



ALFRED-WEGENER-INSTITUT  
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UND MEERESFORSCHUNG

# AWI-CM3 hands-on-course:

## Part 2 esm\_tools

Jan Streffing 08.09.2022

# 1 Why do we need ESM-Tools?

# Earth System Modelling Tools

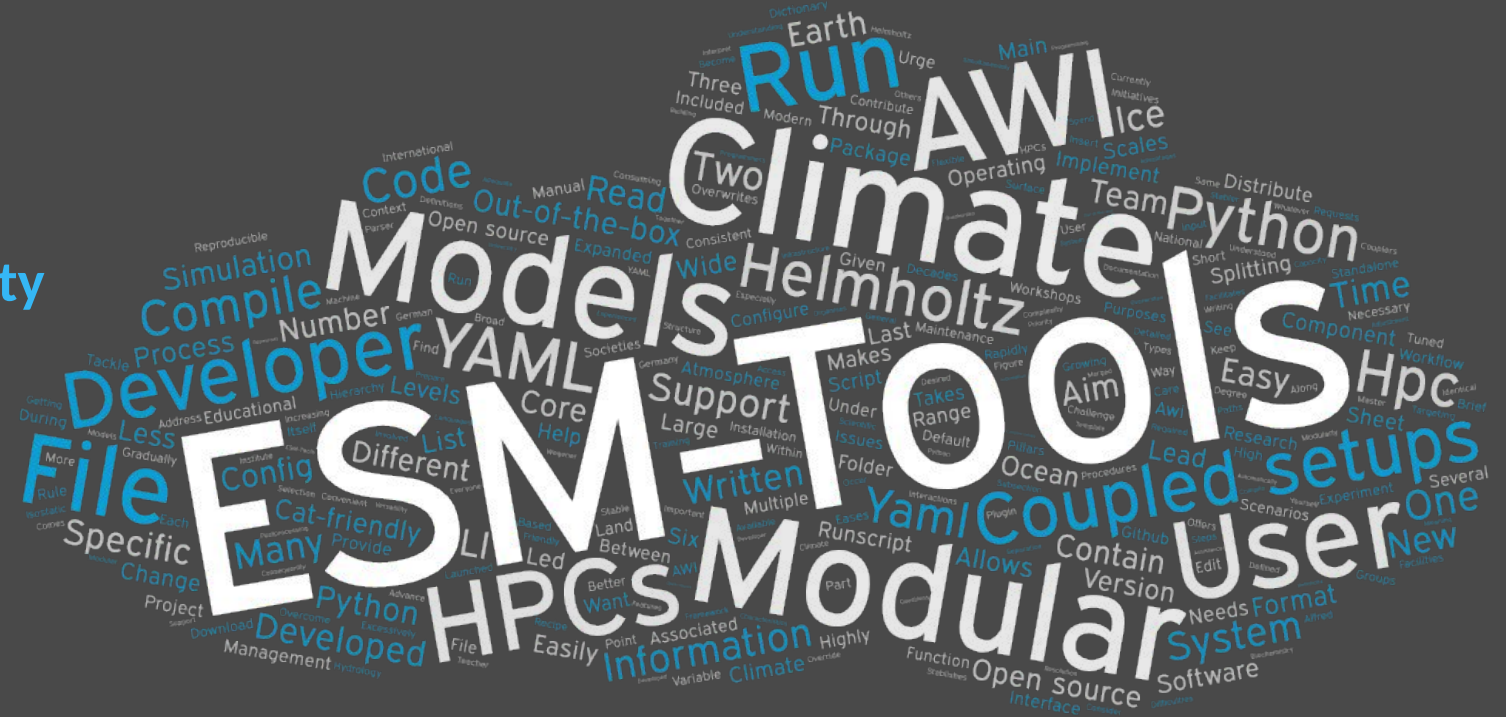
- Modular software infrastructure

- Download
- Configure/compile
- Run simulations
- Organize exp. output/restart
- Calendar operations

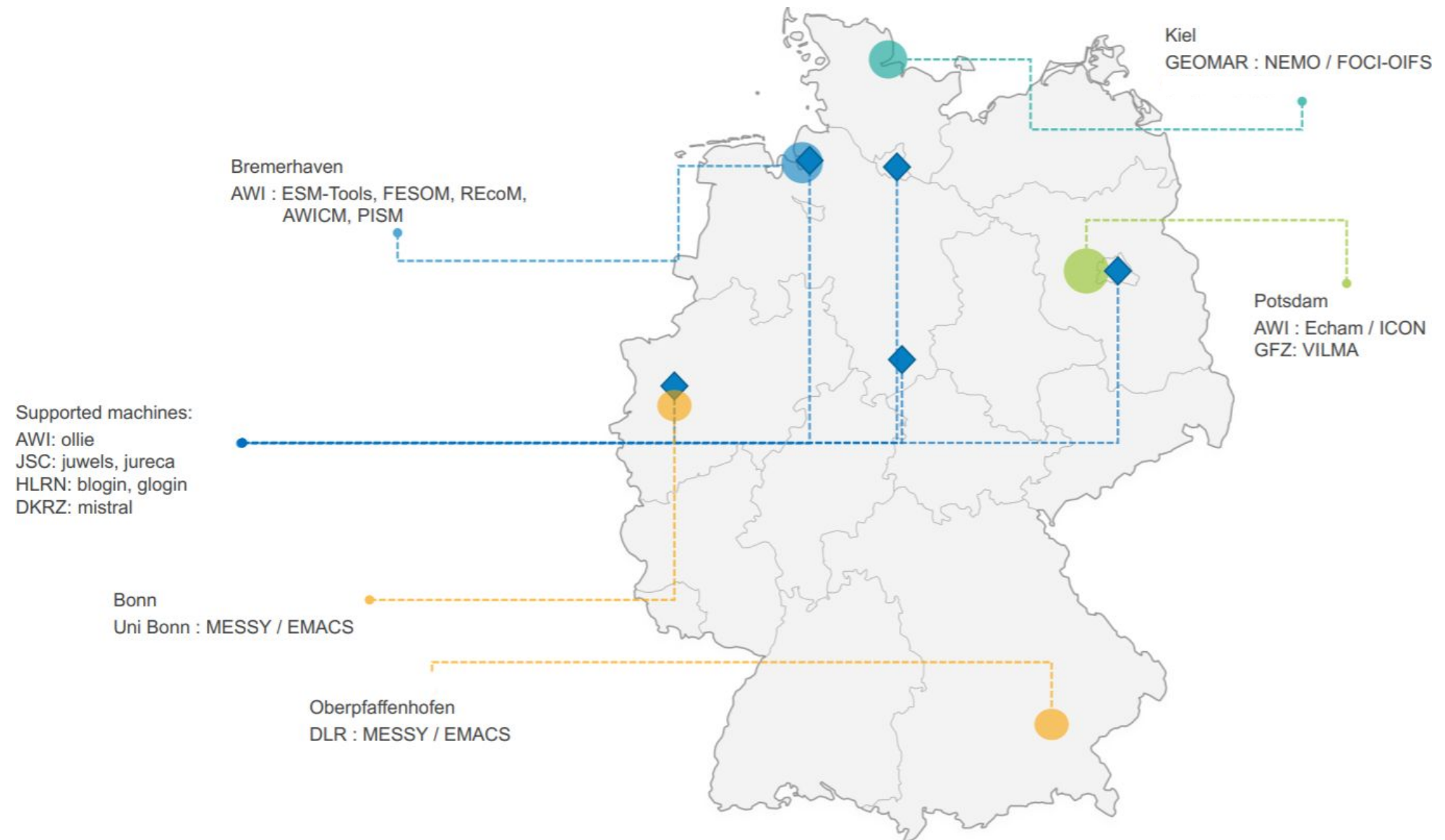
- Standalone Earth system models
- ESM coupled setups
- in different HPC systems

## Advantages

- Unified infrastructure for ESM modelling
- Eases consistent workflows and **experiment reproducibility**
- **Easy to implement** new models/coupled setups
- Identical simulation-folder structure across different models/simulations
- Supports **standalone models** and **coupled setups**
- One software to rule them all
- Adequate for **educational purposes** (easy-to-run ESMs) and **research** (highly modular and **flexible**)





# 1 Supported Models & Couplings, Partners

[illegible]

# Old Workflow

vs

# ESM-Tools workflow

1. Obtain the model source code (usually a tar ball)
2. Build the model
  1. `configure`
  2. `make`
3.  **FAIL:** Read the HPC documentation and repeat (libraries, compilers, modules, ...)
3. Prepare the data folders (input, boundary conditions, output, ...)
4. Setup the namelist for the models
5. Submit your job to the HPC system
  - **Warning:** environment mismatch
6. Resubmit / Iterative coupling
7. Move the data to the storage disk
8. Postprocessing of the results 

Repeat the whole process for the next run or write a shell script for automatization.

- **Obtain** and **build** the model code (from a repository)
  - ✓ **Uniform** environment for both installation and running  
→ guaranteed integrity.

```
esm_master install-awicm3-v3.1
```

- Prepare **YAML** based runscrip
- [OPTIONAL] **Check** if your run would run successfully:

```
esm_runscripts my_awicm_runscript.yaml -e my_first_test -c
```
- **Submit** your job to the system:

```
esm_runscripts my_awicm_runscript.yaml -e my_first_test
```
- Monitor your log files
- **Postprocess** the results (esmviz, in progress)

# Old Workflow

vs

# ESM-Tools workflow

```
echam_prepare_forcing()
{
    # forcing

    if [[ "v$setup_name" = "vecham_standalone" ]]; then

        case $SCENARIO_echam in
            1850 | PI-CTRL*)
                add_to ${echam_INPUT_DIR}/${RES_echam}/${RES_echam}${OCERES_echam}_piControl-LR_sst_1880-2379.nc unit.20
                add_to ${echam_INPUT_DIR}/${RES_echam}/${RES_echam}${OCERES_echam}_piControl-LR_sic_1880-2379.nc unit.96
                ;;
            HIST )
                ;;
        esac

    ...

    ...

    for ((yr = YR0_echam + -2; yr <= YRN_echam + 2; ++yr)); do
        if [ $yr -le 1849 ] ; then
            eval add_to ${echam_INPUT_DIR}/${RES_echam}/ozone/$ozonefile_1850 ozon$yr

        elif [ $yr -le 2014 ] ; then
            eval add_to ${echam_INPUT_DIR}/${RES_echam}/ozone/$ozonefile_hist ozon$yr

        else
            eval add_to ${echam_INPUT_DIR}/${RES_echam}/ozone/$ozonefile_scen ozon$yr
        fi

        if [ $yr -le 1849 ] ; then
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_ir_${RES_echam}_1850.nc strat_aerosol_ir_${yr}.nc
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_sw_${RES_echam}_1850.nc strat_aerosol_sw_${yr}.nc

        elif [ $yr -le 2024 ] ; then
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_ir_${RES_echam}_${yr}.nc strat_aerosol_ir_${yr}.nc
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_sw_${RES_echam}_${yr}.nc strat_aerosol_sw_${yr}.nc

        elif [ $yr -gt 2024 ] ; then
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_ir_${RES_echam}_2024.nc strat_aerosol_ir_${yr}.nc
            add_to ${echam_INPUT_DIR}/${RES_echam}/volcano_aerosols/strat_aerosol_sw_${RES_echam}_2024.nc
        fi
    done
}
```

... and many more

## general:

```
setup_name: "awicm3"
compute_time: "00:15:00"
initial_date: "2000-01-01"
final_date: "2000-02-29"
base_dir: "/work/oillie/dural/sample_work_dir/"
nmonth: 1
nyear: 0
```

## awicm:

```
version: "CMIP6"
postprocessing: false
scenario: "PI-CTRL"
model_dir: "/work/oillie/dbarbi/modelcodes/awicm-CMIP6/"
```

## fesom:

```
pool_dir: "/work/oillie/pool/FESOM/"
mesh_dir: "/work/oillie/pool/FESOM/meshes_default/core/"
restart_rate: 1
restart_unit: "m"
restart_first: 1
further_reading:
    - "fesom_output_control.yaml"
```

# 1 Contact & Community



<https://github.com/esm-tools>

- ✓ [https://github.com/esm-tools/esm\\_tools/discussions](https://github.com/esm-tools/esm_tools/discussions)
- ✓ [https://github.com/esm-tools/esm\\_tools/issues](https://github.com/esm-tools/esm_tools/issues)



<https://esm-tools.readthedocs.io>



<https://www.esm-tools.net>



@ToolsEsm



YouTube ESMTools

Geosci. Model Dev., 14, 4051–4067, 2021  
<https://doi.org/10.5194/gmd-14-4051-2021>  
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## ESM-Tools version 5.0: a modular infrastructure for stand-alone and coupled Earth system modelling (ESM)



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<https://gmd.copernicus.org/articles/14/4051/2021/>

Barbi *et. al.*, GMD (2021): <https://doi.org/10.5194/gmd-14-4051-2021>

Zenodo: <https://doi.org/10.5281/zenodo.5787476>



## 2 Let's Get Started: Installation



<https://esm-tools.readthedocs.io>

- 1 cd to your `${HOME}` directory
- 2 In your `.bash_profile` or `.bashrc` add:

```
export PATH=${PATH} ~/.local/bin
export LC_ALL=en_US.UTF-8
export LANG=en_US.UTF-8
```

```
module load git
module unload netcdf_c #(only on ollie)
module load python3
```

- 3 

```
source .bash_profile
source .bashrc
```

- 4 

```
git clone https://github.com/esm-tools/esm_tools.git
```

- 5 

```
cd esm_tools
./install.sh
```

This will install ESM-Tools and all of the dependencies

- 6 

```
esm_tools --version
```

Verify the installation

# Were you able to log in and install?



Provide feedback at:

<https://github.com/AWI-CM3/hands-on-course/discussions/1>

