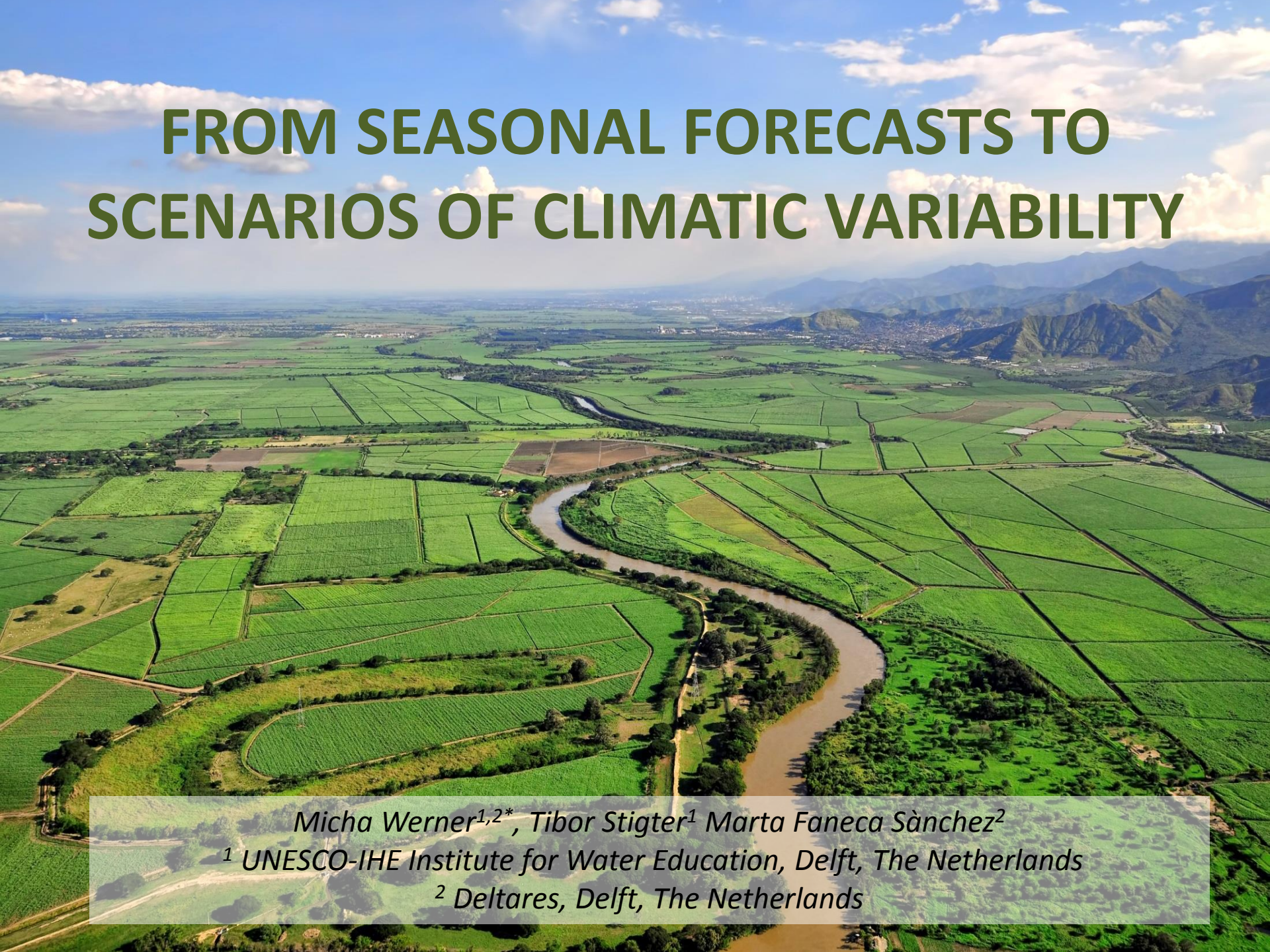
FROM SEASONAL FORECASTS TO SCENARIOS OF CLIMATIC VARIABILITY



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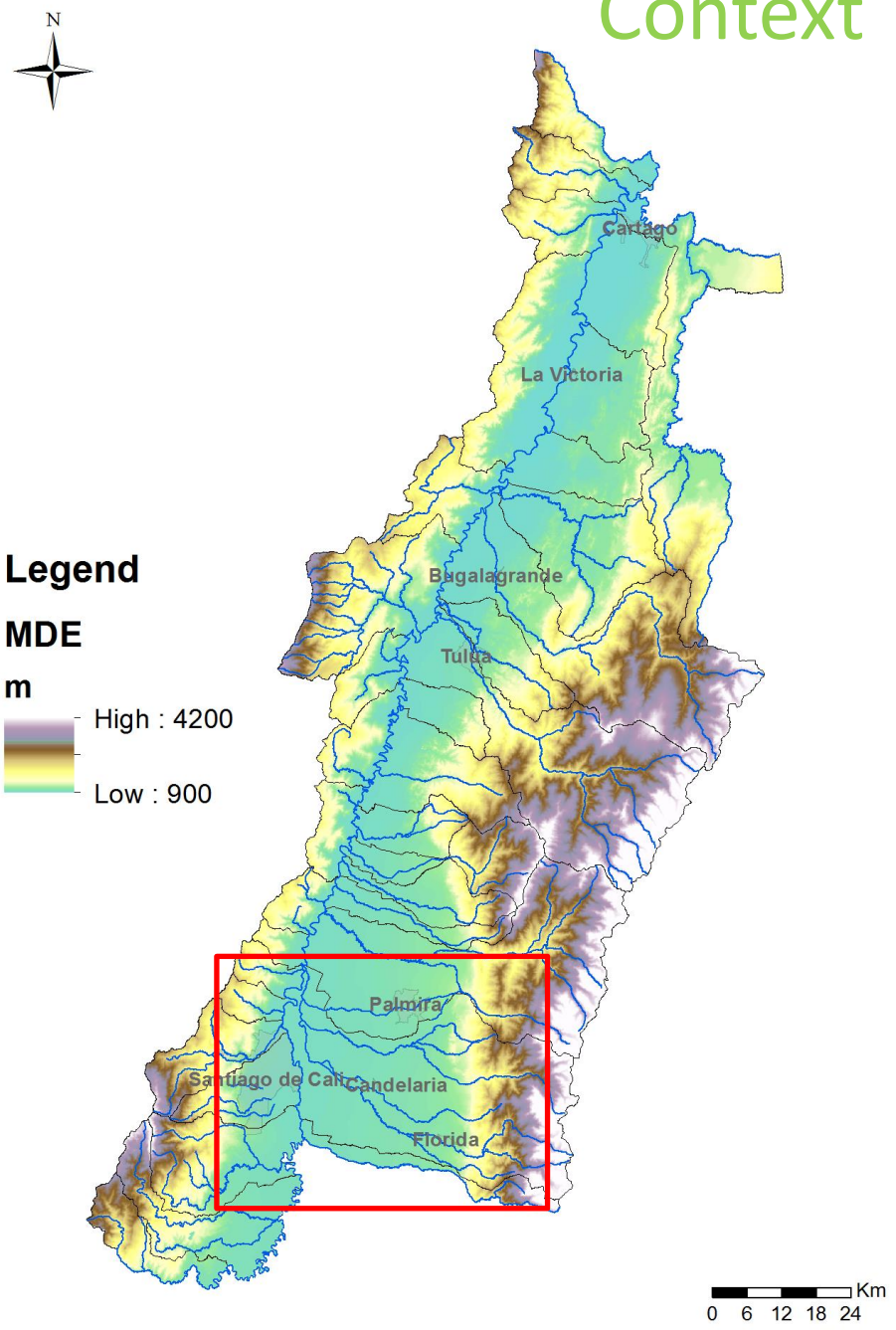
Context



Valle del Cauca, region Colombia

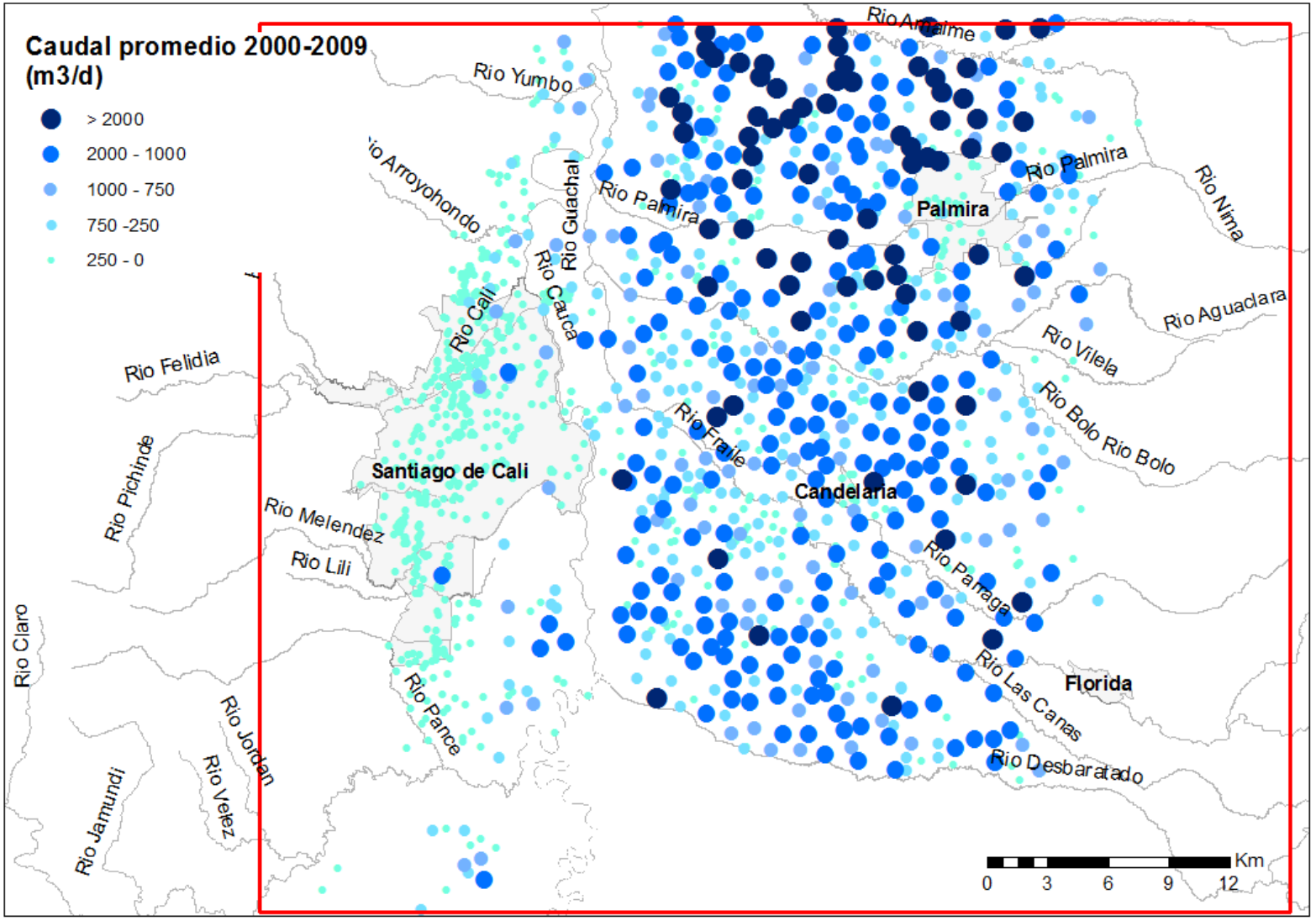
Context

- Extensive areas of irrigated agriculture – mainly sugarcane – 50% of irrigation from groundwater

- Water scarcity can be an issue during extensive drought periods (El Niño) – flooding during wet periods (La Niña)

Context

Context

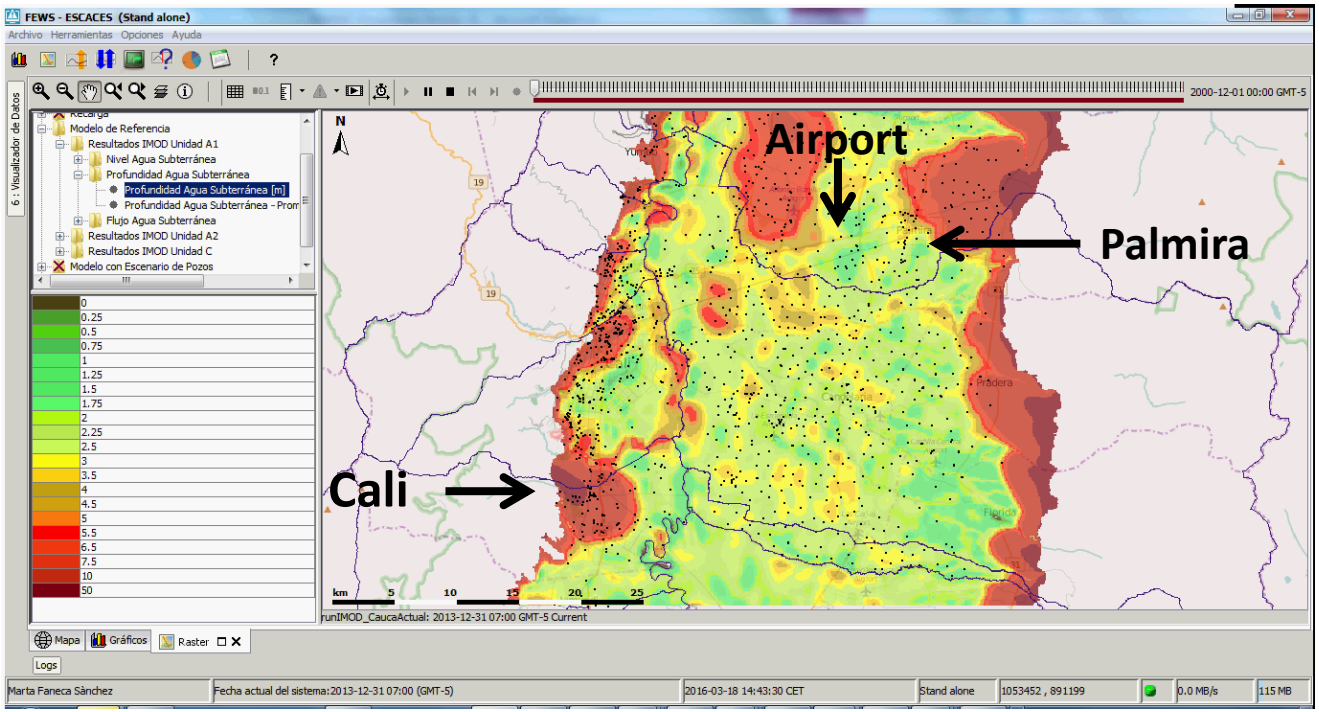

Caudal promedio 2000-2009
(m3/d)
> 2000
2000 - 1000
1000 - 750
750 -250
250 - 0
Rio Yumbo
Rio Arroyohondo
Rio Guachal
Rio Cauca
Rio Cali
Rio Palmira
Palmira
Rio Nima
Rio Aguaclara
Rio Vilela
Rio Bolo
Rio Fraile
Rio Felidia
Rio Pichinde
Santiago de Cali
Rio Melendez
Rio Lili
Candelaria
Rio Pamaga
Florida
Rio Las Canas
Rio Desbaratado
Rio Pance
Rio Claro
Rio Jordan
Rio Velez
Rio Jamundi
Km
0
3
6
9
12

Context

- Regional environment agency, “Corporación Regional Autónoma del Valle del Cauca” (CVC) mandated with the management / regulation of water resources
- Collaborative project “ESCACES” to improve the understanding of the groundwater system and develop tools and strategies to support its sustainable management
- Reasonably well developed hydrometeorological observation network (1975 – current date); detailed data on land use, geology/lithology

Context

Context

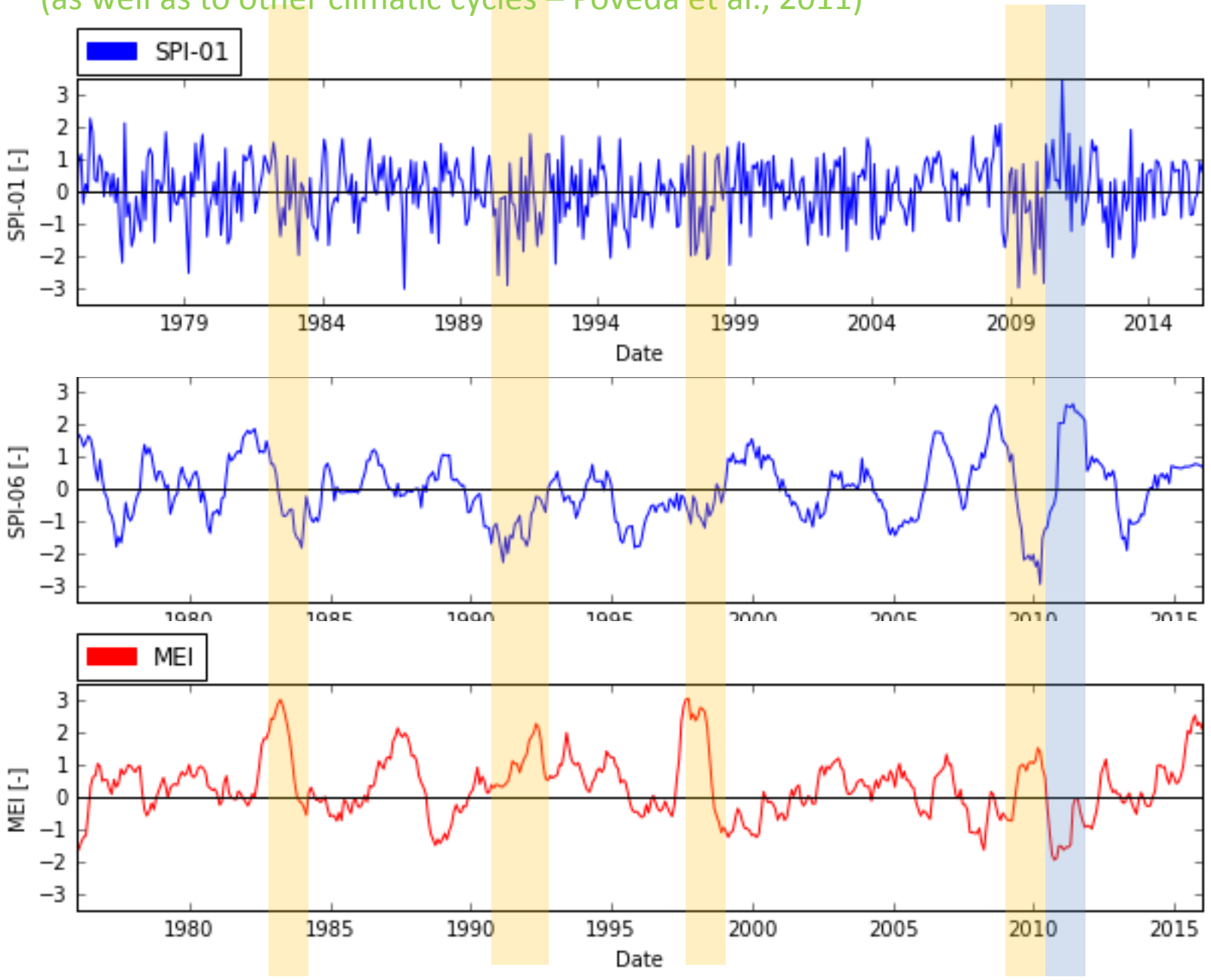


Regional Groundwater Model – Evolution of groundwater depth (3 layers)

- How will evolution of groundwater system to support licenced extractions during extended drought periods?
- How will evolution of groundwater levels & irrigation excess & from rivers
- Groundwater extractions through wells over after return to “normal” conditions?

Variability of rainfall related to El Niño-La Niña

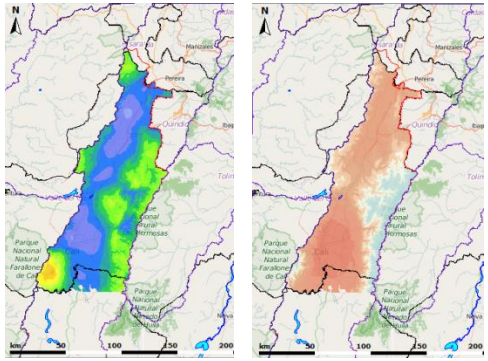
(as well as to other climatic cycles – Poveda et al., 2011)



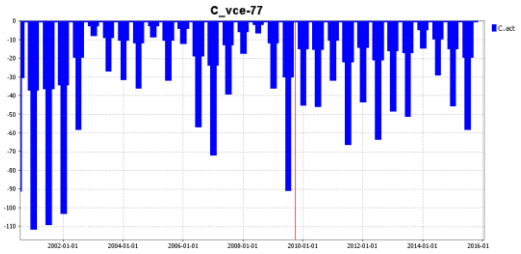
Cross correlation between ENSO indices, rainfall and SPI

	P	SOI	MEI	ONI	SPI1	SPI3	SPI6	SPI12
P	1.00	0.15	-0.15	-0.15	0.75	0.50	0.34	0.23
SOI		1.00	-0.76	-0.73	0.20	0.30	0.34	0.27
MEI			1.00	0.89	-0.21	-0.31	-0.35	-0.28
ONI				1.00	-0.22	-0.30	-0.35	-0.26
SPI1					1.00	0.61	0.40	0.28
SPI3						1.00	0.72	0.49
SPI6							1.00	0.72
SPI12								1.00

Developing an approach to predict the evolution of groundwater levels (2016 – 2025)

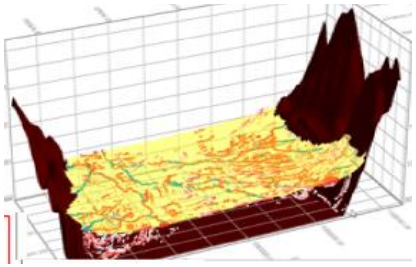


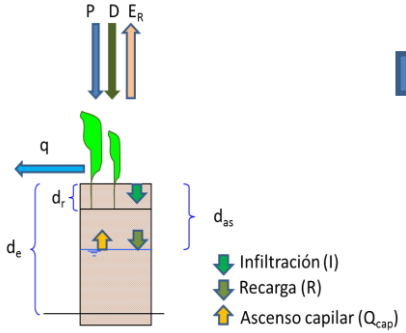
Daily Precip & Evap



Well Pumping Regimes

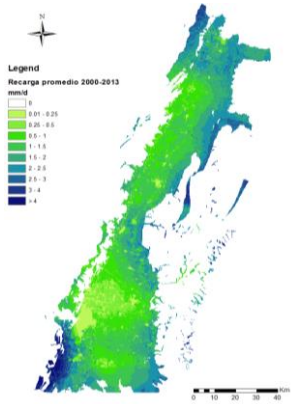
Groundwater Model (IMOD-MODLFOW)



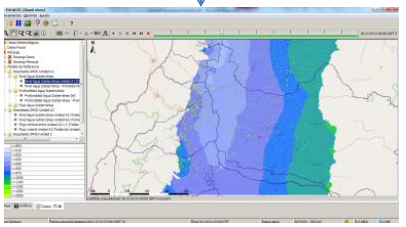


Soil Water Balance to estimate g/w recharge

- Land Cover
- Irrigation
- Soil texture & root depth
- Slope etc.



Maps of Recharge Aggregated to Monthly 1975-2015



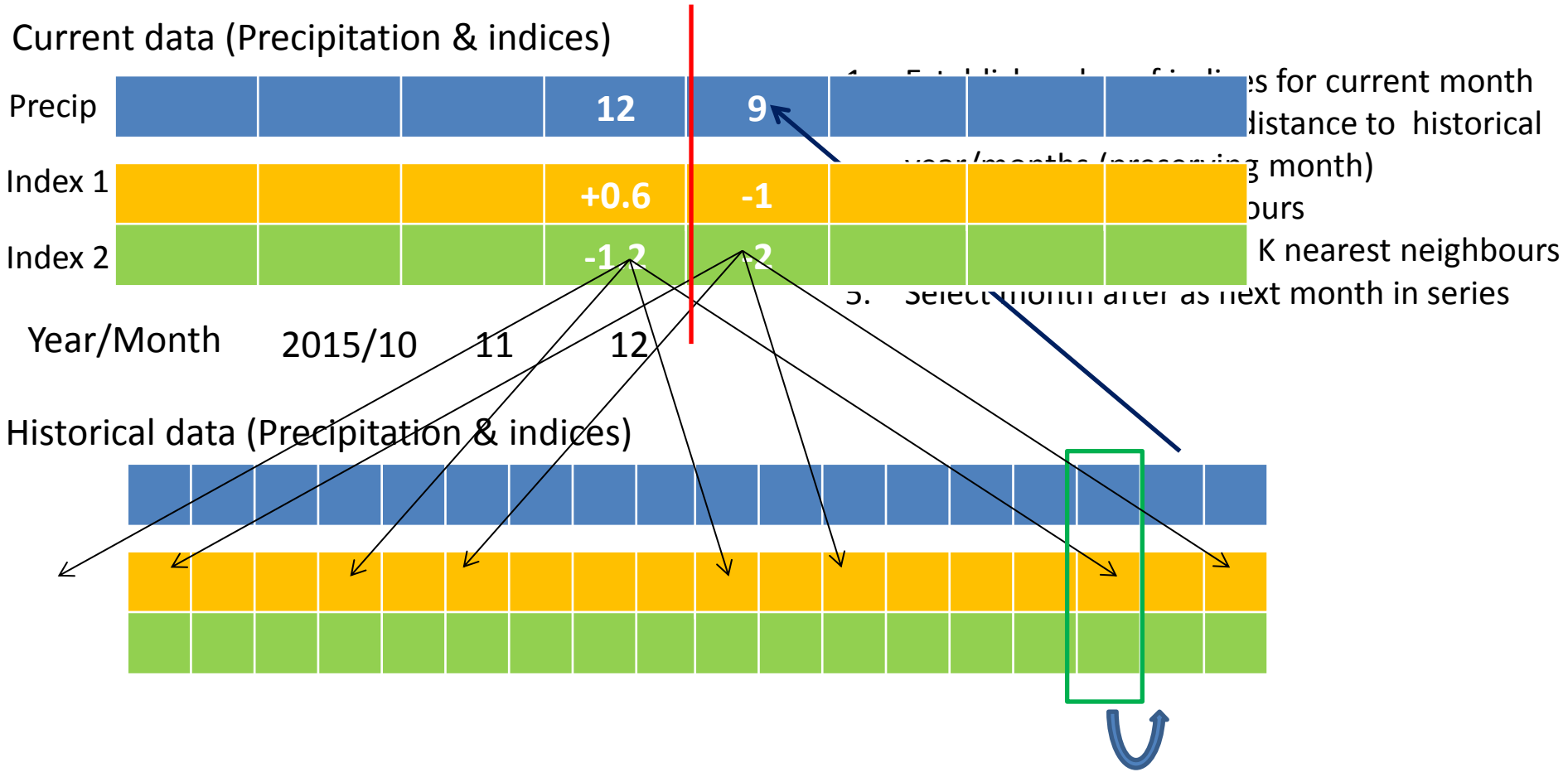
Forecasting Platform (FEWS-ESCACES)

Scenarios of groundwater levels

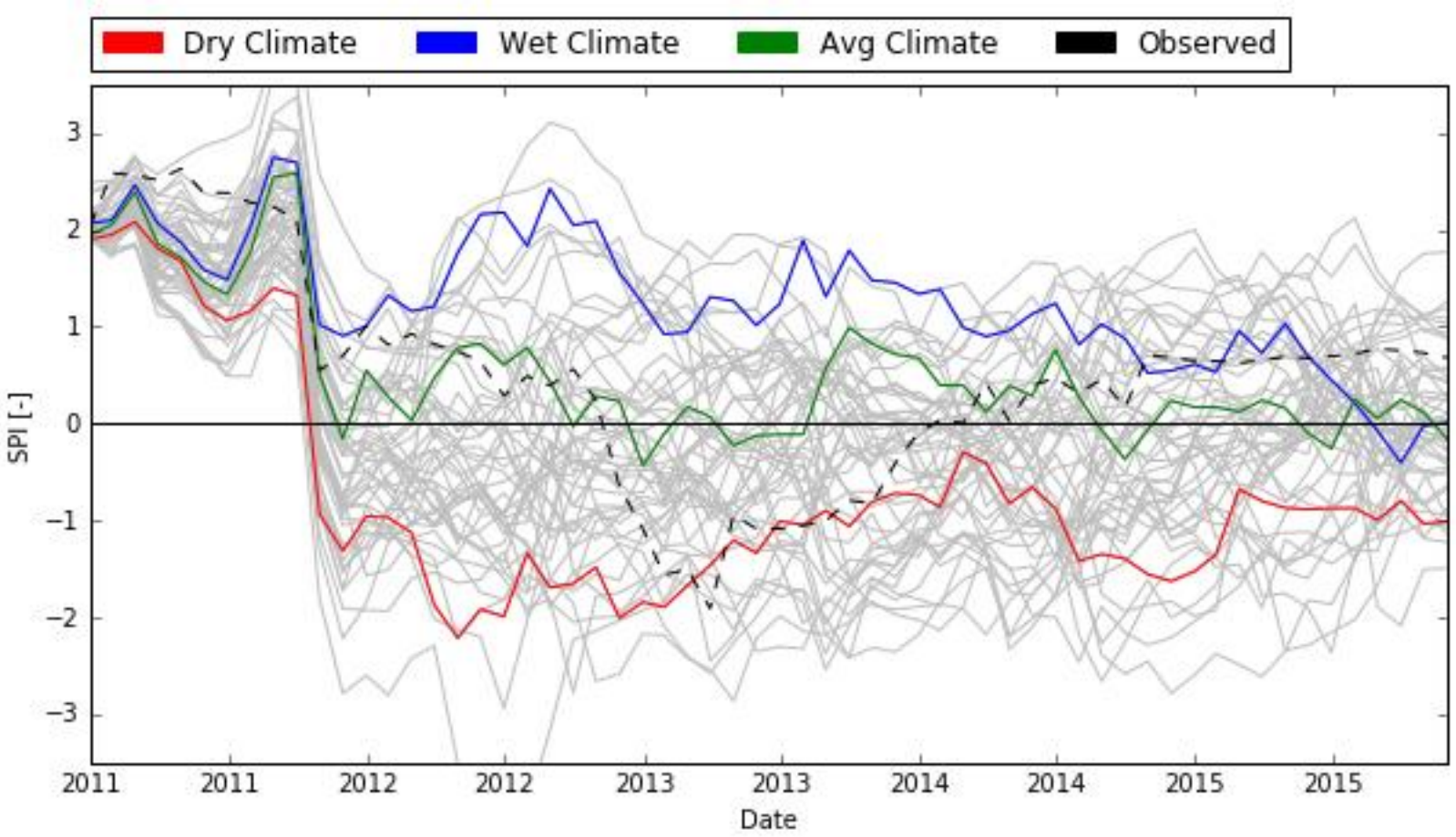
Scenario Generator

Generating climatic scenarios – conditional on current climatic conditions

K-Nearest neighbour sampling approach to create synthetic future rainfall time series (based on Beersma & Buishand, 2003; Peters et al., 2005, Beckers et al., 2016)

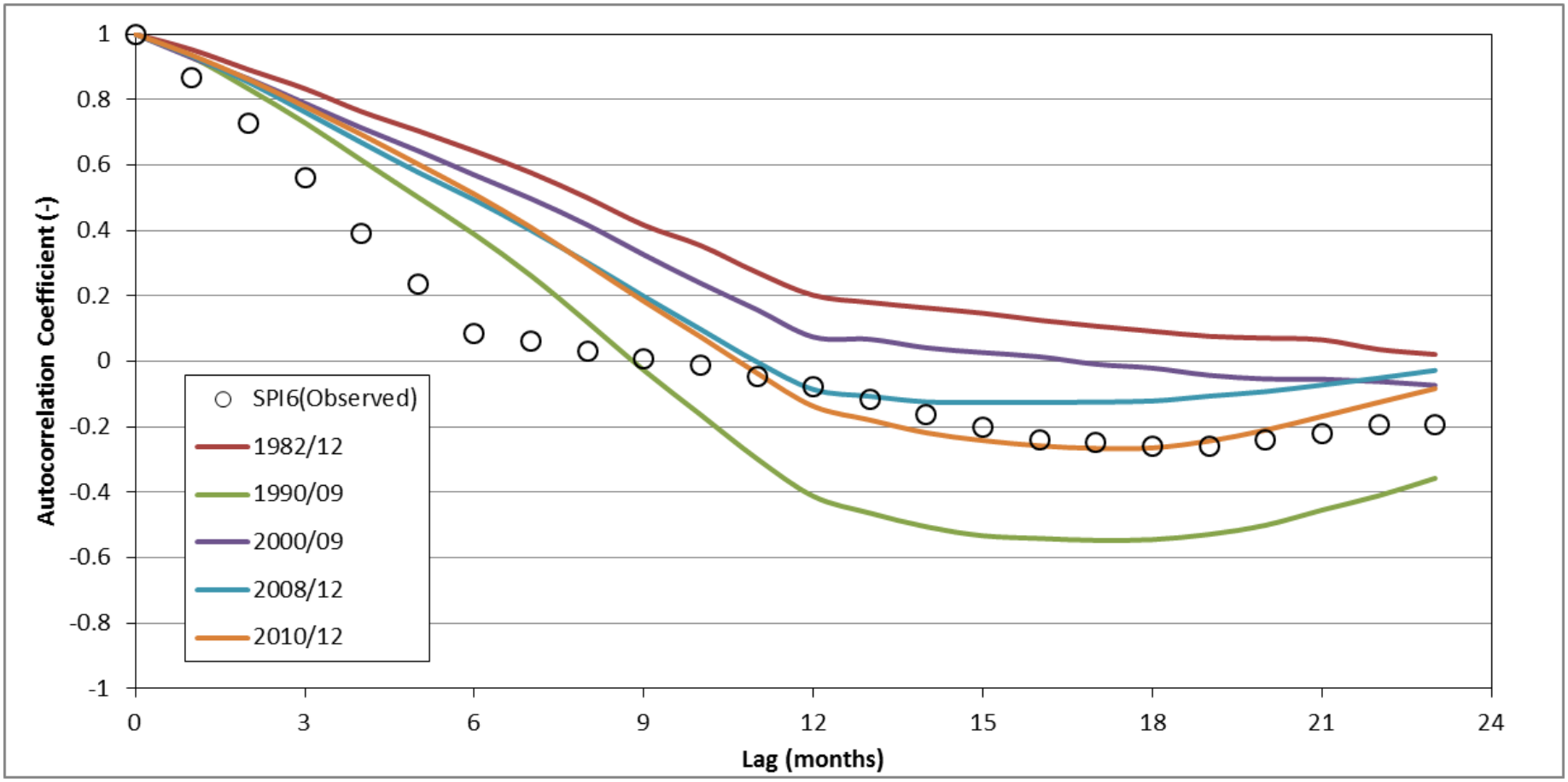


SPI-6 for selected forecasts with K=10 (6 examples)



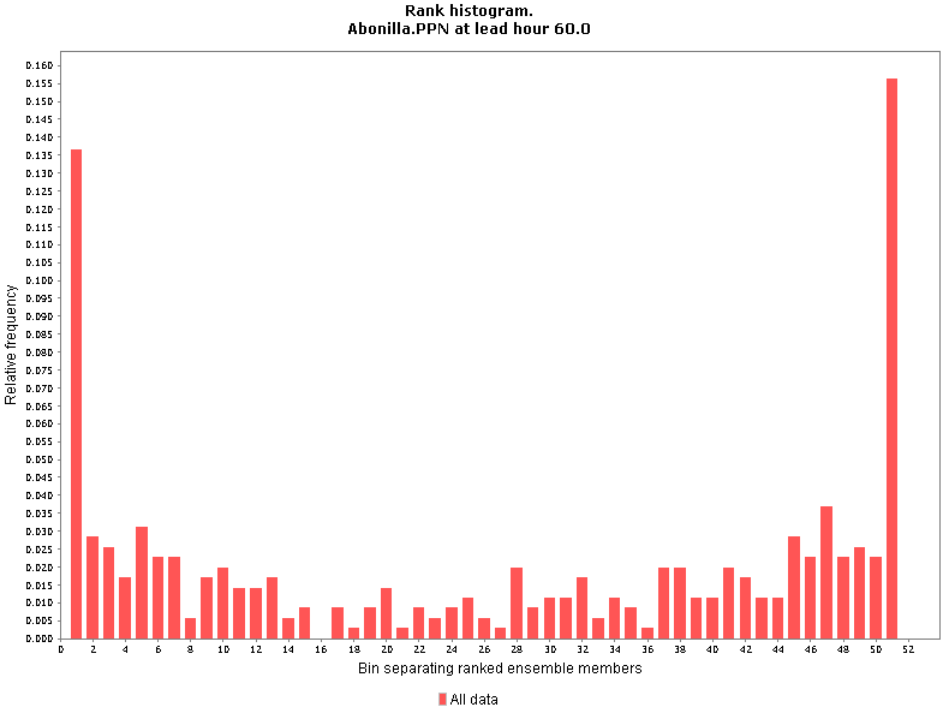
1982/12 1990/09 2000/09 2008/09 2009/09 2010/12

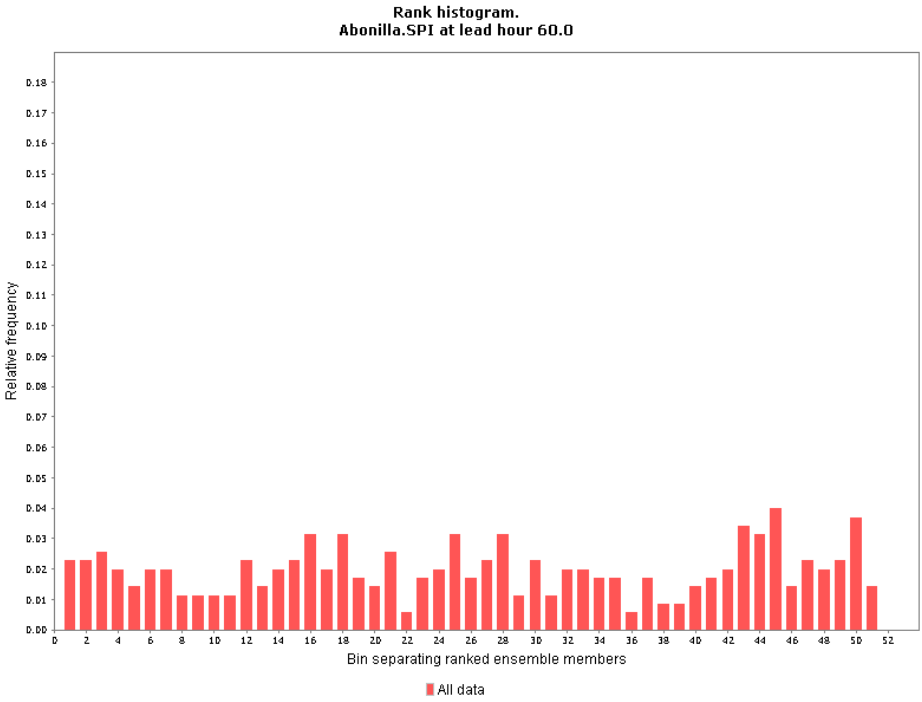
Autocorrelation of SPI-6 series based on resampled rainfall



Rank Histograms for precipitation and SPI-6 forecasts

3 Months 6 Months 12 Months 24 Months 36 Months 60 Months



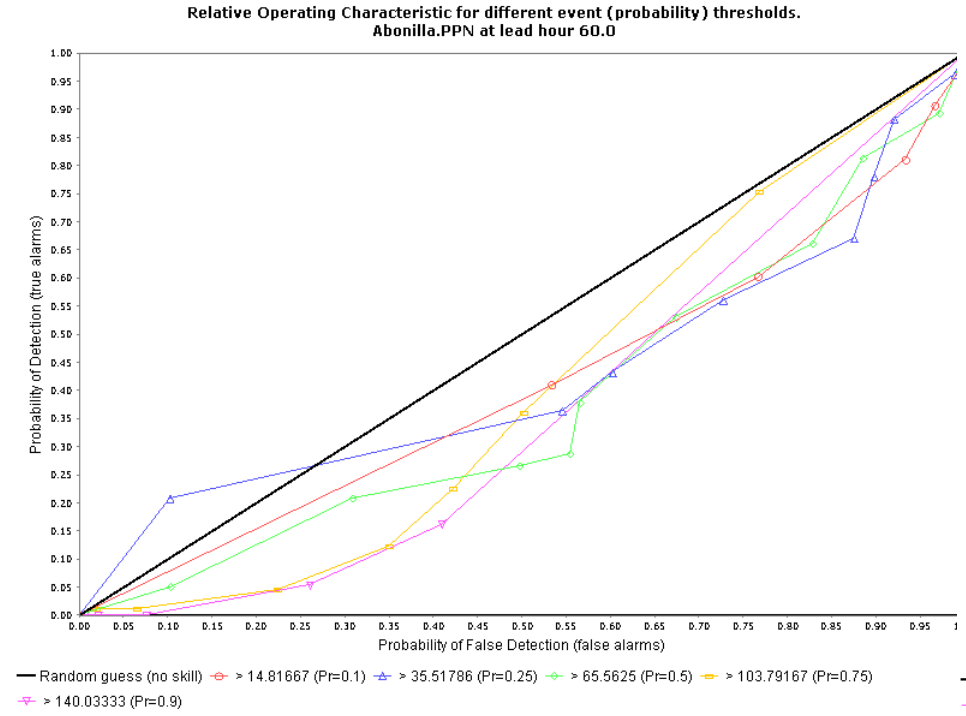


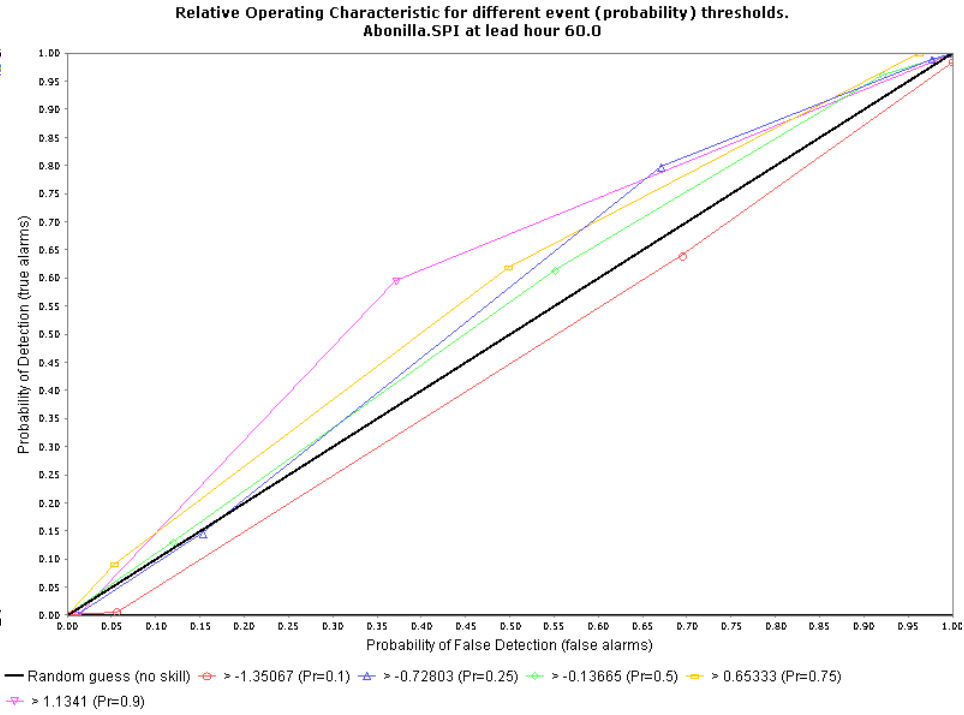
Monthly Precipitation

SPI-06

Relative Operating Characterstic diagrams for precipitation and SPI-6 forecasts

3 Months 6 Months 12 Months 24 Months 36 Months 60 Months





Monthly Precipitation

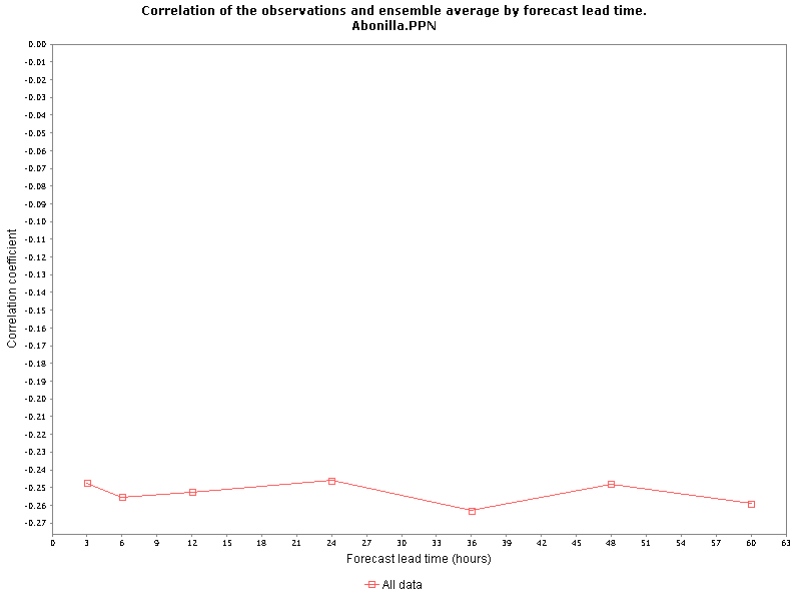
SPI-06

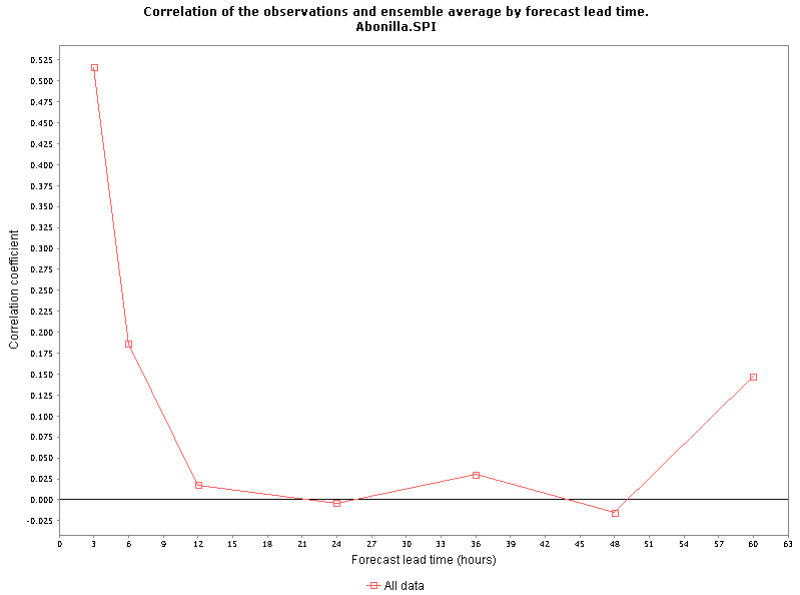
Correlation forecast/observed and MCRPS

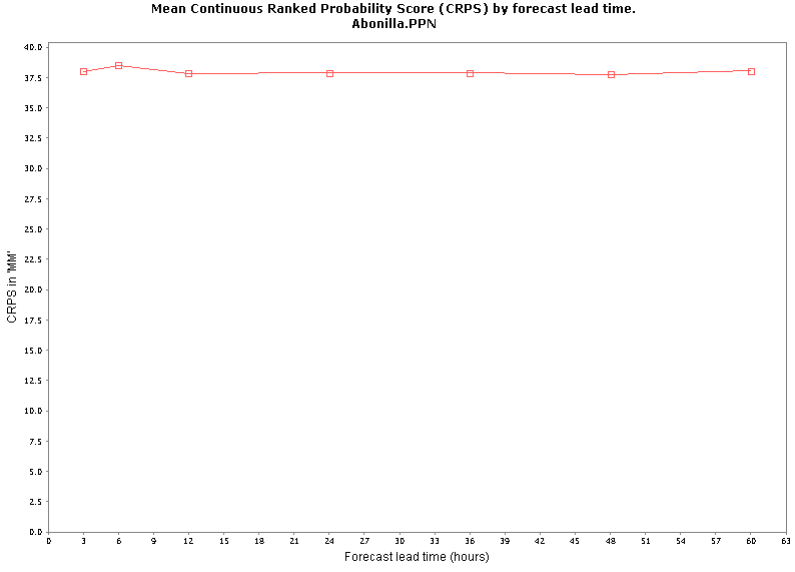
Lead times 0 to 60 months

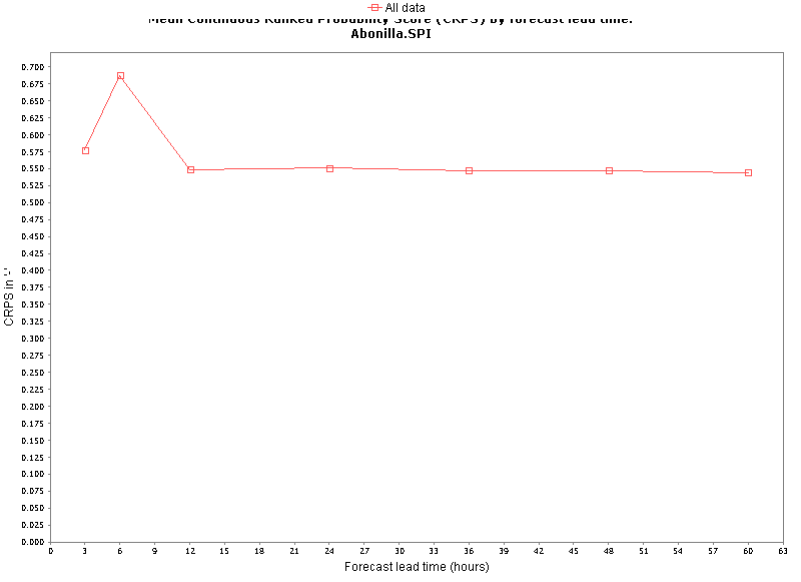
Correlation

MCRPS





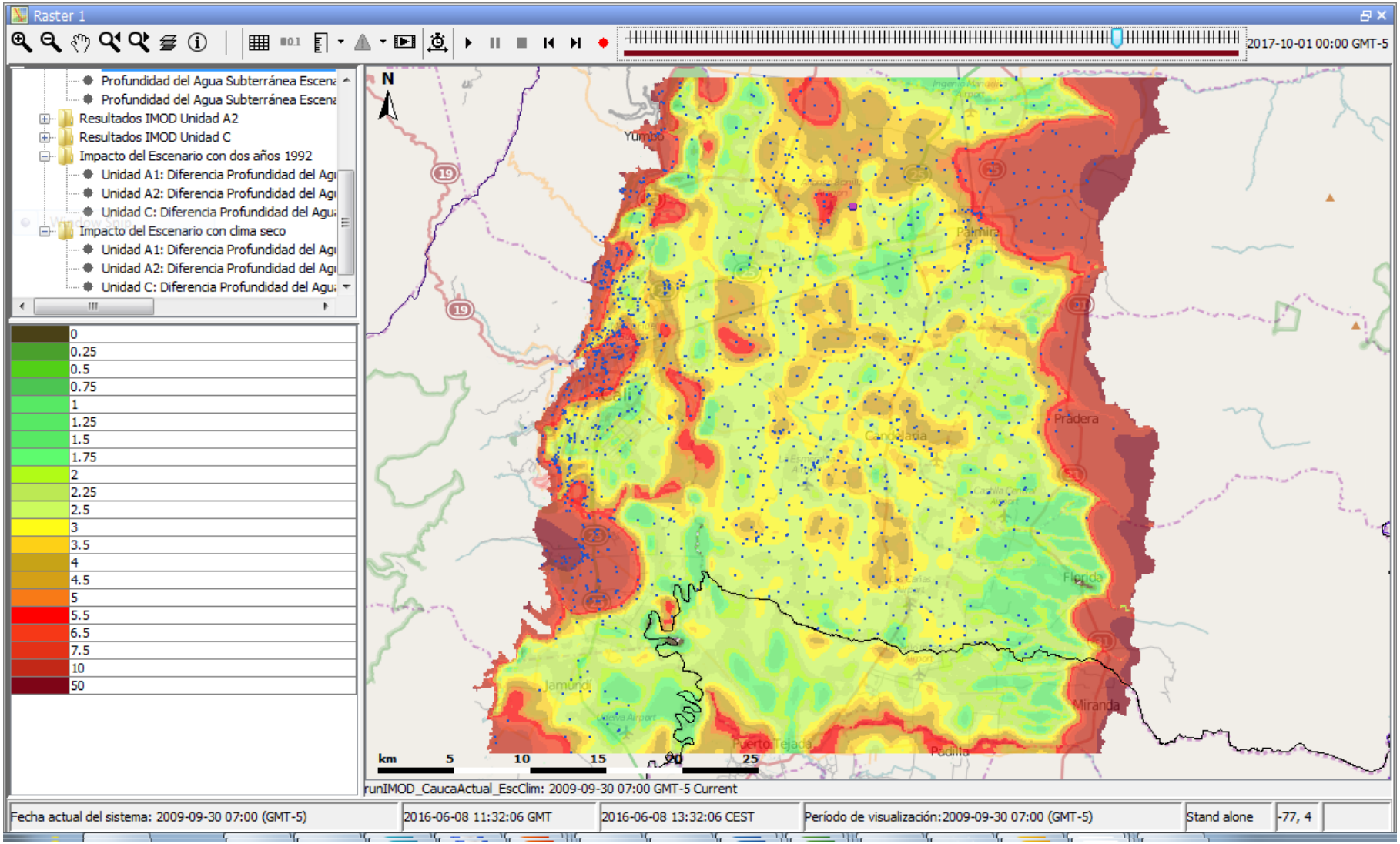




Monthly Precipitation

SPI-06

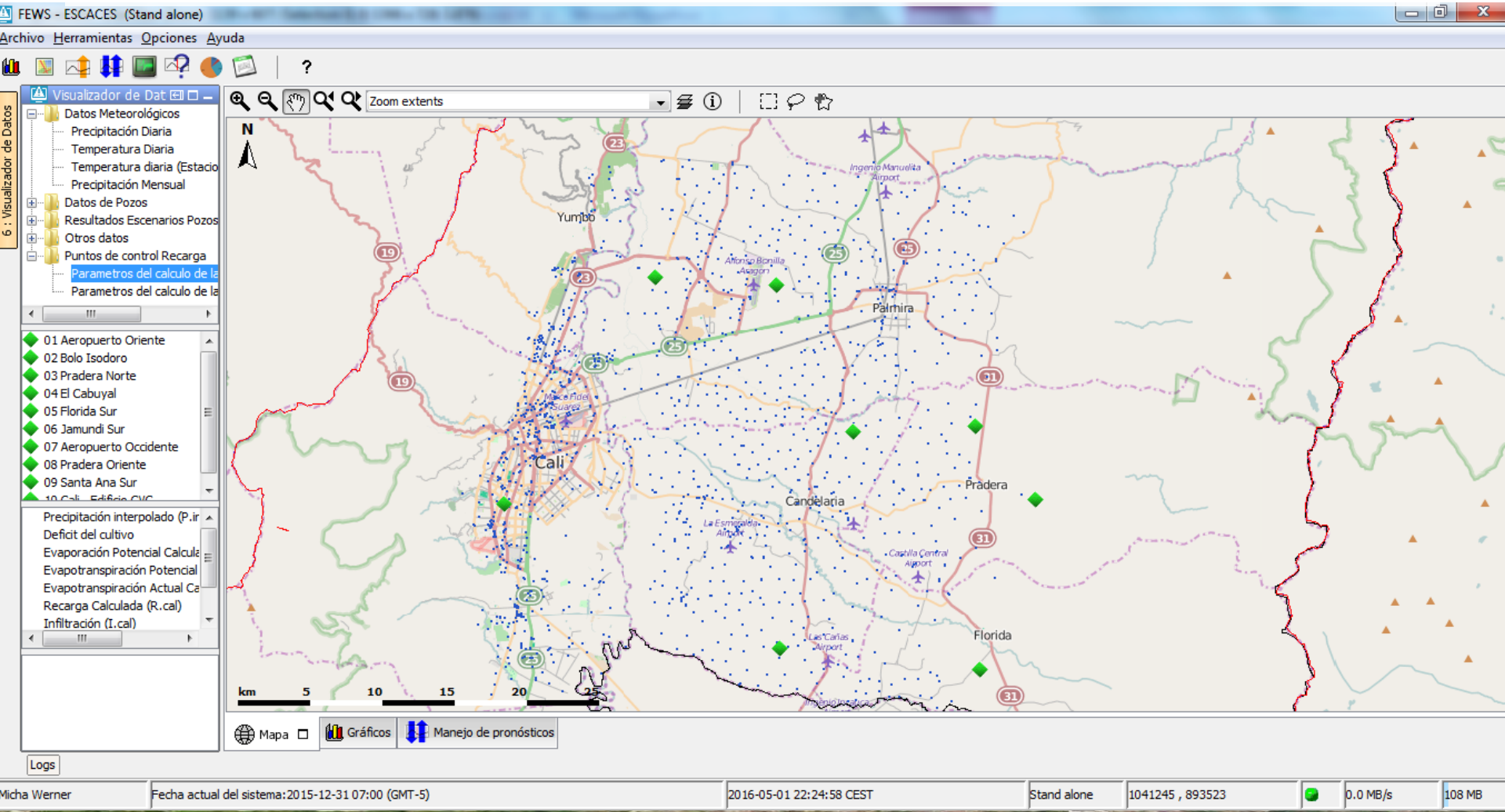
Groundwater Level Scenarios



2009-09 2011-04 2017-10

Scenario of climate variability

Scenario 2015-2025 – conditional on g/w levels & pumping 2015



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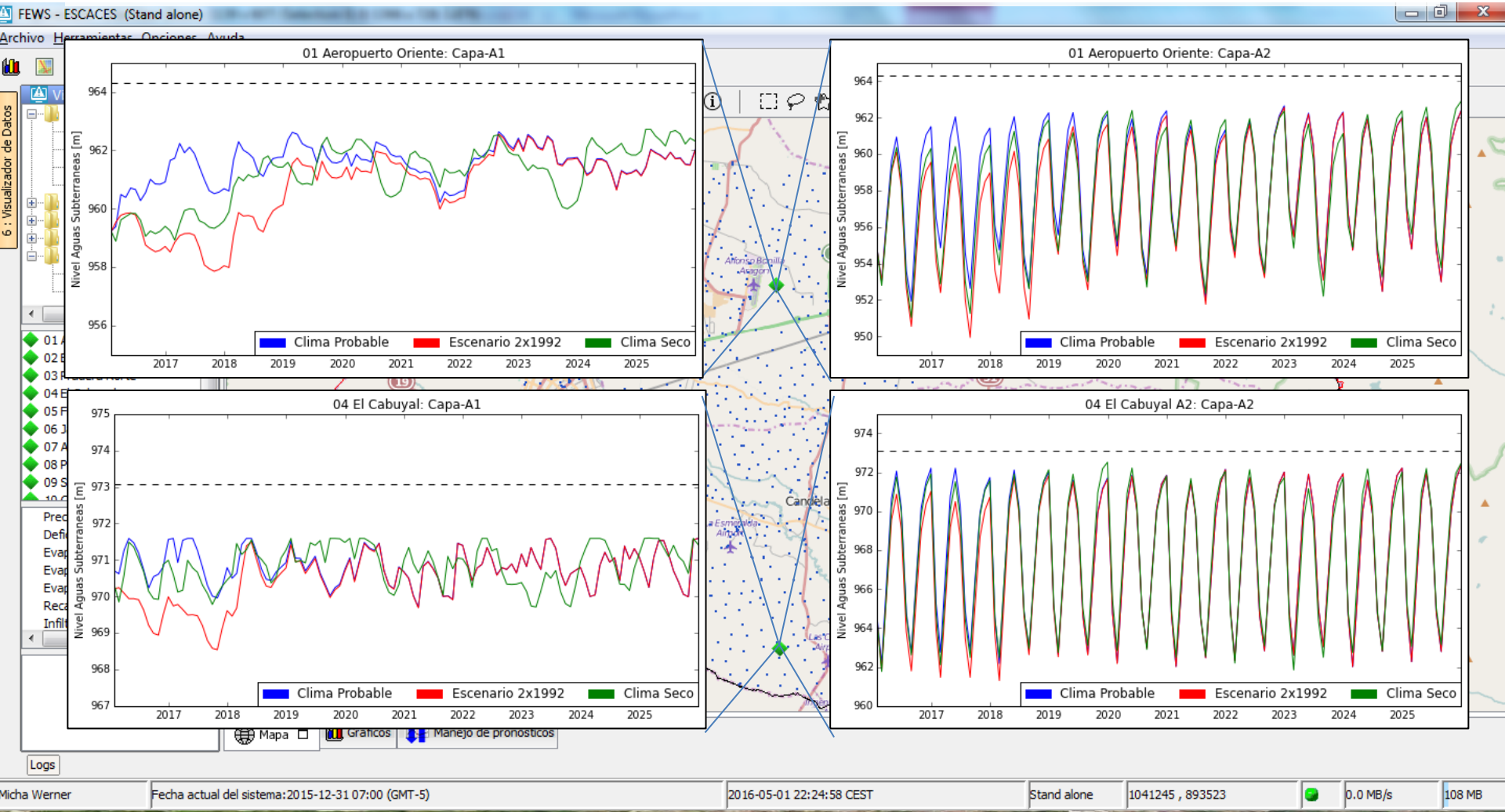

Conclusions & Further Work

- Insight into the development of groundwater resources at the seasonal to scenario timescales – relevant to slow responding groundwater systems

- Approach to developing scenarios conditioned by the current groundwater levels – relatively simple / comprehensible to users

- "Work in progress" – lots of further work to do
  - More elaborate assessment of skill
  - Sensitivity to number of neighbours (K)
  - Weighting of sampled months
  - Sensitivity to other indices (e.g SPI-6 & SPI-12)
  - Conditioning based on predicted indices e.g.
  - Other datasets to re-sample from instead of observed – CHIRPS, Re-analysis,….