Response to Referee #1

First authors thank the anonymous referee #1 who has given good suggestion to improve our manuscript. According to the comments, we have revised the manuscript as follows:

1) The abstract is rewritten. It contains a synthesis of the objective of the study, the methodology used for the analysis and the main findings.
"… soil moisture status at a point can be predicted …": The word "*point*" is changed "grid point". "soil moisture status *prediction*" is changed "soil moisture status estimations". The description of Qilian Mountainous region and information on further studies have been omitted.

2) *Section 1, line 84: "in the study the relationship of the temporal and spatial variation of soil moisture is determined by establishing its controlling factors …"* The sentence is revised as "in this study the relationship between variation of soil moisture and its controlling factors (e.g. topography and precipitation) is established." That mean the modified wetness index.
Line 110: *"… for modelling the areal distribution …", it should be "spatial distribution";* Last paragraph in section 1 has been changed. "areal distribution" was omitted.

3) *Section 2.1, line 127: "The vegetation distribution closely follows the temperature- and precipitation-determined heat-water combination in the Mountains."* This sentence is changed as "The vegetation distribution closely follows the combinations of temperature and precipitation in the Mountains."
4) *Section 2.2, line 147: The authors state that 30 stations were used for regression or interpolation (I suppose precipitation) and 13 to test the models (which models?). Then over "27 plots were located to measure soil water content, 22 plots were in Pailugou catchment…" On the other hand, in the abstract and later on in the text they refer to 15 points to test the method. Thus, the description is still very confusing, then what does it mean "27 plots"? Really, I don't see the difficulty in describing clearly how many rain-gauge stations have been used and how many sites for validation of wetness index.*
The paragraph is changed as "Among 43 rain-gauge stations, 30 stations were chosen to develop the regression model or to use for interpolating and other 13 stations were remained to test the regression model or the results of interpolation." 30 stations can be seen as rain-gauge station. Here models mean regression model and interpolating models. 27 plots were located in the study. But 5 plots are out of the Pailugou catchment. So 27 plots are changed as "22 plots". Among 22 plots, only 15 plots have whole observation data. Therefore, in revised manuscript, Fig.1 is changed. Sampling points out of Pailugou catchment are removed. Available data of 15 plots to validate the wetness index is explained in line 154, the line below equation (1).
Line 153: "Calculation of mean value of soil water content (SWC) is demonstrated as

follows: suppose that SWC of plot i, …" Here the authors do not demonstrate *anything, they just provide the equation for computing SWC. Again what does it mean "SWC of plot i"?* SWC of plot i is the SWC at the *i* plot. *i* = 15. *In addition, in some places the authors refer to soil moisture status, in other places they refer to soil water content. Is there a difference? This can be misleading;* Yes, here authors just provide the equation for computing SWC. Because one reviewer let us show how calculate mean value of soil water content. Soil moisture status is different from soil water content. Soil water content is measured. It can express how much water in the soil. However, soil moisture status only expresses the degree of wetness in soil. It is obtained by estimation.

5) *Section 2.3, line 187: The authors introduce IN2 referring to the paper by Gomez-Plaza et al. (2001). However, in that paper IN2 is defined differently, why? Moreover, I found the paper by Liu et al. (2005) that provides an application very similar to the one proposed here. Why the authors do not refer to that paper? And which are the differences with respect to that paper?* Based on IN1, authors expect to introduce aspect, making IN1 become IN2. Gomez-Plaza et al. (2001) and others consider the aspect is very important factor affecting soil moisture in arid and semiarid area. Our objective referring to the paper by Gomez-Plaza is to let the paper to support our idea, i.e., aspect is an appropriate surrogate of potential insolation. Soil water content is higher in north-facing slope than that in south-facing slope, so cosine of aspect can express the high degree or low degree of soil moisture in north-facing slope or south-facing slope. I could not find the paper by Liu et al. (2005) when we searched relative literatures. Now Mr Liu sends the paper to us. We find that the paper by Liu provides an application very similar to the IN2 in our study. The difference is that precipitation was considered homogeneous in the small catchment in Liu's study, heterogeneous in our study. So a modified wetness index IN3 was developed. Precipitation observation in the Pailugou catchment shows precipitation increase with increase of altitude, reaches the maximum value at 3400m, and then precipitation decreases with the increase of altitude. The relationship between precipitation and altitude was built based on observation and expresses as: $P_i = a + bH + cH^2$, a, b and c was defined in Table 1.

Line 200: the specific catchment area and slope should be clearly defined. The specific catchment area is defined in IN1 description. slope also is defined in IN1 description.

Line 225: From the text, it is not clear which regression model (eq. (5) or eq. (6)) has been finally used for the analysis; regression model in several places in the paragraph is added "(eq. (6))". In revised manuscript, we note regression model (eq. (6)) has been finally used for the analysis.

6) *Section 3.1, line 242: the sentence is a repetition. The aspect should be introduced in the previous section.* The sentence "aspect introduced" is removed to the previous section.

Line 248: "… this capacity increased up to 69%." Which is "capacity"? Now if IN2 explains about 69.5% of variability of the observed soil water content, the improvements obtained with IN3 must be demonstrated. Figure 3 should be

complemented by plots of IN2 versus observed soil water content. The sentence "…
this capacity increased up to 69.5%." is changed as "…., the capacity to explain the
spatial variability of soil moisture increased up to 69.5%." the improvement obtained
with IN3 is demonstrated in the paragraph. Figure 3 can't be complemented by plots
of IN2 versus observed soil water content, because the units in IN2 and IN3 is
different. We show it to the reviewer in the response.
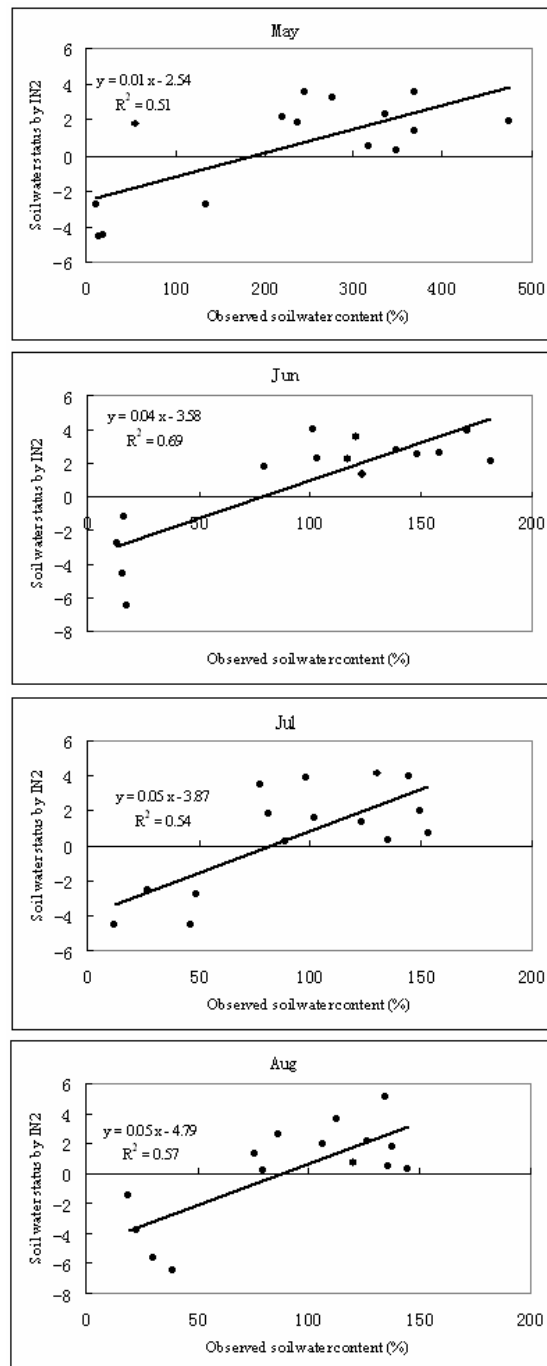
*Line 253: The authors say that "the capacity of the spatial variability of soil moisture
can be explained to be 76% in Pailugou catchment (Fig. 3)". Moreover, Fig. 3 shows
soil water status in m3 m–1 month–1, I don't understand, it is not IN2?;* The sentence

is changed "..., the capacity to explain the spatial variability of soil moisture can reach 76% in Pailugou catchment (Fig. 3).". According to literatures (Grabsa et al., 2009; Rodhe & Seibert, 1999), IN1 and IN2 have no unit, Precipitation P_i here is mm month^{-1}, So unit in IN3 is changed as mm month^{-1} based on IN3 in the study. IN1, IN2 and IN3 is a relative measure of the hydrological conditions of a given site in the landscape. They can be transformed by the relationship between estimated value and observed value.

Grabsa, T., Seiberta, J., Bishopc, K., Laudond H., 2009. Modeling spatial patterns of saturated areas: A comparison of the topographic wetness index and a dynamic distributed model. Journal of Hydrology, 373: 15–23.

Rodhe, A., Seibert, J., 1999. Wetland occurrence in relation to topography: a test of topographic indices as moisture indicators. Agricultural and Forest Meteorology, 98–99: 325–340.

7) Section 3.2, line 300: *"... altitude and longitude depended precipitation is higher." Please explain better, "depended precipitation" does not have sense;* that means precipitation depends on latitude and longitude, In this express, two sentences or compound sentence can become one simple sentence. "altitude and longitude depended" as adjective of precipitation, not depended precipitation.

8) *Section 3.3, line 313: Again 15 sample plots is not clear and Fig.3 is again presented (first introduced in section 3.1) after a description of Fig. 6.* 27 plots are changed as "22 plots" removing 5 plots due to their out of Pailugou chatchment, which is explained in section 2.2. Among 22 plots, only 15 plots have whole observation data. Therefore, in revised manuscript, Fig.1 is changed. Sampling points out of Pailugou catchment are removed. Available data of 15 plots to validate the wetness index is explained in line 154, the line below equation (1).

Line 317: "... the same strategies were employed ..." which strategies? "strategies" mean "steps", "strategies" is changed as "steps" in the revised manuscript.

Line 320–323: The sentence is very confusing, please revise it. "... dryness of the matrix soil water", what is it? The sentence is changed as ".... more insolation on the dryness of the soil water." Removing "matrix", here "matrix" mean "pattern".

Line 332: *"... temporal different in the status of soil moisture, the spatial variation trend of soil moisture ..." What does it mean?* We omit the sentence in the revised manuscript. That means maps of soil moisture status have temporal different, but the spatial variation trend of soil moisture are same.

Line 338: "...(IN3) between 0–800." Please include units of IN3. We have added the units of IN3.

9) *Section 4, line 375: "The model of topographic indices in Eq.(3) is universal in a different sense." What does it mean? And wetness index IN2 now becomes "the model of topographic indices", what a mess!* "The model of topographic indices in Eq.(3) is universal in a different sense." is changed as "The wetness index IN_2 in Eq. (3) is universal in arid and semi-arid areas." "the model of topographic indices" is changed as "The wetness index".

Line 377: The use of the word "large scale" is not proper. "large scale" is changed as 'large region"

Line 386: the four types of variability in relations between soil and relief are not clear. The sentence is changed as "there is a need to take into account four types of variability besides relief: regional, time, depth, and scale."

In Fig. 3 ticks of x-axis should be on the bottom of the figure; units in Fig. 7 are missing. In Table 4 units for NI3 and frequency of communities are missing. In Fig. 3 ticks of x-axis is removed on the bottom of the figure; units in Fig. 7 are added. In Table 4 units for NI3 and frequency of communities are added.

I miss several other points because the list would be too long. However, the suggestion is: several parts of the text seem "words salads", please try to improve the presentation of the study and clarify the improvement obtained by using IN3. We have revised many parts of the text (see revised manuscript) and clarified the improvement obtained by using IN3.

Reference:
Liu Xiande, Zhang Xuelong and Jin Ming, 2005: GIS-assisted modeling of spatial and temporal distribution of soil water moisture in Pailugon catchment of Qilian Mountains. Geoscience and Remote Sensing Symposium, 2005, IGARSS'05 Proceedings. 2005 IEEE International, 4455–4468. We have cited the paper in the text and list it in references