Servicio Meteorológico Nacional
Argentina

KCCP: Reinforcement of meteorological services

-

Action Plan: Argentina

Implementation of Guidance short-term Temperature and Humidity Index forecasts for decision making in Livestock and Agrotechnological Sector

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Introduction

- In Argentina, cattle are raised and used along all the territory
- SENASA (National Agro-Food Health and Quality Service) in 2013 showed that the highest density of cattle is observed in Buenos Aires, Santa Fe, Corrientes, Cordoba and Entre Rios.
- In certain environmental conditions (high temperatures and high relative humidity) can have a negative impact on the animal, altering the physiology of cattle, resulting in a reduction in biological efficiency and productive capacity.
- It is important to have biometeorological indicators (for example: **ITH, Humidity and Temperature Index**) to monitor this situation (past data) and consider the forecast of these indices (short-range forecast data).

Introduction

- It is important to have biometeorological indicators (for example: **ITH, Humidity and Temperature Index**) to monitor this situation (past data) and consider the forecast of these indices (short-range forecast data).

$$ITH = 1.8T + 32 - \frac{0.55 - 0.55HR}{100}(1.8T - 26)$$

Stakeholders Analysis

Beneficiaries and decision makers	Dairy companies	Companies of dairy products (milk, cheese, etc.) wants to know how weather affect their production
Funding agencies	Dairy companies	¿¿¿???
Potential opponents	Animal protection organizations	
Implementing agencies	National Meteorological Service	SMN Argentina
Supporting groups	Argentine national agricultural institute	INTA Argentina

Problem Analysis

Dairy companies has a bad production

Why

Because

Core problem

Not having good quality of ITH products (observed and forecast)

Problem analysis for observation ITH data for insurance companies **(not analyzed)**

Bad quality of NWP

Poor data assimilation

Not Guidance applied

Data is not arriving on time

Not enough in situ stations

Not enough knowledge of technics

Limited dedicated human resources to generate ITH products

There are another important requests to attend

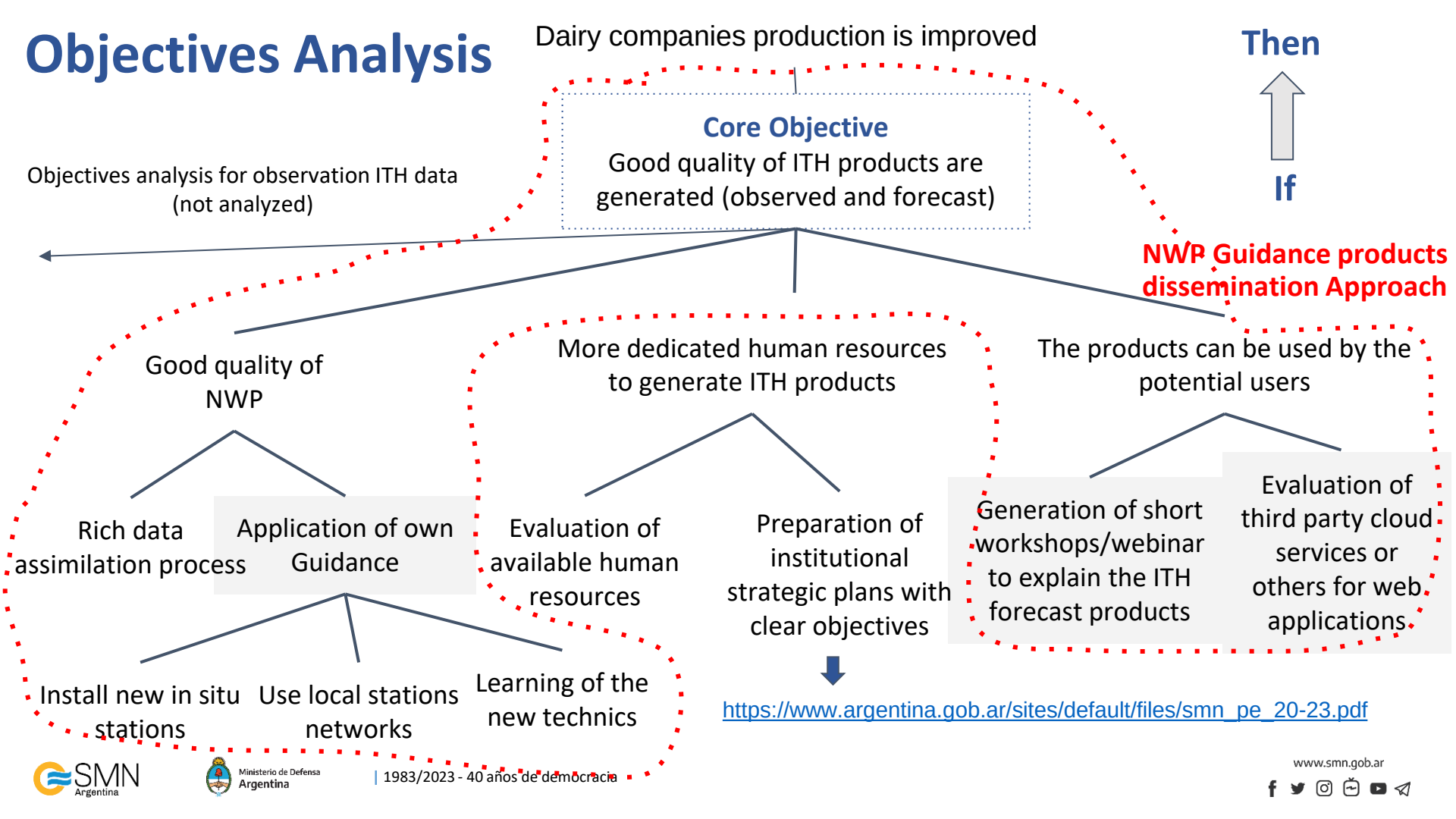
There is no interest in addressing this problematic

The products cannot being used by the potential users

The potential users does not understand the ITH forecast products

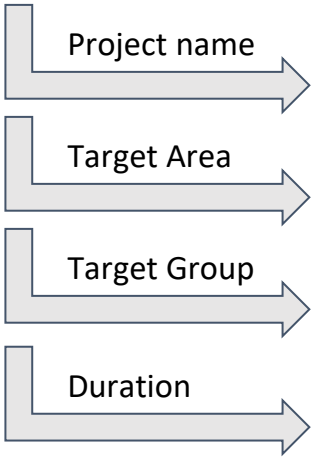
There is not enough technological development to provide services

Objectives Analysis



NWP products dissemination approach

Preliminar PDM



Generation and analysis of Guidance NWP products for Livestock and Agrotechnological sector

Buenos Aires, Santa Fe, Corrientes, Cordoba and Entre Rios

Dairy companies

1 year with once a year re-evaluation (before summer season)

NWP Guidance products dissemination approach

Narrative Summary
Overall Goal ● Dairy companies production is improved
Project Purpose ● Good quality of ITH products are generated
Outputs 1. Application of Guidance with official data and local stations data 2. Generation and implementation of short workshops/webinar for users 3. Evaluation of third party cloud services or others technologies for web applications dissemination
Activities ● Continues in next slide…

NWP Guidance products dissemination approach

Narrative Summary

Outputs

1. Application of Guidance with official data and local stations data
2. Generation and implementation of short workshops/webinar for users
3. Evaluation and use of third party cloud services for dissemination of products

Activities

1-1. International cooperation to understand and evaluate the best techniques of Guidance for each situation.
1-2. Evaluation of availability of official and local data *(Objective analysis for observation → evaluation of the quality of the data, https://repositorio.smn.gob.ar/handle/20.500.12160/1541)*.
1-3. Application of Guidance for the livestock sector.
1-4. Products verification to know the degree of uncertainty.

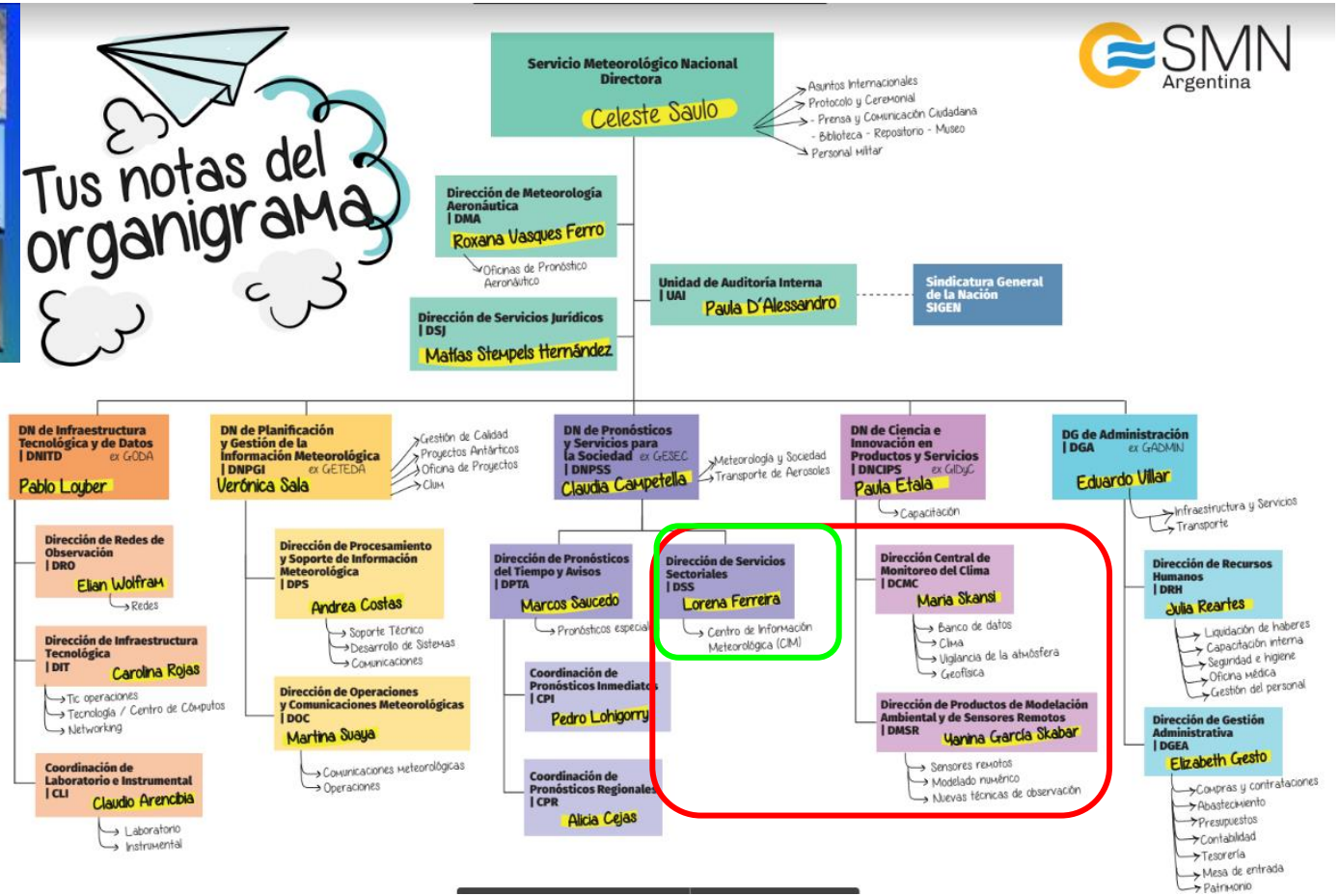
2-1. Evaluation with sector to know the best way of transfer information.
2-2. Short workshop or webinar implementations for the users to understand the data and error.

3-1. International cooperation to have knowledge of best technologies and languages for web apps dissemination.
3-2. Creation of best front-end and back-end framework for best understanding of products.
3-3. Deploying of app (1st version).
3-4. Evaluation with user of 1st version.
3-5. Improvement of 1st version app for a 2nd and final version.
3-6. Re-evaluation of process once a year.

Argentinian NMS Team

12 professionals
11 meteorologists
1 environmental

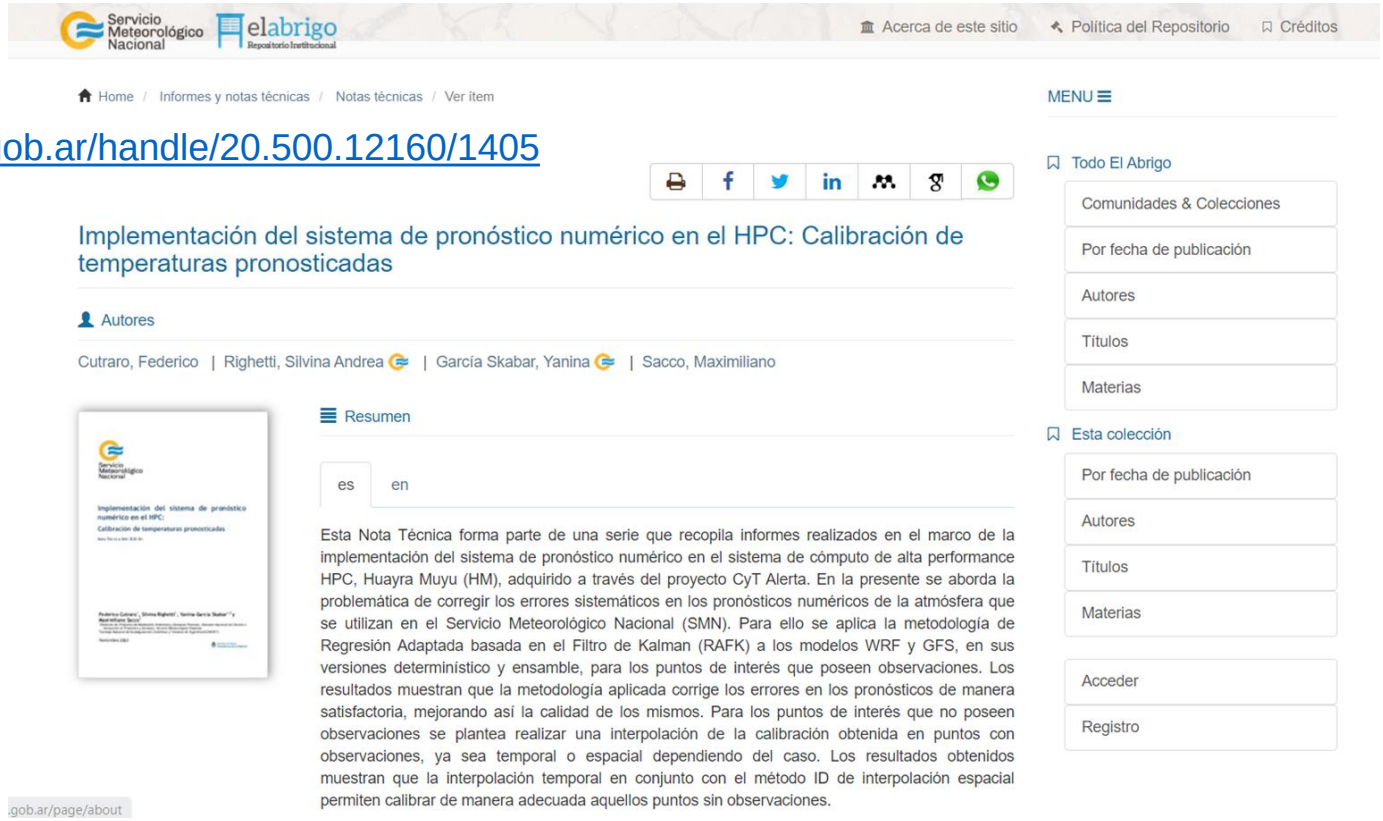
40 professionals
93% meteorologists
7% environmental or IT



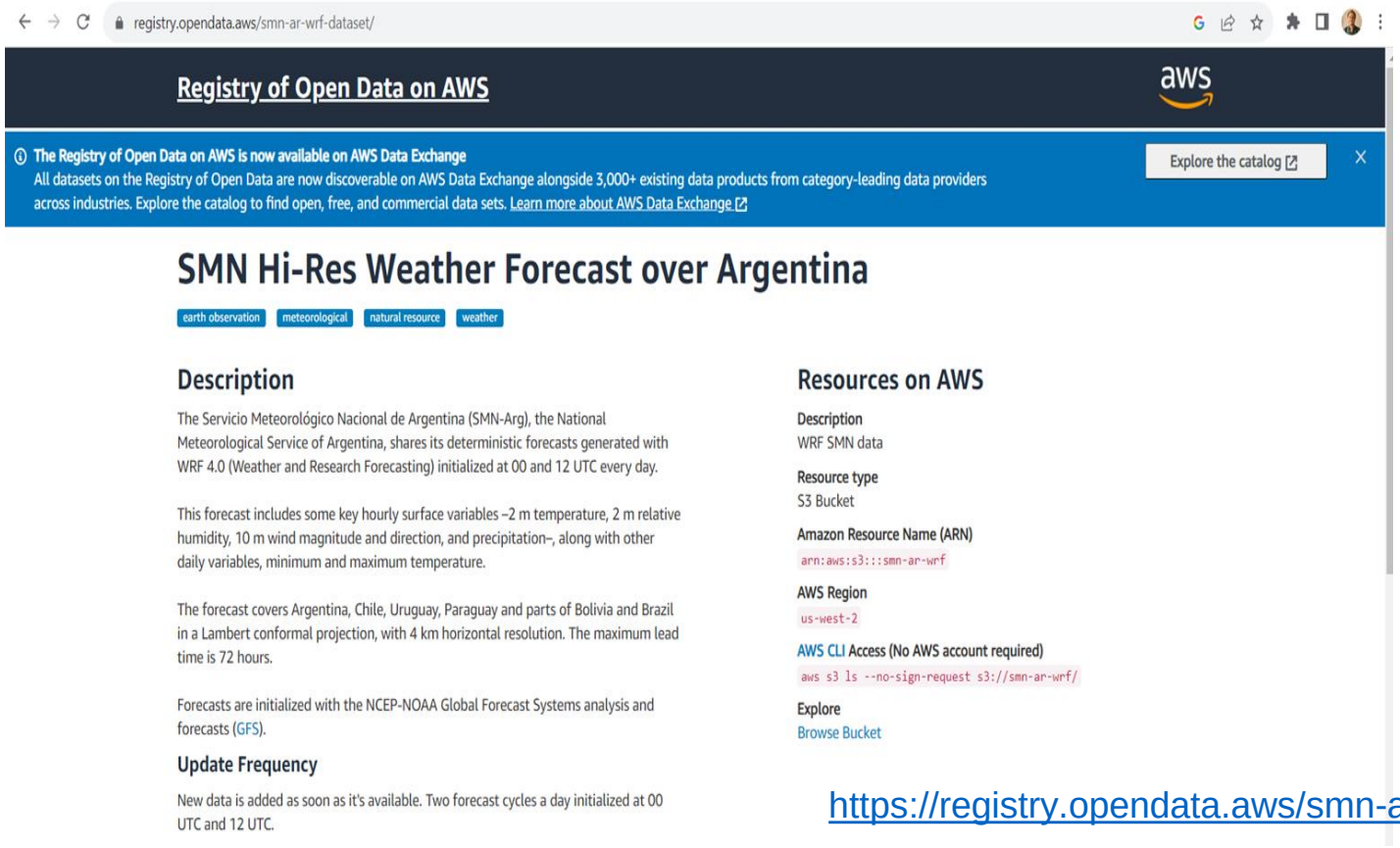
Our experience (Guidance)

https://repositorio.smn.gob.ar/handle/20.500.12160/1405

- Technical Publication Note about technique of Guidance for T2m



Our experience (Guidance)



- Access to WRF regional high resolution model (4km) with Guidance
- Guidance for:
  - T2m
  - Tmax
  - Tmin
  - Wind10
  - *not for HR2*
- Kalman Filter technic
- Also Guidance for GFS model system

https://registry.opendata.aws/smn-ar-wrf-dataset/

Our experience (Guidance)

Documentación

Servicio Meteorológico Nacional Argentina

Buscar documentos

CONTENIDO:

- Información general
- Estructura de datos
- Formato de datos
- Acceso a los datos
- Tutoriales
- Preguntas frecuentes
- Novedades
- Suscripción a novedades
- Contacto
- English version

Las dimensiones de los datos se encuentra en la siguiente tabla:

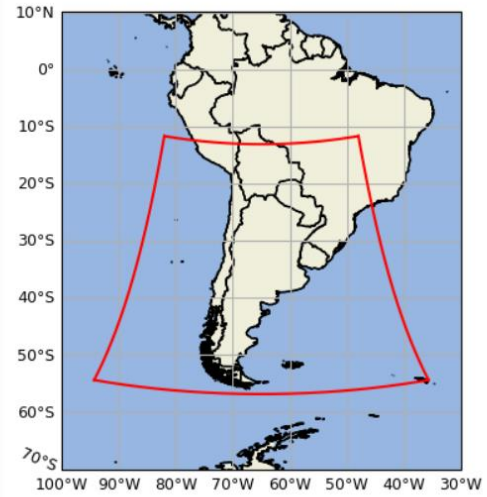
Dimensión	Valor
time	1
y	1249
x	999

https://odp-aws-smn.github.io/documentation_wrf_det/

Variables

Las variables presentes en los archivos son las siguientes:

Variable	Descripción	Unidad	Precisión	Frecue
PP	Precipitación acumulada en 10 miuntos	mm	float32	10M
PP	Precipitación acumulada en una hora	mm	float32	01H
HR2	Humedad relativa a 2 metros	%	float32	01H
T2	Temperatura a 2 metros (*)	°C	float32	01H
dirViento10	Dirección del viento a 10 metros	°	float32	01H
magViento10	Magnitud del viento a 10 metros (*)	m/s	float32	01H
PSFC	Presión en superficie	hPa	float32	01H
ACLWDNB	Radiación de onda larga entrante (**)	J/m2	float32	01H
ACLWUPB	Radiación de onda larga saliente (**)	J/m2	float32	01H
ACSWDNB	Radiación de onda corta entrante (**)	J/m2	float32	01H
TSLB	Temperatura de suelo en la capa 0-10cm	°C	float32	01H
SMOIS	Humedad de suelo en la capa 0-10cm	m3/m3	float32	01H
Freezing_level	Altura sobre el nivel del mar de la isoterma de 0°C	m	float32	01H
Tmax	Temperatura máxima diaria (*)	°C	float32	24H
Tmin	Temperatura mínima diaria (*)	°C	float32	24H



Dominio WRF-Arg delimitado por contorno rojo

Guidance for HR2

- Forecasts initialization: 00z
- Period forecasts: 24h
- Target variable: HR2.obs
- Predictors: HR2.mod, T2.mod, V10.mod

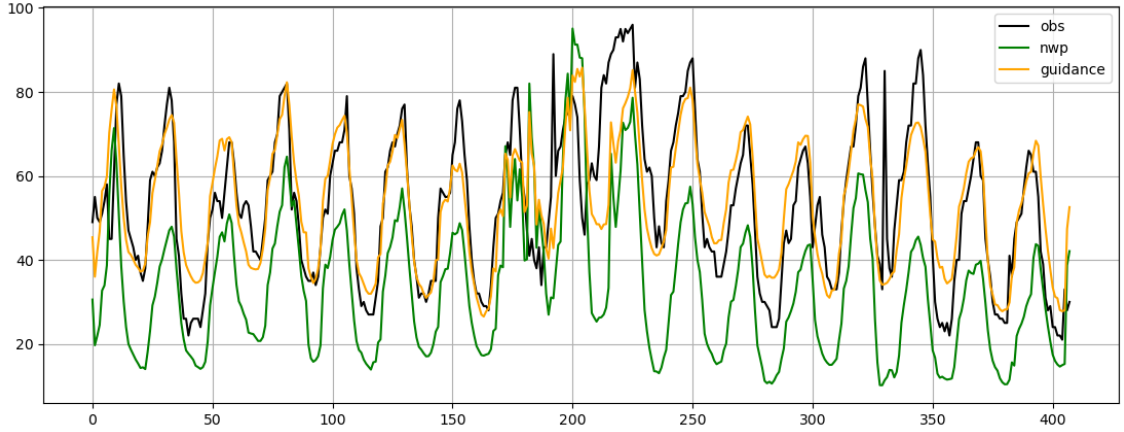
- Training dataset: 2022-12-15 to 2022-12-31
- Verification dataset: 2023-01-01 to 2023-01-15

Dates	HR2.obs	HR2.mod	T2.mod	V10.mod
2022-12-15 00:00:00	49	30.55693	27.39517	6.675395
2022-12-15 01:00:00	51	19.67639	28.67996	10.086987
2022-12-15 02:00:00	54	21.93532	25.97479	8.268994
2022-12-15 03:00:00	58	24.51218	24.68359	5.965716
2022-12-15 04:00:00	45	32.70614	20.46149	4.763986
2022-12-15 05:00:00	45	33.92179	19.80768	5.025846
2022-12-15 06:00:00	61	38.70432	18.85138	5.799422
2022-12-15 07:00:00	77	55.39519	16.95236	4.579865

•••

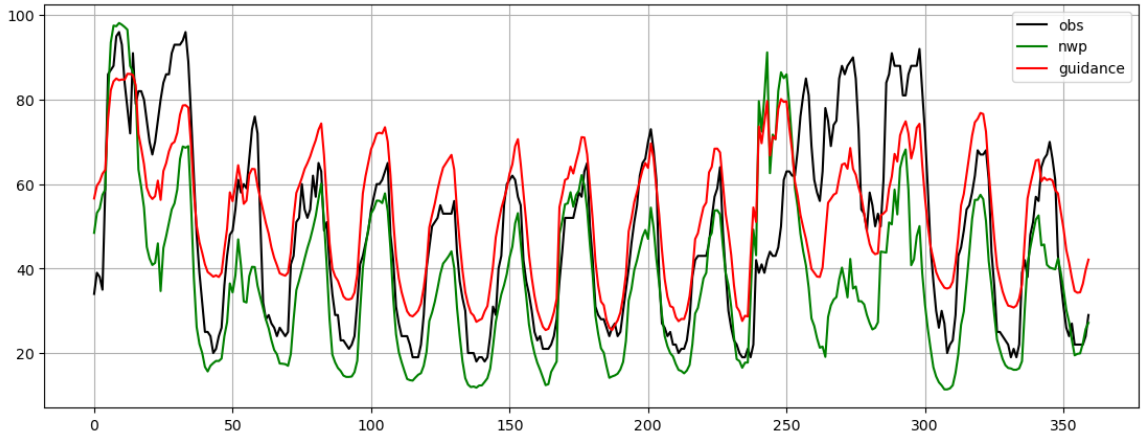
2022-12-31 16:00:00	22	17.44401	32.89279	6.519440
2022-12-31 17:00:00	21	15.94433	34.34851	6.395494
2022-12-31 18:00:00	33	15.09033	34.81747	5.845320
2022-12-31 19:00:00	28	14.60095	36.53183	6.429780
2022-12-31 20:00:00	30	14.95320	36.82608	6.486556
2022-12-31 21:00:00	34	15.23029	36.53162	6.766435
2022-12-31 22:00:00	39	38.71814	29.63272	5.369752
2022-12-31 23:00:00	38	42.08158	28.55676	2.820919

Best result (training)



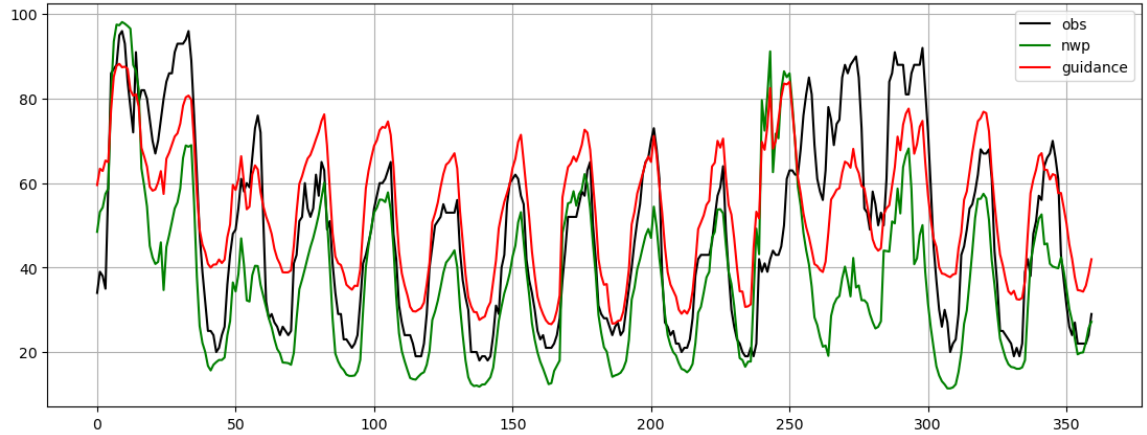

```
formula = HR2obs ~ HR2mod + T2mod + V10mod
Intercept    71.819583
HR2mod        0.418090
T2mod        -1.194468
V10mod       -0.970423
dtype: float64

Verification score of T_fcst by Linear Regression
 NWP   : Bias = -19.7004, RMSE = 23.5642
 Guid  : Bias = -0.0000,  RMSE = 10.3816
```

Guidance for HR2



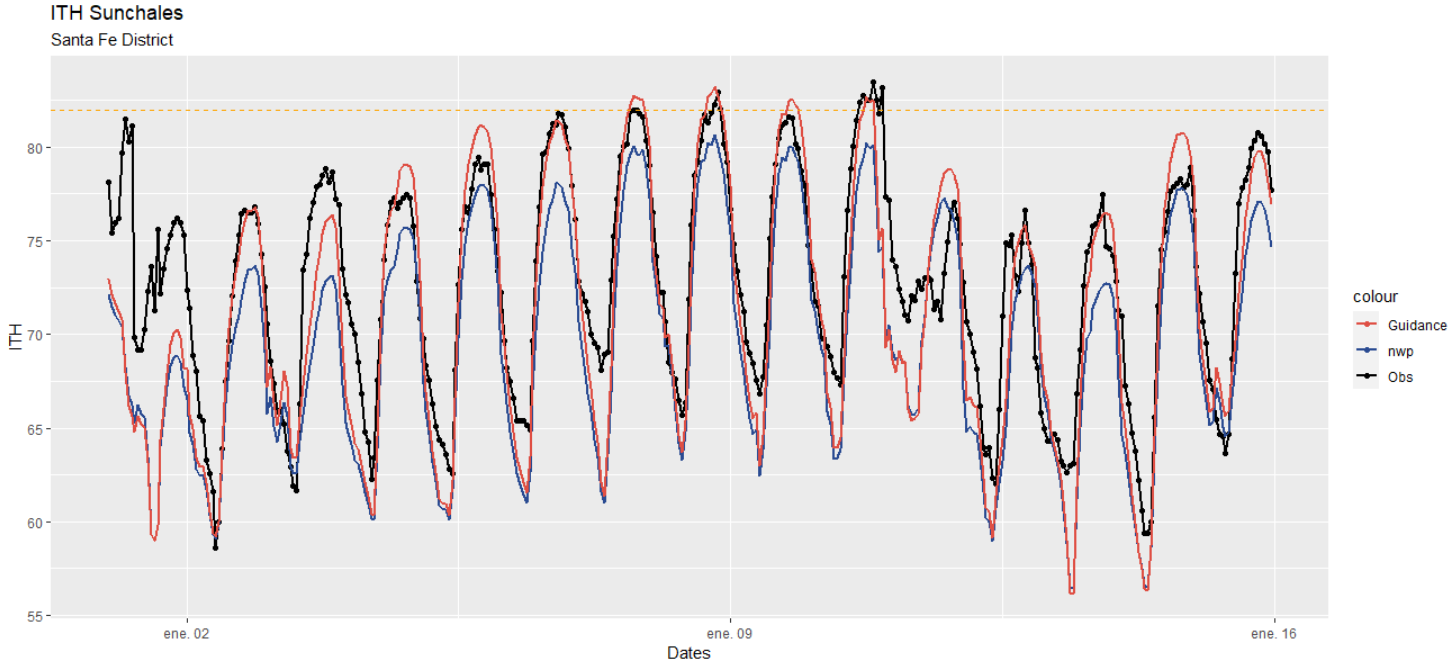
Best results (verification)

```
formula = HR2obs ~ HR2mod + T2mod
Intercept    73.693935
HR2mod        0.384357
T2mod        -1.407426
dtype: float64
Verification score of T_fcst2(independent) by Linear Regression
 NWP  : Bias = -11.3334, RMSE = 19.6579
 Guid : Bias = 4.1662, RMSE = 13.6705
```




```
formula = HR2obs ~ HR2mod + T2mod + V10mod
Intercept    71.819583
HR2mod        0.418090
T2mod        -1.194468
V10mod       -0.970423
dtype: float64
Verification score of T_fcst2(independent) by Linear Regression
 NWP  : Bias = -11.3334, RMSE = 19.6579
 Guid : Bias = 5.2414, RMSE = 14.1795
```

ITH improvement with HR2 Guidance

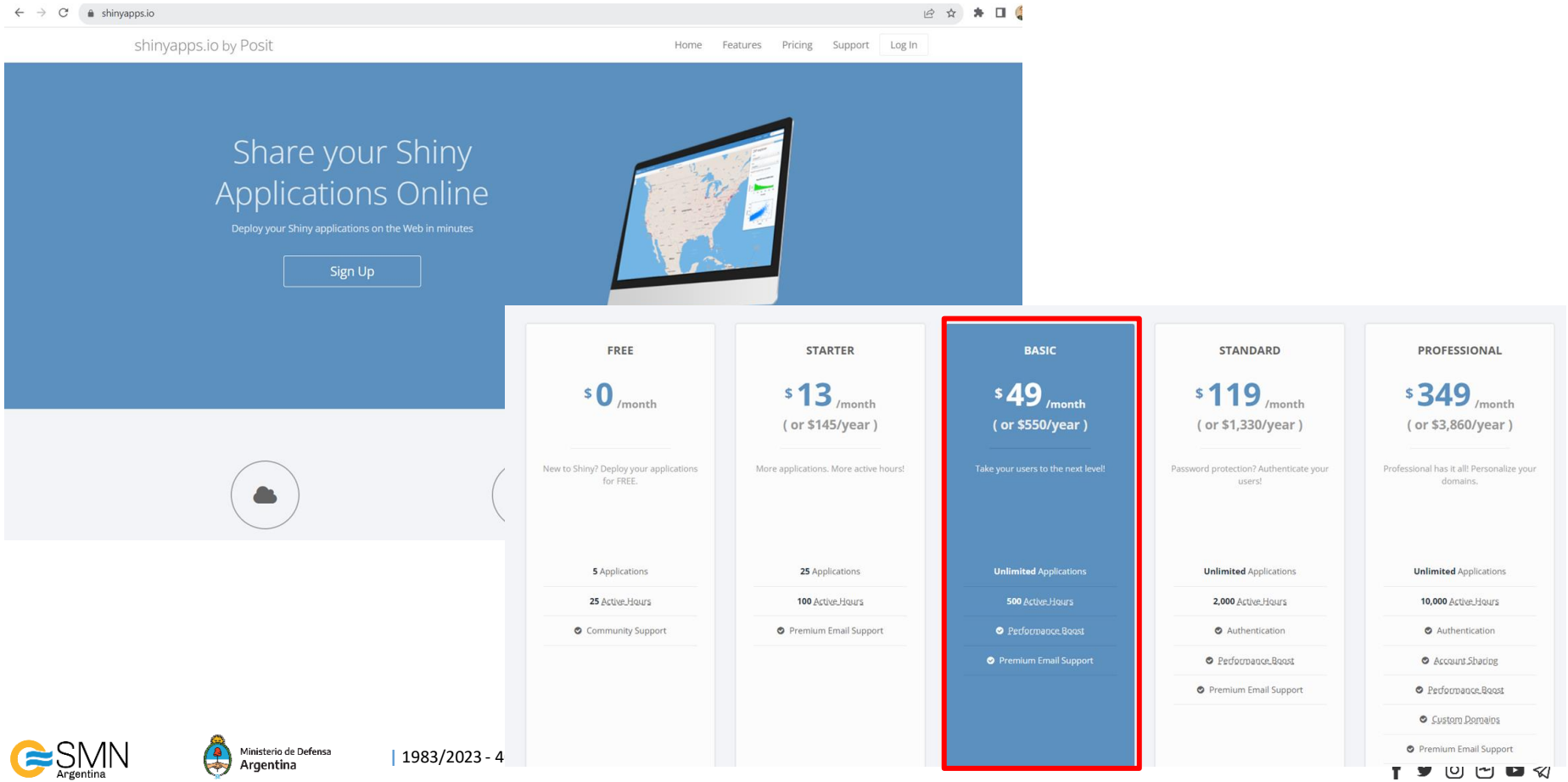


Scores	nwp	Guid
r	0.89	0.89
RMSE	4.22	3.55
NS	0.48	0.64
BIAS (%)	-4.4	-2.2

Our experience (Dissemination)

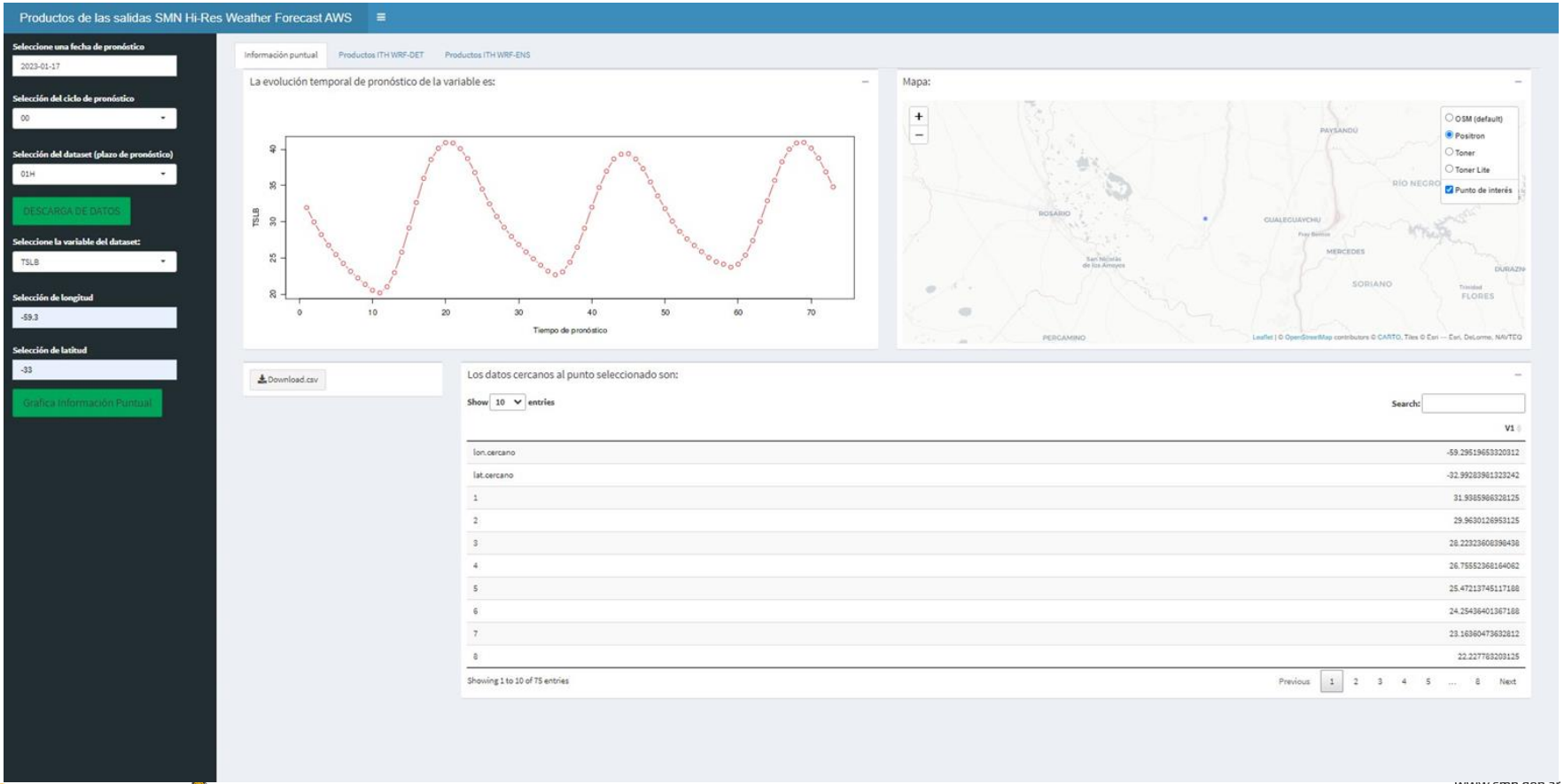
- FTP (nowadays is the most popular option in Argentinian NMS)
- Email (users prefer this option sometimes but it is not the best option to automatization of processes)
- API (users do not have experience in the use of this technologies)
- Web App (new proposal because of the bigger demanding of users)

Our experience (Dissemination)

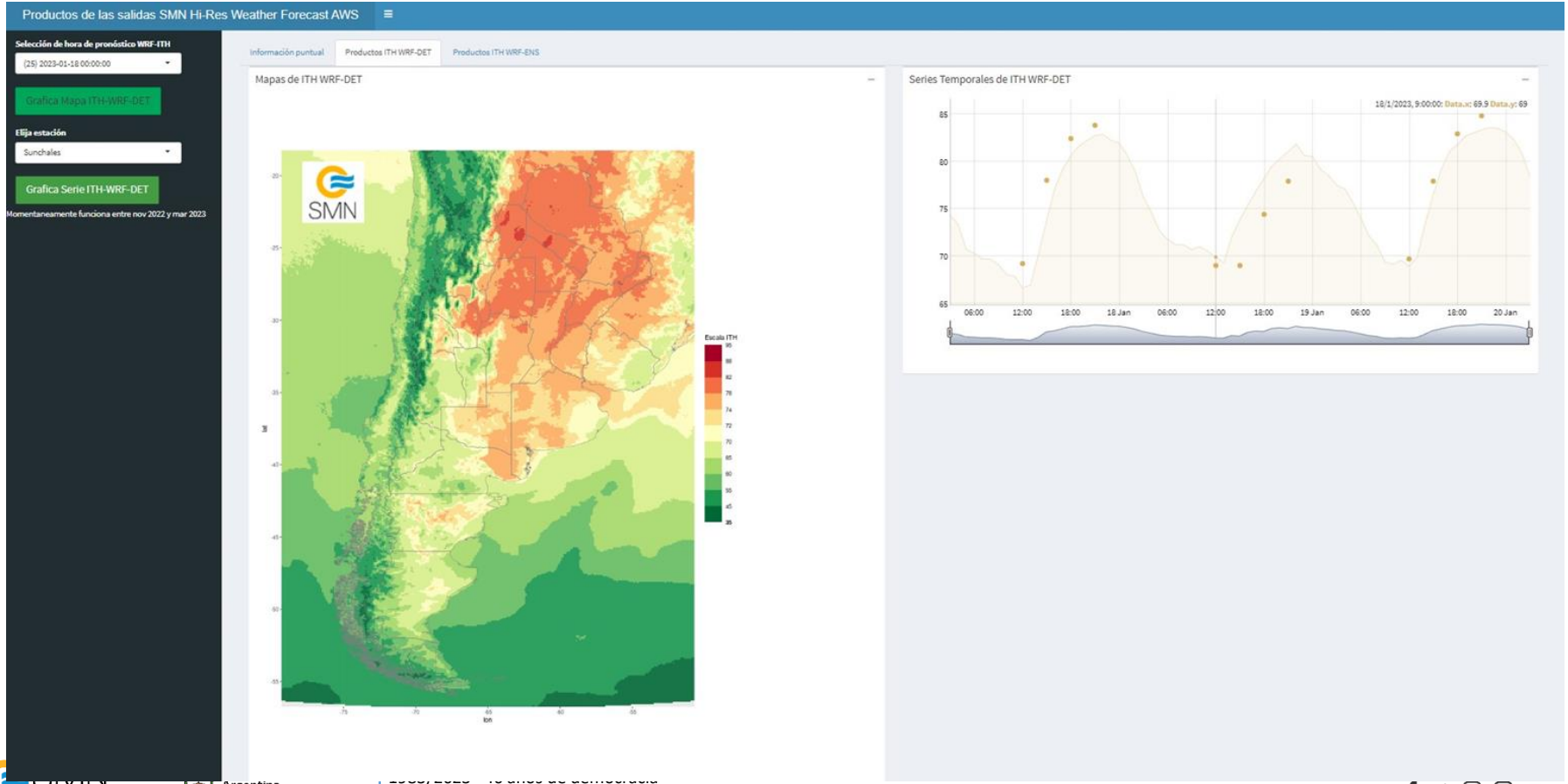


Our experience (Dissemination)

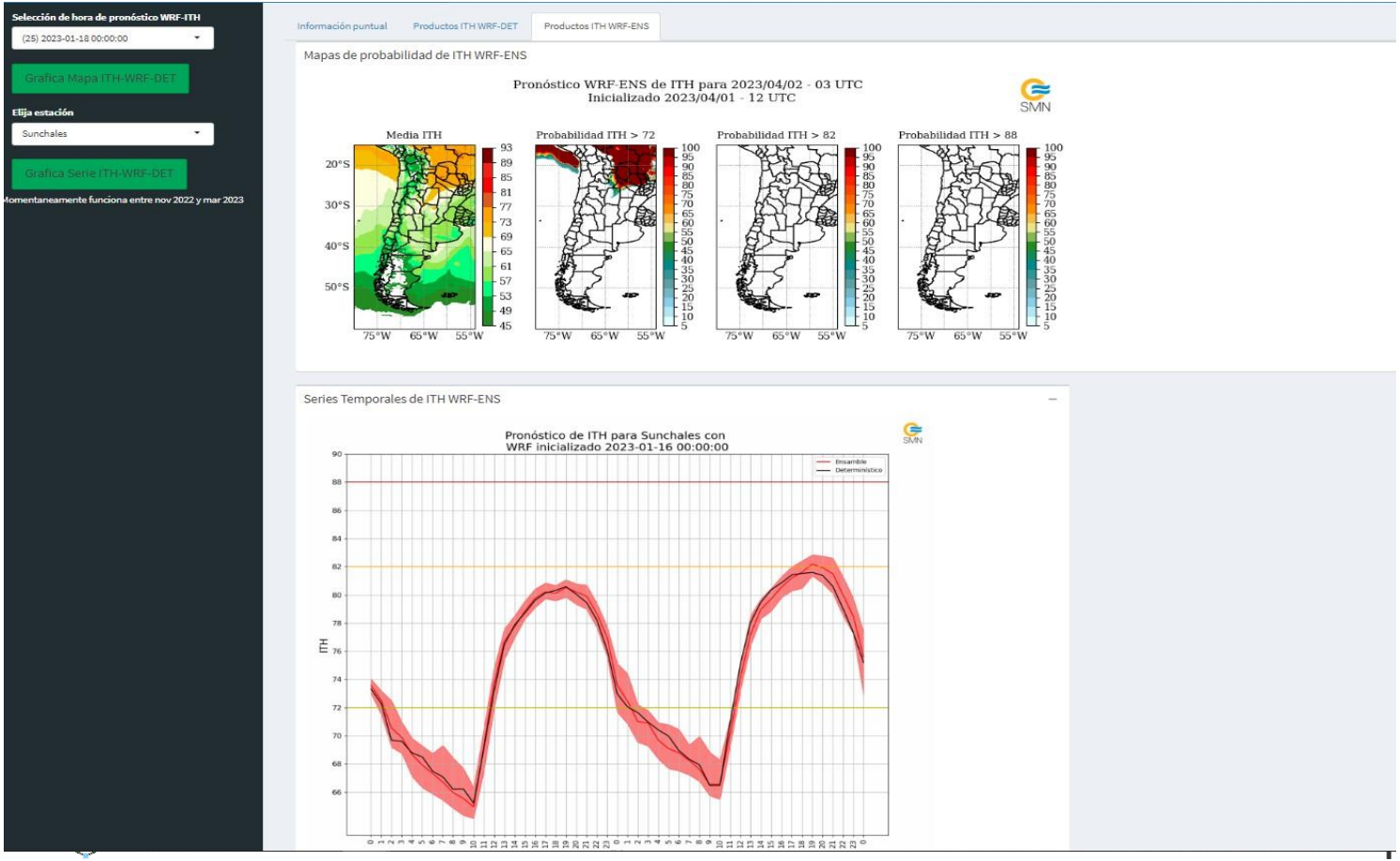
https://dsssmn.shinyapps.io/appWRF_AWS/



Our experience (Dissemination)



Our experience (Dissemination)



Limitations of action plan

- Not enough in situ observations distribution for the application of a reliable Guidance
- Problem in finding the best technique of Guidance for each case (importance of promoting international cooperation)
- Ensure sufficient budget to be able to pay for cloud services (possibility for the user to pay for this service?)

Summary

- Statistical techniques for guidance or calibration of NWP such as those carried out in this training are fundamental for the improvement of the services provided by the National Meteorological Services around the world.

- It is very important to obtain advanced knowledge of these techniques or others in developing countries for the scientific and technical development of these countries.

- Knowing about different technologies for the dissemination of information in web or mobile applications can be very useful in countries that do not have extensive IT human resources.

Arigato

Muchas gracias

Thank you

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