

# ExaWind Automation Tutorial

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## 1 Introduction/TLDR

This base file is setup in the format so that you can declare all necessary variables to run the ExaWind Solver in one file, and by running the "ExaWind.Base.Transform" code you can generate the needed input files (AMR-Wind and Nalu-Wind) to run ExaWind. To use the transformation code, you MUST change the `base_file_path` variable to the location (including the name) of your base file alongside changing the `output_file_path` to indicate where you wish your output files to be saved. Both these variables are at the very top of the transformation code. Then simply run the code (I used VScode). The base file ("Exawind.Base.File.yml") is divided into three sections: AMR-Wind Variables, Nalu-Wind Variables, and Extra Variables with each section being defined by a commented line with dashes:

```
#-----AMR-Wind Variables-----#
```

Please DO NOT delete these section divide comments as they provide the premise for transforming the base file. The code contained in the "Nonfunctional Error Checker" folder is you guessed it, nonfunctional.

## 2 Variables

A common complaint about using ExaWind was the need to declare different variables with the same value. This automation code has been updated so that you do not need to redeclare variables with identical values multiple times, instead only once and it will automatically generate the other variables in the output of the transformation code. The variables which have been updated to do this are:

Declared Variable	Created Variable(s)
<code>incflo.density</code>	<code>xlo/xhi/ylo/yhi/zlo/zhi.density</code> (if <code>xlo/xhi/ylo/yhi/zlo/zhi.type = mass_inflow</code> )
<code>incflo.velocity</code>	<code>ConstValue.velocity.value</code> <code>xlo/xhi/ylo/yhi/zlo/zhi.velocity</code> (if <code>xlo/xhi/ylo/yhi/zlo/zhi.type = mass_inflow</code> )
<code>ConstValue.tke.value</code>	<code>xlo/xhi/ylo/yhi/zlo/zhi.tke</code> (if <code>xlo/xhi/ylo/yhi/zlo/zhi.type = mass_inflow</code> )
<code>ConstValue.sdr.value</code>	<code>xlo/xhi/ylo/yhi/zlo/zhi.sdr</code> (if <code>xlo/xhi/ylo/yhi/zlo/zhi.type = mass_inflow</code> )
<code>Simulations.time_integrator</code>	<code>Time_Integrators.StandardTimeIntegrator.name</code>
<code>Time_Integrators.StandardTimeIntegrator</code>	<code>realms.name</code>
- NA -	<code>realms.boundary_conditions.overset_user_data.mesh_tag_offset = 0</code>
<code>realms.initial_conditions.target_name</code> (if created variables are not declared)	<code>realms.material_properties</code> <code>realms.boundary_conditions.overset_user_data.mesh_group.mesh_parts</code> <code>realms.mesh_transformation.mesh_parts</code> <code>realms.mesh_motion.mesh_parts</code> <code>realms.turbulence_averaging.specifications.target_name</code>
<code>Automation_Information.pos_{n}</code>	<code>realms.mesh_transformation.motion.displacement</code> <code>realms.mesh_motion.motion.centroid</code> <code>realms.post_processing.parameters</code>

You may have noticed some variables you are unfamiliar with in the "Nalu-Wind Variables" section of the base file in a section called "Automation.Information". This section has been included in order to be able to automatically create a number of Nalu-Wind turbine output files. All that is needed from you is the number of turbines you wish to simulate and the positions for each of those turbines as shown in the example ExaWind Base File. Another variable included in the Automation.Information section is the variable "lin\_solvers" asking for a list of the linear solvers you wish to implement. You simply need to declare the variables provided in the realms.linear\_solvers section in the "Nalu-Wind Variables" section and the transformation will automatically create linear solvers for those you declared in the Automation.Information.lin\_solvers variable.

Also included at the bottom of the ExaWind Base File is the "Extra Variables" section which includes any additional variables you may want to declare in the base file without having to consult the AMR-Wind user manual (<https://exawind.github.io/amr-wind/user/user.html>) or the Nalu-Wind user manual (<https://nalu-wind.readthedocs.io/en/latest/source/user/index.html>).

### 3 File Format

The file format has been designed in a very specific way to work with the transformation code. Please DO NOT delete the section divides "AMR-Wind Variables", "Nalu-Wind Variables", and "Extra Variables" as these are what tells the transformation code which variables belong in which output file. Also, please DO NOT delete the commented brackets with the variable type (e.g. # [integer]). The error checker for yaml files is not yet functional but maintaining the setup of the base file will be helpful for future endeavors. You can add as many variables as you please and if there are any new variables that have not been included in the code you can also add those as the transformation code will automatically include them in the new outputs. There are some additional variables at the very bottom of the base file example if you wish to browse more variables without having to consult the AMR-Wind user manual (<https://exawind.github.io/amr-wind/user/user.html>) or the Nalu-Wind user manual (<https://nalu-wind.readthedocs.io/en/latest/source/user/index.html>), as well as an example of how to declare boundary conditions at the very end of the base file script.

### 4 Error Checker

The yaml error checker script is not yet functional as difficulties were being faced in maintaining the comment structure during the transformation of the yaml code as per the nature of yaml files defaulting to not including comments in revised data.

### 5 References

- AMR-Wind User Manual: <https://exawind.github.io/amr-wind/user/user.html>
- Alex Rybchuk's amr-wind-tutorial: <https://github.com/rybchuk/amr-wind-tutorial>
- Nalu-Wind User Manual: <https://nalu-wind.readthedocs.io/en/latest/source/user/index.html>
- Jon Rood's 16 turbine ExaWind example: [https://github.com/Exawind/exawind-cases/tree/main/16\\_turbs\\_uniform\\_inflow](https://github.com/Exawind/exawind-cases/tree/main/16_turbs_uniform_inflow)