

Assessment of the JULES model surface soil moisture using in situ observations over the Brazilian North East semiarid region

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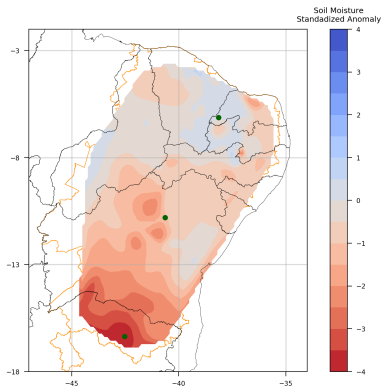
May 2020

Outline

- 1 Site and measurements
- 2 Jules
- 3 Results
 - Jules evaluation
 - Modeled in situ soil moisture data
- 4 Conclusions

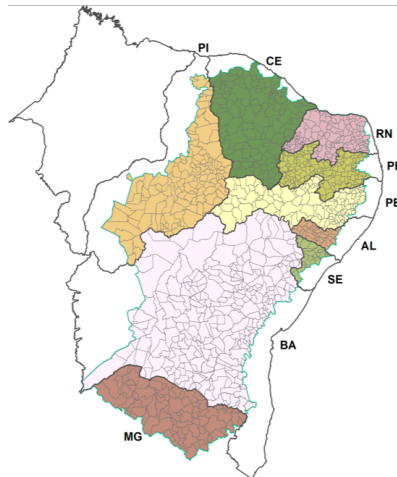
Objectives

- Compare superficial soil water from observations with Jules land surface model
- Derive relationships between model and measurements for applications on:
 - Generate modeled soil moisture data
 - Characterize long-term trends of soil water and drought events



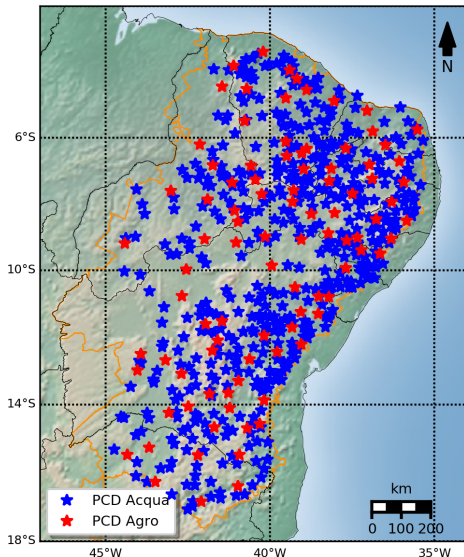
Brazilian Semiarid

- Covering 10 states
- 800,000 km² (10% Brazilian territory)
- 23 million inhabitants
- Caatinga (unique ecosystem with great biodiversity)



Cemaden's network

- Monitoring of rainfall and soil moisture at 595 stations (PCD Acqua, 10 and 20 cm)
- Four depths in 95 stations +
- Air temperature, relative humidity, wind speed, solar radiation (PCD Agro)
- Hourly data via cellular network
- "Rural network"



Database

- 360 stations
- Data coverage from 2015 to 2019
- 2 months to 4 years of data
- Physical consistency (other depths and rainfall)

The screenshot shows the Zenodo dataset page for "A soil moisture dataset over the Brazilian semiarid region". The page includes a header with navigation links (Feed, Library, Suggest, Groups, Datasets, Careers, Funding, Marcelo), a sub-header "This is your published dataset.", and a title "A soil moisture dataset over the Brazilian semiarid region". Below the title, it lists the publication date (20 Sep 2019), version (1), DOI (10.17632/xrk5rfcpvg.1), and contributors (Marcelo Zeri, José Maria Costa, Domingos Urbano, Luz Adriana Cuartas, André Ivo, José Marengo, Regina C. S. Alviá). The "Description of this data" section provides details about the dataset, including the number of stations (360), the time period (2015 to 2019), and the data format (NetCDF). It also mentions the use of a quality control process and the availability of a draft version. The "Experiment data files" section lists two files: "Data.zip" (74 MB) and "Stations.xlsx" (26 KB). The "Related links" section includes the DOI link (https://doi.org/10.3390/w10101421) and a link to the dataset on Mendeley Data. The "Statistics" section shows the number of views (48) and downloads (6). The "Categories" section lists "Meteorology, Drought, Agrometeorology, Soil Moisture, Monitoring in Agriculture". The "Licence" section shows "CC BY 4.0".

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Zeri, Marcelo; Costa, José Maria; Urbano, Domingos; Cuartas, Luz Adriana; Ivo, André; Marengo, José; Alviá, Regina C. S. (2020), "A soil moisture dataset over the Brazilian semiarid region", Mendeley Data, v2

<https://dx.doi.org/10.17632/xrk5rfcpvg.2>

Jules Land Surface Model

- JULES Land Surface Model (the Joint UK Land Environment Simulator)

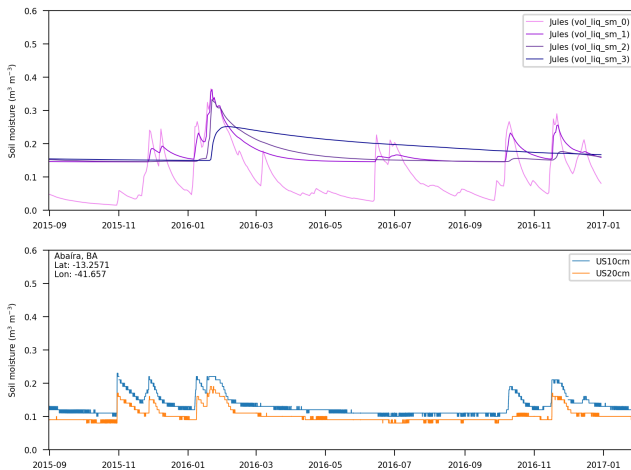
"Skillful seasonal prediction of key carbon cycle components: NPP and fire risk"

Philip Bett, Karina Williams, Chantelle Burton, Adam Scaife, Andrew Wiltshire, Richard Gilham

<https://eartharxiv.org/29ve5/>

- Runs from 1979 to 2016
- Overlap with first full year of measurements

Original data



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Index of agreement (d)

Journal

Physical Geography ›

Volume 2, 1981 - Issue 2

454 82

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Views CrossRef citations to date Altmetric

Original Articles

ON THE VALIDATION OF MODELS

Cort J. Willmott

Pages 184-194 | Published online: 15 May 2013

Download citation <https://doi.org/10.1080/02723646.1981.10642213>

International Journal of Climatology

Short Communication | [Free Access](#)

A refined index of model performance

Cort J. Willmott, Scott M. Robeson, Kenji Matsuura

First published: 09 September 2011 | <https://doi.org/10.1002/joc.2419> | Citations: 353

3. Brief history of the index of agreement

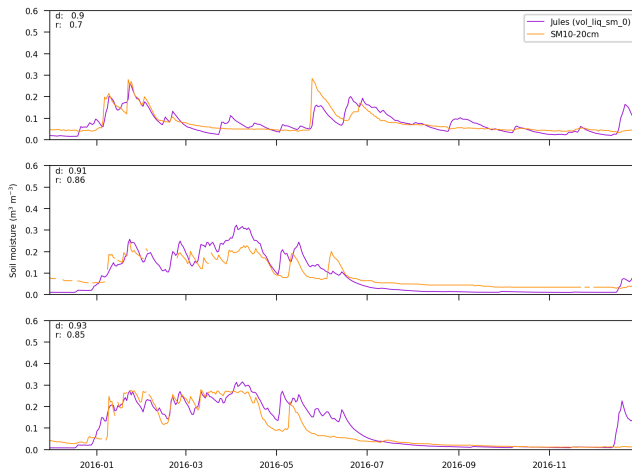
The original form of Willmott's index of agreement (Willmott and Wicks, 1980; Willmott, 1981) was a specification of Equation (1). Willmott and Wicks used d to represent the index (rather than p) and we will follow their convention here. It (d) was a sums-of-squares-based measure, within which δ was the sum of the squared errors while μ was the overall sum of the squares of sums of the absolute values of two partial differences from the observed mean, $|P_i - \bar{O}|$ and $|O_i - \bar{O}|$. Thus, the form of the original index was

$$d = 1 - \frac{\sum_{i=1}^n [(P_i - \bar{O}) - (O_i - \bar{O})]^2}{\sum_{i=1}^n (|P_i - \bar{O}| + |O_i - \bar{O}|)^2} \quad (2a)$$

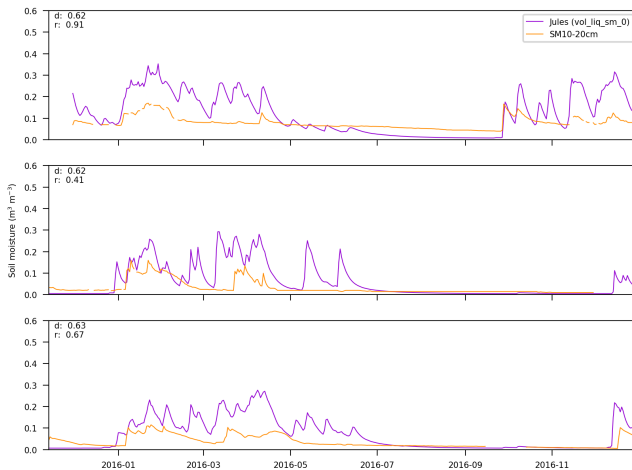
which simplifies to and is commonly written as

$$d = 1 - \frac{\sum_{i=1}^n (P_i - O_i)^2}{\sum_{i=1}^n (|P_i - \bar{O}| + |O_i - \bar{O}|)^2} \quad (2b)$$

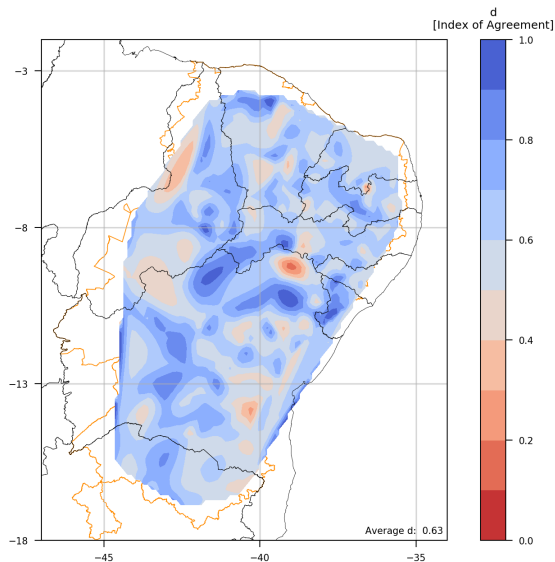
Jules and stations



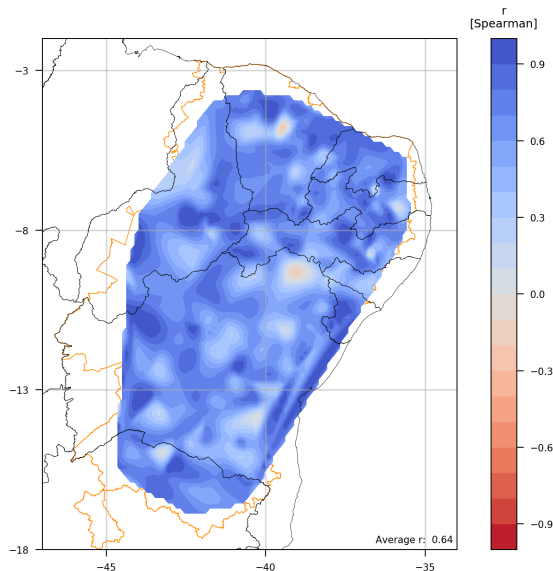
Jules and stations



Index of agreement (d)

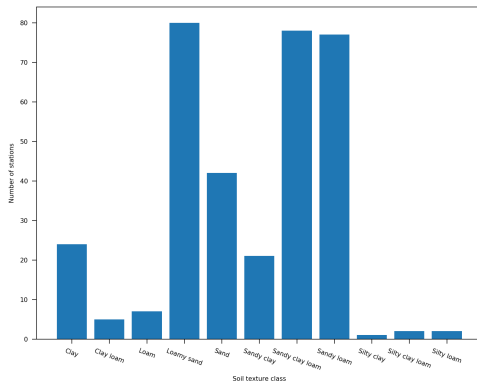


Correlation coefficient (r)



Statistics and soil texture class

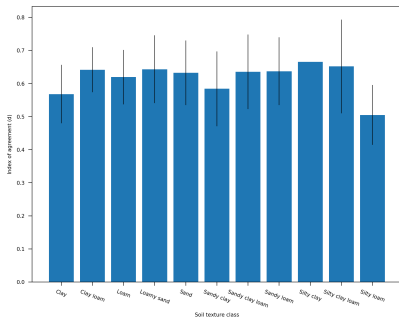
- Fractions of sand, silt and clay
- USDA soil classification



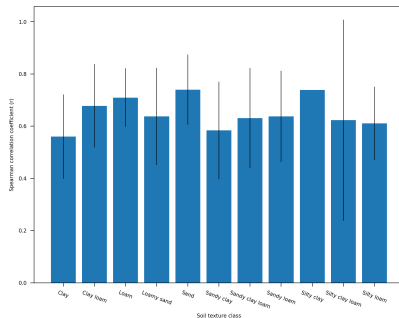
Statistics and soil texture class

Good agreement and correlation between measurements and model for different soil texture classes

Index of agreement



Correlation coefficient

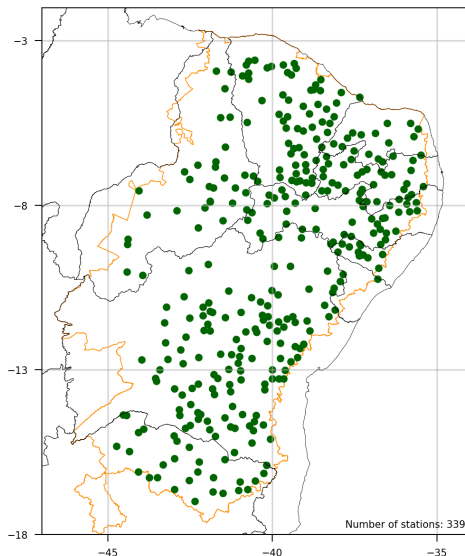


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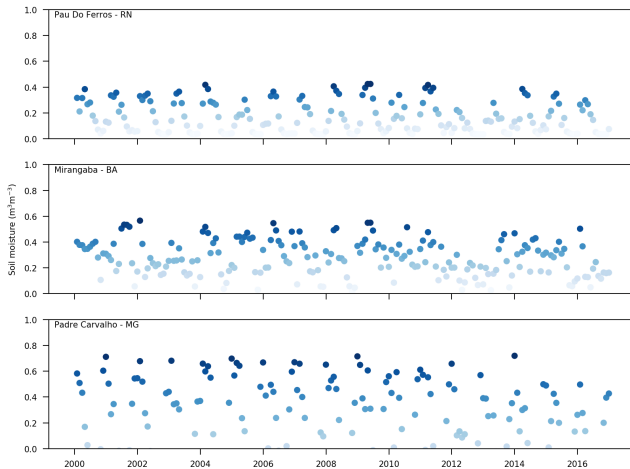
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Modeled in situ soil moisture data

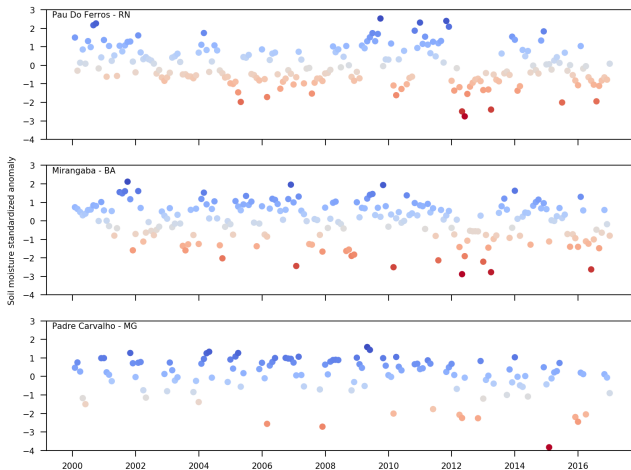
- Generate 1979-2016 soil moisture data
- Locations criteria:
 - Significant correlation (p-value)
 - Correlation higher than 0.6



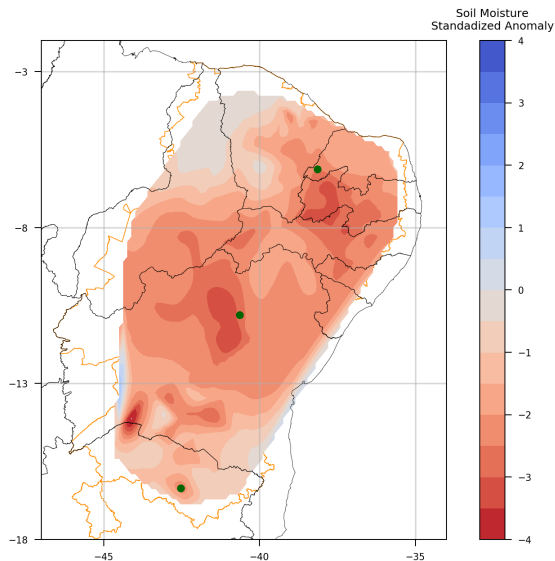
Soil moisture 2000-2016



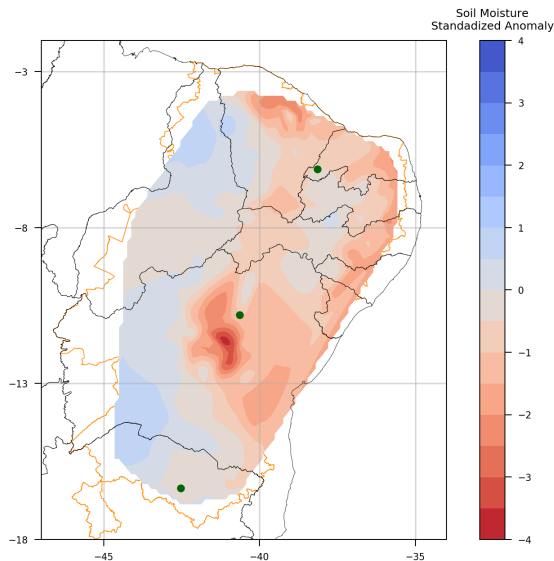
Soil moisture 2000-2016 - Standardized anomaly



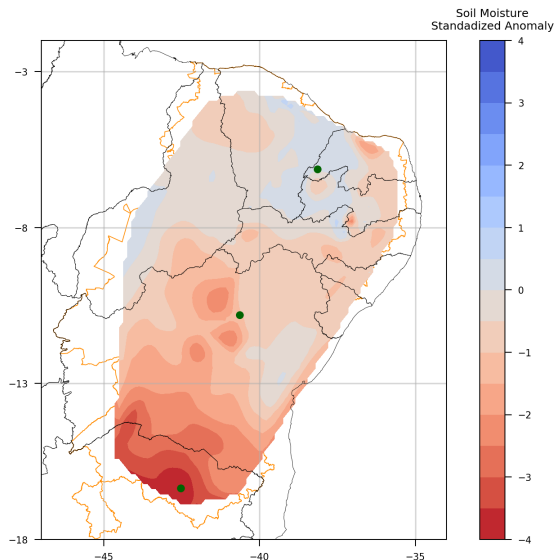
Standardized anomaly - April 2012



Standardized anomaly - April 2013



Standardized anomaly - January 2015



Conclusions

- Good correlation between Jules superficial soil water and measurements
- Modeling of in situ data from 1979 to 2016
- Standardized soil moisture anomaly
 - Correct identification of drought events

Future steps

- Comparison with other metrics (SPI, NDVI)
- Integration with other metrics in a combined drought index

Obrigado!



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² Umbuzeiro tree (*Spondias tuberosa* L.)

Picture: Cláudio Rogério Pontes