Streamlining SWAT+ Climate Input Data

Woes with a Single-File Superhero!

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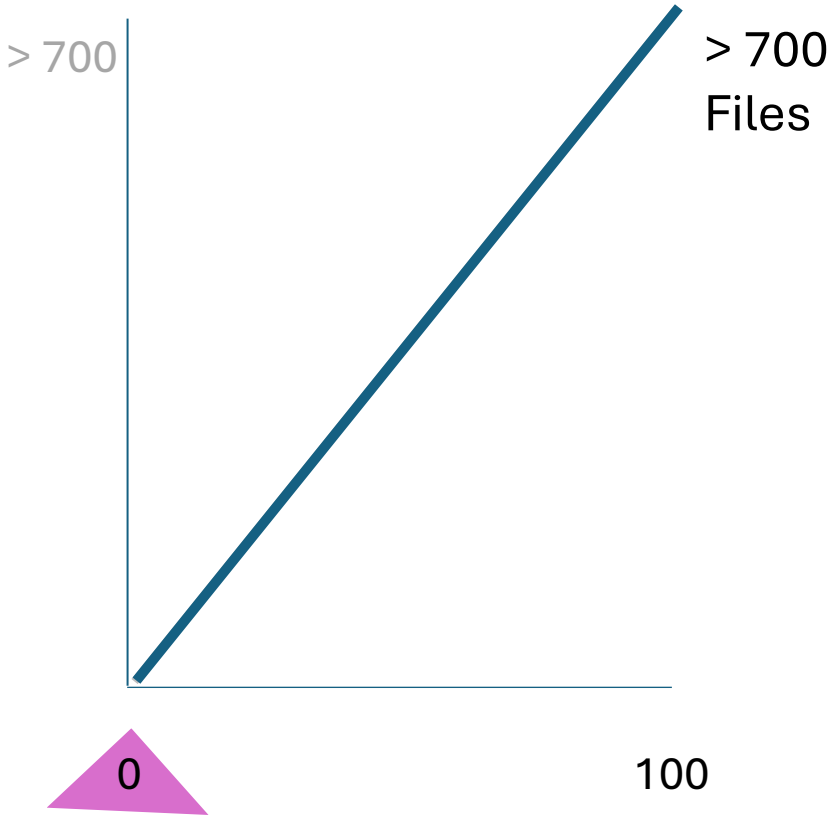
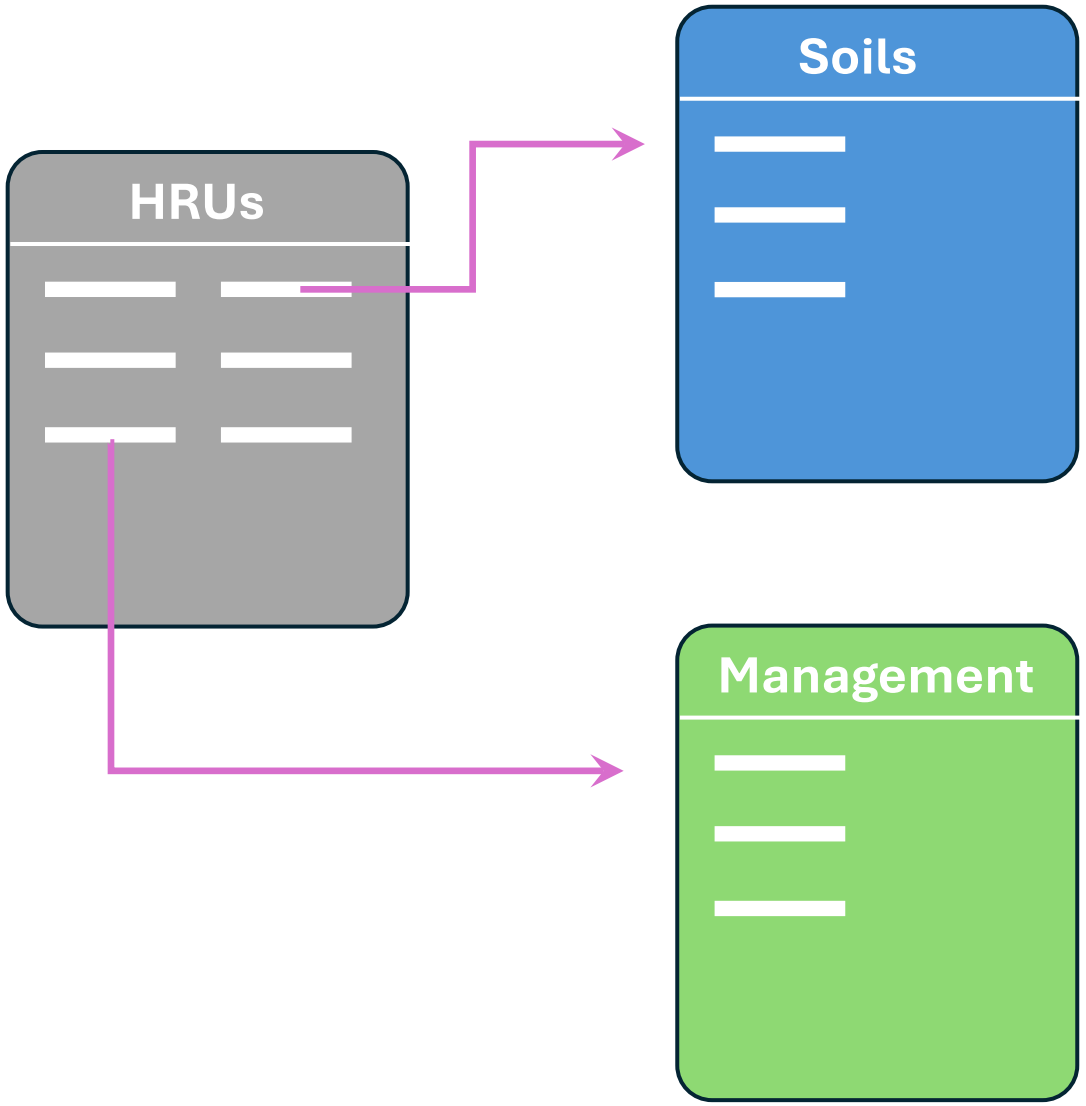
1 HRU

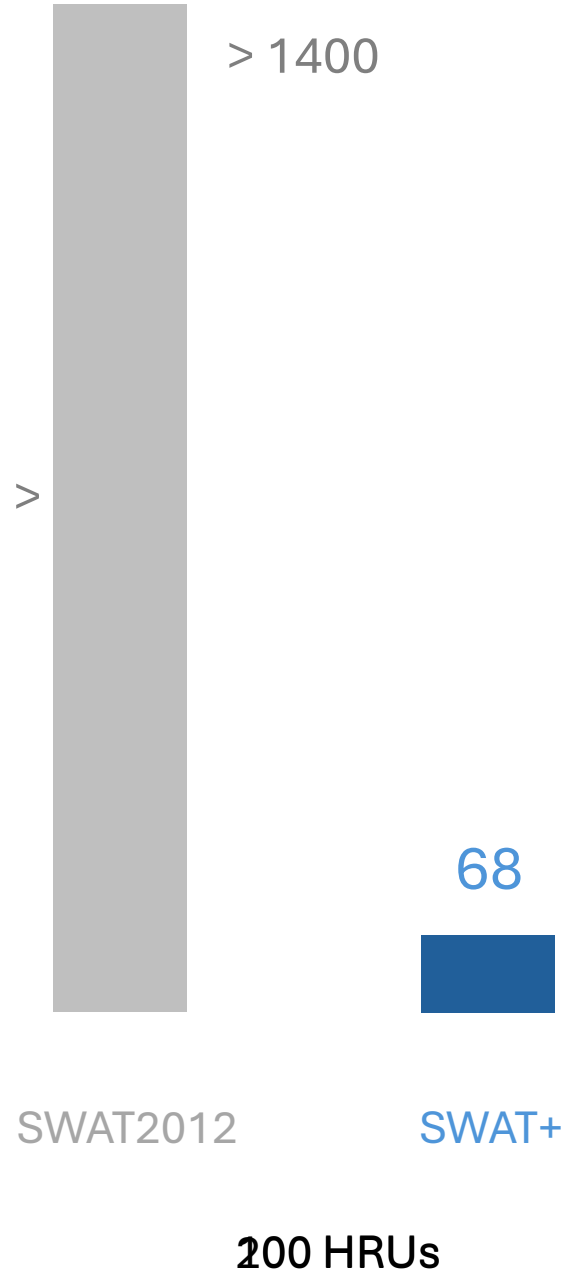
× 7

- .sol
- .chm
- .gw
- .hru
- .mgt
- .sdr
- .sep

.sub, .wgn, .pnd,
.rte, .swq, .wus







200 HRUs


> 1400
Soils
HRUs
Each Weather Station
bout 6 Variables
Precipitation
Min Temperature
Max Temperature
Solar Radiation
Relative Humidity
Wind
ws
github
CoSWAT-Framework
model-setup
CoSWATv0.4.5
Places
Home
Desktop
Documents
Downloads
Music
Pictures
Videos
Trash
chawandaOffice
Name
Size
Results
31 items
TxtInOut
103,311 items
SWAT2012
SWAT+
200 HRUs

Outline

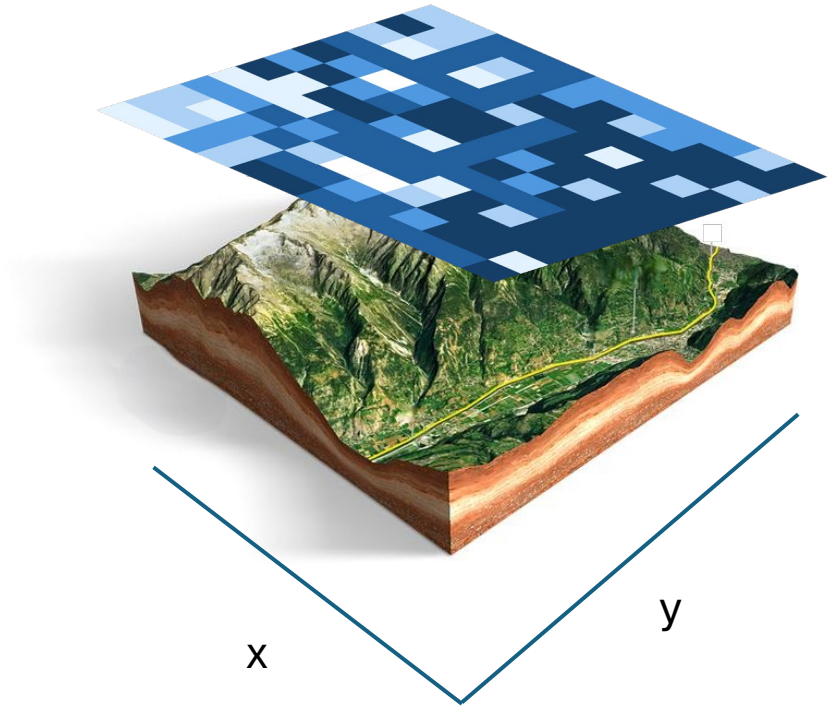
- SWAT+ is a Huge improvement on SWAT2012
- Climate input can Quickly Build up
- NetCDF is an Efficient Format
- Integration of NetCDF into SWAT+
- SWAT+ Benefits from NetCDF Format

NetCDF can clear the clutter

and improve storage and memory

Network Common Data Form

Commonly used with scientific
data with multi dimensional arrays



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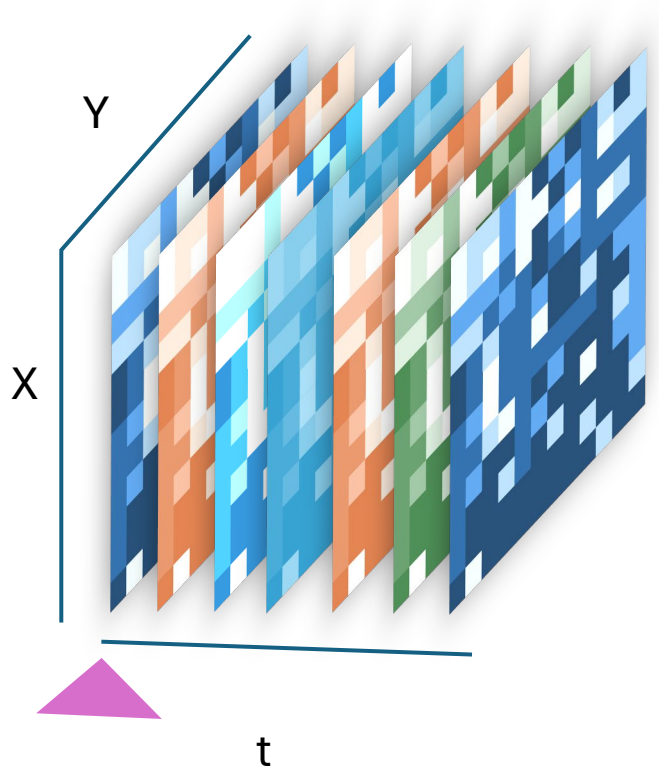


That includes ‘time’

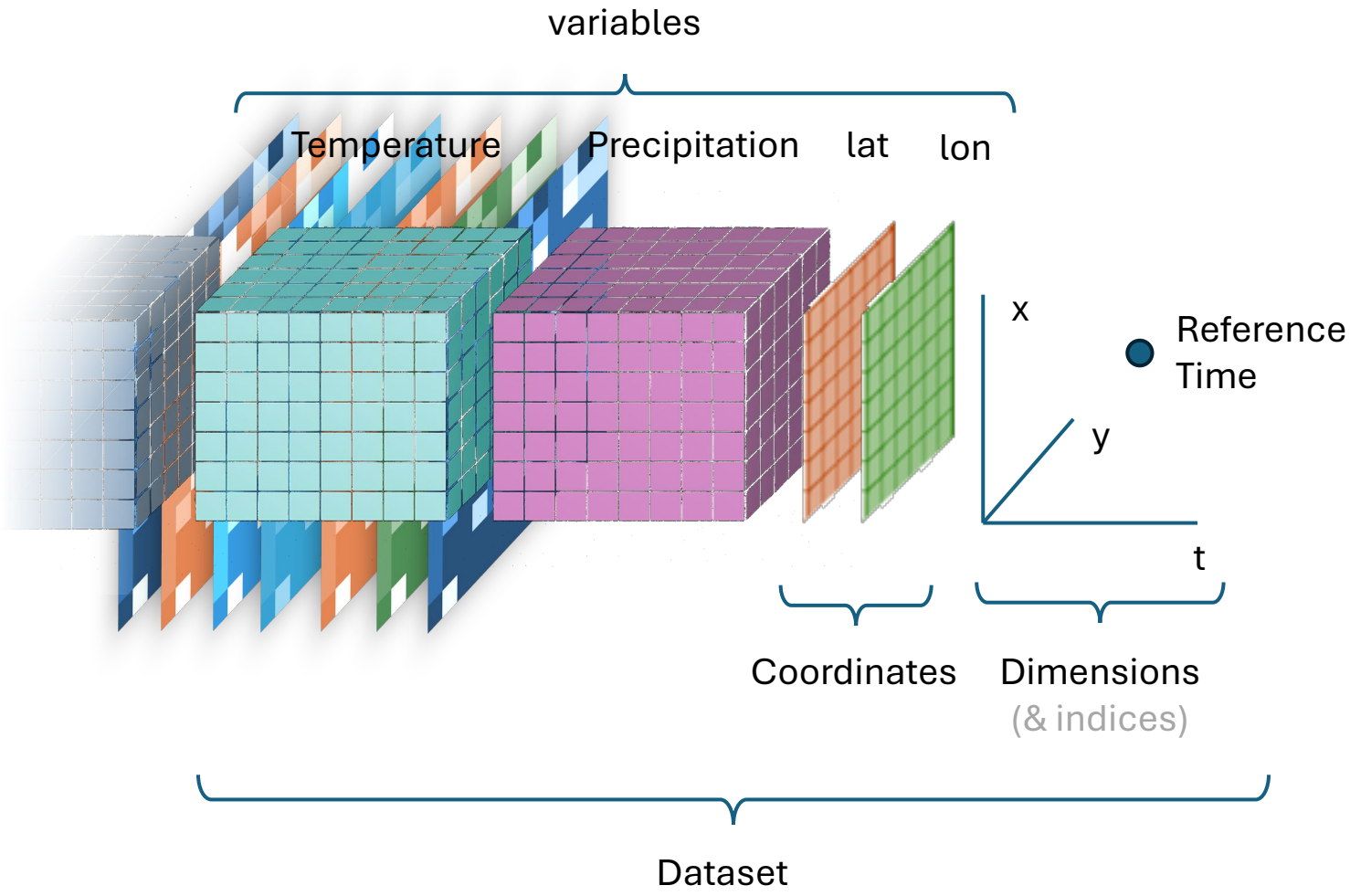
NetCDF can clear the clutter

and improve storage and memory

Network Common Data Form

Commonly used with scientific
data with multi dimensional arrays

You can store as many variables
as needed efficiently in one file



SWAT+ is a Huge improvement on SWAT2012

Climate input can Quickly Build up

NetCDF is an Efficient Format

Integration of NetCDF into SWAT+

SWAT+ Benefits from NetCDF Format

Adapt existing modules

to accommodate new modules

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Additional Role

Gets configuration files used by climate_control.f90

lum	landuse.lum	management.sch	cntable.lum
chg	cal_parms.cal	null	null
init	plant.ini	soil_plant.ini	om_water.ini
soils	soils.sol	nutrients.sol	null
decision_table	lum.dtl	res_rel.dtl	null
regions	ls_unit.ele	ls_unit.def	null
pcp_path	limpopoClimate.nc4		
tmp_path	limpopoClimate.nc4		
slr_path	limpopoClimate.nc4		
hmd_path	limpopoClimate.nc4		
wnd_path	limpopoClimate.nc4		

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netcdf.ncw: written byjames

limpopoClimate.nc4	wgn	latitude	longitude	elevation	pcp	tmin	tmax	slr	hmd	wnd	pet	wnd_dir	atmo_
s18750s23750e	198s250e	-18.75	23.75	947	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s24250e	198s250e	-18.75	24.25	922	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s24750e	198s250e	-18.75	24.75	970	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s25250e	198s253e	-18.75	25.25	1029	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s25750e	198s256e	-18.75	25.75	1069	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s26250e	198s262e	-18.75	26.25	1011	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s26750e	198s269e	-18.75	26.75	1087	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s27250e	198s272e	-18.75	27.25	1048	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s27750e	198s278e	-18.75	27.75	970	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s28250e	198s281e	-18.75	28.25	1040	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s28750e	198s288e	-18.75	28.75	1044	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n
s18750s29250e	198s294e	-18.75	29.25	1237	1.0	1.0	1.0	1.0	1.0	1.0	null	null	n

Adapt existing modules

to accommodate new modules

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Additional Role

decides whether to use NetCDF or traditional weather inputs

Operational Logic

Checks for NetCDF configuration file existence & switches between input methods accordingly

Reading from NetCDF File!

```
inquire (file=in_sim%ncdf_conf, exist=i_exist)
if (.not. i_exist .or. in_sim%ncdf_conf == "null") then
    ! Use traditional weather file system
    call cli_pmeas  ! Read precipitation from .pcp files
    call cli_tmeas  ! Read temperature from .tmp files
    ! ... other traditional weather readers
else
    ! Use NetCDF system
    call cli_meas_netcdf
endif
```

Adapt existing modules

to accommodate **new modules**

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Purpose

Reads weather data from NetCDF files

Maintains compatibility with weather generator

Supported Variables

Precipitation, temperature (min/max), solar radiation, humidity, wind speed, potential evapotranspiration

Adapt existing modules

to accommodate **new modules**

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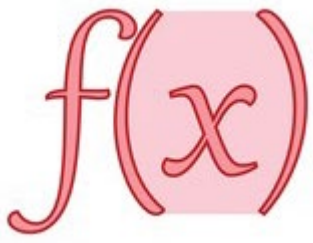
Purpose

Contains the core NetCDF functionality (functions and classes)

netcdf_context_type: Manages NetCDF file context including dimensions, variable IDs, and spatial/temporal metadata

station_type: Defines station properties with latitude, longitude, and scaling factors for different variables



Functions

File opening, variable reading
time/spatial indexing

SWAT+ is a Huge improvement on SWAT2012

Climate input can Quickly Build up

NetCDF is an Efficient Format

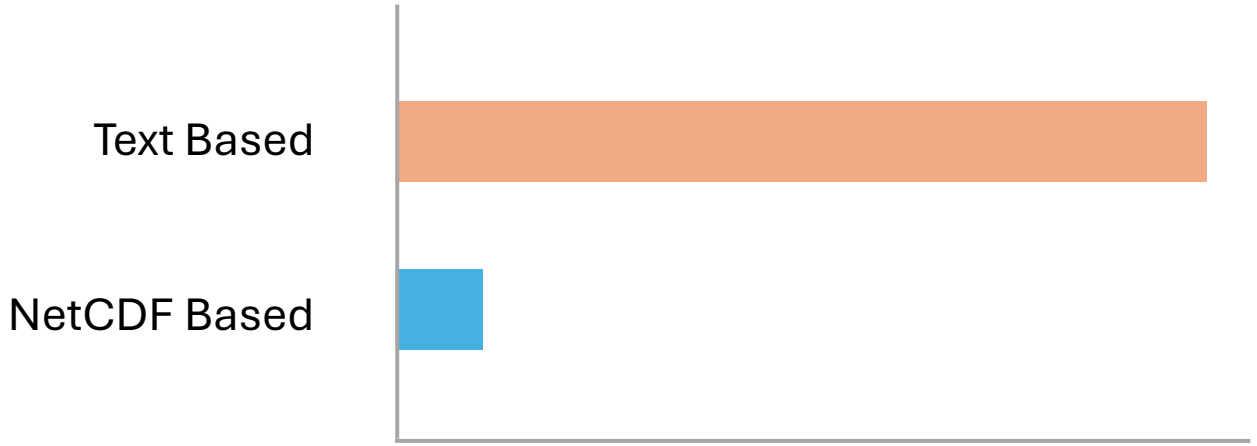
Integration of NetCDF into SWAT+

SWAT+ Benefits from NetCDF Format

SWAT+ with NetCDF

How does it benefit you?

Faster climate reads save you time in large scale modelling



File Edit View Bookmarks Plugins Settings Help

Configure Konsole...

TxtInOut-converted : bash

```
cjames@home-arch drive/../TxtInOut-converted > pwd
/drive/current/wd/africa-zambezi/Scenarios/Default/TxtInOut-converted
cjames@home-arch drive/../TxtInOut-converted > ../rel-swatplus
```

TxtInOut : bash

```
cjames@home-arch drive/../TxtInOut > pwd
/drive/current/wd/africa-zambezi/Scenarios/Default/TxtInOut
cjames@home-arch drive/../TxtInOut > ../rel-swatplus
```

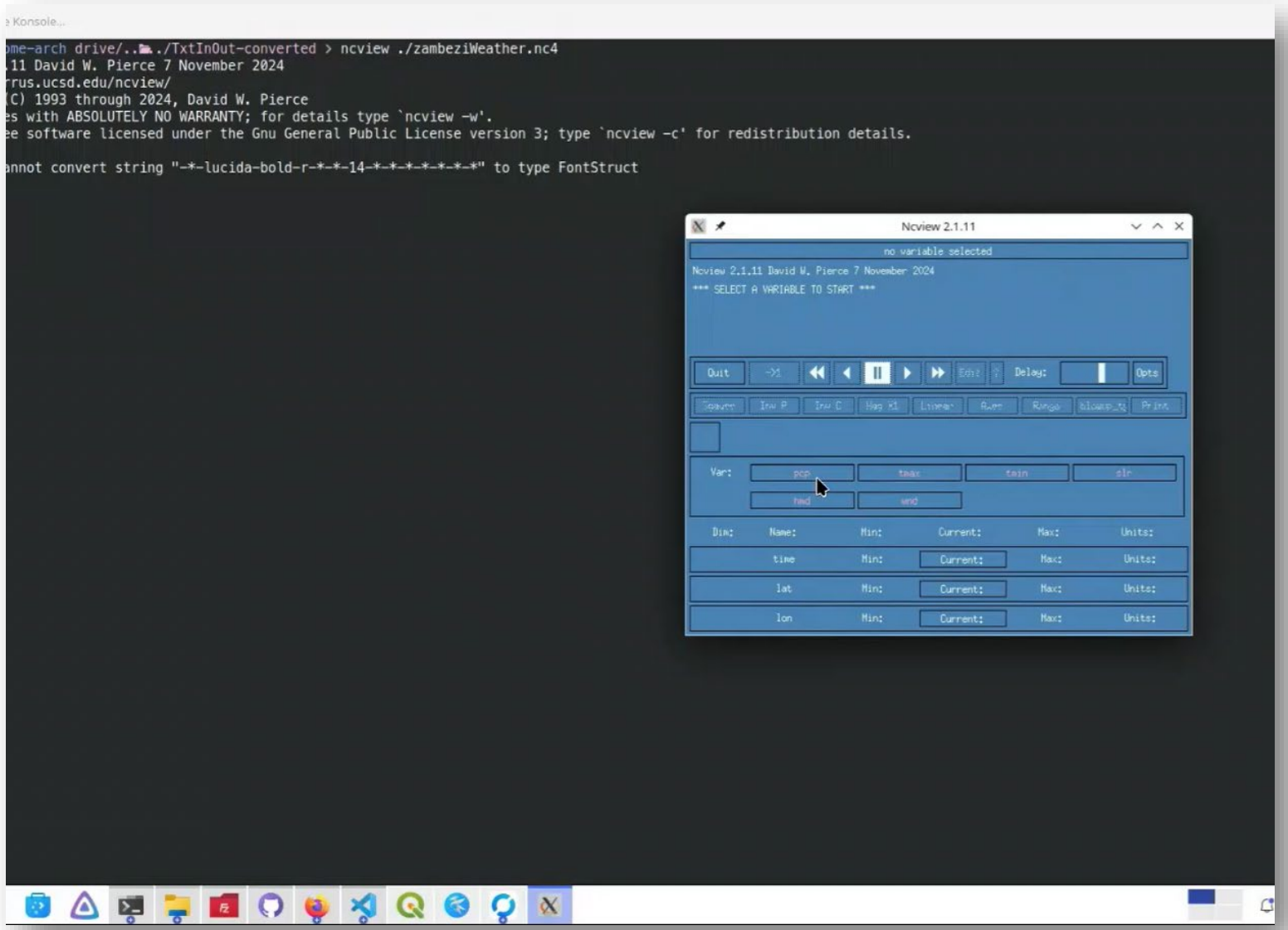
11:10 PM
6/25/25

SWAT+ with NetCDF

How does it benefit you?

Faster climate reads save you
time in large scale modelling

Enables modern workflows by allowing
direct use of gridded climate datasets



SWAT+ with NetCDF

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Faster climate reads save you
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Enables modern workflows by allowing
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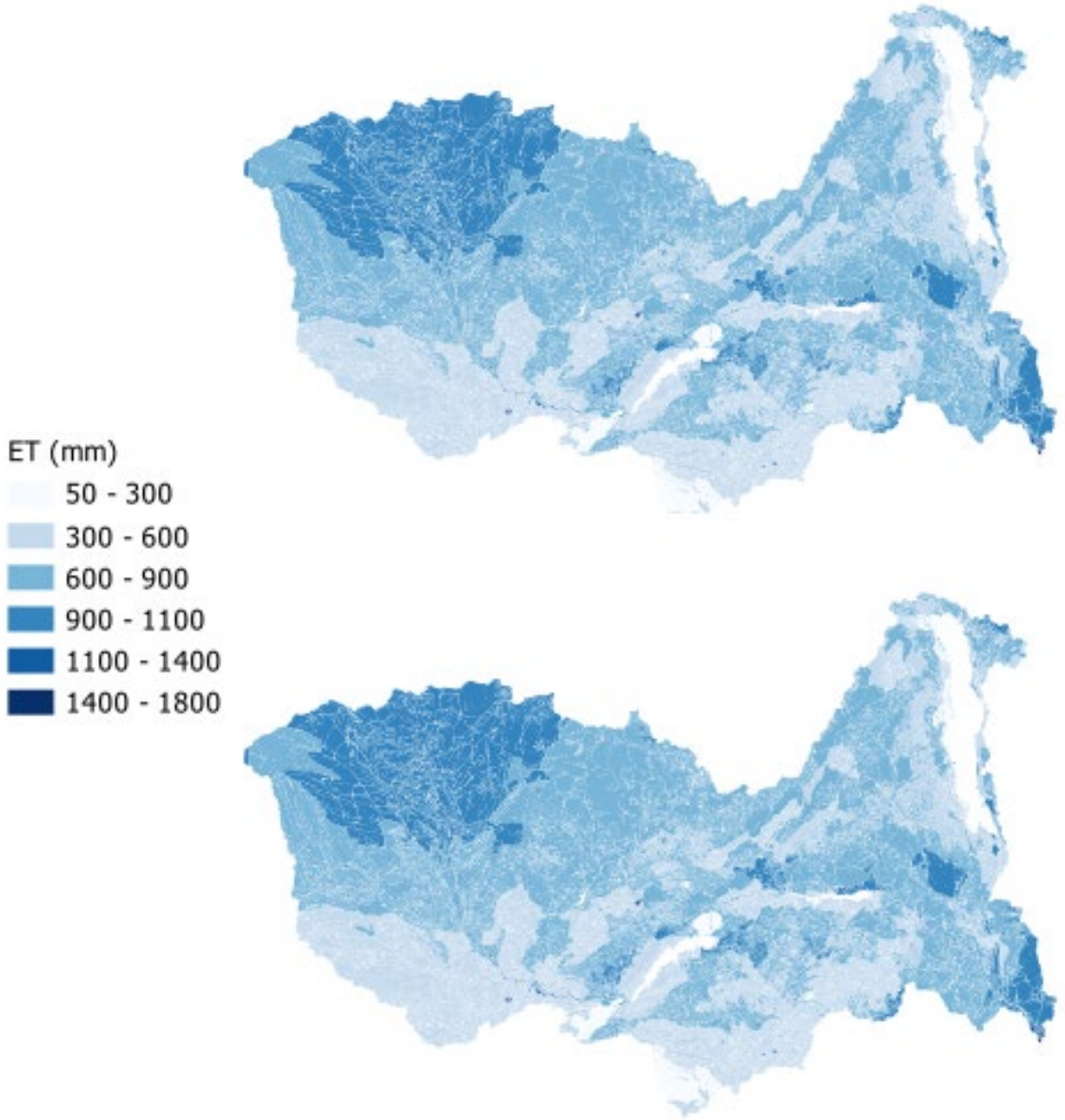
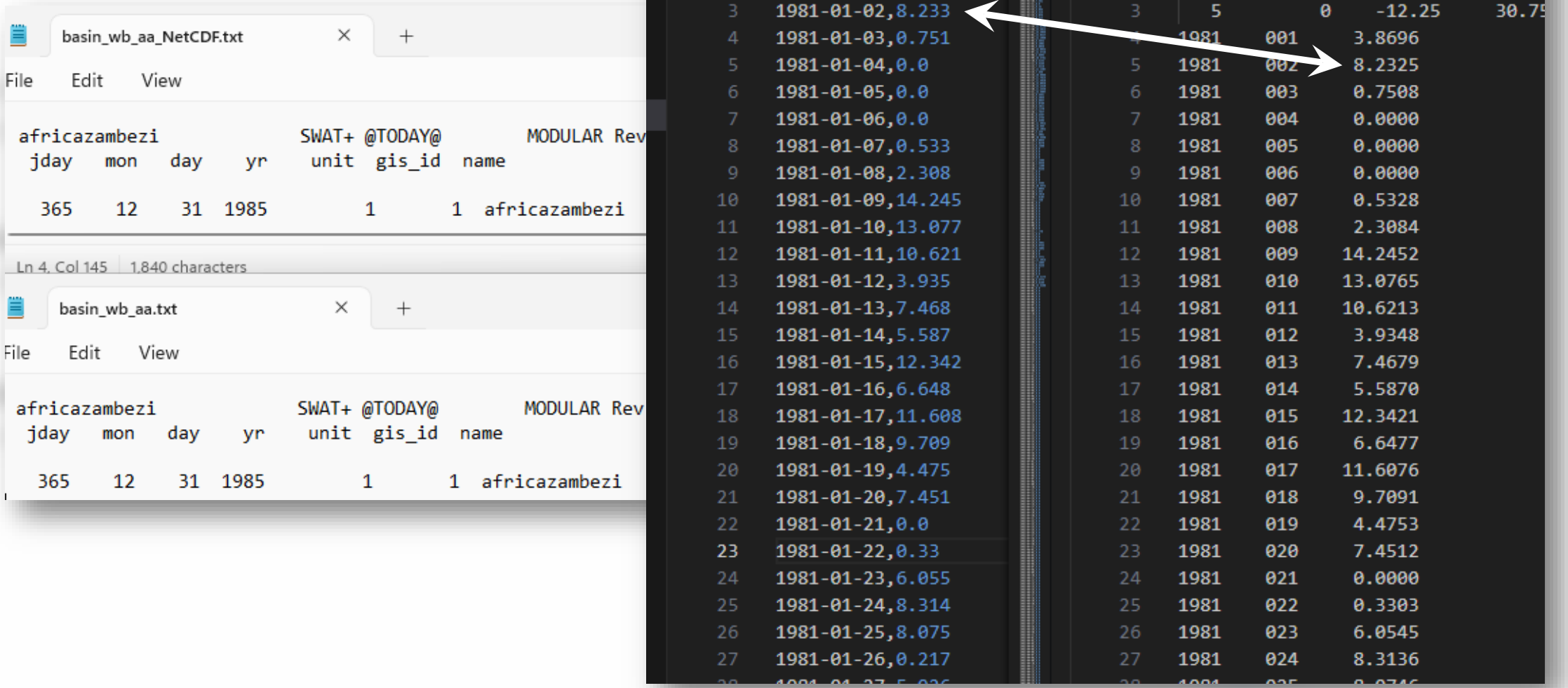
Maintains numerical equivalence
Without the additional processing




basin_wb_aa_NetCDF.txt
File Edit View
africazambezi SWAT+ @TODAY@ MODULAR Rev
jday mon day yr unit gis_id name
365 12 31 1985 1 1 africazambezi
Ln 4, Col 145 1,840 characters
basin_wb_aa.txt
File Edit View
africazambezi SWAT+ @TODAY@ MODULAR Rev
jday mon day yr unit gis_id name
365 12 31 1985 1 1 africazambezi
M12253075-pcp.csv
M12253075-pcp.csv > data
time,pcp
1981-01-01,3.87
1981-01-02,8.233
1981-01-03,0.751
1981-01-04,0.0
1981-01-05,0.0
1981-01-06,0.0
1981-01-07,0.533
1981-01-08,2.308
1981-01-09,14.245
1981-01-10,13.077
1981-01-11,10.621
1981-01-12,3.935
1981-01-13,7.468
1981-01-14,5.587
1981-01-15,12.342
1981-01-16,6.648
1981-01-17,11.608
1981-01-18,9.709
1981-01-19,4.475
1981-01-20,7.451
1981-01-21,0.0
1981-01-22,0.33
1981-01-23,6.055
1981-01-24,8.314
1981-01-25,8.075
1981-01-26,0.217
O3075AM1225.pcp
O3075AM1225.pcp
O3075AM1225.pcp: precipitation cli
nbyr tstep lat lor
5 0 -12.25 30.75
1981 001 3.8696
1981 002 8.2325
1981 003 0.7508
1981 004 0.0000
1981 005 0.0000
1981 006 0.0000
1981 007 0.5328
1981 008 2.3084
1981 009 14.2452
1981 010 13.0765
1981 011 10.6213
1981 012 3.9348
1981 013 7.4679
1981 014 5.5870
1981 015 12.3421
1981 016 6.6477
1981 017 11.6076
1981 018 9.7091
1981 019 4.4753
1981 020 7.4512
1981 021 0.0000
1981 022 0.3303
1981 023 6.0545
1981 024 8.3136

SWAT+ with NetCDF

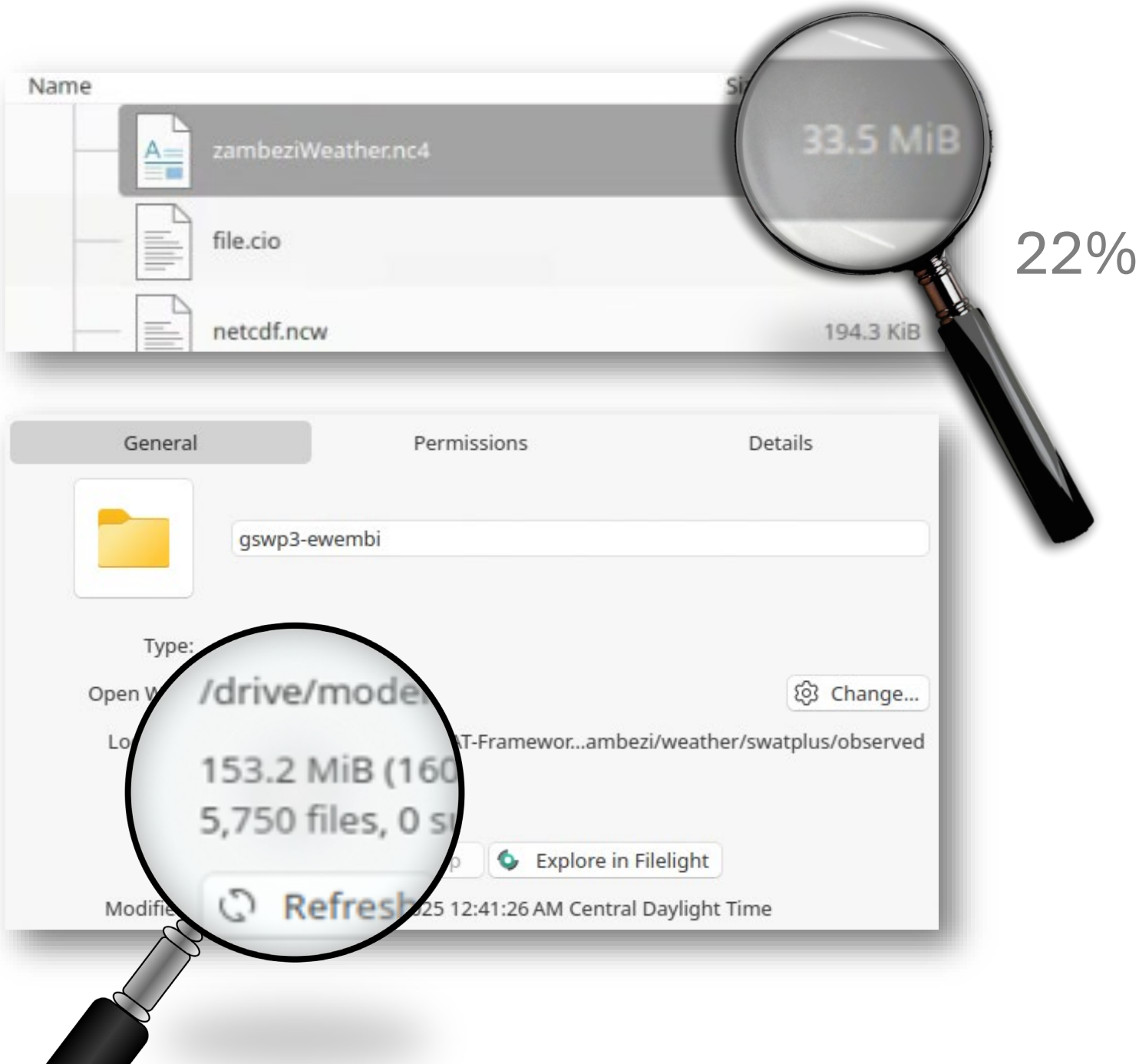
How does it benefit you?

Faster climate reads save you
time in large scale modelling

Enables modern workflows by allowing
direct use of gridded climate datasets

Maintains numerical equivalence
Without the additional processing

Saves you space without all the
clutter. NetCDF data is compact



Challenges and Next Steps

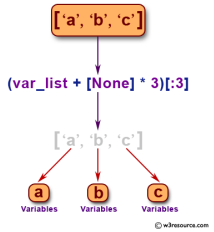
What considerations are there?

Not Easy to Compile Fortran

NetCDF on Windows

File format knowledge

Users need understanding of NetCDF structure Converter? Built into Editor?



Variable mapping

Currently fixed variable names requires use of cdo to rename

NetCDF is the Hero we need

SWAT+ Employs Relational Database Philosophy

Making its structure more efficient over legacy SWAT

Current Weather Structure quickly leads to too much

clutter & slowing as weather stations increase in number

NetCDF implementation Makes Model Faster, Saves

Space and reduces clutter while maintaining flexibility

Streamlining SWAT+ Climate Input Data

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Texas A&M AgriLife

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