# 7.2A FULL VERSUS LIMITED VERSUS NO STEERABILITY

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There is no single definitive "optimum" configuration of antenna beam steerability for all purposes. As with every other design problem, specific requirements suggest specific configurations; in this case, however, the broad spectrum of specific requirements requires a correspondingly broad spectrum of "optimum" configurations.

A preliminary look at the range of phenomena to be studied by the MST radar technique suggests that it may be possible to divide the steerability versus non-steerability problem into two broad subsets, with a third subset (limited steerability) that lies between these two limits.

Basically, it seems reasonable to study processes that are spatially homogeneous on a horizontal scale comparable to the range of steerability of the probing beam by using fixed-beam systems. Alternatively, processes that do vary on a horizontal scale comparable to the area of the probing radar beam can best studied using fully steerable (insofar as possible) beams.

For example, one study that would be optimized using fixed-beam systems would be a long-term study of the mean wind field. On the other hand, orographic effects due to mountain ridges and/or land-sea interfaces demand steerable beams, particularly if the effects are three dimensional in character.

In view of their lack of moving "parts" (mechanical or electrical), fixed beam systems are inherently more reliable. Clearly, there are concomitant limitations that may well be unacceptable for many requirements. It is probably realistic to crudely assume that -- in the long term -- the reliability of a system is inversely proportioned to the number of moving parts. It is unreasonable to expect, for example, that a fully steerable dish can operate at a scan rate of one revolution/minute continuously for a number of years. This is not a problem, however, for fixed-beam systems.

In Table 1 a number of possible atmospheric study programs are listed, along with the most reasonable antenna steering configuration for each. The most reasonable configuration is labelled with three asterisks (***), the second-most reasonable with two asterisks (**), and the least reasonable with one asterisk (*). Note that this listing and comparison should be considered as preliminary and tentative.

In broad aspect, Table 1 shows a roughly equal division of the two extreme antenna configurations for the listed studies. Only two studies (frontal passages and average upward gravity-wave flux measurement) appear to be best served using partially steerable beams.

Finally, it should be stressed that while many of the studies appear to be best done using a fully steerable system, they may be done almost as well using less-than-fully steerable (i.e., partially steerable) beams. Clearly, the optimum configuration for a given study must be examined in terms of the availability of specific systems.

Table 1. Phenomenological study programs vs. antenna steerability

| TOPIC | FULLY STEERABLE | PARTIALLY STEERABLE | FIXED |
|---|---|---|---|
| Orographic studies | *** | ** | * |
| Cloud dynamics | *** | ** | * |
| Severe storms | *** | ** | * |
| Turbulent structure | *** | ** | * |
| Gravity-wave structure | *** | ** | * |
| Ageostrophic winds | *** | ** | * |
| Tropopause folding | *** | ** | * |
| Frontal passages | *** | *** | *** |
| Average upward GW flux | ** | *** | * |
| Mean winds | * | ** | *** |
| Tides | * | ** | *** |
| Planetary waves | * | ** | *** |
| Tropopause monitoring | * | ** | *** |
| Jet stream monitoring | * | ** | *** |
| Vertical winds | * | ** | *** |
| Stratospheric warmings | * | ** | *** |
| Rawinsonde replacement | * | ** | *** |
| Atmospheric turbulence | * | ** | *** |
| Spectral studies $3^{m} < T < 3^{D}$ | * | ** | *** |
| Seasonable variability | * | ** | *** |
| Stratospheric temperature | * | ** | *** |
| Sun-weather relationships | * | ** | *** |