Japanese Cloud Seeding Experiment for Precipitation Augmentation (JCSEPA)

Subtheme 4: Study on numerical modeling of precipitation augmentation for water resources management and drought mitigation

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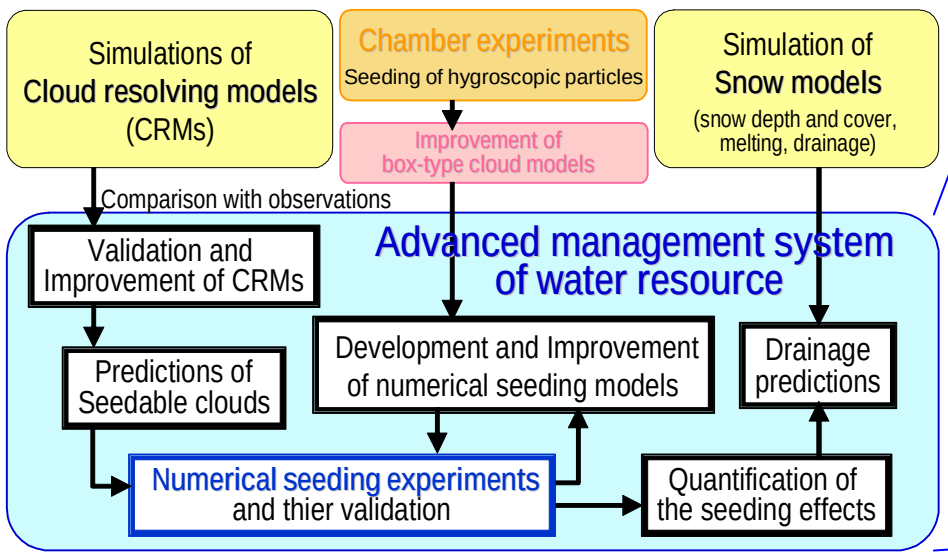
Objective

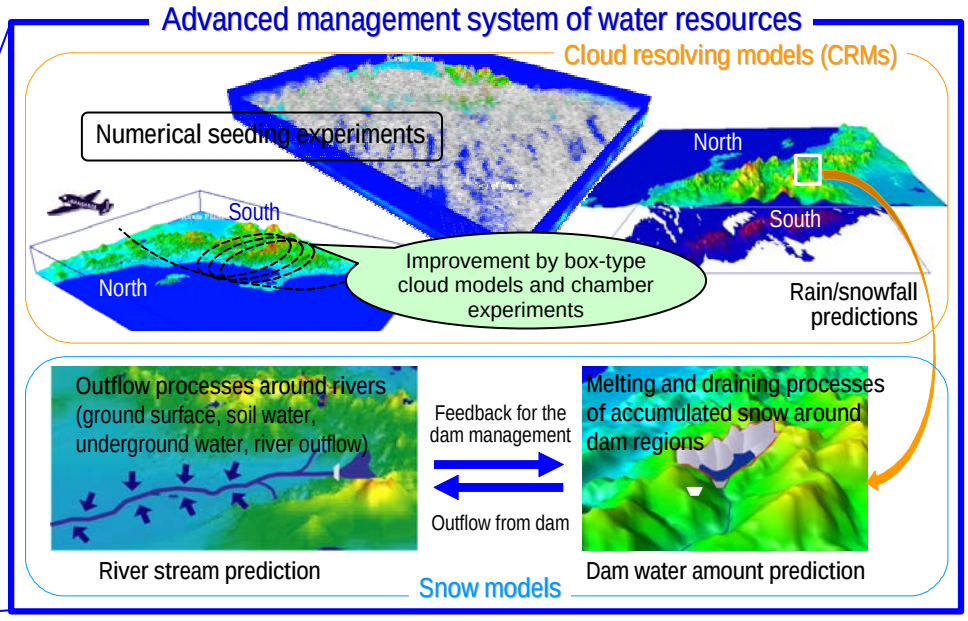
The aim of this subtheme is to develop an "advanced management system of water resources", based on

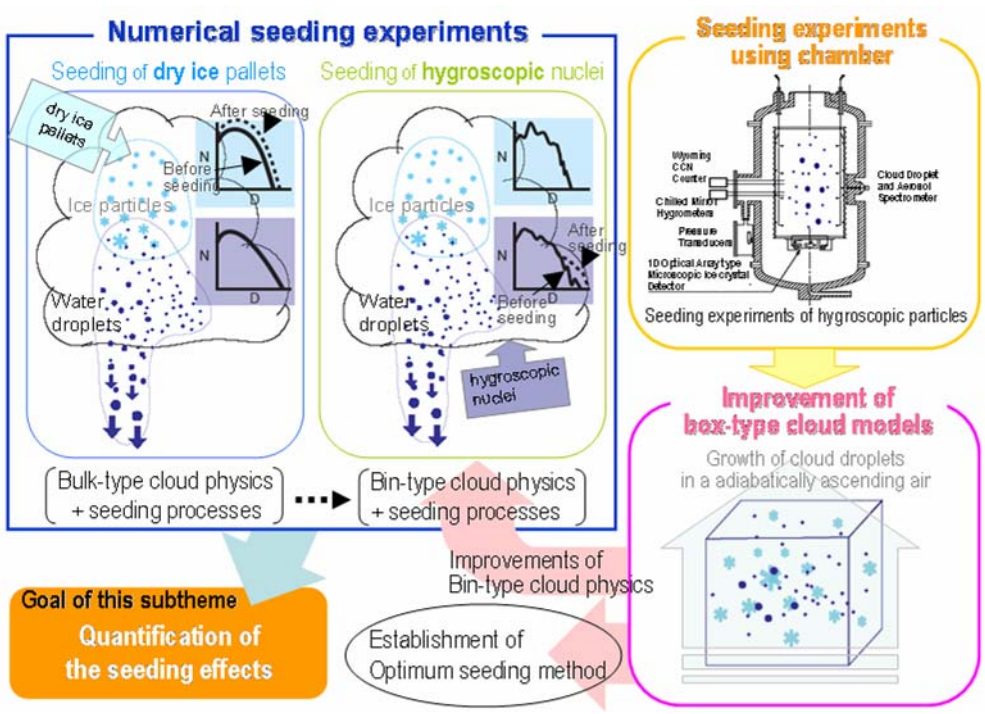
- cloud resolving models (CRMs) that can be applied to seedability assessments,
- snow models that can predict snow cover, melting and draining, and
- laboratory experiments of artificial CCN activation in cloud simulation chamber,

and to quantify the effectuality of this system for water resources management and drought mitigation. This subgroup also quaci-operationally provides the forecasts of cloud resolving model to make guide line plans for subtheme 3.

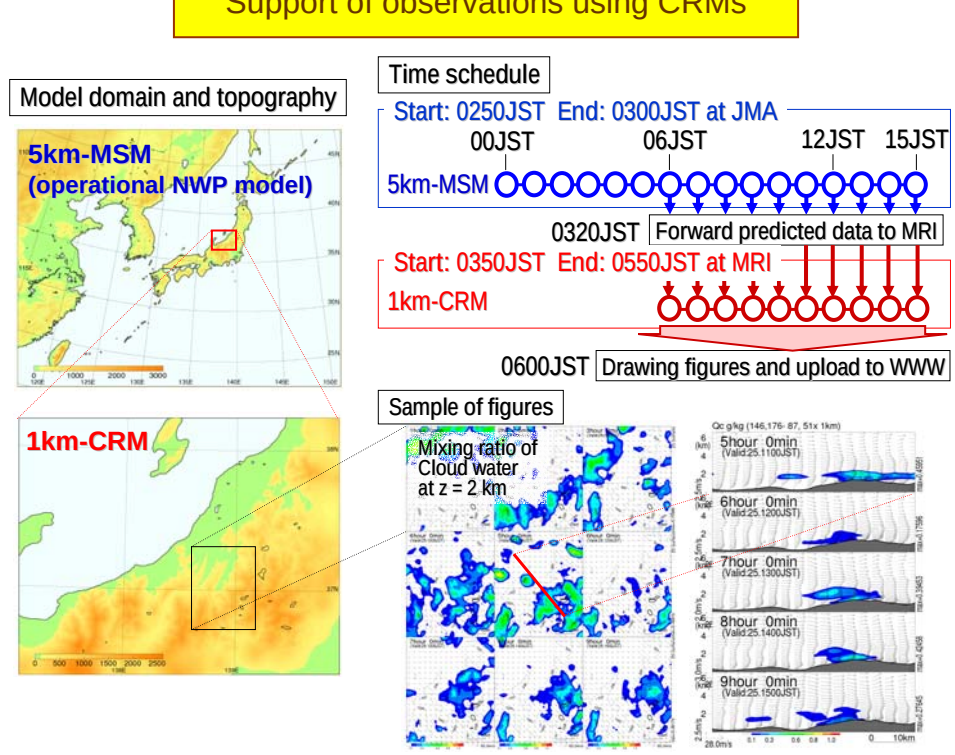
Research design





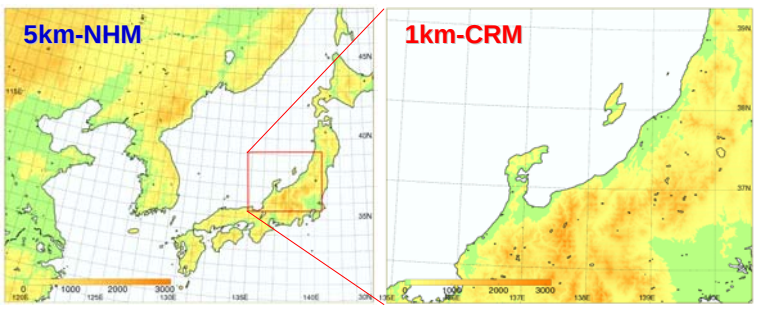


Support of observations using CRMs



CRMs (JMANHM) used in this subtheme

Model domain and topography



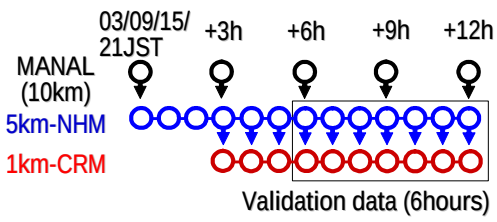
Specifications of 5km-NHM(MSM) / 1km-CRM

Dynamics	Nonhydrostatic
Prognostic variables	*U*, *V*, *W*, *P*, *TKE*, *qv*, *qc*, *qi*, *qr*, *qs*, *qg*, *Nqi*, *Nqs*, *Nqg*
Vertical levels	terrain following (50 levels)
Model top	22060 m
Horizontal discretization	Arakawa C
Horizontal advection	Flux form fourth-order with advection correction and time splitting
Gravity waves	splitting
Sound waves	Time splitting
Moist physics	Vertically implicit, horizontally split and explicit Simplified three-ice bulk-type microphysics/ Three-ice bulk-type microphysics with predicting number density of *qi*, *qs*, and *qg*
Convection	Modified Kain–Fritsch scheme/ none
Turbulence	Diagnostic/ Prognostic (level 2.5) TKE scheme*
Boundary layer	Nonlocal scheme Sun and Chang (1986)*/ none
Radiation thinning	Every 15 min in time, 20 km in space

*TKE scheme is replaced with Mellor-Yamada level 3 and nonlocal scheme is not used from this winter .

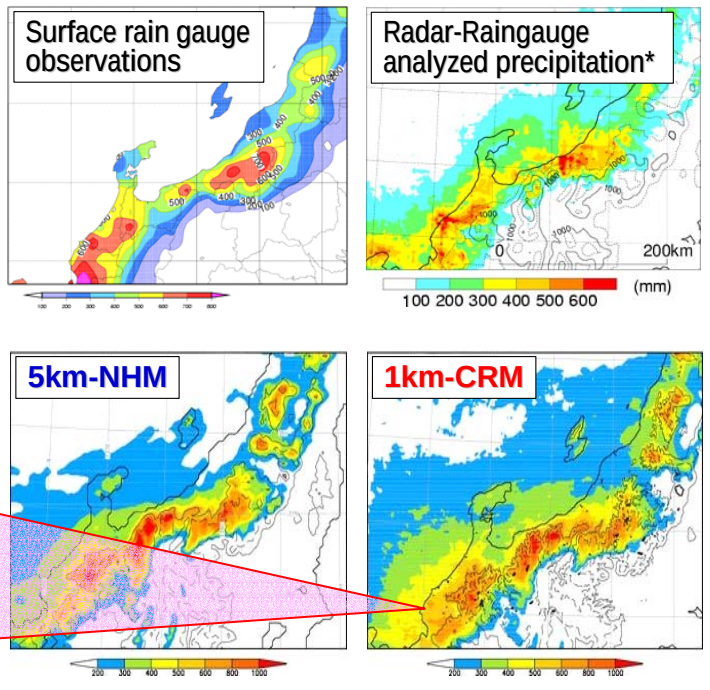
Preliminary results

Procedure method of validation data



- **Distribution of precipitation is well reproduced by 1km-CRM**, while 5km-NHM predicts considerably little precipitation amount in plain regions.
- Predicted precipitation amount is slightly overestimated, but this could be caused by
  - supplement rate of snowfall to surface rain gauge, and.
  - snow production below a height of 2 km at which radar echo is used to estimate the Radar-Raingauge analyzed precipitation.

Example of validation results (Dec. 2005)



* Radar-Raingauge analyzed precipitation is estimated by meteorological radars and calibrated by surface rain gauge observations.