

“Big Data Assimilation”



Real-time Workflow for 30-second-update Forecasting and Perspectives toward DA-AI Integration



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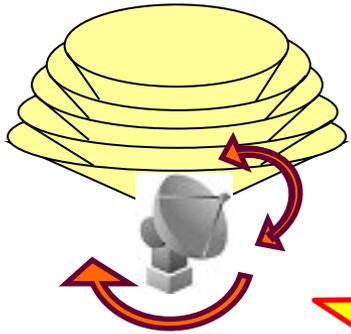
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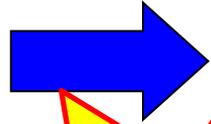


国立研究開発法人
科学技術振興機構
Japan Science and Technology Agency

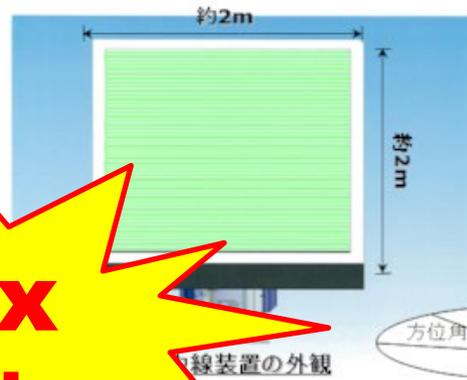
Phased Array Weather Radar (PAWR)



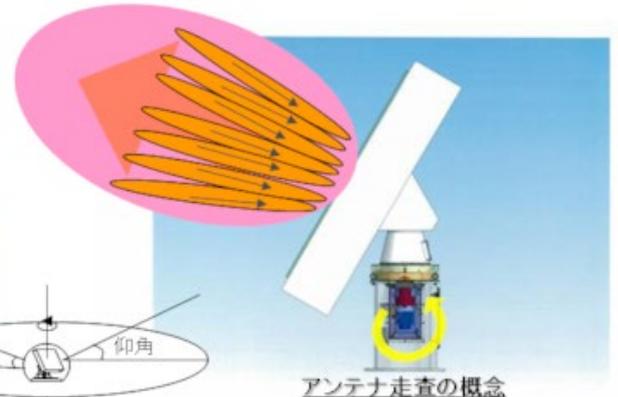
3-dim measurement using a parabolic antenna (150 m, 15 EL angles in 5 min)



100x data size



線装置の外観



アンテナ走査の概念

3-dim measurement using a phased array antenna (100 m, 100 EL angles in 30 sec)

Big Data Assimilation

**Data-driven
Real world**

Observations



Data Assimilation

Simulations



**Process-driven
Cyber world**

100x

Big Data

New sensors, IoT



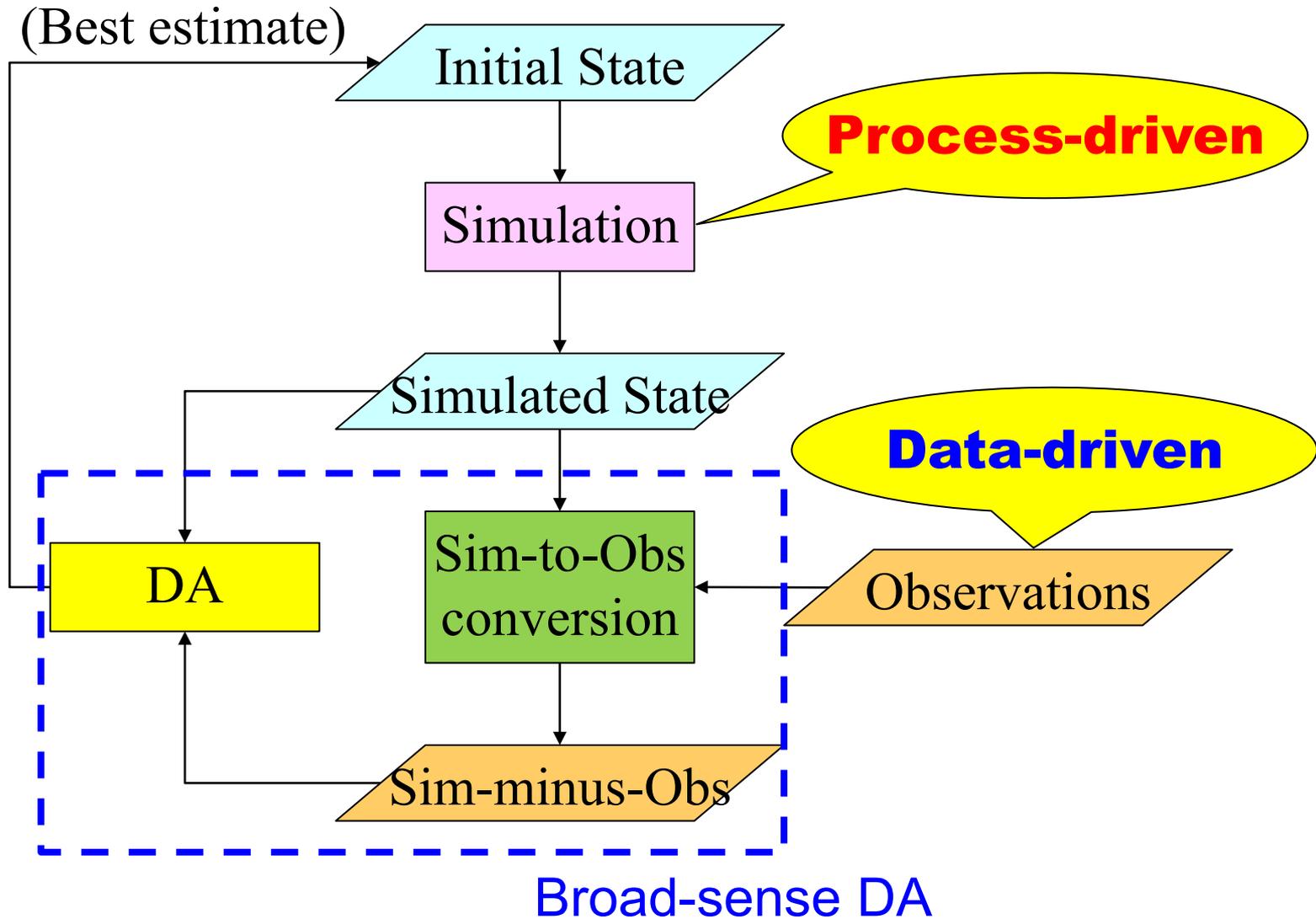
100x

Big Data

Powerful supercomputer



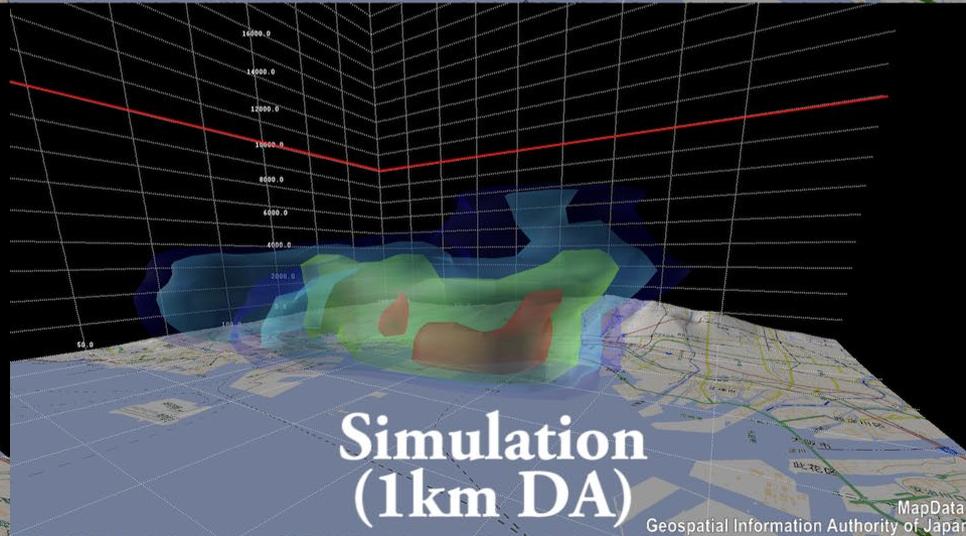
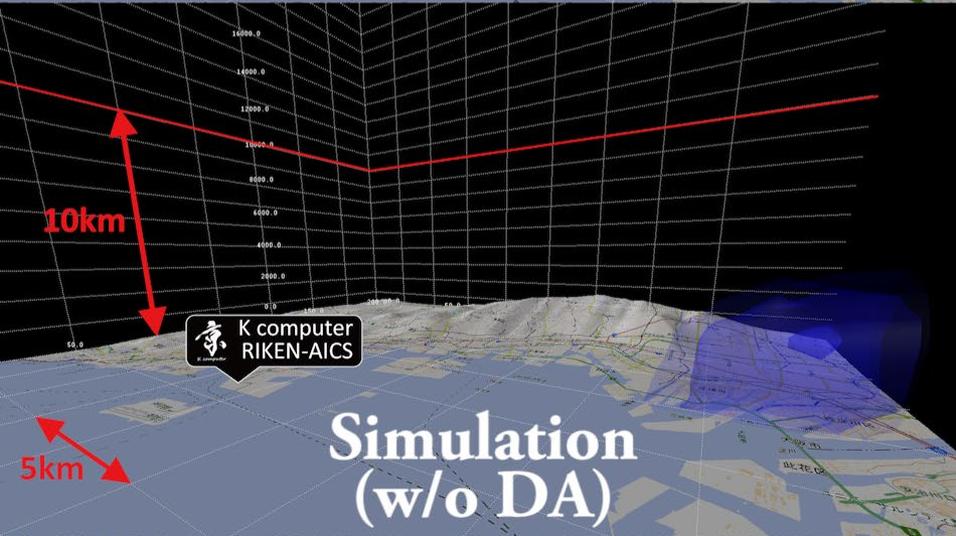
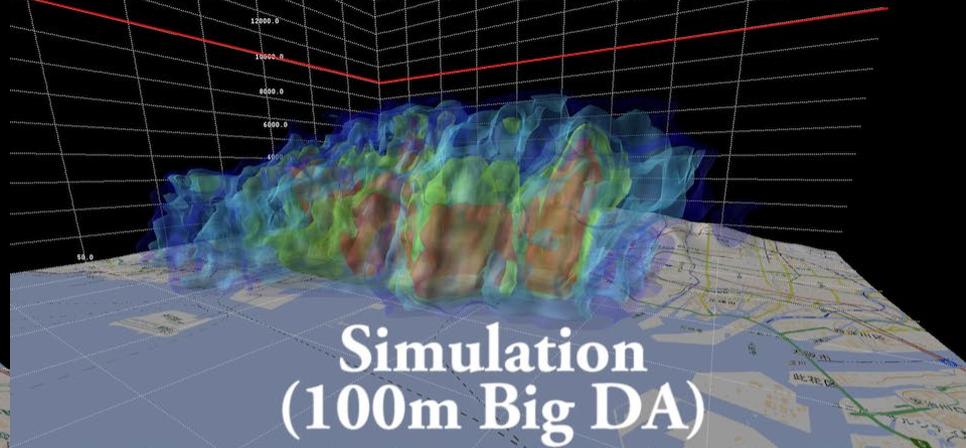
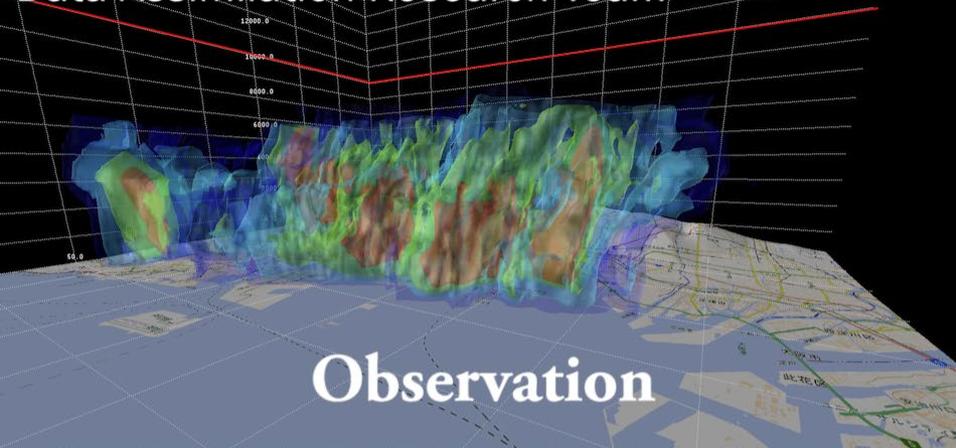
DA workflow



9/11/2014, sudden local rain

RIKEN Advanced Institute for Computational Science
Data Assimilation Research Team

2014.09.11 08:25:00



9/11/2014, sudden local rain

RIKEN Advanced Institute for Computational Science
Data Assimilation Research Team

2014.09.11 08:25:00

**1-h-lead downpour forecast
refreshed every 30 seconds
at 100-m mesh**

10km

K computer
RIKEN-AICS

Simulation
(w/o DA)

Simulation
(1km DA)

Pushing the limits

Big Data × *Big Simulations*

Big ensemble (10240 ensemble members)

Rapid update (30-second update)

High resolution (100-m mesh)

→ Future Numerical Weather Prediction



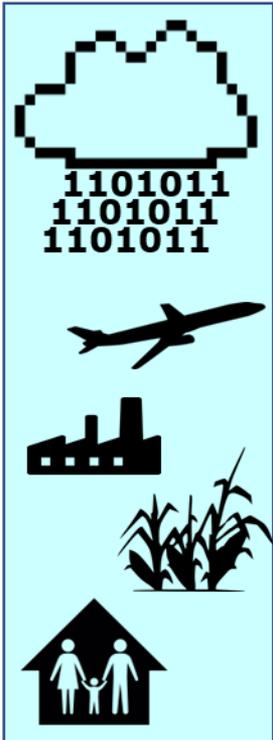
Toward Weather-Ready Society5.0 with

Cyberspace

synchronize
predict & control

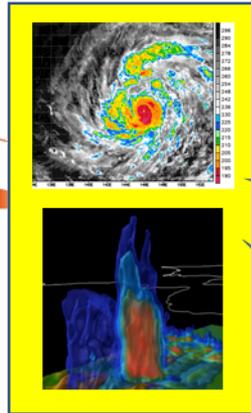
Real world

Simulation



Big Data Assimilation
Data Assimilation

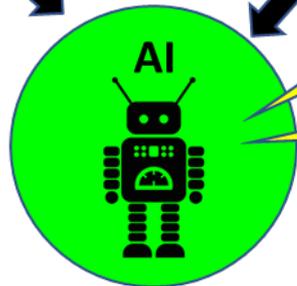
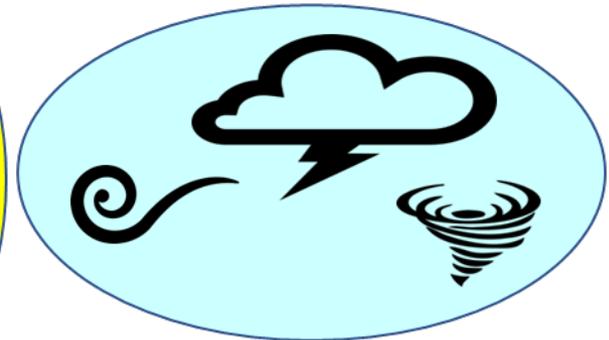
Big Data



Sensing



Nature



IoT



Human society and economy

Toward Weather-Ready Society5.0 with



Cyberspace

synchronize
predict & control

Real world

Simulation

Big Data

Sensing

Nature

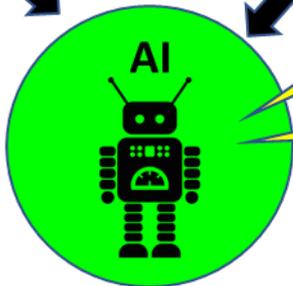
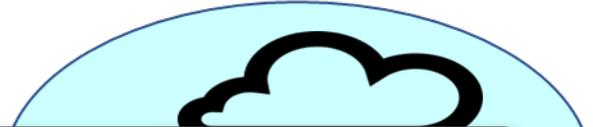
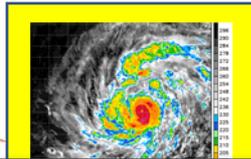
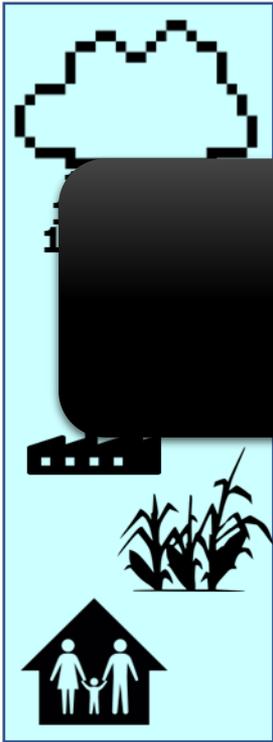
Big Data Assimilation

Toward demonstration at
TOKYO 2020

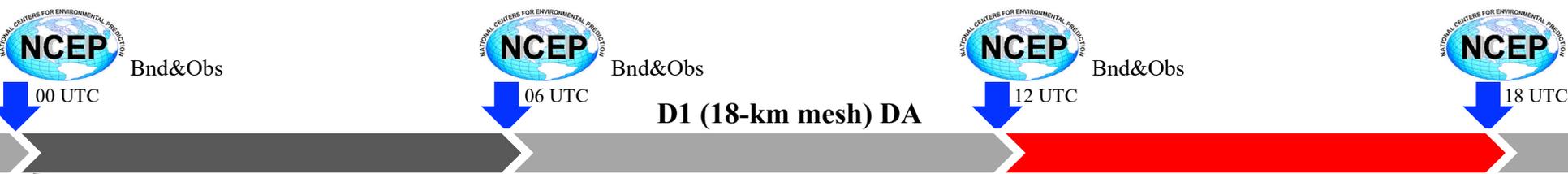
AI

IoT

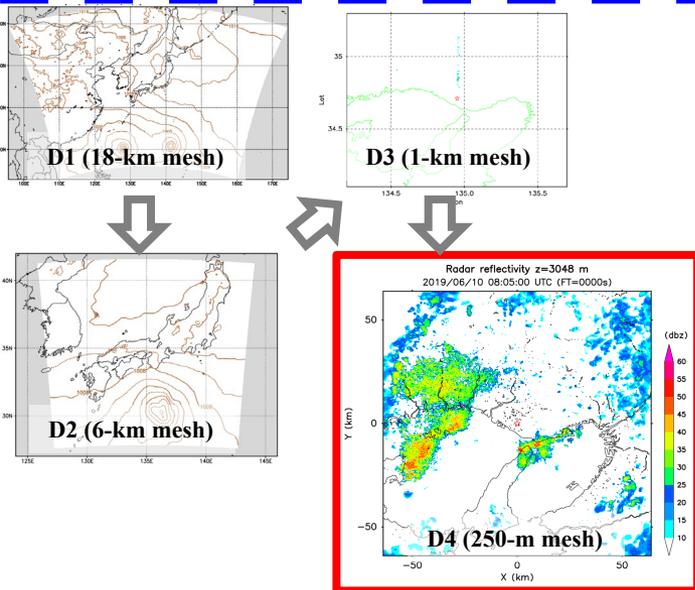
Human society and economy



CREST BDA achievement

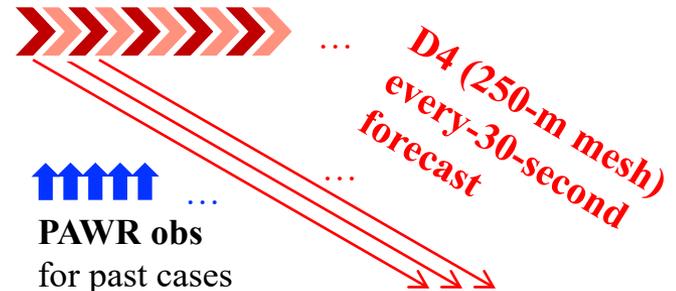


Online, real-time (*Lien et al. 2017, SOLA*)

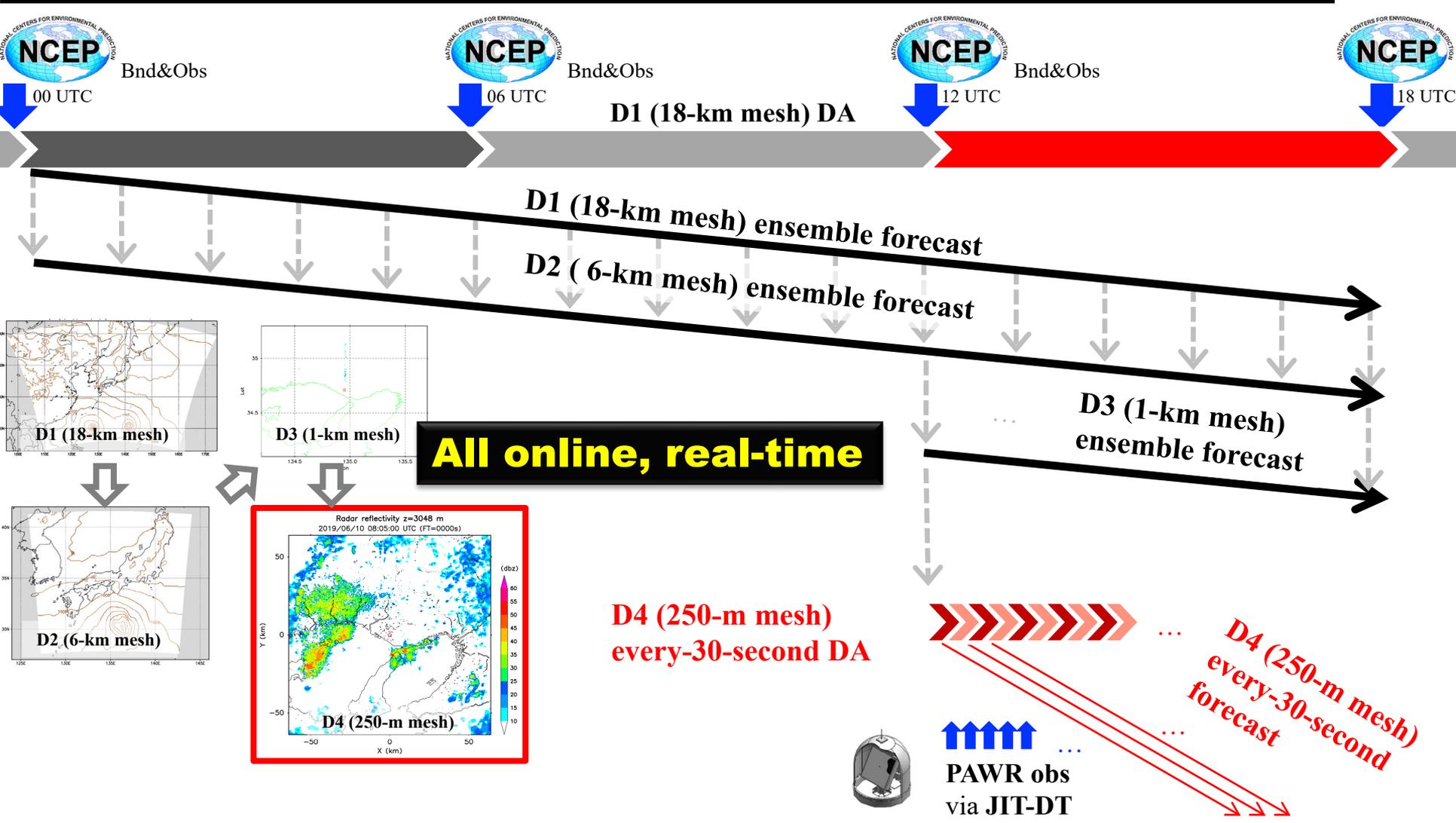


Offline (*Miyoshi et al. 2016a,b, BAMS, PIEEE*)
Computational time <30-sec.

**D4 (250-m mesh)
every-30-second DA**



Goal: fully online, real-time workflow



Test with U.Tokyo OFP on 29 August

Large-scale HPC Challenge



17:46 NCEP GFS (boundary)
19:18 PREPBUFR (obs)

12 UTC

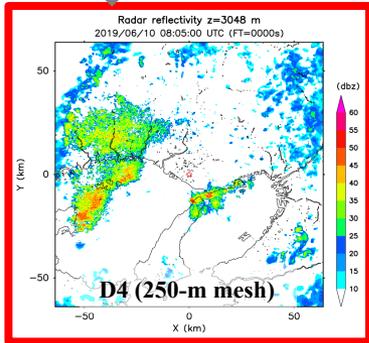
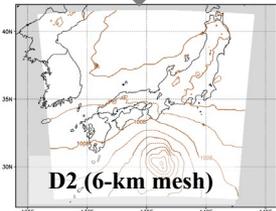
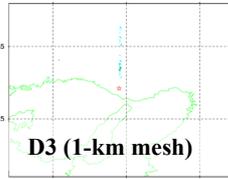
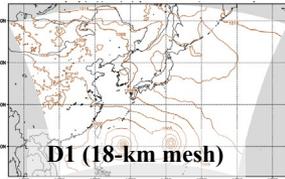
19:25-20:07 D1 DA

D1 (18-km mesh) ensemble forecast

D2 (6-km mesh) ensemble forecast

20:15-21:21 D1&D2 forecast
21:31-22:41 D3 forecast

D3 (1-km mesh) ensemble forecast



23:00 UTC

23:00 D4 (250-m mesh) every-30-second DA

D4 (250-m mesh) every-30-second forecast



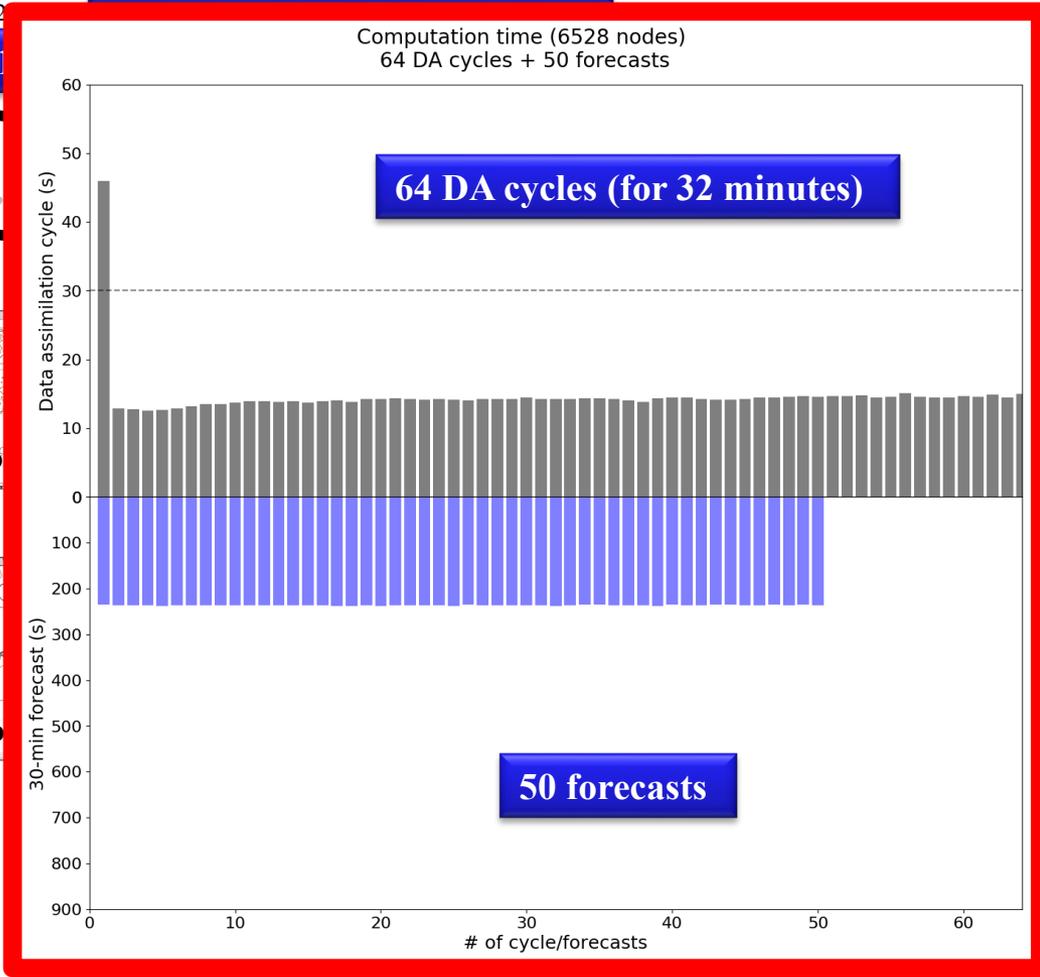
PAWR obs for a past case

Test with U.Tokyo OFP on 30 Nov.



17:46 NCEP GFS (boundary)
19:18 PREPBUFR (obs)

Large-scale HPC Challenge



able forecast

able forecast

D3 (1-km mesh)
ensemble forecast

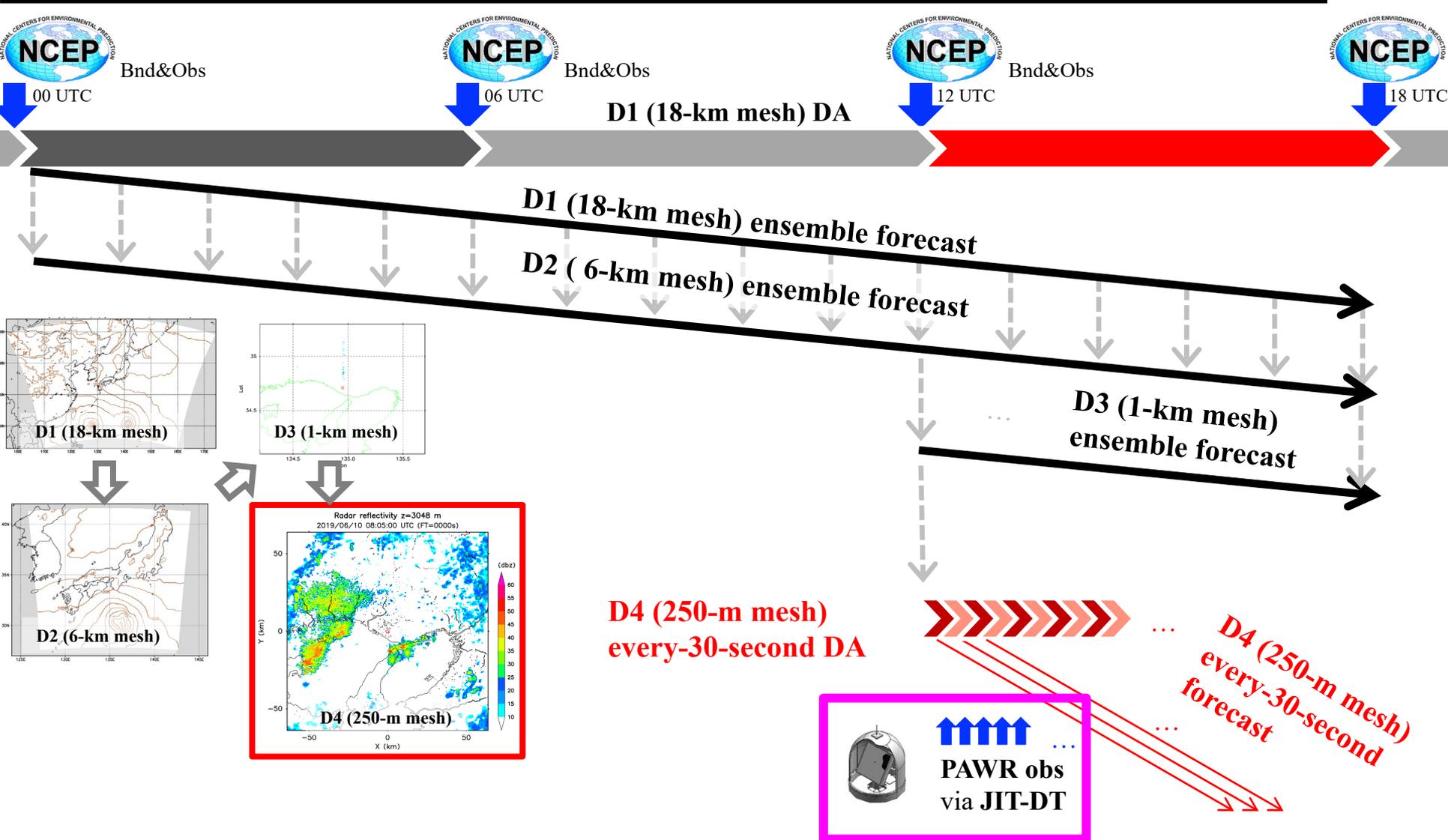
23:00
UTC

mesh)
A

PAWR obs
for a past case

D4 (250-m mesh)
every-30-second
forecast

Remaining part

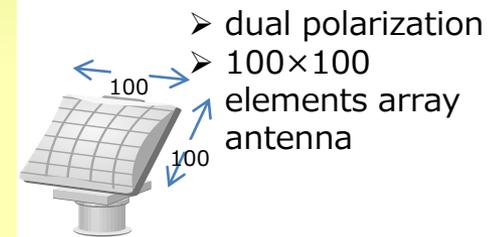
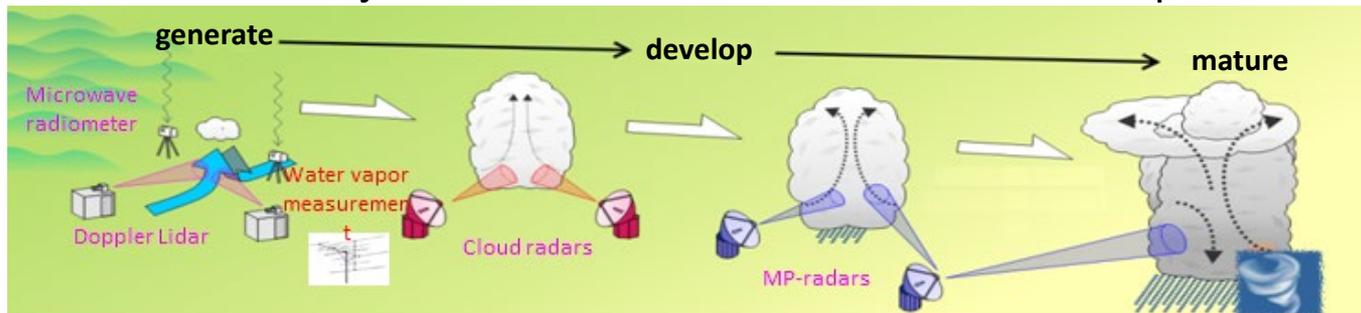


Use JIT-DT in real time

Development of MP-PAWR



Multi-parameter phased array weather radar (MP-PAWR) was developed by SIP (Cross-ministerial Strategic Innovation Promotion Program) in 2014-2018 as a research subject of “torrential rainfall and tornadoes prediction.”

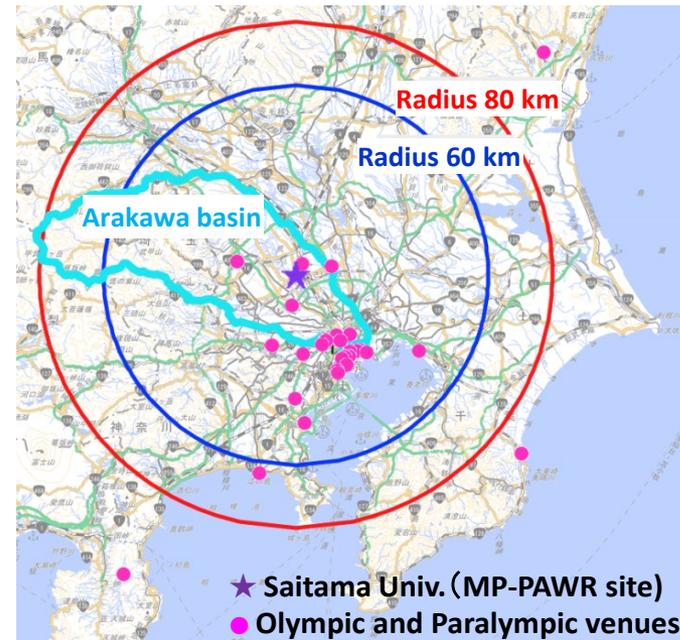


Early forecasting by water vapor, cloud, and precipitation observation

MP-PAWR features



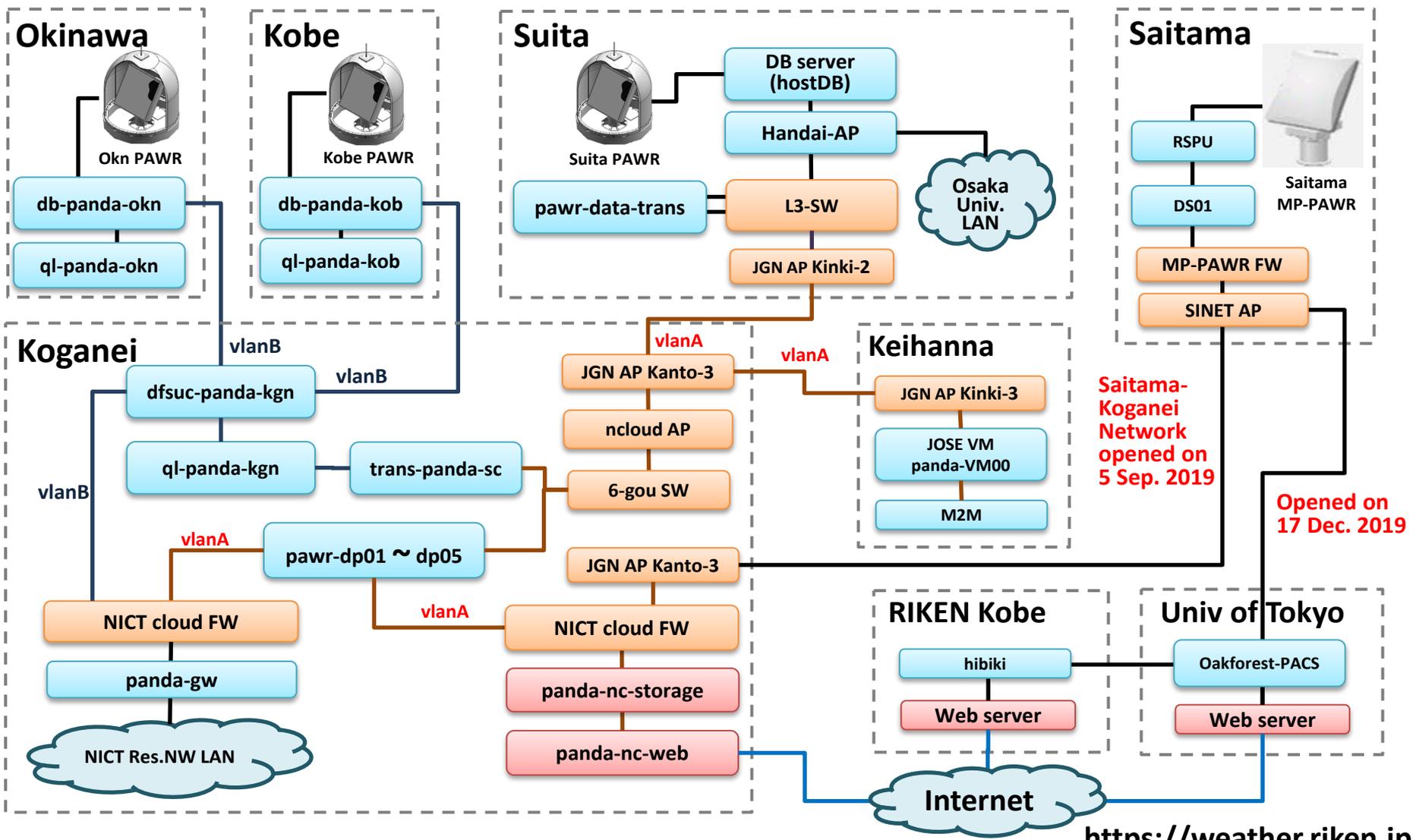
MP-PAWR antenna



MP-PAWR observation area

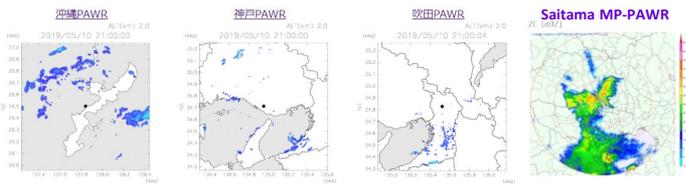
MP-PAWR installed at Saitama Univ. on Nov 21, 2017, and observation began in July 2018.

NICT PAWR Data Utilization System (in NICT cloud)



<https://pawr.nict.go.jp>

<https://weather.riken.jp>



Phased-Array Weather Radar 3D precipitation nowcasting

RIKEN Weather Forecast Research

RIKEN AICS Data Assimilation Research Team

Home

Global Precipitation

Kansai area Precipitation

About DA Team

English / 日本語

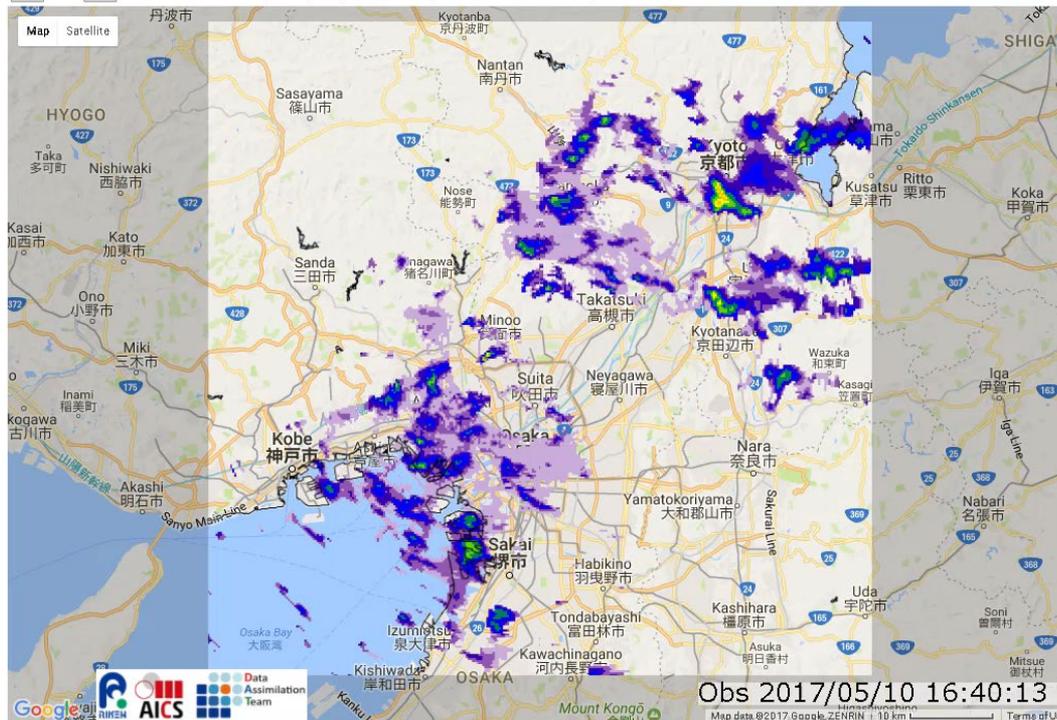
KANSAI PRECIPITATION NOWCAST

30 second update, 10 minute forecast

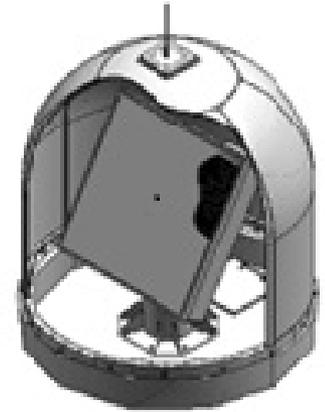
Init time: 2017/05/10 16:45:13

Warnings / Advisories (Japan)

<< 0 >> Animate Auto update (every 30 seconds, auto turn-off in 30mins)



Coast line & lake data based on National Land Numerical Information, MILT, JAPAN



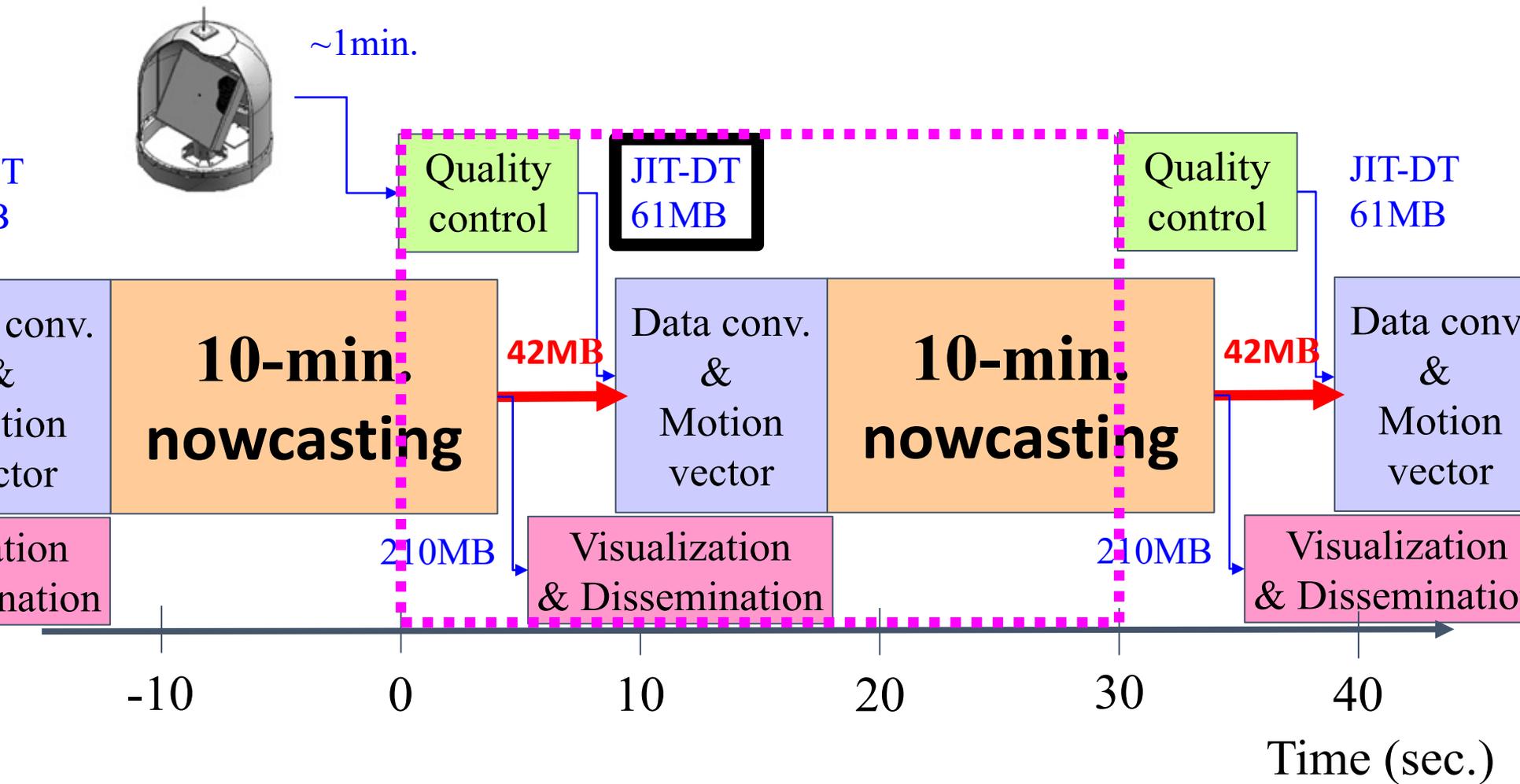
(NICT)

30-second-update
10-min forecast



App by MTI

REAL-TIME 30-second-update nowcasting



Working continuously in
REAL-TIME

Real-time dissemination started on 7/27/2017 with MTI Ltd.

PR TIMES Top | テクノロジー | モバイル | アプリ | エンタメ | ビューティー | ファッション | ライフスタイル | ビジネス
プレスリリース・ニュースリリース配信サービスのPR TIMES

ゲリラ豪雨検知アプリ『3D雨雲ウォッチ』実証実験を関東エリアへ拡大！

～隅田川花火大会の観覧者向けアプリとして、当日の安全な大会をサポート～

株式会社エムティーアイ

**>247,000 DL
Ranked #3!**

4
いいね!
シェア ツイート はてな

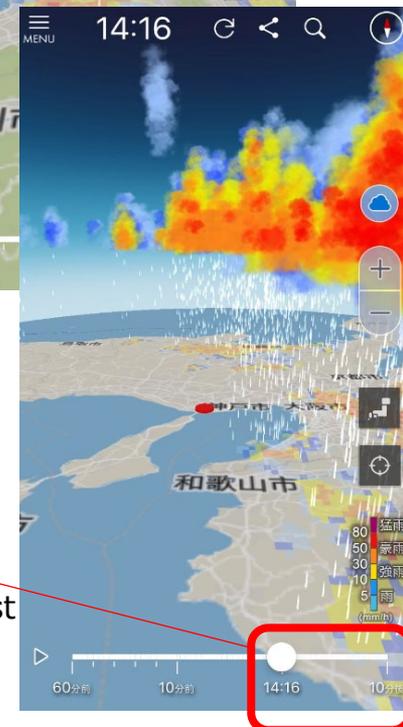
(株)エムティーアイが運営する天気総合情報サイト「イフレンジャー」が、昨年に続き、国立研究開発法人情報通信研究機構との共同研究により開発した、ゲリラ豪雨検知アプリ『3D雨雲ウォッチ～フェーズドアレイレダ～』の実証実験を、7月27日(木)より開始します。

今年で3年目を迎えた予測データを用いたサービスの有用性を検証するため、また今回アプリをサポートを行います。

Making societal impact

◆理研との共同研究による予測データを用いてゲリラ豪雨の発生を10分前に通知！

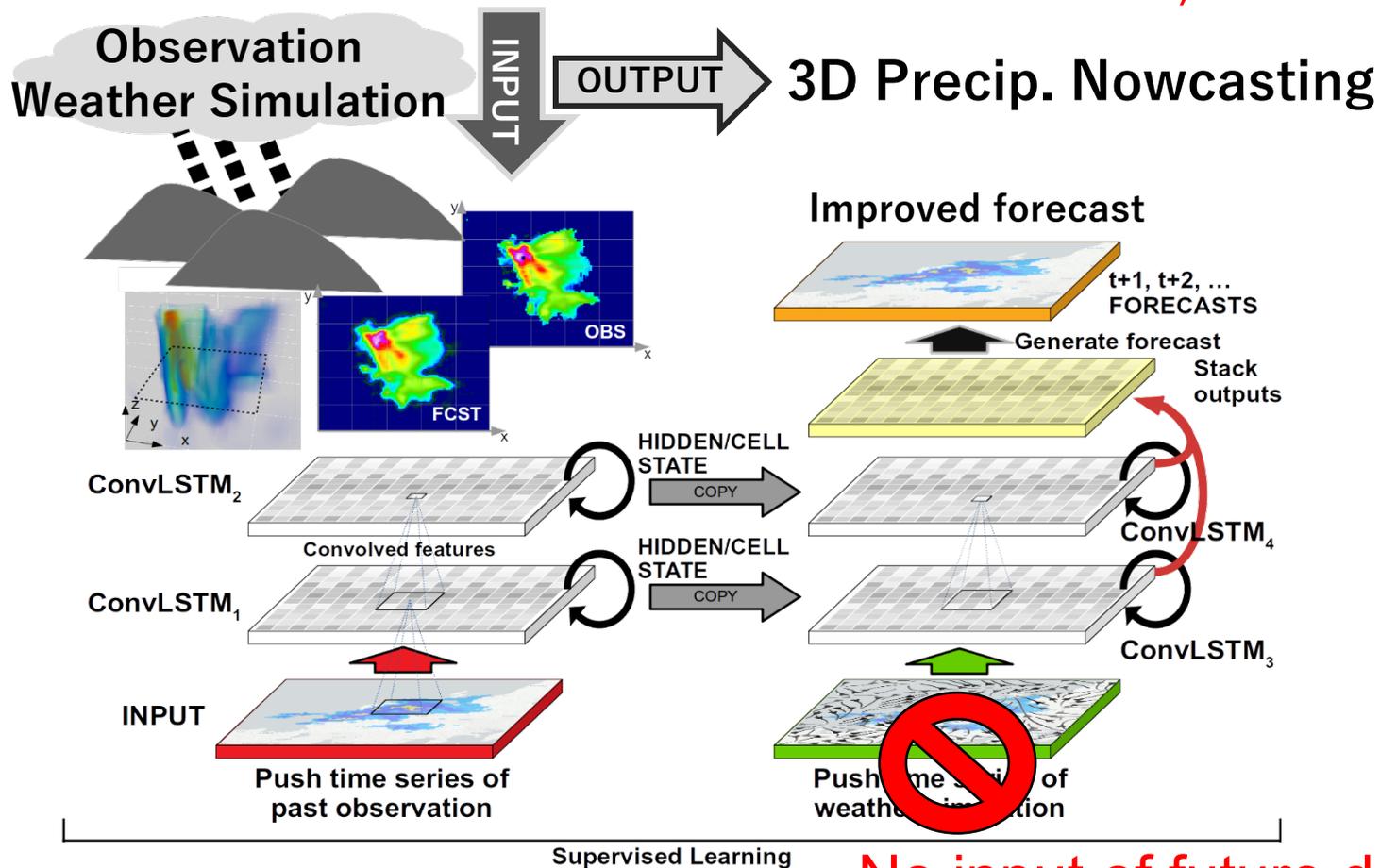
本アプリは、最先端の気象レーダ「フェーズドアレイレダ」のデータを用いてゲリラ豪雨の発生をリアルタイムでお知らせするサービスです。今まで察知が難しかったゲリラ豪雨が発生する可能性を、瞬時にスマートフォンのプッシュ通知で受け取ります。



RIKEN's 3D Nowcast

PAWR 3D Nowcasting

Parallel test of real-time nowcasting w/ ConvLSTM since June 6, 2019!!



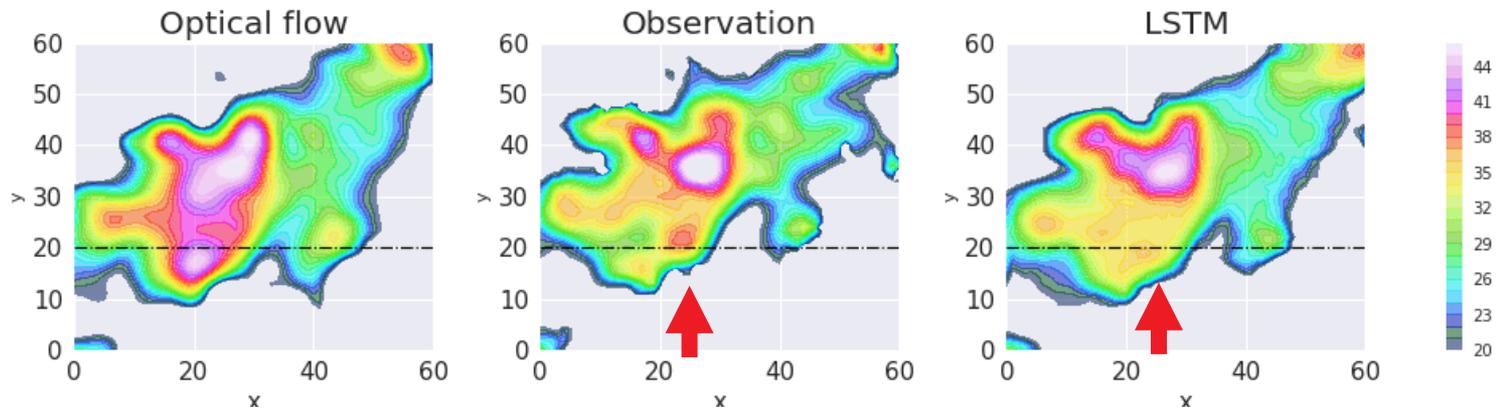
No input of future data at this moment

Conv-LSTM is effective.

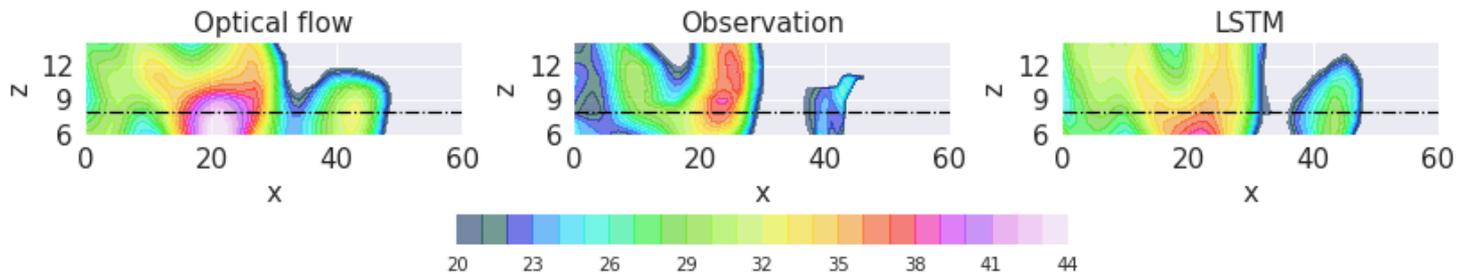
(Work with Mr. Viet Phi Huynh and Prof. Pierre Tandeo)

2.5-min prediction

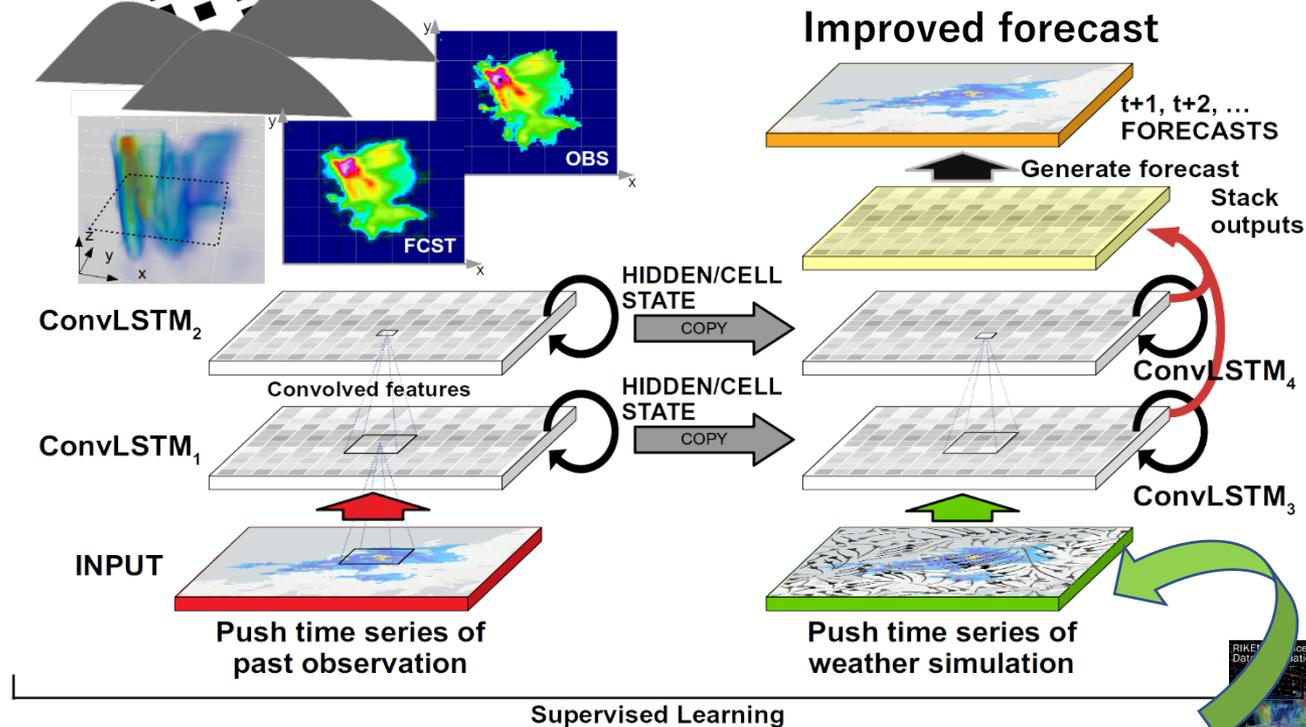
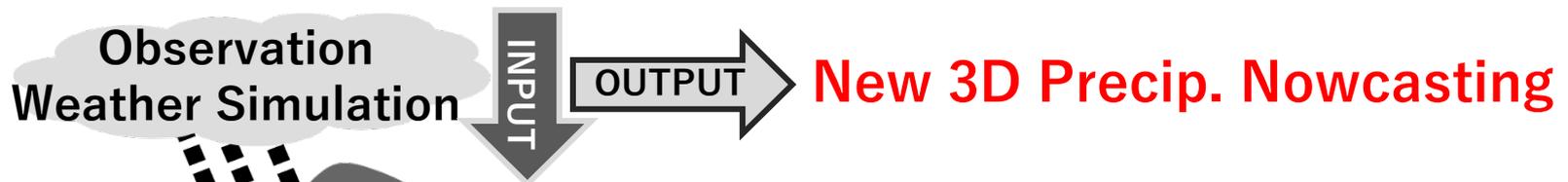
t = 2018-07-27 20:35:30 + 2.5 min



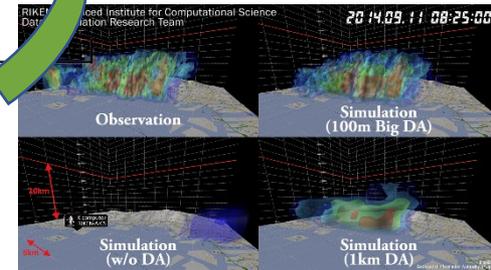
t = 2018-07-27 20:35:30 + 2.5 min



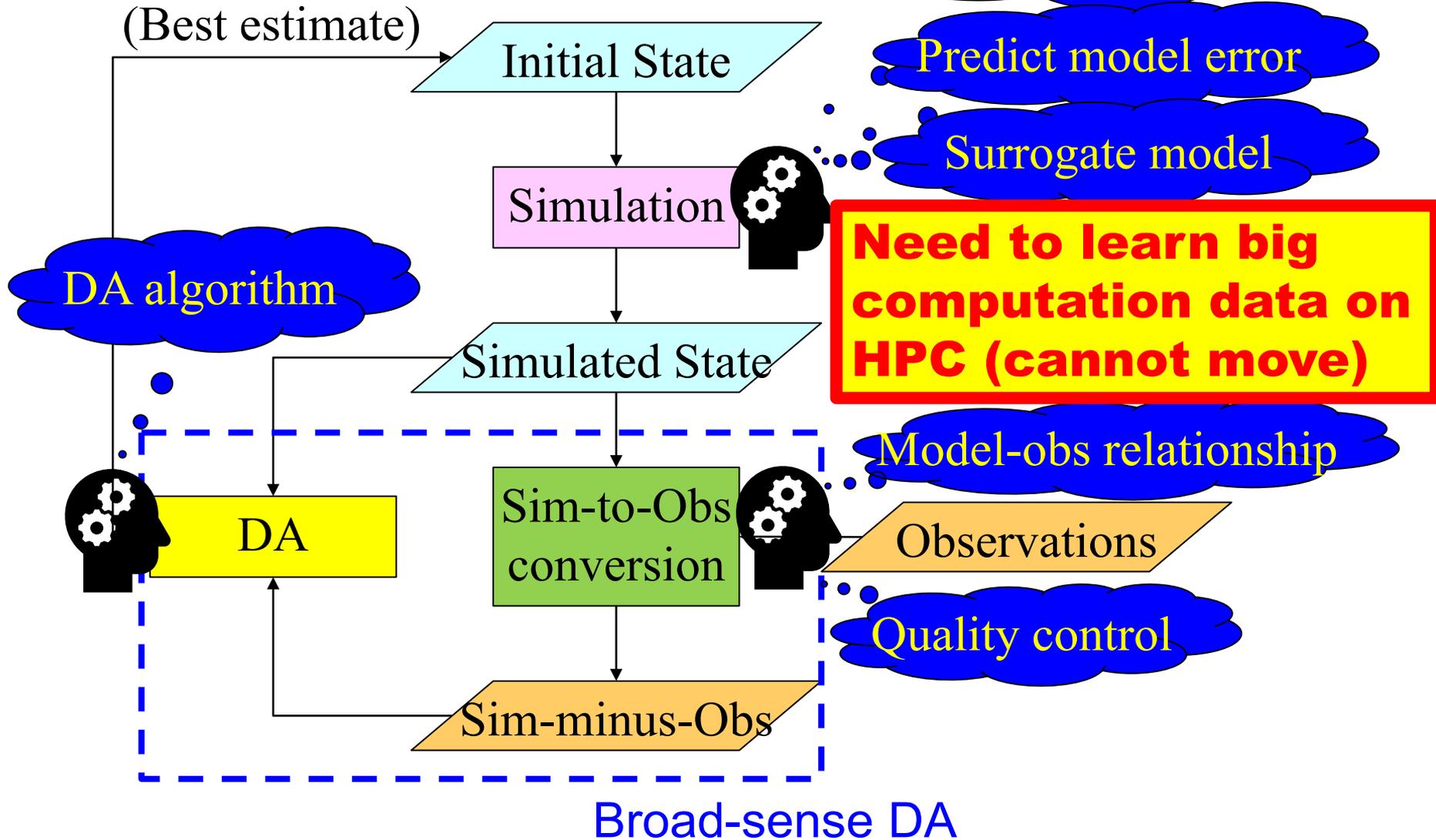
Future direction: **Fusing ML+DA+Simulation**



Input of future data from NWP!!



DA-AI Integration



DA-AI Integration

(Best estimate)

Initial State

Simulation

Predict high-resolution from low-resolution model

Predict model error

Surrogate model

Need to learn big

DA algorithm

Integrating DA and AI
→ Pioneering new meteorology

DA

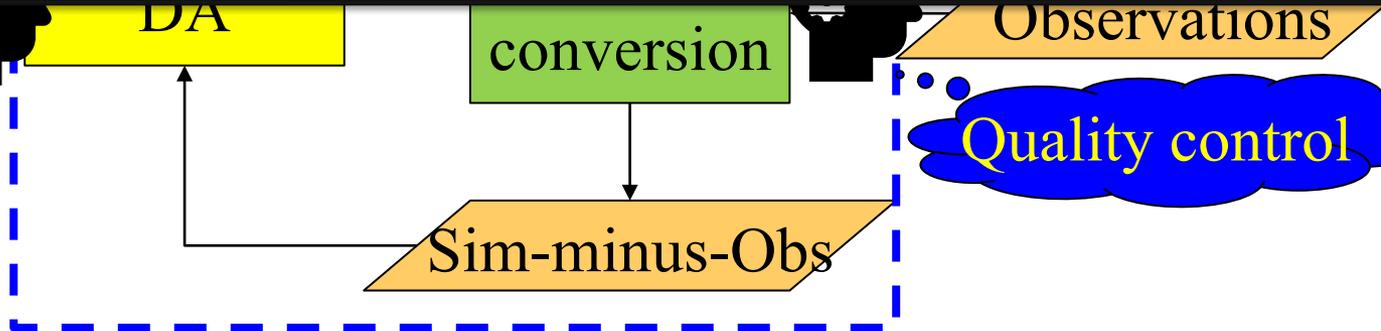
conversion

Observations

Sim-minus-Obs

Quality control

Broad-sense DA



Cyberspace

synchronize
predict & control

Real world

Goals

1. “Big Data Assimilation” × AI
2. International collaborations
3. Demonstration at Tokyo 2020
4. Societal impacts

Human society and economy