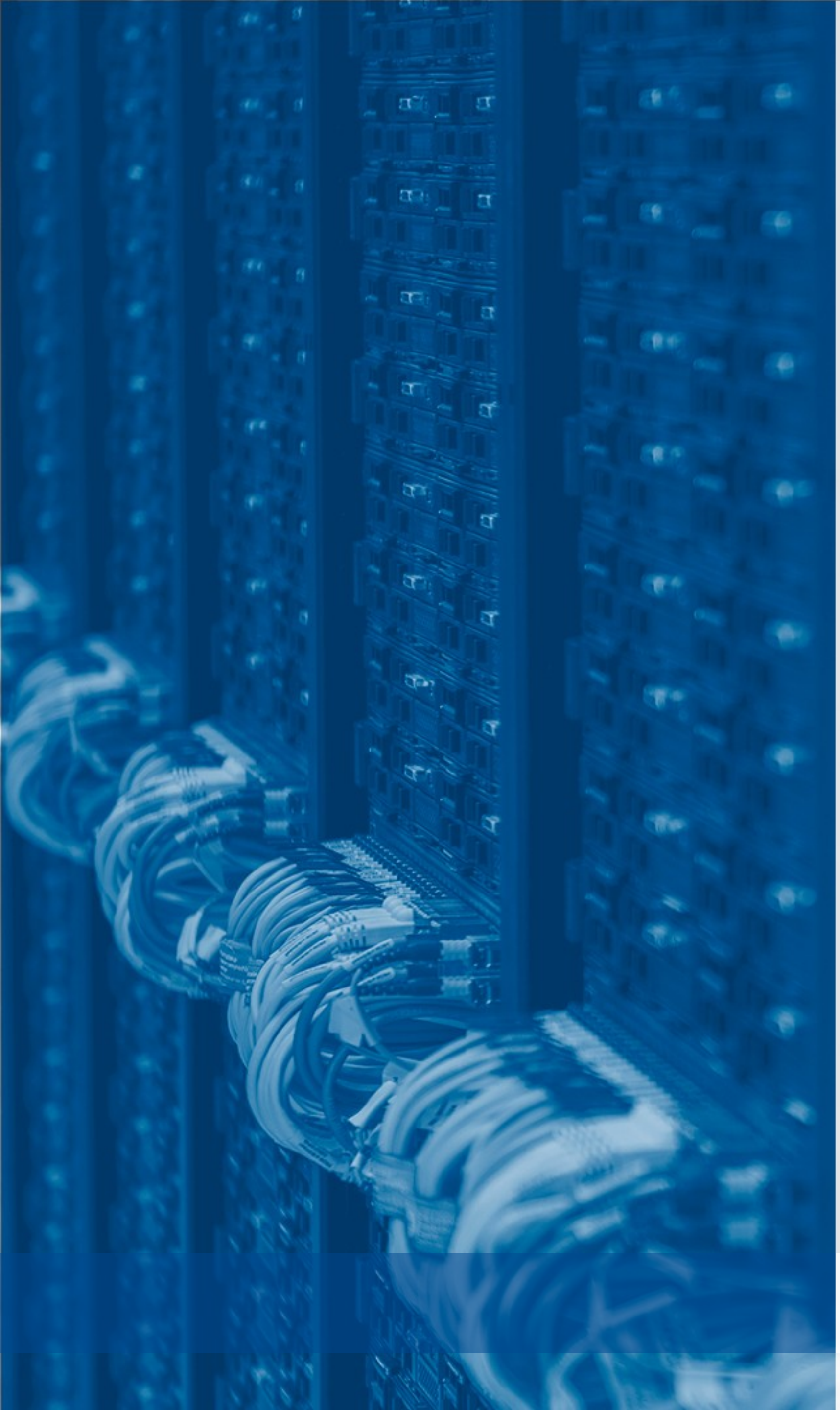


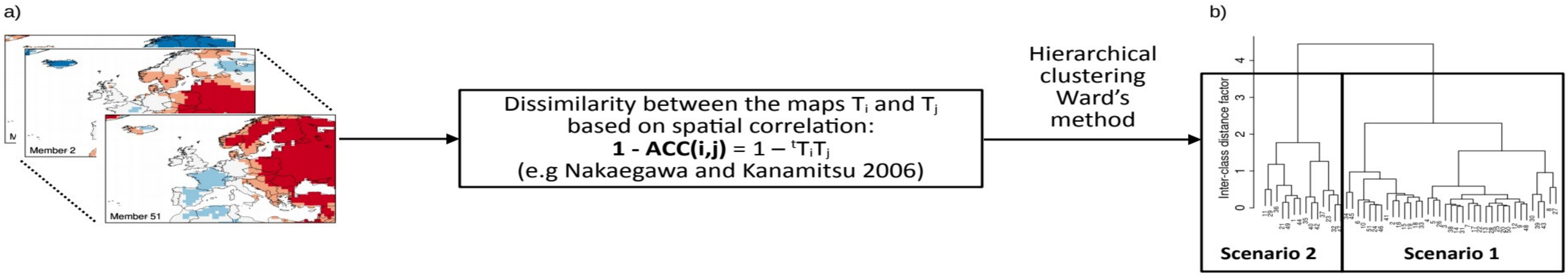
Information for Decision-Makers (I4D) Updates

Lauriane Batté (Météo France)
Ángel G. Muñoz (BSC)

Use and interpretation of seasonal prediction ensembles

Aim: provide additional guidance in preparation of the operational forecast bulletin on possible outcomes of the upcoming season.

Method: hierarchical clustering of **T2m anomalies** based on dissimilarity between spatial maps of ensemble members

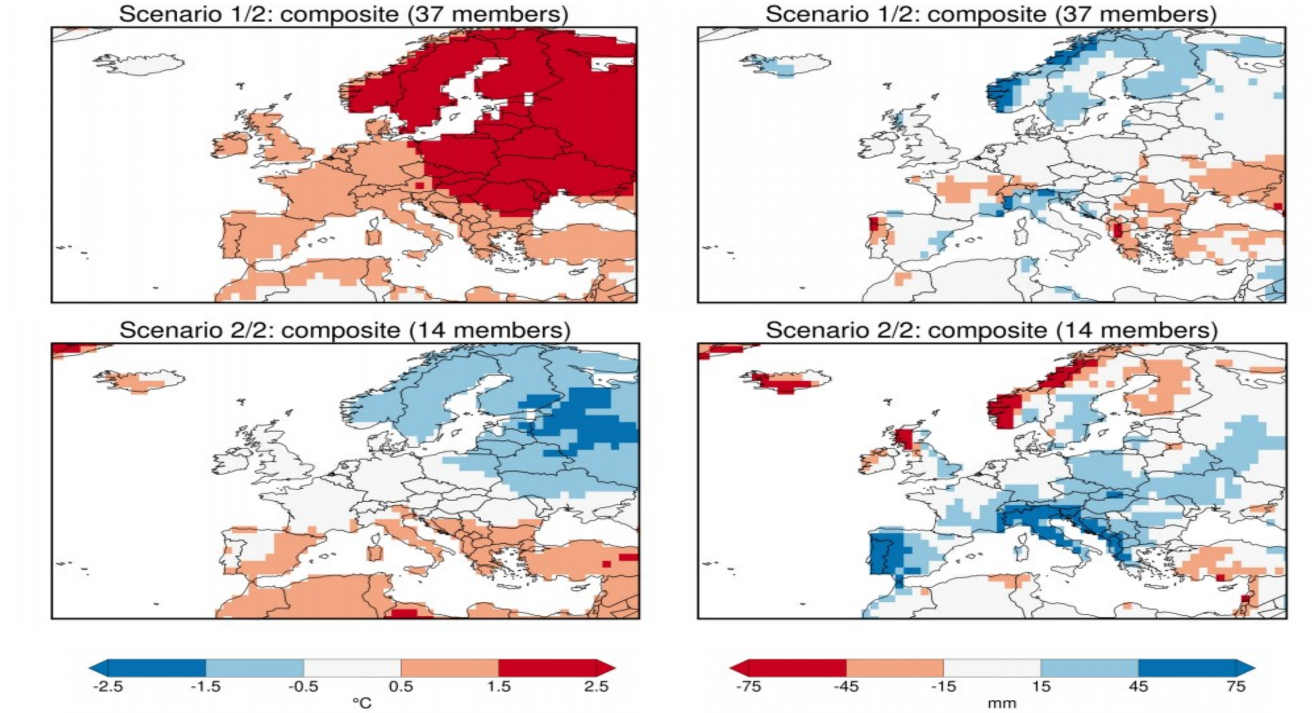


(contact: Damien Specq, CNRM)

Climate Change Service
climate.copernicus.eu

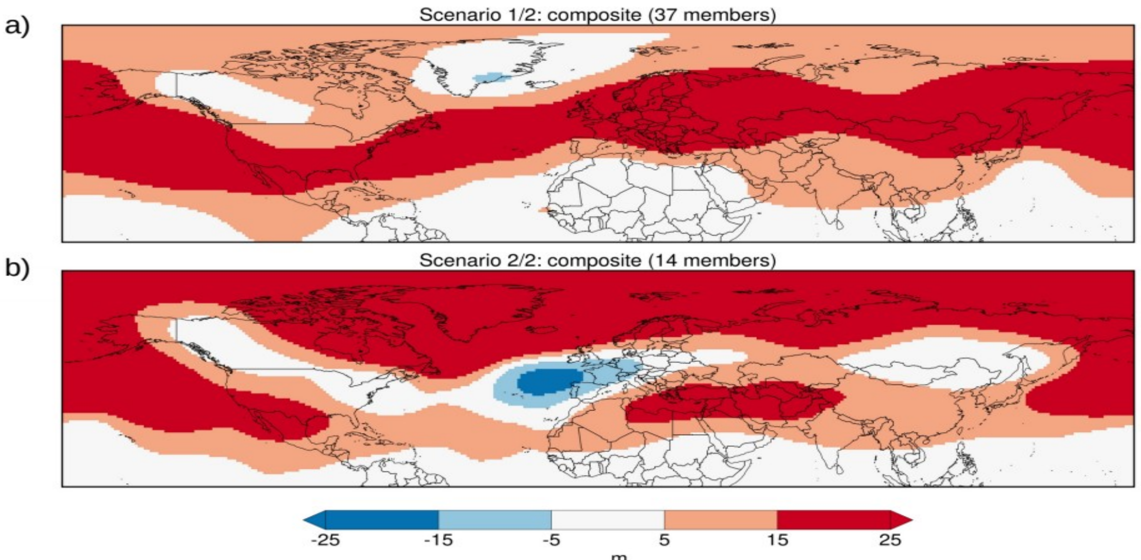
Use and interpretation of seasonal prediction ensembles

lustration: January start for FMA forecast with MF System 8: 2 scenarios (37 members, 14 members)



Composites for temperature (left) and precipitation (right) anomalies of 2 scenarios derived from clustering of the MF System 8 ensemble forecast for FMA (Jan. init)

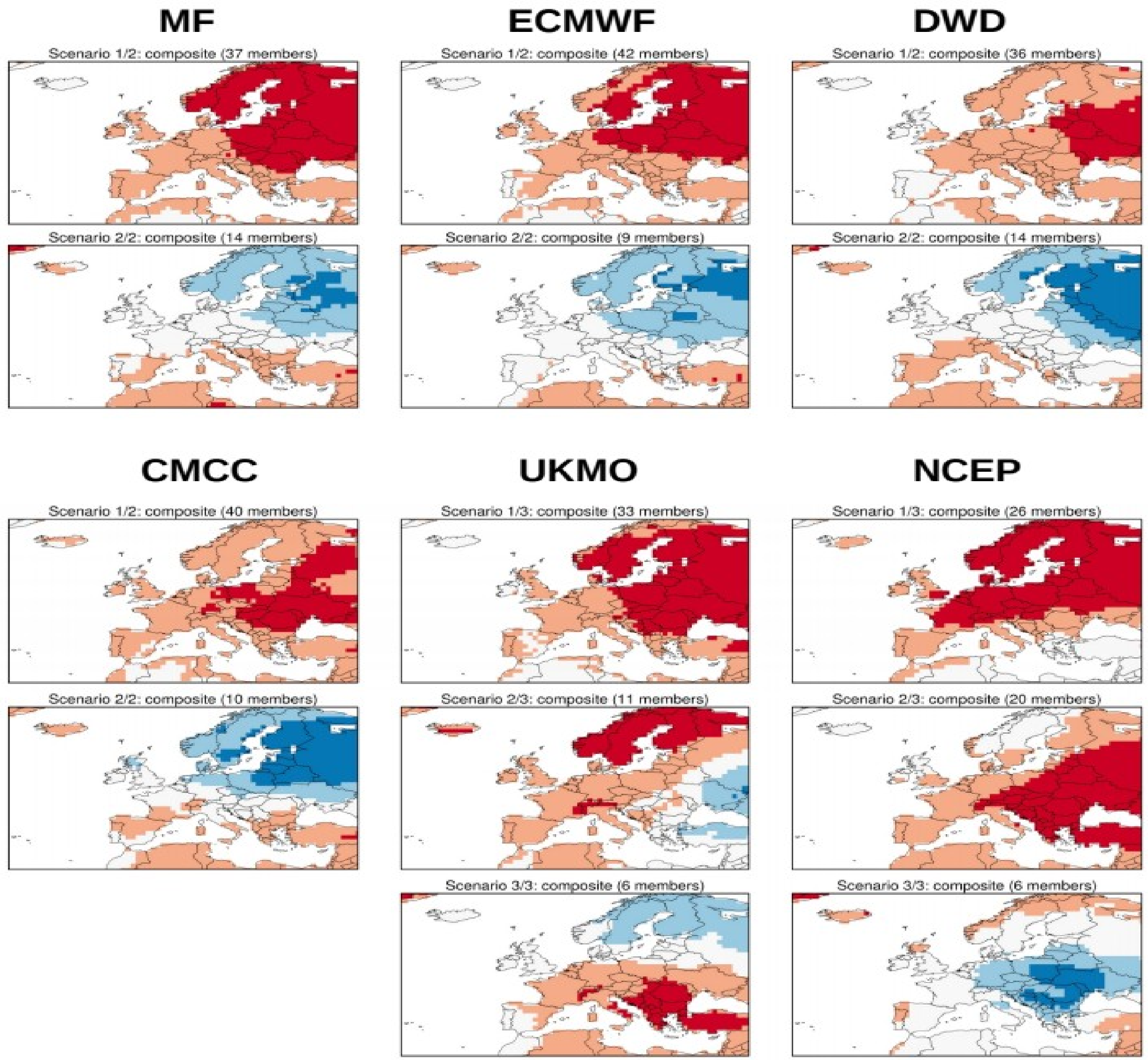
Corresponding circulation patterns for each scenario



Climate Change Service

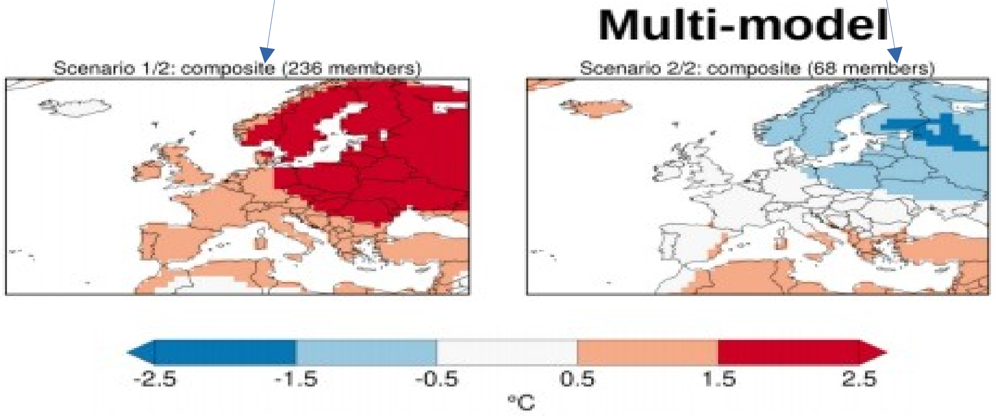
climate.copernicus.eu

Use and interpretation of seasonal prediction ensembles



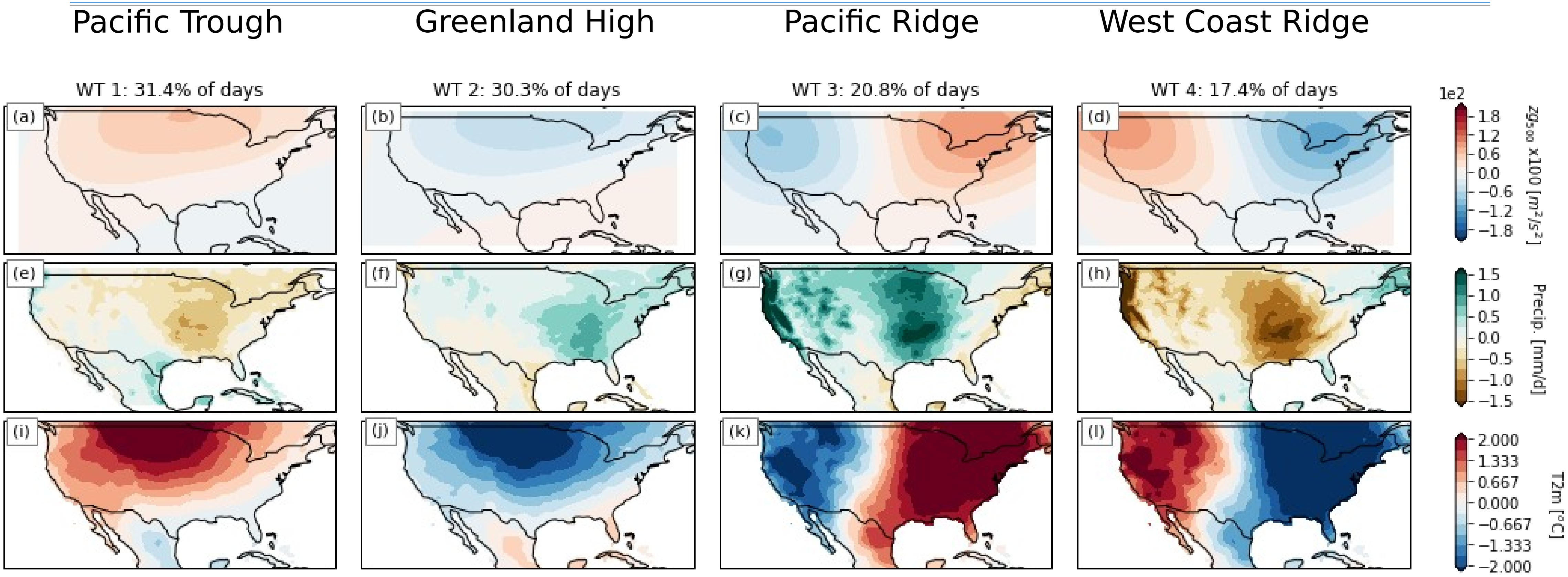
77 % of members belong to this cluster

23 % have a cooler signal over most of Europe → « Minority Report »?



Extending the approach to a multi-system framework using the C3S seasonal predictions

Flow-dependent cross-timescale scenarios

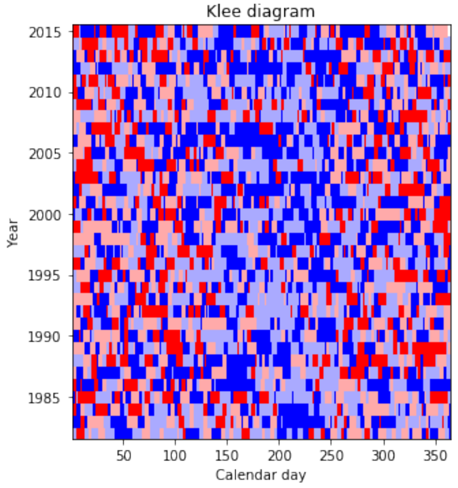


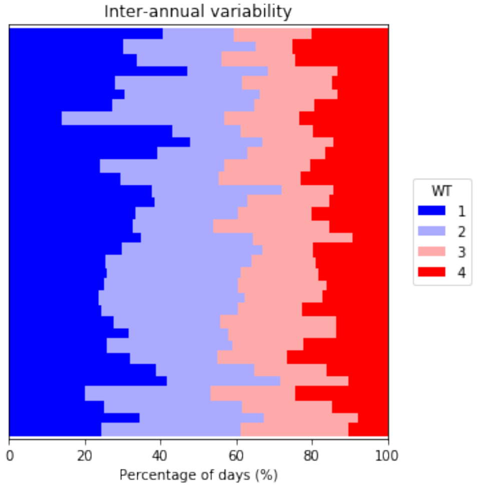
Muñoz et al (in prep)

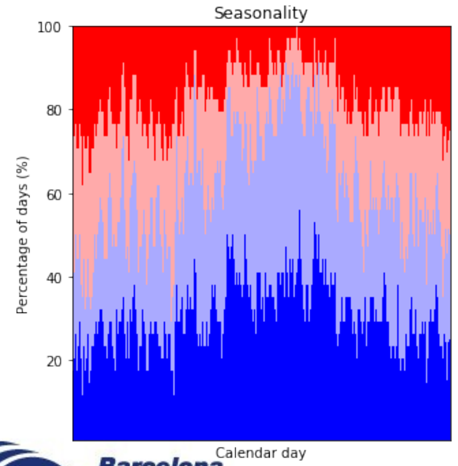
See more about this system here:
https://iri.columbia.edu/s2s-water-workshop-2022/#agenda

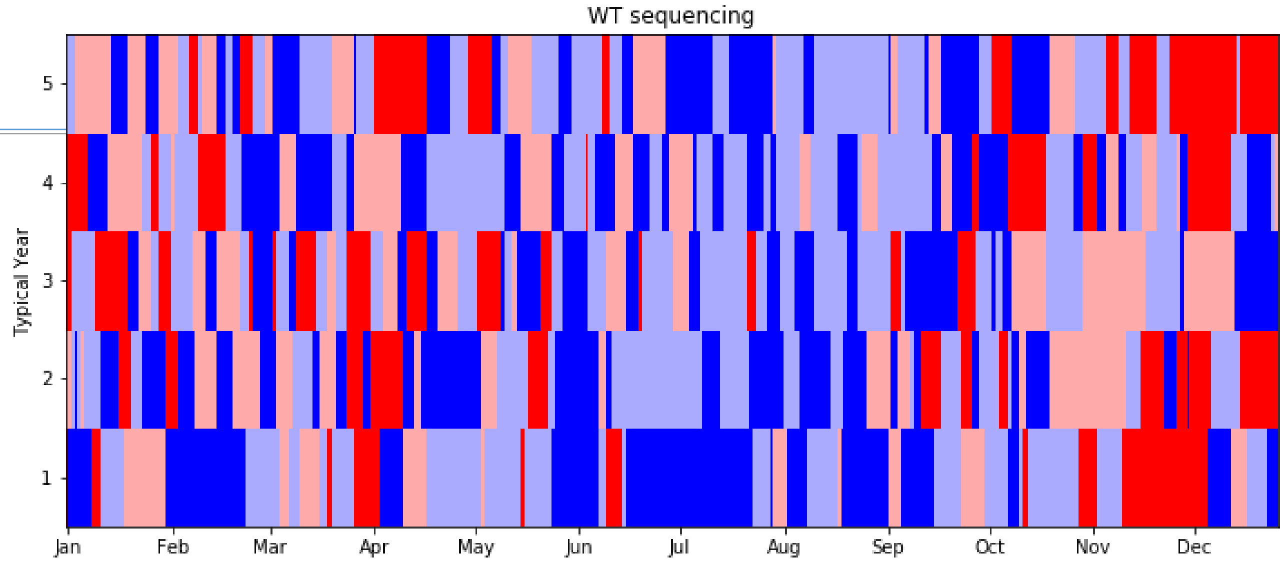
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Flow-dependent cross-timescale scenarios









Cross-validation (3-yr window)

Predictor: frequency of WTs
Predictand: flow-dependent states

TABLE 3. Cross-validated forecasted probabilities (in %) for each scenario, and observed category. Results are shown for the best-guess multinomial logistic model. Probabilities have been rounded to the closest integer.

Year	I	II	III	IV	V	Observed	Hit(1)/Miss(0)
1981	36	64	0	0	1	I	0
1982	68	17	1	7	7	I	1
1983	0	0	1	0	99	V	1
1984	43	48	3	0	7	I	0
1985	0	0	0	100	0	IV	1
1986	13	2	24	0	61	I	0
1987	95	4	0	0	1	I	1
1988	82	10	2	6	0	I	1
1989	49	49	1	0	1	II	1
1990	61	38	0	0	0	I	1
1991	27	0	21	0	52	III	0
1992	8	0	0	0	92	V	1
1993	65	14	1	0	20	II	0
1994	60	17	12	0	11	III	0
1995	72	5	8	0	15	I	1
1996	88	5	1	0	5	III	0
1997	54	44	1	0	1	II	0
1998	0	0	41	0	59	V	1
1999	1	0	42	0	56	III	0
2000	81	12	3	0	4	II	0
2001	0	0	0	100	0	IV	1
2002	10	2	30	0	57	III	0
2003	82	2	3	13	0	IV	0
2004	93	1	3	0	3	I	1
2005	81	6	4	0	9	V	0
2006	1	0	43	0	56	III	0
2007	0	0	0	100	0	IV	1
2008	5	0	58	0	37	V	0
2009	6	8	0	86	0	IV	1

Skill metrics:
Kendall's $\tau = 0.371^*$
HSS = 0.353

* statistically significant value at $p<0.05$

Muñoz et al (in prep)

See more about this system here:
https://iri.columbia.edu/s2s-water-workshop-2022/#agenda

Infant Acute Undernutrition

GOBIERNO de GUATEMALA
DR. ALEJANDRO GIAMMATTEI
SECRETARÍA DE SEGURIDAD ALIMENTARIA Y NUTRICIONAL DE LA PRESIDENCIA DE LA REPÚBLICA

Columbia World Projects

Monitoreo

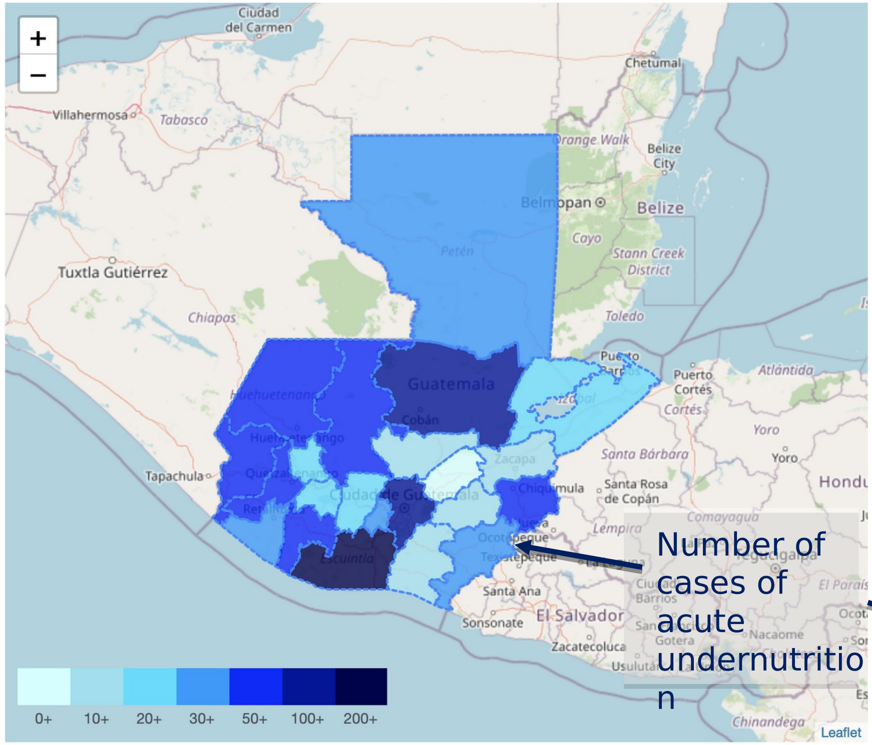
Modelo NextGen de Pronóstico de Desnutrición Aguda

El Instituto Internacional de Investigación para el Clima y la Sociedad (IRI por sus siglas en inglés), a través del proyecto ACToday, ha trabajando con distintas instituciones en Guatemala para apoyar al país en alcanzar el Objetivo de Desarrollo Sostenible número 2. Junto con la Secretaría de Seguridad Alimentaria y Nutrición de Guatemala (SESAN), ambas instituciones han trabajado conjuntamente para desarrollar una herramienta que permita obtener de forma automatizada, un pronóstico probabilístico del número del número de casos de desnutrición aguda infantil en función de una combinación de pronósticos de precipitación a escala estacional (próximos 3-6 meses) y sub-estacional (1 a 6 semanas). Este modelo probabilístico, se nutre de un nuevo sistema de generación de pronósticos (NextGen) desarrollado por el IRI.

Más sobre NextGen

Desnutrición Aguda en Niños Menores a 5 años

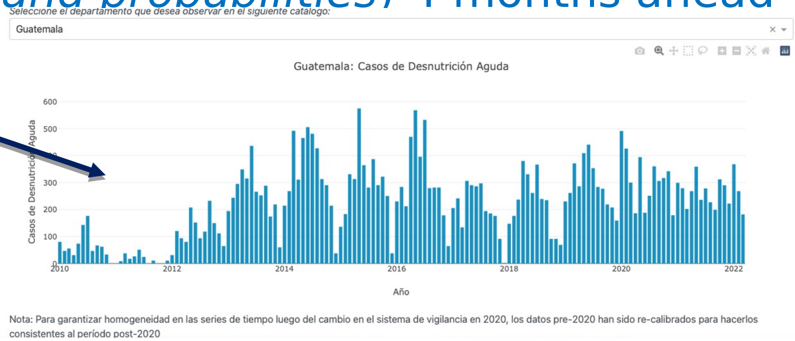
Histórico nacional de casos reportados por MSPAS



* The NextGenNut system was *co-developed* with the **Secretariat for Food Security and Nutrition of Guatemala (SESAN)**

* Predictions based on climate and *socio-economic* patterns

* It allows for visualization of historical cases per department, and monthly predictions (*values and probabilities*) 4 months ahead



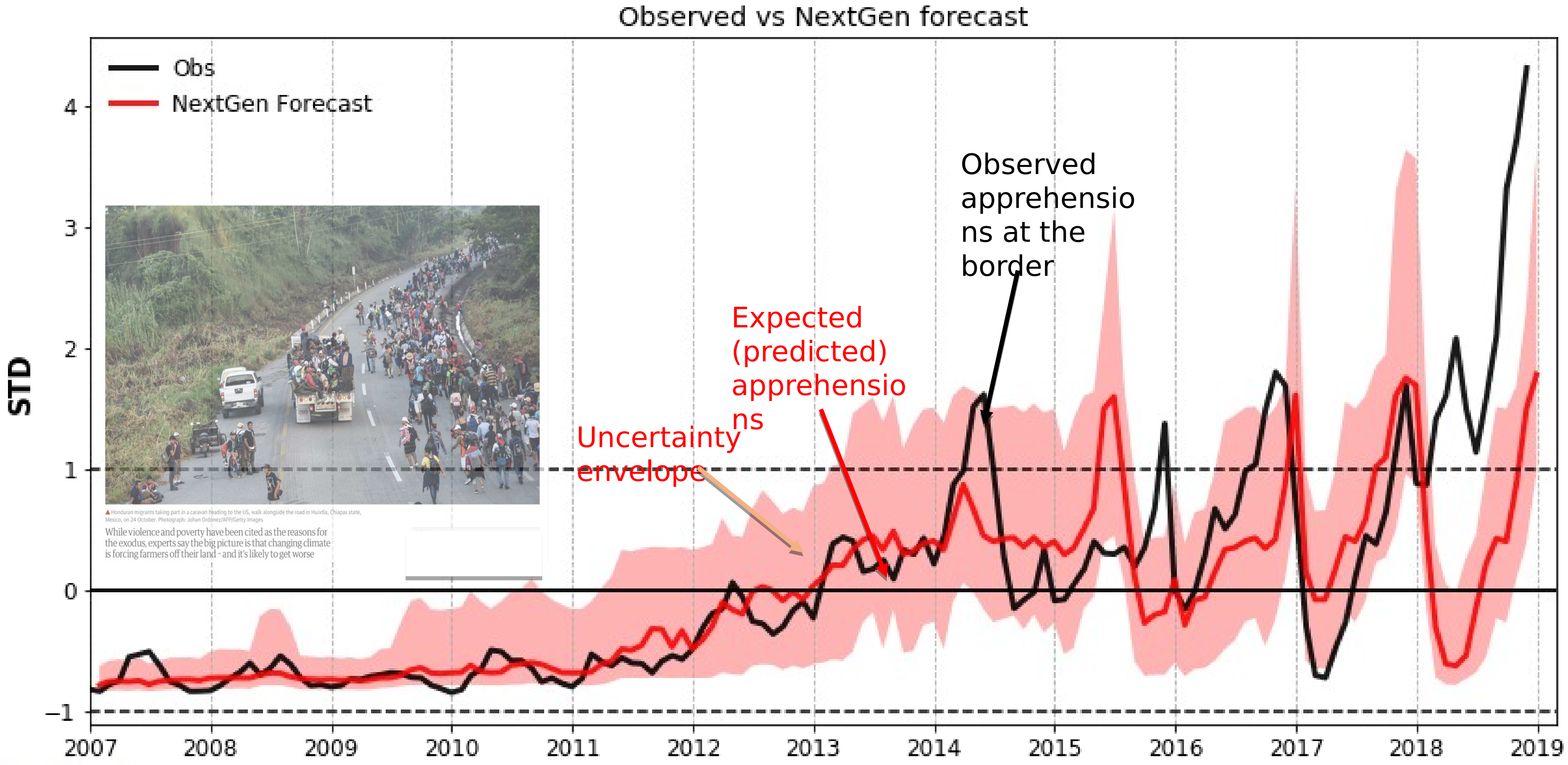
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

See more about this system here: https://sesan.iri.columbia.edu

González Romero et al., (2020, and in prep), White et al. (2022)

Human migration

Human *migration* from Guatemala to the southern border of the US



* NextGenMig: based on climate and *socio-economic* patterns

* *Number* of migrants (apprehensions)

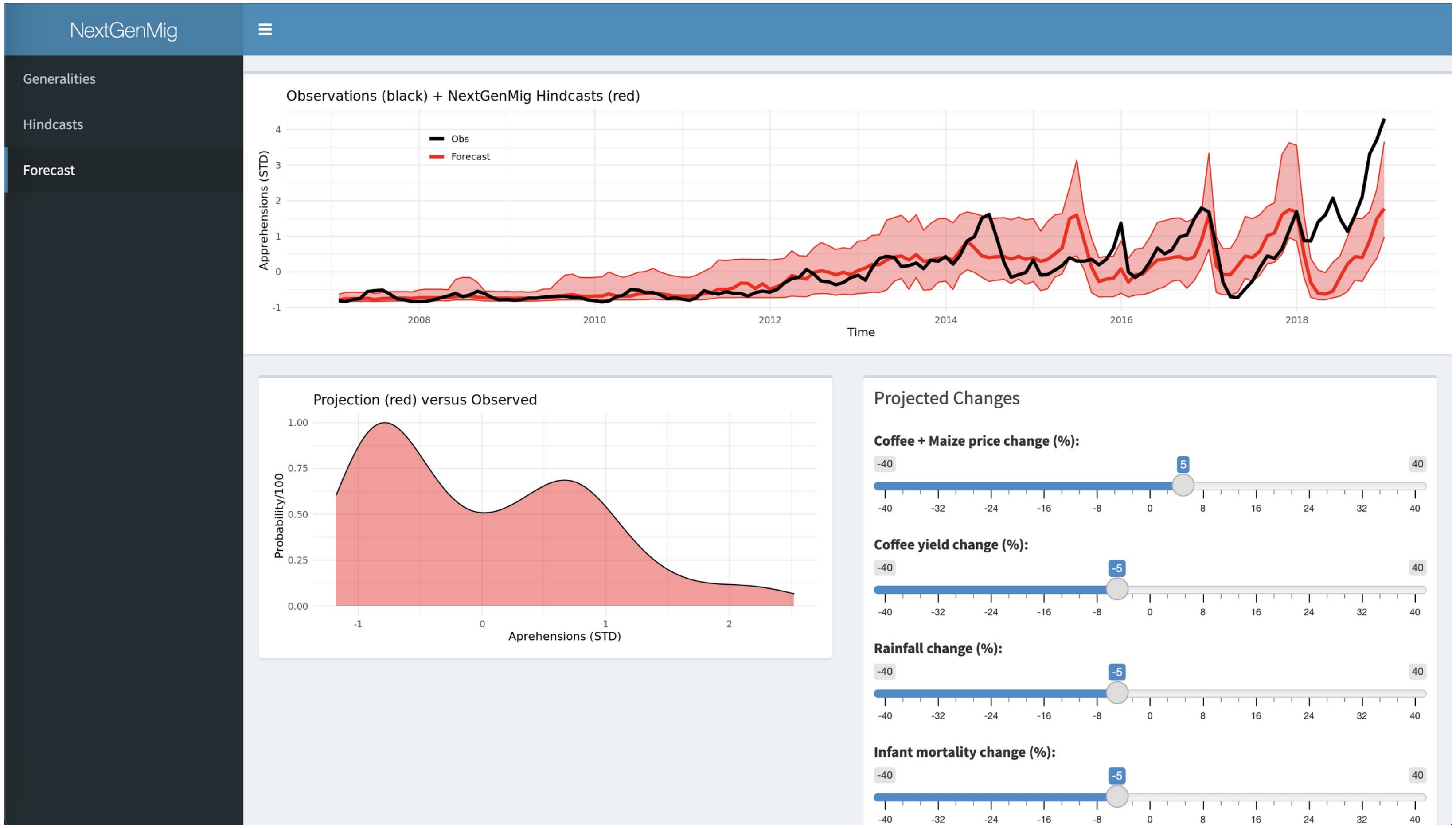
* *Probability* of exceeding thresholds of interest

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

See more about this system in our interactive website: https://fist-shiny.iri.columbia.edu/NextGen/

Muñoz et al., 2019; Muñoz, González Romero et al., (in prep)

Human migration



* NextGenMig: based on climate and *socio-economic* patterns

* *Number* of migrants (apprehensions)

* *Probability* of exceeding thresholds of interest

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

See more about this system in our interactive website:
https://fist-shiny.iri.columbia.edu/NextGen/

Muñoz et al., 2019; Muñoz, González Romero et al., (in prep)

Human Health

BAMS Article

A Decade of the North American Multimodel Ensemble (NMME)

Research, Application, and Future Directions

Emily J. Becker, Ben P. Kirtman, Michelle L'Heureux, Ángel G. Muñoz, and Kathy Pegion

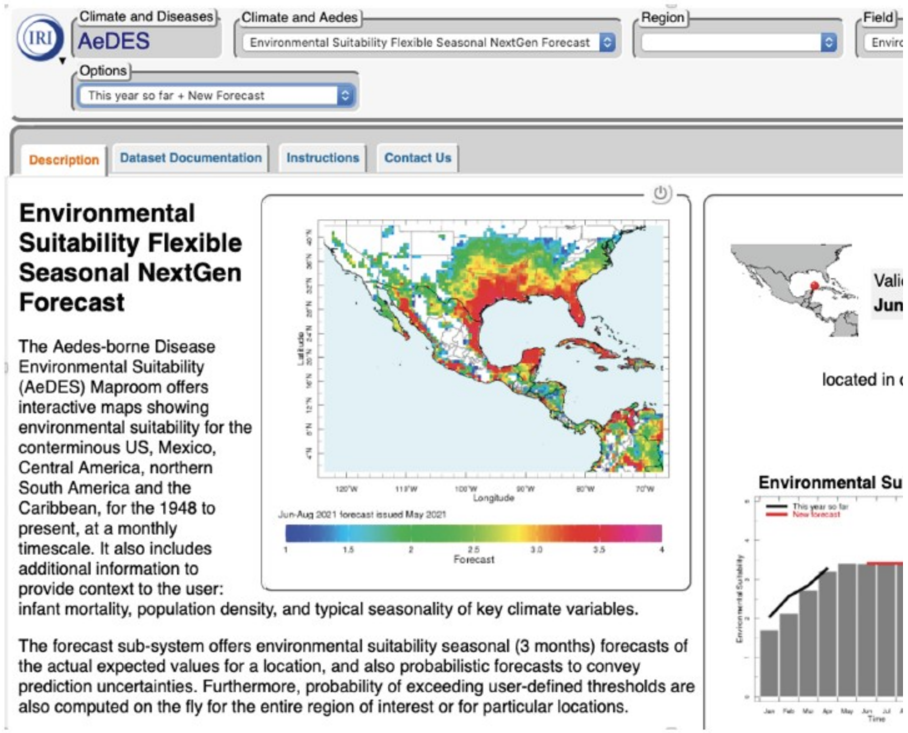


Fig. SB1. Example of the NextGen forecast system from the International Research Institute for Climate and Society's website.

NMME in a prediction application: The NextGen approach

NMME seasonal prediction information is employed by the IRI and partners via the NextGen methodology, a systematic general approach for codesigning, implementing, producing, and verifying objective forecasts at multiple time scales (Muñoz et al. 2019, 2020; WMO 2020). The approach starts with co-identifying with decision-makers and local experts their concrete demand, which defines the variable(s) to predict. A diagnostic analysis is then conducted to help identify the best observed and modeled predictor variables, including both climate and nonclimate factors. As part of the design and implementation of the NextGen forecast system, past model performance is assessed via a statistical and physical-process-based evaluation, helping inform how to best conduct model calibration and ensemble design. The set of predictions produced by the system includes the full range of possible outcomes of the variable (i.e., its entire probability density function, as opposed to just tercile-based predictions), such that decision-makers can obtain tailored forecasts for any particular threshold of interest, and thus trigger the precise set of actions required.

The NextGen methodology is both general and demand oriented, and has been applied to a wide variety of cases beyond forecasting climate variables such as rainfall or temperature. The range of applications include predictions of environmental suitability for transmission of Aedes-borne diseases such as dengue, Zika or chikungunya (Muñoz et al. 2017, 2020) acute undernutrition for children under 5 years old (Romero et al. 2020; White et al. 2022), coffee yield (Pons et al. 2021), and human migration (Muñoz et al. 2019).

To illustrate the approach with a concrete example using NMME model output, consider the NextGen system for Aedes-borne diseases' environmental suitability (AeDES; Muñoz et al. 2020; see Fig. SB1), developed for a geographical domain encompassing North America, Central America, northern South America, and the Caribbean. Work led by the IRI and the Pan-American Health Organization (PAHO)/World Health Organization (WHO) helped identify environmental suitability for disease transmission as the key variable to monitor and forecast (Muñoz et al. 2020).

Muñoz et al., 2017, 2018, 2020; Becker et al., 2022

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

See more about this system in our interactive website: https://fist-shiny.iri.columbia.edu/NextGen/

Information for Decision-Makers (I4D) Updates

Lauriane Batté (Météo France)

Ángel G. Muñoz (BSC)

How does it work?

Hierarchical approach to select best models

Model	Predictor(s)	lag (mo)	BIC	τ
1	R	-4	144357734.0	0.540
2	FDD	-4	144359058.6	0.491
3	YMaize	-4	144382235.2	0.267
4	BBeans	-4	144383270.7	0.294
5	Coffee	-3	144396520.4	0.099
6	R,YMaize	-4,-4	144352354.3	0.550
7	R,BBeans	-4,-4	144350579.0	0.571
8	R,Coffee	-4,-3	144354089.7	0.554
9	R,YMaize,BBeans	-4,-4,-4	**144344286.5**	**0.590**
10	R,BBeans,Coffee	-4,-4,-3	144347540.8	0.573
11	R,YMaize,Coffee	-4,-4,-3	144352071.6	0.556
12	R,YMaize,Beans,Coffee	-4,-4,-4,-3	**144344240.3**	**0.587**

Table 1: Simple and multiple linear regression model configurations, selection and skill assessment. Lag is indicated in months. Model selection is conducted using the Bayesian Information Criterion (BIC). Forecast skill is assessed using Kendall's τ (forecast discrimination), via a retroactive forecast approach, using the first 50% of the period for training, and 50% for out-of-sample verification.

Forecast strategy

Month	Source of predictors
+1	Obs (-4 months)
+2	Obs (-3 months)
+3	Obs (-2 months)
+4	Obs (-1 months)
+5	Obs (present month)
+6	Fcst (+1 months)

Rainfall from the S2S RTP
Projected Ymaize, Bbeans (persistence)

See more about this system here: https://sesan.iri.columbia.edu

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

González Romero et al., (2020, and in prep), White et al. (2022)