

# Coupling SURFEX\_V8 to ALARO-1

## Technical details

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This is a follow-up note on Rafiq Hamdi's 2016 LACE stay report 'Coupling SURFEX\_V8 to ALARO-1 for cy43t2'. This note gives some technical details on the implementation in cy43t2.bf.03.

## 1 Context

SURFEX uses its own drag coefficients and stability functions. In order to have consistency between SURFEX and the upper-air turbulence scheme TOUCANS, both should use the same drag coefficients and stability functions. For this reason, two main modifications were done in the SURFEX code: (i) implementation of TOUCANS stability functions in SURFEX, and (ii) extraction of drag coefficients from SURFEX.

## 2 Implementation of TOUCANS stability functions in SURFEX

The code for the calculation of TOUCANS stability function is copied from the original file (actkehmt.F90) to the SURFEX file surface\_cdch\_1darp.F90.

Parameters that are needed for these calculations (from YOMPHY0, YOMQNSE and YOMLOUIS) are put in a data structure of type `SURF_ATM_TURB_t` (implemented in `modd_surf_atm_turbn.F90`). This structure is passed during setup to SURFEX:

```
SUOYOMB
  SUPHY
    SUPHMF
      SUPHMSE
        SUPHMSE_SURFACE
          AROINI_SURFC
            INIT_SURF_ATM_n
              INIT_SEA_n
                INIT_SEAFLUX_n
              INIT_INLAND_WATER_n
                INIT_WATFLUX_n
              INIT_FLAKE_n
            INIT_NATURE_n
              INIT_ISBA_n
            INIT_TOWN_n
              INIT_TEB_n
```

Inside SURFEX, the TOUCANS parameters are finally stored inside the “model descriptor structures” of the different tiles as defined in `modd_surfexn.F90`, viz. `SEAFLUX_MODEL_t`, `WATFLUX_MODEL_t`, `FLAKE_MODEL_t`, `ISBA_MODEL_t` and `TEB_MODEL_t`.

The fact that the turbulence parameters are now in the SURFEX model descriptor structures, is not yet sufficient to ensure their availability where necessary, because these model descriptor structures are not passed down to all calculation routines. The full call tree to stability functions (surface\_cdch\_1darp) is:

```

ARO_GROUND_PARAM
  COUPLING_SURF_ATM_N
    COUPLING_SEA_n
      COUPLING_SEAFLUX_OROG_n
        COUPLING_SEAFLUX_SBL_n
          INIT_WATER_SBL *
          WATER_FLUX *
          SURFACE_CDCH_1DARP *
        COUPLING_SEAFLUX_n
          WATER_FLUX *
          SURFACE_CDCH_1DARP *
          ECUME_SEAFLUX *
          ICE_SEA_FLUX *
          SURFACE_CDCH_1DARP *
          COARE30_SEAFLUX *
          ICE_SEA_FLUX *
          SURFACE_CDCH_1DARP *
          COUPLING_ICEFLUX_n *
          ICE_SEA_FLUX *
          SURFACE_CDCH_1DARP *
      COUPLING_INLAND_WATER_n
        COUPLING_WATFLUX_OROG_n
          COUPLING_WATFLUX_SBL_n
            INIT_WATER_SBL *
            WATER_FLUX *
            SURFACE_CDCH_1DARP *
          COUPLING_WATFLUX_n
            WATER_FLUX *
            SURFACE_CDCH_1DARP *
            COUPLING_ICEFLUX_n *
        COUPLING_FLAKE_OROGRAPHY_n
          COUPLING_FLAKE_SBL_n
            INIT_WATER_SBL *
            WATER_FLUX *
            SURFACE_CDCH_1DARP *
          COUPLING_FLAKE_n
            WATER_FLUX *
            SURFACE_CDCH_1DARP *
      COUPLING_NATURE_N
        COUPLING_ISBA_SVAT_N
          COUPLING_ISBA_OROGRAPHY_N
            COUPLING_ISBA_CANOPY_N
              INIT_ISBA_SBL *
              DRAG *
              SURFACE_CDCH_1DARP *
            COUPLING_ISBA_N *
              ISBA *
                ISBA_CEB *
                  DRAG *
                  SURFACE_CDCH_1DARP *
                ISBA_MEB *
                  DRAG_MEB *
                    PREPS_FOR_MEB_DRAG *
                    SURFACE_CDCH_1DARP *
                ISBA_SNOW_AGR *
                  SURFACE_CDCH_1DARP *
          COUPLING_TOWN_n
            COUPLING_TEB_OROGRAPHY_n
              COUPLING_TEB_n
                TEB_GARDEN
                  GARDEN *
                  ISBA *
                    ISBA_CEB *
                      DRAG *
                      SURFACE_CDCH_1DARP *
                    ISBA_MEB *
                      DRAG_MEB *
                        PREPS_FOR_MEB_DRAG *
                        SURFACE_CDCH_1DARP *

```

```

        ISBA_SNOW_AGR *
        SURFACE_CDCH_1DARP *
GREENROOF *
ISBA *
    ISBA_CEB *
        DRAG *
        SURFACE_CDCH_1DARP *
    ISBA_MEB *
        DRAG_MEB *
        PREPS_FOR_MEB_DRAG *
        SURFACE_CDCH_1DARP *
    ISBA_SNOW_AGR *
        SURFACE_CDCH_1DARP *
TEB *
    URBAN_DRAG *
    URBAN_EXCH_COEF *
        SURFACE_CDCH_1DARP *

```

The routines marked with a star are routines where the model descriptor structures are no longer available. In other words, these are the routines that were modified in order to pass parameters from the top-level to the actual calculation routine.

It can be noted that once this dataflow is in place, further developments of the stability functions in ALARO will be immediately accessible to SURFEX. For instance, the definition of new parameters may require adding these parameters to the `SURF_ATM_TURB_t` structure, but the passing around of this structure inside SURFEX does not change.

### 3 Extraction of drag coefficients from SURFEX

Drag coefficients (actually the average over the 4 different tiles) are extracted from SURFEX with `ARO_GROUND_DIAG`. However, the atmospheric code in fact needs the drag coefficients (call to `ACPTKE`) before the call to SURFEX. To solve this, drag coefficients from the previous timestep are used.

This is implemented by storing the drag coefficients in the `PGPAR` array.

For the first timestep, the approximation is made to use neutral drag coefficients, which are provided by `ARO_GROUND_DIAG_Z0`.

### 4 Other variables

Finally, some variables in `APLPAR` normally initialized by the `TOUCANS+ISBA` routine `ACTKEHMT` are not initialized by the `TOUCANS+SURFEX` routine `ACTKEZOTLS`. These are now initialized as follows:

- **ZGWDCS**: added as output argument in `ACTKEZOTLS`
- **PCDROV**, **ZCHROV**: calculated in `APLPAR` from `ZGWDCS`, `ZCD` and `ZCH`
- **PNEIJ**: used by `ACCVVEG`, `APLMPHYS`, `ACPLUIZ`; now it is initialized to zero in `APLPAR`, but this should later be replaced by a diagnostic coming from SURFEX.