Thermodynamic Profiles from the SPARC AERI

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1. Data set overview

This dataset contains the retrieved thermodynamic profiles and single-layer liquid cloud properties as observed by the Atmospheric Emitted Radiance Interferometer (AERI). This particular dataset contains retrieved AERI profiles as obtained from the AERI mounted aboard the University of Wisconsin-Madison's Space Science and Engineering Center (SSEC) Portable Atmospheric Research Center (SPARC), a mobile, ground-based, in situ and remote observing platform. During the experiment, SPARC was deployed at many locations throughout the central United States. This dataset covers the entirety of the PECAN experiment, from 2 June – 16 July (in UTC).

Data collected from IOPs are from the following locations:

IOP1	2 June	39.186	-100.872	Oakley KS
IOP2	3 June	38.5536	-99.5657	McCracken KS
IOP3	4 June	39.2919	-96.8305	Rielly KS
IOP4	5 June	39.1966	-99.1587	Codell KS
IOP5	6 June	38.5803	-100.0687	Ness City KS
IOP6	8 June	37.809	-100.346	Cimarron KS
IOP7	10 June	38.5536	-99.5658	McCracken KS
IOP8	11 June	40.4824	-97.3877	Milligan NE
IOP9	12 June	37.524	-99.760	Kingsdown KS
IOP10	15 June	36.993	-98.653	2 km s Hartner NE
IOP11	17 June	40.533	-100.384	Stockville NE
IOP12	20 June	38.5535	-99.5658	McCracken KS
IOP13	22 June*	38.5535	-99.5658	KcCracken KS
IOP14	24 June	40.0112	-98.0582	Superior NE
IOP15	25 June*	41.0218	-95.2286	Red Oak IA
IOP16	26 June	37.8273	-96.2809	Eureka KS
IOP17	1 July	38.6857	-96.4927	Council Grove KS

IOP18	4 July	38.4883	-100.4664	Dighton KS
IOP19	5 July*	40.6873	-100.400	Moorefield NE
IOP20	6 July	43.1547	-97.7103	Scotland SD
IOP21	9 July	split deployment, participated in IOP22 instead		
IOP22	9 July	40.1329	-99.8334	Beaver City NE
IOP23	10 July	split deployment, participated in IOP24 instead		
IOP24	10 July	39.1105	-97.7154	Minneapolis KS
IOP25	11 July	39.3756	-99.7850	Hill City, KS
IOP26	12 July	did not participate due to repositioning		
IOP27	13 July	42.6401	-92.0384	Fairbank, IA
IOP28	14 July	did not participate due to repositioning		
IOP29	14 July	did not participate due to repositioning		
IOP30	15 July	38.4745	-100.8961	Scott City KS
IOP31	16 July	38.3623	-98.3308	Chase KS

* Dates with an asterisk had missions that actually started before 0000 UTC on the date listed. Therefore they officially began on the day before the listed date.

Beginning with the second week of the experiment, when SPARC was not on an official deployment, it was powered on and the AERI was collecting data while parked at the supplies garage on the northern edge of Hays, Kansas (approx. location: 38.9079, -99.3169).

Additional information about SPARC can be found at the system's web site: www.ssec.wisc.edu/sparc

2. Instrument description

AERI is a ground-based infrared radiometer that measures downwelling radiance over the spectral range of 550 to 3000 cm^{-1} with spectral resolution better than 1 cm^{-1}. A description of the instrument is found in Knuteson et al. (2004a) and Knuteson et al. (2004b). AERI radiances contain enough information to retrieve temperature and moisture profiles up to 3 km in above the instrument. The retrieval used in this dataset, AERIoe (Turner and Löhnert 2014) use an optimal estimation retrieval to obtain profiles of temperature and moisture as well as liquid cloud characteristics. Uncertainties for each measurement are also retrieved and included in the dataset.

3. Data collection and processing

The present dataset includes retrievals conducted on radiances that have been noise filtered using a principal component analysis (Turner et al 2006) and averaged over five-minute intervals. Data were processed using version 1.4 of the AERIoe retrieval, and LBLRTM 12.1 was used as the forward model for these calculations. Retrievals at the

native resolution of the instrument are possible on a case-by-case basis; consult T. Wagner directly using the contact information above.

A key input to the AERIoe algorithm is the cloud base height. This was obtained from thresholding the backscatter observed by a collocated Halo Photonics Doppler lidar wind profiler when it was in vertically-staring mode.

The retrieval uses an optimal estimation framework, so a full error covariance matrix of each solution is included in the output file. The 1-sigma uncertainty of each retrieved variable, which is derived from the error covariance matrix, is included for each scientific field and is named "sigma_X", where "X" is the name of the scientific field (e.g., 'temperature'). Note that there is also an overall "qc_flag" field that is set when a retrieval should not be trusted. (The preceeding paragraph comes from AERI thermodynamic profile readme files for the fixed PISA sites written by D. Turner).

4. Data format

Data are stored in netCDF format with one file representing one hour of observations. Since data have been averaged over 5 minute intervals, there are typically 12 observations in each file. The measurements of greatest scientific interest are:

temperature	Atmospheric temperature
waterVapor	Atmospheric water vapor
lwp	Liquid Water Path
lReff	Liquid water droplet effective radius

Much information is contained in the metadata within each netCDF file and users are encouraged to consult them for more details.

Files are named sparcaerioe.YYYYMMDD.hhmmss.cdf where YYYYMMDD is the date of the observation and hhmmss is the time of the first record in the file. All times are in UTC.

5. Data remarks

A hatch automatically closes to protect the instrument optics whenever precipitation is detected. Therefore, no radiances are observed and no retrievals are possible when rain is falling.

6. References

Knuteson, R. and coauthors, 2004a: Atmospheric Emitted Radiance Interferometer. Part I: Instrument design. *J. Atmos. Oceanic Technol.*, **21**, 1763–1776.

------- and coauthors, 2004b: Atmospheric Emitted Radiance Interferometer. Part II: Instrument performance. *J. Atmos. Oceanic Technol.*, **21**, 1777–1789.

Turner, D. D., R. O. Knuteson, H. E. Revercomb, C. Lo and R. G. Dedecker, 2006: Noise reduction of Atmospheric Emitted Radiance Interferometer (AERI) observations using principal component analysis. *J. Atmos. Oceanic Technol.*, **23**, 1223-1238.

--------- and U. Löhnert, 2014: Information content and uncertainties in thermodynamic profiles and liquid cloud properties retrieved from the ground-based Atmospheric Emitted Radiance Interferometer (AERI). J. Appl. Meteor. Clim., 53, 752-771