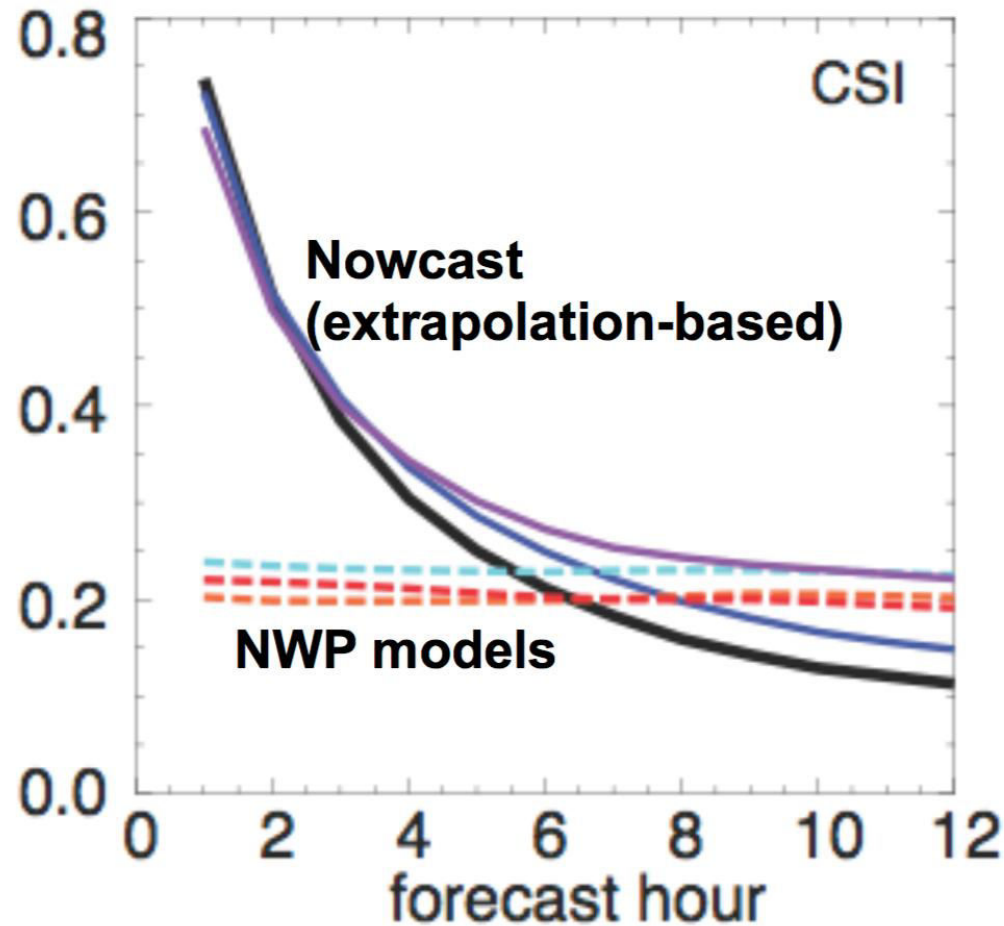


Assimilação de Dados de Radar

Eder Vendrasco

$R > 1 \text{ mm/h}$



Courtesy of Isztar Zawadzki (2012)

Objectives of radar data assimilation

- Improve **short-term** prediction of high impact weather
- For the very short-term range, an ambitious goal is to forecast the **timing and location** of storms at **county/city scale**
- Improved understanding of **mesoscale processes** contributing to the formation of convective weather (may require advanced DA techniques)

Vantagens e Desvantagens em Assimilar Dados de Radar

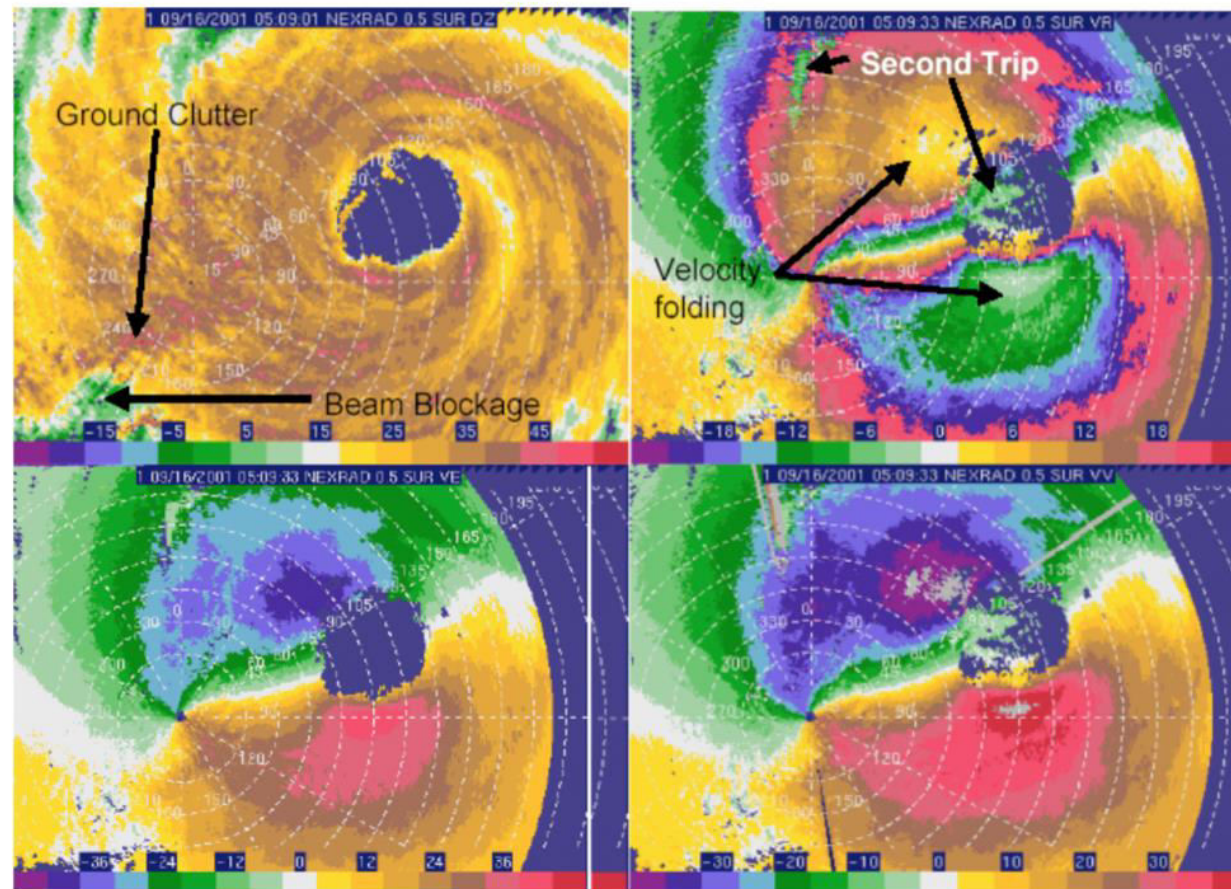
- **Vantagens**

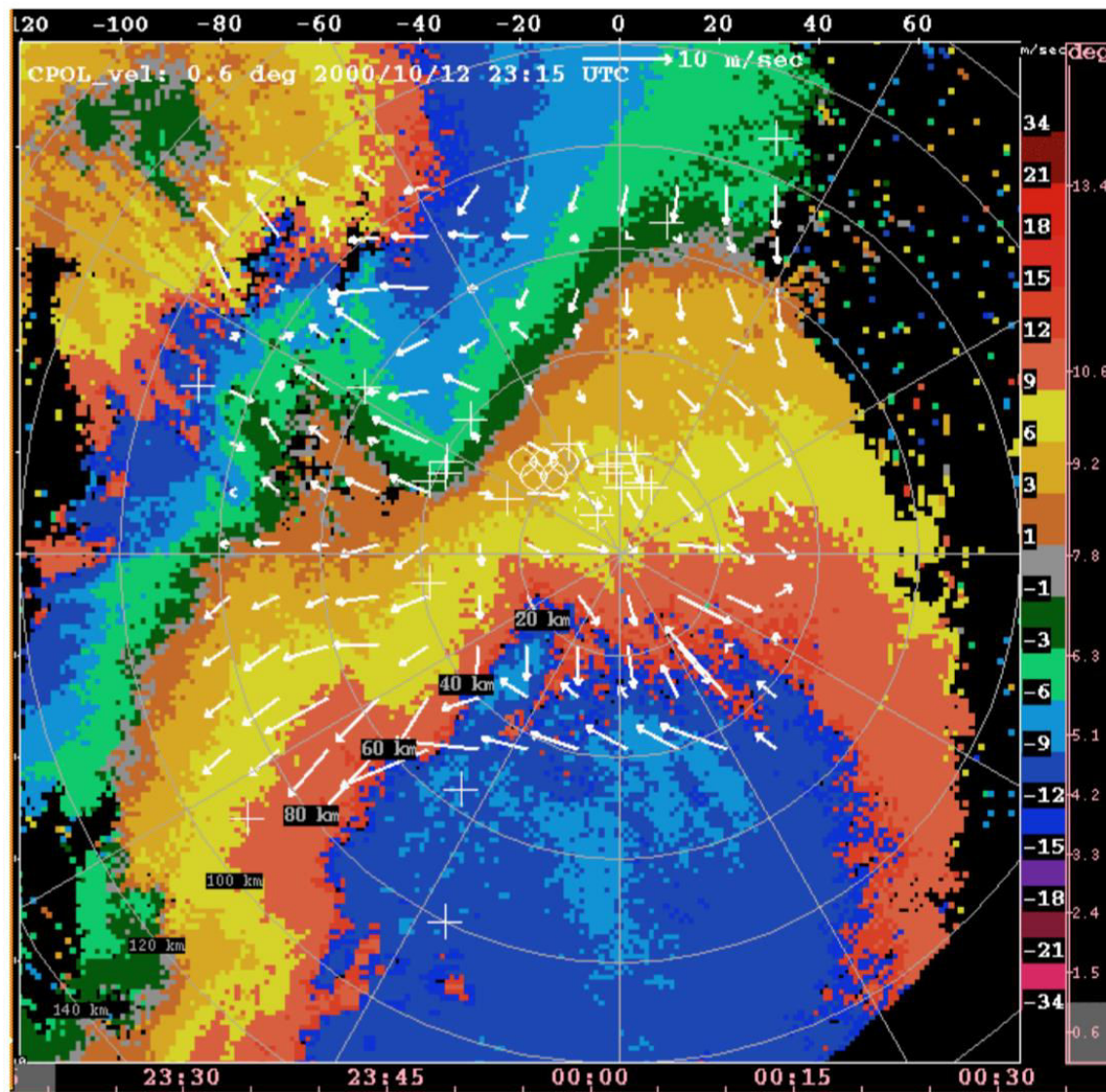
- Alta resolução temporal e espacial;
- Fornece observação do vento (velocidade radial) e da microfísica (refletividade);
- Maioria das observações estão na baixa atmosfera.

- **Desvantagens**

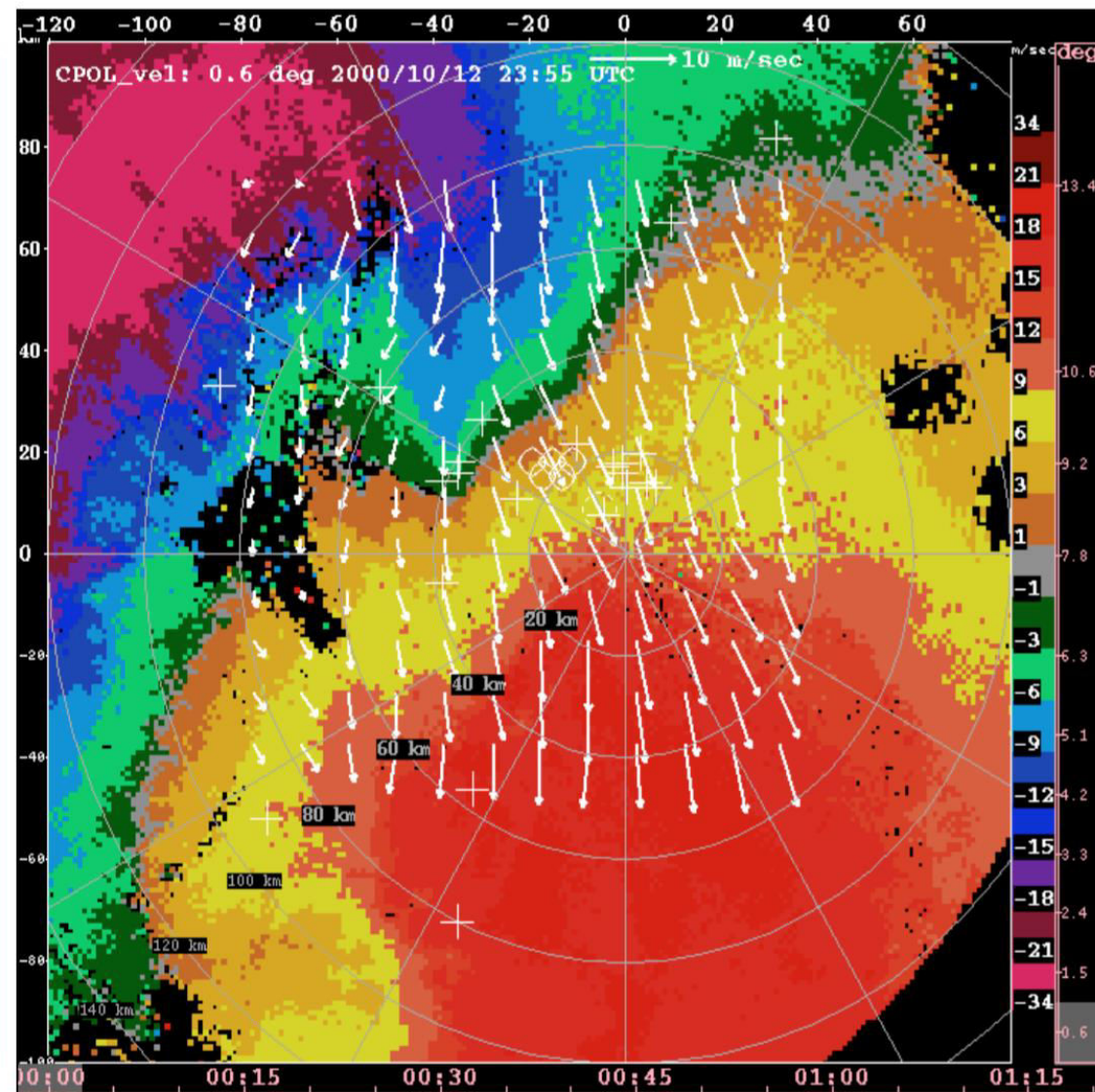
- Observações indiretas – necessita operador observação;
- Cobertura incompleta – limitado alcance e limitada habilidade de detecção em situação de céu limpo;
- Poucas variáveis comparado ao modelo;
- Complicado controle de qualidade;
- Disponível localmente.

- Data quality control is a major issue for radar data assimilation
 - Dealiasing
 - Removal of clutters, second-trip echo and other noises





Aliased velocities



De-aliased velocities

Observation operators

v_r - (u, v, w, q_r) Relation:

$$v_r = \frac{x - x_r}{r} u + \frac{y - y_r}{r} v + \frac{z - z_r}{r} (w - V_T(q_r))$$

Z - q_r Relation (assume Marshal-Palmer DSD)

$$Z = 43.1 + 17.5 \log_{10}(\rho q_r) \quad \text{Sun and Crook (1997)}$$

Can also use empirical relations obtained by fitting with disdrometer data

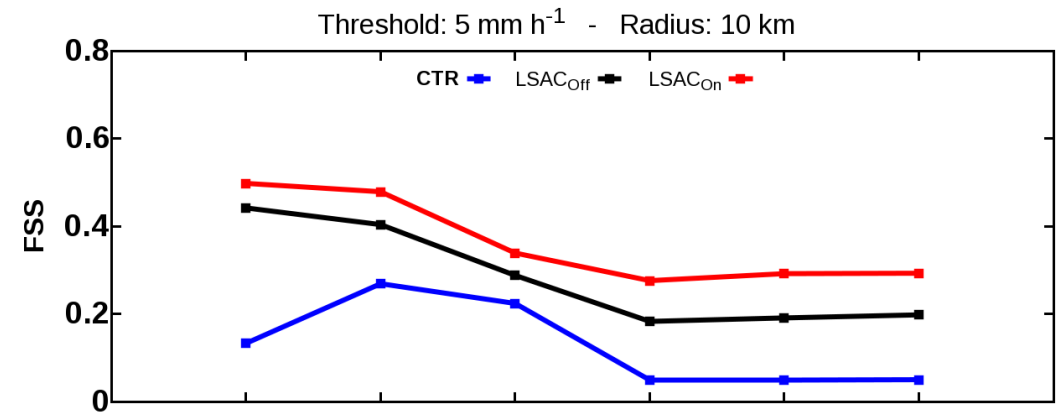
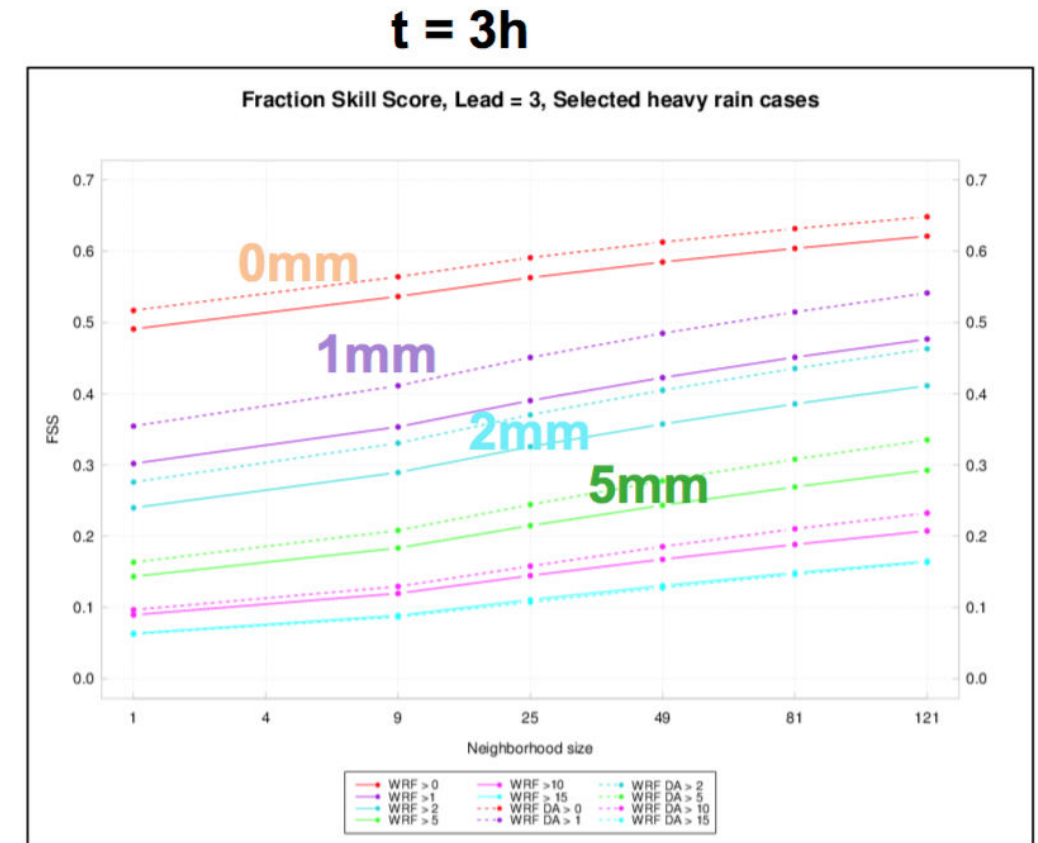
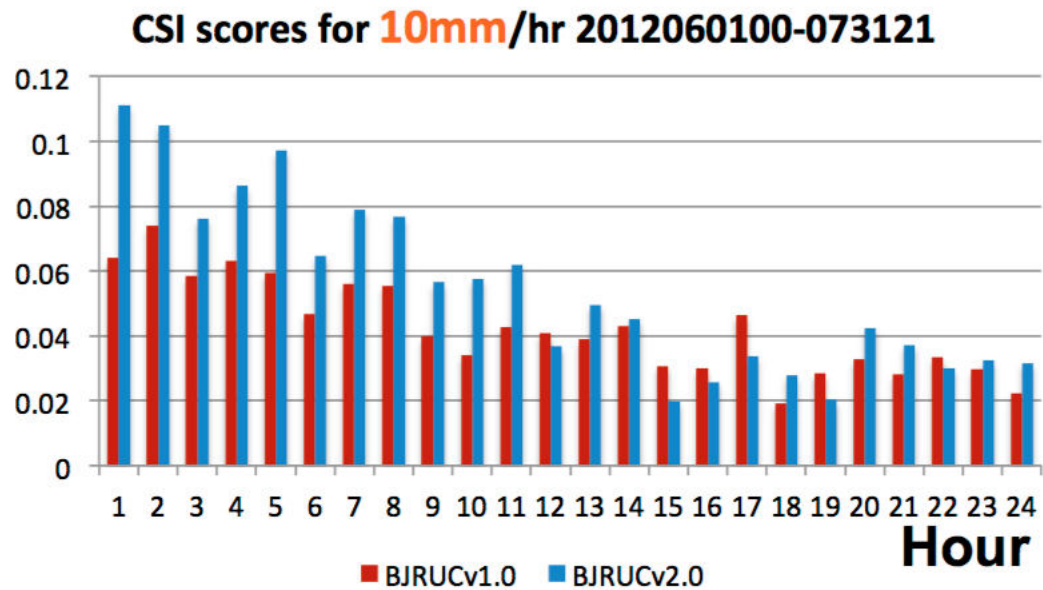
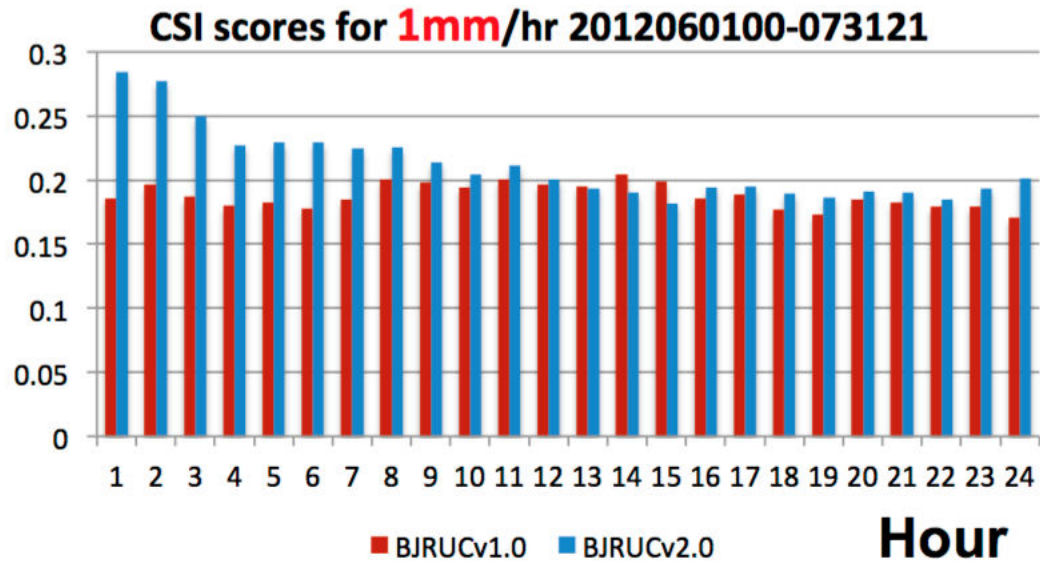
Z - q_s and Z - q_h follow Gao and Stensrud (2012)

Cost Function

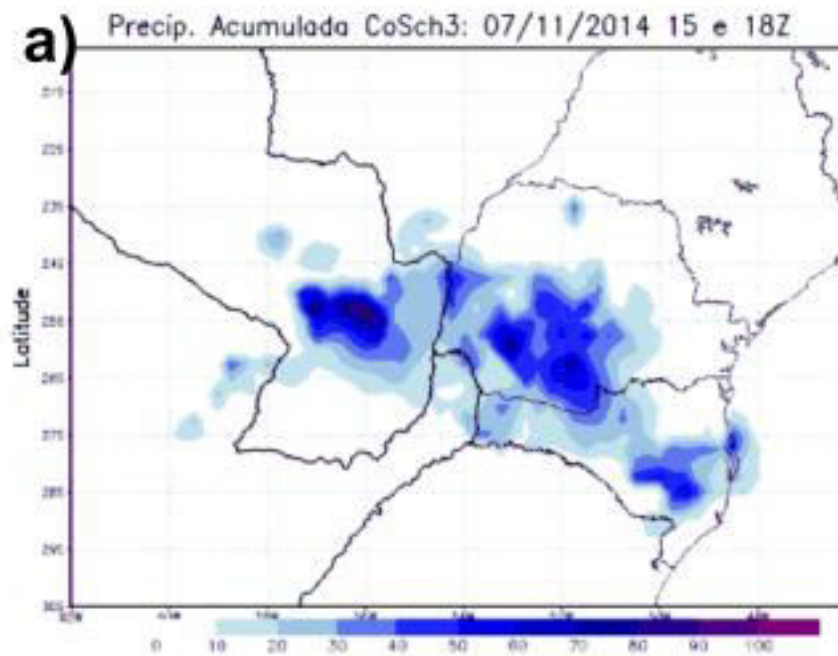
Indirect method with cloud control variables

$$J = J_b + J_o + \underbrace{J_{v_r} + J_{q_r} + J_{q_v}}_{\text{For radar DA}}$$

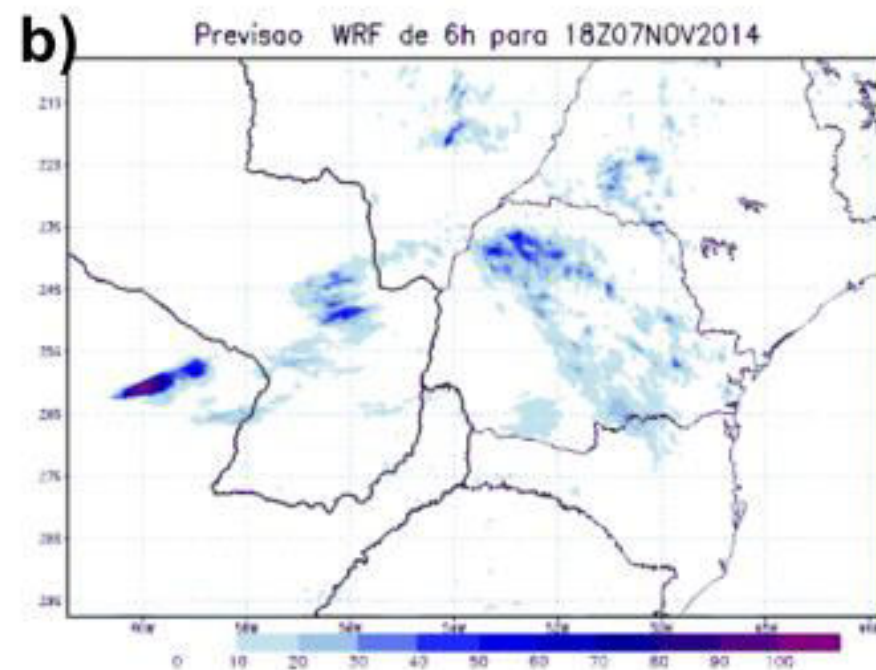
- **Control variables :**
u/v (or Ψ / χ_u), T (or T_u), Ps (or Ps_u), RHs, q_c , q_r , and w
- 3DVar critically depends on a cloud analysis scheme that assimilates estimated in-cloud humidity
- A modified Kessler scheme along with its adjoint produces analyses of microphysics in 4DVar



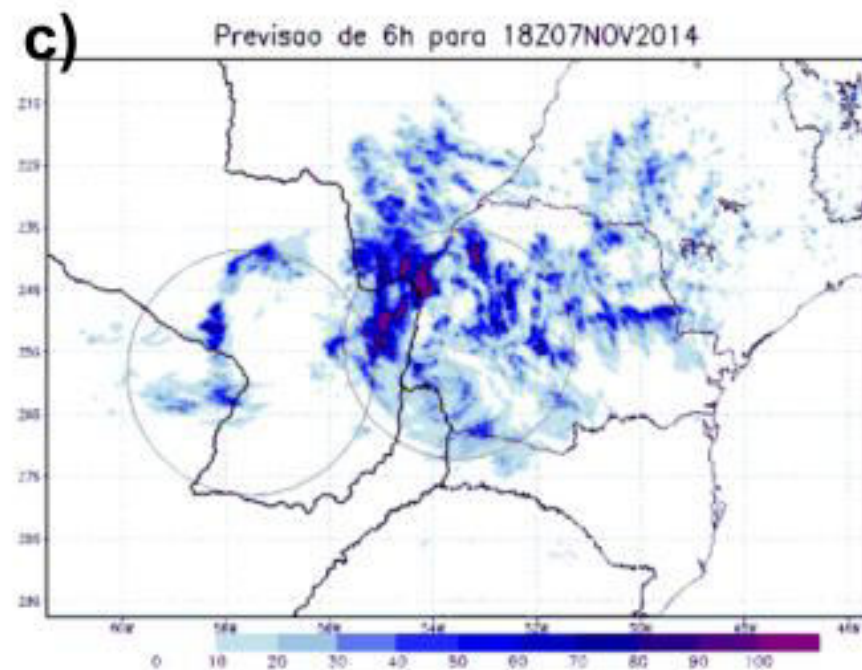
CoSch 3



WRF noDA



WRFDA: Radar



WRFDA: GTS



SOS-CHUVA

- Controle de qualidade
 - Dados convencionais;
 - Radar.
- Assimilação de **todos** os dados convencionais
 - Assimilação de dados de Radar;
 - Velocidade radial;
 - Velocidade derivada por outros métodos (rastreamento);
 - Refletividade;
 - Razão de mistura de água de chuva.
- Assimilação de variáveis polarimétricas?
 - Desenvolvimento de operador observação.