CDI Fortran Manual

Climate Data Interface
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Contents

1. Introduction

CDI is an Interface to access Climate and forecast model Data. The interface is independent from a specific data format and has a C and Fortran API. **CDI** was developed for a fast and machine independent access to GRIB and NetCDF datasets with the same interface. The local MPI-MET data formats SERVICE, EXTRA and IEG are also supported.

1.1. Building from sources

This section describes how to build the **CDI** library from the sources on a UNIX system. **CDI** is using the GNU configure and build system to compile the source code. The only requirement is a working ANSI C99 compiler.
First go to the `download` page (`https://code.mpimet.mpg.de/projects/cdi/files`) to get the latest distribution, if you do not already have it.
To take full advantage of **CDI**'s features the following additional libraries should be installed:

- Unidata NetCDF library (`http://www.unidata.ucar.edu/packages/netcdf`) version 3 or higher. This is needed to read/write NetCDF files with **CDI**.
- ECMWF ecCodes library (`https://software.ecmwf.int/wiki/display/ECC/ecCodes+Home`) version 2.3.0 or higher. This library is needed to encode/decode GRIB2 records with **CDI**.

1.1.1. Compilation

Compilation is now done by performing the following steps:

1. Unpack the archive, if you haven't already done that:

```
gunzip cdi-$VERSION.tar.gz    # uncompress the archive
tar xf cdi-$VERSION.tar       # unpack it
cd cdi-$VERSION
```

2. Run the configure script:

```
./configure
```

Or optionally with NetCDF support:

```
./configure --with-netcdf=<NetCDF root directory>
```

For an overview of other configuration options use

```
./configure --help
```

3. Compile the program by running make:

```
make
```

The software should compile without problems and the **CDI** library (`libcdi.a`) should be available in the `src` directory of the distribution.

1.1.2. Installation

After the compilation of the source code do a make install, possibly as root if the destination permissions require that.

```
make install
```

The library is installed into the directory <prefix>/lib. The C and Fortran include files are installed into the directory <prefix>/include. <prefix> defaults to /usr/local but can be changed with the --prefix option of the configure script.

2. File Formats

2.1. GRIB

GRIB [GRIB] (GRIdded Binary) is a standard format designed by the World Meteorological Organization (WMO) to support the efficient transmission and storage of gridded meteorological data.

A GRIB record consists of a series of header sections, followed by a bitstream of packed data representing one horizontal grid of data values. The header sections are intended to fully describe the data included in the bitstream, specifying information such as the parameter, units, and precision of the data, the grid system and level type on which the data is provided, and the date and time for which the data are valid.

Non-numeric descriptors are enumerated in tables, such that a 1-byte code in a header section refers to a unique description. The WMO provides a standard set of enumerated parameter names and level types, but the standard also allows for the definition of locally used parameters and geometries. Any activity that generates and distributes GRIB records must also make their locally defined GRIB tables available to users.

The GRIB records must be sorted by time to be able to read them correctly with **CDI**.

CDI does not support the full GRIB standard. The following data representation and level types are implemented:

GRIB1 grid type	GRIB2 template	GRIB_API name	description
0	3.0	regular_ll	Regular longitude/latitude grid
3	–	lambert	Lambert conformal grid
4	3.40	regular_gg	Regular Gaussian longitude/latitude grid
4	3.40	reduced_gg	Reduced Gaussian longitude/latitude grid
10	3.1	rotated_ll	Rotated longitude/latitude grid
50	3.50	sh	Spherical harmonic coefficients
192	3.100	–	Icosahedral-hexagonal GME grid
–	3.101	–	General unstructured grid

GRIB1 level type	GRIB2 level type	GRIB_API name	description
1	1	surface	Surface level
2	2	cloudBase	Cloud base level
3	3	cloudTop	Level of cloud tops
4	4	isothermZero	Level of 0° C isotherm
8	8	nominalTop	Norminal top of atmosphere
9	9	seaBottom	Sea bottom
10	10	entireAtmosphere	Entire atmosphere
100	100	isobaricInhPa	Isobaric level in hPa
102	101	meanSea	Mean sea level
103	102	heightAboveSea	Altitude above mean sea level
105	103	heightAboveGround	Height level above ground
107	104	sigma	Sigma level
109	105	hybrid	Hybrid level
110	105	hybridLayer	Layer between two hybrid levels
111	106	depthBelowLand	Depth below land surface
112	106	depthBelowLandLayer	Layer between two depths below land surface
113	107	theta	Isentropic (theta) level
–	114	–	Snow level
160	160	depthBelowSea	Depth below sea level
162	162	–	Lake or River Bottom
163	163	–	Bottom Of Sediment Layer
164	164	–	Bottom Of Thermally Active Sediment Layer
165	165	–	Bottom Of Sediment Layer Penetrated By Thermal Wave
166	166	–	Mixing Layer
210	–	isobaricInPa	Isobaric level in Pa

2.1.1. GRIB edition 1

GRIB1 is implemented in **CDI** as an internal library and enabled per default. The internal GRIB1 library is called CGRIBEX. This is a lightweight version of the ECMWF GRIBEX library. CGRIBEX is written in ANSI C with a portable Fortran interface. The configure option `--disable-cgribex` will disable the encoding/decoding of GRIB1 records with CGRIBEX.

2.1.2. GRIB edition 2

GRIB2 is available in **CDI** via the ECMWF ecCodes [ecCodes] library. ecCodes is an external library and not part of **CDI**. To use GRIB2 with **CDI** the ecCodes library must be installed before the configuration of the **CDI** library. Use the configure option `--with-eccodes` to enable GRIB2 support.
The ecCodes library is also used to encode/decode GRIB1 records if the support for the CGRIBEX library is disabled. This feature is not tested regulary and the status is experimental!
A single GRIB2 message can contain multiple fields. This feature is not supported in **CDI**!

2.2. NetCDF

NetCDF [NetCDF] (Network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The NetCDF library also defines

a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data.
CDI only supports the classic data model of NetCDF and arrays up to 4 dimensions. These dimensions should only be used by the horizontal and vertical grid and the time. The NetCDF attributes should follow the GDT, COARDS or CF Conventions.
NetCDF is an external library and not part of **CDI**. To use NetCDF with **CDI** the NetCDF library must be installed before the configuration of the **CDI** library. Use the configure option `--with-netcdf` to enable NetCDF support (see Build).

2.3. SERVICE

SERVICE is the binary exchange format of the atmospheric general circulation model ECHAM [ECHAM]. It has a header section with 8 integer values followed by the data section. The header and the data section have the standard Fortran blocking for binary data records. A SERVICE record can have an accuracy of 4 or 8 bytes and the byteorder can be little or big endian. In **CDI** the accuracy of the header and data section must be the same. The following Fortran code example can be used to read a SERVICE record with an accuracy of 4 bytes:

```
INTEGER*4 icode,ilevel,idate,itime,nlon,nlat,idispo1,idispo2
REAL*4 field(mlon,mlat)
   ...
READ(unit) icode,ilevel,idate,itime,nlon,nlat,idispo1,idispo2
READ(unit) ((field(ilon,ilat), ilon=1,nlon), ilat=1,nlat)
```

The constants `mlon` and `mlat` must be greater or equal than `nlon` and `nlat`. The meaning of the variables are:

`icode`	The code number
`ilevel`	The level
`idate`	The date as YYYYMMDD
`itime`	The time as hhmmss
`nlon`	The number of longitudes
`nlat`	The number of latitides
`idispo1`	For the users disposal (Not used in **CDI**)
`idispo2`	For the users disposal (Not used in **CDI**)

SERVICE is implemented in **CDI** as an internal library and enabled per default. The configure option `--disable-service` will disable the support for the SERVICE format.

2.4. EXTRA

EXTRA is the standard binary output format of the ocean model MPIOM [MPIOM]. It has a header section with 4 integer values followed by the data section. The header and the data section have the standard Fortran blocking for binary data records. An EXTRA record can have an accuracy of 4 or 8 bytes and the byteorder can be little or big endian. In **CDI** the accuracy of the header and data section must be the same. The following Fortran code example can be used to read an EXTRA record with an accuracy of 4 bytes:

```
INTEGER*4 idate,icode,ilevel,nsize
REAL*4 field(msize)
   ...
READ(unit) idate,icode,ilevel,nsize
READ(unit) (field(isize),isize=1,nsize)
```

The constant `msize` must be greater or equal than `nsize`. The meaning of the variables are:

`idate`	The date as YYYYMMDD
`icode`	The code number
`ilevel`	The level
`nsize`	The size of the field

EXTRA is implemented in **CDI** as an internal library and enabled per default. The configure option `--disable-extra` will disable the support for the EXTRA format.

2.5. IEG

IEG is the standard binary output format of the regional model REMO [REMO]. It is simple an unpacked GRIB edition 1 format. The product and grid description sections are coded with 4 byte integer values and the data section can have 4 or 8 byte IEEE floating point values. The header and the data section have the standard Fortran blocking for binary data records. The IEG format has a fixed size of 100 for the vertical coordinate table. That means it is not possible to store more than 50 model levels with this format. **CDI** supports only data on Gaussian and LonLat grids for the IEG format.
IEG is implemented in **CDI** as an internal library and enabled per default. The configure option `--disable-ieg` will disable the support for the IEG format.

3. Use of the CDI Library

This chapter provides templates of common sequences of **CDI** calls needed for common uses. For clarity only the names of routines are used. Declarations and error checking were omitted. Statements that are typically invoked multiple times were indented and ... is used to represent arbitrary sequences of other statements. Full parameter lists are described in later chapters. Complete examples for write, read and copy a dataset with **CDI** can be found in Appendix B.

3.1. Creating a dataset

Here is a typical sequence of **CDI** calls used to create a new dataset:

```
gridCreate           ! create a horizontal Grid: from type and size
   ...
zaxisCreate          ! create a vertical Z-axis: from type and size
   ...
taxisCreate          ! create a Time axis: from type
   ...
vlistCreate          ! create a variable list
      ...
   vlistDefVar       ! define variables: from Grid and Z-axis
      ...
streamOpenWrite      ! create a dataset: from name and file type
   ...
streamDefVlist       ! define variable list
   ...
streamDefTimestep    ! define time step
      ...
   streamWriteVar    ! write variable
      ...
streamClose          ! close the dataset
   ...
vlistDestroy         ! destroy the variable list
   ...
taxisDestroy         ! destroy the Time axis
   ...
zaxisDestroy         ! destroy the Z-axis
   ...
gridDestroy          ! destroy the Grid
```

3.2. Reading a dataset

Here is a typical sequence of **CDI** calls used to read a dataset:

```
streamOpenRead       ! open existing dataset
   ...
streamInqVlist       ! find out what is in it
      ...
   vlistInqVarGrid   ! get an identifier to the Grid
      ...
```

```
        vlistInqVarZaxis   ! get an identifier to the Z-axis
            ...
        vlistInqTaxis      ! get an identifier to the T-axis
            ...
    streamInqTimestep      ! get time step
            ...
        streamReadVar      ! read varible
            ...
    streamClose            ! close the dataset
```

3.3. Compiling and Linking with the CDI library

Details of how to compile and link a program that uses the **CDI** C or FORTRAN interfaces differ, depending on the operating system, the available compilers, and where the **CDI** library and include files are installed. Here are examples of how to compile and link a program that uses the **CDI** library on a Unix platform, so that you can adjust these examples to fit your installation. There are two different interfaces for using **CDI** functions in Fortran: `cfortran.h` and the instrinsic `iso_c_binding` module from Fortran 2003 standard. At first, the preparations for compilers without F2003 capabilities are described.

Every FORTRAN file that references **CDI** functions or constants must contain an appropriate `INCLUDE` statement before the first such reference:

```
INCLUDE "cdi.inc"
```

Unless the `cdi.inc` file is installed in a standard directory where FORTRAN compiler always looks, you must use the `-I` option when invoking the compiler, to specify a directory where `cdi.inc` is installed, for example:

```
f77 -c -I/usr/local/cdi/include myprogram.f
```

Alternatively, you could specify an absolute path name in the `INCLUDE` statement, but then your program would not compile on another platform where **CDI** is installed in a different location.
Unless the **CDI** library is installed in a standard directory where the linker always looks, you must use the `-L` and `-l` options to links an object file that uses the **CDI** library. For example:

```
f77 -o myprogram myprogram.o -L/usr/local/cdi/lib -lcdi
```

Alternatively, you could specify an absolute path name for the library:

```
f77 -o myprogram myprogram.o -L/usr/local/cdi/lib/libcdi
```

If the **CDI** library is using other external libraries, you must add this libraries in the same way. For example with the NetCDF library:

```
f77 -o myprogram myprogram.o -L/usr/local/cdi/lib -lcdi \
                             -L/usr/local/netcdf/lib -lnetcdf
```

For using the `iso_c_bindings` two things are necessary in a program or module

```
USE ISO_C_BINDING
USE mo_cdi
```

The `iso_c_binding` module is included in `mo_cdi`, but without `cfortran.h` characters and character variables have to be handled separately. Examples are available in section B.4.
After installation `mo_cdi.o` and `mo_cdi.mod` are located in the library and header directory respectively. `cdilib.o` has to be mentioned directly on the command line. It can be found in the library directory, too. Depending on the **CDI** configuration, a compile command should look like this:

```
nagf95 -f2003 -g cdi_read_f2003.f90 -L/usr/lib -lnetcdf -o cdi_read_example
                                    -I/usr/local/include
                                    /usr/local/lib/cdilib.o /usr/local/lib/mo_cdi.o
```

4. CDI modules

4.1. Dataset functions

This module contains functions to read and write the data. To create a new dataset the output format must be specified with one of the following predefined file format types:

CDI_FILETYPE_GRB	File type GRIB version 1
CDI_FILETYPE_GRB2	File type GRIB version 2
CDI_FILETYPE_NC	File type NetCDF
CDI_FILETYPE_NC2	File type NetCDF version 2 (64-bit offset)
CDI_FILETYPE_NC4	File type NetCDF-4 (HDF5)
CDI_FILETYPE_NC4C	File type NetCDF-4 classic
CDI_FILETYPE_NC5	File type NetCDF version 5 (64-bit data)
CDI_FILETYPE_NCZARR	File type NetCDF NCZarr
CDI_FILETYPE_SRV	File type SERVICE
CDI_FILETYPE_EXT	File type EXTRA
CDI_FILETYPE_IEG	File type IEG

CDI_FILETYPE_GRB2 is only available if the **CDI** library was compiled with ecCodes support and all NetCDF file types are only available if the **CDI** library was compiled with NetCDF support!
To set the byte order of a binary dataset with the file format type CDI_FILETYPE_SRV, CDI_FILETYPE_EXT or CDI_FILETYPE_IEG use one of the following predefined constants in the call to streamDefByteorder:

CDI_BIGENDIAN	Byte order big endian
CDI_LITTLEENDIAN	Byte order little endian

4.1.1. Create a new dataset: streamOpenWrite

The function streamOpenWrite creates a new datset.

Usage

```
INTEGER FUNCTION streamOpenWrite(CHARACTER*(*) path, INTEGER filetype)
```

path	The name of the new dataset.
filetype	The type of the file format, one of the set of predefined **CDI** file format types. The valid **CDI** file format types are CDI_FILETYPE_GRB, CDI_FILETYPE_GRB2, CDI_FILETYPE_NC, CDI_FILETYPE_NC2, CDI_FILETYPE_NC4, CDI_FILETYPE_NC4C, CDI_FILETYPE_NC5, CDI_FILETYPE_NCZARR, CDI_FILETYPE_SRV, CDI_FILETYPE_EXT and CDI_FILETYPE_IEG.

Result

Upon successful completion streamOpenWrite returns an identifier to the open stream. Otherwise, a negative number with the error status is returned.

Errors

CDI_ESYSTEM	Operating system error.
CDI_EINVAL	Invalid argument.
CDI_EUFILETYPE	Unsupported file type.
CDI_ELIBNAVAIL	Library support not compiled in.

Example

Here is an example using `streamOpenWrite` to create a new NetCDF file named `foo.nc` for writing:

```
INCLUDE 'cdi.inc'
   ...
INTEGER streamID
   ...
streamID = streamOpenWrite("foo.nc", CDI_FILETYPE_NC)
IF ( streamID .LT. 0 ) CALL handle_error(streamID)
   ...
```

4.1.2. Open a dataset for reading: `streamOpenRead`

The function `streamOpenRead` opens an existing dataset for reading.

Usage

```
INTEGER FUNCTION streamOpenRead(CHARACTER*(*) path)
```

path	The name of the dataset to be read.

Result

Upon successful completion `streamOpenRead` returns an identifier to the open stream. Otherwise, a negative number with the error status is returned.

Errors

CDI_ESYSTEM	Operating system error.
CDI_EINVAL	Invalid argument.
CDI_EUFILETYPE	Unsupported file type.
CDI_ELIBNAVAIL	Library support not compiled in.

Example

Here is an example using `streamOpenRead` to open an existing NetCDF file named `foo.nc` for reading:

```
INCLUDE 'cdi.inc'
   ...
INTEGER streamID
   ...
streamID = streamOpenRead("foo.nc")
IF ( streamID .LT. 0 ) CALL handle_error(streamID)
   ...
```

4.1.3. Close an open dataset: `streamClose`

The function `streamClose` closes an open dataset.

Usage

```
SUBROUTINE streamClose(INTEGER streamID)
```

`streamID` Stream ID, from a previous call to `streamOpenRead` or `streamOpenWrite`.

4.1.4. Get the filetype: `streamInqFiletype`

The function `streamInqFiletype` returns the filetype of a stream.

Usage

```
INTEGER FUNCTION streamInqFiletype(INTEGER streamID)
```

`streamID` Stream ID, from a previous call to `streamOpenRead` or `streamOpenWrite`.

Result

`streamInqFiletype` returns the type of the file format, one of the set of predefined **CDI** file format types. The valid **CDI** file format types are `CDI_FILETYPE_GRB`, `CDI_FILETYPE_GRB2`, `CDI_FILETYPE_NC`, `CDI_FILETYPE_NC2`, `CDI_FILETYPE_NC4`, `CDI_FILETYPE_NC4C`, `CDI_FILETYPE_NC5`, `CDI_FILETYPE_NCZARR`, `CDI_FILETYPE_SRV`, `CDI_FILETYPE_EXT` and `CDI_FILETYPE_IEG`.

4.1.5. Define the byte order: `streamDefByteorder`

The function `streamDefByteorder` defines the byte order of a binary dataset with the file format type `CDI_FILETYPE_SRV`, `CDI_FILETYPE_EXT` or `CDI_FILETYPE_IEG`.

Usage

```
SUBROUTINE streamDefByteorder(INTEGER streamID, INTEGER byteorder)
```

`streamID` Stream ID, from a previous call to `streamOpenWrite`.

`byteorder` The byte order of a dataset, one of the **CDI** constants `CDI_BIGENDIAN` and `CDI_LITTLEENDIAN`.

4.1.6. Get the byte order: `streamInqByteorder`

The function `streamInqByteorder` returns the byte order of a binary dataset with the file format type `CDI_FILETYPE_SRV`, `CDI_FILETYPE_EXT` or `CDI_FILETYPE_IEG`.

Usage

```
INTEGER FUNCTION streamInqByteorder(INTEGER streamID)
```

`streamID` Stream ID, from a previous call to `streamOpenRead` or `streamOpenWrite`.

Result

`streamInqByteorder` returns the type of the byte order. The valid **CDI** byte order types are `CDI_BIGENDIAN` and `CDI_LITTLEENDIAN`

4.1.7. Define the variable list: `streamDefVlist`

The function `streamDefVlist` defines the variable list of a stream.
To safeguard against errors by modifying the wrong vlist object, this function makes the passed vlist object immutable. All further vlist changes have to use the vlist object returned by streamInqVlist().

Usage

```
SUBROUTINE streamDefVlist(INTEGER streamID, INTEGER vlistID)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`vlistID`	Variable list ID, from a previous call to `vlistCreate`.

4.1.8. Get the variable list: `streamInqVlist`

The function `streamInqVlist` returns the variable list of a stream.

Usage

```
INTEGER FUNCTION streamInqVlist(INTEGER streamID)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead` or `streamOpenWrite`.

Result

`streamInqVlist` returns an identifier to the variable list.

4.1.9. Define a timestep: `streamDefTimestep`

The function `streamDefTimestep` defines a timestep of a stream by the identifier tsID. The identifier tsID is the timestep index starting at 0 for the first timestep. Before calling this function the functions `taxisDefVdate` and `taxisDefVtime` should be used to define the timestamp for this timestep. All calls to write the data refer to this timestep.

Usage

```
INTEGER FUNCTION streamDefTimestep(INTEGER streamID, INTEGER tsID)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`tsID`	Timestep identifier.

Result

`streamDefTimestep` returns the number of expected records of the timestep.

4.1.10. Get timestep information: `streamInqTimestep`

The function `streamInqTimestep` sets the next timestep to the identifier tsID. The identifier tsID is the timestep index starting at 0 for the first timestep. After a call to this function the functions `taxisInqVdate` and `taxisInqVtime` can be used to read the timestamp for this timestep. All calls to read the data refer to this timestep.

Usage

```
INTEGER FUNCTION streamInqTimestep(INTEGER streamID, INTEGER tsID)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead` or `streamOpenWrite`.
`tsID`	Timestep identifier.

Result

`streamInqTimestep` returns the number of records of the timestep or 0, if the end of the file is reached.

4.1.11. Write a variable: `streamWriteVar`

The function streamWriteVar writes the values of one time step of a variable to an open dataset. The values are converted to the external data type of the variable, if necessary.

Usage

```
SUBROUTINE streamWriteVar(INTEGER streamID, INTEGER varID, REAL*8 data,
                          INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`varID`	Variable identifier.
`data`	Pointer to a block of double precision floating point data values to be written.
`numMissVals`	Number of missing values.

4.1.12. Write a variable: `streamWriteVarF`

The function streamWriteVarF writes the values of one time step of a variable to an open dataset. The values are converted to the external data type of the variable, if necessary.

Usage

```
SUBROUTINE streamWriteVarF(INTEGER streamID, INTEGER varID, REAL*4 data,
                           INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`varID`	Variable identifier.
`data`	Pointer to a block of single precision floating point data values to be written.
`numMissVals`	Number of missing values.

4.1.13. Write a horizontal slice of a variable: `streamWriteVarSlice`

The function streamWriteVarSlice writes the values of a horizontal slice of a variable to an open dataset. The values are converted to the external data type of the variable, if necessary.

Usage

```
SUBROUTINE streamWriteVarSlice(INTEGER streamID, INTEGER varID, INTEGER levelID,
                               REAL*8 data, INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`varID`	Variable identifier.
`levelID`	Level identifier.
`data`	Pointer to a block of double precision floating point data values to be written.
`numMissVals`	Number of missing values.

4.1.14. Write a horizontal slice of a variable: `streamWriteVarSliceF`

The function streamWriteVarSliceF writes the values of a horizontal slice of a variable to an open dataset. The values are converted to the external data type of the variable, if necessary.

Usage

```
SUBROUTINE streamWriteVarSliceF(INTEGER streamID, INTEGER varID, INTEGER levelID,
                                REAL*4 data, INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenWrite`.
`varID`	Variable identifier.
`levelID`	Level identifier.
`data`	Pointer to a block of single precision floating point data values to be written.
`numMissVals`	Number of missing values.

4.1.15. Read a variable: `streamReadVar`

The function streamReadVar reads all the values of one time step of a variable from an open dataset.

Usage

```
SUBROUTINE streamReadVar(INTEGER streamID, INTEGER varID, REAL*8 data,
                         INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead`.
`varID`	Variable identifier.
`data`	Pointer to the location into which the data values are read. The caller must allocate space for the returned values.
`numMissVals`	Number of missing values.

4.1.16. Read a variable: `streamReadVarF`

The function streamReadVar reads all the values of one time step of a variable from an open dataset.

Usage

```
SUBROUTINE streamReadVar(INTEGER streamID, INTEGER varID, REAL*4 data,
                         INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead`.
`varID`	Variable identifier.
`data`	Pointer to the location into which the data values are read. The caller must allocate space for the returned values.
`numMissVals`	Number of missing values.

4.1.17. Read a horizontal slice of a variable: `streamReadVarSlice`

The function streamReadVarSlice reads all the values of a horizontal slice of a variable from an open dataset.

Usage

```
SUBROUTINE streamReadVarSlice(INTEGER streamID, INTEGER varID, INTEGER levelID,
                              REAL*8 data, INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead`.
`varID`	Variable identifier.
`levelID`	Level identifier.
`data`	Pointer to the location into which the data values are read. The caller must allocate space for the returned values.
`numMissVals`	Number of missing values.

4.1.18. Read a horizontal slice of a variable: `streamReadVarSliceF`

The function streamReadVarSliceF reads all the values of a horizontal slice of a variable from an open dataset.

Usage

```
SUBROUTINE streamReadVarSliceF(INTEGER streamID, INTEGER varID, INTEGER levelID,
                               REAL*4 data, INTEGER numMissVals)
```

`streamID`	Stream ID, from a previous call to `streamOpenRead`.
`varID`	Variable identifier.
`levelID`	Level identifier.
`data`	Pointer to the location into which the data values are read. The caller must allocate space for the returned values.
`numMissVals`	Number of missing values.

4.2. Variable list functions

This module contains functions to handle a list of variables. A variable list is a collection of all variables of a dataset.

4.2.1. Create a variable list: vlistCreate

Usage

```
INTEGER FUNCTION vlistCreate()
```

Example

Here is an example using `vlistCreate` to create a variable list and add a variable with `vlistDefVar`.

```
INCLUDE 'cdi.inc'
   ...
INTEGER vlistID, varID
   ...
vlistID = vlistCreate()
varID = vlistDefVar(vlistID, gridID, zaxisID, TIME_VARYING)
   ...
streamDefVlist(streamID, vlistID)
   ...
vlistDestroy(vlistID)
   ...
```

4.2.2. Destroy a variable list: vlistDestroy

Usage

```
SUBROUTINE vlistDestroy(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate`.

4.2.3. Copy a variable list: vlistCopy

The function `vlistCopy` copies all entries from vlistID1 to vlistID2.

Usage

```
SUBROUTINE vlistCopy(INTEGER vlistID2, INTEGER vlistID1)
```

`vlistID2` Target variable list ID.

`vlistID1` Source variable list ID.

4.2.4. Duplicate a variable list: vlistDuplicate

The function `vlistDuplicate` duplicates the variable list from vlistID1.

Usage

```
INTEGER FUNCTION vlistDuplicate(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

Result

`vlistDuplicate` returns an identifier to the duplicated variable list.

4.2.5. Concatenate two variable lists: `vlistCat`

Concatenate the variable list vlistID1 at the end of vlistID2.

Usage

```
SUBROUTINE vlistCat(INTEGER vlistID2, INTEGER vlistID1)
```

`vlistID2` Target variable list ID.

`vlistID1` Source variable list ID.

4.2.6. Copy some entries of a variable list: `vlistCopyFlag`

The function `vlistCopyFlag` copies all entries with a flag from vlistID1 to vlistID2.

Usage

```
SUBROUTINE vlistCopyFlag(INTEGER vlistID2, INTEGER vlistID1)
```

`vlistID2` Target variable list ID.

`vlistID1` Source variable list ID.

4.2.7. Number of variables in a variable list: `vlistNvars`

The function `vlistNvars` returns the number of variables in the variable list vlistID.

Usage

```
INTEGER FUNCTION vlistNvars(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

Result

`vlistNvars` returns the number of variables in a variable list.

4.2.8. Number of grids in a variable list: `vlistNgrids`

The function `vlistNgrids` returns the number of grids in the variable list vlistID.

Usage

```
INTEGER FUNCTION vlistNgrids(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

Result

`vlistNgrids` returns the number of grids in a variable list.

4.2.9. Number of zaxis in a variable list: `vlistNzaxis`

The function `vlistNzaxis` returns the number of zaxis in the variable list vlistID.

Usage

```
INTEGER FUNCTION vlistNzaxis(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

Result

`vlistNzaxis` returns the number of zaxis in a variable list.

4.2.10. Define the time axis: `vlistDefTaxis`

The function `vlistDefTaxis` defines the time axis of a variable list.

Usage

```
SUBROUTINE vlistDefTaxis(INTEGER vlistID, INTEGER taxisID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate`.

`taxisID` Time axis ID, from a previous call to `taxisCreate`.

4.2.11. Get the time axis: `vlistInqTaxis`

The function `vlistInqTaxis` returns the time axis of a variable list.

Usage

```
INTEGER FUNCTION vlistInqTaxis(INTEGER vlistID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

Result

`vlistInqTaxis` returns an identifier to the time axis.

4.3. Variable functions

This module contains functions to add new variables to a variable list and to get information about variables from a variable list. To add new variables to a variables list one of the following timestep types must be specified:

`TSTEP_CONSTANT`	The data values have no time dimension.
`TSTEP_INSTANT`	The data values are representative of points in space or time (instantaneous).
`TSTEP_ACCUM`	The data values are representative of a sum or accumulation over the cell.
`TSTEP_AVG`	Mean (average value)
`TSTEP_MAX`	Maximum
`TSTEP_MIN`	Minimum
`TSTEP_SD`	Standard deviation

The default data type is 16 bit for GRIB and 32 bit for all other file format types. To change the data type use one of the following predefined constants:

`CDI_DATATYPE_PACK8`	8 packed bit (only for GRIB)
`CDI_DATATYPE_PACK16`	16 packed bit (only for GRIB)
`CDI_DATATYPE_PACK24`	24 packed bit (only for GRIB)
`CDI_DATATYPE_FLT32`	32 bit floating point
`CDI_DATATYPE_FLT64`	64 bit floating point
`CDI_DATATYPE_INT8`	8 bit integer
`CDI_DATATYPE_INT16`	16 bit integer
`CDI_DATATYPE_INT32`	32 bit integer

4.3.1. Define a Variable: `vlistDefVar`

The function `vlistDefVar` adds a new variable to vlistID.

Usage

```
INTEGER FUNCTION vlistDefVar(INTEGER vlistID, INTEGER gridID, INTEGER zaxisID,
                             INTEGER timetype)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate`.
`gridID`	Grid ID, from a previous call to `gridCreate`.
`zaxisID`	Z-axis ID, from a previous call to `zaxisCreate`.
`timetype`	One of the set of predefined **CDI** timestep types. The valid **CDI** timestep types are `TIME_CONSTANT` and `TIME_VARYING`.

Result

`vlistDefVar` returns an identifier to the new variable.

Example

Here is an example using `vlistCreate` to create a variable list and add a variable with `vlistDefVar`.

```
INCLUDE 'cdi.inc'
   ...
INTEGER vlistID, varID
   ...
vlistID = vlistCreate()
varID = vlistDefVar(vlistID, gridID, zaxisID, TIME_VARYING)
   ...
streamDefVlist(streamID, vlistID)
   ...
vlistDestroy(vlistID)
   ...
```

4.3.2. Get the Grid ID of a Variable: `vlistInqVarGrid`

The function `vlistInqVarGrid` returns the grid ID of a Variable.

Usage

```
INTEGER FUNCTION vlistInqVarGrid(INTEGER vlistID, INTEGER varID)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.
`varID`	Variable identifier.

Result

`vlistInqVarGrid` returns the grid ID of the Variable.

4.3.3. Get the Zaxis ID of a Variable: `vlistInqVarZaxis`

The function `vlistInqVarZaxis` returns the zaxis ID of a variable.

Usage

```
INTEGER FUNCTION vlistInqVarZaxis(INTEGER vlistID, INTEGER varID)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.
`varID`	Variable identifier.

Result

`vlistInqVarZaxis` returns the zaxis ID of the variable.

4.3.4. Get the timestep type of a Variable: `vlistInqVarTsteptype`

The function `vlistInqVarTsteptype` returns the timestep type of a Variable.

Usage

```
INTEGER FUNCTION vlistInqVarTsteptype(INTEGER vlistID, INTEGER varID)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.
`varID`	Variable identifier.

Result

`vlistInqVarTsteptype` returns the timestep type of the Variable, one of the set of predefined **CDI** timestep types. The valid **CDI** timestep types are `TSTEP_INSTANT`, `TSTEP_ACCUM`, `TSTEP_AVG`, `TSTEP_MAX`, `TSTEP_MIN` and `TSTEP_SD`.

4.3.5. Define the code number of a Variable: `vlistDefVarCode`

The function `vlistDefVarCode` defines the code number of a variable.

Usage

```
SUBROUTINE vlistDefVarCode(INTEGER vlistID, INTEGER varID, INTEGER code)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate`.
`varID`	Variable identifier.
`code`	Code number.

4.3.6. Get the Code number of a Variable: `vlistInqVarCode`

The function `vlistInqVarCode` returns the code number of a variable.

Usage

```
INTEGER FUNCTION vlistInqVarCode(INTEGER vlistID, INTEGER varID)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.
`varID`	Variable identifier.

Result

`vlistInqVarCode` returns the code number of the variable.

4.3.7. Define the data type of a Variable: `vlistDefVarDatatype`

The function `vlistDefVarDatatype` defines the data type of a variable.

Usage

```
SUBROUTINE vlistDefVarDatatype(INTEGER vlistID, INTEGER varID, INTEGER datatype)
```

`vlistID`	Variable list ID, from a previous call to `vlistCreate`.
`varID`	Variable identifier.
`datatype`	The data type identifier. The valid **CDI** data types are `CDI_DATATYPE_PACK8`, `CDI_DATATYPE_PACK16`, `CDI_DATATYPE_PACK24`, `CDI_DATATYPE_FLT32`, `CDI_DATATYPE_FLT64`, `CDI_DATATYPE_INT8`, `CDI_DATATYPE_INT16` and `CDI_DATATYPE_INT32`.

4.3.8. Get the data type of a Variable: `vlistInqVarDatatype`

The function `vlistInqVarDatatype` returns the data type of a variable.

Usage

```
INTEGER FUNCTION vlistInqVarDatatype(INTEGER vlistID, INTEGER varID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

`varID` Variable identifier.

Result

`vlistInqVarDatatype` returns an identifier to the data type of the variable. The valid **CDI** data types are `CDI_DATATYPE_PACK8`, `CDI_DATATYPE_PACK16`, `CDI_DATATYPE_PACK24`, `CDI_DATATYPE_FLT32`, `CDI_DATATYPE_FLT64`, `CDI_DATATYPE_INT8`, `CDI_DATATYPE_INT16` and `CDI_DATATYPE_INT32`.

4.3.9. Define the missing value of a Variable: `vlistDefVarMissval`

The function `vlistDefVarMissval` defines the missing value of a variable.

Usage

```
SUBROUTINE vlistDefVarMissval(INTEGER vlistID, INTEGER varID, REAL*8 missval)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate`.

`varID` Variable identifier.

`missval` Missing value.

4.3.10. Get the missing value of a Variable: `vlistInqVarMissval`

The function `vlistInqVarMissval` returns the missing value of a variable.

Usage

```
REAL*8 FUNCTION vlistInqVarMissval(INTEGER vlistID, INTEGER varID)
```

`vlistID` Variable list ID, from a previous call to `vlistCreate` or `streamInqVlist`.

`varID` Variable identifier.

Result

`vlistInqVarMissval` returns the missing value of the variable.

4.4. Key attributes

Attributes are metadata used to describe variables or a data set. CDI distinguishes between key attributes and user attributes. User defined attributes are described in the next chapter.
Key attributes are attributes that are interpreted by CDI. An example is the name or the units of a variable.
Key attributes can be defined for data variables and coordinate variables Use the variable ID or one of the following identifiers for the coordinates:

`CDI_XAXIS`	X-axis ID
`CDI_YAXIS`	Y-axis ID
`CDI_GLOBAL`	Global Z-axis

Some keys like name and units can be used for all variables. Other keys are very special and should only be used for certain variables. The user is also responsible for the data type of the key.
CDI supports string, integer, floating point and byte array key attributes. The following key attributes are available:

String keys

`CDI_KEY_NAME`	Variable name
`CDI_KEY_LONGNAME`	Long name of the variable
`CDI_KEY_STDNAME`	CF Standard name of the variable
`CDI_KEY_UNITS`	Units of the variable
`CDI_KEY_REFERENCEURI`	Reference URI to grid file

Integer keys

`CDI_KEY_NUMBEROFGRIDUSED`	GRIB2 numberOfGridUsed
`CDI_KEY_NUMBEROFGRIDINREFERENCE`	GRIB2 numberOfGridInReference
`CDI_KEY_NUMBEROFVGRIDUSED`	GRIB2 numberOfVGridUsed
`CDI_KEY_NLEV`	GRIB2 nlev
`CDI_KEY_CHUNKTYPE`	ChunkType: CDI_CHUNK_AUTO/CDI_CHUNK_GRID/CDI_CHUNK
`CDI_KEY_CHUNKSIZE`	ChunkSize

Floating point keys

`CDI_KEY_MISSVAL`	Missing value

Byte array keys

`CDI_KEY_UUID`	UUID for grid/Z-axis reference [size: CDI_UUID_SIZE]

4.4.1. Define a string from a key: `cdiDefKeyString`

The function `cdiDefKeyString` defines a text string from a key.

Usage

```
INTEGER FUNCTION cdiDefKeyString(INTEGER cdiID, INTEGER varID, INTEGER key,
                                 CHARACTER*(*) string)
```

`cdiID`	CDI object ID (vlistID, gridID, zaxisID).
`varID`	Variable identifier or CDI_GLOBAL.
`key`	The key to be searched.
`string`	The address of a string where the data will be read.

Result

`cdiDefKeyString` returns CDI_NOERR if OK.

Example

Here is an example using `cdiDefKeyString` to define the name of a variable:

```
INCLUDE 'cdi.inc'
   ...
INTEGER vlistID, varID, status
   ...
vlistID = vlistCreate()
varID = vlistDefVar(vlistID, gridID, zaxisID, TIME_VARYING)
   ...
status = cdiDefKeyString(vlistID, varID, CDI_KEY_NAME, "temperature")
   ...
```

4.4.2. Get a string from a key: `cdiInqKeyString`

The function `cdiInqKeyString` gets a text string from a key.

Usage

```
INTEGER FUNCTION cdiInqKeyString(INTEGER cdiID, INTEGER varID, INTEGER key,
                                  CHARACTER*(*) string, INTEGER length)
```

`cdiID`	CDI object ID (vlistID, gridID, zaxisID).
`varID`	Variable identifier or CDI_GLOBAL.
`key`	The key to be searched.
`string`	The address of a string where the data will be retrieved. The caller must allocate space for the returned string.
`length`	The allocated length of the string on input.

Result

`cdiInqKeyString` returns CDI_NOERR if key is available.

Example

Here is an example using `cdiInqKeyString` to get the name of the first variable:

```
INCLUDE 'cdi.inc'
   ...
#define STRLEN 256
   ...
INTEGER streamID, vlistID, varID, status
INTEGER length = STRLEN
```

```
CHARACTER name[STRLEN]
    ...
streamID = streamOpenRead(...)
vlistID  = streamInqVlist(streamID)
    ...
varID = 0
status = cdiInqKeyString(vlistID, varID, CDI_KEY_NAME, name, length)
    ...
```

4.4.3. Define an integer value from a key: `cdiDefKeyInt`

The function `cdiDefKeyInt` defines an integer value from a key.

Usage

```
INTEGER FUNCTION cdiDefKeyInt(INTEGER cdiID, INTEGER varID, INTEGER key,
                              INTEGER value)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).
`varID` Variable identifier or CDI_GLOBAL.
`key` The key to be searched.
`value` An integer where the data will be read.

Result

`cdiDefKeyInt` returns CDI_NOERR if OK.

4.4.4. Get an integer value from a key: `cdiInqKeyInt`

The function `cdiInqKeyInt` gets an integer value from a key.

Usage

```
INTEGER FUNCTION cdiInqKeyInt(INTEGER cdiID, INTEGER varID, INTEGER key,
                              INTEGER value)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).
`varID` Variable identifier or CDI_GLOBAL.
`key` The key to be searched..
`value` The address of an integer where the data will be retrieved.

Result

`cdiInqKeyInt` returns CDI_NOERR if key is available.

4.4.5. Define a floating point value from a key: `cdiDefKeyFloat`

The function `cdiDefKeyFloat` defines a **CDI** floating point value from a key.

Usage

```
INTEGER FUNCTION cdiDefKeyFloat(INTEGER cdiID, INTEGER varID, INTEGER key,
                                REAL*8 value)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).

`varID` Variable identifier or CDI_GLOBAL.

`key` The key to be searched

`value` A double where the data will be read

Result

`cdiDefKeyFloat` returns CDI_NOERR if OK.

4.4.6. Get a floating point value from a key: `cdiInqKeyFloat`

The function `cdiInqKeyFloat` gets a floating point value from a key.

Usage

```
INTEGER FUNCTION cdiInqKeyFloat(INTEGER cdiID, INTEGER varID, INTEGER key,
                                REAL*8 value)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).

`varID` Variable identifier or CDI_GLOBAL.

`key` The key to be searched.

`value` The address of a double where the data will be retrieved.

Result

`cdiInqKeyFloat` returns CDI_NOERR if key is available.

4.4.7. Define a byte array from a key: `cdiDefKeyBytes`

The function `cdiDefKeyBytes` defines a byte array from a key.

Usage

```
INTEGER FUNCTION cdiDefKeyBytes(INTEGER cdiID, INTEGER varID, INTEGER key,
                                unsigned CHARACTER*(*) bytes, INTEGER length)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).

`varID` Variable identifier or CDI_GLOBAL.

`key` The key to be searched.

`bytes` The address of a byte array where the data will be read.

`length` Length of the byte array

Result

`cdiDefKeyBytes` returns CDI_NOERR if OK.

4.4.8. Get a byte array from a key: `cdiInqKeyBytes`

The function `cdiInqKeyBytes` gets a byte array from a key.

Usage

```
INTEGER FUNCTION cdiInqKeyBytes(INTEGER cdiID, INTEGER varID, INTEGER key,
                               unsigned CHARACTER*(*) bytes, INTEGER length)
```

`cdiID` CDI object ID (vlistID, gridID, zaxisID).

`varID` Variable identifier or CDI_GLOBAL.

`key` The key to be searched.

`bytes` The address of a byte array where the data will be retrieved. The caller must allocate space for the returned byte array.

`length` The allocated length of the byte array on input.

Result

`cdiInqKeyBytes` returns CDI_NOERR if key is available.

4.5. User attributes

Attributes are metadata used to describe variables or a data set. CDI distinguishes between key attributes and user attributes. Key attributes are described in the last chapter.
User defined attributes are additional attributes that are not interpreted by CDI. These attributes are only available for NetCDF datasets. Here they correspond to all attributes that are not used by CDI as key attributes.
A user defined attribute has a variable to which it is assigned, a name, a type, a length, and a sequence of one or more values. The attributes have to be defined after the variable is created and before the variables list is associated with a stream.
It is also possible to have attributes that are not associated with any variable. These are called global attributes and are identified by using CDI_GLOBAL as a variable pseudo-ID. Global attributes are usually related to the dataset as a whole.
CDI supports integer, floating point and text attributes. The data types are defined by the following predefined constants:

`CDI_DATATYPE_INT16`	16-bit integer attribute
`CDI_DATATYPE_INT32`	32-bit integer attribute
`CDI_DATATYPE_FLT32`	32-bit floating point attribute
`CDI_DATATYPE_FLT64`	64-bit floating point attribute
`CDI_DATATYPE_TXT`	Text attribute

4.5.1. Get number of attributes: `cdiInqNatts`

The function `cdiInqNatts` gets the number of attributes assigned to this variable.

Usage

```
INTEGER FUNCTION cdiInqNatts(INTEGER cdiID, INTEGER varID, INTEGER nattsp)
```

`cdiID`	CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `streamInqVlist`.
`varID`	Variable identifier, or `CDI_GLOBAL` for a global attribute.
`nattsp`	Pointer to location for returned number of attributes.

4.5.2. Get information about an attribute: `cdiInqAtt`

The function `cdiInqAtt` gets information about an attribute.

Usage

```
INTEGER FUNCTION cdiInqAtt(INTEGER cdiID, INTEGER varID, INTEGER attnum,
                           CHARACTER*(*) name, INTEGER typep, INTEGER lenp)
```

`cdiID`	CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `streamInqVlist`.
`varID`	Variable identifier, or `CDI_GLOBAL` for a global attribute.
`attnum`	Attribute number (from 0 to natts-1).
`name`	Pointer to the location for the returned attribute name. The caller must allocate space for the returned string. The maximum possible length, in characters, of the string is given by the predefined constant `CDI_MAX_NAME`.
`typep`	Pointer to location for returned attribute type.
`lenp`	Pointer to location for returned attribute number.

4.5.3. Define a text attribute: `cdiDefAttTxt`

The function `cdiDefAttTxt` defines a text attribute.

Usage

```
INTEGER FUNCTION cdiDefAttTxt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER len, CHARACTER*(*) tp)
```

`cdiID` CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.

`varID` Variable identifier, or `CDI_GLOBAL` for a global attribute.

`name` Attribute name.

`len` Number of values provided for the attribute.

`tp` Pointer to one or more character values.

Example

Here is an example using `cdiDefAttTxt` to define the attribute "description":

```
INCLUDE 'cdi.inc'
   ...
INTEGER vlistID, varID, status
CHARACTER text[] = "description_of_the_variable"
   ...
vlistID  = vlistCreate()
varID = vlistDefVar(vlistID, gridID, zaxisID, TIME_VARYING)
   ...
status = cdiDefAttTxt(vlistID, varID, "description", LEN(text), text)
   ...
```

4.5.4. Get the value(s) of a text attribute: `cdiInqAttTxt`

The function `cdiInqAttTxt` gets the values(s) of a text attribute.

Usage

```
INTEGER FUNCTION cdiInqAttTxt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, CHARACTER*(*) tp)
```

`cdiID` CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.

`varID` Variable identifier, or `CDI_GLOBAL` for a global attribute.

`name` Attribute name.

`mlen` Number of allocated values provided for the attribute.

`tp` Pointer location for returned text attribute value(s).

4.5.5. Define an integer attribute: `cdiDefAttInt`

The function `cdiDefAttInt` defines an integer attribute.

Usage

```
INTEGER FUNCTION cdiDefAttInt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER type, INTEGER len, INTEGER ip)
```

`cdiID` CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.

`varID` Variable identifier, or `CDI_GLOBAL` for a global attribute.

`name` Attribute name.

`type` External data type (`CDI_DATATYPE_INT16` or `CDI_DATATYPE_INT32`).

`len` Number of values provided for the attribute.

`ip` Pointer to one or more integer values.

4.5.6. Get the value(s) of an integer attribute: `cdiInqAttInt`

The function `cdiInqAttInt` gets the values(s) of an integer attribute.

Usage

```
INTEGER FUNCTION cdiInqAttInt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, INTEGER ip)
```

`cdiID` CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.

`varID` Variable identifier, or `CDI_GLOBAL` for a global attribute.

`name` Attribute name.

`mlen` Number of allocated values provided for the attribute.

`ip` Pointer location for returned integer attribute value(s).

4.5.7. Define a floating point attribute: `cdiDefAttFlt`

The function `cdiDefAttFlt` defines a floating point attribute.

Usage

```
INTEGER FUNCTION cdiDefAttFlt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER type, INTEGER len, REAL*8 dp)
```

`cdiID` CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.

`varID` Variable identifier, or `CDI_GLOBAL` for a global attribute.

`name` Attribute name.

`type` External data type (`CDI_DATATYPE_FLT32` or `CDI_DATATYPE_FLT64`).

`len` Number of values provided for the attribute.

`dp` Pointer to one or more floating point values.

4.5.8. Get the value(s) of a floating point attribute: `cdiInqAttFlt`

The function `cdiInqAttFlt` gets the values(s) of a floating point attribute.

Usage

```
INTEGER FUNCTION cdiInqAttFlt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, REAL*8 dp)
```

`cdiID`	CDI ID, from a previous call to `vlistCreate`, `gridCreate` or `zaxisCreate`.
`varID`	Variable identifier, or `CDI_GLOBAL` for a global attribute.
`name`	Attribute name.
`mlen`	Number of allocated values provided for the attribute.
`dp`	Pointer location for returned floating point attribute value(s).

4.6. Grid functions

This module contains functions to define a new horizontal Grid and to get information from an existing Grid. A Grid object is necessary to define a variable. The following different Grid types are available:

`GRID_GENERIC`	Generic user defined grid
`GRID_LONLAT`	Regular longitude/latitude grid
`GRID_GAUSSIAN`	Regular Gaussian lon/lat grid
`GRID_PROJECTION`	Projected coordinates
`GRID_SPECTRAL`	Spherical harmonic coefficients
`GRID_GME`	Icosahedral-hexagonal GME grid
`GRID_CURVILINEAR`	Curvilinear grid
`GRID_UNSTRUCTURED`	Unstructured grid

4.6.1. Create a horizontal Grid: `gridCreate`

The function `gridCreate` creates a horizontal Grid.

Usage

```
INTEGER FUNCTION gridCreate(INTEGER gridtype, INTEGER size)
```

`gridtype` The type of the grid, one of the set of predefined **CDI** grid types. The valid **CDI** grid types are `GRID_GENERIC`, `GRID_LONLAT`, `GRID_GAUSSIAN`, `GRID_PROJECTION`, `GRID_SPECTRAL`, `GRID_GME`, `GRID_CURVILINEAR` and `GRID_UNSTRUCTURED`.

`size` Number of gridpoints.

Result

`gridCreate` returns an identifier to the Grid.

Example

Here is an example using `gridCreate` to create a regular lon/lat Grid:

```
INCLUDE 'cdi.inc'
   ...
#define  nlon  12
#define  nlat   6
   ...
REAL*8 lons(nlon) = (/0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330/)
REAL*8 lats(nlat) = (/-75, -45, -15, 15, 45, 75/)
INTEGER gridID
   ...
gridID = gridCreate(GRID_LONLAT, nlon*nlat)
CALL gridDefXsize(gridID, nlon)
CALL gridDefYsize(gridID, nlat)
CALL gridDefXvals(gridID, lons)
CALL gridDefYvals(gridID, lats)
   ...
```

4.6.2. Destroy a horizontal Grid: `gridDestroy`

Usage

```
SUBROUTINE gridDestroy(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

4.6.3. Duplicate a horizontal Grid: `gridDuplicate`

The function `gridDuplicate` duplicates a horizontal Grid.

Usage

```
INTEGER FUNCTION gridDuplicate(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridDuplicate` returns an identifier to the duplicated Grid.

4.6.4. Get the type of a Grid: `gridInqType`

The function `gridInqType` returns the type of a Grid.

Usage

```
INTEGER FUNCTION gridInqType(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridInqType` returns the type of the grid, one of the set of predefined **CDI** grid types. The valid **CDI** grid types are `GRID_GENERIC`, `GRID_LONLAT`, `GRID_GAUSSIAN`, `GRID_PROJECTION`, `GRID_SPECTRAL`, `GRID_GME`, `GRID_CURVILINEAR` and `GRID_UNSTRUCTURED`.

4.6.5. Get the size of a Grid: `gridInqSize`

The function `gridInqSize` returns the size of a Grid.

Usage

```
INTEGER FUNCTION gridInqSize(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridInqSize` returns the number of grid points of a Grid.

4.6.6. Define the number of values of a X-axis: `gridDefXsize`

The function `gridDefXsize` defines the number of values of a X-axis.

Usage

```
SUBROUTINE gridDefXsize(INTEGER gridID, INTEGER xsize)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`xsize` Number of values of a X-axis.

4.6.7. Get the number of values of a X-axis: `gridInqXsize`

The function `gridInqXsize` returns the number of values of a X-axis.

Usage

```
INTEGER FUNCTION gridInqXsize(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridInqXsize` returns the number of values of a X-axis.

4.6.8. Define the number of values of a Y-axis: `gridDefYsize`

The function `gridDefYsize` defines the number of values of a Y-axis.

Usage

```
SUBROUTINE gridDefYsize(INTEGER gridID, INTEGER ysize)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`ysize` Number of values of a Y-axis.

4.6.9. Get the number of values of a Y-axis: `gridInqYsize`

The function `gridInqYsize` returns the number of values of a Y-axis.

Usage

```
INTEGER FUNCTION gridInqYsize(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridInqYsize` returns the number of values of a Y-axis.

4.6.10. Define the number of parallels between a pole and the equator: `gridDefNP`

The function `gridDefNP` defines the number of parallels between a pole and the equator of a Gaussian grid.

Usage

```
SUBROUTINE gridDefNP(INTEGER gridID, INTEGER np)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`np` Number of parallels between a pole and the equator.

4.6.11. Get the number of parallels between a pole and the equator: `gridInqNP`

The function `gridInqNP` returns the number of parallels between a pole and the equator of a Gaussian grid.

Usage

```
INTEGER FUNCTION gridInqNP(INTEGER gridID)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

Result

`gridInqNP` returns the number of parallels between a pole and the equator.

4.6.12. Define the values of a X-axis: `gridDefXvals`

The function `gridDefXvals` defines all values of the X-axis.

Usage

```
SUBROUTINE gridDefXvals(INTEGER gridID, REAL*8 xvals)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`xvals` X-values of the grid.

4.6.13. Get all values of a X-axis: `gridInqXvals`

The function `gridInqXvals` returns all values of the X-axis.

Usage

```
INTEGER FUNCTION gridInqXvals(INTEGER gridID, REAL*8 xvals)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

`xvals` Pointer to the location into which the X-values are read. The caller must allocate space for the returned values.

Result

Upon successful completion `gridInqXvals` returns the number of values and the values are stored in `xvals`. Otherwise, 0 is returned and `xvals` is empty.

4.6.14. Define the values of a Y-axis: `gridDefYvals`

The function `gridDefYvals` defines all values of the Y-axis.

Usage

```
SUBROUTINE gridDefYvals(INTEGER gridID, REAL*8 yvals)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`yvals` Y-values of the grid.

4.6.15. Get all values of a Y-axis: `gridInqYvals`

The function `gridInqYvals` returns all values of the Y-axis.

Usage

```
INTEGER FUNCTION gridInqYvals(INTEGER gridID, REAL*8 yvals)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

`yvals` Pointer to the location into which the Y-values are read. The caller must allocate space for the returned values.

Result

Upon successful completion `gridInqYvals` returns the number of values and the values are stored in `yvals`. Otherwise, 0 is returned and `yvals` is empty.

4.6.16. Define the bounds of a X-axis: `gridDefXbounds`

The function `gridDefXbounds` defines all bounds of the X-axis.

Usage

```
SUBROUTINE gridDefXbounds(INTEGER gridID, REAL*8 xbounds)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`xbounds` X-bounds of the grid.

4.6.17. Get the bounds of a X-axis: `gridInqXbounds`

The function `gridInqXbounds` returns the bounds of the X-axis.

Usage

```
INTEGER FUNCTION gridInqXbounds(INTEGER gridID, REAL*8 xbounds)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

`xbounds` Pointer to the location into which the X-bounds are read. The caller must allocate space for the returned values.

Result

Upon successful completion `gridInqXbounds` returns the number of bounds and the bounds are stored in `xbounds`. Otherwise, 0 is returned and `xbounds` is empty.

4.6.18. Define the bounds of a Y-axis: `gridDefYbounds`

The function `gridDefYbounds` defines all bounds of the Y-axis.

Usage

```
SUBROUTINE gridDefYbounds(INTEGER gridID, REAL*8 ybounds)
```

`gridID` Grid ID, from a previous call to `gridCreate`.

`ybounds` Y-bounds of the grid.

4.6.19. Get the bounds of a Y-axis: `gridInqYbounds`

The function `gridInqYbounds` returns the bounds of the Y-axis.

Usage

```
INTEGER FUNCTION gridInqYbounds(INTEGER gridID, REAL*8 ybounds)
```

`gridID` Grid ID, from a previous call to `gridCreate` or `vlistInqVarGrid`.

`ybounds` Pointer to the location into which the Y-bounds are read. The caller must allocate space for the returned values.

Result

Upon successful completion `gridInqYbounds` returns the number of bounds and the bounds are stored in `ybounds`. Otherwise, 0 is returned and `ybounds` is empty.

4.7. Z-axis functions

This section contains functions to define a new vertical Z-axis and to get information from an existing Z-axis. A Z-axis object is necessary to define a variable. The following different Z-axis types are available:

ZAXIS_GENERIC	Generic user defined zaxis type
ZAXIS_SURFACE	Surface level
ZAXIS_HYBRID	Hybrid level
ZAXIS_SIGMA	Sigma level
ZAXIS_PRESSURE	Isobaric pressure level in Pascal
ZAXIS_HEIGHT	Height above ground in meters
ZAXIS_ISENTROPIC	Isentropic (theta) level
ZAXIS_ALTITUDE	Altitude above mean sea level in meters
ZAXIS_MEANSEA	Mean sea level
ZAXIS_TOA	Norminal top of atmosphere
ZAXIS_SEA_BOTTOM	Sea bottom
ZAXIS_ATMOSPHERE	Entire atmosphere
ZAXIS_CLOUD_BASE	Cloud base level
ZAXIS_CLOUD_TOP	Level of cloud tops
ZAXIS_ISOTHERM_ZERO	Level of 0° C isotherm
ZAXIS_SNOW	Snow level
ZAXIS_LAKE_BOTTOM	Lake or River Bottom
ZAXIS_SEDIMENT_BOTTOM	Bottom Of Sediment Layer
ZAXIS_SEDIMENT_BOTTOM_TA	Bottom Of Thermally Active Sediment Layer
ZAXIS_SEDIMENT_BOTTOM_TW	Bottom Of Sediment Layer Penetrated By Thermal Wave
ZAXIS_ZAXIS_MIX_LAYER	Mixing Layer
ZAXIS_DEPTH_BELOW_SEA	Depth below sea level in meters
ZAXIS_DEPTH_BELOW_LAND	Depth below land surface in centimeters

4.7.1. Create a vertical Z-axis: `zaxisCreate`

The function `zaxisCreate` creates a vertical Z-axis.

Usage

```
INTEGER FUNCTION zaxisCreate(INTEGER zaxistype, INTEGER size)
```

`zaxistype` The type of the Z-axis, one of the set of predefined **CDI** Z-axis types. The valid **CDI** Z-axis types are `ZAXIS_GENERIC`, `ZAXIS_SURFACE`, `ZAXIS_HYBRID`, `ZAXIS_SIGMA`, `ZAXIS_PRESSURE`, `ZAXIS_HEIGHT`, `ZAXIS_ISENTROPIC`, `ZAXIS_ALTITUDE`, `ZAXIS_MEANSEA`, `ZAXIS_TOA`, `ZAXIS_SEA_BOTTOM`, `ZAXIS_ATMOSPHERE`, `ZAXIS_CLOUD_BASE`, `ZAXIS_CLOUD_TOP`, `ZAXIS_ISOTHERM_ZERO`, `ZAXIS_SNOW`, `ZAXIS_LAKE_BOTTOM`, `ZAXIS_SEDIMENT_BOTTOM`, `ZAXIS_SEDIMENT_BOTTOM_TA`, `ZAXIS_SEDIMENT_BOTTOM_TW`, `ZAXIS_MIX_LAYER`, `ZAXIS_DEPTH_BELOW_SEA` and `ZAXIS_DEPTH_BELOW_LAND`.

`size` Number of levels.

Result

`zaxisCreate` returns an identifier to the Z-axis.

Example

Here is an example using `zaxisCreate` to create a pressure level Z-axis:

```
INCLUDE 'cdi.inc'
   ...
#define  nlev     5
   ...
REAL*8 levs(nlev) = (/101300, 92500, 85000, 50000, 20000/)
INTEGER zaxisID
   ...
zaxisID = zaxisCreate(ZAXIS_PRESSURE, nlev)
CALL zaxisDefLevels(zaxisID, levs)
   ...
```

4.7.2. Destroy a vertical Z-axis: `zaxisDestroy`

Usage

```
SUBROUTINE zaxisDestroy(INTEGER zaxisID)
```

`zaxisID` Z-axis ID, from a previous call to `zaxisCreate`.

4.7.3. Get the type of a Z-axis: `zaxisInqType`

The function `zaxisInqType` returns the type of a Z-axis.

Usage

```
INTEGER FUNCTION zaxisInqType(INTEGER zaxisID)
```

`zaxisID` Z-axis ID, from a previous call to `zaxisCreate` or `vlistInqVarZaxis`.

Result

`zaxisInqType` returns the type of the Z-axis, one of the set of predefined **CDI** Z-axis types. The valid **CDI** Z-axis types are `ZAXIS_GENERIC`, `ZAXIS_SURFACE`, `ZAXIS_HYBRID`, `ZAXIS_SIGMA`, `ZAXIS_PRESSURE`, `ZAXIS_HEIGHT`, `ZAXIS_ISENTROPIC`, `ZAXIS_ALTITUDE`, `ZAXIS_MEANSEA`, `ZAXIS_TOA`, `ZAXIS_SEA_BOTTOM`, `ZAXIS_ATMOSPHERE`, `ZAXIS_CLOUD_BASE`, `ZAXIS_CLOUD_TOP`, `ZAXIS_ISOTHERM_ZERO`, `ZAXIS_SNOW`, `ZAXIS_LAKE_BOTTOM`, `ZAXIS_SEDIMENT_BOTTOM`, `ZAXIS_SEDIMENT_BOTTOM_TA`, `ZAXIS_SEDIMENT_BOTT` `ZAXIS_MIX_LAYER`, `ZAXIS_DEPTH_BELOW_SEA` and `ZAXIS_DEPTH_BELOW_LAND`.

4.7.4. Get the size of a Z-axis: `zaxisInqSize`

The function `zaxisInqSize` returns the size of a Z-axis.

Usage

```
INTEGER FUNCTION zaxisInqSize(INTEGER zaxisID)
```

`zaxisID` Z-axis ID, from a previous call to `zaxisCreate` or `vlistInqVarZaxis`.

Result

`zaxisInqSize` returns the number of levels of a Z-axis.

4.7.5. Define the levels of a Z-axis: `zaxisDefLevels`

The function `zaxisDefLevels` defines the levels of a Z-axis.

Usage

```
SUBROUTINE zaxisDefLevels(INTEGER zaxisID, REAL*8 levels)
```

`zaxisID`	Z-axis ID, from a previous call to `zaxisCreate`.
`levels`	All levels of the Z-axis.

4.7.6. Get all levels of a Z-axis: `zaxisInqLevels`

The function `zaxisInqLevels` returns all levels of a Z-axis.

Usage

```
SUBROUTINE zaxisInqLevels(INTEGER zaxisID, REAL*8 levels)
```

`zaxisID`	Z-axis ID, from a previous call to `zaxisCreate` or `vlistInqVarZaxis`.
`levels`	Pointer to the location into which the levels are read. The caller must allocate space for the returned values.

Result

`zaxisInqLevels` saves all levels to the parameter `levels`.

4.7.7. Get one level of a Z-axis: `zaxisInqLevel`

The function `zaxisInqLevel` returns one level of a Z-axis.

Usage

```
REAL*8 FUNCTION zaxisInqLevel(INTEGER zaxisID, INTEGER levelID)
```

`zaxisID`	Z-axis ID, from a previous call to `zaxisCreate` or `vlistInqVarZaxis`.
`levelID`	Level index (range: 0 to nlevel-1).

Result

`zaxisInqLevel` returns the level of a Z-axis.

4.8. T-axis functions

This section contains functions to define a new Time axis and to get information from an existing T-axis. A T-axis object is necessary to define the time axis of a dataset and must be assiged to a variable list using `vlistDefTaxis`. The following different Time axis types are available:

TAXIS_ABSOLUTE	Absolute time axis
TAXIS_RELATIVE	Relative time axis

An absolute time axis has the current time to each time step. It can be used without knowledge of the calendar.
A relative time is the time relative to a fixed reference time. The current time results from the reference time and the elapsed interval. The result depends on the used calendar. CDI supports the following calendar types:

CALENDAR_STANDARD	Mixed Gregorian/Julian calendar.
CALENDAR_PROLEPTIC	Proleptic Gregorian calendar. This is the default.
CALENDAR_360DAYS	All years are 360 days divided into 30 day months.
CALENDAR_365DAYS	Gregorian calendar without leap years, i.e., all years are 365 days long.
CALENDAR_366DAYS	Gregorian calendar with every year being a leap year, i.e., all years are 366 days long.

4.8.1. Create a Time axis: `taxisCreate`

The function `taxisCreate` creates a Time axis.

Usage

```
INTEGER FUNCTION taxisCreate(INTEGER taxistype)
```

`taxistype` The type of the Time axis, one of the set of predefined **CDI** time axis types. The valid **CDI** time axis types are `TAXIS_ABSOLUTE` and `TAXIS_RELATIVE`.

Result

`taxisCreate` returns an identifier to the Time axis.

Example

Here is an example using `taxisCreate` to create a relative T-axis with a standard calendar.

```
INCLUDE 'cdi.inc'
   ...
INTEGER taxisID
   ...
taxisID = taxisCreate(TAXIS_RELATIVE)
taxisDefCalendar(taxisID, CALENDAR_STANDARD)
taxisDefRdate(taxisID, 19850101)
taxisDefRtime(taxisID, 120000)
   ...
```

4.8.2. Destroy a Time axis: `taxisDestroy`

Usage

```
SUBROUTINE taxisDestroy(INTEGER taxisID)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate`

4.8.3. Define the reference date: `taxisDefRdate`

The function `taxisDefRdate` defines the reference date of a Time axis.

Usage

```
SUBROUTINE taxisDefRdate(INTEGER taxisID, INTEGER rdate)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate`
`rdate` Reference date (YYYYMMDD)

4.8.4. Get the reference date: `taxisInqRdate`

The function `taxisInqRdate` returns the reference date of a Time axis.

Usage

```
INTEGER FUNCTION taxisInqRdate(INTEGER taxisID)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate` or `vlistInqTaxis`

Result

`taxisInqRdate` returns the reference date.

4.8.5. Define the reference time: `taxisDefRtime`

The function `taxisDefRtime` defines the reference time of a Time axis.

Usage

```
SUBROUTINE taxisDefRtime(INTEGER taxisID, INTEGER rtime)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate`
`rtime` Reference time (hhmmss)

4.8.6. Get the reference time: `taxisInqRtime`

The function `taxisInqRtime` returns the reference time of a Time axis.

Usage

```
INTEGER FUNCTION taxisInqRtime(INTEGER taxisID)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate` or `vlistInqTaxis`

Result

`taxisInqRtime` returns the reference time.

4.8.7. Define the verification date: `taxisDefVdate`

The function `taxisDefVdate` defines the verification date of a Time axis.

Usage

```
SUBROUTINE taxisDefVdate(INTEGER taxisID, INTEGER vdate)
```

`taxisID`	Time axis ID, from a previous call to `taxisCreate`
`vdate`	Verification date (YYYYMMDD)

4.8.8. Get the verification date: `taxisInqVdate`

The function `taxisInqVdate` returns the verification date of a Time axis.

Usage

```
INTEGER FUNCTION taxisInqVdate(INTEGER taxisID)
```

`taxisID`	Time axis ID, from a previous call to `taxisCreate` or `vlistInqTaxis`

Result

`taxisInqVdate` returns the verification date.

4.8.9. Define the verification time: `taxisDefVtime`

The function `taxisDefVtime` defines the verification time of a Time axis.

Usage

```
SUBROUTINE taxisDefVtime(INTEGER taxisID, INTEGER vtime)
```

`taxisID`	Time axis ID, from a previous call to `taxisCreate`
`vtime`	Verification time (hhmmss)

4.8.10. Get the verification time: `taxisInqVtime`

The function `taxisInqVtime` returns the verification time of a Time axis.

Usage

```
INTEGER FUNCTION taxisInqVtime(INTEGER taxisID)
```

`taxisID`	Time axis ID, from a previous call to `taxisCreate` or `vlistInqTaxis`

Result

`taxisInqVtime` returns the verification time.

4.8.11. Define the calendar: `taxisDefCalendar`

The function `taxisDefCalendar` defines the calendar of a Time axis.

Usage

```
SUBROUTINE taxisDefCalendar(INTEGER taxisID, INTEGER calendar)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate`

`calendar` The type of the calendar, one of the set of predefined **CDI** calendar types. The valid **CDI** calendar types are `CALENDAR_STANDARD`, `CALENDAR_PROLEPTIC`, `CALENDAR_360DAYS`, `CALENDAR_365DAYS` and `CALENDAR_366DAYS`.

4.8.12. Get the calendar: `taxisInqCalendar`

The function `taxisInqCalendar` returns the calendar of a Time axis.

Usage

```
INTEGER FUNCTION taxisInqCalendar(INTEGER taxisID)
```

`taxisID` Time axis ID, from a previous call to `taxisCreate` or `vlistInqTaxis`

Result

`taxisInqCalendar` returns the type of the calendar, one of the set of predefined **CDI** calendar types. The valid **CDI** calendar types are `CALENDAR_STANDARD`, `CALENDAR_PROLEPTIC`, `CALENDAR_360DAYS`, `CALENDAR_365DAYS` and `CALENDAR_366DAYS`.

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A. Quick Reference

This appendix provide a brief listing of the Fortran language bindings of the **CDI** library routines:

cdiDefAttFlt

```
INTEGER FUNCTION cdiDefAttFlt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER type, INTEGER len, REAL*8 dp)
```

Define a floating point attribute

cdiDefAttInt

```
INTEGER FUNCTION cdiDefAttInt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER type, INTEGER len, INTEGER ip)
```

Define an integer attribute

cdiDefAttTxt

```
INTEGER FUNCTION cdiDefAttTxt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER len, CHARACTER*(*) tp)
```

Define a text attribute

cdiDefKeyBytes

```
INTEGER FUNCTION cdiDefKeyBytes(INTEGER cdiID, INTEGER varID, INTEGER key,
                                unsigned CHARACTER*(*) bytes, INTEGER length)
```

Define a byte array from a key

cdiDefKeyFloat

```
INTEGER FUNCTION cdiDefKeyFloat(INTEGER cdiID, INTEGER varID, INTEGER key,
                                REAL*8 value)
```

Define a floating point value from a key

cdiDefKeyInt

```
INTEGER FUNCTION cdiDefKeyInt(INTEGER cdiID, INTEGER varID, INTEGER key,
                              INTEGER value)
```

Define an integer value from a key

cdiDefKeyString

```
INTEGER FUNCTION cdiDefKeyString(INTEGER cdiID, INTEGER varID, INTEGER key,
                                 CHARACTER*(*) string)
```

Define a string from a key

cdiInqAtt

```
INTEGER FUNCTION cdiInqAtt(INTEGER cdiID, INTEGER varID, INTEGER attnum,
                           CHARACTER*(*) name, INTEGER typep, INTEGER lenp)
```

Get information about an attribute

cdiInqAttFlt

```
INTEGER FUNCTION cdiInqAttFlt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, REAL*8 dp)
```

Get the value(s) of a floating point attribute

cdiInqAttInt

```
INTEGER FUNCTION cdiInqAttInt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, INTEGER ip)
```

Get the value(s) of an integer attribute

cdiInqAttTxt

```
INTEGER FUNCTION cdiInqAttTxt(INTEGER cdiID, INTEGER varID, CHARACTER*(*) name,
                              INTEGER mlen, CHARACTER*(*) tp)
```

Get the value(s) of a text attribute

cdiInqKeyBytes

```
INTEGER FUNCTION cdiInqKeyBytes(INTEGER cdiID, INTEGER varID, INTEGER key,
                                unsigned CHARACTER*(*) bytes, INTEGER length)
```

Get a byte array from a key

cdiInqKeyFloat

```
INTEGER FUNCTION cdiInqKeyFloat(INTEGER cdiID, INTEGER varID, INTEGER key,
                                REAL*8 value)
```

Get a floating point value from a key

cdiInqKeyInt

```
INTEGER FUNCTION cdiInqKeyInt(INTEGER cdiID, INTEGER varID, INTEGER key,
                              INTEGER value)
```

Get an integer value from a key

cdiInqKeyString

```
INTEGER FUNCTION cdiInqKeyString(INTEGER cdiID, INTEGER varID, INTEGER key,
                                 CHARACTER*(*) string, INTEGER length)
```

Get a string from a key

cdiInqNatts

```
INTEGER FUNCTION cdiInqNatts(INTEGER cdiID, INTEGER varID, INTEGER nattsp)
```

Get number of attributes

gridCreate

```
INTEGER FUNCTION gridCreate(INTEGER gridtype, INTEGER size)
```

Create a horizontal Grid

gridDefNP

```
SUBROUTINE gridDefNP(INTEGER gridID, INTEGER np)
```

Define the number of parallels between a pole and the equator

gridDefXbounds

```
SUBROUTINE gridDefXbounds(INTEGER gridID, REAL*8 xbounds)
```

Define the bounds of a X-axis

gridDefXsize

```
SUBROUTINE gridDefXsize(INTEGER gridID, INTEGER xsize)
```

Define the number of values of a X-axis

gridDefXvals

```
SUBROUTINE gridDefXvals(INTEGER gridID, REAL*8 xvals)
```

Define the values of a X-axis

gridDefYbounds

```
SUBROUTINE gridDefYbounds(INTEGER gridID, REAL*8 ybounds)
```

Define the bounds of a Y-axis

gridDefYsize

```
SUBROUTINE gridDefYsize(INTEGER gridID, INTEGER ysize)
```

Define the number of values of a Y-axis

gridDefYvals

```
SUBROUTINE gridDefYvals(INTEGER gridID, REAL*8 yvals)
```

Define the values of a Y-axis

gridDestroy

```
SUBROUTINE gridDestroy(INTEGER gridID)
```

Destroy a horizontal Grid

gridDuplicate

```
INTEGER FUNCTION gridDuplicate(INTEGER gridID)
```

Duplicate a horizontal Grid

gridInqNP

```
INTEGER FUNCTION gridInqNP(INTEGER gridID)
```

Get the number of parallels between a pole and the equator

gridInqSize

```
INTEGER FUNCTION gridInqSize(INTEGER gridID)
```

Get the size of a Grid

gridInqType

```
INTEGER FUNCTION gridInqType(INTEGER gridID)
```

Get the type of a Grid

gridInqXbounds

```
INTEGER FUNCTION gridInqXbounds(INTEGER gridID, REAL*8 xbounds)
```

Get the bounds of a X-axis

gridInqXsize

```
INTEGER FUNCTION gridInqXsize(INTEGER gridID)
```

Get the number of values of a X-axis

gridInqXvals

```
INTEGER FUNCTION gridInqXvals(INTEGER gridID, REAL*8 xvals)
```

Get all values of a X-axis

gridInqYbounds

```
INTEGER FUNCTION gridInqYbounds(INTEGER gridID, REAL*8 ybounds)
```

Get the bounds of a Y-axis

gridInqYsize

```
INTEGER FUNCTION gridInqYsize(INTEGER gridID)
```

Get the number of values of a Y-axis

gridInqYvals

```
INTEGER FUNCTION gridInqYvals(INTEGER gridID, REAL*8 yvals)
```

Get all values of a Y-axis

streamClose

```
SUBROUTINE streamClose(INTEGER streamID)
```

Close an open dataset

streamDefByteorder

```
SUBROUTINE streamDefByteorder(INTEGER streamID, INTEGER byteorder)
```

Define the byte order

streamDefRecord

```
SUBROUTINE streamDefRecord(INTEGER streamID, INTEGER varID, INTEGER levelID)
```

Define the next record

streamDefTimestep

```
INTEGER FUNCTION streamDefTimestep(INTEGER streamID, INTEGER tsID)
```

Define a timestep

streamDefVlist

```
SUBROUTINE streamDefVlist(INTEGER streamID, INTEGER vlistID)
```

Define the variable list

streamInqByteorder

```
INTEGER FUNCTION streamInqByteorder(INTEGER streamID)
```

Get the byte order

streamInqFiletype

```
INTEGER FUNCTION streamInqFiletype(INTEGER streamID)
```

Get the filetype

streamInqTimestep

```
INTEGER FUNCTION streamInqTimestep(INTEGER streamID, INTEGER tsID)
```

Get timestep information

streamInqVlist

```
INTEGER FUNCTION streamInqVlist(INTEGER streamID)
```

Get the variable list

streamOpenRead

```
INTEGER FUNCTION streamOpenRead(CHARACTER*(*) path)
```

Open a dataset for reading

streamOpenWrite

```
INTEGER FUNCTION streamOpenWrite(CHARACTER*(*) path, INTEGER filetype)
```

Create a new dataset

streamReadVar

```
SUBROUTINE streamReadVar(INTEGER streamID, INTEGER varID, REAL*8 data,
                         INTEGER numMissVals)
```

Read a variable

streamReadVarF

```
SUBROUTINE streamReadVar(INTEGER streamID, INTEGER varID, REAL*4 data,
                         INTEGER numMissVals)
```

Read a variable

streamReadVarSlice

```
SUBROUTINE streamReadVarSlice(INTEGER streamID, INTEGER varID, INTEGER levelID,
                              REAL*8 data, INTEGER numMissVals)
```

Read a horizontal slice of a variable

streamReadVarSliceF

```
SUBROUTINE streamReadVarSliceF(INTEGER streamID, INTEGER varID, INTEGER levelID,
                               REAL*4 data, INTEGER numMissVals)
```

Read a horizontal slice of a variable

streamWriteVar

```
SUBROUTINE streamWriteVar(INTEGER streamID, INTEGER varID, REAL*8 data,
                          INTEGER numMissVals)
```

Write a variable

streamWriteVarF

```
SUBROUTINE streamWriteVarF(INTEGER streamID, INTEGER varID, REAL*4 data,
                           INTEGER numMissVals)
```

Write a variable

streamWriteVarSlice

```
SUBROUTINE streamWriteVarSlice(INTEGER streamID, INTEGER varID, INTEGER levelID,
                               REAL*8 data, INTEGER numMissVals)
```

Write a horizontal slice of a variable

streamWriteVarSliceF

```
SUBROUTINE streamWriteVarSliceF(INTEGER streamID, INTEGER varID, INTEGER levelID,
                                REAL*4 data, INTEGER numMissVals)
```

Write a horizontal slice of a variable

taxisCreate

```
INTEGER FUNCTION taxisCreate(INTEGER taxistype)
```

Create a Time axis

taxisDefCalendar

```
SUBROUTINE taxisDefCalendar(INTEGER taxisID, INTEGER calendar)
```

Define the calendar

taxisDefRdate

```
SUBROUTINE taxisDefRdate(INTEGER taxisID, INTEGER rdate)
```

Define the reference date

taxisDefRtime

```
SUBROUTINE taxisDefRtime(INTEGER taxisID, INTEGER rtime)
```

Define the reference time

taxisDefVdate

```
SUBROUTINE taxisDefVdate(INTEGER taxisID, INTEGER vdate)
```

Define the verification date

taxisDefVtime

```
SUBROUTINE taxisDefVtime(INTEGER taxisID, INTEGER vtime)
```

Define the verification time

taxisDestroy

```
SUBROUTINE taxisDestroy(INTEGER taxisID)
```

Destroy a Time axis

taxisInqCalendar

```
INTEGER FUNCTION taxisInqCalendar(INTEGER taxisID)
```

Get the calendar

taxisInqRdate

```
INTEGER FUNCTION taxisInqRdate(INTEGER taxisID)
```

Get the reference date

taxisInqRtime

```
INTEGER FUNCTION taxisInqRtime(INTEGER taxisID)
```

Get the reference time

taxisInqVdate

```
INTEGER FUNCTION taxisInqVdate(INTEGER taxisID)
```

Get the verification date

taxisInqVtime

```
INTEGER FUNCTION taxisInqVtime(INTEGER taxisID)
```

Get the verification time

vlistCat

```
SUBROUTINE vlistCat(INTEGER vlistID2, INTEGER vlistID1)
```

Concatenate two variable lists

vlistCopy

```
SUBROUTINE vlistCopy(INTEGER vlistID2, INTEGER vlistID1)
```

Copy a variable list

vlistCopyFlag

```
SUBROUTINE vlistCopyFlag(INTEGER vlistID2, INTEGER vlistID1)
```

Copy some entries of a variable list

vlistCreate

```
INTEGER FUNCTION vlistCreate()
```

Create a variable list

vlistDefTaxis

```
SUBROUTINE vlistDefTaxis(INTEGER vlistID, INTEGER taxisID)
```

Define the time axis

vlistDefVar

```
INTEGER FUNCTION vlistDefVar(INTEGER vlistID, INTEGER gridID, INTEGER zaxisID,
                             INTEGER timetype)
```

Define a Variable

vlistDefVarCode

```
SUBROUTINE vlistDefVarCode(INTEGER vlistID, INTEGER varID, INTEGER code)
```

Define the code number of a Variable

vlistDefVarDatatype

```
SUBROUTINE vlistDefVarDatatype(INTEGER vlistID, INTEGER varID, INTEGER datatype)
```

Define the data type of a Variable

vlistDefVarMissval

```
SUBROUTINE vlistDefVarMissval(INTEGER vlistID, INTEGER varID, REAL*8 missval)
```

Define the missing value of a Variable

vlistDestroy

```
SUBROUTINE vlistDestroy(INTEGER vlistID)
```

Destroy a variable list

vlistDuplicate

```
INTEGER FUNCTION vlistDuplicate(INTEGER vlistID)
```

Duplicate a variable list

vlistInqTaxis

```
INTEGER FUNCTION vlistInqTaxis(INTEGER vlistID)
```

Get the time axis

vlistInqVarCode

```
INTEGER FUNCTION vlistInqVarCode(INTEGER vlistID, INTEGER varID)
```

Get the Code number of a Variable

vlistInqVarDatatype

```
INTEGER FUNCTION vlistInqVarDatatype(INTEGER vlistID, INTEGER varID)
```

Get the data type of a Variable

vlistInqVarGrid

```
INTEGER FUNCTION vlistInqVarGrid(INTEGER vlistID, INTEGER varID)
```

Get the Grid ID of a Variable

vlistInqVarMissval

```
REAL*8 FUNCTION vlistInqVarMissval(INTEGER vlistID, INTEGER varID)
```

Get the missing value of a Variable

vlistInqVarTsteptype

```
INTEGER FUNCTION vlistInqVarTsteptype(INTEGER vlistID, INTEGER varID)
```

Get the timestep type of a Variable

vlistInqVarZaxis

```
INTEGER FUNCTION vlistInqVarZaxis(INTEGER vlistID, INTEGER varID)
```

Get the Zaxis ID of a Variable

vlistNgrids

```
INTEGER FUNCTION vlistNgrids(INTEGER vlistID)
```

Number of grids in a variable list

vlistNvars

```
INTEGER FUNCTION vlistNvars(INTEGER vlistID)
```

Number of variables in a variable list

vlistNzaxis

```
INTEGER FUNCTION vlistNzaxis(INTEGER vlistID)
```

Number of zaxis in a variable list

zaxisCreate

```
INTEGER FUNCTION zaxisCreate(INTEGER zaxistype, INTEGER size)
```

Create a vertical Z-axis

zaxisDefLevels

```
SUBROUTINE zaxisDefLevels(INTEGER zaxisID, REAL*8 levels)
```

Define the levels of a Z-axis

zaxisDestroy

```
SUBROUTINE zaxisDestroy(INTEGER zaxisID)
```

Destroy a vertical Z-axis

zaxisInqLevel

```
REAL*8 FUNCTION zaxisInqLevel(INTEGER zaxisID, INTEGER levelID)
```

Get one level of a Z-axis

zaxisInqLevels

```
SUBROUTINE zaxisInqLevels(INTEGER zaxisID, REAL*8 levels)
```

Get all levels of a Z-axis

zaxisInqSize

```
INTEGER FUNCTION zaxisInqSize(INTEGER zaxisID)
```

Get the size of a Z-axis

zaxisInqType

```
INTEGER FUNCTION zaxisInqType(INTEGER zaxisID)
```

Get the type of a Z-axis

B. Examples

This appendix contains complete examples to write, read and copy a dataset with the **CDI** library.

B.1. Write a dataset

Here is an example using **CDI** to write a NetCDF dataset with 2 variables on 3 time steps. The first variable is a 2D field on surface level and the second variable is a 3D field on 5 pressure levels. Both variables are on the same lon/lat grid.

```
      PROGRAM CDIWRITE

      IMPLICIT NONE

      INCLUDE 'cdi.inc'

      INTEGER nlon, nlat
      INTEGER nlev, nts
      PARAMETER (nlon = 12) ! Number of longitudes
      PARAMETER (nlat = 6) ! Number of latitudes
      PARAMETER (nlev = 5) ! Number of levels
      PARAMETER (nts = 3) ! Number of time steps

      INTEGER gridID, zaxisID1, zaxisID2, taxisID
      INTEGER vlistID, varID1, varID2, streamID, tsID, i, status
      INTEGER nmiss
      REAL*8 lons(nlon), lats(nlat), levs(nlev)
      REAL*8 var1(nlon*nlat), var2(nlon*nlat*nlev)

      DATA lons /0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330/
      DATA lats /-75, -45, -15, 15, 45, 75/
      DATA levs /101300, 92500, 85000, 50000, 20000/

      nmiss = 0

!     Create a regular lon/lat grid
      gridID = gridCreate(GRID_LONLAT, nlon*nlat)
      CALL gridDefXsize(gridID, nlon)
      CALL gridDefYsize(gridID, nlat)
      CALL gridDefXvals(gridID, lons)
      CALL gridDefYvals(gridID, lats)

!     Create a surface level Z-axis
      zaxisID1 = zaxisCreate(ZAXIS_SURFACE, 1)

!     Create a pressure level Z-axis
      zaxisID2 = zaxisCreate(ZAXIS_PRESSURE, nlev)
      CALL zaxisDefLevels(zaxisID2, levs)

!     Create a variable list
      vlistID = vlistCreate()
```

```
!       Define the variables
        varID1 = vlistDefVar(vlistID, gridID, zaxisID1, TIME_VARYING)
        varID2 = vlistDefVar(vlistID, gridID, zaxisID2, TIME_VARYING)

!       Define the variable names
        CALL vlistDefVarName(vlistID, varID1, "varname1")
        CALL vlistDefVarName(vlistID, varID2, "varname2")

!       Create a Time axis
        taxisID = taxisCreate(TAXIS_ABSOLUTE)

!       Assign the Time axis to the variable list
        CALL vlistDefTaxis(vlistID, taxisID)

!       Create a dataset in netCDF format
        streamID = streamOpenWrite("example.nc", CDI_FILETYPE_NC)
        IF ( streamID < 0 ) THEN
           WRITE(0,*) cdiStringError(streamID)
           STOP
        END IF

!       Assign the variable list to the dataset
        CALL streamDefVlist(streamID, vlistID)

!       Loop over the number of time steps
        DO tsID = 0, nts-1
!          Set the verification date to 1985-01-01 + tsID
           CALL taxisDefVdate(taxisID, 19850101+tsID)
!          Set the verification time to 12:00:00
           CALL taxisDefVtime(taxisID, 120000)
!          Define the time step
           status = streamDefTimestep(streamID, tsID)

!          Init var1 and var2
           DO i = 1, nlon*nlat
              var1(i) = 1.1
           END DO
           DO i = 1, nlon*nlat*nlev
              var2(i) = 2.2
           END DO

!          Write var1 and var2
           CALL streamWriteVar(streamID, varID1, var1, nmiss)
           CALL streamWriteVar(streamID, varID2, var2, nmiss)
        END DO

!       Close the output stream
        CALL streamClose(streamID)

!       Destroy the objects
        CALL vlistDestroy(vlistID)
        CALL taxisDestroy(taxisID)
        CALL zaxisDestroy(zaxisID1)
        CALL zaxisDestroy(zaxisID2)
        CALL gridDestroy(gridID)
```

```
      END
```

B.1.1. Result

This is the `ncdump -h` output of the resulting NetCDF file `example.nc`.

```
netcdf example {
dimensions:
        lon = 12 ;
        lat = 6 ;
        lev = 5 ;
        time = UNLIMITED ; // (3 currently)
variables:
        double lon(lon) ;
                lon:long_name = "longitude" ;
                lon:units = "degrees_east" ;
                lon:standard_name = "longitude" ;
        double lat(lat) ;
                lat:long_name = "latitude" ;
                lat:units = "degrees_north" ;
                lat:standard_name = "latitude" ;
        double lev(lev) ;
                lev:long_name = "pressure" ;
                lev:units = "Pa" ;
        double time(time) ;
                time:units = "day as %Y%m%d.%f" ;
        float varname1(time, lat, lon) ;
        float varname2(time, lev, lat, lon) ;
data:

 lon = 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 ;

 lat = -75, -45, -15, 15, 45, 75 ;

 lev = 101300, 92500, 85000, 50000, 20000 ;

 time = 19850101.5, 19850102.5, 19850103.5 ;
}
```

B.2. Read a dataset

This example reads the NetCDF file `example.nc` from Appendix B.1.

```
      PROGRAM CDIREAD

      IMPLICIT NONE

      INCLUDE 'cdi.inc'

      INTEGER nlon, nlat
      INTEGER nlev, nts
      PARAMETER (nlon = 12) ! Number of longitudes
      PARAMETER (nlat = 6) ! Number of latitudes
      PARAMETER (nlev = 5) ! Number of levels
      PARAMETER (nts = 3) ! Number of time steps

```

```
      INTEGER gridID, zaxisID1, zaxisID2, taxisID
      INTEGER vlistID, varID1, varID2, streamID, tsID
      INTEGER status, vdate, vtime
      INTEGER nmiss
      REAL*8 var1(nlon*nlat), var2(nlon*nlat*nlev)

!     Open the dataset
      streamID = streamOpenRead("example.nc")
      IF ( streamID < 0 ) THEN
         WRITE(0,*) cdiStringError(streamID)
         STOP
      END IF

!     Get the variable list of the dataset
      vlistID = streamInqVlist(streamID)

!     Set the variable IDs
      varID1 = 0
      varID2 = 1

!     Get the Time axis from the variable list
      taxisID = vlistInqTaxis(vlistID)

!     Loop over the number of time steps
      DO tsID = 0, nts-1
!        Inquire the time step
         status = streamInqTimestep(streamID, tsID)

!        Get the verification date and time
         vdate = taxisInqVdate(taxisID)
         vtime = taxisInqVtime(taxisID)
         WRITE(0, *)"read timestep ",tsID+1,"date=",vdate,"time=",vtime


!        Read var1 and var2
         CALL streamReadVar(streamID, varID1, var1, nmiss)
         CALL streamReadVar(streamID, varID2, var2, nmiss)
      END DO

!     Close the input stream
      CALL streamClose(streamID)

      END
```

B.3. Copy a dataset

This example reads the NetCDF file `example.nc` from Appendix B.1 and writes the result to a GRIB dataset by simple setting the output file type to `CDI_FILETYPE_GRB`.

```
      PROGRAM CDICOPY

      IMPLICIT NONE

      INCLUDE 'cdi.inc'

      INTEGER nlon, nlat, nlev, nts
```

```
      PARAMETER (nlon = 12) ! Number of longitudes
      PARAMETER (nlat = 6) ! Number of latitudes
      PARAMETER (nlev = 5) ! Number of levels
      PARAMETER (nts = 3) ! Number of time steps

      INTEGER gridID, zaxisID1, zaxisID2, tsID
      INTEGER vlistID1, vlistID2, varID1, varID2, streamID1, streamID2
      INTEGER i, status
      INTEGER nmiss
      REAL*8 var1(nlon*nlat), var2(nlon*nlat*nlev)

!     Open the input dataset
      streamID1 = streamOpenRead("example.nc")
      IF ( streamID1 < 0 ) THEN
         WRITE(0,*) cdiStringError(streamID1)
         STOP
      END IF

!     Get the variable list of the dataset
      vlistID1 = streamInqVlist(streamID1)

!     Set the variable IDs
      varID1 = 0
      varID2 = 1

!     Open the output dataset (GRIB format)
      streamID2 = streamOpenWrite("example.grb", CDI_FILETYPE_GRB)
      IF ( streamID2 < 0 ) THEN
         WRITE(0,*) cdiStringError(streamID2)
         STOP
      END IF

      vlistID2 = vlistDuplicate(vlistID1)

      CALL streamDefVlist(streamID2, vlistID2)

!     Loop over the number of time steps
      DO tsID = 0, nts-1
!        Inquire the input time step */
         status = streamInqTimestep(streamID1, tsID)

!        Define the output time step
         status = streamDefTimestep(streamID2, tsID)

!        Read var1 and var2
         CALL streamReadVar(streamID1, varID1, var1, nmiss)
         CALL streamReadVar(streamID1, varID2, var2, nmiss)

!        Write var1 and var2
         CALL streamWriteVar(streamID2, varID1, var1, nmiss)
         CALL streamWriteVar(streamID2, varID2, var2, nmiss)
      END DO

!     Close the streams
      CALL streamClose(streamID1)
      CALL streamClose(streamID2)
```

```
END
```

B.4. Fortran 2003: mo_cdi and iso_c_binding

This is the Fortran 2003 version of the reading and writing examples above. The main differenc to `cfortran.h` is the character handling. Here `CHARACTER(type=c_char)` is used instead of `CHARACTER`. Additionally plain fortran charcters and character variables have to be convertet to C charcters by

- appending `'\0'` with `//C_NULL_CHAR`
- prepending `C_CHAR_` to plain charcters
- take `ctrim` from `mo_cdi` for `CHARACTER(type=c_char)` variables

```
PROGRAM CDIREADF2003
  use iso_c_binding
  use mo_cdi

  IMPLICIT NONE

  INTEGER :: gsize, nmiss
  INTEGER :: nlevel, nvars, code
  INTEGER :: vdate, vtime, status, ilev
  INTEGER :: streamID, varID, gridID, zaxisID
  INTEGER :: tsID, vlistID, taxisID
  DOUBLE PRECISION, ALLOCATABLE :: field(:,:)
  CHARACTER(kind=c_char), POINTER, DIMENSION(:) :: &
       msg, cdi_version
  CHARACTER(kind=c_char, LEN = cdi_max_name + 1) :: &
       name, longname, units
  INTEGER :: name_c_len, longname_c_len, units_c_len

  cdi_version => cdiLibraryVersion()

  WRITE (0, '(a,132a)') 'cdi_version: ', cdi_version

  ! Open the dataset
  streamID = streamOpenRead(C_CHAR_"example_f2003.nc"//C_NULL_CHAR)
  IF ( streamID < 0 ) THEN
    PRINT *, 'Could not Read the file.'
    msg => cdiStringError(streamID)
    WRITE(0,'(132a)') msg
    STOP 1
  END IF

  ! Get the variable list of the dataset
  vlistID = streamInqVlist(streamID)

  nvars = vlistNvars(vlistID)

  DO varID = 0, nvars-1
    code = vlistInqVarCode(vlistID, varID)
    CALL vlistInqVarName(vlistID, varID, name)
    CALL vlistInqVarLongname(vlistID, varID, longname)
    CALL vlistInqVarUnits(vlistID, varID, units)
```

```
  ! CALL ctrim(name)
  ! CALL ctrim(longname)
  ! CALL ctrim(units)

  longname_c_len = c_len(longname)
  name_c_len = c_len(name)
  units_c_len  = c_len(units)
  PRINT '(a,2(i0,a),132a)', 'Parameter: ', varID+1, ' ', code, ' ', &
       name(1:name_c_len), ' ', longname(1:longname_c_len), ' ', &
       units(1: units_c_len ), ' |'

END DO

! Get the Time axis form the variable list
taxisID = vlistInqTaxis(vlistID)

! Loop over the time steps
DO tsID = 0, 999999
  ! Read the time step
  status = streamInqTimestep(streamID, tsID)
  IF ( status == 0 ) exit

  ! Get the verification date and time
  vdate = taxisInqVdate(taxisID)
  vtime = taxisInqVtime(taxisID)

  PRINT '(a,i3,i10,i10)', 'Timestep: ', tsID+1, vdate, vtime

  ! Read the variables at the current timestep
  DO varID = 0, nvars-1
    gridID = vlistInqVarGrid(vlistID, varID)
    gsize  = gridInqSize(gridID)
    zaxisID = vlistInqVarZaxis(vlistID, varID)
    nlevel  = zaxisInqSize(zaxisID)
    ALLOCATE(field(gsize, nlevel))
    CALL streamReadVar(streamID, varID, field, nmiss)
    DO ilev = 1, nlevel
      PRINT '(a,i3,a,i3,a,f10.5,1x,f10.5)', '   var=', varID+1, &
           ' level=', ilev, ':', &
           MINVAL(field(:,ilev)), MAXVAL(field(:,ilev))
    END DO
    DEALLOCATE(field)
  END DO
END DO

! Close the input stream
CALL streamClose(streamID)

END PROGRAM CDIREADF2003
```

```
      PROGRAM CDIWRITEF2003

      USE iso_c_binding
      USE mo_cdi

      IMPLICIT NONE
```

```fortran
      INTEGER :: nlev, nts
      INTEGER :: nlon, nlat, nmiss
      PARAMETER (nlon = 12) ! Number of longitudes
      PARAMETER (nlat = 6) ! Number of latitudes
      PARAMETER (nlev = 5) ! Number of levels
      PARAMETER (nts = 3) ! Number of time steps

      INTEGER gridID, zaxisID1, zaxisID2, taxisID
      INTEGER vlistID, varID1, varID2, streamID, tsID
      INTEGER i, status
      DOUBLE PRECISION lons(nlon), lats(nlat), levs(nlev)
      DOUBLE PRECISION var1(nlon*nlat), var2(nlon*nlat*nlev)
      CHARACTER(len=256, kind=c_char) :: varname
      CHARACTER(kind=c_char,len=1), POINTER :: msg(:)

      DATA lons /0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330/
      DATA lats /-75, -45, -15, 15, 45, 75/
      DATA levs /101300, 92500, 85000, 50000, 20000/

      nmiss = 0

!     Create a regular lon/lat grid
      gridID = gridCreate(GRID_LONLAT, nlon*nlat)
      CALL gridDefXsize(gridID, nlon)
      CALL gridDefYsize(gridID, nlat)
      CALL gridDefXvals(gridID, lons)
      CALL gridDefYvals(gridID, lats)

!     Create a surface level Z-axis
      zaxisID1 = zaxisCreate(ZAXIS_SURFACE, 1)

!     Create a pressure level Z-axis
      zaxisID2 = zaxisCreate(ZAXIS_PRESSURE, nlev)
      CALL zaxisDefLevels(zaxisID2, levs)

!     Create a variable list
      vlistID = vlistCreate()

!     Define the variables
      varID1 = vlistDefVar(vlistID, gridID, zaxisID1, TIME_VARYING)
      varID2 = vlistDefVar(vlistID, gridID, zaxisID2, TIME_VARYING)

!     Define the variable names
      varname = "varname1" // c_null_char
      CALL vlistDefVarName(vlistID, varID1, varname)
      CALL vlistDefVarName(vlistID, varID2, C_CHAR_"varname2"//C_NULL_CHAR)

!     Create a Time axis
      taxisID = taxisCreate(TAXIS_ABSOLUTE)

!     Assign the Time axis to the variable list
      CALL vlistDefTaxis(vlistID, taxisID)

!     Create a dataset in netCDF format
      streamID = streamOpenWrite(C_CHAR_"example_f2003.nc"//C_NULL_CHAR, CDI_FILETYPE_NC)
      IF ( streamID < 0 ) THEN
```

```
         msg => cdiStringError(streamID)
         WRITE(0,'(132a)') msg
         STOP 1
      END IF

!     Assign the variable list to the dataset
      CALL streamDefVlist(streamID, vlistID)

!     Loop over the number of time steps
      DO tsID = 0, nts-1
!        Set the verification date to 1985-01-01 + tsID
         CALL taxisDefVdate(taxisID, 19850101+tsID)
!        Set the verification time to 12:00:00
         CALL taxisDefVtime(taxisID, 120000)
!        Define the time step
         status = streamDefTimestep(streamID, tsID)

!        Init var1 and var2
         DO i = 1, nlon*nlat
            var1(i) = 1.1
         END DO
         DO i = 1, nlon*nlat*nlev
            var2(i) = 2.2
         END DO

!        Write var1 and var2
         CALL streamWriteVar(streamID, varID1, var1, nmiss)
         CALL streamWriteVar(streamID, varID2, var2, nmiss)
      END DO

!     Close the output stream
      CALL streamClose(streamID)

!     Destroy the objects
      CALL vlistDestroy(vlistID)
      CALL taxisDestroy(taxisID)
      CALL zaxisDestroy(zaxisID1)
      CALL zaxisDestroy(zaxisID2)
      CALL gridDestroy(gridID)

      END PROGRAM CDIWRITEF2003
```

C. Environment Variables

The following table describes the environment variables that affect **CDI**.

Variable name	Default	Description
CDI_CONVERT_CUBESPHERE	1	Convert cubed-sphere data to unstructured grid.
CDI_CHUNK_CACHE	0	Set the NetCDF4 chunk cache size.
CDI_CHUNK_CACHE_MAX	0	Set maximum chunk cache size.
CDI_GRIB1_TEMPLATE	None	Path to a GRIB1 template file for GRIB_API.
CDI_GRIB2_TEMPLATE	None	Path to a GRIB2 template file for GRIB_API.
CDI_INVENTORY_MODE	None	Set to time to skip double variable entries.
CDI_QUERY_ABORT	1	Abort if query entry not found
CDI_READ_CELL_CORNERS	1	Read grid cell corners.
CDI_SHUFFLE	0	Set shuffle option to NetCDF4 deflation compression.
CDI_VERSION_INFO	1	Set to 0 to disable NetCDF global attribute CDI.

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