



Roving Seminar - Typhoon Committee

**Application of Short-range Warning of Intense Rainstorms
in Localized System (SWIRLS) with Vietnam radar data
and high resolution NWP to improve quantitative
precipitation forecast (QPF) of tropical cyclone landed
Vietnam coastal**

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Contents

- Limited in Quantitative Precipitation Forecasting (QPF) for Vietnam
- Short-range Warning of Intense Rainstorms in Localized Systems (SWIRLS)
- Implementing QPF system based on a NCHMF's Numerical Weather Prediction (NWP) and SWIRLS
- Applying for Tropical cyclone (TC) cases
- Conclusion





Limited in Quantitative Precipitation Forecasting (QPF)

➤ Quantitative Precipitation Forecasting (QPF):

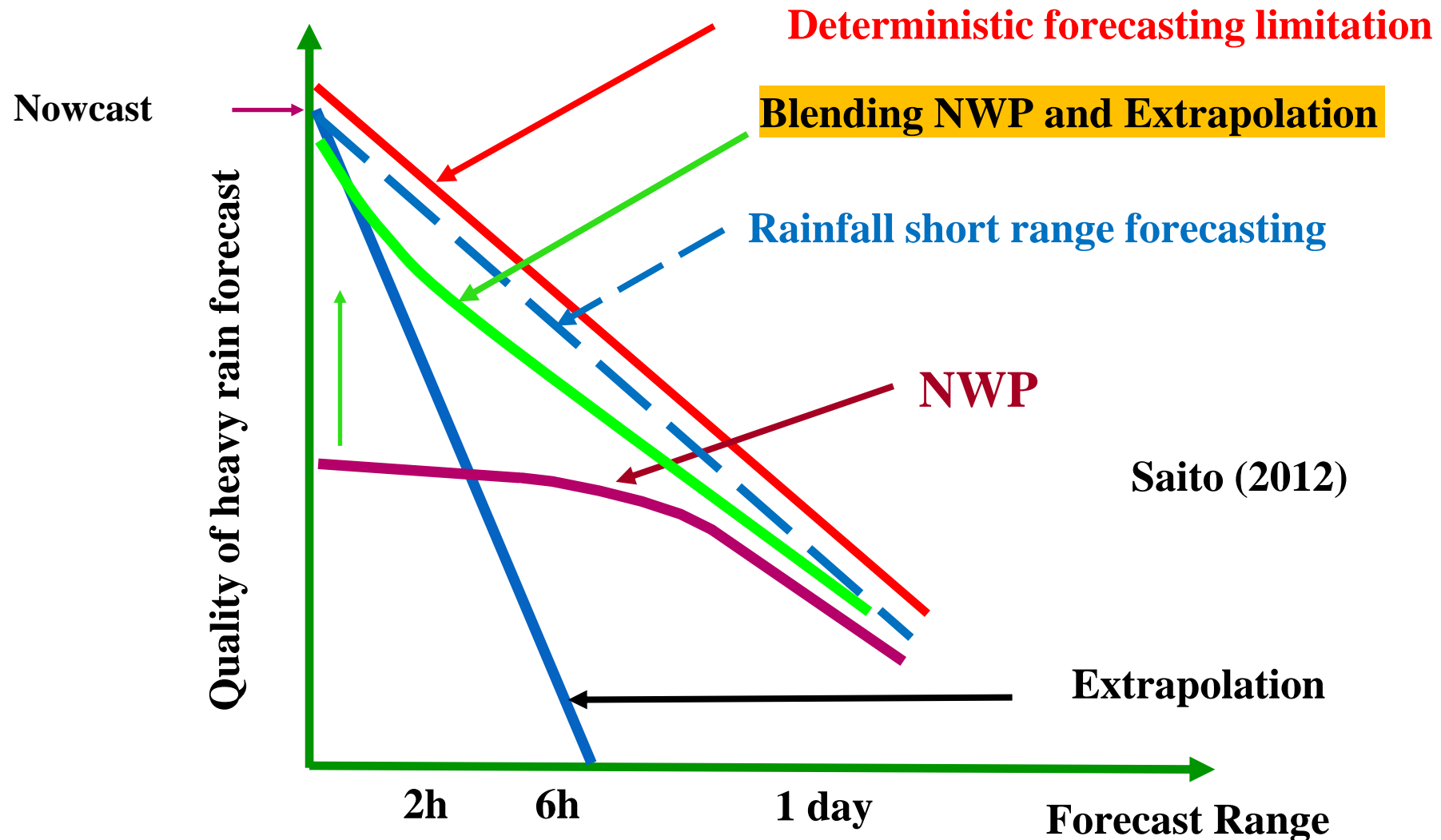
- ✓ mostly based on Numerical Weather Prediction (NWP) products up to 10 days forecast
- ✓ Extrapolation from satellite/radar data for nowcast or very short range forecast

➤ Issues related to NWPs:

- Delay of model product in operation
- Spin-up time of the model, *especially for TCs (initial location/intensity/structures)*
- The detail of the rainfall forecast map (depend on NWP's resolution)
- The initial field of the numerical model has many errors unless many observations are added: depending on the ability to implement complex data assimilation systems (a high-frequency data assimilation system: Rapid-Update-Cycle (RUC)-NOAA, RAP-NOAA, SIFONY-DWD)



Solution: take advantages of extrapolation products and NWP





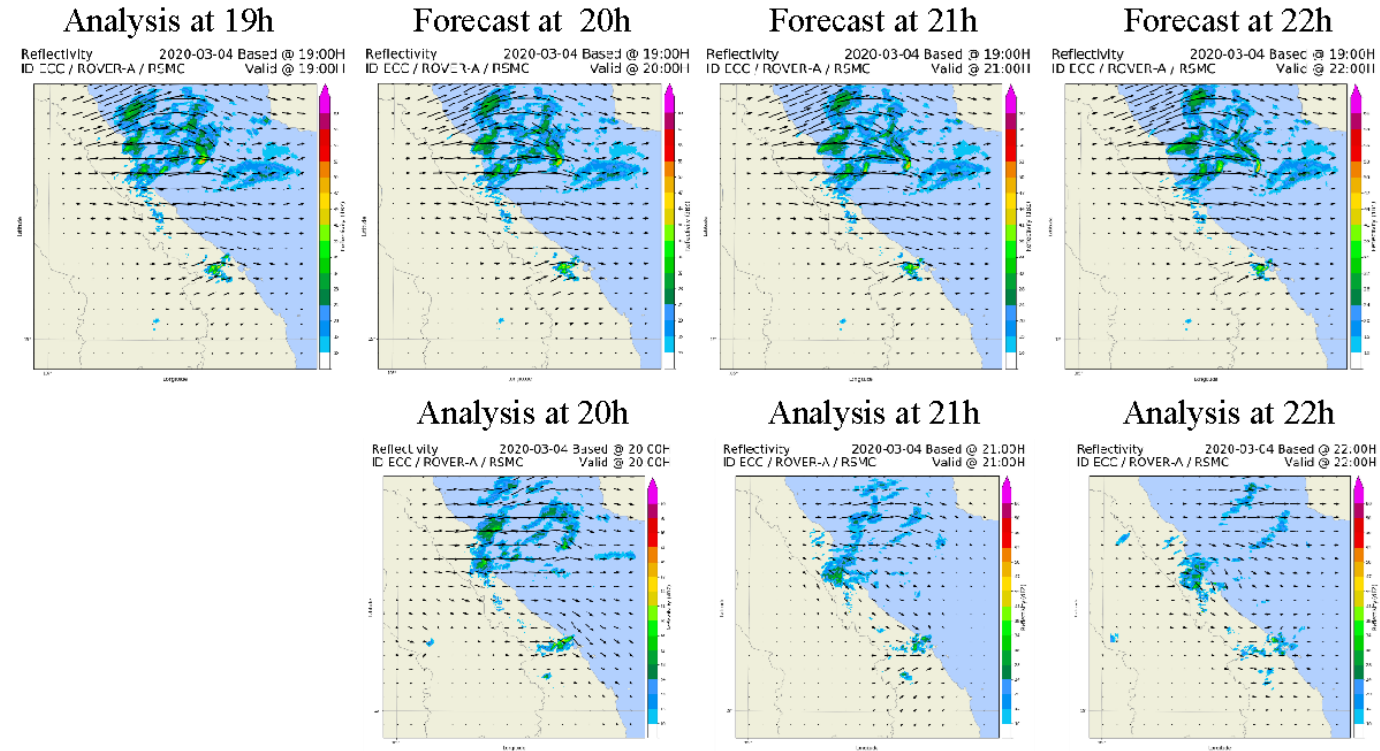
Short-range Warning of Intense Rainstorms in Localized Systems (SWIRLS)

Short-range **W**arning of **I**ntense **R**ainstorms in
Localized **S**ystems from Hong Kong Observatory
(HKO)

Optical flow: Consecutive radar data over time to establish the directional field and displacement velocity of convective forcings that can cause rain and thunderstorms.

Lagrangian: Extrapolating reflectivity over time (up to 3-6 hours) to identify areas that will be affected in the short range.

Woo (2017)



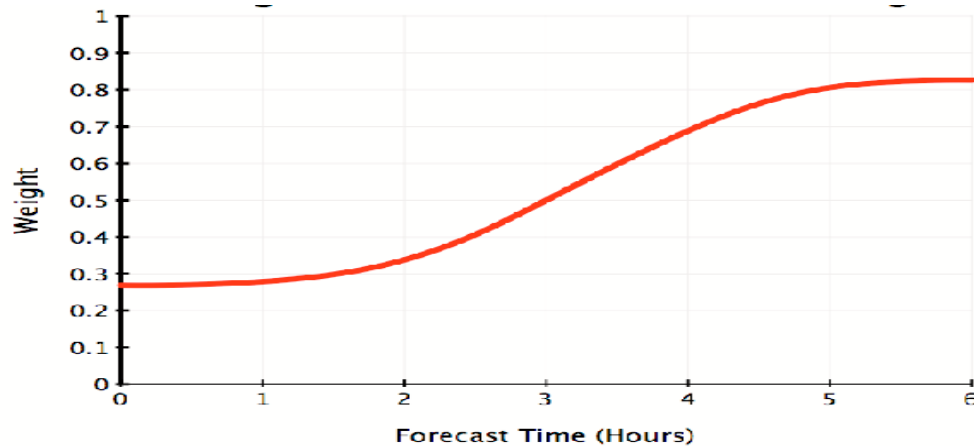
Calculation of motion field for Dong Ha radar at 19:00 on April 3, 2020 and forecast up to 3 hours later. Analysis field is observation from radar, forecast field is extrapolated calculation by SWIRLS system.



SWIRLS: implementing with NCHMF's data

- Sharing Community SWIRLS Nowcast System to NCHMF via the "Severe Weather Forecasting Program" (SWFP) for Southeast Asia of the World Meteorological Organization (WMO)
- Using mosaic radar data and NWP of NCHMF

$$QPF_{RaINS} = (1 - w(t)) \times QPF_{SWIRLS} + w(t) \times QPF_{WRF}$$

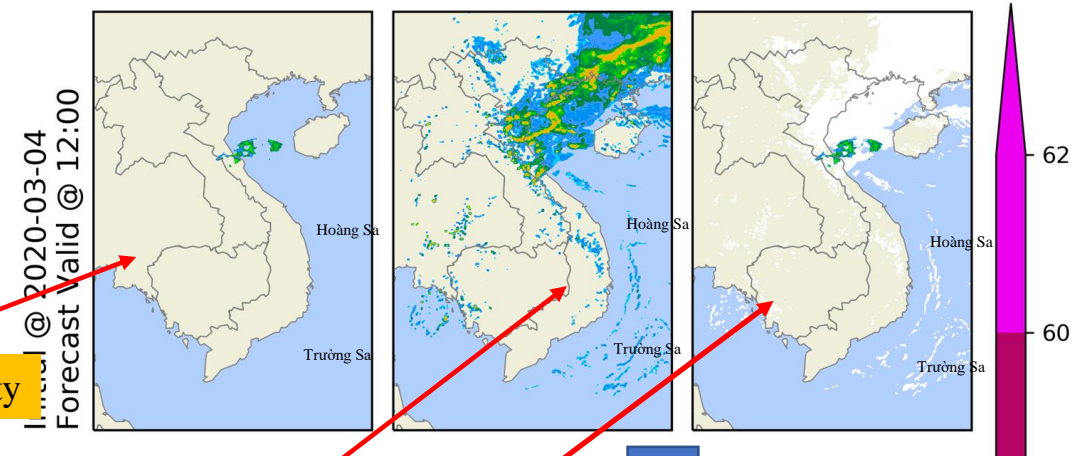


Blending weight function between reflectivity from radar and nwp for the first 6 hours of the model

26/06/2023

2020-03-04 11:50 (GMT+07)

SWIRLS Reflectivity NWP Reflectivity Blended Reflectivity



Radar Reflectivity

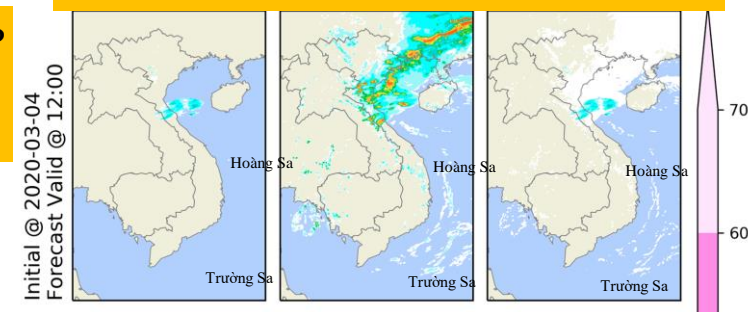
NWP
reflectivity

Radar and NWP
reflectivity
blended

$$Z = 200R^{1.6}$$

2020-03-04 11:50 (GMT+07)

Rainfall

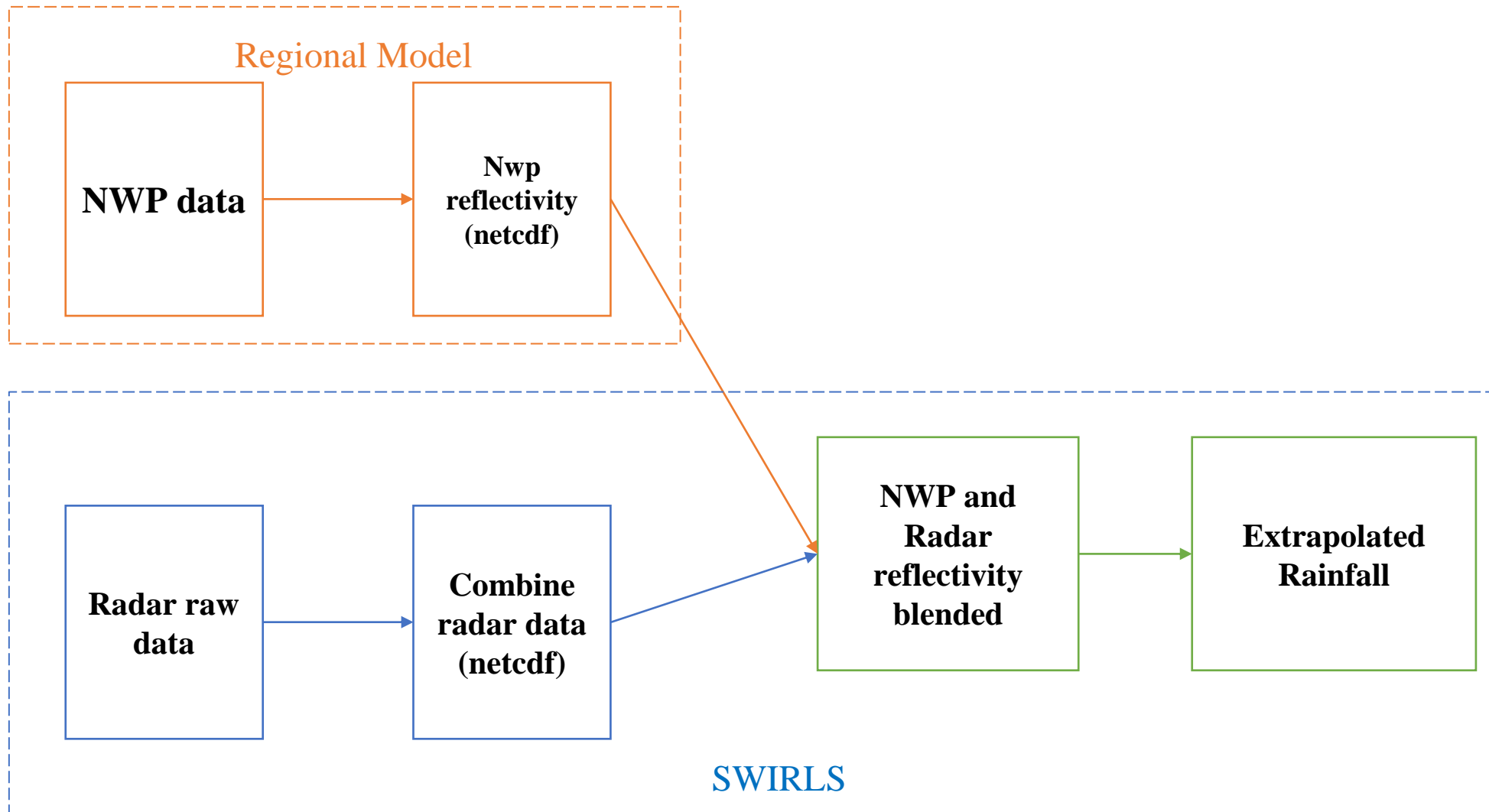


Wong (2006)



Quantitative rainfall forecast system based on a blend precipitation radar and NWP by using the SWIRLS

Program
system block
diagram





Case study

TC DIANMU – from 06 - 12UTC, 23/9/2021

Tropical Cyclone (TC) originated from the East Sea, tracked west-northwestwards, and made landfall in Quang Ngai, Viet Nam on the evening of 23 Sep 2021. TC DIANMU weakened into a tropical depression as it moved over Central Viet Nam and Attapeu and Salavan provinces in Southern Lao PDR. TC DIANMU dissipated over eastern Thailand on 24 Sep 2021

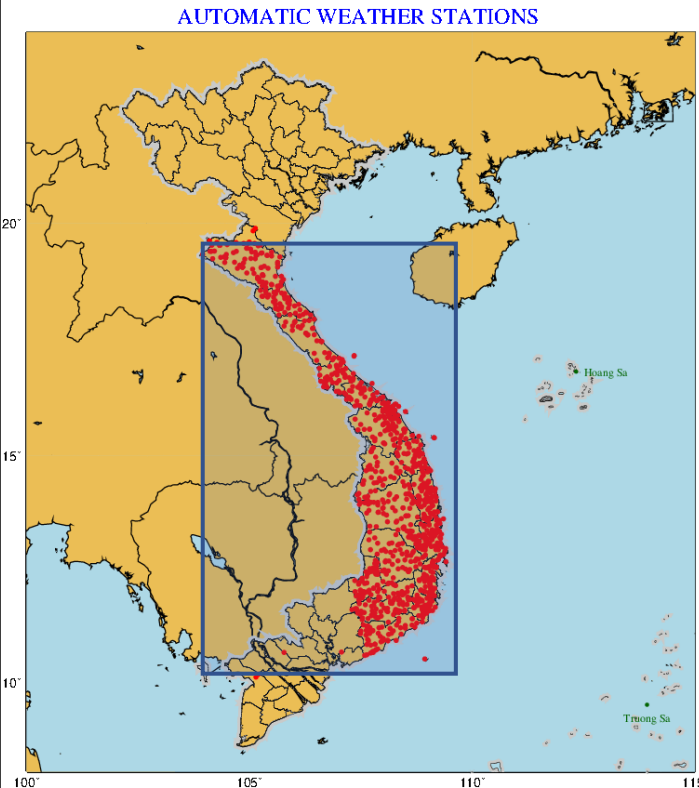
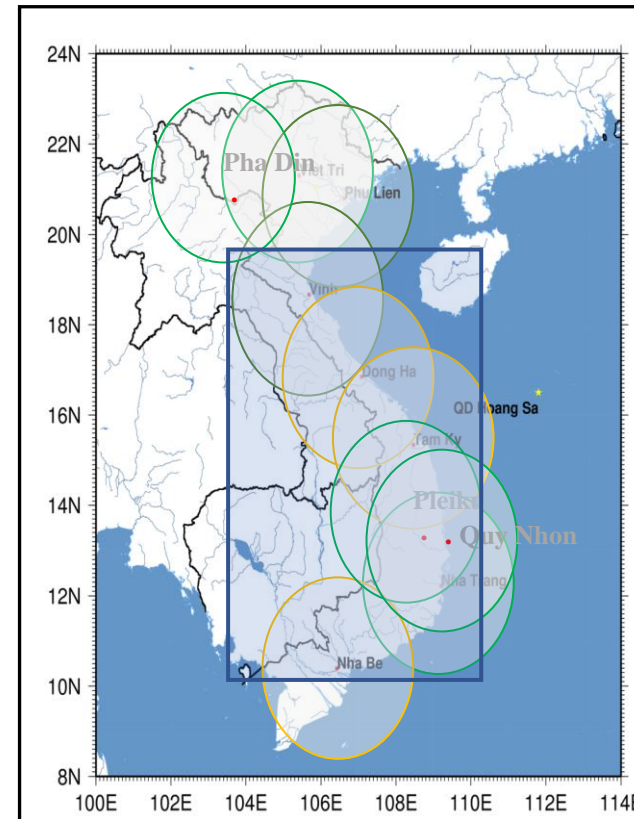
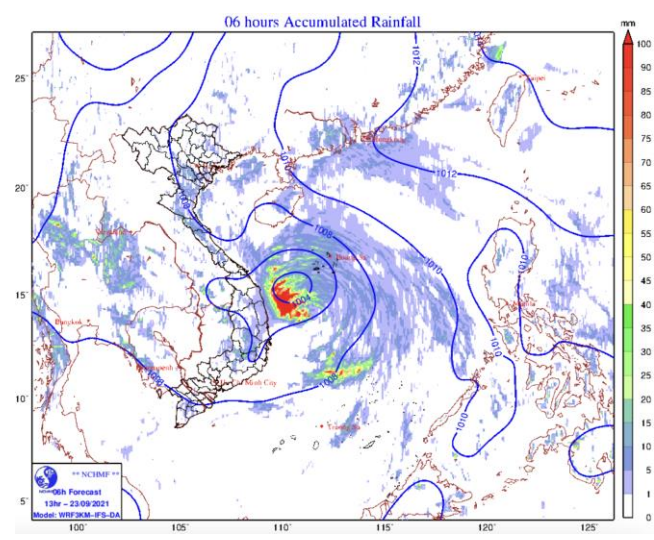
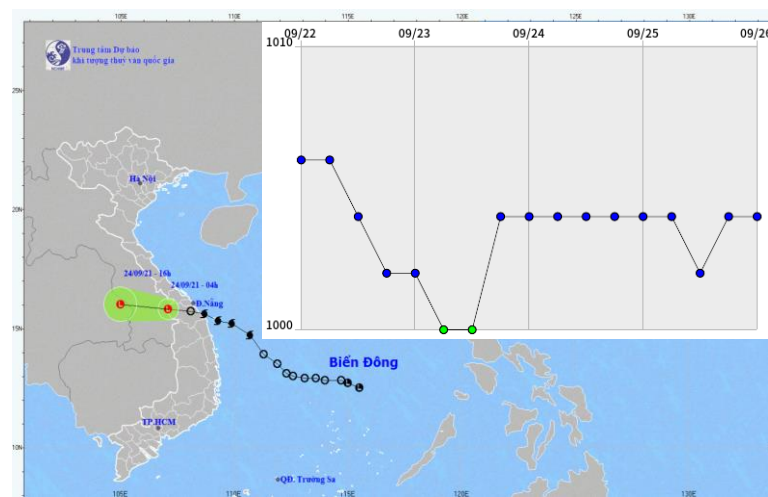
Data:

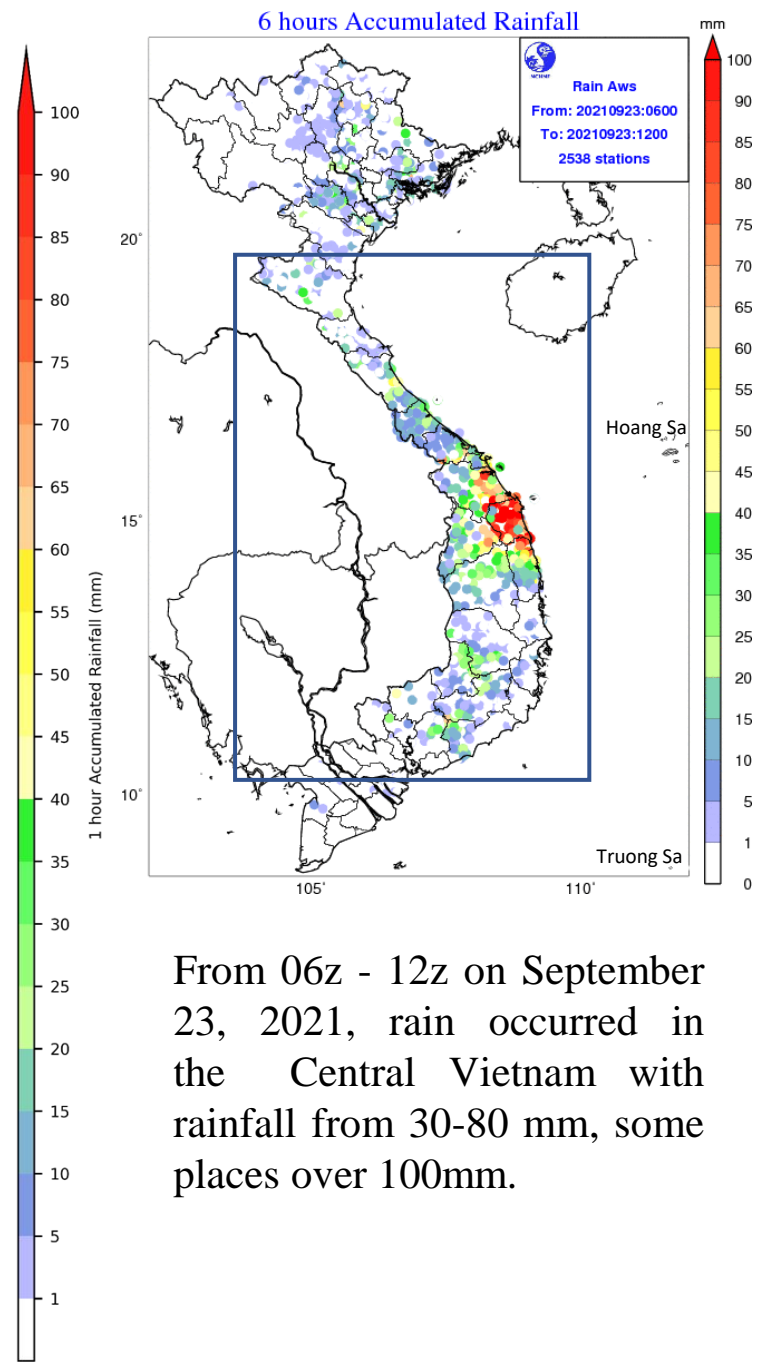
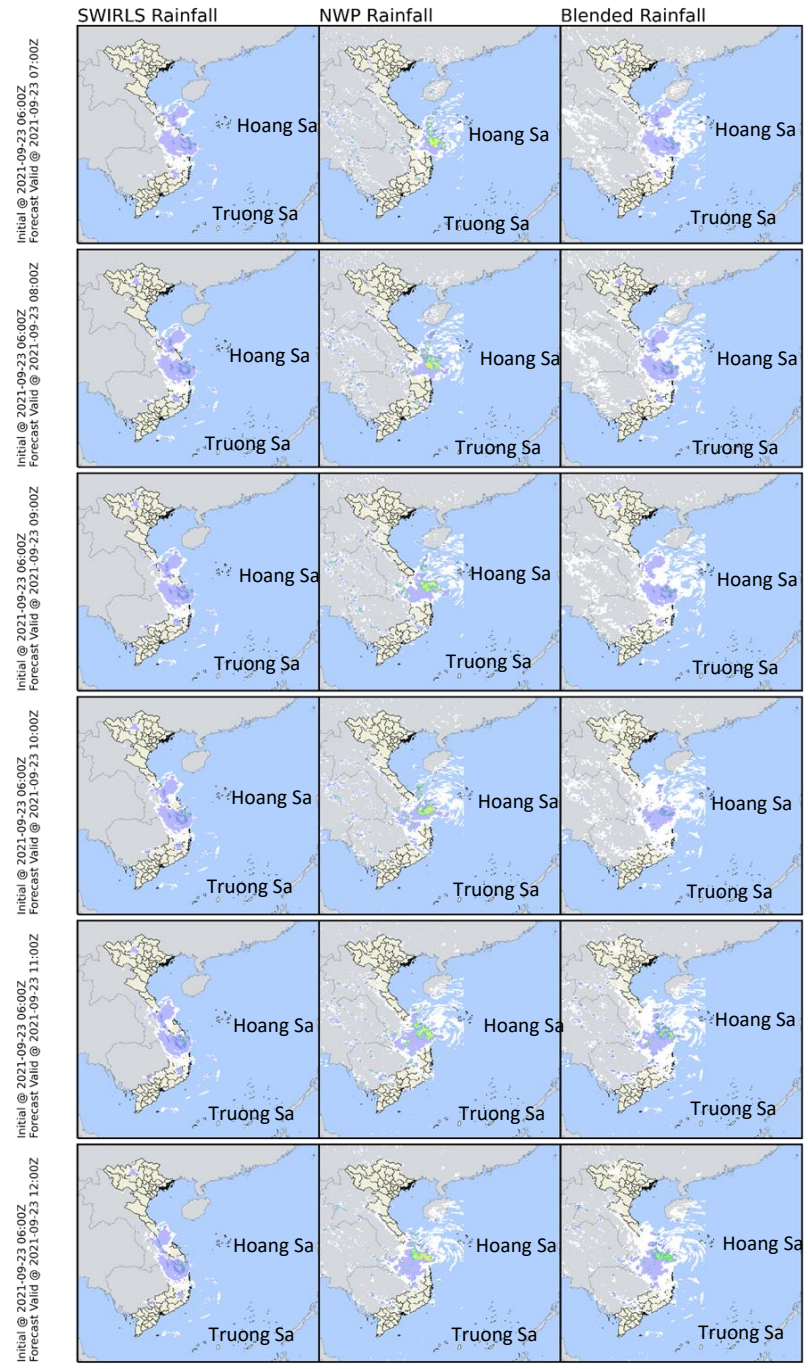
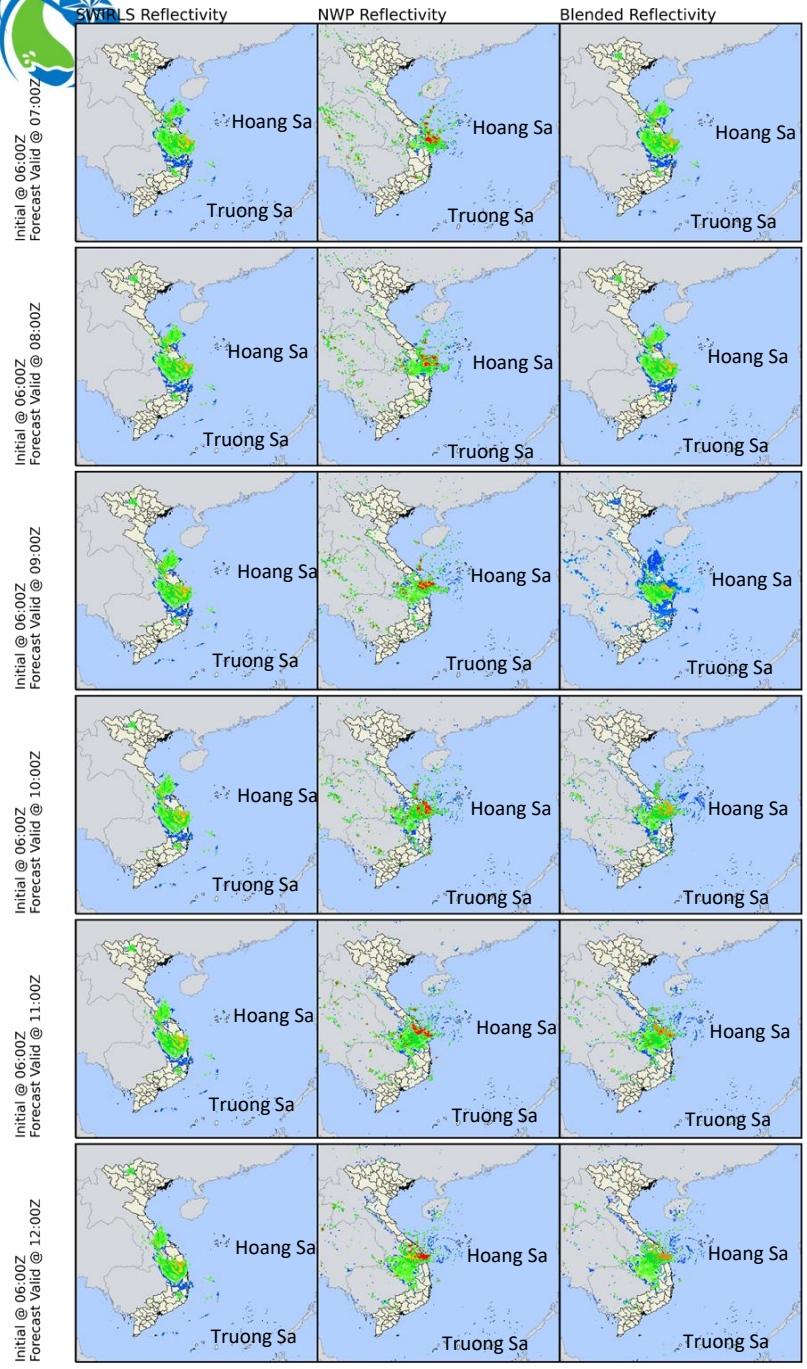
Reflectivity of WRF-IFS-3km-DA

Reflectivity radar: 5/10 radars

Rainfall from AWS: > 1000 stations

Frequency update: 10 minutes





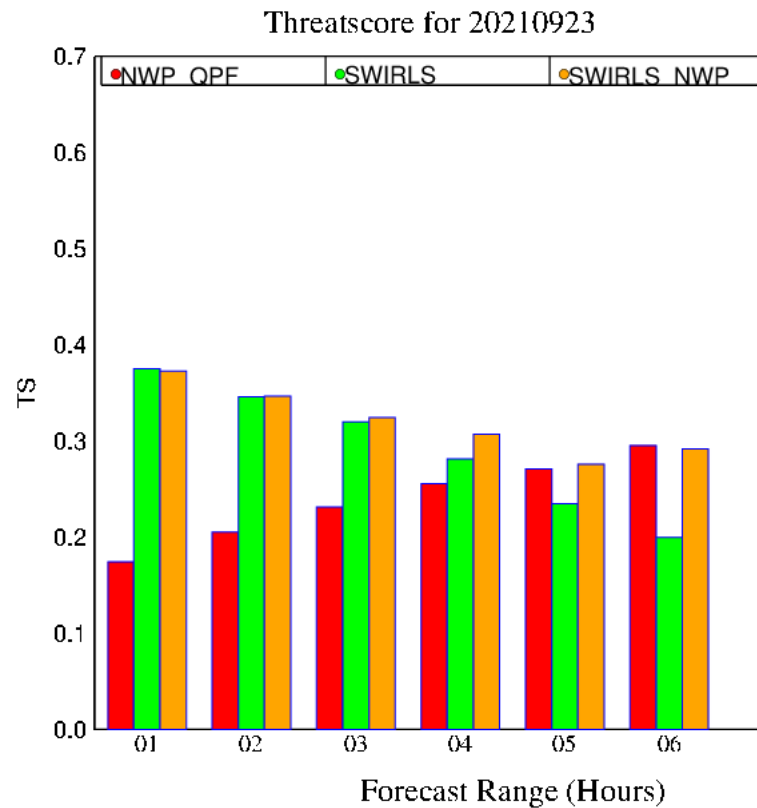


Verification

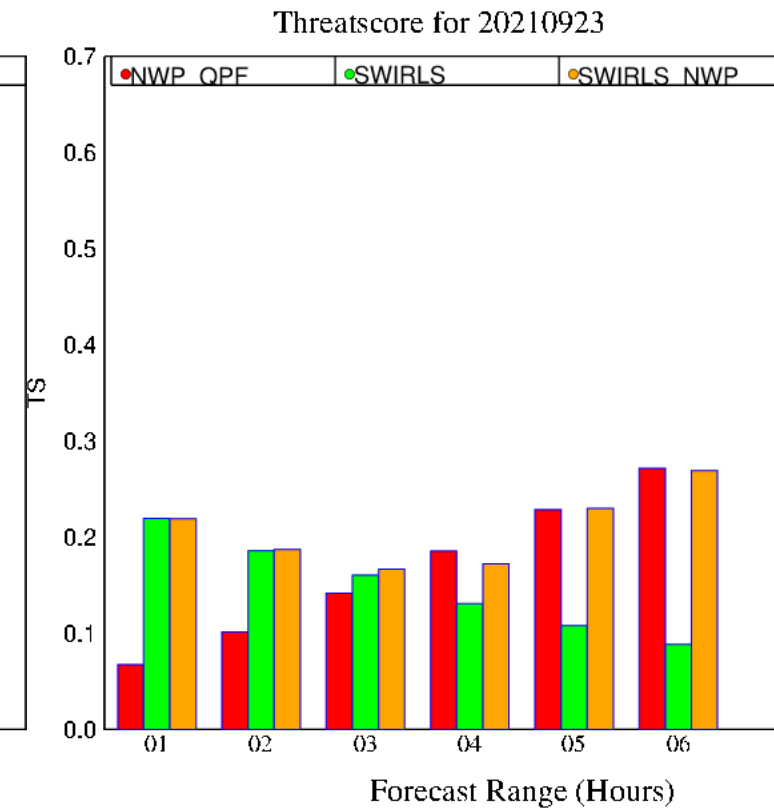
In the first 3 hours of forecast range, the forecasting skill of extrapolation from SWIRLS is better than that of very short range forecast of numerical model

Over the next 3 hours, the TS score of the extrapolated forecast rapidly declines and becomes smaller than the TS of the very short range forecast of the model.

Blending rainfall from extrapolation and very short forecast of the model has improved the quality of rain forecast for 6 hours



01mm/h



05mm/h

Score	Range	Usage
	Range: 0 to 1, 0 indicates no skill. Perfect score: 1	<i>Answers the question: How well did the forecast "yes" events correspond to the observed "yes" events?</i>

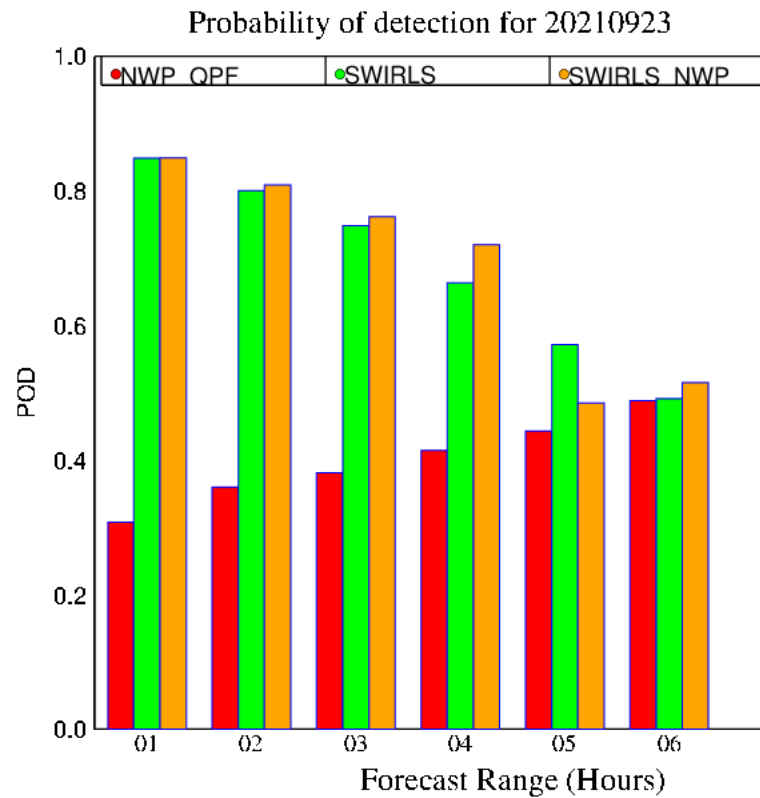


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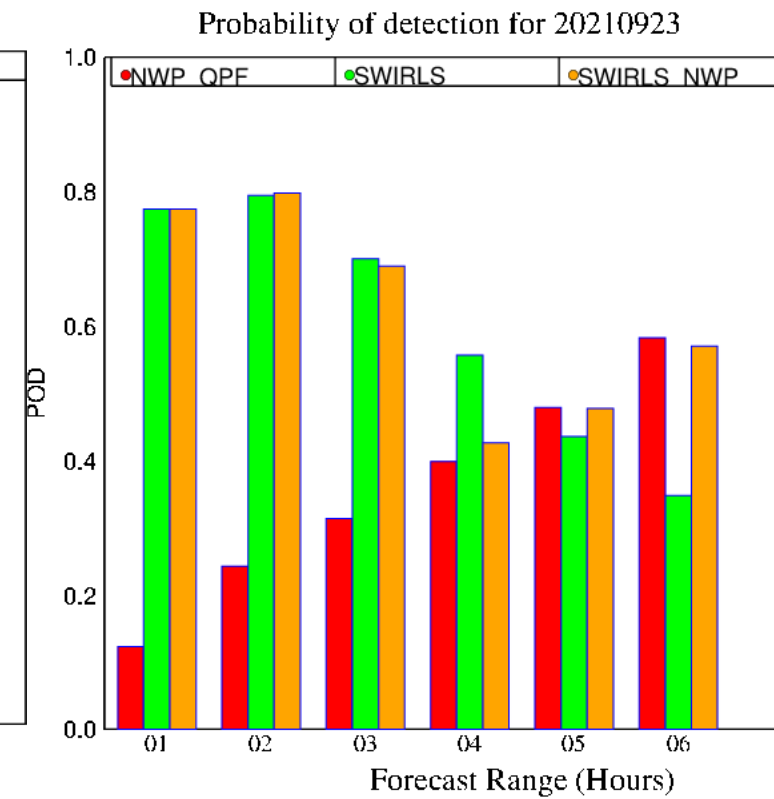
The POD of the SWIRLS extrapolation decreases rapidly with time

The POD of the model's short-range forecast is smaller than the POD of the extrapolation, but it tends to increase over 6 hours.

The blending has made rain forecast take advantage of extrapolation in the earlier hours and the forecasting skill of the model in the later hours. POD of blending increase in last 3 forecast range



01mm/h



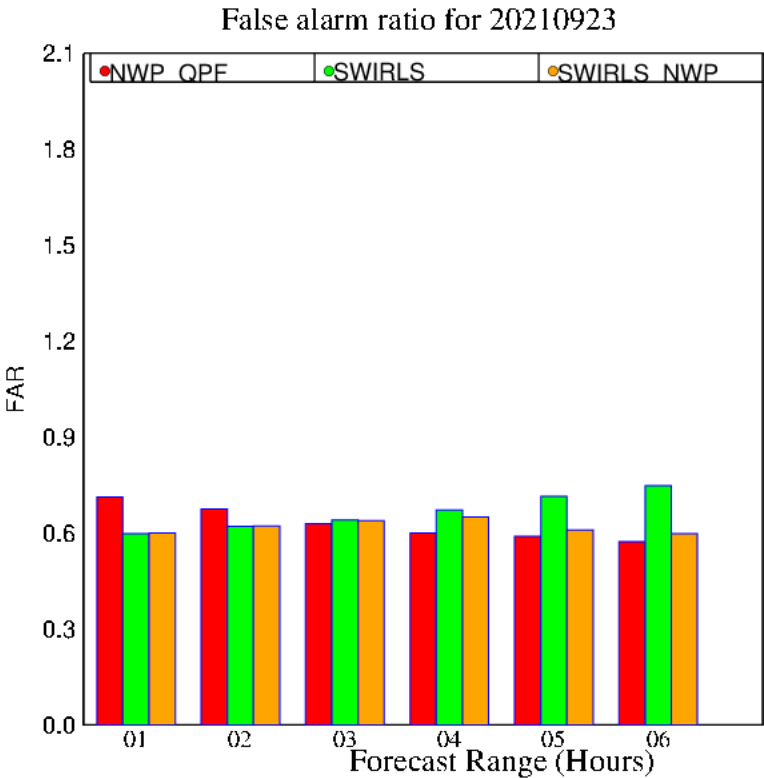
05mm/h

Score	Range	Usage
	Range: 0 to 1. Perfect score: 1	Answers the question: What fraction of the observed "yes" events were correctly forecast?

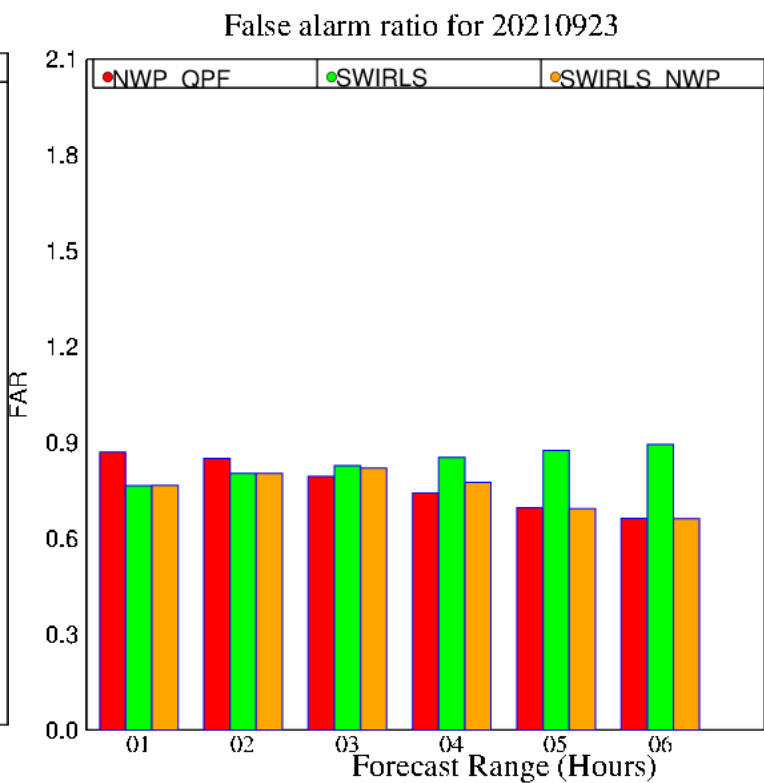


Verification

The blending has reduced overestimate forecast of extrapolation



01mm/h



05mm/h

Score	Range	Usage
	Range: 0 to 1. Perfect score: 0	<i>Answers the question: What fraction of the predicted "yes" events actually did not occur (i.e., were false alarms)?</i>



Summary

- Using the SWIRLS system can take advantage of radar based extrapolation products and NCHMF's NWP's to improve QPF at very short range forecast
- Next:
 - Calibrating nowcast of SWIRLS by using Vietnam's AWSs and more investing with Marshall-Palmer relationship for reverting quantitative precipitation estimation (QPE) from reflectivity parameters
 - More case studies for verification activities



Thank you for your attention