Text S1: Inclusion and Exclusion Criteria

All articles that addressed the presence of LD and evaluated the impact of environmental factors in LD in the EU/EEA were included. We included both EU and EEA countries because they share common meteorological and environmental features and report surveillance outcomes to the ECDC. The PRISMA guideline steps were followed, specifying the reasons for exclusion [16]. A registry was kept, identifying each study as included or excluded and the exclusion reason. Duplicates were removed. We only included original research studies. Studies that did not assess the impact of environmental factors on LD in humans, hosts or its vectors or were carried out outside the EU/EEA were excluded (supplementary Table 1).

The recovered abstracts were read by two researchers independently (double peer review), and inclusion/exclusion criteria were applied to produce the final list of publications to be read in full text. During the second filtering, those articles that did not fit the inclusion criteria were also excluded. If there were uncertainties whether to include a study, a third reviewer assessed if the article should be included or not. To assess the inclusion or exclusion the following questions were answered as yes, no or uncertain:

1. Does the study address the study area?
2. Does the study address LD?
3. Does the study consider meteorological, environmental or climate change factors?
4. Does the study assess the relationship between LD and meteorological, environmental or climate change factors?

The reference was discarded when the answer to any question was "no".

Text S2: Search Strategy

Two main reviewers searched for indexed articles published in the PubMed, Scopus, Embase and CENTRAL databases and published between 01/01/2000 and 31/12/2022. The search was performed in Spanish, English, French, Italian, German and Portuguese.

We also cross-checked the reference list of all included articles for relevant studies.

Our study area was the EU/EEA. Articles needed to refer to the presence of LD and/or its vectors and present data regarding meteorological, environmental or climate change variables (from this point on, environmental factors). All databases were searched for original articles.

The following search terms were screened in title, abstract and keywords using the AND Boolean logic operator and using the option 'title/abstract':

1. (Lyme OR lyme borreliosis OR Borrelia burgdorferi OR Borrelia burgdorferi infection OR lyme infection OR Borrelia mayonii OR Borrelia afzelii OR Borrelia garinii OR Borrelia bavariensis OR Borrelia spielmanii OR Borrelia lusitaniae OR Borrelia mayonii infection OR Borrelia afzelii infection OR Borrelia garinii infection OR Borrelia bavariensis infection OR Borrelia spielmanii infection OR Borrelia lusitaniae infection OR borreliosis OR borreliosis infection OR neuroborreliosis) AND

2. (climat* OR environment* OR temperature OR warm* OR meteo* OR rainfall OR humidity OR altitude OR drought OR flood OR habitat OR landscape use OR land use OR climate change OR meteorological) AND
3. (Austria OR Belgium OR Bulgaria OR Croatia OR Cyprus OR Czech Republic OR Denmark OR Estonia OR Finland OR France OR Germany OR Greece OR Hungary OR Iceland OR Ireland OR Italy OR Latvia OR Liechtenstein OR Lithuania OR Luxembourg OR Malta OR Netherlands OR Norway OR Poland OR Portugal OR Romania OR Slovakia OR Slovenia OR Spain OR Sweden OR Europe OR European Union).

Supplementary figures

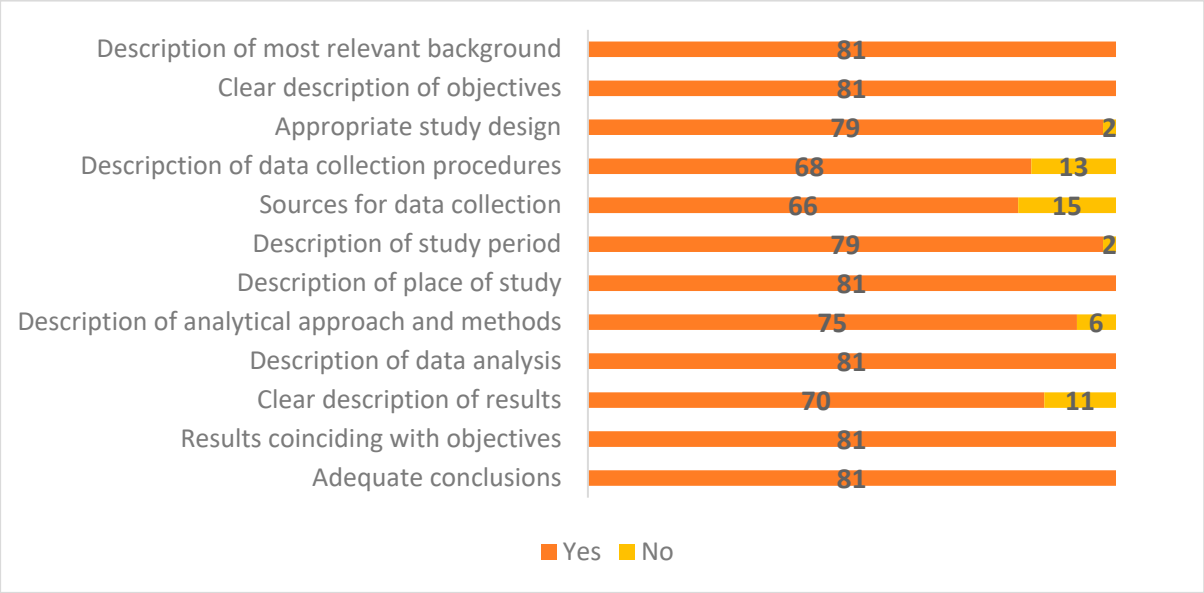

Figure S1. Scored points in quality assessment (n=81).

Supplementary tables

Table S1. Eligibility criteria

Inclusion criteria	**Exclusion criteria**
Original research studies	Other type of study
Studies must refer to LD in humans, hosts or its vectors and analyze the impact of environmental and meteorological factors or climate change	Not assessing the impact of environmental and meteorological factors or climate change on LD
Published between 01/01/2000 and 31/12/2022	Published before 01/01/2000 or after 31/12/2022

Languages: English, French, Portuguese, Italian, German and Spanish	Not addressing any of the included countries or regions

Table S2. Definition of analyzed variables.

Variable	**Definition**
Meteorological	
Temperature	A physical quantity that quantitatively expresses the perceptions of hotness and coldness.
Precipitation	Any liquid or frozen water that forms in the atmosphere and falls back to Earth.
Humidity	The amount of water vapor in the air.
NDWI	A remote sensing-derived index related to liquid water.
Wind	The movement of air caused by the uneven heating of the Earth by the sun and the Earth's own rotation.
NAO	A cyclical meteorological phenomenon over the North Atlantic Ocean of fluctuations in the difference of atmospheric pressure at sea level between the Icelandic Low and the Azores High.
Daylight	The natural light of the day.
Altitude/Elevation	The height of a point in relation to sea level or ground level.
Saturation deficit	Index which describes the functional relationship between saturation vapour pressure, temperature and relative humidity and thus provides an integrated measure of the drying power of the atmosphere.
Soil	The upper layer of earth in which plants grow, typically consisting of a mixture of organic remains, clay and rock particles.
Environmental	
Land use	How people are using the land.
Land cover	The physical land type such as forest or open water.
Vegetation	Plants considered collectively, especially those found in a particular area or habitat.
EVI	Index which is used to quantify vegetation, forest density and extension.
NDVI	Index which is used to quantify vegetation, forest density and extension.
Climate change	
Climate change	Long-term shifts in temperatures and weather patterns.
Emissions	The production and discharge of gas or radiation.

Pollution	The presence in or introduction into the environment of a substance which has harmful or poisonous effects.
Disease	
Human population density & exposure	A measurement of human population per unit land area.
Human LD infection	Confirmed human LD cases.
Animal host population density	A measurement of animal host population per unit land area.
Vector population density	A measurement of vector population per unit land area.

EVI: enhanced vegetation index; LD: Lyme disease; NAO: North Atlantic Oscillation; NDVI: normalized difference vegetation index; NDWI: normalized difference water index. Source: World Meteorological Organization (2023) [117].

Table S3. Effect of different environmental variables on vectors

Variable	**Country/Region**	**Vector density**	**Vector expansion**	**Other: tick bites, vector infection**	**Vector species**
Temperature	Belgium [27,41,54,55], Czech Republic [28–30,32,33,78], Denmark [35,37–39], Estonia [54,55], Europe [40,43], Finland [44], France [15,46–49,51,54,55], Germany [54–57,59–67,78], Hungary [78], Italy [72,75–78], Netherlands [79,80], Norway [38,39,81], Poland [83–85], Romania [86], Slovakia [78,87,88], Slovenia [90], Spain [91–94], Sweden [38,39,54,55]	Increase [15,27–30,32,33,35,37–41,43,44,46,47,49,57,59–66,72,75,77,80,81,84,85,87,90,91,93,94]	Increase [40,43,57]	Increased tick bites [79]	*D. reticulatus* [33,59], *H. concinna* [33], *H. punctata* [94], *I. frontalis* [67], *I. hexagonus* [67], *I. inopinatus* [67], *I. persulcatus* [44], *I. ricinus* [15,27–30,32,33,35,37–41,43,44,46–49,51,54–57,60–67,72,75–78,80,81,83–88,90–94], tick bites [79]
Precipitation	Belgium [27,41,54,55], Czech Republic [28–30,33,78], Denmark [37–39], Estonia [54,55], Europe [40], Finland [44], France [15,49,54,55], Germany [54–56,63,64,66,78], Hungary [78], Italy [75–78], Netherlands [79], Norway [38,78], Poland [85], Romania	Increase [40,91]; Decrease [28–30,37,44,49,63,64,79,86,91,94]	Increase [40]	Decreased tick bites [79]	*D. reticulatus* [33], *H. concinna* [33], *H. punctata* [94], *I. persulcatus* [44], *I. ricinus* [15,27–30,33,37–41,44,49,54–56,63,64,66,75–78,85,86,88,90,91,94], tick bites [79]

	[86], Slovakia [78,88], Slovenia [90], Spain [91,94], Sweden [38,39,54,55]				
Humidity	Belgium [21,27,41], Czech Republic [30,32,33,78], Denmark [36], Finland [44], France [15,47,48,51,52], Germany [57,59–65,67,78], Hungary [78], Italy [72,75–78], Netherlands [79,80], Norway [81], Poland [83–85], Slovakia [78,87,88], Slovenia [90], Spain [91,94], Sweden [96]	Decrease [91]; Increase [15,27,32,33,36,41,44,47,51,52,57,59,60,62–64,80,83–85,87,94,96]	Increase [57]	Not assessed	*D. reticulatus* [33,59], *H. concinna* [33], *H. punctata* [94], *I. frontalis* [67], *I. hexagonus* [67], *I. inopinatus* [67], *I. persulcatus* [44], *I. ricinus* [15,21,27,30,32,33,36,41,44,47,48,51,52,57,60–65,67,75–78,80,81,83–85,87,88,90,91,94,96], tick bites [79]
Wind	Belgium [41], Czech Republic [33], Germany [65], Poland [85]	Increase [41]	Not assessed	Not assessed	*D. reticulatus* [33], *H. concinna* [33], *I. ricinus* [33,41,65,85]
Saturation deficit	France [47,48,52], Germany [61,67], Italy [77], Poland [85], Slovakia [88], Slovenia [90]	Decrease [47,52,77,85,88,90]	Not assessed	Not assessed	*I. frontalis* [67], *I. hexagonus* [67], *I. inopinatus* [67], *I. ricinus* [47,48,52,61,67,77,85,88,90]
Land use and land cover	Belgium [21,24,27,41,54,55], Czech Republic [28,29,78], Denmark [37,39], Estonia [54,55], Finland [44], France [47,48,50–55], Germany [54,55,58,61,62,64–67,78], Hungary [70,78], Italy [71,73,78], Netherlands [79], Norway [39], Poland [84,85], Romania [86], Slovakia [78], Spain [91,92,94], Sweden [39,54,55,96,97,99]	Increase [24,28,29,37,41,48,50–55,58,61,62,65,67,70,71,73,84,86,92,94,96,97,99]; Decrease [28,66,92]	Increase [71]	Increased tick bites [79], increased vector infection [58]	*D. marginatus* [70,71], *D. reticulatus* [70], *H. concinna* [70], *H. inermis* [70], *H. punctata* [94], *I. frontalis* [67], *I. hexagonus* [67], *I. inopinatus* [67], *I. persulcatus* [44], *I. ricinus* [21,24,27–29,37,39,41,44,47,48,50–55,58,61,62,64–67,70,71,73,78,84–86,91,92,94,96,97,99], tick bites [79]
Vegetation and NDVI	Belgium [21,24,27], Czech Republic [28,78], Denmark [38,39], Europe [43], Finland [44], France [15,50,53], Germany [78], Hungary [78], Italy [75,76,78], Netherlands [79,80], Norway [38,39],	Increase [15,24,27,38,39,43,76,78,80,91,93,97]; Decrease [28,75]	Not assessed	Not assessed	*I. persulcatus* [44], *I. ricinus* [15,21,24,27,28,38,39,43,44,50,53,75,76,78,80,91–93,97], tick bites [79]

	Slovakia [78], Spain [91–93], Sweden [38,39,97]				
Soil	Belgium [54,55], Czech Republic [28], Denmark [38,39], Estonia [54,55], Finland [44], France [15,47,48,51,54,55], Germany [54,55,62], Italy [73], Netherlands [79], Norway [38,39], Sweden [38,39,54,55]	Increase [47,48,62,73]	Not assessed	Not assessed	*I. persulcatus* [44], *I. ricinus* [15,28,38,39,47,48,51,54,55,62,73], tick bites [79]
Daylight	Czech Republic [32], Denmark [35,39], Finland [44], France [15,47], Germany [64,65,67], Netherlands [80], Norway [39], Poland [85], Spain [94], Sweden [39]	Increase [32,35,39,44,64,80,85]	Not assessed	Not assessed	*H. punctata* [94], *I. frontalis* [67], *I. hexagonus* [67], *I. inopinatus* [67], *I. persulcatus* [44], *I. ricinus* [15,32,35,39,44,47,64,65,80,85,94]
Altitude/Elevation	Czech Republic [29], Denmark [38,39], Finland [44], France [15,47], Germany [61], Italy [71,73,75], Norway [38,39,81], Romania [86], Slovakia [88], Spain [94], Sweden [38,39]	Decrease [73,81,88]; Increase [29,39,47,61,71,75,94]	Increase [71]	Not assessed	*D. marginatus* [71], *H. punctata* [94], *I. persulcatus* [44], *I. ricinus* [15,29,38,39,44,47,61,71,73,75,78,81,86,88,94]
Human population density and exposure	Denmark [37], Europe [40], Finland [44], Netherlands [79], Norway [38], Spain [94], Sweden [38]	Increase [40,79]	Not assessed	Increased tick bite [79]	*I. persulcatus* [44], *I. ricinus* [37,38,40,44,94], tick bites [79]
Human LD infection	Czech Republic [30], Denmark [35–37], Netherlands [80], Poland [83]	Increase [36]	Not assessed	Not assessed	*I. ricinus* [30,35–37,80,83]
Animal host population density	Belgium [21,27], Denmark [35,36], Finland [44], France [48,50,53], Germany [56,60], Italy [71–73,75,77], Netherlands [80], Slovakia [88], Spain [91,94], Sweden [96]	Increase [21,35,36,44,48,50,53,71–73,75,77,80,91,94,96]	Not assessed	Not assessed	*D. marginatus* [71], *H. punctata* [94], *I. persulcatus* [44], *I. ricinus* [21,27,35,36,44,48,50,53,56,60,71–73,75,77,80,88,91,94,96]
Others	Europe [40], Poland [83], Sweden [97]	Increase [40,97]	Increase [40,97]	Not assessed	*I. ricinus* [40,83,97]

NDVI: normalized difference vegetation index.

Table S4. Effect of different environmental variables on LD in human hosts

Variable	Country/Region	Effect on LD incidence	Effect on LD prevalence	Effect on LD expansion	LD measure (Case/Seroprevalence)
Temperature	Belgium [23], Czech Republic [30,31], Hungary [68,69], Sweden [95,98]	Increase [23,30,68,69,95,98]	Not assessed	Not assessed	Human EM cases [95], human LD cases [23,30,31,69], human LB & EM cases [68], human neuroborreliosis cases [98]
Precipitation	Czech Republic [30,31], Sweden [95,98]	Decrease [30,98]	Not assessed	Not assessed	Human EM cases [95], human LD cases [30,31], human neuroborreliosis cases [98]
Vegetation/NDVI	Belgium [23,25], Slovenia [89]	Increase [23,25]	Not assessed	Increase [25]	Human LD cases [23,25,89]
Land use and land cover	Belgium [20,22,25], France [45], Italy [74], Poland [82], Slovenia [89]	Increase [20,74,89]; Decrease [45]	Increase [22,82]; Decrease [22]	Increase [89]	Human EM cases [45], human LD cases [20,25,74,89], human LD seroprevalence [22,82]
Humidity and NDWI	Belgium [26], Czech Republic [30], Sweden [95,98]	Increase [26,95]	Not assessed	Not assessed	Human EM cases [95], human LD cases [26,30], human neuroborreliosis cases [98]
Altitude/Elevation	France [45], Slovenia [89]	Increase [45]; Decrease [89]	Not assessed	Not assessed	Human EM cases [45], human LD cases [89]
Human population density and exposure	Belgium [20,25], Hungary [69], Poland [82], Slovenia [89]	Increase [20,25,69]	Not assessed	Increase [25,89]	Human LD cases [20,25,69,89], human LD seroprevalence [82]
Animal host population density	Belgium [20,22], Czech Republic [34], Poland [34], Slovakia [34], Slovenia [89]	Increase [20,34]	Not assessed	Increase [89]	Human LD cases [20,34,89], human LD seroprevalence [22]
Vector population density	Czech Republic [30], Slovenia [89]	Not assessed	Not assessed	Not assessed	Human LD cases [30,89]
Other	Czech Republic [31,34], Poland [34], Slovakia [34], Slovenia [89]	Increase [34,89]	Not assessed	Increase [89]	Human LD cases [31,34,89]

EM: erythema migrans; LD: Lyme disease; NAO: North Atlantic Oscillation; NDVI: normalized difference vegetation index; NDWI: normalized difference water index.

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