

JOINT WMO TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA PROCESSING AND FORECASTING SYSTEM AND NUMERICAL WEATHER PREDICTION RESEARCH ACTIVITIES FOR 2016

New Zealand / Meteorological Service of New Zealand Limited

1. Summary of highlights

"[Major changes in the data processing and forecasting system during the last year]"

[Routine pre-eruptive ash fall simulations for NZ volcanoes.](#)

2. Equipment in use

"[information on the major data processing units]"

[12 node, 144 core, QDR Infiniband Linux Intel cluster, plus other Linux Intel blade servers. IBM Storwize v7000 Unified storage system.](#)

3. Data and Products from GTS in use

- SYNOP-500 (please modify according to your situation)
- [SYNOP-6000](#)
- [METAR-10000](#)
- [AMDAR-12000](#)
- [SHIP-160](#)
- [TEMP-80](#)
- [PILOT-80](#)
- [BUOY-1600](#)
- [Atmospheric Motion Vectors \(Himawari-8\)-270000.](#)

4. Forecasting system

4.1 System run schedule and forecast ranges

"[general structure of a prognostic system, models in operational use, run schedule, forecast ranges]"

- [4km WRF run with GFS initial and boundary conditions. Model starts 4h 30m from data time four times daily out to 60 hours](#)
- [8km WRF run with GFS initial and boundary conditions. Model starts 4h 30m from data time four times daily out to 84 hours](#)
- [8km WRF run with UKMO initial and boundary conditions. Model starts 5h 30m from data time two times daily out to 84 hours](#)
- [8km WRF run with ECMWF initial and boundary conditions. Model starts 7h 00m from data time two times daily out to 84 hours](#)

4.2 Medium range forecasting system (4-10 days)

4.2.1 Data assimilation, objective analysis and initialization

4.2.1.1 In operation

"[information on Data assimilation, objective analysis and initialization]"

4.2.1.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.2.2 Model

4.2.2.1 In operation

"[Model in operational use, (*resolution, number of levels, time range, hydrostatic?, physics used*)] "

4.2.2.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.2.3 Operationally available Numerical Weather Prediction Products

"[brief description of variables which are outputs from the model integration]"

4.2.4 Operational techniques for application of NWP products (*MOS, PPM, KF, Expert Systems, etc..*)

4.2.4.1 In operation

"[brief description of automated (formalized) procedures in use for interpretation of NWP output]"

4.2.4.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.2.5 Ensemble Prediction System (EPS)

4.2.5.1 In operation

"[Number of runs, initial state perturbation method, perturbation of physics?]" *(Describe also: time range, number of members and number of models used: their resolution, number of levels, main physics used, perturbation of physics, post-processing: calculation of indices, clustering)*

4.2.5.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.2.5.3 Operationally available EPS Products

"[brief description of variables which are outputs from the EPS]"

4.3 Short-range forecasting system (0-72 hrs)

4.3.1 Data assimilation, objective analysis and initialization

4.3.1.1 In operation

"[information on Data assimilation (*if any*), objective analysis and initialization,]" *(Indicate boundary conditions used)*

- The 4km WRF uses FDDA (observation nudging) with surface and upper air observations as well as Himawari-8 Atmospheric Motion Vectors

4.3.1.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.3.2 Model

4.3.2.1 In operation

"[Model in operational use, (*domain, resolution, number levels, range, hydrostatic?, physics used*)] "

- Operationally the WRF-ARW runs at 8km and 4km; driven by different global models as stated in the schedule above

4.3.2.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.3.3 Operationally available NWP products

"[brief description of variables which are outputs from the model integration]"

- Public good forecasts are provided to forecasters at the Meteorological Service of New Zealand Limited in the form of maps, vertical profiles and time-series at spots
- Some time-series data in the form of graphs and charts are presented directly to the public on the Meteorological Service of New Zealand Limited web site

4.3.4 Operational techniques for application of NWP products

4.3.4.1 In operation

"[brief description of automated (formalized) procedures in use for interpretation of NWP output]" (*MOS, PPM, KF, Expert Systems, etc..*)

- Probabilistic spot forecasts are generated using multi-model MOS from all available models
- Automated spot text forecasts are generated from model output

4.3.4.2 Research performed in this field

"[Summary of research and development efforts in the area]"

- Improvement for wind speed and temperature forecasts

4.3.5 Ensemble Prediction System

4.3.5.1 In operation

"[Number of runs, initial state perturbation method, perturbation of physics?]" *(Describe also: time range, number of members and number of models used: their domain, resolution, number of levels, main physics used, for post-processing: calculation of indices, clustering)*

4.3.5.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.3.5.3 Operationally available EPS Products

"[brief description of variables which are outputs from the EPS]"

4.4 Nowcasting and Very Short-range Forecasting Systems (0-12 hrs)

4.4.1 Nowcasting system

4.4.1.1 In operation

"[information on processes in operational use, as appropriate related to 4.4]"

(Note: please also complete the CBS/PWS questionnaire on Nowcasting Systems and Services, 2014)

- TITAN: <http://www.ral.ucar.edu/projects/titan/home/>

4.4.1.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.4.2 Models for Very Short-range Forecasting Systems

4.4.2.1 In operation

"[information on models in operational use, as appropriate related to 4.4]"

4.4.2.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.5 Specialized numerical predictions

[Specialized NP on sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc.]

4.5.1 Assimilation of specific data, analysis and initialization (where applicable)

4.5.1.1 In operation

"[information on the major data processing steps, where applicable]"

4.5.1.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.5.2 Specific Models (as appropriate related to 4.5)

4.5.2.1 In operation

"[information on models in operational use, as appropriate related to 4.5]"

- Volcanic Ash dispersion models:
 - PUFF (driven by 1 degree GFS for NZ VAAC region)
 - HYSPLIT
 - ensemble dispersion simulations using
 - multiple NWP: (ECMWF, GFS, 4km WRF)
 - multiple eruption parameters
 - ash fall simulations using volcano specific particle size distributions, multiple erupted volumes and plume heights

4.5.2.2 Research performed in this field

"[Summary of research and development efforts in the area]"

- Best eruption parameters, particle size distribution, and configuration for volcanic ash dispersion modelling with HYSPLIT for NZ volcanoes

4.5.3 Specific products operationally available

"[brief description of variables which are outputs from the model integration]"

- VAAC Wellington operations receives prognostic charts of volcanic ash, mass loading and ash concentration at various flight levels
- Charts and gridded data (netcdf) of ash fall for NZ volcanoes to GNS

4.5.4 Operational techniques for application of specialized numerical prediction products (*MOS, PPM, KF, Expert Systems, etc.*) (as appropriate related to 4.5)

4.5.4.1 In operation

"[brief description of automated (formalized) procedures in use for interpretation of specialized NP output]"

4.5.4.2 Research performed in this field

"[Summary of research and development efforts in the area]"

4.5.5 Probabilistic predictions (where applicable)

4.5.5.1 In operation

"[Number of runs, initial state perturbation method etc.]" (*Describe also: time range, number of members and number of models used: their resolution, main physics used etc.*)

4.5.5.2 Research performed in this field
"[Summary of research and development efforts in the area]"

4.5.5.3 Operationally available probabilistic prediction products
"[brief description of variables which are outputs from probabilistic prediction techniques]"

4.6 Extended range forecasts (ERF) (10 days to 30 days)

4.6.1 Models

4.6.1.1 In operation
"[information on Models and Ensemble System in operational use, as appropriate related to 4.6]"

4.6.1.2 Research performed in this field
"[Summary of research and development efforts in the area]"

4.6.2 Operationally available NWP model and EPS ERF products

"[brief description of variables which are outputs from the model integration]"

4.7 Long range forecasts (LRF) (30 days up to two years)

4.7.1 In operation
"[Describe: Models, Coupled? (1 tier, 2 tiers), Ensemble Systems, Methodology and Products]"

4.7.2 Research performed in this field
"[Summary of research and development efforts in the area]"

4.7.2 Operationally available EPS LRF products
"[brief description of variables which are outputs from the model integration]"

5. Verification of prognostic products

5.1 "[annual verification summary to be inserted here]"

5.2 Research performed in this field
"[Summary of research and development efforts in the area]"

6. Plans for the future (next 4 years)

6.1 Development of the GDPFS

- 6.1.1 "[major changes in the Operational DPFS which are expected in the next year]"
- Enable use of local and international eruption data in volcanic ash dispersion models
 - Establish SO₂ dispersion capability
 - Ingest satellite mass loading products
 - Implement on-demand 4 km WRF ensemble over the New Zealand domain and on-demand 2 km WRF ensemble over cities
 - Establish a baseline hourly-cycled WRF over the New Zealand domain
- 6.1.2 "[major changes in the Operational DPFS which are envisaged within the next 4 years]"
- Establish a high-resolution rapid update NWP model with assimilation of radar, and other appropriate observations
 - Initialise volcanic ash dispersion simulations from existing ash clouds

6.2 Planned research Activities in NWP, Nowcasting, Long-range Forecasting and Specialized Numerical Predictions

"[Summary of planned research and development efforts in NWP, Nowcasting, LRF and Specialized Numerical Predictions for the next 4 years]"

6.2.1 Planned Research Activities in NWP

- Assimilation of radar radial winds and reflectivities
- GPS precipitable water assimilation or zenith tropospheric delay
- NZ-wide ensemble
- Hybrid 3D VAR/ensemble based assimilation
- Data assimilation for volcanic ash dispersion
- More sophisticated volcanic ash dispersion modelling including the treatment of ash particle aggregation

6.2.2 Planned Research Activities in Nowcasting

- Radar assimilation as above
- Very high resolution rapid update limited area models

6.2.3 Planned Research Activities in Long-range Forecasting

6.2.4 Planned Research Activities in Specialized Numerical Predictions

7. References

"[information on where more detailed descriptions of different components of the DPFS can be found]"
(Indicate related Internet Web sites also)