Summary of ORCHIDEE - V4 impacts in IPSL-CM7

Frederique C. & Philippe P.

(for the whole ORC team)

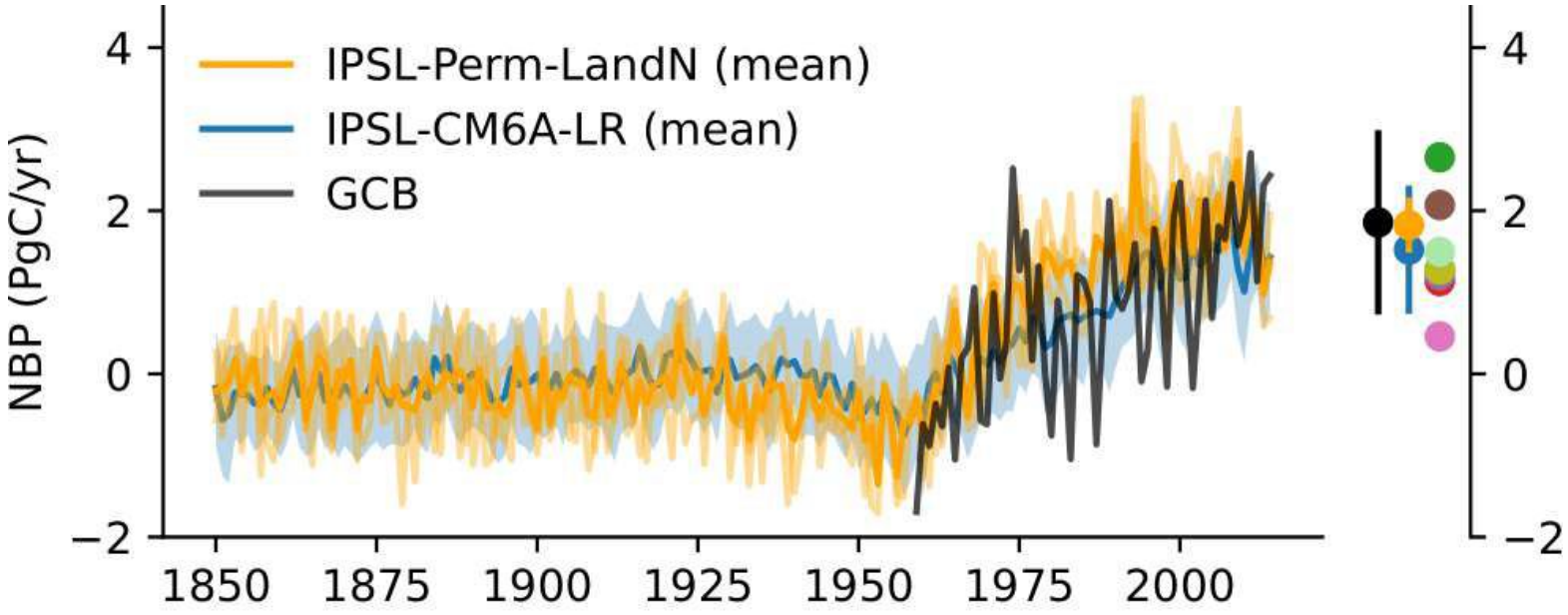
Changements majeurs entre ORC2 → ORC4

1. **Cycle de l'Azote** ⇒ Impact la dynamique du LAI et croissance
2. **Permafrost (**Chaleur lat. gel/dégel) ⇒ Fort impact de T2m arctic et débit rivières
3. **Neige à 12 couche**s ⇒ Impacte fonte printemps (accélérée)
4. **Dynamique forestière** ⇒ Impact rugosité et flux turbulents (et surtout bilan C)
5. **Nouvel Albedo (2 stream RT)** ⇒ Fort impact global (surtout zones avec neige)
6. **Changement conductance stomatique (très récent)** ⇒ Impact fort sur la Transpiration (forte augmentation)
7. **Autres Chgs généraux**: Résistances transpiration, Inter-lost; Phénologie, dynamique C sol, routage, … ⇒ impact modéré sur climat pd

Note : Résistance à l'évaporation du sol nu (do_rsoil): "FALSE" dans les tests actuels
⇒ Rendu continue (Rsoil_scale) pour tuning final (vis à vis biais chaud printemps-estival)
(Activation ⇒ meilleur ratio transpiration/evap totale; mais possible biais chaud estival)

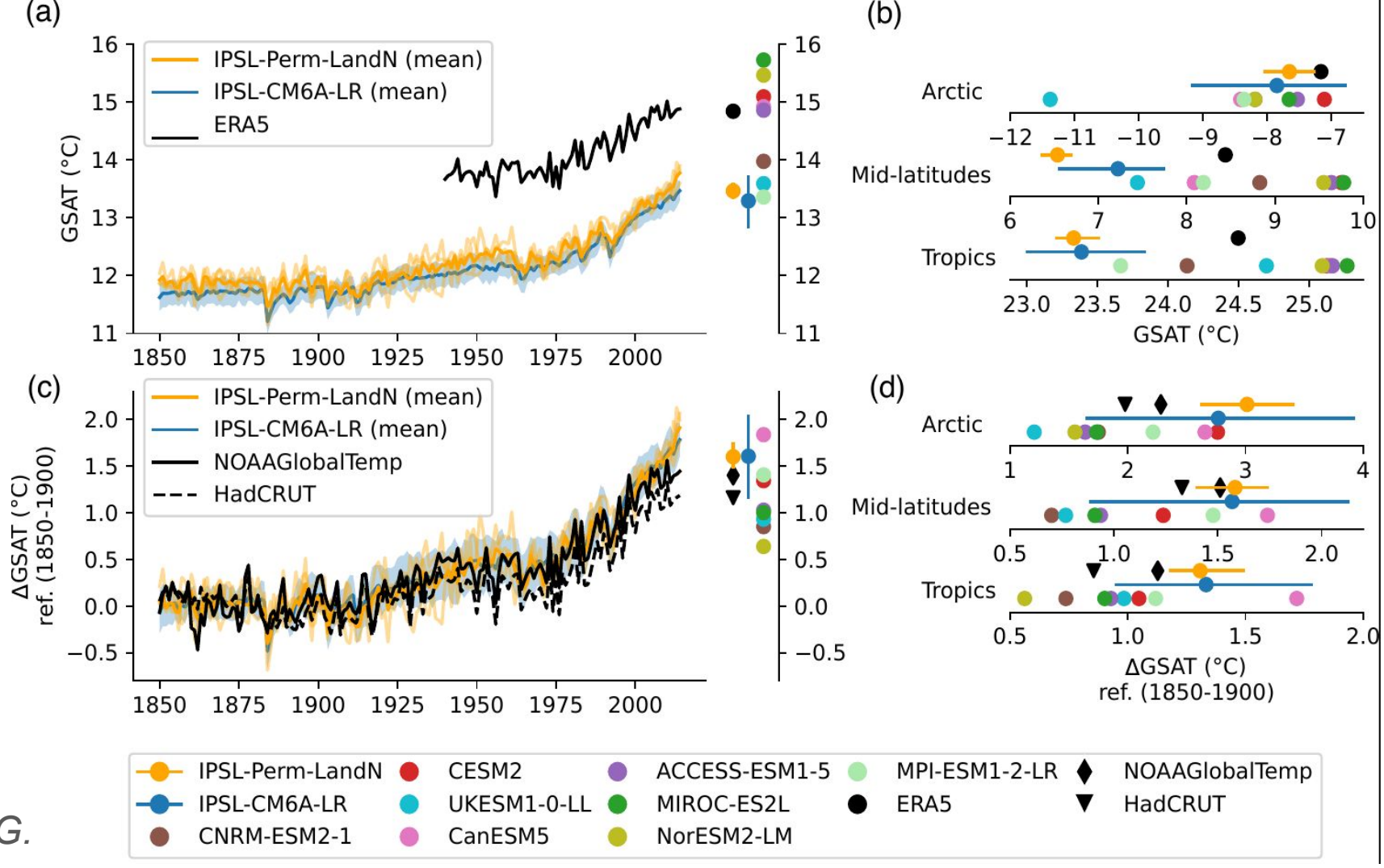
Impact of N cycle in coupled mode : historical

Global NBP



IPSL-Perm-LandN
IPSL-CM6A-LR
CNRM-ESM2-1
CESM2
UKESM1-0-LL
CanESM5
ACCESS-ESM1-5
MIROC-ES2L
NorESM2-LM
MPI-ESM1-2-LR
GCB

Thèse Remi G.

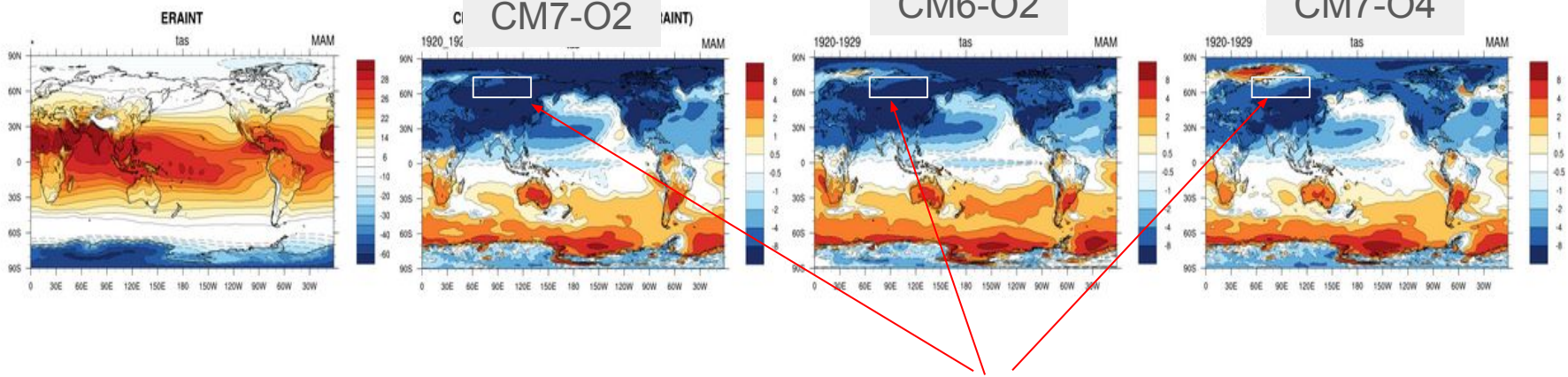

(a)
IPSL-Perm-LandN (mean)
IPSL-CM6A-LR (mean)
ERA5
GSAT (°C)
(b)
Arctic
Mid-latitudes
Tropics
GSAT (°C)
(c)
IPSL-Perm-LandN (mean)
IPSL-CM6A-LR (mean)
NOAAGlobalTemp
HadCRUT
ΔGSAT (°C)
ref. (1850-1900)
(d)
Arctic
Mid-latitudes
Tropics
ΔGSAT (°C)
ref. (1850-1900)
IPSL-Perm-LandN
IPSL-CM6A-LR
CNRM-ESM2-1
CESM2
UKESM1-0-LL
CanESM5
ACCESS-ESM1-5
MIROC-ES2L
NorESM2-LM
MPI-ESM1-2-LR
ERA5
NOAAGlobalTemp
HadCRUT

Thèse
Remi G.

Nouvelles du canal mattermost: https://mattermost.lmd.ipsl.fr/lmdz/channels/tuning-ico-lmdz

- **2M Temperature (tas) ; season = MAM ; REF = ERAINT**

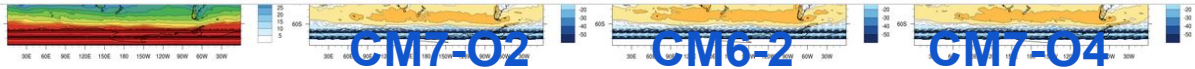
simul. PD control Arnaud



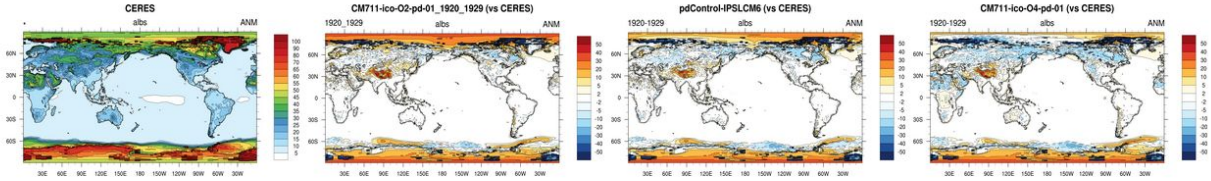
Régions boréales beaucoup plus froides au Printemps avec CM6 et CM7-O2

https://thredds-su.ipsl.fr/thredds/fileServer/tgcc_thredds/work/p86caub/C-ESM-EP/IPSLCM7/DEVT/pdControl/CM711-ico-O2-pd-01/Analyse/CM711-ico-O2-pd-01_rur

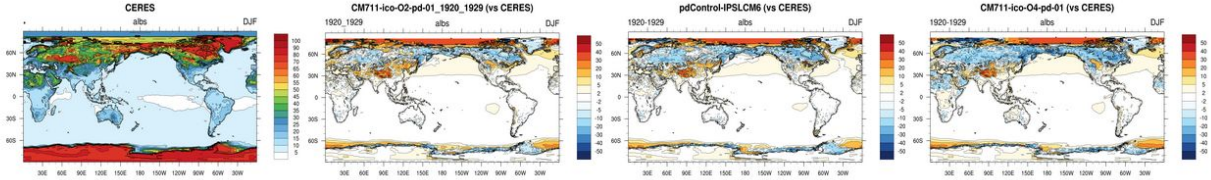
Boîte récept.999+ | r - Plot matrix rows wi… | Getting Started | Image result for cold … | David Salas y Mélia, cli… | Livre : 3 pour 2 achetés | Crise en Ukraine : la Fr… | menu | Entra con SPID



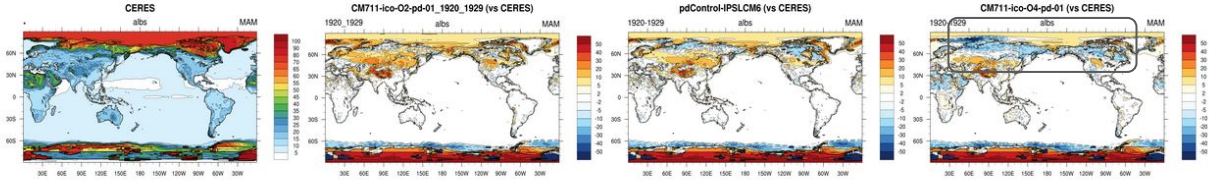
- **Surface albedo (albs) ; season = ANM ; REF = CERES**



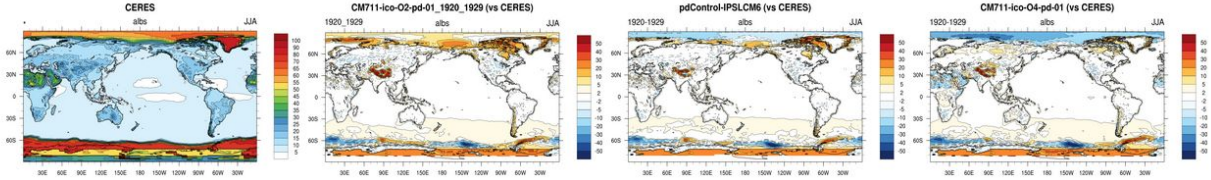
- **Surface albedo (albs) ; season = DJF ; REF = CERES**



- **Surface albedo (albs) ; season = MAM ; REF = CERES**



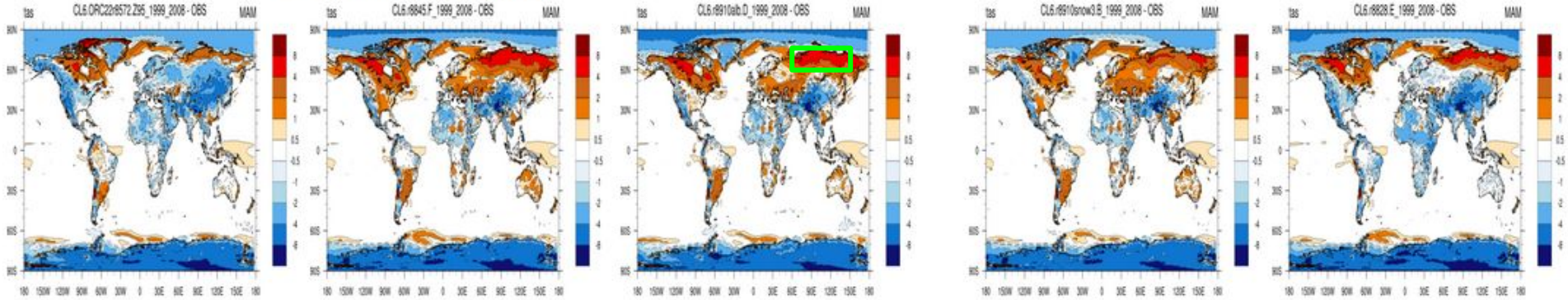
- **Surface albedo (albs) ; season = JJA ; REF = CERES**



albedo OR4 sous-estimé sur les hautes latitudes continentales surtout au Printemps

Biais chaud au printemps à la frontière continent-glace accentué avec ORC4 (un peu moins snow3). Ce n'est pas do_rsol ici.

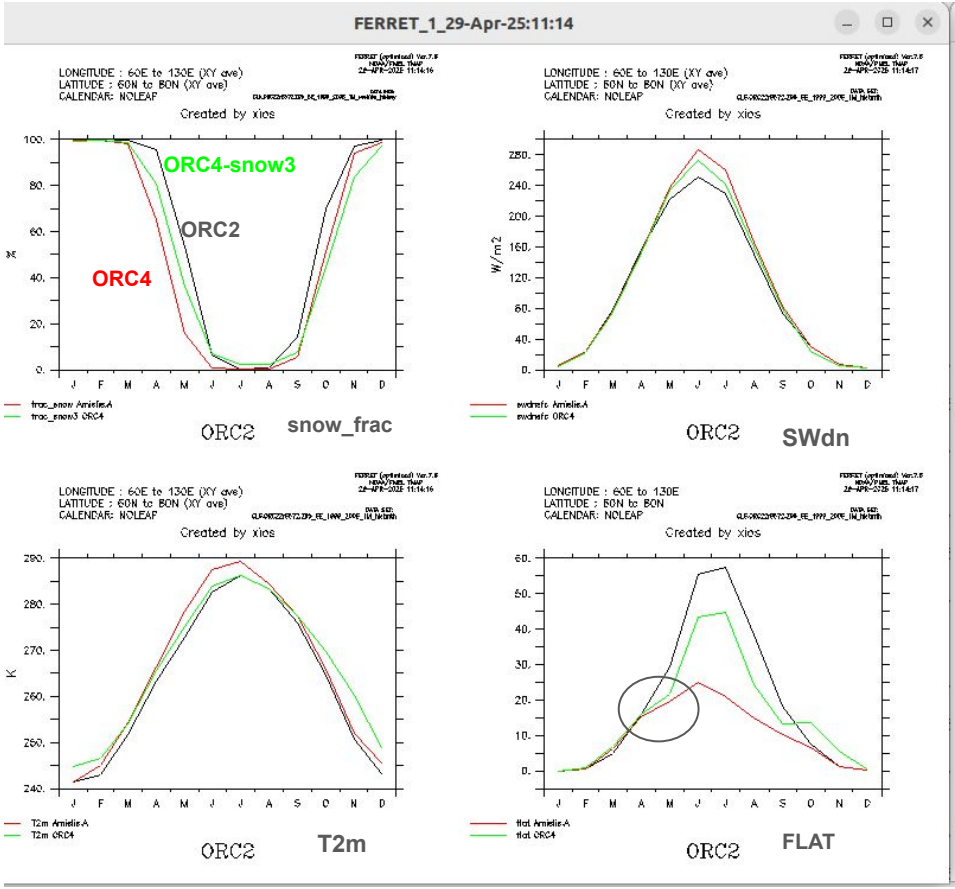
- **2M Temperature (tas)**

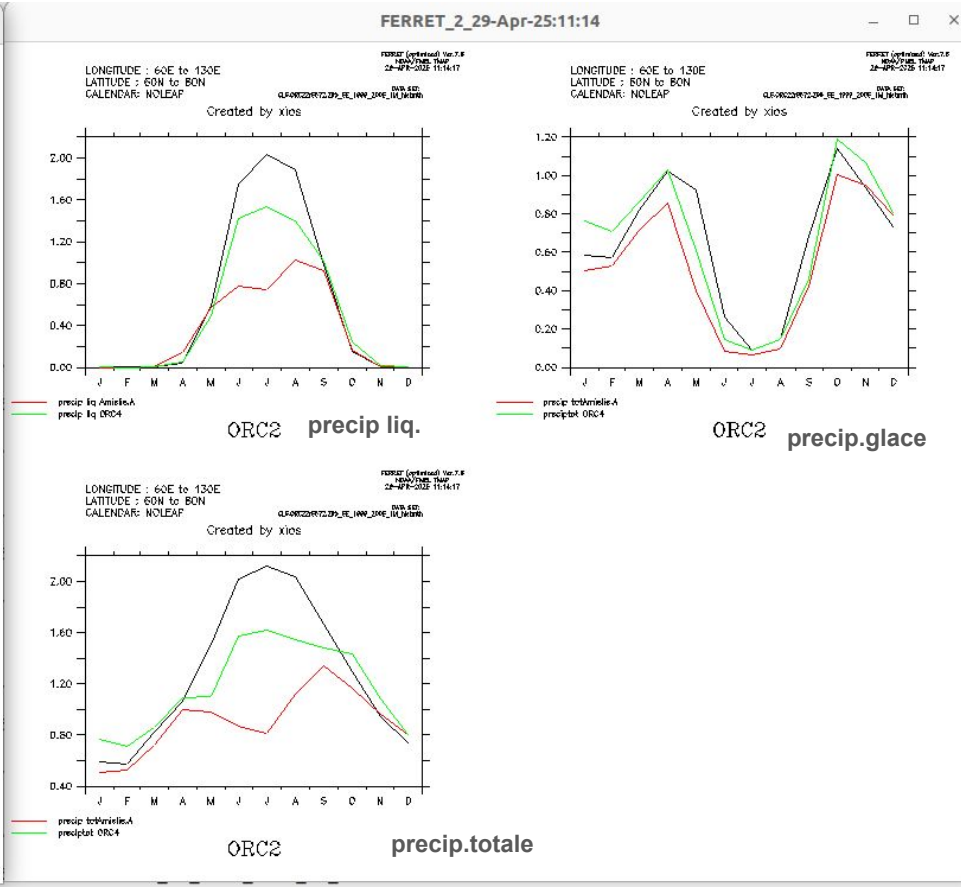


REF. ORC4 init | slope_NO_REINF=50 | snow3 | do_rsoil=n

warm biais still present

cycles saisonniers 10 ans : couplage precip(tot et solide) -snow-evap-température



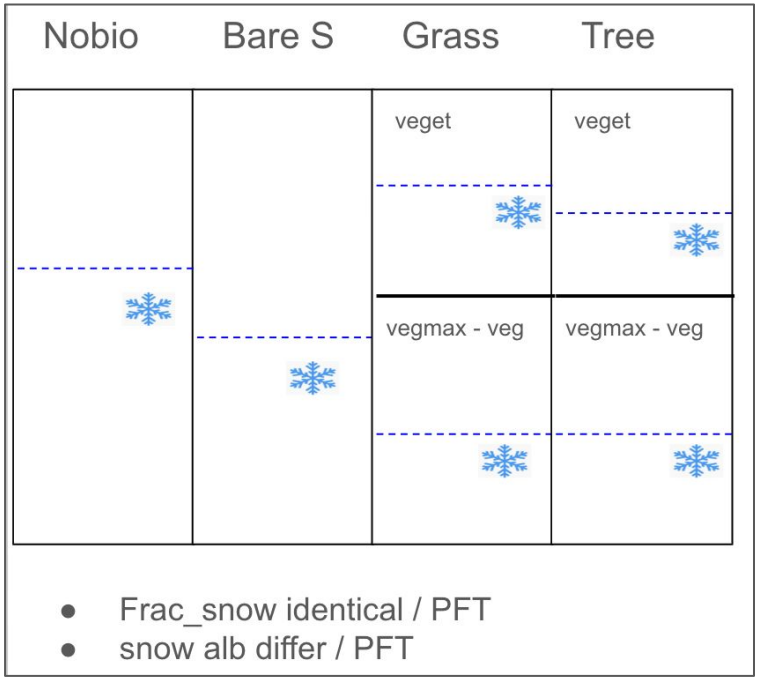


Correction du bug sur l'albedo

- Problème initial dans le calcul de l'albédo total d'un point de grille lié au merge entre partie enneigé et non-enneigé !

- ⇒ Induisait une fort biais dans zones boréales avec des albédo beaucoup trop faible ⇒ fort biais positif de température

- Pourquoi débuggage fut long ?
  On comparait essentiellement en mode forcé avec une ancienne simul ORC-V2 ayant aussi un bug lié au NoBio sur l'albédo !



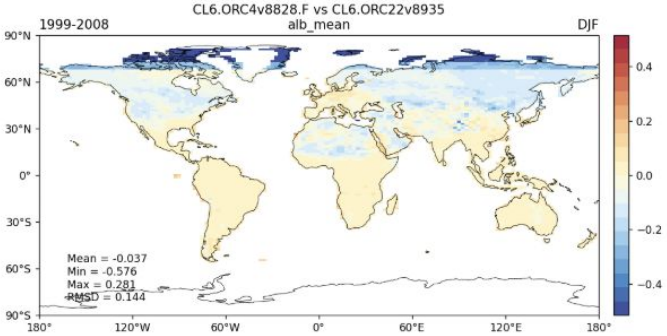
⇒ Correction initiale du bug ne fait plus fondre glace mer

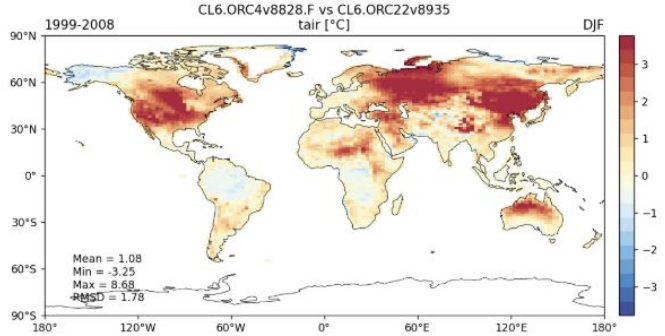
⇒ Modif plus récentes encore en cours de test

Albedo bug correction: https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

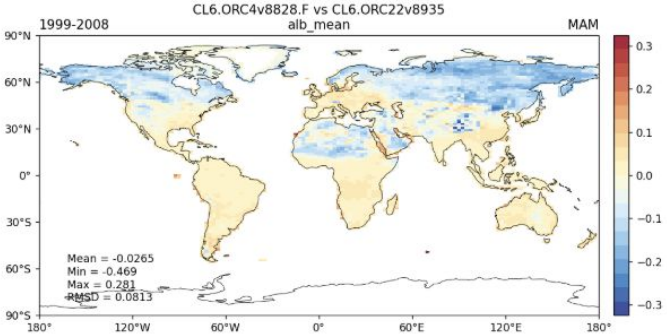
Albedo | ORCV4-bug - ORC-V2 | T2m

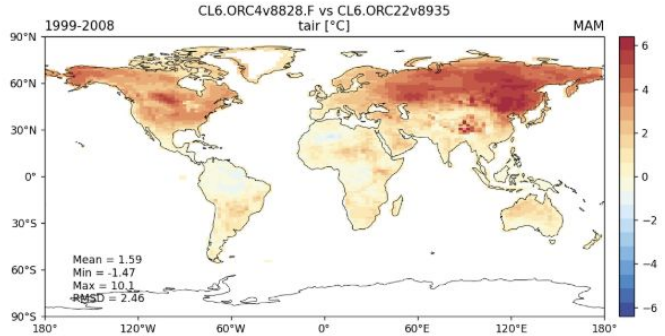
DJF





MAM

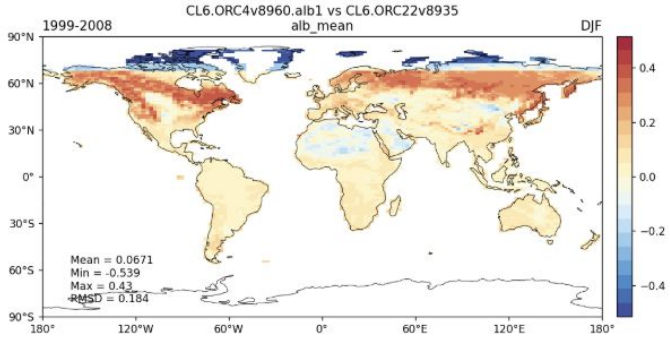


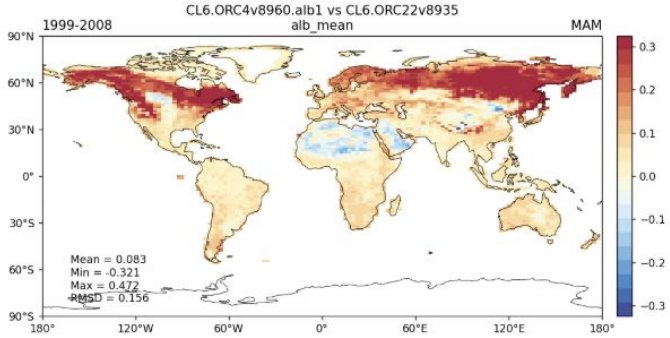


Albedo bug correction: https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

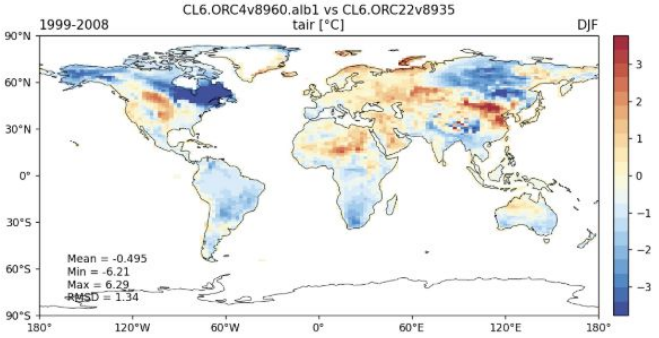
ORC-V4-Alb-cor - ORC-V2

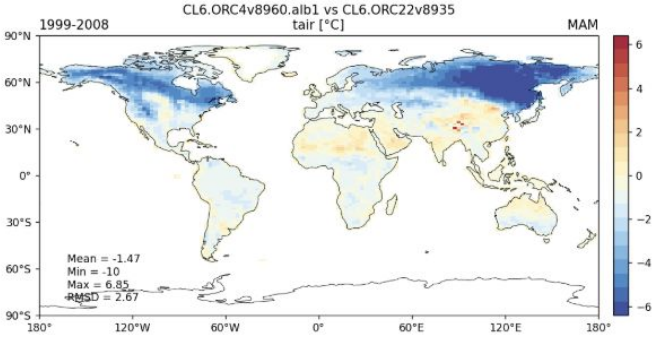
Albedo





T2m





Summary for the albedo

- **Mixing snow albedo and Plant albedo is critical** !

- **Ongoing calibration** of the overall albedo of ORC-V4 (like V2) using MODIS
  - **Technically more complicated** than ORC-V2 (2 stream RT with albedo depending on solar angle)
  - Optimization of **2 parameters per PFT** (Single scattering albedo & preferred transmission direction)
  - Optimisation of **1 Background albedo for each grid cell !**

  ⇒ To be done for this summer (end July ?)

  ⇒ But in between we can use “JRC-Tip” background albedo map and standard PFT albedo values

  ⇒ Snow parameters for the albedo have been re-tuned with ORC-V2 !

- **Work in progress to improve snow albedo scheme (Sujith + snow group)**

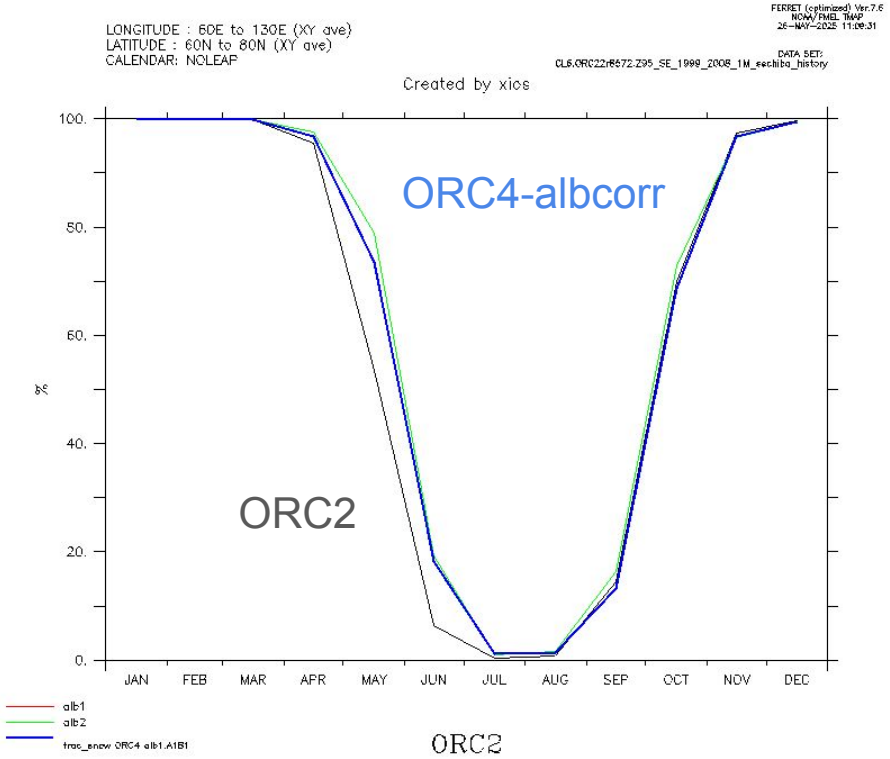
“Sea-ice lost issue” help us to better test/understand ORCV4

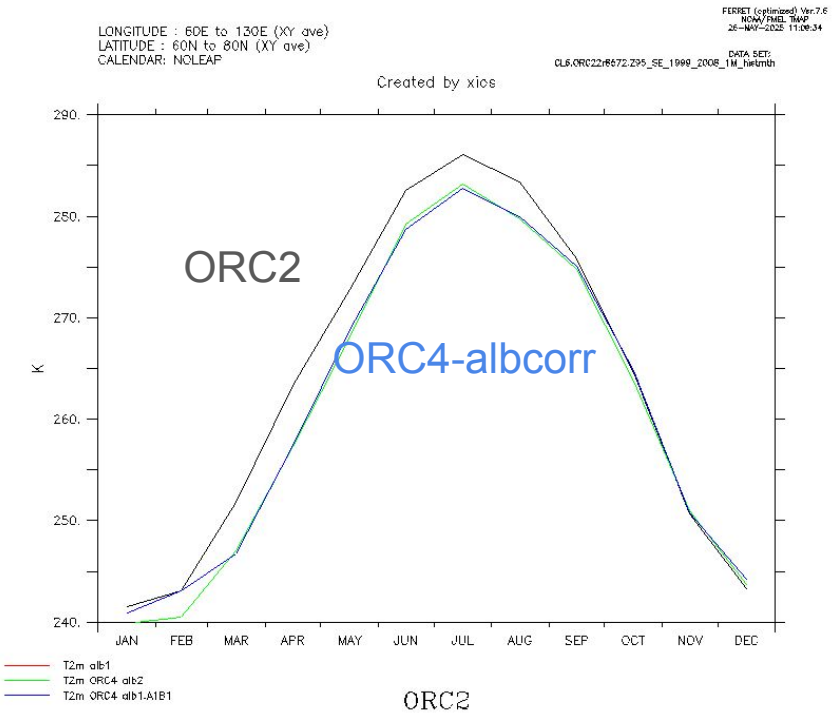
- We tested many configuration (mostly in LMDZOR and a few fully coupled)
  - Land cover (using old CMIP6 LC)
  - Soil texture : from Zobler (3 classes) => USDA (12 classes)
  - River water discharge (hosing)
  - Change of snow layer model (3 vs 12)
  - Change of soil C insulation (Ok_moss, Soil C max)
  - Test with different value Rsoil_scale (do_rsoil): 0 vs 1
  - Test with reduced soil water drainage
  - Test with increased soil water infiltration

- ⇒ NO significant impact on Sea-ice lost issue !

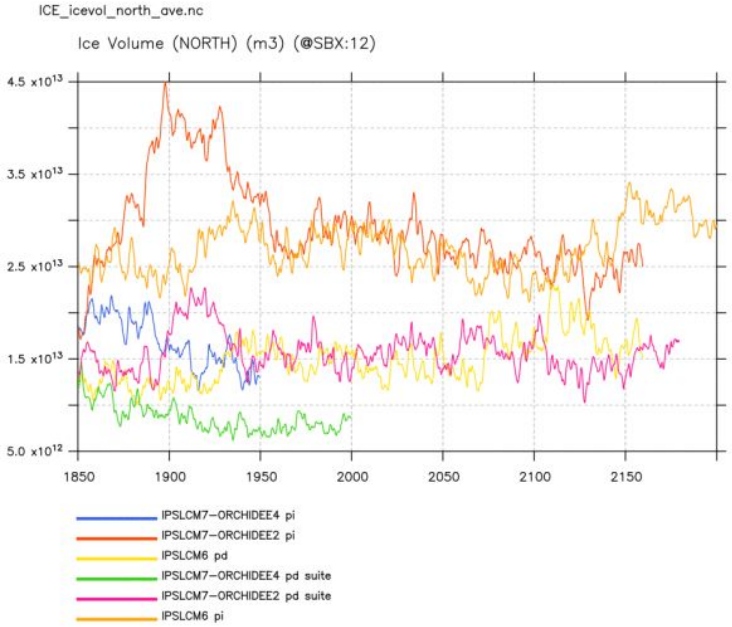
- ⇒ BUT some impacts on T2m regionally !
  We need to further / better valorize these tests for the final ORC-V4 physical tunning !

LMDZOR4: albedo neige corrigé (PP)

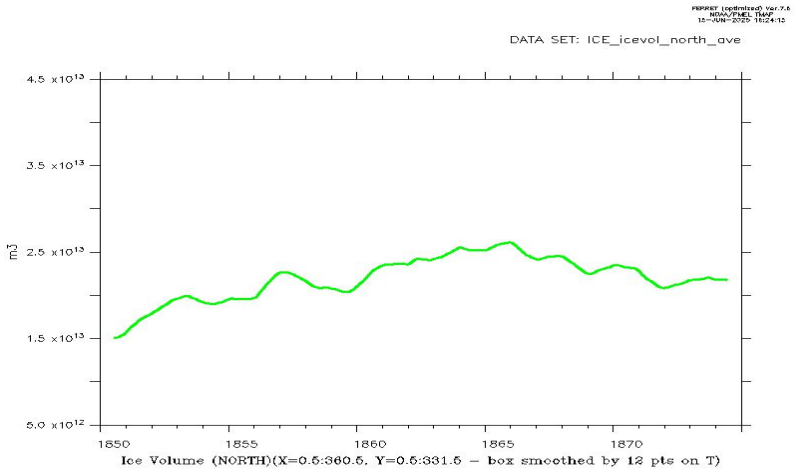




Ice volume



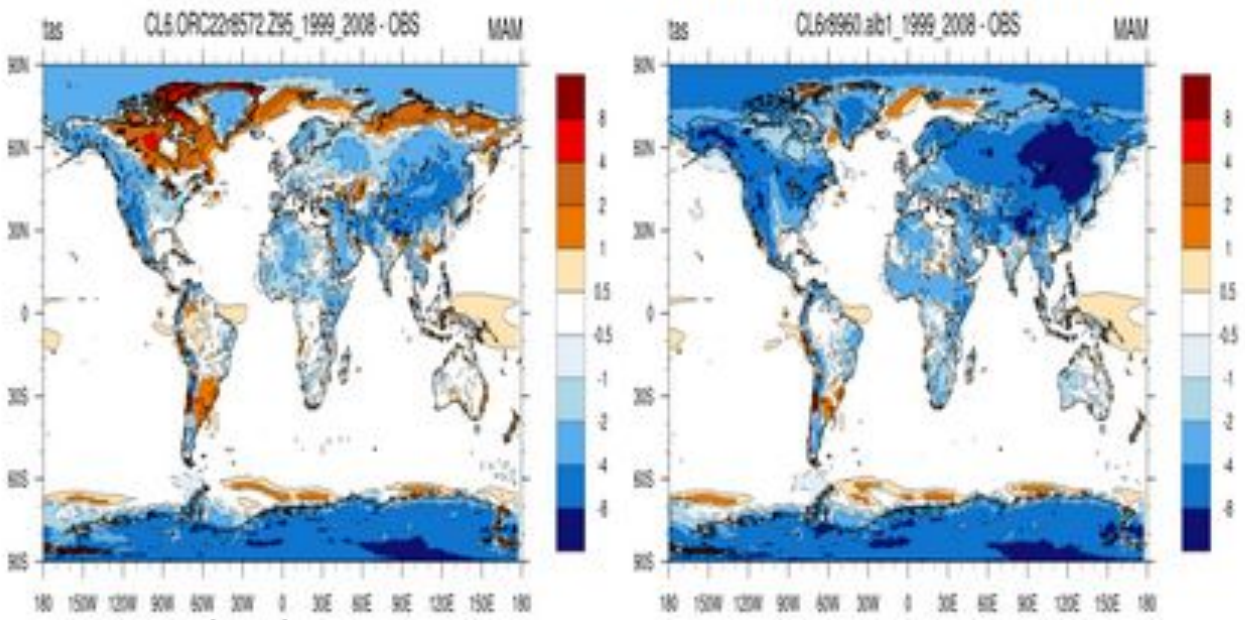
early test Arnaud



preliminary (test Josefine)

MAM

• **2M Temperature (tas)**



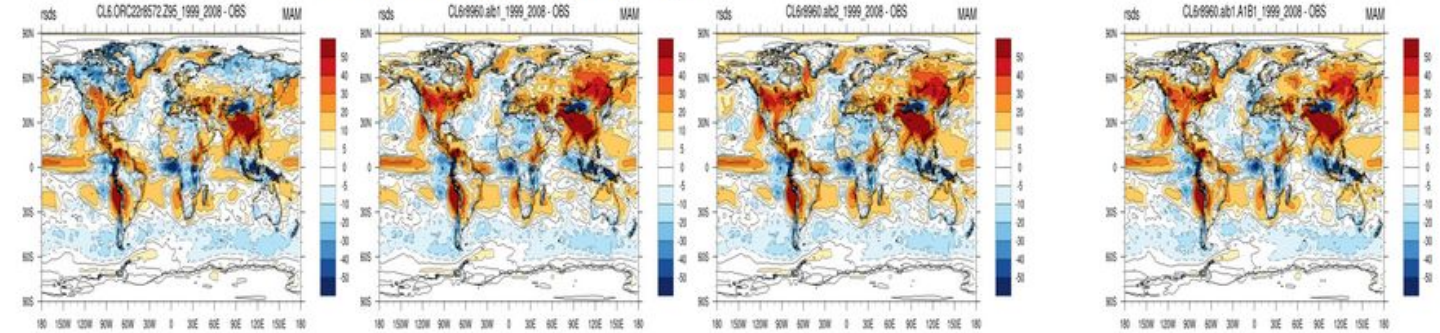
ORC2

ORC4 - Alb corrigé

bug albedo moyen ORC4 avec neige 12 couches corrigé

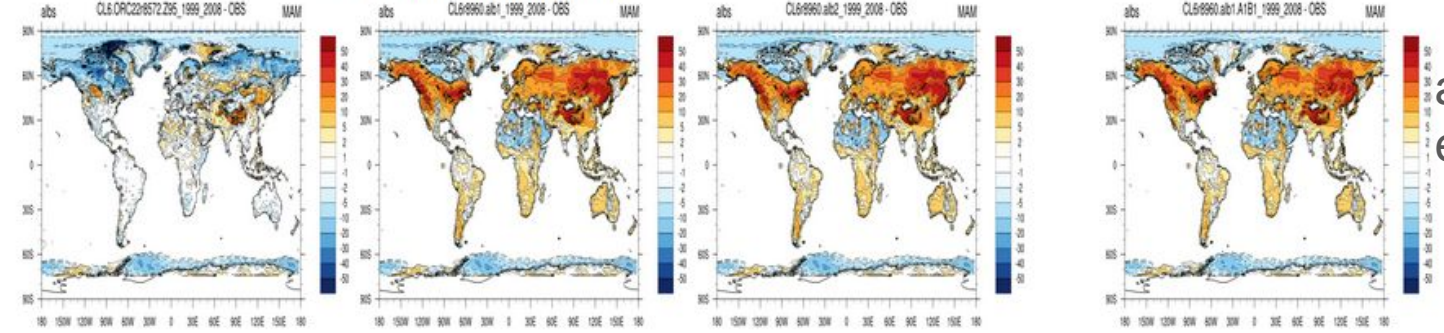
Peut être un peu trop froid y compris en été

- **Rad. SW Down Sfce (rsds)**



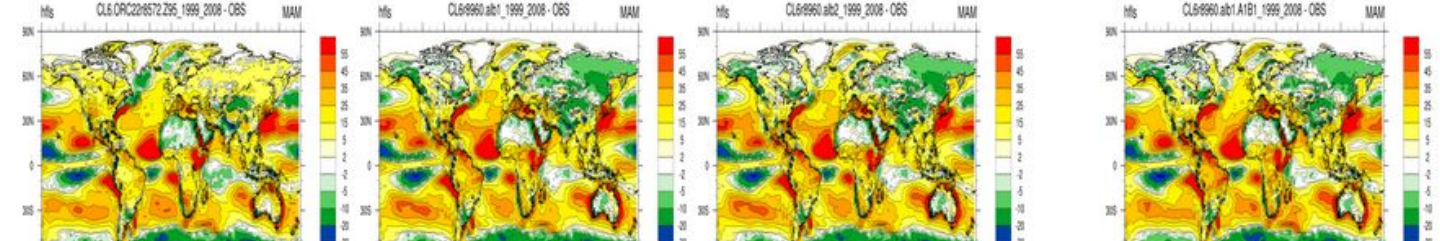
SWdn plus (trop?) élevé

- **Surface albedo (albs)**



albedo plus (trop?) élevé

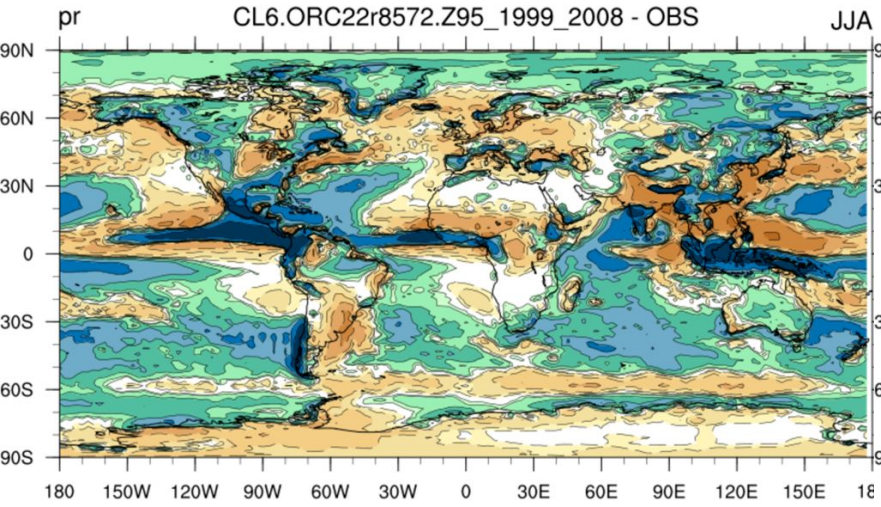
- **Latent heat flux (hfls)**



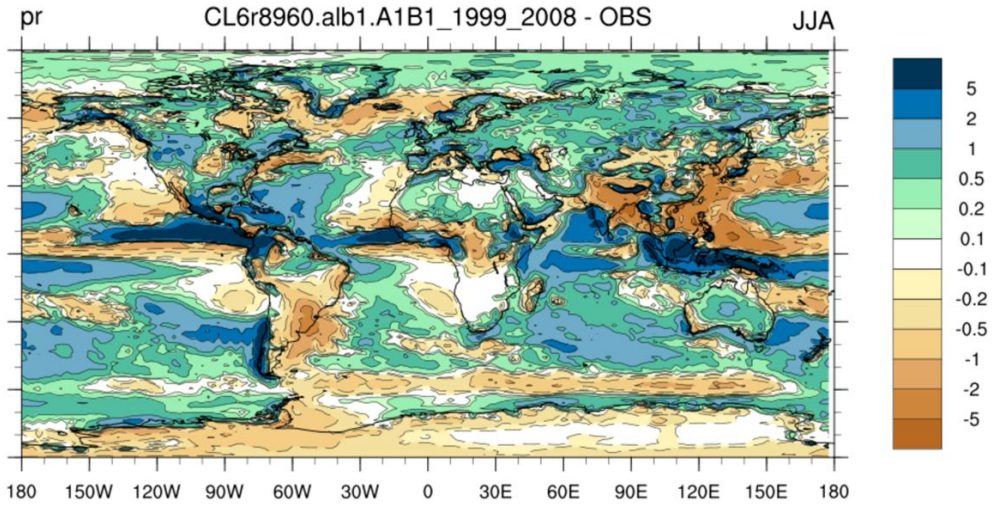
moins d'évap.

Biais de precipitation

ORC2



ORC4 (LMDZOR 95 niveau new alb)

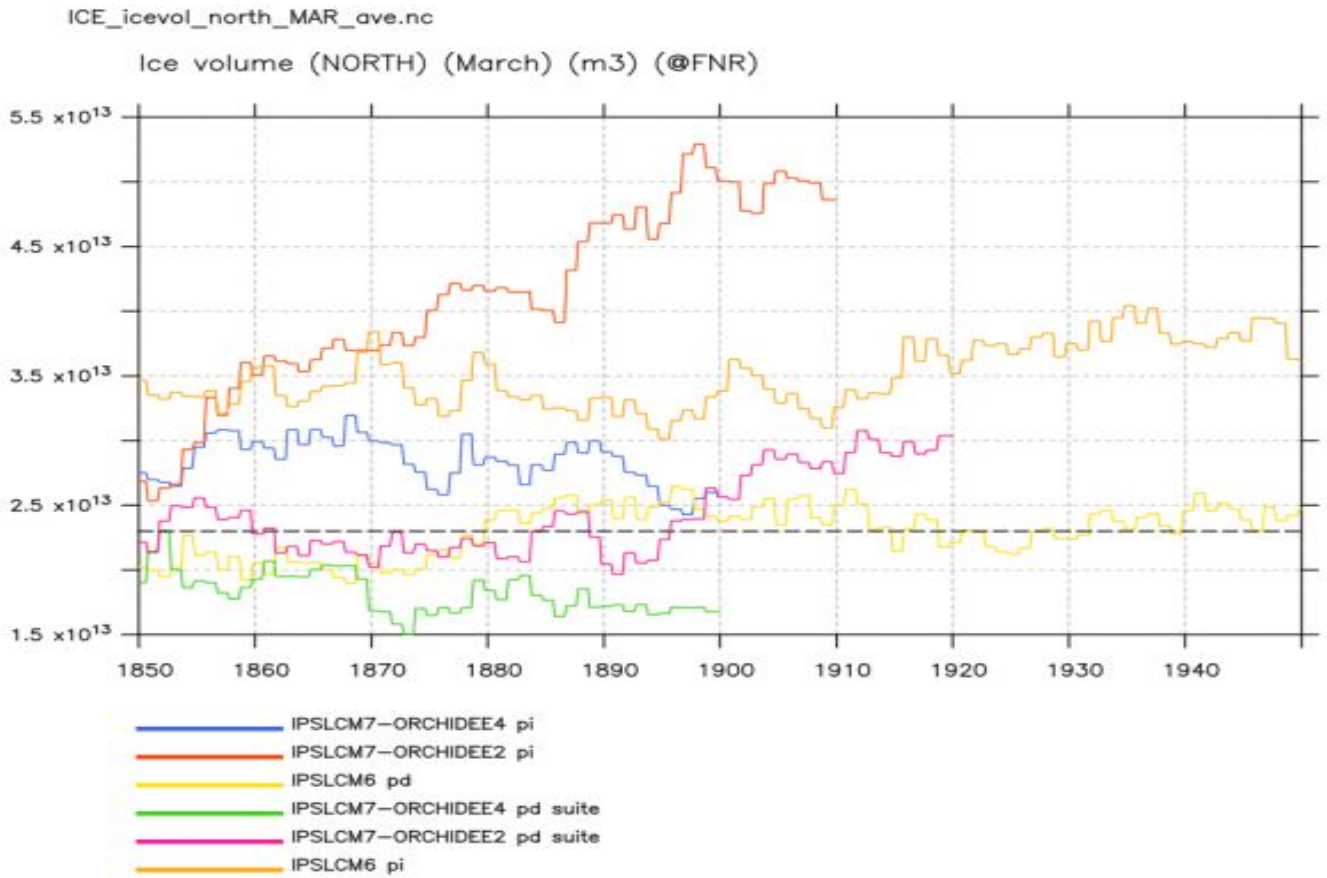


Future steps of ORC-V4 for CMIP7-FT

- **Optimization of the albedo**
- **Update of the Land Cover** forcing (according to CMIP7)
- **Investigation** of the potential **High Lat. summer warm biais** ?
  - Given the new “stomatal conductance” (with more Transpiration)
  - Given test to enhance soil water content : Decrease drainage and/or Increase infiltration
  - Potential adjustment of soil thermal insulation (through Organic Matter)
  - Use “Rsoil_scale” (do_rsoil) for final adjustment !
- **Test with irrigation** (likely to be activated for CMIP-7)
- **Calibration of the global Net Carbon budget**
  - Potential update of Tree mortality to have the “right” Net C Uptake
  - Potential change of the tropical grass / crop phenology (still some issues)
  - Update of the decomposition of wood carbon pools
  - Potential tuning of Soil N / C dynamics
- and potentially other fine tuning…
- **A full complete technical description planned for end 2025 + Article**
- **BUT no FIRE ; no wetland CH4 ; no floodplain ? ; still “poor crop” model !**
- **A lot of land-surface/atmosphere interactions to be investigated yet**

Pages to share plots/diagnostics on the adjustment of ORCHIDEE for CMIP7-FT coupled simulations

ce qui est inquiétant pour le couplé avec ORC4: **Ice Volume**



T2m diagnostic of LMDZOR last simulations (rev 8828) : CL6 (SST clim)

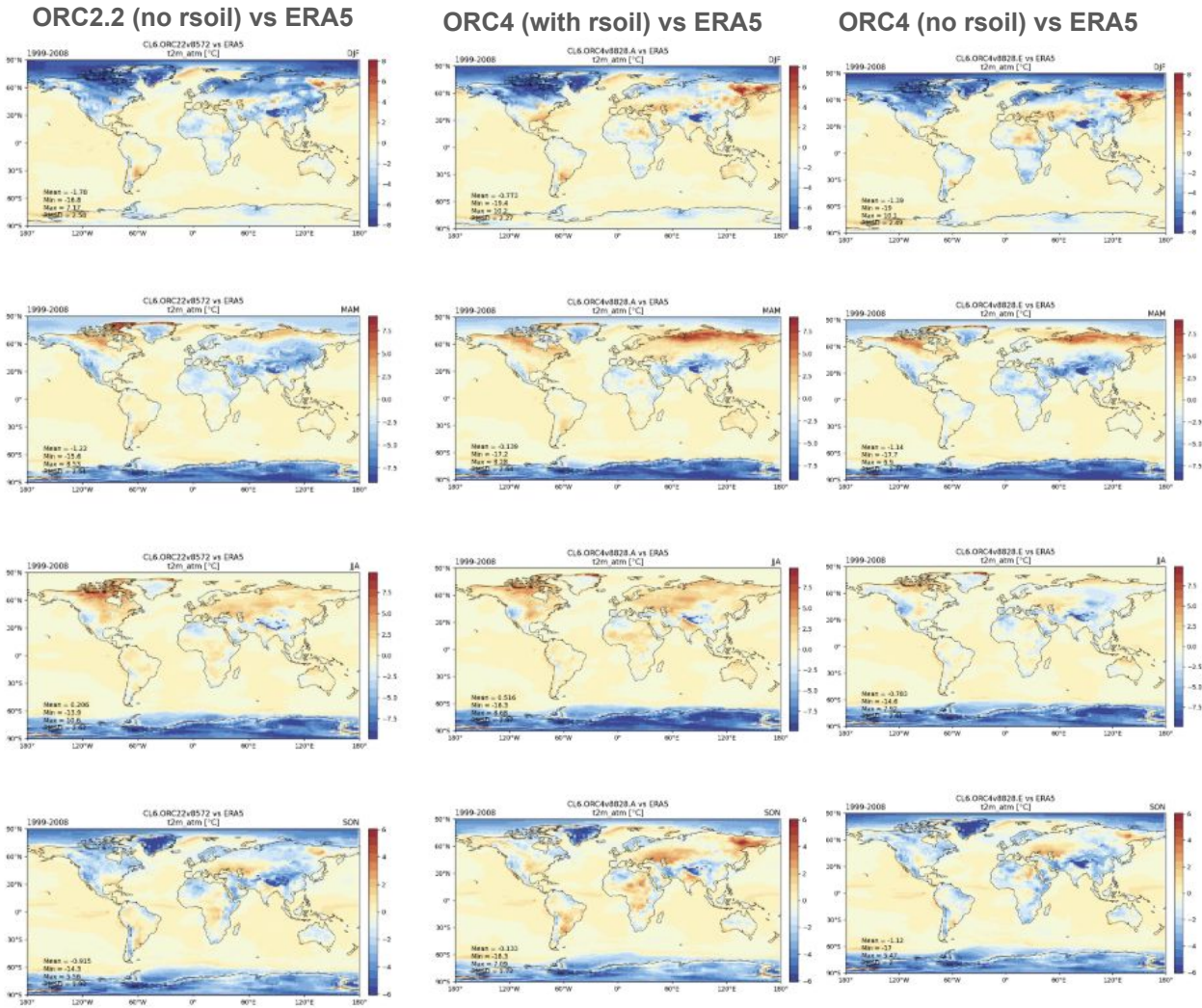
https://orchidas.lsce.ipsl.fr/mapper?set=rev.8828&mode=CL6&group=5&freq=1&type=1

⇒ ORC2 est trop froid en hiver dans arctique

⇒ ORC4 est mieux

⇒ ORC4 à un biais chaud marqué en MAM et diffus en JJA

⇒ Do_rsoil = NO réduit fortement le biais chaud été !



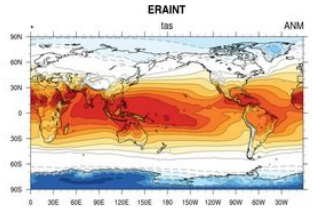
T2M en “full couplé (LMDZOR + NEMO)” RS= sans do_rsoil ;

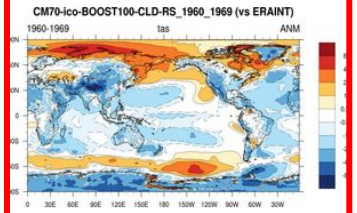
https://thredds-su.ipsl.fr/thredds/fileServer/tgcc_thredds/work/p86caub/C-ESM-EP/IPSLCM7/DEVT/pdControl/CM70-ico-BOOST100-CLD-RS/Analyse/CM70-ico-BOOST100-CLD-RS_run_comparison/Atmosphere_Surface/atlas_Atmosphere_Surface_CM70-ico-BOOST100-CLD-RS_run_comparison.html

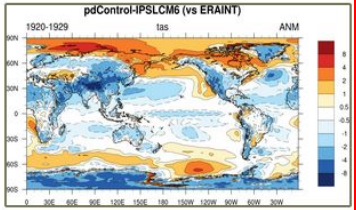
OR4-NO_dorsoil

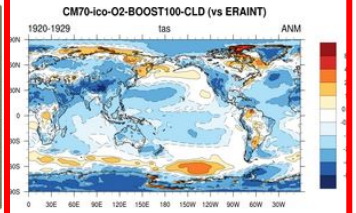
OR2

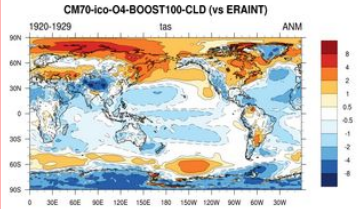
- **2M Temperature (tas) ; season = ANM ; REF = ERAINT**



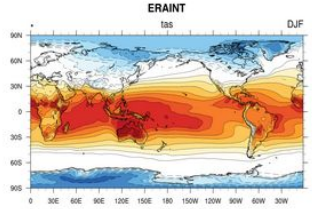


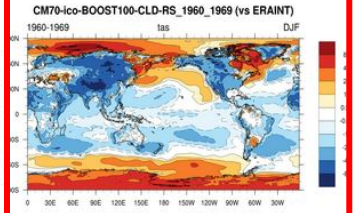


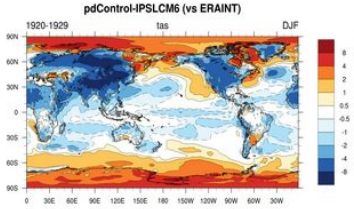


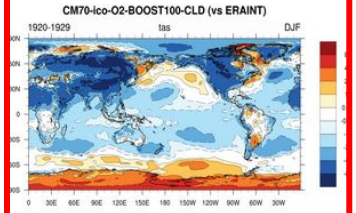


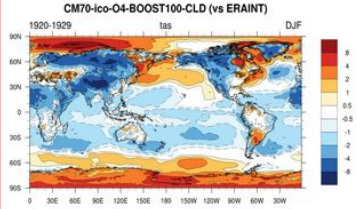
- **2M Temperature (tas) ; season = DJF ; REF = ERAINT**



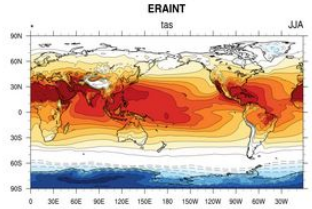


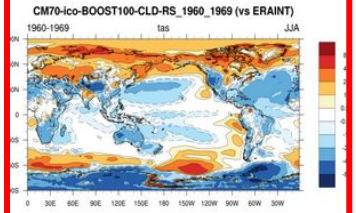


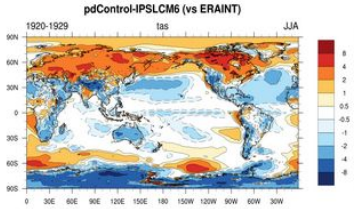


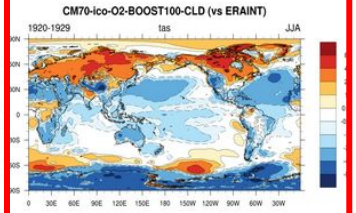


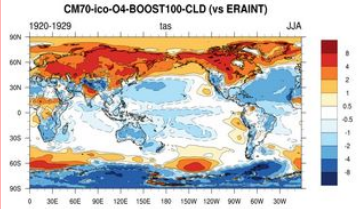
- **2M Temperature (tas) ; season = JJA ; REF = ERAINT**



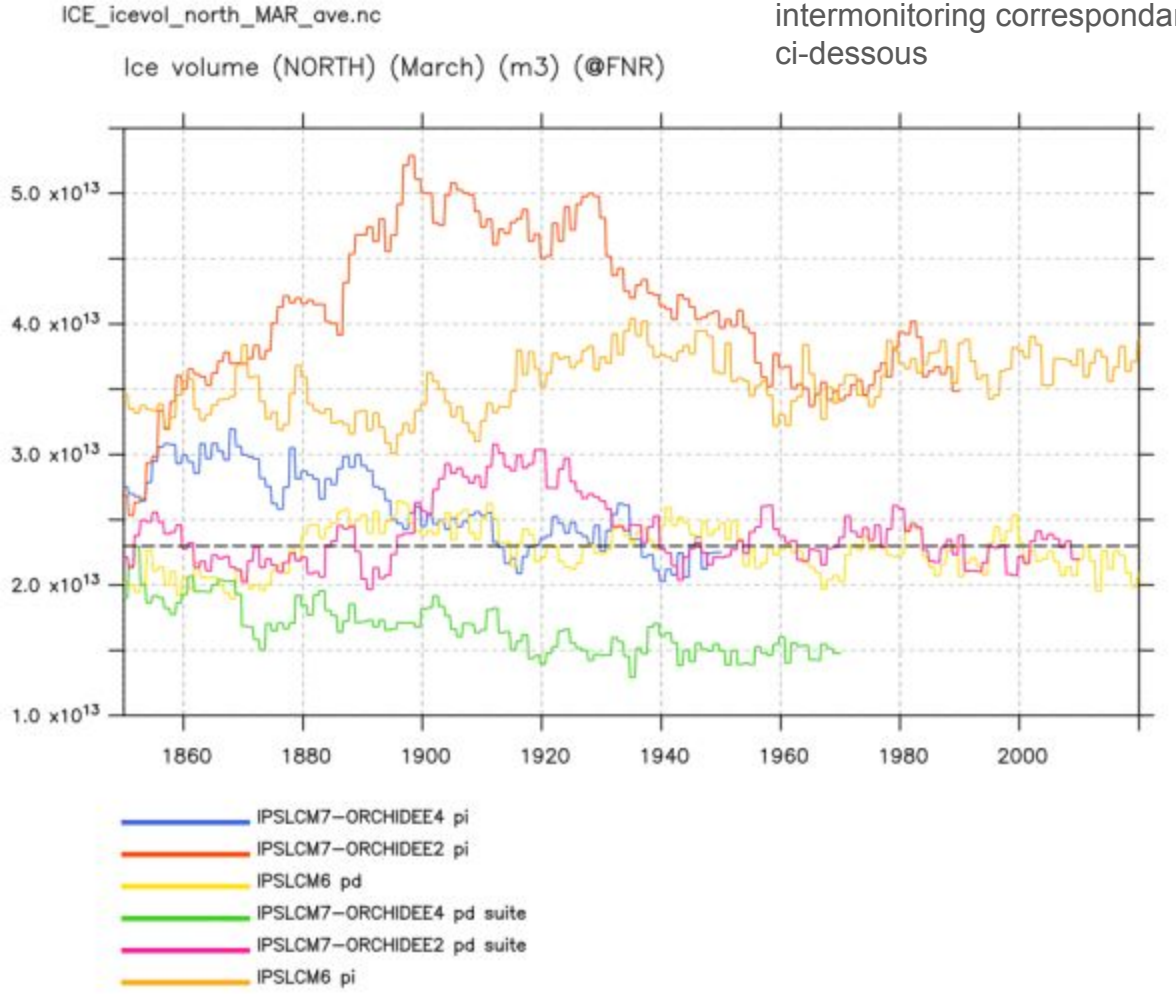








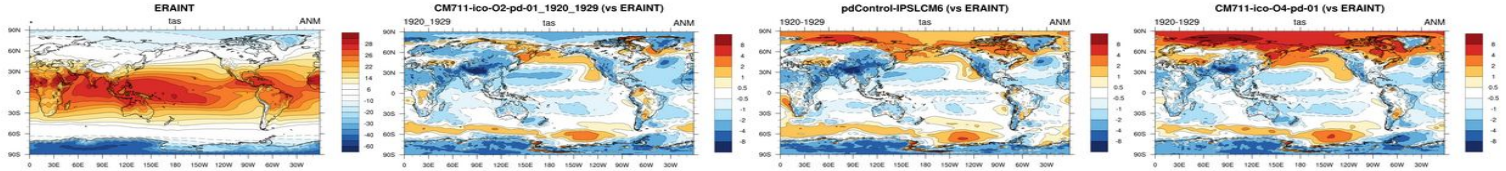
intermonitoring correspondant aux 2 planches ci-dessous



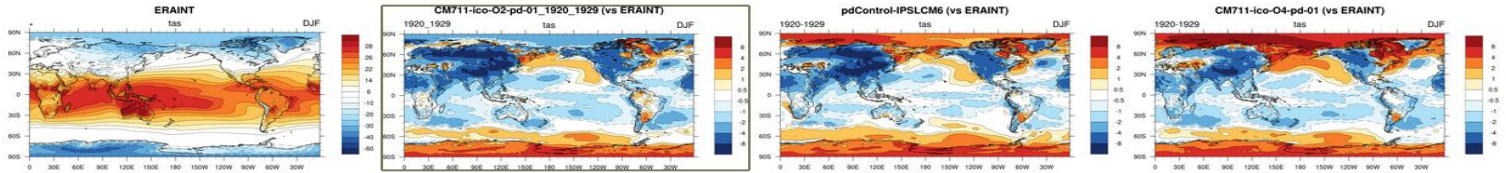
https://thredds-su.ipsl.fr/thredds/fileServer/tgcc_thredds/work/p86caub/C-ESM-EP/IPSLCM7/DEVT/pdControl/CM711-ico-O2-pd-01/Analyse/CM711-ico-O2-pd-01_r

Boîte récept.999+ | r - Plot matrix rows wi... | Getting Started | Image result for cold ... | David Salas y Mélia, cli... | Livre : 3 pour 2 achetés | Crise en Ukraine : la Fr... | menu | Entra con SPID

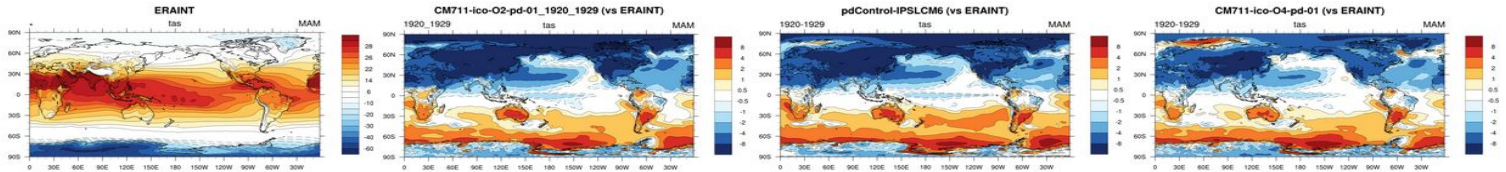
- **2M Temperature (tas) ; season = ANM ; REF = ERAINT**



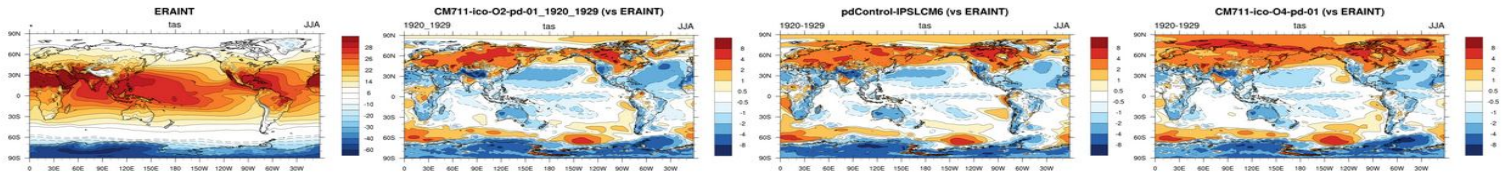
- **2M Temperature (tas) ; season = DJF ; REF = ERAINT**



- **2M Temperature (tas) ; season = MAM ; REF = ERAINT**



- **2M Temperature (tas) ; season = JJA ; REF = ERAINT**

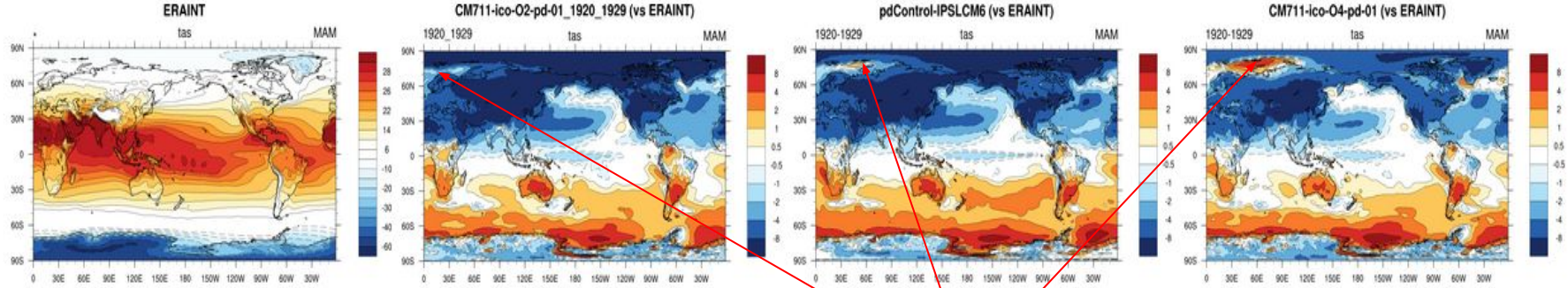


OR-4 sans do_rsoil

Nouvelles du canal mattermost: https://mattermost.lmd.ipsl.fr/lmdz/channels/tuning-ico-lmdz

- **2M Temperature (tas) ; season = MAM ; REF = ERAINT**

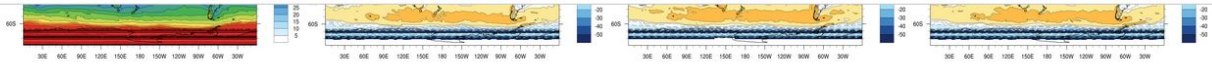
simul. PD control Arnaud



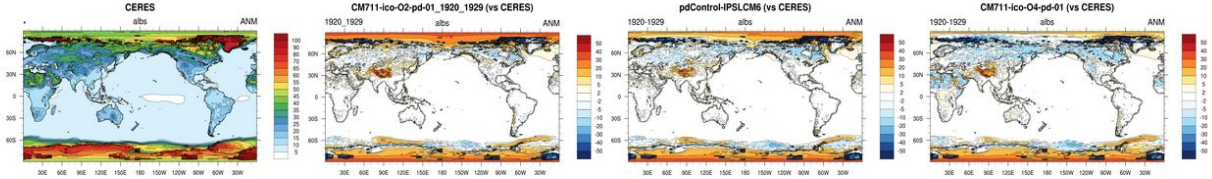
zone plus chaude sur la glace que l'environnement pour toutes les config. , comme CM7icoO4 est plus chaude en général cette zone est aussi plus chaude, peut être un impact sur la fonte de la glace de mer (comment?)

https://thredds-su.ipsl.fr/thredds/fileServer/tgcc_thredds/work/p86caub/C-ESM-EP/IPSLCM7/DEVT/pdControl/CM711-ico-O2-pd-01/Analyse/CM711-ico-O2-pd-01_rur

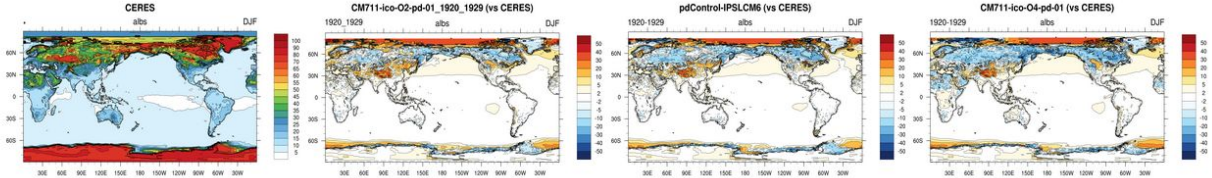
Boîte récept.999+ | r - Plot matrix rows wi… | Getting Started | Image result for cold … | David Salas y Mélia, cli… | Livre : 3 pour 2 achetés | Crise en Ukraine : la Fr… | menu | Entra con SPID



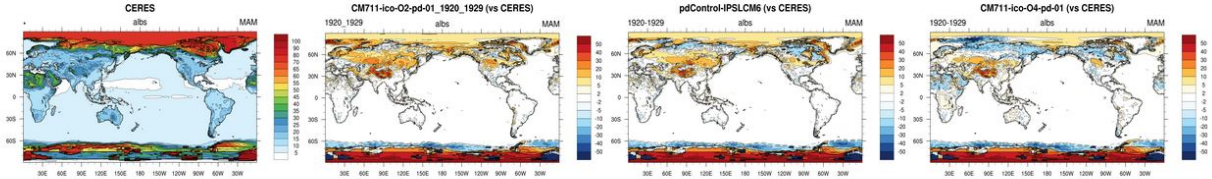
- **Surface albedo (albs) ; season = ANM ; REF = CERES**



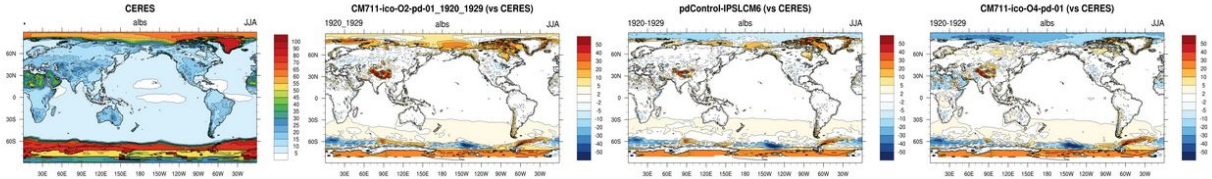
- **Surface albedo (albs) ; season = DJF ; REF = CERES**



- **Surface albedo (albs) ; season = MAM ; REF = CERES**



- **Surface albedo (albs) ; season = JJA ; REF = CERES**



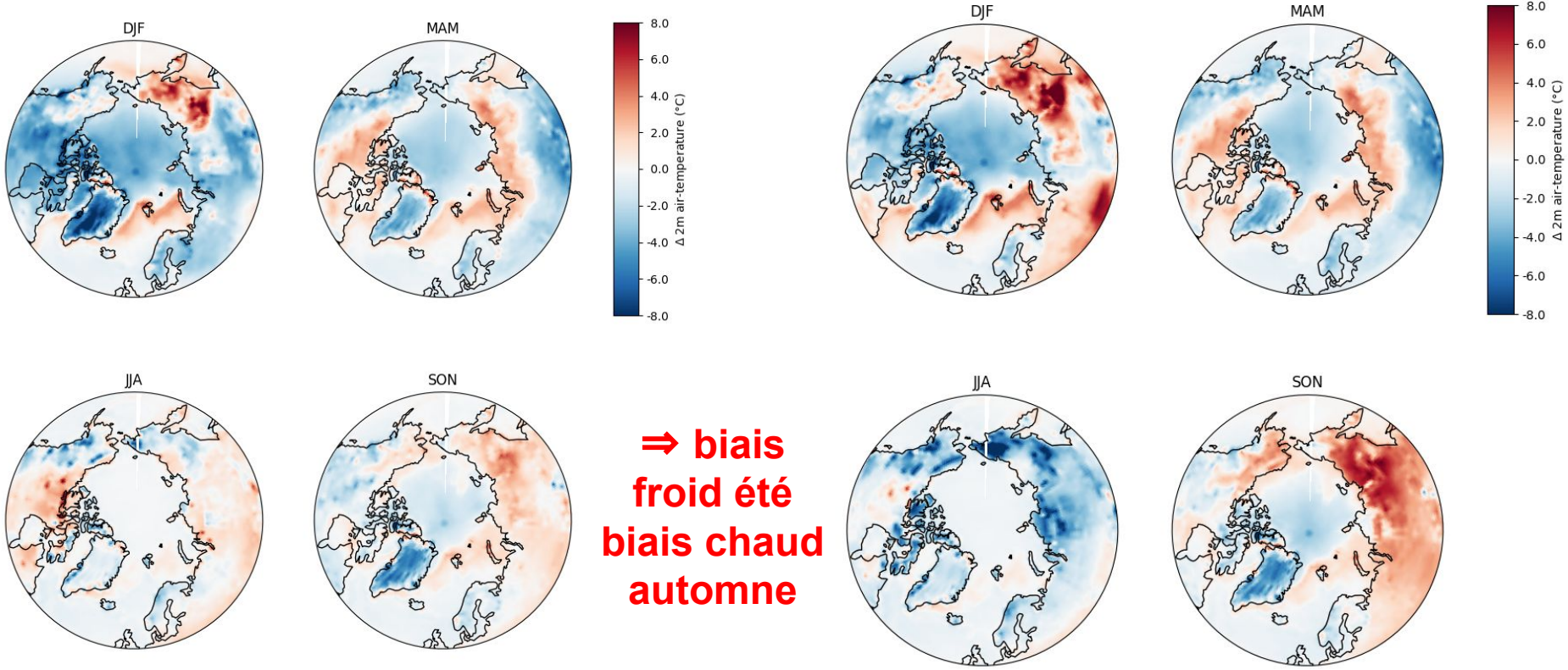
albedo OR4 sous-estimé sur les hautes latitudes continentales (ne sais pas si fiable sur la glace de mer)

T2M en LMDZOR de Rémi Gaillard : Avec ORC-V3 / LMDZ-CM6LR (CL6 exp)

Ref: CMIP6 - like (sans gel)

Gel du sol SANS isolation

T2m: Model - ERA5
(1995-2004)



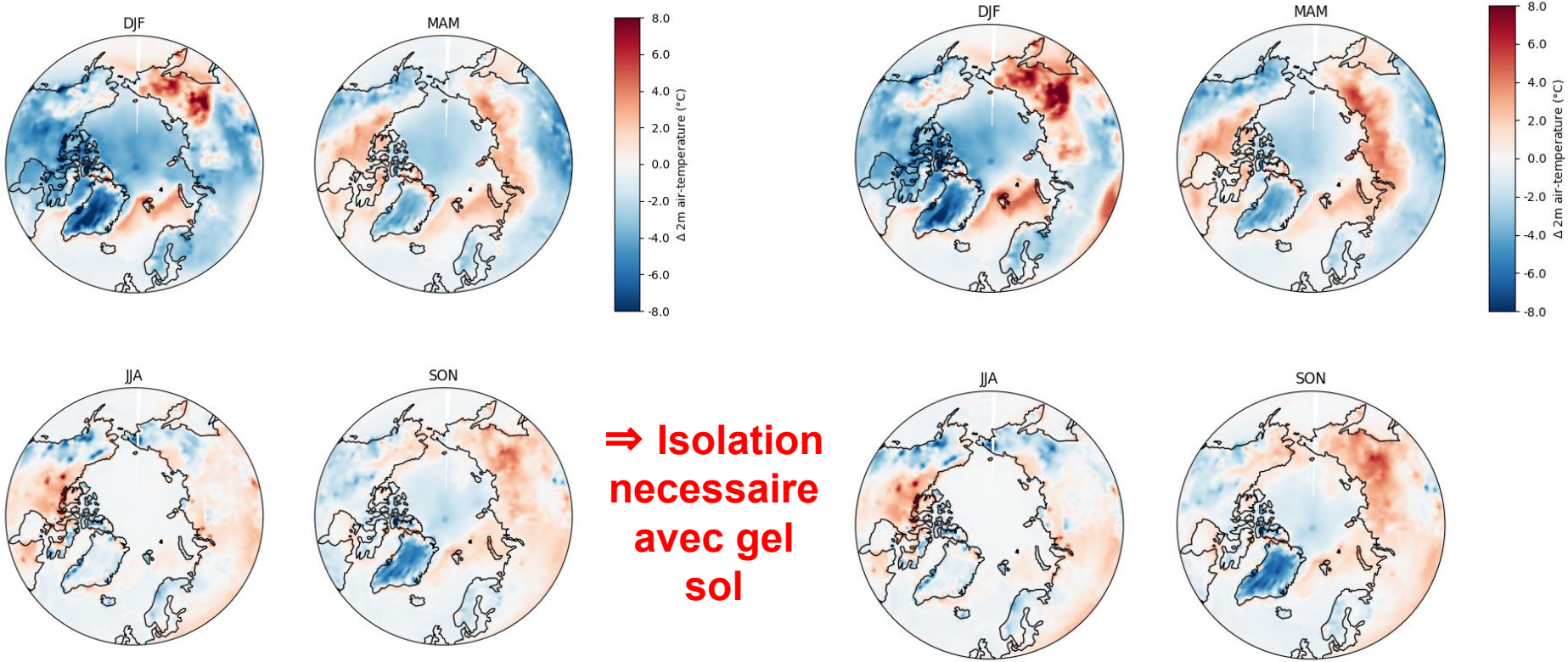
⇒ biais froid été
biais chaud automne

T2M en LMDZOR de Rémi Gaillard : Avec ORC-V3 / LMDZ-CM6LR (CL6 exp)

Ref: CMIP6 - like (sans gel)

Gel du sol AVEC isolation

T2m: Model - ERA5
(1995-2004)



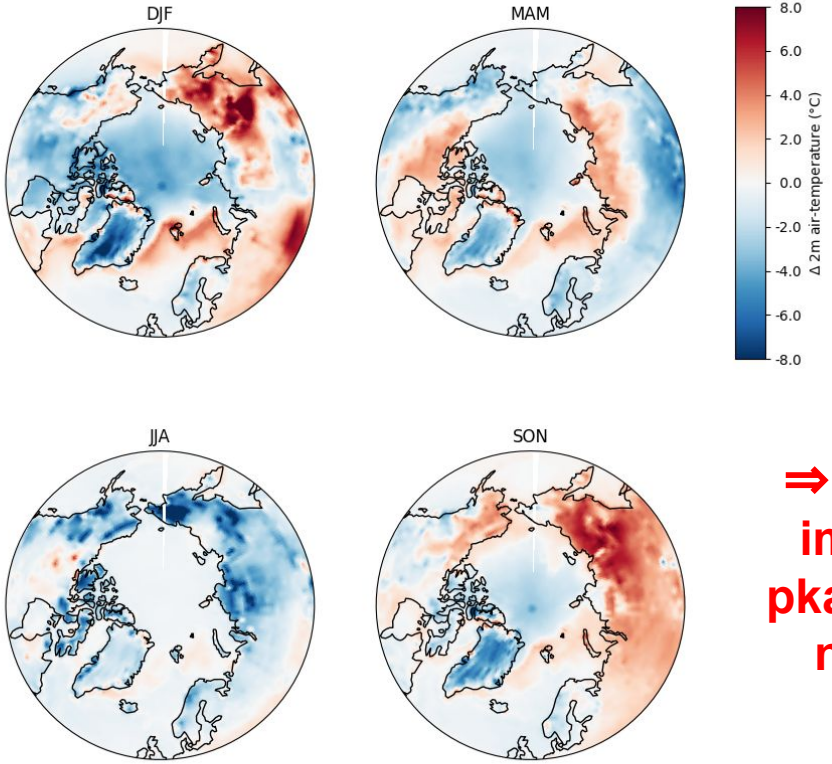
⇒ Isolation necessaire avec gel sol

T2M en LMDZOR de Rémi Gaillard : Avec ORC-V3 / LMDZ-CM6LR (CL6 exp)

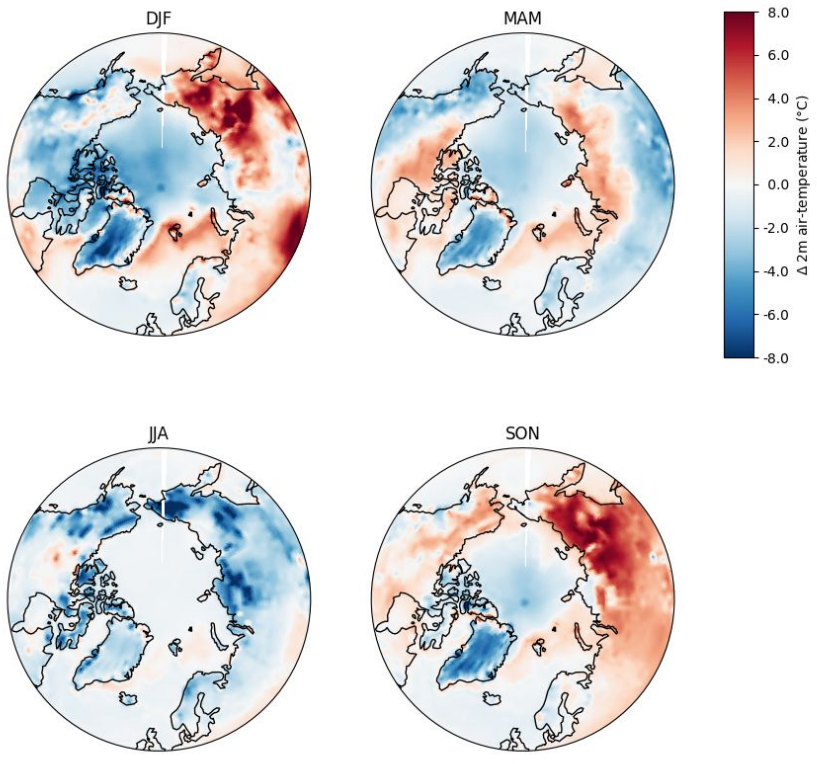
Gel du sol SANS isolation

T2m: Model - ERA5
(1995-2004)

Gel du sol SANS isolation
+ Isolation neige x3 (pkappa_snow / 3)



⇒ faible impact pkappa_snow !

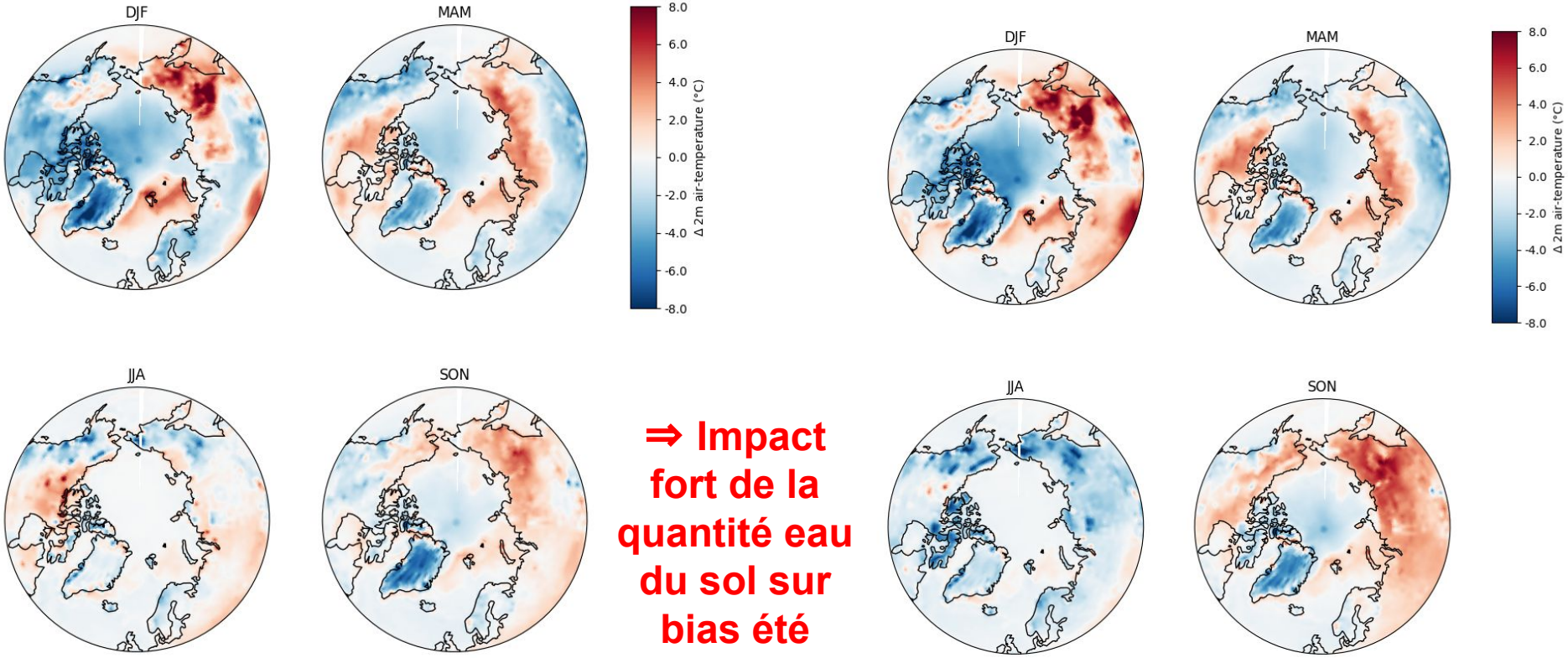


T2M en LMDZOR de Rémi Gaillard : Avec ORC-V3 / LMDZ-CM6LR (CL6 exp)

Gel du sol AVEC isolation

T2m: Model - ERA5
(1995-2004)

Gel du sol Avec Isolation
+ Porosité sol augmentée (Peat)



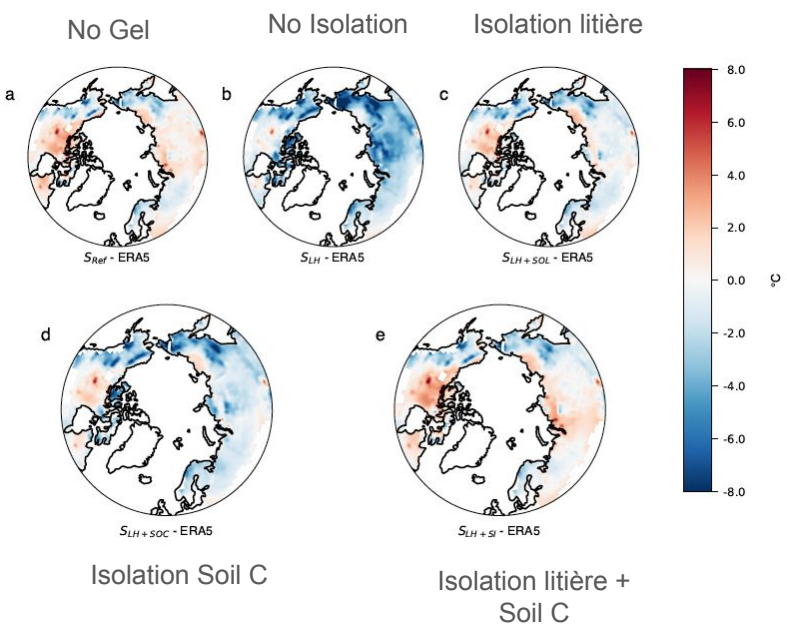
⇒ Impact fort de la quantité eau du sol sur bias été

T2M en LMDZOR de Rémi Gaillard : Avec ORC-V3 / LMDZ-CM6LR (CL6 exp)

Juin - Juillet

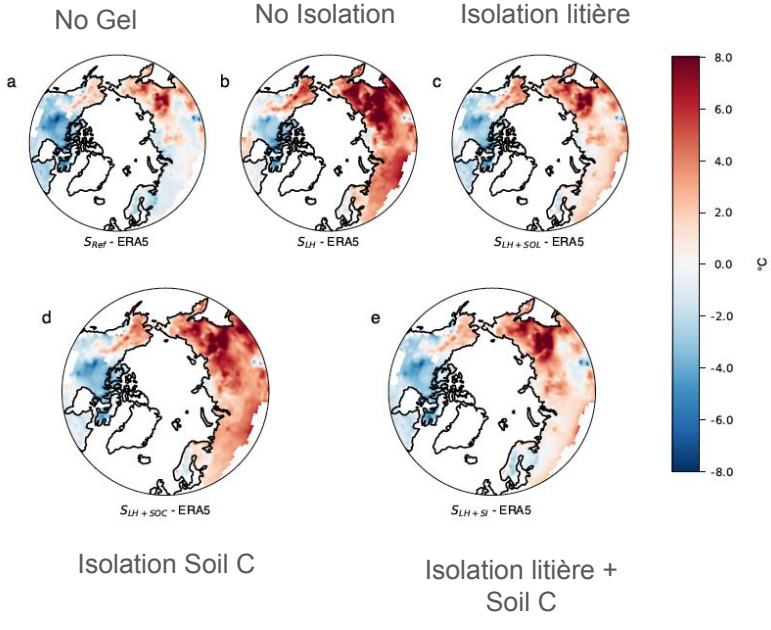
Impact de l'isolation sur T2m:
Model - ERA5 (1995-2004)

Novembre - Decembre



Isolation Soil C

Isolation litière + Soil C



Isolation Soil C

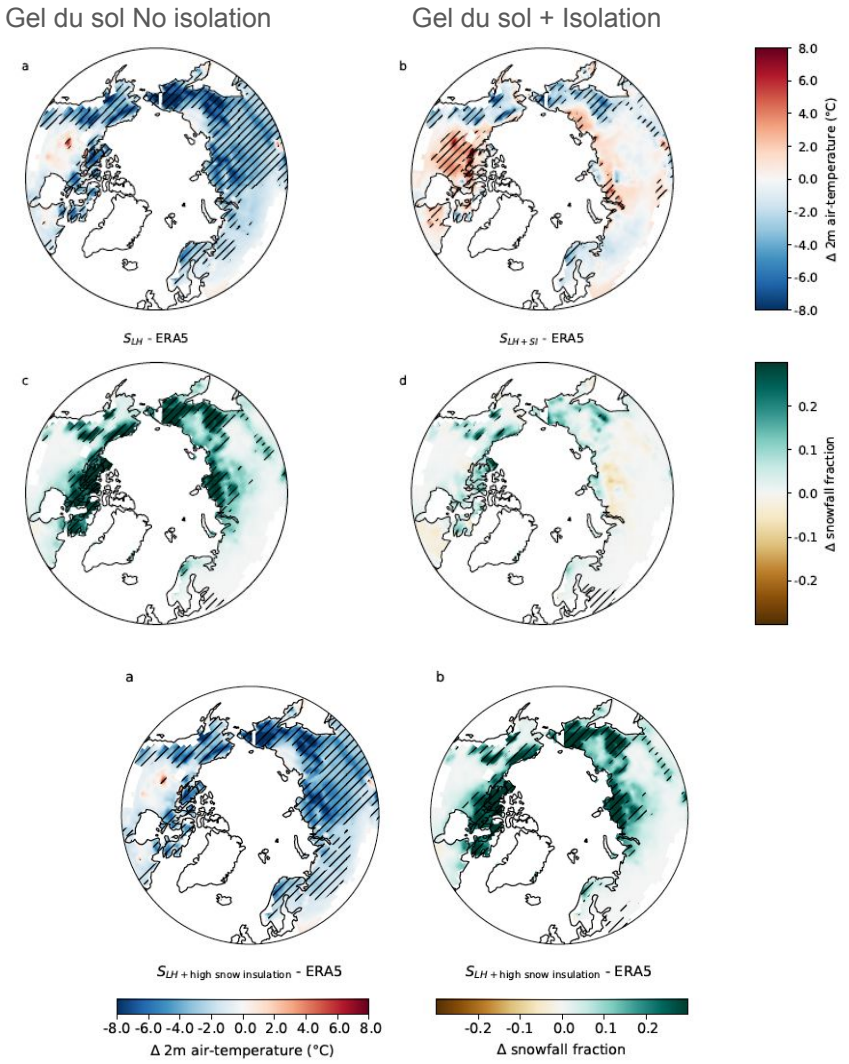
Isolation litière + Soil C

⇒ Impact litière + Mousse > impact C soil

T2M en LMDZOR de Rémi Gaillard

Initial results of Remi (Juin - Juillet)
⇒ Soil Carbon and Moss insulation reduce the cold biais in Summer & improve the snowfall ratio !

Test with No Insulation BUT reduce thermal conductivity of snow (pkappa_snow / 3)
⇒ No impact of snow insulation in JJ



T2M en Full Couplé (Oce + Atm) de Rémi Gaillard

Version IPSL_ORC3 - ERA5

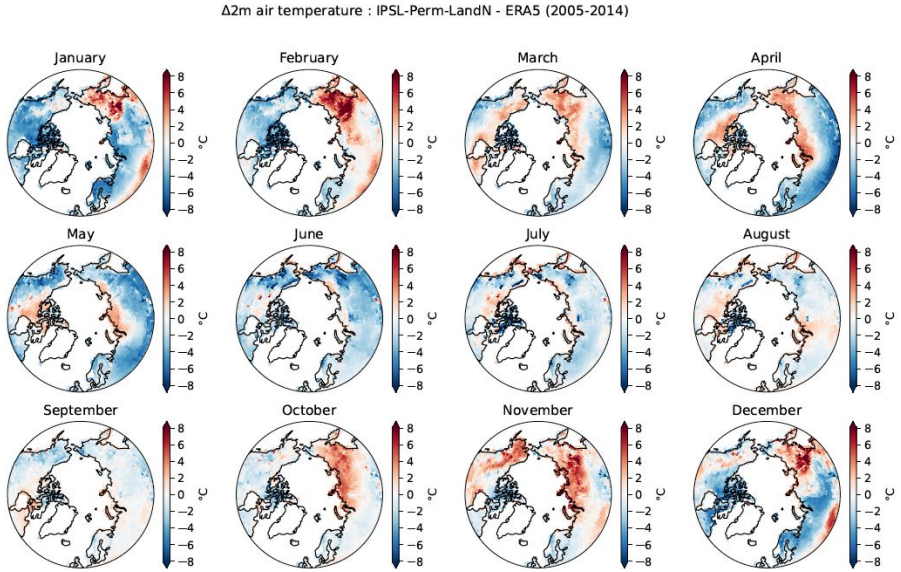


Figure IV.19: **Arctic surface air temperature bias of IPSL-Perm-LandN (2005-2014)**. Mean monthly difference in surface air temperature (*t2m)* between IPSL-Perm-LandN and ERA5 (Copernicus Climate Change Service, 2019a) for the period 2005-2014.

Version IPSL-CM6 - ERA5

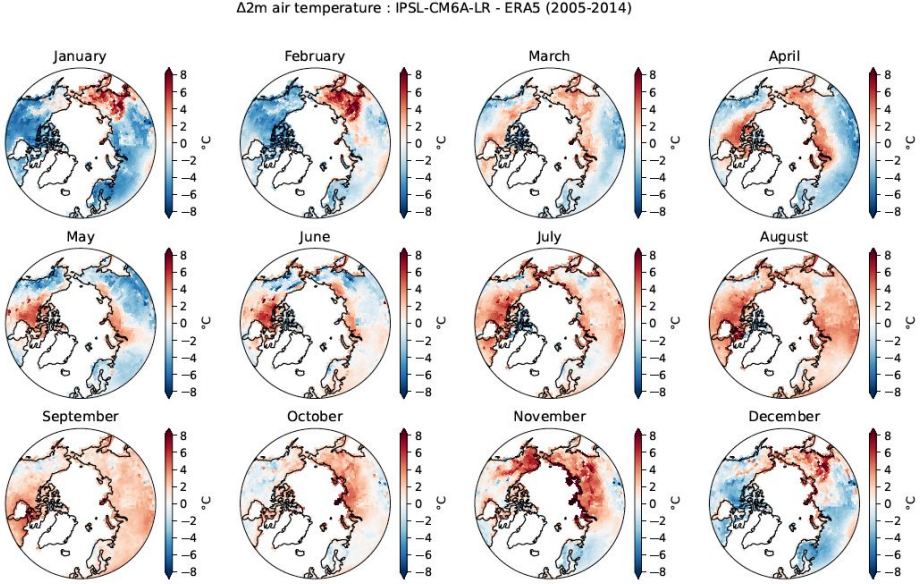


Figure IV.20: **Arctic surface air temperature bias of IPSL-CM6A-LR (2005-2014)**. Mean monthly difference in surface air temperature (*t2m)* between IPSL-CM6A-LR and ERA5 (Copernicus Climate Change Service, 2019a) for the period 2005-2014.

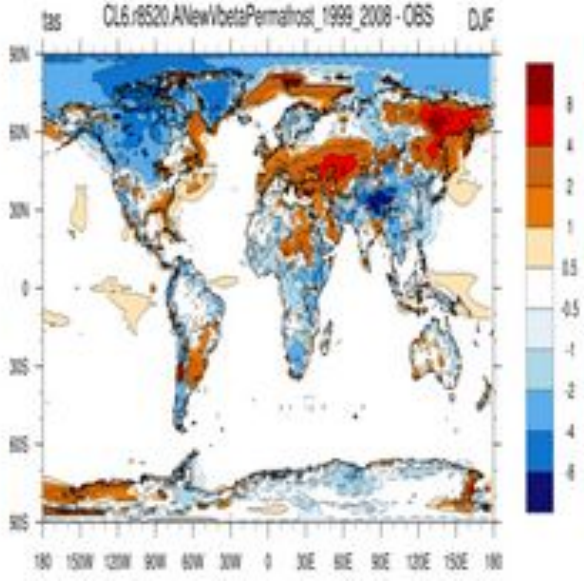
⇒ Inclusion ORC-V3 (gel + N) change relativement peu T2m mais réduit le biais chaud en été (=> devient un léger biais froid)

tests forcés avec et sans permafrost

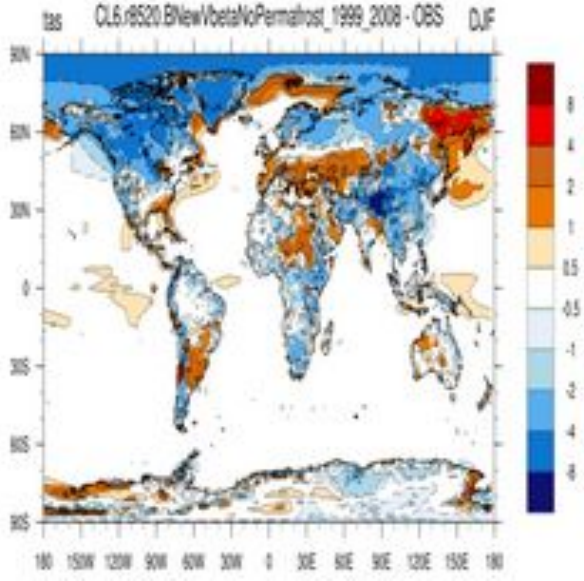
https://thredds-su.ipsl.fr/thredds/fileServer/ipsl_thredds/fabric/lmdz/MultiSimu/FC_ORCPERMA/BIASGLOBDJF.html

légèrement plus chaud en hiver avec

Avec

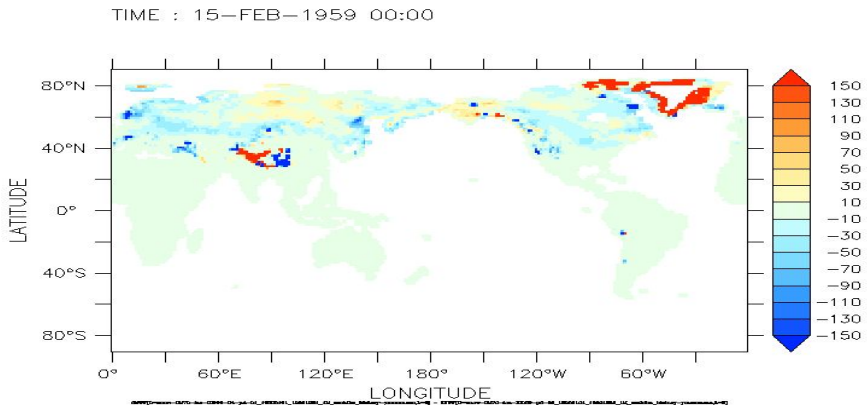


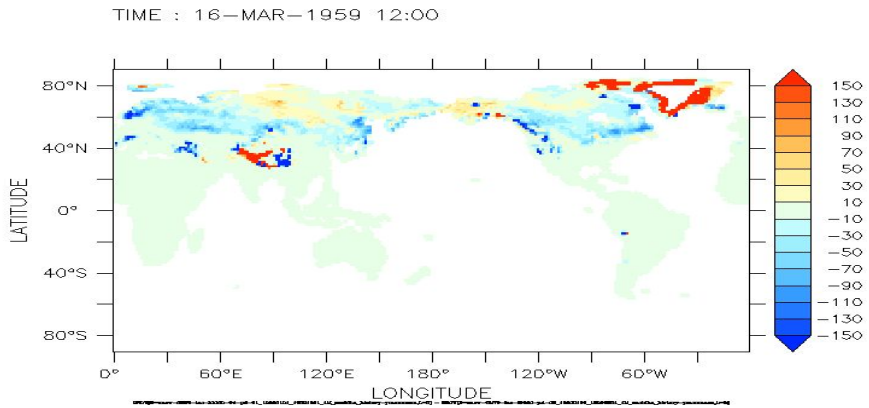
SANS

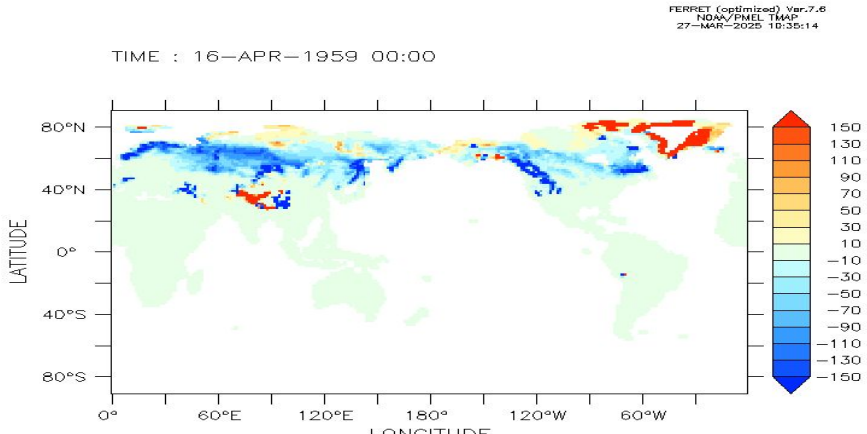


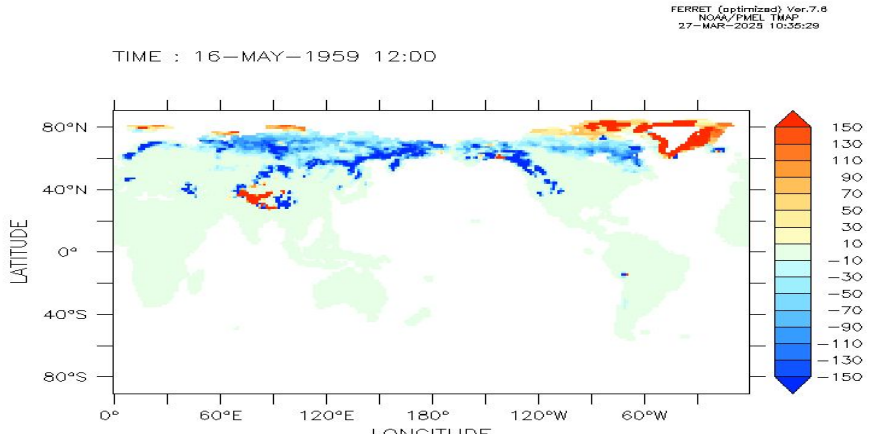
Tests neige (Christophe Dumas): IPSLCM7_ICO60_ORCH4 (ORCHIDEE 4) et IPSLCM7_ICO60 (ORCHIDEE 2).

Différence de masse de neige OR4 - OR2 sur Fev, Mars, Avril et Mai. (rev. 8402 ORC)

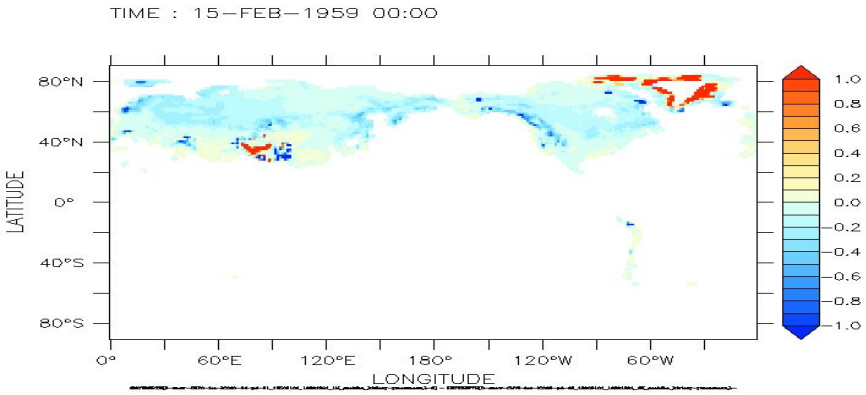


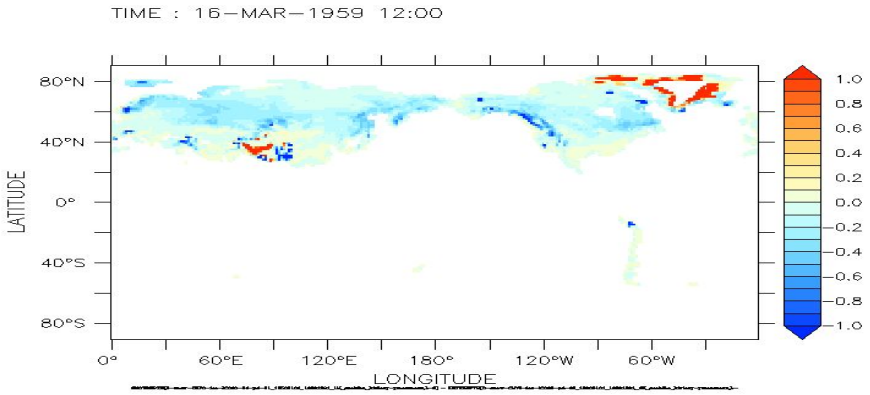


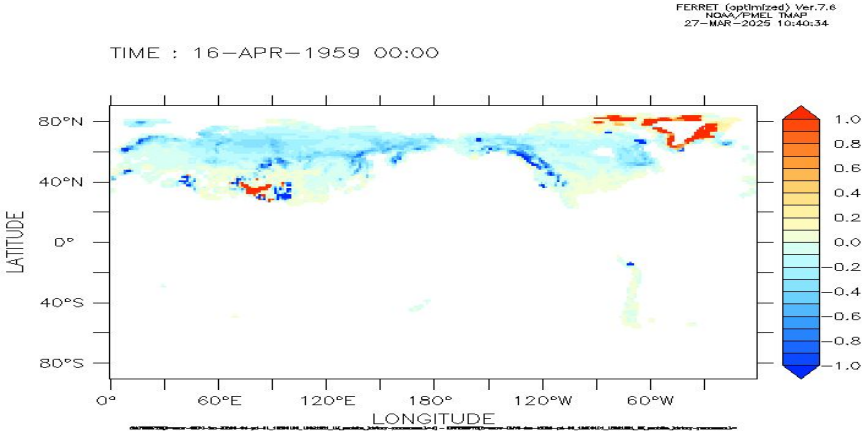


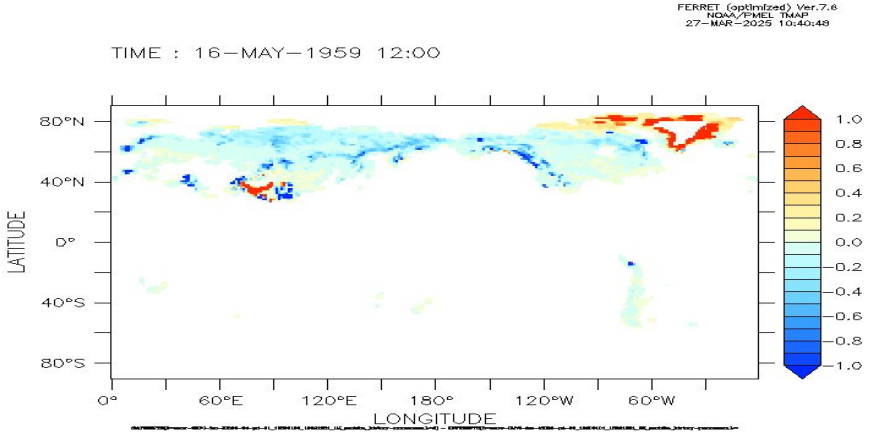


Différence d'épaisseur de neige OR4 - OR2 sur Fev, Mars, Avril et Mai.

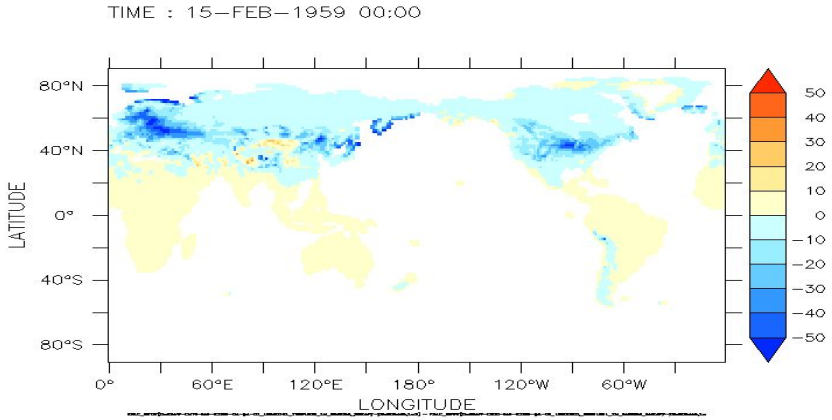


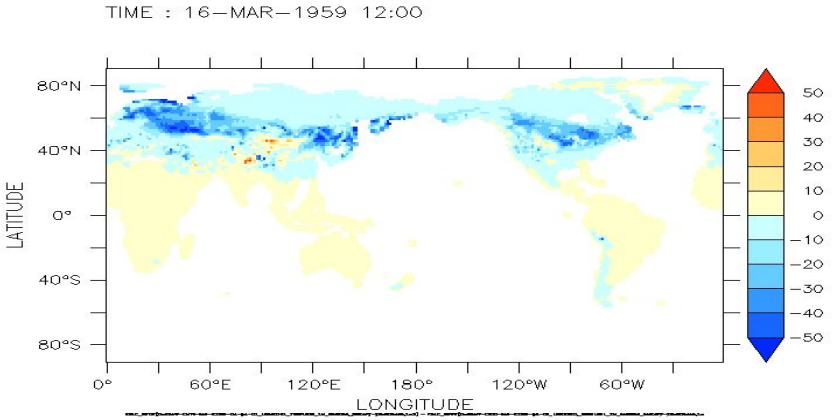


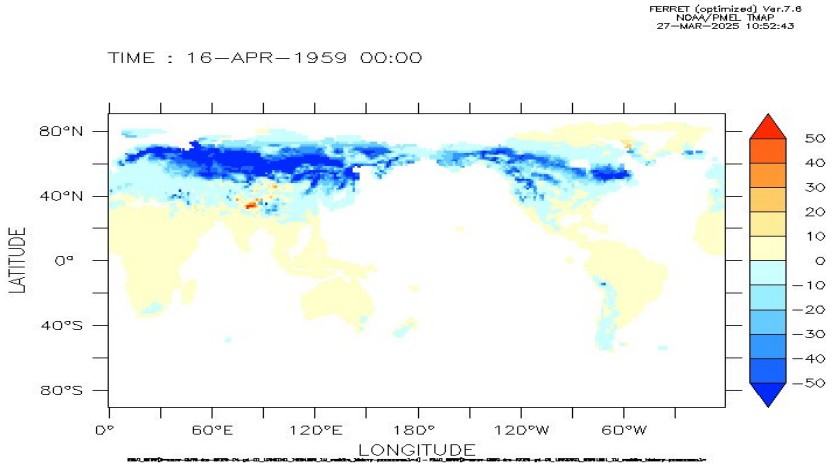


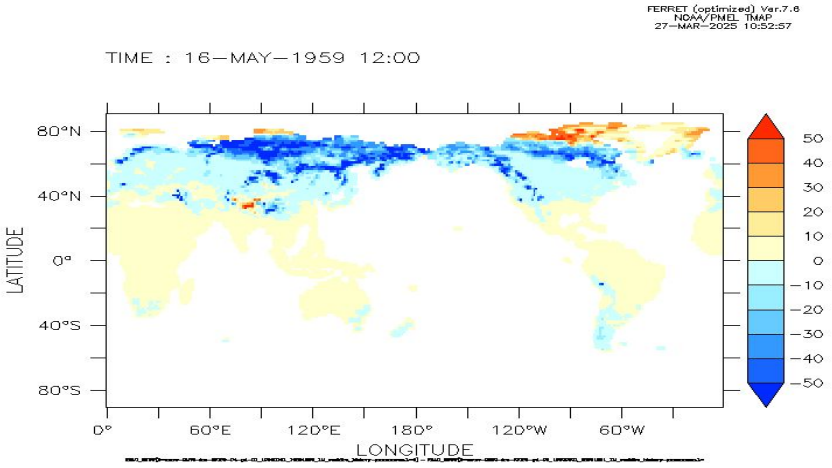


Différence de fraction de neige au sol (frac_snow) OR4 - OR2 sur Fev, Mars, Avril et Mai.

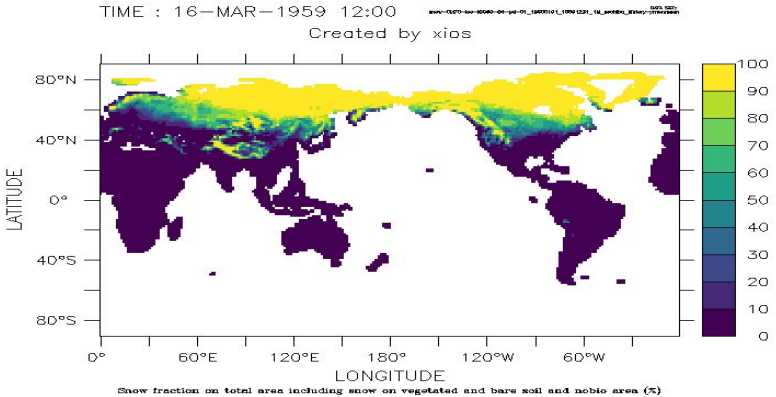


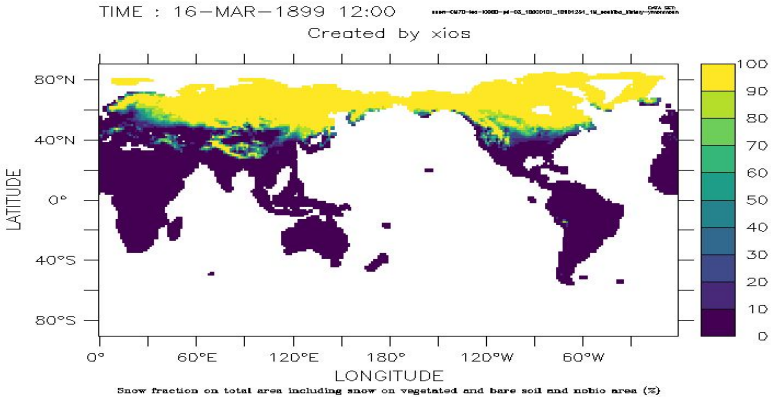


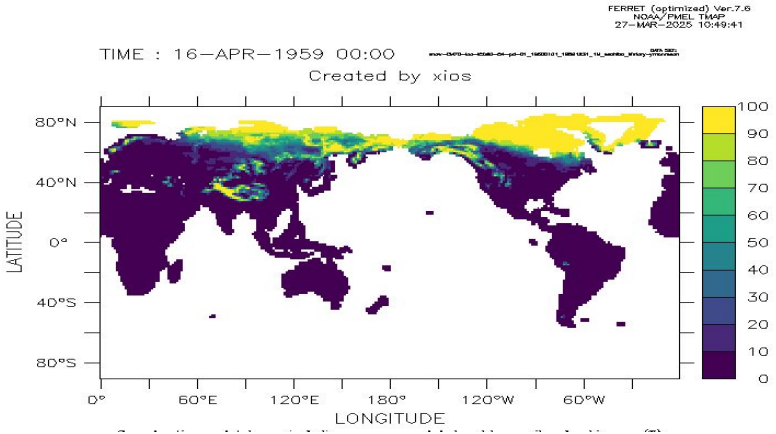


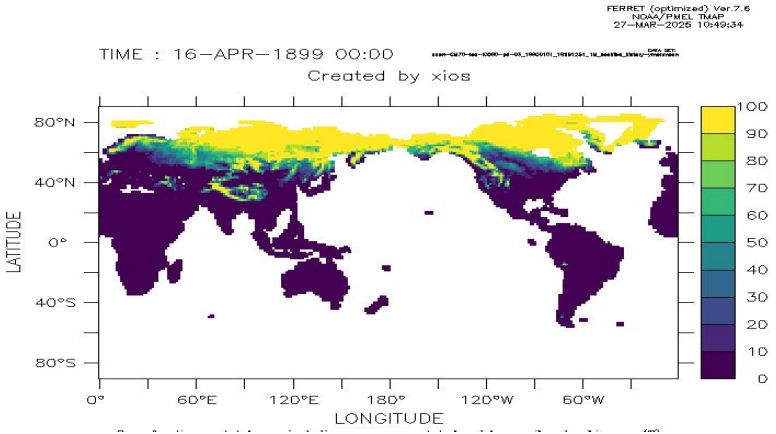


frac_snow pour les 2 modèles en mars et avril. ORCHIDEE4 à gauche, ORCHIDEE2 à droite.







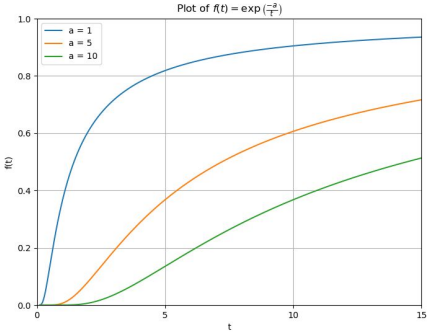


Optimization of the snow albedo : Vlad, Amélie, Catherine, Luis, PP

Snow albedo equation : (see https://orchidas.lsce.ipsl.fr/dev/albedo/computation.php)

$$alb_{snow,veg} = \frac{\sum_{pft=1}^{13} frac_{max,pft} \cdot \left[alb_{snow,aged,pft} + alb_{snow,dec,pft} \cdot \exp(-age_{snow}/tcst_{snow})\right]}{\sum_{pft=1}^{13} frac_{max,pft}}$$

$$age_{snow,i+1} = (age_{snow,i} + (1 - age_{snow,i}/age_{snow,max}) \cdot dt) \cdot \exp(-precip_{snow}/trans_{snow})$$



⇒ Vlad re-optimized the snow albedo parameters (*snowa_aged, snowa_dec, tcst_snowa*) using Modis and ESACCI snow cover data for year 2015 (daily values, done with ORC-V2.2)

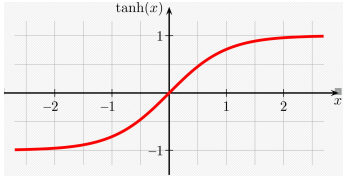
Parameter	PFT1	PFT2	PFT3	PFT4	PFT5	PFT6	PFT7	PFT8	PFT9	PFT10-15
NIR aged+dec (trunk)	0.50+0.13	0.37+0.10	0.08+0.16	0.10+0.10	0.37+0.10	0.08+0.16	0.16+0.04	0.17+0.07	0.27+0.08	0.44+0.12
NIR aged+dec (opt22)	0.584+0.05	—	—	0.268+0.0151	0.108+0.0461	0.23+0.0297	0.271+0.01	0.454+0.01	0.235+0.01	0.54+0.05
NIR total diff	↑0.63%	—	—	↑42%	↓67%	↑8.2%	↑41%	↑93%	↓30%	↑5.4%
VIS aged+dec (trunk)	0.74+0.21	0.24+0.14	0.07+0.08	0.08+0.14	0.24+0.08	0.07+0.17	0.18+0.05	0.18+0.06	0.33+0.09	0.57+0.15
VIS aged+dec (opt22)	0.68+0.3	—	—	0.24+0.01	0.228+0.11	0.203+0.01	0.313+0.01	0.5+0.116	0.315+0.01	0.68+0.192
VIS total diff	↑3.2%	—	—	↑14%	↑5.6%	↓11%	↑40%	↑156%	↓23%	↑21%
tsct_snow (trunk)	10									
tsct_snow (opt22)	15									
tsct_snow diff	↑50%									

⇒ more info: https://docs.google.com/document/d/19mvBXhQo6Rh1qDG9JefTKrTZek_0CA-lOJxLo9le5yA/edit?usp=sharing

Bilan vis à vis de la neige

- En couplé: ORC traite seulement “bio” et “Nobio” (land ice) traité par LMDZ
- Albédo de la neige
  - Nouveau Tuning ⇒ Albédo plus fort ⇒ a tester !
  - Potentiel Tuning de la relation Snow cover = f (snow water equivalent)
    Tuning param “0.025” ?

$$frac_{snow,veg} = \tanh \frac{50 \cdot d_{snow}}{0.025 \cdot \varrho_{snow}}$$



- Test Snow-3 couches ?
  - Snow_3 : fonte moins rapide de la neige au printemps !
  - Mais a terme on veut le snow_12 (pour land_ice) !

- Observations (snow_cover, SWE) : ESA-CCI
  - Produits grillés mais pas couverture temporelle complète !
  - Travail en cours pour comparaison obs - modèle rigoureuse: Amélie / CO
  - ⇒ produits dispo au LSCE; bilan la semaine du 7 Avril.

Analysis of the impact of do_rsoil in previous studies (through Rsoil_scale factor)

Raoult et al. 2021 (Assimilation of SSM)

*We generally **find that soil resistance to evaporation—through parameter rs*—is increased after assimilation.** Since we found that the model generally dries out faster than the observations, this result is consistent with our prior analysis. We also find rs* to be the parameter with the highest reduction in error highlighting its importance in accurately modeling drydowns.*

Luis study (Assimilation of LST

Stabilité ou lègère aumentation de Rsoil_scale

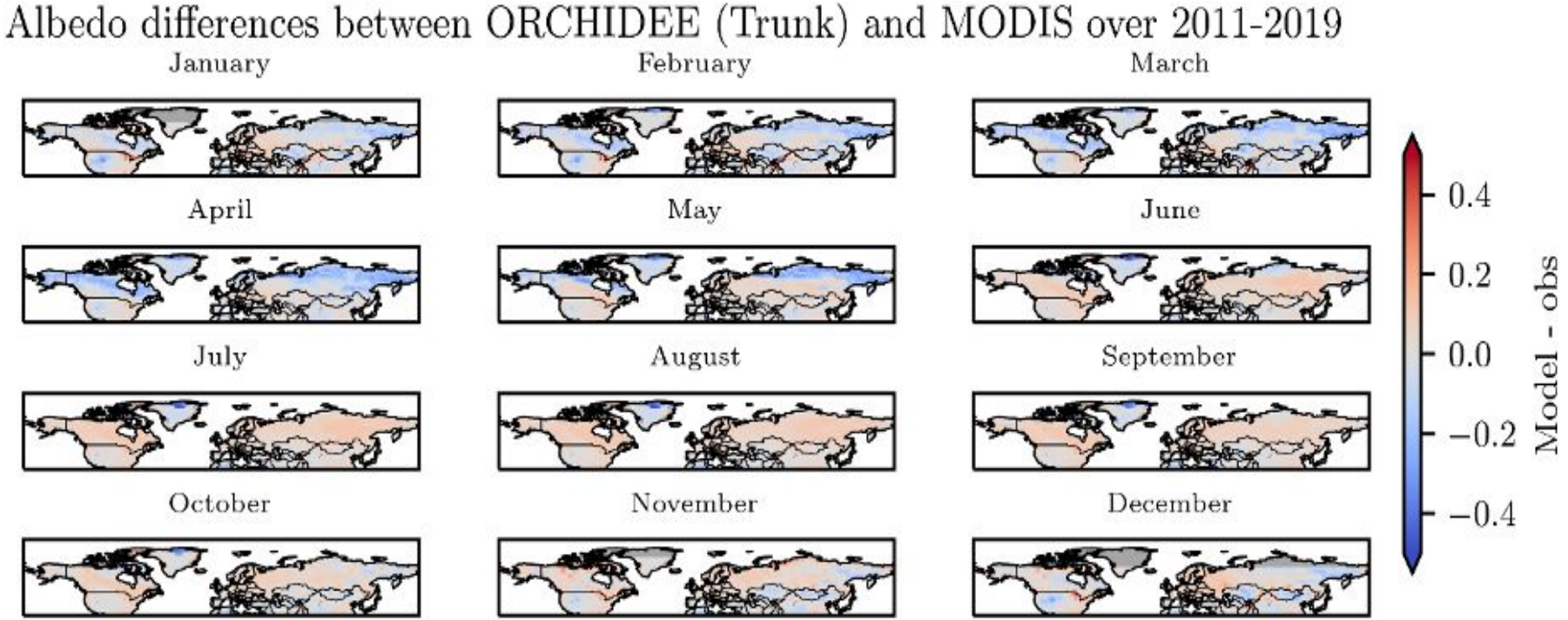
Camille study (Assimilation of FluxNet over EU)

Optimization des 2 paramètres de l' équation

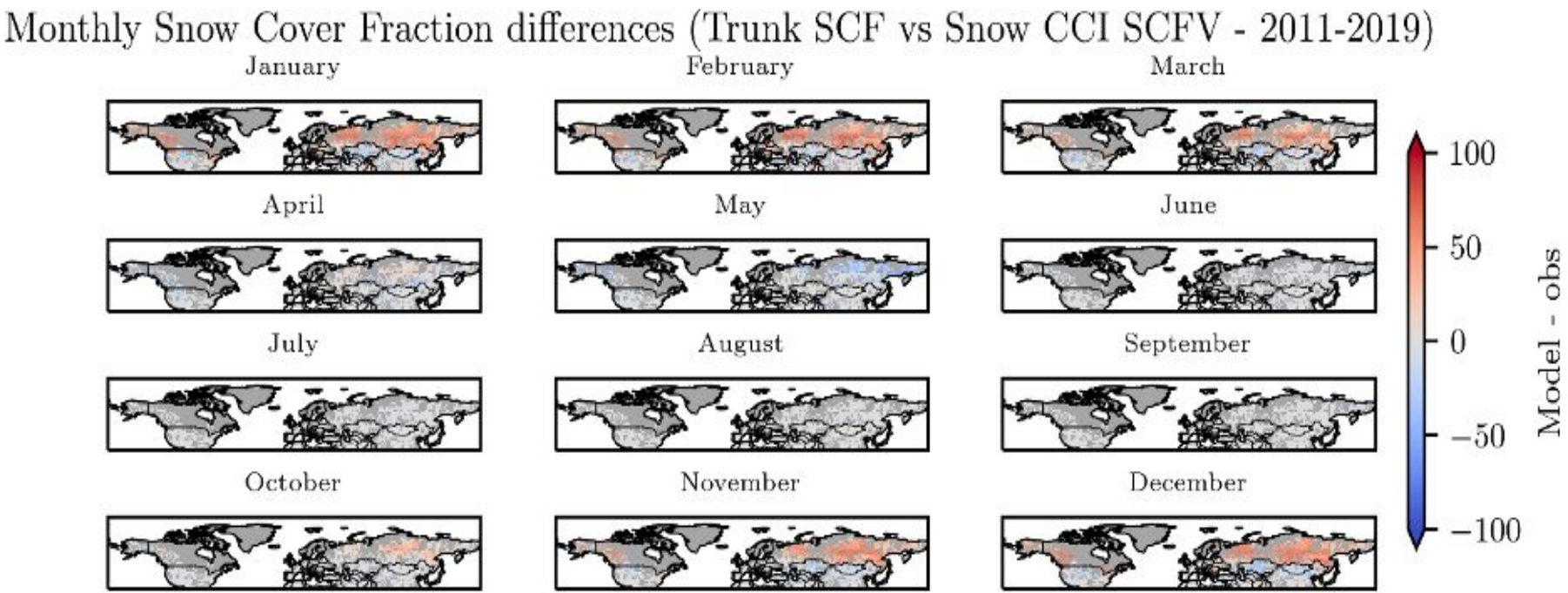
$$r_{soil} = exp\left(r1_{soil} - r2_{soil} \cdot \frac{\theta_{litter}}{\theta_{SAT,litter}}\right)$$

Augmentation de Rsoil après optimisation ! (environ 50%)

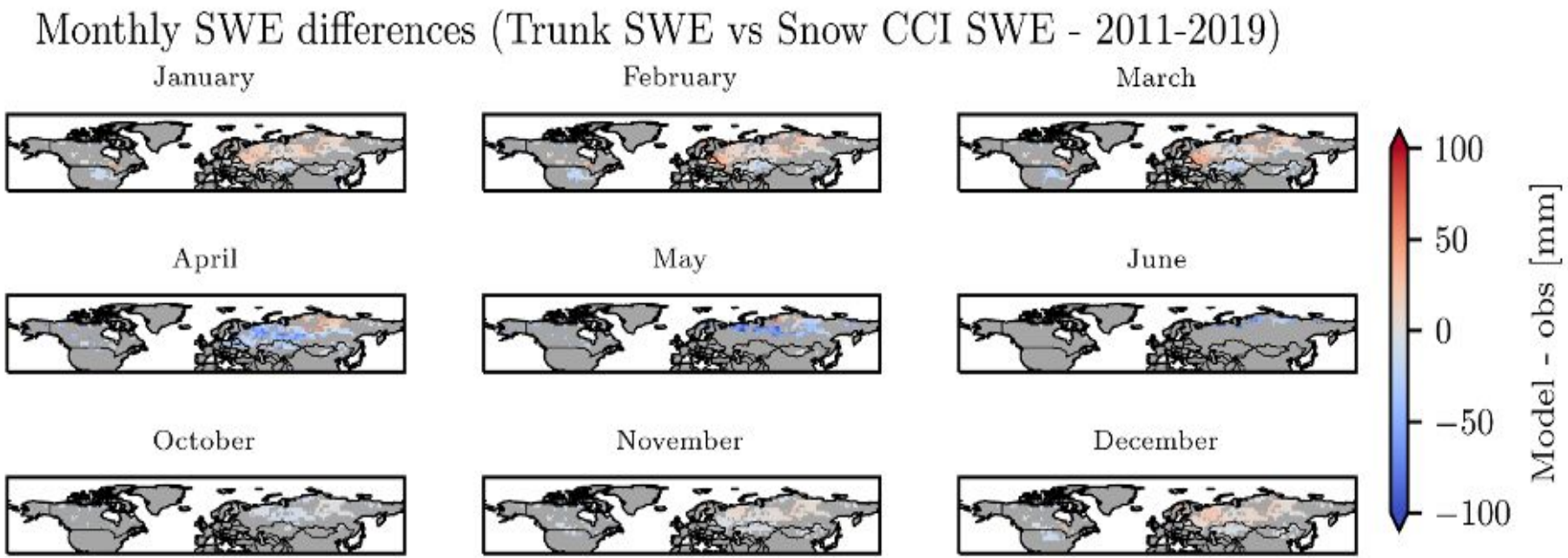
Test of ORC-V4 : comparison with ESA-CCI data for Snow : SWE et Fcover



Test of ORC-V4 : comparison with ESA-CCI data for Snow : SWE et Fcover

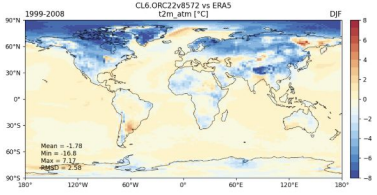


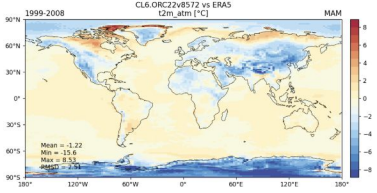
Test of ORC-V4 : comparison with ESA-CCI data for Snow : SWE et Fcover

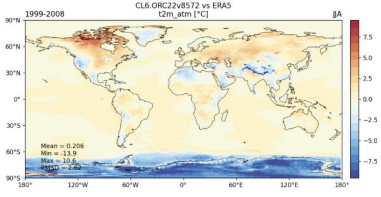


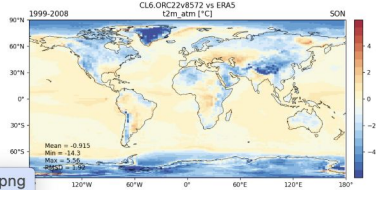
Result of Test with new snow albedo parameters : T2m (ORC - ERA5)

ORC-2

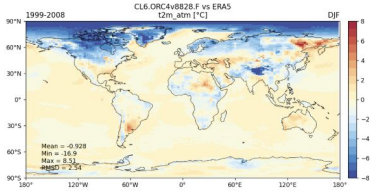


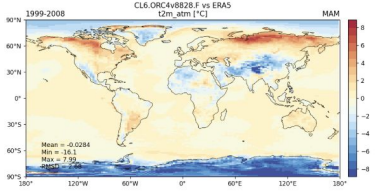


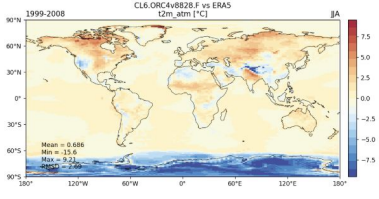


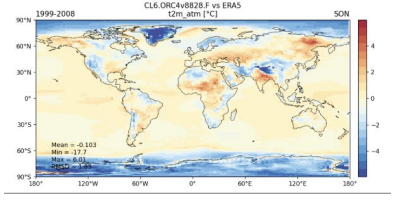


ORC-4

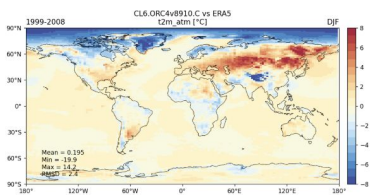


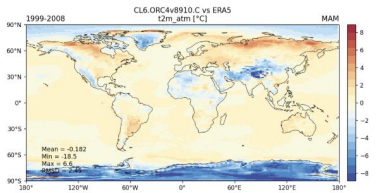


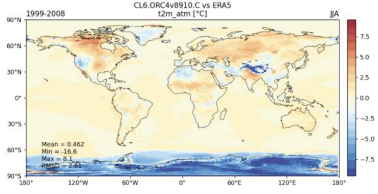


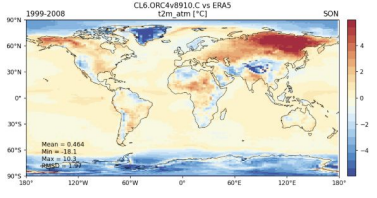


ORC-4-Snow3

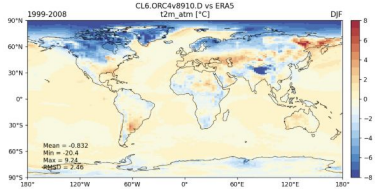


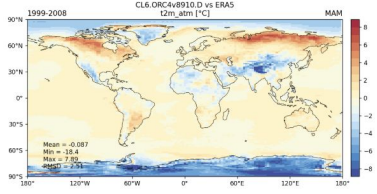


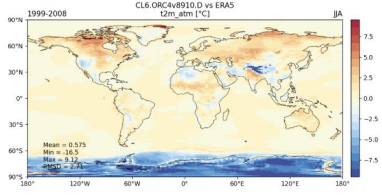


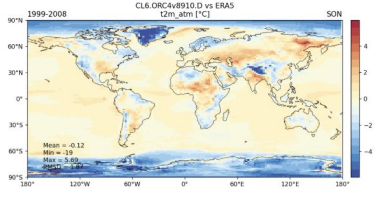


ORC-4-NewSnowAlb



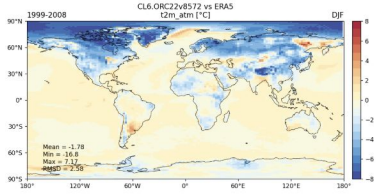


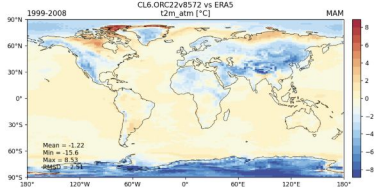


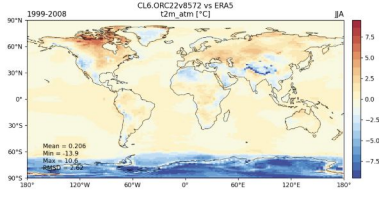


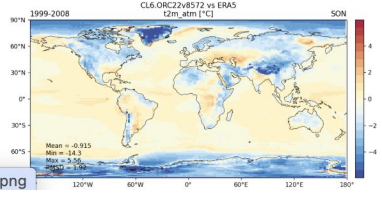
Result of Test with updated SOC insulation : T2m (ORC - ERA5)

ORC-2

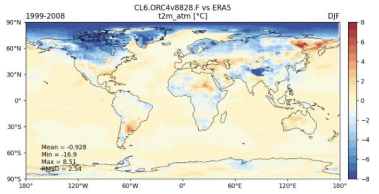


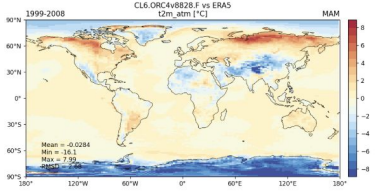


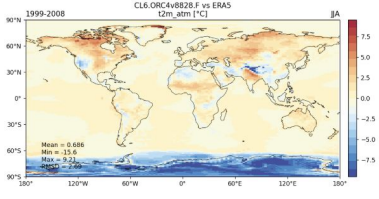


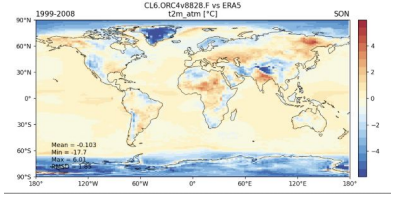


ORC-4

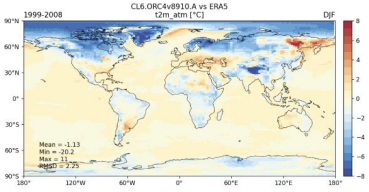


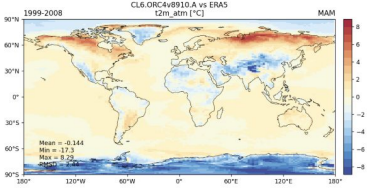


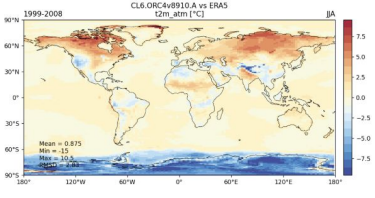


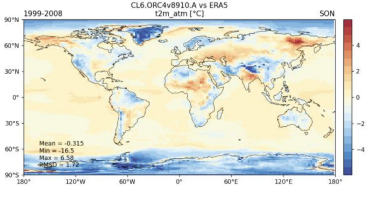


ORC-4-newSOC insulation (Amélie)



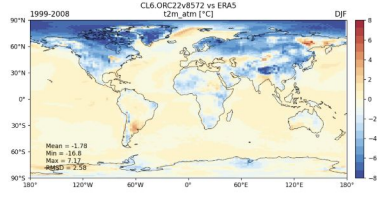


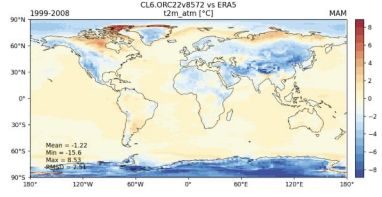


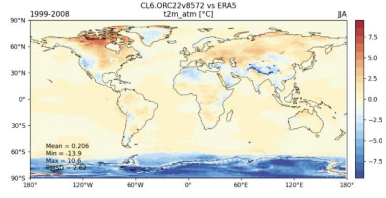


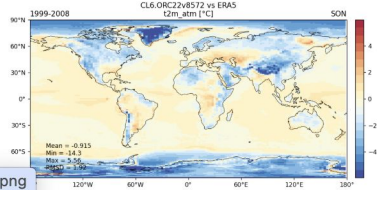
Result of Test with updated SOC insulation : T2m (ORC - ERA5)

ORC-2

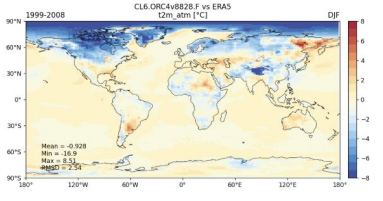


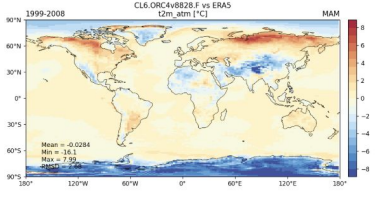


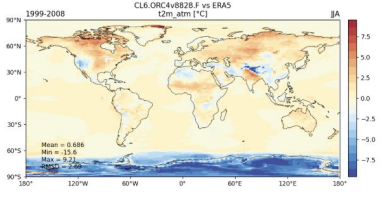


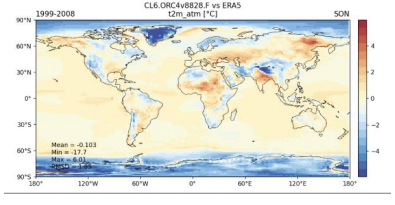


ORC-4

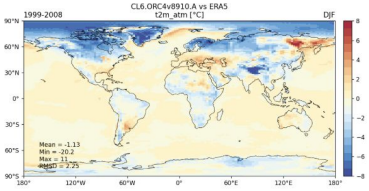


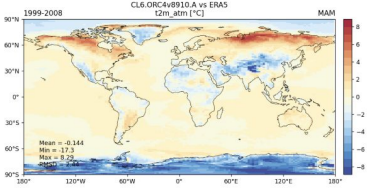


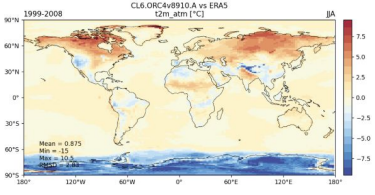


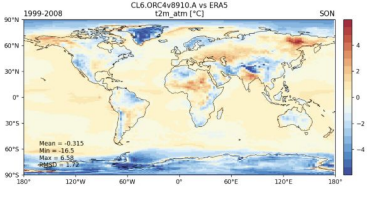


ORC-4-newSOC insulation (Amélie)





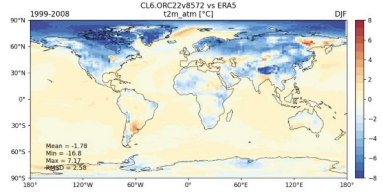


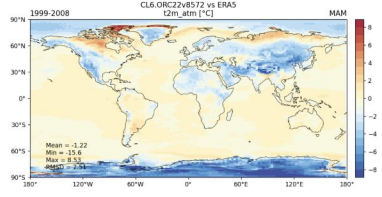


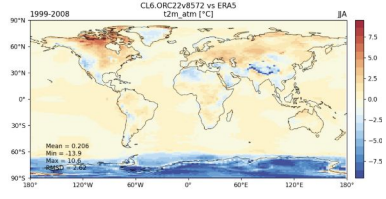
⇐ Summer impact

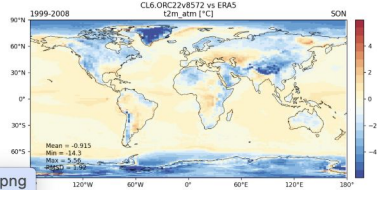
Result of Test with updated SOC insulation : T2m (ORC - ERA5)

ORC-2

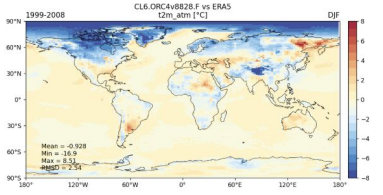


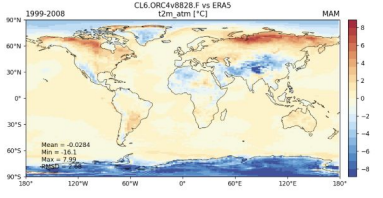


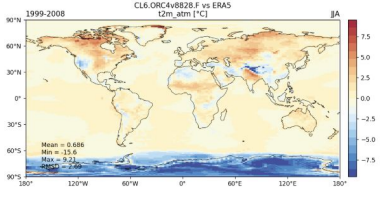


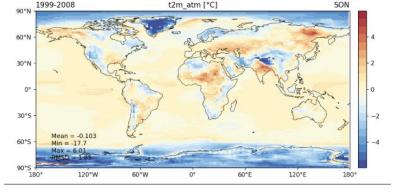


ORC-4

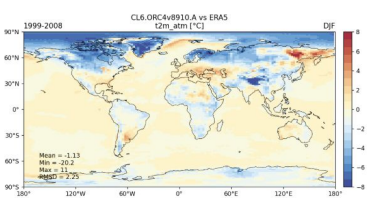


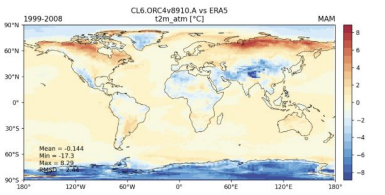


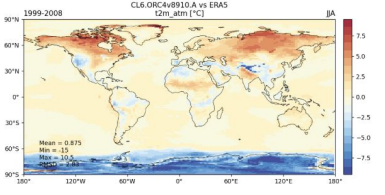


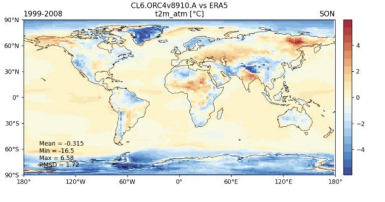


ORC-4-newSOC

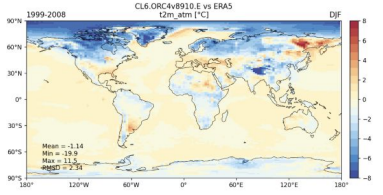


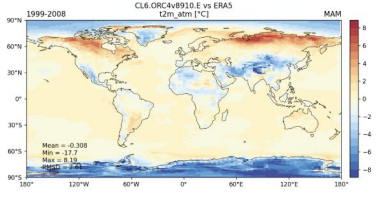


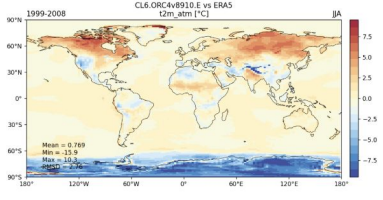


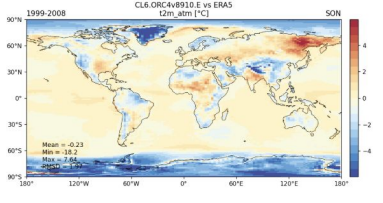


ORC-4-newSOC+no moss





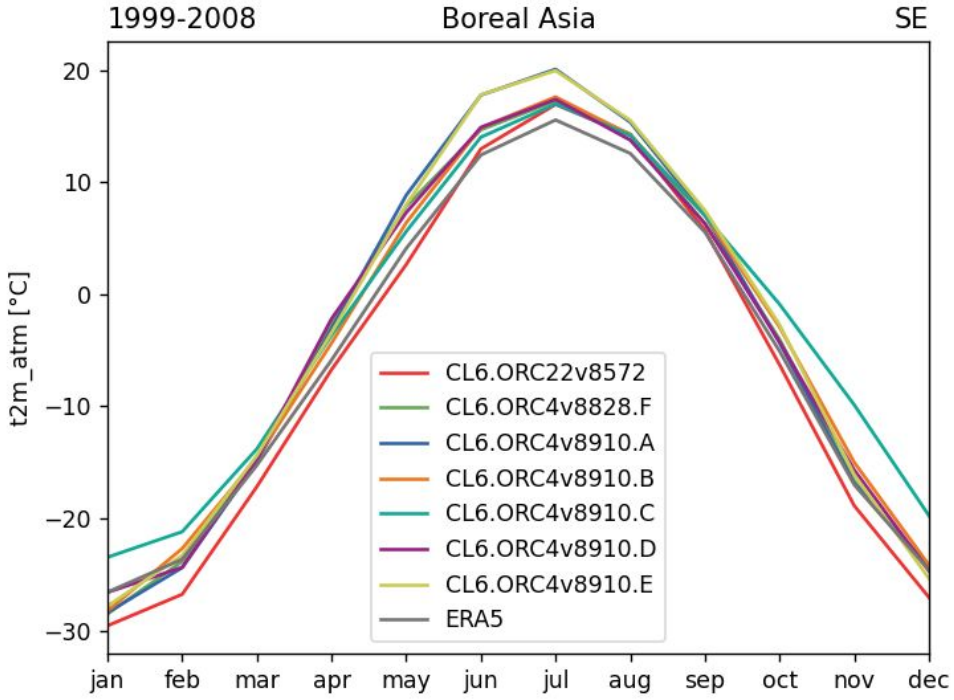


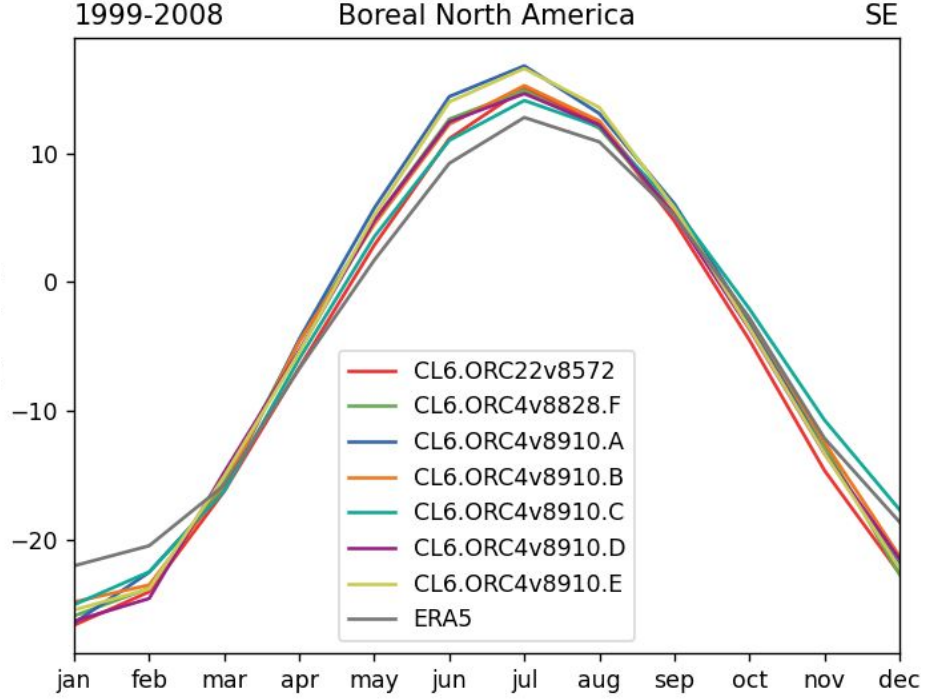


png

Times series of the new tests for T2m (ORC - ERA5)

CL6.ORC22v8572 (ORC22 ref)
CL6.ORC4v8828.F (ORC4 setup F)
CL6.ORC4v8910.A (USE_THERMO_NEWDISC = y, OK_SOIL_CARBON_DISCRETIZATION = y)
CL6.ORC4v8910.B (default as CL6.r8845.F with OK_MOSS=n)
CL6.ORC4v8910.C (default as CL6.r8845.F with NSNOW=3)
CL6.ORC4v8910.D (default as CL6.r8845.F with new optimized snow albedo parameters)
CL6.ORC4v8910.E (as CL6.r8910amelie.A with OK_MOSS=n)





Potential tests to be launched !

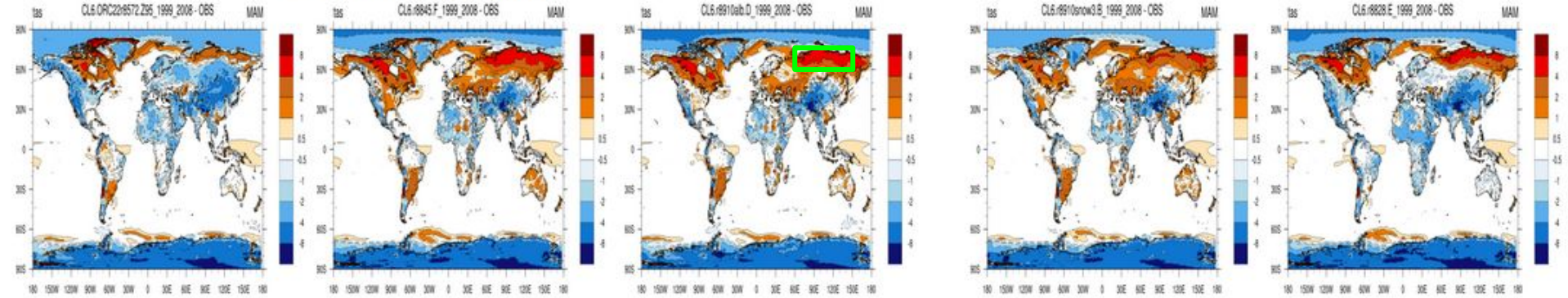
- Test Isolation soil
  - Nouveau test avec paramétrisation Amélie pour SOC isolation
    - CL6.r8910amelie.A : USE_THERMO_NEWDISC = y, OK_SOIL_CARBON_DISCRETIZATION = y, USE_SOILC_INSULATION = y
  - Test sans “effet des mousses / litière” = OK_moss = FALSE
    - CL6.r8910amelienoMOSS.E : As CL6.r8910amelie.A with OK_MOSS=n (on the top of New Amélie SOC isolation)
    - CL6.r8910noMOSS.B : Default as CL6.r8845.F with OK_MOSS=n (without Amélies changes and without OK_SOIL_CARBON_DISCRETIZATION)

- Tests Neige
  - Test avec snow model 3 couches
    - CL6.r8910snwow3.C : Default as CL6.r8845.F with NSNOW=3
  - Nouveau set de paramètres pour albédo neige (à Commiter Vlad + JG)
    - CL6.r8910alb.D : Default as CL6.r8845.F with new optimized snow albedo parameters
  - Evaluation Neige à mettre en place (Amélie / CO / Vlad)

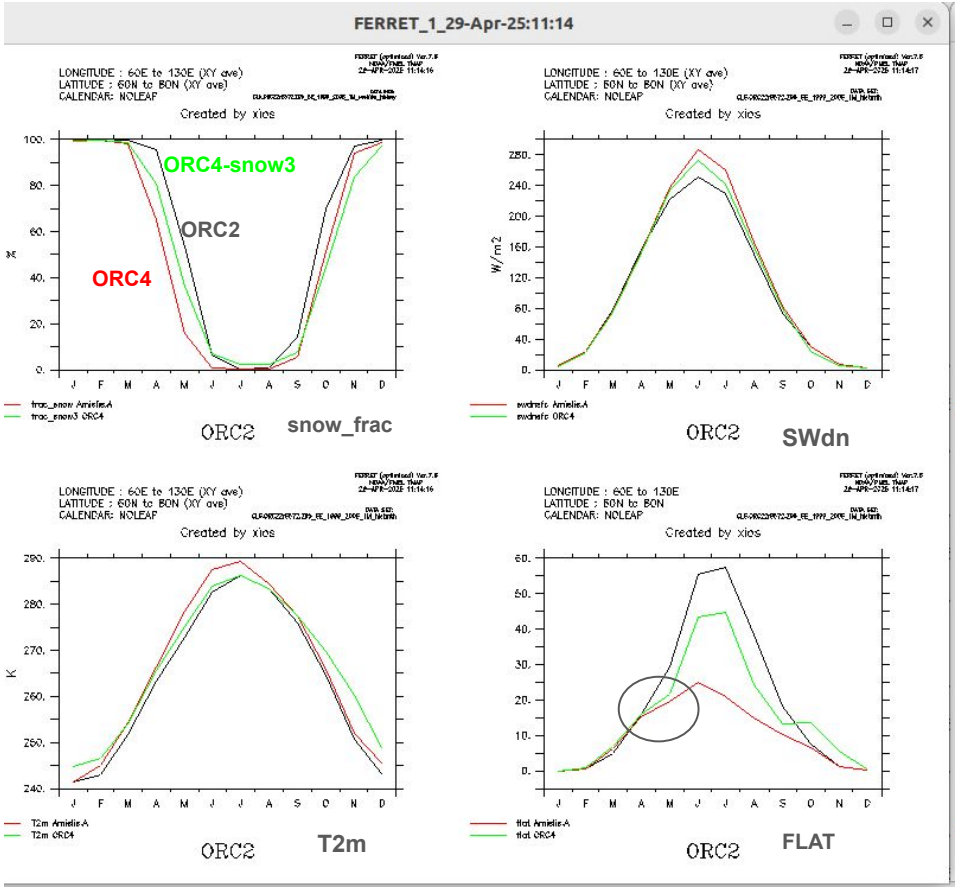
- Point de comparaison: la simulation de référence précédente CL6.r8845.F qui correspond au default settings avec DO_RSOIL=y
- Test Infiltration ?
- Test drainage ?
- Test do_rsoil
  - ??

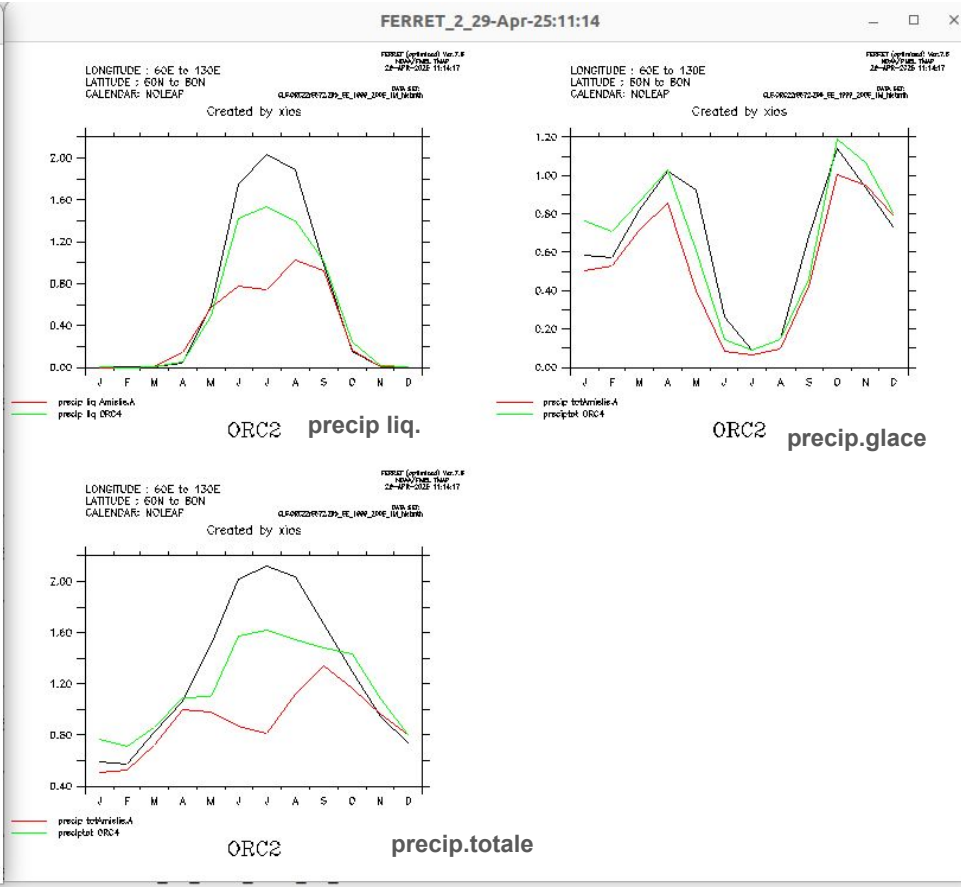
Biais chaud au printemps à la frontière continent-glace accentué avec ORC4 (un peu moins snow3). Ce n'est pas do_rsol ici.
Pourrait-il contribuer au manque de glace de mer?

- **2M Temperature (tas)**

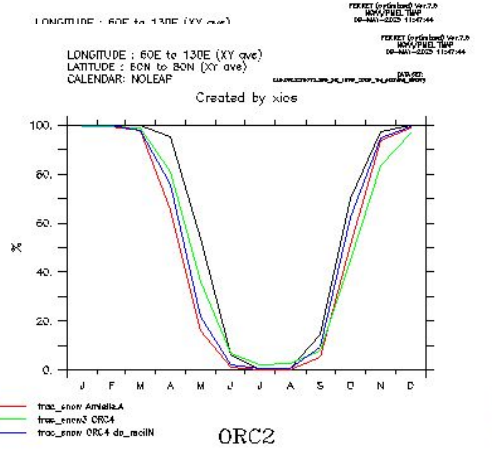


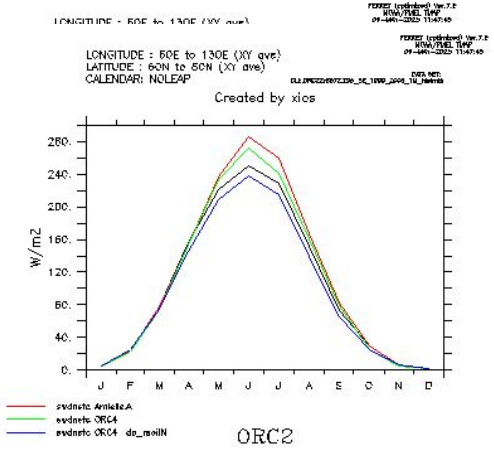
cycles saisonniers 10 ans : couplage precip(tot et solide) -snow-evap-température

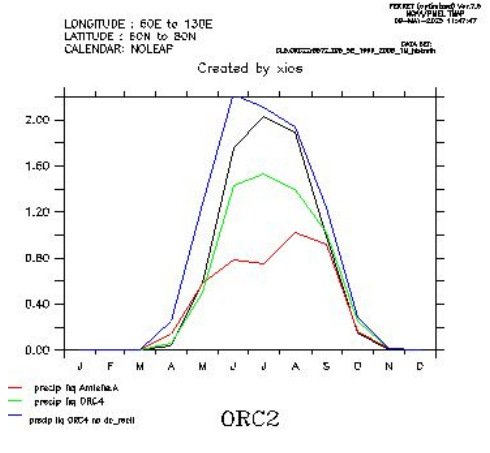


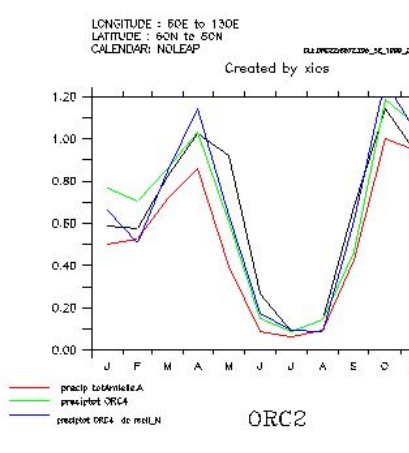


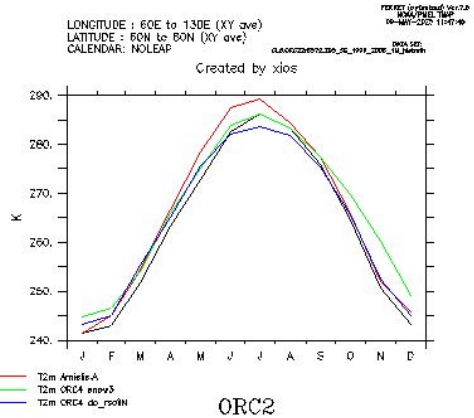
do_rsoil=n : fraction de neige faible et biais chaud mais precip.totale voisines voire supérieure ORC2 > reste impact du gel du sol complet

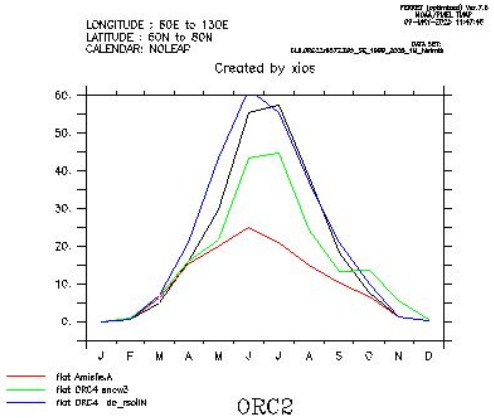


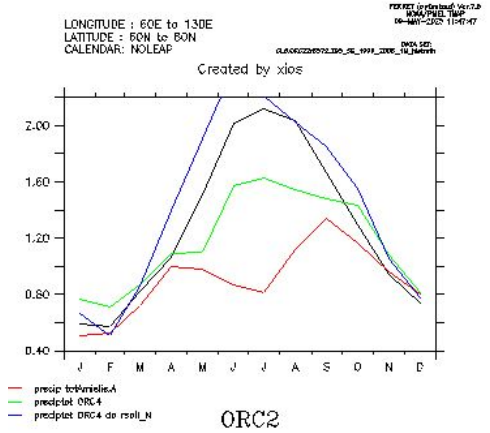




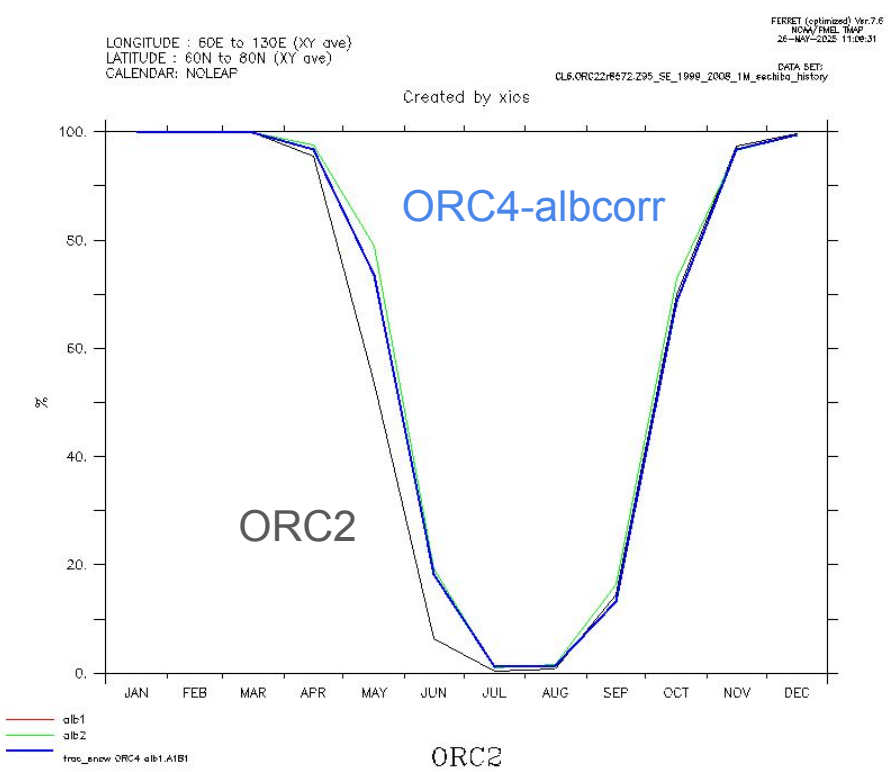


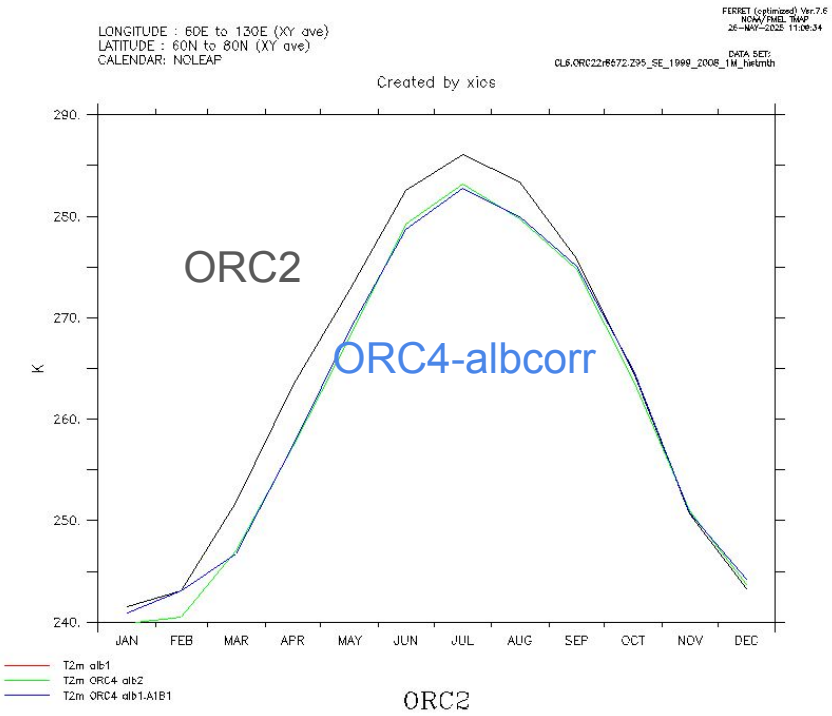


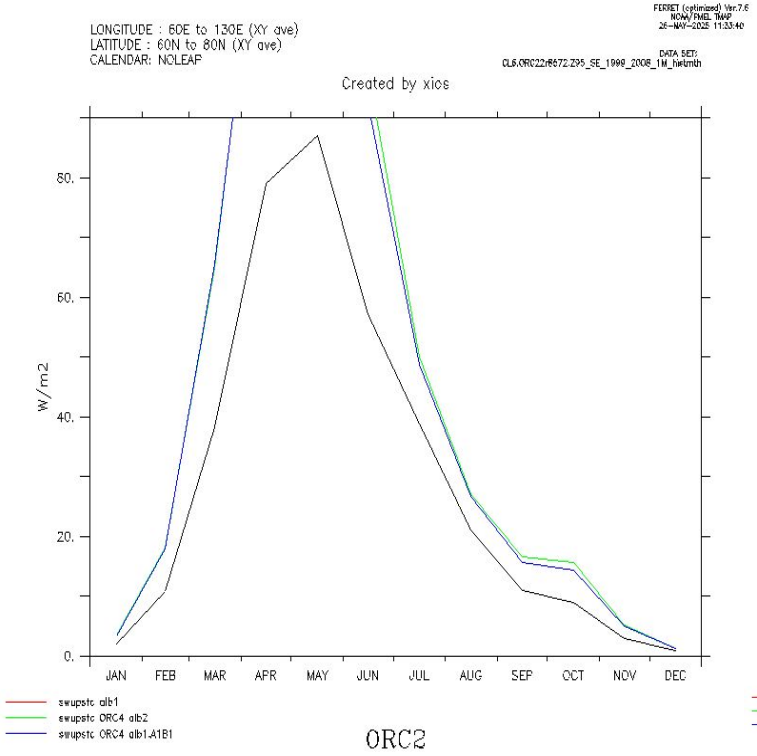




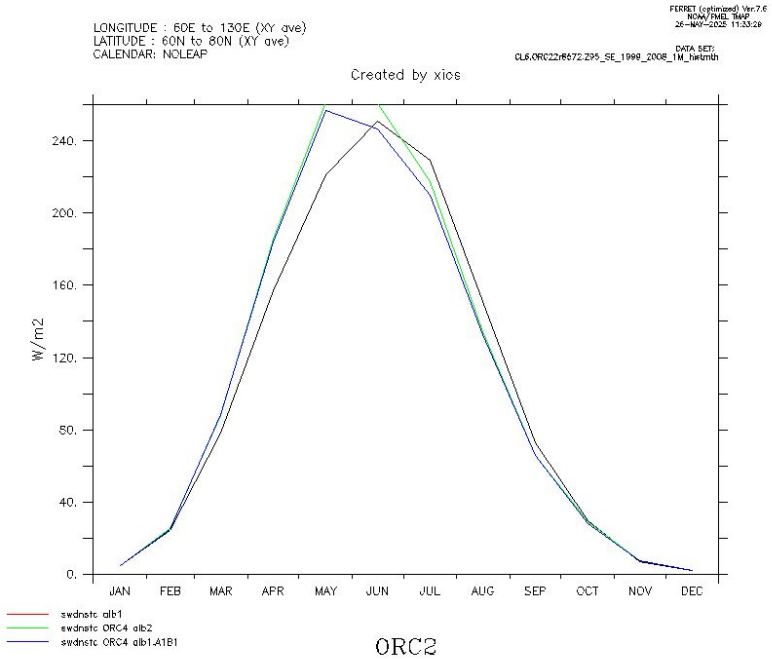
LMDZOR4: albedo neige corrigé



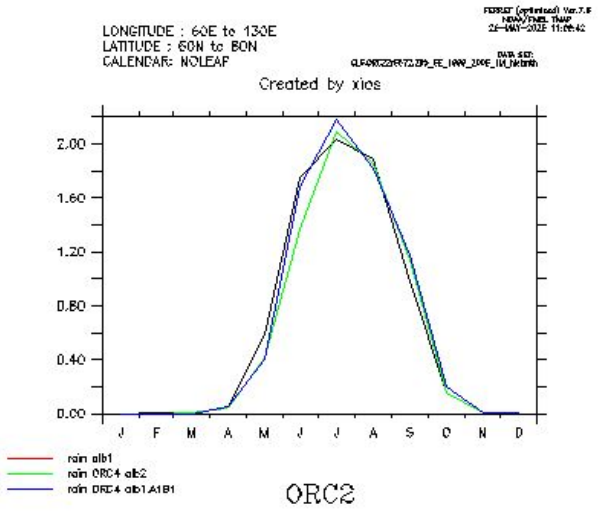


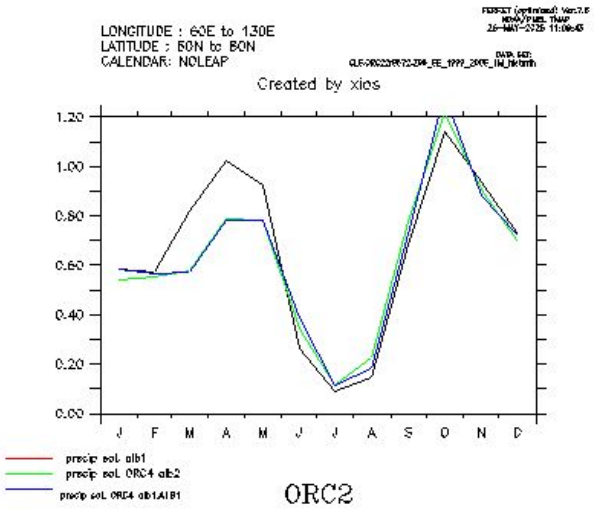

LONGITUDE : 60E to 130E (XY ave)
LATITUDE : 60N to 80N (XY ave)
CALENDAR: NOLEAP
Created by xios
W/m2
0.
20.
40.
60.
80.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
swupstc alb1
swupstc ORC4 alb2
swupstc ORC4 alb1-A1B1
ORC2

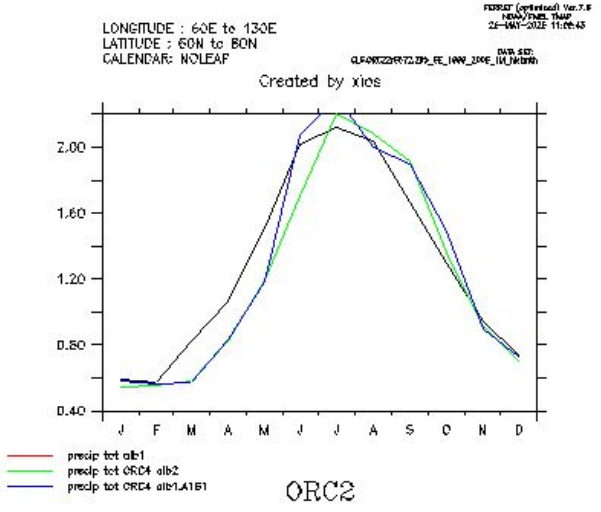
SWup


LONGITUDE : 60E to 130E (XY ave)
LATITUDE : 60N to 80N (XY ave)
CALENDAR: NOLEAP
Created by xios
W/m2
0.
40.
50.
120.
160.
200.
240.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
swdnstc alb1
swdnstc ORC4 alb2
swdnstc ORC4 alb1-A1B1
ORC2

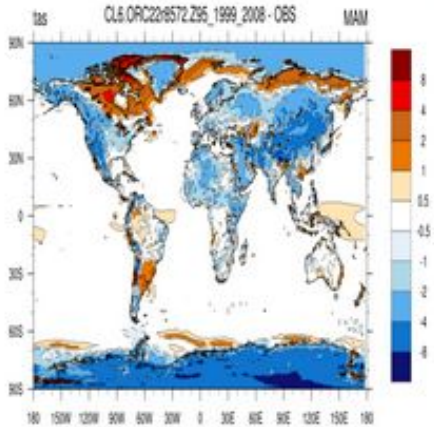
SWdn


LONGITUDE : 60E to 130E
LATITUDE : 60N to 80N
CALENDAR: NOLEAP
Created by xies
2.00
1.60
1.20
0.80
0.40
0.00
J F M A M J J A S O N D
rain alb1
rain ORC4 alb2
rain ORC4 alb1.A1B1
ORC2

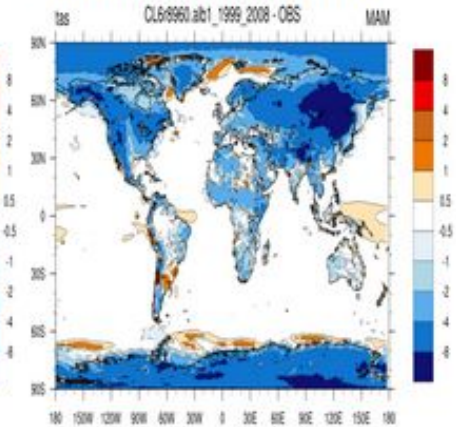

LONGITUDE : 60E to 130E
LATITUDE : 60N to 80N
CALENDAR: NOLEAP
Created by xies
1.20
1.00
0.80
0.60
0.40
0.20
0.00
J F M A M J J A S O N D
precip soL alb1
precip soL ORC4 alb2
precip soL ORC4 alb1.A1B1
ORC2


LONGITUDE : 60E to 130E
LATITUDE : 60N to 80N
CALENDAR: NOLEAP
Created by xies
2.00
1.60
1.20
0.80
0.40
J F M A M J J A S O N D
precip tot alb1
precip tot ORC4 alb2
precip tot ORC4 alb1.A1B1
ORC2

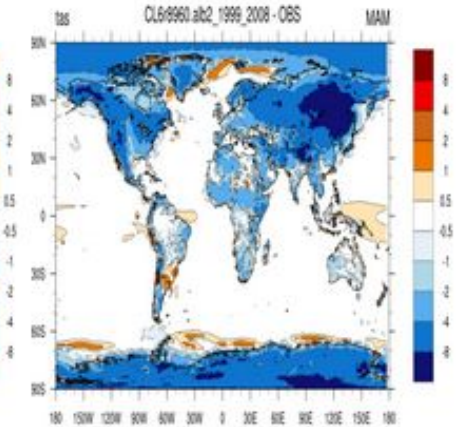
- **2M Temperature (tas)** MAM



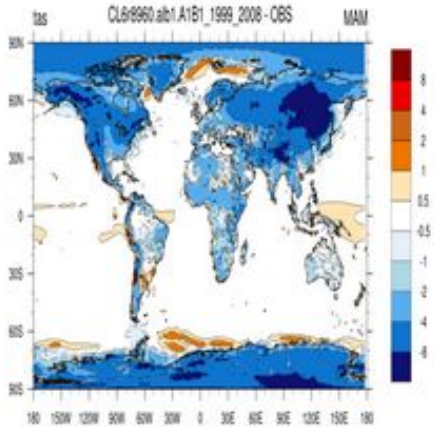
ORC2



alb1



alb2

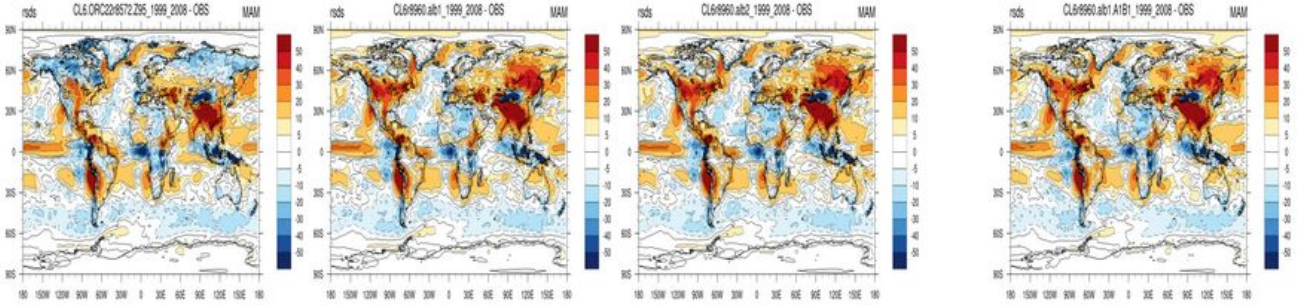


alb1.A1B1

bug albedo moyen ORC4 avec neige 12 couches corrigé

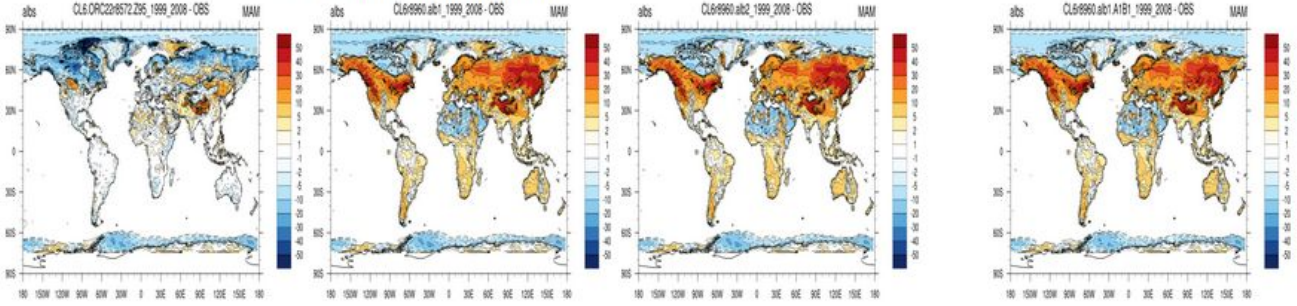
Peut être un peu trop froid

- **Rad. SW Down Sfce (rsds)**



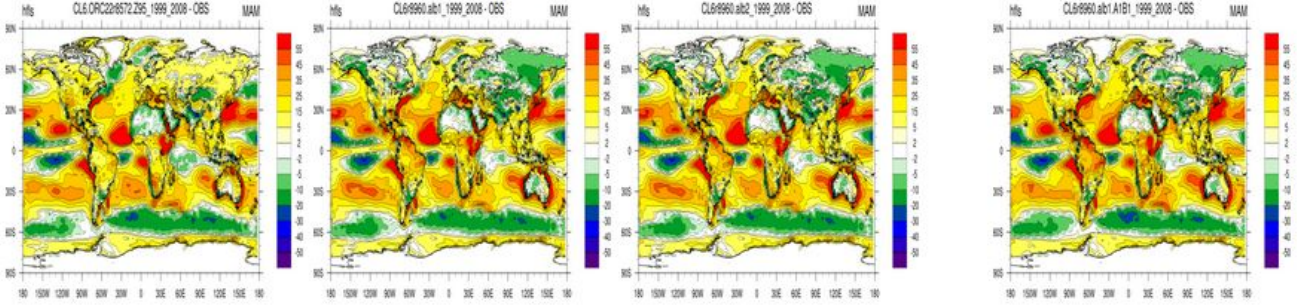
SWdn plus (trop?) élevé

- **Surface albedo (albs)**



albedo plus (trop?) élevé

- **Latent heat flux (hfls)**



Plus (trop?) d'évap.

Rémi Gaillard : IPSL_ORC-V3

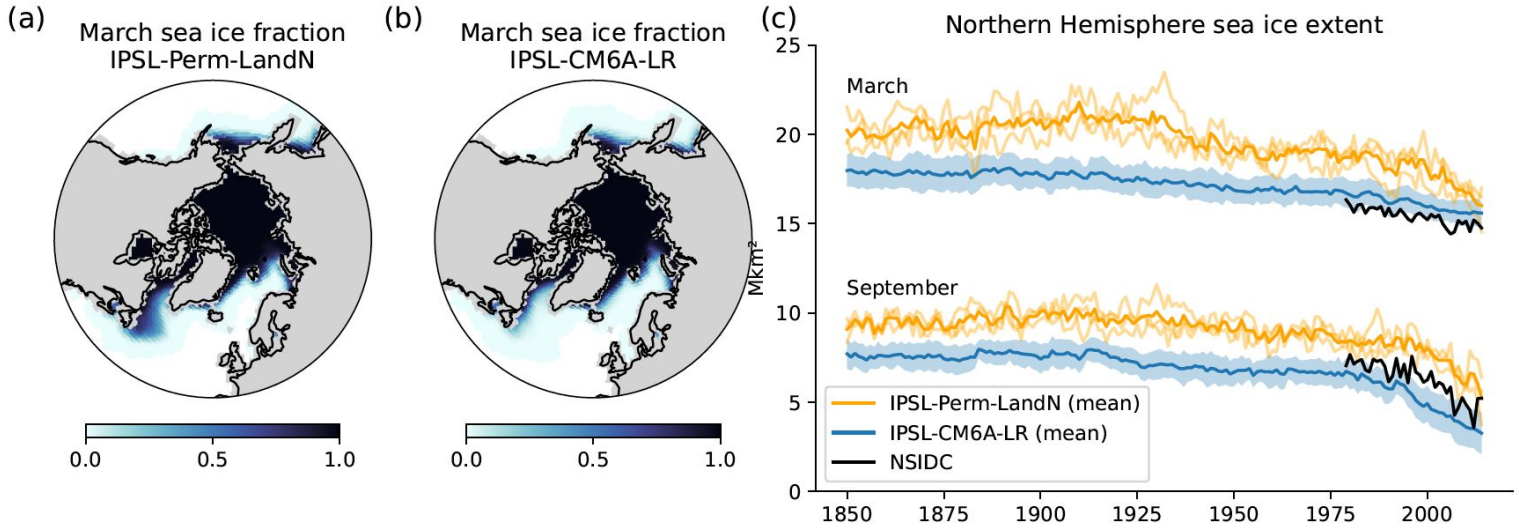
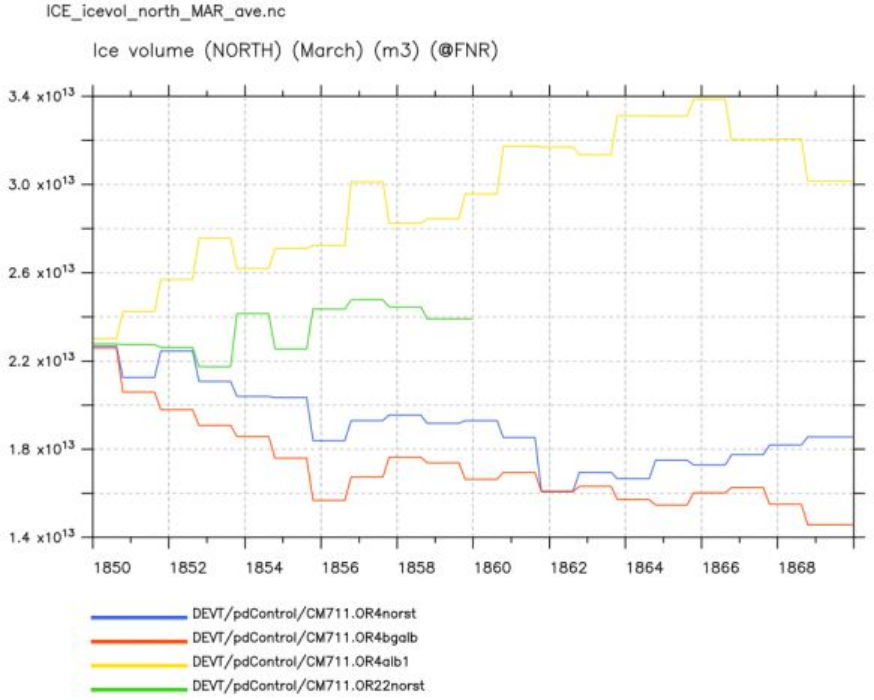
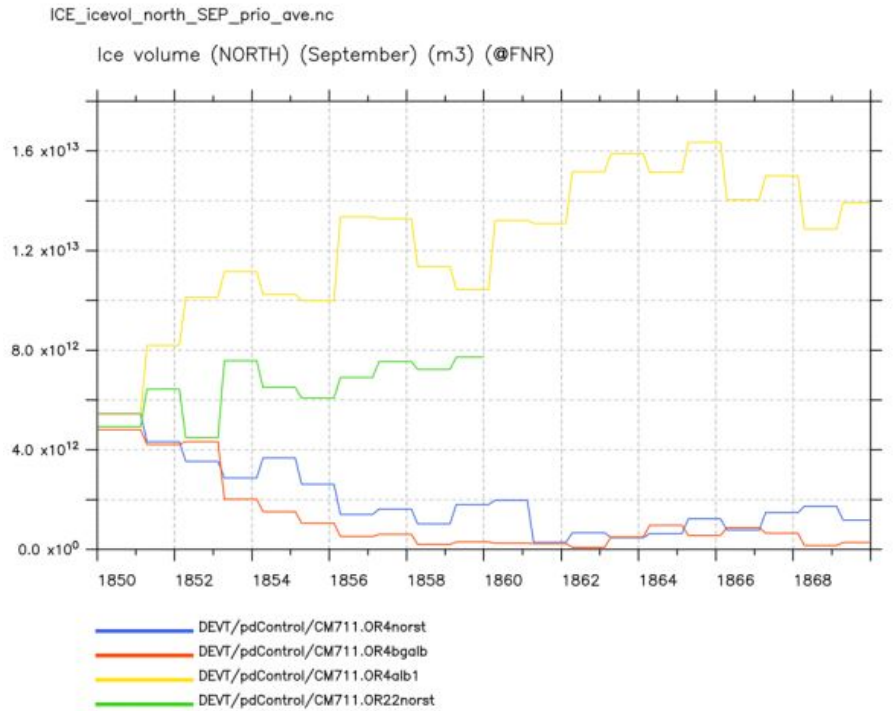


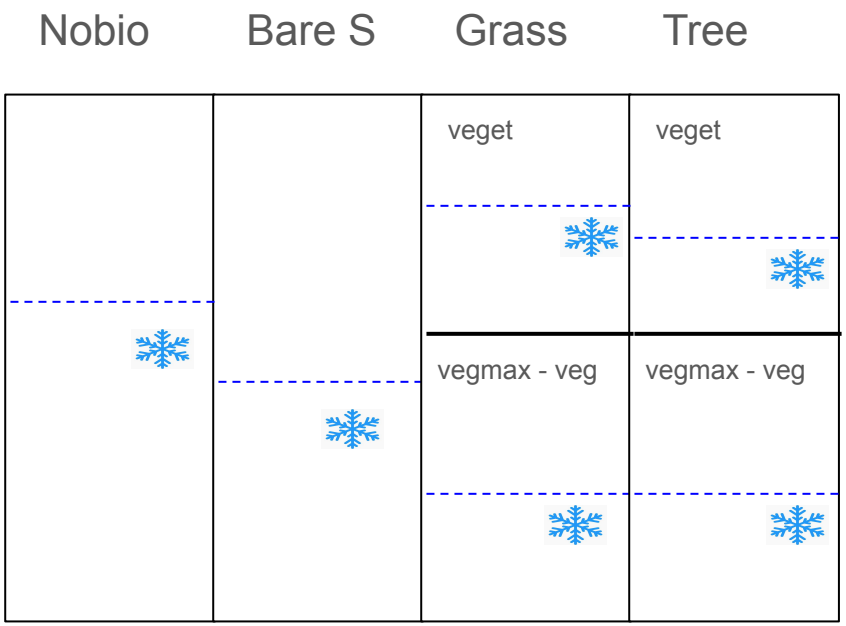
Figure IV.7: **Historical sea ice**. Mean march sea ice fraction (2005-2014) for **(a)** IPSL-Perm-LandN and **(b)** IPSL-CM6A-LR. **(c)** Time series of sea ice extent (total area enclosed within the 15% sea ice fraction) over the Northern Hemisphere for IPSL-Perm-LandN, IPSL-CM6A-LR and NSIDC observations (DiGirolamo et al., 2022). The upper and lower curves represent March and September sea ice extents, respectively. Light orange lines represent the three historical members for IPSL-Perm-LandN. The light blue envelope corresponds to one standard deviation between members.

Result of test with corrected albedo (alb1: “veget based)





Albedo aggregation



- Frac_snow identical / PFT
- snow alb differ / PFT

First calculate snow albedo: snowa

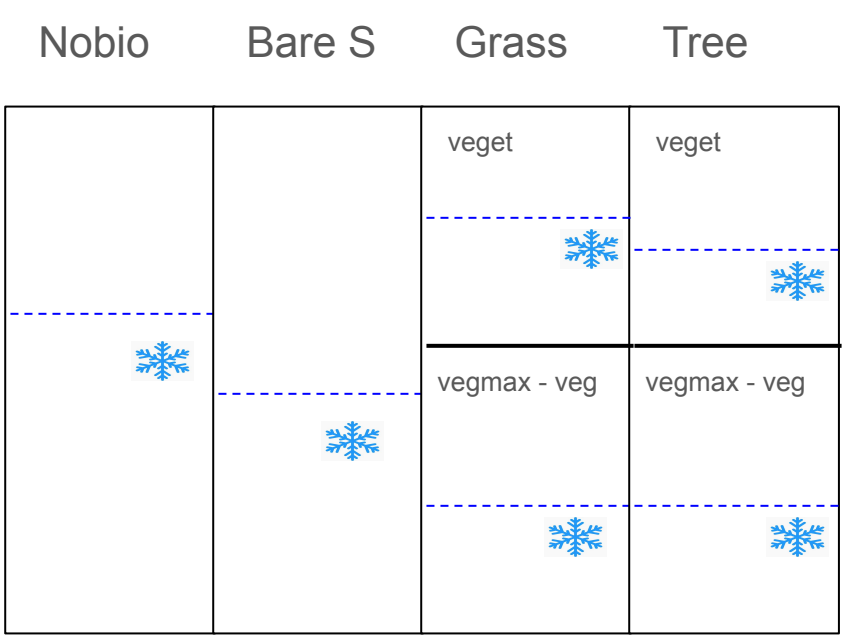
```
agefunc_veg(ipts) = EXP(-snow_age(ipts)/tcst_snowa)
snowa_veg(ipts,ivm,ks) =  snowa_aged_tmp(ivm,ks) + &
                          snowa_dec_tmp(ivm,ks) * agefunc_veg(ipts)
```

Second calculate albedo of 2-Stream RT

```
IF (is_tree(nvm)) THEN
      br_base_temp = (un-frac_snow_veg(ipts)) *  bckgrnd_alb(ipts,ks) + &
                     ( frac_snow_veg(ipts)  ) * snowa_veg(ipts,ivm,ks)
ELSE
      br_base_temp = bckgrnd_alb(ipts,ks)
ENDIF
```

```
converged_albedo = direct_light_weight*Collim_Alb_Tot(nlevels_tot) + &
                   (un-direct_light_weight)*Isotrop_Alb_Tot(nlevels_tot)
```

Albedo aggregation



- Frac_snow identical / PFT
- snow alb differ / PFT

Case “veget” (Alb1)

```
IF (is_tree(nvm)) THEN
   albedo(ipts,ks) = albedo(ipts,ks) +  veget(ipts,ivm) * converged_albedo  + &
   (veget_max(ipts,ivm) - veget(ipts,ivm)) *
        ((un-frac_snow_veg(ipts))*alb_bare(ipts,ks) +
        frac_snow_veg(ipts)*snowa_veg(ipts,ibare_sechiba,ks))
 ELSE
   albedo(ipts,ks) = albedo(ipts,ks) + veget(ipts,ivm) *
        ((un-frac_snow_veg(ipts))*converged_albedo +
        frac_snow_veg(ipts)*snowa_veg(ipts,nvm,ks))  + &
   (veget_max(ipts,ivm) - veget(ipts,ivm)) *
        ((un-frac_snow_veg(ipts))*alb_bare(ipts,ks)
        + frac_snow_veg(ipts)*snowa_veg(ipts,ibare_sechiba,ks))
ENDIF
```

Case “veget_max” (Alb2)

```
IF (is_tree(nvm)) THEN
   albedo(ipts,ks) = albedo(ipts,ks) + veget_max(ipts,ivm) * converged_albedo
ELSE
   albedo(ipts,ks) = albedo(ipts,ks) + &
        veget_max(ipts,ivm) * ((un-frac_snow_veg(ipts))*converged_albedo +
              frac_snow_veg(ipts)*snowa_veg(ipts,nvm,ks))
ENDIF
```

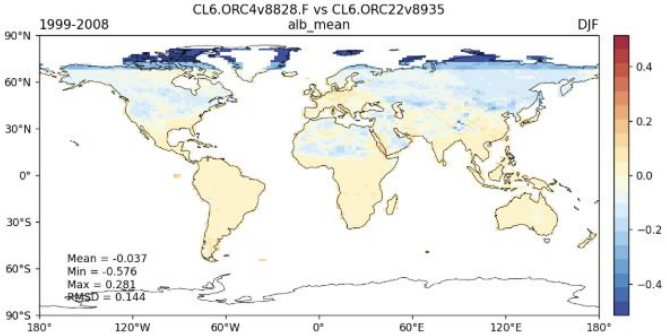
Some CL6 results : https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

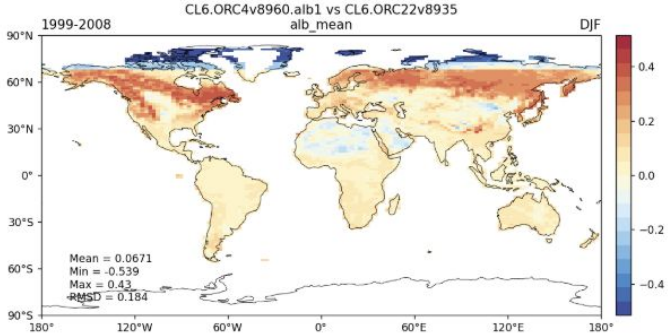
Albedo

ORCV4 - ORC-V2

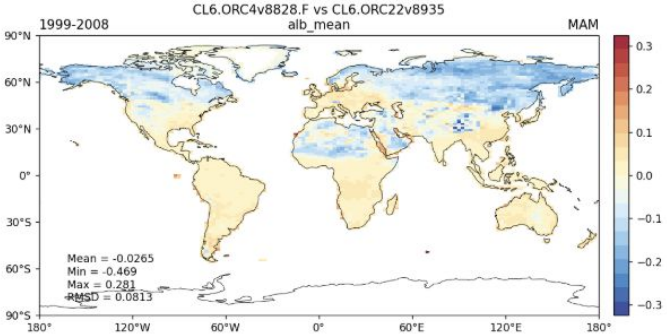
ORC-V4-Alb1 - ORC-V2

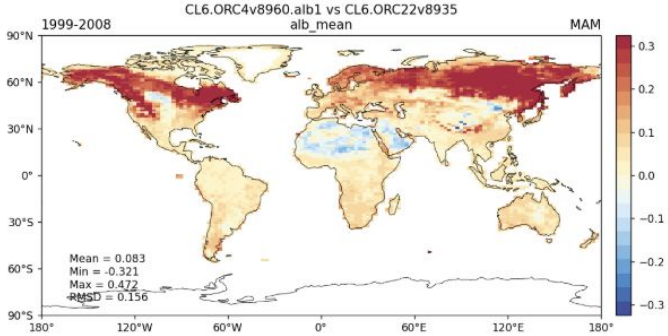
DJF





MAM





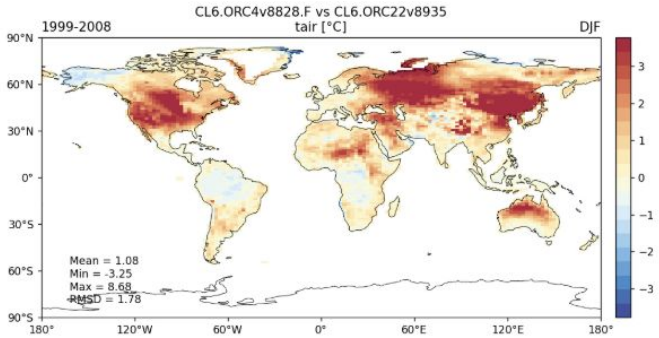
Some CL6 results : https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

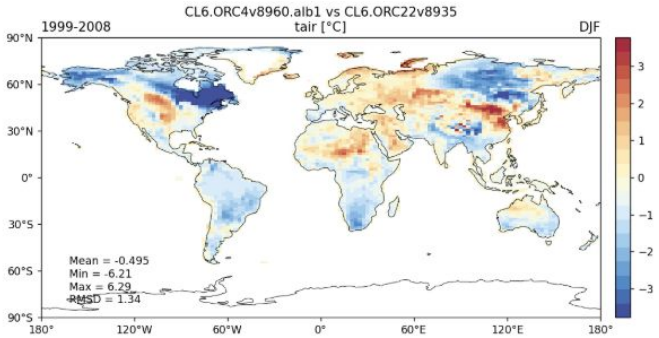
T2m

ORCV4 - ORC-V2

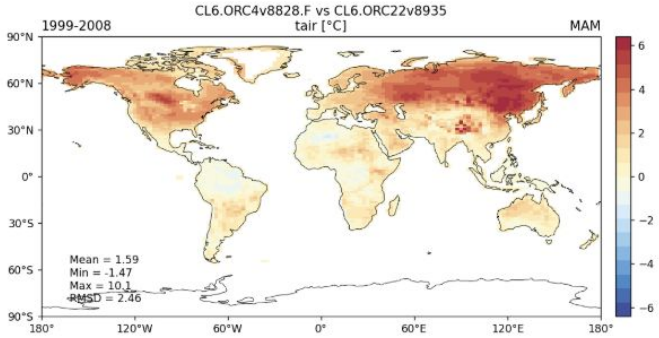
ORC-V4-Alb1 - ORC-V2

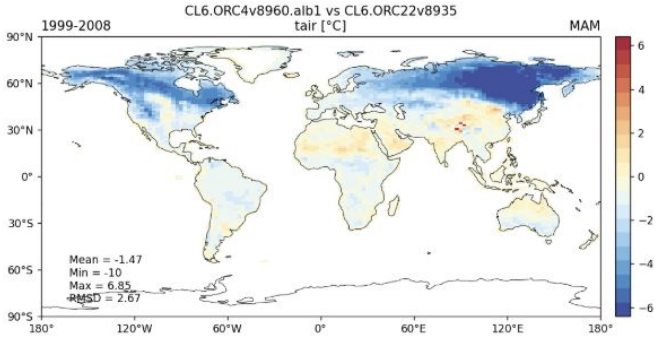
DJF





MAM

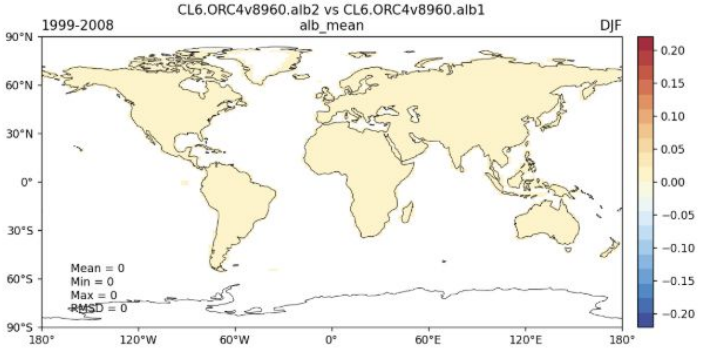


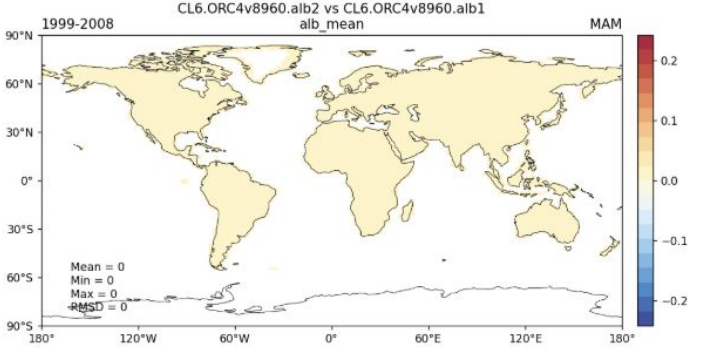


Some CL6 results : https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

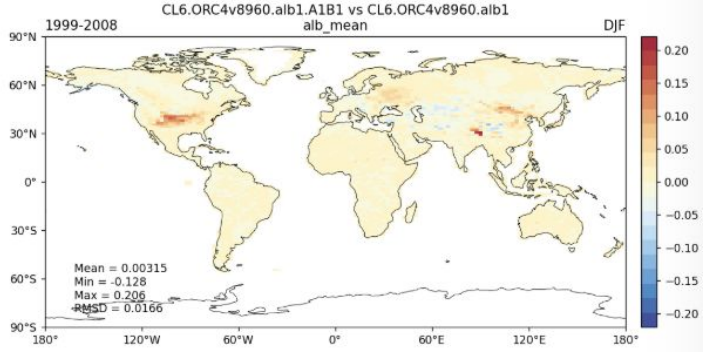
Albedo

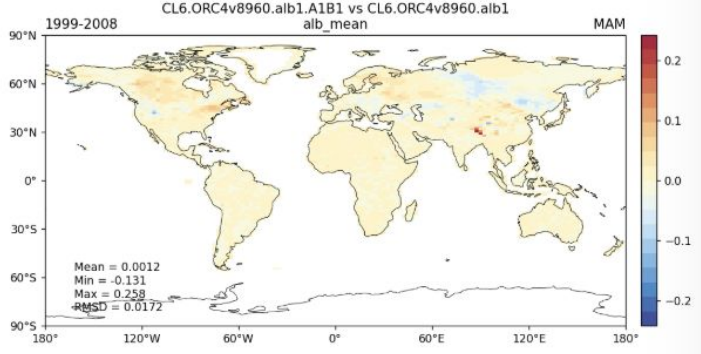
Alb2 - Alb 1





Alb1-A1B1 - Alb 1

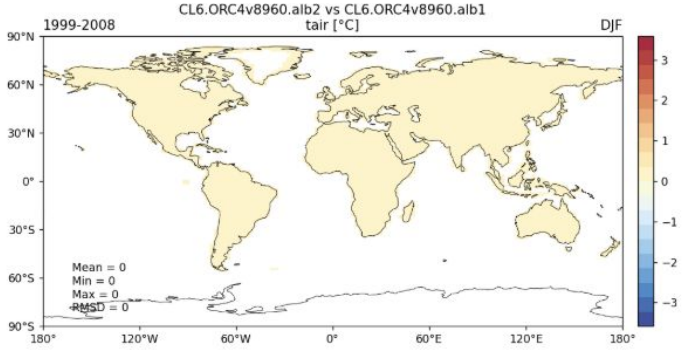


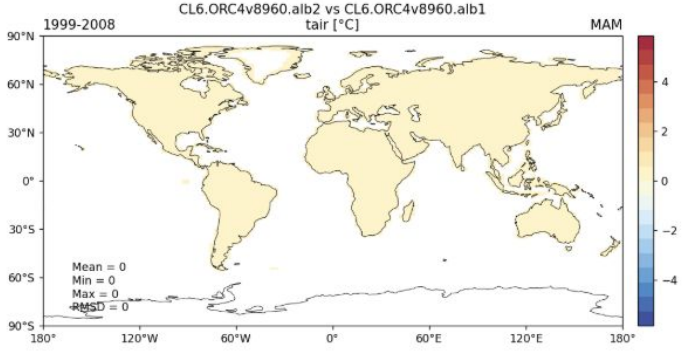


Some CL6 results : https://orchidas.lsce.ipsl.fr/mapper?set=tag4.2modif&mode=CL6&group=0&freq=1&type=2

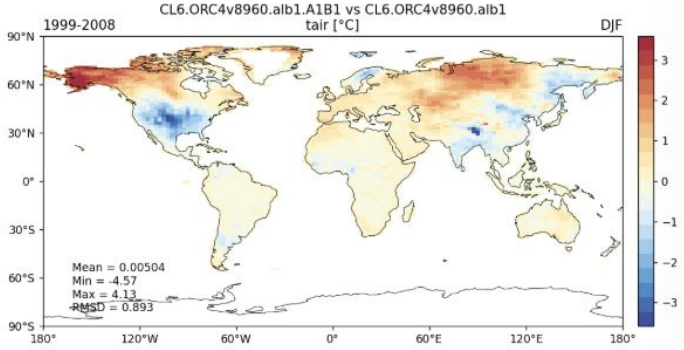
T2m

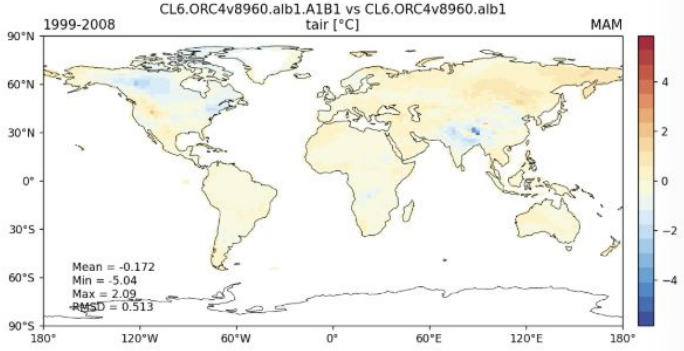
Alb2 - Alb 1





Alb1-A1B1 - Alb 1





Specific questions / issues !

- Veget is calculated with LAI ! Should it be with LAIeff ?
- “Veget case”
  - Not coherent with the idea that Pgap account for whole veget_max !
  -
- “Veget_max case”
  - Maybe not coherent with the calculation of “soil evaporation” that is taken over “veget_max - veget” ?

- Questions for 2-stream RT
  - Mixing direct / diffuse is fixed over time - space ?
  - Correction of “potential negative”