Computation of spectral orography in configuration 923

NAMCLA

NAMCLA allows to control the computation of orography in configuartion 923/1. It includes the following options :

LKEYF : computation of spectral orography
default : .TRUE.
.FALSE. is usually used for post-processing grids
if .FALSE., spectral orography is written, but with all coefficients set to -9999.

Optimization of spectral orography using a gridpoint cost function : 2 keys and 1 constant
LNEWORO : "Bouteloup" cost function
LNEWORO2 : "Jerczynski" cost function
Both defaults are .FALSE. (simply calling (E)REESPE / (E)SPEREE)
SCEXT : Scaling factor for the weight of the extension zone, to limit relaxation towards not physically meaningful values along the minimization process. Default is 0. (no specific treatment), large values may lead to convergence problems.

Using "Bouteloup" cost function :
LNEWORO = .TRUE.
LNEWORO2 = .FALSE.
QMAX : Maximum value of weight
QMIN : Minimum value of weight
HMIN : Reference height in the formulation of weight
HDIM : Scaling factor for the orography deviation
XINCOC = 0. (option not working)
Defaults correspond to an old ARPEGE tuning and have been used for ARPEGE and ALADIN-France since then : QMAX = 4., QMIN = 2., HMIN = 150., HDIM = 1.

Using "Jerczynski" cost function :
LNEWORO2 = .TRUE.
LNEWORO = .FALSE.
FACE : 1. for the initial formulation, 0. for a simple polynomial one
QMAX : Maximum value of weight
QMIN : Minimum value of weight
HMIN : Reference height in the formulation of weight
XINCOC : Part of sea fraction in the weight (not used in polynomial case)
QPOWER : Exponent in the polynomial term
QCONST : Scaling factor in the polynomial term
The initial LACE tuning corresponds to : QMAX = 2500., QMIN = 1., HMIN = 150., and defaults : XINCOC = 0. , QPOWER = 3.5, QCONST = 0.4, FACE = 1. . It has been used for many "continental" ALADIN domains since then.

Importing external data :

New orography and land-sea mask data can be read on an external ARPEGE/ALADIN file (of name *Neworog*) if required, erasing the fields computed from standard input data. If only gridpoint data are available in the input file, and in case of ALADIN, optimization can be performed afterwards.

LNORO : Key for reading a new orography on a separate file

LNLSM : Key for reading a new land-sea mask on a separate file

Both defaults are .FALSE., and LNLSM can be used only if LNORO = .TRUE.

Smoothing orography :

In gridpoint space, via calls to ELISLAP (ALADIN only) :

NLISSR : Number of calls to ELISLAP to smooth the orography (0 is the default)

The characteristic length must be changed in EINCLI1 (default is 4000.)

In spectral space :

NLISSP : type of smoothing

0 : no (default),

1 : importing a lower resolution one (implying that LNORO = .TRUE.)

2 : within optimization, via an additional spectral cost function (implying that LNEWORO or LNEWORO2 is set to .TRUE.) :

FLISA : tuning parameter if NLISSP=2

FLISB : threshold in spectral space if NLISSP=2

Both defaults are 0.

Envelope orography :

FENVN : Scaling factor at the pole of interest

FENVS : Scaling factor at the antipode of the pole of interest (ARPEGE only)

Both defaults are 0. (no envelope).

Orographic roughness length :

NLISSZ : Number of calls to (E)LISLAP to smooth the roughness length

Default is 3. The characteristic length must be changed in (E)INCLI1 (default is 4000.)

FACZ0 : Scaling factor for the orographic part of Z0

Default is 1.0, but FACZ0 = 0.53 is used in operations.

Formulation of the cost functions to be minimized

$\boldsymbol{J} = \boldsymbol{J^{GP}} + \boldsymbol{J^{SP}}$

$\boldsymbol{J^{GP}}$: **gridpoint** component, to damp Gibbs oscillations, especially over **low** areas

"Bouteloup" :

$$J_1^{GP} = \sum_i \omega\, f_{ext}(i) \left[\left| h(i) - h_r(i) \right| / \mathbf{HDIM} \right]^{w_1(i)}$$

$$w_1(i) = \mathbf{QMIN} + (\mathbf{QMAX} - \mathbf{QMIN})\, exp[-h_r(i)/\mathbf{HMIN}]$$

"Jerczynski" :

$$J_2^{GP} = \sum_i \omega\, f_{ext}(i) \left[\mathbf{FACE}\, w_2(i) \left| h(i) - h_r(i) \right|^2 + \left(\mathbf{QCONST} \left| h(i) - h_r(i) \right| \right)^{\mathbf{QPOWER}} \right]$$

$$w_2(i) = \left(\mathbf{QMIN} + (\mathbf{QMAX} - \mathbf{QMIN})\, exp[-h_r(i)/\mathbf{HMIN}] \right) (1 + \mathbf{XINCOC}\, sea(i))$$

f_{ext} : weight in the extension zone, from **1** to 1/(1+**SCEXT**)

$\boldsymbol{J^{SP}}$: **spectral** component

$$J^{SP} = \sum_{m,n} exp\left((k_{m,n} - \mathbf{FLISB})^{\mathbf{FLISA}} \right) h_{m,n}^2$$

Case of a "linear" spectral truncation

In this case (at least), spectral orography must be filtered, to damp the smallest scales (at least $2\Delta x$). There are two main options available :

The "classical" one, used in operations, is performed in 2 steps : optimizing spectral orography with a "quadratic" truncation, based on $\boldsymbol{J^{GP}}$, then importing it in a "linear" configuration. It implies 2 runs of part 1 of configuration 923 :

1. with quadratic spectral orography in NAMDIM, a standard setup of NAMCLA , and the usual set of input data
2. with linear spectral orography in NAMDIM, LNORO = .TRUE. and NLISSP = 1 in NAMCLA (+ setup for Z0), and the result of the first step, renamed as *Neworog*, and the usual data set as input.

The "direct" one, performed directly in the "linear" configuration, with an optimization based on $\boldsymbol{J^{GP}} + \boldsymbol{J^{SP}}$. Note that the tuning of $\boldsymbol{J^{GP}}$ may differ here, since adding a spectral cost function helps to damp Gibbs waves.

To end with, let us recall that tuning parameters are domain dependent ! As an example, the reports from Steluta Alexandru are now available on the ALADIN web site.