

A Brief Overview on Harmonie Physics (36h1.4)

- What physics options exist?
- How to control different options?
- From top to bottom:
 - “high level” control file
 - namelists level
 - the code level

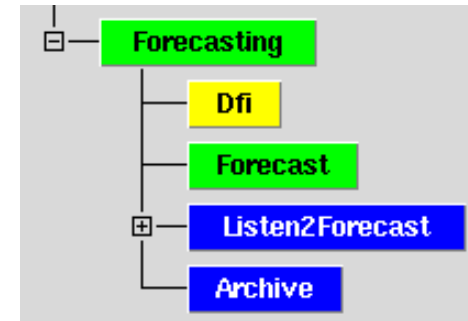
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FMI

HARMONIE training course
SMHI,
19. - 23.9.2011



Physics options

Harmonie contains 4 complete physics packages



AROME physics (default)

ICE3 microphysics
TKE-I turbulence (CBR)
ECMWF radiation
No deep convection
EDMF shallow convection
SURFEX surface

ALARO physics

Lopez microphysics, RK available
TKE-based turbulence (TOUCANS)
ALARO (ACRANEB) /ECMWF radiation
3MT convection scheme
SURFEX (old ISBA surface)

ALADIN physics

Lopez microphysics
TKE-based turbulence
Partly ECMWF radiation ?
“Mass flux”-type convection scheme
SURFEX/old ISBA surface

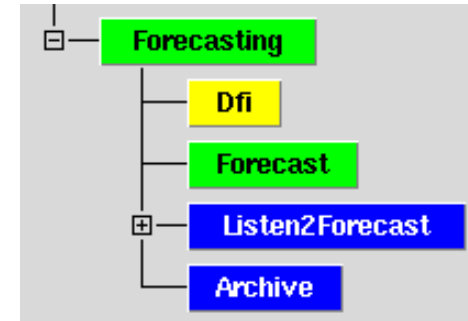
HIRLAM physics

Straco convection/microphysics
TKE-I turbulence (CBR)
Savijärvi-radiation
(SURFEX/old ISBA surface)
NOT USED AS A PACKAGE?



Physics options

- *high level switches* -



You can switch between different packages in
sms/config_exp.h

```
# **** High level forecast options ****  
DYNAMICS="nh"      # (h|nh)  
PHYSICS="arome"  # (aladin|arome|alaro|hiral) d  
SURFACE="surfex"  # (old_surface|surfex)  
DFI="none"        # (idfi|fdfi|none)  
  
# Highlighted physics switches  
MASS_FLUX_SCHEME=edmf # (edkf|edmf)
```

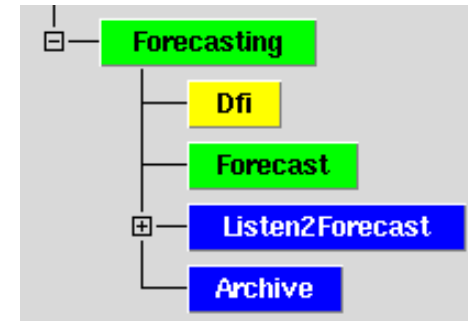
- **PHYSICS** selects the upper air physics package

arome = AROME-physics
alaro = ALARO-physics
aladin = ALADIN-physics
hiral = HIRLAM-physics (not up to date)



Physics options

- *high level switches* -



You can switch between different packages in
sms/config_exp.h

```
# **** High level forecast options ****  
DYNAMICS="nh"      # (h|nh)  
PHYSICS="arome"   # (aladin|arome|alaro|hira|d)  
SURFACE="surfex" # (old_surface|surfex)  
DFI="none"        # (idfi|fdfi|none)  
  
# Highlighted physics switches  
MASS_FLUX_SCHEME=edmf # (edkf|edmf)
```

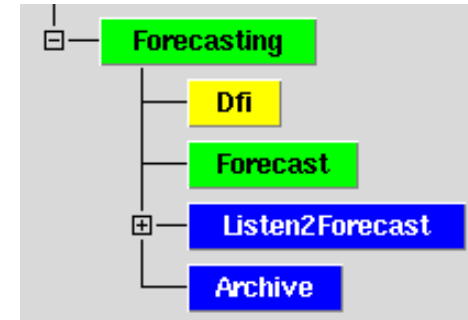
- **SURFACE** selects the surface scheme to be used

surfex = SURFEX-scheme
old_surface = ISBA (from aladin)



Physics options

- *high level switches* -



You can switch between different packages in
sms/config_exp.h

```
# **** High level forecast options ****
DYNAMICS="nh"      # (h|nh)
PHYSICS="arome"  # (aladin|arome|alaro|hiral)
SURFACE="surfex"  # (old_surface|surfex)
DFI="none"        # (idfi|fdfi|none)
```

```
# Highlighted physics switches
MASS_FLUX_SCHEME=edmf # (edkf|edmf)
```

- **MASS_FLUX_SCHEME** selects the shallow convection scheme

→ Used only if **PHYSICS=arome!**

edmf = EDMF (Siebesma et al. 2007)

edkf = EDMF (Pergaud et al. 2009)

(EDMF = "Eddy-Diffusivity Mass-Flux")

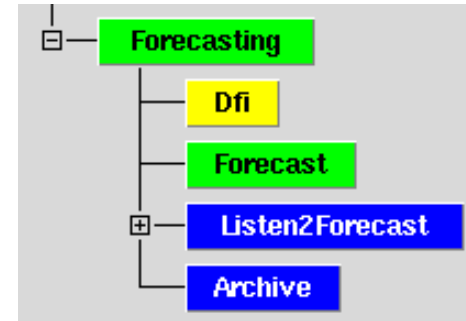


Namelist options

Control of individual schemes within physics package.

Namelist options can be set in perl module:

nam/harmonie_namelists.pm



```

#####
# Main physics options
#####

# ALADIN
%aladin=(...);
# AROME
%arome=(...);
# EDMFM switches, to be applied after AROME
%edmf=(...);
# Alaro
%alaro=(...);
# Old surface
%old_surface=(...);
# SURFEX
%surfex=(...);
  
```

- Namelists and the variables are grouped for each physics package
- “on/off” switches for individual schemes
- Large number of tuning parameters for individual physics schemes.
- Not only physics options
→ e.g. controlling switches for coupling (LBC).

Namelist options

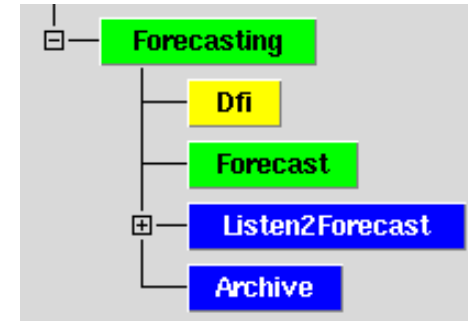
Control of individual schemes within physics package.

Namelist options can be set in perl module:

nam/harmonie_namelists.pm

```
#####
# Main physics options
#####

# AROME
%arome=(...
  NAMARPHY=>{
    'LKFB CONV' => '.FALSE.',
    'LKFB D' => '.FALSE.',
    'LKFB S' => '.FALSE.',
    'LMF SHAL' => '.TRUE.',
    'LMICRO' => '.TRUE.',
    'LMPA' => '.TRUE.',
    'LMSE' => '.TRUE.',
    'LTURB' => '.TRUE.',
  },
  ...);
```



AROME-example: on/off-switches

- Namelist **NAMARPHY**

LKFB CONV = KFB convection scheme
LKFB D = KFB deep convection
LKFB S = KFB shallow convection
LMF SHAL = EDMF shallow conv.
LMICRO = ICE3 microphysics
LMSE = Surfex scheme
LTURB = Turbulence scheme
LMPA = global switch for AROME phys.

Namelist options

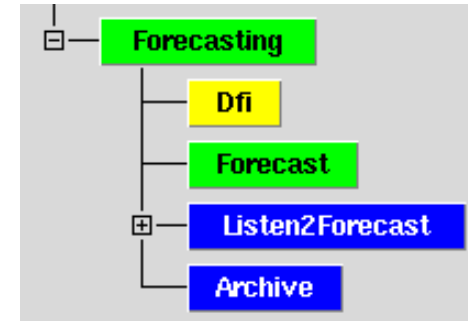
Control of individual schemes within physics package.

Namelist options can be set in perl module:

nam/harmonie_namelists.pm

```
#####  
# Main physics options  
#####
```

```
# AROME  
%arome=(...  
  NAMARPHY=>{  
    'LKFB CONV' => '.TRUE.',  
    'LKFB D' => '.TRUE.',  
    'LKFB S' => '.FALSE.',  
    'LMF SHAL' => '.FALSE.',  
    'LMICRO' => '.TRUE.',  
    'LMPA' => '.TRUE.',  
    'LMSE' => '.TRUE.',  
    'LTURB' => '.TRUE.',  
  },  
...);
```



AROME-example: on/off-switches

- Namelist **NAMARPHY**

LKFB CONV = KFB convection scheme

LKFB D = KFB deep convection

LKFB S = KFB shallow convection

LMF SHAL = EDMF shallow conv.

LMICRO = ICE3 micorphysics

LMSE = Surfex scheme

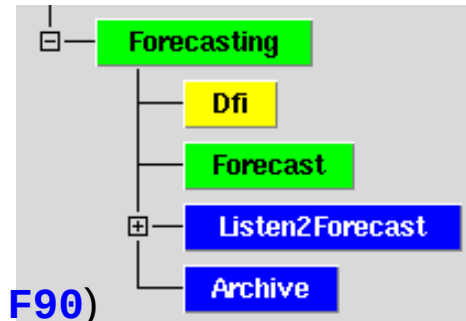
LTURB = Turbulence scheme

LMPA = global switch for AROME phys.

→ **Deep convection on and shallow conv. off.**



Namelist options

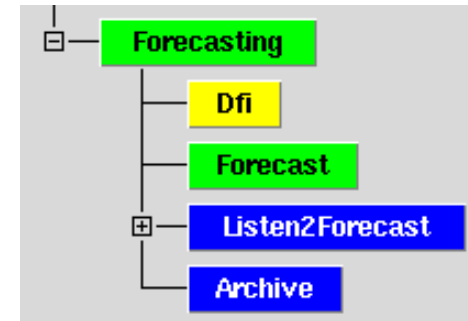


- **Namelist parameters are shortly explained in the source code:**
 - Variables are defined in modules (e.g. `src/arp/module/yom* .F90`)
 - The default values of namelist variables are given in setup routines (e.g. `src/arp/setup/su* .F90`)
- **Physics namelists:**
 - NAMPHY** = Physics scheme switches for ALADIN/ALARO (`src/arp/module/yomphy .F90`)
 - NAMARPHY** = Physics scheme switches for AROME (`src/arp/module/yomarphy .F90`)
 - NAMPHY[0-3]** = Physics tuning switches (`src/arp/module/yomphy[0-3] .F90`)
- **EXCEPTION: SURFEX has its own namelist and it is created in `scr/Forecast`**
Check “**EXSEG1.nam**” from script `scr/Forecast`

The different SURFEX options are described in **SURFEX User's Guide**:
<http://www.cnrm.meteo.fr/surfex/>



Physics source code



src/arp/phys_dmn/mf_phys.F90

for AROME-phys

phys_dmn/apl_arome.F90

for ALARO/ALADIN-phys

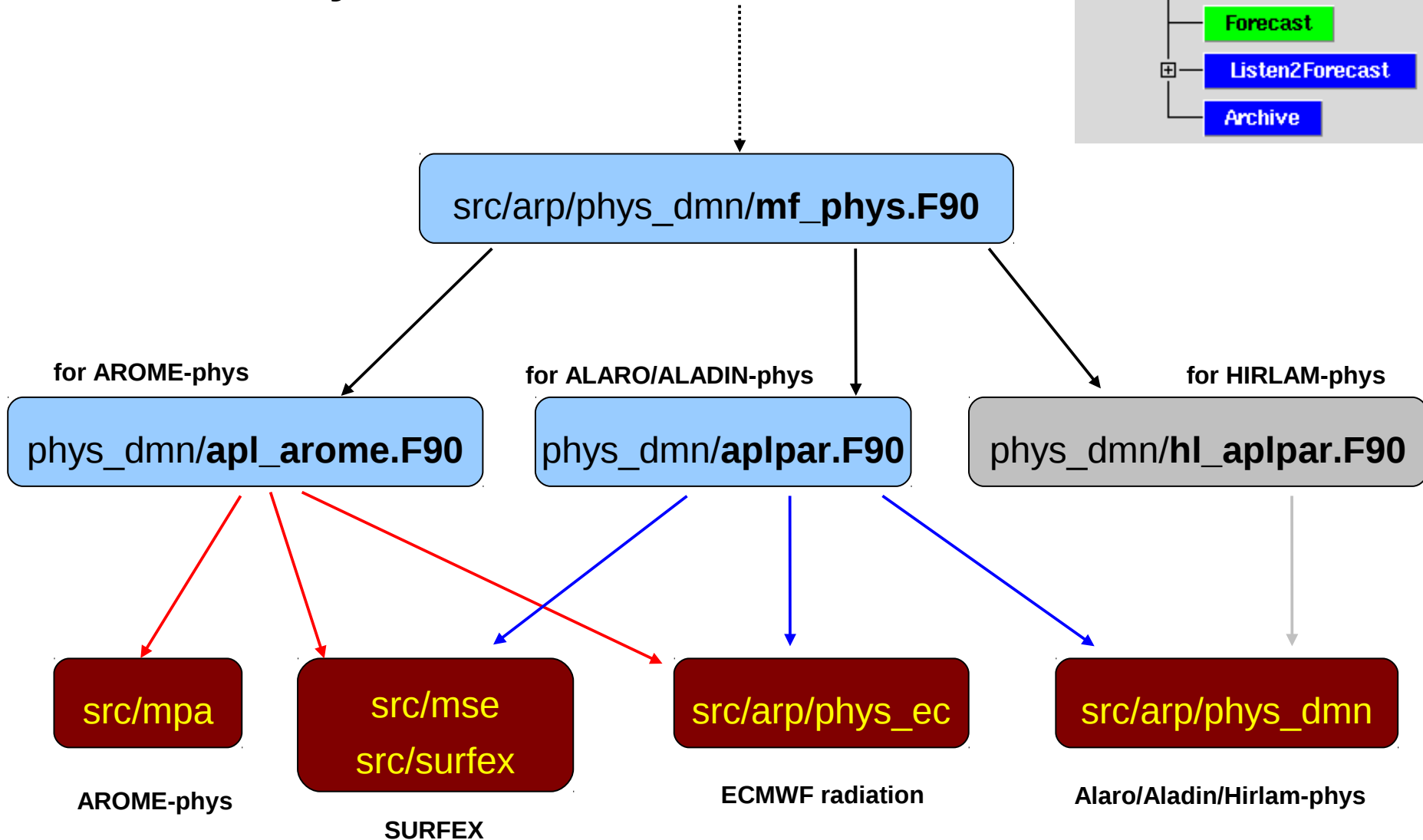
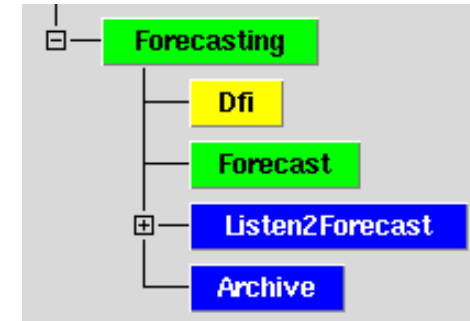
phys_dmn/aplpar.F90

for HIRLAM-phys

phys_dmn/hl_aplpar.F90



Physics source code

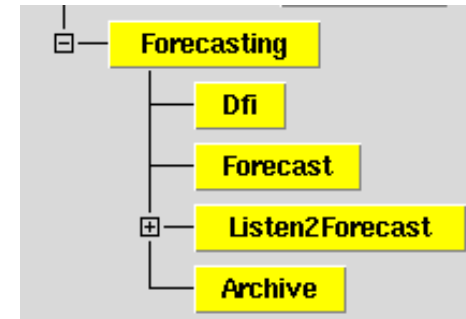


A FEW STRATEGIC COMMENTS

Towards scale-adaptive, cross-package physical parametrisations in HARMONIE

Towards integrated operational surface modelling: physiography, data assimilation, prognostic parametrisations

Towards full consistency between physics, dynamics, data assimilation and probabilistic forecasting



QUESTIONS?

**Next: the case of
radiation
parametrisations**