HIGH-RESOLUTION PRECIPITATION NOWCASTS

Outline

Since summer 2004, the Japan Meteorological Agency (JMA) has issued Precipitation Nowcasts (referred to here as conventional Precipitation Nowcasts, or CPNs) providing information on horizontal precipitation distribution up to an hour ahead with a spatial resolution of 1 km. To mark the 10th anniversary of the launch of CPNs, High-Resolution Precipitation Nowcasts (HRPNs) were introduced in August 2014 with the primary objective of enhancing capacity for observation and prediction of torrential localized heavy rain and mitigation of related damage.
This section describes the analysis/prediction techniques used in HRPN generation.

Data used in HPRNs

HRPN analysis algorithm inputs are observation data including two distinct radar networks, surface, inter-agency rain gauge, radiosonde, wind profiler, GPS (Global Positioning System)-based precipitable water and Lightning Detection Network System (LIDEN) information. Data on typhoon locations and maximum wind speeds are also used

Observations

JMA's C-band Radar
MLIT X-band MP Radar
Photo: Japan's MLIT
Inter-agency Rain Gauge
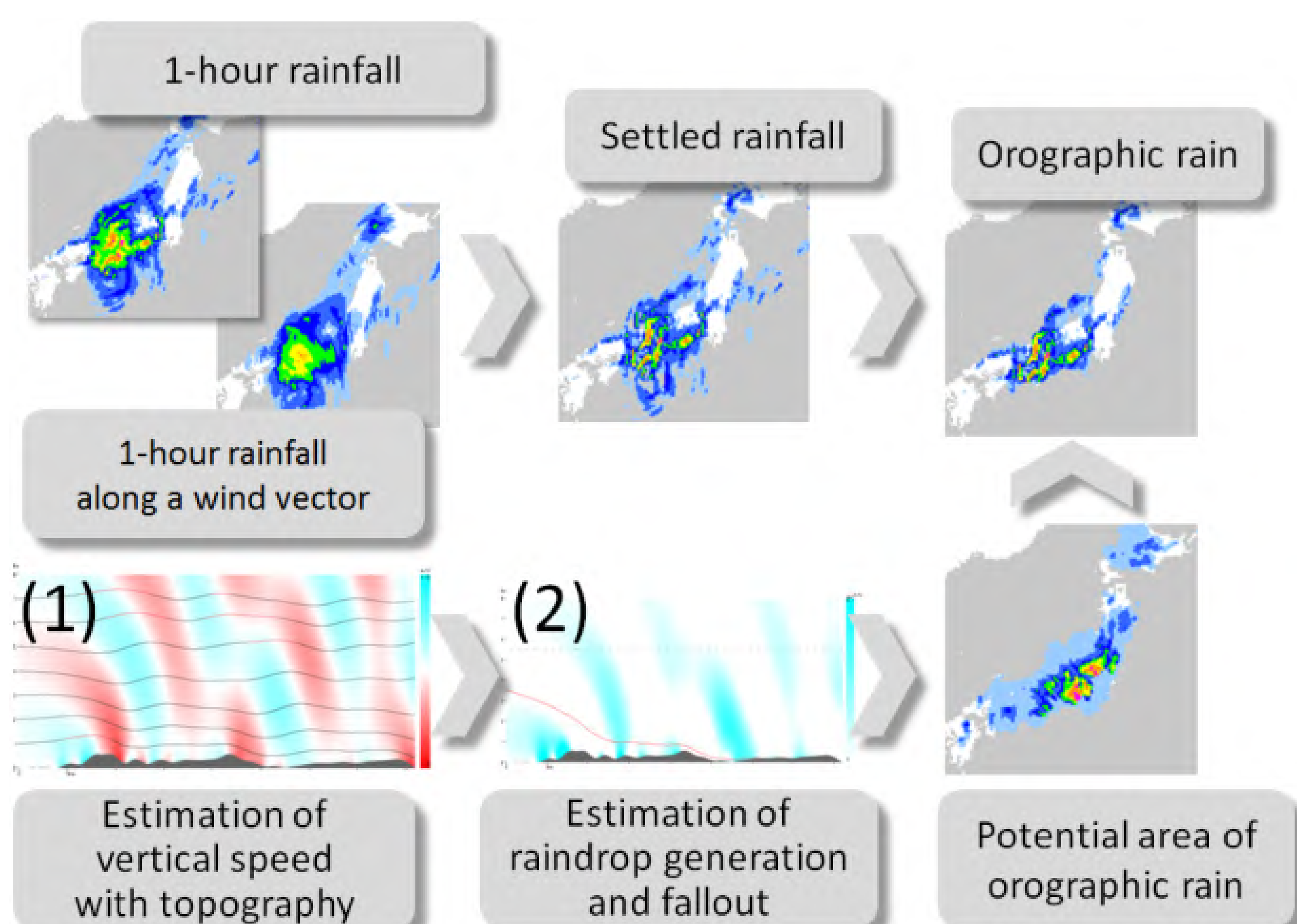Sonde
Surface
Wind Profiler

Motion detection

A multi-scale motion detection technique is adopted for HRPNs, as with CPNs, to determine motion on various temporal and spatial scales for the establishment of echo motion vectors. Scales range in time from 5 minutes to 1 hour, and on a horizontal scale from cumulonimbus cloud size to nearly 100 km.
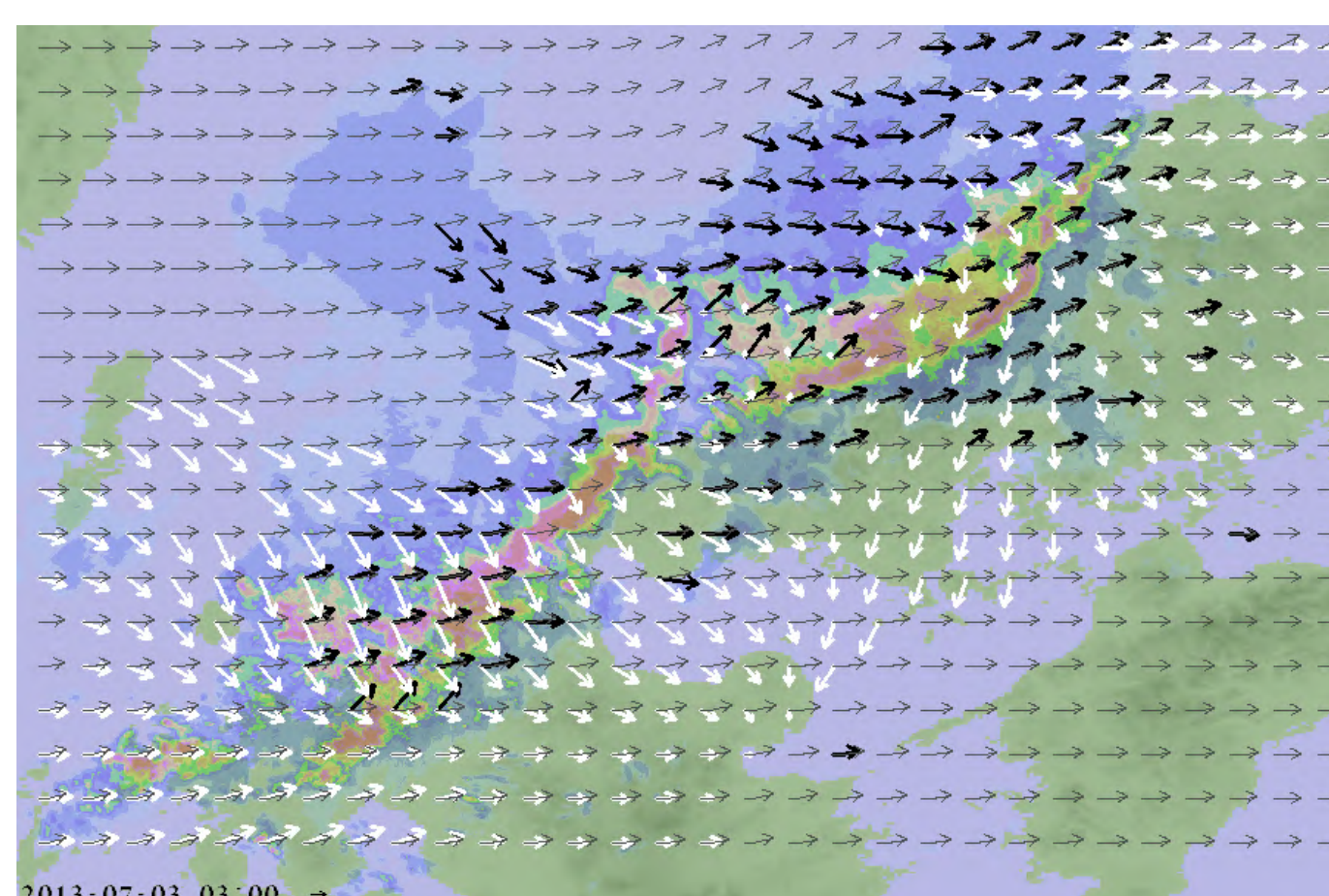
Echo motion vectors (gray arrows) and trend vectors (white)
Wind vectors calculated from Doppler radar velocity data are shown as black arrows. The background of the figure is analysis precipitation intensity distribution superimposed onto the map.

Orographic rain estimation

Settled rain is calculated by subtracting the along-track 1-hour rainfall from stationary rainfall. Figure (1) shows the vertical section of vertical velocity with wind from left to right. Ascending and descending areas are indicated in blue and red, respectively. Figure (2) shows the same region as (1), but for precipitation intensity. Darker shades of blue indicate higher rain rates.

1-hour rainfall
Settled rainfall
Orographic rain
1-hour rainfall along a wind vector
(1)
(2)
Estimation of vertical speed with topography
Estimation of raindrop generation and fallout
Potential area of orographic rain

Quick and easy access

HRPNs are intended to support self-protection against sudden heavy rain. JMA's related web pages are designed to give users an overview of the situation with the minimum number of clicks to enable prompt evacuation for safety. These resources are optimized for mobile-device and PC viewing.


http://www.jma.go.jp/en/highresorad/
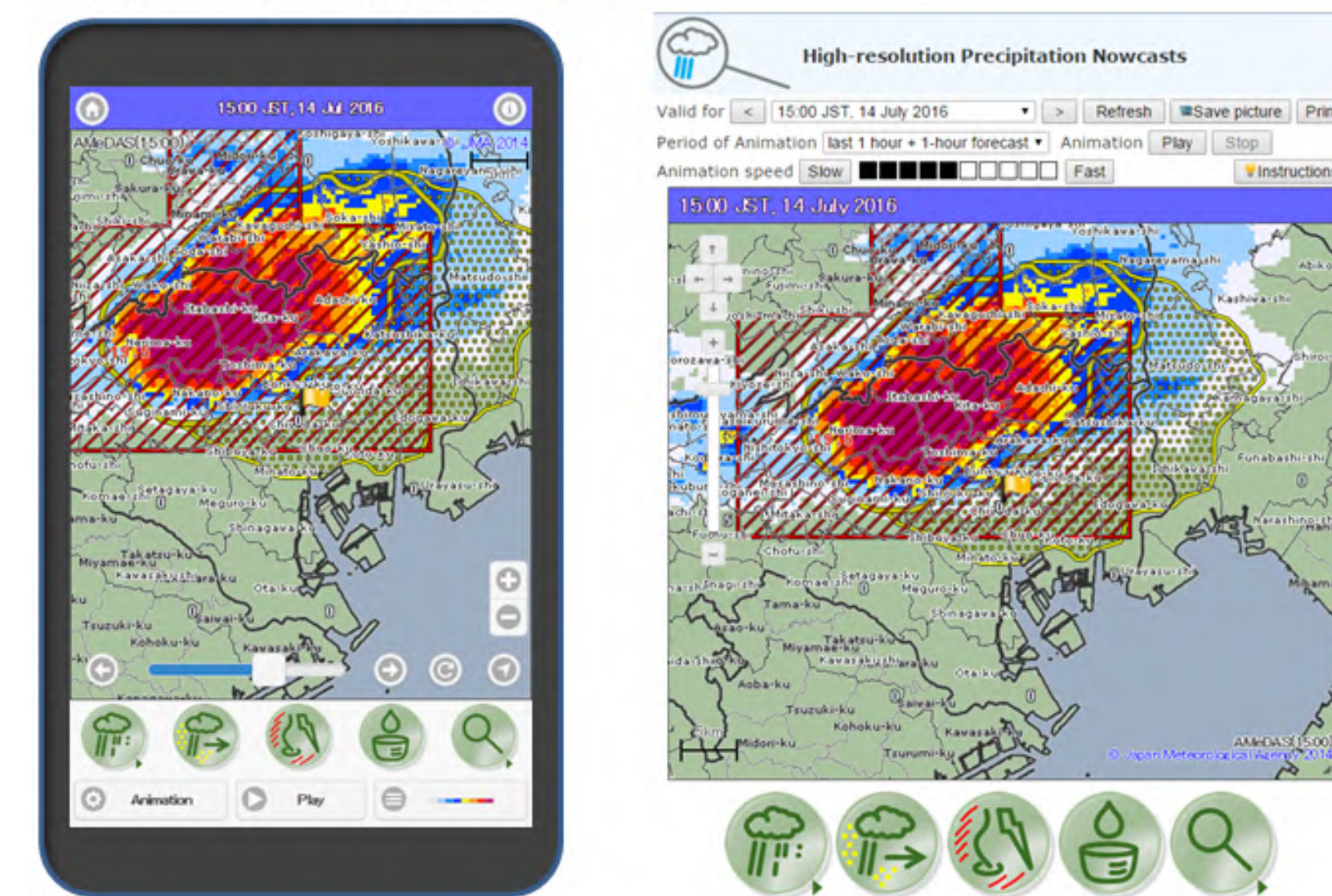
JMA's HRPN web resources
Mobile (left) and PC (right) resources are provided to support self-protection. Several options are given for superimposition of information on areas where heavy rain, lightning and hazardous winds are expected. Rainfall amounts from rain gauge observation can also be displayed.

Error band-width estimation

Nowcasting prediction improvement has brought new challenges in the provision of information on prediction quality to users. The quality of prediction between a well-observed echo already present at the initial time and a cumulonimbus developing during the forecast time may differ significantly.
From another viewpoint, prediction quality is affected by the integrity of initial values (i.e., analysis data). Incorrect data caused by radio wave interference can make rain appear heavier than it actually is, and persistent non-precipitation echoes caused by structures such as windmills may be erroneously interpreted as orographic rain. Accordingly, prediction quality is indirectly linked to radar observation quality.
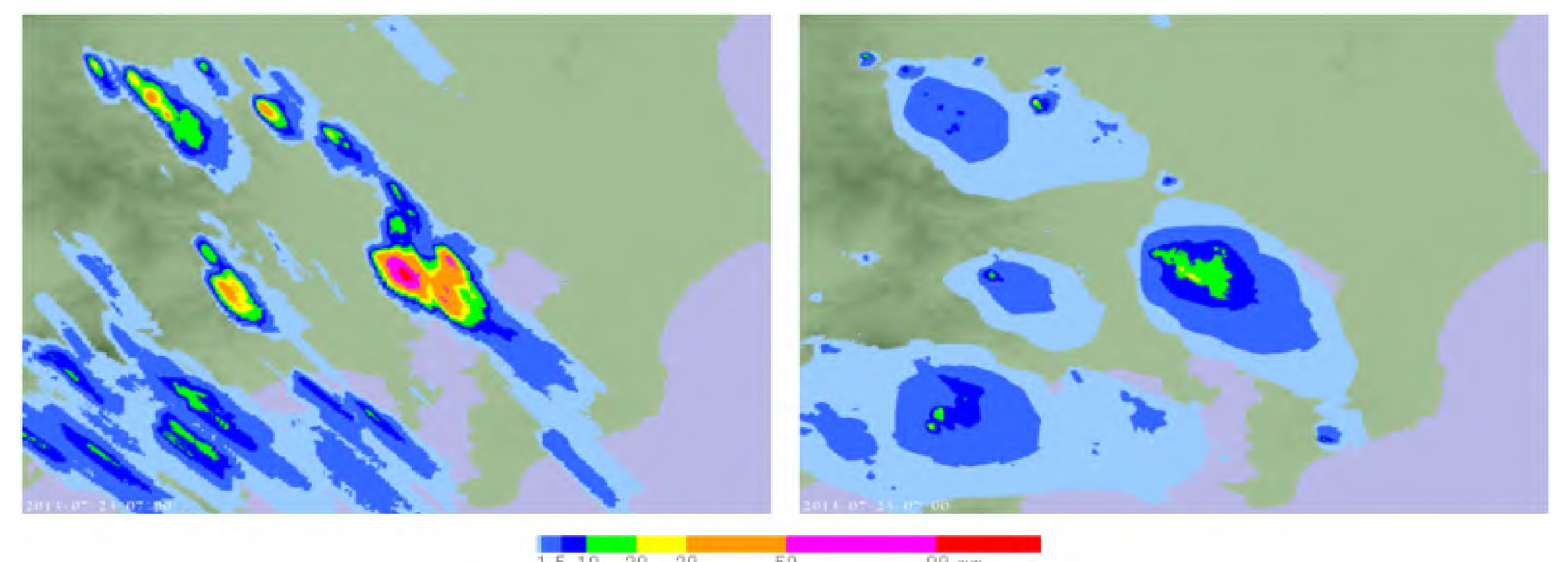
Hourly forecast rainfall P (left) and error band-width ε (right) at 1600 JST on July 23 2013

3D Prediction

HRPNs adopt an approach using a high-resolution prediction by spatial three dimensions regarding notable heavy rain regions selected. Predictions outside the selected regions are generated by a longer time step and reduced vertical calculations using several two-dimensional information converted from the three-dimensional distribution of rain. This enables to distribute a high-resolution and high-quality prediction with securing its timeliness as nowcasting products.

3-Dimentional Prediction Approach

Limited Area High Vertical Resolution
3-Dimentional Radar Observations
Nationwide Low Vertical Resolution
Rain Rate
Echo Top
VIL
Vii
Vertical Acceleration
Vertical Speed
Surface Rain Rate Prediction