The role of forests in addressing Climate Change in the Mediterranean

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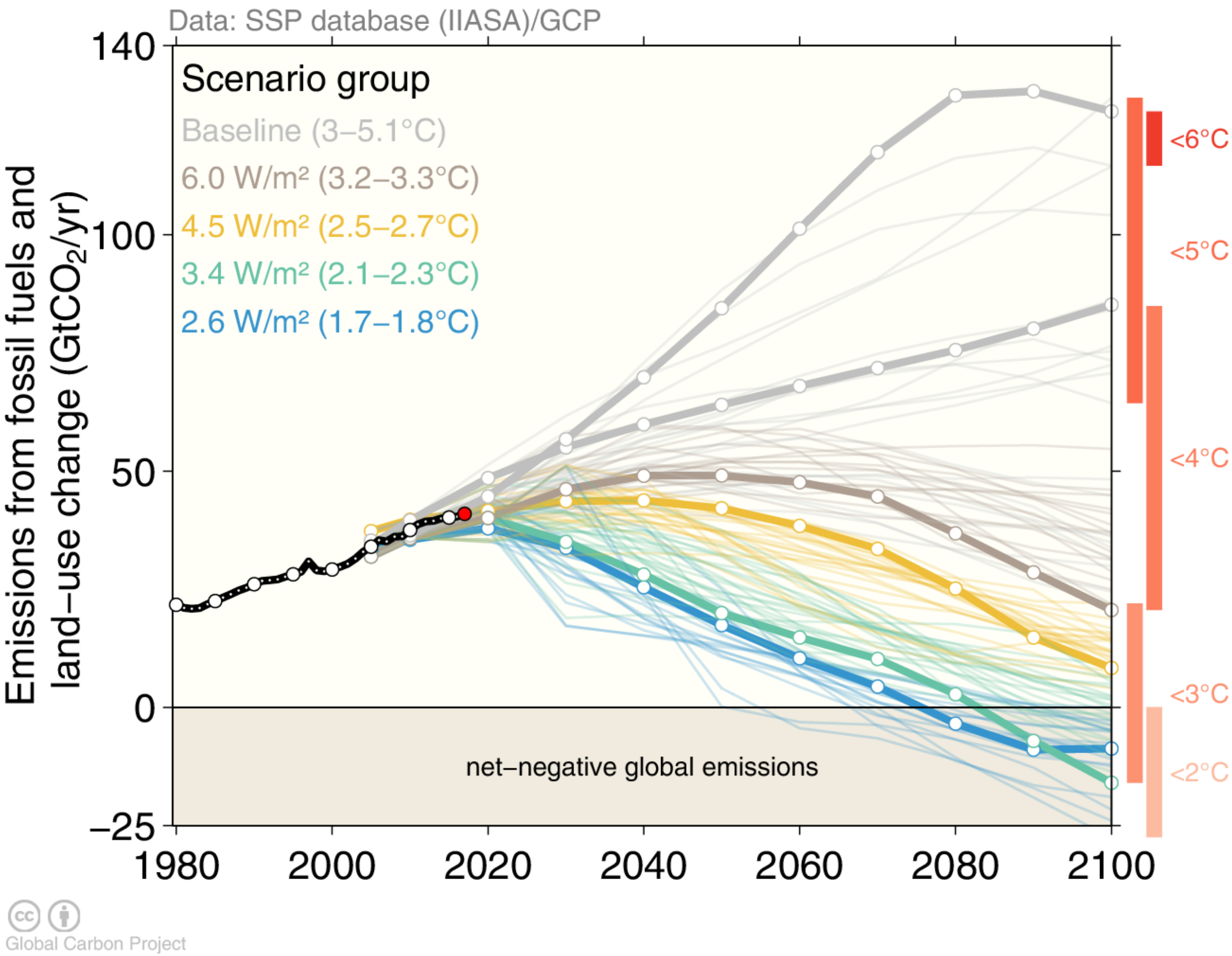
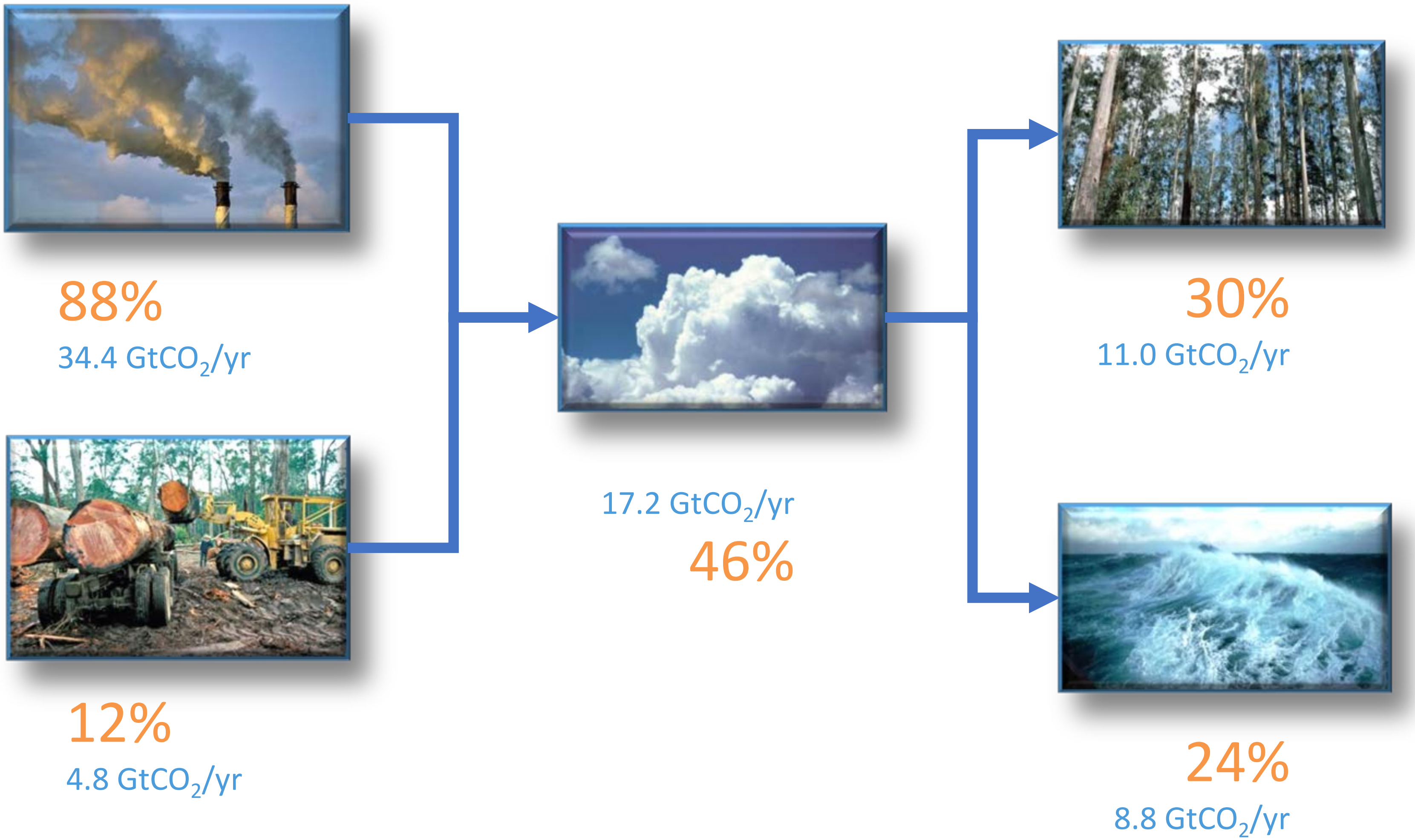
The future of Climate Scenarios

In the lead up to the IPCC's Sixth Assessment Report new scenarios have been developed to more systematically explore key uncertainties in future socioeconomic developments



Five Shared Socioeconomic Pathways (SSPs) have been developed to explore challenges to adaptation and mitigation.
Shared Policy Assumptions (SPAs) are used to achieve target forcing levels (W/m²). Marker Scenarios are indicated.
Source: Riahi et al. 2016; IIASA SSP Database; Global Carbon Budget 2017

Fate of anthropogenic CO_2 emissions (2007–2016)

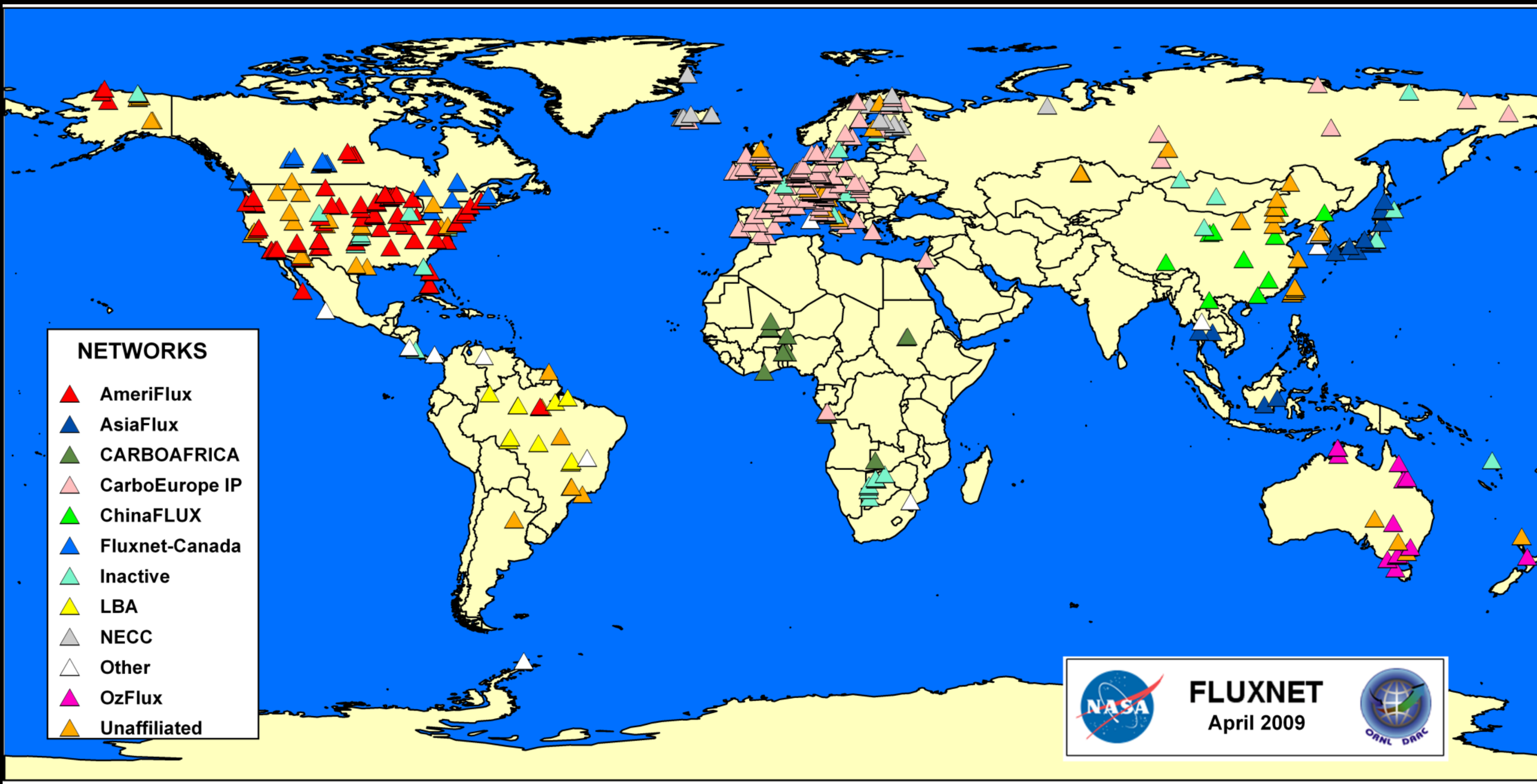


Budget Imbalance:
(the difference between estimated sources & sinks)

6%
2.2 $GtCO_2/yr$

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Le Quéré et al 2017; Global Carbon Budget 2017

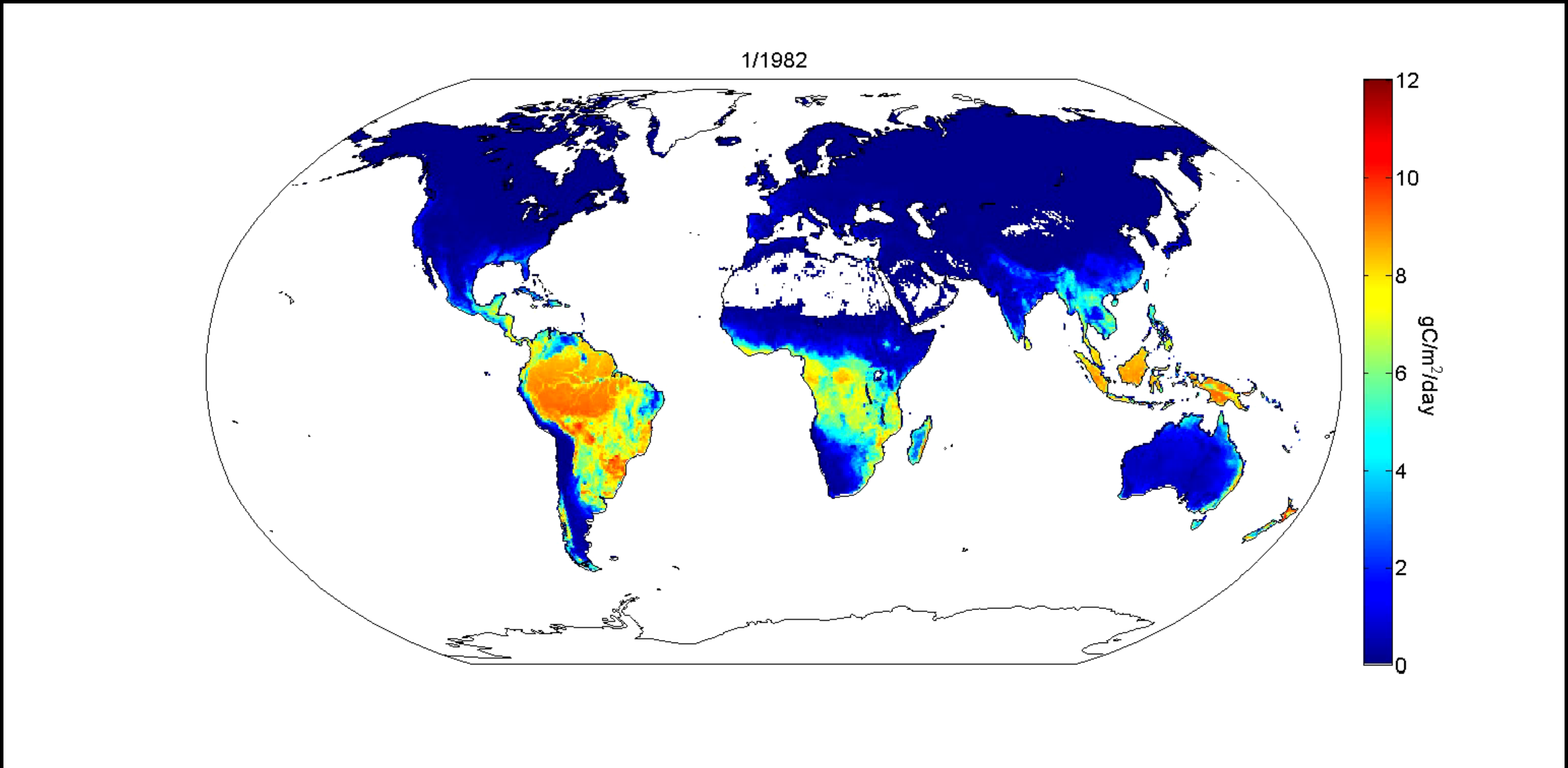
FLUXNET: A Global Network of Observation Sites
500+ Sites, 10 Regional Networks, 45 Countries



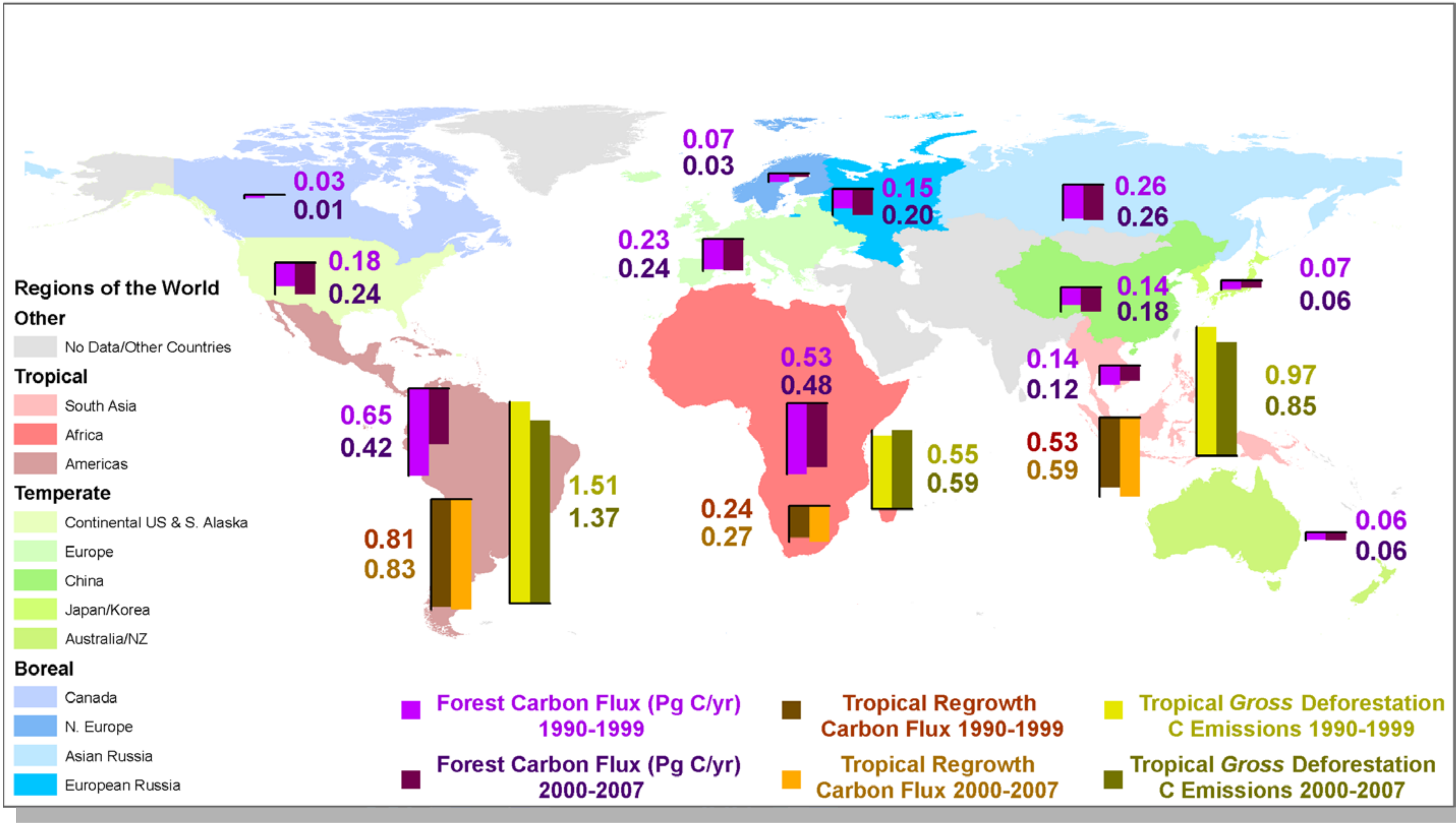
Quantify and understand causes of variation in terrestrial exchange of carbon, water and energy with atmosphere

www.fluxdata.org

First global GPP estimate by FLUXNET (Beer et al. 2010) (123±8 Pg Cy^{-1})



Large and Consistent Global Forest Carbon Sink



Pan et al. 2011, Science

Global Forest Carbon Balance, 2000-2007

Forest land

Biome	(Pg C yr^{-1})
Boreal	0.5 ± 0.1
Temperate	0.8 ± 0.1
Tropical (intact)	1.0 ± 0.5
Total	2.3 ± 0.5

LUC in tropics

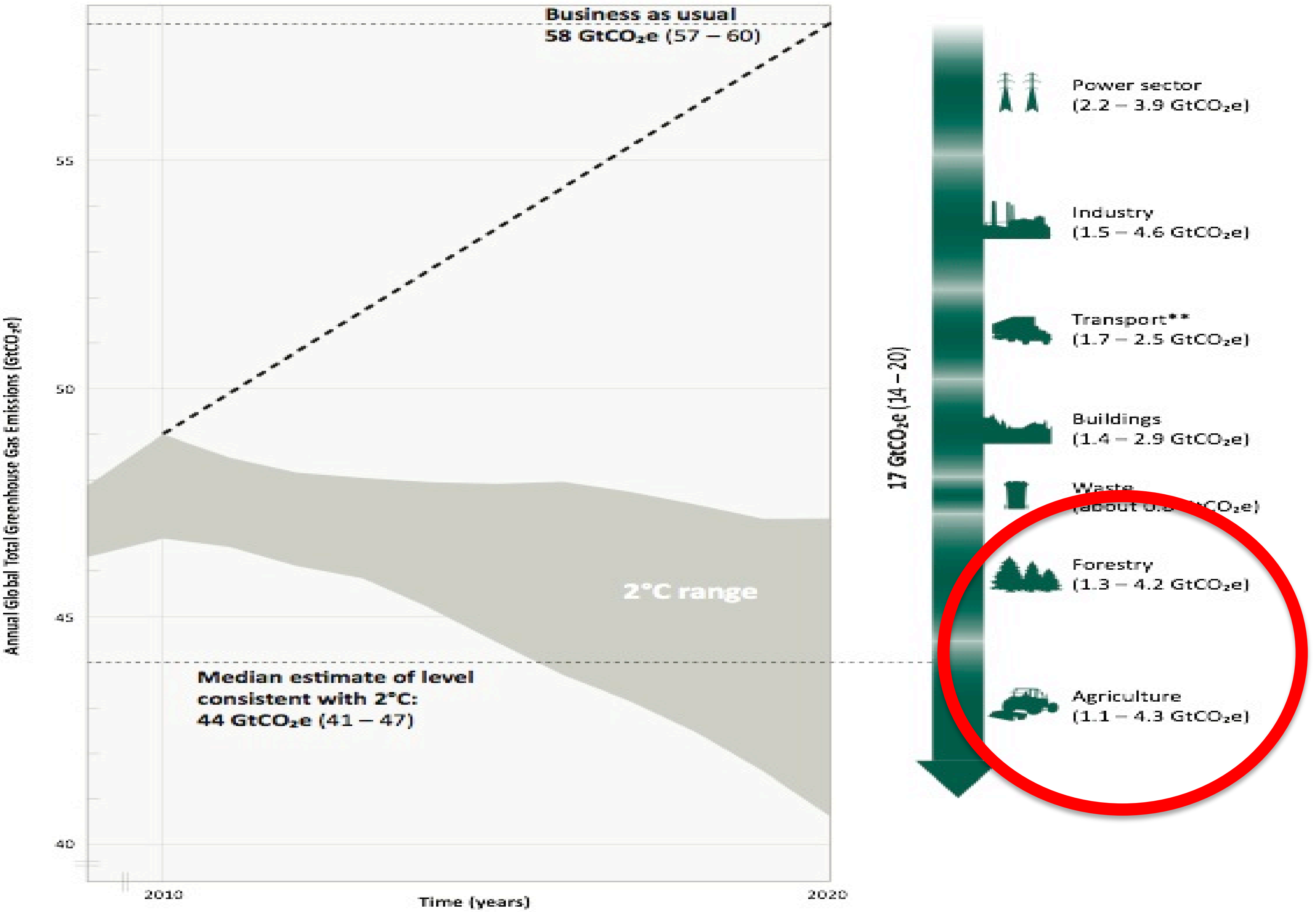
Land class	(Pg C yr^{-1})
Deforestation emissions	-2.8 ± 0.5
Regrowth (after LUC)	1.7 ± 0.5
Total	-1.1 ± 0.7

1.3 Pg C yr^{-1}

-0.1 Pg C yr^{-1}

Global *net* forest sink = 1.2 ± 0.9
(Net sinks in temperate and boreal zones)

How to bridge the gap: results from sectoral policy analysis*



*based on results from Bridging the Emissions Gap Report 2011
**including shipping and aviation

Achieving 2°C target

BECCS (Biomass Energy with Capture and Storage)

3.3. Gt C y-1 170 EJ y-1   (30% of fossil fuel emissions)
Cumulative 160 GtC by 2100
380-700 Mha of land = 50 % present cropland

Forest based land mitigation

0.6 – 2 GtC y-1
>320 Mha new forests

Mediterranean forests Area = **85 M ha** (2% of world forest area)

Mediterranean forest growing stock = 9623 million m3 ≈ **5 Gt C**

Mediterranean forest carbon sequestration (biomass)@1990-2010 ≈ **0.06 Gt C y-1**

Mediterranean GHG emissions@2010 = 2,487 Mt CO2eq Forest sink ≈ **9% emissions**

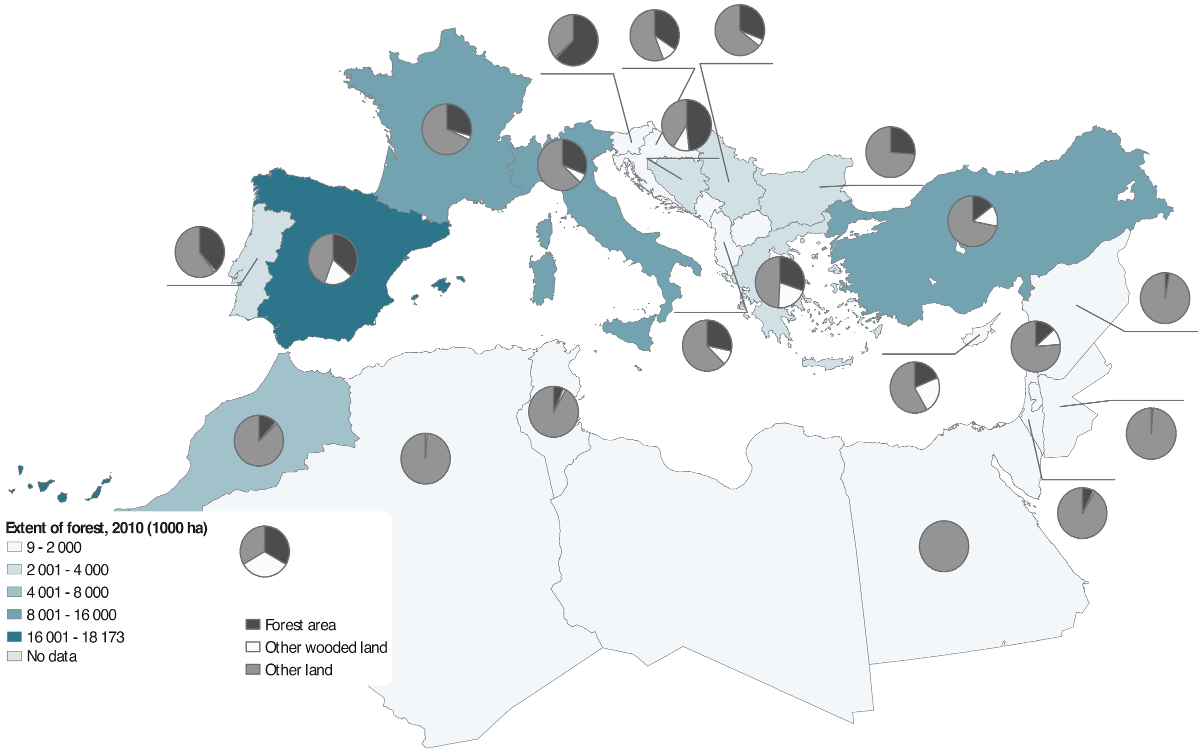


Figure 2.1. Extent of forest area in Mediterranean countries, 2010
Source: FAO, 2010b.

Increased carbon sequestration by land use management in Mediterranean forest

(Ruiz-Peinado et al. 2017)
(Munoz-Rojas et al. 2016)

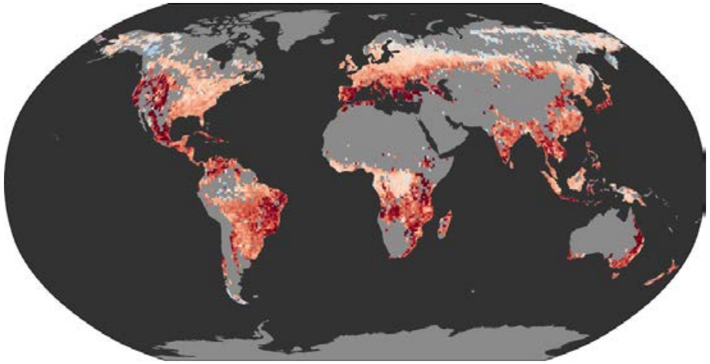
Thinning
(light versus unthinned/heavily thinned) **5-10% C ha-1**

Extending rotation period (20-30 y) **6-37% C ha-1**

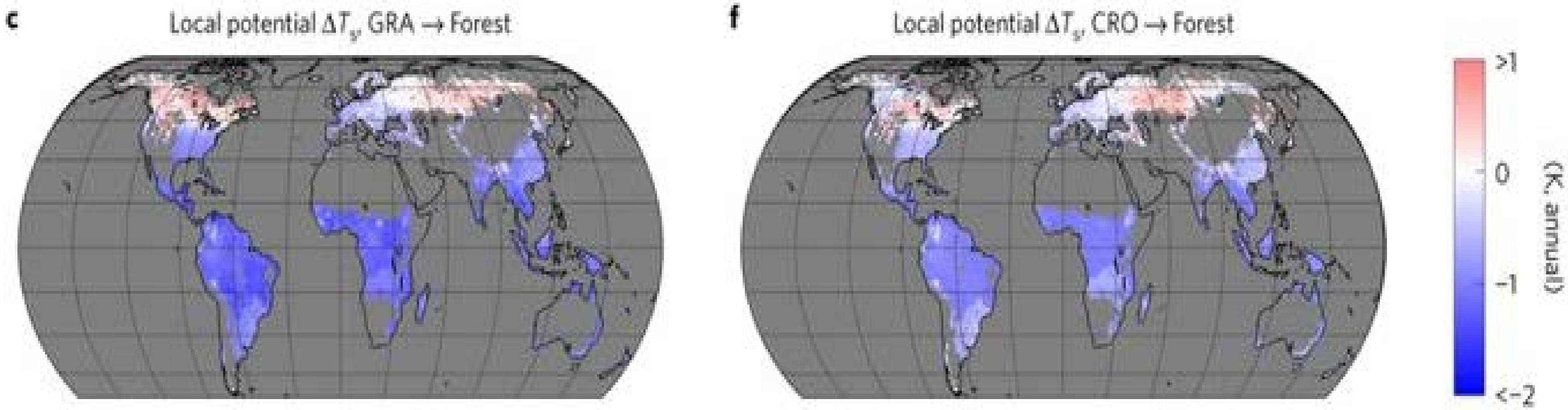
Soil carbon changes
(reforestation/afforestation) **-10 + 45% C ha-1**

Climate effects of deforestation (Cooling or Heating ?) *Duveiller et al. 2018*

ΔT= $0.23 \pm 0.03°C$
(2000-2015)



The impact of Reforestation – non radiative cooling effects at low latitude
(Bright et al. 2017)



The Mediterranean – a specific case

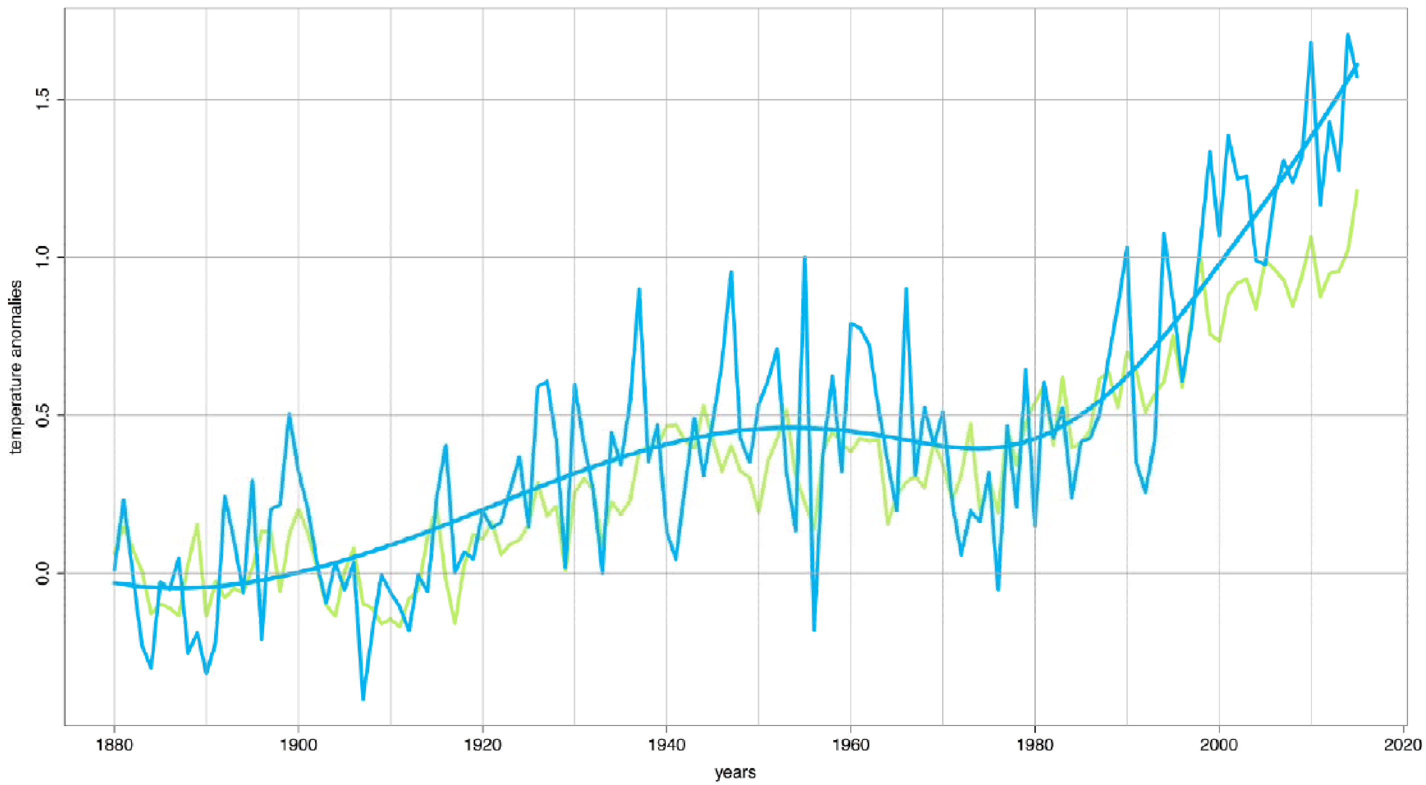
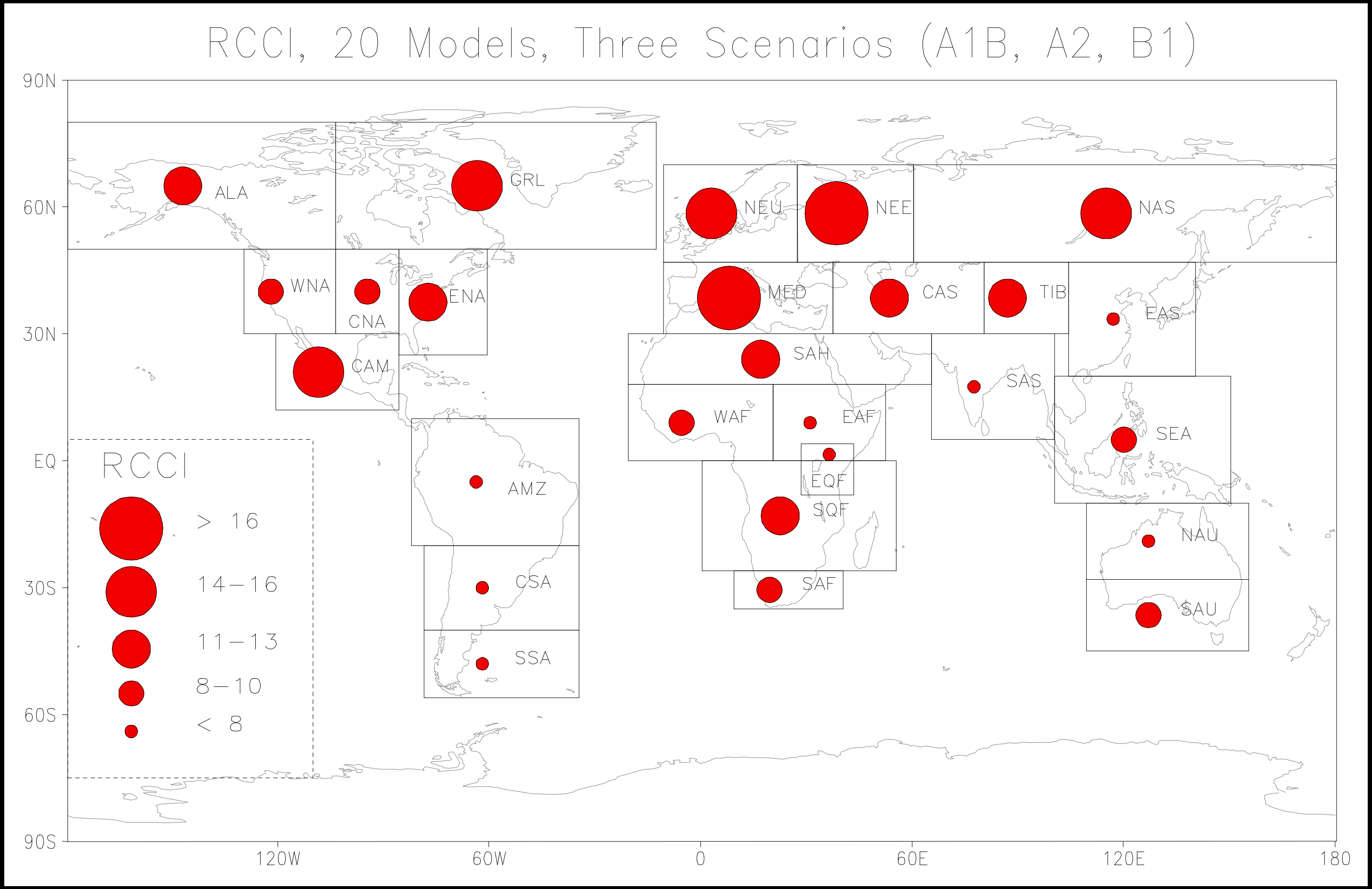
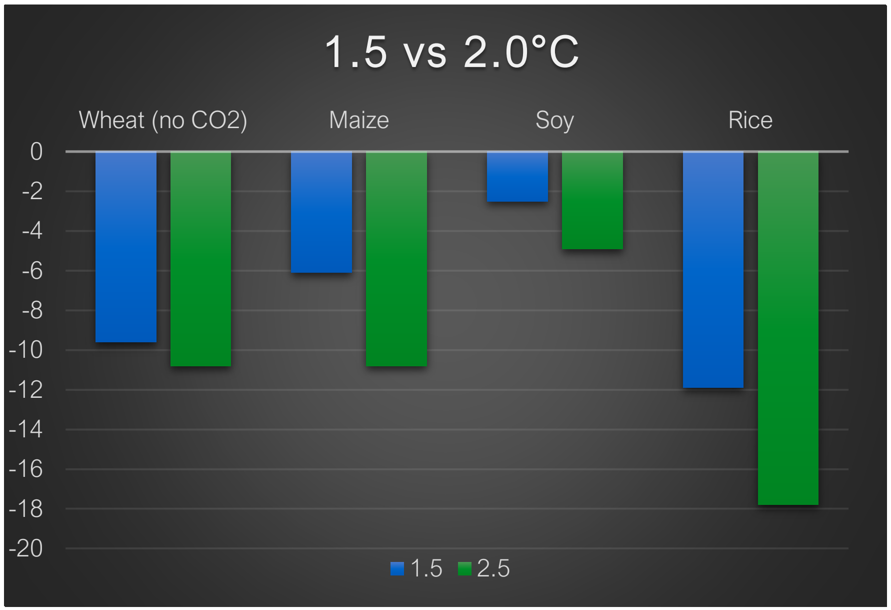


Figure S.1.
Historic warming of the atmosphere (annual mean temperature anomalies with respect to the period 1880-1899), in the Mediterranean Basin (blue lines, with and without smoothing) and for the globe (green line). Data from Berkeley Earth available at http://berkeleyearth.org/

Mediterranean - a hot-spot of climate change - hotter, dryer



1.5 versus 2.0 °C in Mediterranean region



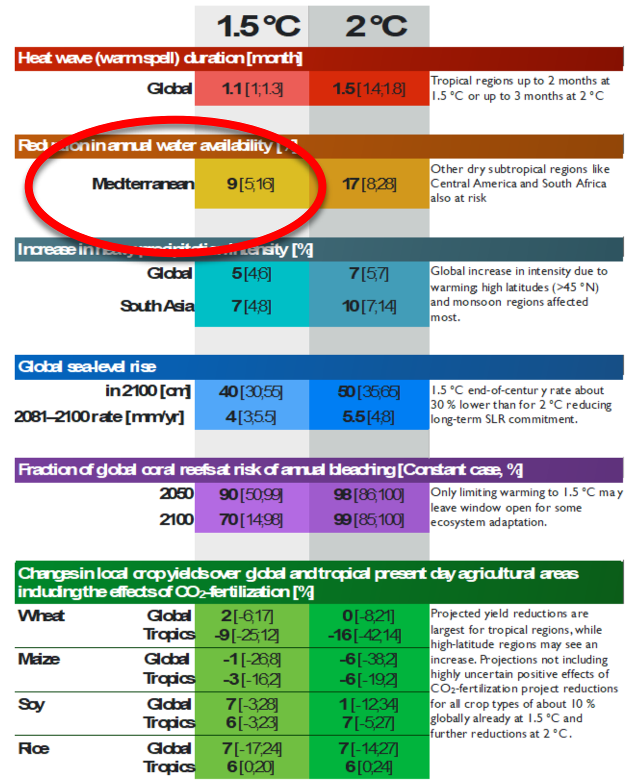
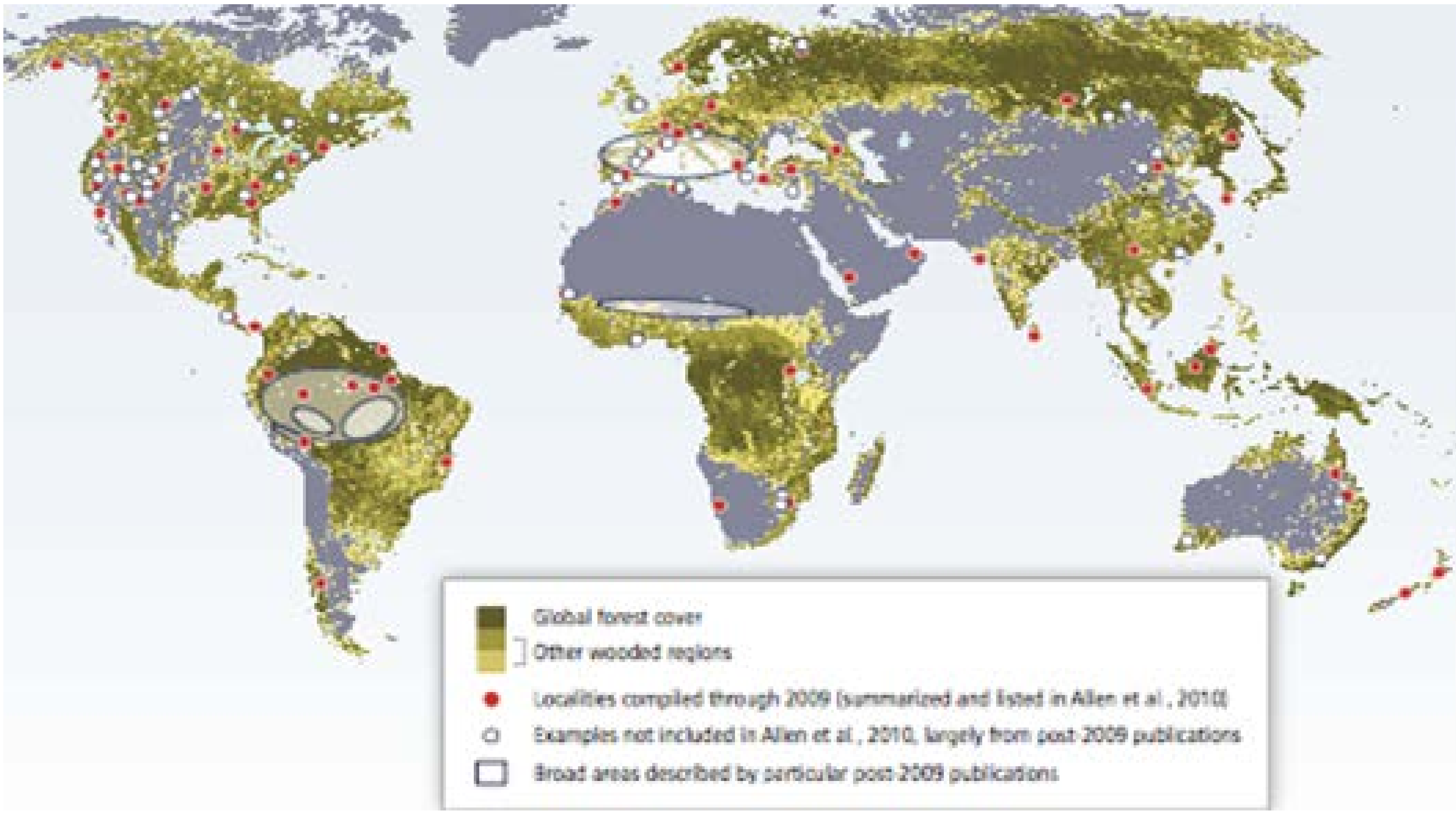


Figure 15. Summary of key differences in climate impacts between a warming of 1.5 °C and 2 °C above pre-industrial and stylized 1.5 °C and 2 °C scenarios over the 21st century. Square brackets give the likely (66 %) range.

Global Tree Mortality : Climate Risk?



Are pest and diseases a threat to carbon mitigation potential ?

Table 3 Equilibrium C cycle effects of a potential invasive alien disturbance regime compared to the natural disturbance regime in Europe

		Current climate (Tg C)	Future climate (Tg C)
Invasive alien disturbance regime	ALB—Asian Long-horned Beetle	246.0	252.0
	PWN—Pine Wood Nematode	188.4	291.2
	SOD—Sudden Oak Death	9.0	32.7
	BBC—Beech Bleeding Canker	5.7	11.7
	PPC—Pitch Pine Canker	10.4	46.5
	All	308.7	392.6
Natural disturbance regime	Wind, native bark beetles, and wildfires	319.8	503.4

Values indicate the long-term reduction of total ecosystem C storage capacity in Europe's forests due to disturbance (Tg C). For invasive alien pests, the implementation of effective pest management measures is considered under both current climate (1950–2000) and future climate (RCP 4.5, 2030–2080), as also natural disturbance risk is commonly managed in Europe's forests. Values for the natural disturbance regime of Europe are taken from Seidl et al.[6] and refer to observations for 1971–2010 (current climate) and the median projection for an ensemble of 12 climate change scenarios for 2021–2030. Please note that, while methodologically similar, the reference periods and climate scenarios differ between the assessments of invasive alien and natural disturbance regimes. All: upper bound of the equilibrium C cycle effect from all five invasive alien pests jointly

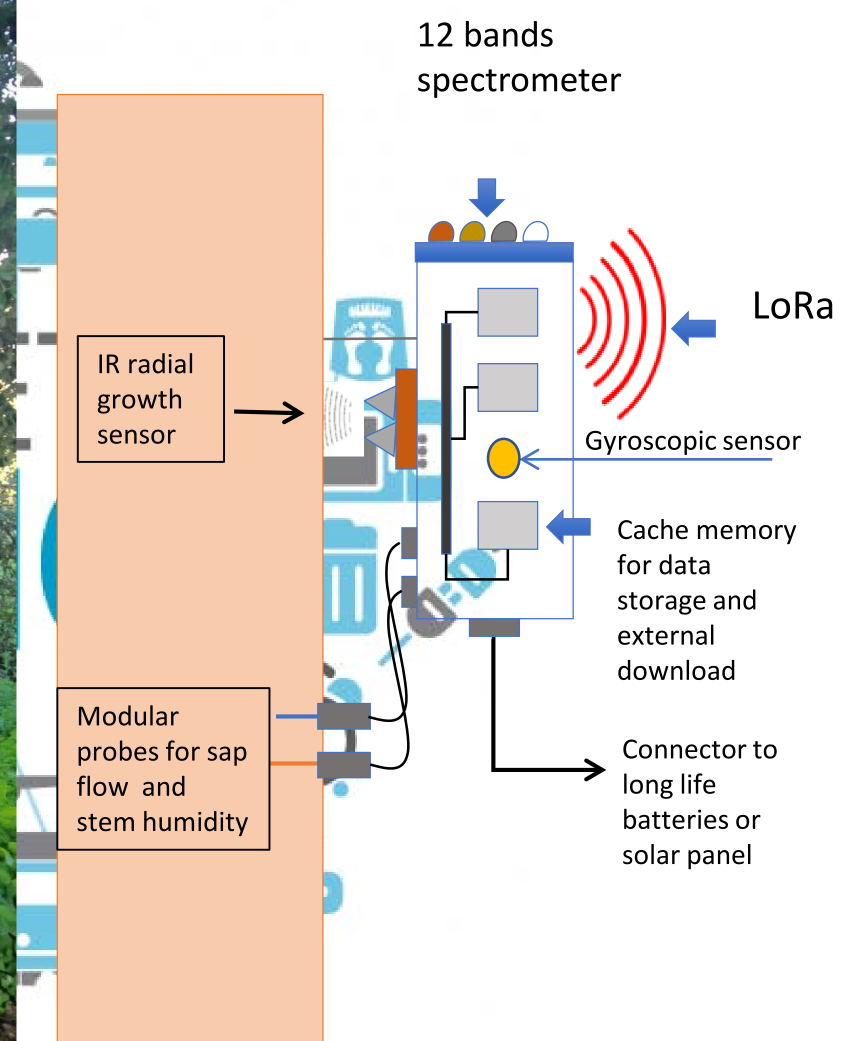
Moving forward forest monitoring

Can we monitor all ?

IoT – Big Data Analytics

The TreeTalker Project

| Revolution



The TreeTalker concept

- **Water transport inside the plant**
- **Diameter growth**
- **Foliage Health (light transmission in 12 spectral bands)**
- **Climate and soil parameters (temperature, humidity).**
- **Tree stability with gyroscopic sensor**
- **Air temperature and humidity**
- **Soil temperature and humidity**

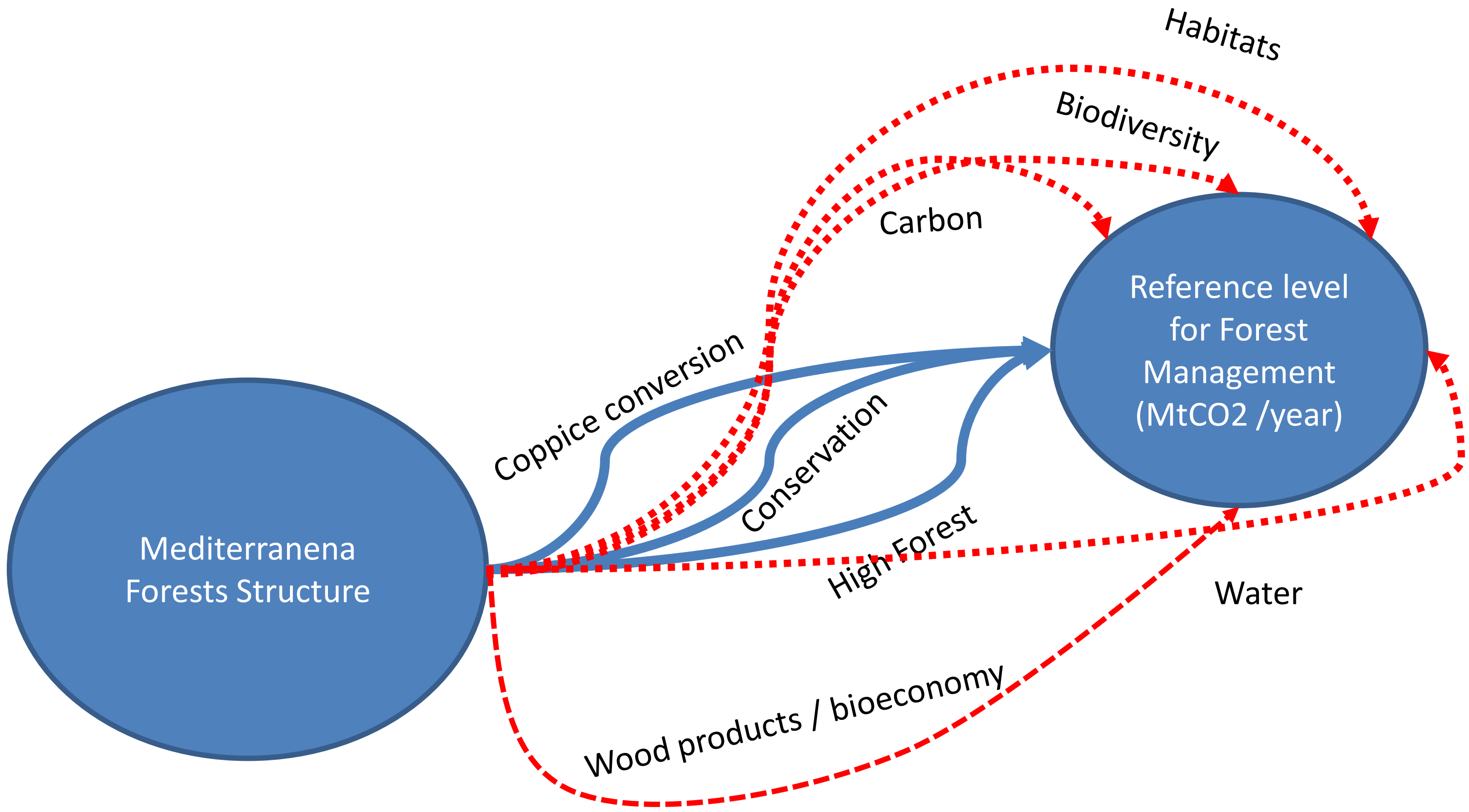
The TreeTalker is *connected wireless* (using powerful low power chipset LoRa or SIG-FOX) *to a node managed by another microcontroller (***TT-CLOUD***)* serving up to 48 devices in one cluster (we suggest 20 to avoid data collision) .

The **TT-CLOUD** is then connected via modem to a GPRS network and internet connected to a computer server.

The TreeTalker is running with high efficient Li-Io batteries and solar panels. Depending from application it can run from **1 month** to **1 year**, depending on solar availability**.**

CONCLUSIONS 1/2

Mediterranean Forests Climate Pathways



CONCLUSIONS 2/2

1. Land based mitigation potential is fundamental for achieving the 2 and even more 1.5 ° C targets but we cannot ask more to land – <u>decarbonization still needed !</u>

2. Mediterranean forests have a large mitigation potential due to soil accumulation and biomass growth

3. Additional climate benefits are shown for non – radiative cooling of afforestation/reforestation in Mediterranean region

4. Lack of integrated pan- Mediterranean studies for mitigation potential including wood products and energy substitution

5. We need a rapid deployment of IoT technologies in the forestry sector (Nature 4.0)

3. The reaching of reference level in GHG accounting (EU directive and beyond) is a great opportunity for designing a "new Mediterranean forest sustainable pathways".