Roughness Length (z0) in LMDZOR

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I. Main points

Note: This document is writen based on ORCHIDEE model version of: 2664 (Last Changed Date: 2015-04-20 17:21:30 +0200 (Mon, 20 Apr 2015))
z0 refers to roughness length for momentum; z0h means roughness length for heat.
The main calculation of z0 in LMDZOR is done in 'condveg_z0cdrag'.
The z0h is set to z0 in surf_land_mod.F90.

- z0 in LMDZOR (from ORCHIDEE to LMDZ):
  condveg.f90 (z0) –> sechiba.f90 (z0_out) –> intersurf.f90 (z0) –> surf_land_orchidee_mod.F90(z0) –> surf_land_mod.F90 (z0h=z0) –> ...
- The surface includes bare soil, vegetation (12 PFTs), and land ice.
  z0_bare, z0_ice are constant (see below),
  while z0_veg(:,jv) = MAX(height(:,jv) * z0_over_height, z0_bare).
  height(:,jv): height of vegetation (m), it is calculated in slowproc.f90
- Some constants:
  z0_bare = 0.01; z0_ice = 0.001; z0_over_height = un/16.
  ct_karman = 0.35 (Van Karmann Constant, unitless) !!! Problem: should be 0.4 (?).
- Some variables:
  veget: PFT coverage fraction of a PFT !! $(m^2 m^{-2})$
  veget_max: PFT "Maximal" coverage fraction of a PFT !! $(m^2 m^{-2})$
  frac_nobio: Fraction of non-vegetative surfaces, i.e. continental ice, lakes, etc. (unitless)
  tot_bare_soil: total evaporating bare soil fraction
  d_veg: PFT coverage of vegetative PFTs(m^2/m^2)
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  IF (is_tree(jv)) THEN ! In the case of forest, use parameter veget_max because tree trunks influence the roughness even when there are no leaves
  d_veg(:,jv) = veget_max(:,jv)
  ELSE ! In the case of grass, use parameter veget because grasses only influence the roughness during the growing season
  d_veg(:,jv) = veget(:,jv)
  ENDIF
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  kjpindex: Domain size - Number of land pixels (unitless)
  jv: Loop index over PFTs (unitless)
  zlev: Height of first layer (m)

*LMD/IPSL

- The roughness length over one grid is obtained by "effective roughness length".
  It is done by averaging the drag coefficients (Cdrag) at level ztmp for different surfaces.
  The level ztmp needs to be high enough above the canopy to avoid singularities of the LOG.
  It is set to minimum 10m above ground: ztmp(:) = MAX(10., zlev(:))
- Cdrag for different surfaces:
  bare soil: Cdrag_bare(:) = (ct_karman/LOG(ztmp(:)/z0_bare))**2
  vegetative PFTs: Cdrag_veg(:,jv) = (ct_karman / LOG(ztmp(:) / z0_veg(:,jv)))**2
  ice: Cdrag_ice(:) = (ct_karman/LOG(ztmp(:)/z0_nobio))**2
- Averaging Cdrag over one grid:
  Cdrag(:) = tot_bare_soil(:) * Cdrag_bare(:) + d_veg(:,jv) * Cdrag_veg(:,jv) + frac_nobio(:,jv) * Cdrag_ice(:)
- Calculate z0 from Cdrag over one grid:
  z0(:) = ztmp(:) / EXP(ct_karman/SQRT(Cdrag(:)))
- ...