



Economic Commission for Europe
Inland Transport Committee
Working Party on Transport Trends and Economics
**Group of Experts on Assessment of Climate Change
 Impacts and Adaptation for Inland Transport**
Nineteenth session

Geneva, 1 and 2 October 2020

Item 4 of the provisional agenda

Climate change and transport assets data
**Indices for analysing potential climate change impacts on
 transport assets**
Note by the secretariat
I. Background

1. The Group of Experts on Climate Change Impacts and Adaptation for Transport Networks and Nodes during its 2015–2019 mandate analysed impacts from climate change on transport assets using the following indices:

<i>Climate index</i>	<i>Definition</i>
Warm spell duration index (WSDI)	Annual count of days with at least six consecutive days when daily maximum temperature is higher than the 90th percentile in the base period
Very hot days (VHD)	Annual count of days when daily maximum temperature is greater than 30° C
Icing days (ID)	Annual count of days when daily maximum temperature is less than 0° C
R20mm	Annual count of days when daily precipitation amount is greater than 20 mm
Rx5day	Maximum precipitation amount over a 5-day period
Consecutive dry days (CDD)	Maximum number of consecutive dry days (where precipitation is less than 1mm)



2. In its final report the outgoing Group of Experts suggested that the incoming Group of Experts on Assessment of Climate Change Impacts and Adaptation for Inland Transport expands the analysis of the future climate impacts on transport by assessing changes in both relative and absolute terms for the existing indices as well as by using additional climate indices. Those additional indices may measure changes in parameters such as temperature, precipitation or evapotranspiration.

3. This document, prepared by the secretariat in collaboration with Ms. Stephanie Hänsel (Deutscher Wetterdienst, Germany), contains a list of indices that the incoming Group of Experts may consider with the aim of selecting additional indices for carrying out its analysis. In doing so, the Group of Experts should reflect on climate events that are more important to analyse and thus select the most appropriate indices for measuring such events. The Group of Experts should also consider availability of data for measuring the additional indices for the entire region of the Economic Commission for Europe (ECE).

II. List of climate indices

4. A non-exhaustive list of possible climate indices is provided below for the consideration by the Group of Experts.

<i>Index</i>	<i>Unit</i>	<i>Description</i>
Air temperature at 2 m height		
Average temperature, T_{av}	°C	Average temperature (monthly, seasonal, annual)
Daily maximum temperature, T_{max}	°C	Monthly, seasonal or annual average of T_{max}
Daily minimum temperature, T_{min}	°C	Monthly, seasonal or annual average of T_{min}
Diurnal temperature range, DTR	°C	Monthly, seasonal or annual average $T_{max} - T_{min}$
Summer days	No.	Days with $T_{max} > 25^{\circ}\text{C}$
Tropical nights	No.	Days with $T_{min} \geq 20^{\circ}\text{C}$
Frost days	No.	Days with $T_{min} < 0.0^{\circ}\text{C}$
Days with freeze/thaw cycles	No.	Days with $T_{min} < 0.0^{\circ}\text{C}$ and $T_{max} > 0.0^{\circ}\text{C}$
Cold days	No.	Days with $T_{av} < 10\text{th percentile}$
Cold nights	No.	Days with $T_{min} < 10\text{th percentile}$
Cold afternoons	No.	Days with $T_{max} < 10\text{th percentile}$
Warm days	No.	Days with $T_{av} > 90\text{th percentile}$
Warm nights	No.	Days with $T_{min} > 90\text{th percentile}$
Warm daytimes	No.	Days with $T_{max} > 90\text{th percentile}$
Ice periods	Days	Annual maximum duration of consecutive ice days
Frost periods	Days	Annual maximum duration of consecutive frost days
Severe frost period	Days	Annual maximum duration of consecutive days with $T_{min} < -5^{\circ}\text{C}$
Cold spells	Days	Annual maximum duration of consecutive cold nights
Warm spells	Days	Annual maximum duration of consecutive warm days
Warm spells with warm nights	No./days	Number/average duration of episodes with warm daytimes and warm nights lasting at least 6 days

<i>Index</i>	<i>Unit</i>	<i>Description</i>
Heatwave (of ≥ 3 or 6 hot days)	No./days	Frequency/Average duration of periods with at least 3 or 6 consecutive hot days
Heatwave (percentile based)	No./days	Frequency/Average duration of periods with at least 3 consecutive days with Tas > 95th percentile
Heatwave with tropical nights	No./days	Frequency/Average duration of periods with at least 3 consecutive hot days and tropical nights
Precipitation		
Precipitation total, Pr	mm	Monthly, seasonal or annual average of Pr
Days with precipitation	No.	Days with precipitation ≥ 0.1 mm
Wet days	No.	Days with precipitation ≥ 1 mm
Consecutive wet days	Days	Maximum duration of consecutive wet days
Precipitation at wet days	mm	Seasonal/Annual total precipitation at wet days
Mean precipitation at wet days	mm	Ratio of 'precipitation at wet days' and the number of wet days
Heavy precipitation	No.	Number of days with precipitation above a predefined fixed threshold (e.g., 10 mm, 20 mm, 30 mm) or a percentile threshold (90th, 95th, 99th)
Precipitation at heavy precipitation days	mm	Seasonal/Annual total precipitation at days with heavy precipitation (using one of the definitions above)
Mean precipitation at days with heavy precipitation	mm	Ratio of 'Precipitation at heavy precipitation days' and the number of heavy precipitation days
Percentage of the total precipitation at heavy precipitation days	%	Ratio of total precipitation at days with heavy precipitation (using one of the definitions above) and total precipitation
Dry days	No.	Number of days with precipitation < 1 mm
Dry periods	No.	Frequency of dry periods with predefined duration (e.g., > 4 or 11 days duration)
Heavy precipitation following a dry period	No.	Dry period (> 11 days) terminated by a heavy precipitation event with ≥ 20 mm/d
Maximum daily precipitation	mm	Seasonal or annual maximum of daily precipitation
Multi-day precipitation total	mm	Seasonal or annual maximum precipitation total for a predefined number of days [e.g. 3, 5, 10, and 30 days]
Continuous rain	No.	Events with precipitation ≥ 30 mm/48 h or ≥ 40 mm/72 h (or another threshold and duration)
Precipitation anomaly	mm	Accumulated monthly precipitation anomaly over a defined number of months
Parameters relevant for evapotranspiration		
Global radiation	W/m ²	Monthly, seasonal or annual average
Sunshine duration	h	Monthly, seasonal or annual average
Wind speed (at 10 m height)	m/s	Monthly, seasonal or annual average
High winds	m/s	Daily maximum wind speed (seasonal/annual average)

<i>Index</i>	<i>Unit</i>	<i>Description</i>
	m/s	Wind speed of a specific percentile (e.g., 90th, 95th or 98th percentile)
	No.	Number of days with maximum wind speed above a predefined threshold (e.g., 90th, 95th or 98th percentile; 8 or 10 Beaufort)
Relative humidity	%	Monthly, seasonal or annual average
Evapotranspiration	mm	Monthly, seasonal or annual total (diverse calculation methods are available)
Combined indices		
Potential snow days	No.	Wet days with $T_{as} \leq 2^{\circ}\text{C}$
Climatic water balance	mm	Difference of total precipitation and evapotranspiration

5. Experts may also consider information and lists of indices presented at the sessions of the former Group of Experts, e.g.: www.unece.org/fileadmin/DAM/trans/doc/2017/wp5/1b_France_Mr_Andre_Leuxe_Climat_e_Change_12th_27-28_March_2017.pdf.

6. The Group of Experts may wish to agree and list candidate indices to be used in the analysis for further consideration at the subsequent meeting.