ECOCLIMAP Second Generation

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History

- **2015** : Study of needs around the databases of surface parameters lead in CNRM and with the external partners (JC Calvet)

- **2016** : Definition of the specifications for ECOCLIMAP-SG

- **2017** :
  - Realisation of the new land cover map
  - Creation of a first set of maps of parameters
  - First OFFLINE and INLINE tests

The land cover map

- global at 300m-resolution, geographic projection (latitude-longitude)

- 1 pixel = 1 type (surface type or vegetation type)

  → Pixels are pure at 300m-resolution

- Based on ESA-CCI Land Cover version 1.6.1 (2016), epoch 2008-2012, satellites MERIS FR && RR et SPOT/VGT.

- Transformation applied to pass from the ESA-CCI classes to the ECOCLIMAP-SG types (transfer function)

  → mainly automated in order to be able to apply it again over time, on the updated ESA-CCI map.

The ECOCLIMAP-SG types

1. Sea and oceans (cov. 1)
2. Lakes (cov. 2)
3. Rivers (cov. 3)
4. Bare soil (veg. 1)
5. Bare rock (veg. 2)
6. Permanent snow (veg. 3)
7. boreal broadleaf deciduous (veg. 16)
8. temperate broadleaf deciduous (veg. 4)
9. tropical broadleaf deciduous (veg. 13)
10. temperate broadleaf evergreen (veg. 14)
11. tropical broadleaf evergreen (veg. 6)
12. boreal needleleaf evergreen (veg. 5)
13. temperate needleleaf evergreen (veg. 15)
14. boreal needleleaf deciduous (veg. 17)
15. shrubs (veg. 19)
16. boreal grassland (veg. 18)
17. temperate grassland (veg. 10)
18. tropical grassland (veg. 11)
19. Winter C3 crops (veg. 7)
20. Summer C3 crops (new)
21. C4 crops (veg. 8)
22. Tree cover, flooded (new)
23. Shrub or herbaceous cover, flooded (new)
24. urban LCZ1: compact high-rise (new)
25. urban LCZ2: compact midrise (new)
26. urban LCZ3: compact low-rise (new)
27. urban LCZ4: open high-rise (new)
28. urban LCZ5: open midrise (new)
29: urban LCZ6: open low-rise (new)
30: urban LCZ7: lightweight low-rise (new)
31: urban LCZ8: large low-rise (new)
32: urban LCZ9: sparsely built (new)
33: urban LCZ10: heavy industry (new)

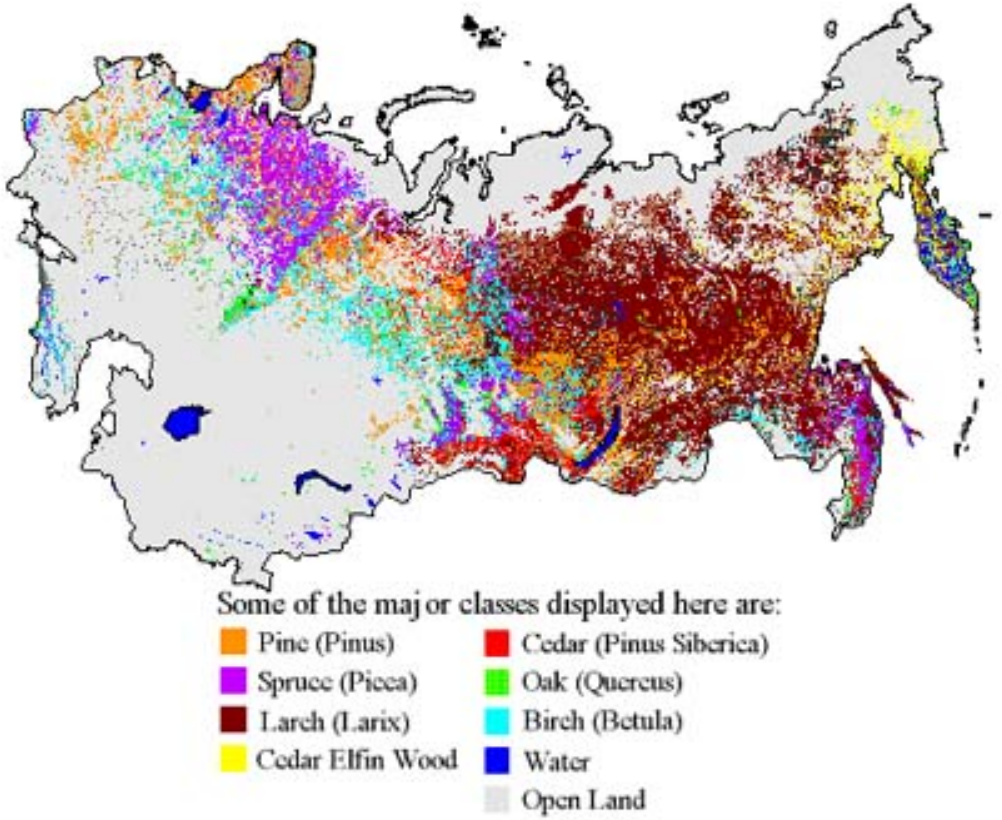
Data sources used

	Difficulty	*Data sources used*
Sea, lakes and rivers	To separate them	- personal try to manually separate them - SRTM Water Body Data from USGS - GSHHC and WDBII from NOAA
Bare soil and bare rock	To separate them	- GLC2000 regional tiles
Forests / grassland	To distinguish the boreal / temperate / tropical climatic areas	- The bioclim_LPJ.nc map (already used to move from 12 to 19 vegtypes)
Crops	To distinguish winter C3 / summer C3 / C4 crops	- FAO crops statistics by country for the whole world, year 2014 - USDA map of crops for the USA at 30m resolution, year 2015 - AGRESTE statistics by French departement, year 2015
Urban areas	To separate them into the 10 urban LCZs	- CLC2012 - GHSL_LABEL pre-release data

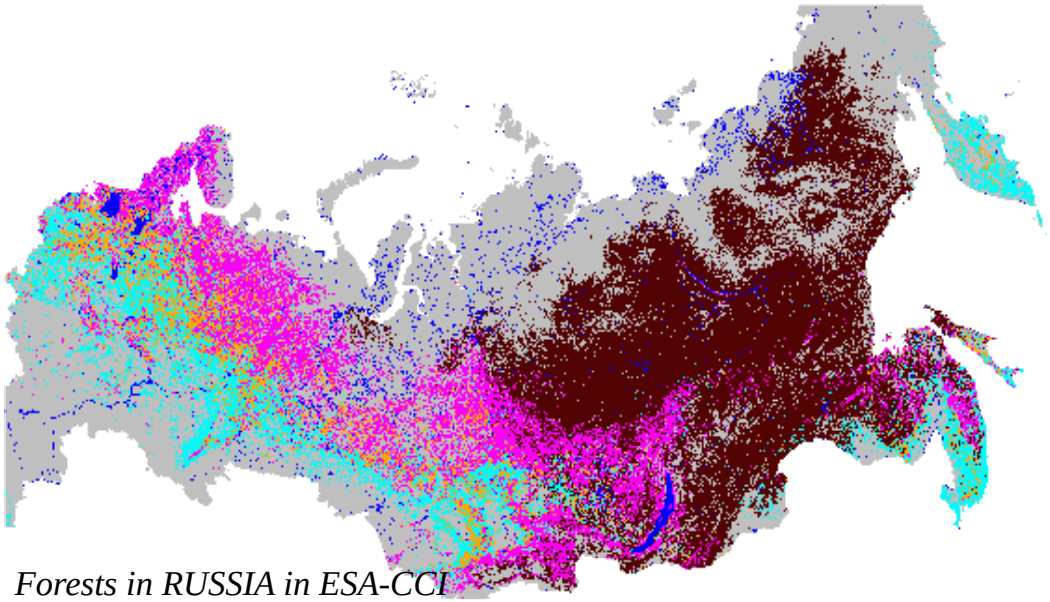
First set of primary parameters maps

- Maps of primary parameters passed by the namelist :
  - **Leaf area index (LAI)** : 10-day period data of LAI from satellite PROBA-V (Copernicus), 300m-resolution, years 2014-2016.
  - **Soil and vegetation albedos** : 10-day period data of surface albedo from satellite SPOT/VGT (Copernicus), 1km-resolution, years 1998-2014.
    - Desagregation by a KALMAN filter (method from Carrer et al.,2014)
  - **Height of trees** : global map of tree height at 1km-resolution (Simard et al., 2011, NASA).
  - **Soil depths (root and total soil depths)** : uniform values by vegetation types inspired by the values displayed in classical ECOCLIMAP.

The ESA-CCI land cover map : comparisons (1/2) needleleaf deciduous forest in Russia



Forest Cover Map of the Former Soviet Union (January 1993)
(http://www.borealforest.org/world/rus_mgmt.htm)

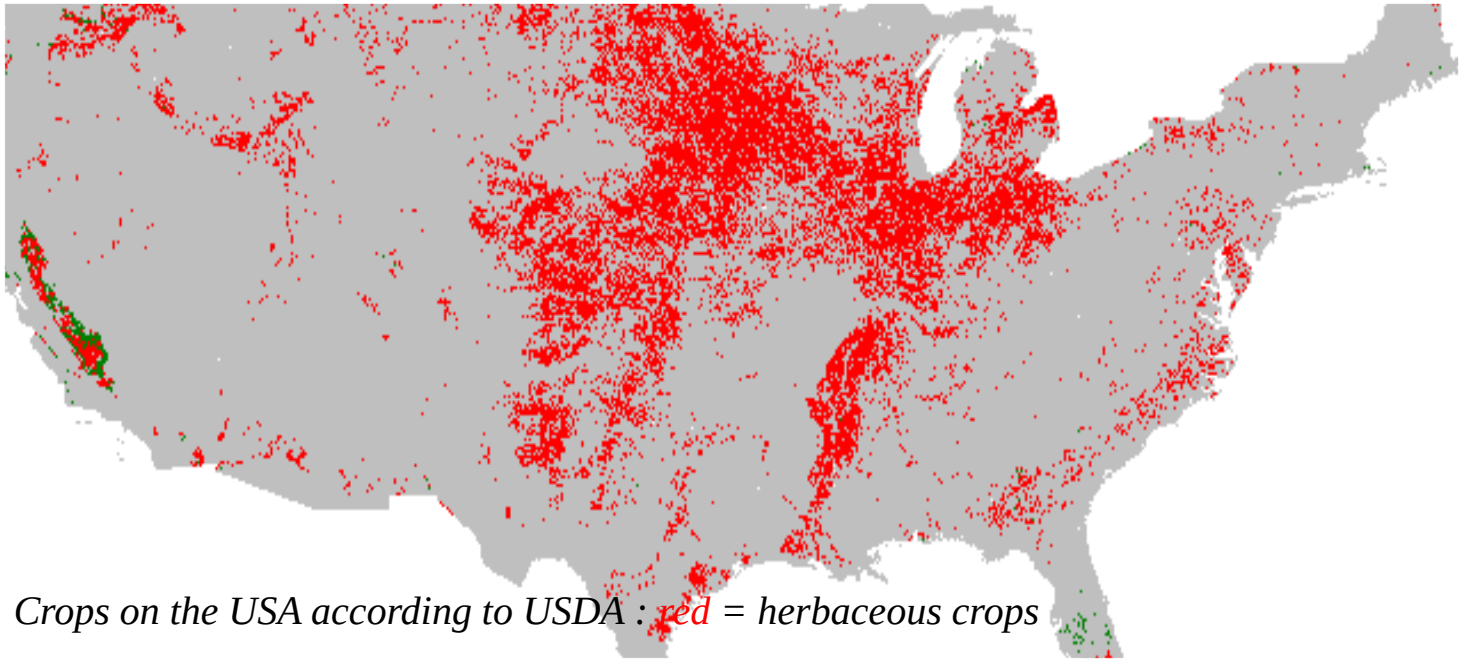


Forests in RUSSIA in ESA-CCI

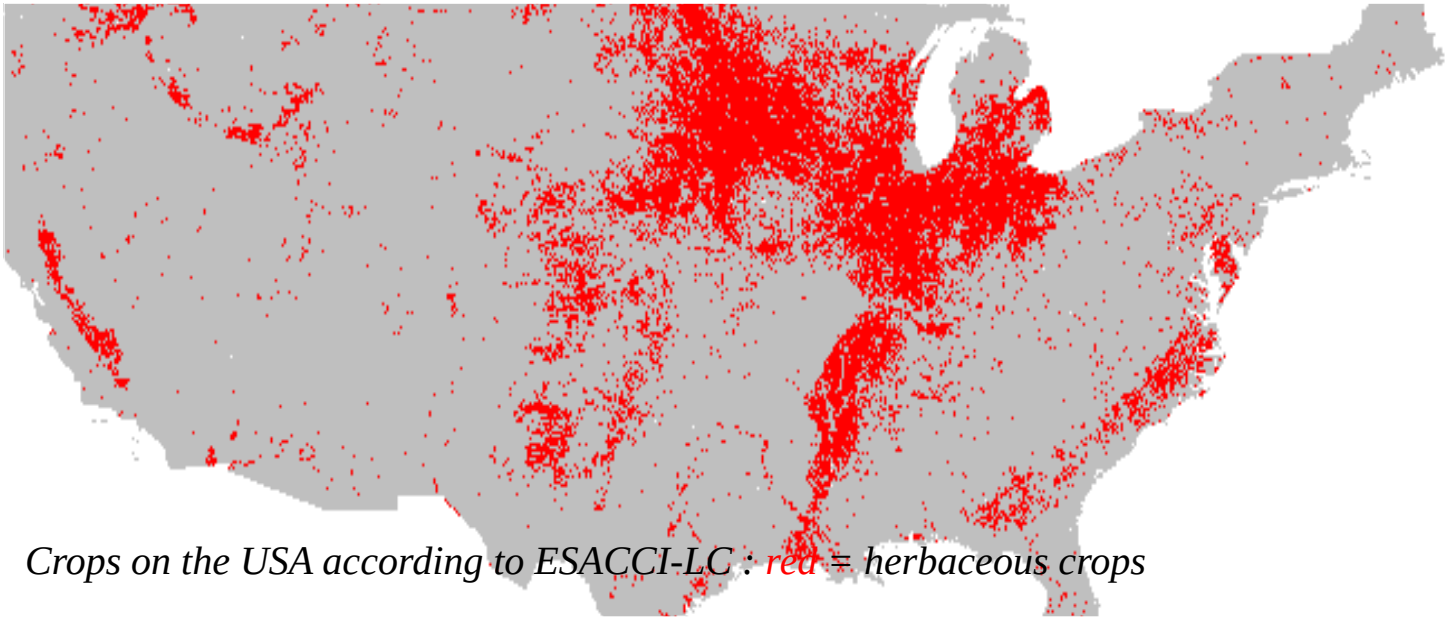
- **in brown, needleleaf deciduous** → Visually, the similarity is not too bad.

- In pink, yellow and red, needleleaf evergreen
- In light blue and green, broadleaf deciduous
- In orange, needleleaf evergreen on the left, mixed forest on the right

The ESA-CCI land cover map : comparisons (2/2) crops on the USA



Crops on the USA according to USDA : red = herbaceous crops



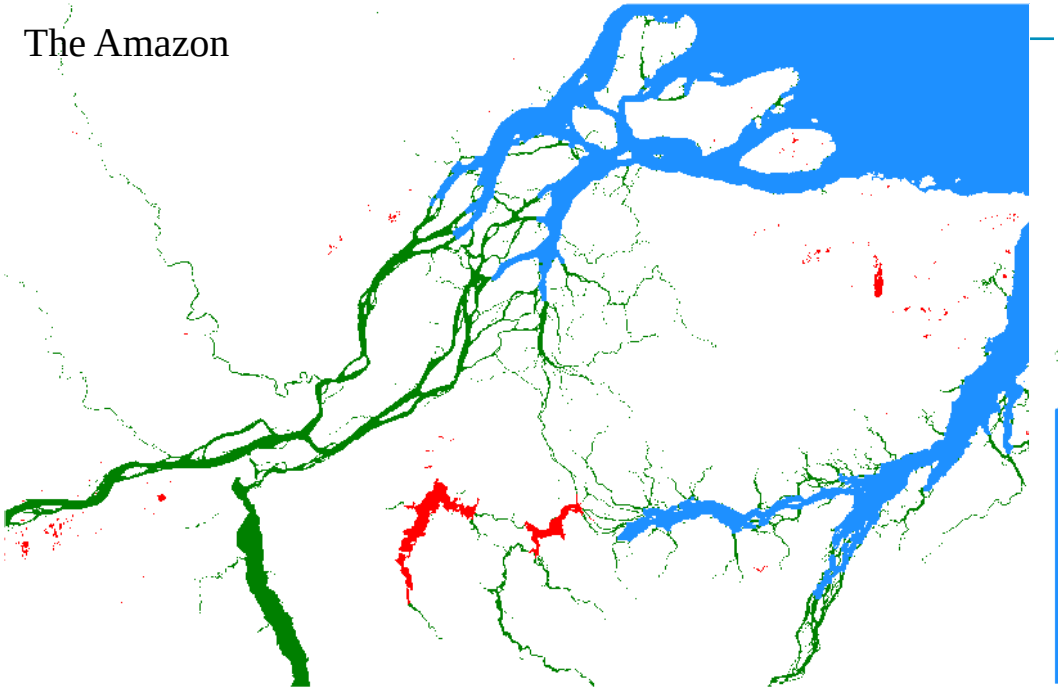
Crops on the USA according to ESACCI-LC : red = herbaceous crops

→ The similarity between crops according to USDA and according to ESA-CCI LC, on the USA, is visually not to bad.

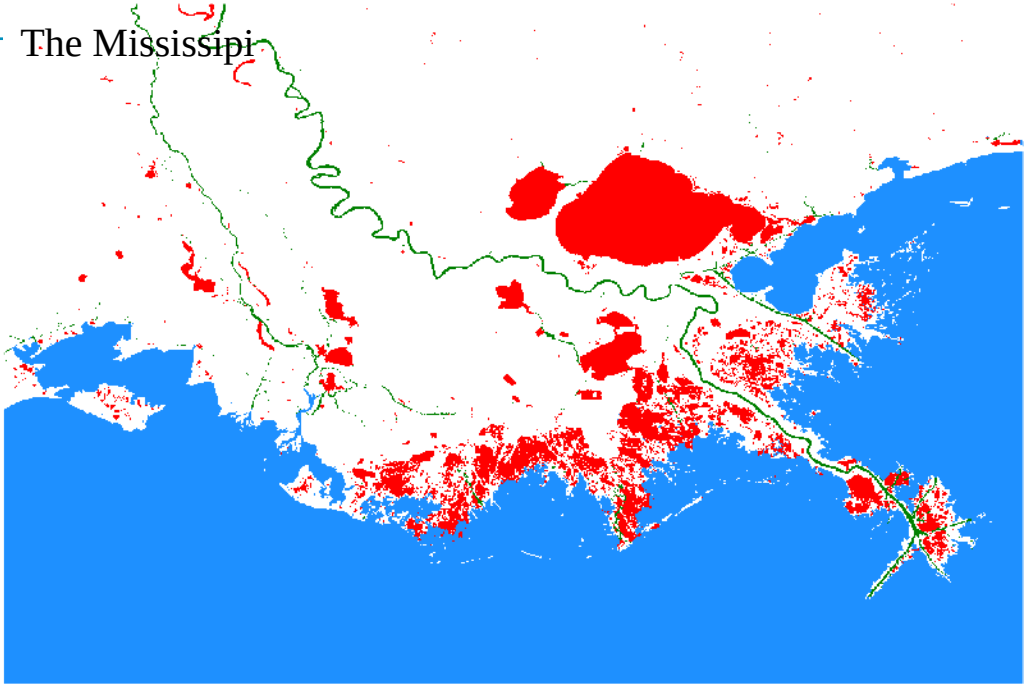
METEO FRANCE

Illustrations : sea, lakes and rivers (1/2)

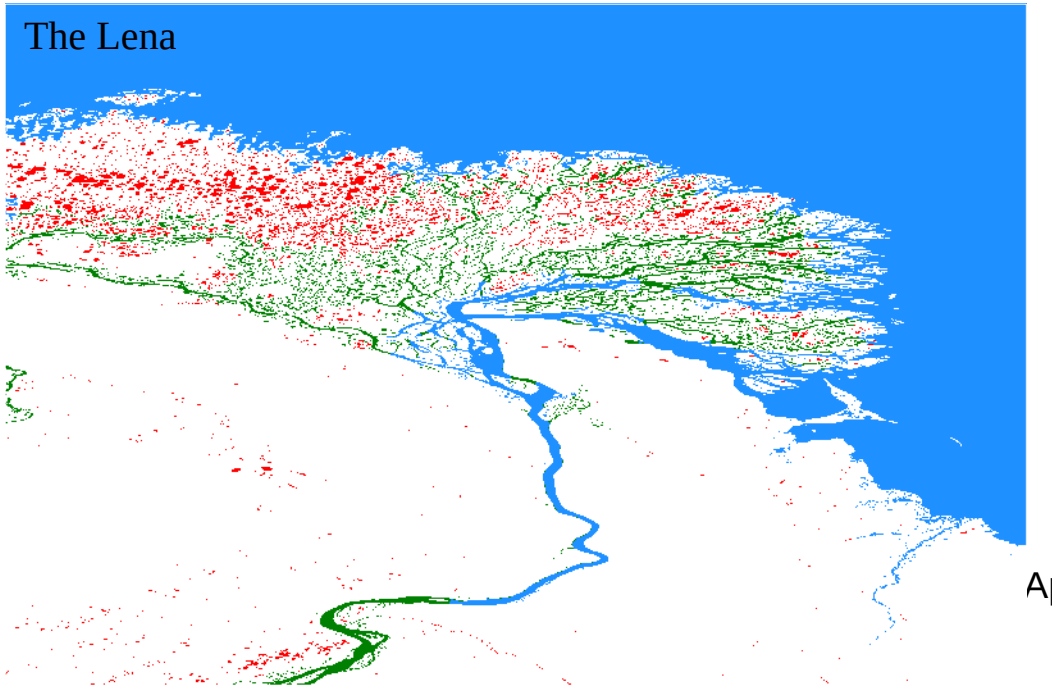
The Amazon



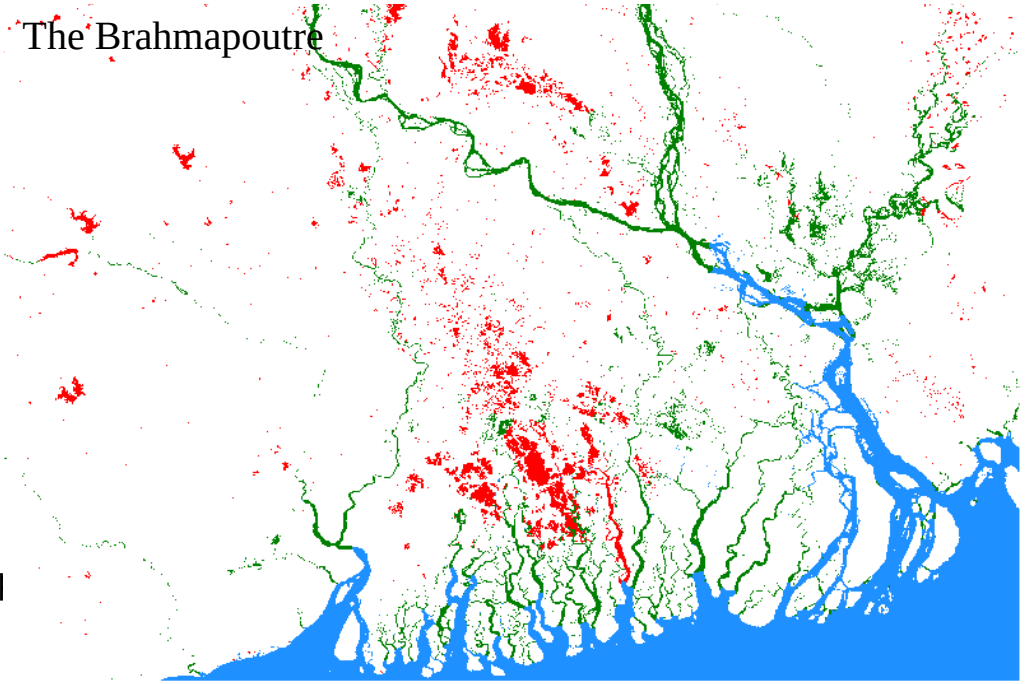
The Mississipi



The Lena

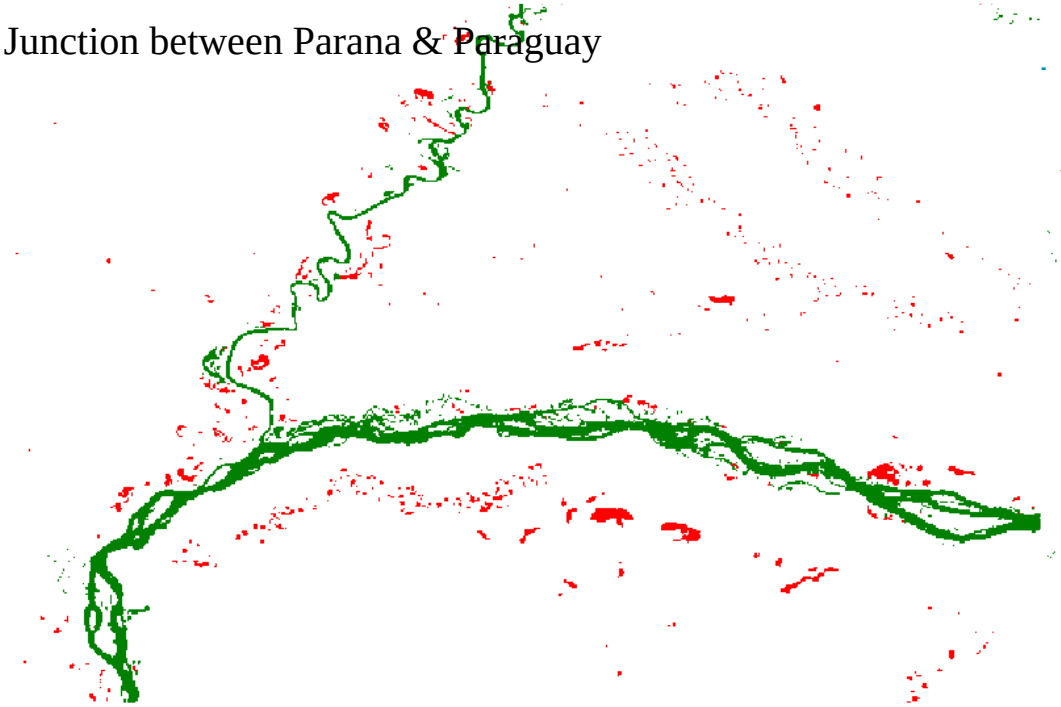


The Brahmapoutre

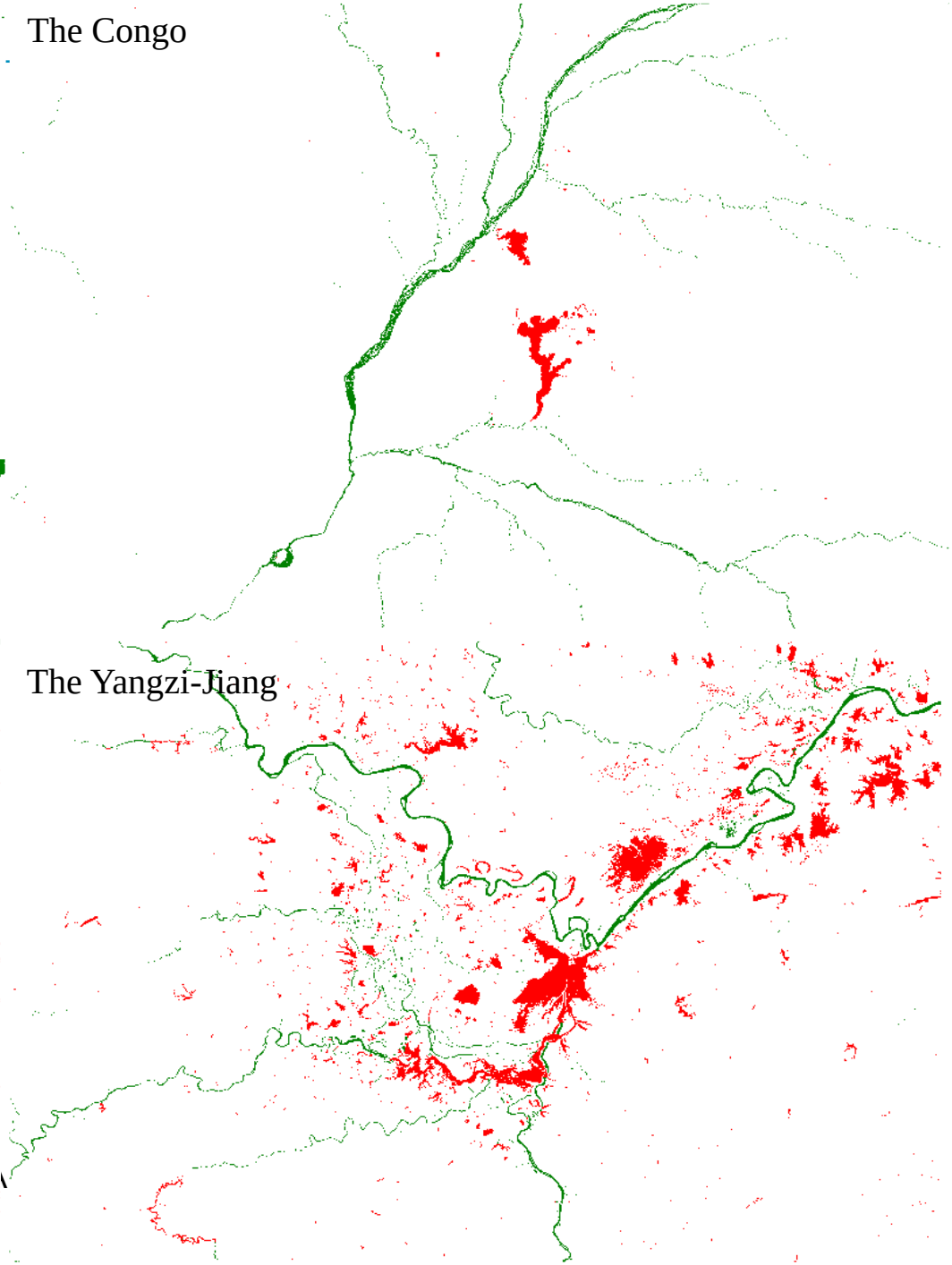


Illustrations : sea, lakes and rivers (2/2)

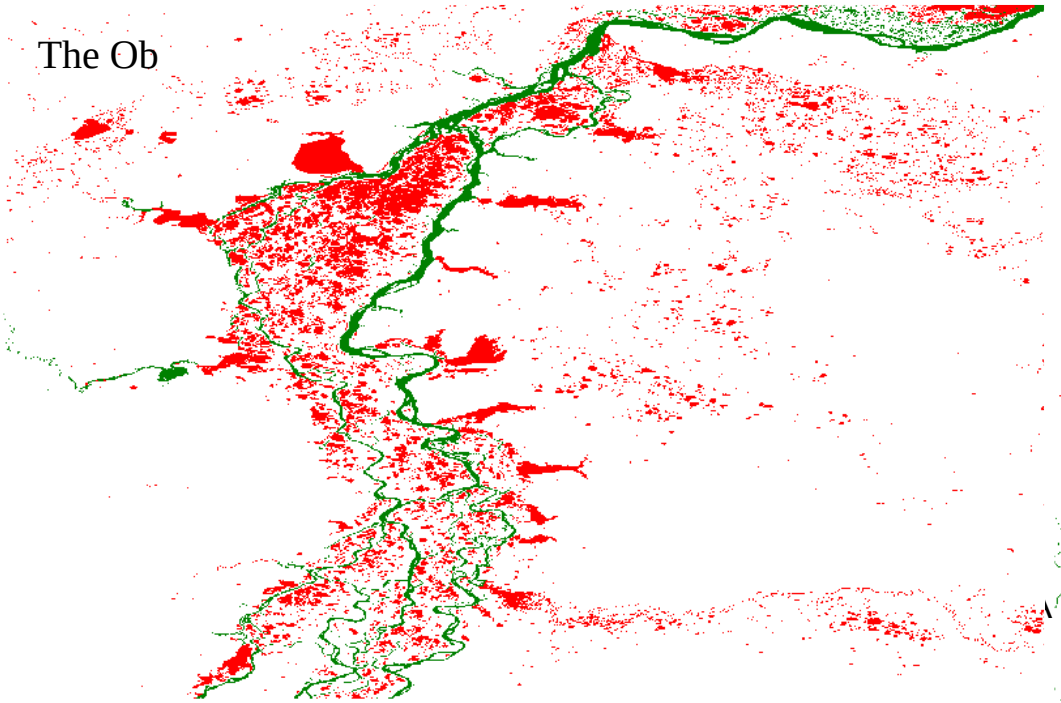
Junction between Parana & Paraguay



The Congo

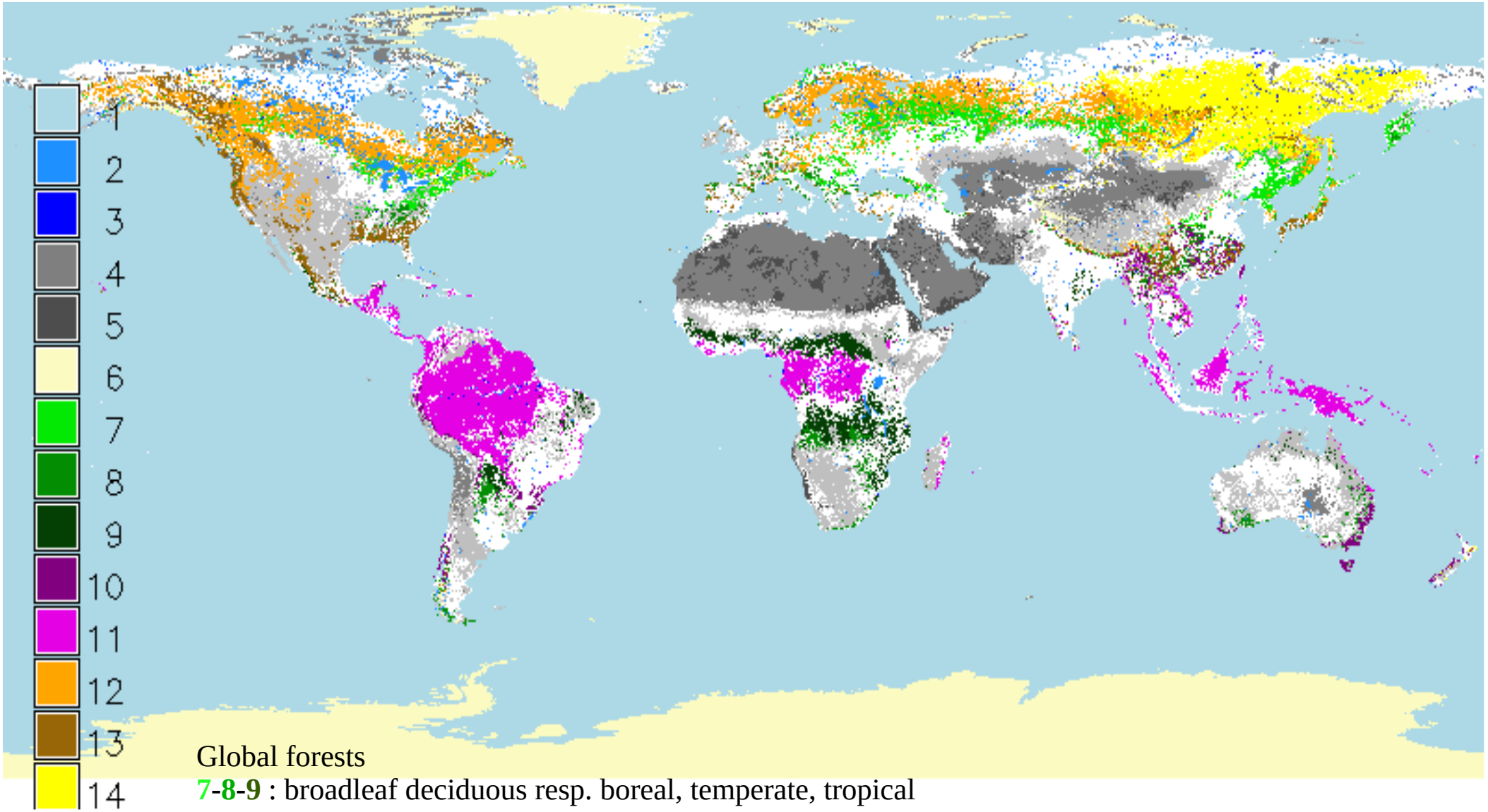


The Ob



The Yangzi-Jiang

Illustrations : the forests

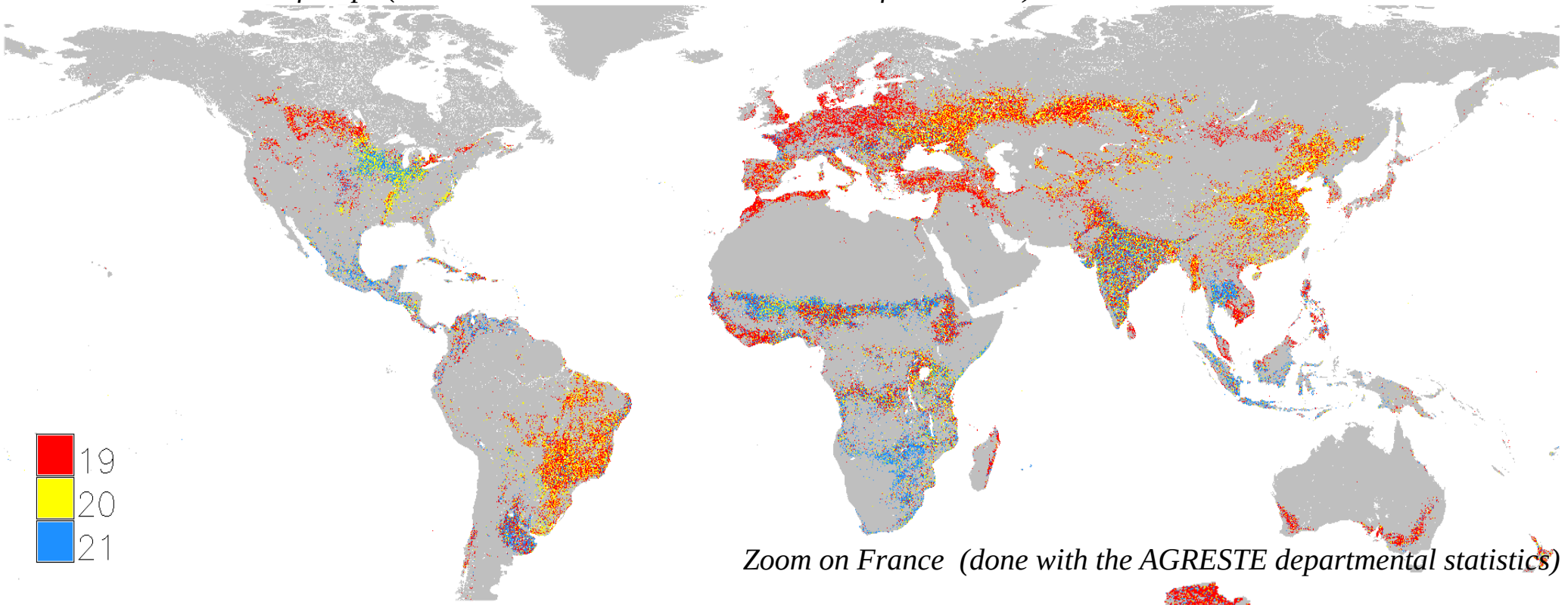


Global forests
7-8-9 : broadleaf deciduous resp. boreal, temperate, tropical
10-11 : broadleaf evergreen resp. temperate, tropical
12-13 : needleleaf evergreen resp. boreal, temperate
14 : needleleaf deciduous, boreal

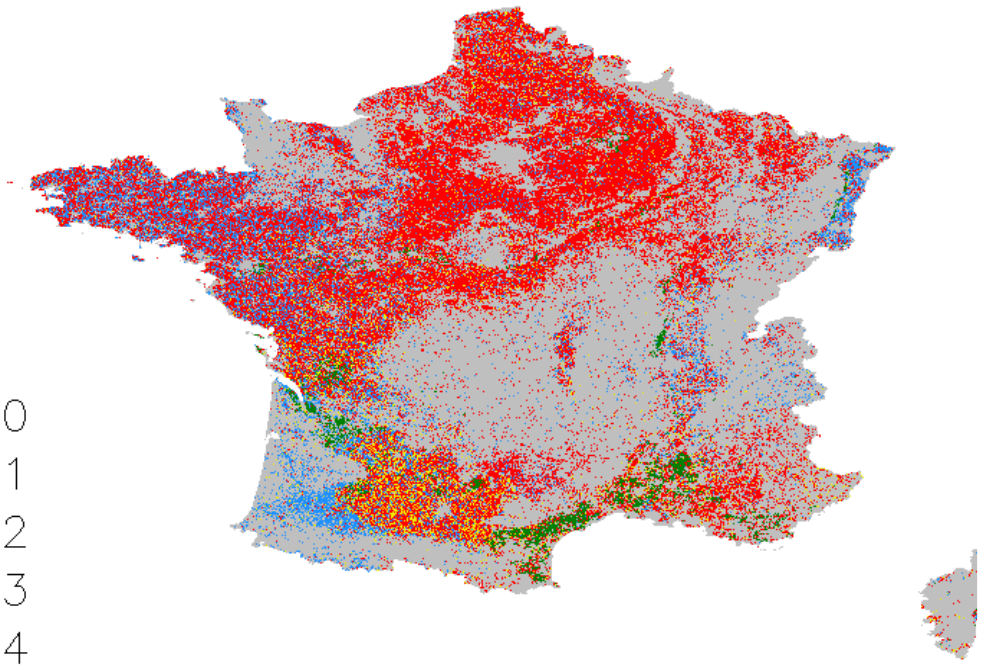
METEO FRANCE

Illustrations : the crops

Global distribution of crops (done with the FAO statistics and USDA for the USA)



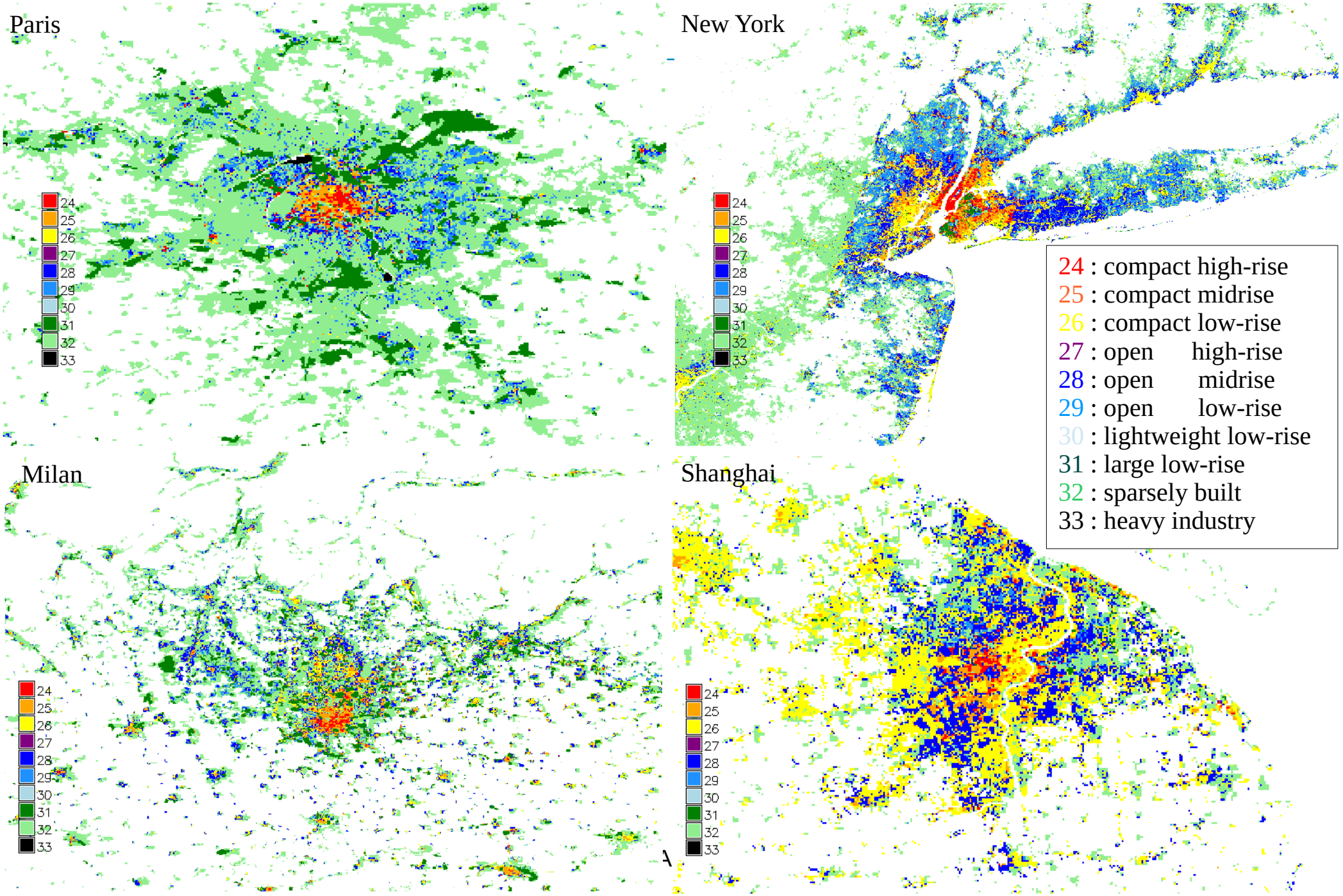
Zoom on France (done with the AGRESTE departmental statistics)



19 / 1 -red : winter C3 crops
20 / 2 – yellow : summer C3 crops
21 / 3 - blue : C4 crops

Toulouse, .

Illustrations : the urban areas



Practically

- The AROME PGD with ECOCLIMAP-SG takes ~7h to execute, with 4 nodes, 40 tasks MPI et 4 OPEN-MP threads by task.

- The input maps for ECOCLIMAP-SG are compressed and represent around 600 gigabytes of data.

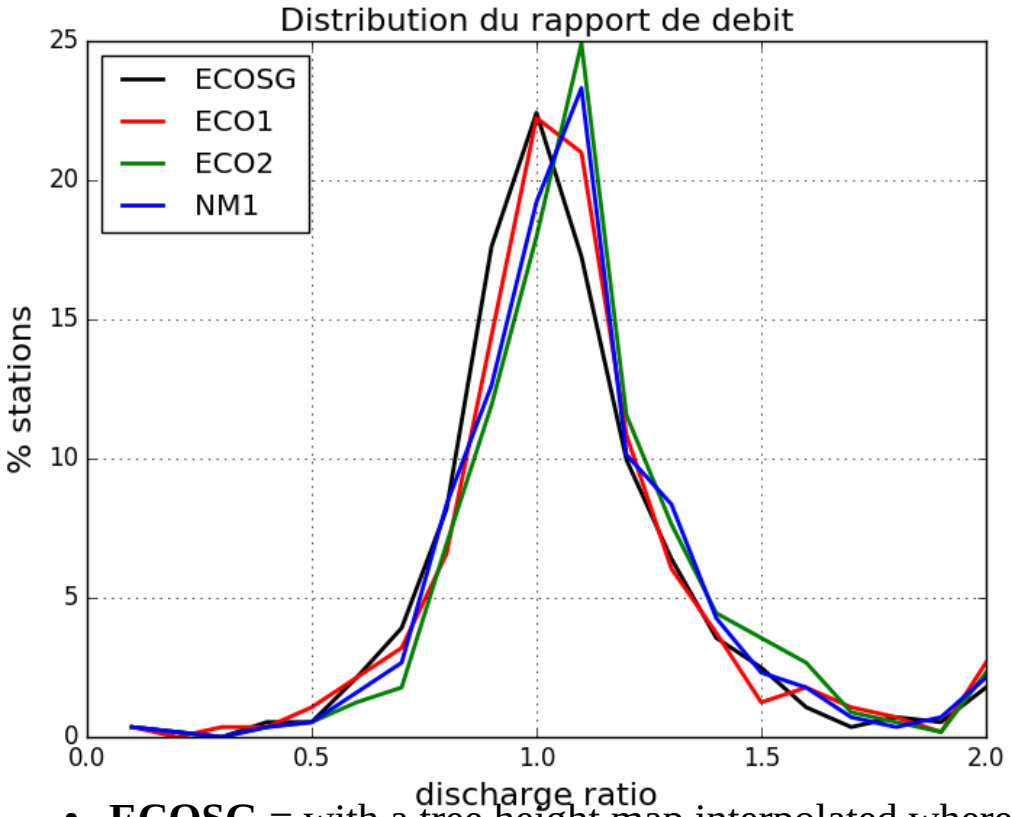
- The output PGD file for AROME with ECOCLIMAP-SG makes 65 gigabytes.

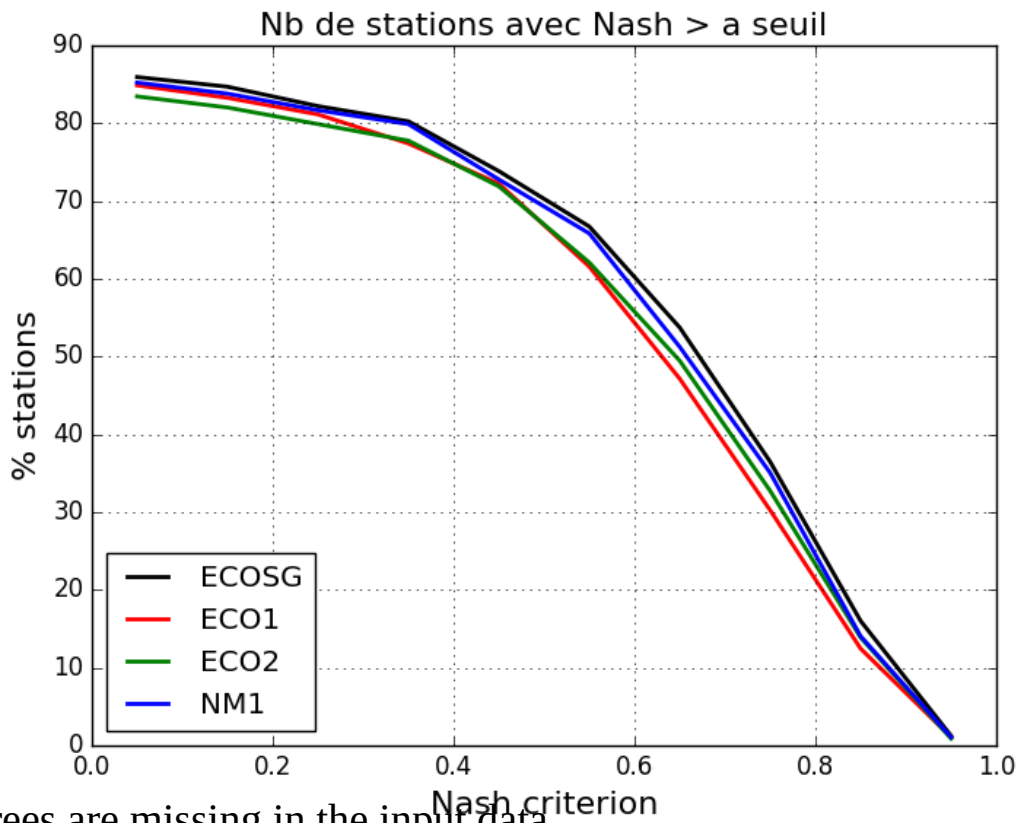
→ To use ECOCLIMAP-SG is expensive :

  - Particularly during the PGD step
  - During the PREP step if the initialisation is done from a PREP file realized with ECOCLIMAP

Test in Safran Isba Modcou (SIM, France)

Context : period 1995-2005 (10 years), ISBA-DF, 12 patchs





- **ECOSG** = with a tree height map interpolated where trees are missing in the input data

- **NM1** = ECOSG with a tree height map with low values where trees are missing in the input data, regarding that these missing values notably correspond to the areas of vineyard and shrubs

- → the NASH criterion is better with ECOCLIMAP-SG
  → the discharge ratio is very sensitive to the height of trees

Tests in AROME-FRANCE : February and July 2016

- Tests are done during 1 month (February and July 2016)

- They show :
  - A negative bias on the wind speed, in February and July, correlated to the trees areas
  - A positive bias on the temperature TCOR, in July, especially during night, correlated to the crops areas

- The plots of parameters show :
  - The LAI is very lower in July on the crops areas in ECOSG
  - The height of tree is quite higher in ECOSG

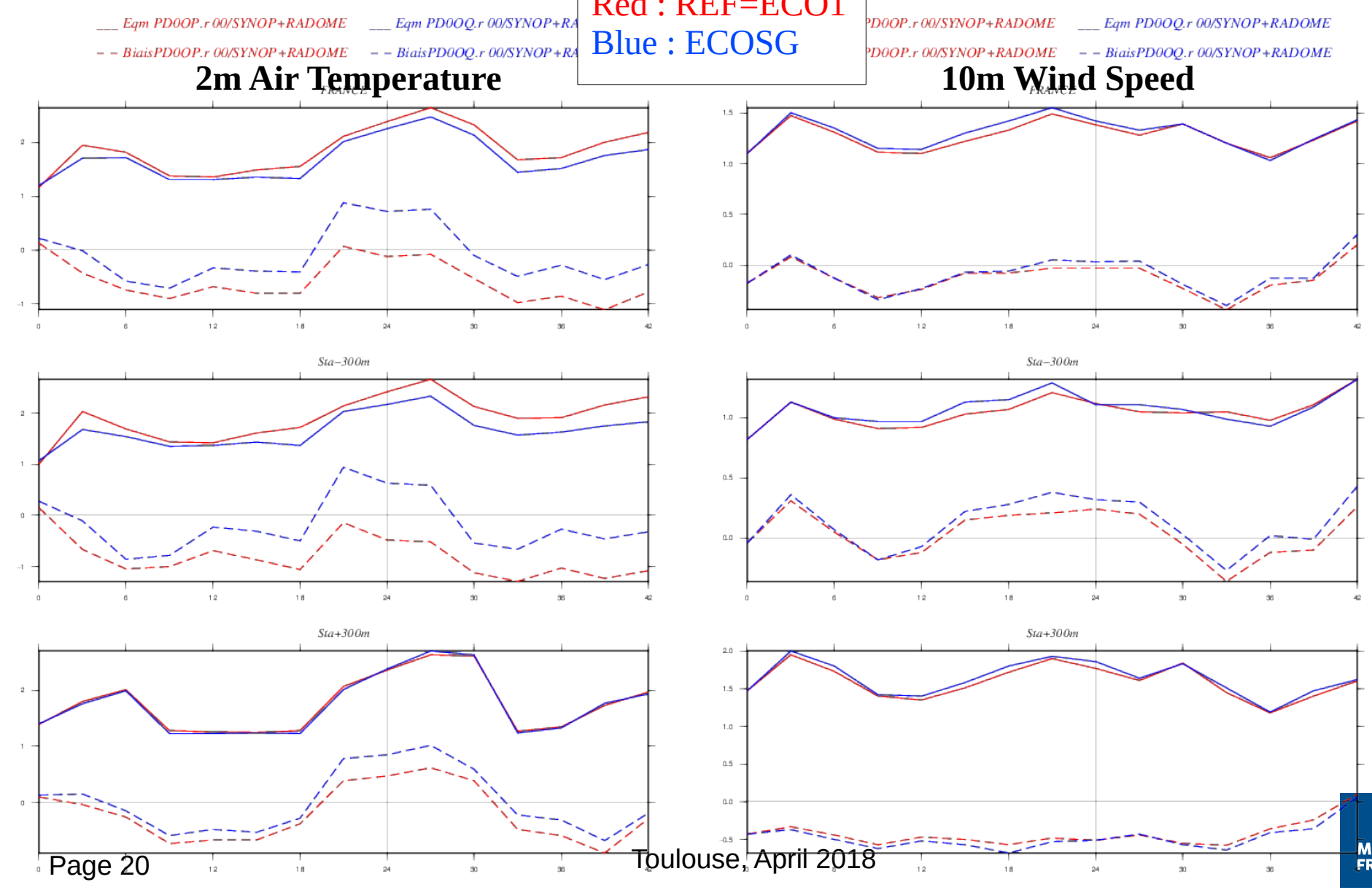
Tests in AROME-FRANCE : February and July 2016

- Putting :
  - CSCOND= »NP89 » in NAM_ISBAn
  - CV = CV*5 on crops areas
  - VEG_HEIGHT = Height of trees / 3 in the Z0 calculation

- Leads to :
  - Correct the temperature bias and obtain better scores with ECOSG than with ECOCLIMAP
  - Reduce the bias on the wind speed but not totally remove it
  - Keep a night bias on humidity

Tests in AROME-FRANCE : July 2016

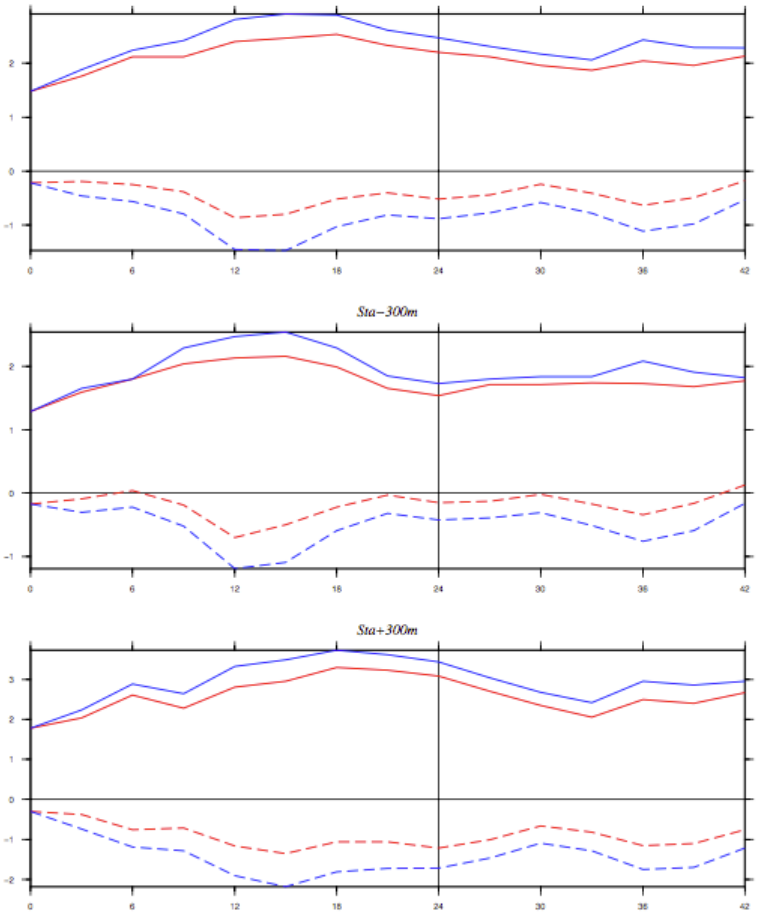
Red : REF=ECO1
Blue : ECOSG



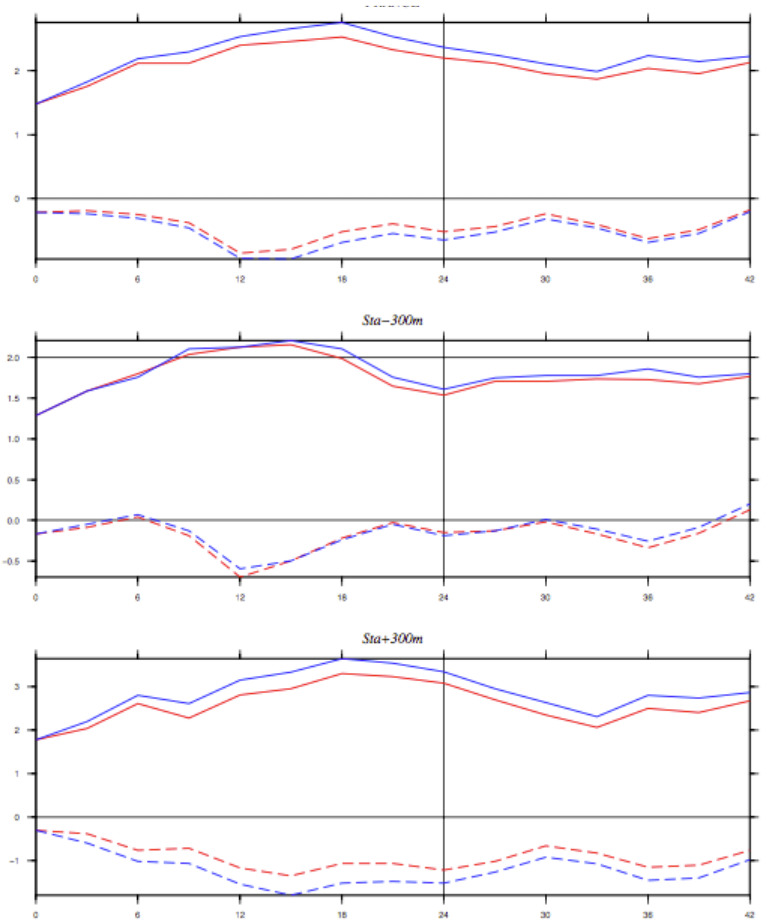
Tests in AROME-FRANCE : February 2016
Impact of missing data height of trees

Red : REF=ECO1
Blue : ECOSG

Height of Trees missing data replaced by interpolated values



Height of Trees missing data replaced by low vegetation height



Tests in AROME-FRANCE : February and July 2016

- Other sensitivity of the scores :
  - Humidity is sensitive to the ratio Z0/Z0H
  - Temperature is also sensitive to the RSMIN

- Other tests to do :
  - To use the more realistic tree height map (cf SIM test)
  - To improve the Z0 calculation to improve the wind speed score
  - To harmonize the parameters values to have good scores in SIM and in AROME with a same set of parameters

Conclusion and prospects

- The first version of ECOCLIMAP-SG is available with documentation and files to download at :

  https://opensource.umr-cnrm.fr/projects/ecoclimap-sg/wiki

- Further tests will be conducted to identify and possibly adjust parameters on which uncertainties exist (Z0, RSMIN, CV, Z0_O_Z0H, ROOT DEPTH, SOIL DEPTH…)
- Need to document the algorithm, to value the work that has been achieved

- This is the first guess of this new generation of surface parameters database
  - The hardest work of building ECOSG and interfacing it into SURFEX is now done
  - It belongs to all of us to use it, critisize it (no doubt on that!), and participate to its improvement and its integration into applications for the whole community