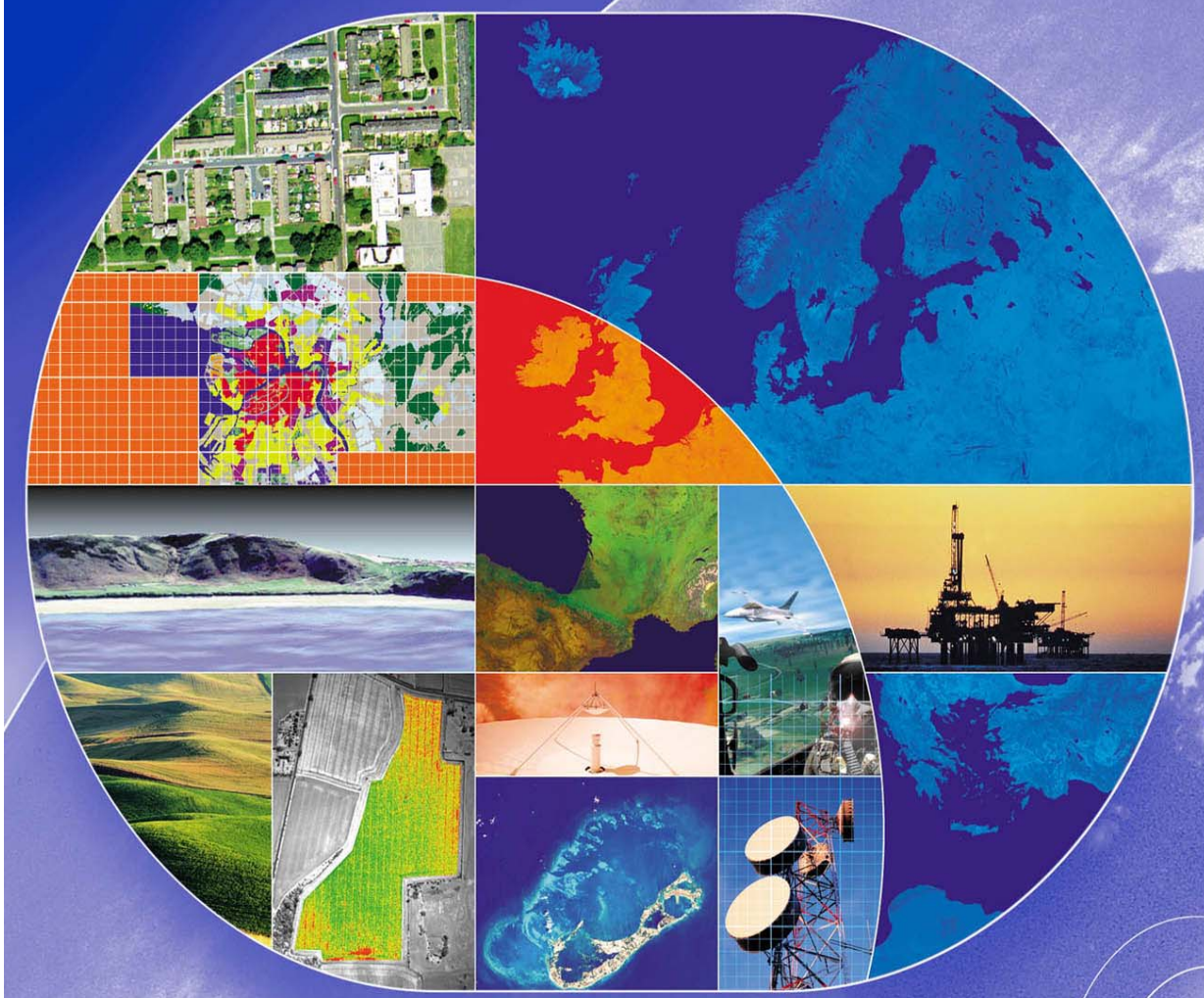


geoland

Observatory of Natural Carbon fluxes

HALO Workshop

Issue I.1.00

Jean-Christophe Calvet
and the
geoland / ONC Team

November 2004

ONC – Observatory of Natural Carbon fluxes

ONC overview

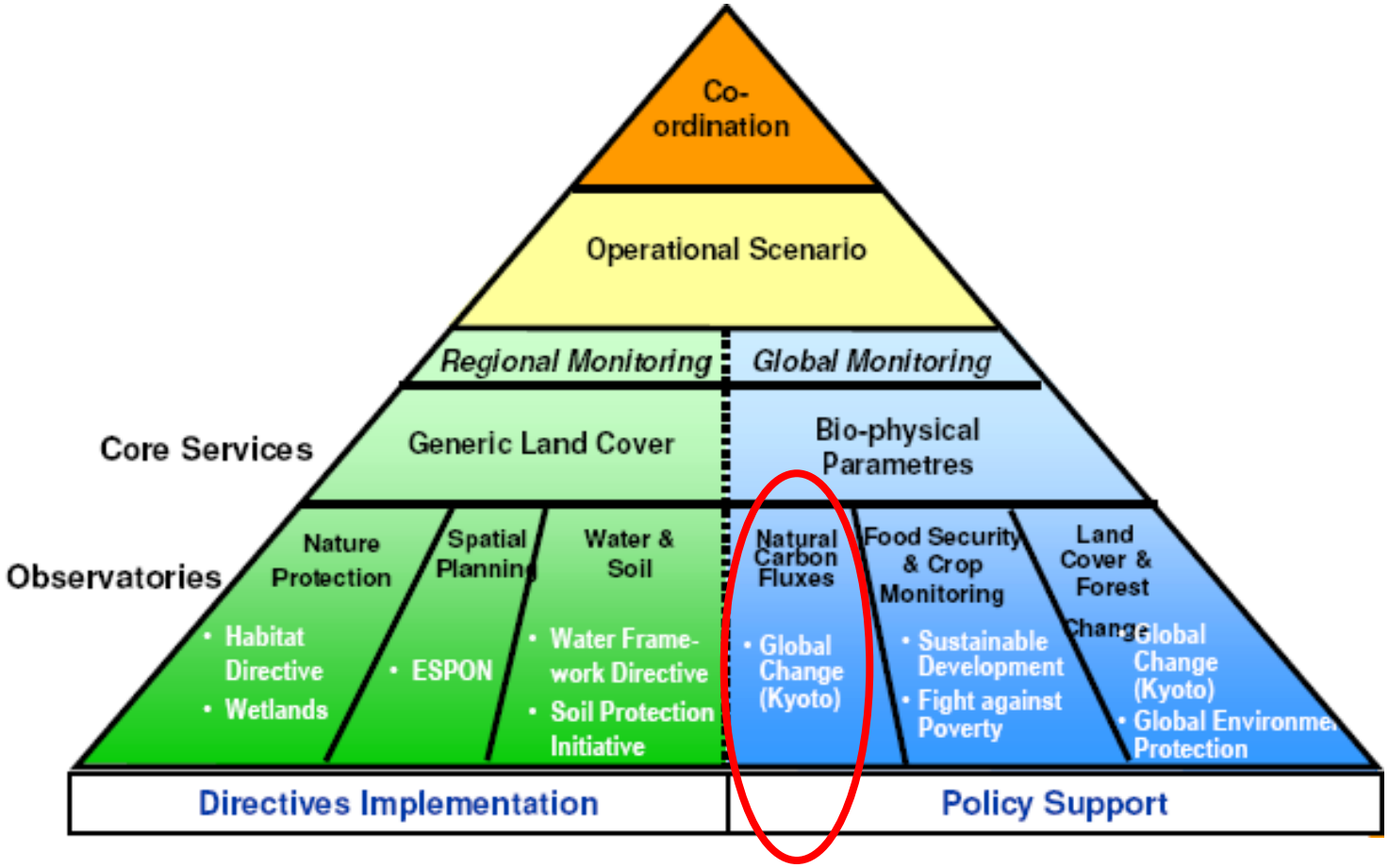
ONC tools

ONC implementation

ONC first results

Conclusions

ONC – Observatory of Natural Carbon fluxes



ONC – Observatory of Natural Carbon fluxes

- **Objectives**
  - Transpose the tools used for weather forecast to the monitoring of vegetation : Real-time monitoring based on modelling, in situ data, RS data assimilation, at the global scale.
  - Validation of the system by using field campaigns.
- **Users**
  - Int'l organisations in charge of assessing the Carbon Balance and consulting political decision makers (IGBP, IGOS-P, PIK, GCP)
- **Policies/Directives**
  - UN Framework Convention on Climate Change
  - Kyoto protocol
- **Product / Service**
  - Global assimilation of RS products in order to monitor water & carbon fluxes on land (downscaling of models to regional scale enabled through higher resolution of input parametres)
  - Linking global models (with high resolution in time) and national Kyoto estimates (cross-validation potential)

Consortium Partners :

• **Research**
LSCE, KNMI, ALTERRA

• **Service Providers :**
ECMWF,
METEO-FRANCE

• **Associated Users**
LSCE

Users
IGBP, IGOS-P, PIK, GCP

ONC – Observatory of Natural Carbon fluxes

❑ Products

- The terrestrial biospheric CO_2 flux at the soil-vegetation-atmosphere interface
- The water flux at the soil-vegetation-atmosphere interface
- The vegetation biomass
- The leaf area index
- The root-zone soil moisture
- The carbon storage.

SPATIAL RESOLUTION: ½ degree

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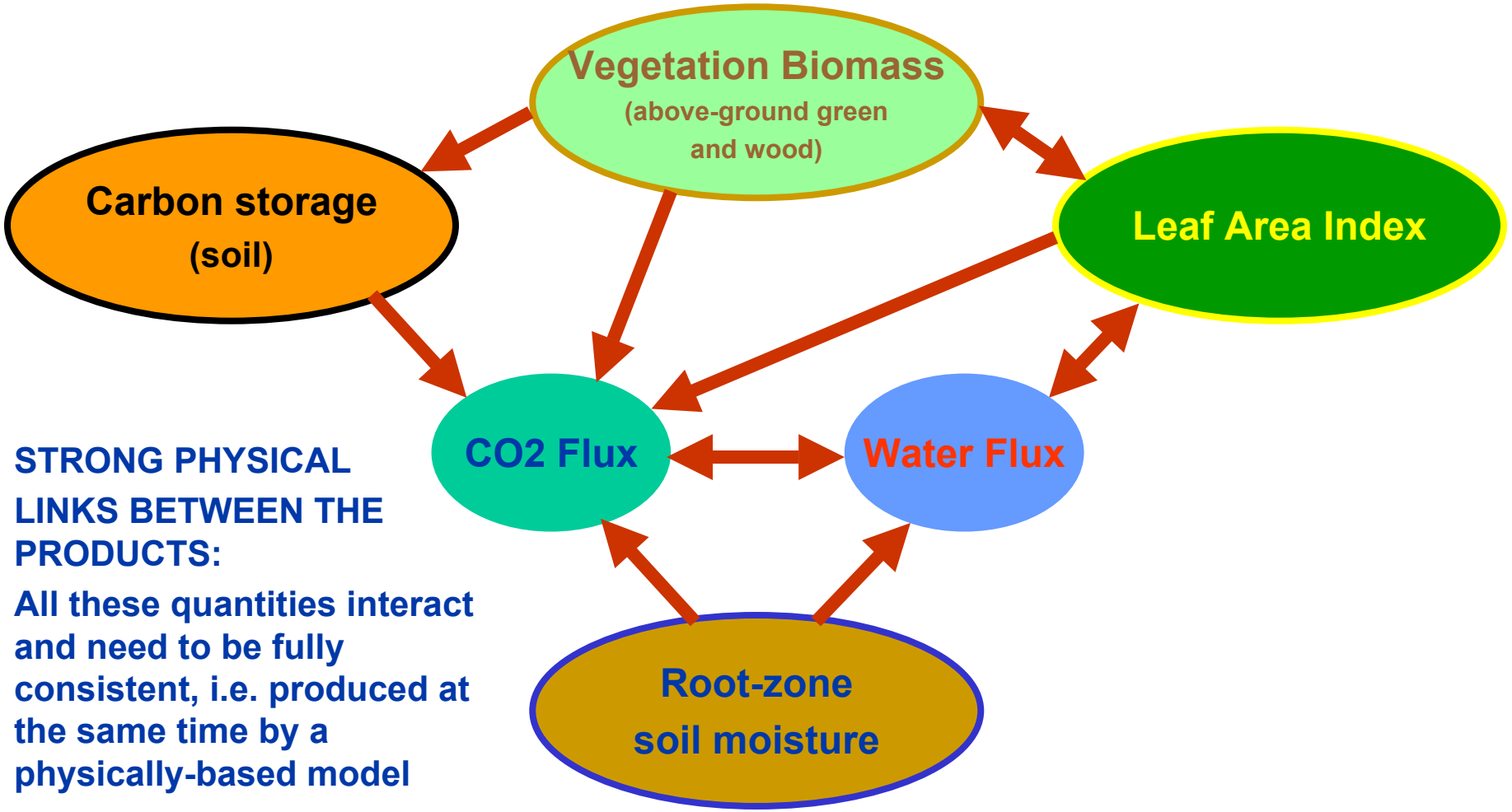

STRONG PHYSICAL LINKS BETWEEN THE PRODUCTS:

All these quantities interact and need to be fully consistent, i.e. produced at the same time by a physically-based model

ONC – Observatory of Natural Carbon fluxes

- **geoland/ONC tentative operational scenario**
  - Near operational global system at ECMWF (2007-)
  - *Longer term: regional system (France, Western Europe?) at Météo-France*
- **Work plan**
  - Start -> 01/2004
  - Model & Assimilation testing (field experiment(s)) -> 03/2005
  - Integration of the assimilation system at ECMWF -> 03/2005
  - Validation of the integrated system -> 04/2006
  - Pre-operational integration -> 12/2006
- **Requirements**
  - Remote sensing products (CSP): LAI, heating rates, surface soil moisture, albedo, precipitation rate, incident radiation,...
  - Atmospheric forcing (ECMWF): air temperature & humidity, wind speed, precipitation rate, incident radiation
- **Links to other GMES-related activities**
  - HALO (SSA): coordinate atmosphere – ocean – land components and prepare the operational GMES (>2007)
  - GMES IPs: GEMS, EURORISK, WATER-IP?

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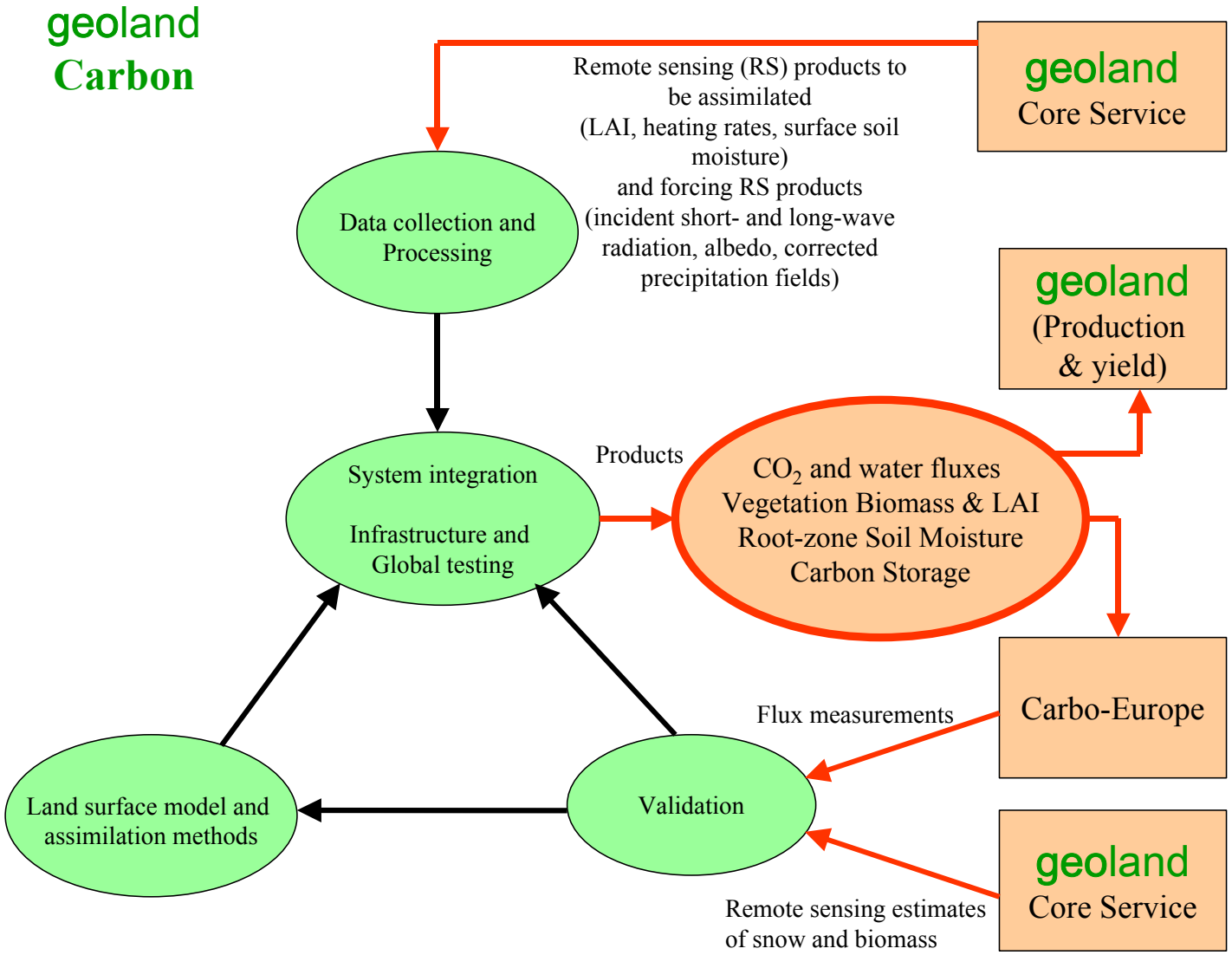

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ISBA-A-gs

geoland

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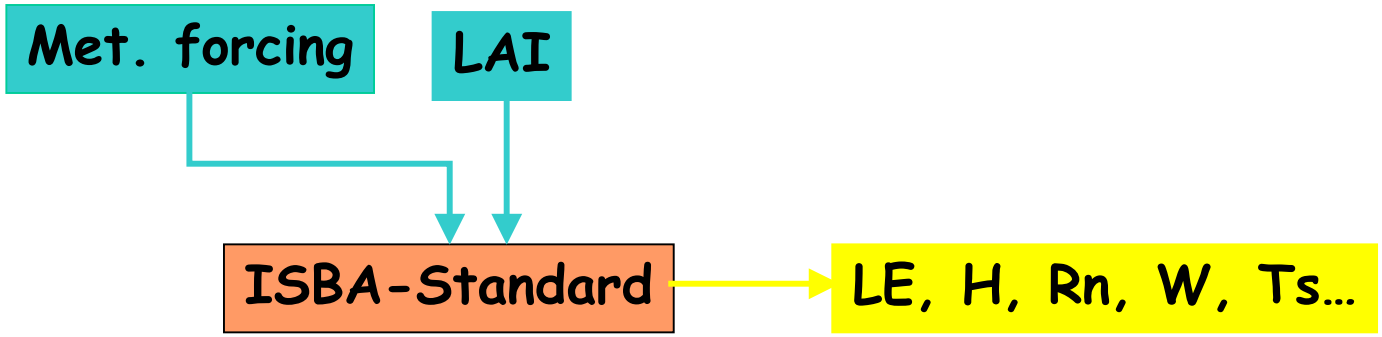

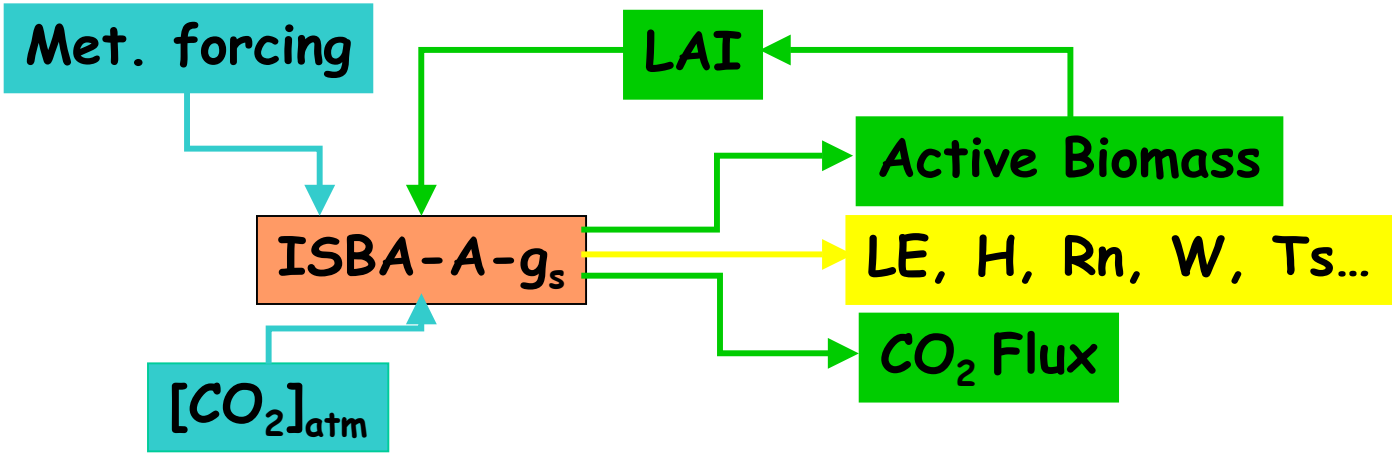

ORCHIDEE

geoland

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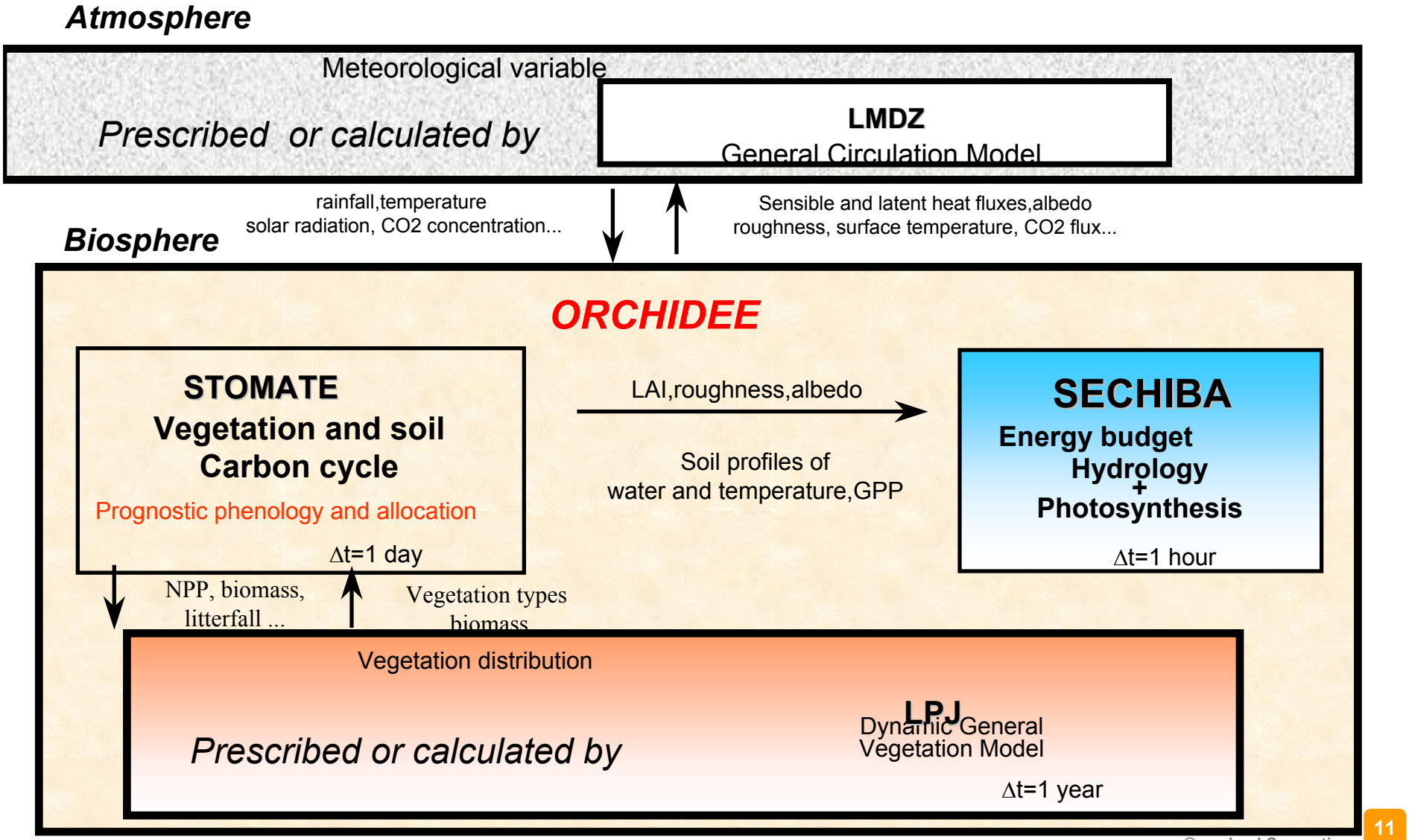

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- **Assimilation of Remote Sensing data**
  - Goal: Reduce the error of the system by using the CSP products
- **Error source**
  - Model
  - Observations
  - Initialisation of (very slow) soil carbon
  - Atmospheric forcing (e.g. precipitation, radiation)
  - Model parameters
  - Land use map
  - Scaling
- **Error reduction by using satellite data**
  - Model -> Bias reduction
  - Atmospheric forcing -> Precipitation + Radiation (CSP products)
  - Model parameters -> Assimilation of CSP products
  - Land use map -> New issues of ECOCLIMAP
  - Scaling -> Tiling

+ analysis of biomass by assimilation of CSP products

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Existing Models

- TESSEL: operational at ECMWF, no photosynthesis, no biomass, no soil carbon, no wood
- ISBA-A-gs: research at Météo-France, photosynthesis, biomass, no soil carbon, no wood
- ORCHIDEE: research at LSCE, photosynthesis, biomass, soil carbon, wood

Modelling objective

- ISBA-A-gs: research at Météo-France, photosynthesis, biomass, soil carbon, wood
- C-TESSEL: operational at ECMWF, photosynthesis, biomass, soil carbon, wood
- Method:

Photosynthesis, biomass	ISBA-A-gs	-> C-TESSEL
Soil carbon, wood	ORCHIDEE	-> ISBA-A-gs
Photosynthesis, biomass, soil carbon, wood	ISBA-A-gs	-> C-TESSEL

ONC – Observatory of Natural Carbon fluxes

- **Methods integration & testing (WP6310)**
  - Leader: Bart van den Hurk (KNMI)
  - Models
  - Assimilation methods
- **System integration & infrastructure (WP6320)**
  - Leader: Pedro Viterbo (ECMWF)
  - Data collection & modelling
  - Integration of the assimilation system
  - Pre-operational integration
- **Validation of the integrated system (WP6120)**
  - Leader: Eddy Moors (ALTERRA)
  - Validation Methods
  - Link with other projects (e.g. CarboEurope, CarboInvent)

ONC – Observatory of Natural Carbon fluxes

FIRST 18 months	WP 6310	WP 6320
Title	**Methods integration**	**Processing line**
Leader	**Bart van den Hurk (KNMI)**	**Pedro Viterbo (ECMWF)**
Staff	**Voogt** (KNMI) **Jarlan**, Gibelin, Munoz (METEO-F) Viovy (LSCE)	**Lafont** (ECMWF) **Demarty** (LSCE) Gibelin (METEO-F)
Contributors	ECMWF (Tessel) METEO-F (ISBA-A-gs) LSCE (Orchidee) ALTERRA (validation)	LSCE (assimilation into Orchidee) METEO-F (help implementation of C-Tessel, interface with CSP)
Objectives	Update Tessel Test 0D & 2D Test Assimilation	Implementation and testing of a near-operational assimilation system at a global scale
Products	C-Tessel	Software for assimilation
Maturity	Tessel, Isba-A-gs, Orchidee run at a global scale	Assimilation of Ta & qa already operational, ELDAS
Challenges	C-Tessel >= Tessel ?	Quality of forcing & RS products

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❑ Parameters of ISBA-A-gs at a global scale

Vegetation type	$g_m^\star(mm/s)$	$\tau_M(j)$	$f_0^\star$	$D_{max}^\star(g\,kg^{-1})$	$g_c\,(mm/s)$	$e(m^2\,kg^{-1}\%^{-1})$	$f(m^2\,kg^{-1})$	$N_L\,(\%)$
C3 Crops	0.58	60	0.95	121	0.25	3.79	9.84	3.3
C4 crops	3.1	60	0.6	109	0.15	7.68	-4.33	1.9
Irrigated C4 crops	3.1	60	0.6	109	0.15	7.68	-4.33	1.9
C3 grasslands	0.58	90	0.95	121	0.25	5.56	6.73	2.4
C4 grasslands	3.1	90	0.6	109	0.15	7.68	-4.33	1.9
Irrigated C3 crops	0.58	90	0.95	121	0.25	5.56	6.73	2.4
Coniferous forests	1.8	365	0.59	128	0	4.85	-0.24	1.5
Evergreen forests	3.3	365	0.5	105	0.15	4.83	2.53	1.2
Deciduous forests	3.	230	0.51	109	0.15	4.83	2.53	2.4

Mesophyll conductance

Max leaf time span

Other Photosynthesis parameters

N Plasticity parameters

Leaf N

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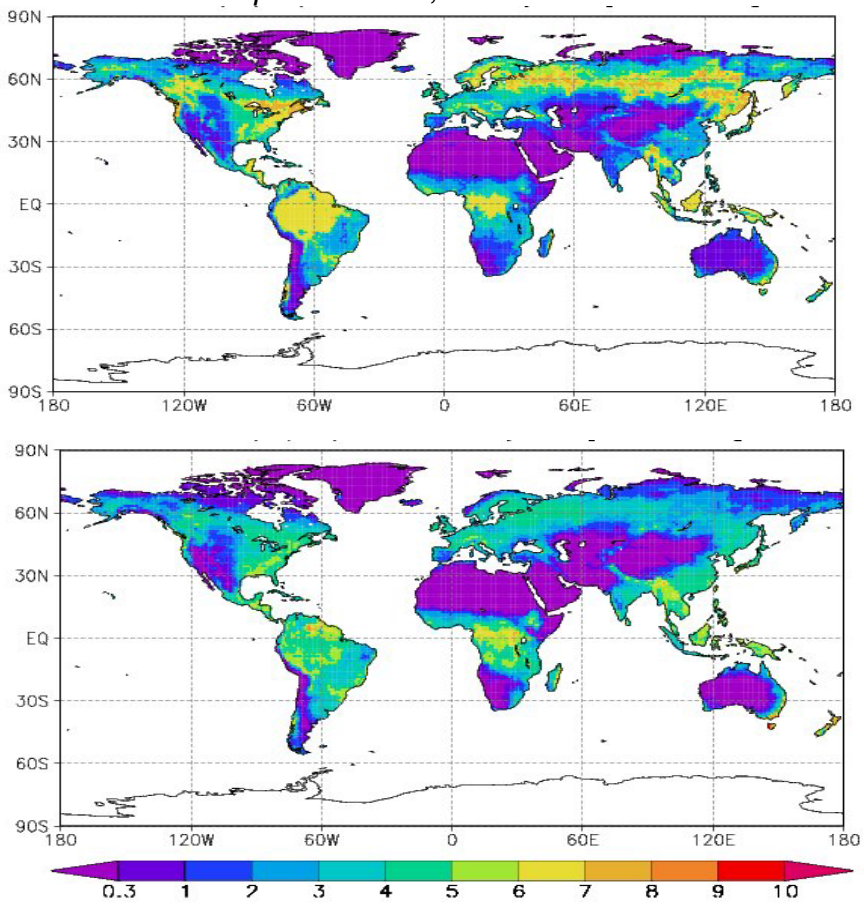
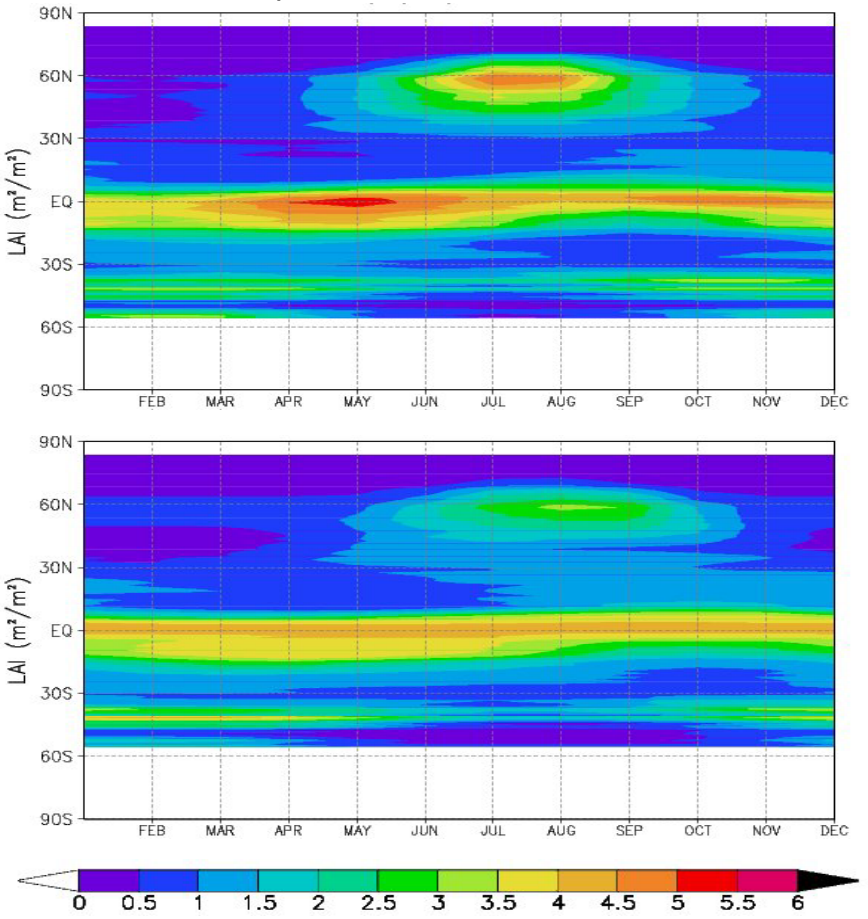
❑ Global LAI simulations with ISBA-A-gs (offline)

Yearly Maximum of LAI (mean 1986-1995)
Top: ISLSCP2 ; Down: Model.



Monthly zonal LAI (mean 1986-1995)
Top: ISLSCP2 ; Down: Model



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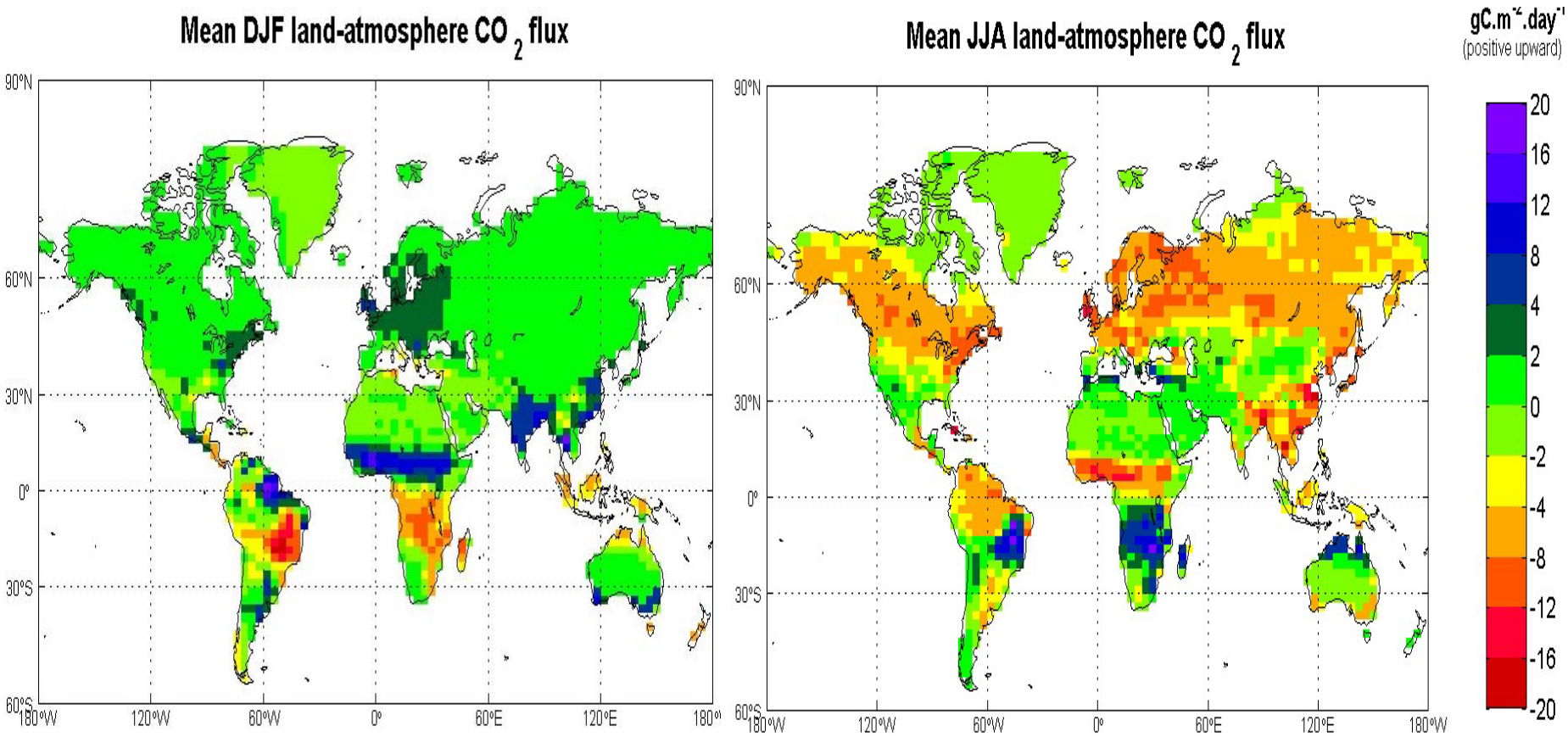
- Global CO_2 flux simulations with ORCHIDEE



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ONC – Observatory of Natural Carbon fluxes

- **Main goal of geoland/ONC**
  - The main objective of ONC is to build a GMES near-operational service at ECMWF

- **ONC will build on past research projects and existing expertise**
  - Modeling: TESSEL, ISBA-A-gs, ORCHIDEE (ECMWF, Météo-France, LSCE)
  - Assimilation: ELDAS (FP5)
  - Mapping & tiling: ECOCLIMAP (Météo-France)

- **Transpose ONC at the regional scale?**
  - Probably a post-geoland objective