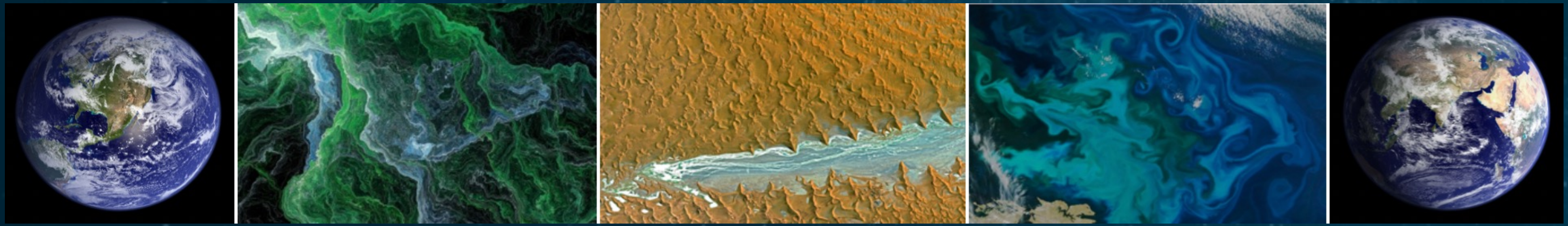
EO IN SUPPORT OF THE UNFCCC PARIS AGREEMENT



Michaela I. Hegglin
University of Reading

Colocation Meeting 07/10/2021

MANDATE BY THE UNFCCC PARIS AGREEMENT

The Paris Agreement highlights in a request to the Parties to "… *strengthen scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making*" (Article 7.7c).

However, it does not tell us how this needs to happen in practice!

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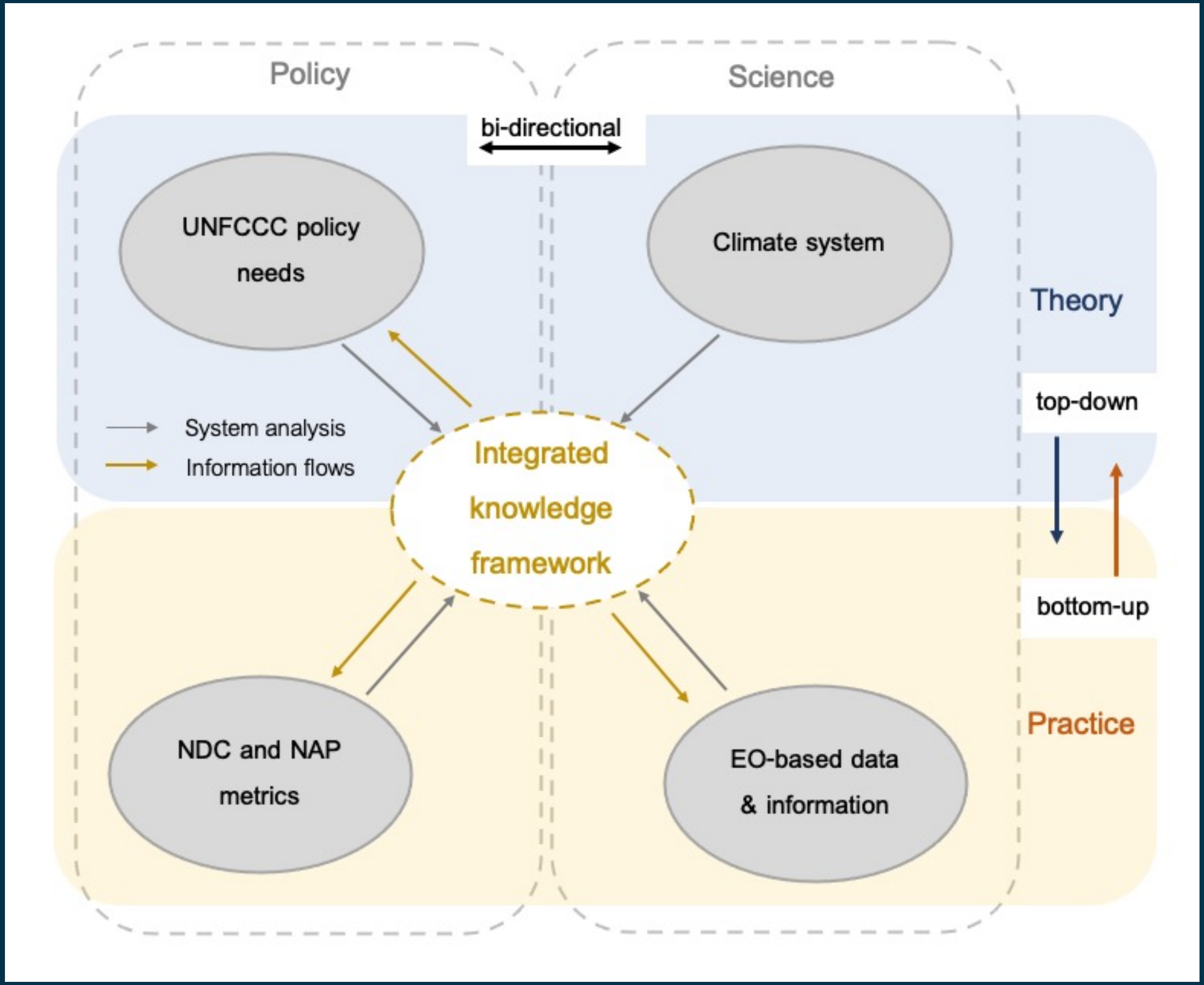
However, it does not tell us how this needs to happen in practice!

Provides opportunity for EO community to help define these needs!

METHODOLOGY

- Aims at deriving a conceptual framework from reality, rather than deriving 'reality' from a conceptual framework.

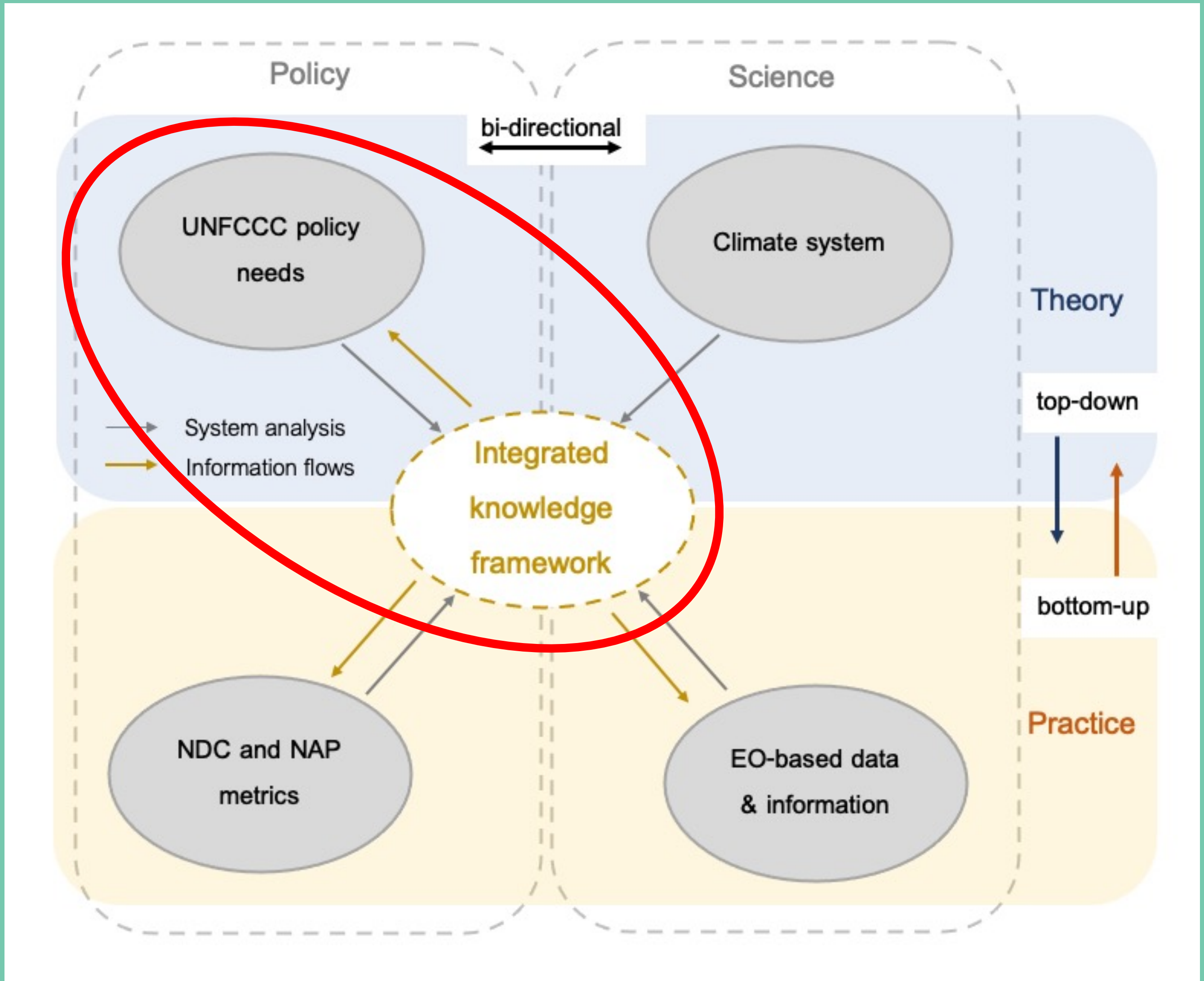
(adapted from E. F. Schumacher – Small is Beautiful 1973)



Hegglin et al., in preparation

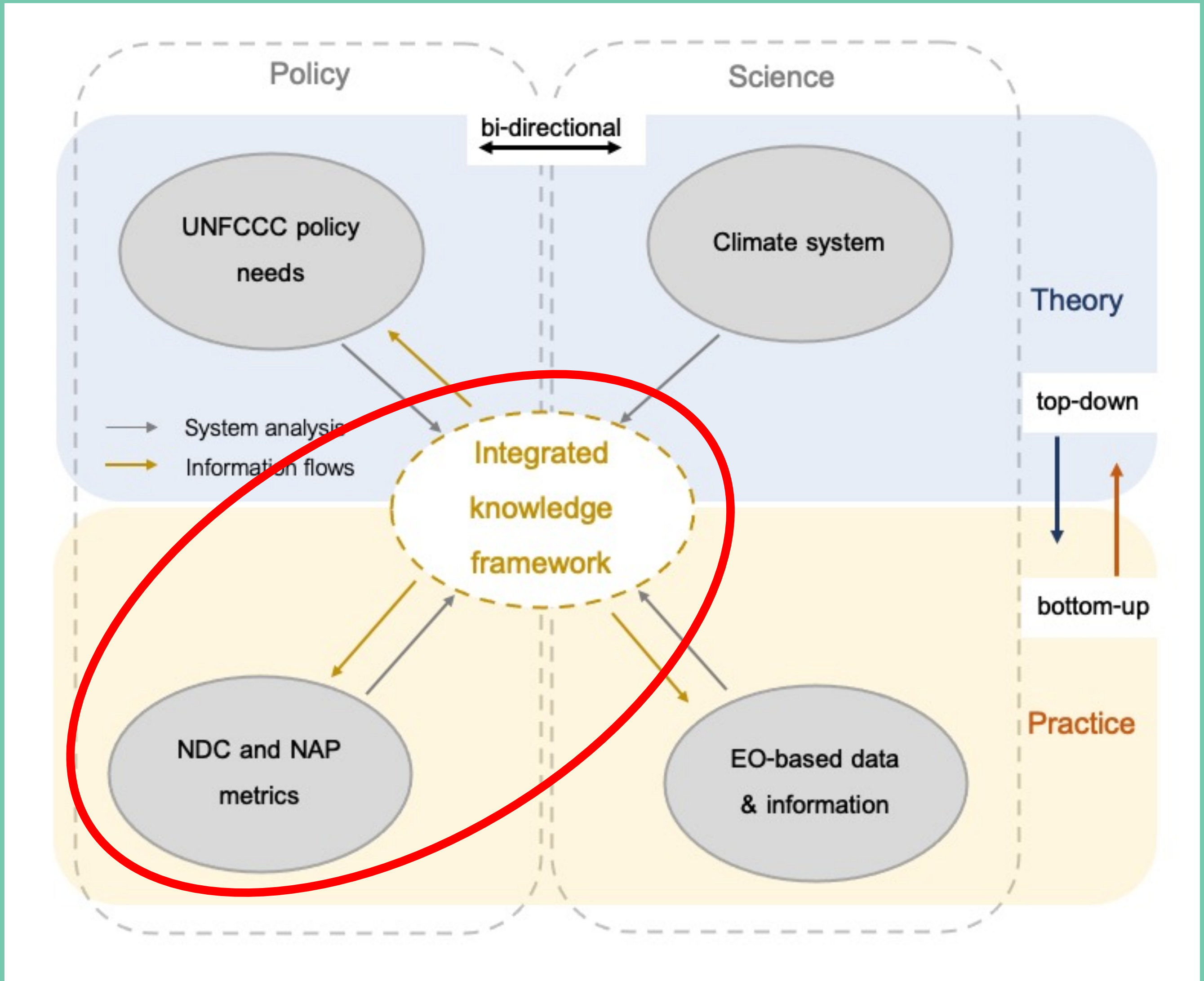
STEP 1: IDENTIFYING TOP-DOWN POLICY NEEDS

- *The study of the legal text* of the Paris Agreement uncovers the political goals of the international treaty, and thus indirectly its needs.



STEP 2: IDENTIFYING BOTTOM-UP POLICY NEEDS

- *Involvement of national agencies* in the discourse revealed implications of these policy needs for work on the ground.



THE UNFCCC PARIS AGREEMENT

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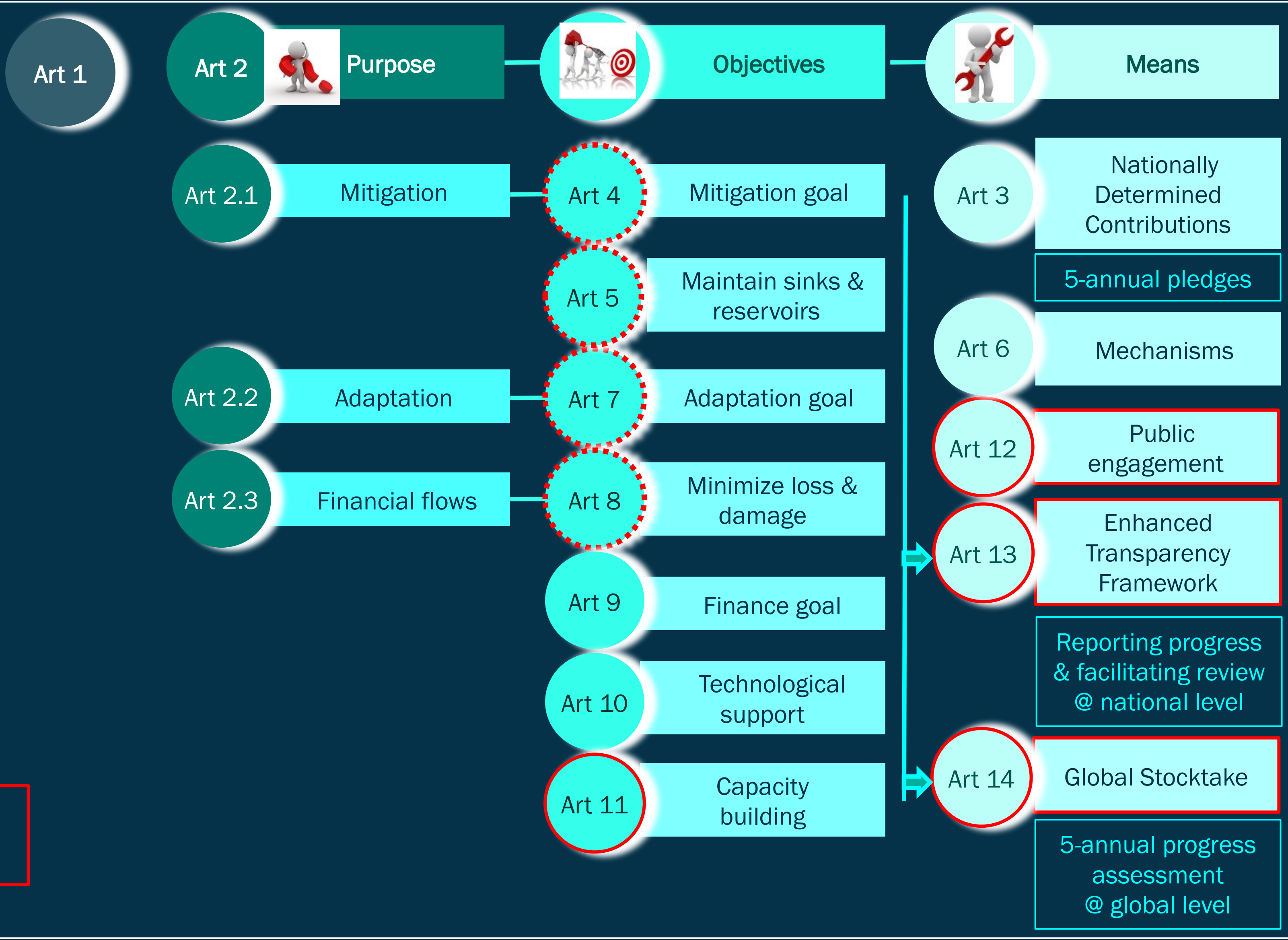

…… *thematic areas* EO can support
____ *action pathways* EO can support

STEP 3: IDENTIFYING TOP-DOWN SCIENCE NEEDS

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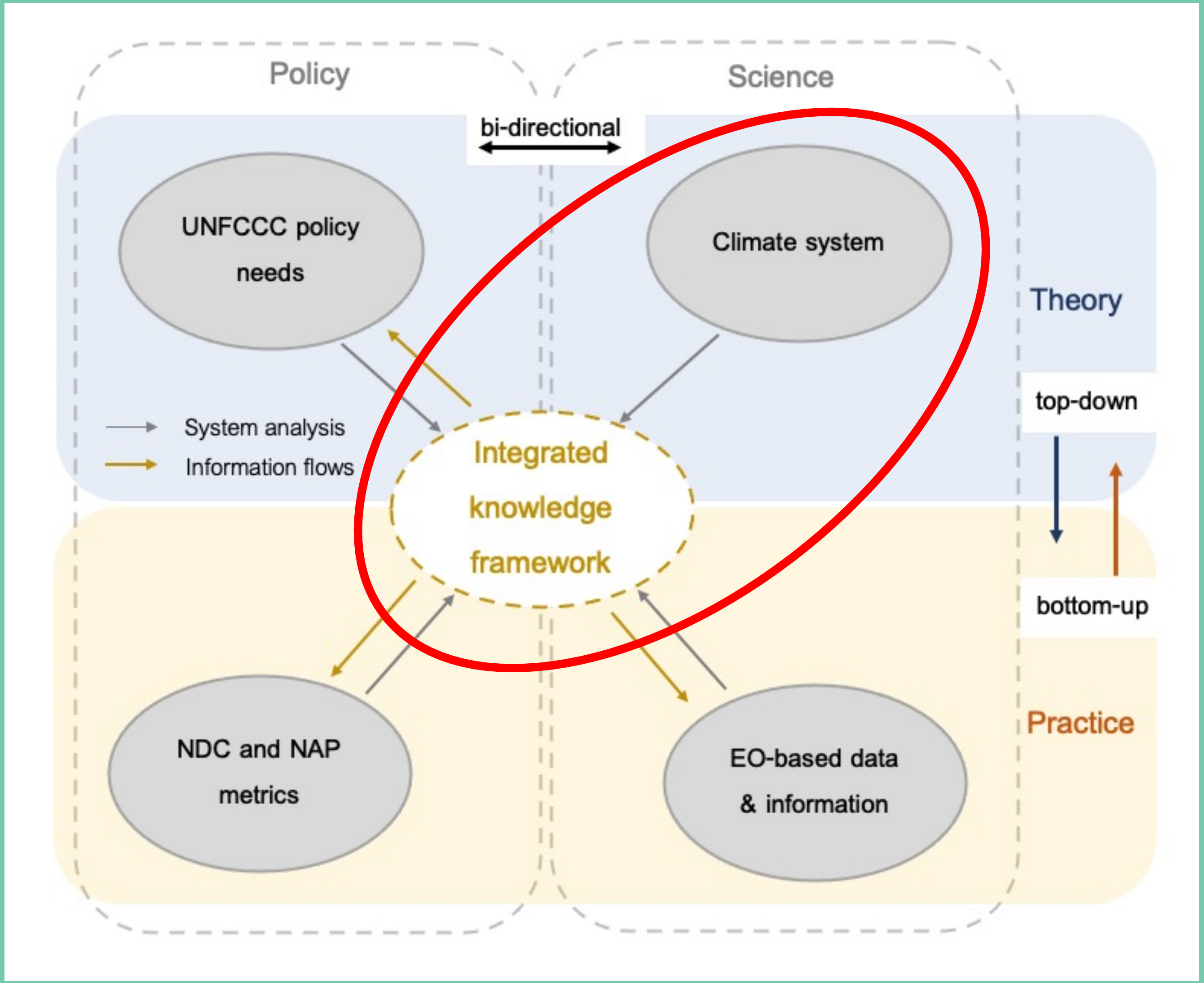
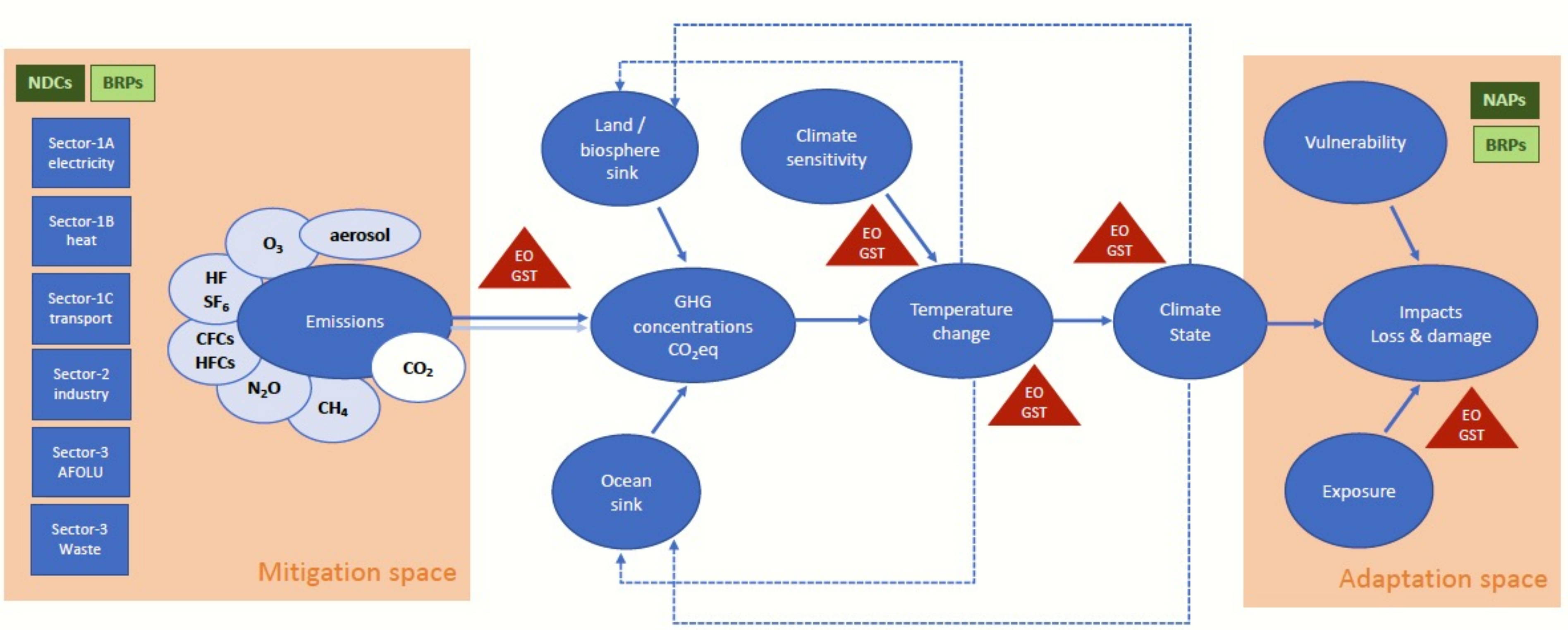
- *Integrated knowledge of the Earth system* is needed to inform policy of potential pitfalls and suitable approaches.



IMPORTANCE OF SYSTEM PERSPECTIVE

- Cause-effect network to reflect system-dependencies, helps avoiding pitfalls.
- What we need to know is not directly measurable and using indicators of progress can be dangerous; we need attribution!

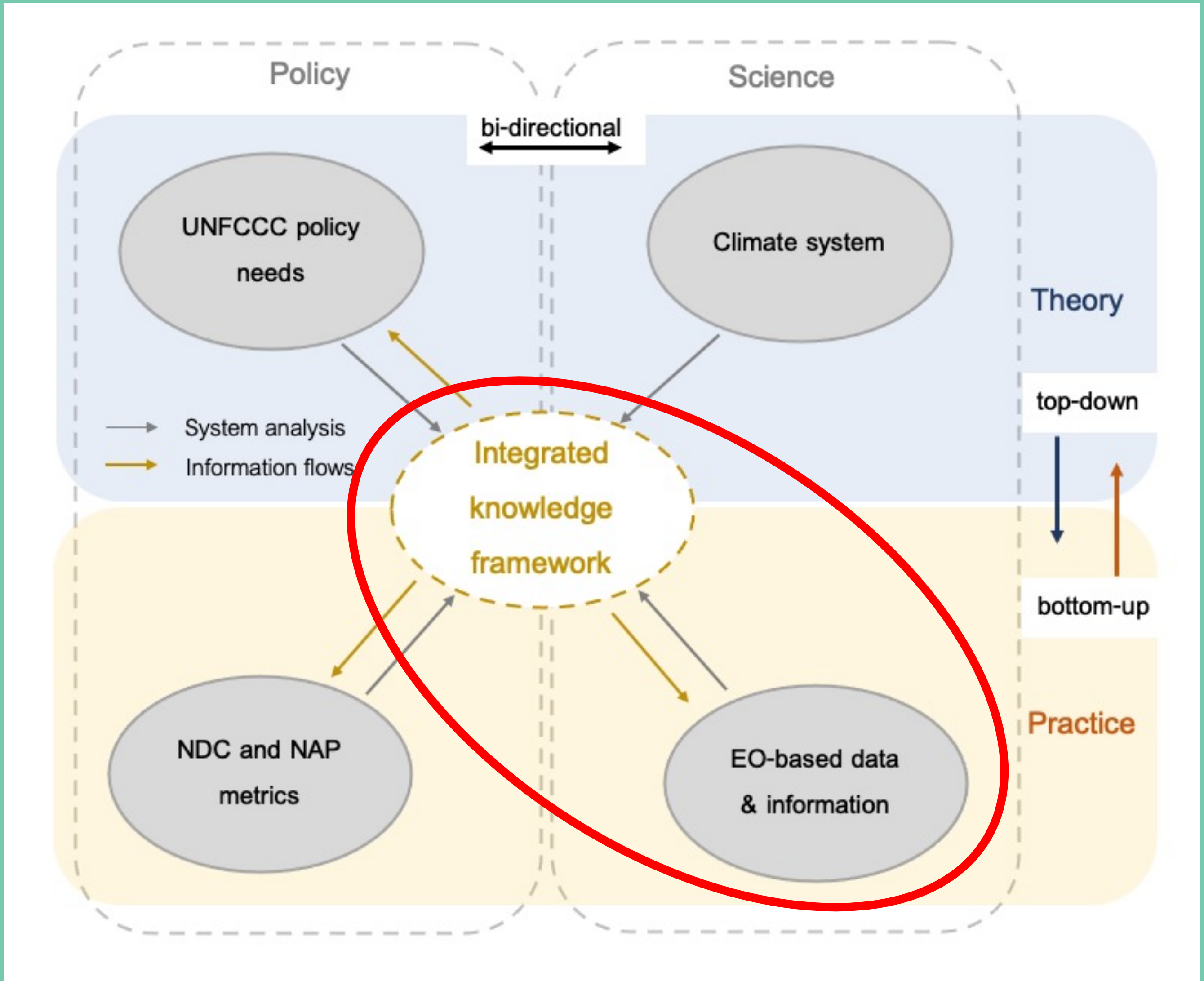


Hegglin et al., in preparation

- The link between ***emissions and temperature*** change (the PA targets) can only be measured if climate feedbacks and climate sensitivity are known.
- ***Climate adaptation and loss and damage*** can only be measured if the climate system response to GHG forcings is known.
- ***Decision-relevant metrics*** as in the NDCs and NAPs do not map directly onto physically measurable quantities (from EO).

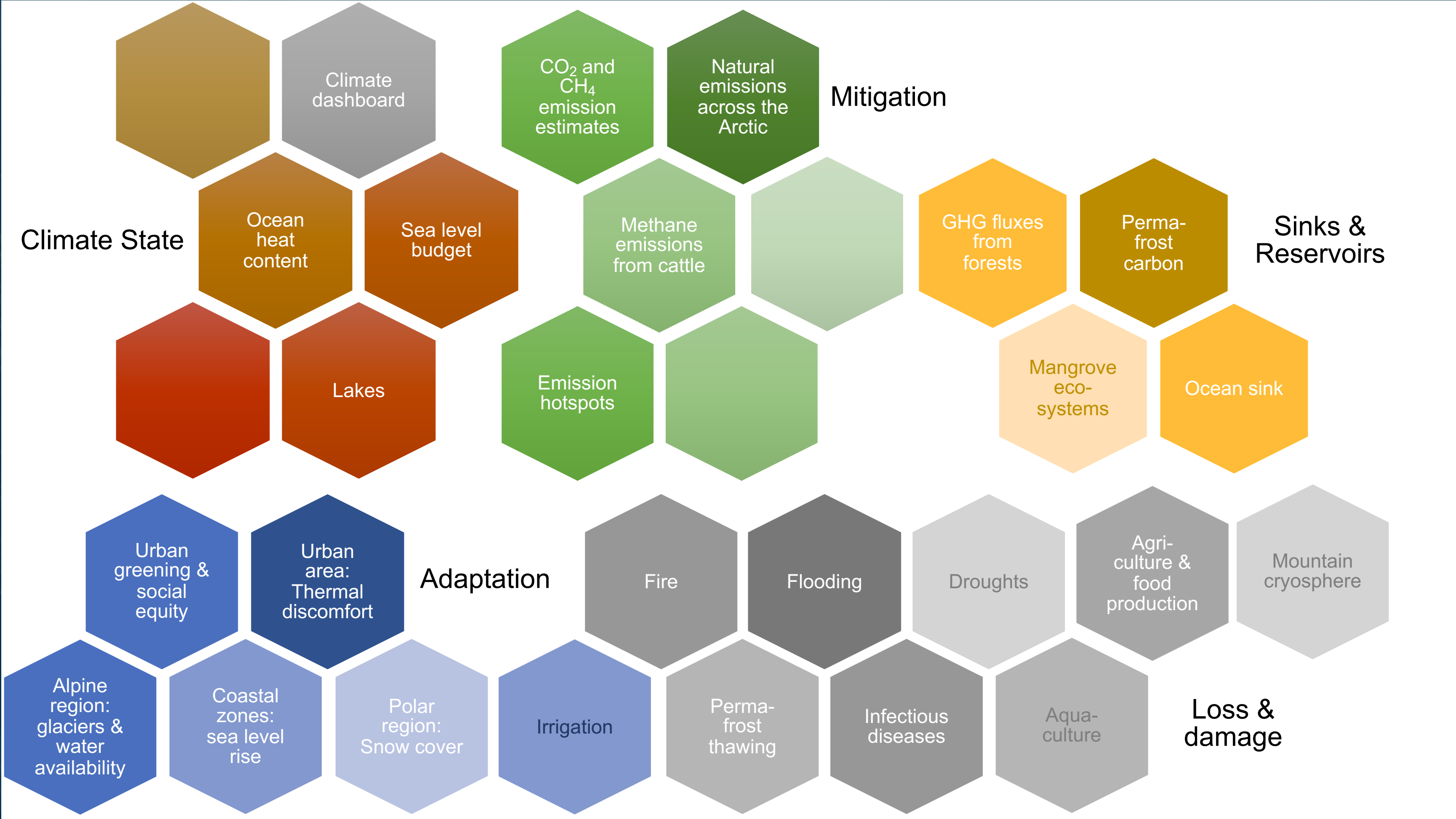
STEP 4: IDENTIFYING EO CAPACITIES

- *Assessment of case studies* of how Earth observations are currently used reveal potential of EO to support the Paris Agreement.



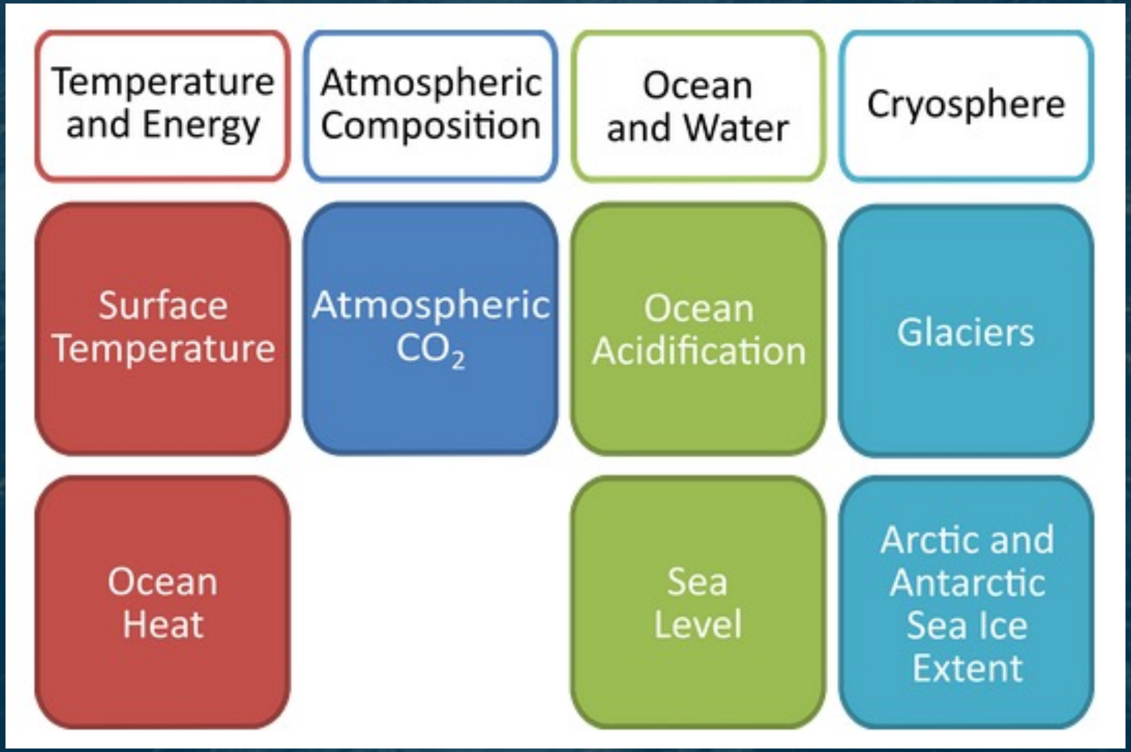
CASE STUDIES

- *21 case studies* have been identified, show-casing the potential of EO to answer policy needs in different key areas of the Paris Agreement. *Big thanks to all CCI projects for their input!!*

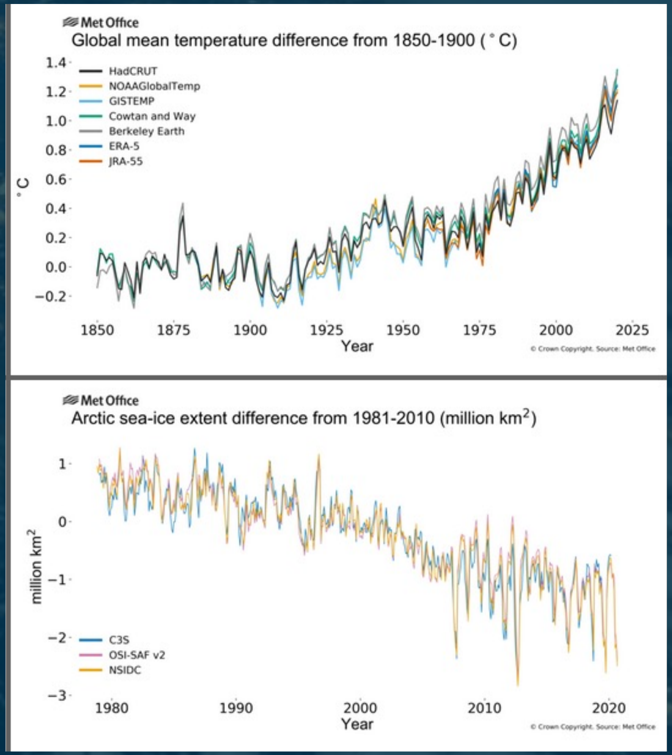


CLIMATE STATE

- *Global climate indicators* have already wide applications: IPCC, WMO, GCOS, CarbonBrief, BAMS, C3S …
- *High-quality CDRs* (such as provided by ESA CCI) are crucial to build these indicators.
- Do currently not inform on the full complexity of the Earth system necessary for the attribution to climate feedbacks.



WMO/GCOS



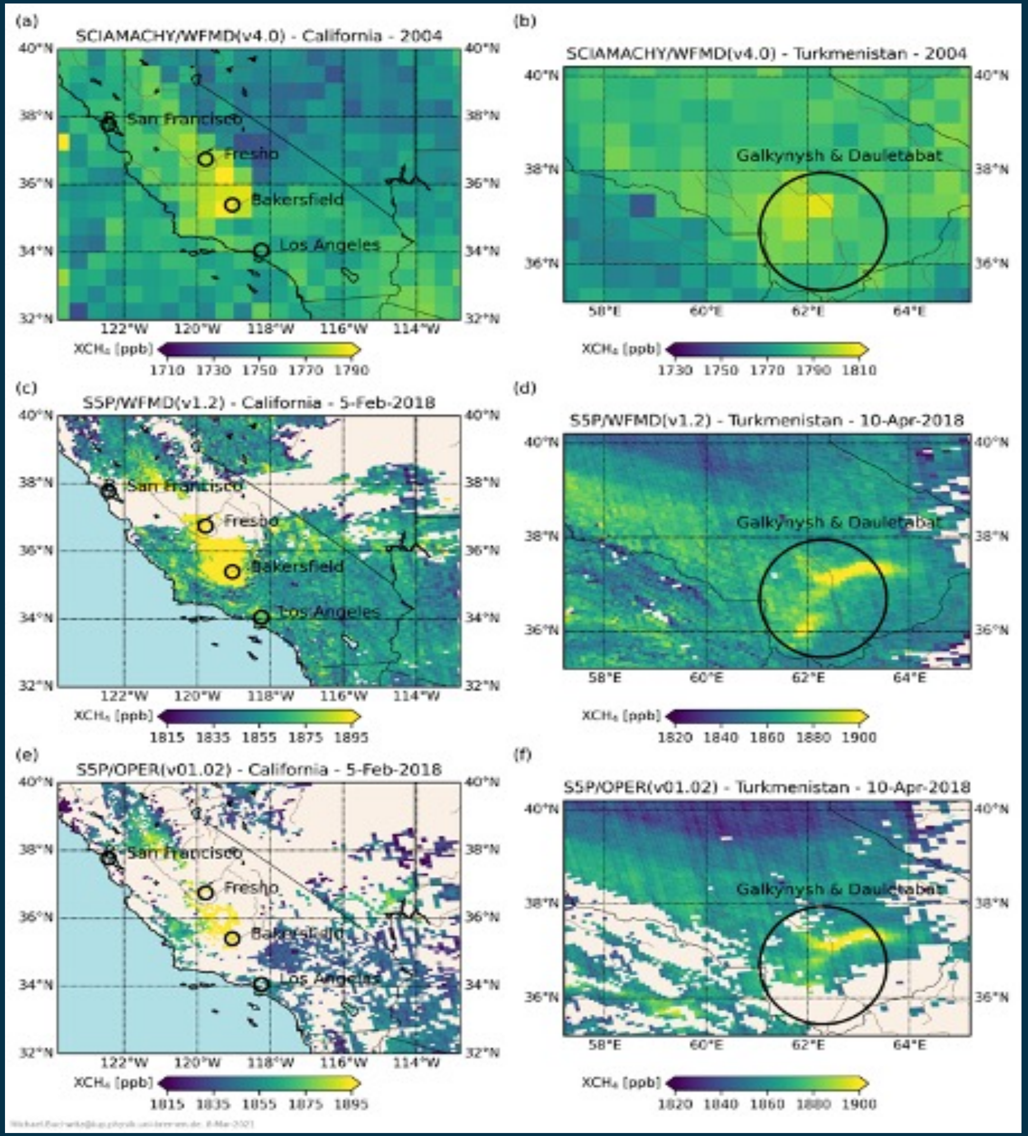
MetOffice dashboard

MITIGATION

- Currently the **best developed EO capacity** in direct support of the UNFCCC PA.
- Global view, but still limited temporal & spatial coverage.
- Generally, lack of accuracy and precision.

SCIAMACHY and S5P CH_4 observations

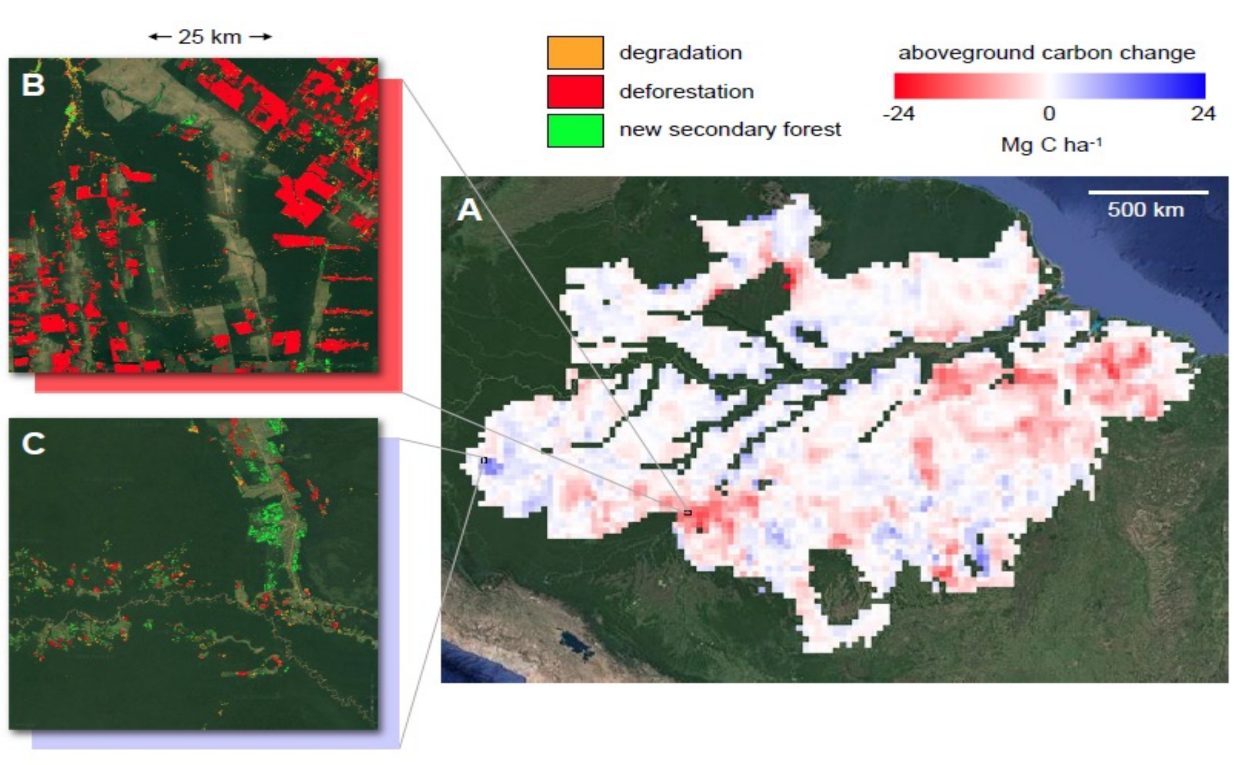
- EO are used to detect hotspots of GHG emissions.
- Informs policy makers and industry of *mitigation opportunities.*



Case study courtesy Michael Buchwitz and Heinrich Bovensmann

SINKS AND RESERVOIRS

- Focus on *AFOLU* (agriculture, forestry & other land use).
- Key task is the global ***assessment of the temporal change*** in sink and reservoir sizes and ***attribution to natural*** (e.g., fires, drought, diseases) and ***anthropogenic drivers*** (e.g., logging, agricultural & urban expansion).
- Information is necessary to assess effectiveness of mitigation measures.



Remotely sensed carbon dynamics in the Brazilian Amazon and illustration of associated land-cover changes.

- Information ultimately delivers change in aboveground C.
- Observations: Landsat, Sentinels

Case study courtesy RECCAP: Dominic Fawcett and Ana Bastos

ADAPTATION

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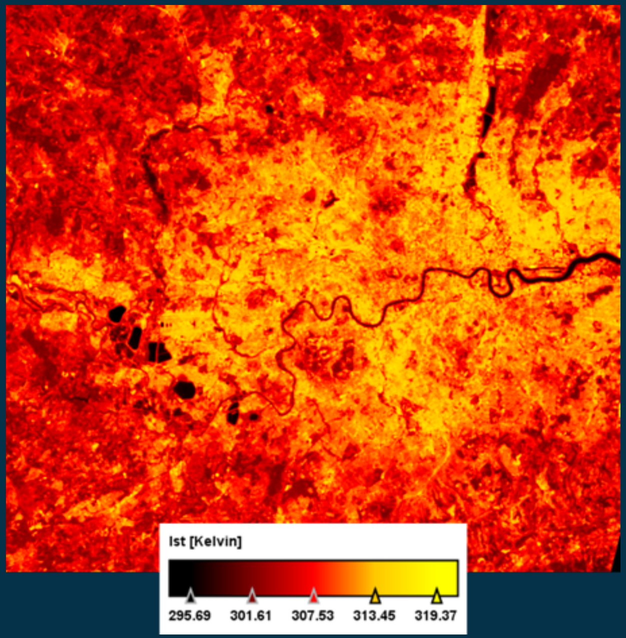
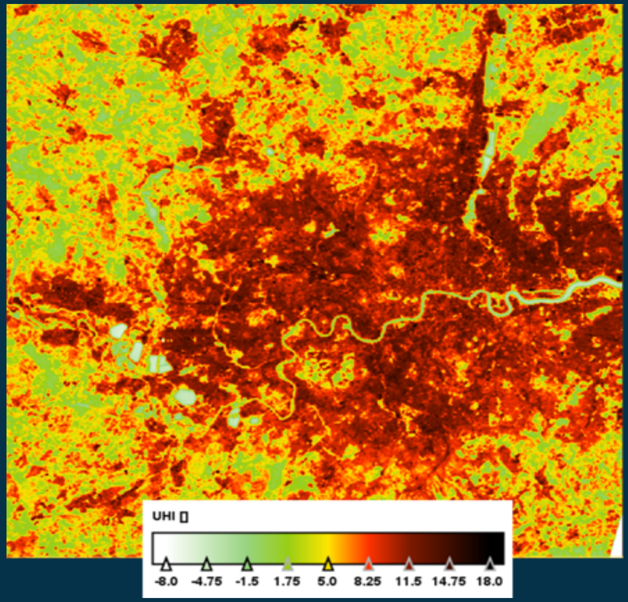
- *Adaptation has no global target and common indicators are lacking* since it is dependent on location-specific economic, social, and environmental conditions.

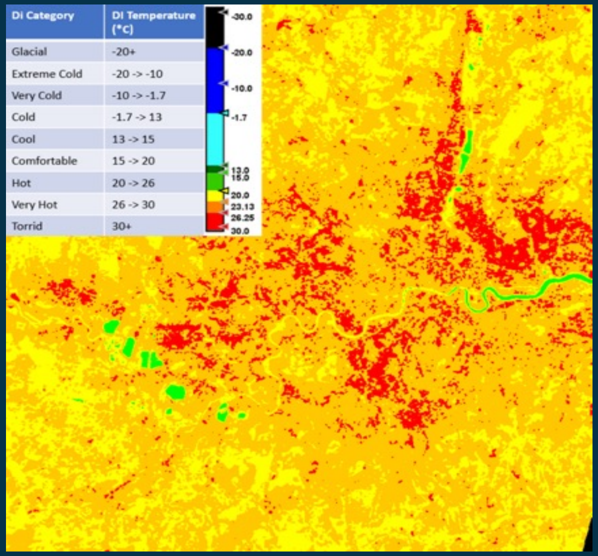
  → *co-development of adaptation indicators needed!*

From LST to urban heat island effect and thermal discomfort index

- Adaptation strategies (e.g., greening) are measurable over time, thereby also addressing demands by the PA to help the poor to adapt.
- Observations: high-res LST data







Case study courtesy Darren Ghent

LOSS & DAMAGE

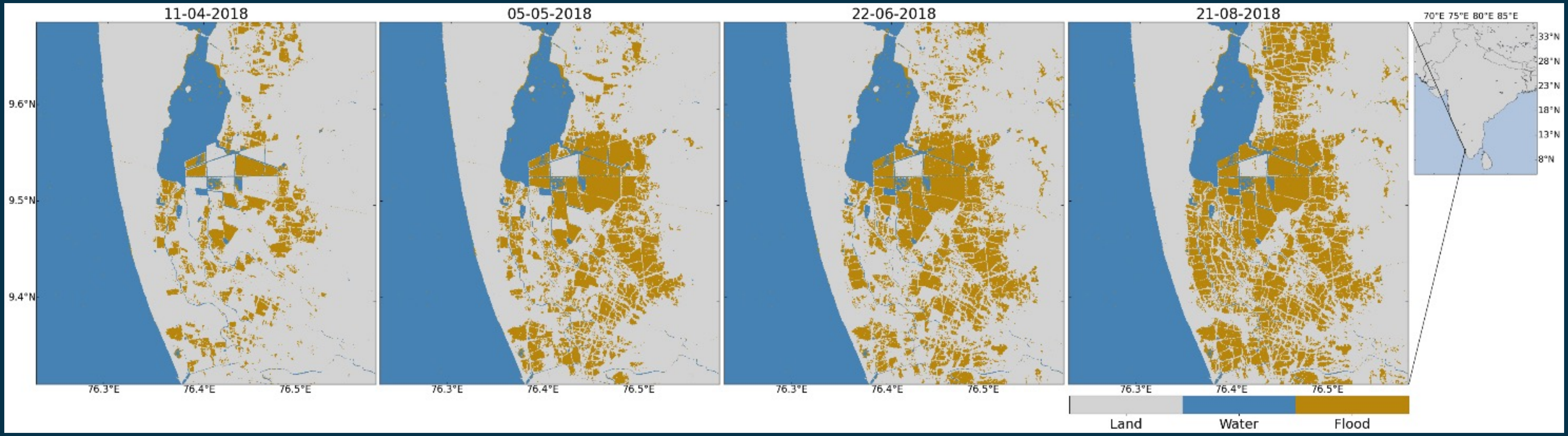
- Loss and damage occurs due to both ***sudden-onset*** (e.g., cyclones, flooding, heat-waves, fires) and ***slow-onset*** (e.g., sea-level rise, glacial melting, droughts) events.
- It can be both ***economic*** (e.g., resources, goods or services) and *non-economic* (e.g., health, culture, biodiversity).

→ *Again, co-development of indicators needed!*

Flooding during extreme monsoon season in 2018 Kerala, India

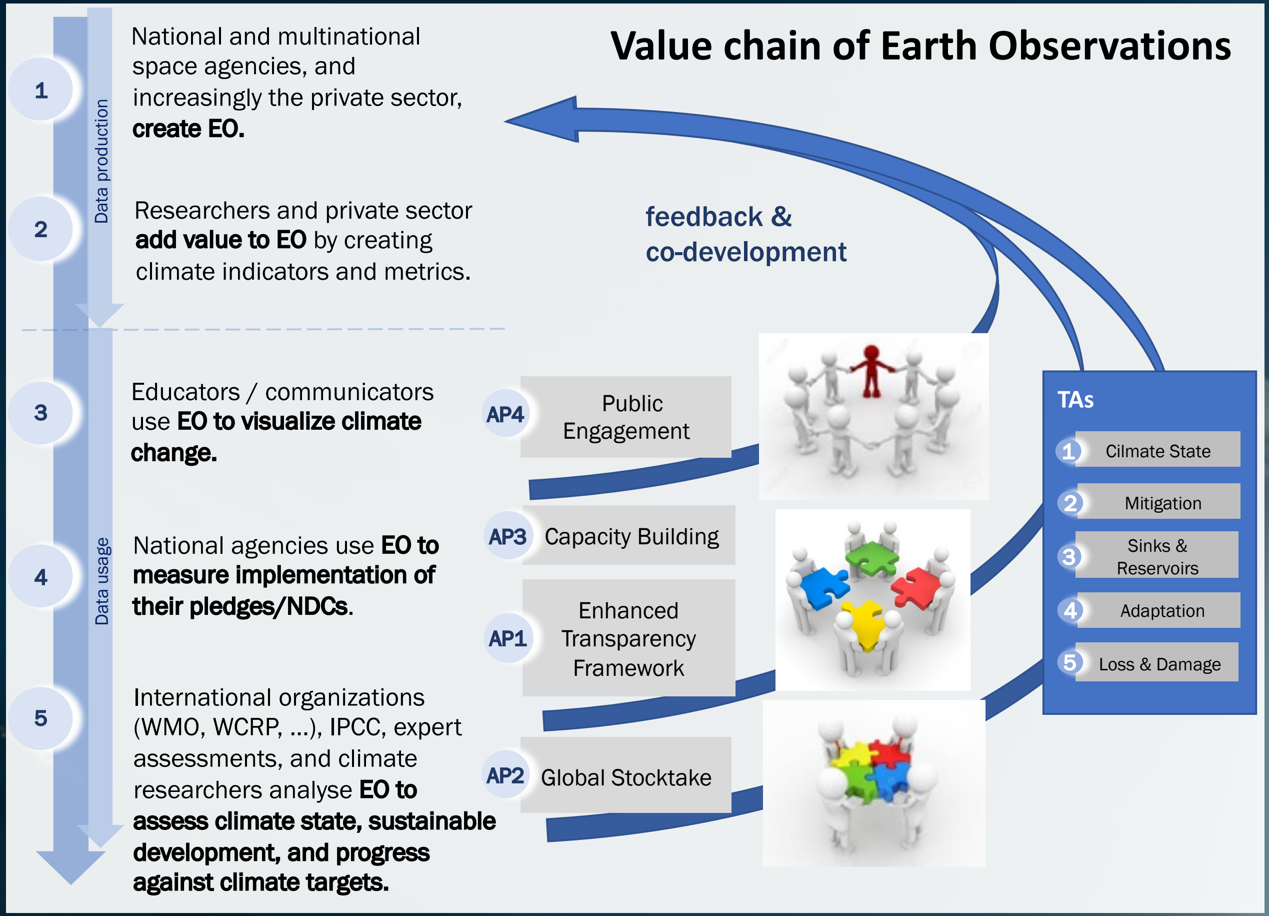
- Areal maps of flooding help assess extent and damage of event.
- Aso key for disaster management and emergency responses.
- Observations used: Sentinel-1A and -1B SAR images

Case study courtesy Gemma Kulk and Shubha Sathyendranath



SUMMARY AND CONCLUSIONS

Hegglin et al., in preparation



- EO shows great potential to support the UNFCCC Paris Agreement at both the national (via the ETF) and global level (via the GST).
- However, its full potential needs still to be realized, i.e. the ***transformation to actionable information useful to decision-making***.
- Key in this process will be the *co-development* through collaboration across communities (research, private sector, governments), also internationally.
- This move to trans-disciplinary research will require a ***radical overhaul of both the way we think and work!***

WAYS FORWARD

- The development and production of high-quality, long-term, and stable *climate data records (CDRs)* for the purpose of monitoring climate change should be continued. Increased attention should go into:
    - cross-ECV consistency (see also *Popp et al.*, BAMS 2021),
    - improved spatial and temporal resolution,
    - increased timeliness of data delivery,
    - enhancing CDRs through exploitation of AI.
- *To inform mitigation*, multi-ECV satellite observations should be integrated into data assimilation systems of full Earth system models to quantify, attribute, and predict changes in the carbon cycle.
    - Also, should be anchored by observations from high-quality in-situ measurement networks.
- *To inform adaptation*, a case study approach focusing on nation-specific needs should be envisaged.
    - Adopt cross-ECV approaches to gather integrated information on local systems.
    - Develop high-resolution, self- and inter-consistent, collocated EO information, enhanced by socio-economic information.
- Enhance outreach, education, and capacity building to raise awareness of the immediacy of climate change.
- More programmatically, scientific exploitation of EO should be aligned with the lighthouse activities within the *World Climate Research Programme* '*Explaining and Prediction Earth System Change*' and '*Digital Earths*'.