

ECOCLIMAP
A GLOBAL DATABASE OF LAND SURFACE
PARAMETERS AT 1KM RESOLUTION FOR
METEOROLOGICALS MODELS

[J.-L. Champeaux and V. Masson, 2001]

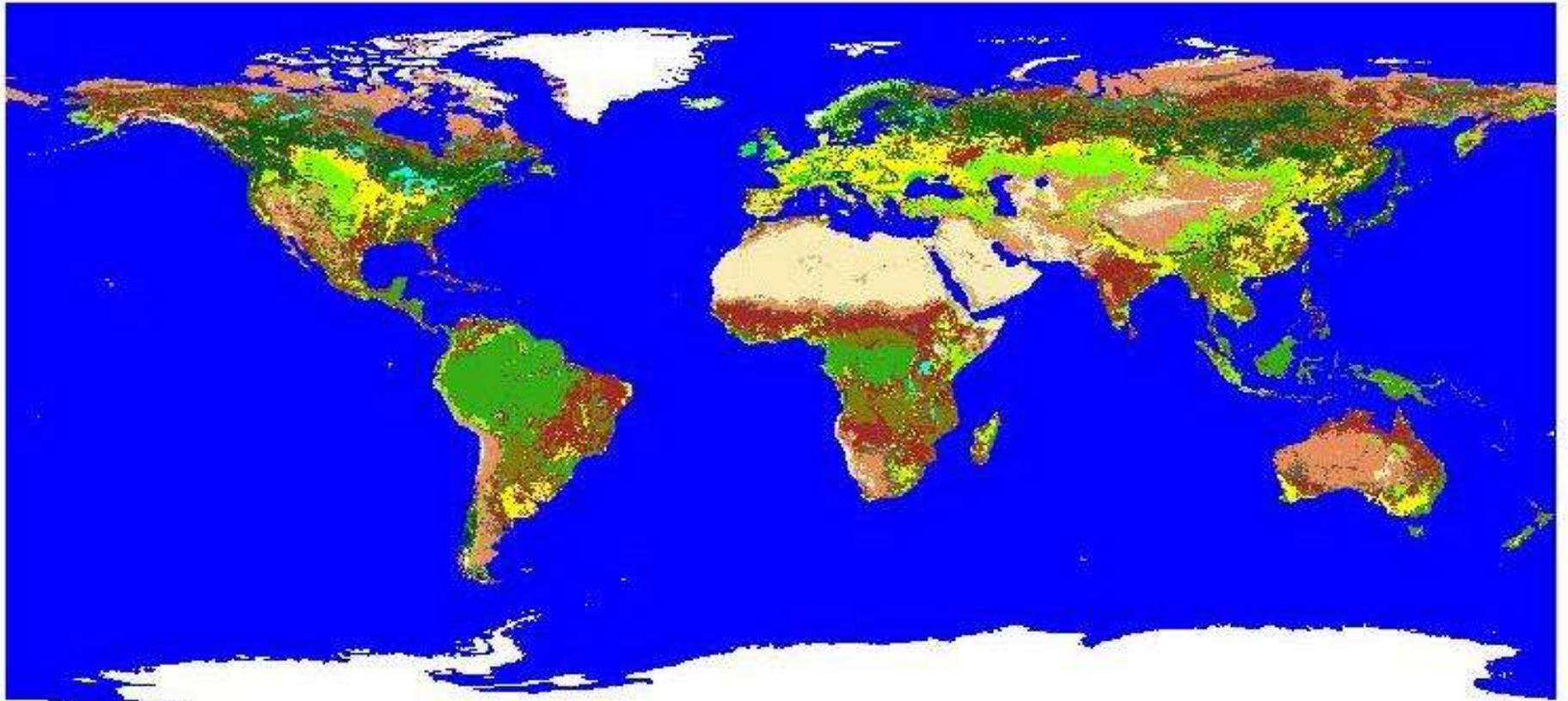
Patrick Le Moigne

15th ALADIN Workshop: 6-10 June, Bratislava

SURFACE PARAMETERS

- Depending on soil
 - ✓ Percentage of sand and clay
 - ✓ Soil depth
- Depending on vegetation
 - ✓ Fraction of vegetation
 - ✓ Leaf area index
 - ✓ Minimal stomatal resistance
 - ✓ Roughness length
- Depending on soil and vegetation
 - ✓ Albedo
 - ✓ emissivity

Land cover map at 1km resolution (University of Maryland)



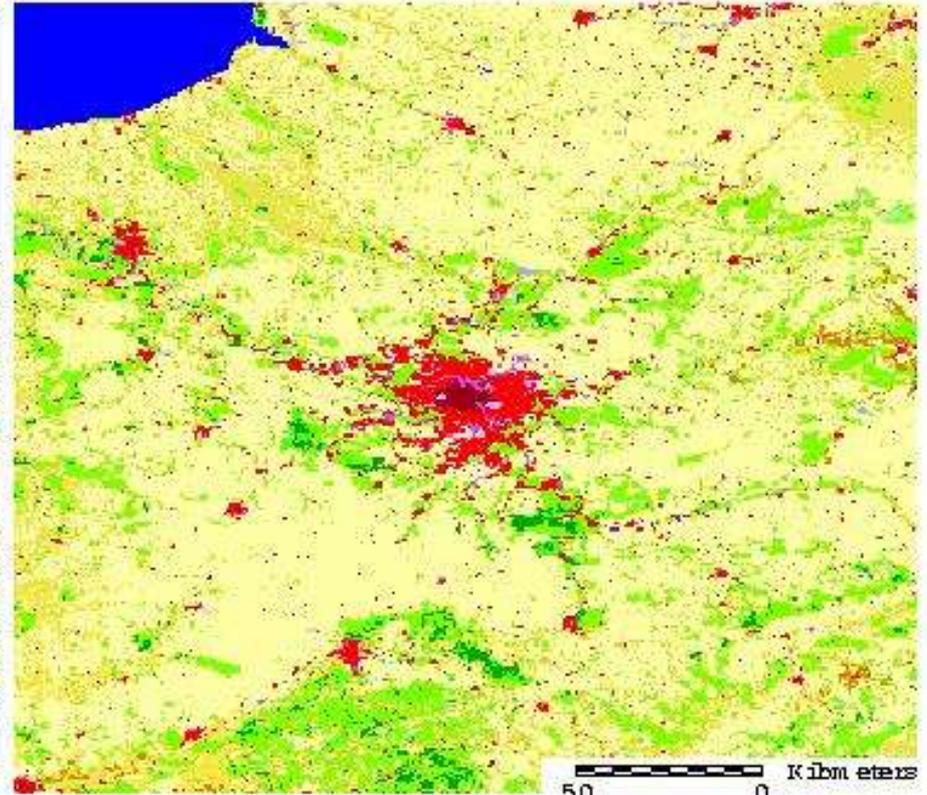
Sea
Water bodies
Bare land
Rocks
Permanent ice

Urban
Evergreen needleleaf forest
Evergreen broadleaf forest
Deciduous needleleaf forest
Deciduous broadleaf forest

Mixed forest
Woodland
wooded grassland
closed shrubland
open shrubland

grassland
cropland
wetlands

Corine Land cover over Europe at 250m resolution



- | | |
|--|--|
|  Sea |  Port and leisure facilities |
|  Continuous urban fabric |  Non-irrigated arable land |
|  Discontinuous urban fabric |  Permanently irrigated land |
|  Industrial areas and construction sites |  Rice fields |
|  Road and rail networks and associated infrastructure |  Vineyards |
|  Ports |  Fruit trees and berry plantations |
|  Airports |  Olive groves |
|  Mining extraction sites |  Pastures |
|  Dump sites |  Annular plots associated with permanent pastures |
|  Construction sites |  Complex cultivation patterns |
|  Green urban areas |  Land principally occupied by agriculture |

- | | |
|---|---|
|  Agro-forestry areas |  Burnt areas |
|  Broad-leaved forest |  Glaciers and perpetual snow |
|  Coniferous forest |  Inland marshes |
|  Mixed forest |  Fast bogs |
|  Natural grasslands |  Salt marshes |
|  Moors and heath lands |  Salines |
|  Sclerophyllous vegetation |  Intertidal flats |
|  Transitional woodland scrub |  Water courses |
|  Beaches, sand, dunes |  Water bodies |
|  Bare rocks |  Coastal lagoons |
|  Sparsely vegetated areas |  Estuaries |

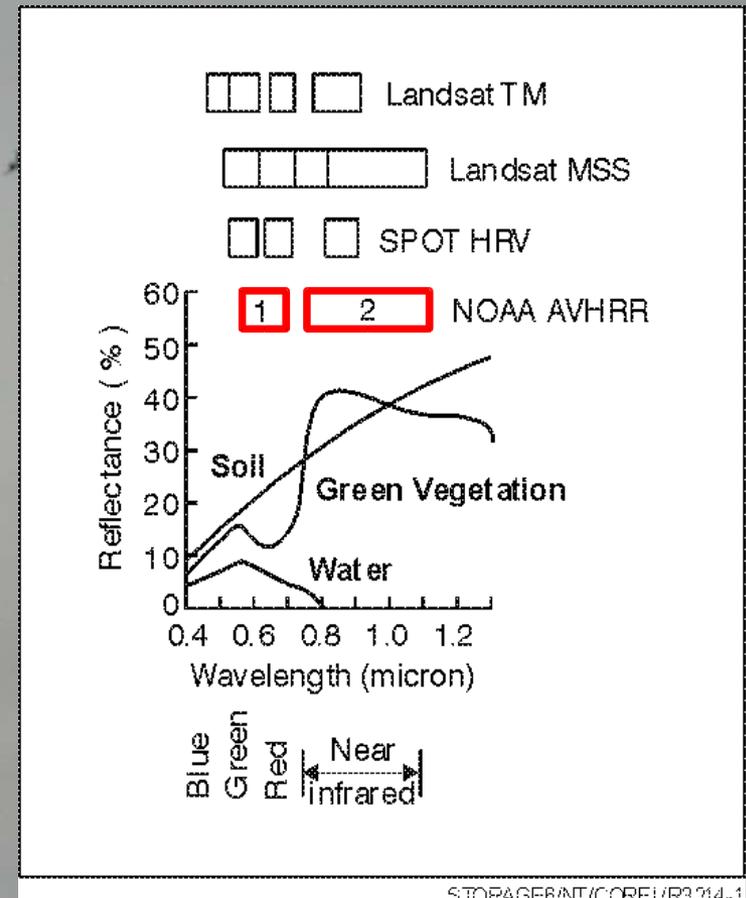
NDVI: Normalised Difference Vegetation Index

$$\text{NDVI} = (\text{PIR} - \text{VIS}) / (\text{PIR} + \text{VIS})$$

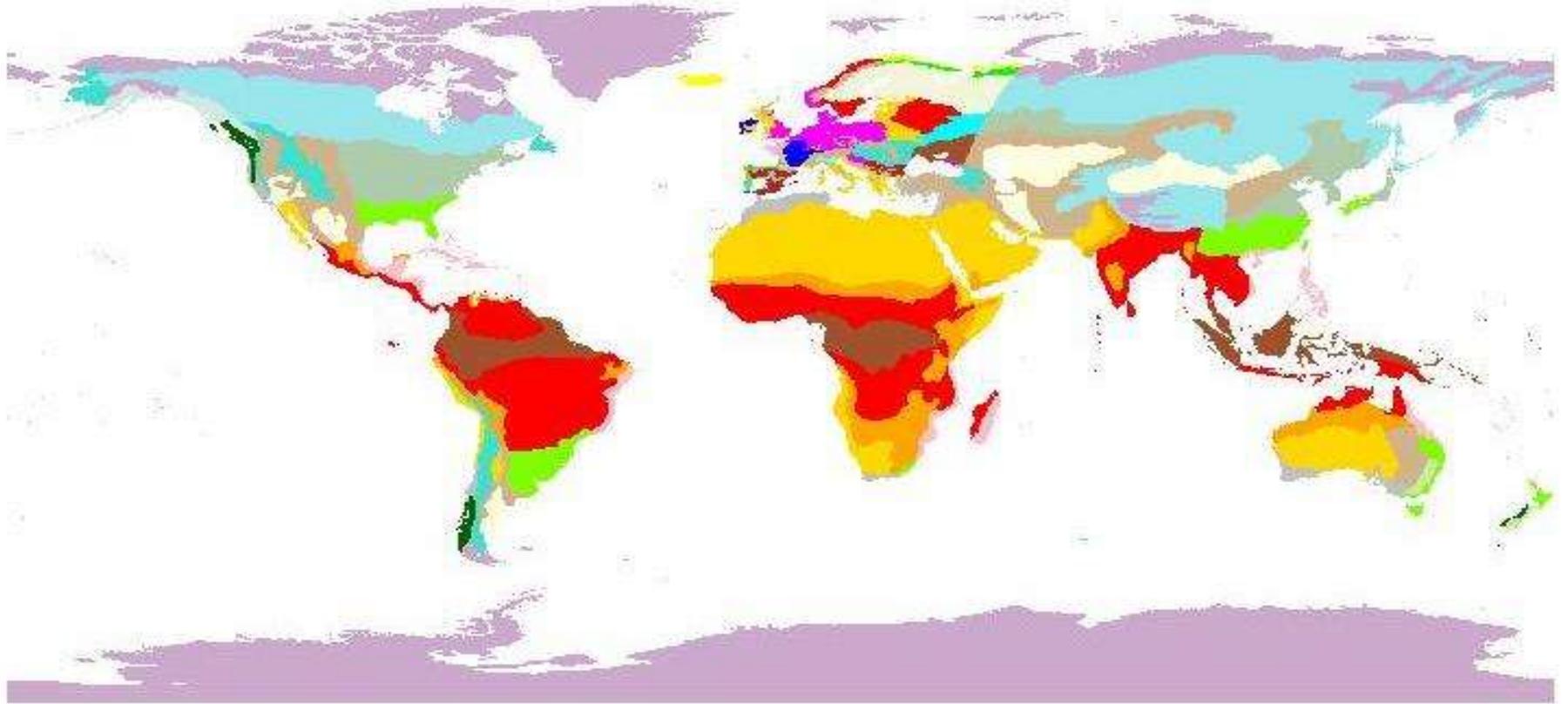
PIR : near infra-red reflectance
[0.725 microns, 1.0 microns]

VIS : visible reflectance
[0.58 microns, 0.68 microns]

NDVI = { 0.1 ; 0.6 }

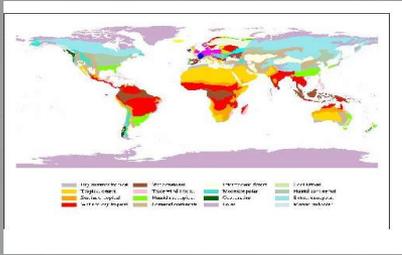


Climate global map (Koeppen et de Lond, 1958)



■ Dry summer tropical	■ Wet equatorial	■ Intermediate desert	■ Cool littoral
■ Tropical desert	■ Trade wind littoral	■ Moderate polar	■ Humid continental
■ Semiarid tropical	■ Humid subtropical	■ Cool marine	■ Extreme subpolar
■ Wet and dry tropical	■ Semiarid continental	■ Polar	■ Marine subpolar

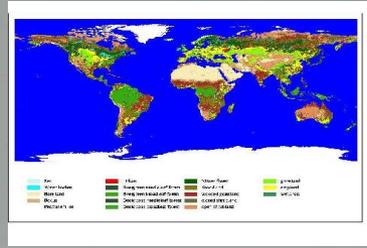
CLIMATE MAP



Koeppe et de Lond 1958

1km: 16 classes

LAND COVER MAPS



University of Maryland

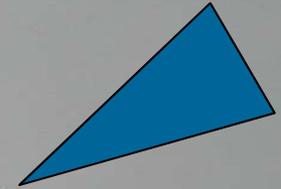
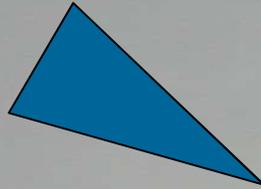
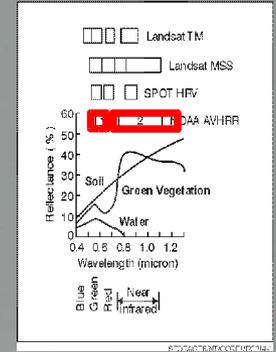
1km: 15 classes



Corine land cover

« 250m »: 44 cl.

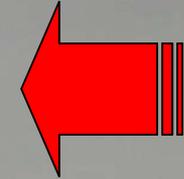
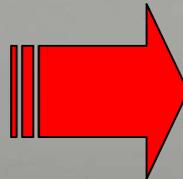
NDVI profiles



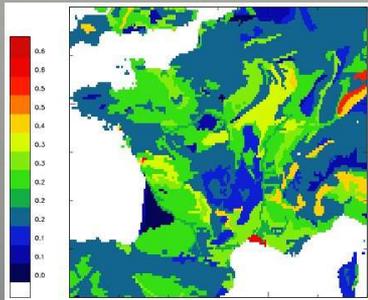
215 ecosystems



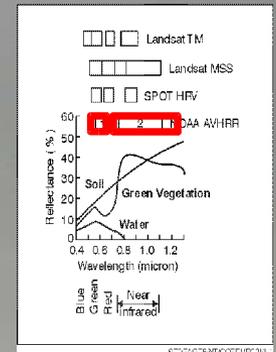
1KM, MONTHLY SURFACE PARAMETERS DATABASE



Texture: FAO



NDVI profiles



Basis of the algorithm

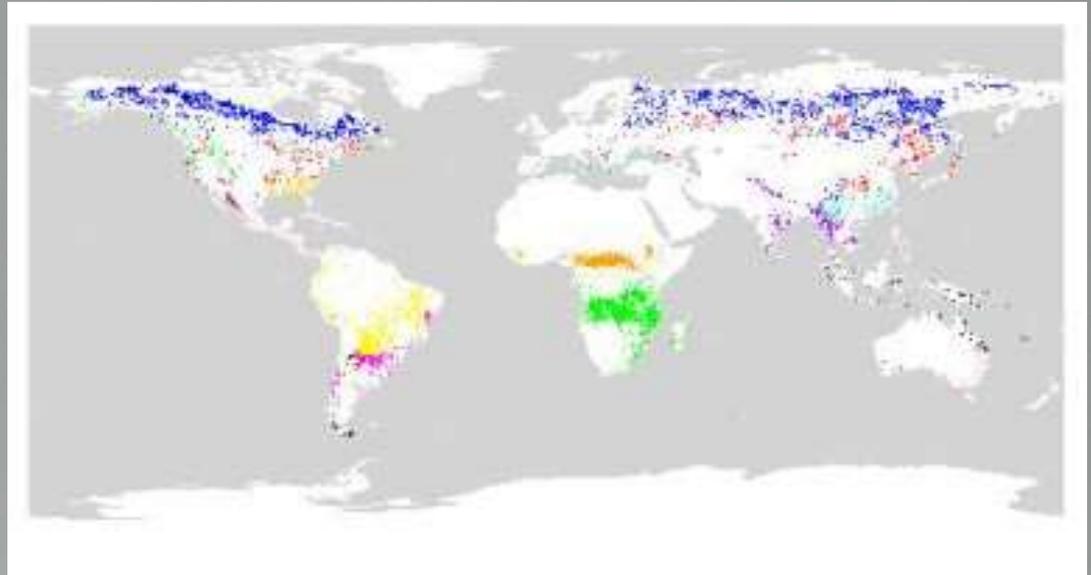
Each land cover is represented as a fraction of vegetation types (12 vegetation types):

fraction of woody vegetation, herbaceous vegetation and bare soil for each land cover

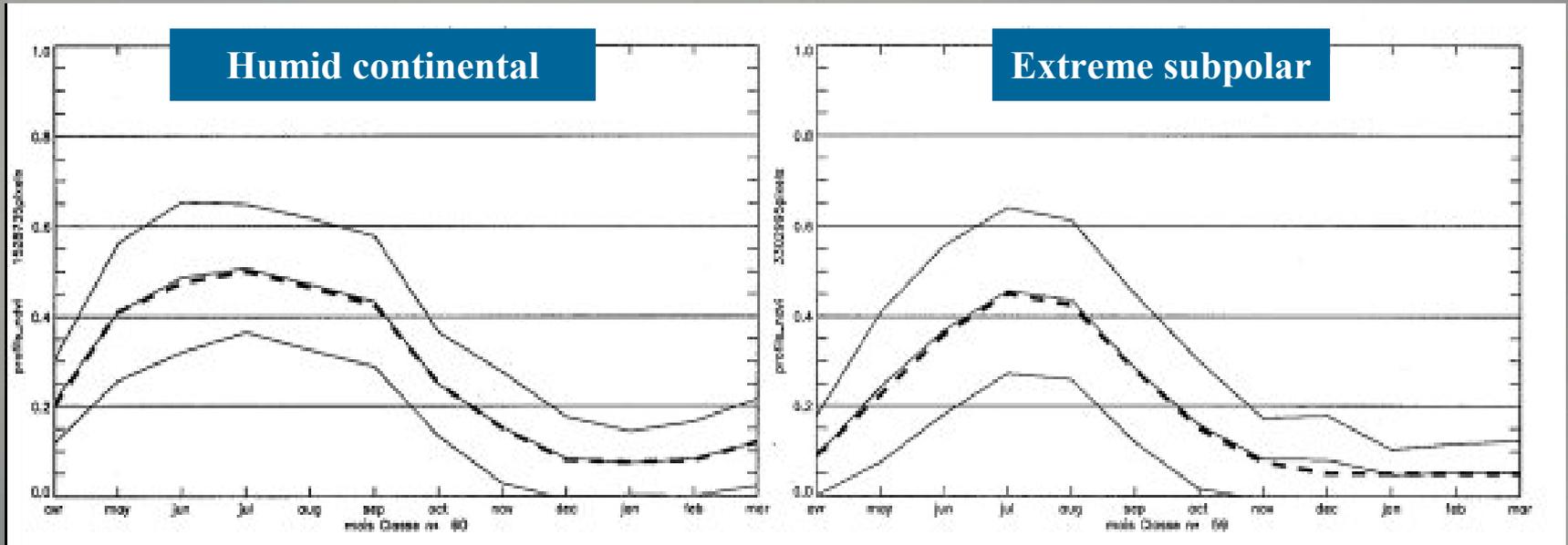
landcover	bare soil: bare soil / rocks / permanent snow	woody vegetation: evergreen broadleaf / deciduous broadleaf / needleleaf	herbaceous: C3 / C4 / irr. crops / natural herbaceous (temperate) / natural herbaceous (tropics) wetland and irr. herbaceous
any forest		100%	
woodland	0-10%	40-50%	50%
wooded grassland	0-20%	20-30%	50-70%
closed shrubland	20-30%	20%	50-60%
open shrubland	20-60%		40-80%
grassland			100%
crops			100%
bare soil; rock, permanent snow	90-100%		0-10%

% variation depends on climate

1. Earth repartition of woodland



2. NDVI profiles of wooded grassland



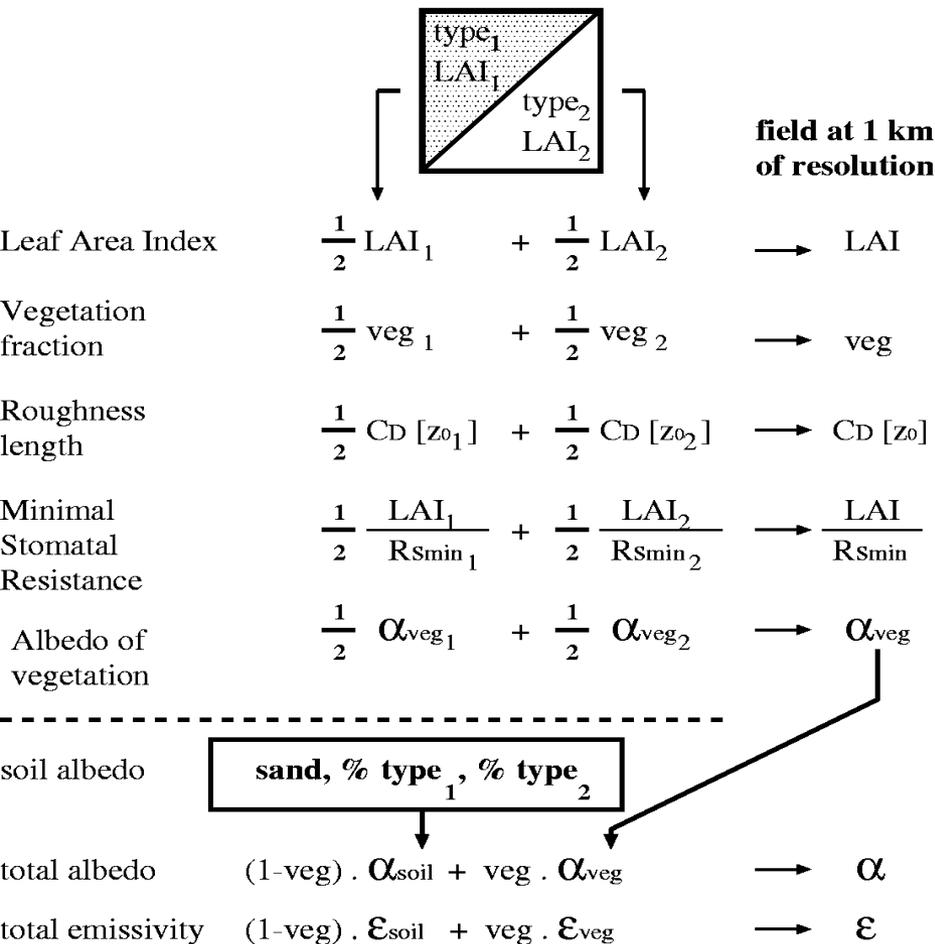
Computation of surface parameters

$$LAI = LAI_{\min} + (LAI_{\max} - LAI_{\min}) * (NDVI - NDVI_{\min}) / (NDVI_{\max} - NDVI_{\min})$$

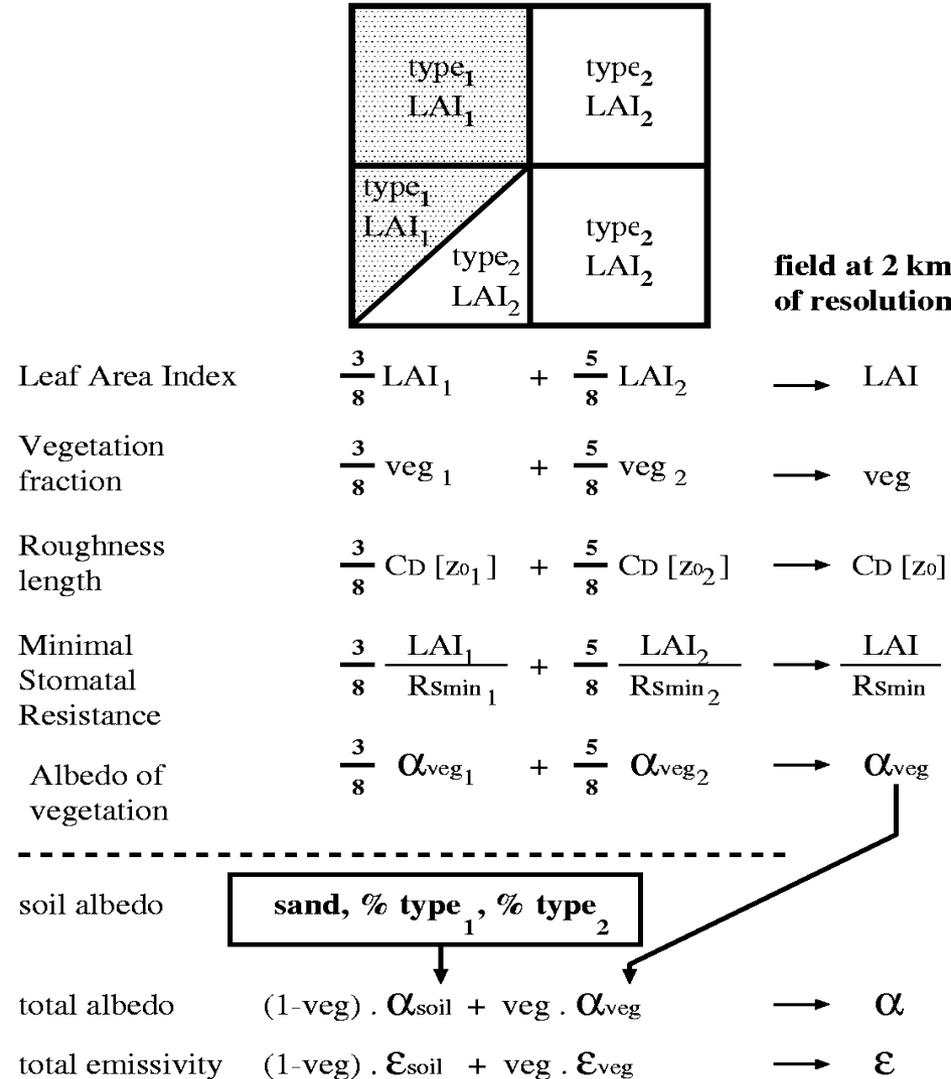
vegetation type	total vegetation fraction	roughness length (m)	albedo of vegetation	minimal stomatal resistance (sm^{-1})	emissivity of vegetation
bare soil	0	0.013			
rocks	0	0.13			
permanent snow and ice	0	0.0013			
C3 crops	$1 - e^{-0.6LAI}$	$0.13 \min(1, e^{\frac{LAI-3.5}{1.3}})$	0.20	40	0.97
C4 and irr. crops	$1 - e^{-0.6LAI}$	$0.13 \min(2.5, e^{\frac{LAI-3.5}{1.3}})$	0.20	40	0.97
natural herbaceous (tropics)	0.95	$0.13 \frac{LAI}{6}$	0.20	120	0.97
Other herbaceous	0.95	$0.13 \frac{LAI}{6}$	0.20	40	0.97
Needleleaf trees	0.95	$0.13 h$	0.10	150	0.97
Evergreen broadleaf trees	0.99	$0.13 h$	0.13	250	0.97
Deciduous broadleaf trees	0.95	$0.13 h$	0.15	150	0.97

Aggregation rules

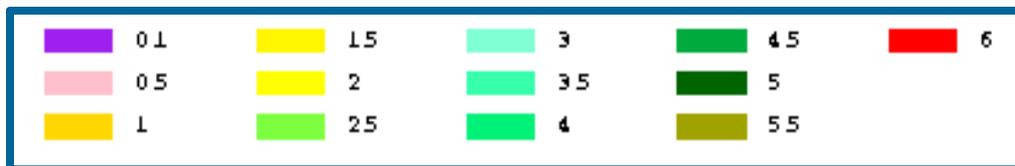
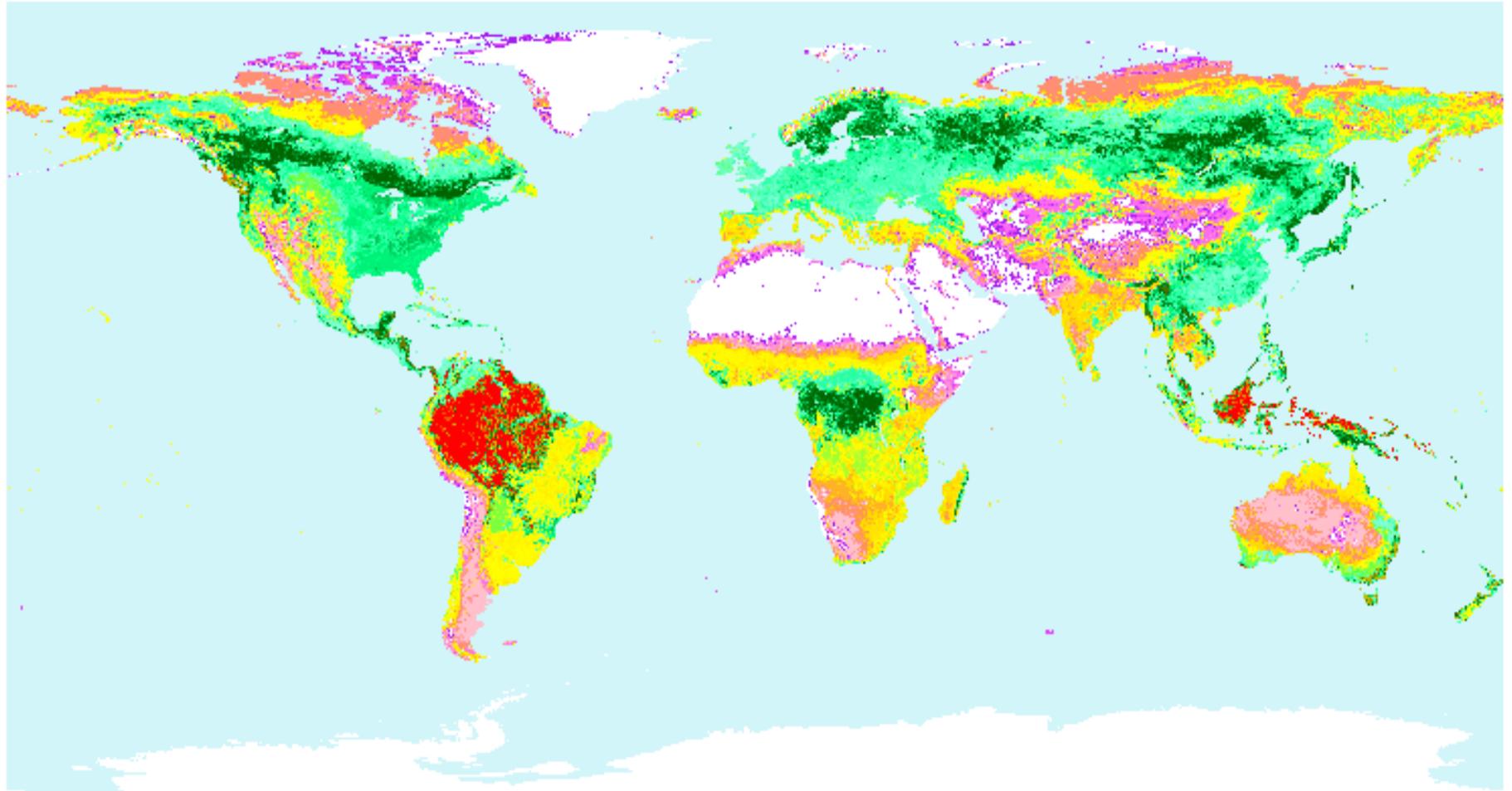
a) Example: aggregated parameters for:
1 pixel of mixed ecosystem, (say a woodland)



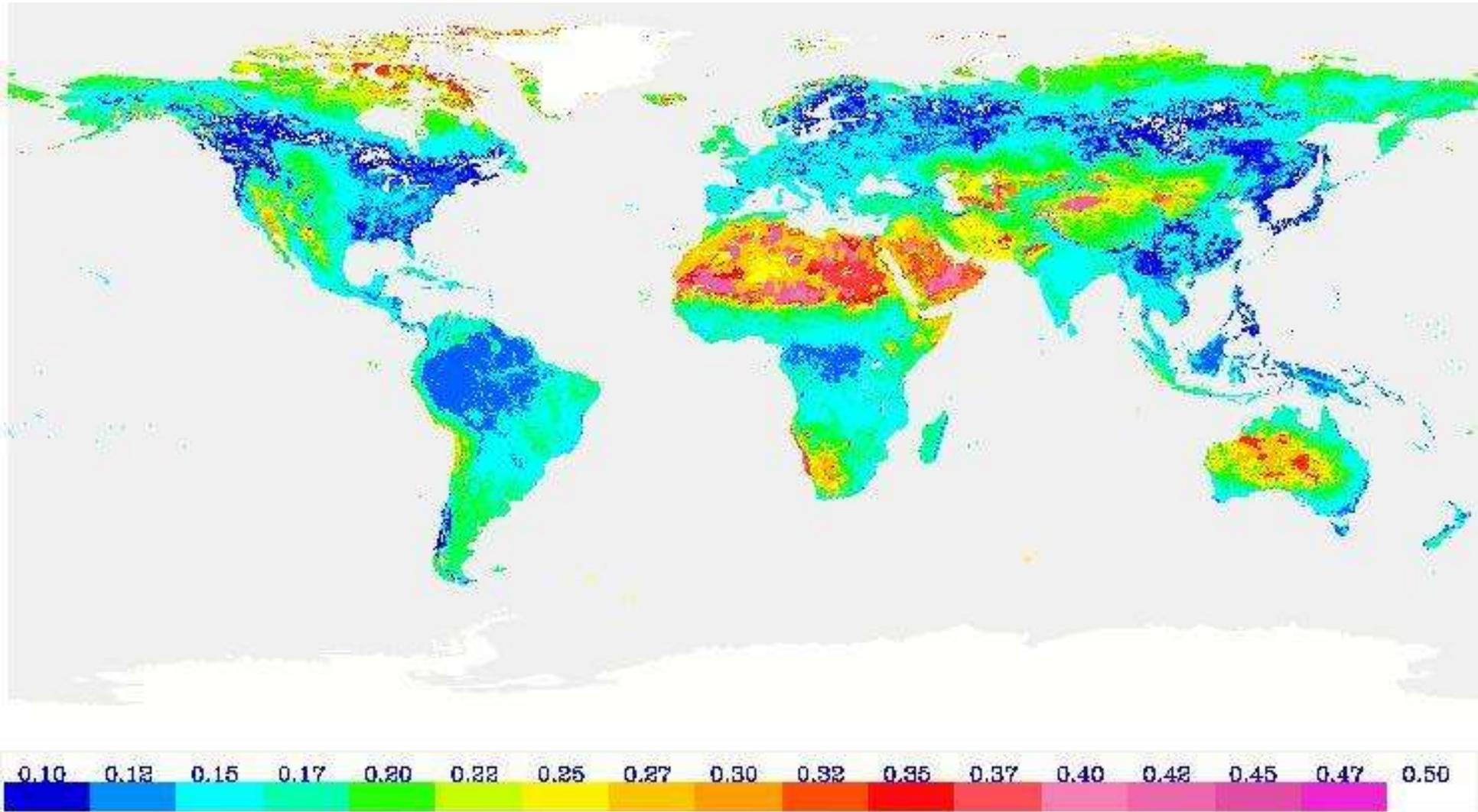
b) Example: aggregation of 4 pixels:
1 pixel of pure ecosystem "1" (say a forest),
2 pixels of pure ecosystem "2" (say crops),
1 pixel of mixed ecosystem "3", (say a woodland)



Leaf Area Index for July



Mean annual albedo



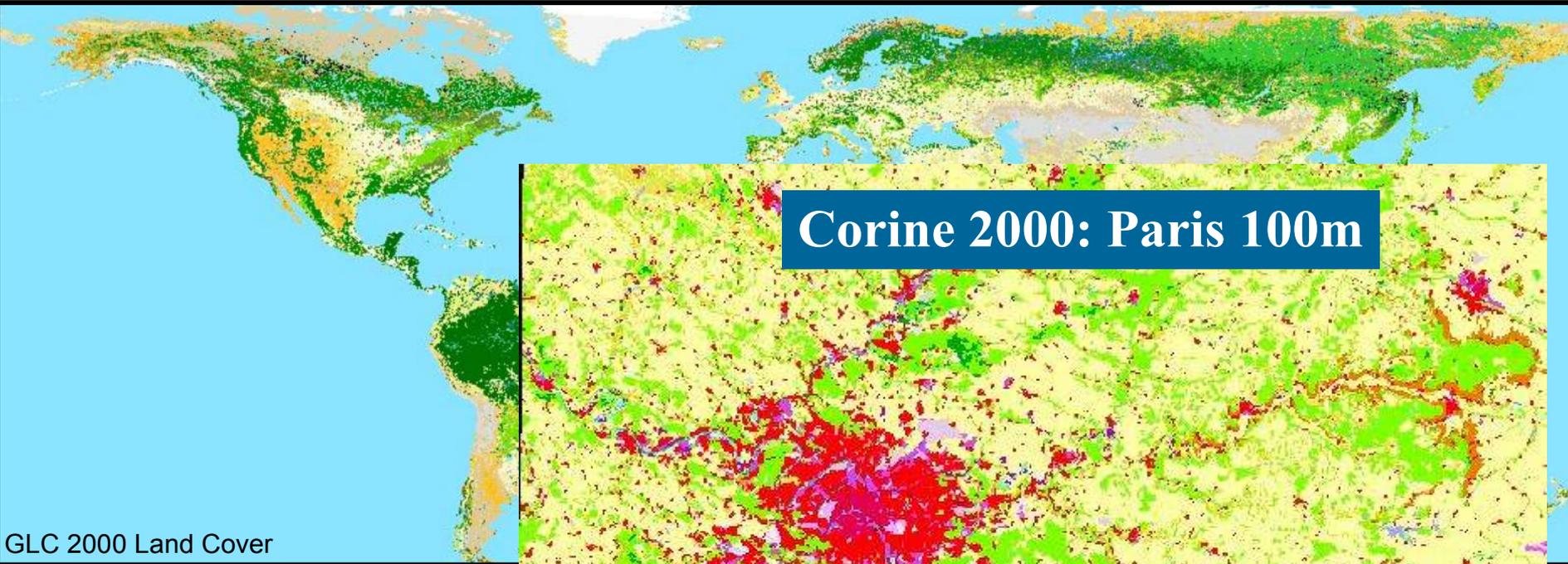
Evolution towards ECOCLIMAP 2

User requirements for surface parameters indicate a need of higher spatial and temporal resolution associated to a good accuracy and availability.

ECOCLIMAP 2 is an answer to these requirements:

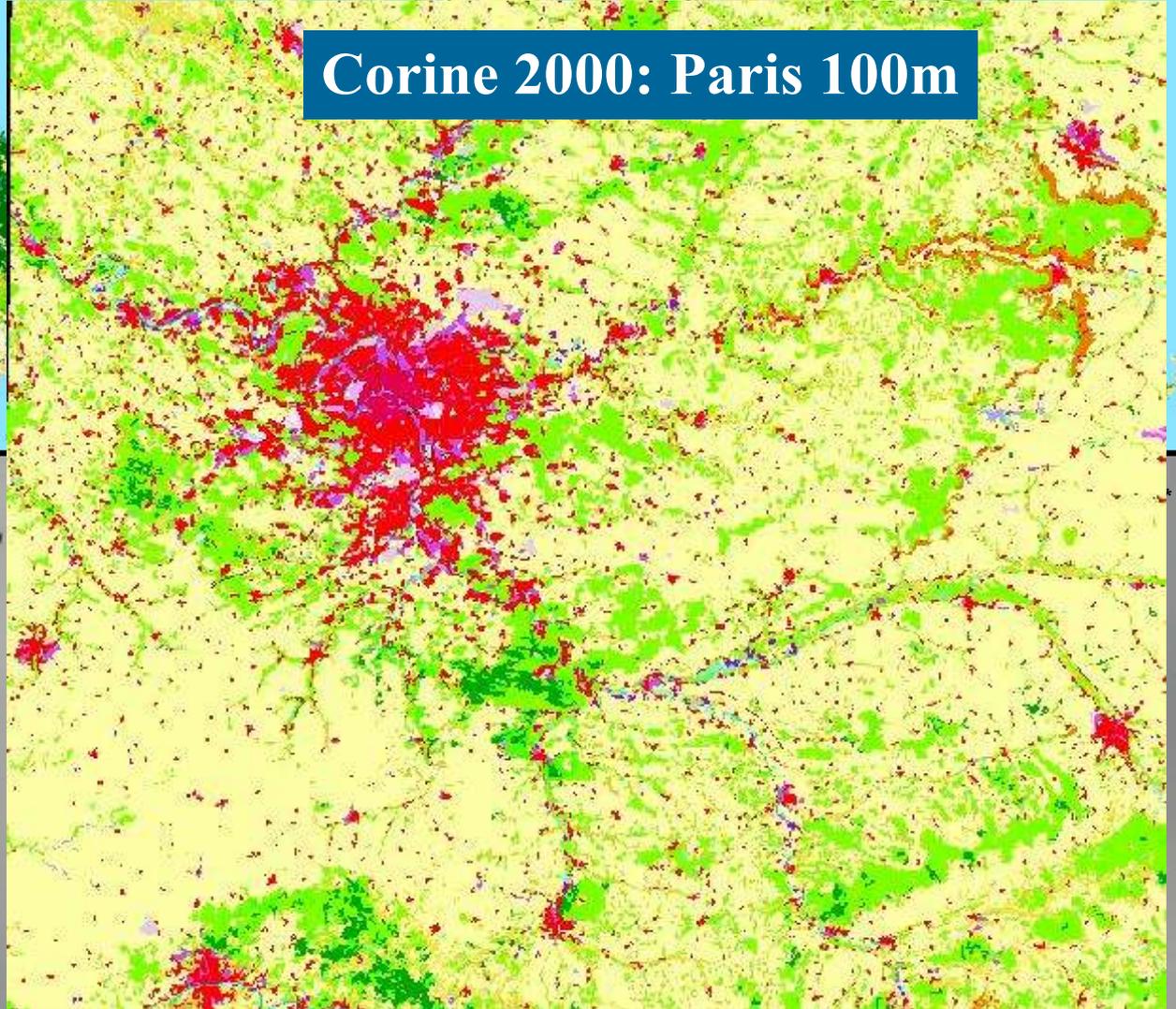
- New land cover maps: GLC2000, Corine 2000
- NDVI temporal profiles taken from SPOT/VEGETATION 10 days frequency and better accuracy than NOAA/AVHRR
- Daily Albedo from Land SAF

GLC2000 land cover map at 1km resolution (from JRC,2003)



GLC 2000 Land Cover

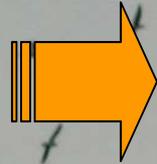
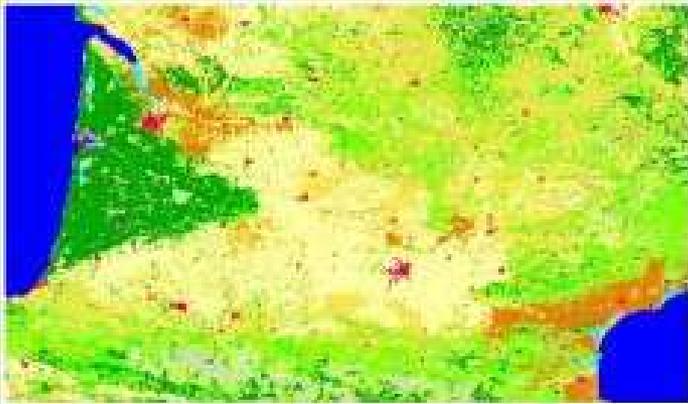
- Tree Cover, broadleaved, evergreen
- Tree Cover, broadleaved, deciduous, closed
- Tree Cover, broadleaved, deciduous, open
- Tree Cover, needle-leaved, evergreen
- Tree Cover, needle-leaved, deciduous
- Tree Cover, mixed leaf type
- Tree Cover, regularly flooded, fresh water
- Tree Cover, regularly flooded, saline water



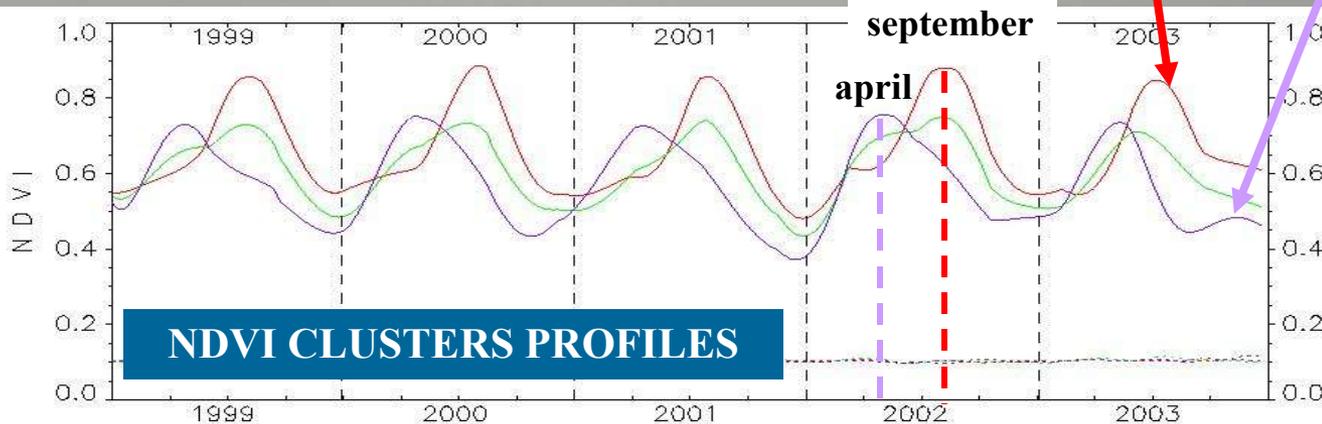
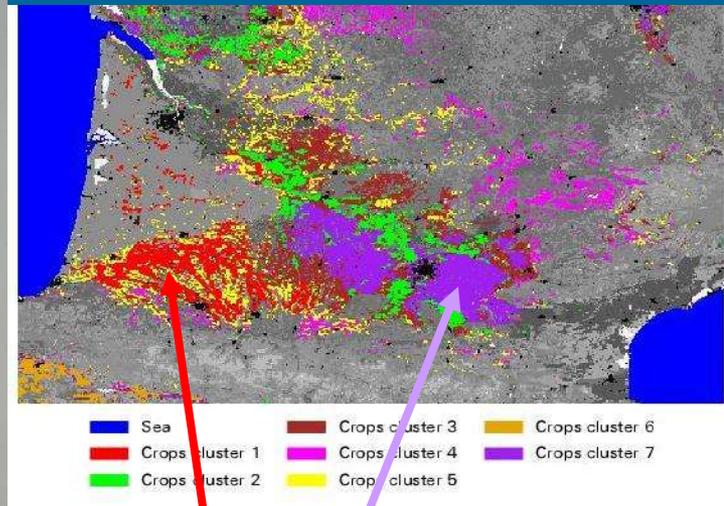
Evolution towards ECOCLIMAP 2

New concept: each land cover class (from GLC2000 and Corine 2000) is splitted into homogeneous classes using the NDVI profiles and climate maps:

Land cover from Corine 2000:
250m resolution



cropland divided into 7 clusters



Summer crops (maize)

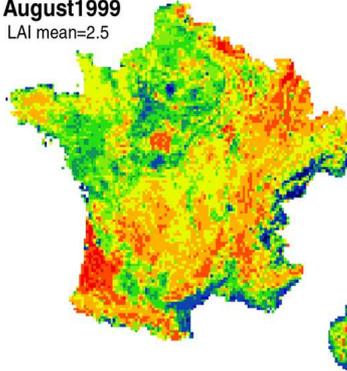
Winter crops (wheat)

Polycrops

INTERANNUAL VARIABILITY OF LAI OVER FRANCE

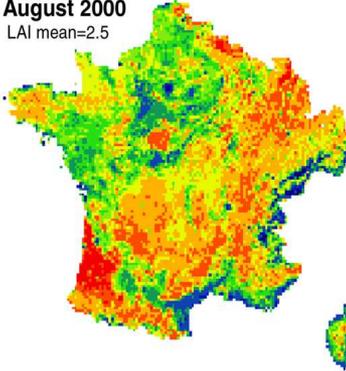
August 1999

LAI mean=2.5



August 2000

LAI mean=2.5



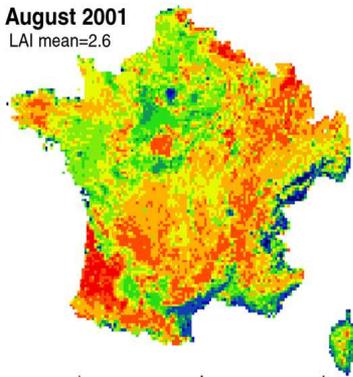
Leaf Area Index (LAI)

from SPOT/VEGETATION data

- Multiannual comparison
for August - France

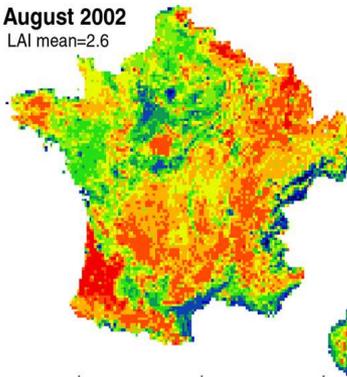
August 2001

LAI mean=2.6



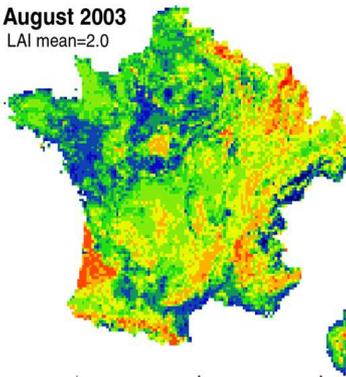
August 2002

LAI mean=2.6



August 2003

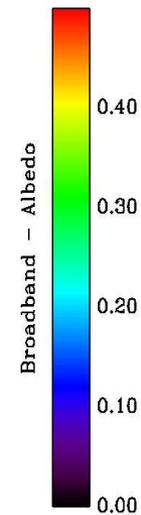
LAI mean=2.0



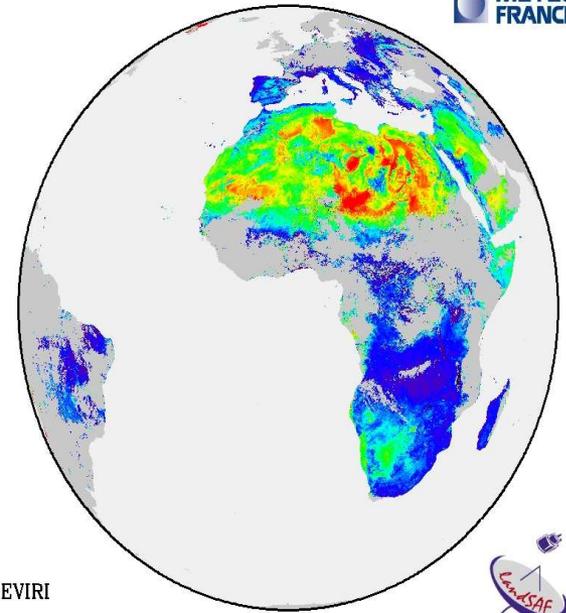
LAI 4.0 3.6 3.2 2.8 2.4 2.0 1.6 1.2 0.8 0.4 0.0

Broadband Albedo (Geiger, 2004)

28.07.2003



Meteosat-8/SEVIRI



Conclusion

- Global database of surface parameters at 1km resolution
- Allows tile approach
- Provides the surface parameters at any resolution
- Used in the Arpege Climate model, meso-NH and Arome models
- Multitemporal SPOT/VEGETATION data allow to build a more precise database: ECOCLIMAP 2
- Possibility to add other datasets, like albedo from Land SAF

Database available at following address:

http://www.cnrm.meteo.fr/gmme/PROJETS/ECOCLIMAP/page_ecoclimap.htm