Requirements for Measuring Wind Profiles in Post-EPS

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EUMETSAT
Preparation activities for EUMETSAT Polar System (EPS): Background

Approach approved by EUMETSAT Council Nov. 2003

Current focus is on establishing Mission Requirements:

- Starting point is MTG User Consultation
- User needs/priorities from application, technology-free perspective
- Assessment of observing techniques suitable from GEO/LEO
- Updates expected, especially with demonstration of new capabilities
Need for expansion of EUMETSAT User Consultation: from MTG to Post-EPS

- Oceanography was only partially addressed in Global NWP
- Atmospheric chemistry & carbon cycle (focus was $dT < 1$ hour)
- Land surface analysis at large scale (meteorology only addressed)
- Climate monitoring (no specific requests for products, however better calibration and characterisation needed)

Observing techniques:
- Full assessment of LEO capabilities as focus was GEO
Application Experts Groups (AEG)

- Support of EUMETSAT user consultation towards Post-EPS

- Analysing the needs of EUMETSAT users in the 2019+ timeframe
  - Starting with MTG Position Papers
    - Global numerical weather prediction
    - Regional numerical weather prediction
    - Nowcasting
  - Analysing the evolution of those applications
  - Taking account of further applications:
    - Operational oceanography
    - Atmospheric chemistry and carbon cycle (protocol monitoring and air quality)
    - Land surface analysis at large scale
    - Climate monitoring

- Formulation of EUMETSAT user needs: Position Papers
User Requirements Definition (1)

Step 1

Initial formulation of potential user requirements for each parameter:

– List of objective and threshold requirements,
  – Objective: Observation goal
  – Threshold: Minimum level for usefulness
– Accuracy
– Spatial sampling
– Temporal sampling
– Data latency
– Breakthrough level: Expected to make a delta improvement in the targeted service
– Priority

Basis for AEG discussion and subsequent user consultation
User Requirements Definition (2)

Step 2

Initial assessment of suitable observation techniques

For each potential user requirement:

– Broad identification of observation techniques

– Identification of precursor instruments/missions

– Estimation of performance against threshold-objective range
User Requirements Definition (3)

**Step 3**  Generation of Mission Requirements

- Grouping of user requirements in candidate missions
- Definition of data levels  
  (raw, calibrated, resampled at satellite radiances, level 2 data, ...)
- Derivation of observation requirements  
  (spatial, spectral resolution, radiometric accuracy, ...)
- Identification of non-observation requirements / user services

**Step 4**  Technical Requirements (ESA)

- Derivation of technical requirements for sensor/system studies  
  (e.g. MTF, spectral response, pointing accuracy, ...)

The ADM-Aeolus Workshop, ESTEC, 26 – 28 September 2006
User Requirements Definition (4)

from Phase 0 (mission definition) to Phase A (feasibility)

Requirements and Mission Analysis
Scientific/Technical Studies

Mission Requirements → End-User Requirements

Sensor/System/Mission Analysis
Technical Studies

Technical Requirements → System Requirements

Programme Proposal (Phase B)
Tentative Post-EPS Missions

- Atmospheric Sounding
  ➢ Wind Profiling
- Ocean Imaging including Sea Ice and Surface Wind
- Ocean Surface Topography
- Cloud, Precipitation and Large-Scale Land Surface Imaging
- Atmospheric Chemistry

+ Climate Monitoring (to be supported within above missions)
On Requirement Metrics

• Objective:
  – Observation goal, above which no substantial further benefit can be expected

• Threshold:
  – Minimum requirement, below which the measurement is useless

• Breakthrough (between Threshold and Objective):
  – Level at which the measurement is expected to provide a substantial improvement in the targeted services
### EXAMPLE: Accuracy Requirements for Profile of Horizontal Wind Vector

<table>
<thead>
<tr>
<th>Level</th>
<th>Threshold (m/s)</th>
<th>Breakthrough (m/s)</th>
<th>Objective (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Troposphere</td>
<td>5/5/5</td>
<td>3/2/3</td>
<td>1/1/2</td>
</tr>
<tr>
<td>Higher Troposphere</td>
<td>8/5/5</td>
<td>3/2/3</td>
<td>1/1/2</td>
</tr>
<tr>
<td>Lower Stratosphere</td>
<td>5/5/5</td>
<td>3/3/3</td>
<td>1/1/2</td>
</tr>
<tr>
<td>Higher Stratosphere And Mesosphere</td>
<td>10/-/7</td>
<td>5/-/5</td>
<td>1/-/3</td>
</tr>
</tbody>
</table>

Global NWP / Regional NWP / Climate Monitoring
Summary and Outlook

• Translation of User into Mission Requirements results in
  ➢ Identification of candidate observation mission:
    ➢ for instance: Doppler Wind Lidar

• Formulation of mission (observation) requirements by dedicated analyses
  – Extrapolation from existing knowledge and instruments
  – Specific studies (e.g. simulation of impact of different realisations, …)

• Industrial concept studies on instruments and system architecture

- Real measurements (ADM/Aeolus) will have decisive impact on relative
  importance and priority of Doppler Wind Lidar Mission in Post-EPS
- and/or necessary enhancements of a Doppler Wind Lidar Mission
- More info: www.eumetsat.int (all position papers and 1st P-EPS Workshop)