A new soil dryness product for fire prediction applications

Vinodkumar[1, 2], Imtiaz Dharssi[1], Paul Fox-Hughes[1]

[1]Science to Services, Bureau of Meteorology, Australia, [2]Bushfire and Natural Hazards Cooperative Research Centre, Australia

The present study discuss the development and evaluation of a new soil dryness product based on an advanced land surface modelling system

SUMMARY

This research has developed a prototype, high-resolution soil-moisture analysis system called JASMIN, that is more accurate than the currently used soil dryness indices. JASMIN is capable of producing hourly analyses of soil moisture and other land surface fields at a 5 km resolution. JASMIN soil column is 3 m deep and the moisture content is estimated at 4 different layers (10 cm, 35 cm, 65 cm and 1 m). JASMIN outputs are available through AFMS website (http://wenfo.org/afms/). The long-term goal is to integrate the JASMIN outputs into the new National Fire Danger Rating System.

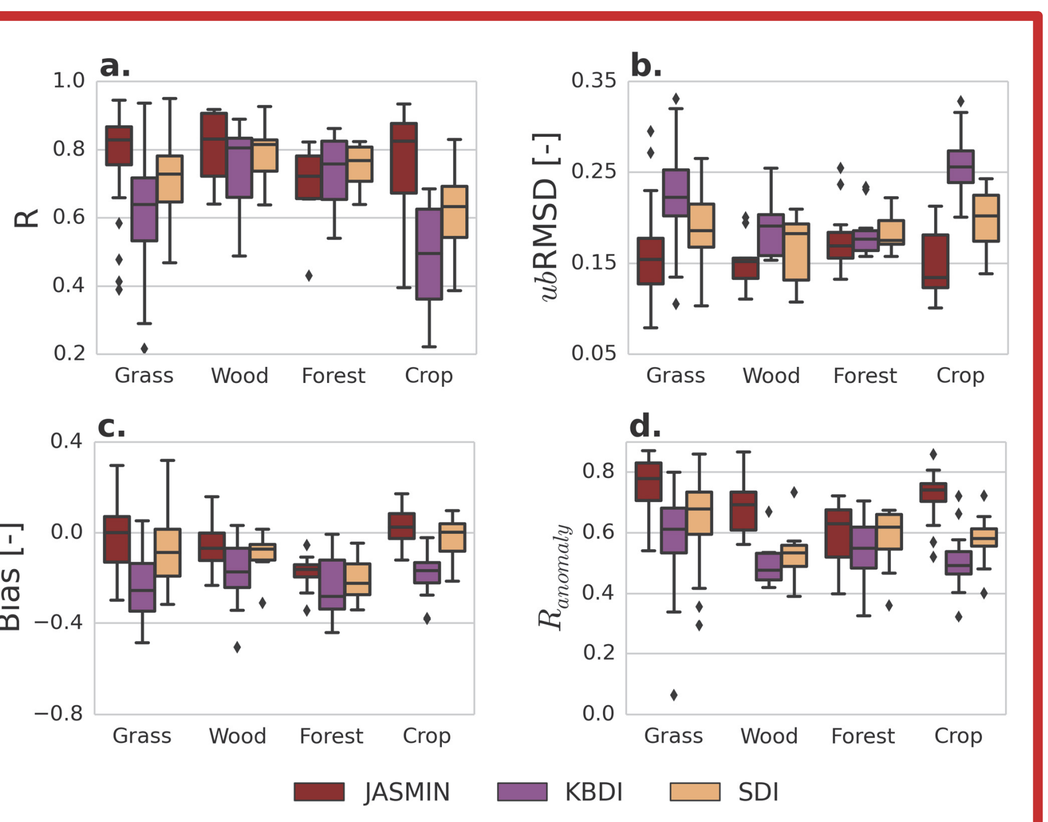

Figure 1. Skill of each model against in-situ observations over various land cover types: a) Pearson's correlation, b) unbiased RMSD, c) bias, and d) anomaly correlation. The red, blue and green boxes and whiskers represent JASMIN, KBDI and SDI respectively.

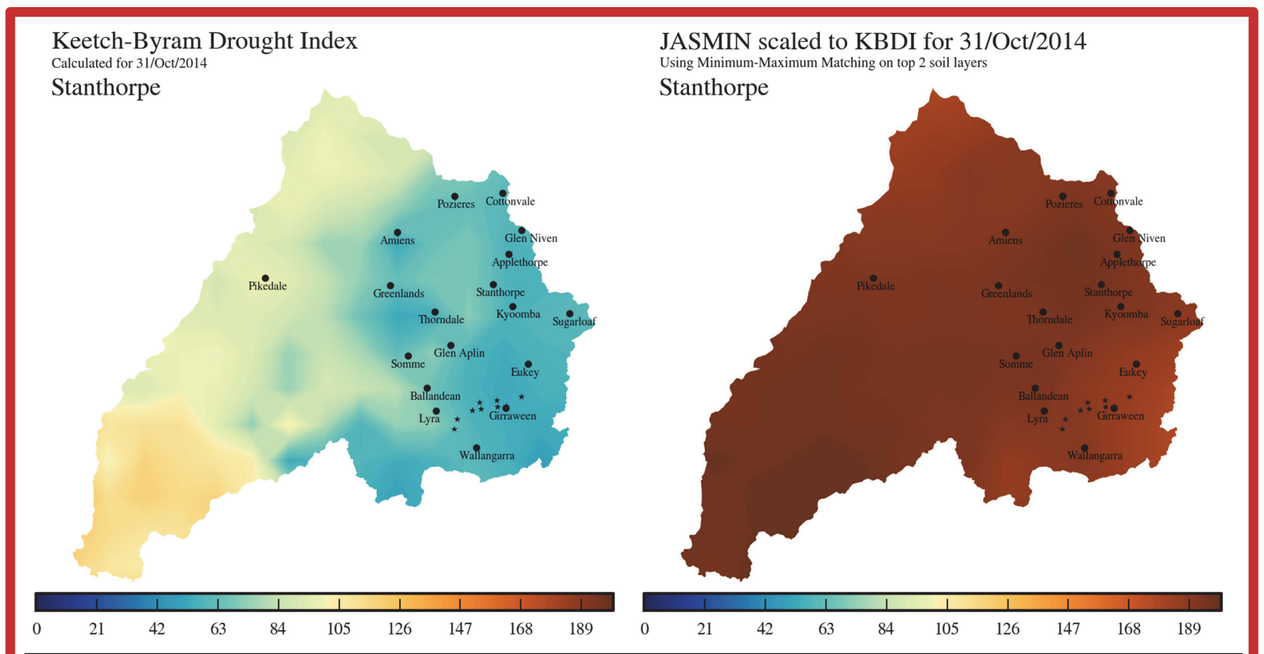

Figure 2. Soil dryness for 31 Oct 2014 from a)the Keetch-Byram drought index and b)rescaled JASMIN. The black stars depict MODIS hot spots. The plot shape shows administrative boundary of the Shire of Stanthorpe in Queensland.

CALIBRATION

One of the cases being studied as part of the evaluation of JASMIN product is the Ballandean fire, which occurred within the administrative boundaries of Stanthorpe Shire, Queensland in October 2014. The JASMIN product is far drier and the KBDI may be significantly under-predicting soil dryness. Verification against in-situ soil moisture observations has shown that KBDI generally has a large wet-bias.

Evaluations against MODIS derived Fire Radiative Power data indicate that fires with intensity > 2000 MW correspond to a very wet soil in KBDI (Figure 3a). The shift towards a drier soil in the JASMIN product calibrated using the Minimum-Maximum method leads to these large intensity fires being attributed to higher soil moisture deficits (Figure 3b). It is interesting to note that no fires with FRP > 1000 MW occur over very wet soils (SMD < 20 mm) in the calibrated JASMIN product.

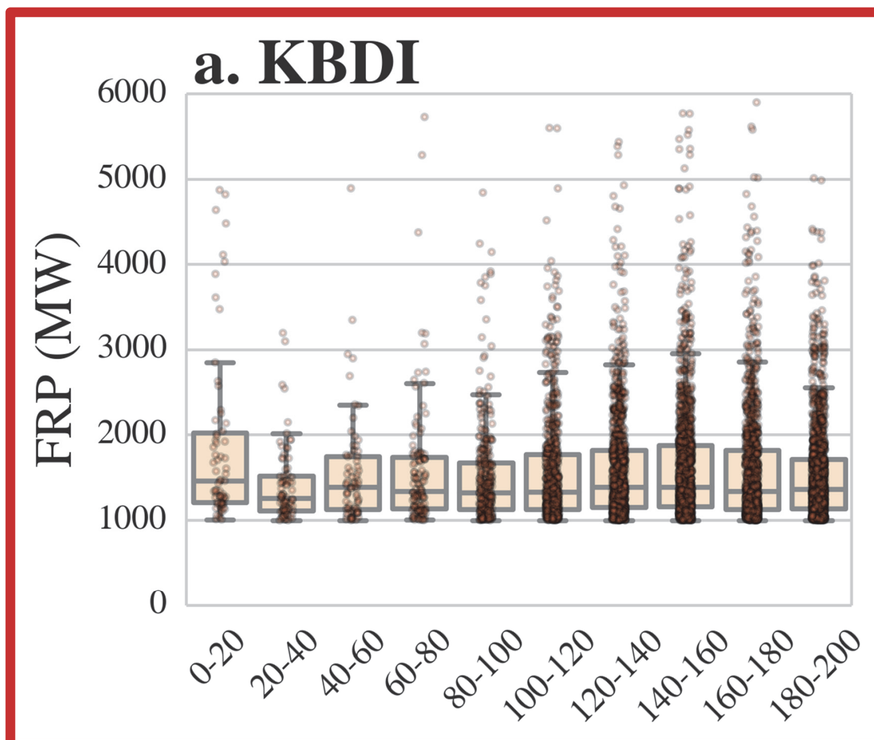

Figure 3. Box and whisker plots along with scatter plots depicting MODIS Fire Radiative Power (FRP) product against a) KBDI, and b) JASMIN product rescaled using Minimum-Maximum (MM) method. JASMIN product correspond to 0 – 350 mm model soil profile. The datasets span from January 2010 to February 2015. Each soil moisture deficit bin has a width of 20 mm. Only pixels with FRP > 1000 MW are selected. The basis of the given plots relates to the fact that large fires occur in association with very dry soils.

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Correspondence to:
Vinodkumar
Bureau of Meteorology
vinod.kumar@bom.gov.au
+61 3 9616 8448