A Feature Track Correction (FTC) Observation Operator applied to Aeolus-AMV Collocations

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In this study we propose and test a feature track correction (FTC) observation operator for atmospheric motion vectors (AMVs). The FTC has four degrees of freedom corresponding to wind speed multiplicative and additive corrections (γ and δV), a vertical height assignment correction (h), and an estimate of the depth of the layer that contributes to the AMV (Δz). Since the effect of the FTC observation operator is to add a bias correction to a weighted average of the profile of background winds an alternate formulation is in terms of a profile of weights (w_k) and δV.

The FTC observation operator is tested in the context of a collocation study between AMVs projected onto the collocated Aeolus horizontal line-of-sight (HLOS) and the Aeolus HLOS wind profiles. This is a prototype for an implementation in a variational data assimilation system and here the Aeolus profiles act as the background in the FTC observation operator. Results were obtained for ten days of data using modest QC. The overall OMB or collocation difference SD for a global solution applied to the independent sample is 5.49 m/s with negligible mean. For comparison the corresponding simple (or pure) collocation SD is 7.85 m/s, and the null solution, which only interpolates the Aeolus profile to the reported height of the AMV and removes the overall bias, has an OMB SD of 7.23 m/s. These values correspond to reductions of variance of 51.0% and 42.3%, due to the FTC observation operator in comparison to the simple collocation and null solution, respectively.

These preliminary tests demonstrate the potential for the FTC observation operator for

- Improving AMV collocations (including triple collocation) with profile wind data.
- Characterizing AMVs. For example, summary results for the HLOS winds show that AMVs compare best with wind profiles averaged over a 4.5 km layer centered 0.5 km above the reported AMV height.
- Improving AMV observation usage within data assimilation (DA) systems. Lower estimated error and more realistic representation of AMVs with variational FTC (VarFTC) should result in greater information extracted. The FTC observation operator accomplishes this by accounting for the effects of h and Δz.