WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO/UNEP Integrated Global Greenhouse Gas Information System in the context of the international efforts to support climate actions

Oksana Tarasova*, Phil De Cola and BIG IG3IS TEAM
*WMO Research Department

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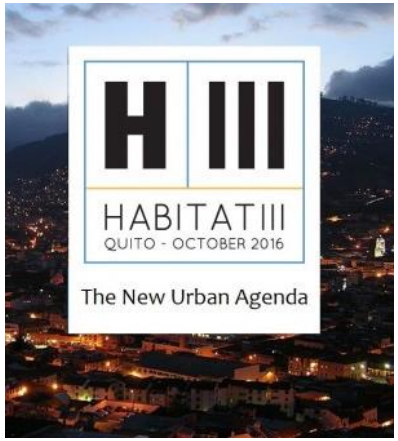
GAW

Broad international agenda

- “Transforming our world: the 2030 Agenda for Sustainable Development” - 17 Sustainable Development Goals with 169 associated targets
- Sendai Framework for Disaster Risk Reduction 2015–2030 with seven global targets
- Paris Agreement adopted by conference of parties to United Nations Framework Convention on Climate Change (COP-21)
- The New Urban Agenda adopted at Habitat III



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Key features of the Paris agreement

- **New legal agreement** for the post-2020 climate regime under the UNFCCC
- Addresses **mitigation, adaptation and minimizing loss and damage**
- Ambition to limit warming **to well below 2 °C above pre-industrial levels** while **pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels**
- Addresses the means of implementation: finance, technology and capacity building
- Builds on **Nationally Determined Contributions** (NDCs) from Parties to the UNFCCC, a crucial step towards common objective
- Countries invited to update emission targets by 2020 and every five years
- **Transparency** and reporting on national progress

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COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Paris Agreement and GHG Monitoring: Evolving from Top-Down versus Bottom-Up Paradigm

Then (2009)

Binding Multi-national Treaty Commitments

"we will verify your reported emissions"

A grand top-down GHG Information System

Advocates: Science Community!!!

Now (2016)

Nationally Determined Contributions

"we will help you improve your data"

Federation of focused monitoring systems

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

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2018 Talanoa Dialogue Platform to support global stocktake

"Talanoa is a traditional word used in Fiji and across the Pacific to reflect a process of inclusive, participatory and transparent dialogue. The purpose of Talanoa is to share stories, build empathy and to make wise decisions for the collective good. The process of Talanoa involves the sharing of ideas, skills and experience through storytelling.
During the process, **participants build trust and advance knowledge** through empathy and understanding. **Blaming others and making critical observations are inconsistent with building mutual trust and respect, and therefore inconsistent with the Talanoa concept**.
Talanoa fosters stability and inclusiveness in dialogue, by creating a safe space that embraces mutual respect for a platform for decision making for a greater good."

WMO/ scientific community has numerous tools and methods to share in support of climate actions!

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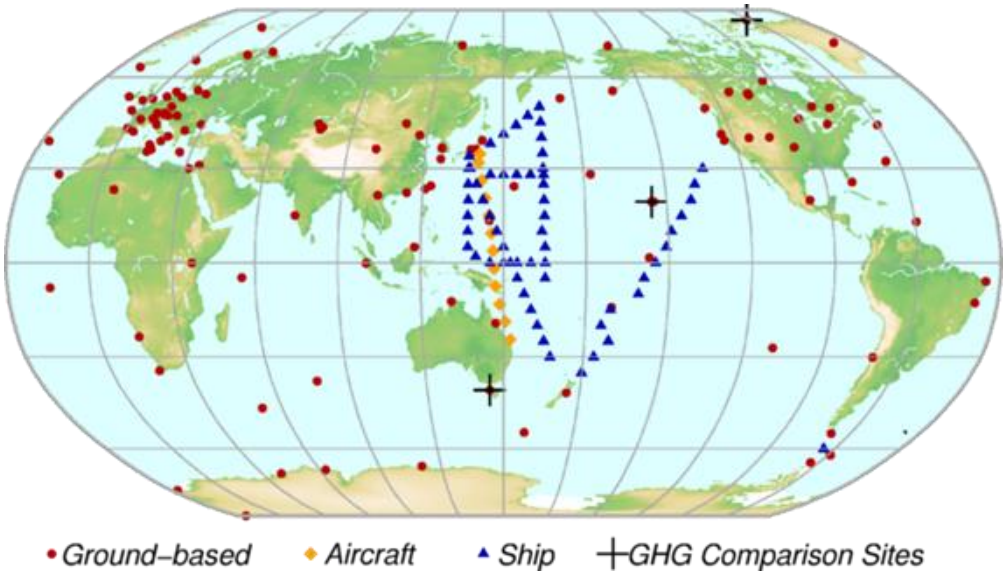
Memorandum of Understanding between WMO and UNFCCC

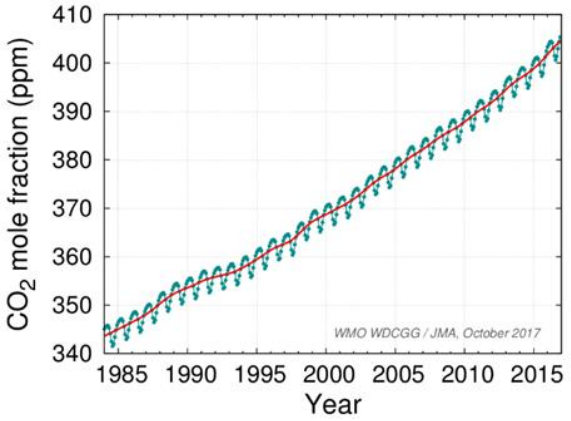
- Overarching framework (signed COP 23)
  - Research and evidence to support climate policy-making and investment
  - Technical cooperation on data, tools and methods to improve climate products and services for mitigation and adaptation
  - Frameworks and mechanisms for capacity-building at the regional and national levels

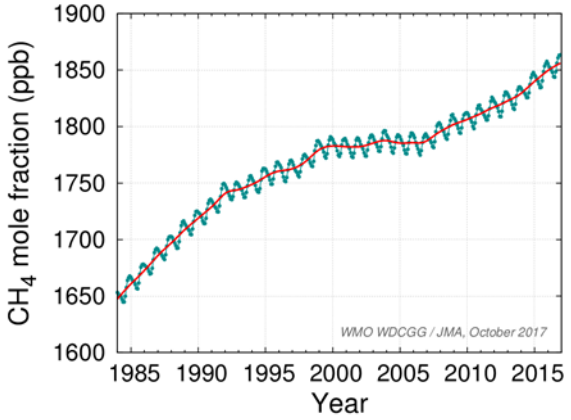
Memorandum of Understanding between WMO and UNFCCC

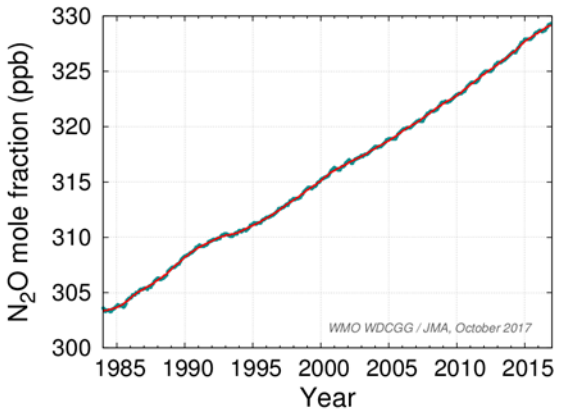
- Collaborative projects
  - Annual reporting on atmospheric GHG concentrations and the state of the global climate
  - Observation-based tools for improved national greenhouse gas emission estimates [IG^{3}IS]
  - Climate services for supporting adaptation planning and implementation
  - Regional collaboration for supporting adaptation and mitigation action

Role of WMO









- Facilities establishment of the common standards, measurement methods and quality assurance for the GHG and other observations of atmospheric composition
- Promotes development of high quality atmospheric transport and data inversion models
- Leverage capabilities across programs and nations
- Build capacity in developing nations

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Globally averaged mole fractions

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:

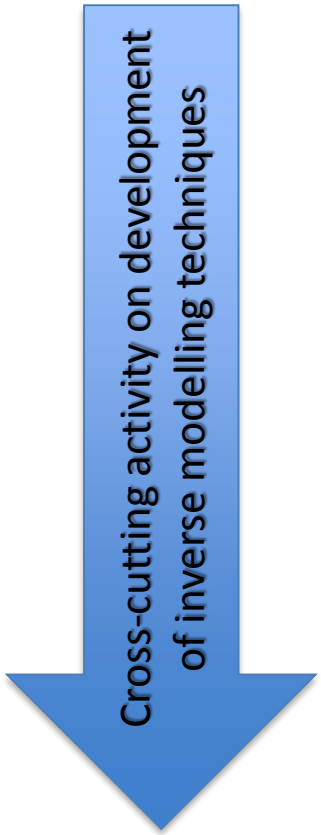
- **Improve knowledge of the national emissions**,
- **identifies large and additional emission reduction opportunities**, and
- **provides nations with timely and quantified guidance on progress towards their emission reduction strategies and pledges (e.g., NDCs)**

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

- IG^{3}IS will take a ***unified approach*** that combines atmospheric measurements with socioeconomic data and information on natural cycles to better quantify and attribute greenhouse gas emissions and sinks as well as their trends.
- IG^{3}IS will serve as **an international coordinating mechanism and a common platform to** establish and propagate consistent methods and good-practice approaches for using atmospheric measurements and models in support of improving understanding of GHG emission inside a framework of measurement standards. While the methodological details will vary, IG^{3}IS will establish **benchmarks** for expected skill and quality of emission information produced.
- The products will be initiated and developed in close **dialogue with** users while implementations success can be judged based on the users and **decision makers ability to take action** to reduce emissions of greenhouse gases and co-emitted pollutants.
- The system **must be practical** and focused on where the scientific and technical skill is proven, and where the use-case exists and the decision-maker recognizes value.

Near-term IG^{3}IS Objectives (3-5 year horizon)

1. Improve knowledge and reduce uncertainty of national emission inventory reporting to UNFCCC;
2. Locate and quantify previously unknown emission reduction opportunities such as fugitive methane emissions from industrial sources; and,
3. Provide subnational entities such as large urban source regions (megacities) with timely and quantified information on the amounts, trends and attribution by sector of their GHG emissions to evaluate and guide progress towards emission reduction goals.
4. Support of global stock taking



Annotated outline of the IG^{3}IS Implementation Plan was presented at EC-69 in May 2017

International context of IG^{3}IS

UNFCCC Paris agreement

- Articles 4, 13 -Extended Transparency Framework
- Article 7 – Systematic observations and science

IPCC emission inventories 2006 Guidebook refinement

- Issue 3: Update/elaborate verification guidance because the existing guidance is outdated (especially the guidance on comparisons with atmospheric measurements and new datasets) – section 6.

SBSTA under UNFCCC (COP23 decision)

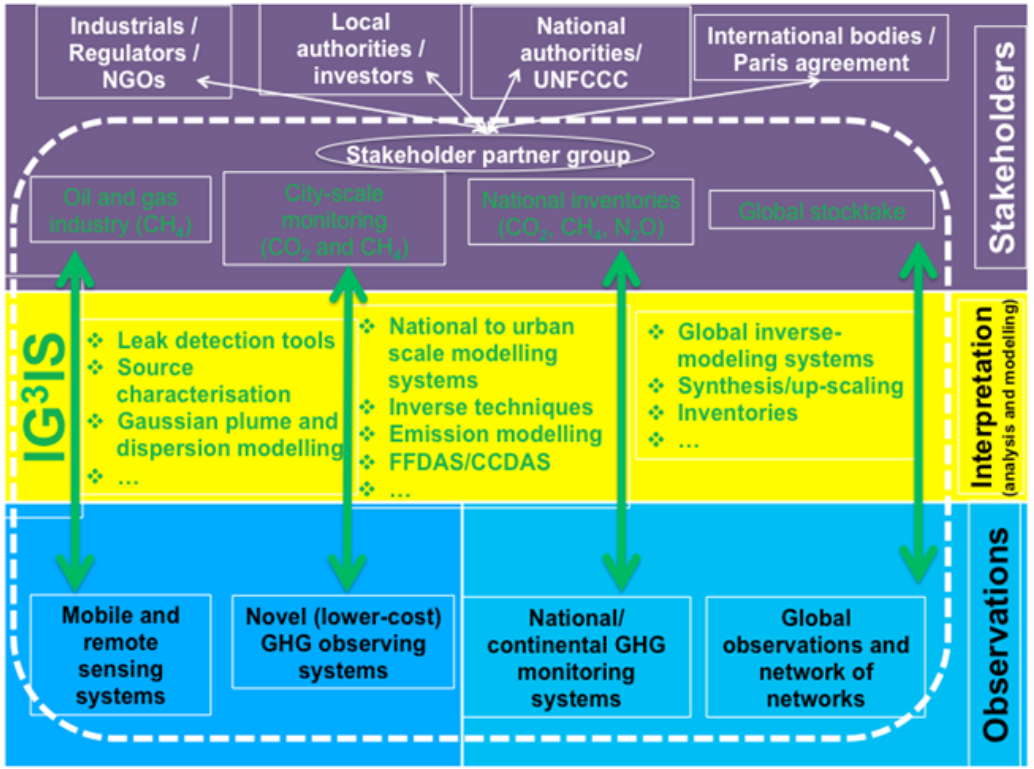
- "12. The SBSTA noted the increasing capability to systematically monitor greenhouse gas concentrations and emissions and its relevance in support of the Paris Agreement.[footnote: See reference in footnote 4 to the WMO submission, decision 51- IG^{3}IS Implementation Plan, and reference in footnote 3 to the Earth Information Day summary report, paragraphs 30–31 and 73–86.]"

IG³IS Implementation

IG³IS implementation is proceeding along two lines of activity:

1. The preparation of methodological guidelines that describe “good practice” use of atmospheric measurements for implementation under each objective area (Implementation plan to be finalized by April 2018)

2. The initiation of new projects and demonstrations that propagate and advance these good practice capabilities and build confidence in the value of IG³IS information with stakeholders.



Switzerland supports IG³IS project office (to be established in WMO)

More demonstrations and pilots are needed!

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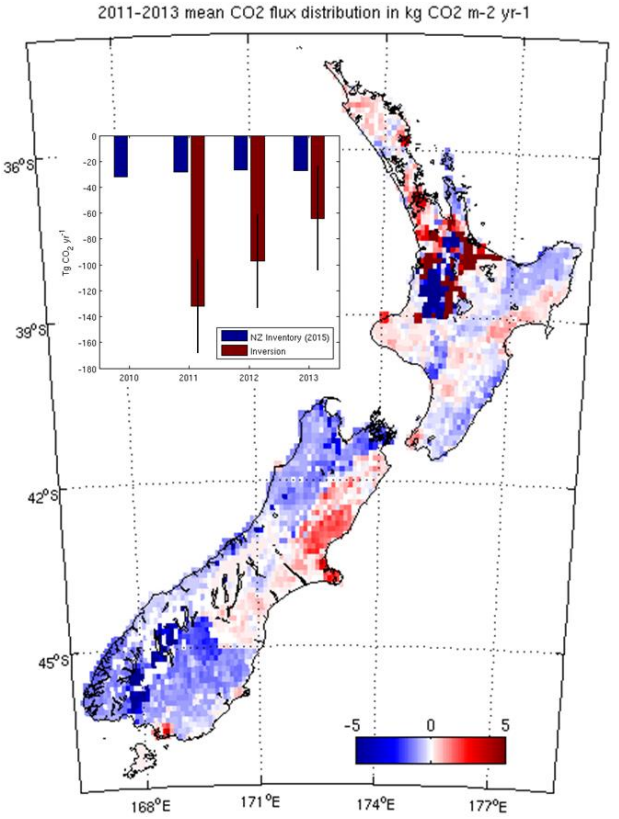
Objective 1: IG^{3}IS in Support of National Inventory Preparation

Leads: Alistair Manning, Dominik Brunner and Shamil Maksyutov

- Document the best practices of the GAUGE project in UK and CarboCount-CH project in Switzerland (for CH_4)
- Unique contribution from New Zealand for national land use sector emission estimates combining CO_2 and $^{14}CO_2$ observations



courtesy of Brailsford Gordon, NIWA

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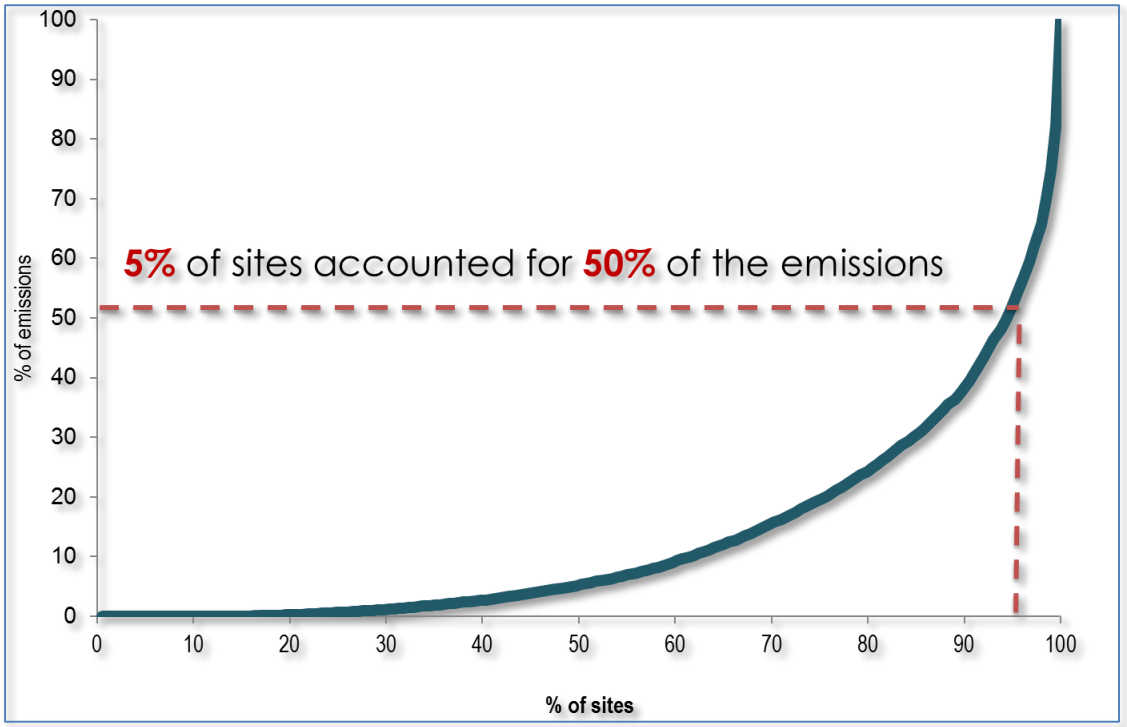
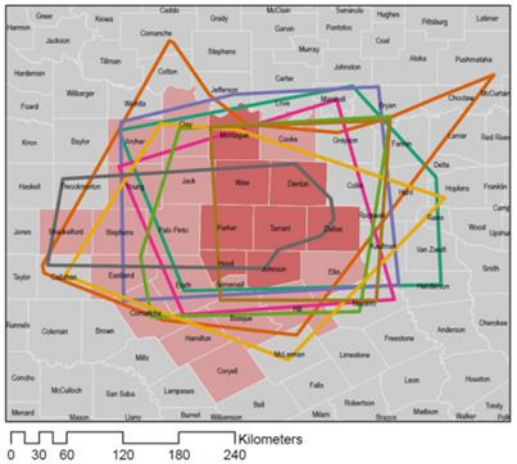
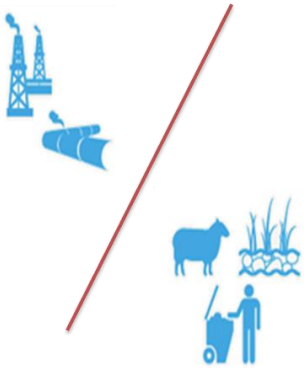
Objective 2: Detect and Quantify Anthropogenic Methane Emissions

Leads: Daniel Zavala, Rod Robinson and Gabrielle Petron



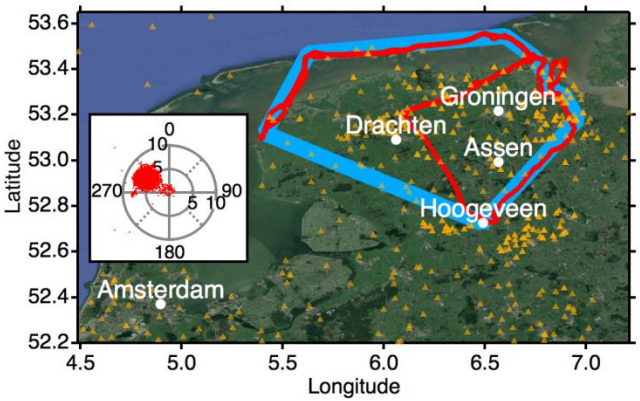


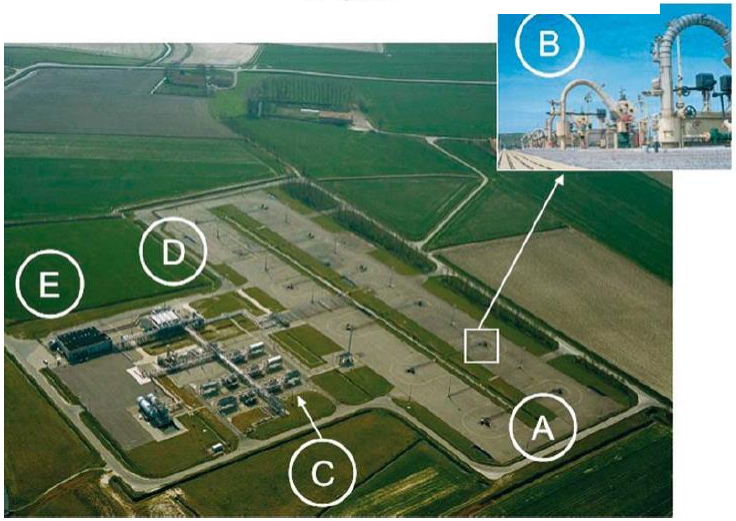
Multiple flights



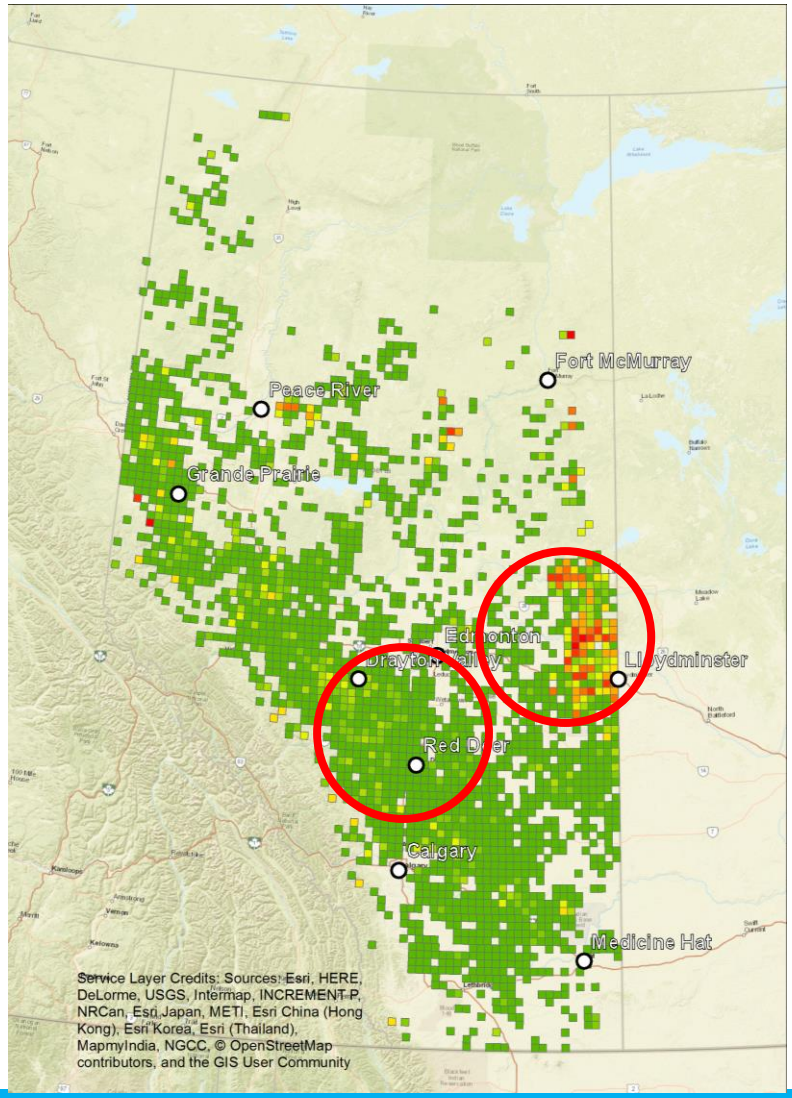
Attribution techniques

Multi-scale coordinated campaigns outside of the US





Groningen field,
The Netherlands



Alberta, Canada

Objective 3: IG^{3}IS in Support of City-Scale Mitigation Efforts

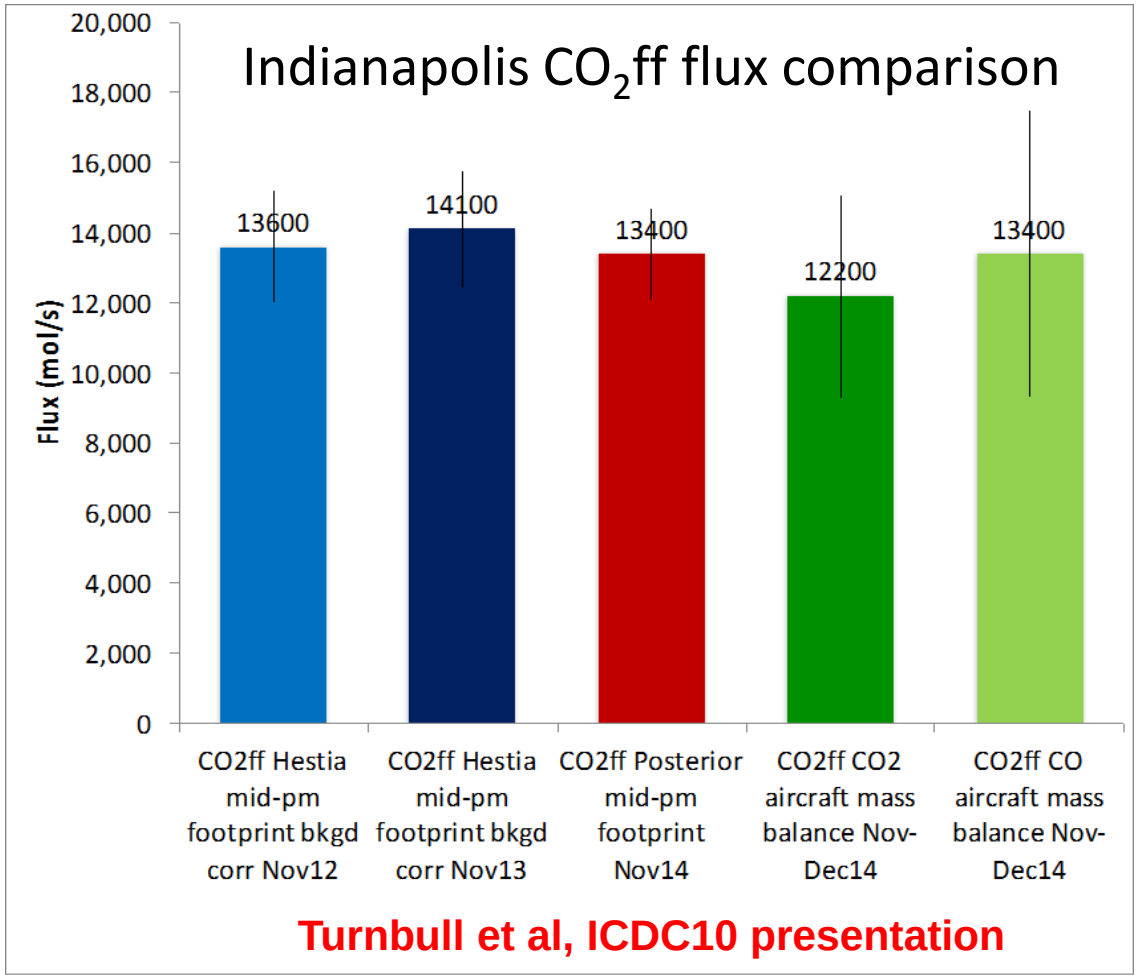
Leads: Felix Vogel, Jocelyn Turnbull and Kevin Gurney

- Hestia high resolution bottom-up data product
- Atmospheric inversion based on in situ tower CO_2 data and WRF/LPDM
- Mass balance using downwind aircraft measurements

➢ Flask measurements used to convert total CO_2 or CO to CO_{2ff} for aircraft and inversion

Excellent agreement across top-down and bottom-up methods

13,300 mols/s ± 6%



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Level of sophistication of urban stakeholder needs

Complexity of solution

Identify major emitters and anomaly detection	Quantification of total GHG emissions	Assessment of GHG emissions per sector	Tracking annual and long-term emission changes	Understand short-term emission changes and spatial patterns	Process understanding of emissions and tracking of mitigation impacts
Inventory validation (A1)	Inventory or emission model (A2)	Sector-specific inventory or emission model (A3)	Continuously updated inventory or emission model (A4)	Temporally and spatially disaggregated inventory or emission model (A5)	Process-based emission model using real-time emission data
Mobile surveys (B1)	Mass-balance (B2) Radon tracer method (B3)	Multi-tracer ratio observations (B4)	Radon tracer method (B5) Multi-tracer observations (B6)	Mobile surveys (B7) Repeated mass-balance	Dedicated field campaigns (
Remote sensing (C1)	DAS using short-term observations (C2)	*DAS using dense observations(C3)* *DAS using multi-species data*	DAS using long-term observations (C4)	*DAS using dense observations (C5)*	FFDAS DAS using multi-species

Demonstrated skills
Theoretically tested skills
Future potential skills

DAS = data assimilation system

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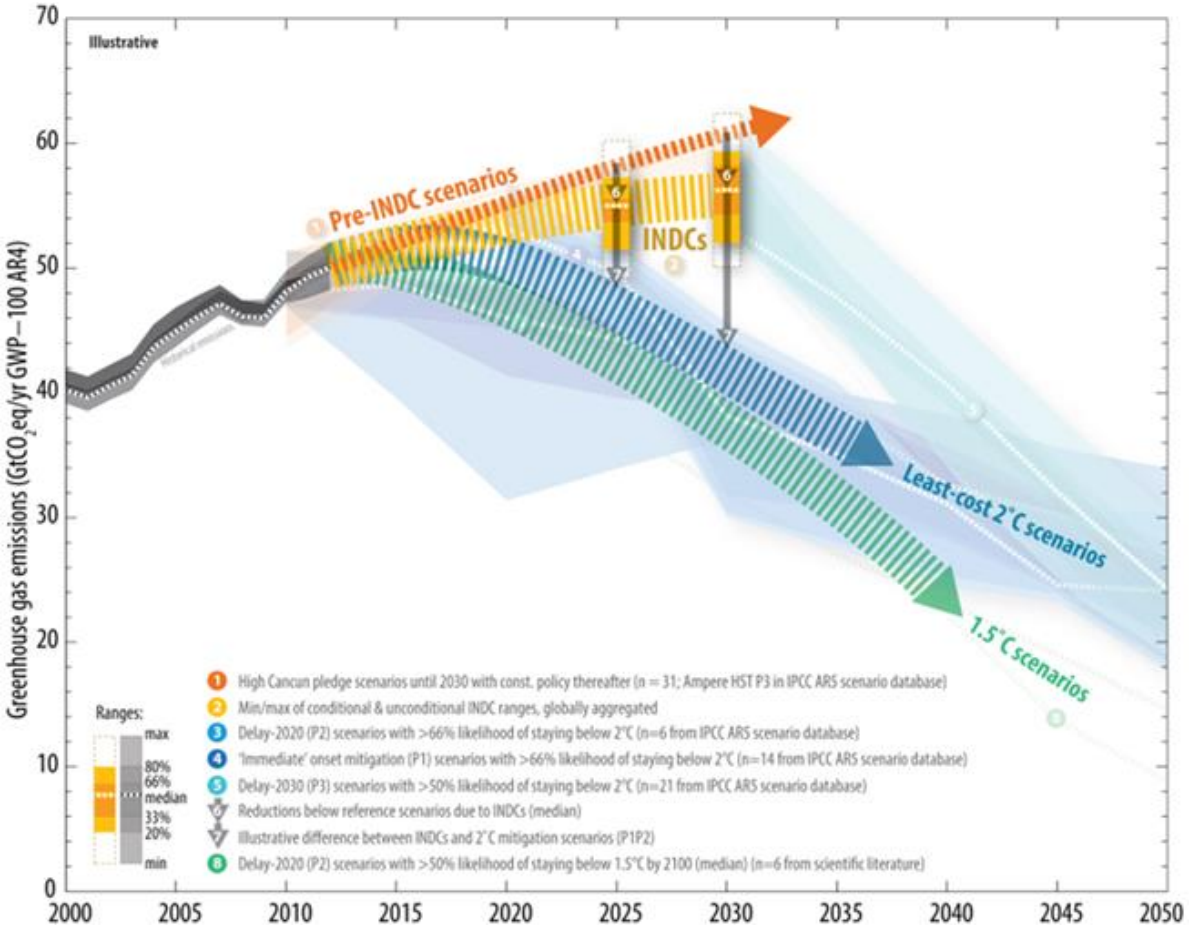
Objective 4: IG^{3}IS in Support of the Global Stock Take

Leads: Florin Vladu, Philippe Ciais and Frederic Chevallier



IPCC Special Report

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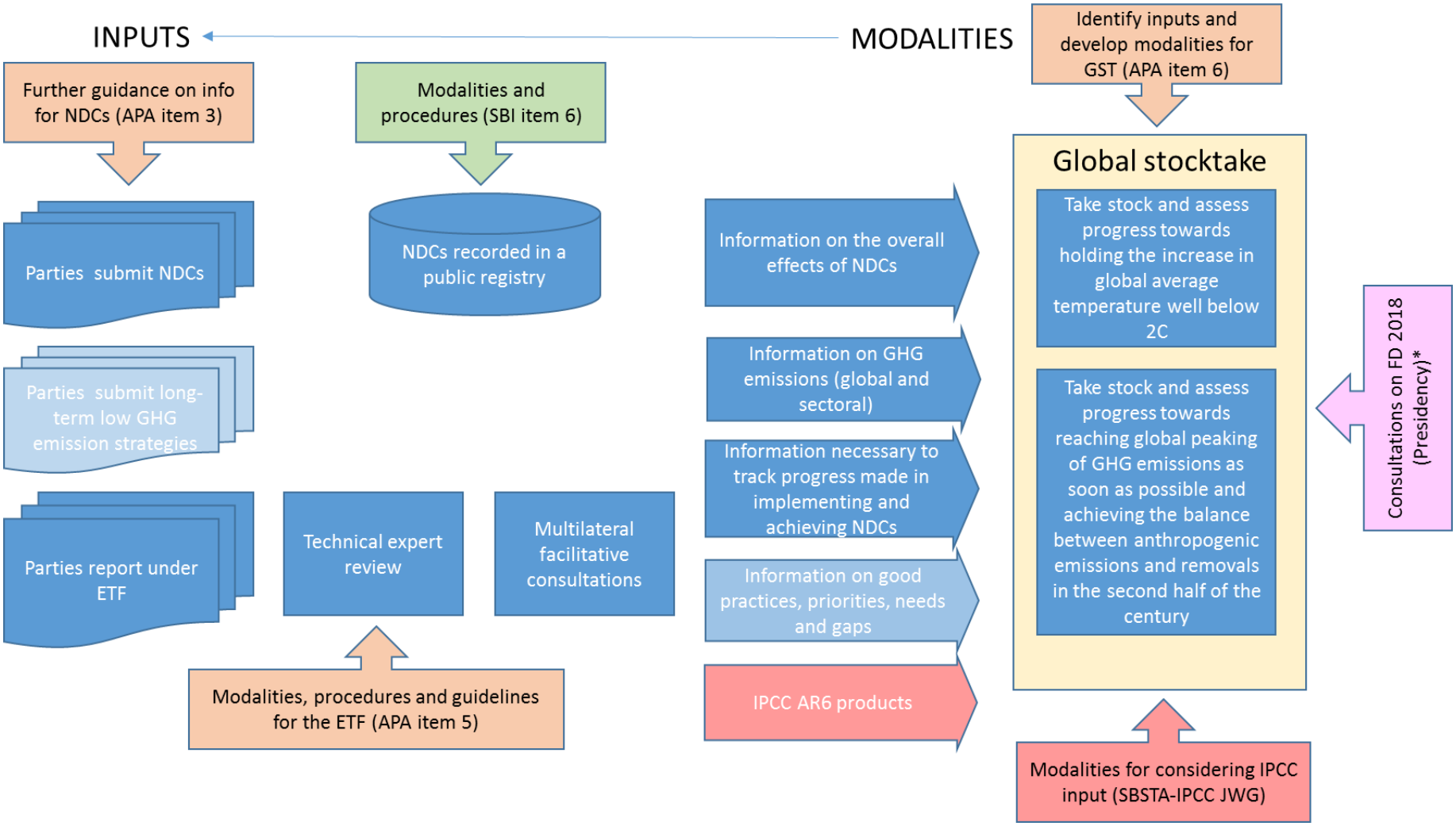
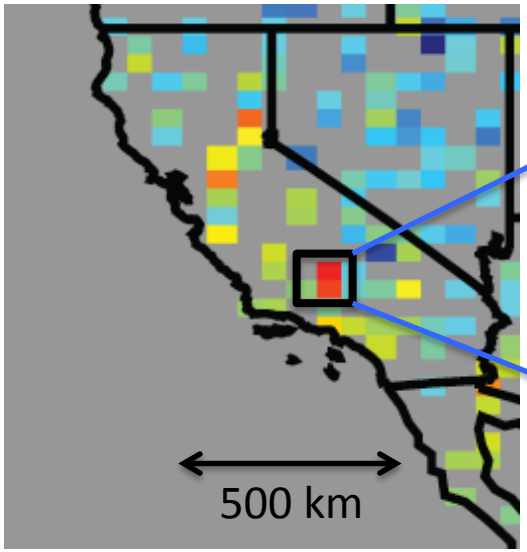
Ongoing activities on mitigation that could inform the global stocktake



Slide courtesy of Florin Vladu

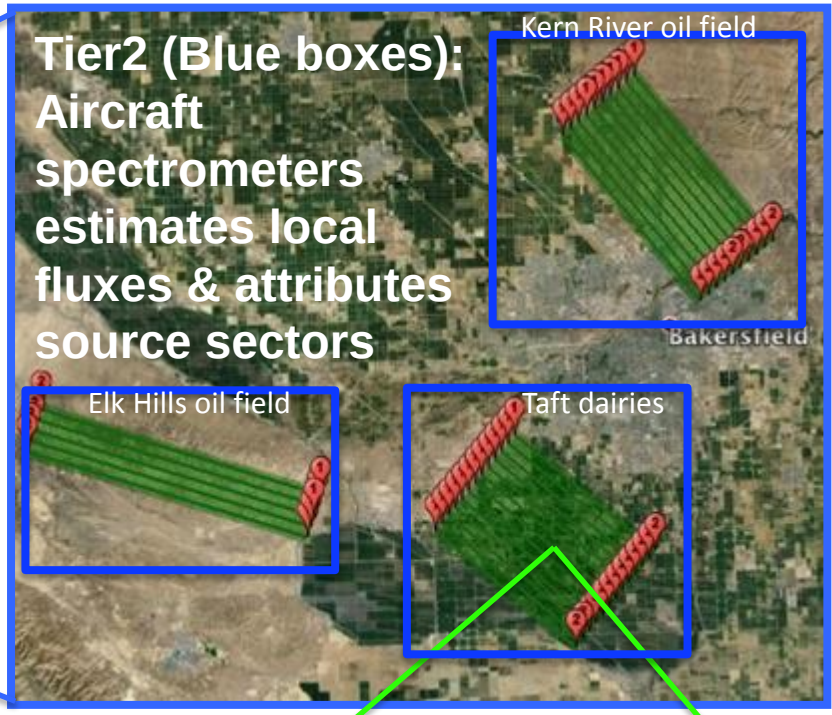
A tiered strategy for monitoring methane leaks in the US

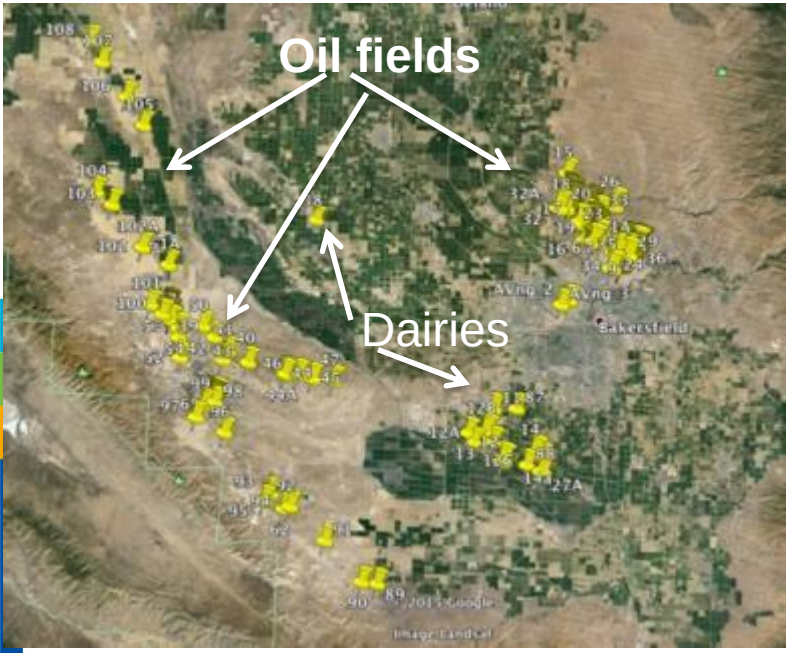
Tier 1: Satelite detects hotspot region



Turner et al 2015

Tier2 (Blue boxes): Aircraft spectrometers estimates local fluxes & attributes source sectors

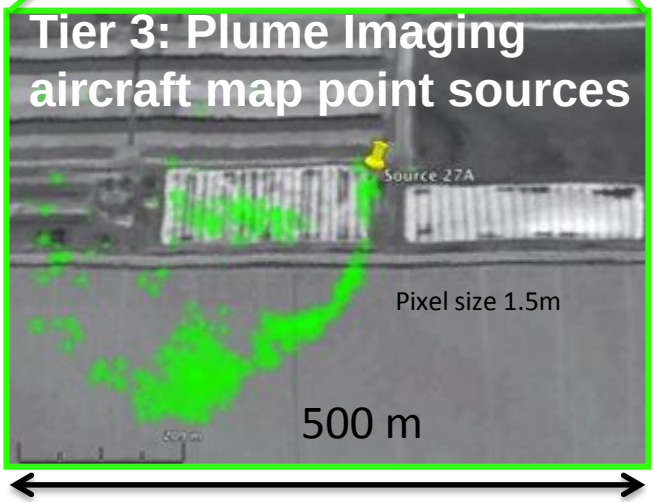




Enhanced Activity Data

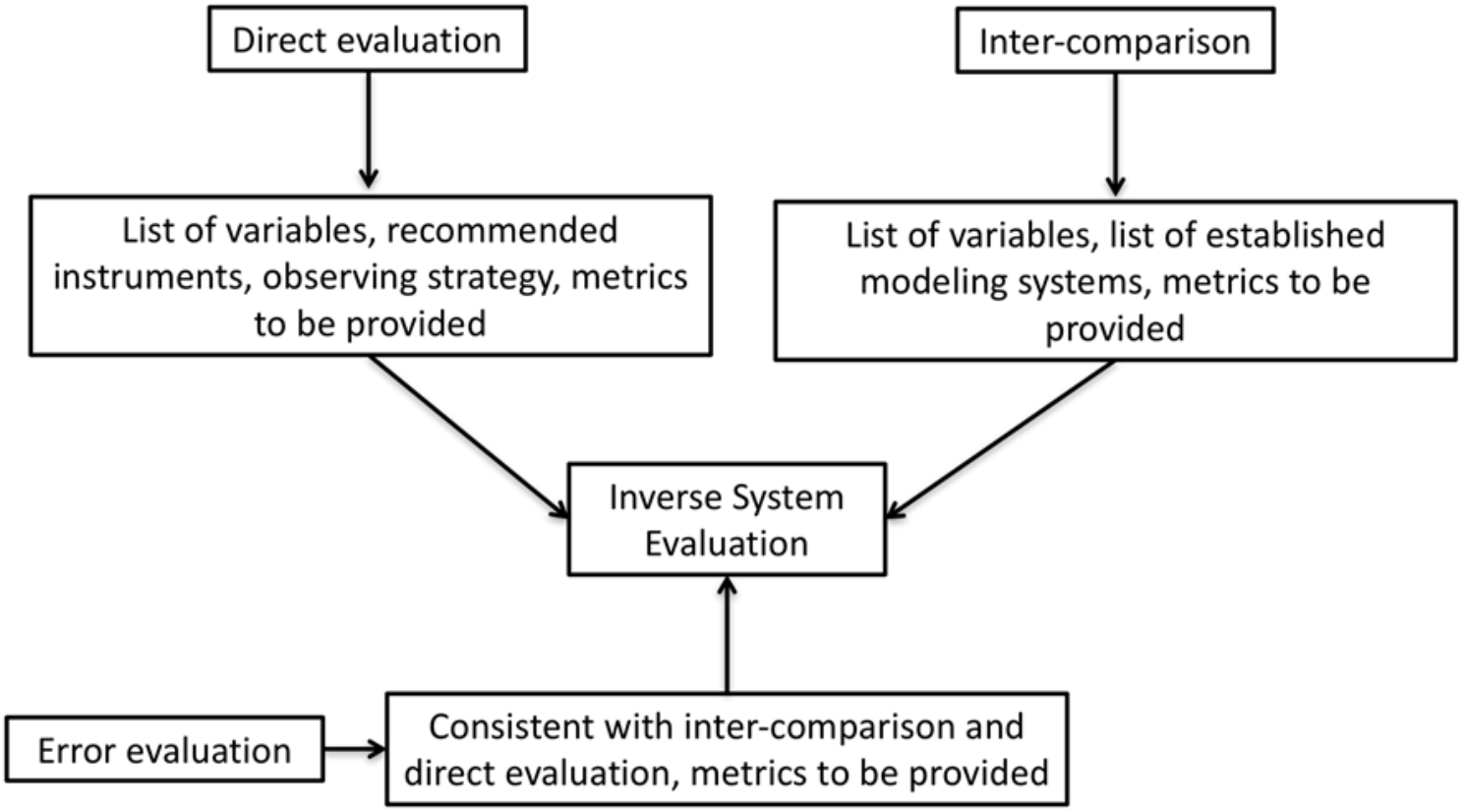
Tier 4 (not shown): Surface observations

Tier 3: Plume Imaging aircraft map point sources



IG^{3}IS Inverse Modeling Cross Cutting Activities

Lead: Sander Houweling and Thomas Lauvaux



Goal is to establish benchmarks for expected skill and quality of emission information produced.

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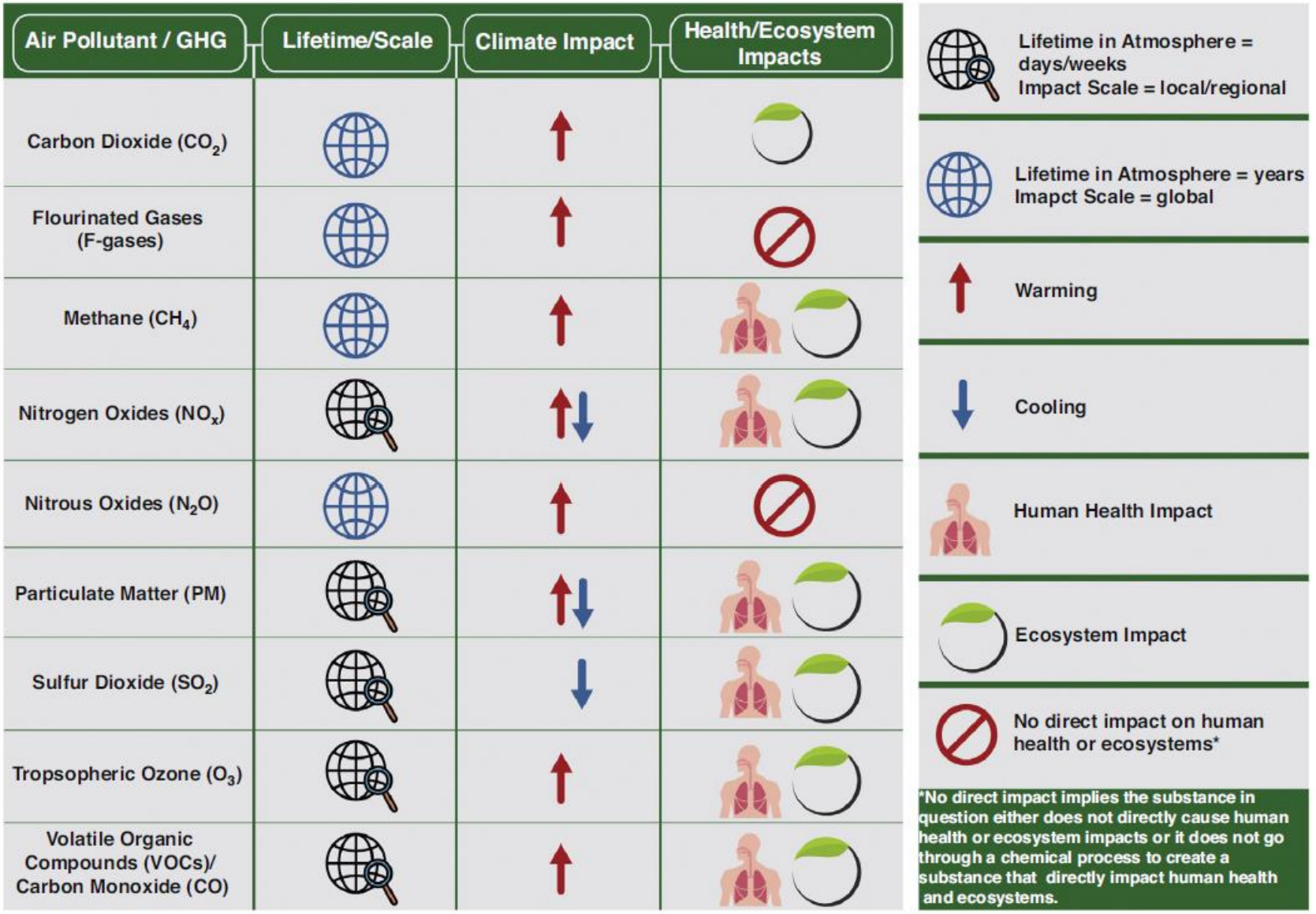
Co-benefits of combined climate and air quality policies



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(from Melamed et al., 2017)

What sectors can be supported by IG^{3}IS?

Mitigations	Main observations	Observations needed for sector attribution	Additional benefits
Transport and energy	CO_2	^{14}C in CO_2 CO, NOx	Air quality and health through co-emitted
Oil and gas emissions/ waste management	CH_4	CH_4 isotopic composition Volatile Organic Compounds (VOC)	Regional air quality (agricultural production loss due to O_3), health risks
Agriculture/ land use	CH_4, N_2O	CH_4 isotopic composition Volatile Organic Compounds (VOC) NOx	The same as above plus water quality

Adaptation measures:

- Minimization of impacts on human health
- Sustainable agricultural practices (with optimal use of fertilizers)
- Food security and development and development of pollution sustainable crops

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The players in the field

- **Global Climate Observing System (GCOS)** which officially reports on the state of the climate observations to UNFCCC and recommends on the Essential Climate Variable
- **ICOS (European Network for GHG observations in several domains: atmosphere, biosphere and ocean),** most of observations in the atmosphere contribute to WMO global network
- **GEO-Carbon :** global strategy on carbon
- **Copernicus Service** is operated by European Commission and aims also on building the integrated system for "emission verification", largely builds on the same infrastructure as WMO, but with much more focus on satellite capabilities
- **Climate and Clean Air Coalition** works on promotion of actions to reduce short-lived climate pollutants (black carbon and methane), CCAC will benefit from the observing system as it will serve as a tool to ensure the effectiveness of the measures taken by different economic sectors. CCAC promotes co-benefits of actions on pollutants for climate as the emitting sectors are largely the same

- **(Research) projects funded by the European Commissions (CHE, VERIFY), by EDF and NSF in USA and by national funding agencies that adopt IG³IS principles constitute the main implementation agents!**
- **IG³IS Team works to develop the sustained recourse mobilization strategy**

Thank you!
Merci!

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