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Interactive comment on "Predicting parameters of degradation succession processes of Tibetan *Kobresia* grasslands" *by* L. Li et al.

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Dear referees, Thank you very much for constructive comments on our manuscript entitled as "Predicting parameters of degradation succession processes of Tibetan Kobresia grasslands" (se-2015-54). We have carefully revised our manuscript based on your comments. Please see our detailed responses point by point as follows:

1. The first and main concern is about"Introduction needs further reorganized".

In the new version, we reorganized the introduction, please see lines 35-87: "Alpine grasslands are one of the most important grassland types on earth, and they are distributed across the tundra zone of North Eurasia and North America. More than 48% of alpine grasslands are distributed on the Tibetan Plateau of China (Sun and Zheng,

1998; Wang et al., 1998; Harmsen and Grogan, 2008). Alpine grasslands represent one of the major natural types of pastures for pastoralists living in alpine regions, especially for those living on the Tibetan Plateau where livestock grazing is the most important human activity (Zhang et al., 2003a). Livestock mainly affects alpine grasslands through two ways. First, their grazing can affect the structure and composition of plant community, and the constitution of plant life forms and ecotypes in alpine grasslands (de la Paix et al., 2013; Zhao et al., 2013; Mekuria and Aynekulu, 2013). Second, their trampling can reduce infiltration rates, surface sealing, and physical crust formation (Cerda and Lavee, 1999; Angassa, 2014). With increased grazing, a part of alpine grasslands gradually degrade and become bare soil due to decreased vegetation protection (Zhang et al., 2003b; Zhang et al., 2003c; Wang et al., 2007a, b; Foggin, 2008). Consequently, this reduces the role of alpine grasslands in soil and water protection (Wen et al., 2010; Brandt et al., 2013; You et al., 2014). Such grazing-induced degradation of alpine grasslands has been observed in the early 2000s (Wang et al., 1997; Liu et al., 2008; Wang et al., 2009; Harris, 2010; Lin et al., 2013a, b), mainly because livestock number increased from approximately 0.8$\times$108 in 1997 to 1.08$\times$108 sheep unit in 2011 on the Tibetan Plateau (Yang, 2002; He et al., 2008; Sun, 2012). In the past decade, degradation in alpine grasslands has been getting more and more serious due to increasing grazing density. This has started to affect the living of pastoralists and the development of local economy. How to restore those degraded grasslands and maintain sustainable development of alpine grasslands is a big challenge. An important prerequisite for this is how to diagnose the degree to which alpine grasslands have degraded (Li et al., 2014). So far, numerous studies separately used plant community (Han et al., 2008; Lin et al., 2013a,b; Angassa, 2014; Giangiacomo, 2014) or environmental indexes (Lin et al., 2010, 2013a, b) as indicators to diagnose grassland degradation (Li et al., 2014; Wang et al., 2015). However, grassland degradation caused by grazing is a very complicated ecological process, including changes in both vegetation and soil. This emphasizes the importance of the plant-soil system for improving degradation of alpine grasslands. Among the plant-soil system, plants are the

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link of the atmosphere, biosphere, hydrosphere, and lithosphere (Brevik et al., 2015). The existence of plants can protect the soil surface against kinetic energy of drops, reduces runoff and increases infiltration (Groen and Wood, 2008). Therefore, the vegetation cover play a fundamental role in the soil development and soil erosion (Cerdà, 2002; Keesstra et al., 2014), and soil degradation (Ziadat and Taimeh, 2013), and also in the geomorphological (Nanko et al., 2015) and hydrological (Keesstra, 2007; Gabarrón-Galeote et al., 2013) behaviour of the Earth System and their interactions with the biota (Araújo et al., 2014; Bochet et al., 2015). At the same time, plants can shape soil microenvironments through living roots (Bardgett, 2002; Puente et al., 2004; Cerdà, 2002; Dai et al., 2013; Keesstra et al., 2014; Shang et al., 2014; Keesstra, 2014; Gabarrón-Galeote et al., 2013) and affects microbial function (Wang et al., 2015; Pereg and McMillan, 2015). In contrast to the vegetation, the soil system provides an important carrier for growth of plants and microorganisms. Almost all nutrient transformation processes operate by microorganisms in the soil. Therefore, the analysis on the soil-plant system must be approached from a multidisciplinary strategy (Brevik et al., 2015). To identify the degradation stages of the Tibetan Kobresia grasslands, we conducted a large field investigation in alpine grasslands across the Qinghai province. We collected a large number of indicators, including visible (e.g., species diversity, plant height, vegetation coverage, and plant biomass, plant functional groups) and invisible (e.g., root biomass, organic matter content, total nitrogen, and available nutrients in the soil). To reduce the parameters dimensionality (Lin et al., 2012), ordination and classification approaches were used for the multivariate analysis because it has been used to explore which factors contribute most to plant community change (Ali et al., 2014; Christopher, 2014). Therefore, our objectives of this study are to: (1) analyze the degree of degradation in grasslands through reducing the parameter dimensionality from a large number of visible and invisible parameters, and (2) develop a useful approach to diagnose and predict the extent of degradation of alpine grasslands for the sustainable development of alpine grasslands."

2. The second concern is about"the change of livestock density during the past

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decades".

In the past decades, livestock number increased from 0.8×108 to 1.08×108 sheep unit From the early 2000 to 2011 in Tibetan Plateau (Yang, 2002; He et al., 2008; Sun, 2012), see lines 51-52.

Yang R.R.: Analysis on Western China grassland degradation and of Sustainable Development. Pratacultural Science. 19(1), 23–27, 2002 Sun D.S. Studies on the effects of grazing intensity on vegetation and soil in alpine meadow on the eastern Qinghai-Tibetan Plateau. Lanzhou University, Lanzhou, 1-12, 2012 He Y.L., Zhou H.K., Zhao X.Q., Lai D.Z., Zhao J.Z.: Alpine grassland degradation and its restoration on Qinghai-Tibet Plateau. Pratacultural Science, 11, 1–9, 2008

3. The third concern is about "study region covered 32 counties in three districts, and maybe the precipitation and temperature would have some effects in results".

Our experimental sites were selected from 32 counties, because these sites have the similar topography under the similar climate conditions to avoid potential effects caused by different temperature and precipitation.

4. The forth concern is about page 12, line 22 "requires soil volume to hold roots "

Here our meaning is that increased root biomass causes higher ratios of roots to soil due to high root volume. In the new version, we clarified the meaning.

Please also note the supplement to this comment:
http://www.solid-earth-discuss.net/7/C1178/2015/sed-7-C1178-2015-supplement.pdf

Interactive comment on Solid Earth Discuss., 7, 2185, 2015.