Re-organization of ORCHIDEE's interpolation

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Overview: HEAT project

- HEAT project aims to develop a new Global Climate Model (GCM) using different components:
  - New atmospheric dynamical core called DYNAMICO
  - LMD atmospheric physics from LMDZ GCM
  - IPSL land model: ORCHIDEE
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  - ...
- DYNAMICO uses an unstructured grid and XIOS libraries for I/O
- All the components have to be prepared to be able to work on an unstructured grid (or not with OASIS) and with XIOS libraries
  - Components' code have to use XIOS
  - Input and initialization files have to be understandable by XIOS

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- Planned steps:
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- Work done in a new branch:
  `svn://forge.ipsl.jussieu.fr/orchidee/branches/ORCHIDEE-DYNAMICO/ORCHIDEE`

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variable	file	shape	subroutine
LAI	lai2D.nc	4D	slowproc.f90
soilalb_[dry/we/moy][a]	soils_param.nc	3D	condveg.f90
veget	PFTmap.nc	3D	slowproc.f90
vegetation_map	carteveg5km.nc	1D	slowproc.f90
soilclass[b], clayfraction[b]	soils_param.nc	3D	slowproc.f90
pente	cartepente2d_15min.nc	2D	slowproc.f90
bg_albedo	alb_bg_jrctip.nc	4D	condveg.f90
N_qt_[WRICE/OTHER]_year	orchidee_fertilizer_1995.nc	2D	chemistry.f90
flx_co2_bbg_year	orchidee_bbg_clim.nc	2D	chemistry.f90
remperature	reftemp.nc	2D	thermsoil[c].f90

[a] from soilcolor, visisble and infrared

[b] from soiltext

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- Writing of 'all-purpose' interpolation code grouped in a new module `src_global/module_InerpWeight.f90` all forcing files (even that ones not using `aggregate_p`)

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- Writing of 'all-purpose' interpolation code grouped in a new module `src_global/module_InerpWeight.f90` all forcing files (even that ones not using `aggregate_p`)
  - Tinny modifications, readiness to use outcomes from XIOS
  - New variable `aover` availability of data for the interpolation ($[0, 1]$, where < 0 value when data was not available)

$$aovar_{i,j} = \frac{\sum_{k=1}^{Ncoin.} \mathcal{A}_k^{in}}{\mathcal{A}_{i,j}^{OR}}$$

  - Generalized version of ORCHIDEE interpolation !!

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- Proposal:

`https://forge.ipsl.jussieu.fr/orchidee/wiki/Documentation/Forcings/CfStandard`

  - Provide file with mask incorporated
  - Homogenization of names: dimensions, variables, ...
  - Provide a new variable with a new dimension for the categories/types

ORCHIDEE files' proposed homogenization

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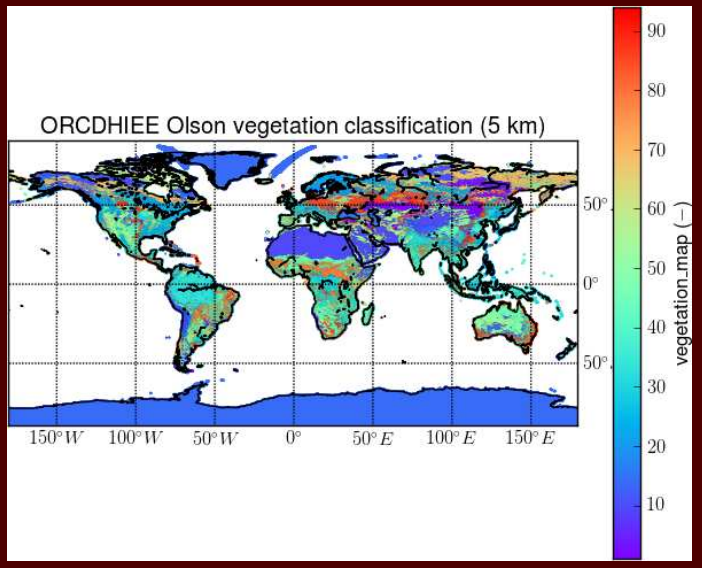
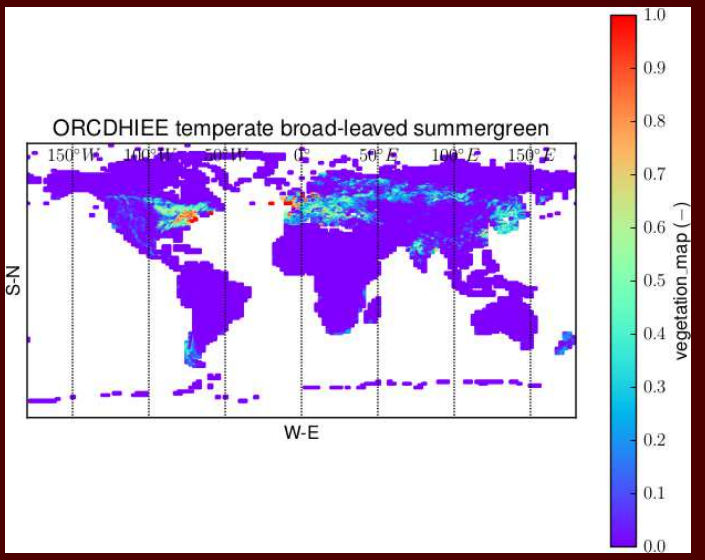
  - Proper definition of land/sea mask ensures right representation of the continents, coastal lines, ...
  - Incorporated within the file avoids possible errors from computation
  - Provider of data best to know
  - Use `_FillValue` to mask oceanic points

`carteveget_5km_XIOS.nc`



`PFTmap_IPCC_2000_XIOS.nc`



ORCHIDEE files' proposed homogenization

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- Mask
- Labelization (following CF-standard)
  - Standard nomenclature avoids confusion
  - Flexible/general programs, use of files
  - Add bounds variables (`lat_bnds`, `lon_bnds`) for non regular lon/lat projections of input data (as `carteveg5km.nc`, Goode Homolosine)

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  - New string variable `char typesnames(Ntypes, Lstring)`

generic	**PFTmap.nc**	**soils_param.nc**
1: [type 1]	1: bare soil	1: light (brightness=1)
2: [type 2]	2: tropical broad-leaved evergreen	2: bright (brightness=0.875)
(...)	(...)	(...)
N: [type N]	13: C4 agriculture	9: dark (brightness=0)

  - Robust information content of the files
  - Flexibility on interpolation of files (via the dimension `Ntypes`)
  - Clear framework easier to incorporate new forcing files

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- Labelization (following CF-standard)
- Types/categories
- All current ORCHIDEE files have been CF-standardized. Python tools to check/create files.:

`https://forge.ipsl.jussieu.fr/orchidee/wiki/Documentation/Forcings/CfStandard`

  - `file_rectifier.py`: rectifies input files
  - `file_checker.py`: checks the consistency of the file

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  2. On the branch:
     (a) Adapting interpolation to be done via XIOS2 (replacing all calls to `InterpWeight[N]D`)
     (b) Generalization of interpolation adding multi-projection interface recently incorporated from J. Polcher
     (c) Incorporate `aovar` variable in output (where?)
     (d) Coding interpolation of routing to unstructured and XIOS2-based framework
     (e) First coupled runs before the end of 2016
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Thank you for you attention !!

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- Currently ORCHIDEE interpolation done via `aggregate_p` with a specific interface for each file with a given masking and modification of file values
- Interpolation in all files follows a similar structure:
  1. Getting variable and variable's lon,lat
  2. Check variable values (if necessary modify them)
  3. Mask values
  4. Check matching grid-point areas of ORCHIDEE grid via `aggregate_p`
  5. Provide interpolated values (PFT fractions, albedos, ...) using matching of areas ($\mathcal{A}^{OR}, \mathcal{A}^{in}$)

$$\mathcal{X}_{i,j}^{OR} = \frac{\sum_{k=1}^{Ncoin.} \mathcal{X}_k^{in} \mathcal{A}_k^{in}}{\sum_{k=1}^{Ncoin.} \mathcal{A}_k^{in}} \quad ; Ncoin. \in \mathcal{A}^{OR}$$

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- Writing of 'all-purpose' interpolation code grouped in a new module `src_global/module_InerpWeight.f90`
  - nD-generalization of the interpolation
  - Inclusion of all the 'modification' and 'masking' methodologies found for the different files
  - Use of the `aggregate_p` methodology for all the files including: `reftemp.nc`, `orchidee_fertilizer_1995.nc`, `orchidee_bbg_clim.nc`
  - XIOS-like calculation of the final ORCHIDEE values

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- Writing of 'all-purpose' interpolation code grouped in a new module `src_global/module_InerpWeight.f90`
- re-structured interpolation:
  1. Set-up file, variable and methods to use
  2. Call general interpolation subroutines: `InterpWeight1D-4D`
     (a) Modify values
     (b) Mask values
     (c) use `aggregate_p`
     (d) Provide interpolated values via `provide_fractions2D-4D`
     (e) New variable `aover` availability of data for the interpolation ($[0, 1]$, where < 0 value when data was not available)

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