A most effective approach to challenge the established climatology of precipitation anywhere is to place raingauges at an elevation where none were available previously. Yet, constrained by sensor specificities, and by spatial and temporal sampling, precipitation measurements tend to disappoint. Beyond the question of quality (how accurate, how reliable), other pressing questions concern the representativeness of the measurements, and their utility (that is, what to do with them). On the other hand, the notion of precipitation observation implies a deliberate, though imperfect, measurement placed in the context of regional hydrology and hydrometeorology. An observational plan for a field experiment is therefore a measurement plan with a purpose (i.e. driven by science questions). Here, we first discuss the challenges of measuring and observing precipitation in mountainous regions, including sensor suite selection, and siting. Next, we show how precipitation observations in the Himalayas, in the Southern Appalachians, and in the Andes allowed us to examine fundamental science questions from the scaling habits of clouds, to the spatial stationarity of the diurnal cycle, to the impact of aerosol-cloud interactions and land-cover changes on the space-time properties of regional rainfall, among others.