2009.2.4-6, 3rd GEOSS AP Symposium, Kyoto, Japan

Theme and Task of Parallel Session: Monitoring and Predicting Climate Change

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Center for Global Environmental Research (CGER)

WG1: Monitoring and Predicting Climate Change

February 5 (Thu) February 2009
Co-Chair: Dr.Yukihiro Nojiri and Dr.Nobuko Saigusa
(National Institute for Environmental Studies)

09:30-9:40 Opening Climate Change Session (GEO Secretariat and Co-Chair)

9:40-10:05
Yasunori Tohjima (National Institute for Environmental Studies, Japan)
"Terrestrial and oceanic CO2 budget from atmospheric O2/N2 ratio measurement"

10:05-10:30
Patra Prabir (Frontier Research Center for Global Change, Japan Agency for Marine-Earth Science and Technology, Japan)
"Top-down estimation of CO2 fluxes: lesson learnt and challenges ahead"

WG1: Monitoring and Predicting Climate Change

10:30-10:55

Yan Xiaoyuan (Institute of Soil Science, Chinese Academy of Sciences, China): 25min.

“Trace gas emissions from croplands in Monsoon Asia”

10:55-11:20

Akio Kitoh (Meteorological Research Institute, Japan Meteorological Agency, Japan)

“Climate modeling for adaptation to climate change in Asia”

11:20-12:00

General Discussion and wrap-up (Chair: Y. Nojiri)

Existing Data Exchange Platforms

- Atmosphere
  - WDCGG
- Ocean
  - CDIAC/Ocean Carbon
  - IOCCP (GCP), GOSHIP, SOCAT
- Terrestrial
  - CDIAC/FLUXNET

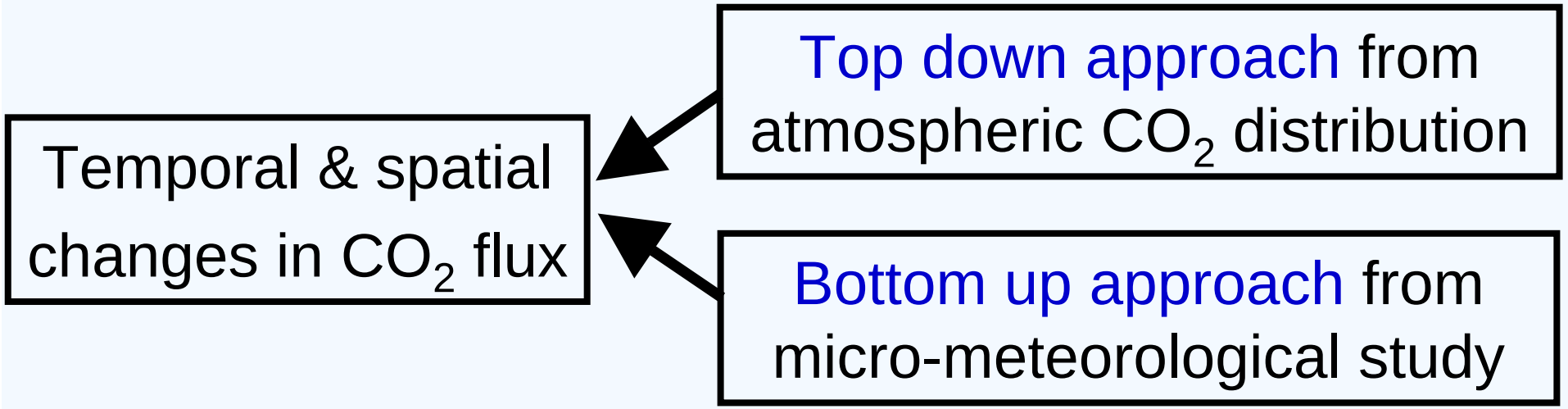
Stages of Observation

- Process study
- Research observation
- Operational observation

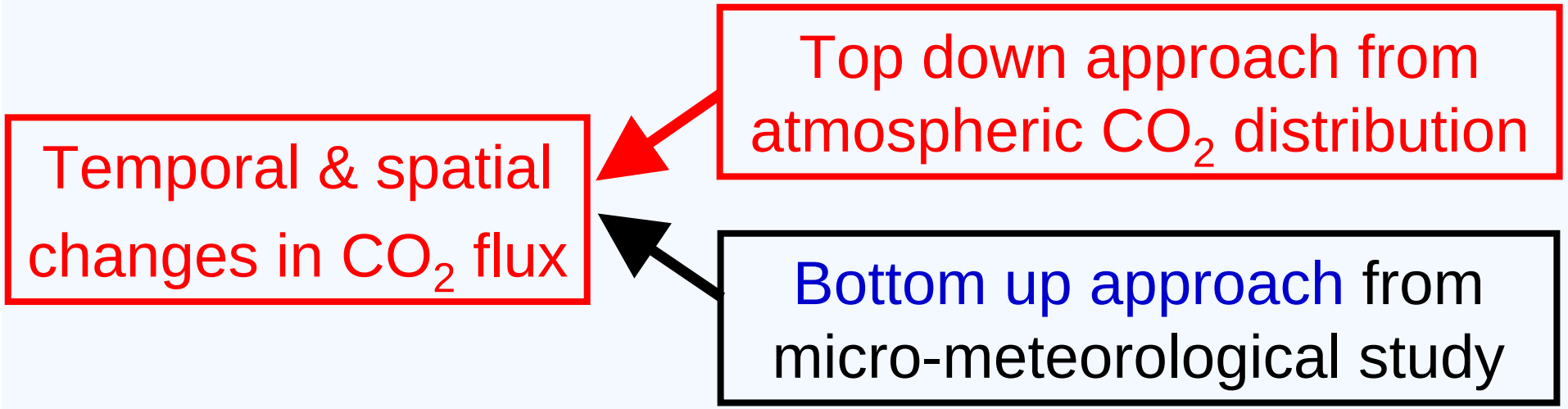
Complementary Relationship

- In-situ observation
- Remote sensing

CO_2 flux estimation from atm. observation



CO_2 flux estimation from atm. observation



CO_2 flux estimation from atm. observation

Top down approach from atmospheric CO_2 distribution

Temporal & spatial changes in CO_2 flux

Bottom up approach from micro-meteorological study

Top down approach using:

① Tracers

② Global atmospheric CO_2

CO_2 flux estimation from atm. observation

Top down approach from atmospheric CO_2 distribution

Temporal & spatial changes in CO_2 flux

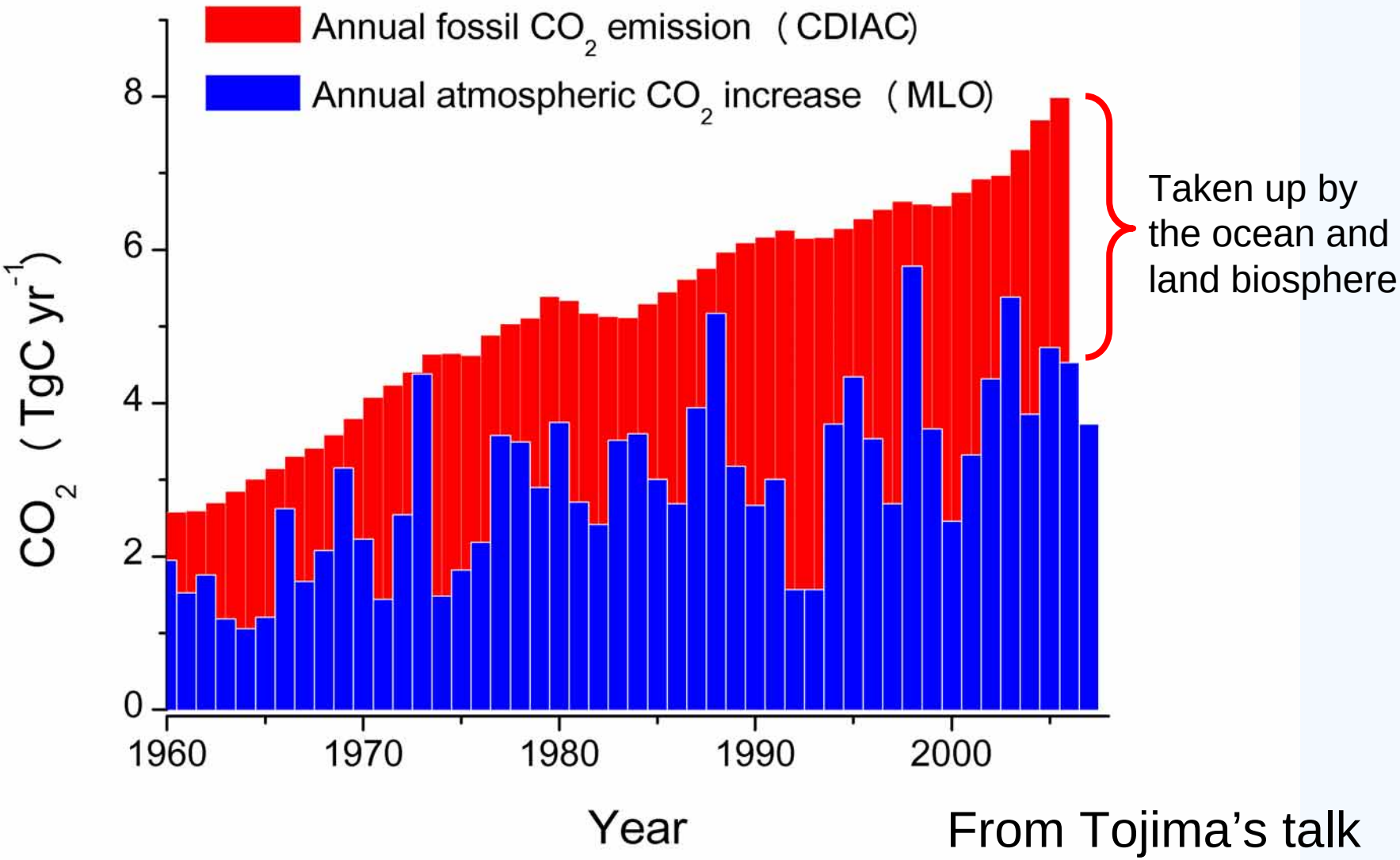
Bottom up approach from micro-meteorological study

① Tracers (←mass balance)

- Difference in isotopic fractionation of ^{13}C
- Difference in O_2 efflux

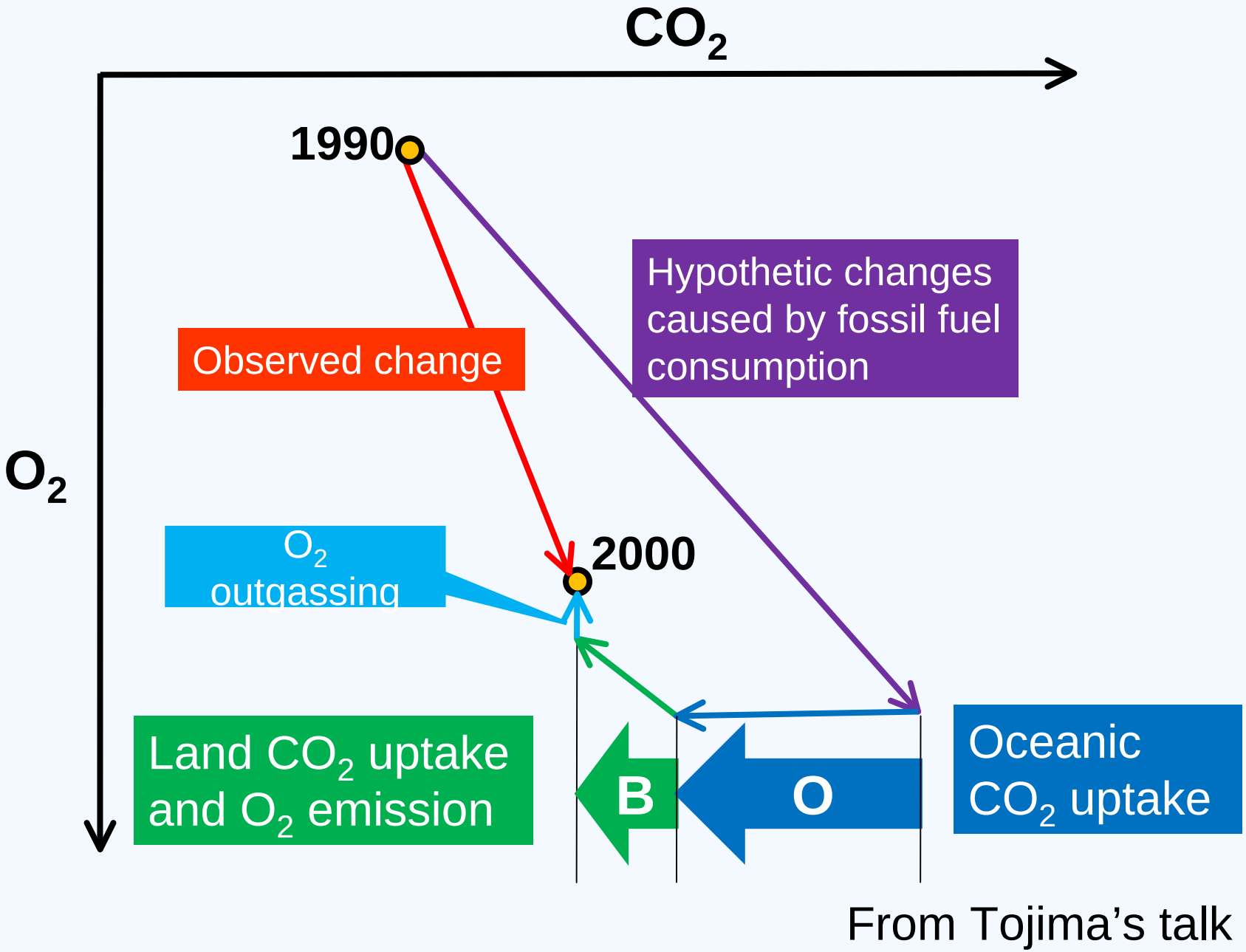
between terrestrial & oceanic ecosystems

Fossil CO_2 emission and atmospheric accumulation



From Tojima's talk

Graphical explanation of budget calculation



From Tojima's talk

CO_2 flux estimation from atm. observation

Top down approach from atmospheric CO_2 distribution

Temporal & spatial changes in CO_2 flux

Bottom up approach from micro-meteorological study

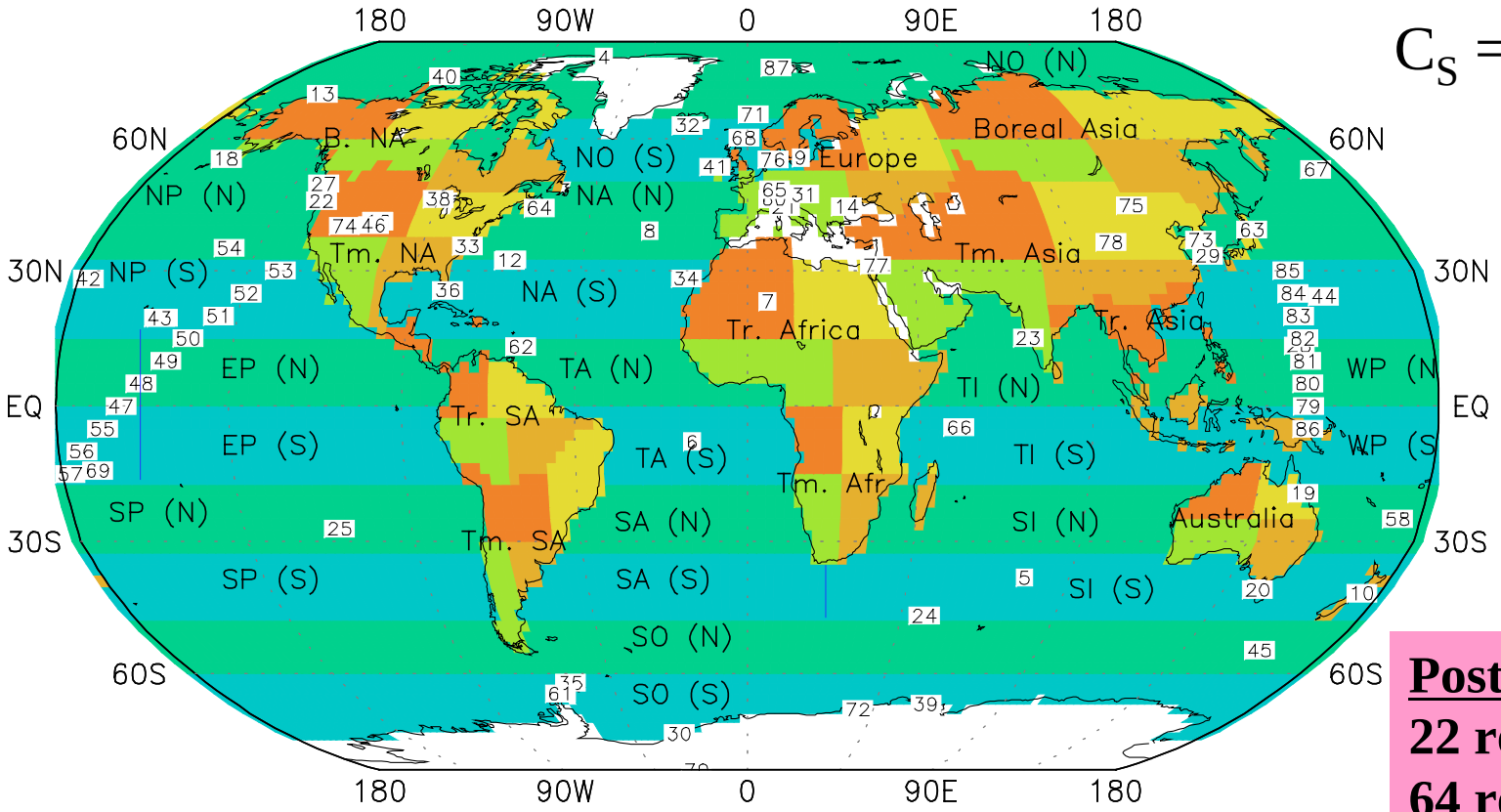
② Global atmospheric CO_2

Less quantitative

- Seasonal amplitude of atm. CO_2
- Inverse calculation of semi continental scales using atm. transportation model

64-Regions Inverse Model

(using NIES/FRCGC CTM and interannually varying NCEP/NCAR reanalysis meteorology)



$$C_S = c_{s1} + c_{s2} \cdots$$

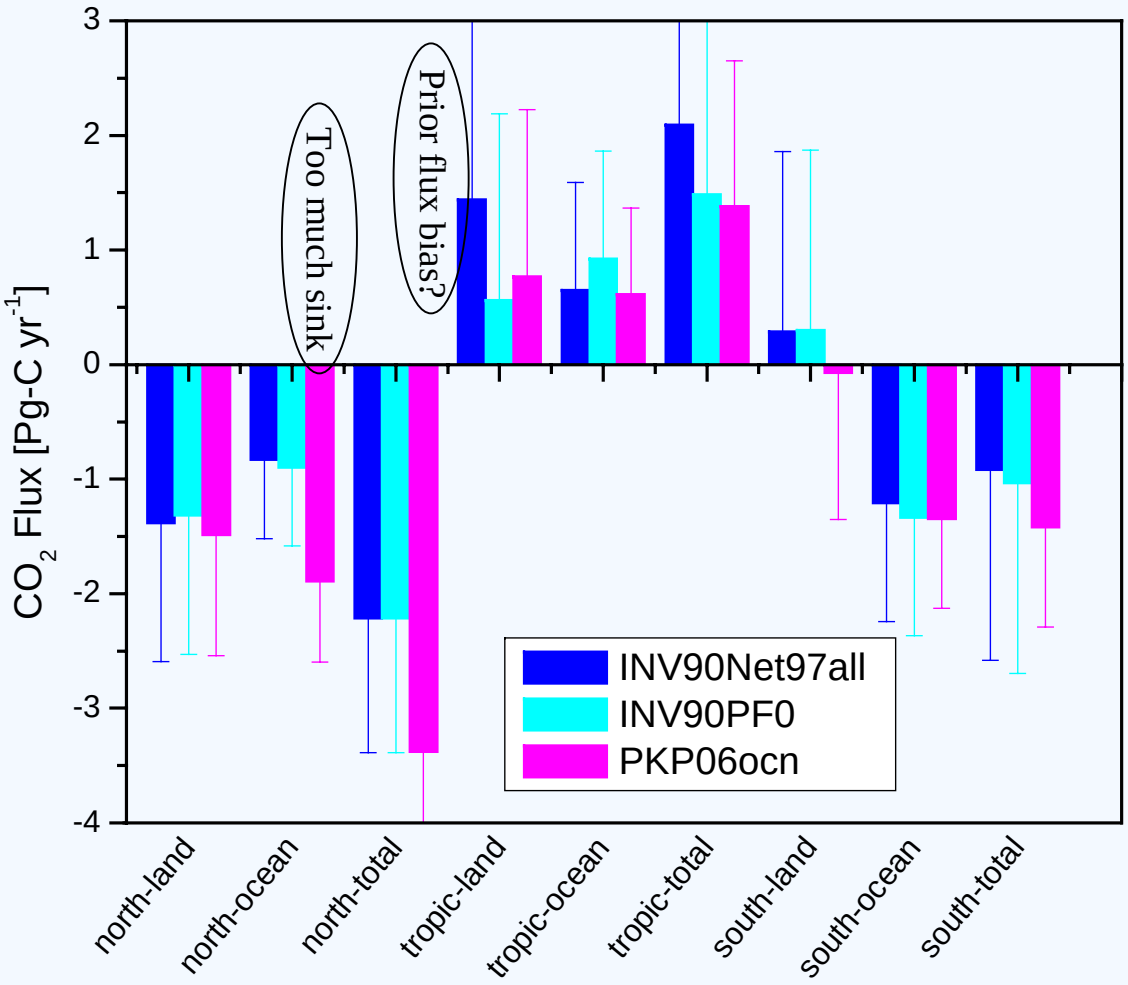
Post Inversion χ^2	
22 reg	2.15
64 reg	1.11
64+IAV	0.99

$$\chi^2 = \frac{1}{T}\left[\frac{1}{N}\sum_1^N \left[(D - D_{predicted})^2 / C_D + \frac{1}{M}\sum_1^M (S_0 - S)^2 / C_S\right]\right]$$

Patra et al., Global Biogeochem. Cycles., 2005a,b

From Patra's talk

Importance of increased observation network and well validated model transport



INV90Net97all:
90region Inv. mod.,
97-site obs. Network,
Incl. land & ocean sites

INV90PF0: As above,
But with 0 Prior Flux

PKP06ocn: From
Patra et al. (GRL, 2006),
22-region Inv. mod.,
16 transport mod.,
Ocean only network

Patra et al., *work in progress*

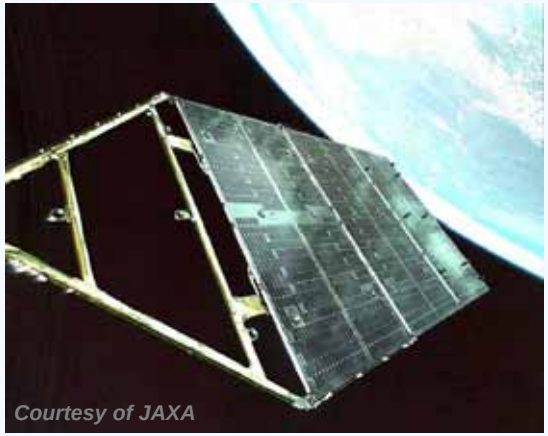
From Patra's talk

Looks like, we can ingest data from the both Land & Ocean sites, and Inverse model results can be free of initialization (prior flux)

Successful Launch of GOSAT (Jan. 23, 2009), a new tool for top down approach

Launch of H-IIA No. 15 at 12:54 (JST) on Jan. 23, 2009

GOSAT in orbit (CG)



Successful deployment of a solar paddle

GOSAT (Greenhouse Gases Observing Satellite) was launched successfully from JAXA's Tanegashima Space Center on January 23, 2009.

GOSAT completed its critical phase operation and started the initial functional verification phase operation which will last for three months.

GOSAT Level 2 products including atmospheric column CO2 and CH4 amounts will be freely available from NIES GOSAT website twelve months after the launch.

Flux estimation for GHG other than CO_2

Top down approach from atmospheric distribution

Global emission for each GHG

Bottom up approach from major emission sources

Bottom up approach based on:

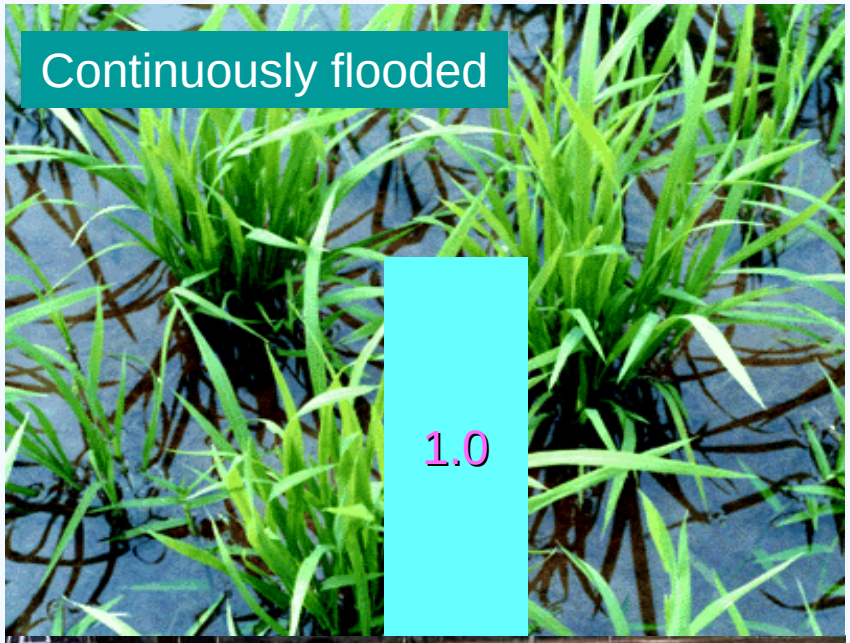
- Emission factors
- Activities of major sources

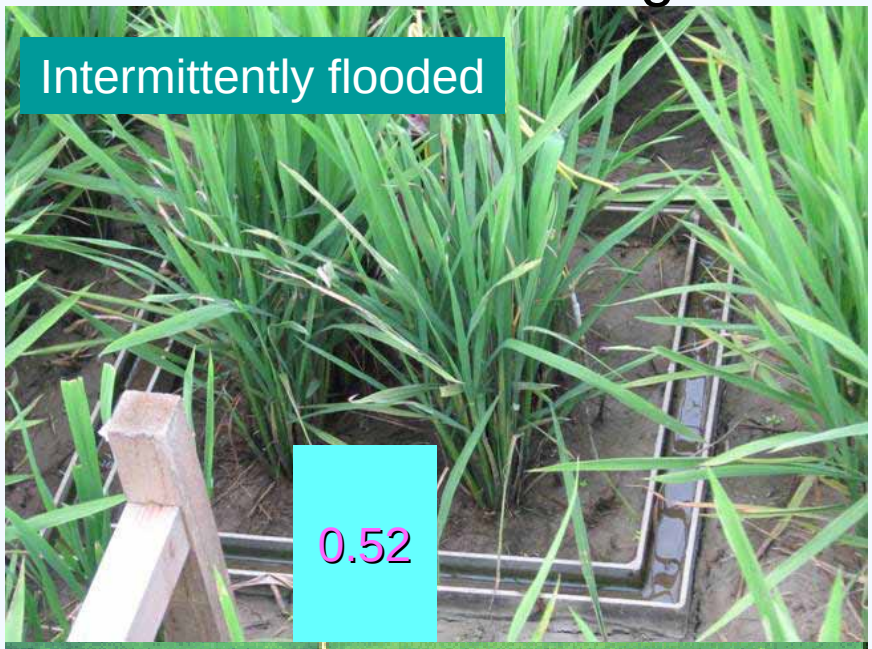
Need: Improvement of accuracy

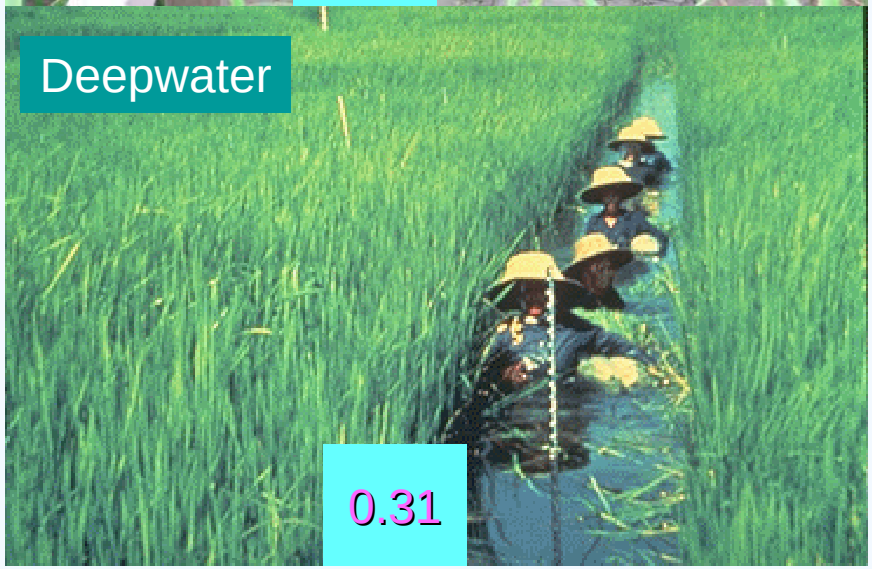
Top down approach is still difficult

Emission factor of CH_4 from rice paddy

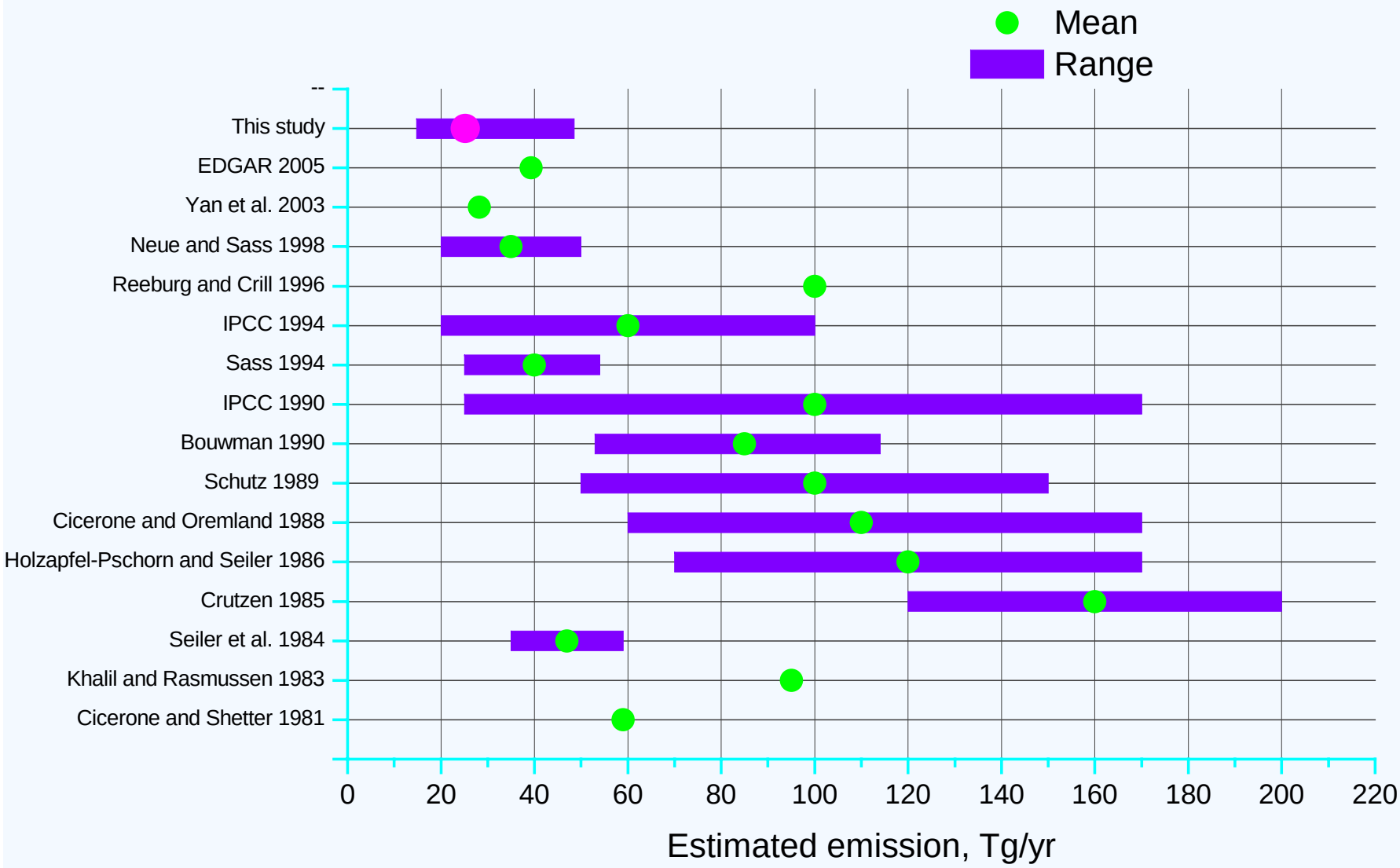
From Yang's talk





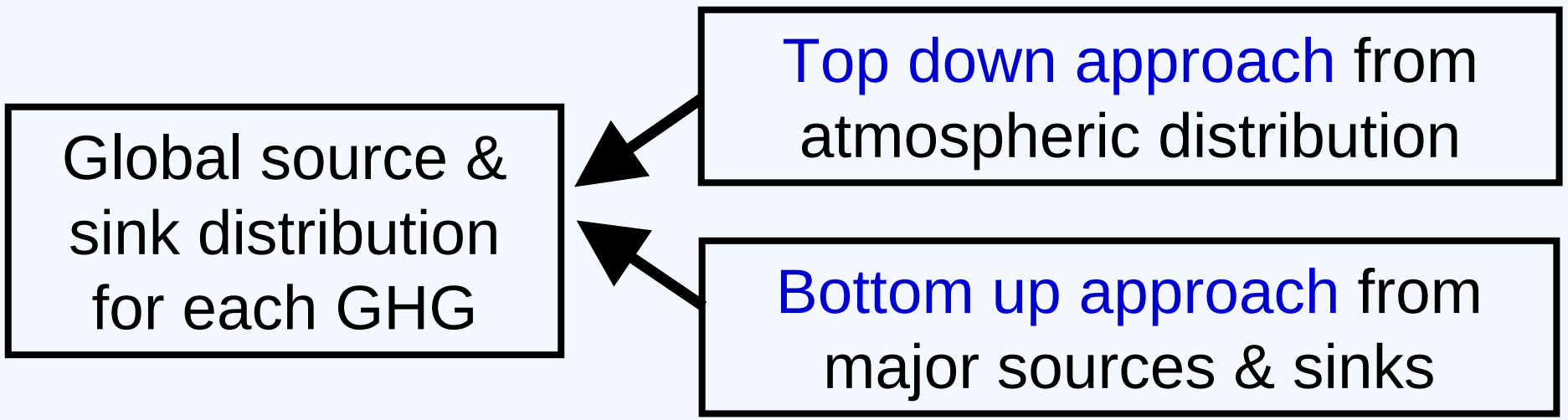


Comparison global CH_4 emission estimates



From Yang's talk

Prediction of future GHG exchanges



Needs:

- ✓Prediction of climate feedback
- ✓Adaptation strategy
- ✓Uncertainty reduction in ocean & terrestrial processes

Research needs and issues to be addressed

- Better simulation of physical and biogeochemical processes sufficiently reflecting feedbacks
  → *Advancing climate modeling and projection*
- Addressing uncertainties in climate model projection
  → *Quantification and reduction of uncertainty*
- Impact assessment on natural disasters by extreme events through sufficiently high resolution projection
  → *Application of regional projection to natural disasters*

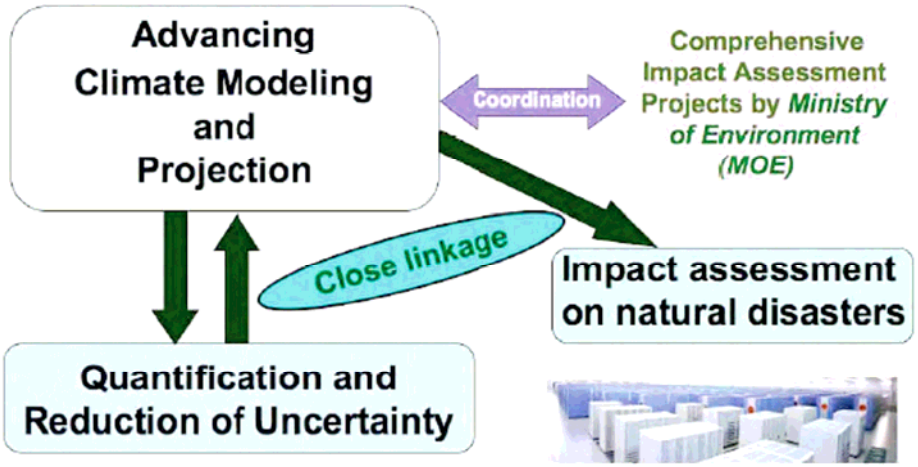
From Koto's talk

Innovative Program of Climate Change Projection for the 21st century (KAKUSHIN Program)

FY2007-FY2011

KAKUSHIN

Program structure



Participating groups and their studies

- ***Long-term global environmental projection***
  with an earth system model
  – Frontier Research Center for Global Change (**FRCGC**) et al.

- ***Near-term climate prediction***
  with a high-resolution coupled ocean-atmosphere GCM
  - Center for Climate System Research (**CCSR**) of the University of Tokyo et al.

- ***Projection of changes in extremes in the future***
  with super-high-resolution atmospheric models
  - Meteorological Research Institute (**MRI**) et al.

http://www.kakushin21.jp/eng/index.html

From Koto's talk