



The 8th CCMC Community Workshop
11-15 April, 2016, Annapolis, Maryland



Opportunities for CCMC-PSTEP Partnership

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Nagoya University



Outline

- Introduction to PSTEP
 - What is PSTEP
 - Motivation, Objectives & Organization
 - Strategies and Roadmap
 - PSTEP Models
- CCMC-PSTEP Partnership
 - Possible collaborations
 - International Framework for Coordinated Model



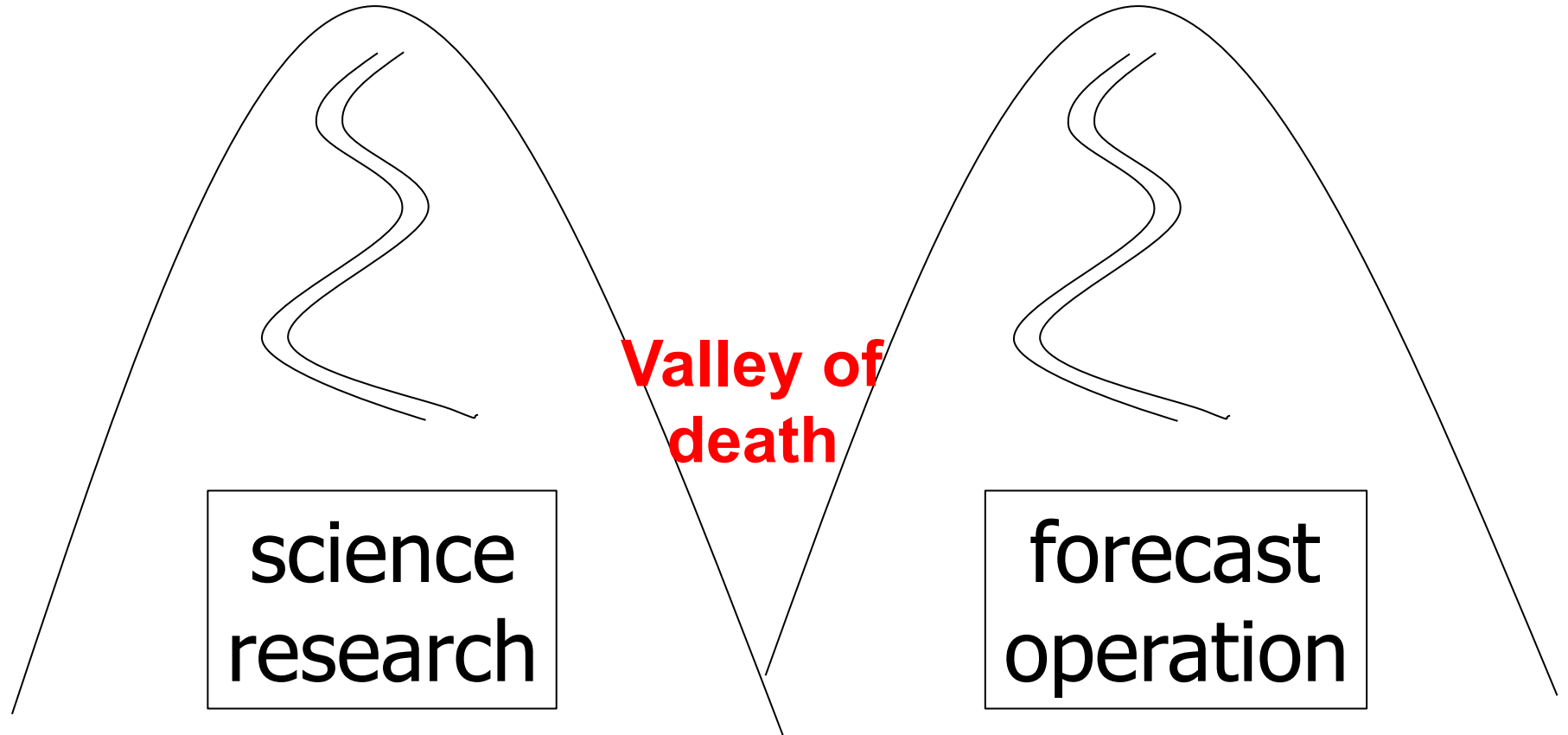
Introduction to PSTEP Project for Solar-Terrestrial Environment Prediction



Research & Operation

“understanding”

“predicting”

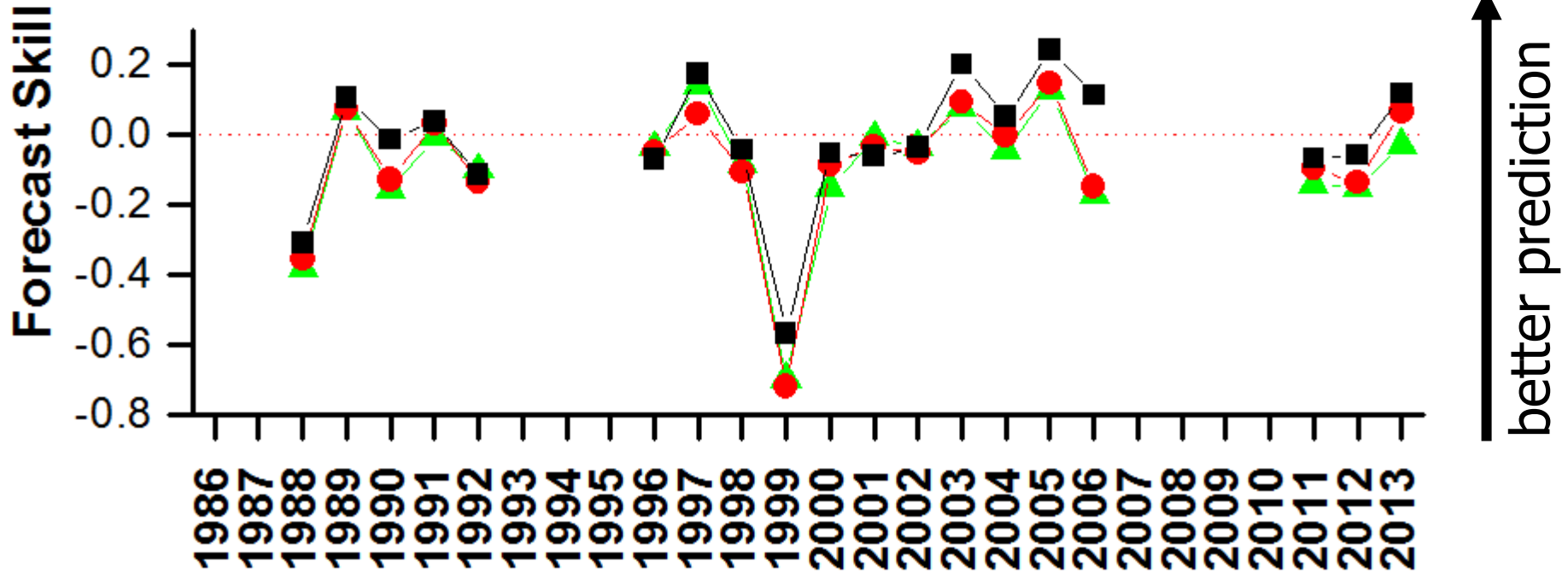
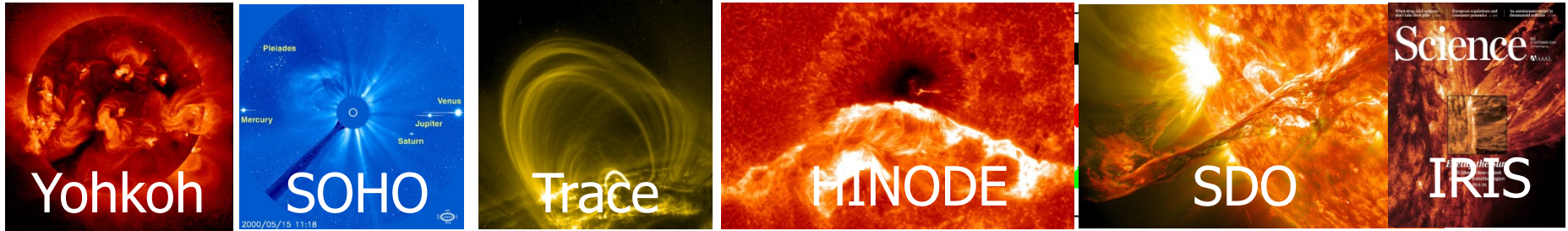


science
research

forecast
operation

Valley of
death

History of Flare Prediction Skill



2014, NOAA Space Weather Prediction Center, Boulder, CO, USA

Research & Operation

“understanding”

“predicting”

Application of forecast results for Science



Application of our understanding for Forecast

Valley of death

science
research

forecast
operation

Physics-based Model

2015-2019 科学研究費補助金 新學術領域研究(研究領域提案型)

Project for Solar-Terrestrial Environment Prediction (PSTEP)

supported by a Grant-in-Aid for Scientific Research on Innovative Areas from MEXT/Japan

太陽地球圈環境予測



synergistic
development

【Objective 1】

To answer fundamental questions of solar-terrestrial environment:

- The onset mechanism of solar flares
- The mechanism of radiation belt dynamics
- The physical process whereby the sun affects climate

【Objective 2】

To build the base for next-generation space weather forecast system

- Useful prediction for each industrial activities
- Physics-based assessment of severe space weather disaster

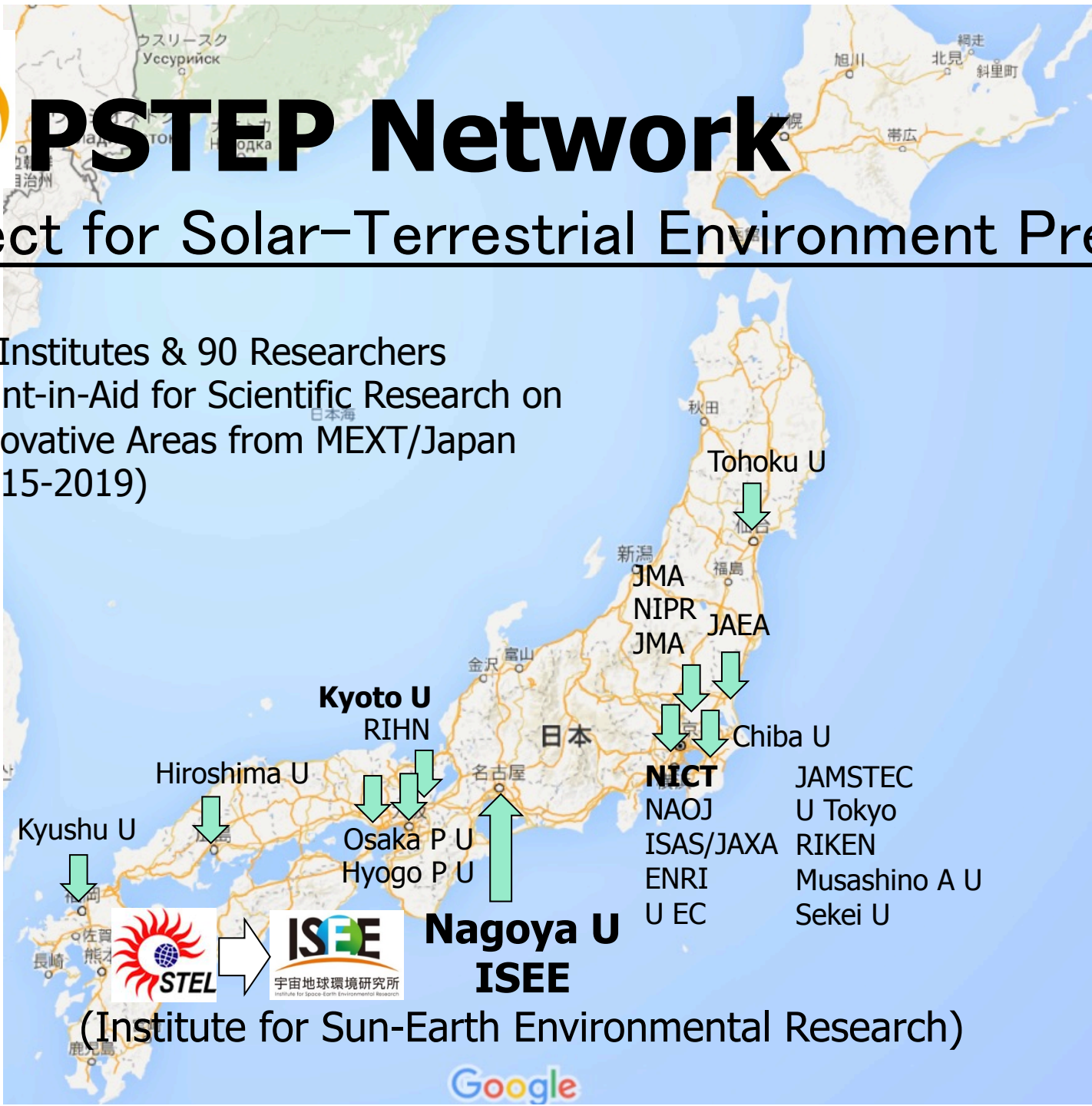
Physics-based Prediction
+
Observation Network & HPC



PSTEP Network

Project for Solar-Terrestrial Environment Prediction

- 20 Institutes & 90 Researchers
- Grant-in-Aid for Scientific Research on Innovative Areas from MEXT/Japan (2015-2019)



Tohoku U
 JMA
 NIPR
 JAEA
 Chiba U
 NICT
 JAMSTEC
 U Tokyo
 RIKEN
 Musashino A U
 Seikei U
 Kyoto U
 RIHN
 Hiroshima U
 Osaka P U
 Hyogo P U
 Nagoya U
 ISEE
 Kyushu U
 STEL

(Institute for Sun-Earth Environmental Research)



Organization of PSTEP



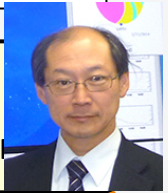
International partners

Steering Committee
Kusano (Nagoya U.)



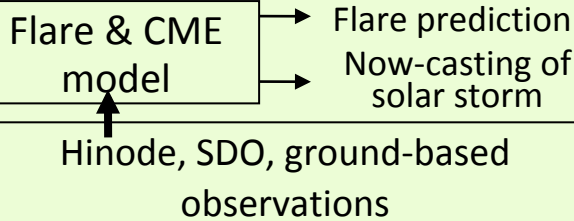
Partners in Industries

① **A01 Space Weather Forecast Operation Group** Ishii (NICT)
Forecast systems to meet the needs of society, Assessment of severe space weather

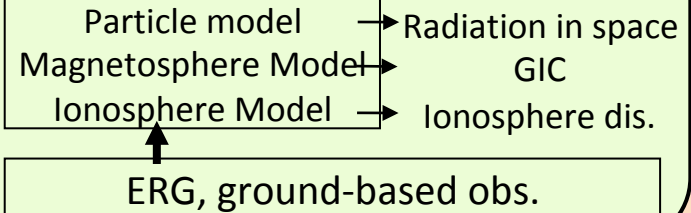


② Short-term (space weather)

A02 Solar-Storm group
Ichimoto (Kyoto Univ.)

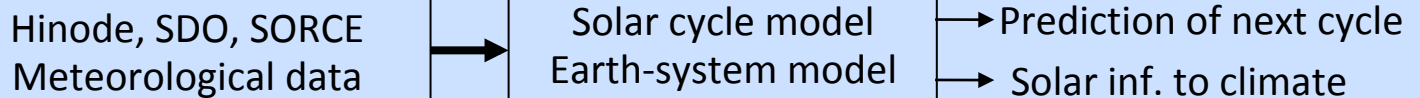
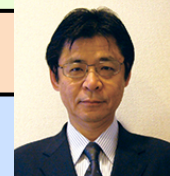


A03 Geomagnetism group
Miyoshi (Nagoya Univ.)



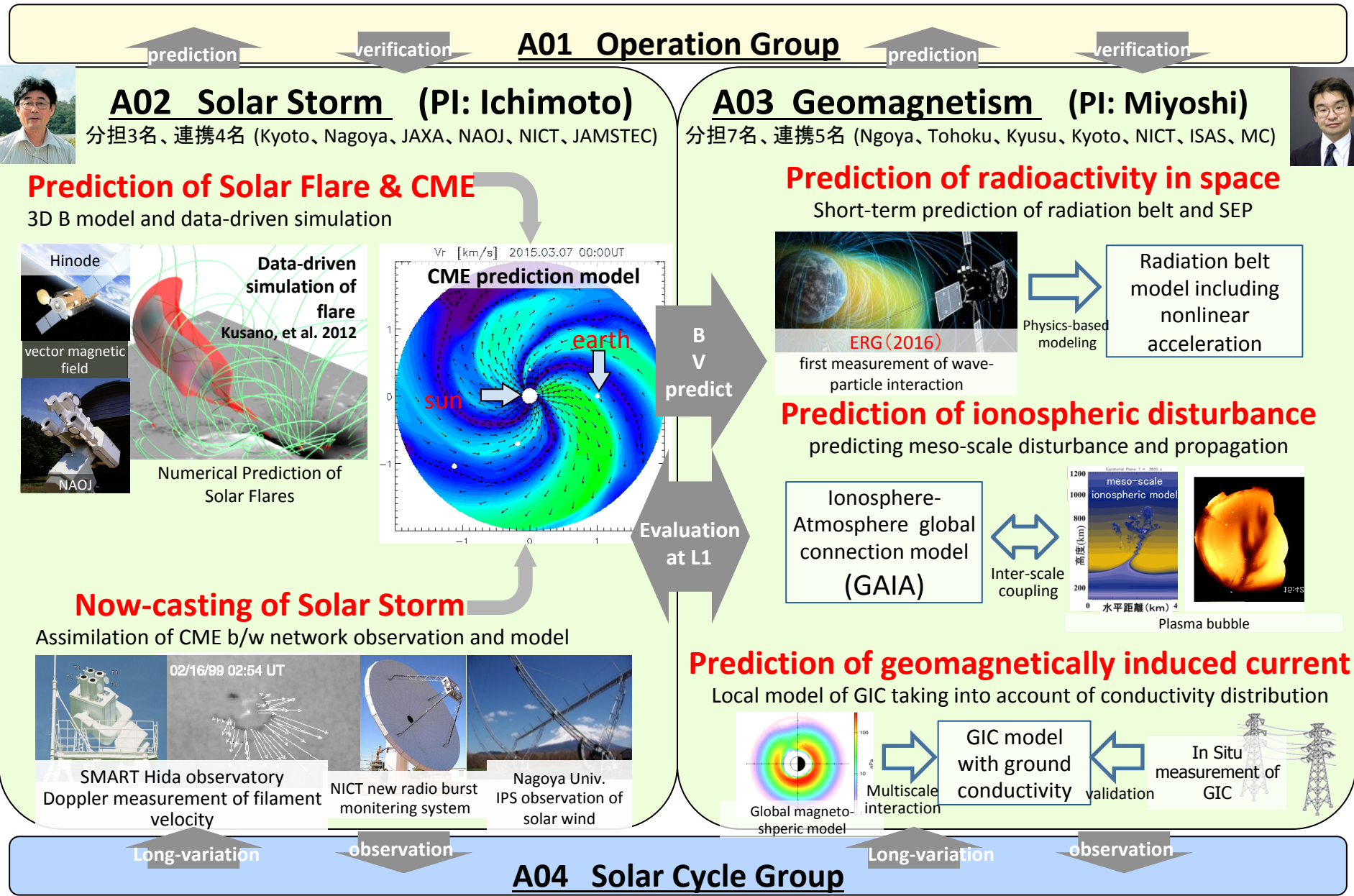
③ Long-term (space climate)

A04 Solar cycle and climate, Yoden (Kyoto Univ.)



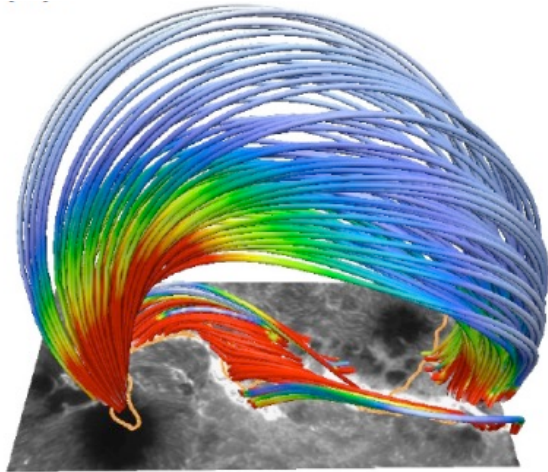
Research Units (proposal-based)

② Short-term prediction (Space Weather)

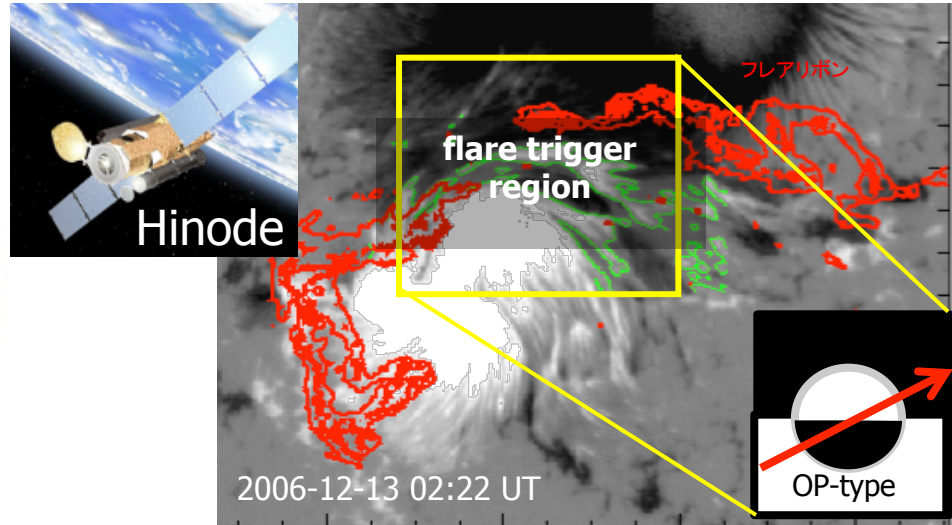


Flare Trigger Models

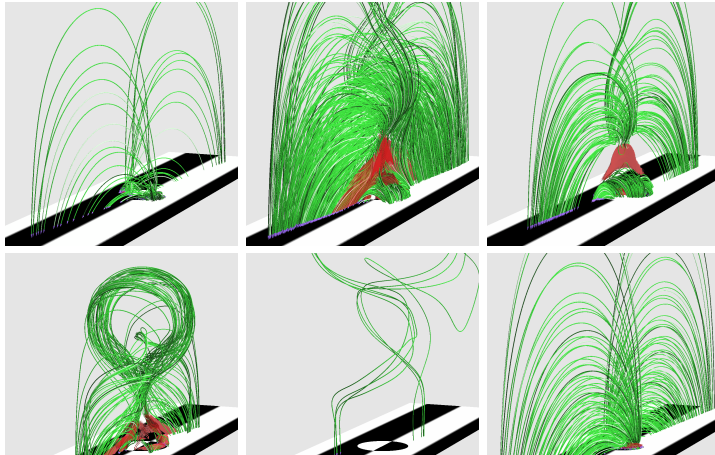
- Kusano+2012, Bamba+2013, Inoue+2016



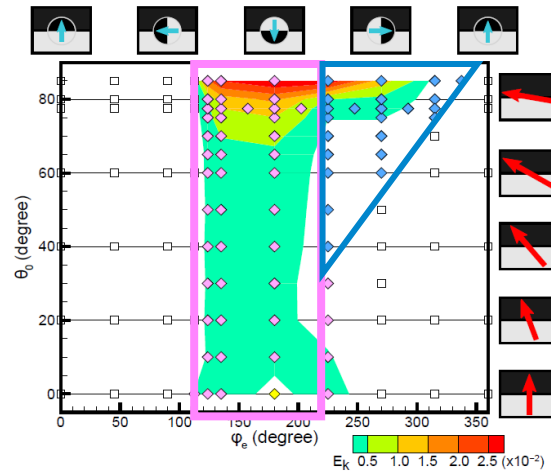
NLFF model



Vector magnetic field analyzer for flare trigger



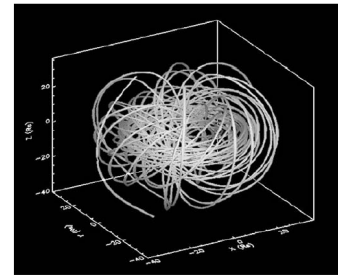
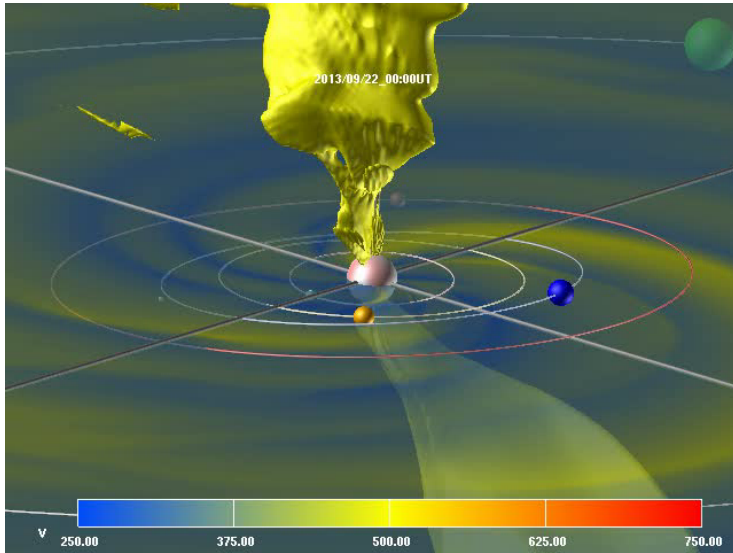
Ensemble simulator for flare trigger



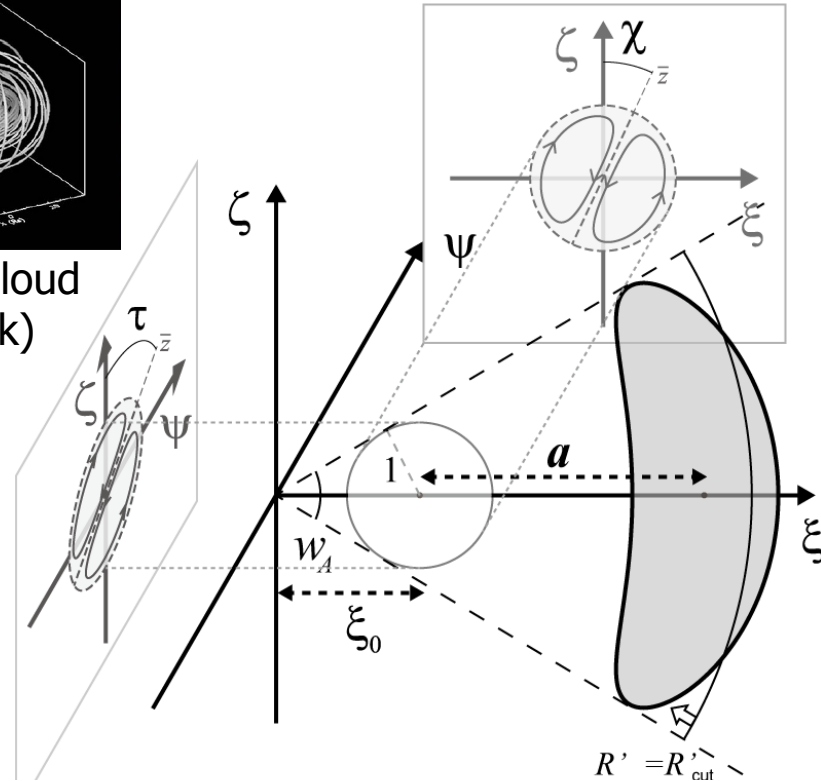
Distribution of possible flare energy on the parameter space of trigger field structure

Solar Wind & CME Model

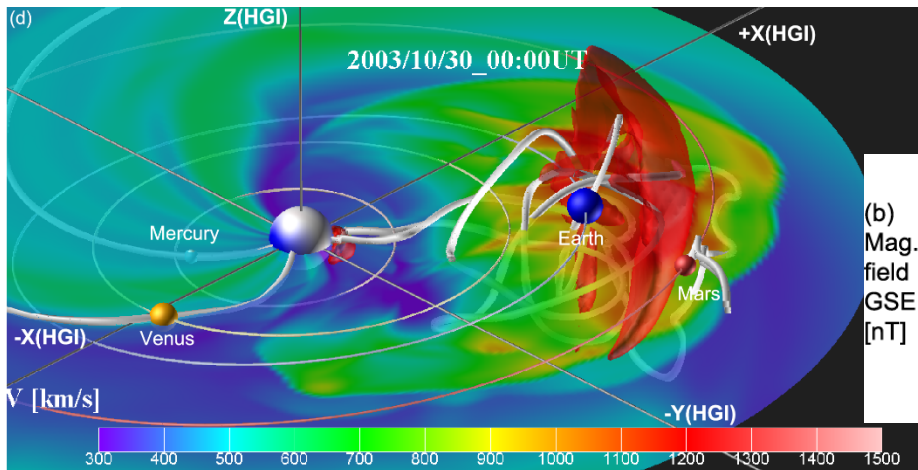
SUSANOO



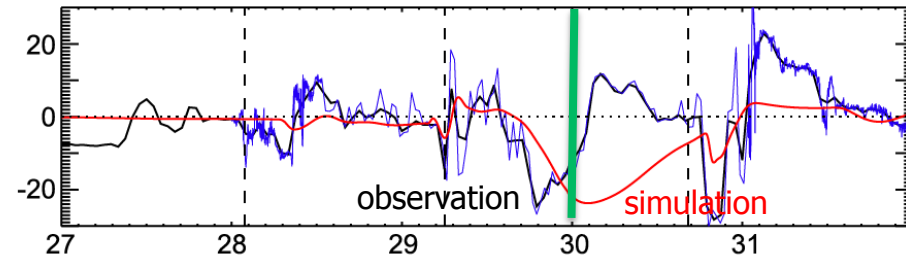
magnetic cloud (spheromak)



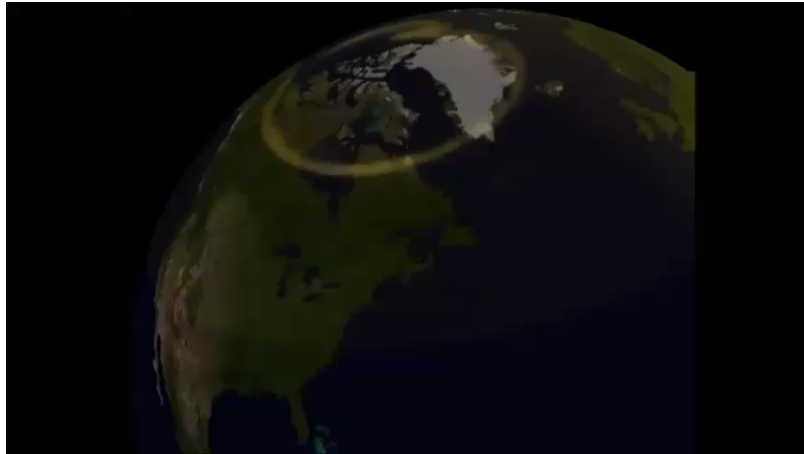
Shiota & Kataoka 2016



(b) Mag. field GSE Z [nT]



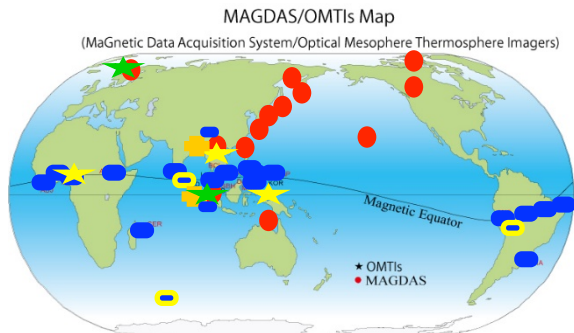
M+I Models



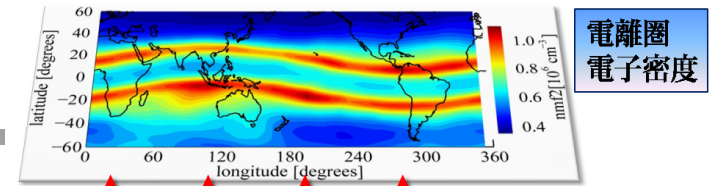
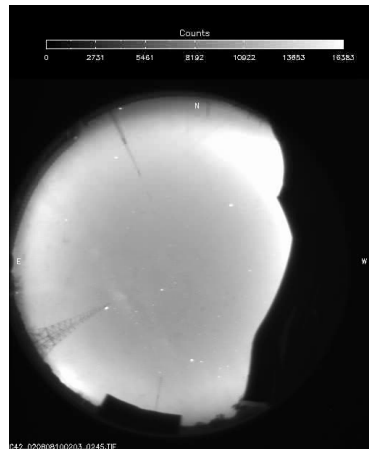
Global MI-coupling Model

Ebihara and Tanaka (2015, JGR)

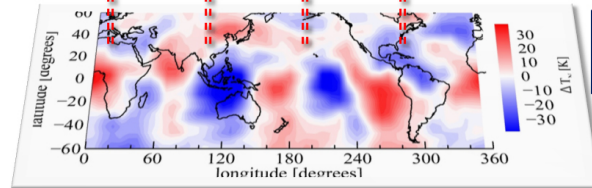
The evolution of auroral breakup with substorms.



Ground-based Observation network



電離圈
電子密度

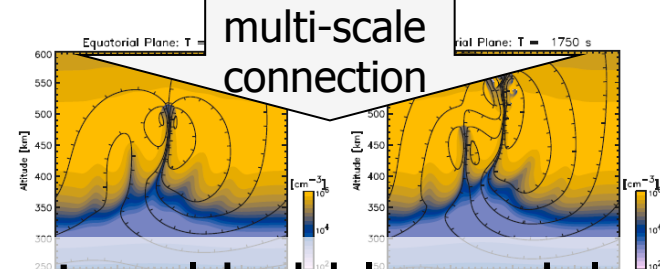


熱圈
溫度



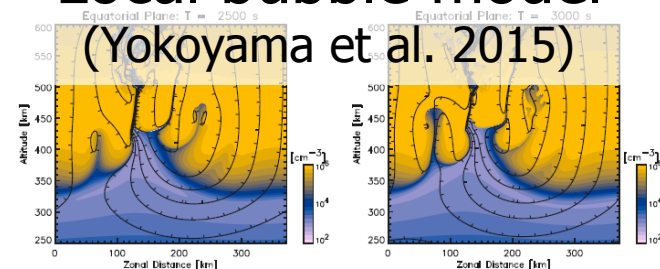
地上
雨量

GAIA: Whole Atmosphere-Ionosphere Coupled Model (Shinagawa+ 2011)



multi-scale connection

Local bubble model (Yokoyama et al. 2015)



If contours by solid curves on magnetic equatorial planes at $T = 0, 500, 1000, 1250, 1500, 1750, 2000, 2500$, ours are drawn every 30 V. Tick marks on each contour indicate the direction of electric field vectors.

③ Long-term prediction (space climate)

A02

最新データ

Solar Storm

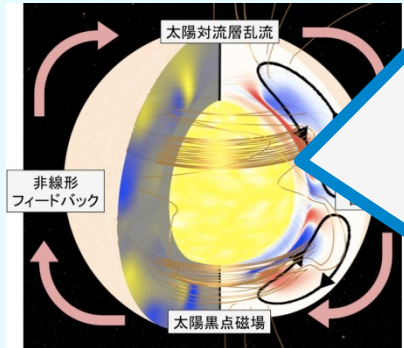
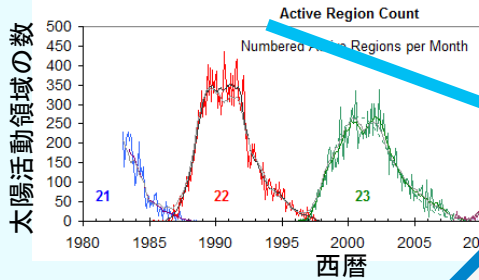
長期活動予測

prediction

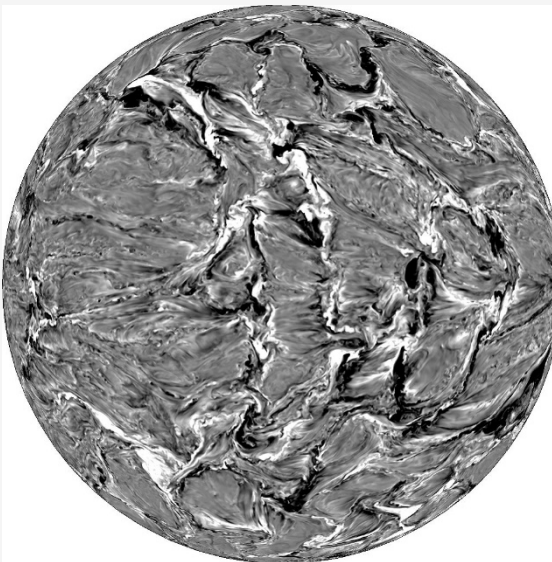
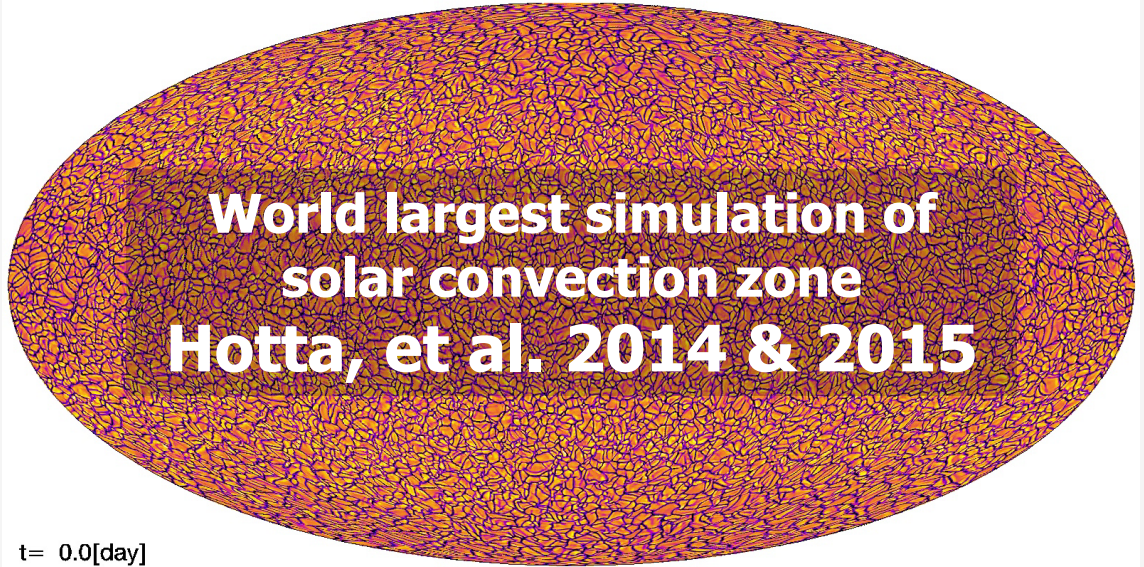
A04班

Kyoto, Nagoya,

Prediction of C



3D dynamo model
Using K-comp

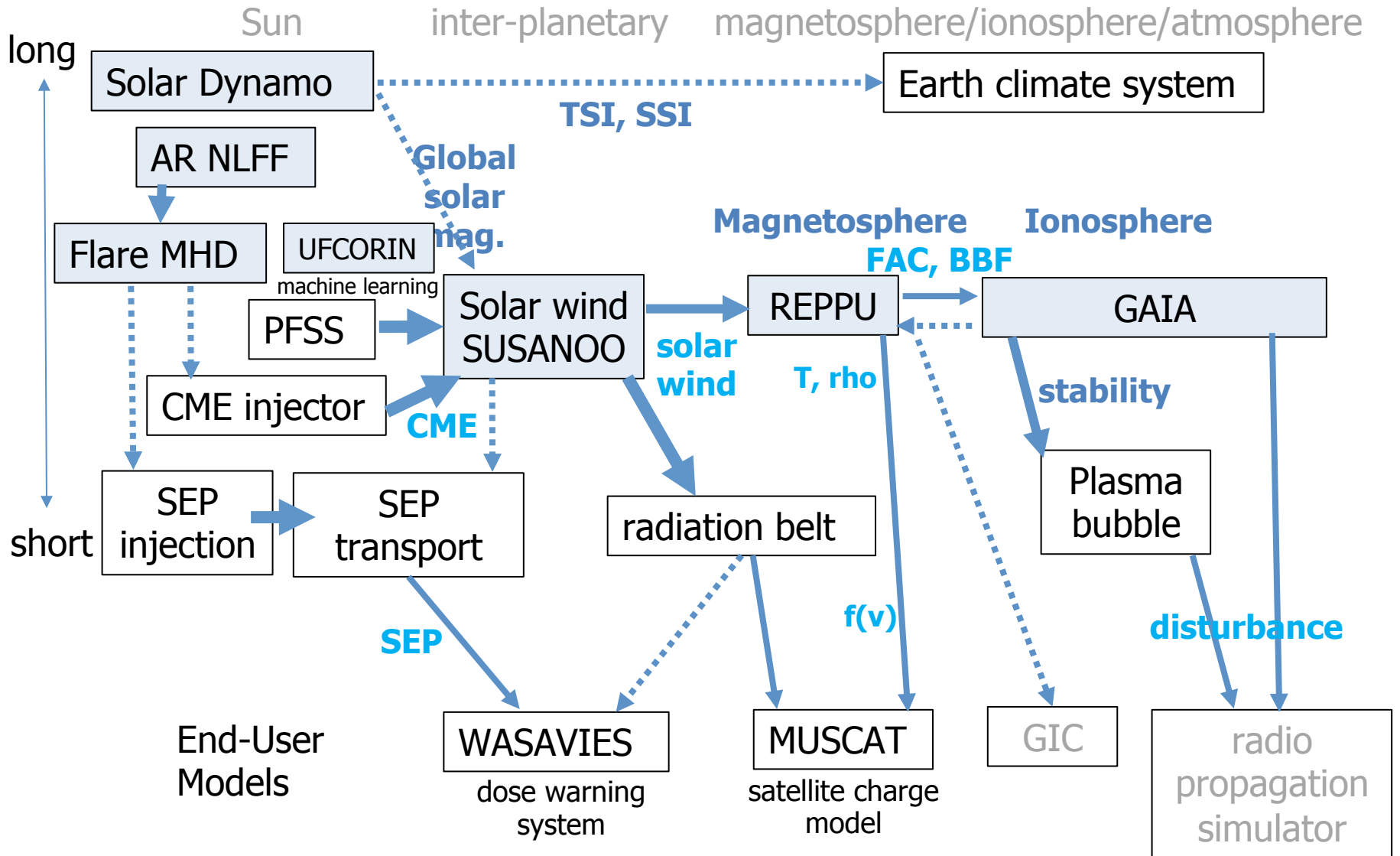


World largest solar dynamo simulation (Hotta et al. 2016 Science)



System map of PSTEP models

A02-A04モデル



International collaborations

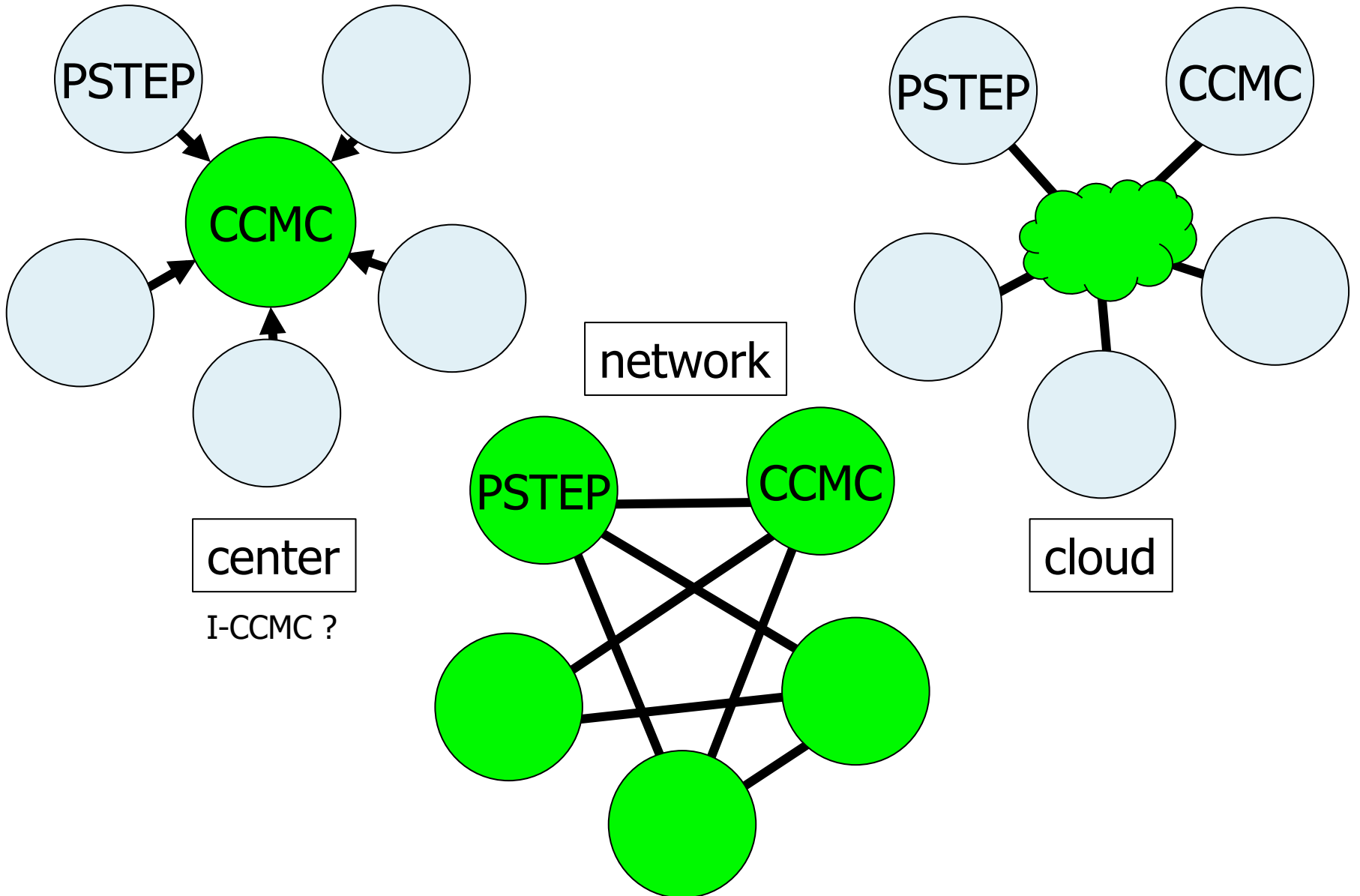
International Symposium PSTEP-1

Jan 13-14, 2016

Nagoya University, Japan



International frameworks





PSTEP

Project for
Solar-Terrestrial Environment Prediction

PSTEP is a new nation-wide project in Japan for space weather & space climate study. PSTEP aims to synergistically improve both our scientific understanding and predictive capability. The international joint activity is very important for PSTEP.



① Forecast Operation Group

Socio-Economic System

assessment

evaluation

A01

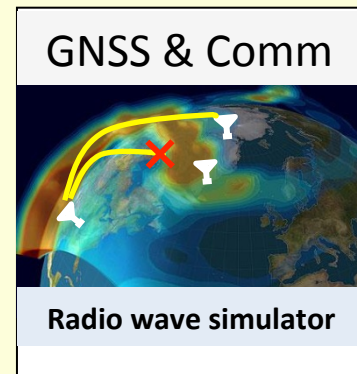
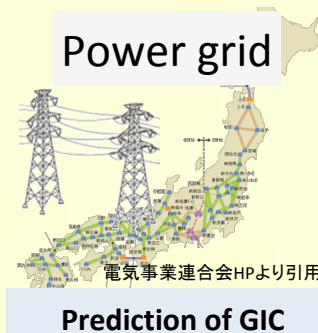
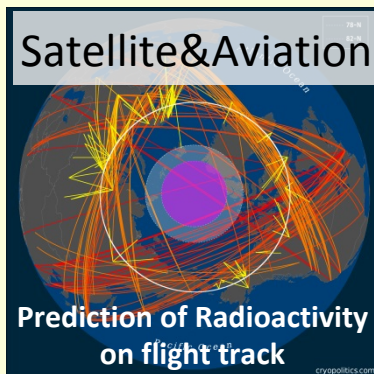
Mamoru Ishii (NICT)

宇宙天気予報運用機関(NICT)と
大学・研究所・企業による
強力な産官学連携研究

- 情報通信研究機構(代表、連携2名)
- 電子航法研究所(分担1名)
- 原子力研究開発機構(分担1名)
- JAXA本部(連携1名, 協力1名)
- 東京電力(協力1名)
- 電気通信大学(分担1名)
- 名古屋大学太陽地球環境研(連携1名)
- 自然災害影響調査の専門家

to build the base of next-generation space weather forecast

- Forecast systems to meet the needs of society,
- Assessment of severe space weather



prediction

feedback

Integration of Physics-based Models

integration

evaluation

A02 Solar Storm

flare prediction model
CME prediction model

A03 Geomagnetism

Radiation prediction model
GIC prediction model
Ionosphere model

A04 Solar cycle

Solar cycle model
Earth system model