

Coupler and I/O PAE meeting
Sankt-Augustin,
October 25-26-27, 2006

Participants: From NEC-CCRLE: R.Redler, H. Ritzdorf;
From CERFACS: L. Coquart, S. Valcke

Agenda

1. Review actions from last meeting
2. Status of interaction with external projects + conference to come
3. Interpolation for ORCA grid (tests by Laure)
4. PSMILe and T behaviour for interpolation particular cases (if_masked, etc.)
5. Trilinear case and relation with global search
6. 2D1D PSMILe-Transformer interaction
7. Bicubic interpolation and mirror option
8. Memory leak in Transformer
9. Conservative remapping
10. Detail about PSMILe search routines
11. Other issues

1- Review actions from last meeting (1/2)

1- Use of subversion at CERFACS and Trac:

- Server at CERFACS will migrate from CVS to Subversion. CVS and Subversion will not be kept in parallel for a while so that user are encouraged to switch to subversion.
- Use of FCM:
- Compared to tkcvs, FCM offers probably a more controlled access to Subversion, a naming convention, and wrapper to Subversion commands
- We think that no particular installation is required at CERFACS if a user wants to use FCM on his site.
- PRISM SCE was not released with last version of OASIS3; we will investigate further the use of FCM and it is possible that OASIS3/4 be one day released with FCM.

2- OASIS4 on NEC SX5 at IDRIS:

The problem reported by Josefine to Rene and Hubert was probably a site related problem; we will not investigate further and see until this pops up again (it is probably a problem that should be solved by IDRIS administrators).

3- Exchange protocol version:

When the interface between the PSMILe and the Driver/Transformer evolves, the protocol version (parameter PSMILe_latest_protocol_version in psmile.inc for the psmile, and parameter Drv_latest_protocol_version in prismdrv_constants.F90) need to be updated. Rene implemented an additional transfer of information between the psmile and the Driver so to check the coherency of the protocol version. **Action: Rene to check-in this modification; Sophie to update protocol version following last PSMILe-Driver interface modifications (number of corners).**

1- Review actions from last meeting (2/2)

4- Global search:

Work is in progress. The global search is implemented for linear and cubic interpolation for regionlatvrt and for irregionlat_regvrt grids. It is almost implemented for nearest-neighbour interpolation, except when all neighbours are masked (Hubert is currently working on this). It still needs to be implemented for Gaussian reduced grids. We still target beginning of 2007 for its full implementation (excluding conservative remapping).

Action: Sophie to ask Johannes about partition problem reported in June 07 mail. Sophie to ask Johannes for which grid the global search is needed in GEMS.

5- Status of vertical interpolation "none" for the different interpolations:

When 2D1D with none in the vertical is requested vertical levels do not match, there should be a check and an abort (because it does not make sense to ask for NONE in the vertical in that case.. **Action: Rene to implement this.**

6- Wiki page for current development platforms, users, institutions and contact names.

Action: Sophie to set-up this wiki page.

7- Papers:

- General paper on OASIS4 to the Journal of Atmosphere and Ocean Technology” . **Action: Sophie to contact one editor with 2 page summary of what we would like to publish and ask for their advice.**
- Other scientific paper: with SMHI when first scientific results will be available. **Action: Rene.**
- Chapter in book possibly published by Springer: lead authors showed interest; proposal to Springer mid-November, target date: late spring 2008.
- EOS: short article on PRISM to be submitted shortly. **Action: Sophie.**

2- a) Status of interaction with external projects

1- SMHI:

- quasi-production runs (used for atmosphere parameter tests). New coupled model based on (old) regional ocean (old RCO), new regional atmosphere (new RCA) with OASIS4.
- The domain is centered at the pole; RCA domain is larger than RCO; climatology is used to fill the difference.
- Currently, RCO and RCA grids are almost identical (irrlonlat_regvrt), so there are no high interpolation requirements for now; the coupling would be 2D.
- Data exchange occur through root process (no global search for now).
- A memory leak is observed (memory grows with time, even with RCA in stand-alone, but it is 10 times worse in coupled mode). Finally, the model crashes in a psmile_bsend because no memory available (but this does not mean that the memory leak necessarily happens in the psmile).
- With the full set-up, some RCO and RCA points are found to match directly, whereas no matching point is found when coupling of those grids is done in toy example.

2- GEMS: ripples temporarily solved; waiting for their feedback; see also actions in 1 above.

3- Met Office: 2D global coupling with ORCA2 and MetOffice atm model. Conservative remapping needed, but no global search as exchange occurs through root process only. The interpolation problem at the pole is solved, we are waiting for their feedback. **Action: Sophie to ask about intention behind their mail about psmile_bsend (reuse part of the software? or improvements? if so, why?)**

2- a) Status of interaction with external projects

4-Seasonal forecasting group at ECMWF:

Decided to step back to OASIS3 for their coupled model due at the end of the year in the MERSEA project, but they intend to switch to OASIS4 later.

5- NERSC:

This group is evaluating both OASIS3 and OASIS4 for their ARPEGE-Micom coupling. Action: Sophie to ask them about the results of their tests.

6- Japanese MetOffice and University of Tokyo: A

Asked for the code some months ago, but we have not heard anything from them

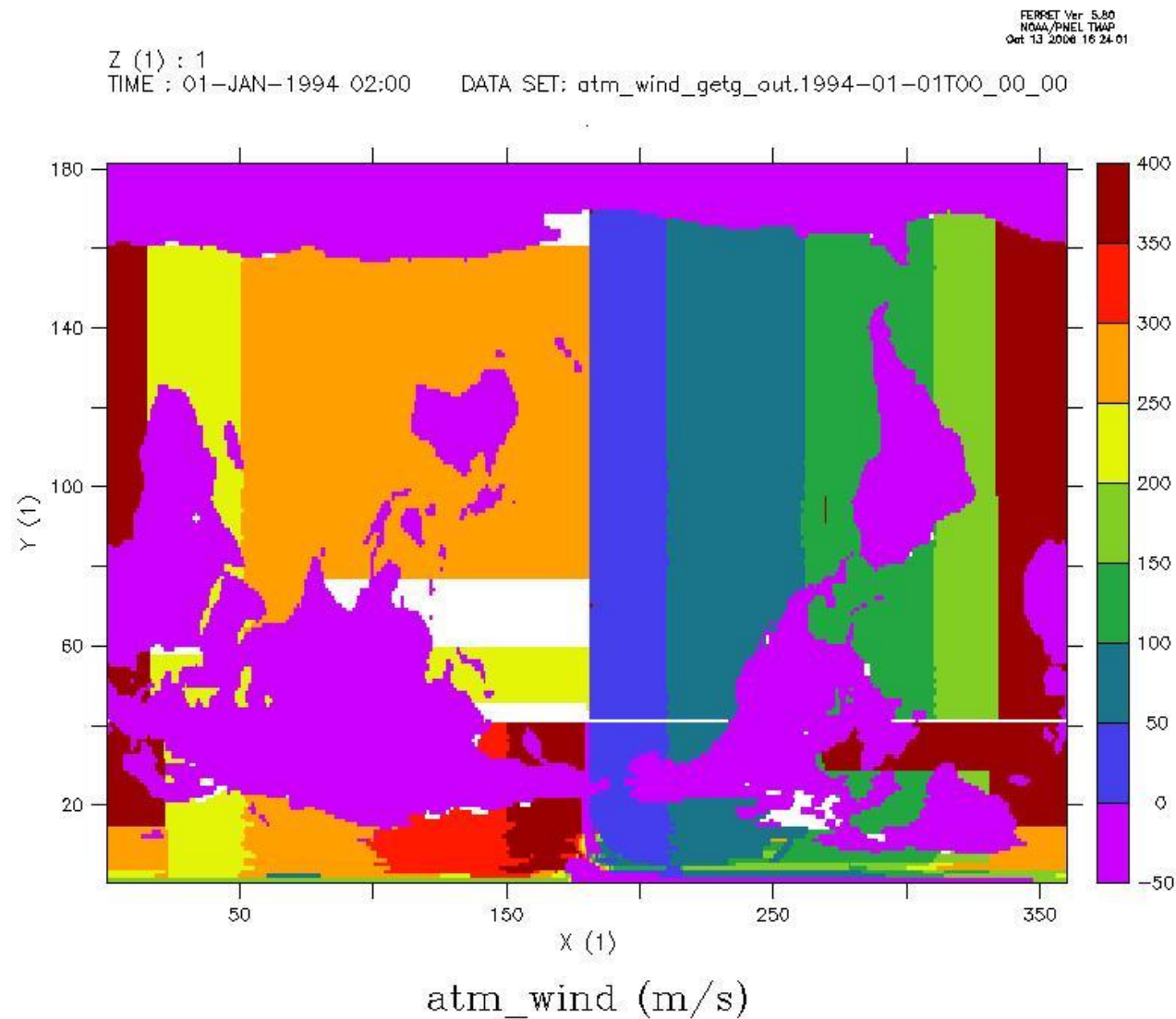
2- b) Conference to come

1- BMRC (Melbourne):

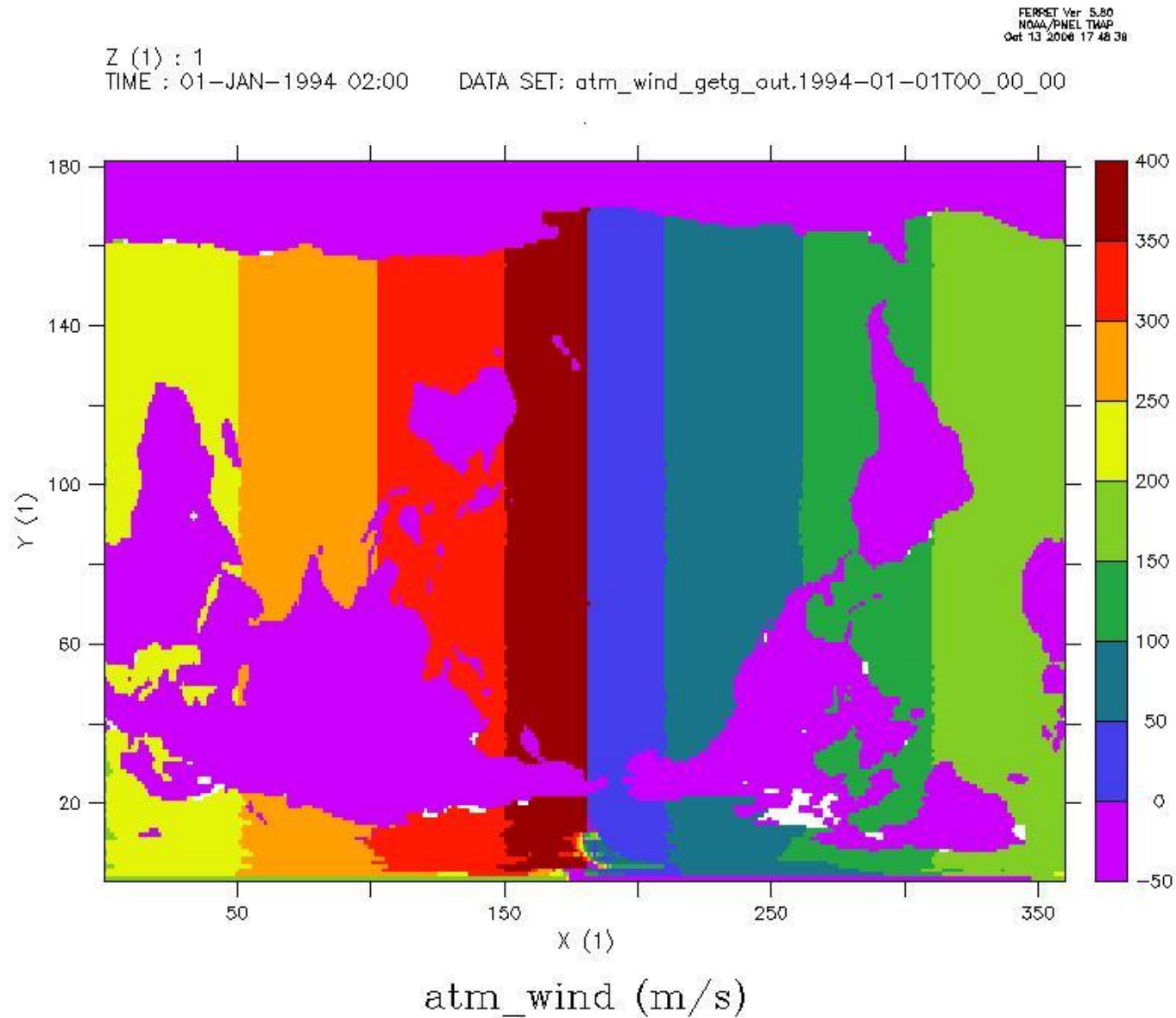
The Australian Community Climate Earth System Simulator (ACCESS) - Challenges & Opportunities: presentation about PRISM and OASIS4, November 28-30 2006

3- Interpolation for ORCA grid (tests by Laure)

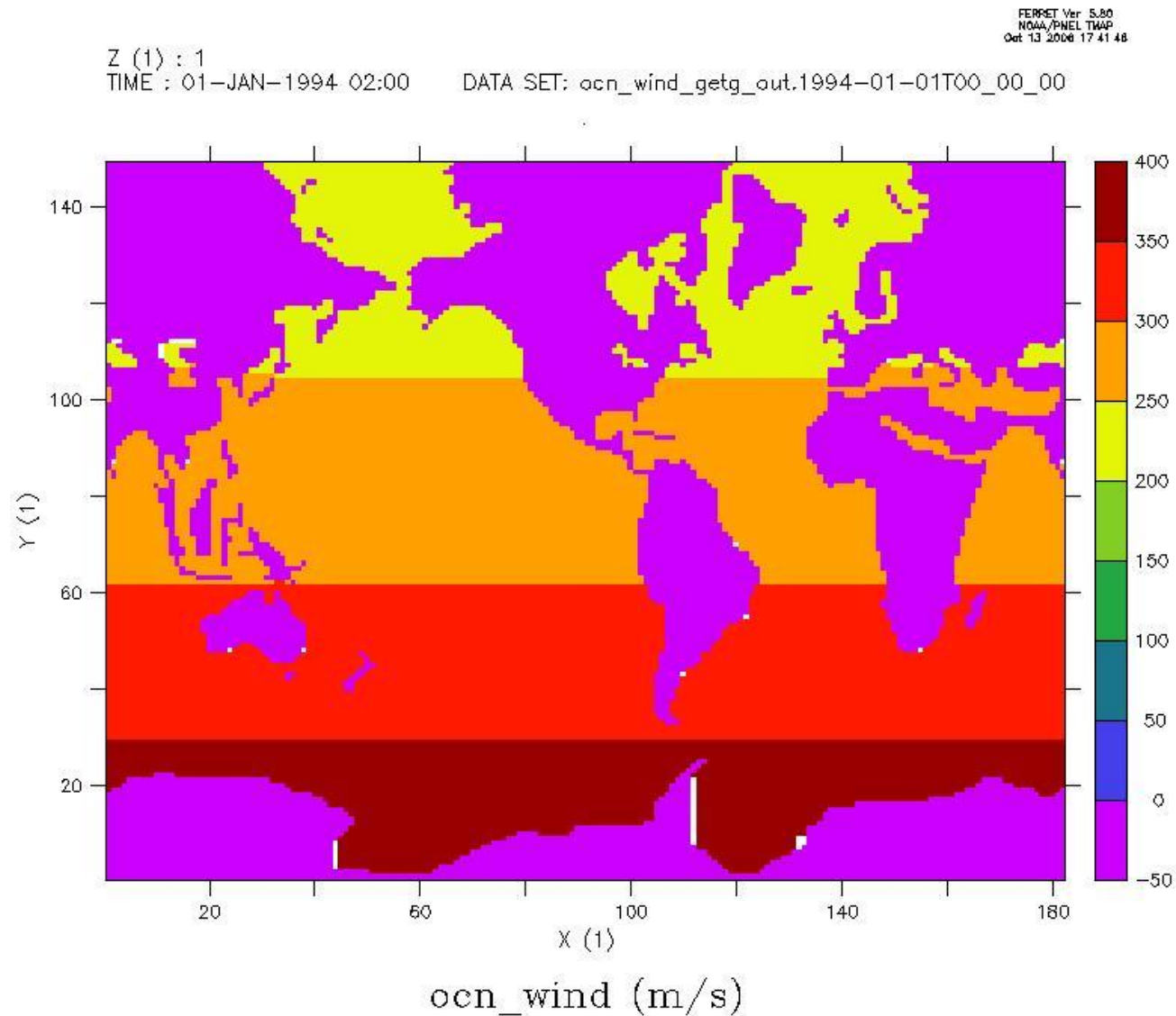
From ORCA -> regionlatvrt
nneighbour3D with **original corners from toyoa4** (proto_ex)



From ORCA -> regionlatvrt nneighbour3D with **new corners from Sebastien**



From regionlatvrt -> ORCA nneighbour3D with **new corners from Sebastien**



Conclusion: New corners from Sebastien seem to provide correct results. The details have to be investigated further by Laure; in particular, the option `if_masked=nneighbour` should be tested.

4- PSMILe and T behaviour for interpolation particular cases (if masked, etc.)

Currently:

- >nneighbour2D/3D: used_masked (not implemented)
 - true: all points are considered by psmile and the T detects masked points
 - false: psmile chooses only among non masked points
- > bi/tri-cubic/linear: if_masked
 - novalue: if some of the neighbours are masked, target point= PRISM_undef
 - tneighbour: if some of the neighbours are masked, other algorithm with non-masked neighbours; if all neighbours masked, target point= PRISM_undef
 - nneighbour: as for tneighbour, except that at least non-masked nearest-neighbour is always found by PSMILe

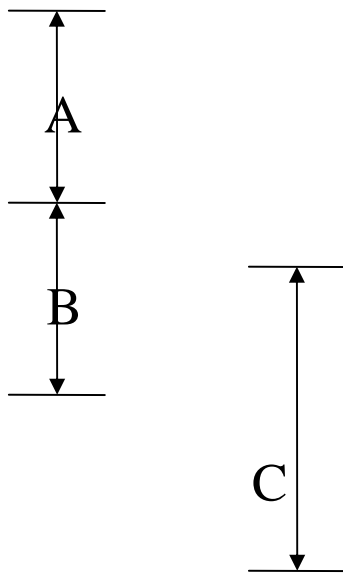
What we agreed on:

- > do not implement used_masked option
- > keep if_masked option and use it for nneighbour2D/3D too, adding nsneighbour (for nneighbour2D/3D only): psmile chooses only among non masked points.

Actions: Rene/Hubert implement it for nneighbour2D/3D. In case of novalue, verify that the t point is part of an epio with no valid neighbours. Sophie: Ensure that T gives PRISM_undef to appropriate t points (novalue and tneighbour when all neighbours are masked) (masked target points are not touched by the T).

- > for points with missing neighbours, default behaviour is extrapolation (or “new mirror” only for GR extending to the pole); we will see if a if_missing option is ever needed (if_missing could be: no_value, tneighbour, mirror, extrapolation).
- > for points falling outside any source grid cell, currently no value is calculated, even if its cell partially intersects a source cell (see next page); this is fine for now, we will see if users ask for other “if_outside” options one day.

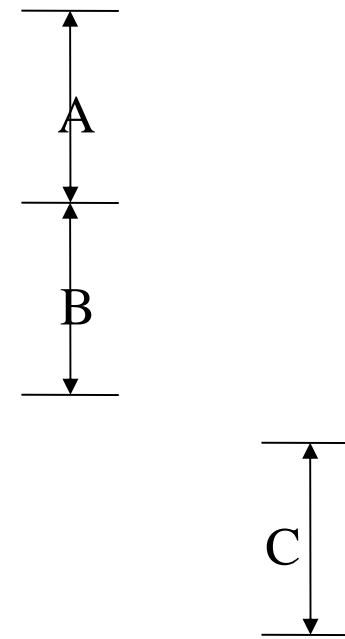
Case A)



Model 1 ↔ Model 2

- Only cell B receives info from C.
- For C, as cells C and B overlap, C should receive info from B only if Conservative remapping is used.

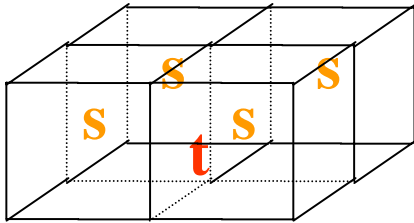
Case B)



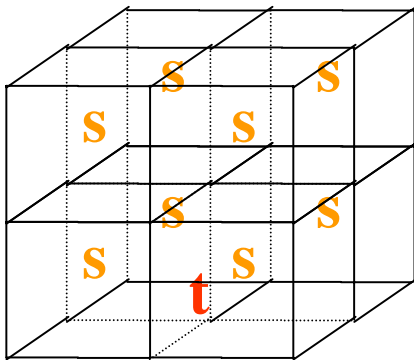
Model 1 ↔ Model 2

- Currently, neither model 1 nor model 2 receive info from other model.

5- Trilinear case and relation with global search: *what happens currently*



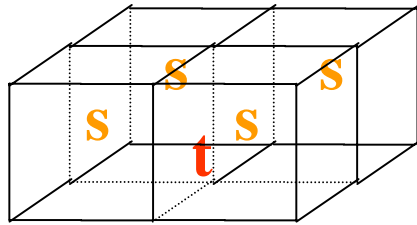
- Only one level of s; t is located on the bottom face of s cells:
2 times the same 4 s points at same levels are transferred to T and
this leads to wrong weight calculation results



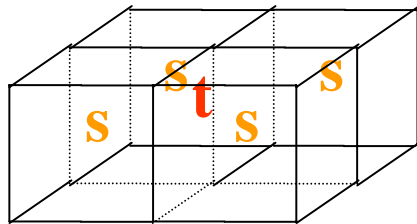
- More than one level of s; t is located on the bottom face of s cells
Without TRANSFORMER_SUPPORTS_2D_INTERPOLATION
some t do not get any neighbour, no value is calculated

With TRANSFORMER_SUPPORTS_2D_INTERPOLATION
8 neighbours s above t and trilinear is applied

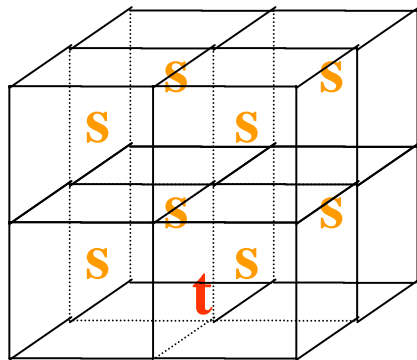
5- Trilinear case and relation with global search: *what we agreed on*



A) Only one level of s; t is located on the bottom face of s cells
-> Only 4 neighbours should be transferred. Should T switch to nearest-neighbour taking the vertical distance into account or to bilinear neglecting the vertical distance?



B) Only one level of s; t is located at the same level than s points
-> As above



C) More than one level of s; t is located on the bottom face of s cells
-> 8 neighbours should be transferred and T should perform trilinear with those 8 neighbours

Actions:

- **Rene/Hubert** to correct the number of neighbours transferred in those cases
- **Sophie:** to check that bilinear gives same results than nearest-neighbour when the target point is surrounded by the source points
- **Sophie:** to understand why trilinear algorithm does not converge when 2 times the same 4 neighbours are transferred to the Transformer (would solve all bilinear vs nneighbour problem).

6- 2D1D PSMILe-Transformer interaction

Proposition was: Totally decouple the horizontal and the vertical treatment and therefore define an epio for the horizontal treatment and an epio for the vertical treatment (see difference between proposed psmile_trs_set_src_epio2d1d_double.F90 and psmile_trs_set_src_epio3d_double.F90 and look at prismtrs_set_tgt/src_epio_double/real.F90)

What we agreed on: 2D1D interpolation make senses only if the grid is regular in the vertical (“regvrt”) (**Action: Sophie: coherence check to implement**), even if the grid does not repeat itself vertically. So we keep only the 3d interface and T will detect the number of vertical levels and the first index at each level for each target point, based on the vertical position of the points (requirements: source points are ordered; source grid is regvrt). nbr_of_vertical_levels depends on the vertical interpolation, except if 1D conservative remapping is used vertically. If for any reason, this turns out not to be possible, then this information would have to be transferred by the psmile (see Sophie’s psmile_trs_give_neighbors3d.F90).

(For optimization in 2D1D case if the source and target horizontal grid repeat themselves vertically, we could use the following integers in the 3d routine

```
ila_args(1) = PSMILe_trans_Set_src_epio_info; ila_args(2) = global_rank
ila_args(3) = PRISM_Double_Precision; ila_args(4) = Appl%sequence_number
ila_args(5) = Appl%rank; ila_args(6) = id_epio_id
ila_args(7) = id_epio_horsize; ila_args(8) = id_epio_vrtsize
ila_args(9) = PSMILe_2D1D; ila_args(10) = id_mask
ila_args(11) = id_nbr_corner
```

In this case, T would have to do the horizontal intersection calculation only once and then do the normalisation for each level)

7- Bicubic interpolation and mirror option

What we agreed on:

The current fix under CPP flags `-D__MIRROR_POINTS` seems to solve GEMS ripples problem; however we agreed that a more physically-based behaviour should be implemented for target point near the border of the domain for which the 4 or 16 neighbours for bilinear or bicubic interpolation are not found:

- For Gaussian reduced (GR) grid extending to the pole (pole_covered smioc information confirmed internally by psmile), take source points at $j=j_{\max}$ at $i=i+180$ degrees; if the grid does not extend to the pole, take 4 or 16 border points (this last behaviour can be forced by putting `periodic=false` in the smioc).
- Problem: Does a point at $i+180$ necessarily exist? For GR grid, the algorithm to find the $i+180$ degree point can be based on the indices, but it cannot be in general for all grids. For reglonlat grid in general, the psmile would have to find the point closest to longitude of $i + 180$, i.e extra search. For irreglonlat, the algorithm to find the points would be even more complex.
- Note: distinction between periodic and cyclic: cyclic: $i+n \Rightarrow i_{\max}+n$ (with i_{\max} not including overlapping points); periodic: $j_{\max}+1=j_{\max}$, $j_{\max}+2=j_{\max}-1$
- For now; apply “new” mirror option it automatically for GR grids if source grid covers the pole; do not do anything for reglonlat or irreglonlat grids for now.

Actions: Rene/Sophie: apply current mirror behaviour for bilinear if needed by GEMS; apply “new” mirror behaviour (described above) for bilinear/bicubic; action with medium priority depending on GEMS reaction to MIRROR_POINTS results.

8- Memory leak in Transformer:

- symptom: the memory is increasing because some local arrays are not deallocated in some Transformer subroutines. For IBM compiler, there exist a compiling flag `-qxlf90=autodealloc` that ensure that local allocatable arrays are deallocated at the end of the subroutine and this solved the problem (this option does not exist for absoft).
- Rene checked that the problem still exist with absoft compiler even after last month corrections.
- **Action: Sophie to test with IBM compiler with long run loop up to 10000 around prism_put call.**
- There exist C tools to detect memory leak, but it has to be investigated if they work with Fortran. Alternatively, call to additional trace functions which add the array name in a list when allocated and remove it from the list when deallocated; it can then be checked that the list is empty at the end. **Action: Hubert and Rene to create routines calling those trace function.**

9- Conservative remapping:

- > see PSMILe-Transformer interface routines `psmile_trs_set_src_epio_xxx.F90` and `prismtrs_set_src_epio_xxx.F90`
- > either the method points or corners info is known; therefore, modify the routines assuming that if `id_nbr_corner=1`, only method point info is transferred; if `id_nbr_corner>1`, only corner information is transferred (i.e dimension arrays with `id_epio_size*id_nbr_corner`).

10- Detail about PSMILe search routines:

PSMILe search routines were explained by Rene and Hubert (see Rene's presentation).

11- Other points discussed

- Remove workaround in `psmile_to_be_coupled.F90`. **Actions: Sophie: build the list of components coupled when the Driver checks coherency of SMIOC exchanges; Rene use that list in `psmile_to_be_coupled.F90` .**
- `psmile_spawn_child.F90`: change file and routine name for `prismtrs_spawn_child`; add in interface; change file name of 2 other routines (to ensure coherency between file and routine name).
- patent issue: CNRS currently advice us to stop diffusing OASIS in Japan and USA until a more detailed investigation is done. But PRISM SB (P. Bougeault and J.C. Andre) decided to keep on diffusing OASIS in those country. J.-C. Andre will probably ask CNRS to proceed to more detailed investigation.
- `irrlonlatvrt` grids are supported but as no `volume_type` is defined yet, the `psmile` supposes for now that 8 corners are defined for each cell, 4 for the “ bottom” of the cell and 4 for the “ top” of the cell.