Afulilo Water Storage and Outlook Module (AWSOM-2)

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NIWA

Presentation summary

In consultation with the Samoa Electric Power Corporation (EPC) and the Samoa Meteorology Division (SMD), the Afulilo Water Storage Outlook Module (AWSOM) that was developed as a manually operated spreadsheet application prior to COSPPac-1, has now been redeveloped as an automated web application (AWSOM-2). The Afulilo Hydropower Scheme is the largest renewable power scheme in Samoa, and is central to Samoa's goal of becoming 100% renewable in the energy sector by 2030. AWSOM-2 draws on weekly, monthly, and seasonal rainfall forecast products from the ACCESS-S forecasting system, as well as weather and climate forecasts from other global models. Additionally, AWSOM-2 draws on rainfall observations from the dam, dam level measurements conducted by EPC and the Samoa Water Resource Division, and power generation rates being operated by EPC. The model incorporates physical relationships derived from studies of how the reservoir responds to rainfall, water runoff from the upper catchment, and losses from evapotranspiration and seepage.

Samoan Met staff operationally review model outputs, add interpretive commentary from local knowledge and perspectives, and then forward the reservoir storage outlook report to EPC. This enables EPC to consider options for optimising water use for power generation which maintaining a guaranteed electricity supply.

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Presentation to 9th Pacific Islands Climate Outlook Forum

21-22 October 2021

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COSPPac

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Acknowledgements

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  Tauiliili Ekiumeni Fauolo, Leata Tangatauli

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- Samoa Water Resources Division, MNRE

  Emarosa Romeo

- Australian Bureau of Meteorology, BOM

  Amanda Amjadali, Grant Beard, Tony Falkland, Simon McGree, Jason Smith, Louise Wicks,

- Pacific Islands Ocean Observing System, PACIOOS

  Yi-Leng Chen

- National Oceanic and Atmospheric Administration, NOAA

  National Weather Service (NCEP), National Centers for Environmental Prediction (NCEP)

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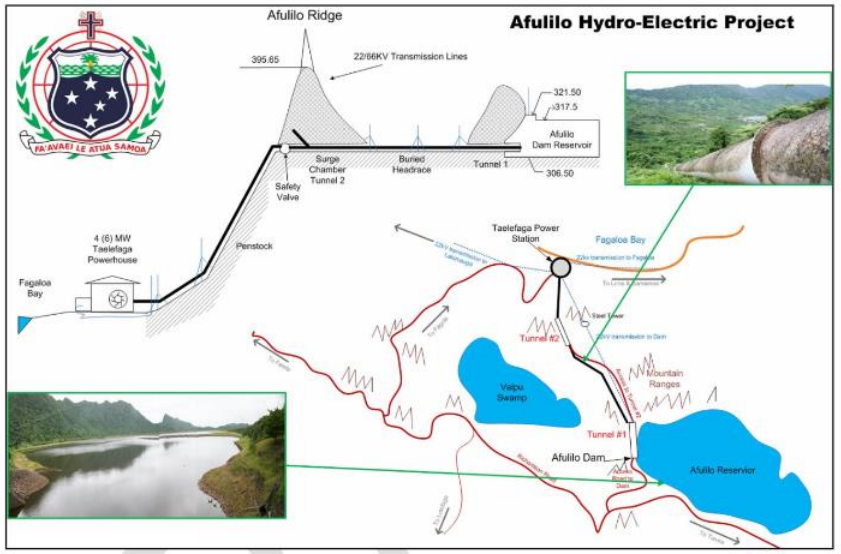
Afulilo Hydropower Scheme – background

- Annual rainfall ~ 5000 mm
- Catchment 11.84 km^2
- 10,000 ML stored generation potential: 310 to 317.6 m AMSL
- 4 MW/h generation capacity
- Aim to fine tune operational decisions to enhance management of the available water resources of the reservoir
- Reduce reliance on fossil fuels
- Samoa aims to be energy self-sufficient by 2030

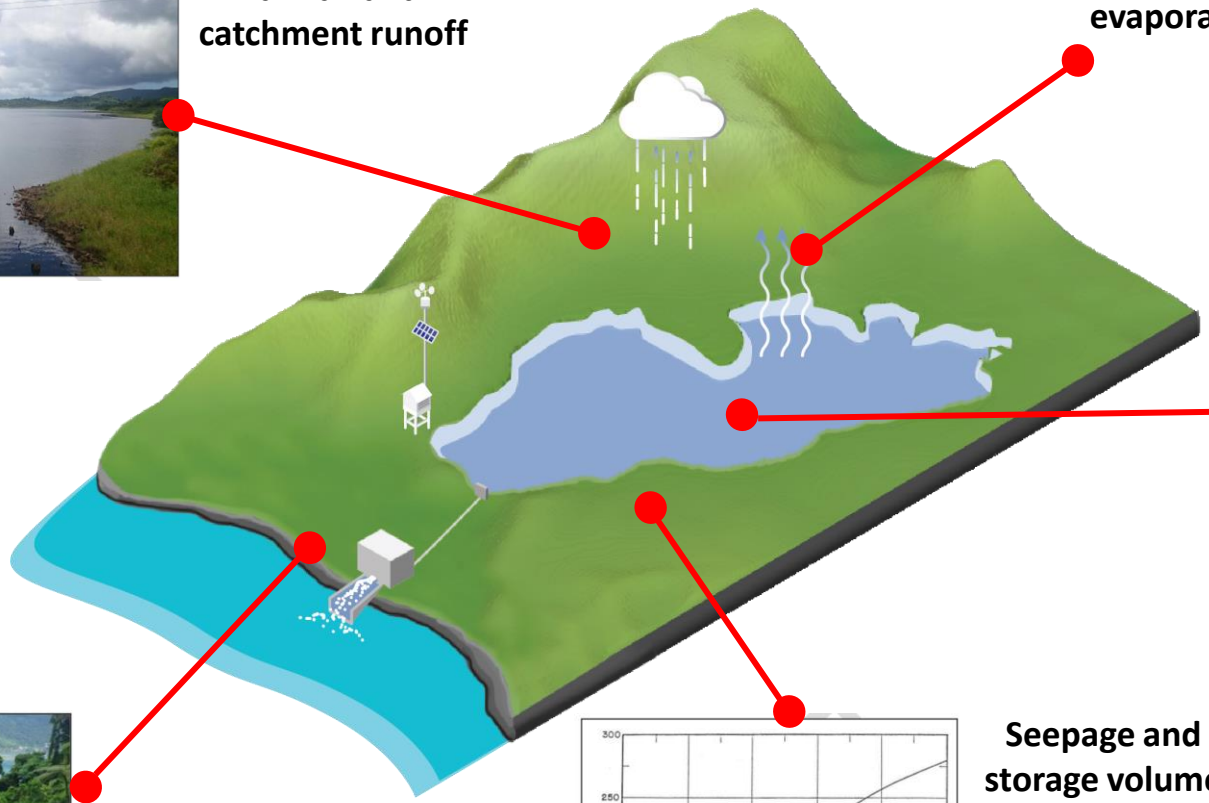
Afulilo Water Storage and Outlook Model (AWSOM-2): Upgrading the model

- From SCOPIC to ACCESS-S seasonal forecasts
- Move from monthly to sub-daily model runs
- Incorporate weather forecasts
- Automatic ingest of real-time rainfall and dam level measurements
- Enable run-time options for storage outlook scenarios
- Provide additional seasonal climate information for advance planning.

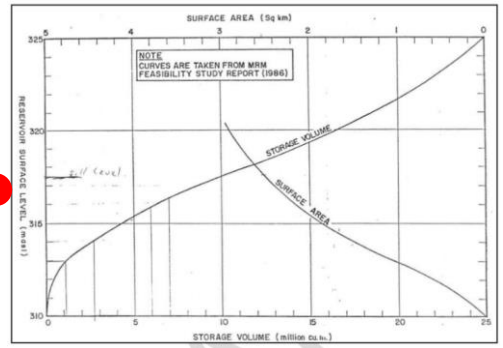


AWSOM-2: Physical features

Rainfall and catchment runoff

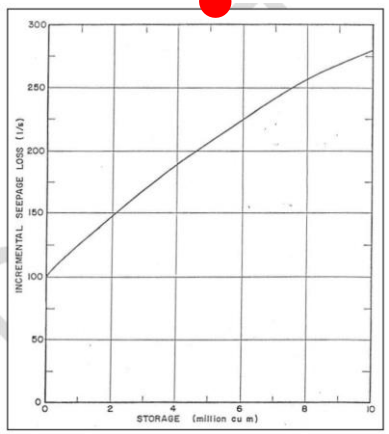


Surface area and evaporation



Surface area and storage volume

Outflow and power generation



Seepage and storage volume

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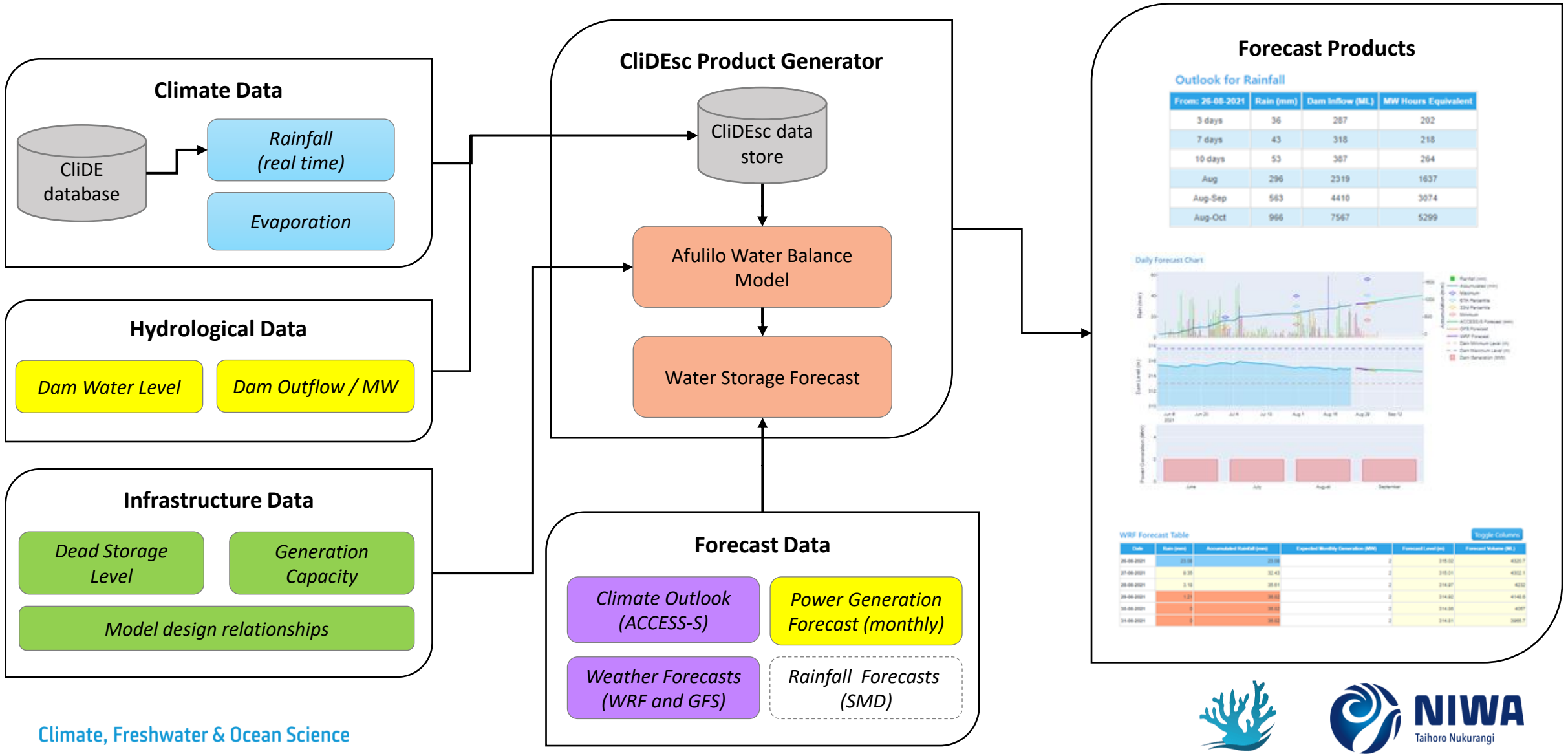
AWSOM-2: model components



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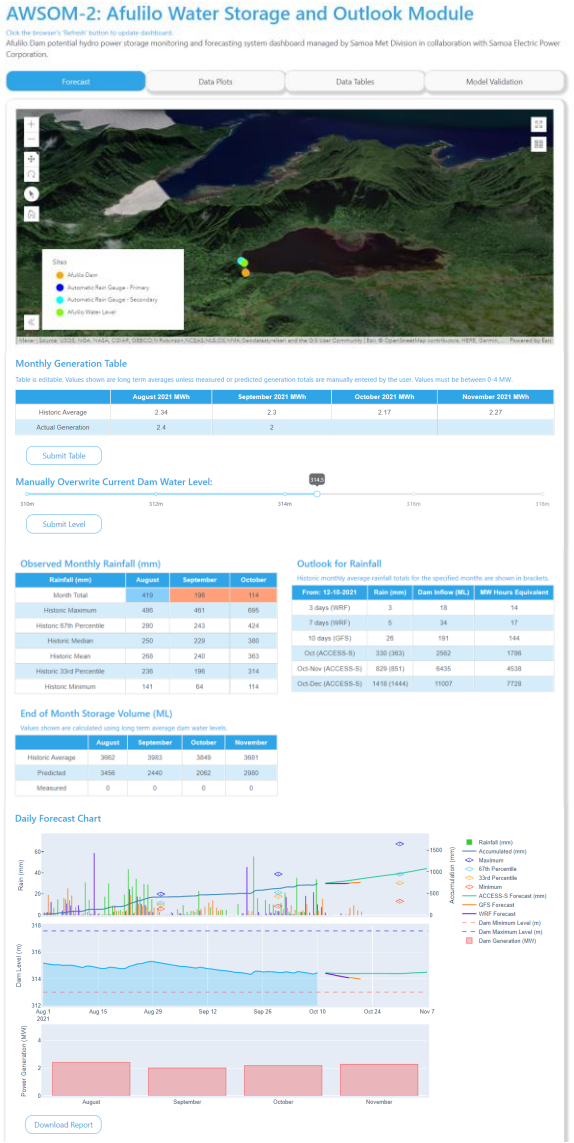
AWSOM-2: Run time options

- Application accessed via CliDEsc's product catalogue and viewed in a web browser.

- The user can edit the Monthly Generation Table to:
  - add actual generation for past months
  - add expected generation for future months
  - test the impact of future energy generation scenarios

- The impact of changes to the Monthly Generation Table on the dam's storage volume can be reviewed in the forecast charts and data tables.



AWSOM-2: Run time options

Monthly Generation Table

Table is editable. Values shown are long term averages unless measured or predicted generation totals are manually entered by the user. Values must be between 0-4 MW.

	August 2021 MWh	September 2021 MWh	October 2021 MWh	November 2021 MWh
Historic Average	2.34	2.3	2.17	2.27
Actual Generation	2.4	2	4	4

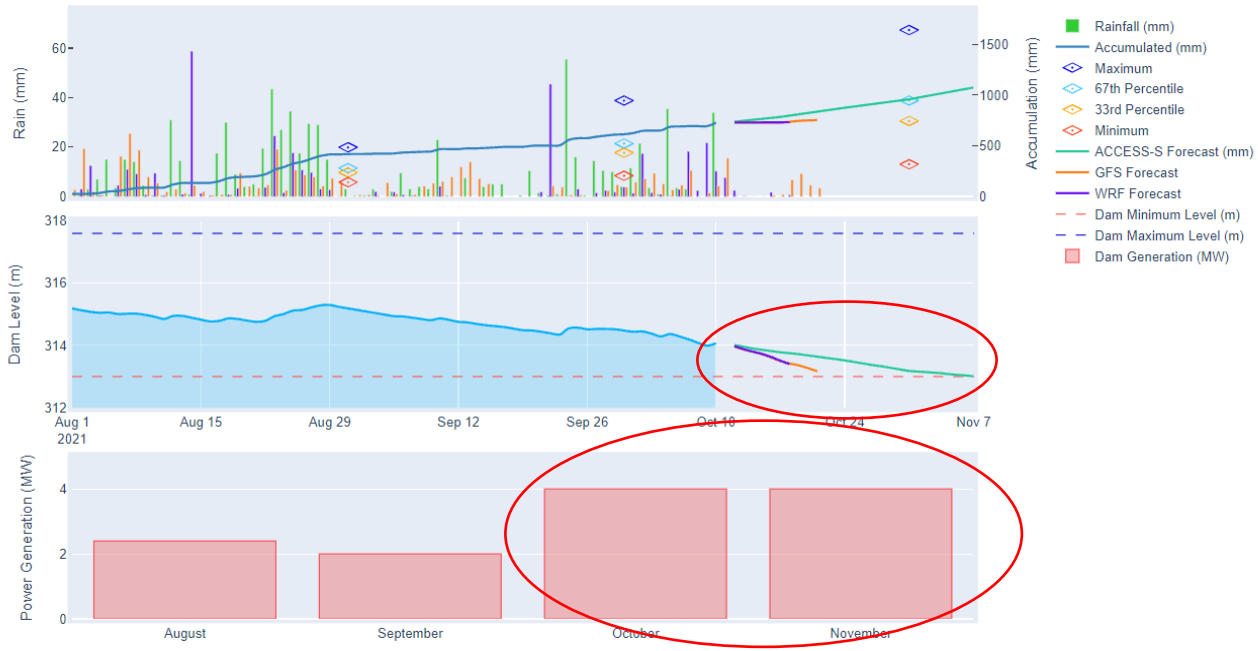
Submit Table

Manually Overwrite Current Dam Water Level

310m 312m

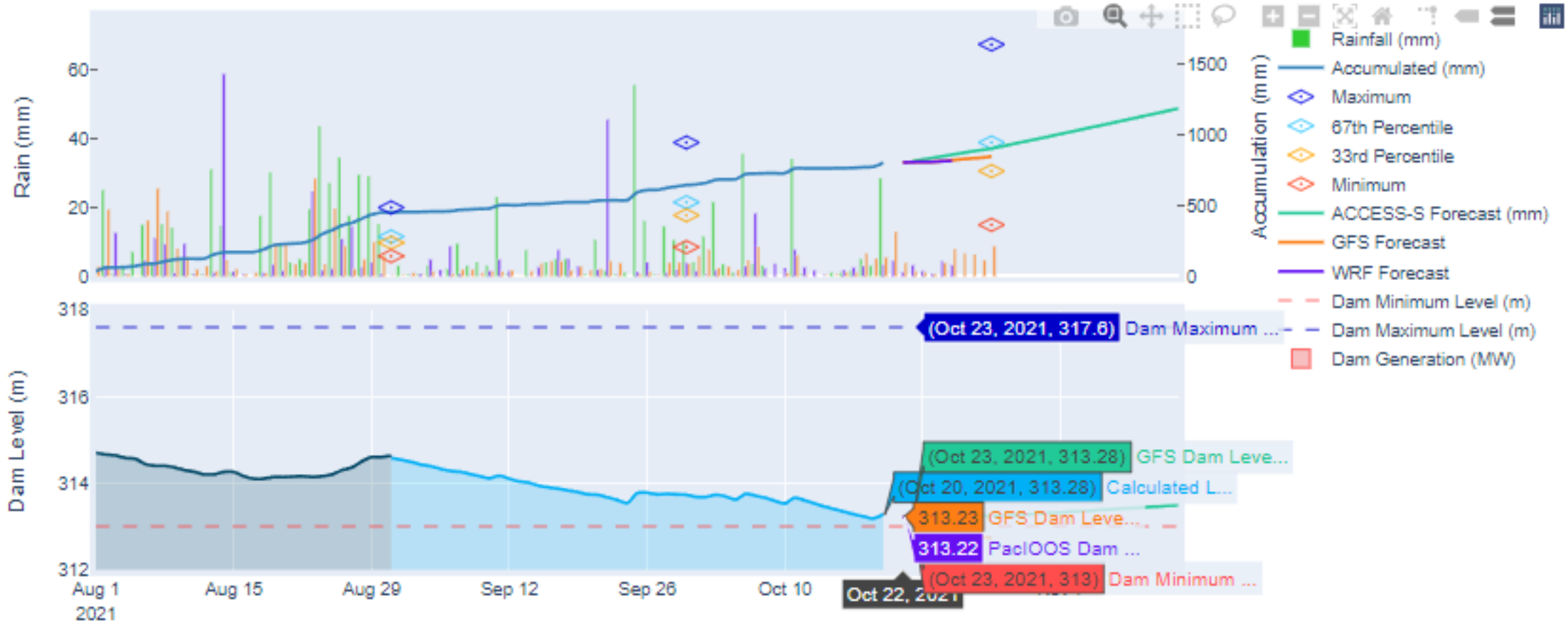
Submit Level

Daily Forecast Chart



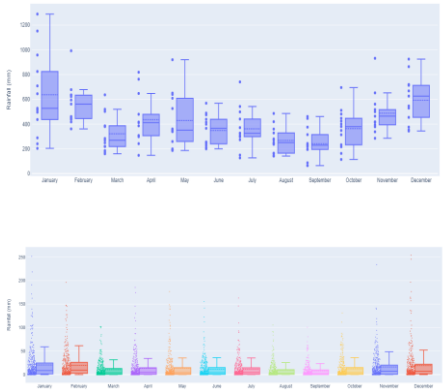
Download Report

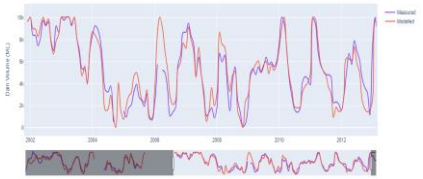
Daily Forecast Chart

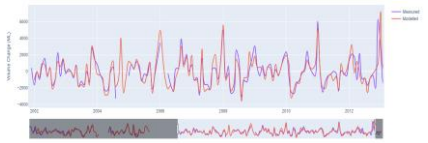


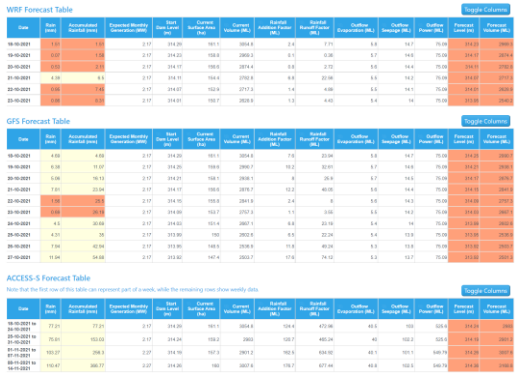
AWSOM-2: System output

- Track and display dam water level over past three months and forecast level for the coming month and longer
- Show rainfall forecasts and impacts on dam storage volumes
  - 3 days
  - 7 days
  - 10 days
  - 1 month
- Estimate dam inflows and hence MWh potential of incoming rainfall









AWSOM-2: Afulilo Water Storage and Outlook Module

Afulilo Dam potential hydro power storage monitoring and forecasting system dashboard managed by Samoa Met Division in collaboration with Samoa Electric Power Corporation.

Monthly Generation Table

Values shown are long term averages unless measured or predicted generation totals are manually entered by the user.

	August 2021 MWh	September 2021 MWh	October 2021 MWh	November 2021 MWh
Historic Average	2.34	2.3	2.17	2.27
Actual Generation	2.34	2.3	NaN	NaN

Observed Monthly Rainfall (mm)

Rainfall (mm)	August	September	October
Month Total	450	194	158
Historic Maximum	486	461	695
Historic 67th Percentile	280	243	424
Historic Median	250	229	380
Historic Mean	270	240	367
Historic 33rd Percentile	236	194	314
Historic Minimum	141	64	158

Outlook for Rainfall

Historic monthly average rainfall totals for the specified months are shown in brackets.

From: 21-10-2021	Rain (mm)	Dam Inflow (ML)	MW Hours Equivalent
3 days (WRF)	9	56	36
7 days (WRF)	18	117	84
10 days (GFS)	47	336	240
Oct (ACCESS-S)	334 (367)	2527	1786
Oct-Nov (ACCESS-S)	795 (854)	6015	4246
Oct-Dec (ACCESS-S)	1421 (1447)	10752	7507

End of Month Storage Volume (ML)

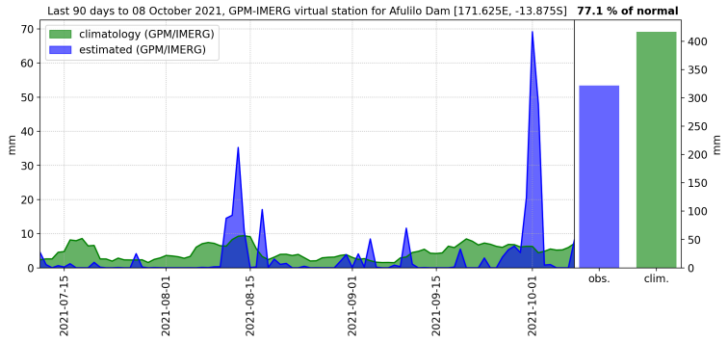
Values shown are calculated using long term average dam water levels.

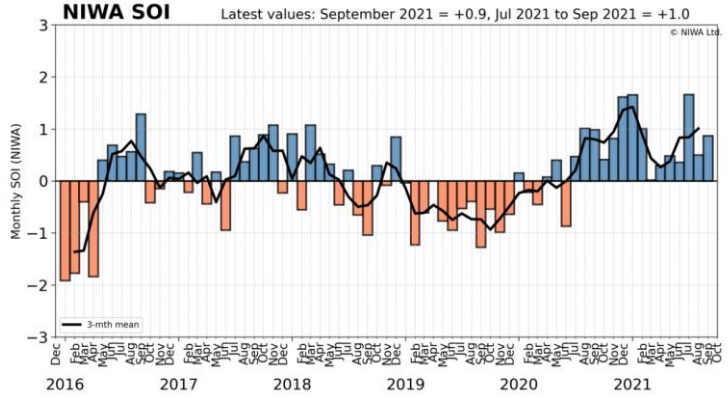
	August	September	October	November
Historic Average	3662	3983	3849	3681
Predicted	3539	2207	1868	2513
Measured	0	0	0	0

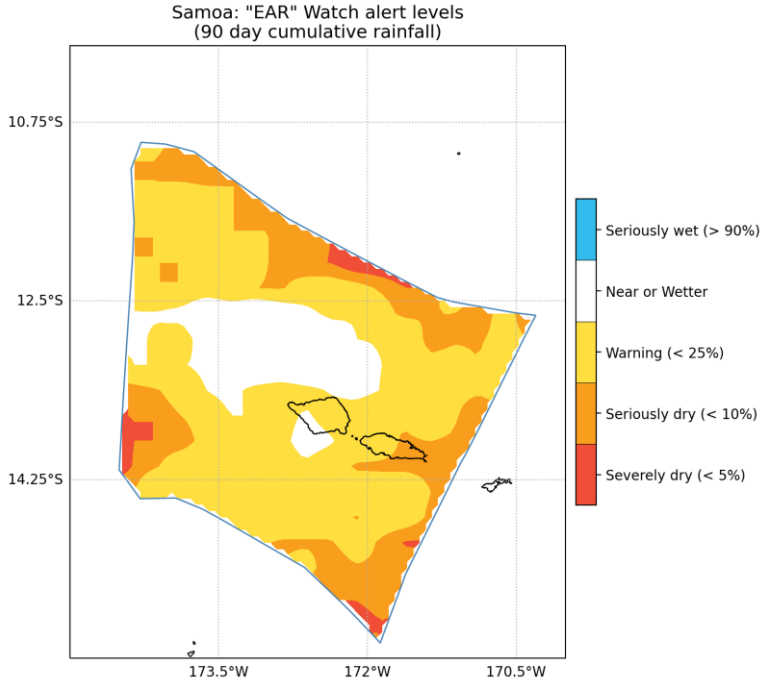
Forecast Chart

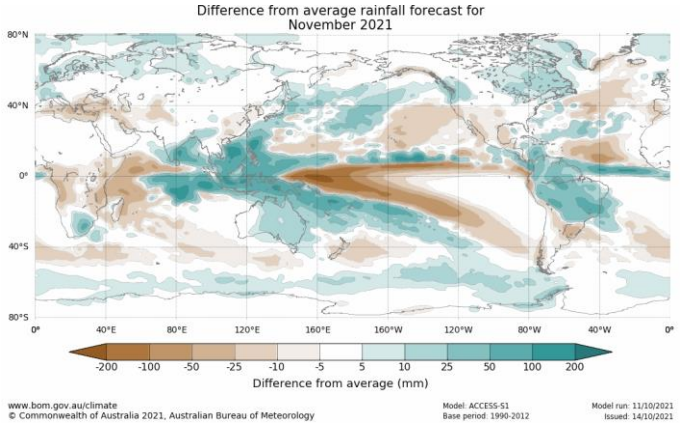
Powered by CliDEsc. 21-10-2021, 22:56:22

Decision support: customised clidesc portal for EPC



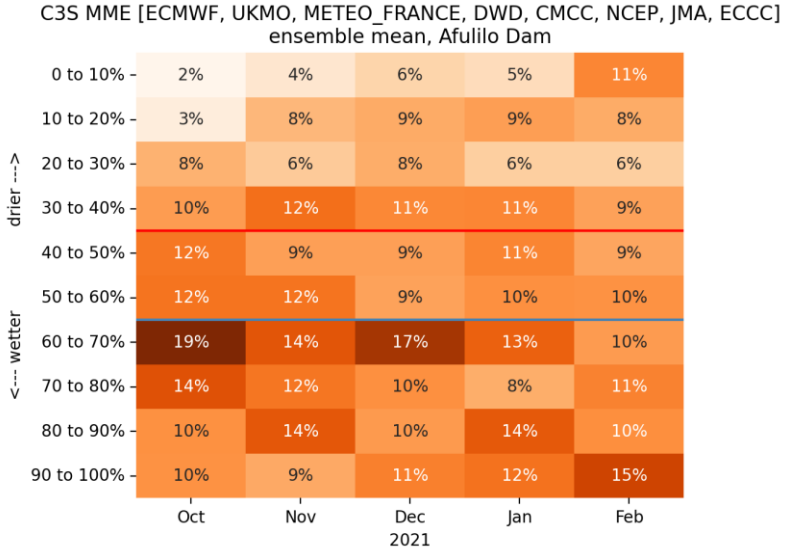






Many options for customisation

- Afulilo storage outlook report
- Model performance tracking
- Regional data/context
- ENSO outlook



AWSOM-2: Future development

- Validation and further customisation – focus on key decision making schedules
- Improve catchment scale physical features modelling eg lag time for catchment runoff
- Integrate with EPC data management system as needed (SCADA)
- Add option for rainfall forecast intervention from Samoa Met Division forecasts
- Incorporate spillway losses (rare)
- Improve integration of seasonal scale storage planning
- Incorporate real time dam level monitoring (in progress)

Afulilo Water Storage and Outlook Module – AWSOM-2

Nga mihi kia koutou, tena koutou katoa
Thank you for listening to my presentation.

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