How to Use H SAF Snow Extent Products for Snowmelt Runoff Predictions

Aynur Şensoy, Gökçen Uysal, A.Arda Şorman

Eskişehir Technical University, Eskişehir, Turkey
asensoy@eskisehir.edu.tr

Satellite Snow Data and Modeling

Satellite snow data have been used in hydrologic models:

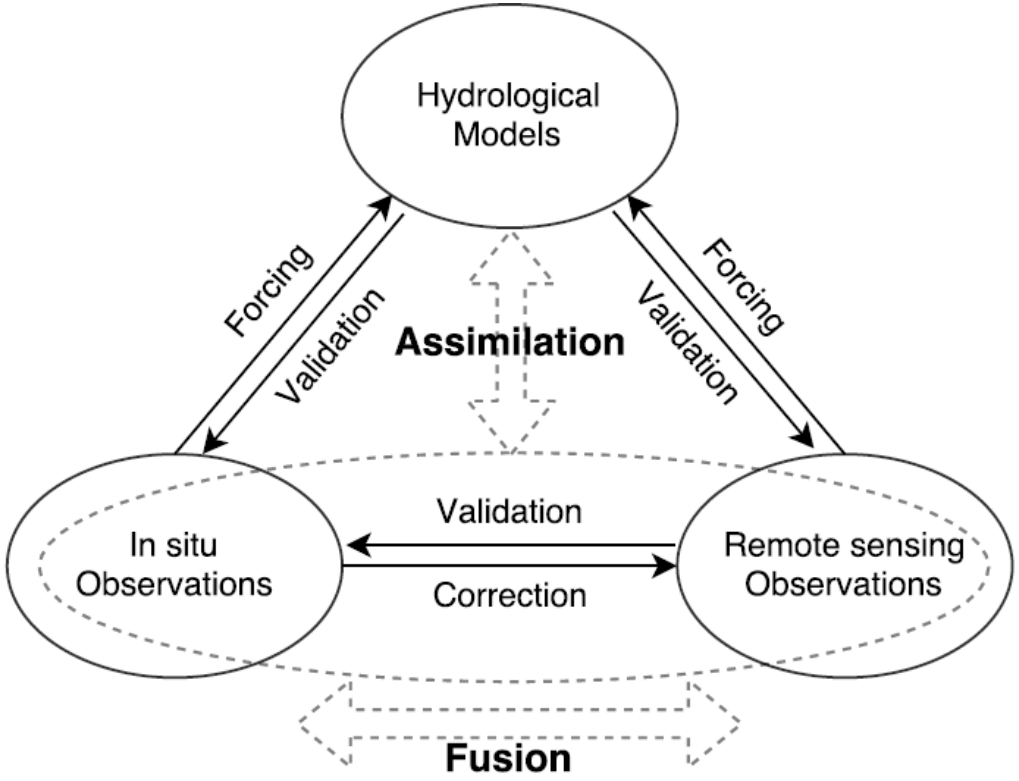
a) to assign model forcing

b) to set model initial conditions

c) as time-varying state data

For the purpose of water resources planning and management decisions on

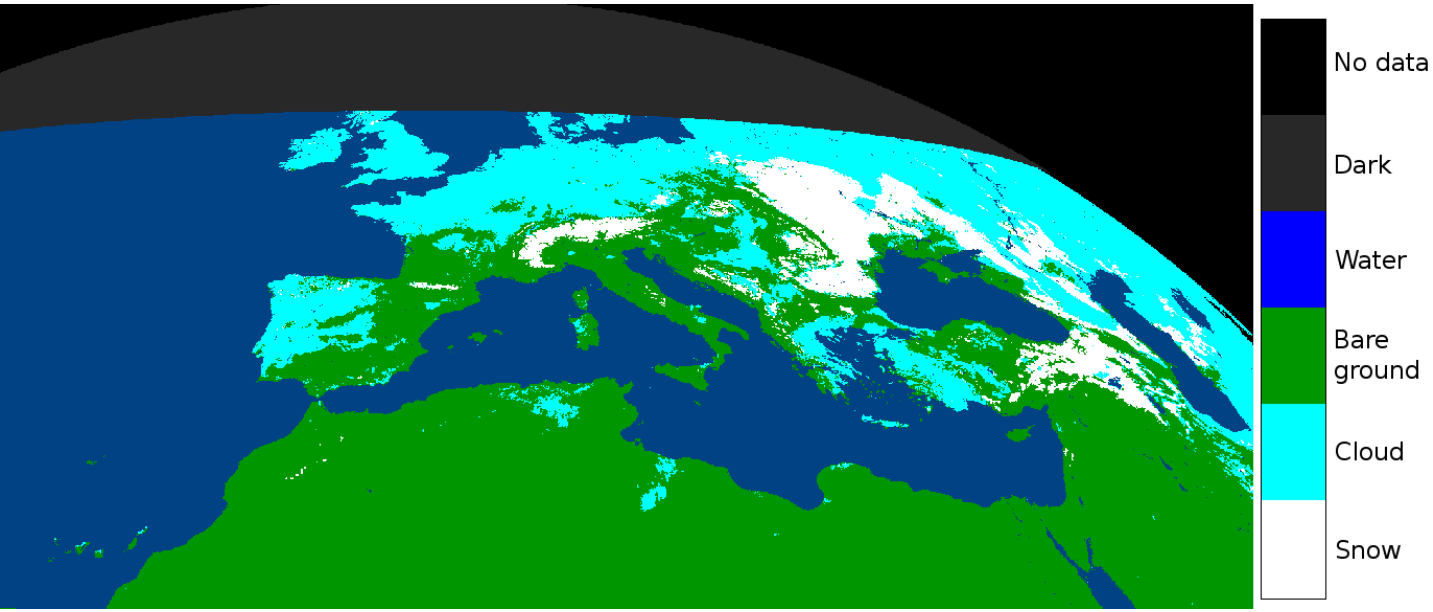
- Flood
- Drought
- Forecasting
- Reservoir operation
- Climate change, etc.



Dong, C. (2018). Remote sensing, hydrological modeling and in situ observations in snow cover research: A review. *Journal of Hydrology*, *561*, 573-583.

Satellite Snow Data: SE-E-SEVIRI(H10), Snow Cover Area

Snow detection (snow mask) by VIS/IR radiometry



SE-E-SEVIRI(H10)

https://hsaf.meteoam.it/Products/Detail?prod=H10

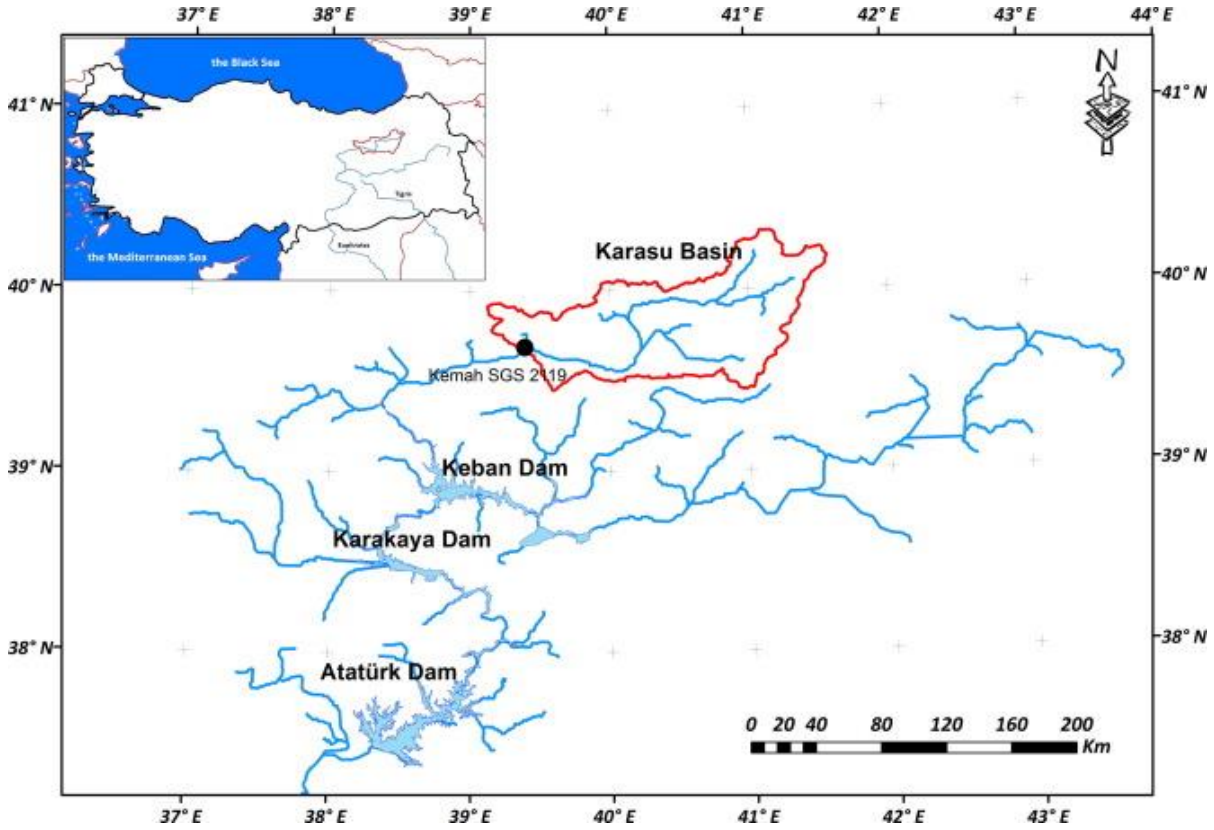
- **Coverage**: The H-SAF area [25-75°N lat, 25°W-45°E long]
- **Cycle**: Daily
- **Resolution**: 1 to 5 km
- **Accuracy**: POD 95 %, FAR 10 % - Depending on geographical situation (flat/forested areas, mountainous regions)
- **Timeliness**: Fixed time of the day, product updated to account for data available until 1 h before delivery

Study Area: Upper Euphrates Basin, Turkey

Upper Euphrates Basin (Karasu), Turkey:

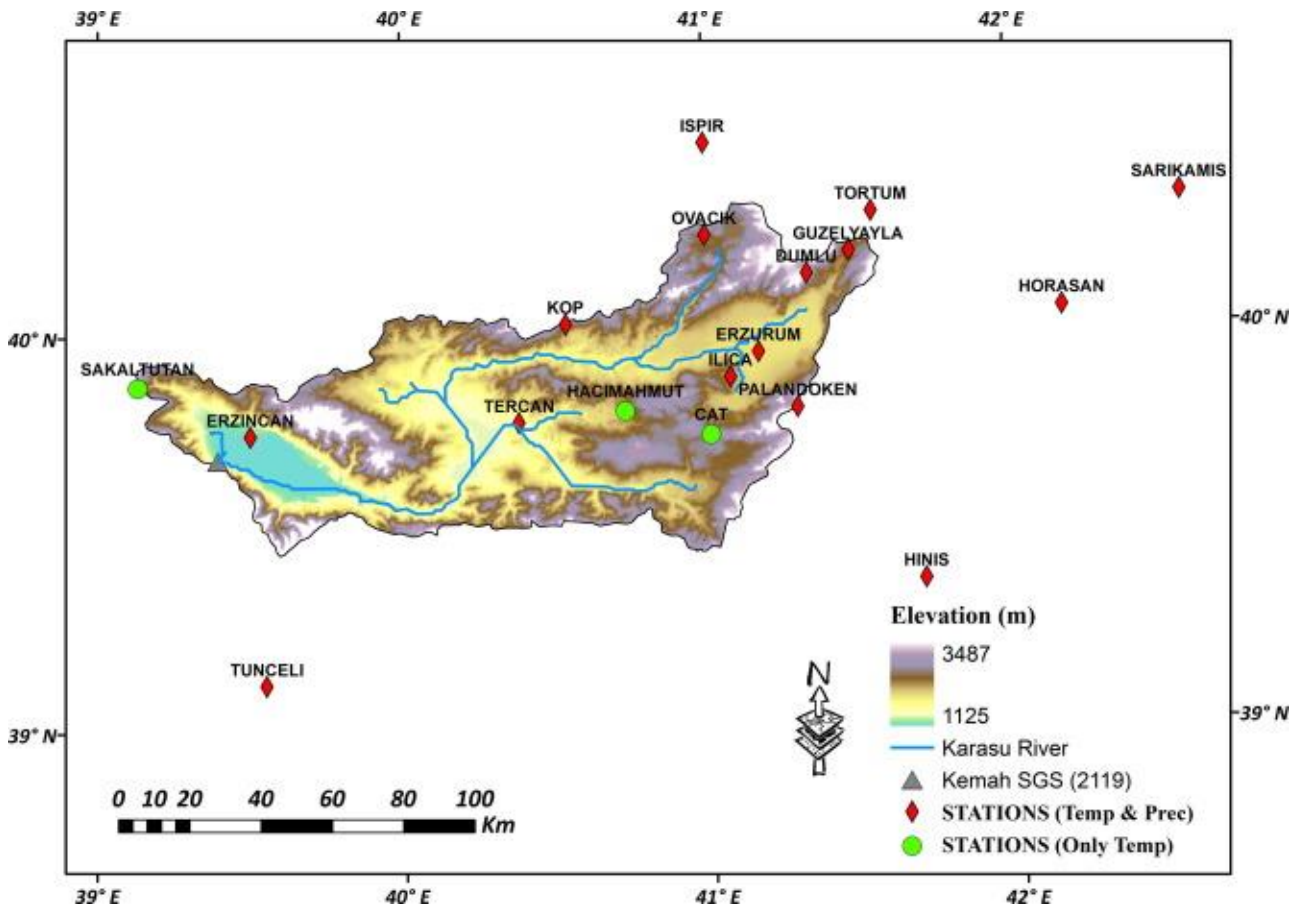
Area: 10,275 km^2

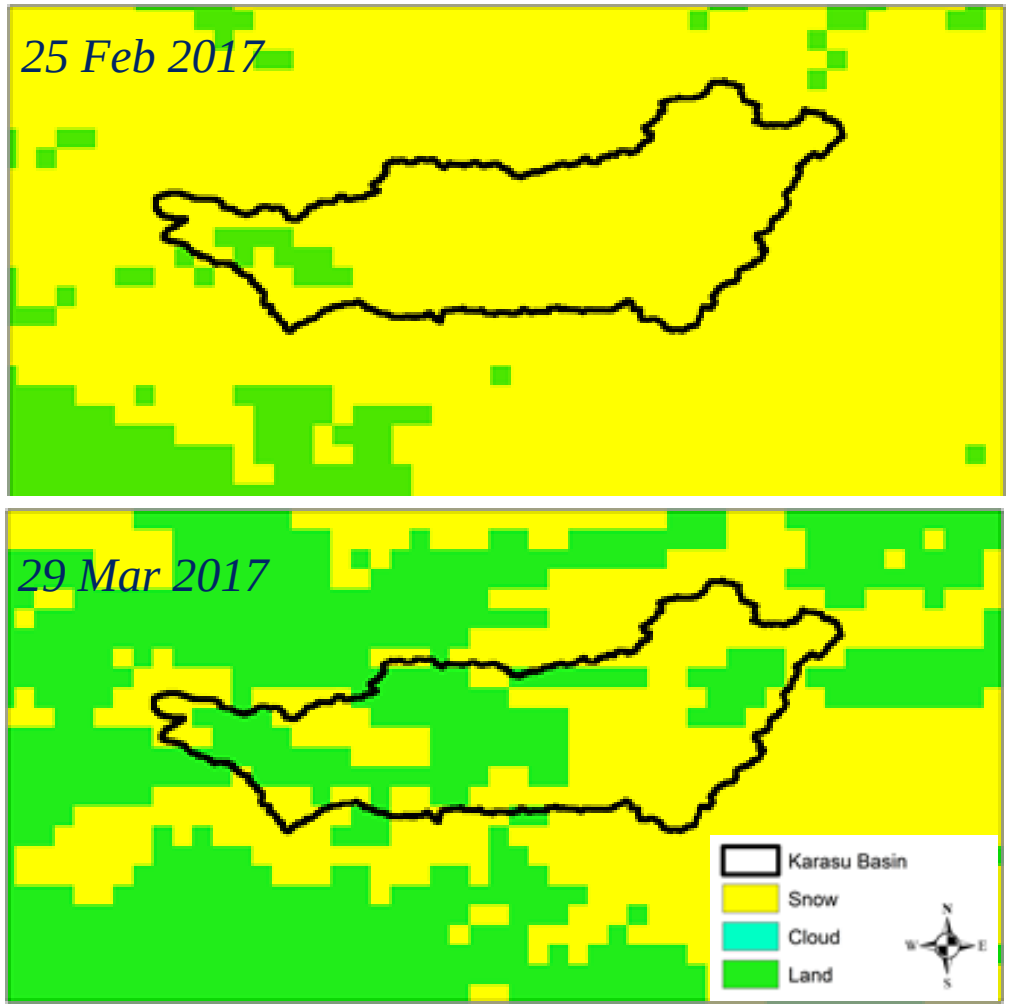
Elevation between 1125 and 3487 m



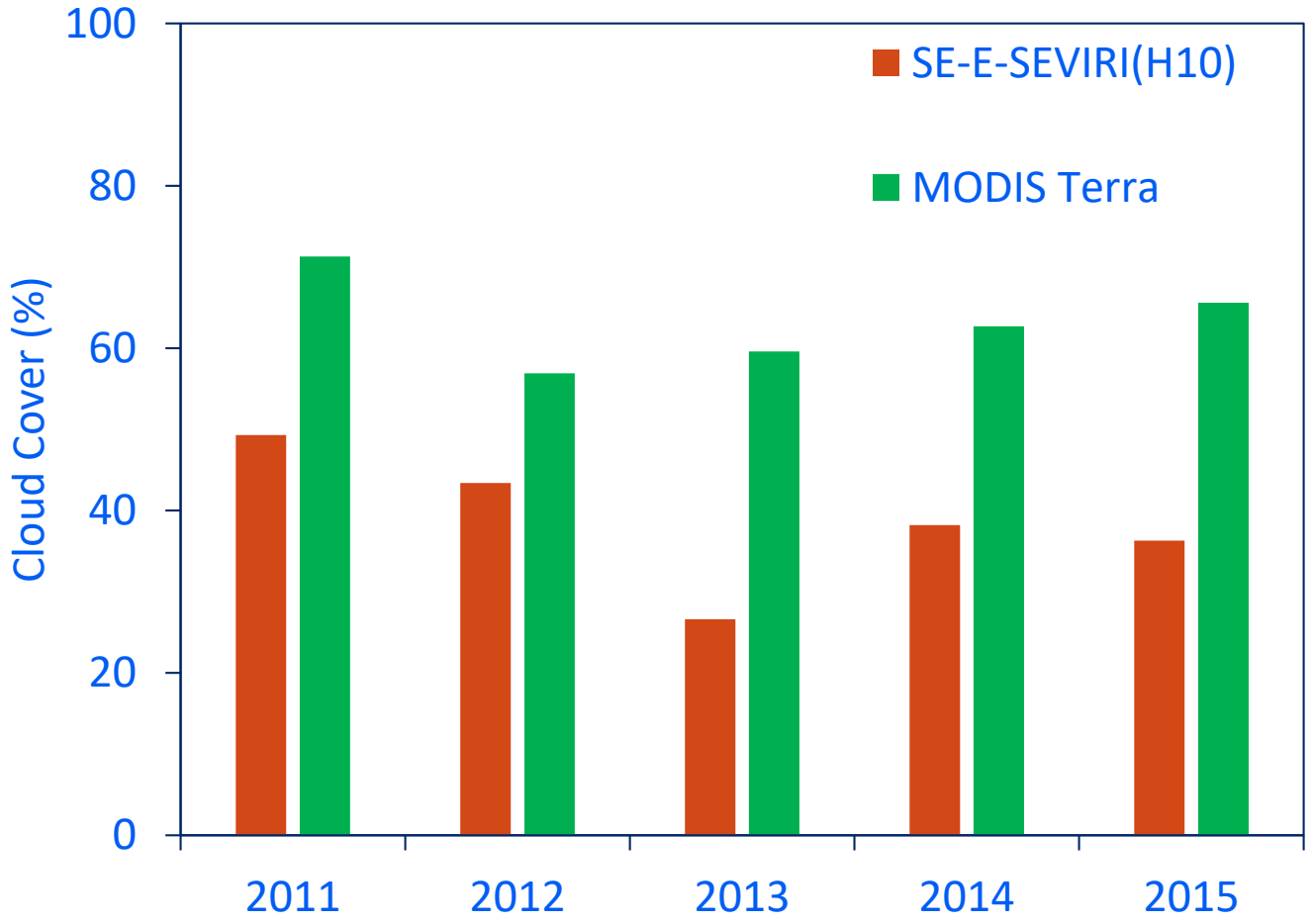
https://blogs.egu.eu/divisions/hs/2020/10/28/water-towers-of-mesopotamia/

Study Area: Observation Network

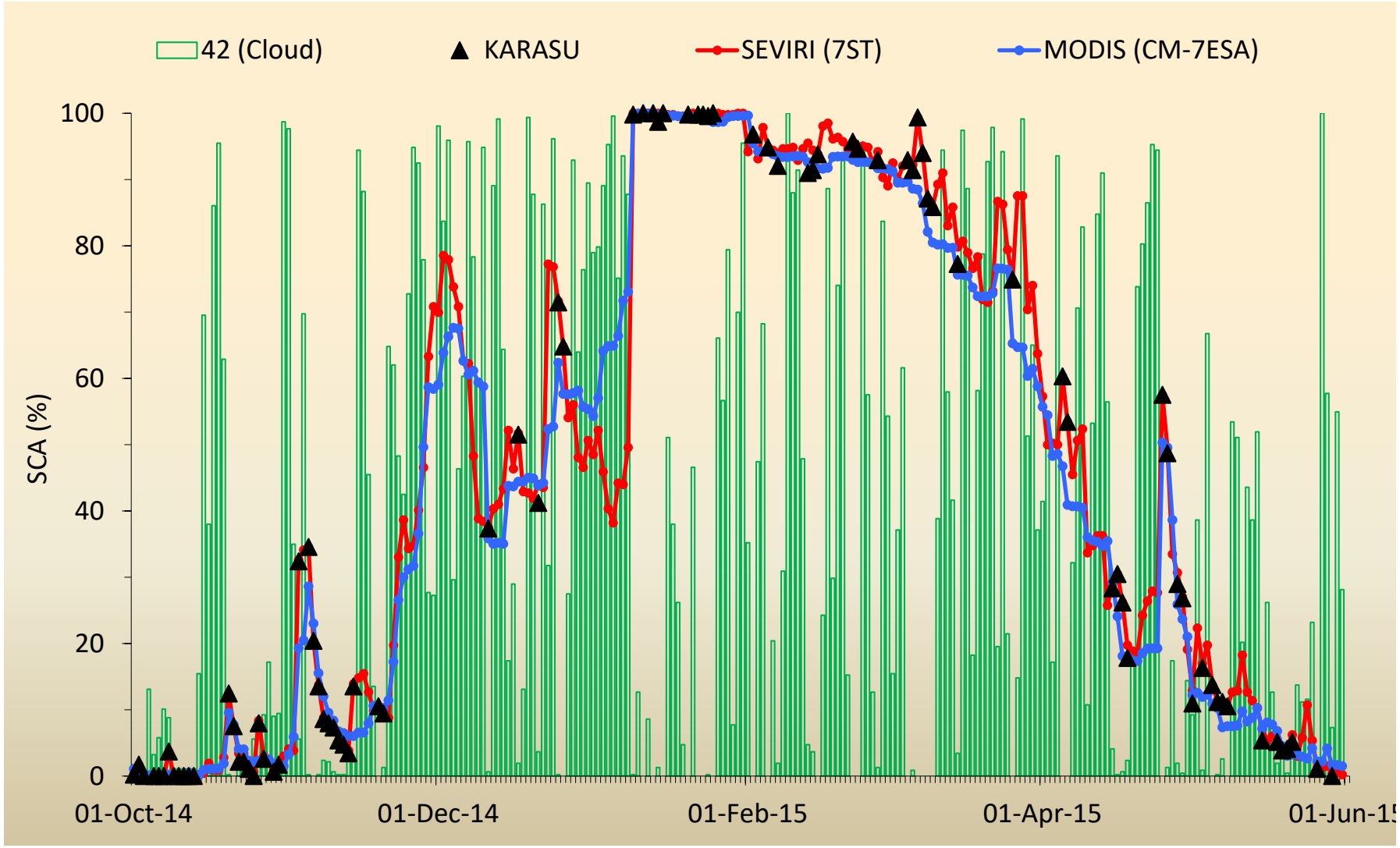




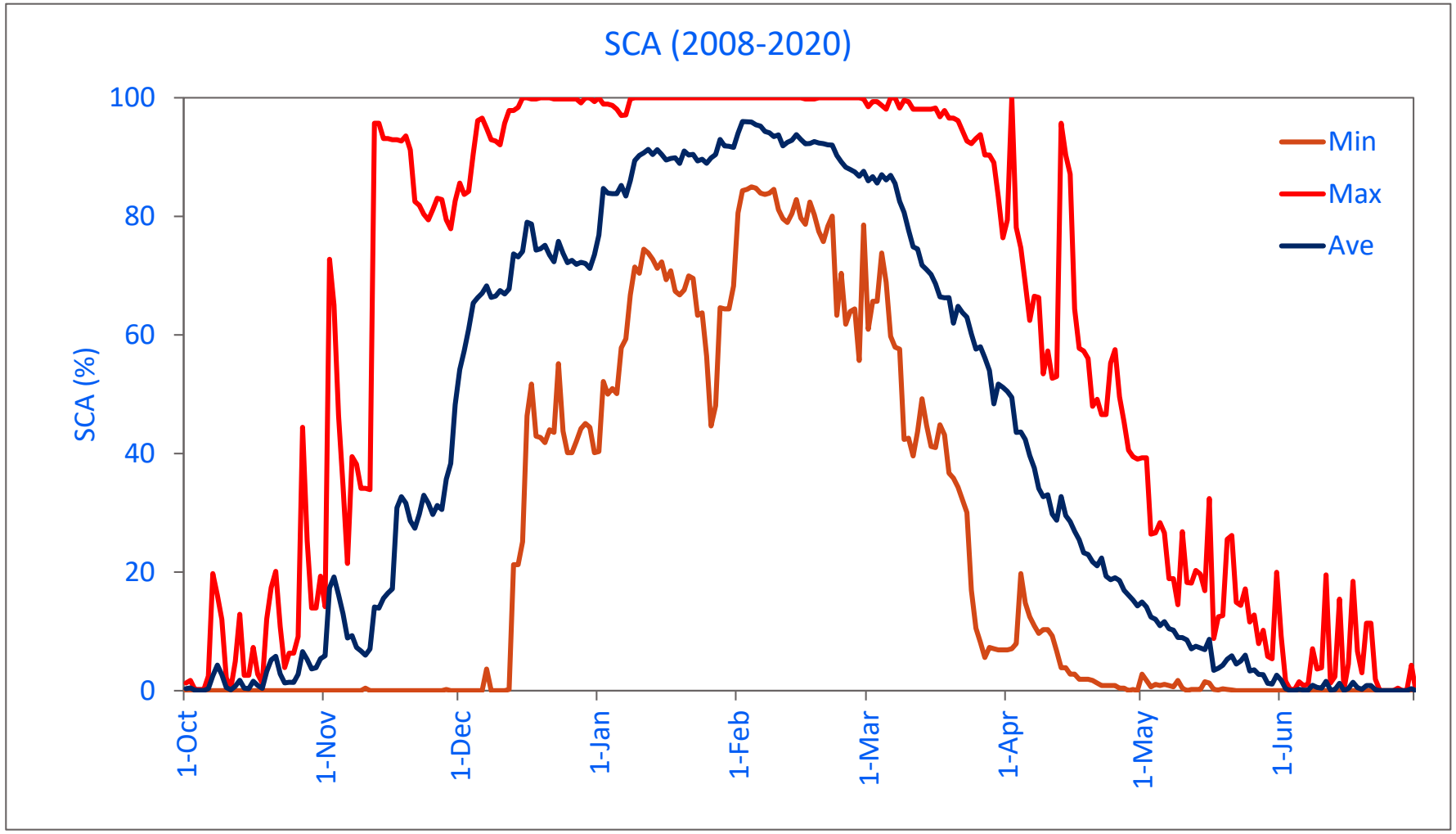
Cloud Cover Advantage of SE-E-SEVIRI(H10)



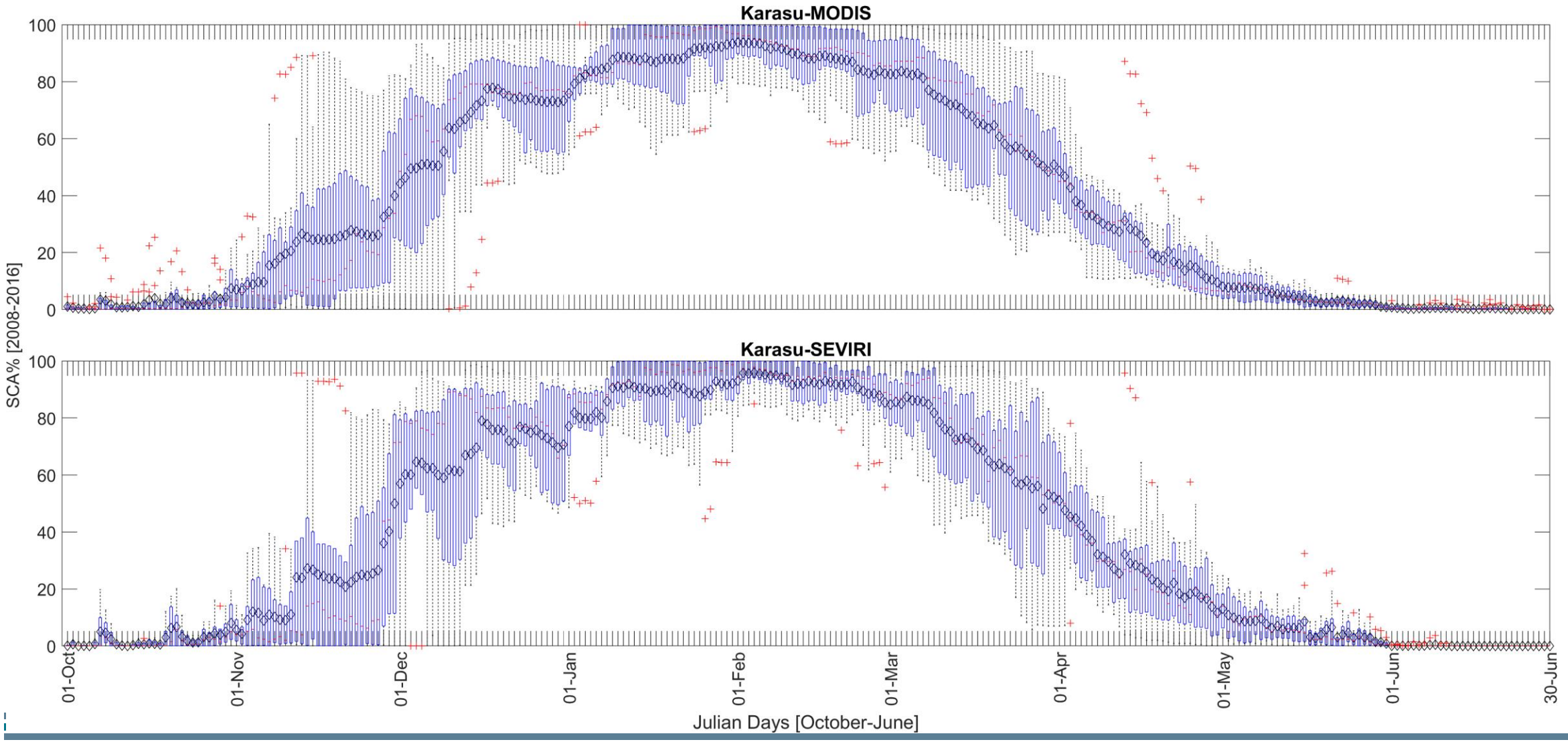
Cloud Filtering



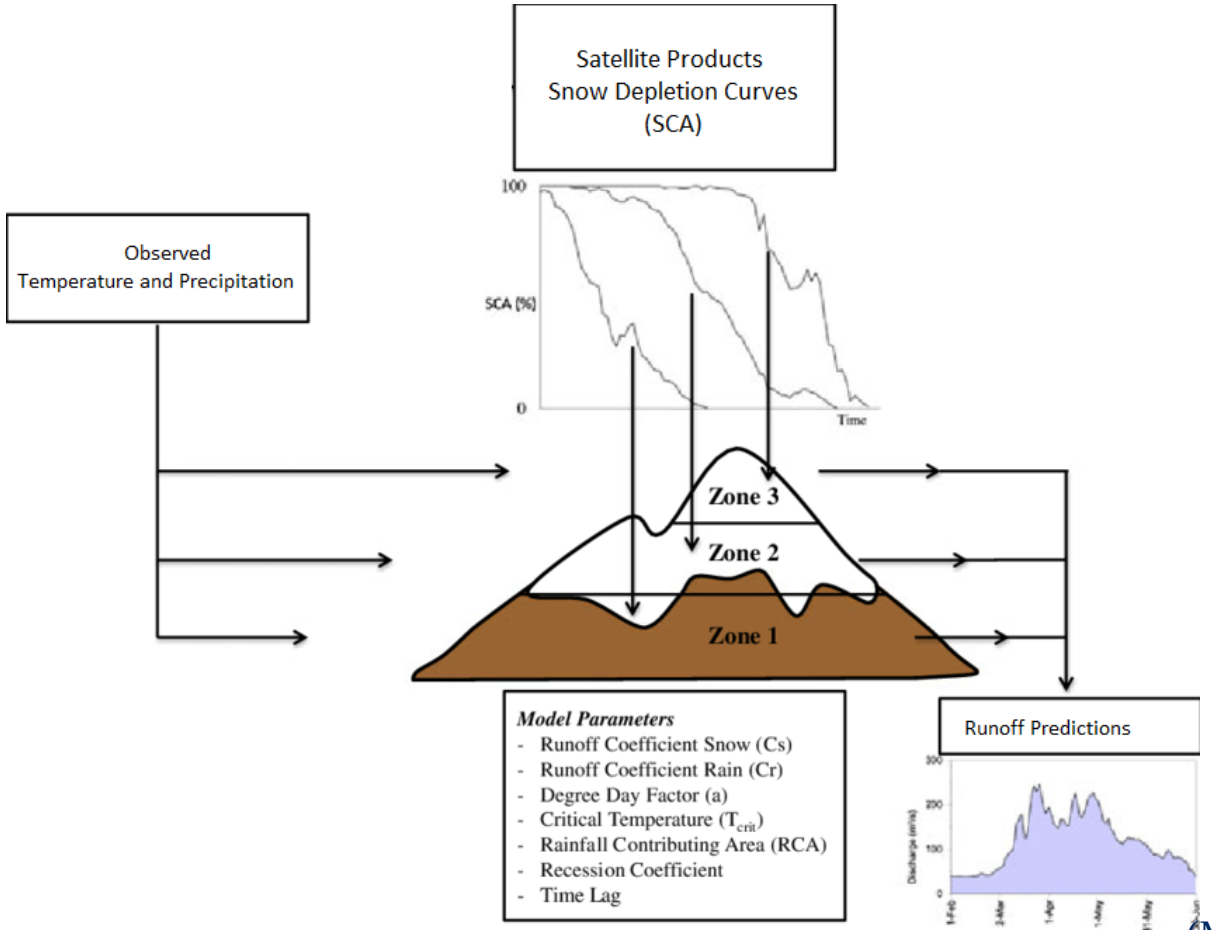
Satellite Snow Data: SE-E-SEVIRI(H10), Snow Cover Area



Comparison: SE-E-SEVIRI(H10) and MODIS (2008-2016)



SRM, Snowmelt Runoff Model



SRM Model

Forcing (model inputs):

- Precipitation (P)
- Temperature (T)
- **Snow Cover Area (SCA)**

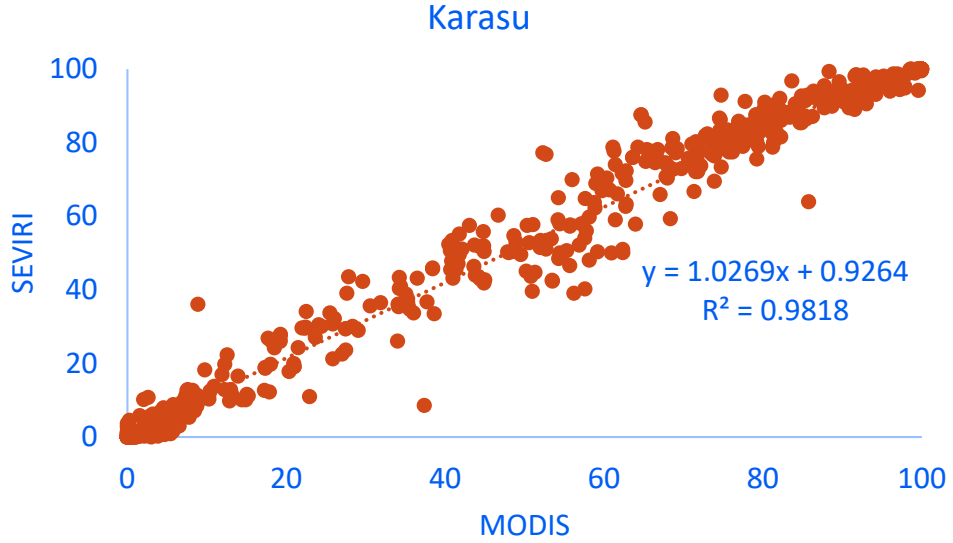
Output variables:

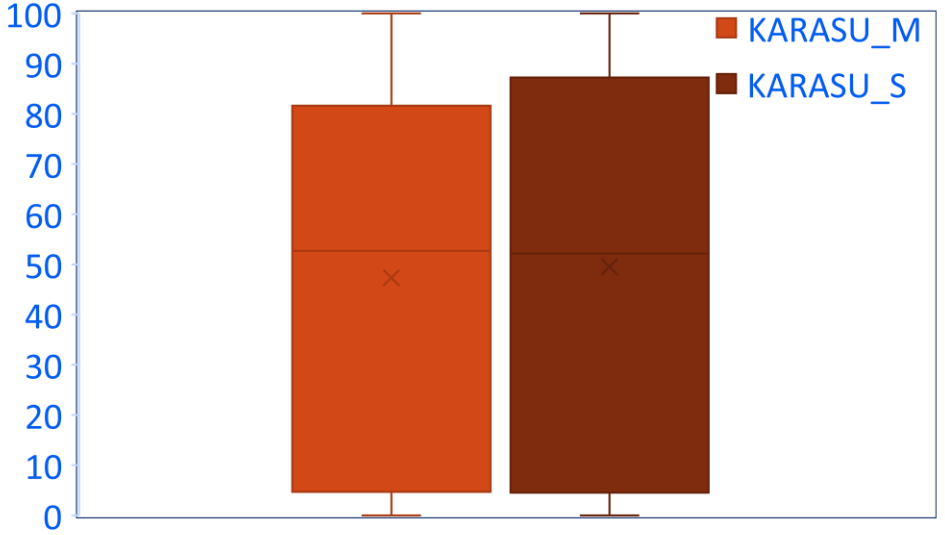
- Discharge (Q)

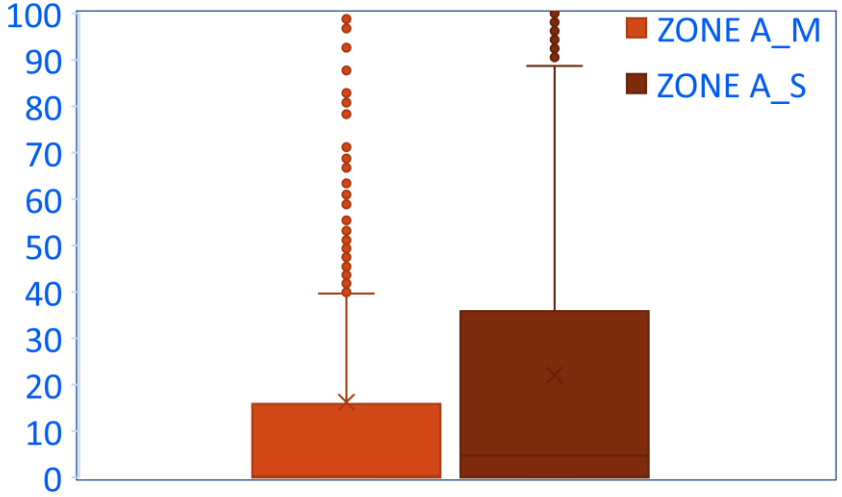
(Martinec et al., 2008)

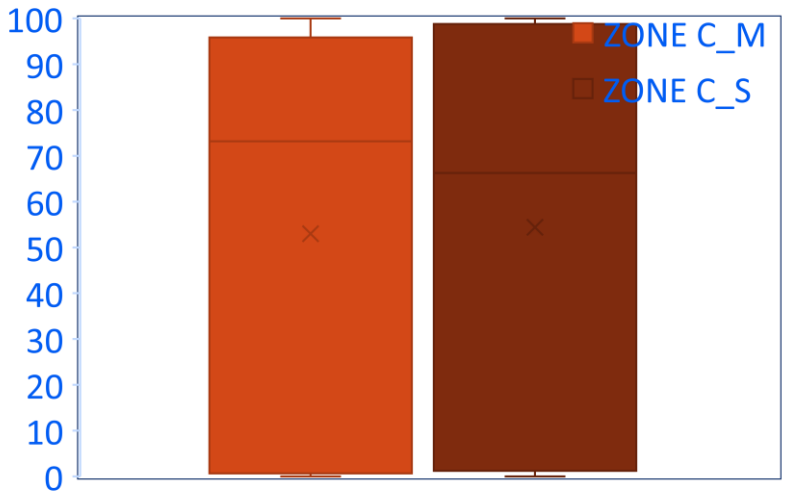
$$Q_{t+1} = [c_{St}.\, a_t(T_t + \Delta T_t)S_t + c_{Rt}P_t].\,(A.\,1000/86400).\,(1 - k_{t+1}) + Q_t k_{t+1}$$

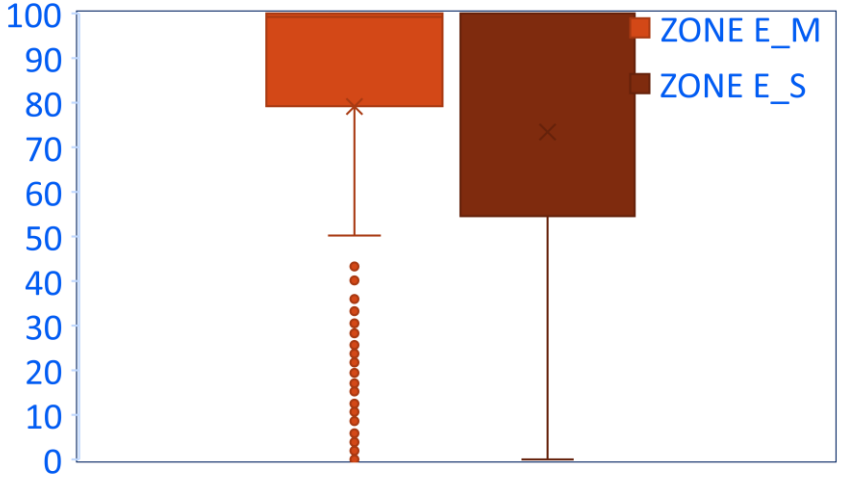
Comparison: SE-E-SEVIRI(H10) and MODIS (2013-2015)



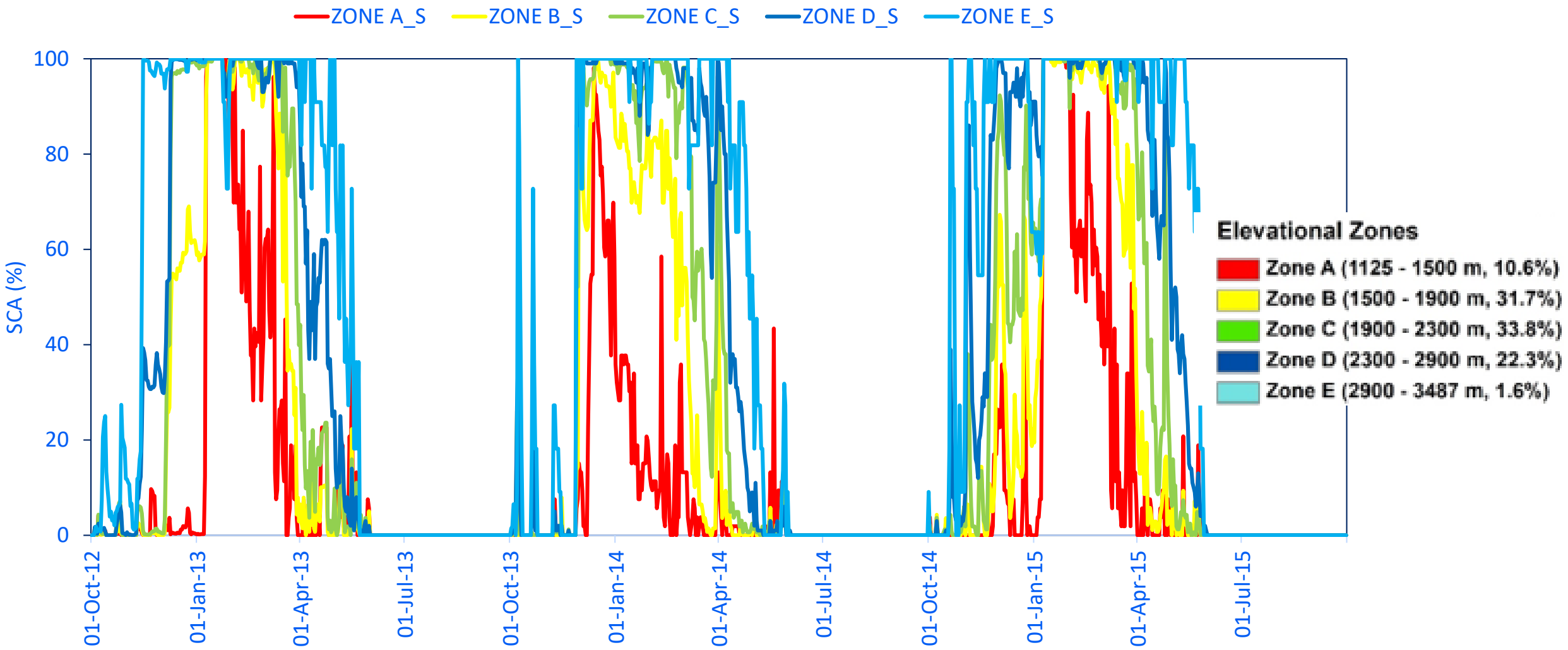




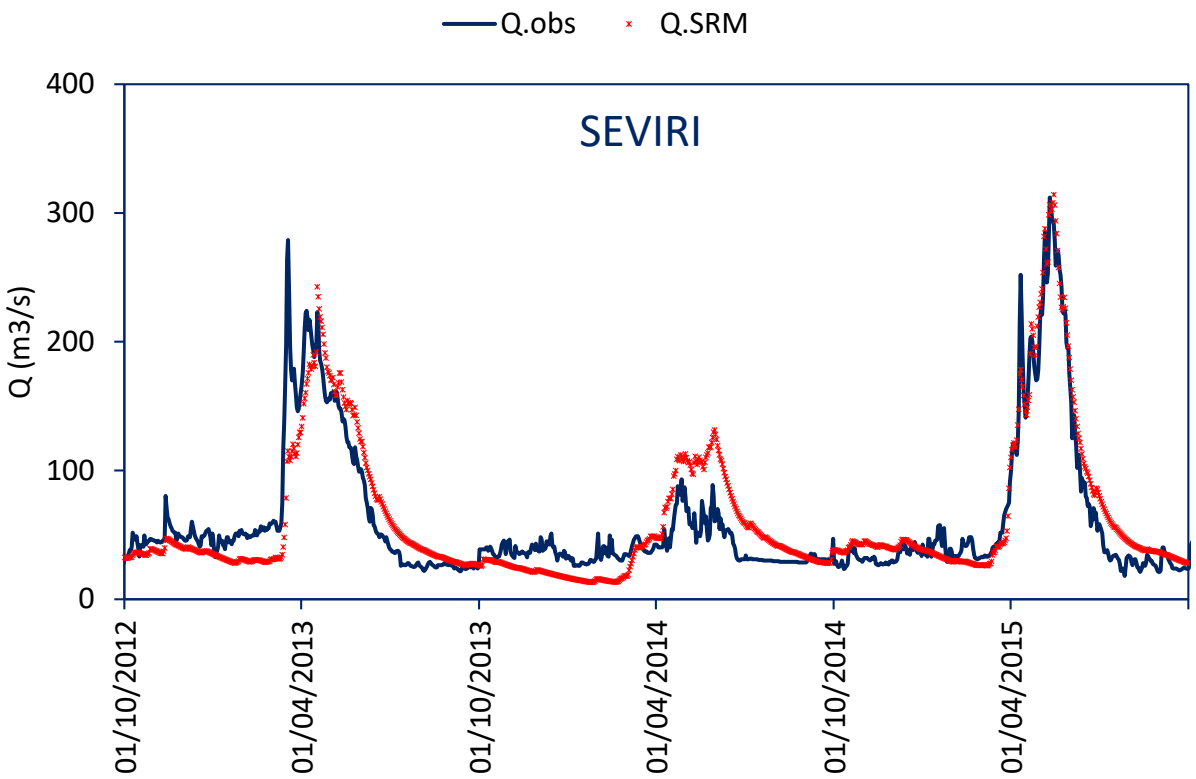


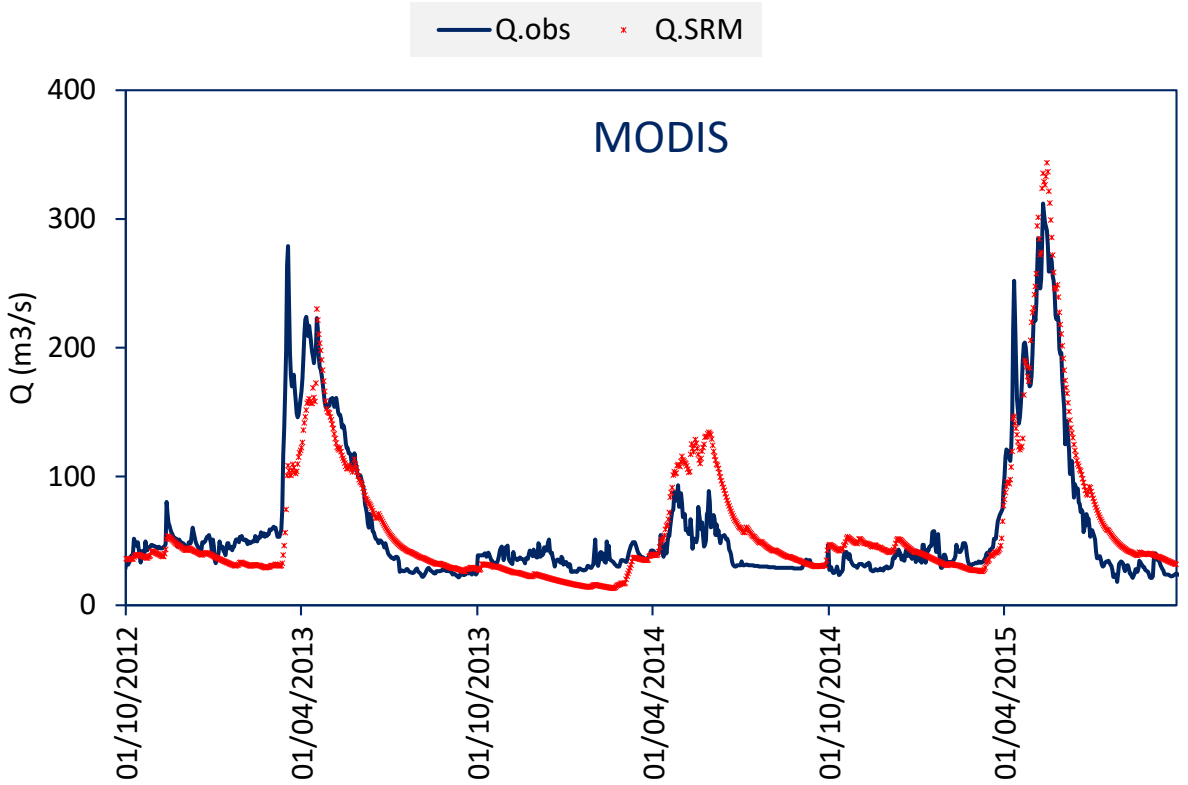


Satellite Snow Data: SE-E-SEVIRI(H10), Elevation Zones



Satellite Snow Data: Impact Assessment





Years	KGE	P-Bias (%)
2013-2015	0.91	4.14

$$P - Bias = \frac{\sum_{t=1}^{T}(Q_S^t - Q_O^t)}{\sum_{t=1}^{T} Q_O^t}$$

Years	KGE	P-Bias (%)
2013-2015	0.89	2.45

$$KGE = 1 - \sqrt{(R-1)^2 + (\beta-1)^2 + (\alpha-1)^2}$$

(Sensoy et. al., HsJ, under review)

Conclusion

- The results show the usefulness of H SAF snow extent data set in comparison to a conventional one.
- Impact of the product is also validated by data driven models. Machine learning techniques can be implemented using SCA as forcing.
- Hydro-validation of products with other conceptual model applications also indicates products applicability for runoff forecasting in snow dominated regions.
- The products are also used to improve the model output and state variables with various data assimilation approaches.
- The data set is also used for multi calibration purpose to increase model reliability.
- The product is superior in terms cloud cover
- The products are being improved in each developing phase (CDOP) of H SAF project

Thank you..

asensoy@eskisehir.edu.tr