Hindawi
Advances in Meteorology
Volume 2018, Article ID 4328574, 2 pages
https://doi.org/10.1155/2018/4328574

Editorial

Satellite Soil Moisture and Its Applications

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Received 5 August 2018; Accepted 5 August 2018; Published 26 September 2018

With satellite soil moisture (SM) retrievals becoming widely and continuously available, it is desirable to use the remote sensing SM data to enhance the accuracy of weather forecast and flooding prediction, improve natural disasters (e.g., drought, dust storm, wild fire, and flood) monitoring, and identify the role of SM in climate change. To promote the application of SM retrievals, downscaling satellite SM data from coarser to finer resolution and combining individual SM retrievals to generate a blended SM product, as well as optimizing bias-correction approach in the land data assimilation system have been reported in recent researches.

The purpose of this special issue is to provide assessments on the advances in the development and validations of satellite soil moisture products and their applications in meteorology. Open scientific questions related to developing high-quality satellite SM retrievals, understanding SM-climate change feedback, and enhancing the performance of weather forecast, climate, and hydrology models are explored in the accepted papers. Twenty-two submissions from worldwide have been received in a one-year period, which reflects the intense interest in the special issue in SM community. Lots of high-quality manuscripts completed by leading experts in the related research fields result in 16 published papers after strict external review.

Among the published papers in the special issue, three papers propose to promote SM retrieval through implementation of either artificial neural network (ANN) or the H/A/Alpha polarization decomposition approach, and other three papers refine SM retrieval by downscaling/fusing satellite soil moisture observations. Four papers propose enhancement on land surface model performance, in turn improving weather forecast accuracy by optimizing the bias-correction method, assimilating satellite SM observations, and updating parameters. Another three papers exhibit temporal variations of soil moisture, estimation of actual evapotranspiration and potential use of soil moisture in drought monitoring, and spatiotemporal variables of soil moisture by investigating long-term historical records. Finally, there are three papers introducing air quality and variation characteristics of vegetative precipitation-use efficiency. A very brief summary of the addressed researches is presented as follows:

In "Soil drought and vegetation response during 2001–2015 in North China based on GLDAS and MODIS data" by S. Yang et al., the soil moisture availability index (SMAI) was developed for quantifying soil drought conditions. The results of SMAI on vegetation would assist drought research and application in North China.

In "Bias correction in monthly records of satellite soil moisture using nonuniform CDFs" by S. Wang et al., the Douglas–Peucker curve approximation algorithm was used to approximate the cumulative distribution functions (CDFs). The new nonuniformly spaced sampling method to a shorter time series can achieve the same reduction in standard deviation.

In "Changes of soil moisture from multiple sources during 1988–2010 in the Yellow River Basin, China" by D. Lou et al., the spatiotemporal variables of soil moisture from the passive microwave product, ERA-Interim reanalysis, the National Center for Environmental Prediction/Department of Energy's reanalysis, and the Variable Infiltration Capacity model products are evaluated against in situ observations in the Yellow River Basin, China.

The results help to understand the soil moisture from multisources in terms of temporal variations.

In "Estimation of actual evapotranspiration distribution in the Huaihe river upstream basin based on the generalized complementary principle" by J. Gao et al., actual evapotranspiration at 1 km resolution over the 1961–2000 period is estimated using meteorological and hydrological data. Results show that the actual evapotranspiration in the Huaihe River upstream showed a decreasing trend over the period, with a rate of 24.1 mm/10 years.

In "Intercomparison of downscaling techniques for satellite soil moisture" by D. Kim et al., a new downscaling method using support vector regression (SVR) is introduced. The finer resolution SM provides lower uncertainties and stronger consistency with respect to in situ measurements. The results suggest the SVR downscaling approach is effective to improve spatial resolution of satellite SM observations.

In "Human settlement quality evaluation based on air quality in major cities of China" by S. Li et al., based on the monthly human settlements quality index data of 12 months and the monthly data of air quality index in 30 major cities, the quality of human settlements in 2015 was analyzed.

In "Spatiotemporal variation characteristics of vegetative PUE in China from 2000 to 2015" by H. Xu et al., the annual value, multiyear mean value, interannual standard deviation, and interannual linear trend of Chinese terrestrial vegetative Precipitation-use Efficiency (PUE) are calculated using MODIS net primary production and China's spatial interpolation precipitation data from 2000 to 2015.

In "Spatiotemporal variability of Arctic soil moisture detected from high-resolution RADARSAT-2 SAR data" by A. Collingwood et al., an artificial neural network (ANN) is implemented for determining, at high spatial and temporal resolutions, surface soil moisture and its changes through time in the Canadian high Arctic from synthetic aperture radar (SAR) data.

In "ESA CCI soil moisture assimilation in swat for improved hydrological simulation in upper huai river basin" by Y. Liu et al., satellite soil moisture observation from European Space Agency (ESA) Climate Change Initiative (CCI) is assimilated into the physically based semi-distributed hydrological Soil and Water Assessment Tool (SWAT) model using the ensemble Kalman filter. The stream flow simulations of SWAT model are improved with benefits of assimilating remote sensing soil moisture.

In "A preliminary assessment of the impact of assimilating satellite soil moisture data products on NCEP global forecast system" by W. Zheng et al., a preliminary test of assimilating satellite soil moisture data products from NOAA-NESDIS Soil Moisture Operational Product System (SMOPS) into NOAA-NCEP Global Forecast System (GFS) is conducted. Forecasts of surface humidity and air temperature, 500 hPa height anomaly correlations, and the precipitation forecast skill demonstrated certain level improvements after the soil moisture assimilation against those without the soil moisture assimilation.

In "Multitemporal soil moisture retrieval over bare agricultural areas by means of alpha model with multisensor SAR data" by X. Zhang et al., the Alpha model is optimized by employing multisensor SAR data. The optimized Alpha model shows an obvious improvement for soil moisture retrieval. The results in this paper indicate multisensor and multitemporal SAR data are favorable for time series soil moisture retrieval over bare agricultural areas.

In "Analysis of SO_2 pollution changes of Beijing-Tianjin-Hebei region over China based on OMI observations from 2006 to 2017" by Z. Wang et al., the characteristics of Sulfur dioxide (SO_2) distribution and variation over Beijing-Tianjin-Hebei region are discussed.

In "Impact of using near real-time green vegetation fraction in noah land surface model of NOAA-NCEP on numerical weather predictions" by L. Fang et al., near real-time (NRT) green vegetation fraction (GVF) data products have been generated from the Visible Infrared Imaging Radiometer Suite (VIIRS) and the Moderate Resolution Imaging Spectroradiometer (MODIS)-Leaf Area Index (LAI) data are used to access the impact of NRT GVF on the numerical weather prediction (NWP). Improvements of soil moisture simulations as well as forecasts of 2-meter air temperature, humidity, and precipitation were observed using the NRT GVF data products.

In "Research on fusing multisatellite soil moisture data based on bayesian model averaging" by S. Wang et al., a Bayesian model averaging (BMA) method is used to integrate multisatellite SM data. The superiority of the BMA method over the traditional averaging method is revealed.

In "Combined use of GF-3 and landsat-8 satellite data for soil moisture retrieval over agriculture areas using artificial neural network" by Q. Meng et al., an artificial neural network(ANN)-based inversion technique is introduced. Results in this paper highlight the contribution of the combined use of GF-3 synthetic aperture radar and Landsat-8 images on improving soil moisture estimates using the ANN approach.

In "Combining of the H/A/Alpha and Freeman–Durden polarization decomposition methods for soil moisture retrieval from full-polarization radarsat-2 data" by Q. Xie et al., the H/A/Alpha polarization decomposition approach is used to extract accurate threshold values of decomposed scattering components. The algorithm shows great potential for promoting L-band polarization-based soil moisture retrieval.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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