

## 1. PROJECT

Title: **Diagnosing Earth's Energy Pathways in the Climate system (DEEP-C)**

Dates: 2014 - 2017

Funding organisation: **NERC**

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## 2. DATASET

Reconstructions of the radiation fluxes at the top of atmosphere and net surface energy flux: DEEP-C Version 5.0

**Citation:** **Chunlei Liu** and **Richard P Allan** (2022) Reconstructions of the radiation fluxes at the top of atmosphere and net surface energy flux: DEEP-C Version 5.0. University of Reading. Dataset. <https://doi.org/10.17864/1947.000347>

**Description:** In order to study the energy flow in the climate system, the radiative fluxes (OLR: Outgoing Longwave Radiation, ASR: Absorbed Solar Radiation, NET: Net radiative flux) at the top of atmosphere (TOA) prior to the CERES (Clouds and the Earth's Radiant Energy System) period have been reconstructed using satellite observations of CERES v4.1 and ERBS WFOV v3.0 (Earth Radiation Budget Experiment Satellite wide field of view), atmospheric reanalysis (ERA5: the fifth generation ECMWF ReAnalysis) and AMIP6 (the sixth phase of the coupled model intercomparison project) model simulations (**Liu et al 2020**). The new approaches using the mass-corrected atmospheric energy divergencies (transports) and consistent enthalpy treatment of water substances from **Mayer et al (2017)** and **Mayer et al (2021)** are employed to estimate the net surface energy fluxes.

This is version 5.0 of the DEEP-C dataset created in 2022. CERES version 4.1 and ERBS WFOV version 3.0 are used. The TOA flux anomaly is constrained by WFOV anomaly in each 10 degree x 10 degree grid box. This is the updated version of previous studies (**Allan et al 2014; Liu et al 2015, 2017, 2020**).

The atmospheric energy transport is based on the new enthalpy treatment of water substances ([Mayer et al 2021](#)).

**Source(s):** [https://ceres.larc.nasa.gov/order\\_data.php](https://ceres.larc.nasa.gov/order_data.php)  
<http://www.ecmwf.int/en/research/climate-reanalysis/era-interim>.

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### 3. TERMS OF USE

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<https://creativecommons.org/licenses/by/4.0/>.

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### 4. CONTENTS

#### ***File listing:***

#### *TOA radiative fluxes:*

DEEP-C\_TOA\_OLR\_v5\_1985-2020.nc

DEEP-C\_TOA\_ASR\_v5\_1985-2020.nc

DEEP-C\_TOA\_NET\_v5\_1985-2020.nc

#### *Net surface energy flux:*

DEEP-C\_Fmass\_v5\_198501-201711.nc

#### ***Brief description:***

All files are in netcdf format. The downward net fluxes are defined as positive.

The TOA radiation fluxes are from January 1985 to July 2020.

The surface energy flux is the net energy flux from January 1985 to November 2017.

DEEP-C\_Fmass\_v5\_198501-201711.nc : as in version 4.0, the excess/deficit land surface fluxes are redistributed to the oceans zonally (using normal distribution weight in latitude direction).

#### ***Previous versions:***

Version 4: Liu, Chunlei and Allan, Richard (2020): Reconstructions of the radiation fluxes at the top of the atmosphere and net surface energy flux over 1985-2017 - DEEP-C Version 4.0. University of Reading. Dataset. <https://doi.org/10.17864/1947.271>

Version 3: Liu, Chunlei and Allan, Richard (2017): Reconstructions of the radiation fluxes at top of atmosphere and net surface energy flux in the period 1985-2015 from DEEP-C project. University of Reading. Dataset. <https://doi.org/10.17864/1947.111>

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## 5. METHOD and PROCESSING

*For detailed method, please see*

Allan, R.P., Liu, C., Loeb, N.G., Palmer, M.D., Roberts, M., Smith, D. and Vidale, P.-L. (2014), Changes in global net radiative imbalance 1985-2012. *Geophysical Research Letters*, 41 (15). pp. 5588-5597. ISSN 0094-8276 doi: [10.1002/2014GL060962](https://doi.org/10.1002/2014GL060962).

Liu, C., Allan, R.P., Berrisford, P., Mayer, M., Hyder, P., Loeb, N., Smith, D., Vidale, P.-L. and Edwards, J.M. (2015), Combining satellite observations and reanalysis energy transports to estimate global net surface energy fluxes 1985-2012. *Journal of Geophysical Research: Atmospheres*, 120 (18). pp. 9374-9389. ISSN 2169-8996 doi: [10.1002/2015JD023264](https://doi.org/10.1002/2015JD023264).

Liu, C., Allan, R. P., Mayer, M., Hyder, P., Loeb, N. G., Roberts, C. D., Valdivieso, M., Edwards, J. M. and Vidale, P. L. (2017) *Evaluation of satellite and reanalysis-based global net surface energy flux and uncertainty estimates*. *Journal of Geophysical Research: Atmospheres*, 122 (12). pp. 6250-6272. ISSN 2169-8996 doi: [10.1002/2017JD026616](https://doi.org/10.1002/2017JD026616)

Liu C RP Allan, M Mayer, P Hyder, D Desbruyeres, L Cheng, J Xu, F Xu and Y Zhang (2020) Variability in the global energy budget and transports 1985-2017, *Clim. Dyn.*, doi: [10.1007/s00382-020-05451-8](https://doi.org/10.1007/s00382-020-05451-8).

Mayer M, Haimberger L, Edwards JM, Hyder P (2017) Toward consistent diagnostics of the 626 coupled atmosphere and ocean energy budgets. *J Climate*, 30(22):9225-9246, doi: <https://doi.org/10.1175/JCLI-D-17-0137.1>

Mayer J, Mayer M, Haimberger L (2021) Consistency and Homogeneity of Atmospheric Energy, Moisture, and Mass Budgets in ERA5. *Journal of Climate*, doi: <https://doi.org/10.1175/JCLI-D-20-0676.1>, 34(10):3955–3974