Cloud_cci / Cloud_cci+

From global, long-term heritage data records to higher temporal and spatial scales of SEVIRI and SLSTR

Martin Stengel *(science lead) and the Cloud_cci+ project team*

Latest results using Cloud_cci long-term AVHRR-PMv3 data

Philipp, D., M. Stengel, and B. Ahrens, 2020: **Analyzing the Arctic Feedback Mechanism between Sea Ice and Low-Level Clouds Using 34 Years of Satellite Observations**. J. Climate, 33, 7479–7501, https://doi.org/10.1175/JCLI-D-19-0895.1.

This paper uses Cloud_cci cloud and radiation data and provides strong evidence for a positive cloud – sea-ice feedback with the capability to contribute to autumnal Arctic amplification.

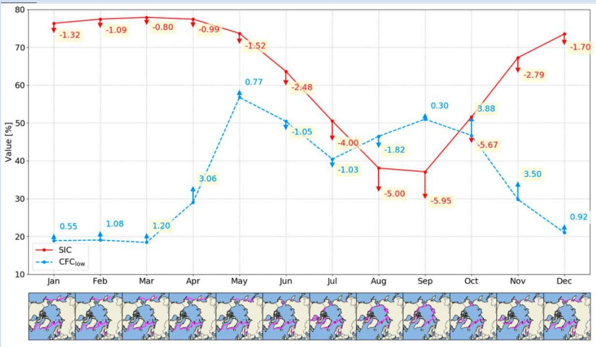


FIG. 3. Red and blue lines indicate Arctic SIC and CFC_{low} monthly mean annual cycle, respectively. Arrows on each data point represent monthly decadal trends. The value of the trend is given by the number next to the arrow. The unit of the trend is percent per decade. Yellowish shaded numbers are statistically significant. CFC_{low} is averaged over pixels within each month's 1982–90 median sea ice edge. Each month's 1982–90 median sea ice edge is shown by the magenta contour line in the maps below the line plot.

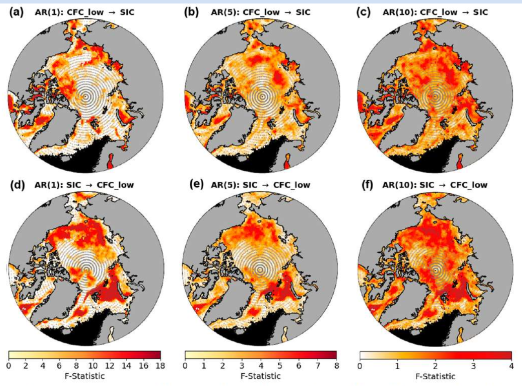


FIG. 10. Arctic year-round F statistics of GC tests for CFC_{low} and SIC. (top) Influence of CFC_{low} on SIC for an (a) AR(1), (b) AR(5), and (c) AR(10) model. (bottom) As in the top panels, but the influence of SIC on CFC_{low} is shown. Dotted areas mark statistically insignificant F statistics below a 95% level of confidence. Black shaded areas indicate where SIC was constant over the whole analysis period and thus no F statistic was calculated. Please note the different color bar ranges.

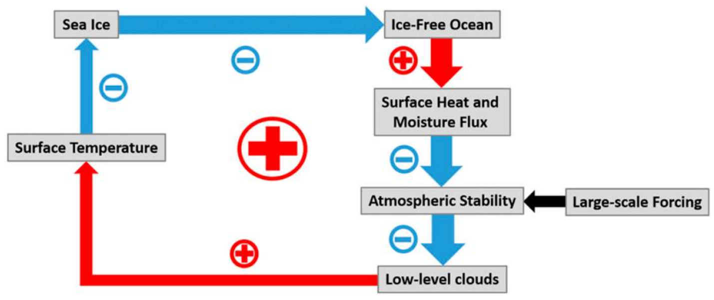


FIG. 14. Schematic diagram of the autumnal cloud–sea ice feedback mechanism. Blue arrows indicate negative influence (e.g., the smaller A is, the larger B is) and red arrows indicate positive influence (e.g. the smaller A is, the smaller B is). Black arrows indicate an external influencing factor. Wider arrows between the "sea ice" and "low-level clouds" box indicate that the influence of sea ice on low-level clouds is likely stronger than low-level clouds on sea ice (as discussed in section 4b).

Introduction to Cloud_cci+

ESA Cloud_cci+ was kicked of in March 2020. Cloud_cci will contribute to and improve on the successful efforts of Cloud_cci: the development, validation and application of novel cloud property data sets maximising the use of ESA and other European EO mission data and targeting the GCOS requirements for the Cloud ECV. The ultimate goal of the ESA Cloud_cci+ is the improvement of retrieval algorithms and processing concepts and implementations, and the development of two novel data sets based on measurements form the Spinning Enhances Visible and Infrared Imager (SEVIRI) and from Sea and Land Surface Temperature Radiometer (SLSTR). The processing systems will have the potential to be used for ensuring a sustainable provision of such data from operational entities through for instance the EUMETSAT SAF network and the Copernicus Climate Change Service after the initial R&D under the ESA CCI programme has been completed.

<u>In this context, the objectives of Cloud_cci+ are in brief:</u>

- Improvement of the Community Cloud Retrieval for Climate (CC4CL), a coherent physical retrieval framework for cloud properties which is an open community retrieval framework and publicly available and usable by all interested scientists;
- Optimizing the integration of new European capacities on cloud properties monitoring from Sentinel-3 (SLSTR), and well established geostationary EUMETSAT MSG (SEVIRI) capacities into the coherent physical retrieval framework;
- Exploiting the additional spectral information available from SEVIRI and SLSTR compared to the AVHRR heritage channels used previously in Cloud_cci;
- Extension and advancement of the currently available processing systems towards SLSTR and SEVIRI, also in the light of fit-for-purpose capabilities for future operational services;
- Development of two annual global(SLSTR)/regional(SEVIRI) data sets for the GCOS cloud property ECV including uncertainty estimates at all processing levels from Level-2 to Level-3;
- Validation of these cloud property products against space- and ground-based reference observations taking into account the individual error structures of the individual observations as far as possible;
- Development of simplified cloud-simulator package for SLSTR to strengthen the application of Cloud_cci products for global and regional climate model analysis;
- Contributing to cloud retrieval assessments conducted in the framework of International Cloud Working Group (ICWG);
- Intensify the link with climate modelling community by, among others, conducting two user case studies focussing on aerosol-cloud interaction and on cloud climate indices

<u>Focus of the further CC4CL development will be on:</u>

- Improvement of Cloud detection over snow and ice surfaces (e.g. in polar regions), in mountainous regions and in the presence of optically thin cirrus clouds
- Improvement of cloud phase determination and the detection of multi-layer cloud situations as knowledge of both aspects significantly impacts the subsequent retrieval of cloud properties
- Improvement of the uncertainty

<u>First examples:</u>

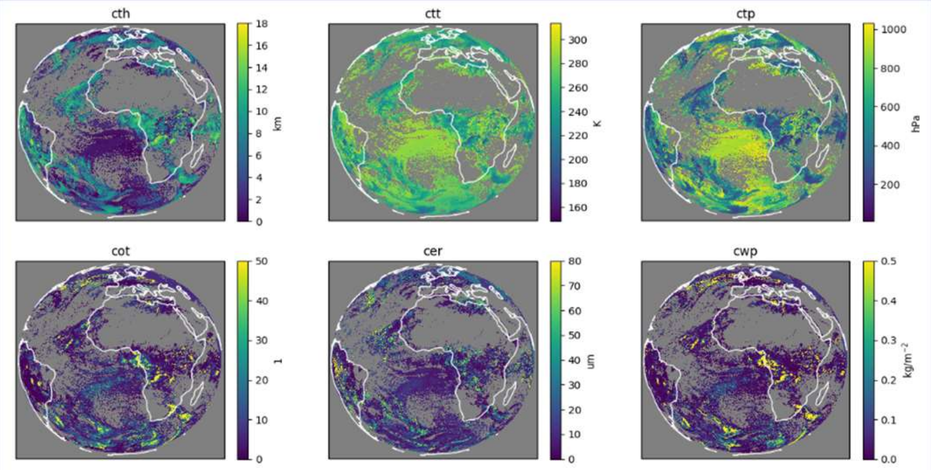
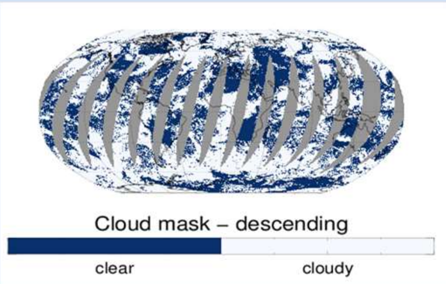


Figure: Examples for CC4CL applied to SEVIRI 2015/11/14 1200 UTC



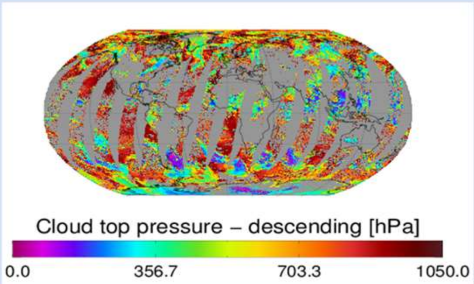


Figure: Examples for CC4CL applied to SLSTR: cloud mask L3U (left) and cloud top pressure (right) for 2017/08/22.

Project consortium

The project consortium of Cloud_cci+ consists of Deutscher Wetterdienst (DWD, lead), the Rutherford Appleton Laboratory (RAL) and the University of Oxford. The Project will cover three years and is expected to kick-off soon.

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RAL Space

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