The DYAMOND Project

Bjorn Stevens & Masaki Satoh

MAX-PLANCK-GESELLSCHAFT

Max-Planck-Institut
für Meteorologie

Same same?

On the basis of these data relating to each month for 260 stations an empirical formula was derived

$$I = a + BT - (a_1 + B_1 T)n \qquad (1)$$

where I = outgoing radiation in kcal/cm² month,

T = temperature at the level of Earth's surface in °C,

n = cloudiness in fractions of unit,

the values of dimensional coefficients of which equal: $a = 14.0$; $B = 0.14$; $a_1 = 3.0$; $B_1 = 0.10$.

The root-mean-square deviation of the results of calculation by this formula from the initial data accounts for less than 5% of the radiation values.

Comparing formula (1) with similar dependence that can be obtained from the work by Manabe and Wetherald (1967), it is possible to conclude that they practically coincide for the conditions of cloudless sky and differ in considering the cloudiness effect on radiation.

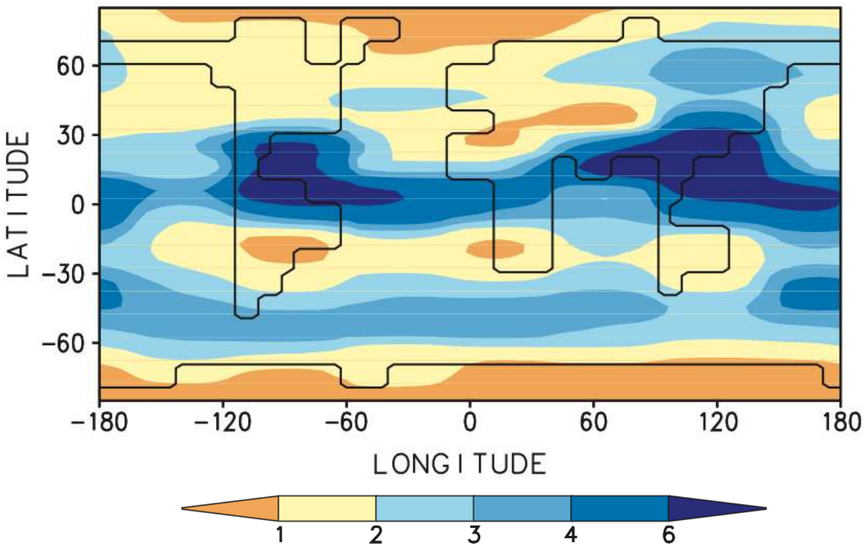
For mean annual conditions, the equation of the heat balance of the Earth-atmosphere system has the following form:

$$Q(1 - \alpha) - I = A \qquad (2)$$

where Q = solar radiation coming to the outer boundary of the atmosphere;

α = albedo;

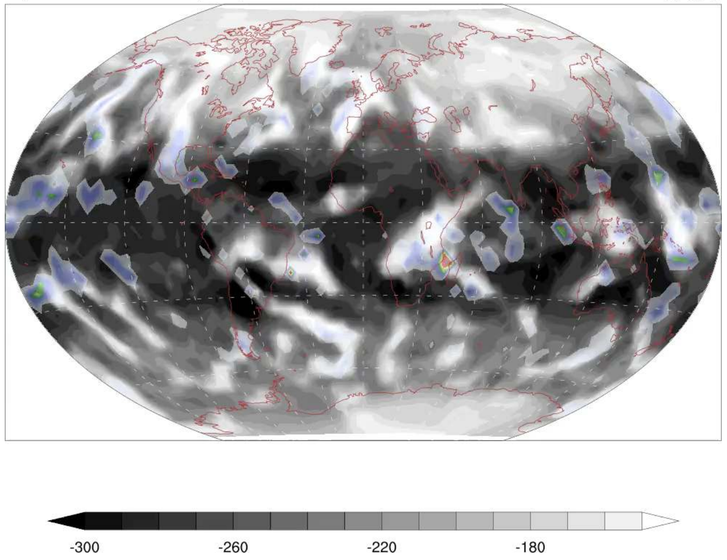
A = gain or loss of heat as a result of the atmosphere and hydrosphere circulation, including heat redistribution of phase water transformations.



1 Jan 7901 00Z

top thermal radiation (OLR)

W m-2



Same same?

On the basis of these data relating to each month for 260 stations an empirical formula was derived

$$I = a + BT - (a_1 + B_1 T)n \qquad (1)$$

where I = outgoing radiation in kcal/cm² month,

T = temperature at the level of Earth's surface in °C,

n = cloudiness in fractions of unit,

the values of dimensional coefficients of which equal: $a = 14.0$; $B = 0.14$; $a_1 = 3.0$; $B_1 = 0.10$.

The root-mean-square deviation of the results of calculation by this formula from the initial data accounts for less than 5% of the radiation values.

Comparing formula (1) with similar dependence that can be obtained from the work by Manabe and Wetherald (1967), it is possible to conclude that they practically coincide for the conditions of cloudless sky and differ in considering the cloudiness effect on radiation.

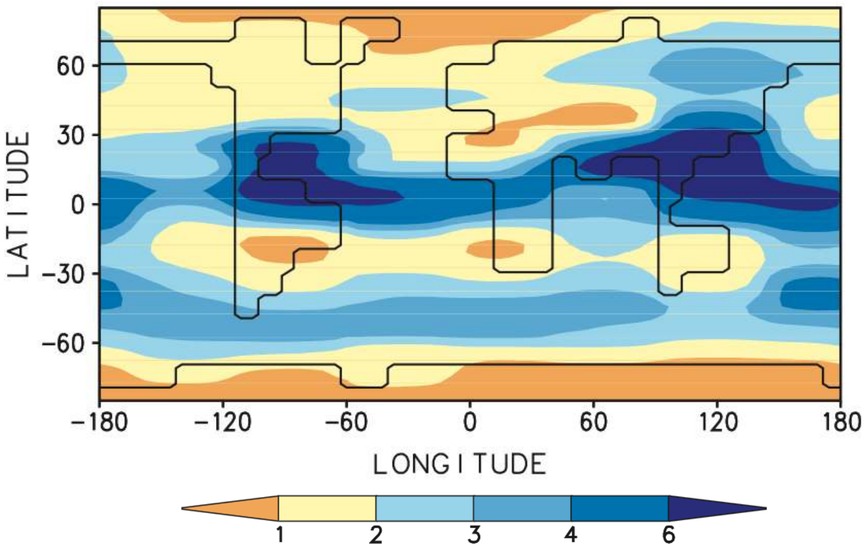
For mean annual conditions, the equation of the heat balance of the Earth-atmosphere system has the following form:

$$Q(1 - \alpha) - I = A \qquad (2)$$

where Q = solar radiation coming to the outer boundary of the atmosphere;

α = albedo;

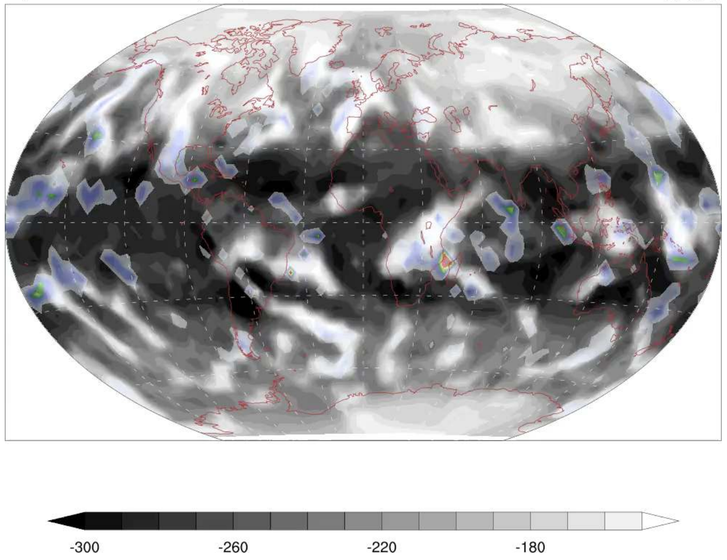
A = gain or loss of heat as a result of the atmosphere and hydrosphere circulation, including heat redistribution of phase water transformations.



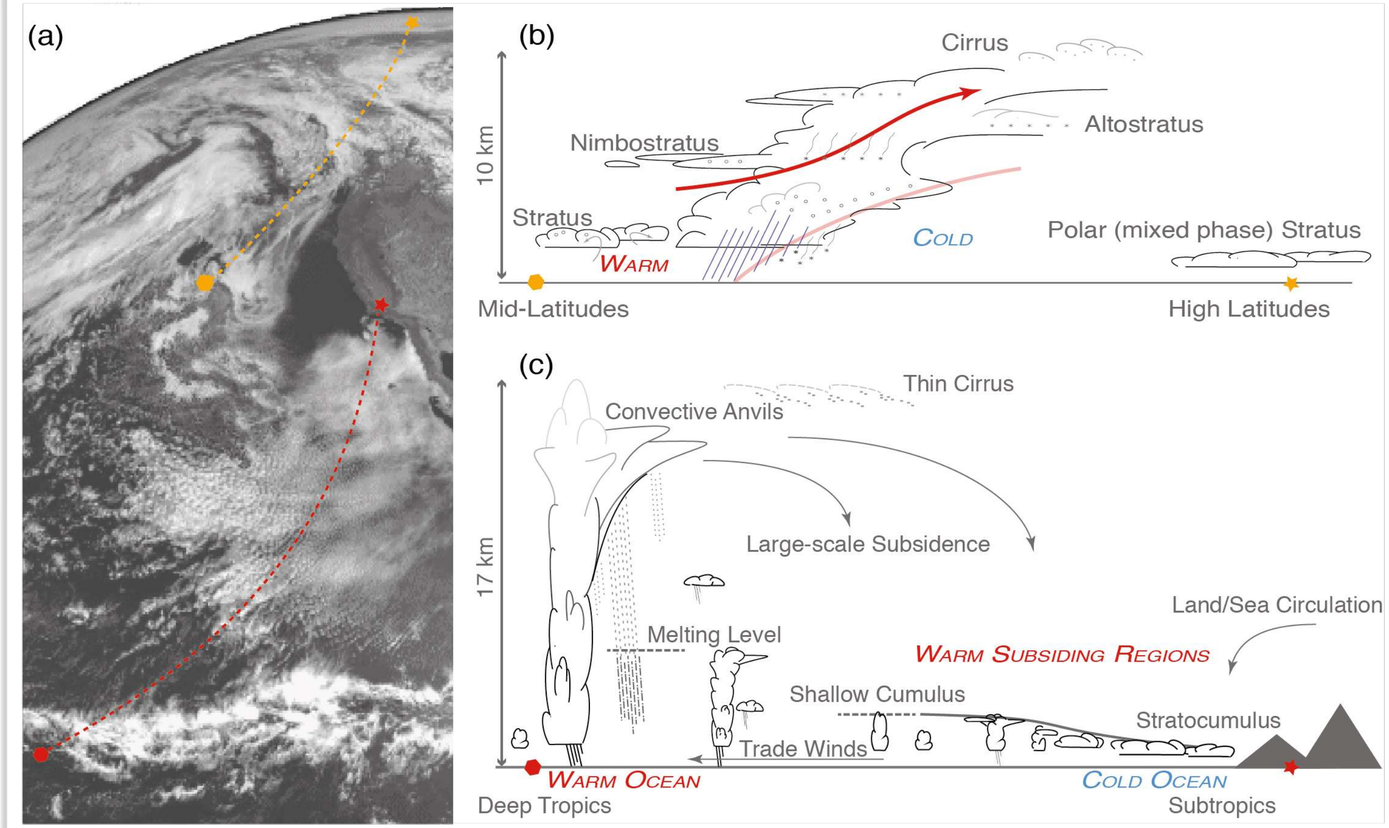
1 Jan 7901 00Z

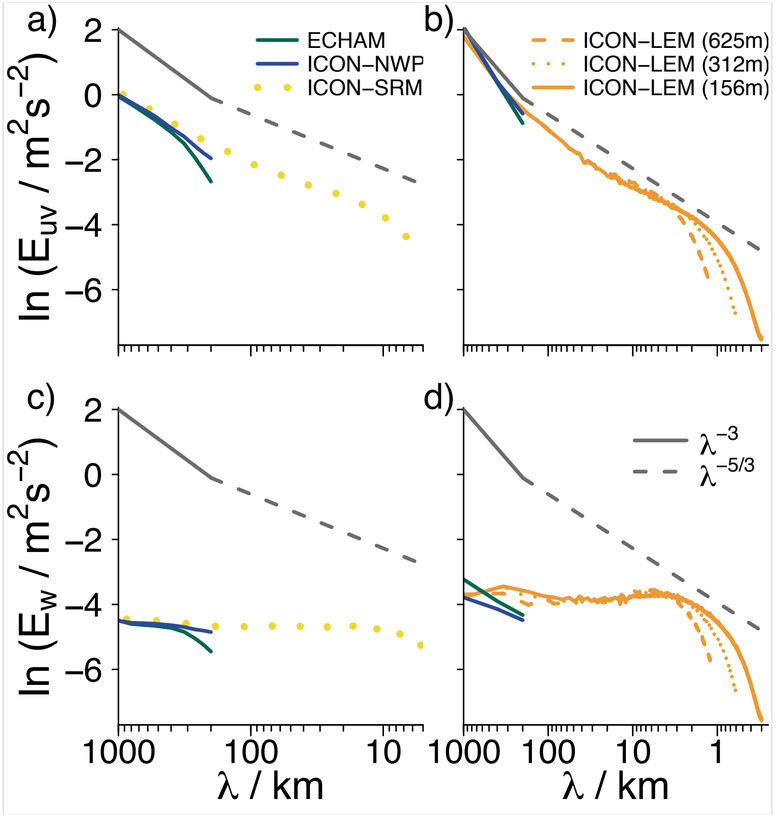
top thermal radiation (OLR)

W m-2



The great leap … coupling circulation to clouds and precipitation





Sanshiro Pond, Sept-Nov 2017

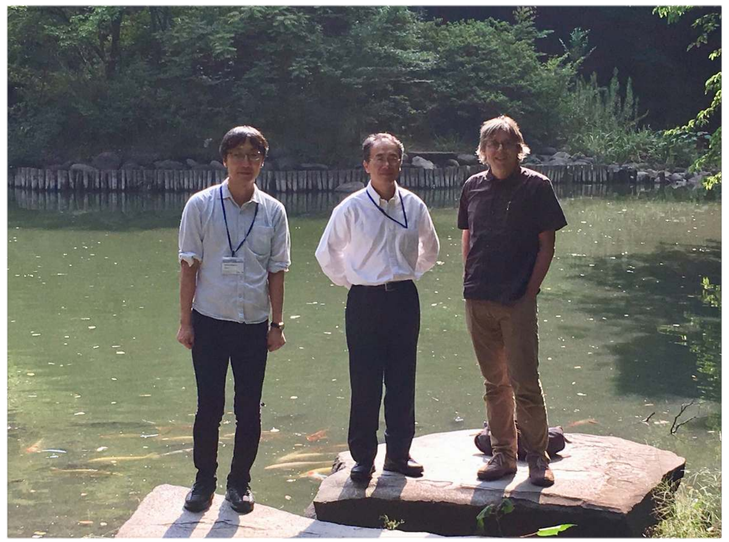
三四郎池（育徳園）

加賀藩主前田氏が、現在の赤門から池にかけての一帯の地を将軍家から賜ったのは、大阪の役後のこと。園池を大築造したのは寛永15年（1638）、その性、豪宕で風雅を好んだという当主前田利常のときである。かれの死後、綱紀がさらに補修して、当時江戸諸侯邸の庭園中第一と称せられた。育徳園と命名され、園中に八景、八境の勝があって、その泉水・築山・小亭等は数奇をきわめたものだといわれている。池の形が「心」という字をかたどっており、この池の正式名称は「育徳園心字池」なのだが、夏目漱石の小説「三四郎」以来、三四郎池の名で親しまれている。

The Story of Sanshiro Pond

The Maeda family was given the property which is now the Sanshiro Pond by the Shogun after the fall of Osaka Castle in 1615. The Pond and surrounding Garden were greatly embellished in the days of Maeda Toshitsune who was known for his lavish style. After the death of Toshitsune, Tsunanori did additional work on the garden.
The garden came to be known as the most beautiful one among on the gardens of Edo (Tokyo).
Named "Iku Toku En" or "Garden of Teaching Virtue", the garden featured the traditional 8 landscapes and 8 borders, and it's pond, artificial hills and pavillions were known for their originality.

The contours of the pond are in the shape of the chinese character "Kokoro (or Shin)" or "Heart". The official name of the pond is "Iku Toku En SHINJIIKE" or "HEART CHARACTER POND of Garden of teaching Virtue". However, Since the publication of Natsume Soeseki's "SANSHIRO" it has come to be known under the name of "Sanshiro Pond".



27 September

PROJECT DYAMOND

MASAKI SATOH, BJORN STEVENS, CHRISTOPHER S. BRETHERTON AND JOACHIM BIERCAMP

SYNOPSIS

Project DYAMOND (DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains) describes a framework for the intercomparison of an emerging class of atmospheric circulations model that, through their resolution of the major modes of atmospheric heat transport, endeavor to represent the most important scales of the full three-dimensional fluid dynamics of the atmospheric circulation. Phase 0 of DYAMOND will compare at least two models (ICON and NICAM). The project is, however open to all and several groups from the US have indicated their interest in praticipating. Simulations will be performed for a forty day period with the goal of: (i) identifying similarities and differences that emerge at storm resolving scales (1 km to 5 km) as compared to traditional (hydrostatic-scale) representations of the atmospheric circulation; and (ii) to better define the frameworks and protocols for subsequent, and scientifically more ambitious, phases.

29 September - 26 November

Objectives & Protocol

(i) identifying similarities and differences that emerge at storm resolving scales (1km to 5km) as compared to traditional (hydrostatic-scale) representations of the atmospheric circulation; and

(ii) to better define the frameworks and protocols for subsequent, and scientifically more ambitious, phases.

"Moses entered the midst of the cloud as he went up to the mountain; and Moses was on the mountain forty days and forty nights." (Exodus 24:18)

- 40 days and 40 nights initialized from IFS Analysis on 1 Aug 2016 (NARVAL2)
- sub 5 km, with modestly high top and no parameterization of deep convection
- full representation of microphysical processes and realistic land-sea mask (not a dynamical core intercomparison)

Keeping things simple

On 12 Jan. 2018 6:08, Shian-Jiann Lin: *I love it, the anti-bureaucratic intercomparison.*

On 11. Jan. 2018 at 2:59 PM, Bjorn Stevens: *Well I just added Bill's email to this. So see, now you are registered; DYAMOND is the anti-bureaucratic intercomparison.*

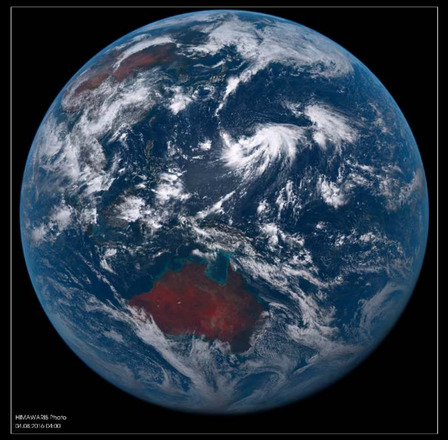
On 11 Jan 2018, at 20:22, Shian-Jiann Lin: *I did not know we have to register. The GFDL POC is me. The NASA side is Bill Putman.*

On 11 Jan 2018 at 12:18 PM Bjorn Stevens: *That would be great! I'll alert the DKRZ crew, and they should register their interest/provide a contact.*

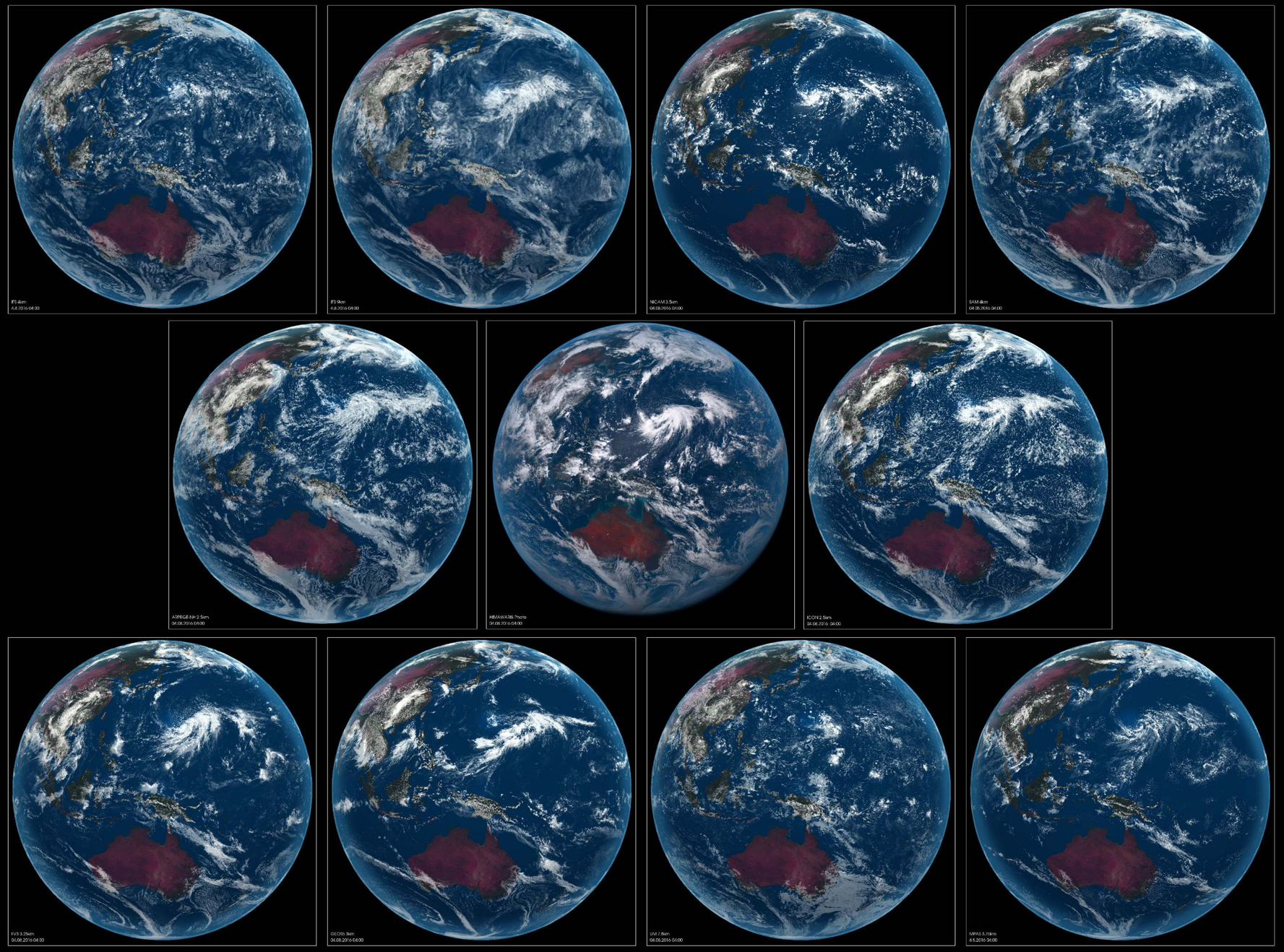
On 11 Jan 2018, at 16:29, Shian-Jiann Lin: *During AMS, the NASA/GSFC group (led by Bill Putman) expressed to me their very strong interest on the Dyamond project. … Can you add them to the "US participation"?*

"Groups are left free to initialize soil moisture according to their sense of best practice. … "

"Groups should try to conform to the specified output, and document what and how they provide output, but in recognition of the challenges in writing output from such large simulations conformance to the output requirements is left up to the individual groups best judgement."



Satoh et al., *Cur. Clim. Change Rep.* (2019), *Stevens et al., Prog. Earth Planet. Sci., (*2019), Hohenegger et al., *J. Meteorol. Soc.Japan* (2019), submitted



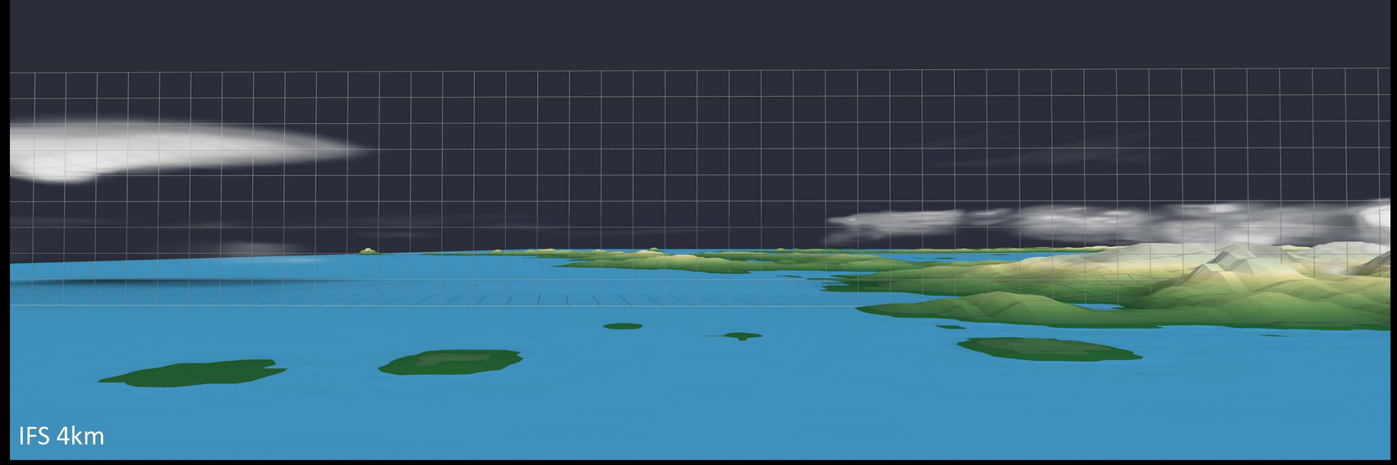
Satoh et al., *Cur. Clim. Change Rep.* (2019), *Stevens et al., Prog. Earth Planet. Sci., (*2019), Hohenegger et al., *J. Meteorol. Soc.Japan* (2019), submitted

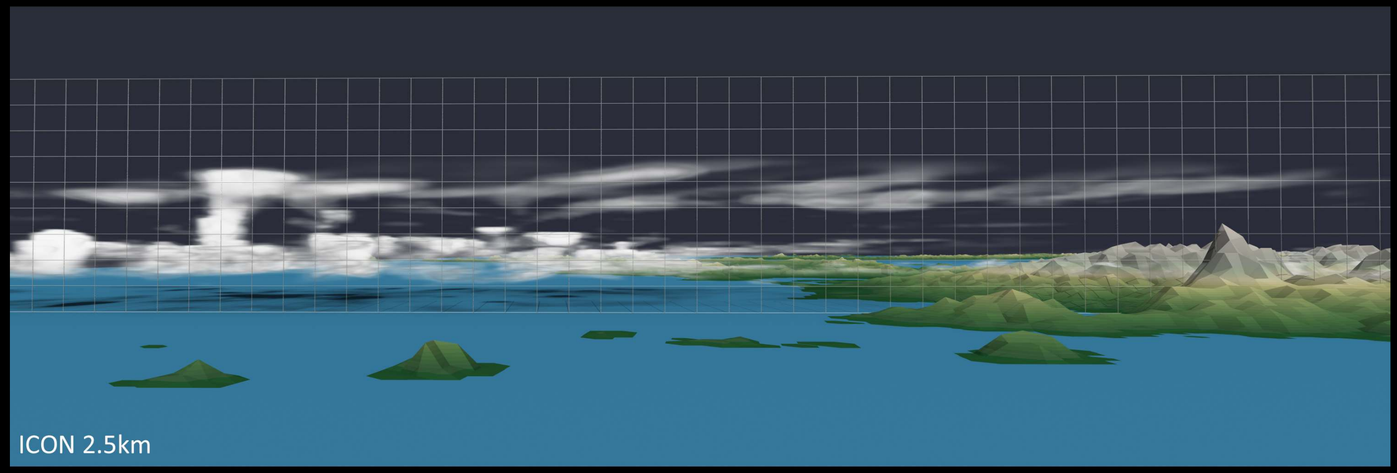
Participating Groups

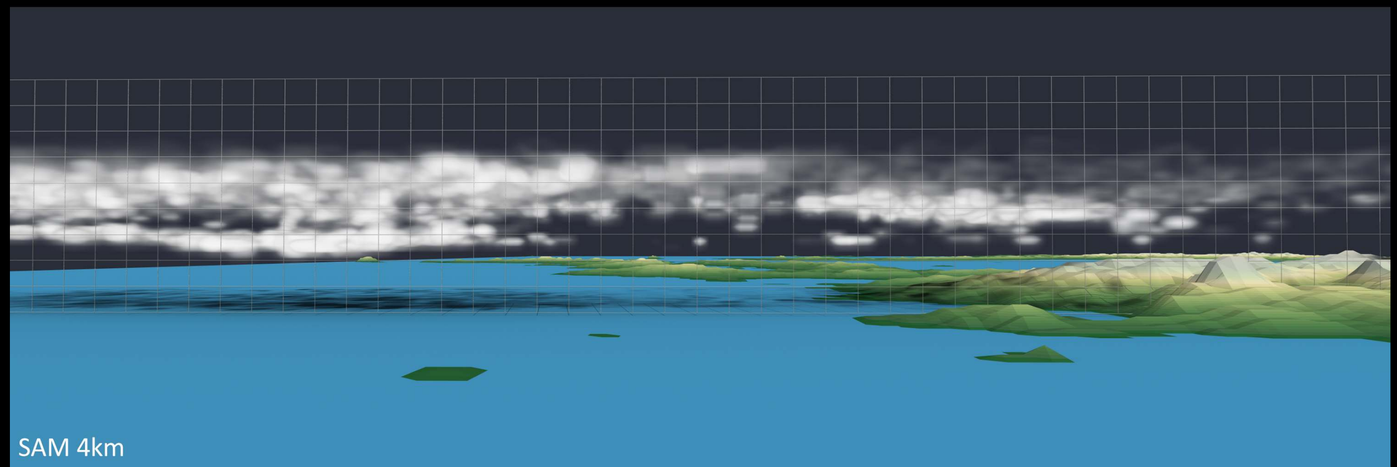
Name	Grid	$\#_{\text{Mcol}}$	$\#_{\text{lev}}$	$\#_{\mu}$	$\sqrt{A_{\text{max}}}$	H_{top}	H_{spng}	CP	BL	FC
ARPEGE-NH	Kurihara	82	75	5	2.5 km	70 km	34 km	N	T	yes
FV3	Cube	57	79	6	3.3 km	39 km	25 km	S	K	yes
GEOS	Cube	57	132	5	3.3 km	80 km	75 km	F	K	yes
ICON	Icoso	84	90	5	2.5 km	75 km	44 km	N	T	yes
IFS	Octo	26	137	5	4.8 km	80 km	65 km	S	K	yes
MPAS	Voronoi	42	75	6	3.8 km	40 km	30 km	F	T	yes
NICAM	Icoso	42	78	5	3.5 km	50 km	25 km	N	K	no
SAM	La-Lo	43	74	5	4.3 km	37 km	22 km	N	S	no
UM	La-Lo	20	85	6	7.8 km	85 km	42 km	S	K	yes

Stevens et al., *Prog. Earth Planet. Sci.,* (2019)

Land Surface Masks



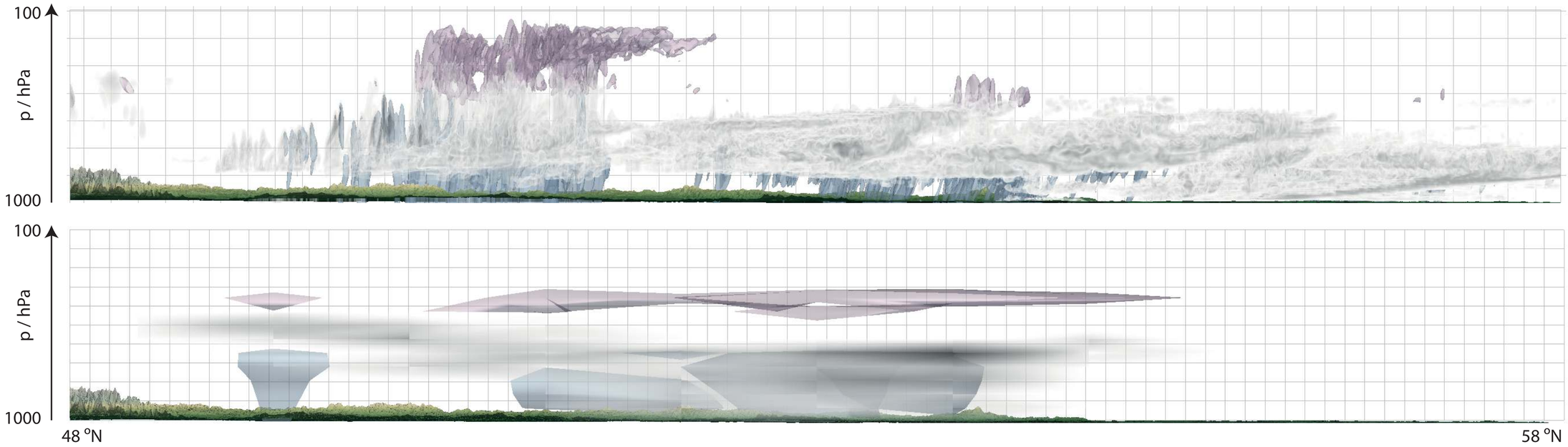




Accidental Ensemble

Name	A_{max}	Salient (additional) difference
FV3	6.5 km	three member ensemble
GEOS5	6 km	none
ICON	5 km	none
"	10 km	"
"	20 km	"
"	40 km	"
"	80 km	"
"	20 km	full NWP physics (convective parameterization)
"	40 km	"
"	80 km	"
"	5 km	DWD grid
"	5 km	DWD grid, erroneous specification of surface albedo over Asia
"	5 km	Fixed SST (to value on 1 August)
IFS	9 km	TCo1279 near-operational configuration, with fully active convective parametrization
MPAS	7 km	none
"	3.5 km	with fully active convective parameterization
"	7.0 km	"
NICAM	7 km	none
"	14 km	"
UM	15 km	none
ECHAM6	100 km	T127 (100 km) ten-membe ensemble with full parameterization

What's in a Name: SRM, CPM, CRM, CSRM?



… clouds are un-resolvable, and models run on grids of many tens, even hundreds of kilometers permit convection.
Storms are familiar creatures of the mesoscale (2 km - 2 000 km).

Satoh et al., *Cur. Clim. Change Rep.* (2010), Matsui et al., *J Hydrometeorol.* (2016) Klocke D. *Nat Geosci.* (2017)

To keep in mind

- Part of why we did this was to explore new workflows, so accessing the data will be difficult and we want to understand these difficulties.
- What is new… vis a vis NICAM or the community of regional scale models.
- The considerable supplementary simulations (accidental ensemble).
- The bandwidth with the observational data.
- Progress in climate science will come from those who can infer information about the climate system from decadal scales of variability DYAMOND is a start.
- What would be interesting next steps (Satoh-san's talk)