# Integrated Models, Scenarios and Dynamics of Climate, Land Use and Common Birds for France: Dynamic Maps

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This page contains the dynamic maps associated to the following **research paper**:

**Ay Jean-Sauveur, Raja Chakir, Luc Doyen, Frédéric Jiguet, and Paul Leadley**. Integrated models, scenarios and dynamics of climate, land use and common birds. *Revision: Climatic Change*, March 2013.

## 1 Presentation

### 1.1 Framework

We present here only a brief overview of the methods used in this research, a more complete picture can be found in the last working paper version and the associated online ressources.

The modeling framework is structured in 3 blocks:

**Species Distribution Models** relating climate, land use and environmental variables (elevation, slope, etc.) to common birds abundances. They are calibrated on FBBS survey 2001–2011 through negative binomial Generalized Additive Models.

**Land Use Change Econometric Models** relating climate, returns from land (in euros) and environmental variables (slope, land quality, etc.) to land use choices. They are calibrated on TERUTI survey 1993–2003 through multinomial models.

**Ricardian Models** relating climate and environmental variables (slope, geographical coordinates, etc.) to the economic returns from land (approximated by land prices). They are calibrated on land price data from the French Ministry of Agriculture 1990–2005 through gaussian Generalized Additive Models.

Because some of our data have a restricted access, not all our work is reproducible from this page. From here, only the output data frames from our simulations are available. This suffices nevertheless to reproduce all the Figures of the paper and to produce some dynamic maps that reflect more precisely than the published paper the dynamic content of our results.

### 1.2 Scenarios

As illustrated by the following Figure, we simulate 5 different scenarios in order to disentangle the respective effects of the integrated modeling blocks.

In the Figure, **CC** counts for climate change, **SDM** for species distribution models, **RIC** for Ricardian models of returns from land, **LU** for land use and **CP** for conservation payments. Simu-

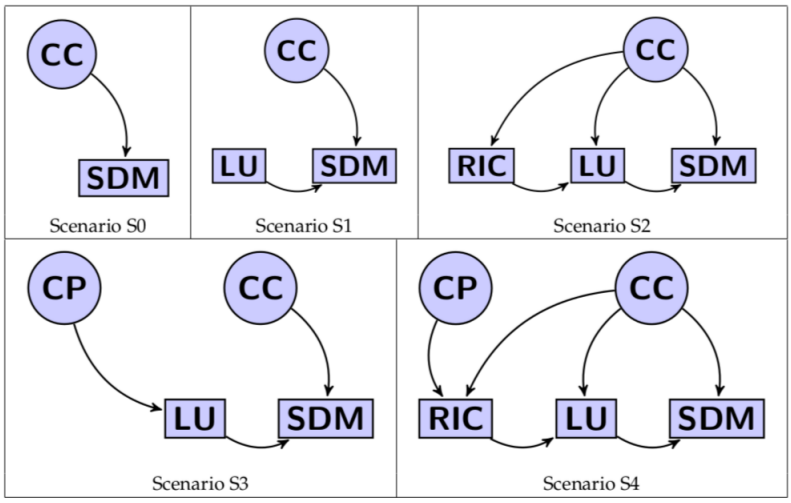


**Figure 1:** Modelling structure and differences between scenarios

lations of bird population by SDM pursue the observed 2001–2009 trends and integrate climate change in all scenarios. In scenario S0, land use is constant. In scenario S1, the model of LUC is used to extrapolate the temporal trends to obtain a kind of business-as-usual scenario. In scenario S2, the effects of climate change on the returns from land and, consequently, on LUC are taken into account. Scenario S3 and S4 are respectively equivalent to S1 and S2 with a conservation policy providing uniform payments for pastures.

### 1.3 Content

The rest of this file first presents the Land Use Changes (section 2) and the Bird Abundances (section 3) associated to each scenario. Each section contains the data from simulations (in compressed `.Rda` format for the R software). Sections 4 and 5 are the Acknowledgements and some Additional Material required to run the R codes (they are tangled in `myFunctions.R` and are loaded in the workspace with `source("myFunctions.R")`) that allow to produce the dynamic maps. Moreover, this HTML page is exported from an Org Mode file than can be opened with GNU Emacs and is also available as a `.pdf` file for easy print. More details on this work flow is available at the following webpage. If you see any errors or strange results, you can contact me at `jsay_dot_site_at_gmail_dot_com`.

## 2 Land Use Changes

### 2.1 Scenario S0

Land use is constant in this scenario, only birds are impacted by climate change, see section 1.2 for a description of scenarios.

## 2.2 Scenario S1

This scenario is a kind of "business as usual" scenario in terms of land use changes. The dynamics 1990–2005 of returns from land is extrapolated to 2053. In particular, it does not integrate the climate change effects on returns.

You can download the data from this scenario simulation here. See Section 5.1 for the functions.

This scenario presents an increase in annual crops, forests and urban area and a decrease in pastures and perennial crops. The following Table contains the links to the R Codes and the Animations 2003–2053 at the national scale.

**Table 1:** Land Use Changes according to scenario S1

| Land Use | Variations 2003–2053 | R Code | Animation |
|---|---|---|---|
| Annual Crops | + 3.17% | Click here | Click here |
| Pastures | - 17.7% | Click here | Click here |
| Perennial Crops | - 17.7% | Click here | Click here |
| Forests | + 9.11% | Click here | Click here |
| Urban Area | + 33.4% | Click here | Click here |

*More interpretations to come.*

## 2.3 Scenario S2

This scenario integrates climate-induced land use changes. The dynamics 1990–2005 of returns from land are modeled through climate variables, and the IPCC projection A1B is used to estimate the future returns from land. Then, the econometric model of land use allows to establish the consequences in terms of land use changes.

You can download the data from this scenario simulation here. See Section 5.1 for the functions.

This scenario presents an increase in annual crops, perennial crops, forests and urban area. The pastures are proven to potentially suffer from climate change, with a strong decrease of the acreages. The following Table contains the links to the R Codes and the Animations 2003–2053 at the national scale.

**Table 2:** Land Use Changes according to scenario S2

| Land Use | Variations 2003–2053 | R Code | Animation |
|---|---|---|---|
| Annual Crops | + 27.2% | Click here | Click here |
| Pastures | - 55.5% | Click here | Click here |
| Perennial Crops | + 177 % | Click here | Click here |
| Forests | + 1.71% | Click here | Click here |
| Urban Area | + 60.1% | Click here | Click here |

*More interpretations to come.*

## 2.4 Scenario S3

This scenario corresponds to S1 coupled with a payment of € 200 per hectare for pastures.

You can download the data from this scenario simulation here. See Section 5.1 for the functions.

This scenario presents an increase in pastures and urban area and a decrease in annual crops, perennial crops and forests. For this scenario, the animations of the following Table are not the absolute land use changes but the land use change relatively to S1, to show the net effect of the policy of payments for pastures.

**Table 3:** Land Use Changes from scenario S3 relatively to S1

| Land Use | Variations 2003–2053 | R Code | Animation |
|---|---|---|---|
| Annual Crops | - 20.8% | Click here | Click here |
| Pastures | + 22.6% | Click here | Click here |
| Perennial Crops | - 27.6% | Click here | Click here |
| Forests | - 2.15% | Click here | Click here |
| Urban Area | + 17.5% | Click here | Click here |

*More interpretations to come.*

## 2.5 Scenario S4

This scenario corresponds to S2 coupled with a payment of € 200 per hectare for pastures.

You can download the data from this scenario simulation here. See Section 5.1 for the functions.

This scenario presents an increase in annual crops, perennial crops and urban area and a decrease in pastures and forests. With climate-induced land use changes, the payments are not sufficient to reverse the decreasing trend of pastures. For this scenario, the animations of the following Table are not the absolute land use changes but the land use change relatively to S2, to show the net effect of the policy of payments for pastures.

**Table 4:** Land Use Changes according to scenario S4 relatively to scenario S2

| Land Use | Variations 2003–2053 | R Code | Animation |
|---|---|---|---|
| Annual Crops | + 16.2% | Click here | Click here |
| Pastures | - 19.4% | Click here | Click here |
| Perennial Crops | + 83.7% | Click here | Click here |
| Forests | - 9.43% | Click here | Click here |
| Urban Area | + 23.5% | Click here | Click here |

*More interpretations to come.*

# 3 Bird Abundances

## 3.1 Scenario S0

This scenario is with constant land use, it shows the direct response of birds' distributions from the climate projections IPCC A1B.

Download the data for the simulation here. The dynamic map 2003–2053 for the aggregate bird index as presented in the working paper (equation 9) is here with the corresponding R code.

Species names are available from this .csv file from which we build the following tabular containing the animations 2003–2053 of bird abundances from all the species studied in this research. The R Code using to generate the simulations from the raw data is here. The Table is simply obtained from the following R script.

```
NDO <- read.csv("Data/NomsDoizos.csv")
(OIZO <- data.frame("CODE"= NDO$SPEC, "French"= NDO$NOM, "English"= NDO$Anglais,
                    "Latin"= paste("/",NDO$ESP1," ",NDO$ESP2,"/",sep= ""),
                    "Animation"= paste("[[./output/", NDO$SPEC, "S0/",
                                       NDO$SPEC,"S0.html][Click here]]",sep="")))
```

**Table 5:** Links to the animations 2003–2053 for scenario S0 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| ALAARV | Alouette des champs | Sky Lark | *Alauda arvensis* | Click here |
| ALERUF | Perdrix rouge | Red-legged Partridge | *Alectoris rufa* | Click here |
| ANTPRA | Pipit farlouse | Meadow Pipit | *Anthus pratensis* | Click here |
| APUAPU | Martinet noir | Common Swift | *Apus apus* | Click here |
| BUTBUT | Buse variable | Common Buzzard | *Buteo buteo* | Click here |
| CARCAN | Linotte mélodieuse | Linnet | *Carduelis cannabina* | Click here |
| CARCAR | Chardonneret élégant | Goldfinch | *Carduelis carduelis* | Click here |
| CARCHL | Verdier d'Europe | Greenfinch | *Chloris chloris* | Click here |
| CERBRA | Grimpereau des jardins | Short-toed Treecreeper | *Certhia brachydactyla* | Click here |
| CERFAM | Grimpereau des bois | Eurasian Treecreeper | *Certhia familiaris* | Click here |
| COCCOC | Grosbec casse-noyaux | Hawfinch | *Coccothraustes coccothraustes* | Click here |
| COLPAL | Pigeon ramier | Wood Pigeon | *Columba palumbus* | Click here |
| CORCOR | Corneille noire | Carrion Crow | *Corvus corone* | Click here |
| CORFRU | Corbeau freux | Rook | *Corvus frugilegus* | Click here |
| CORMON | Choucas des tours | Western Jackdaw | *Coloeus monedula* | Click here |
| COTCOT | Caille des blés | Common Quail | *Coturnix coturnix* | Click here |
| CUCCAN | Coucou gris | Common Cuckoo | *Cuculus canorus* | Click here |
| DELURB | Hirondelle de fenêtre | House Martin | *Delichon urbicum* | Click here |
| DENMAJ | Pic épeiche | Great Spotted Woodpecker | *Dendrocopos major* | Click here |
| DENMED | Pic mar | Middle Spotted Woodpecker | *Dendrocopos medius* | Click here |
| DRYMAR | Pic noir | Black Woodpecker | *Dryocopus martius* | Click here |
| EMBCIR | Bruant zizi | Cirl Bunting | *Emberiza cirlus* | Click here |
| EMBCIT | Bruant jaune | Yellowhammer | *Emberiza citrinella* | Click here |
| ERIRUB | Rouge-gorge familier | Robin | *Erithacus rubecula* | Click here |
| FALTIN | Faucon crécerelle | Common Kestrel | *Falco tinnunculus* | Click here |
| FRICOE | Pinson des arbres | Common Chaffinch | *Fringilla coelebs* | Click here |
| GARGLA | Geai des chênes | Eurasian Jay | *Garrulus glandarius* | Click here |
| HIPPOL | Hypolaïs polyglotte | Melodious Warbler | *Hippolais polyglotta* | Click here |

Continued on next page

**Table 5:** Links to the animations 2003–2053 for scenario S0 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| HIRRUS | Hirondelle rustique | Barn Swallow | *Hirundo rustica* | Click here |
| LANCOL | Pie-grièche écorcheur | Red-backed Shrike | *Lanius collurio* | Click here |
| LULARB | Alouette lulu | Wood Lark | *Lullula arborea* | Click here |
| LUSMEG | Rossignol philomèle | Rufous Nightingale | *Luscinia megarhynchos* | Click here |
| MILCAL | Bruant proyer | Corn Bunting | *Emberiza calandra* | Click here |
| MOTFLA | Bergeronnette printanière | Yellow Wagtail | *Motacilla flava* | Click here |
| ORIORI | Loriot d'Europe | Golden Oriole | *Oriolus oriolus* | Click here |
| PARATE | Mésange noire | Coal Tit | *Periparus ater* | Click here |
| PARCAE | Mésange bleue | Blue Tit | *Cyanistes caeruleus* | Click here |
| PARCRI | Mésange huppée | Crested Tit | *Lophophanes cristatus* | Click here |
| PARMAJ | Mésange charbonnière | Great Tit | *Parus major* | Click here |
| PARMON | Mésange boréale | Willow Tit | *Parus montanus* | Click here |
| PARPAL | Mésange nonnette | Marsh Tit | *Poecile palustris* | Click here |
| PASDOM | Moineau domestique | House Sparrow | *Passer domesticus* | Click here |
| PASMON | Moineau friquet | Tree Sparrow | *Passer montanus* | Click here |
| PERPER | Perdrix grise | Grey Partridge | *Perdix perdix* | Click here |
| PHOOCH | Rougequeue noir | Black Redstart | *Phoenicurus ochruros* | Click here |
| PHOPHO | Rougequeue à front blanc | Common Redstart | *Phoenicurus phoenicurus* | Click here |
| PHYBON | Pouillot de Bonelli | Western Bonelli's Warbler | *Phylloscopus bonelli* | Click here |
| PHYCOL | Pouillot véloce | Common Chiffchaff | *Phylloscopus collybita* | Click here |
| PHYSIB | Pouillot siffleur | Wood Warbler | *Phylloscopus sibilatrix* | Click here |
| PHYTRO | Pouillot fitis | Willow Warbler | *Phylloscopus trochilus* | Click here |
| PICCAN | Pic cendré | Grey-headed Woodpecker | *Picus canus* | Click here |
| PICPIC | Pie bavarde | Magpie | *Pica pica* | Click here |
| PICVIR | Pic vert | Green Woodpecker | *Picus viridis* | Click here |
| PRUMOD | Accenteur mouchet | Dunnock | *Prunella modularis* | Click here |
| PYRPYR | Bouvreuil pivoine | Bullfinch | *Pyrrhula pyrrhula* | Click here |
| REGIGN | Roitelet triple-bandeau | Firecrest | *Regulus ignicapilla* | Click here |
| REGREG | Roitelet huppé | Goldcrest | *Regulus regulus* | Click here |
| SAXRUB | Tarier des prés | Whinchat | *Saxicola rubetra* | Click here |
| SAXTOR | Tarier pâtre | Common Stonechat | *Saxicola rubicola* | Click here |
| SERSER | Serin cini | European Serin | *Serinus serinus* | Click here |
| SITEUR | Sittelle torchepot | Eurasian Nuthatch | *Sitta europaea* | Click here |
| STRDEC | Tourterelle turque | Collared Dove | *Streptopelia decaocto* | Click here |
| SYLATR | Fauvette à tête noire | Blackcap | *Sylvia atricapilla* | Click here |
| SYLCOM | Fauvette grisette | Common Whitethroat | *Sylvia communis* | Click here |
| SYLMEL | Fauvette mélanocéphale | Sardinian Warbler | *Sylvia melanocephala* | Click here |
| TROTRO | Troglodyte mignon | Wren | *Troglodytes troglodytes* | Click here |
| TURMER | Merle noir | Blackbird | *Turdus merula* | Click here |
| TURPHI | Grive musicienne | Song Thrush | *Turdus philomelos* | Click here |
| TURVIS | Grive draine | Mistle Thrush | *Turdus viscivorus* | Click here |
| UPUEPO | Huppe fasciée | Hoopoe | *Upupa epops* | Click here |
| VANVAN | Vanneau huppé | Northern Lapwing | *Vanellus vanellus* | Click here |

*More interpretations to come.*

### 3.2 Scenario S1

This scenario corresponds to a "business-as-usual" scenario for land use, with climate effects on birds as in S0.

Download the data for the simulation here. The dynamic map 2003–2053 for the aggregate bird

index as presented in the working paper (equation 9) is here with the corresponding R code.

Species names are available from this .csv file from which we build the following tabular containing the animations 2003–2053 of bird abundances from all the species studied in this research. The R Code using to generate the simulations from the raw data is here. The Table is simply obtained from the following R script.

```
Outliers <- c("ALAARV", "APUAPU")
NDO <- subset(read.csv("Data/NomsDoizos.csv"), !SPEC %in% Outliers)
(OIZO <- data.frame("CODE"= NDO$SPEC, "French"= NDO$NOM, "English"= NDO$Anglais,
                    "Latin"= paste("/", NDO$ESP1, " ", NDO$ESP2, "/", sep= ""),
                    "Animation"= paste("[[./output/", NDO$SPEC, "S1/",
                                       NDO$SPEC,"S1.html][Click here]]", sep= "")))
```

**Table 6:** Links to the animations 2003–2053 for scenario S1 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| ALERUF | Perdrix rouge | Red-legged Partridge | *Alectoris rufa* | Click here |
| ANTPRA | Pipit farlouse | Meadow Pipit | *Anthus pratensis* | Click here |
| BUTBUT | Buse variable | Common Buzzard | *Buteo buteo* | Click here |
| CARCAN | Linotte mélodieuse | Linnet | *Carduelis cannabina* | Click here |
| CARCAR | Chardonneret élégant | Goldfinch | *Carduelis carduelis* | Click here |
| CARCHL | Verdier d'Europe | Greenfinch | *Chloris chloris* | Click here |
| CERBRA | Grimpereau des jardins | Short-toed Treecreeper | *Certhia brachydactyla* | Click here |
| CERFAM | Grimpereau des bois | Eurasian Treecreeper | *Certhia familiaris* | Click here |
| COCCOC | Grosbec casse-noyaux | Hawfinch | *Coccothraustes coccothraustes* | Click here |
| COLPAL | Pigeon ramier | Wood Pigeon | *Columba palumbus* | Click here |
| CORCOR | Corneille noire | Carrion Crow | *Corvus corone* | Click here |
| CORFRU | Corbeau freux | Rook | *Corvus frugilegus* | Click here |
| CORMON | Choucas des tours | Western Jackdaw | *Coloeus monedula* | Click here |
| COTCOT | Caille des blés | Common Quail | *Coturnix coturnix* | Click here |
| CUCCAN | Coucou gris | Common Cuckoo | *Cuculus canorus* | Click here |
| DELURB | Hirondelle de fenêtre | House Martin | *Delichon urbicum* | Click here |
| DENMAJ | Pic épeiche | Great Spotted Woodpecker | *Dendrocopos major* | Click here |
| DENMED | Pic mar | Middle Spotted Woodpecker | *Dendrocopos medius* | Click here |
| DRYMAR | Pic noir | Black Woodpecker | *Dryocopus martius* | Click here |
| EMBCIR | Bruant zizi | Cirl Bunting | *Emberiza cirlus* | Click here |
| EMBCIT | Bruant jaune | Yellowhammer | *Emberiza citrinella* | Click here |
| ERIRUB | Rouge-gorge familier | Robin | *Erithacus rubecula* | Click here |
| FALTIN | Faucon crécerelle | Common Kestrel | *Falco tinnunculus* | Click here |
| FRICOE | Pinson des arbres | Common Chaffinch | *Fringilla coelebs* | Click here |
| GARGLA | Geai des chênes | Eurasian Jay | *Garrulus glandarius* | Click here |
| HIPPOL | Hypolaïs polyglotte | Melodious Warbler | *Hippolais polyglotta* | Click here |
| HIRRUS | Hirondelle rustique | Barn Swallow | *Hirundo rustica* | Click here |
| LANCOL | Pie-grièche écorcheur | Red-backed Shrike | *Lanius collurio* | Click here |
| LULARB | Alouette lulu | Wood Lark | *Lullula arborea* | Click here |
| LUSMEG | Rossignol philomèle | Rufous Nightingale | *Luscinia megarhynchos* | Click here |
| MILCAL | Bruant proyer | Corn Bunting | *Emberiza calandra* | Click here |
| MOTFLA | Bergeronnette printanière | Yellow Wagtail | *Motacilla flava* | Click here |
| ORIORI | Loriot d'Europe | Golden Oriole | *Oriolus oriolus* | Click here |
| PARATE | Mésange noire | Coal Tit | *Periparus ater* | Click here |
| PARCAE | Mésange bleue | Blue Tit | *Cyanistes caeruleus* | Click here |
| PARCRI | Mésange huppée | Crested Tit | *Lophophanes cristatus* | Click here |

Continued on next page

**Table 6:** Links to the animations 2003–2053 for scenario S1 and each bird species

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|---|---|---|---|---|
| PARMAJ | Mésange charbonnière | Great Tit | *Parus major* | Click here |
| PARMON | Mésange boréale | Willow Tit | *Parus montanus* | Click here |
| PARPAL | Mésange nonnette | Marsh Tit | *Poecile palustris* | Click here |
| PASDOM | Moineau domestique | House Sparrow | *Passer domesticus* | Click here |
| PASMON | Moineau friquet | Tree Sparrow | *Passer montanus* | Click here |
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| PHYTRO | Pouillot fitis | Willow Warbler | *Phylloscopus trochilus* | Click here |
| PICCAN | Pic cendré | Grey-headed Woodpecker | *Picus canus* | Click here |
| PICPIC | Pie bavarde | Magpie | *Pica pica* | Click here |
| PICVIR | Pic vert | Green Woodpecker | *Picus viridis* | Click here |
| PRUMOD | Accenteur mouchet | Dunnock | *Prunella modularis* | Click here |
| PYRPYR | Bouvreuil pivoine | Bullfinch | *Pyrrhula pyrrhula* | Click here |
| REGIGN | Roitelet triple-bandeau | Firecrest | *Regulus ignicapilla* | Click here |
| REGREG | Roitelet huppé | Goldcrest | *Regulus regulus* | Click here |
| SAXRUB | Tarier des prés | Whinchat | *Saxicola rubetra* | Click here |
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| SERSER | Serin cini | European Serin | *Serinus serinus* | Click here |
| SITEUR | Sittelle torchepot | Eurasian Nuthatch | *Sitta europaea* | Click here |
| STRDEC | Tourterelle turque | Collared Dove | *Streptopelia decaocto* | Click here |
| SYLATR | Fauvette à tête noire | Blackcap | *Sylvia atricapilla* | Click here |
| SYLCOM | Fauvette grisette | Common Whitethroat | *Sylvia communis* | Click here |
| SYLMEL | Fauvette mélanocéphale | Sardinian Warbler | *Sylvia melanocephala* | Click here |
| TROTRO | Troglodyte mignon | Wren | *Troglodytes troglodytes* | Click here |
| TURMER | Merle noir | Blackbird | *Turdus merula* | Click here |
| TURPHI | Grive musicienne | Song Thrush | *Turdus philomelos* | Click here |
| TURVIS | Grive draine | Mistle Thrush | *Turdus viscivorus* | Click here |
| UPUEPO | Huppe fasciée | Hoopoe | *Upupa epops* | Click here |
| VANVAN | Vanneau huppé | Northern Lapwing | *Vanellus vanellus* | Click here |

*More interpretations to come.*

### 3.3 Scenario S2

This scenario corresponds to a climate-induced scenario for land use, with climate effects on birds as in S0.

Download the data for the simulation here. The dynamic map 2003–2053 for the aggregate bird index as presented in the working paper (equation 9) is here with the corresponding R code. Some explanations.

Species names are available from this `.csv` file from which we build the following tabular containing the animations 2003–2053 of bird abundances from all the species studied in this research. The R Code using to generate the simulations from the raw data is here. The Table is simply obtained from the following R script.

```
Outliers <- c("ALAARV", "APUAPU", "MOTFLA", "SYLMEL")
NDO <- subset(read.csv("Data/NomsDoizos.csv"), !SPEC %in% Outliers)
(OIZO <- data.frame("CODE"= NDO$SPEC, "French"= NDO$NOM, "English"= NDO$Anglais,
                    "Latin"= paste("/", NDO$ESP1, " ", NDO$ESP2, "/", sep= ""),
                    "Animation"= paste("[[./output/", NDO$SPEC, "S2/",
                                       NDO$SPEC,"S2.html][Click here]]", sep= "")))
```

**Table 7:** Links to the animations 2003–2053 for scenario S2 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| ALERUF | Perdrix rouge | Red-legged Partridge | *Alectoris rufa* | Click here |
| ANTPRA | Pipit farlouse | Meadow Pipit | *Anthus pratensis* | Click here |
| BUTBUT | Buse variable | Common Buzzard | *Buteo buteo* | Click here |
| CARCAN | Linotte mélodieuse | Linnet | *Carduelis cannabina* | Click here |
| CARCAR | Chardonneret élégant | Goldfinch | *Carduelis carduelis* | Click here |
| CARCHL | Verdier d'Europe | Greenfinch | *Chloris chloris* | Click here |
| CERBRA | Grimpereau des jardins | Short-toed Treecreeper | *Certhia brachydactyla* | Click here |
| CERFAM | Grimpereau des bois | Eurasian Treecreeper | *Certhia familiaris* | Click here |
| COCCOC | Grosbec casse-noyaux | Hawfinch | *Coccothraustes coccothraustes* | Click here |
| COLPAL | Pigeon ramier | Wood Pigeon | *Columba palumbus* | Click here |
| CORCOR | Corneille noire | Carrion Crow | *Corvus corone* | Click here |
| CORFRU | Corbeau freux | Rook | *Corvus frugilegus* | Click here |
| CORMON | Choucas des tours | Western Jackdaw | *Coloeus monedula* | Click here |
| COTCOT | Caille des blés | Common Quail | *Coturnix coturnix* | Click here |
| CUCCAN | Coucou gris | Common Cuckoo | *Cuculus canorus* | Click here |
| DELURB | Hirondelle de fenêtre | House Martin | *Delichon urbicum* | Click here |
| DENMAJ | Pic épeiche | Great Spotted Woodpecker | *Dendrocopos major* | Click here |
| DENMED | Pic mar | Middle Spotted Woodpecker | *Dendrocopos medius* | Click here |
| DRYMAR | Pic noir | Black Woodpecker | *Dryocopus martius* | Click here |
| EMBCIR | Bruant zizi | Cirl Bunting | *Emberiza cirlus* | Click here |
| EMBCIT | Bruant jaune | Yellowhammer | *Emberiza citrinella* | Click here |
| ERIRUB | Rouge-gorge familier | Robin | *Erithacus rubecula* | Click here |
| FALTIN | Faucon crécerelle | Common Kestrel | *Falco tinnunculus* | Click here |
| FRICOE | Pinson des arbres | Common Chaffinch | *Fringilla coelebs* | Click here |
| GARGLA | Geai des chênes | Eurasian Jay | *Garrulus glandarius* | Click here |
| HIPPOL | Hypolaïs polyglotte | Melodious Warbler | *Hippolais polyglotta* | Click here |
| HIRRUS | Hirondelle rustique | Barn Swallow | *Hirundo rustica* | Click here |
| LANCOL | Pie-grièche écorcheur | Red-backed Shrike | *Lanius collurio* | Click here |
| LULARB | Alouette lulu | Wood Lark | *Lullula arborea* | Click here |
| LUSMEG | Rossignol philomèle | Rufous Nightingale | *Luscinia megarhynchos* | Click here |
| MILCAL | Bruant proyer | Corn Bunting | *Emberiza calandra* | Click here |
| ORIORI | Loriot d'Europe | Golden Oriole | *Oriolus oriolus* | Click here |
| PARATE | Mésange noire | Coal Tit | *Periparus ater* | Click here |
| PARCAE | Mésange bleue | Blue Tit | *Cyanistes caeruleus* | Click here |
| PARCRI | Mésange huppée | Crested Tit | *Lophophanes cristatus* | Click here |
| PARMAJ | Mésange charbonnière | Great Tit | *Parus major* | Click here |
| PARMON | Mésange boréale | Willow Tit | *Parus montanus* | Click here |
| PARPAL | Mésange nonnette | Marsh Tit | *Poecile palustris* | Click here |
| PASDOM | Moineau domestique | House Sparrow | *Passer domesticus* | Click here |
| PASMON | Moineau friquet | Tree Sparrow | *Passer montanus* | Click here |
| PERPER | Perdrix grise | Grey Partridge | *Perdix perdix* | Click here |
| PHOOCH | Rougequeue noir | Black Redstart | *Phoenicurus ochruros* | Click here |
| PHOPHO | Rougequeue à front blanc | Common Redstart | *Phoenicurus phoenicurus* | Click here |
| PHYBON | Pouillot de Bonelli | Western Bonelli's Warbler | *Phylloscopus bonelli* | Click here |

Continued on next page

**Table 7:** Links to the animations 2003–2053 for scenario S2 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| PHYCOL | Pouillot véloce | Common Chiffchaff | *Phylloscopus collybita* | Click here |
| PHYSIB | Pouillot siffleur | Wood Warbler | *Phylloscopus sibilatrix* | Click here |
| PHYTRO | Pouillot fitis | Willow Warbler | *Phylloscopus trochilus* | Click here |
| PICCAN | Pic cendré | Grey-headed Woodpecker | *Picus canus* | Click here |
| PICPIC | Pie bavarde | Magpie | *Pica pica* | Click here |
| PICVIR | Pic vert | Green Woodpecker | *Picus viridis* | Click here |
| PRUMOD | Accenteur mouchet | Dunnock | *Prunella modularis* | Click here |
| PYRPYR | Bouvreuil pivoine | Bullfinch | *Pyrrhula pyrrhula* | Click here |
| REGIGN | Roitelet triple-bandeau | Firecrest | *Regulus ignicapilla* | Click here |
| REGREG | Roitelet huppé | Goldcrest | *Regulus regulus* | Click here |
| SAXRUB | Tarier des prés | Whinchat | *Saxicola rubetra* | Click here |
| SAXTOR | Tarier pâtre | Common Stonechat | *Saxicola rubicola* | Click here |
| SERSER | Serin cini | European Serin | *Serinus serinus* | Click here |
| SITEUR | Sittelle torchepot | Eurasian Nuthatch | *Sitta europaea* | Click here |
| STRDEC | Tourterelle turque | Collared Dove | *Streptopelia decaocto* | Click here |
| SYLATR | Fauvette à tête noire | Blackcap | *Sylvia atricapilla* | Click here |
| SYLCOM | Fauvette grisette | Common Whitethroat | *Sylvia communis* | Click here |
| TROTRO | Troglodyte mignon | Wren | *Troglodytes troglodytes* | Click here |
| TURMER | Merle noir | Blackbird | *Turdus merula* | Click here |
| TURPHI | Grive musicienne | Song Thrush | *Turdus philomelos* | Click here |
| TURVIS | Grive draine | Mistle Thrush | *Turdus viscivorus* | Click here |
| UPUEPO | Huppe fasciée | Hoopoe | *Upupa epops* | Click here |
| VANVAN | Vanneau huppé | Northern Lapwing | *Vanellus vanellus* | Click here |

*More interpretations to come.*

### 3.4 Scenario S3

Scenario S1 coupled with a payment of € 200 per hectare for pastures, with climate effects on birds as in S0.

Download the data for the simulation here. The dynamic map 2003–2053 for the aggregate bird index as presented in the working paper (equation 9) is here with the corresponding R code. Some explanations.

Species names are available from this .csv file from which we build the following tabular containing the animations 2003–2053 of bird abundances from all the species studied in this research. The R Code using to generate the simulations from the raw data is here. The Table is simply obtained from the following R script.

```
Outliers <- c("ALAARV", "APUAPU", "SYLMEL")
NDO <- subset(read.csv("Data/NomsDoizos.csv"), !SPEC %in% Outliers)
(OIZO <- data.frame("CODE"= NDO$SPEC, "French"= NDO$NOM, "English"= NDO$Anglais,
                    "Latin"= paste("/", NDO$ESP1, " ", NDO$ESP2, "/", sep= ""),
                    "Animation"= paste("[[./output/", NDO$SPEC, "S3/",
                                       NDO$SPEC,"S3.html][Click here]]", sep= "")))
```

**Table 8:** Links to the animations 2003–2053 for scenario S3 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| ALERUF | Perdrix rouge | Red-legged Partridge | *Alectoris rufa* | Click here |
| ANTPRA | Pipit farlouse | Meadow Pipit | *Anthus pratensis* | Click here |
| BUTBUT | Buse variable | Common Buzzard | *Buteo buteo* | Click here |
| CARCAN | Linotte mélodieuse | Linnet | *Carduelis cannabina* | Click here |
| CARCAR | Chardonneret élégant | Goldfinch | *Carduelis carduelis* | Click here |
| CARCHL | Verdier d'Europe | Greenfinch | *Chloris chloris* | Click here |
| CERBRA | Grimpereau des jardins | Short-toed Treecreeper | *Certhia brachydactyla* | Click here |
| CERFAM | Grimpereau des bois | Eurasian Treecreeper | *Certhia familiaris* | Click here |
| COCCOC | Grosbec casse-noyaux | Hawfinch | *Coccothraustes coccothraustes* | Click here |
| COLPAL | Pigeon ramier | Wood Pigeon | *Columba palumbus* | Click here |
| CORCOR | Corneille noire | Carrion Crow | *Corvus corone* | Click here |
| CORFRU | Corbeau freux | Rook | *Corvus frugilegus* | Click here |
| CORMON | Choucas des tours | Western Jackdaw | *Coloeus monedula* | Click here |
| COTCOT | Caille des blés | Common Quail | *Coturnix coturnix* | Click here |
| CUCCAN | Coucou gris | Common Cuckoo | *Cuculus canorus* | Click here |
| DELURB | Hirondelle de fenêtre | House Martin | *Delichon urbicum* | Click here |
| DENMAJ | Pic épeiche | Great Spotted Woodpecker | *Dendrocopos major* | Click here |
| DENMED | Pic mar | Middle Spotted Woodpecker | *Dendrocopos medius* | Click here |
| DRYMAR | Pic noir | Black Woodpecker | *Dryocopus martius* | Click here |
| EMBCIR | Bruant zizi | Cirl Bunting | *Emberiza cirlus* | Click here |
| EMBCIT | Bruant jaune | Yellowhammer | *Emberiza citrinella* | Click here |
| ERIRUB | Rouge-gorge familier | Robin | *Erithacus rubecula* | Click here |
| FALTIN | Faucon crécerelle | Common Kestrel | *Falco tinnunculus* | Click here |
| FRICOE | Pinson des arbres | Common Chaffinch | *Fringilla coelebs* | Click here |
| GARGLA | Geai des chênes | Eurasian Jay | *Garrulus glandarius* | Click here |
| HIPPOL | Hypolaïs polyglotte | Melodious Warbler | *Hippolais polyglotta* | Click here |
| HIRRUS | Hirondelle rustique | Barn Swallow | *Hirundo rustica* | Click here |
| LANCOL | Pie-grièche écorcheur | Red-backed Shrike | *Lanius collurio* | Click here |
| LULARB | Alouette lulu | Wood Lark | *Lullula arborea* | Click here |
| LUSMEG | Rossignol philomèle | Rufous Nightingale | *Luscinia megarhynchos* | Click here |
| MILCAL | Bruant proyer | Corn Bunting | *Emberiza calandra* | Click here |
| MOTFLA | Bergeronnette printanière | Yellow Wagtail | *Motacilla flava* | Click here |
| ORIORI | Loriot d'Europe | Golden Oriole | *Oriolus oriolus* | Click here |
| PARATE | Mésange noire | Coal Tit | *Periparus ater* | Click here |
| PARCAE | Mésange bleue | Blue Tit | *Cyanistes caeruleus* | Click here |
| PARCRI | Mésange huppée | Crested Tit | *Lophophanes cristatus* | Click here |
| PARMAJ | Mésange charbonnière | Great Tit | *Parus major* | Click here |
| PARMON | Mésange boréale | Willow Tit | *Parus montanus* | Click here |
| PARPAL | Mésange nonnette | Marsh Tit | *Poecile palustris* | Click here |
| PASDOM | Moineau domestique | House Sparrow | *Passer domesticus* | Click here |
| PASMON | Moineau friquet | Tree Sparrow | *Passer montanus* | Click here |
| PERPER | Perdrix grise | Grey Partridge | *Perdix perdix* | Click here |
| PHOOCH | Rougequeue noir | Black Redstart | *Phoenicurus ochruros* | Click here |
| PHOPHO | Rougequeue à front blanc | Common Redstart | *Phoenicurus phoenicurus* | Click here |
| PHYBON | Pouillot de Bonelli | Western Bonelli's Warbler | *Phylloscopus bonelli* | Click here |
| PHYCOL | Pouillot véloce | Common Chiffchaff | *Phylloscopus collybita* | Click here |
| PHYSIB | Pouillot siffleur | Wood Warbler | *Phylloscopus sibilatrix* | Click here |
| PHYTRO | Pouillot fitis | Willow Warbler | *Phylloscopus trochilus* | Click here |
| PICCAN | Pic cendré | Grey-headed Woodpecker | *Picus canus* | Click here |
| PICPIC | Pie bavarde | Magpie | *Pica pica* | Click here |
| PICVIR | Pic vert | Green Woodpecker | *Picus viridis* | Click here |
| PRUMOD | Accenteur mouchet | Dunnock | *Prunella modularis* | Click here |
| PYRPYR | Bouvreuil pivoine | Bullfinch | *Pyrrhula pyrrhula* | Click here |

Continued on next page

**Table 8:** Links to the animations 2003–2053 for scenario S3 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| REGIGN | Roitelet triple-bandeau | Firecrest | *Regulus ignicapilla* | Click here |
| REGREG | Roitelet huppé | Goldcrest | *Regulus regulus* | Click here |
| SAXRUB | Tarier des prés | Whinchat | *Saxicola rubetra* | Click here |
| SAXTOR | Tarier pâtre | Common Stonechat | *Saxicola rubicola* | Click here |
| SERSER | Serin cini | European Serin | *Serinus serinus* | Click here |
| SITEUR | Sittelle torchepot | Eurasian Nuthatch | *Sitta europaea* | Click here |
| STRDEC | Tourterelle turque | Collared Dove | *Streptopelia decaocto* | Click here |
| SYLATR | Fauvette à tête noire | Blackcap | *Sylvia atricapilla* | Click here |
| SYLCOM | Fauvette grisette | Common Whitethroat | *Sylvia communis* | Click here |
| TROTRO | Troglodyte mignon | Wren | *Troglodytes troglodytes* | Click here |
| TURMER | Merle noir | Blackbird | *Turdus merula* | Click here |
| TURPHI | Grive musicienne | Song Thrush | *Turdus philomelos* | Click here |
| TURVIS | Grive draine | Mistle Thrush | *Turdus viscivorus* | Click here |
| UPUEPO | Huppe fasciée | Hoopoe | *Upupa epops* | Click here |
| VANVAN | Vanneau huppé | Northern Lapwing | *Vanellus vanellus* | Click here |

*More interpretations to come.*

### 3.5 Scenario S4

Scenario S2 coupled with a payment of € 200 per hectare for pastures, with climate effects on birds as in S0.

Download the data for the simulation here. The dynamic map 2003–2053 for the aggregate bird index as presented in the working paper (equation 9) is here with the corresponding R code. Some explanations.

Species names are available from this `.csv` file from which we build the following tabular containing the animations 2003–2053 of bird abundances from all the species studied in this research. The R Code using to generate the simulations from the raw data is here. The Table is simply obtained from the following R script.

```
Outliers <- c("ALAARV", "APUAPU", "SYLMEL")
NDO <- subset(read.csv("Data/NomsDoizos.csv"), !SPEC %in% Outliers)
(OIZO <- data.frame("CODE"= NDO$SPEC, "French"= NDO$NOM, "English"= NDO$Anglais,
                    "Latin"= paste("/", NDO$ESP1, " ", NDO$ESP2, "/", sep= ""),
                    "Animation"= paste("[[./output/", NDO$SPEC, "S4/",
                                       NDO$SPEC,"S4.html][Click here]]", sep= "")))
```

**Table 9:** Links to the animations 2003–2053 for scenario S4 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| ALERUF | Perdrix rouge | Red-legged Partridge | *Alectoris rufa* | Click here |
| ANTPRA | Pipit farlouse | Meadow Pipit | *Anthus pratensis* | Click here |
| BUTBUT | Buse variable | Common Buzzard | *Buteo buteo* | Click here |
| CARCAN | Linotte mélodieuse | Linnet | *Carduelis cannabina* | Click here |

Continued on next page

**Table 9:** Links to the animations 2003–2053 for scenario S4 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| CARCAR | Chardonneret élégant | Goldfinch | *Carduelis carduelis* | Click here |
| CARCHL | Verdier d'Europe | Greenfinch | *Chloris chloris* | Click here |
| CERBRA | Grimpereau des jardins | Short-toed Treecreeper | *Certhia brachydactyla* | Click here |
| CERFAM | Grimpereau des bois | Eurasian Treecreeper | *Certhia familiaris* | Click here |
| COCCOC | Grosbec casse-noyaux | Hawfinch | *Coccothraustes coccothraustes* | Click here |
| COLPAL | Pigeon ramier | Wood Pigeon | *Columba palumbus* | Click here |
| CORCOR | Corneille noire | Carrion Crow | *Corvus corone* | Click here |
| CORFRU | Corbeau freux | Rook | *Corvus frugilegus* | Click here |
| CORMON | Choucas des tours | Western Jackdaw | *Coloeus monedula* | Click here |
| COTCOT | Caille des blés | Common Quail | *Coturnix coturnix* | Click here |
| CUCCAN | Coucou gris | Common Cuckoo | *Cuculus canorus* | Click here |
| DELURB | Hirondelle de fenêtre | House Martin | *Delichon urbicum* | Click here |
| DENMAJ | Pic épeiche | Great Spotted Woodpecker | *Dendrocopos major* | Click here |
| DENMED | Pic mar | Middle Spotted Woodpecker | *Dendrocopos medius* | Click here |
| DRYMAR | Pic noir | Black Woodpecker | *Dryocopus martius* | Click here |
| EMBCIR | Bruant zizi | Cirl Bunting | *Emberiza cirlus* | Click here |
| EMBCIT | Bruant jaune | Yellowhammer | *Emberiza citrinella* | Click here |
| ERIRUB | Rouge-gorge familier | Robin | *Erithacus rubecula* | Click here |
| FALTIN | Faucon crécerelle | Common Kestrel | *Falco tinnunculus* | Click here |
| FRICOE | Pinson des arbres | Common Chaffinch | *Fringilla coelebs* | Click here |
| GARGLA | Geai des chênes | Eurasian Jay | *Garrulus glandarius* | Click here |
| HIPPOL | Hypolaïs polyglotte | Melodious Warbler | *Hippolais polyglotta* | Click here |
| HIRRUS | Hirondelle rustique | Barn Swallow | *Hirundo rustica* | Click here |
| LANCOL | Pie-grièche écorcheur | Red-backed Shrike | *Lanius collurio* | Click here |
| LULARB | Alouette lulu | Wood Lark | *Lullula arborea* | Click here |
| LUSMEG | Rossignol philomèle | Rufous Nightingale | *Luscinia megarhynchos* | Click here |
| MILCAL | Bruant proyer | Corn Bunting | *Emberiza calandra* | Click here |
| MOTFLA | Bergeronnette printanière | Yellow Wagtail | *Motacilla flava* | Click here |
| ORIORI | Loriot d'Europe | Golden Oriole | *Oriolus oriolus* | Click here |
| PARATE | Mésange noire | Coal Tit | *Periparus ater* | Click here |
| PARCAE | Mésange bleue | Blue Tit | *Cyanistes caeruleus* | Click here |
| PARCRI | Mésange huppée | Crested Tit | *Lophophanes cristatus* | Click here |
| PARMAJ | Mésange charbonnière | Great Tit | *Parus major* | Click here |
| PARMON | Mésange boréale | Willow Tit | *Parus montanus* | Click here |
| PARPAL | Mésange nonnette | Marsh Tit | *Poecile palustris* | Click here |
| PASDOM | Moineau domestique | House Sparrow | *Passer domesticus* | Click here |
| PASMON | Moineau friquet | Tree Sparrow | *Passer montanus* | Click here |
| PERPER | Perdrix grise | Grey Partridge | *Perdix perdix* | Click here |
| PHOOCH | Rougequeue noir | Black Redstart | *Phoenicurus ochruros* | Click here |
| PHOPHO | Rougequeue à front blanc | Common Redstart | *Phoenicurus phoenicurus* | Click here |
| PHYBON | Pouillot de Bonelli | Western Bonelli's Warbler | *Phylloscopus bonelli* | Click here |
| PHYCOL | Pouillot véloce | Common Chiffchaff | *Phylloscopus collybita* | Click here |
| PHYSIB | Pouillot siffleur | Wood Warbler | *Phylloscopus sibilatrix* | Click here |
| PHYTRO | Pouillot fitis | Willow Warbler | *Phylloscopus trochilus* | Click here |
| PICCAN | Pic cendré | Grey-headed Woodpecker | *Picus canus* | Click here |
| PICPIC | Pie bavarde | Magpie | *Pica pica* | Click here |
| PICVIR | Pic vert | Green Woodpecker | *Picus viridis* | Click here |
| PRUMOD | Accenteur mouchet | Dunnock | *Prunella modularis* | Click here |
| PYRPYR | Bouvreuil pivoine | Bullfinch | *Pyrrhula pyrrhula* | Click here |
| REGIGN | Roitelet triple-bandeau | Firecrest | *Regulus ignicapilla* | Click here |
| REGREG | Roitelet huppé | Goldcrest | *Regulus regulus* | Click here |
| SAXRUB | Tarier des prés | Whinchat | *Saxicola rubetra* | Click here |
| SAXTOR | Tarier pâtre | Common Stonechat | *Saxicola rubicola* | Click here |
| SERSER | Serin cini | European Serin | *Serinus serinus* | Click here |

Continued on next page

**Table 9:** Links to the animations 2003–2053 for scenario S4 and each bird species

| CODE | French | English | Latin | Animation |
|---|---|---|---|---|
| SITEUR | Sittelle torchepot | Eurasian Nuthatch | *Sitta europaea* | Click here |
| STRDEC | Tourterelle turque | Collared Dove | *Streptopelia decaocto* | Click here |
| SYLATR | Fauvette à tête noire | Blackcap | *Sylvia atricapilla* | Click here |
| SYLCOM | Fauvette grisette | Common Whitethroat | *Sylvia communis* | Click here |
| TROTRO | Troglodyte mignon | Wren | *Troglodytes troglodytes* | Click here |
| TURMER | Merle noir | Blackbird | *Turdus merula* | Click here |
| TURPHI | Grive musicienne | Song Thrush | *Turdus philomelos* | Click here |
| TURVIS | Grive draine | Mistle Thrush | *Turdus viscivorus* | Click here |
| UPUEPO | Huppe fasciée | Hoopoe | *Upupa epops* | Click here |
| VANVAN | Vanneau huppé | Northern Lapwing | *Vanellus vanellus* | Click here |

*More interpretations to come.*

# 4 Acknowledgements

This research has been founded by the FRB (*Fondation de Recherche sur la Biodiversité*) and GDF–SUEZ through the MOBILIS project. R. Chakir also acknowledges the financial support from French *Agence Nationale de la Recherche* through the ModULand project (ANR–11–BSH1–005). The authors also acknowledge volunteer ornithologists, French Ministry of Agriculture (*Service de la Statistique et de la Prospective*), IGN, INRA InfoSol, and Météo France for the production of data that allow such work. We are grateful to Laurent Terray, Christian Pagé and Julian Boé for the regional climate scenarios, Vincent Badeau for the development of the 8km soil data set and Christophe François for his assistance in the use of climate and soils data sets.

# 5 Additional Material

## 5.1 Geographic files

The compressed geographical shapefiles are available here.

```
library(sp) ; library(rgdal)
MAP    <- readOGR("./Data", "GrMaille", verbose= FALSE)
CRD    <- data.frame(MAP, coordinates(MAP))
F2C    <- readOGR("./Data", "F2C"     , verbose= FALSE)
FD.CRT <- list("sp.polygons", F2C, lwd= 10)
```

## 5.2 Linear Approx.

```
LinApprox <- function(pdat, nc= 2: 52){
    prd <- matrix(0, ncol= length(nc))
    for (i in unique(pdat$MAILLE)){
```

```
        yop <- approx(pdat$time[pdat$MAILLE== i],
                      pdat$value[pdat$MAILLE== i], n= length(nc))$y
        prd <- rbind(prd, yop)
    }
    DAT <<- data.frame(unique(pdat$MAILLE), prd[-1, ], row.names= NULL)
    names(DAT) <<- c("MAILLE", paste("N", 2003: 2053, sep= ""))
    DAT[, nc]  <<- (DAT[, nc]- DAT[, 2])* 100
}
```

## 5.3 Animations

```
library(RColorBrewer) ; library(classInt) ; library(animation)
AnimHTML <- function(SPDF, ttle, brks, pal, t1, t2, dir, name){
    IC <- classIntervals(-100: 100, n= length(brks)+ 1,
                         style= "fixed", fixedBreaks= brks)
    CR <- attr(findColours(IC, brewer.pal(5, pal)), "palette")
    saveHTML({
        oopt <- ani.options(interval= 0.15, nmax= 100, title= ttle)
        opar <- par(mar= c(3, 3, 1, 0.5), mgp= c(2, .5, 0),
                    tcl= -0.3, cex.axis= 1.5, cex.lab= 1.5, cex.main= 2)
        for(i in 2: 52){
            dev.hold()
            mp <- spplot(SPDF[, i], cuts= IC$brks, col.regions= CR,
                         cex= 1, pch= 15, colorkey= T, sp.layout= FD.CRT,
                         main= paste(t1, substr(names(SPDF)[ i], 2, 5),
                                     t2, sep= ""),
                         par.settings= list(panel.background=
                                            list(col="grey")))
            mp$legend$right$args$key$at <- IC$brks ; print(mp)
            ani.pause()
        }
    }, autoplay= FALSE, loop= FALSE, verbose= FALSE, outdir = dir,
             htmlfile = name, autobrowse= FALSE, single.opts=
             "'controls': ['first', 'previous',
              'play', 'next', 'last', 'loop', 'speed'], 'delayMin': 0")
}
```