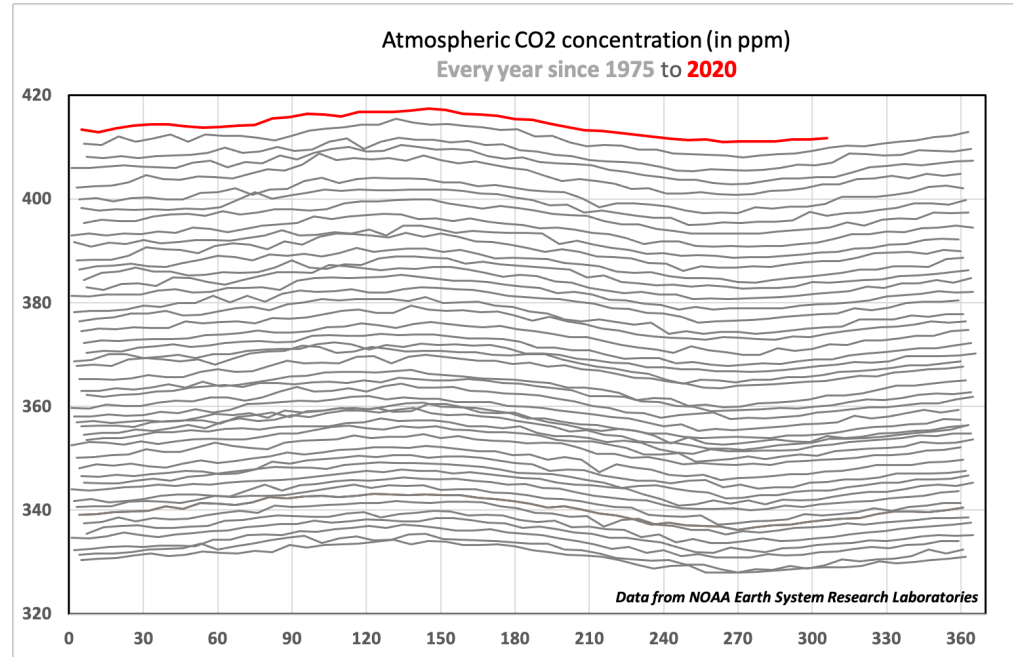


Summary and Recommendations on
Carbon budgets including climate factors
in the COVID-19 pandemics

*Philippe Peylin, Kasia Tokarska, Pierre Friedlingstein, Han Dolman, Debbie Rosen,
Jessica Clarke, Chris Jones, Gianpaolo Balsamo, Jean-Baptiste Sallee, Christophe Heinze,
& Project Members (VERIFY, CONSTRAIN, CRESCENDO, 4C, CHE, COMFORT, SO-CHIC)*

Limited impact of Covid-19 on CO2 emissions

- Drop in CO₂ emissions had **no detectable impact** on atmospheric CO₂ or climate change
- It is **extremely small compared to the emissions accumulated so far**, and compared to the emission cut needed to tackle climate change.



See specific talks during VERIFY – CHE general assembly in July 2020
<http://verify.lsce.ipsl.fr/index.php/events/the-che-verify-joint-general-assembly-2020-2>

Covid-19 crisis

Policy – Relevant Messages

- **Revealed** how drastic **changes in human behaviour impact** on anthropogenic GHG fluxes.
- Highlighted the **current lack of near real time direct quantification** of anthropogenic CO₂ emissions (i.e. not based on proxies of activity) at the country level.

Research & Innovation gaps

- Better **quantify “near real time”** anthropogenic CO₂ emissions (especially for EU, US, China, India).

Future carbon budgets and climate change

Policy – relevant messages:

- Longer term reductions in CO₂ emissions **strongly depend on government actions.**
- We **need to reach a net-zero global emissions level** to stabilize global warming.
- Current **NDC pledges are insufficient** to meet the PA long-term temp stabilization goal.
- **Only around 10 years of today CO₂ emission left**, to reach the 1.5 °C target
- Limiting other environmental changes (**e.g., ocean acidification**) can be more demanding.

Research and innovation gaps

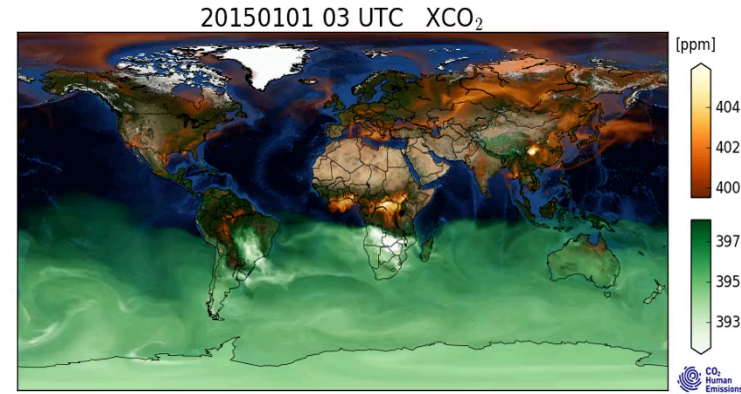
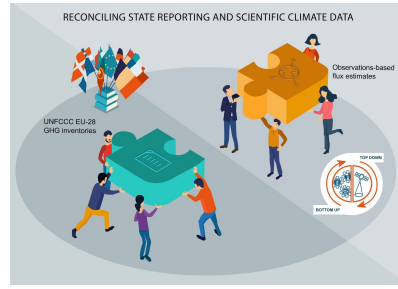
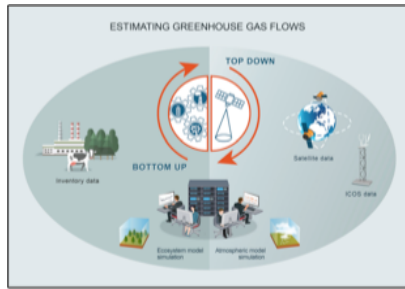
- Better quantify **transient climate sensitivity and the climate-carbon cycle feedbacks.**
- Better **understand the robustness of TCRE** (Transient climate response to cumulated emissions) range in scenarios where CO₂ emissions decline to zero
- Monitor the progress towards warming target while keeping the global C budget target.

Carbon budget accounting (VERIFY – CHE)

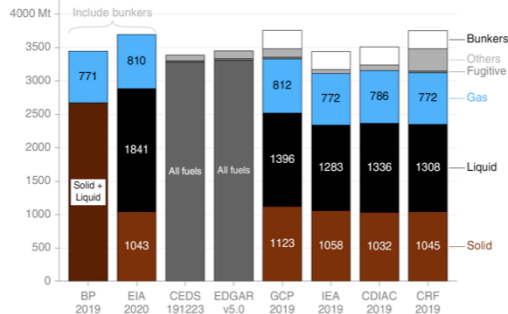
Observation-based method to monitor GHG fluxes to complement UNFCCC reporting

VERIFY: Country-scale GHG flux synthesis at:
<http://webportals.ipsl.jussieu.fr/VERIFY/FactSheets/>

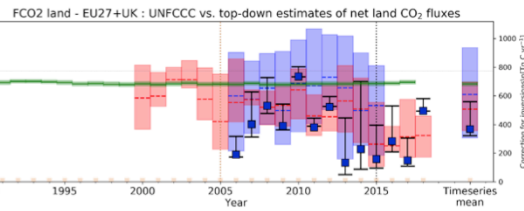
Promising path with upcoming satellite XCO₂ dat



Comparison of fossil CO₂ emissions: EU27+UK 2014



©@VERIFY Project



- Kyoto Protocol (entering into force)
- Paris Agreement
- UNFCCC LULUCF NGHGI (2019)
- UNFCCC LULUCF NGHGI (2019) uncertainty
- rivers_lakes_reservoirs_ULB
- Mean of CarboScopeReg (removing rivers_lakes_reservoirs_ULB)
- Mean of EUROCOM inversions (removing rivers_lakes_reservoirs_ULB)
- UNFCCC LULUCF NGHGI (2019) uncertainty
- Min/Max of EUROCOM inversions
- Mean of GCP inversions (removing rivers_lakes_reservoirs_ULB)
- Min/Max of GCP inversions

Local scale



Carbon budget accounting and understanding

Policy – relevant messages

- Fair allocation of the remaining C budget to individual countries - sectors is a key priority
- Providing a **transparent & robust country level Monitoring and Verification System** (complement to the existing UNFCCC CO₂ and non-CO₂ emissions reporting) is crucial to assess country progresses.
- **Obs-based methods** for CO₂ emissions are **not yet robust enough at country scales**.
- Needs for **more integrated & freely available C cycle measurements** (in situ & satellite).

Research & innovation gaps messages

- **Monitor both C fluxes as well as C stocks and stock changes** in all reservoirs (land, ocean) to evaluate current trends & **improve model** skills (i.e., through model data fusion)
- Understanding and **quantifying the role of non-CO₂ emissions** in the carbon budget framework.
- **Quantify the role/impact of land management and extreme events** on the terrestrial C budget.
- **Earth system model biogeochemical developments** are still needed (C-N cycles coupling, permafrost).

Additional points on Ocean carbon budgets

Key policy-relevant messages:

Oceanic uptake of carbon leads to acidification with hazards for a suite of marine organisms, *for many warm water corals the tipping point for bleaching has already been crossed*

Crossing tipping points and associated abrupt changes in different marine hotspots can induce abrupt changes in marine carbon uptake/storage, *hot spots: North Atlantic circulation, Arctic ocean sub-sea permafrost destabilisation, changes in **Southern Ocean carbon sink***

Once the ocean is acidified (by C uptake), this cannot be reversed on human time scales

Research & innovation gaps

Assessing planetary boundaries and safe operating space: *What are the multiple Earth system targets for emission reductions that work?*

Feasible mitigation pathways: *Find a climate-crisis-exit strategy with optimal global fare?*