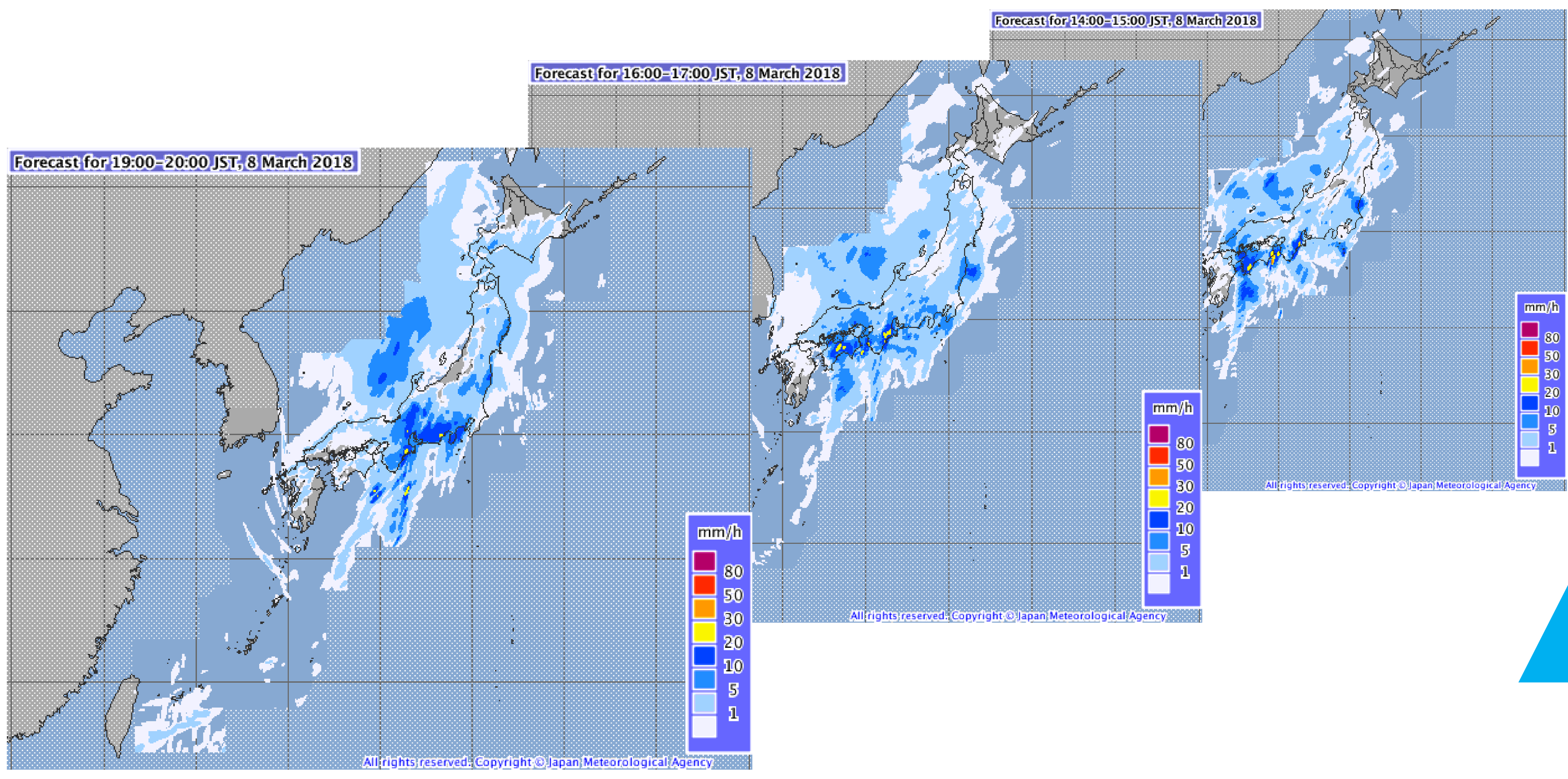
VERY-SHORT-RANGE FORECASTS OF PRECIPITATION

Outline

Very-short-range forecasts of precipitation (referred to here as "VSRF") are issued at 10 minute intervals to predict one-hour precipitation amounts for the next six hours.
Extrapolation from an initial value is the most accurate method for precipitation prediction with a head time of up to a few hours. This approach involves prediction of precipitation distribution based on initial intensity and velocity. As the fundamental characteristic of extrapolation is linear, the accuracy of extrapolation-based prediction decreases with head time and deteriorates markedly beyond the lifecycle of a precipitation phenomenon. The accuracy of numerical weather prediction (NWP) also decreases with time, but the deterioration is gradual and lower than that of the extrapolation method in the first few hours. Based on these characteristics, appropriate combination of extrapolation and NWP provides optimal performance in precipitation prediction with a head time of up to several hours.

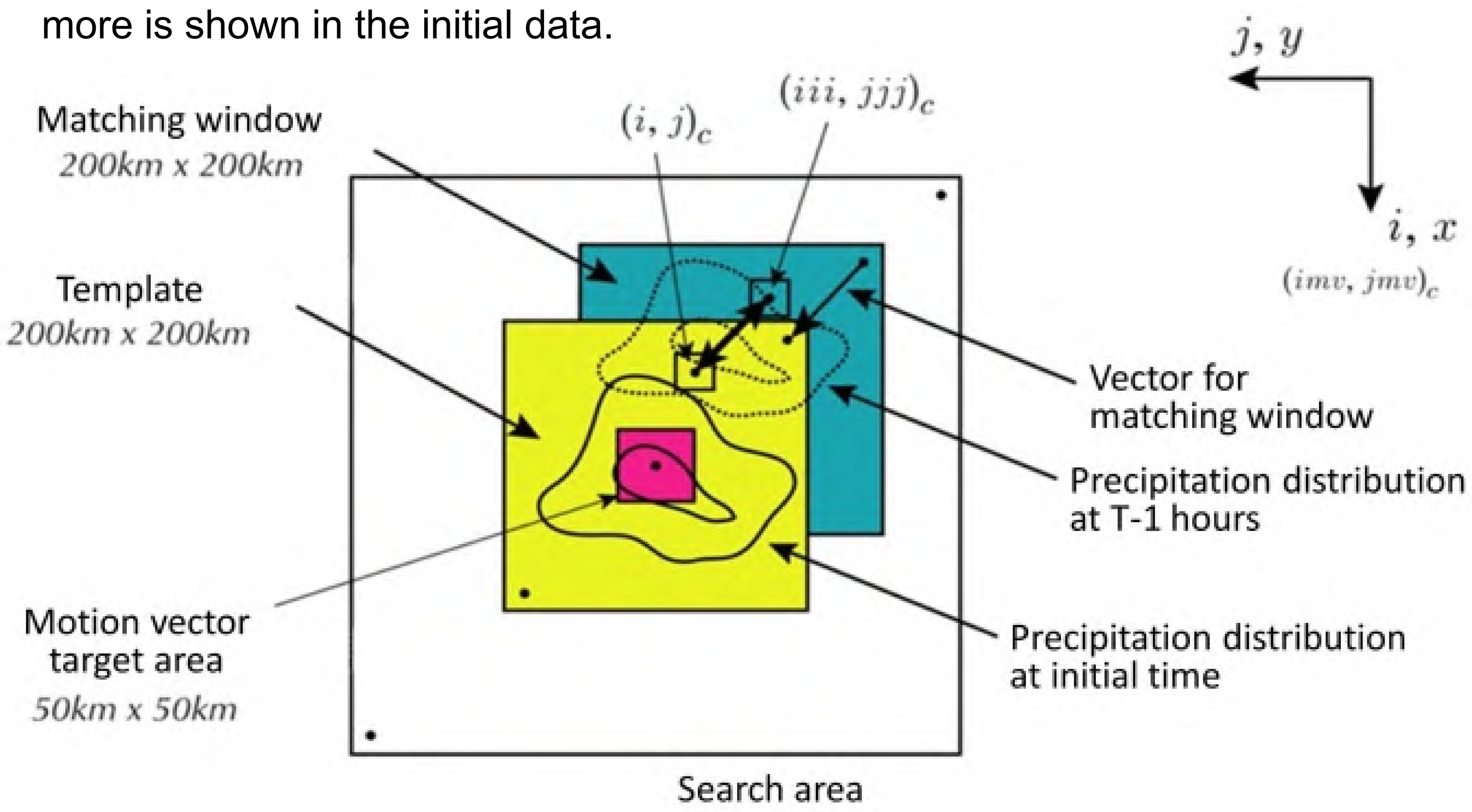


Initial values

The initial values of precipitation distribution prediction are calculated from the nationwide composition of radar echo intensity and the primary and secondary factors obtained in R/A generation.

Motion vectors

Large-scale motion vectors of precipitation distribution are estimated as universal motion vectors based on R/A series data from the past three hours. Heavy rain motion vector determination is based on tracking of only heavy rain areas if rainfall of 10 – 30 mm/h or more is shown in the initial data.



Overall Prediction

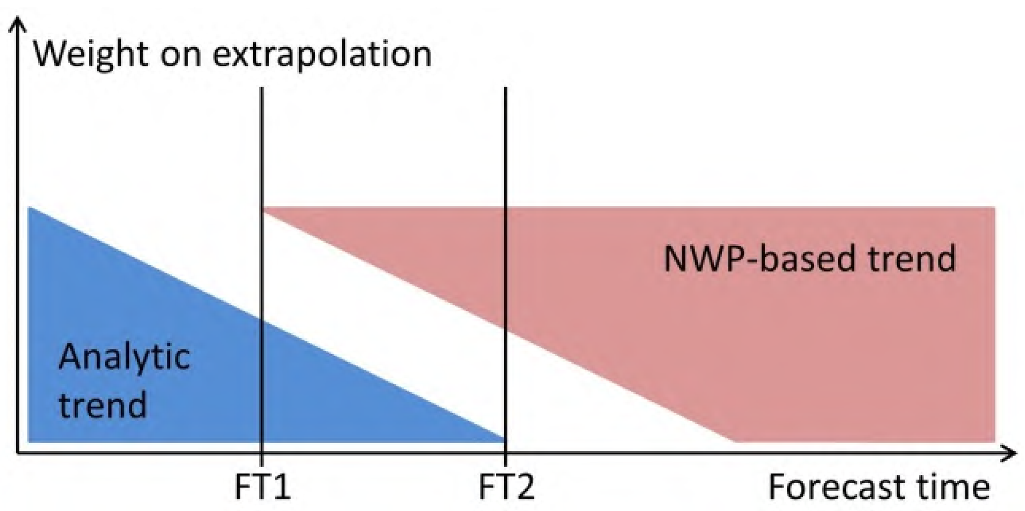
Prediction of precipitation intensity distribution is based on extrapolation of the nationwide composition of precipitation intensity at the initial time with related trend prediction.

Heavy-rain-area motion vectors are merged with universal motion vectors. Multi-time-interval motion vectors are used for prediction at the corresponding forecast time. Thus, while prediction at earlier forecast times is generated using motion vectors determined at shorter time intervals, prediction at later forecast times is based on motion vectors with longer time intervals.

Trend prediction

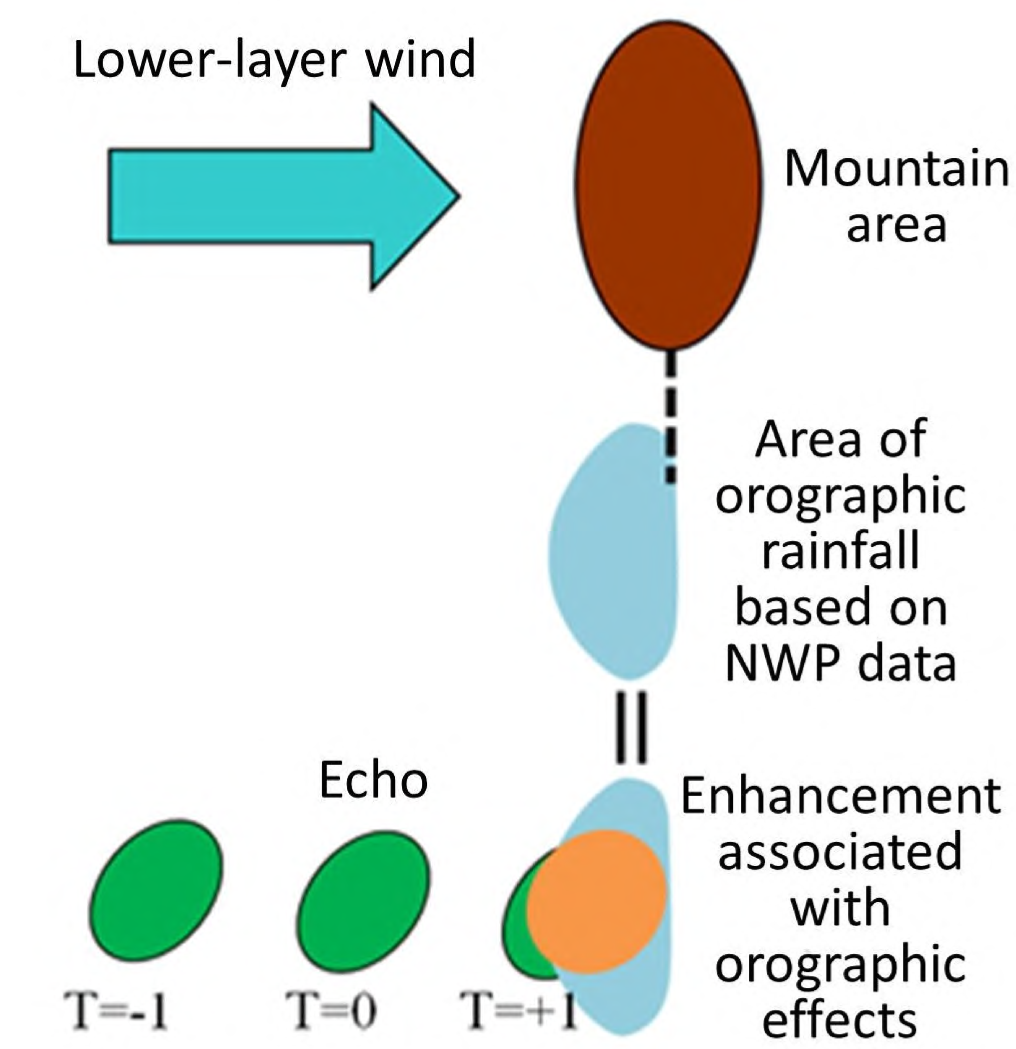
Precipitation intensity trends are estimated and predicted using the latest data on echo motion and NWP rainfall forecasts.
In the extrapolation method, the drift of precipitation intensity is predicted without intensity change except for orographic effects. This approach provides accurate prediction up to a few hours for large-scale (i.e., long-lasting) meteorological disturbances. However, for small-scale disturbances, trend prediction is needed to improve prediction accuracy.

For VSRF, a method of trend prediction (i.e., variations in precipitation intensity with time) is adopted. This approach is based on trend estimation at the initial time and the trend calculated from NWP data. As illustrated below, the relative weights for this estimation are changes with forecast time. The analytic trend is highly weighed in the first hour, and its weight decreases with time.

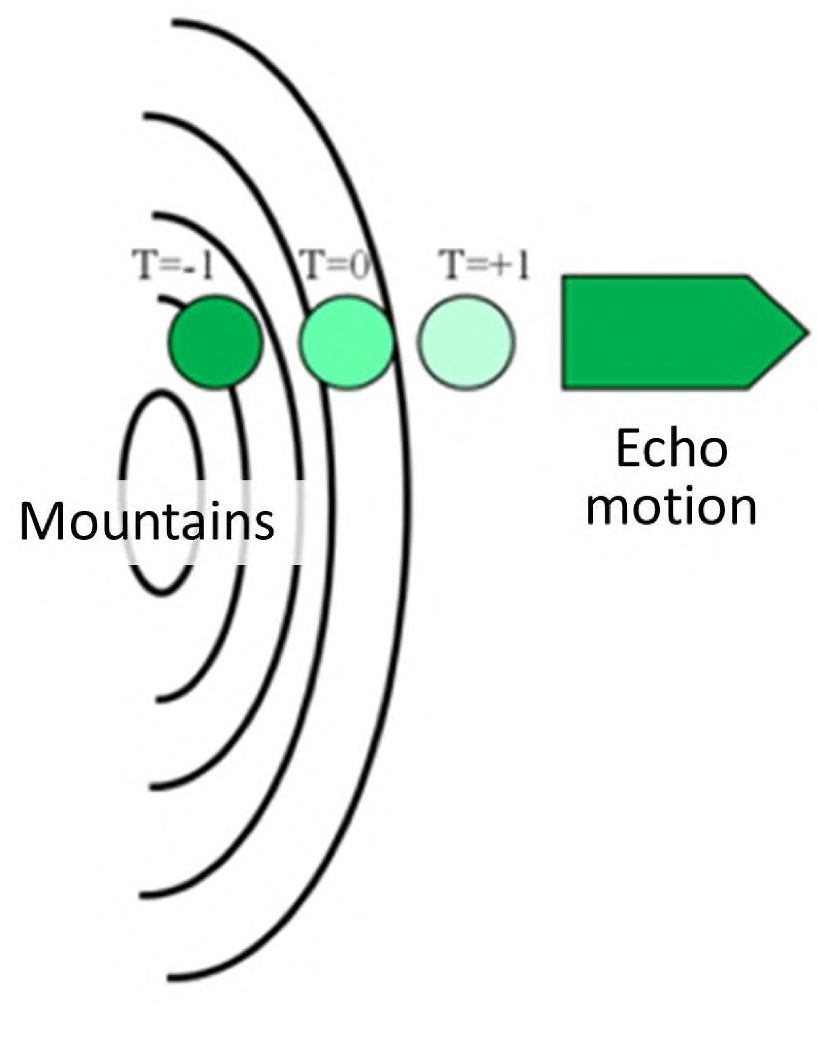


Orographic effects

Calculation of landform-induced effects in VSRF involves enhancement in consideration of orographic rainfall, dissipation and mountain overlapping. Orographic rainfall information contained in initial data is estimated using NWP data.



Precipitation enhancement associated with orographic effects
An echo (green oval) approaches mountains and strengthens due to orographic effects (orange).



Mountain lee-side reduction
An echo weakens with time (from dark green to light green).
Precipitation reduction is estimated via comparison of T = 0 with advection-based from T = -1.

The analytic trend is also useful when complex echo motions are observed. Top: A precipitation system (blue) moves eastward and a heavy-rain area (red) in the system moves southeastward.
The extrapolation method involves the use of motion vectors created by combining universal motion vectors with heavy-rain-area motion vectors. If there is a difference in motion between the precipitation system and the heavy rain core, prediction may be insufficient due to the mismatching of motion vectors against this system and core. Trend extrapolation solves this problem.
Bottom: Analytic trend information improves prediction accuracy for complex echo motion.