QA-DKRZ:
The Annotation Model

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Overview

- **QA-DKRZ Tool**
  - Work-flow
  - Dependencies
- **Annotation Model**
  - Specification of actions tagged to checks
  - Structure of results: Files and directories
  - YAML formatted log-file output
  - JSON formatted summary
- **QA-DKRZ: status**

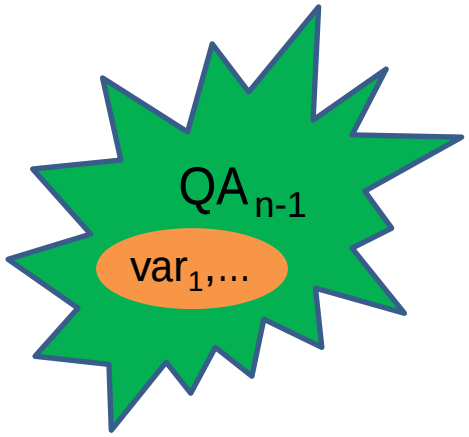
Purpose:

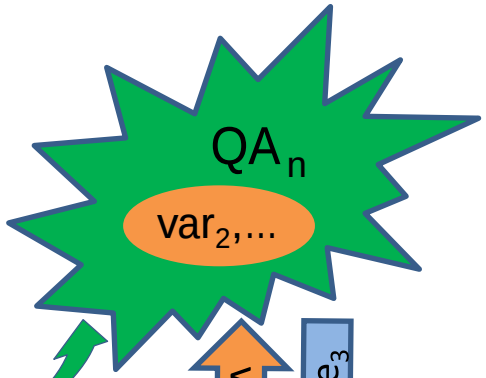
Assure that every file entering ESGF complies to conventions and project rules.

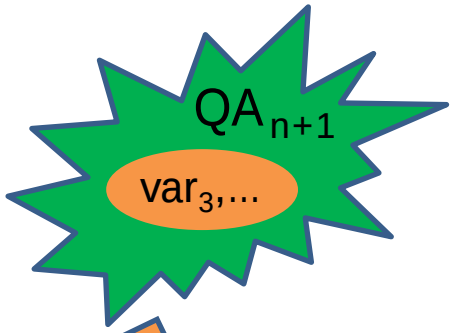
If not, then issue annotations.

Tables:

- Conventions
- Check-lists
- CV
- DRS
- Variable Requ.



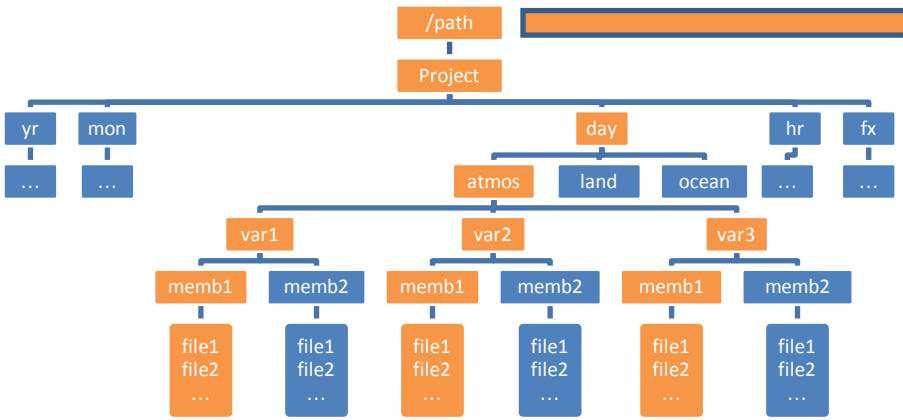




var2, MIP, sub-temp5

results: var1, filename3

var3, MIP, sub-temp1



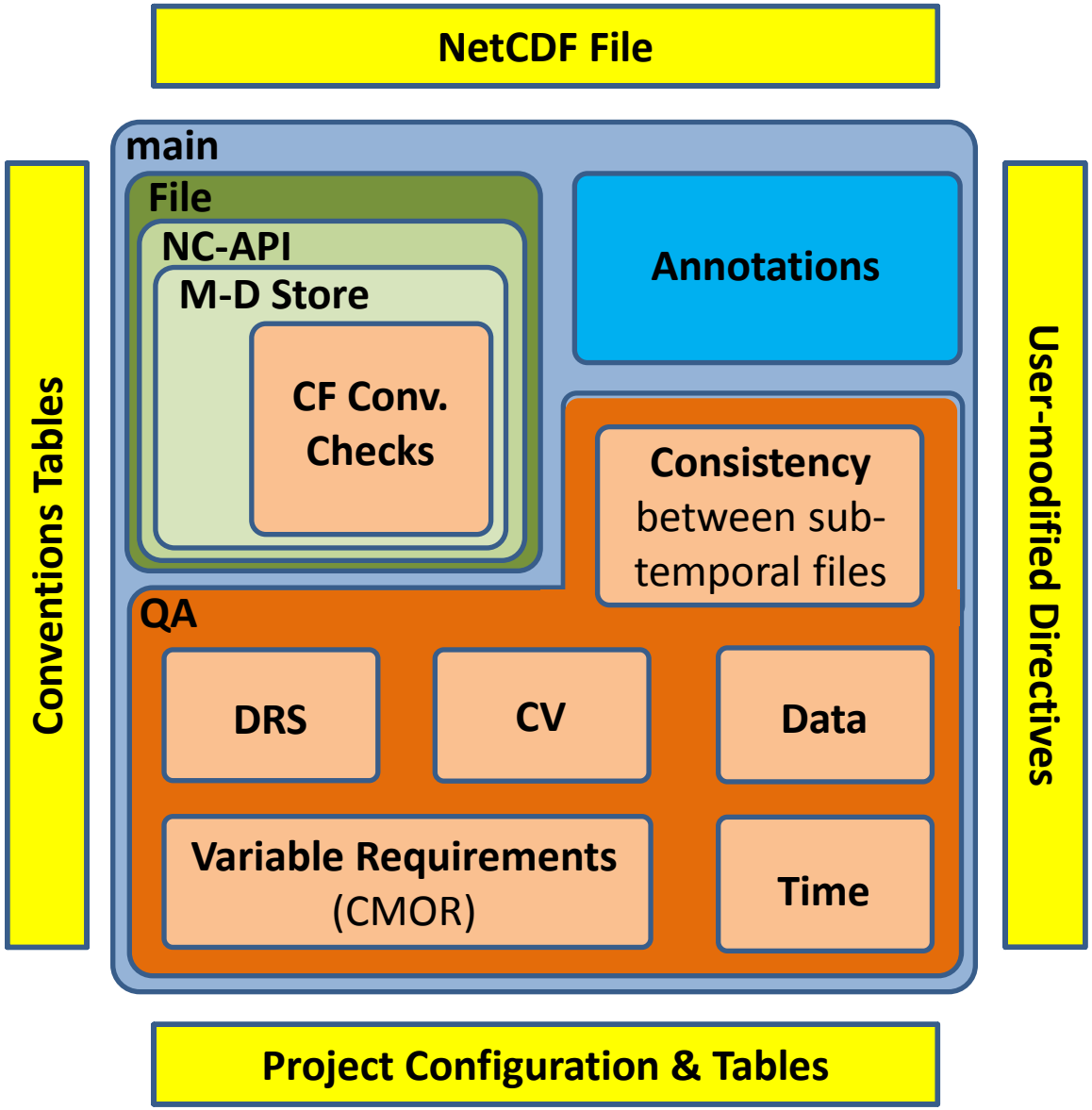
persistent QA controller

configuration

Results:

- log-file
- sum.json
- tag-wise
- atomic Δt

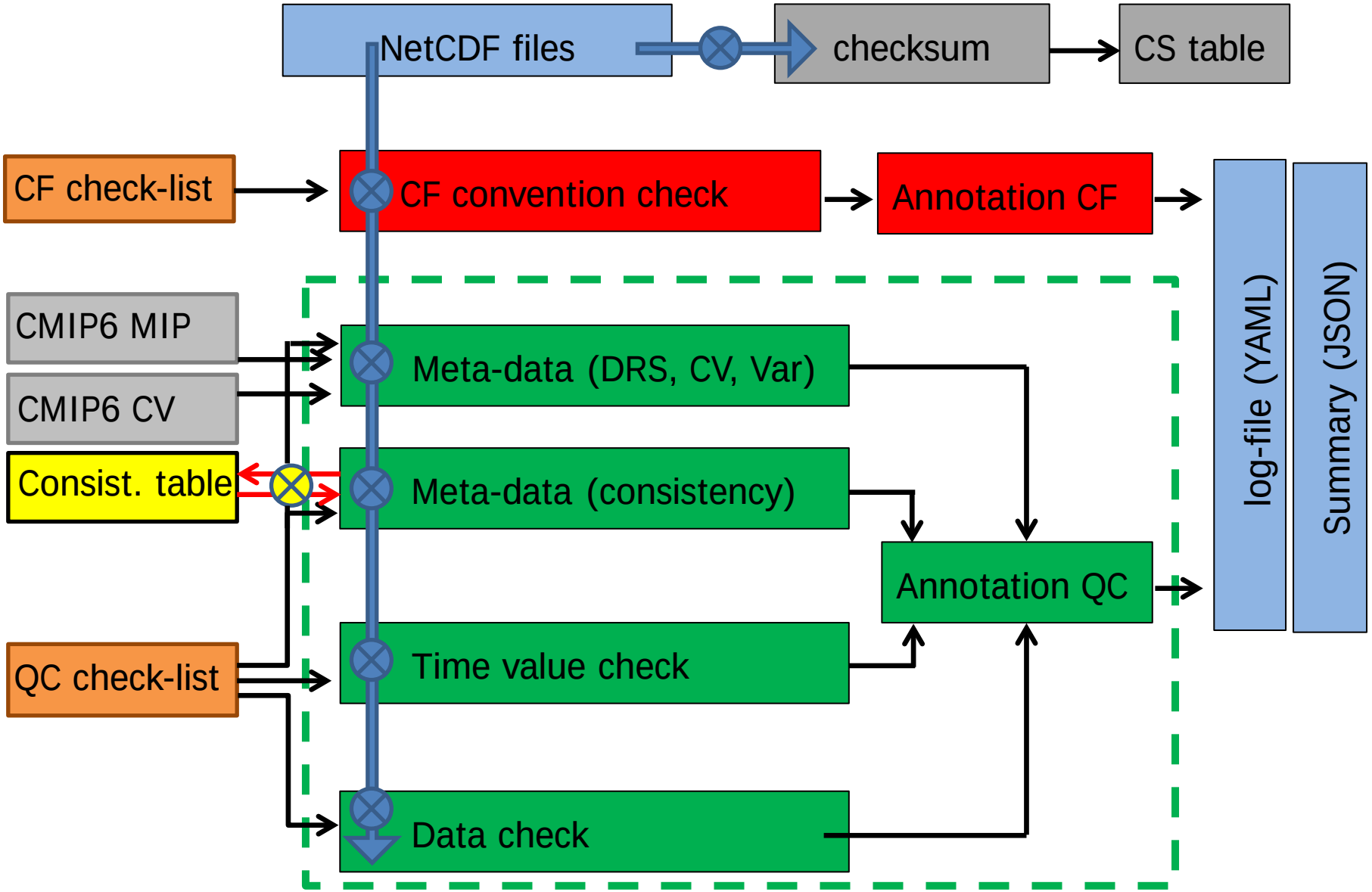
QA Program (C++)



Quality Assurance (QA)

- **Data Reference Syntax (DRS)**
- **Controlled Vocabulary (CV)**
- **Variable Requirements** (CMIP Model Output Requir.)
- **Time Properties**
- **Consistency** between parent - child files (atomic and experiments)
- **Data Checks**
  infinity and not-a-number
  outlier tests
  replicated record detection

Note:
every check may be disabled


NetCDF files
checksum
CS table
CF check-list
CF convention check
Annotation CF
log-file (YAML)
Summary (JSON)
CMIP6 MIP
CMIP6 CV
Consist. table
Meta-data (DRS, CV, Var)
Meta-data (consistency)
Annotation QC
QC check-list
Time value check
Data check

Libraries

- zlib www.zlib.net
- hdf5 www.hdfgroup.org/HDF5
- netcdf www.unidata.ucar.edu/netcdf
- udunits2 www.unidata.ucar.edu/software/udunits

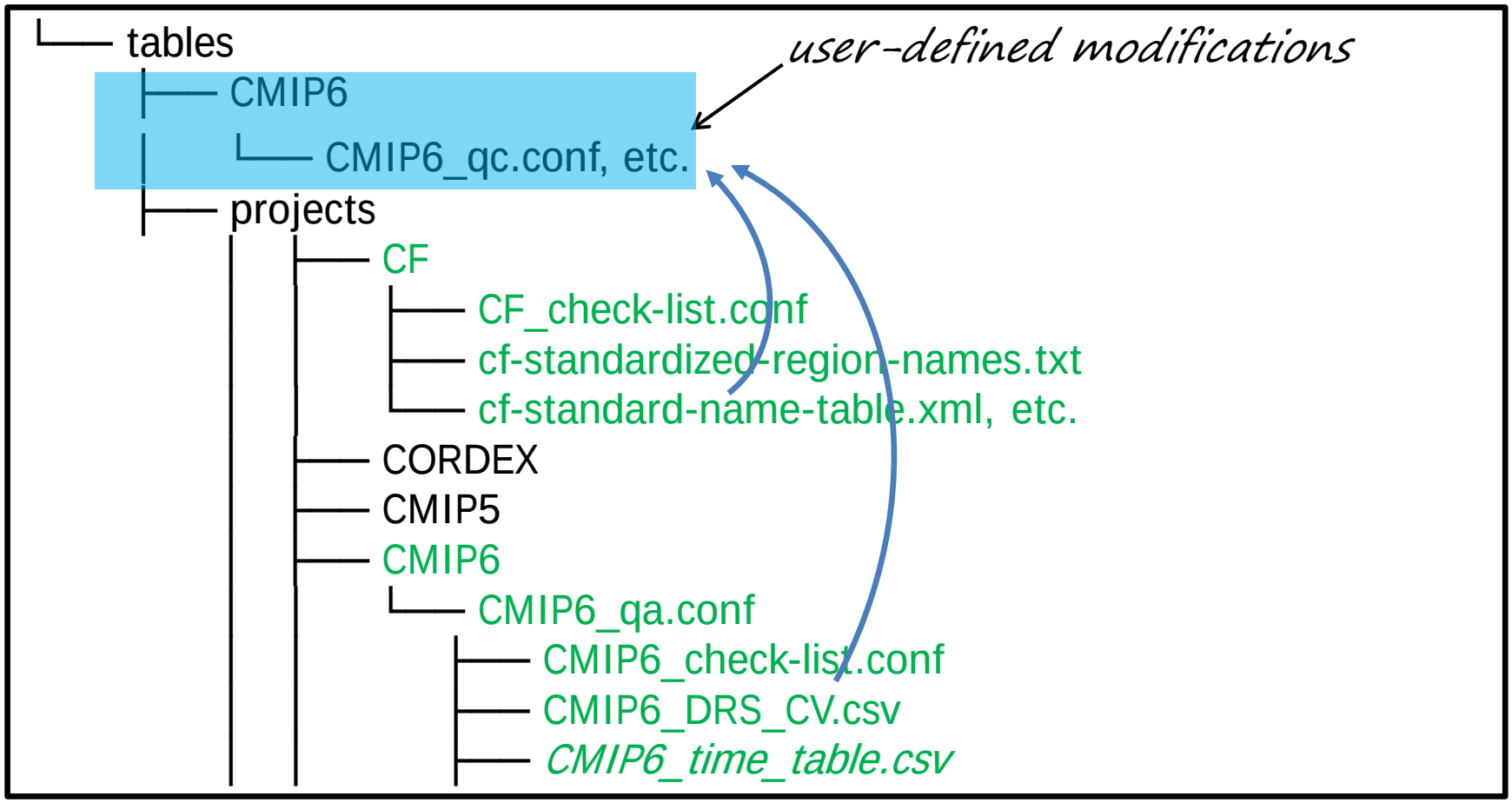
Tables

- CF Conv. http://cfconventions.org
- CMIP6_MIP http://proj.badc.rl.ac.uk/svn/exarch/CMIP6dreq/tags/latest/dreqPy/docs/CMIP6_MIP_tables.xlsx
- CMIP6_CV https://github.com/WCRP-CMIP/CMIP6_CVs

Externals

- xlsx2csv http://github.com/dilshod/xlsx2csv
- jsoncpp https://github.com/open-source-parsers/jsoncpp
- PrePARE http://cmor.llnl.gov/mydoc_cmip6_validator

Path: /home/user/.qa-dkrz



Precedence of Tables (Directives)

- Command-line
- Current Directory (Task File)
- User-defined Modifications
- Default (Projects Directory)

QA-DKRZ

- **Sources: GitHub**

  https://github.com/IS-ENES-Data/QA-DKRZ

- **Binaries**

  conda install -c birdhouse -c conda-forge qa-dkrz

  ehbrecht@dkrz.de

- **Documentation: ReadTheDocs.org**

  http://qa-dkrz.readthedocs.io/en/latest

Annotation Model

- Check-lists
- QA_Results
  - Log-file (YAML)
  - Summary
    - Annotations (JSON)
    - Atomic Time Interval

Check-list File

Format: [text] & tag [,level] [,task] [,variable] [,constraint]

Brace grouping {}:
Example: given: a,b{v{D(z),x,b=2}},{u,v},w
result: 'a,b,w', 'a,v,x,b=2,w', 'a,b,u,v, w'

Key words of actions: {Ln, D, EM, tag, var, V=value, R=record}

- level: L1 – L4 (warning – emergency stop)
- D: Discard
- tag: Identifier.
- EM: Email notification (EM)
- var: Comma-separated acronyms of variables; directive is only applied to these variable(s).
- value: Constraining value, *e.g {tag,D,V=0,var} discards test for variable var only if value=0*
- record: apply to time value(s) r_0 [- r_1]

Check-list File

Groups:

(1) Directory and Filename Structure (DRS)

(2) Required Attributes (CV)

(3) Variables

(4) Dimensions

(5) Auxiliaries

(6) Tables

(7) Consistency Check

(8) Miscellaneous

(M) Pre-check failure detection

(R) Data / Time (record/based)

Examples (from `CORDEX_check-list.conf`):

Height requires units=m

& 2_3,L1

every height variable is checked for units [m]

Near-surface height must be 0 - 10m

& 5_6,L1,{D,rlut,rsdt,rsut}

variables discarded from check: rlut, rsdt, rsut

Suspecting replicated records

& R3200,L1{D,sund},{D,V=0,clivi,mrfso,prsn,sftgif}

sund discarded,
clivi … discarded for records
with constant value=0.

QA Results

Structure of QA-Results: Files and Directories

```
QA_Results/project/institute  (root directory)
└── check_logs
    ├── AFR-44_CNRM_ECMWF-ERAINT_evaluation_r1i1p1_v1.log
    │
    ├── Annotation
    │   └── AFR-44_CNRM_ECMWF-ERAINT_evaluation_r1i1p1_v1.json
    │
    ├── AtomicTimeRange
    │   └── AFR-44_CNRM_ECMWF-ERAINT_evaluation_r1i1p1_v1.period
    │   └── AFR-44_CNRM_ECMWF-ERAINT_evaluation_r1i1p1_v1.range
    └── Tags
        └── AFR-44_CNRM_ECMWF-ERAINT_evaluation_r1i1p1_v1
            ├── CF_73d
            ├── L1_1_2
            ├── L1_CMOR_xzy
            ├── L2_SF
```

Log-file (YAML)

```
---
# Log-file of a QA session started by qa-DKRZ
configuration:
  command-line: -m -f task.CMIP6 -e_check_mode=-CNSTY -e_next
  options:
    APPLY_MAXIMUM_DATE_RANGE:
    …
    SELECT_VAR_LIST: .*
start:
  date: 2016-12-02T11:23:38
  qa-revision: master-66ca331
items:
  - date: 2016-12-02T11:23:40
    file: tas_Amon_1pctCO2_MPI-ESM-LR_r1i1p1f2_gn_200601-210012.nc
    data_path: /path/CMIP6/CMIP/MPI-M/…/r1i1p1f2/Amon/tas/gn/v20161130
    conclusion: 'CF: FAIL, CV: FAIL, DATA: PASS, DRS(F): PASS, DRS(P): FAIL, TIME: PASS
    checksum:        ce5e24ffeb5c38665a17570f4a564f0e.md5
    creation_date:   2016-12-02T12:40:29Z
    tracking_id:     06cfd581-917a-4888-9b92-a07a726469d0
```

```
events:
  - event:
      caption: 'DRS path: path component member_id=<r1i1p1f2> does not
                match global attribute value <r1i1p1f1>.'
      impact: L1
      tag: '1_2'
  - event:
      caption: 'Attribute institution:
                found <Max Planck Institute for Meteorology>,
                expected from CMIP6_institution_id.json
                <Max Planck Institute for  Meteorology, Hamburg 20146,
                 Germany>.'
      impact: L2
      tag: '2_4'
  - event:
      caption: 'Coordinate variable <height>: No data.'
      impact: L1
      tag: 'CF_0d,
status: 2
```

Time Intervals of atomic Variables (*YAML*):

```
--- # Time intervals of atomic variables.
- frequency: day
  number_of_variables: 42
      - variable: evspsbl_AFR-44_ECMWF-ERAINT_evaluation_r1i1p1_v1_day
            begin: 1989-01-01T00:00:00
            end: 2009-01-01T00:00:00
            status: PASS | FAIL:B | FAIL:E
       - ...
- frequency: mon
   number_of_variables: 71
      - variable: evspsbl_AFR-44_ECMWF-ERAINT_evaluation_r1i1p1_v1_mon
            begin: 1989-01-01T00:00:00
            end: 2009-01-01T00:00:00
            status: PASS | FAIL:B | FAIL:E
      - …
```

Note: FAIL:B | FAIL:E means that not all files begin|end with the same date.

Time Intervals of atomic Variables (*human read.*):

Frequency: day
Number of variables: 4
clh_EUR-11_ECMWF-ERAINT...day 1979-01-01T00:00:00 - 2013-01-01T00:00:00
clivi_EUR-11_ECMWF-ERAINT...day --> 1980-01-01T00:00:00 - 2013-01-01T00:00:00
cll_EUR-11_ECMWF-ERAINT...day 1979-01-01T00:00:00 - 2010-01-01T00:00:00 <--
clm_EUR-11_ECMWF-ERAINT...day 1979-01-01T00:00:00 - 2013-01-01T00:00:00

Frequency: fx
Number of variables: 1
orog_EUR-11_ECMWF-ERAINT -

Frequency: mon
Number of variables: 4
clt_EUR-11_ECMWF-ERAINT...mon --> 1980-01-01T00:00:00 - 2013-01-01T00:00:00
evspsbl_EUR-11_ECMWF-ERAINT...mon 1979-01-01T00:00:00 - 2013-01-01T00:00:00
hfls_EUR-11_ECMWF-ERAINT...mon --> 1980-01-01T00:00:00 - 2010-01-01T00:00:00 <--
hfss_EUR-11_ECMWF-ERAINT...mon 1979-01-01T00:00:00 - 2013-01-01T00:00:00

Summary (JSON)

```
{
   "QA_conclusion": [ PASS | FAIL ]  ",
   "project": "CORDEX",
   "DRS_0": "cordex",
   "DRS_1": "output",
   "DRS_2": "AFR-44",
   …
   "DRS_8": "v1",
   "DRS_9": "SHARED",
   "DRS_10": "SHARED",
   "annotation":
   [
      {
         "DRS_9": ["day", "mon"],
         "DRS_10": ["tauv", "zg500"],
         "caption": "DRS CV path: global attribute RCMModelName = <QWER> vs. <ASDF>.",
         "severity": "L1"
      },
      {…}
  ]
}
```

CMIP6 Files → ESGF

QA Procedure

- **Check (only) DRS of paths and filenames.**

- **Run PrePARE checker for CMIP6 CV.**

EXAMPLE: CMIP6 Test File with Faults

QA-DKRZ: DRS Check

- event:

  capt: DRS path component
  member_id=<r1i1p1f2> does not match
  global attribute value <r1i1p1f1>.

  impact: L1

  tag: 1_2

Annotations by PrePARE

- !!!
  ! Warning: Your input attribute institution
  ! "Max Planck Institute for Meteorology" will
  ! be replaced with "Max Planck Institute for
  ! Meteorology, Hamburg 20146, Germany" as
  ! defined in your Control Vocabulary file.
  !!!
- !!!
  ! Error: The source_id, "MPI-ESM-LR", which
  ! you specified in your input file could not be
  ! found in your Controlled Vocabulary file.
  !!!

QA-DKRZ: status

		CMIP5	CORDEX	CMIP6	Comment
Conv	CF	v1.4	v1.4	v1.7	www.cfconventions.org
	UGRID	-	-	v1.0	ugrid-conventions.github.io
DRS	(Path)				
	(File)				
CV		[1]			[1]) CMOR guide → machine read.
Var. Requir.				[2]	[2]) CMIP6_MIP_tables.xlsx
Consistency					files across atomic & exp. scope
Time					
Data					NaN, Inf, replications, outlier
CMOR		-	-	PrePARE	http://cmor.llnl.gov
WPS					
OpenDAP					