

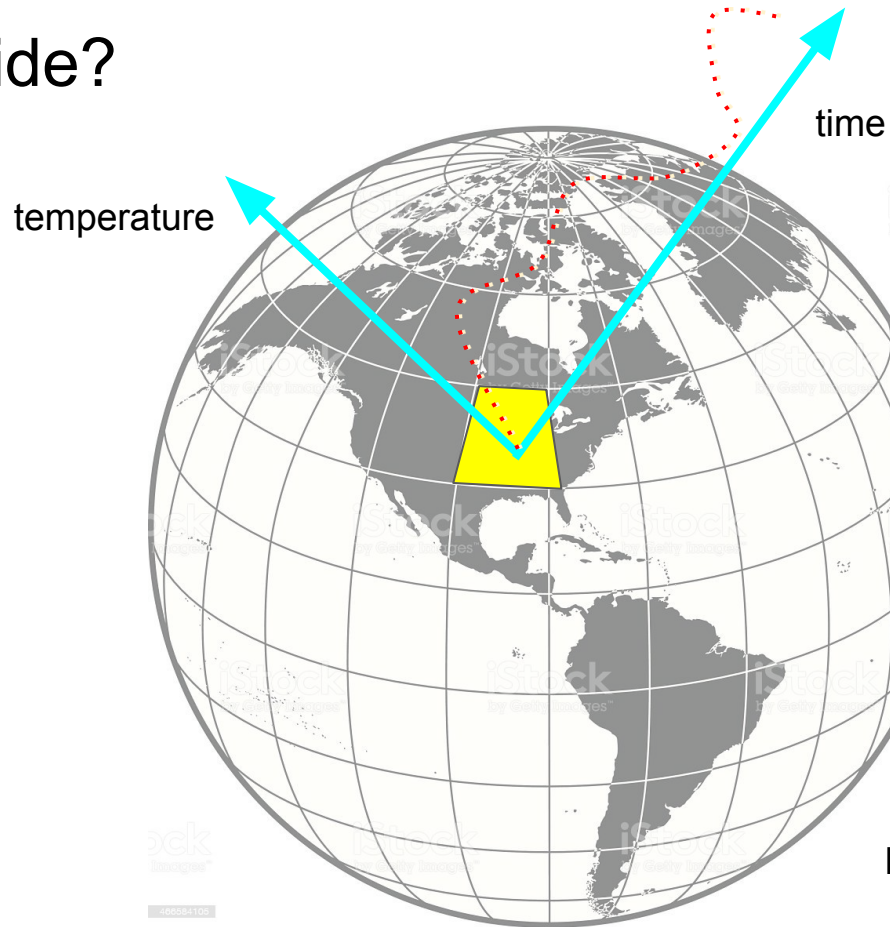
Exploring the climate data



Plan

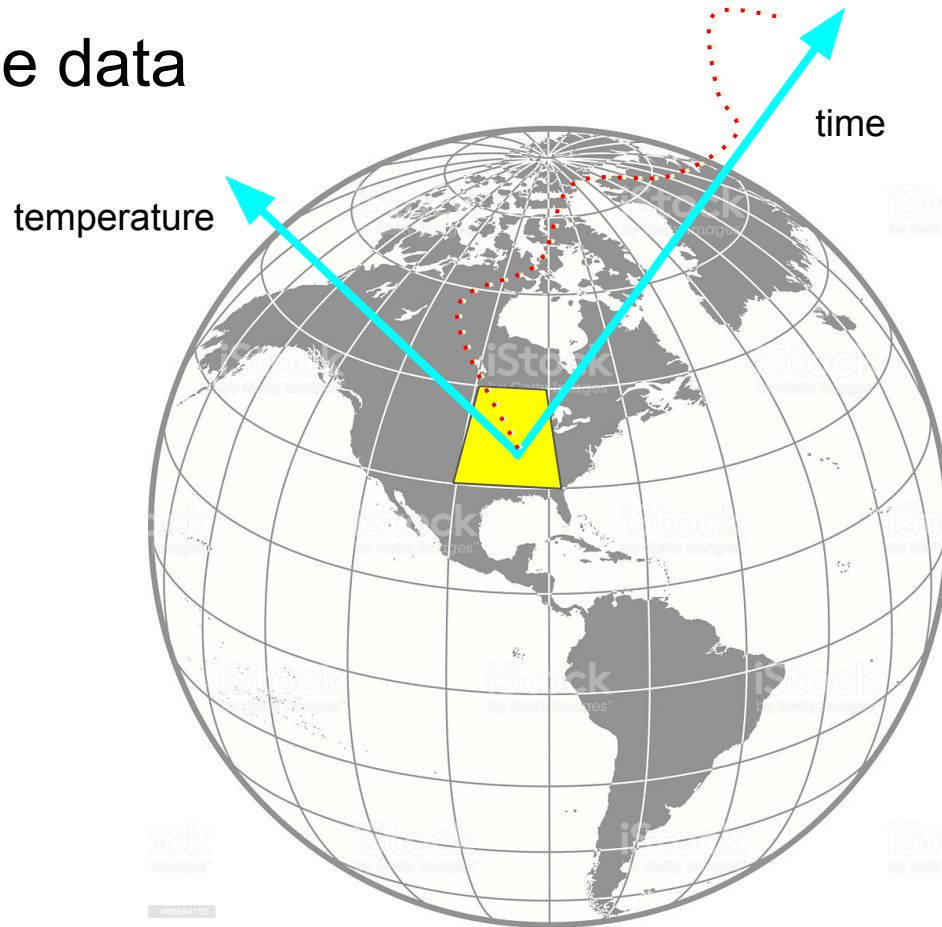
- The data
- What we do with it?
- How we do it?
- What we could do?

What's inside?

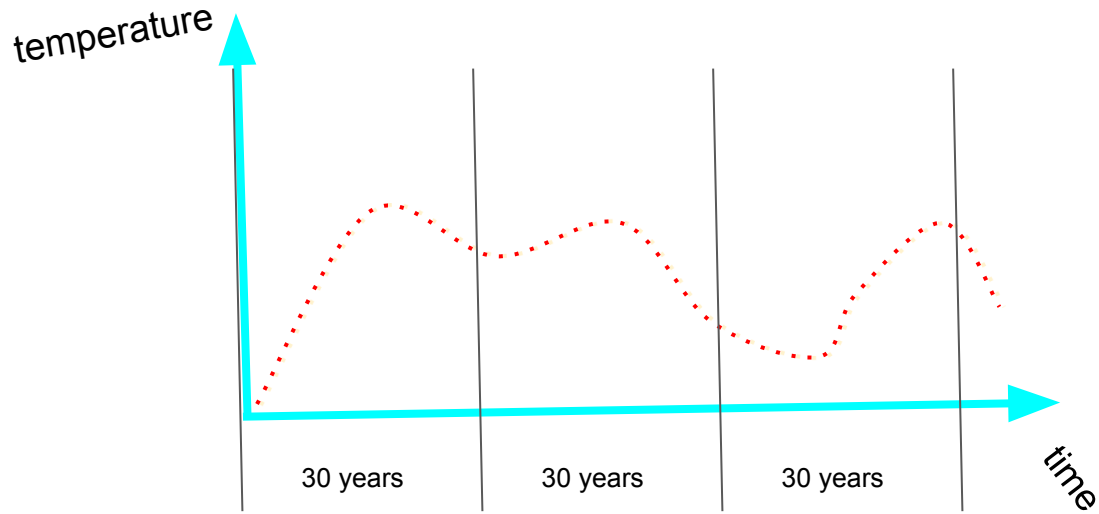


Format: netCDF4

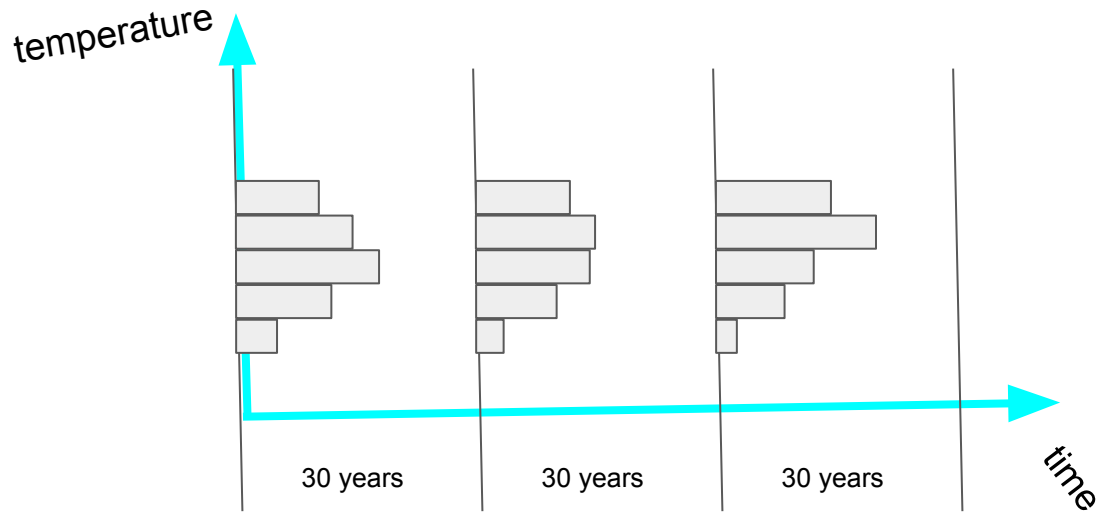
We take the data



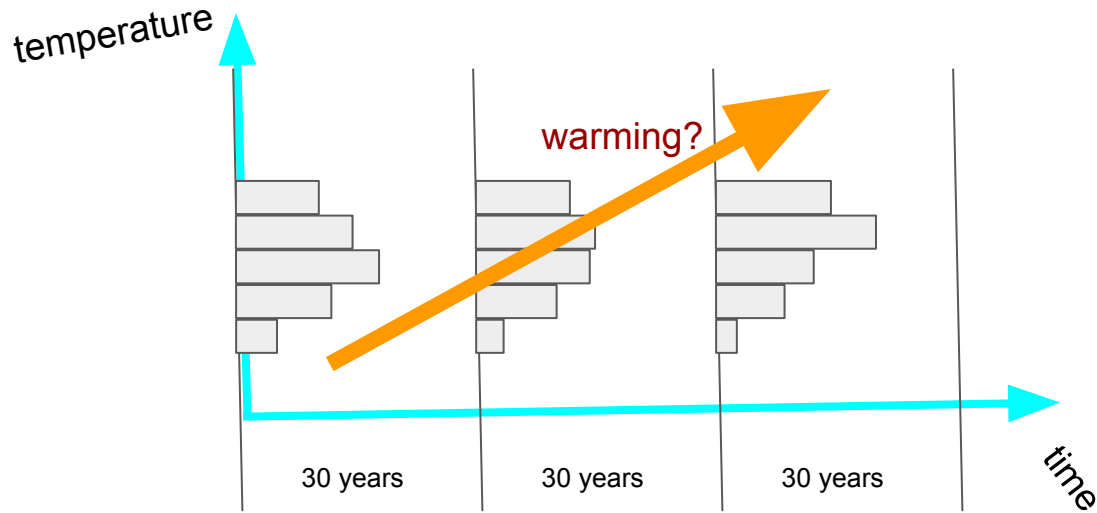
Split the timeline into 30-year slices



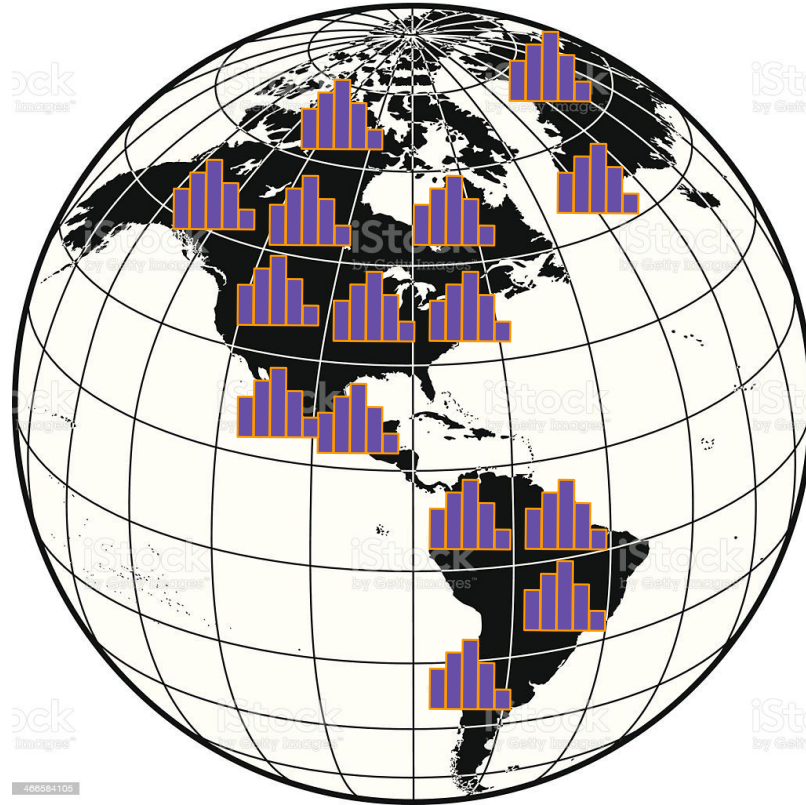
Build distribution of the variable within each slice



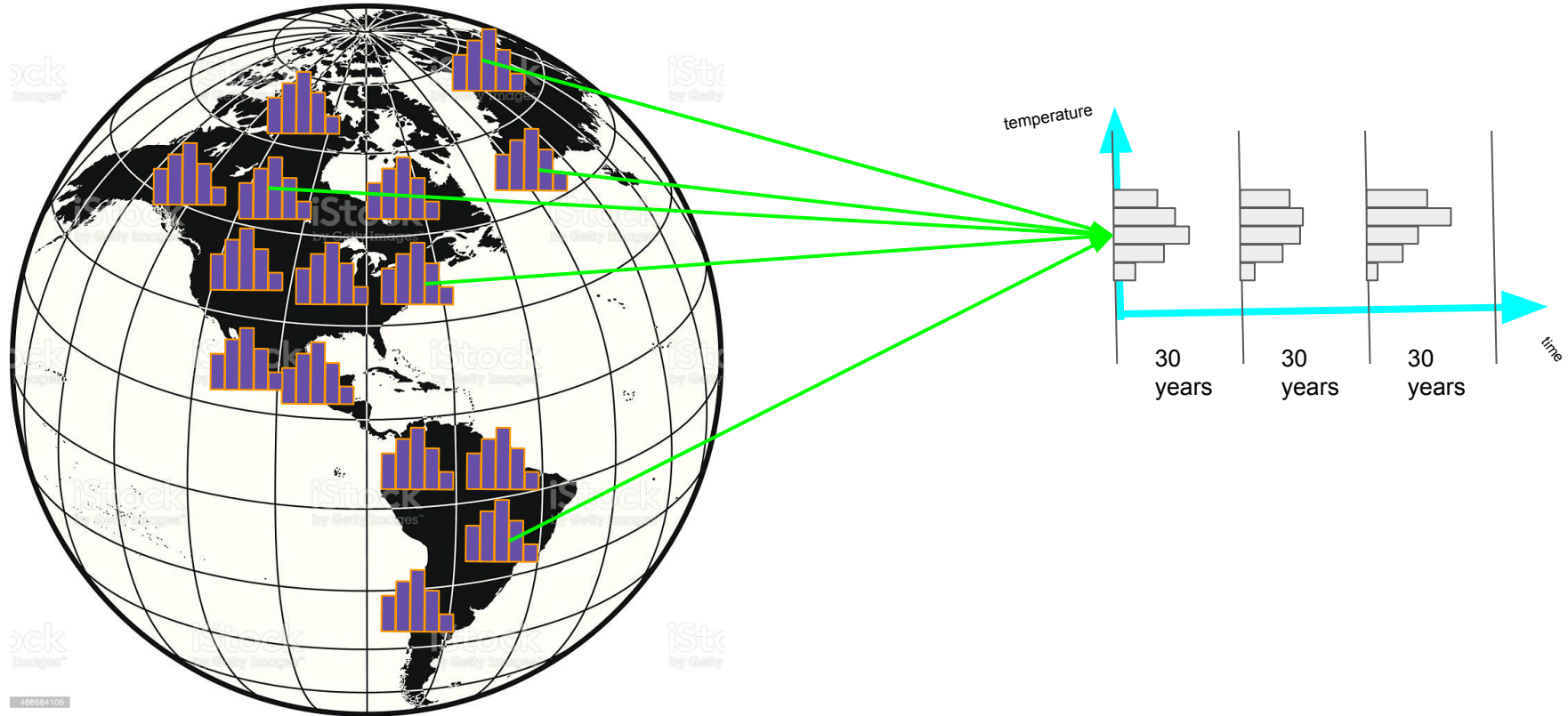
Build distribution of the variable within each slice



We do it for every grid cell



and compute weighted average proportional to the cell area



Example of the dataset: ETCCDI (Climate Change Detection and Indices)

model

CNRM-ESM2-1
ACCESS-CM2
CanESM5
MIROC6
ACCESS-ESM1-5
BCC-CSM2-MR
BCC-ESM1
CNRM-CM6-1
CNRM-CM6-1-HR
EC-Earth3-Veg

50

×

scenario

historical
ssp126
ssp245
ssp370
ssp585

5

×

init_params

r1i1p1f2
r1i1p1f1
r1i1p1f3

2 (on avg)

×

frequency

mon
yr

2

×

timespan

1850-2014
2015-2100

1

×

variable

tn10pETCCDI
suETCCDI
sdiiETCCDI
tnxETCCDI
trETCCDI
tx10pETCCDI
tx90pETCCDI
txnETCCDI
txxETCCDI
wsdiETCCDI

30

Annual Maximum of Daily Minimum Temperature

Reset filter

Filtered configurations:

CNRM-ESM2-1,historical,r1i1p1f2,yr,1850-2014,tnxETCCDI
ACCESS-CM2,historical,r1i1p1f1,yr,1850-2014,tnxETCCDI
ACCESS-CM2,ssp245,r1i1p1f1,yr,2015-2100,tnxETCCDI
CNRM-ESM2-1,ssp245,r1i1p1f2,yr,2015-2100,tnxETCCDI
HadGEM3-GC31-LL,historical,r1i1p1f3,yr,1850-2014,tnxETCCDI
HadGEM3-GC31-LL,ssp245,r1i1p1f3,yr,2015-2100,tnxETCCDI

6 out of 30 000

Example of the dataset: ETCCDI (Climate Change Detection and Indices)

model

CNRM-ESM2-1
ACCESS-CM2
CanESM5
MIROC6
ACCESS-ESM1-5
BCC-CSM2-MR
BCC-ESM1
CNRM-CM6-1
CNRM-CM6-1-HR
EC-Earth3-Veg

Reset filter

scenario

historical
ssp126
ssp245
ssp370
ssp585

init_params

r1i1p1f2
r1i1p1f1
r1i1p1f3

frequency

mon
yf

timespan

1850-2014
2015-2100

variable

tn10pETCCDI
suETCCDI
sdiiETCCDI
tnxETCCDI
trETCCDI
tx10pETCCDI
tx90pETCCDI
txnETCCDI
txxETCCDI
wsdiETCCDI

Filtered configurations:

CNRM-ESM2-1,historical,r1i1p1f2,yr,1850-2014,tnxETCCDI
ACCESS-CM2,historical,r1i1p1f1,yr,1850-2014,tnxETCCDI
ACCESS-CM2,ssp245,r1i1p1f1,yr,2015-2100,tnxETCCDI
CNRM-ESM2-1,ssp245,r1i1p1f2,yr,2015-2100,tnxETCCDI
HadGEM3-GC31-LL,historical,r1i1p1f3,yr,1850-2014,tnxETCCDI
HadGEM3-GC31-LL,ssp245,r1i1p1f3,yr,2015-2100,tnxETCCDI

Regions

SAM :: South-American-Mo
SWS :: S.W.South-America
SES :: S.E.South-America
SSA :: S.South-America
NEU :: N.Europe
WCE :: West&Central-Euro
EEU :: E.Europe
MED :: Mediterranean
SAH :: Sahara
WAF :: Western-Africa

58

Aggregate

☒ years
☒ scenarios
☒ regions
☒ models
☒ model ensembles (init_par...

Plot type

fldmean first
fldmean last
mean val
time series

Reference window size

50

Sliding window size

30

Slide step

30

+ Stage

☐ Subtract reference
☒ Normalize histograms

Example of the dataset: ETCCDI (Climate Change Detection and Indices)

model

CNRM-ESM2-1
ACCESS-CM2
CanESM5
MIROC6
ACCESS-ESM1-5
BCC-CSM2-MR
BCC-ESM1
CNRM-CM6-1
CNRM-CM6-1-HR
EC-Earth3-Veg

scenario

historical
ssp126
ssp245
ssp370
ssp585

init_params

r1i1p1f2
r1i1p1f1
r1i1p1f3

frequency

mon
yf

timespan

1850-2014
2015-2100

variable

tn10pETCCDI
suETCCDI
sdiiETCCDI
tnxETCCDI
trETCCDI
tx10pETCCDI
tx90pETCCDI
txnETCCDI
txxETCCDI
wsdiETCCDI

Reset filter

Filtered configurations:

CNRM-ESM2-1,historical,r1i1p1f2,yr,1850-2014,tnxETCCDI
ACCESS-CM2,historical,r1i1p1f1,yr,1850-2014,tnxETCCDI
ACCESS-CM2,ssp245,r1i1p1f1,yr,2015-2100,tnxETCCDI
CNRM-ESM2-1,ssp245,r1i1p1f2,yr,2015-2100,tnxETCCDI
HadGEM3-GC31-LL,historical,r1i1p1f3,yr,1850-2014,tnxETCCDI
HadGEM3-GC31-LL,ssp245,r1i1p1f3,yr,2015-2100,tnxETCCDI

Regions

SES :: S.E.South-America
SSA :: S.South-America
NEU :: N.Europe
WCE :: West&Central-Europe
EEU :: E.Europe
MED :: Mediterranean
SAH :: Sahara
WAF :: Western-Africa
CAF :: Central-Africa
NEAF :: N.Eastern-Africa

Aggregate

☒ years
☒ regions
☒ models
☒ model ensembles
☐ prefer model groups

Plot type

fldmean first
fldmean last
avg time

☐ Subtract reference
☒ Normalize histograms

Reference window size

30

+ Stage

Sliding window size

30

Slide step

30

```
{  
  "input_query": [  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "CNRM-ESM2-1",  
      "scenario": "ssp245",  
      "init_params": "r1i1p1f2",  
      "frequency": "yf",  
      "timespan": "1850-2014",  
      "variable": "tnxETCCDI"  
    },  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "ACCESS-CM2",  
      "scenario": "historical",  
      "init_params": "r1i1p1f1",  
      "frequency": "yf",  
      "timespan": "1850-2014",  
      "variable": "tnxETCCDI"  
    },  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "ACCESS-CM2",  
      "scenario": "ssp245",  
      "init_params": "r1i1p1f1",  
      "frequency": "yf",  
      "timespan": "2015-2100",  
      "variable": "tnxETCCDI"  
    },  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "CNRM-ESM2-1",  
      "scenario": "ssp245",  
      "init_params": "r1i1p1f2",  
      "frequency": "yf",  
      "timespan": "2015-2100",  
      "variable": "tnxETCCDI"  
    },  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "HadGEM3-GC31-LL",  
      "scenario": "historical",  
      "init_params": "r1i1p1f3",  
      "frequency": "yf",  
      "timespan": "1850-2014",  
      "variable": "tnxETCCDI"  
    },  
    {  
      "regions": [  
        "NEU",  
        "WCE",  
        "EEU"  
      ],  
      "model": "HadGEM3-GC31-LL",  
      "scenario": "ssp245",  
      "init_params": "r1i1p1f3",  
      "frequency": "yf",  
      "timespan": "2015-2100",  
      "variable": "tnxETCCDI"  
    }  
  ]  
}
```

Unstage

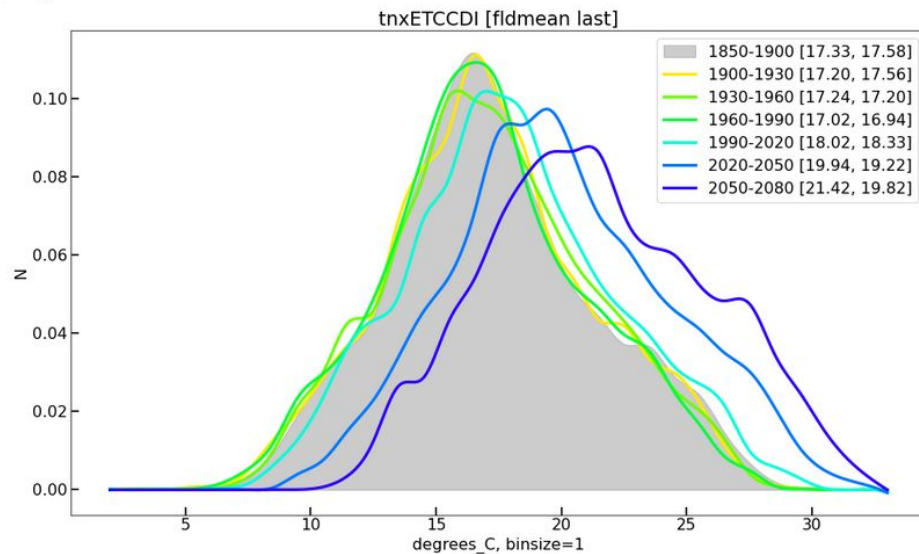
Rebuild

Example: tnxETCCDI

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  
      "CNRM-ESM2-1",  
      "ACCESS-CM2"  
    ],  
  },  
}
```

Unstage

Rebuild



Index description: Annual Maximum of Daily Minimum Temperature
Regions: NEU, WCE, EEU

What are the other plot types?

model	scenario	init_params	frequency	timespan	variable
CNRM-ESM2-1 ACCESS-CM2 CanESM5 MIROC6 ACCESS-ESM1-5 BCC-CSM2-MR BCC-ESM1 CNRM-CM6-1 CNRM-CM6-1-HR EC-Earth3-Veg	historical ssp126 ssp245 ssp370 ssp585	r1i1p1f2 r1i1p1f1 r1i1p1f3	mon yr	1850-2014 2015-2100	tn10pETCCDI suETCCDI sdiiETCCDI tnxETCCDI trETCCDI tx10pETCCDI tx90pETCCDI txnETCCDI txxETCCDI wsdiETCCDI

[Reset filter](#)

Filtered configurations:

CNRM-ESM2-1,historical,r1i1p1f2,yr,1850-2014,tnxETCCDI
ACCESS-CM2,historical,r1i1p1f1,yr,1850-2014,tnxETCCDI
ACCESS-CM2,ssp245,r1i1p1f1,yr,2015-2100,tnxETCCDI
CNRM-ESM2-1,ssp245,r1i1p1f2,yr,2015-2100,tnxETCCDI
HadGEM3-GC31-LL,historical,r1i1p1f3,yr,1850-2014,tnxETCCDI
HadGEM3-GC31-LL,ssp245,r1i1p1f3,yr,2015-2100,tnxETCCDI

Regions	Aggregate	Plot type	Reference window size	Sliding window size	Slide step
SAM :: South-American-Mo SWS :: S.W.South-America SES :: S.E.South-America SSA :: S.South-America NEU :: N.Europe WCE :: West&Central-Euro EEU :: E.Europe MED :: Mediterranean SAH :: Sahara WAF :: Western-Africa	<input checked="" type="checkbox"/> years <input checked="" type="checkbox"/> scenarios <input checked="" type="checkbox"/> regions <input checked="" type="checkbox"/> models <input checked="" type="checkbox"/> model ensembles (init_par...	<div>?</div> <div>fldmean first fldmean last mean val time series</div> <div><input type="checkbox"/> Subtract reference <input checked="" type="checkbox"/> Normalize histograms</div>	50	30	30

[+ Stage](#)

Other plot types: Mean value

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  

```

Unstage

Rebuild

Regions

GIC :: Greenland/Iceland
NWN :: N.W.North-America
NEN :: N.E.North-America
WNA :: W.North-America
CNA :: C.North-America
ENA :: E.North-America
NCA :: N.Central-America
SCA :: S.Central-America
CAR :: Caribbean
NWS :: N.W.South-America

Aggregate

- ☒ years
- ☒ scenarios
- ☒ regions
- ☒ models
- ☒ model ensembles (init_par...

Plot type

fldmean first
fldmean last
mean val
time series

- ☐ Subtract reference
- ☒ Normalize histograms

Reference window size

50

Sliding window size

30

Slide step

30

+ Stage



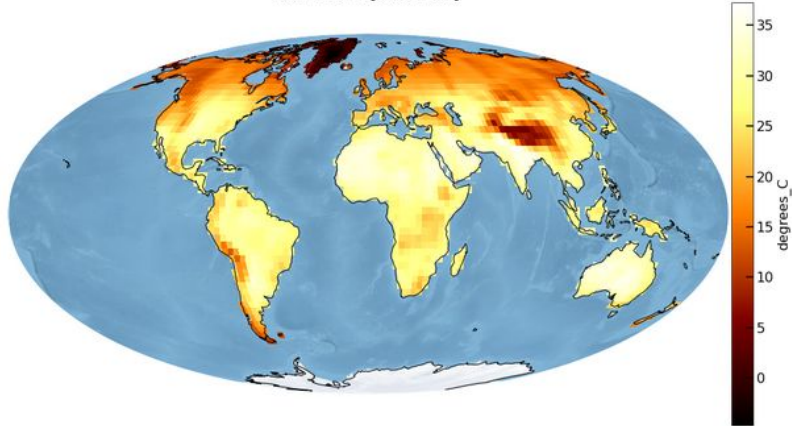
0

Index description: Annual Maximum of Daily Minimum Temperature
Regions: GIC, NWN, NEN, WNA, CNA, ENA, NCA, SCA, CAR, NWS, NSA, NES, SAM, SWS, SES,
SSA, NEU, WCE, EEU, MED, SAH, WAF, CAF, NEAF, SEAF, WSAF, ESAF, MDG, RAR, WSB, ESB,
RFE, WCA, ECA, TIB, EAS, ARP, SAS, SEA, NAU, CAU, EAU, SAU, NZ

Other plot types: Mean value

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  
      "CanESM5",  
      "ACCESS-CM2",  
      "ACCESS-ESM1-0"  
    ]  
  }  
}
```

tnxETCCDI [mean val]



Index description: Annual Maximum of Daily Minimum Temperature
Regions: GIC, NWN, NEN, WNA, CNA, ENA, NCA, SCA, CAR, NWS, NSA, NES, SAM, SWS, SES, SSA, NEU, WCE, EEU, MED, SAH, WAF, CAF, NEAF, SEAF, WSAF, ESAF, MDG, RAR, WSB, ESB, RFE, WCA, ECA, TIB, EAS, ARP, SAS, SEA, NAU, CAU, EAU, SAU, NZ

Unstage

Rebuild

Other plot types: Mean value

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  

```

Unstage

Rebuild

Regions

GIC :: Greenland/Iceland
NWN :: N.W.North-America
NEN :: N.E.North-America
WNA :: W.North-America
CNA :: C.North-America
ENA :: E.North-America
NCA :: N.Central-America
SCA :: S.Central-America
CAR :: Caribbean
NWS :: N.W.South-America

Aggregate

- ☒ years
- ☒ scenarios
- ☒ regions
- ☒ models
- ☒ model ensembles (init_par...

Plot type

fldmean first
fldmean last
mean val
time series

- ☒ Subtract reference
- ☒ Normalize histograms

Reference window size

50

Sliding window size

30

Slide step

30

+ Stage

Index description: Annual Maximum of Daily Minimum Temperature
Regions: GIC, NWN, NEN, WNA, CNA, ENA, NCA, SCA, CAR, NWS, NSA, NES, SAM, SWS, SES,
SSA, NEU, WCE, EEU, MED, SAH, WAF, CAF, NEAF, SEAF, WSAF, ESAF, MDG, RAR, WSB, ESB,
RFE, WCA, ECA, TIB, EAS, ARP, SAS, SEA, NAU, CAU, EAU, SAU, NZ

Other plot types: Mean value

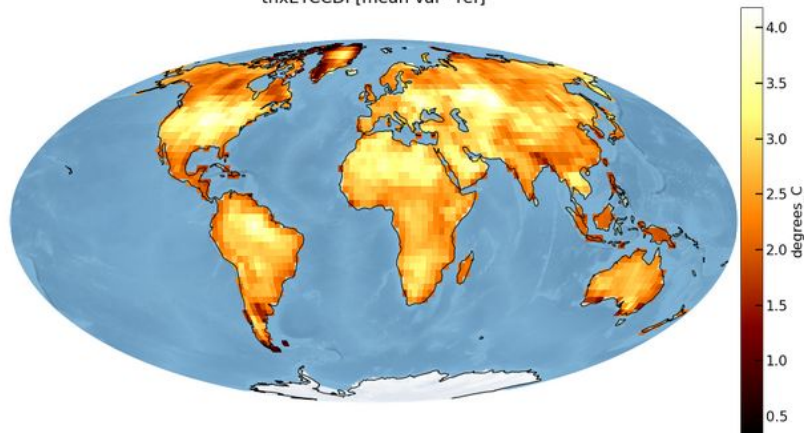
☒ Subtract reference

```
"sliding_window_size": 30,  
"slide_step": 30,  
"normalize_histograms": true,  
"colormap": "afmhot",  
"subtract_reference": true,  
"regions": [  
  "GIC",  
  "NWN",  
  "NEN".
```

Unstage

Rebuild

tnxETCCDI [mean val - ref]



Index description: Annual Maximum of Daily Minimum Temperature

Regions: GIC, NWN, NEN, WNA, CNA, ENA, NCA, SCA, CAR, NWS, NSA, NES, SAM, SWS, SES, SSA, NEU, WCE, EEU, MED, SAH, WAF, CAF, NEAF, SEAF, WSAF, ESAF, MDG, RAR, WSB, ESB, RFE, WCA, ECA, TIB, EAS, ARP, SAS, SEA, NAU, CAU, EAU, SAU, NZ

Other plot types: Time series

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  
      "CanESM5",  
      "ACCESS-CM2",  
      "ACCESS-ESM1.5"  
    ]  
  }  
}
```

Unstage

Rebuild

tnxETCCDI [time series]

Regions

GIC :: Greenland/Iceland
NWN :: N.W.North-America
NEN :: N.E.North-America
WNA :: W.North-America
CNA :: C.North-America
ENA :: E.North-America
NCA :: N.Central-America
SCA :: S.Central-America
CAR :: Caribbean
NWS :: N.W.South-America

Aggregate

- ☒ years
- ☒ scenarios
- ☒ regions
- ☒ models
- ☒ model ensembles (init_par...

Plot type

fldmean first
fldmean last
mean val
time series

- ☐ Subtract reference
- ☒ Normalize histograms

Reference window size

50

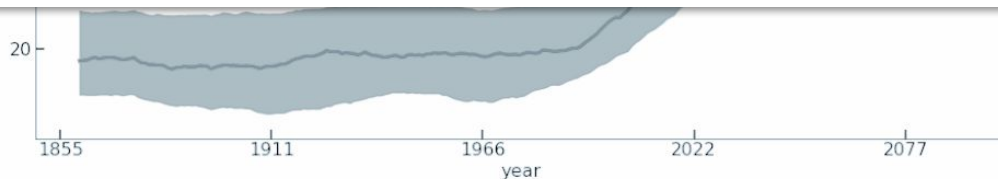
Sliding window size

30

Slide step

30

+ Stage

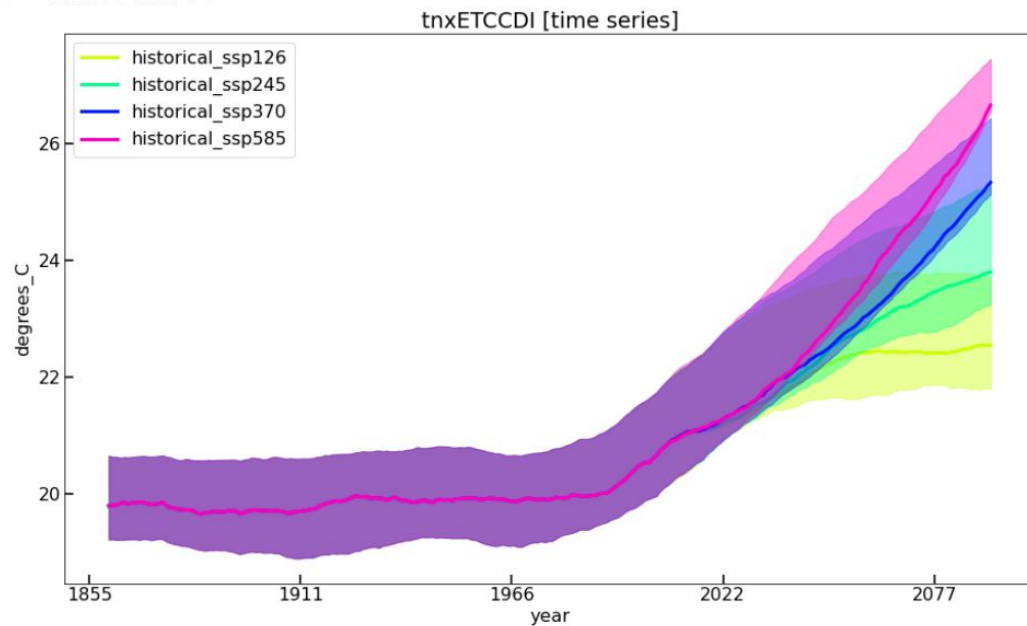


Other plot types: Time series

```
{  
  "input_query": {  
    "variable": [  
      "tnxETCCDI"  
    ],  
    "model": [  
      "CanESM5",  
      "ACCESS-CM2",  
      "ACCESS-ESM1.5"  
    ]  
  }  
}
```

Unstage

Rebuild



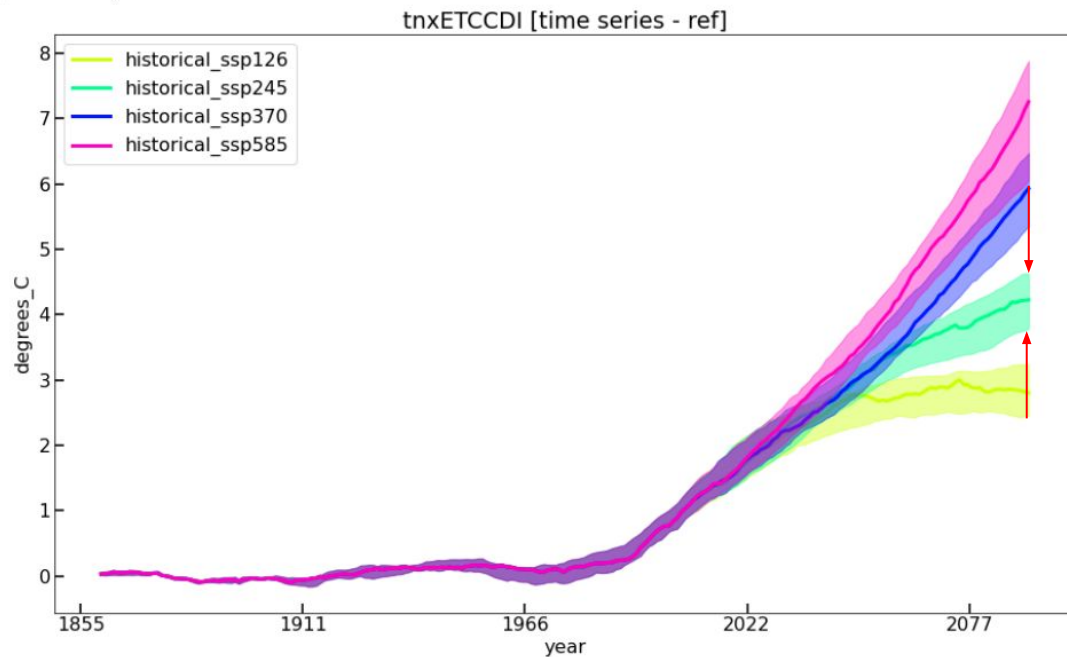
Other plot types: Time series

☒ Subtract reference

```
"sliding_window_size": 30,  
"slide_step": 30,  
"normalize_histograms": true,  
"colormap": "gist_rainbow",  
"subtract_reference": true,  
"regions": [  
  "GIC",  
  "NWN",  
  "NEN",
```

Unstage

Rebuild



Links:

User interface based on IPyWidgets inside Jupyter Notebook:

<https://github.com/vindex10/cicliminds>

Tools used for plotting, data processing, normalization and merging:

<https://github.com/vindex10/cicliminds-lib>