

Creating standardized and FAIR data in AnaEE Denmark

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AnaEE Denmark and potential users of data

AnaEE (Analysis and Experimentation on Ecosystems)

- A pan-European research infrastructure for experimental field-scale research facilities (<u>https://www.anaee.eu/</u>)
- Partners in AnaEE Denmark are UCPH, AU, DTU and RUC

Potential users of data

- Research institutions
- Companies / industry
- Governmental institutions

AnaEE Denmark will share all data together with (the international) AnaEE ERIC community through a central data and modelling center (with decentralised data storage).



AnaEE Denmark FAIR data strategy

- Decentralised data storage no common database (same at international level)
- Go for DOIs resources and repositories are now becoming available at the Universities, e.g. ERDA at UCPH, LOAR (Royal Library, AU), and DTU Data at DTU
- Develop standardized metadata descriptions across platforms
- Data in several categories:
 - "Easy": Standard meteorological data from experiments
 - "Difficult": Measured response data (highly variable)



Start here!

AnaEE Denmark has had two FAIR data projects: – co-funded by DeiC (Danish e-infrastructure Cooperation)

- Project 1: 10 MM in total in 2019
- Project 2: 5 x 2-3 days workshops in June-October 2020 with DeiC + GOFAIR. No MM, but free workshops



Implementing FAIR – project 1 proces

July-August 2019

Project plan

Project group

Selection of people from all 3 universities (KU, AU, DTU) within AnaEE DK

1st meeting

Introductions by project participants and FAIR status at each university

Introduction to FAIR by DeIC

September 2019

Identification of variables and metadata standards

Each participant shared standards and variables from their common practice, the group searched for already established standards in the field and several discussions led to a common ontology, which leans towards one already established and well known standard (ICOS).

October 2019

Creating metadata

Participants started creating their own metadata based on the agreed standards.

Finding repositories

The group started searching for appropriate repositories – within and outside their universities.

November 2019

<u>Creating metadata</u> Participants started creating their own metadata based on the agreed standards.

Uploading datasets Participants started uploading datasets to a common repository (at KU), registering metadata and creating DOIs.

December 2019 ->

<u>3 FAIRfied datasets</u>

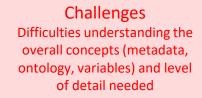
3 complete datasets were uploaded to KUs ERDA with DOIs

Learning and reporting

Participants have continued following the practice in the pilotproject – the second project focused on making machinereadable metadata, but university infrastructure is not yet capable of supporting this. Primarke and the second s

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Challenges Different levels of repository options at different institutions – AU did not have a repository, KU had one but with very low level of search- and findability options.

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The steps we went through (in short):

Create standardized templates for data and meta data

- Find a persistent data repository, i.e. ERDA (UCPH) and LOAR (Royal Library for AU)
- Get a PID (in our case DOI ERDA and Royal Library can provide)
- Create machine-readable metadata (M4M)

Link to data: https://anaee.dk/access/



AnaEE DK FAIR datasets

Brandbjerg/CLIMAITE Data from CLIMAITE (Brandbjerg), Copenhagen University: <u>doi.org/10.17894/ucph.e58a99c2-da7b-444a-b1c0-11f00e70041c</u>

For more information about the site: CLIMAITE/Brandbjerg (Copenhagen University)

Højbakkegård

Data from Højbakkegård, Copenhagen University: <u>doi.org/10.17894/ucph.8d941a14-b098-</u> <u>4ca5-b177-412f50be1731</u>

For more information about the site: Højbakkegård (Copenhagen University)

Foulumgård

Data from Foulumgård, Aarhus University: <u>dx.doi.org/10.21994/loar4109</u>

For more information about the site: Foulum (Aarhus University)



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Data files are "flat" csv files – time series of data

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Additional metadata file follows each data file – metadata on variables (adapted from ICOS)

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14 VETRAD W m-2 Net shortwave radiation 1.5 m Kinn & Zonen CNR1 1 minute 1 minute values 10 minute mean Data were calculated and not flagged 4.2.0.4.0	S TIMESTAM Year Month Day Hour TA TA_flag RH 6 2026+11 2018 5 25 0 13.5 1 7 2026+11 2018 5 25 1 13 1 8 2.026+11 2018 5 25 2 12.2 1 9 2026+11 2018 5 25 3 11.5 1 10 2.026+11 2018 5 25 4 11.2 1 11 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 6 14.3 1	3 Year 4 Month 5 Day 6 Hourd 7 rA 8 RH 9 WD 10 WS 11 P 12 G	Hour *C % * m s-1 mm	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation			NA NA 2 m 2 m 2 m 2 m 2 m 1.5 m	NA NA NA PT100 Rotronic Vector instruments A10 Vector Insturments W2 OTT Pluvio2	NA NA NA 1 minute 1 minute 01 M/L 1 minute 00P 1 minute 0.1 mm		NA NA NA 1 minute values, 10 mi 1 minute values, 10 mi 1 minute values, 10 mi 1 minute values, 10 mi	All times are UTC +1 (always wintertime, rely) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2001 Data were flagged for gapfilling by applying vith vi≤ 4.20.0.0 nute mean Data were flagged for gapfilling by applying vith vi≤ 4.20.1.1 Data were flagged for gapfilling by applying vith vi≤ 4.20.2.0 Data were flagged for gapfilling by applying vith vi≤ 4.20.2.1 nute mean Data were flagged for gapfilling by applying vith vi≤ 4.20.2.1 nute mean Data were flagged for gapfilling by applying vith vi≤ 4.20.2.1 nute mean Data were flagged for gapfilling by applying vith vi≤ 4.20.2.1
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16 TS_1_1 *C Soil temperature under grass -0.05 m PT100 1 minute 1 minute values, 10 minute mean Data were flagged for gapfilling by applying vitor 4.2.2.0.2	S TIMESTAM Year Month Day Hour TA TA_flag RH 6 2026+11 2018 5 25 0 13.5 1 7 2026+11 2018 5 25 1 13 1 8 2.026+11 2018 5 25 2 12.2 1 9 2026+11 2018 5 25 3 11.5 1 10 2.026+11 2018 5 25 4 11.2 1 11 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 6 14.3 1	3 Year 4 Month 5 Day 6 Hout 7 rA 8 RH 9 WD 10 WS 11 P 12 G 13 PA 14 NETRAD 15 SW_N	Hour *C % * m s-1 mm W m-2 hPa W m-2	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation Soil heat flux Air pressure Net shortwave Global radiation	radiation		NA NA 2 m 2 m 2 m 1.5 m 5 cm depth 2 m 1.5 m	NA NA NA PT100 Rotronic Vector instruments A10 Vector Instruments W2 OTT Pluvio2 Campbell scientific: HF Vaisala PTB101B Kipp & Zonen CNR1	NA NA I minute 1 minute 01 M/L 1 minute 0.1 mm 13-L 1 minute 1 minute 1 minute		NA NA NA 1 minute values, 10 mi 1 minute values, 10 mi	All times are UTC +1 (always wintertime, rely) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2001 Data were flagged for gapfilling by applying vith vit 4.2.0.0.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.1.1 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.2.1 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.1.8 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.0 nute mean Data were calculated and not flagged Data were calculated and not flagged 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.4.0
17 TS_2_1 Soil temperature at 10 cm depth below bare soil - 0.10 m PT100 1 minute 1 minute values, 10 minute mean Data were flagged for gapfilling by and long vith vis 4.2.2.0.2	S TIMESTAM Year Month Day Hour TA TA_flag RH 6 2026+11 2018 5 25 0 13.5 1 7 2026+11 2018 5 25 1 13 1 8 2.026+11 2018 5 25 2 12.2 1 9 2026+11 2018 5 25 3 11.5 1 10 2.026+11 2018 5 25 4 11.2 1 11 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 5 12.2 1 12 2.026+11 2018 5 25 6 14.3 1	3 Year 4 Month 5 Day 6 Hourn 7 rA 8 RH 9 WD 10 WS 11 P 12 G 13 PA 14 VETRAD 15 SW2 16 TS_1_1	Hour *C % * ms-1 mm W m-2 hPa W m-2 W m-2 W m-2	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation Soil heat flux Air pressure Net shortwave Global radiation	radiation		NA NA 2 m 2 m 2 m 1.5 m 5 cm depth 2 m 1.5 m 1.5 m	NA NA NA PT100 Rotronic Vector instruments A11 Vector Insturments W2 OTT Pluvio2 Campbell scientific: HF Vaisala PTB101B Kipp & Zonen CNR1	NA NA NA 1 minute 1 minute 01 M/L 1 minute 0.1 mm T3-L 1 minute 1 minute 1 minute 1 minute		NA NA NA 1 minute values, 10 mi 1 minute values, 10 mi	All times are UTC +1 (always wintertime, rely) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.05.2001 bate were flagged for gapfilling by applying vith vit 4.2.0.1.0 04.05.2001 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.2.0 04.06.2001 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.2.0 04.06.2001 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.2.1 10.01 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.26 10.02 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.26 10.02 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.3.0 10.02 nute mean Data were calculated and not flagged 4.2.0.4.0 nute mean Data were calculated and not flagged 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vit 4.2.0.4.0 10.04
18 TS_2_2 *C *temperature at 30 cm depth below bare soil - 0.30 m PT100 1 minute 1 minute values, 10 minute mean Data were flagged for paetiming by applying vith vis 4.2.2.0.2	IMESTANYear Month Day Hour TA TA_flag RH 6 2026+11 2018 5 25 0 13.5 1 7 2.026+11 2018 5 25 1 13 1 88 2.026+11 2018 5 25 2 12.2 1 99 2.026+11 2018 5 25 3 11.5 1 04 2.026+11 2018 5 25 4 11.2 1 141 2.026+11 2018 5 25 5 12.2 1 122 0.2026+11 2018 5 25 5 12.2 1 122 0.2026+11 2018 5 25 6 14.3 1 FOULUM_20180525_2019123_HOURLY FOULUM_20180525_2019123_HOURLY	3 Year 4 Month 5 Day 6 Hour 7 A 8 RH 9 WD 10 WS 11 P 12 G 13 PA 14 NETRAD 15 SW2 16 TS_11 17 TS_21	Hour *C % * ms-1 mm W m-2 hPa W m-2 W m-2 W m-2	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation Soil heat flux Air pressure Solbal radiation Soil temperatur	radiation n re under grass	h below bare soil	NA NA 2 m 2 m 2 m 2 m 1.5 m 5 cm depth 2 m 1.5 m 1.5 m 1.5 m - 0.05 m	NA NA NA PT100 Rotronic Vector instruments A11 Vector Insturments W2 OTT Pluvio2 Campbell scientific: HF Vaisala PTB101B Kipp & Zonen CNR1 Kipp & Zonen CNR1 PT100	NA NA NA 1 minute 1 minute 01 M/L 1 minute 0.1 mm T3-L 1 minute 1 minute 1 minute 1 minute 1 minute		NA NA NA 1 minute values, 10 min 1 minute values, 10 min	All times are UTC +1 (always wintertim. elv) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 Data were flagged for gapfilling by applying vith vis 4.2.0.1.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.1.8 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.1.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.1.3 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean
19	IMESTANYear Month Day Hour TA TA_flag RH 6 2026+11 2018 5 25 0 13.5 1 7 2.026+11 2018 5 25 1 13 1 88 2.026+11 2018 5 25 2 12.2 1 99 2.026+11 2018 5 25 3 11.5 1 04 2.026+11 2018 5 25 4 11.2 1 141 2.026+11 2018 5 25 5 12.2 1 122 0.2026+11 2018 5 25 5 12.2 1 122 0.2026+11 2018 5 25 6 14.3 1 FOULUM_20180525_2019123_HOURLY FOULUM_20180525_2019123_HOURLY	3 Year 4 Month 5 Day 6 Hour 7 A 8 RH 9 WD 10 WS 11 P 12 G 13 PA 14 NETRAD 15 SW2 16 TS_11 17 TS_21	Hour *C % * m s-1 mm W m-2 hPa W m-2 W m-2 W m-2 * *	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation Soil heat flux Air pressure Net shortwave Global radiation Soil temperatur Soil temperatur	radiation n re under grass re at 10 cm depti		NA NA 2 m 2 m 2 m 2 m 1.5 m 5 cm depth 2 m 1.5 m 1.5 m 1.5 m - 0.05 m - 0.10 m	NA NA NA PT100 Rotronic Vector instruments A10 Vector Instruments W2 OTT Pluvio2 Campbell scientific: HF Vaisala PTB101B Kipp & Zonen CNR1 Kipp & Zonen CNR1 PT100 PT100	NA NA NA 1 minute 1 minute 00P 1 minute 0.1 mm T3-L 1 minute 1 minute 1 minute 1 minute 1 minute 1 minute 1 minute		NA NA NA I minute values, 10 mi 1 minute values, 10 mi	All times are UTC +1 (always wintertime, rely) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 Data were flagged for gapfilling by applying vith vis 4.2.0.0.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.1.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.2 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.7 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.0.2 nute mean
20 For WMO code tables. Grib code table FM_92 (Ver.23.0.0) see https://www.iwMOCodes/WMO306_v12/LatestVERSION/Latest	B5 TIMESTAN Year Month Day Hour TA TA_flag RH 62 2.026+11 2018 5 25 0 13.5 1 73 2.026+11 2018 5 25 1 13 1 88 2.026+11 2018 5 25 2 12.2 1 99 2.026+11 2018 5 25 3 11.5 1 04 2.026+11 2018 5 25 4 11.2 1 41 2.026+11 2018 5 25 5 12.2 1 42 2.026+11 2018 5 25 6 14.3 1 FOULUM_20180525_2019123_HOURLY	3 Year 4 Month 5 Day 6 Hourd 7 rA 8 RH 9 WD 10 WS 11 P 12 G 13 PA 14 NETRAD 15 SW_1 16 TS_1_1 17 TS_2_1 18 TS_2_2	Hour *C % * m s-1 mm W m-2 hPa W m-2 W m-2 W m-2 * *	Time (daily) Time (hourly) Air temperature Relative Humidi Wind direction Wind speed Precipitation Soil heat flux Air pressure Net shortwave Global radiation Soil temperatur Soil temperatur	radiation n re under grass re at 10 cm depti		NA NA 2 m 2 m 2 m 2 m 1.5 m 5 cm depth 2 m 1.5 m 1.5 m 1.5 m - 0.05 m - 0.10 m	NA NA NA PT100 Rotronic Vector instruments A10 Vector Instruments W2 OTT Pluvio2 Campbell scientific: HF Vaisala PTB101B Kipp & Zonen CNR1 Kipp & Zonen CNR1 PT100 PT100	NA NA NA 1 minute 1 minute 00P 1 minute 0.1 mm T3-L 1 minute 1 minute 1 minute 1 minute 1 minute 1 minute 1 minute		NA NA NA I minute values, 10 mi 1 minute values, 10 mi	All times are UTC +1 (always wintertime, rely) 04.04.2003 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 All times are UTC +1 (always wintertime only) 04.04.2002 Data were flagged for gapfilling by applying vith vis 4.2.0.0.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.1.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.1 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.2 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.3.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.4.0 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.7 nute mean Data were flagged for gapfilling by applying vith vis 4.2.0.2.0.2 nute mean
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