



**METEOROLOGICAL
SERVICE
SINGAPORE**
Centre for Climate Research Singapore

Tropical Convective-scale Modeling and Data Assimilation

Hans HUANG Xiang-Yu

Senior Principal Research Scientist

Acknowledge:

Dale Barker, the UKMO SINGV manager, and
other the SINGV team members

YMC workshop, Jakarta, 25 November 2015



SINGV Project

- Collaboration: Met Office and Meteorological Service Singapore.
- Pursue world-leading research in tropical, convective-scale NWP.
- A NWP/Nowcasting system for operational use at MSS.
- A 5-year project (2013 – 2018).
- ~4FTE/year from each partner.

SINGV Project Staff

MSS (~4FTE/year):

Hans Huang

Xiangming Sun

Mai Nguyen

Jeff Lo

Sijin Zhang

Bruce Kuo

Jianyu Liu

Anurag Dipanka (Jan 2016)

Claudio Sanchez (UKMO)



UKMO (~4FTE/year):

Dale Barker

Stuart Webster

Douglas Boyd

Kalli Furtado

Jonathan Wilkinson

Adrian Lock

Martin McMillan

Laura Stewart

Graeme Kelly

Adam Maycock

Bruce Macpherson

Marion Mittermaier

Ric Crocker

Rachel North

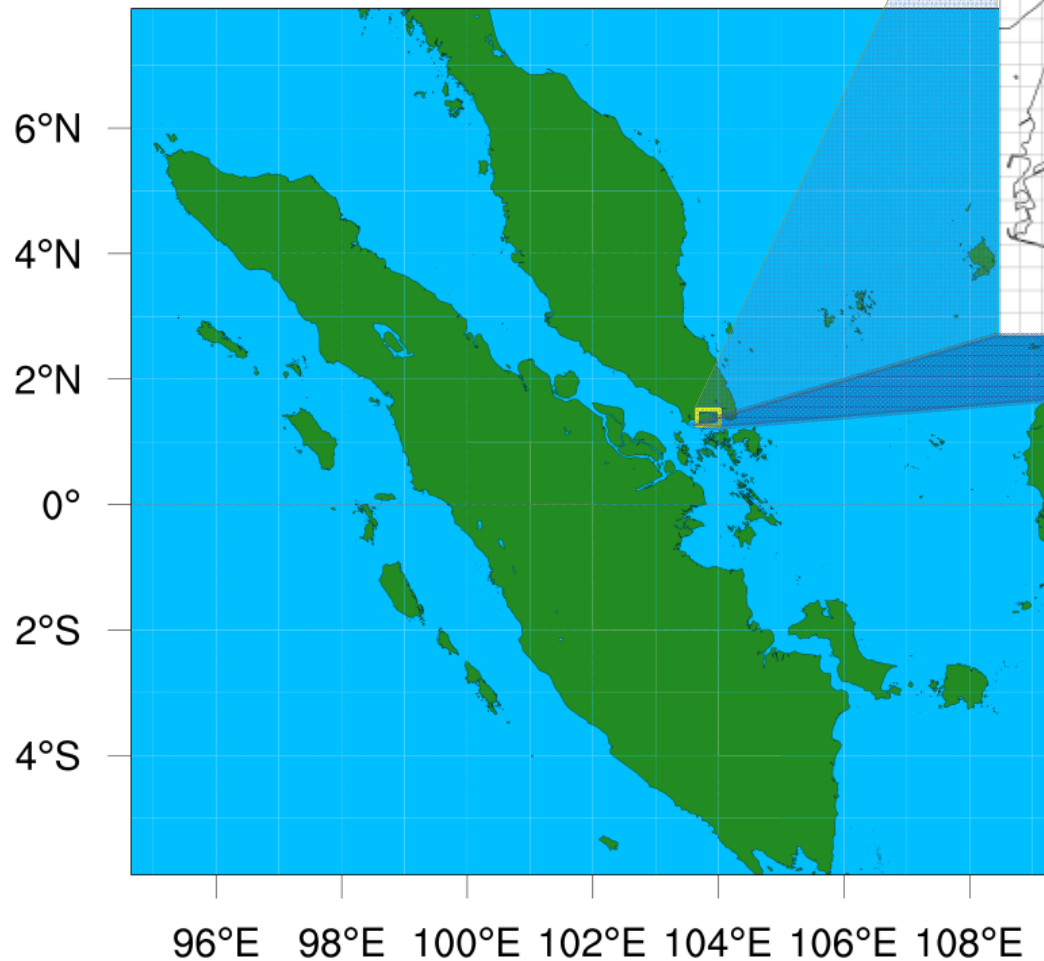


SINGV Project Milestones

- Year 1: Establish a tropical, convective-scale NWP R&D testbed at MSS.
- Year 2: Initial real-time SINGV downscaler running in Singapore.
- **Year 3: Upgraded model configuration (e.g. variable grid, improved physics), test cycling 3D-Var data assimilation including local observations.**
- Year 4: Upgraded model (e.g. improved physics), experimental convective-scale ensemble, consider post-processing needs.
- Year 5: Further improvements to model, DA and ensemble.



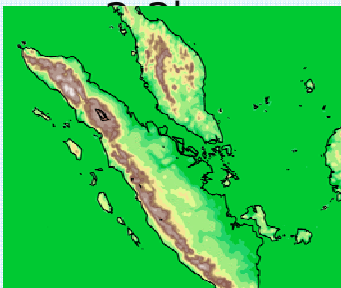
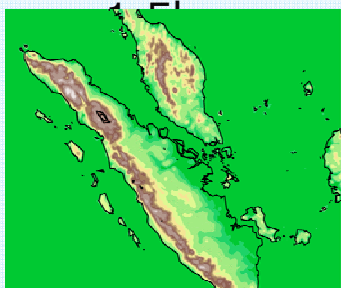
SINGV Version 2

(April 2015)



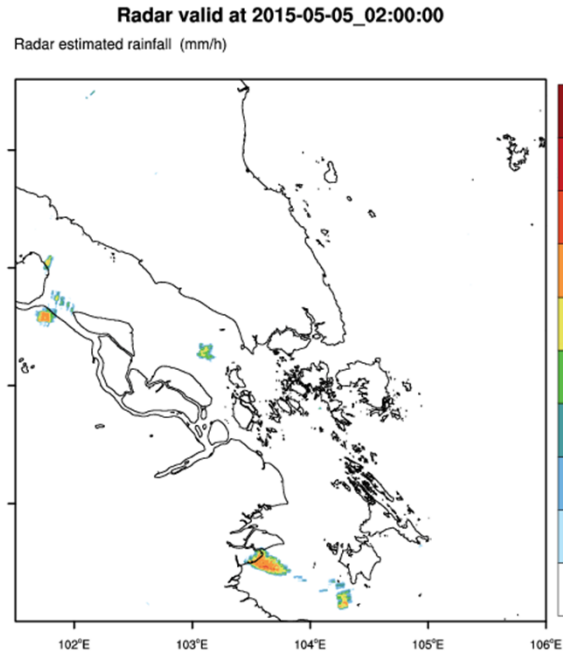
- Based on PS35 UKV ENDGame
 - No MURK aerosol
 - But L80 rather than L70
- Changes from Version 1
 1. P2A blended BL scheme
 2. Single 1.5 km domain
 - As opposed to version 1 = double nest
 - 1092 x 1026 x L80, dt=50s
 - Fixed not variable resolution
 - ~5 times cost of Version 1 configuration

Real Time NWP systems in MSS

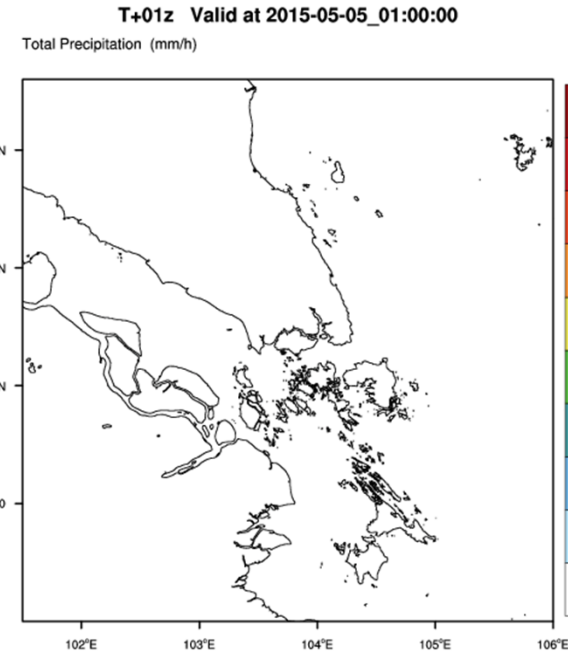
System	WRF-GFS	WRF-ECMWF	SINGV 2.2km	SINGV 1.5km
Model	WRF V3.6.1	WRF V3.6.1	UM 9.2	UM 9.2
IC & BC	0.25-degree GFS pressure level	0.135-degree ECMWF; model level	17km global UM	17km global UM
Domains				
Forecast cycles	00, 12UTC [T+72h]	00, 12UTC [T+36]	00, 12UTC [T+36h]	00, 12UTC [T+36h]
DA	Nil	Nil	Implementation ongoing	
Real time since	April 2015	April 2015	Feb 2015	Feb 2015
Downstream applications	a) Forecast guidance to WSD b) Air dispersion model (HRU) c) Air dispersion model (DSO ARGOS)		Transition planned	

**Radar
Estimated
Rainfall
and
Precipitation
Forecasts
from
SINGV-UM,
WRF-GFS,
WRF-EC

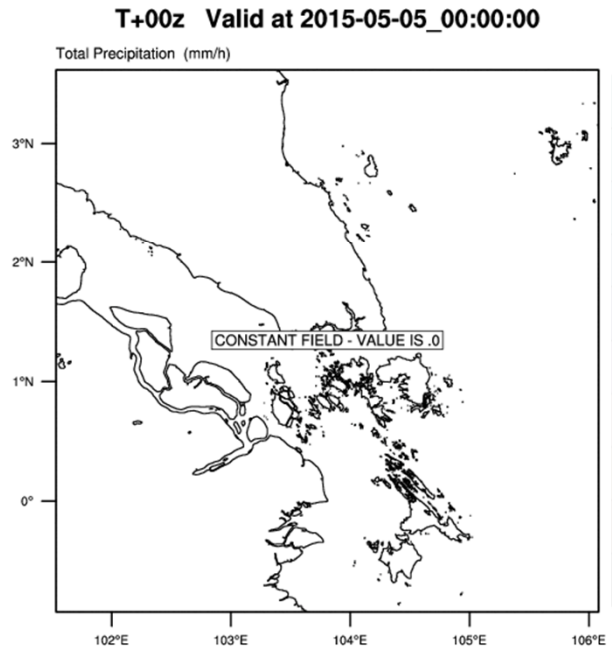
(in progress)**



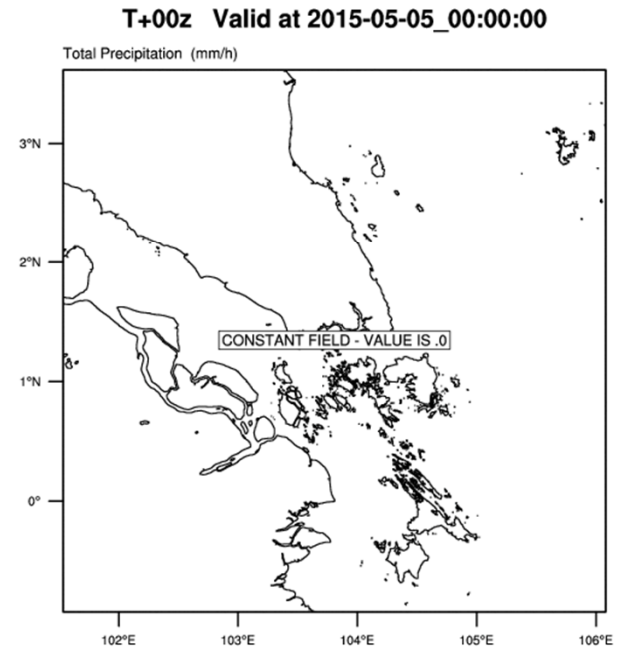
Radar



UM

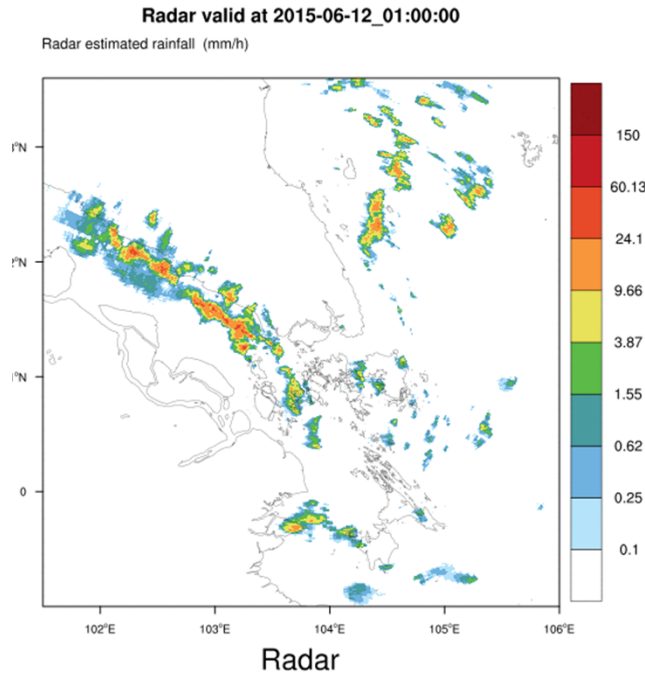


WRF-EC

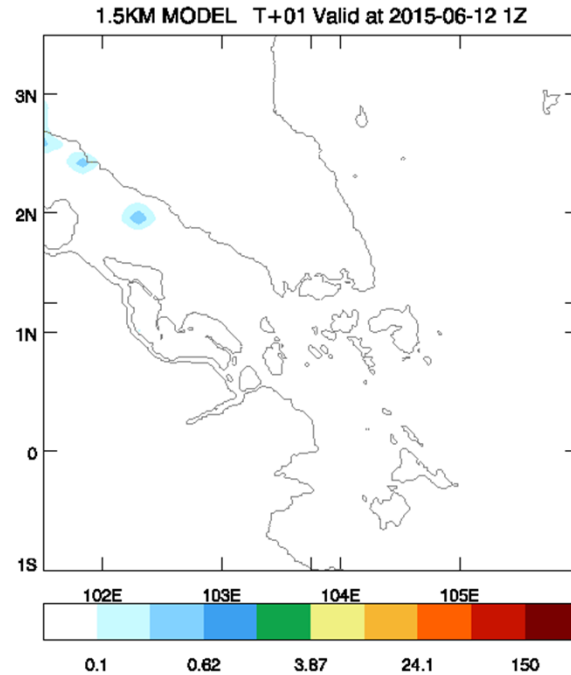


WRF-GFS

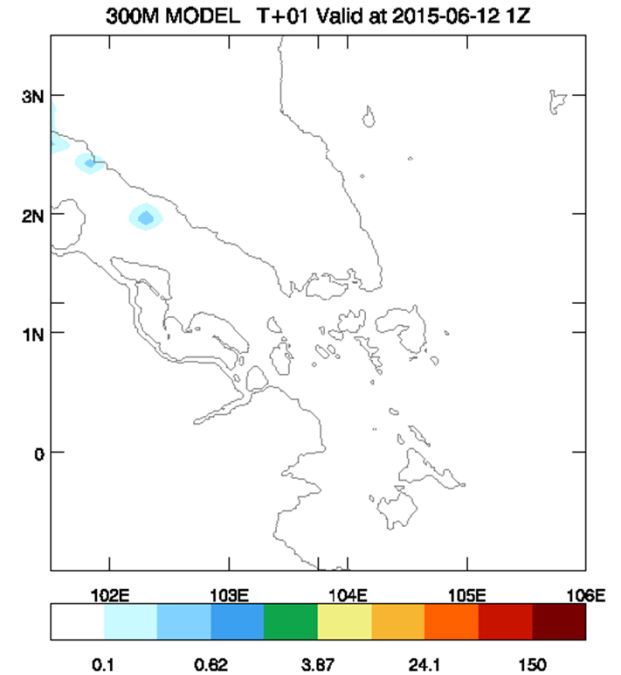
Initial tests at 300m grid-spacing



Radar



SINGV (1.5km)



SINGV (300m)

Stu Webster (UKMO)

SINGV Data Assimilation

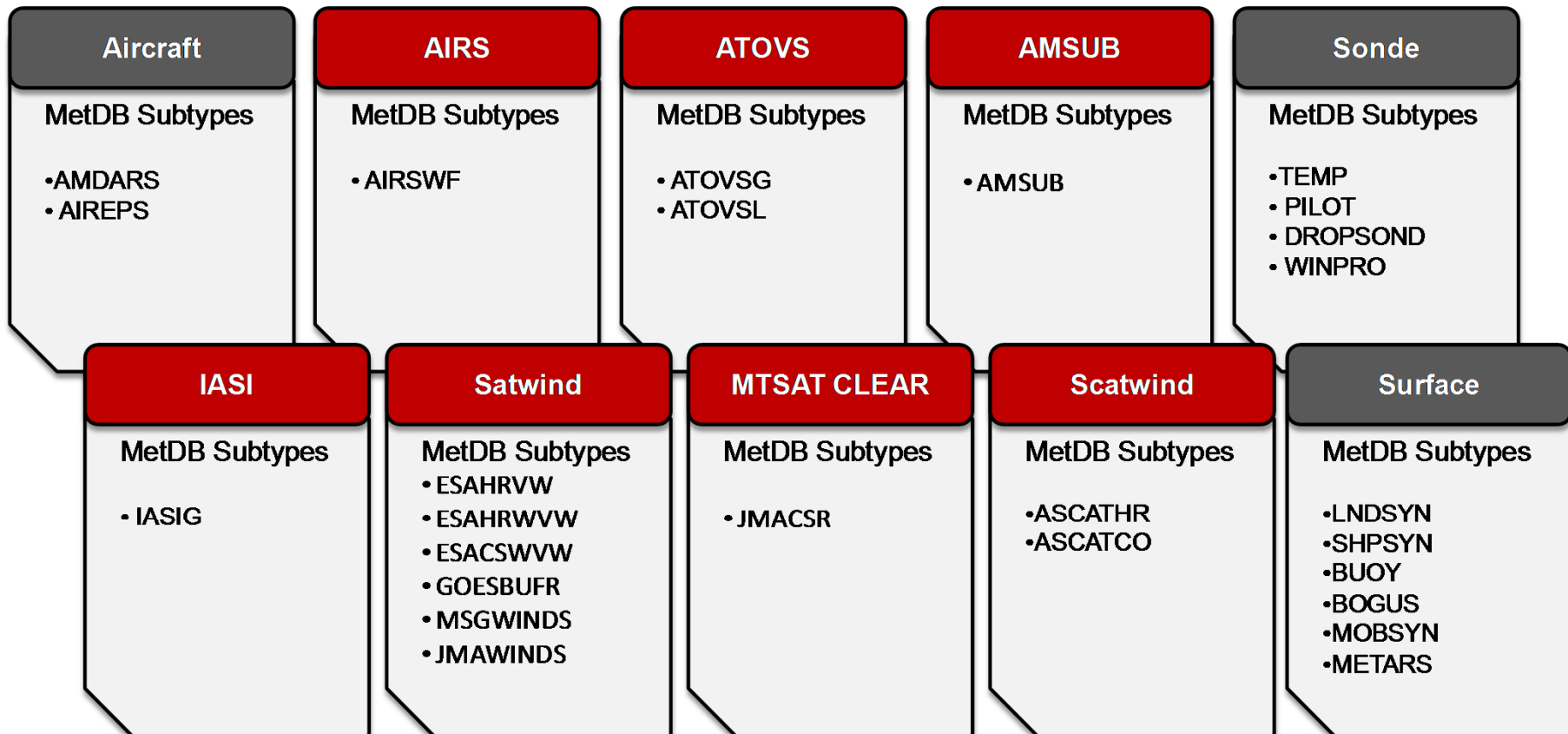
- Initial technique: 3D-Var cycling every 3hr
- **Real time implementation: April 2016**
(useful for YMC?)
- Consider 4D-Var: 2016
- Adding ensemble to DA:2017

SINGV DA Version 1: conventional observations
+ amsub + iasi + satwind + mtsatclear (with global bias
configuration)

SINGV DA Version 2: conventional observations
+ amsub + iasi + satwind + **scatwind + airs + saphir** (with
SINGV specific configuration) + **Singapore radar**

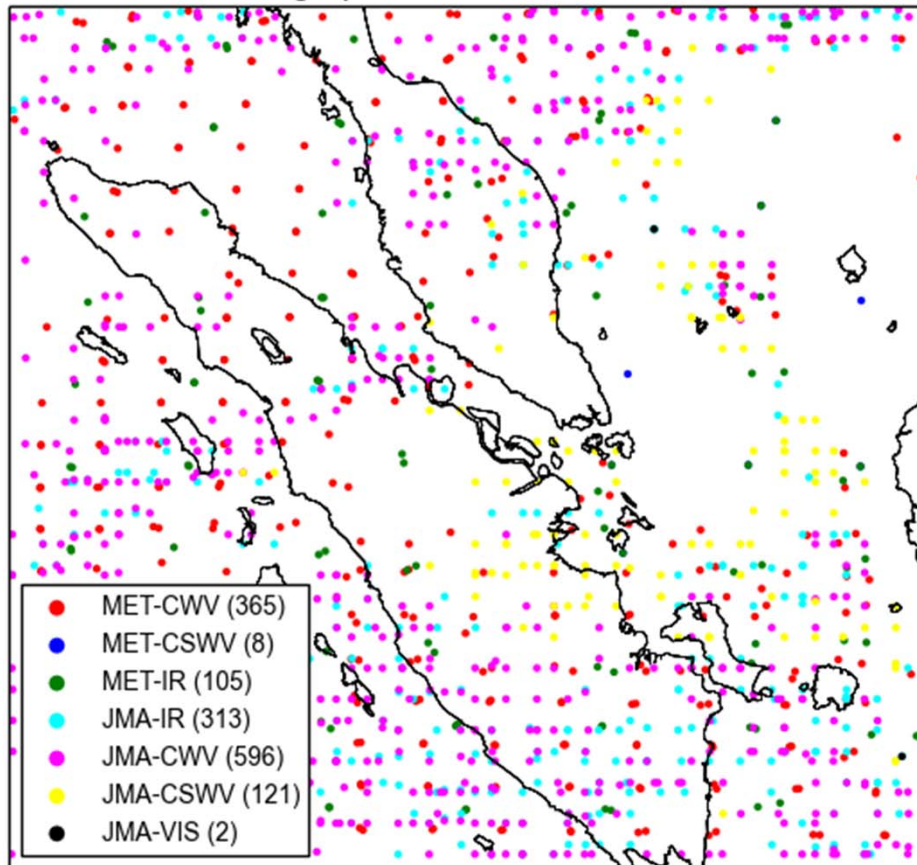
Observation Types

Observation types assimilated in the initial test setup:



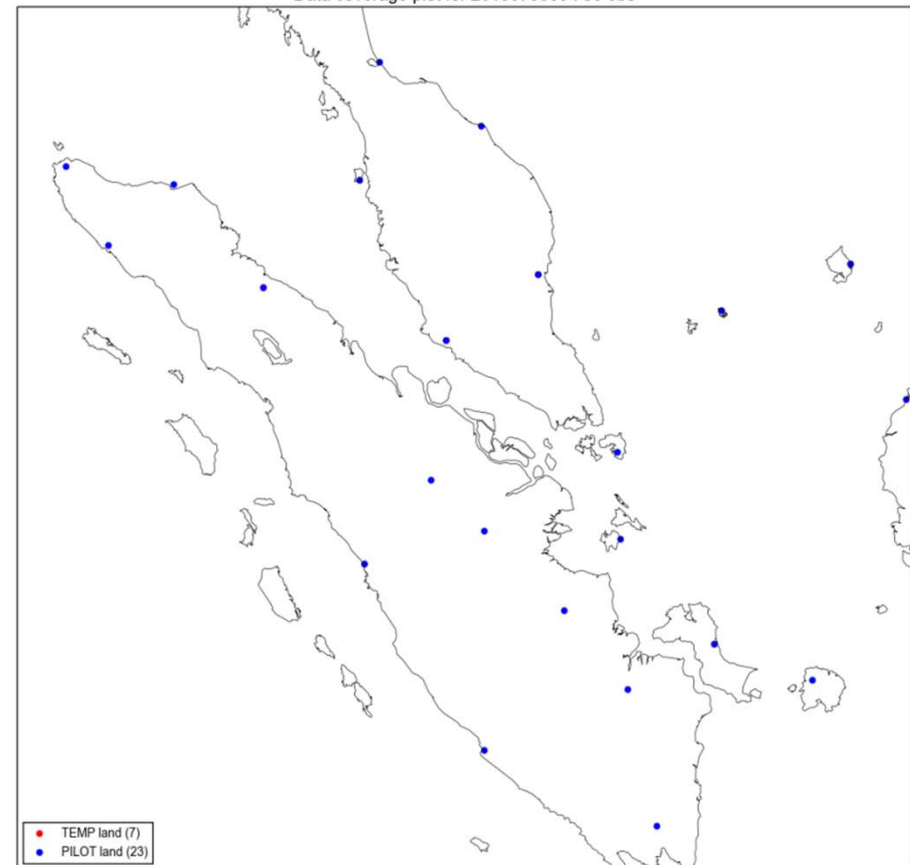
Examples of data coverage

Data coverage plot for 2013070800 : 1510 obs



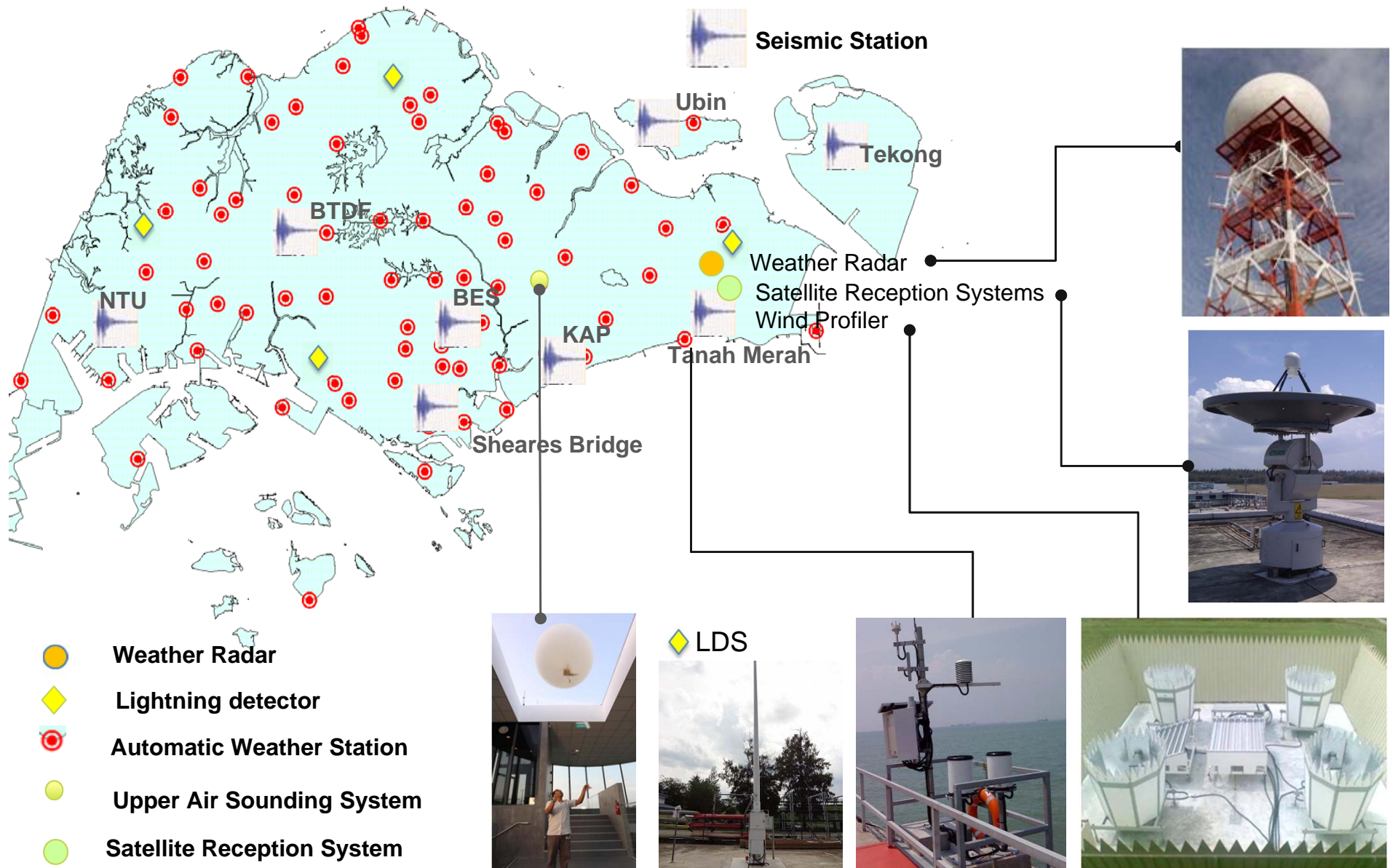
Satwind Coverage: 08/07/13 – 00Z

Data coverage plot for 2013070800 : 30 obs



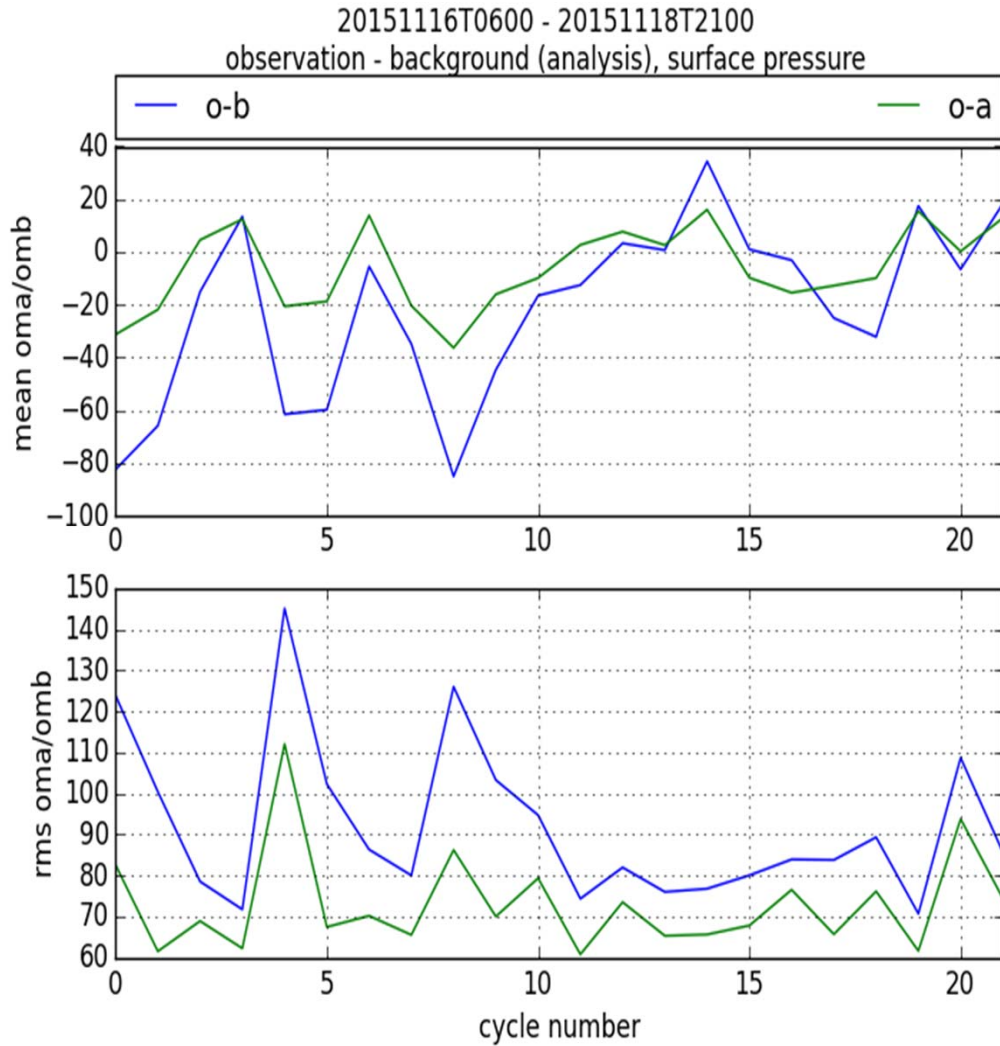
Sonde Coverage: 08/07/13 – 00Z

Network of Observations within MSS

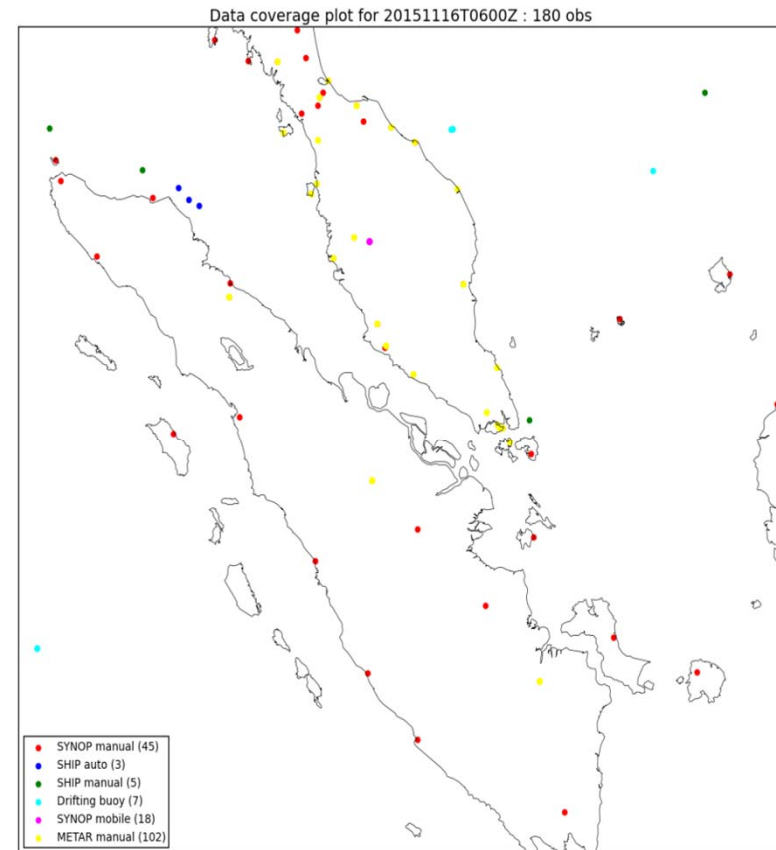


From: Lesley Choo (MSS)

Initial test of SINGV DA



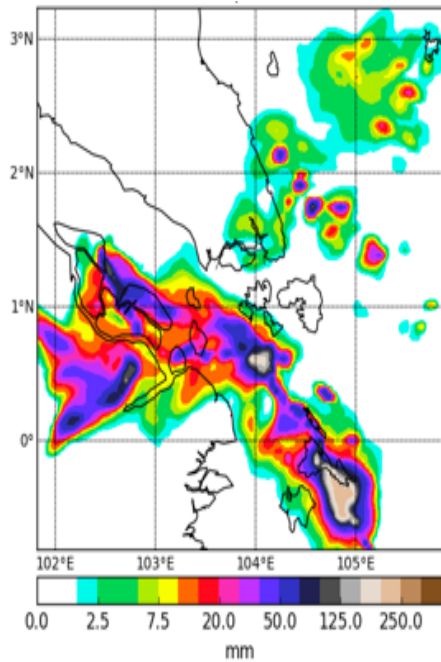
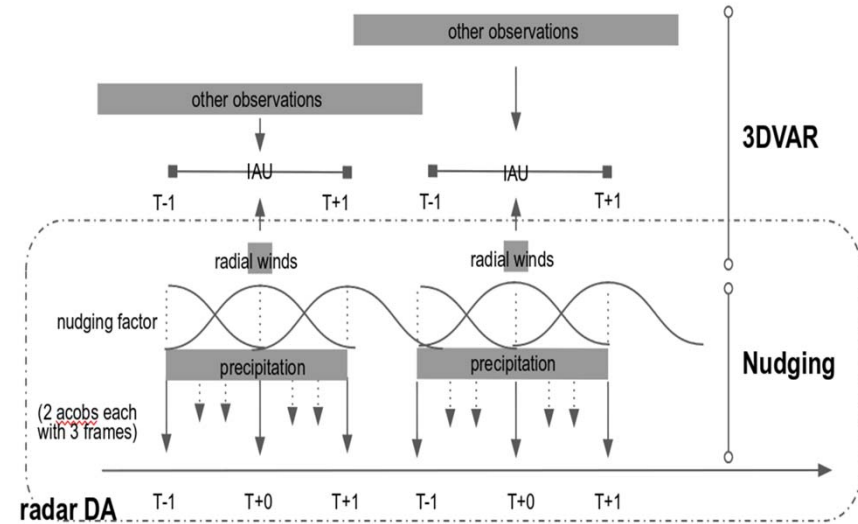
OMB and OMA ~ 3h cycling,
22 cycles



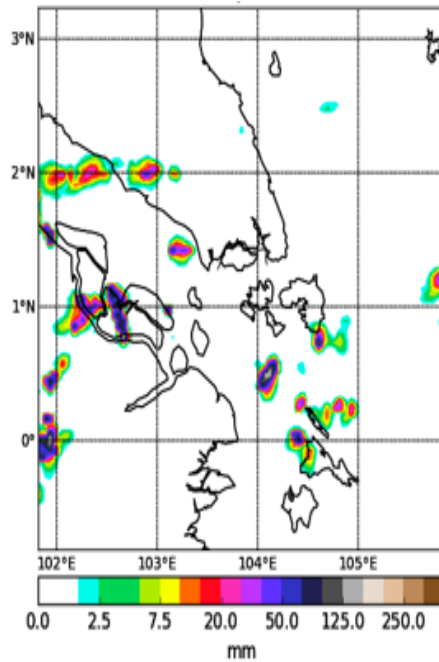
Surface observation distribution
assimilated at 2015111606

SINGV radar (ref.) data assimilation through LHN ~ a way towards convective scale DA

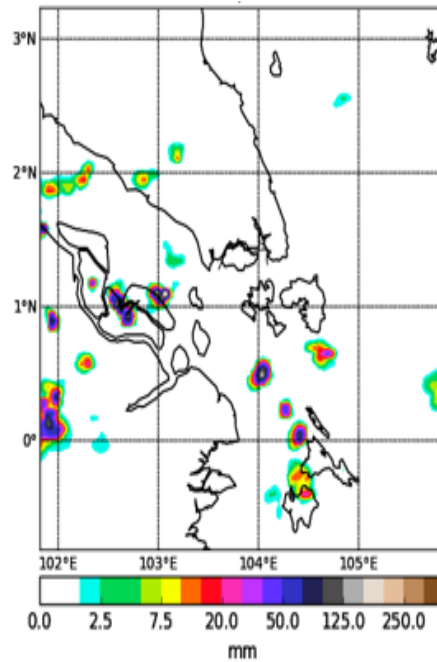
Precipitation forecasting at 1800 UTC (T+2) 18 Nov 2015 (6th cycle)



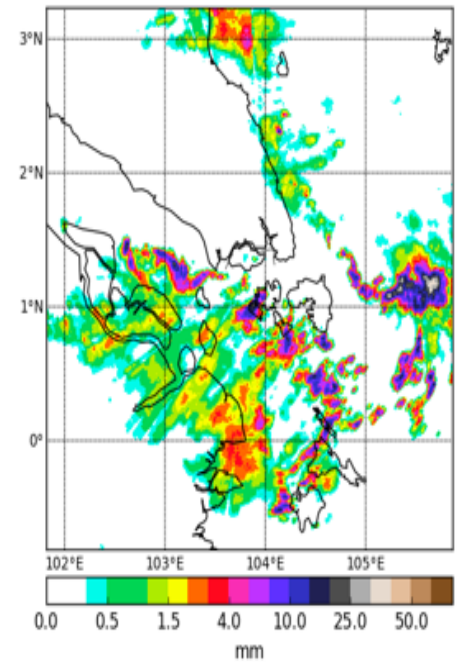
SINGV LHN
(in progress)



UKV LHN
(no tuning)

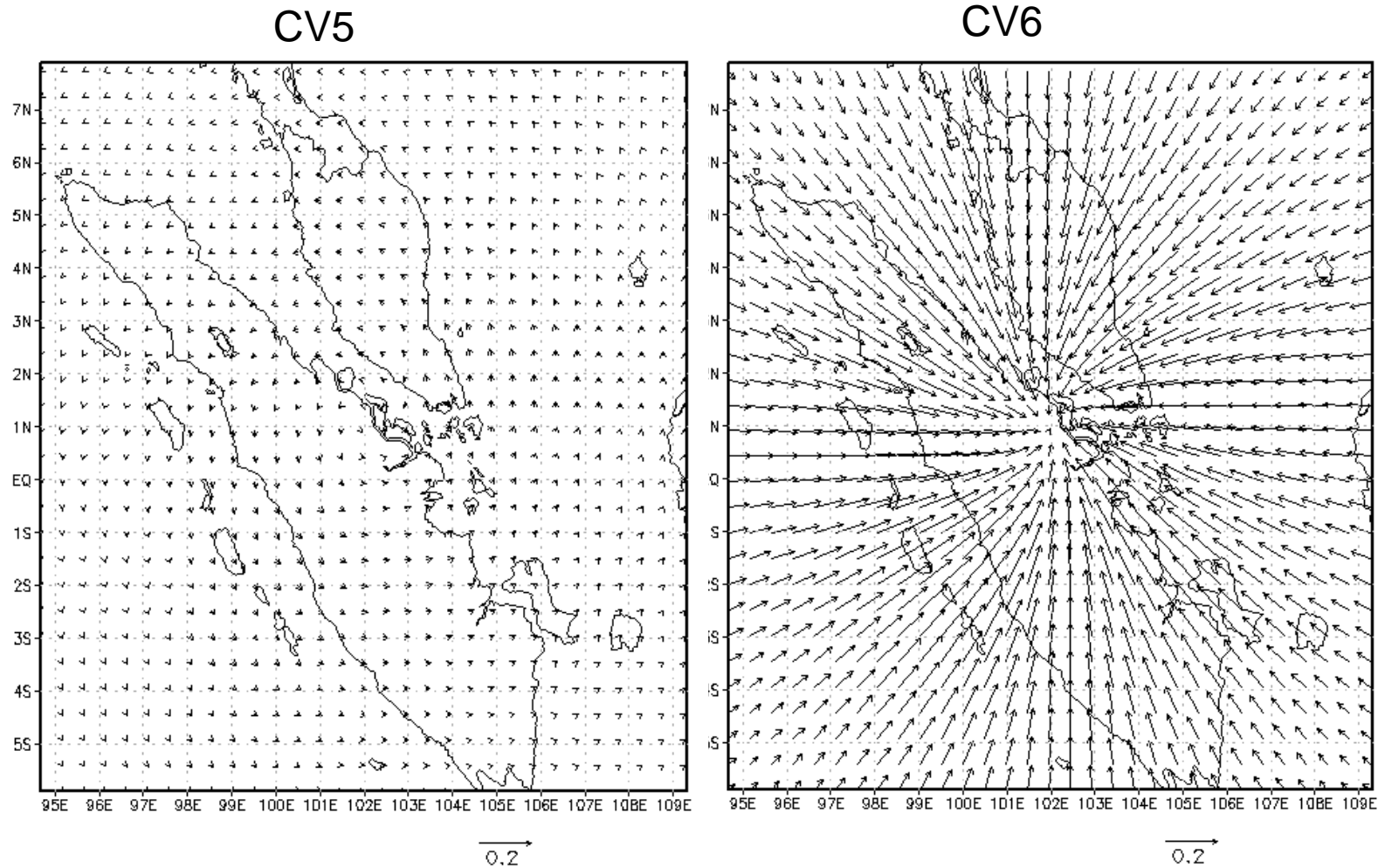


No LHN



Observation (radar)

BE: Covariance Modeling

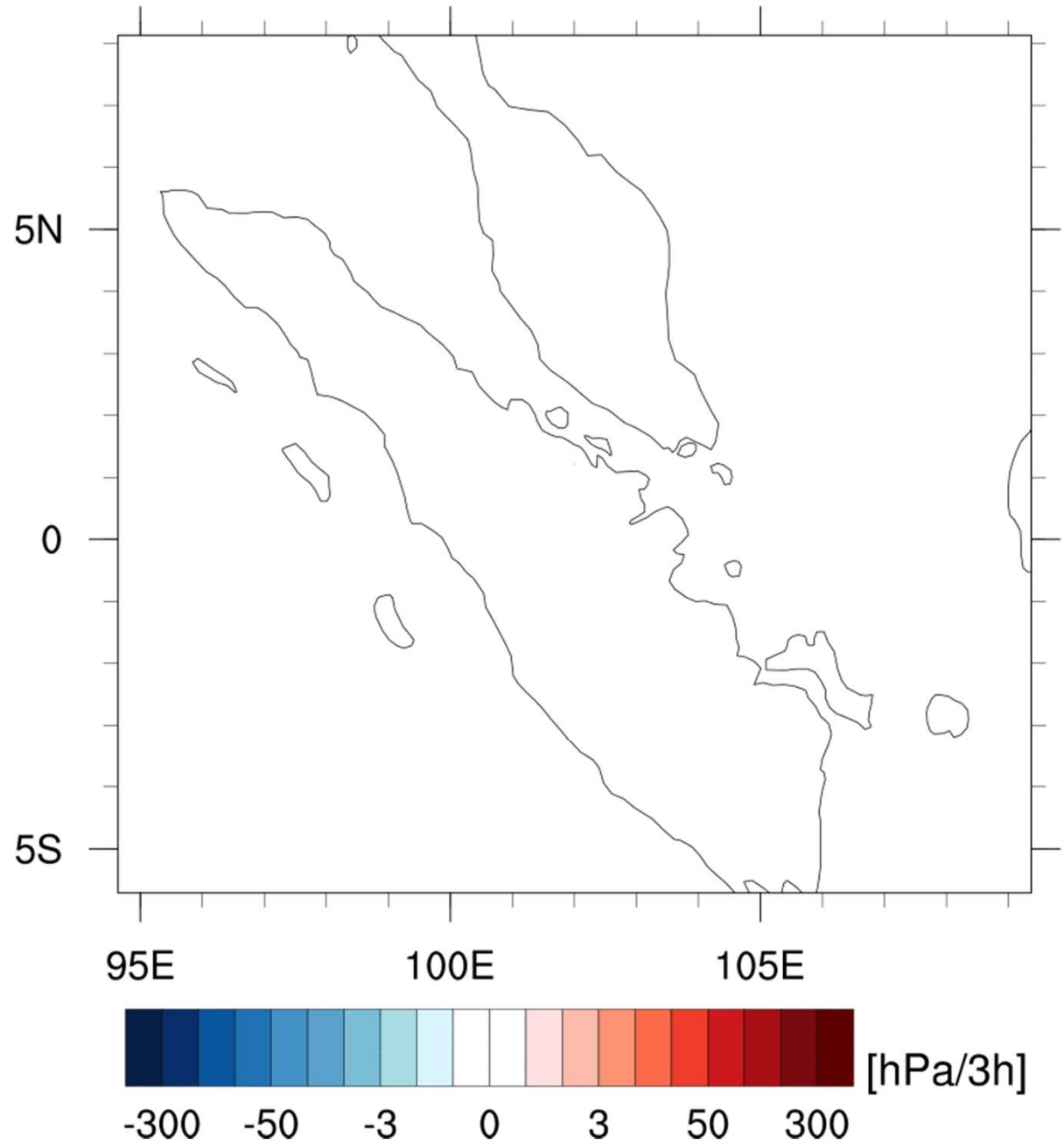


Wind increments (m/s) after assimilating a single T observation at model level 5

IMBALANCE

Surface
Pressure
Tendency
(hPa/3h)

SP incr at step 0, 0.0 minutes



Summary

- SINGV is a multi-year project to develop a UM-based tropical, convective-scale NWP capability suitable for S. E. Asia.
- Active collaboration between Met Office and MSS managed through yearly agreed work plans, dedicated WP leaders, exchange visitors, etc.
- Initial model improvements focused on resolution and physics.
- Initial data assimilation capability based on 3DVar, with 4DVar planned for the future.
- Wide range of additional observations available for assimilation, including satellite, radar, aircraft, etc.
- Data assimilation related research activities: background error covariance modelling, blending global model and regional model fields, model dynamic balancing, etc.