TempestExtremes

1 DetectCyclonesUnstructured

```
Usage: DetectCyclonesUnstructured <parameter list>
Parameters:
  --in_data <string> [""]
  --in_data_list <string> [""]
  --in_connect <string> [""]
  --out <string> [""]
  --out_file_list <string> [""]
  --searchbymin <string> [""] (default PSL)
  --searchbymax <string> [""]
  --minlon <double> [0.000000] (degrees)
  --maxlon <double> [0.000000] (degrees)
  --minlat <double> [0.000000] (degrees)
  --maxlat <double> [0.000000] (degrees)
  --topofile <string> [""]
  --maxtopoht <double> [0.000000] (m)
  --mergedist <double> [0.000000] (degrees)
  --closedcontourcmd <string> [""] [var,delta,dist,minmaxdist;...]
  --noclosedcontourcmd <string> [""] [var,delta,dist,minmaxdist;...]
  --thresholdcmd <string> [""] [var,op,value,dist;...]
  --outputcmd <string> [""] [var,op,dist;...]
  --timestride <integer> [1]
  --regional <bool> [false]
  --out_header <bool> [false]
  --verbosity <integer> [0]
```

`--in_data <string>`
A list of input datafiles in NetCDF format, separated by semi-colons.

`--in_data_list <string>`
A file containing the `--in_data` argument for a sequence of processing operations (one per line).

`--in_connect <string>`
A connectivity file, which uses a vertex list to describe the graph structure of the input grid. This parameter is not required if the data is on a latitude-longitude grid.

`--out <string>`
The output file containing the filtered list of candidates in plain text format.

`--out_file_list <string>`
A file containing the `--out` argument for a sequence of processing operations (one per line).

`--searchbymin <string>`
The input variable to use for initially selecting candidate points (defined as local minima). By default this is "PSL", representing detection of surface pressure minima. Only one of `searchbymin` and `searchbymax` may be set.

`--searchbymax <string>`
The input variable to use for initially selecting candidate points (defined as local maxima). Only one of `searchbymin` and `searchbymax` may be set.

`--minlon <double>`
The minimum longitude for candidate points.

`--maxlon <double>`
The maximum longitude for candidate points.

`--minlat <double>`
The minimum latitude for candidate points.

`--maxlat <double>`
The maximum latitude for candidate points.

`--mergedist <double>`
Merge candidate points with distance (in degrees) shorter than the specified value. Among two candidates within the merge distance, only the candidate with lowest `searchbymin` or highest `searchbymax` value will be retained.

`--closedcontourcmd <cmd1>;<cmd2>;...` Eliminate candidates if they do not have a closed contour. Closed contour commands are separated by a semi-colon. Each closed contour command takes the form `var,delta,dist,minmaxdist`. These arguments are as follows.

> `var <variable>` The variable used for the contour search.
>
> `dist <double>` The great-circle distance (in degrees) from the pivot within which the closed contour criteria must be satisfied.
>
> `delta <double>` The amount by which the field must change from the pivot value. If positive (negative) the field must increase (decrease) by this value along the contour.
>
> `minmaxdist <double>` The distance away from the candidate to search for the minima/maxima. If `delta` is positive (negative), the pivot is a local minimum (maximum).

`--noclosedcontourcmd <cmd1>;<cmd2>;...`
As `closedcontourcmd`, except eliminates candidates if a closed contour is present.

`--thresholdcmd <cmd1>;<cmd2>;...` Eliminate candidates that do not satisfy a threshold criteria (there must exist a point within a given distance of the candidate that satisfies a given equality or inequality). Threshold commands are separated by a semi-colon. Each threshold command takes the form `var,op,value,dist`. These arguments are as follows.

> `var <variable>` The variable used for the contour search.
>
> `op <string>` Operator that must be satisfied for threshold (options include `>`, `>=`, `<`, `<=`, `=`, `!=`).
>
> `value <double>` The value on the RHS of the comparison.
>
> `dist <double>` The great-circle-distance away from the candidate to search for a point that satisfies the threshold (in degrees).

`--outputcmd <cmd1>;<cmd2>;...` Include additional columns in the output file. Output commands take the form `var,op,dist`. These arguments are as follows.

> `var <variable>` The variable used for the contour search.
>
> `op <string>` Operator that is applied over all points within the specified distance of the candidate (options include `max`, `min`, `avg`, `maxdist`, `mindist`).
>
> `dist <double>` The great-circle-distance away from the candidate wherein the operator is applied (in degrees).

`--timestride <integer>`
Only examine discrete times at the given stride (by default 1).

`--regional`
When a latitude-longitude grid is employed, do not assume longitudinal boundaries to be periodic.

`--out_header`
Output a header describing the columns of the data file.

`--verbosity <integer>`
Set the verbosity level (default 0).

1.1 Variable Specification

Quantities of type `<variable>` include both NetCDF variables in the input file (for example, "Z850") and simple operations performed on those variables. By default it is assumed that NetCDF variables are specified in the `.nc` file as

`float Z850(time, lat, lon)` or `float Z850(time, ncol)`

for structured latitude-longitude grids and unstructured grids, respectively. If variables have no time variable, they have the related specification

`float Z850(lat, lon)` or `float Z850(ncol)`

If variables include an additional dimension, for instance,

`float Z(time, lev, lat, lon)` or `float Z(time, lev, ncol)`

they may be specified on the command-line as `Z(<lev>)`, where the integer index `<lev>` corresponds to the first dimension (or the dimension after `time`, if present).

Simple operators are also supported, including

`_ABS(<variable>)` Absolute value of a variable,

`_AVG(<variable>, <variable>)` Pointwise average of variables,

`_DIFF(<variable>, <variable>)` Pointwise difference of variables,

`_F()` Coriolis parameter,

`_MEAN(<variable>, <distance>)` Spatial mean over a given radius,

`_PLUS(<variable>, <variable>)` Pointwise sum of variables,

`_VECMAG(<variable>, <variable>)` 2-component vector magnitude.

For instance, the following are valid examples of `<variable>` type,

`_MEAN(PSL,2.0)`, `_VECMAG(U850, V850)` and `_DIFF(U(3),U(5))`.

1.2 MPI Support

The `DetectCyclonesUnstructured` executable supports parallelization via MPI when the `--in_data_list` argument is specified. When enabled, the parallelization procedure simply distributes the processing operations evenly among available MPI threads.

2 StitchNodes

```
Usage: StitchNodes <parameter list>
Parameters:
  --in <string> [""]
  --out <string> [""]
  --format <string> ["no,i,j,lon,lat"]
  --range <double> [5.000000] (degrees)
  --minlength <integer> [3]
  --min_endpoint_dist <double> [0.000000] (degrees)
  --min_path_dist <double> [0.000000] (degrees)
  --maxgap <integer> [0]
  --threshold <string> [""] [col,op,value,count;...]
  --timestride <integer> [1]
  --out_format <string> ["std"] (std|visit)
```

`--in <string>`
The input file (a list of candidates from DetectCyclonesUnstructured).

`--out <string>`
The output file containing the filtered list of candidates in plain text format.

`--format <string>`
The structure of the columns of the input file.

`--range <double>`
The maximum distance between candidates along a path.

`--minlength <integer>`
The minimum length of a path (in terms of number of discrete times).

`--min_endpoint_dist <double>`
The minimum great-circle distance between the first candidate on a path and the last candidate (in degrees).

`--min_path_dist <double>`
The minimum path length, defined as the sum of all great-circle distances between candidate nodes (in degrees).

`--maxgap <integer>`
The largest gap (missing candidate nodes) along the path (in discrete time points).

`--threshold <cmd1>;<cmd2>;...`
Eliminate paths that do not satisfy a threshold criteria (a specified number of candidates along path must satisfy an equality or inequality). Threshold commands are separated by a semi-colon. Each threshold command takes the form `col,op,value,count`. These arguments are as follows.

- `col <integer>` The column in the input file to use in the threshold criteria.
- `op <string>` Operator used for comparison of column value (options include `>`, `>=`, `<`, `<=`, `=`, `!=`).
- `value <double>` The value on the right-hand-side of the operator.
- `count <integer>` The minimum number of candidates along the path that must satisfy this criteria.

`--timestride <integer>`
Only examine discrete times at the given stride (by default 1).