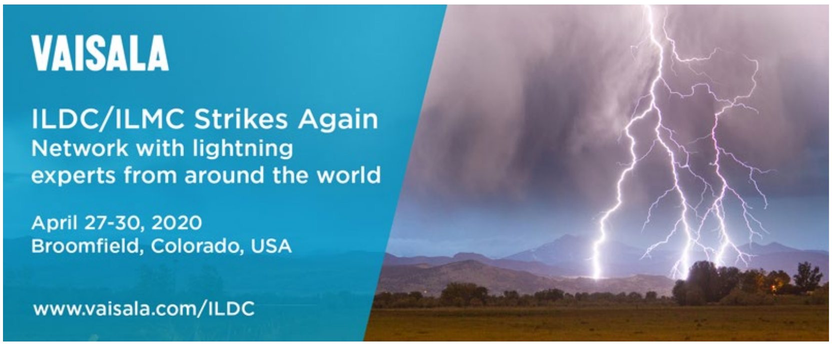

Lightning: An Essential Climate Variable and Community Perspective

Authors

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Abstract

Routine observations of lightning are commonplace worldwide and recent satellite instruments have further enhanced measurement coverage. Lightning can be used as a proxy for monitoring severe convection and precipitation, improving estimates of severe storm development, evolution and intensity, and hence provide early warnings for severe weather phenomena. In addition, lightning itself impacts the global climate by producing nitrogen oxides (NO_X), a strong greenhouse gas. In regard to climate variability and change monitoring, lightning has been shown to follow trends and extremes in convective storms (convective mode, flash rate, flash extent) and track global surface air temperature on many natural time scales (diurnal, semiannual, annual, ENSO). The global lightning recorded by the Lightning Imaging Sensor (Albrecht et al., 2016) has been shown to be statistically flat during the recent hiatus in global warming (Williams et al., 2019).

Due to this relevance and potential as a climate variable, lightning has been added to the list of Essential Climate Variables (ECV) in the 2016 Global Climate Observing System Implementation Plan (IP), including a first attempt to define the requirements for climate monitoring of lightning measurements (Aich et al., 2018). Action 29 of the IP called for defining "the requirement for lightning measurements, including data exchange, for climate monitoring and to encourage space agencies and operators of ground-based systems to strive for global coverage and reprocessing of existing datasets." A task-team on lightning observations for climate applications (TTLOCA) completed an initial study that summarizes the work done by TTLOCA and covers key aspects of lightning observations for climate applications (*WMO, 2019*). It explains the relevance of lightning observations, describes the current status of observations, discusses gaps and open research questions and provides suggestions for monitoring requirements for lightning, including metadata requirements. Recommendations are made with the intention that these recommendations will be considered for the respective WMO regulations. The task team is seeking all relevant data sets to address climate questions using information about lightning. We also seek proxy lightning data sets. For instance, we started an initiative to extend lightning data into the distant past (many decades) using "thunder day" data. Identifying these and related data sets (e.g., Schumann Resonances) with regional or global coverage is an important aspect for the task team. The task team has started to address the detailed questions of who will archive these data and who should be offered access. Some of the data are naturally in the public domain, but most of the ground-based lightning network data are privately owned, sold commercially, and copyrighted. In this presentation on behalf of the task team we present a summary of our findings and discuss next steps.

Aich, V., R. Holzworth, S. J. Goodman, Y. Kuleshov, C. Price, and E. Williams (2018), Lightning: A new essential climate variable, Eos, 99, https://doi.org/10.1029/2018EO104583. Published on 07 September 2018.

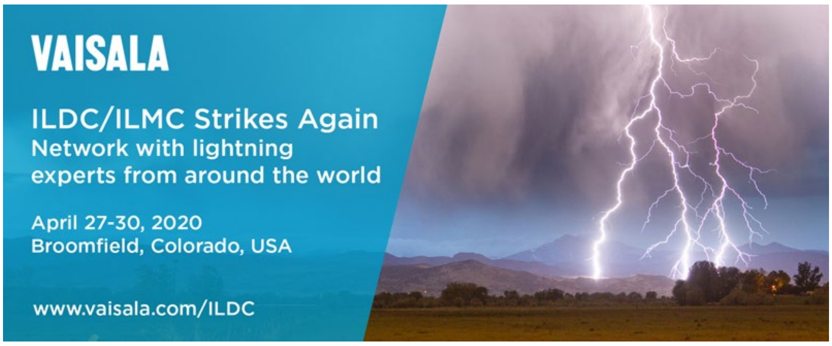
Albrecht, R. I., Steven J. Goodman, Dennis E. Buechler, Richard J. Blakeslee, and Hugh J. Christian, 2016: Where are the lightning hotspots on Earth?, Bull. Am. Meteor. Soc., http://dx.doi.org/10.1175/BAMS-D-14-00193.1.

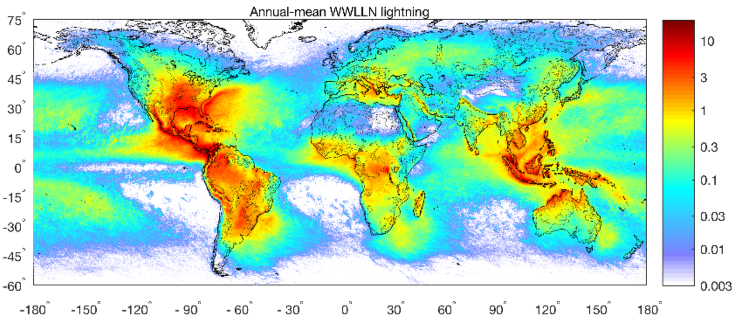
Williams, E. A. Guha, R. Boldi, H. Christian, and D. Buechler, 2019: Global lightning activity and the hiatus in global warming, J. ASTP, 189, 27-34, https://doi.org/10.1016/j.jastp.2019.03.011

WMO, 2019. Lightning for Climate A Study by the Task Team on Lightning Observation for Climate Applications (TT-LOCA) Of the Atmospheric Observation Panel for Climate (AOPC), GCOS-227, 56 pp.

Attachments

wwlln_annual.highRes_from_Bob.png





Albrecht_Fig_BAMS_Hot_Spots.png

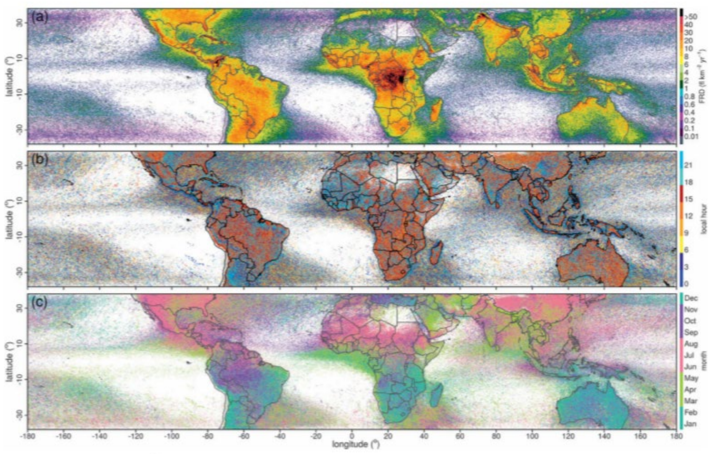


Fig. 1. Very high horizontal (0.1°) resolution total lightning climatology from 16 years (1998–2013) of TRMM LIS total lightning observations: (a) FRD (fl km^{-2} yr^{-1}), (b) local hour of maximum FRD, and (c) month of maximum FRD. Data shown for the latitude band of ±38°.

Williams_et_al_JASTP_2019.png

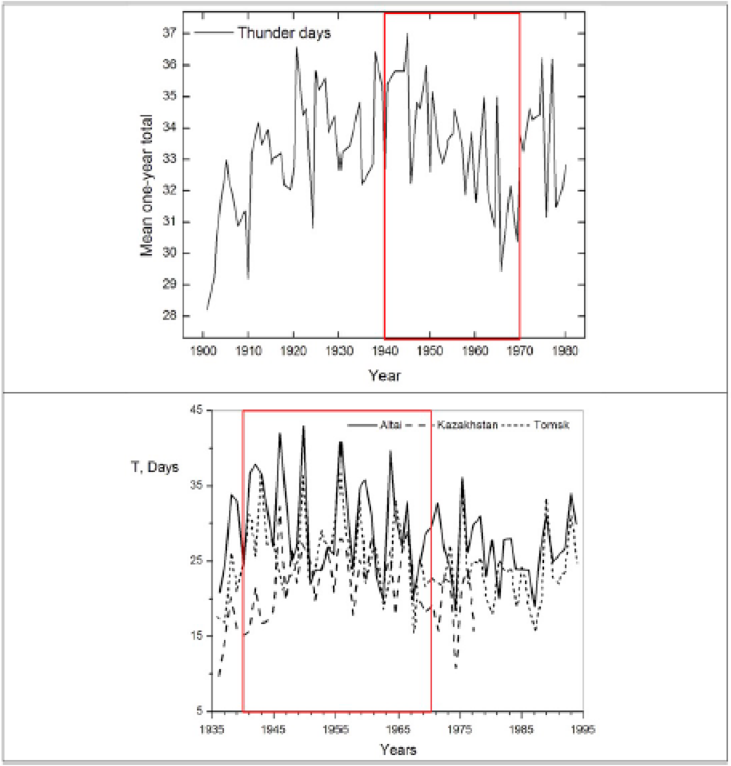


Fig. 2. Trends in thunder days during the "big hiatus" in global warming from 1940 to 1972 (red boxed), including analysis for North America by Changnon and Hsu (1984) (top) and for Siberia by Gorbatenko and Dulzon (2001) (bottom).

Topic Areas

Lightning Climatology

Submission Format

Oral