

Curriculum Vitae - Søren Thorndahl

Personal data: Full name: Søren Liedtke Thorndahl
Birthday: July 29, 1978
Family status: Married to Kathrine Liedtke Thorndahl (2009), one daughter (2014).
Citizenship: Danish
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Current position: Associate professor in Environmental and Hydraulic Engineering

Research interests: Uncertainty assessment; urban hydrology; urban drainage modelling; numerical modelling; hyetology; weather radars; hydrometeorology; forecasting

Education: Ph.D. in Civil Engineering, Aalborg University, Denmark, April 2008, with thesis: *Uncertainty assessment in long term urban drainage modelling*.
M.Sc. in Civil Engineering (Water & Environment), Aalborg University, June 2004 with thesis: *Numerical modelling of water and sediment transport in highway drainage detention ponds*.
High school (mathematical), Aalborg Katedralskole, June 1998.

Professional experience: Associate Professor, Department of Civil Engineering, Aalborg University, Nov. 2011 to present.
Postdoc with teaching responsibilities, Department of Civil Engineering, Aalborg University, May 2010 to Nov. 2011.
Postdoc, Department of Civil Engineering, Aalborg University, May 2008 to May 2010. Project: *Storm- and Wastewater Informatics (SWI)*.
Teaching assistant, Department of Civil Engineering, Aalborg University, Nov. 2007 to May 2008.
PhD student, Department of Civil Engineering, Aalborg University, Nov. 2004 to Nov. 2007.
Research assistant, Department of Civil Engineering, Aalborg University, Sep. 2004 – Nov. 2004.

Publications: Peer reviewed journal publications: 30 (17 as first author)
Peer reviewed conference proceedings: +50
Other scientific publications: 9
Papers under review for journal publication: 4

Citations: Scopus: 375 (h-index: 11)
ISI Web of Knowledge: 322 (h-index: 10)
Google Scholar: 589 (h-index: 13)

Granted funding	<p>Project owner of granted funds since 2011: 8.6 mill DKK (The Danish Council for Independent Research: 1.6 mill DKK; National funds: 4.8 mill DKK; EU-funding: 2.2 mill DKK)</p>
International experience:	<p>Research stay at University of Missouri, Columbia, Missouri, USA, advised by Professor Neil Fox School of Natural Resources - Atmospheric Sciences Aug– Dec, 2019.</p> <p>Lead on a joint review paper within the International group on urban rainfall (IGUR) under the IWA/IAHR Joint Committee on Urban Drainage on application of Weather radar rainfall data in urban hydrology (2016).</p> <p>Paper “Weather radar rainfall data in urban hydrology” by Thorndahl et al. (2017) in Hydrology and Earth System Sciences has of May 2018 been marked as a “highly cited paper” within the field of Geosciences on Web of Science.</p> <p>Member of conference scientific committees: Urban drainage Modelling (UDM 2018, Palermo, Italy), Weather Radar and Hydrology (WRAH 2017 Seoul, Korea), International Conference on Urban Drainage (ICUD 2017, Prague Czech Republic)</p> <p>Research stay at Princeton University, USA advised by Professor James Smith. Civil and Environmental Engineering – the Hydrometeorology Research Group. Oct – Dec, 2011</p> <p>Research stay at University of Iowa, USA advised by Professor Witold Krajewski, Iowa Flood Center and IIHR Hydroscience and engineering. Aug – Oct, 2011</p> <p>Research stay (during PhD studies) at Katholieke Universiteit Leuven, Belgium under supervision of Professor Patrick Willems. Period: Mar 2006 – Jul 2006.</p> <p>Speaker at more than twenty international conferences and workshops.</p> <p>Reviewer for the journal Water Science and Technology, Water Research, Journal of Hydrology, Journal of Hydro-environment Research, Hydrology and Earth System sciences, Urban Water Journal, Hydrological Processes and for several conference proceedings.</p> <p>PhD examiner at Aalborg University and Technical University of Denmark</p>
Key research and development projects:	<p><i>GRAVA</i> - Samspil mellem GRundvand, Afløbssystem og VAndløb i byer (<i>Interaction between GRundwater, Drainage system and streams in urban areas</i>). Funded by VUDP. Total budget DKK 2.2M, AAU grant: DKK 1M. Partners: AAU, Niras, Aalborg Forsyning and Aalborg Kommune. Søren Thorndahl is AAU project leader.</p> <p><i>VÆRDI</i> – VÆRktøjer og regndata til DIMensionering af fremtidens klimatilpassede afløbssystemer (<i>Tools and rainfall data for design of future climate-adapted urban drainage systems</i>). Funded by VUDP. Total budget: DKK 3.2M, AAU grant: DKK 325k. Partners: Novafos, HOFOR, Aarhus Vand, Vandcenter Syd, KLAR forsyning, DTU Miljø, AAU, DHI, HydroCONSULT, Birgit Paludan, Krüger, Rambøll, Spildevandskomiteen, DMI, Just Business. Søren Thorndahl is AAU responsible.</p> <p><i>MOTO</i> - Monitoring af Overfladeafstrømning fra grønne områder II (<i>Monitoring and warning of surface runoff from green urban areas II</i>)dec 2018-dec 2020. Funded by VUDP. Total budget DKK 1.4M, AAU grant: DKK 300k. Partners: Aarhus Vand, AAU, Envidan. Søren Thorndahl is work package leader.</p> <p><i>MUFFIN</i> - Multiscale Urban Flood forecasting (2016-2019) funded by ERA-NET Cofund Water Works 2014, Total budget € 1.2M; AAU grant: € 289k. Consortium: Swedish Meteorological and Hydrological Institute, Aalborg University (Denmark), Delft University of Technology TUD (The Netherlands), Aalto University AALTO (Finland), and Swedish Geotechnical Institute. Søren Thorndahl is work package and AAU project leader.</p> <p><i>KLIMAKS</i> – Klimafremskrivning af kontinuerte historiske regneserier (Climate projection of continuous historical rainseries): Partners: AAU, Niras, Aarhus Vand, Danish Meteorological Institute. Funded by VUDP in autumn 2017. Budget 1.5M DK, AAU share: 0.95M DKK. Søren Thorndahl is project leader.</p> <p><i>MOGO</i> - Monitoring og varsling af Overfladeafstrømning fra Grønne Områder (<i>Monitoring and warning of surface runoff from green urban areas</i>) funded by VTU-Fonden. Total budget DKK 2.8M,</p>

AAU grant: DKK 588k. Consortium: AAU, Aarhus Vand, and Envidan. Søren Thorndahl is work package leader and AAU project leader.

Sikkert Søbad, Overvågning, rensning og varsling af regnvandsbetingede overløb (Safe bathing lake water quality). Partners: Teknologisk Institut, Skanderborg Forsyning, AAU, Amphibac, Stjernholm, Killian Waters. Project sum: 4.3 mill DKK. AAU share: 860.000 DKK. Project period: Jan 2016- Jan 2018. Funded by MUDP (Miljø- og Fødevareministeriets Miljøteknologiske Udviklings- og DemonstrationProgram). Søren Thorndahl is work package leader and AAU project leader.

Uncertainty in high spatio-temporal resolution rainfall estimation: Personal two- year postdoc scholarship funded by the Danish Council for Independent Research – Technology and Production (Det Frie forskningsråd – Teknologi og Produktion). Project period: Aug. 2011 – Aug. 2013. Grant: 1.628.128 DKK. The project included ½-year research visit at University of Iowa and Princeton University, USA.

Overflow from combined sewer systems (Overløb fra fælleskloak – Hvordan måles det – og Hvorfor?) Vandsektorens Teknologiuudviklingsfond (2013-2014): Parteners: DHI, DTU, Krüger, AAU and Aarhus Vand. Project sum DKK 3.5 mill. Participation approx. 200 working hours.

Storm- and Wastewater Informatics (SWI): Employment as postdoc for a two year period (May 2008- May 2010) working on “Advanced methods for data integration” (weather radar calibration, nowcasting, numerical weather models, urban drainage modeling). The SWI-project is a cooperation between Danish universities, research intuitions, private companies, and public utilities and is founded by *The Danish Council for Strategic Research*. Budget 30 mio. DKK.

Weather radar based control of wastewater systems, Danish title: *Vejrradarbaseret styring af spildevandssystemer* (Part 1: Jan. 2008 - Dec. 2008 and Part 2: Mar. 2009 - Jun. 2010). Personally responsible for development of radar rainfall forecast model, radar calibrations, and real time operation of seven different radar forecasts. This project was a collaboration between Aalborg University (Associate Professor Michael Rasmussen and postdoc Søren Thorndahl), Krüger Veolia Water, and seven Danish municipal utility companies.

Uncertainty assessment in long term urban drainage modeling, PhD project (Nov. 2004 to Apr. 2008). Defended in public April, 14. 2008. Supervisors: Associate Professor Kjeld Schaarup-Jensen and Assistant Professor Jacob Birk Jensen.

Comities:

Designated member of the Danish Wastewater Committee (Spildevandskomiteen) under the society of Danish engineers (IDA). From April 2013 to present. From April 2014 vice-chairman and member of the exclusive committee.

Member of the rainfall committee under the Danish Wastewater Committee. From April 2017 to present.

Chair of working group on uncertainties in urban drainage design, Danish Wastewater Committee From June 2018.

Member of Working group on rainfall for urban drainage design, Danish Wastewater Committee. From Jan 2018.

Member of the International group on urban rainfall (IGUR) under the IWA/IAHR Joint Committee on Urban Drainage since Sep. 2011.

Vice chairman of the Joint Consultation Committee (in Danish: Samarbejds-udvalget), Department of Civil engineering, Aalborg University. From 2007 to present.

Member of validation advisory board for the report “State of the Nation 2012’ by the Danish Association of Consulting Engineers (Foreningen af Rådgivende Ingeniører- FRI)

PhD supervision:

Principal PhD supervisor of Christoffer Bang Andersen (Sep. 2018 - Aug. 2021): *Climate projection of precipitation observations for urban drainage applications*.

Principal supervision of Rasmus Vest Nielsen (Aug. 2016 - Aug. 2019): *Multi-scale Urban Flood Modelling*. Project: MUFFIN.

Secondary supervision of Malte Ahm (Defended Jan. 2016). *Improving weather radar accuracy with ground and in-sewer measurements*. Project: SWI. Principal supervisor: Michael Rasmussen.

Secondary supervision of David G. Nielsen (Defended Dec. 2015). *Assimilation of radar rainfall in numerical weather prediction models*. Project: HydroCast. Principal supervisor: Michael Rasmussen.

Secondary supervision of Jesper Ellerbæk Nielsen (Defended Dec. 2013). *Integration of X- and C-band radar data for urban-scale application*. Project: SWI. Principal supervisor: Michael Rasmussen.

Teaching experience:

Rain measurement and analysis in an urban hydrological context, PhD course, AAU, 2013 (course responsible)

Urban Hydroinformatics, 3th semester master course (course responsible). 2012 to present

Urban drainage modelling, 6th semester bachelor (course and semester responsible). 2004 to present

Climate and hydrology of the dense city, 1st semester master course. 2018-present

Applied Statistics in Traffic Planning, 1st semester master (course responsible). 2005 to 2010.

Basic urban drainage, 3rd semester bachelor (course responsible). 2008 to 2011.

Project supervisor for several project groups on both bachelor and master level.

Project supervisor for bachelor thesis projects (+30) and master thesis projects (30).

Responsible for bachelor and master internships and internship supervisor for the Water and Environment education. From 2011 to present.

Contributor to study curriculums (in Danish: Studieordninger), Bachelor in Civil engineering, bachelor in Water and Environment and Master in Water and Environment.

Completed university pedagogy for assistant professor (in Danish: Adjunkt pædagogikum). 2009 to 2011.

Language skills: Danish and English, spoken and written, German at tourist level.

List of published journal papers

- [30] Nielsen, K.T., Moldrup, P., Thorndahl, S., Nielsen, J.E., Uggerby, M., Rasmussen, M.R. (2019) Field-scale monitoring of urban green area rainfall-runoff processes. *Journal of Hydrologic Engineering* 24 (8). [https://doi.org/10.1061/\(ASCE\)HE.1943-5584.0001795](https://doi.org/10.1061/(ASCE)HE.1943-5584.0001795)
- [29] Thorndahl, S., Nielsen, J.E., Rasmussen, M.R. (2019) Estimation of storm-centred areal reduction factors from radar rainfall for design in urban hydrology. *Water*, 11(6), 1120 <https://doi.org/10.3390/w11061120>
- [28] Sørup, H.J.D., Davidsen, S., Löwe, R. Thorndahl, S., Borup; M., Arnbjerg-Nielsen, K. (2018) Evaluating catchment response to artificial rainfall from four weather generators for present and future climate. *Water Science and Technology*, 77 (11): 2578-2588. <https://doi.org/10.2166/wst.2018.217>
- [27] Tuyls, D.M., Thorndahl, S., Rasmussen, M.R. (2018.) Return period assessment of urban pluvial floods through modelling of rainfall-flood response. *Journal of Hydroinformatics* 20(4), pp. 829-845. <https://doi.org/10.2166/hydro.2018.133>
- [26] Thorndahl, S., Andersen, A.K., and Larsen, A. B. (2017) Event-based stochastic point rainfall resampling for statistical replication and climate projection of historical rainfall series. *Hydrology and Earth System Sciences*, 21(9), 4433-4448. <https://doi.org/10.5194/hess-21-4433-2017>

- [25] Thorndahl, S., Einfalt, T., Willems, P., Nielsen, J. E., ten Veldhuis, M.-C., Arnbjerg-Nielsen, K., Rasmussen, M. R., and Molnar, P. (2017) Weather radar rainfall data in urban hydrology. *Hydrology and Earth System Sciences*, 21(3), 1359–1380. <http://dx.doi.org/10.5194/hess-21-1359-2017> *Web of Science Highly Cited Paper**
- [24] Ahm, M., Thorndahl, S., Nielsen, J.E., Rasmussen, M.R. (2016) Estimation of combined sewer overflow discharge: A software sensor approach based on local water level measurements *Water Science and Technology* 74(11) pp. 2683-2696. <http://dx.doi.org/10.2166/wst.2016.361>
- [23] Thorndahl, S. Nielsen, J.E., Jensen, D.G. (2016) Urban pluvial flood prediction: evaluating radar rainfall nowcasts and numerical weather prediction models as inputs. *Water Science and Technology* 74 (11) pp: 2599-2610 <http://dx.doi.org/doi:10.2166/wst.2016.474>
- [22] Thorndahl, S., Balling, J.D., Larsen, U.B.B. (2016) Analysis and integrated modelling of groundwater infiltration to sewer networks. (2016) *Hydrological Processes* 30(18), pp. 3228-3238. <http://dx.doi.org/doi:10.1002/hyp.10847>
- [21] Thorndahl, S., Scharup-Jensen, K., Rasmussen, M.R. (2015). On Hydraulic And Pollution Effects Of Converting Combined Sewer Catchments To Separate Sewer Catchments. *Urban Water Journal* 12(2). <http://dx.doi.org/doi:10.1080/1573062X.2013.831915>
- [20] Nielsen, J. E., Beven, K., Thorndahl, S., Rasmussen, M.R. (2015) GLUE based marine X-band weather radar data calibration and uncertainty estimation, *Urban Water Journal* 12 (4) <http://dx.doi.org/doi:10.1080/1573062X.2013.871044>
- [19] Thorndahl, S. Smith, J.A., Baeck, M.L., Krajewski, W.F. (2014) *Analyses of the Temporal and Spatial Structure of Heavy Rainfall from a Catalog of High-Resolution Radar Rainfall fields*, *Atmospheric Research* 144 111–125, <http://dx.doi.org/10.1016/j.atmosres.2014.03.013> .
- [18] Löwe, R., Thorndahl, S., Mikkelsen, P.S., Rasmussen, M.R., Madsen, H (2014), Probabilistic online runoff forecasting for urban catchments using inputs from rain gauges as well as statically and dynamically adjusted weather radar, *Journal of Hydrology*, Volume 512, 397-407, <http://dx.doi.org/10.1016/j.jhydrol.2014.03.027>
- [17] Nielsen, J.E., Thorndahl, S., Rasmussen, M.R. (2014) Improving Weather Radar Precipitation Measurements by Combining two Types of Radars. *Atmospheric Research* 139, 36-45. <http://dx.doi.org/10.1016/j.atmosres.2013.12.013>
- [16] Thorndahl, S., Nielsen, J.E., Rasmussen M.R. (2014) *Bias adjustment and advection interpolation of long-term high resolution radar rainfall series*, *Journal of Hydrology*, Volume 508, 214-226. <http://dx.doi.org/doi:10.1016/j.jhydrol.2013.10.056>
- [15] Nielsen, J.E., Thorndahl, S., Rasmussen, M.R., (2014) *A numerical method to generate high temporal resolution precipitation time series by combining weather radar measurements with a nowcast model*, *Atmospheric research* 138, 1-12. <http://dx.doi.org/doi:10.1016/j.atmosres.2013.10.015>
- [14] Thorndahl, S., Rasmussen, M. R. (2013). Short-Term Forecasting of Urban Storm Water Runoff in Real-Time using Extrapolated Radar Rainfall Data. *Journal of Hydroinformatics* 15 (3): 897–912. <http://dx.doi.org/doi:10.2166/hydro.2013.161>
- [13] Nielsen, J.E., Thorndahl, S., Rasmussen, M.R. (2013), Development of method for X-band weather radar calibration. *Journal of Hydroinformatics* 15 (4), 1326-1339. <http://dx.doi.org/doi:10.2166/hydro.2013.126>
- [12] Thorndahl, S., Poulsen, T. S., Bøvith, T., Borup, M., Ahm, M., Nielsen, J. E., Grum, M., Rasmussen, M. R., Gill, R., Mikkelsen, P. S. (2013) Comparison of short term rainfall forecasts for model based flow prediction in urban drainage systems. *Water Science and Technology* 68(2) pp 472–478. <http://dx.doi.org/doi:10.2166/wst.2013.274>
- [11] Ahm, M., Thorndahl, S., Rasmussen, M. R., Bassø, L. (2013) Estimating subcatchment runoff coefficients using weather radar and a downstream runoff sensor. *Water Science and Technology* 68(6) pp 1293–1299. <http://dx.doi.org/doi:10.2166/wst.2013.371>

- [10] Thorndahl, S., Rasmussen, M.R. (2012), Marine X-band weather radar data calibration, Atmospheric Research vol. 103. <http://dx.doi.org/doi:10.1016/j.atmosres.2011.04.023>
- [9] Thorndahl, S., Bøwith, T., Rasmussen, M.R. & Gill, R.S. (2012), On Combining NWP and Radar QPF Models for Forecasting of Urban Runoff, IAHS Publication series 351. ISBN 978-1-907161-26-1
- [8] Rasmussen, M.R., Quist, M., Thorndahl, S. (2012) Aspects of applying weather radar based nowcast for highways in Denmark, IAHS Publication series 351. ISBN 978-1-907161-26-1
- [7] Nielsen, J.E., Rasmussen, M.R., Thorndahl, S. (2012) What is the proper resolution of weather radar precipitation estimates for urban drainage modeling? IAHS Publication series 351. ISBN 978-1-907161-26-1
- [6] Thorndahl, S., (2009): Stochastic long term modelling of a drainage system with estimation of return period uncertainty, Water Science and Technology, vol. 59, no. 12, pp. 2331-2339. <http://dx.doi.org/10.2166/wst.2009.290>
- [5] Schaarup-Jensen, K., Rasmussen, M.R. & Thorndahl, S., (2009), To what extent does variability of historical rainfall series influence extreme event statistics of sewer system surcharge and overflows?, Water Science and Technology, vol. 60, no. 1, pp. 87-95. <http://dx.doi.org/10.2166/wst.2009.290>
- [4] Thorndahl, S., Beven, K., Jensen, J.B. & Schaarup-Jensen, K. (2008), Event based uncertainty assessment in urban drainage modelling, applying the GLUE methodology, Journal of Hydrology, vol. 357, no. 3-4, pp. 421-437. <http://dx.doi.org/10.1016/j.jhydrol.2008.05.027>
- [3] Thorndahl, S., Schaarup-Jensen, K. & Jensen, J.B. (2008), Probabilistic Modelling of Combined Sewer Overflow Using the First Order Reliability Method, Water Science and Technology, vol. 57, no. 9, pp. 1337-1344. <http://dx.doi.org/doi:10.2166/wst.2008.301>
- [2] Thorndahl, S., Willems, P. (2008), Probabilistic modelling of overflow, surcharge and flooding in urban drainage using the first-order reliability method and parameterization of local rain series, Water Research, vol. 42, no. 1-2, pp. 455-466. <http://dx.doi.org/10.1016/j.watres.2007.07.038>
- [1] Thorndahl, S., Johansen, C., & Schaarup-Jensen, K. (2006), Assessment of runoff contributing catchment areas in rainfall runoff modelling, Water Science and Technology, vol. 54, no. 6-7, pp. 49-56. <http://dx.doi.org/doi:10.2166/wst.2006.621>

**As of May/June 2018, this highly cited paper received enough citations to place it in the top 1% of the academic field of Geosciences based on a highly cited threshold for the field and publication year.*

Submitted journal papers in review

Nielsen, R.V., Thorndahl, S. (Subm) Sensitivity Analysis of an Integrated Urban Flood Model. Submitted to Journal of Environmental Management. Feb 2019

Nielsen, K.T., Moldrup, P., Thorndahl, S. Nielsen, J.E., Duus, L.B., Rasmussen, S.H, Uggerby, M., Rasmussen, M.R. (subm) Automated physical rainfall simulator for temporal variable rainfall on urban permeable green surfaces. Submitted to Hydrological processes. Mar. 2019.