Explanation of NH-specific namelist variables

and related concepts

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Namelists and related concepts for integration

namelist-controlled integration :

- logical switches for big "yes or no" options (e.g. H vs. NH, etc.)
- numerical values for tunable parameters (e.g. length of time-step).

advantage :

- being able changing only one parameter or option easily

inconvenience :

- code exponentially growing $\longrightarrow$ needs "pruning action"
- same growth for validation of code at each new version

Namelists and related concepts for integration

Outline of this talk

- a) NH prognostic variables
- b) SI background

Outline

NH prognostic variables

in NH, there are two extra variables compared to H :

- Pressure related variable.
- Vertical velocity related variable.

Recall : in ALADIN/AROME we use strange variants :

- Pressure : $\mathcal{P} = \frac{p-\pi}{\pi}$ or $\hat{q} = \ln\left(\frac{p}{\pi}\right)$.
- Vertical velocity : $d_3 = -\frac{g}{mR_aT}\frac{\partial w}{\partial \eta}$ or $d_4 = D_3 - D$

NH prognostic variables

choosing pressure departure variable NPDVAR :

- NPDVAR=1 $\longrightarrow$ progn.var. $\mathcal{P} = \frac{p-\pi}{\pi}$
- NPDVAR=2 $\longrightarrow$ progn.var. $\hat{q} = \ln\left(\frac{p}{\pi}\right)$.

choosing vertical divergence variable NVDVAR :

- NVDVAR=3 $\longrightarrow$ progn.var. $d_3 = -\frac{g}{mR_aT}\frac{\partial w}{\partial \eta}$
- NVDVAR=4 $\longrightarrow$ progn.var. $d_4 = D_3 - D$.

choosing vertical velocity variable w for grid-point space LGWADV :

- LGWADV=F $\longrightarrow$ keep the variable NVDVAR for grid-point computations
- LGWADV=T $\longrightarrow$ enforces use of w in grid-point computations

NH prognostic variables

comments :

- NPDVAR=1 and NPDVAR=2 almost undistinguishable
- NVDVAR=4 supposed to be safer in presence of orography
- NVDVAR=4 leads to more complex code
- LGWADV=T seems to be useful mostly for severe academic cases

Recommended values :

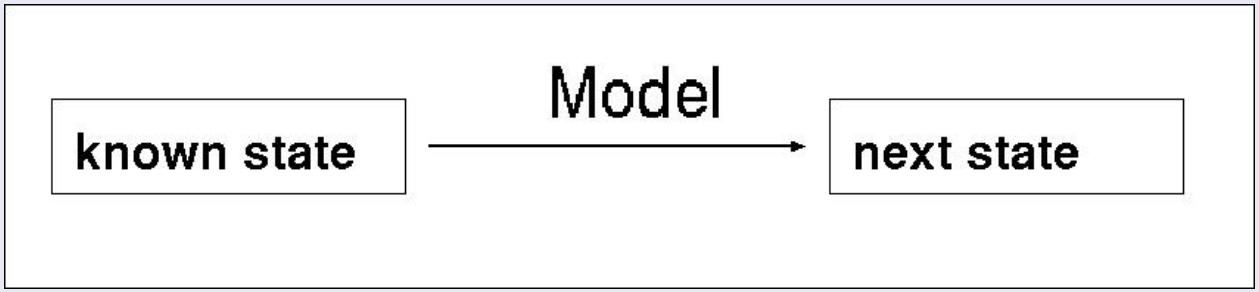
NPDVAR=2, NVDVAR=4 and LGWADV=F

Outline

SI background

For beginners : introducing "symbolic notation"

- Consider the forecast model as a black box :



- define "known state" as a (huge) column-vector X^t
- define "next state" as a (huge) column-vector X^{t+1}
- both X^t and X^{t+1} have N components
- Then "Model" may be considered as a huge operator M : $X^{t+1} = M[X^t]$
- for each component of vector : $X_i^{t+1} = M_i[X^t]$

SI background

comments

- M is usually non linear :
  e.g. $X_i^{t+1} = \exp(X_j^t) + \ldots$
  e.g. $X_i^{t+1} = X_j^t X_k^t + \ldots$
- M is usually non "algebraic" when physics and SL :
  e.g. If $X_j^t > 0$ then $X_i^{t+1} = A$ else $X_i^{t+1} = B$
- M may be divided into parts (dynamics, physics,...)

linear operator

- under some circumstance M can be linear :
  $X_i^{t+1} = \sum m_{ij} X_j^t$
  e.g. for a resting state $M = I$

SI background

- This symbolic notation is useful for discussing time-discretisation
- e.g. Leap-frog explicit dynamics :
  $X^{t+1} = X^{t-1} + 2\Delta t M[X^t]$
- e.g. Leap-frog semi-implicit dynamics :

$$X^{t+1} = X^{t-1} + 2\Delta t M[X^t] + 2\Delta t L^*[\frac{X^{t+1} + X^{t-1}}{2} - X^t]$$

  where L^* is an ad-hoc linear operator

SI background

- The linear operator L^* used for AROME's SI scheme is characterized by only three parameters :
  - a so-called reference surface-pressure π_s^* : `SIPR`
  - a so-called reference temperature T^* : `SITR`
  - a so-called acoustic reference temperature T_a^* : `SITRA`
- The values of these parameters have an impact on stability (as in the H case)
- the impact of the choice of L^* is subtle (see various publications)
- For a Two-Time-Level (2-TL) scheme, recommended values :
  - `SIPR` : 101325 hPa
  - `SITR` : 350 K (warmer than any likely temperature)
  - `SITRA` : 50 (100 ?) K (colder than any likely temperature)

SI background

Comments on SI background state

- The NH SI background state is very similar to the H one
- The only difference is the new $\texttt{SITRA} = T_a^*$ feature
- The SI background state is exactely identical to that used for more implicit iterative "“ICI schemes”" (Jozef's talk)
  and same values should be used for SI and ICI.

Summary

When running NH mode (LNHDYN=T)

- Check that NH variable choice are properly defined
  - NPDVAR=2,NVDVAR=4, LGWADV=F
- Check the SI or ICI background state is properly defined
  - SITR=350,SITRA=50 or 100, SIPR=101325.