Communication of Climate Prediction Products, including Uncertainties

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Thanks to Simon Mason, Lisa Goddard, Andrew Robertson, Elisabeth Gawthrop, Cédric van Meerbeeck and Ernesto Rodríguez

2nd WMO Workshop on Operational Climate Prediction
30 May – 1 June 2018, Barcelona, Spain

Outline

1. Communication and Translation
2. Prediction Skill
3. Uncertainties
4. Predictions in Context, Flexible Format

Communication and Translation

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Two essential steps every time you communicate outside of your immediate scientific circle:

Think about audience!

Their background, skills, wants and needs

Reduce jargon!

Not a definitions problem, but context

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e.g., SKILLFUL

Public meaning: Huh?, talented (as in sports or crafts, as opposed to scientific)

Scientific meaning: Better than a reference set of forecasts

Better choice: Ability to predict [successfully / well]

Communication and Translation

Terms that have different meanings for scientists and the public

Scientific term	Public meaning	Better choice
enhance	improve	intensify, increase
aerosol	spray can	tiny atmospheric particle
positive trend	good trend	upward trend
positive feedback	good response, praise	vicious cycle, self-reinforcing cycle
theory	hunch, speculation	scientific understanding
uncertainty	ignorance	range
error	mistake, wrong, incorrect	difference from exact true number
bias	distortion, political motive	offset from an observation
sign	indication, astrological sign	plus or minus sign
values	ethics, monetary value	numbers, quantity
manipulation	illicit tampering	scientific data processing
scheme	devious plot	systematic plan
anomaly	abnormal occurrence	change from long-term average

Scientists are from Mars, the public is from Earth

By Phil Plait | October 19, 2011 7:00 am

Climate Prediction: Skill

Good forecasts:

- **Reliable** (= well calibrated)
- **Sharp** (= limited uncertainty/very high probabilities)
- **Resolution/discrimination** (differentiate between categories)

Useful forecasts:

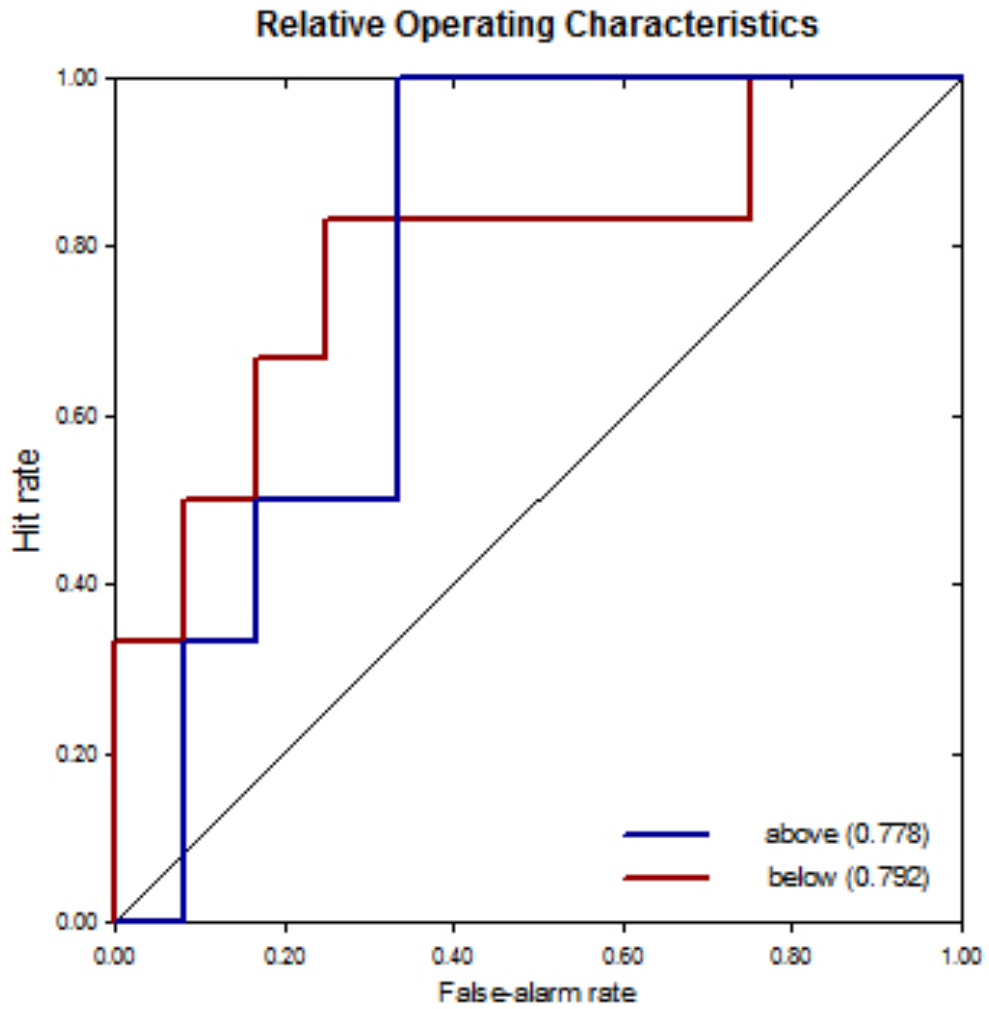
- **Timely**
- **Understandable**
- **Salient** (= relevant)
- **Contextualised** (= previous + usual climatological context and climate impacts)

Manageable operations:

- **Cost-effective**
- **Sustainable**

Courtesy of Cédric van Meerbeeck
See: Mason and Stephenson (2007)

Example of Skill: Discrimination



Muñoz et al (2016)

How well your model discriminates between the forecast categories?

2AFC: probability of successfully identifying warmer / wetter category

ROC: probability of successfully identifying observation in current category

Can your model discriminate?

Outcome:
Two categories

Thanks to Ernesto Rodríguez (AEMET)!

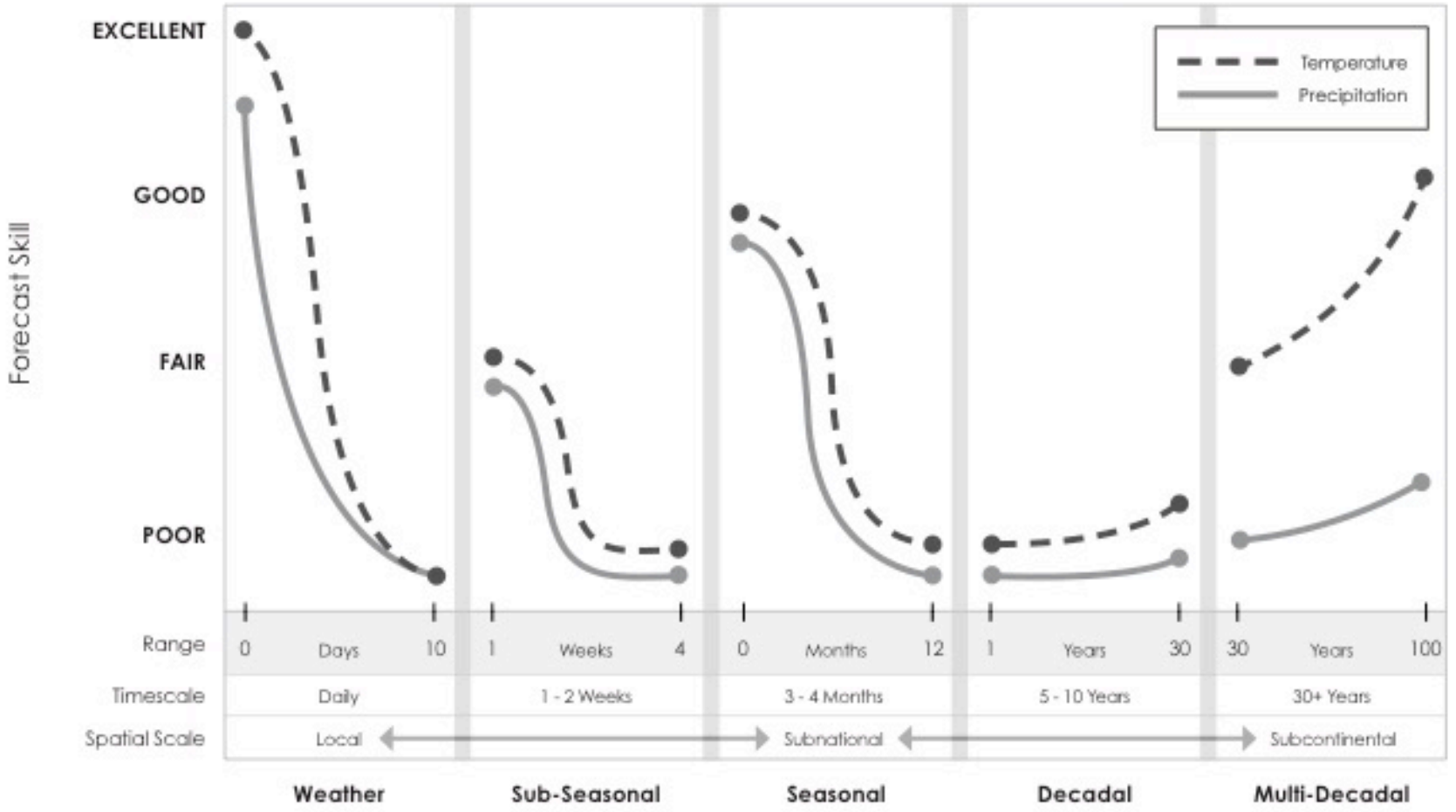
Can your model discriminate?

Three categories?

Thanks to Ernesto Rodríguez (AEMET) and Sean Connery (and Cédric van Meerbeeck!)

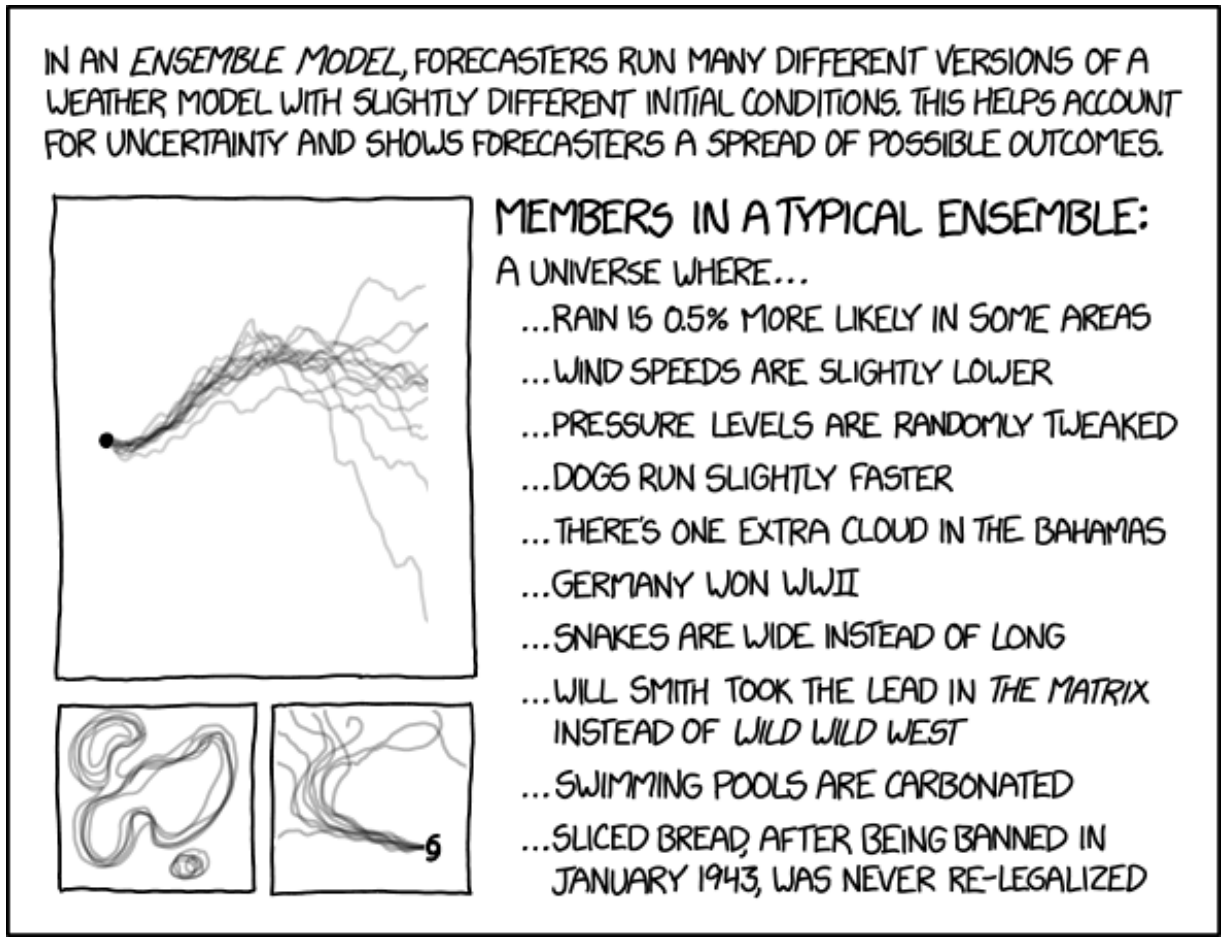
Climate Prediction: Skill

Communicate information on skill for that timescale



Thomson MC, et al. (2018). Chapter 3. Connecting Climate with health outcomes. Thomson MC, S.J. M, eds. Climate Information for Public Health Action. London UK: Routledge.

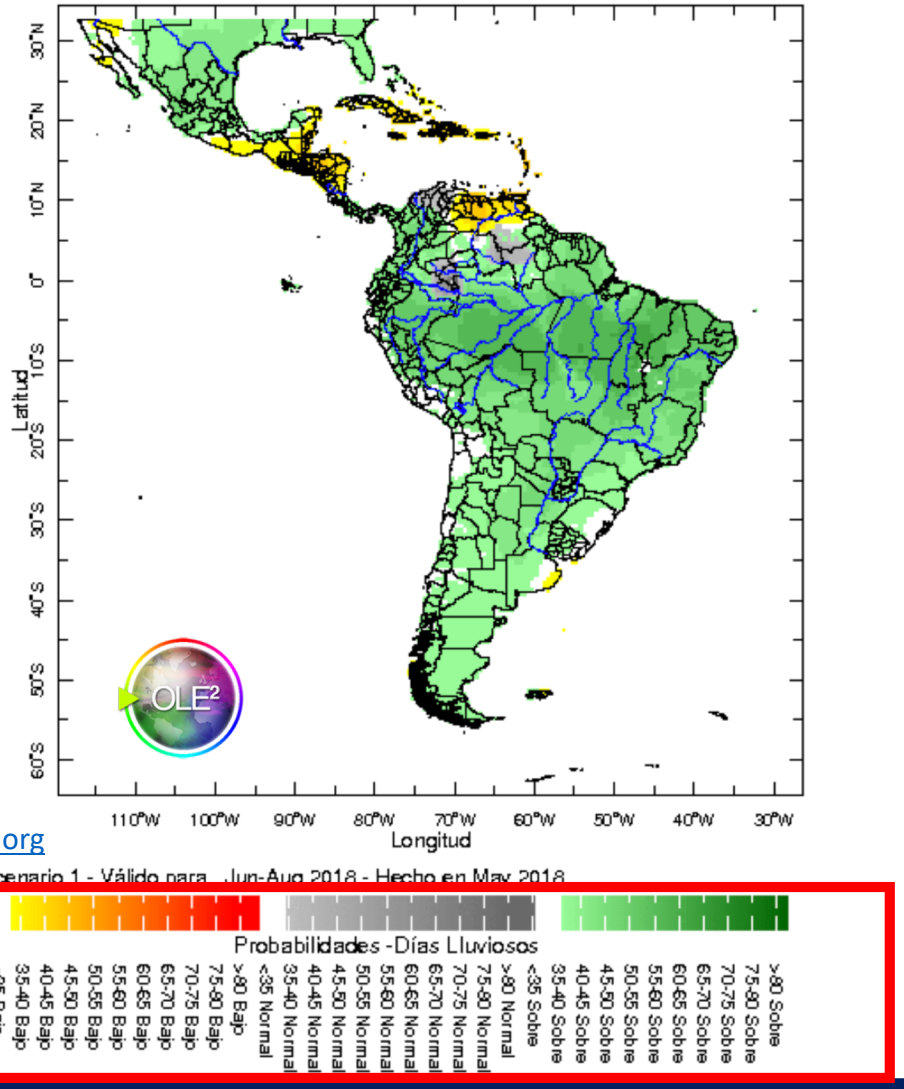
Climate Prediction: Uncertainties



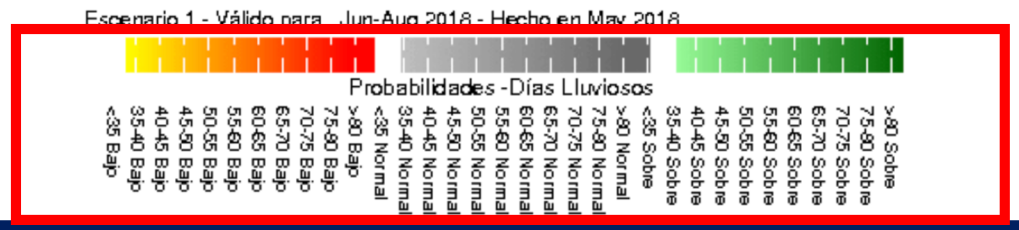
Always provide information on the uncertainties:

Probabilities (or odds!)
Prediction limits

Climate Prediction: Uncertainties



http://datoteca.ole2.org



Always provide information on the uncertainties:

Probabilities

Forecasts

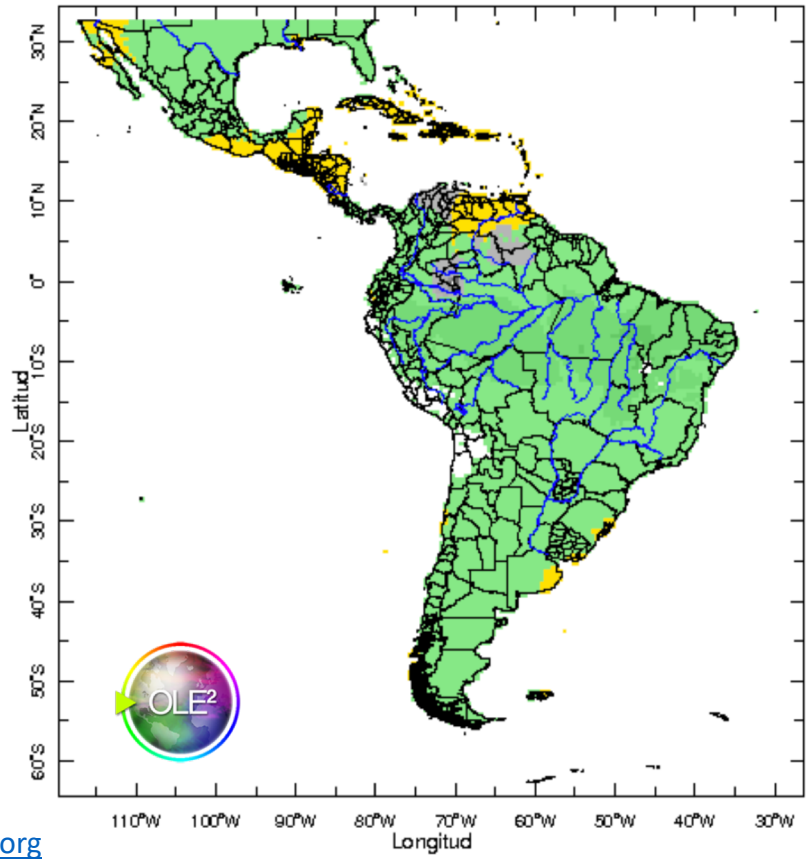
Probabilities:

Year	Probabilities			Odds			Relative Odds		
	B	N	A	B	N	A	B	N	A
2018	64	18	18	1.84	0.21	0.21	3.67	0.43	0.43

Forecast ranges:

Year	Forecast	Lower	Upper
2018	-1515.580	-1827.106	-1204.053

Climate Prediction: Uncertainties



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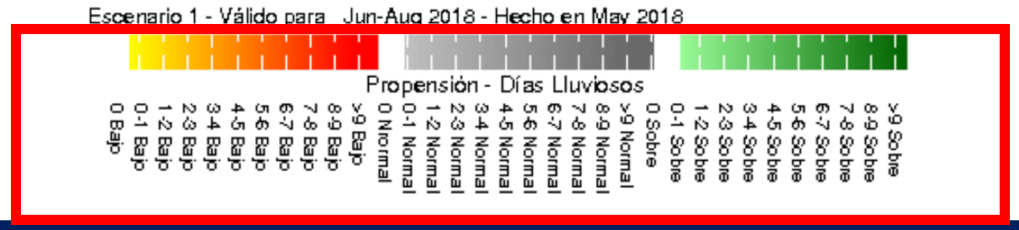

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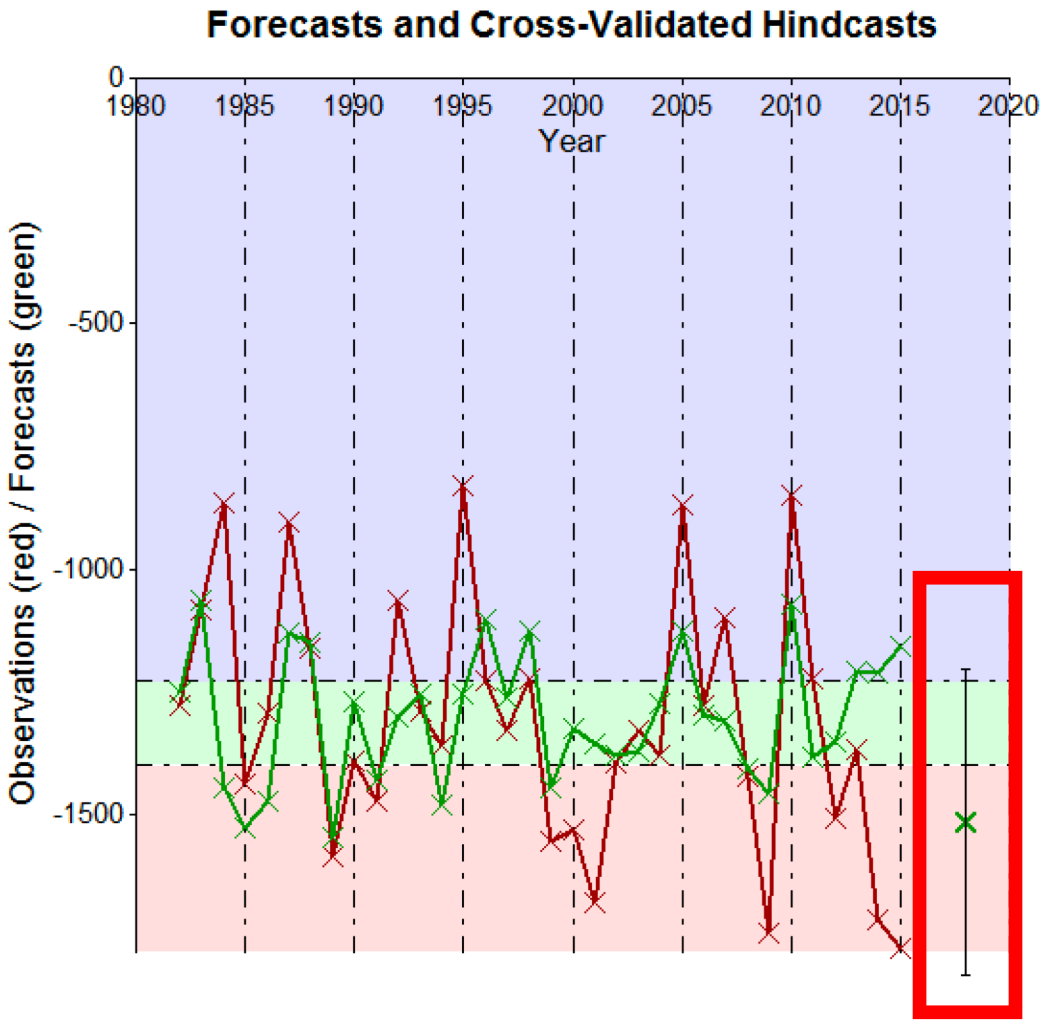

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Climate Prediction in Context

Data Library Maproom | International Federation Forecasts in Context | Region: Global

International Federation of Red Cross and Red Crescent Societies

Six-Day Forecasts | Three-Month Forecasts | Past Conditions | Recent Climate Trends | Vulnerability Indicators

International Federation of Red Cross and Red Crescent Societies: Forecasts in Context

This collection of maps provides information that can be used for humanitarian decision-making around the world, developed by the IRI and the IFRC. It also provides information on the types of early action that can be taken based on these maps.

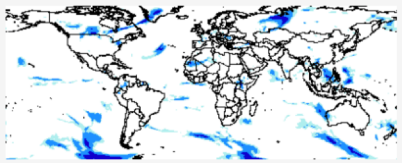
Click the tabs (top right) for links to the following useful maps:

- **Six-Day forecasts:** These maps show where heavy rainfall is expected in the next six days, and how much rainfall is expected.
- **Three-Month Forecasts:** These maps show where large or small amounts of rainfall are expected in the next three months.

Six-Day Forecasts

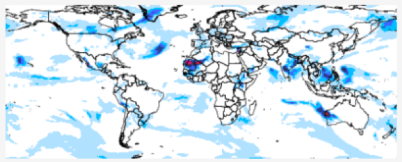
Where is exceptionally heavy rainfall expected?

This map shows places in the world that are forecasted to receive exceptionally heavy rainfall in the next six days relative to what is normal for their location.



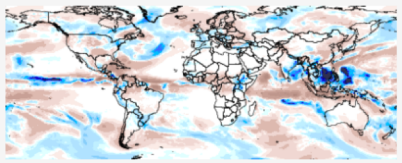
How does expected rainfall compare to normal rainfall for this month?

This map shows places in the world that are forecasted to receive over the next six days a large percentage of the rainfall that normally falls over this entire month in their location.



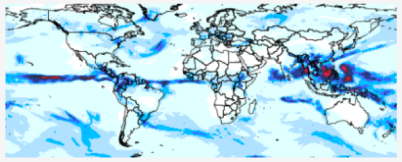
Where is it expected to be wetter than average?

This map shows where the total rain/snow over the next six days is expected to be more or less than what is average for this time of year.



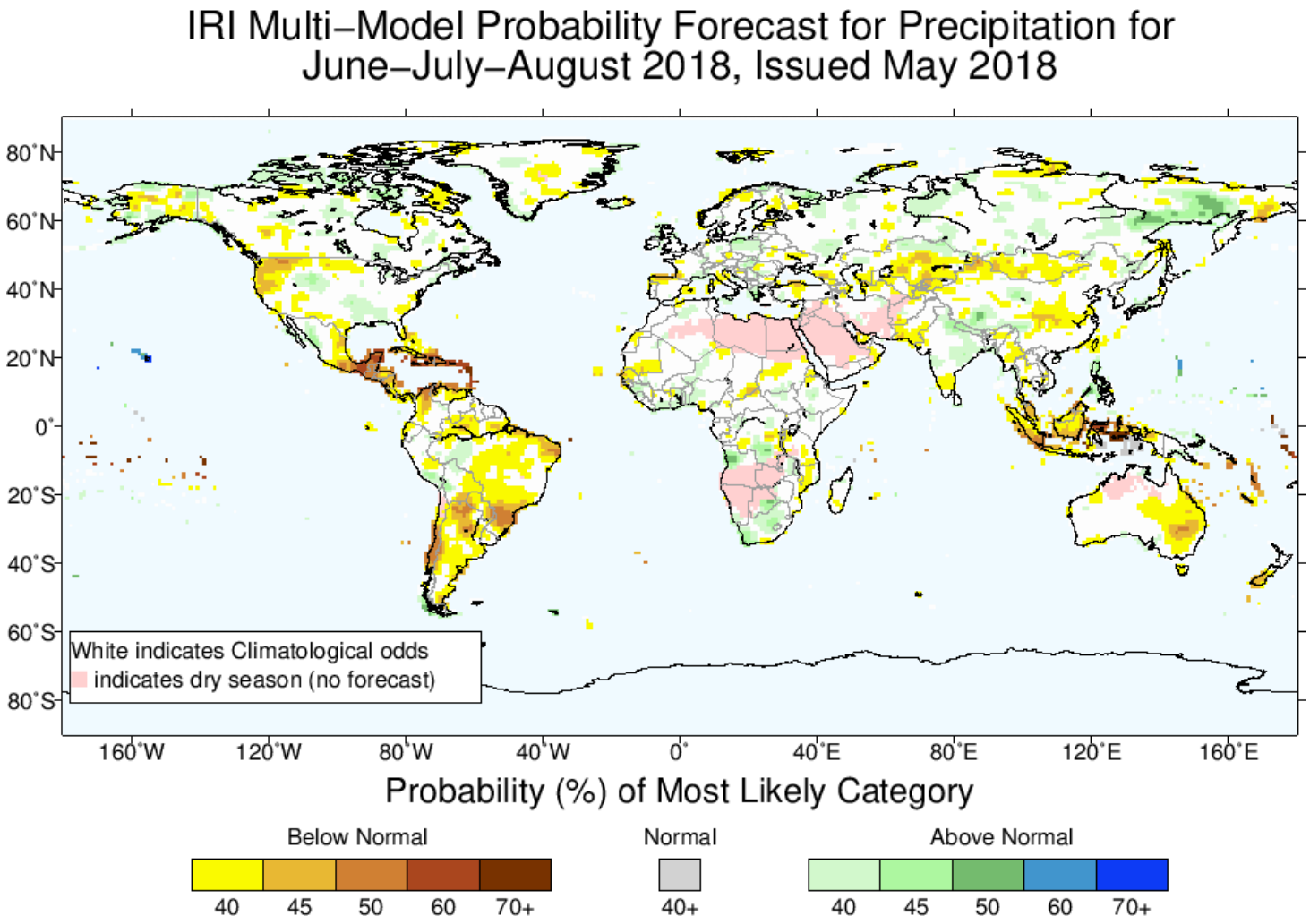
How much rain is expected?

This map shows the total amount of rain or snow (in mm) that is expected to fall in the next 6 days.



http://iridl.ldeo.columbia.edu/maproom/IFRC/index.html

Climate Prediction in Context



Climate Predictions in Flexible Format

Climate Forecasts | Flexible Forecasts: Precipitation Flexible Seasonal Forecast | Region: Global | Target Time: Jun-Aug 2018 | Probability: exceeding Percentile 80.0 %-ile

Description | Dataset Documentation | Instructions | Contact Us

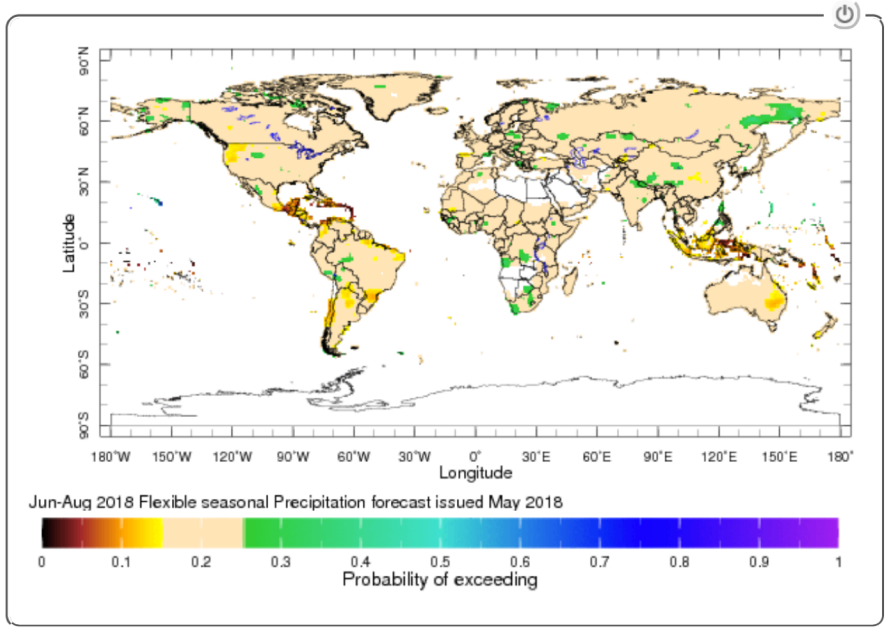
Precipitation Flexible Seasonal Forecast

This seasonal forecasting system consists of probabilistic precipitation seasonal forecasts based on the full estimate of the probability distribution.

Please refer to our licensing agreement for permission to use any IRI forecast material.

Probabilistic seasonal forecasts from multi-model ensembles through the use of *statistical recalibration*, based on the historical performance of those models, provide reliable information to a wide range of climate risk and decision making communities, as well as the forecast community. The flexibility of the full probability distributions allows to deliver interactive maps and point-wise distributions that become relevant to user-determined needs.

The default map shows globally the seasonal precipitation forecast probability (colors between 0 and 1) of exceeding the 50th percentile of the distribution from historical 1982-2010 climatology. The forecast shown is the latest forecast made (e.g. Dec 2017) for the next season to come (e.g. Jan-Mar 2018). Four different seasons are forecasted and it is also possible to consult forecasts made previously. The forecasts are directly computed from the extended logistic regression model as probabilities of exceeding (or non-exceeding) of every 5th percentile of the climatological distribution. The specific quantile (in steps of 5 percentile points) can then be selected. The user can also specify a quantitative value in physical units (here seasonal total precipitation in mm) for probability of exceeding or non-exceeding. The final probability maps are smoothed spatially with a 9×9 point Gaussian smoother.



Clicking on a point on the map will show the local probability of exceeding and probability distribution of the forecast (green) together with the climatological distribution (black).

The distribution of seasonal rainfall may often rightfully be approximated by a normal distribution, especially when considering only years when it actually rained. But there can be a significant number of years in the sample when rainfall is 0. This translates in situations where the probability of rainfall to be just above 0 is less than 100%, which are represented in by the vertical lines at 0mm in the distributions graphs.

Colors Scales

Color scales are colors indicating that the distribution of the forecast tends towards drier (shades of brown) or wetter (shades of blue) conditions than normal (moccasin).

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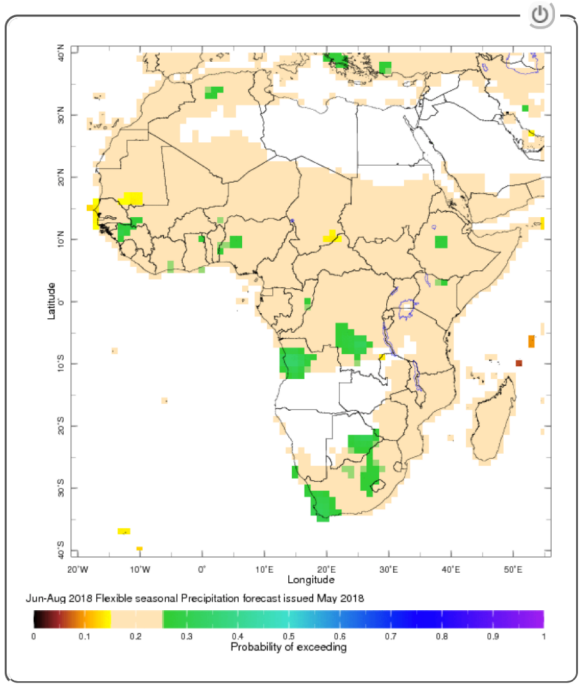

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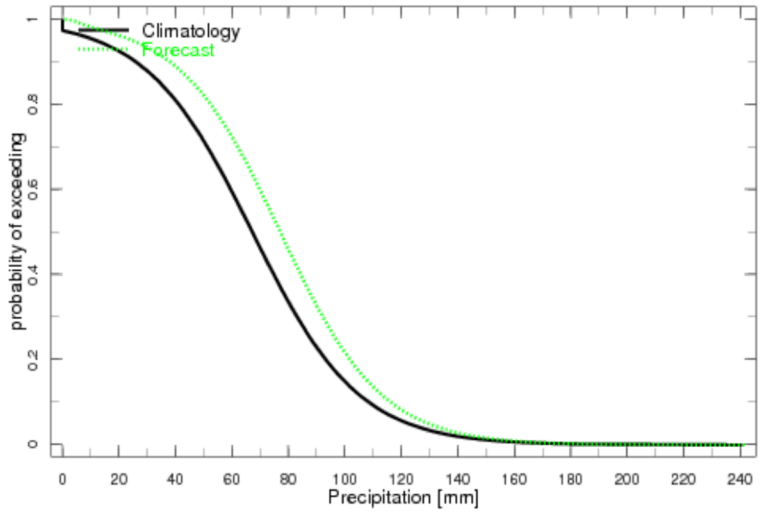
Target Date	Issue Date	Lead Time
Jun-Aug 2018 0000 1 May 2018		2.5

Forecast made for **[20E-21E, 33S-32S]**
located in or near **Namakwa District Municipality, Northern Cape, South Africa**

Probability of Exceeding



Jun-Aug 2018 Flexible seasonal Precipitation forecast issued May 2018

http://iridl.ldeo.columbia.edu/maproom/Global/Forecasts/index.html

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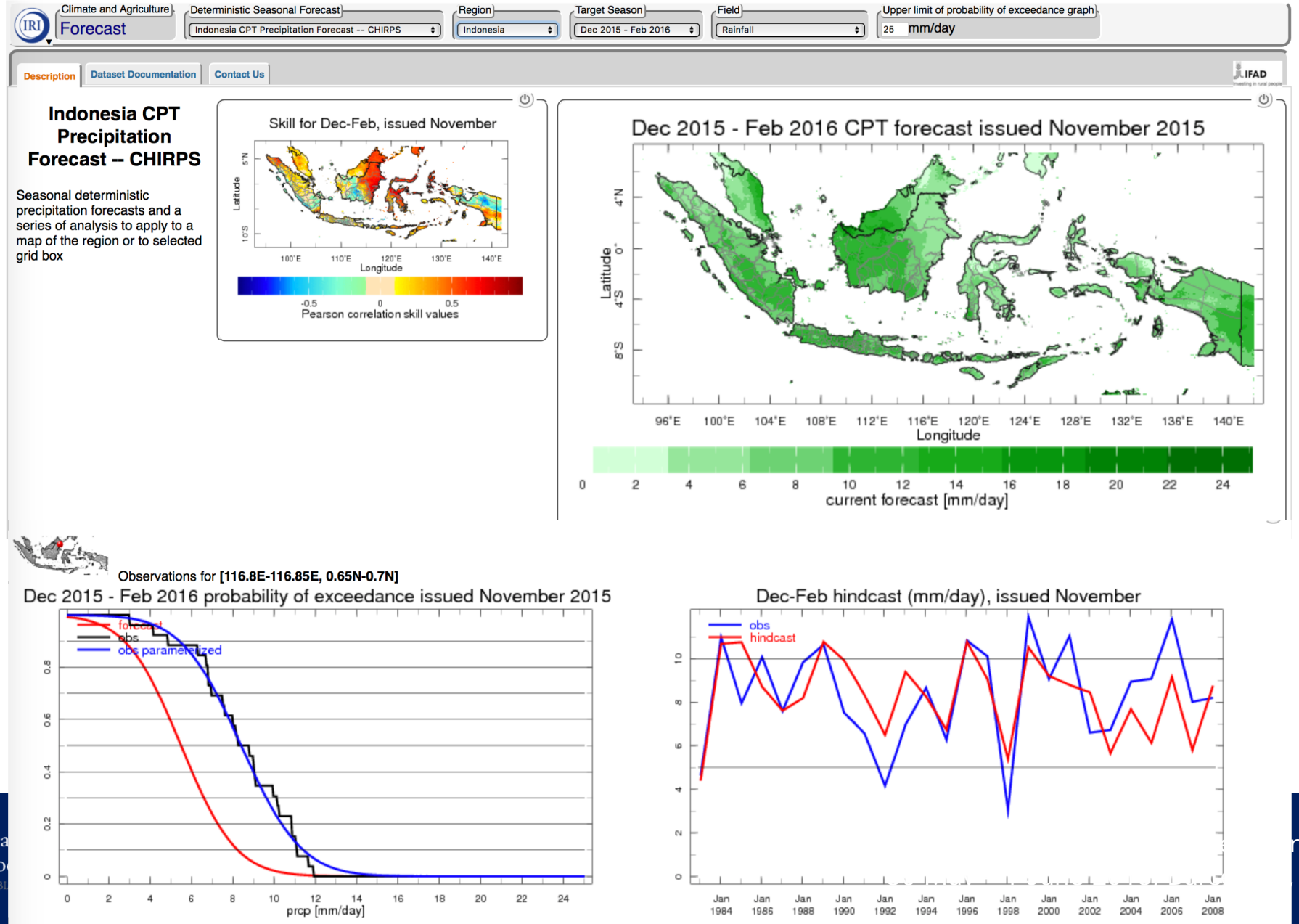

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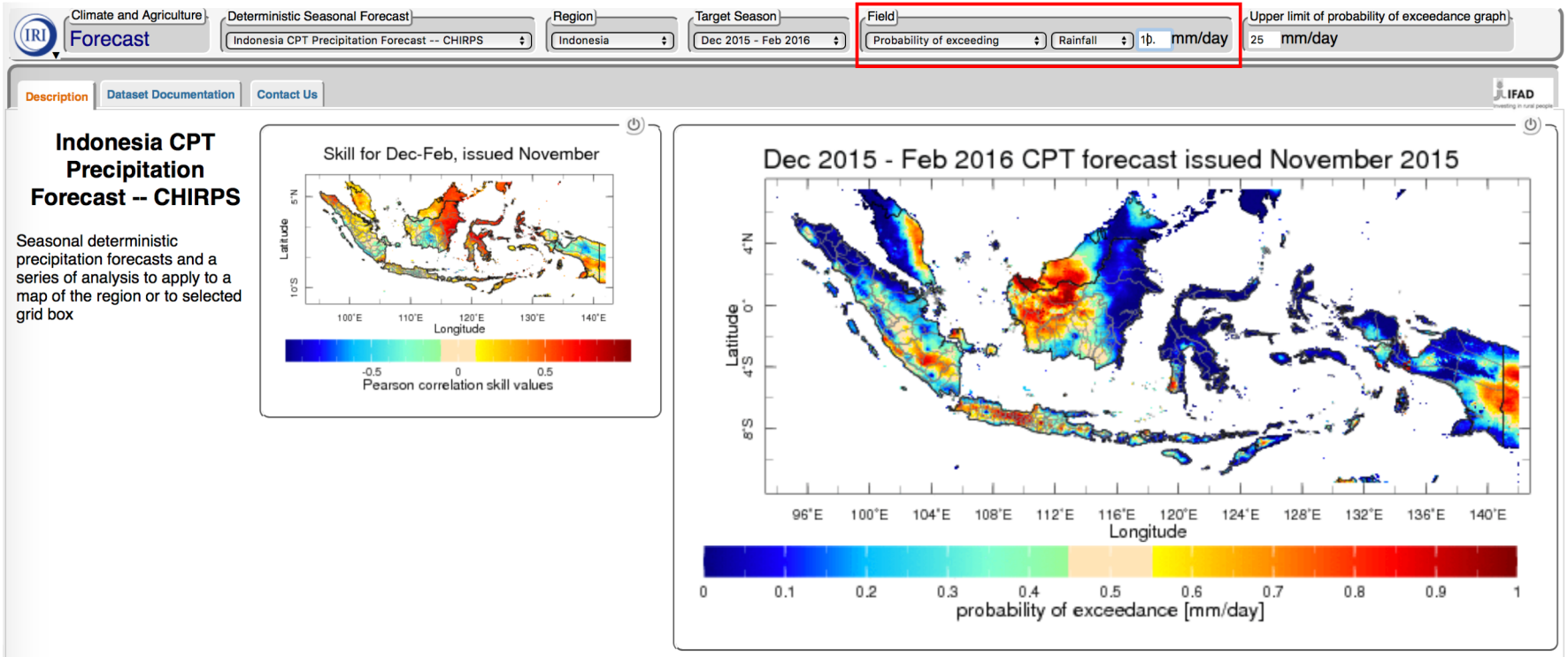

Conclusions

- Communication is translation
- No prediction should be provided without information on the associated skill
- ***Always*** use a measure of uncertainty: probabilities (or odds), prediction limits
- Contextualize the forecasts: same product means different things for different people
- Tailored climate information: use the entire probability density function! Example: IRI flexible format (where skill is good enough)

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