Figure 11. Time-series daily original soil moisture, SGD-SM 1.0/2.0, and precipitation results at location (48.875°N, 140.375°E) in 2013.

5.3 Uncertainty analysis

The uncertainty of SGD-SM 2.0 and proposed model could be classified as three types: 1) The errors of original AMSR-E/WindSat/AMSR2 products; 2) The meteorological factors; 3) The generalization of proposed reconstructing model.

1) The errors of original AMSR-E/WindSat/AMSR2 products: The proposed SGD-SM product is generated based on original AMSR-E/WindSat/AMSR2 products. While these passive soil moisture products also exist errors (i.e. above 0.8 m$^3$·m$^{-3}$), due to the satellite sensor imaging and soil moisture retrieval algorithm. As shown in Table 1, the R, RMSE, and MAE evaluation indexes of the original products are 0.679, 0.094, and 0.075, respectively. These errors are also inevitably transmitted into the generated SGD-SM 2.0 products. In other words, SGD-SM 2.0 absolutely trusts the initial satellite-based SM values without any hesitation.

2) The meteorological factors: The proposed method relies on the temporal continuity and spatial consistency for daily soil moisture gap-filling. Nevertheless, if the unusual meteorologic occurs in single day such as precipitation and snowfall, it may disturb above assumption and influence the reconstructing effects. This uncertainty can be noticed in time-series validation, especially for the rainy season. Although we fuse the daily precipitation products into the proposed model in SGD-SM 2.0, it still cannot adequately reflect the emergency meteorological factors such as brief precipitation.