Documentation for LMDZ, Planets version

The horizontal dissipation

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1 Theoretical aspects

To be written

2 Pratical aspects in the code

The horizontal dissipation parameters are chosen in gcm.def.

Parameters related to the operators

- idissip: timestep for dissipation. Should be equal to iperiod.
- lstardis: boolean that indicates whether to use a star operator (or not). Usually set to *True*.
- nitergdiv: number of iterations for the *gradiv* operator
- nitergrot: number of iterations for the *nxgradrot* operator
- niterh: number of iterations for the *divgrad* operator

Parameters related to timescales

- tetagdiv: time scale (in s) for the *gradiv* operator. It corresponds to the attenuation of the smallest wavelengths for u and v perturbations.
- tetagrot: time scale (in s) for the *nxgradrot* operator. It corresponds to the attenuation of the smallest wavelengths for u and v perturbations.
- tetatemp: time scale (in s) for the *divgrad* operator. It corresponds to the attenuation of the smallest wavelengths for h perturbations.

These timescales are the one for the deep atmosphere. However, they are modified by some factors as the pressure decreases. For these factors, two steps are implemented: dissip_fac_mid and dissip_fac_up (also chosen in gcm.def). The first step is always applied, the second is applied only when ok_strato is set to *True*. Timescales are divided by the factor f computed as detailed below.

For dissip_fac_mid (which is usually equal to 2.), transition is computed with:

$$x = 1. - \frac{\text{preff}}{p}$$

$$f_1 = \text{dissip\_fac\_mid} - \frac{\text{dissip\_fac\_mid} - 1.}{1. + x^2}$$

When applied (ok_strato set to *True*), the transition from dissip_fac_mid to dissip_fac_up is done with a tanh function, using further parameters:

- dissip_deltaz: altitude range (in km) for the transition.
- dissip_hdelta: scale height (in km) at the altitude of the transition.
- dissip_pupstart: pressure (in Pa) corresponding to the bottom of the transition region.

The function used is:

$$f_2 = \left[1 + \left(\frac{\text{dissip\_fac\_up}}{\text{dissip\_fac\_mid}} - 1.\right) \times \left(1 - \frac{1 + \tanh X}{2}\right)\right]$$

with

$$X = \frac{6. \times \text{dissip\_hdelta}}{\text{dissip\_deltaz}} \log \frac{p}{\text{dissip\_pupstart} \times \exp\left(\frac{-\text{dissip\_deltaz}}{2\text{dissip\_hdelta}}\right)}$$

A last parameter...

There is one last coefficient in gcm.def related to dissipation: coefdis. It is used in inigeom.F to compute gamdi_gdiv, gamdi_grot, gamdi_h. Usually put to 0... Should be explained here...