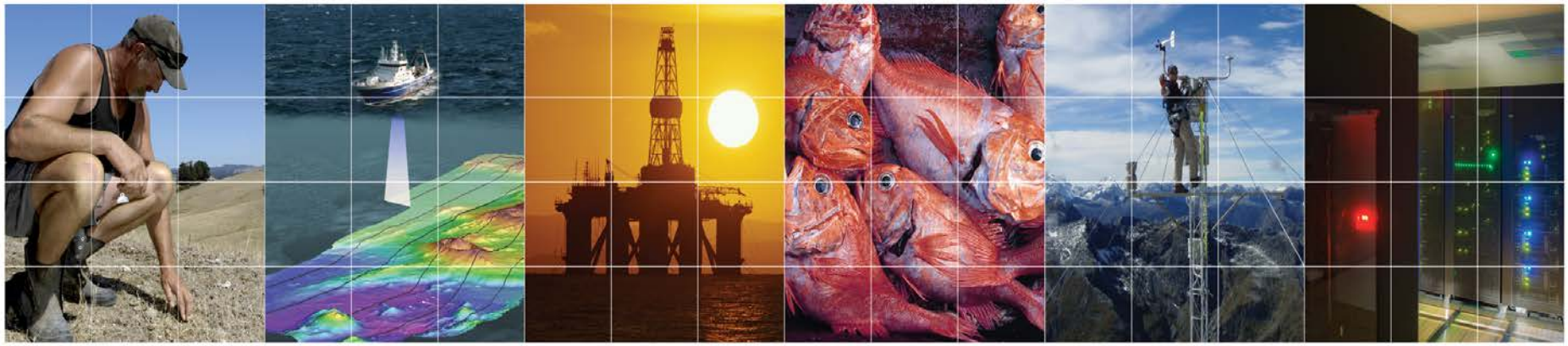

Progress with implementation of the Integrated Global Greenhouse Gas Information System (IG3IS) and New Zealand pilot project

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9th GEOSS Asia-Pacific Symposium, Tokyo, 11th-13th January 2017

Integrated Global GHG Information System (IG³IS) - Evidence Based Policy Support and Evaluation

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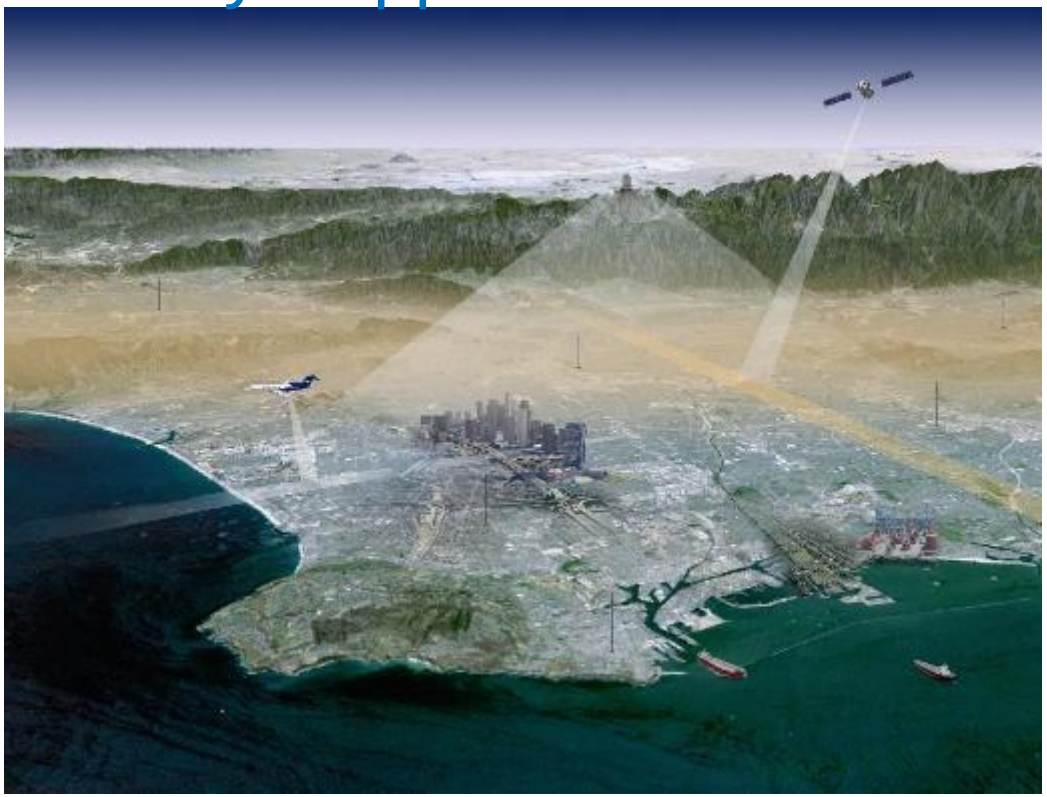

and the IG³IS Planning Team

John Burrows, Jane Burston, James Butler,Tony Janetos, Vincent-Henri Peuch, Pep Canadell, Philippe Ciais, Sander Houweling, Alistair Manning, Peter Rayner, Steve Wofsy, Christoph Gerbig, Beverly Law, Kevin Gurney, David Schimel, Felix Vogel,Jae Edmonds, John Miller, Riley Duren, Prabir Patra, Shuangxi Fang, Luciana Gatti, Tim Arnold, Luisa Molina, Toshinobu Machida, Ed Dlugokencky, Diane Stanitski, Deon Terblanche, James Whetstone, Jack Kaye, Hratch Semerjian, Steven Hamburg, Stephan Reimann, Daniel Zavala-Araiza, Dominik Brunner and others **community effort!**

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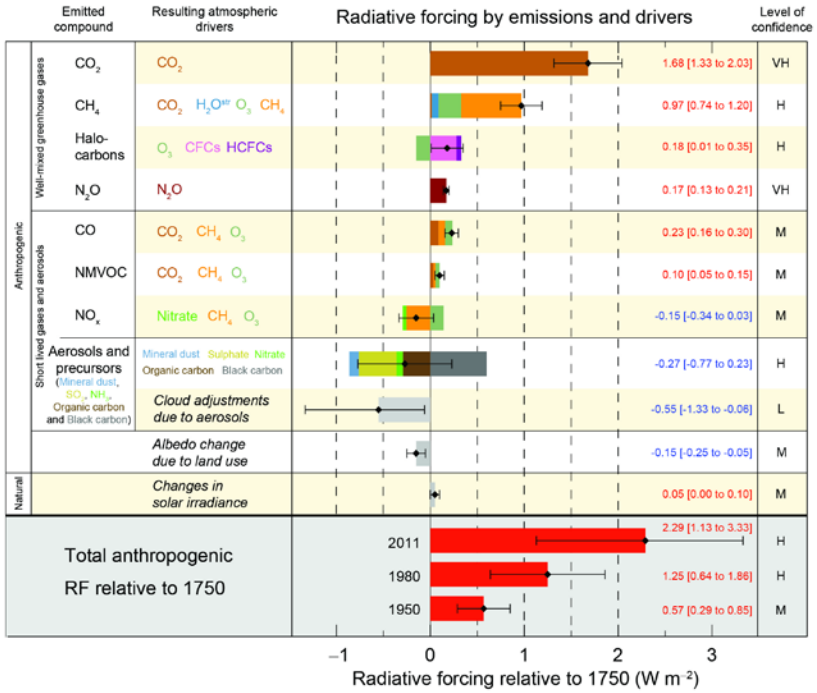
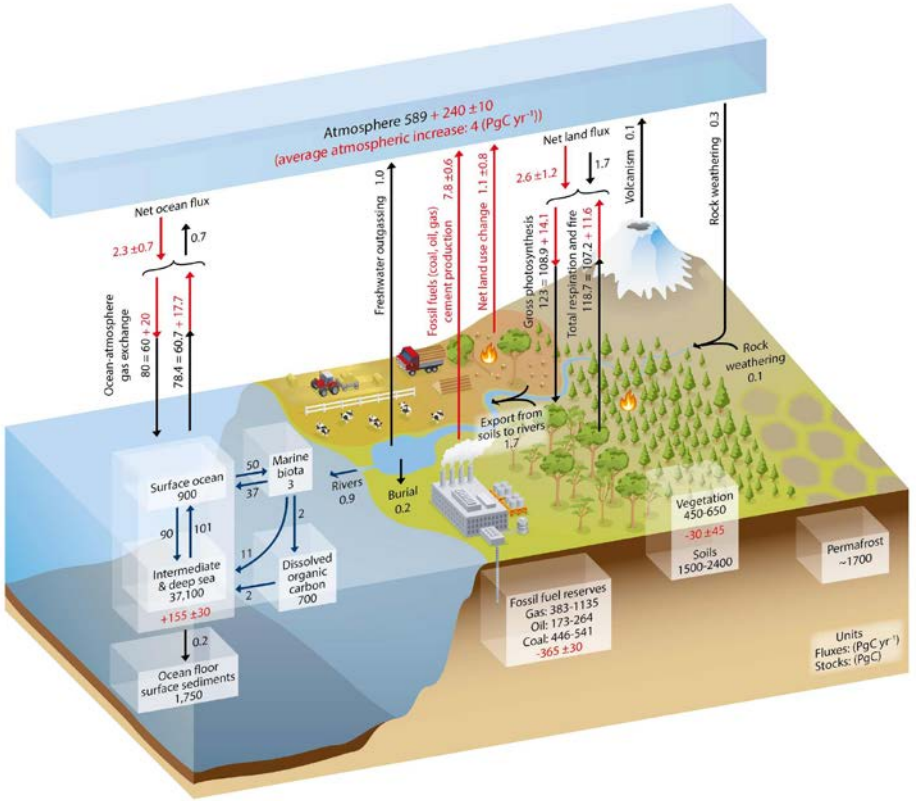
UNEP
United Nations Environment Programme

Paris Agreement – limit the warming below 2° C (by limiting emissions)

Fundamental problem – it is what you **HAVE** in the atmosphere, not what you **PUT** in the atmosphere, that controls the temperature





Calculations are for year in 2011

Human (9GtC in) – ocean (2.3GtC out) – biosphere(2.6GtC out)

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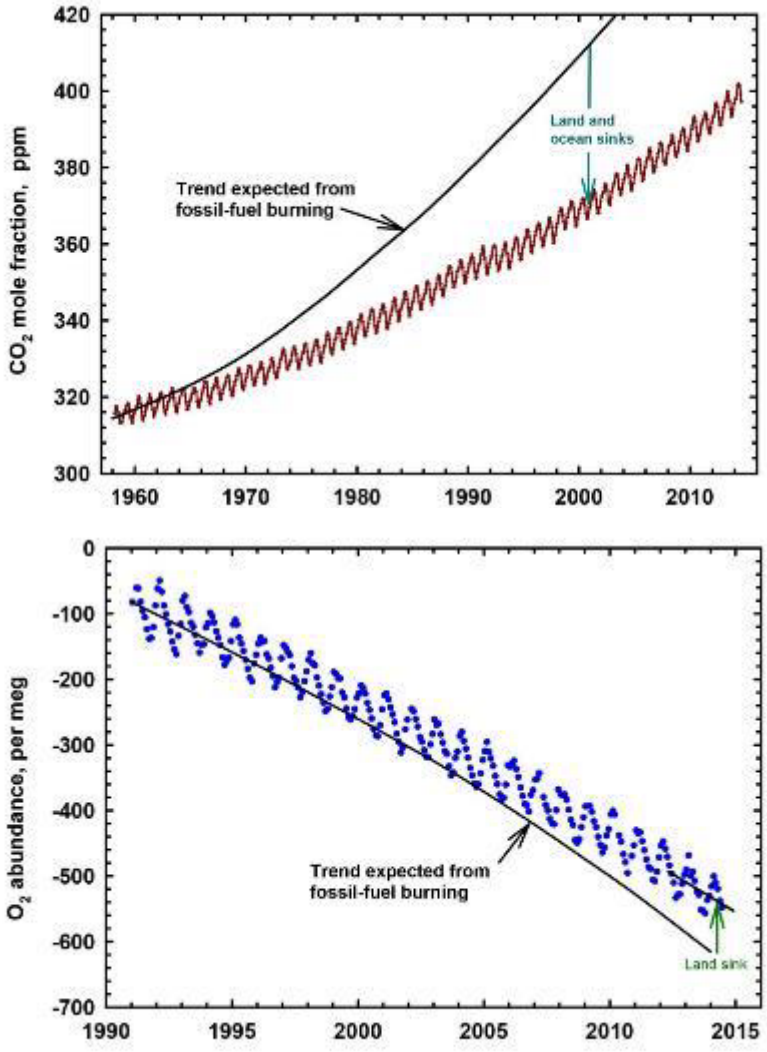
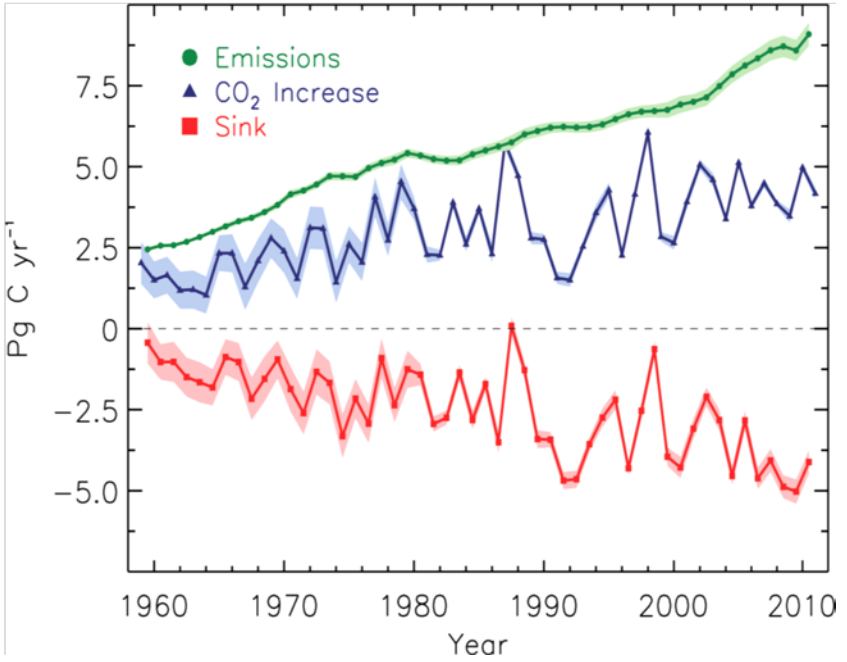
Complexity of carbon cycle





- Identification of sinks needs dedicated measurements
- CO_2 uptake by oceans lead to ocean acidicfication
- Knowledge of **terrestrial** and **ocean** sinks is essential for definition of **anthropogenic contribution**

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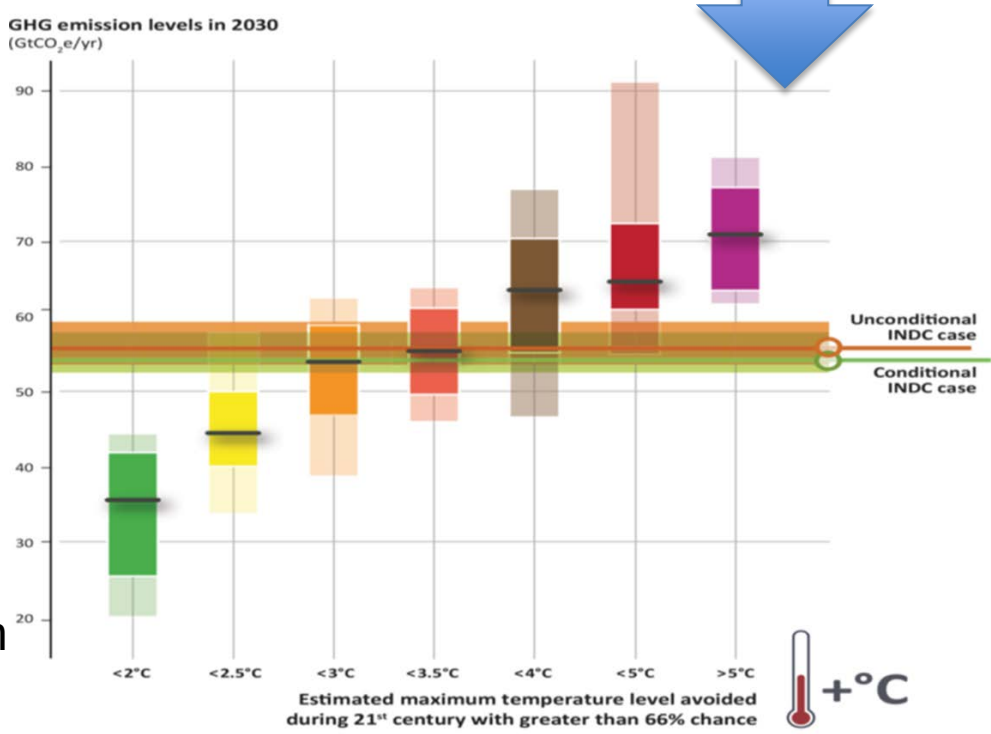
How to get emissions?

- "Bottom-up" measurements (IPCC reporting)
  - Emissions reporting
  - Reported and "verified" offsets
  - Site-specific measurements
- **"Top-down" measurements**
  - Comprehensive atmospheric observation system
  - Ecosystem and ocean observations
  - Inverse modelling
- **Combination of above**
  - Need to compliment bottom with observed

NDCs

Assuming that we know ocean and biospheric uptake



NDC are evaluated every 5 years

- **Are we on the right track?**
- **Where can we cut more?**
- **Are oceans and biosphere working as expected?**

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UNFCCC Process and concept evolution

Then (2010)

Binding Multi-national Treaty Commitments

"we will <u>verify</u> your reported emissions"

A grand, top-down GHG Information System

Advocates: Science Community!!!

Now (2016)

Nationally Determined Contributions

"we will <u>help</u> you <u>improve</u> your data"

Federation of focused monitoring systems

Advocates: WMO (191 countries), States (eg, CA), Cities (eg, C40), NGOs, Industry (eg, Oil Companies)

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The Integrated Global Greenhouse Gas Information System (IG^{3}IS)

Goal: Support the success of post-COP21 actions of nations, sub-national governments, and the private sector to reduce climate-disrupting GHG emissions through a sound-scientific, measurement-based approach that:

- **reduces uncertainty of national emission inventory reporting,**
- **identifies large and additional emission reduction opportunities, and**
- **provides nations with timely and quantified guidance on progress towards their emission reduction strategies and pledges (e.g., NDCs)**

Concept paper was approved by WMO Executive Council in 2016

The Integrated Global Greenhouse Gas Information System (IG³IS)

Principles

- IG³IS will serve as an international coordinating mechanism and establish and propagate consistent methods and standards.
- Diverse measurement and analysis approaches will fit within a common framework.
- Stakeholders are entrained from the beginning to ensure that information products meet user priorities and deliver on the foreseen value proposition.
- Success-criteria are that the information guides additional and valuable emission-reduction actions.
- IG³IS must mature in concert with evolution of technology and user-needs / policy.

Near-term IG³IS Objectives (3-5 year horizon)

Support of Paris Agreement:

- Improved national inventory reporting by making use of atmospheric measurements for all countries
- Timely and quantified trend assessment of NDCs in support of "Global Stocktaking"

Key sub-national efforts and new mitigation opportunities:

- GHG monitoring in large urban source areas (megacities)
- Detection and quantifying large unknown CH_4 emissions

Implementations of IG^{3}IS

Two main directions of work:

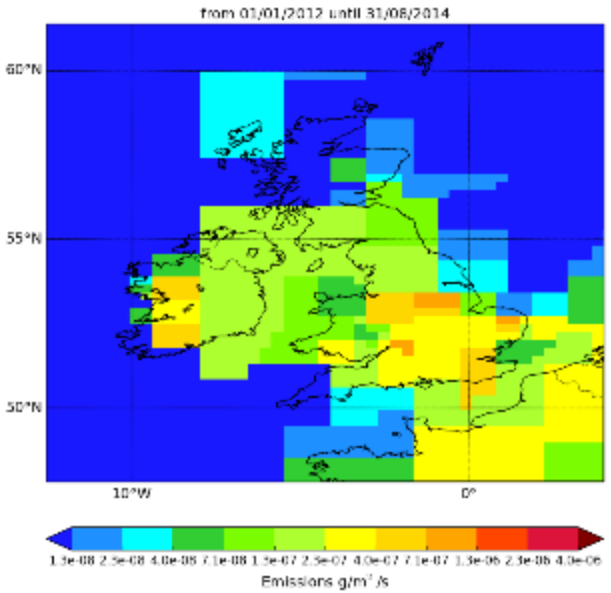
- Development of best practices for each of the four near-term objectives
- Implementation of pilot projects for different objectives

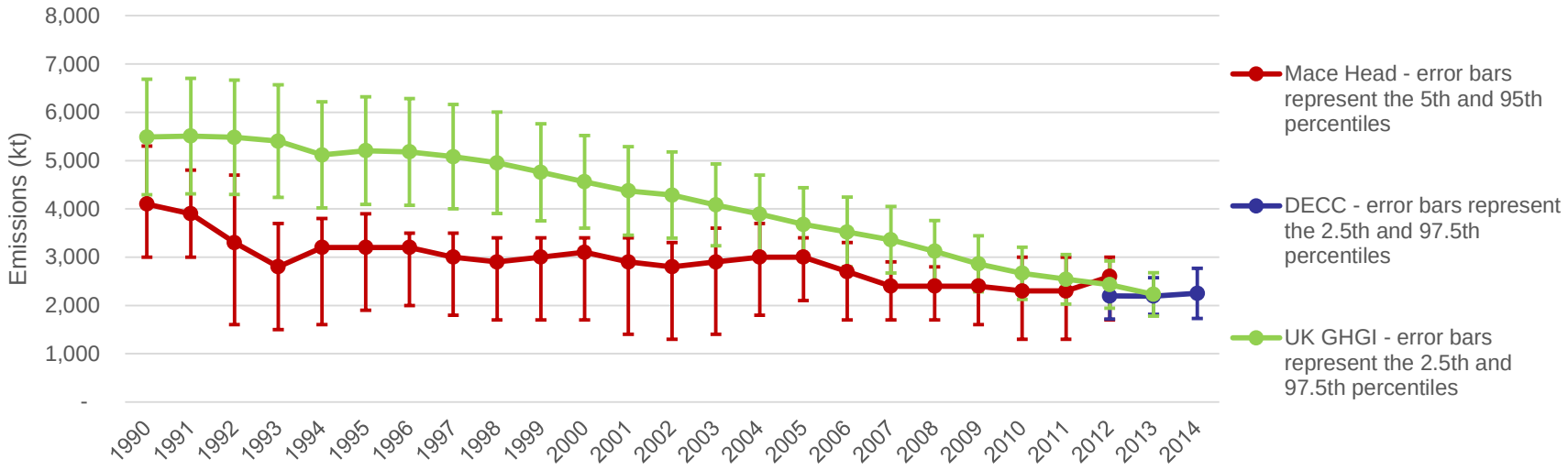
Preparation on the pilot projects (for improved inventories reporting and trend assessment):

- Switzerland and UK demonstrated possibility (“best practices”)
- Applications to Green Climate Fund are being developed by Brazil, South Africa and Morocco to establish national projects
- Areas of interested to be addressed by the projects are agriculture, land use change (may be energy production)
- Network design to be developed as a part of feasibility study
- Other countries are planning national studies using national funds (Australia, New Zealand, South Korea)

Example from UK report to UNFCCC: Methane

- Early (1990s) mismatch with the inventory.
- Difficult to understand, most likely cause is landfill emissions but retrospectively challenging to investigate.
- Inspired DECC to expand the network from 1 to 4 stations.





UK MetOffice NAME model is used for flux mapping

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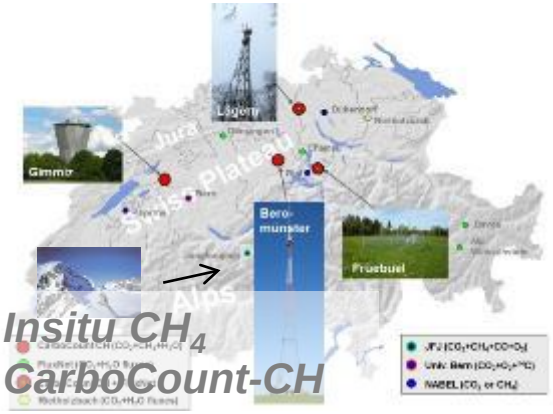
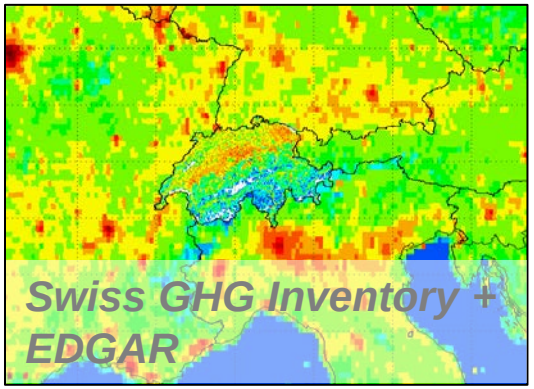
Inverse Modelling for Inventory Validation

Empa
Materials Science and Technology



Insitu CH_4 CarboCount-CH

High resolution FLEXPART-COSMO



Swiss GHG Inventory + EDGAR

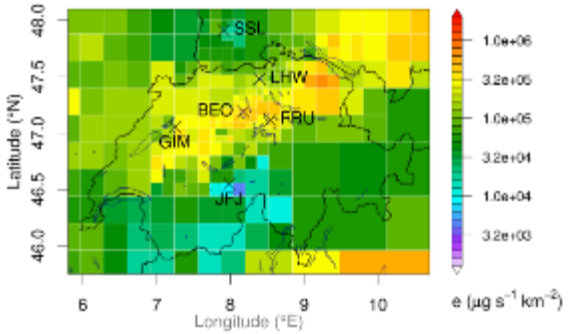
Constituent observations

Simulated flux sensitivities

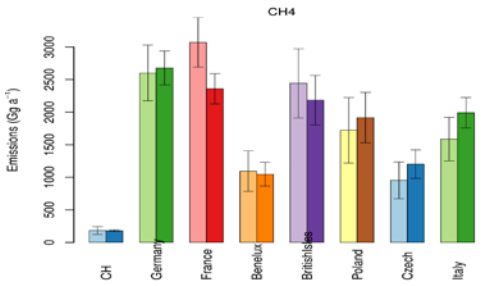
A priori estimates of surface flux

Inversion algorithm

A posteriori estimates of surface flux



Total CH_4 emissions 2013

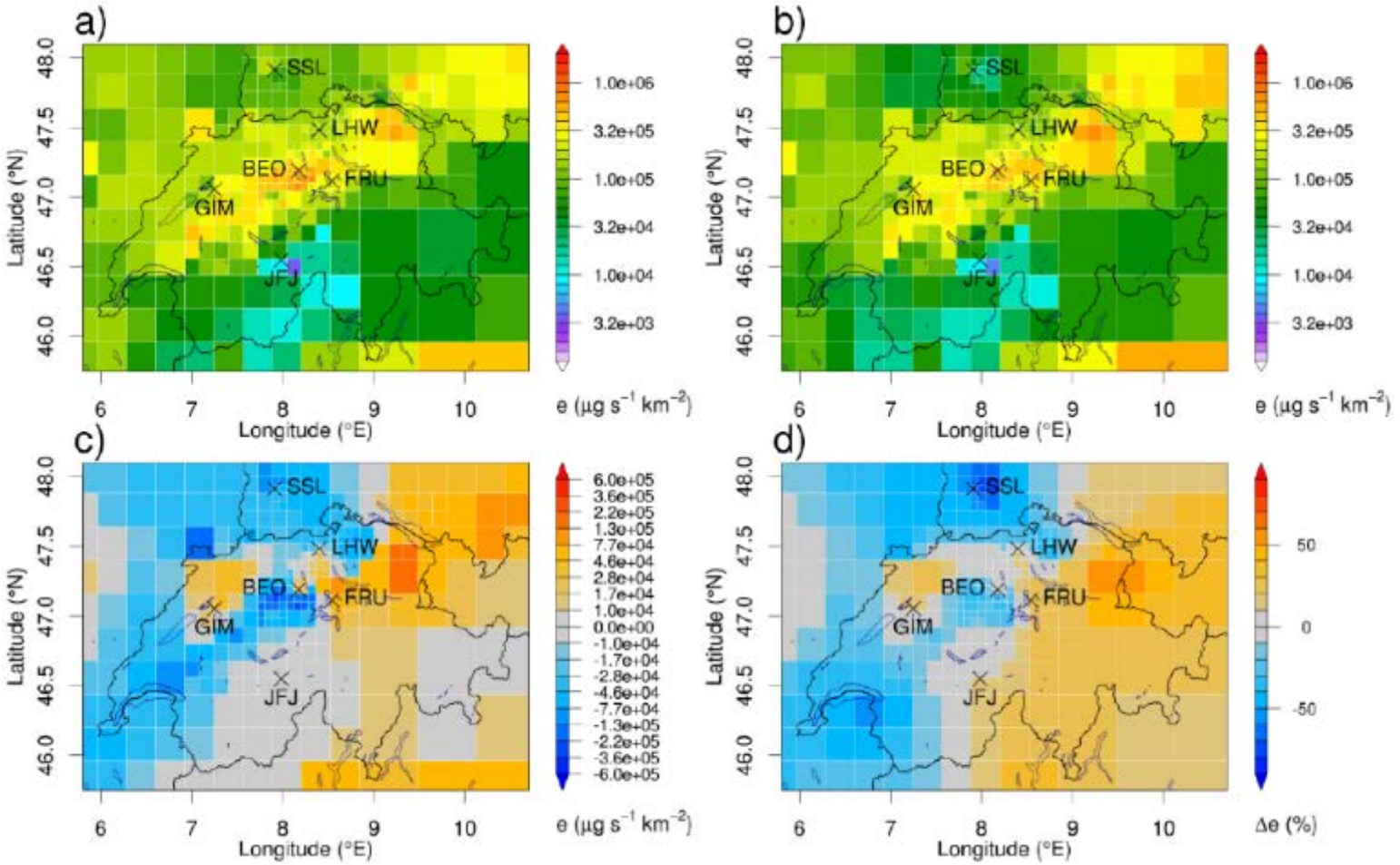


Country total emissions

stephan.henne@empa.ch

Example from Switzerland: Methane

- Great match between national total (“bottom-up” and “top-down”) but incorrect spatial distribution



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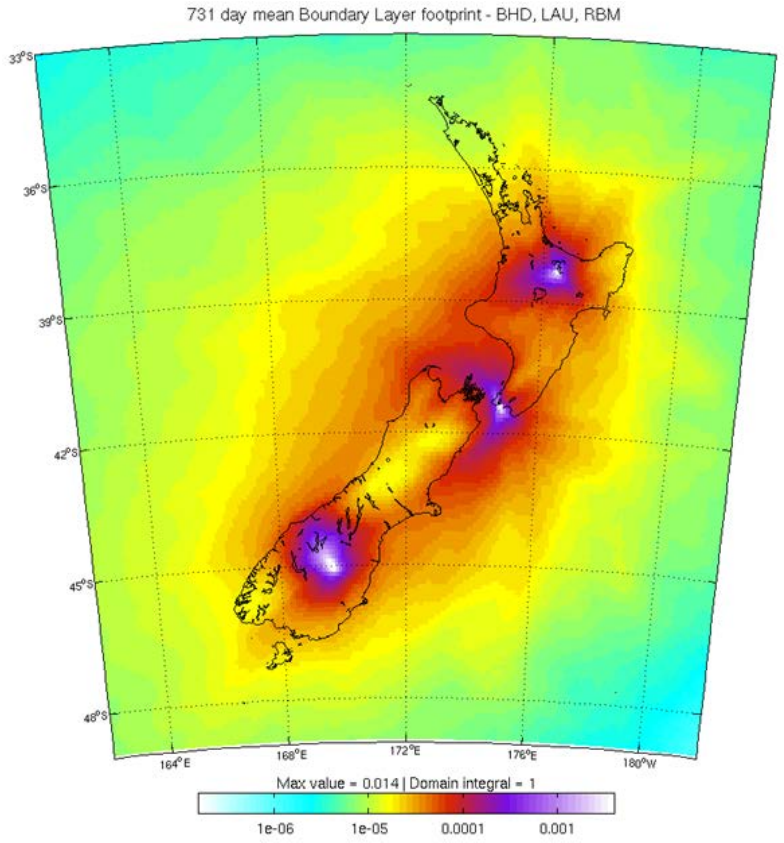
(S. Henne et al., 2016)

New Zealand “top-down” regional carbon programme

- NAME is used for the inverse modelling.
- Currently 3 observation sites contribute CO_2 data to the inverse model.
- NIES Transfuture 5 observations are included when it is within the domain.
- Adding 2 new sites this year.



(Steinkamp etal, 2017)

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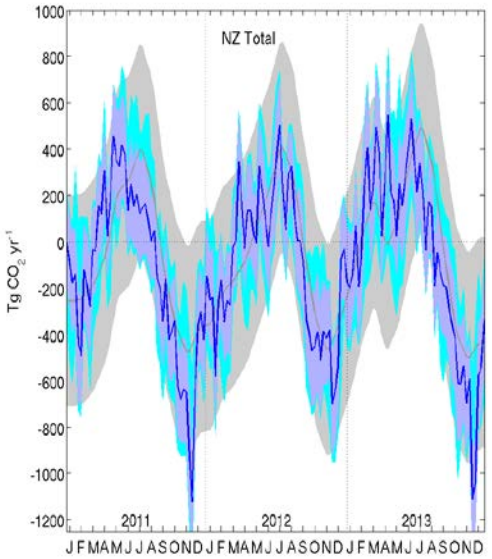
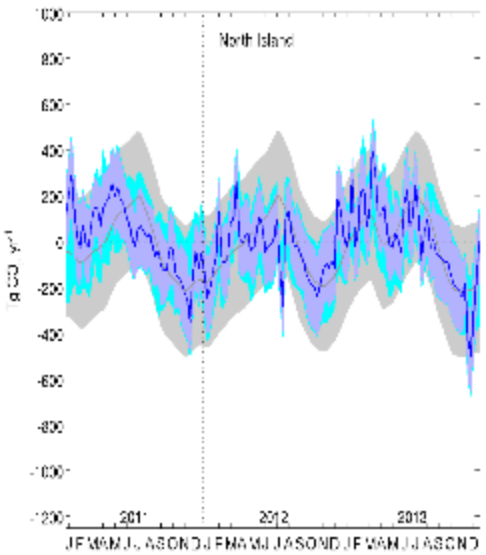
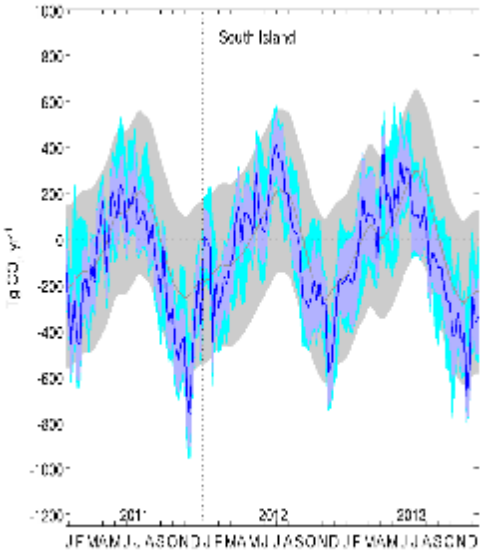
Terrestrial Biosphere Flux Estimates





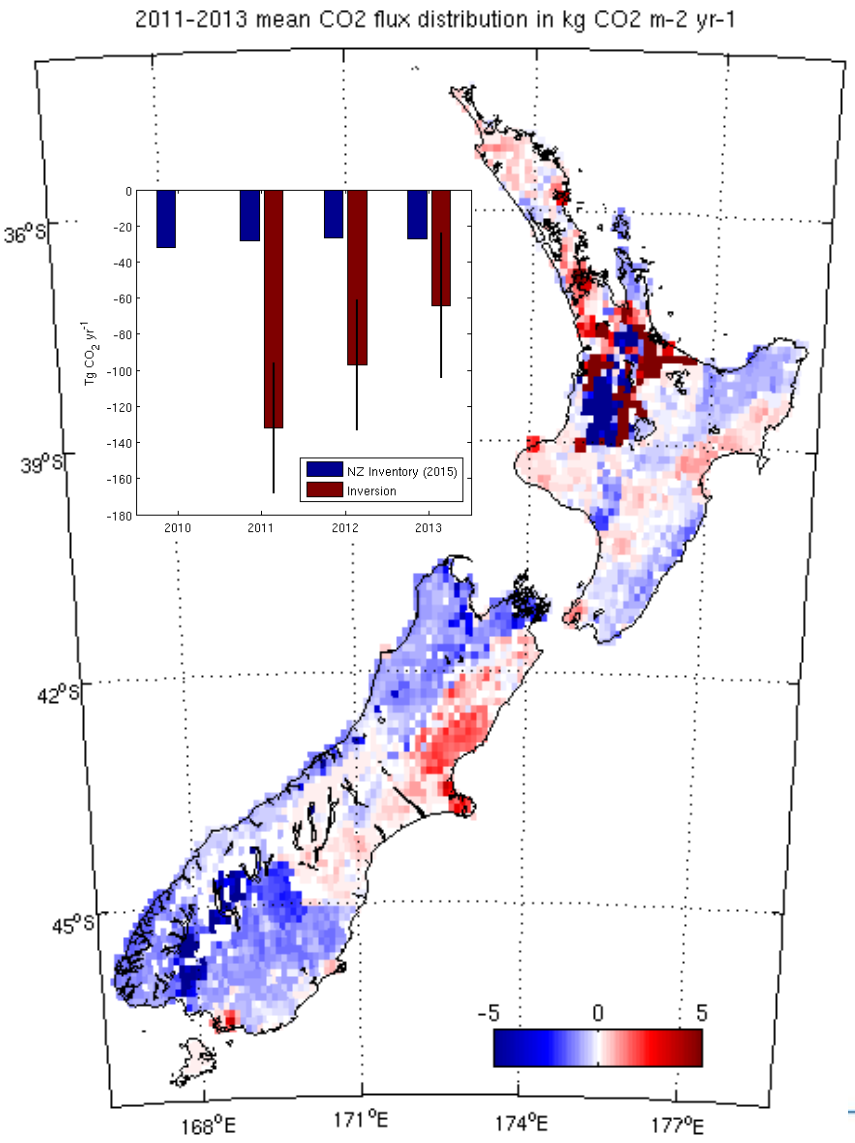


Inverse Estimates

Prior Uncertainty

Formal uncertainty from the inversion

Sensitivity cases



Geographic Distribution of Inverse Flux Estimates

- Larger uptake than prior model or bottom up accounting, particularly in forested regions
- Differences to bottom up accounting partly due to differences between LULUCF and what the atmosphere 'sees'. These issues are still being resolved.

How to make it happen?

National scale (reduction of emission inventories uncertainties and situational awareness):

- Installation of several new measurement stations (with initial analysis of footprint)
- Enhanced measurement programme (for attribution), including isotopic measurements
- Installation of transport models (linked with NWP) to be operated in inverse mode
- Establishment of appropriate data infrastructure (to combine diverse information)

Urban scale and new mitigation opportunities:

- Use of national GHG maps (as above), combined with satellite observations to identify “hot spots”
- Equip mobile laboratory with high resolution GHG equipment
- On urban level – collect additional information on high resolution meteorology
- Perform inverse modelling

Required partnerships:

- National emission inventory agency for a-priori emission information and **uptake of results**
- Municipalities – for urban statistics and **uptake of results**
- Environmental protection Agency – for joint development of **high density urban network** (both air quality and GHG with use of high quality GAW recommended equipment at a number of stations and potential lower cost technologies for dense monitoring)

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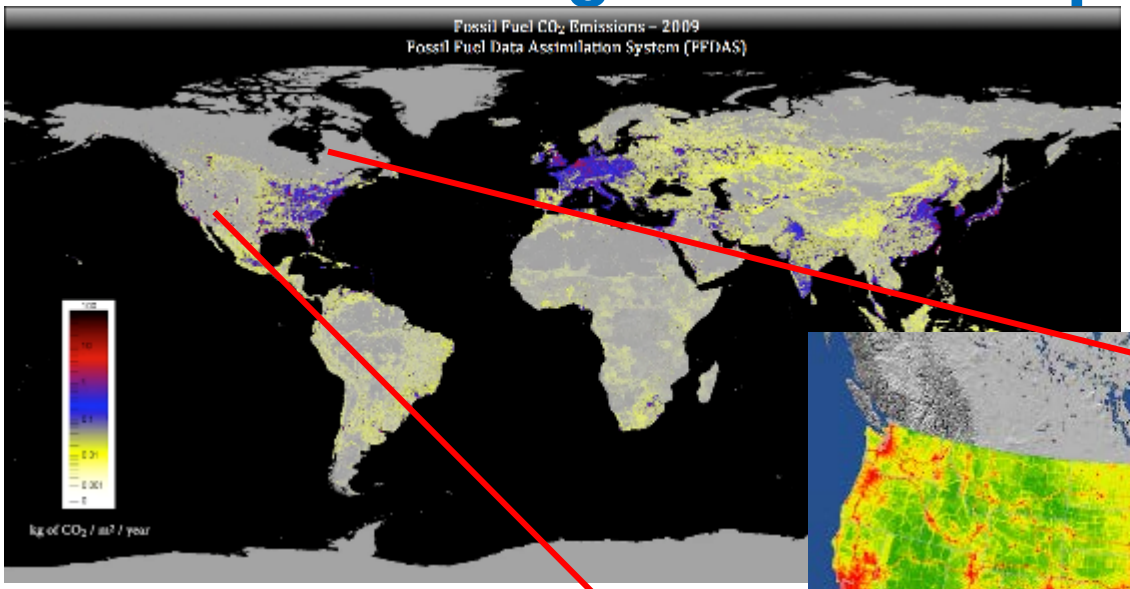
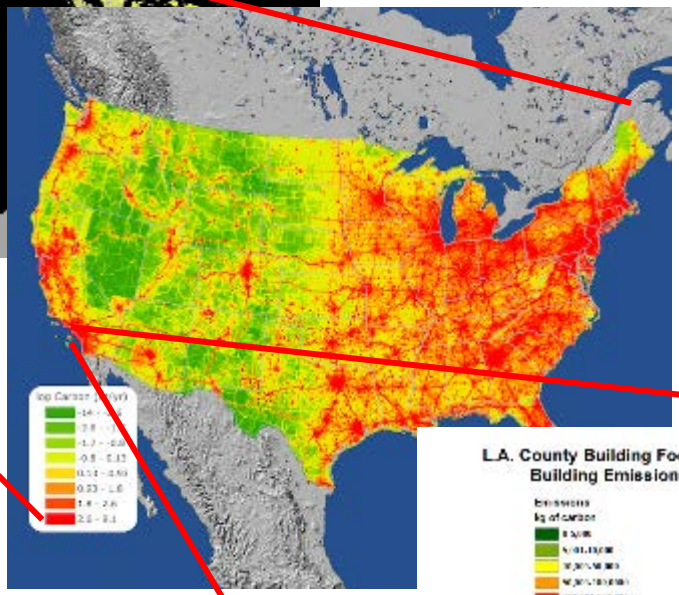
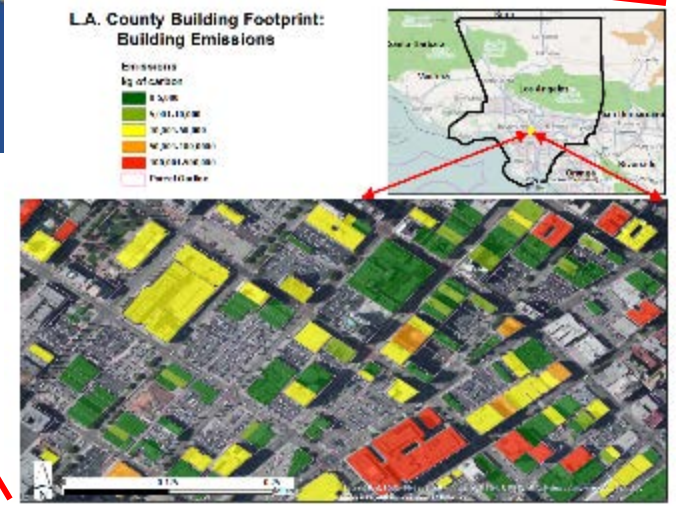
Where do we want to get to?
"Nesting" – from the planet to a building







- Global consistency
- Consistency across scales
- standardization

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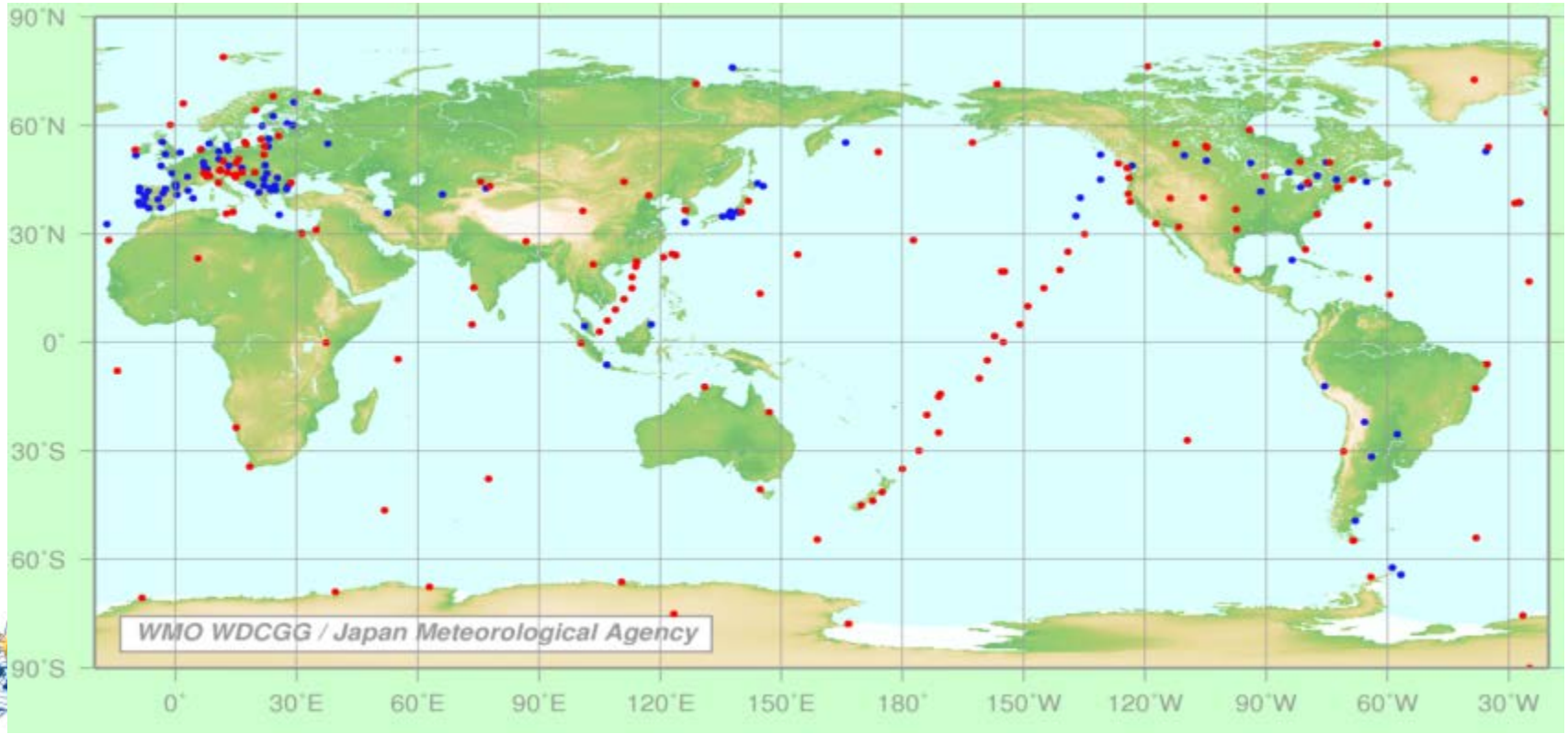
WMO Role in GHG Information and IG^{3}IS: Methods and standards for GHG Observations

The Role of the World Meteorological Organization (WMO)

- Ensure high quality, consistent, continuous GHG and other observations of atmospheric composition
- Develop high quality atmospheric transport and data inversion models
- Coordinate global atmospheric measurements; improve models and analysis
- Leverage capabilities across programs and nations
- Build capacity in developing nations



Summary

- There is an immediate need for tools to assist in national emission inventory assessment
- IG3IS and other complimentary products offer this.
- Best practice studies to be established as pilot projects
- Availability of tools to enable a wide uptake.
- Need to ensure consistent language for clarity.

Thoughts on future needs

- How do we ensure two/three way conversations are taking place to more rapidly meet the goals?
- What can we add as observations that aid the interpretation of source and sink processes?
- How do we access/combine/promote observations of different lineages.
- We have a need to work across boundaries at all levels ensuring that the big picture stays clear.

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