GOES-R AWG Hydrology Team: ABI Probability of Rainfall Algorithm
June 17, 2010

Presented By: Bob Kuligowski
NOAA/NESDIS/STAR

Hydrology Algorithm Team

- **Chair:** Bob Kuligowski
- **Team Members**
  - » Ralph Ferraro (STAR / CoRP)
  - » Sheldon Kusselson (OSDPD / SSD / SAB)
  - » Matthew Sapiano (Colorado State U.)
  - » Kuolin Hsu (UC-Irvine)
  - » George Huffman (NASA / SSAI)

Outline

- Executive Summary
- Requirements Specification Evolution
- Algorithm Description
- Validation Strategy
- Validation Results
- Summary

Executive Summary

- This ABI Probability of Rainfall algorithm generates the Option 2 Probability of Rainfall product.
- Version 3 is on track for late June delivery. ATBD (80%) is on track for August delivery.
- Since there were no legacy algorithms available, an algorithm was developed “from scratch”.
- The algorithm uses intermediate rainfall rate forecasts from the Rainfall Potential algorithm as inputs to a statistical model that was trained using linear regression.
- Ground validation is being performed against ground radar (Nimrod) over Western Europe.
- Validation studies indicate that the algorithm is partially compliant with spec at this time.

Requirements Specification Evolution

Name	User & Priority	Geographic Coverage (G, H, C, M)	Vertical Resolution	Horizontal Resolution	Mapping Accuracy	Measurement Range	Measurement Accuracy	Product Refresh Rate / Coverage Time (Mode 3)	Refreshment Rate / Coverage Time (Mode 4)	Vendor Allocated Ground Latency	Product Measurement Precision
Probability of Rainfall	GOES-R	FD	N/A	2.0 km	1.0 km	0 to 100%	25%	FD: 15 min	FD: 5 min	266 sec	40%

Temporal Coverage Qualifiers	Product Extent Qualifier	Cloud Cover Conditions Qualifier	Product Statistics Qualifier
Day and night	Quantitative out to at least 70 degrees LZA or 60 degrees latitude, whichever is less, and qualitative beyond	N/A	Over rainfall cases and mesoscale-sized surrounding regions

Algorithm Description

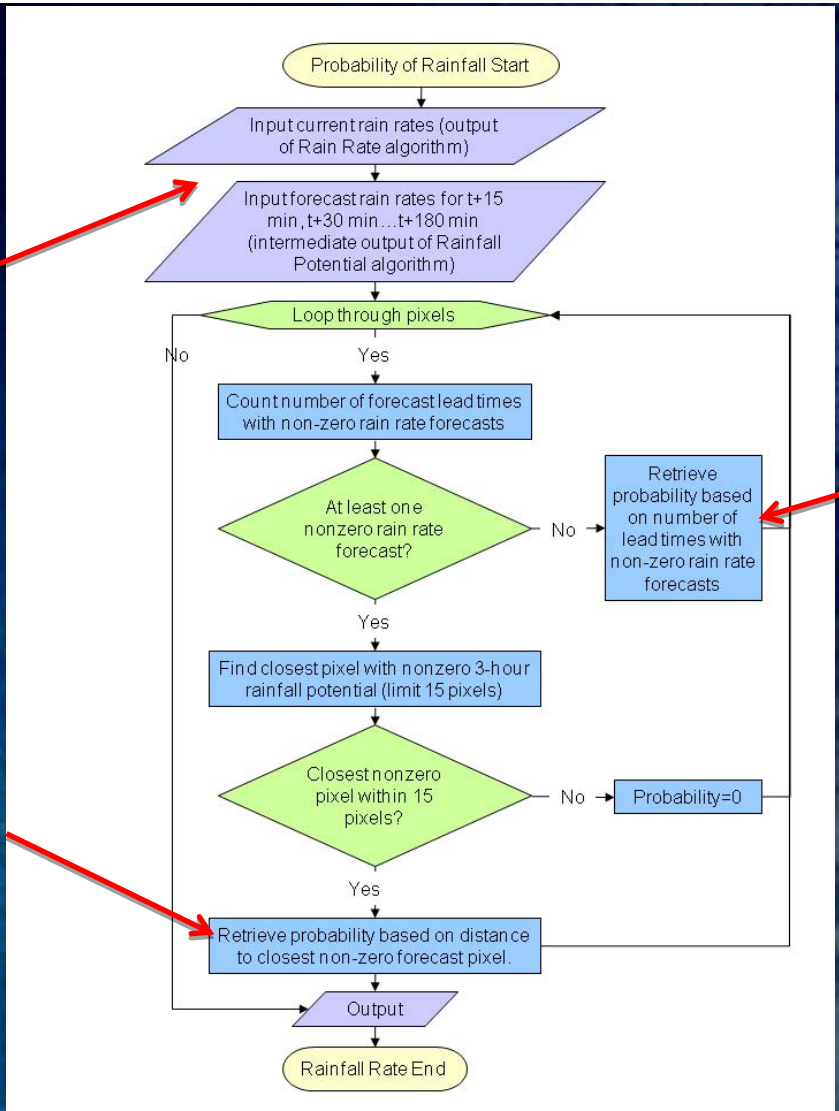
Algorithm Description

- This ABI Probability of Rainfall algorithm generates the Option 2 Probability of Rainfall product.
- The algorithm derives the probability of rainfall during the next 3 h from the current Rainfall Rate product and intermediate (every 15 min) nowcasts of rainfall from the Rainfall Potential algorithm.
- The algorithm was calibrated using regression against the Rainfall Rate product instead of ground measurements to:
  - » Eliminate uncertainties associated with errors in the Rainfall Rate algorithm;
  - » Allow much more spatially widespread calibration (ground truth is generally available over Western Europe only)

Algorithm Description

Input rain rates at 15-min intervals from current time to t+180 min

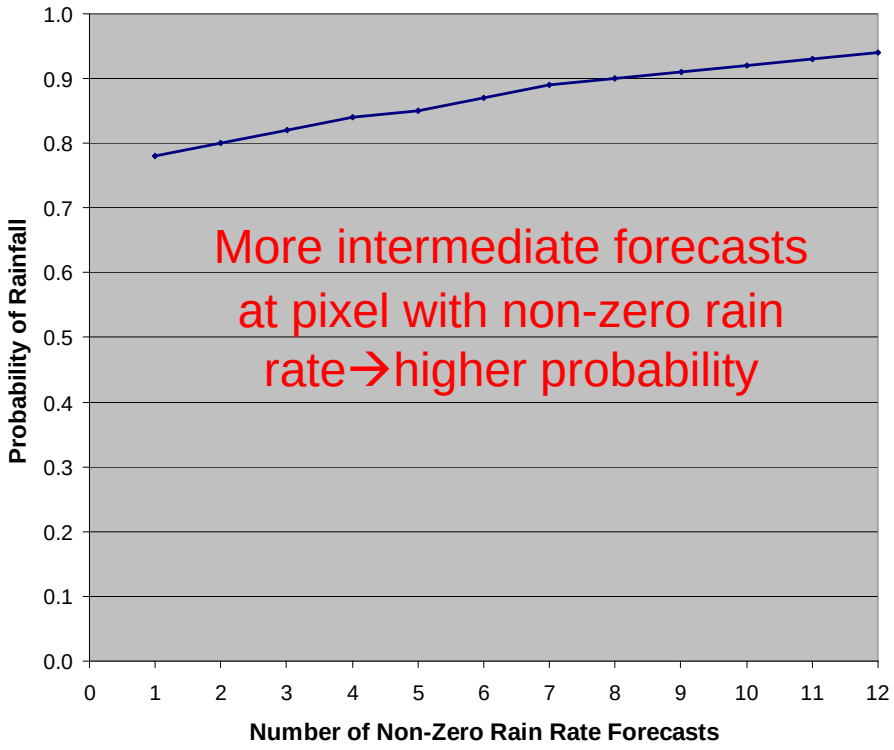
Compute 0-3 h probability for pixels with zero rainfall predicted



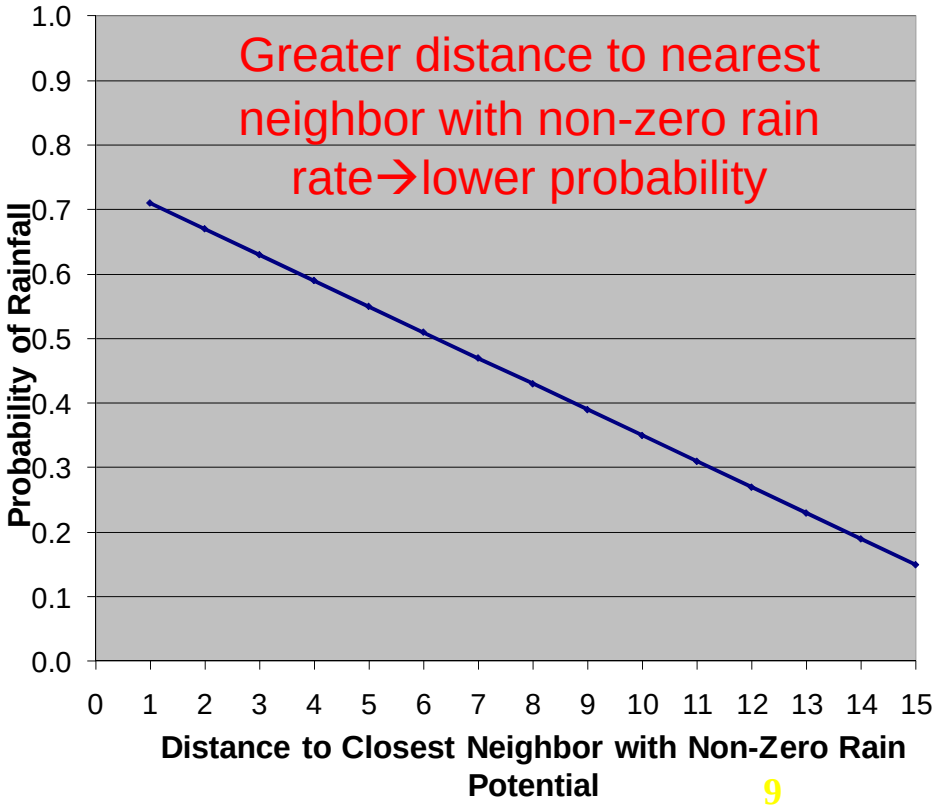
Compute 0-3 h probability for pixels with non-zero rainfall predicted

Algorithm Description

Probability of Rainfall if pixel has one or more intermediate Rainfall Potential forecasts of non-zero rainfall

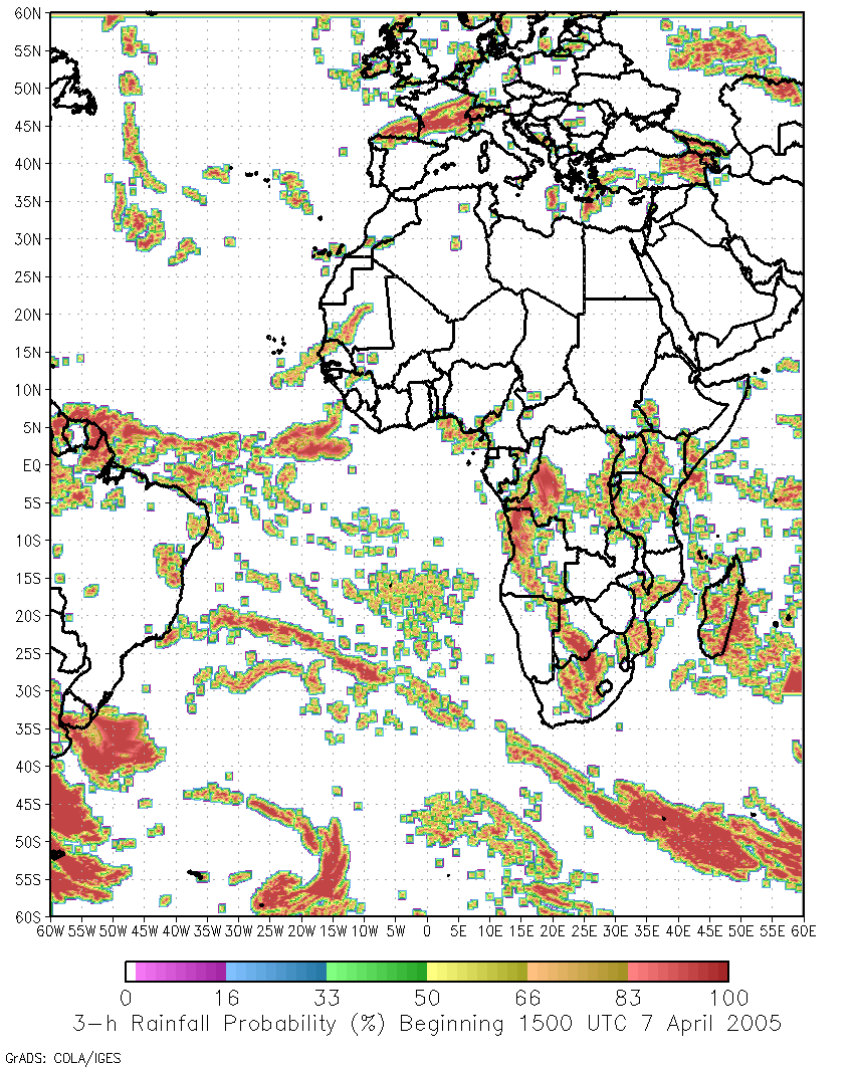


Probability of Rainfall if pixel Rainfall Potential is zero but a neighbor pixel has a non-zero Rainfall Potential



Example Probability of Rainfall Output

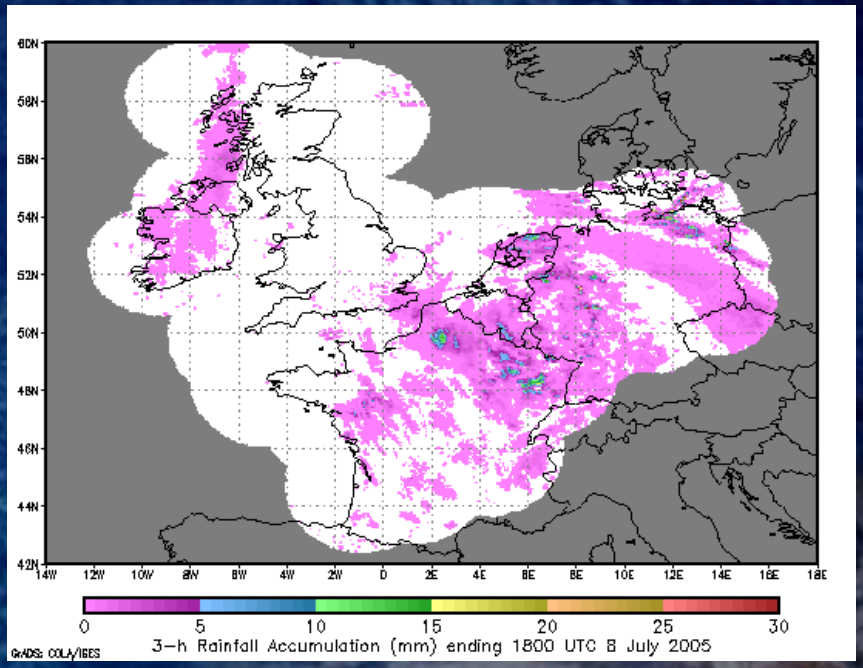
Probability of Rainfall from 1500-1800 UTC 8 July 2005 derived from intermediate output of Rainfall Potential algorithm (which in turn uses SEVIRI-derived Rainfall Rate fields from 1445 and 1500 UTC as input).



Validation Strategy

Validation Strategy

- Since the requirement is for probability over a 3-h period, radar and short-term gauges are the only available source of data for validation against spec
- Ground-based radars:
  - » Nimrod radars in UK and Western Europe—5-km grid composite



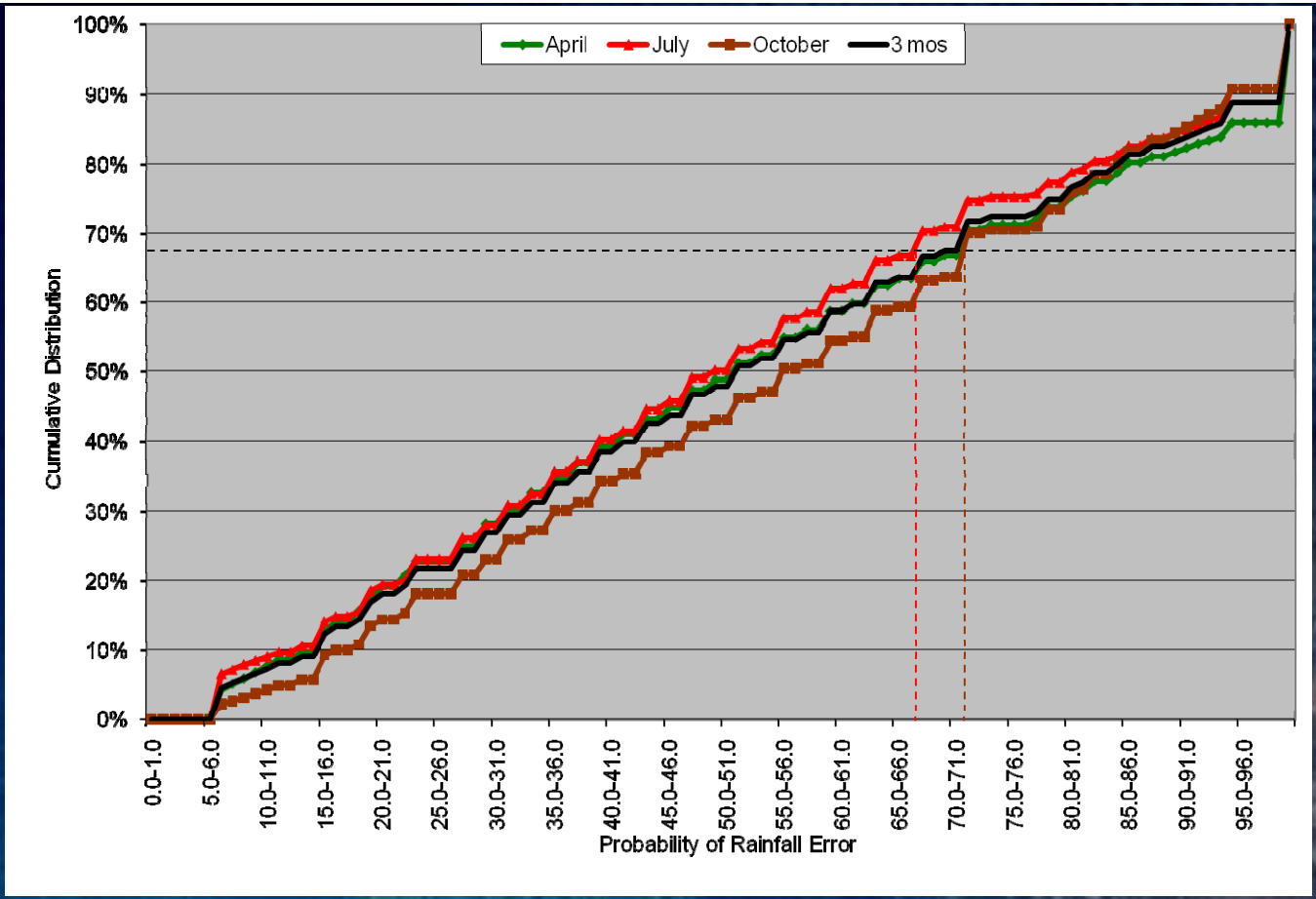
Sample Nimrod 3-h accumulation

Validation Strategy

- Derive probability of rainfall from intermediate Rainfall Potential outputs (in turn derived from rainfall rates retrieved from GOES-R ABI proxy datasets)
  - » Meteosat-8 SEVIRI inputs to rainfall rates: Bands 5 (6.2 µm), 6 (7.3 µm), 7 (8.7 µm), 9 (10.8 µm), and 10 (12.0 µm)
- Collocate (in space and time) derived rainfall potential with ground validation rainfall accumulations
  - » 3-hour observed probability of rainfall (0 or 1) derived from Nimrod radar
- Generate comparative statistics (satellite rainfall accumulation – ground truth rainfall accumulation)
  - » Accuracy
  - » Precision

Validation Results

Rainfall Potential Validation



CDF's of (absolute) errors of Probability of Rainfall vs. Nimrod radar data (Western Europe only) for the 5th-9th of April, July, and October 2005.

Rainfall Potential Validation vs. Spec

Validation versus Nimrod radar data (covering Western Europe only) for 15 days of data: 5th-9th of April, July, and October 2005:

	F&PS		Evaluation vs. Nimrod radar	
%	Accuracy	Precision	Accuracy	Precision
Probability of Rainfall	25	40	25	71

Next Steps to Reach 100%

- Improvements to (input) Rainfall Potential algorithm should enhance skill
- Consider additional predictors:
  - » Rainfall rate (rather than just presence / absence of rainfall)—higher rates should be associated with higher confidence
  - » Lead time with nonzero rainfall in intermediate Rainfall Potential fields (lower lead time should be associated with higher confidence, but all lead times currently weighed equally)

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