ISBA for climate modelling at CNRM

The story starts in the early 1990s… but without ISBA

Climate Dynamics 11:487–505

Climate Dynamics

Climatology and interannual variability simulated by the ARPEGE-OPA coupled model

L. Terray[1], O. Thual[1], S. Belamari[1], M. Déqué[2], P. Dandin[3*], P. Delecluse[3], C. Lévy[3]

[1] Climate Modelling and Global Change Project, Cerfacs, 42, Avenue Gustave Coriolis, 31057 Toulouse Cedex, France
[2] Météo-France, Centre National de Recherches Météorologiques, 42, Avenue Gustave Coriolis, 31057 Toulouse Cedex, France
[3] Laboratoire d'Océanographie Dynamique et de Climatologie – UMR 121, Université Pierre et Marie Curie – Case 100, 4, Place Jussieu, 75252 Paris Cedex 05, France

Received: 20 June 1994 / Accepted: 24 April 1995

Climate Dynamics (1994) 10:249–266

Climate Dynamics

The ARPEGE/IFS atmosphere model: a contribution to the French community climate modelling

M Déqué, C Dreveton, A Braun, D Cariolle

Météo-France, Centre National de Recherches Météorologiques, 42 Av. Coriolis, Toulouse, France

Received: 30 September 1993/Accepted: 15 April 1994

- ➢ CNRM-CM1 climate model developed at CERFACS
- ➢ Motivations: Study global climate, Seasonal forecast, Climate projections (IPCC report), etc…

- ➢ Based on first version of ARPEGE GCM

The story starts in the early 1990s… but without ISBA

Climate Dynamics 11:487–505

Climate Dynamics

Climatology and interannual variability simulated by the ARPEGE-OPA coupled model

L. Terray[1], O. Thual[1], S. Belamari[1], M. Déqué[2], P. Dandin[3]*, P. Delecluse[3], C. Lévy[3]

[1] Climate Modelling and Global Change Project, Cerfacs, 42, Avenue Gustave Coriolis, 31057 Toulouse Cedex, France
[2] Météo-France, Centre National de Recherches Météorologiques, 42, Avenue Gustave Coriolis, 31057 Toulouse Cedex, France
[3] Laboratoire d'Océanographie Dynamique et de Climatologie – UMR 121, Université Pierre et Marie Curie – Case 100, 4, Place Jussieu, 75252 Paris Cedex 05, France

Received: 20 June 1994 / Accepted: 24 April 1995

Climate Dynamics (1994) 10:249–266

Climate Dynamics

The ARPEGE/IFS atmosphere model: a contribution to the French community climate modelling

M Déqué, C Dreveton, A Braun, D Cariolle

Météo-France, Centre National de Recherches Météorologiques, 42 Av. Coriolis, Toulouse, France

Received: 30 September 1993/Accepted: 15 April 1994

- ➢ CNRM-CM1 climate model developed at CERFACS
- ➢ Motivations: Study global climate, Seasonal forecast, and Climate projections (IPCC report)

➢ Based on first version of ARPEGE GCM

$$\frac{\partial T_{surf}}{\partial t} = \frac{1}{C_s} F_{surf} + \frac{2\pi}{\tau_1}(T_{deep} - T_{surf}) \quad (43)$$

$$\frac{\partial T_{deep}}{\partial t} = \frac{2\pi}{\tau_2}(T_{surf} - T_{deep}) + \frac{2\pi}{\tau_3}(T_{clim} - T_{deep}) \quad (44)$$

➢Force-restore temperature following Bhumralkar (1975) and Blackadar (1976) with simple soil inertia and time constants set to 1, 5 and 20 days

The soil moisture is described by two reservoirs W_{surf} and W_{deep}. The maximum value is 20 mm for W_{surf} and 100 mm for W_{deep}. The time evolution of the reservoirs follows the scheme proposed by Deardorff (1977). A snow reservoir W_{snow} is also calculated. The snow cover S_c is given by:

$$S_c = \frac{W_{scri}}{W_{snow} + W_{scri}} \quad (45)$$

with $W_{scri} = 10$ mm.

➢Simple bucket for hydrology and snow (Manabe 1969)

Based on the EMERAUDE GCM

In the same time… ISBA within EMERAUDE GCM

ELSEVIER

Journal of Hydrology 155 (1994) 353–387

Journal of Hydrology

[3]

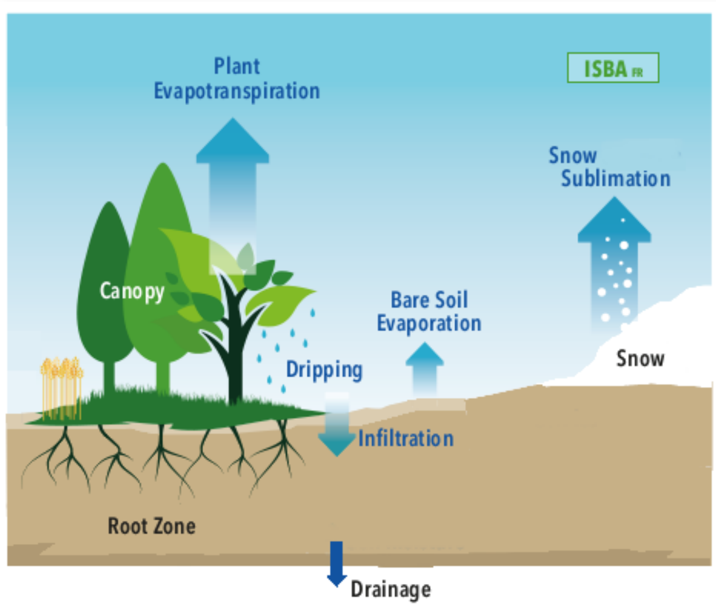
Implementation of the ISBA parametrization scheme for land surface processes in a GCM — an annual cycle experiment

A.O. Manzi*, S. Planton

Météo-France, Centre National de Recherches Météorologiques, 42, av. G. Coriolis, 31057 Toulouse, France

(Received 20 March 1992; revision accepted 7 May 1993)

- First implementation of ISBA in a climate GCM (thesis of Antonio Manzi)
- Motivation : Impact of deforestation



- ISBA-2L original scheme developed by Joel and Serge with the main land surface processes related to vegetation and soil, the gravitational drainage of Jean-François, an obscure simplified snow scheme, but no soil freezing

In the same time… ISBA within EMERAUDE GCM

ELSEVIER

Journal of Hydrology 155 (1994) 353–387

Journal of Hydrology

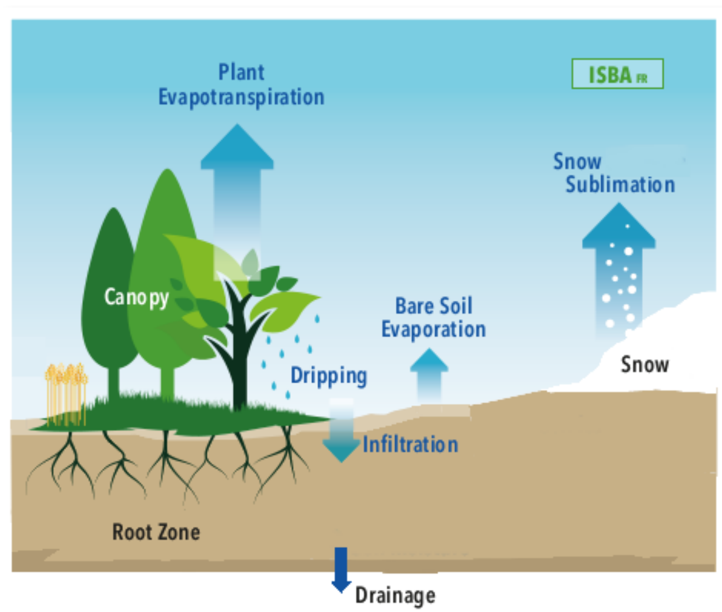
[3]

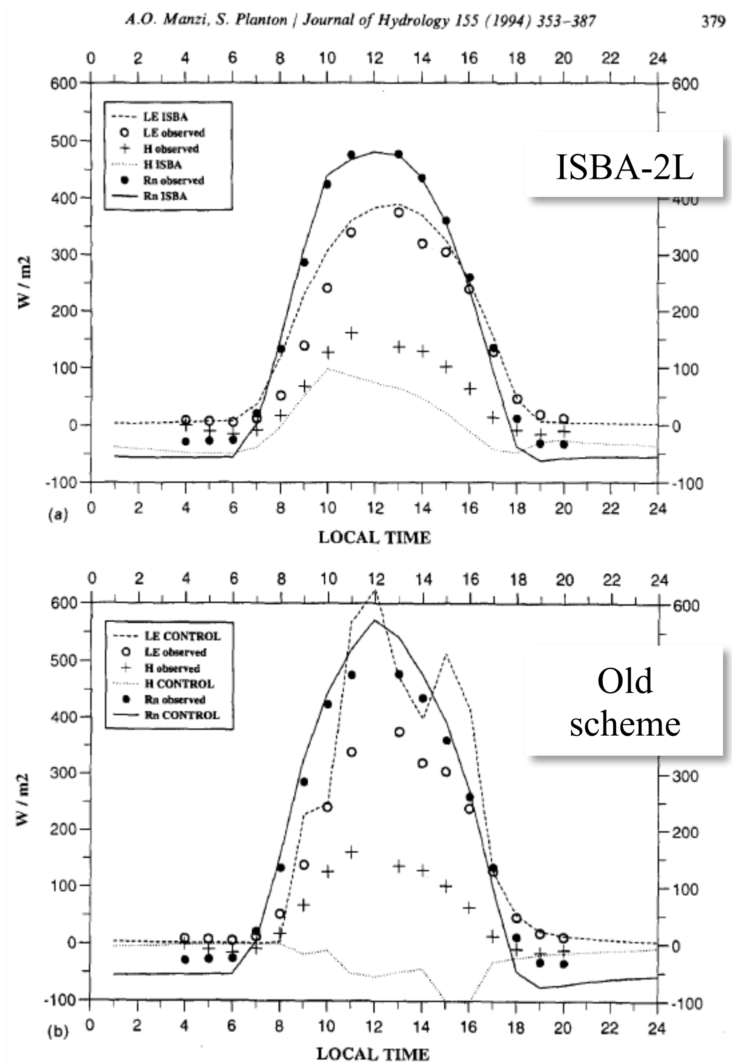
Implementation of the ISBA parametrization scheme for land surface processes in a GCM — an annual cycle experiment

A.O. Manzi*, S. Planton

Météo-France, Centre National de Recherches Météorologiques, 42, av. G. Coriolis, 31057 Toulouse, France

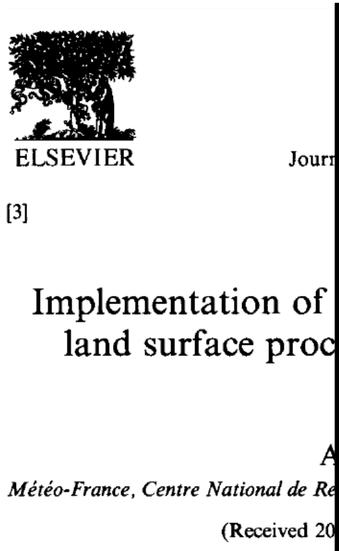
(Received 20 March 1992; revision accepted 7 May 1993)





Surface energy budget simulated in July (climatological diurnal cycle) at a grid point near Manaus (observation from ARME experiment).

In the same time… ISBA within EMERAUDE GCM


ELSEVIER

Jour

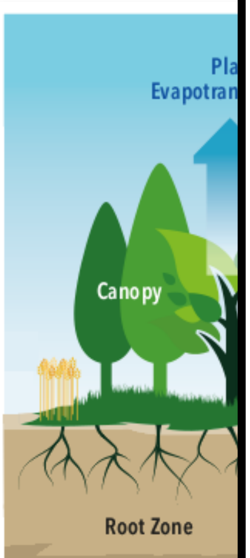
[3]

Implementation of
land surface proc

A

Météo-France, Centre National de Re

(Received 20



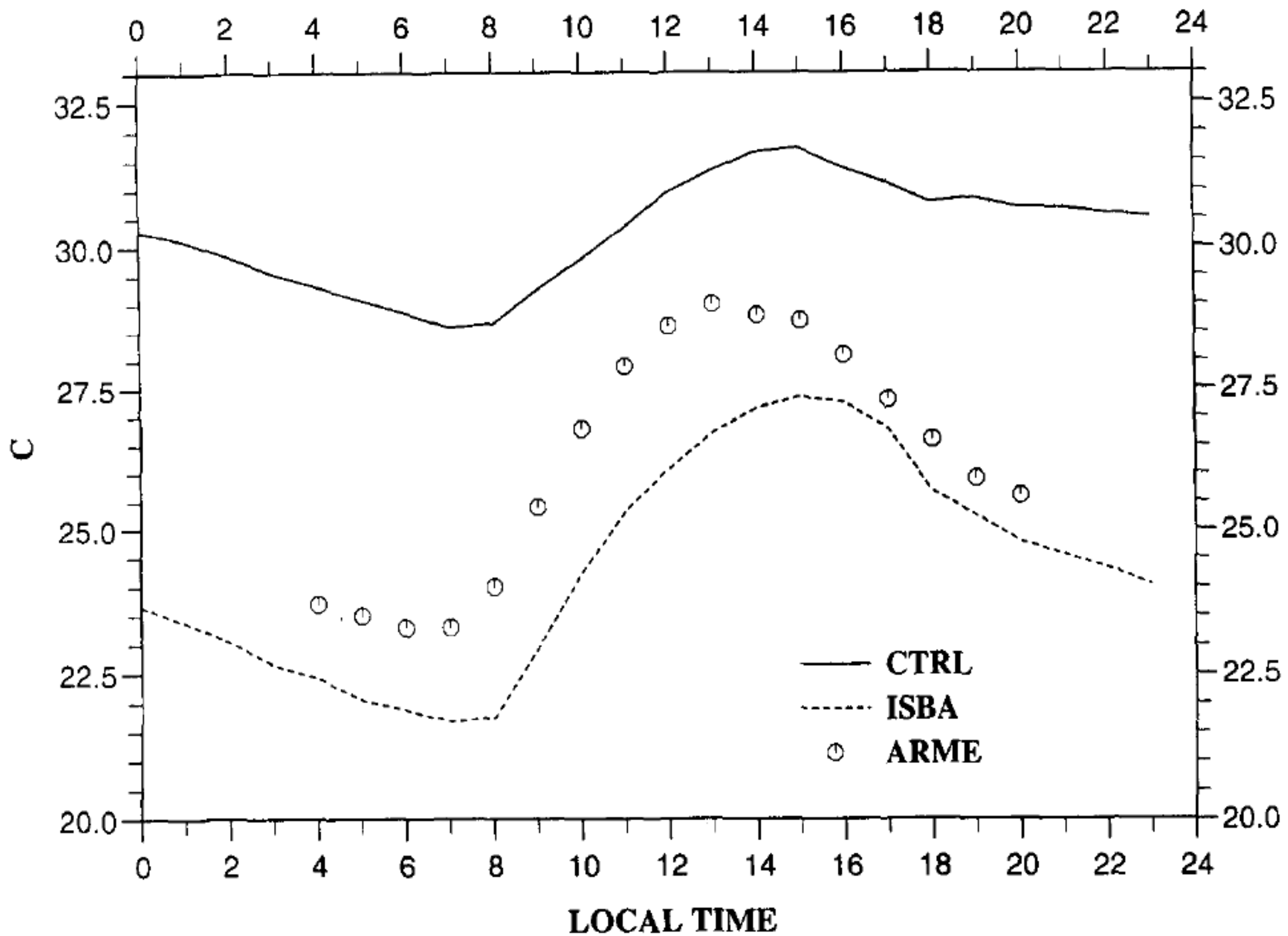


Fig. 8. Surface air temperature averaged for the three simulated July months at the nearest grid point from Manaus (3°S, 60°W) for ISBA and control experiments and observations from the ARME experiment (Shuttleworth et al., 1984, after Sato et al., 1989).

One year later… ISBA within ARPEGE GCM

AUGUST 1995 JOURNAL OF CLIMATE VOLUME 8

The Land Surface Scheme ISBA within the Météo-France Climate Model ARPEGE. Part I: Implementation and Preliminary Results

J.-F. MAHFOUF*

Météo-France/CNRM, Toulouse, France

A. O. MANZI

Instituto Nacional De Pesquisas Espaciais, São José Dos Campos, Brasil

J. NOILHAN, H. GIORDANI, AND M. DÉQUÉ

Météo-France/CNRM, Toulouse, France

(Manuscript received 14 July 1994, in final form 28 February 1995)

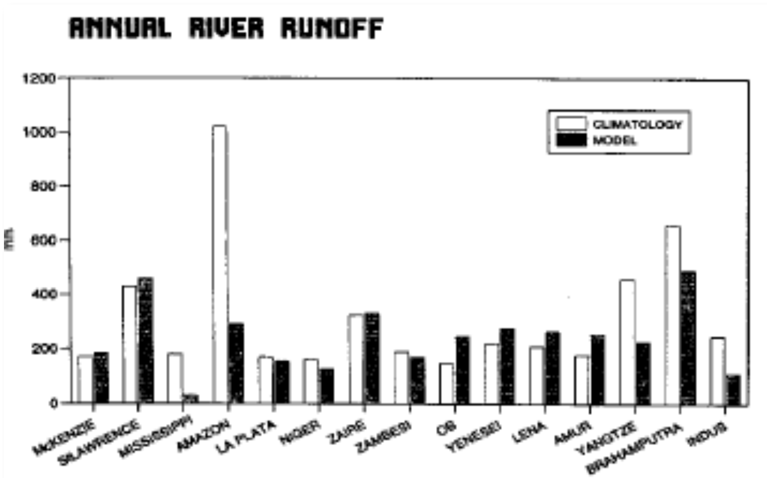


FIG. 7. Mean annual runoff for the world's largest rivers. Comparison between modeled runoff and observed runoff of Milliman and Maede (1983).

One year later… ISBA within ARPEGE GCM

AUGUST 1995 JOURNAL OF CLIMATE VOLUME 8

The Land Surface Scheme ISBA within the Météo-France Climate Model ARPEGE. Part I: Implementation and Preliminary Results

J.-F. MAHFOUF*

Météo-France/CNRM, Toulouse, France

A. O. MANZI

Instituto Nacional De Pesquisas Espaciais, São José Dos Campos, Brasil

J. NOILHAN, H. GIORDANI, AND M. DÉQUÉ

Météo-France/CNRM, Toulouse, France

(Manuscript received 14 July 1994, in final form 28 February 1995)

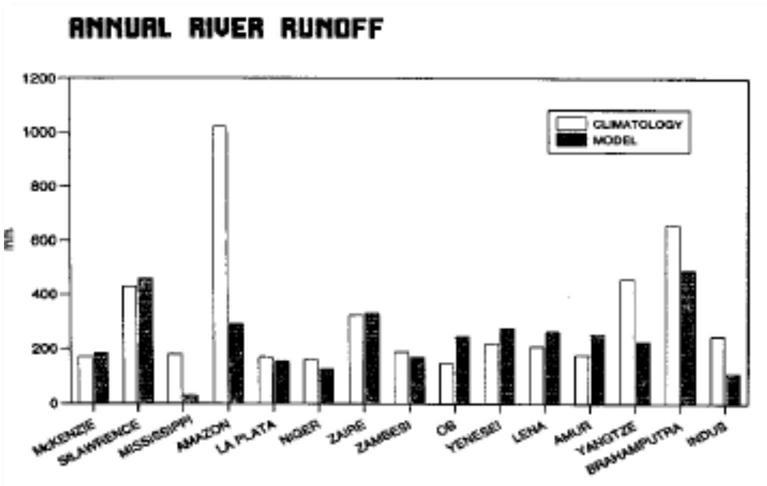


FIG. 7. Mean annual runoff for the world's largest rivers. Comparison between modeled runoff and observed runoff of Milliman and Maede (1983).

<u>The first sub-grid process in ISBA:</u>
Important because coarse GCM grid

By assuming an exponential distribution of precipitation (Eagleson et al. 1987), the drip from the interception reservoir can be written as (Shuttleworth 1988b; Dolman and Gregory 1992):

$$R_r = P_v \exp\left(-\mu \frac{W_r - W_{r\max}}{P_v \Delta t}\right). \qquad (8)$$

The parameter μ represents the fraction of the grid cell area covered by rainfall, and P_v is the mean precipitation rate predicted by the GCM above the canopy within the grid cell.

Important contribution for coarse grids… used today yet !

206 JOURNAL OF CLIMATE VOLUME 8

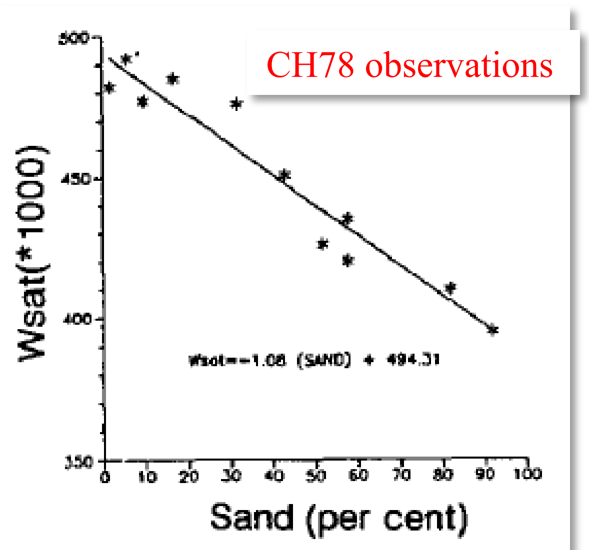
GCM Grid-Scale Evaporation from Mesoscale Modeling

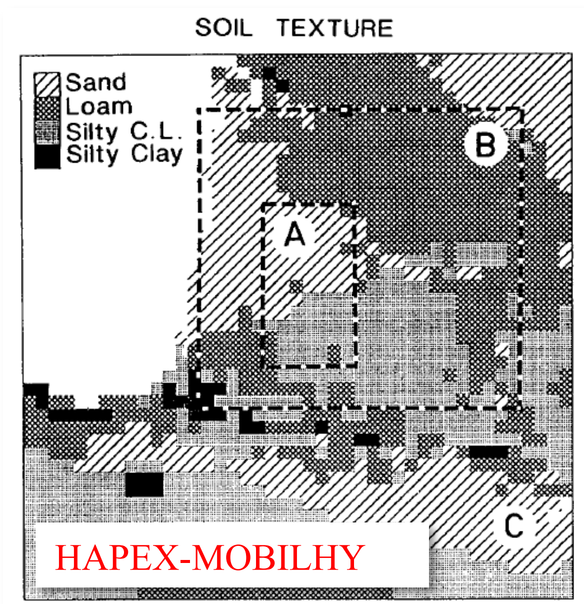
J. NOILHAN AND P. LACARRÈRE
Méteo-France, CNRM, Toulouse, France

(Manuscript received 25 January 1994, in final form 15 June 1994)

ABSTRACT

Aggregation strategy for vegetation and soil parameters





Important contribution for coarse grids… used today yet !

206 JOURNAL OF CLIMATE VOLUME 8

GCM Grid-Scale Evaporation from Mesoscale Modeling

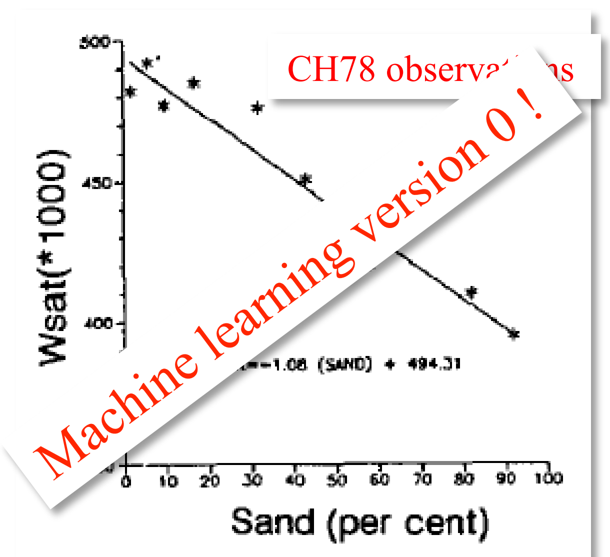
J. NOILHAN AND P. LACARRÈRE

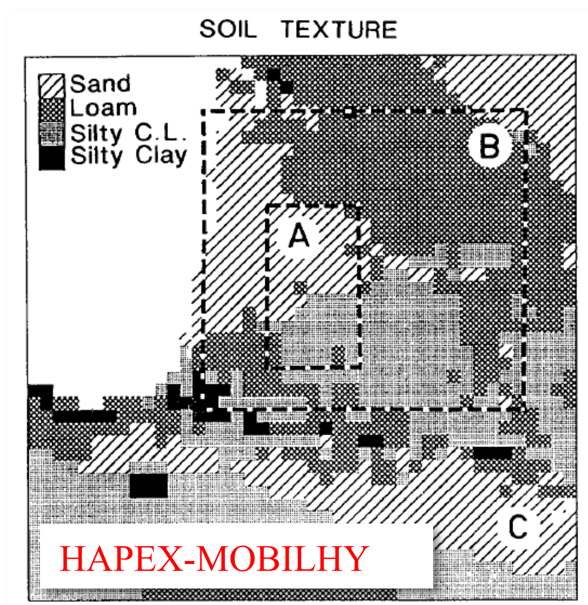
Météo-France, CNRM, Toulouse, France

(Manuscript received 25 January 1994, in final form 15 June 1994)

ABSTRACT

Aggregation strategy for vegetation and soil parameters





Important contribution for coarse grids… used today yet !

206 JOURNAL OF CLIMATE VOLUME 8

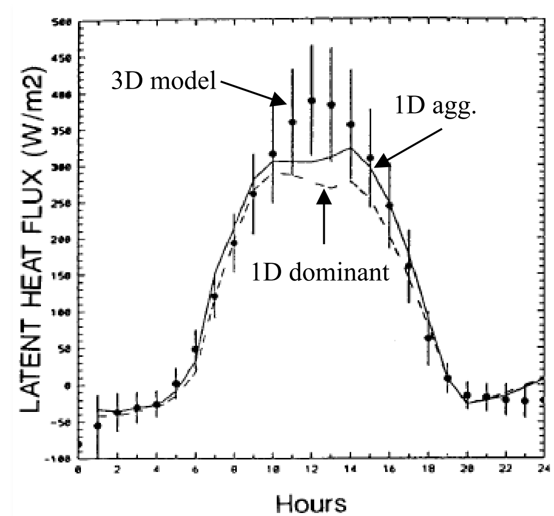
GCM Grid-Scale Evaporation from Mesoscale Modeling

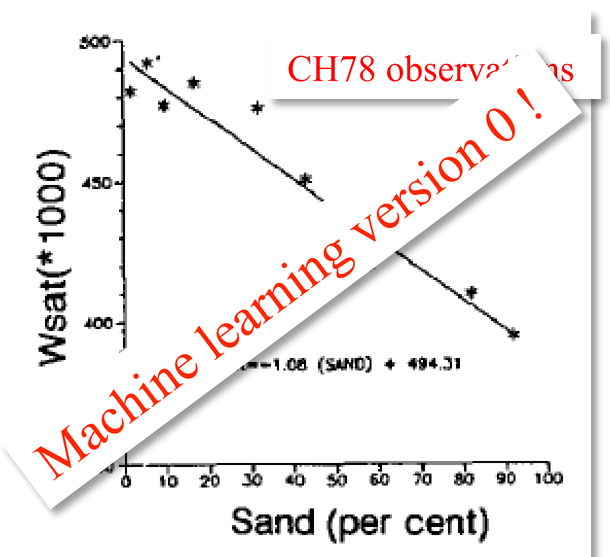
J. NOILHAN AND P. LACARRÈRE
Méteo-France, CNRM, Toulouse, France

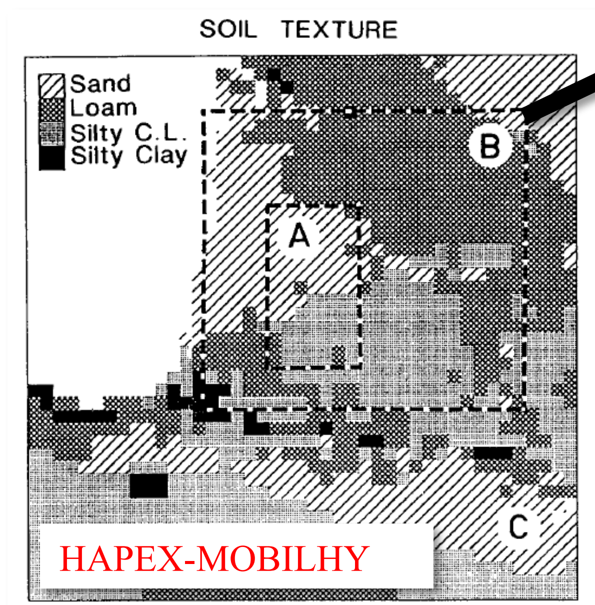
(Manuscript received 25 January 1994, in final form 15 June 1994)

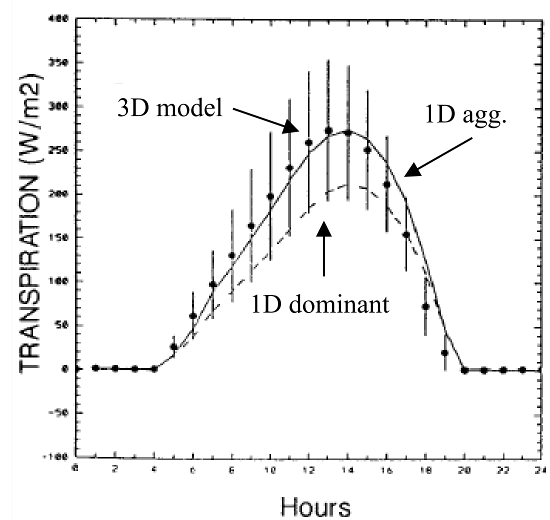
ABSTRACT

Aggregation strategy for vegetation and soil parameters

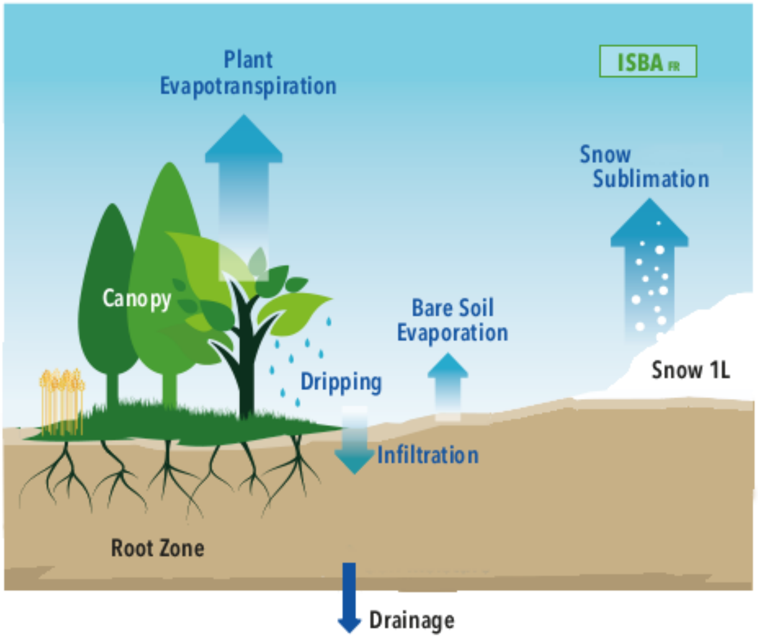


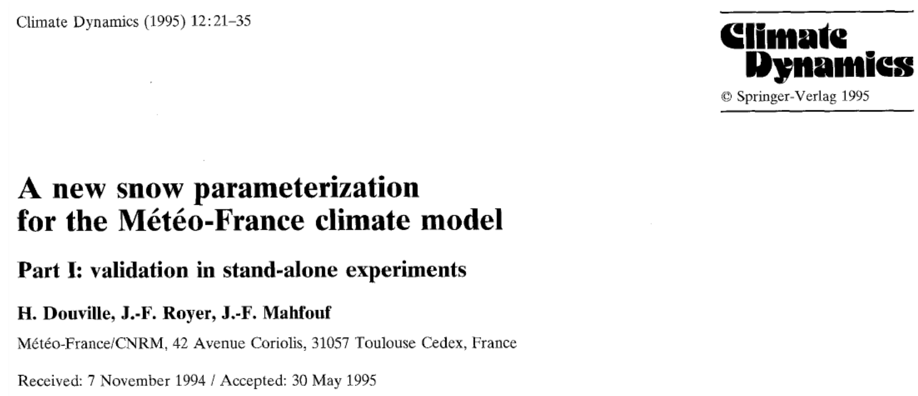






From CNRM-CM2 to build CNRM-CM3




Climate Dynamics (1995) 12:21–35

Climate Dynamics

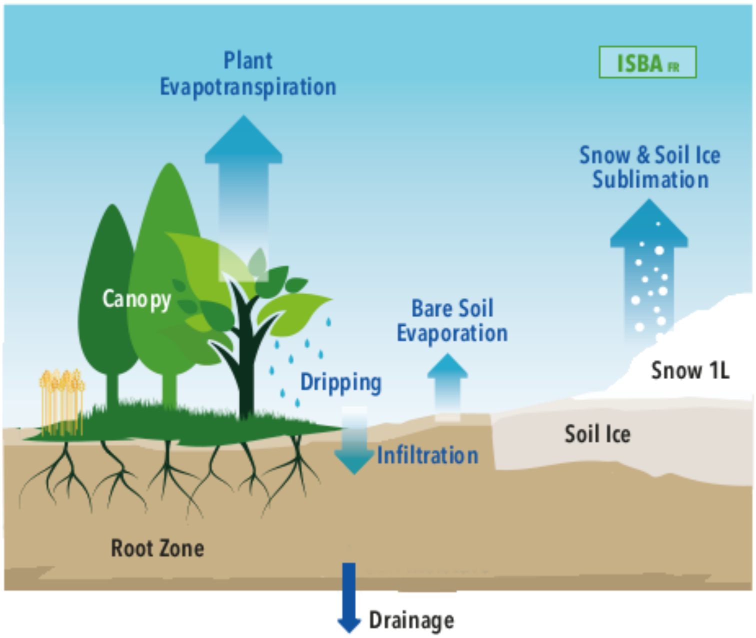
A new snow parameterization for the Météo-France climate model

Part I: validation in stand-alone experiments

H. Douville, J.-F. Royer, J.-F. Mahfouf
Météo-France/CNRM, 42 Avenue Coriolis, 31057 Toulouse Cedex, France

Received: 7 November 1994 / Accepted: 30 May 1995

From CNRM-CM2 to build CNRM-CM3



Climate Dynamics (1995) 12:21–35

Climate Dynamics

A new snow parameterization for the Météo-France climate model

Part I: validation in stand-alone experiments

H. Douville, J.-F. Royer, J.-F. Mahfouf

Météo-France/CNRM, 42 Avenue Coriolis, 31057 Toulouse Cedex, France

Received: 7 November 1994 / Accepted: 30 May 1995

MONTHLY WEATHER REVIEW VOLUME 128

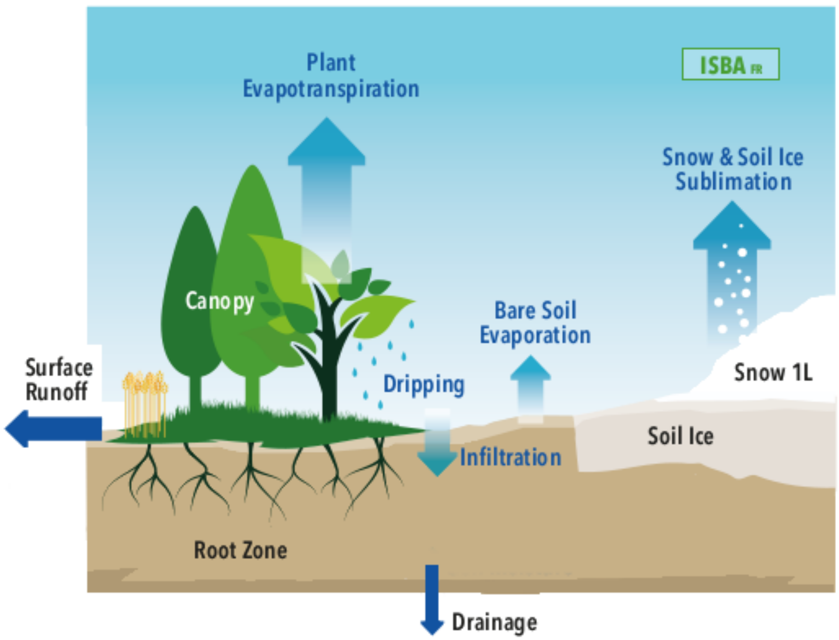
Implementation of a New Assimilation Scheme for Soil and Surface Variables in a Global NWP Model

D. GIARD AND E. BAZILE

Météo-France/CNRM, Toulouse, France

(Manuscript received 27 July 1998, in final form 26 May 1999)

From CNRM-CM2 to build CNRM-CM3



Climate Dynamics (1995) 12:21–35

Climate Dynamics

A new snow parameterization for the Météo-France climate model

Part I: validation in stand-alone experiments

H. Douville, J.-F. Royer, J.-F. Mahfouf

Météo-France/CNRM, 42 Avenue Coriolis, 31057 Toulouse Cedex, France

Received: 7 November 1994 / Accepted: 30 May 1995

Prognostic snow albedo and density

MONTHLY WEATHER REVIEW VOLUME 128

Implementation of a New Assimilation Scheme for Soil and Surface Variables in a Global NWP Model

D. GIARD AND E. BAZILE

Météo-France/CNRM, Toulouse, France

(Manuscript received 27 July 1998, in final form 26 May 1999)

ELSEVIER

Journal of Hydrology 217 (1999) 75–96

Journal of Hydrology

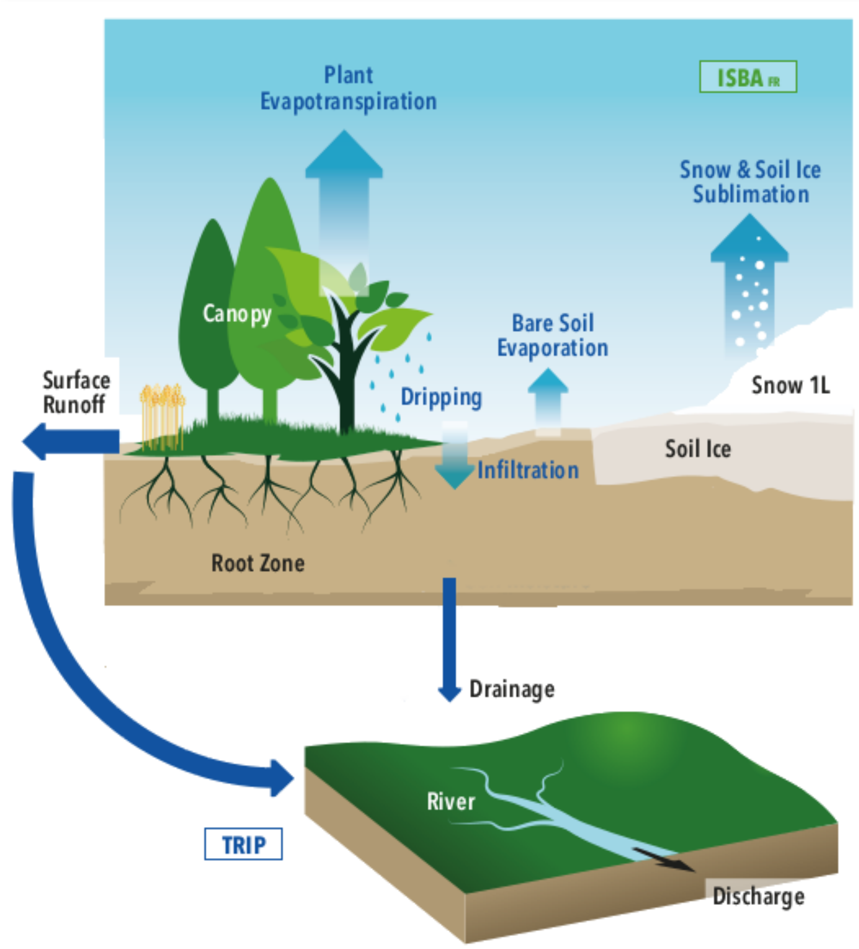
The ISBA surface scheme in a macroscale hydrological model applied to the Hapex-Mobilhy area
Part I: Model and database

F. Habets[a], J. Noilhan[a,*], C. Golaz[b], J.P. Goutorbe[a], P. Lacarrère[a], E. Leblois[c], E. Ledoux[b], E. Martin[a], C. Ottlé[d], D. Vidal-Madjar[d]

[a]*Météo-France/CNRM, 42 avenue Coriolis, 31057 Toulouse, France*
[b]*ENSMP/CIG, 35 rue St Honoré, 77305 Fontainebleau, France*
[c]*CEMAGREF, 3bis quai Chauveau, 69336 Lyon, France*
[d]*CETP/CNRS/UVSQ, 10-12 avenue de l'Europe, 78140 Vélizy, France*

Received 12 August 1997; accepted 26 January 1999

From CNRM-CM2 to build CNRM-CM3



Climate Dynamics (2002) 19: 141–154
DOI 10.1007/s00382-001-0213-9

N. Chapelon · H. Douville · P. Kosuth · T. Oki

Off-line simulation of the Amazon water balance: a sensitivity study with implications for GSWP

Climate Dynamics (1995) 12:21–35

Climate Dynamics

A new snow parameterization for the Météo-France climate model

Part I: validation in stand-alone experiments

H. Douville, J.-F. Royer, J.-F. Mahfouf

Météo-France/CNRM, 42 Avenue Coriolis, 31057 Toulouse Cedex, France

Received: 7 November 1994 / Accepted: 30 May 1995

Prognostic snow albedo and density

MONTHLY WEATHER REVIEW VOLUME 128

Implementation of a New Assimilation Scheme for Soil and Surface Variables in a Global NWP Model

D. GIARD AND E. BAZILE

Météo-France/CNRM, Toulouse, France

(Manuscript received 27 July 1998, in final form 26 May 1999)

ELSEVIER

Journal of Hydrology 217 (1999) 75–96

Journal of Hydrology

The ISBA surface scheme in a macroscale hydrological model applied to the Hapex-Mobilhy area
Part I: Model and database

F. Habets[a], J. Noilhan[a,*], C. Golaz[b], J.P. Goutorbe[a], P. Lacarrère[a], E. Leblois[c], E. Ledoux[b], E. Martin[a], C. Ottlé[d], D. Vidal-Madjar[d]

[a]*Météo-France/CNRM, 42 avenue Coriolis, 31057 Toulouse, France*
[b]*ENSMP/CIG, 35 rue St Honoré, 77305 Fontainebleau, France*
[c]*CEMAGREF, 3bis quai Chauveau, 69336 Lyon, France*
[d]*CETP/CNRS/UVSQ, 10-12 avenue de l'Europe, 78140 Vélizy, France*

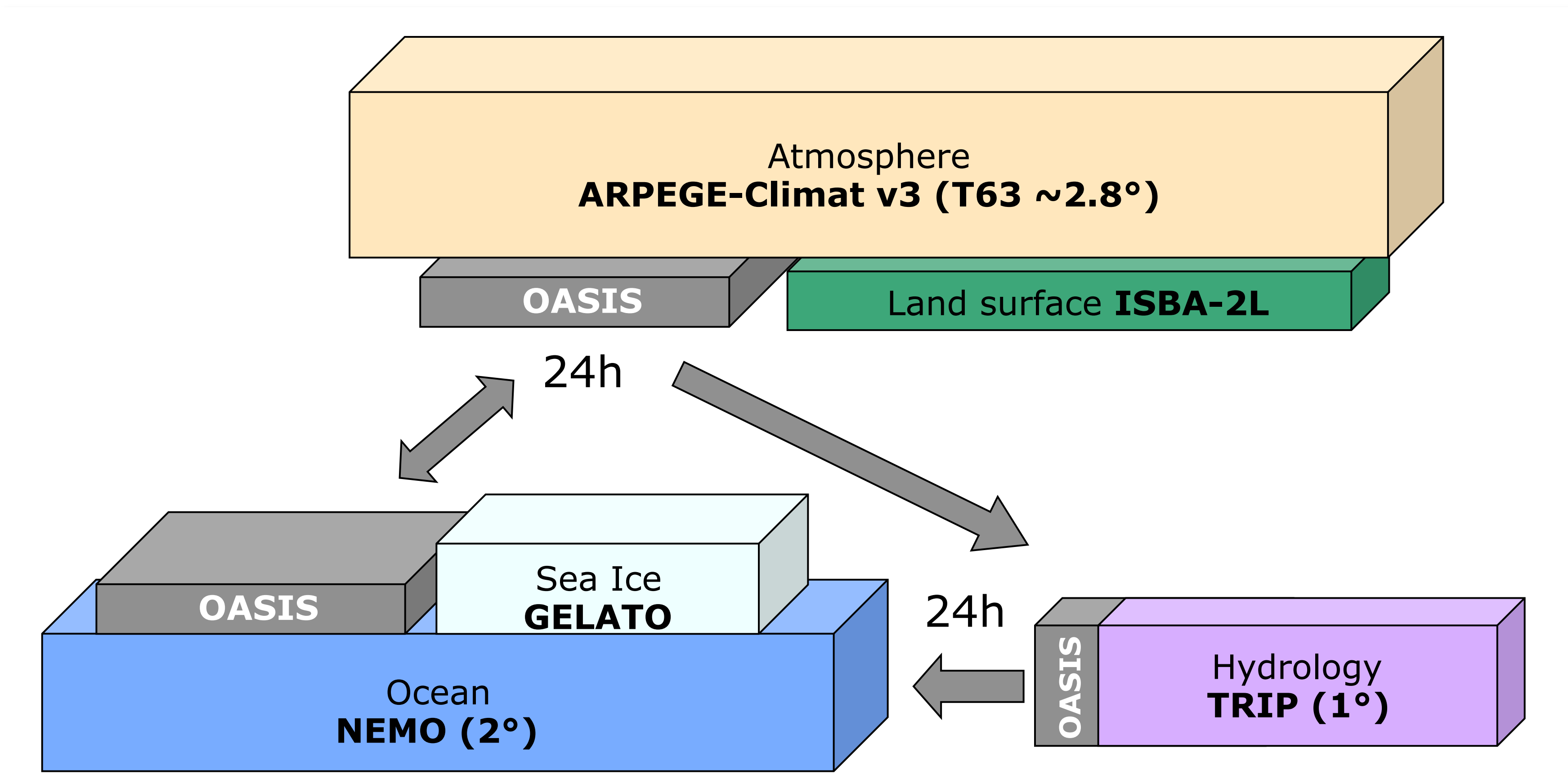
Received 12 August 1997; accepted 26 January 1999

CNRM-CM3 designed in the early 2000's

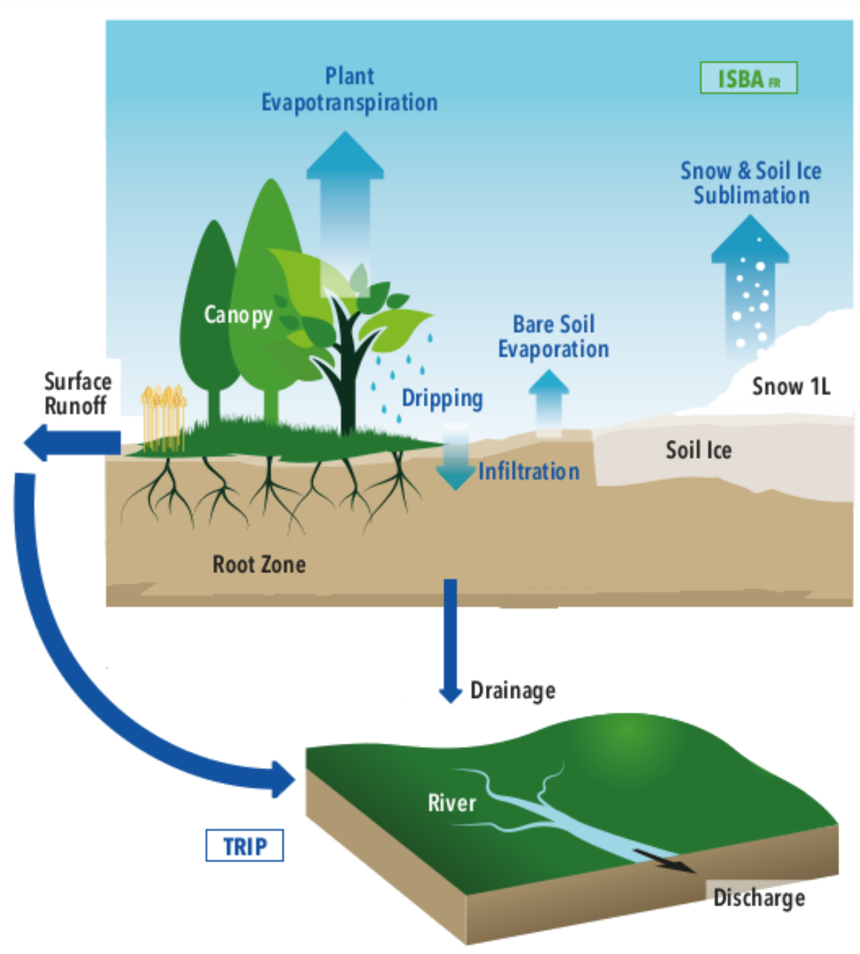
Manuscript draft submitted to Climate Dynamics, 30 september 2005

Description and validation of the CNRM-CM3 global coupled model

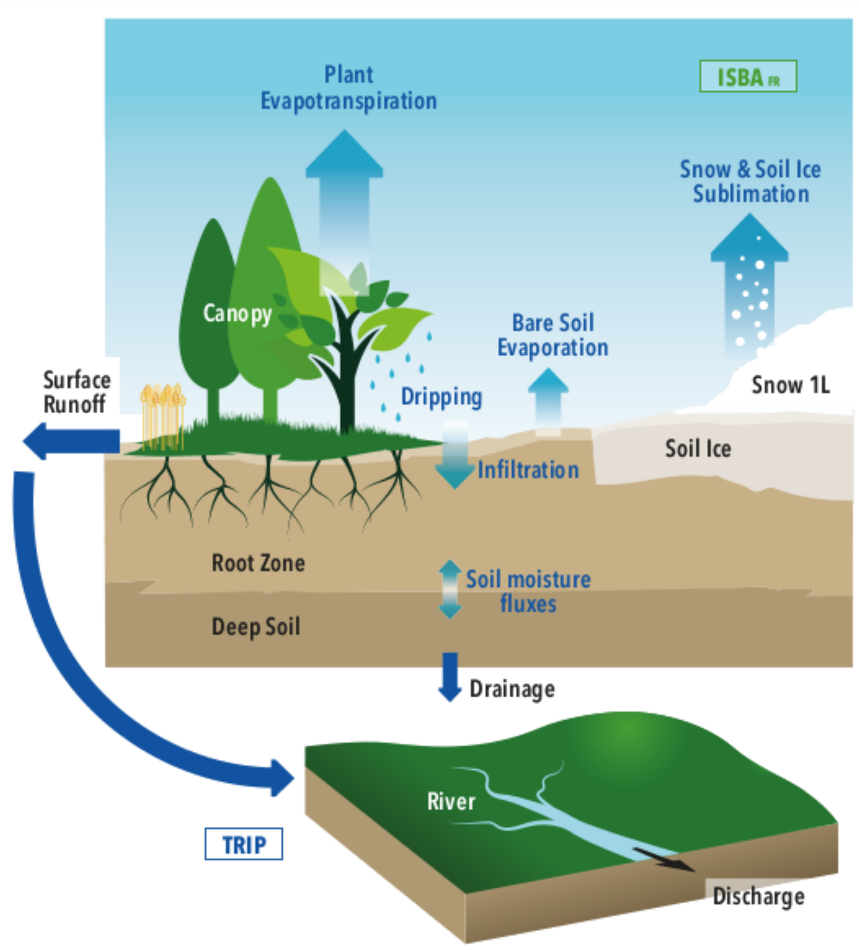
D. Salas-Mélia, F. Chauvin, M. Déqué, H. Douville, J.F. Guérémy, P. Marquet, S. Planton, J.F. Royer and S. Tyteca



From **CNRM-CM3** to build CNRM-CM5



From CNRM-CM3 to build CNRM-CM5



The Influence of the Inclusion of Soil Freezing on Simulations by a Soil–Vegetation–Atmosphere Transfer Scheme

A. Boone and V. Masson

Météo-France/Centre National de Recherche Météorologique, Toulouse, France

T. Meyers

Atmospheric Turbulence and Diffusion Division, National Oceanic and Atmospheric Administration, Oak Ridge, Tennessee

J. Noilhan

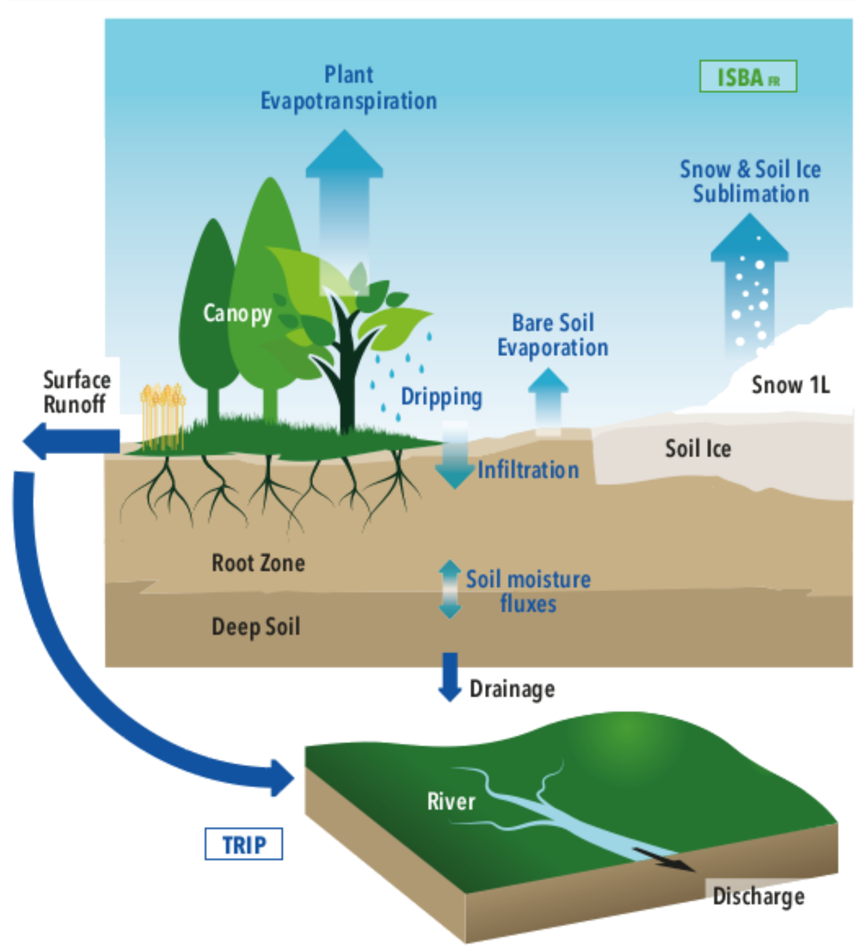
Météo-France/Centre National de Recherche Météorologique, Toulouse, France

Inclusion of a Third Soil Layer in a Land Surface Scheme Using the Force–Restore Method

Aaron Boone, Jean-Christophe Calvet, and Joël Noilhan

Météo-France/Centre National de Recherche Météorologique, Toulouse, France

From CNRM-CM3 to build CNRM-CM5



JOURNAL OF APPLIED METEOROLOGY VOLUME 38

Inclusion of a Third Soil Layer in a Land Surface Scheme Using the Force–Restore Method

AARON BOONE, JEAN-CHRISTOPHE CALVET, AND JOËL NOILHAN
Météo-France/Centre National de Recherche Météorologique, Toulouse, France

1544 JOURNAL OF APPLIED METEOROLOGY VOLUME 39

The Influence of the Inclusion of Soil Freezing on Simulations by a Soil–Vegetation–Atmosphere Transfer Scheme

A. BOONE AND V. MASSON
Météo-France/Centre National de Recherche Météorologique, Toulouse, France

T. MEYERS
Atmospheric Turbulence and Diffusion Division, National Oceanic and Atmospheric Administration, Oak Ridge, Tennessee

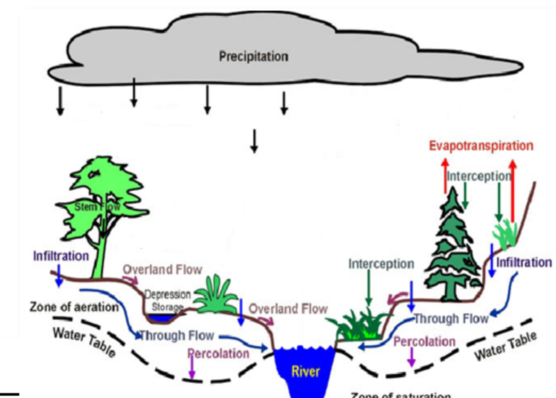
J. NOILHAN
Météo-France/Centre National de Recherche Météorologique, Toulouse, France

62 JOURNAL OF HYDROMETEOROLOGY VOLUME 7

Impact of an Exponential Profile of Saturated Hydraulic Conductivity within the ISBA LSM: Simulations over the Rhône Basin

B. DECHARME, H. DOUVILLE, A. BOONE, F. HABETS, AND J. NOILHAN
Météo-France/CNRM, Toulouse, France

Climate Dynamics (2005)
DOI 10.1007/s00382-005-0059-7



Grid-cell ~50 to 200 km

B. Decharme · H. Douville

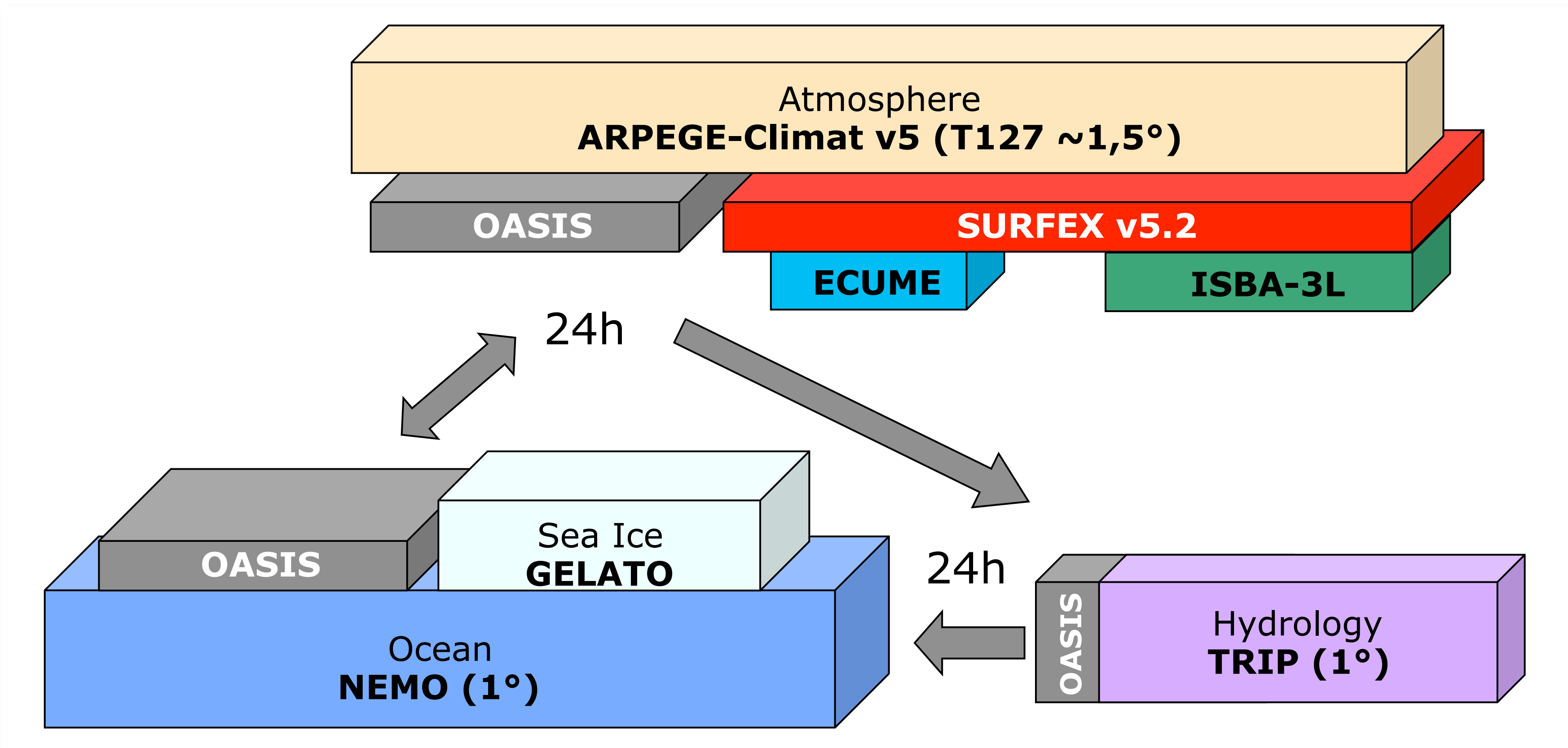
Introduction of a sub-grid hydrology in the ISBA land surface model

CNRM-CM5 designed in the late 2000's

Clim Dyn (2013) 40:2091–2121
DOI 10.1007/s00382-011-1259-y

The CNRM-CM5.1 global climate model: description and basic evaluation

A. Voldoire · E. Sanchez-Gomez · D. Salas y Mélia · B. Decharme · C. Cassou · S. Sénési ·
S. Valcke · I. Beau · A. Alias · M. Chevallier · M. Déqué · J. Deshayes · H. Douville ·
E. Fernandez · G. Madec · E. Maisonnave · M.-P. Moine · S. Planton · D. Saint-Martin ·
S. Szopa · S. Tyteca · R. Alkama · S. Belamari · A. Braun · L. Coquart · F. Chauvin



Global <u>offline</u> climate studies with CM5 version of ISBA

nature climate change

LETTERS

PUBLISHED ONLINE: 29 JULY 2012 | DOI: 10.1038/NCLIMATE1632

Anthropogenic influence on multidecadal changes in reconstructed global evapotranspiration

H. Douville[1]*, A. Ribes[1], B. Decharme[1], R. Alkama[1] and J. Sheffield[2]

Detection & Attribution studies

nature climate change

LETTERS

PUBLISHED ONLINE: 23 MARCH 2014 | DOI: 10.1038/NCLIMATE2159

The rate of sea-level rise

Anny Cazenave[1]*, Habib-Boubacar Dieng[1], Benoit Meyssignac[1], Karina von Schuckmann[2], Bertrand Decharme[3] and Etienne Berthier[1]

Sea level studies

15 June 2011 JOURNAL OF CLIMATE VOLUME 24

Trends in Global and Basin-Scale Runoff over the Late Twentieth Century: Methodological Issues and Sources of Uncertainty

R. Alkama, B. Decharme, H. Douville, and A. Ribes

CNRM-GAME, Météo-France, and CNRS, Toulouse, France

Hydrological studies

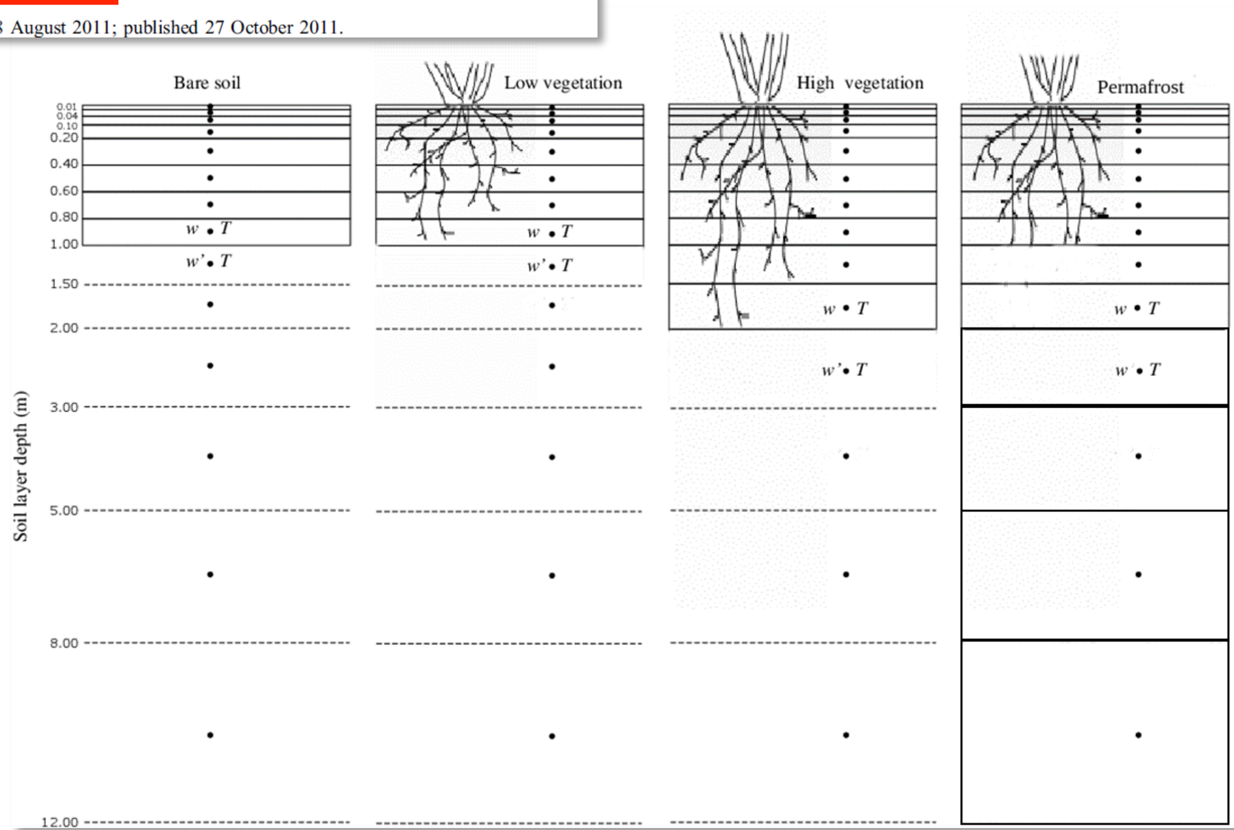
From CNRM-CM5 to build CNRM-CM6 (today)

- 14-Layers explicit soil scheme with the same sub-grid processes for runoff than previously
    - *Boone et al., 2000*
    - JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 116, D20126, doi:10.1029/2011JD016002, 2011

Local evaluation of the Interaction between Soil Biosphere Atmosphere soil multilayer diffusion scheme using four pedotransfer functions

B. Decharme,[1] A. Boone,[1] C. Delire,[1] and J. Noilhan[1]

Received 24 March 2011; revised 13 July 2011; accepted 8 August 2011; published 27 October 2011.



From CNRM-CM5 to build CNRM-CM6 (today)

➢14-Layers explicit soil scheme with the same sub-grid processes for runoff than previously

➢*Boone et al., 2000*

➢

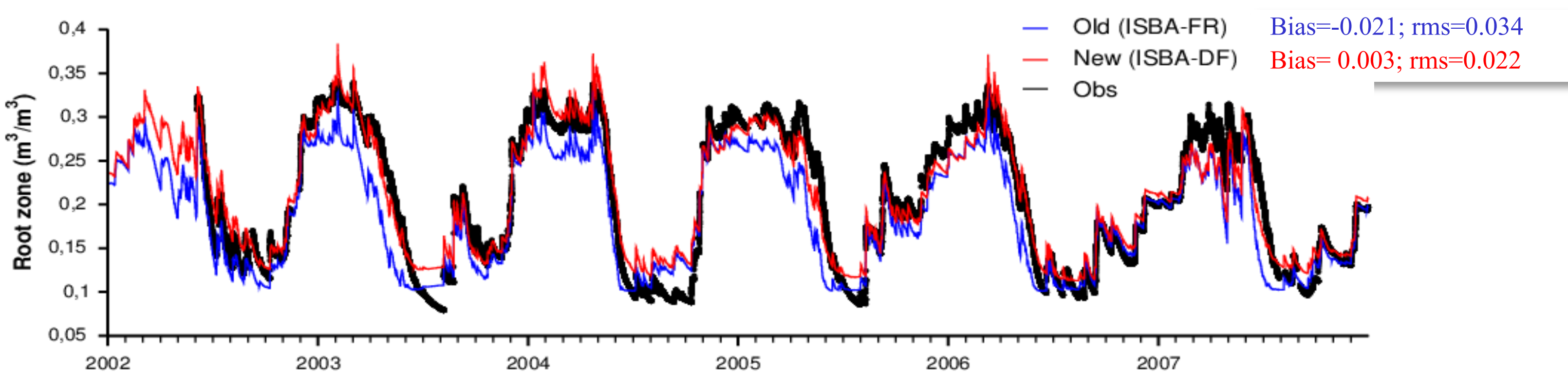
JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 116, D20126, doi:10.1029/2011JD016002, 2011

Local evaluation of the Interaction between Soil Biosphere Atmosphere soil multilayer diffusion scheme using four pedotransfer functions

B. Decharme,[1] A. Boone,[1] C. Delire,[1] and J. Noilhan[1]

Received 24 March 2011; revised 13 July 2011; accepted 8 August 2011; published 27 October 2011.

Root zone soil moisture at SMOSREX



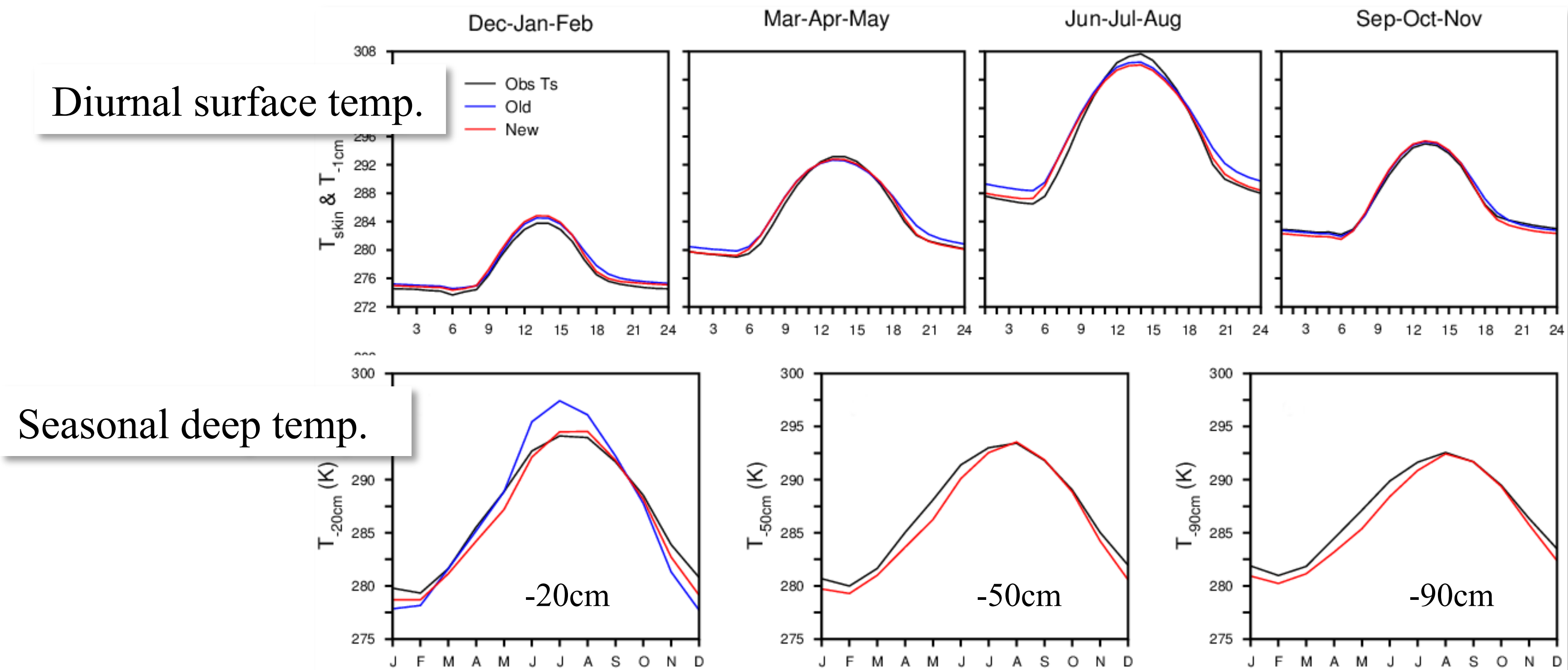
From CNRM-CM5 to build CNRM-CM6 (today)

- <u>14-Layers explicit soil </u>scheme with the same sub-grid processes for runoff than previously
  - *Boone et al., 2000*
  - JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 116, D20126, doi:10.1029/2011JD016002, 2011

Local evaluation of the Interaction between Soil Biosphere Atmosphere soil multilayer diffusion scheme using four pedotransfer functions

B. Decharme,[1] A. Boone,[1] C. Delire,[1] and J. Noilhan[1]

Received 24 March 2011; revised 13 July 2011; accepted 8 August 2011; published 27 October 2011.



From CNRM-CM5 to build CNRM-CM6 (today)

➢14-Layers explicit soil scheme with the same sub-grid processes for runoff than previously
  - ➢*Boone et al., 2000*
  - ➢*Decharme et al., 2011 & 2013*

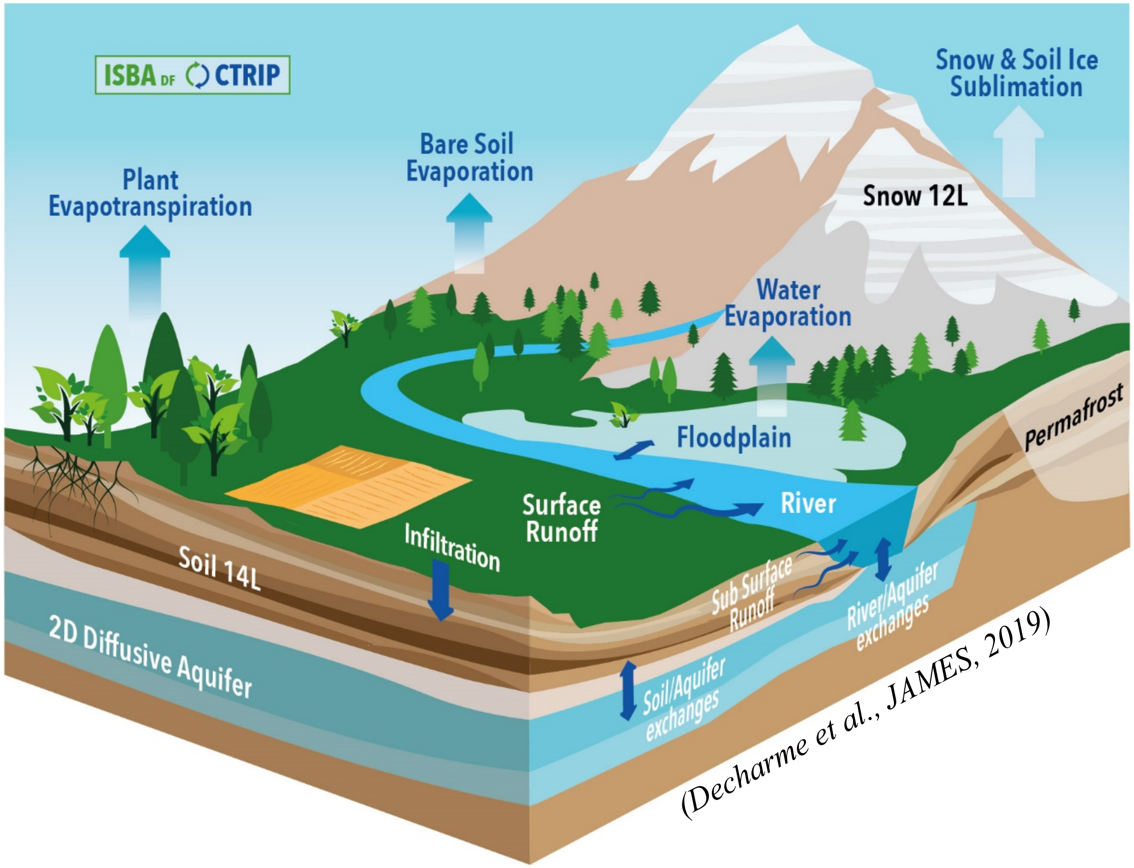
➢Soil organic carbon effects on soil properties
  - ➢*Decharme et al., 2016*

➢12-Layers explicit snow scheme (mass and heat)
  - ➢*Boone and Etchevers, 2001*
  - ➢*Decharme et al., 2016*

➢Transpiration via carbon cycling in the vegetation
  - ➢*Calvet et al., 1998*
  - ➢*Joetzjer et al., 2014*

➢Variable stream flow velocity according water mass and river network at 0.5°
  - ➢*Decharme et al., 2011*

➢ Two-dimensional diffusive aquifer scheme allowing exchanges with the river and upward capillarity fluxes to the subsoil
  - ➢*Vergnes et al., 2012 & 2014*
  - ➢*Vergnes and Decharme, 2012*



https://www.umr-cnrm.fr/spip.php?article1092

➢Floodplains dynamical scheme allowing floodwater evaporation and soil re-infiltration
  - ➢*Decharme et al., 2008 & 2012*

➢Two-way coupling between ISBA and CTRIP via a standardized coupling interface in SURFEX using OASIS-MCT
  - ➢*Voldoire et al. 2017*

➢SURFEX interfaced with the XIOS I/O server in order to provide high performance output for massively parallel simulations

From CNRM-CM5 to build CNRM-CM6 (today)

➢<u>14-Layers explicit soil </u>scheme with the same sub-grid processes for runoff than previously
  - ➢*Boone et al., 2000*
  - ➢*Decharme et al., 2011 & 2013*

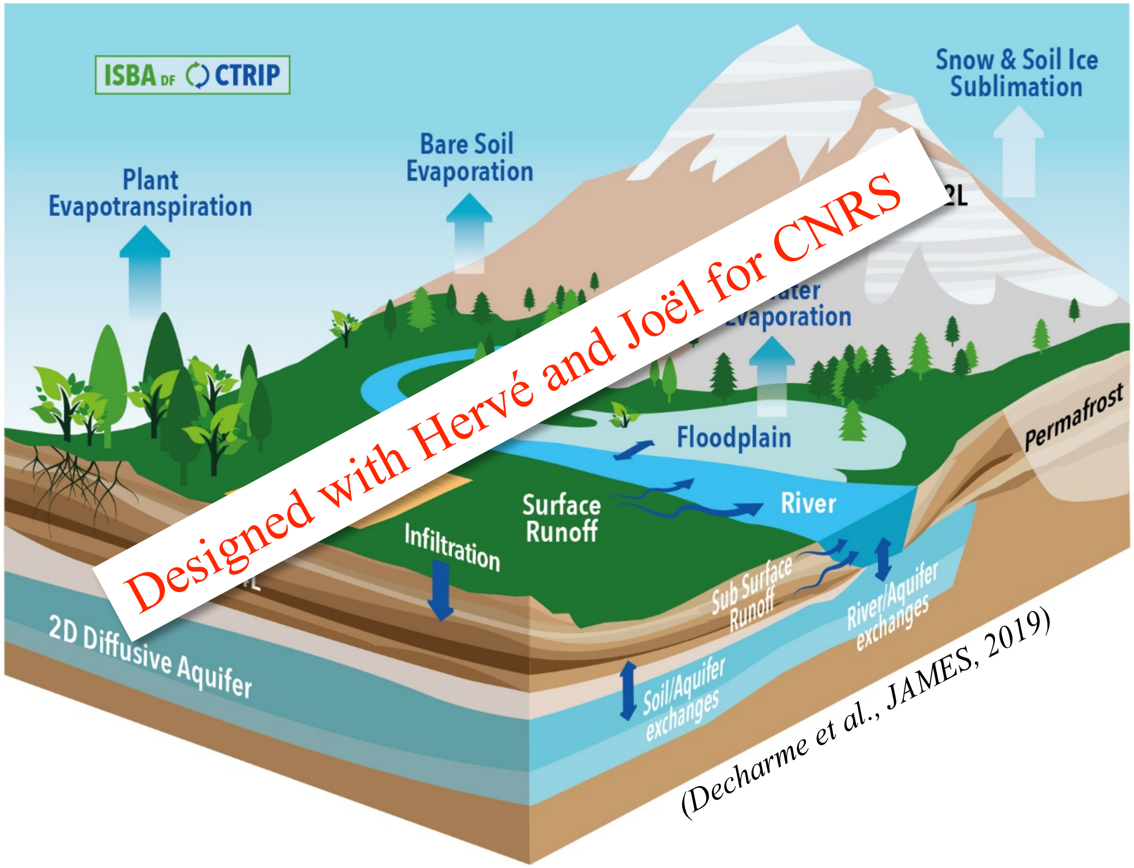
➢Soil organic carbon effects on soil properties
  - ➢*Decharme et al., 2016*

➢<u>12-Layers explicit snow</u> scheme (mass and heat)
  - ➢*Boone and Etchevers, 2001*
  - ➢*Decharme et al., 2016*

➢Transpiration via carbon cycling in the vegetation
  - ➢*Calvet et al., 1998*
  - ➢*Joetzjer et al., 2014*

➢Variable stream flow velocity according water mass and river network at 0.5°
  - ➢*Decharme et al., 2011*

➢ <u>Two-dimensional diffusive aquifer </u>scheme allowing exchanges with the river and <u>upward capillarity fluxes to the subsoil</u>
  - ➢*Vergnes et al., 2012 & 2014*
  - ➢*Vergnes and Decharme, 2012*



https://www.umr-cnrm.fr/spip.php?article1092

➢<u>Floodplains</u> dynamical scheme allowing floodwater evaporation and soil re-infiltration
  - ➢*Decharme et al., 2008 & 2012*

➢<u>Two-way coupling </u>between ISBA and CTRIP via a standardized coupling interface in SURFEX using OASIS-MCT
  - ➢*Voldoire et al. 2017*

➢SURFEX interfaced with the XIOS I/O server in order to provide high performance output for massively parallel simulations

CNRM-CM6 today

Geosci. Model Dev., 10, 4207–4227, 2017
https://doi.org/10.5194/gmd-10-4207-2017

Geoscientific Model Development
Open Access
EGU

SURFEX v8.0 interface with OASIS3-MCT to couple atmosphere with hydrology, ocean, waves and sea-ice models, from coastal to global scales

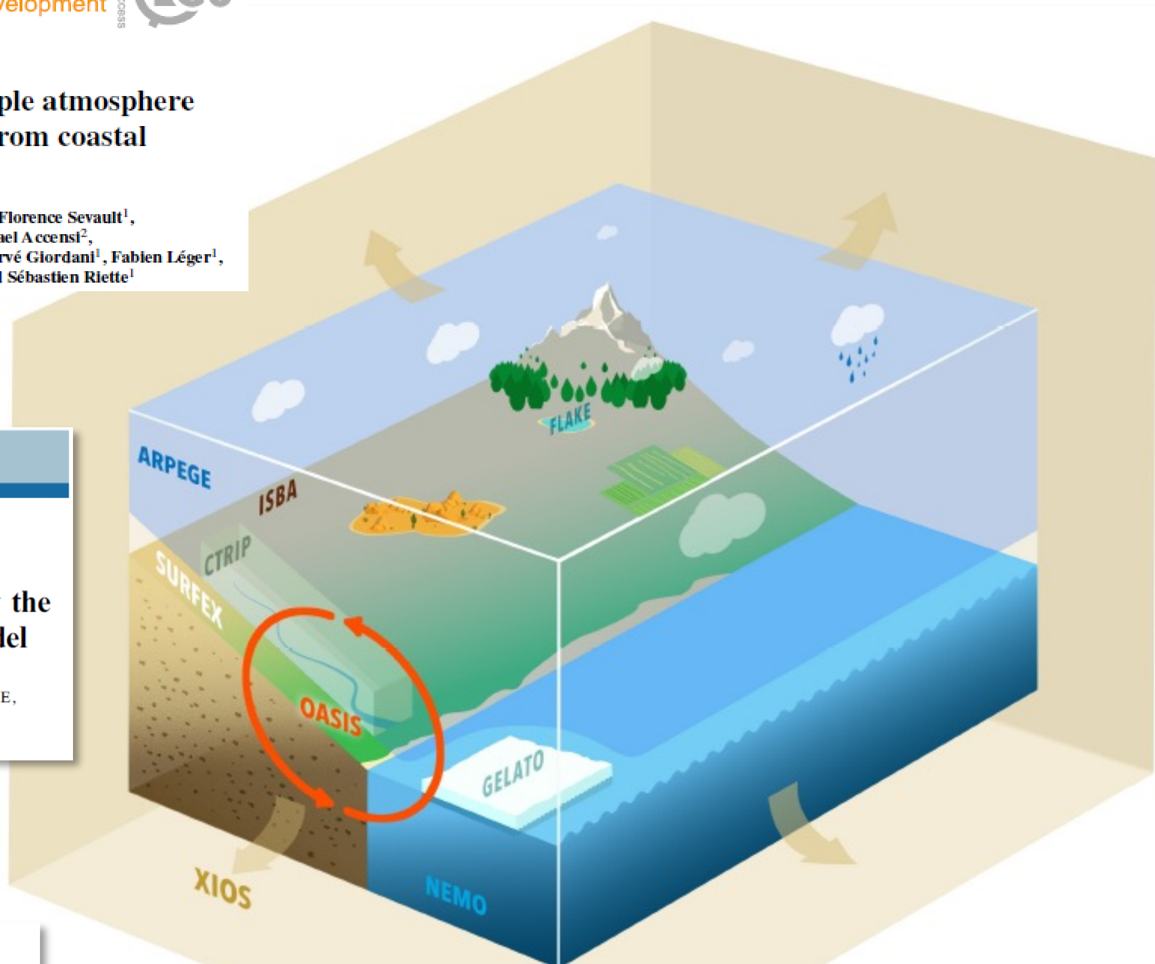
Aurore Voldoire[1], Bertrand Decharme[1], Joris Pianezze[2,4], Cindy Lebeaupin Brossier[1], Florence Sevault[1], Léo Seyfried[3], Valérie Garnier[2], Soline Bielli[4], Sophie Valcke[5], Antoinette Alias[1], Mickael Accensi[2], Fabrice Ardhuin[2], Marie-Noëlle Bouin[1,2], Véronique Ducrocq[1], Stéphanie Faroux[1], Hervé Giordani[1], Fabien Léger[1], Patrick Marsaleix[3], Romain Rainaud[1], Jean-Luc Redelsperger[2], Evelyne Richard[3], and Sébastien Riette[1]

Tellus
SERIES A
DYNAMIC METEOROLOGY AND OCEANOGRAPHY
PUBLISHED BY THE INTERNATIONAL METEOROLOGICAL INSTITUTE IN STOCKHOLM

Impact of lake surface temperatures simulated by the FLake scheme in the CNRM-CM5 climate model

By PATRICK LE MOIGNE*, JEANNE COLIN and BERTRAND DECHARME,
CNRM UMR 3589, CNRS/Météo-France, Toulouse, France

(Manuscript received 4 January 2016; in final form 20 July 2016)



ARPEGE	= T127 (~1,5°) or T355 (0,5°)
NEMO	= 1° or 0,25°
CTRIP	= 0,5°

http://www.umr-cnrm.fr/cmip6/

CNRM-CM6 today

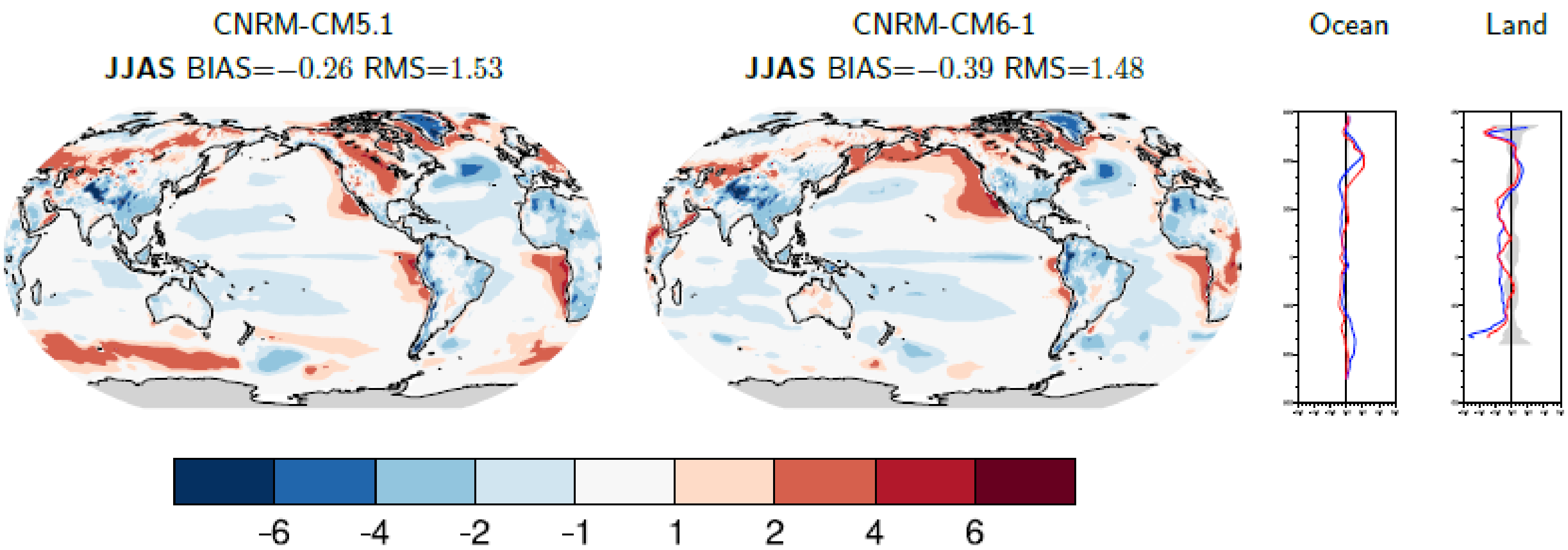


Figure 4: Biases in near surface temperature over land and of sea surface temperature (SST) over oceans for CNRM-CM5.1 (first column) and CNRM-CM6-1 (second column) in DJFM (top row) and JJAS (bottom row). Biases are estimated as the difference between ensemble means of model historical simulations averaged over 1981-2010 and the average of several datasets over the same period. Details on observation products used can be found in Appendix 1. Zonal mean errors over ocean (third column) and land (last column) show the inter-member range (±1,64 times the inter-member variance) for simulations in color shading and the range of data for observational estimates in grey shading.

(Voldoire et al., submitted at JAMES, 2019)

CNRM-CM6 today

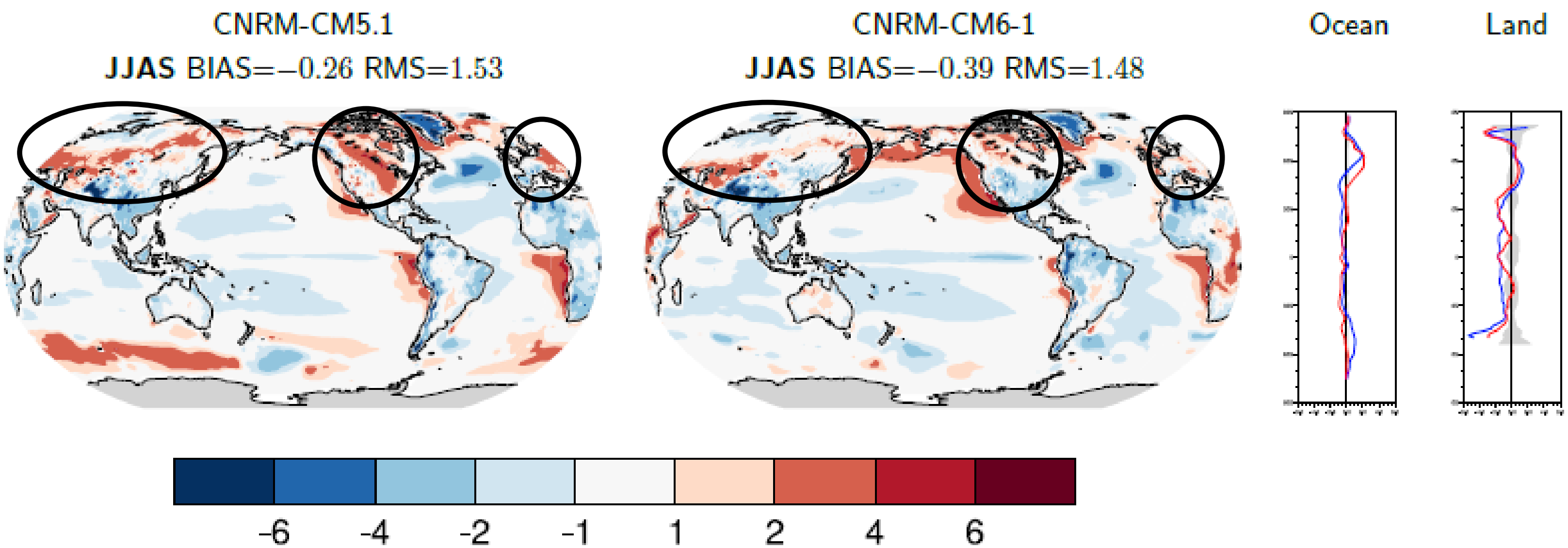


Figure 4: Biases in near surface temperature over land and of sea surface temperature (SST) over oceans for CNRM-CM5.1 (first column) and CNRM-CM6-1 (second column) in DJFM (top row) and JJAS (bottom row). Biases are estimated as the difference between ensemble means of model historical simulations averaged over 1981-2010 and the average of several datasets over the same period. Details on observation products used can be found in Appendix 1. Zonal mean errors over ocean (third column) and land (last column) show the inter-member range (±1,64 times the inter-member variance) for simulations in color shading and the range of data for observational estimates in grey shading.

(Voldoire et al., submitted at JAMES, 2019)

CNRM-CM6 today

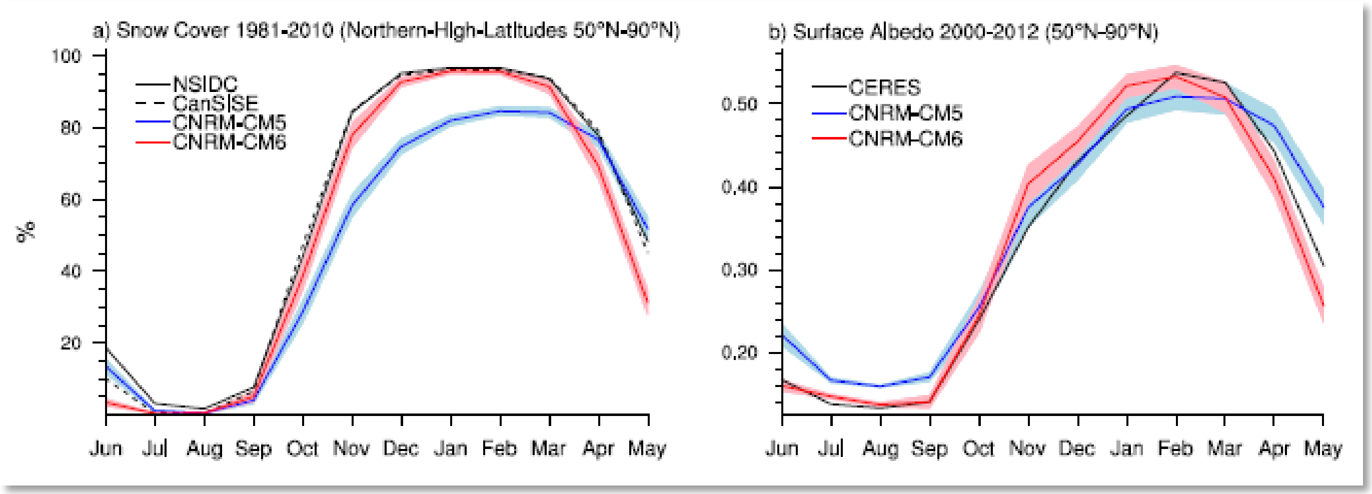


Figure 9: Comparison between observed and simulated monthly-mean seasonal cycles of (a) snow cover extents and (b) surface albedo. Observation are in black, CNRM-CM5 in blue and CNRM-CM6 in red. Details on observation products and processing can be found in Appendix 1.

(Voldoire et al., submitted at JAMES, 2019)

CNRM-CM6 today

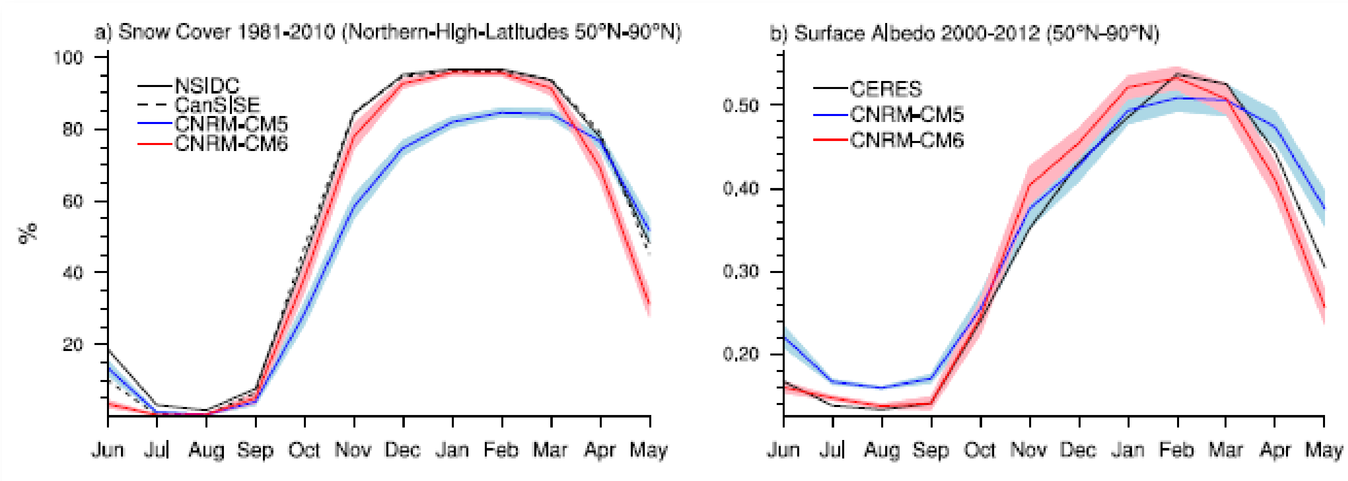
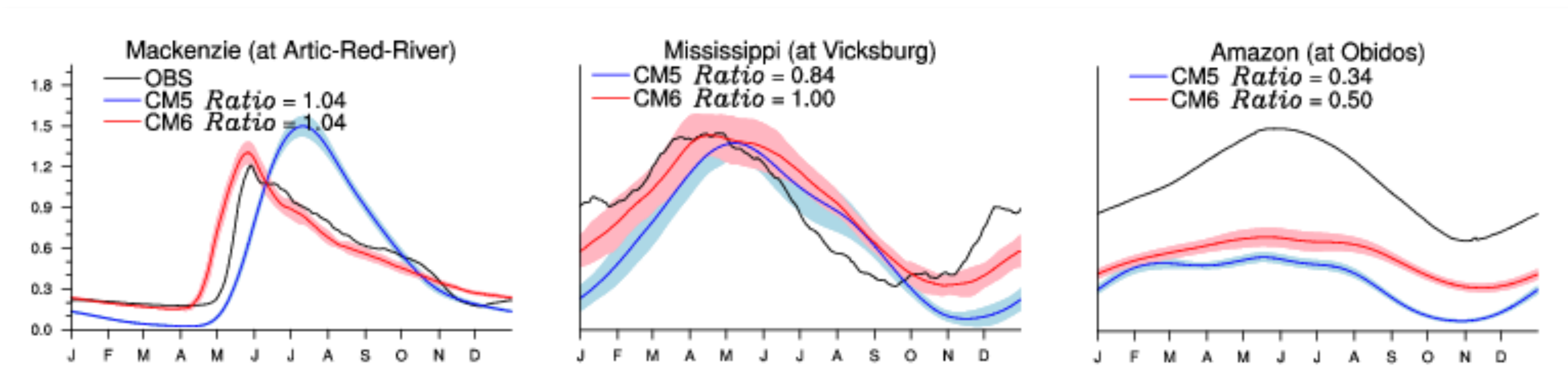
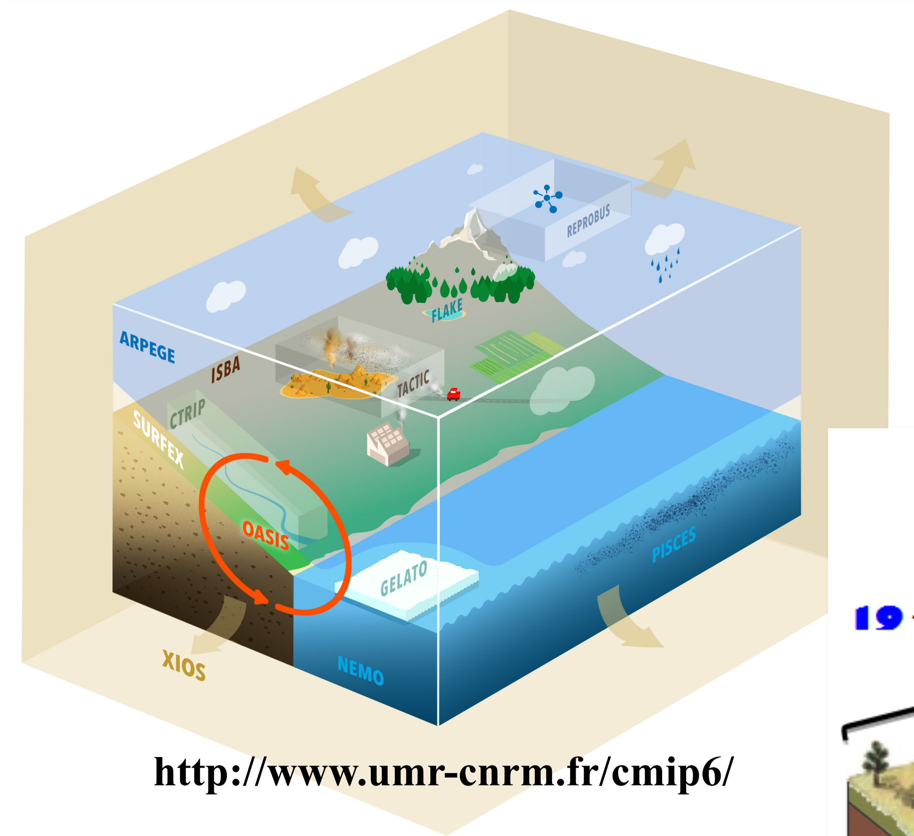


Figure 9: Comparison between observed and simulated monthly-mean seasonal cycles of (a) snow cover extents and (b) surface albedo. Observation are in black, CNRM-CM5 in blue and CNRM-CM6 in red. Details on observation products and processing can be found in Appendix 1.



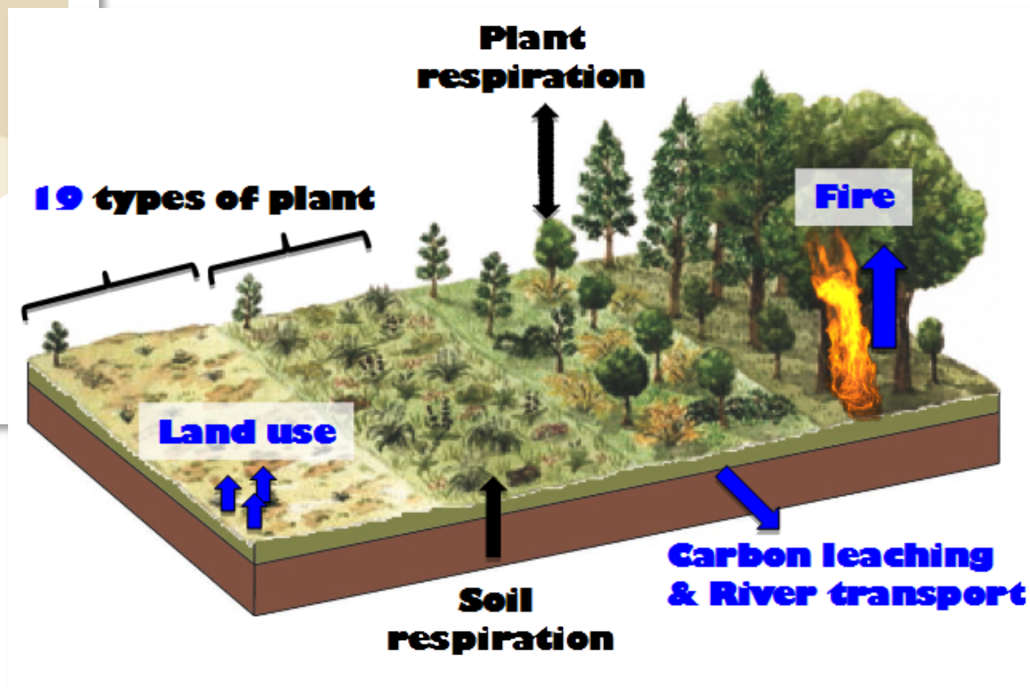
Climatological daily river discharges observed and simulated “in-line” over 1979-2010

Earth System Model : CNRM-ESM2



(Seferian et al., in prep for JAMES, 2019)

Based on CNRM-CM6 but with :
- Prognostic atmospheric chemistry and aerosol
- Global carbon cycle



(Delire et al., in prep for JAMES, 2019)

Conclusions

- <u>ISBA for climate modelling has been, is, and will be (I hope) used for many studies :</u>
  - *Climate projections for IPCC3, IPCC5 and now IPCC6*
  - *Seasonal forecast activities (Copernicus)*
  - *Impact of land surface on climate predictability*
  - *Land surface versus Climate impacts and/or feedbacks (soil moisture, deforestation, Eurasian snow, etc.)*
  - *Detection/Attribution of climate change on the land surface*
  - *Global hydrology, water resources*
  - *Etc…*
- <u>Joël Noilhan contribution to climate modeling at CNRM is major :</u>
  - *He has always maintained ISBA close to "the state of the art" trough his own work or students supervision*
  - *His work is always used today (as for example the work on "aggregation method")*
  - *Its insistence to promote the coupling of SURFEX and ARPEGE-Climat to prepare CNRM-CM5*
  - *To initiate in 2008 the transition from the "force-restore" to the "diffusion soil scheme" for CNRM-CM6*

Conclusions

- <u>ISBA for climate modelling has been, is, and will be (I hope) used for many studies :</u>
  - *Climate projections for IPCC3, IPCC5 and now IPCC6*
  - *Seasonal forecast activities (Copernicus)*
  - *Impact of land surface on climate predictability*
  - *Land surface versus Climate impacts and/or feedbacks (soil moisture, deforestation, Eurasian snow, etc.)*
  - *Detection/Attribution of climate change on the land surface*
  - *Global hydrology, water resources*
  - *Etc…*
- <u>Joël Noilhan contribution to climate modeling at CNRM is major :</u>
  - *He has always maintained ISBA close to "the state of the art" trough his own work or students supervision*
  - *His work is always used today (as for example the work on "aggregation method")*
  - *Its insistence to promote the coupling of SURFEX and ARPEGE-Climat to prepare CNRM-CM5*
  - *To initiate in 2008 the transition from the "force-restore" to the "diffusion soil scheme" for CNRM-CM6*
- <u>He would be happy to see ISBA now simulates also soil gases diffusion and methane emissions</u>

JAMES | Journal of Advances in Modeling Earth Systems

Published online 27 JAN 2019

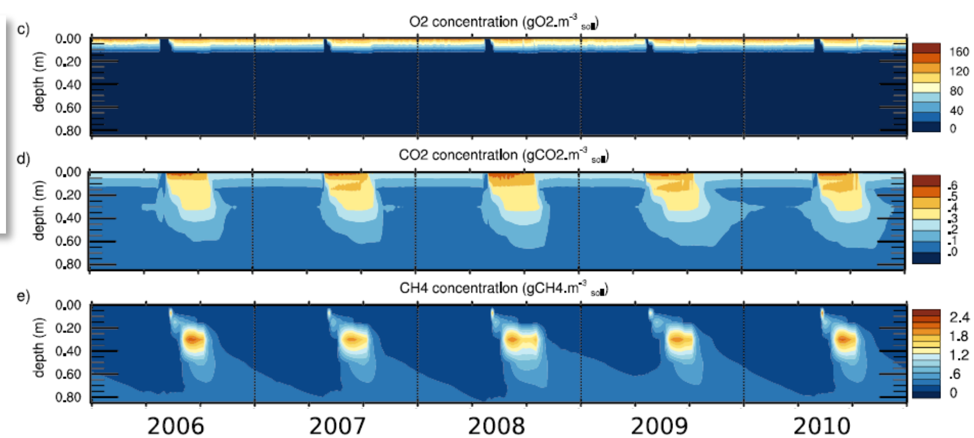
RESEARCH ARTICLE

10.1029/2018MS001329

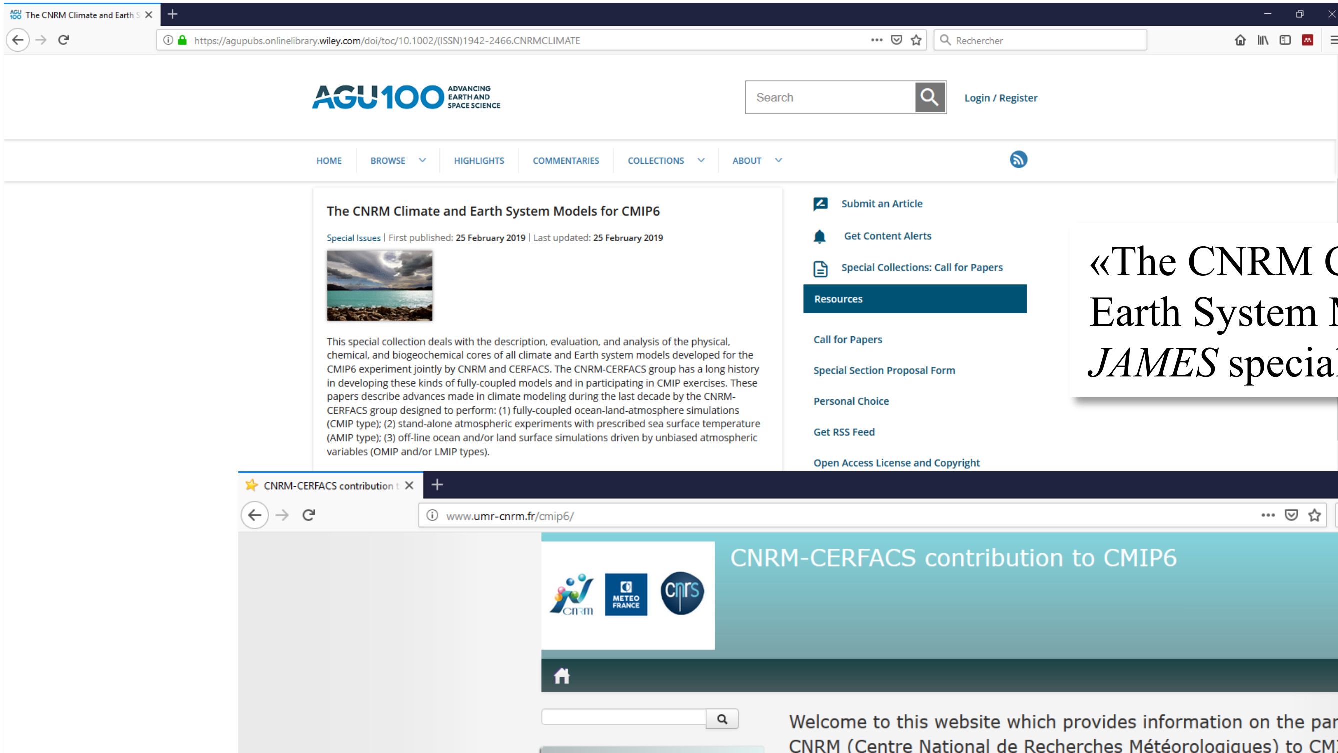
Key Points:
- A vertically discretized soil carbon and methane emission module controlled by the O_2 profile is developed

A New Process-Based Soil Methane Scheme: Evaluation Over Arctic Field Sites With the ISBA Land Surface Model

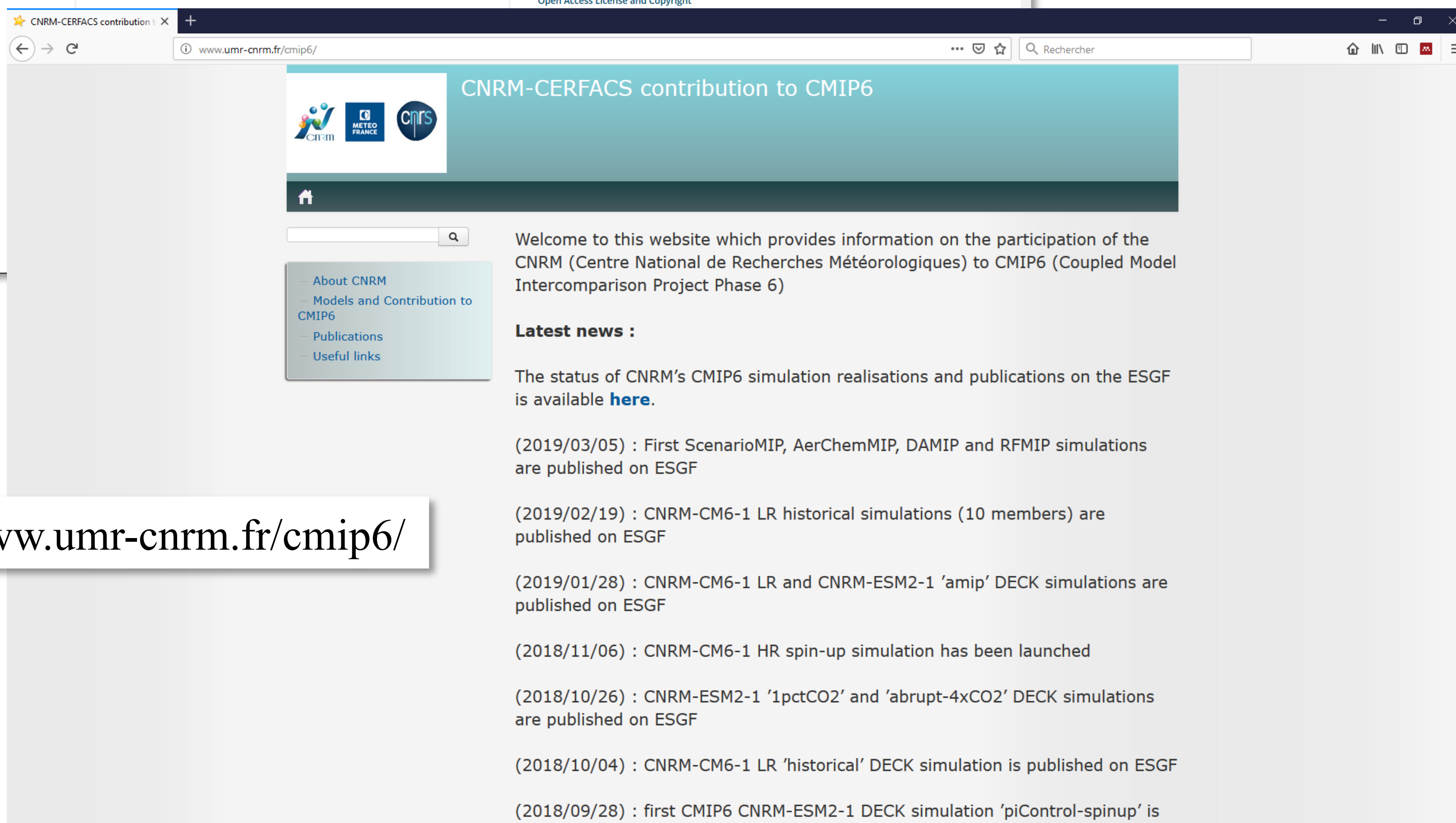
X. Morel[1], B. Decharme[1], C. Delire[1], G. Krinner[2], M. Lund[3], B. U. Hansen[4], and M. Mastepanov[3,5]



O_2, CO_2 and CH_4 soil concentration for a peatland in Greenland permafrost



«The CNRM Climate and Earth System Models for CMIP6 »
JAMES special issue



http://www.umr-cnrm.fr/cmip6/