The climate impact of forestry extends beyond its carbon budget

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Article 2

Article 5

Article 7

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Holding the increase in the global average temperature to well below 2 °C above pre-industrial [...], recognizing that this would significantly reduce the risks and impacts of climate change.

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Article 7

Paris Agreement

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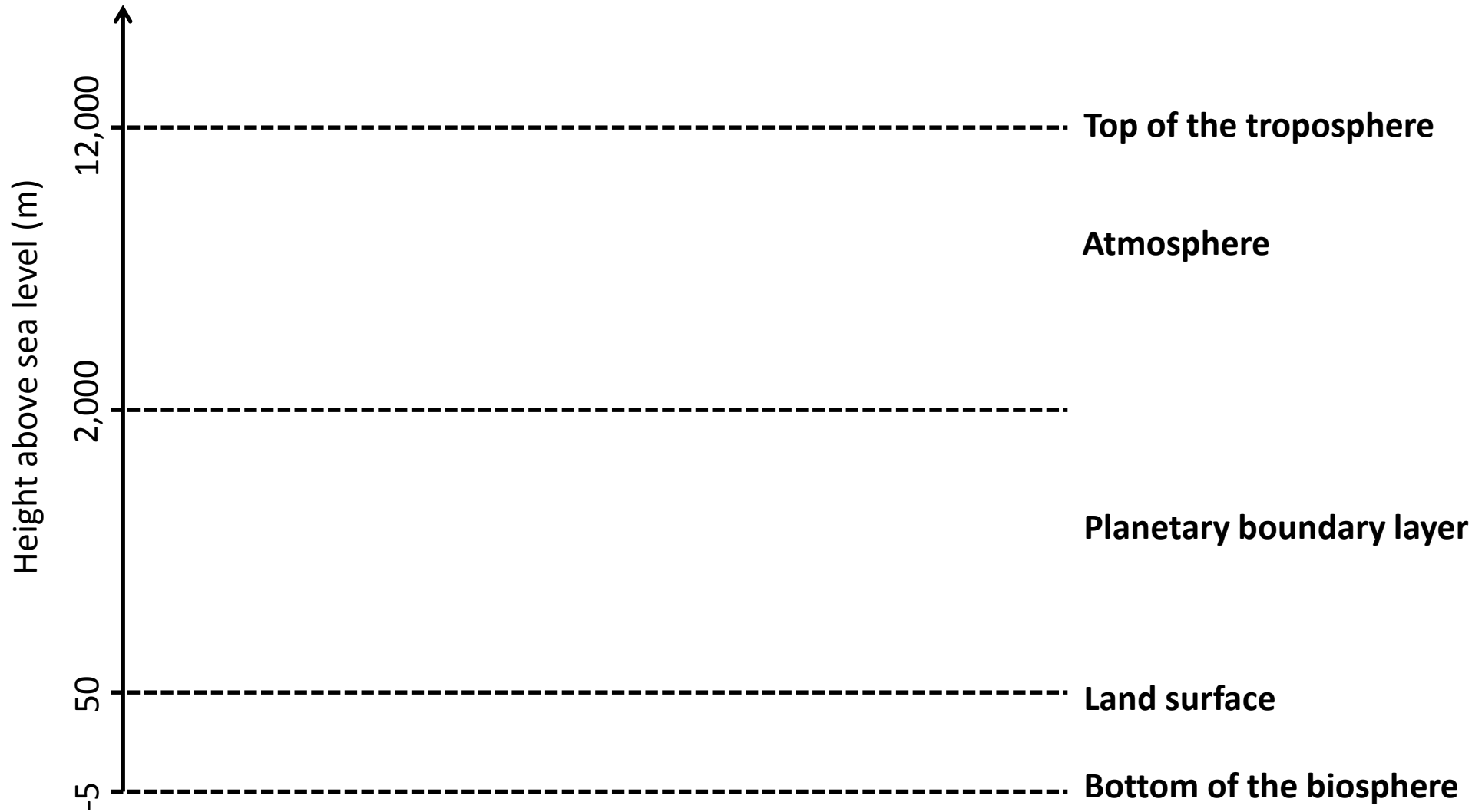
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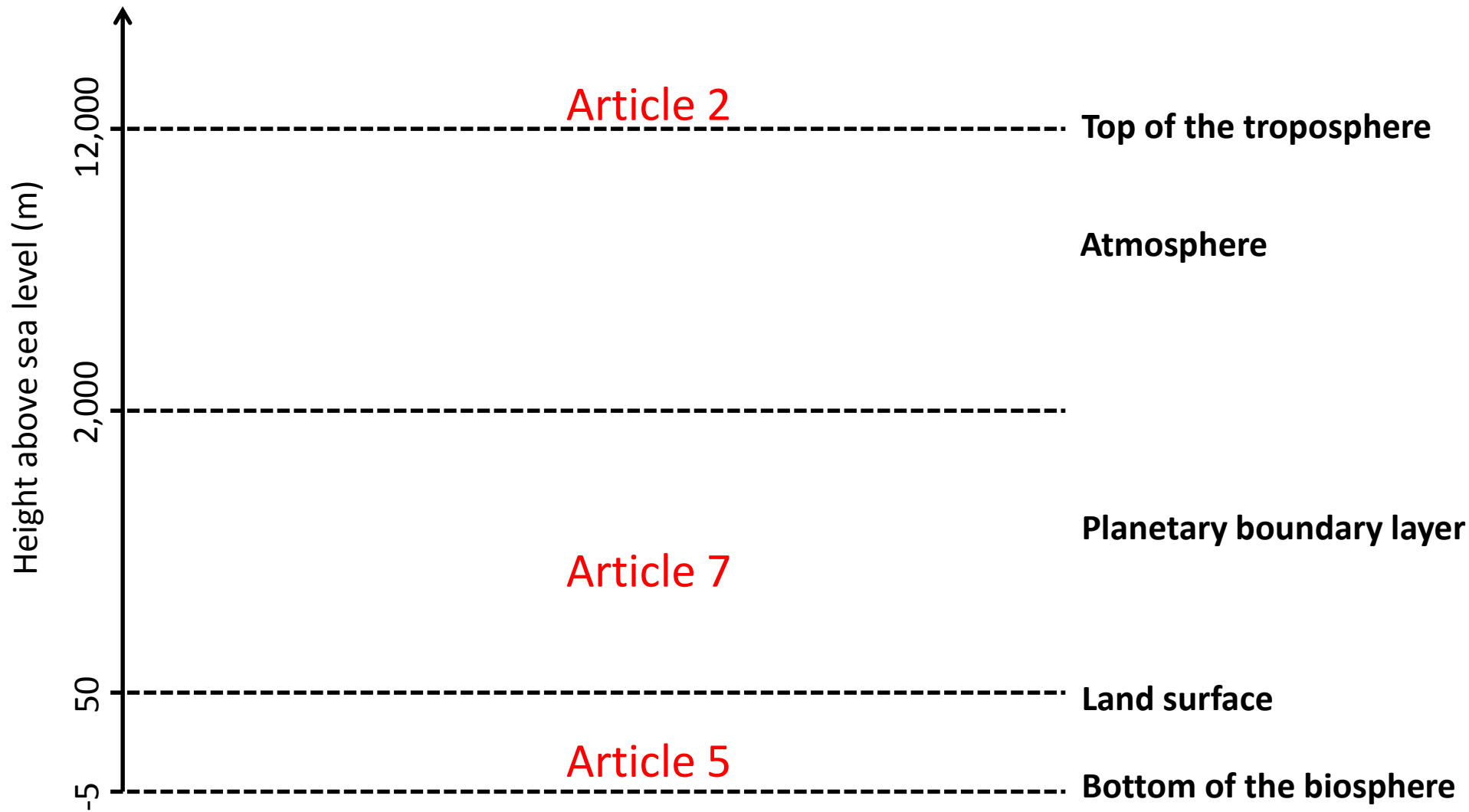
Article 7

[...] makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems. [...] greater levels of mitigation can reduce the need for additional adaptation efforts.
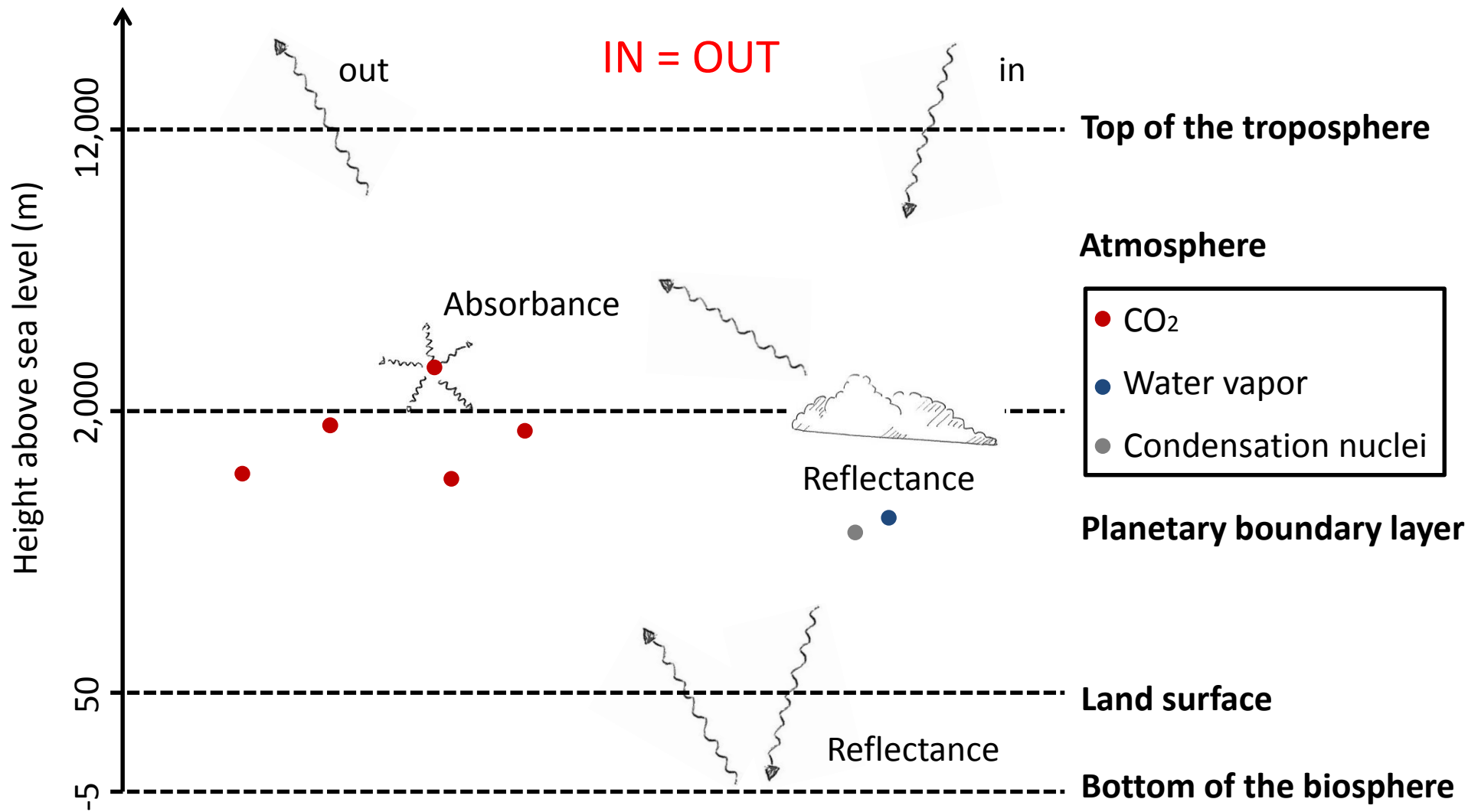
From Paris to the Earth system

Height above sea level (m)

- 12,000 — **Top of the troposphere**

  Atmosphere

- 2,000 —

  Planetary boundary layer

- 50 — **Land surface**

- -5 — **Bottom of the biosphere**

From Paris to the Earth system

The basics of the radiative balance

The basics of climate change
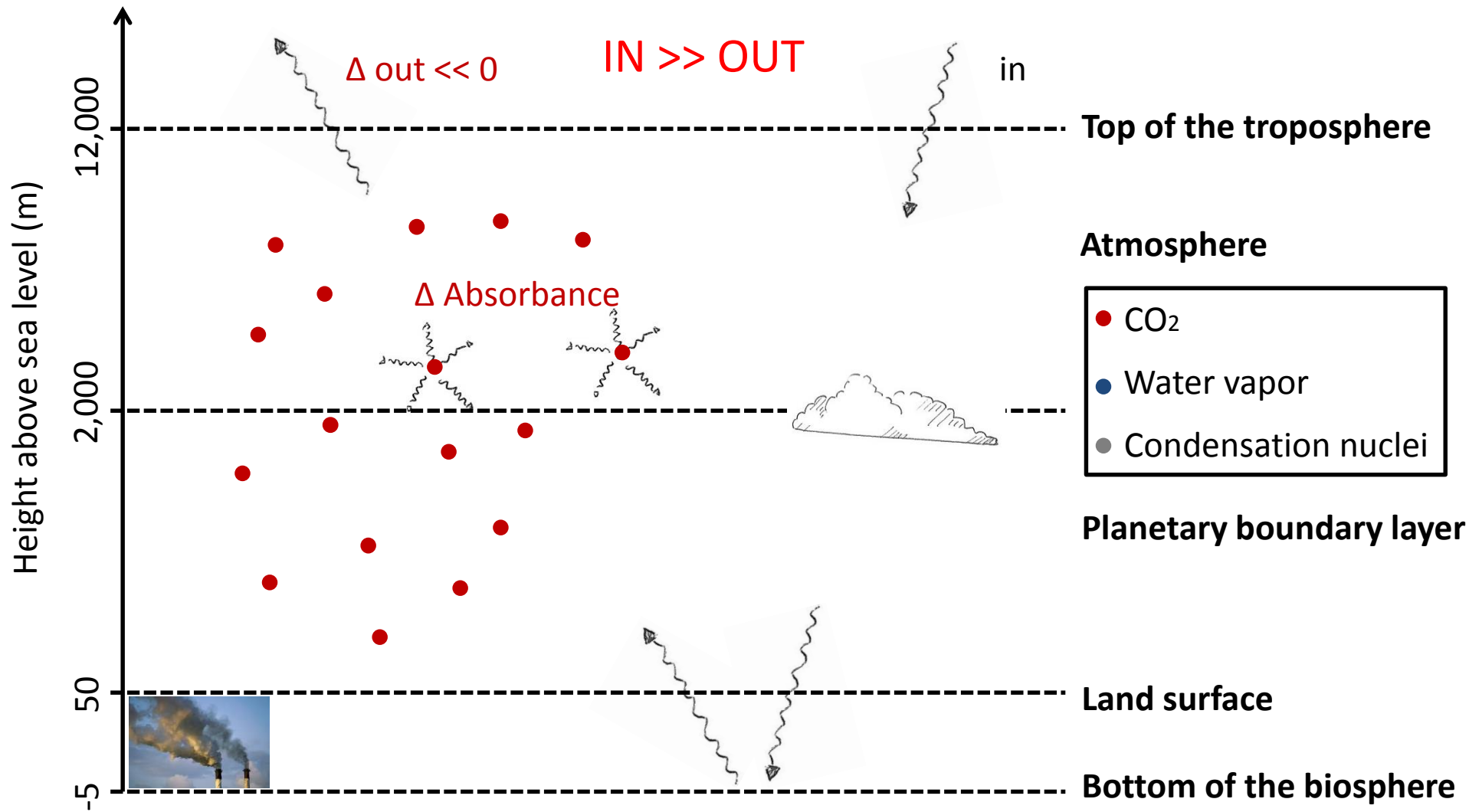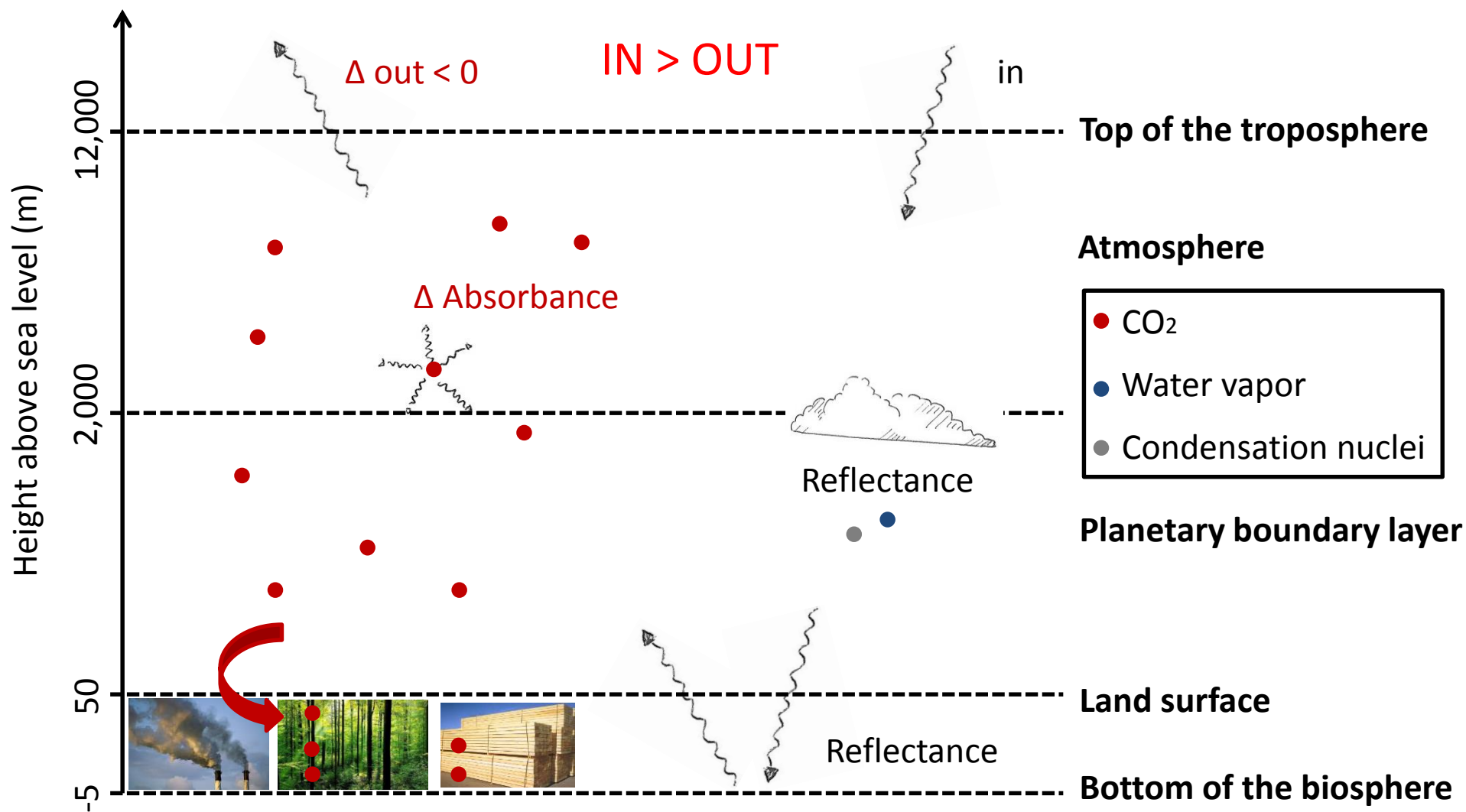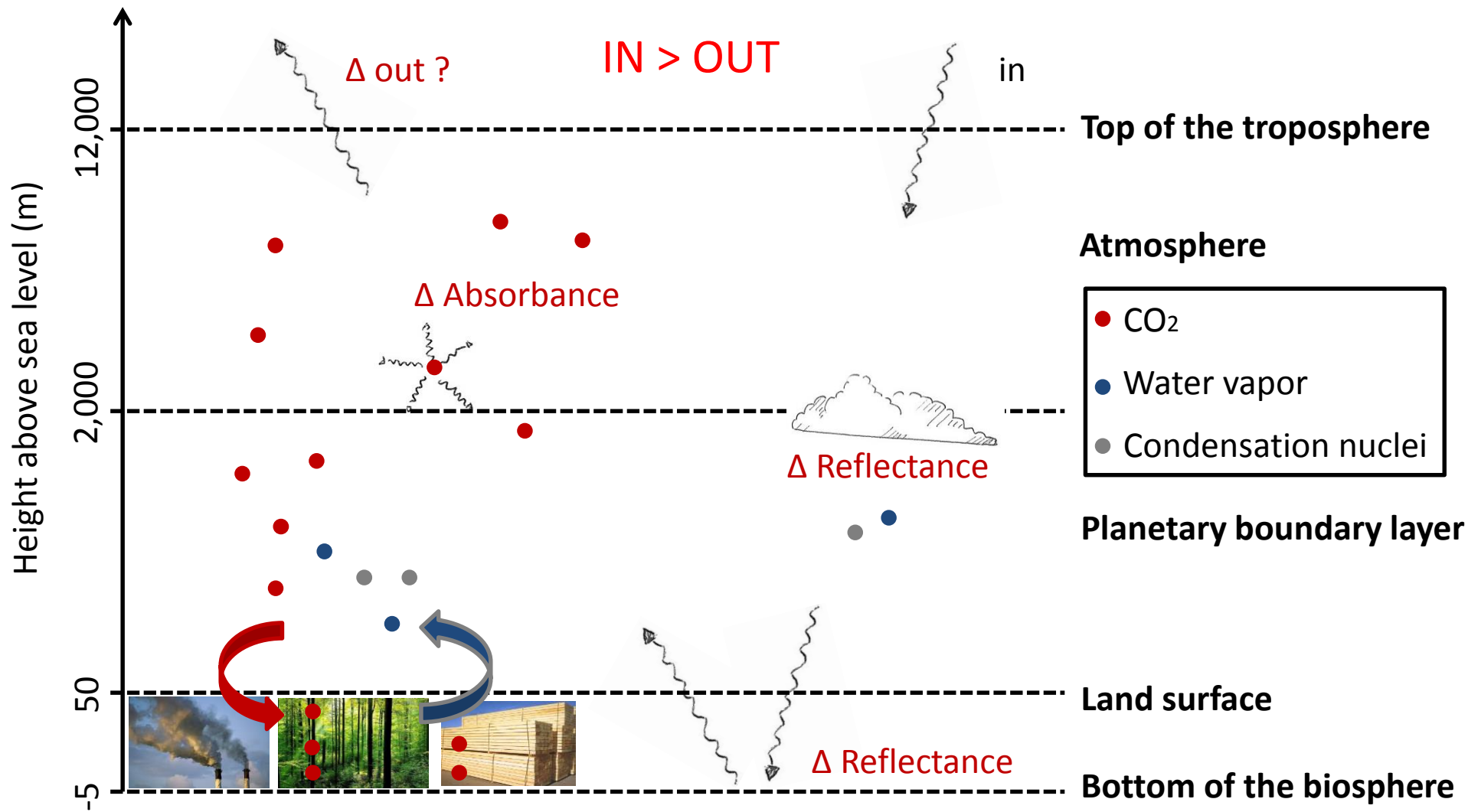
Assessing the net climate effect

Soil: CO_2, CH_4, N_2O
Litter: CO_2
Biomass: CO_2
Land-use: CO_2, CH_4, N_2O
Land-cover: CO_2
Disturbances: CO_2, CO, CH_4, N_2O
Management: CO_2
Transport: CO_2
Wood transformation: CO_2
Wood products: CO_2
Landfilling: CO_2, CH_4
Avoided emissions: CO_2, CO, CH_4, N_2O

Albedo
Emissivity
Evapotranspiration
BVOCs
Roughness
Evapotranspiration

Assessing the net climate effect

				Top of the troposphere
Net Climate effect (includes feedbacks)				**Top of the troposphere** **Planetary boundary layer**
Biogeochemical forcing No feedbacks!			Biophysical forcing No feedbacks!	**Land surface**
GHG sink	GHG accounting		(Non) radiative	

Soil: CO_2, CH_4, N_2O
Litter: CO_2
Biomass: CO_2
Land-use: CO_2, CH_4, N_2O
Land-cover: CO_2
Disturbances: CO_2, CO, CH_4, N_2O

Management: CO_2
Transport: CO_2
Transformations: CO_2
Wood products: CO_2
Landfilling: CO_2, CH_4
Avoided emissions: CO_2, CO, CH_4, N_2O

Albedo
Emissivity
Evapotranspiration
BVOCs
Sensible heat
Roughness
Evapotranspiration

Bottom of the biosphere

Assessing the net climate effect

Net Climate effect (includes feedbacks)		
Biogeochemical forcing **No feedbacks!**		**Biophysical forcing** **No feedbacks!**
GHG sink	GHG accounting	(Non) radiative
Soil: CO_2, CH_4, N_2O Litter: CO_2 Biomass: CO_2 Land-use: CO_2, CH_4, N_2O Land-cover: CO_2 Disturbances: CO_2, CO, CH_4, N_2O	Management: CO_2 Transport: CO_2 Transformations: CO_2 Wood products: CO_2 Landfilling: CO_2, CH_4 Avoided emissions: CO_2, CO, CH_4, N_2O	Albedo Emissivity Evapotranspiration BVOCs Sensible heat Roughness Evapotranspiration

ARTICLE 5
26 Pg C

Net Climate effect (includes feedbacks)			
Biogeochemical forcing No feedbacks!			Biophysical forcing No feedbacks!
GHG sink	GHG accounting		(Non) radiative
Soil: CO_2, CH_4, N_2O Litter: CO_2 Biomass: CO_2 Land-use: CO_2, CH_4, N_2O Land-cover: CO_2 Disturbances: CO_2, CO, CH_4, N_2O	Management: CO_2 Transport: CO_2 Transformations: CO_2 Wood products: CO_2 Landfilling: CO_2, CH_4	Avoided emissions: CO_2, CO, CH_4, N_2O	Albedo Emissivity Evapotranspiration BVOCs Sensible heat Roughness Evapotranspiration

ARTICLE 2, 5 & 7
7 Pg C

Assessing the net climate effect

Net Climate effect (includes feedbacks)		
Biogeochemical forcing		**Biophysical forcing**
No feedbacks!		No feedbacks!
GHG sink	GHG accounting	(Non) radiative
Soil: CO_2, CH_4, N_2O / Litter: CO_2 / Biomass: CO_2 / Land-use: CO_2, CH_4, N_2O / Land-cover: CO_2 / Disturbances: CO_2, CO, CH_4, N_2O	Management: CO_2 / Transport: CO_2 / Transformations: CO_2 / Wood products: CO_2 / Landfilling: CO_2, CH_4 / Avoided emissions: CO_2, CO, CH_4, N_2O	Albedo / Emissivity / Evapotranspiration / BVOCs / Sensible heat / Roughness / Evapotranspiration

Earth system models
Integrated assessment models
(economic feedbacks!)

Observations
Life cycle analysis
Simple models
Complex models

Assessing the net climate effect

Net Climate effect (includes feedbacks)		
Biogeochemical forcing		Biophysical forcing
No feedbacks!		No feedbacks!
GHG sink	GHG accounting	(Non) radiative
Soil: CO_2, CH_4, N_2O Litter: CO_2 Biomass: CO_2 Land-use: CO_2, CH_4, N_2O Land-cover: CO_2 Disturbances: CO_2, CO, CH_4, N_2O	Management: CO_2 Transport: CO_2 Transformations: CO_2 Wood products: CO_2 Landfilling: CO_2, CH_4 Avoided emissions: CO_2, CO, CH_4, N_2O	Albedo Emissivity Evapotranspiration BVOCs Sensible heat Roughness Evapotranspiration

High uncertainty on the sign of the net change

Low uncertainty on the sign of the gross changes

Moderate uncertainty on the magnitude of the gross changes

- **When managing the carbon balance of a forest, unintended but unavoidable changes in surface properties and behavior occur. These should be accounted for when assessing the climate impact of forest management.**
- **Carbon-management and climate-management should not be used interchangeable**