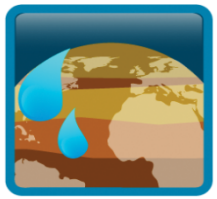
CMUG – assessment at the MPI-M

CCI fire

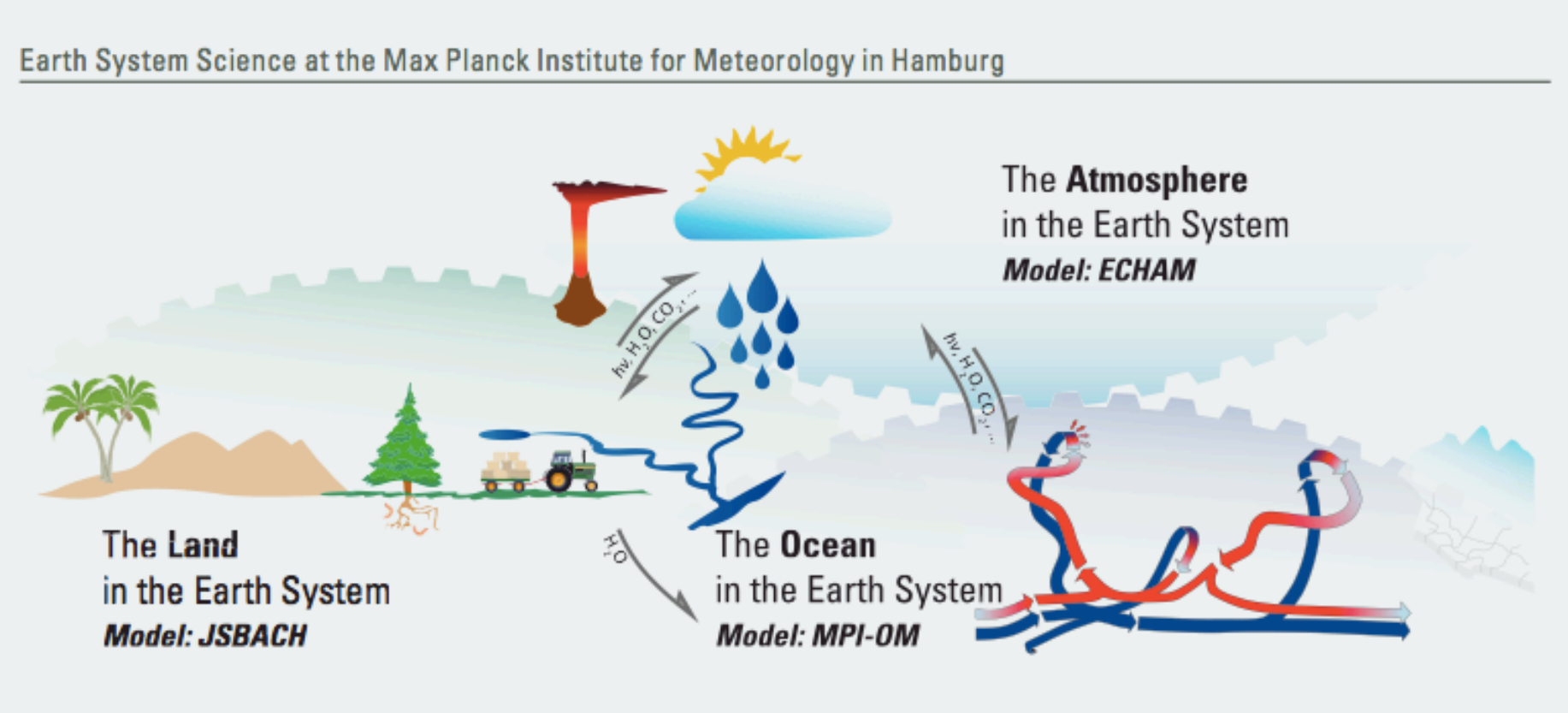
CCI Soil Moisture



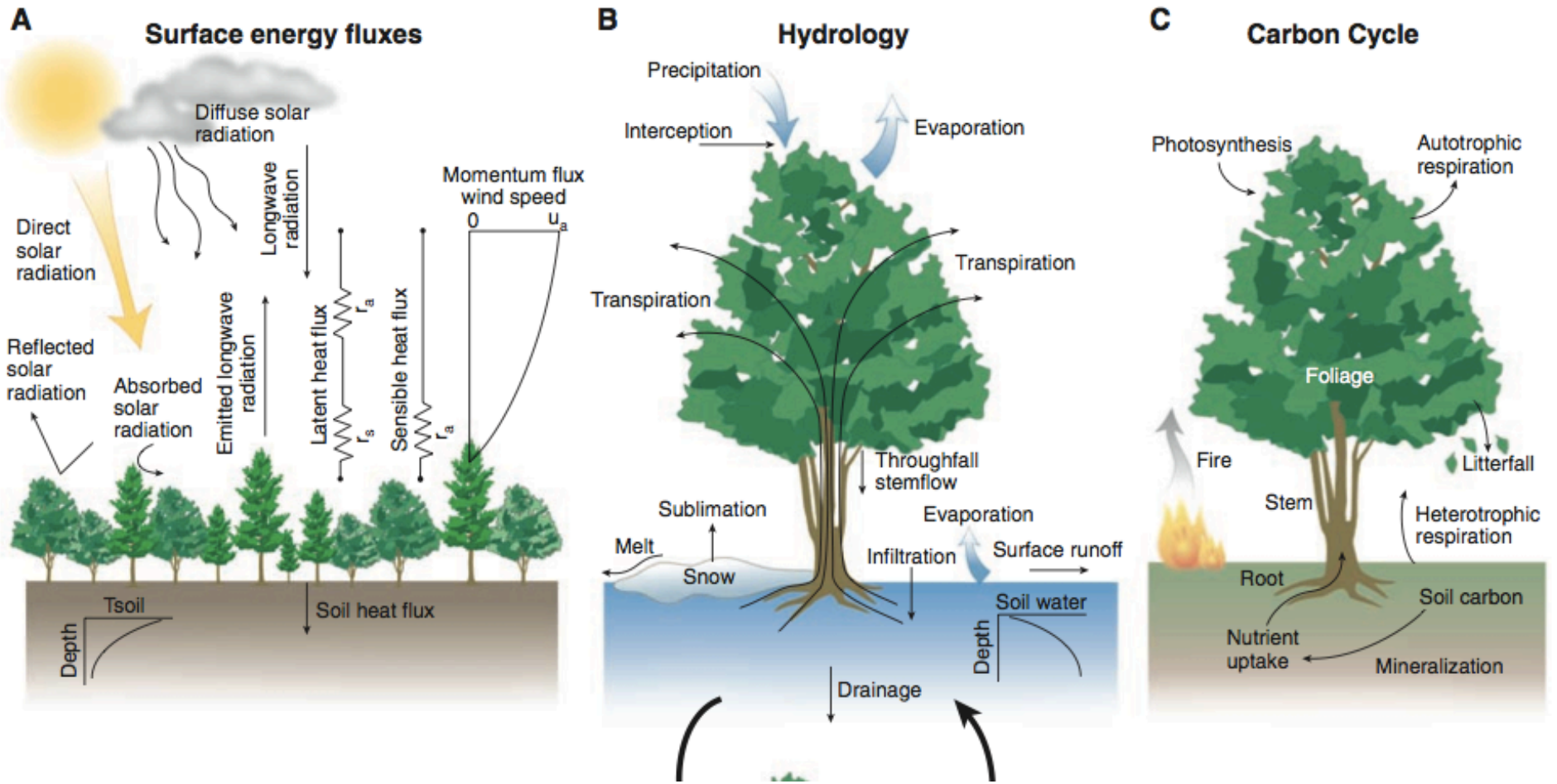
CCI landcover

Silvia Kloster, Alexander Loew,
Iryna Khlystova

Earth System model – MPI –M ESM

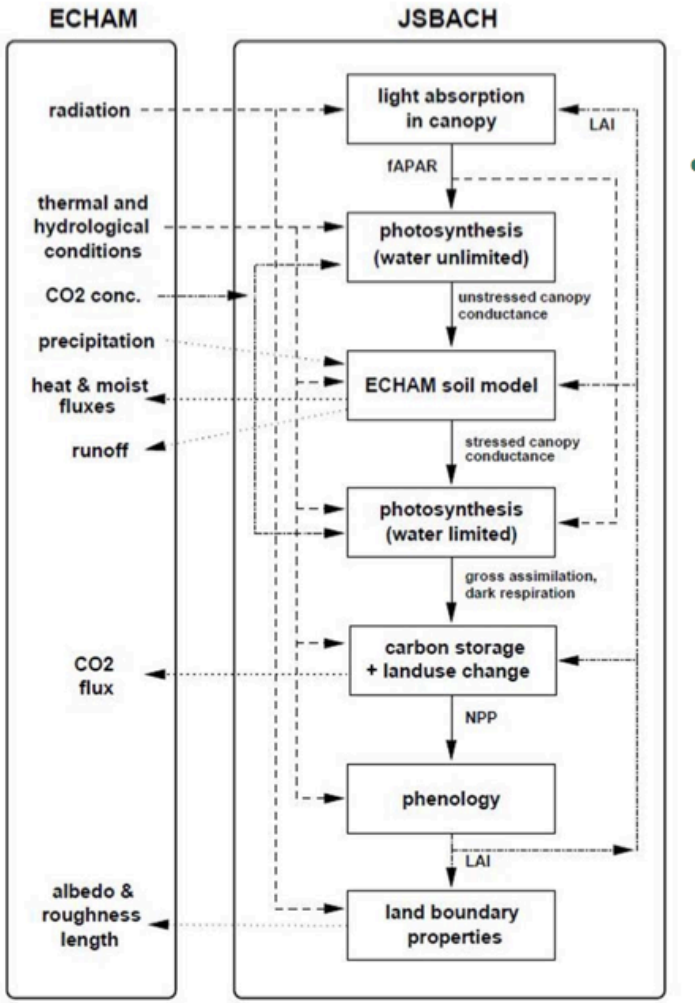


Land vegetation model



© Bonan, Science , 2008

Land vegetation model - JSBACH



JSBACH

- Land surface model of the Earth System Model of the Max Planck Institute for Meteorology
- Simulates fluxes of energy, water, momentum, and CO2 between land and atmosphere
- Vegetation types are represented by 14 different plant function types (PFTs)
- Standard setup: Coupled in the MPI- ESM
- Offline mode: Forced with prescribed meteorological forcing
- Vegetation simulated dynamically or prescribed
- Anthropogenic Land Use Change

MODEL - JSBACH

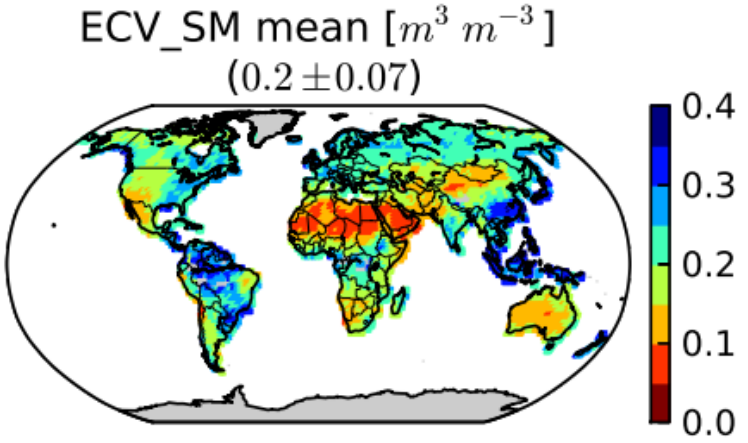
Soil moisture → Prognostic variable

Land Cover → Boundary Condition

Burned Area → Prognostic variable / Boundary Condition

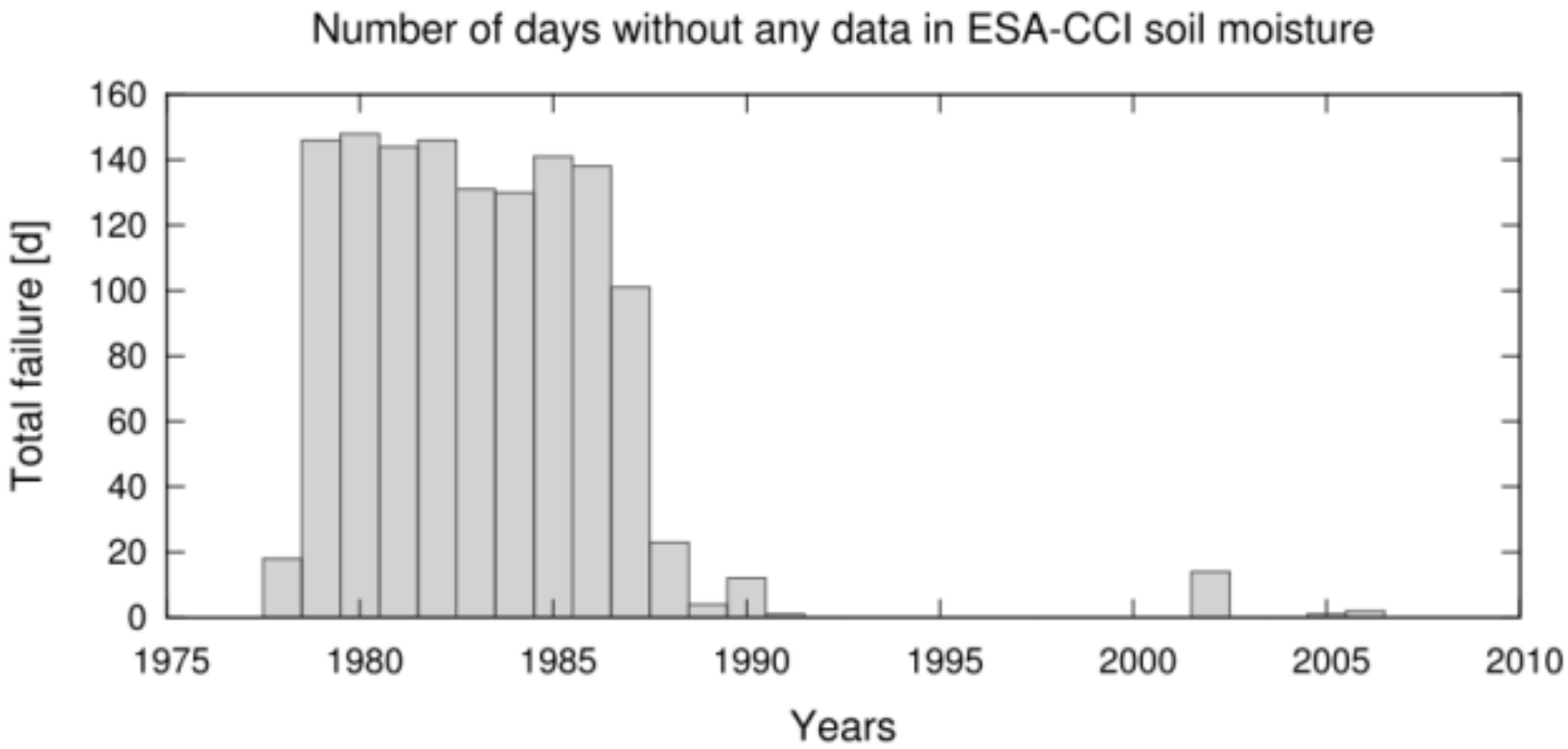
CCI soil moisture v0.1 (ECV_SM)

- 1978-2010
- 0.25°
- Daily
- Active/passive microwave data



Loew et al., 2013

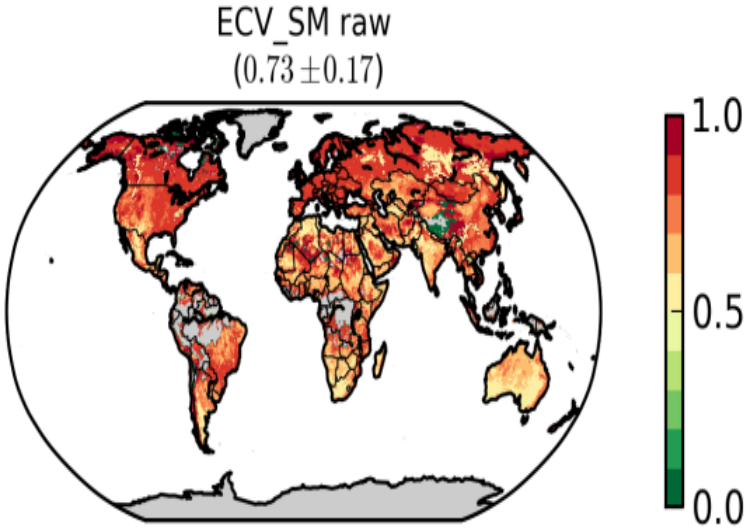
CCI soil moisture v0.1 (ECV_SM) – Data Coverage



Loew et al., 2013

CCI soil moisture v0.1 – Data Coverage

Fraction of missing soil moisture data (1978 – 2010)

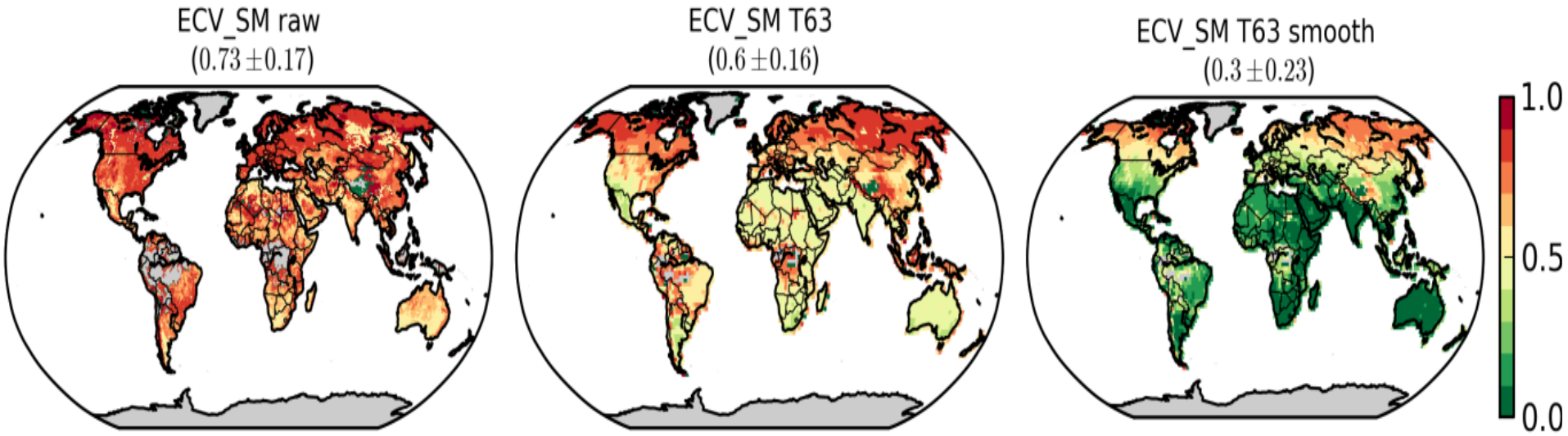


raw (0.25 deg)
(73%)

Loew et al., 2013

CCI soil moisture v0.1 – Data Coverage

Fraction of missing soil moisture data (1978 – 2010)



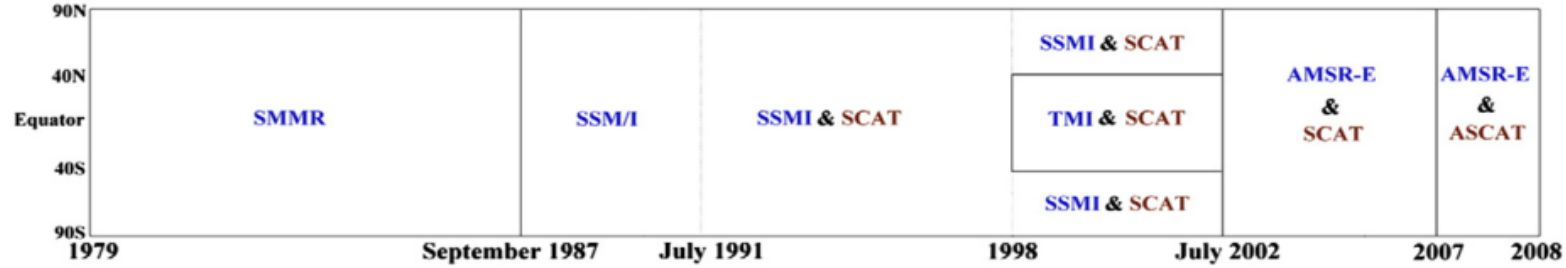
raw (0.25 deg)
(73%)

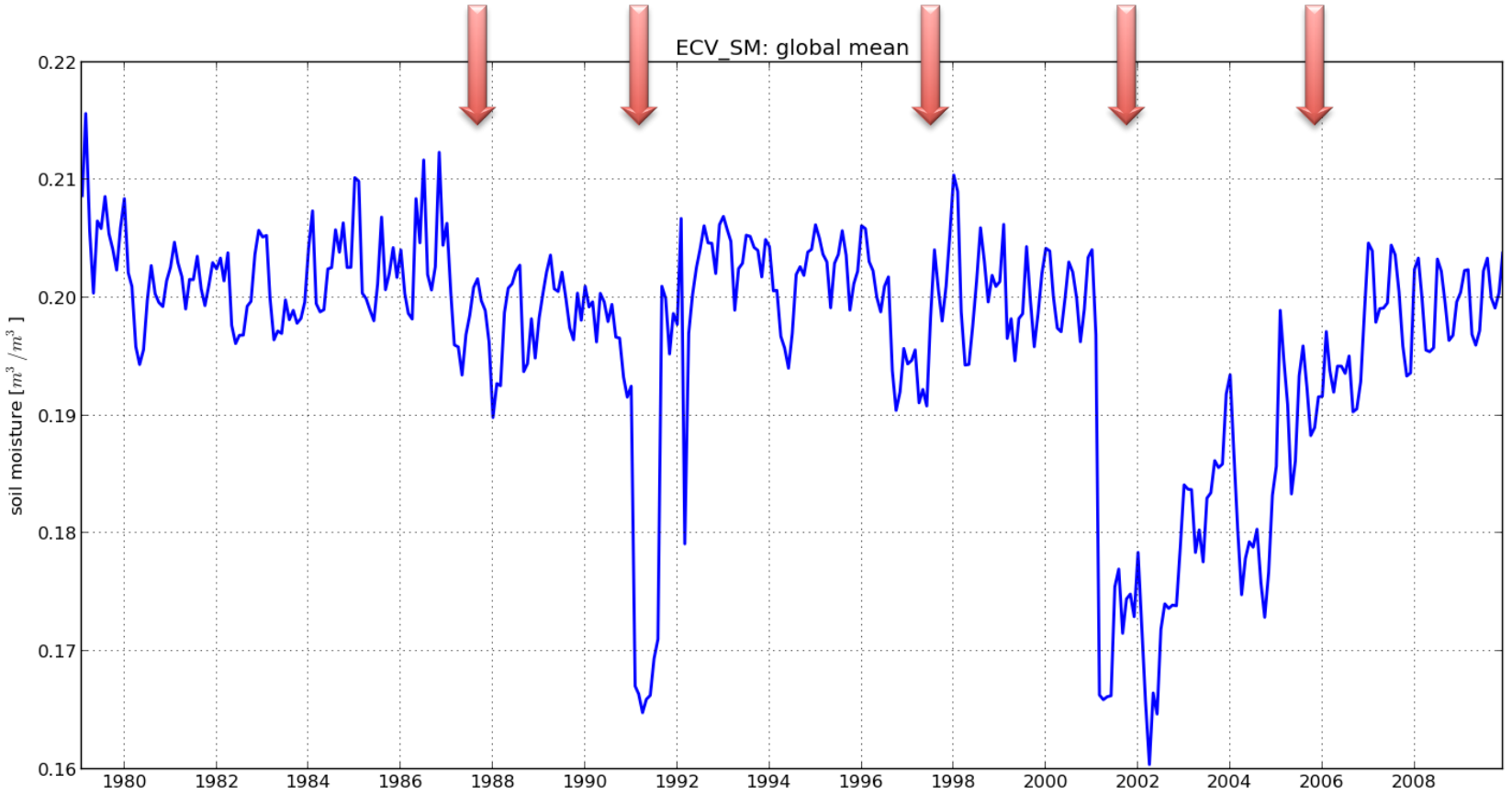
Interpolated to T63 (1.8 deg)
(60%)

Interpolated to T63 (1.8 deg)
and 5 day running mean
(30%)

Loew et al., 2013

CCI - SM – longterm trend





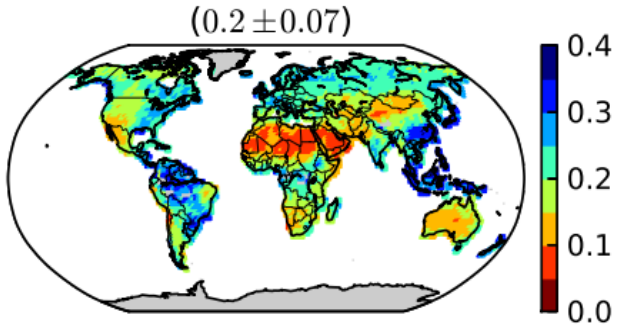
passive / active

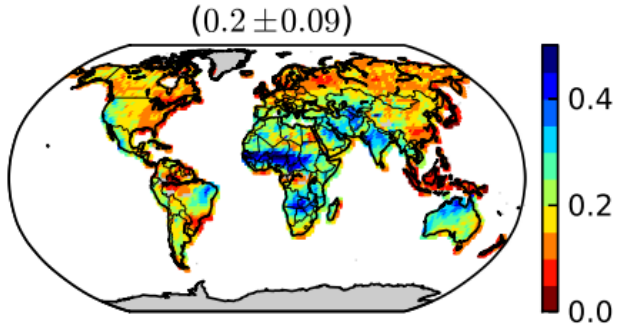
CCI - SM – comparison with reanalysis and model

Mean (1979 – 2009)

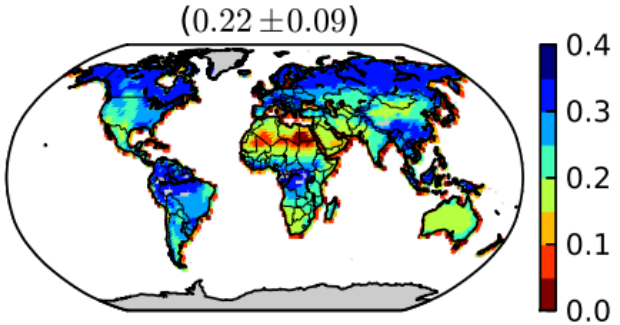
coefficient of variance

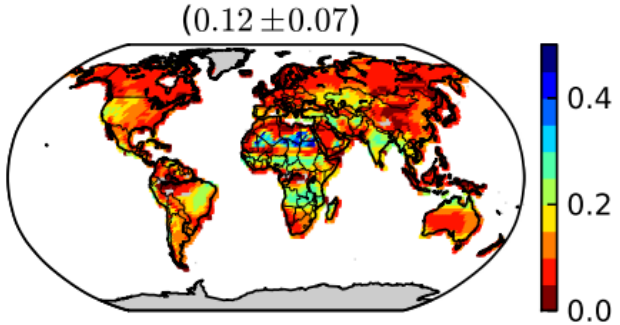
CCI – SM



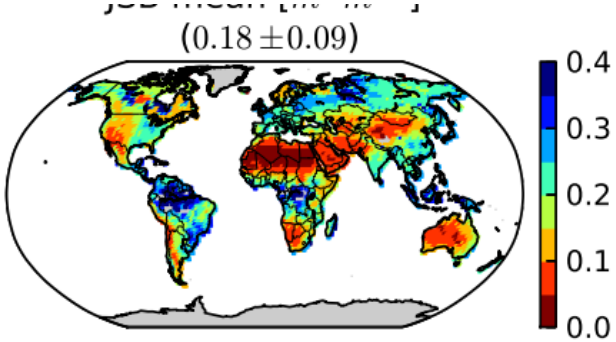


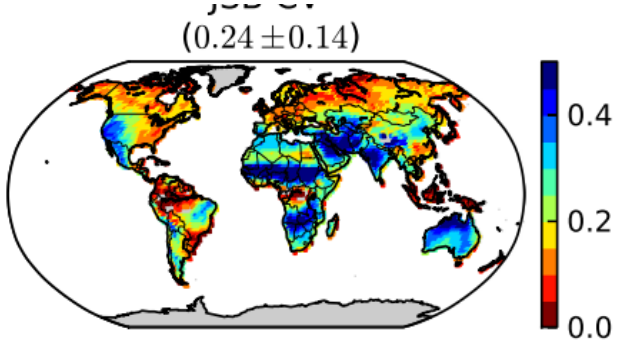
ERA-interim





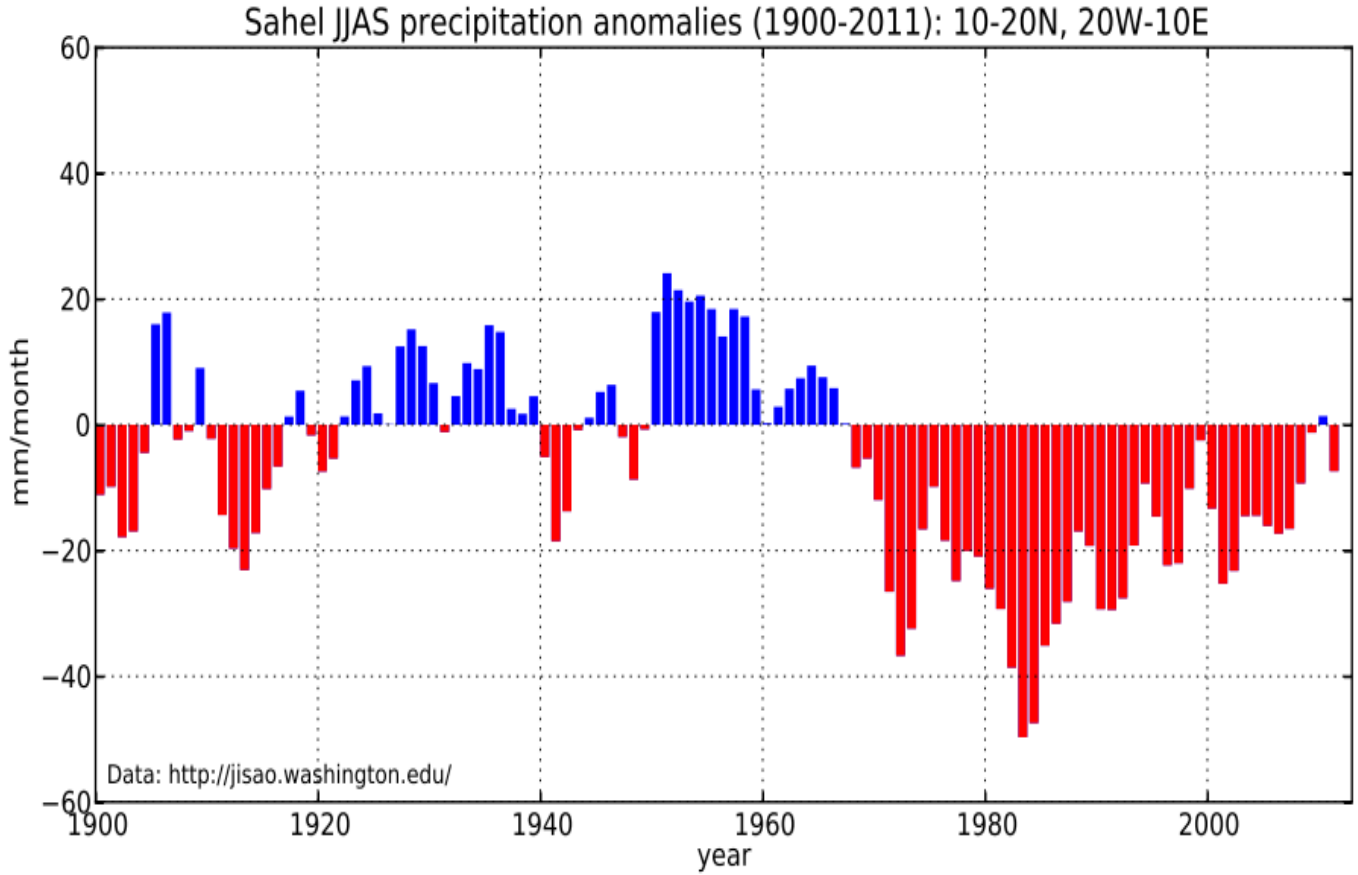
JSBACH





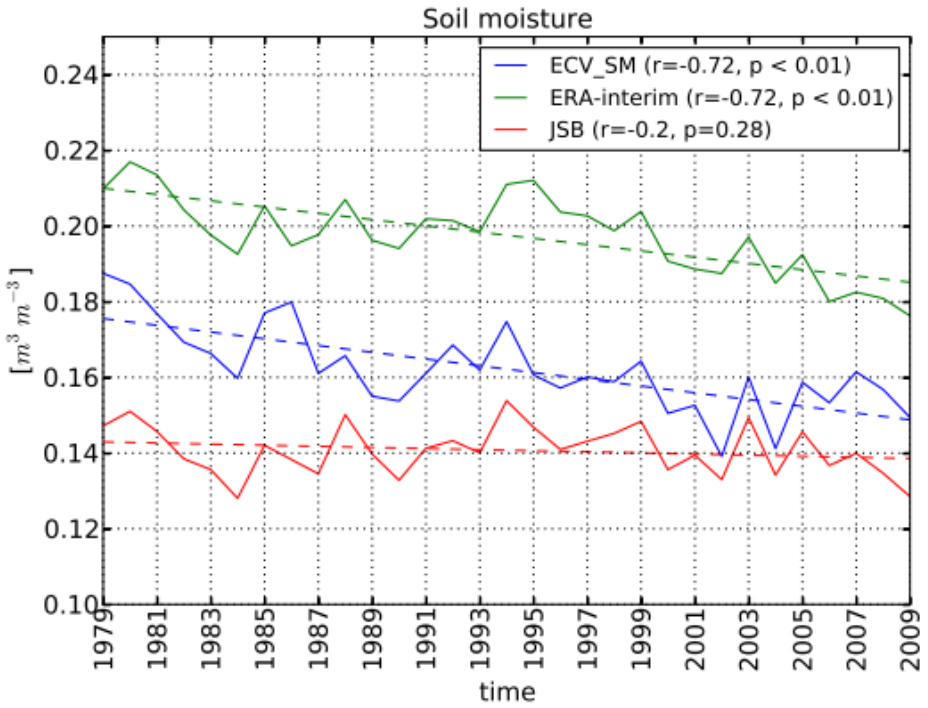
Loew et al., 2013

CCI – SM regional application – Sahelian drought



CCI – SM regional application – Sahelian drought

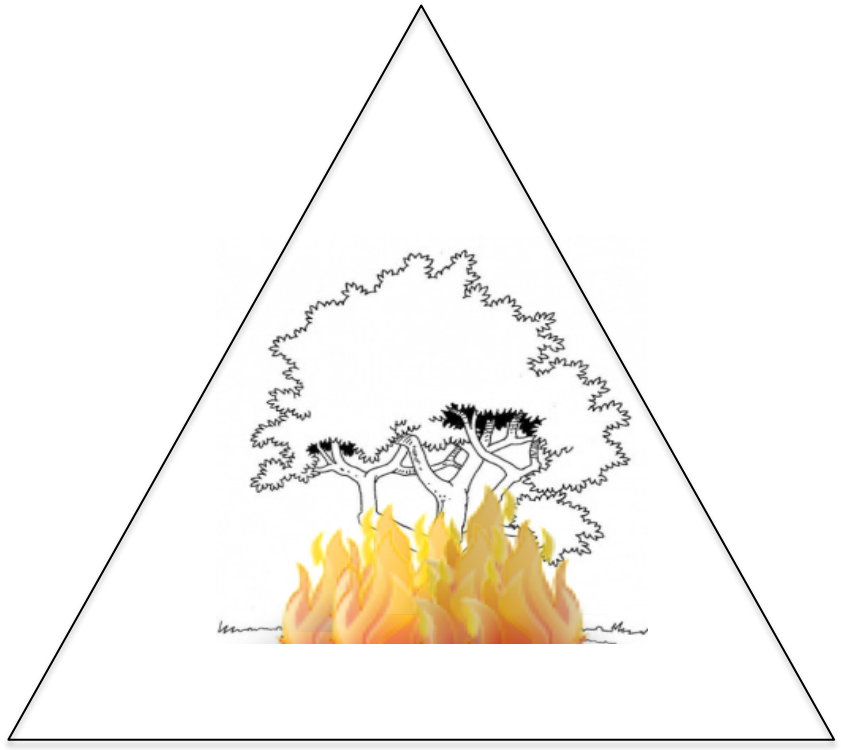
soil moisture average over the Sahel



ERA interim
CCI – SM
JSBACH

CCI – SM and Fire (Burned Area)

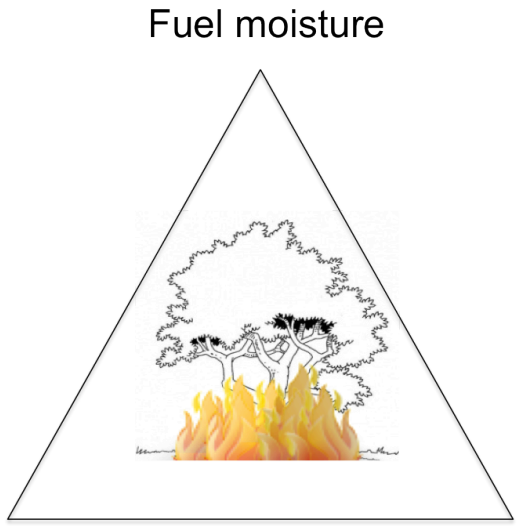
Fuel moisture



Fuel availability

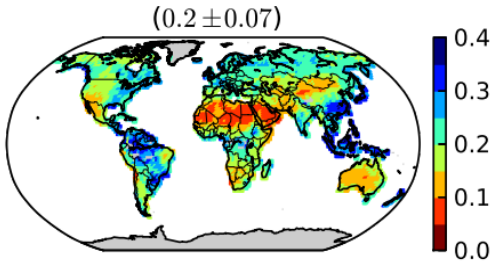
Ignition Source

CCI – SM and Fire (Burned Area)



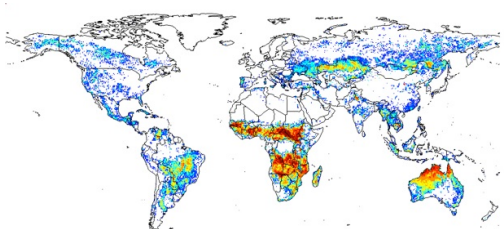
Functional relationship between soil moisture and burned area ?

soil moisture



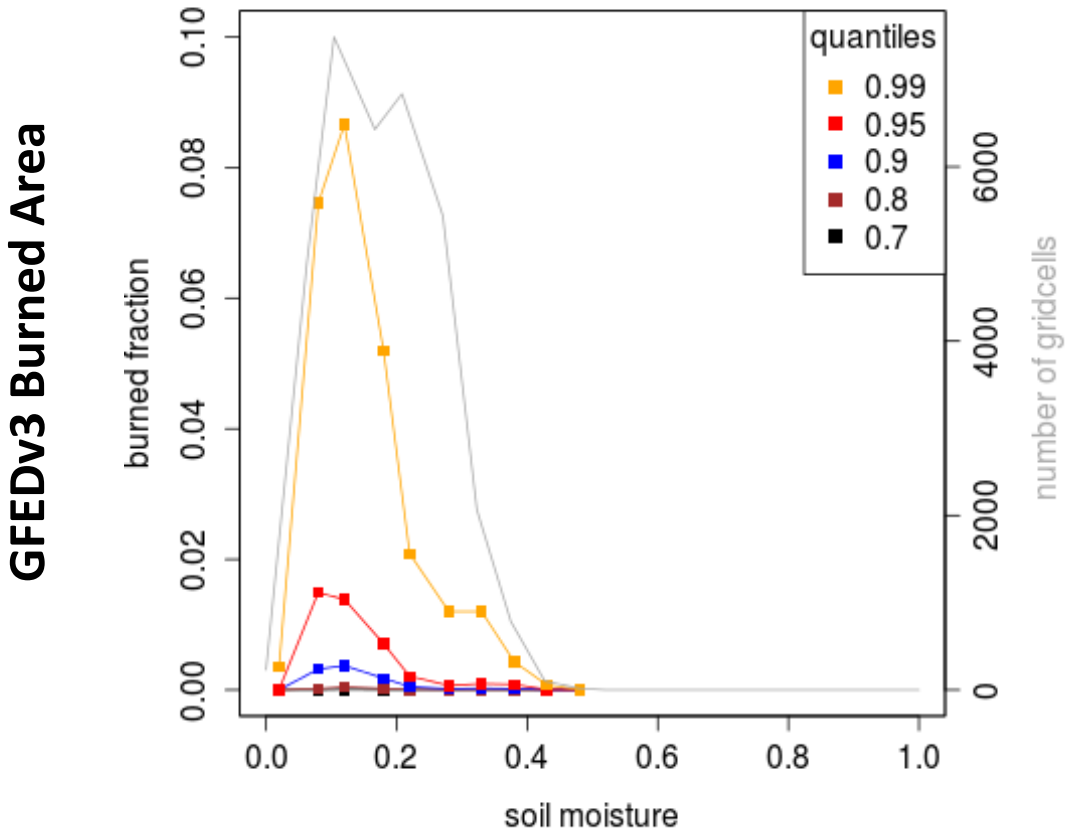
CCI SM

burned area

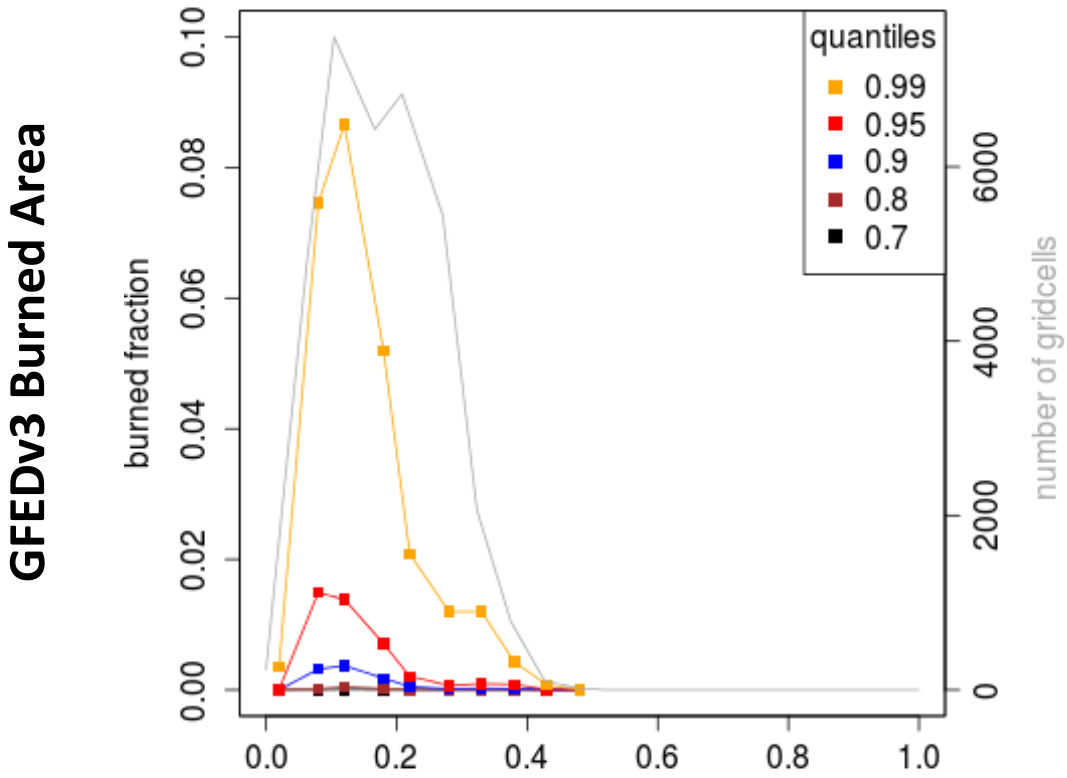


GFEDv3

CCI – SM and Fire (Burned Area)

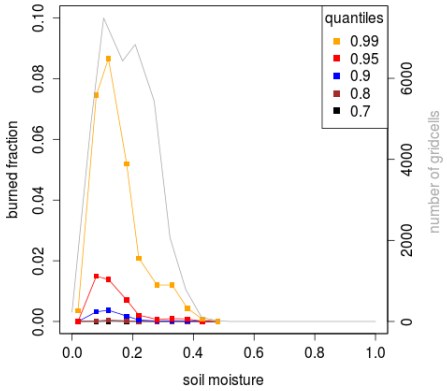


CCI – SM and Fire (Burned Area)

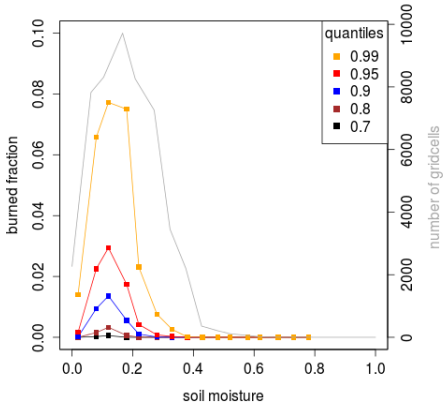


CCI – SM and Fire (Burned Area)

ESA CCI



MODEL / MPI-ESM-SPITFIRE



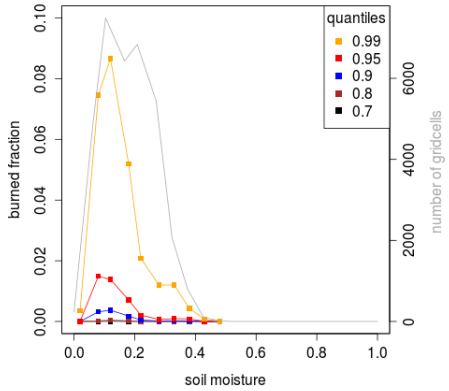
CCI – SM and Fire (Burned Area)

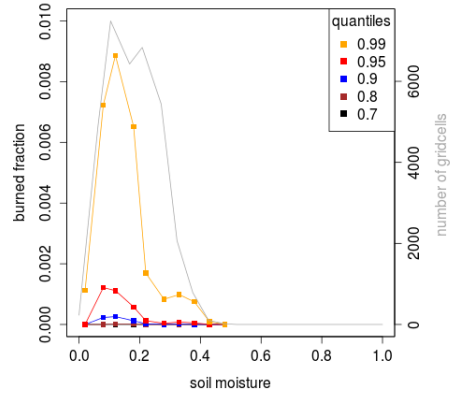
GRASS

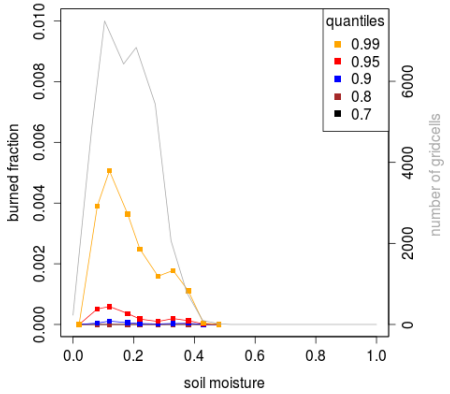
TREE

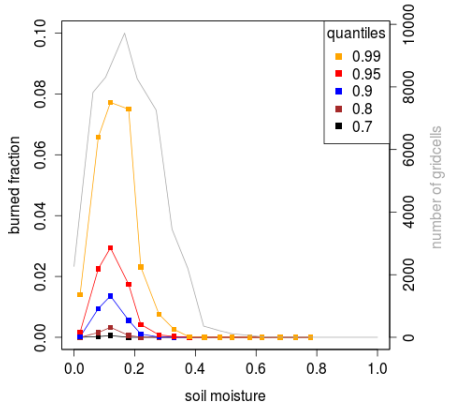
ESA CCI

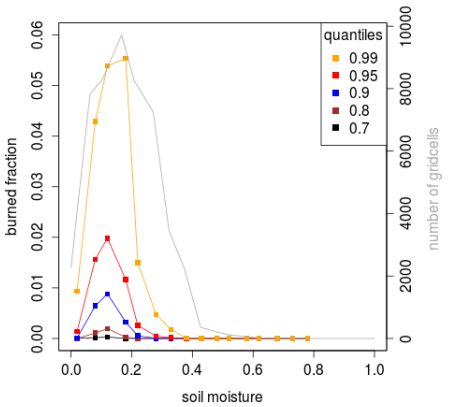
MODEL / MPI-ESM-SPITFIRE

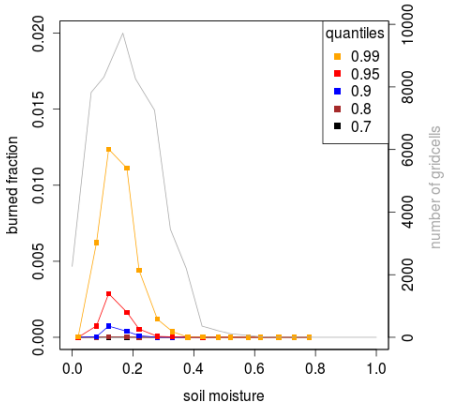




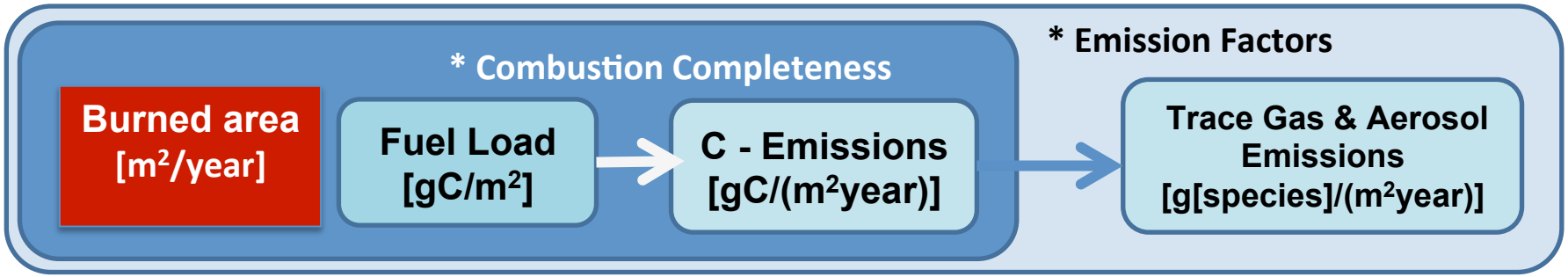






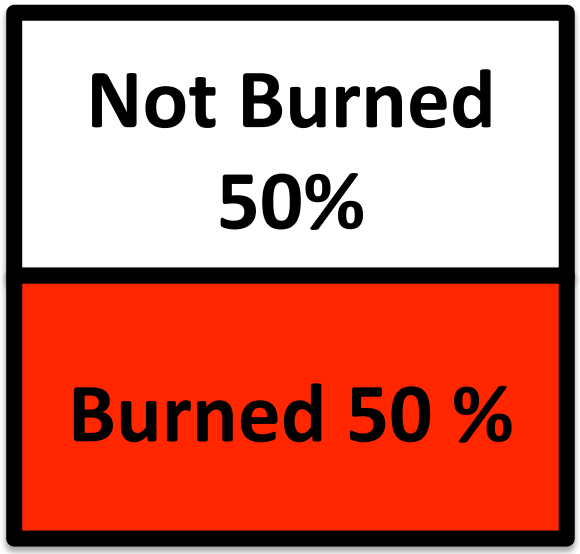


Fire (burned area) - Model integration

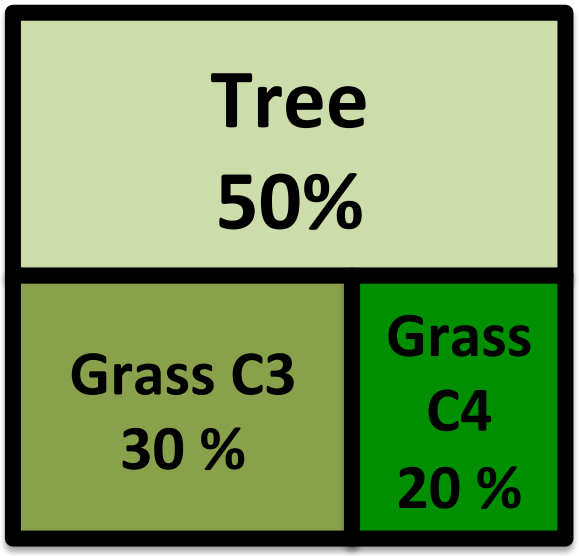


Fire (burned area) - Model integration

Data

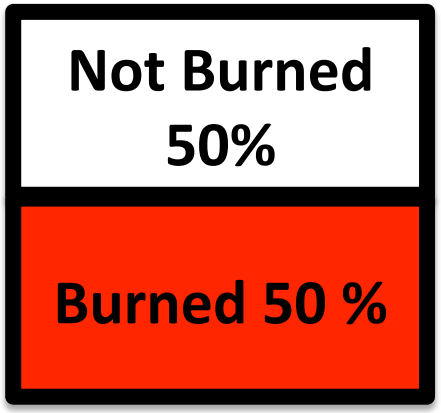


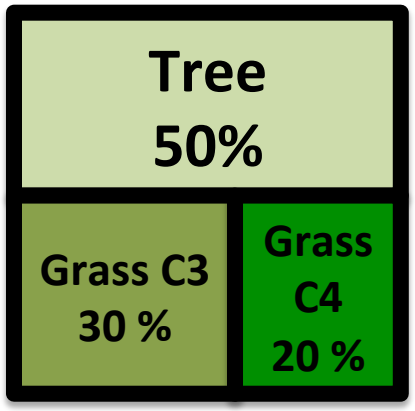
Model Grid box



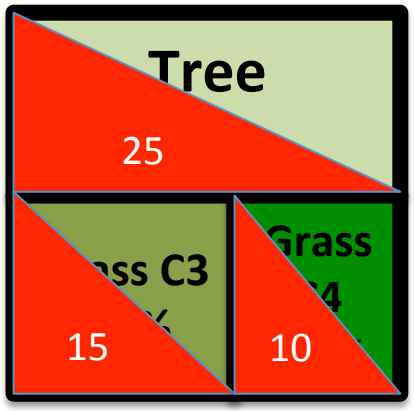
Fire (burned area) - Model integration

Burned Area data



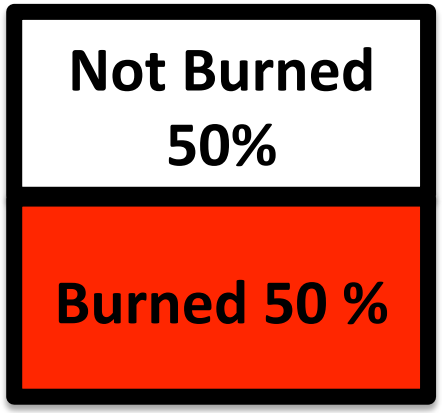


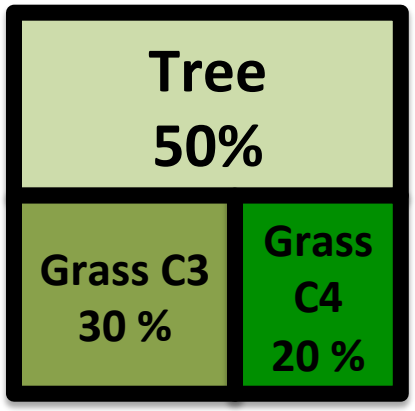
Model burned area



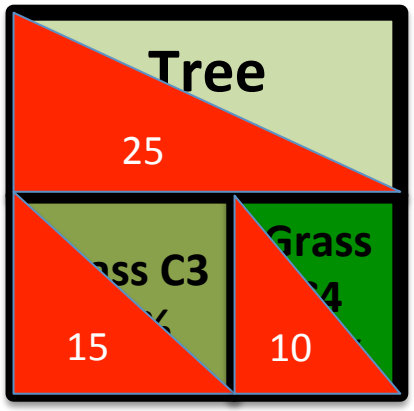
Fire (burned area) - Model integration

Burned Area data

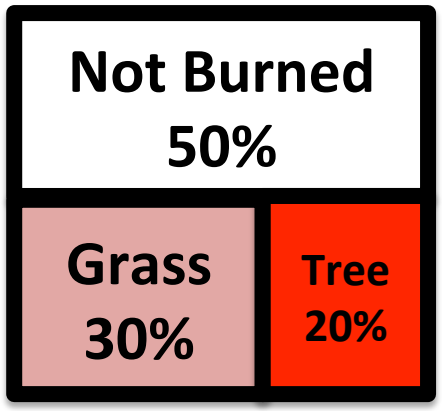


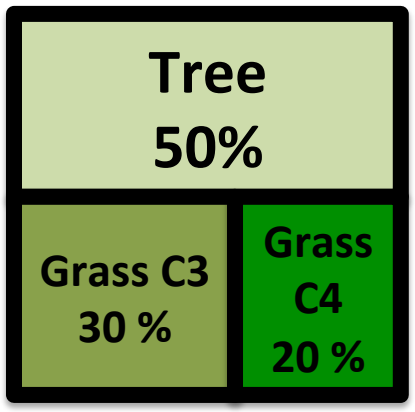


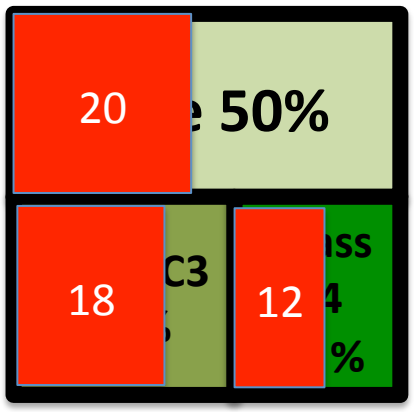
Model burned area



Burned Area data & Vegetation type burned

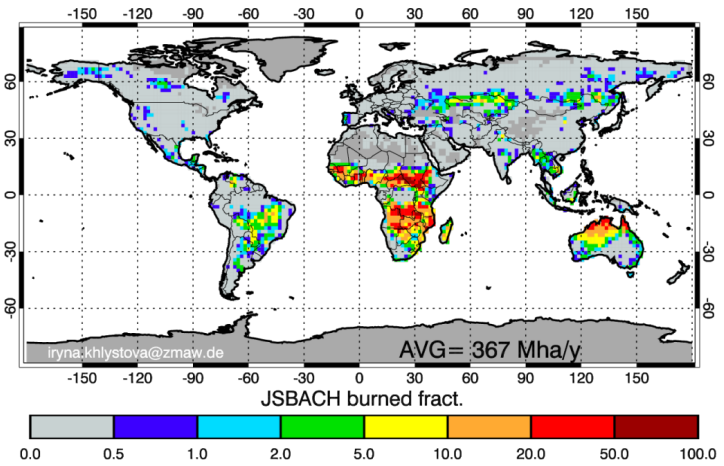






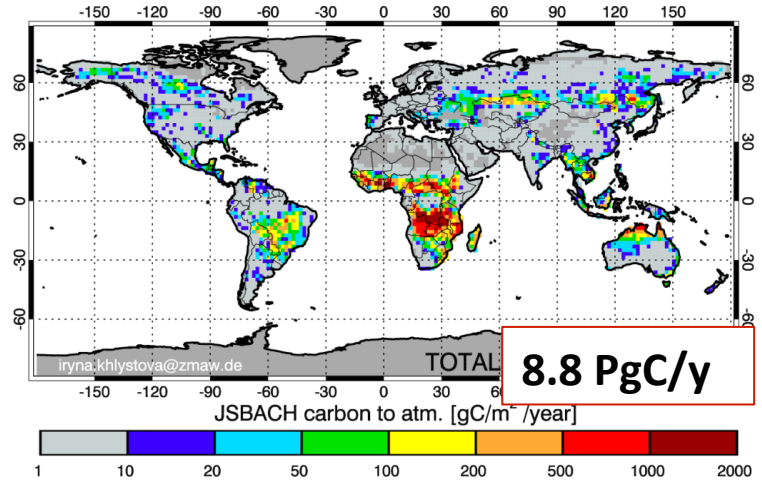
Fire (burned area) - Model integration

Burned Area (GFEDv3) (1997 – 2006)

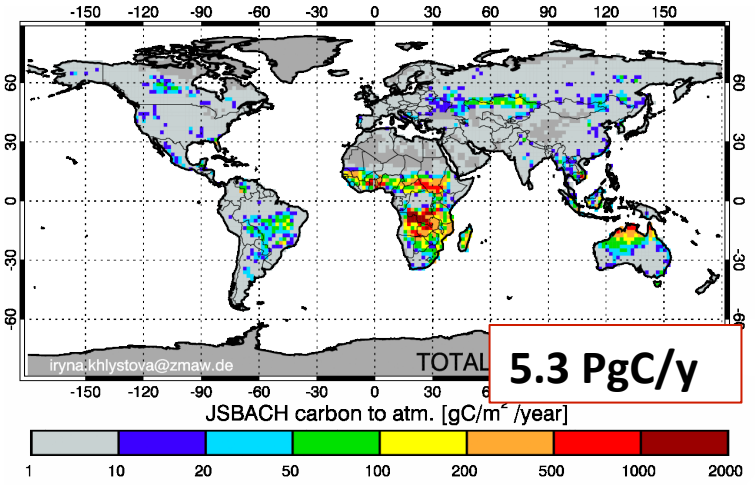


Carbon Emissions

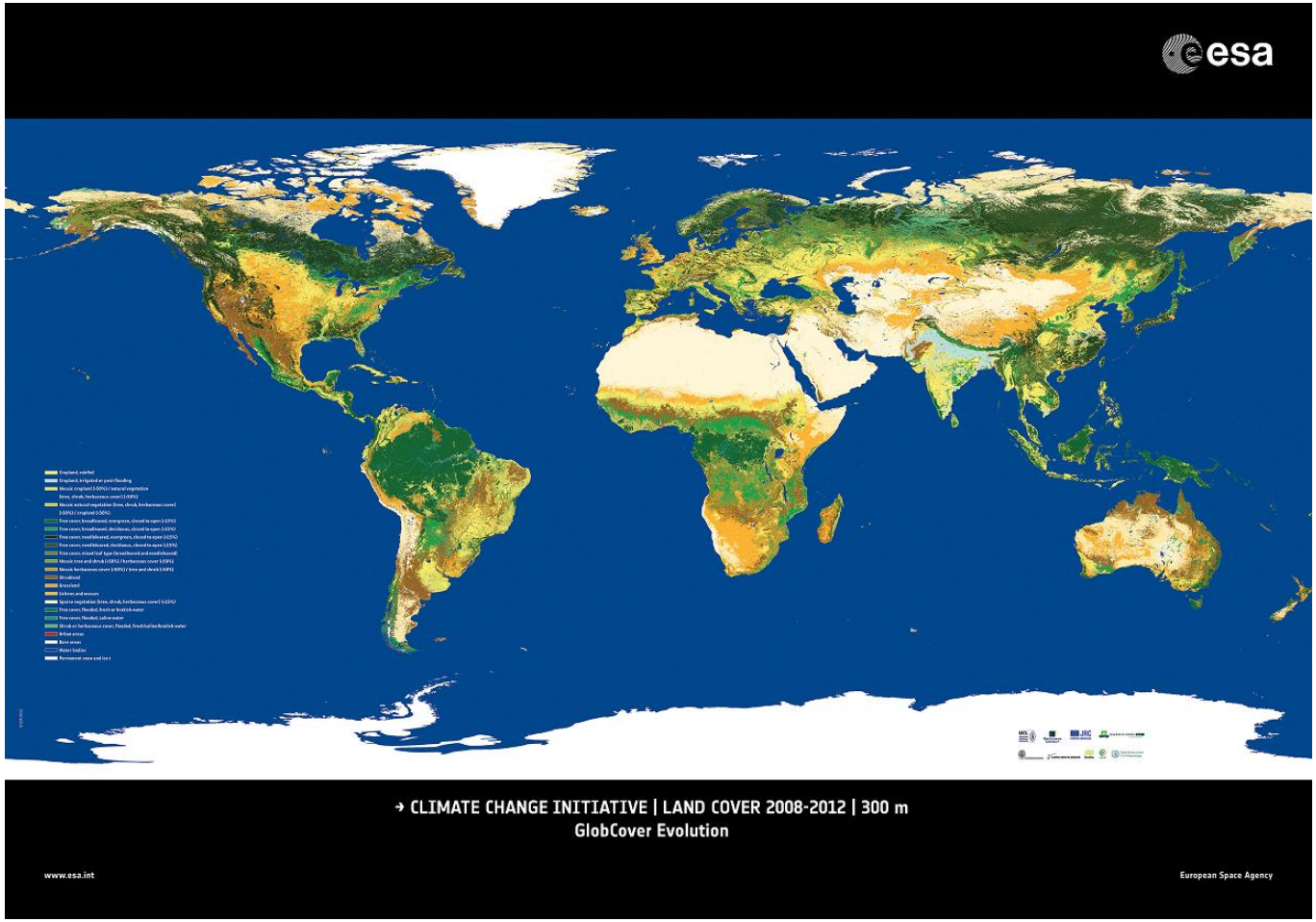
Burned Area information only



Burned Area & vegetation type burned



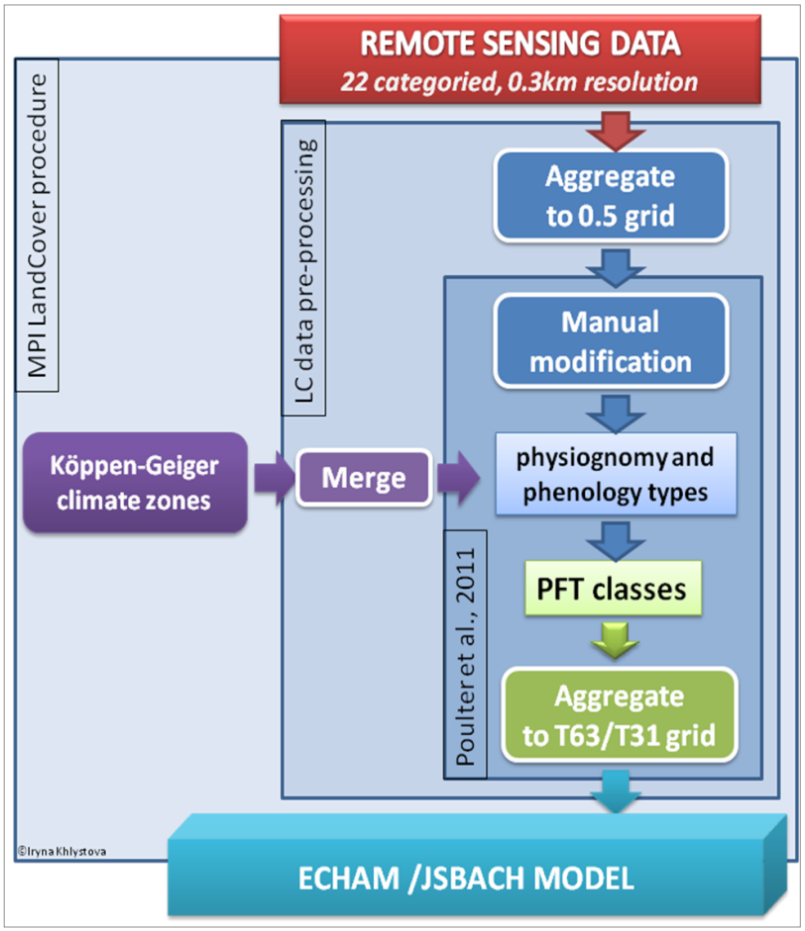
CCI Landcover - Data



CCI LC prototype data, 2005

New CCI LC product (2000,2005,2010) in progress

CCI Landcover – Data Conversion



Step 1 **File conversion and aggregation**
- Convert from TIFF to netCDF format
- Tile by type
- Reducing resolution to 0.5x0.5 (in order to apply other satellite datasets for further conversion, e.g. KG Biomes classification)

Step 2 **Reclassification (slightly modified schema by Poulter et al., 2011)**
- reduce to general types (forest, herbac, crop)
- apply biome mask (Climate classification)
- scale not used types (e.g. anthrop. water on land)

Step 3 **Regrid** to Model Resolution (T63/T31)

Adapted from Poulter et al, 2011

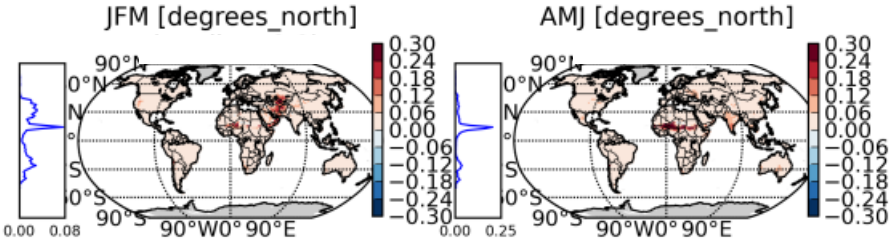
CCI Landcover – Model Application

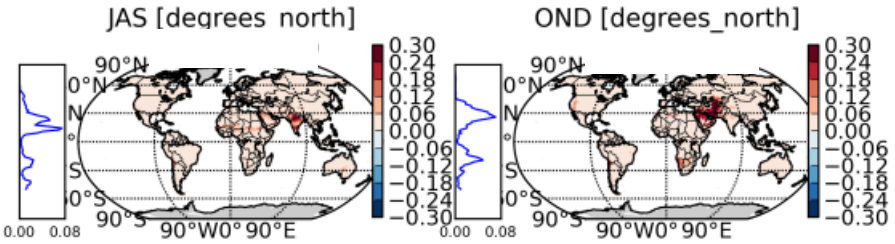
Simulation setup

Forcing	GlobCover	CCI_landcover
WATCH forcing	X	X
CRU/NCEP forcing	X	X
Coupled (Atm., land)	X	X

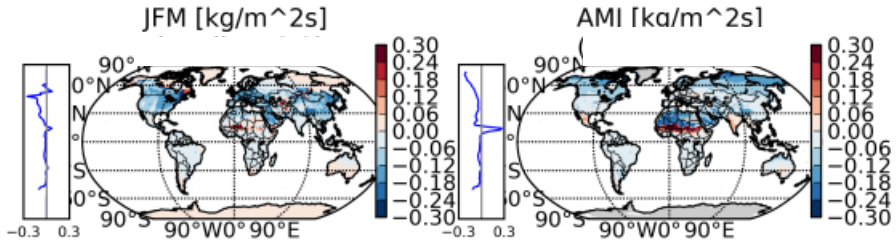
CCI Landcover – Model application

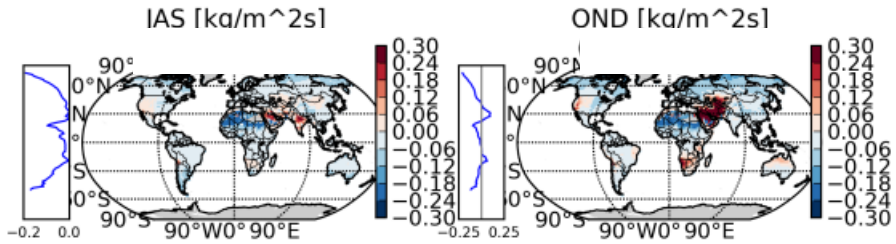
Leaf area index





Evaporation

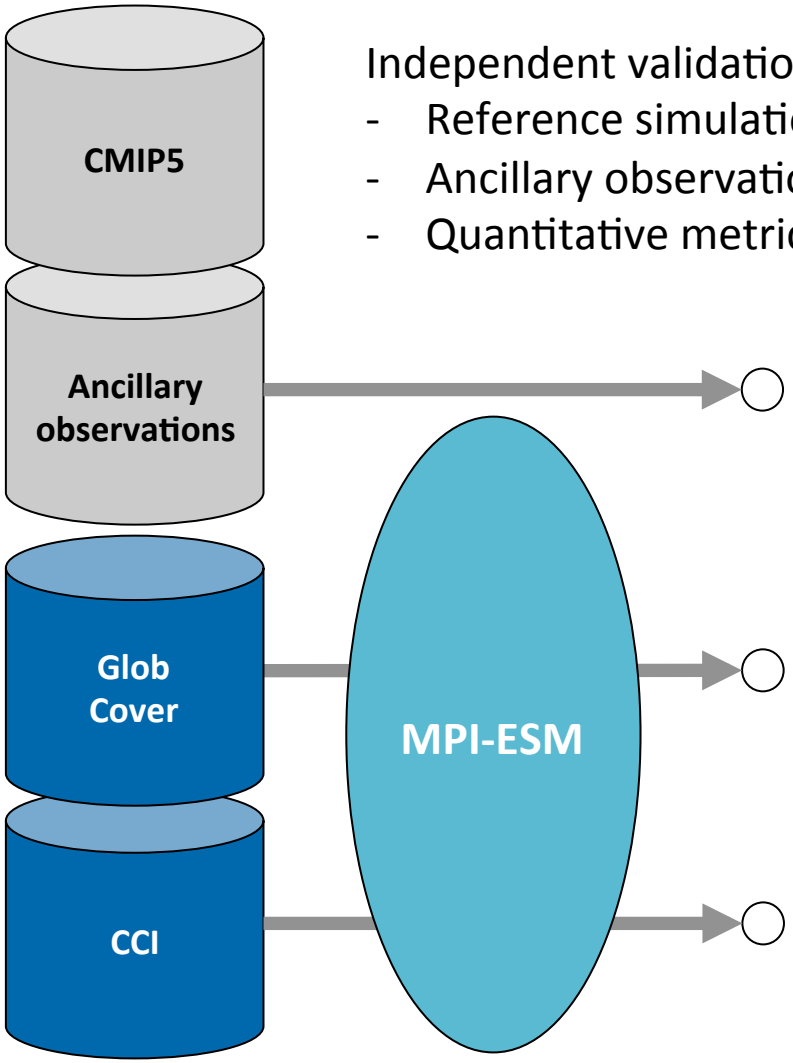




Relative differences between GlobCover and CCI LC: $CCI-GCV/GCV$

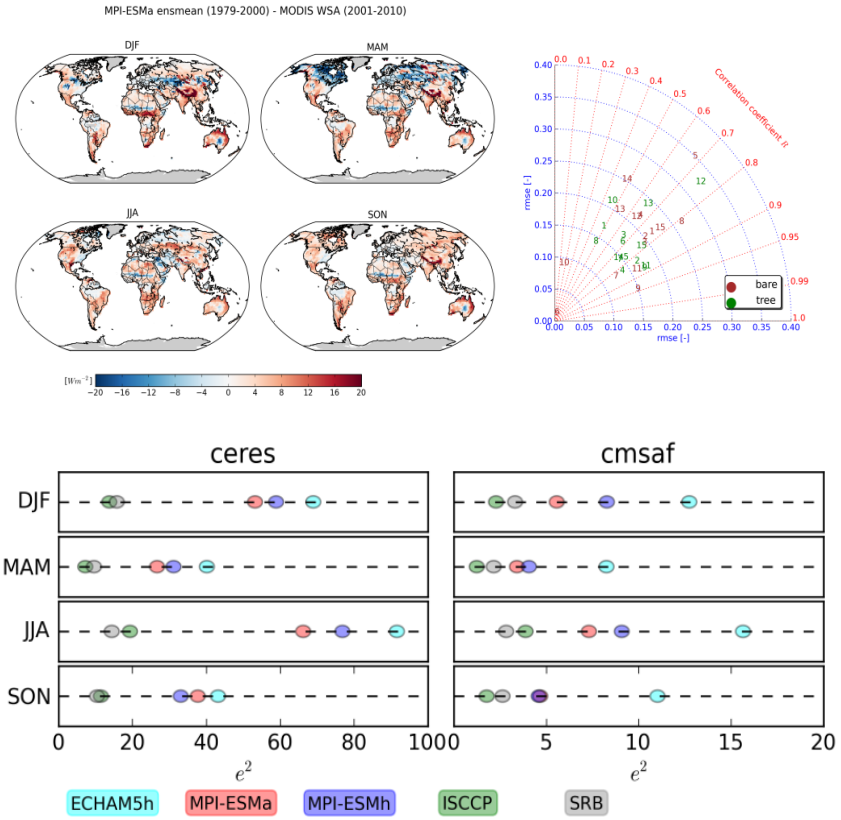
- Analysis of 20 different model state variables
- Small differences in water, energy and carbon cycle components

CCI Landcover – Benchmarking assessment

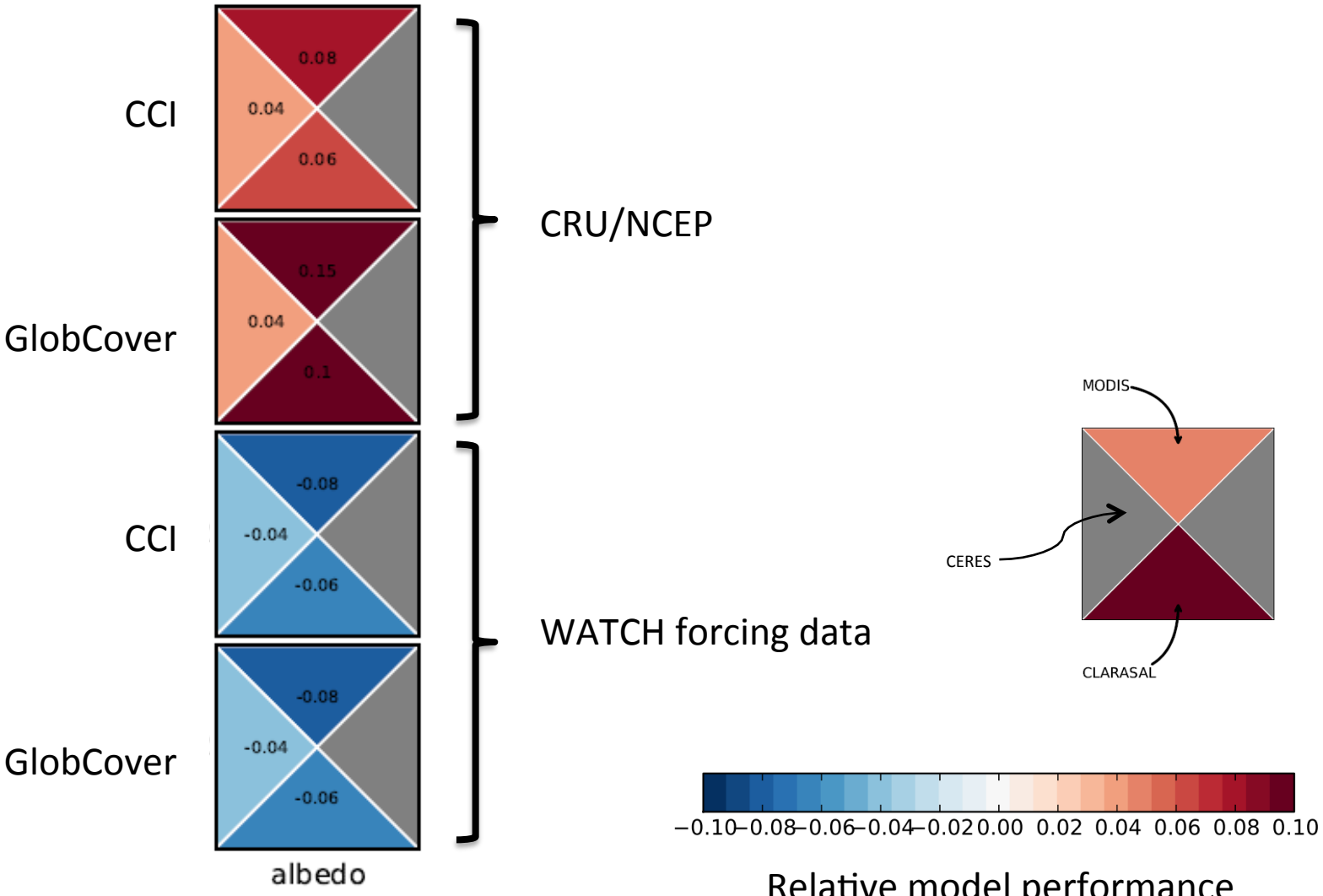


Independent validation of model performance:

- Reference simulations
- Ancillary observations (albedo, temperature, precipitation)
- Quantitative metrices (e.g. Reichler & Kim, 2008)



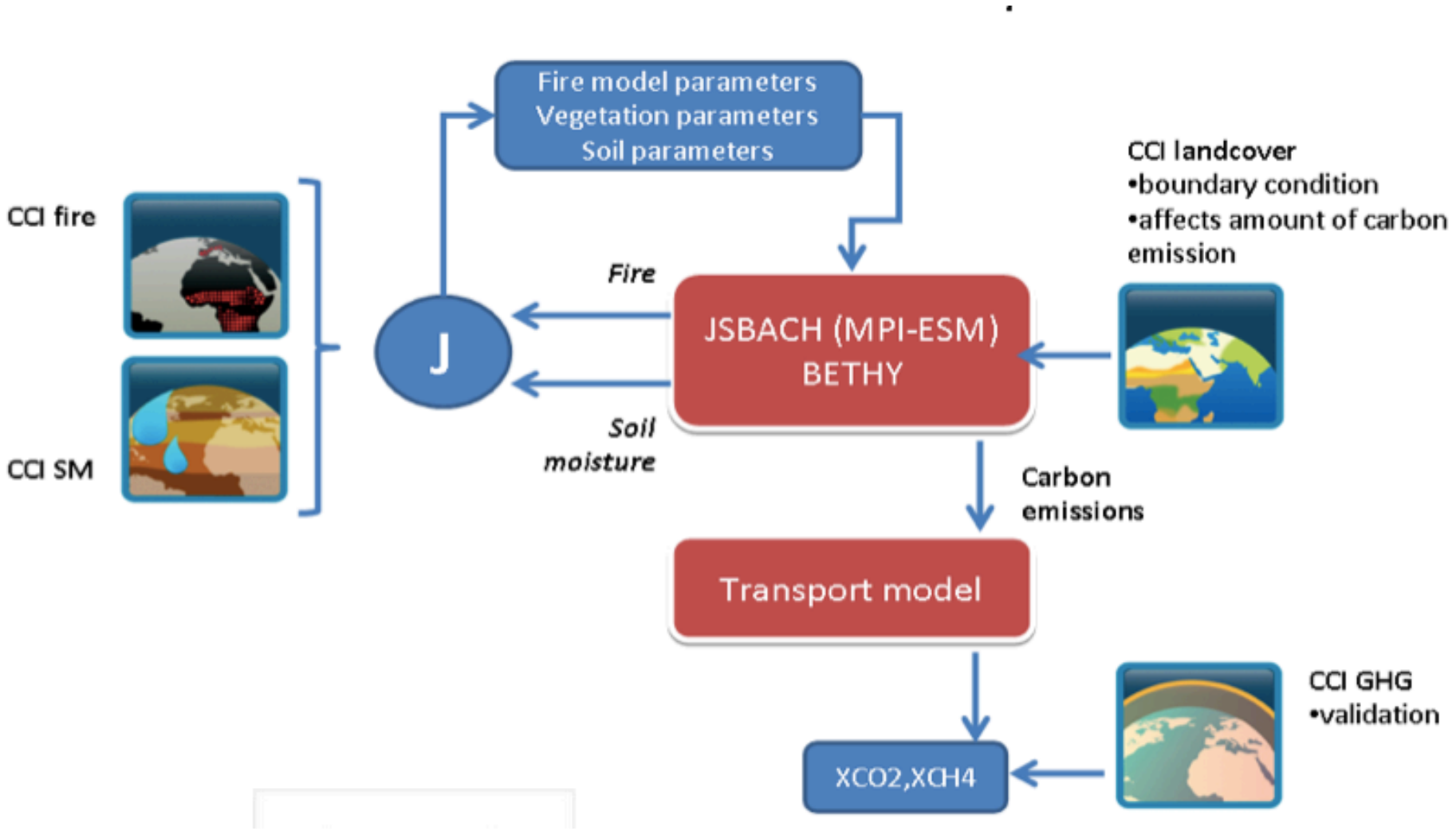
CCI Landcover – Benchmarking assessment



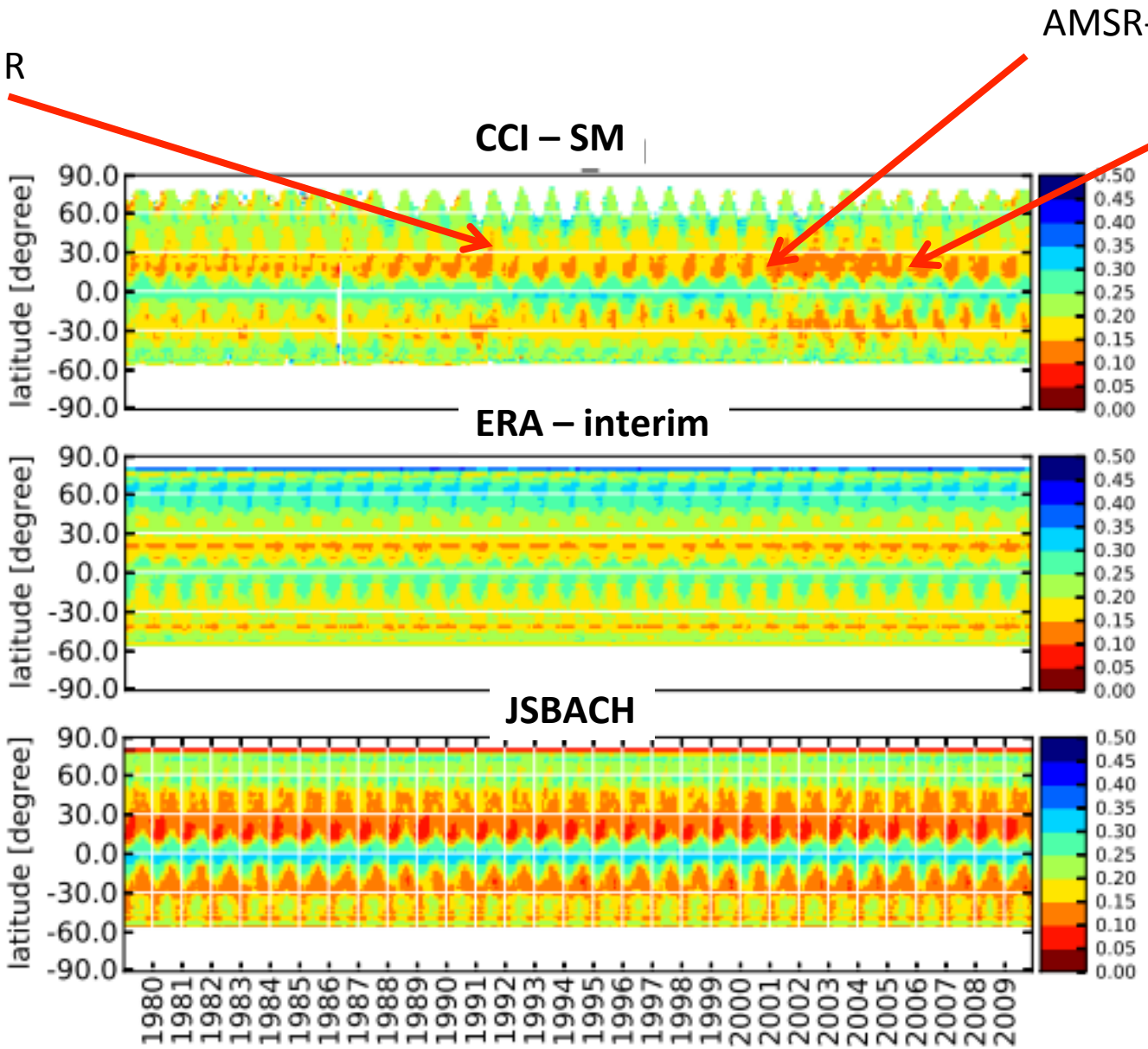
Summary / Conclusion

- soil moisture
  - CCI soil moisture shows reasonable agreement with the ERA-interim and JSBACH soil moisture
  - CCI soil moisture shows discontinuities in its time series
  - Detailed assessment in Loew et al., Hydrology and Earth System Sciences Discussion, 2013
- soil moisture & fire
  - Functional relationship between soil moisture and fire as new evaluation metric
- fire
  - The conversion from burned area to fire carbon emissions needs the information of the vegetation type burned
- Land cover
  - CCI LC and GlobCover lead to very similar results in JSBACH when applied as boundary conditions

Outlook / phase 2



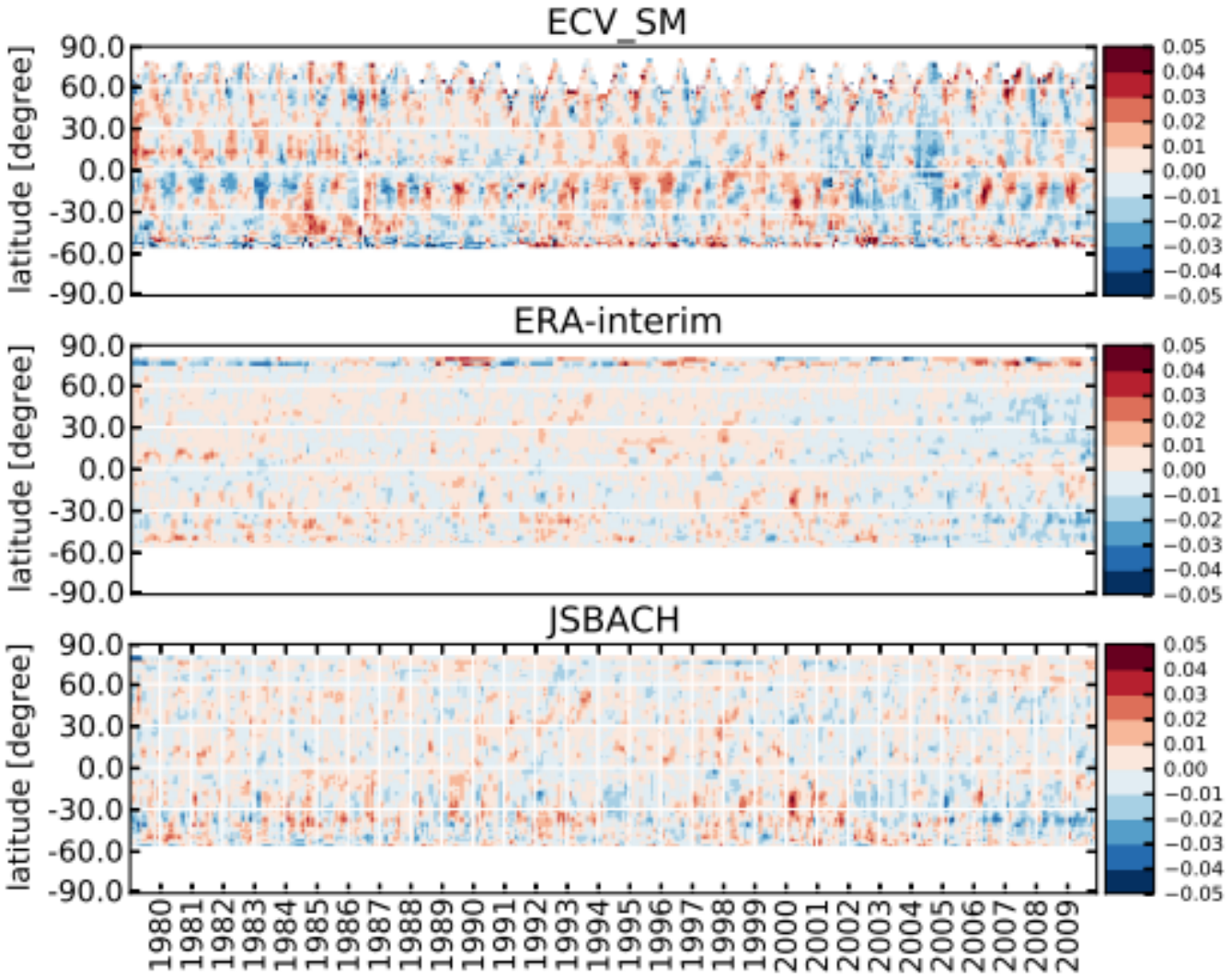
CCI - SM – longterm trend



Loew et al., 2013

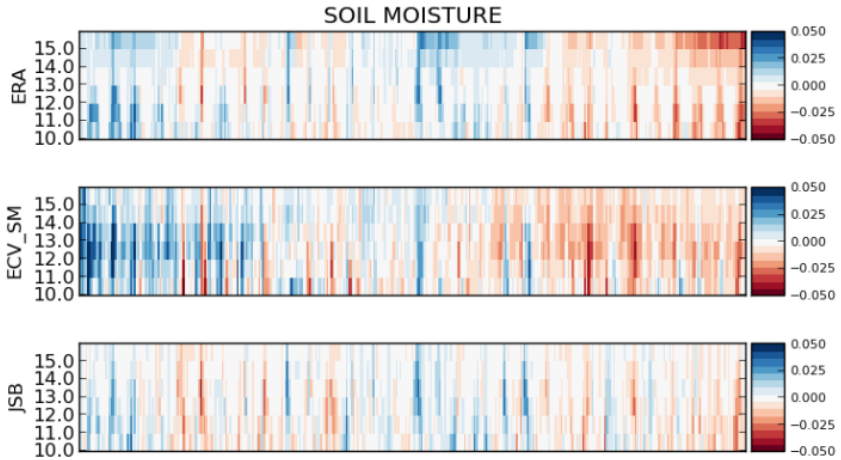
CCI soil moisture v0.1 (ECV_SM)

Anomalies

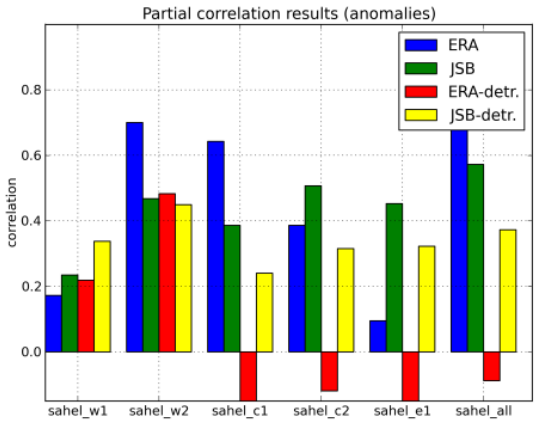


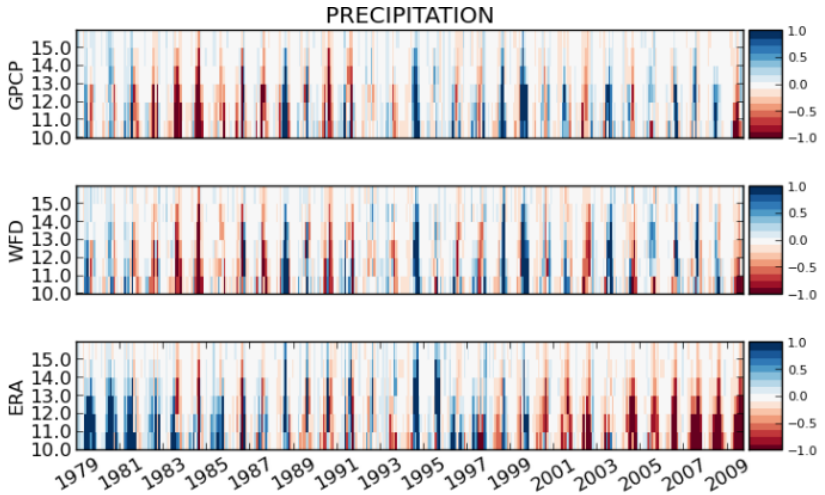
Loew et al., 2013

Sahelian soil moisture anomalies



Soil moisture relationship when precipitation forcing removed.





Loew et al., 2013

Potential and limitations of multidecadal satellite soil moisture observations for climate model evaluation studies

A. Loew[1], T. Stacke[1], W. Dorigo[2], R. de Jeu[3], and S. Hagemann[1]

[1]Max-Planck-Institute for Meteorology, KlimaCampus, Hamburg, Germany
[2]Department of Geodesy and Geo-Information, Vienna University of Technology, Vienna, Austria
[3]Department of Earth Sciences, Faculty of Earth and Life Sciences, VU University Amsterdam, the Netherlands

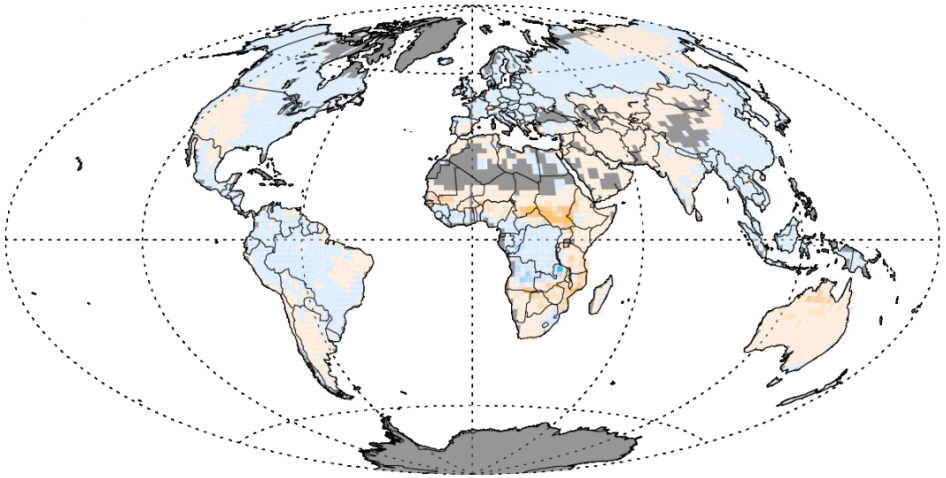
Correspondence to: Alexander Loew
(alexander.loew@zmaw.de)

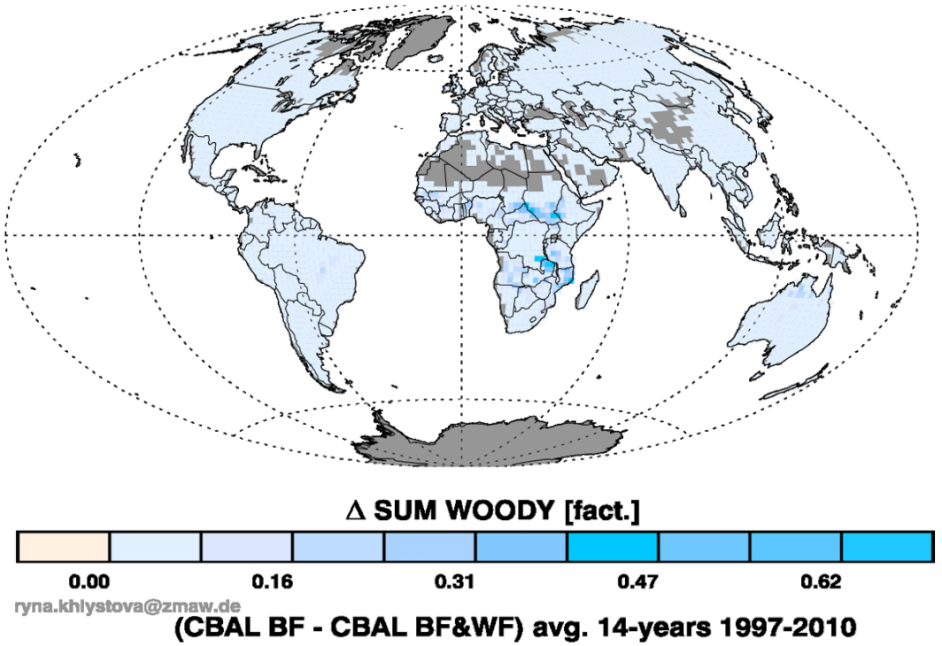
submitted to HESS (02/2013)

Summary

Potential	Current limitations
Climate model evaluation	
Percentile statistics are useful tool for model evaluation	ECVSM soil moisture probability density function is dependent on Noah GLDAS and therefore does not provide a model independent dataset for soil moisture percentile distribution
ECVSM shows consistent temporal trend patterns with precipitation and ancillary soil moisture data	ECVSM shows discontinuities in the longterm time-series which are likely to be the result from changing observing systems. Any conclusions from trend analysis therefore needs to be done very carefully.
	Time series not homogeneous due to different data rescaling approaches before and after 1988; see Liu et al. (2012), sec. 3.1.2 for details
	Limited data coverage in early years (< 1990)
Process and regional studies	
Good representation of intra- and interannual soil moisture anomalies at global to regional scale	Risk of regionally missing soil moisture information due to binary like blending technique applied; example: missing heat wave 2003 in Europe
Suitable soil moisture information for land-atmosphere interactions in the Sahel	High latitude limitation due to snow cover and frozen soil conditions

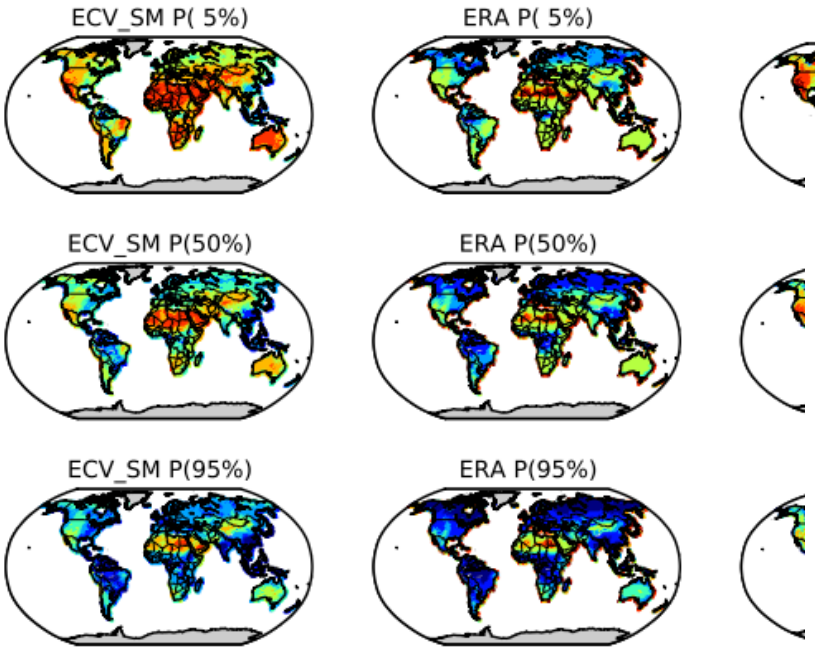
Fire (burned area) - Model integration

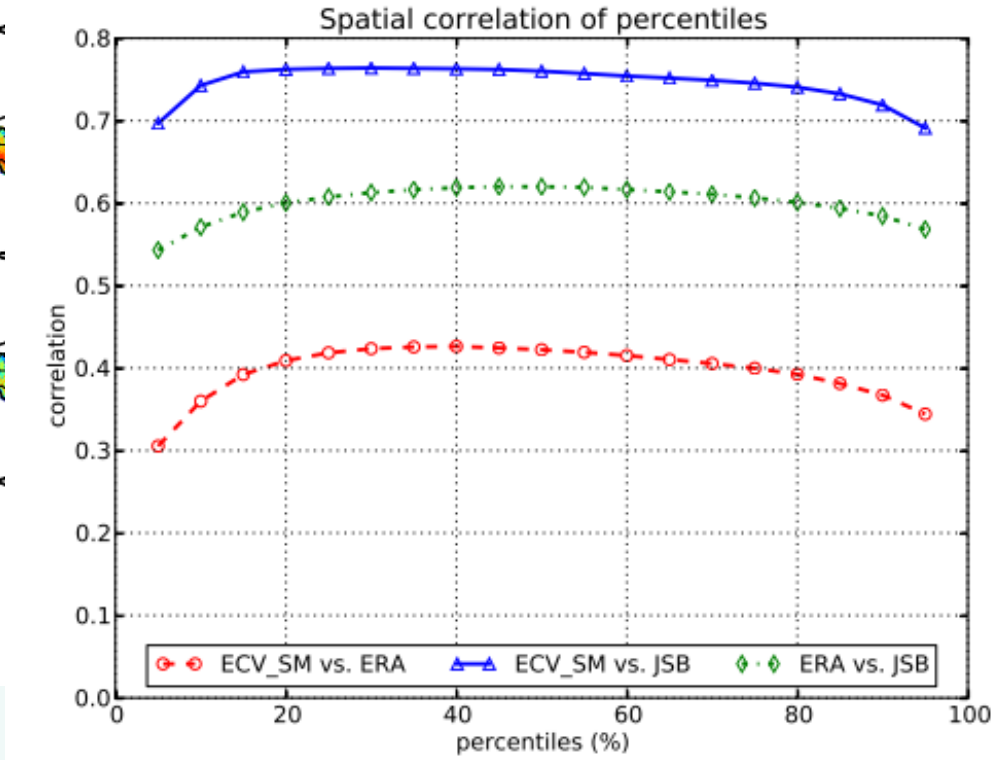




Do models have characteristic soil moisture dynamics?

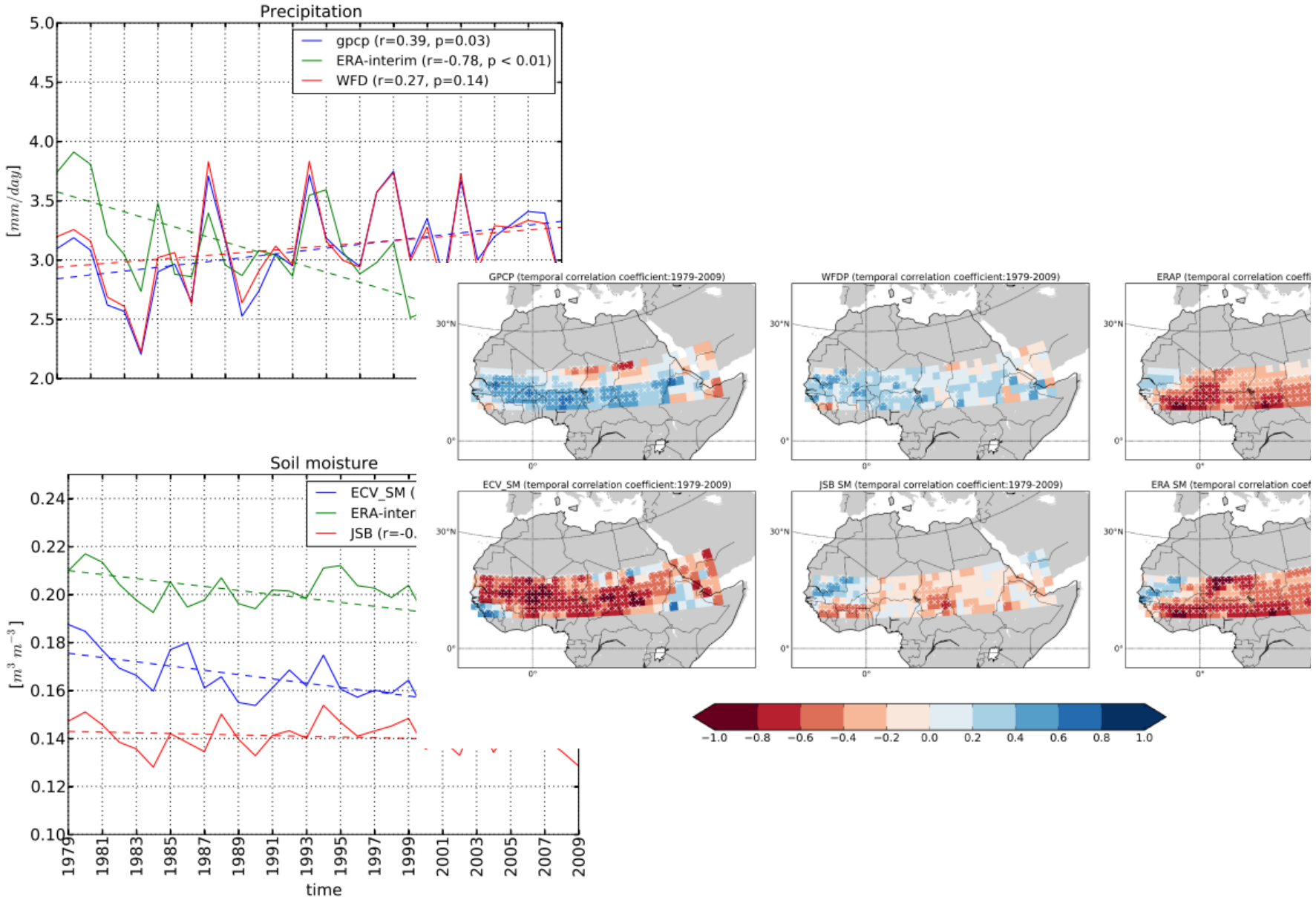
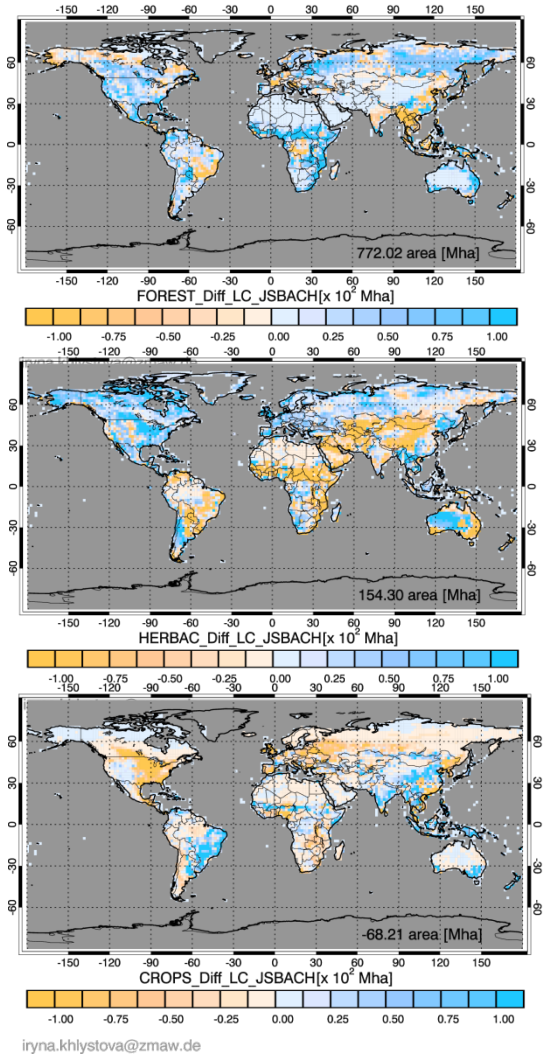
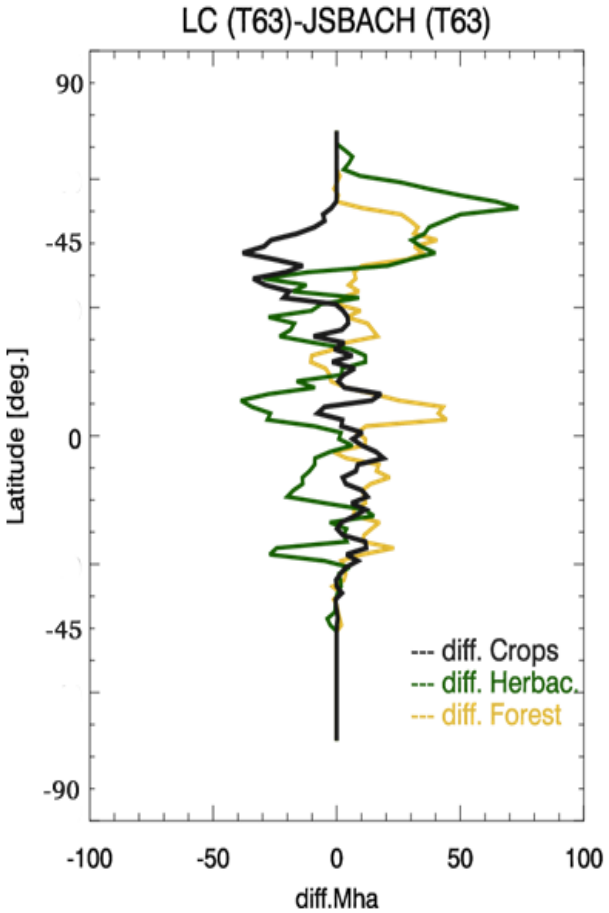
Percentile distribution pattern





Loew et al., 2013

CCI – SM regional application – Sahelian drought



CCI Landcover