A set of Soil Moisture and Ocean Salinity (SMOS) soil moisture (SM) data assimilation (DA) experiments are presented. The SMOS soil moisture dataset used in this study was produced specifically for this project training a neural network (NN) using SMOS brightness temperatures as input and H-TESSEL SM fields as reference for the training. In this way, the SMOS NN SM dataset has a similar climatology to the model and it does not present a global bias with respect to the model. The DA experiments are computed using a surface-only Land Data Assimilation System (so-LDAS) based on the HTESSEL land surface model. This system is very efficient computationally and allows to perform long surface assimilation experiments (one whole year, 2012). SMOS NN SM DA experiments are compared to Advanced Scatterometer (ASCAT) SM DA. In both cases, experiments with and without 2 metre air temperature and relative humidity DA are discussed using different observation errors for the ASCAT and SMOS datasets. Seasonal, geographical and soil-depth-related differences between the results of those experiments are presented and discussed. The different SM analysed fields are evaluated against a large number of in situ measurements of SM. On average, the SM analysis gives in general similar results to the model open loop with no assimilation even if significant differences can be seen for some sites with in situ measurements. The sensitivity to observation errors to the SM dataset slightly differ depending on the networks of in situ measurements, however it is relatively low for the tests conducted here. Finally, the effect of the soil moisture analysis on the Numerical Weather Prediction (NWP) is evaluated comparing experiments for different configurations of the system, with and without (Open Loop) soil moisture data assimilation. Assimilation of ASCAT soil moisture improves the forecast in the tropics and adds information with respect to the near surface conventional observations. In contrast, SMOS degrades the forecast in the Tropics in July-September. In the Southern hemisphere ASCAT degrades the forecast in July-September both alone and using 2m air temperature and relative humidity. On the other hand, experiments using SMOS (even without screen level variables) improve the forecast for all the seasons, in particular, in July-December. In the northern hemisphere both with ASCAT and SMOS, the experiments using 2m air temperature and relative humidity improve the forecast in April-September. SMOS alone has a significant positive effect in July-September for experiments with low observation error. Maps of the forecast skill with respect to the open loop experiment show that SMOS improves the forecast in North America and to a lesser extent in northern Asia for up to 72 hours.