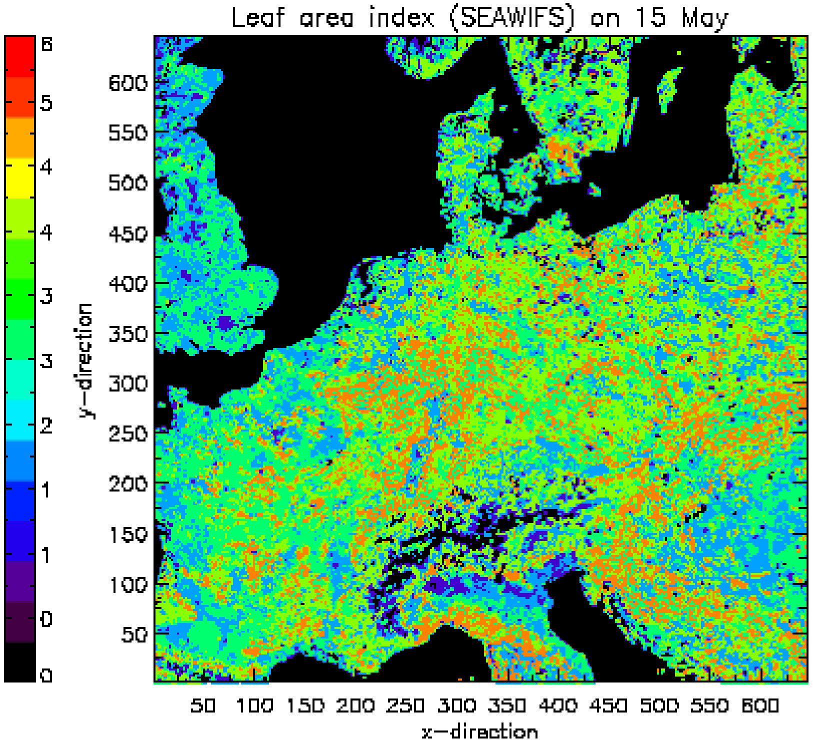
# Preliminary studies towards a more realistic root parameterisation

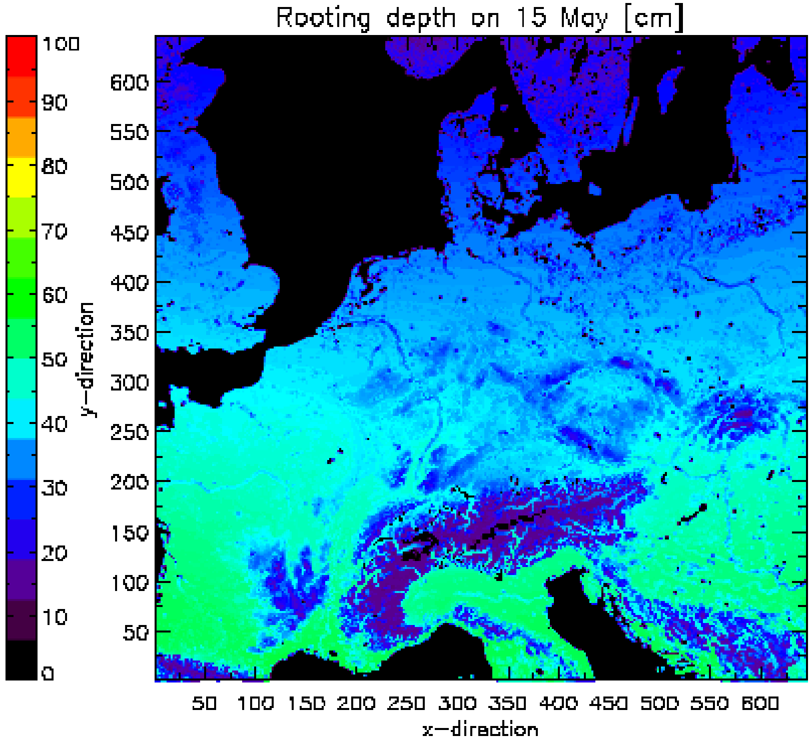
*G. Vogel*

# COSMO-DE domain

Deutscher Wetterdienst
*Wetter und Klima aus einer Hand*

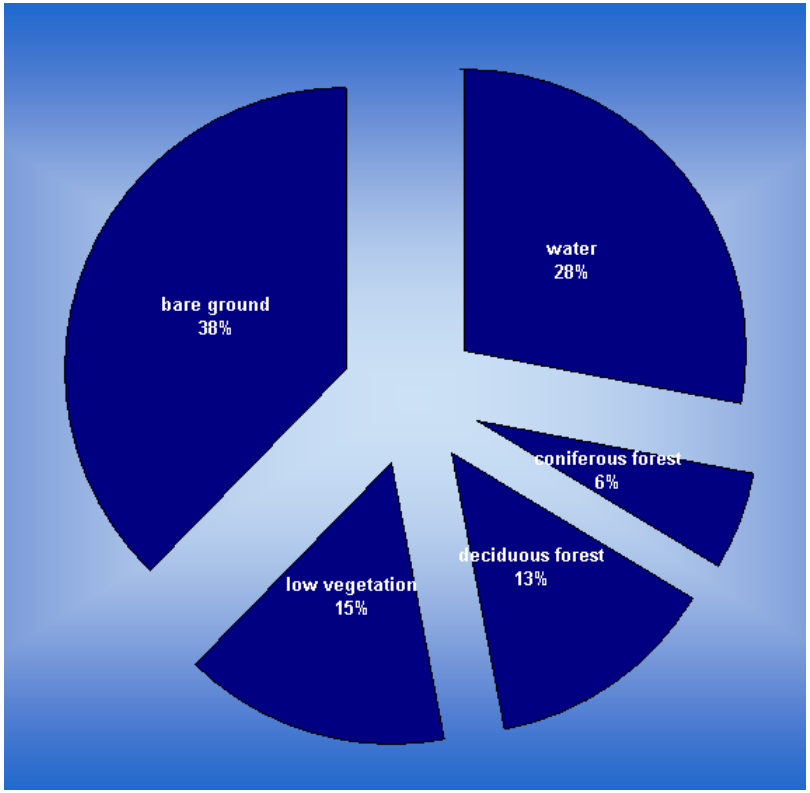
Current parameterisation



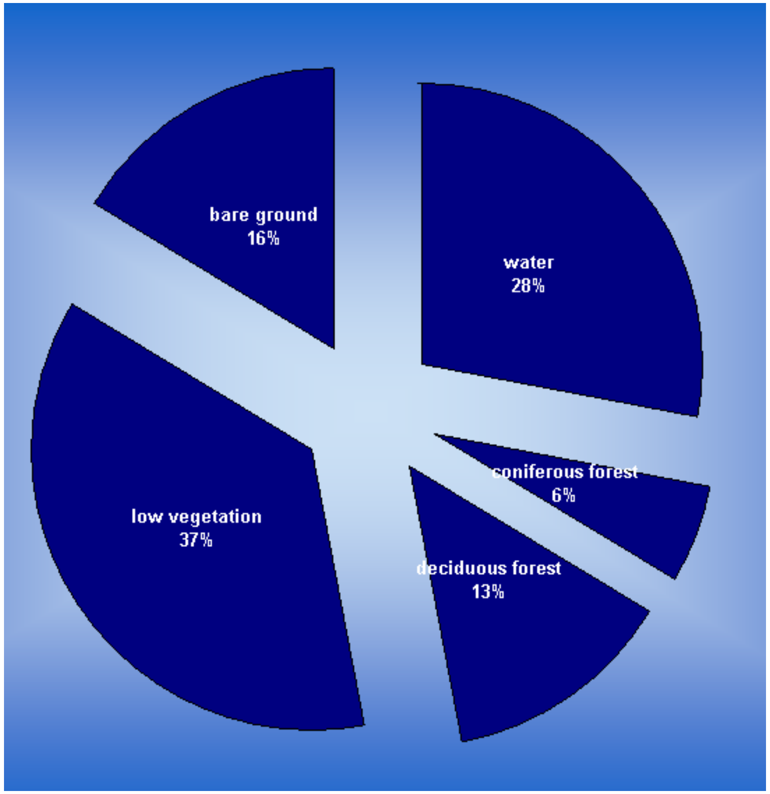



# Percental land use in the COSMO-DE domain (645 x 645 grid boxes) based on SEAWIFS data

January



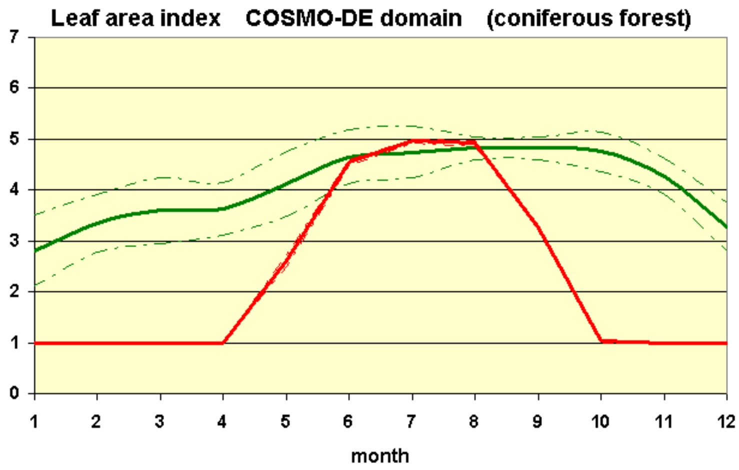

July

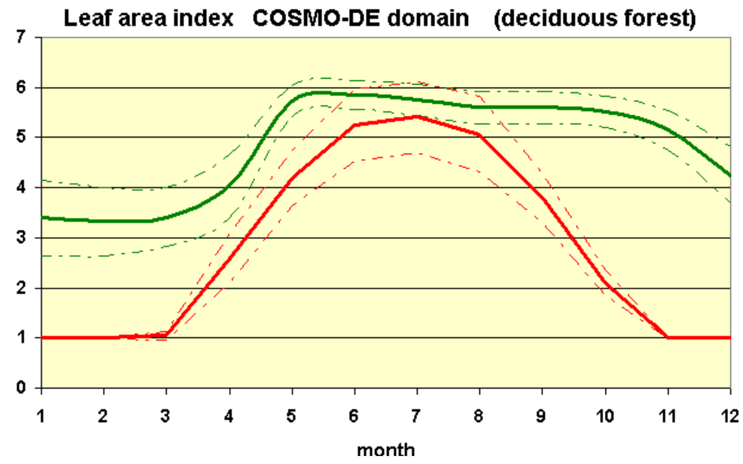


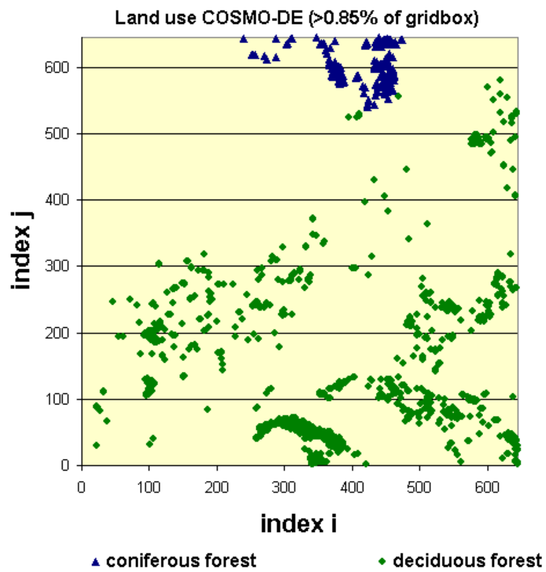
## plant cover ≥ 0.85 (forest)

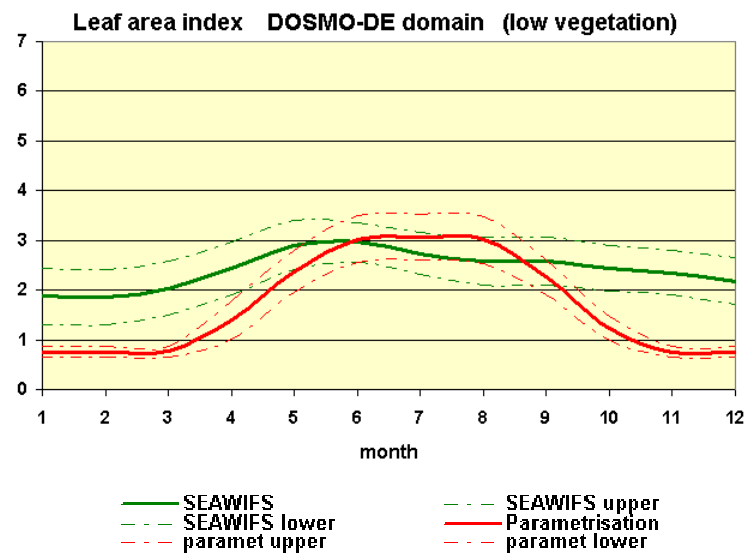
## Plant cover ≥ 0.99 (low vegetation)





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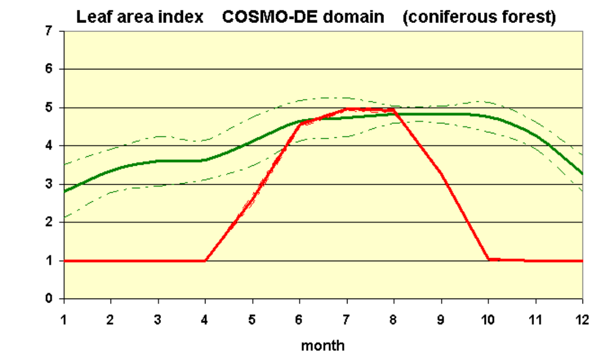
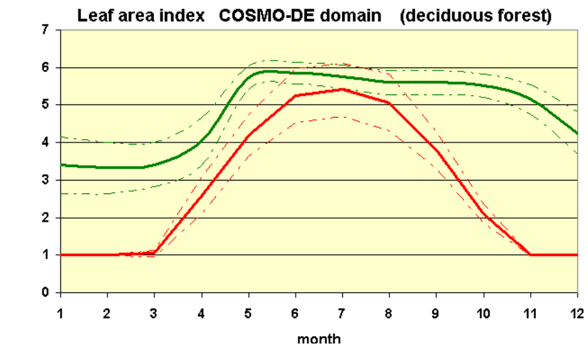
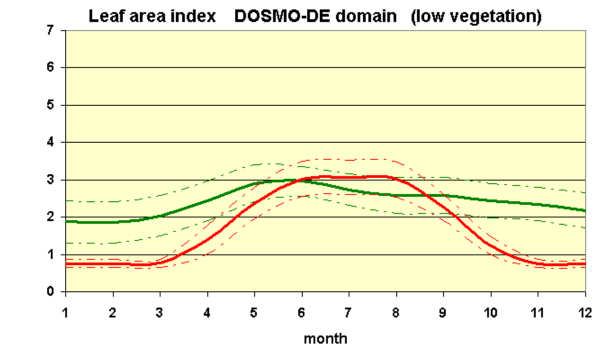
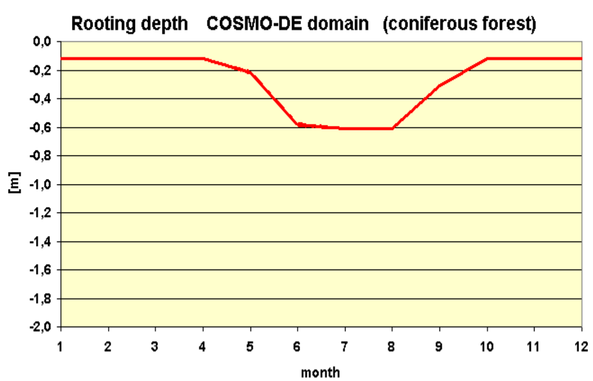
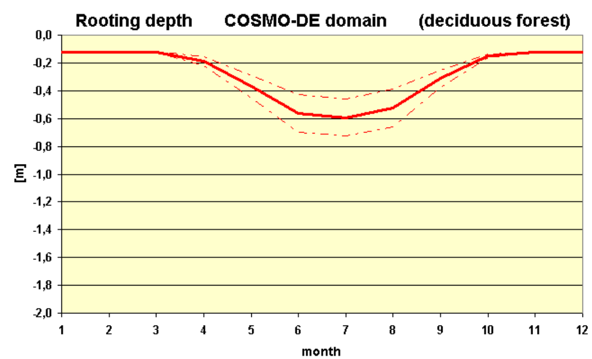


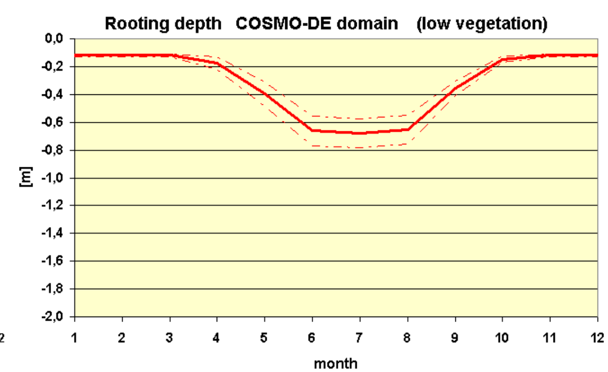



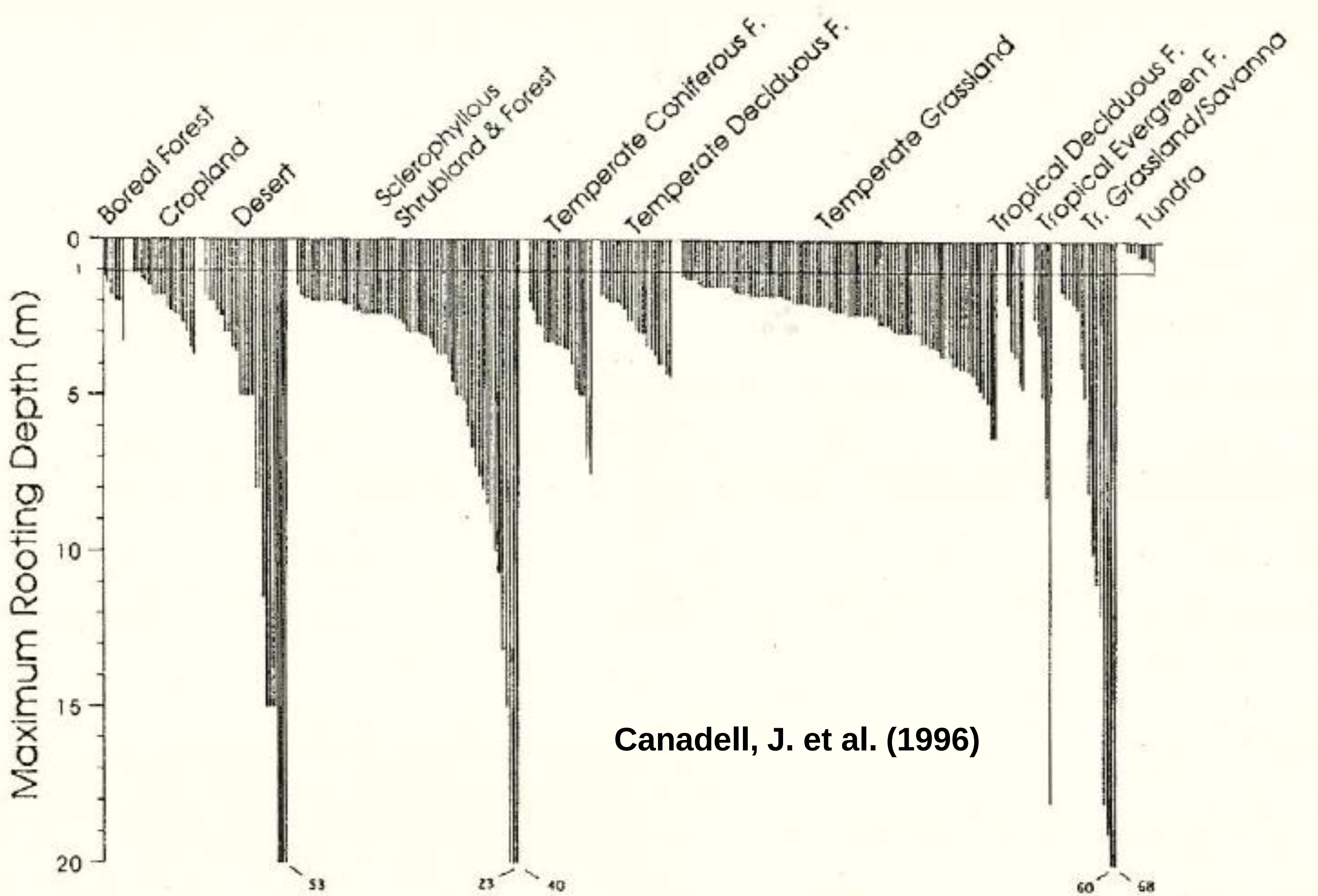

SEAWIFS — current parameterization




current parameterization




Canadell, J. et al. (1996)

# Basis representation of root distribution

(Jackson et al., 1996)
(Arora and Boer, 2003)

Root density

$$\rho_i(z,t) = A_i(t)\beta_i^{\,z} = A_i(t)e^{-a_i z}$$

**A(t): surface root density of a specific kind of vegetation**

$$a_i = -\ln \beta_i$$

**parameter values known from literature for a lot of biomes**

Root biomass

$$B_i(z,t) = \int_0^z A_i(t)\, e^{-a_i z} dz = \frac{A_i(t)}{a_i}\left(1 - e^{-a_i z}\right)$$

$$B_{\infty,i}(t) = \frac{A_i(t)}{a_i} \qquad f_i(z) = \frac{B_i(z,t)}{B_{\infty,i}(t)} = \left(1 - e^{-a_i z}\right) \qquad d_i(z) = \frac{-\ln\left(1 - f_i(z)\right)}{a_i} = -\frac{3}{\ln\left(\beta_i\right)}$$

# Extended formulation (Arora and Boer, 2003)

new structure parameters

$$a(t)=\frac{A(t)}{B_\infty(t)} \longrightarrow a(t)=\frac{b}{B_\infty^\alpha(t)}$$

**B, a ,al: determined from field measure-ments for relevant biomes**

density profile [kg/m²]

$$\rho(z,t)=a(t)B_\infty(t)e^{-a(t)z}=bB_\infty^{1-\alpha}(t)\exp\left[-\frac{b}{B_\infty^\alpha(t)}z\right]$$

cumulative root fraction

$$f(z,t)=1-e^{-a(t)z}=1-\exp\left[-\frac{b}{B_\infty^\alpha(t)}z\right]$$

rooting depth [m]
**(comprising 95% of root biomass)**

$$d(t)=\frac{3}{a(t)}=\frac{3B_\infty^\alpha(t)}{b}$$

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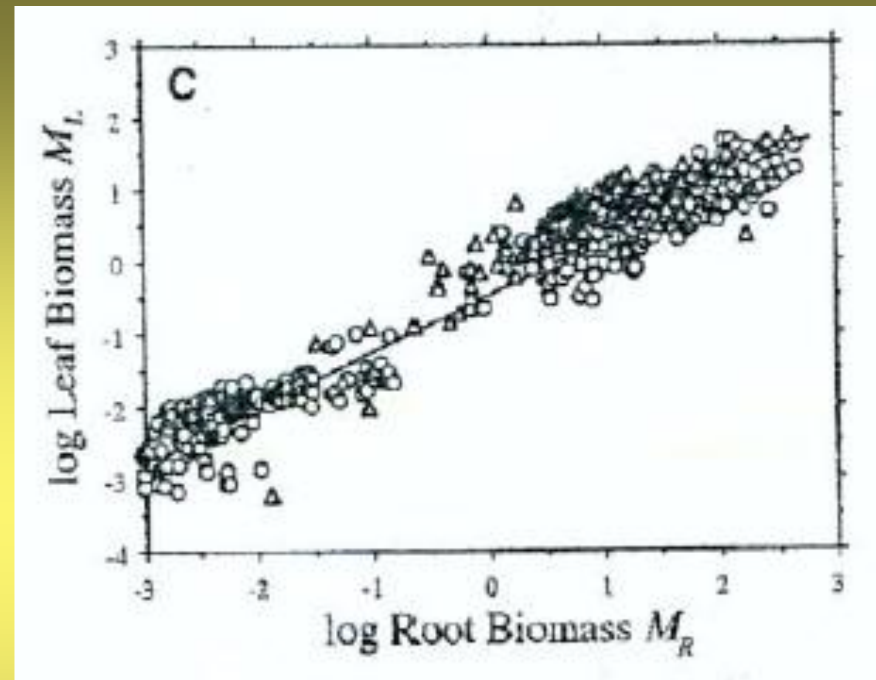
# Global Allocation Rules for Patterns of Biomass Partitioning in Seed Plants

Brian J. Enquist[1,2]* and Karl J. Niklas[3]

A general allometric model has been derived to predict intraspecific and interspecific scaling relationships among seed plant leaf, stem, and root biomass. Analysis of a large compendium of standing organ biomass sampled across a broad sampling of taxa inhabiting diverse ecological habitats supports the relations predicted by the model and defines the boundary conditions for above- and below-ground biomass partitioning. These canonical biomass relations are insensitive to phyletic affiliation (conifers versus angiosperms) and variation in averaged local environmental conditions. The model thus identifies and defines the limits that have guided the diversification of seed plant biomass allocation strategies.




$$M_R \propto M_L^{4/3}$$

# Use of SEAWIFS based NDVI-ratio for time-scaling

**rooting depth [m]**

$$d = \frac{3B_{\infty}^{\alpha}}{b}$$

$$\overline{b} = \Sigma\, a_v b_v \qquad \overline{\alpha} = \Sigma\, a_v \alpha_v \qquad \overline{B}_{\infty} = \Sigma\, a_v B_{\infty}^{v}$$

$$\overline{d}(t) = \frac{3}{\overline{b}}\left(r_{ndvi}(t)\overline{B}_{\infty}\right)^{\overline{\alpha}}$$

$\overline{B}_{\infty}$ : gridbox-averaged total root biomass

$r_{ndvi}$ : SAEWIFS-based NDVI-ratio

$\overline{\alpha}, \overline{b}$ : gridbox-averaged vegetation parameters

$a_v$ : area percentage of vegetation kind

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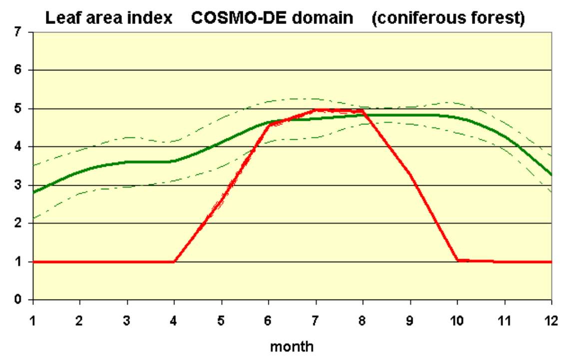
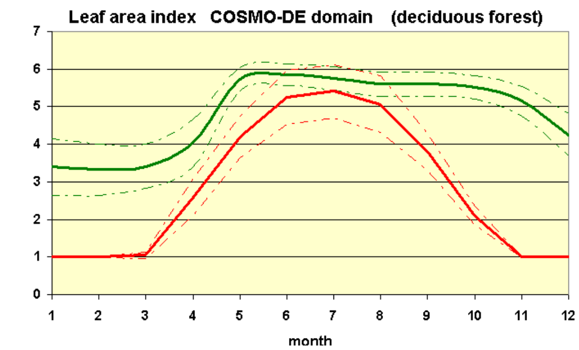
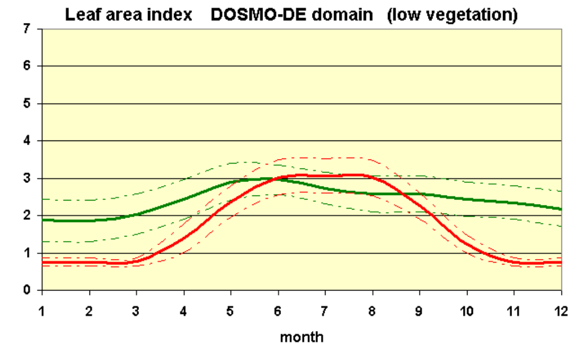
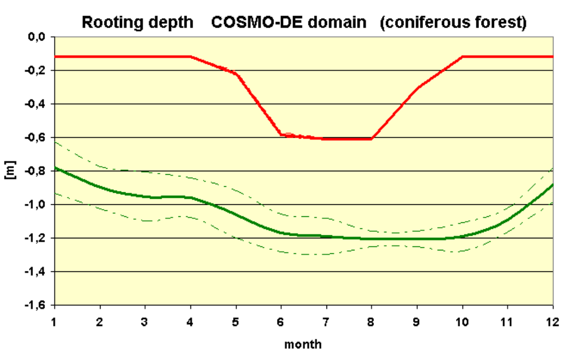
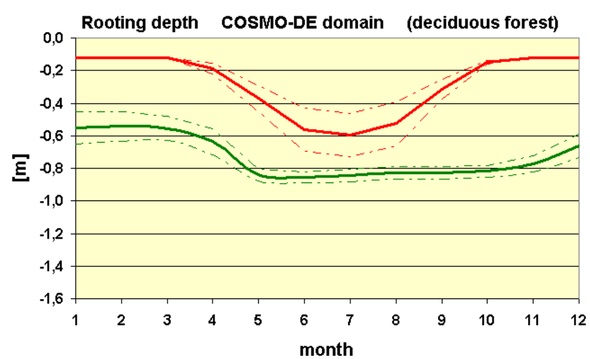


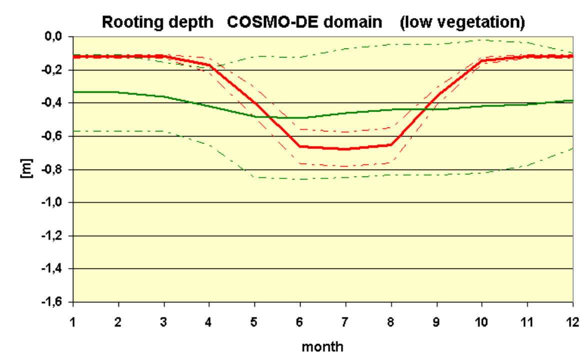




current parameterisation SEAWIFS




current parameterisation Arora and Boer (2003)

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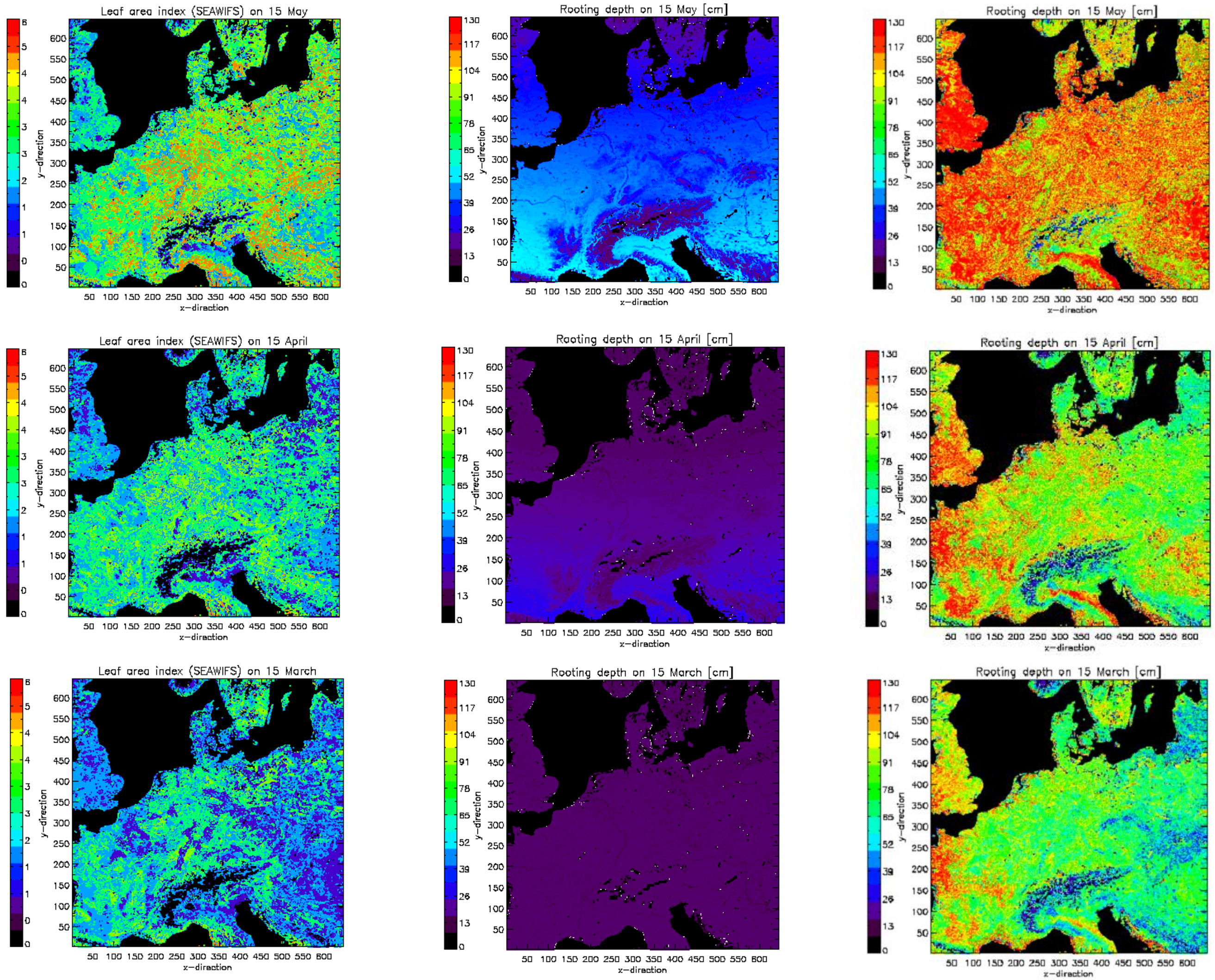
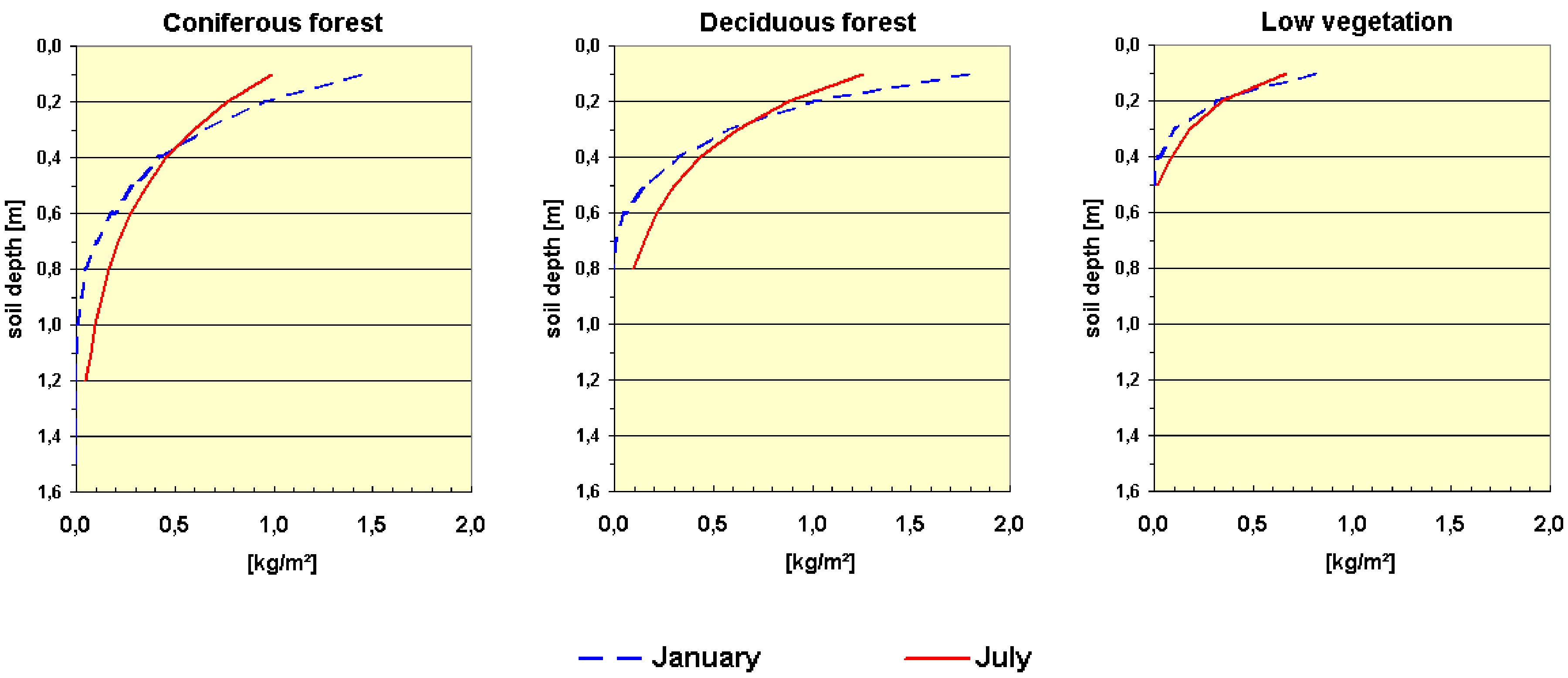
| | LAI | Rooting depth (old) | Rooting depth (new) |
|---|---|---|---|
| 15 May | | | |
| 15 April | | | |
| 15 March | | | |



# Seasonal variation of root biomass



# Conclusions and future works

The use of SEAWIFS-based LAI and plant cover values leads to a serious inconsistency among the external parameters describing the structural vegetation properties if the parameterization of the rooting depth is not likewise updated.

Based on an approach by Arora and Boer (2003) the annual cycle of the rooting depth is made consistent to LAI and plant cover by scaling the total root biomass with the ndvi-ratio.

Moreover, the approach opens the way for a more plant-specific parameterization being of interest for the coming TILE-approach.

The current transpiration scheme of the TERRA module should be adapted to the presented root parameterization. This way, its reliability and usefulness can be verified in more detail.

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# Many thanks for your attention!