Climate Model Output Rewriter (CMOR) Version 3

CMIP6 tables and MIPs post-processing

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Agenda

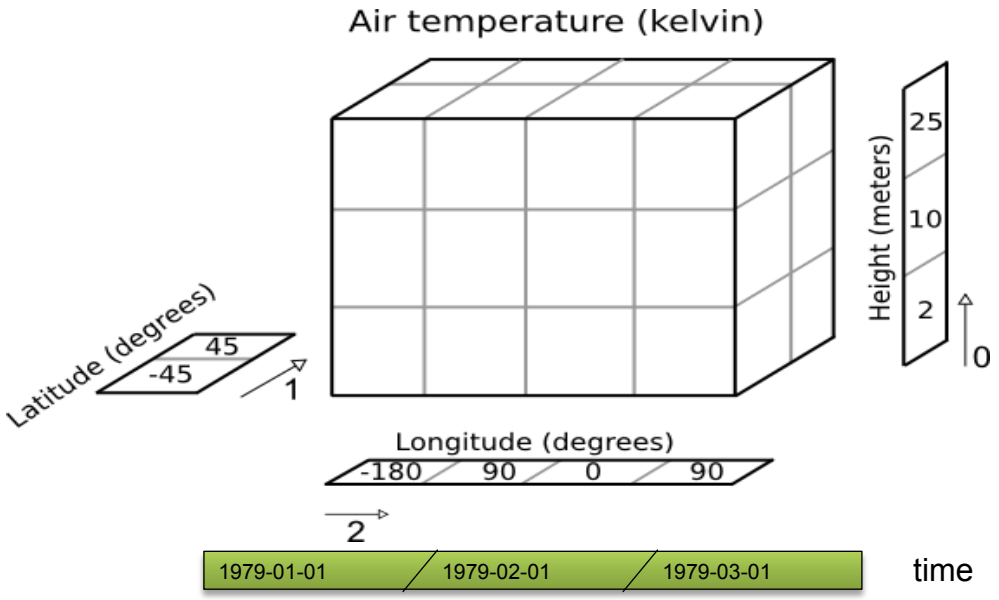
- Background
  - What is CMOR?
- What is needed for CMIP6?
- What is new in CMOR3?
  - CMIP6 tables for CMOR3.
- What's needed for similar projects such as obs4MIPs, ana4MIPs, CREATE?
  - Introduction to ezCMOR.

Background

- What is CMOR?
  - Create a uniform output file from different models following the CF-1 standard format to facilitate model outputs intercomparison.
  - Capability to reorder axis order, reverse axis direction and convert units.
  - Follow CF conventions – provides for standardized description of data contained in a file.
  - Data Reference Syntax (DRS) – defines vocabulary used in uniquely identifying MIP datasets and specifying file and directory names
    - http://cmip-pcmdi.llnl.gov/cmip5/docs/cmip5_data_reference_syntax.pdf

What is CMOR?

- Define axes.
- Define variables to be written by CMOR.
- Write an array of data that includes one or more time samples for a defined variable.



Coupled Model Intercomparison Project 6

- What is needed for CMIP6?

1. More flexibility with global attributes.
   - Realization, Initialization, Physics in configuration file (table).
2. Allow additional “required” global attributes.
3. Allow user to “define” their custom global attributes.
4. Provide more complete QC information to CMOR.

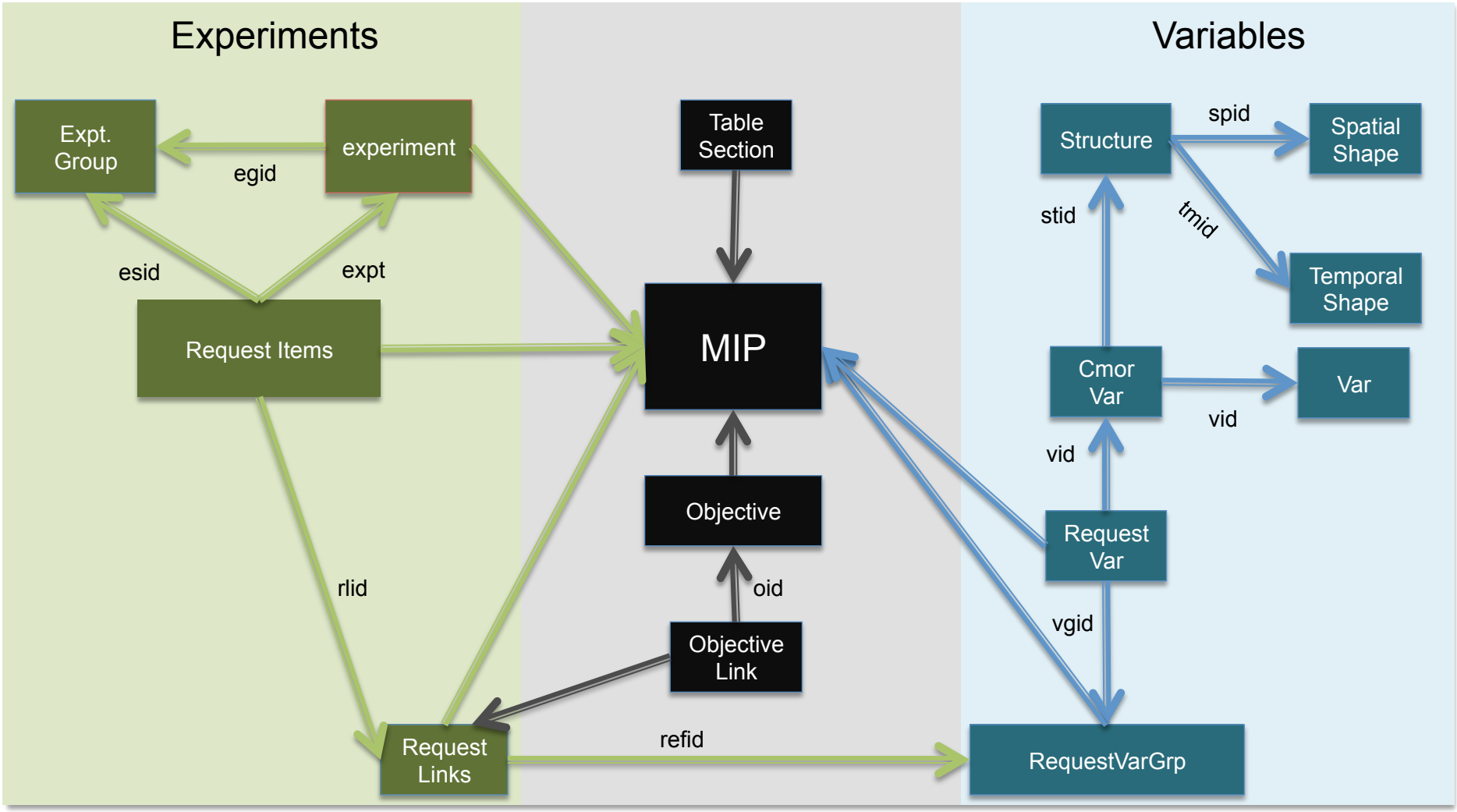
Current projects for CMIP6

- Gather information from different “MIP” projects for CMIP6.

AerChemMIP	ISMIP6
C4MIP	LS3MIP
CFMIP	LUMIP
CORDEX	OMIP
DAMIP	PDRMIP
DCPP	PMIP
DECK	RFMIP
DynVar	SIMIP
FAFMIP	ScenarioMIP
GMMIP	SolarMIP
GeoMIP	VIACSAB
HighResMIP	VolMIP

  - Architecture of current XML database.

CMOR3
Gathering information for CMIP6 (XML)



CMOR3
What's new?

- Conversion of XML table to SQlite3 relational database

```
create table var (
        uid                     text primary key not NULL ,
        description             text,
        id                      text,
        label                   text,
        procComment             text,
        procNote                text,
        prov                    text,
        sn                      text,
        title                   text,
        units                   text)
```

CMOR3
What's new?

- From SQL create JSON format table.
  - CMOR3 will read JSON format table.

```
"GeoMIP": {
    "Experiments": {
        "G6sulfurSlice2": {
            "Variables": {
                "va": {
                    "modeling_realm": "atmos",
                    "ok_max_mean_abs": "4.679",
                    "ok_min_mean_abs": "0.9886",
                    "levels": "17",
                    "timeLabel": "time-mean",
                    "mipTable": "Amon",
                    "valid_max": "69.93",
                    "valid_min": "-71.1",
                    "frequency": "mon",
                    "cell_methods": "time: mean",
                    "timeDimension": "time",
                    "dimensions": "longitude|latitude|plevs"
                    }
                }
            }
        }
    }
```

CMOR3
What's new?

1. Add new tables to better handle a wider range of model output and observational data.

2. Convert tables to JSON files

3. Allow more flexibility specially for metadata.

4. Add new projects for CMIP6.

5. Add new variables, spatial and temporal resolution.

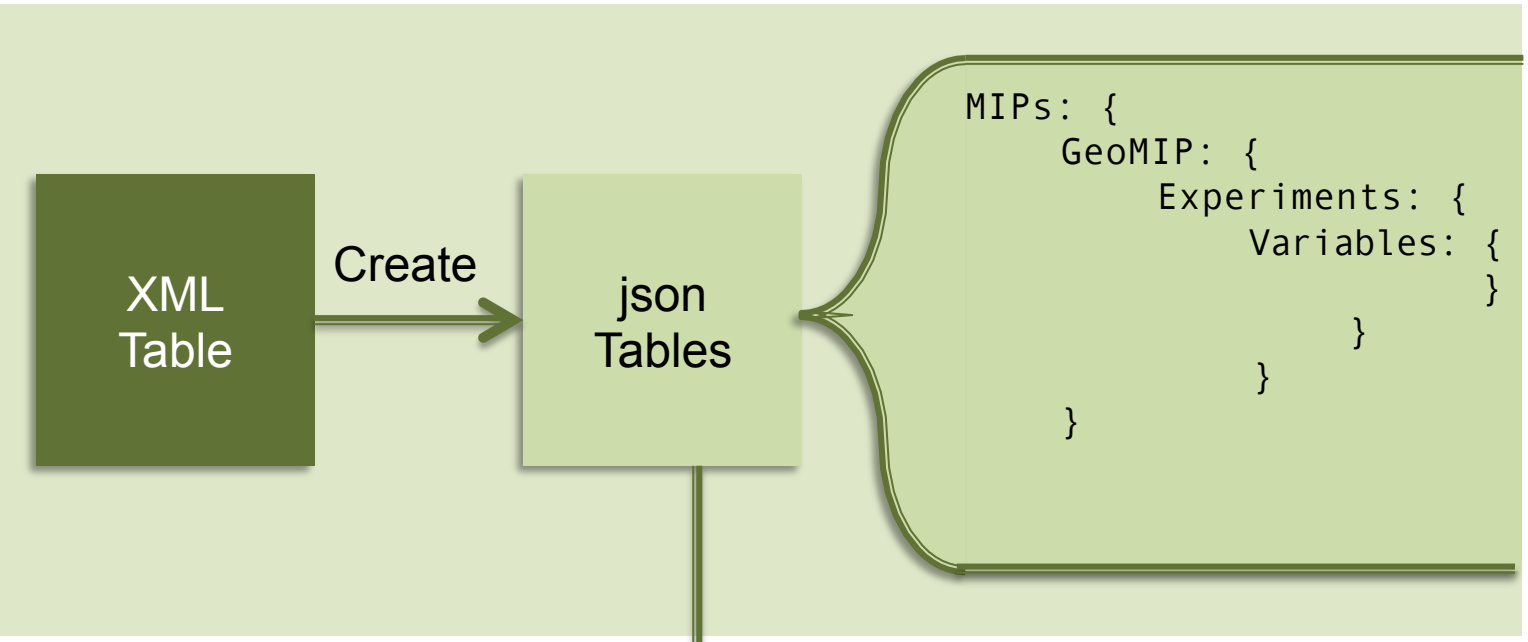
6. Provide more complete Quality Control information
   - (e.g., valid max and min for more fields)

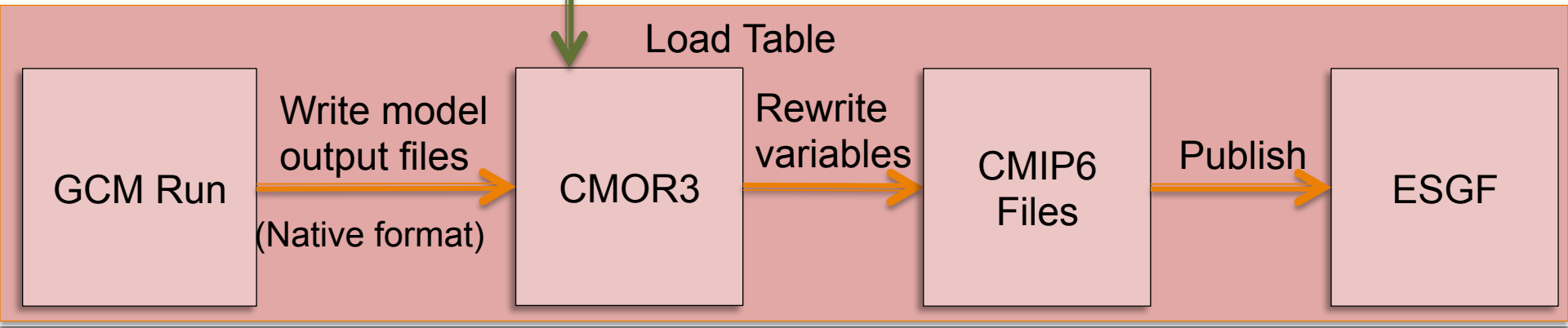
CMOR3
What's new?

Use filename templates:

- **CMIP5**
  - **hfss_Amon_HadGEM2-AO_historical_r1i1p1_186001-200512.c**
    - **<variable>_<realm>_<institute>_<experiment>_<rip>_<timestamp>.nc**
- **CMIP6**
  - **<variable_id>_<table_id>_<experiment_id>_<*source_id*>_<run_variant_id(rip)>_ <*grid_id(regrid*)>_<time_range>.nc**
- **obs4MIPs**
  - **cltNobs_MODIS_L3_C5_200003-201109.nc**
    - **<variable>_<satellite>_<Level>_<version>_<timestamp>.nc**

CMOR3 Workflow





Introduction to ezCMOR

- Collaboration with NASA Goddard Space Flight Center (NCCS)
  - Convert observation gridded data to CMIP file format using CMOR
  - Convert model reanalysis data format using CMOR.
- Post-processing CMOR2 output files
  - Delete attributes
    - Realization, initialization, physics
  - Add attributes
    - Title
  - Set filename convention.
  - Set directory path convention.
- Add these options to CMOR version 3 for flexibility.

ezCMOR

Handlers

Index	0	1	2	3	4
0	65,340	12,483	138,189	902,960	633,877
1	5,246	424,642	650,380	821,254	866,122
2	89,678	236,781	601,691	329,274	913,534
3	103,902	4,567	733,611	263,010	85,550
4	2,778	658,305	128,788	978,155	620,702
5	45,024	55,058	705,586	89,672	384,605
6	780	47,538	523,784	556,801	617,107
7	32,667	350,890	834,753	638,108	85,188
8	56,083	145,582	775,040	548,322	756,587
9	41,123	543,542	537,738	513,048	418,482

Read resource files

Grads/CTL

netCDF

netCDF list

matlab

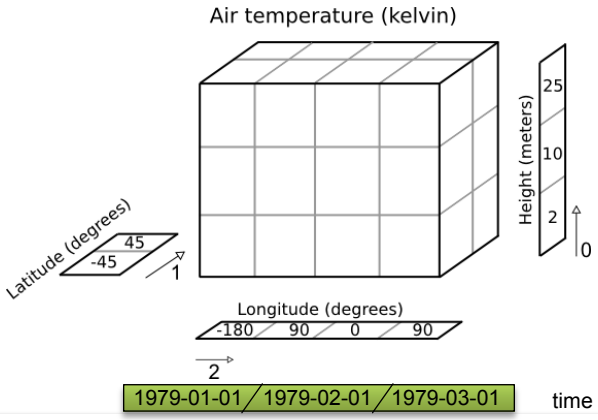
Call CMOR

Post-processing

Goal:

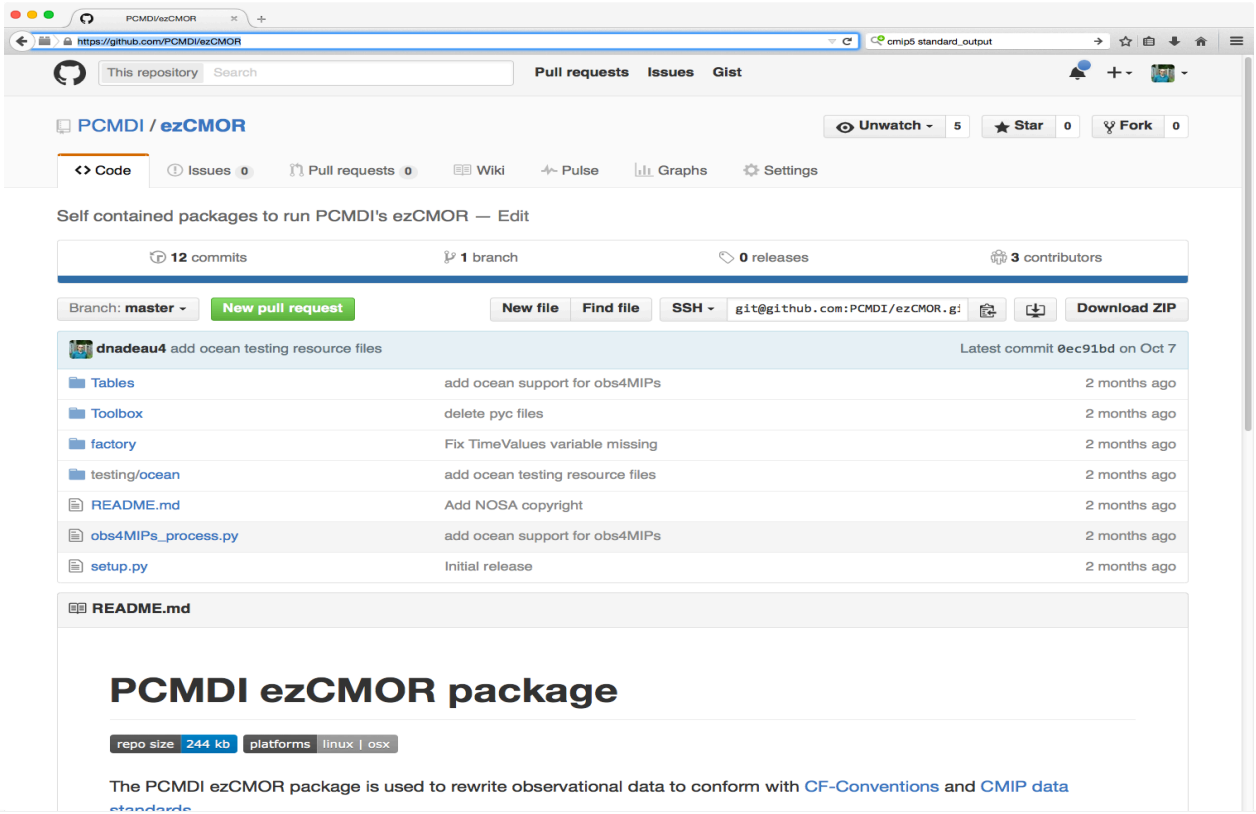
Create time/level/lat/lon

Prepare axes for CMOR2



For further information.

- https://github.com/PCMDI/xml-cmor3-database
- https://github.com/PCMDI/ezCMOR



ezCMOR

Variables

Variable Name	Dimension	Description	Units
T	3D	Air Temperature	K
U	3D	Eastward wind component	m s-1
V	3D	Northward wind component	m s-1
TO	3D	Ocean Temperature	K
PREC	2D	precipitation	mm

ezCMOR

User variable conversion table.

CMOR Variable Name	User Variable Name	Units	Level	Positive Up/Down	Equation
ta	T	K	all		data
ua	U	m s-1	all		data
va	V	m s-1	all		data
to	TOCEAN	K	all	up	data
rsds	SWGNT	W m-2		down	data
rsut	equation	W m-2		up	@DIFF(SWTDN,SWTNT)
rsutc	equation	W m-2		up	@DIFF(SWTDN,SWTNTCLR)
clt	CLDTOT	%			data*100
cl	CLOUD	%	all		data

ezCMOR

- Resource file for monthly MERRA assimilation data.

```
years=1979,1980,1981
file_template          = "data/instM_3d_asm_Cp_{0}.lst”
…..
inpath                 = "Tables"
table                  = 'CMIP5_Amon_createip'
inpath                 = 'Tables'
OutputTimeUnits        = "months since 1900-1-1"
InputTimeUnits         = "internal"
SetGlbAttributes       = "[(\global\,rc[\product\]),
                           (\processing_version\,rc[\processing_version\]),
                           (\title\,\reanalysis output prepared for ana4MIPs
                           NASA-GSFC\)]"
DelGlbAttributes       = "[\realization\,\experiment\,\physics_version\,\initialization_method\]"
excel_file             = 'MERRA_ana4MIPs_public.xls'
```

ezCMOR

rsut	**equation**	**W m-2**		**up**	**@DIFF(SWTDN,SWTNT)**
rsutc	equation	W m-2		up	@DIFF(SWTDN,SWTNTCLR)

```
def DIFF(h, a, b):
    '''
    compute difference between a and b (a-b)
    '''
    var_a = h.getData( variable=a )
    var_b = h.getData( variable=b )
    res=(var_a - var_b)
    return res
```