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Refresh of presentation material

David Smyth

Friday, 2nd December 2022, session 11–4

Reunion Island

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Maynooth University
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Actions where progress is required, but not time-bound

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2009

- Boers 2009: Boers, R., and E. van Meijgaard (2009), What are the demands on an observational program to detect trends in upper tropospheric water vapor anticipated in the 21st century?, Geophys. Res. Lett., 36, L19806, doi: 10.1029/2009GL040044
- Seidel 2009: Seidel, D. J.; Berger, F. H.; Diamond, H. J.; Dykema, J.; Goodrich, D.; Immler, F.; Murray, W.; Peterson, T.; Sisterson, D.; Sommer, M.; Thorne, P.; Vömel, H. & Wang, J., Reference Upper-Air Observations for Climate: Rationale, Progress, and Plans. Bulletin of the American Meteorological Society, 2009, 90, 361–369, doi: 10.1175/2008BAMS2540.1

2010

- Immler 2010: Immler, F. J.; Dykema, J.; Gardiner, T.; Whiteman, D. N.; Thorne, P. W. and Vömel, 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
- Shimizu 2010: Shimizu, K. and Hasebe, F.: Fast-response high-resolution temperature sonde aimed at contamination-free profile observations, Atmos. Meas. Tech. Discuss., 3, 3293-3317, doi: 10.5194/amt-3-1673-2010

2011

- Madonna 2011:Madonna, F., Amodeo, A., Boselli, A., Cornacchia, C., Cuomo, V., D'Amico, G., Giunta, A., Mona, L., and Pappalardo, G.: CIAO: the CNR-IMAA advanced observatory for atmospheric research, Atmos. Meas. Tech., 4, 1191-1208, https://doi.org/10.5194/amt-4-1191-2011
- Seidel 2011: Seidel, D. J., B. Sun, M. Pettey, and A. Reale (2011), Global radiosonde balloon drift statistics, J. Geophys. Res., 116, D07102, doi: 10.1029/2010JD014891
- Whiteman 2011: Whiteman, D. N., K. C. Vermeesch, L. D. Oman, and E. C. Weatherhead (2011), The relative importance of random error and observation frequency in detecting trends in upper tropospheric water vapor, J.Geophys. Res., 116, D21118, doi: 10.1029/2011JD016610

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2012

- Kobayashi 2012: Kobayashi, E., Y. Noto, S. Wakino, H. Yoshii, T. Ohyoshi, S. Saito, and Y. Baba, 2012: Comparison of Meisei RS2-91 rawinsondes and Vaisala RS92-SGP radiosondes at Tateno for the data continuity for climatic data analysis. J. Meteor. Soc. Japan, 90, 923-945, doi: 10.2151/jmsj.2012-605
- Philipona 2012: Philipona, R., A. Kräuchi, and E. Brocard, Solar and thermal radiation profiles and radiative forcing measured through the atmosphere, Geophys. Res. Lett., 2012, 39, L13806, doi: 10.1029/2012GL052087
- Reichardt 2012: Jens Reichardt, Ulla Wandinger, Volker Klein, Ina Mattis, Bernhard Hilber, and Robert Begbie, "RAMSES: German Meteorological Service autonomous Raman lidar for water vapor, temperature, aerosol, and cloud measurements," Appl. Opt. **51**, 8111-8131 (2012); doi: 10.1364/AO.51.008111
- Whiteman 2012:Whiteman, D. N., Cadirola, M., Venable, D., Calhoun, M., Miloshevich, L., Vermeesch, K., Twigg, L., Dirisu, A., Hurst, D., Hall, E., Jordan, A., and Vömel, H.: Correction technique for Raman water vapor lidar signal-dependent bias and suitability for water vapor trend monitoring in the upper troposphere, Atmos. Meas. Tech., 5, 2893-2916, https://doi.org/10.5194/amt-5-2893-2012, 2012.

2013

- Baray 2013:Baray, J.-L., Courcoux, Y., Keckhut, P., Portafaix, T., Tulet, P., Cammas, J.-P., Hauchecorne, A., Godin Beekmann, S., De Mazière, M., Hermans, C., Desmet, F., Sellegri, K., Colomb, A., Ramonet, M., Sciare, J., Vuillemin, C., Hoareau, C., Dionisi, D., Duflot, V., Vérèmes, H., Porteneuve, J., Gabarrot, F., Gaudo, T., Metzger, J.-M., Payen, G., Leclair de Bellevue, J., Barthe, C., Posny, F., Ricaud, P., Abchiche, A., and Delmas, R.: Maïdo observatory: a new high-altitude station facility at Reunion Island (21° S, 55° E) for long-term atmospheric remote sensing and in situ measurements, Atmos. Meas. Tech., 6, 2865-2877, doi: 10.5194/amt-6-2865-2013
- Brocard 2013:Brocard, E., Philipona, R., Haefele, A., Romanens, G., Mueller, A., Ruffieux, D., Simeonov, V., and Calpini, B.: Raman Lidar for Meteorological Observations, RALMO – Part 2: Validation of water vapor measurements, Atmos. Meas. Tech., 6, 1347-1358, doi: 10.5194/amt-6-1347-2013
- Brocard 2013: Brocard, E., P. Jeannet, M. Begert, G. Levrat, R. Philipona, G. Romanens, and S. C. Scherrer (2013): Upper air temperature trends above Switzerland 1959–2011, J. Geophys. Res. Atmos., 118, 4303–4317, doi: 10.1002/jgrd.50438
- Gardiner 2013: T. Gardiner, F. Madonna, J. Wang, D. N. Whiteman, J. Dykema, A. Fassò, P. W. Thorne, and G. Bodeker (2013): Sampling and measurement issues in establishing a climate reference upper air network. AIP Conf. Proc. 1552, pp. 1066-1071; doi: 10.1063/1.4821422
- Nalli 2013: Nalli, N. R., et al. (2013), Validation of satellite sounder environmental data records: Application to the Cross-track Infrared Microwave Sounder Suite, *J. Geophys. Res. Atmos.*, 118, 13,628–13,643, doi: 10.1002/2013JD020436 .
- Philipona 2013: Philipona, R., A. Kräuchi, G. Romanens, G. Levrat, R. Ruppert, E. Brocard, P. Jeannet, D. Ruffieux, and B. Calpini (2013), Solar and thermal radiation errors on upper-air radiosonde temperature measurements, J. of Atmos. and Oceanic Tech., 30, 2382-2393, doi: 10.1175/JTECH-D-13-00047.
- Thorne 2013: P. W. Thorne, H. Vömel, G. Bodeker, M. Sommer, A. Apituley, F. Berger, S. Bojinski, G. Braathen, B. Calpini, B. Demoz, H. J. Diamond, J. Dykema,A. Fassò, M. Fujiwara, T. Gardiner, et al. (2013): GCOS reference upper air network (GRUAN): Steps towards assuring future climate

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2014

- Ciesielski 2014: Paul E. Ciesielski, Hungjui Yu, Richard H. Johnson, Kunio Yoneyama, Masaki Katsumata, Charles N. Long, Junhong Wang, Scot M. Loehrer, Kathryn Young, Steven F. Williams, William Brown, John Braun, and Teresa Van Hove, 2014: Quality-Controlled Upper-Air Sounding Dataset for DYNAMO/CINDY/AMIE: Development and Corrections. J. Atmos. Oceanic Technol., 31, 741–764, doi: 10.1175/JTECH-D-13-00165.1
- Dirksen 2014: Dirksen, R. J., Sommer, M., Immler, F. J., Hurst, D. F., Kivi, R., and Vömel, H. (2014): Reference quality upper-air measurements: GRUAN data processing for the Vaisala RS92 radiosonde, Atmos. Meas. Tech., 7, 4463-4490, doi: 10.5194/amt-7-4463-2014
- Fassò 2014: Fassò, A, Ignaccolo, R, Madonna, F, Demoz, B. and Franco-Villoria M. (2014) Statistical modelling of collocation uncertainty in atmospheric thermodynamic profiles, Atmos. Meas. Tech., 7, 1803–1816, doi: 10.5194/amt-7-1803-2014
- Ignaccolo 2014: Ignaccolo R., Franco-Villora M., Fassò A. (2014) Modelling collocation uncertainty of 3D atmospheric profiles. Stochastic Environmental Research and Risk Assessment. On-line first. doi: 10.1007/s00477-014-0890-7
- Madonna 2014: Madonna, F., Rosoldi, M., Güldner, J., Haefele, A., Kivi, R., Cadeddu, M. P., Sisterson, D., and Pappalardo, G., Quantifying the value of redundant measurements at GCOS Reference Upper-Air Network sites, Atmos. Meas. Tech., 2014, 7, 3813-3823, doi: 10.5194/amt-7-3813-2014
- Sairanen 2014: Hannu Sairanen, Martti Heinonen, Richard Högström, Antti Lakka & Heikki Kajastie (2014) A Calibration System for Reference Radiosondes that Meets GRUAN Uncertainty Requirements, NCSLI Measure, 9:3, 56-60, DOI: 10.1080/19315775.2014.11721696

2015

- Antón 2015:Antón, M., Loyola, D., Román, R., and Vömel, H.: Validation of GOME-2/MetOp-A total water vapour column using reference radiosonde data from the GRUAN network, Atmos. Meas. Tech., 8, 1135-1145, doi: 10.5194/amt-8-1135-2015
- Bodeker 2015: Bodeker, G. E. and Kremser, S. (2015): Techniques for analyses of trends in GRUAN data, Atmos. Meas. Tech. Discuss., 7, 11957-11989, doi: 10.5194/amt-8-1673-2015
- Brogniez 2015:Brogniez, H., G. Clain, and R. Roca, 2015: Validation of Upper-Tropospheric Humidity from SAPHIR on board Megha-Tropiques Using Tropical Soundings.*J. Appl. Meteor. Climatol.*,**54**, 896–908, https://doi.org/10.1175/JAMC-D-14-0096.1
- Butterfield 2015: Butterfield, D. and Gardiner, T. (2015): Determining the temporal variability in atmospheric temperature profiles measured using radiosondes and assessment of correction factors for different launch schedules, Atmos. Meas. Tech., 8, 463-470, doi: 10.5194/amt-8-463-2015
- Dionisi 2016:Dionisi, D., Keckhut, P., Courcoux, Y., Hauchecorne, A., Porteneuve, J., Baray, J. L., Leclair de Bellevue, J., Vérèmes, H., Gabarrot, F., Payen, G., Decoupes, R., and Cammas, J. P.: Water vapor observations up to the lower stratosphere through the Raman lidar during the Maïdo Lidar Calibration Campaign, Atmos. Meas. Tech., 8, 1425-1445, https://doi.org/10.5194/amt-8-1425-2015, 2015.
- Keckhut 2016: Keckhut, Philippe; Courcoux, Yann; Baray, Jean-Luc; Porteneuve, Jacques; Vérèmes, Hélène; Hauchecorne, Alain; Dionisi, Davide; Posny, Françoise; Cammas, Jean-Pierre; Payen, Guillaume; Gabarrot, Franck; Evan, Stephanie; Khaykin, Sergey; Rüfenacht, Rolf; Tschanz, Brigitte; Kämpfer, Niklaus; Ricaud, Philippe; Abchiche, Abdel; Leclair-de-Bellevue, Jimmy und Duflot, Valentin (2015). Introduction to the Maïdo Lidar Calibration Campaign dedicated to the validation of upper air meteorological parameters. Journal of Applied Remote Sensing, 9(1), 094099. Society of Photo-optical Instrumentation Engineers (SPIE) doi: 10.1117/1.JRS.9.094099
- Kreher 2015: Kreher, K., Bodeker, G. E., and Sigmond, M.: An objective determination of optimal site locations for detecting expected trends in

2016

- Bodeker 2016: G. E. Bodeker, S. Bojinski, D. Cimini, R. J. Dirksen, M. Haeffelin, J. W. Hannigan, D. F. Hurst, T. Leblanc, F. Madonna, M. Maturilli, A. C. Mikalsen, R. Philipona, T. Reale, D. J. Seidel, D. G. H. Tan, P. W. Thorne, H. Vömel, and J. Wang: Reference Upper-Air Observations for Climate: From Concept to Reality. Bull. Amer. Meteor. Soc., 97, 123–135; doi: 10.1175/BAMS-D-14-00072.1
- Brogniez 2016: Brogniez, H., R. Fallourd, C. Mallet, R. Sivira, and C. Dufour, 2016: Estimating Confidence Intervals around Relative Humidity Profiles from Satellite Observations: Application to the SAPHIR Sounder. J. Atmos. Oceanic Technol., 33, 1005–1022, https://doi.org/10.1175/JTECH-D-15-0237.1
- Ghysels 2016:Ghysels, M., Riviere, E. D., Khaykin, S., Stoeffler, C., Amarouche, N., Pommereau, J.-P., Held, G., and Durry, G.: Intercomparison of in situ water vapor balloon-borne measurements from Pico-SDLA H_2O and FLASH-B in the tropical UTLS, Atmos. Meas. Tech., 9, 1207-1219, https://doi.org/10.5194/amt-9-1207-2016, 2016.
- Hall 2016: Hall, E. G., Jordan, A. F., Hurst, D. F., Oltmans, S. J., Vömel, H., Kühnreich, B., and Ebert, V.: Advancements, measurement uncertainties, and recent comparisons of the NOAA frost point hygrometer, Atmos. Meas. Tech., 9, 4295-4310, doi: 10.5194/amt-9-4295-2016
- Hurst 2016: Hurst, D. F., Read, W. G., Vömel, H., Selkirk, H. B., Rosenlof, K. H., Davis, S. M., Hall, E. G., Jordan, A. F., and Oltmans, S. J.: Recent divergences in stratospheric water vapor measurements by frost point hygrometers and the Aura Microwave Limb Sounder, Atmos. Meas. Tech., 9, 4447-4457, doi: 10.5194/amt-9-4447-2016
- Jensen 2016: Jensen, M. P., Holdridge, D. J., Survo, P., Lehtinen, R., Baxter, S., Toto, T., and Johnson, K. L.: Comparison of Vaisala radiosondes RS41 and RS92 at the ARM Southern Great Plains site, Atmos. Meas. Tech., 9, 3115-3129, doi: 10.5194/amt-9-3115-2016
- Kräuchi 2016: Kräuchi, A., Philipona, R., Romanens, G., Hurst, D. F., Hall, E. G., and Jordan, A. F.: Controlled weather balloon ascents and descents for atmospheric research and climate monitoring, Atmos. Meas. Tech., 9, 929-938, doi: 10.5194/amt-9-929-2016
- Kräuchi 2016: Kräuchi, A. and Philipona, R.: Return glider radiosonde for in situ upper-air research measurements, Atmos. Meas. Tech., 9, 2535-2544, https://doi.org/10.5194/amt-9-2535-2016, 2016.
- Kuik 2016: Kuik, F., Lauer, A., Churkina, G., Denier van der Gon, H. A. C., Fenner, D., Mar, K. A., and Butler, T. M.: Air quality modelling in the Berlin–Brandenburg region using WRF-Chem v3.7.1: sensitivity to resolution of model grid and input data, Geosci. Model Dev., 9, 4339–4363, 2016, doi: 10.5194/gmd-9-4339-2016
- Leblanc 2016: Leblanc, T., Sica, R. J., van Gijsel, J. A. E., Godin-Beekmann, S., Haefele, A., Trickl, T., Payen, G., and Gabarrot, F.: Proposed standardized definitions for vertical resolution and uncertainty in the NDACC lidar ozone and temperature algorithms – Part 1: Vertical resolution, Atmos. Meas. Tech., 9, 4029-4049, https://doi.org/10.5194/amt-9-4029-2016
- Leblanc 2016: Leblanc, T., Sica, R. J., van Gijsel, J. A. E., Godin-Beekmann, S., Haefele, A., Trickl, T., Payen, G., and Liberti, G.: Proposed standardized definitions for vertical resolution and uncertainty in the NDACC lidar ozone and temperature algorithms – Part 2: Ozone DIAL uncertainty budget, Atmos. Meas. Tech., 9, 4051-4078, https://doi.org/10.5194/amt-9-4051-2016

2017

- Calbet 2017: Calbet, X., Peinado-Galan, N., Rípodas, P., Trent, T., Dirksen, R., and Sommer, M.: Consistency between GRUAN sondes, LBLRTM and IASI, Atmos. Meas. Tech., 10, 2323-2335, doi: 10.5194/amt-10-2323-2017
- Kawai 2017: Kawai, Y., Katsumata, M., Oshima, K., Hori, M. E., and Inoue, J.: Comparison of Vaisala radiosondes RS41 and RS92 launched over the oceans from the Arctic to the tropics, Atmos. Meas. Tech., 10, 2485-2498, doi: 10.5194/amt-10-2485-2017
- Kayser 2017: Kayser, M. , Maturilli, M. , Graham, R. M. , Hudson, S. R. , Rinke, A. , Cohen, L. , Kim, J. H. , Park, S. J. , Moon, W. and Granskog, M. A. (2017): Vertical thermodynamic structure of the troposphere during the Norwegian young sea ICE expedition , Journal of Geophysical Research-Atmospheres . doi: 10.1002/2016JD026089
- Lee 2017: Lee, S.-W., Park, E.U., Choi, B.I., Kim, J.C., Woo, S.-B., Park, S., Yang, S.G. and Kim, Y.-G. (2018), Dual temperature sensors with different emissivities in radiosondes for the compensation of solar irradiation effects with varying air pressure. Met. Apps, 25: 49-55. https://doi.org/10.1002/met.1668
- Pincus 2017: Pincus, R., Beljaars, A., Buehler, S. A., Kirchengast, G., Ladstaedter, F., and Whitaker, J. S.: The Representation of Tropospheric Water Vapor Over Low-Latitude Oceans in (Re-)analysis: Errors, Impacts, and the Ability to Exploit Current and Prospective Observations, Surv Geophys (2017) 38:1399–1423, doi: 10.1007/s10712-017-9437-z
- Sun 2017: B. Sun, A. Reale, F. H. Tilley, M. E. Pettey, N. R. Nalli and C. D. Barnet, "Assessment of NUCAPS S-NPP CrIS/ATMS Sounding Products Using Reference and Conventional Radiosonde Observations," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 10, no. 6, pp. 2499-2509, June 2017., doi: 10.1109/JSTARS.2017.2670504
- Tradowsky 2017: Tradowsky, J. S., Burrows, C. P., Healy, S. B., & Eyre, J. R. (2017). A New Method to Correct Radiosonde Temperature Biases Using Radio Occultation Data, Journal of Applied Meteorology and Climatology, 56(6), 1643-1661. https://doi.org/10.1175/JAMC-D-16-0136.1
- von Rohden 2017: von Rohden, C., Naebert, T., Sommer, M., et al. (2017). Temperaturmessung in der Atmosphäre mit Radiosonden. tm - Technisches Messen, 84(12), pp. 804-813, from doi: 10.1515/teme-2017-0074
- Weatherhead 2017: Weatherhead, E.C., G.E. Bodeker, A. Fassò, K. Chang, J.K. Lazo, C.T. Clack, D.F. Hurst, B. Hassler, J.M. English, and S. Yorgun, 2017: Spatial Coverage of Monitoring Networks: A Climate Observing System Simulation Experiment. J. Appl. Meteor. Climatol., 56, 3211–3228, doi: 10.1175/JAMC-D-17-0040.1
- Weaver 2017: Weaver, D., Strong, K., Schneider, M., Row, P. M., Sioris, C., Walker, K. A., Mariani, Z., Uttal, T., McElroy, C. T., Vömel, H., Spassiani, A., and Drummond, J. R.: Intercomparison of atmospheric water vapour measurements at a Canadian High Arctic site, Atmos. Meas. Tech., 10, 2851–2880, 2017, doi: 10.5194/amt-10-2851-2017

2018

- Bobryshev 2018: Bobryshev, O., S. A. Buehler, V. O. John, M. Brath, and H. Brogniez (2018), Is there really a closure gap between 183.31 GHz satellite passive microwave and in-situ radiosonde water vapor measurements?, IEEE T. Geosci. Remote, 56(5), 2904–2910, doi: 10.1109/TGRS.2017.2786548.
- Borger 2018: Borger, C., Schneider, M., Ertl, B., Hase, F., García, O. E., Sommer, M., Höpfner, M., Tjemkes, S. A., and Calbet, X.: Evaluation of MUSICA IASI tropospheric water vapour profiles using theoretical error assessments and comparisons to GRUAN Vaisala RS92 measurements, Atmos. Meas. Tech., 11, 4981–5006, 2018, doi: 10.5194/amt-11-4981-2018
- Brunamonti 2018: Brunamonti, S., Jorge, T., Oelsner, P., Hanumanthu, S., Singh, B. B., Kumar, K. R., Sonbawne, S., Meier, S., Singh, D., Wienhold, F. G., Luo, B. P., Boettcher, M., Poltera, Y., Jauhiainen, H., Kayastha, R., Karmacharya, J., Dirksen, R., Naja, M., Rex, M., Fadnavis, S., and Peter, T.: Balloon-borne measurements of temperature, water vapor, ozone and aerosol backscatter on the southern slopes of the Himalayas during StratoClim 2016–2017, Atmos. Chem. Phys., 18, 15937-15957, https://doi.org/10.5194/acp-18-15937-2018, 2018.
- Calbet 2018: Calbet, X., Peinado-Galan, N., DeSouza-Machado, S., Kursinski, E.R., Oria, P., Ward, D., Otarola, A., Rípodas, P. and Kivi, R. (2018) Can turbulence within the field of view cause significant biases in radiative transfer modeling at the 183 GHz band? Atmos. Meas. Tech., 11, 6409–6417, 2018, doi: 10.5194/amt-11-6409-2018
- Choi 2018: Choi, B. I., Lee, S.-W., Woo, S.-B., Kim, J. C., Kim, Y.-G., and Yang, S. G.: Evaluation of radiosonde humidity sensors at low temperature using ultralow-temperature humidity chamber, Adv. Sci. Res., 15, 207–212, https://doi.org/10.5194/asr-15-207-2018, 2018.
- de Podesta 2018: M. de Podesta, S. Bell, and R. Underwood, Air temperature sensors: dependence of radiative errors on sensor diameter in precision metrology and meteorology, Metrologia, 55(2), 229, doi:10.1088/1681-7575/aaaa52, 2018, http://iopscience.iop.org/article/10.1088/1681-7575/aaaa52/pdf
- de Podesta 2018: M de Podesta, R Underwood, L Bevilacqua and S Bell, Air temperature measurement challenges in precision metrology, IOP Conf. Series: Journal of Physics: Conf. Series 1065 (2018) 122027 IOP Publishing, doi: 10.1088/1742-6596/1065/12/122027
- Finazzi 2018: Finazzi F., Fassò A., Madonna F., Negri I., Sun B., and Rosoldi M.: Statistical harmonization and uncertainty assessment in the comparison of satellite and radiosonde climate variables, Environmetrics, On line first, 1-17, doi: 10.1002/env.2528
- Gierens 2018: Gierens, K., Eleftheratos, K., and Sausen, R.: Intercalibration between HIRS/2 and HIRS/3 channel 12 based on physical considerations, Atmos. Meas. Tech., 11, 939–948, 2018, doi: 10.5194/amt-11-939-2018
- Gilpin 2018: Gilpin, S., Rieckh, T., and Anthes, R.: Reducing representativeness and sampling errors in radio occultation–radiosonde comparisons, Atmos. Meas. Tech., 11, 2567–2582, 2018, doi: 10.5194/amt-11-2567-2018
- Gozlan 2018: Kobi Gozlan, Yuval Reuveni, Kfir Cohen, Boaz Ben-Moshe and Eyal Berliner (June 20th 2018). Cost-Effective Platforms for Near-Space Research and Experiments, Space Flight George Dekoulis, IntechOpen, DOI: 10.5772/intechopen.72168. Available from: https://www.intechopen.com/books/space-flight/cost-effective-platforms-for-near-space-research-and-experiments

2019

- Brunamonti 2019:Brunamonti, S., Füzér, L., Jorge, T., Poltera, Y., Oelsner, P., Meier, S., et al. (2019). Water vapor in the Asian summer monsoon anticyclone: Comparison of balloon-borne measurements and ECMWF data. *Journal of Geophysical Research: Atmospheres*, 124, 7053– 7068. https://doi.org/10.1029/2018JD030000
- Carminati 2019: Carminati, F., Migliorini, S., Ingleby, B., Bell, W., Lawrence, H., Newman, S., Hocking, J., and Smith, A.: Using reference radiosondes to characterise NWP model uncertainty for improved satellite calibration and validation, Atmos. Meas. Tech., 12, 83-106, https://doi.org/10.5194/amt-12-83-2019, 2019.
- Ferreira 2019: Ferreira, A. P., Nieto, R., and Gimeno, L.: Completeness of radiosonde humidity observations based on the Integrated Global Radiosonde Archive, Earth Syst. Sci. Data, 11, 603-627, https://doi.org/10.5194/essd-11-603-2019, 2019.
- Hicks-Jalali 2019: Hicks-Jalali, S., Sica, R. J., Haefele, A., and Martucci, G.: Calibration of a water vapour Raman lidar using GRUAN-certified radiosondes and a new trajectory method, Atmos. Meas. Tech., 12, 3699-3716, https://doi.org/10.5194/amt-12-3699-2019
- Jalali 2019: Jalali, A., Hicks-Jalali, S., Sica1, R.J., Haefele, A., and von Clarmann, T. (2019). A practical information-centered technique to remove a prioriinformation from lidar optimal-estimation-method retrievals. Atmos. Meas. Tech., 12, 3943–3961, 2019. https://doi.org/10.5194/amt-12-3943-2019
- Kobayashi 2019:Kobayashi, E., Hoshino, S., Iwabuchi, M., Sugidachi, T., Shimizu, K., and Fujiwara, M.: Comparison of the GRUAN data products for Meisei RS-11G and Vaisala RS92-SGP radiosondes at Tateno (36.06° N, 140.13° E), Japan, Atmos. Meas. Tech., 12, 3039-3065, https://doi.org/10.5194/amt-12-3039-2019, 2019.
- Lee 2019: Sang-Wook Lee et al 2019 Metrologia 56 025009; https://doi.org/10.1088/1681-7575/ab0cc0
- Lee 2019: Lee, S-W, Yang, I, Choi, BIL, et al. Development of upper air simulator for the calibration of solar radiation effects on radiosonde temperature sensors. Meteorol Appl. 2020; 27:e1855. https://doi.org/10.1002/met.1855
- Matthews 2019: Matthews, J.L.; Shi, L. Intercomparisons of Long-Term Atmospheric Temperature and Humidity Profile Retrievals. Remote Sens. 2019, 11, 853, https://doi.org/10.3390/rs11070853
- Naakka 2019: Naakka, T., Nygård, T., Tjernström, M.,Vihma, T., Pirazzini, R., and Brooks, I. M. (2019). The impact of radiosounding observations on numerical weather prediction analyses in the Arctic. Geophysical Research Letters, 46, 8527–8535. https://doi.org/10.1029/2019GL083332
- Rinke 2019: Rinke, A., Segger, B., Crewell, S., Maturilli, M., Naakka, T., Nygård, T., Vihma, T., Alshawaf, F., Dick, G., Wickert, J., and Keller, J. (2019). Trends of Vertically Integrated Water Vapor over the Arctic during 1979–2016: Consistent Moistening All Over?. Journal of Climate 32, 18, 6097-6116, https://doi.org/10.1175/JCLI-D-19-0092.1
- Schröder 2019: Schröder, M.; Lockhoff, M.; Shi, L.; August, T.; Bennartz, R.; Brogniez, H.; Calbet, X.; Fell, F.; Forsythe, J.; Gambacorta, A.; Ho, S.-P.; Kursinski, E.R.; Reale, A.; Trent, T.; Yang, Q. The GEWEX Water Vapor Assessment: Overview and Introduction to Results and Recommendations. Remote Sens. 2019, 11, 251, https://doi.org/10.3390/rs11030251

2020

- Almansa 2020: Almansa, A.F.; Cuevas, E.; Barreto, Á.; Torres, B.; García, O.E.; Delia García, R.; Velasco-Merino, C.; Cachorro, V.E.; Berjón, A.; Mallorquín, M.; López, C.; Ramos, R.; Guirado-Fuentes, C.; Negrillo, R.; de Frutos, Á.M. Column Integrated Water Vapor and Aerosol Load Characterization with the New ZEN-R52 Radiometer. Remote Sens. 2020, 12, 1424. https://doi.org/10.3390/rs12091424
- Becker 2020: Becker, R., Maturilli, M., Philipona, R. et al. In situ sounding of radiative flux profiles through the Arctic lower troposphere. Bull. of Atmos. Sci.& Technol. (2020). https://doi.org/10.1007/s42865-020-00011-8
- Dirksen 2020: Dirksen, R. J., Bodeker, G. E., Thorne, P. W., Merlone, A., Reale, T., Wang, J., Hurst, D. F., Demoz, B. B., Gardiner, T. D., Ingleby, B., Sommer, M., von Rohden, C., and Leblanc, T.: Managing the transition from Vaisala RS92 to RS41 radiosondes within the Global Climate Observing System Reference Upper-Air Network (GRUAN): a progress report, Geosci. Instrum. Method. Data Syst., 9, 337–355, https://doi.org/10.5194/gi-9-337-2020, 2020.
- Dupont 2020: Dupont, J., M. Haeffelin, J. Badosa, G. Clain, C. Raux, and D. Vignelles, 2020: Characterization and Corrections of Relative Humidity Measurement from Meteomodem M10 Radiosondes at Midlatitude Stations. J. Atmos. Oceanic Technol., 37, 857–871, https://doi.org/10.1175/JTECH-D-18-0205.1.
- Evan 2020: Evan, S., Brioude, J., Rosenlof, K., Davis, S. M., Vömel, H., Héron, D., Posny, F., Metzger, J.-M., Duflot, V., Payen, G., Vérèmes, H., Keckhut, P., and Cammas, J.-P.: Effect of deep convection on the tropical tropopause layer composition over the southwest Indian Ocean during austral summer, Atmos. Chem. Phys., 20, 10565–10586, https://doi.org/10.5194/acp-20-10565-2020, 2020.
- Fassò 2020: Fassò, A., Sommer, M., and von Rohden, C.: Interpolation uncertainty of atmospheric temperature profiles, Atmos. Meas. Tech., 13, 6445–6458, https://doi.org/10.5194/amt-13-6445-2020, 2020.
- Gierens 2020: Gierens, Klaus; Wilhelm, Lena; Sommer, Michael; Weaver, Dan, 2020: On ice supersaturation over the Arctic.Meteorologische Zeitschrift (2020), https://doi.org/10.1127/metz/2020/1012
- Hanumanthu 2020: Hanumanthu, S., Vogel, B., Müller, R., Brunamonti, S., Fadnavis, S., Li, D., Ölsner, P., Naja, M., Singh, B. B., Kumar, K. R., Sonbawne, S., Jauhiainen, H., Vömel, H., Luo, B., Jorge, T., Wienhold, F. G., Dirkson, R., and Peter, T.: Strong day-to-day variability of the Asian Tropopause Aerosol Layer (ATAL) in August 2016 at the Himalayan foothills, Atmos. Chem. Phys., 20, 14273–14302, https://doi.org/10.5194/acp-20-14273-2020, 2020.
- Héron 2020: Héron, D., Evan, S., Brioude, J., Rosenlof, K., Posny, F., Metzger, J.-M., and Cammas, J.-P.: Impact of convection on the upper-tropospheric composition (water vapor and ozone) over a subtropical site (Réunion island; 21.1° S, 55.5° E) in the Indian Ocean, Atmos. Chem. Phys., 20, 8611–8626, https://doi.org/10.5194/acp-20-8611-2020, 2020.
- Hicks-Jalali 2020: Hicks-Jalali, S., Sica, R. J., Martucci, G., Maillard Barras, E., Voirin, J., and Haefele, A.: A Raman lidar tropospheric water vapour climatology and height-resolved trend analysis over Payerne, Switzerland, Atmos. Chem. Phys., 20, 9619–9640, https://doi.org/10.5194/acp-20-9619-2020, 2020.

2021

- Crewell 2021: Crewell, S., Ebell, K., Konjari, P., Mech, M., Nomokonova, T., Radovan, A., Strack, D., Triana-Gómez, A. M., Noël, S., Scarlat, R., Spreen, G., Maturilli, M., Rinke, A., Gorodetskaya, I., Viceto, C., August, T., and Schröder, M.: A systematic assessment of water vapor products in the Arctic: from instantaneous measurements to monthly means, Atmos. Meas. Tech., 14, 4829–4856, https://doi.org/10.5194/amt-14-4829-2021, 2021.
- Graf 2021: Graf, M., Scheidegger, P., Kupferschmid, A., Looser, H., Peter, T., Dirksen, R., Emmenegger, L., and Tuzson, B.: Compact and lightweight mid-infrared laser spectrometer for balloon-borne water vapor measurements in the UTLS, Atmos. Meas. Tech., 14, 1365–1378, https://doi.org/10.5194/amt-14-1365-2021, 2021.
- Jing 2021: Jing, X.; Shao, X.; Liu, T.-C.; Zhang, B. Comparison of GRUAN RS92 and RS41 Radiosonde Temperature Biases. Atmosphere 2021, 12, 857. https://doi.org/10.3390/atmos12070857
- Jorge 2021: Jorge, T., Brunamonti, S., Poltera, Y., Wienhold, F. G., Luo, B. P., Oelsner, P., Hanumanthu, S., Singh, B. B., Körner, S., Dirksen, R., Naja, M., Fadnavis, S., and Peter, T.: Understanding balloon-borne frost point hygrometer measurements after contamination by mixed-phase clouds, Atmos. Meas. Tech., 14, 239–268, https://doi.org/10.5194/amt-14-239-2021, 2021.
- Ma 2021: Ma, Z., Li, Z., Li, J., Schmit, T. J., Cucurull, L., Atlas, R., & Sun, B. (2021). Enhance low level temperature and moisture profiles through combining NUCAPS, ABI observations, and RTMA analysis. Earth and Space Science, 8, e2020EA001402. https://doi.org/10.1029/2020EA001402
- Madonna 2021: Madonna, F.; Summa, D.; Di Girolamo, P.; Marra, F.; Wang, Y.; Rosoldi, M. Assessment of Trends and Uncertainties in the Atmospheric Boundary Layer Height Estimated Using Radiosounding Observations over Europe. Atmosphere 2021, 12, 301. https://doi.org/10.3390/atmos12030301
- Martucci 2021: Martucci, G., Navas-Guzmán, F., Renaud, L., Romanens, G., Gamage, S. M., Hervo, M., Jeannet, P., and Haefele, A.: Validation of pure rotational Raman temperature data from the Raman Lidar for Meteorological Observations (RALMO) at Payerne, Atmos. Meas. Tech., 14, 1333–1353, https://doi.org/10.5194/amt-14-1333-2021, 2021.
- Smale 2021: Dan Smale, Susan E. Strahan, Richard Querel, Udo Frieß, Gerald E. Nedoluha, Sylvia E. Nichol, John Robinson, Ian Boyd, Michael Kotkamp, R. Michael Gomez, Mark Murphy, Hue Tran & Jamie McGaw (2021) Evolution of observed ozone, trace gases, and meteorological variables over Arrival Heights, Antarctica (77.8°S, 166.7°E) during the 2019 Antarctic stratospheric sudden warming, Tellus B: Chemical and Physical Meteorology, 73:1, 1-18, DOI: 10.1080/16000889.2021.1933783
- Sun 2021: Sun, B.; Calbet, X.; Reale, A.; Schroeder, S.; Bali, M.; Smith, R.; Pettey, M. Accuracy of Vaisala RS41 and RS92 Upper Tropospheric Humidity Compared to Satellite Hyperspectral Infrared Measurements. Remote Sens. 2021, 13, 173. https://doi.org/10.3390/rs13020173
- Tu 2021: Tu, Q., Hase, F., Blumenstock, T., Schneider, M., Schneider, A., Kivi, R., Heikkinen, P., Ertl, B., Diekmann, C., Khosrawi, F., Sommer, M., Borsdorff, T., and Raffalski, U.: Intercomparison of arctic XH2O observations from three ground-based Fourier transform infrared networks and application for satellite validation, Atmos. Meas. Tech., 14, 1993–2011, https://doi.org/10.5194/amt-14-1993-2021, 2021.

2022

- Colombo 2022: Pietro Colombo and Alessandro Fassò 2022 Meas. Sci. Technol. 33 074001; https://doi.org/10.1088/1361-6501/ac5bff
- Dekhtyareva 2022: Dekhtyareva, A., Hermanson, M., Nikulina, A., Hermansen, O., Svendby, T., Holmén, K., and Graversen, R. G.: Springtime nitrogen oxides and tropospheric ozone in Svalbard: results from the measurement station network, Atmos. Chem. Phys., 22, 11631–11656, https://doi.org/10.5194/acp-22-11631-2022, 2022.
- Hoshino 2022: Hoshino, S., Sugidachi, T., Shimizu, K., Kobayashi, E., Fujiwara, M., and Iwabuchi, M.: Comparison of GRUAN Data Products for Meisei iMS-100 and Vaisala RS92 Radiosondes at Tateno, Japan, Atmos. Meas. Tech. Discuss. [preprint], https://doi.org/10.5194/amt-2021-374, in review, 2022.
- Ingleby 2022: Ingleby, B., Motl, M., Marlton, G., Edwards, D., Sommer, M., von Rohden, C., Vömel, H., and Jauhiainen, H.: On the quality of RS41 radiosonde descent data, Atmos. Meas. Tech., 15, 165–183, https://doi.org/10.5194/amt-15-165-2022, 2022.
- Lee 2022a: Lee, S.-W., Kim, S., Lee, Y.-S., Choi, B. I., Kang, W., Oh, Y. K., Park, S., Yoo, J.-K., Lee, J., Lee, S., Kwon, S., and Kim, Y.-G.: Radiation correction and uncertainty evaluation of RS41 temperature sensors by using an upper-air simulator, Atmos. Meas. Tech., 15, 1107–1121, https://doi.org/10.5194/amt-15-1107-2022, 2022.
- Lee 2022b: Lee, S.-W., Kim, S., Lee, Y.-S., Yoo, J.-K., Lee, S., Kwon, S., Choi, B. I., So, J., and Kim, Y.-G.: Laboratory characterisation and intercomparison sounding test of dual thermistor radiosondes for radiation correction, Atmos. Meas. Tech., 15, 2531–2545, https://doi.org/10.5194/amt-15-2531-2022, 2022.
- Rosoldi 2022: Rosoldi, M.; Coppa, G.; Merlone, A.; Musacchio, C.; Madonna, F. Intercomparison of Vaisala RS92 and RS41 Radiosonde Temperature Sensors under Controlled Laboratory Conditions. Atmosphere 2022, 13, 773. https://doi.org/10.3390/atmos13050773
- von Rohden 2022: von Rohden, C., Sommer, M., Naebert, T., Motuz, V., and Dirksen, R. J.: Laboratory characterisation of the radiation temperature error of radiosondes and its application to the GRUAN data processing for the Vaisala RS41, Atmos. Meas. Tech., 15, 383–405, https://doi.org/10.5194/amt-15-383-2022, 2022.
- Zhang 2022: Zhang, Y., Zhang, B., and Yang, N. (2022). Characteristics of Temperature and Humidity Inversions Based on High-Resolution Radiosonde Observations at Three Arctic Stations. Journal of Applied Meteorology and Climatology 61, 4, 415-428, https://doi.org/10.1175/JAMC-D-21-0054.1, 2022.

GRUAN ICM-14

Moving forward - demonstrating added value

Why reference measurements are so important

Features

- Centralised processing – no site bias
- Traceability
- Quantified uncertainty
- GDPs (and GDPs under development)

Benefits

- Visibility
- Data usage
- Knowledge exchange - ICMs
- Recognition

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Proposed actions

Timebound

Refresh handouts / poster

- By end Q1 2023

Refresh brochure

- By end Q2 2023

Update web video (cost ...)

- By end Q4 2023