GCOS Reference Upper Air Network: Towards characterizing uncertainty in atmospheric profile observations associated with collocation of measurements

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A cornerstone of the GCOS Reference Upper Air Network (GRUAN) is complete characterization of observational uncertainty in upper-air profiles. However, neither the scientific underpinning, nor a wellestablished methodology, for uncertainty budget analysis of profile observations is well established. A particular challenge is combining uncertainty estimates from observations of a given variable (e.g., temperature) from different instruments that are not perfected collocated. The GRUAN Analysis Team for Network Design and Operations Research has undertaken to address this issue through a series of related studies. One study (Sun et al. 2010) quantifies uncertainties in 12 different operational radiosonde types via comparison with radio-occultation observations from the Global Navigation Satellite System. That study also presents a coherent methodology for determining uncertainty associated with imperfect time and space collocation of two independent observations of the same variable. A second (Seidel et al. 2011) compiles a global climatology of radiosonde balloon drift statistics, in part to aid in assessing collocation-related uncertainty, both for satellite and ground-based remote-sensing observations. The drift statistics have other GRUAN applications as well, including (1) evaluating the possibility of combining sonde observations from one location with measurements from other instruments at a nearby station, and (2) planning the retrieval of expensive reference radiosondes after use. With these foundational results, we are currently developing a software tool to calculate the overall uncertainty budget in GRUAN profile observations, given estimates of uncertainties in individual observations and of uncertainties associated with space and time collocation mis-matches, using the framework presented by Immler et al. (2010). Immler, F. J.; Dykema, J.; Gardiner, T.; Whiteman, D. N.; Thorne, P. W. and V[^]mel, H., Reference Quality Upper-Air Measurements: guidance for developing GRUAN data products. Atmospheric Measurement Techniques, 2010, 3, 1217-1231, doi:10.5194/amt-3-1217-2010. Seidel, D. J., B. Sun, M. Pettev, A. J. Reale. 2011: Radiosonde balloon drift statistics. Geophys. Res., 116. D07102. doi:10.1029/2010JD014891. Sun, B., A. Reale, D. J. Seidel, and D. C. Hunt, 2010: Comparing radiosonde and COSMIC atmospheric profile data to quantify differences among radiosonde types and the effects of imperfect collocation on comparison statistics. J. Geophys. Res., 115, D23104, doi:10.1029/2010JD014457.