Computation of “clim” files for ALADIN : what's new ?

(ALADIN WS - Bratislava - June 2005)
CONTENTS

• New geometry

• New options

• Updated computation of orography

• Corrections in biperiodization
  ➔ Source code available in the second CY29T2 export version
  thanks to:
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    M. Janousek, F. Taillefer, J. Woyciechowska, and many phasers
  ➔ Scripts available by Françoise Taillefer and the GCO team

• New databases to be tested next summer ? next winter ?
  ➔ to be discussed !
New geometry /1:
simplified setup of domains ("new EGGX")

- both safer and simpler

- 3 types of projections: Mercator, polar stereographic, Lambert
  - according to the reference latitude ($\theta_0 = 0^\circ, \pm 90^\circ, else$)

- 6 main pieces of information required:
  - reference point: $(\theta_0, \lambda_0), (\text{ELAT0, ELON0}) \ (^\circ)$
  - centre of the domain: $(\theta_C, \lambda_C), (\text{ELATC, ELONC}) \ (^\circ)$
  - gridpoint resolution: $(\delta x, \delta y), (\text{EDELX, EDELY}) \ (m, ^\circ)$
  - number of points in the (C+I) zone $(\text{NDGUX, NDLUX})$
  - grid type: "model": $\text{LRPLANE= . T.}$ or "latlon": $\text{LRPLANE= . F.}$
  - rotated tilted Mercator projection: $\text{LMRT= . T.}$
New geometry /2: rotated tilted Mercator projection

1. Rotation to the Equator \((\theta_C, \lambda_C)\)
2. Tilting \((\beta)\)
3. Projection
New geometry /3 : Formulae

1. Rotation to the Equator

\[ (\lambda, \theta) \rightarrow (\lambda', \theta') \]
\[ \theta' = \arcsin \left[ \cos \theta C \sin \theta - \sin \theta C \cos \theta \cos (\lambda - \lambda C) \right] \]
\[ \cos \lambda' = \frac{1}{\cos \theta'} \left[ \sin \theta C \sin \theta + \cos \theta C \cos \theta \cos (\lambda - \lambda C) \right] \]
\[ \sin \lambda' = \frac{1}{\cos \theta'} \left[ \cos \theta \sin (\lambda - \lambda C) \right] \]

2. Tilting

\[ (\lambda', \theta') \rightarrow (\lambda'', \theta'') \]
\[ \theta'' = \arcsin \left[ \cos \beta \sin \theta' + \sin \beta \cos \theta' \sin \lambda' \right] \]
\[ \cos \lambda'' = \frac{1}{\cos \theta''} \left[ \cos \theta' \cos \lambda' \right] \]
\[ \sin \lambda'' = -\frac{1}{\cos \theta''} \left[ \sin \beta \sin \theta' - \cos \beta \cos \theta' \sin \lambda' \right] \]

3. Projection

\[ (\lambda'', \theta'') \rightarrow (x, y) \]
\[ x = a \lambda'' \]
\[ y = a \ln \left[ \tan \left(\frac{\pi}{4} + \frac{\theta''}{2} \right) \right] \]
New geometry /4 : 
Advantages

Flexibility

- It can replace the 3 previous ALADIN projections
- It can simulate precisely latitude × longitude domains, such as HIRLAM ones, with just slight differences for y grid lines

Simple formulation of the map factor:

\[ m = \cosh \left( \frac{y}{a} \right) \approx \alpha \cos(y) + \beta \cos(2y) \]

Computaion of the other geometry-related parameters:

of equivalent complexity ...

Few changes in the setup of domains

- reference point : \( \theta_0 = 0, \lambda_0 = \beta \) (Mercator + Tilt definition)
- centre of the domain : \((\theta_C, \lambda_C)\) (Rotation definition)
- gridpoint resolution : \((\delta x, \delta y)\)
- number of points in the (C+I) zone
- grid type : \( LRPLANE= . T. \) (Model type)
- new definitions :
  - \( LMRT= . T. \) (Model domain definition)
  - \( LFPMRT= . T. \) (FullPos domain definition)
The 10 Options of 923 Configuration /1:

★ 1: description of orography
   moving to GLOB95 to GTOPT030 : resolution 2'30 everywhere?
   higher resolution required for research applications (e.g. AROME)
   → new Manu files at higher resolution?
   → using local data and EE923?
   → using other interpolation tools and importing orography?
   → gathering local data into a larger database?

★ 2: other permanent surface characteristics
The 10 Options of 923 Configuration /2:

★ 3: SST, old relaxation values for surface variables
★ 4: vegetation characteristics
★ 5: correcting land fields using local high resolution data
★ 6: correcting relaxation values for surface variables
   moving to new global databases (E. Bazile, I. Kos, R. Zaaboul, 2000)?
   ➤ resolution 1° instead of 1.5°
   ➤ moisture from the GSWP experiments
   ➤ temperature and snow from 2 years of ARPEGE analyses
The 10 Options of 923 Configuration /3:

- **7**: improving sea and lakes description using local data

- **8**: coefficients for ozone description
  - 3 monthly 2d fields
  - input: 1 global file, resolution 2.5°

- **9**: aerosols
  - 4 monthly 2d fields
  - input: 1 global file, resolution 5°

- **10**: aqua-planet
  - all fields in one run, SST as input (file or namelist)
Update of the computation of spectral orography /1:

- a jump of 5 cycles and significant cleaning
  now independent from changes in minimization for variational applications
  increased ARPEGE - ALADIN consistency, unused options removed

- formulation of the cost function to be minimized (or not)
  \[ J = J_{GP} + J_{SP} \]
  \( J_{GP} \): gridpoint component, to damp Gibbs oscillations, especially over low areas
  “Bouteloup”:

“Jerczynski”:

\[ f_{ext} : \text{weight in the extension zone, from 1 to } 1/(1+S_{CEXT}) \]
Update of the computation of spectral orography /2:

\[ J^{SP} : \text{spectral component, to damp the smallest scales (at least } 2\Delta x) \]

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

**Tuning parameters are domain dependent!**

- **case of a “linear” spectral truncation**
  spectral orography must be filtered:
  - optimization with a quadratic spectral truncation, based on \( J^{GP} \), then import
  - direct optimization, based on \( J^{GP} + J^{SP} \)
Changes in biperiodization:

Physically meaningful values are required also in the extension zone:
→ performed by Full-Pos

Mistake in the original design:
→ correction by Full-Pos over the whole domain: too much!

Bug corrected now:
→ impact on climatological snow coverage (wider)
→ potential positive impact on the initialization of snow cover