Neue Studie: Der jüngste „beispiellose" Rückgang der Wolkendecke treibt den Klimawandel der Gegenwart (und der Vergangenheit)

geschrieben von Chris Frey | 29. März 2025

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„Der Anstieg der absorbierten Sonnenstrahlung ist in erster Linie auf natürliche Schwankungen der Bewölkung und der Oberflächenalbedo zurückzuführen, die in den letzten zwei Jahrzehnten die Hauptantriebsfaktoren für den Energiefluss über der Atmosphäre waren." – Diodato et al., 2025

Es wird allgemein angenommen, dass die von Satelliten beobachtete (CERES) Verringerung der Albedo der Wolkendecke zu einem Anstieg der von den Ozeanen der Erde absorbierten Sonnenstrahlung geführt hat. Dieser zunehmende Trend der absorbierten Sonnenstrahlung (ASR) erklärt den globalen Temperaturanstieg nach 2000 (Dübal und Vahrenholt, 2021; Loeb et al., 2021; Stephens et al., 2022; Koutsoyiannis et al., 2023; Loeb et al., 2024; Nikolov und Zeller, 2024).

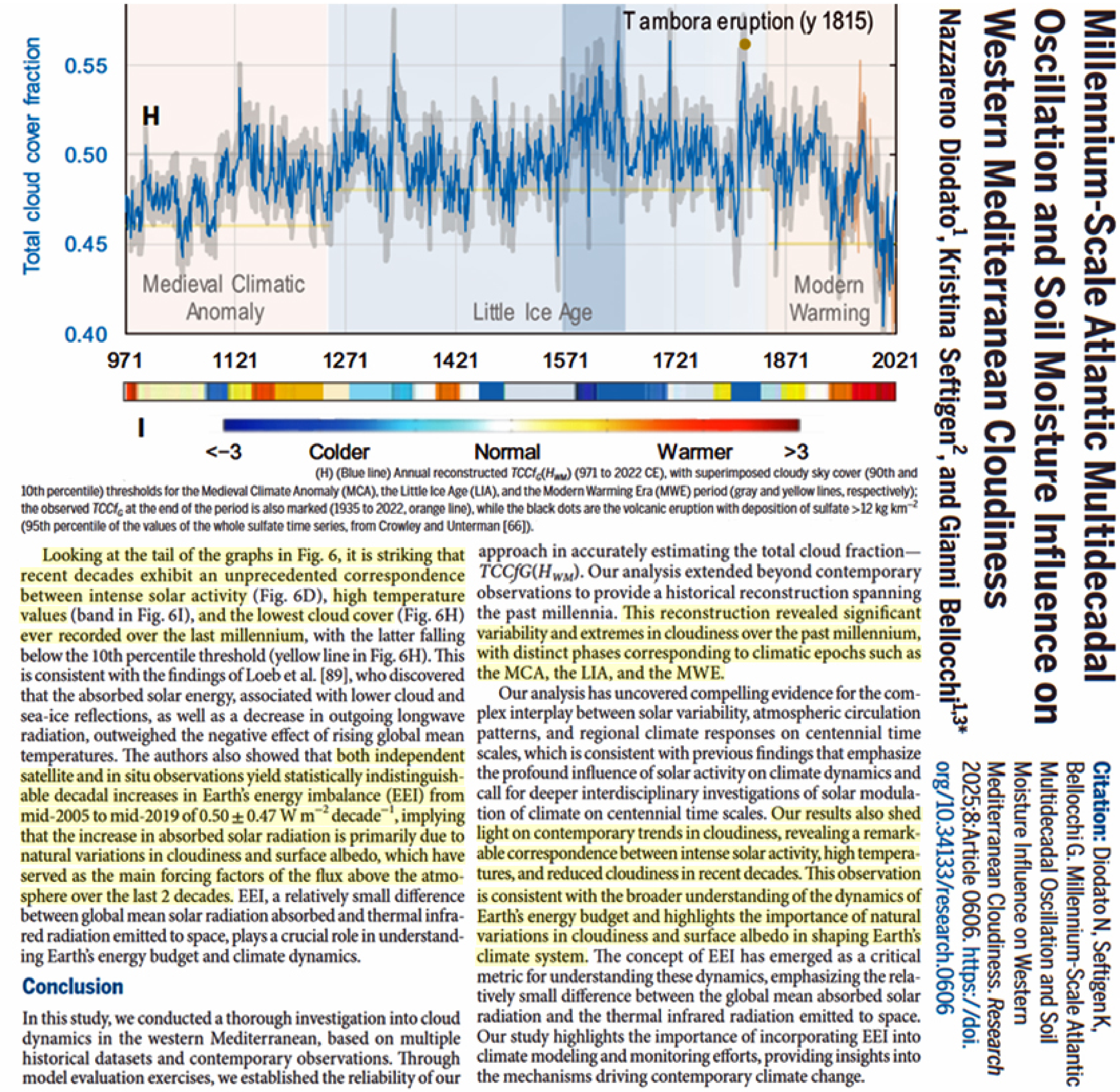
Und nun haben Wissenschaftler in zwei neuen Studien (Diodato et al., 2024 und Diodato et al., 2025) damit begonnen, Rekonstruktionen der Wolkenbedeckung über dem Mittelmeerraum zu erstellen, die sich bis in die mittelalterliche Warmzeit (970 n. Chr.) zurückverfolgen lassen.

Die Autoren weisen darauf hin, dass ihre Rekonstruktionen der Wolkenbedeckung möglicherweise nicht nur für diese Region repräsentativ sind, da sie ein Produkt großräumiger Prozesse sind, die „über geografische Grenzen hinausgehen". Mit anderen Worten: Was in der Mittelmeerregion geschieht, kann durchaus globale Auswirkungen haben.

Ihre Rekonstruktionen deuten darauf hin, dass der moderne Trend der abnehmenden Bewölkung nicht erst seit dem Jahr 2000 zu beobachten ist, sondern mit Ausnahme eines kurzen Anstiegs zwischen 1945 und 1980 (der mit einem globalen Abkühlungstrend zusammenfiel) bereits seit über 200 Jahren anhält. Der „Wendepunkt" war 1815-1818, nach dem Ausbruch des Mount Tambora. Seit diesem Zeitpunkt ist die Bewölkung sprunghaft zurückgegangen, was von der mehrdekadischen Variabilität abweicht.

Die Autoren schlagen vor, dass zu den „dominanten" Faktoren, die mit dem Erwärmungstrend nach 1800 in Verbindung stehen, der solare Antrieb, der vulkanische Antrieb und die mehrdekadische atlantische Oszillation gehören (Diodato et al., 2024).

Mit anderen Worten, die heutige Erwärmung sowie die Klimaveränderungen der Vergangenheit sind möglicherweise „in erster Linie auf natürliche Schwankungen der Bewölkung und der Oberflächenalbedo zurückzuführen, die als Hauptantriebsfaktoren dienten“ (Diodato et al., 2025).



Millennium-Scale Atlantic Multidecadal Oscillation and Soil Moisture Influence on Western Mediterranean Cloudiness

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(H) (Blue line) Annual reconstructed $TCCf_G(H_{WM})$ (971 to 2022 CE), with superimposed cloudy sky cover (90th and 10th percentile) thresholds for the Medieval Climate Anomaly (MCA), the Little Ice Age (LIA), and the Modern Warming Era (MWE) period (gray and yellow lines, respectively); the observed $TCCf_G$ at the end of the period is also marked (1935 to 2022, orange line), while the black dots are the volcanic eruption with deposition of sulfate >12 kg km^{-2} (95th percentile of the values of the whole sulfate time series, from Crowley and Unterman [66]).

Looking at the tail of the graphs in Fig. 6, it is striking that recent decades exhibit an unprecedented correspondence between intense solar activity (Fig. 6D), high temperature values (band in Fig. 6I), and the lowest cloud cover (Fig. 6H) ever recorded over the last millennium, with the latter falling below the 10th percentile threshold (yellow line in Fig. 6H). This is consistent with the findings of Loeb et al. [89], who discovered that the absorbed solar energy, associated with lower cloud and sea-ice reflections, as well as a decrease in outgoing longwave radiation, outweighed the negative effect of rising global mean temperatures. The authors also showed that both independent satellite and in situ observations yield statistically indistinguishable decadal increases in Earth's energy imbalance (EEI) from mid-2005 to mid-2019 of 0.50 ± 0.47 W m^{-2} decade^{-1}, implying that the increase in absorbed solar radiation is primarily due to natural variations in cloudiness and surface albedo, which have served as the main forcing factors of the flux above the atmosphere over the last 2 decades. EEI, a relatively small difference between global mean solar radiation absorbed and thermal infrared radiation emitted to space, plays a crucial role in understanding Earth's energy budget and climate dynamics.

Conclusion

In this study, we conducted a thorough investigation into cloud dynamics in the western Mediterranean, based on multiple historical datasets and contemporary observations. Through model evaluation exercises, we established the reliability of our approach in accurately estimating the total cloud fraction—$TCCfG(H_{WM})$. Our analysis extended beyond contemporary observations to provide a historical reconstruction spanning the past millennia. This reconstruction revealed significant variability and extremes in cloudiness over the past millennium, with distinct phases corresponding to climatic epochs such as the MCA, the LIA, and the MWE.

Our analysis has uncovered compelling evidence for the complex interplay between solar variability, atmospheric circulation patterns, and regional climate responses on centennial time scales, which is consistent with previous findings that emphasize the profound influence of solar activity on climate dynamics and call for deeper interdisciplinary investigations of solar modulation of climate on centennial time scales. Our results also shed light on contemporary trends in cloudiness, revealing a remarkable correspondence between intense solar activity, high temperatures, and reduced cloudiness in recent decades. This observation is consistent with the broader understanding of the dynamics of Earth's energy budget and highlights the importance of natural variations in cloudiness and surface albedo in shaping Earth's climate system. The concept of EEI has emerged as a critical metric for understanding these dynamics, emphasizing the relatively small difference between the global mean absorbed solar radiation and the thermal infrared radiation emitted to space. Our study highlights the importance of incorporating EEI into climate modeling and monitoring efforts, providing insights into the mechanisms driving contemporary climate change.

Quelle: Diodato et al., 2025

Ocean-Land-Atmosphere Research

Downward Mediterranean Cloudiness Beyond Little Ice Age Background Variability

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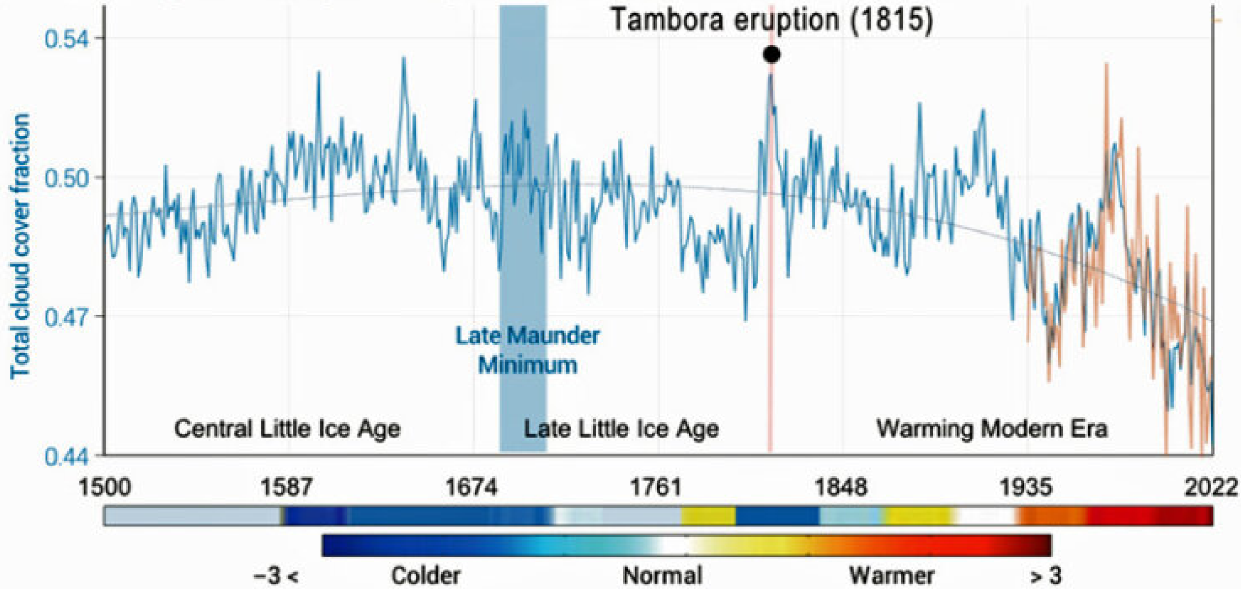
Following the eruption of Mount Tambora in 1815 (Fig. 6D, black dot) and the subsequent year (1816), the time series demonstrates a noticeable second peak in $TCCf_G$. Our study, drawing parallels with reanalysis and satellite-based machine learning studies, underscored the legacy of this eruption: an approximate 10% rise in cloud cover [3], entwined with positive PDSI anomalies (Fig. 6A and B). It is at this juncture that our study charted an unprecedented course, identifying a change point in 1818 (Fig. 6C, red arrow), a point of departure that reconfigured multidecadal variability, heralding an irreversible decline in cloudiness (Fig. 6D). This shift in cloud cover reflected the decrease in cloudiness evident in the post-1850 Neuberger painting sample (in Germany) [56]. In addition, its variability demonstrated uninterrupted growth, surging beyond the background of the LIA (Fig. 6C). Specifically, the reduction in cloudiness exhibited statistical significance with a decreasing Mann–Kendall test trend (S: −807, Z: 8.66, $P \sim 0.00$), whereas the enhancement of its variability displayed significance with an increasing trend (S: 748, Z: 8.41, $P \sim 0.00$). This divergence corresponded to an initial gradual increase in AMO and solar activity. Subsequently, with the advent of the 20th century, the AMO surged into a positive phase (Fig. 6F), accompanied by a significant rise in solar forcing (Fig. 6F) and temperatures (Fig. 6E). This combination of factors likely contributed to a substantial decrease in cloud cover in the Mediterranean area during the MWE. This phenomenon is evident through the interpolation of the annual $TCCf_G$ data with a third-order polynomial line (Fig. 6D, line with small blue dots). This profound interaction, especially evident after the 1818 change point, was a hallmark of our study and echoed similar findings [64], indicating the dominant roles of external forces—volcanic, solar, and oceanic—in their mutual influence after the LIA.

As the 20th century unfolded, a crescendo of influences emerged, shaping cloud cover across the Mediterranean. These forces not only shaped cloud cover across the entire Mediterranean expanse but also imprinted their signature on specific locales. The mean $TCCf_G$, averaged by our model for the Mediterranean warming era, aligned with historical cloudiness assessments for Greece from 1882 to 2012 [30], which observed a reduction in stratiform low clouds during winter. Moreover, the accelerated trend of $TCCf_G$ in recent decades concurred with the data reported for Montenegro (Balkan peninsula) [65], as well as with negative trends indicated for the Chinese mainland [66]. In addition, Sfîcă et al. [67] supported a similar negative trend across Europe, attributing this decline to an increase in circulation types related to the establishment of high-pressure centers in the central and northern parts of the European continent. In particular, Manara et al. [68] referred to a reduction of the $TCCf_G$ over the central Mediterranean region in decadal time-scale variability from 1951 to 2018, claiming that the origins of this trend are primarily associated with large-scale factors rather than local-scale changes.

The reconstruction of the cloudiness time series contributes to a comprehensive representation of the Mediterranean region, providing valuable insights into long-term variability and advancing our understanding of regional cloud cover dynamics. Moreover, our study's broader implications extend beyond the Mediterranean region. The cloud–climate interactions revealed by our findings transcend geographical boundaries. The implications of our study extend far beyond the Mediterranean, contributing to a foundational understanding of cloud variability on a global scale. This understanding is imperative for advancing climate science and refining climate models, ultimately leading to more accurate predictions of Earth's future climate scenarios.

In conclusion, our study highlighted the need to improve our understanding of the interactions between climate forces and cloudiness, emphasizing key drivers such as summer precipitation, PDSI, and their interplay with cloudiness and shifts in the AMO. The identified change point in multidecadal variability signaled a subsequent decline in cloudiness since 1818, consistent with concurrent increases in temperature, AMO, solar forcing, and geopotential height of 500 hPa. This intricate link between cloud dynamics and broader climate shifts warrants further investigation to unravel this connection over centuries.



Quelle: [Diodato et al., 2024](https://doi.org/10.34133/olar.0053)Link: https://notrickszone.com/2025/03/25/new-study-recent-unprecedented-cloud-cover-decline-driving-modern-and-past-climate-change/

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