

INFLUENCE OF THE VENTO NORTE PHENOMENON ON WHEAT PRODUCTIVITY IN SOUTHERN BRAZIL: FIRST APPROACH

Michel Stefanello¹, Cinara Ewerling da Rosa^{1,2}, Diego Portalanza^{1,3}, Simone Ferraz¹ and Gervásio Annes Degrazia¹
michelstefanello@gmail.com

¹Universidade Federal de Santa Maria (UFSM), Departamento de Física, Santa Maria, Brasil

²Instituto Federal Farroupilha – Campus São Vicente do Sul (IFFAR-SVS)

³Agencia de Regulación y Control Fito y Zoonosanitario (AGROCALIDAD), Guayaquil, Ecuador

Palabras clave: Wheat, Vento Norte, Winter Phenomenon, Temperature Anomalies.

1) INTRODUCTION

Southern Brazil is the main wheat producing region accounting for ~26% of the total national production. Yield changes due to precipitation and air temperature anomalies considerably affect wheat productivity and can disturb the phenological cycle. The Vento Norte phenomenon (VNOR; Portuguese for “North Wind” Sartori, 2003; Stefanello et al, 2020; da Rosa et al 2021,2022) consists of constant and intense magnitudes north direction gust associated with a notable increase in the air temperature that affects the southern Brazilian region. This geophysical flow, manifests itself mostly in the southern winter, affecting and altering meteorological and climatological parameters characteristics. Currently, there are few studies on the influence of the VNOR over yield productivity in Brazil. The actions of typical regional winds are of great importance in the interpretation of data and the search for perceptual agricultural responses. The present study aimed, to evaluate the correlation between VNORs occurrence and wheat productivity for the winter period from 2004 to 2019.

2) MATERIAL AND METHODS

For the identification of VNOR events, hourly observational data from the winter period between 2004 and 2020 were used. Meteorological data were obtained from the automatic meteorological station A803 of the Brazilian National Institute of Meteorology (INMET) located in the city of Santa Maria. The Meteorological tower is in an area of the Pampa biome within the Federal University of Santa Maria campus (29°43'29.27”S, 53°43'13.67”W; elevation of 103.10-m) (Roberti et al, 2012). The criteria used to detect VNOR episodes follow Chamis and Nascimento (2012) and Da Rosa et al (2022). They are wind gusts greater than 11ms⁻¹, direction between 300° (West-Northwest) and 30° (North-Northeast), and air temperature above the 90% percentile (q90) of the respective time and month. Yield data were obtained from the latest survey by the National Supply Company (CONAB) and detrended to remove a technology linear trend that could cause distortion.

3) RESULTS AND DISCUSSION

The detection criteria applied to the hourly atmospheric observation yielded 120 VNOR episodes with an average duration of 9 hours. Figure 1a shows the annual frequency distribution of VNOR episodes (blue), ranging from 5 (2018) to 114 (2006) hours. This figure also shows the annual variation in wheat yield (orange), which was in deficit in 2018, a period when there were fewer VNOR episodes. Note that consequently, the year 2018 was the one that recorded the lowest average temperatures during the occurrence of the phenomenon, though it continued at the winter climatic normal (Fig. 1b).

Additionally, it is possible to observe in Figure 1b-c that the city of Santa Maria has an average temperature in the order of 15°C and relative humidity of 83% for the winter period, while in the VNOR, it reaches 27° and 47% respectively. The combination of low winter temperatures and high relative humidity interleaved with VNOR episodes which are characterized by a few hours of persistence warm air advection with low relative humidity appears to be ideal for wheat cultivation, whose annual yield shows a positive correlation (0.48*) in relation to VNOR mean air temperature (Fig. 2).

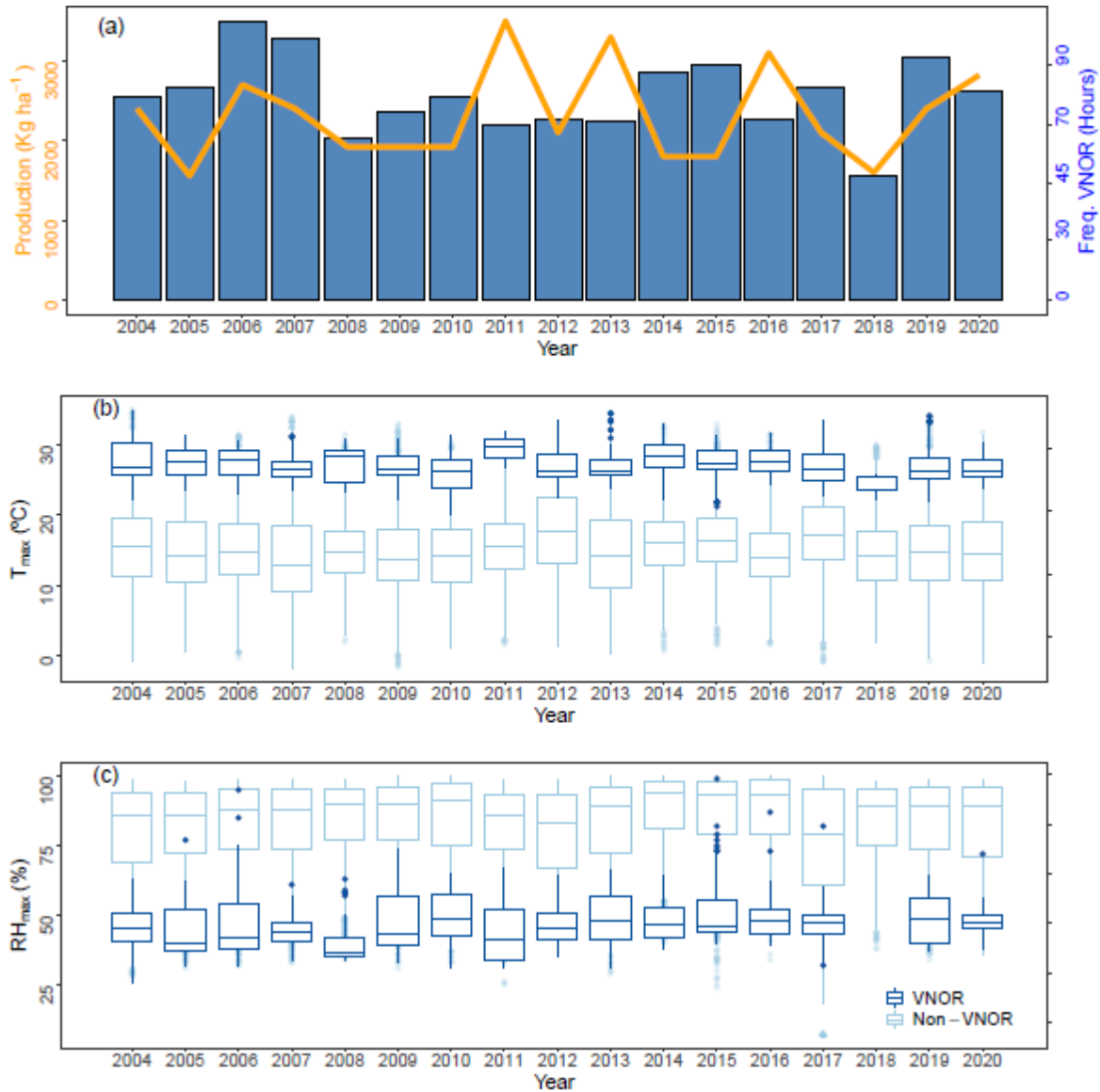


Figure 1 (a) Frequency hours of VNOR about the winter years. The Orange line represents annual wheat yield (Kg ha⁻¹). Boxplots of distribution (b) maximum temperature and (c) maximum relative humidity of VNOR and Non-VNOR episodes. Dots represent outliers.

4) CONCLUSIONS AND OUTLOOK

This study investigated the influence of unseasonably high temperatures related to the VNOR phenomenon on wheat productivity in the winter months in southern Brazil. The first approach provided by this study suggests that wheat productivity seems to be influenced by the occurrence of VNOR episodes, since the years in which lower productivity was observed

were also related to lower detection of VNOR cases.

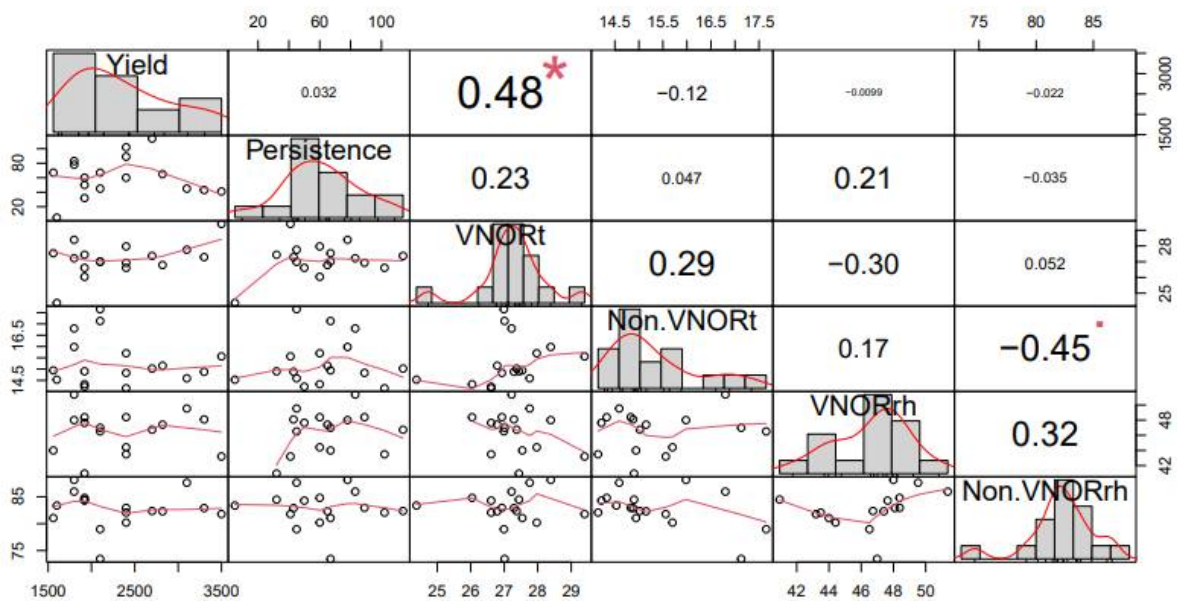


Figure 2 Correlation matrix of VNOR and Non-VNOR temperature and Relative humidity components. On top the (absolute) value of the correlation plus the result of the correlation test as red stars. On bottom, the bivariate scatterplots, with a fitted line (red).

Future analyzes of the influence of VNOR on other agricultural crops may be useful to define modeling strategies that could lead to improvement of efforts to address the deficiencies in yield loss, sustainable water use, and wheat management.

REFERENCES

Sartori, M. d. G. B., 2003: Gênese e características do vento norte regional em santa maria/rs. In X Simpósio brasileiro de geografia física e aplicada.

Stefanello, M, Nascimento, E. d. L., da Rosa, C.E., Degrazia, G., Mortarini, L., and Cava, D., 2020: A micrometeorological analysis of the vento norte phenomenon in southern brazil, *Boundary-Layer Meteorology*,1–25.

da Rosa, C.E., Stefanello, M., Nascimento, E.d.L., Rossi, F.D., Roberti, D.R. and Degrazia, G.A., 2021: Meteorological observations of the vento norte phenomenon in the central region of rio grande do sul, *Revista Brasileira de Meteorologia*.

da Rosa, C.E., Stefanello, M., Facco, D.S., Roberti, D.R., Rossi, F.D., Nascimento, E. d. L. and Degrazia, G.A., 2022: Regional-scale meteorological characteristics of the vento norte phenomenon observed in southern brazil, *Environ. Fluid Mech.* pp. 1–19.

Roberti, D.R., Acevedo, O.C. and Moraes, O. L., 2012: A brazilian network of carbon flux stations, *Eos, Transactions Am. Geophys. Union* 93, 203–203.

Chamis, M.L. and Nascimento, E.d.L, 2012: Condições atmosféricas associadas a episódios de "vento norte" na região central do rs. In *Anais XVII Congresso Brasileiro de Meteorologia*.