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Radar QPE for Extreme Precipitation using the Lontras S-Band Dual-Pol radar in Southern Brazil

ID 54

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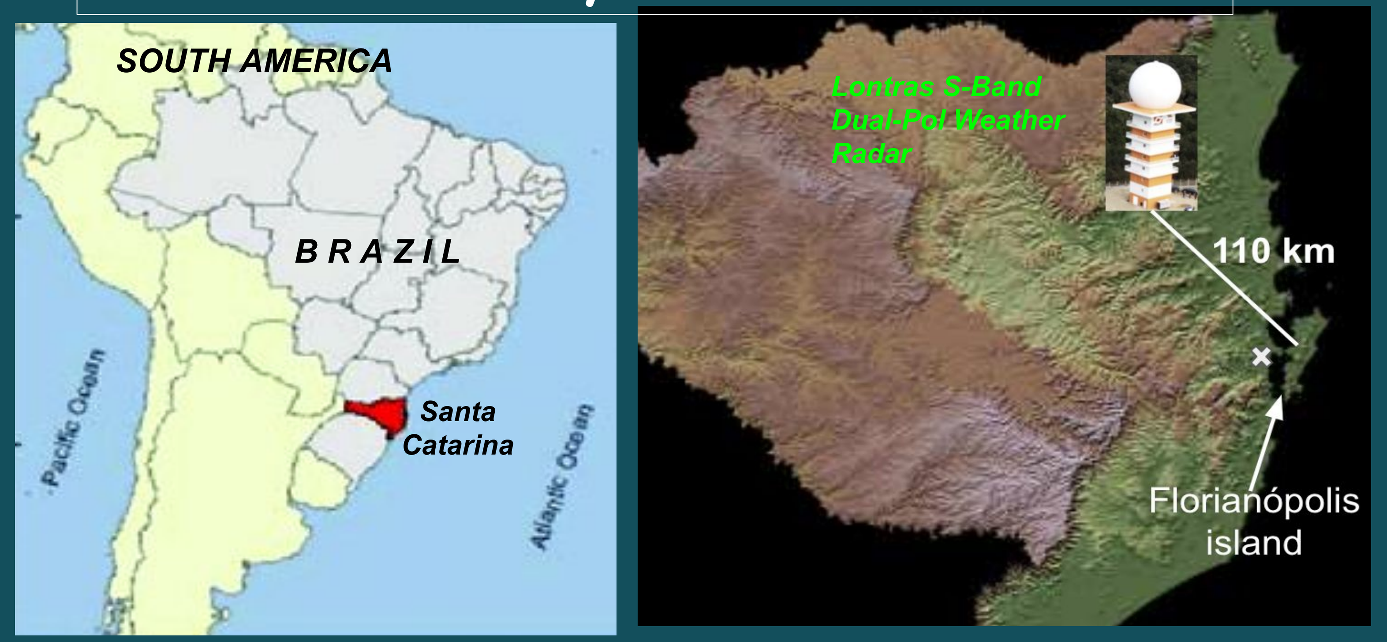
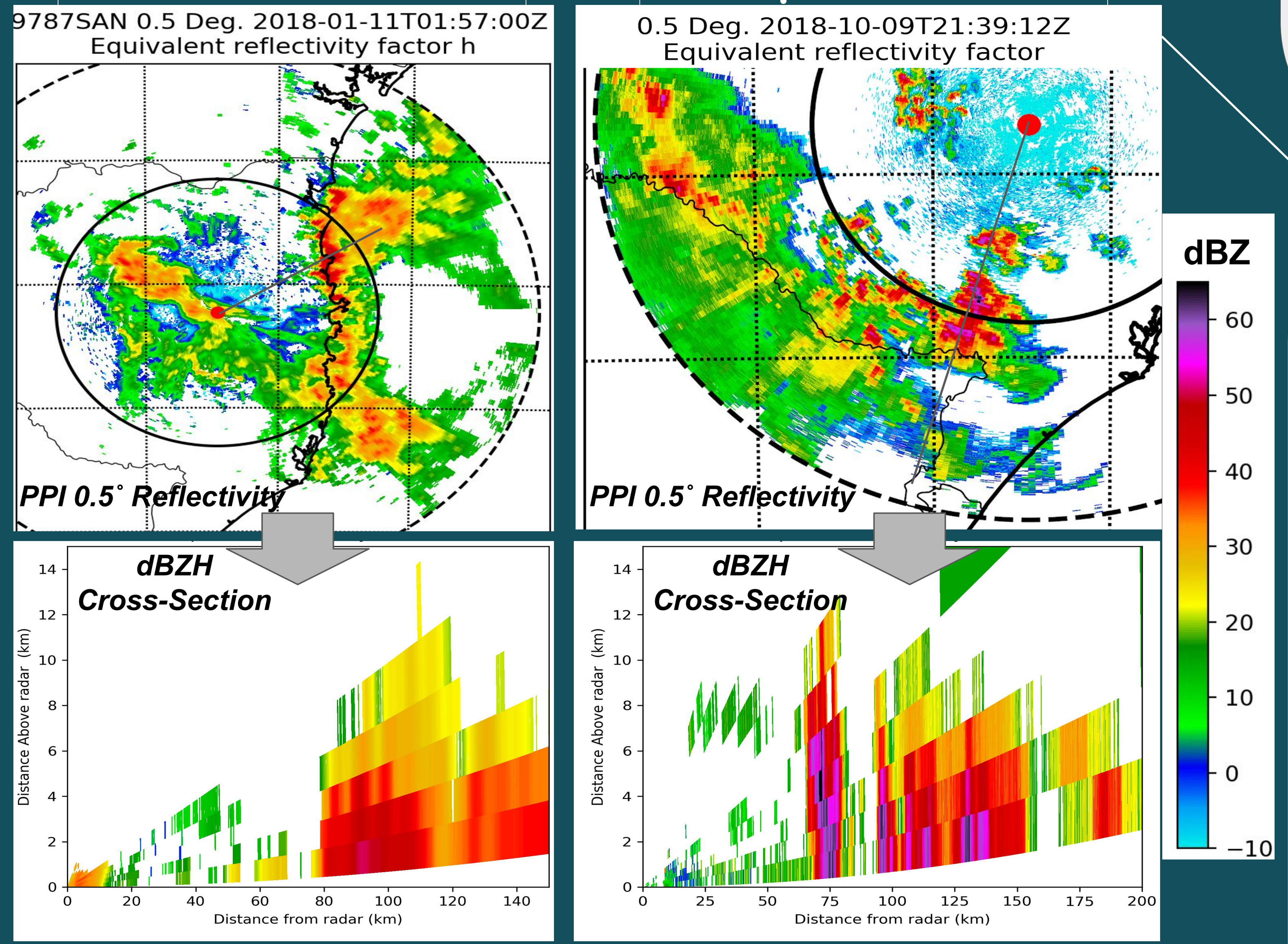
Study Location

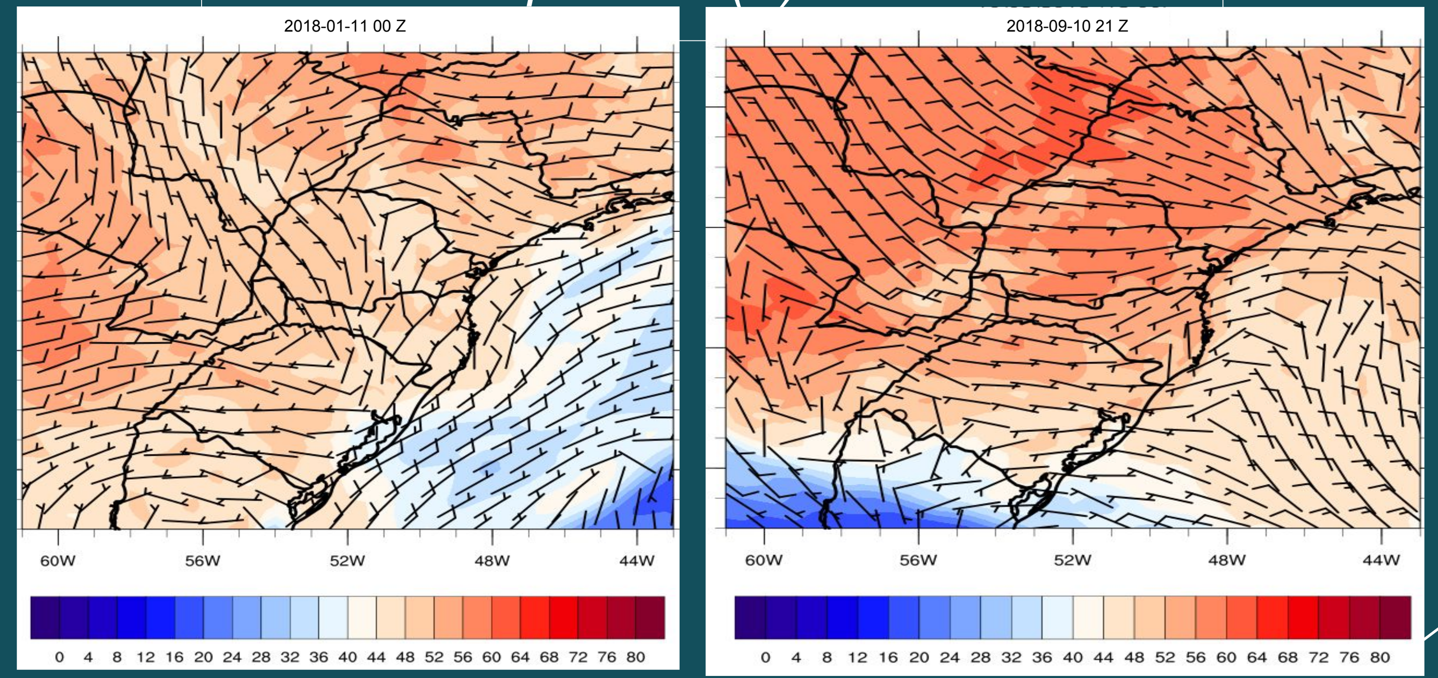


Stratiform

Deep Convection



850 mb Temperature(K) and Wind Barbs

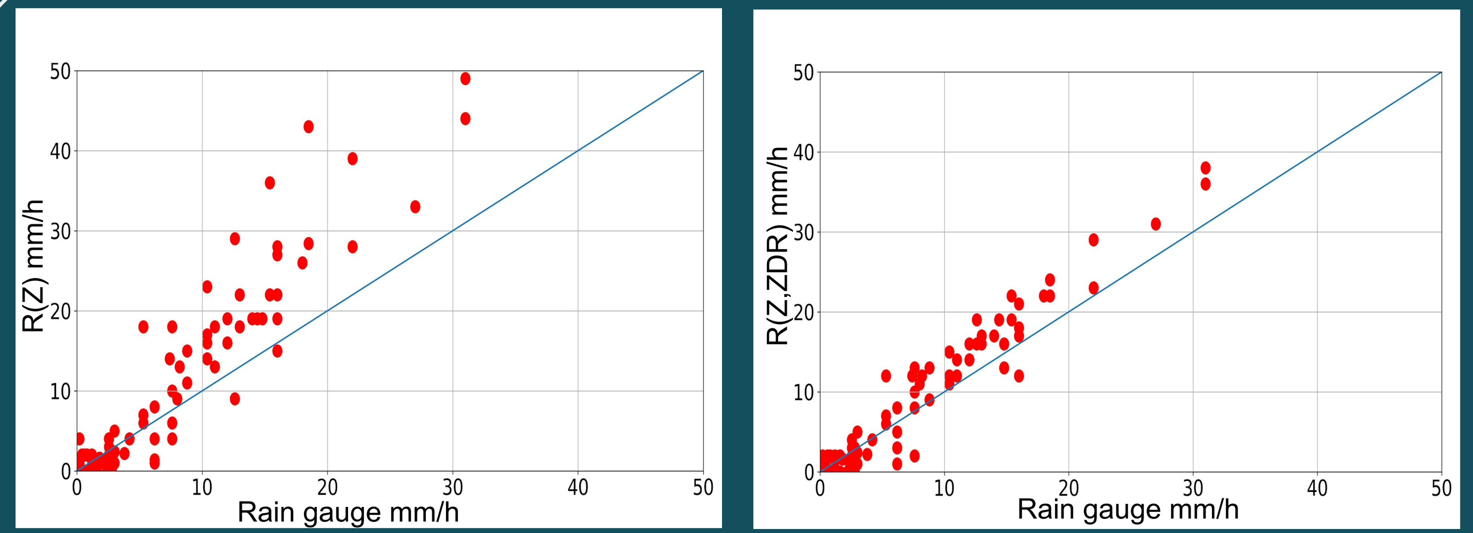


Extreme flash flood events in two differents regimes

In 2018 was registered two extreme flash flood events with two different precipitation regimes in Santa Catarina State, Southern Brazil. First, a multi day stratiform rainfall event over the coast of the Atlantic Ocean persisted for three days (10-12 January 2018) causing a record flooding during a beach tourism season. The second type was about deep convection storms observed in continental areas. The first one was caused by an intense advection of moisture from ocean to coast which yielded a record precipitation of 409 mm in three days. During all three days, it was registered a continuous stratiform rain ranging from 1 to 8 mm/h. At early morning of the third day, the rain rate increase quickly to values of 31.4 mm/h and 25.8 mm/h close Florianópolis City. Furthermore, a historical record of 31.2 mm in 10 minutes in Florianopolis island caused severe flash floods. The deep convection event produced 74.8 mm/h in São Bento City with a peak of 19 mm/10min. Theses differents regimes generate different hydrometeor content difficulting the use of operational weather radar Z-R relationships for Quantitative Precipitation Estimation (QPE).

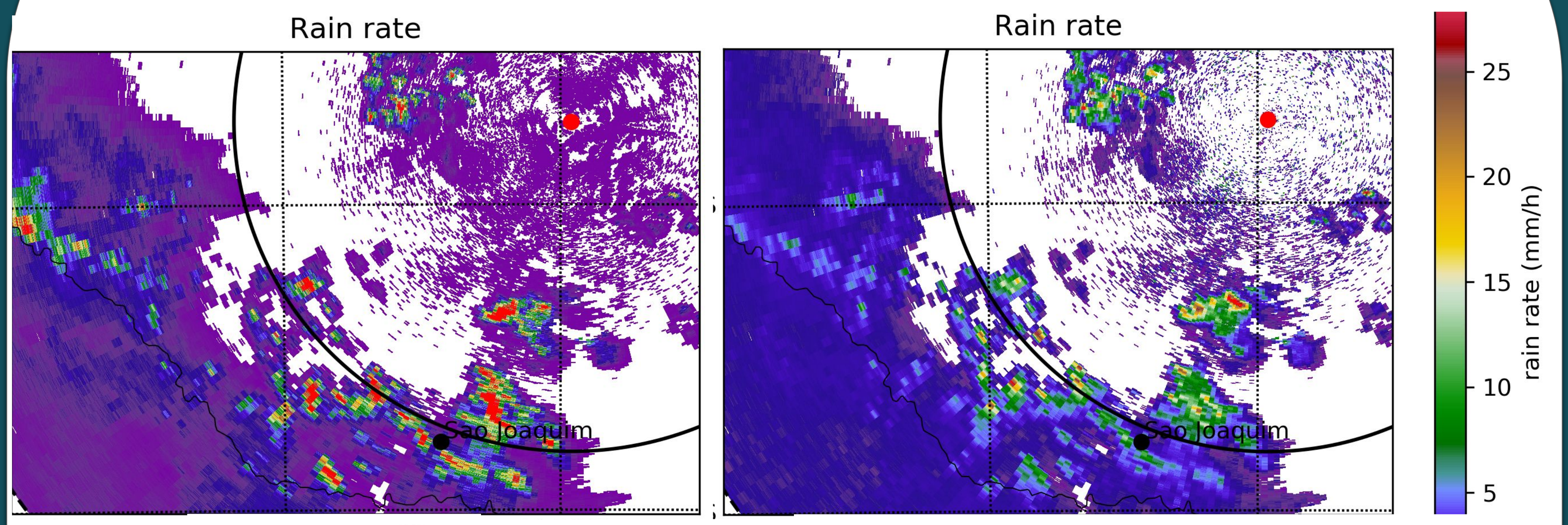
Comparison between Stratiform and deep convection events: in both cases it was observed more than 20 mm/10min causing flash-floods in Santa Catarina State. While in the stratiform cloud there was water content, in the deep convection it was observed large hails. Although the amount of rain is similar for both cases it's impossible use the same Z-R adjustment because the reflectivity are very larger in deep convection events.

The synoptic pattern explains the difference in the hydrometeor content. The deep convection was generated by heat advection from northwestern flux of South America (in general with a low-level jet and strong shear) and the stratiform pattern was yeldied by ocean moisture advection.



Hourly QPE as a reflectivity function(R(Z))(left) and reflectivity differential (R(Z,ZDR)) (right) for Jan-Aug 2018. The use of ZDR was important to adjust the QPE data.

Radar QPE for deep convection



$$Z = aR^b$$

a=236 ; b=1.5

$$R = c_1 Z_h^{a_1} 10^{0,1 b_1 Z_{DR}}$$

a1=0.084 ; b=0.928 ; c1=0.6

For stratiform cases, it was possible to estimate rain rates closer to rain gauges using relationships as the traditional Marshall-Palmer $Z=aR^b$ (a~200 and b~1.6). But for deep convection, the ice content in the cloud "contaminates" the signal backscattered to the antenna (the weather radar uses dielectric coefficient for liquid water) leading erroneous estimates. To solve this problem, it has been used differential reflectivity (ZDR) and reflectivity (Z) as function of precipitation Kim et al. (2016), with some modifications in *c* and *a* parameters. For example in the figure above, it it was possible reduce rain rates from irrealistics 50-60 mm/h to 20-30 mm/h values which was measured in the rain gauge network.

Conclusions

The present study indicates no trivial QPE adjustment in Santa Catarina State due two differents precipitation regimes. For easterly circulation ones, the Marshall-Palmer relationship could be used with no problems. But for deep convection it was necessary introduce polarimetric variables as a function of precipitation because the reflectivity increase quickly due the presence of melting hail produced during the development of the severe storms. Note that both regimes produced similar extreme rain rates and QPE was a very important tool as a guidance to flash-flood forecasting.

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