Overview

The single column model (SCM) represents a single gridpoint in IFS and allows all the physical processes to be run in a single vertical column.

IFS cycle 43r3 was the operational model at ECMWF from July 2017 to June 2018.

SCM 43r3 will not produce the same results as the previous release SCM 40r1. This is due to significant changes in the representation of the physical processes and a new radiation code.

Support

Please report any issues or problems with this release to either the OpenIFS User Forums or the openifs-support@ecmwf.int email.

Model documentation

For a full description of the physical processes included in the single column model, please see the IFS 43r3 Physical Processes manual (PDF).

Summary of changes

For more details of the changes introduced at IFS 43r3 and previous operational models (since 40r1) please see: Changes in ECMWF IFS model.

Brief summary:

- new radiation scheme ecRad (see below), more efficient with reduced noise and more accurate longwave radiation transfer calculation.
- revised interpolation of moist variables in the upper-troposphere / lower stratosphere (UTLS).
- cloud scheme change of rain evaporation, auto-conversion/accretion, riming, precipitation fraction.
- increased super-cooled liquid water at colder temperatures from the convection scheme.
- improved representation of supercooled 'freezing rain'.
- modified convective detrainment.
- changed parcel perturbation for deep convection to be proportional to surface fluxes.
- increased cloud erosion rate when convection is active to reduce cloud cover slightly particularly over ocean.
- changes to boundary layer cloud for marine stratocumulus and at high latitudes.
- new output diagnostics fields.

New radiation code ecRad

A new ECMWF radiation scheme became operational in IFS 43r3, replacing the older McRad scheme which first became operational in 2007. The new ecRad scheme is more modular allowing individual components to be swapped for faster and more accurate ones. It is also much more efficient. It uses a new implementation of the McICA (Monte Carlo Independent Column Approximation) code that is less noisy in partially cloudy conditions. Improvements in longwave radiation transfer reduce biases in temperature profiles. In operational IFS cycle 43r3, ecRad brings slight improvements in forecast skill.

For further information about ecRad please see the following sources:

- ECMWF newsletter 155: A new radiation scheme for the IFS
- A flexible and efficient radiation scheme for the ECMWF model, 2018, JAMES.
- ECMWF technical report: ECRAD. A new radiation scheme for the IFS (older version)
- ecRad home page

A standalone version of ecRad can be obtained by following the ecRad home page link above. It requires a separate (similar) license to OpenIFS.

Technical aspects

The SCM requires the grib-api (or ecCodes) GRIB library (from ECMWF) and the netCDF library to be available in order to read and write files.

GNU, Intel and Cray compilers are supported. The PGI compiler is no longer supported.

The SCM has been increasingly integrated with the IFS code with each release, in order to be able to minimize the extra code required to extract and run the SCM standalone. Users will note a number of changes as a result, particularly in the namelist switches. This is in addition to the usual updates in the IFS physics parametrization code.
Namelist NAEPHY has two new switches compared to SCM 40r1. They are:

- LEPHYS=T, which activates all of the physics package (default)
- LEFLAKE=T, activates the lake scheme (FLAKE), new in SCM 43r3.

The logical namelist variable LSCMEC has been deleted. The code in the single column model no longer requires this switch. The 3D OpenIFS code only uses it to prevent execution of SCM specific code. The standalone SCM code implicitly assumes it's set true.

The variable CMODID parameter is used as a string to locate the initial files. It doesn't record the version of the model. SCM forcings are not fixed to a given model cycle, these are dependent on the experiment being run.

There are two namelist files in the test-run directory:

- namelist.trref_winds_rel
- namelist.trref_winds_rel.simpl

The former one defines non-linear physics, the latter one the simplified physics (you may be surprised how close the results from the two packages are). We expect most users to use the full non-linear physics option.

The advection of cloud has been re-activated by setting LWADVCLD=true. If this causes a problem, it can be disabled via the namelist.

Semi-Lagrangian

By default the semi-Lagrangian scheme is activated (LSLAG=.T.) with the physics being averaged along a trajectory (LSLPHY=.T.). This follows the defaults in the IFS.

If you like to use Eulerian advection set LSLAG=.F., reduce the model timestep (don't forget to change number of time steps accordingly) and disable the semi-Lagrangian physics by setting LSLPHY=.F.