TMD’s Numerical Weather Prediction System

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Outline

😊 History of TMD’s NWP
😊 Graphic User Interface
😊 Operation System
😊 Future Work
History of TMD’s NWP

1997

- **System computer types**
  - HPE Apollo 2000 series
  - Proliant XL170r Gen 9
  - 192 Nodes (compute) (3 types)
  - Performance: 228 TF
  - Main memory: 128 GiB per node
  - High-speed storage: 3PB
- Operating system: Linux
- Model: WRF-ARW

2017

- **System computer types**
  - HPC-WRF
  - Storage (3PB)
  - Computer graphics

1000MBs

140MBs
Graphic User Interface (GUI)

Is native python language

To developed for reconfiguration and operational the numerical weather prediction system

To configure and installed related libraries packages and WRF model to fit on the computing environment on both local and/or remote machine

HOST=localhost BUILD=True ~/pybin/wrf_apps

HOST=localhost ~/pybin/wrf_apps
Forecasting System

The Cycle run four time per day at 00, 06, 12 and 18UTC with forecast. There are 3 domain for operational which are the WRFV3.8.1 (changing to latest 4.1.3)

- **Short range forecast (0-72 hours):**
  - Forecast +48 hours run spacing grid 2 km². output hourly
  - Forecast +72 hours run spacing grid 6 km². output hourly

- **Medium-range forecasting system (4 – 10 days)**
  - Forecast +10 days run spacing grid 18 km². output 3 hourly

The Cycle run a time per day at 00 with forecast. There are 2 domain for operational which are the WRFV3.8.1 (changing to latest 4.1.3)

- **Long range forecast (climate model)**
  - Forecast +397 days run spacing grid 27 km². output 6 hourly
Global Forecasting

2004 Global RAMS (Regional Atmospheric Modeling System) after that is Ocean-Land-Atmosphere Model (OLAM)
2005 A global version of the fifth-generation Pennsylvania State University–National Center for Atmospheric Research Mesoscale Model (PSU–NCAR MM5)
2007 Experimental Climate Prediction Center (ECPC) Global to Regional Spectral Model (G-RSM)
2015 Global Weather Research and Forecasting Model (WRF-ARW)
2017 Model for Prediction Across Scales-Atmosphere (MPAS-A)
2018 OLAM-SOIL
2019 Couple system of WRF and NEMO (currently on the way to coupling)
**Configuration domain for run WRF GSI**

<table>
<thead>
<tr>
<th>Grid point</th>
<th>resolution/time forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1483x741x19=20,879,157</td>
<td>27 กม. (Fc 126 Days)</td>
</tr>
<tr>
<td>585x55x40=12,987,000</td>
<td>18 กม. (Fc 10 Days)</td>
</tr>
<tr>
<td>547x544x40=11,902,720</td>
<td>6 กม. (Fc 3 Days)</td>
</tr>
<tr>
<td>547x913x40=19,976,440</td>
<td>2 กม. (Fc 2 Days)</td>
</tr>
</tbody>
</table>
High Performance Computing

System computer types
HPE Apollo 2000 series Proliant XL170r Gen 9
- 192 Nodes (compute) (3 types)
- Performance : 228 TF
- Main memory : 128 GiB per node
- High-speed storage: 3PB

Operating system : Linux
Model : WRF-ARW
Mobile Application
Hourly Table/Time-Series/Map
TMD Weather Forecast API

https://data.tmd.go.th/nwpapi/doc
Forecasting Results

Short-term and long-term weather forecasting system, WRF-4.1.3, 2-km (48-h), 6-km (72-h), 18-km (10-days), 4-time a day, (http://www.nwp.tmd.go.th)

Short-term and long-term climate forecasting system, WRF-4.1.3, 54-km, and 18-km (397-days), once a day. http://weather.tmd.go.th/seasonal
Point/Area Forecasting Results
Future Work

**Development of weather with high performance phase I (2017 to 2020)**

<table>
<thead>
<tr>
<th>Forecast Range</th>
<th>Forecast Resolution</th>
<th>Forecast member ensemble</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 6 month</td>
<td>27 km. X 27 km (729 sqm)</td>
<td>&gt; 7 members</td>
</tr>
<tr>
<td>2. 240-h(10 day)</td>
<td>18 km X 18 km (324 sqm)</td>
<td>-</td>
</tr>
<tr>
<td>3. 72-h (3 day)</td>
<td>6 km X 6 km (36 sqm)</td>
<td>-</td>
</tr>
<tr>
<td>4. 48-h (2 day)</td>
<td>2 km X 2 km (4 sqm)</td>
<td>-</td>
</tr>
</tbody>
</table>

5. Testing seasonal forecast with ensemble
6. To do data assimilation every 6-h for short range forecast
**Future Work**

**Development of weather with high performance phase II (2021 to 2025)**

<table>
<thead>
<tr>
<th>Forecast Range</th>
<th>Forecast Resolution</th>
<th>Forecast member ensemble</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 6 month</td>
<td>27 km. X 27 km (729 sqm)</td>
<td>&gt; 50 members</td>
</tr>
<tr>
<td>2. 240-h(10 day)</td>
<td>9 km X 9 km (81 sqm)</td>
<td>&gt; 10 members</td>
</tr>
<tr>
<td>3. 72-h (3 day)</td>
<td>3 km X 3 km (9 sqm.)</td>
<td>&gt; 10 members</td>
</tr>
<tr>
<td>4. 48-h (2 day)</td>
<td>1 km X 1 km (1 sqm)</td>
<td>&gt; 10 members</td>
</tr>
<tr>
<td>5. To develop data assimilation every hour for short range forecast</td>
<td></td>
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<tr>
<td>6. To develop and test couple models</td>
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<tr>
<td>7. To develop regional climate change projection</td>
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<tr>
<td>8. To Applied AI</td>
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</tbody>
</table>
The technology of numerical weather prediction or forecast by computer have been developed and used in the country for a long time more than 20 years, to be used as tools in support of the weather and climate prediction of forecaster and meteorologists.

According with the rapidly developed on height performance computing and the weather forecast technology,

TMD has updated the numerical weather prediction systems to ensure efficiency and accuracy in weather forecasting for nowcasting, short-range, medium-range, long-range and extended-range expectations for natural disasters such as the heavy rain flooding, tropical cyclone movement and track, drought, storm surges in the risk area especially in mountain areas and southern and western coast of Gulf of Thailand.
Acknowledgements

WRF model developer groups which strong update and continuous improved,

NCEP for available initial and boundary condition data,

ITs developer,

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Thank you for your Attention