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# A new approach to validating remote sensing products at regional to large scales

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We introduce a new concept for validating remote sensing and other products at regional to large scales based on their hydrologic predictive skill. Traditionally, such products have been validated against point scale observations, an approach which is hampered by mismatches of spatial scale, data accuracy and data availability in certain parts of the world and especially over large scales. As an alternative, we show how these products can be assessed in terms of their skill in predicting the land surface hydrologic budget within a modeling and assimilation framework. The methodology can be applied to any product including remote sensing, modeled and even in-situ measurements and is more relevant to water cycle applications than just the ability to replicate a point scale measurement. The general concept is to assess, through modeling and assimilation, the consistency of the product within the total water budget. This can be implemented, for example, in terms of its skill in predicting other components of the water cycle relative to observed and random products or in how well it can correct, through assimilation, for given errors in other parts of the water cycle. We show examples of assessments of predictive skill for remotely sensed precipitation, soil moisture and evaporation products and compare these to competing products from reanalysis, off-line modeling and in-situ measurements. Firstly, for precipitation, we took estimates from remote sensing (TRMM merged and microwave only), combined remote sensing and gauge (CMORPH), and reanalysis (NARR, ERA-40), and assessed their predictive skill with reference to radar/gauge based (NLDAS) data and climatology (randomly shuffled NLDAS data). Here skill is measured by the normalized error variances in predicted soil moisture and runoff. Secondly, remotely sensed soil moisture products from TMI and AMSR-E retrievals have been assessed over regions of the US and compared with off-line simulations and in-situ measurements. In this case, the skill of the soil moisture products was assessed by assimilating them into

a land surface model and assessing the consistency between the increments and the prescribed errors in the precipitation forcing. Results indicate relatively high skill in the remotely sensed products as compared to reanalysis and in-situ data, although skill is diminished over densely vegetated regions as would be expected. The methodology is currently being applied to assess various remote sensing evaporation products.