

Global change projection for ocean biogeochemistry and ecosystem

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Technology



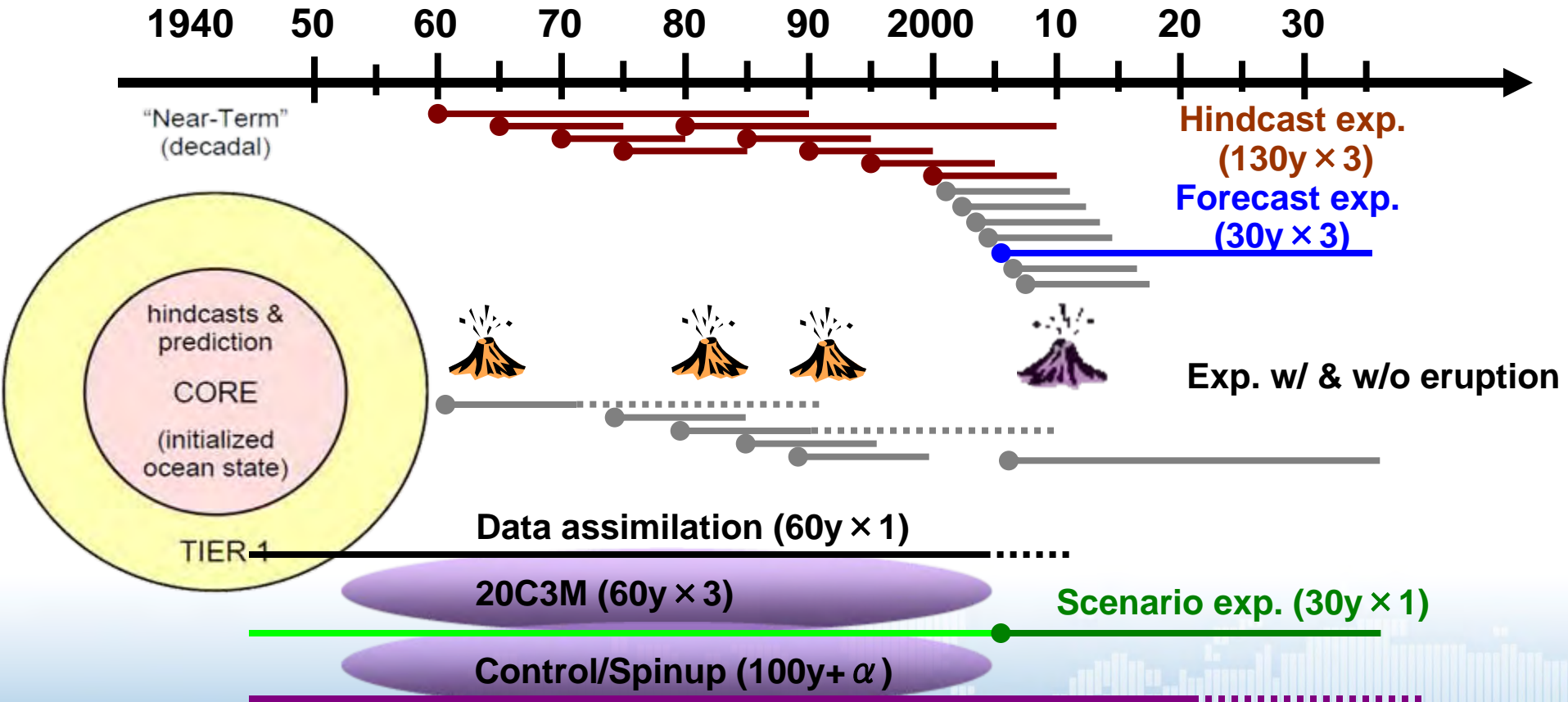
KAKUSHIN

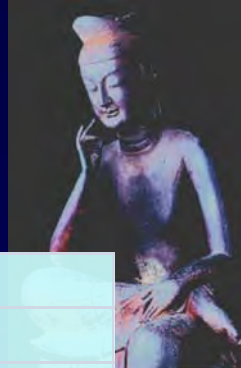
Introduction: Framework for IPCC AR5

- Experimental design
 - Centennial
 - Medium resolution (~200km)
 - Desirably with carbon cycle
 - Decadal
 - High resolution (50-100km)
 - Ensemble prediction with ocean data assimilation
 - Extreme events
 - High resolution (global & regional) modeling with time slice approach
 - Compilation IPCC special report on extreme events now underway
- Representative Concentration Pathways (RCP)
 - Four benchmark scenarios as a community effort
 - Expected to facilitates interactions between WGs1,3

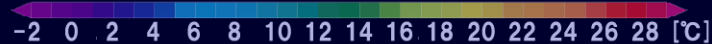


Near-Term Prediction (MIROC4 hi-res. model)



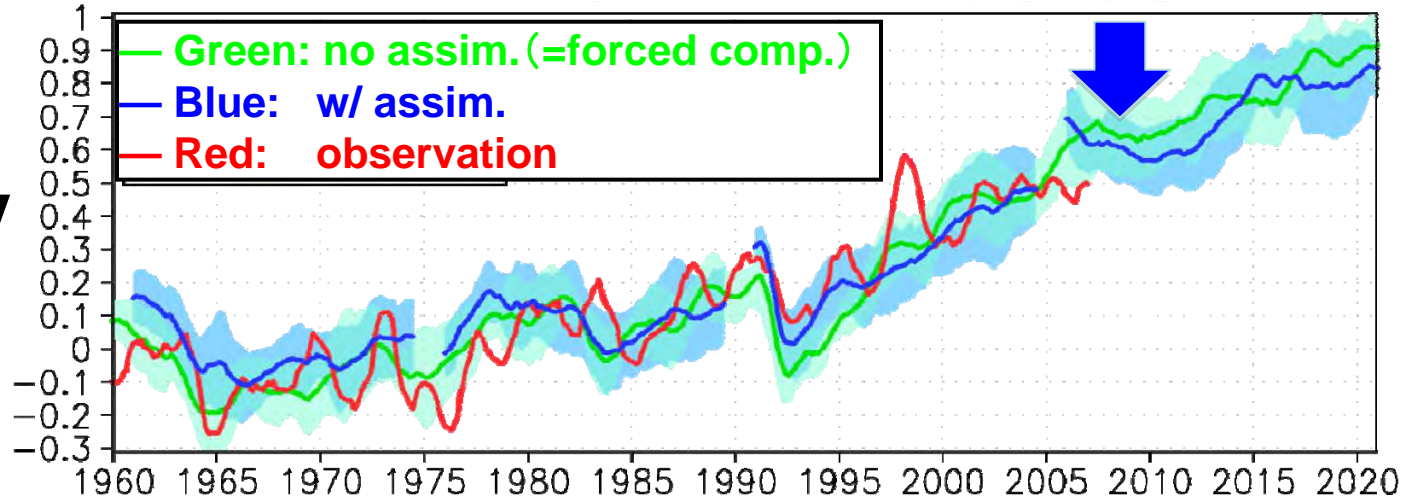


	MIROC3.2	MIROC 5
Atmosphere		
Resolution	T106L56 (hires) T42L20 (medres)	T213L56 (hires) T85L56 (medres)
Radiation	MSTRN-8 (37ch)	MSTRN-X (111ch)
Aerosol	simplified SPRINTARS	full SPRINTERS w/ Nitrate
Chemistry	Off-line CHASER	Off-line CHASER
LS condensati	Diagnostic (LeTreut-Li) + Simple water/ice partition	Prognostic PDF + Ice microphysics
PBL	Mellor-Yamada lvl 2.0	Mellor-Yamada-Nakanishi-Niino lvl 2.5
Cumulus	Prognostic A-S + critical RH	Prognostic A-S + critical RH with water/ice partition
Land	MATSIRO	mosaic MATSIRO + prognostic LAI
Carbon Cycle	Off	Off
Ocean		
Coordinate	lat-lon (rotated in hires)	Tripolar (in medres)
Resolution	20x30km (hirss) 100x140km (medres)	20x30km (hires) 100x140km (medres)
Sea ice	EVP single thickness category + 0D thermodynamics	EVP multiple thickness categories + 1D thermodynamics

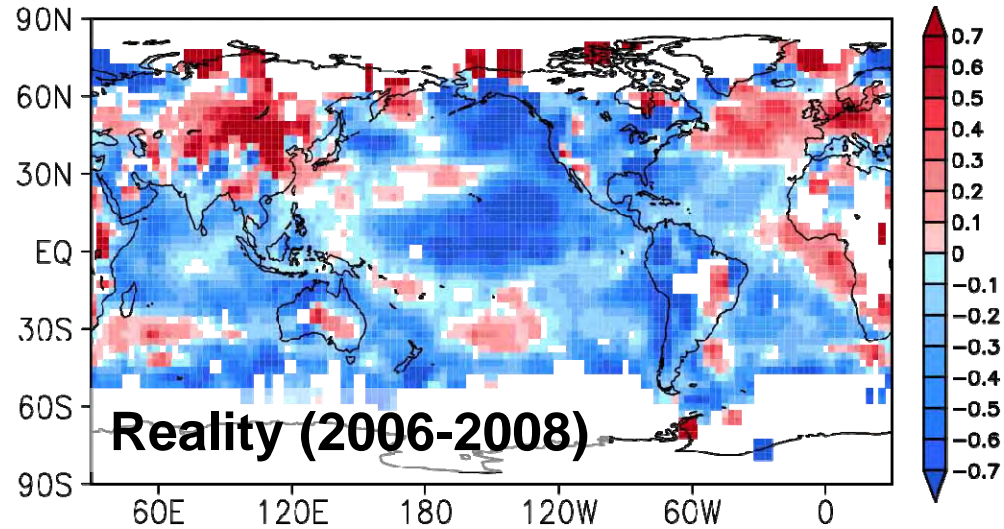
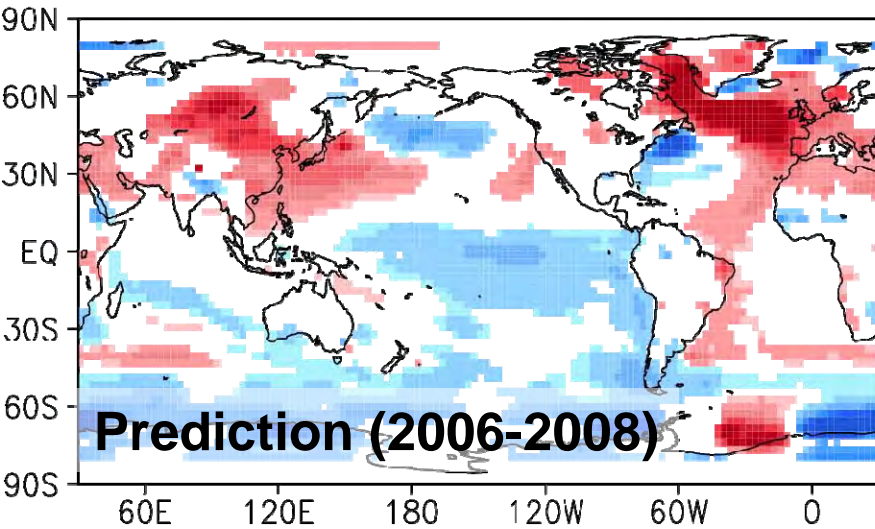


PDO Predictability

Global mean surface temperature

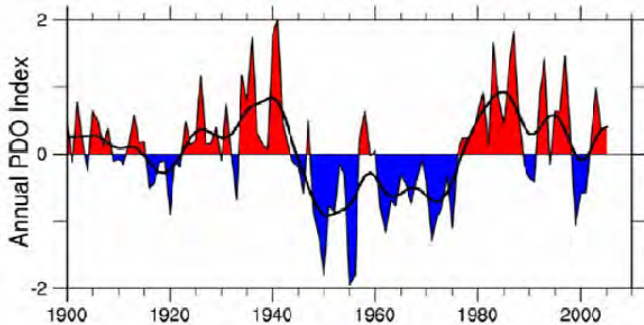
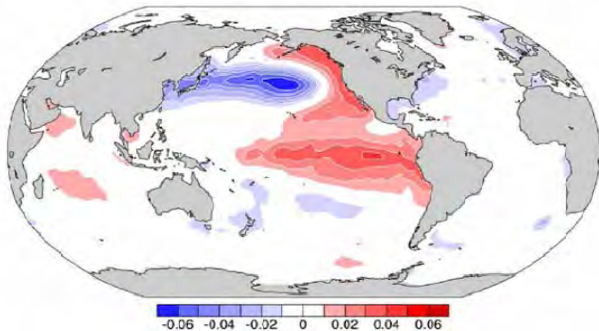


Surface temperature (deviation from the forced component)



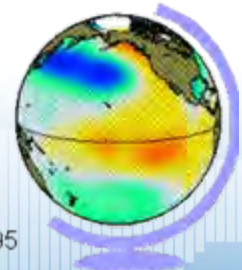
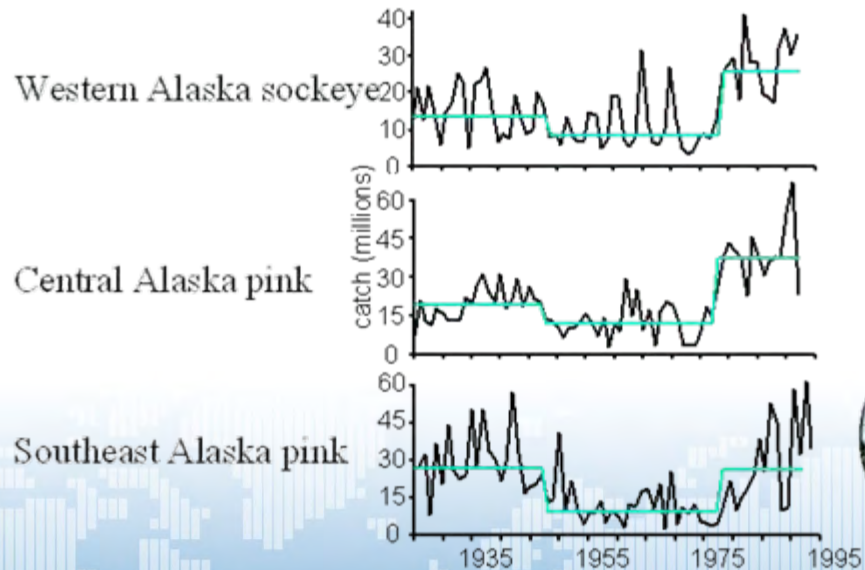
Implication of PDO prediction on fishery

SST Anomalies: projected EOF 1: 20.8%

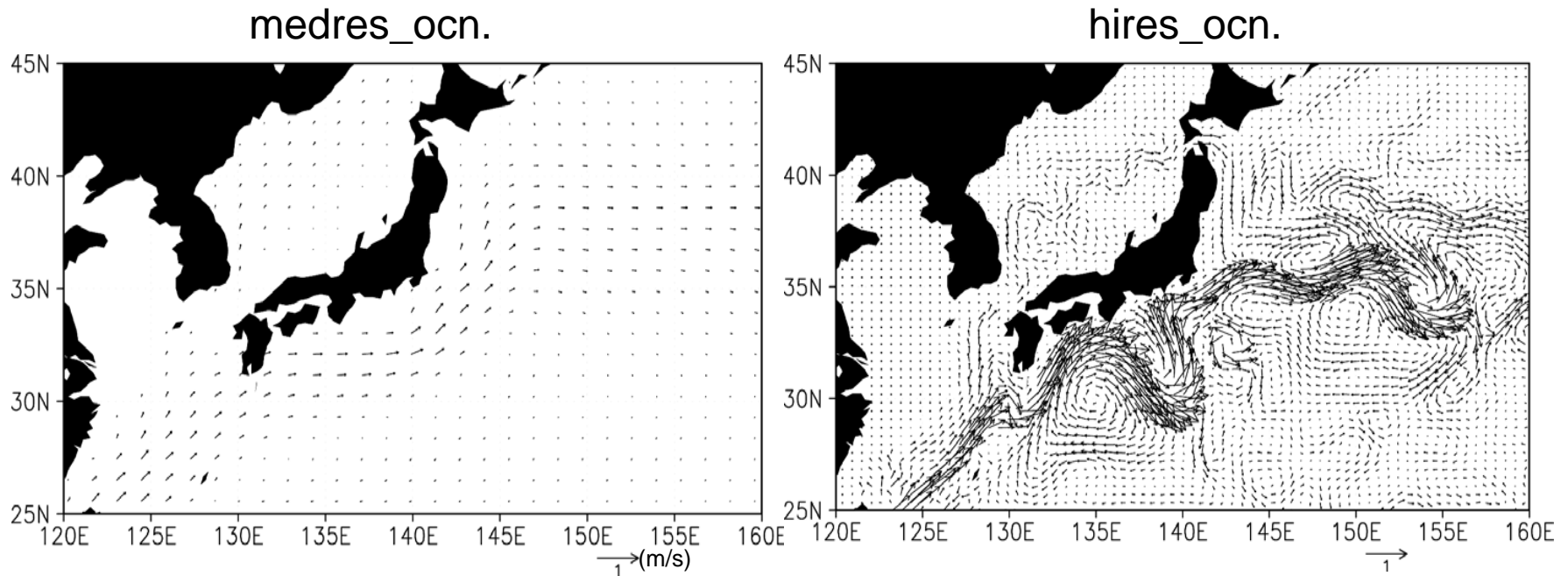


Pacific Decadal Oscillation (PDO)

Alaskan Salmon Catches, 1925-1995

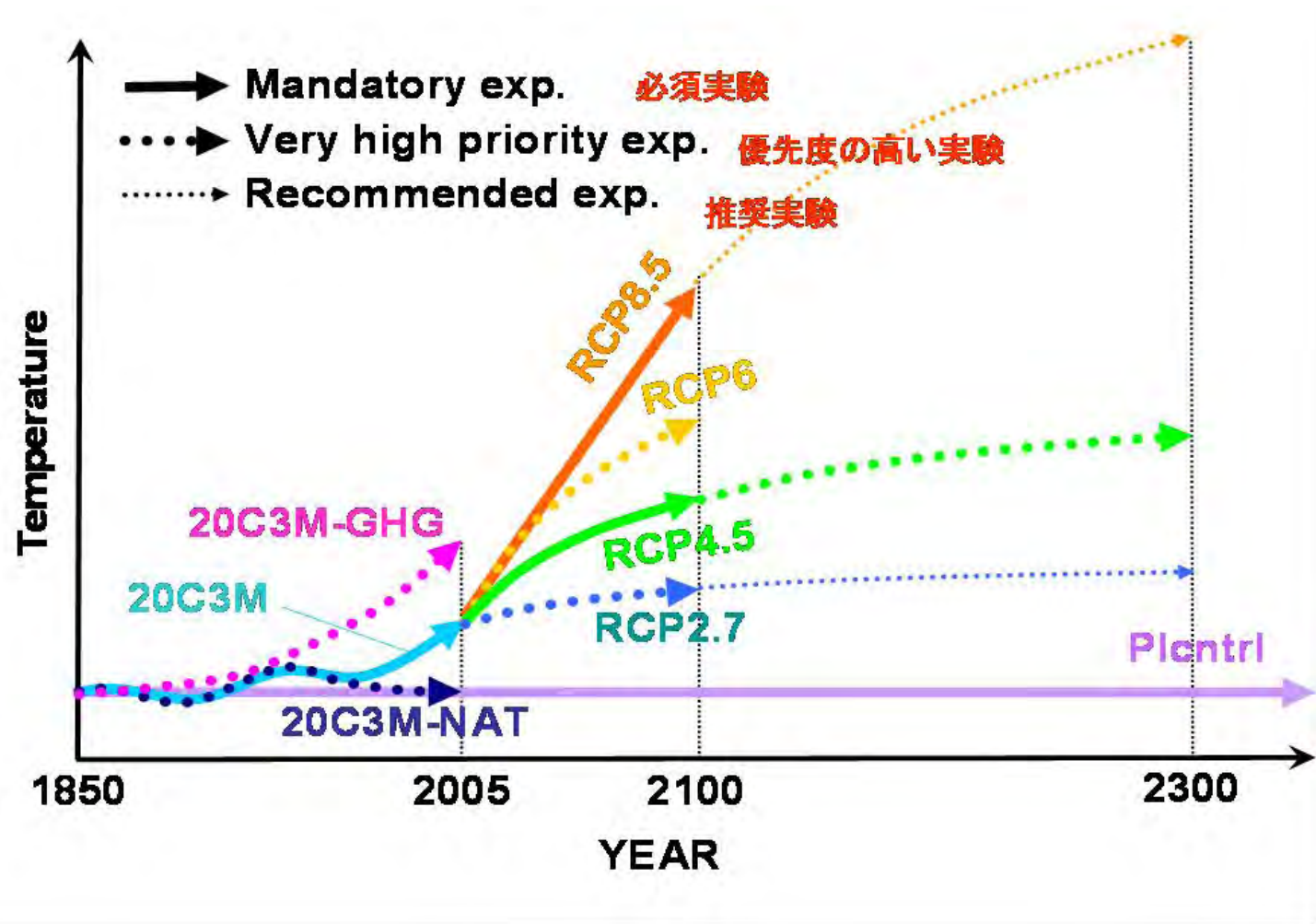


High-resolution (~20km) model

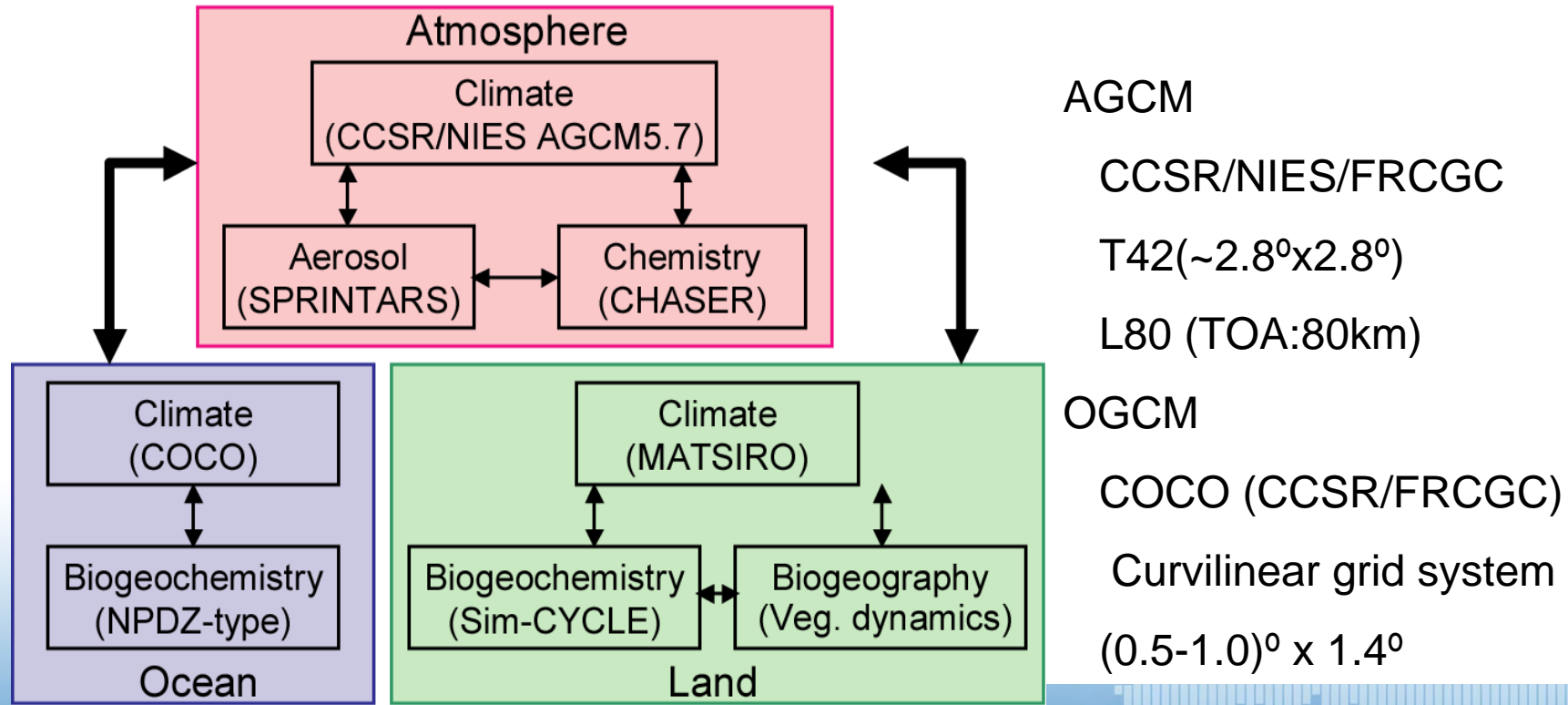


Higher-resolution model results will be introduced by T. Sakamoto, later this session (check out the updated schedule...).

Experimental Design of CMIP5 (Long-term projection)



MIROC-ESM: an GCM-based Earth System Model



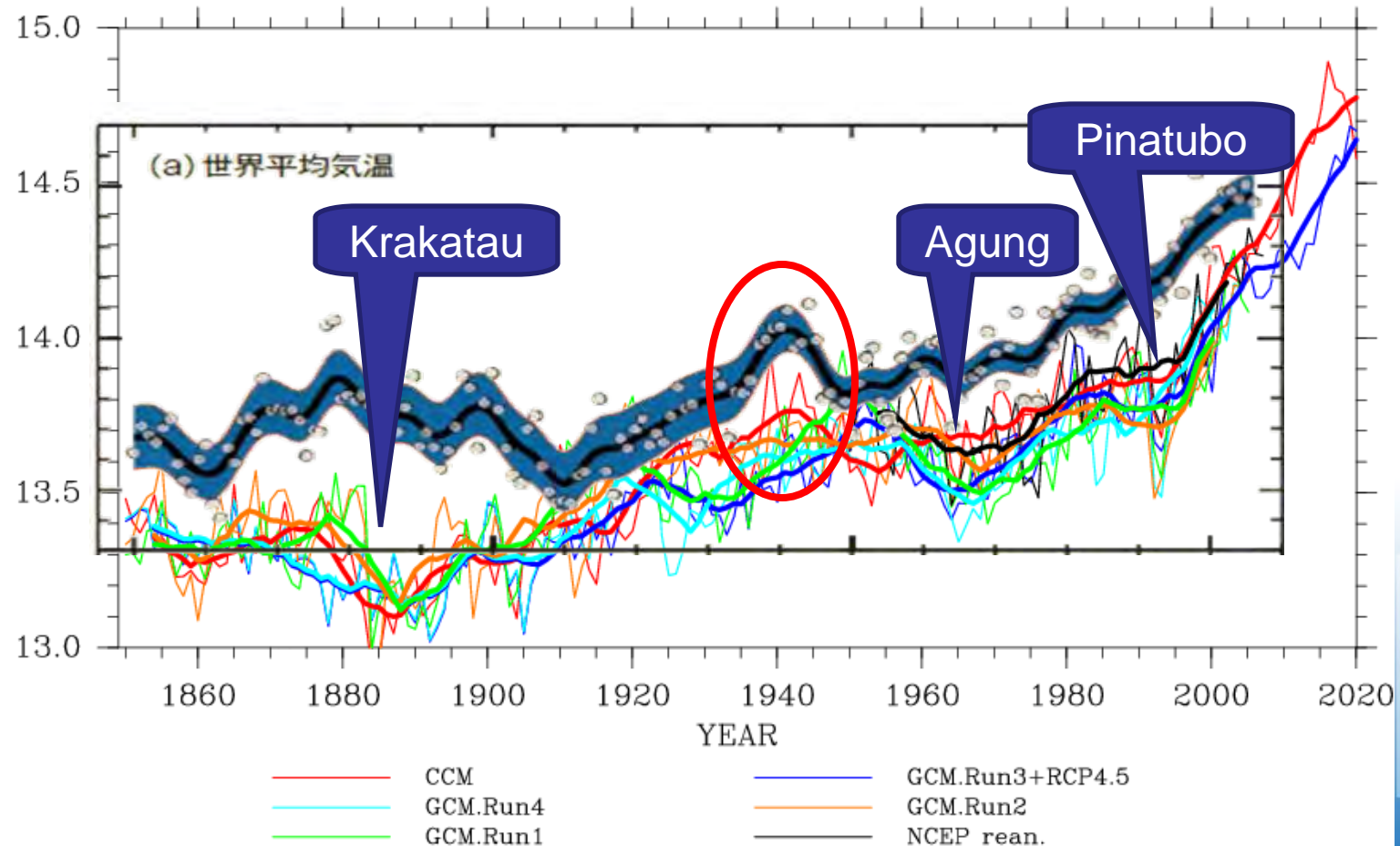
with full chemistry: 5 nodes, 4-year-integration a day
 w/o full chemistry: 3 nodes, 10-year-integration a day

The model yields reasonable results so far...

2m temperature

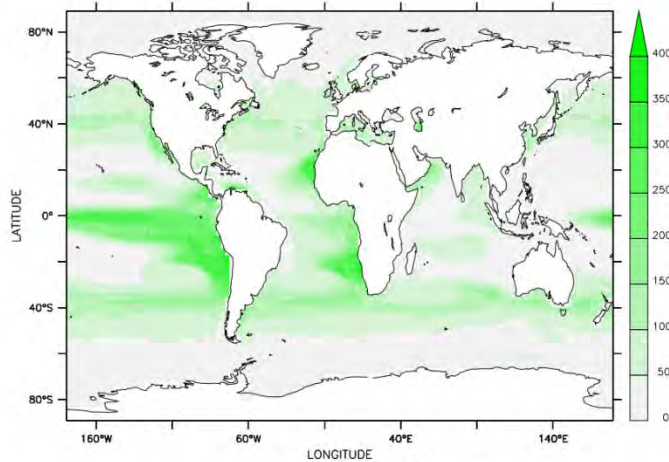
MIROC-ESM

1850/01/16.12-2039/12/16.12



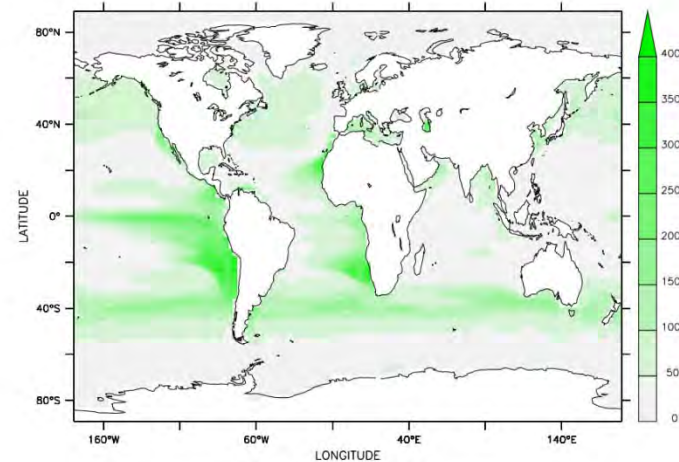
Modeled PP change

Pre-industrial



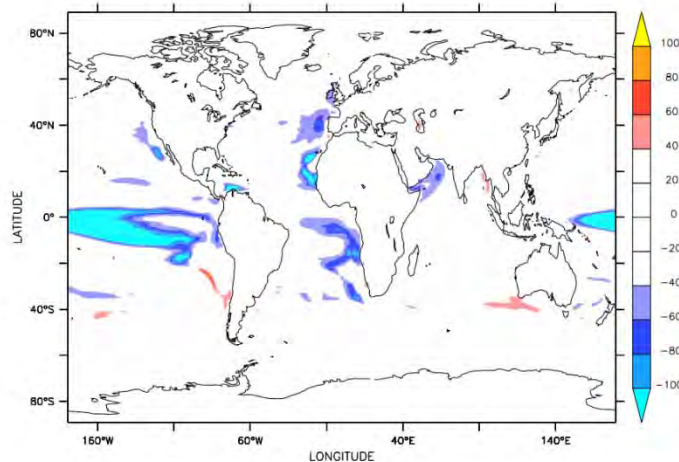
GPP: (gC/m²/year) Uncoupled

~2100 (SRES A2)



GPP: (gC/m²/year) Coupled

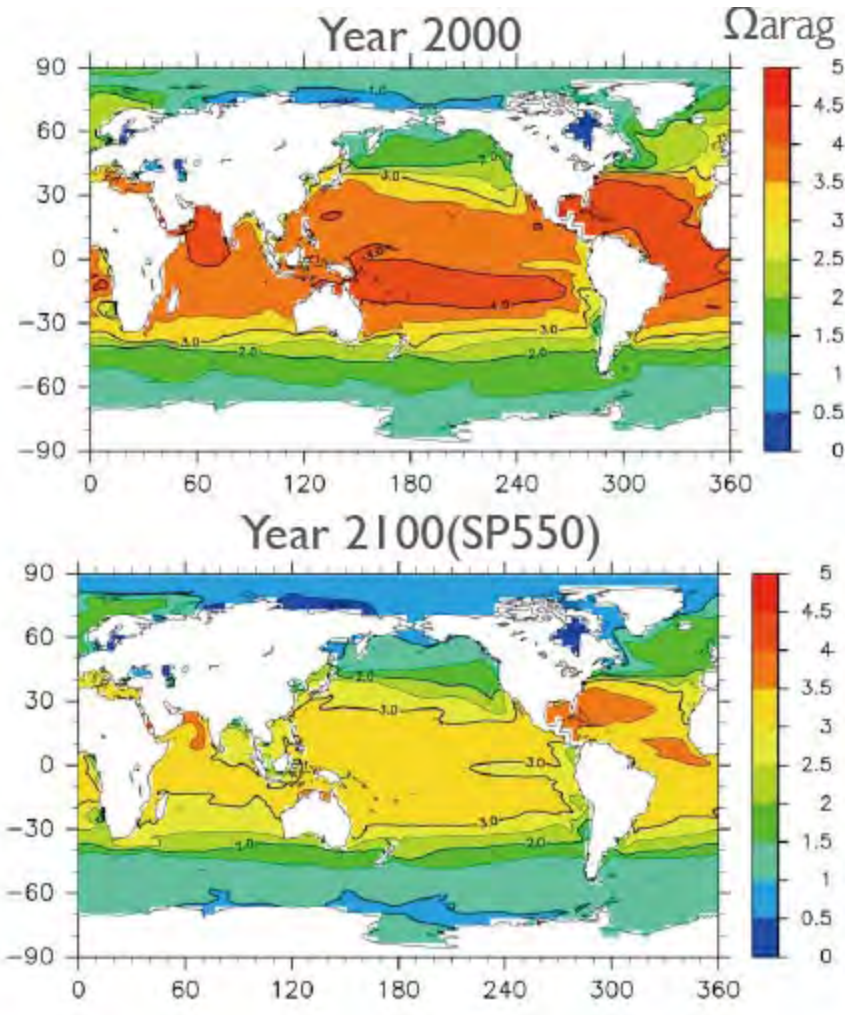
2100 – pre-industrial



GPP: (gC/m²/year) Coupled–Uncoupled

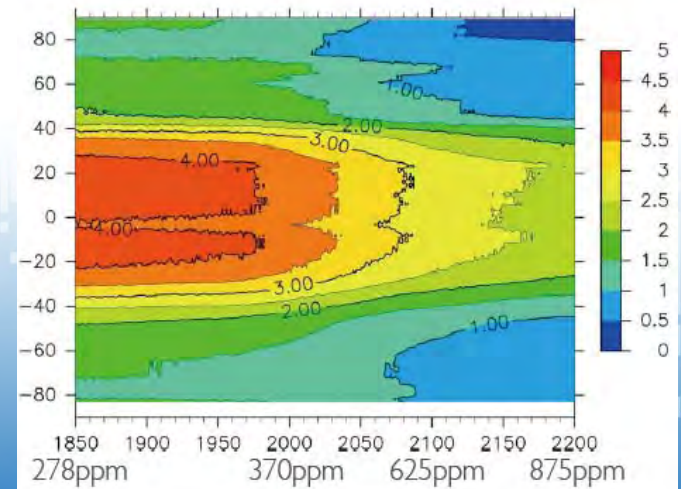
PP decreases in the equatorial region due to reduced upwelling.

Ocean acidification

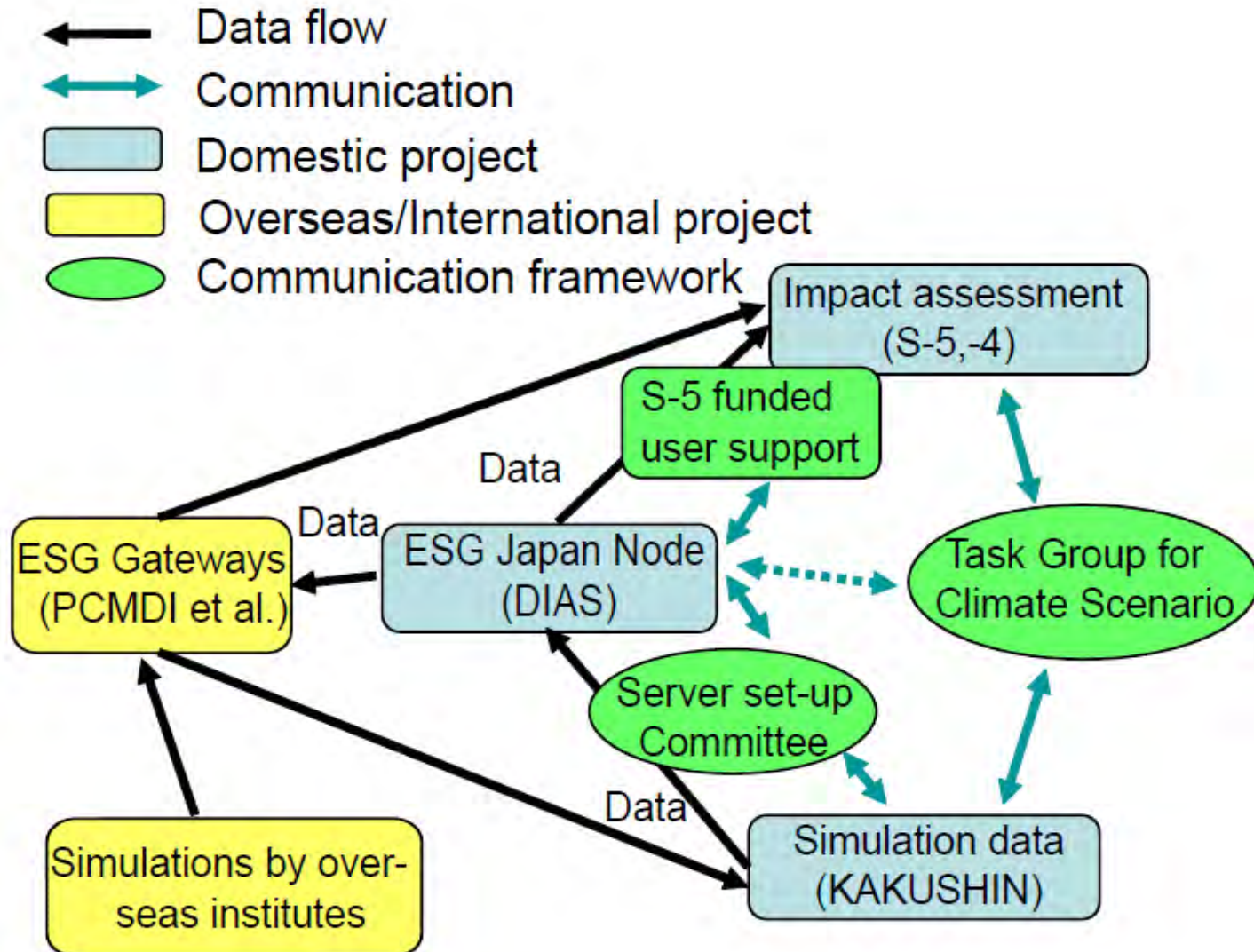


Models predict that the arctic is the first region to become under-saturated.

Observational data are, however, too sparse for us to be confident of it.



Organizing a consortium among impact assessment researchers, computer scientists and climate modelers



CMIP5 (or IPCC AR5 WG1) timeframe

- CMIP5 model simulations commence
- Model output starts becoming available – mid-2010
- Model output that will likely be considered in time for IPCC in place – end of 2011
- Journal articles submitted – 31 July 2012
- Journal articles accepted – 15 March 2013
- IPCC AR5 published – late 2013

Summary

- Preliminary results show:
 - Some predictability of PDO
 - Rapid acidification in the arctic region, lower PP in the equatorial region
- Projection data available toward AR5 include:
 - High resolution (~20km) physical properties (T, S, V etc.) for decadal prediction (~2035)
 - Biogeochemical (carbon, nutrients etc.) data for centennial projection (~2100 and beyond).
 - Data available by mid-2010: Global system for data distribution is being established
- Caveat: Use multi-model approach whenever possible!