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1 Introduction

The Climate Data Operator (CDO) software is a collection of operators for standard processing of climate and forecast model data.

This document describes additional CDO operators to compute climate indices of daily temperature and precipitation extreme. The definition of these climate indices are from the European Climate Assessment (ECA) project.

The climate indices were implemented in CDO by Ralf Quast (Brockmann Consult) on behalf of the Service Gruppe Anpassung (SGA) in 2006. SGA was part of the Model and Data Group (M&D) at the MPI for Meteorology. In 2010, the Model and Data Group became the Data Management department at DKRZ (Deutsches Klimarechenzentrum) and the SGA was disintegrated. For this reason there is no further user support available for these CDO operators.
2 Climate indices reference manual

This section gives a description of all CDO operators to compute the climate indices of daily temperature and precipitation extreme. Related operators are grouped to modules. For easier description all single input files are named infile or infile1, infile2, etc., and an arbitrary number of input files are named infiles. All output files are named outfile or outfile1, outfile2, etc. Further the following notion is introduced:

\[ i(t) \] Timestep \( t \) of infile

\[ i(t, x) \] Element number \( x \) of the field at timestep \( t \) of infile

\[ o(t) \] Timestep \( t \) of outfile

\[ o(t, x) \] Element number \( x \) of the field at timestep \( t \) of outfile

Here is a short overview of all operators in this section:

- **eca_cdd**: Consecutive dry days index per time period
- **eca_cfd**: Consecutive frost days index per time period
- **eca_csu**: Consecutive summer days index per time period
- **eca_cwd**: Consecutive wet days index per time period
- **eca_cwdi**: Cold wave duration index w.r.t. mean of reference period
- **eca_cwfi**: Cold-spell days index w.r.t. 10th percentile of reference period
- **eca_etr**: Intra-period extreme temperature range
- **eca_fd**: Frost days index per time period
- **eca_gsl**: Growing season length index
- **eca_hd**: Heating degree days per time period
- **eca_hwdi**: Heat wave duration index w.r.t. mean of reference period
- **eca_hwfi**: Warm spell days index w.r.t. 90th percentile of reference period
- **eca_id**: Ice days index per time period
- **eca_r75p**: Moderate wet days w.r.t. 75th percentile of reference period
- **eca_r75ptot**: Precipitation percent due to R75p days
- **eca_r90p**: Wet days w.r.t. 90th percentile of reference period
- **eca_r90ptot**: Precipitation percent due to R90p days
- **eca_r95p**: Very wet days w.r.t. 95th percentile of reference period
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<td>Very warm days percent w.r.t. 90th percentile of reference period</td>
</tr>
</tbody>
</table>
2.0.1 ECACDD - Consecutive dry days index per time period

Synopsis

\texttt{eca\_cdd[R][N]} infile outfile

Description

Let \texttt{infile} be a time series of the daily precipitation amount \(RR\), then the largest number of consecutive days where \(RR\) is less than \(R\) is counted. \(R\) is an optional parameter with default \(R = 1\) mm. A further output variable is the number of dry periods of more than \(N\) days. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Parameter

- \texttt{R} \quad \texttt{FLOAT} \quad \text{Precipitation threshold (unit: mm; default: R = 1 mm)}
- \texttt{N} \quad \texttt{INTEGER} \quad \text{Minimum number of days exceeded (default: N = 5)}

Example

To get the largest number of consecutive dry days of a time series of daily precipitation amounts use:

\begin{verbatim}
cdo eca_cdd rrfile outfile
\end{verbatim}

2.0.2 ECACFD - Consecutive frost days index per time period

Synopsis

\texttt{eca\_cfd[N]} infile outfile

Description

Let \texttt{infile} be a time series of the daily minimum temperature \(TN\), then the largest number of consecutive days where \(TN < 0\) °C is counted. Note that \(TN\) have to be given in units of Kelvin. A further output variable is the number of frost periods of more than \(N\) days. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Parameter

- \texttt{N} \quad \texttt{INTEGER} \quad \text{Minimum number of days exceeded (default: N = 5)}

Example

To get the largest number of consecutive frost days of a time series of daily minimum temperatures use:

\begin{verbatim}
cdo eca_cfd tnfile outfile
\end{verbatim}
2.0.3 ECACSU - Consecutive summer days index per time period

Synopsis

\texttt{eca\_csu[,T[,N]]} infile outfile

Description

Let \texttt{infile} be a time series of the daily maximum temperature TX, then the largest number of consecutive days where TX > T is counted. The number T is an optional parameter with default \( T = 25^\circ\text{C} \). Note that TN have to be given in units of Kelvin, whereas T have to be given in degrees Celsius. A further output variable is the number of summer periods of more than N days. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Parameter

\begin{itemize}
  \item \texttt{T} FLOAT Temperature threshold (unit: °C; default: \( T = 25^\circ\text{C} \))
  \item \texttt{N} INTEGER Minimum number of days exceeded (default: \( N = 5 \))
\end{itemize}

Example

To get the largest number of consecutive summer days of a time series of daily maximum temperatures use:

\begin{verbatim}
cdo eca_csu txfile outfile
\end{verbatim}

2.0.4 ECACWD - Consecutive wet days index per time period

Synopsis

\texttt{eca\_cwd[,R[,N]]} infile outfile

Description

Let \texttt{infile} be a time series of the daily precipitation amount RR, then the largest number of consecutive days where RR is at least R is counted. R is an optional parameter with default \( R = 1 \text{ mm} \). A further output variable is the number of wet periods of more than N days. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Parameter

\begin{itemize}
  \item \texttt{R} FLOAT Precipitation threshold (unit: mm; default: \( R = 1 \text{ mm} \))
  \item \texttt{N} INTEGER Minimum number of days exceeded (default: \( N = 5 \))
\end{itemize}

Example

To get the largest number of consecutive wet days of a time series of daily precipitation amounts use:

\begin{verbatim}
cdo eca_cwd rrfile outfile
\end{verbatim}
2.0.5 ECACWDI - Cold wave duration index w.r.t. mean of reference period

Synopsis

\texttt{eca\_cwdi[\textit{nday},\textit{T}]} infile1 infile2 outfile

Description

Let \texttt{infile1} be a time series of the daily minimum temperature \(TN\), and let \texttt{infile2} be the mean \(TN_{\text{norm}}\) of daily minimum temperatures for any period used as reference. Then counted is the number of days where, in intervals of at least \textit{nday} consecutive days, \(TN < TN_{\text{norm}} - T\). The numbers \textit{nday} and \textit{T} are optional parameters with default \textit{nday} = 6 and \(T = 5\)\(^\circ\text{C}\). A further output variable is the number of cold waves longer than or equal to \textit{nday} days. \(TN_{\text{norm}}\) is calculated as the mean of minimum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both \(TN\) and \(TN_{\text{norm}}\) have to be given in the same units. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Parameter

\begin{itemize}
\item \textit{nday} INTEGER Number of consecutive days (default: \textit{nday} = 6)
\item \textit{T} FLOAT Temperature offset (unit: \(^\circ\text{C}\); default: \(T = 5\)\(^\circ\text{C}\))
\end{itemize}

Example

To compute the cold wave duration index of a time series of daily minimum temperatures use:

\texttt{cdo eca\_cwdi tnfile tnnormfile outfile}

2.0.6 ECACWFI - Cold-spell days index w.r.t. 10th percentile of reference period

Synopsis

\texttt{eca\_cwfi[\textit{nday}]} infile1 infile2 outfile

Description

Let \texttt{infile1} be a time series of the daily mean temperature \(TG\), and \texttt{infile2} be the 10th percentile \(TG_{\text{10}}\) of daily mean temperatures for any period used as reference. Then counted is the number of days where, in intervals of at least \textit{nday} consecutive days, \(TG < TG_{\text{10}}\). The number \textit{nday} is an optional parameter with default \textit{nday} = 6. A further output variable is the number of cold-spell periods longer than or equal to \textit{nday} days. \(TG_{\text{10}}\) is calculated as the 10th percentile of daily mean temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both \(TG\) and \(TG_{\text{10}}\) have to be given in the same units. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Parameter

\begin{itemize}
\item \textit{nday} INTEGER Number of consecutive days (default: \textit{nday} = 6)
\end{itemize}

Example

To compute the number of cold-spell days of a time series of daily mean temperatures use:

\texttt{cdo eca\_cwfi tgfile tgn10file outfile}
2.0.7 ECAETR - Intra-period extreme temperature range

Synopsis

eca_etranfile1infile2outfile

Description

Let infile1 and infile2 be time series of the maximum and minimum temperature TX and TN, respectively. Then the extreme temperature range is the difference of the maximum of TX and the minimum of TN. Note that TX and TN have to be given in the same units. The date information of a timestep in outfile is the date of the last contributing timesteps in infile1 and infile2.

Example

To get the intra-period extreme temperature range for two time series of maximum and minimum temperatures use:

cdo eca_etrtxfiletnfileoutfile

2.0.8 ECAFD - Frost days index per time period

Synopsis

eca_fdinfileoutfile

Description

Let infile be a time series of the daily minimum temperature TN, then the number of days where TN < 0 °C is counted. Note that TN have to be given in units of Kelvin. The date information of a timestep in outfile is the date of the last contributing timestep in infile.

Example

To get the number of frost days of a time series of daily minimum temperatures use:

cdo eca_fdtnfileoutfile
2.0.9 ECAGSL - Thermal Growing season length index

Synopsis

\texttt{eca\_gsl[nday[,T[,fland]]] infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series of the daily mean temperature \( TG \), and \texttt{infile2} be a land-water mask. Within a period of 12 months, the thermal growing season length is officially defined as the number of days between:

- first occurrence of at least nday consecutive days with \( TG > T \)
- first occurrence of at least nday consecutive days with \( TG < T \) within the last 6 months

On northern hemisphere, this period corresponds with the regular year, whereas on southern hemisphere, it starts at July 1st. Please note, that this definition may lead to weird results concerning values \( TG = T \): In the first half of the period, these days do not contribute to the \texttt{gsl}, but they do within the second half. Moreover this definition could lead to discontinuous values in equatorial regions.

The numbers \texttt{nday} and \( T \) are optional parameter with default \texttt{nday = 6} and \( T = 5°C \). The number \texttt{fland} is an optional parameter with default value \texttt{fland = 0.5} and denotes the fraction of a grid point that have to be covered by land in order to be included in the calculation. A further output variable is the start day of year of the growing season. Note that \( TG \) have to be given in units of Kelvin, whereas \( T \) have to be given in degrees Celsius.

The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Parameter

<table>
<thead>
<tr>
<th>\texttt{nday}</th>
<th>\texttt{INTEGER}</th>
<th>Number of consecutive days (default: \texttt{nday = 6})</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{T}</td>
<td>\texttt{FLOAT}</td>
<td>Temperature threshold (unit: °C; default: \texttt{T = 5°C})</td>
</tr>
<tr>
<td>\texttt{fland}</td>
<td>\texttt{FLOAT}</td>
<td>Land fraction threshold (default: \texttt{fland = 0.5})</td>
</tr>
</tbody>
</table>

Example

To get the growing season length of a time series of daily mean temperatures use:

\begin{verbatim}
cdo eca_gsl tgfile maskfile outfile
\end{verbatim}
2.0.10 ECAHD - Heating degree days per time period

Synopsis

`eca_hd[,T1[,T2]] infile outfile`

Description

Let `infile` be a time series of the daily mean temperature `TG`, then the heating degree days are defined as the sum of `T1 - TG`, where only values `TG < T2` are considered. If `T1` and `T2` are omitted, a temperature of 17°C is used for both parameters. If only `T1` is given, `T2` is set to `T1`. Note that `TG` have to be given in units of kelvin, whereas `T1` and `T2` have to be given in degrees Celsius. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile`.

Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>T1</code></td>
<td>FLOAT</td>
<td>Temperature limit (unit: °C; default: <code>T1 = 17°C</code>)</td>
</tr>
<tr>
<td><code>T2</code></td>
<td>FLOAT</td>
<td>Temperature limit (unit: °C; default: <code>T2 = T1</code>)</td>
</tr>
</tbody>
</table>

Example

To compute the heating degree days of a time series of daily mean temperatures use:

```
cdo eca_hd tgfile outfile
```

2.0.11 ECAHWDI - Heat wave duration index w.r.t. mean of reference period

Synopsis

`eca_hwdi[,nday[,T]] infile1 infile2 outfile`

Description

Let `infile1` be a time series of the daily maximum temperature `TX`, and let `infile2` be the mean `TXnorm` of daily maximum temperatures for any period used as reference. Then counted is the number of days where, in intervals of at least `nday` consecutive days, `TX > TXnorm + T`. The numbers `nday` and `T` are optional parameters with default `nday = 6` and `T = 5°C`. A further output variable is the number of heat waves longer than or equal to `nday` days. `TXnorm` is calculated as the mean of maximum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both `TX` and `TXnorm` have to be given in the same units. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile1`.

Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>nday</code></td>
<td>INTEGER</td>
<td>Number of consecutive days (default: <code>nday = 6</code>)</td>
</tr>
<tr>
<td><code>T</code></td>
<td>FLOAT</td>
<td>Temperature offset (unit: °C; default: <code>T = 5°C</code>)</td>
</tr>
</tbody>
</table>
2.0.12 ECAHWFI - Warm spell days index w.r.t. 90th percentile of reference period

Synopsis

`eca_hwfi[,nday]` `infile1` `infile2` `outfile`

Description

Let `infile1` be a time series of the daily mean temperature TG, and `infile2` be the 90th percentile `T Gn90` of daily mean temperatures for any period used as reference. Then counted is the number of days where, in intervals of at least `nday` consecutive days, `TG > T Gn90`. The number `nday` is an optional parameter with default `nday = 6`. A further output variable is the number of warm-spell periods longer than or equal to `nday` days. `T Gn90` is calculated as the 90th percentile of daily mean temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both `TG` and `T Gn90` have to be given in the same units. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile1`.

Parameter

- `nday` INTEGER Number of consecutive days (default: `nday = 6`)

Example

To compute the number of warm-spell days of a time series of daily mean temperatures use:

```
cdo eca_hwfi tgfile tgn90file outfile
```

2.0.13 ECAID - Ice days index per time period

Synopsis

`eca_id` `infile` `outfile`

Description

Let `infile` be a time series of the daily maximum temperature TX, then the number of days where `TX < 0 °C` is counted. Note that `TX` have to be given in units of Kelvin. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile`.

Example

To get the number of ice days of a time series of daily maximum temperatures use:

```
cdo eca_id txfile outfile
```
2.0.14 ECAR75P - Moderate wet days w.r.t. 75th percentile of reference period

Synopsis

\texttt{eca\_r75p infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series RR of the daily precipitation amount at wet days (precipitation $\geq 1$ mm) and \texttt{infile2} be the 75th percentile RRn75 of the daily precipitation amount at wet days for any period used as reference. Then the percentage of wet days with RR $> RRn75$ is calculated. RRn75 is calculated as the 75th percentile of all wet days of a given climate reference period. Usually \texttt{infile2} is generated by the operator \texttt{ydaypctl,75}. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Example

To compute the percentage of wet days with daily precipitation amount greater than the 75th percentile of the daily precipitation amount at wet days for a given reference period use:

\begin{verbatim}
cdo eca_r75p rrfile rrn75file outfile
\end{verbatim}

2.0.15 ECAR75PTOT - Precipitation percent due to R75p days

Synopsis

\texttt{eca\_r75ptot infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series RR of the daily precipitation amount at wet days (precipitation $\geq 1$ mm) and \texttt{infile2} be the 75th percentile RRn75 of the daily precipitation amount at wet days for any period used as reference. Then the ratio of the precipitation sum at wet days with RR $> RRn75$ to the total precipitation sum is calculated. RRn75 is calculated as the 75th percentile of all wet days of a given climate reference period. Usually \texttt{infile2} is generated by the operator \texttt{ydaypctl,75}. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}. 
2.0.16 ECAR90P - Wet days w.r.t. 90th percentile of reference period

Synopsis

cda_r90p infile1 infile2 outfile

Description

Let infile1 be a time series RR of the daily precipitation amount at wet days (precipitation >= 1 mm) and infile2 be the 90th percentile RRn90 of the daily precipitation amount at wet days for any period used as reference. Then the percentage of wet days with RR > RRn90 is calculated. RRn90 is calculated as the 90th percentile of all wet days of a given climate reference period. Usually infile2 is generated by the operator ydaypctl,90. The date information of a timestep in outfile is the date of the last contributing timestep in infile1.

Example

To compute the percentage of wet days where the daily precipitation amount is greater than the 90th percentile of the daily precipitation amount at wet days for a given reference period use:

cdo cda_r90p rrfie rrn90file outfile

2.0.17 ECAR90PTOT - Precipitation percent due to R90p days

Synopsis

cda_r90ptot infile1 infile2 outfile

Description

Let infile1 be a time series RR of the daily precipitation amount at wet days (precipitation >= 1 mm) and infile2 be the 90th percentile RRn90 of the daily precipitation amount at wet days for any period used as reference. Then the ratio of the precipitation sum at wet days with RR > RRn90 to the total precipitation sum is calculated. RRn90 is calculated as the 90th percentile of all wet days of a given climate reference period. Usually infile2 is generated by the operator ydaypctl,90. The date information of a timestep in outfile is the date of the last contributing timestep in infile1.
2.0.18 ECAR95P - Very wet days w.r.t. 95th percentile of reference period

Synopsis

\texttt{eca\_r95p infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series RR of the daily precipitation amount at wet days (precipitation \( \geq 1 \) mm) and \texttt{infile2} be the 95th percentile RRn95 of the daily precipitation amount at wet days for any period used as reference. Then the percentage of wet days with RR > RRn95 is calculated. RRn95 is calculated as the 95th percentile of all wet days of a given climate reference period. Usually \texttt{infile2} is generated by the operator \texttt{ydaypctl,95}. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Example

To compute the percentage of wet days where the daily precipitation amount is greater than the 95th percentile of the daily precipitation amount at wet days for a given reference period use:

\begin{verbatim}
cdo eca_r95p rrfile rrn95file outfile
\end{verbatim}

2.0.19 ECAR95PTOT - Precipitation percent due to R95p days

Synopsis

\texttt{eca\_r95ptot infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series RR of the daily precipitation amount at wet days (precipitation \( \geq 1 \) mm) and \texttt{infile2} be the 95th percentile RRn95 of the daily precipitation amount at wet days for any period used as reference. Then the ratio of the precipitation sum at wet days with RR > RRn95 to the total precipitation sum is calculated. RRn95 is calculated as the 95th percentile of all wet days of a given climate reference period. Usually \texttt{infile2} is generated by the operator \texttt{ydaypctl,95}. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.
2.0.20 ECAR99P - Extremely wet days w.r.t. 99th percentile of reference period

Synopsis

ecar99p infile1 infile2 outfile

Description

Let *infile1* be a time series RR of the daily precipitation amount at wet days (precipitation $\geq 1$ mm) and *infile2* be the 99th percentile Rn99 of the daily precipitation amount at wet days for any period used as reference. Then the percentage of wet days with RR $> Rn99$ is calculated. Rn99 is calculated as the 99th percentile of all wet days of a given climate reference period. Usually *infile2* is generated by the operator *ydaypctl,99*. The date information of a timestep in *outfile* is the date of the last contributing timestep in *infile1*.

Example

To compute the percentage of wet days where the daily precipitation amount is greater than the 99th percentile of the daily precipitation amount at wet days for a given reference period use:

```
cdo eca_r99p rrfile rrn99file outfile
```

2.0.21 ECAR99PTOT - Precipitation percent due to R99p days

Synopsis

ecar99ptot infile1 infile2 outfile

Description

Let *infile1* be a time series RR of the daily precipitation amount at wet days (precipitation $\geq 1$ mm) and *infile2* be the 99th percentile RRn99 of the daily precipitation amount at wet days for any period used as reference. Then the ratio of the precipitation sum at wet days with RR $> RRn99$ to the total precipitation sum is calculated. RRn99 is calculated as the 99th percentile of all wet days of a given climate reference period. Usually *infile2* is generated by the operator *ydaypctl,99*. The date information of a timestep in *outfile* is the date of the last contributing timestep in *infile1*. 
2.0.22 ECAPD - Precipitation days index per time period

Synopsis

\texttt{eca\_pd,x infile outfile}
\texttt{eca\_r10mm infile outfile}
\texttt{eca\_r20mm infile outfile}

Description

Let \texttt{infile} be a time series of the daily precipitation amount \( RR \) in [mm] (or alternatively in [kg m\(^{-2}\)]), then the number of days where \( RR \) is at least \( x \) mm is counted. \texttt{eca\_r10mm} and \texttt{eca\_r20mm} are specific ECA operators with a daily precipitation amount of 10 and 20 mm respectively. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile}.

Operators

\begin{itemize}
\item \texttt{eca\_pd} \quad Precipitation days index per time period
  \quad Generic ECA operator with daily precipitation sum exceeding \( x \) mm.
\item \texttt{eca\_r10mm} \quad Heavy precipitation days index per time period
  \quad Specific ECA operator with daily precipitation sum exceeding 10 mm.
\item \texttt{eca\_r20mm} \quad Very heavy precipitation days index per time period
  \quad Specific ECA operator with daily precipitation sum exceeding 20 mm.
\end{itemize}

Parameter

\begin{itemize}
\item \( x \) \quad FLOAT \quad Daily precipitation amount threshold in [mm]
\end{itemize}

Note

Precipitation rates in [mm/s] have to be converted to precipitation amounts (multiply with 86400 s). Apart from metadata information the result of \texttt{eca\_pd,1} and \texttt{eca\_r1} is the same.

Example

To get the number of days with precipitation greater than 25 mm for a time series of daily precipitation amounts use:

\begin{verbatim}
cdo eca\_pd,25 infile outfile
\end{verbatim}
2.0.23 ECARR1 - Wet days index per time period

**Synopsis**

`eca_rr1[,R]` `infile` `outfile`

**Description**

Let `infile` be a time series of the daily precipitation amount `RR` in [mm] (or alternatively in [kg m$^{-2}$]), then the number of days where `RR` is at least `R` is counted. `R` is an optional parameter with default `R = 1 mm`. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile`.

**Parameter**

`R` `FLOAT` Precipitation threshold (unit: mm; default: `R = 1 mm`)

**Example**

To get the number of wet days of a time series of daily precipitation amounts use:

```
cdo eca_rr1 rrfile outfile
```  

2.0.24 ECARX1DAY - Highest one day precipitation amount per time period

**Synopsis**

`eca_rx1day[,mode]` `infile` `outfile`

**Description**

Let `infile` be a time series of the daily precipitation amount `RR`, then the maximum of `RR` is written to `outfile`. If the optional parameter `mode` is set to 'm' the maximum daily precipitation amounts are determined for each month. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile`.

**Parameter**

`mode` `STRING` Operation mode (optional). If `mode = 'm'` then maximum daily precipitation amounts are determined for each month.

**Example**

To get the maximum of a time series of daily precipitation amounts use:

```
cdo eca_rx1day rrfile outfile
```

If you are interested in the maximum daily precipitation for each month, use:

```
cdo eca_rx1day,m rrfile outfile
```

Apart from metadata information, both operations yield the same as:

```
cdo timmax rrfile outfile
cdo monmax rrfile outfile
```
2.0.25 ECARX5DAY - Highest five-day precipitation amount per time period

Synopsis

\texttt{eca\_rx5day[/x/ \textit{in\texttt{file}} \textit{outfile}}

Description

Let \textit{in\texttt{file}} be a time series of 5-day precipitation totals RR, then the maximum of RR is written to \textit{out\texttt{file}}. A further output variable is the number of 5 day period with precipitation totals greater than $x$ mm, where $x$ is an optional parameter with default $x = 50$ mm. The date information of a timestep in \textit{out\texttt{file}} is the date of the last contributing timestep in \textit{in\texttt{file}}.

Parameter

$x$ \hspace{1em} FLOAT \hspace{1em} Precipitation threshold (unit: mm; default: $x = 50$ mm)

Example

To get the maximum of a time series of 5-day precipitation totals use:

\begin{verbatim}
  cdo eca\_rx5day rrfile outfile
\end{verbatim}

Apart from metadata information, the above operation yields the same as:

\begin{verbatim}
  cdo timmax rrfile outfile
\end{verbatim}

2.0.26 ECASDII - Simple daily intensity index per time period

Synopsis

\texttt{eca\_sdii[/R/ \textit{in\texttt{file}} \textit{outfile}}

Description

Let \textit{in\texttt{file}} be a time series of the daily precipitation amount RR, then the mean precipitation amount at wet days (RR > $R$) is written to \textit{out\texttt{file}}. $R$ is an optional parameter with default $R = 1$ mm. The date information of a timestep in \textit{out\texttt{file}} is the date of the last contributing timestep in \textit{in\texttt{file}}.

Parameter

$R$ \hspace{1em} FLOAT \hspace{1em} Precipitation threshold (unit: mm; default: $R = 1$ mm)

Example

To get the daily intensity index of a time series of daily precipitation amounts use:

\begin{verbatim}
  cdo eca\_sdii rrfile outfile
\end{verbatim}
2.0.27 ECASU - Summer days index per time period

Synopsis

ecasu[,T] infile outfile

Description

Let infile be a time series of the daily maximum temperature TX, then the number of days where TX > T is counted. The number T is an optional parameter with default T = 25°C. Note that TX have to be given in units of Kelvin, whereas T have to be given in degrees Celsius. The date information of a timestep in outfile is the date of the last contributing timestep in infile.

Parameter

T FLOAT Temperature threshold (unit: °C; default: T = 25°C)

Example

To get the number of summer days of a time series of daily maximum temperatures use:

cdo eca-su txfile outfile
2.0.28 ECATG10P - Cold days percent w.r.t. 10th percentile of reference period

Synopsis

\texttt{eca\_tg10p infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series of the daily mean temperature \(TG\), and \texttt{infile2} be the 10th percentile \(TG_{n10}\) of daily mean temperatures for any period used as reference. Then the percentage of time where \(TG < TG_{n10}\) is calculated. \(TG_{n10}\) is calculated as the 10th percentile of daily mean temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both \(TG\) and \(TG_{n10}\) have to be given in the same units. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Example

To compute the percentage of timesteps with a daily mean temperature smaller than the 10th percentile of the daily mean temperatures for a given reference period use:

\texttt{cdo eca\_tg10p tgfile tgn10file outfile}

2.0.29 ECATG90P - Warm days percent w.r.t. 90th percentile of reference period

Synopsis

\texttt{eca\_tg90p infile1 infile2 outfile}

Description

Let \texttt{infile1} be a time series of the daily mean temperature \(TG\), and \texttt{infile2} be the 90th percentile \(TG_{n90}\) of daily mean temperatures for any period used as reference. Then the percentage of time where \(TG > TG_{n90}\) is calculated. \(TG_{n90}\) is calculated as the 90th percentile of daily mean temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both \(TG\) and \(TG_{n90}\) have to be given in the same units. The date information of a timestep in \texttt{outfile} is the date of the last contributing timestep in \texttt{infile1}.

Example

To compute the percentage of timesteps with a daily mean temperature greater than the 90th percentile of the daily mean temperatures for a given reference period use:

\texttt{cdo eca\_tg90p tgfile tgn90file outfile}
2.0.30 ECATN10P - Cold nights percent w.r.t. 10th percentile of reference period

Synopsis

```
eca_tn10p infile1 infile2 outfile
```

Description

Let `infile1` be a time serie of the daily minimum temperature TN, and `infile2` be the 10th percentile TNN10 of daily minimum temperatures for any period used as reference. Then the percentage of time where TN < TNN10 is calculated. TNN10 is calculated as the 10th percentile of daily minimum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both TN and TNN10 have to be given in the same units. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile1`.

Example

To compute the percentage of timesteps with a daily minimum temperature smaller than the 10th percentile of the daily minimum temperatures for a given reference period use:

```
cdo eca_tn10p tnfile tnn10file outfile
```

2.0.31 ECATN90P - Warm nights percent w.r.t. 90th percentile of reference period

Synopsis

```
eca_tn90p infile1 infile2 outfile
```

Description

Let `infile1` be a time series of the daily minimum temperature TN, and ` infile2` be the 90th percentile TNN90 of daily minimum temperatures for any period used as reference. Then the percentage of time where TN > TNN90 is calculated. TNN90 is calculated as the 90th percentile of daily minimum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both TN and TNN90 have to be given in the same units. The date information of a timestep in `outfile` is the date of the last contributing timestep in `infile1`.

Example

To compute the percentage of timesteps with a daily minimum temperature greater than the 90th percentile of the daily minimum temperatures for a given reference period use:

```
cdo eca_tn90p tnfile tnn90file outfile
```
2.0.32 ECATR - Tropical nights index per time period

Synopsis

eca_tr[,T] infile outfile

Description

Let infile be a time series of the daily minimum temperature TN, then the number of days where TN > T is counted. The number T is an optional parameter with default T = 20°C. Note that TN have to be given in units of Kelvin, whereas T have to be given in degrees Celsius. The date information of a timestep in outfile is the date of the last contributing timestep in infile.

Parameter

T FLOAT Temperature threshold (unit: °C; default: T = 20°C)

Example

To get the number of tropical nights of a time series of daily minimum temperatures use:

cdo eca_tr tnfile outfile

2.0.33 ECATX10P - Very cold days percent w.r.t. 10th percentile of reference period

Synopsis

eca_tx10p infile1 infile2 outfile

Description

Let infile1 be a time series of the daily maximum temperature TX, and infile2 be the 10th percentile TXn10 of daily maximum temperatures for any period used as reference. Then the percentage of time where TX < TXn10 is calculated. TXn10 is calculated as the 10th percentile of daily maximum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both TX and TXn10 have to be given in the same units. The date information of a timestep in outfile is the date of the last contributing timestep in infile1.

Example

To compute the percentage of timesteps with a daily maximum temperature smaller than the 10th percentile of the daily maximum temperatures for a given reference period use:

cdo eca_tx10p txfile txn10file outfile
2.0.34 ECATX90P - Very warm days percent w.r.t. 90th percentile of reference period

Synopsis

eca_tx90p infile1 infile2 outfile

Description

Let $\text{infile1}$ be a time series of the daily maximum temperature $\text{TX}$, and $\text{infile2}$ be the 90th percentile $\text{TXn90}$ of daily maximum temperatures for any period used as reference. Then the percentage of time where $\text{TX} > \text{TXn90}$, is calculated. $\text{TXn90}$ is calculated as the 90th percentile of daily maximum temperatures of a five day window centred on each calendar day of a given climate reference period. Note that both $\text{TX}$ and $\text{TXn90}$ have to be given in the same units. The date information of a timestep in $\text{outfile}$ is the date of the last contributing timestep in $\text{infile1}$.

Example

To compute the percentage of timesteps with a daily maximum temperature greater than the 90th percentile of the daily maximum temperatures for a given reference period use:

```
cdo eca_tx90p txfile txn90file outfile
```
Bibliography

[CDI] Climate Data Interface, from the Max Planck Institute for Meteorologie

[CDO] Climate Data Operator, from the Max Planck Institute for Meteorologie

[ECA] ECA indices of extremes, from the Koninklijk Nederlands Meteorologisch Instituut, KNMI)
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