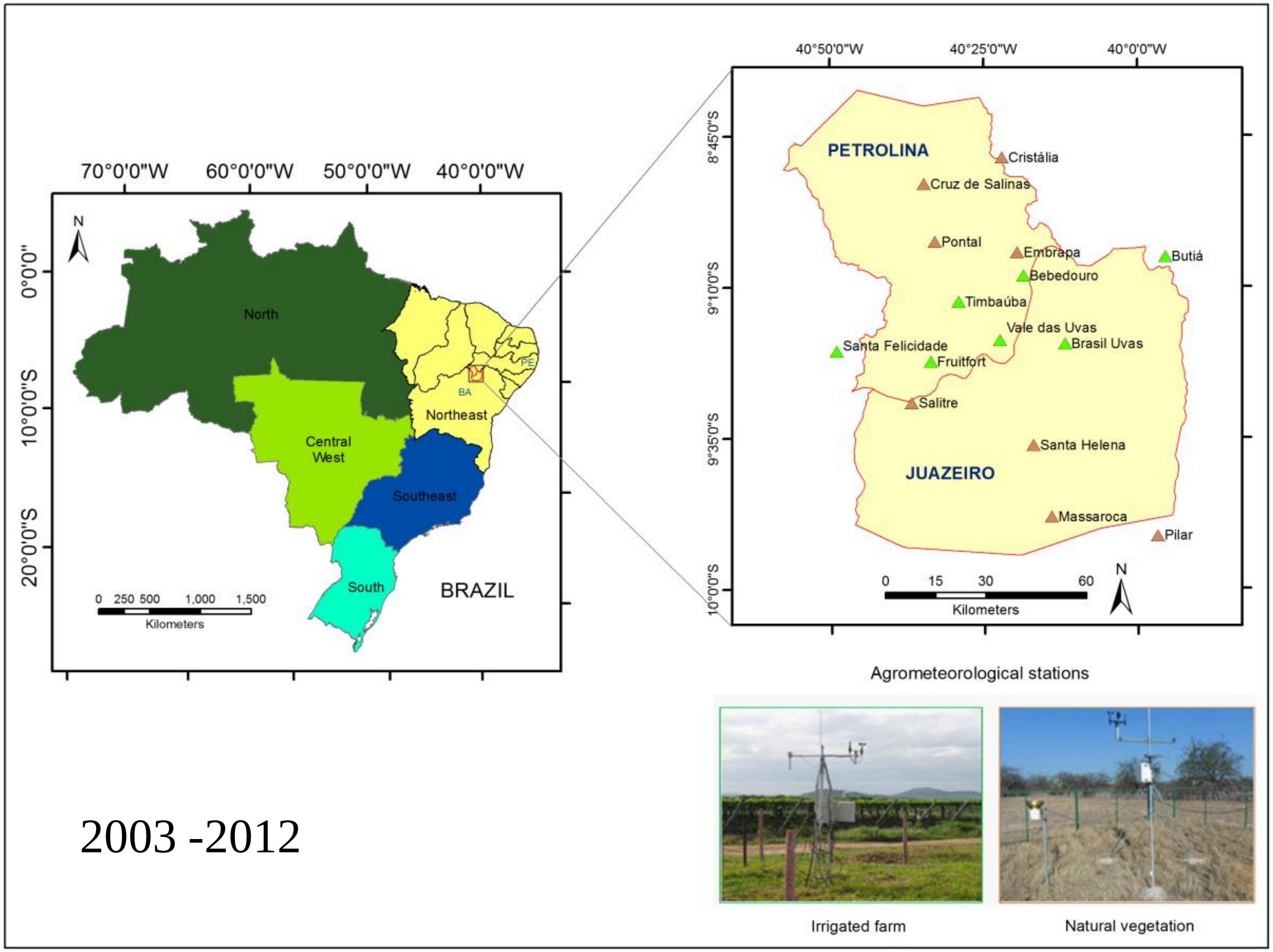
Over the last years, the Brazilian tropical region has appeared among the new wine producing areas.

The rising of the air temperature with a consequent increase in evapotranspiration rates and aridity in the Northeast region will affect the wine grape quality and water requirements.

The coupled effect of rising water consumption and decreasing precipitation, together with land use change, makes it important to characterize the thermo-hydrological conditions of vineyards on a large scale to subsidize winemaking adaptations and water productivity improvements in the near future.

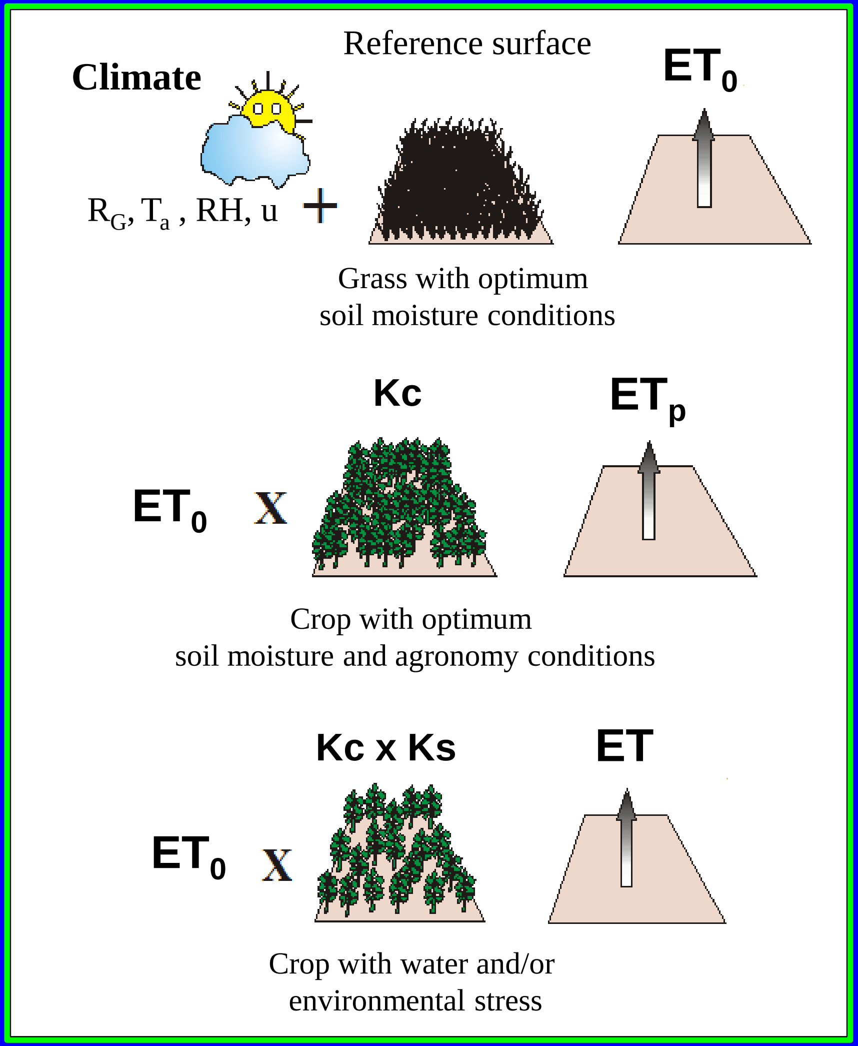
This paper aimed this characterization on large scale in the wine grape growing region of Petrolina and Juazeiro municipalities, located respectively in Pernambuco (PE) and Bahia (BA) states, in the Brazilian semi-arid region, simulating different pruning dates. The temohydrological conditions were delimitated, generating subsidizes for the rational expansion of vineyards and higher probability of success in these municipalities.

Growing regions and agrometeorological stations



2003 -2012

Petrolina and Juazeiro municipalities, in the Brazilian Northeast, together with the agrometeorological stations used for the interpolation processes.



Different concepts of evapotranspiration

Actual ET

Bpwen ratio method

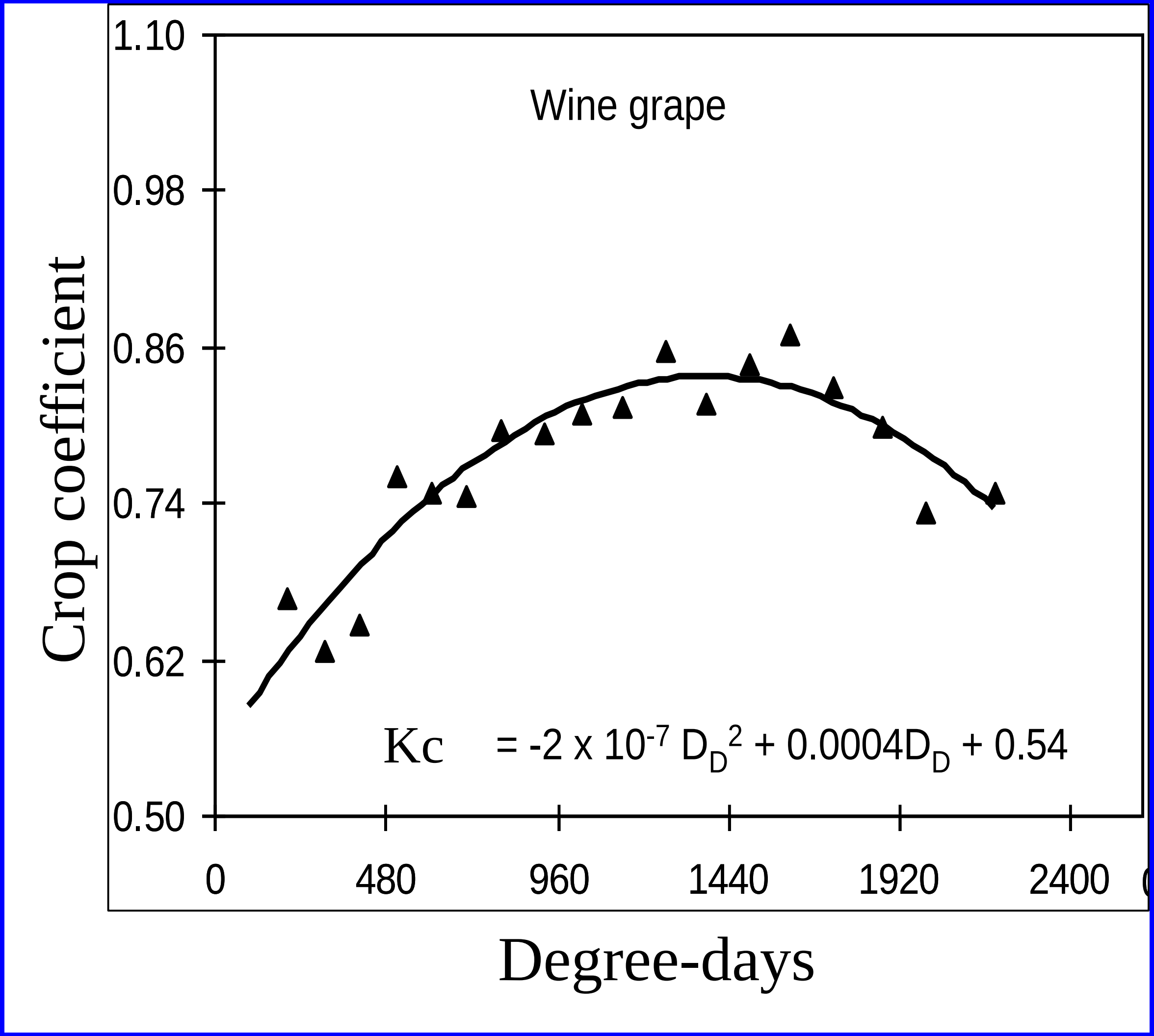
$$\lambda E_v = \frac{R_{n_v} - G}{1+\beta}$$

$$\beta = \gamma\left(\frac{\Delta T}{\Delta e}\right)$$

λE ➡ ET

Energy balance and soil moisture

Thermohydrological indicators



Crop coefficient

$$K_c = \frac{ET_p}{ET_0}$$

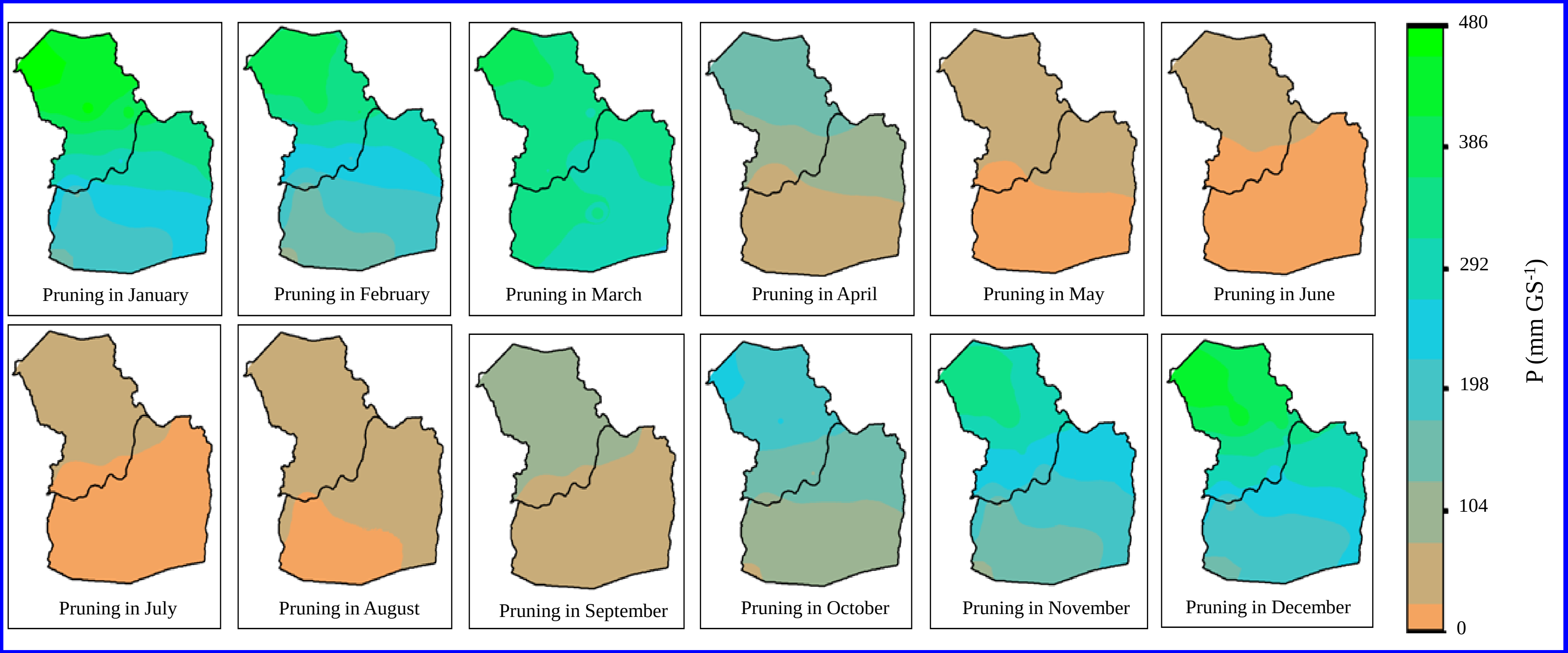
Water requirements

$$WR_{GS} = Kc_{GS} ET0_{GS}$$

Water index

$$WI_{GS} = \frac{P_{GS}}{WR_{GS}}$$

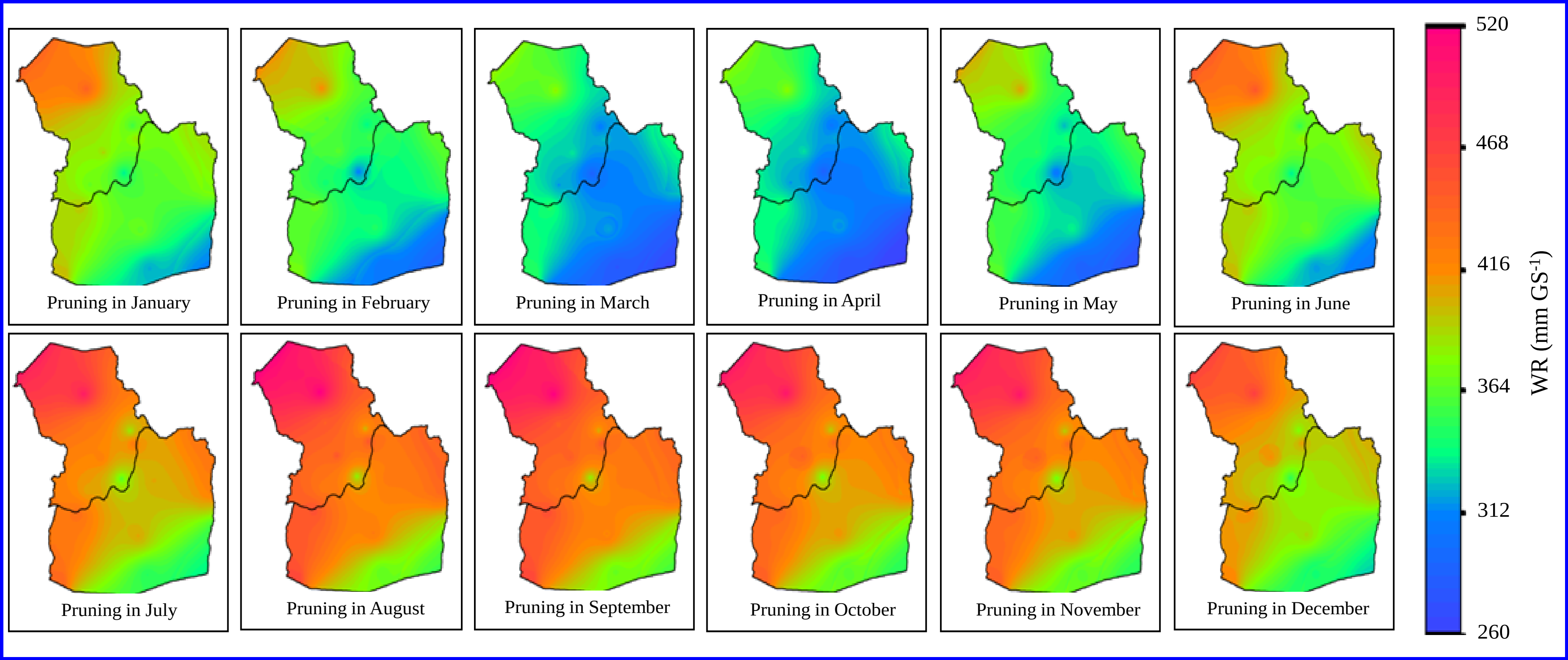
Long-term totals of precipitation for a growing season (P_{GS}) of wine grape crop, cv. *Syrah*, for a mean GS of four months



The pruning dates with the highest P_{GS} values are in January, presenting long-term values of 397 and 253 mm GS^{-1} for f Petrolina-PE and Juazeiro-BA, respectively.

The lowest P_{GS} values of 44 mm GS^{-1} e 19 mm GS^{-1} are for pruning done in July.

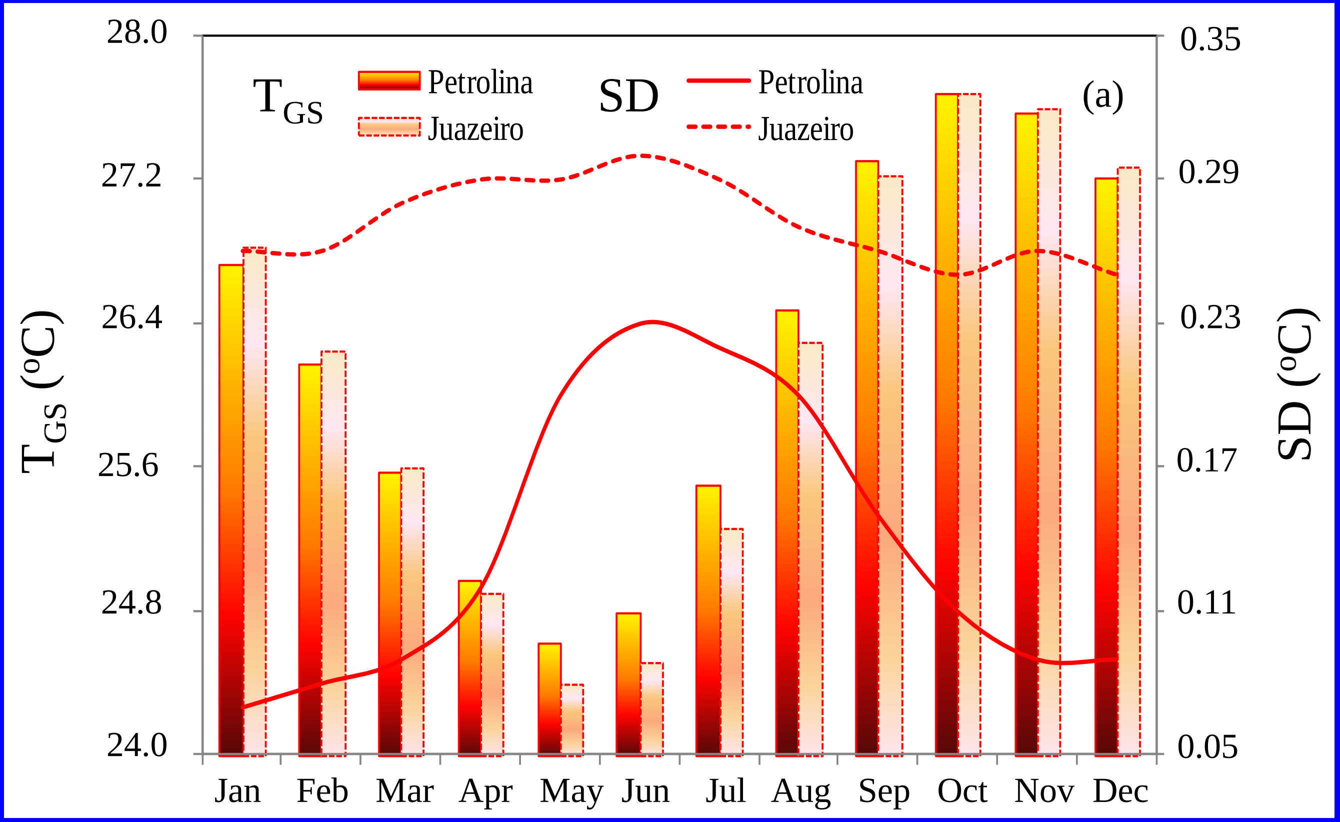
Long-term totals of water requirements for a growing season (WR_{GS}) of wine grape crop, cv. *Syrah*, for a mean GS of four months



The pruning dates with the highest WR_{GS} values are in September, presenting long-term values of 461 and 417 mm GS^{-1} for f Petrolina-PE and Juazeiro-BA, respectively.

The lowest WR_{GS} values of 340 mm GS^{-1} e 310 mm GS^{-1} are for pruning done in April.

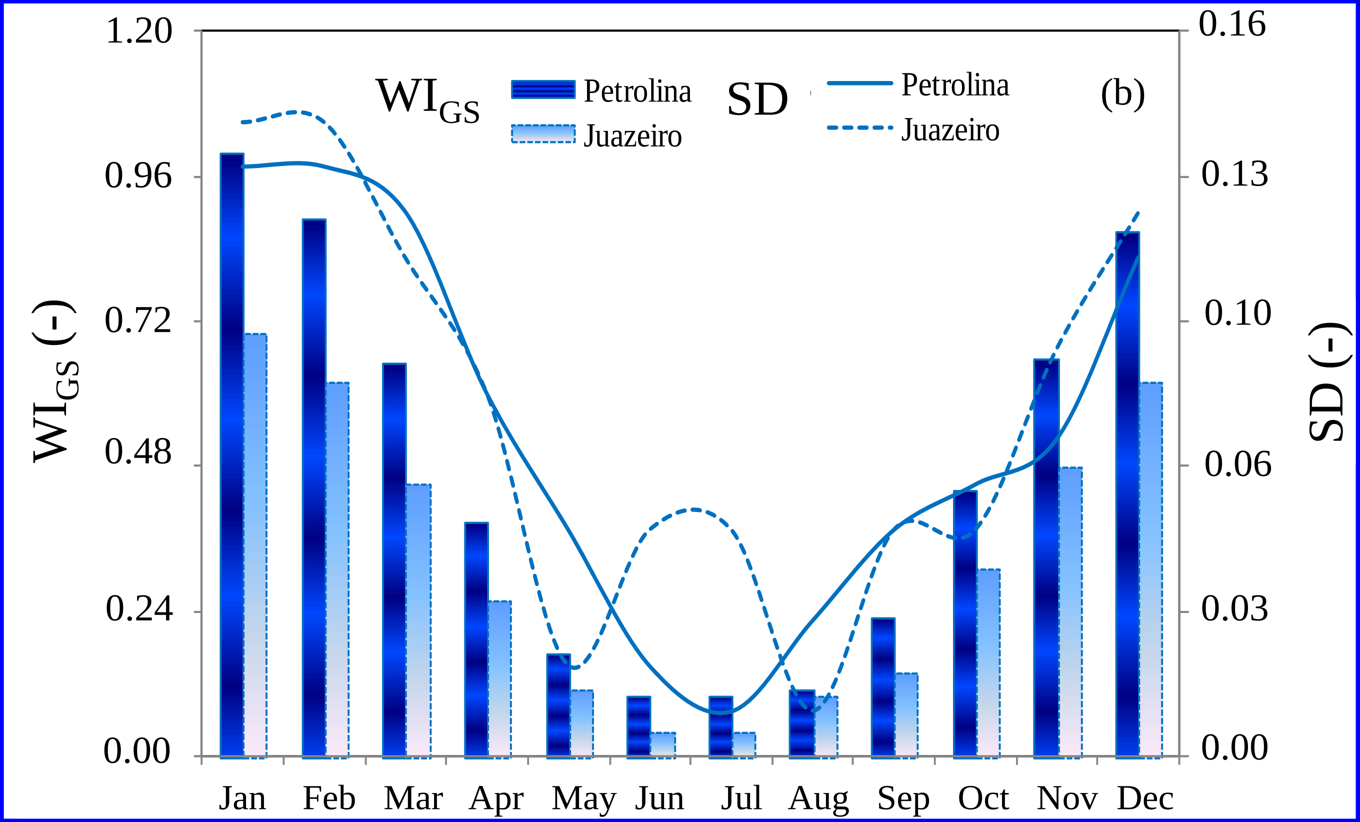
Long-term totals of the mean air temperature for a growing season (T_{GS}) of wine grape crop, cv. *Syrah*, for a mean GS of four months



Warmest pruning date: October – T_{GS} = 27.7 ºC

Coldest pruning date: May – T_{GS} = 24.5 ºC

Long-term totals of the water index for a growing season (WI_{GS}) of wine grape crop, cv. *Syrah*, for a mean GS of four months



Wetest pruning date: January – WI_{GS} = 1.0 and 0.7 for Petrolina and Juazeiro

Driest pruning date: June to July – WI_{GS} = 0.01

CONCLUSIONS

Bioclimatic indices allowed the classification and delimitation of the thermohydrological conditions for wine grape in the growing regions of the Brazilian semi-arid.

The best pruning dates were from May to July, when aiming better wine quality with irrigation water availability

These indicators, joined with other ecological characteristics, are important for a rational planning of the commercial wine production expansion, mainly in situations of rapid land use changes and rising water competition along the years in the Brazilian Northeastern region.


Thank you
heriberto.teixeira@embrapa.br